
Digital Tapchanger Control TCC300

User Manual





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Table of contents

Section 1	Introduction.....	17
	This manual.....	17
	Intended audience.....	17
	Product documentation.....	17
	Document revision history.....	17
	Symbols and conventions.....	18
	Symbols.....	18
	Document conventions.....	18
Section 2	TCC300 overview.....	21
	Overview.....	21
	Adapter panel or surface mounting kit.....	23
	Accessories.....	25
	TCC600 Communications Software.....	25
	Optional communication ports.....	25
	M-2025B(D) Current Loop Interface Modules.....	25
	Backup relay.....	26
	M-2026 AC-DC control power backup supply.....	26
	M-2027 control power backup supply for AC only.....	26
	B-0920 control power backup harness.....	26
	M-2948 tap position sensor.....	27
Section 3	Operation.....	29
	Front panel controls and indicators.....	29
	Display and push buttons.....	29
	Status indicators.....	34
	Operation (HMI/TCC600).....	35
	Message screens.....	35
	Access codes.....	38
	Access levels.....	38
	Smart flash SD card user access key code.....	39
	HMI Level Access prompt.....	39
	Oscillograph recorder.....	39
	Triggering oscillograph recorder from TCC600.....	39
	Retrieving oscillograph record from TCC600.....	40
	Clearing oscillograph records from TCC600.....	43

Table of contents

Clearing oscillograph records from the HMI.....	44
Sequence of events recorder.....	45
Triggering sequence of events recorder from TCC600.....	45
Retrieving sequence of events record from TCC600.....	46
Viewing sequence of events from TCC600.....	47
Clearing sequence of events records from TCC600.....	48
Data logging.....	49
Retrieving data logging data.....	49
Clearing data log records from TCC600.....	52
Converting datalog files to CSV format.....	53
Clearing data log records from the HMI.....	54
Active setpoint profile.....	54
Setting active setpoint profile from TCC600.....	54
Metering and status.....	56
Accessing of monitoring screens from the HMI.....	59
Accessing the metering screens from the HMI.....	61
Accessing the status screens from the HMI.....	62
Accessing the tapchanger status screens from the HMI.....	62
Accessing the alarm status screens from the HMI.....	63
Accessing the input status screens from the HMI.....	64
Accessing the output status screens from the HMI.....	65
Accessing the metering and status screen from TCC600.....	66
Primary metering (single or three phase).....	67
Remote voltage bias.....	68
Secondary metering status.....	68
Tap information.....	69
Tapchanger status.....	70
Aux input status.....	71
Input status.....	72
Output status.....	72
Alarm status.....	73
CBEMA events and counter status.....	76
Demand and energy metering.....	76
Accessing the present demand screens from the HMI.....	76
Setting the demand interval from the HMI.....	77
Accessing the demand history screens from the HMI.....	77
Accessing the demand and energy metering from TCC600.....	78
Demand history/energy metering.....	80
Accessing the energy metering screens from the HMI.....	81

Resetting individual demand history or energy metering values from the HMI.....	82
Resetting all demand history or energy metering parameter values from the HMI.....	82
MASTER RESET of all demand history and energy metering parameter values from the HMI.....	82
Real Time Voltage Plot.....	83
Accessing Real Time Voltage Plot from TCC600.....	83
Display all metering.....	84
Motor current profile.....	87
Accessing the motor current screens from the HMI.....	87
Initializing motor current values from the HMI.....	87
Accessing motor current profile screen, resetting training mode and peak motor current from TCC600.....	88
Harmonic analysis.....	89
Accessing the harmonics screens from the HMI.....	89
Viewing individual voltage/current harmonics screens from the HMI	90
Accessing harmonic analysis screen from TCC600.....	90
Tap information.....	91
Accessing the tap information screens from the HMI.....	91
Calibrating tap position from the HMI.....	92
Drag hands.....	92
Resetting drag hands values from the HMI.....	92
Resetting drag hands values from TCC600.....	92
Resettable operation counter.....	93
Resetting operation counter from the HMI.....	93
Resetting operation counter from TCC600.....	93
Tap statistics.....	93
Viewing specific tap statistics from the HMI.....	93
Clearing tap statistics from the HMI.....	94
Viewing tap statistics from TCC600.....	94
Smart flash SD card.....	95
Accessing the smart flash SD card screens from the HMI.....	95
SD card quick capture.....	95
Quick capture file naming convention.....	96
Initiating a smart flash SD card quick capture.....	96
Loading setpoints from a smart flash SD card.....	97
Saving setpoints to a smart flash SD card.....	98
Saving control data record files to a smart flash SD card.....	98
Clone save and load.....	99

Saving clone to a smart flash SD card.....	100
Loading clone from a smart flash SD card.....	101
Loading configuration files from a smart flash SD card.....	101
Saving configuration files to a smart flash SD card.....	102
Updating firmware from smart flash SD card.....	103
Entering the smart flash SD card user access code.....	103
Utility/Calibration.....	105
Accessing utility/calibration screens from the HMI.....	105
Source voltage.....	107
Changing source voltage input.....	107
Watchdog and power resets.....	107
Resetting watchdog and power counters.....	107
Reinitializing control setpoints due to checksum error.....	108
About screens.....	108
Accessing the about screens from the HMI.....	108
Remote control.....	109
Low current alarm/block.....	112
Clearing low current alarm/block from the HMI.....	112
Clearing low current alarm/block from TCC600.....	112
Motor seal-in failure alarm/block.....	113
Resetting motor seal-in failure alarm block from the HMI.....	114
Resetting motor seal-in failure alarm/block from TCC600.....	115
Lockout alarms.....	115
Clearing master/follower or delta VAr peer to peer lockout alarm from the HMI.....	115
Clearing master/follower lockout alarm from TCC600.....	115
Clearing delta VAr peer to peer paralleling lockout/alarms from TCC600.....	117
Section 4 TCC600.....	121
Hardware requirements.....	121
Installing TCC600.....	121
Initial local communications using direct USB connection.....	122
Using RS-485 communications.....	126
Using fiber-optic communications.....	128
Using Ethernet communications.....	130
Using bluetooth communications.....	132
Communications with multiple controls.....	133
Cautions.....	136
Operation overview.....	137

File menu.....	139
Connect menu.....	141
Communication menu.....	144
Monitor menu.....	151
Metering & Status.....	152
Motor Current Profile.....	161
Demand & Energy Metering.....	162
Tap Statistics.....	165
Real Time Voltage Chart.....	166
Harmonic Analysis.....	166
Master/Follower Alarm Messages.....	168
Display All Metering.....	169
Set Metering Colors.....	172
Setup menu.....	174
Profile.....	176
Tapchanger Type.....	176
Setpoints.....	178
Configuration.....	184
Tap Settings.....	193
Alarms.....	197
Wakeup Screens.....	199
Data Logging.....	201
Harmonics Setup.....	203
Oscillograph.....	204
Sequence of Events.....	209
CBEMA Events.....	215
Display All Settings Command.....	216
Utility menu.....	218
Remote Control.....	219
Control Information.....	221
Change User Access Code.....	221
Set Date & Time.....	223
Device Discovery.....	225
Multi Level Access Code.....	226
SD Card Access Code.....	227
IEC 61850.....	227
DNP.....	230
Peer to Peer Paralleling Configuration.....	237
Master/Follower Configuration.....	237
Send Firmware Update.....	238

Convert Datalog File to CSV Format.....	241
Convert Binary Soe File to .SOE Format.....	241
Windows menu.....	242
Help menu.....	242
TapPlot analysis software.....	243
Starting TapPlot.....	252
Section 5 System setup.....	255
General unit setup.....	255
User access codes.....	255
Setting level 1 or level 2 user access codes from the HMI.....	256
Setting level 1 or level 2 user access codes from TCC600.....	257
Setting multi level access codes from TCC600.....	258
User lines.....	260
Setting user lines from the HMI.....	260
Setting user lines from TCC600.....	261
System clock.....	261
Setting time/date and daylight savings from the HMI.....	262
Setting date/time and daylight savings from TCC600.....	263
Oscillograph setup.....	265
Setting up the oscillograph recorder.....	266
Sequence of events recorder.....	268
Setting up the sequence of events recorder.....	270
Wakeup screens.....	274
Selecting wakeup screen parameters.....	275
Communication.....	276
Enabling communication access security and timeout from the HMI.....	278
Enabling communication access security and setting timeout from TCC600.....	278
Source address validation.....	279
Enabling source address validation from the HMI.....	279
Enabling source address validation from TCC600.....	280
Feeder and substation addressing.....	280
Setting substation address from the HMI.....	284
Setting feeder address from the HMI.....	284
Setting communication addresses from TCC600.....	285
Automatic mode blocking.....	286
Comm Block Auto.....	287
Setting Comm Block Auto from the HMI.....	287
Setting Comm Block Auto at power off from TCC600.....	287

SCAMP initialize on power up.....	288
Setting SCAMP initialize on power up from the HMI.....	289
Setting SCAMP initialize on power up from TCC600.....	289
Optional Ethernet port.....	290
Configuring Ethernet port from TCC600.....	291
Configuring network time synchronization from TCC600.....	293
Configuring the control's Ethernet port from the HMI for use on a network that supports DHCP protocol	295
Configuring the control's Ethernet port from the HMI for use on a network that does not support DHCP protocol	295
Setting the MODBUS and DNP ports from the HMI.....	297
Setting the Ethernet keepalive time from the HMI.....	297
RS-485/Fiber-optic port.....	298
Configuring RS-485/fiber-optic port from the HMI.....	298
Configuring RS-485/fiber-optic port from TCC600.....	299
RS-232 port.....	300
Configuring RS-232 port from the HMI.....	300
Configuring RS-232 port from TCC600.....	301
Installation of modems.....	302
Connecting the PC modem.....	302
Initializing the PC modem from TCC600.....	302
Connecting the local modem to the control.....	303
Optional bluetooth.....	305
Configuring bluetooth from the HMI.....	307
Configuring bluetooth from TCC600.....	308
Setting up bluetooth MODE1 from TCC600.....	311
Resetting bluetooth module from the HMI.....	311
Resetting bluetooth module from TCC600.....	312
Resetting bluetooth passkey from the HMI.....	313
Resetting bluetooth passkey from TCC600.....	314
SCADA heartbeat.....	315
Setting SCADA HeartBeat option from TCC600.....	321
Section 6 Configuration.....	323
Tapchanger type selections.....	323
Configuration.....	326
User programmable alarm relay.....	326
Setting programmable alarm relay inputs from TCC600.....	326
Setting programmable alarm relay inputs from the HMI.....	330
Programmable alarm relay mode.....	330

Op Count Signal Alarm.....	333
Setting Op Count Signal Alarm from the HMI.....	333
Setting Op Count Signal Alarm from TCC600.....	333
Counters.....	335
Operation counter.....	335
Setting the Operation Counter Configuration from the HMI.....	337
Setting Operation Counter X Mode Delay from the HMI.....	338
Setting Operation Counter X Mode Delay from the HMI.....	338
Configuring the Operation Counter from TCC600.....	339
Resetting the Resettable Operation Counter from the HMI.....	341
Resetting the Resettable Operation Counter from TCC600.....	341
Presetting the Presettable Operation Counters from the HMI....	343
Presetting the Presettable Operation Counters from TCC600...	343
Inputs and switch configuration.....	345
Setting Input Selection 1 Operation Counter Input Configuration to Switch Status from the HMI.....	345
Setting Input Selection 1 Operation Counter Input Configuration to Switch Status from TCC600.....	346
Motor seal-in failure block.....	348
Setting Input Selection 1 Operation Counter Input Configuration to Motor Seal-In from the HMI.....	350
Setting Input Selection 1 Operation Counter Input Configuration to Motor Seal-In from TCC600.....	351
Setting Motor Seal-in Failure Alarm/Block from the HMI.....	352
Setting Motor Seal-in Failure Alarm/Block from TCC600.....	353
Input Selection 2 (Non-Sequential or SCADA Cutout).....	354
Input Selection 3 (VR2 or Aux).....	356
Auto/Manual switch type.....	358
Setting Auto/Man Switch Type from the HMI.....	358
Setting Auto/Manual Switch Type from TCC600.....	359
Ratio multipliers.....	360
Voltage and current multipliers.....	360
Setting the Voltage and Current Multipliers from the HMI.....	361
Setting the Voltage and Current Multipliers from TCC600.....	362
Primary power display.....	363
Setting Primary Power Display Selection from the HMI.....	363
Setting Primary Power Display Selection from TCC600.....	364
Correction factors.....	365
VT ratio correction.....	365
Setting Load and/or Source VT Correction Factor from the HMI	366

Setting Load and/or Source VT Correction Factors from TCC600.....	366
CT/VT phase shift.....	368
Setting CT/Load and/or CT/Source Phase Shift Quantities from the HMI.....	369
Setting CT/Load and/or CT/Source Phase Shift Quantities from TCC600.....	369
Auxiliary current transformer.....	371
Setting Auxiliary Current Transformer Units Display from the HMI.....	371
Setting Auxiliary Current Transformer Units Display from TCC600.....	372
Metering factors.....	373
Secondary.....	375
Primary.....	375
Present demand.....	375
Energy metering.....	375
Demand history.....	376
Frequency.....	377
Load VT configuration.....	377
Setting Load VT Configuration from the HMI.....	377
Setting Load VT Configuration from TCC600.....	377
Output selection.....	379
Output pulse.....	379
Setting Output Configuration from the HMI.....	380
Setting Output Configuration from TCC600.....	380
Motor current detection and monitoring.....	382
Setting the Motor Current Detection Settings from the HMI.....	383
Setting the Motor Current Detection Settings from TCC600.....	384
Regulator type.....	385
Setting Regulator Type from the HMI.....	387
Setting Regulator Type from TCC600.....	387
Remote voltage bias.....	389
Enabling/Disabling Remote Voltage Bias from the HMI.....	391
Enabling/Disabling and Setting Remote Voltage Bias from TCC600.....	391
Run through neutral.....	393
Enabling/Disabling and Setting Run Through Neutral from the HMI.....	394
Enabling/Disabling and Setting Run Through Neutral from TCC600.....	395

Fast voltage recovery.....	396
Enabling/Disabling and Setting Fast Voltage Recovery from the HMI.....	397
Enabling/Disabling and Setting Fast Voltage Recovery from TCC600.....	398
Parallel operation.....	399
Circulating current and delta VAR methods.....	399
Circulating current/ Δ VAR1.....	399
Δ VAR2 paralleling and Δ VAR2 paralleling + KeepTrack™.....	404
Δ VAR2 connection.....	405
Selecting and Setting Δ VAR2 Paralleling Method from the HMI.....	409
Selecting and Setting Δ VAR2 Paralleling Method from TCC600.....	409
Optional master/follower paralleling method.....	411
Grouping operation algorithm (GOA).....	412
Master/follower alarm messages.....	414
Lockout condition.....	414
Master/follower configuration tool.....	415
Setting of masters and followers from TCC600.....	417
Setting of masters and followers from the HMI.....	422
Optional delta VAR peer to peer paralleling method.....	429
Bus topology.....	431
Grouping operation algorithm (GOA).....	434
Delta VAR peer to peer paralleling alarm messages.....	436
Lockouts.....	437
Delta VAR peer to peer paralleling configuration tool.....	438
Delta VAR peer to peer paralleling application.....	441
Setting up Delta VAR Peer to Peer Paralleling Control from TCC600.....	441
Setting up Delta VAR Peer to Peer Paralleling Control from the HMI.....	443
Tap settings.....	445
Tap information.....	445
Load tapchanger (LTC) positive tap position knowledge.....	445
Contact KeepTrack™.....	446
Shaft Coupled KeepTrack™ tap position knowledge.....	452
Resistor Divider KeepTrack™ tap position knowledge for LTCs.....	454
Motor Direct Drive KeepTrack™.....	456
Selecting Tap Position Knowledge from the HMI.....	459
Selecting Tap Position Knowledge from TCC600.....	459
Contact KeepTrack™ 1N – Additional TCC600 settings screen.....	461

Initializing Tap Position When Motor Direct Drive KeepTrack "INTERNAL KEEPTRACK" is Active from the HMI.....	463
Initializing Tap Position When Motor Direct Drive KeepTrack™ "INTERNAL KEEPTRACK" is Active from TCC600.....	464
Initializing Tap Position When Regulate (Reg or XFMR) External or Contact KeepTrack™ 1R1L/1N is Active from the HMI.....	465
Initializing Tap Position When Regulate (Reg or XFMR) External or Contact KeepTrack™ 1R1L/1N is Active from TCC600.....	466
Setting Highest and Lowest Tap from the HMI.....	468
Setting Highest and Lowest Tap from TCC600.....	469
Intertap time delay.....	471
Setting the Intertap Delay from the HMI.....	472
Setting Intertap Time Delay from TCC600.....	472
Tap limits.....	474
Enabling/Disabling and Setting Tap Limits from the HMI.....	474
Enabling/Disabling and Setting Tap Limits from TCC600.....	475
Data logging and harmonics.....	476
Data logging.....	476
Setting up Data Logging from the HMI.....	477
Setting up Data Logging from TCC600.....	478
Harmonics setup.....	479
Setting the Active Harmonics Inputs to the Oscilloscope and Sequence of Events Recorders from the HMI.....	479
Setting the Harmonic Voltage, Current Threshold and Minimum Current Threshold Settings from the HMI.....	480
Setting the Harmonic Voltage and Current Threshold Delay from the HMI.....	481
Setting the Active Harmonics Inputs to the Oscilloscope and Sequence of Events Recorders from TCC600.....	481
CBEMA configuration.....	483
CBEMA functionality.....	483
Setting up CBEMA from the HMI.....	484
Setting up CBEMA from TCC600.....	485
Section 7 Setpoints.....	489
Setpoint profiles.....	489
Editing of setpoint profiles.....	489
Selecting a setpoint profile for editing from the HMI.....	490

Selecting a setpoint profile for editing from TCC600.....	491
Naming setpoint profiles.....	491
Assigning a setpoint profile name from the HMI.....	491
Assigning a setpoint profile name from TCC600.....	492
Regulation limits.....	493
Setting the Overvoltage Block Raise and Block Lower Limit from the HMI.....	496
Enabling or disabling Voltage Runup from the HMI.....	497
Setting the Voltage Runback and Runup Deadband from the HMI.....	497
Setting the Current Block Limit from the HMI.....	498
Enabling or disabling the Low Current Block/Alarm from the HMI.....	498
Enabling or disabling the Low Current Block/Alarm from TCC600.....	499
Setting Limits Runback Runup from TCC600.....	501
Voltage reduction.....	503
Setting Voltage Reduction Steps 1, 2 and 3 from the HMI.....	504
Setting Voltage Reduction Steps 1, 2 and 3 from TCC600.....	504
Enabling or disabling Standard Voltage Reduction from the HMI.....	506
Smart Voltage Reduction.....	507
Enabling or disabling and setting Smart Voltage Reduction from the HMI.....	507
Enabling or disabling and setting Standard or Smart Voltage Reduction from TCC600.....	507
Save Voltage Reduction at power off.....	509
Setting Save Voltage Reduction at Power Off from the HMI.....	509
Selecting Save Voltage Reduction at Power Off from TCC600.....	509
Setting Voltage Reduction Turnoff Timer from the HMI.....	511
Setting Voltage Reduction Turnoff Timer from TCC600.....	511
Line drop compensation.....	513
Selecting Line Drop Compensation Type and Settings from the HMI.....	516
Setting Power Flow Forward and Power Flow Reverse LDC Resistance (R) and Reactance (X) values from the HMI.....	517
Setting Power Flow Forward and Power Flow Reverse LDC Z values from the HMI.....	518
Setting Line Drop Compensation from TCC600.....	519
Basic time delay.....	521
Setting Basic Time Delay Timer Characteristic and Type from the HMI.....	522
Setting Basic Time Delay Timer Characteristic and Type from TCC600.....	523
Reverse power operation.....	525

Setting Reverse Power Operation and Power Direction Bias Mode from the HMI.....	530
Setting Reverse Power Operation and Power Direction Bias Mode from TCC600.....	531
Power flow settings.....	533
Setting Bandcenter and Bandwidth from the HMI.....	534
Setting Bandcenter and Bandwidth from TCC600.....	535
Setting the Definite or Inverse Delay from the HMI.....	537
Setting the Definite or Inverse Delay from TCC600.....	537
VAr bias.....	539
Step VAr bias method.....	540
Enabling Step VAr Bias Method from the HMI.....	541
Enabling Step VAr Bias Method from TCC600.....	542
Linear VAr bias method.....	545
Enabling Linear VAr Bias Method from the HMI.....	546
Enabling Linear VAr Bias Method from TCC600.....	547
Section 8 Installation.....	551
Installation.....	551
External connections.....	551
Non-sequential operation.....	561
Multi-step voltage reduction.....	561
LTC backup control.....	562
Communication ports.....	562
Communication cables.....	565
Grounding.....	566
Typical LTC connection.....	566
Typical regulator connection.....	568
Control power backup input connection.....	570
Installation of TCC600 Communications Software and establishment of initial local communications.....	573
Section 9 Testing.....	575
Set-up procedure.....	575
Bench-testing.....	576
Starting check-out procedure.....	578
Performing operational test.....	580
Performing in-service test.....	580
Testing bias voltage.....	581
Testing control front panel LEDs.....	582
Testing control inputs.....	583

Testing control outputs.....	584
Testing front panel push buttons.....	584
Delta VAr peer to peer paralleling checkout procedure.....	585
Performing two transformer verification.....	585
Performing three transformer verification.....	588
Section 10 Appendix A HMI.....	595
HMI menu flow.....	595
HMI Screen Review.....	603
Monitor.....	603
Metering.....	603
Present Demand.....	605
Demand History.....	606
Energy Metering.....	607
Status.....	608
Motor Current.....	610
Harmonics.....	610
Tap Information.....	611
Setpoints.....	613
Profile Settings.....	613
Common Settings.....	614
Power Flow Forward.....	615
Power Flow Reverse.....	616
Voltage Reduction.....	617
Limits.....	618
VAr Bias.....	619
VAr Bias.....	619
VAr Bias (Step).....	619
VAr Bias (Linear).....	620
Configuration.....	622
Tapchanger Type.....	622
Tap Settings.....	622
Paralleling.....	625
Programmable Alarm.....	629
System Clock.....	632
Input Selection.....	632
Mtr Current Profile.....	633
CBEMA Setup.....	633
Harmonics Setup.....	634
Data Logging.....	635

Nameplate.....	636
Run Through Neutral.....	639
Remote Voltage Bias.....	640
Communication.....	641
Comm Settings.....	641
Memory Card.....	643
Ethernet.....	645
HMI.....	647
Bluetooth.....	648
RS232.....	649
Utilities.....	650
Calibration-Test.....	650
About.....	653
Section 11 Appendix B Setpoint, Configuration and Communication Record Forms.....	655
Setpoints.....	655
Configuration.....	657
Tap settings.....	661
Alarms.....	663
Wakeup screens.....	663
Data logging.....	664
Harmonics setup.....	664
Oscillograph setup.....	665
Sequence of events setup.....	666
CBEMA settings.....	667
Comm settings.....	668
Section 12 Appendix C DNP Configuration Editor.....	671
DNP Configuration Editor.....	671
Section 13 Appendix D IEC 61850 Configuration Editor.....	681
IEC 61850 Configuration Editor.....	681
Section 14 Appendix E Self-test error codes.....	691
Self-test error codes.....	691
Section 15 Appendix F Remote Ethernet file update utility.....	695
Remote Ethernet file update (REFU) utility.....	695
Remote Ethernet firmware update.....	695
Remote Ethernet file update and cyber security.....	696
Updating Ethernet firmware remotely.....	697

Table of contents

Updating data file remotely.....	700
Section 16 Glossary.....	705

Section 1 Introduction

1.1 This manual

The user manual contains product overview and instructions on how to install, commission, configure and operate the device via HMI or TCC600 communications software. The manual can be used as a technical reference by system engineers and maintenance personnel during the testing, engineering, installation and commissioning phases, and during normal service.

1.2 Intended audience

This manual addresses users, configuration engineers and installation and commissioning personnel, who use technical data during engineering, installation and commissioning, and in normal service.

1.3 Product documentation

1.3.1 Document revision history

Document revision/date	History
A/2016-08-10	First release
B/2019-05-27	Content updated



Download the latest documents from the ABB Web site
<http://www.abb.com>.

1.4 Symbols and conventions

1.4.1 Symbols



The electrical warning icon indicates the presence of a hazard which could result in electrical shock.



The warning icon indicates the presence of a hazard which could result in personal injury.



The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.



The information icon alerts the reader of important facts and conditions.



The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although warning hazards are related to personal injury, it is necessary to understand that under certain operational conditions, operation of damaged equipment may result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warning and caution notices.

1.4.2 Document conventions

A particular convention may not be used in this manual.

- Abbreviations and acronyms are spelled out in the glossary. The glossary also contains definitions of important terms.
- Menu paths are presented in bold.
Select **Main menu/Settings**.
- HMI messages are shown in Courier font.
To save the changes in nonvolatile memory, select *Yes*.
- Parameter names are shown in italics.

-
- The function can be enabled and disabled with the *Operation* setting.
Parameter values are indicated with quotation marks.
The corresponding parameter values are "Enabled" and "Disabled".

Section 2 TCC300 overview

2.1 Overview

The TCC300 Digital Tapchanger Control is a microprocessor-based transformer and step-voltage regulator load tapchanger control.

The control is designed for initial OEM installation on new tapchangers or to replace a particular manufacturer's tapchanger control. The TCC300 is designed to mechanically and electrically replace an old control, with mounting hardware to facilitate the replacement.

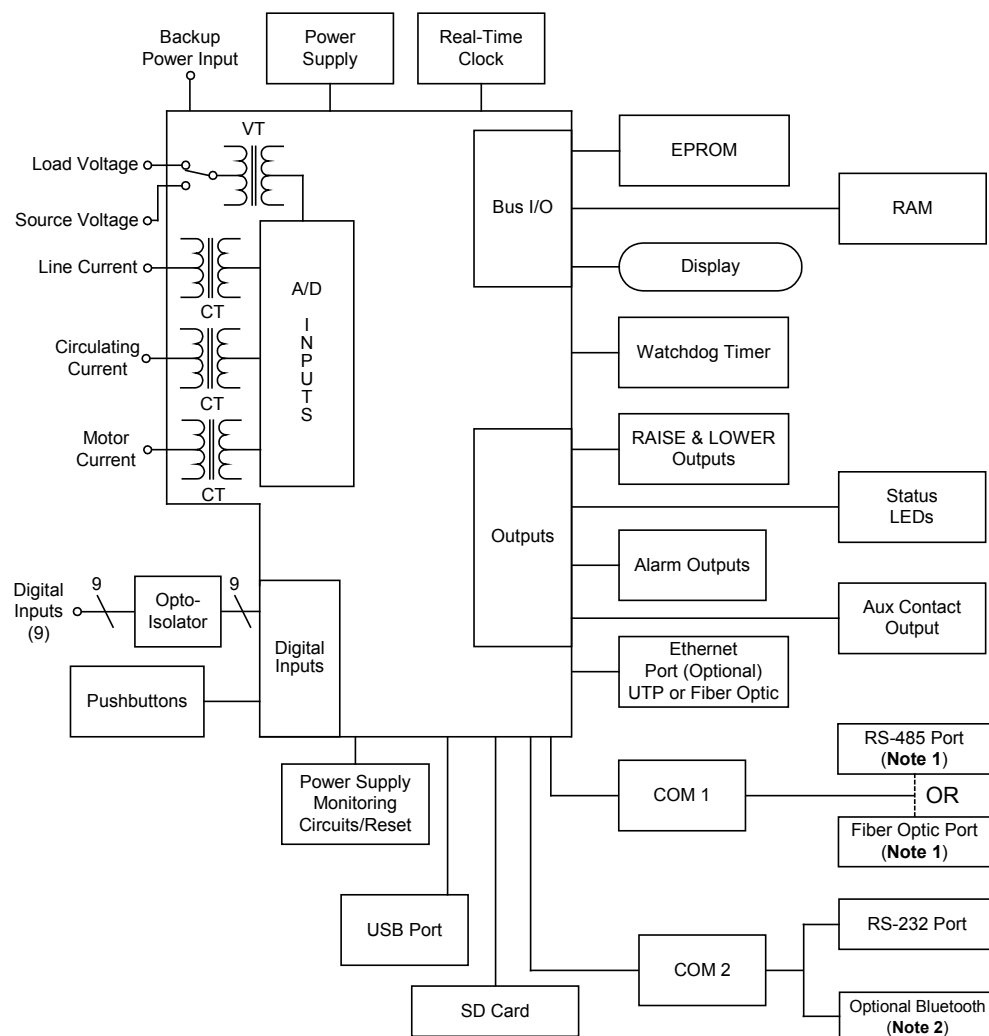


Figure 1: Functional Diagram



1. The RS-485 and Fiber Optic ports are standard on COM 1. However, only one can be active at a time.
2. COM 2 is limited to either the standard RS-232 Port or the optional Bluetooth® capability. Only one option can be active on COM 2 at a time.

Interrogation of the control and setting changes are made using either the front panel HMI, or through the communications ports (MODBUS® or DNP3.0 protocol) utilizing TCC600 Communications Software. The HMI consists of a 20-character by 2-line display and seven push buttons. Two Access Codes are available to the user from the push buttons.

All setpoints are stored in nonvolatile memory which is unaffected by control voltage disturbances.

Three Tapchanger operation counters are provided:

- Presetable Operations
- Counter Resettable Operations
- Counter Presetable Neutral Counter

Ten LEDs are used to indicate Tapchanger Band Status, timing for RAISE and LOWER, REV PWR Reverse Power detection, CPU OK, ALARM, V/RED Voltage Reduction in Effect, MANUAL, LOCAL, and TX/RX.

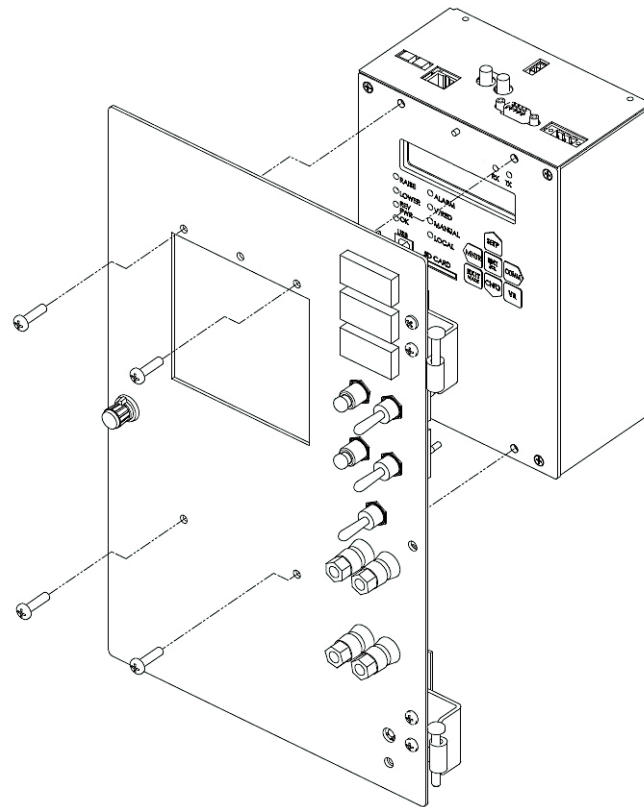
The alphanumeric display and six push button interface provides complete front panel access to the scrolling menu program. The control applies to tapchangers with ± 16 taps and one neutral position.

A Voltage Reduction push button allows the user to locally apply up to three levels of Voltage Reduction from the control front panel.

2.2

Adapter panel or surface mounting kit

An adapter panel or an M-2050 or M-2054 Surface Mounting Kit must be used with the TCC300 Tapchanger Control. Each panel adapts TCC300 as a transformer and regulator control replacement and provides the external connections necessary for operation via terminal blocks on the rear of the adapter panel. Contact ABB for a list of adapter panels that are currently available. See the application guides of the specific adapter panel for the mounting details.



The M-2050 is an adapter kit which permits surface mounting of the control using two right angle mounting brackets, four screws and a 24-pin connector with six-foot pigtailed on each pin. The M-2050 does not include features available on adapter panels. These features include mechanical configurations and wiring connections for direct replacement, CT shorting or front panel switches, fuses or test points. See the instruction manual of the M-2050 for the mounting details.

24

2.3 Accessories

2.3.1 TCC600 Communications Software

TCC600 is a Windows-based communications software program available for remote control and metering of the TCC300 Tapchanger Control. It is designed to interface with the microprocessor of the control through the standard USB Port (MODBUS®) and all installed communication ports. The TCC600 software displays all pertinent operating information. All operations that can be performed from the front panel user interface of the control can be duplicated remotely, through TCC600.

- Changing setpoint values. This includes those values for normal tapchanger control operation, as well as custom configuration to the site.
- Monitoring values. This includes measured and calculated values of real-time operating parameters.
- Data logging. The control can internally store various parameters at selected intervals. The TCC600 program can download this data into a spreadsheet and display. Alternatively, the PC can be programmed to poll the control and obtain a pre-selected list of parameters at selected intervals. Also, TCC600 includes a utility to convert the downloaded Datalog files from the Smart Flash SD Card into a spreadsheet readable format.
- Remote Control. The Remote Control feature allows the user to remotely raise or lower one tap position as well as apply voltage reduction to the target control.

2.3.2 Optional communication ports

The TCC300 Digital Tapchanger Control can be equipped with optional Bluetooth® capability (COM2). COM2 is located on the top rear of the unit. COM2 utilizes the DNP 3.0 and MODBUS protocols.

TCC300 can also be equipped with an optional Ethernet Port through a RJ-45 Jack (10/100 Base-T) or Fiber Optic through ST connectors (100 Base-Fx). These ports support DNP over TCP/IP and MODBUS over TCP/IP.

2.3.3 M-2025B(D) Current Loop Interface Modules

The M-2025B(D) are external self-contained interfaces designed to operate with the tapchanger control for tap position by positive knowledge, for LTC transformer applications. The modules connect to the current loop output of a tap position monitor such as the 1250-series INCON Programmable Position Monitors. The tap position monitor includes current loop outputs whose level corresponds linearly to any of a pre-

programmed number of tap positions depending on the tapchanger mechanism being monitored. The modules accept current loop ranges of:

- 0 to 1 mA dc
- 0 to 2 mA dc
- -1 to +1 mA dc
- 4 to 20 mA dc

The Tap Information screen is provided in the tapchanger's Tap Settings Menu to select whether the control uses the current loop method or the Motor Direct Drive KeepTrack™ method for tap position knowledge. The M-2025B(D) Current Loop Interface module is not used with the "KeepTrack™" method. The Motor Direct Drive KeepTrack method is used with single-phase line regulators having a counter contact and a neutral contact. The M-2025B(D) module easily connects to the tapchanger control through a six-pin connector located on the bottom of the control.

For parallel operation using the circulating current method, the following accessories are needed: the M-0115A Parallel Balancing Module, the M-0127A AC Current Relay and the M-0169A Auxiliary Current Transformer.

2.3.4 Backup relay

The M-0329B Backup Relay or the M-5329 Multi phase Backup Relay are available to provide protection against failure of the primary control.

2.3.5 M-2026 AC-DC control power backup supply

The M-2026 accepts either AC or DC input over a range of 21 to 32, 42 to 60 and 105 to 145 V. The unit will supply a regulated +12 Vdc at up to a 1.5 A output. The unit includes a fused input, surge protection, and reverse polarity protection.

2.3.6 M-2027 control power backup supply for AC only

The M-2027 will accept an AC input over a range of 105 to 140 Vac at 50/60 Hz. The unit will supply a +12 Vdc at up to 1.0 A output.

2.3.7 B-0920 control power backup harness

The B-0920 Control Power Backup Harness provides fused (3 A) power to TCC300 when a M-2026 or M-2027 Control Power Backup Supply is not used.

2.3.8

M-2948 tap position sensor

The M-2948 tap position sensor is a rotary shaft encoder that includes a built-in microprocessor that provides stepped output signals in 9 or 10 degree increments. The M-2948 is available with 0 to 297°, 306°, 315°, 330°, 340° and 350° rotation for ±16 taps and 1, 2 or 3 neutral positions. The electrical output of the sensor is a 4-20 mA current loop that converts easily to a voltage signal at the input of the M-2025B(D) with the addition of a proper value shunt resistor. For a 4-20 mA Current Loop, 150 ohms is required on the input of the M-2025B(D). The signal from the M-2025B(D) is then conditioned and sent to TCC300 as an analog signal. The M-2948 Tap Position Sensor is available with either a positive or negative slope. Negative slope (clockwise rotation) causes a decrease in Tap Position. Positive slope (clockwise rotation) causes an increase in Tap Position. M-2948 Tap Position Sensor directly mechanically replaces the Selsyn-Type Tap Position Sensor.

Section 3 Operation

3.1 Front panel controls and indicators

3.1.1 Display and push buttons

The front-panel user interface consists of a Liquid Crystal Display (LCD) or Vacuum Fluorescent (VFD) Display, directional (Hot Buttons), EXIT, ENT, and VR push buttons, and the status indicators.



Figure 3: Front Panel

The display normally displays the user lines and remains so until the UP, DOWN, LEFT, RIGHT or ENT push button is depressed. Pressing any push button will display the heading corresponding to the "Hot Button" label above the push button. The "Hot Buttons" directly access the menu headers and can only be selected from either the user lines or the cycling display.

UP, DOWN, LEFT and RIGHT push buttons

The directional push buttons have three functions.

- They are used to change screens and scroll through selections.
- They are used to enter new values by incrementing or decrementing the displayed value. The new value is not stored until the ENT push button is pressed a second time.
- Activate the "Hot Button" feature for the corresponding labels above each push button to jump to that screen.

HMI menu structure

The HMI menu structure (Appendix A) consists of three levels: Header, Sub-Header and Data/Data Entry. From the header level the user can navigate to the adjacent headers with the LEFT and RIGHT push buttons, go to the sub-header level by pressing ENT or DOWN push button, or clear the screen by pressing the EXIT push button.

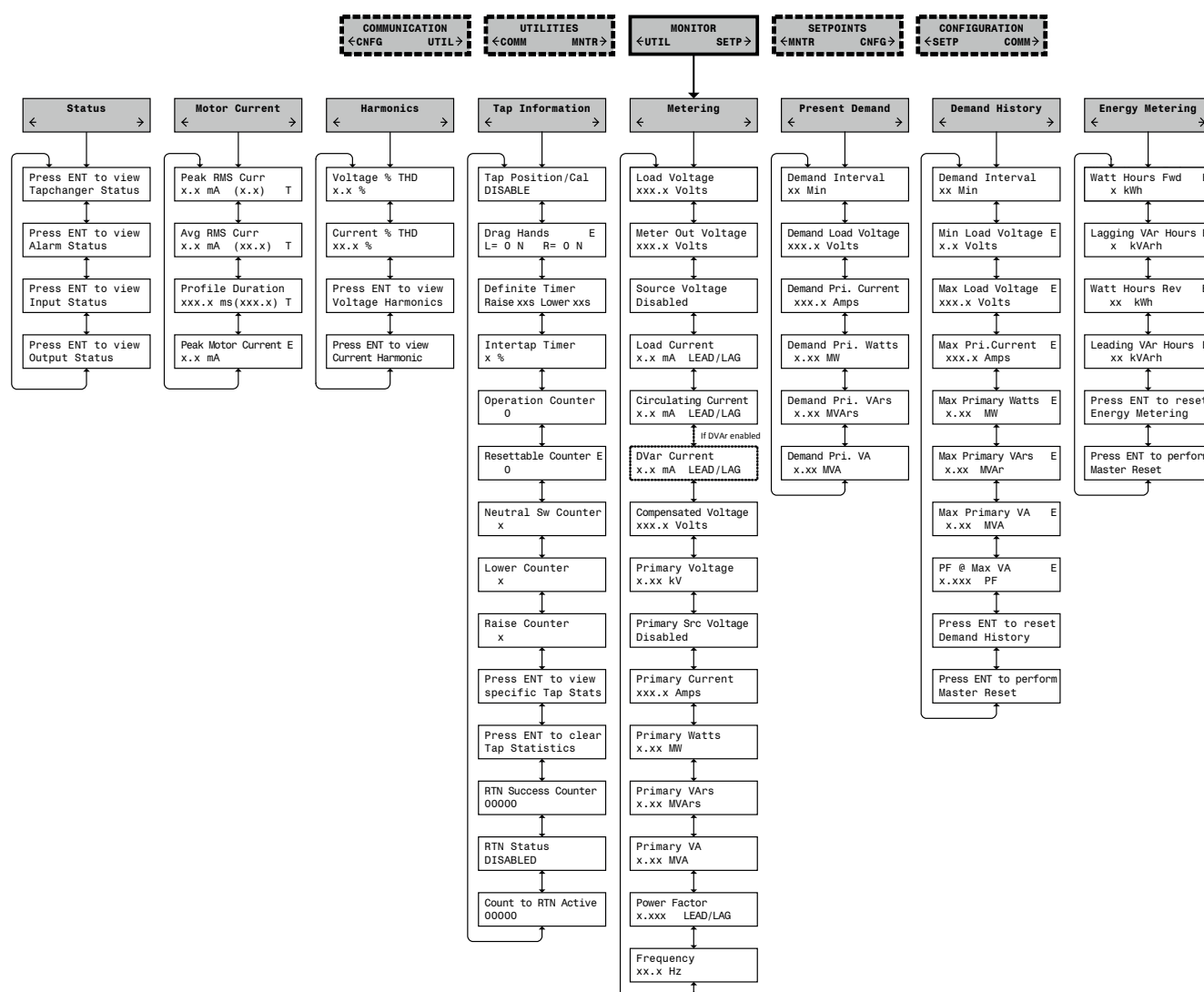


Figure 4: Example of HMI Menu Structure, Header, Sub-Header and Data/Data Entry Menus

From the sub-header level, the user can navigate to the adjacent sub-headers with the LEFT and RIGHT push buttons, return to the header level by pressing the EXIT or UP push buttons, or enter the data/data entry level by pressing ENT or DOWN. Once in the data/data entry screens, the user can navigate through the list with the UP and DOWN push buttons. In this level the list wraps around. To exit the level, the user can press EXIT to return to the corresponding sub-header, or use the LEFT and RIGHT push buttons to go to the adjacent sub-header level. To enter data, reset parameters or access data screens, press ENT.

ENT push button

The ENT push button is a hot button for the "Utility Menu". It is also used to perform the following functions:

- Enter the "edit" mode of a screen
- Store a setpoint or condition in memory
- Enter the sub-header or data level
- Reset certain monitoring screens

EXIT push button

The EXIT push button is a hot button for a unit "wakeup", which starts cycling through a series of user selectable metering and tap information screens. The user can move up and down the automatic cycling using the UP and DOWN push buttons. Pressing EXIT will stop the cycling on the displayed parameter. The screens for the wakeup sequence can be enabled or disabled from the TCC600 Communications Software.

The EXIT push button is also used to perform the following functions:

- Exit a level to the next higher level
- Cancel data entry
- Clear the screen when at the header level

Data entry screens

Data entry screens are of three types:

- Alphanumeric
- List
- Bit Mask

For Alphanumeric Data, the LEFT and RIGHT push buttons advance the cursor to the digit to be edited and the UP and DOWN push buttons change the value. For List Data, the UP and DOWN push buttons change the data. For Bit Mask (i.e. Prog Alarm Function) the LEFT and RIGHT push buttons move the cursor to the bit and the UP and DOWN push buttons change the value. For all screens the ENT push button saves the value and EXIT push button cancels the operation. A "C" indicates the user is in the edit mode.

Power up screens

Each time the control is powered up, it will briefly display a series of screens that include:

-
- User Lines
 - Control Firmware Number
 - Serial Number
 - Date
 - Time of Day

Screen blanking

The display automatically displays the user lines after exiting from any menu, or from any screen after 15 minutes of unattended operation.

LCD screen contrast

The LCD screen contrast can be set/reset from the control front panel through the HMI menu item or at any time. Pressing the Right and Left arrow push buttons at the same time displays the LCD Contrast screen which cycles from dim to bright. Selecting ENT during the cycle sets the displayed contrast to the value at the time ENT was pressed. The LCD Screen Contrast adjustment menu item is located in the Communication/HMI menu.

"C" CHANGE prompt

This prompt, in the bottom right corner of a screen, is enabled by initially pressing Utility/ENT. This prompt indicates that the user can change a setting using the UP or DOWN push buttons to increment or decrement the settings. Values have factory preset increments, such as 0.1 volt or 1 second. Press ENT the second time to execute the setting change.

"ENT" prompt

When the "E" prompt appears in the top right corner of the display window it indicates that the value of the display will reset if the ENT push button is pressed.

LEFT and RIGHT prompt

Some setpoints screens include the Left and Right Arrows but do not move to the adjacent sub-header, but instead go to a configuration screen.

Volt Red push button (Voltage Reduction)

The VR push button acts as a "hot" key to allow the user to change the Voltage Reduction status from the front panel. It can only be accessed when the screen displays the user lines, or a cycling message is being displayed on the front panel. The Voltage Reduction push button allows the user to apply 3 Steps of Voltage Reduction.

3.1.2

Status indicators

RAISE LED

The Raise LED (yellow) illuminates when the voltage is below the lower band edge and the timer has started timing for a tapchanger Raise operation.

LOWER LED

The Lower LED (yellow) illuminates that the voltage is above the upper band edge and the timer has started timing for a tapchanger Lower operation.

REV PWR LED

The Reverse Power LED (red) will illuminate to indicate when the unit detects reverse power flow.

OK LED

The OK LED (green) will remain illuminated whenever power is applied to the unit and the control is functioning properly. The OK LED will also extinguish when a Motor Seal-in Failure Block is in effect.

ALARM LED

The Alarm LED (red) will illuminate when any of the Programmable Alarm Functions set the output relay to true.

V/RED LED

The Voltage Reduction LED (yellow) will flash corresponding to the level of Voltage Reduction that has been invoked. This is true for any Voltage Reduction process whether it came from an external contact, any Comm input or HMI.

- 1 Flash for Level 1 Voltage Reduction
- 2 Flashes for Level 2
- 3 Flashes for Level 3

MANUAL LED

The Manual LED (red) will illuminate when Auto operation of the control has been blocked from any Com port. It will also illuminate when Manual Mode has been selected using the Adapter Panel Auto/Manual Push button or Toggle switch.

LOCAL LED

The Local LED (yellow) will illuminate when all SCADA write capability to the control is blocked.

COM1 TX/RX LEDs

The Transmit TX (red) and Receive RX LEDs (green) indicate that the control is transmitting and/or receiving through COM1. Also, during the boot-up sequence the TX and RX LEDs will cycle indicating that the memory test is in progress. If the memory test is successful, then the TX and RX LEDs will be extinguished. If the memory test fails then both TX and RX LEDs will illuminate.

Smart Flash SD Card Slot

The Smart Flash SD Card Slot allows the user to:

- Quick Capture
- Load and Save Setpoints
- Save Datalog files (in COMTRADE format)
- Save Sequence of Events files
- Save Oscillograph records (in COMTRADE format)
- Clone Save and Load
- Load and Save DNP files
- Update Firmware
- Save Wakeup Screen parameters
- Save All Metering parameters
- Utilize the SD Card as an Access Code Key
- Save/Load IEC 61850 CID Files (when IEC 61850 is purchased)

3.2 Operation (HMI/TCC600)

3.2.1 Message screens

Default Message Screen

When the TCC300 is energized and unattended, the User Logo lines are displayed.

Local Voltage Reduction Screen

If Local Voltage Reduction is active, the display will cycle the appropriate Voltage Reduction Screen. When Local Voltage Reduction is terminated, then the display will return to the User Lines.

Op Count Signal Alarm Screen

The Op Count Signal Alarm will initiate a cycling display as long as the alarm is active.

Oscillograph Record Triggered Screen

If the "ENABLE OSC Message" feature is enabled (default setting is Enabled) and the Oscillograph has been triggered, a cycling display indicating that there is an oscillograph record available for download will be displayed. The screen will be displayed until the oscillograph record is cleared or the "ENABLE OSC Message" is disabled. However, if the Oscillograph file is not cleared, re-enabling this feature will restart the cycling.

The "Oscillograph Record Triggered" cycling display can be enabled from the TCC600 Communications Software by navigating to the "Front Panel Message" (Setup/Oscillograph/Front Panel Message) dialog screen and selecting "Enable". It can also be enabled from the HMI by navigating to the "Communication HMI" menu.

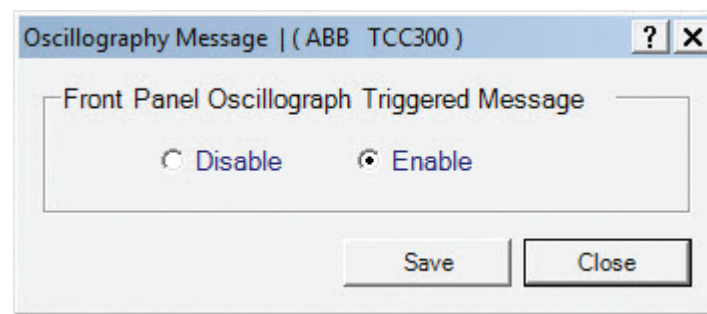


Figure 5: Oscillograph Message Dialog Screen

Wakeup Message Screens

If the "Wake/EXIT" pushbutton is selected, then control will respond as follows:

- When the User Lines are being displayed press "WAKE/EXIT" to initiate a stepped display of the selected Wakeup parameters for a period of 15 minutes.
- If no Wakeup screens are selected, then no parameters will be displayed and the User Lines will blink for a moment.



The Adapter Panel Drag Hand Reset only resets the Tap Position Drag Hands.

- During the stepped parameter display, pressing ENT on any Demand Metering value will reset ALL Demand Metering Drag Hand values. This is also true for ALL Energy Metering Drag Hand values.
- The Wakeup stepped display can be stopped on the displayed parameter by selecting EXIT. Select EXIT again to terminate the stepped parameter display and return to the User Lines. The Wakeup screen values can be browsed by utilizing the Up and Down

arrow pushbuttons. In this mode, if the ENT pushbutton is pressed while on a Demand or Energy Metering value, it will only reset that individual Drag Hand value.

- While in the Wakeup screen menu, when a Smart Flash SD Card is present in the control, an additional Smart Flash SD Card menu item will be displayed. All Wakeup screen parameters can be saved to the Smart Flash SD Card in *.csv format by performing the following steps.

To save Wakeup screen parameters to a Smart Flash SD Card proceed as follows:

1. Verify that a (FAT) formatted Smart Flash SD Card is inserted into the Smart Flash SD Card slot.
2. Press "WAKE/EXIT" to initiate the Wakeup screen cycling display.
3. When the "Save Wake Data to SD Press ENT to begin" screen is displayed, press the ENT pushbutton. The control will display the following:
Enter file name
TCC300MT
4. Utilizing the Up/Down and Left/Right arrow pushbuttons enter the desired "File Name".
5. Press the ENT pushbutton, the control will display the following sequence of screens.
Saving CSV...
"File Name"
Save Wake Data to SD
Press ENT to begin

Alarms

If enabled the following alarms will be displayed on the HMI when the alarm condition is active and set in the Programmable Alarm Relay:

- Communication Block
- Block Raise (Tap)
- Block Lower (Tap)
- Block Raise (Voltage)
- Block Lower (Voltage)
- Voltage Reduction
- Max VAr Bias Duration–Lag
- Max VAr Bias Duration–Lead
- Individual Tap Wear
- LDC/LDZ
- Line Current Limit
- Reverse Power Flow
- Abnormal Tap Position
- Backup Fail (If Backup Power purchased)
- Op Count Signal
- Tap Changer Failure

The Alarm Activity feature can be accessed from the Utility/Calibration/Test HMI menu to display all currently active alarms.

The following alarms will also be displayed on the HMI when their features are enabled:

- Motor Seal-in Failure
- Δ VAR®2 Over Current Limit
- Low Current Block
- Master/Follower Lockout

3.2.2 Access codes

To prevent unauthorized access to the control functions, there are provisions in the software for assigning a Level 1 and/or Level 2 Access Code (up to six characters). A fixed factory assigned Level 3 Access Code is required for changing calibration factors. When Level 1 or Level 2 Access Codes are active, then an additional 30 Level Access Codes (up to 15 characters) can be enabled as either Level 1 or Level 2. The Access Codes can be set in the **Communication/HMI Menu** or from TCC600.

Level Access protection will be automatically reinstated when either of the following conditions are met:

- No HMI menu activity for a period of 15 minutes
- The user exits to the top of the HMI menu for a period of greater than 10 seconds

3.2.3 Access levels

General access to read setpoints, to monitor status, to reset drag hand parameters and the resettable operations counter do not require an Access Code.

The Level 1 Access Code, if set, is required to make setpoint changes. If the Level 1 Access Code is set to all zeros, this request for an Access Code will not be seen and changes can be made without an Access Code. The default Level 1 Access Code is 000000.

The Level 2 Access Code, if set, is required to make changes to the configuration, communication, and utilities. If the Level 2 Access Code is set to all zeros, this request for an Access Code will not be seen and changes can be made without an Access Code. The default Level 2 Access Code is 222222.

The Level 3 Access Code is required to make changes to calibration settings on the control. Contact ABB Customer Service for TCC300 Level 3 Access Codes.

3.2.3.1 Smart flash SD card user access key code

If a Smart Flash SD Card inserted into the control has a valid Access Level 1 or Access Level 2 code written to it, the control will accept the code and not prompt for an Access Code.

3.2.3.2 HMI Level Access prompt

When Level Access is active, to change any settings which require a Level Access Code, the control will display an "Enter Level 1 (2 or 3) Access" prompt as applicable. Enter a valid Level Access Code as described below:

1. When prompted, press the ENT pushbutton to enter the "Change" mode.
2. If Level Access is active, the applicable Level Access prompt will be displayed.



When entering the Level Access Code the display will automatically advance the cursor to the next digit when input is momentarily paused.

3. Enter a valid Level Access Code, then press the ENT pushbutton.
If a valid Level Access Code was entered, the display will briefly flash a confirmation screen and then display the applicable change prompt screen.
4. If the control briefly displays an "Access Denied" screen, re-enter a valid code.

3.2.4 Oscillograph recorder

3.2.4.1 Triggering oscillograph recorder from TCC600

The Oscillograph Recorder can be manually triggered by the user from TCC600.

1. Start TCC600, then establish communications with the target control.
2. Select **Setup/Oscillograph/Trigger** from the TCC600 toolbar. TCC600 will display an Oscillograph Trigger confirmation dialog screen.

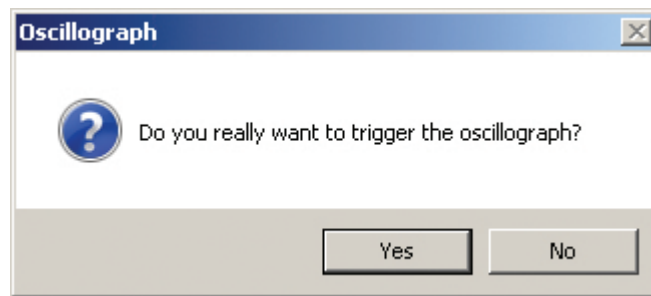


Figure 6: Manual Oscilloscope Trigger Confirmation Dialog Screen

3. Select **Yes**. TCC600 will display an "Oscilloscope was triggered successfully" confirmation screen.

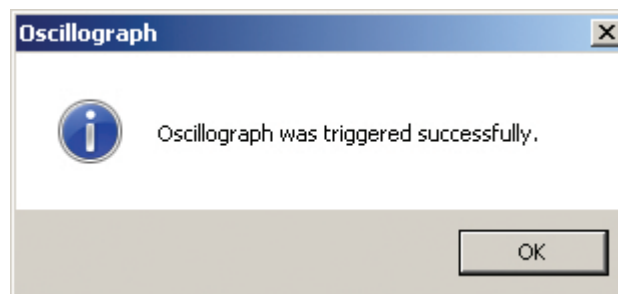


Figure 7: Oscilloscope Recorder Successfully Triggered Confirmation Dialog Screen

The control will display an "Oscilloscope Record Triggered" cycling message indicating that an oscilloscope record is available for download. This screen message will continue until the oscilloscope record is cleared.

4. Select **OK**. TCC600 will return to the Main screen.

3.2.4.2

Retrieving oscilloscope record from TCC600

Oscilloscope data must be retrieved from the control in a Comtrade file (*.cfg) in order to be viewed. TCC600® can be utilized to view the file contents.

1. Start TCC600®, then establish communications with the target control.
2. Select **Setup/Oscilloscope/Retrieve** from the TCC600 toolbar. TCC600 will display a "Retrieve Oscilloscope Record" dialog screen.

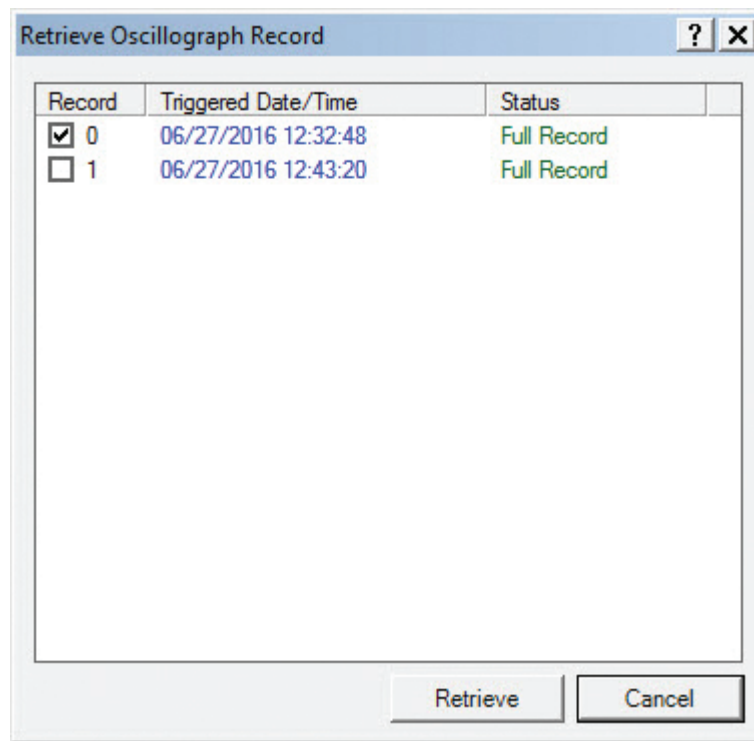


Figure 8: Retrieve Oscillograph Record Dialog Screen

3. Select the desired oscillograph record, then select Retrieve. TCC600 will display a Retrieve Oscillograph Record "Save As" dialog screen.

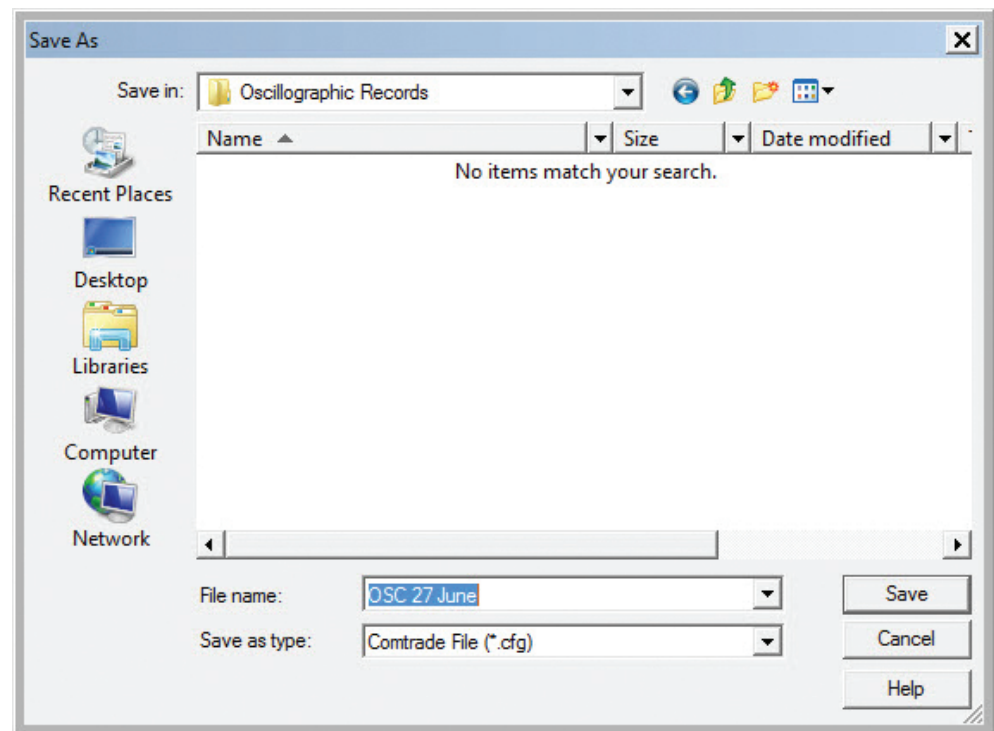


Figure 9: Retrieve Oscillograph Record (Save As) Dialog Screen

4. Select a folder to save the file to and the desired file name, then select Save, TCC600 will momentarily display an Initialization status screen, then a Retrieving Oscillograph Record status screen.

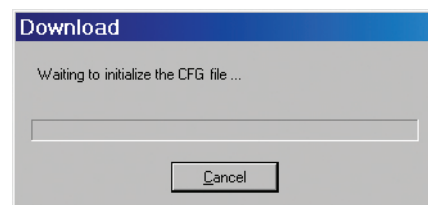


Figure 10: Initialize Oscillograph Record Download Screen

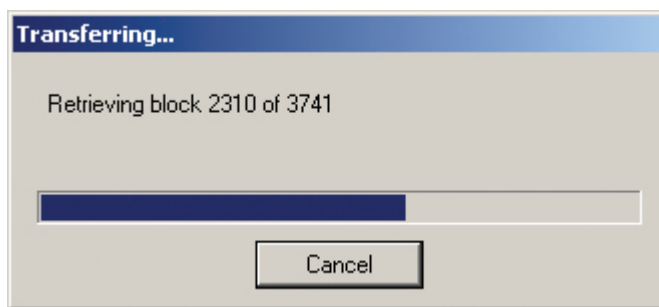


Figure 11: Retrieving Oscilloscope Record Status Screen

When the oscilloscope record has been downloaded, TCC600 will display a confirmation screen. Also, the cycling display on the control will not stop until the oscilloscope records are cleared.

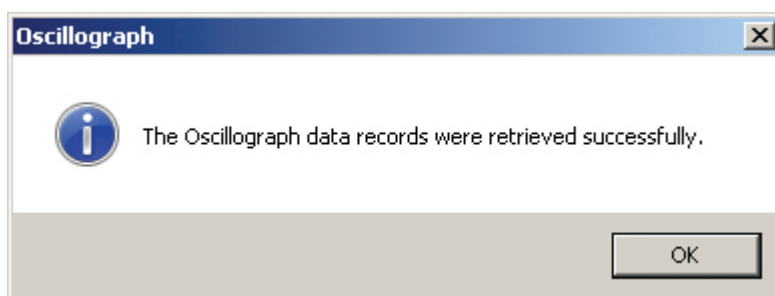


Figure 12: Oscilloscope Data Records Were Retrieved Confirmation Screen

5. Select **OK**. TCC600 will return to the Retrieve Oscilloscope Record screen.
6. Select any additional records to retrieve or select **Cancel** to return to the Main screen.

3.2.4.3

Clearing oscilloscope records from TCC600

1. Start TCC600®, then establish communications with the target control.
2. Select **Setup/Oscilloscope/Clear** from the TCC600 toolbar. TCC600 will display a Clear Oscilloscope Record confirmation screen.

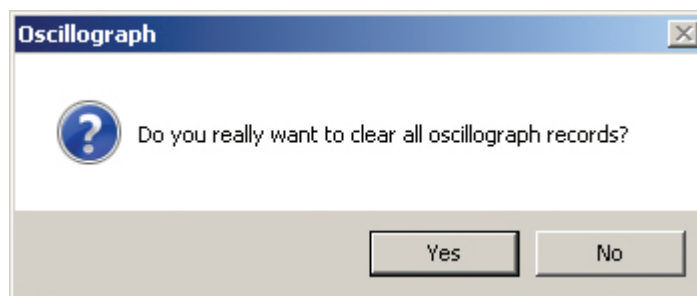


Figure 13: Clear Oscillograph Record Confirmation Screen

3. Select **Yes**. TCC600 will display a confirmation dialog screen.

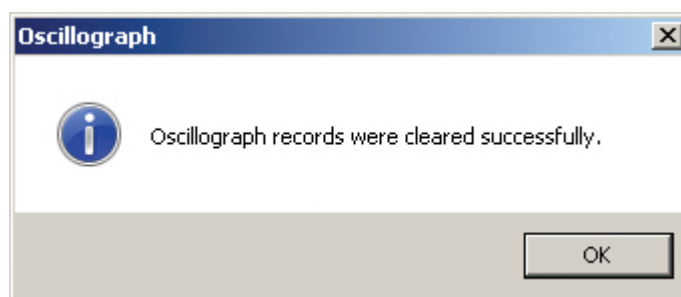


Figure 14: Clear Oscillograph Record Confirmation Screen

4. Select **OK**. TCC600 will return to the Main screen. The cycling display will be stopped.

3.2.4.4

Clearing oscillograph records from the HMI

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "**COMMUNICATION**" or "**Memory Card**" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings" or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "HMI" is displayed.
3. Press the Down arrow as necessary until the following is displayed:
Clear OSC Records
Ready Press ENTER
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Confirm press ENTER
Cancel press EXIT.
5. Press the ENT pushbutton. The following will be displayed:

Records Cleared!
Any key to continue

3.3 Sequence of events recorder

3.3.1 Triggering sequence of events recorder from TCC600

The Sequence of Events Recorder can be manually triggered by the user from TCC600®.

1. Start TCC600, then establish communications with the target control.
2. Select **Setup/Sequence of Events/Trigger** from the TCC600 toolbar. TCC600 will display a Sequence of Events Trigger confirmation dialog screen.

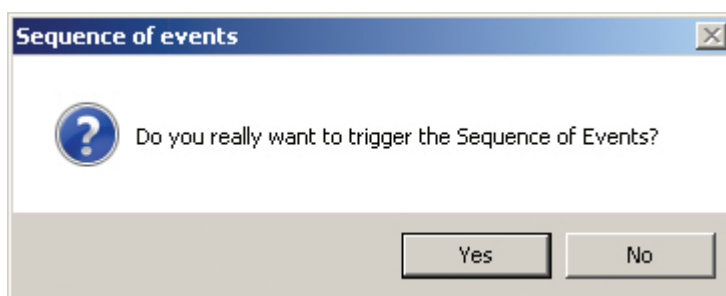


Figure 15: Sequence of Events Trigger Confirmation Dialog Screen

3. Select Yes. TCC600 will display a "Sequence of Events was triggered successfully" confirmation screen.

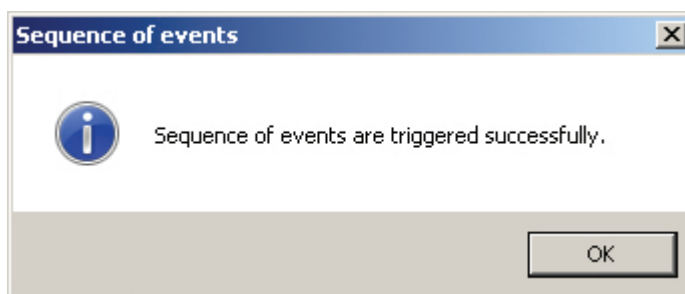


Figure 16: Sequence of Events Recorder Successfully Triggered Confirmation Dialog Screen

4. Select **OK**. TCC600 will return to the Main screen.

3.3.2 Retrieving sequence of events record from TCC600

TCC600 can be utilized to view the file contents.

1. Start TCC600®, then establish communications with the target control.
2. Select **Setup/Sequence of Events/Retrieve** from the TCC600 toolbar. TCC600 will display a Retrieve Sequence of Events Record "Save As" dialog screen.

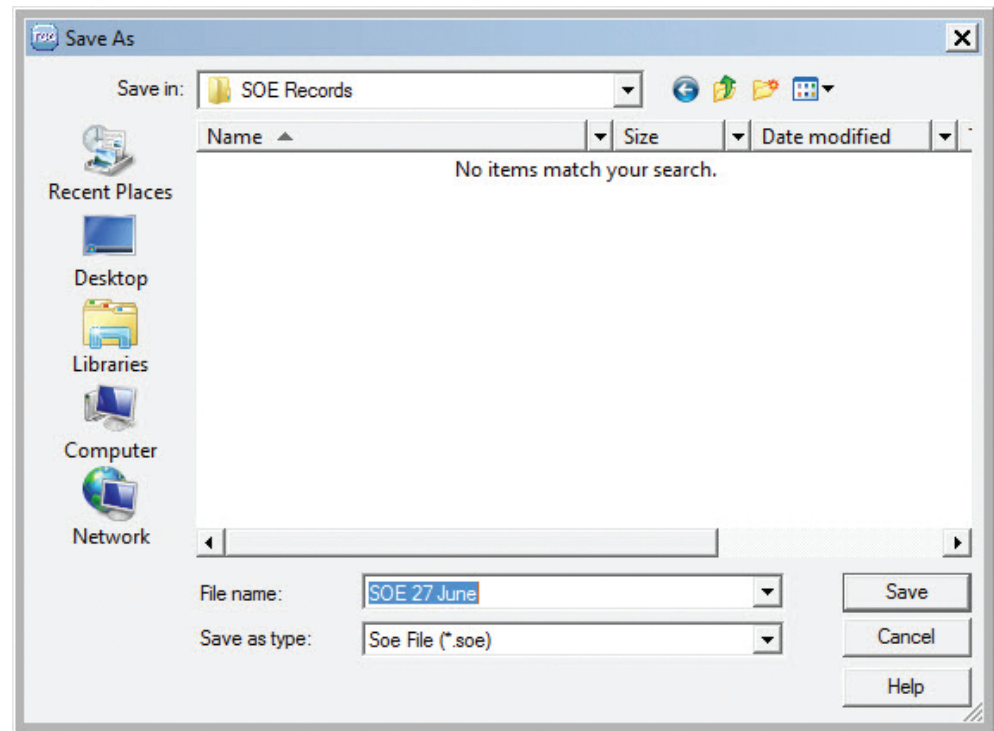


Figure 17: Retrieve Sequence of Events Record (Save As) Dialog Screen

3. Select a folder to save the file to and the desired file name, then select **Save**. TCC600 will momentarily display an Initialization status screen, then a "Retrieving Sequence of Events Record" status screen.

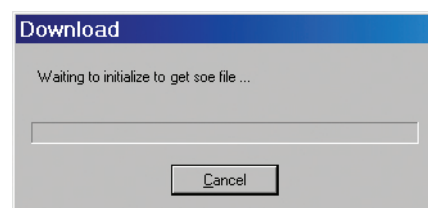


Figure 18: Initialize Sequence of Events Record Download Screen

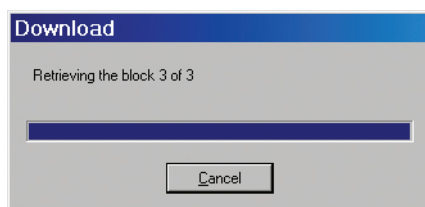


Figure 19: Retrieving Sequence of Events Record Status Screen

When the Sequence of Events record has been downloaded TCC600 will display a confirmation screen.

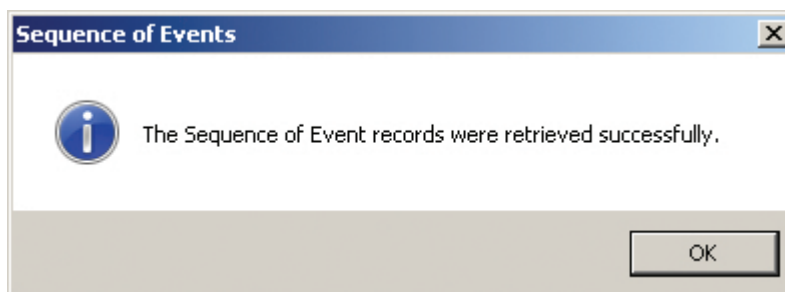


Figure 20: Sequence of Events Records Retrieved Successfully Confirmation Screen

4. Select **OK**. TCC600 will display "View Sequence of Events Record" dialog screen.

3.3.3

Viewing sequence of events from TCC600

1. Start TCC600®, then establish communications with the target control.
2. Select **Setup/Sequence of Events/View** from the TCC600 toolbar. TCC600 will display a "View Sequence of Events Record" dialog screen.
3. Select the desired Sequence of Events record to display the captured parameters.
 - **Trigger Status**
 - The "Trigger Status" section of the View Sequence of Events Dialog Screen displays the current trigger status at the instant the Sequence of Events Recorder was triggered. Sequence of Events is monitored at a fixed period of 1 cycle.
 - **Pickup/Dropout**
 - The "Pickup and Dropout" sections of the View Sequence of Events Dialog Screen indicate which signal caused the Sequence of Events recorder to trigger. These sections also include all the signals that changed at the instant that the Sequence of Events Recorder triggered

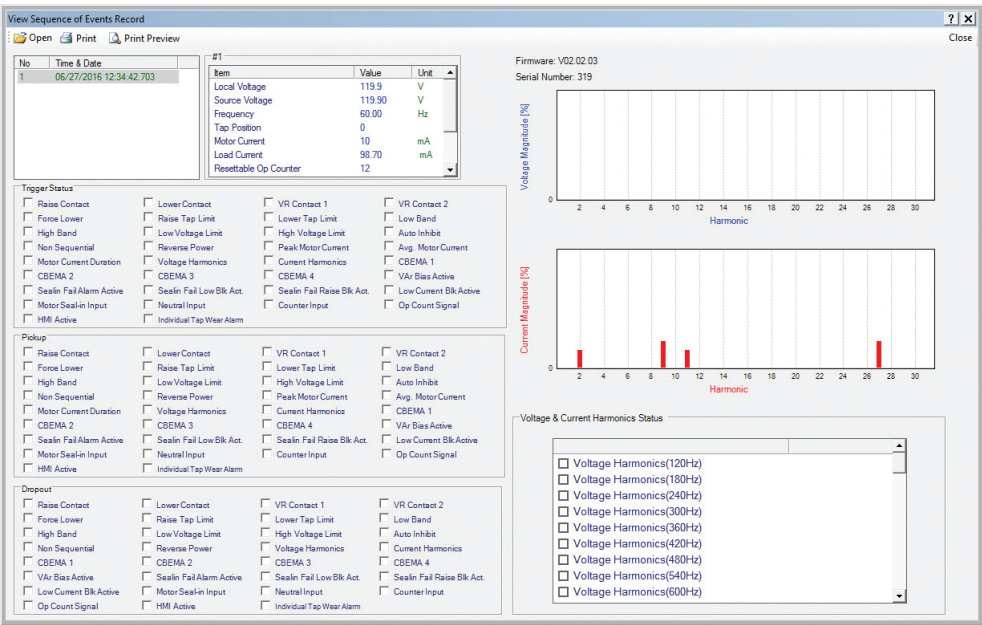


Figure 21: View Sequence of Events Dialog Screen

3.3.4

Clearing sequence of events records from TCC600

- 1. Start TCC600®, then establish communications with the target control.
- 2. Select **Setup/Sequence of Events/Clear** from the TCC600 toolbar. TCC600 will display a Clear Sequence of Events Record confirmation screen.

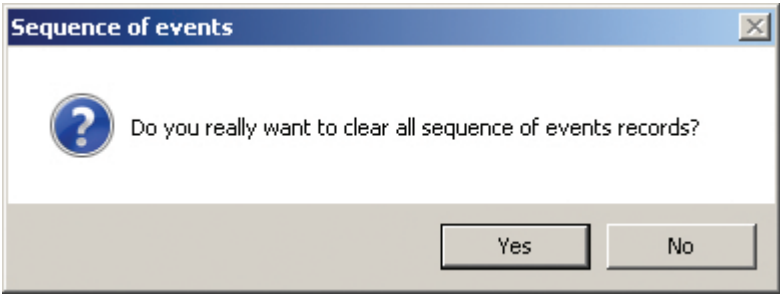


Figure 22: Clear Sequence of Events Record Confirmation Screen

- 3. Select **Yes**. TCC600 will display a "Clear" status screen, then a Sequence of Events records cleared successfully confirmation screen.

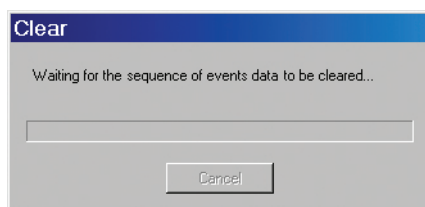


Figure 23: Clear Status Screen

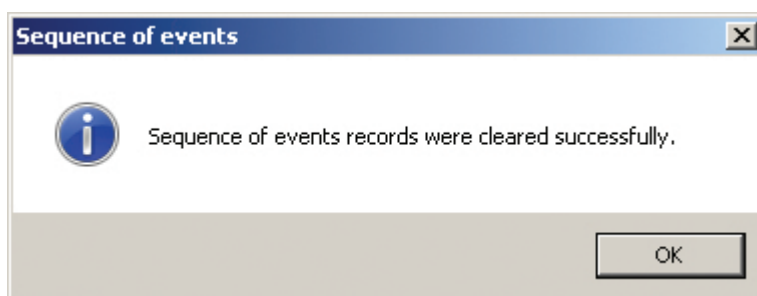


Figure 24: Sequence of Events Records Cleared Successfully Confirmation Screen

4. Select **OK**. TCC600 will return to the Main screen.

3.4 Data logging

3.4.1 Retrieving data logging data



When Load Voltage, Compensated Voltage, Source Voltage and Load Current are selected, the data to be retrieved will consist of the average, minimum and maximum values over the sampling period.

1. Start TCC600, then establish communications with the target control.
2. Select Setup/Data Logging/Retrieve from the TCC600 toolbar. TCC600 will display a Data Log Download dialog screen.

Figure 25: Data Log Download Dialog Screen



Load Voltage, Compensated Voltage, Load Current and Source Voltage are the average value during the data logging interval.

3. From the "Data to be retrieved" section of the Data Log Download screen select the desired parameters to be retrieved.
4. From the "Data Log Download Range" section of the Data Log Download screen select the "Start Date", "Start Time", "End Date" and "End Time" or select "Set 'Download Range' to start from last retrieval".
5. Select "Download". TCC600® will display a "Setpoints Successfully written to the control" confirmation screen and then display a "Save As" dialog screen.

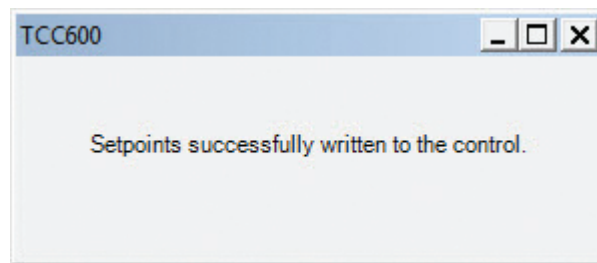


Figure 26: Setpoints Successfully Written To Control Confirmation Screen

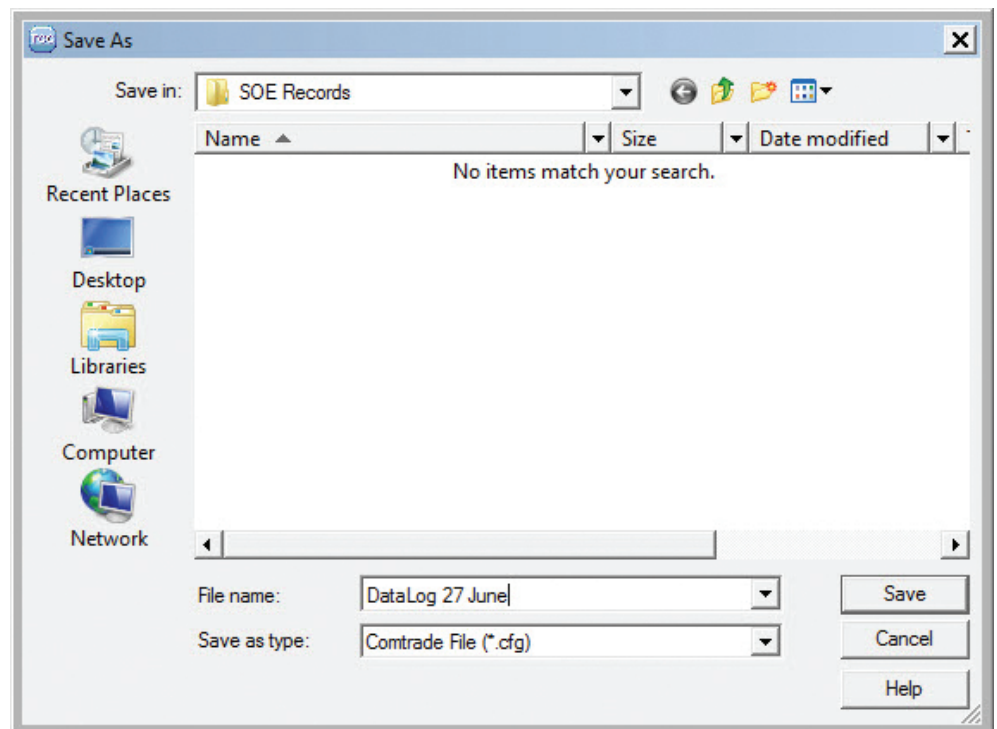


Figure 27: Data Log Download (Save As) Dialog Screen

6. Select a folder to save the file to and the desired file name, then select Save. TCC600 will display a Transferring Data Log status screen.

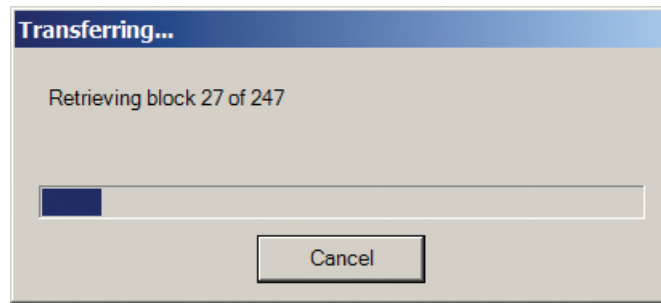


Figure 28: Transferring Data Log Status Screen

When the Data Log download is complete TCC600 will display a confirmation screen.

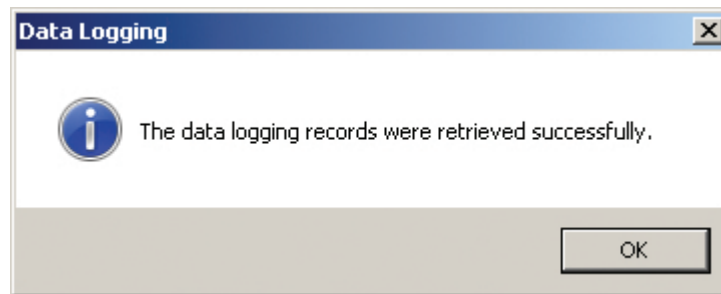


Figure 29: Data Log Records Retrieved Successfully Confirmation Screen

7. Select **OK**. TCC600 will return to the Main screen.

3.4.2

Clearing data log records from TCC600

1. Start TCC600®, then establish communications with the target control.
2. Select **Setup/Data Log/Clear** from the TCC600 toolbar. TCC600 will display a Clear Data Log Record confirmation screen.

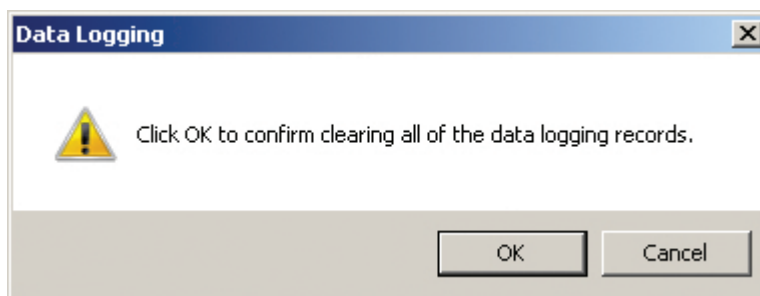


Figure 30: Clear Data Log Record Confirmation Screen

3. Select **OK**. TCC600 will display a "Clear" status screen and then a "All of the data logging records were cleared" confirmation screen.

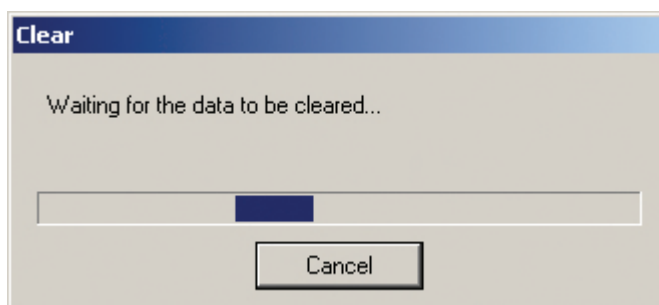


Figure 31: Clear Data Log Record Status Screen

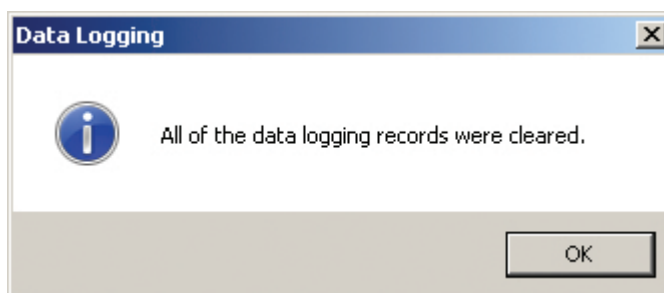


Figure 32: Data Log Records Cleared Successfully Confirmation Screen

4. Select **OK**. TCC600 will return to the Main screen.

3.4.3

Converting datalog files to CSV format

This utility converts "*.CFG" datalog files to "*.CSV" files for viewing in Excel. Selecting this utility from the TCC600® utility drop down menu opens an "Open" file

dialog screen. Selecting the target CFG file and then selecting "Open" converts the file and saves the resulting CSV file in the target file directory.

3.4.4 Clearing data log records from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to awaken the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Data Logging" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Press ENT to clear Data Log Records" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Press ENT to confirm clearing Data Log
6. Press the ENT pushbutton, the following sequence of screens will be displayed.
Erasing Data Log records...
Data Log records have been cleared.

3.5 Active setpoint profile

3.5.1 Setting active setpoint profile from TCC600

1. Start TCC600®, then establish communications with the target control.
2. Select **Setup/Profile/Set Active Profile** from the TCC600 toolbar.

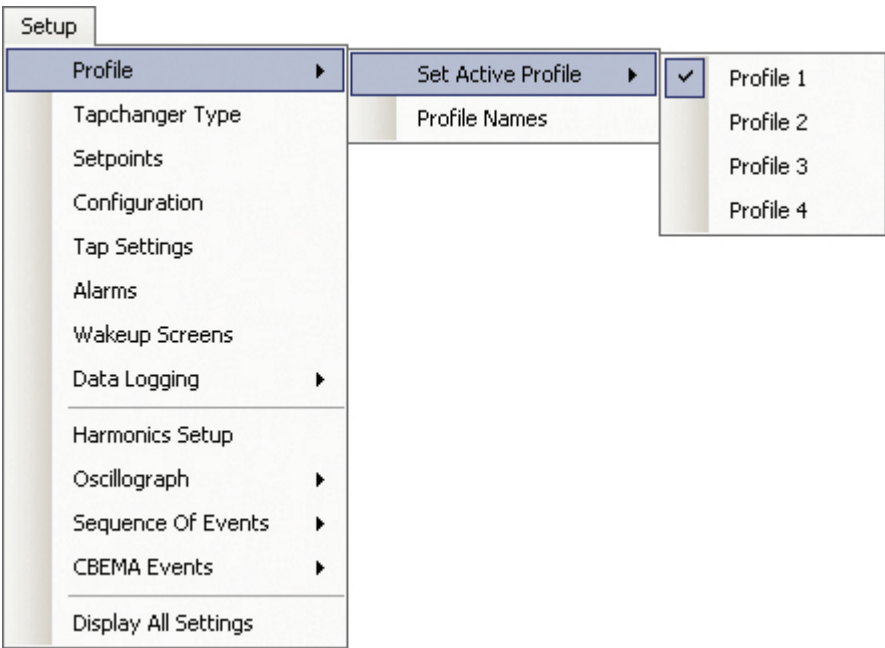


Figure 33: Selecting Set Active Profile



The control will immediately respond to the new Active Setpoint Profile settings.

- 3. Select the desired profile to activate. The Active Profile will be indicated in the menu dropdown and the TCC600 Lower Information Bar.

The Active Profile can also be selected from the Lower Information Bar.

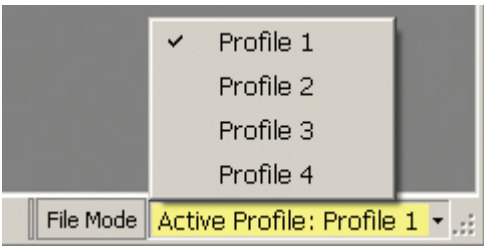


Figure 34: Set Active Profile from TCC600 Information Bar

3.6 Metering and status

Metering

The control has the capability of displaying measured and calculated secondary quantities and calculated primary quantities.

Secondary

The display will show local voltage, source voltage, compensated voltage, line frequency, and load current in secondary quantities along with load power factor. The voltage is displayed on a 120 V base and the current is displayed on a 200 mA base.



The local voltage displayed will not match the voltage measured at the test terminals on the adapter panel if a sensing VT ratio correction other than 0.0 V has been entered.

Primary

In order to use the calculated primary quantities feature, the user must enter the following data in the Configuration Menu:

- Select line-to-line or line-to-ground VT configuration.
- Select single-phase quantities based on measured inputs, or three-phase quantities based on measured inputs and assume a balanced system.
- Select primary voltage and current multipliers needed to calculate primary quantities.

Present Demand

The Present Demand metering capability provided in the control follows the concept of a lagged demand meter. The demand time interval is selected by the user as 5, 10, 15, 30 or 60 minutes. This is the time it takes for a thermal meter to indicate 90% of a change in load.

Energy Metering

The Energy Metering function of the control displays the following measured values:

- Total Lagging VAr Hours (KVArh, MVArh or GVArh)
- Total Leading VAr Hours (KVArh, MVArh or GVArh)
- Total Reverse Watt Hours (KWh, MWh or GWh)
- Total Forward Watt Hours (KWh, MWh or GWh)

The measured values are retained in non-volatile memory. A real time clock is utilized to record a date/time stamp for each quantity to indicate when the period of measurement was initiated.

When a Energy Metering screen is selected, the screen cycles continuously to indicate the total value, date and time the measurement was initiated. The **E** indicates that the measured value can be reset by pushing **ENT**.

Demand History

Demand History quantities are the maximum and minimum values for the period since the last reset command. These are retained in non-volatile memory. A real-time clock allows the recording of a date/time stamp with each Demand History quantity. The following are available for drag-hand use:

- Min/Max tap position (when Tap Position is enabled)
- Min Load voltage (120 V base)
- Max Load voltage (120 V base)
- Max Primary current
- Max Primary watts, kW or MW
- Max Primary VAr, kVAr or MVar
- Max Primary VA, kVA or MVA
- Power Factor at max VA

Where primary quantities are used, values displayed are single-phase or three-phase as defined in the Pri Pwr Display Screen of the Configuration Menu.



When the TCC300 Tapchanger Control is used with a ABB adapter panel, the panel's drag hands reset button only resets the mechanical drag hands of the regulator or LTC transformer. The button does not reset the tap drag hands information stored in the control. The maximum and minimum tap position of the control should always be reset when the mechanical drag hands are reset.

The values retained in memory are time-tagged quantities that are calculated using the demand period selected (5, 10, 15, 30 or 60 minutes). For voltage, values are the average of samples taken over a period of 32 seconds which avoids undue retention of momentary voltage transients. The load power factor retained is the value at the time of max VA.

When selected, three screens for each parameter cycle continuously and indicate the value, date and time of each parameter. The **E** indicates that the drag-hand can be reset by pushing **ENT**.

The control is equipped with a real-time, 24-hour clock which is used with the drag-hand feature to record date/time stamp information on quantities saved in memory. The power source for the clock is maintained for at least 24 hours during a system power outage by a charged capacitor (no battery). If the power outage lasts longer than 24 hours, check the clock and reset if necessary.

Frequency

The control provides for real-time metering of the line frequency. If the control is a 60 Hz model, the operating frequency is 55 to 65 Hz; if the control is a 50 Hz model, the operating frequency is 45 to 55 Hz.

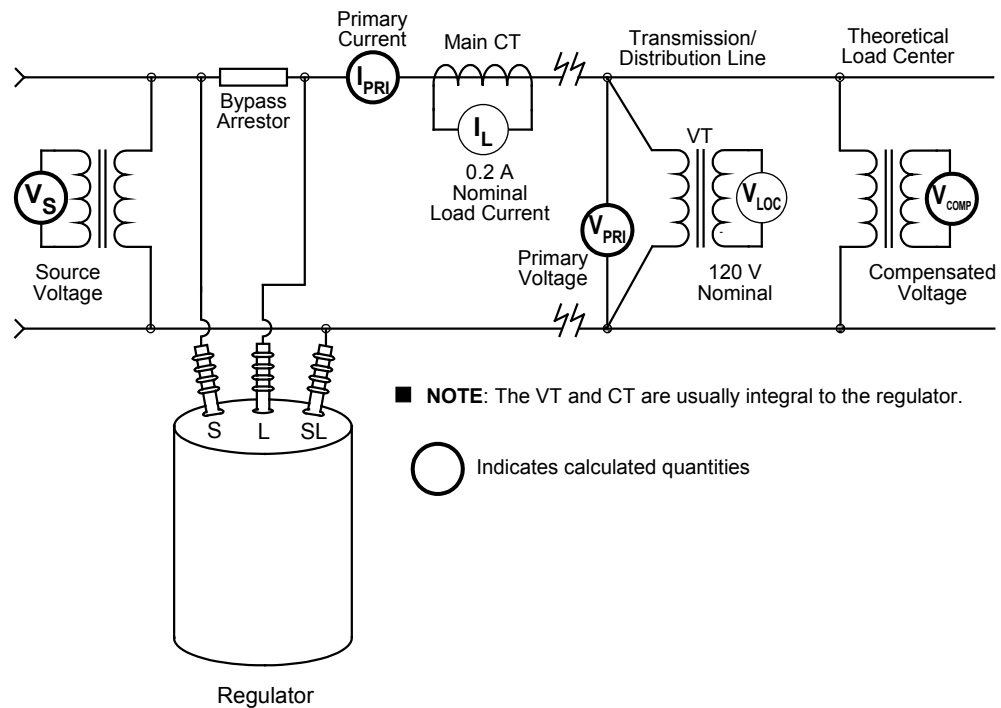


Figure 35: Secondary Quantity Metering and Primary Quantity Calculations for Regulator Applications

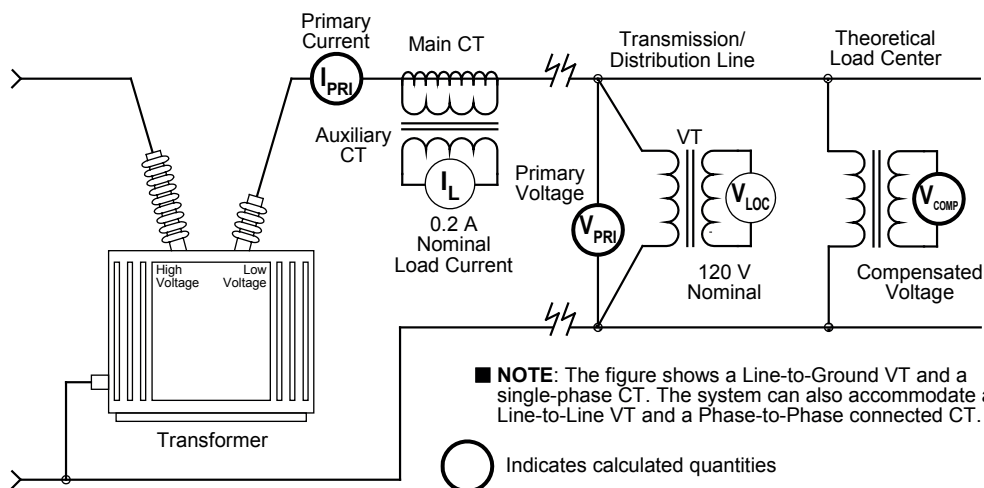


Figure 36: Secondary Quantity Metering and Primary Quantity Calculations for Transformer Applications

3.6.1

Accessing of monitoring screens from the HMI

The Monitor menu provides the user with the capability to view the Metering, Status, Tap Information, Present Demand, Demand History, Energy Metering, Harmonics and Motor Current elements of the monitoring screens (Single or Three Phase). The steps necessary to access, view, and where applicable, perform parameter specific operations for each monitoring category are described herein.

Table 1: *HMI categories/parameters for monitoring*

Category	Parameter
Metering	Load Voltage Meter Out Voltage Source Voltage Load Current Circulating/DVAr Current Compensated Voltage Primary Voltage Primary Src Voltage Primary Current Primary Watts Primary VArS Primary VA Power Factor Frequency
Status	Tapchanger Status Alarm Status Input Status Output Status
Tap Information	(E) Indicates Tap Information parameters that can be reset to zero or set to a value. Tap Position/Cal Drag Hands (E) Definite Timer Intertap Timer Operation Counter Resettable Counter (E) Neutral Sw Counter Lower Counter Raise Counter Specific Tap Statistics Clear Tap Statistics RTN Counter RTN Status Count to RTN Active
Present Demand	Demand Interval Demand Load Voltage Demand Primary Current Demand Primary Watts Demand Primary VArS Demand Primary VA
Demand History	(E) Indicates Demand History parameters that can be reset to zero. Demand Interval Min Load Voltage (E) Max Load Voltage (E) Max Primary Current (E) Max Primary Watts (E) Max Primary VArS (E) Max Primary VA (E) PF @ Max VA (E)
Table continues on next page	

Category	Parameter
Energy Metering	(E) Indicates Energy Metering parameters that can be reset to zero. Watt Hours Fwd (E) Lagging VAr Hours (E) Watt Hours Rev (E) Leading VAr Hours (E)
Harmonics	Voltage % THD Current % THD View Voltage Harmonics View Current Harmonics
Motor Current	(E) Indicates Motor Current parameters that can be reset to zero. Peak RMS Curr Avg RMS Curr Profile Duration Peak Motor Current (E)

3.6.1.1

Accessing the metering screens from the HMI

1. Press the Left Arrow (MNTR Hot Button) pushbutton to awaken the unit. The menu will advance to "MONITOR".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Metering
3. Pressing the Down arrow pushbutton will display the first metering parameter (Load Voltage). Pressing the Down arrow pushbutton will advance to the following Metering parameters:
 - Load Voltage
 - Meter Out Voltage
 - Source Voltage
 - Load Current
 - Circulating Current or D VAr Current
 - Compensated Voltage
 - Primary Voltage
 - Primary Source Voltage
 - Primary Current
 - Primary Watts
 - Primary VAr
 - Primary VA
 - Power Factor
 - Frequency

3.6.1.2 Accessing the status screens from the HMI

1. Press the Left Arrow (MNTR Hot Button) pushbutton to awaken the unit. The menu will advance to "MONITOR".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Metering
3. Press the Right or Left arrow pushbutton as necessary to navigate to the "Status" screen.
4. Press the Down arrow pushbutton once. The menu will advance to the first status element (Tapchanger Status) of the Status groups.

The status groups can be accessed by continuing to press the Down pushbutton within the Status menu and then pressing ENT to view.

The Status screens consist of four individual status groups that include:

- Tapchanger Status
- Alarm Status
- Input Status
- Output Status

3.6.1.3 Accessing the tapchanger status screens from the HMI

1. Navigate to the "Tapchanger Status" screen.
Press ENT to view Tapchanger Status
2. Press the ENT pushbutton. The control will display a summary of the Tapchanger Status parameters.
 - TAP = Tap Position ^[1]
 - BDS = Band Status
 - PWR = Power Direction
 - BLK = Blocks In Effect
 - VRD = Voltage Reduction
3. To cycle through each element of the "Tapchanger Status" display press the Down arrow pushbutton.

[1] In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, the Tap Position screen will display "- -" instead of "0".

Table 2: *Tapchanger status parameters*

Parameter	Values
Tap Position	The range of displayed values for Tap Position (TAP) are 16L–0–16R.
Band Status	The range of displayed values for Band Status (BDS) are HIGH, LOW and In Band.
Power Direction	The range of displayed values for Power Direction (PWR) are Forward and Reverse.
Blocks in Effect	The range of displayed values for Blocks in Effect (BLK) from left to right are: Position 1 LL – Block Line Limit DL – Delta VAr Overcurrent Limit Block Position 2 FL – Force Lower Block BR – Volt Block Raise BL – Volt Block Lower Position 3 TR – Tap Raise Block TL – Tap Lower Block Position 4 NS – Non Sequential Block SR – Seal - in Failure Raise Block SL – Seal - in Failure Lower Block IB – Low Current Block Position 5 CB – Comm Block Position 6 RP – Reverse Power Block Position 7 SC – SCADA Cutout Local
Voltage Reduction	The range of displayed values for Voltage reduction (VRD) are on and off. Press the Exit pushbutton to return to the "Tapchanger Status" screen.

3.6.1.4

Accessing the alarm status screens from the HMI

1. Navigate to the "Alarm Status" screen.
2. Press the ENT pushbutton. The control will display a summary of the Alarm Status parameters.
Alarm Status Display Key
 - – = Disabled/Condition Not Met
 - 1 = ALARM, ENABLED/Condition Met
 - 0 = ENABLED/Condition Not Met
 - X = Disabled/Condition Met
3. To cycle through each element of the Alarm Status display, press the Down arrow pushbutton. The control will display a detailed status screen.

Table 3: *Alarm status parameters*

Parameter	Value
A	Block Raise Tap disabled/not met
B	Block Lower Tap disabled/not met
C	Block Raise Volt ENABLED/not met
D	Block Lower Volt ENABLED/not met
E	Voltage Reduction disabled/not met
F	Power Direction disabled/not met
G	Current Limit disabled/not met
H	Comm Block disabled/not met
I	LDC/LDZ disabled/not met
J	Abnormal Tap disabled/not met
K	VAr Bias Lag disabled/not met
L	VAr Bias Lead disabled/not met
M	Backup Fail (If purchased) disabled/not met
N/M ¹⁾	DVar2 Over Curr (If purchased) disabled/not met
O/N ^{1)/M²⁾}	Seal-in Failure disabled/not met
P/O ^{1)/N²⁾}	Low Current Blk disabled/not met
Q/P ^{1)/O²⁾}	RTN Fail disabled/not met
R/Q ^{1)/P²⁾}	Ind Tap Wear disabled/not met
S/R ^{1)/Q²⁾}	Op Count Signal disabled/not met
T/S ^{1)/R²⁾}	Tap Changer Fail disabled/not met

1) These parameters will decrement by 1 letter if Backup Power (M) is not purchased.

2) These parameters will decrement by 2 letters if Backup Power (M) and DVar2 (N) are not purchased.

The range of displayed values for each Alarm element are, disabled/not met, ENABLED/not met, COND MET/disabled and ALARM (Enabled/condition exists).

4. Press the Exit pushbutton to return to the "Alarm Status" screen.

3.6.1.5

Accessing the input status screens from the HMI

1. Navigate to the "Input Status" screen.
2. Press the ENT pushbutton. The control will display a summary of the Input Status parameters.
Input Status Parameter Key:

- C = Counter Contact
- NS = Non-Sequential Input
- VR = Voltage Reduction 1, Voltage Reduction 2
- TC = Tap Connection
- KT = Keeptrack Lower, Keeptrack Raise
- N = Neutral Tap Position
- MS = Motor Seal-In

Input Status Display Key:

- 1 = On
- 0 = Off

For VR:

- - - = No Voltage Reduction Steps
- 1 - = Voltage Reduction Step 1 in effect - -
- - 2 = Voltage Reduction Step 2 in effect
- 1 2 = Voltage Reduction Step 3 in effect

For KT:

- - - = No Raise or Lower inputs active
- R - = Raise Input detected - - -
- L = Lower Input detected
- RL = Motor power is not connected or circuit failure

3. To cycle through each element of the "Input Status" display press the Down arrow pushbutton. The control will display a detailed status screen.

3.6.1.6

Accessing the output status screens from the HMI

1. Navigate to the "Output Status" screen.
2. Press the ENT pushbutton. The control will display a summary of the Output Status parameters.

Output Status Parameter Key

- RAISE = Raise Output Contact
- LOWER = Lower Output Contact
- ALARM = Alarm Output Contact

Output Status Display Key:

- 1 = On
- 0 = Off

3. To cycle through each element of the "Output Status" display press the Down arrow pushbutton. The control will display a detailed status screen.

3.6.1.7 **Accessing the metering and status screen from TCC600**

The Metering & Status Screen, when connected to a control, displays parameter values consistent with the capabilities of the communication system.

To access the Metering and Status screen from the TCC600® Main Menu, select Monitor/Metering & Status, or the menu bar Metering & Status hot button. TCC600 will display the Metering & Status screen.

The Metering Status display colors and text can be set in the Monitor/Set Metering Colors dialog screen.



When changing Metering and Status screen colors you must exit the Metering and Status screen for the color change to take affect.

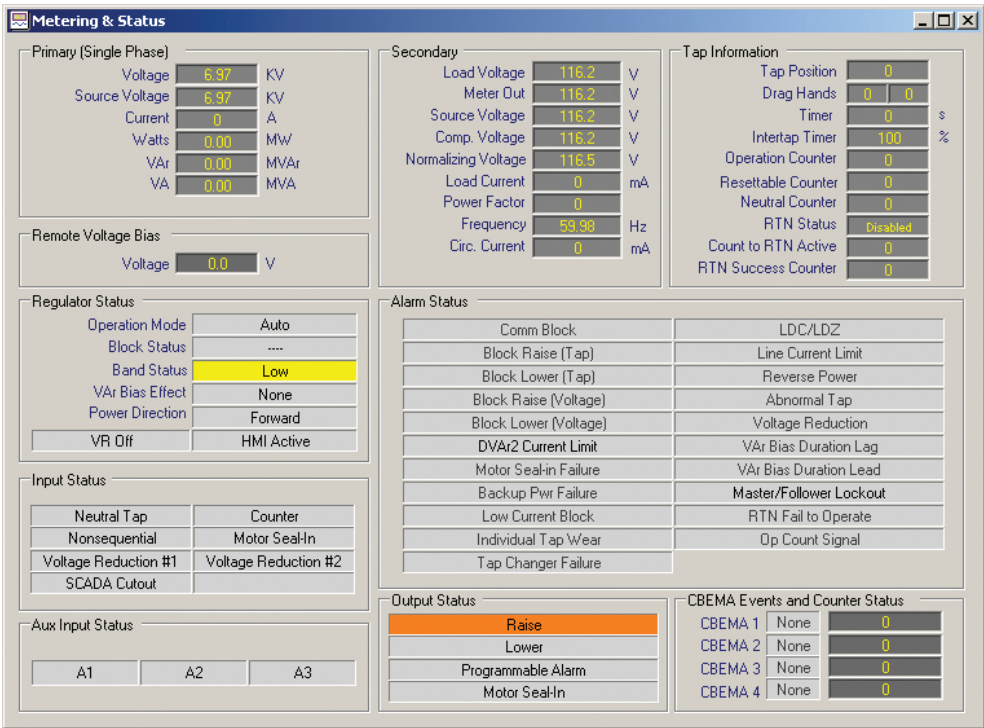


Figure 37: Metering and Status Screen

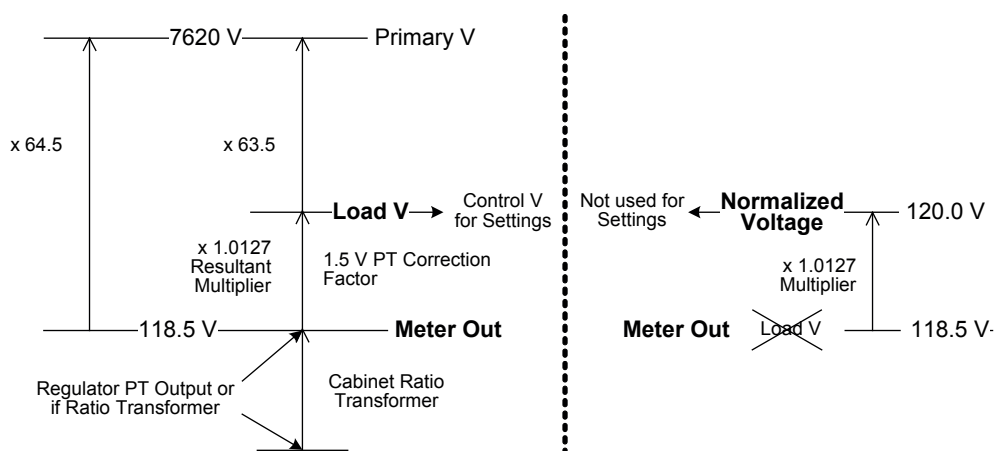


Figure 38: Meter Out Voltage Calculation

3.6.2

Primary metering (single or three phase)

Voltage

Displays the calculated primary voltage based on the user-selected voltage multiplier, VT corrections, and measured secondary voltage.

Source Voltage

Displays the calculated primary source voltage based on the user selected source voltage multiplier, source VT corrections and source secondary voltage.

Current

Displays the calculated primary current based on the user-selected current multiplier, and measured secondary current.

Watts

Displays the calculated primary quantity based on the user-selected voltage and current multipliers; VT configuration (line-to-ground or line-to-line), singlephase or three-phase, and measured secondary voltage and current.

VAR

Displays the calculated primary quantity based on the user-selected voltage and current multipliers, VT configuration (line-to-ground or line-to-line), singlephase or three-phase, and measured secondary voltage and current.

VA

Displays the calculated primary quantity based on the user-selected voltage and current multipliers, VT configuration (line-to-ground or line-to-line), singlephase or three-phase, and measured secondary voltage and current.

3.6.3 Remote voltage bias

Voltage

Displays the Remote Voltage value provided to the control utilizing either DNP 3.0, MODBUS or IEC 61850 protocols. If a voltage value is present the control is utilizing the Remote Voltage Bias Voltage to control.

3.6.4 Secondary metering status

Load Voltage

Displays the real-time measured value of voltage at the Tapchanger and includes any corrections made using the user-selected VT correction voltage.

Meter Out Voltage

Displays the measured voltage at the terminals of the TCC300 without any software modifications. Used as the base for normalizing voltage.

Source Voltage

Displays the real-time calculated/measured source voltage and includes any corrections made using the user-selected VT correction voltage.

Compensated Voltage

Displays the calculated voltage at the "load center".

Normalizing Voltage

Displays the result of the Normalizing Multiplier (0.80 to 1.20) times the Meter Out Voltage.

Load Current

Displays the real-time measured value of current.

Power Factor

Displays the real-time calculated value of power factor.

Frequency

Displays the real-time measured frequency value.

Circulating Current

Displays a representable value of circulating current, if the control is used with the ABB M-0115A Parallel Balancing Module, or it's equivalent.

3.6.5

Tap information

Tap Position

Displays the tap position of the tapchanger when any method of KeepTrack™ is used. Recognizes tapchanges commanded via manual, automatic or external (SCADA) means.



In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, "- - -" will be displayed instead of "0".

Drag Hands

Displays the tap position Drag Hands values for each direction.

Timer (Raise/Lower)

Displays the integrated out-of-band time for a voltage excursion outside the upper/lower band limit up to the value of the time delay setpoint.

Intertap Timer

In the sequential mode of operation, displays the integrated out-of-band time for a voltage excursion and the subsequent tapchange. Adjustable from 0 to 60 seconds, in 1 second increments, with a factory setting of 0 seconds.

Operation Counter

Records the number of raise and lower operations. The operation counter will increment based on the counter configuration, as set by the user. This counter is not resettable.

The counter accommodates 999,999 operation counts and the number of counts stored in memory is not affected by a loss of supply power. Total operation count is displayed in the Status Menu. This counter cannot be reset, but can be preset to any value up to 999,999 in the Configuration menu.

Resettable Operations Counter

The user resets this counter to zero by pressing ENT while viewing the resettable operation counter screen within the Status Menu. No password is required to reset the resettable operations counter.



The counter will only increment with a connection to the counter input.

Neutral Counter

Records the number of times the Neutral Input is energized.

The counter accommodates 999,999 operation counts and the number of counts stored in memory is not affected by a loss of supply power. Total operation count is displayed in the Status Menu. This counter cannot be reset, but can be preset to any value up to 999,999 in the Configuration menu.

RTN Status

Displays the "Run Through Neutral" feature status (Enabled or Disabled).

Count To RTN Active

Displays the number of counter operations since the operations between runs setting was set, or since the feature was enabled. The counter will reset to zero if the feature is enabled and successfully runs through neutral.

RTN Success Counter

The RTN Counter will increment after each successful operation of the Run Through Neutral feature.

3.6.6

Tapchanger status

Operation Mode

Indicates the operational mode of the control (Auto, Manual or Off).

Block Status

Indicates blocks that are active. Blocks that can be active include:

- Selftest
- Comm Block
- Line Limit
- Reverse Power
- Over Voltage Runback

- Block Raise (Tap)
- Block Lower (Tap)
- Block Raise (Voltage)
- Block Lower (Voltage)
- SCAMP Switch
- Front Panel Switch
- Non-Sequential Block
- Seal-in Failure Raise Block
- Seal-in Failure Lower Block
- Low Current

Band Status

Indicates one of three conditions: High, when voltage is out of band high, Low when voltage is out of band low, or OK when voltage is within band.

VAr Bias Effect

Indicates one of three conditions when enabled. If the control has determined that the absolute reactive power is $> \frac{3}{4}$ of the Max Cap Bank Setting and the inverse timer has timed out, then the control will increase the effective bandcenter by 1 Volt depending on the direction of the reactive power and will either indicate "Bandcenter Raise" for negative reactive power or "Bandcenter Lower" for positive reactive power. If the absolute power is $< \frac{3}{4}$ of the Max Cap Bank Setting then the display will indicate "None".

Power Direction

Indicates one of two power directions: Forward (forward power condition) or Reverse (reverse power condition).

Voltage Reduction

VR Off indicates voltage reduction is not active, blocked either by non-sequential input, reverse power condition, or by communicated command. VR Step 1, 2, and 3 indicate that voltage reduction is in effect for the stated step value. VR Step 1, 2, and 3 indicate that voltage reduction has been implemented from the control front panel for the stated step value.

HMI Active Mode

Indicates that HMI menu at the control is active. Turns off after 15 minutes of inactivity.

3.6.7

Aux input status

Indicates (red) when the Auxiliary Input is active.

3.6.8

Input status

Neutral Tap

Indicates neutral position contact input is closed.

Counter

Indicates operation counter contact input is closed.

Non-Sequential

Indicates Non-sequential contact input is closed. Tapchanger control blocks raise or lower operation on a sustained closed contact.

Motor Seal-In

Indicates when motor power is applied.

Voltage Reduction 1

Indicates Step 1 Voltage Reduction contact output is closed.

Voltage Reduction 2

Indicates Step 2 Voltage Reduction contact output is closed.

SCADA Cutout

Indicates SCADA (switch) input is closed. Tapchanger control blocks remote Raise or Lower operation.

3.6.9

Output status

Raise

Indicates when a Tap Raise output is active. Limited by tap Block Raise setpoint and tap position limit settings.

Lower

Indicates when a Tap Lower output is active. Limited by tap Block Lower setpoint and tap position limit settings.

Programmable Alarm

Indicates when a Programmable Alarm condition is true.

Motor Seal-In

Indicates when a Motor Seal-In Output is active.

3.6.10

Alarm status

There are three available states designated by color for each of the Alarm Status elements:

- Gray with Dark Gray Text – Alarm disabled.
- Gray with Black Text – Alarm enable and condition not met.
- RED – Alarm enabled and condition exists.

Comm Block

The control has had its automatic operation blocked via communications and is now in manual operation mode and the alarm output is on due to this condition.

Block Raise (Tap)

The tap position equals or exceeds the block raise tap limit setting and the alarm output is on due to this condition.

Block Lower (Tap)

The tap position equals or exceeds the block lower tap limit setting and the alarm output is on due to this condition.

Block Raise (Voltage)

The tap position equals or exceeds the block raise voltage limit setting and the alarm output is on due to this condition.

Block Lower (Voltage)

The tap position equals or exceeds the block lower voltage limit setting and the alarm output is on due to this condition.

DVAr2 Load Current Limit

DVAr2 Load Current is exceeding the respective maximum current limit setting and the alarm output is on due to this condition.

Mtr. Seal-In Failure

Indicates that motor current has not been detected for a period 15 seconds after a Raise or Lower command has been executed. This event must occur two consecutive times for this alarm to occur.

Backup Pwr Failure

Indicates the absence of Backup Power circuiting when Backup Power option has been detected.

Low Current Block

When enabled the control determines if Load Current following a tapchange is less than 4 mA, coincident with Tap Delta Voltage being less than 4 Vac. When these conditions exist the control will initiate an alarm and block regulation.

Individual Tap Wear

The number of operations on any single tap exceeds the Individual Tap Wear Alarm setting.

Tap Changer Failure

When the Operation Counter Configuration is set to "Cam Follower" and this alarm has been enabled, indicates the counter contact input has detected a Tap Changer Failure condition.

A Cam Follower contact is a cam driven contact which is normally closed when the Tapchanger is at rest, and opens and closes once during each tap operation in either direction. If this contact does not open and close within 30 seconds after the control issues a Raise or Lower in either local automatic or remote manual operational modes, this alarm will activate. This alarm can be reset either by the Cam Follower contact operating correctly during a subsequent Raise or Lower operation, or if reset by the user.

LDC/LDZ

Any value other than zero has been set for LDC/ LDZ.

Line Current Limit

The line current is exceeding the respective maximum current limit setting and the alarm output is on due to this condition.

Reverse Power

Reverse power is present at the control and the alarm output is on due to this condition.

Abnormal Tap Position

Abnormal Tap Position is indicated when the alarm is enabled, KeepTrack™ is enabled and the neutral input is detected but the present tap position at that instant is neither at minus one nor plus one. The Abnormal Tap Position Alarm will also be activated when the Motor Seal-in Failure detection feature has detected a Motor Seal-in Failure.

Voltage Reduction

Any level of voltage reduction is active.

VAR Bias Lead or Lag

Indicates when the VAR Bias effect (Lead or Lag) has exceeded the time limit imposed by the Max VAR Bias Duration Setting.

Master/Follower Lockout

There are two types of lockout conditions, Master lockout and Follower lockout. Any lockout of the paralleling mode will set the Master/Follower Lockout Alarm. When a lockout condition exists, the control issuing the lockout will stop any further GOOSE publishing and will stop load voltage regulation. Also, the alarm can be configured as a DNP event, or as a report in case of IEC 61850. The lockout state will be displayed on the control front panel display and in the Master/Follower Configuration Tool.



Master/Follower Alarm messages can be observed for the connected control from the TCC600® Monitor/Master/ Follower Alarm messages menu item.

Master Lockout

- Follower Detection Lockout - When the control powers up in Master Mode, the control will wait for approximately 65 seconds to allow all the GOOSE messages from all the Followers in the network to reach the Master. Once all GOOSE messages have been received, the Master will start its normal algorithm. If within the initial 65 second period the Master does not receive all the GOOSE messages it expected, it will enter the Master lockout state.
- Follower Timer Lockout - The Tap Position Response Timer will start after the Master has published its new tap position message after it has performed a successful tap operation. If it doesn't receive the tap position messages from all the participating Followers in the network before the timer expires, then a Master Lockout is issued.
- Tap Difference Lockout - If the Tap position difference between any Follower and the Master is greater than or equal to the Tap Difference setting, the Master will enter the lockout state.
- Follower Comm. Loss Lockout - If any follower does not send a valid retransmitted GOOSE message within a 65 second internal keepalive time, then a lockout is issued, signaling a broken communication link.

Follower Lockout

- Master Comm. Loss Lockout - When the Follower does not receive a valid retransmitted GOOSE message from the Master, within a 65 second internal keepalive time, and if the previous Master GOOSE message indicates that the breaker

statuses were closed, then a Follower Lockout is issued. This provides an indication that a broken communication occurred.

- Follower Comm. Loss Lockout - If any follower does not send a valid retransmitted GOOSE message within a 65 second internal keepalive time, then a lockout is issued, signaling a broken communication link.
- Tap Difference Lockout - If the Tap Position Difference between the Follower and the Master is greater than or equal to the Tap Difference setting, the Follower will enter the lockout state.

RTN Fail to Operate

The RTN Fail alarm will actuate when the "Maximum RTN operations before Alarms" setting has been exceeded.

Op Count Signal

The total number of operations has exceeded the Operations Counter Alarm Limit setting.

3.7

CBEMA events and counter status

When the Load Voltage is sagging or swelling greater than the pickup setting, then a pickup status will be set after a minimum duration, in addition to incrementing a counter.

Up to 4 CBEMA events can be set and enabled allowing the control to trigger a Sequence of Events record when each event occurs. Also, the control will report both the time and duration of each event via DNP. These 4 settings allow the control to be set to record violations of the ITIC curves (formerly known as CBEMA curves).

3.8

Demand and energy metering

3.8.1

Accessing the present demand screens from the HMI

1. Press the Left Arrow (MNTR Hot Button) pushbutton to awaken the unit. The menu will advance to "MONITOR".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Metering
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Present Demand" screen.
4. Pressing the Down arrow pushbutton once will advance the menu to the first element (Demand Interval) of the "Present Demand" screens.
Demand Interval

15 Min

5. Press the Down arrow pushbutton to access the remaining Present Demand parameter screens.
 - Demand Load Voltage
 - Demand Primary Current
 - Demand Primary Watts
 - Demand Primary VArS
 - Demand Primary VA

3.8.2

Setting the demand interval from the HMI



The Demand Interval can be set from either the "Present Demand" menu or the "Demand History" menu.

1. Navigate to the desired "Demand Interval" screen (Present Demand or Demand History), then press the ENT pushbutton.
If prompted, enter a valid Level 2 Access Code.
2. Utilizing either the Up or Down arrow pushbuttons, select between 5, 10, 15, 30 or 60 minute interval settings, then press the ENT pushbutton.
The display will return to the "Demand Interval" screen and display the new interval.

3.8.3

Accessing the demand history screens from the HMI

1. Press the Left Arrow (MNTR Hot Button) pushbutton to awaken the unit. The menu will advance to "MONITOR".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Metering
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Demand History" screen.
4. Press the Down arrow pushbutton once. The menu will advance to the first element (Demand Interval) of the "Demand History" screens.
Demand Interval
15 Min



Demand Interval is also included in the "Present Demand" menu. The Demand Interval can be set from either menu.

The remaining "Demand History" screens are accessed by navigating within the "Demand History" menu. When accessed, the individual screen's bottom line display will cycle between the Demand History parameter value and the

corresponding Date and Time Stamp for that value. "Demand History" screens that include an "E" on the right side of the top display line can be reset individually or all at one time.

5. Press the Down arrow pushbutton to access the remaining Demand History parameter screens:
 - Min Load Voltage E
 - Max Load Voltage E
 - Max Pri. Current E
 - Max Primary Watts E
 - Max Primary VArS E
 - Max Primary VA E
 - PF @ Max VA E
 - Press ENT to reset Demand History
 - Press ENT to perform Master Reset

3.8.4

Accessing the demand and energy metering from TCC600

1. To access the Demand & Energy Metering screen from the TCC600® Main Menu, select Monitor/Demand & Energy Metering. TCC600 will display the Demand & Energy Metering screen.
The Demand & Energy Metering screen, when connected to a control, displays parameter values consistent with the capabilities of the communication system.

Demand & Energy Metering

Demand Interval (minutes): ☐ 5 ☐ 10 ☒ 15 ☐ 30 ☐ 60 Apply

Demand Present

Item	Value	Unit
Load Voltage	119.3	V
Primary Current	1	A
Primary Watts	0.00	MW
Primary VAr	-0.01	MVA
Primary VA	0.01	MVA

Demand History

Item	Value	Unit	Date/Time
<input type="checkbox"/> Minimum Load Voltage	0.0	V	1/8/1970 2:29:11 AM
<input type="checkbox"/> Maximum Load Voltage	120.9	V	8/12/2013 7:45:23 AM
<input type="checkbox"/> Maximum Primary Current	8	A	8/12/2013 9:29:43 AM
<input type="checkbox"/> Maximum Primary Watts	0.01	MW	8/8/2013 11:40:28 AM
<input type="checkbox"/> Maximum Primary VAr	0.02	MVA	8/12/2013 8:22:56 AM
<input type="checkbox"/> Maximum Primary VA	0.06	MVA	8/12/2013 9:29:58 AM
<input type="checkbox"/> Power Factor @Max VA	-0.67		8/12/2013 9:29:58 AM

Energy Metering

Item	Value	Unit	Date/Time
<input type="checkbox"/> Forward Watt Hours	7	kWh	1/8/1970 2:29:11 AM
<input type="checkbox"/> Reverse Watt Hours	129	kWh	1/8/1970 2:29:11 AM
<input type="checkbox"/> Lagging VAr Hours	13	kVAh	1/8/1970 2:29:11 AM
<input type="checkbox"/> Leading VAr Hours	123	kVAh	1/8/1970 2:29:11 AM

Select All Clear All Reset Selected Items Close

Figure 39: Demand and Energy Metering Screen

2. Each element of the Demand History and Energy Metering can be reset individually by selecting the desired parameter(s) and then selecting **Reset Selected Items**. When the **Reset** command is issued, the metered value is reset to zero and the time and date are updated.
 - Select All – Allows the user to select all parameters.
 - Clear All – Allows the user to reset all parameter values.
 - Reset Selected Items – Allows the user to reset only the selected parameter values.

Table 4: *Demand & Energy Metering screen contents*

Item	Description
Demand Interval	The Demand Interval applies to the Demand Present Primary Current (Amps) parameter and the Demand History parameters. The Demand Interval can be set to 5, 10, 15, 30, and 60 minutes.
Demand Present Primary Current	The Demand Present Primary Current parameter value follows the concept of a lagged demand meter. The demand time interval is selected by the user as 5, 10, 15, 30 or 60 minutes. This is the time it takes for a thermal meter to indicate 90% of a change in load.
Load Voltage	Displays the real-time measured value of voltage at the Tapchanger or transformer and includes any corrections made using the user selected VT Correction Voltage.
Primary Current	Displays the calculated primary demand current based on the user-selected current multiplier and measured secondary current.
Primary Watts	Displays the real time demand value base on the user-selected voltage and current multipliers; VT configuration (line-to-ground or line-to-line), single-phase or three-phase, and measured secondary voltage and current.
Primary VAr	Displays the real time demand value based on the user-selected voltage and current multipliers, VT configuration (line-to-ground or line-to-line), single-phase or three-phase, and measured secondary voltage and current.
Primary VA	Displays the real time demand value based on the user-selected voltage and current multipliers, VT configuration (line-to-ground or line-to-line), single-phase or three-phase, and measured secondary voltage and current.

3.8.5

Demand history/energy metering

All demand history (single phase) and Energy Metering Values include the date and time at which each occurred. A drag hand value is the maximum or minimum value of a measured quantity recorded since the last reset.

Table 5: *Demand history (single phase) and Energy Metering values*

Item	Description
Minimum Load Voltage	Displays minimum Load voltage at the Tapchanger or transformer. This value continuously averaged over consecutive 32-second intervals.
Maximum Load Voltage	Displays drag hand maximum Load voltage at the Tapchanger or transformer. This value continuously averaged over consecutive 32-second intervals.
Maximum Primary Current	Displays drag hand maximum primary current.
Maximum Primary Watts	Displays drag hand maximum primary watts.
Maximum Primary VAr	Displays drag hand maximum primary VAr.
Maximum Primary VA	Displays drag hand maximum primary VA. Resets automatically when Power Factor at (Max) VA value, below, is reset.
Power Factor @ Max VA	Displays drag hand power factor at time of maximum VA.
Forward Watt Hours	Displays drag hand forward Watt hours.
Reverse Watt Hours	Displays drag hand reverse Watt hours.
Lagging VAr Hours	Displays drag hand Lagging VAr hours.
Leading VAr Hours	Displays drag hand Leading VAr hours.

3.8.6

Accessing the energy metering screens from the HMI

1. Press the Left Arrow (MNTR Hot Button) pushbutton to awaken the unit. The menu will advance to "MONITOR".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Metering
3. Press the Right or Left arrow pushbutton, as necessary, to advance to "Energy Metering".
4. Press the Down arrow pushbutton once. The menu will advance to the first element (Watt Hours Fwd) of the "Energy Metering" screens.
The remaining "Energy Metering" screens are accessed by navigating within the "Energy Metering" menu. When accessed, the individual screen's bottom line display will cycle between the Energy Metering parameter value and the corresponding Date and Time Stamp for that value. "Energy Metering" screens that include an "E" on the right side of the top display line can be reset individually or all at one time.
5. Press the Down arrow pushbutton to access the remaining Energy Metering parameter screens:
 - Lagging VAr Hours E
 - Watts Hours Rev E
 - Leading VAr Hours E

- Press ENT to reset Energy Metering
- Press ENT to perform Master Reset

3.8.7 **Resetting individual demand history or energy metering values from the HMI**

The presence of the "E" on the top line of the display indicates that the value can be reset from this menu item. The steps necessary to reset individual Demand History or Energy Metering items are as follows:

1. Navigate to the desired Demand History or Energy Metering parameter screen, then press the ENT pushbutton.
2. Press the ENT pushbutton. The control will reset the displayed value.
The screen will return to the parameter screen and display the new value.

3.8.8 **Resetting all demand history or energy metering parameter values from the HMI**

All Demand History or Energy Metering parameter menu items that include an "E" on the top line of the display can be reset from this menu item. The steps necessary to reset ALL Demand History or Energy Metering parameter values are as follows:

1. Navigate to the "Reset Demand History" or "Reset Energy Metering" screen.
2. Press the ENT pushbutton. The control will display a "confirmation" screen similar to the following.
`Press Ent to confirm reset Demand History (or Energy Metering)`
3. Press the ENT pushbutton. The control will reset ALL the Demand History or Energy Metering values.
`Demand History (or Energy Metering) has been reset.`
4. Press the Exit pushbutton to return to the "Demand History" or "Energy Metering" menu.

3.8.9 **MASTER RESET of all demand history and energy metering parameter values from the HMI**

The "Demand History" menu includes the capability to initiate a Master Reset of both the Demand History and Energy Metering parameter values. This capability is also included in the "Energy Metering" menu. The steps necessary to reset ALL Demand History and Energy Metering parameter values are as follows:

1. Navigate to the "Master Reset" menu item within the "Demand History" or "Energy Metering" menus.
2. Press the ENT pushbutton. The control will respond with a "confirmation" screen.
Press ENT to confirm
Press Exit to cancel
3. Press the ENT pushbutton. The control will then display the following sequence of screen displays.
Master Reset is complete.
Press ENT to perform Master Reset
4. Press the Exit pushbutton to return to the "Demand History" or "Energy Metering" menu.

3.9 Real Time Voltage Plot

3.9.1 Accessing Real Time Voltage Plot from TCC600

The Real Time Voltage Plot feature allows the user to monitor in real time the last 60 seconds of the source voltage value and load voltage. The Voltage Chart freezes the last 30 seconds of the voltage profile and displays the current values.

- To access the Real Time Voltage Plot screen from the TCC600® Main Menu, select **Monitor/Real Time Voltage Plot**. TCC600 will display the Real Time Voltage Chart screen.

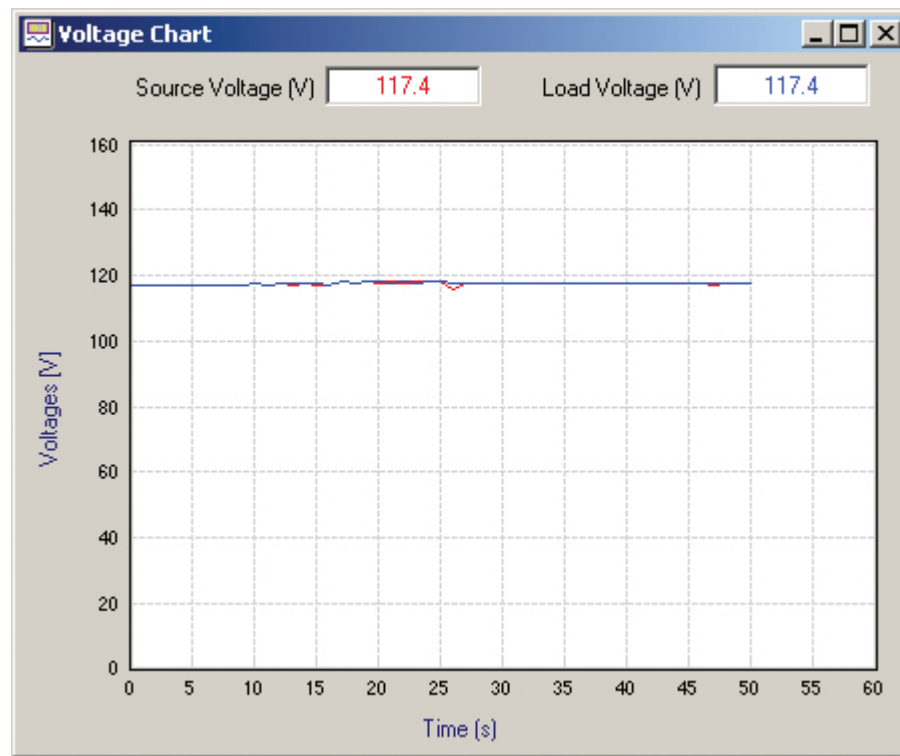


Figure 40: Real Time Voltage Chart

3.10 Display all metering

The Display All Metering feature provides the user with a snapshot of all metering parameters. This feature also allows the Display All Metering screen to be printed or saved to a *.HTM file.

TCC300 All Metering

Software Version: D-0375V10.09.04
 Firmware version: D-0214V02.02.03
 Serial Number: 319
 ABB
 TCC300

Metering			
Primary			
Voltage:	7.18 (KV)	Source Voltage:	Disabled
Current:	593 (A)	Watts:	4.27 (MW)
VAr:	-0.05 (MVar)	VA:	4.27 (MVA)
Secondary			
Load Voltage:	119.8 (V)	Meter Out Voltage:	119.8 (V)
Source Voltage:	Disabled	Comp. Voltage:	119.9 (V)
Load Current:	98 (mA)	Circulating Current:	0 (mA)
Power Factor:	1.000 (Lag)	Frequency:	60.00 (Hz)
Normalizing Voltage:	119.8 (V)		
Tap Information			
Tap Position:	0	Drag Hands Raise:	0
Drag Hands Lower:	0	Intertap Timer:	100 (%)
Raise Timer:	5 (s)	Resettable Counter:	12
Operation Counter:	2	RTN Status:	Disabled
Neutral Counter:	0	RTN Success Counter:	0
Count to RTN Active:	0		
Remote Voltage Bias			
RVB Status:	Disabled	Remote Voltage Value:	-- (V)
STATUS			
Regulator			
Operation Mode:	Auto	Block Status:	--
Band Status:	Ok	VAr Bias Effect:	None
Power Direction:	Forward	Voltage Reduction:	--
HMI Active Status:	Not Active		
Alarm			
Comm Block:	--	LDC/LDZ:	--
Block Raise (Tap):	--	Line Current Limit:	--
Block Lower (Tap):	--	Reverse Power:	--
Block Raise (Volt):	--	Block Lower(Volt):	--
Voltage Reduction:	--	Abnormal Tap Position:	--
VAr Bias Duration Lag:	--	VAr Bias Duration Lead:	--
DVar2 Current Limit:	--	Motor Seal-in Failure:	--
Master/Follower Lockout:	Inactive	Low Current Block:	--
RTN Fail to Operate:	--	Individual Tap Wear:	--
Op Count Signal:	--	Tap Changer Failure:	--
Input			
Neutral Tap:	--	Counter:	--
Nonsequential:	--	Motor Seal-In:	--
Voltage Reduction #1:	--	Voltage Reduction #2:	--
SCADA Cutout:	--	Aux Input 1:	0
Aux Input 2:	0	Aux Input 3:	0
Output			
Raise:	--	Lower:	--
Programmable Alarm:	--	Motor Seal-In:	--
CBEMA Events Status			
CBEMA 1:	None	CBEMA 1 Counter:	16
CBEMA 2:	None	CBEMA 2 Counter:	16
CBEMA 3:	None	CBEMA 3 Counter:	0
CBEMA 4:	None	CBEMA 4 Counter:	0

Demand			
Demand Interval			
Interval:	15 minutes		
Present			
Load Voltage:	119.9 (V)	Primary Current:	592.0 (A)
Primary Watts:	4.26 (MW)	Primary VAr:	-0.06 (MVar)
Primary VA:	4.26 (MVA)		
History			
Min Load Voltage:	0.0 (V)	1/20/1970 12:30:27 PM	
Max Load Voltage:	131.9 (V)	5/2/2016 11:45:50 AM	
Max Primary Current:	594 (A)	4/21/2016 2:44:42 PM	
Max Primary Watts:	4.31 (MW)	4/21/2016 3:45:56 PM	
Max Primary VAr:	0.81 (MVar)	6/14/2016 1:35:17 AM	
Max Primary VA:	4.31 (MVA)	4/21/2016 3:45:56 PM	
Power Factor @ Max VA:	1.00 (Lag)	4/21/2016 3:45:56 PM	

Energy			
Metering			
Forward Watt Hours:	84.43 (MWh)	1/20/1970 12:30:27 PM	
Reverse Watt Hours:	153 (kWh)	1/20/1970 12:30:27 PM	
Lagging VAr Hours:	26.36 (MVarh)	1/20/1970 12:30:27 PM	
Leading VAr Hours:	11.41 (MVarh)	1/20/1970 12:30:27 PM	

Motor Current Profile			
Present Current Motor Profile			
Peak Rms Current:	0.0 (mA)	Average Rms Current:	0.0 (mA)
Average Duration:	0.0 (msec)		
Average Current Motor Profile			
Peak Rms Current:	0.0 (mA)	Rms Current:	0.0 (mA)
Duration:	0.0 (msec)	Training Mode:	In Training Mode

All Metering
Print
Print Preview
Save
Refresh

Band Status:	Ok	VAR Bias Effect:	None
Power Direction:	Forward	Voltage Reduction:	--
HMI Active Status:	Not Active		

Alarm

Comm Block:	--	LDC/LDZ:	--
Block Raise (Tap):	--	Line Current Limit:	--
Block Lower (Tap):	--	Reverse Power:	--
Block Raise (Volt):	--	Block Lower(Volt):	--
Voltage Reduction:	--	Abnormal Tap Position:	--
VAR Bias Duration Lag:	--	VAR Bias Duration Lead:	--
DVAR2 Current Limit:	--	Motor Seal-in Failure:	--
Master/Follower Lockout:	Inactive	Low Current Block:	--
RTN Fail to Operate:	--	Individual Tap Wear:	--
Op Count Signal:	--	Tap Changer Failure:	--

Input

Neutral Tap:	--	Counter:	--
Nonsequential:	--	Motor Seal-In:	--
Voltage Reduction #1:	--	Voltage Reduction #2:	--
SCADA Cutout:	--	Aux Input 1:	0
Aux Input 2:	0	Aux Input 3:	0

Output

Raise:	--	Lower:	--
Programmable Alarm:	--	Motor Seal-In:	--

CBEMA Events Status

CBEMA 1:	None	CBEMA 1 Counter:	16
CBEMA 2:	None	CBEMA 2 Counter:	16
CBEMA 3:	None	CBEMA 3 Counter:	0
CBEMA 4:	None	CBEMA 4 Counter:	0

Demand

Demand Interval

Interval:	15 minutes
-----------	------------

Present

Load Voltage:	119.9 (V)	Primary Current:	592.0 (A)
Primary Watts:	4.26 (MW)	Primary VAR:	-0.06 (MVAR)
Primary VA:	4.26 (MVA)		

History

Min Load Voltage:	0.0 (V)	1/20/1970 12:30:27 PM
Max Load Voltage:	131.9 (V)	5/2/2016 11:45:50 AM
Max Primary Current:	594 (A)	4/21/2016 2:44:42 PM
Max Primary Watts:	4.31 (MW)	4/21/2016 3:45:56 PM
Max Primary VAR:	0.81 (MVAR)	6/14/2016 1:35:17 AM
Max Primary VA:	4.31 (MVA)	4/21/2016 3:45:56 PM
Power Factor @ Max VA:	1.00 (Lag)	4/21/2016 3:45:56 PM

Energy

Metering

Forward Watt Hours:	84.43 (MWh)	1/20/1970 12:30:27 PM
Reverse Watt Hours:	153 (kWh)	1/20/1970 12:30:27 PM
Lagging VAR Hours:	26.36 (MVARh)	1/20/1970 12:30:27 PM
Leading VAR Hours:	11.41 (MVARh)	1/20/1970 12:30:27 PM

Motor Current Profile

Figure 41: Display All Metering Screen

3.11 Motor current profile

3.11.1 Accessing the motor current screens from the HMI

1. Press the Left Arrow (MNTR Hot Button) pushbutton to awaken the unit. The menu will advance to "MONITOR".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Metering
3. Press the Right or Left arrow pushbutton, as necessary, to advance to the "Motor Current" screen.
4. Pressing the Down arrow pushbutton will advance the menu to the first element (Peak RMS Curr) of the "Motor Current" screens.
5. Press the Down arrow to access the following "Motor Current" parameter screens.
 - Avg RMS Curr
 - Profile Duration
 - Peak Motor Current E

The remaining Motor Current screens are accessed by navigating within the "Motor Current" menu. When accessed, the individual screen displays bottom line will display current values for each parameter. For Peak Motor Current, Peak RMS Current, Average RMS Current and Duration the bottom display line may also include a "T" that indicates the Motor Current Monitoring is in the "Training" mode. The "Training" mode is used during commissioning of the Tapchanger control. Several tapchange operations are manually performed, then the profile is stored in the EEPROM. The profile is compared during normal tapchange operation to initiate alarms.

3.11.2 Initializing motor current values from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to awaken the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton as necessary until "Mtr Current Profile" is displayed.
4. Press the Down arrow pushbutton, as necessary, to navigate to the "Init. Motor Current" screen.
5. Press the ENT pushbutton. The control will momentarily display the following.
Init. Motor Current Initialization Done
Init. Motor Current Press ENT to reset

3.11.3 Accessing motor current profile screen, resetting training mode and peak motor current from TCC600

1. Start TCC600, then establish communications with the target control.
2. Select **Monitor/Motor Current Profile** from the TCC600 toolbar. TCC600 will display a "Motor Current Profile" dialog screen.

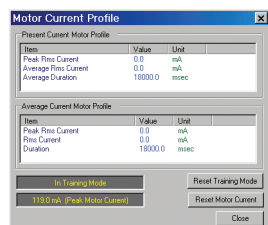


Figure 42: Motor Current Profile Dialog Screen

3. To reset the Motor Current Profile to the Training Mode select "Reset Training Mode". TCC600 will display a "Motor Current Profile Reset" confirmation screen.

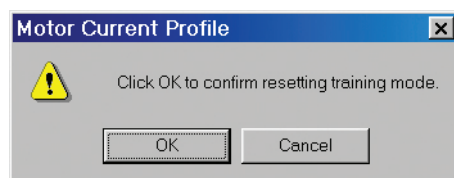


Figure 43: Motor Current Profile Training Mode Reset Confirmation Screen

4. Select **OK**. TCC600® will display a Motor Current Profile Reset successfully sent confirmation screen.

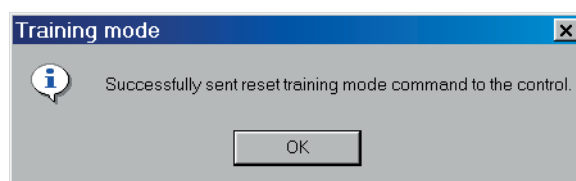


Figure 44: Reset Training Mode Command Successfully Sent Confirmation Screen

5. To reset the Peak Motor Current Value to zero select "Reset Motor Current". TCC600 will display a "Peak Motor Current" reset configuration screen.

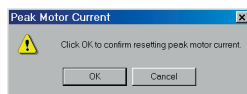


Figure 45: Peak Motor Current Profile Reset Confirmation Screen

6. Select **OK**. TCC600 will display a Peak Motor Current reset successfully sent confirmation screen.

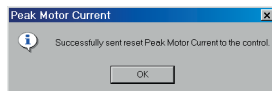


Figure 46: Peak Motor Current Profile Reset Successfully Sent Confirmation Screen

7. Select **OK**. TCC600 will return to the Motor Current Profile dialog screen

3.12 Harmonic analysis

3.12.1 Accessing the harmonics screens from the HMI

1. Press the Left Arrow (MNTR Hot Button) pushbutton to awaken the unit. The menu will advance to "MONITOR".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Metering
3. Press the Right or Left arrow pushbutton, as necessary, to advance to the "Harmonics" screen.
4. Pressing the Down arrow pushbutton will advance the menu to the first element (Voltage % THD) of the "Harmonics" screens.
5. Press the Down arrow to access the remaining "Harmonics" parameter screens.
 - Current % THD
 - View Voltage Harmonics
 - View Current Harmonics

The remaining "Harmonics" screens are accessed by navigating within the "Harmonics" menu.

3.12.2 Viewing individual voltage/current harmonics screens from the HMI

- 1. Navigate to the "Voltage" or "Current Harmonics" screen.
- 2. Press the ENT pushbutton.
- 3. Press the Up or Down arrow pushbutton as necessary to navigate to the desired Harmonic.

3.12.3 Accessing harmonic analysis screen from TCC600

- 1. Start TCC600®, then establish communications with the target control.
- 2. Select Monitor/Harmonic Analysis from the TCC600 toolbar. TCC600 will display a "Harmonic Analysis" screen.

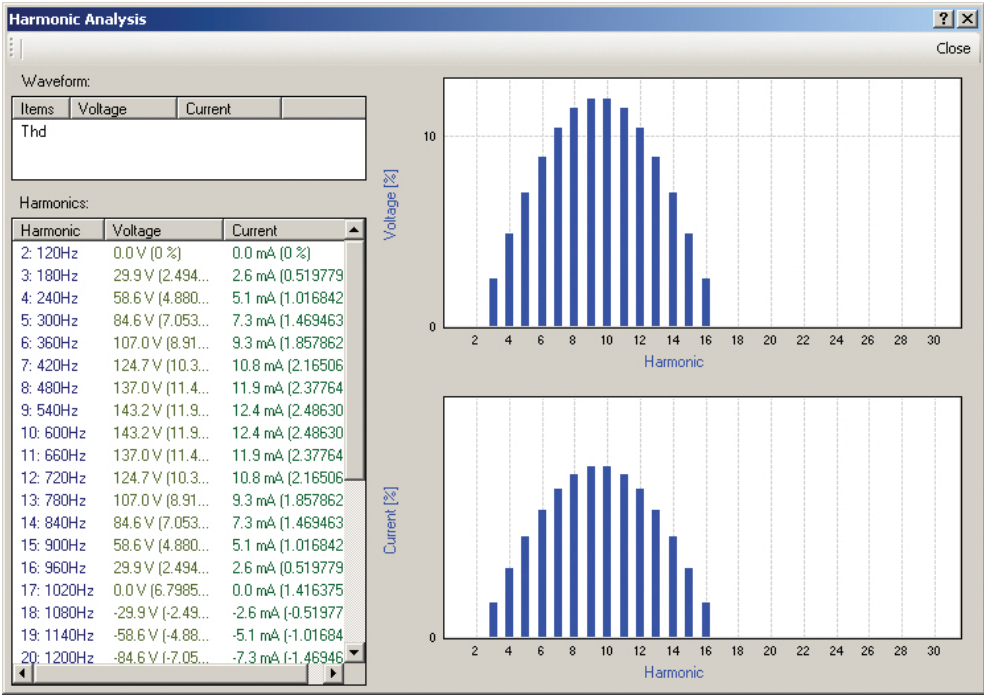


Figure 47: Harmonic Analysis Screen

3.13 Tap information

3.13.1 Accessing the tap information screens from the HMI

1. Press the Left Arrow (MNTR Hot Button) pushbutton to awaken the unit. The menu will advance to "MONITOR".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Metering
3. Press the Left or Right arrow pushbutton, as necessary, to advance to "Tap Information".
4. Press the Down arrow pushbutton once. The menu will advance to the first element (Tap Position/Cal) of the "Tap Information" screens.



In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, the Tap Position screen will display "- - -" instead of "0".

The remaining "Tap Information" screens are accessed by navigating within the "Tap Information" menu. "Tap Information" screens that include an "E" on the right side of the top display line can be reset from this menu item.

- Tap Position/Cal
- Drag Hands (Reset)
- Definite Timer (Raise Sec./Lower Sec.)
- Intertap Timer (0-100%)
- Operation Counter
- Resettable (Operation) Counter (reset)
- Neutral Switch Counter
- Lower Counter
- Raise Counter
- View Specific Tap Statistics
- Clear Specific Tap Statistics
- RTN Success Counter
- RTN Status (Enabled/Disabled)
- Count to RTN Active

3.13.2 Calibrating tap position from the HMI

1. Navigate to the "Tap Position/Cal" screen in the Monitor/Tap Information menu.
2. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code.
3. At the cursor, input the desired Tap Position utilizing arrow pushbuttons, then press the ENT pushbutton. The display will return to the "Tap Position/Cal" screen.

3.14 Drag hands

3.14.1 Resetting drag hands values from the HMI

1. Navigate to the "Drag Hands" screen in the Monitor/Tap Information menu.
The presence of the "E" on the top line of the display indicates that the Drag Hands values can be reset from this menu item.
2. Press the ENT pushbutton. The displayed "E" will change to a "R".
3. Press the ENT pushbutton. The control will display the following.
`Drag Hands R Press ENT to confirm`
4. Press the ENT pushbutton. The control will display the following.
`Drag Hands L=0N R=0N`
The Drag Hands values are now reset to the current value.

3.14.2 Resetting drag hands values from TCC600

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.
2. From the "Drag Hands" section of the Tap Settings dialog screen select "Reset".
3. Select **Save**. TCC600 will display a "Save to Device" confirmation screen.
4. Select **OK**. TCC600 will display a Setpoints "Successfully Written to Control" confirmation screen.
The Drag Hands values will be reset to the current value.

3.15 Resettable operation counter

3.15.1 Resetting operation counter from the HMI

1. Navigate to the "Resettable Counter" screen in the Monitor/Tap Information menu.
2. Press the ENT pushbutton. The displayed "E" will change to a "R", then press ENT again.
3. Press the ENT pushbutton. The control will display the following.
Resettable Counter 0
The Operation Counter is now reset.
4. Press the Exit pushbutton to return to the "Tap Information" screen.

3.15.2 Resetting operation counter from TCC600

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.
2. From the "Operation Counter" section of the Tap Settings dialog screen select the "Reset" for the "Resettable" parameter.
3. Select **Save**. TCC600 will display a "Save to Device" confirmation screen.
4. Select **OK**. TCC600 will display a Setpoints "Successfully Written to Control" confirmation screen.
The Operations Counter value will be reset to zero.

3.16 Tap statistics

3.16.1 Viewing specific tap statistics from the HMI

1. Navigate to the View Specific Tap Statistics screen in the Monitor/Tap Information menu.
2. Press the ENT pushbutton. The control will display the number of recorded tapchanges and the Accumulated Primary Current for each individual tap position on the Tapchanger control.
3. The Up and Down arrow pushbuttons are utilized to scroll through the tap positions. Press the Exit pushbutton to exit Tap Stats.

3.16.2 Clearing tap statistics from the HMI

- 1. Navigate to the Clear Tap Statistics screen in the Monitor/Tap Information menu.
- 2. Press the ENT pushbutton. The control will display the following.
Press ENT to confirm Clearing Tap Stats
- 3. Press the ENT pushbutton. The control will briefly display the "Tap Statistics have been cleared" confirmation and then return to the previous display.
- 4. Press the Exit pushbutton to exit Tap Statistics.

3.16.3 Viewing tap statistics from TCC600

- 1. Start TCC600, then establish communications with the target control.
- 2. Select Monitor/Tap Statistics from the TCC600 toolbar. TCC600 will display a "Tap Statistics" screen.

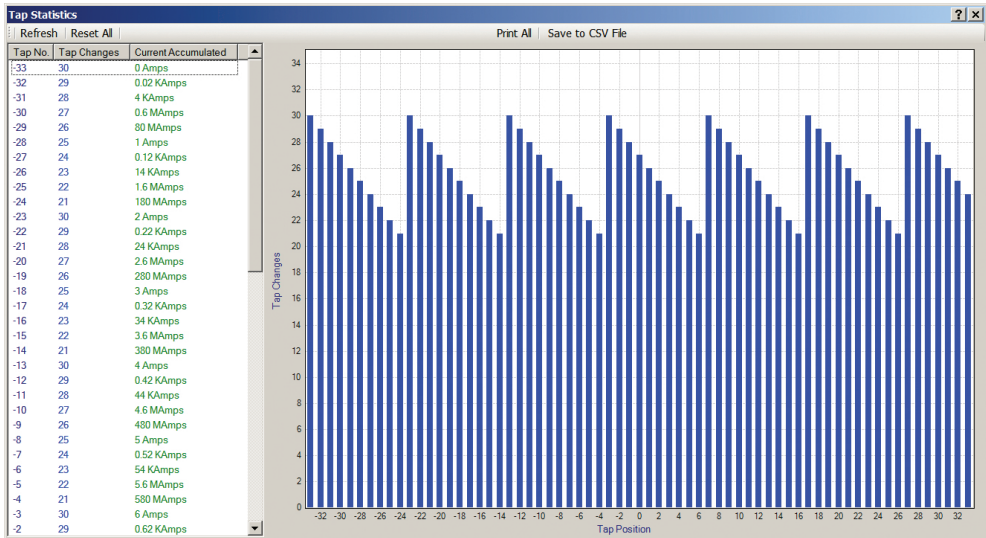


Figure 48: Tap Statistics Screen



By pointing the mouse to any bar, the corresponding tap statistic will be highlighted as well as displayed in a tool tip.

The "Tap Statistics" screen includes the capability to Refresh the screen display, Reset All displayed values, and save the data to a ".csv" file which can be read by a spreadsheet program. Selecting "Reset All" will clear the Individual Tap Wear Alarm in the Metering & Status screen.

3.17 Smart flash SD card

3.17.1 Accessing the smart flash SD card screens from the HMI



The "Smart Flash SD Card" menu screens can only be accessed when a properly formatted Smart Flash SD Card or SDHC Card is inserted and seated in the Smart Flash SD Card slot.

1. Verify that a (FAT) formatted Smart Flash SD or SDHC Card is inserted into the Smart Flash SD Card slot.
2. Press the Right Arrow (COMM Hot Button) pushbutton to awaken the unit. The menu will advance to "Memory Card".
The Memory Card can now be utilized to:
 - Quick Capture
 - Load Setpoints
 - Save Setpoints
 - Save Data Log
 - Save Sequence of Events
 - Save Oscilloscope Records
 - Clone Save
 - Clone Load
 - Load DNP Config
 - Save DNP Config
 - Save Metering Data
 - Firmware Update
 - Save/Load IEC 61850 CID Files
 - User Access Code Key
 - Save Wakeup Screen Parameter data



If the Smart Flash SD Card has a valid Access Level 1 or Level 2 code saved to it, the control will accept the code and not prompt for an Access Code.

3.17.2 SD card quick capture

The SD Card Quick Capture feature provides the means (in one step) to initiate a save of the following data files to the inserted SD Card (if they exist on the control):

- Control Clone
- Data Logging
- Oscillography
- Sequence of Events
- DNP Map
- Multi-user Access Code
- Multi-user Access Code Log

The SD Card Quick Capture feature requires a Level 2 Access Code to initiate. If any data file other than "Control Clone" does not exist on the control at the time the Quick Capture is initiated, the control will display a "XXX file doesn't exist" message for approximately three seconds before continuing with the Quick Capture process.

3.17.2.1

Quick capture file naming convention

Since Data Logging and Oscillography files both utilize the same Comtrade format, the Quick Capture feature will name Data Logging files as DSXXXXXX.dat and DSXXXXXX.cfg. Oscillography files will be named as YYXXXXXX.dat and YYXXXXXX.cfg, with YY representing the "Partition" and XXXXXX representing the "Serial Number" of the control. For example, 16009999.dat would be an Oscillography file of the 16th Partition in control Serial Number 9999.

3.17.3

Initiating a smart flash SD card quick capture

1. Insert the target Smart Flash SD Card into the control as previously described.
2. Press the Right Arrow (Comm Hot Button) pushbutton. The control will go directly to the "Memory Card" menu.
3. Press the Down Arrow pushbutton as necessary to navigate to the "SD Quick Capture" menu item.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
 Confirm press ENT
 Cancel press EXIT.
5. Press the "ENT" pushbutton. The control will cycle through the Quick Capture sequence of displays.
 Confirm press ENT Cancel press EXIT
 Saving... Clone File
 Saving... DNP CFG file
 Saving... SOE file
 Saving... Data Log file
 Saving data file
 Saving... OSC file
 Saving... Multi-user Pass.log

Quick Cap Complete Any key to continue



If a file is not present (OSC for example) the control will display a "XXX file does not exist" message for approximately three seconds before continuing with the next save item in the Quick Capture sequence.

3.17.4

Loading setpoints from a smart flash SD card

1. Insert the target Smart Flash SD Card (that includes the setpoints file) into the control as previously described.
2. Press the Right Arrow (COMM Hot Button) pushbutton. The control will go directly to the "Memory Card" menu.
3. Press the Down pushbutton arrow as necessary to navigate to the "Load Setpoints" menu item.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Confirm press ENT
Cancel press EXIT.



If an arrow is displayed on either end of the bottom display line, additional setpoint files are available for selection.

5. Press the ENT pushbutton. The control will prompt the user to select the file to be loaded.
6. Utilize the Right or Left arrow pushbutton to select the desired setpoint file (*.tpt).



Setpoint changes are immediately acted upon by the control and may cause undesired control operation.

7. Select ENT. The control will briefly display a progress screen and then display the setpoints loaded screen.
Loading file. Please wait.....
Setpoints loaded. Any key to continue
The new setpoints are now available to the control.

3.17.5 Saving setpoints to a smart flash SD card

1. Insert the Smart Flash SD Card (that has adequate space available) into the control as previously described.
2. Press the Right Arrow (COMM Hot Button) pushbutton. The control will go directly to the "Memory Card" menu.
3. Press the Down pushbutton arrow as necessary to navigate to the "Save Setpoints" menu item.
4. Press the ENT pushbutton. The control will respond with a "confirmation" message screen.
 Confirm press ENT
 Cancel press EXIT.
5. Press the ENT pushbutton. The control will prompt for a file name to be entered.
6. Utilize the arrow pushbuttons to enter the desired file name.
7. Select ENT. The control will briefly display a progress screen and then display the setpoints loaded screen.
 Saving setpoints Please wait.....
 File saved! Any key to continue

3.17.6 Saving control data record files to a smart flash SD card

Control data record files may be saved to a Smart Flash SD card. The following data files are available from the "Memory Card" menu:

- Data Log (selectable data range)
- Sequence of Events
- Oscillograph Record (selectable partition)
- Metering Data
- Wakeup Screen Data

The following steps illustrate saving a Data Log file to the SD Card. The steps to save other available data record files are similar.

1. Insert the Smart Flash SD Card (that has adequate space available) into the control as previously described.
2. Press the Right Arrow (COMM Hot Button) pushbutton. The control will go directly to the "Memory Card" menu.
3. Press the Down pushbutton arrow as necessary to navigate to the "Save Data Log" menu item.
4. Press the ENT pushbutton. The control will respond with a "confirmation" message screen.
 Press ENT to view available data range
5. Press the ENT pushbutton. The control will display a range of data.

6. Press the ENT pushbutton to enter the desired data range.
7. Utilizing the arrow pushbuttons enter the desired "start" date and time, then press ENT.
8. Utilizing the arrow pushbuttons enter the desired "end" date and time, then press ENT.
9. Utilizing the arrow pushbuttons enter the desired "file name", then press ENT. The control will briefly display a progress screen and then display the file saved screen. Saving data file. Please wait.....
File saved! Any key to continue

3.17.7

Clone save and load

There are two types of "Clone Save" and "Clone Load" features included in the control. The two types are distinguished by the file name that is utilized when initiating a Clone Save or Clone Load.

Clone Save with "DNP Configuration" and "Multi-user Password" files

When the Clone Save feature is initiated, a default file name that includes the control Serial Number is displayed (SNxxxxxx). If the user utilizes the default file name, the control will write the control Settings File, DNP Configuration File and Multi-user Password File (if the DNP and Password files exist on the control) to the Smart Flash SD Card.

If the DNP and/or Password files do not exist on the cloned control, a message stating "DNP CFG file does not exist" or "Multi-user Password file doesn't exist" will be displayed during the Load sequence.

Clone Load with "DNP Configuration" and "Multi-user Password" files

When the Clone Load feature is initiated, the user must enter/select the clone file name that includes the control Serial Number (SNxxxxxx) that was saved with the associated DNP Configuration and Multi-user Password files. When the clone file name is entered, the control will check for DNP and Multi-user Password files named for the serial number of the clone file and will write the found files to the target control.

If the DNP and/or Password files do not exist on the cloned control, a message stating "DNP CFG file does not exist" or "Multi-user Password file doesn't exist" will be displayed during the Load sequence.

Clone Save Without "DNP Configuration" and "Multi-user Password" files

When the Clone Save feature is initiated, a default file name that includes the control Serial Number is displayed (SNxxxxxx). If the user enters a different file name the control will only write the control Settings File to the Smart Flash SD Card.

3.17.7.1

Saving clone to a smart flash SD card

1. Insert the Smart Flash SD Card (that has adequate space available) into the control as previously described.
2. Press the Right Arrow (COMM Hot Button) pushbutton. The control will display the "Memory Card" menu.
3. Press the Down pushbutton arrow as necessary to navigate to the "Clone Save" menu item.
4. Press the ENT pushbutton. The control will respond with a "confirmation" screen.
Confirm press ENT
Cancel press EXIT.
5. Press ENT. The control will respond with a "Enter file name" prompt screen with the cursor under the far left position.
6. Determine if any found DNP Configuration and Multi-user Password files are to be included in the Clone Save and proceed as follows:
 - If found DNP Configuration and Multi-user Password files are to be included in the Clone Save go to Step 10.
 - If found DNP Configuration and Multi-user Password files are not to be included in the Clone Save go to Step 7.
7. Utilizing the arrow pushbuttons enter the desired file name, then press ENT.
8. When the file has been saved to the Smart Flash SD Card, then the control will display the following "confirmation" screen:
File Saved!
Any key to continue
9. Press any key. The display will return to the "Clone Save" screen. No further action is required.
10. To include found DNP Configuration and/or Multi-user Password files in the Clone Save, Do Not change the default file name displayed by the control.
11. Press "ENT". The control will display the following sequence of screens:
Saving data XXXXXXXXXX
Saving... DNP CFG File
If DNP Configur ation file does not exist on the control the following will be displayed:
DNP CFG File doesn't exist!
Saving... Multi-user Password
If Multi - user Password File file does not exist on the control the following will be displayed:
Multi-user Pass File File doesn't exist!
File Saved! Any key to continue
12. Press any key, the display will return to the "Clone Save" screen. No further action is required.

3.17.7.2**Loading clone from a smart flash SD card**

To load Clone files to another control which may or may not include DNP Configuration and/or Multi-user Password files proceed as follows.

1. Insert the Smart Flash SD Card (that includes the Clone file) into the control as previously described.
2. Press the Right Arrow (COMM Hot Button) pushbutton. The control will go directly to the "Memory Card" menu.
3. Press the Down pushbutton arrow as necessary to navigate to the "Clone Load" menu item.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Confirm press ENT
Cancel press EXIT.
5. Press ENT. The control will display the following:
SN000001.cln
MM/DD/YYYY HH:MM →
6. Utilizing the arrow pushbuttons select the desired Clone File name, then press ENT. The control will display the following:
Loading file Please wait
Loading... DNP CFG File
If DNP Configur ation file does not exist on the control the following will be displayed:
DNP CFG File doesn't exist!
Loading... Multi-user Password
If Multi - user Password File file does not exist on the control the following will be displayed:
Multi-user Pass Log File doesn't exist!
7. When the clone file has been loaded the control will display the following "confirmation" screen:
Clone loaded Any key to continue
8. Press any key. The display will return to the "Clone load" screen.

3.17.8**Loading configuration files from a smart flash SD card**

Configuration files may be loaded from a Smart Flash SD card. The following Configuration files are available to load from the "Memory Card" menu:

- DNP
- IEC 61850 (if purchased)

The following steps illustrate loading a DNP Configuration file from the SD Card. The steps to load an IEC 61850 Configuration file are similar.

1. Insert the Smart Flash SD Card (that includes the DNP config file) into the control as previously described.
2. Press the Right Arrow (COMM Hot Button) pushbutton. The control will go directly to the "Memory Card" menu.
3. Press the Down pushbutton arrow as necessary to navigate to the "Load DNP Config" menu item.
4. Press the ENT pushbutton.
5. Select the desired file name, then press the ENT pushbutton. The control will display the following:
File loaded! Any key to continue
The new DNP configuration is now available to the control.

3.17.9

Saving configuration files to a smart flash SD card

Configuration files may be saved to a Smart Flash SD card. The following Configuration files are available from the "Memory Card" menu:

- DNP
- IEC 61850 (if purchased)

The following steps illustrate saving a DNP Configuration file to the SD Card. The steps to save an IEC 61850 Configuration file are similar.

1. Insert the Smart Flash SD Card (that has adequate space available) into the control as previously described.
2. Press the Right Arrow (COMM Hot Button) pushbutton. The control will go directly to the "Memory Card" menu.
3. Press the Down pushbutton arrow as necessary to navigate to the "Save DNP Config" menu item.
4. Press the ENT pushbutton.
5. Utilizing the arrow pushbuttons enter the desired file name, then press the ENT pushbutton. The control will save the DNP config file and respond with a "confirmation message" screen.
File saved! Any key to continue

3.17.10**Updating firmware from smart flash SD card**

1. Insert the Smart Flash SD Card (that contains the firmware update file) into the control as previously described.
2. Press the Right Arrow (COMM Hot Button) pushbutton. The control will go directly to the "Memory Card" menu.
3. Press the Down pushbutton arrow as necessary to navigate to the "Firmware Update" menu item.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The control will begin the firmware update.
Updating From SDCARD ...
5. When the firmware update is complete the control will display a "confirmation message" screen.
Update Complete Rebooting...
After the setpoints and configuration have been successfully restored after rebooting, the control will display the following:
Update Successful Any Key to continue
At this point the control is fully operational by pressing any key.
6. Press any key. The control will display the following sequence of screens:
User Line 1
User Line 2
D-0214VXX.XX.XX
Serial Number XXXX
Date & Time
XX/XX/XX XX:XX:XX
Factory Options
XXXXXX XXXXX
User Line 1
User Line 2
If restoring of setpoints and configuration fail, then the control will display the following:
Failed to restore! Any key to continue
At this point the control will be operating with default initialized setpoints and configuration data.
If this condition exists, the user should reload the correct file settings and contact ABB Customer Service.

3.17.11**Entering the smart flash SD card user access code**

A user Access Code Level 1 or 2 can be written to a Smart Flash SD Card. The user Access Code will be read by the control when the SD Card is inserted into the Smart Flash Card slot on the front of the control. As long as the SD Card is inserted, the control will not prompt for the Level Access Code contained on the SD Card.

1. Start the TCC600® Communications Software on the PC.
2. Open a TCC600 "File" or connect to TCC300 control.
3. Verify that the target Smart Flash Card is inserted in the PC.
4. Select **Utility/SD Card Access Code**. TCC600 will display the SD Card dialog screen.

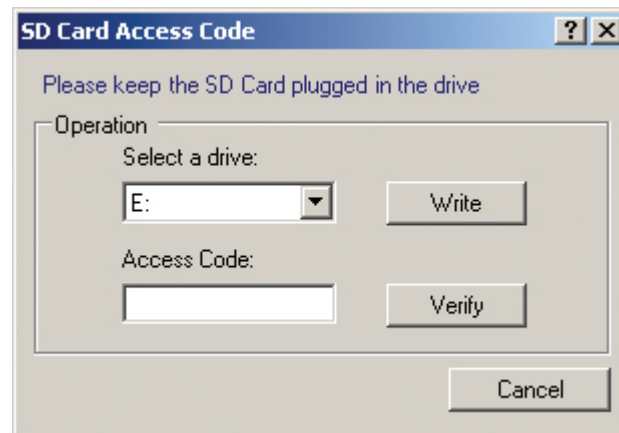


Figure 49: SD Card Dialog Screen

5. From the Operation section of the dialog screen select the drive that the SD Card represents in the drop down menu.
6. Enter the desired User Access Code, then select "Write". TCC600 will display a "Write Successfully" confirmation screen.

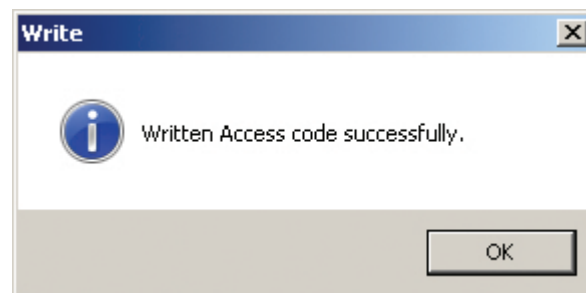


Figure 50: SD Card Access Code Written Successfully Confirmation Screen

7. Select "OK", then select "Verify". TCC600 will display the user Access Code that was written to the SD Card.

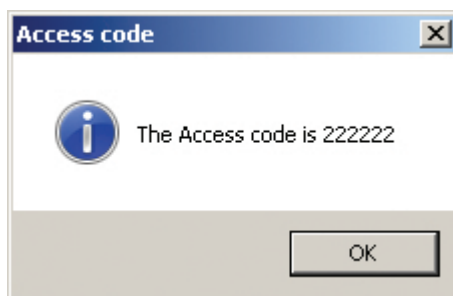


Figure 51: SD Card User Access Code Verification Screen

8. Select OK. The SD Card now contains the user Access Code and will be read each time the SD Card is inserted into the control.

3.18 Utility/Calibration

3.18.1 Accessing utility/calibration screens from the HMI



The following information regarding changing calibration parameters is intended for authorized personnel only. Changes to these parameters can result in physical damage to the control and the system/component to which it is applied.

The Utility/Calibration HMI screens provide access to calibration parameters that can be reset by the user as necessary to restore calibration settings to those that were calculated at the factory. Also included are key parameters that are indication only.

The following calibration parameters can be accessed and set by the user:

- Voltage Offset
- Volt Cal Coefficient
- Volt RMS Coefficient
- Curr Cal Coefficient
- I Sin Coefficient
- I Cos Coefficient
- Mtr Cal. Coefficient
- Mtr Sin Coefficient
- Mtr Cos Coefficient
- Mtr RMS Coefficient

- Circ Cal Coefficient
- Circ Sin Coefficient
- Circ Cos Coefficient

Indication only parameters available from the Calibration/Test HMI menus:

- Load Voltage
- Control Load I
- Power Factor
- Motor Current
- X1 Duration

These instructions describe making a change to the "Volt Cal Coefficient" calibration parameter. The other calibration parameters are changed in the same manner.



Incorrect calibration parameter settings can result in damage to the control.

1. Press the ENT (UTIL Hot Button) pushbutton to awaken the unit. The menu will advance to "UTILITIES".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Calibration/Test
3. Press the Down arrow pushbutton as necessary to navigate to the "Volt Cal Coefficient" calibration parameter screen.
4. Press the ENT pushbutton. The following will be displayed.
ENTER LEVEL 3 ACCESS
5. Enter a valid Level 3 Access code, then press the ENT pushbutton.
If a valid Level 3 Access code was entered, then the display will briefly flash a confirmation screen, then a "C". If not, reenter a valid code.
6. At the cursor, input the desired Voltage Calibration Coefficient value utilizing the arrow pushbuttons, then press the ENT pushbutton. The display will return to the "Voltage Calibration Coefficient" screen.
7. Remove power to the control, then reapply power to the control.

3.19 Source voltage

3.19.1 Changing source voltage input

This feature allows the user to manually switch the sensing voltage source for diagnostic procedures.

To manually switch the Source Voltage input proceed as follows:

1. Press the ENT (UTIL Hot Button) pushbutton to awaken the unit. The menu will advance to "UTILITIES".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Calibration/Test
3. Press the Down arrow pushbutton as necessary to navigate to the "Change Src Input" screen.
4. To toggle between voltage source inputs press the ENT pushbutton. The following will be displayed depending on the source that is selected:
Change Src Input Calculated XXX.X V
Change Src Input Measured XXX.X V

3.20 Watchdog and power resets

3.20.1 Resetting watchdog and power counters

This feature provides the user with the ability to determine the number of processor resets that have occurred and also the number of power cycles the control has experienced. Both counters can be reset by the user.

In the event that a "checksum error" occurs this menu will change to "Init Setpoints".

1. Press the ENT (UTIL Hot Button) pushbutton to awaken the unit. The menu will advance to "UTILITIES".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Calibration/Test
3. Press the Down arrow pushbutton as necessary to navigate to the "Clear reset counters" screen.
4. Press the ENT pushbutton. The following will be displayed:
Confirm press ENTER
Cancel press EXIT.
5. Press ENT. The control will display a "Counters Reset" screen, then return to the following:

Clear reset counters
Press ENT to begin

3.20.2

Reinitializing control setpoints due to checksum error



When a Checksum ERROR occurs the voltage control element of the control is NOT available.

In the event a "checksum error" occurs, then the control will initiate a cycling "Checksum Error" display. In this case the "Clear reset counters" menu item in the Utilities/Configuration/Test menu display will change to "Init setpoints" function. To reinitialize the control setpoints perform the following:

1. Press the ENT (UTIL Hot Button) pushbutton to awaken the unit. The menu will advance to "UTILITIES".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Calibration/Test
3. Press the Down arrow pushbutton as necessary to navigate to the "Init setpoints" screen.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Init setpoints
Press ENT to begin
5. Press the ENT pushbutton. The following will be displayed:
Confirm press ENT
Cancel press EXIT.
6. Press ENT. The control will display the following sequence of screen displays:
Initializing....
Initialization Done
Init Setpoints
Press ENT to begin

3.21

About screens

3.21.1

Accessing the about screens from the HMI

The About screens provide the user with unit serial number and firmware version.

1. Press the ENT (UTIL Hot Button) pushbutton to awaken the unit. The menu will advance to "UTILITIES".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Calibration/Test
3. Press the Right or Left arrow pushbutton. The menu will advance to About.
4. Press the Down arrow pushbutton as necessary to navigate to the desired screen.

3.22

Remote control



This feature should be used with extreme caution.

The Remote Control menu item located in the Utility drop down menu displays the applicable Remote Control screen.

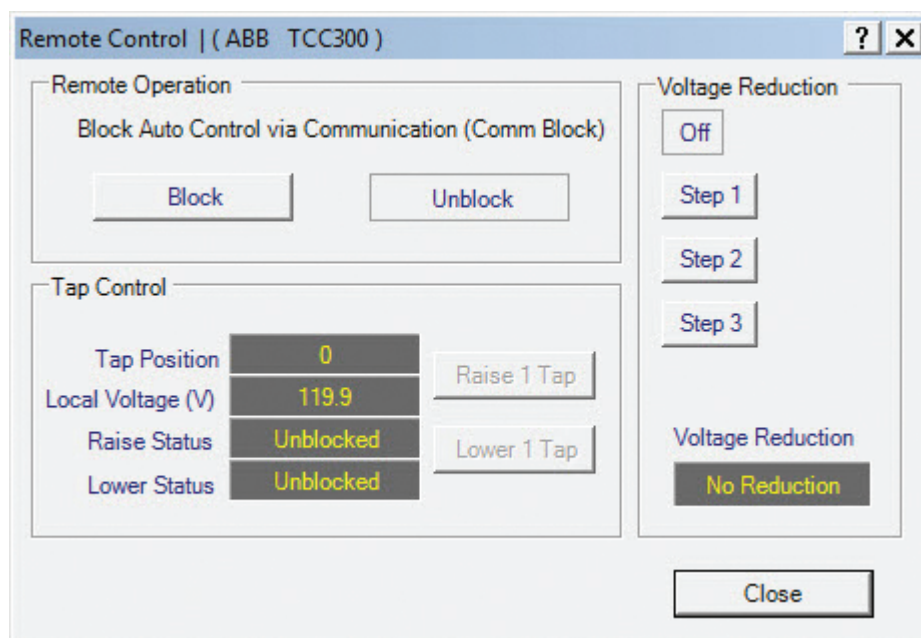


Figure 52: Remote Control Screen for Toggle or None Auto/Manual Switch Type

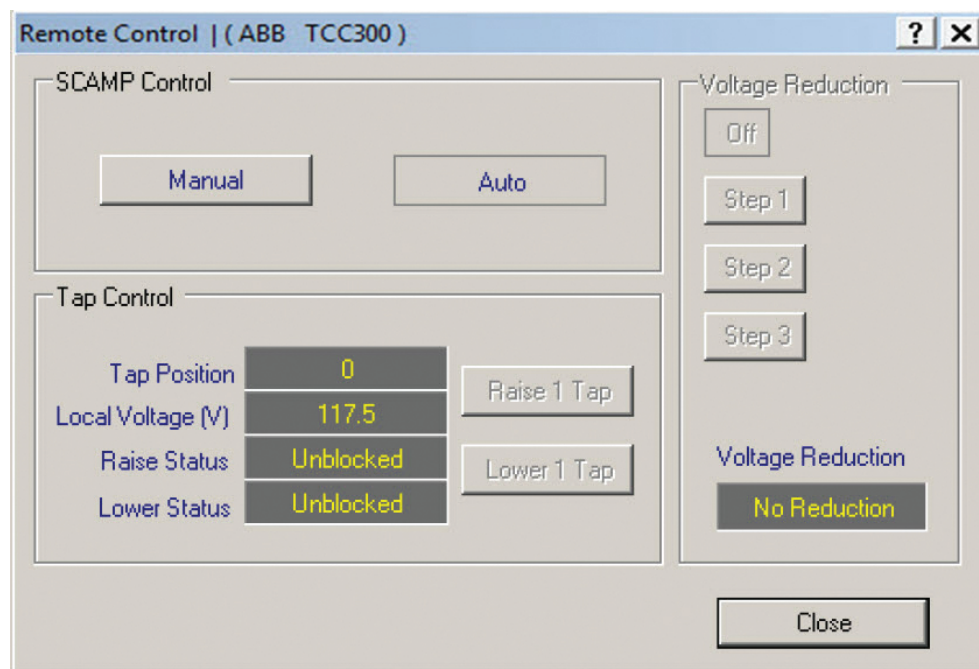


Figure 53: Remote Control Screen for SCAMP Auto/Manual Switch Type

Remote Control allows the user to:

- Remotely raise or lower one tap position.
- Apply Voltage Reduction Step 1 or 2 or 3.
- When the Auto/Manual Switch Type is set to either "Toggle" or "NONE" the Block Auto Control via Communication (Comm Block) setting is available.
- When the Auto/Manual Switch Type is set to "SCAMP" the SCAMP Auto/Manual Control setting is available.

Remote Tap Control



If the unit is supplied with DC Power Backup, then all automatic Raise or Lower operations are blocked when the input voltage decreases to less than 85.0 Vdc. Remote initiated Raise or Lower operations will still be initiated if Motor Power is available.



The control will not accept a new command unless the previous command is completed.

Lower 1 Tap

Initiates remote Lower in 1 tap increments. Limited by tap Block Lower setpoint and tap position limit settings.



If an appropriate pulse width setting is not input, then a misoperation of the tapchanger may occur when a SCADA Manual Raise or Lower is initiated.

Raise 1 Tap

Initiates remote Raise in 1 tap increments. Limited by tap Block Raise setpoint and tap position limit settings.

Remote Voltage Reduction

Off

No Voltage Reduction command is sent when Apply is selected.

Step #1

Initiates first step voltage reduction command for addressed control.

Step #2

Initiates second step voltage reduction command for addressed control.

Step #3

Initiates third step voltage reduction command for addressed control.

Block Auto Control via Communication

Block

Blocks automatic operation of the addressed control.

Unblock

Initiates automatic operation of the addressed control.

Remote Control/Miscellaneous

Close

Returns to the TCC600® main screen.

SCAMP control

The SCAMP Control feature allows the user to remotely observe the status of the Adapter Panel SCAMP pushbutton (when equipped). This feature also allows the user to change the state of the Local SCAMP pushbutton on the Adapter Panel/Control.

3.23 Low current alarm/block

3.23.1 Clearing low current alarm/block from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to awaken the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, until "Programmable Alarm" is displayed.
4. Press the Down arrow, as necessary, until the following is displayed.
Clr Low Current Blk
Ready Press ENTER
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Confirm press ENTER
Cancel press EXIT.
6. Press the ENT pushbutton. The following sequence of screens will be displayed:
Confirm press ENTER Cleared
Clr Low Current Blk Ready Press ENTER

3.23.2 Clearing low current alarm/block from TCC600

1. Select **Setup/Alarms** from the TCC600 toolbar. TCC600 will display the Programmable Alarm dialog screen.

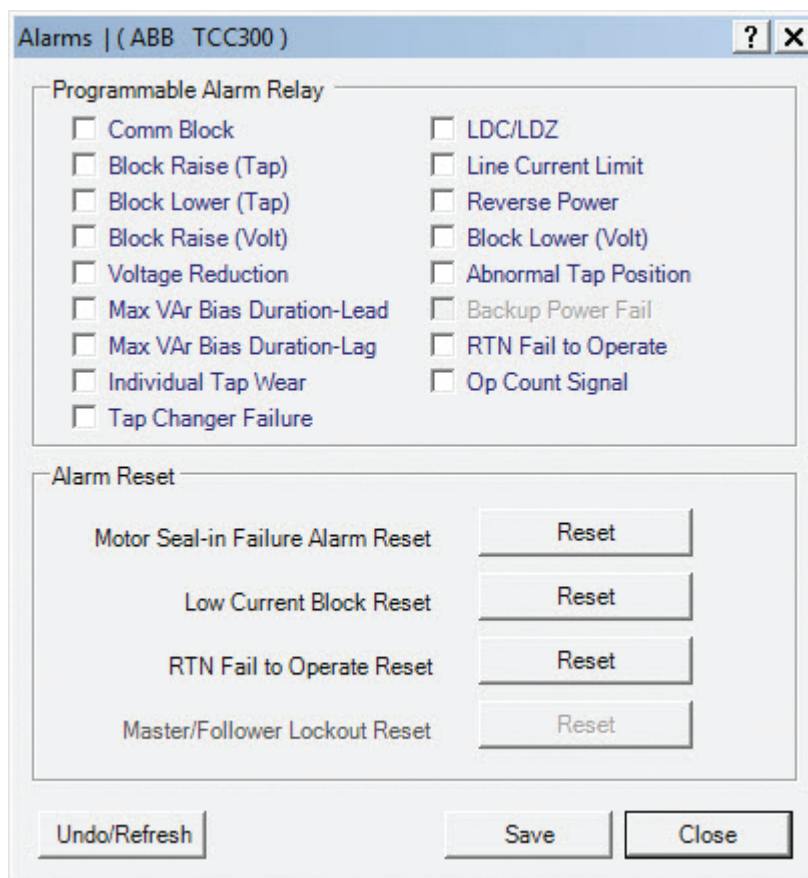


Figure 54: Programmable Alarms Dialog Screen

- From the Low Current Block Reset section of the dialog screen select Reset.

3.24

Motor seal-in failure alarm/block

When Motor Seal-in is selected in the control the Motor Seal-in Failure Alarm/Block feature and the input to the Abnormal Tap Position alarm are enabled by default. The user may choose to disable the Motor Seal-in Block feature. However, the input to the Abnormal Tap Position alarm and the Motor Seal-in Failure Alarm is always enabled when Motor Seal-in is selected. The feature includes the following:

Abnormal Tap Position Alarm Input - The Motor Seal-in Failure Block feature provides an input to the "Abnormal Tap Position" alarm. This input is actuated on the first occurrence of a tapchange coincident with no motor seal-in current detected for 15 seconds.

Motor Seal-in Failure Alarm - The Motor Seal-in Failure Alarm is actuated on the second occurrence (either direction) of a tapchange coincident with no motor seal-in current detected for 15 seconds. This alarm can be reset by the user from the Human Machine Interface (HMI), from the TCC600® "Alarms" dialog screen or via SCADA. The alarm is also reset when a successful tapchange operation occurs (motor seal-in current detected) in either direction.

Alarm Active

MTR SEAL-IN FAILURE

Motor Seal-in Failure Block - The Motor Seal-in Failure Block is actuated on the second occurrence of a tapchange coincident with no motor seal-in current detected for 15 seconds in either direction. The block will be in effect in the direction that produced the second Motor Seal-in Failure occurrence. If a Motor Seal-in Failure is detected in the opposite direction, then operation will be blocked in that direction also.

This Block can be reset by the user from the HMI, from the TCC600 "Alarms" dialog screen or via SCADA. The block is also reset when a successful tapchange operation occurs (motor seal-in current is detected) in the opposite direction.

The internal accumulator that counts the occurrences of failed tapchanges is stored in volatile memory and is set to zero when a loss of power occurs and the unit is not equipped with a backup power supply. This is considered normal operation of the feature.

3.24.1

Resetting motor seal-in failure alarm block from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to awaken the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, until "Programmable Alarm" is displayed.
4. Press the Down arrow, as necessary, until the following is displayed.
Clear Seal in Alarm
Ready Press ENTER
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Confirm press ENTER
Cancel press EXIT.
6. Press the ENT pushbutton. The following sequence of screens will be displayed:
Confirm press ENTER Cleared
Clear Seal in Alarm Ready Press ENTER

3.24.2 Resetting motor seal-in failure alarm/block from TCC600

1. Select **Setup/Alarms** from the TCC600 toolbar. TCC600 will display the Programmable Alarm dialog screen.
2. From the Motor Seal-in Failure Alarm reset section of the dialog screen select Reset.

3.25 Lockout alarms

3.25.1 Clearing master/follower or delta VAr peer to peer lockout alarm from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to awaken the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, until "Paralleling" is displayed.
4. Press the Down arrow, as necessary, until the following will be displayed:
Clear Lockout Alarm
Ready Press ENTER
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Confirm press ENTER
Cancel press EXIT.
6. Press the ENT pushbutton. The following sequence of screens will be displayed:
Confirm press ENTER Cleared
Clear Lockout Alarm Ready press ENTER

3.25.2 Clearing master/follower lockout alarm from TCC600

1. Select **Utility/Master/Follower configuration** from the TCC600 toolbar. TCC600 will display the Access Level Code dialog screen.

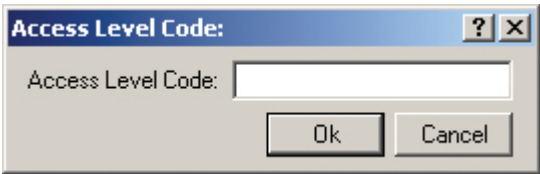


Figure 55: Access Level Code Dialog Screen

- 2. Enter a valid Level 2 Access Code, then select OK. TCC600 will display the Access Granted Successfully confirmation screen.

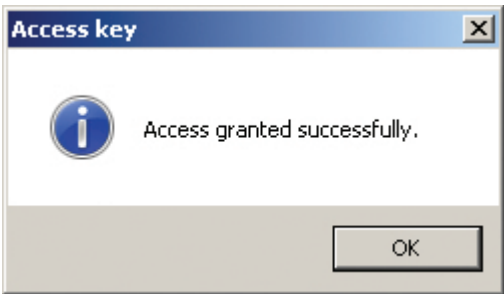


Figure 56: Access Granted Successfully Confirmation Screen

- 3. Select OK. TCC600 will display the Master/Follower Configuration Tool dialog screen.

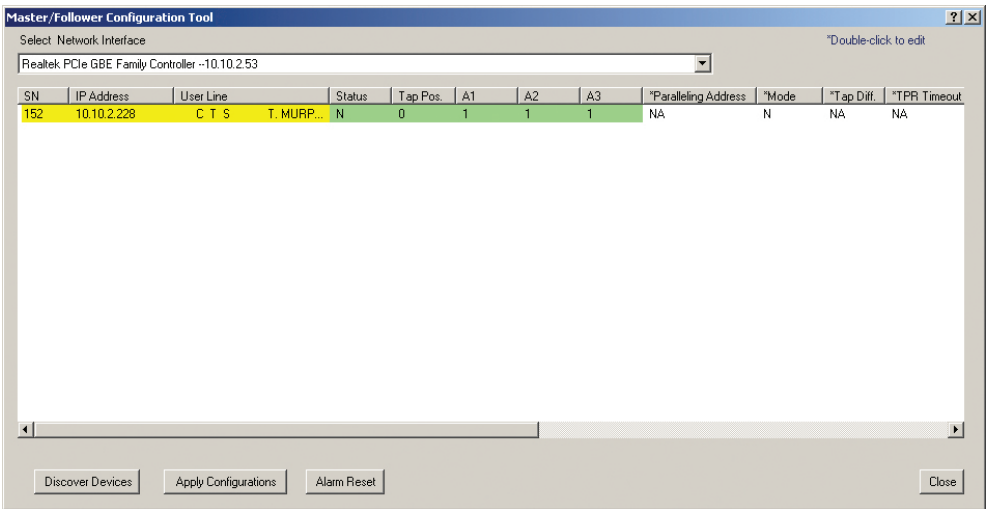


Figure 57: Master/Follower Configuration Tool Dialog Screen

- 4. Select the desired control to be reset, then select "Alarm Reset" to reset the Master/Follower Lockout Alarm.



The Master/Follower Lockout Alarm can also be reset from the Programmable Alarm dialog screen.

3.25.3

Clearing delta VAr peer to peer paralleling lockout/alarms from TCC600

Delta VAr Peer to Peer Paralleling Lockout/Alarms can be cleared/reset in TCC600® in two places. Individual control Lockout/Alarms can be reset from the Alarms dialog screen under the Setup menu and also from the Peer to Peer Paralleling Configuration Tool. All or selected individual control Alarms/Lockouts can be reset from the Peer to Peer Paralleling Configuration Tool.

To clear/reset Delta VAr Peer to Peer Paralleling Lockout/Alarms on an individual control from the TCC600 Alarms Setup dialog screen, perform the following:

1. Establish communications with the target control.
2. Select **Setup/Configuration/Alarms** from the TCC600 toolbar. TCC600 will display the Alarms dialog screen.
3. Select "Peer to Peer Lockout Reset". TCC600 will display the "Command successfully sent to control" dialog screen.

To clear/reset Delta VAr Peer to Peer Paralleling Lockout/Alarms on an individual control or multiple controls from the TCC600 Peer to Peer Configuration Utility perform the following:

1. Establish Ethernet communications with the target control.
2. Select **Utility/Peer to Peer Paralleling Configuration** from the TCC600 toolbar. TCC600 will display the Access Level Code dialog screen.

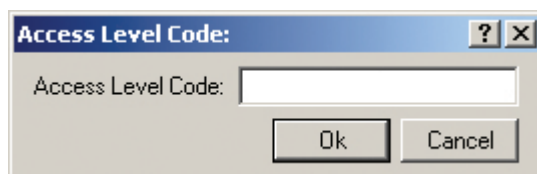


Figure 58: Access Level Code Dialog Screen

3. Enter a valid Level 2 Access Code, then select "OK". TCC600 will display a "Access granted successfully." dialog screen.
4. Select "OK". TCC600 will display an un-populated "Peer to Peer Paralleling Configuration Tool" dialog screen.

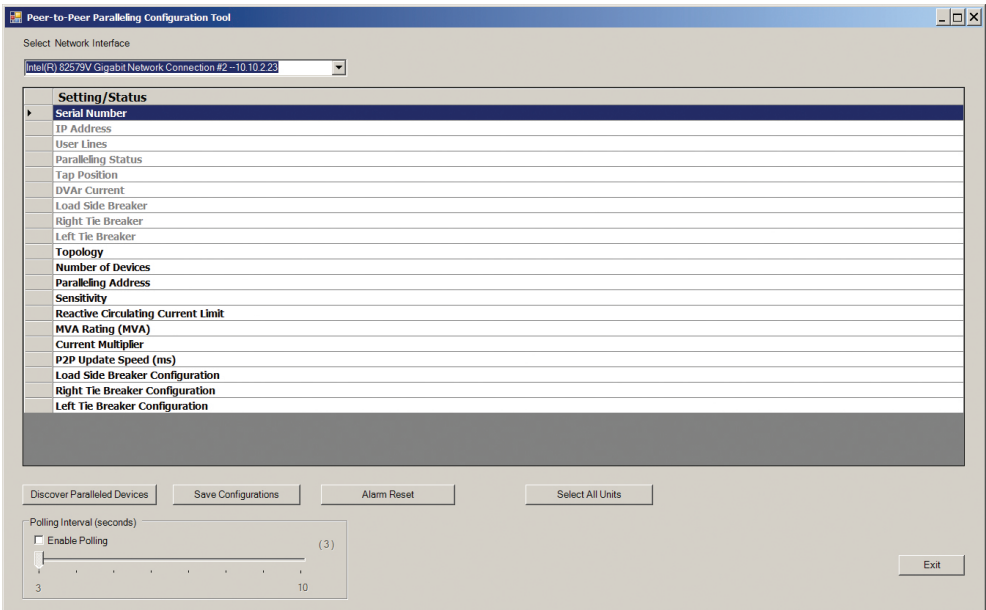


Figure 59: Un-populated Peer to Peer Paralleling Configuration Tool Dialog Screen

5. Verify/select the correct Network Interface.
6. Select "Discover Paralleled Devices". TCC600 will populate the Setting/Status portion of the dialog screen with those devices identified as Peer to Peer Paralleling devices.

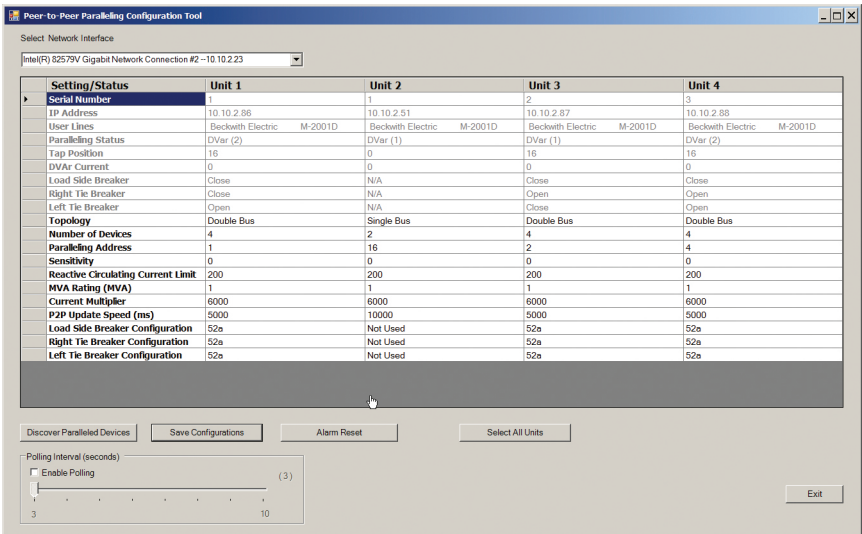


Figure 60: Populated Peer to Peer Paralleling Configuration Tool Dialog Screen

7. Select the individual unit or the "Select All Units" selection.
8. Select "Alarm Reset". TCC600 will display the "Alarm Reset" dialog screen.



Figure 61: Alarm Reset dialog screen

9. Select "OK". TCC600® will display a "Successfully sent reset command." confirmation Screen.

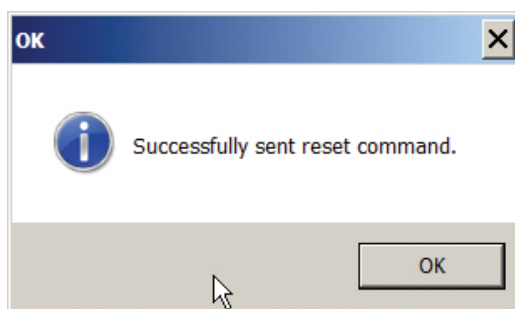


Figure 62: Successfully Sent Reset Command Confirmation Screen

Section 4 TCC600

4.1 Hardware requirements

TCC600 will run on any PC that provides at least the following:

- Windows 2000®, Windows XP®, Windows Vista® or Windows 7®
- One CD-ROM drive
- One USB (serial) port

Hardware Required for Direct USB (Serial) Communication

To use TCC600 to communicate with a ABB Digital Tapchanger Control using a direct USB (serial) connection, a USB cable is required.

The TCC300 Digital Tapchanger Control includes a fiber optic port and RS-485 port.

4.2 Installing TCC600

The TCC600 installation program has been written to overwrite previous versions of TCC600. However, considering variations in installed software, hardware and operating systems, if you are upgrading from a previous version of TCC600, it is recommended that any older versions of the TCC600 program be removed before installing the new TCC600.

TCC600 runs with the Windows 2000, Windows XP, Windows Vista or Windows 7 operating system. Familiarity with Windows is important in using TCC600, as the conventions defined in the Windows documentation are strictly followed.

TCC600 will be installed on the host PC's hard disk. While it does not require special installation procedures, an installation utility has been provided to make the process easier.



The USB cable must be disconnected from the TCC300 control before installing TCC600.

1. Insert the TCC600 software into your CD-ROM drive.
2. Select **Run** from the **Start Menu**.
3. In the **Run** dialog box, initiate software installation by typing D:\Setup.exe (or other drive designator:\Setup.exe, depending on the letter designation for the CD-ROM drive).
4. The Installation Wizard will prompt the user through the installation process. After installation, the TCC600 program icon (located in the Becoware folder) can be placed on the desktop.



Figure 63: TCC600 Program Icon

5. Select the TCC600 program-item icon from the Becoware group in the Program Manager, or select TCC600 from the program list using the Start Menu to start TCC600. The TCC600 Main Screen will be displayed.

4.3

Initial local communications using direct USB connection

The TCC300 and TCC600 Communications Software are shipped from the factory with the same default communication parameters. Therefore, it may not be necessary to setup communication parameters.

To use TCC600® to interrogate, set, or monitor the TCC300 Digital Tapchanger Control using a direct USB connection, the appropriate driver must be loaded. The driver that is required to be resident in the "windows\inf" folder on the host PC is "beco_usb.inf." This driver is automatically loaded by the TCC600 installation software.

When the control is connected to the PC utilizing a USB cable, Windows will enumerate the control as a serial com device and will assign an unused COM Port to the control.

1. For Direct Communication Using USB (Serial) Connection, ensure the following conditions exist:
 - 1.1. TCC600 is installed on the host computer
 - 1.2. The control is energized
2. Plug the USB cable into the host PC USB port.
3. Plug the USB cable into the USB port on the control. The host PC will:

- 3.1. Interrogate the control to determine the type of hardware device it is.



If the host PC cannot identify the proper driver for the TCC300, the driver can be found on the TCC600 software installation disk.

- 3.2. Load any required drivers.
- 3.3. Assign the next available COM port to the USB connection.
4. Start the TCC600 program. TCC600 will display the TCC600 **Main** dialog screen.
5. Select **Connect/USB** from the Connect drop-down menu.

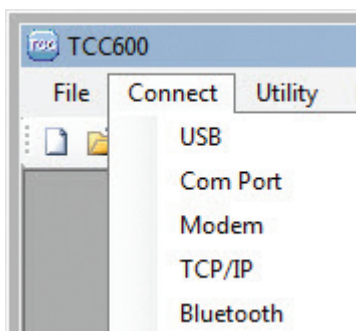


Figure 64: Selecting USB from the Connect menu

TCC600 will display the USB Port dialog screen.

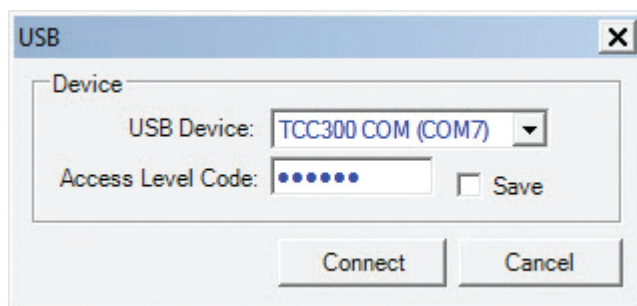


Figure 65: USB Port Connection Dialog Screen

6. Ensure that the correct COM port is displayed for the selected USB device.



TCC600 will automatically choose the port for the connected control.

7. Enter "Access Level Code" and check "Save" if desired. Default Values:

- Level 1: 000000 (Disabled)
- Level 2: 222222

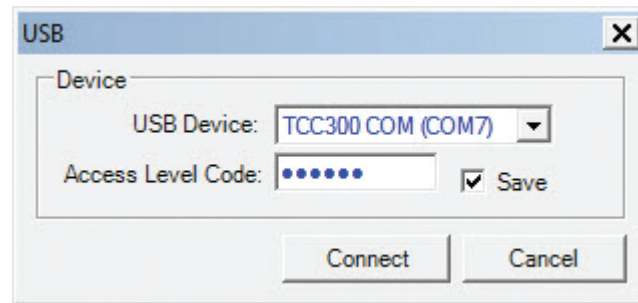


Figure 66: Checking Save

8. Select **Connect**. TCC600 will attempt to connect to the target control.
9. If TCC600® returns a Failed to Connect Error screen, then repeat Steps 6,7 and 8.

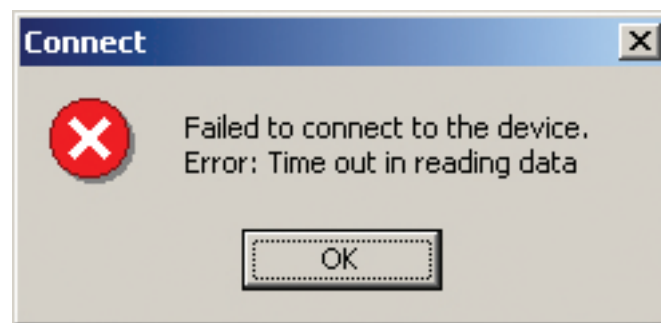


Figure 67: Failed to Connect Error Screen

10. If Level 1 Access is not active or the proper Level 1 or Level 2 access code was entered, then TCC600 will briefly display a "Successfully Connected Level 1/Level 2" confirmation screen, then display the connected version of the TCC600 Main Screen with the appropriate Access Level.
11. If Level 1 Access is active and an invalid access code was entered, then TCC600 will display a "Failed to complete Access Code Verification" error message.

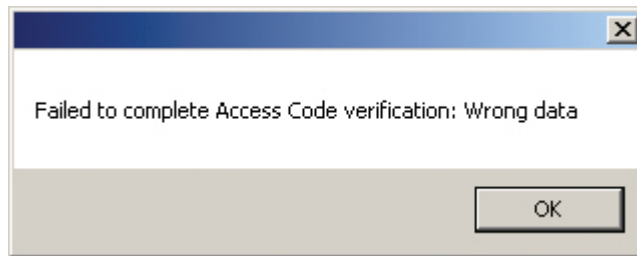


Figure 68: Failed to complete Access Code Verification Error Screen

12. Select **OK**. TCC600 will briefly display the "Successfully Connected Read-Only Access" screen and then display the connected version of the TCC600 Main Screen with Read-Only permission.

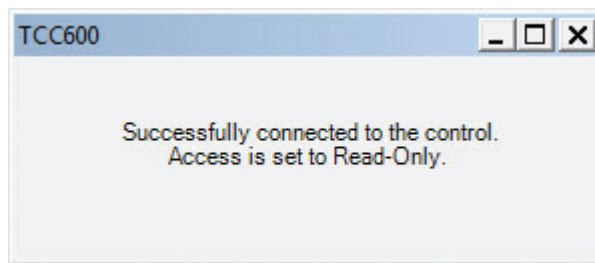


Figure 69: Successfully Connected Read Only Access Screen

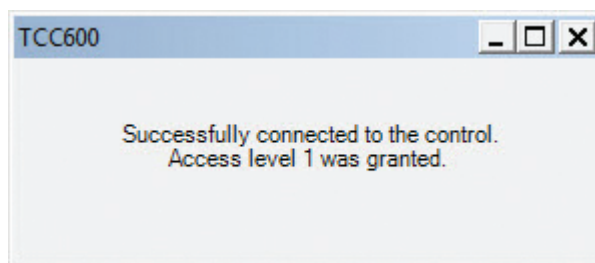


Figure 70: Successfully Connected Access level 1 Screen

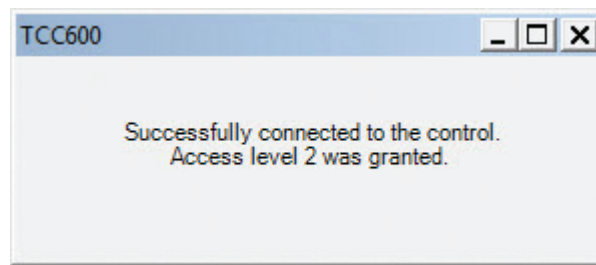


Figure 71: Successfully Connected Access level 2 Screen

4.4 Using RS-485 communications

To use TCC600 to interrogate, set, or monitor the TCC300 Digital Tapchanger Control using a RS-485 connection the following conditions must be met:

- The control is physically connected to a RS-485 network consistent with the correct hardware and connection requirements.
- TCC600 software communication parameters and device parameters must match the control's default RS-485 settings and the selected/default device parameters.

Elements of the control's RS-485 Port communication parameters include the following (default settings):

- Baud Rate (9600 bps)
- Sync Time (2 ms)
- Parity (None)
- Stop Bits (1)

Default device parameters that are at the default settings or have been configured locally at the control include (default settings):

- Device (Comm) Address (1)
- Protocol (DNP)
- Echo Cancel (fiber optic) (None)

1. For Communication Using RS-485 Connection, ensure the following conditions exist:

- 1.1. The control is physically connected to the RS-485 network
- 1.2. TCC600® is installed on the host computer
- 1.3. The control is energized
2. Start the TCC600 program. TCC600 will display the TCC600 **Main** dialog screen.
3. Select **Connect/Com Port** from the **Connect** drop-down menu.

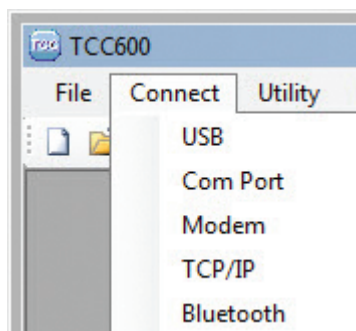


Figure 72: Serial Port dialog screen

- TCC600 will display the Serial Port dialog screen.
4. Ensure that the correct COM port is displayed.
 5. Ensure that both the Device and Comm settings are consistent with the control's default values.
 6. Select **Connect**. TCC600 will attempt to connect to the target control.
 7. If TCC600 returns a Failed to Connect Error screen, then repeat Steps 4, 5 and 6.

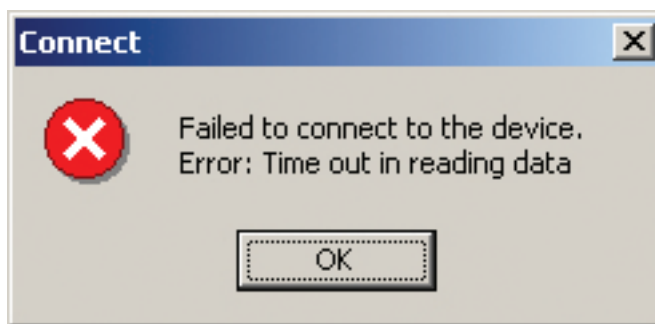


Figure 73: Failed to Connect Error Screen

8. If Level 1 Access is not active or the proper Level 1 or Level 2 access code was entered, then TCC600 will briefly display a "Successfully Connected Level 1/Level 2" confirmation screen, then display the connected version of the TCC600 Main Screen with the appropriate Access Level.
9. If Level 1 Access is active and an invalid access code was entered, then TCC600 will display a "Failed to complete Access Code Verification" error message. Select **OK**. TCC600 will briefly display the "Successfully Connected Read-Only Access"

screen and then display the connected version of the TCC600 Main Screen with Read-Only permission.

4.5 Using fiber-optic communications

The fiber optic interface is connected to the rear COM Port of the device. It can be enabled through the front panel under the Comm setting menu. When fiber optic is selected, the RS-485 is disabled. The fiber optic baud rate is selectable from 300 to 115200 bps.

The echoing of the received data is supported by the hardware. Switch (located on the side of the control to the right of the TX fiber transmitter connection as viewed from the rear of the control) opened, will disable the echoing feature (echo off). Echo ON is primarily used if the control is in a daisy chain network. Disabling the echo transmission is usually done when there is peer to peer communication. If the client software supports echo canceling, as is the case for TCC600, then there is no need to disable echo transmission. In this case echo cancel should be enabled on the client software. Physical specification:

- Fiber type: Multi mode
- Tested with fiber size 62.5/125 or 200 HCSTTM
- 820 nm nominal wavelength

To use TCC600 to interrogate, set, or monitor the TCC300 Digital Tapchanger Control using a Fiber Optic connection the following conditions must be met:

- The control is physically connected to a Fiber Optic network consistent with the correct hardware and connection requirements.
- TCC600 software communication parameters and device parameters must match the control's default Fiber Optic settings and the selected/default device parameters.

Elements of the control's Fiber Optic Port communication parameters include the following (default settings):

- Baud Rate (115200 bps)
- Sync Time (2 ms)
- Parity (None)
- Stop Bits (1)

Default device parameters that are at the default settings or have been configured locally at the control include (default settings):

- Device (Comm) Address (1)
 - Protocol (MODBUS®)
 - Echo Cancel (fiber optic) (None)
1. For Communication Using Fiber Optic Connection, ensure the following conditions exist:
 - 1.1. The control is physically connected to the Fiber Optic network
 - 1.2. TCC600® is installed on the host computer
 - 1.3. The control is energized
 2. Start the TCC600 program. TCC600 will display the TCC600 **Main** dialog screen.
 3. Select **Connect/Com Port** from the Connect drop-down menu.

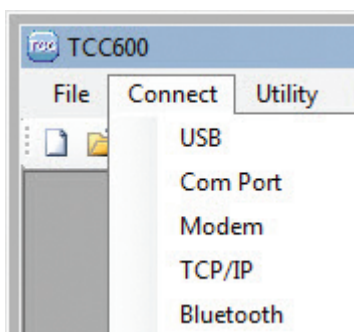


Figure 74: Serial Port dialog screen

TCC600 will display the Serial Port dialog screen.

4. Ensure that the correct COM port is displayed.
5. Ensure that both the Device and Comm settings are consistent with the control's default values.
6. Select **Connect**. TCC600 will attempt to connect to the target control.
7. If TCC600 returns a Failed to Connect Error screen, then repeat Steps 4, 5 and 6.

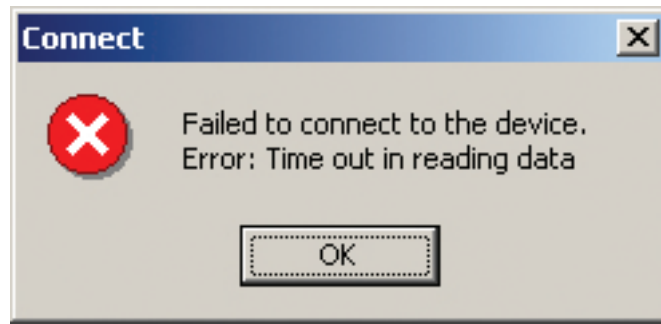


Figure 75: Failed to Connect Error Screen

8. If Level 1 Access is not active or the proper Level 1 or Level 2 access code was entered, then TCC600 will briefly display a "Successfully Connected Level 1/Level 2" confirmation screen, then display the connected version of the TCC600 Main Screen with the appropriate Access Level.
9. If Level 1 Access is active and an invalid access code was entered, then TCC600 will display a "Failed to complete Access Code Verification" error message. Select **OK**. TCC600 will briefly display the "Successfully Connected Read-Only Access" screen and then display the connected version of the TCC600 Main Screen with Read-Only permission.

4.6

Using Ethernet communications

The optional Ethernet Port can be purchased as either a RJ-45 (10/100 Base-T) interface or Fiber Optic through ST or SC connectors (100 Base-Fx) for Ethernet communication to the TCC300. The port supports up to 17 concurrent connections. The maximum number of allowed DNP connections is five. The maximum number of MODBUS® connections is eight. When IEC 61850 is purchased, the maximum number of IEC 61850 connections is four. The port supports DHCP protocol and also allows manual configuration of the Ethernet port. MODBUS protocol "Port Number" and DNP Protocol "Port Number" are required for manual configuration.



TCC600 can be used through the Ethernet port and may be considered a MODBUS connection for the purpose of determining how many concurrent connections are allowed.



Using Fiber Ethernet requires the Auto Negotiate setting in the control be set to Disable to operate correctly

Ethernet Fiber Optic Physical Specification:

- Fiber type: Multi mode
 - Tested with Fiber size 62.5/125 or 200 HCS™
 - 1300 nm nominal wavelength
-
1. For Communication Using Ethernet Connection, ensure the following conditions exist:
 - 1.1. The control is physically connected to the Ethernet network
 - 1.2. TCC600 is installed on the host computer
 - 1.3. The control is energized
 2. Start the TCC600 program. TCC600 will display the TCC600 **Main** dialog screen.
 3. Select **Connect/TCP/IP** from the **Connect** drop-down menu. TCC600 will display the TCP/IP Connection Dialog Screen
 4. Enter the Device and TCP/IP parameters for the target control or select from the Address Book.
 5. Select **Connect**. TCC600 will attempt to connect to the target control.
 6. If TCC600 returns a Failed to Connect Error screen, then repeat Steps 4 and 5.
 7. If Level 1 Access is not active or the proper Level 1 or Level 2 access code was entered, then TCC600 will briefly display a "Successfully Connected Level 1/Level 2" confirmation screen, then display the connected version of the TCC600 Main Screen with the appropriate Access Level.
 8. If Level 1 Access is active and an invalid access code was entered, then TCC600 will display a "Failed to complete Access Code Verification" error message. Select OK. TCC600 will briefly display the "Successfully Connected Read-Only Access" screen and then display the connected version of the TCC600 Main Screen with Read-Only permission.

If the control is to be connected to a network that does not support DHCP protocol, then the following information must be obtained from the Network Administrator, to be entered locally at the control or remotely utilizing TCC600:

- IP Address
- Net Mask
- Gateway (may be necessary)

Also, if the network MODBUS® Port address is not "502" or the DNP Port address is not "20000", then the MODBUS and DNP Port settings must be set.

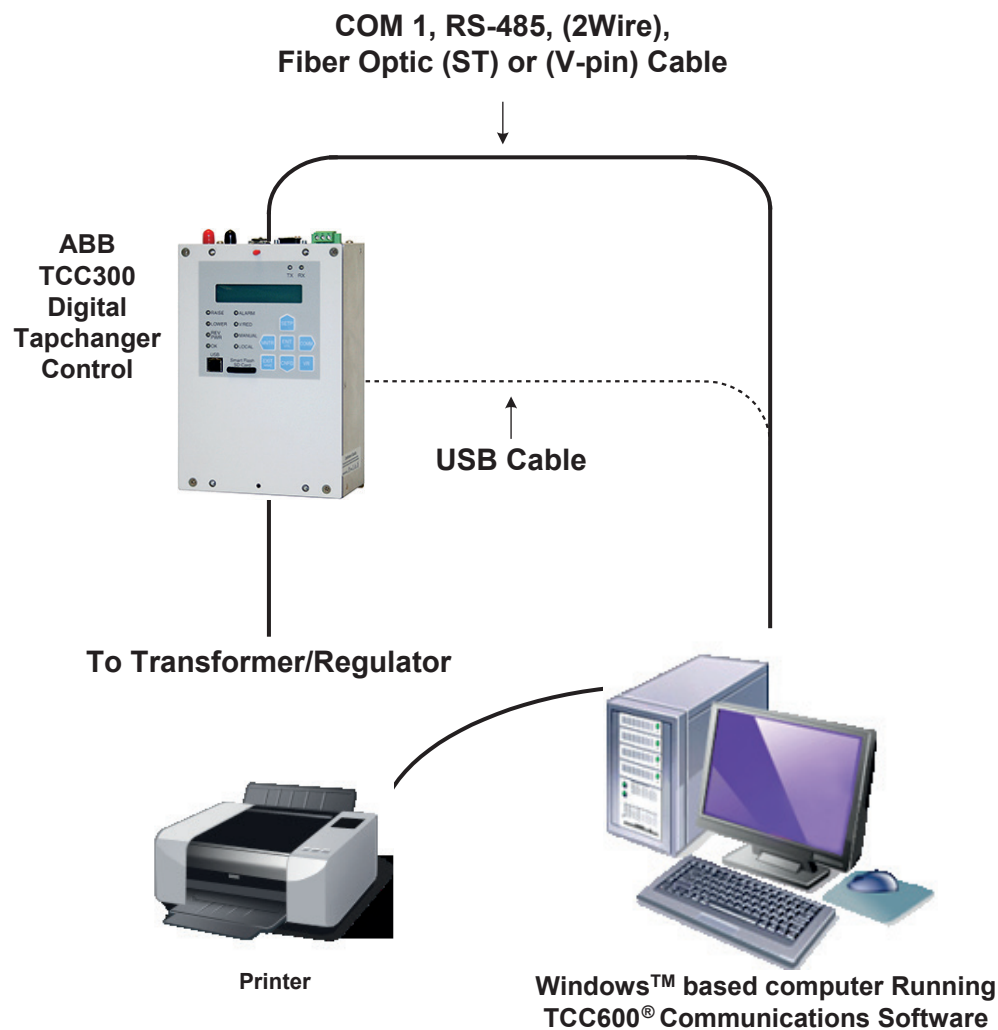


Figure 76: Direct Connection

4.7

Using bluetooth communications

Optional Bluetooth

The Bluetooth® option enables wireless access to the TCC300. Utilizing the Bluetooth wireless feature the user is able to configure the control, read status and metering values, as well as change setpoints.

The ABB factory default values for device information are:

- Friendly Name – TCC300-Serial Number
 - Mode of Device – Mode0 (discoverable)
 - Internal operation status – Standby
 - Authentication: None
 - Encryption: None
1. For Communication Using Bluetooth Connection, ensure the following conditions exist:
 - 1.1. The Bluetooth Factory Option is enabled on the control
 - 1.2. The Bluetooth Status on the control is "Present" and "Connectable"
 - 1.3. TCC600 is installed on the host computer
 2. Start the TCC600 program. TCC600 will display the TCC600 **Main** dialog screen.
 3. Select **Connect/Bluetooth** from the **Connect** drop-down menu. TCC600 will display the Bluetooth Connection Dialog Screen.
 4. Enter the Bluetooth device parameters for the target control or select from the Address Book.
 5. Select **Connect**. TCC600 will attempt to connect to the target control. The connection time to the control will depend on the distance between the control and the client device and also on the amount of RF interference present.
 6. If TCC600 returns a Failed to Connect Error screen, then repeat Steps 4 and 5.
 7. If Level 1 Access is not active or the proper Level 1 or Level 2 access code was entered, then TCC600 will briefly display a "Successfully Connected Level 1/Level 2" confirmation screen, then display the connected version of the TCC600 Main Screen with the appropriate Access Level.
 8. If Level 1 Access is active and an invalid access code was entered, then TCC600 will display a "Failed to complete Access Code Verification" error message. Select OK. TCC600 will briefly display the "Successfully Connected Read-Only Access" screen and then display the connected version of the TCC600 Main Screen with Read-Only permission.

4.8

Communications with multiple controls



Each control connected to either a direct or modem connection configuration must have a unique communications address. If two or more controls share the same address, corrupted communication will result.

The remote addressing capability of TCC600® and the TCC300 Digital Tapchanger Control allows multiple controls to share a direct or network connection. A fiber optic loop network, RS-485 tree configuration or Ethernet Network may also be used.

A control address of zero is a "wild card" that will illicit a response from all controls on a shared connection and result in corrupted communication.

With these arrangements, any control can be selected from within TCC600 by specifying it's unique communications address, ranging from 1 to 200. The communications address must have previously been set from the control's front panel.

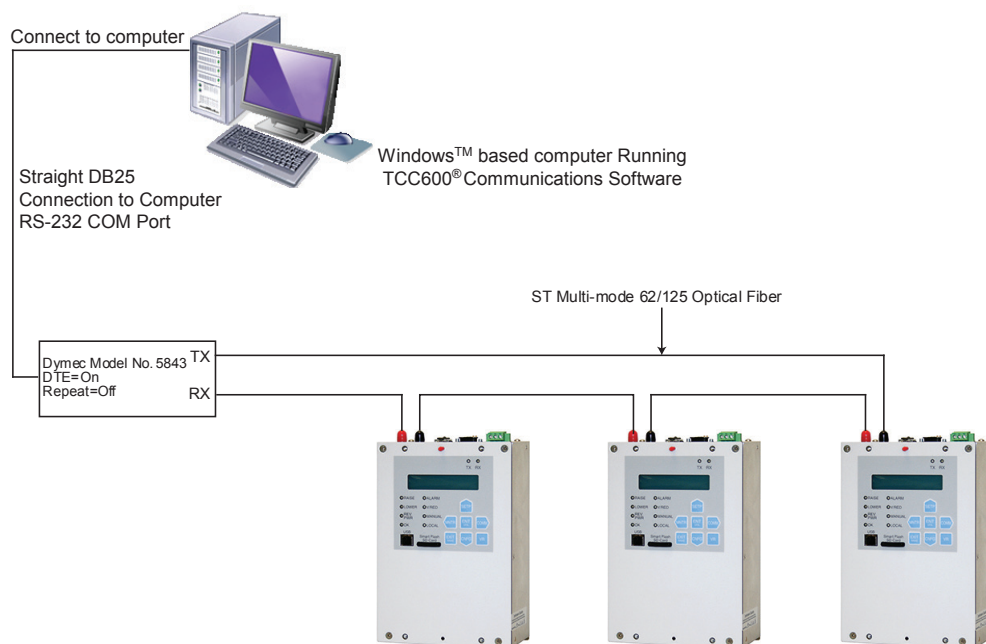


Figure 77: Fiber Optic Connection Loop

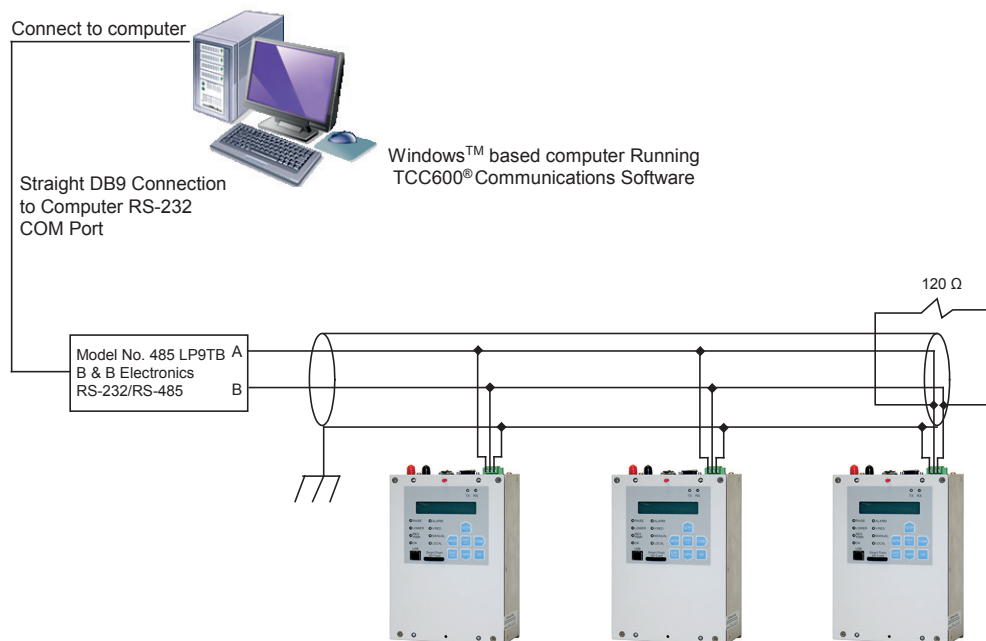


Figure 78: RS-485 Connection Tree

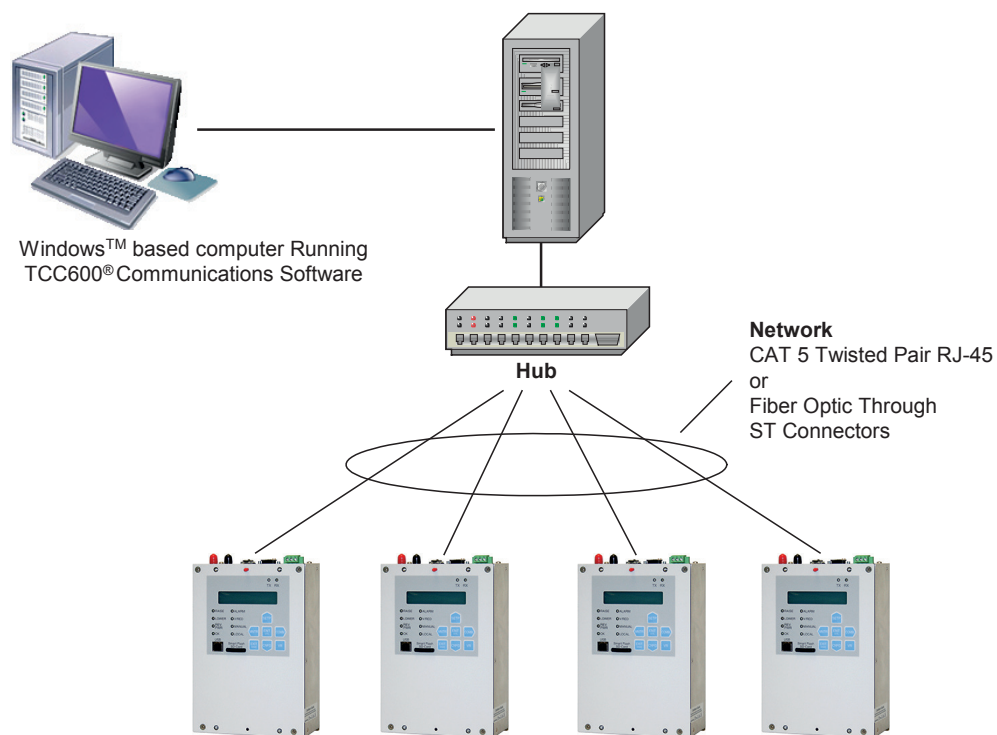


Figure 79: Optional Ethernet Network Connection

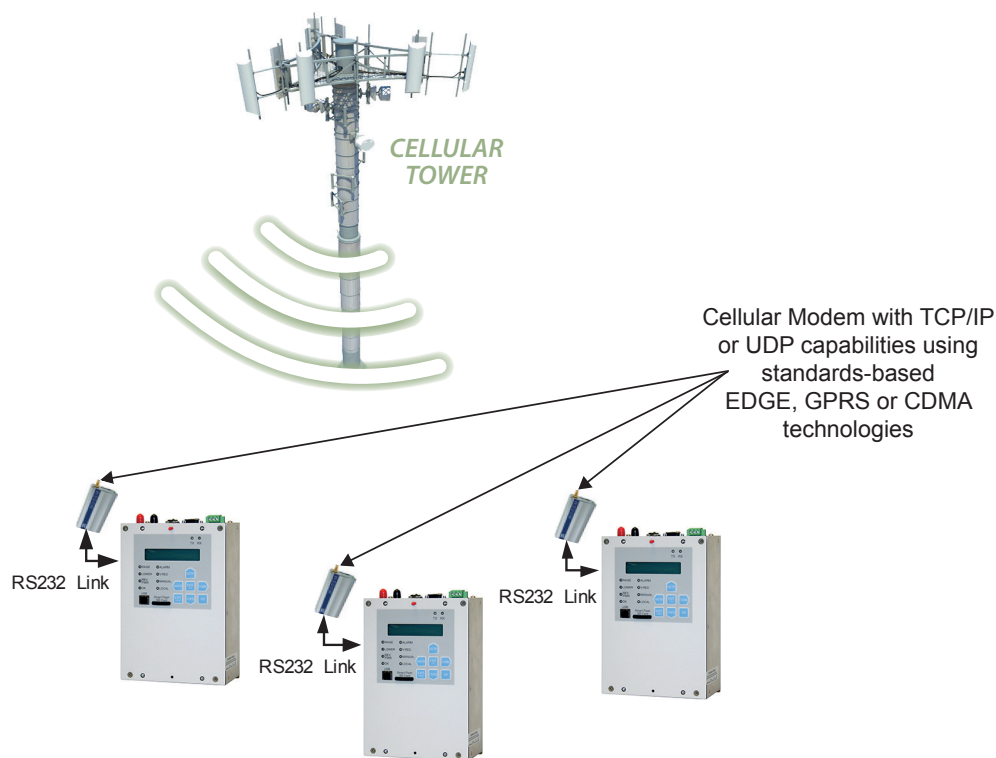


Figure 80: Cellular Modem Network

4.9

Cautions

Control and TCC600 Compatibility

Every attempt has been made to maintain compatibility with previous control software versions. In some cases (most notably, with older controls), compatibility cannot be maintained. However, TCC600 should work correctly with more than one version of the TCC300 Series Digital Tapchanger Controls on a single bus, provided that the controls are all set to use the same protocol. If there is any question about compatibility, contact the factory.

Control Priority

Control conflicts will not occur as local commands initiated from the front panel receive priority recognition.

Time and Date Stamping

Time and date stamping of events is only as useful as the validity of the control's internal clock. Under the Configuration/System Clock menu, the Set Control Date/Time command allows you to manually set the control's clock. For reference, the computer's clock is also displayed.

4.10 Operation overview

The TCC600® Communications Software can be used to successfully communicate settings and operational commands to the TCC300 as well as access the extensive monitoring and status reporting features. [Figure 81](#) represents the TCC600 Main Screen menu structure. TCC600 Main Screen "File Mode" menu structure and TCC600 Main Screen "Connected" menu structure are presented in [Figure 82](#) and [Figure 83](#) respectively.

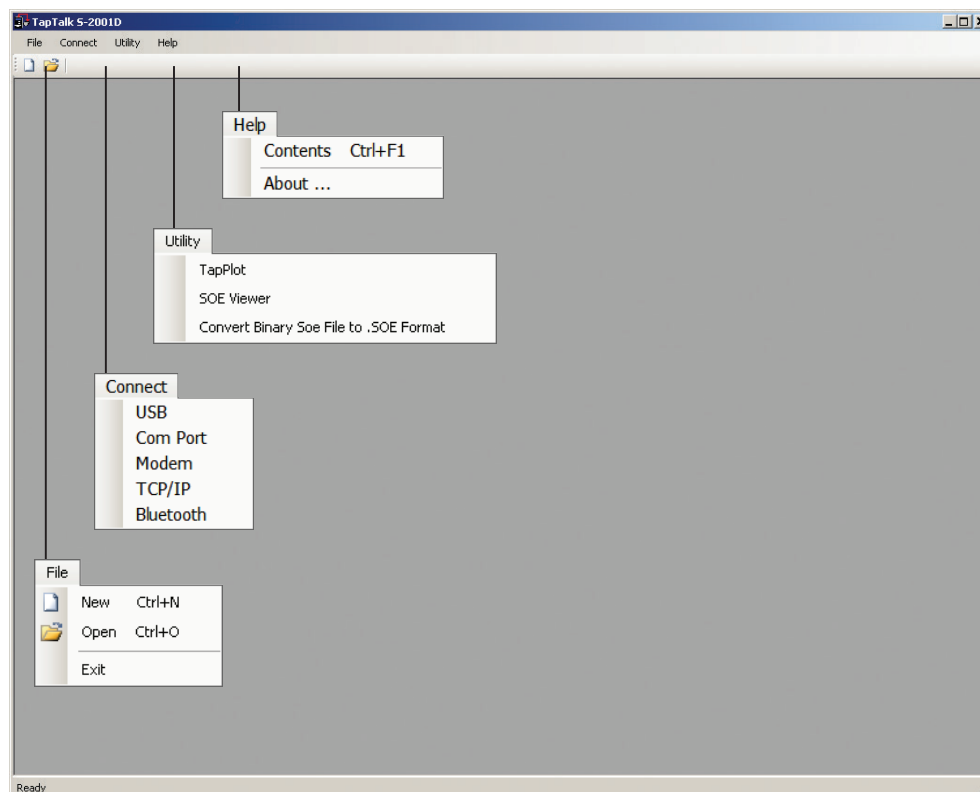


Figure 81: TCC600 Main Screen Menu Selections

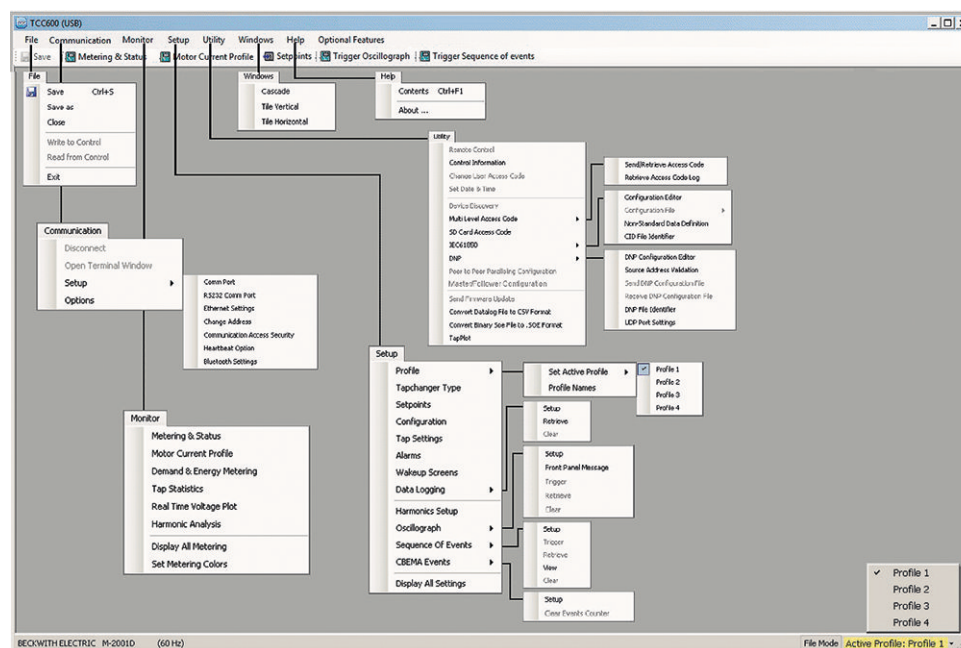


Figure 82: TCC600 Main Screen Menu Selections (File Mode)

This section provides a general description of each TCC600 menu selection and command in the same order as they are displayed in the software program.

The TCC600® Main Screen "Connected" also displays the type of connection that is in effect (top of menu bar), and on the bottom menu bar the Control Time, Firmware Version, Connection Status and Active Setpoint Profile. When in File Mode with a named file open the file name and path to the file are displayed in the top menu bar. Also displayed is the Active Profile in the bottom menu bar.

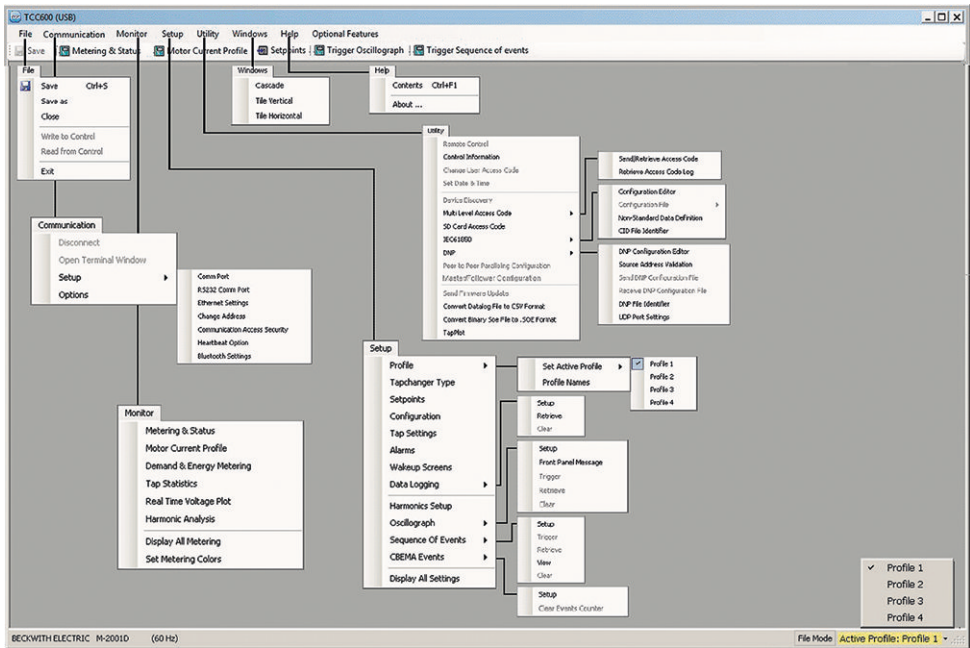


Figure 83: TCC600 Main Screen Menu Selections (Connected)



If communication is not established to the unit and no file is open, items relating to settings, utilities, or monitoring are disabled. If not connected but a file is open, monitoring and utilities screens are displayed without data (Tap and Harmonics display simulated data.)

Once installed, the TCC600® program-item icon is available from the Program Manager and TCC600 can be run like any other Windows™ program (The installation utility places TCC600 in a Program Manager group named Becoware).

4.10.1

File menu

The contents of the File menu depend on whether TCC600 is connected to a control or a file is open.



Figure 84: File menu in the Not Open or Not Connected Mode

Table 6: *File menu contents in the Not Open or Not Connected Mode*

Item	Description
New	Opens the File Information Box to allow the user to select the unit type and nominal frequency.
Open	Opens the file browser window to allow the user to select an existing file. It will not allow the user to create a new file.
Exit	Exits the TCC600 program.

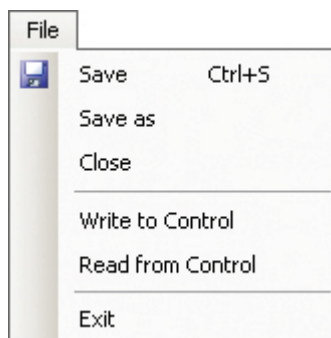


Figure 85: *File menu in the Open or Connected Mode*

Table 7: *File menu contents in the Open or Connected Mode*

Item	Description
Save	Saves the open file.
Save As	Allows the user to save the open file with a different file name.
Close	Closes the open file in the control window.
Write to Control	When connected to a control and no file is previously open, this function allows the user to open a *.cfg file and send the setpoints and configuration to the control in one step.
Read from Control	When connected to a control and no file is previously open, this function allows the user to recall the control profile and save the data to a *.cfg file.
Exit	Exits the TCC600 program.

4.10.2

Connect menu

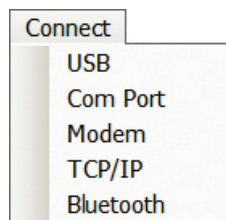


Figure 86: Connect menu

The Connect drop down menu is displayed when the unit is not connected to a control. This menu provides the user with access to the screens that are necessary to set TCC600® communication parameters and connect to the target control. Menu selections include USB, Com Port, Modem, TCP/IP and Bluetooth.

Table 8: Connect menu contents

Item	Description
USB	The USB menu selection initiates the USB dialog screen to connect to the TCC300 USB Port (Figure 87). The user is prompted to input the required Device and Access code. The USB/Comm Port selection identifies the PC Comm Port to be utilized for communication.
Com Port	The Com Port menu selection initiates the Serial Port dialog screen (Figure 88). The user is prompted to input the necessary communications information to open Serial communications through the selected Comm Port.
Modem	The Modem menu selection initiates the Modem communication dialog screen (Figure 89). This screen contains the Device, Phone, PC Comm Port and Modem parameters that are necessary to setup and communicate with a modem attached to the host PC and the target TCC300. This screen also contains a phone book, selection of Comm Port or modem and a selection for bringing up a terminal window after dialing.
TCP/IP	The TCP/IP menu selection initiates the TCP/IP communication dialog screen (Figure 90). This screen contains the parameter settings for communicating with a TCC300 over a network.
Bluetooth	The Bluetooth menu selection initiates the Bluetooth communication dialog screen (Figure 91). This screen contains the parameter settings for communicating with a TCC300 using the optional Bluetooth feature.

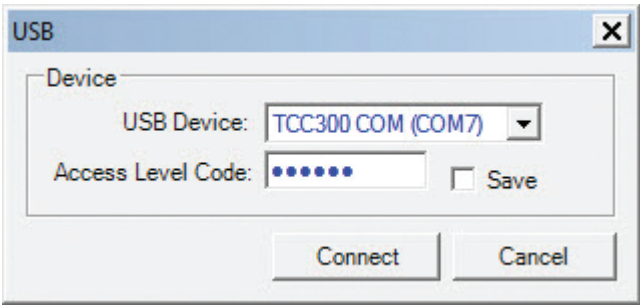


Figure 87: USB Port Connection Dialog Screen

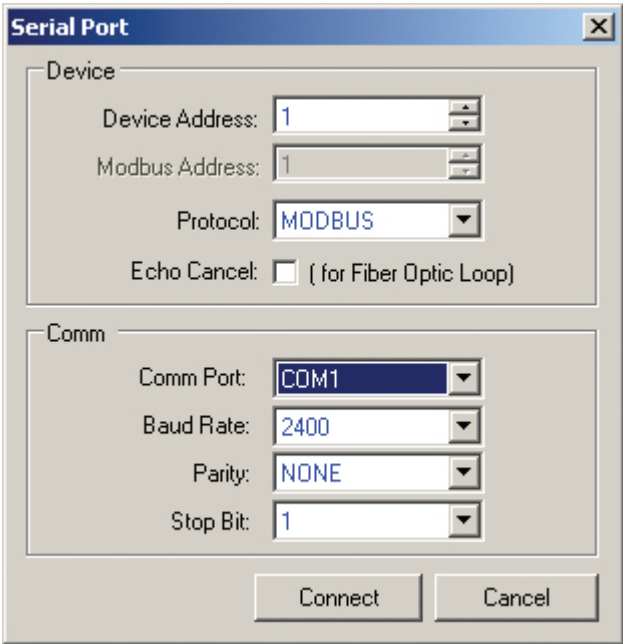
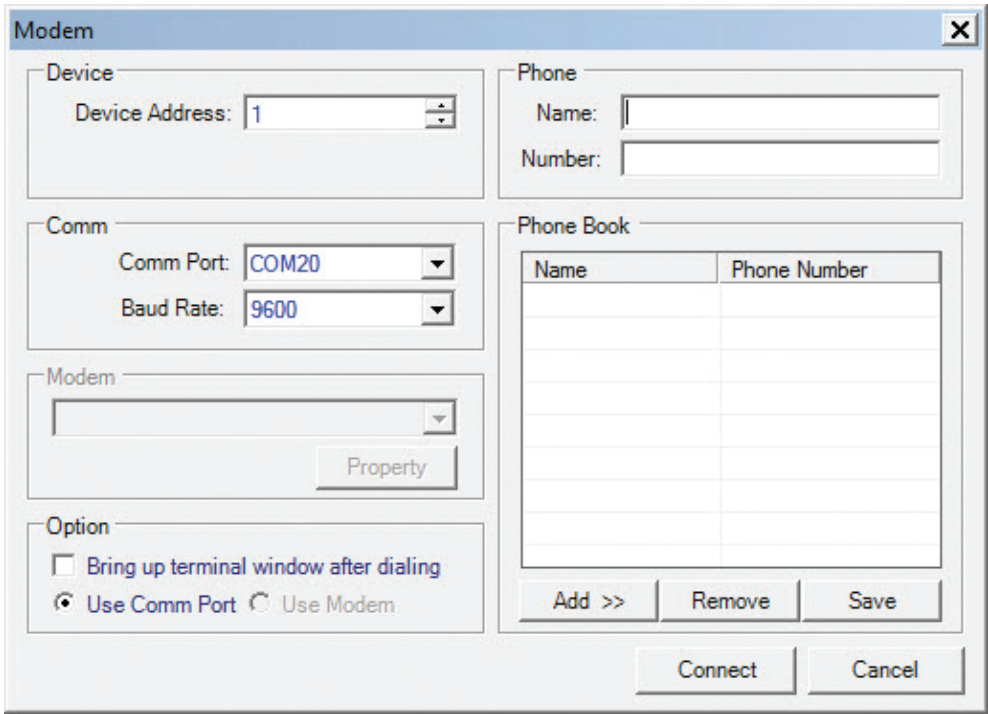


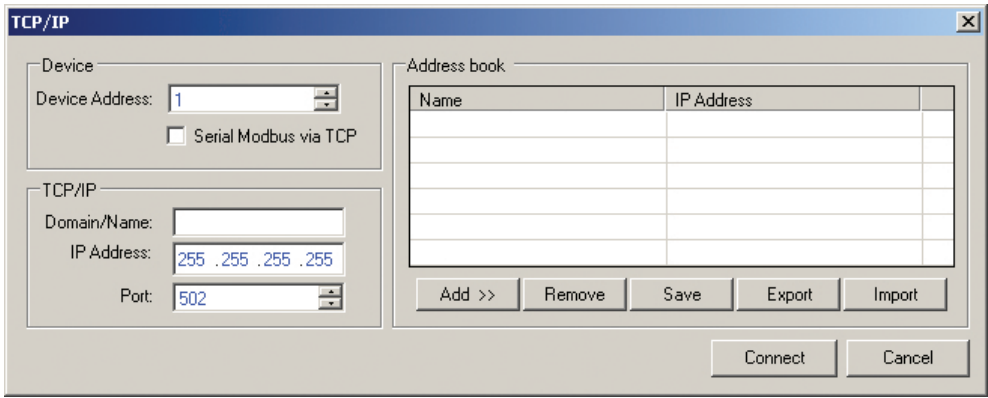
Figure 88: Serial Port Connection Dialog Screen



The 'Modem' dialog box contains several sections for configuring a modem connection. The 'Device' section has a 'Device Address' dropdown set to '1'. The 'Comm' section has 'Comm Port' set to 'COM20' and 'Baud Rate' set to '9600'. The 'Modem' section has a dropdown menu and a 'Property' button. The 'Option' section has two radio buttons: 'Bring up terminal window after dialing' (unchecked) and 'Use Comm Port' (checked). The 'Phone' section has 'Name' and 'Number' text boxes. The 'Phone Book' section has a table with 'Name' and 'Phone Number' columns. At the bottom are 'Add >>', 'Remove', 'Save', 'Connect', and 'Cancel' buttons.

Name	Phone Number

Figure 89: Modem Connection Dialog Screen



The 'TCP/IP' dialog box contains sections for configuring a TCP/IP connection. The 'Device' section has a 'Device Address' dropdown set to '1' and a 'Serial Modbus via TCP' checkbox. The 'TCP/IP' section has 'Domain/Name', 'IP Address' (set to '255.255.255.255'), and 'Port' (set to '502') fields. The 'Address book' section has a table with 'Name' and 'IP Address' columns. At the bottom are 'Add >>', 'Remove', 'Save', 'Export', 'Import', 'Connect', and 'Cancel' buttons.

Name	IP Address

Figure 90: TCP/IP Connection Dialog Screen

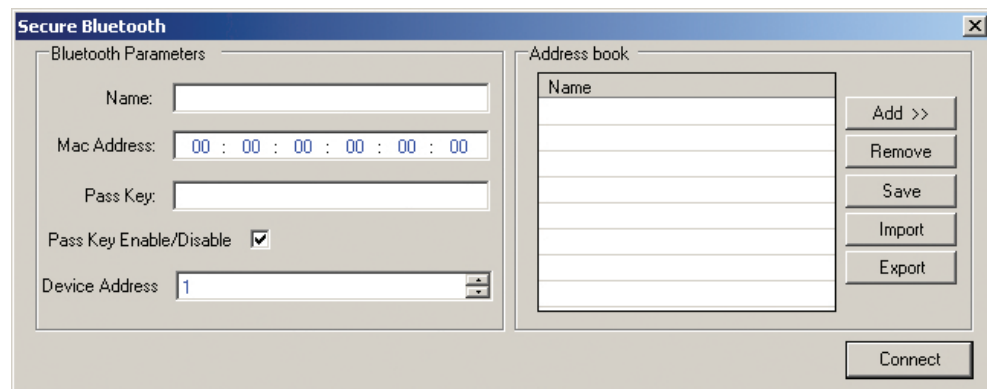


Figure 91: Bluetooth Connection Dialog Screen

4.10.3

Communication menu

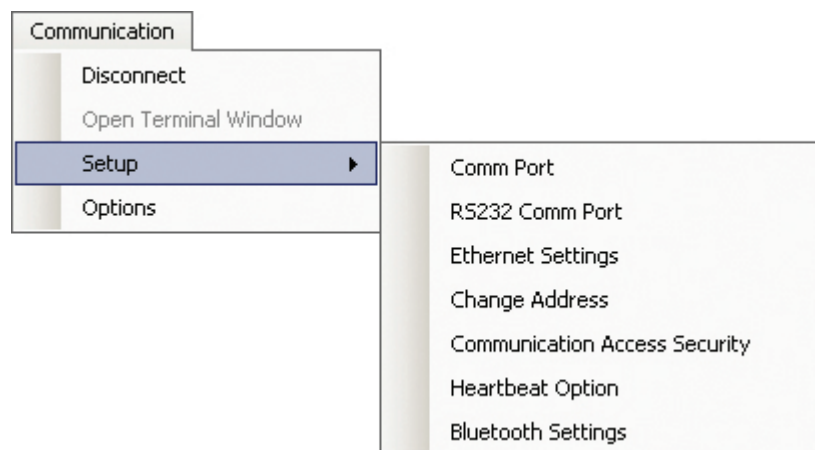


Figure 92: Communication menu

The Communication drop down menu is displayed when TCC600 is connected to a control. This menu provides the user with access to the screens that are necessary to Disconnect from the target control, initiate the Open Terminal Window feature or access the Setup menu items.

The Setup submenu provides the user with the capability to setup and configure the standard RS485 Fiber Optic Port. Also, the Setup submenu provides for the setup and configuration of the RS-232 port, optional Ethernet and Bluetooth® communication features.

The Communication/Setup submenu also provides the user with access to the Change Address, Communication Access Timeout and HeartBeat settings.

Table 9: *Communication menu contents*

Item		Description
Disconnect		The Disconnect menu item when selected prompts the user to confirm the disconnect command (Figure 93).
Open Terminal Window		Not Available at this time.
Setup	Comm Port	The Comm Port settings can be modified in the Setup Comm Port dialog (Figure 94) when the RS-485/Fiber Optic rear Comm Port is present.
	RS-232 Comm Port	The RS-232 Comm Port settings can be modified in the Setup RS232 Comm Port dialog (Figure 95) when the RS-232 Comm Port is present.
	Ethernet	The Ethernet Port Settings can be modified in the Setup Ethernet dialog (Figure 96) when the Ethernet Port is present.
	Change Address	<p>Multiple Control Addressing</p> <p>The Control Communication Address can be modified in the Change Communication Address screen (Figure 97). The Communication Address is used for both MODBUS® and DNP protocols. Substation and Feeder Addresses apply only to DNP protocol.</p> <p>When Change Address submenu item is selected, TCC600® will respond with a confirming dialog screen (Figure 98). As long as communication to the remote location is maintained, the user can switch between controls.</p> <p>Miscellaneous:</p> <p>Save – The Save command saves the Address change to the control when TCC600 is connected to a control.</p> <p>Close – The Close command cancels any Address changes before the changes have been sent to the control.</p>
	Communication Access Security	When Communication Access Security is enabled it applies only when MODBUS has been selected regardless of the physical interface. If enabled, the user Level Access Code must match either the Level 1 or Level 2 Access Codes in order to be granted the access to control settings ascribed to each Level. If an invalid Access Level Code is entered at the connection prompt, then read only access will be granted. TCC600® must be closed for the timeout period specified (1 to 50,000 seconds) in order for any Access Code changes to take effect when this feature is enabled. The setting range is from 1 to 50,000 seconds (Figure 99).
	HeartBeat Option	<p>The purpose of the SCADA HeartBeat feature is to have two sets of settings for the control and switch between these two setting sets based on the presence or absence of SCADA communications (utilizing the DNP protocol) to the control. The SCADA HeartBeat feature can be enabled from TCC600 Communications software. There are four different types of SCADA HeartBeat modes that can be selected:</p> <ul style="list-style-type: none"> • SCADA HeartBeat for transformer control applications (LTC) • SCADA HeartBeat for regulator control applications (Regulator) • Profile Switching (DNP) • Profile Switching (GOOSE) <p>HeartBeat can be enabled or disabled (Figure 100) and the control type selected.</p>
	Bluetooth® Settings	The Bluetooth Information dialog screen (Figure 101) provides the user with the capability to setup Bluetooth communication parameters and also initiate a "Reset" of the Bluetooth module.
Table continues on next page		

Item	Description
Options	This feature allows the user to enable RS-232 and the optional Bluetooth module if equipped (Figure 102). TCC600 provides the means to enable or disable installed RS-232 and Bluetooth modules. This capability is provided by a communication options utility under the Communications menu. Prompts to enable communication hardware are also contained in the individual port setup menus.

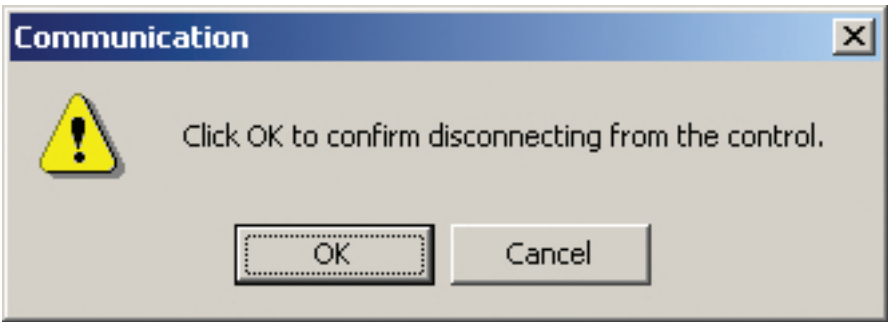


Figure 93: Disconnect Command Confirmation Screen

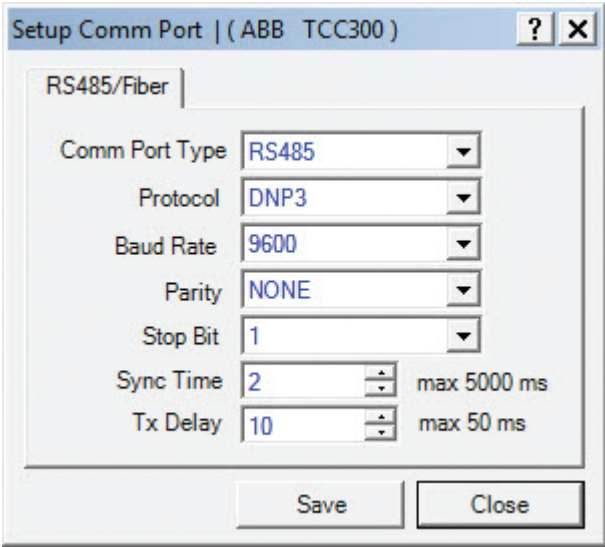


Figure 94: Setup Comm Port Dialog Screen

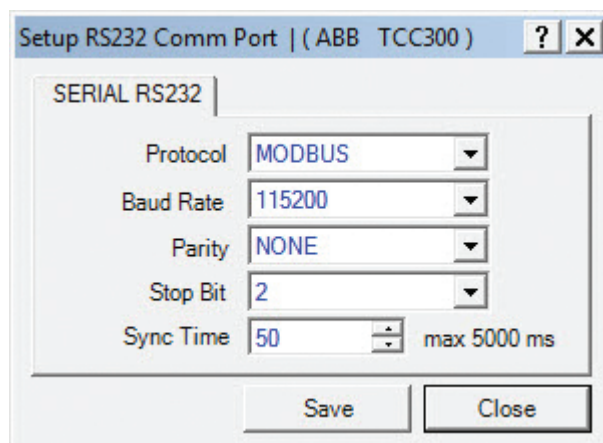


Figure 95: Setup RS-232 Comm Port Dialog Screen

Setup Ethernet | (ABB TCC300)

Ethernet

Auto Negotiation

☐ Disable

☒ Enable

DHCP Protocol

☐ Disable

☒ Enable

IP Address

0

.0

.0

.0

Net Mask

0

.0

.0

.0

Gateway

0

.0

.0

.0

Keepalive Time

7200

max 50000 sec

Port

Modbus Port

502

DNP3.0 Port

20000

Network Time Synchronization

Simple Network Time Protocol:

☒ Disable

☐ Enable

SNTP Server

Server Name:


IP Address:

68

.0

.14

.76



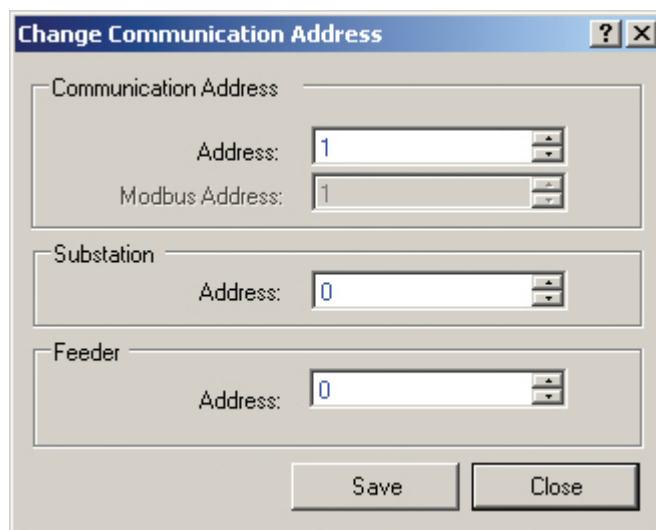
Time Zone:

(GMT -5) Eastern time (US & Canada)

Save

Close

Figure 96: Ethernet Setup Dialog Screen

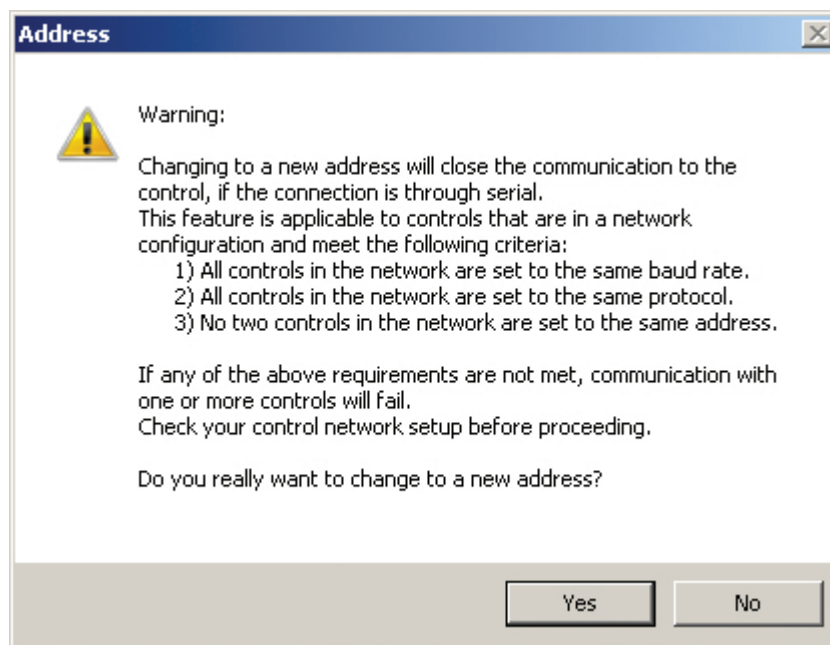


The dialog box is titled "Change Communication Address" and contains three sections for address configuration:

- Communication Address:** Includes "Address:" and "Modbus Address:" fields, both set to 1.
- Substation:** Includes an "Address:" field set to 0.
- Feeder:** Includes an "Address:" field set to 0.

At the bottom are "Save" and "Close" buttons.

Figure 97: Change Communication Address Dialog Screen



The dialog box is titled "Address" and displays a warning message with a yellow warning icon:

Warning:

Changing to a new address will close the communication to the control, if the connection is through serial.
This feature is applicable to controls that are in a network configuration and meet the following criteria:

- 1) All controls in the network are set to the same baud rate.
- 2) All controls in the network are set to the same protocol.
- 3) No two controls in the network are set to the same address.

If any of the above requirements are not met, communication with one or more controls will fail.
Check your control network setup before proceeding.

Do you really want to change to a new address?

At the bottom are "Yes" and "No" buttons.

Figure 98: Change Address Warning Screen

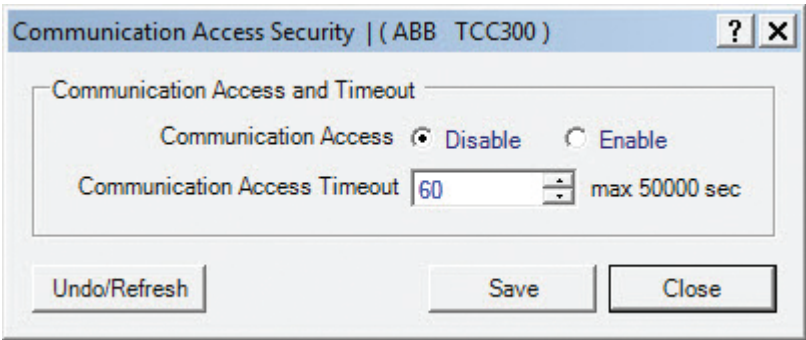


Figure 99: Communication Access Security Dialog Screen

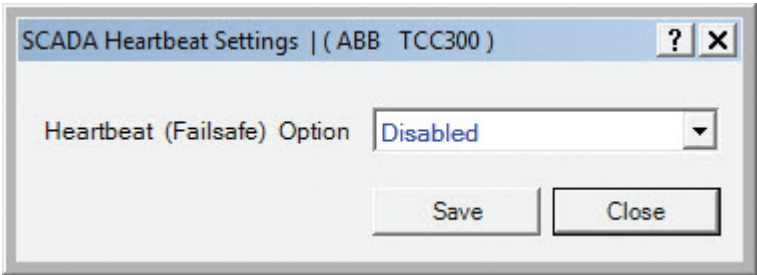


Figure 100: HeartBeat Option Screen

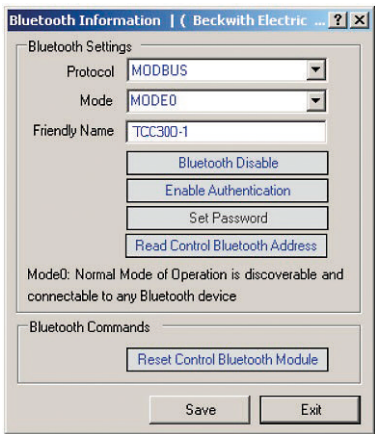


Figure 101: Bluetooth Information Dialog Screen

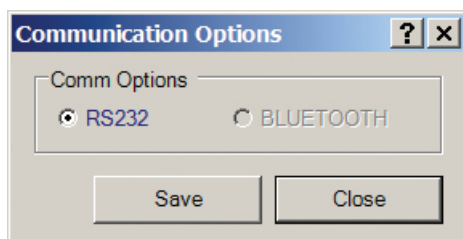


Figure 102: Communication Options Dialog Screen

4.10.4

Monitor menu

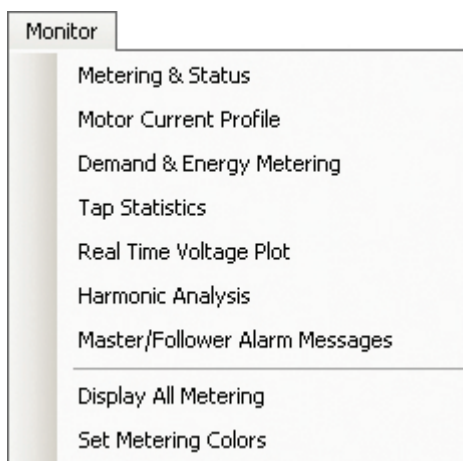


Figure 103: Monitor menu

The Monitor toolbar item provides the user with the means to display the control's screens.

- Metering & Status
- Motor Current Profile
- Demand & Energy Metering
- Tap Statistics
- Real Time Voltage Plot
- Harmonic Analysis
- Master/Follower Alarm Messages
- Display All Metering
- Set Metering Colors

The data that is displayed is only available when communication is established between the control and the PC.

4.10.4.1 **Metering & Status**

The Metering & Status submenu item displays the Metering & Status Screen. Values displayed are updated depending on communication system capabilities.



Figure 104: Metering and Status Screen

Table 10: PRIMARY STATUS (Single or Three-Phase)

Item	Description
Voltage	Displays the calculated primary voltage based on the user-selected voltage multiplier, VT corrections, and measured secondary voltage.
Source Voltage	Displays the calculated primary source voltage based on the user selected source voltage multiplier, source VT corrections and source secondary voltage.
Current	Displays the calculated primary current based on the user-selected current multiplier, and measured secondary current.
Table continues on next page	

Item	Description
Watts	Displays the calculated primary quantity based on the user-selected voltage and current multipliers; VT configuration (line-to-line or line-to-ground), single-phase or three-phase, and measured secondary voltage and current.
VA _r	Displays the calculated primary quantity based on the user-selected voltage and current multipliers, VT configuration (line-to-line or line-to-ground), single-phase or three-phase, and measured secondary voltage and current.
VA	Displays the calculated primary quantity based on the user-selected voltage and current multipliers, VT configuration (line-to-line or line-to-ground), single-phase or three-phase, and measured secondary voltage and current.

Table 11: REMOTE VOLTAGE BIAS

Item	Description
Voltage	Displays the Remote Voltage value provided to the control utilizing either DNP 3.0, MODBUS or IEC 61850 protocols. If a voltage value is present the control is utilizing the Remote Voltage Bias Voltage to control.

Table 12: SECONDARY STATUS

Item	Description
Load Voltage	Displays the real-time measured value of voltage at the regulator or transformer and includes any corrections made using the user-selected VT correction voltage.
Meter Out Voltage	Displays the measured voltage at the terminals of the TCC300 without any software modifications. Used as the base for normalizing voltage.
Source Voltage	Displays the calculated primary source voltage based on the user selected source voltage multiplier, source VT corrections and source secondary voltage.
Compensated Voltage	Displays the calculated voltage at the "load center".
Normalizing Voltage	A Normalizing Voltage Multiplier with a range of 0.80 to 1.20 is available to be applied to Meter Out Voltage and displayed in real time as Normalizing Voltage.
Load Current	Displays the real-time measured value of current.
Power Factor	Displays the real-time calculated value of power factor.
Table continues on next page	

Item	Description
Frequency	Displays the real-time measured frequency value.
Circulating Current	Displays a representative value of circulating current, if the control is used with a ABB M-0115A Parallel Balancing Module, or its equivalent.
DVAr Current	Displays a representative value of DVAr current when in the DVAr Peer to Peer Paralleling mode.

Table 13: *TAP INFORMATION*

Item	Description
Tap Position	<p>Displays the tap position of the tapchanger when any method of KeepTrack™ is used. Recognizes tapchanges commanded via manual, automatic or external (SCADA) means.</p> <div> </div> <p>In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, "- -" will be displayed instead of "0".</p>
Drag Hands	Displays the tap position Drag Hands values for each direction.
Raise Timer	Displays the integrated out-of-band time for a voltage excursion greater than the upper band limit up to the value of the time delay setpoint.
Lower Timer	Displays the integrated out-of-band time for a voltage excursion less than the lower band limit up to the value of the time delay setpoint.
Intertap Timer	In the sequential mode of operation, displays the integrated out-of-band time for a voltage excursion and the subsequent tap-change. Adjustable from 0 to 60 seconds, in 1 second increments, with a factory setting of 0 seconds.
Operation Counter	Records the number of raise and lower operations. The operation counter will advance by one or two counts, as set by the user, for each open-close-open contact operation. This counter is not resettable. The counter accommodates 999,999 operation counts and the number of counts stored in memory is not affected by a loss of supply power. Total operation count is displayed in the Status Menu. This counter cannot be reset, but can be preset to any value up to 999,999 in the Configuration menu.
Table continues on next page	


Item	Description
Resettable Operations Counter	<p>second, resettable operations counter operates with the method selected by X1/X2/Count Window. The user resets this counter to zero by pressing ENT while viewing the resettable operation counter screen within the Status Menu. No password is required to reset the resettable operations counter.</p> <div>  <p>The counter will only increment with a connection to the counter input.</p> </div>
Neutral Switch Counter	The Neutral Switch Counter is updated each time the neutral input is detected. Neutral Switch Counter can also preset to any value. The Neutral Switch Counter is a software counter that is stored in non-volatile memory and has a maximum value of 1,000,000.
RTN Status	Displays the "Run Through Neutral" feature status (Enabled or Disabled).
Count To RTN Active	Displays the number of counter operations since the operations between runs setting was set, or since the feature was enabled. The counter will reset to zero if the feature is enabled and successfully runs through neutral.
RTN Counter	The RTN Counter will increment after each successful operation of the Run Through Neutral feature.

Table 14: *TAPCHANGER STATUS*


Item	Description
Operation Mode (Auto)	<p>Gray Background – Indicates that the control is in automatic mode of operation.</p> <p>Yellow Background – Indicates Automatic but some Limits in effect.</p> <p>Red Background – Indicates Auto Operation Blocked.</p>
Block Status	Indicates blocks that are active.
Band Status	Indicates one of three conditions: High, when voltage is out of band high, Low when voltage is out of band low, and OK when voltage is within band.
Table continues on next page	

Item	Description
VAr Bias Effect	Indicates one of three conditions when enabled. If the control has determined that the absolute reactive power is $>\frac{3}{4}$ of the Max Cap Bank Setting and the inverse timer has timed out, then the control will increase the effective bandcenter by 1 Volt depending on the direction of the reactive power and will either indicate "Bandcenter Raise" for negative reactive power or "Bandcenter Lower" for positive reactive power. If the absolute power is $<\frac{3}{4}$ of the Max Cap Bank Setting then the display will indicate "None". Whenever VAr Bias is in effect, the control will display the "VAr Bias in effect" message on the display and the appropriate Raise/Lower LED will flash.
Power Direction	Indicates one of two power directions: Forward (forward power condition) and Reverse (reverse power condition).
Voltage Reduction VR Off	Indicates voltage reduction is not active, blocked either by non-sequential input, a reverse power condition, or by communicated command. Steps 1, 2, and 3 indicate that voltage reduction is in effect for the stated step value.
HMI Active Mode	Indicates (Yellow) that HMI menu at the control is active.

Table 15: ALARM STATUS

Item	Description
Comm Block	The control has had its automatic operation blocked via communications and is now in manual operation mode and the alarm output is on due to this condition.
Block Raise (Tap)	The tap position equals or exceeds the block raise tap limit setting and the alarm output is on due to this condition.
Block Lower (Tap)	The tap position equals or exceeds the block lower tap limit setting and the alarm output is on due to this condition.
Block Raise (Voltage)	The tap position equals or exceeds the block raise voltage limit setting and the alarm output is on due to this condition.
Block Lower (Voltage)	The tap position equals or exceeds the block lower voltage limit setting and the alarm output is on due to this condition.
DVar2 Load Current Limit	DVar2 Load Current is exceeding the respective maximum current limit setting and the alarm output is on due to this condition.
Motor Seal-In Failure	Indicates that motor current has not been detected for a period 15 seconds after a Raise or Lower command has been executed. This event must occur two consecutive times for this alarm to occur.
Table continues on next page	

Item	Description
Backup Pwr Failure	Indicates the absence of Backup Power circuiting when Backup Power option has been detected.
Low Current Block	When enabled the control determines if Load Current following a tap change is less than 4 mA, coincident with Tap Delta Voltage being less than 4 Vac. When these conditions exist the control will initiate an alarm and block regulation.
Individual Tap Wear	The number of operations on any single tap exceeds the Individual Tap Wear Alarm setting.
Tap Changer Failure	When the Operation Counter Configuration is set to "Cam Follower" and this alarm has been enabled, indicates the counter contact input has detected a Tap Changer Failure condition. A Cam Follower contact is a cam driven contact which is normally closed when the Tapchanger is at rest, and opens and closes once during each tap operation in either direction. If this contact does not open and close within 30 seconds after the control issues a Raise or Lower in either local automatic or remote manual operational modes, this alarm will activate. This alarm can be reset either by the Cam Follower contact operating correctly during a subsequent Raise or Lower operation, or if reset by the user.
LDC/LDZ	Any value other than zero has been set for LDC/LDZ.
Line Current Limit	The line current is exceeding the respective maximum current limit setting and the alarm output is on due to this condition.
Reverse Power	Reverse power is present at the control and the alarm output is on due to this condition.
Abnormal Tap Position	Abnormal Tap Position is indicated when the alarm is enabled, KeepTrack TM is enabled and the neutral input is detected but the present tap position at that instant is neither at minus one nor plus one. The Abnormal Tap Position Alarm will also be activated when the Motor Seal-in Failure detection feature has detected a Motor Seal-in Failure.
Voltage Reduction	Any level of voltage reduction is active.
VAr Bias Lead or Lag	Indicates when the VAr Bias effect (Lead or Lag) has exceeded the time limit imposed by the Max VAr Bias Duration Setting.
Table continues on next page	

Item	Description
<p>Indicates when the VAr Bias effect (Lead or Lag) has exceeded the time limit imposed by the Max VAr Bias Duration Setting.</p>	<p>There are two types of lockout conditions, Master lockout and Follower lockout. Any lockout of the paralleling mode will set the Master/Follower Lockout Alarm. When a lockout condition exists, the control issuing the lockout will stop any further GOOSE publishing and will stop load voltage regulation. Also, the alarm can be configured as a DNP event, or as a report in case of IEC 61850. The lockout state will be displayed on the control front panel display and in the Master/Follower Configuration Tool.</p> <div>  </div> <p>Master/Follower Alarm messages can be observed for the connected control from the TCC600® Monitor/Master/Follower Alarm messages menu item.</p>
Table continues on next page	

Item	Description
Peer to Peer Lockout	<p>The Delta VAr Peer to Peer Paralleling feature includes the following alarms which will activate the "Peer to Peer Lockout" Alarm:</p> <ul style="list-style-type: none"> • Sympathy Lockout – actuates when a control detects that another control in the network has locked out due to a Tie Breaker Status Conflict Lockout or a Delta VAr Limit Lockout. • Initiator Communications Lockout – actuates when an Initiator fails to receive the expected messages for three consecutive Peer to Peer Update Frames. • Reactive Current Limit Lockout – actuates when the calculated Reactive Current value is greater than the configured Reactive Current limit. This lockout/alarm can only be cleared by the user. • Non-Initiator Detection Lockout – When the control powers up in Initiator Mode, the control will wait for approximately 65 seconds to allow all the GOOSE messages from all the Non-Initiators in the network to reach the Initiator. Once all GOOSE messages have been received, the Initiator will start its normal algorithm. If within that initial 65 second period the Initiator does not receive all the GOOSE messages it expected, it will enter the Initiator Lockout state. This lockout/alarm can only be cleared by the user. • Breaker Status Conflict Lockout – activates when a control detects that it's status for a tie breaker, shared with another control, disagrees with that unit's status for the same tie breaker. The Breaker Status Conflict Lockout alarm is only applicable in the "Single" and "Ring Bus" topology. • Message Response Time Lockout – actuates when a Non-Initiator has not received all the expected GOOSE messages within the specified time period for three consecutive update periods.
RTN Fail	The RTN Fail alarm will actuate when the "Maximum RTN operations before Alarms" setting has been exceeded.
Op Count Signal	The total number of operations has exceeded the Operations Counter Alarm Limit setting.

There are three available states designated by color for each of the Alarm Status elements:

- Gray with Dark Gray Text – Alarm disabled.
- Gray with Black Text – Alarm enable and condition not met
- RED – Alarm enabled and condition exists

Table 16: *INPUT STATUS*

Item	Description
Neutral Tap	Indicates (Green) neutral position contact input is closed.
Counter	Indicates (Green) operation counter contact input is closed.
Non-Sequential	Indicates (Green) Non-sequential contact input is closed. Tapchanger control blocks raise or lower operation on a sustained closed contact.
Motor Seal-in	Indicates (Green) when motor power is applied.
Volt Reduction 1	Indicates (Green) Step 1 voltage reduction contact output is closed.
Volt Reduction 2	Indicates (Green) Step 2 voltage reduction contact output is closed.
SCADA Cutout	Indicates (Green) SCADA (switch) input is closed. Tapchanger control blocks Raise or Lower operation.

Table 17: *OUTPUT STATUS*

Item	Description
Raise	Indicates (Green) when a Tap Raise output is active. Limited by tap Block Raise setpoint and tap position limit settings.
Lower	Indicates (Green) when a Tap Lower output is active. Limited by tap Block Lower setpoint and tap position limit settings.
Programmable Alarm	Indicates (Green) when a Programmable Alarm condition is true.
Motor Seal-In	Indicates when a Motor Seal-In Output is active.

CBEMA EVENTS AND COUNTER STATUS

When the Load Voltage is sagging or swelling greater than the pickup setting, then a pickup status will be set after a minimum duration, in addition to incrementing a counter.

Up to 4 CBEMA events can be set and enabled allowing the control to trigger a Sequence of Events record when each event occurs. Also, the control will report both the time and duration of each event via DNP. These 4 settings allow the control to be set to record violations of the ITIC curves (formerly known as CBEMA curves).

AUX INPUT STATUS

Indicates (red) when the Auxiliary Input is active.

4.10.4.2

Motor Current Profile

The TCC300 Tapchanger Control measures the motor current during tapchange operation. The motor current is sampled at 64 samples per cycle and the total RMS value of the current is computed every cycle (60 Hz or 50 Hz cycle). The dynamic range of the current measurement is from 0 to 10 A.

The tapchange start signal is generated when the motor current exceeds a threshold value (user programmable or fixed at a small value such as 0.1 A). The tapchange operation is considered complete when the counter contact input is generated. If the tapchanger is making multiple tapchanges where the current is not interrupted between tapchanges then the counter contact can be used to decide the completion of one tap before the start of the next tap.

The following parameters are logged for the motor current profile:

- Average RMS value of the motor current (once every cycle for the complete duration of the tapchange)
- Total duration of the tapchange in ms
- Peak RMS value of the motor current

The Sequence of Events Recorder will trigger when any of the following conditions occur:



The average RMS current is the average of the RMS current for the tapchange duration.

- Peak RMS current exceeds a certain percent (programmable from 110% to 200%) of the stored peak current which was recorded during the training mode.
- Average RMS current exceeds a certain percent (programmable from 110% to 200%) of the stored average RMS current which was recorded during the training mode.
- Total duration of the tapchange exceeds a certain percent (programmable from 110% to 200%) of the stored value which was recorded during the training mode.

The training mode will be used during the commissioning of the Tapchanger Control. In this mode twenty tapchange operations will be manually conducted and the average profile stored in non-volatile memory. This profile will be compared with the profile during normal tapchange operation to trigger the Sequence of Events Recorder when the above conditions occur.

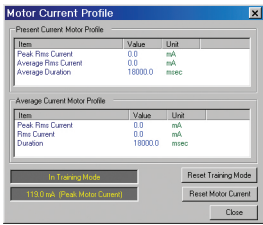


Figure 105: Motor Current Profile Dialog Screen

4.10.4.3 Demand & Energy Metering

The Demand & Energy Metering submenu item displays the Demand & Energy Metering screen. Real-time demand and metering information can be monitored from an addressed control.

Demand & Energy Metering [?] [X]

Demand Interval (minutes): ☐ 5 ☐ 10 ☒ 15 ☐ 30 ☐ 60 Apply

Demand Present

Item	Value	Unit
Load Voltage	119.3	V
Primary Current	1	A
Primary Watts	0.00	MW
Primary VAr	-0.01	MVAr
Primary VA	0.01	MVA

Demand History

Item	Value	Unit	Date/Time
<input type="checkbox"/> Minimum Load Voltage	0.0	V	1/8/1970 2:29:11 AM
<input type="checkbox"/> Maximum Load Voltage	120.9	V	8/12/2013 7:45:23 AM
<input type="checkbox"/> Maximum Primary Current	8	A	8/12/2013 9:29:43 AM
<input type="checkbox"/> Maximum Primary Watts	0.01	MW	8/8/2013 11:40:28 AM
<input type="checkbox"/> Maximum Primary VAr	0.02	MVAr	8/12/2013 8:22:56 AM
<input type="checkbox"/> Maximum Primary VA	0.06	MVA	8/12/2013 9:29:58 AM
<input type="checkbox"/> Power Factor @Max VA	-0.67		8/12/2013 9:29:58 AM

Energy Metering

Item	Value	Unit	Date/Time
<input type="checkbox"/> Forward Watt Hours	7	kWh	1/8/1970 2:29:11 AM
<input type="checkbox"/> Reverse Watt Hours	129	kWh	1/8/1970 2:29:11 AM
<input type="checkbox"/> Lagging VAr Hours	13	kVArh	1/8/1970 2:29:11 AM
<input type="checkbox"/> Leading VAr Hours	123	kVArh	1/8/1970 2:29:11 AM

Select All Clear All Reset Selected Items Close

Figure 106: Demand & Energy Metering Dialog

Table 18: Demand & Energy Metering

Item	Description
Demand Interval	The Demand Interval applies to the Demand Present Primary Current (Amps) parameter and the Demand History parameters. The Demand Interval can be set to 5, 10, 15, 30, and 60 minutes.
Demand Present	The Demand Present Primary Current parameter value follows the concept of a lagged demand meter. The demand time interval is selected by the user as 15, 30 or 60 minutes. This is the time it takes for a thermal meter to indicate 90% of a change in load.
Load Voltage	Displays the real-time measured value of voltage at the regulator or transformer. This value continuously averaged over consecutive 32-second intervals.
Primary Current	Displays the calculated primary demand current based on the user-selected current multiplier and measured secondary current.
Primary Watts	Displays the real time demand value base on the user-selected voltage and current multipliers; VT configuration (line-to-ground or line-to-line), single-phase or three-phase, and measured secondary voltage and current.
Primary VAr	Displays the real time demand value based on the user-selected voltage and current multipliers, VT configuration (line-to-ground or line-to-line), single-phase or three-phase, and measured secondary voltage and current.
Primary VA	Displays the real time demand value based on the user-selected voltage and current multipliers, VT configuration (line-to-ground or line-to-line), single-phase or three-phase, and measured secondary voltage and current.
Demand History	All demand history values (single phase) include the date and time at which each occurred. A drag hand value is the maximum or minimum value of a measured quantity recorded since the last reset.
Minimum Load Voltage	Displays minimum local voltage at the regulator or transformer. This value continuously averaged over consecutive 32-second intervals.
Maximum Load Voltage	Displays drag hand maximum local voltage at the regulator or transformer. This value continuously averaged over consecutive 32-second intervals.
Maximum Primary Current	Displays drag hand maximum primary current.
Maximum Primary Watts	Displays drag hand maximum primary watts.
Maximum Primary VAr	Displays drag hand maximum primary VARs.
Maximum Primary VA	Displays drag hand maximum primary VA. Resets automatically when Power Factor at (Max) VA value, below, is reset.
Power Factor @ Max VA	Displays drag hand power factor at time of maximum VA.

Energy Metering

The Energy Metering section of the Demand & Energy Metering screen displays the Energy Metering parameters. This feature enables the user to review real-time and historical demand metering information (Single Phase). This section includes Forward and Reverse Watt Hours and Lagging and Leading VAr Hours.

Miscellaneous

Each element of the Demand History and Energy Metering can be reset individually by selecting the desired parameter(s) and then selecting Reset Selected Items. When the Reset command is issued, the metered value is reset to zero and the time and date are updated

- Select All – Allows the user to select all parameters.
- Clear All – Allows the user to reset all parameter values.
- Reset Selected Items – Allows the user to reset only the selected parameter values.

4.10.4.4

Tap Statistics

The Tap Statistics submenu item displays a statistical representation of the Tapchanger operation. The cumulative (since last visit) number of tapchanges and the Accumulated Primary Current for each tap position is displayed both graphically and numerically. Selecting Refresh updates tap statistical data. Selecting Reset All resets all tap statistic counters to zero and clears the Individual Tap Wear Alarm in the Metering & Status screen. Selecting Save to CSV File allows the user to save the tap statistics as a ".csv" file which can be read by a spreadsheet program.

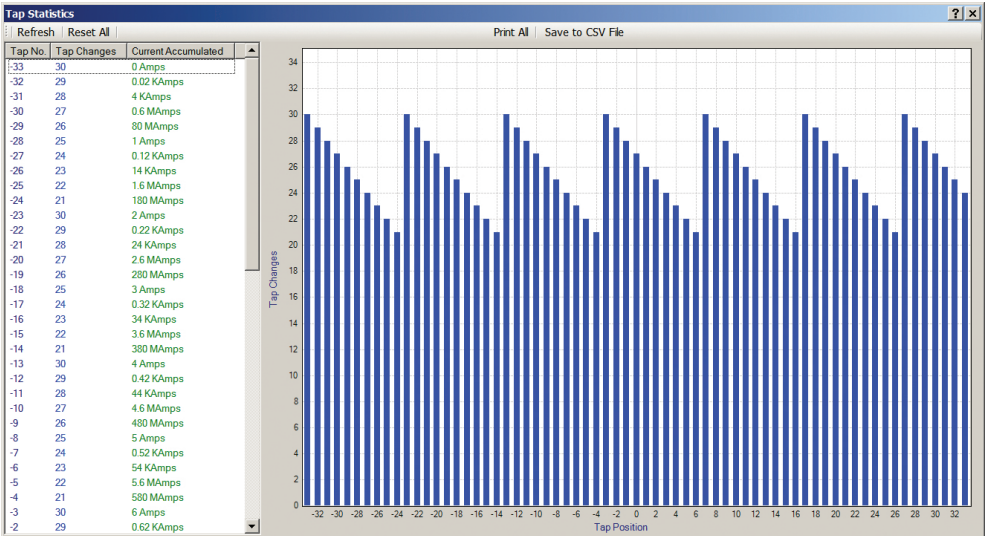


Figure 107: Tap Statistics Screen



By pointing the mouse to any bar, the corresponding tap statistic will be highlighted as well as displayed in a tool tip.

4.10.4.5

Real Time Voltage Chart

The Real Time Voltage Chart feature allows the user to monitor in real time the last 60 seconds of the source voltage value and load voltage. The Voltage Chart freezes the last 30 seconds of the voltage profile and displays the current values.

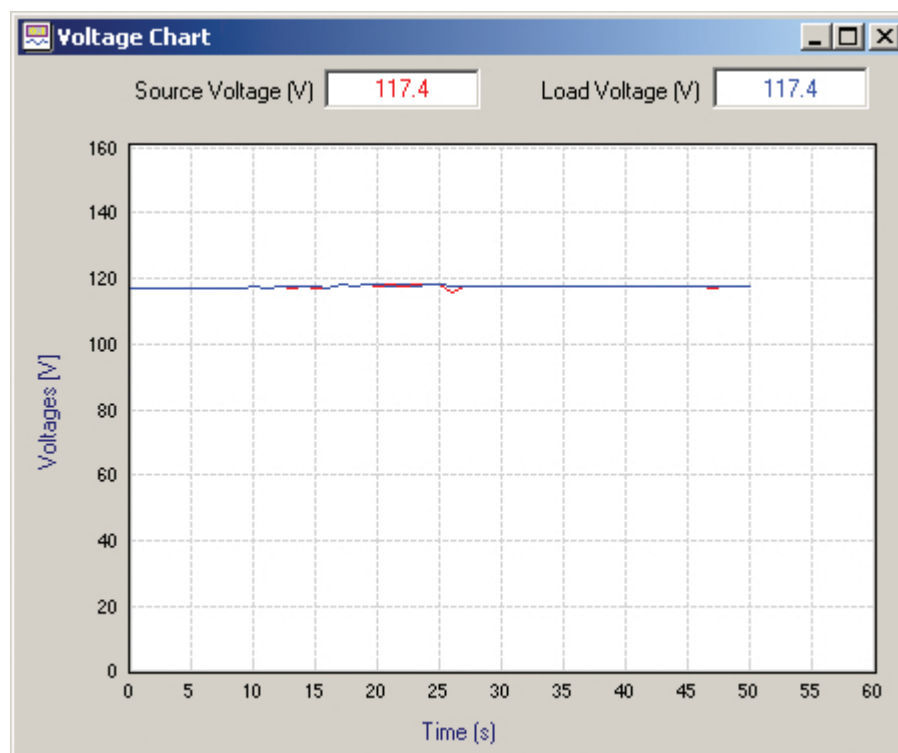


Figure 108: Real Time Voltage Chart

4.10.4.6

Harmonic Analysis

The input signal is sampled at 64 samples per cycle, giving an overall sampling rate of 3840 samples per second for a 60 Hz system. This provides the ability to reproduce signals of up to 1920 Hz. Therefore, up to the 31st harmonic can be calculated using discrete Fourier transform with a fundamental frequency of 60 Hz. The fundamental for both the Voltage and Current channels is calculated every sample meaning, every 260.41 μ s. These

voltage and current magnitudes are used in a real-time decision making algorithm and real-time metering.

Total Harmonic Distortion (THD) for both voltage and current are calculated and displayed using the following equation:

$$THD = \frac{\left[\sum_{k=2}^{31} A_k^2 \right]}{A_0^2}$$

(Equation 1)

k Harmonic number k=2,3...31

In addition to Harmonics and THD calculations the secondary task also triggers the Sequence of Event (SOE) recorder whenever any Harmonic selected by the user exceeds a preset threshold level.

The user is able to select which Harmonic(s) will trigger the SOE function and also set the threshold level, above which the SOE recorder will be initiated and below which the current will be ignored. The threshold level is set as a percentage of the magnitude of the fundamental. The user can also set the threshold level of either the Voltage or the Current Harmonic.

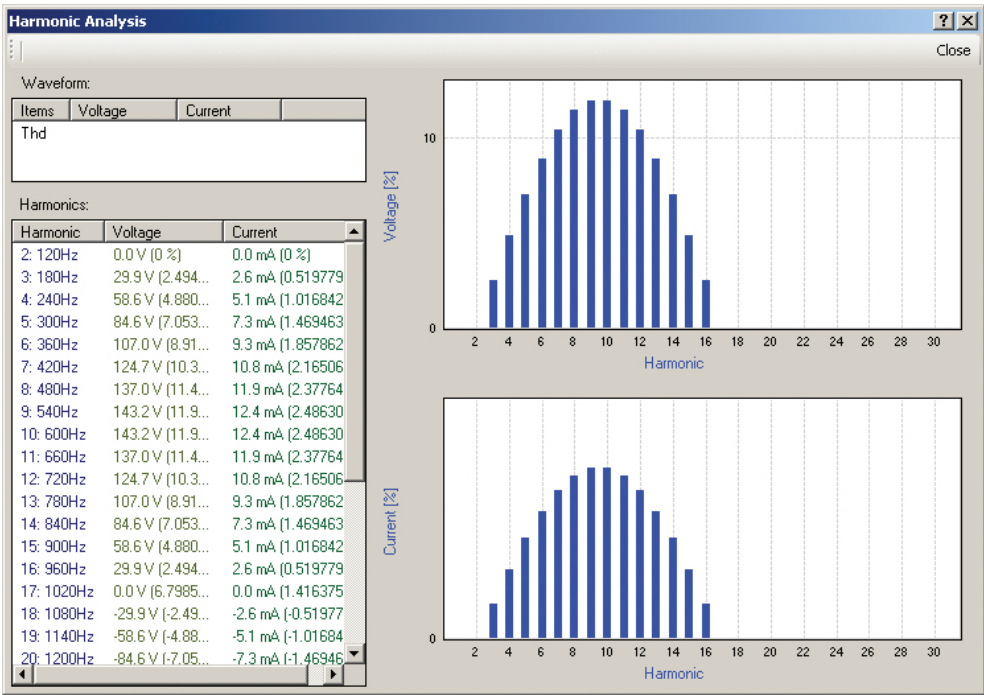


Figure 109: Harmonic Analysis Dialog Screen

4.10.4.7 Master/Follower Alarm Messages

Master/Follower Alarm Messages for the control that TCC600® is connected to can be observed from TCC600 by selecting Monitor/Master/Follower Alarm Messages.

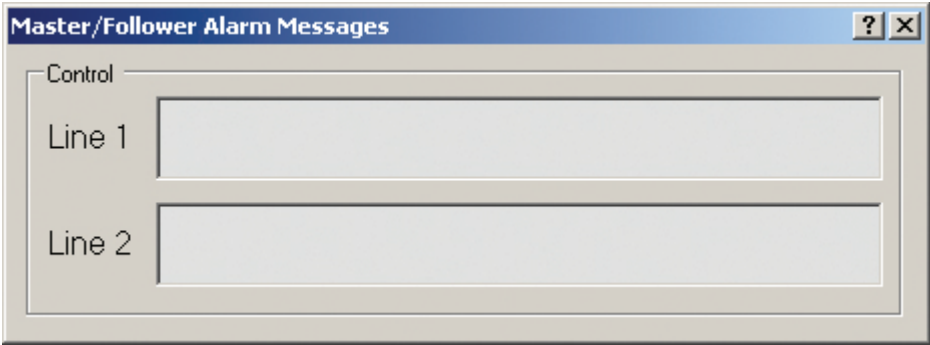


Figure 110: Master/Follower Alarm Messages Screen

4.10.4.8**Display All Metering**

The Display All Metering feature provides the user with a snapshot of all metering parameters. This feature also allows the Display All Metering screen to be printed or saved as a *.HTML file. The menu bar also includes a refresh feature to refresh parameters displayed on the screen.

TCC300 All Metering

Software Version: D-0375V10.09.04
Firmware version: D-0214V02.02.03
Serial Number: 319
ABB
TCC300

Metering			
Primary			
Voltage:	7.18 (KV)	Source Voltage:	Disabled
Current:	593 (A)	Watts:	4.27 (MW)
VAr:	-0.05 (MVar)	VA:	4.27 (MVA)
Secondary			
Load Voltage:	119.8 (V)	Meter Out Voltage:	119.8 (V)
Source Voltage:	Disabled	Comp. Voltage:	119.9 (V)
Load Current:	98 (mA)	Circulating Current:	0 (mA)
Power Factor:	1.000 (Lag)	Frequency:	60.00 (Hz)
Normalizing Voltage:	119.8 (V)		
Tap Information			
Tap Position:	0	Drag Hands Raise:	0
Drag Hands Lower:	0	Intertap Timer:	100 (%)
Raise Timer:	5 (s)	Resettable Counter:	12
Operation Counter:	2	RTN Status:	Disabled
Neutral Counter:	0	RTN Success Counter:	0
Count to RTN Active:	0		
Remote Voltage Bias			
RVB Status:	Disabled	Remote Voltage Value:	-- (V)
STATUS			
Regulator			
Operation Mode:	Auto	Block Status:	--
Band Status:	Ok	VAr Bias Effect:	None
Power Direction:	Forward	Voltage Reduction:	--
HMI Active Status:	Not Active		
Alarm			
Comm Block:	--	LDC/LDZ:	--
Block Raise (Tap):	--	Line Current Limit:	--
Block Lower (Tap):	--	Reverse Power:	--
Block Raise (Volt):	--	Block Lower(Volt):	--
Voltage Reduction:	--	Abnormal Tap Position:	--
VAr Bias Duration Lag:	--	VAr Bias Duration Lead:	--
DVar2 Current Limit:	--	Motor Seal-in Failure:	--
Master/Follower Lockout:	Inactive	Low Current Block:	--
RTN Fail to Operate:	--	Individual Tap Wear:	--
Op Count Signal:	--	Tap Changer Failure:	--
Input			
Neutral Tap:	--	Counter:	--
Nonsequential:	--	Motor Seal-In:	--
Voltage Reduction #1:	--	Voltage Reduction #2:	--
SCADA Cutout:	--	Aux Input 1:	0
Aux Input 2:	0	Aux Input 3:	0
Output			
Raise:	--	Lower:	--
Programmable Alarm:	--	Motor Seal-In:	--
CBEMA Events Status			
CBEMA 1:	None	CBEMA 1 Counter:	16
CBEMA 2:	None	CBEMA 2 Counter:	16
CBEMA 3:	None	CBEMA 3 Counter:	0
CBEMA 4:	None	CBEMA 4 Counter:	0

Demand			
Demand Interval			
Interval:	15 minutes		
Present			
Load Voltage:	119.9 (V)	Primary Current:	592.0 (A)
Primary Watts:	4.26 (MW)	Primary VAr:	-0.06 (MVar)
Primary VA:	4.26 (MVA)		
History			
Min Load Voltage:	0.0 (V)	1/20/1970 12:30:27 PM	
Max Load Voltage:	131.9 (V)	5/2/2016 11:45:50 AM	
Max Primary Current:	594 (A)	4/21/2016 2:44:42 PM	
Max Primary Watts:	4.31 (MW)	4/21/2016 3:45:56 PM	
Max Primary VAr:	0.81 (MVar)	6/14/2016 1:35:17 AM	
Max Primary VA:	4.31 (MVA)	4/21/2016 3:45:56 PM	
Power Factor @ Max VA:	1.00 (Lag)	4/21/2016 3:45:56 PM	

Energy			
Metering			
Forward Watt Hours:	84.43 (MWh)	1/20/1970 12:30:27 PM	
Reverse Watt Hours:	153 (kWh)	1/20/1970 12:30:27 PM	
Lagging VAr Hours:	26.36 (MVarh)	1/20/1970 12:30:27 PM	
Leading VAr Hours:	11.41 (MVarh)	1/20/1970 12:30:27 PM	

Motor Current Profile			
Present Current Motor Profile			
Peak Rms Current:	0.0 (mA)	Average Rms Current:	0.0 (mA)
Average Duration:	0.0 (msec)		
Average Current Motor Profile			
Peak Rms Current:	0.0 (mA)	Rms Current:	0.0 (mA)
Duration:	0.0 (msec)	Training Mode:	In Training Mode

All Metering			
<div> <div>Print</div> <div>Print Preview</div> <div>Save</div> <div>Refresh</div> </div>			
Band Status:	Ok	VAr Bias Effect:	None
Power Direction:	Forward	Voltage Reduction:	--
HMI Active Status:	Not Active		
Alarm			
Comm Block:	--	LDC/LDZ:	--
Block Raise (Tap):	--	Line Current Limit:	--
Block Lower (Tap):	--	Reverse Power:	--
Block Raise (Volt):	--	Block Lower(Volt):	--
Voltage Reduction:	--	Abnormal Tap Position:	--
VAr Bias Duration Lag:	--	VAr Bias Duration Lead:	--
DVAr2 Current Limit:	--	Motor Seal-in Failure:	--
Master/Follower Lockout:	Inactive	Low Current Block:	--
RTN Fail to Operate:	--	Individual Tap Wear:	--
Op Count Signal:	--	Tap Changer Failure:	--
Input			
Neutral Tap:	--	Counter:	--
Nonsequential:	--	Motor Seal-In:	--
Voltage Reduction #1:	--	Voltage Reduction #2:	--
SCADA Cutout:	--	Aux Input 1:	0
Aux Input 2:	0	Aux Input 3:	0
Output			
Raise:	--	Lower:	--
Programmable Alarm:	--	Motor Seal-In:	--
CBEMA Events Status			
CBEMA 1:	None	CBEMA 1 Counter:	16
CBEMA 2:	None	CBEMA 2 Counter:	16
CBEMA 3:	None	CBEMA 3 Counter:	0
CBEMA 4:	None	CBEMA 4 Counter:	0
Demand			
Demand Interval			
Interval:	15 minutes		
Present			
Load Voltage:	119.9 (V)	Primary Current:	592.0 (A)
Primary Watts:	4.26 (MW)	Primary VAr:	-0.06 (MVAr)
Primary VA:	4.26 (MVA)		
History			
Min Load Voltage:	0.0 (V)	1/20/1970 12:30:27 PM	
Max Load Voltage:	131.9 (V)	5/2/2016 11:45:50 AM	
Max Primary Current:	594 (A)	4/21/2016 2:44:42 PM	
Max Primary Watts:	4.31 (MW)	4/21/2016 3:45:56 PM	
Max Primary VAr:	0.81 (MVAr)	6/14/2016 1:35:17 AM	
Max Primary VA:	4.31 (MVA)	4/21/2016 3:45:56 PM	
Power Factor @ Max VA:	1.00 (Lag)	4/21/2016 3:45:56 PM	
Energy			
Metering			
Forward Watt Hours:	84.43 (MWh)	1/20/1970 12:30:27 PM	
Reverse Watt Hours:	153 (kWh)	1/20/1970 12:30:27 PM	
Lagging VAr Hours:	26.36 (MVArh)	1/20/1970 12:30:27 PM	
Leading VAr Hours:	11.41 (MVArh)	1/20/1970 12:30:27 PM	
Motor Current Profile			

Figure 111: Display All Metering Screen

4.10.4.9

Set Metering Colors

This feature allows the user to select individual display colors for the Metering and Status screen. The Alarm, Warning, Input, Output and Metering Background text and background colors can be set.

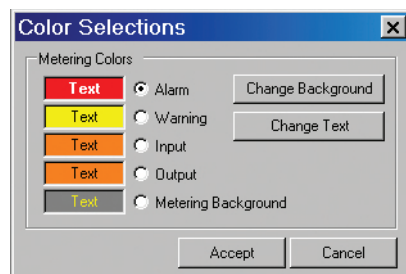


Figure 112: Set Metering Colors Screen

Toolbar Editor

The Toolbar Editor feature allows the user to create TCC600® toolbar menu items that are available from the TCC600 main menu screen. By right clicking on the toolbar TCC600 will display the Toolbar Editor Mode selections "Start Edit Toolbar" and "End Edit Toolbar". To add a Toolbar item simply select "Start Edit Toolbar" and then drag and drop the desired single menu item onto the main toolbar. To remove menu items drag and drop the item on the "Help" menu item. When the Toolbar Editor is active (as displayed in the TCC600 menu top line) no TCC600 functions can be initiated.

By right clicking and selecting "End Edit Toolbar" TCC600 features are accessible.

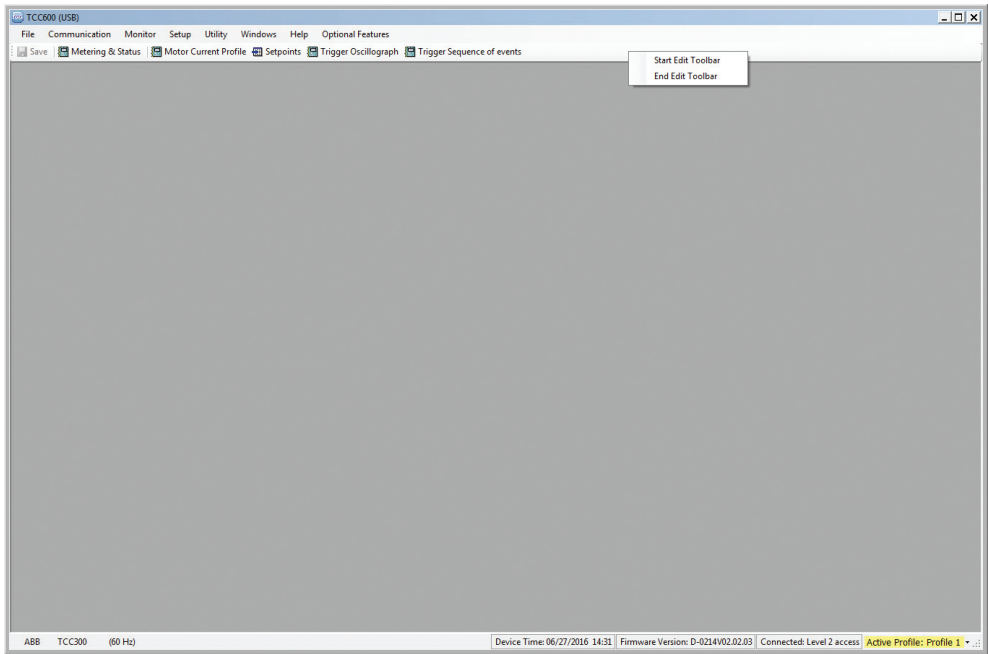


Figure 113: TCC600 Main Menu Screen with Toolbar Editor Active

4.10.5

Setup menu

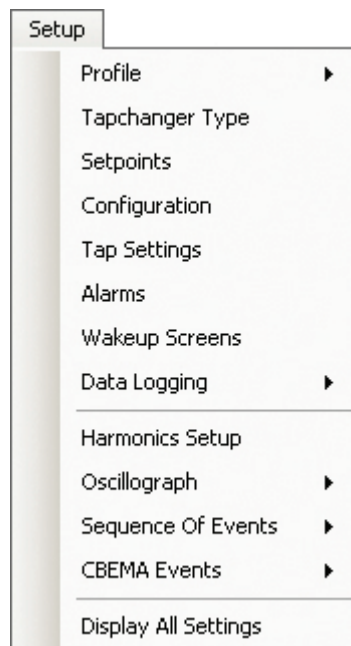


Figure 114: Setup menu

The Setup menu item provides the user with access to the submenu items.

- Profile
- Tapchanger Type
- Setpoints
- Configuration
- Tap Settings
- Alarms
- Wakeup Screens
- Data Logging
- Harmonics Setup
- Oscillograph
- Sequence of Events
- CBEMA Events

The setpoint information displayed on these screens can be from either the control or from an open TCC600® file.

Also included in the Setup submenu is the Display All Settings command which when invoked displays the TCC300 All Setpoints Dialog Screen

All Setpoints

Print Print Preview Save

TCC300 All Setpoints

Software Version: D-0375V10.09.04
Firmware version: D-0214V02.02.03
Serial Number: 319
ABB
TCC300

[Setpoints](#)

Profile 1

General

Line Drop Compensation:	R, X	Time Delay Selection:	Definite Time
Basic Timer Type:	Integrating	Power Direction Bias:	None

Forward Power

Band Center:	120.0 (V)	Band Width:	2.0 (V)
Definite Time Delay:	5 (sec)	LDC-Z:	0 (V)
LDC Resistance:	0 (V)	LDC Reactance	0 (V)

Reverse Power

Reverse Operation:	Block	Band Width:	2.0 (V)
Band Center:	120.0 (V)	LDC-Z:	0 (V)
Definite Time Delay:	30 (sec)	LDC Reactance	0 (V)
LDC Resistance:	0 (V)		

Voltage Reduction

Step 1:	2.5 (%)	Step 2:	5.0 (%)
Step 3:	7.5 (%)	Standard VR:	Enable
Smart VR:	Disable	Com VR turnoff Timer:	0 (Min)
Save VR at Power Off:	Don't Save		

Limit and Runback

Block Raise:	126.0 (V)	Block Lower:	114.0 (V)
Runback Deadband:	2.0 (V)	Current Limit:	640 (mA)
Runup Enable:	Disable	Runup Deadband:	2.0 (V)

Var Bias

VAr Bias:	Disable
-----------	---------

Profile 2

General

Line Drop Compensation:	R, X	Time Delay Selection:	Definite Time
Basic Timer Type:	Integrating	Power Direction Bias:	None

Forward Power

Band Center:	120.0 (V)	Band Width:	2.0 (V)
Definite Time Delay:	30 (sec)	LDC-Z:	0 (V)
LDC Resistance:	0 (V)	LDC Reactance	0 (V)

Reverse Power

Reverse Operation:	Block	Band Width:	2.0 (V)
Band Center:	120.0 (V)	LDC-Z:	0 (V)
Definite Time Delay:	30 (sec)	LDC Reactance	0 (V)
LDC Resistance:	0 (V)		

Voltage Reduction

Step 1:	2.5 (%)	Step 2:	5.0 (%)
Step 3:	7.5 (%)	Standard VR:	Disable
Smart VR:	Disable	Com VR turnoff Timer:	0 (Min)
Save VR at Power Off:	Don't Save		

Limit and Runback

Block Raise:	128.0 (V)	Block Lower:	114.0 (V)
Dead Band:	2.0 (V)	Current Limit:	640 (mA)

Figure 115: All Setpoints Dialog Screen

4.10.5.1

Profile

The Profile menu item includes the "Set Active Profile" selection which allows the user to manually select the active Setpoint Profile. Also included is the "Profile Names" menu item which allows the user to Enter/Edit the 16 character Profile name for each file

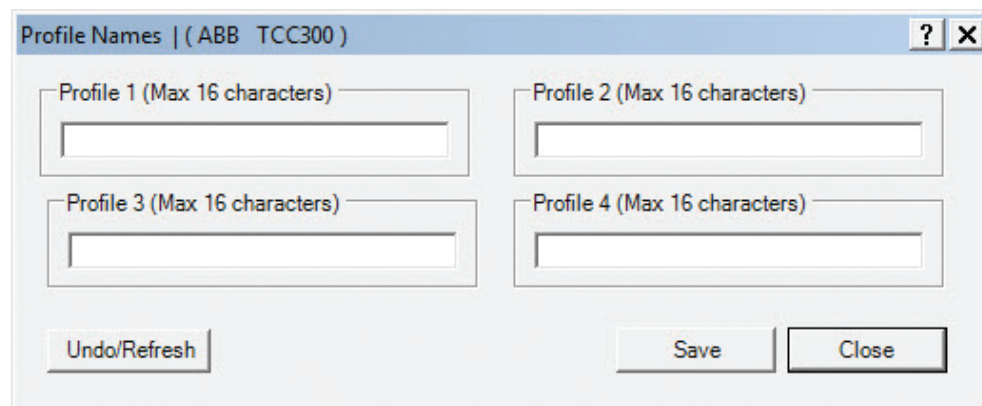


Figure 116: Profile Names Dialog Screen

4.10.5.2

Tapchanger Type

The Tapchanger Type Selection feature provides the user with the ability to set regulator vendor specific configuration settings in the control from TCC600.

Tapchanger Type Selections | (ABB TCC300)

Regulator

☒ Type A ☐ Type B ☐ LTC

Regulator Vendor

Default

Tap Settings

Tap Information

Disabled

Intertap Delay

0

0

60 (sec)

Operation Counter

Configuration

☒ X1 ☐ X2 ☐ Count Window

Cooper Quick Drive

☒ Disable ☐ Enable

Raise/Lower Output Contacts

☒ Continuous ☐ Pulsed

Pulse Width

1.0

0.2

12.0 (sec)

Inputs

Input Selection 1

Switch Status

Write SOE Seal-In Triggers?

☒ Yes ☐ No

Save

Close

Figure 117: Tapchanger Type Selections Dialog Screen

4.10.5.3

Setpoints

Table 19: *General*

Item	Description
Line Drop Compensation	Toggles between two modes of operation: R, X (factory setting), and Z.
Timer Delay Selection	Toggles between two modes of operation: Definite Time (factory setting) and Inverse Time.
Basic Timer Type	Toggles between Integrating and Instant Reset.
Power Direction Bias	The Power Direction Bias setpoint feature includes three settings to determine how the control will switch between forward and reverse power operation. The three settings are None, Forward, and Reverse.

Table 20: *Voltage Reduction*

Item	Description
Step 1	First of three independent steps of voltage reduction adjustable from 0% to 10% in 0.1% increments of the bandcenter setpoint. Factory setting is 2.5%.
Step 2	Second voltage reduction step, adjustable from 0% to 10% in 0.1% increments of the bandcenter setpoint. Factory setting is 5.0%.
Step 3	Third voltage reduction step, adjustable from 0% to 10% in 0.1% increments of the bandcenter setpoint. Factory setting is 7.5%.
Standard VR	Allows standard Voltage Reduction to be Enabled or Disabled.
Smart VR	Allows Smart Voltage Reduction to be Enabled or Disabled. This setting is only available when Standard VR is Disabled.
Com VR Turnoff Timer	Allows Voltage Reduction to be turned off after a prescribed time period from 1 to 999 minutes. A setting of zero disables this feature.
Save VR at Power Off	Save Voltage Reduction at Power Off allows the state of the "Voltage Reduction" communication command to be saved or not saved when power has been lost. The default setting is "Don't Save".

Table 21: *Limit and Runback*

Item	Description
Block Raise	Over voltage limit is adjustable from 95.0 V to 135.0 V in 0.1 V increments with a factory setting of 128.0 V.
Runback Deadband	Adjustable from 1.0 V to 4.0 V in 0.1 V increments with a factory setting of 2.0 V.
Block Lower	Under voltage limit is adjustable from 95.0 V to 135.0 V in 0.1 V increments with a factory setting of 114.0 V.
Runup Deadband	Adjustable from 1.0 V to 4.0 V in 0.1 V increments with a factory setting of 2.0 V.
Runup	This feature may be Enabled/Disabled.
Current Limit	Adjustable from 50 mA to 640 mA, in increments of 1 mA. If the value of the current exceeds the current limit setpoint, the unit will not permit automatic control in either the raise or lower direction. Factory setting is 640 mA.

Table 22: *Forward Power*

Item	Description
Band Center	Adjustable from 100.0 V to 135.0 V in 0.1 V increments with a factory setting of 120 V.
Band Width	Adjustable from 1.0 V to 10.0 V in 0.1 V increments with a factory setting of 2.0 V.
Definite/Inverse Time	Adjustable from 1 sec. to 360 sec. in 1 second increments with a factory setting of 30 seconds.
LDC-Z	Adjustable from 0 V to 72 V in 1 V increments with a factory setting 0 V.
LDC Resistance	Adjustable from -72 V to +72 V in 1 V increments with a factory setting of 0 V.
LDC Reactance	Adjustable from -72 V to +72 V in 1 V increments with a factory setting of 0 V.

Table 23: Reverse Power

Item	Description
Operation	<p>Toggles between eight modes of operation:</p> <ul style="list-style-type: none"> Block – inhibits automatic tapchange operation. Regulate Forward (Ignore) – continues unit action as though forward power flow continued to exist. Regulate Reverse – (calculated voltage or measured voltage) detects a reverse power condition and regulates according to reverse power settings. Return to Neutral – detects a reverse power operation and drives tap position to neutral and then stops. Regulate Reverse (Measured) – allows the control to switch it's voltage sensing input from a load side VT to a source side VT if one is available and operate in Reverse Power Mode using that input. Distributed Generation – allows alternate LDC R and X values to be applied to the control when reverse power is detected. Auto Determination – allows the control to use the "Smart Reverse Power" feature to choose the applicable reverse power mode, either Distributed Generation or Regulate Reverse. Auto Determination (Measured) – allows the control to use the "Smart Reverse Power" feature to choose the applicable reverse power mode, either Distributed Generation or Regulate Reverse (Measured). <p>The Setpoints Reverse Power section also contains a link which displays the "Reverse Power Vendor Cross Reference" table showing Cooper/Siemens reverse power names and their ABB equivalents (Figure 121).</p>
Band Center	Adjustable from 100.0 V to 135.0 V in 0.1 V increments with a factory setting of 120 V.
Band Width	Adjustable from 1.0 V to 10.0 V in 0.1 V increments with a factory setting of 2.0 V.
Definite/Inverse Time	Adjustable from 1 sec. to 360 sec. in 1 second increments with a factory setting of 30 seconds
LDC-Z	Adjustable from 0 V to 72 V in 1 V increments with a factory setting 0 V.
LDC Resistance	Adjustable from -72 V to +72 V in 1 V increments with a factory setting of 0 V.
LDC Reactance	Adjustable from -72 V to +72 V in 1 V increments with a factory setting of 0 V.

VAr Bias can be enabled or disabled. Use of VAr Bias allows coordination of the TCC300 with Autodaptive® Control devices and M-6280 series Capacitor Bank Controls.

Table 24: *VAr Bias (Step)*

Item	Description
Disable on Reverse Power	When selected, the control will disable VAr Bias when Reverse Power is detected.
Forward Power Max 3 Phase Capacitor Bank Size	Maximum Capacitor Bank size is adjustable from 4 KVAR to 12000 KVAR.
Reverse Power Max 3 Phase Capacitor Bank Size	Maximum Capacitor Bank size is adjustable from 4 KVAR to 12000 KVAR.
Lead % Bank Size Pickup	Lower negative Var limit in percentage of the Max Cap Bank size below which the control will increase the upper band edge by the amount defined by VAr Bias Voltage Step.
Lag % Bank Size Pickup	Upper positive Var limit in percentage of the Max Cap Bank size above which the control will decrease the lower band edge by the amount defined by VAr Bias Voltage Step.
VAr Bias Voltage Step	Amount by which the control will increase or decrease the Upper or Lower band edges when there is a VAr Bias out of band situation.
Max VAr Bias Duration	Maximum allowable time in minutes the control will bias the voltage edge.

Table 25: *VAr Bias (Linear)*

Item	Description
Disable on Reverse Power	When selected, the control will disable VAr Bias when Reverse Power is detected.
Current Multiplier Base Value	Adjustable from 0 to 32600.
No Voltage Reduction:	
Linear Voltage Bias (-X)	The Linear Voltage Bias (-X) setting defines the amount of voltage bias to be applied to the Bandcenter when at 1 PU reactive current loading. Adjustable from -72 to 0 Volts at 200 mA Reactive Load.
Linear Voltage Bias (-X) Limit	The Linear Voltage Bias (-X) Limit, limits the total voltage bias that can affect the control Bandcenter. Adjustable from -5.0 to 0.0 Volts.
During Voltage Reduction:	
Linear Voltage Bias (+X)	The Linear Voltage Bias (+X) setting defines the amount of voltage bias to be applied to the Bandcenter when at 1 PU reactive current loading. Adjustable from 0 to 72 Volts at 200 mA Reactive Load.
Linear Voltage Bias (+X) Limit	The Linear Voltage Bias (+X) Limit, limits the total voltage bias that can affect the control Bandcenter. Adjustable from 0.0 to 5.0 Volts.

Table 26: Miscellaneous

Item	Description
Undo/Refresh	The Undo command allows the user to undo any setting changes in the Setpoints screen before the settings have been saved to either the Device or Open File. It also refreshes the screen with the data stored in the unit.
Save	The Save command saves the setting changes to either the Open File when in File mode or the Device when TCC600® is connected to a device.
Close	The Close command cancels any setting changes before the settings changes have been sent to either the Device or Open File.

Setpoints | (ABB TCC300)

Profile 1 | Profile 2 | Profile 3 | Profile 4

General

Line Drop Compensation: ☒ R, X ☐ Z

Time Delay Selection: ☒ Definite Time ☐ Inverse Time

Basic Timer Type: ☒ Integrating ☐ Instant Reset

Power Direction Bias:

Voltage Reduction

Step 1: 0.0

Step 2: 0.0

Step 3: 0.0

Standard VR: ☐ Disable ☒ Enable

Smart VR: ☐ Disable ☒ Enable

Com VR Turnoff Timer: 0

Save VR at Power Off: ☒ Don't Save ☐ Save

Limit and Runback

Block Raise: 95.0

Runback Deadband: 1.0

Block Lower: 95.0

Runup Deadband: 1.0

Runup: ☒ Disable ☐ Enable

Current Limit: 50

Forward Power

Band Center: 100.0

Band Width: 1.0

Definite Time: 1

LDC-Z: 0

LDC Resistance: -72

LDC Reactance: -72

Reverse Power

Operation:

Reverse Power Vendor Cross Reference

Band Center: 100.0

Band Width: 1.0

Definite Time: 1

LDC-Z: 0

LDC Resistance: -72

LDC Reactance: -72

VAr Bias

VAr Bias Method: ☒ Disable ☐ Step ☐ Linear

Undo/Refresh Save Close

Figure 118: Setpoints Dialog Screen

VAR Bias

VAR Bias Method : ☐ Disable ☒ Step ☐ Linear

☐ Disable on Reverse Power

Forward Power Max 3 Phase Cap Bank Size	12000	4	12000 (KVAR)
Reverse Power Max 3 Phase Cap Bank Size	12000	4	12000 (KVAR)
Lead % Bank Size Pickup	75	10	100 (%)
Lag % Bank Size Pickup	75	10	100 (%)
VAR Bias Voltage Step	1.0	0.1	2.0 (V)
Max VAR Bias Duration	300	10	1440 (min)

Figure 119: Setpoints Dialog Screen with Step VAR Bias Enabled

VAR Bias

VAR Bias Method : ☐ Disable ☐ Step ☒ Linear

☐ Disable on Reverse Power

Current Multiplier Base Value	20000	0	32600
Primary Current Multiplier:	6000		
No Voltage Reduction			
Linear Voltage Bias* (-X)	-10	-72	0 (V*)
Normalized Linear Voltage Bias (-X)	-3.0		(V*)
Linear Voltage Bias (-X) Limit	-1.0	-5.0	0.0 (V*)
During Voltage Reduction			
Linear Voltage Bias* (+X)	10	0	72 (V*)
Normalized Linear Voltage Bias (+X)	3.0		(V*)
Linear Voltage Bias (+X) Limit	1.0	0.0	5.0 (V*)

* Voltage Bias at 200 mA Reactive Load.

Figure 120: Setpoints Dialog Screen with Linear VAR Bias Enabled

Reverse Power Vendor Cross Reference	
Beckwith Reverse Power Mode	Cooper/Siemens Reverse Power Mode
Block	Locked Forward Mode
Regulate Forward (Ignore) *	Reverse Idle Mode
Regulate Reverse	None
Return to Neutral *	Neutral Idle Mode
Regulate in Reverse (Measured) *	Bi-Directional Mode
Distributed Generation	Cogeneration Mode
Auto Determination	None
*Low Current block feature must also be enabled to be equivalent to this Cooper Reverse Power Mode.	
OK	

Figure 121: Reverse Power Vendor Cross Reference Table

4.10.5.4

Configuration

Table 27: Primary

Item	Description
Voltage Multiplier	Adjustable from 0.1 to 3260.0 in 0.1 increments with a factory setting of 60.0. User selection must include knowledge of VT ratio and sensing VT-ratio correction.
Voltage Source Multiplier	Adjustable from 0.1 to 3260.0 in 0.1 increments with a factory setting of 60.0. User selection must include knowledge of source VT ratio and sensing source VT-ratio correction.
Current Multiplier	Adjustable from 1 to 32600 in 1 increments with a factory setting of 6000. User selection must include knowledge of CT ratio, from primary rating to 0.2 A rating of control.
Primary Power Display	Toggles between two modes of operation: Single-Phase – based on measured inputs, and Three-Phase – based on measured inputs and presumed balanced system. Factory setting is single-phase.

Table 28: *VT/CT Load*

Item	Description
Normalizing Voltage Multiplier	Displays the result of the Normalizing Multiplier (0.80 to 1.20) times the Meter Out Voltage.
VT Correction	Adjustable from –15.0 V to +15.0 V in 0.1 V increments with a factory setting of 0.0 V.
CT/VT Phasing	Adjustable from 0° to 330° in 30° increments with a factory setting of 0°.
Aux Current Transformer	The Current Transformer units display scaling selection can be set to 200 mA, 1 A or 5 A. This choice determines the unit display scaling of both the metering readout quantities and the settings and current values.
VT Configuration	Load VT configuration toggles between Line-to-Line and Line-to-Ground.

Table 29: *VT/CT Source*

Item	Description
VT Source Correction	Adjustable from –15.0 V to +15.0 V in 0.1 V increments with a factory setting of 0.0 V.
CT/VT Source Phasing	Adjustable from 0° to 330° in 30° increments with a factory setting of 0°.

Table 30: *Raise/Lower Output Contacts*

Item	Description
Output Selection	Toggle between two modes of operation: CONTINUOUS (factory setting) and PULSED.
Pulse Width	Adjustable from 0.2 seconds to 12.0 seconds in 0.1 second increments with a factory setting of 1.5 second. When the output is set to pulse and the control is calling for Raise/Lower (and no non-sequential or counter input is applied), an output will turn on for the preprogrammed time, and then turn off for 0.5 seconds, plus the intertap time delay. A square wave is generated on the output.

Table 31: *Motor Current Settings*

Item	Description
Peak RMS Current	Adjustable from 110% to 200% in 1% increments.
Avg RMS Current	Adjustable from 110% to 200% in 1% increments.
Avg Duration	Adjustable from 110% to 200% in 1% increments.

Program Alarm Relay Mode

When the Auto/Manual Switch Type configuration is set to "SCAMP", then the Programmable Alarm Function can be set to function as "Normal" or "As a Deadman Output". This option is available when SCAMP mode is used since the Deadman Output is not available.

Table 32: *Inputs and Switch*

Item	Description
Input Selection 1	Allows the Operation Counter Input to be selected to either Seal-In Input or Switch Status. When a Cooper Regulator is used the "Seal-In Input" selection must be chosen.
Input Selection 2	The Input Selection 2 can be configured to be either an input that initiates Non-Sequential control operation or a SCADA Cutout switch input. The default configuration setting is Non-Sequential.
Input Selection 3	Can be configured to become an Auxiliary Input that can be read as a DNP point or Voltage Reduction 2.
Auto/Manual Switch Type	The Auto/Manual Switch Type setting allows the Auto/Man Switch type on the adapter panel to be set to "Toggle, SCAMP or None". None is used when no Auto/Manual Switch exists. The default configuration setting is None.

Table 33: *Regulator*

Item	Description
Regulator Type	Allows the Regulator type to be selected as Type A or B for correct source voltage calculation. Factory setting is Type A.

Table 34: *Paralleling*

Item	Description
Paralleling Type	Paralleling Type can be selected (when purchased) to Disable, Circulating Current, Δ VAR®1, Δ VAR2, Δ VAR2 (KeepTrack™), Master/Follower, or Δ VAR Peer to Peer.

Configuration | (ABB TCC300)

Primary

Voltage Multiplier

60.0

0.1

3260.0 (X)

Voltage Source Multiplier

60.0

0.1

3260.0 (X)

Current Multiplier

6000

1

32600 (X)

Primary Power Display

Single Phase

Three Phase

VT/CT Load

Normalizing Volt. Multiplier

1.00

0.80

1.20 (X)

VT Correction

0.0

-15.0

15.0 (V)

CT/VT Phasing

0 degree

Aux Current Transformer

200 mA

VT Configuration

Line to Line

Line to Ground

VT/CT Source

VT Source Correction

0.0

-15.0

15.0 (V)

CT/VT Source Phasing

0 degree

Raise/Lower Output Contacts

Continuous

Pulsed

Pulse Width

1.0

0.2

12.0 (sec)

Motor Current Settings

Peak Rms Current

110

110

200 (%)

Average Rms Current

110

110

200 (%)

Remote Voltage Bias

Disable

Enable

RVB Scale Factor

1.0

0.1

100.0

RVB Heart Beat Timer

5

2

120 (sec)

Reverse RVB Scale Factor

1.0

0.1

100.0

Run Through Neutral

Disable

Enable

Counter Reset

Maximum Allowed Taps

4

3

7

Tap Operations Between Runs

1000

10

10000

Maximum Load Current

50

1

200 (mA)

Maximum RTN Standby Operations

20

1

10000

Low Current Block

Disable

Enable

SCAMP Initialize on Power Up

Auto Mode

Last Save

Fast Voltage Recovery

Disable

Enable

Fast Voltage Recovery

5.0

1.0

15.0 (V)

Undo/Refresh

Save

Close

Configuration | (ABB TCC300)

CT/VT Source Phasing

0 degree

Raise/Lower Output Contacts

Continuous

Pulsed

Pulse Width

1.5

0.2

12.0 (sec)

Motor Current Settings

Peak Rms Current

110

110

200 (%)

Average Rms Current

110

110

200 (%)

Average Duration

110

110

200 (%)

Program Alarm Relay Mode

Normal

Deadman Out

Inputs and Switch

Input Selection 1

Switch Status

Input Selection 2

Non-sequential

Input Selection 3

VR2

Auto/Man Switch Type

None

Regulator

Type A

Type B

Paralleling

Paralleling Type

Circ. Current

Save Comm Block at Power Off

Don't Save

Save

Fast Voltage Recovery

Disable

Enable

Fast Voltage Recovery

5.0

1.0

15.0 (V)

Undo/Refresh

Save

Close

Figure 122: Configuration Dialog Screens

Table 35: *Paralleling Options for Δ VAR2 and Δ VAR2 (KeepTrack)*

Item	Description
Sensitivity	Adjustable from -4 to +4 in 0.1 increments with a factory setting of 0.0.
Circulating Current Limit (Reactive)	Adjustable from 5 mA to 200 mA in 1.0 mA increments with a factory setting of 200 mA.
Input Ratio (Load/Parallel)	Adjustable from 0.50 to 2.00 in 0.01 increments with a factory setting of 1.00.

The screenshot shows a software interface for configuring paralleling options. At the top, under the 'Paralleling' section, there is a dropdown menu for 'Paralleling Type' which is currently set to 'DVAR 2'. Below this, in the 'Paralleling Options' section, there are three rows of controls. Each row consists of a label, a numeric input field, and a range indicator with left and right arrow buttons. The first row is 'Sensitivity' with a value of 0.0 and a range from -4.0 to 4.0. The second row is 'Circ. Curr. Limit (Reactive)' with a value of 200 and a range from 5 to 200 (mA). The third row is 'Input Ratio (Load/parallel)' with a value of 1.00 and a range from 0.50 to 2.00.

Figure 123: *DVAR2 and DVAR2 (Keeptrack) Configuration Dialog Screen*

Table 36: *Master/Follower Paralleling Configuration Settings*

Item	Description
Paralleling Address	The unique address for each device (range 1-16).
Master/Follower Configuration	Sets the control configuration as None, a Follower or a Master.
Number of Devices	The total number of devices that are in the paralleling scheme (maximum of 16 inclusive of the master).
Tap Difference	The difference between Master and Follower tap positions that will result in a Lockout condition.
Tap Position Response Timeout	The time within which the Followers have to be at the same tap position as that of the Master (range 1,000 ms - 6,000 ms). If the Master Timeout is greater than the intertap delay setting, then the Master Timeout is used as the Intertap delay, so that the Master waits for all the Followers to make a tapchange before the Master takes the next Tap.
Line Breaker, Right Tie Breaker, Left Tie Breaker	The Line Breaker, Right and Left Tie Breakers can be individually selected to be included or excluded from the algorithm. Furthermore, the polarity of the input detection can be either negative or positive.

The dialog screen is titled "Paralleling" and contains the following sections:

- Paralleling Type:** A dropdown menu set to "Master/Follower".
- Master/Follower Configuration:** Three radio buttons: "None" (selected), "Follower", and "Master".
- Master/Follower Configuration Settings:**
 - Paralleling Address:** A text box containing "16". To its right is a range slider from 1 to 16.
 - Number of Devices:** A text box containing "2". To its right is a range slider from 2 to 16.
 - Tap Difference:** A text box containing "2". To its right is a range slider from 2 to 8.
 - Tap Pos. Response Timeout:** A text box containing "60000". To its right is a range slider from 1000 to 60000 (ms).
 - Line Breaker:** Two columns of radio buttons: "Not In Use" (selected) and "In Use", with "Positive Polarity" (selected) and "Negative Polarity" below them.
 - Right Tie Breaker:** Two columns of radio buttons: "Not In Use" (selected) and "In Use", with "Positive Polarity" (selected) and "Negative Polarity" below them.
 - Left Tie Breaker:** Two columns of radio buttons: "Not In Use" (selected) and "In Use", with "Positive Polarity" (selected) and "Negative Polarity" below them.

Figure 124: Master/Follower Configuration Dialog Screen

Table 37: Delta VAR Peer to Peer Options

Item	Description
Sensitivity	Adjustable from -4 to +4 in 0.1 increments with a factory setting of 0.0.
Circulating Current Limit (Reactive)	Adjustable from 5 mA to 200 mA in 1.0 increments with a factory setting of 200 mA.
Number of Devices	The number of total devices that are in the paralleling scheme (maximum 16 inclusive of the Initiator).
Paralleling Address	The unique address for each device (Range 1 – 16).
Peer to Peer Update Speed (in milliseconds)	The time period allocated to read all the paralleled units relevant data, make the necessary calculations and disseminate paralleling driven updates to the system (Range 1000 to 10000).
MVA Rating	The MVA rating of the transformer (Range 1.0 to 1000.0).
Peer to Peer Current Multiplier Correction	A scaling factor to compensate Delta Vars Calculation, if the CT value is not in the ratio to the MVA rating (Range 20 to 500 %).
Table continues on next page	

Item	Description
Topology	Single Bus, Ring Bus or Double Bus topologies may be entered.
Load Side Breaker Configuration	Can be set to Not Used, 52a (positive polarity), or 52b (negative polarity).
Right Tie Breaker Configuration	Can be set to Not Used, 52a (positive polarity), or 52b (negative polarity).
Left Tie Breaker Configuration	Can be set to Not Used, 52a (positive polarity), or 52b (negative polarity).

Paralleling

Paralleling Type: Peer2Peer DVar (P2P DVar)

Paralleling Options

Sensitivity: 0.0 (-4.0 to 4.0)

Circ. Curr. Limit (Reactive): 200 (5 to 200 (mA))

Number of Devices: 2 (2 to 16)

Paralleling Address: 16 (1 to 16)

P2P Update Speed: 10000 (1000 to 10000 (ms))

MVA Rating: 1.0 (1.0 to 1000.0)

P2P Current Multiplier Correction: 100 (20 to 500 (%))

Topology: Single Bus

Load Side Breaker: 52A (Positive Polarity)

Right Tie Breaker: 52B (Negative Polarity)

Left Tie Breaker: 52A (Positive Polarity)

Figure 125: Delta VAr Peer to Peer Configuration Dialog Screen

Table 38: *Remote Voltage Bias*

Item	Description
Enable/Disable	Allows Remote Voltage Bias to be Enabled or Disabled.
RVB Scale Factor	Allows a forward scale factor to be applied to the raw value being supplied to the control from SCADA.
RVB Heartbeat Timer	The Heartbeat Timer is the refresh value of the Internal Heartbeat. The remote voltage parameter must be written to the control within the period defined in the RVB Heartbeat Timer. If the timer times out, the control reverts back to the normal chosen regulating method using the bandcenter and LDC settings.
Reverse RVB Scale Factor	Allows a reverse scale factor to be applied to the raw value being supplied to the control from SCADA.

Table 39: *Run Through Neutral*

Item	Description
Enable/Disable	Allows the Run Through Neutral feature to be Enabled and Disabled.
Maximum Allowed Taps	The Maximum Allowed Tap setting provides a user selectable limit for the number of taps that are allowed to be taken to accomodate taking one tap through neutral.
Tap Operations Between Runs	This setting is the number of operations the control will count up to before allowing the Run Through Neutral feature to operate if all pre-conditions are met.
Maximum Load Current	The Run Through Neutral feature will not be allowed to operate when the Maximum Load Current setting is exceeded.
Maximum RTN Standby Operations	This setting provides the number of attempts to exceed the RTN feature before the "RTN Fail to Operate" Alarm is initiated.

Low Current Block

When enabled the control determines if Load Current is less than 4 mA coincident with Tap Delta Voltage being less than .4 V AC. When these conditions exist the control will initiate an alarm and block regulation.

Save Comm Block at Power Off

When the Auto/Manual Switch Type is set to "None" or "Toggle", the following selections are available:

- Don't Save – Allows the state of the "Block Auto Operation" communication command to NOT be saved when power has been lost.
- Save – Allows the state of the "Block Auto Operation" communication command to be saved when power has been lost.

SCAMP Initialize on Power Up

When the Auto/Manual Switch Type is set to "SCAMP", the following selections are available:

When Last Save is selected, the SCAMP switch is configured in such a way that upon the control performing a cold power up, the state of the SCAMP switch is initialized to the last saved state of the SCAMP switch prior to the control powering off.

For example, if prior to powering off the control, the SCAMP switch was in Manual, then when the control is powered back on the control will initially go back to the Manual state and vice versa. Now when Auto Mode is selected, the control always initializes into the Auto Mode after powering up regardless of the saved state of the control prior to powering off.

Table 40: *Fast Voltage Recovery*

Item	Description
Enable/Disable	Allows Fast Voltage Recovery to be Enabled or Disabled.
Fast Voltage Recovery	Allows a setting from 1.0 to 15.0 V outside the normal band edges in 1.0 V increments. When voltage exceeds the Raise or Lower band edge plus the Fast Voltage Recovery setting, the normal definite or inverse time delay is replaced with instantaneous operation (<0.5 Sec).

Table 41: *Miscellaneous*

Item	Description
Undo/Refresh	The Undo command allows the user to undo any setting changes in the Configuration screen before the settings have been saved to either the Device or Open File. It also refreshes the screen with the data stored in the unit.
Save	The Save command saves the setting changes to either the Open File when in File mode or the Device when TCC600® is connected to a device.
Close	The Close command cancels any hardware setting changes before the hardware settings changes have been sent to either the Device or Open File.

4.10.5.5

Tap Settings

Table 42: *General*

Item	Description
Tap Information	<p>Tap information can be disabled or can be selected to one of the following tap position knowledge methods:</p> <ul style="list-style-type: none"> • Regulate Internal (KeepTrack™) • Regulate External #1 • Regulate External #2 • Regulate External #3 • XFMR External #1 • XFMR External #2 • XFMR External #3 • Contact KeepTrack™ 1R1L • Contact KeepTrack 1N
InterTap Delay	Adjustable from 0 to 60 seconds in 1 second increments with a factory setting of 0 seconds. This value must be set less than the count window setting for counter operation.

Table 43: *Tap Limits*

Item	Description
Enable/Disable	Allows Tap Limits to be enabled or disabled.
Block Raise/Block Lower	When enabled, Block Raise and Block Lower are adjustable from the Tap Maximum configuration point to the Tap Minimum value in 1 step increments (Tap Limit Block Raise cannot be lower than Tap Limit Block Lower +4. Tap Limit Block Lower cannot be higher than Tap Limit Block Raise -4).
Highest Tap/Lowest Tap	The TCC300 Digital Tapchanger Control tap position information applies to many different configurations of tapchangers, e.g., ± 16 taps, 1 to 17 taps, ± 10 taps, 1 to 33 taps, etc. Two configuration points, Lowest Tap and Highest Tap, are assigned to allow the user to select the range of a specific tapchanger. The Highest Tap range is 0 to 33 taps, and the Lowest Tap range is -33 to +29 taps.

Table 44: *Operation Counter*

Item	Description
Configuration	<p>Selects the contact operation sequence that will cause the software counter to increment by one. Open/close/open (X1), open/close or close/open contact operation (X2). The count window mode registers any activity as a valid input within the count window time setting. Factory setting is X1.</p> <p>The Cam Follower setting should be selected when a Cam Follower contact input is wired into the Counter contact input of the TCC300. The operation counter and resettable operation counter will increment when the counter input sees the cam follower open and then close.</p> <p>The Cooper Quick Drive setting should be enabled for a Cooper QD regulator. When enabled, this setting applies a 0 second seal-in output. For Cooper Spring Drive and Direct Drive regulators, this setting should be disabled. When disabled, this applies a 3 second seal-in output.</p>
Count Window	<p>Operation count will increment by only one count during a set time period or "Count Window". This is true no matter how many counter inputs occur during the count window time period. After a counter input is accepted, the count window timer begins and another count won't be accepted until the count window time period expires. The count window time period can be set from 0.5 to 60.5 seconds. The count window setting must be set greater than the InterTap Delay setting.</p>
X Mode Delay	<p>When the control is using X1 or X2 mode counter contact detection method, the X1/X2 mode delay setting in millisecond can be used to delay the detection of the NEUTRAL position switch. This is sometimes necessary if the regulator activates the counter contact switch before the neutral switch when moving to the neutral position. The default value is 10 ms.</p>
Preset (Counter)	<p>Displays the number of operations since the last reset.</p>
Alarm Limit (Op Count Signal Alarm)	<p>Displays the Op Count Signal Alarm limit value from 0 to 999,999. This value sets the trigger for the Programmable Alarm "Op Count Signal" if enabled.</p>
Resettable (Operation Counter)	<p>Displays the number of operations since the last reset. Selecting the Reset check box and then selecting Save sends a reset command to the control.</p>
Neutral Counter	<p>The Neutral Switch Counter is updated each time the neutral input is detected. Neutral Switch Counter can also preset to any value. The Neutral Switch Counter is a software counter that is stored in non-volatile memory and has a maximum value of 999,999.</p>

Motor Seal-in Failure Block

When Input Selection 1 is set to "Seal-In Input", the Motor Seal-in Failure Block feature and the input to the Abnormal Tap Position alarm are enabled by default. The user may choose to disable the Motor Seal-in Block feature. However, the input to the Abnormal Tap Position alarm is always enabled when Motor Seal-in is selected.

Table 45: *Drag Hands*

Item	Description
Drag Hands Lower	Displays the lowest tap since last reset. Selecting the Reset check box and then selecting Save sends a reset command to the control.
Drag Hands Raise	Displays the highest tap since last reset. Selecting the Reset check box and then selecting Save sends a reset command to the control.

Tap Statistics

The Tap Statistics Tap Wear feature provides the user with the capability to determine tap wear in a regulator's tap change mechanism. The Tap Statistics Tap Wear feature records the accumulated primary current on each tap change using the measured Primary Current just prior to moving off a tap. Primary current is calculated from measured Secondary Load Current times the Primary Current Multiplier. The accumulated Primary Current for each tap position is displayed on the Tap Statistics dialog screen which displays the number of times the regulator has been on each tap. The Tap Statistics are stored in non-volatile memory and will remain intact through power cycle and firmware update, as its value is in its long term indication of mechanism wear.

The Tap Statistics can be downloaded to a CSV file and printed. Tap Statistics can also be downloaded in CSV format to an SD card. The File name defaults to the serial number of the unit but allows for user modification.

The Tap Statistics Tap Wear feature also includes two settings that are located in the TCC600, Tap Settings dialog screen in the Tap Statistics section and in the HMI under the Configuration/Tap Settings menu. Both settings are considered to generate a Programmable Alarm output "Individual Tap Wear Alarm":

- Maximum Tap Wear setting – The Maximum Tap Wear setting can be set from 1–65534.
- Individual Tap Wear Alarm setting – The Individual Tap Wear Alarm setting is a percentage setting with a range from 1-200% and a default of 100%. This setting is used in conjunction with the Maximum Tap Wear setting to determine when the "Individual Tap Wear Alarm" is triggered. The Individual Tap Wear alarm will trigger when the number of operations on any single tap exceeds the Individual Tap Wear Alarm setting. This alarm also triggers SOE and OSC.

Figure 126: Setup Tap Settings Dialog Screen

Figure 127: Tap Settings Dialog Screen – Contact KeepTrack™ 1N

Tap Calibration

Tap Position – Value of actual tap position can be set from -16 to 16 including Neutral.



In order to verify Neutral Tap Position, when the tap position is 0, but no neutral input is detected, "- - -" will be displayed instead of "0".

Table 46: *Miscellaneous*

Item	Description
Undo/Refresh	The Undo command allows the user to undo any setting changes in the Tap Settings screen before the settings have been saved to either the Device or Open File. It also refreshes the screen with the data stored in the unit.
Save	The Save command saves the Tap Settings changes to either the Open File when in File mode or the Device when TCC600® is connected to a device.
Close	The Close command cancels any Tap Settings changes before the changes have been sent to either the Device or Open File.

4.10.5.6**Alarms****Programmable Alarm Relay**

The programmable alarm function provides alarm monitoring for one or more of the following conditions: Comm Block, Block Raise (Tap), Block Lower (Tap), Block Raise (Voltage), Voltage Reduction, Max VAr Bias Duration Lead/Lag, Individual Tap Wear, LDC/LDZ, Line Current Limit, Reverse Power, Block Lower (Voltage), Abnormal Tap Position, Backup Power Fail, Run Through Neutral Fail to Operate, and Operations Count Signal. Alarm conditions are continuously displayed in the Metering & Status screen.

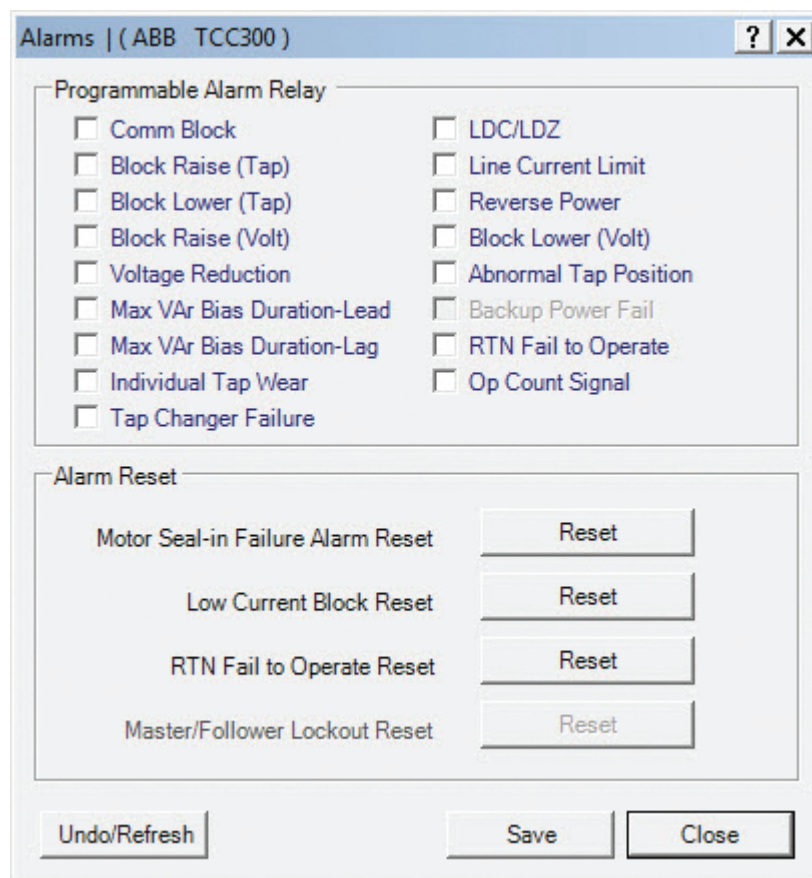


Figure 128: Programmable Alarms Dialog Screen

The Tap Changer Failure Alarm is only functional when the Operation Counter configuration is set to Cam Follower.

The Alarms Dialog screen also provides the means to reset the Motor Seal-in Failure Alarm/Block, the Low Current Block, the Run Through Neutral Fail to Operate Alarm, Master/Follower Lockout and Peer to Peer Lockout.

Table 47: *Miscellaneous*

Item	Description
Undo/Refresh	The Undo command allows the user to undo any setting changes in the Alarms screen before the settings have been saved to either the Device or Open File. It also refreshes the screen with the data stored in the unit.
Save	The Save command saves the Alarms settings changes to either the Open File when in File mode or the Device when TCC600 is connected to a device.
Close	The Close command cancels any Alarms setting changes before the changes have been sent to either the Device or Open File.

4.10.5.7

Wakeup Screens

The Wakeup Screens feature allows the user to select specific control parameters that will be displayed when the control is awakened by depressing the EXIT/WAKE pushbutton. When the control is awakened the selected parameters are displayed in a cycling fashion. The display can also be directed to a specific parameter by utilizing the Up or Down pushbuttons. Pressing the EXIT pushbutton will stop the cycling display on the displayed parameter. Press EXIT again to return to the User Lines screen.

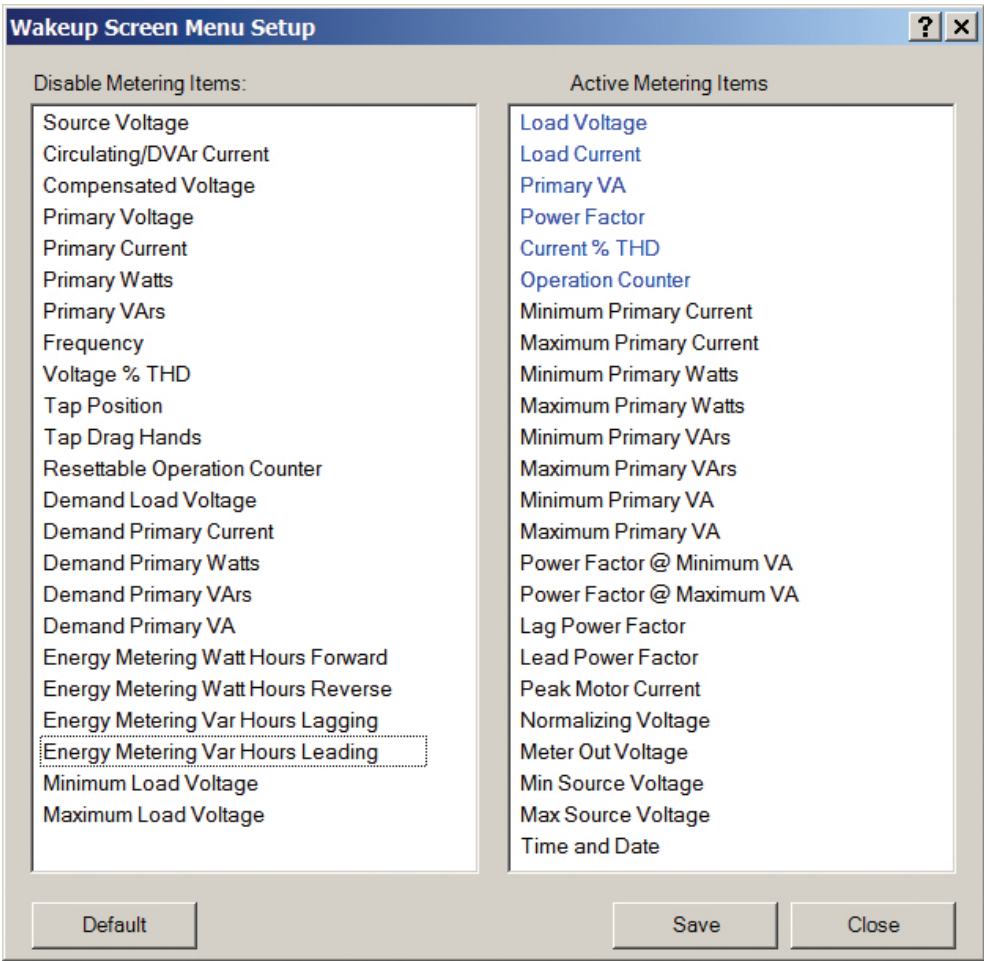


Figure 129: Setup Wakeup Screen Dialog Screen

Table 48: Miscellaneous

Item	Description
Default	The Default command allows the user to reset the Wakeup Screens to the default settings.
Save	The Save command saves the Wakeup Screen changes to either the Open File when in File mode or the Device when TCC600® is connected to a device.
Close	The Close command cancels any Wakeup Screen changes before the changes have been sent to either the Device or Open File.

4.10.5.8**Data Logging**

Data is recorded internally into non volatile memory. The data log is transferred in the Comtrade format. The Comtrade format consist of two files, the configuration file (*.cfg) and the data file (*.dat).

Data logging will continue indefinitely as long as the data interval is set to a non-zero value. A zero value for the data interval will effectively disable data logging. The data log, can be downloaded using MODBUS® (see TCC300 protocol document) or DNP (using file transfer) protocol. The data can be viewed using any Comtrade compatible viewer. TCC600 provides such a tool.

Data logging interval ranges from 0 to 120 min with an increment of 1 minute. Once data logging is enabled, the control will store the data in records at the data interval rate. Each record has the following data:

- Load Voltage
- Primary VA
- Power Factor
- Source Voltage
- Compensated Voltage
- Primary VAr
- Frequency
- Primary Watts
- Load Current
- Tap Position
- Primary Current
- Operations Count
- Circulating/DVAr Current
- Meter Out Voltage
- RTN Counter

The checksum is used to ensure the integrity of the record stored. The average value is calculated over the data logging interval.

Due to the internal structure of the Comtrade format, time stamping is always performed. A total of 6 Mbytes (100,000 records) of data can be saved in non volatile memory.

When connected to a TCC300 Tapchanger Control the Data Logging feature provides the user with the ability to initiate data logging of all control parameters to the selected control for downloading at a later time.

This feature allows the user to configure the parameters that the control will use to log data, and to download the logged data to a Comtrade (*.cfg) file. This file format can be viewed by a third party Common Format for Transient Data Exchange (COMTRADE) format viewer software.

Table 49: Setup

Item	Description
Data Log Interval	Allows the user to input the interval in minutes at which the data will be logged.
Save	The Save command saves the Data Logging Setup changes to either the Open File when in File mode or the Device when TCC600® is connected to a device.
Close	The Close command cancels any Data Logging setup changes before the changes have been sent to either the Device or Open File.



When Load Voltage, Compensated Voltage, Source Voltage and Load Current are selected, the data to be retrieved will consist of the average, minimum and maximum values over the sampling period.

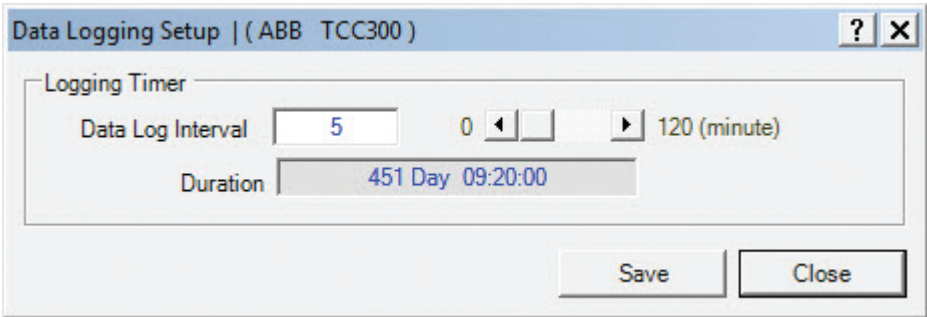


Figure 130: Data Logging Setup Dialog Screen

Retrieve

This submenu item when selected, displays the Data Log Download Screen which allows selection of the parameters and date/time range to be retrieved. Selecting "Download" initiates the retrieval of the current data logging file from the control.

Data Log Download | (ABB TCC300)

Downloading Information

Data to Be Retrieved

<input checked="" type="checkbox"/> Load Voltage	<input checked="" type="checkbox"/> Compensated Voltage	<input checked="" type="checkbox"/> Primary Watts
<input checked="" type="checkbox"/> Primary VA	<input checked="" type="checkbox"/> Primary VAr	<input checked="" type="checkbox"/> Load Current
<input checked="" type="checkbox"/> Power Factor	<input checked="" type="checkbox"/> Frequency	<input checked="" type="checkbox"/> Tap Position
<input checked="" type="checkbox"/> Source Voltage	<input checked="" type="checkbox"/> Primary Current	<input checked="" type="checkbox"/> Operation Count
<input checked="" type="checkbox"/> Circulating Current	<input checked="" type="checkbox"/> Meter Out Voltage	<input checked="" type="checkbox"/> RTN Counter

Data Log Available Range

Start Date: 6/27/2016 End Date: 6/27/2016

Start Time: 12:46:26 PM End Time: 2:51:26 PM

Data Log Download Range

Start Date: 6/27/2016 End Date: 6/27/2016

Start Time: 12:46:26 PM End Time: 12:46:26 PM

Set 'Download Range' to start from last retrieval (6/27/2016 12:49:26 PM)

Download Close

Figure 131: Data Log Download Dialog Screen

Clear

This submenu item when selected, clears the data logging information stored in the control.

4.10.5.9

Harmonics Setup

The Harmonics Setup dialog screen provides the user with the ability to select Voltage and Current Harmonics for monitoring relative to a Voltage and Current threshold setting. Whenever any selected Voltage or Current Harmonic exceeds their respective threshold if selected in Sequence of Events setup will initiate Sequence of Events recording. The threshold level is set as a percentage of the fundamental.

Harmonics Setup | (New File)

Voltage Harmonics Selection

<input checked="" type="checkbox"/> 2 nd	<input checked="" type="checkbox"/> 3 rd	<input checked="" type="checkbox"/> 4 th	<input checked="" type="checkbox"/> 5 th	<input checked="" type="checkbox"/> 6 th	<input checked="" type="checkbox"/> 7 th
<input checked="" type="checkbox"/> 8 th	<input checked="" type="checkbox"/> 9 th	<input checked="" type="checkbox"/> 10 th	<input checked="" type="checkbox"/> 11 th	<input type="checkbox"/> 12 th	<input checked="" type="checkbox"/> 13 th
<input checked="" type="checkbox"/> 14 th	<input checked="" type="checkbox"/> 15 th	<input type="checkbox"/> 16 th	<input checked="" type="checkbox"/> 17 th	<input type="checkbox"/> 18 th	<input type="checkbox"/> 19 th
<input type="checkbox"/> 20 th	<input type="checkbox"/> 21 st	<input type="checkbox"/> 22 nd	<input type="checkbox"/> 23 rd	<input type="checkbox"/> 24 th	<input type="checkbox"/> 25 th
<input type="checkbox"/> 26 th	<input type="checkbox"/> 27 th	<input type="checkbox"/> 28 th	<input type="checkbox"/> 29 th	<input type="checkbox"/> 30 th	<input type="checkbox"/> 31 st

Voltage Threshold

Voltage Percent 0.0 30.0 (%)

Current Harmonics Selection

<input checked="" type="checkbox"/> 2 nd	<input checked="" type="checkbox"/> 3 rd	<input checked="" type="checkbox"/> 4 th	<input checked="" type="checkbox"/> 5 th	<input checked="" type="checkbox"/> 6 th	<input checked="" type="checkbox"/> 7 th
<input checked="" type="checkbox"/> 8 th	<input checked="" type="checkbox"/> 9 th	<input type="checkbox"/> 10 th	<input checked="" type="checkbox"/> 11 th	<input type="checkbox"/> 12 th	<input checked="" type="checkbox"/> 13 th
<input checked="" type="checkbox"/> 14 th	<input checked="" type="checkbox"/> 15 th	<input type="checkbox"/> 16 th	<input checked="" type="checkbox"/> 17 th	<input type="checkbox"/> 18 th	<input type="checkbox"/> 19 th
<input type="checkbox"/> 20 th	<input type="checkbox"/> 21 st	<input type="checkbox"/> 22 nd	<input type="checkbox"/> 23 rd	<input type="checkbox"/> 24 th	<input type="checkbox"/> 25 th
<input type="checkbox"/> 26 th	<input type="checkbox"/> 27 th	<input type="checkbox"/> 28 th	<input type="checkbox"/> 29 th	<input type="checkbox"/> 30 th	<input type="checkbox"/> 31 st

Current Threshold

Current Percent 0 100 (%)

Minimum Fundamental Current Threshold

☐ Disable ☒ Enable

Min Current Threshold 0 200 (mA)

Voltage & Current Harmonic Alarm Delay

Delay 1 10 (sec)

Undo/Refresh Save Close

Figure 132: Harmonics Setup Dialog Screen

4.10.5.10

Oscilloscope

Setup

The Oscilloscope Recorder provides comprehensive data recording (voltage, current and status input/output signals) for all monitored waveforms (at 16 samples per cycle). Oscilloscope data can be downloaded using the communications ports to any Windows™ personal computer running the TCC600® Communications Software. Once downloaded,

the waveform data can be examined and printed using the TapPlot® Oscillograph Data Analysis Software.

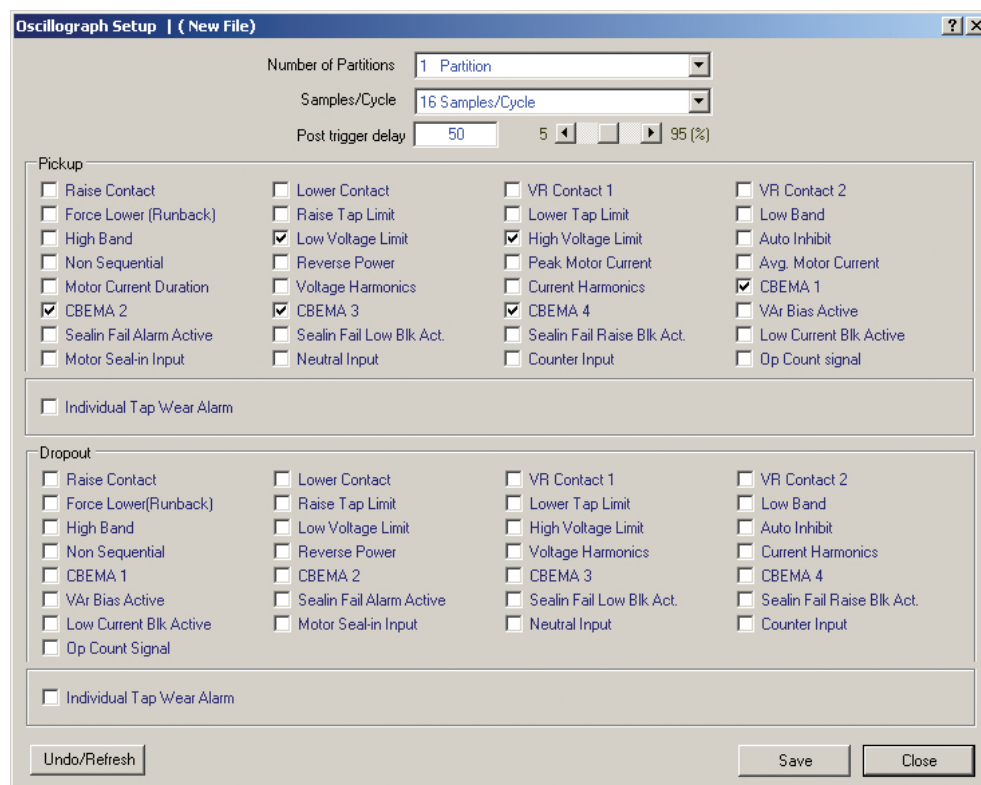


Figure 133: Oscillograph Setup Dialog Screen

The general information required to setup the Oscillograph Recorder includes:

- **Number of Partitions** – When untriggered, the recorder continuously records waveform data, keeping the data in a buffer memory. The recorder's memory may be partitioned into 1 to 16 partitions. When triggered, the time stamp is recorded and the recorder continues recording for a user-defined period. The snapshot of the waveform is stored in memory for later retrieval using TCC600 Communications Software.
- **Samples/Cycle** – The number of samples/cycle can be selected to either 16, 32 or 64 samples/cycle.
- **Post-Trigger Delay** – A post-trigger delay of 5% to 95% must be specified. After triggering, the recorder will continue to store data for the programmed portion of the total record before rearming for the next record. For example, a setting of 80% will result in a record with 20% pre-trigger data and 80% post-trigger data.

Table 50: *Oscillograph Recorder Partitions and Cycles for 16 Samples/Cycle*

Number of Partitions	Cycles Per Partition
1	1365
2	910
3	682
4	546
5	455
6	390
7	341
8	303
9	273
10	248
11	227
12	210
13	195
14	182
15	170
16	160

Front Panel Message

The "Oscillograph Record Triggered" cycling display can be enabled from the TCC600® Communications Software by navigating to the "Oscillography Message" (Setup/Oscillograph/Front Panel Message) dialog screen and selecting "Enable". It can also be enabled from the HMI by navigating to the "Communication HMI" menu.

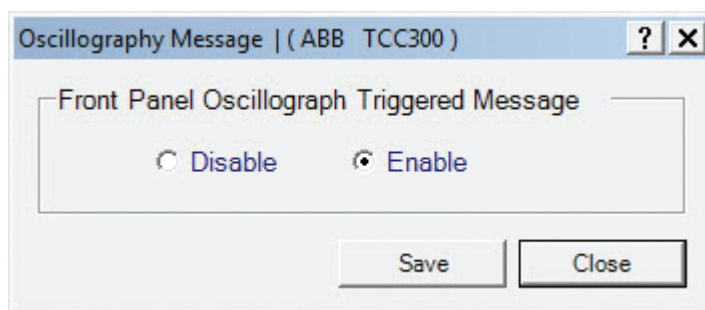


Figure 134: *Oscillograph Front Panel Message Dialog Screen*

Trigger

The Oscilloscope Recorder can be manually triggered by the user. When trigger is selected a confirming dialog screen is displayed. Selecting Yes triggers the Oscilloscope Recorder and TCC600 displays a confirming dialog screen.

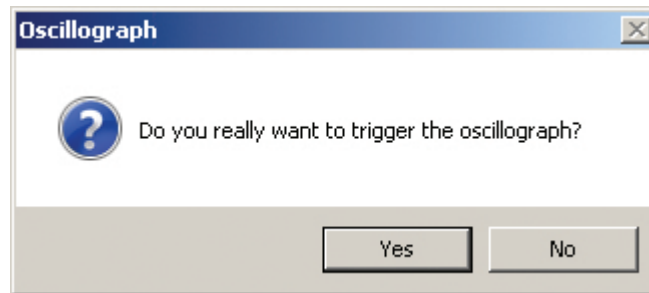


Figure 135: Oscilloscope Trigger Dialog Screen

Retrieve

The Retrieve command initiates a sequence of dialog screens to download the Oscilloscope data from the currently connected control. Oscilloscope data must be retrieved from the control in a Comtrade file (*.cfg) in order to be viewed. TapPlot® can be utilized to view the file contents.

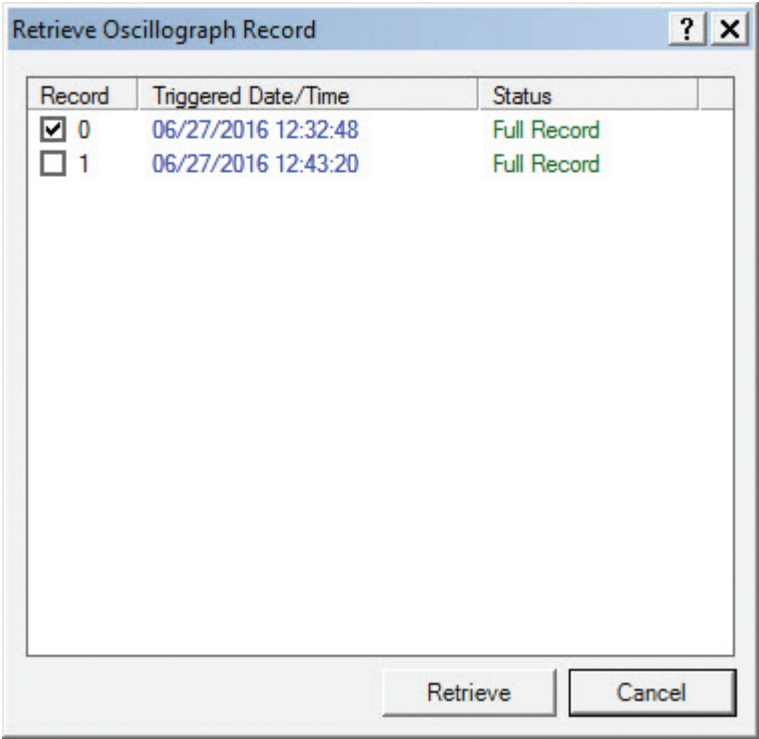


Figure 136: Retrieve Oscillograph Record Dialog Screen

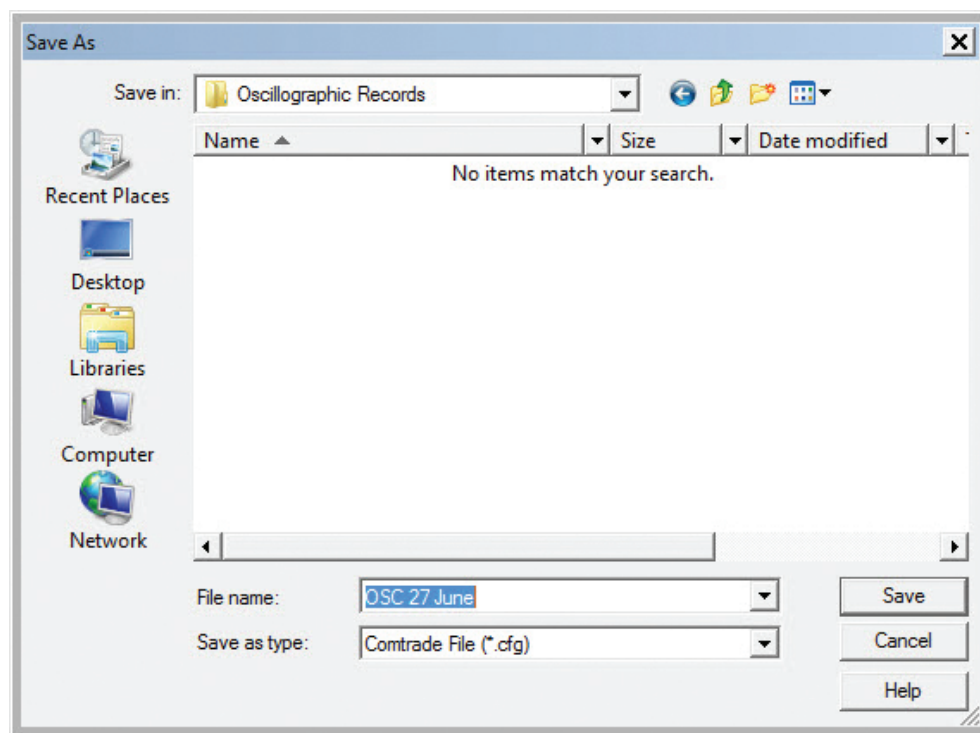


Figure 137: Retrieve Oscillograph Record (Save As) Dialog Screen

Clear

The Clear command clears any Oscillograph records on the connected control.

4.10.5.11

Sequence of Events

Setup

The Sequence of Events Setup consists of selecting the initiating Pickup and Dropout elements of the control and also setting any logical conditions relative to the Pickup and Dropout sequence to trigger the Sequence of Events recorder.

Selecting the OR and AND Trigger elements is accomplished by selecting either OR or AND Gate boxes. TCC600® will display the OR Gate or AND Gate Setup Dialog Screen. After selections are made in the OR Gate and AND Gate dialog screens the user must select either OR or AND logic to initiate the Sequence of Events recorder. Selecting SAVE then writes the settings to the control.

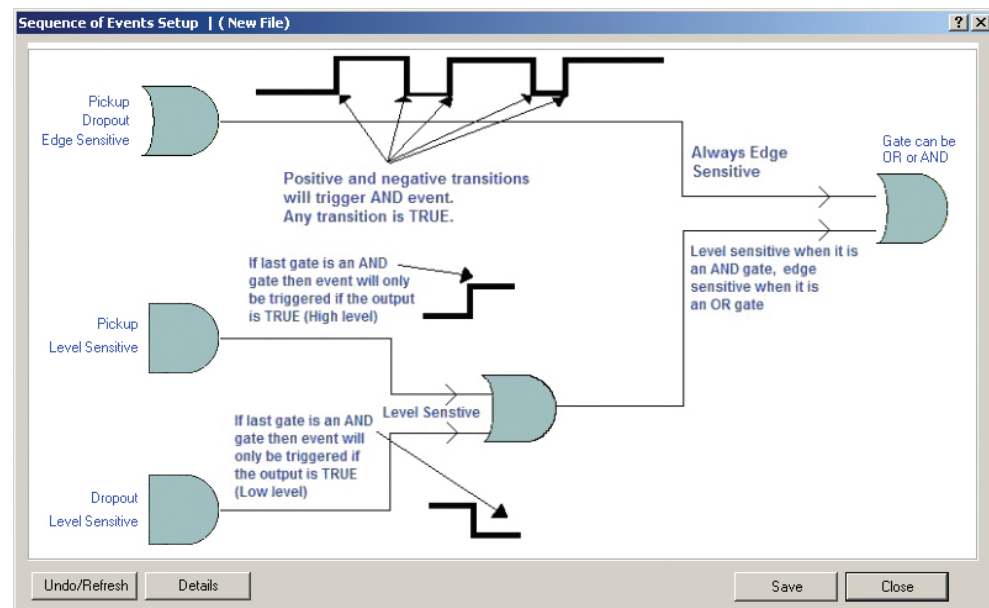


Figure 138: Sequence of Events Trigger Logic and Element Selection Dialog Screen

The diagram illustrates the 'OR Gate Setup' dialog box. It is divided into two main sections: 'Pickup (Edge Sensitive)' and 'Dropout (Edge Sensitive)'. Each section contains a list of checkboxes for various events and conditions. The 'Pickup (Edge Sensitive)' section includes checkboxes for 'Raise Contact', 'Force Lower (Runback)', 'High Band', 'Non Sequential', 'Motor Current Duration', 'CBEMA Event 2', 'Sealin Fail Alarm Active', 'Motor Seal-in Input', 'Lower Contact', 'Raise Tap Limit', 'Low Voltage Limit', 'Reverse Power', 'Voltage Harmonics', 'CBEMA Event 3', 'Sealin Fail Low Blk Act.', 'Neutral Input', 'VR Contact 1', 'Lower Tap Limit', 'High Voltage Limit', 'Peak Motor Current', 'Current Harmonics', 'CBEMA Event 4', 'Sealin Fail Raise Blk Act.', 'Counter Input', 'VR Contact 2', 'Low Band', 'Auto Inhibit', 'Avg. Motor Current', 'CBEMA Event 1', 'VAr Bias Active', 'Low Current Blk Active', and 'Op Count Signal'. The 'Dropout (Edge Sensitive)' section includes checkboxes for 'Raise Contact', 'Force Lower (Runback)', 'High Band', 'Non Sequential', 'CBEMA Event 1', 'VAr Bias Active', 'Low Current Blk Active', 'Op Count Signal', 'Lower Contact', 'Raise Tap Limit', 'Low Voltage Limit', 'Reverse Power', 'CBEMA Event 2', 'Sealin Fail Alarm Active', 'Motor Seal-in Input', 'Neutral Input', 'VR Contact 1', 'Lower Tap Limit', 'High Voltage Limit', 'Voltage Harmonics', 'CBEMA Event 3', 'Sealin Fail Low Blk Act.', 'Counter Input', 'VR Contact 2', 'Low Band', 'Auto Inhibit', 'Current Harmonics', 'CBEMA Event 4', 'Sealin Fail Raise Blk Act.', and 'Op Count Signal'. The dialog box includes buttons for 'HMI Active' and 'Individual Tap Wear Alarm' at the bottom, and an 'OK' button at the bottom right.

Figure 139: Sequence of Events Pickup/Dropout Edge Sensitive OR Gate Setup Dialog Screen

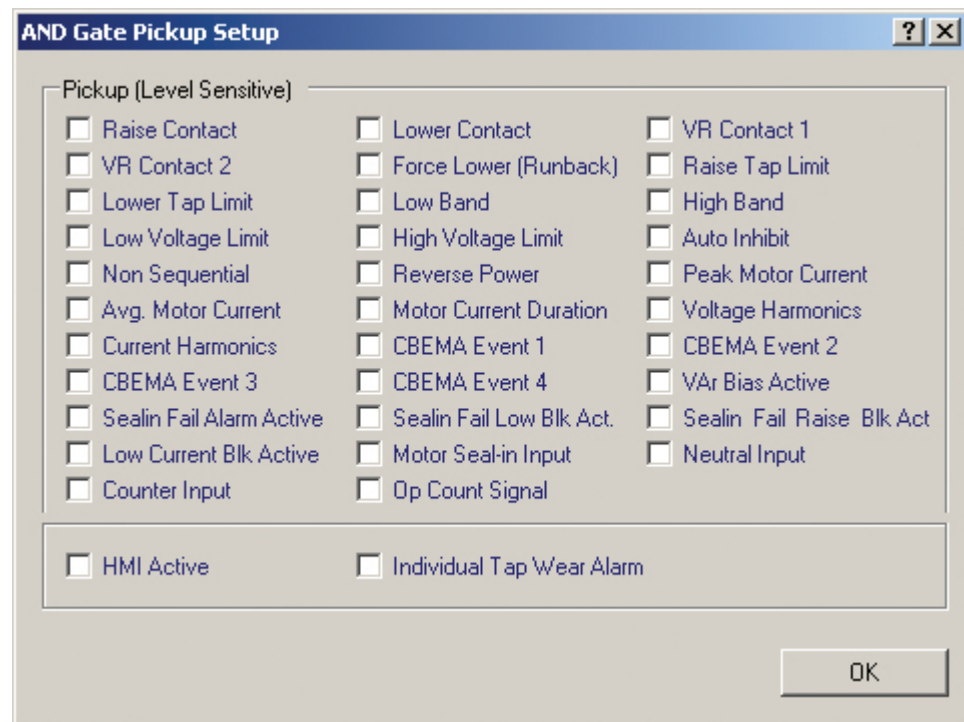


Figure 140: Sequence of Events Pickup Level Sensitive AND Gate Setup Dialog Screen

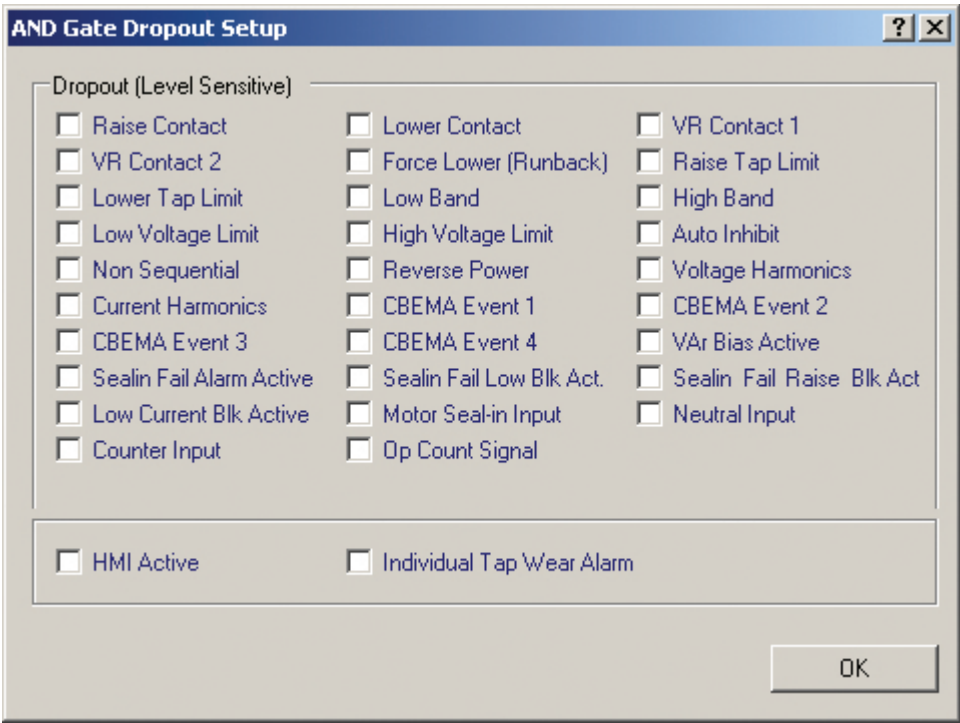


Figure 141: Sequence of Events Dropout Level Sensitive AND Gate Setup Dialog Screen

Retrieve

The Retrieve command downloads the events from the currently connected control. Events must be retrieved from the control and stored in a file in order to be viewed.

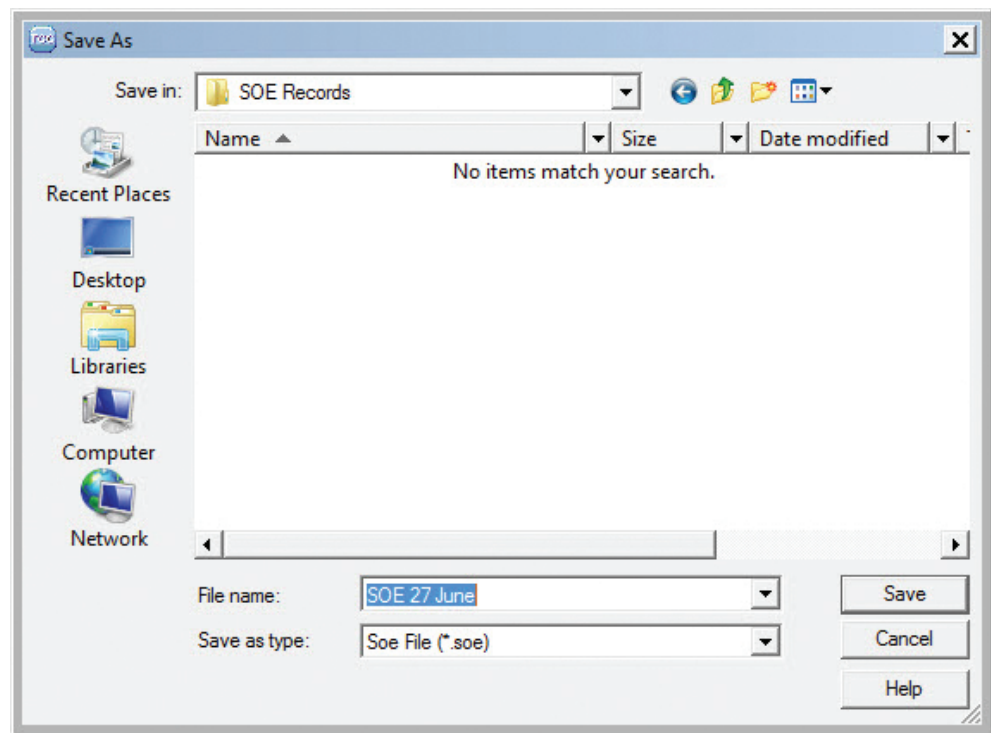


Figure 142: Retrieve Sequence of Events File Save As Dialog Screen

View

The View command permits the user to display a detailed list of past Sequence of Events and their corresponding captured parameters. The parameters captured in the Sequence of Events file include:

- Local Voltage
- Source Voltage
- Frequency
- Tap Position
- Motor Current
- Load Current
- Resettable Operations Counter
- RMS Voltage
- Meter Out Voltage
- RTN Success Counter
- Profile Number
- Time Stamp
- Trigger Status
- Voltage Harmonics Magnitude

- Current Harmonics Magnitude
- Voltage Harmonics Status (31)
- Current Harmonics Status (31)

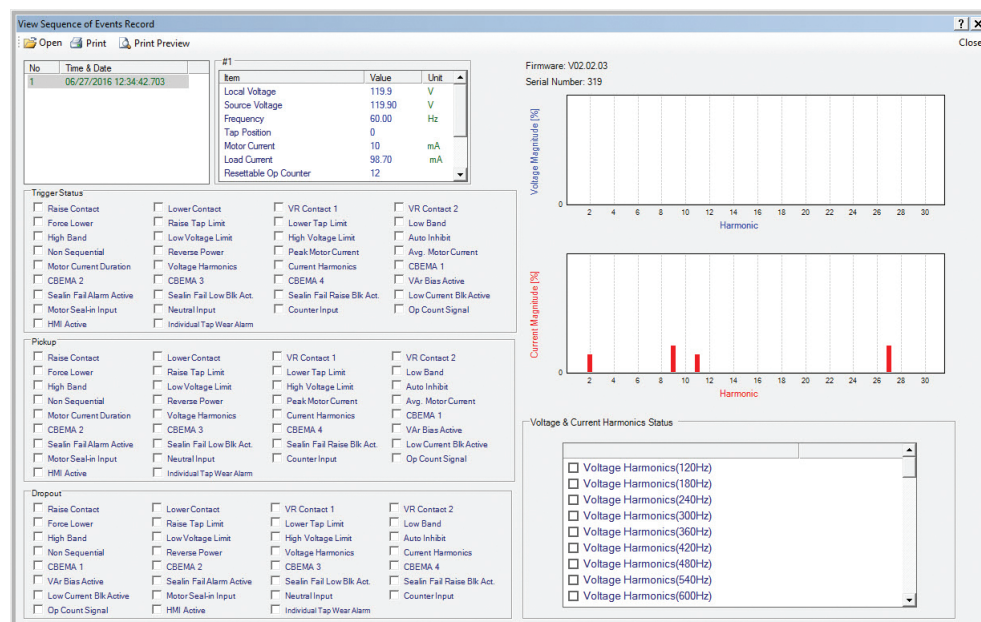


Figure 143: View Sequence of Events Record Dialog Screen

Clear

The Clear command clears out the Sequence of Events recorder.

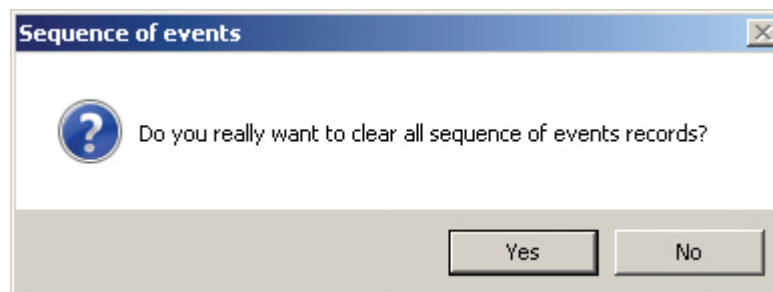


Figure 144: Clear Sequence of Events Record Dialog Screen

4.10.5.12 CBEMA Events

Setup

There are a total of 4 Event Monitors in CBEMA (Computer Business Equipment Manufacturers Association). Each CBEMA event monitor has a different minimum duration limit; Event 1, 1 – 60 cycles, Event 2, 1 – 120 cycles, Event 3, 60 – 60000 cycles and Event 4, 1 – 60 cycles. When Pickup is set to less than 100% it operates as a sag (under voltage) function, and when it is greater than 100% it operates as a swell (over voltage) function.

CBEMA Sequence of Events Setup | (New File) ? x

Normal Voltage 120.0 100.0 130.0 (V)

CBEMA Event 1

☐ Disable ☒ Enable

Sag Pickup 70 50 130 (%)

Sag Dropout 95 71 130 (%)

Sag Minimum Duration 1 1 60 (cycles) 16.67 msec

CBEMA Event 2

☐ Disable ☒ Enable

Sag Pickup 80 50 130 (%)

Sag Dropout 95 81 130 (%)

Sag Minimum Duration 1 1 120 (cycles) 16.67 msec

CBEMA Event 3

☐ Disable ☒ Enable

Sag Pickup 90 50 130 (%)

Sag Dropout 95 91 130 (%)

Sag Minimum Duration 60 60 60000 (cycles) 1.00 sec

CBEMA Event 4

☐ Disable ☒ Enable

Swell Pickup 115 50 130 (%)

Swell Dropout 105 50 114 (%)

Swell Minimum Duration 1 1 60 (cycles) 16.67 msec

Save Close

Figure 145: CBEMA Setting Dialog Screen

4.10.5.13

Display All Settings Command

Selecting Display All Settings displays the All Setpoints dialog screen. This dialog screen contains the settings for each control function within a single window to allow scrolling through all control setpoint and configuration values.

All Setpoints

Print Print Preview Save

TCC300 All Setpoints

Software Version: D-0375V10.09.04
Firmware version: D-0214V02.02.03
Serial Number: 319
ABB
TCC300

Setpoints

Profile 1

General

Line Drop Compensation:	R, X	Time Delay Selection:	Definite Time
Basic Timer Type:	Integrating	Power Direction Bias:	None

Forward Power

Band Center:	120.0 (V)	Band Width:	2.0 (V)
Definite Time Delay:	5 (sec)	LDC-Z:	0 (V)
LDC Resistance:	0 (V)	LDC Reactance	0 (V)

Reverse Power

Reverse Operation:	Block	Band Width:	2.0 (V)
Band Center:	120.0 (V)	LDC-Z:	0 (V)
Definite Time Delay:	30 (sec)	LDC Reactance	0 (V)
LDC Resistance:	0 (V)		

Voltage Reduction

Step 1:	2.5 (%)	Step 2:	5.0 (%)
Step 3:	7.5 (%)	Standard VR:	Enable
Smart VR:	Disable	Com VR turnoff Timer:	0 (Min)
Save VR at Power Off:	Don't Save		

Limit and Runback

Block Raise:	126.0 (V)	Block Lower:	114.0 (V)
Runback Deadband:	2.0 (V)	Current Limit:	640 (mA)
Runup Enable:	Disable	Runup Deadband:	2.0 (V)

Var Bias

VAr Bias:	Disable
-----------	---------

Profile 2

General

Line Drop Compensation:	R, X	Time Delay Selection:	Definite Time
Basic Timer Type:	Integrating	Power Direction Bias:	None

Forward Power

Band Center:	120.0 (V)	Band Width:	2.0 (V)
Definite Time Delay:	30 (sec)	LDC-Z:	0 (V)
LDC Resistance:	0 (V)	LDC Reactance	0 (V)

Reverse Power

Reverse Operation:	Block	Band Width:	2.0 (V)
Band Center:	120.0 (V)	LDC-Z:	0 (V)
Definite Time Delay:	30 (sec)	LDC Reactance	0 (V)
LDC Resistance:	0 (V)		

Voltage Reduction

Step 1:	2.5 (%)	Step 2:	5.0 (%)
Step 3:	7.5 (%)	Standard VR:	Disable
Smart VR:	Disable	Com VR turnoff Timer:	0 (Min)
Save VR at Power Off:	Don't Save		

Limit and Runback

Block Raise:	128.0 (V)	Block Lower:	114.0 (V)
Dead Band:	2.0 (V)	Current Limit:	640 (mA)

Figure 146: All Setpoints Dialog Screen

The individual Feature and Function selection buttons are described in the applicable sections.

The All Setpoint Table includes Jump Command Buttons which allow the user to jump from a scrolling dialog screen to an individual control function dialog screen and return to the scrolling dialog screen. All available parameters can be reviewed or changed when jumping to an individual control function dialog screen.

The All Setpoints screen can be printed or saved to a *.HTM file for viewing.

4.10.6

Utility menu

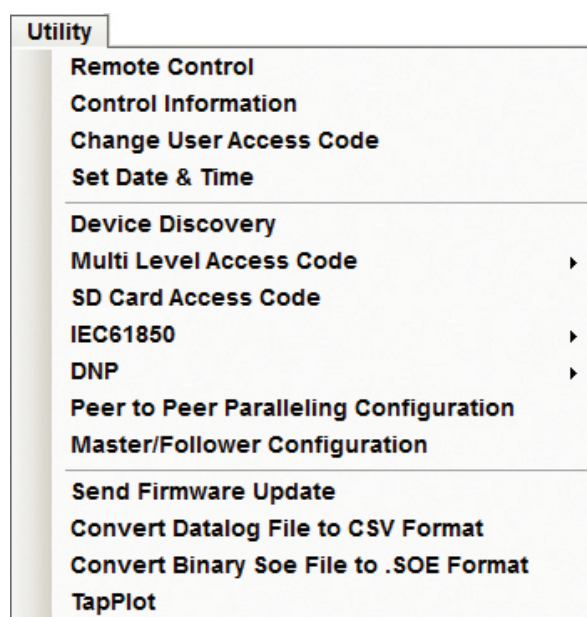


Figure 147: Utility menu

The Utility menu includes the submenu items.

- Remote Control
- Control Information
- Change User Access Code
- Set Date & Time
- Device Discovery
- Multi Level Access Code
- SD Card Access Code
- IEC 61850
- DNP
- Peer to Peer Paralleling Configuration
- Master/Follower Configuration

- Send Firmware Update
- Convert Datalog File to CSV Format
- Convert Binary Soe File to .SOE Format
- TapPlot®

4.10.6.1

Remote Control



This feature should be used with extreme caution.

The Remote Control menu item located in the Utility drop down menu displays the applicable Remote Control screen. Remote Control allows the user to:

- Remotely raise or lower one tap position.
- Apply Voltage Reduction Step 1 or 2 or 3.
- When the Auto/Manual Switch Type is set to either "Toggle" or "NONE" the Block Auto Control via Communication (Comm Block) setting is available.
- When the Auto/Manual Switch Type is set to "SCAMP" the SCAMP Auto/Manual Control setting is available.

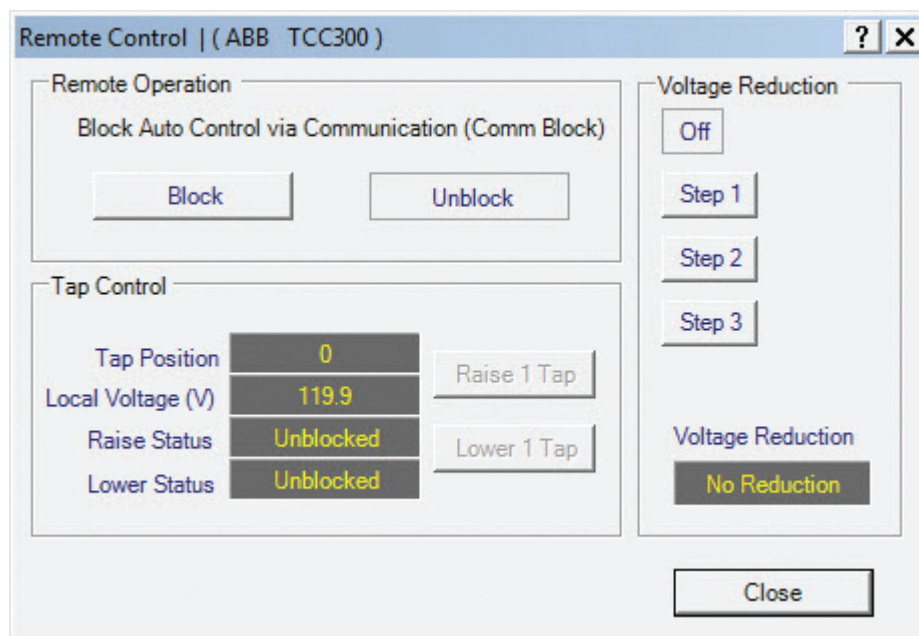


Figure 148: Remote Control Screen for Toggle or None Auto/Manual Switch Type

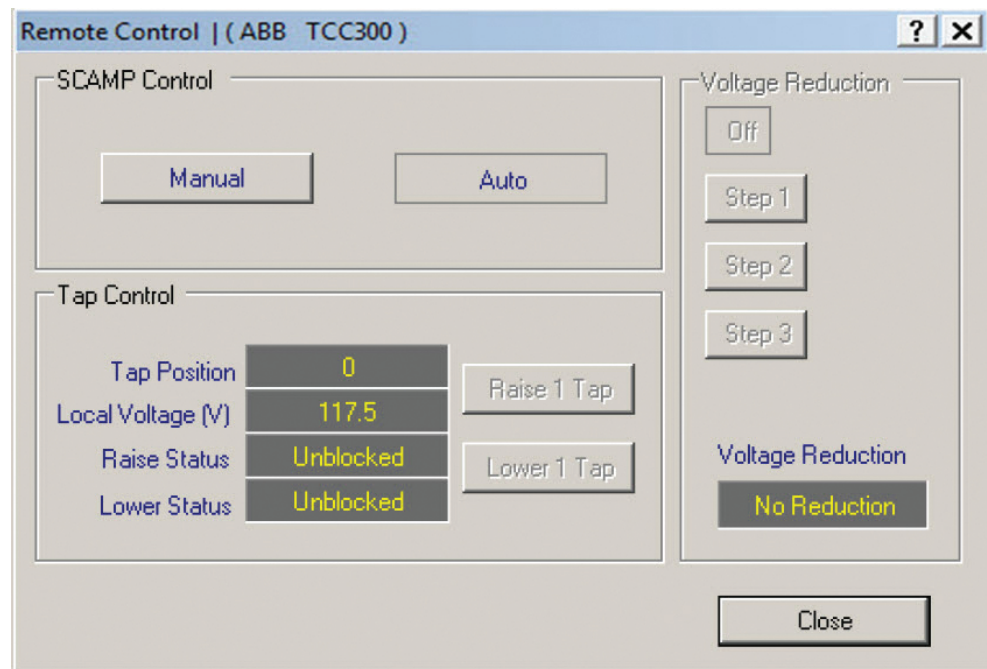


Figure 149: Remote Control Screen for SCAMP Auto/Manual Switch Type

Block Auto Control via Communication

Block – Blocks automatic operation of the addressed control.

Unblock – Initiates automatic operation of the addressed control.

Restoring Automatic Operation (Local)

Automatic operation can be restored from the front panel by removing the "Block Auto Control via Communication" through TCC600® or by performing the following:

1. From the control front panel pushbuttons change the Comm Block Auto setting in the Configuration/Nameplate menu to DON'T SAVE.
2. Remove power to the control, then reapply power to the control. Automatic operation will then be restored.

SCAMP Control

The SCAMP Control feature allows the user to remotely observe the status of the Adapter Panel SCAMP pushbutton (when equipped). This feature also allows the user to change the state of the Local SCAMP pushbutton on the Adapter Panel/Control.

4.10.6.2 **Control Information**

The Control Information submenu item displays the Control Information Screen. The Control Information screen provides specific information about the addressed control.

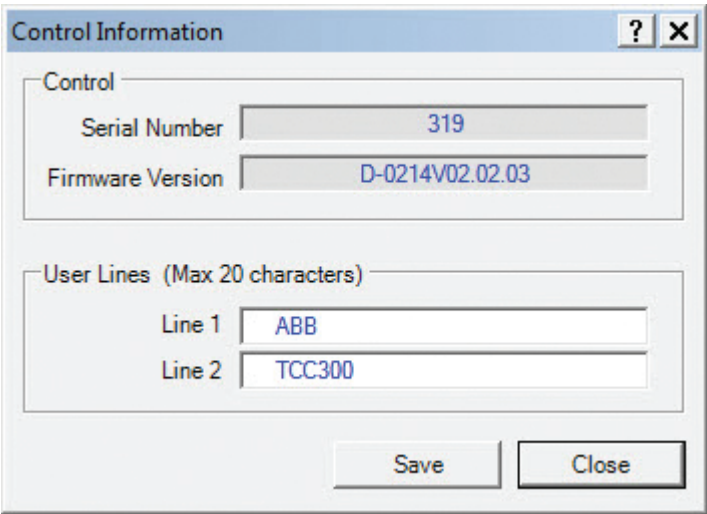


Figure 150: Control Information Screen

The Control Information screen includes the following:

- The addressed control’s serial number
- Control’s firmware version
- The text currently displayed in the User Lines 1 and 2

The Control Information screen also provides the user with the ability to review and change the user lines for the addressed control.

Table 51: *Miscellaneous*

Item	Description
Save	The Save command saves the User Line changes to the control when TCC600® is connected to a control.
Close	The Close command cancels any User Line changes before the changes have been sent to the control.

4.10.6.3 **Change User Access Code**

The User Access Code Level 1 and User Access Code Level 2 protect access to the control from the front keypad and TCC600.

Table 52: *User Access Code protection, when implemented*

Level	Description
Default	View All
Level 1	Change Setpoints, Date/Time
Level 2	Change Setpoints, Configuration, Communication, Set New Access Codes, Start Data Logging, Setup Data Logging, Remote Control, Set User Text Lines, Set Control Date/Time



If additional Access Codes are desired, see [Multi Level Access Code](#).

Changing User Level Access Codes

1. Select **Utility/Change User Access Code** from the TCC600 toolbar. TCC600 will display the Change User Access Code dialog screen.

Figure 151: *Change User Access Code Dialog Screen*

2. Enter a new Level 1/Level 2 six digit alphanumeric User Access Code.
3. Enter the User Access Code from Step 2, in **Confirm New User Access Code**.
4. Select **Save**. TCC600 will display a Save to Device confirmation screen.
5. Select **Yes**. TCC600 will return to the Main Screen.

4.10.6.4

Set Date & Time

The Set Date & Time submenu item enables the user to review the internal clocks for the PC or the addressed control and also allows the selection of daylight saving.

Setting date/time and daylight savings from TCC600

1. Select **Utility/Set Date & Time** from the TCC600® toolbar. TCC600 will display a Warning regarding time stamped values. Select OK.

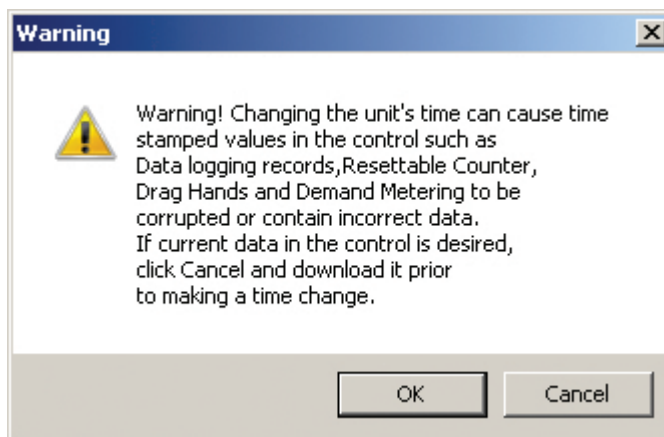


Figure 152: Set Date/Time Warning Dialog Screen

2. From the Set Control Date/Time dialog screen select either "Control Clock" or "PC Clock".

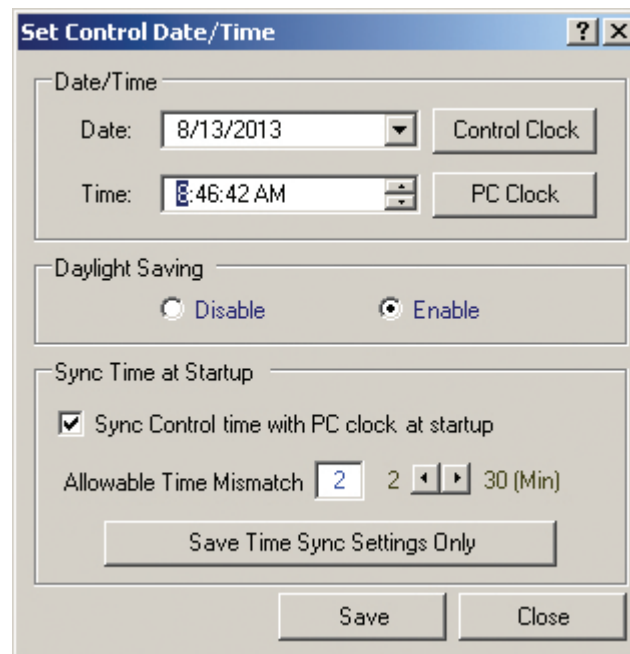


Figure 153: Set Control Date/Time Dialog Screen

3. Verify that the desired Daylight Saving setting is selected.
4. If desired select "Sync Time at Startup" and the desired "Allowable Time mismatch" value.
5. Determine if the control is to be set to either "PC Clock" or "Control Clock", then proceed as follows:
 - If "PC Clock" was selected and the Date/Time of the PC is the desired time to be set in the control, then select Save.
 - If "Control Clock" was selected, input the desired Date/Time, then select Save.

TCC600 will respond with a Reset Demand and Energy warning screen.

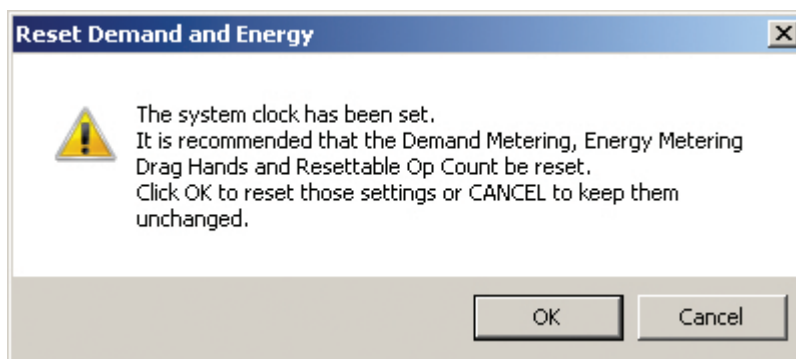


Figure 154: Reset Demand and Energy Warning Dialog Screen



Whenever the clock is reset and data logging is enabled the data log should be cleared.

6. Select OK to reset Demand Metering, Energy Metering, Drag Hands and Resettable Operation Counter or Cancel which will not reset these parameters. TCC600 will return to the Main Screen.

4.10.6.5

Device Discovery

The Device Discovery menu selection can be used when the control exists on an Ethernet network. It allows the user utilizing TCC600® to discover TCC300 ABB products on the network without needing to know the individual IP Addresses of other controls. When a control is found and selected the user can send and receive DNP Configuration files, IEC 61850 CID files and receive Access Code Log files.

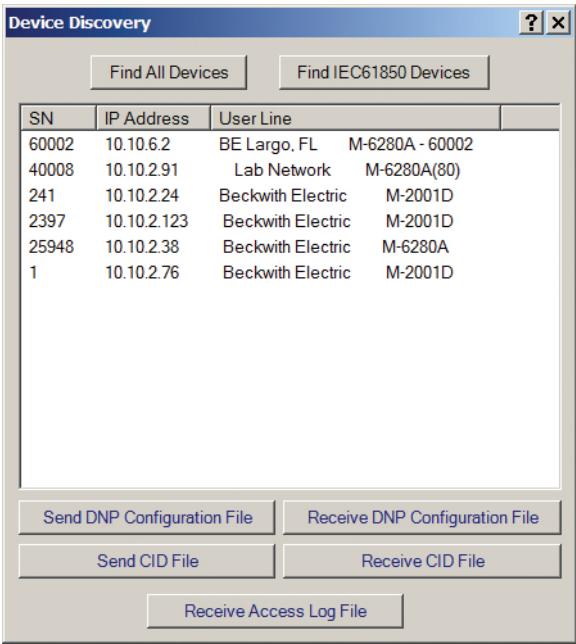


Figure 155: Device Discovery Dialog Screen

4.10.6.6

Multi Level Access Code

The Multi Level Access Code menu selection provides the user with the ability to create up to 30 unique fifteen character Access Codes. The list is created in TCC600 and downloaded to the control. Once a control has the list, the user can download a log of date and time each access code was used to access the control as well as when that access was terminated.

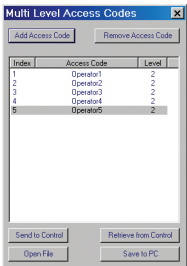


Figure 156: Multi Level Access Code Dialog Screen

4.10.6.7

SD Card Access Code

This feature allows the user to write a User Access Code Level 1 or 2 to a Smart Flash SD Card. When a User Access Code is present on the SD Card, when inserted, the control reads the User Access Code and does not prompt for the Access Code while the SD Card is inserted.

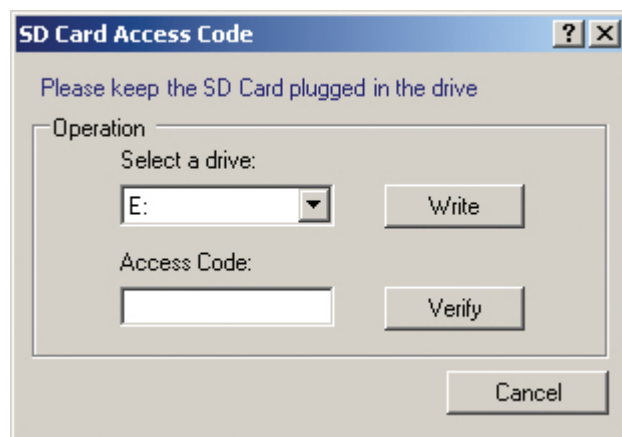


Figure 157: SD Card Access Code Dialog Screen

4.10.6.8

IEC 61850

The IEC 61850 menu selection (when purchased) provides the user with access to the IEC 61850 Protocol Configuration Editor.

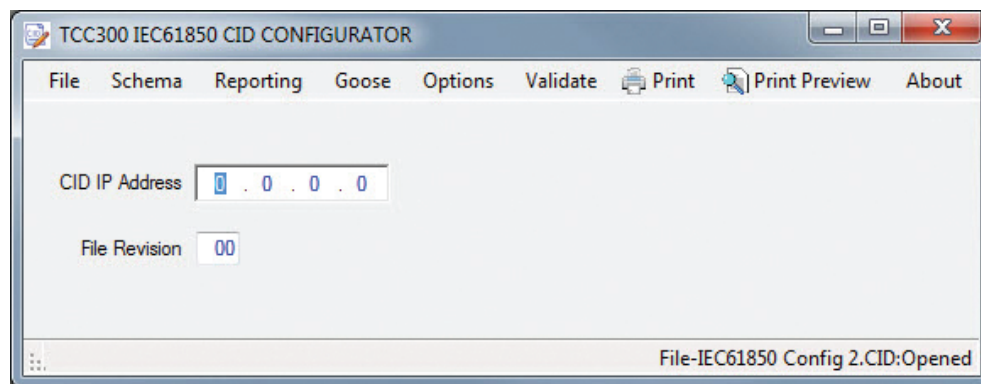


Figure 158: IEC 61850 Configuration Editor Dialog Screen

The following Configuration Editor features are provided:

- File - New, Open, Save Template, Save, Save As
- Schema - 1.4 or 3.0
- Reporting - Metering Dataset and Status Dataset
- GOOSE Publisher - 1 through 5
- GOOSE Subscriber - 1 and 2
- Validate • Print and Print Preview
- See Appendix D for detailed information

Also, the IEC 61850 menu provides access to "Send" and "Receive" Configuration Files, CID File Identifier and the Non-Standard Data Definition document (.pdf) for reference.

Sending IEC 61850 configuration files

1. Start the TCC600® Communications Software on the PC.
2. Connect to the TCC300 control.
3. Select **Utility/IEC61850/Configuration File/Send**. TCC600 will display the "Authentication Key Generated Successfully" confirmation screen.

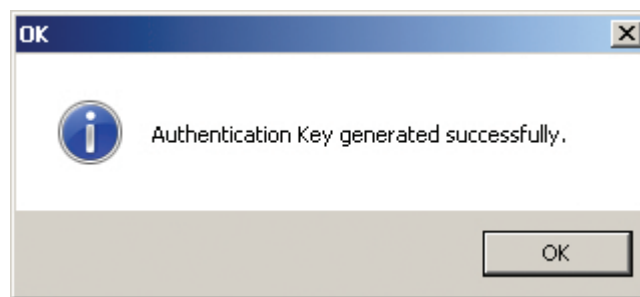


Figure 159: Authentication Key Generated Dialog Screen

4. Select **OK**. TCC600 will display the "Open" dialog screen with a default file extension of "*.cid".
5. Select the desired Configuration file, then select "Open". TCC600 will display the "Send" status screen while the Configuration file is sent.

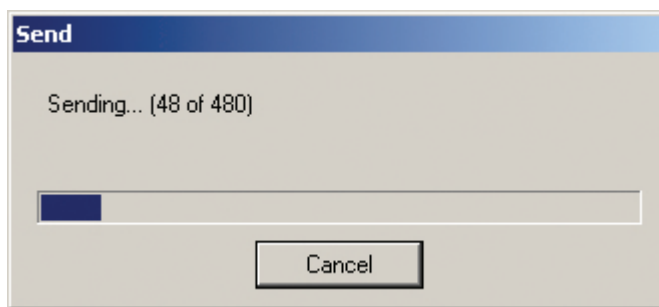


Figure 160: Send Status Screen

6. When the file has been successfully sent to the control, TCC600 will display the File Uploaded Successfully confirmation screen.

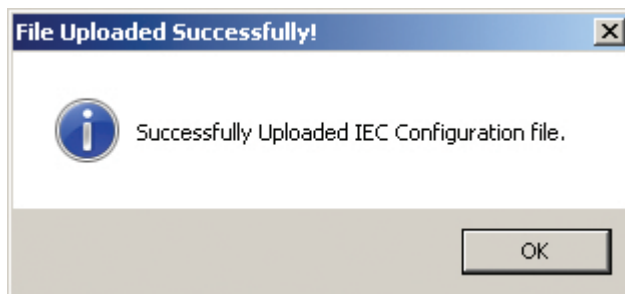


Figure 161: IEC Configuration File Uploaded Successfully Confirmation Screen

Receiving IEC 61850 configuration files

1. Start the TCC600 Communications Software on the PC.
2. Connect to the TCC300 control.
3. Select **Utility/IEC61850/Configuration File/Receive**. TCC600 will display the "Save As" dialog screen with a default file extension of "*.cid".
4. Name the Configuration file, then select "Save". TCC600 will display the "Transferring" status screen while the Configuration file is transferred.

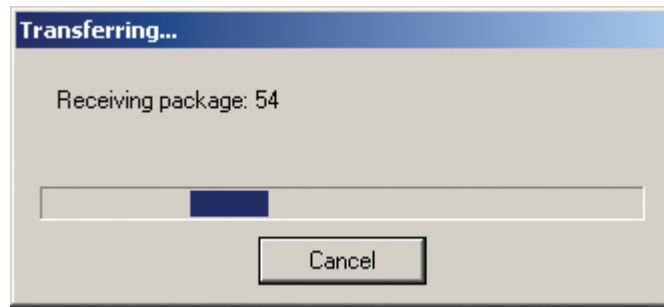


Figure 162: IEC Configuration File Transferring Status Screen

5. When the file has been successfully downloaded from the control, TCC600 will display the File Downloaded Successfully confirmation screen.

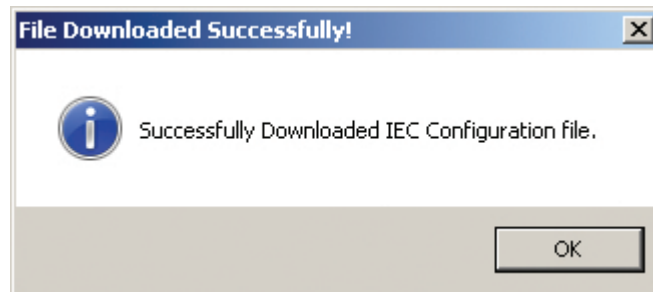


Figure 163: IEC Configuration File Downloaded Successfully Confirmation Screen

4.10.6.9

DNP

The Utility DNP Menu provides access to the DNP Configuration Editor, Source Address Validation, Send DNP Configuration, Receive DNP Configuration File, DNP File Identifier and UDP Port Settings features.

DNP Configuration Editor

The DNP Configuration Editor menu selection opens the TCC300 DNP Configuration Editor dialog screen which provides the user with the following capabilities:

- TCC300 default DNP configuration files (*.xml) can be loaded for editing or become the basis for new DNP configuration files.
- Selected DNP configuration files (*.xml) other than TCC300 default files can be loaded for editing or become the basis for new DNP configuration files.
- Binary Inputs, Analog Inputs, Binary/Control Outputs and Analog Outputs may be added, edited or deleted.
- Dummy positions may be added to allow SCADA table matching.
- Variations may also be edited.

- File can be saved to disk or to the connected control.
- Items in the editor can be moved, added and removed by dragging and dropping.
- Enable/Disable unsolicited response.
- Screen can be printed.
- Master Address for unsolicited responses and/or Source Address Validation.
- See Appendix C for detailed information.

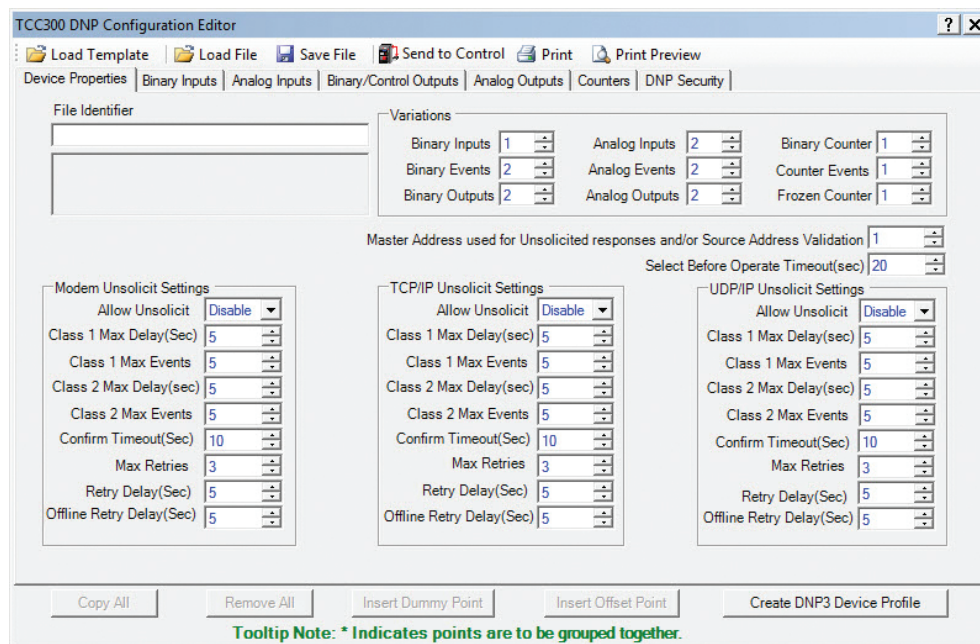


Figure 164: TCC300 DNP Configuration Editor Dialog Screen

Source Address Validation

The Source Address Validation feature is available from the Utility/DNP menu selection. When Source Address Validation is enabled it applies only when DNP3.0 Protocol has been selected regardless of the physical interface. If enabled the client address must match the address set by the user in the DNP Configuration file before accepting the message as a valid one.

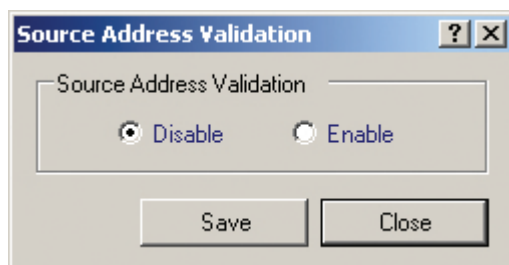


Figure 165: Source Address Validation Dialog Screen

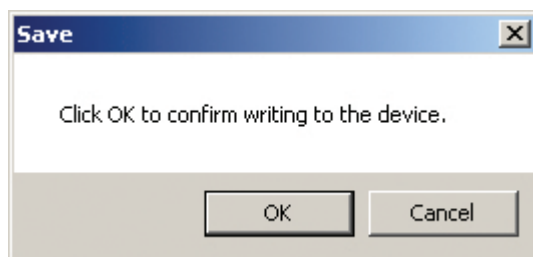


Figure 166: Confirm Writing to the Device Dialog Screen

Send DNP Configuration File

The Send DNP Configuration File menu selection provides the user with the capability to upload a DNP configuration file to the control.

Receive DNP Configuration File

The Receive DNP Configuration File menu selection provides the user with the capability to download a DNP configuration file from the control.

DNP File Identifier

The DNP File Identifier menu selection when selected displays the DNP File Identifier that is loaded onto the control.

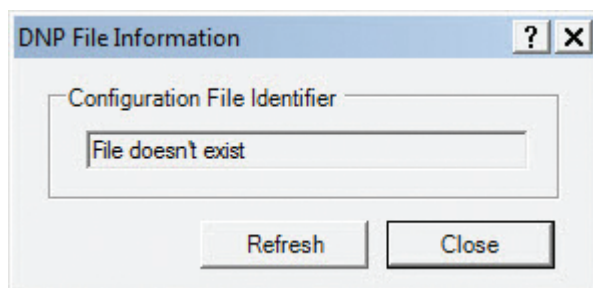


Figure 167: DNP File Information Dialog Screen

UDP Port Settings

A total of 5 UDP channels exist for DNP. The first channel is reserved for unsolicited messages. The control will send any unsolicited responses to the UDP Remote IP/Port that has been configured. If the Remote IP and Port have not been configured, the unit will not send any unsolicited messages.

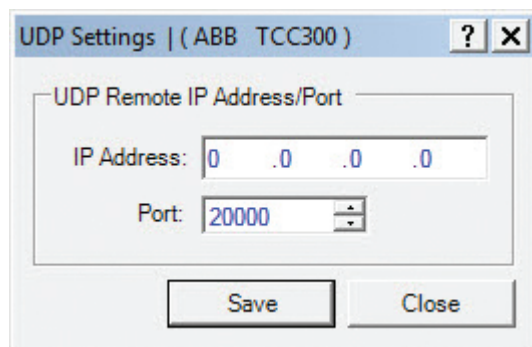


Figure 168: UDP Settings Dialog Screen

Uploading DNP configuration files

1. From the TCC600® Main Screen select **Utility/DNP/Send DNP Configuration File**. TCC600 will display the Authentication Key Generated dialog screen.

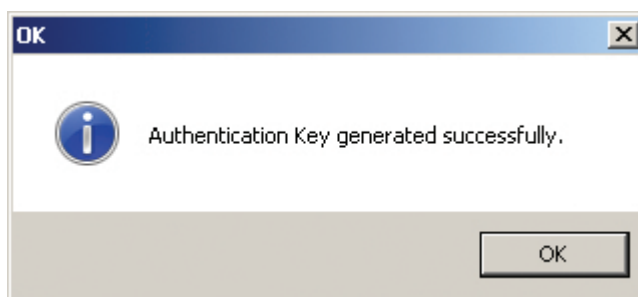


Figure 169: Authentication Key Generated Dialog Screen

2. Select **OK**. TCC600 will display the Open File Dialog screen with a default *.xml file extension.

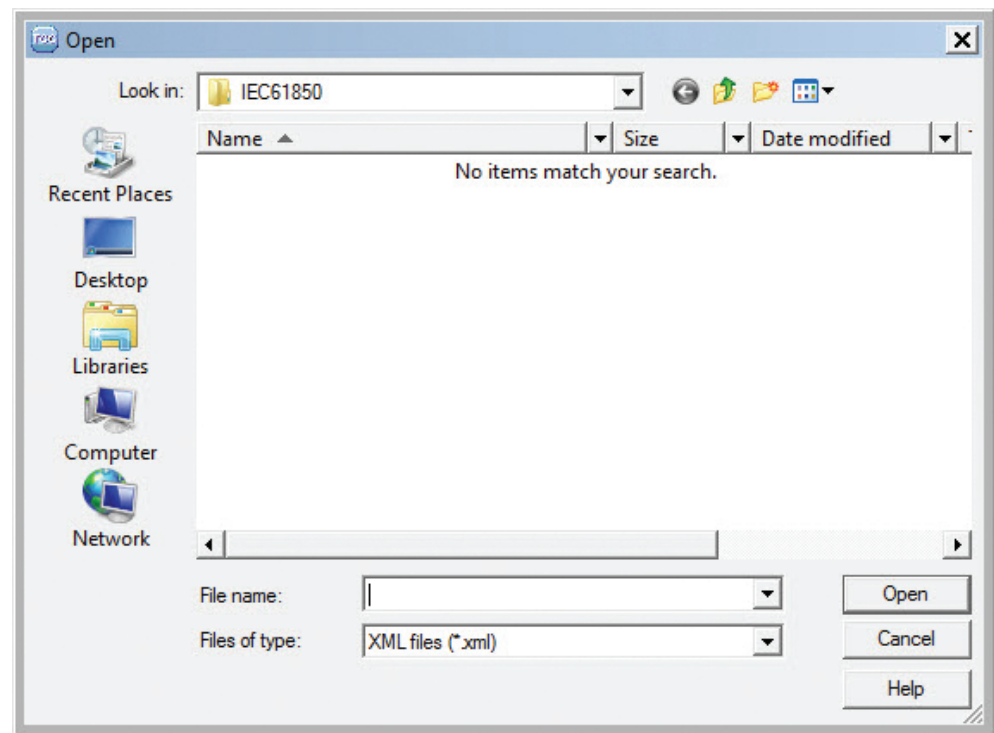


Figure 170: DNP Open File Dialog Screen

3. Select the target file, then select **Open**. TCC600 will display the DNP Send status screen.

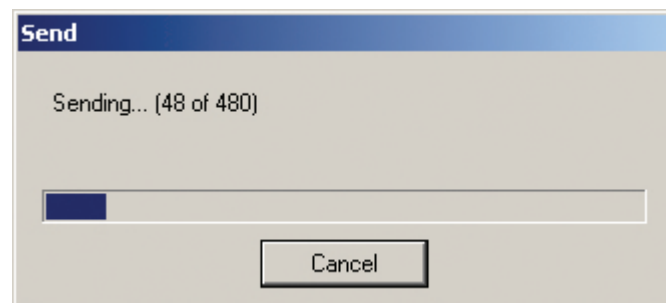


Figure 171: Send Status Screen

4. When the DNP Configuration file has been uploaded TCC600® will display a confirmation screen. Select **OK**. TCC600 will return to the Main Screen.

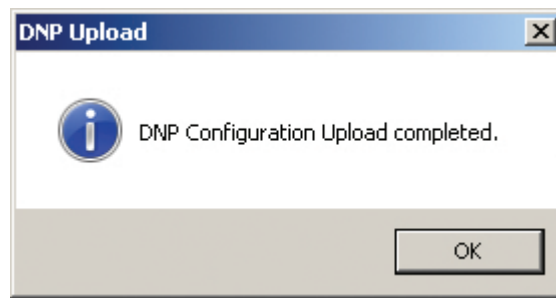


Figure 172: DNP Upload Complete Screen

Downloading DNP configuration files

1. From the TCC600® Main Screen select **Utility/DNP/Receive DNP Configuration File**. TCC600 will display the Save As dialog screen with a default *.xml file extension.

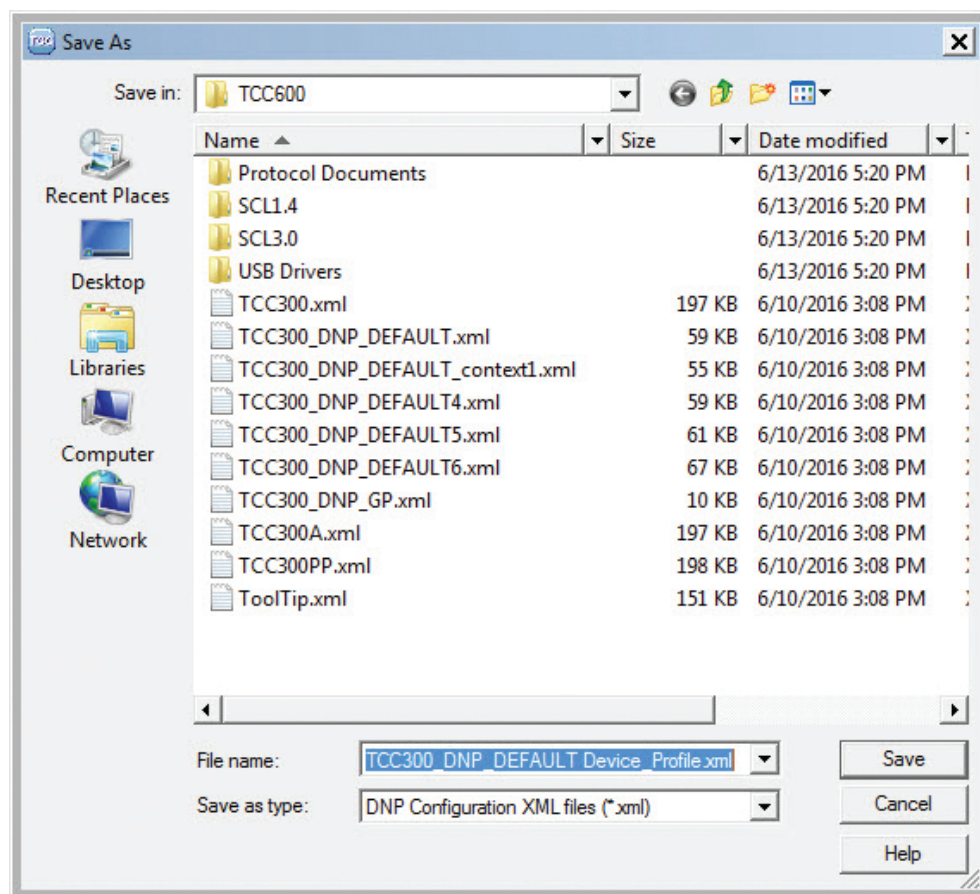


Figure 173: Save As File Dialog Screen

2. Select the target file or enter a valid name for the new file, then select **Save**. TCC600 will momentarily display a download status screen.
3. When the DNP Configuration file has been downloaded TCC600 will display a confirmation screen. Select **OK**. TCC600 will return to the Main Screen.

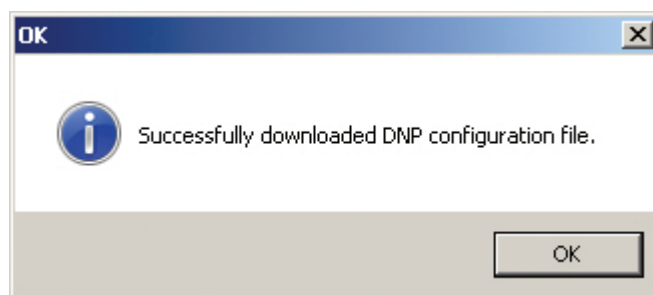


Figure 174: Download Complete Dialog Screen

4.10.6.10 Peer to Peer Paralleling Configuration

The Peer to Peer Paralleling Configuration tool is available when Delta VAr Peer to Peer Paralleling is selected in Setup/Configuration.

The configuration tools provide the means to:

- Discover Paralleled Devices
- Save configurations on multiple discovered controls
- Reset Alarms/Lockouts on multiple controls
- Change Delta VAr Peer to Peer settings on multiple controls
- Poll multiple status information

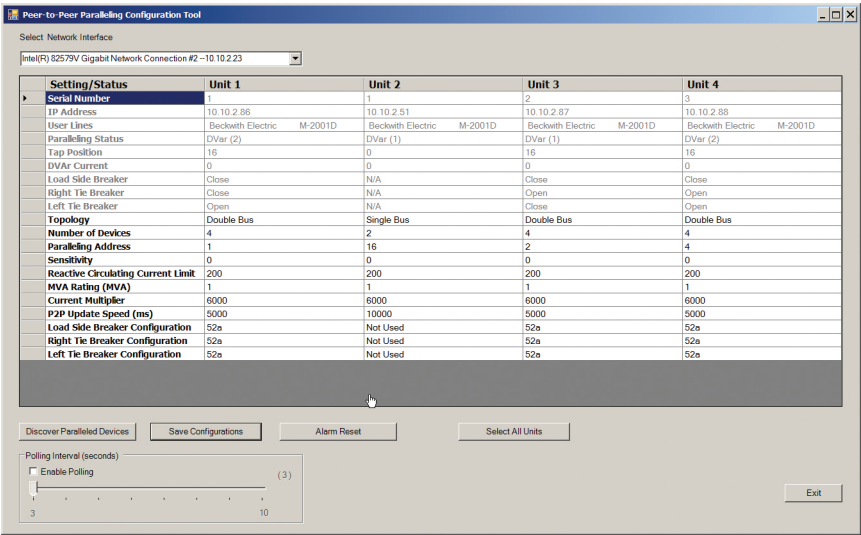


Figure 175: Delta VAr Peer to Peer Paralleling Configuration Tool

4.10.6.11 Master/Follower Configuration

The Master/Follower Configuration menu selection (when purchased) provides the user with access to the Master/Follower Configuration Tool dialog screen.

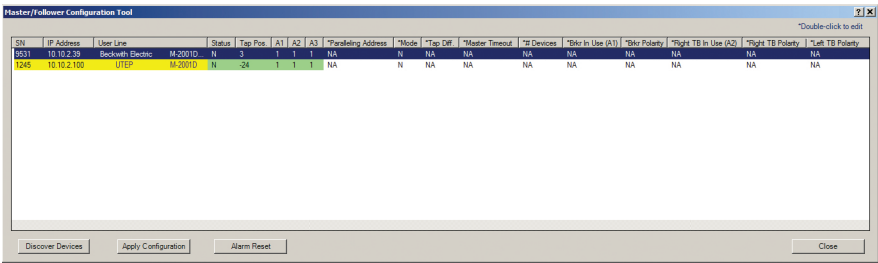


Figure 176: Master/Follower Configuration Tool

The Configuration Tool provides the means to:

- Discover Master/Follower controls on the connected network
- Display Control Master/Follower settings
- Edit and apply Master/Follower settings to the selected control
- Reset the Master/Follower Lockout Alarm

4.10.6.12

Send Firmware Update

The Send Firmware Update feature is available from the Utility menu selection. This feature allows the user to upload firmware updates to the control. Firmware updates may be uploaded at any time, as the control settings are not affected.

Sending a firmware update to TCC300

1. Remove the control from service.
2. From the TCC600® Main Screen select **Utility/Send Firmware Update**. TCC600 will display the Open file dialog screen with a default *.bot file extension.

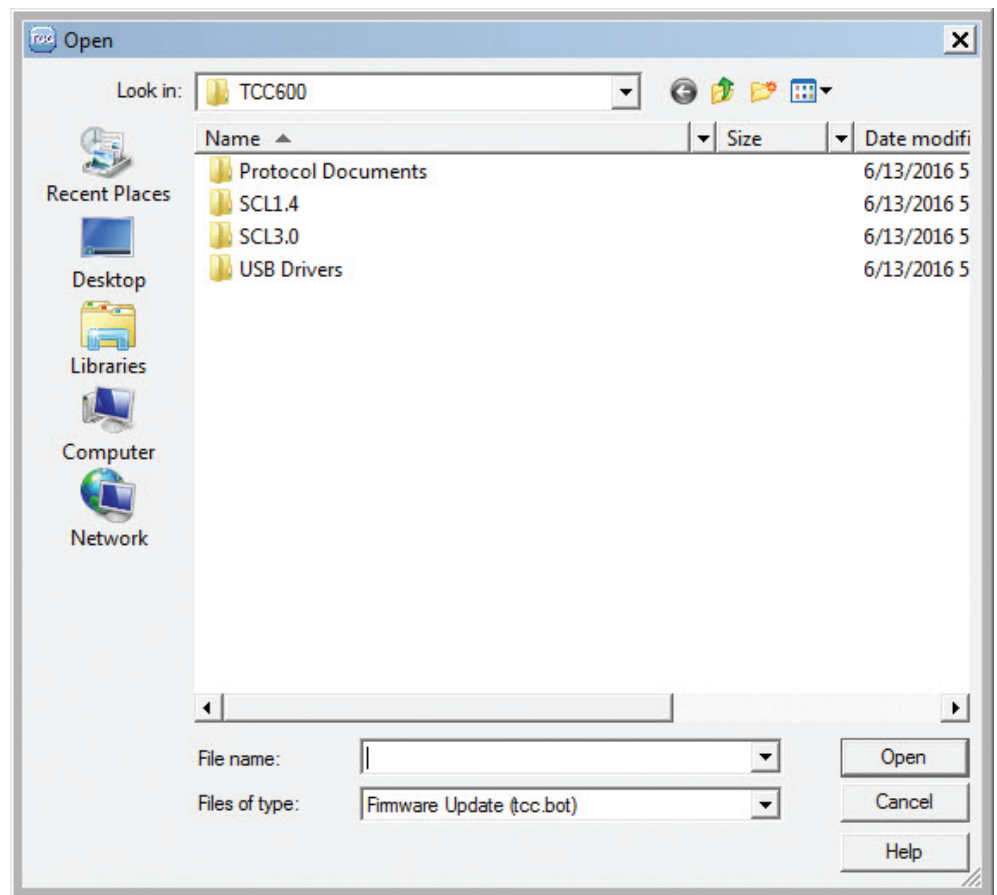


Figure 177: Open File Dialog Screen

3. Select the target file, then select Open. TCC600 will display the Firmware Upload dialog screen.

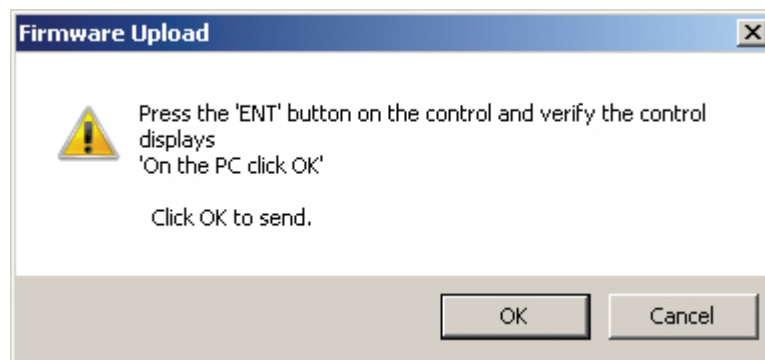


Figure 178: Firmware Upload Screen

The dialog screen contains instructions to verify that the control displays "On the PC click OK" the control will display the following:

Firmware Update

← Press ENT to begin

4. Press the ENT pushbutton, the control will display the following:
On the PC
Click OK
5. From the Upload dialog screen select **OK**. TCC600 will display the Send Status Screen.

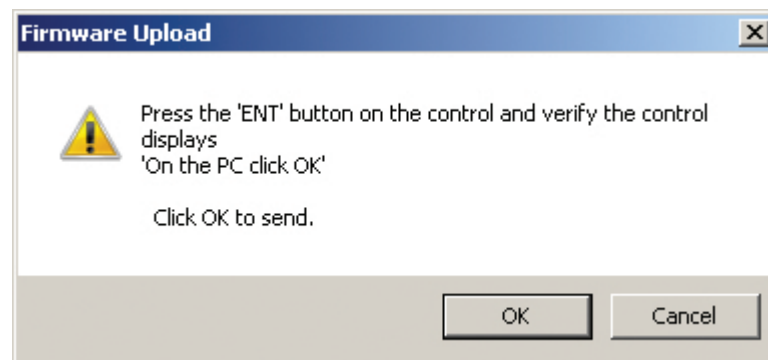


Figure 179: Firmware Upload Screen

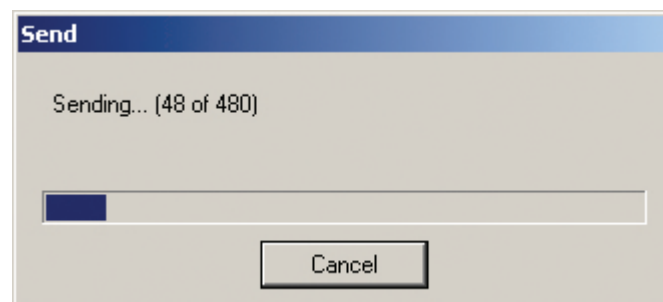


Figure 180: Send Status Screen

When the file transfer has been completed TCC600 will display a Firmware Upload Confirmation screen and close communications.

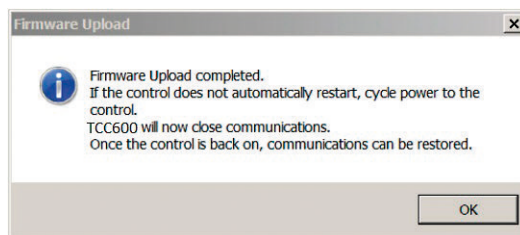


Figure 181: File Transfer Confirmation Screen

6. When the control displays the following, it will reboot automatically.
Update Complete
Rebooting



After a Firmware Update, remove power to the control and then reapply power to initialize the unit.

7. Select **OK**. TCC600 will return to the main screen. Communication will need to be reestablished.

4.10.6.13

Convert Datalog File to CSV Format

This feature allows Datalog Files created on the TCC300 to be converted to "*.csv" format files that can be opened in any spreadsheet program.

4.10.6.14

Convert Binary Soe File to .SOE Format

This feature allows the user to convert binary Soe files downloaded from third party software to the Beco (.SOE) format for viewing in the TCC600 SOE Viewer

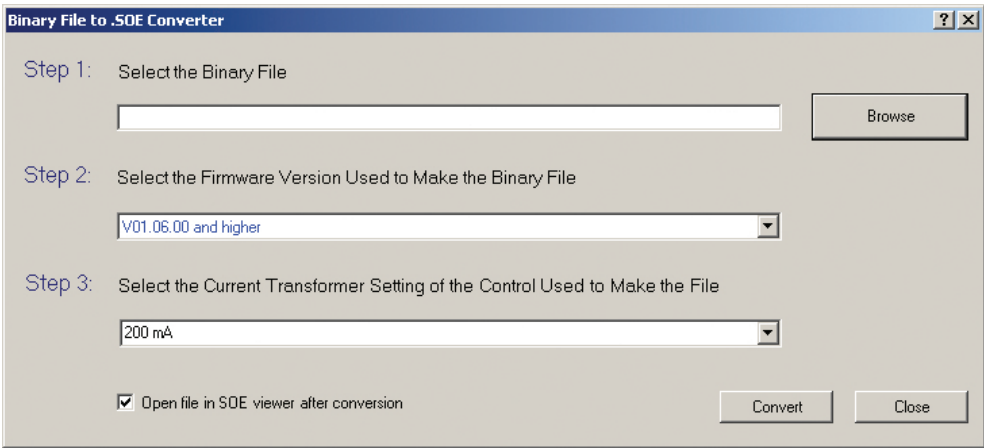


Figure 182: Convert Binary File to SOE Format Dialog Screen

4.10.7

Windows menu

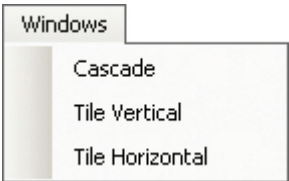


Figure 183: Windows menu

The Windows toolbar item provides the Cascade and Tile display options. The Windows toolbar item also allows the user to select between open TCC600® windows.

4.10.8

Help menu

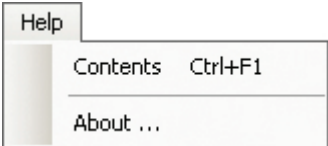


Figure 184: Help menu

The Help toolbar item provides the user with information about the control and the firmware version that is installed in the unit.

Table 53: Help menu contents

Item	Description
Contents	The Instruction Book menu topic has been indexed to its Table of Contents. By selecting the 'Navigator pane' in Adobe Acrobat Reader, the user can directly access selected topics.
About	The About submenu item provides the TCC600 software version number, control firmware version, (if connected), and copyright information.

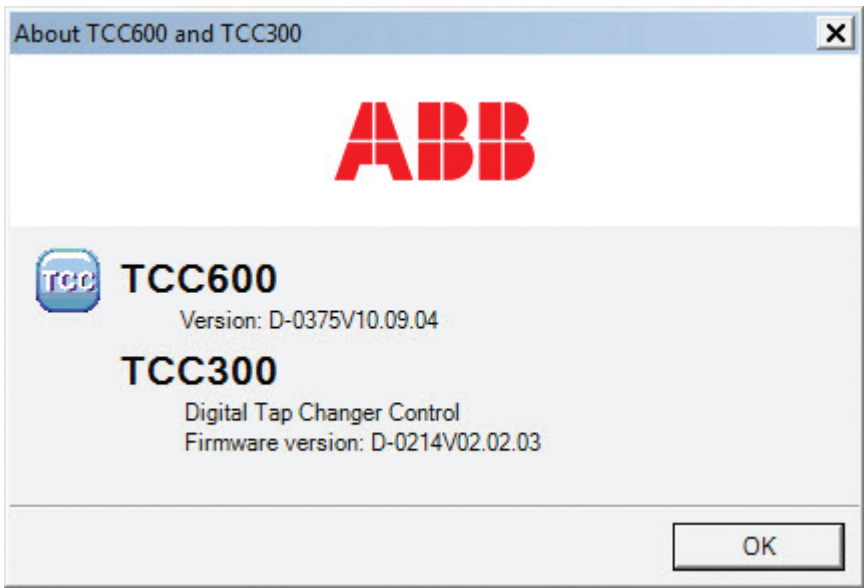


Figure 185: About TCC600

4.11

TapPlot analysis software


The TapPlot® Analysis Software operates in conjunction with all TCC600® Communications Software on any computer running Windows™. TapPlot allows the user to plot and print tap data (comtrade*.cfg) retrieved from ABB TCC300 series Digital Tapchanger Controls.

TapPlot® is a windows based program for viewing the data that has been retrieved using the Data Logging feature of TCC600®.

When TapPlot is started, a menu and tool bar are displayed. This section describes each TapPlot menu selection and explains each TapPlot command in the same order that they are displayed in the software program.

Markers

TapPlot includes two user selectable markers. The first is positioned by double clicking on the plotted wave form data. The second is positioned by pressing and holding the SHIFT key and then double clicking on the plotted wave form data.

The markers can be dragged by moving the cursor over the marker until the cursor changes to a double-headed arrow , then holding down the Left mouse button and dragging the marker. The first marker can also be moved an interval at a time by pressing the LEFT or RIGHT arrow key. The second marker can be moved by pressing the Shift key and the Left or Right arrow key.

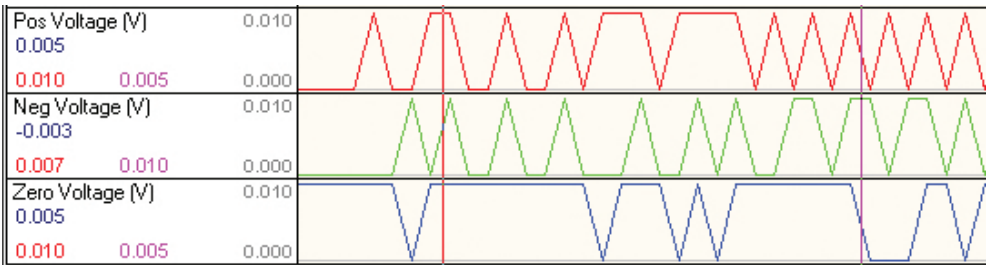


Figure 186: TapPlot Screen With Callouts

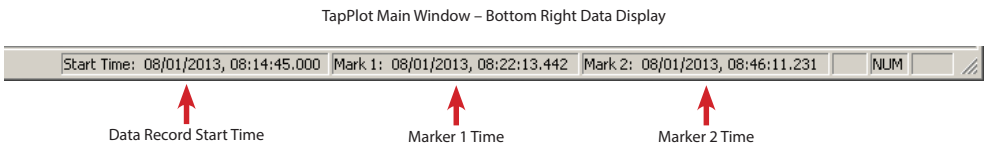


Figure 187: TapPlot Main Screen Data Time Stamp Display

Right-Click Filter Menus

Right-Click menus are available to allow filtering of the data results. [Figure 188](#) and [Figure 189](#) show examples of the right-click menus available in either a Datalog or Oscillograph file.

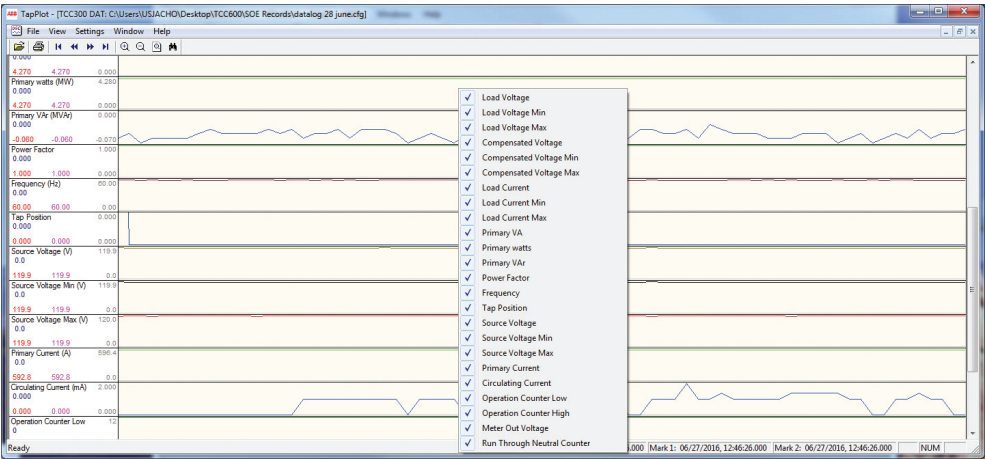


Figure 188: Datalog File Right-Click Filter Menu

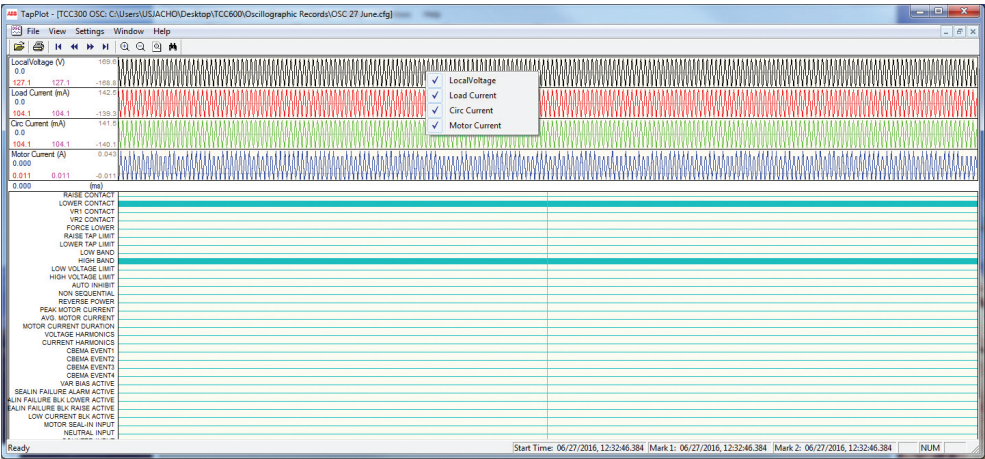


Figure 189: Oscillograph File Right-Click Filter Menus

File Menu

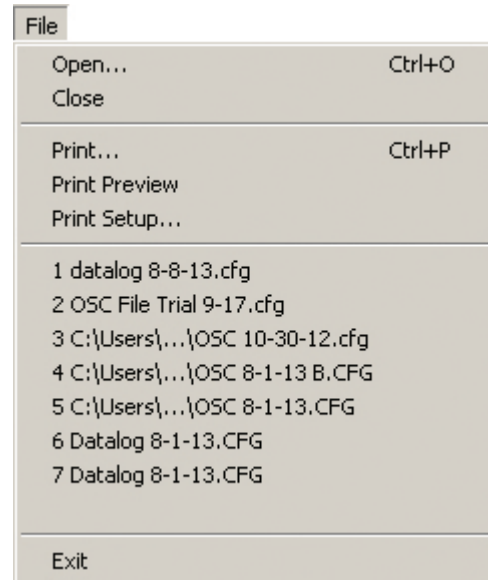


Figure 190: File menu

The File menu allows the user to:

- Open a TapPlot® (.cfg) file previously downloaded by TCC600®.
- Print the displayed TapPlot data.
- A Print Preview of the displayed TapPlot data.
- Select the printer and printer settings to be used.
- Select from previously viewed .cfg files (the last eight files displayed).
- Exit the TapPlot program.

View Menu

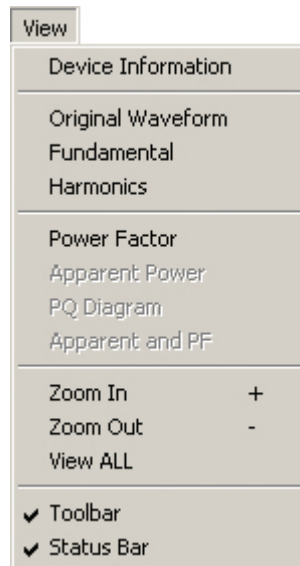


Figure 191: View menu

The View menu allows the user to:

- Display the Device Information for the corresponding TapPlot data file.
- Fundamental
- Original Waveform
- Harmonics
- Power Factor
- Apparent Power
- PQ Diagram
- Apparent and PF
- Zoom In, increase the resolution of the tap data displayed on the screen.
- Zoom Out, decrease the resolution of the tap data displayed on the screen.
- View ALL, returns the display to include all data within the record.
- Select which Tool Bar (Toolbar/Status Bar) is available on the display window.

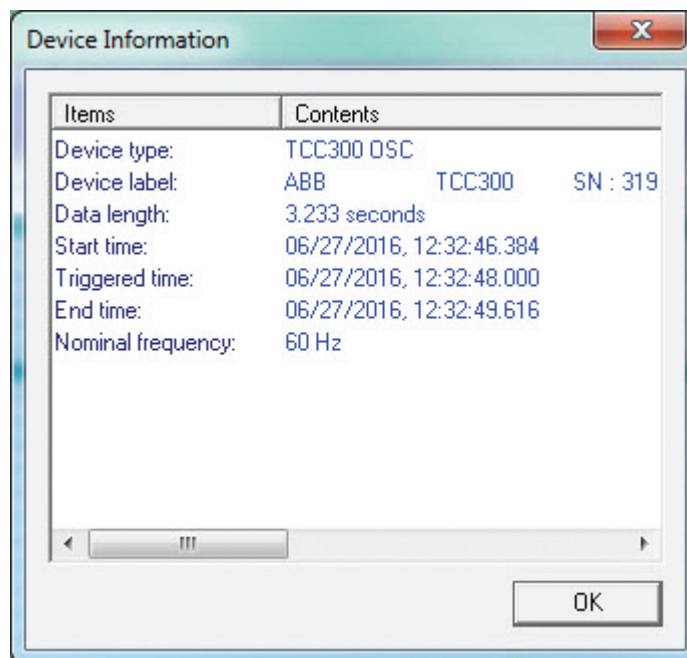


Figure 192: Device Information Screen

Settings Menu

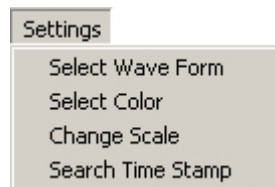


Figure 193: Settings menu

The Settings menu allows the selection of the waveforms to be displayed and the format of display colors.

Select Waveform allows the selection of any of the following Data Log Tap Parameters to be plotted or printed:

- Load Voltage (V)
- Compensated Voltage (V)
- Primary Watts (W)
- Primary (VA)
- Primary (VAr)
- Load Current (A)
- Power Factor
- Frequency

- Tap Position
- Source Voltage (V)
- Primary Current (A)
- Circulating Current (mA)
- Operation Counter

The Waveform selections are made from the Select Waveform screen.

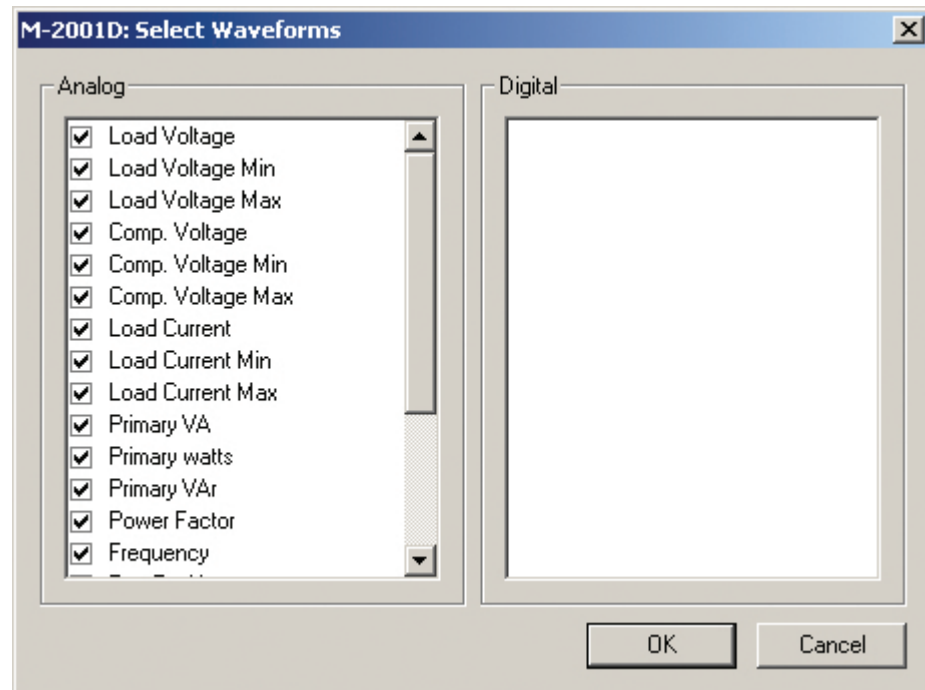


Figure 194: Select Waveform Dialog Screen

Select Color provides the user with the capability to change Foreground and Background display color of individual Waveform traces for customized plotting.

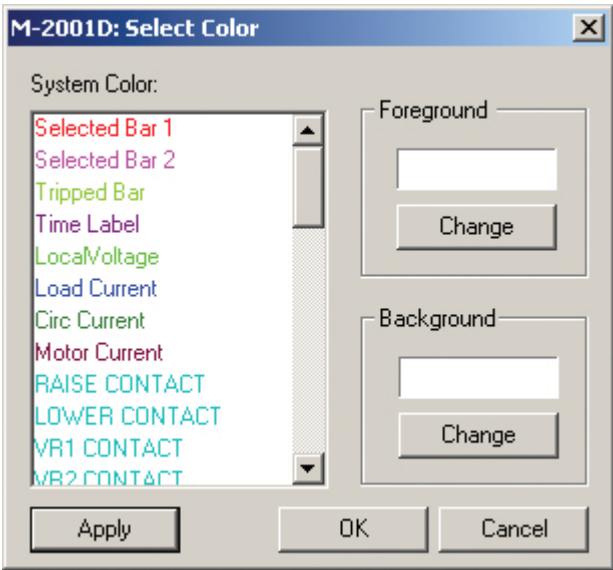


Figure 195: Select Color Dialog Screen

Change Scale provides the user with the capability to change the scaling of the displayed parameter.

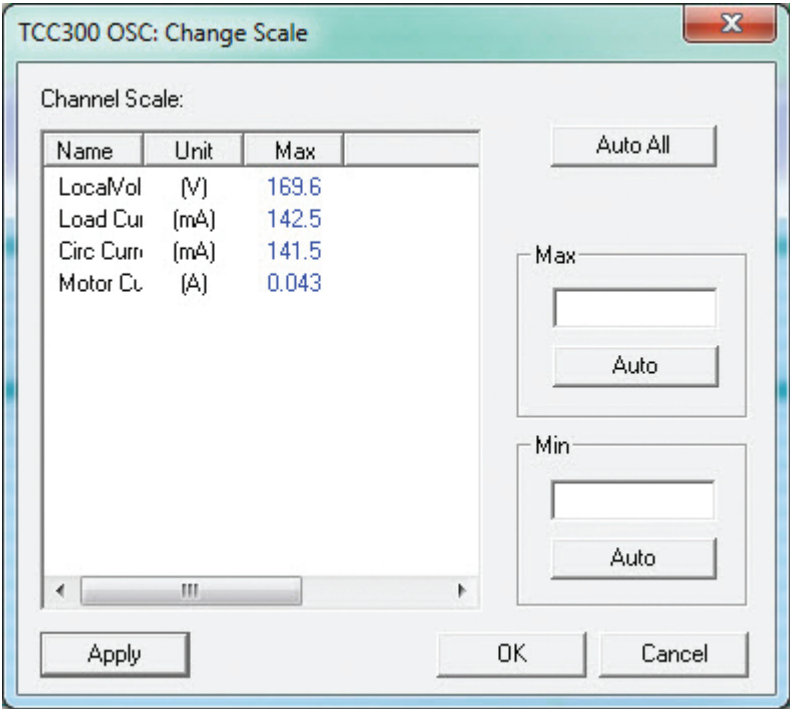


Figure 196: Change Scale Screen

Search Time Stamp provides the user with the capability to place the marker exactly at the desired time stamp in the TapPlot® window.

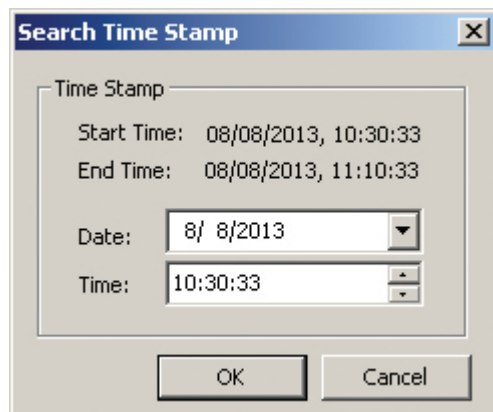


Figure 197: Search Time Stamp Scree

Help Menu



Figure 198: Help menu

The Help menu provides access to the Quick Guide which provides basic information about TapPlot menus and commands. The About command provides version information for TapPlot.

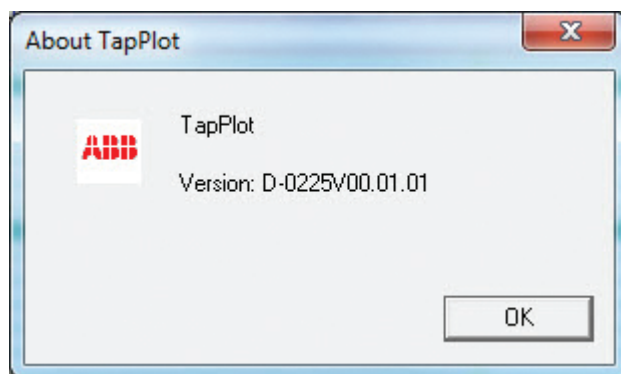


Figure 199: About TapPlot Screen

4.11.1

Starting TapPlot

1. Select the TapPlot menu item from the TCC600 Menu (Utility/TapPlot.) The TapPlot Window and Toolbar is displayed.

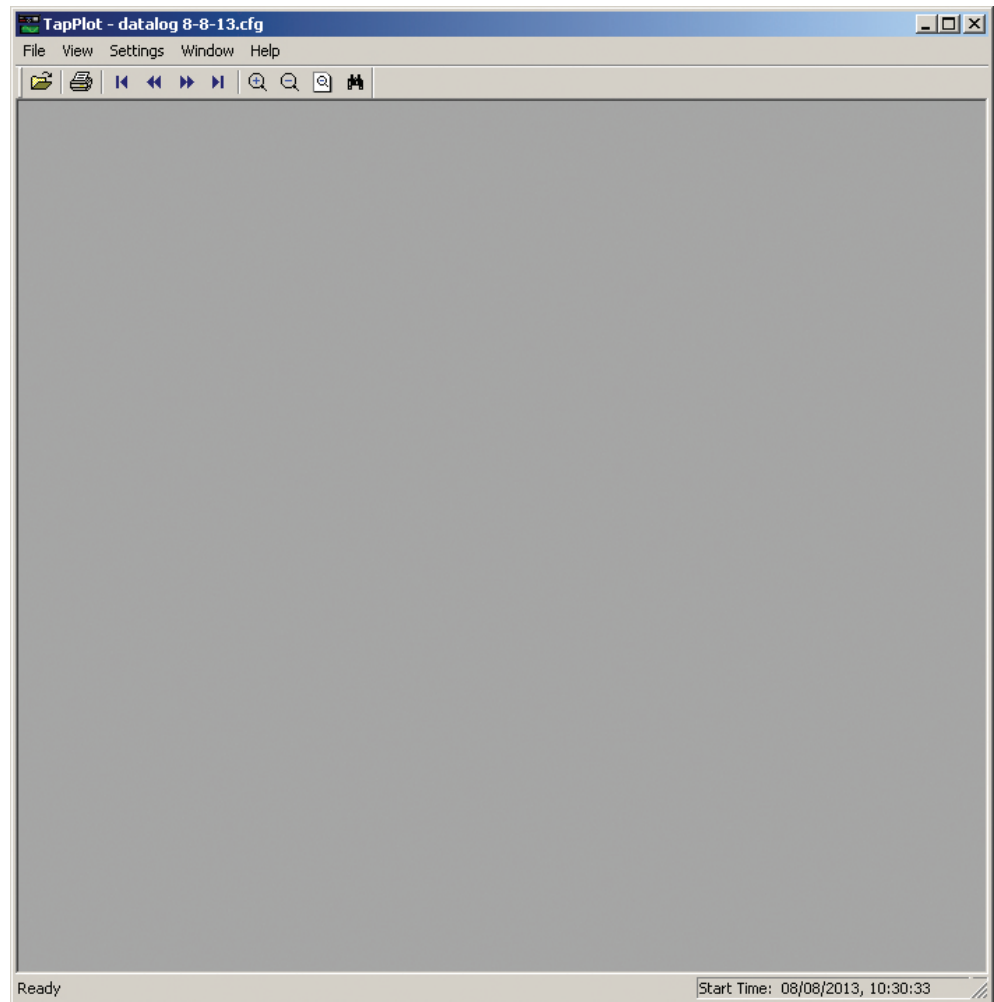


Figure 200: TapPlot Main Window with Submenus

2. Select File/Open from the menu, and browse for the .cfg file.
3. Open the file. TapPlot should display the saved data.

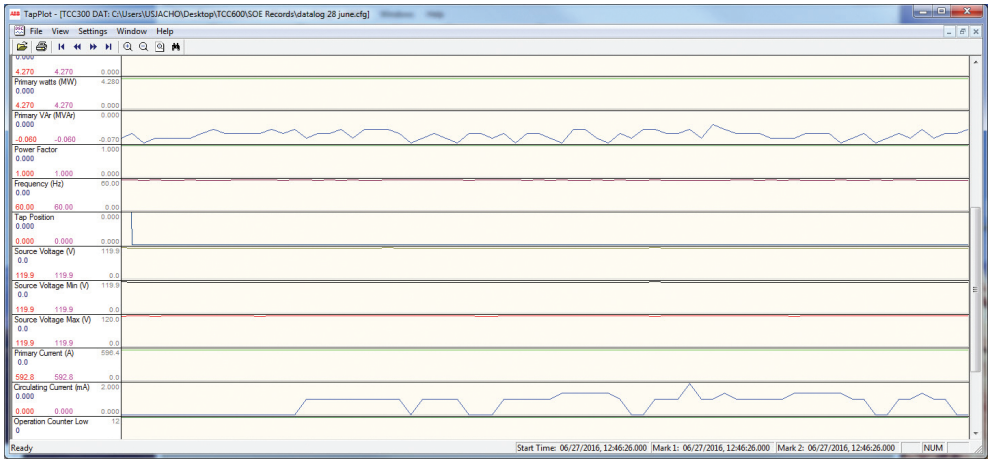


Figure 201: TapPlot Window with Data Logging Data Example

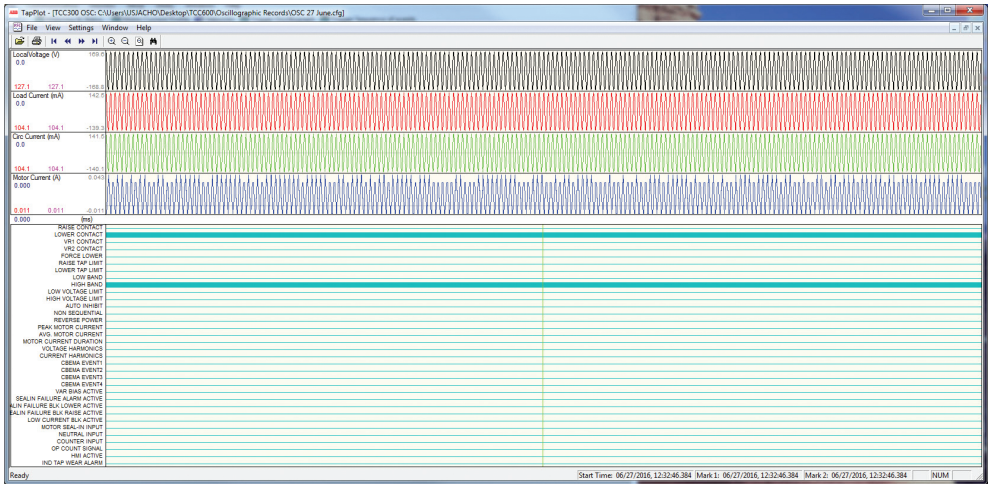


Figure 202: TapPlot Window with Oscillograph Data Example

Section 5 System setup



Appendix A includes the HMI menu structure for reference. Appendix B is available to document control settings.

5.1 General unit setup

The General Unit setup consists of the setup of the following features and functions:

- User Access Codes
- User Lines
- System Clock
- Time and Date

5.1.1 User access codes

To prevent unauthorized access to the control functions, there are provisions in the software for assigning a Level 1 and/or Level 2 Access Code (up to six characters). A fixed factory assigned Level 3 Access Code is required for changing calibration factors. When Level 1 or Level 2 Access Codes are active, then an additional 30 Level Access Codes (up to 15 characters) can be enabled as either Level 1 or Level 2. The Access Codes can be set in the Communication/HMI Menu or from TCC600®.

Level Access protection will be automatically reinstated when either of the following conditions are met:

- No HMI menu activity for a period of 15 minutes
- The user exits to the top of the HMI menu for a period of greater than 10 seconds

General access to read setpoints, to monitor status, to reset draghand parameters and the resettable operations counter do not require an Access Code.

The Level 1 Access Code, if set, is required to make setpoint changes. If the Level 1 Access Code is set to all zeros, this request for an Access Code will not be seen and changes can be made without an Access Code. The default Level 1 Access Code is 000000.

The Level 2 Access Code, if set, is required to make changes to the configuration, communication, and utilities. If the Level 2 Access Code is set to all zeros, this request for an Access Code will not be seen and changes can be made without an Access Code. The default Level 2 Access Code is 222222.

The Level 3 Access Code is required to make changes to calibration settings on the control. Contact ABB Customer Service for TCC300 Level 3 Access Codes.



Record all user access codes in a secure location. Contact the factory if the user access code is lost or forgotten.

Smart Flash SD Card User Access Key Code

If a Smart Flash SD Card inserted into the control has a valid Access Level 1 or Access Level 2 code written to it, the control will accept the code and not prompt for an Access Code.

HMI Level Access Prompt

When Level Access is active, the control will display an "Enter Level 1 (2 or 3) Access" screen if applicable. A valid Level Access Code should be entered to operate the control.

5.1.1.1

Setting level 1 or level 2 user access codes from the HMI



Level 1 and Level 2 User Access Codes are alphanumeric. The alphabetic characters are upper case only.

When changing an access code, if no key entry is made for approximately 15 minutes, and the screen goes blank, and the digit furthest to the left has not been entered, the user access code will revert to the previous one regardless of digits that have been changed. After a new Level 2 User Access Code has been entered, the new User Access Code must be used to re-enter the Communications/HMI menu. Be sure to record the new user access code for future use.

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings" or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "HMI" is displayed.
3. Press the Down arrow, as necessary, until the following is displayed.

Level 1 Access Code Pres ENT to change

4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Change Access Code 000000



When entering the new user access code the display will automatically advance the cursor to the next digit when input is momentarily paused.

5. Utilizing the arrow pushbuttons, enter the new Level 1/Level 2 User Access Code, then press the ENT pushbutton. The following will be displayed:
Access Code Updated

As soon as new User Access Codes are entered, they will be required to change any setpoint or configuration parameter.

5.1.1.2

Setting level 1 or level 2 user access codes from TCC600

1. Select **Utility/Change User Access Code** from the TCC600® toolbar. TCC600 will display the "Change User Access Code" dialog screen.

Figure 203: Change User Access Code Dialog Screen

2. Input a new Level 1/Level 2 six digit alphanumeric User Access Code.
3. Input the User Access Code from Step 2, in **Confirm New User Access Code**.
4. Select **Save**. TCC600 will display a "Save to Device" confirmation screen.

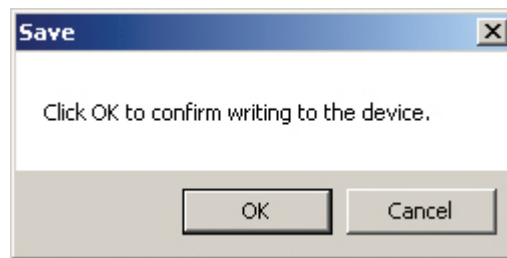


Figure 204: Save to Device Confirmation Screen

5. Select **OK**. TCC600 will display an "Access Codes Were Changed Successfully" confirmation screen.

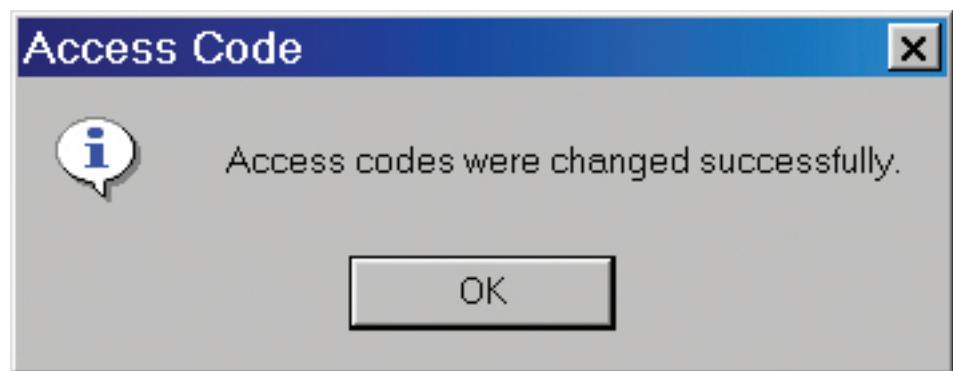


Figure 205: Access Codes Were Changed Successfully Dialog Screen

6. Select **OK**. TCC600 will return to the Main Screen.

As soon as new User Access Codes are entered, they will be required to change any setpoint or configuration parameter.

5.1.1.3

Setting multi level access codes from TCC600

The Multi Level Access Code feature allows the user to create up to 30 unique Access Codes. Each Access Code can be up to 15 characters in length including spaces. After creating a list of Access Codes, the list can be saved to either the host computer or to the control. The Access Code file is encrypted for security measures.

1. Select **Utility/Multi Level Access Code/Send/Retrieve** from the TCC600® toolbar. TCC600 will display the "Multi Level Access Code" dialog screen.

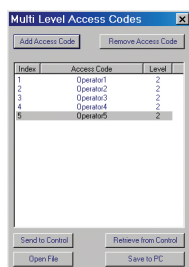


Figure 206: Multi Level Access Code Dialog Screen

2. Select "Add Access Code". TCC600 will display the next consecutive Access Code Index with a default Level 2 access.
3. Select the desired index (left click), then double left click. TCC600 will display the Access Code entry/edit dialog box.
4. Enter/Edit the Access Code, then click off the Access Code in the dialog screen.
5. Select "Save to PC". TCC600 will display the "Save As" dialog screen with an *.xml default file extension.
6. Enter the desired file name and destination folder, then select "Save".
7. To send the Multi Level Access Code file to the control select "Send to Control". TCC600 will display the "Access Level Code" dialog screen.

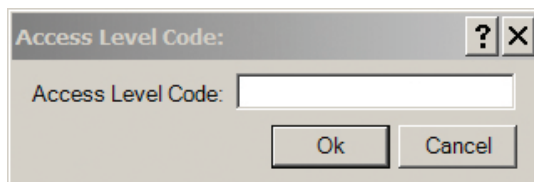


Figure 207: Access Level Code Dialog Screen

8. Enter a valid Level 2 Access Code, then select **OK**. If a valid Level 2 Access Code was entered, then TCC600 will display the "Access granted successfully" dialog screen. If not, re-enter a valid code.



Figure 208: Access Key Dialog Screen

9. Select **OK**, TCC600® will display the "Authentication Key generated successfully" dialog screen.



Figure 209: Authentication Key Generated Successfully Dialog Screen

10. Select **OK**, TCC600 will display the "Open" dialog screen.
11. Select the Access Code file to be sent to the control, then select "Open". TCC600 will briefly display a status dialog screen followed by a "Multi Access Code Upload" dialog screen.

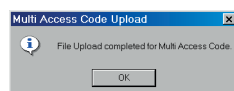


Figure 210: Multi Access Code Upload Complete

12. Select **OK**. TCC600 will return to the Multi Level Access Code dialog screen.

5.1.2

User lines

The user station identification lines (User Lines) allow the user to uniquely identify the unit. Each line of this display can have up to 20 ASCII characters. User Lines are factory preset with "ABB" for Line 1 and "TCC300" for Line 2.

When ENT is pressed at the Communications/HMI/User Line 1 or User Line 2 menu, an underline cursor is displayed under the left-most digit. Each digit is changed by using the Up and Down pushbuttons to select the ASCII character (the ASCII character list begins with "!"). The Left or Right pushbutton is used to move the underline to the next digit. When the ENT pushbutton is pressed, the new user line is stored into nonvolatile memory.

5.1.2.1

Setting user lines from the HMI

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings" or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "HMI" is displayed.
3. Press the Down arrow as necessary until the following is displayed:
User Line 1 E ABB
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
New User Line 1 ABB



When entering the new User Line the display will automatically advance the cursor to the next digit when input is momentarily paused.

- Utilizing the arrow pushbuttons enter the new Line 1/Line 2 user line(s), then press the ENT pushbutton. The following will be displayed.
User Line 1 E ABB

5.1.2.2

Setting user lines from TCC600

- Select **Utility/Control Information** from the TCC600® toolbar. TCC600 will display the Control Information dialog screen.

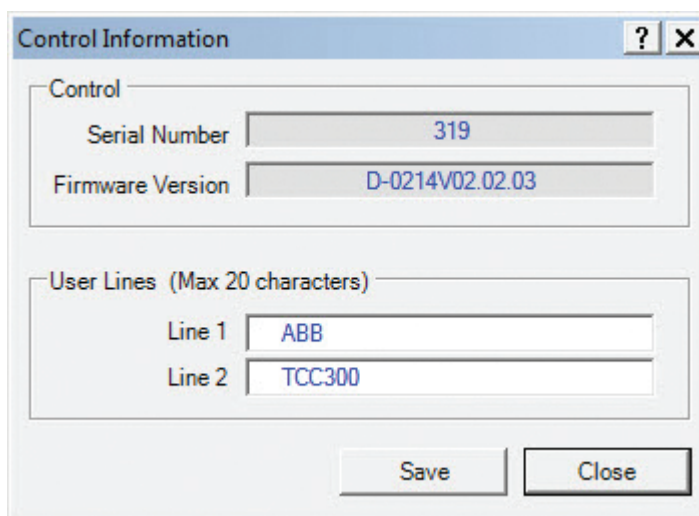


Figure 211: Control Information Screen

- Input the new Line 1/Line 2 Information.
- Select Save. TCC600 will display a "Confirm Writing to Device" confirmation screen.

5.1.3

System clock

The control is equipped with a real-time, 24-hour clock which is used with the Demand History feature to record date/time stamp information on quantities saved in memory.

The power source for the clock is maintained for at least 24 hours during a system power outage by a charged capacitor (no battery). If the power outage lasts longer than 24 hours, check the clock and reset if necessary.

The system clock includes the capability to automatically switch to and from daylight savings time.

5.1.3.1

Setting time/date and daylight savings from the HMI



Whenever clock is reset and data logging is enabled, the data log should be cleared.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to awaken the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right/Left arrow pushbuttons, as necessary, until the "System Clock" screen is displayed.
4. Press the Down arrow pushbutton, as necessary, until the "Set Date and Time" dialog screen is displayed.
Set Date and Time
MM/DD/YY HH:MM:SS
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Set Date and Time
MM/DD/YY HH:MM:SS C



The cursor will be positioned under the far left hand "Month" element of the date. Utilizing the Up/Down arrow pushbuttons will change the Month. Utilizing the Right/Left arrow pushbuttons will move the cursor between each element of the date and time.

6. Utilizing the arrow pushbuttons enter the desired Date and Time, then press the ENT pushbutton.
7. Press the Down arrow pushbutton, as necessary, until the "Daylight Savings" dialog screen is displayed.
8. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Daylight Savings
disable C
9. Utilizing the Up/Down arrow pushbuttons select "ENABLE", then press the ENT pushbutton. The following will be displayed:
Daylight Savings
ENABLE

5.1.3.2

Setting date/time and daylight savings from TCC600

1. Select **Utility/Set Date & Time** from the TCC600® toolbar. TCC600 will display a Warning regarding time stamped values. Select OK.

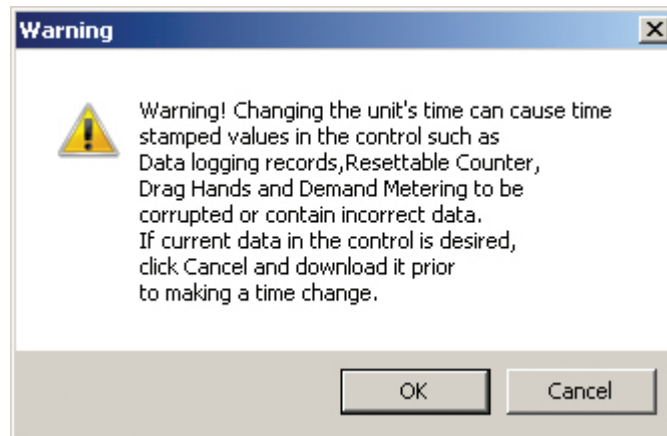


Figure 212: Set Date/Time Warning Dialog Screen

2. From the Set Control Date/Time dialog screen select either "Control Clock" or "PC Clock".

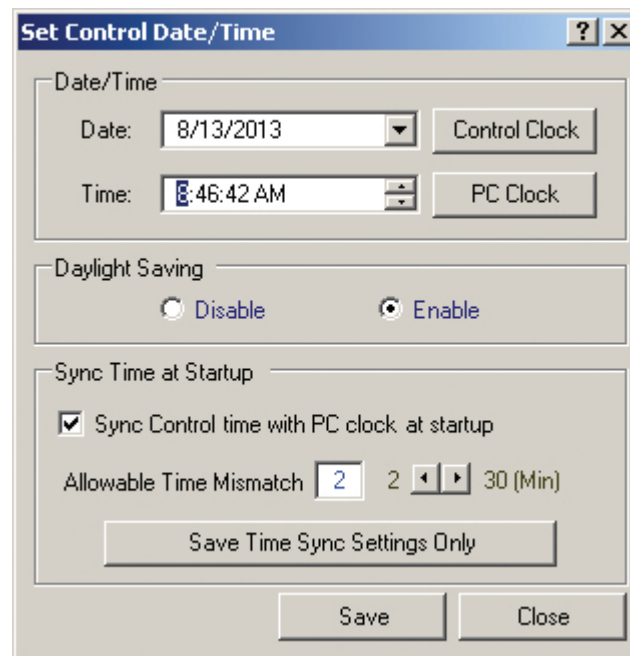


Figure 213: Set Control Date/Time Dialog Screen

3. Verify that the desired Daylight Saving setting is selected.
4. If desired select "Sync Time at Startup" and the desired "Allowable Time mismatch" value.
5. Determine if the control is to be set to either "PC Clock" or "Control Clock", then proceed as follows:
 - If "PC Clock" was selected and the Date/Time of the PC is the desired time to be set in the control, then select Save.
 - If "Control Clock" was selected, input the desired Date/Time, then select Save.

TCC600 will respond with a Reset Demand and Energy warning screen.

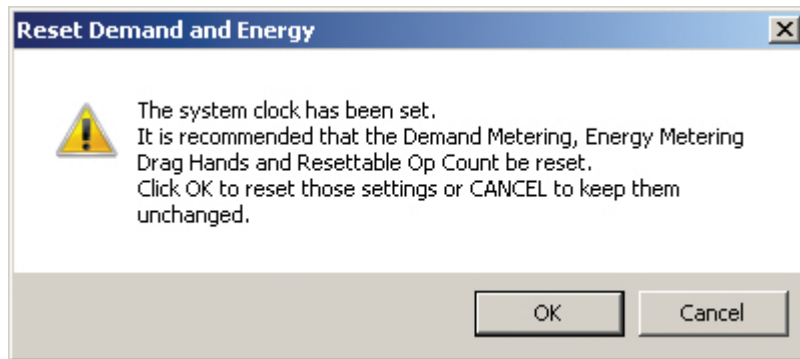


Figure 214: Reset Demand and Energy Warning Dialog Screen



Whenever the clock is reset and data logging is enabled the data log should be cleared.

6. Select OK to reset Demand Metering, Energy Metering, Drag Hands and Resettable Operation Counter or Cancel which will not reset these parameters. TCC600 will return to the Main Screen.

5.2 Oscillograph setup

The Oscillograph Recorder provides comprehensive data recording (voltage, current, and status input/output signals) for all monitored waveforms. Oscillograph data can be downloaded using the communications ports to any PC compatible personal computer running the TCC600® Communications Software. Once downloaded, the waveform data can be examined and printed using TapPlot® Analysis Software. The waveform data is also available in COMTRADE file format. Oscillograph records are retained if power to the control is interrupted.

The general information required to be input to complete the Oscillograph Setup includes:

- Number of Partitions – When untriggered, the recorder continuously records waveform data, keeping the data in a buffer memory. The recorder's memory may be partitioned into 1 to 16 partitions. When triggered, the time stamp is recorded, and the recorder continues recording for a user-defined period. The snapshot of the waveform is stored in memory for later retrieval using TapPlot Analysis Software.
- Samples/Cycle – The number of samples/cycle can be selected to either 16, 32 or 64 samples/cycle.
- Post-Trigger Delay – A post-trigger delay of 5% to 95% must be specified. After triggering, the recorder will continue to store data for the programmed portion of the

total record before re-arming for the next record. For example, a setting of 80% will result in a record with 20% pre trigger data, and 80% post-trigger data.

- Inputs and Outputs – The recorder can be triggered remotely through serial communications using TCC600, or automatically, using programmed status signals.

Table 54: *Recorder Partitions and Cycles for 16 Samples/Cycle*

Number of partitions	Cycles per partition
1	1365
2	910
3	682
4	546
5	455
6	390
7	341
8	303
9	273
10	248
11	227
12	210
13	195
14	182
15	170
16	160

5.2.1

Setting up the oscillograph recorder



Communication must be established with the target control for this procedure. When not connected to the control, the Send selection does not save the Oscillograph Recorder settings to an open file.

1. From the TCC600® Main Screen menu, select **Setup/Oscillograph/Setup**. TCC600 will display the Oscillograph Setup dialog screen.

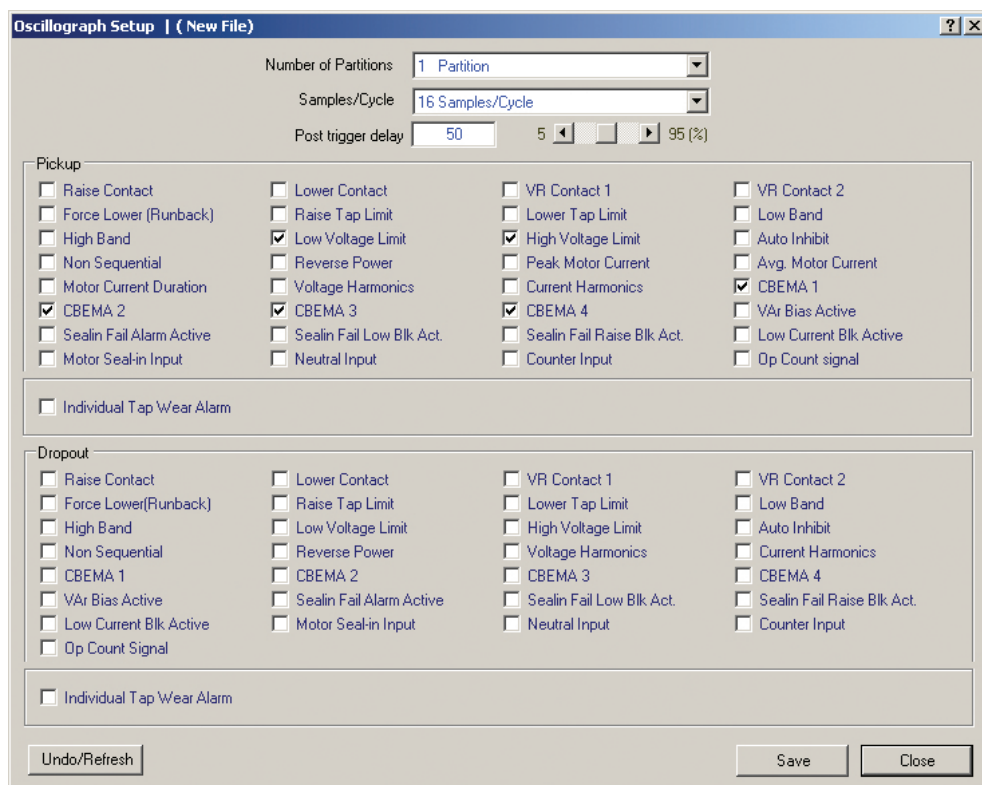


Figure 215: Oscillograph Setup Dialog Screen

2. Select the **Number of Partitions**. The recorder's memory may be partitioned into 1 to 16 partitions. The Oscillograph Recorder memory buffer is fixed and contains room for a finite number of cycles of recorded data. Consider [Table 54](#) when determining the number of Oscillograph records. The number of cycles of recorded data is directly related to the number of records selected.
3. Select the number of **Samples/Cycle**. The number of Samples/Cycle can be selected to either 16, 32 or 64 Samples/Cycle.
4. Select the **Post Trigger Delay**. A post - trigger delay of 5% to 95% must be specified. After triggering, the recorder will continue to store data for the programmed portion of the total record before re-arming for the next record. For example, a setting of 80% will result in a record with 20% pre-trigger data, and 80% post-trigger data.
5. Select the desired **Pickup Trigger(s)** and **Dropout Trigger(s)**. The recorder can be triggered remotely through serial communications using TCC600, or automatically, using programmed status inputs or outputs.
6. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.
7. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

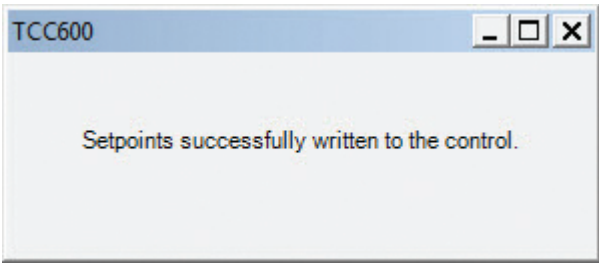


Figure 216: Setpoints Successfully Written To The Control Confirmation Screen

5.3 Sequence of events recorder

The Sequence of Events recorder provides comprehensive time tagged data recording of the following parameters:

- Time Tag
- Local Voltage
- Source Voltage
- Frequency
- Tap Position
- Motor Current
- Load Current
- Counter Operation (presettable)
- Voltage Harmonics Values
- Current Harmonics Values
- Voltage Harmonics Status
- Current Harmonics Status

The total number of events that can be recorded is 132. Sequence of Events data can be downloaded using the communications ports to any computer running the TCC600® Communications Software. The Sequence of Events Recorder can be triggered by the status change of any of the signals in [Table 54](#) or manually by the user from TCC600.

Table 55: Sequence of Events Recorder Triggers

Sequence of Events Recorder Triggers	State
Raise Command	Initiated
Lower Command	Initiated
VR Contact 1	True
VR Contact 2	True
Table continues on next page	

Sequence of Events Recorder Triggers	State
Force Lower (Runback)	Initiated
Raise Tap Limit	True
Lower Tap Limit	True
Low Band	Exceeded
High Band	Exceeded
Low Voltage Limit	True
High Voltage Limit	True
Auto Inhibit	True
Non-Sequential	Exceeded
Reverse Power	Detected
Peak Motor Current	Exceeded
Average Motor Current	Exceeded
Motor Current Duration	Exceeded
Voltage Harmonics	Exceeded
Current Harmonics	Exceeded
CBEMA Event 1	True
CBEMA Event 2	True
CBEMA Event 3	True
CBEMA Event 4	True
VAr Bias	Active
Seal-in Failure Alarm	Active
Seal-in Failure Raise Block	Active
Seal-in Failure Lower Block	Active
Low Current Block	Active
Motor Seal-in Input	Detected
Neutral Input	Detected
Counter Input	Detected
Op Count Signal	Exceeded
HMI Active	True
Individual Tap Wear Alarm	Active

Event Logic

Combinations of the trigger signals in [Table 54](#) can be AND'ed and OR'ed to produce the desired trigger logic. [Figure 217](#) illustrates the trigger logic that can be applied.

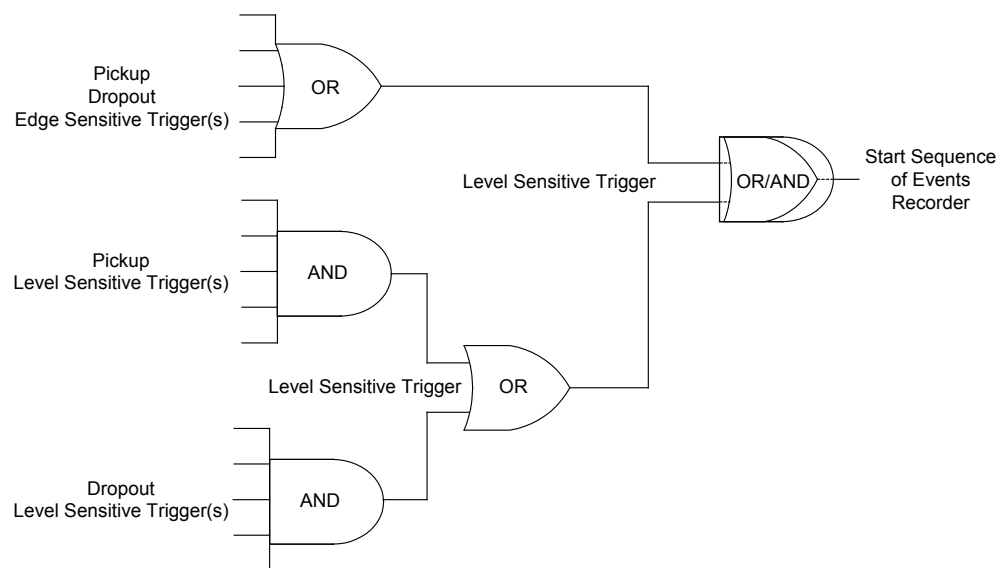


Figure 217: Sequence Of Events Recorder Trigger Logic

The first level of the Event Logic consists of an "AND" gate and an "OR" gate which uses the trigger parameters in [Table 54](#) as inputs. The output of the "AND" and "OR" gates are passed to a logic gate that is user selectable as either an "AND" or "OR" gate. When the logic is true, it triggers the Sequence of Events Recorder.

The event will be recorded in volatile SDRAM and transferred to non-volatile flash memory every four cycles. There is a possibility that events can be lost in cases where the control loses power in the middle of a storage cycle.

5.3.1

Setting up the sequence of events recorder

Pickup or Dropout for each trigger parameter may be selected to trigger the Sequence of Events Recorder.



Communication must be established with the target control for this procedure. When not connected to the control, the Save selection does not save the Sequence of Event settings to the open file.

1. From the TCC600® Main Screen menu select **Setup/Sequence of Events/Setup**. TCC600 will display the Sequence of Events Setup dialog screen.

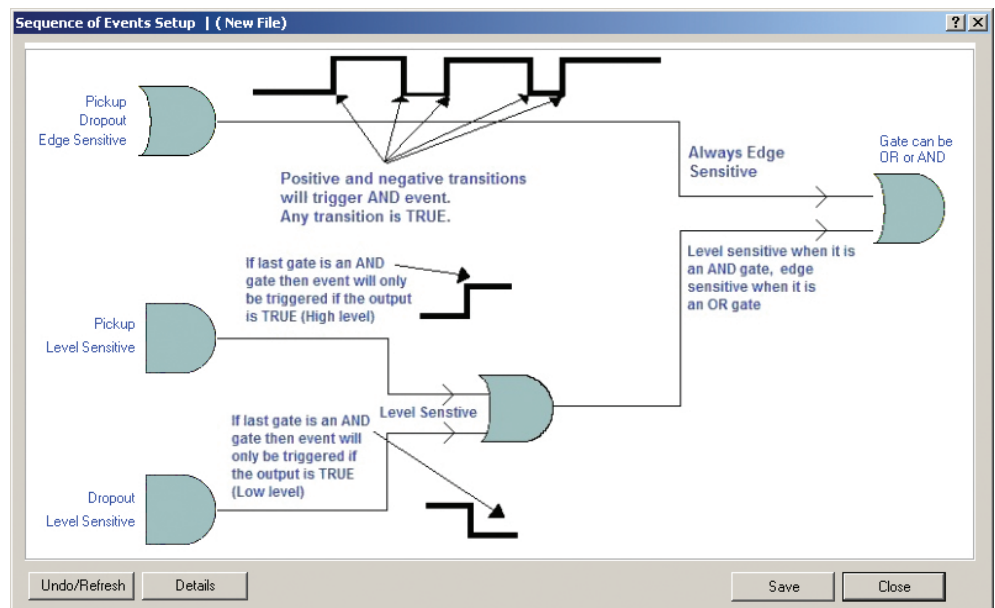


Figure 218: Sequence of Events Setup Dialog Screen

2. If an "OR" type trigger logic is desired, then select "Pickup Dropout Edge Sensitive". TCC600 will display the "OR gate setup" dialog screen. Select the desired "OR gate setup", Pickup and/or Dropout trigger parameters, and then select **OK**. TCC600 will return to the Sequence of Events setup dialog screen.

The image shows a software dialog box titled "OR Gate Setup". It contains two main sections: "Pickup (Edge Sensitive)" and "Dropout (Edge Sensitive)". Each section has a grid of 16 checkboxes for various parameters. In the Pickup section, the following are checked: Force Lower (Runback), Non Sequential, CBEMA Event 2, Sealin Fail Alarm Active, Raise Tap Limit, Low Voltage Limit, Reverse Power, CBEMA Event 3, Lower Tap Limit, High Voltage Limit, Peak Motor Current, CBEMA Event 4, and VR Contact 1. In the Dropout section, the following are checked: Force Lower (Runback), Non Sequential, VAr Bias Active, Low Current Blk Active, Raise Tap Limit, Low Voltage Limit, Reverse Power, CBEMA Event 2, Lower Tap Limit, High Voltage Limit, Voltage Harmonics, CBEMA Event 3, Sealin Fail Low Blk Act., and VR Contact 1. Both sections also have checkboxes for "HMI Active" and "Individual Tap Wear Alarm", which are currently unchecked. An "OK" button is located at the bottom right of the dialog.

Pickup (Edge Sensitive)			
<input type="checkbox"/> Raise Contact	<input type="checkbox"/> Lower Contact	<input type="checkbox"/> VR Contact 1	<input type="checkbox"/> VR Contact 2
<input checked="" type="checkbox"/> Force Lower (Runback)	<input checked="" type="checkbox"/> Raise Tap Limit	<input checked="" type="checkbox"/> Lower Tap Limit	<input type="checkbox"/> Low Band
<input type="checkbox"/> High Band	<input checked="" type="checkbox"/> Low Voltage Limit	<input checked="" type="checkbox"/> High Voltage Limit	<input checked="" type="checkbox"/> Auto Inhibit
<input checked="" type="checkbox"/> Non Sequential	<input checked="" type="checkbox"/> Reverse Power	<input type="checkbox"/> Peak Motor Current	<input type="checkbox"/> Avg. Motor Current
<input type="checkbox"/> Motor Current Duration	<input type="checkbox"/> Voltage Harmonics	<input type="checkbox"/> Current Harmonics	<input checked="" type="checkbox"/> CBEMA Event 1
<input checked="" type="checkbox"/> CBEMA Event 2	<input checked="" type="checkbox"/> CBEMA Event 3	<input checked="" type="checkbox"/> CBEMA Event 4	<input checked="" type="checkbox"/> VAr Bias Active
<input checked="" type="checkbox"/> Sealin Fail Alarm Active	<input type="checkbox"/> Sealin Fail Low Blk Act.	<input type="checkbox"/> Sealin Fail Raise Blk Act.	<input type="checkbox"/> Low Current Blk Active
<input type="checkbox"/> Motor Seal-in Input	<input type="checkbox"/> Neutral Input	<input type="checkbox"/> Counter Input	<input type="checkbox"/> Op Count Signal
<input type="checkbox"/> HMI Active <input type="checkbox"/> Individual Tap Wear Alarm			

Dropout (Edge Sensitive)			
<input type="checkbox"/> Raise Contact	<input type="checkbox"/> Lower Contact	<input type="checkbox"/> VR Contact 1	<input type="checkbox"/> VR Contact 2
<input checked="" type="checkbox"/> Force Lower (Runback)	<input checked="" type="checkbox"/> Raise Tap Limit	<input checked="" type="checkbox"/> Lower Tap Limit	<input type="checkbox"/> Low Band
<input type="checkbox"/> High Band	<input checked="" type="checkbox"/> Low Voltage Limit	<input checked="" type="checkbox"/> High Voltage Limit	<input checked="" type="checkbox"/> Auto Inhibit
<input type="checkbox"/> Non Sequential	<input type="checkbox"/> Reverse Power	<input type="checkbox"/> Voltage Harmonics	<input type="checkbox"/> Current Harmonics
<input type="checkbox"/> CBEMA Event 1	<input type="checkbox"/> CBEMA Event 2	<input type="checkbox"/> CBEMA Event 3	<input type="checkbox"/> CBEMA Event 4
<input checked="" type="checkbox"/> VAr Bias Active	<input type="checkbox"/> Sealin Fail Alarm Active	<input type="checkbox"/> Sealin Fail Low Blk Act.	<input type="checkbox"/> Sealin Fail Raise Blk Act.
<input type="checkbox"/> Low Current Blk Active	<input type="checkbox"/> Motor Seal-in Input	<input type="checkbox"/> Neutral Input	<input type="checkbox"/> Counter Input
<input type="checkbox"/> Op Count Signal			
<input type="checkbox"/> HMI Active <input type="checkbox"/> Individual Tap Wear Alarm			

Figure 219: Sequence of Events Pickup/Dropout Edge Sensitive OR Gate Setup Dialog Screen

3. If an "AND" type trigger logic is desired, then select the AND "Pickup" or "Dropout". TCC600 will display the applicable dialog screen. Select the desired "AND gate setup" Pickup and/or Dropout trigger parameters, then select **OK**. TCC600 will return to the Sequence of Events setup dialog screen.

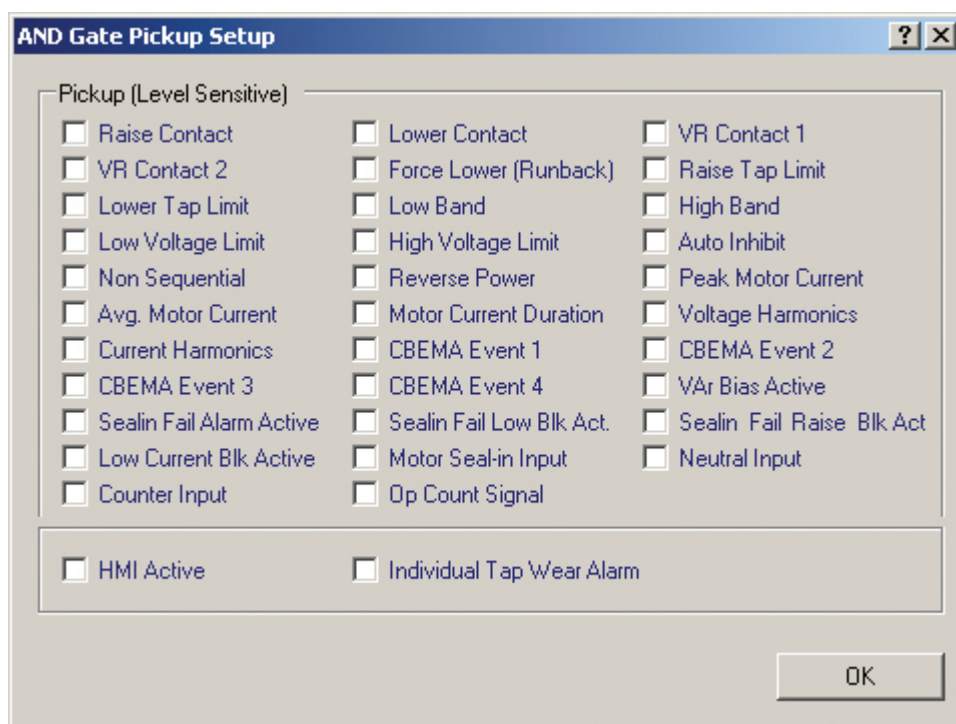


Figure 220: Sequence of Events Pickup Level Sensitive AND Gate Pickup Setup Dialog Screen

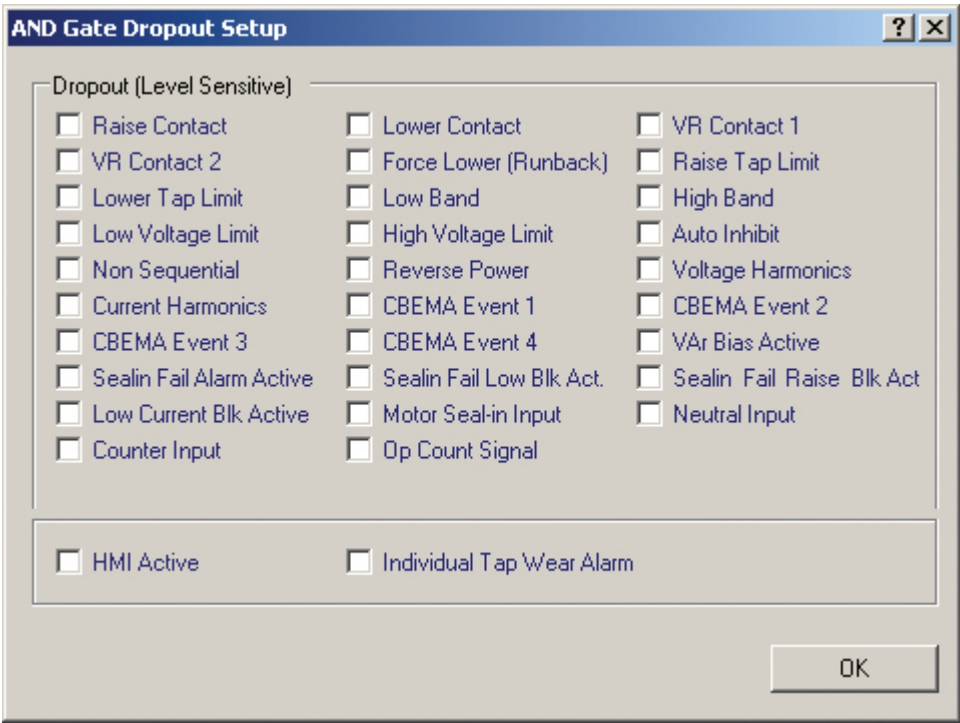


Figure 221: Sequence of Events Dropout Level Sensitive AND Gate Dropout Setup Dialog Screen

4. Select the desired logic gate OR/AND for the "OR" and "AND" gates, then select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

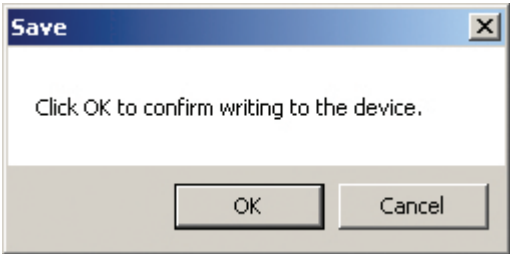


Figure 222: Save to Device Confirmation Screen

5. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

5.4 Wakeup screens

If the "Wake/EXIT" pushbutton is selected, then control will respond as follows:

- Pressing "EXIT" when User Lines are being displayed will initiate a cycling display of the selected Wakeup parameters for a period of 15 minutes and then return to the User Lines display.
- If no Wakeup screens are selected, then nothing will be displayed and the User Lines will blink for a moment.



The Adapter Panel Drag Hand Reset switches only reset the Tap position Drag Hands value.

- While cycling is in effect, when ENT is pressed on any demand metering value ("E" displayed on screen), all demand metering Drag Hand parameters will be reset. This is also true for all metering Drag Hand values when ENT is pressed on an energy metering menu.
- The Wakeup stepped display can be stopped on the displayed parameter by pressing EXIT. Press EXIT again to terminate the stepped parameter display and return to the User Lines. The Wakeup screen values can be browsed by utilizing the Up and Down arrow pushbuttons. In this mode, if the ENT pushbutton is pressed while on a demand or energy metering value, it will only reset that individual Drag Hand value.
- The Wake screen cycles at a 3 second interval between parameters. While the wake screen menu is cycling, if a parameter is missed while recording, press the up arrow to display it again. This displays the previous parameter and then continues cycling to the next parameter 3 seconds later. Pressing ENT stops the cycling and allows the user to utilize the Up and Down Arrows to view the Wake screen parameters at a user defined pace.
- When there is a Smart Flash SD Card present while in the Wakeup screen menu, an additional Smart Flash SD Card menu item will be present. All Wakeup screen parameters can be saved to the Smart Flash SD Card in *.csv format.

5.4.1

Selecting wakeup screen parameters

1. Select **Setup/Wakeup Screens** from the TCC600® toolbar. TCC600 will display the "Wakeup Screen Menu Setup" dialog screen.

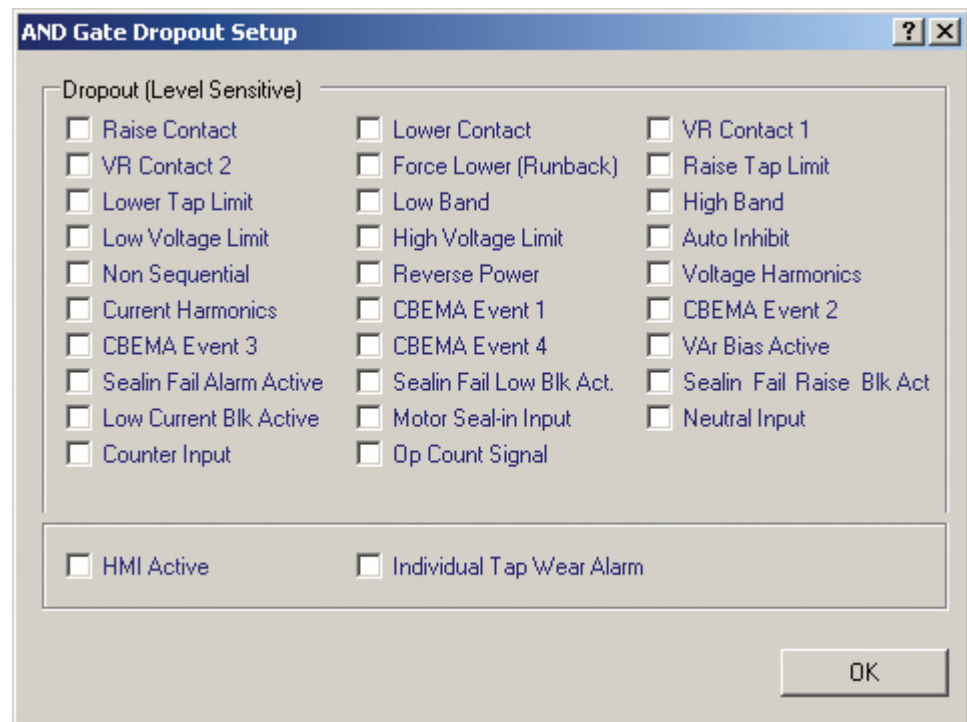


Figure 223: Wakeup Screen Menu Setup Dialog Screen



The order in which parameters are being displayed can be changed by dragging and dropping items in the active metering window.

2. Select the Wakeup Screen parameters to be displayed by moving, (dragging and dropping), each parameter from the "Disable Metering Items" to the "Active Metering Items" list.
3. Select the Wakeup Screen parameters that are not to be displayed by moving (dragging and dropping) those parameter from the "Active Metering Items" list to the "Disable Metering Items" list.
4. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.
5. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

5.5 Communication

The communication ports provide access to all features, including metering, software updates, and programming of all functions. This is accomplished using a connection from

any Windows™ computer running the TCC600® Communications Software or SCADA communications software.

Using a PC, the operator has real-time, remote access to all functions of the Digital Tapchanger Control. The control can act as the monitoring point for all voltage, current, and related power quantities. This simplifies operation while avoiding transducers and multiple Remote Terminal Unit (RTU) analog inputs. The protocols implement half-duplex, two-way communications. This allows all functions, which would otherwise require the presence of an operator at the control, to be performed remotely.

Communication capabilities include:

- Interrogation and modification of setpoints
- Broadcast of commands, such as tapchange inhibit and voltage reduction (up to three steps) to networked controls
- Recognition of alarm conditions, such as voltage extremes and excessive load
- Selective control of raise and lower tapchange operations
- Re-configuration of the control, such as a change to the demand integration time period or a selection of different alarm parameters

TCC600 provides the means to enable or disable installed RS-232 and Bluetooth® modules. This capability is provided by a communication options utility under the Communication menu. Prompts to enable communication hardware are also contained in the individual port setup menus.

Direct Connections

TCC600 supports direct communication (MODBUS® protocol) with a ABB Digital Tapchanger Control using the applicable connector (USB cable) for the PC, Fiber Optic communication using ST standard, two-wire RS-485 or RS-232.

Protocols

The standard protocols included in the TCC300 are DNP3.0 and MODBUS. IEC 61850 is available as an option. The USB port uses MODBUS for local communications. The optional Ethernet Port supports DNP over TCP/IP and UDP; MODBUS over TCP/IP and UDP protocol and IEC 61850 over TCP/IP protocols simultaneously. The user must select the protocol that is to be used with the TCC300 Tapchanger Control's RS485/Fiber Optic Port.

Detailed descriptions of the data points used for the standard protocols are available from ABB upon request, and are available for download from our website, www.abb.com.

Communication Access Security and Timeout

When Communication Access Security and Timeout is enabled it applies only when MODBUS has been selected regardless of the physical interface. If enabled the user Level

Access Code must match either the Level 1 or Level 2 Access Codes in order to be granted the access to control settings ascribed to each Level. If an invalid Access Level Code is entered at the connection prompt, then read only access will be granted. TCC600 must be closed for the timeout period specified (1 to 50,000 seconds) in order for any Access Code changes to take effect when this feature is enabled.

5.5.1 Enabling communication access security and timeout from the HMI

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. If Memory Card is displayed, then press the Right or Left arrow pushbutton, as necessary, until "Comm Settings" is displayed.
3. Press the Down arrow pushbutton, as necessary, until the "Comm Access Security" menu item is displayed.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
`Comm Access Security disable C`
5. Utilizing the arrow pushbuttons select "ENABLE", then press the ENT pushbutton. The desired Communication Access Security mode will be displayed.
`Comm Access Security ENABLE or disable`
6. Press the Down arrow pushbutton, as necessary, until the "Comm Access Timeout" menu item is displayed.
7. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
`Comm Access timeout 60 Sec C`
8. Utilizing the arrow pushbuttons enter the desired Comm Access timeout value, then press the ENT pushbutton. The desired Comm Access timeout value will be displayed.

5.5.2 Enabling communication access security and setting timeout from TCC600

1. Select **Communication/Setup/Communication Access Security** from the TCC600® toolbar. TCC600 will display the "Communication Access Security" dialog screen.

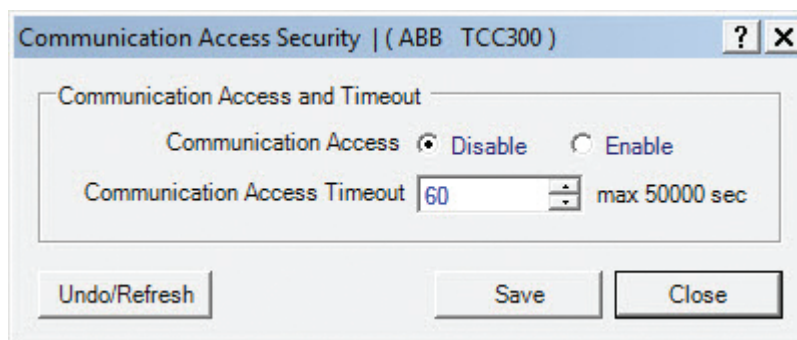


Figure 224: Communication Access Security Setup Dialog Screen

2. Select "ENABLE", then enter the desired Communication Access Timeout value from 1 to 50,000 seconds.
3. Select "Save". TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen

5.6 Source address validation

When Source Address Validation is enabled it applies only when DNP3.0 Protocol has been selected regardless of the physical interface. If enabled the client address must match the address set by the user in the DNP Configuration file before accepting the message as a valid one.

5.6.1 Enabling source address validation from the HMI

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. If Memory Card is displayed, then press the Right or Left arrow pushbutton, as necessary, until "Comm Settings" is displayed.
3. Press the Down arrow pushbutton, as necessary, until the "Source Address Validation" menu item is displayed.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Src Addr Validation disable C
5. Utilizing the arrow pushbuttons select "ENABLE", then press the ENT pushbutton. The desired Source Address Validation mode will be displayed.

5.6.2 Enabling source address validation from TCC600

1. Select **Utility/DNP/Source Address Validation** from the TCC600® toolbar. TCC600 will display the "Source Address Validation" dialog screen.

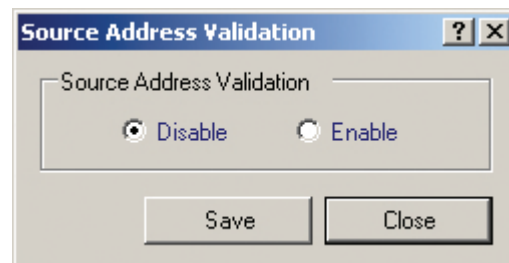


Figure 225: Source Address Validation Dialog Screen

2. Select "ENABLE", then select "Save". TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

5.7 Feeder and substation addressing

Each control has three addresses.

1. Communications address
2. Feeder address
3. Substation address

Any valid DNP command can be used to communicate with individual controls using the Communications address. To address a group of controls using the Feeder and/or the Substation addresses, a DNP command with no acknowledgment shall be used. For example Direct Operate with NO acknowledgment (FC 06). If a command with acknowledgment is sent by the Client, the control will accept the command but will not reply with an acknowledgment.

All addresses range from 0 to 0xFFEF. For feeder and substation addresses, setting the value to zero effectively Disables the corresponding address. It is important that there are no duplicate addresses on any device on the network.

In the system depicted in [Figure 226](#), there are three substations: S1, S2, and S3. There are a total of 9 feeders, F1-F9, grouped as shown. Each feeder has 3 controls, one for each phase. Each control will have 3 addresses assigned to it.

For example: control D1 on Feeder F4 in substation S2 will have the following.

-
1. Individual not duplicated communications address (0x212)
 2. Feeder address = 0x4003
 3. Substation address = 0x5001

In order to poll D1 on an individual basis address, 0x212 is used.

To invoke for example, voltage reduction individually on D1, use direct operate with or without acknowledge for address 0x212 on the appropriate point.

To invoke voltage reduction on Feeder F4, use direct operate without acknowledge to address 0x4003 instead of 3 different commands sent to D1, D2 and D3 individually.

Similarly, invoking voltage reduction on an entire substation requires a direct operate command without acknowledge to be sent to that substation address e.g. substation S2 (address 0x5001).

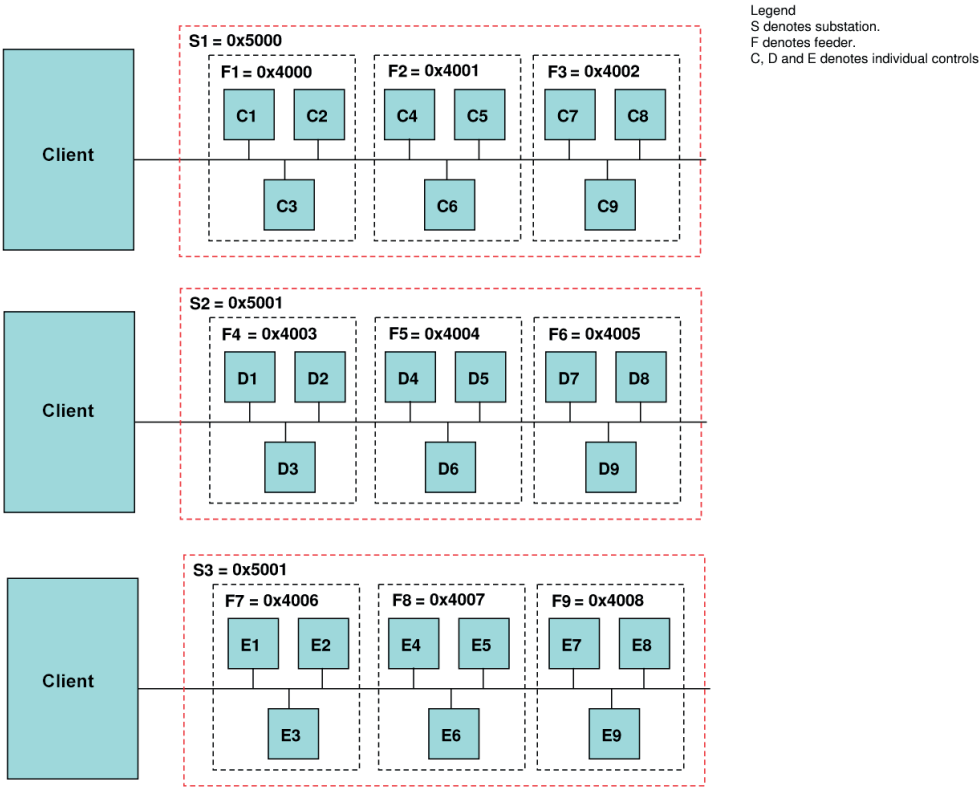


Figure 226: Multiple Client, Feeder and/or Substation Addressing



The same concept applies to network configuration.

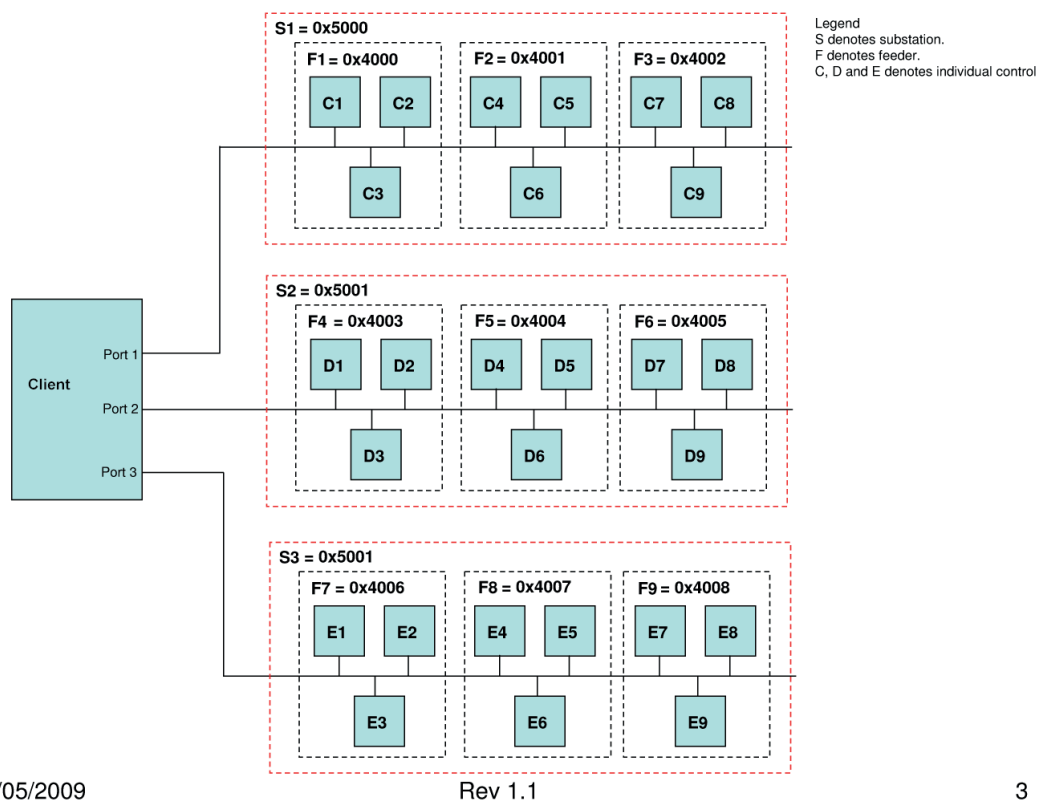


Figure 227: Single Client, Feeder and/or Substation Addressing Network Connection

Ethernet use with Substation and Feeder Addresses

In order to use the Substation and Feeder addresses over ethernet, the user must send the commands as mentioned above using DNP over UDP instead of TCP and must use 255.255.255.255 as the IP address to send to (the DNP Broadcast IP address).

5.7.1 Setting substation address from the HMI

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. If Memory Card is displayed, then press the Right or Left arrow pushbutton, as necessary, until "Comm Settings" is displayed.
3. Press the Down arrow pushbutton, as necessary, until the "Substation Address" menu item is displayed.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Substation Address 0 C



When entering the digital values the display will automatically advance the cursor to the next digit when input is momentarily paused.

5. Utilizing the arrow pushbuttons enter the desired Substation Address, then press the ENT pushbutton. The desired Substation Address will be displayed.

5.7.2 Setting feeder address from the HMI

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. If Memory Card is displayed, then press the Right or Left arrow pushbutton, as necessary, until "Comm Settings" is displayed.
3. Press the Down arrow pushbutton, as necessary, until the "Feeder Address" menu item is displayed.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Feeder Address 0
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Feeder Address 0 C



When entering the digital values the display will automatically advance the cursor to the next digit when input is momentarily paused.

- Utilizing the arrow pushbuttons enter the desired Feeder Address, then press the ENT pushbutton. The desired Feeder Address will be displayed.

5.7.3

Setting communication addresses from TCC600

- Select **Communication/Setup/Change Address** from the TCC600® toolbar. TCC600 will display the "Change Address Warning" dialog screen.

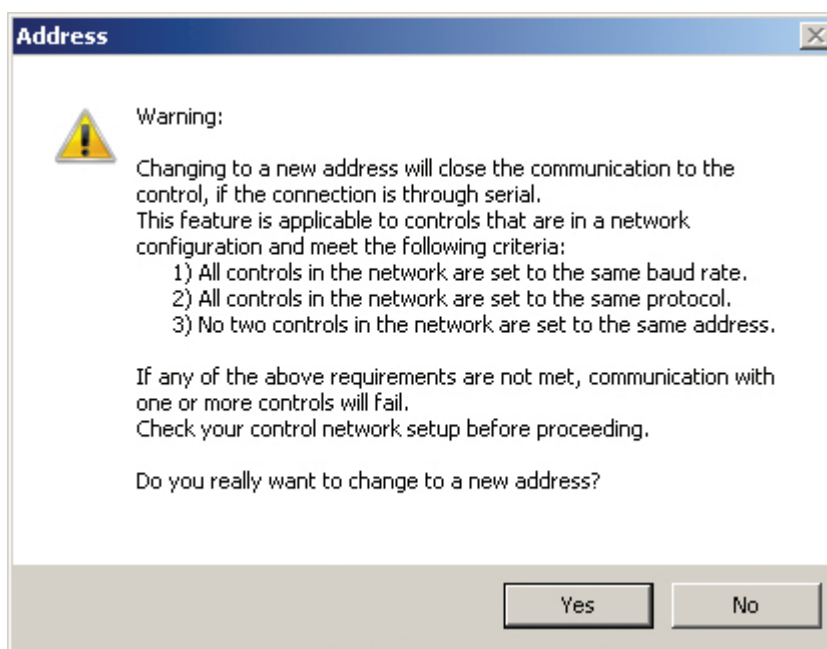


Figure 228: Change Address Warning Dialog Screen

- Select **Yes**. TCC600 will display the "Change Communication Address" dialog screen.

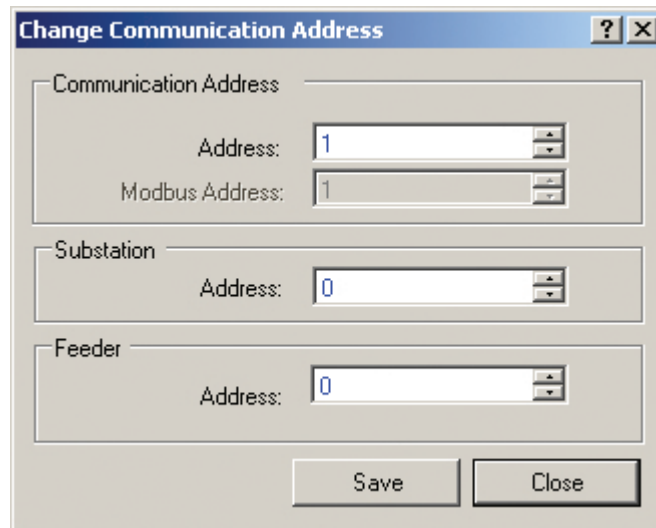
The image shows a software dialog box titled "Change Communication Address". It has a standard Windows-style title bar with a question mark icon and a close button (X). The dialog is divided into three sections. The first section, "Communication Address", contains two spin boxes: "Address:" with the value "1" and "Modbus Address:" with the value "1". The second section, "Substation", contains a spin box "Address:" with the value "0". The third section, "Feeder", contains a spin box "Address:" with the value "0". At the bottom of the dialog are two buttons: "Save" and "Close".

Figure 229: Change Communication Address Dialog Screen

3. Enter the desired Communication, Substation or Feeder address, then select "Save". TCC600 will display the "Save to Device" confirmation screen.
4. Select "OK". TCC600 will display the "Setpoints Successfully Written to Control" confirmation screen.

5.8 Automatic mode blocking

The Automatic Mode Blocking feature will cause the control to respond in a predefined manner to either a serial communication interruption or power loss to the control. The Control will respond as follows:

- If Automatic control has been Blocked using TCC600, then Automatic Control will remain Blocked if serial communication is disrupted or lost.
- If Automatic Control has been Blocked using TCC600, and the Save Comm Block at Power Off selection is Save, then the Automatic Control Block will be reinstated at power up.
- If Automatic Control has been Blocked using TCC600, and the Save Comm Block at Power Off selection is Don't Save, then the Automatic Control Block will not be reinstated at power up.

5.8.1 Comm Block Auto

Comm Block Auto allows the state of the "Block Auto Operation" communication command to be saved or not saved when power has been lost. The default setting is "DON'T SAVE".



The Comm Block Auto at power off setting requires the "Auto/Manual Switch Type" in the configuration to be set to either "None" or "Toggle".

5.8.1.1 Setting Comm Block Auto from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to awaken the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.
4. Press the Down arrow pushbutton, as necessary, until "Comm Block Auto" is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Comm Block auto DON'T SAVE C
6. Utilizing the Up/Down arrow pushbuttons, select "DON'T SAVE or SAVE", then press the ENT pushbutton. The selected setting will be displayed.

5.8.1.2 Setting Comm Block Auto at power off from TCC600



The Comm Block Auto at Power Off setting requires the "Auto/Manual Switch Type" in the configuration to be set to either "None" or "Toggle".

1. Select **Setup/Configuration** from the TCC600® toolbar. TCC600 will display the "Configuration" dialog screen.

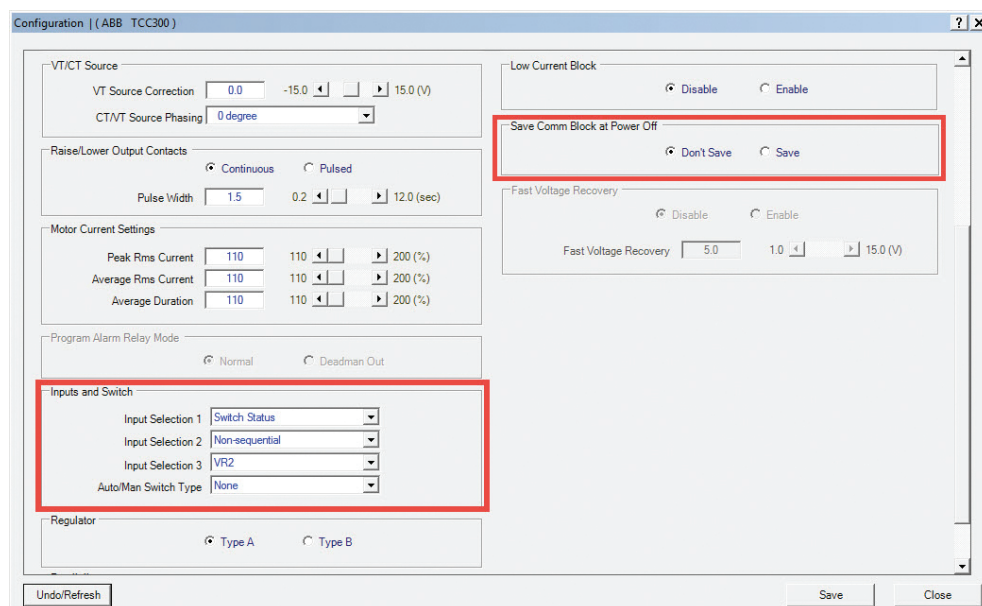


Figure 230: Configuration (Save Comm Block at Power Off) Dialog Screen

2. Verify that the Auto/Manual Switch Type is set to either "None" or "Toggle". From the "Save Comm Block at Power Off" section, select either "Don't Save" or "Save", then select "Save". TCC600 will display the "Save to Device Confirmation Screen".

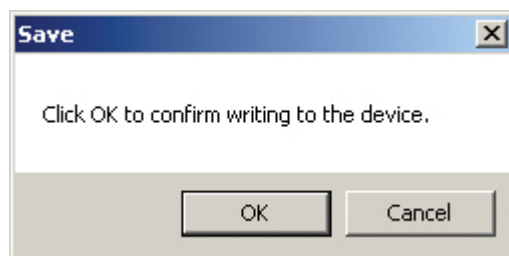


Figure 231: Save to Device Confirmation Screen

3. Select "OK". TCC600 will briefly display the "Setpoints successfully written to the control" confirmation screen.

5.8.2

SCAMP initialize on power up

When Last Save is selected, the SCAMP switch is configured in such a way that upon the control performing a cold power up, the state of the SCAMP switch is initialized to the last saved state of the SCAMP switch prior to the control powering off.

For example, if prior to powering off the control, the SCAMP switch was in Manual, then when the control is powered back on the control will initially go back to the Manual state and vice versa. Now when Auto Mode is selected, the control always initializes into the Auto Mode after powering up regardless of the saved state of the control prior to powering off.



The "Auto/Manual Switch Type" setting in configuration must be set to "SCAMP" to effect this setting change.

5.8.2.1

Setting SCAMP initialize on power up from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to awaken the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.
4. Press the Down arrow pushbutton, as necessary, until "SCAMP Init Pwrup" is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Scamp Init Pwrup Last Save C
6. Utilizing the Up/Down arrow pushbuttons, select "Last Save or Auto Mode", then press the ENT pushbutton. The selected setting will be displayed.

5.8.2.2

Setting SCAMP initialize on power up from TCC600



The "Auto/Manual Switch Type" setting in configuration must be set to "SCAMP" to effect this setting change.

1. Select **Setup/Configuration** from the TCC600® toolbar. TCC600 will display the "Configuration" dialog screen.

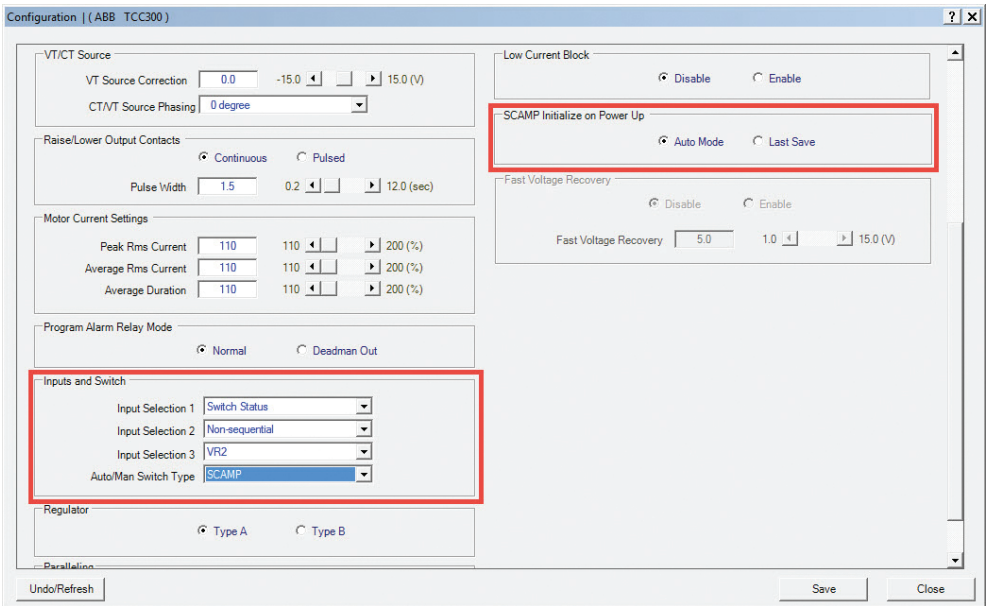


Figure 232: Configuration (SCAMP Initialize on Power Up) Dialog Screen

2. Verify that the Auto/Manual Switch Type is set to "SCAMP". From the "SCAMP Initialize on Power Up" section, select either "Auto Mode" or "Last Save", then select "Save". TCC600 will display the "Save to Device Confirmation Screen".

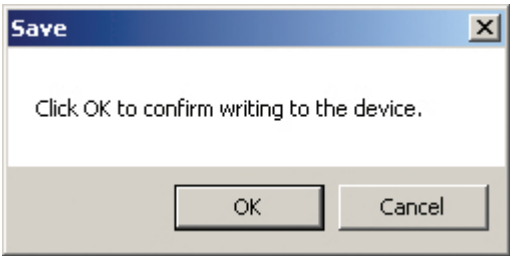


Figure 233: Save to Device Confirmation Screen

3. Select "OK". TCC600 will briefly display the "Setpoints successfully written to the control" confirmation screen.

5.9 Optional Ethernet port

The optional Ethernet Port is available through an RJ45 (10/100 Base-T) or a (100 Base-Fx) Fiber Optic interface for ethernet communication to the TCC300. The port supports up to 17 concurrent connections. The maximum number of allowed DNP connections is five. The maximum number of MODBUS® connections is eight. When IEC 61850 is

purchased the maximum number of IEC 61850 connections is four. The port supports DHCP protocol and also allows manual configuration of the Ethernet port. MODBUS protocol "Port Number" and DNP Protocol "Port Number" are required for manual configuration.

If no communication activity is detected on a previously open ethernet socket, for the amount of time specified by the "Keepalive Time" setting, the control will then close the socket and make it available for future connection.



Keepalive Time applies only to Ethernet communication.

5.9.1

Configuring Ethernet port from TCC600



Manual configuration of the Ethernet Port (not enabling DHCP Protocol) requires that the IP Address, Net Mask and Gateway settings be obtained from the System Administrator.

1. Ensure the following conditions exist:
 - The control is energized
 - TCC600® is installed on the host computer
 - The host computer is physically connected to the target control through either a USB, Serial Port or Modem connection
 - The host computer and the control are physically connected to the target Ethernet network
2. Start the TCC600 program. TCC600 will display the TCC600 **Main** dialog screen.
3. Select **Connect/USB, Com Port or Modem** from the Connect dropdown menu. TCC600 will display the appropriate Connection Dialog Screen.
4. Enter a valid Level 2 Access Code (if enabled), then select Connect, TCC600 will attempt to connect to the target control.
5. If TCC600 returns a Failed to Connect Error screen, repeat Steps 3 and 4.
6. Level 2 Access if enabled is necessary to complete the Ethernet Port configuration. If an invalid Access Code was entered, TCC600 will display the connected version of the TCC600 main screen with either "Read-Only" or "Level 1" access. Disconnect from the control and repeat Step 4.
7. If Level Access is not active or a valid Level 2 Access Code was entered, TCC600 will briefly display the "Successfully Connected Level 2" screen and then display the connected version of the TCC600 Main Screen with Level 2 Access.
8. From the **Communication** drop-down menu, select **Setup/Ethernet Settings**. TCC600 will then display the Setup Ethernet dialog screen.

Setup Ethernet | (ABB TCC300)

Ethernet

Auto Negotiation ☐ Disable ☒ Enable

DHCP Protocol ☐ Disable ☒ Enable

IP Address: 0 . 0 . 0 . 0

Net Mask: 0 . 0 . 0 . 0

Gateway: 0 . 0 . 0 . 0

Keepalive Time: 7200 max 50000 sec

Port

Modbus Port: 502

DNP3.0 Port: 20000

Network Time Synchronization

Simple Network Time Protocol:

☒ Disable ☐ Enable

SNTP Server

Server Name:

IP Address: 68 . 0 . 14 . 76

Time Zone: (GMT -5) Eastern time (US & Canada)

Save Close

Figure 234: Setup Ethernet Dialog Screen

9. If the Ethernet network that the target control is connected to supports DHCP Protocol, then perform the following:

- 9.1. From the Setup Ethernet dialog screen select DHCP Protocol "Enable"
 - 9.2. Select the desired "Keepalive Time" duration.
 - 9.3. Select "Save" to save the settings to the target control.
 - 9.4. Go to Step 11.
10. If the Ethernet network that the target control is connected to does not support DHCP Protocol, or manual configuration is desired, perform the following:
 - 10.1. Select DHCP Protocol "Disable".
 - 10.2. Enter the IP Address, Net Mask, Gateway and the applicable MODBUS® or DNP3.0 Port settings.
 - 10.3. Select the desired "Keepalive Time" duration.
 - 10.4. Select "Save" to save the settings to the target control. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.
11. If the Network MODBUS Port address is not "502" or the DNP Port address is not "20000", set these parameters to match the target network settings.

The Ethernet option for the control is now enabled. Proceed to connect to the target control through the Ethernet connection and enable Source Address Validation if desired.

5.9.2

Configuring network time synchronization from TCC600



Network Time Synchronization requires the SNTP (Simple Network Time Protocol) "Server Name" or "Server IP Address" to be known and also the Control Location "Time Zone".

1. From the **Communication** drop-down menu, select **Setup/Ethernet Settings**. TCC600® will then display the "Setup Ethernet" dialog screen.

Setup Ethernet | (ABB TCC300)

Ethernet

Auto Negotiation ☐ Disable ☒ Enable

DHCP Protocol ☐ Disable ☒ Enable

IP Address: 0 . 0 . 0 . 0

Net Mask: 0 . 0 . 0 . 0

Gateway: 0 . 0 . 0 . 0

Keepalive Time: 7200 max 50000 sec

Port

Modbus Port: 502

DNP3.0 Port: 20000

Network Time Synchronization

Simple Network Time Protocol:

☒ Disable ☐ Enable

SNTP Server

Server Name:

IP Address: 68 . 0 . 14 . 76

Time Zone:

(GMT -5) Eastern time (US & Canada)

Save Close

Figure 235: Setup Ethernet Dialog Screen

2. From the "SNTP Server" section of the dialog screen proceed as follows:
 - 2.1. If the Server Name is known, enter the Server Name and then select the magnified glass icon. TCC600 will search for the corresponding IP Address.
 - 2.2. If the server IP Address is known, enter the IP Address.
3. Select the Time Zone that the control resides in, then select "Save". TCC600 will display a "Setpoints Successfully Written to Control" Confirmation Screen.

5.9.3 Configuring the control's Ethernet port from the HMI for use on a network that supports DHCP protocol

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings" or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "Ethernet" is displayed.
3. Press the Down arrow pushbutton once. The following will be displayed.
DHCP Enable disable
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
DHCP Enable disable C
5. Utilizing the Up/Down arrow pushbuttons select ENABLE, then press the ENT pushbutton. The following will be displayed.
DHCP Enable ENABLE
6. The control is now addressable from TCC600® over the target network.
 - If the network MODBUS® Port address is not "502" or the DNP Port address is not "20000", proceed to setting the MODBUS Port and DNP Port.
 - Enable Source Address Validation if desired.

5.9.4 Configuring the control's Ethernet port from the HMI for use on a network that does not support DHCP protocol

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings" or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "Ethernet" is displayed.
3. Press the Down arrow pushbutton once. The following will be displayed.
DHCP Enable disable
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
DHCP Enable disable C
5. Utilizing the Up/Down arrow pushbuttons, select "disable", then press the ENT pushbutton. The following will be displayed.
DHCP Enable disable

6. Press the Down arrow pushbutton once. The following will be displayed.
IP Address
0.0.0.0
7. Press the ENT pushbutton. The following will be displayed.
IP Address
0.0.0.0 C
8. Utilizing the arrow pushbuttons input the desired IP Address, then press the ENT pushbutton, the desired IP Address will be displayed.
9. Follow the procedure above to enter the desired:
 - Net Mask
 - Gateway



Auto negotiation is an Ethernet procedure by which two connected devices choose common transmission parameters, such as speed and duplex mode. In this process, the connected devices first share their capabilities as for these parameters and then choose the fastest transmission mode they both support.

10. If the control is connected to a host device which is capable of 10 and 100 mbps transmission rates and handles both half or full duplex modes, the Ethernet port is now configured to support network communications with the MODBUS® port and DNP port default values. If the network requires specific MODBUS port and DNP port settings, proceed to setting the MODBUS and DNP ports from the HMI.



Auto Negotiation must be disabled if using Fiber Ethernet.

11. If a fixed speed of 100 mbps is desired as in the case of Fiber Optic mode, utilize the Up/Down arrow pushbuttons to navigate to the "Auto Negotiation" menu item.
12. Press the ENT pushbutton. The following will be displayed.
Auto Negotiation ENABLE C
13. Utilizing the Up/Down arrow pushbuttons select "disable", then press the ENT pushbutton. The following will be displayed.
Auto Negotiation disable

The Ethernet port is now configured to support network communications with the MODBUS port, DNP port, and Keepalive Time default values. If the network requires specific MODBUS port and DNP port settings, proceed to setting the MODBUS and DNP ports from the HMI. If a Keepalive Time duration other than 7200 seconds is desired, proceed to setting the Ethernet keepalive time from the HMI.

Enable Source Address Validation if desired.

5.9.5 Setting the MODBUS and DNP ports from the HMI

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings" or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "Ethernet" is displayed.
3. Press the Down arrow pushbutton, as necessary, until the "Enter MODBUS Port" menu item is displayed.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
`Enter Modbus Port 502 C`
5. Utilizing the arrow pushbuttons enter the desired MODBUS® port address, then press the ENT pushbutton. The desired MODBUS port address will be displayed.
6. Press the Down arrow pushbutton once. The following will be displayed.
`Enter DNP Port 20000`
7. Press the ENT pushbutton. The following will be displayed.
`Enter DNP Port 20000 C`
8. Utilizing the arrow pushbuttons, input the desired DNP Port address, press the ENT pushbutton, the desired DNP Port address will be displayed.
The control is no w addressable from TCC600® over the network. Ensure that the MODBUS and DNP Port values are the same as the values manually set when attempting to communicate with the control from TCC600.

5.9.6 Setting the Ethernet keepalive time from the HMI

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings" or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "Ethernet" is displayed.
3. Press the Down arrow pushbutton, as necessary, until the "Keepalive time" menu item is displayed.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
`Keepalive time 7200 sec C`
5. Utilizing the arrow pushbuttons enter the desired Keepalive Time value, then press the ENT pushbutton. The desired Keepalive Time value will be displayed.

5.10 RS-485/Fiber-optic port

TCC300 COM Port can be selected for two different configurations: RS-485 or Fiber Optics.

5.10.1 Configuring RS-485/fiber-optic port from the HMI

This procedure provides the steps necessary to setup all RS-485 and Fiber Optic parameters. Parameter definitions and the default value (default value) for each parameter are included below:

- Comm Protocol – Allows selection between standard protocols, DNP 3.0 or MODBUS®. (DNP3.0)
 - Comm Address – Configures a three-digit numerical address, from 1 to 200, for remote communications. (1)
 - Baud Rate – Selects baud rate for COM1, located on the top of the control. (9600)
 - Parity – None, odd or even parity is available. (NONE)
 - Stop Bits – One or two stop bits are available. (ONE STOPBIT)
 - Sync Time – This time delay improves robust operation when communication lines are intermittent. Communication dead-sync time is the time that the control will wait from the last received character and continue without attempting to resynchronize. (2 ms)
 - Echo/Repeat – Selects Echo/Repeat on/off as determined by the user. Selector switch is located on side of unit adjacent to the Fiber Optic connection and is accessed through the slot in the cover. Switch position towards the front of the control is the off position. (OFF)
-
1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
 2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. If Memory Card is displayed, then press the Right or Left arrow pushbutton, as necessary, until "Comm Settings" is displayed.
 3. Press the Down arrow pushbutton, as necessary, until "Comm1 Port Type" is displayed.
 4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Comm1 Port Type RS485 C
 5. Utilizing the Up/Down arrow pushbuttons select "RS485 or FIBER", then press the ENT pushbutton. The selected port type will be displayed.
 6. Follow the procedure above to enter the desired:

- Comm Protocol
 - Comm Address
 - Baud Rate
 - Parity
 - Stop Bits
 - Sync Time
7. The RS-485 or Fiber Optic Port is now available for communications.
 8. If DNP3.0 was selected as the Comm Protocol and Source Address Validation is required, proceed to Enabling Source Address Validation.

5.10.2

Configuring RS-485/fiber-optic port from TCC600

1. Select Communication/Setup/Comm Port from the TCC600® toolbar. TCC600 will display the "Setup Comm Port" dialog screen.

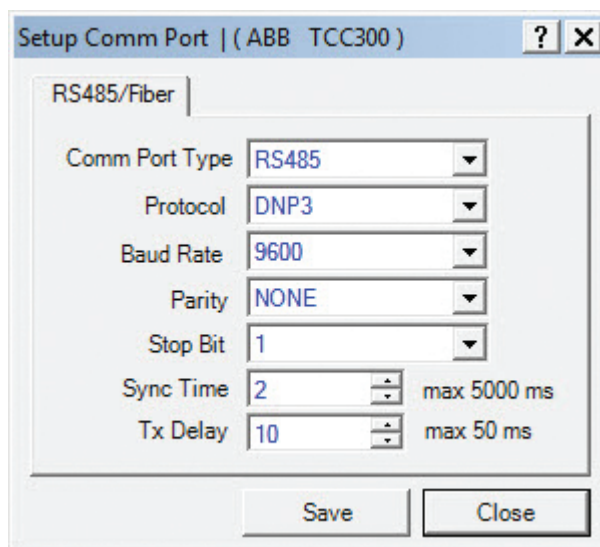


Figure 236: Setup Comm Port Dialog Scree

2. Select Comm Port Type "RS-485" or "Fiber".
3. If Echo/Repeat is required then Enable Echo/Repeat by placing the Echo/Repeat on/off switch located adjacent to the Fiber connection on the side of the control in the on position towards the rear of the control.
4. Enter the desired settings for the following parameters:
 - Protocol
 - Baud Rate
 - Parity

-
- Stop Bits
 - Sync Time
 - TX Delay
5. Select Save. TCC600 will display a "Confirm Writing to Device" confirmation screen.
 6. Select OK. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.
 7. If DNP3.0 was selected in Step 4 and Source Address Validation is desired, proceed to enabling Source Address Validation.

5.11 RS-232 port

5.11.1 Configuring RS-232 port from the HMI

This procedure provides the steps necessary to setup all RS-232 Port parameters. Parameter definitions and the default value (default value) for each parameter are included below:

- Comm Protocol – Allows selection between standard protocols, DNP 3.0 or MODBUS®. (MODBUS)
 - Baud Rate – Selects baud rate for COM2, located on the top of the control. (115,200)
 - Parity – None, odd or even parity is available. (NONE)
 - Stop Bits – One or two stop bits are available. (TWO STOPBITS)
 - Sync Time – This time delay improves robust operation when communication lines are intermittent. Communication dead-sync time is the time that the control will wait from the last received character and continue without attempting to re-synchronize. (50 ms)
1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
 2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings" or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "RS232" is displayed.
 3. Press the Down arrow pushbutton once. The unit will display the following:
Protocol MODBUS
 4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Protocol MODBUS C

5. Utilizing the Up/Down arrow pushbuttons, select "DNP3.0 or MODBUS®", then press the ENT pushbutton. The selected protocol will be displayed.
6. Follow the procedure above to enter the desired:
 - Baud Rate
 - Parity
 - Stop Bits
 - Sync Time
7. If DNP3.0 was selected as the Protocol and Source Address Validation is desired, proceed to enabling Source Address Validation.

5.11.2

Configuring RS-232 port from TCC600

1. Select Communication/Setup/RS232 Comm Port from the TCC600® toolbar. TCC600 will then display the Setup RS-232 Comm Port dialog screen.

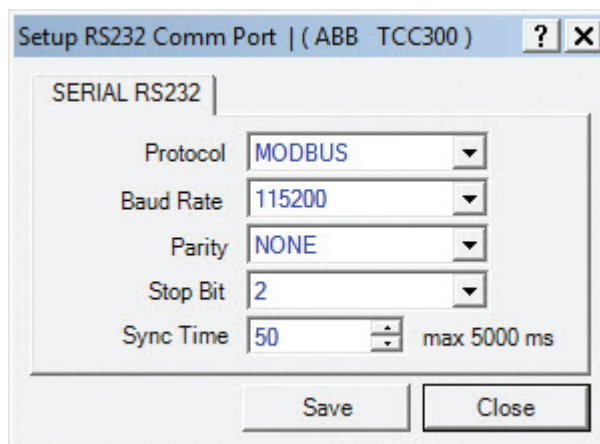


Figure 237: Setup RS-232 Comm Port Dialog Screen

2. Enter the desired settings for the following parameters:
 - Protocol
 - Baud Rate
 - Parity
 - Stop Bits
 - Sync Time
3. Select Save. TCC600 will display a "Confirm Writing to Device" confirmation screen.
4. Select OK. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.
5. If DNP3.0 was selected in Step 2 and Source Address Validation is desired, proceed to enabling Source Address Validation.

The RS-232 option for the control is now enabled. Proceed to connect to the target control through the RS-232 connection.

5.12 Installation of modems

Using TCC600® to interrogate, set or monitor the control using a modem requires both a remote modem connected at the controls location and a local modem connected to the computer with TCC600 installed.



Any compatible modem may be used; however, the unit only communicates at 1200 to 9600 baud.

In order to use TCC600 to communicate with the control using a modem, the following must be provided with the control:

- An external modem (1200 baud or higher), capable of understanding standard AT commands.
- Serial modem cable with 9-pin connector for the control and the applicable connector for the modem.

Similarly, the computer running TCC600 must also have access to a compatible internal or external modem.

5.12.1 Connecting the PC modem

1. If the computer has an external modem, then use a standard straight-through RS-232 modem cable (M-3933) to connect the computer to the modem.
2. If the computer has an internal modem, then refer to the modem's instruction book to determine which communications port should be selected.
3. Verify that the modem is attached to (if external) or assigned to (if internal) the same serial port as assigned in TCC600. While TCC600 can use any of the 255 serial ports (COM1 through COM255), most computers support only COM1 and COM2.
4. Connect the modem to a telephone line, then energize the modem.

5.12.2 Initializing the PC modem from TCC600

1. Verify that the modem is connected as described in "Connecting the PC Modem".
2. Open TCC600, then select the **Connect/Modem** menu item.
3. TCC600 will display the Modem Connection Dialog screen.

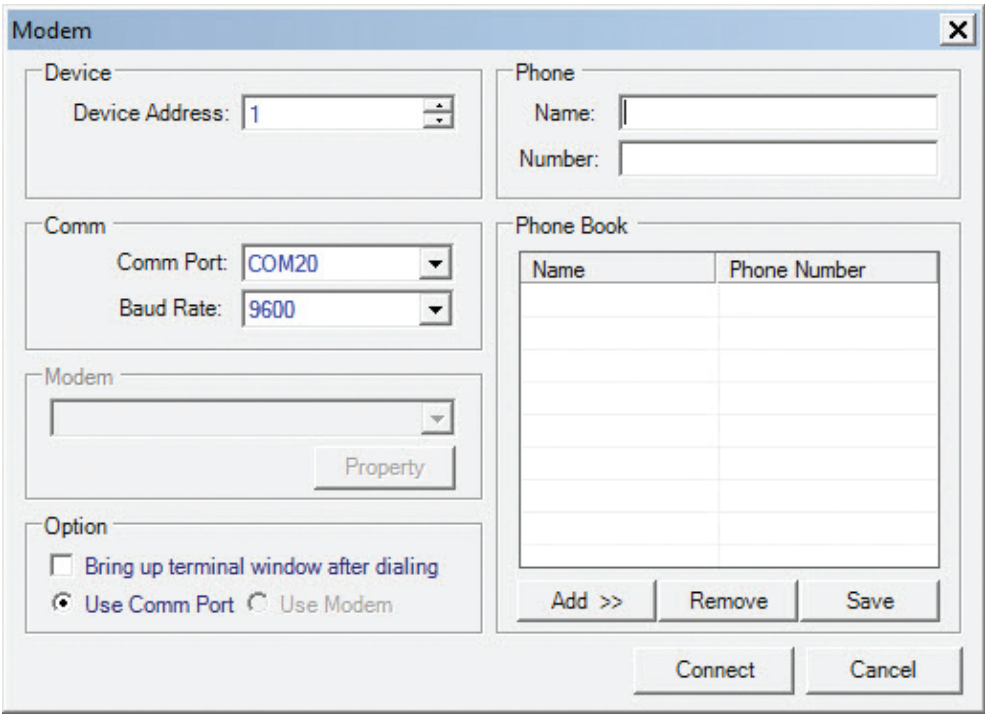
The image shows a 'Modem' dialog box with several sections. The 'Device' section has a 'Device Address' dropdown set to '1'. The 'Phone' section has 'Name' and 'Number' text boxes. The 'Comm' section has 'Comm Port' set to 'COM20' and 'Baud Rate' set to '9600'. The 'Modem' section has a dropdown menu and a 'Property' button. The 'Option' section has a checkbox for 'Bring up terminal window after dialing' and two radio buttons, 'Use Comm Port' (selected) and 'Use Modem'. On the right, the 'Phone Book' section contains a table with 'Name' and 'Phone Number' columns. At the bottom right are 'Add >>', 'Remove', 'Save', 'Connect', and 'Cancel' buttons.

Figure 238: Modem Connection Dialog Screen

- 4. Enter the required information in the Modem Settings section of the screen, then select **Connect**.

Table 56: Command buttons

Button	Description
Add	Allows you to review and change the user lines (unit identifier), phone number, and communication address of a selected entry.
Remove	Deletes a selected entry.
Save	Saves any changes to the displayed information.
Connect	Dials the entry selected from the directory.
Cancel	Ends modem communication, allowing the user to dial again.

5.12.3 Connecting the local modem to the control

Setup of the modem attached to the control may be slightly complicated. It involves programming parameters (using the AT command set), and storing this profile in the modem’s nonvolatile memory.

After programming, the modem will power up in the proper state for communicating with the control. Programming may be accomplished by using the "Bring Up Terminal Window after dialing" selection. Refer to your modem manual for further information.

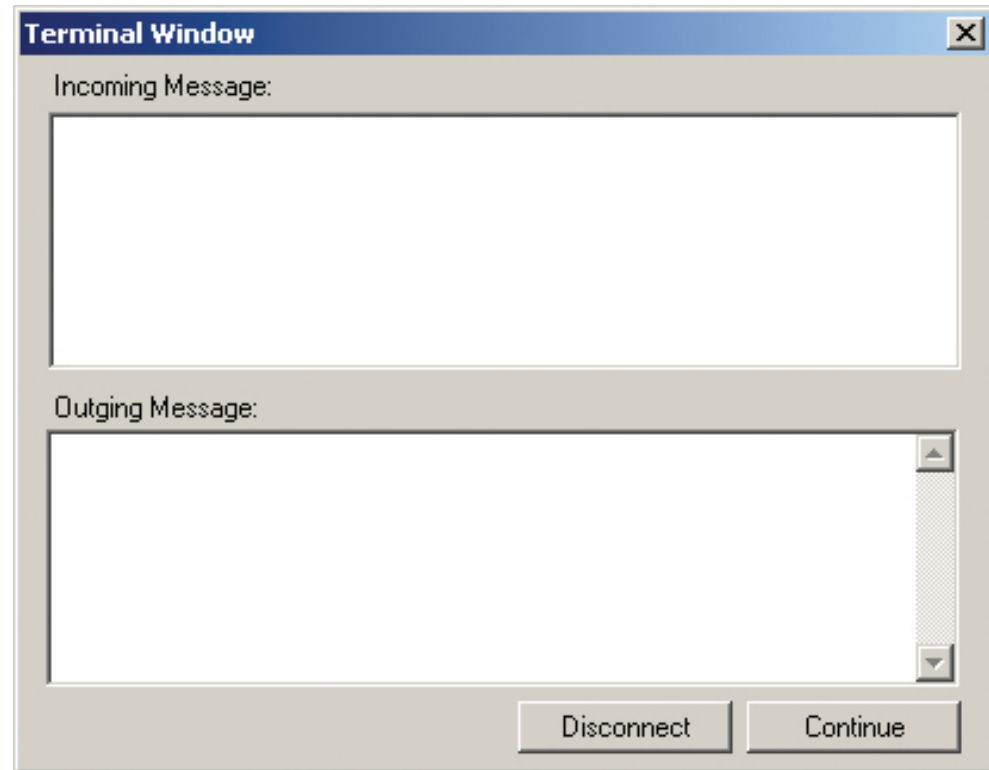


Figure 239: Terminal Window



The control does not issue or understand any modem commands. It will not adjust the baud rate and should be considered a "dumb" peripheral. It communicates with 1 start, 8 data, and 0, 1 or 2 stop bits.

1. Connect the unit to an external modem by attaching a standard RS-232 modem cable to the appropriate serial communications port on both the unit and the modem.
2. Connect the modem to a telephone line, then energize the modem.

The modem attached to the control must have the following AT command configuration:

- E0 No Echo
- Q1 Don't return result code
- &D3 On to OFF DTR, hangup and reset
- &S0 DSR always on
- &C1 DCD ON when detected
- S0=2 Answer on second ring

The following commands may also be required at the modem:

- &Q6 Constant DTE to DCE
- N0 Answer only at specified speed
- W Disable serial data rate adjust
- \Q3 Bidirectional RTS/CTS relay
- &B1 Fixed serial port rate
- S37 Desired line connection speed

When connected to another terminal device, the Terminal Window allows the user to send messages or commands. Outgoing communications are displayed in the top pane and incoming messages are displayed in the bottom two panes, in ASCII text and HEX format.

There are some variations in the AT commands supported by modem manufacturers. Refer to the hardware user documentation for a list of supported AT commands and direction on issuing these commands.

5.13 Optional bluetooth

The Bluetooth® option enables wireless access to the TCC300. Utilizing the Bluetooth wireless feature the user is able to configure the control, read status and metering values, as well as change setpoints. The following lists the initialization scheme and setpoint options available for Bluetooth.

The TCC300 provides generic serial Bluetooth service. The user must select the generic serial service among any other listed services, if the user's Bluetooth device doesn't automatically recognize the available service.

The following features on the TCC300 are available to the user:

- Enable/Disable – The user can enable or disable Bluetooth functionality.
- Reset – The Bluetooth can be reset to ABB factory default values.
- Authentication – The device can be authenticated for security purposes, if enabled, the user can select a passkey to connect to the device.
- Passkey – If authentication is enabled, the customer can assign up to a maximum of 16 alphanumeric characters as a passkey.

- Friendly Name – The user can give the Bluetooth his/her preferred name, which can be a maximum of 20 characters, including alphanumeric as well as the '_' and '-' characters.
- Mode – The following configurations are available for the Bluetooth Mode:
 - Mode 0, the device is discoverable and connectable to any client station.
 - Mode 1, the device is non-discoverable but it is connectable to any client station that knows the control Bluetooth device address indicated under "Control BT Device" in the HMI menu.
- Protocol – MODBUS or DNP.

Bluetooth Module Initialization



For first time Bluetooth® module use, the Bluetooth module needs to be reset to ensure that the Bluetooth module functions according to the ABB values.

Following a control power cycle, the TCC300 hardware is checked for Bluetooth by sending an AT command and waiting for an 'OK' response. If no response is received, a 'Bluetooth not present' message will be displayed on the HMI. If an 'ERROR' message is received, Bluetooth is reset to factory default values and the hardware is checked again.

The Bluetooth device information, i.e., BD address, friendly name, mode of device, internal operation state and status of authentication and encryption features will be retrieved.

The ABB default values for device information are:

- Friendly Name – TCC300-Serial Number
- Mode of Device – Mode0
- Internal operation status – Standby
- Authentication: None
- Encryption: None

The retrieved Bluetooth device information is compared to the factory defaults, if they are not the same; they are forced to the default values. If internal operation status is not standby, an AT+BTCANCEL command is issued to force standby status. The mode is set by issuing a AT+BTMODE command. The friendly name is set by AT+BTNAME. The device is now in connectable mode, hence the user can use the Bluetooth device to connect to the TCC300 using the generic serial service.

5.13.1

Configuring bluetooth from the HMI

In order to setup the Bluetooth feature on the TCC300 from the HMI the following conditions must be present:

- The Bluetooth Factory Option must be enabled on the control
- The Bluetooth Status on the control must be "Present" and "Connectable"

To verify that these conditions are present on the control, observe the display while applying power to the control. The following sequence of messages will be displayed during the control boot up:

Factory Options BLUETOOTH

Bluetooth Status BLUETOOTH PRESENT

Bluetooth Status CONNECTABLE

If the unit display messages are consistent with the above, the unit is physically ready to be setup for wireless communication.



If it becomes necessary to reset the Bluetooth module during the performance of this procedure, navigate to the Bluetooth Reset menu item and select ENT.

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings" or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "Bluetooth" is displayed.
3. Press the Down arrow pushbutton once. The unit will display the following:
Bluetooth Enable disable
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Bluetooth Enable disable C
5. Utilizing the Up/Down arrow pushbuttons, select "ENABLE", then press the ENT pushbutton. The following will be displayed.
Bluetooth Enable ENABLE
6. Press the Up/Down arrow pushbutton, as necessary, until the "Bluetooth Protocol" menu item is displayed.

7. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
`Bluetooth Protocol MODBUS C`
8. Utilizing the Up/Down arrow pushbuttons select "MODBUS® or DNP3.0", then press the ENT pushbutton. The selected Protocol setting will be displayed.
9. Press the Up/Down arrow pushbutton, as necessary, until the "Authentication" menu item is displayed.
10. If "Authentication" is to be ENABLED, press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
`Authentication disable C`
11. Utilizing the Up/Down arrow pushbuttons select "ENABLE", then press the ENT pushbutton. The following will be displayed.
`Please Enter Passkey _`
12. Utilizing the arrow pushbuttons enter the desired Passkey (up to 16 characters), then press ENT. The following sequence of screens will be displayed:
`Please Enter Passkey Please -WAIT-`
`Please Enter Passkey -DONE-`
`Authentication ENABLE`
13. Press the Up/Down arrow pushbutton, as necessary, until the "Friendly Name" menu item is displayed.
14. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
`Enter New Name -`
15. Utilizing the arrow pushbuttons, enter the desired Friendly Name value (up to 21 characters), then press the ENT pushbutton. The Friendly Name that was entered will be displayed.
The Bluetooth® "Device Address" is available by pressing the Down arrow once.
16. Press the Up/Down arrow pushbutton, as necessary, until the "Bluetooth Mode" menu item is displayed.
17. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
`Bluetooth Mode Mode0 C`
18. Utilizing the arrow pushbuttons, select the desired Bluetooth Mode (0 or 1), then press the "ENT" pushbutton. The selected Bluetooth Mode will be displayed.
The Bluetooth feature is now available for use.
19. If DNP3.0 was selected as the protocol and Source Address Validation is desired, proceed to enabling Source Address Validation.

5.13.2

Configuring bluetooth from TCC600

In order to setup the Bluetooth feature on the TCC300, the following conditions must be present:

- The Bluetooth Factory Option must be enabled on the control
- The Bluetooth Status on the control must be "Present" and "Connectable"

To verify that these conditions are present on the control, observe the display while applying power to the control. The following sequence of messages will be displayed during the control bootup:

Factory Options BLUETOOTH

Bluetooth Status BLUETOOTH PRESENT

Bluetooth Status CONNECTABLE

If the unit HMI display messages are consistent with the above, the unit is physically ready to be setup for wireless communication.



If it becomes necessary to reset the Bluetooth module during the performance of this procedure, see [Resetting bluetooth module TCC600](#).

1. Select **Communication/Setup/Bluetooth Settings** from the TCC600 toolbar. Depending on the status of the Bluetooth option in the control, TCC600 will respond as follows:
 - If the Bluetooth option is disabled in the control, TCC600 will display the Bluetooth Hardware option dialog screen.
 - If the Bluetooth option is enabled in the control, TCC600 will display the Bluetooth Information dialog screen.
2. If the Bluetooth Hardware option dialog screen is displayed, proceed as follows:
 - 2.1. If the Bluetooth hardware is present, then select "OK" to enable. TCC600 will then display the Bluetooth Information dialog screen. Go to Step 3.
 - 2.2. If the Bluetooth hardware is not present, then select "Cancel". TCC600 will return to the Main screen.

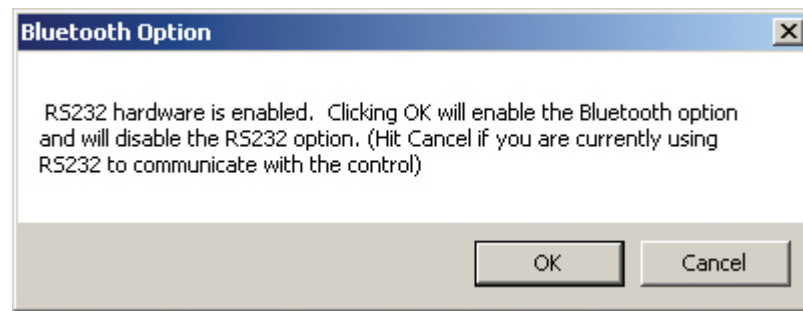


Figure 240: Bluetooth Hardware Option Dialog Screen

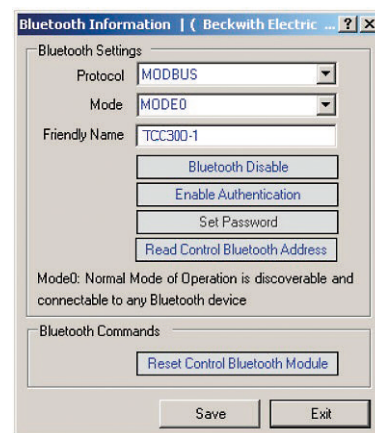


Figure 241: Bluetooth Information Dialog Screen

3. Enter the desired settings for the following parameters:
 - Protocol (MODBUS® or DNP3.0)
 - Mode (0 or 1)
 - Friendly Name (20 characters max)
 - Bluetooth (Enable/Disable)
 - Authentication (Enable or Disable)
 - Set Password (16 characters max) if Authentication is "Enabled"
4. Select **Save**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.
5. Verify that removing power to the control will not cause upset operation conditions on the control.
6. Remove power to the control, and then reapply power to the control. The Bluetooth feature is now available for use. Consult the Bluetooth wireless device

documentation that is to be used to communicate with the TCC300 for setup information.

7. If DNP3.0 was selected in Step 3 and Source Address Validation is desired, proceed to enabling Source Address Validation.

5.13.3 Setting up bluetooth MODE1 from TCC600

When the control's Bluetooth module is set to MODE1, the only way to connect to the control is to use the Secure Non-Discoverable connection method.

1. Select **Connect/Bluetooth** from the TCC600® toolbar. TCC600 will display the "Secure Bluetooth" dialog screen.

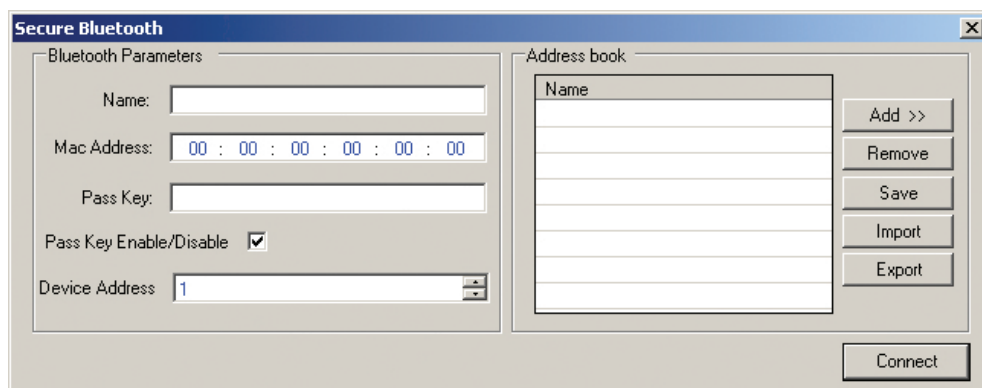


Figure 242: Secure Bluetooth Setup Screen

2. Enter the Control Name, the control MAC Address, Pass Key if needed and the Device Address. The user can create a Bluetooth session and save it to an address book. The session must contain a name unique to the address book, the MAC address, Pass Key and Device address.

5.13.4 Resetting bluetooth module from the HMI

The Bluetooth Module can be reset to ABB factory values if necessary.

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings"

-
- or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "Bluetooth" is displayed.
3. Press the Down arrow pushbutton as necessary to navigate to the "Bluetooth Reset" menu item.
 4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
CONFIRM PRESS ENTER
Cancel press EXIT.
 5. Press the ENT pushbutton. The following sequence of screens will be displayed:
Bluetooth Reset Resetting -WAIT-
Bluetooth Reset -DONE-

5.13.5 Resetting bluetooth module from TCC600

The Bluetooth Module can be reset to ABB factory values if necessary.

1. Select **Communication/Setup/Bluetooth Settings** from the TCC600® toolbar. TCC600 will display the "Bluetooth Information" dialog screen.
2. Select "Reset Control Bluetooth Module". TCC600 will respond with a "Bluetooth Reset Command Sent Successfully" confirmation screen.

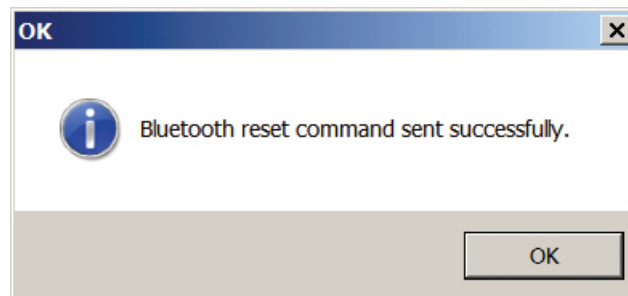


Figure 243: Bluetooth Reset Command Sent Confirmation Screen

3. Select "OK". TCC600 will send the "reset" command to the control and display a "Waiting for Bluetooth to Reset" status screen.

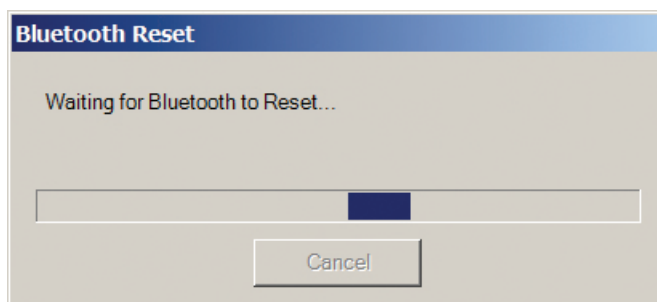


Figure 244: Bluetooth Reset Status Screen

When the Bluetooth Module has been reset, TCC600 will display "Bluetooth has been reset successfully" message.

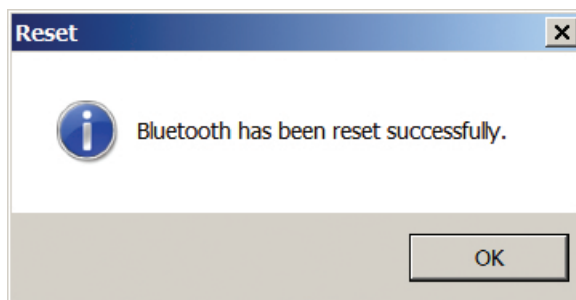


Figure 245: Bluetooth Reset Confirmation Screen

4. Select "OK". TCC600 will return to the "Bluetooth Information" Dialog Screen.

5.13.6

Resetting bluetooth passkey from the HMI

The Bluetooth Passkey can be changed or reset to default conditions (no Passkey and Authentication Disabled) if necessary.

1. Press the Right Arrow (COMM Hot Button) to wake the unit. The menu will advance to either "COMMUNICATION" or "Memory Card" (when a Smart Flash SD CARD is present).
2. If the "Communication" menu is displayed, then press the Down Arrow pushbutton once. The unit will display the "Comm Settings" menu. From the "Comm Settings" or "Memory Card" menu, press the Right or Left Arrow pushbutton as necessary until "Bluetooth" is displayed.
3. Press the Down arrow pushbutton as necessary to navigate to the "Bluetooth Pass Reset" menu item.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:

- Confirm press ENTER
Cancel press EXIT.
5. Press the ENT pushbutton. The following sequence of screens will be displayed:
Bluetooth Pass Reset Resetting -WAIT-
Cancel press EXIT.
Bluetooth Pass Reset Ready Press ENTER
The Passkey is now set to NONE and Authentication is disabled.
 6. To assign a NEW Passkey, press the Up/Down arrow pushbutton, as necessary, until the "Authentication" menu item is displayed.
 7. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Authentication disable C
 8. Utilizing the Up/Down arrow pusbuttons select "ENABLE", then press the ENT pushbutton. The following will be displayed:
Please Enter Passkey _
 9. Utilizing the arrow pushbuttons enter the desired Passkey (up to 16 characters), then press ENT. The following sequence of screens will be displayed:
Bluetooth Pass Reset Resetting -WAIT-
Bluetooth Pass Reset -DONE-
Bluetooth Pass Reset Ready Press ENTER

5.13.7

Resetting bluetooth passkey from TCC600

The Bluetooth Passkey can be reset if necessary.

1. Select **Communication/Setup/Bluetooth Settings** from the TCC600® toolbar. TCC600 will display the "Bluetooth Information" dialog screen.
2. Select "Set Password". TCC600 will display the "Bluetooth Authentication Password" dialog screen.



Figure 246: Bluetooth Authentication Password Dialog Screen

3. Enter the "Old" Password and then enter the desired "New" Password (up to 16 characters).

4. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.
5. Select **OK**. TCC600 will display a "New Password written successfully" confirmation screen.

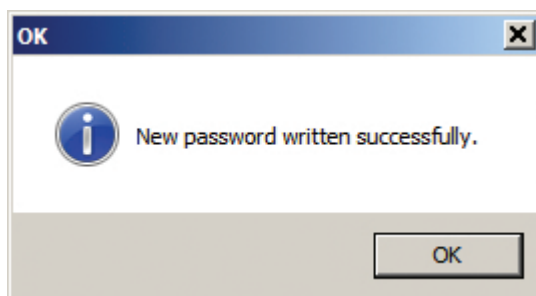


Figure 247: New Bluetooth Password Written Successfully Screen

6. Select **OK**. TCC600 will return to the "Bluetooth Information" Dialog screen.

5.14

SCADA heartbeat

The purpose of the SCADA HeartBeat feature is to have sets of settings for the control and switch between these settings sets based on the presence or absence of SCADA communications to the control.

In order to determine if the SCADA communications is present a HeartBeat detection algorithm is implemented.

There are four different types of SCADA HeartBeat modes:

- SCADA HeartBeat for transformer control applications (LTC)
- SCADA HeartBeat for regulator control applications (Regulator)
- SCADA HeartBeat for Profile Switching
- Manual HeartBeat Mode

The LTC, Regulator and Profile Switching have to be selected using TCC600® Communications software or from the HMI, for these modes to be operational. But the Manual HeartBeat Mode does not need to be selected for operation.

SCADA HeartBeat for LTC and Regulator

SCADA HeartBeat, when enabled, provides an additional set of control settings called HeartBeat DNP points (HBBandcenter (Forward), HBBandwidth (Forward), etc), that are only accessible through communications utilizing the DNP protocol. Although LTC and Regulator modes are mutually inclusive (meaning if one of the options is selected, the

other selection is also available), the selection is still required due to a difference in the physical input requirement. In LTC mode, the non-sequential input is used as a counter input, and hence an object 10 point "Non-Sequential" is made available to activate non sequential through communication. When SCADA HeartBeat is active, HeartBeat DNP points are used as a second set of settings.

The HeartBeat DNP points (applicable only for forward power settings) include:

- Bandcenter
- Bandwidth
- Time Delay
- LDC R
- LDC X
- Block Lower Voltage
- Block Raise Voltage
- Intertap Time Delay
- Inverse Time Delay
- HeartBeat Timer Period
- Voltage Reduction 1
- Voltage Reduction 2
- Voltage Reduction 3

As the TCC300 has 4 different setpoint profiles to choose from, when the SCADA HeartBeat is inactive, the previously selected active profile is used. In order to determine the actively used settings a third group of DNP points called the Active DNP points ("Active Bandcenter (Forward)", "Active Bandwidth (Forward)" etc), can be used. Reading the Active DNP points gives the current used settings, but writing always changes the selected Active Profile.

The SCADA HeartBeat DNP3.0 Protocol sequence for LTC and Regulator are provided in [Figure 248](#). Also, Object 40 point "Write HB" is mapped by default to Point 195, "HeartBeat Timer" mapped to 159, "Direct HeartBeat" mapped to 211 and "VRed Turnoff Time" mapped to 212.

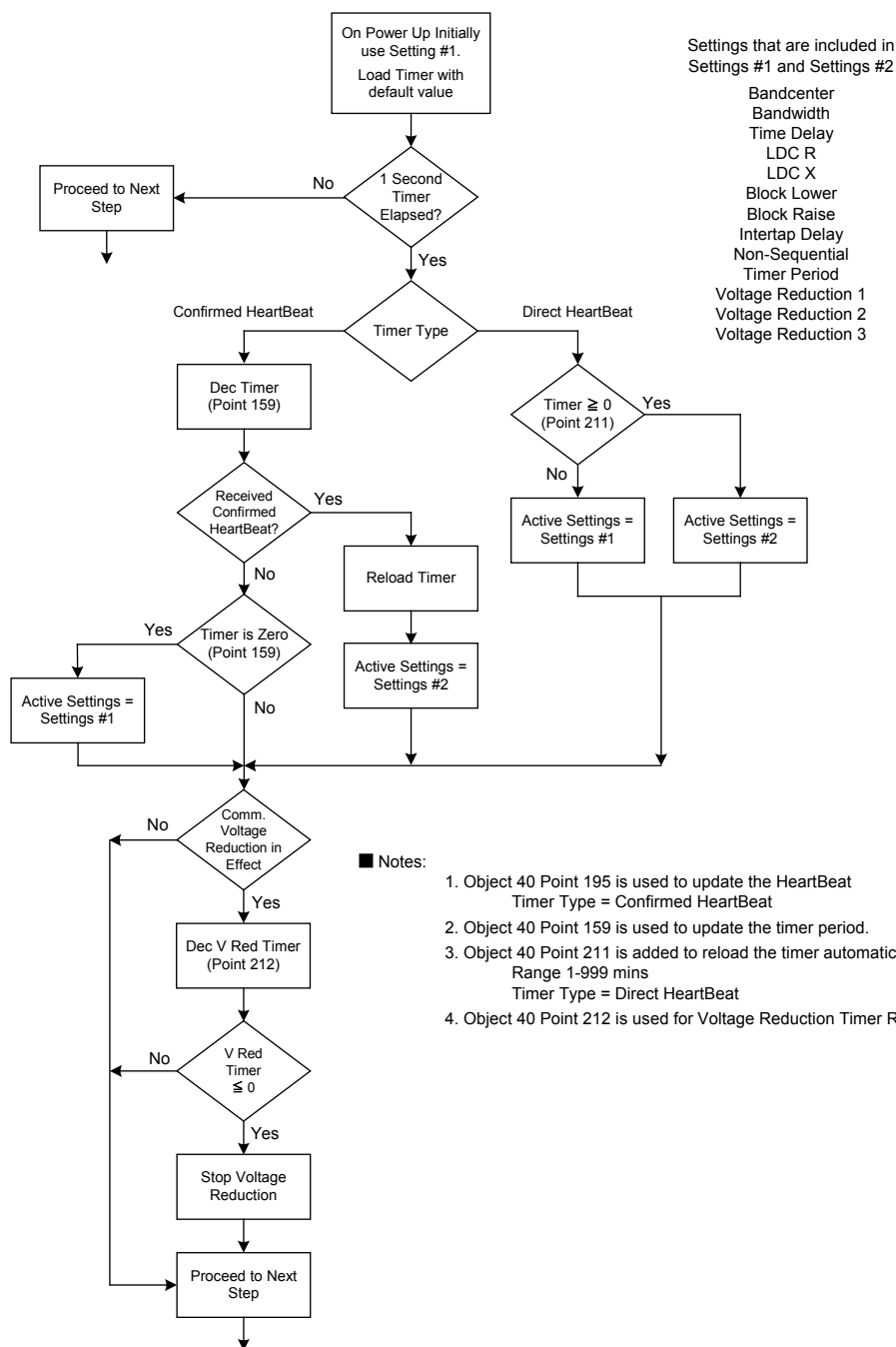


Figure 248: SCADA HeartBeat LTC and Regulator DNP 3.0 Protocol Sequence

SCADA HeartBeat for Profile Switching

In the TCC300 algorithm, the user will use Object 40 point "ScadaHB Profile Switch" (default Point: 79) to renew the Direct HeartBeat timer (writing to point 79), lower 12 bits of the data will contain the timer reload value in minutes and the most significant 4 bits will have the profile number to be activated when the timer expires. The range for the timer is from 0 to 999 minutes and for the profile is from 0 to 3 (profiles 1 through 4). It is important to know that to terminate the HeartBeat timer at any instant of time and to revert back to the original active profile, a zero value should be entered for the entire 16 bits of the analog point. The SCADA HeartBeat DNP3.0 Protocol sequence for Profile Switching is provided in [Figure 249](#).

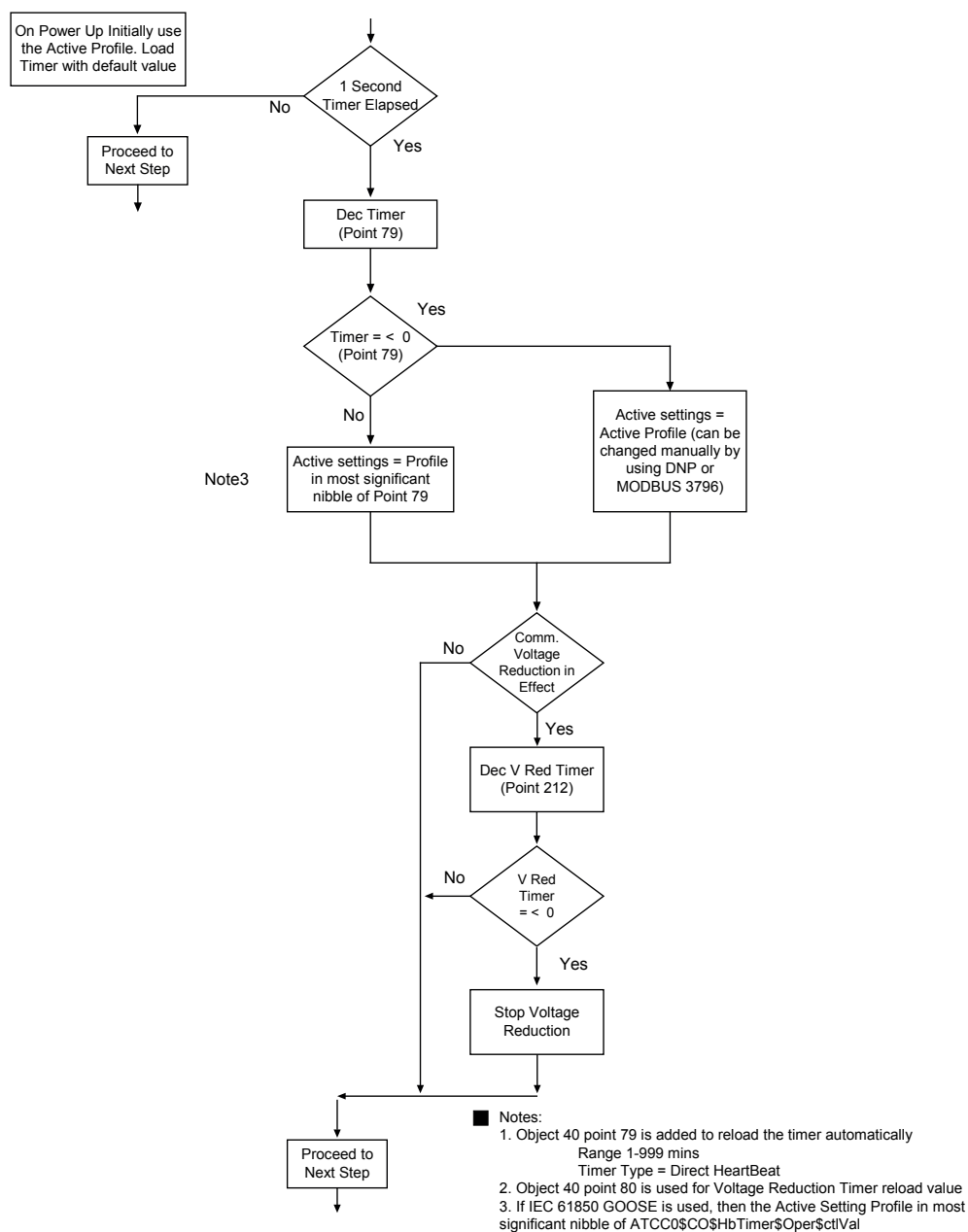


Figure 249: Profile Switching

Additionally an IEC 61850 method of providing a HeartBeat for profile switching is available when the optional IEC 61850 protocol is purchased. The HeartBeat mode for the IEC 61850 algorithm works exactly like profile switching HeartBeat mode in DNP, except that GOOSE subscription is used in case of IEC 61850. The TCC300 subscribes to HeartBeat GOOSE message which has the following attributes:

- VLAN-ID: 0
- VLAN-PRIORITY: 4
- MAC Address: 01-0C-CD-00-00-10
- APPID: 0

Also, the GOOSE dataset contains only one data which is organized as, the most significant 4 bits will have the profile number to be activated and the rest will contain the timer reload value.

Using this method, the IEC 61850 client should repetitively publish a GOOSE message with the above mentioned attributes and data, before the timer reload value expires.

HeartBeat Manual Mode

The purpose of the Manual HeartBeat Mode feature is to provide a method to place the control in Manual operation and automatically place the control back in Auto mode based on a HeartBeat Timer setting (settable only via DNP communication). The HeartBeat Timer setting is Object 40 "Remote Manual Timer".

The Manual HeartBeat Timer is settable from 0 to 999 Minutes. When the timer is set to a non zero value it will place the control in HeartBeat Manual Mode (Auto operation blocked). If the timer expires the control is placed back in auto mode. If the timer is refreshed before it expires, the control stays in HeartBeat Manual mode.

The DNP status point (binary input Object 1) that shows if the control is in the HeartBeat Manual Mode is: "Manual HeartBeat Status". This point will be set to 1 when placed in manual using the Manual HeartBeat Timer only and not by any other means.

The HeartBeat Manual Mode is separate from the original comm block manual mode. They both perform the same function, but use a different method and DNP point to activate auto or Manual mode. When the control is in Comm Blk Manual, the Manual LED will turn on steady as before, but when in the HeartBeat Manual mode it will flash. The HeartBeat manual method can only be activated via the new HeartBeat timer setting point while the old comm blk method can be activated via comms or the toggle/scamp switch as before.

The Comm Blk mode has priority over the HeartBeat Manual mode regardless of how it is enabled (through communication or switch input). When in HeartBeat Manual mode the tap/voltage limit blocks are active just as before with comm blk mode, but in HeartBeat manual the runback due to high Voltage will also be enabled. If the control is in HeartBeat Manual mode and the comm blk manual is also turned on (via comms or switch input), then the HeartBeat timer will continue to count down. If Comm Blk is turned off, then it will go back to HeartBeat Manual mode unless the HeartBeat manual timer has reached 0.

5.14.1

Setting SCADA HeartBeat option from TCC600

1. Select **Communication/Setup/Heartbeat Option** from the TCC600® toolbar. TCC600 will display the Heartbeat option dialog screen.

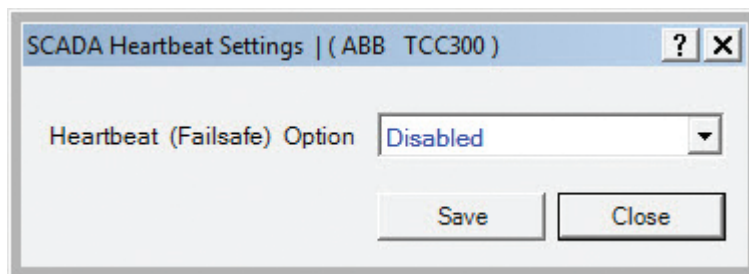


Figure 250: SCADA HeartBeat Dialog Screen

2. Select either "Disable," "LTC (DNP)," "Regulator (DNP)," "Profile Switching (DNP)" or "Profile Switching (GOOSE)".
3. Select "Save". TCC600 will momentarily display a "Setpoints Successfully written to control" confirmation screen.

Section 6 Configuration

6.1 Tapchanger type selections

The Tapchanger Type Selection feature provides the user with the ability to set vendor specific regulator configuration settings in the control from TCC600®. These settings can be accessed through the traditional settings screens or from the Tapchanger Type Selections dialog screen located in the Setup dropdown menu.

Tapchanger Type Selections | (ABB TCC300)

Regulator
☒ Type A ☐ Type B ☐ LTC

Regulator Vendor
 Default

Tap Settings
 Tap Information: Disabled
 Intertap Delay: 0 0 60 (sec)

Operation Counter
 Configuration: ☒ X1 ☐ X2 ☐ Count Window
 Cooper Quick Drive: ☒ Disable ☐ Enable

Raise/Lower Output Contacts
☒ Continuous ☐ Pulsed
 Pulse Width: 1.0 0.2 12.0 (sec)

Inputs
 Input Selection 1: Switch Status

Write SOE Seal-In Triggers?
☒ Yes ☐ No

Save Close

Figure 251: Tapchanger Type Selections Dialog Screen

The selectable settings are available for the following vendor regulator models:

- Siemens
- Howard
- General Electric
- Cooper Spring Drive
- Cooper Direct Drive
- Cooper Quick Drive

The Tap Changer Type Selection feature allows the user to easily select the Vendor of the Regulator the control is being installed on and populate the settings specific to that Vendor Regulator type in a single menu. This menu will always display ABB recommended settings by default for each vendor when opening it, but the interface allows the user to make changes if desired, and save them to the control or settings file. Once this menu is saved, these settings are written to the control or settings file and can be viewed in their appropriate locations.

Table 57: Vendor Specific Regulator Settings

Vendor	Regulator Type	Tap Information	Intertap Delay	Operation Counter Configuration	Raise/Lower Output Contacts Configuration	Raise/Lower Output Contacts Pulse Width	Input Selection 1 Configuration	Write SOE Triggers?
Default	A	Disabled	0	X1	Continuous	1.0 Sec.	Switch Status	N/A
Siemens	A	Regulate Internal (KeepTrack)	1 Sec.	X2	Pulsed	8.0 Sec.	Switch Status	N/A
Howard	A	Regulate Internal (KeepTrack)	1 Sec.	X2	Continuous	8.0 Sec.	Switch Status	N/A
General Electric	A	Regulate Internal (KeepTrack)	1 Sec.	X1	Pulsed	8.0 Sec.	Switch Status	N/A
Cooper Spring Drive	A	Regulate Internal (KeepTrack)	1 Sec.	X1	Pulsed	3.0 Sec.	Seal-In Input	Yes
Cooper Direct Drive	A	Regulate Internal (KeepTrack)	1 Sec.	X1	Pulsed	0.5 Sec.	Seal-In Input	Yes
Cooper Quick Drive	A	Regulate Internal (KeepTrack)	1 Sec.	X1	Pulsed	0.3 Sec.	Seal-In Input	Yes

The Tapchanger "Type" (A or B) and "Regulator Vendor" selection settings can be observed in the HMI in the CONFIGURATION menu "Tapchanger Type" submenu. These settings however, cannot be changed from the HMI.

6.2 Configuration

6.2.1 User programmable alarm relay

The User Programmable Alarm Relay (Form c) is a non-latching relay that is capable of switching 6 A at 125 Vac or 0.2 A at 125 Vdc and is user-programmable to indicate one or more of the following conditions:

- Block Comm is in effect
- Block-Raise Voltage Limit exceeded
- Block-Lower Voltage Limit exceeded
- Voltage Reduction of any step is invoked
- Reverse Power Flow condition is detected
- Line Current Limit/Limit exceeded
- Tap Block Raise/Lower is in effect
- LDC_LDZ is in effect
- Abnormal Tap position detected
- VAr Bias Lead Limit Exceeded
- VAr Bias Lag Limit Exceeded
- Backup Power Fail (If purchased)
- RTN Fail to Operate
- Individual Tap Wear Limit Exceeded
- Operations Count Limit Exceeded
- Tap Changer Failure

When activated, the LDC/LDZ programmable alarm will initiate when any non-zero setting has been entered as LDC Fwd resistance or reactance, or LDC-Z. It will also alarm when any non-zero setting has been entered as LDC Rev resistance or reactance with the "Rev Power Oper" configuration set to "Regulate in Reverse" and the control in reverse power mode.

The Alarm Relay will de-energize and generate an output without any of the conditions being enabled when power to the unit is lost.

6.2.1.1 Setting programmable alarm relay inputs from TCC600

1. Select **Setup/Alarms** from the TCC600 toolbar. TCC600 will display the Alarms dialog screen.

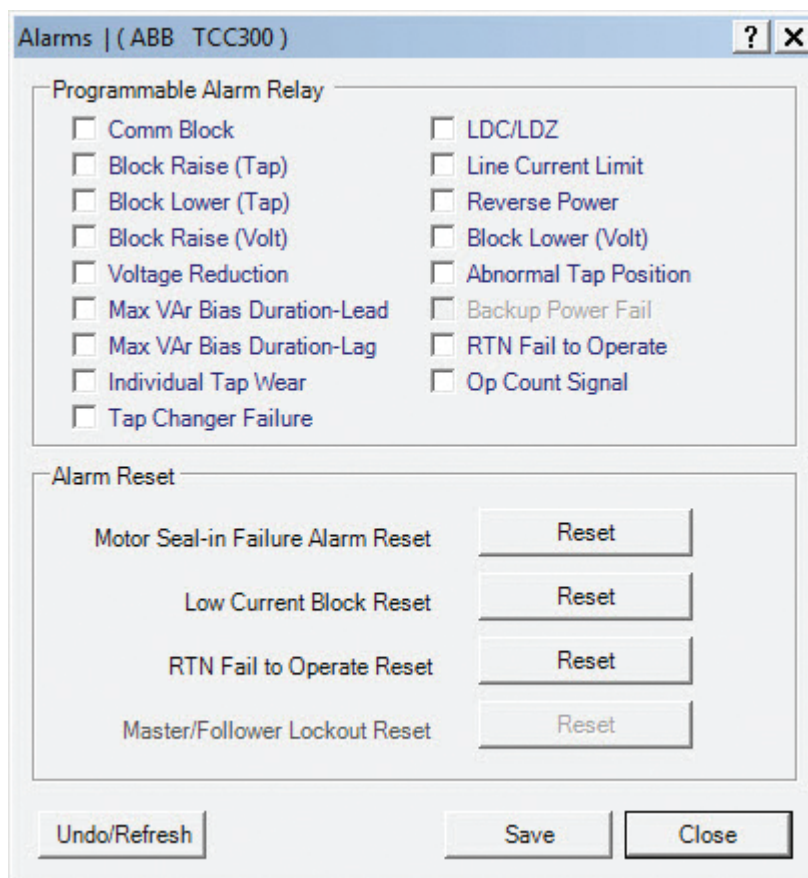


Figure 252: Programmable Alarm Relay Setting Dialog Screen

2. Select the desired Programmable Alarm relay inputs.
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

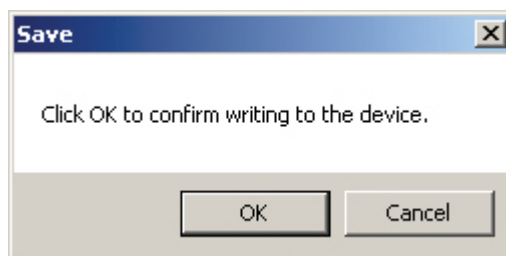


Figure 253: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

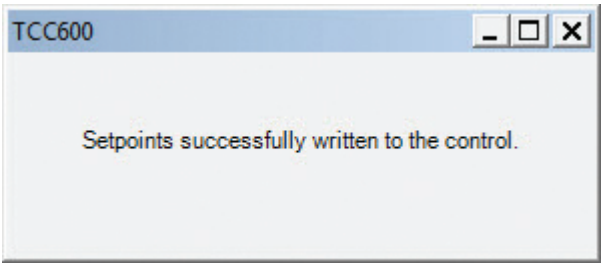


Figure 254: Setpoints Successfully Written To The Control Dialog Screen

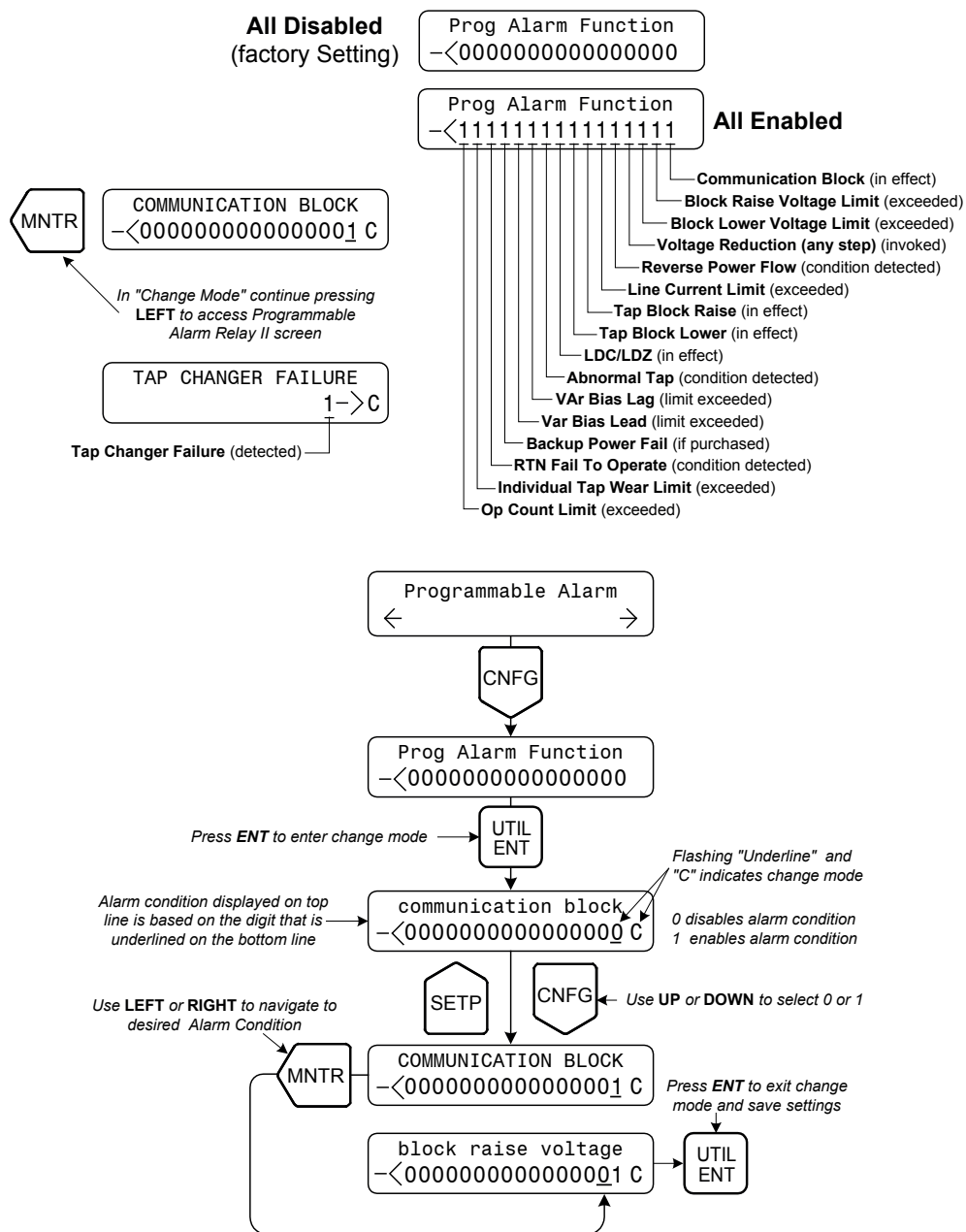


Figure 255: Programmable Alarm Function Programming

6.2.1.2

Setting programmable alarm relay inputs from the HMI

Each alarm condition corresponds to one of the digits on the bottom line of the display: a "0" indicates that the alarm condition is disabled; a "1" indicates that the alarm condition is enabled.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Programmable Alarm" menu.
4. Press the Down arrow, as necessary, until either of the following are displayed depending upon whether the Auto/Manual Switch Type is selected to "SCAMP".
Prog Alarm Function
-<0000000000000000
OR when the Auto/Manual Switch Type is selected to "SCAMP":
Prog Alarm Function
NORMAL or AS DEADMAN OUT
5. If the unit displays the Programmable Alarm setup screen (zeros and/or ones on Line 2), then proceed to Step 8.
6. If the unit displays the "SCAMP" Programmable Alarm Function screen, an additional step is required to access the Programmable Alarm setup screen. Press the "ENT" pushbutton. If prompted, enter a valid Level 2 Access Code.
7. Ensure the selection is set to "NORMAL" and press the "ENT" pushbutton.
8. Press the ENT pushbutton. The following will be displayed:
communication block
-<0000000000000000 C



See [Figure 255](#) for the index of alarm functions.

9. Utilizing the arrow pushbuttons, enter a "1" for those Alarm Functions to be activated and a "0" for those that are to be disabled, then press the ENT pushbutton. The selected alarm will change from "lower case" when disabled (0), to "UPPER CASE" when activated (1).

6.2.1.3

Programmable alarm relay mode

When the Auto/Man Switch Type is set to "SCAMP", the Programmable Alarm Function can be set to "Normal" or "As a Deadman Output". This option is used since the Deadman Output is not available. The default configuration setting is NORMAL.

Setting Programmable Alarm relay mode from the HMI



The "Auto/Man Switch Type Selection" in configuration must be set to "SCAMP" to access this setting.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Programmable Alarm" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Programmable Alarm Function" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Prog Alarm Function
NORMAL C
6. Utilizing the arrow pushbuttons, select the desired Programmable Alarm Function Mode (NORMAL or AS DEADMAN OUT), then press the ENT pushbutton.

Setting Programmable Alarm relay mode from TCC600



The "Auto/Man Switch Type Selection" in configuration must be set to "SCAMP" to access this setting.

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

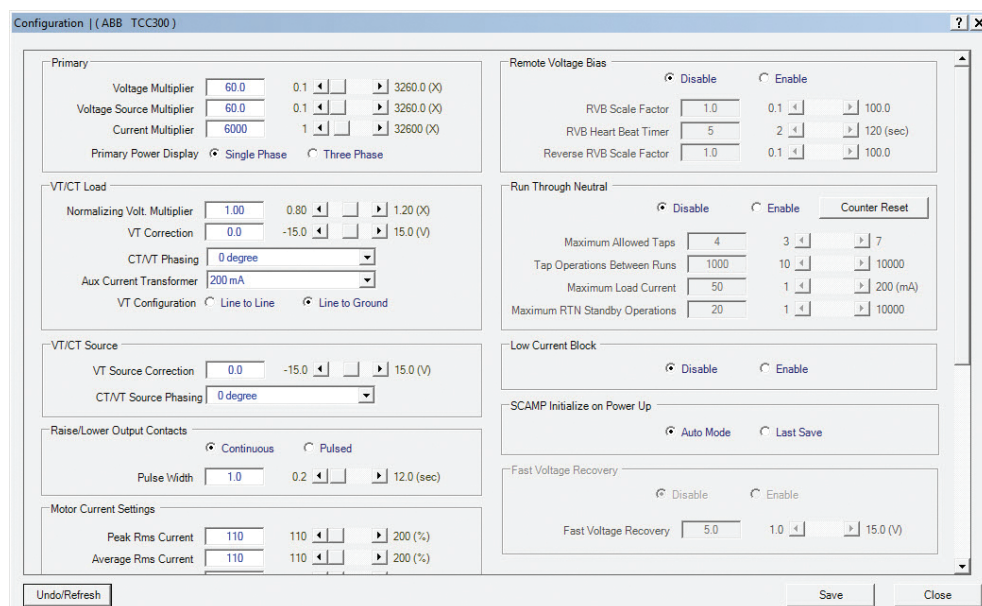


Figure 256: Configuration Dialog Screen

2. Select the desired Programmable Alarm relay inputs.
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

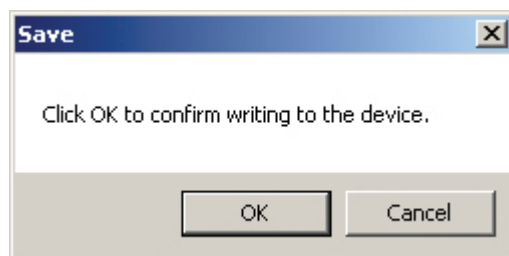


Figure 257: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

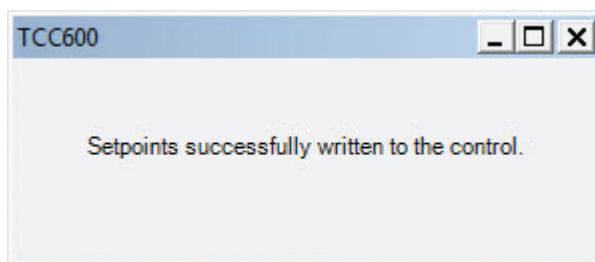


Figure 258: Setpoints Successfully Written To The Control Dialog Screen

6.2.2 Op Count Signal Alarm

The Op Count Signal Alarm feature provides the user with the ability to set a predefined alarm point for the number of tapchanges initiated by the control. When the predefined alarm setting is exceeded, the following alarm message will be displayed on the HMI screen:

Op Count Signal Alarm

Rst Op Count XXX

6.2.2.1 Setting Op Count Signal Alarm from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, until "Programmable Alarm" is displayed.
4. Press the Down arrow, as necessary, until the following is displayed.
Op Count Signal Alm
0
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code.
6. Utilizing the Up/Down arrow pushbuttons enter the desired alarm value, then press the ENT pushbutton.

6.2.2.2 Setting Op Count Signal Alarm from TCC600

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

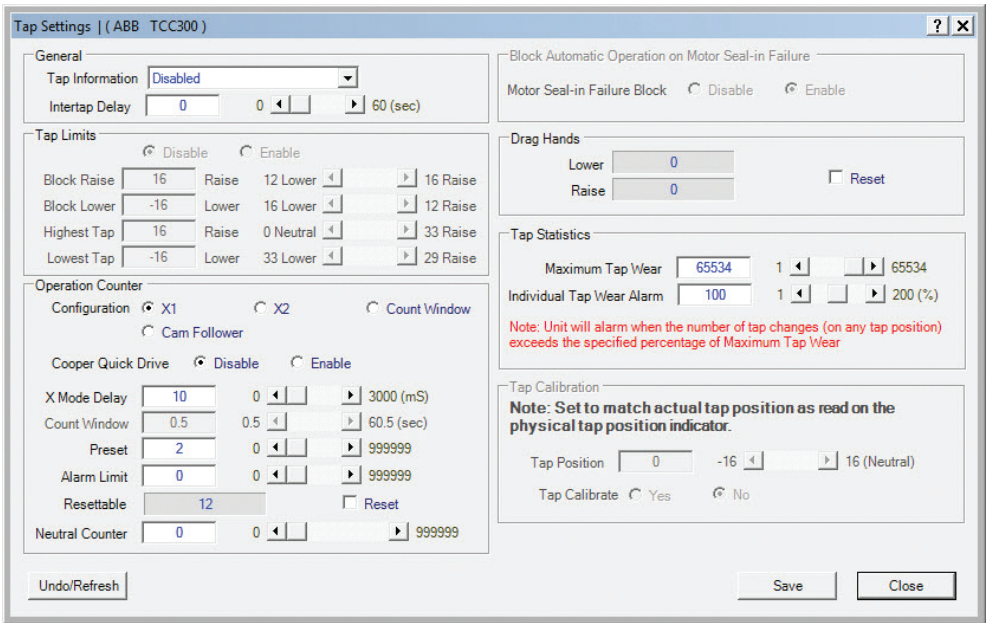


Figure 259: Tap Settings Dialog Screen

- From the "Operation Counter" section of the Tap Settings screen select the desired Op Count Signal Alarm setpoint (Alarm Limit).
- Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

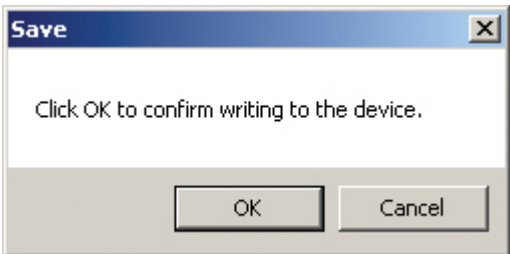


Figure 260: Save to Device Confirmation Screen

- Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

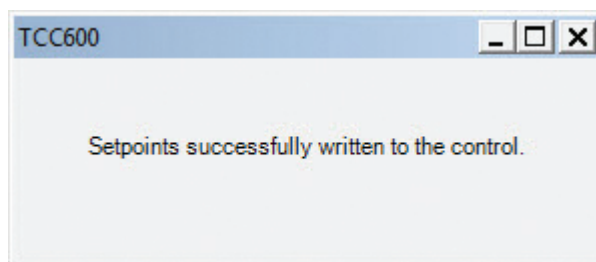


Figure 261: Setpoints Successfully Written To The Control Dialog Screen

6.2.3 Counters

6.2.3.1 Operation counter

The user must select the method of counting tapchanger operations consistent with the tapchanger.

The Operation Counter accommodates 999,999 operation counts. The number of counts are stored in non-volatile memory and are not affected by a loss of supply power to the control. The total number of operation counts is displayed in the Status Menu. The Operation Counter can be preset to any value up to 999,999.

Cooper Regulators do not provide a counter contact. Therefore, the "Operation Counter Input Configuration" must be set to "Seal-In Input". The Seal-In Input selection has a fixed 3 second Seal-In Delay.

X1

Operation count will increment by one with an open-close-open state change on the tapchanger counter switch. The closed state must be present for at least 20 mS. The open state may be present indefinitely.

X Mode Delay (X1)

When the control is using X1 Mode counter contact detection method, the X Mode Delay setting in millisecond is used to define the minimum time duration for the X1 counter contact signal. Any signal duration of less than the X Mode Delay will be considered as an invalid counter contact signal. Depending on the condition of the counter contact switch, the X Mode Delay should be set between 10 - - 20 mS. For greater noise immunity a debounce window of 160 mS exists after valid count operation.

X2

Operation count will increment by one with either an open-close or a close-open state change of the tapchanger operation counter switch. Both the closed and open states may exist indefinitely.

X Mode Delay (X2)

When the control is in X2 Mode detection, the X Mode Delay setting is used to delay the detection and processing of the next X2 counter contact signal. This is necessary especially in the case where the neutral signal starts before the next counter contact signal when the voltage regulator is moving to neutral.

Count Window

Operation count will increment by only one count during a set time period of "Count Window". This is true no matter how many counter inputs occur during the count window time. After a counter input is accepted, the count window timer begins and another count won't be accepted until the count window time expires. The count window time can be set from 0.5 to 60.5 seconds.



The Count Window setting should not be set to a value greater than the Intertap Delay when in pulsed or continuous mode. Also, it should not be set greater than the Pulse Width setting, if Pulsed mode is used.

Cam Follower

The Cam Follower setting should be selected when a Cam Follower contact input is wired into the Counter contact input of the TCC300. The operation counter and resettable operation counter will increment when the counter input sees the cam follower open and then close.



The Cam Follower contact requires a minimum of 500 milliseconds to open and a minimum of 500 milliseconds to close. For this reason, if configuring the Output Selection to Pulsed Mode, the Pulse Width must be set to longer than the actual time it takes for the Cam Follower switch to complete its operational cycle. If this is not set correctly, tap position could be inaccurate. ABB recommends that Output Selection be configured to Continuous unless the LTC mechanism requires Pulsed Mode to operate correctly.

Cooper Quick Drive

The Cooper Quick Drive setting should be enabled for a Cooper QD regulator. When enabled, this setting applies a 0 second seal-in output. For Cooper Spring Drive and Direct

Drive regulators, this setting should be disabled. When disabled, this applies a 3 second seal-in output.

Neutral Switch Counter

The Neutral Switch Counter is updated each time the neutral input is detected. Neutral Switch Counter can also preset to any value. The Neutral Switch Counter is a software counter that is stored in non-volatile memory and has a maximum value of 999,999.

6.2.3.2

Setting the Operation Counter Configuration from the HMI



This feature is not functional unless Input Selection 1 is set to "Switch Status".

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Operation Counter Configuration" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Op Counter Config
1 X C
6. Utilizing the Up/Down arrow pushbuttons, select the desired counter configuration for the application (1 X, 2 X, COUNT WINDOW or CAM FOLLOWER), then press the ENT pushbutton. The following will be displayed reflecting the counter configuration that was entered.
7. Press the Down arrow pushbutton, as necessary, until the "Cooper Quick Drive" screen is displayed.
8. Press the ENT pushbutton. The following will be displayed.
Cooper Quick Drive
disable C
9. Utilizing the Up/Down arrow pushbuttons, select ENABLE for a Cooper Quick Drive regulator. For a Cooper Spring Drive or Direct Drive regulator, leave this selection "disable".
10. Press the Down arrow pushbutton, as necessary, until the "Cam Follower" screen is displayed.
11. Press the ENT pushbutton. The following will be displayed.
Cam Follower

disable C

12. Utilizing the Up/Down arrow pushbuttons, select ENABLE to enable the Cam Follower feature.
13. Depending on the Operation Counter configuration that was selected, proceed as follows to complete the Operation Counter configuration:
 - If the "1 X" or "2 X" counter configuration was selected, proceed to setting the Operations Counter X Mode Delay from the HMI.
 - If the "COUNT WINDOW" counter configuration was selected, proceed to setting the Counter Time Window.
 - If the "CAM FOLLOWER" counter configuration was selected, the Operation Counter configuration is complete.

6.2.3.3

Setting Operation Counter X Mode Delay from the HMI



This feature is not functional unless Input Selection 1 is set to "Switch Status".

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.
4. Press the Down arrow pushbutton, as necessary, until the "X Mode Delay" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
X Mode Delay
10 ms C
6. Utilizing the Up/Down arrow pushbuttons select the desired Counter X Mode Delay value for the application (0 to 3000 ms), then press the ENT pushbutton.

6.2.3.4

Setting Operation Counter X Mode Delay from the HMI



This feature is not functional unless Input Selection 1 is set to "Switch Status".

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Counter Time Window" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Counter Time Window
0.5 Sec C
6. Utilizing the arrow pushbuttons select the desired "Counter Time Window" value for the application (0.5 to 60.5 Seconds), then press the ENT pushbutton.

6.2.3.5

Configuring the Operation Counter from TCC600



This feature is not functional unless Input Selection 1 is set to "Switch Status".

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

Figure 262: Tap Settings Dialog Screen

2. Select the desired Operation Counter configuration (X1, X2, Count Window or Cam Follower).
3. If "X1 or X2" configuration was selected in Step 2, enter the desired "X Mode Delay" setting (0 to 3000 mS).
4. If "Count Window" configuration was selected in Step 2, enter the desired "Count Window" setting (0.5 to 60.5 seconds).
5. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

Figure 263: Save to Device Confirmation Screen

6. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

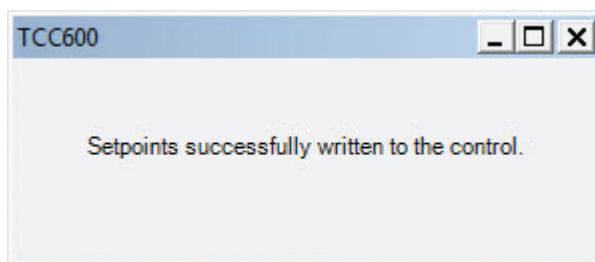


Figure 264: Setpoints Successfully Written To The Control Dialog Screen

6.2.3.6 Resetting the Resettable Operation Counter from the HMI

The resettable operation counter operates with the method selected by X1, X2, Count Window or Cam Follower. This counter can be reset to zero.

1. Press the Left Arrow (MNTR Hot Button) pushbutton to wake the unit. The menu will advance to "MONITOR".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Metering
3. Press the Right or Left arrow pushbutton, as necessary to advance to the "Tap Information" screen.
4. Press the Down arrow pushbutton, as necessary, to navigate to the "Resettable Counter" menu.
5. Press ENT, a flashing "R" will be displayed. Press ENT again to reset the Operations Counter.

6.2.3.7 Resetting the Resettable Operation Counter from TCC600

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

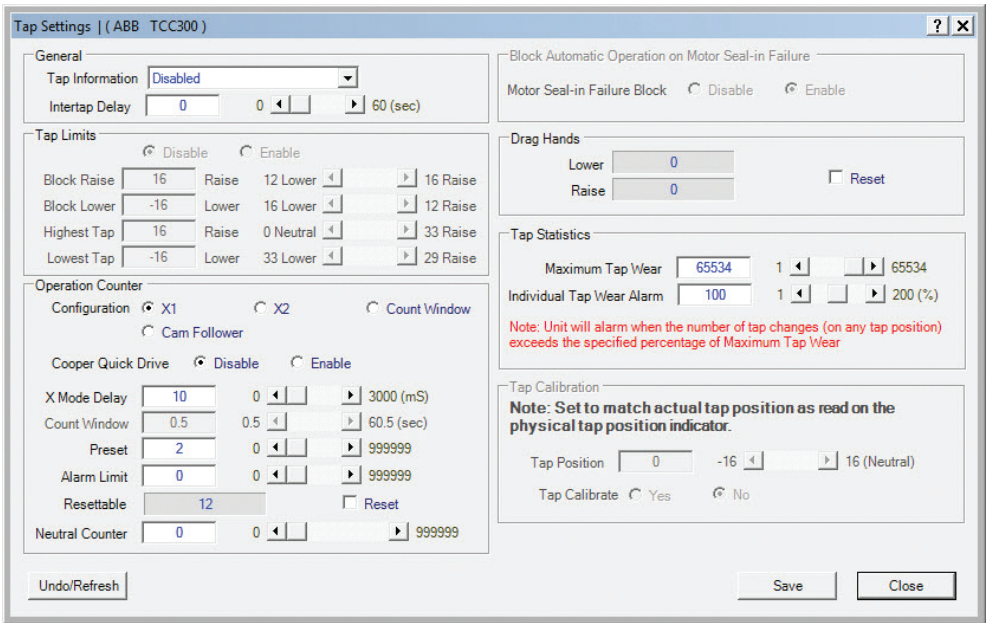


Figure 265: Tap Settings Dialog Screen

2. Select the "Reset" check box located next to the "Resetttable" counter located in the Operation Counter section of the dialog screen.
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

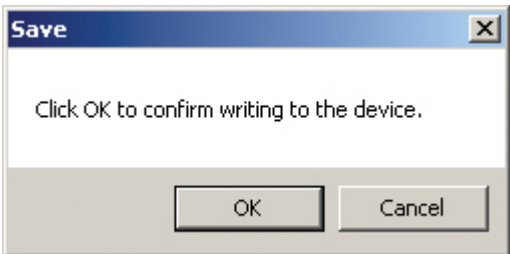


Figure 266: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

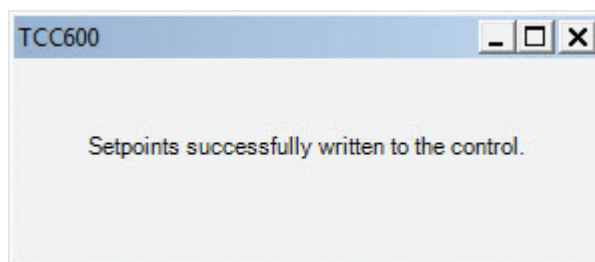


Figure 267: Setpoints Successfully Written To The Control Dialog Screen

6.2.3.8

Presetting the Presettable Operation Counters from the HMI

The Operation, Neutral, Lower and Raise Counters operate with the selected count method (X1, X2, Count Window or Cam Follower). It provides the user with the ability to preset a value up to 999,999. The counters will increment from the preset value based on the selected count method.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Op Counter Preset" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Op Counter Preset
000000 C
6. Utilizing the arrow pushbuttons enter the desired Operations Counter Preset value from 0 to 999,999, then press the ENT pushbutton.

6.2.3.9

Presetting the Presettable Operation Counters from TCC600

To Preset the Operation and/or Neutral Counter from TCC600®, perform the following:

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

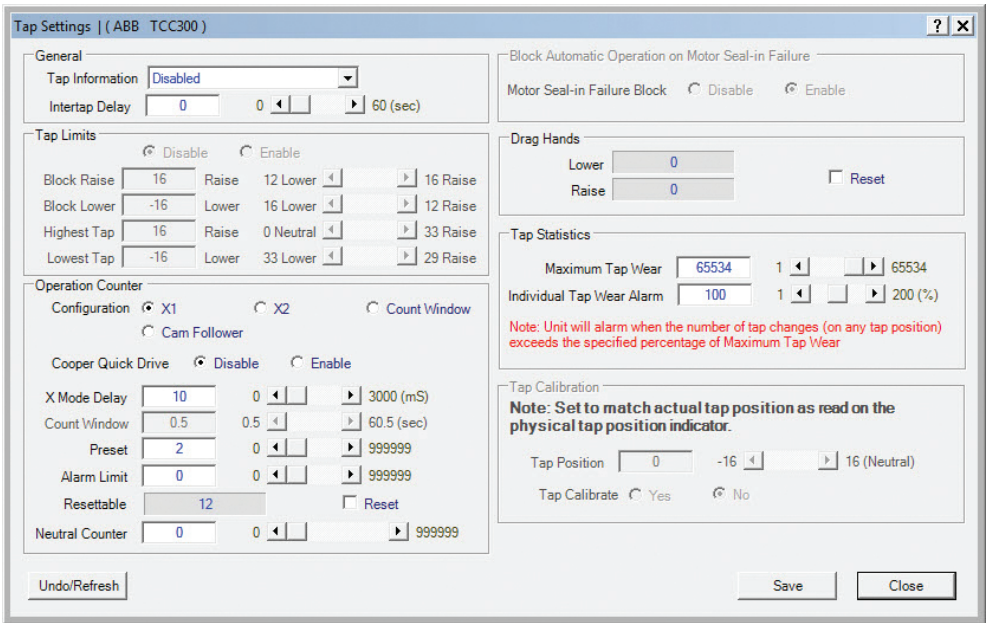


Figure 268: Tap Settings Dialog Screen

2. Enter the Operation/Neutral Counter Preset value located in the Operation Counter section of the dialog screen.
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

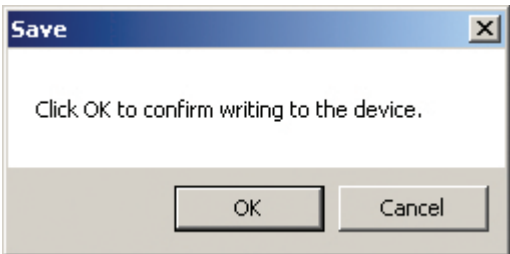


Figure 269: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

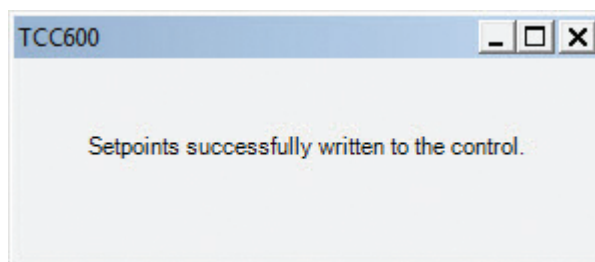


Figure 270: Setpoints Successfully Written To The Control Dialog Screen

6.2.4 Inputs and switch configuration

6.2.4.1 Setting Input Selection 1 Operation Counter Input Configuration to Switch Status from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left Arrow pushbutton, as necessary, until "Input Selection" is displayed.
4. Press the Down arrow pushbutton, as necessary, until the "Input Selection 1" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access
Input Selection 1
SWITCH STATUS C



Input Selection 1 is required to be set to "Switch Status" if "Contact KeepTrack™ 1R1L" or "Contact KeepTrack 1N" is selected for Tap Information. The unit will display the following error message if applicable:

Tap Info conflict
Any Key to Continue

6. Utilizing the Up/Down arrow pushbuttons, select "SWITCH STATUS" then press the ENT pushbutton.

The applicable counter type must be selected in Tap Settings.

6.2.4.2

Setting Input Selection 1 Operation Counter Input Configuration to Switch Status from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

Figure 271: Configuration Dialog Screen



Input Selection 1 is required to be set to "Switch Status" if "Contact KeepTrack 1R1L" or "Contact KeepTrack 1N" is selected for Tap Information. TCC600 will display the following Error Screen if applicable.

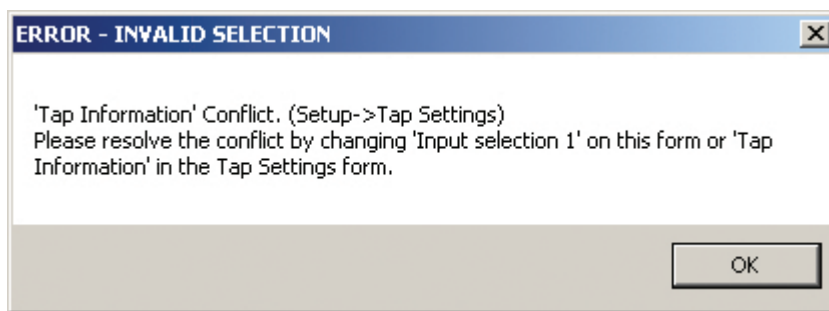


Figure 272: Tap Information/Input Selection Conflict Error Screen

2. From the "Inputs and Switch" section of the dialog screen set Input Selection 1 to "Switch Status".
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

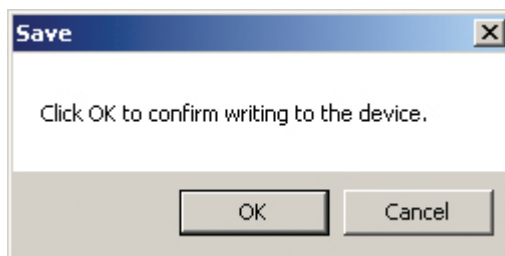


Figure 273: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

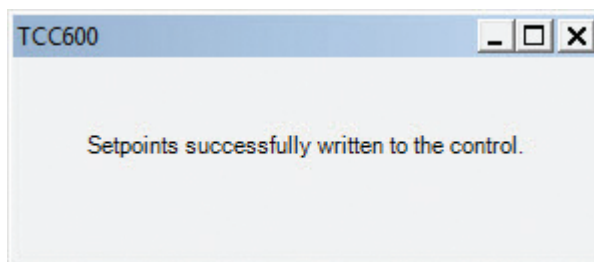


Figure 274: Setpoints Successfully Written To The Control Dialog Screen

6.2.5 Motor seal-in failure block

The Motor Seal-in Failure Block feature addresses the following scenarios that can occur on Cooper regulators which can result in incorrect tap position, a failure of the regulator to regulate voltage, or both conditions simultaneously.

Failing or Open Motor Capacitor (Stalled Tapchanger)

If the motor capacitor degrades over time, it will result in a motor that does not always have enough torque to operate correctly. Eventually, it will degrade enough to prevent any operation of the motor. The result of this scenario is a regulator that intermittently and eventually permanently fails to regulate voltage and cannot track tap position accurately.

The Motor Seal-in Failure Block feature will block the regulator from operating and actuate an alarm to alert the user to this malfunction. If the motor capacitor is not open but degraded, then input voltage affects the motor's ability to operate. For this reason, instead of blocking the regulator operation permanently, it will only block in the direction it was moving when the Motor Seal-in Failure Block feature was triggered.

Low Motor Voltage (Stalled Tapchanger)

For example a brown out condition, could result in a motor temporarily not having enough torque to operate correctly. The result of this scenario is a regulator that intermittently fails to regulate voltage and cannot track tap position accurately.

In this scenario, the motor also does not have enough torque to execute a tapchange. The Motor Seal-in Failure Block feature will operate the same as it does for a failing or open motor capacitor except that once voltage is restored, the control will operate normally. The alarm will alert the user to the low voltage condition and its effect on the regulator.

Motor Seal-In Switch Malfunction

The Motor Seal-in Switch in the Cooper regulator may malfunction in either one direction or both. The result of this condition is a regulator that cannot track tap position accurately.

In this scenario, the motor is capable of turning, but tap position will be inaccurate as the circuit's proper operation is the only method of tracking tap position accurately. Since it is possible for the Motor Seal-in switch to fail in only one direction, the blocking function of the Motor Seal-in Failure feature is designed to be unidirectional such that it will allow the regulator to operate in the opposite direction that caused the block to occur.

The Motor Seal-in Failure Block feature actuates an alarm to alert the user to the problem. The operation block would not be needed in this scenario as loss of accurate KeepTrack™ is the only negative consequence of the malfunction. Since the unit cannot detect the difference between this failure and the Stalled Tapchanger scenario, the block must be in effect. The block function of this feature can be disabled by the user if it is desired to

continue operating the regulator with this failure until it can be repaired. The alarm however, will remain in effect as long as the failure conditions exist.

Reaching a Physical Tap Limit Set in the Regulator

When the tap limit is reached, motor power is physically disconnected from the raise or lower motor windings in the direction of the tap limit and operation in that direction cannot occur.

This scenario removes motor power from the raise or lower motor winding when the associated physical tap limit is reached. There is no negative consequence of this occurring when the Motor Seal-in Failure Block feature is disabled. With the Motor Seal-in Failure Block feature enabled however, the control cannot detect the difference between Reaching a Physical Tap Limit and a Motor Seal-in Switch failure, so it must block and alarm.

The unidirectional nature of the block is designed for this scenario as well as a Motor Seal-in Switch failure to allow operation of the regulator in the opposite direction when needed. Alarming in this condition can provide the user with information that there may be a settings error or an upstream Fixed Tap Transformer may be tapped incorrectly as a regulator should not normally need to issue a raise or lower command when at its physical limit.

When Motor Seal-in is selected in the control the Motor Seal-in Failure Block feature and the input to the Abnormal Tap Position alarm are enabled by default. The user may choose to disable the Motor Seal-in Block feature. However, the input to the Abnormal Tap Position alarm is always enabled when Motor Seal-in is selected. The feature includes the following:

Abnormal Tap Position Alarm Input

The Motor Seal-in Failure Block feature provides an input to the "Abnormal Tap Position" alarm. This input is actuated on the first occurrence of a tapchange coincident with no motor seal-in current detected for 15 seconds.

Motor Seal-in Failure Alarm

The Motor Seal-in Failure Alarm is actuated on the second occurrence (either direction) of a tapchange coincident with no motor seal-in current detected for 15 seconds. This alarm can be reset by the user from the Human Machine Interface (HMI), from the TCC600® "Alarms" dialog screen or via SCADA. The alarm is also reset when a successful tapchange operation occurs (motor seal-in current detected) in either direction.

Motor Seal-in Failure Block

The Motor Seal-in Failure Block is actuated on the second occurrence of a tapchange coincident with no motor seal-in current detected for 15 seconds in either direction. The block will be in effect in the direction that produced the second Motor Seal-in Failure

occurrence. If a Motor Seal-in Failure is detected in the opposite direction, then operation will be blocked in that direction also.

This Block can be reset by the user from the HMI, from the TCC600 "Alarms" dialog screen or via SCADA. The block is also reset when a successful tapchange operation occurs (motor seal-in current is detected) in the opposite direction.

The internal accumulator that counts the occurrences of failed tapchanges is stored in volatile memory and is set to zero when a loss of power occurs and the unit is not equipped with a backup power supply. This is considered normal operation of the feature.

6.2.5.1

Setting Input Selection 1 Operation Counter Input Configuration to Motor Seal-In from the HMI



If Tap Information is selected to either "Contact KeepTrack™ 1R1L" or "Contact KeepTrack 1N" the control will not accept an Input Selection 1 setting of "Seal-In Input". The unit will display the following error message if applicable:
Tap Info conflict
Any Key to Continue



Motor Seal-in Delay is fixed at 3 seconds.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right/Left arrow pushbutton as necessary to navigate the "Input Selection" screen.
4. Press the Down arrow pushbutton, as necessary, until the "Input Selection 1" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Input Selection 1
SWITCH STATUS C
6. Utilizing the Up/Down arrow pushbuttons, select "SEAL-IN INPUT", then press the ENT pushbutton.

6.2.5.2

Setting Input Selection 1 Operation Counter Input Configuration to Motor Seal-In from TCC600



If Tap Information is selected to either "Contact KeepTrack 1R1L" or "Contact KeepTrack 1N" the control will not accept an Input Selection 1 setting of "Seal-In Input". TCC600 will display the Tap Information/Input Selection Error Screen if applicable.

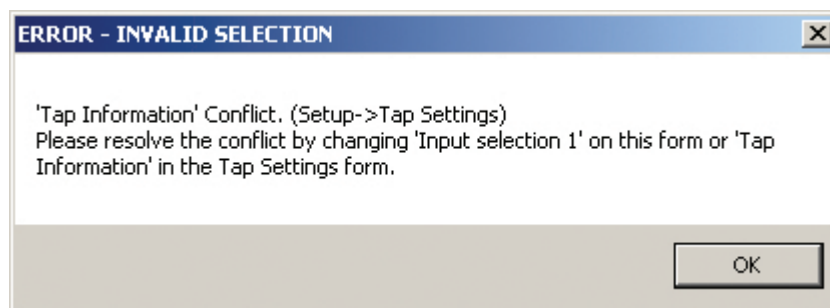


Figure 275: Tap Information/Input Selection Conflict Error Screen

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Tap Configuration dialog screen.

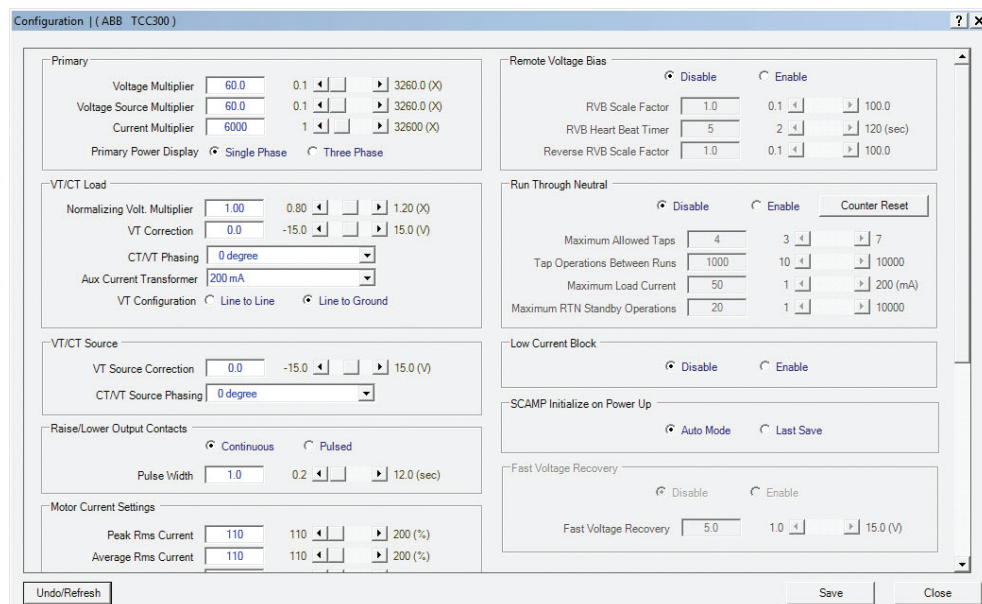


Figure 276: Configuration Dialog Screen

- From the "Inputs and Switch/Input Selection 1" section of the dialog screen select "Seal-in Input".
- Select **Save**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

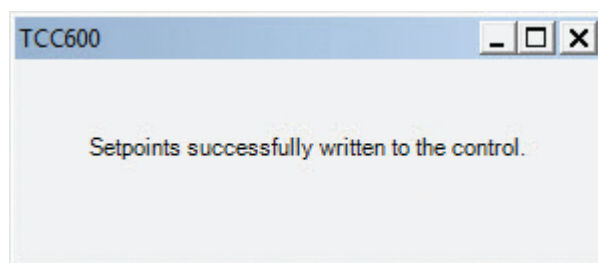


Figure 277: Setpoints Successfully Written To The Control Dialog Screen

6.2.5.3

Setting Motor Seal-in Failure Alarm/Block from the HMI

- Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
- Press the Down Arrow pushbutton once. The unit will display the following: Tapchanger Type
- Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.

4. Press the Down arrow, as necessary, until the following will be displayed.
Seal-In Fail Block
disable
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code.
6. Utilizing the Up/Down arrow pushbuttons select enable, then press the ENT pushbutton.

6.2.5.4

Setting Motor Seal-in Failure Alarm/Block from TCC600

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

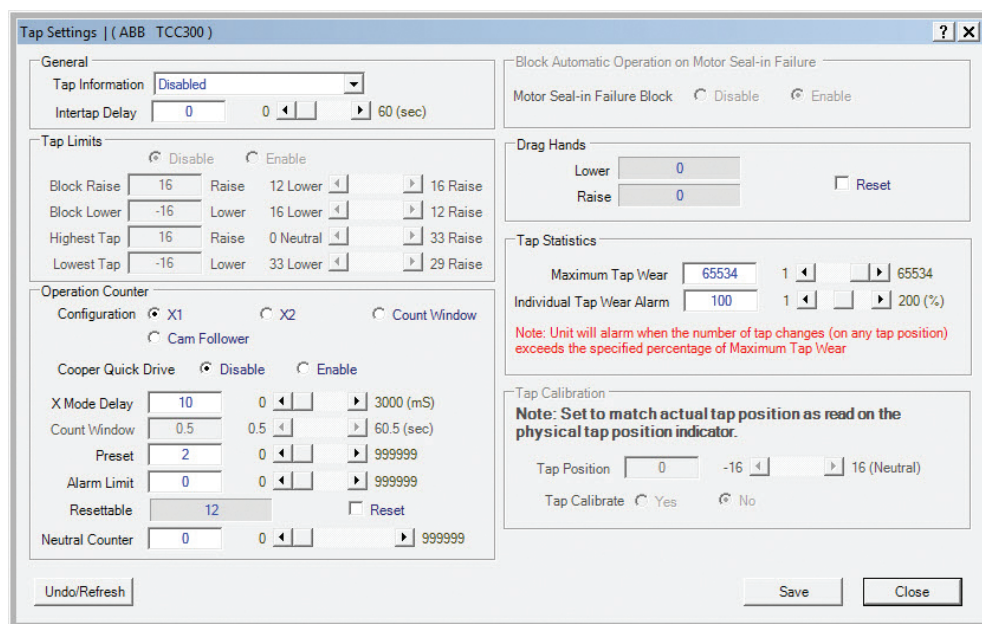


Figure 278: Tap Settings Dialog Screen

2. From the "Block Automatic Operation on Motor Seal-in Failure" section of the Tap settings screen select Motor Seal-in Failure "Enable" or "Disable".
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

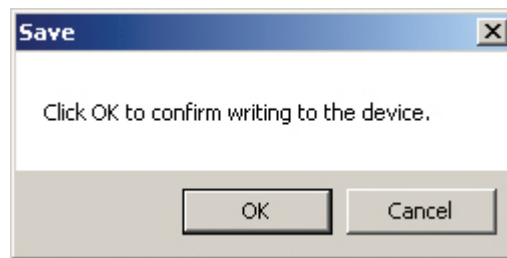


Figure 279: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

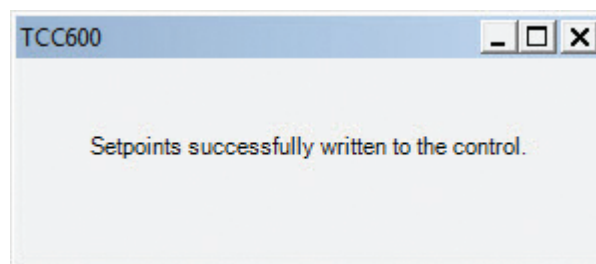


Figure 280: Setpoints Successfully Written To The Control Dialog Screen

6.2.5.5

Input Selection 2 (Non-Sequential or SCADA Cutout)

The Input Selection 2 can be configured to be either an input that initiates Non-Sequential control operation or a SCADA Cutout switch input. The default configuration setting is Non-Sequential.

Setting Input Selection 2 from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Input Selection" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Input Selection 2" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Input Selection 2

NONSEQ INPUT C

- Utilizing the arrow pushbuttons, select the desired Input Selection 2 (Non-Sequential or SCADA Cutout), then press the ENT pushbutton.

Setting Input Selection 2 from TCC600

- Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

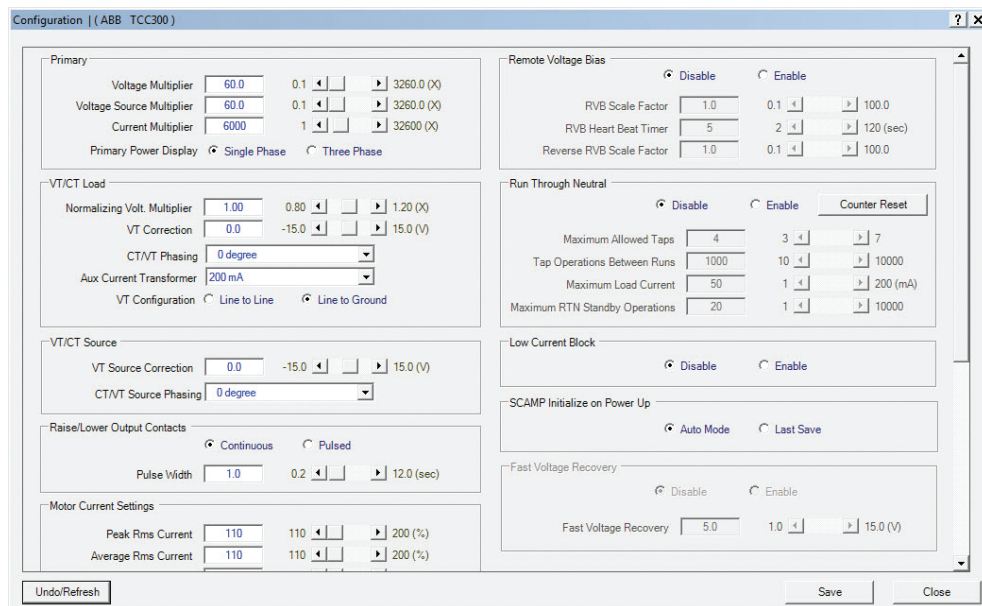


Figure 281: Configuration Dialog Screen

- From the "Inputs and Switch/Input Selection 2" section of the dialog screen select either "Non-sequential" or "SCADA Cutout".
- Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

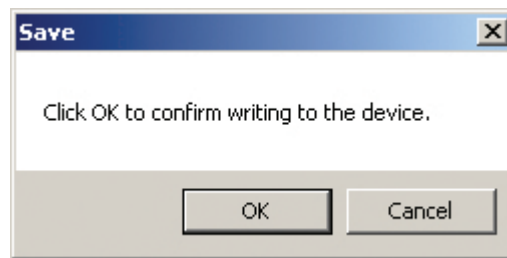


Figure 282: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

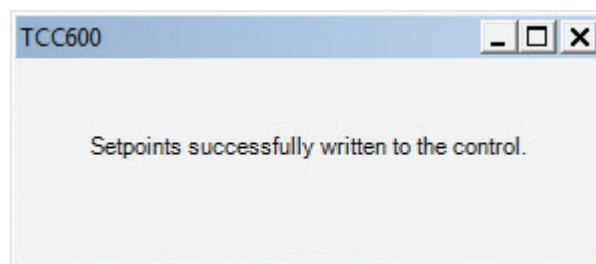


Figure 283: Setpoints Successfully Written To The Control Dialog Screen

6.2.5.6

Input Selection 3 (VR2 or Aux)

The Input Selection 3 can be configured as the Voltage Reduction 2 input or as an auxiliary input that can be read as a DNP or MODBUS® point. The default configuration setting is Voltage Reduction 2.

Setting Input Selection 3 (VR2/Aux) from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Input Selection" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Input Selection 3" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Input Selection 3

VOLTAGE RED 2 C

- Utilizing the arrow pushbuttons, select the desired Input Selection (VR2/Aux), then press the ENT pushbutton.

Setting Input Selection 3 from TCC600

- Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

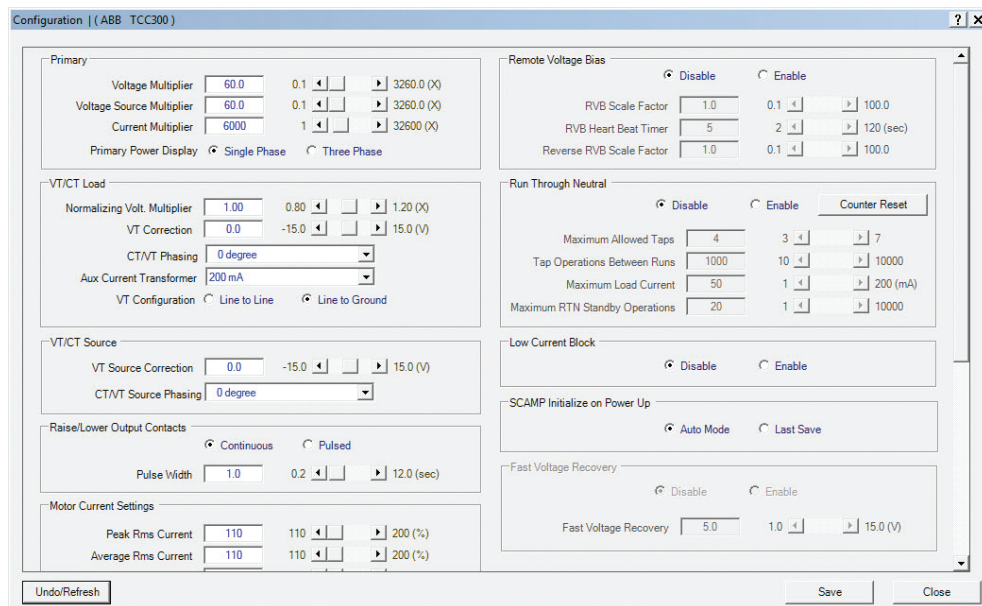


Figure 284: Configuration Dialog Screen

- From the "Inputs and Switch/Input Selection 3" section of the dialog screen select either "VR2" or "Aux" for Input Selection 3.
- Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

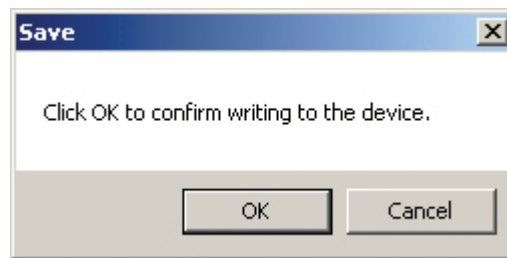


Figure 285: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

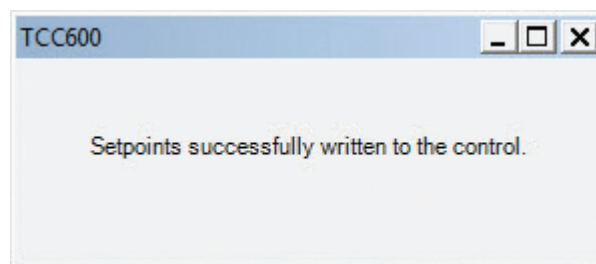


Figure 286: Setpoints Successfully Written To The Control Dialog Screen

6.2.6 Auto/Manual switch type

The Auto/Manual Switch Type setting allows the Auto/Man Switch type on the adapter panel to be set to "Toggle, SCAMP or None". None is used when no Auto/Manual Switch exists. The default configuration setting is None.



When the Auto/Manual Switch Type configuration is set to "SCAMP", the Programmable Alarm Function can be set to function as "Normal" or "As a Deadman Output". This option is available when SCAMP mode is used since the Deadman Output is not available.

6.2.6.1 Setting Auto/Man Switch Type from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:

- Tapchanger Type
- Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.
 - Press the Down arrow pushbutton, as necessary, until the "Auto/Man Sw Type" screen is displayed.
 - Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Auto/Man Sw Type
NONE C
 - Utilizing the arrow pushbuttons, select the desired Auto/Manual Switch Type (None, Toggle or SCAMP), then press the ENT pushbutton.

6.2.6.2

Setting Auto/Manual Switch Type from TCC600

- Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

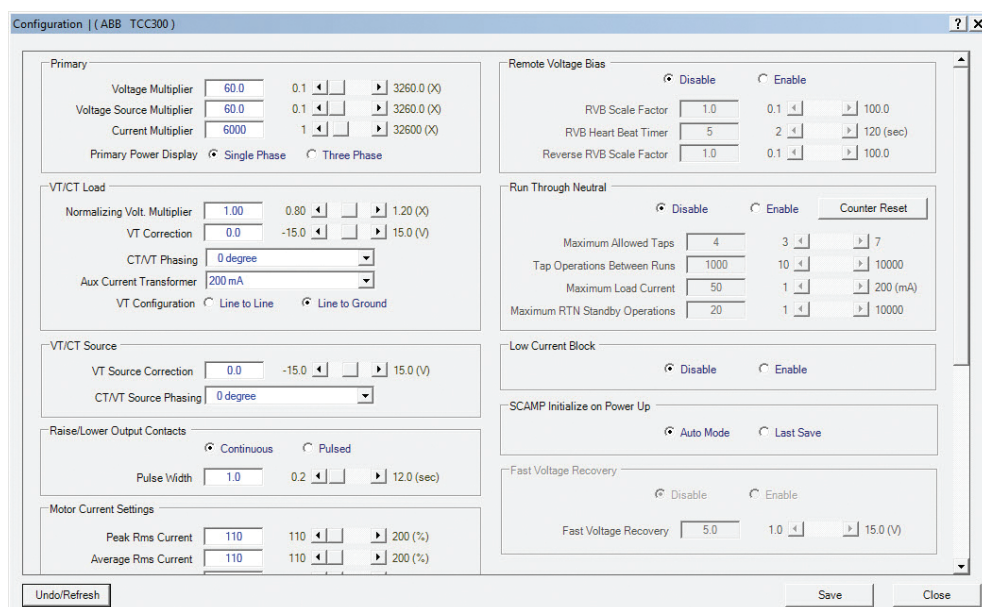


Figure 287: Configuration Dialog Screen

- From the "Inputs and Switch/Auto/Man Switch Type" section of the dialog screen select either "None, Toggle or SCAMP".
- Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

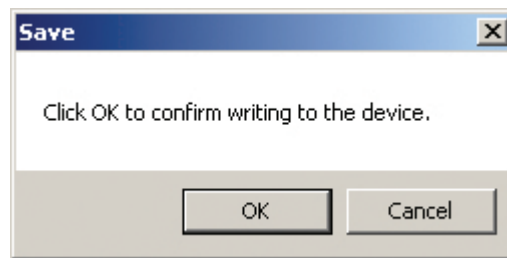


Figure 288: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

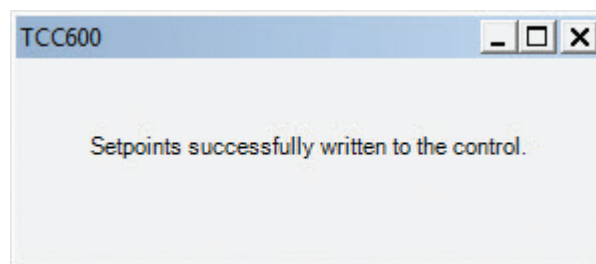


Figure 289: Setpoints Successfully Written To The Control Dialog Screen

6.2.7 Ratio multipliers

6.2.7.1 Voltage and current multipliers



The voltage and current multipliers do not affect the regulation of the control. They are only used in the calculation of primary values.



The use of a voltage correction factor is incorporated in the calculation of primary quantities in the control. Although the control operation is not affected, erroneous values will be displayed and recorded if the VT correction factor is not included in the PT multiplier.

Primary quantities are displayed when voltage and current multipliers are set in the control. The voltage multiplier is:

$$V_{\text{mult}} = V_{\text{pri}} / (V_{\text{sec}} + V_{\text{corr}})$$

For a VT ratio of 7620/117 V and a voltage correction of 3 V, the multiplier is:

$$V_{\text{mult}} = 7620 / (117 + 3) = 63.5$$

The voltage multiplier setting range is from 0.1 to 3260.0 in 0.1 steps.

The current multiplier is the value of the line CT primary rating divided by 0.2 A. For a CT primary rating of 1000 A, the multiplier is:

$$CT_{\text{mult}} = 1000 / 0.2 = 5000$$

The current multiplier setting range is from 1 to 32600 in 1 step increments.

Normalizing Voltage Multiplier

A Normalizing Voltage Multiplier with a range of 0.80 to 1.20 is available to be applied to Meter Out Voltage and displayed in real time as Normalizing Voltage. The purpose of the Normalizing Voltage Multiplier is to allow the user to overcome differences in the ratio of the PT that the Meter Out Voltage input is using versus the PT the end user or other metering methods are using.

6.2.7.2

Setting the Voltage and Current Multipliers from the HMI



The current input to the control is rated at 0.2 A continuous, 0.4 A for two hours, and 4.0 A for 1 second.



The CT Multiplier selection in the Configuration/CT and VT menu only changes the scaling factor for current reading and setting.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.



The following sequence of steps provide direction for setting the Current Multiplier. The steps necessary to set the Load Voltage, Source Voltage and Normalizing Voltage multipliers are similar.

4. Press the Down arrow pushbutton, as necessary, until the "Current Multiplier" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
CT Multiplier
6000 X C
6. Utilizing the arrow pushbuttons enter the desired Current Multiplier value from 1 to 32600, then press the ENT pushbutton.

6.2.7.3

Setting the Voltage and Current Multipliers from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

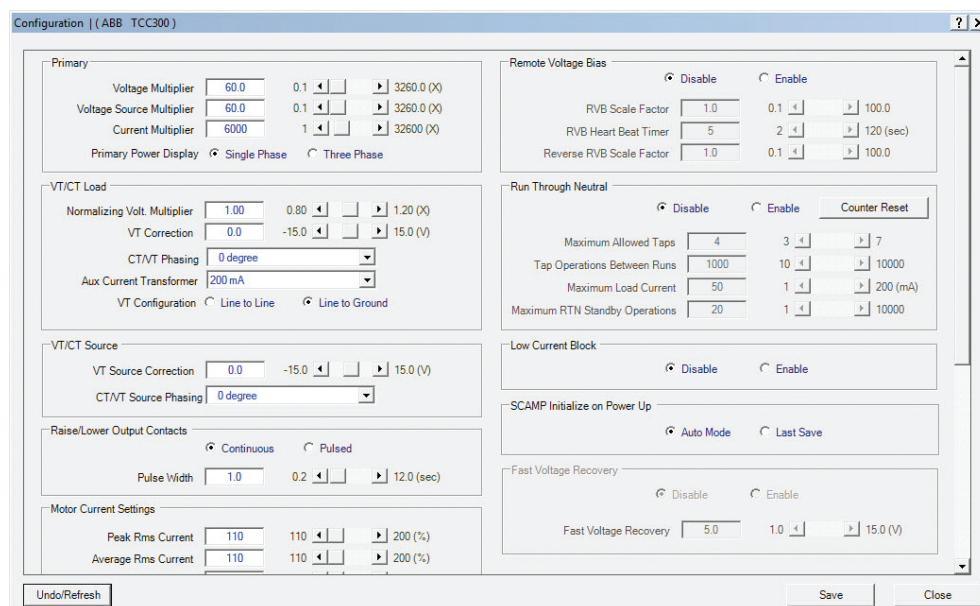


Figure 290: Configuration Dialog Screen

2. Enter the Current, Voltage, Voltage Source and Normalizing Voltage Multipliers.
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

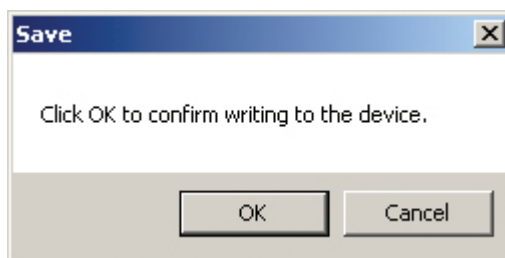


Figure 291: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

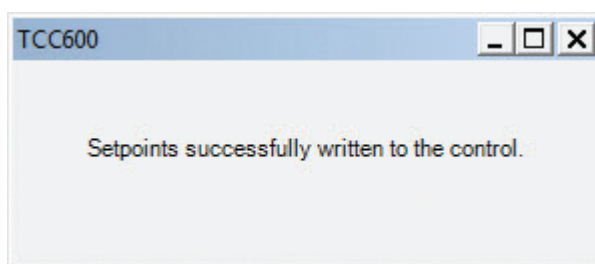


Figure 292: Setpoints Successfully Written To The Control Dialog Screen

6.2.8 Primary power display

The Primary Power Display Selection toggles between two modes of operation:

- Single-Phase-based on measured inputs
- Three-Phase-based on measured inputs and presumed balanced system

Factory setting is single-phase.

6.2.8.1 Setting Primary Power Display Selection from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.

4. Press the Down arrow pushbutton, as necessary, until the "Power Display Option" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Power Display Option
SINGLE_PHASE C
6. Utilizing the arrow pushbuttons, select the desired Power Display Option, then press the ENT pushbutton.

6.2.8.2

Setting Primary Power Display Selection from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

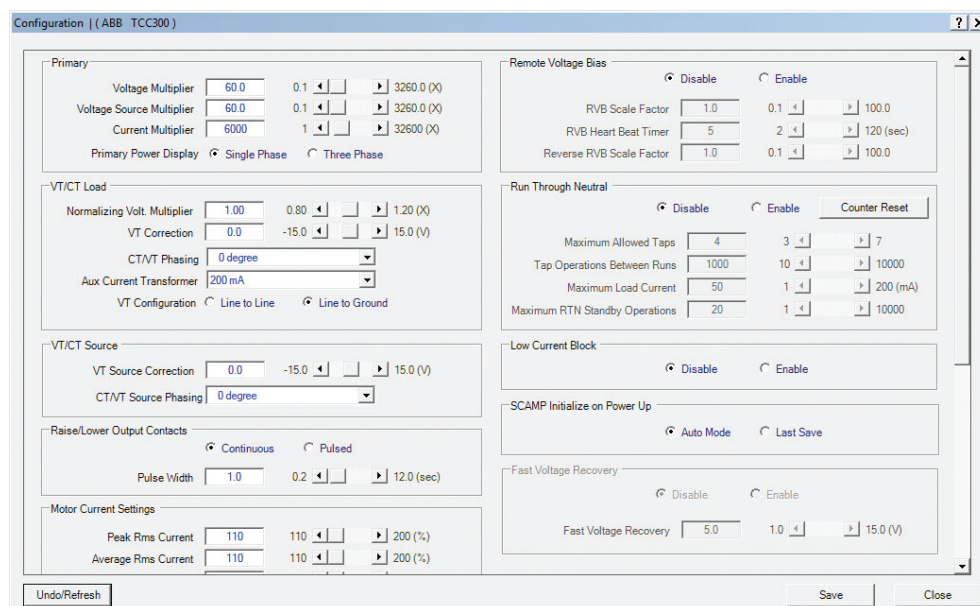


Figure 293: Configuration Dialog Screen

2. From the "Primary Power Display" section of the dialog screen select either "Single Phase" or "Three Phase".
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

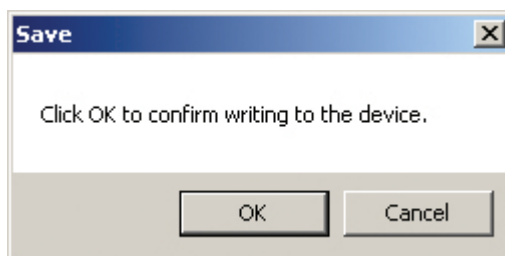


Figure 294: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

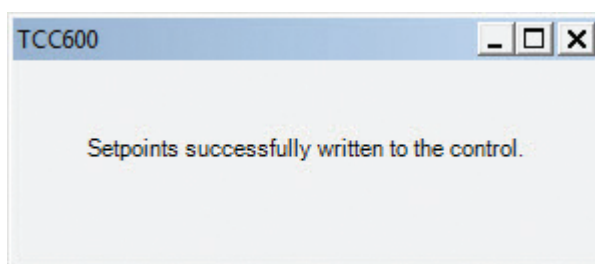


Figure 295: Setpoints Successfully Written To The Control Dialog Screen

6.2.9 Correction factors

6.2.9.1 VT ratio correction

The operation of some regulators is such that the internal VT does not provide the desired voltage ratio. In these cases, it is desirable to correct the VT secondary voltage to a 120 Vac reference base. This change is easily made in software, eliminating the need for a multi-tap sensing transformer.

The correction is derived from information provided by the regulator original equipment manufacturer (OEM). The numerical value of the correction is the value, in volts, required to adjust the VT nominal secondary voltage to 120.0 volts. The correction range is ± 15 volts in 0.1 volt increments.



The maximum allowable continuous VT secondary voltage is 140 volts. The correction is made only in software. As a result, the value of VLoad read on the control display will differ from that measured at the voltmeter test terminals by the percent of the correction voltage.

6.2.9.2 Setting Load and/or Source VT Correction Factor from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Load (Source) VT Correction" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Load (Source) VT Correction
0.0 Volts C
6. Utilizing the arrow pushbuttons, enter the desired Load (Source) VT Correction value from -15.0 to +15.0 Volts, then press the ENT pushbutton.

6.2.9.3 Setting Load and/or Source VT Correction Factors from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

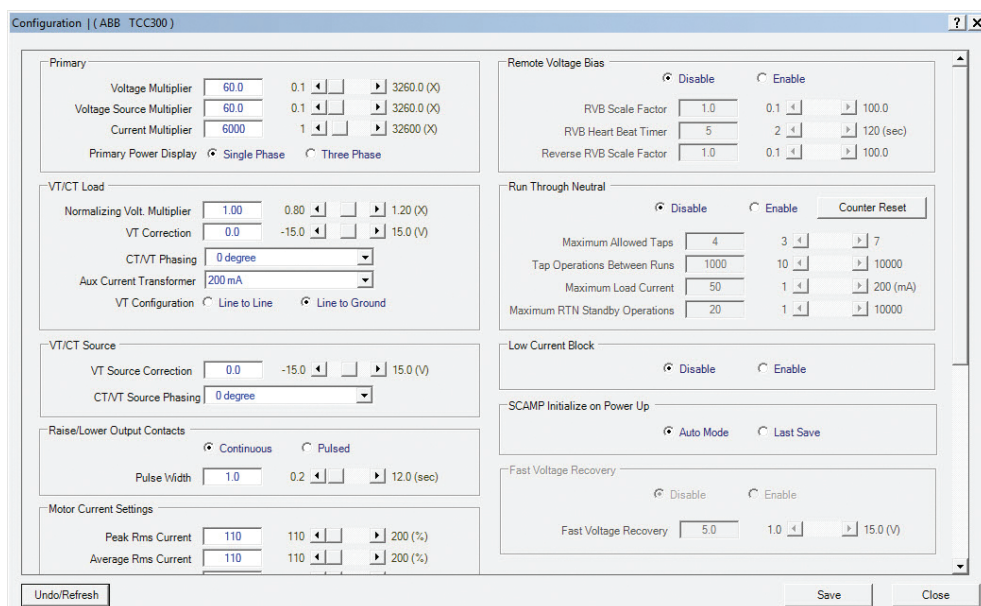


Figure 296: Configuration Dialog Screen

2. Enter the Load and/or Source VT Correction Factor value(s) (–15.0 to +15.0 Volts).
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

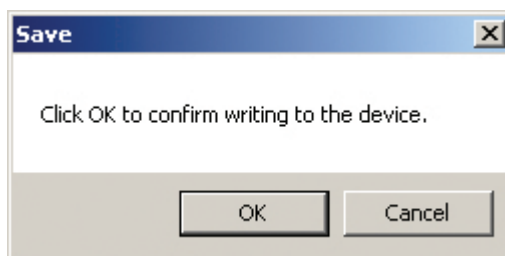


Figure 297: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

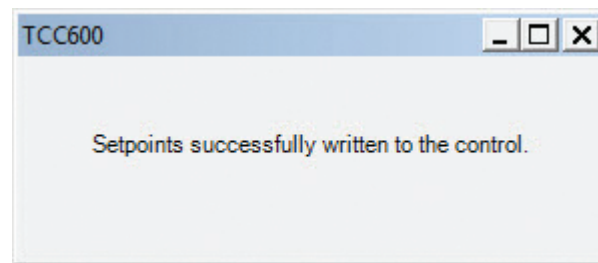


Figure 298: Setpoints Successfully Written To The Control Dialog Screen

6.2.9.4

CT/VT phase shift

The control will recognize forward and reverse power flow to the load. With the CT and VT (reference) signals in-phase for unity power flow to the load, it will properly calculate line drop compensation.

Depending on the connection of the CT and VT, the phasors may not be in-phase. If this is the case, the phase shift can be corrected in software. The usual characteristics of three phase systems only allow multiples of 30° phase shifts. The control, therefore, has a range of 0° to 330° in 30° increments.

By comparing system operating conditions with power flow direction and power factor as shown on the TCC300 Tapchanger Control, improper phase shift can be determined. An incorrect connection may be resolved using well-known phasor methods.

The following procedure may be useful to check the choice of correction or even to determine the correction by trial and error:

1. Place the regulator in manual control.
2. Determine the Watts and VArS load on the regulator from other metering.
3. Read the Watts and VArS indicated by the control, and make certain that they are of the same sign and ratio of magnitudes as obtained from the external readings.
4. If not, change the correction in 30° increments until the control and external readings are in best agreement.

When two single-phase regulators are connected in open delta, the current signals will be out-of-phase with the voltage signals. For one regulator, the current will lead the voltage by 30° and is called the "leading" regulator. For the "lagging" regulator, the current will lag the voltage by 30°.

Contact ABB for more information on VT and CT connections.



Source Side parameters are used when operation mode is regulate reverse (measured) and the system is in reverse power.

6.2.9.5

Setting CT/Load and/or CT/Source Phase Shift Quantities from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.



The following sequence of steps provide direction for setting the CT/Load VT Phasing quantities. The steps necessary to set the CT/Source VT Phasing are similar.

4. Press the Down arrow pushbutton, as necessary, until the "CT/Load VT Phasing" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
CT/Load VT Phasing
0 Deg C
6. Utilizing the arrow pushbuttons, enter the desired CT/Load VT Phasing value from 0 to 330 Degrees (30 Degree increments), then press the ENT pushbutton.

6.2.9.6

Setting CT/Load and/or CT/Source Phase Shift Quantities from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

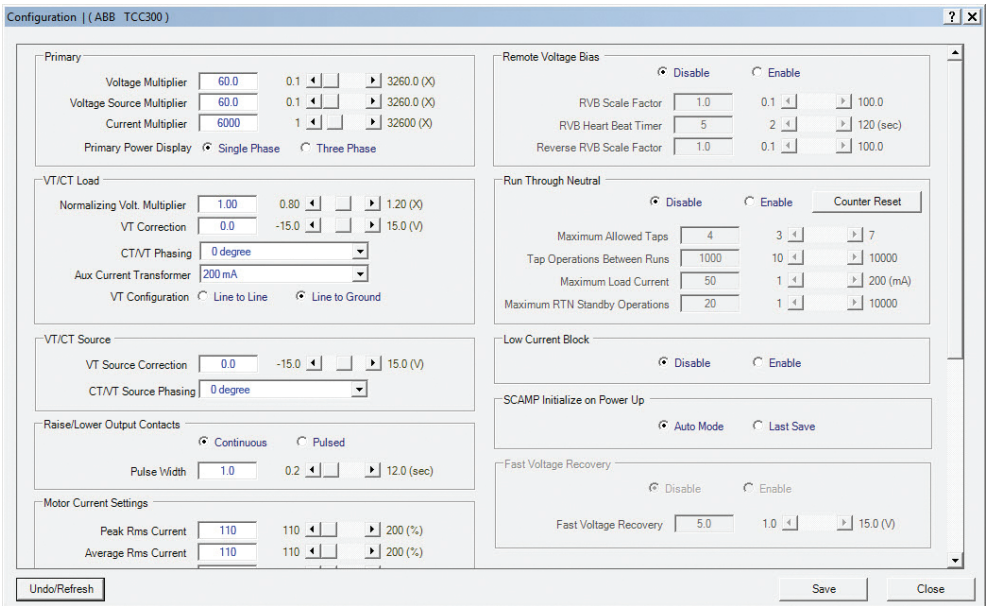


Figure 299: Configuration Dialog Screen

2. Enter the CT/Load or CT/Source Phase Shift Quantities (0 to 330 Degrees, in 30 Degree Increments).
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

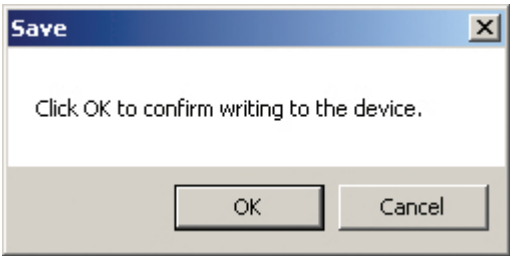


Figure 300: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

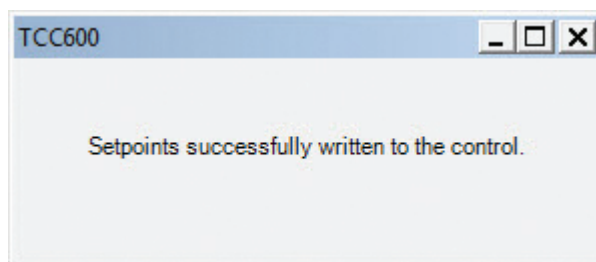


Figure 301: Setpoints Successfully Written To The Control Dialog Screen

6.2.10

Auxiliary current transformer

The current input rating of the TCC300 Tapchanger Control is 200 mA, continuous. Auxiliary CT's are necessary if primary currents exceed this value.

The Current Transformer units display scaling selection is set in the Configuration menu to be 200 mA, 1 A or 5 A. This choice determines the unit display scaling of both the metering readout quantities and the settings of current values.

The metering screens showing this information, Load Current and Circulating Current will be updated accordingly. The Line Limit Current setpoint screen is also affected by this selection.



This selection is for scaling purposes only, and neither 1 A nor 5 A should be input to the control.

The values of the current displayed in the control Load Current, and on Circulating Current screens can be displayed in either 200 mA, 1 A or 5 A units. 1 A or 5 A displayed values are calculated from the actual 200 mA connected current.



The current input to the control is rated at 0.2 A continuous, 0.4 A for two hours, and 4.0 A for 1 second.

6.2.10.1

Setting Auxiliary Current Transformer Units Display from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:

3. Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Aux Current Transformer" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Aux Curr Transformer
200 mA C
6. Utilizing the arrow pushbuttons, enter the desired Aux Current Transformer units display (200 mA, 1 Amp or 5 Amps), then press the ENT pushbutton.

6.2.10.2

Setting Auxiliary Current Transformer Units Display from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

Figure 302: Configuration Dialog Screen

2. From the "VT/CT Load/Aux Current Transformer" section of the dialog screen select either "200 mA, 1 Amp or 5 Amps".
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

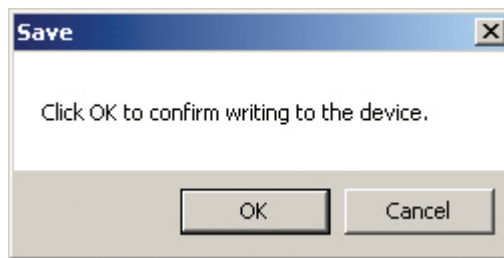


Figure 303: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

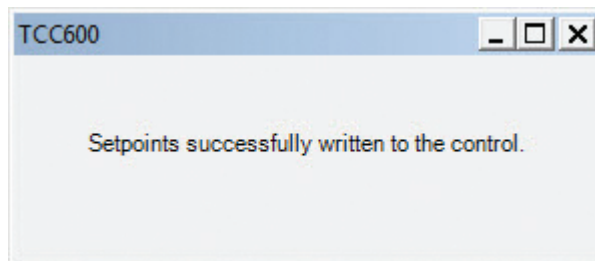


Figure 304: Setpoints Successfully Written To The Control Dialog Screen

6.2.11

Metering factors

The control has the capability of displaying measured and calculated secondary quantities and calculated primary quantities.

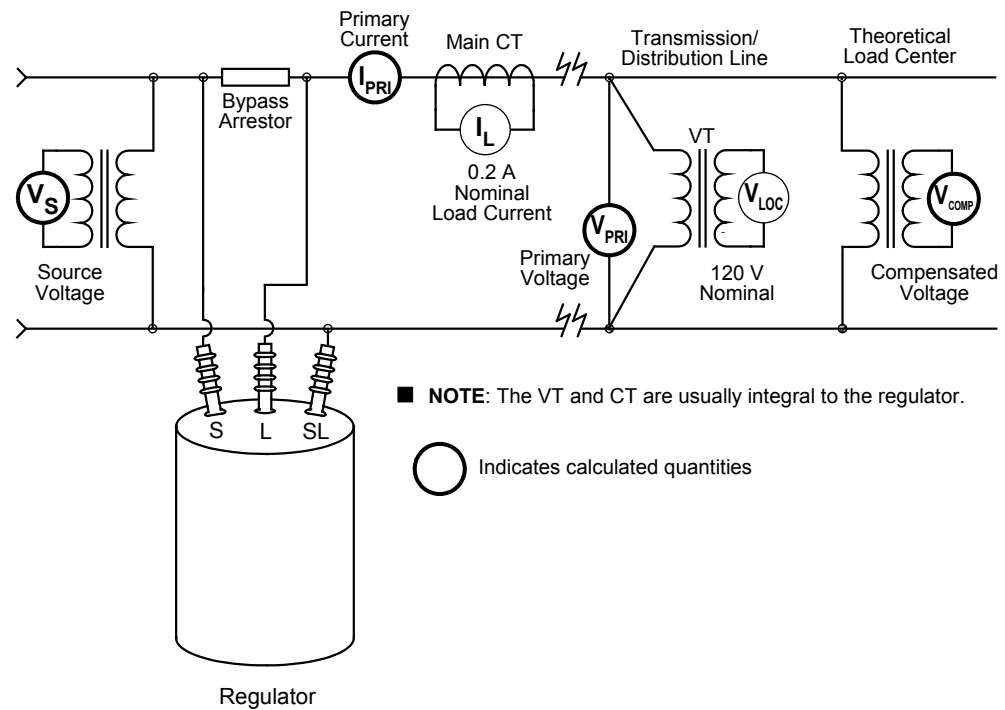


Figure 305: Secondary Quantity Metering and Primary Quantity Calculations for Regulator Applications

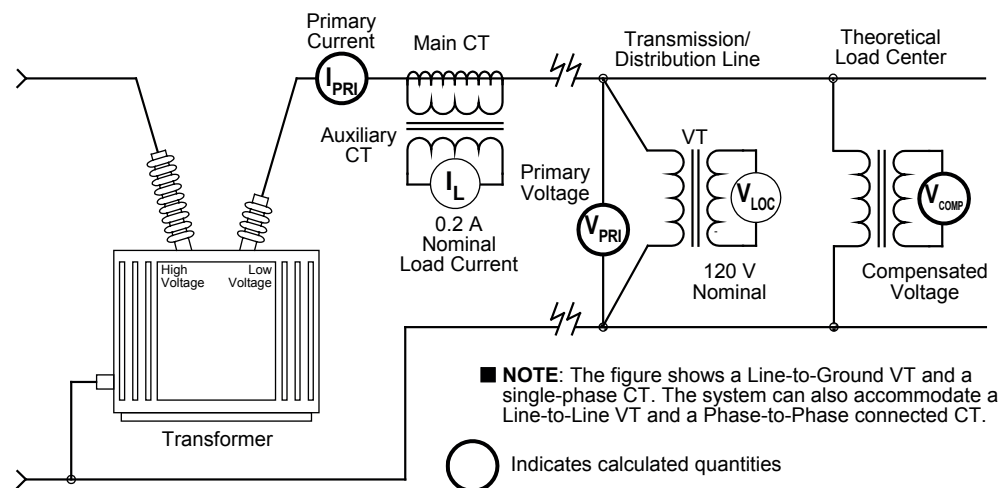


Figure 306: Secondary Quantity Metering and Primary Quantity Calculations for Transformer Applications

6.2.11.1**Secondary**

The display will show local voltage, source voltage, compensated voltage, line frequency, and load current in secondary quantities along with load power factor. The voltage is displayed on a 120 V base and the current is displayed on a 200 mA base.



The local voltage displayed will not match the voltage measured at the test terminals on the adapter panel if a sensing VT ratio correction other than 0.0 V has been entered.

6.2.11.2**Primary**

In order to use the calculated primary quantities feature, the user must enter the following data in the Configuration Menu:

- Select line-to-line or line-to-ground VT configuration.
- Select single-phase quantities based on measured inputs, or three-phase quantities based on measured inputs and assume a balanced system.
- Select primary voltage and current multipliers needed to calculate primary quantities.

6.2.11.3**Present demand**

The Present Demand metering capability provided in the control follows the concept of a lagged demand meter. The demand time interval is selected by the user as 5, 10, 15, 30 or 60 minutes. This is the time it takes for a thermal meter to indicate 90% of a change in load.

6.2.11.4**Energy metering**

The Energy Metering function of the control displays the following measured values:

- Total Lagging VAR Hours (KVARh, MVARh or GVARh)
- Total Leading VAR Hours (KVARh, MVARh or GVARh)
- Total Reverse Watt Hours (KWh, MWh or GWh)
- Total Forward Watt Hours (KWh, MWh or GWh)

The measured values are retained in non-volatile memory. A real time clock is utilized to record a date/time stamp for each quantity to indicate when the period of measurement was initiated.

When a Energy Metering screen is selected, the screen cycles continuously to indicate the total value, date and time the measurement was initiated. The E indicates that the measured value can be reset by pushing ENT.

6.2.11.5

Demand history

Demand History quantities are the maximum and minimum values for the period since the last reset command. These are retained in non-volatile memory. A real-time clock allows the recording of a date/time stamp with each Demand History quantity. The following are available for drag hand use:

- Min/Max tap position (when Tap Position is enabled)
- Min Load voltage (120 V base)
- Max Load voltage (120 V base)
- Max Primary current
- Max Primary watts, kW or MW
- Max Primary VAr, kVAr or MVAr
- Max Primary VA, kVA or MVA
- Power Factor at max VA

Where primary quantities are used, values displayed are single-phase or three-phase as defined in the Primary Power Display Screen of the Configuration Menu.



When the TCC300 Tapchanger Control is used with an ABB adapter panel, the panel's drag hands reset button only resets the mechanical drag hands of the regulator or LTC transformer. The button does not reset the tap drag hands information stored in the control. The maximum and minimum tap position of the control should always be reset when the mechanical drag hands are reset.

The values retained in memory are time-tagged quantities that are calculated using the demand period selected (5, 10, 15, 30 or 60 minutes). For voltage, values are the average of samples taken over a period of 32 seconds which avoids undue retention of momentary voltage transients. The load power factor retained is the value at the time of max VA.

When selected, two screens for each parameter cycle continuously and indicate the value, date and time of each parameter. The E indicates that the drag hand can be reset by pushing ENT.

The control is equipped with a real-time, 24-hour clock which is used with the drag hand feature to record date/time stamp information on quantities saved in memory. The power source for the clock is maintained for at least 24 hours during a system power outage by a charged capacitor (no battery). If the power outage lasts longer than 24 hours, check the clock and reset if necessary.

6.2.11.6 Frequency

The control provides for real-time metering of the line frequency. If the control is a 60 Hz model, the operating frequency is 55 to 65 Hz; if the control is a 50 Hz model, the operating frequency is 45 to 55 Hz.

6.2.12 Load VT configuration

Load VT Configuration toggles between Line-to-Line and Line-to-Ground.

6.2.12.1 Setting Load VT Configuration from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Load VT Configuration" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Load VT Config
LINE_TO_GROUND C
6. Utilizing the arrow pushbuttons, select the desired Load VT Configuration (Line-to-Line or Line-to-Ground), then press the ENT pushbutton.

6.2.12.2 Setting Load VT Configuration from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

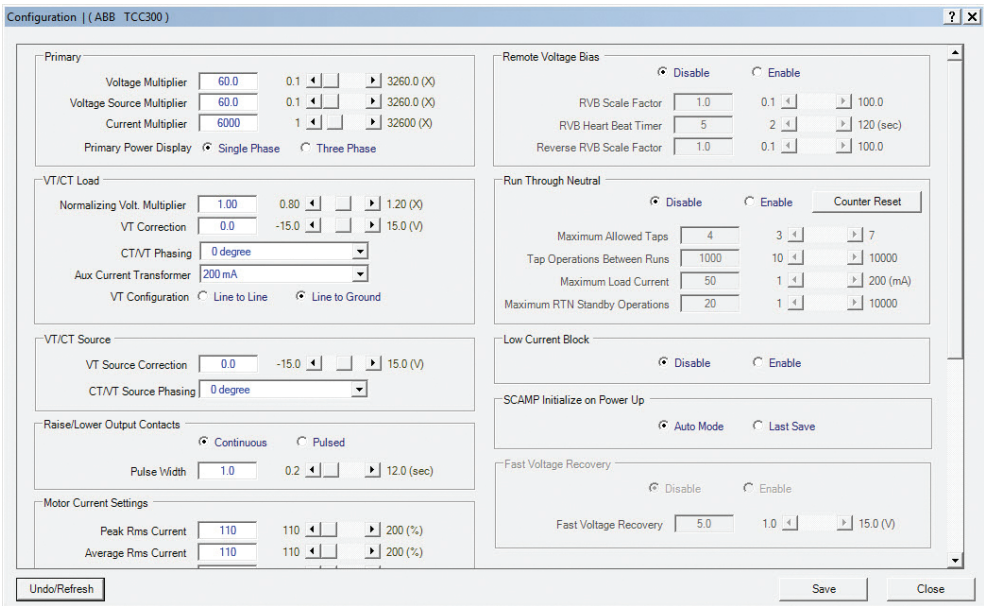


Figure 307: Configuration Dialog Screen

- From the "VT/CT Load" section of the dialog screen select either "Line-to-Line" or "Line-to-Ground".
- Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

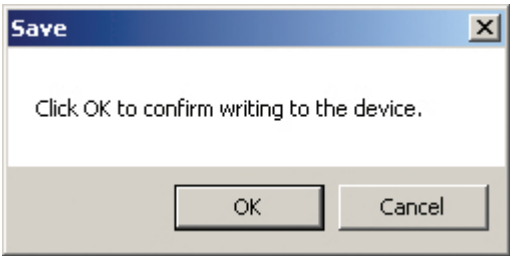


Figure 308: Save to Device Confirmation Screen

- Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

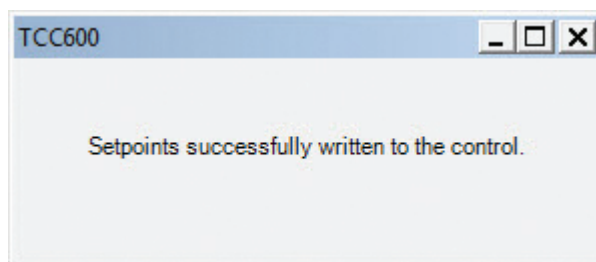


Figure 309: Setpoints Successfully Written To The Control Dialog Screen

6.2.13 Output selection

6.2.13.1 Output pulse



If an appropriate pulse width setting is not entered, then a misoperation of the tapchanger may occur when a SCADA Manual Raise or Lower is initiated.

When the output selection is "Pulsed", the pulse width can be programmed from 0.2 to 12 seconds, in increments of 0.1 seconds. An initiated pulse will continue until the pulse time has been reached or a counter contact or motor hold input operates.

Under normal conditions, when the output is set to "Pulsed" and the control is calling for Raise/Lower, an output will turn on for the pre-programmed time, or until a counter contact or motor hold input operates, and then turn off the output for a time period of 0.5 seconds plus the intertap time delay setting value. When the control is calling for a Raise/Lower and no non-sequential or counter input or motor hold input is applied, the output will activate for the full pre-programmed time and deactivate for 0.5 seconds, plus the intertap time delay.

When a counter input or motor hold input is applied, and there is an intertap delay, the pulse will cease immediately with counter contact closure for the intertap time delay. After the counter contact or motor hold input opens, the intertap timer will start at the end of the time delay. If there is still a Raise/Lower condition, another pulse will start.

When the non-sequential input is applied, the Raise/Lower timers will reset with the contact closure, and a timer count will start again, if a Raise/Lower condition is still present, the pulse will start once more.

SCADA INITIATED Manual Raise/Lower

When the control is placed in Manual via SCADA, to perform a Manual Raise/Lower, the control will switch to the "Pulsed" output mode until the control is returned to "Auto". This

will allow only a single Raise/Lower operation to take place each time a SCADA Raise/Lower command is sent. When the control is returned to "Auto," the control will revert back to the output selection setting. Therefore, an appropriate "Pulsed" output time setting should be set if SCADA initiated Manual Raise/Lower operations are performed.

Continuous

The output is continuous until the voltage returns into the bandwidth.

6.2.13.2

Setting Output Configuration from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Output Selection" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Output Selection
0CONTINUOUS C
6. Utilizing the Up/Down arrow pushbuttons, select the desired Output configuration (CONTINUOUS or PULSED), then press the ENT pushbutton.
7. Depending on the Output configuration that was selected, proceed as follows to complete the Output configuration:
 - If the "CONTINUOUS" Output configuration was selected, the Output configuration is complete.
 - If a "PULSED" Output configuration was selected, proceed as follows.
8. Press the Down arrow pushbutton, as necessary, until the "Output Pulse" screen is displayed.
9. Press the ENT pushbutton. The following will be displayed:
Output Pulse
1.5 Sec C
10. Utilizing the arrow pushbuttons, enter the desired "Output Pulse" (0.2 to 12.0 Sec) duration, then press the ENT pushbutton.

6.2.13.3

Setting Output Configuration from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

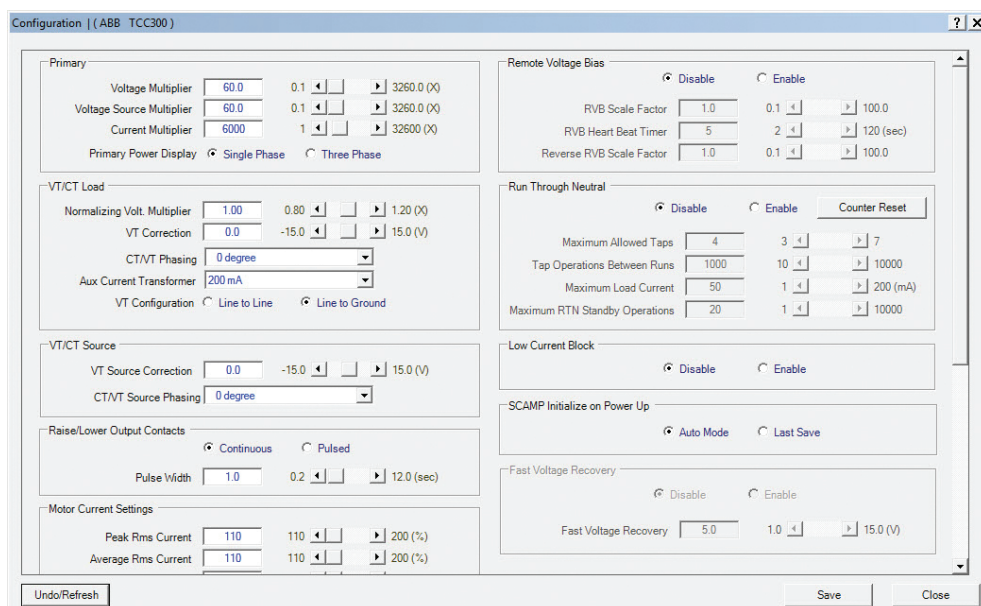


Figure 310: Configuration Dialog Screen

2. From the "Raise/Lower Output Contacts" section of the dialog screen select either "Continuous" or "Pulsed", then proceed as follows:
 - If "Continuous" was selected, go to Step 3.
 - If "Pulsed" was selected, enter a "Pulse Width" value (0.2 to 12.0 seconds)
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

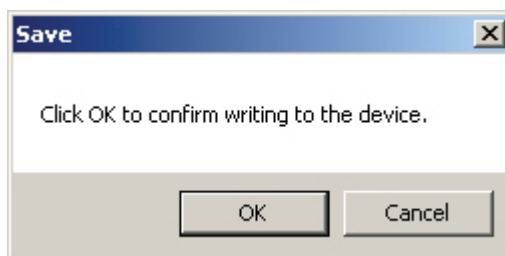


Figure 311: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

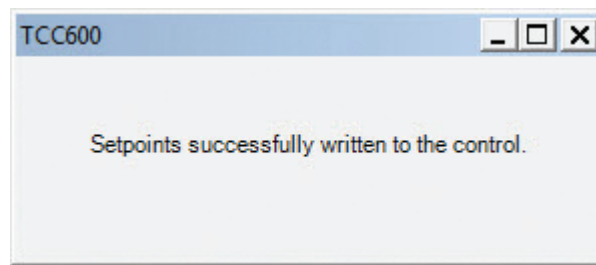


Figure 312: Setpoints Successfully Written To The Control Dialog Screen

6.2.14

Motor current detection and monitoring

The TCC300 includes a tapchanger Motor Current Measurement and Recording feature. The TCC300 tapchanger control measures the motor current during tapchange operations. The motor current is sampled at 64 samples per cycle and the total RMS value of the current is computed every cycle (60 Hz or 50 Hz cycle). The dynamic range of the current measurement is from 0 to 10 A.

The tapchange start signal is generated when the control begins a Raise or Lower operation. The tapchange operation is considered complete when the counter contact input is generated. If the tapchanger is making multiple tapchanges where the current is not interrupted between tapchanges then the counter contact can be used to decide the completion of one tap before the start of the next tap.

The Motor Current Monitor feature also includes a Training Mode which will be used during the commissioning of the tapchanger control. In this mode several tapchange operations will be manually conducted and the profile stored. This profile will be compared with the profile during normal tapchange operation to generate alarm signals.

Based on the type of regulator, the counter contact signal will be different:

- GE: Counter pulse is used to indicate the completion of the tapchange
- SIEMENS and Howard: State change of the counter contact is used to detect the tapchange (X 2 setting)
- Cooper: Motor seal-in current is used to detect the tapchange operation.

The following parameters are logged for the motor current profile and are stored in battery backed-up RAM for each tapchange:

- Peak RMS Current

$$\sqrt{\frac{1}{i} \sum_{i=1}^{Totalprofiles} PeakRMSCurrent_i^2}$$

(Equation 2)

- Average RMS Current

$$\sqrt{\frac{1}{i} \sum_{i=1}^{Totalprofiles} AverageRMSCurrent_i^2}$$

(Equation 3)

- Average Duration

$$\frac{1}{i} \sum_{i=1}^{Totalprofiles} Duration_i$$

(Equation 4)

Where i is the training profile number and Totalprofiles is the total number of training profiles (fixed to 20 training operations).

An alarm will be generated when any of the following conditions occur:

- Peak RMS current exceeds a defined percent (programmable from 110% to 200%) of the stored Peak RMS Current which was recorded during the Training Mode.
- Average RMS Current exceeds a certain percent (programmable from 110% to 200%) of the stored Average RMS Current which was recorded during the Training Mode. The Average RMS Current is the average of the RMS current for the tapchange duration.
- The Average Duration of the tapchange exceeds a certain percent (programmable from 110% to 200%) of the stored value which was recorded during the Training Mode.

6.2.14.1

Setting the Motor Current Detection Settings from the HMI



The steps necessary to set the Peak RMS Current Percent Change setting are described here. The steps to set the Average RMS Percent Change and Average Duration Percent Change are similar.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:

- Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Mtr Current Profile" menu.
4. Press the Down arrow pushbutton, as necessary, to navigate to the "Peak RMS % Change" (Average RMS Current % Change or Average Duration % Change) settings dialog screen.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Peak RMS % Change
110 C
6. Utilizing the arrow pushbuttons enter the desired Peak RMS Current % Change value (110% to 200%), then press the ENT pushbutton.

6.2.14.2

Setting the Motor Current Detection Settings from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

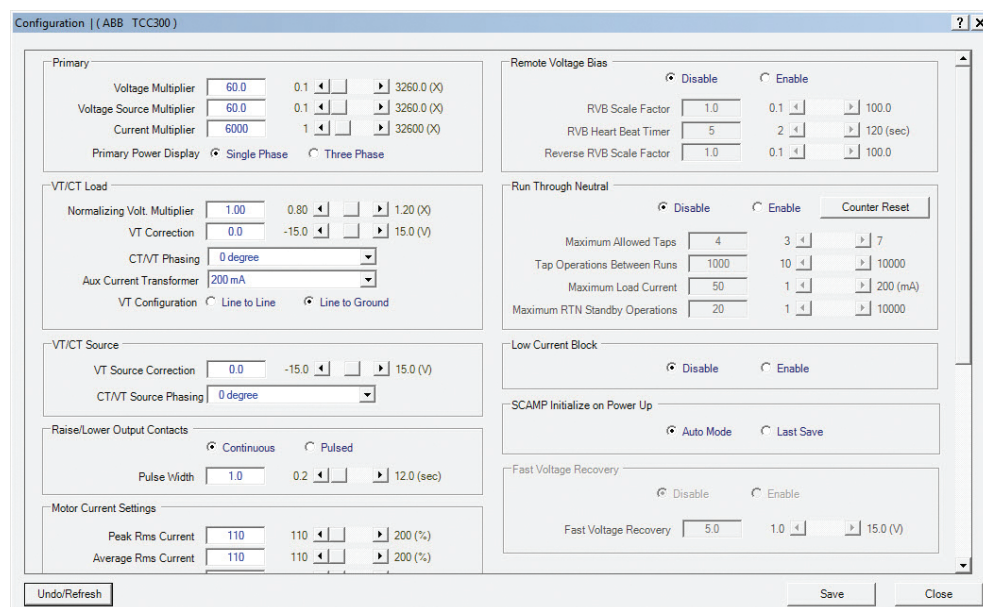


Figure 313: Configuration Dialog Screen

2. From the "Motor Current Settings" section of the dialog screen enter the desired Peak RMS Current, Average RMS Current and Average Duration settings (110% to 200%).
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

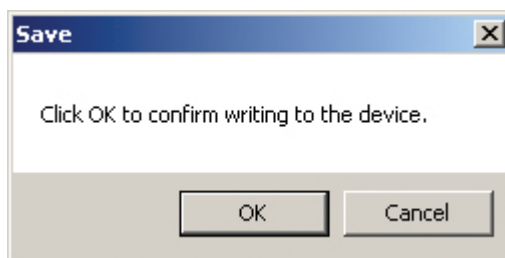


Figure 314: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

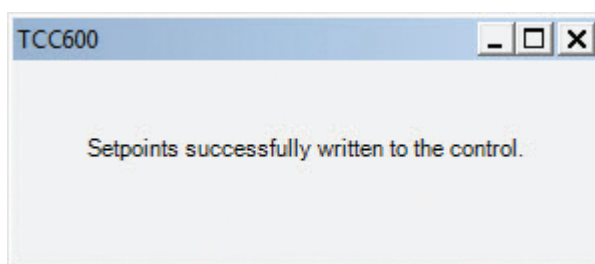


Figure 315: Setpoints Successfully Written To The Control Dialog Screen

6.2.15

Regulator type

Regulator Type A or B can be selected. This will allow the source voltage to be calculated correctly for either type of regulator. It will also allow the control to operate more accurately when in the "regulate in reverse power" mode.

General Electric VR-1 voltage regulators are available in two winding configurations; Type "A" non-inverted configuration and type "B" inverted configuration. These types refer to the internal power component connections.

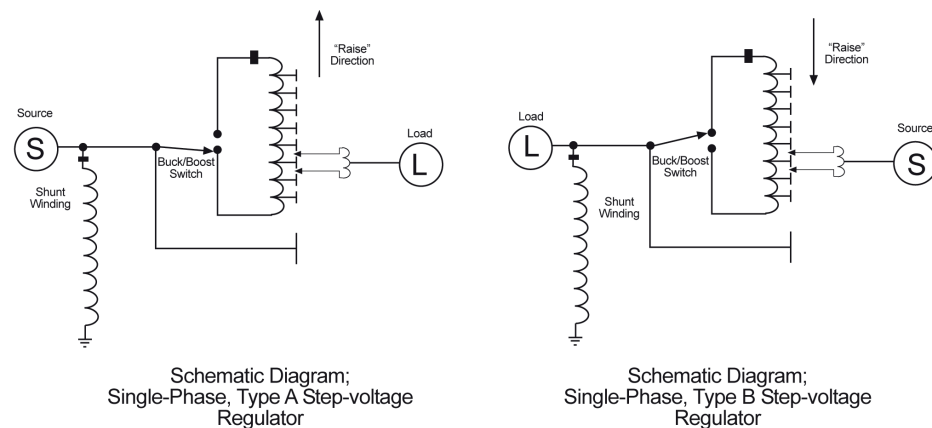


Figure 316: *Regulator Type*

The Type "A" non-inverted configuration regulator includes a wire jumper on the NN terminal block for Potential Transformer tap selection.

On the older regulator controls (those not having power disconnect and CT shorting knife switches), the PT tap selection jumper is usually connected between terminals NN-9 and NN-20, NN-21 or NN-22. On newer regulator controls, (those with power disconnect and CT shorting knife switches), the PT tap selection jumper is usually connected between terminals NN-8 and NN-20, NN-21 or NN-22. There are special cases when a PT ratio correcting transformer is supplied and the jumper position is different. In all cases consult the regulator tank nameplate for the proper jumper connections.

The Type "B" inverted configuration regulator is supplied from the factory with a standard 0.75 ohm resistor installed on the NN terminal block in addition to the PT tap selection jumper. This series resistor limits short circuit currents in the event of an external fault.

On the older regulator controls (those not having a power disconnect and CT shorting knife switches), the resistor is usually connected between terminals NN-9 and NN-22. The PT tap selection jumper is usually connected between terminals NN-22 and NN-20 or NN-21. On newer regulator controls, (those with power disconnect and CT shorting knife switches) the resistor is usually connected between terminals NN-8 and NN-22. The PT tap selection jumper is usually connected between terminals NN-22 and NN-20 or NN-21. In all cases, consult the regulator tank nameplate for the proper jumper connections.



The control can be damaged if the PT tap selection jumper is not connected properly when the regulator is energized.

The control is not powered if either the PT tap selection jumper or resistor is missing or open.

The user should always verify proper connections by consulting the nameplate on the regulator tank. The user is cautioned that the nameplate on the control cabinet could possibly be incorrect if the control has ever been replaced. If the serial number on the control cabinet matches the serial number on the regulator tank or nameplate, the control cabinet nameplate may be consulted for proper jumper configuration.

6.2.15.1

Setting Regulator Type from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Regulator Type" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Regulator Type
TYPE A C
6. Utilizing the Up/Down arrow pushbuttons, select the desired Regulator Type (Type A or Type B), then press the ENT pushbutton.

6.2.15.2

Setting Regulator Type from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

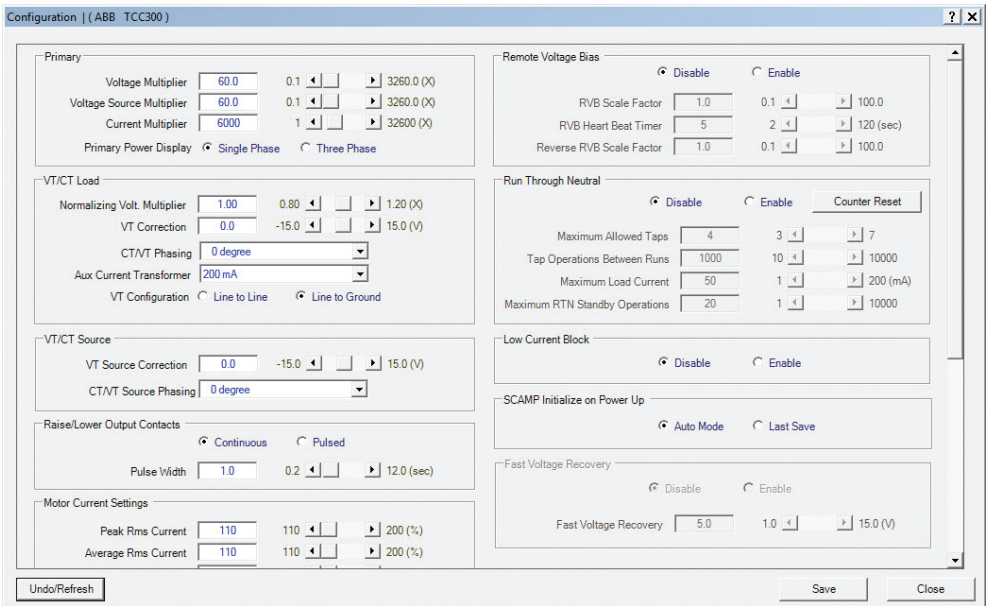


Figure 317: Configuration Dialog Screen

- From the "Regulator "section of the dialog screen select either "Type A" or "Type B".
- Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

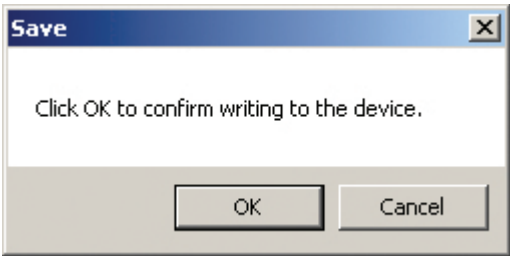


Figure 318: Save to Device Confirmation Screen

- Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

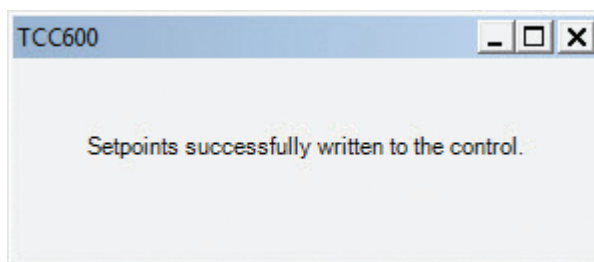


Figure 319: Setpoints Successfully Written To The Control Dialog Screen

6.2.16

Remote voltage bias

The Remote Voltage Bias (RVB) feature is similar to Load Drop Compensation (LDC) that biases the Bandcenter of the control using the difference between a remotely monitored voltage and the control's Load voltage. This method allows the control to operate using the existing timing as well as allow it to respond to the blocking limits and runback functions.

The TCC300 will regulate the measured voltage according to a calculated Effective Bandcenter. The Effective Bandcenter will ONLY be calculated when a Remote measurement is supplied to the control. The Effective Bandcenter calculation is based on the following equations:

$$BC_{bias} = V_{remote} - BC$$

(Equation 5)

BC_{bias} Bandcenter bias

V_{remote} Remote voltage

BC Bandcenter setting

$$EffBC_i = (V_{measured} - BC_{bias})$$

(Equation 6)

$EffBC_i$ Effective Bandcenter

$V_{measured}$ Measured secondary voltage

BC_{bias} Bandcenter bias

The currently effective high band $(V_{\text{eff}_{hi}})_i$ will be at $\text{EffBC}_i + \text{BW}/2$ and the currently effective low band $(V_{\text{eff}_{lo}})_i$ will be at $\text{EffBC}_i - \text{BW}/2$, where BW is the regular bandwidth setting.

Example:

If $\text{BC} = 120 \text{ V}$, $\text{BW} = 2 \text{ V}$ and the system is in band $V_{\text{measured}} = 120 \text{ V}$.

Initially before the first V_{remote} is received, $\text{EffBC}_i = \text{BC} = 120 \text{ V}$.

Then, if $V_{\text{remote}} = 117 \text{ V}$, $\text{BC}_{\text{bias}} = (117 - 120) = -3$, $\text{EffBC}_i = 120 - (-3) = 120 + 3 = 123 \text{ V}$

Since V_{measured} is 120 V , the control will perform approximately 3 tap operations in the RAISE direction to bring the V_{measured} back in band.

The Remote Voltage Bias feature requires a remote voltage parameter to be written to the control within a period defined by a Remote Voltage Heartbeat timer. If the timer times out without the Remote Voltage being written to the control, then the control reverts back to the normal chosen regulating method using the Bandcenter and LDC settings.

A Forward and a Reverse Remote Voltage parameter can be written to the control utilizing DNP3.0, MODBUS or IEC 61850 protocols. The range is determined by the "Remote Voltage Maximum" and "Remote Voltage Minimum" values. Each value has a range from 90.00 to 150.00 volts. Any value received by the control above or below these settings will be discarded and the Remote Voltage Heartbeat Timer will not be refreshed. Upon receiving a valid Forward/Reverse Remote Voltage value, the control will start or restart an internal heartbeat timer with the value set by the "Remote Voltage Heartbeat Timer" setting. Upon timeout, the control removes the Bandcenter bias and controls solely by the Bandcenter and LDC settings.

The Forward parameter will be used as V_{remote} in Forward Power mode only. This point's associated internal timer will only be used in Forward Power mode. Similarly, the Reverse parameter will be used as V_{remote} in Reverse Power mode only. This point's associated internal timer will only be used in Reverse Power mode.

The RVB scale factor is the scale factor by which the raw remote voltage value obtained through the DNP3.0, MODBUS or IEC 61850 analog output point is scaled by before being used in the Remote Voltage Bias feature.

If Voltage Reduction is initiated while RVB mode is enabled and active, it will be calculated based on the regular Bandcenter setting, not the Effective Bandcenter.

If Reverse Power is sensed and the control is set to "Regulate Reverse" or "Regulate Reverse (Measured)", the control will use the "Reverse Remote Voltage" parameter in the

Effective Bandcenter calculation. It will also apply BC_{bias} to the Reverse Power Bandcenter setting.

The equation for BC_{bias} when in reverse:

$$BC_{bias} = V_{remote} - BC_{reverse}$$

6.2.16.1

Enabling/Disabling Remote Voltage Bias from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, until the "Remote Voltage Bias" screen is displayed.
4. Press the Down Arrow pushbutton once. The unit will display the following:
Enable/Disable
disable
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code.
6. Utilizing the Up/Down arrow pushbuttons, select either "Enable" or "Disable", then press the ENT pushbutton.
7. Depending on the selection, proceed as follows:
 - If Remote Voltage Bias was "DISABLED", no further action is required.
 - If Remote Voltage Bias was "ENABLED", proceed as follows.
8. Press the Down arrow pushbutton, as necessary, until the "RVB HB Timer" screen is displayed.
9. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
RVB HB Timer
5 Secs C
10. Utilizing the arrow pushbuttons, enter the desired RVB Heartbeat Timer (2 to 120 Seconds), then press the ENT pushbutton.
11. Follow the procedure above to enter the desired:
 - Forward RVB Scale Factor
 - Reverse RVB Scale Factor

6.2.16.2

Enabling/Disabling and Setting Remote Voltage Bias from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

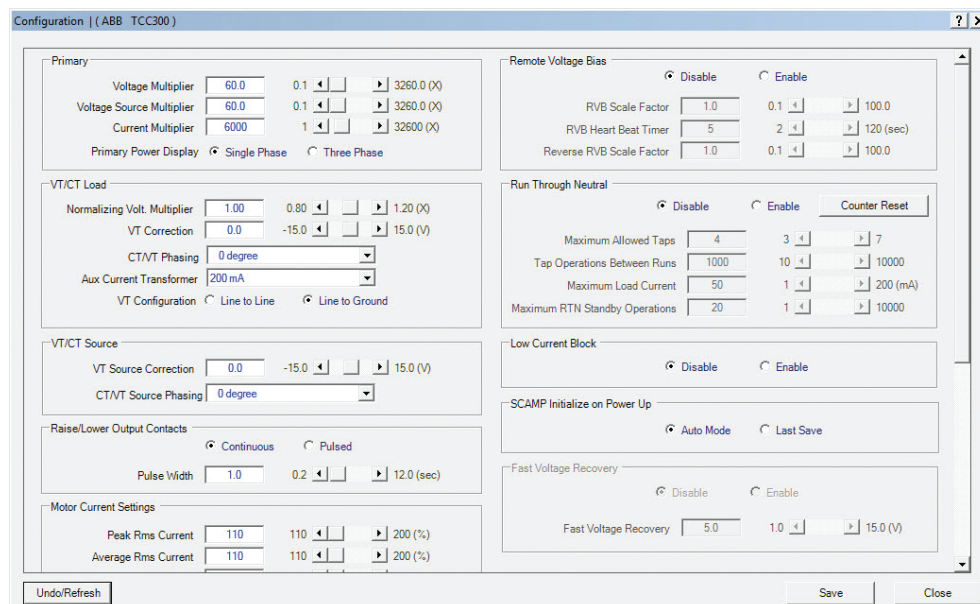


Figure 320: Configuration Dialog Screen

2. Select "Enable" or "Disable" from the Remote Voltage Bias section of the dialog screen.
3. If Remote Voltage Bias was "ENABLED", proceed as follows.
4. Enter the Remote Voltage Bias settings:
 - Forward RVB Scale Factor (0.1 to 100.0)
 - RVB Heartbeat Timer (2 to 120 Sec)
 - Reverse RVB Scale Factor (0.1 to 100.0)
5. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

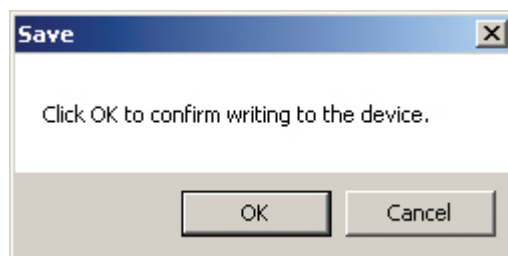


Figure 321: Save to Device Confirmation Screen

6. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

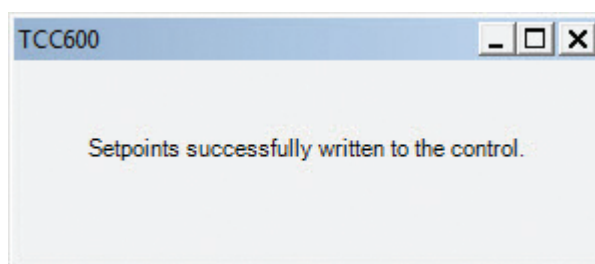


Figure 322: Setpoints Successfully Written To The Control Dialog Screen

6.2.17 Run through neutral

The Run Through Neutral feature allows the reversing switch of a regulator to be exercised periodically to prevent contact buildup and coking. The Run Through Neutral feature considers regulator operating parameters to periodically run the regulator through neutral. The frequency is primarily based on the Tap Operations Between Runs setting value. However, in addition to the Tap Operations Between Runs setting, the following regulator operating parameters are also considered and must all be within prescribed limits before the feature will be activated.

- The regulator must be within 2-6 taps of neutral (Actual value based on a Maximum Allowed taps setting). The Run Through Neutral feature will require the control to take one tap in the same direction it was moving once a Neutral input is received to accomplish the swipe of the reversing switch.
- Measured load current is below the user set Maximum Load Current setting.
- The feature will not operate the regulator if its operation would cause the control to exceed any voltage or tap limits. (If tap limits are enabled.)
- The feature will not operate if any of the Motor Current settings are exceeded.

The control also considers the following conditions during operation of the Run Through Neutral feature:

- If detected tap position is determined to be incorrect during the feature's operation, the control will attempt to find neutral within an allowed number of operations, and trigger an Abnormal Tap Position alarm if it is unsuccessful.
- If the control initiates the feature and does not receive a neutral input by the time it reaches the Maximum Allowed Taps setting, it will initiate operations in the opposite direction not to exceed the original starting position, plus the Maximum Allowed Taps setting.

For example, if the Maximum Allowed Taps setting is 4, and Tap Position starts at 3R, the control will move 4 taps towards what it thinks is neutral, and if the Neutral input is not

energized, then 7 taps in the opposite direction. It will not take the eighth tap as that is reserved for exercising the reversing switch by passing through neutral).

If Neutral indication is not sensed during this process, the Abnormal Tap Position alarm will be activated and will not reset until the tap position has been re-calibrated.

If Neutral is "found" during this process, but the feature cannot complete the reversing switch swipe successfully due to the Maximum Allowed Taps setting, then the Run Through Neutral feature will standby until the conditions that are necessary to run are met and it can complete.

After the feature has completed successfully, the control will return to regulation and take any taps necessary to satisfy its settings requirements.



Manipulating the Tap position via communications or HMI while Run Through Neutral is active and in the process of running through neutral will result in the feature not properly executing and could trigger an Abnormal Tap Position Alarm depending on the changes made and where tap position was when it was changed by a user.

6.2.17.1

Enabling/Disabling and Setting Run Through Neutral from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, until the "Run Through Neutral" screen is displayed.
4. Press the Down Arrow pushbutton once. The unit will display the following:
Enable/Disable
disable
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code.
6. Utilizing the Up/Down arrow pushbuttons, select either "Enable" or "Disable", then press the ENT pushbutton.
7. Depending on the selection, proceed as follows:
 - If Run Through Neutral was "DISABLED", no further action is required.
 - If Run Through Neutral was "ENABLED", proceed as follows.
8. Press the Down arrow pushbutton, as necessary, until the "Reset RTN Success Counter" screen is displayed.
9. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Confirm press ENTER

Cancel press EXIT

10. Press the ENT pushbutton. The following will briefly be displayed confirming the reset of the counter and then return to the "Reset RTN Succ Ctr" screen.
RTN Succ Ctr Reset
11. Follow the procedure above to enter the desired:
 - Max Allowed Taps
 - Taps Between Runs
 - Max Load Current
 - Max RTN Standby Ops

6.2.17.2 Enabling/Disabling and Setting Run Through Neutral from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

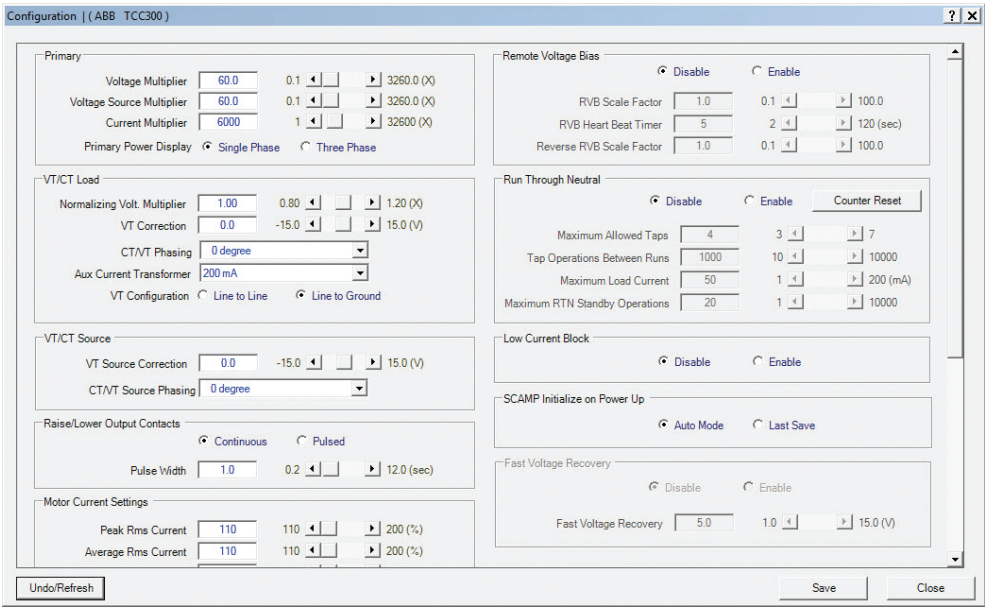


Figure 323: Configuration Dialog Screen

2. Select "Enable" or "Disable" from the Run Through Neutral section of the dialog screen.
3. If Run Through Neutral was "ENABLED", proceed as follows:
4. Enter the following Run Through Neutral settings:

- If desired, reset the RTN Successful Operations Counter
 - Maximum Allowed Taps (3 to 7)
 - Tap Operations Between Runs (10 to 10000)
 - Maximum Load Current (1 to 200 mA)
 - Maximum RTN standby operations before Alarm (1 to 10000)
5. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

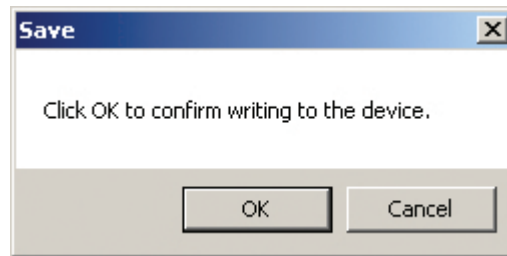


Figure 324: Save to Device Confirmation Screen

6. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

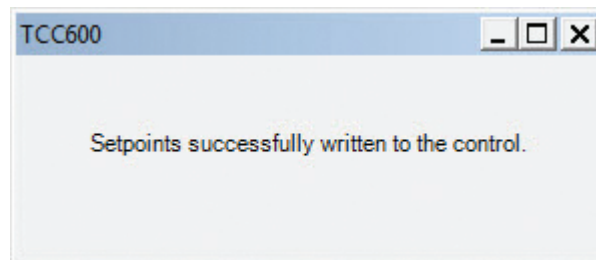


Figure 325: Setpoints Successfully Written To The Control Dialog Screen

6.2.18 Fast voltage recovery

The Fast Voltage Recovery feature when enabled, bypasses normal timing operation to return voltage to an in-band condition as rapidly as possible. This is required for unplanned and planned load transfers to allow critical loads to be shifted to a transformer quickly without causing that transformer's voltage to decrease too quickly.

When Fast Voltage Recovery is enabled in automatic mode and the voltage exceeds either the Raise or Lower Band edges plus the Fast Voltage Recovery setting, the normal definite or inverse time delay curve and setting is replaced with instantaneous operation (<0.5 seconds). In all cases, once the normal time delay has been replaced with instantaneous operation, normal timing will not be in effect until the voltage returns in band. This feature

can be enabled or disabled and will not affect other functions until the Fast Voltage Recovery setting is exceeded.

The setting range is from 1.0 to 15.0 volts outside the normal band edges in 0.1 V increments. Once the voltage is back in band, the instantaneous operation curve is replaced by the normal definite or inverse time delay curve and setting. Subsequent excursions outside the bandwidth will use the original time delay unless the voltage again exceeds the Fast Voltage Recovery threshold setting.

When Fast Voltage Recovery is active, Overcurrent Blocking (Current limit setting) will be bypassed should conditions require this block to be in effect. Fast Voltage Recovery is not available if any paralleling method is active. If an Intertap delay is set in the control, it will not be bypassed by this feature.

6.2.18.1

Enabling/Disabling and Setting Fast Voltage Recovery from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, until the "Nameplate" screen is displayed.
4. Press the Down Arrow pushbutton as necessary to navigate to the "Fast Voltage Recovery" menu item.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Fast Volt Recovery
disable C
6. Utilizing the Up/Down arrow pushbuttons, select either "Enable" or "Disable", then press the ENT pushbutton.
7. Enabling/Disabling and Setting Fast Voltage Recovery from the HMI
 - If Fast Voltage Recovery was "DISABLED", no further action is required.
 - If Fast Voltage Recovery was "ENABLED", proceed as follows.
8. Press the Down arrow pushbutton, as necessary, until the "Fast Volt R Setting" screen is displayed.
9. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Fast Volt R Setting
5.0 V C
10. Utilizing the arrow pushbuttons, enter the desired Fast Voltage Recovery setting (1.0 to 15.0 V), then press the ENT pushbutton.

6.2.18.2

Enabling/Disabling and Setting Fast Voltage Recovery from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

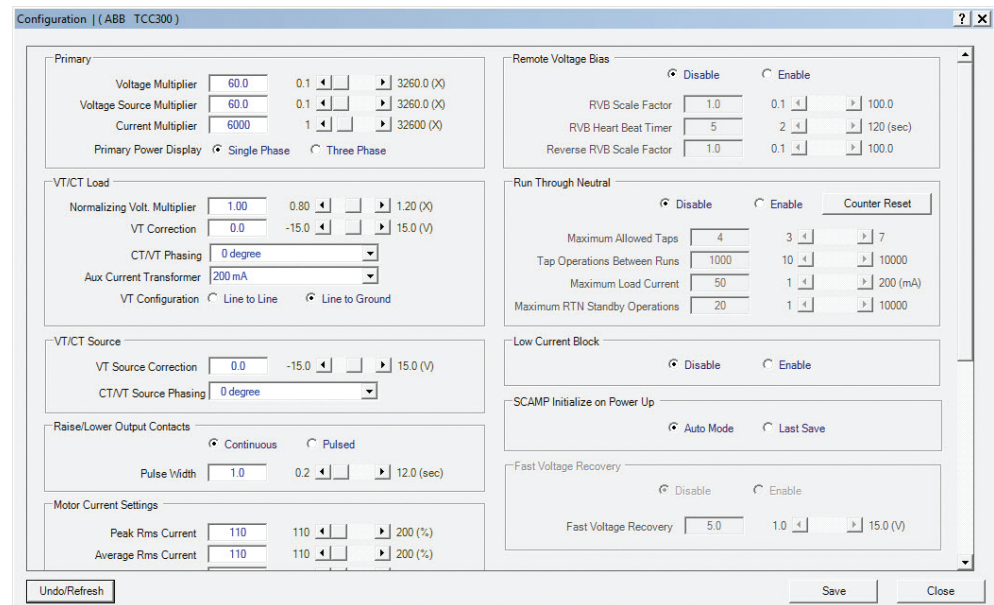


Figure 326: Configuration Dialog Screen

2. Select "Enable" or "Disable" from the Fast Voltage Recovery section of the dialog screen.
3. If Fast Voltage Recovery was "ENABLED", proceed as follows.
4. Enter the Fast Voltage Recovery setting (1.0 to 15.0 V).
5. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

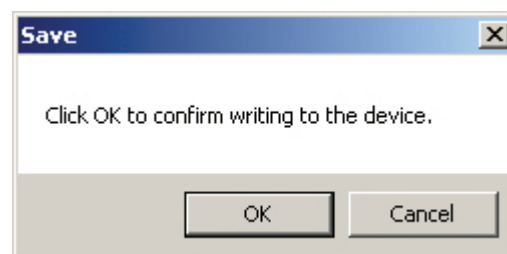


Figure 327: Save to Device Confirmation Screen

6. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

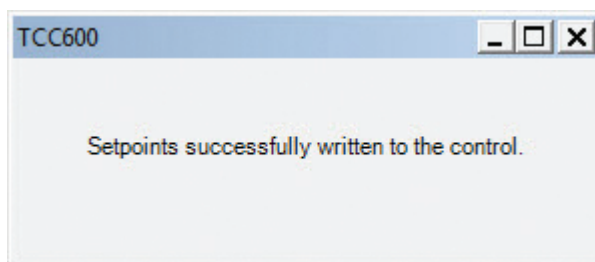


Figure 328: Setpoints Successfully Written To The Control Dialog Screen

6.3 Parallel operation

6.3.1 Circulating current and delta VAR methods

The user with access to the Configuration Menu may select the circulating current method of paralleling LTC transformers, or disable the feature. If the optional Δ VAR[®]1/ Δ VAR2 methods were purchased, they may also be selected. Paralleling by the circulating current method or the Δ VAR1 method involves a configuration in which each TCC300 Tapchanger Control is used with an ABB M-0115A Parallel Balancing Module. The control is provided with a current input which is representative of the circulating current between two or more LTC transformers operating in parallel.



See Appendix A for the HMI Configuration Menus.

6.3.1.1 Circulating current/ Δ VAR1

The general paralleling schemes for two and three transformer paralleling using the circulating current method are shown in [Figure 329](#), [Figure 330](#) and [Figure 331](#).

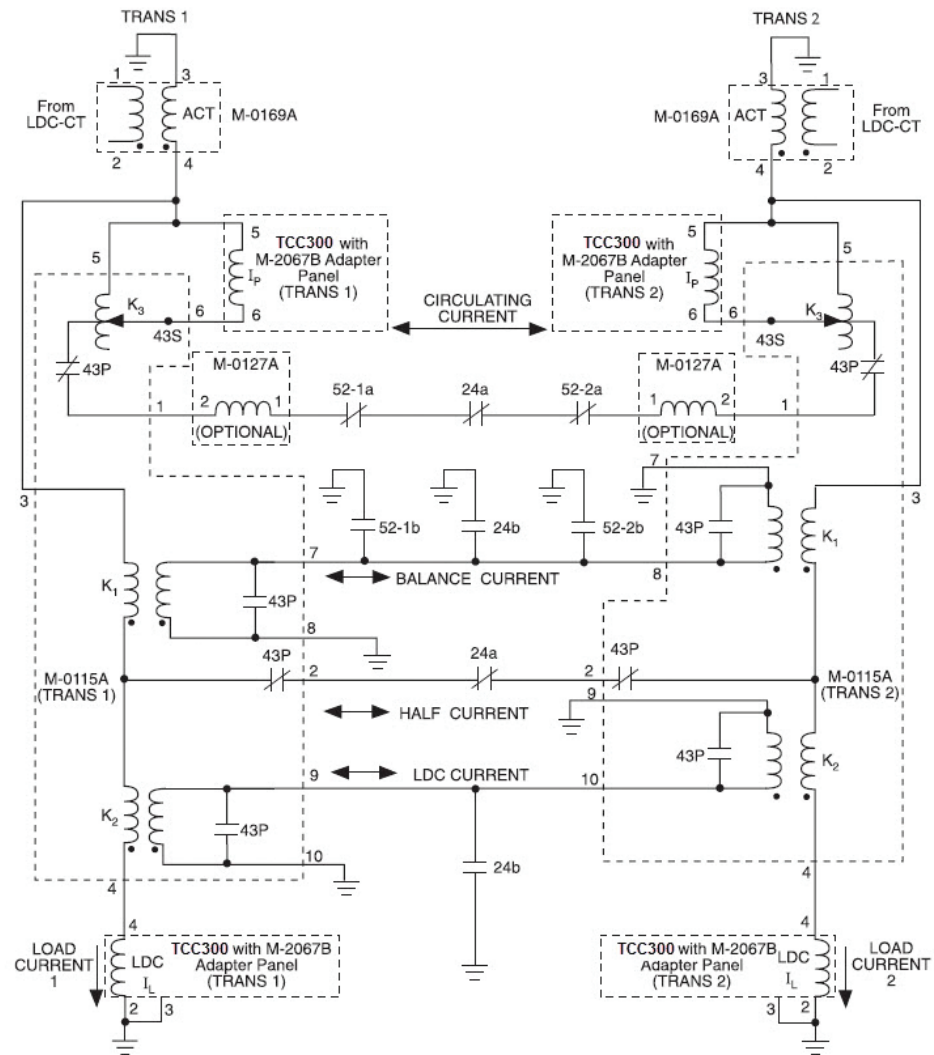


Figure 329: Simplified Schematic of Current Circuit for TCC300 Paralleling Two Transformers using the Circulating Current or ΔVAR° Method



1. 52 contacts are shown in the breaker closed position; 43P in parallel position.
2. K3 is a circulating current sensitivity control.
3. M-0127A is a current relay to detect excessive circulating current.

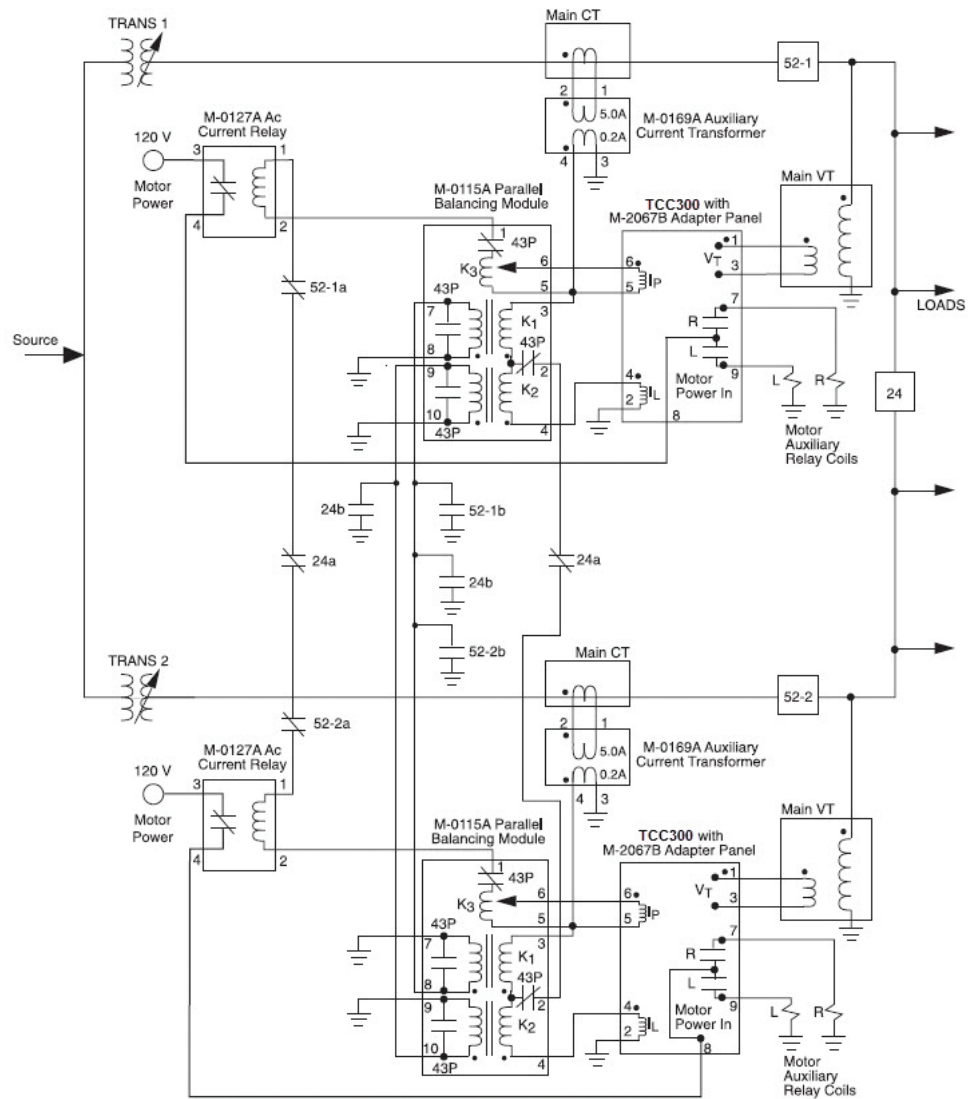


Figure 330: TCC300 and TCC300M2067 Paralleling Scheme for Two Transformers using the Circulating Current or ΔVAR° Method

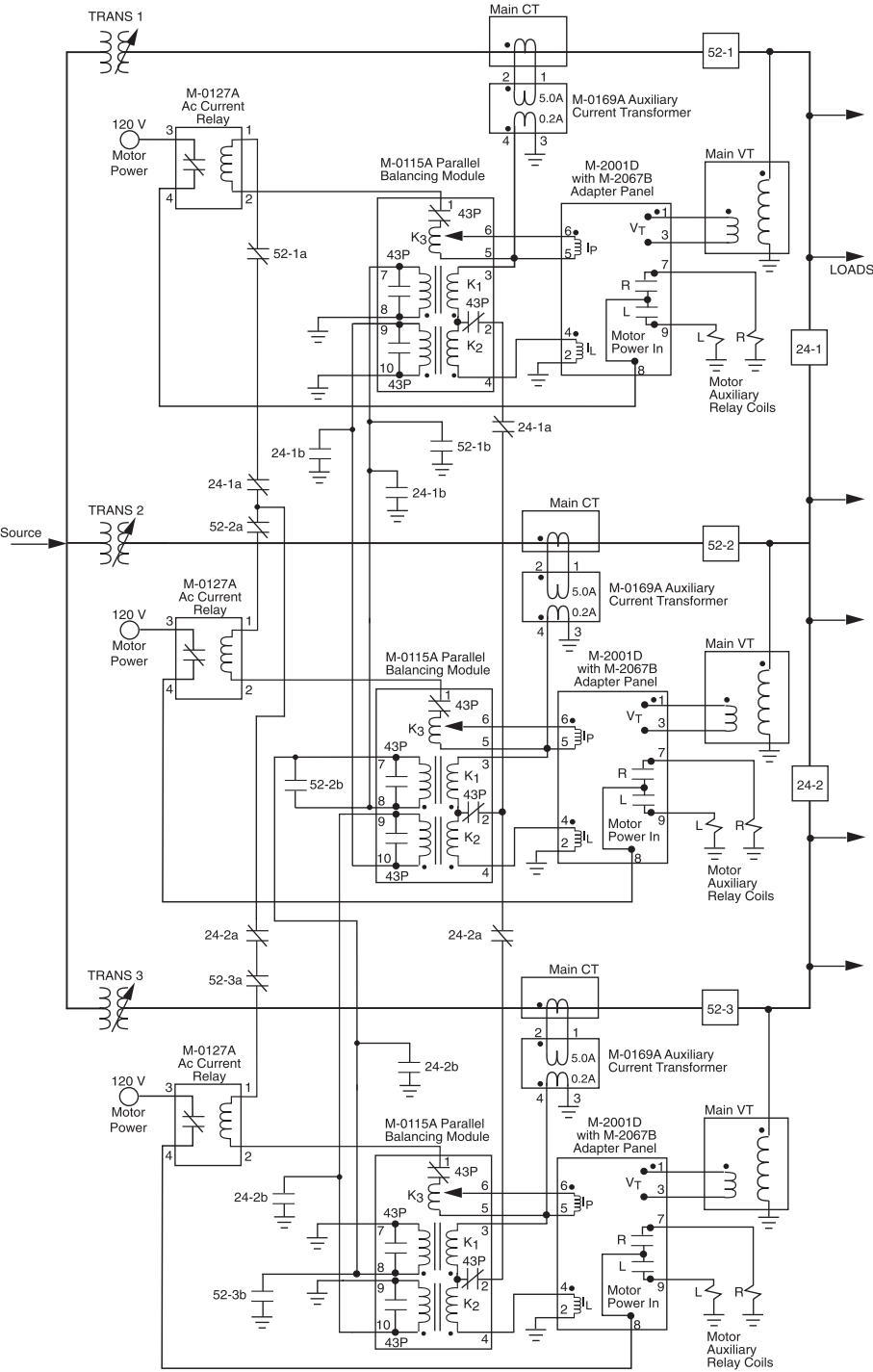


Figure 331: *TCC300 and TCC300M2067 Paralleling Scheme for Three Transformers using the Circulating Current or ΔVAR° Method*

[Figure 329](#) is a schematic of the current circuit only; redrawn from the Paralleling Scheme figures to allow easier tracing of the load current (IL) and circulating current (Ip) paths.

current, is fed to the M-0115A unit. Because of the secondary parallel connection, however, this is actually the vector sum of the desired load current and any undesired circulating current. The M-0115A separates these currents, and sends them to the proper load (LDC) and circulating current inputs of the associated control.

Two current loops are formed. One involves the K3 auxiliary transformers in each of the M-0115A units. This loop forms a measure of the transformer bank circulating current, subtracted from the LDC control input and forced to flow into the control circulating current input.

The second loop involves the K1 and K2 auxiliary transformers. They force the load current to divide properly between the various controls so that each senses its proper portion of the total bank load. Thus, the LDC setting for each control may properly be the same, regardless of whether or not the associated transformer is being used in parallel.

The first current path shown (Circulating Current) has a current analogous in angle and magnitude to the reactive current circulating through the paralleled transformers. It also includes the M-0127A Overcurrent Relay, which is used to detect excessive circulating current and block the tapchanger movement, if this occurs. Also, a lamp will alert the operator when excessive circulating current is detected.

The second path shown (Balance Current), connecting the K1 auxiliary CT of the M-0115A modules together, has a balance current which forces the two load currents of transformers #1 and #2 to be identical. This means that any difference in currents must flow in the circulating current path.

The third and fourth path shown (Half Current and LDC Current), connecting the K2 auxiliary CT of the M-0115A modules together, ensures proper operation of the Load Drop Compensator circuit if one of the transformers is taken out of service by opening its breaker. For instance, if transformer #2 is taken out of service by opening breaker 52-2, then half of transformer #1's load current is forced to flow through the half current loop. In this way, transformer #1's voltage regulating control sees the same load current as it did before, and the proper amount of line drop compensation in the transformer #1 control is maintained. This circuit configuration and grounding points must be maintained, if transformers are to be successfully paralleled.

A more detailed description of the theory of operation is available from ABB upon request. Application Note #11, "Introduction to Paralleling of LTC Transformers by the Circulating Current Method" and Application Note #13, "Advanced Paralleling of LTC Transformers by the Circulating Current Method" provide a thorough analysis of parallel LTC transformers operating by the circulating current method.

It is suggested that either the non-sequential or Intertap time delay be used when paralleling.

The sensitivity of the control or the amount of control setpoint bias for a 200 mA circulating current is 24 V. For circulating current applications, that is a 24 V setpoint shift for 200 mA of total circulating current input. For Δ VAR1 applications, that is a 24 V setpoint shift for 200 mA of reactive circulating current.

For applications with low transformer impedances, the circulating current or VAr per tap difference is greater than in applications with high transformer impedances. This creates a need for a method to adjust the sensitivity of the control according to the system application.

On the circulating current application method and the Δ VAR1 application method, this is accomplished with a sensitivity adjustment on the M-0115A Parallel Balancing Module (see the M-0115A Instruction Book.)



In all M-0115A applications, the M-0115A sensitivity settings should be equal on all paralleled transformers.

6.3.1.2

Δ VAR2 paralleling and Δ VAR2 paralleling + KeepTrack™

The theoretical basis for the Δ VAR®2 Method of paralleling is that paralleled transformers are meant to SHARE the VAr load (as well as the KW load) of the load bus. Since the KW sharing of the parallel transformers is determined by the relative transformer impedances and NOT the tap position, KW flow should not effect tap position choice. Further, that the best choice of loading parallel transformers is to maintain the VAr sharing regardless of KW loading which can be accomplished with relative tap positioning.

The Δ VAR Method will result in the VAr flow to the substation load to be shared in the appropriate ratio of the paralleled transformers' ratings. It should be noted that auxiliary CT's are required in circulating current schemes to balance the currents when transformers with different impedances are paralleled. Those auxiliary CT's are not necessary when the Δ VAR Method is used.

The Δ VAR2 implementation is limited to use with no more than two transformers and each transformer current is input to each control. This eliminates the need for the parallel balancing module and removes the path for the installation of the overcurrent relay. For this implementation, the sensitivity setting is added to the TCC300 Tapchanger Control along with a circulating current overcurrent inhibit function. The Δ VAR2 implementation also contains a CT ratio-matching setting making it unnecessary to match CT ratios exactly to transformer MVA ratings for proper operation.

The Δ VAR2 Method is incorporated in the ABB TCC300 Tapchanger Control, as an option. This option internally calculates and compares the individual transformer VAR flows. Decisions for voltage setpoint biasing are then made and implemented to change tap positions in such a manner that the difference in VAR flow is minimized.

Action is taken continuously as the MVAR load is changing such that the magnitude of difference in VAR loading is minimized (depending on the VAR difference of one, off-optimum, tap position).

The use of LDC (line drop compensation) is precluded when Δ VAR2 is used since no provision is made for the increase in load currents in one transformer when the other is out of service. The result would be doubling the LDC effect when in independent operation.

6.3.1.3

Δ VAR2 connection

As shown in [Figure 332](#), the current input is connected to the load current terminals of the control and then into the circulating current terminals (Ip) of the paralleled transformer control. Each control now sees the same voltage and each transformer current separately. This allows each control to calculate the VAR flows in both transformers for comparison, without externally sorting out the load and circulating current values. Breaker contact 52-3b is used to signal the TCC300 Control to disable paralleling using the neutral light input (Redefined when Δ VAR2 selected). An external independent/parallel switch (43P) is suggested to provide manual control for testing and maintenance. The effectiveness of this grounding is important for the recognition of this condition.

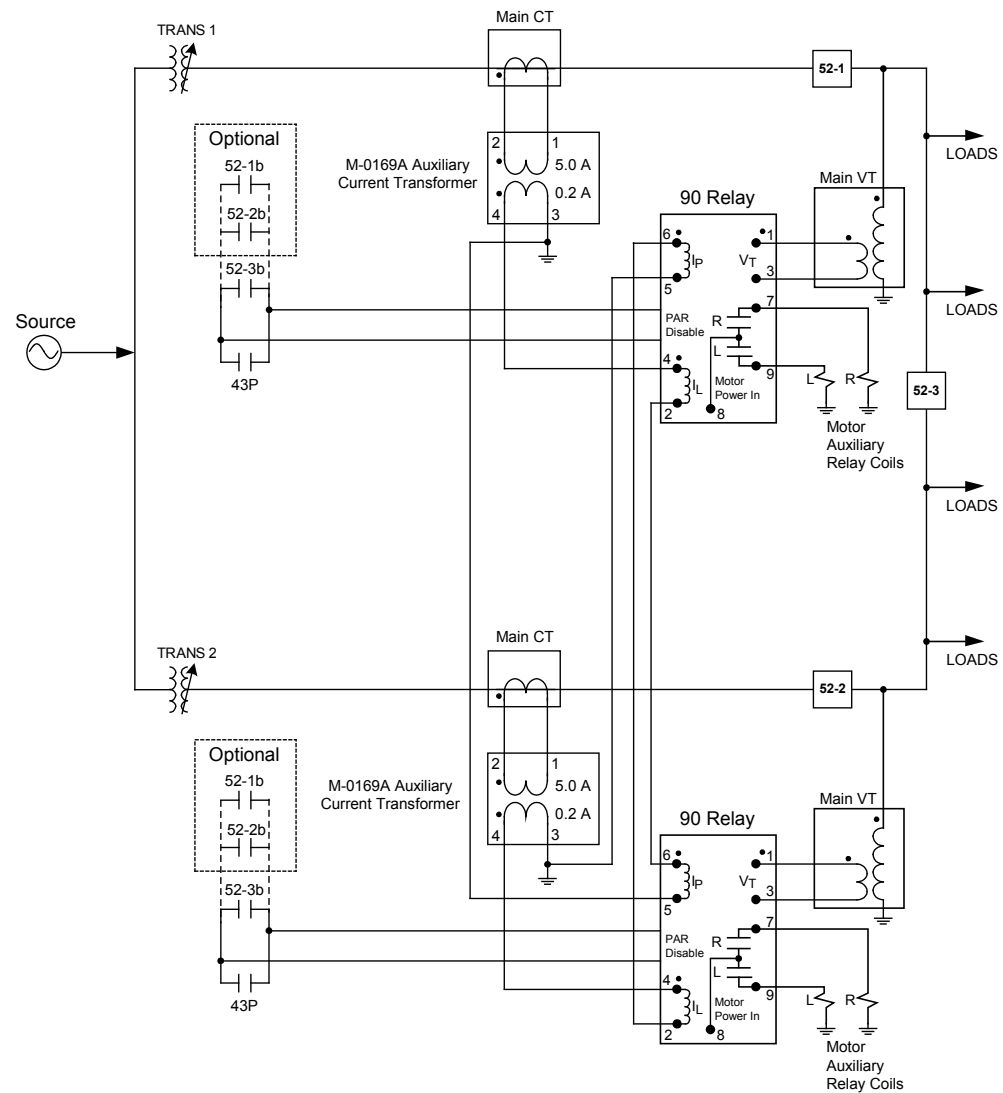


Figure 332: Δ VAR[®]2 Paralleling

Paralleling by the Δ VAR2 method does not use the M-0115A Parallel Balancing Module. This method of paralleling can only be used for two transformers. See [Figure 332](#) for the Δ VAR2 connections. Instead, the two load currents are brought into the control, and the actual Δ VAR's which exist between the paralleled transformers is calculated internally. When using the Δ VAR2 method, the control's load current input is to be connected to the load current CT of the transformer which is controlling the tap position. The control's circulating current is to be connected to the load current CT for the opposite paralleled transformer.

The measured voltage the TCC300 controls on each of the transformers will be biased in such a way as to attempt to minimize the circulating current between the two. In the case of Δ VAR, the tap positions will minimize the difference in VArS from each transformer.

For Δ VAR2 applications, there is a 24 V setpoint shift for 200 mA of calculated reactive current difference between transformers. (Δ VAR2 is only applicable for two parallel transformer applications.)

For applications with low transformer impedances, the circulating current or VArS per tap difference is greater than in applications with high transformer impedances. This creates a need for a method to adjust the sensitivity of the control according to the system application.

On the Δ VAR[®]2 application method, which uses no M-0115A module, a control setting is provided to accomplish the sensitivity adjustment.



In all Δ VAR2 applications, the sensitivity settings should be equal on all paralleled transformer controls.

Exclusively for the Δ VAR2 method, there are three functions activated and set in the Configuration menu for proper operation: Δ VAR2 Sensitivity, Δ VAR2 Reac Limit, and Δ VAR2 I Ratio. When the Δ VAR option has not been purchased, these input screens will be disabled.

The Δ VAR2 Sensitivity ranges from -4.0 to $+4.0$, as did the M-0115A adjustment. At a Δ VAR2 Sensitivity setting of 0.0 , 100% of calculated reactive current difference will be used to bias the setpoint. At a setting of -4.0 , only 50% of the calculated reactive current difference will be used to bias the setpoint, making the control less sensitive to the circulating current. At a setpoint of $+4.0$, the bias will be adjusted by a value of 200% of the calculated reactive current difference, making the control more sensitive to the system current.

The Δ VAR2 Circ Limit I setpoint establishes a limit on the calculated reactive current difference between transformers. The settings range from 5 mA to 200 mA in 1 mA increments. If the calculated reactive current difference reaches this setpoint, the operation of the control will be blocked and the alarm output function will be activated, if enabled. The purpose of this limit is to stop any runaway condition. This feature is required to replace the M-0127A overcurrent relay used in the circulating current and Δ VAR1 applications.



Care must be taken in setting the Δ VAR2 Circ Limit I, to ensure it is high enough to allow a two or three tap difference from optimum in transformers before operating. Some knowledge of system impedances are useful in determining this setting, but the current difference may also

be tested for immediate system conditions by reading the current change when one tap is changed on either transformer.

The ΔVAR2 I Ratio is used to adjust the sensitivity to the line current input versus the circulating current input (opposite transformer load current) to compensate for unequal CT ratios between transformers. For proper operation with a ratio setting of 1, the ratio of the CT ratios must be equal to the ratio of the transformer ratings (CT1/CT2=MVA1/MVA2).

$$\left(\frac{TX1 \text{ Rating}}{TX2 \text{ Rating}} \right) \left(\frac{TX2 \text{ CT Ratio}}{TX1 \text{ CT Ratio}} \right) = \text{Ratio TX 1}$$

(Equation 7)

$$\left(\frac{TX2 \text{ Rating}}{TX1 \text{ Rating}} \right) \left(\frac{TX1 \text{ CT Ratio}}{TX2 \text{ CT Ratio}} \right) = \text{Ratio TX 2}$$

(Equation 8)

Example:

A 20 MVA transformer is being paralleled with a 15 MVA transformer. If the CT ratios are 2000 A and 1500 A to 0.2 A, no compensation would be required (both transformers are fully loaded when the CT outputs are 200 mA.) However, if they each had 2000 A to 0.2 A CTs, the ΔVAR2 I Ratio on the 20 MVA transformer control should be 1.34, and the ΔVAR2 I Ratio on the 15 MVA transformer control should be 0.75.

The settings for this ratio are 0.50 to 2.00, in 0.01 increments. When the setting is 0.50, the control will be 0.50 times as sensitive to the VArS from the circulating current input versus the load input current. The default setting for the sensitivity is 1.00, indicating the ratio of the CT ratios are equal to the ratio of the transformer ratings.

This feature can also be used to replace the need for auxiliary transformer for matching transformer CT ratios. No correction is necessary to compensate for impedance differences in the transformers with ΔVAR operation.

For ΔVAR2 applications (without KeepTrack™), paralleling will be disabled if either current input drops to less than approximately 10 mA or if a neutral input is present. When ΔVAR2 operation is configured, the normal neutral input is directed to this duty rather than the normal neutral light operation. It is highly recommended that this input be connected to operate whenever any breaker opens which isolates the transformer from parallel operation.

For ΔVAR2 Paralleling mode the Auxiliary Input A1 will be the ΔVAR2 Disable Input. This is needed since the Neutral Position Input is used for KeepTrack.



This input configuration has changed from previous firmware versions (V01.05.13 and prior).

6.3.1.4 Selecting and Setting ΔVAR2 Paralleling Method from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Paralleling" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Paralleling Type" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Paralleling Type
DISABLE C
6. Utilizing the arrow pushbuttons, select DVAR2 or DVAR2 (KeepTrack) then press the ENT pushbutton.
7. Press the Down arrow pushbutton once. The following will be displayed.
DVAR2 Sensitivity
0.0
8. Press the ENT pushbutton. The following will be displayed
DVAR2 Sensitivity
0.0 C
9. Utilizing the arrow pushbuttons, select the desired DVAR2 Sensitivity, then press the ENT pushbutton.
10. Follow the procedure above to enter the desired:
 - DVAR2 Reac I Lmt
 - DVAR2 I Ratio

6.3.1.5 Selecting and Setting ΔVAR2 Paralleling Method from TCC600

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

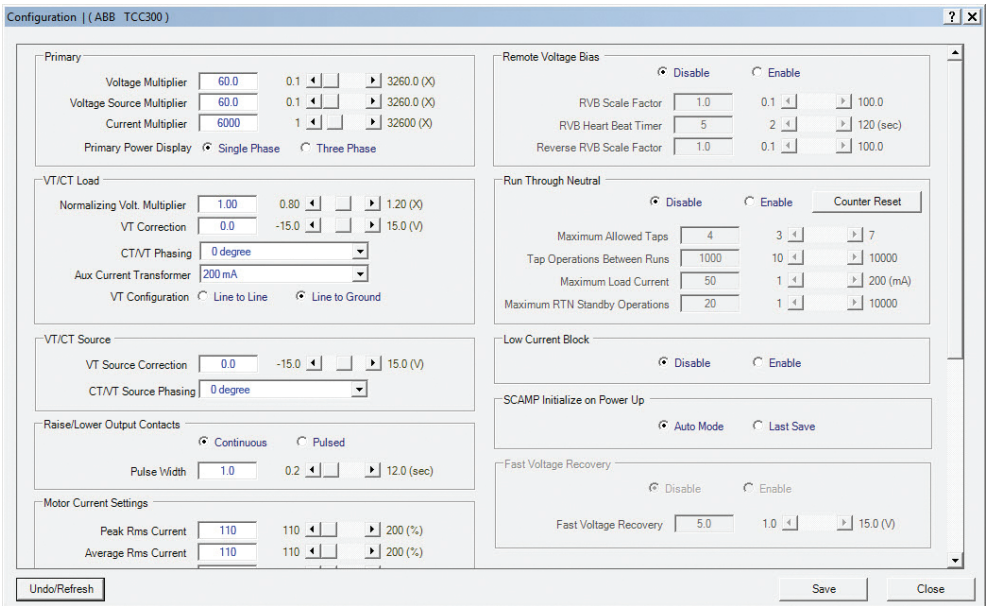


Figure 333: Configuration Dialog Screen

2. From the "Paralleling" section of the dialog screen select DVAr 2 or DVAr 2 (KeepTrack) Paralleling Type. Enter the desired DVAr2 Sensitivity, Reactive Current Limit and Input Ratio.

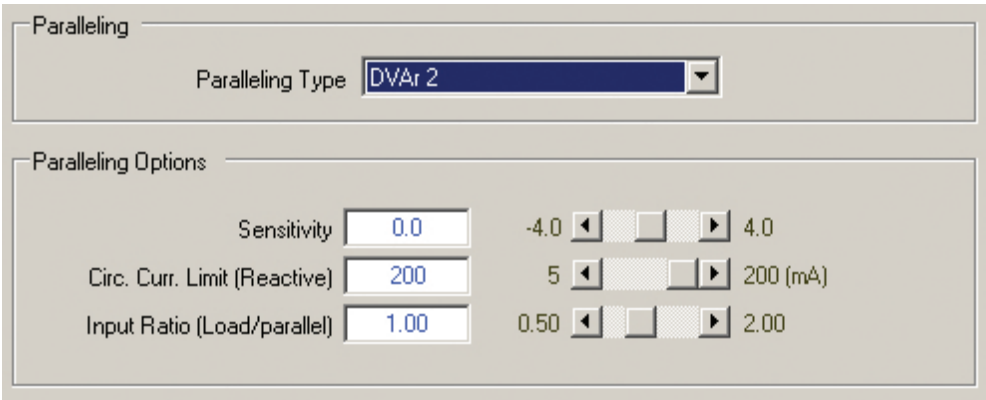


Figure 334: DVAr2 and DVAr2 (KeepTrack) Paralleling Settings (Configuration Dialog Screen)

3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

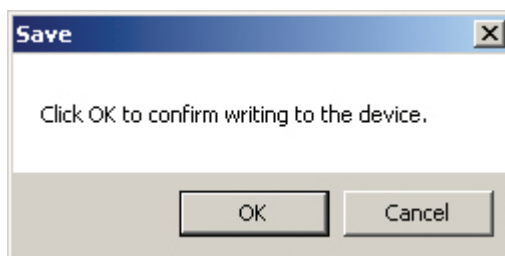


Figure 335: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

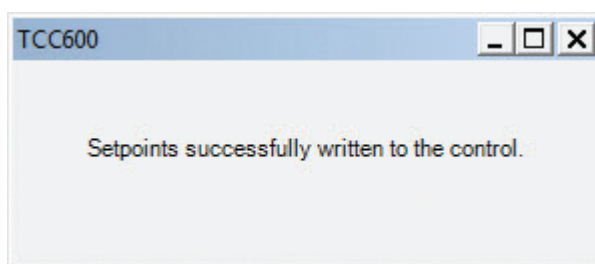


Figure 336: Setpoints Successfully Written To The Control Dialog Screen

6.3.2

Optional master/follower paralleling method

The Master/Follower Paralleling scheme employs the GOOSE messaging of the IEC 61850 protocol to provide peer to peer communications. The control can be placed in either the Master or Follower mode if paralleling is to be achieved. The Master/Follower settings can also be changed individually on each control through Setup/Configuration/Paralleling. The Master/Follower Configuration Tool includes the settings for each control in the network for the Master/Follower paralleling scheme.

Paralleling

Paralleling TypeMaster/Follower

Master/Follower Configuration

☒None

☐Follower

☐Master

Master/Follower Configuration Settings

Paralleling Address16

116

Number of Devices2

216

Tap Difference2

28

Tap Pos. Response Timeout60000

100060000 (ms)

Line Breaker

☒Not In Use

☐In Use

☒Positive Polarity

☐Negative Polarity

Right Tie Breaker

☒Not In Use

☐In Use

☒Positive Polarity

☐Negative Polarity

Left Tie Breaker

☒Not In Use

☐In Use

☒Positive Polarity

☐Negative Polarity

Figure 337: Master/Follower Paralleling Settings (Configuration Dialog Screen)

Master/Follower Configuration Tool

Double-click to edit

SN	IP Address	User Line	Status	Tap Pos.	A1	A2	A3	Paralleling Address	Mode	Tap Diff	Master Timeout	# Devices	TB In Use (A1)	TB Polarity	TB In Use (A2)	TB Polarity	TB In Use (A3)	TB Polarity
151	10.10.2.99	Beckwith Electric	M-20010	N	3	1	1	1	NA	N	NA	NA	NA	NA	NA	NA	NA	NA
152	10.10.2.100	1111	3-20010	N	24	1	1	1	NA	N	NA	NA	NA	NA	NA	NA	NA	NA

Discover Devices

Apply Configuration

Alarm Reset

Close

Figure 338: Master/Follower Configuration Tool Dialog Screen

6.3.2.1 Grouping operation algorithm (GOA)

This GOA determines the action that is taken by the control when it detects any OPEN Tie Breakers in the network.

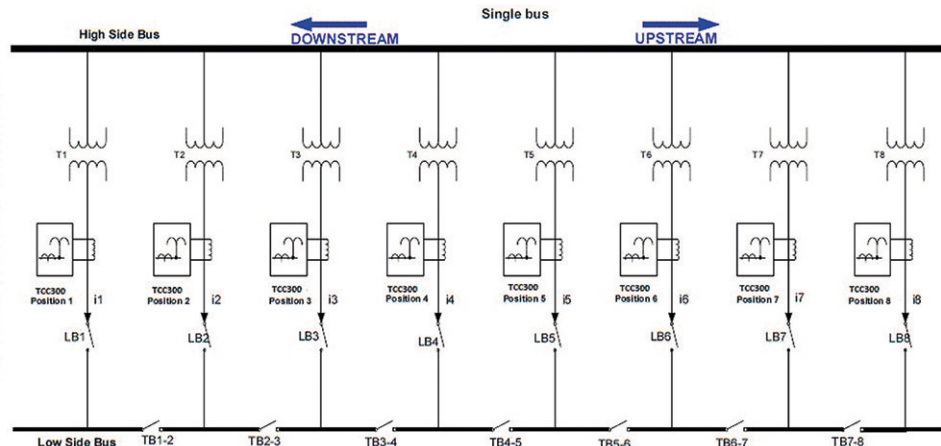


Figure 339: Breaker/Control Network Map

Each control individually monitors the status of the Tie Breakers (A2, A3 Auxiliary Inputs) and broadcasts to all the other controls these statuses via a GOOSE message. Each control in turn processes the tie breaker statuses to produce a map of the network every 64 ms.

Each control upon detecting a change in any Breaker Status or Tap Position will issue a GOOSE message to update all the other controls in the network with the new information.

The following rules are applied to produce the Control Network Map:

- The Master in the initial setup of the network should always be at the highest position in the network map (e.g. position 8).
- The paralleling address of each control should be the same as the position it is located in the network map (e.g. position 7 = address 7).
- All GOOSE messages are sorted according to their corresponding paralleling addresses.
- The control scans all the tie breakers statuses (if any) in the downstream positions to find the downstream boundary.
- The first OPEN status indicates the boundary has been reached. Similarly the control scans all the upstream tiebreaker statuses (if any) to find the upstream boundary. Once the boundaries are located the sub network is defined.
- If the control is a Master, the control will determine how many Followers are in its network.
- If the control is a Follower, the Master/Follower Identification will be equal to the address of the Master in that network.

6.3.2.2 Master/follower alarm messages

The Master/Follower Alarm Messages that are displayed on the Control's HMI display, can be remotely observed from TCC600® utilizing the Monitor/Master/Follower Alarm Messages menu selection. In addition to the lockout conditions, it also will display the serial number of the Follower that caused the lockout condition for Tap Difference Lockout.

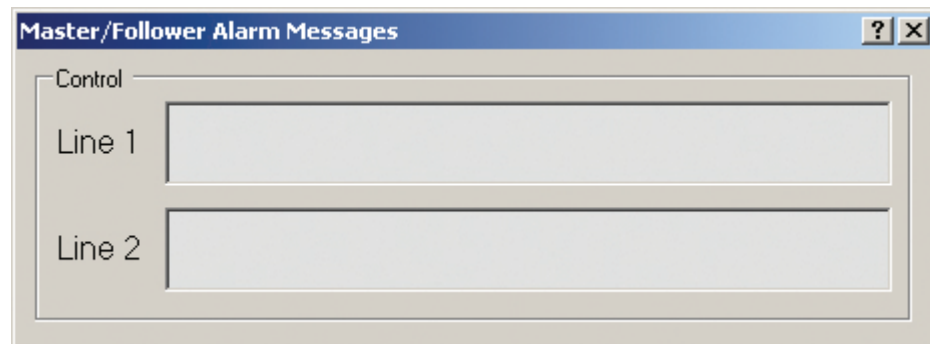


Figure 340: Master/Follower Alarm Messages

6.3.2.3 Lockout condition

There are two types of lockout conditions, Master Lockout and Follower Lockout. Any lockout of the paralleling mode will initiate a Lockout alarm. When a lockout is active, the unit issuing the lockout will stop any further GOOSE publishing and will stop load voltage regulation. Also, the alarm can be configured as a DNP event, or as a report in the case of IEC 61850. The lockout alarm will be displayed on the control front panel HMI display and in the Master/Follower Configuration Tool.



Master/Follower Alarm messages can be observed for the connected control from the TCC600 Monitor/Master/Follower Alarm Messages menu item.

Master lockout

There are four Master Lockouts:

1. GOOSE Message Delay – When the control powers up in Master Mode, the control will wait for approximately 65 sec to allow all the GOOSE messages from all the Followers in the network to reach the Master. Once all GOOSE messages have been received, the Master will start its normal algorithm. If within that initial 65 second

period the Master does not receive all the GOOSE messages it expected, it will enter the Master lockout state.

2. Tap Position Response Timeout Lockout – The Tap Position Response Timeout will start after the Master has published its new tap position message after it has performed a successful tap operation. If it doesn't receive the tap position messages from all the participating Followers in the network before the timer expires, then a Master Lockout is issued.
3. Tap Difference Lockout – If the Tap position difference between any Follower and the Master is greater than or equal to Tap Difference setting, the Master will enter the lockout state.
4. Follower Communication Loss Lockout – If any follower does not send a valid re-transmitted GOOSE message within a 65 sec internal Follower Detection Lockout "Keep Alive" time, then a lockout is issued, signaling a broken communication link.

Follower lockout

There are three types of Follower Lockout:

1. Master Communication Loss Lockout – When the Follower does not receive a valid re-transmitted GOOSE message from the Master within a 65 second internal "Keep Alive" time, and the previous Master GOOSE message indicates that the breaker statuses were closed, then a Follower Lockout is activated. This Lockout is an indication that communication with the Master has been lost.
2. Follower Communication Loss Lockout – If any follower does not send a valid re-transmitted GOOSE message within a 65 sec internal Keep Alive time, then a lockout is activated, indicating a broken communication link.
3. Tap Difference Lockout – If the Tap Position Difference between the Follower and the Master is greater than or equal to the Tap Difference setting, a Follower Lockout will be activated.

6.3.2.4

Master/follower configuration tool

TCC600® includes a Master/Follower Configuration Tool located in the Utility menu to help configure the controls for the Master/Follower Paralleling scheme. The tool allows the user to discover on a Local Area Network (LAN) all the ABB TCC300 controls that have the Master/Follower feature. Note that the Master/Follower Paralleling scheme can only be implemented on controls that are on the same network. In addition, if a multiple network adapter exists on the host computer the configuration tool will allow the user to select on which network card the tool should perform the discover of all TCC300 controls. Failure to choose the correct network card may result in the tool not discovering all the available TCC300 controls. Accessing the Master/Follower Paralleling Tool dialog screen requires a Level 2 Access code.

Discovered devices

Each discovered control and its data is displayed on the Master/Follower Configuration Tool dialog screen. The data is organized into control identifiers, read only statuses, and configurable (writable) settings. The control identifiers are indicated by the color "yellow", read only statuses by "green", and configurable settings are identified by an asterisk. NA indicates the data is not applicable.

The Control Identifiers are:

- SN – Serial Number of the device
- IP Address – IP address of the device
- User Line – User Logo on the device

The Read Only Statuses are:

- Status – Indicates whether the device is a Master, Follower or None and whether the unit is in Lockout condition.
- Tap Pos – Tap position of the device
- A1 – Line Breaker status of the device
- A2 – Right Tie Breaker status of the device
- A3 – Left Tie Breaker status of the device

A1, A2, and A3 are references to the TCC300 Auxiliary Inputs.

The Configuration Tool allows the user to enter the following settings:

- Paralleling Mode – Master/Follower Paralleling Mode is automatically changed to Master/Follower when settings are written to the control.
- Paralleling Address – The unique address for each device (Range 1 – 16)
- Mode – Master/Follower mode of operation. M = Master, F= Follower, N = None
- Tap Difference – The difference between Master and Follower tap positions for which Lockout will be issued.
- Tap Position Response Timeout – Time within which the Followers have to be at the same tap position as that of the Master (Range 1000 ms – 60000 ms). If the Tap Position Response Timeout is greater than the Intertap Delay setting, then the Tap Position Response Timeout is used as the Intertap Delay, so that the Master waits for all the Followers to make a tapchange before the Master takes the next tap.
- # Devices – The number of total devices that are in the paralleling scheme (maximum 16 inclusive of the Master)
- Breaker In Use (A1) – Option to use the Line Breaker Status in the algorithm.
- Breaker Polarity – Positive or negative polarity of the Line Breaker.
- Right TB In Use (A2) – Option to use the Right Tie Breaker Status in the algorithm.
- Right TB Polarity – Positive or negative polarity of the Right Tie Breaker.
- Left TB In Use (A3) – Option to use the Left Tie breaker Status in the algorithm.
- Left TB Polarity – Positive or negative polarity of the Left Tie Breaker.

6.3.2.5

Setting of masters and followers from TCC600

A minimum of 2 controls are required for the paralleling scheme to work. The Master unit will be configured first and then the Follower(s).



This procedure requires communication to be established with the target control (Master or Follower) with Level 2 Access.

Setting up Master Control from TCC600

1. Verify that the appropriate Setup Settings have been entered for the control application.
2. Place the Master Control to be setup in Manual by selecting "Block" from the Remote Control dialog screen "Remote Operation/Block Auto Control via Communication (Comm Block)" section.

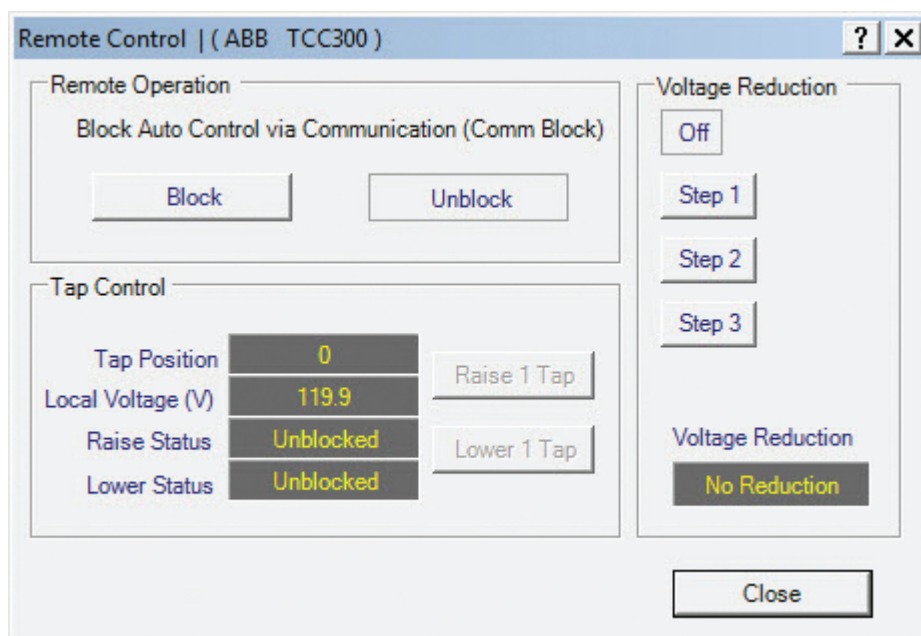


Figure 341: Remote Control Dialog Screen

3. Select Paralleling Type to be "Master/Follower" from the "Paralleling" section of the "Configuration" dialog screen.

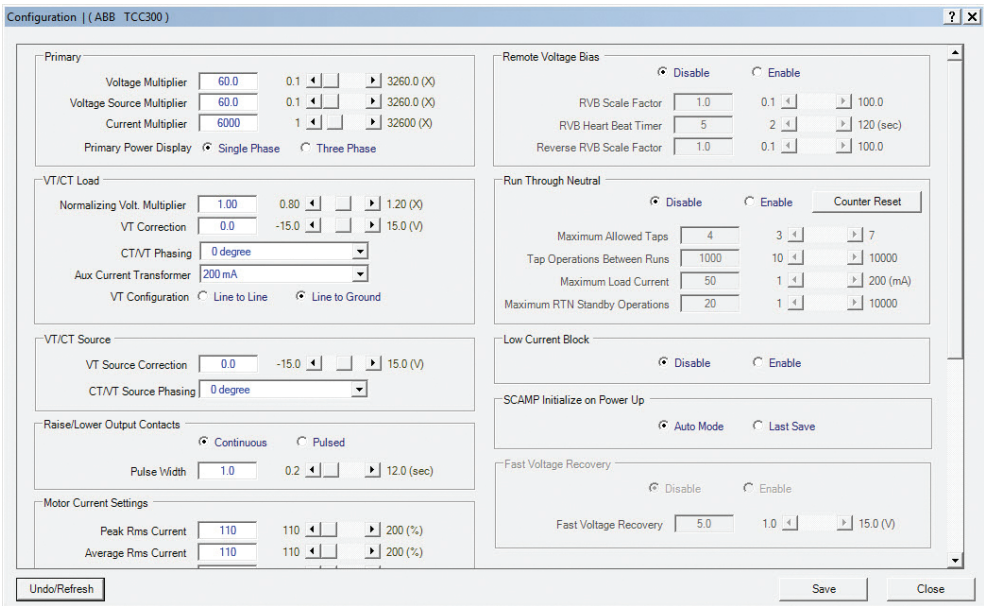


Figure 342: Configuration Dialog Screen

4. Select "None" from the "Master/Follower Configuration" section of the "Configuration" dialog screen.



The Master/Follower Configuration settings can also be set utilizing the Master/Follower Configuration Tool.

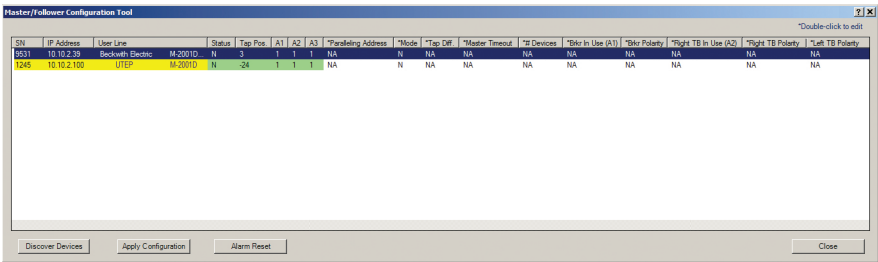


Figure 343: Master/Follower Configuration Tool Dialog Screen

5. Enter the desired Master/Follower Configuration Settings from the "Master/Follower Configuration Settings" section of the "Configuration" dialog screen:
- Paralleling Address (1 to 16) – The Master Paralleling Address must be the highest address in the network. All Follower addresses must be a value less than the Master. The control's position in the paralleling network is determined by its paralleling address. As shown in [Figure 339](#), Position 1

should be assigned a paralleling address of 1, Position 2 a paralleling address of 2 and so on, in an ascending order. In this example the Master control will be in Position 8 with a Paralleling Address of 8.

- Number of Devices (2 to 16)
- Tap Difference (2 to 8)
- Tap Position Response Timeout (1000 to 60000 ms) The Tap Position Response Timeout is the time within which the Followers have to be at the same tap position as that of the Master (Range 1000 ms – 60000 ms). If the Tap Position Response Timeout is greater than the Intertap Delay setting, then the Tap Position Response Timeout is used as the Intertap Delay, so that the Master waits for all the Followers to make a tapchange before the Master takes the next tap.
- Line Breaker "Not In Use" or "In Use" (Auxiliary Input A1)
- Line Breaker Polarity "Positive" or "Negative"
- Right Tie Breaker "Not In Use" or "In Use" (Auxiliary Input A2)
- Right Tie Breaker Polarity "Positive" or "Negative"
- Left Tie Breaker "Not In Use" or "In Use" (Auxiliary Input A3)
- Left Tie Breaker Polarity "Positive" or "Negative"



Followers are in remote manual mode and operate in "Pulse Mode" regardless of the mode of operation of the Raise/Lower Output contacts.

Setting up Follower Control from TCC600

1. Verify that the appropriate Setup Settings have been entered for the control application.
2. Verify that the designated network Master Control operational mode is as follows:
 - The control is in "Manual".
 - The "Master/Follower Configuration" section of the Configuration dialog screen is selected to "None".
3. Select Paralleling Type to be "Master/Follower" from the "Paralleling" section of the "Configuration" dialog screen.

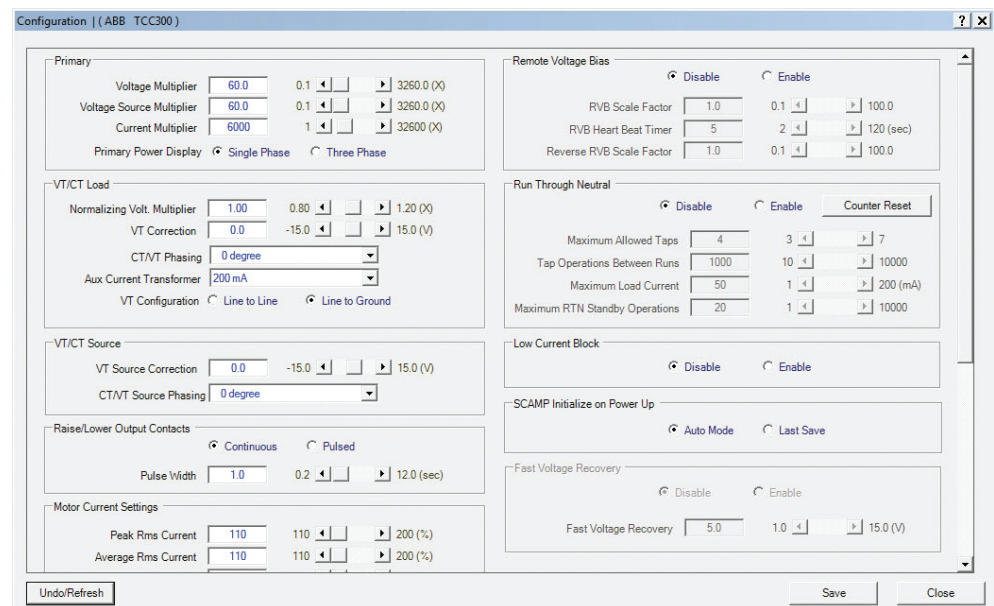


Figure 344: Configuration Dialog Screen

4. Select "Follower" From the "Master/Follower Configuration" section of the "Configuration" dialog screen.
5. Enter the desired Master/Follower Configuration Settings from the "Master/Follower Configuration Settings" section of the "Configuration" dialog screen:
 - Paralleling Address (1 to 16) – The Follower Paralleling Address must be a value less than the Master. The control's position in the paralleling network is determined by its paralleling address. As shown in [Figure 339](#), Position 1 should be assigned a paralleling address of 1, Position 2 a paralleling address of 2 and so on, in an ascending order. In this example the Master control will be in Position 8 with a Paralleling Address of 8.
 - Number of Devices (2 to 8)
 - Tap Difference (2 to 8)
 - Tap Position Response Timeout (1000 to 60000 ms) The Tap Position Response Timeout is the time within which the Followers have to be at the same tap position as that of the Master (Range 1000 to 60000 ms). If the Tap Position Response Timeout is greater than the Intertap Delay setting, then the Tap Position Response Timeout is used as the Intertap Delay, so that the Master waits for all the Followers to make a tapchange before the Master takes the next tap.
 - Line Breaker "Not In Use" or "In Use" (Auxiliary Input A1)
 - Line Breaker Polarity "Positive" or "Negative"
 - Right Tie Breaker "Not In Use" or "In Use" (Auxiliary Input A2)

- Right Tie Breaker Polarity "Positive" or "Negative"
 - Left Tie Breaker "Not In Use" or "In Use" (Auxiliary Input A3)
 - Left Tie Breaker Polarity "Positive" or "Negative"
6. Drive the Follower Tap Position to match the Master Tap Position.
 7. Repeat Steps 3 through 6 for each Follower in the Master/Follower scheme.
 8. Determine the Master Band Status, then proceed as follows:
 9. If the Master Band Status is "In-Band":
 - 9.1. Select "Master" from the Master, "Master/Follower Configuration" section of the "Configuration" dialog screen.



After placing the Master control in "Master" the Master will not respond to any tapchange requests for 32 seconds.

- 9.2. When at least 32 seconds have elapsed, initiate a Raise or Lower tapchange from the Master, Remote Control dialog screen "Tap Control" section.
- 9.3. Verify that all Followers initiate tapchanges to match the Master tap position.
- 9.4. If necessary, return the Master to an "In-Band" tap position.
- 9.5. Select "Unblock" from the Master, Remote Control dialog screen "Remote Operation/Block Auto Control via Communication (Comm Block)" section.

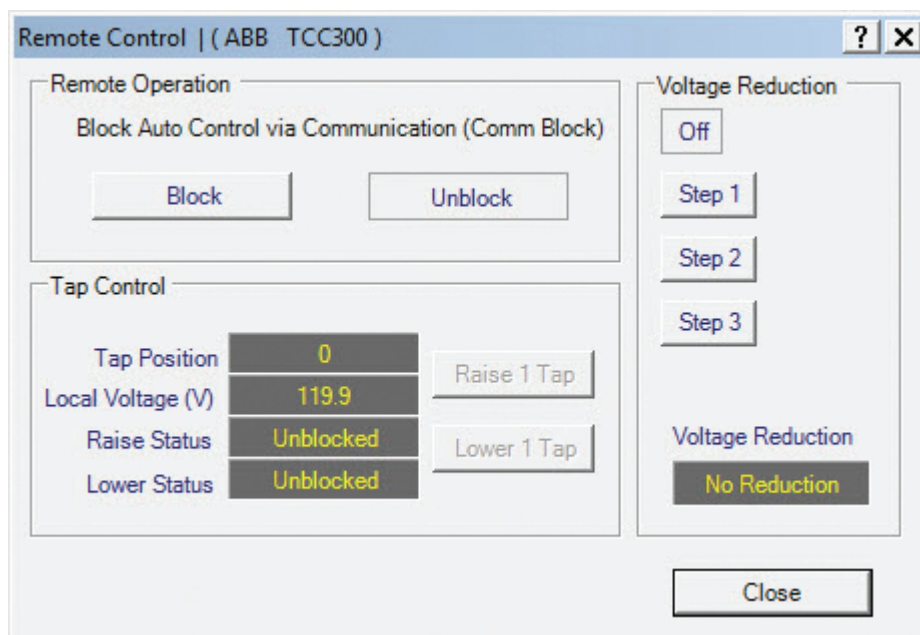


Figure 345: Remote Control Dialog Screen

10. If the Master Band Status is not In-Band:

- 10.1. Adjust the Master tap position by initiating a tapchange as necessary to bring the Master Band Status "In-Band" from the Master, Remote Control dialog screen "Tap Control" section.
- 10.2. Drive each Follower tap position in the Master/Follower scheme to match the Master tap position.
- 10.3. Select "Master" from the Master, "Master/Follower Configuration" section of the "Configuration" dialog screen.



After placing the Master control in "Master" the Master will not respond to any tapchange requests for 32 seconds.

- 10.4. When at least 32 seconds have elapsed, initiate a Raise or Lower tapchange from the Master, Remote Control dialog screen "Tap Control" section.
 - 10.5. Verify that all Followers initiate tapchanges to match the Master tap position.
 - 10.6. If necessary, return the Master to an "In-Band" tap position.
 - 10.7. Select "Unblock" from the Master, Remote Control dialog screen "Remote Operation/Block Auto Control via Communication (Comm Block)" section.
11. The Master/Follower Paralleling scheme is now in effect.

6.3.2.6

Setting of masters and followers from the HMI

A minimum of 2 controls are required for the paralleling scheme to work. The Master unit will be configured first and then the Follower(s).

Setting up Master Control from the HMI



This procedure requires Level 2 Access.

1. Verify that the appropriate Setup Settings have been entered for the control application.
2. Place the Master Control to be setup in Manual.
3. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
4. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
5. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Paralleling" menu.
6. Press the Down arrow pushbutton, as necessary, until the "Paralleling Type" screen is displayed.

7. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
 Paralleling Type
 DISABLE C
8. Utilizing the arrow pushbuttons, select the Paralleling Type to be "MASTER/FOLLOWER", then press the ENT pushbutton.
9. Press the Down arrow pushbutton once, the "Master/Follower" screen will be displayed.
10. Verify that the Master/Follower Configuration is selected to "NONE".
 - If the Master/Follower Configuration is set to "NONE", proceed to the next step.
 - If the Master/Follower Configuration is not set to "NONE", utilize the arrow pushbuttons to select "NONE", then press the ENT pushbutton.
11. Press the Down arrow pushbutton once, the "Paralleling Address" screen will be displayed.
 Paralleling Address
 16
 The Master Paralleling Address must be the highest address in the network. All Follower addresses must be a value less than the Master.
 The control's position in the paralleling network is determined by its paralleling address. As shown in [Figure 339](#), Position 1 should be assigned a paralleling address of 1, Position 2 a paralleling address of 2 and so on, in an ascending order. In this example the Master control will be in Position 8 with a Paralleling Address of 8.
12. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
 Paralleling Address
 16 C
13. Utilizing the arrow pushbuttons, enter the desired Paralleling Address (1 to 16) then press the ENT pushbutton.
14. Press the Down arrow pushbutton once, the "Num. Devices" screen will be displayed.
 Number of Devices is the number of total devices that are in the paralleling scheme (maximum 16 inclusive of the Master).
15. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
 Num. Devices
 2 C
16. Utilizing the arrow pushbuttons, enter the total Number of Devices then press the ENT pushbutton.
17. Press the Down arrow pushbutton once, the "T.P.R. Timeout" screen will be displayed.
 T.P.R. Timeout
 60000 ms

The Tap Position Response Timeout is the time within which the Followers have to be at the same tap position as that of the Master (Range 1000 to 60000 ms).

If the Tap Position Response Timeout is greater than the Intertap Delay setting, then the Tap Position Response Timeout is used as the Intertap Delay, so that the Master waits for all the Followers to make a tapchange before the Master takes the next tap.

18. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
T.P.R. Timeout
60000 ms C
19. Utilizing the arrow pushbuttons, enter the desired Tap Position Response Timeout then press the ENT pushbutton.
20. Press the Down arrow pushbutton once, the "Breaker Option" screen will be displayed.
21. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
line breaker
000000 C
22. Utilizing the arrow pushbuttons, enter the desired Breaker Options:



Position 1 is the first position from the right.

Position 1 – Line Breaker (A1)

- "0" = Not Selected
- "1" = Selected

Position 2 – Line Breaker Polarity

- "0" = Positive
- "1" = Negative

Position 3 – Right Tie Breaker (A2)

- "0" = Not Selected
- "1" = Selected

Position 4 – Right Tie Breaker Polarity

- "0" = Positive
- "1" = Negative

Position 5 – Left Tie Breaker (A3)

- "0" = Not Selected
- "1" = Selected

Position 6 – Left Tie Breaker Polarity

- "0" = Positive
- "1" = Negative

When all Break er Options have been entered, then press the ENT pushbutton.

23. Press the Down arrow pushbutton once, the "Tap Difference" screen will be displayed.
The Tap Difference setting is the difference between Master and Follower tap positions for which Lockout will be issued.
24. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Tap Difference
2 C
25. Utilizing the arrow pushbuttons, enter the desired Tap Difference setting (2 to 8) then press the ENT pushbutton.

Setting up Follower Control from the HMI



This procedure requires Level 2 Access.

1. Verify that the appropriate Setup Settings have been entered for the control application.
2. Verify that the designated network Master Control operational mode is as follows:
 - The control is in "Manual"
 - The "Master/Follower Configuration" section of the Configuration dialog screen is selected to "None".

If the designated network Master Control is not in the operational mode described above, then take the necessary steps to place the control in the described operational mode before continuing.

3. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
4. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
5. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Paralleling" menu.
6. Press the Down arrow pushbutton, as necessary, until the "Paralleling Type" screen is displayed.
7. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Paralleling Type
DISABLE C

8. Utilizing the arrow pushbuttons, select the Paralleling Type to be "MASTER/FOLLOWER", then press the ENT pushbutton.
9. Press the Down arrow pushbutton once, the "Master/Follower" screen will be displayed.
10. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Master/Follower
NONE C
11. Utilizing the arrow pushbuttons select "FOLLOWER", then press the ENT pushbutton.
12. Press the Down arrow pushbutton once, the "Paralleling Address" screen will be displayed.
The Master Paralleling Address must be the highest address in the network. All Follower addresses must be a value less than the Master.
The control's position in the paralleling network is determined by its paralleling address. As shown in [Figure 339](#), Position 1 should be assigned a paralleling address of 1, Position 2 a paralleling address of 2 and so on, in an ascending order. In this example the Master control will be in Position 8 with a Paralleling Address of 8.
13. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Paralleling Address
16 C
14. Utilizing the arrow pushbuttons, enter the desired Paralleling Address (1 to 16) then press the ENT pushbutton.
15. Press the Down arrow pushbutton once, the "Num. Devices" screen will be displayed.
Number of Devices is the number of total devices that are in the paralleling scheme (maximum 16 inclusive of the Master).
16. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Num. Devices
2 C
17. Utilizing the arrow pushbuttons, enter the total Number of Devices then press the ENT pushbutton.
18. Press the Down arrow pushbutton once, the "T.P.R. Timeout" screen will be displayed.
The Tap Position Response Timeout is the time within which the Followers have to be at the same tap position as that of the Master (Range 1000 to 60000 ms).
If the Tap Position Response Timeout is greater than the Intertap Delay setting, then the Tap Position Response Timeout is used as the Intertap Delay, so that the Master waits for all the Followers to make a tapchange before the Master takes the next tap.
19. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
T.P.R. Timeout

60000 ms C

20. Utilizing the arrow pushbuttons, enter the desired Tap Position Response Timeout then press the ENT pushbutton.
21. Press the Down arrow pushbutton once, the "Breaker Option" screen will be displayed.
22. Press the ENT pushbutton. If Level 2 Access is not active or has been previously input, the following will be displayed.
line breaker
000000 C
23. Utilizing the arrow pushbuttons, enter the desired Breaker Options:



Position 1 is the first position from the right.

Position 1 – Line Breaker (A1)

- "0" = Not Selected
- "1" = Selected

Position 2 – Line Breaker Polarity

- "0" = Positive
- ""1" = Negative

Position 3 – Right Tie Breaker (A2)

- "0" = Not Selected
- "1" = Selected

Position 4 – Right Tie Breaker Polarity

- "0" = Positive
- ""1" = Negative

Position 5 – Left Tie Breaker (A3)

- "0" = Not Selected
- "1" = Selected

Position 6 – Left Tie Breaker Polarity


- "0" = Positive
- ""1" = Negative

When all Break er Options have been entered, then press the ENT pushbutton.

24. Press the Down arrow pushbutton once, the "Tap Difference" screen will be displayed.

The Tap Difference setting is the difference between Master and Follower tap positions for which Lockout will be issued.

25. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Tap Difference
2 C
26. Utilizing the arrow pushbuttons, enter the desired Tap Difference setting (2 to 8) then press the ENT pushbutton.
27. Drive the Follower Tap Position to match the Master Tap Position.
28. Repeat the procedure above for each Follower in the Master/Follower scheme.
29. Determine the Master "Band Status" by navigating on the Master HMI menu to the "Monitor/Status" menu item, then proceed as follows:
 - 29.1. Press the Down arrow pushbutton as necessary to navigate to the "Tapchanger Status" screen.
 - 29.2. Press the ENT pushbutton. The control will display a summary of the Tapchanger Status parameters.
TAP BDS PWR BLK VRD
0 lo fwd --- off
BDS = Band Status "lo, hi, ok"
 - 29.3. If the Master Band Status is not In-Band:
 - Adjust the Master tap position by initiating a tapchange as necessary to bring the Master Band Status In-Band.
 - Drive each Follower tap position in the Master/Follower scheme to match the Master tap position.
30. With the Master Band Status In-Band "ok", proceed as follows:
 - 30.1. From the Master Control HMI, navigate to the "Master/Follower" menu.
 - 30.2. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Master/Follower
NONE C
 - 30.3. Utilizing the arrow pushbuttons select "MASTER", then press the ENT pushbutton.



After placing the Master control in "Master" the Master will not respond to any tapchange requests for 32 seconds.

 - 30.4. When at least 32 seconds have elapsed, initiate a Raise or Lower tapchange.
 - 30.5. Verify that all Followers initiate tapchanges to match the Master tap position.
 - 30.6. Place the Master Control in Automatic and verify Automatic operation.

The Master/Follower Paralleling scheme is now in effect.

6.3.3 Optional delta VAR peer to peer paralleling method

The Delta VAr Peer to Peer Paralleling method utilizes the difference in VArS between the VAr contribution of an individual transformer and the average number of VArS (the sum of VArS in the paralleled transformers, divided by the number of transformers paralleled) produced in a parallel configuration. The difference in VArS is then converted to an equivalent bias voltage. This bias voltage is utilized to proportionally increase or decrease the control center band of the control based on the VAr deficiency or excess.

The Delta VAr Peer to Peer Paralleling method employs the GOOSE messaging element of the IEC 61850 protocol to provide peer to peer communications. The paralleling configuration consists of one Initiator (INI) control that holds the highest network address and up to 15 Non-Initiator (NINI) controls on the same network. All of the controls perform their own calculations based on the information being passed between the controls using the peer to peer communications. Once a control has been determined to be the Initiator, it starts (initiates) the parallel calculations in the network (or sub-network) of Non-Initiator controls.

The Delta VAr Peer to Peer settings are available to be changed individually on each control through Setup/Configuration/Paralleling. Also included is the Delta VAr Peer to Peer Paralleling Configuration Tool which contains the editable settings for each individual control in the Delta VAr Peer to Peer paralleling network.

Paralleling

Paralleling TypePeer2Peer DVAr (P2P DVAr)

Paralleling Options

Sensitivity0.0-4.04.0

Circ. Curr. Limit (Reactive)2005200 (mA)

Number of Devices2216

Paralleling Address16116

P2P Update Speed10000100010000 (ms)

MVA Rating1.01.01000.0

P2P Current Multiplier Correction10020500 (%)

TopologySingle Bus

Load Side Breaker52A (Positive Polarity)

Right Tie Breaker52B (Negative Polarity)

Left Tie Breaker52A (Positive Polarity)

Figure 346: Delta VAr Peer to Peer Paralleling Settings (Configuration Dialog Screen)

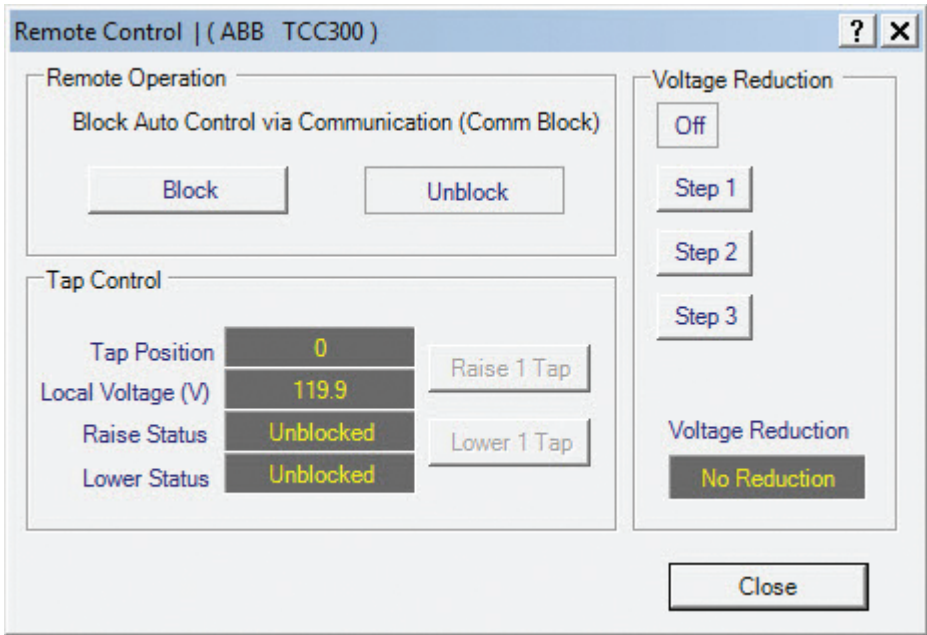


Figure 347: Delta VAr Peer to Peer Paralleling Configuration Tool Dialog Screen

6.3.3.1

Bus topology

Bus configurations are processed to divide the main paralleling group into several sub groups. The algorithm that is used to accomplish this task is called the Grouping Operation Algorithm (GOA).

The basic bus configurations supported are Single Bus, Ring Bus and Double Bus. In addition to obtaining VAr or load Current information through communication, this method has the capability to recognize which transformers are still in parallel in the event of tiebreakers or switches being opened or closed. Depending on the bus configuration, each control monitors 1 Line Breaker and 1 or 2 Tie Breakers.

A means to make commissioning of the paralleling system easier, TCC600 provides a feature to detect all ABB controls that form part of the parallel network. After detection of the controls, depending on the bus configuration selected, the user can view the paralleling network as a whole and also individually configure each control.

Single bus

A Single Bus with eight transformers is shown in [Figure 348](#).

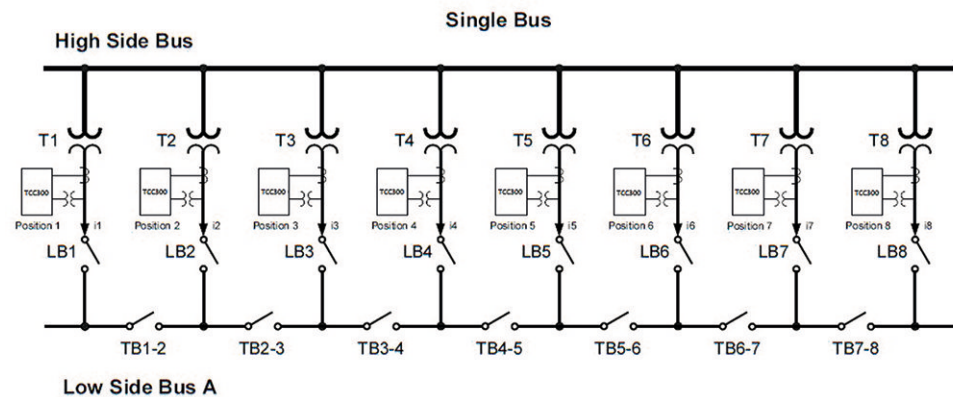


Figure 348: Single Bus Breaker/Control Network Map

LB1 through LB8 are the Line Breakers and TB1-2 through TB7-8 are the Tie Breakers. The user is required to enter the position of each control in the network.

The upstream control will be given Position 8 and consecutively decrement this number as the user moves towards the downstream of this control. It is important to note that the user should activate the Position 8 control last since this control is the Initiator, the one responsible to start any timing signal/messages.

Ring bus

[Figure 349](#) represents a Ring Bus with 8 transformers.

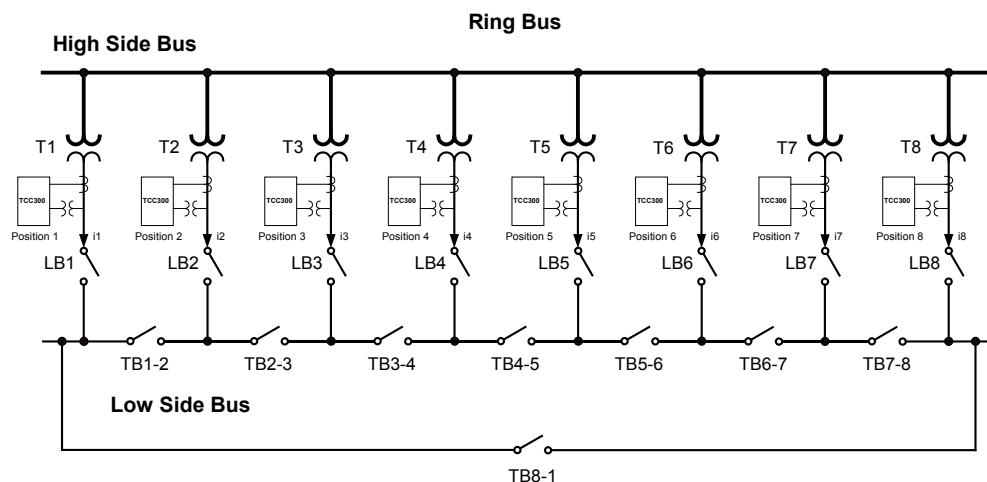


Figure 349: Ring Bus Breaker/Control Network Map

LB1 through LB8 are Line Breakers and TB1-2 through TB8-1 are the Tie Breakers which take the transformer out of paralleling. Transformer 8 is connected to Transformer 1 through the Tie Breaker TB8-1 which makes the single bus a special case of a ring bus.

To isolate a single transformer or create two sub-networks, at least two Tie Breakers must be open. For example, consider [Figure 349](#). When it is time for the control in Position 8 on the ring bus to publish its GOOSE message, the control will determine whether Tie Breakers TB8-1 and TB7-8 are both open. This would create two sub-networks. Transformers 7 & 8 would be one paralleled network, and transformers 1 through 6 would be a separate paralleled network. Each network would operate individually as separate parallel groups.

The Ring Bus application is similar to a Single Bus application except that the last designated control in the ring must evaluate the TB8-1 Tie Breaker and adjust the Delta VAr Peer to Peer Paralleling system accordingly.

Double bus

[Figure 350](#) represents a Double Bus with eight transformers.

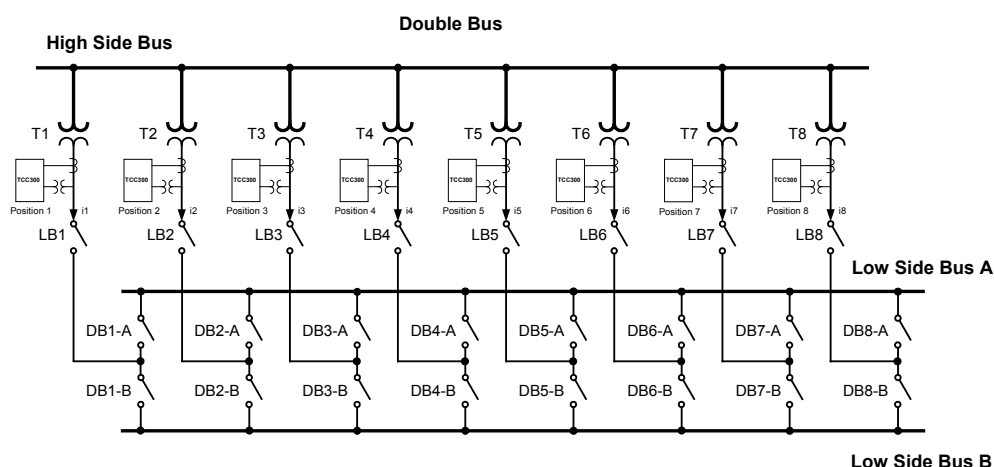


Figure 350: Double Bus Breaker/Control Network Map

LB1 through LB8 are the Line Breakers. DB1-A through DB8-A and DB1-B through DB8-B are Double Bus Breakers, which connect the transformer to either the Low Side Bus A or Low Side Bus B, or both.

There are two Low Side buses which the transformer can drive. The user must enter the position of the control in the network. The downstream control should be given position 1 and consecutively increment this number as the user moves towards the right most control. The Initiator address is incremented based on the Line breaker.

In a Double Bus application, paralleling groups are formed in the following ways:

- If any adjacent Double Breakers DBx-A and DBx-B (on the same node Nx) are both Closed, then every transformer whose DBx-A or DBx-B double breaker is Closed is in parallel with each other. For example, if DB8-A and DB8-B are Closed, then if DB1-A, DB2-B, DB3-B, DB4-A, DB5-B, DB6-B, DB7-A are Closed, then all transformers are paralleled.
- There can be a maximum of two Paralleling Groups, only if none of the adjacent Double Breakers DBx-A and DBx-B (on the same node Nx) are both Closed. For example, if DB1-A, DB2-B, DB3-A, DB4-B, DB5-A, DB6-B, DB7-A, DB8-B then T1,T3,T5,T7 are in one group and T2, T4, T6, T8 are in the other group.

Table 58: Double Bus Truth Table

XFMR Position	DA(x) Double Breaker	DB(x) Double Breaker	LB(x) Line Breaker	Parallel Condition
X	1	0	0	0
	0	1	0	0
	0	0	1	0
	1	0	1	1
	0	1	1	2
	1	1	1	3
	1	1	0	3

- Parallel Condition = 0 The transformer at position "X" is not contributing to any load and not paralleling
- Parallel Condition = 1 The transformer at position "X" is contributing to Low Side Bus A and is in Paralleling Group 1
- Parallel Condition = 2 The transformer at position "X" is contributing to Low Side Bus B and is in Paralleling Group 2
- Parallel Condition = 3 The Low Side Bus A and Low Side Bus B are tied together, therefore all transformers whose Parallel Condition = 1 or 2, are in parallel



If a unit has either Tie Breaker closed, and any other unit has both closed, then the first unit (with one Tie Breaker closed) is still paralleled on both buses.

6.3.3.2

Grouping operation algorithm (GOA)

This GOA determines the action that is taken by the control when it detects any Open Tie Breakers in the network.

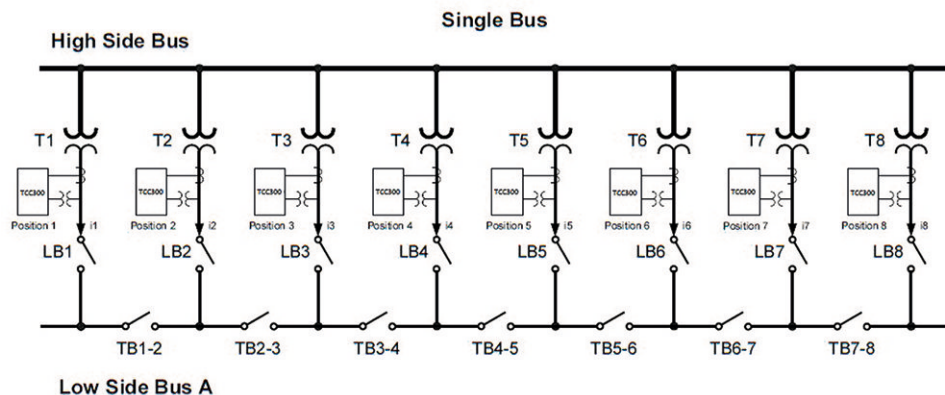


Figure 351: Single Bus Breaker/Control Network Map

Each control individually monitors the status of the Tie Breakers (A2, A3 Auxiliary Inputs) connected to its section of the bus, and broadcasts to all the other controls these statuses via a GOOSE message. Each control in turn processes the tie breaker statuses from the other controls to produce a map of the network every 64 ms.

Each control upon detecting a change in any Breaker Status will issue a GOOSE message to update all the other controls in the network with the new information.

The following rules are applied to produce the Control Network Map:

- The Initiator in the initial setup of the network should always be at the highest position in the network map (e.g. Position 8).
- The paralleling address of each control should be the same as the position it is located in the network map (e.g. Position 7 = Address 7).
- All GOOSE messages are sorted according to their corresponding paralleling addresses.
- The control scans all the tie breakers statuses (if any) in the downstream positions to find the downstream boundary.
- The first OPEN status indicates the boundary has been reached. Similarly the control scans all the upstream tie breaker statuses (if any) to find the upstream boundary. Once the boundaries are located the sub network is defined.
- In each sub network the control with the highest paralleling address becomes the Initiator.
- If the control is a Initiator, the control will determine how many Non-Initiators are in its network.
- The Initiator then starts the paralleling calculations in the controls in its network (or sub network).

6.3.3.3

Delta VAr peer to peer paralleling alarm messages

The Delta VAr Peer to Peer Paralleling Alarm Messages that are displayed on the Control's HMI display are also displayed on the TCC600® "Metering & Status" screen

Table 59: *Delta VAr Peer to Peer Paralleling front panel alarms*

Message	Description
Alarm Active P2P Sympathy Lockout	The Sympathy Lockout/Alarm actuates when a control detects that another control in the network has locked out due to a Tie Breaker Status Conflict Lockout or a Delta VAr Limit Lockout. The Sympathy Lockout/Alarm will reset when the control with the Tie Breaker Status Conflict Lockout or Delta VAr Limit Lockout resets the lockout, or if cleared by the user.
Alarm Active P2P INI Comm Lockout	The Initiator Communications Lockout alarm will actuate when an Initiator fails to receive the expected messages for three consecutive Peer to Peer Update Frames. The Initiator will enter lockout and stop sending GOOSE messages which effectively disables the Peer to Peer paralleling scheme. This lockout can only be cleared by the user.
Alarm Active P2P React I Limit LO	The Reactive Current Limit Lockout alarm actuates when the calculated Reactive Current value is greater than the configured Reactive Current limit. This lockout/alarm can only be cleared by the user.
Alarm Active P2P NINI Detect Lockout	Non - Initiator Detection Lockout – When the control powers up in Initiator Mode, the control will wait for approximately 65 seconds to allow all the GOOSE messages from all the Non-Initiators in the network to reach the Initiator. Once all GOOSE messages have been received, the Initiator will start its normal algorithm and the algorithm of the other controls in its network. If within that initial 65 second period the Initiator does not receive all the GOOSE messages it expected, it will enter the Initiator Lockout state. This lockout/ alarm can only be cleared by the user.
Alarm Active P2P Brk Status Confl LO	The Breaker Status Conflict Lockout alarm activates when a control detects that its status for a tie breaker, shared with another control, disagrees with that unit's status for the same tie breaker. The Breaker Status Conflict Lockout alarm is only applicable in the "Single" and "Ring Bus" topology.
Alarm Active P2P Msg Rsp Time Lockout	The Message Response Time Lockout alarm will actuate when a Non-Initiator has not received all the expected GOOSE messages within the specified time period for three consecutive update periods.

6.3.3.4**Lockouts**

The Delta VAr Peer to Peer Paralleling Mode includes the following lockouts:

- Initiator Lockout
- Non-Initiator Lockout
- Shared Lockout

Any lockout of the paralleling mode will initiate a Lockout alarm. When a lockout is active, the unit issuing the lockout will stop any further GOOSE publishing and will stop load voltage regulation. Also, the alarm can be configured as a DNP event, or as a report in the case of IEC 61850. The lockout alarm will be displayed on the control front panel HMI display and in the TCC600 Metering & Status screen.

Initiator lockout

There are two Initiator Lockouts:

1. Non-Initiator Detection Lockout – When the control powers up in Initiator Mode, the control will wait for approximately 65 seconds to allow all the GOOSE messages from all the Non-Initiators in the network to reach the Initiator. Once all GOOSE messages have been received, the Initiator will start its normal algorithm. If within that initial 65 second period the Initiator does not receive all the GOOSE messages it expected, it will enter the Initiator Lockout state. This lockout can only be cleared by the user.
2. Communication Loss Lockout – The Initiator will enter lockout and stop sending GOOSE messages if it fails to receive any expected messages for three consecutive Peer to Peer Update Frames. This effectively disables the Peer to Peer paralleling scheme. This lockout can only be cleared by the user.

Non-initiator lockout

There are two Non-Initiator Lockouts:

1. Initiator Communication Loss Lockout – When the Non-Initiator does not receive a valid Initiator GOOSE message within the Peer to Peer Update Frame, it will enter the Non-Initiator lockout state. This lockout can only be cleared by the user.
2. Communication Loss Lockout – A Non-Initiator will enter lockout state and stop sending its GOOSE messages if it fails to receive any expected messages for three consecutive Peer to Peer Update Frames. This condition will eventually cause the Initiator to disable the Peer to Peer paralleling scheme.

Shared lockouts

There are three lockouts that are shared between Initiator and Non-Initiator controls:

1. Tie Breaker Status Conflict Lockout – The Tie Breaker Status Conflict Lockout activates when a control detects that its status for a tie breaker, shared with another

- control, disagrees with that unit's status for the same tie breaker. The Tie Breaker Status Conflict Lockout is only applicable in the "Single" and "Ring Bus" topology. Any control receiving a GOOSE message indicating that a unit is in a Tie Breaker Status Conflict Lockout will immediately enter lockout state. This lockout can only be cleared by the user.
2. Delta VAr Limit Lockout – The Delta VAr Limit Lockout actuates when the calculated Delta VAr value is greater than the configured Delta VAr limit. This lockout can only be cleared by the user.
 3. Sympathy Lockout – The Sympathy Lockout actuates when a control detects that another control in the network has locked out due to a Tie Breaker Status Conflict Lockout or a Delta VAr Limit Lockout. The Sympathy Lockout will reset when the control with the Tie Breaker Status Conflict Lockout or Delta VAr Limit Lockout resets the lockout, or if cleared by the user. If the Sympathy Lockout was cleared by the user, the control will re-enter the lockout state if any GOOSE messages indicate that either the Tie Breaker Status Conflict Lockout or Delta VAr Limit Lockout state still exists.

6.3.3.5 Delta VAr peer to peer paralleling configuration tool

TCC600® includes a Delta VAr Peer to Peer Paralleling Configuration Tool located in the Utility menu to help configure the controls for the Delta VAr Peer to Peer Paralleling scheme.

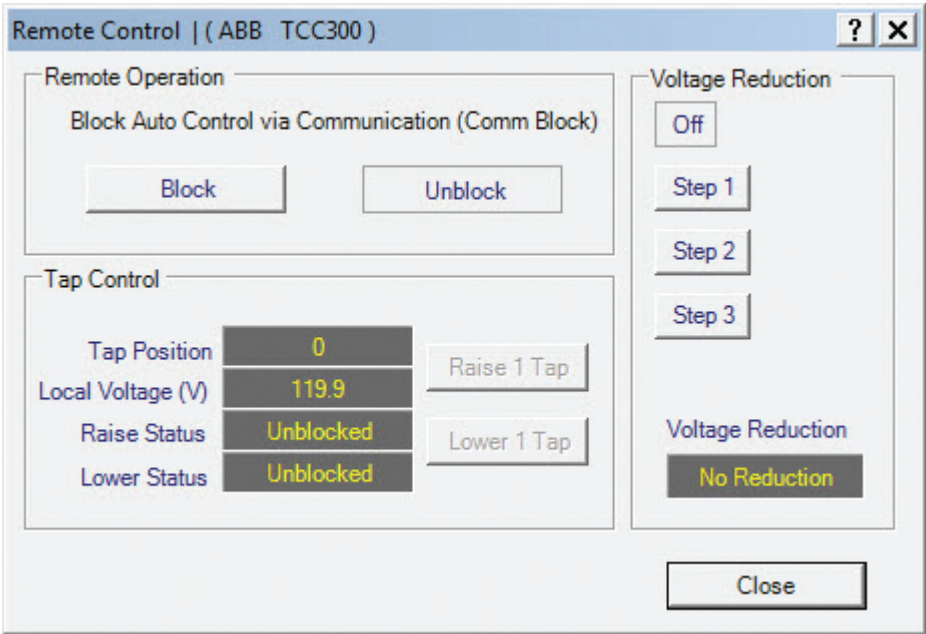


Figure 352: Delta VAr Peer to Peer Paralleling Configuration Tool Dialog Screen

The tool allows the user to discover on a Local Area Network (LAN) all the ABB TCC300 controls that have the Delta VAr Peer to Peer feature. Note that the Delta VAr Peer to Peer Paralleling scheme can only be implemented on controls that are on the same network. In addition, if a multiple network adapter exists on the host computer the configuration tool will allow the user to select which network card the tool is to perform the discover of all TCC300 controls.

Failure to choose the correct network card may result in the tool not discovering all the available TCC300 controls. Accessing the Delta VAr Peer to Peer Paralleling Configuration Tool dialog screen requires a Level 2 Access code.

Discovered paralleled devices

Each discovered control and its data is displayed on the Delta VAr Peer to Peer Configuration Tool dialog screen. The data is organized into control identifiers, read only statuses, and configurable (writable) settings. The control read only statuses are indicated by the color "gray", and configurable settings are identified by Bold Type. NA indicates the data is not applicable.

The Control Identifiers are:

- SN – Serial Number of the device
- IP Address – IP address of the device
- User Line – User Logo on the device

The Read Only Statuses are:

- Paralleling Status – Indicates whether the device is a DVAr (1) Initiator or DVAr (2) Non-Initiator, or None and whether the unit is in a Lockout condition.
- Tap Pos – Tap position of the device (if available)
- DVAr Current
- A1 – Line Breaker status of the device
- A2 – Right Tie Breaker status of the device
- A3 – Left Tie Breaker status of the device



A1, A2, and A3 are references to the TCC300 Auxiliary Inputs.

The Configuration Tool allows the user to enter the following settings:

- Topology – Single Bus, Ring Bus or Double Bus topologies may be entered.
- Number of Devices – The number of total devices that are in the paralleling scheme (maximum 16 inclusive of the Initiator)
- Paralleling Address – The unique address for each device (Range 1 – 16)

- Sensitivity – Allows the user to scale the control's reaction to changes in Reactive Circulating Current (Irc). The following data demonstrates the linear relationship between the Sensitivity setting and the % Multiplier (Range -4.0 to +4.0).
 - $-4.0 = I_{rc} \cdot 50 \%$
 - $-2.0 = I_{rc} \cdot 75 \%$
 - $0.0 = I_{rc} \cdot 100 \%$
 - $+2.0 = I_{rc} \cdot 150 \%$
 - $+4.0 = I_{rc} \cdot 200 \%$
- Reactive Circulating Current Limit – The Reactive Circulating Current Limit is the maximum Delta VAR value allowed for bandcenter adjustment. Range and units are dependent on the Aux Current Transformer units display setting in TCC300.

Table 60: *Reactive Circulating Current Limit values*

CT Display	Range	Units
200 mA	5...200	mA
1 A ¹⁾	0.02...1.00	A
5 A ¹⁾	0.1...5.0	A

1) Calculated from the actual 200 mA connected current

- MVA Rating – The MVA rating of the transformer (Range 1.0 to 1000.0).
- Current Multiplier – The overall ratio of CT supplying the load current to the control, including the main CT and any auxiliary CTs. For example, if the main CT is 600 to 5 A with auxiliary CT of 5 to 0.2 A, then current multiplier is $600/0.2 = 3,000$. (Range 1 to 32600).
- Peer to Peer Update Speed – The time period allocated to read all the paralleled units' relevant data, make the necessary calculations and disseminate paralleling driven updates to the system (Range 1000 to 10000 ms).
- Peer to Peer Current Multiplier Correction – A scaling factor to compensate Delta Vars Calculation, if the CT value is not in the ratio to the MVA rating (Range 20 to 500 %).
- Load Side Breaker Configuration – Can be set to Not Used, 52a (positive polarity), or 52b (negative polarity).
- Right Tie Breaker Configuration – Can be set to Not Used, 52a (positive polarity), or 52b (negative polarity).
- Left Tie Breaker Configuration – Can be set to Not Used, 52a (positive polarity), or 52b (negative polarity).
- Polling Interval – The Polling Interval of the Configuration Tool can be set from 3 to 10 seconds. When Enabled, the user must select "Discover Paralleled Devices" to start polling the controls.

The Configuration Tool also provides the means to:

- Save Configurations
- Reset Alarms

6.3.3.6**Delta VAr peer to peer paralleling application**

A minimum of two controls are required for the Delta VAr Peer to Peer Paralleling scheme to function. The Delta VAr Peer to Peer Paralleling scheme can accommodate up to sixteen controls (including the Initiator Control which has the highest assigned numerical Paralleling Address). The Non-Initiator controls which have a lower Paralleling Address are configured first and then the Initiator control which starts the timing of the messaging.

Control network map determination

The Delta VAr Peer to Peer Paralleling settings for each control must meet the criteria described below based on the Bus Topology. It is recommended that the user create a Control Network Map of the proposed Delta VAr Peer to Peer Paralleling scheme similar to those presented in [Figure 348](#), [Figure 349](#) and [Figure 350](#):

The following criteria must be incorporated in the user's Control Network Map to properly implement the Delta VAr Peer to Peer Paralleling scheme:

- The Bus Topology must be identifiable as either Single Bus, Ring Bus or Double Bus.
- The Initiator in the initial setup of the network must always be at the highest position in the Control Network Map. For example, Position 8, [Figure 348](#).
- The Paralleling Address of each control must be the same as the position that it is located at in the Control Network Map. For example, Position 7 = Address 7.

6.3.3.7**Setting up Delta VAr Peer to Peer Paralleling Control from TCC600**

This procedure requires communication to be established with the target control (Initiator or Non-Initiator) with Level 2 Access.



Until the Initiator control is added to the Delta VAr Peer to Peer Paralleling scheme the Non-Initiator controls will not respond to system changes.

1. Determine the number of controls in the Delta VAr Peer to Peer Paralleling scheme from the Control Network Map.
2. For the first Non-Initiator control to be setup, verify that all the appropriate Setup Settings other than the "Paralleling Type" setting have been entered for the control application.
3. From the Paralleling Type section of the TCC600® Configuration dialog screen select "Peer2Peer DVar".

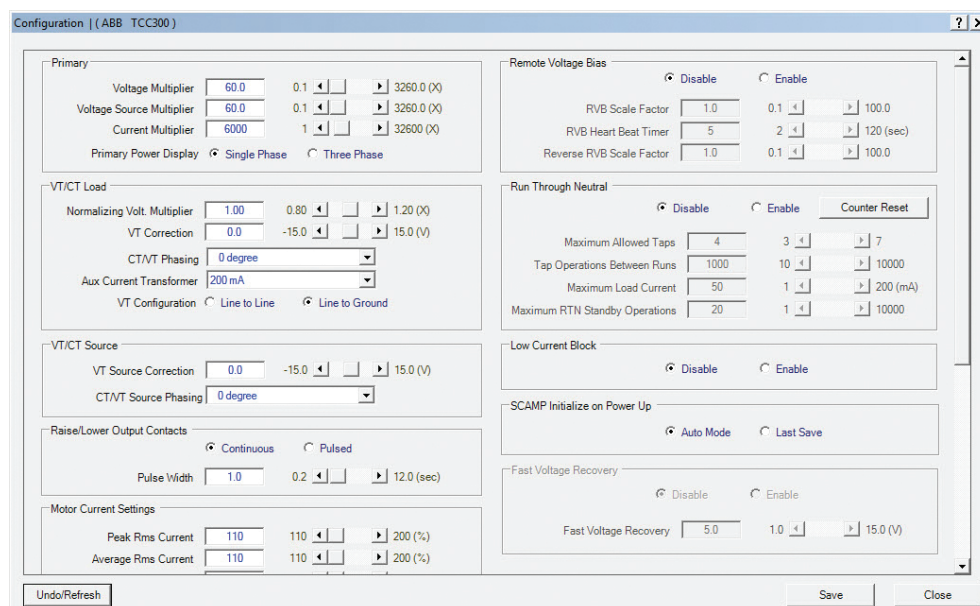


Figure 353: Configuration Dialog Screen

4. From the Paralleling Options section of the Configuration dialog screen, enter the following settings consistent with the control's position in the Control Network Map:
 - Number of Devices – Total number of controls in the Delta VAr Peer to Peer Paralleling scheme determined in Step 1, (2 to 16).
 - Sensitivity (-4.0 to +4.0)
 - Reactive Circulating Current Limit

Range and units are dependent on the Aux Current Transformer units display setting in TCC300.

Table 61: Reactive Circulating Current Limit values

CT Display	Range	Units
200 mA	5...200	mA
1 A ¹⁾	0.02...1.00	A
5 A ¹⁾	0.1...5.0	A

1) These are calculated from the actual 200 mA connected current.

- Paralleling Address (Control Network Map position, 1 to X)
- Peer to Peer Update Speed (1000 to 10000 ms)
- MVA Rating (1.0 to 1000.0)
- Peer to Peer Current Multiplier Correction (20 to 500 %)

- Topology (Single Bus, Ring Bus or Double Bus)
 - Load Side Breaker Configuration (Not Used, 52A Positive Polarity, or 52B Negative Polarity)
 - Right Tie Breaker Configuration (Not Used, 52A Positive Polarity, or 52B Negative Polarity)
 - Left Tie Breaker Configuration (Not Used, 52A Positive Polarity, or 52B Negative Polarity)
5. Repeat Steps 2 through 4 for the remaining Non-Initiator controls.



After placing the Initiator control in the Delta VAr Peer to Peer Paralleling scheme the controls will not respond to any tapchange requests for 30 seconds.

6. Repeat Steps 2 through 4 for the Initiator control.
7. The Delta VAr Peer to Peer Paralleling scheme is now in effect. The proper operation of the Delta VAr Peer to Peer Paralleling scheme should be verified by performing the Delta VAr Peer to Peer Paralleling Test Procedure.

6.3.3.8

Setting up Delta VAr Peer to Peer Paralleling Control from the HMI



This procedure requires Level 2 Access.

1. Determine the number of controls in the Delta VAr Peer to Peer Paralleling scheme from the Control Network Map determined earlier in this section.
2. For the first Non-Initiator control to be setup, verify that all the appropriate Setup Settings other than the "Paralleling Type" setting have been entered for the control application.
3. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
4. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
5. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Paralleling" menu.
6. Press the Down arrow pushbutton, as necessary, until the "Paralleling Type" screen is displayed.
7. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Paralleling Type
DISABLE C

8. Utilizing the arrow pushbuttons, select the Paralleling Type to be "PEER2PEER DELTAVAR", then press the ENT pushbutton.
9. Press the Down arrow pushbutton as necessary, to navigate to the "P2P DVar Sensitivity" menu.
10. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
P2P DVar Sensitivity
0.0 C
11. Utilizing the arrow pushbuttons, enter the desired P2P DVar Sensitivity (-4.0 to +4.0), then press the ENT pushbutton.
12. Follow the procedure above to enter the desired:
 - DVAR2 Reac I Lmt
 - Bus Topology
 - Paralleling Address ^[1]
 - Number of Devices
 - P2P Update Speed
 - Load Side Breaker Configuration
 - Right Tie Breaker Configuration
 - Left Tie Breaker Configuration
 - MVA Rating
 - Current Multiplier Correction

The control's position in the paralleling network is determined by its paralleling address. As shown in [Figure 348](#), Position 1 should be assigned a paralleling address of 1, Position 2 a paralleling address of 2 and so on, in an ascending order. In this example the Master control will be in Position 8 with a Paralleling Address of 8.

13. Repeat the Configuration Steps for the remaining controls. The control with the highest address (the Initiator) must be setup last.



After placing the Initiator control in the Delta VAr Peer to Peer Paralleling scheme the controls will not respond to any tapchange requests for 30 seconds.

14. The Delta VAr Peer to Peer Paralleling scheme is now in effect.
The proper operation of the Delta VAr Peer to Peer Paralleling scheme should be verified by performing the Delta VAr Peer to Peer Paralleling Test Procedure.

[1] The Initiator Paralleling Address must be the highest address in the network. All Non-Initiator addresses must be a value less than the Initiator.

6.4 Tap settings

6.4.1 Tap information

The TCC300 Digital Tapchanger Control tap position information applies to many different configurations of tapchangers, for example, ± 16 taps, 1...17 taps, ± 10 taps, 1...33 taps, and so on. Two configuration points, Lowest Tap and Highest Tap, are assigned to allow the user to select the range of a specific tap changer. The Highest Tap range is 0...33 taps, and the Lowest Tap range is $-33...+29$ taps. The user is able to program the control to select the method of tap position knowledge or to disable this feature.

Table 62: Tap Information Screen Selections

Screen resolutions	Tap position knowledge method	Current range	Screens disabled
XFMR EXTERNAL #3	Current Loop	0...1 mA	Primary & Secondary Source Voltage
XFMR EXTERNAL #2	Current Loop	4...20 mA	Primary & Secondary Source Voltage
XFMR EXTERNAL #1	Current Loop	0...1; 0...2; or ± 1 mA	Primary & Secondary Source Voltage
REG EXTERNAL #3	Resistor Divider	N/A	None
REG EXTERNAL #2	Current Loop	4...20 mA	None
REG EXTERNAL #1	Current Loop	0...1; 0...2; or ± 1 mA	None
INTERNAL KEEPTACK	Motor Direct Drive KeepTrack	N/A	None
CONTACT KT 1R1L	Direct Contact KeepTrack	N/A	Primary & Secondary Source Voltage
CONTACT KT 1N	Direct Contact KeepTrack	N/A	Primary & Secondary Source Voltage
DISABLE	None	None	Primary & Secondary Source Voltage, Tap Position

6.4.1.1 Load tapchanger (LTC) positive tap position knowledge

With the advent of Smart Grid initiatives, Utility SCADA systems require positive tap position information for Real Time Power Flow Calculations that are required for proper implementation of their Integrated Volt VAr Management (IVVM) programs. This section reviews several different methods that can be used to provide positive tap position knowledge in LTC transformer applications. The following positive tap position knowledge methods will be reviewed that can be applied in new and retrofit applications depending on installed equipment.

- Contact KeepTrack™
- Shaft Coupled KeepTrack™
- Resistor Divider KeepTrack™
- Motor Direct Drive KeepTrack™

6.4.1.2

Contact KeepTrack™

TCC300 Tapchanger Control Firmware Version D-0214V01.06.04 and above include the 1R/1L and 1N Contact KeepTrack methods. No cost firmware upgrades are available for TCC300 Tapchanger Controls with earlier firmware versions.

There are two basic methods of Contact KeepTrack. The applicable method used depends on whether a neutral contact is available that will always stay closed while the LTC is on neutral, including multiple neutrals. Both methods require that up to four contacts be available and accessible in the LTC to operate correctly.

The original TCC300 Voltage Reduction inputs are now used for the Aux Raise and Aux Lower Inputs required by the Contact KeepTrack methods. Thus, the voltage reduction function via physical contacts will not be available when Contact KeepTrack is selected, but voltage reduction via communications is not affected.

The Raise and Lower Outputs from the control must agree with the operation of the external Aux Raise and Aux Lower status contacts, and this must be maintained whether the tapchanger is on the low or the high side of the transformer.

The Neutral input on the TCC300 is used for Tap Calibration in the Contact KeepTrack method.

Contact KeepTrack Method I – Using 1R/1L Contact Input

If the neutral contact can't be used, the following four Cam switch based dry contacts are required.

- Aux Raise contact – This contact must close and open once between taps each time the LTC takes a tap in only the Raise direction.
- Aux Lower contact – This contact must close and open once between taps each time the LTC takes a tap in only the Lower direction.
- 1R contact – This contact must close when the tapchanger moves onto the 1 Raise tap position and open when leaving it.
- 1L Contact – This contact must close when the tapchanger moves onto the 1 Lower tap position and open when leaving it.

All four contacts must be either dry contacts or run through auxiliary relay contacts if wet. The TCC300 control Voltage Reduction, Neutral, and Counter inputs require dry inputs wetted internally with 12 Vdc.

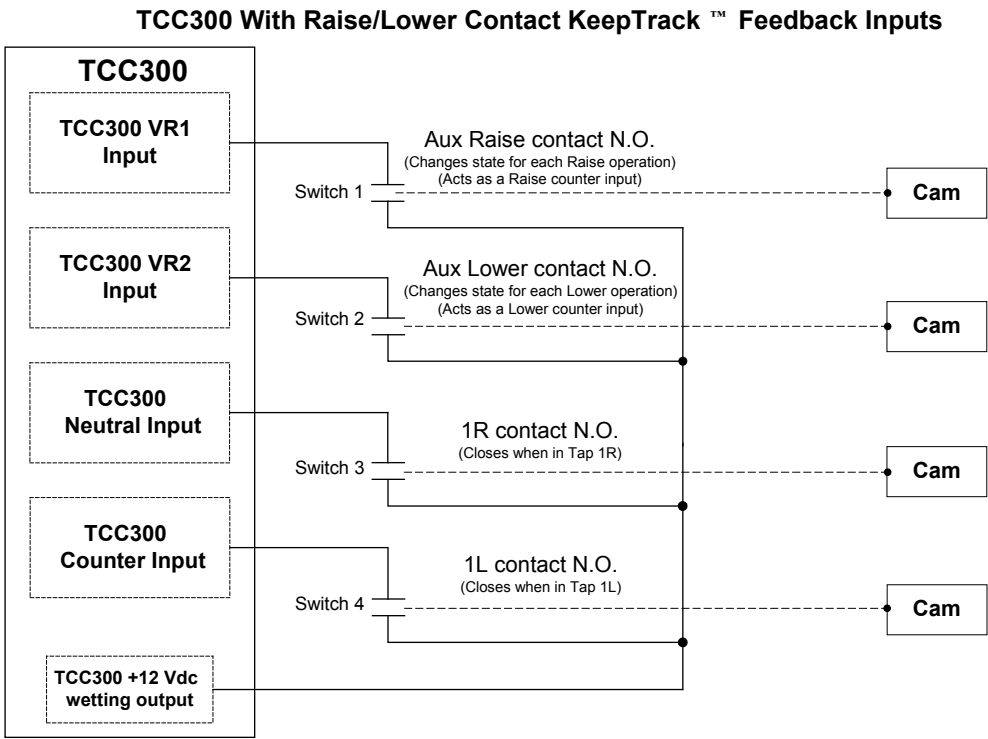


Figure 354: Cam Switches Available With Dry Contacts

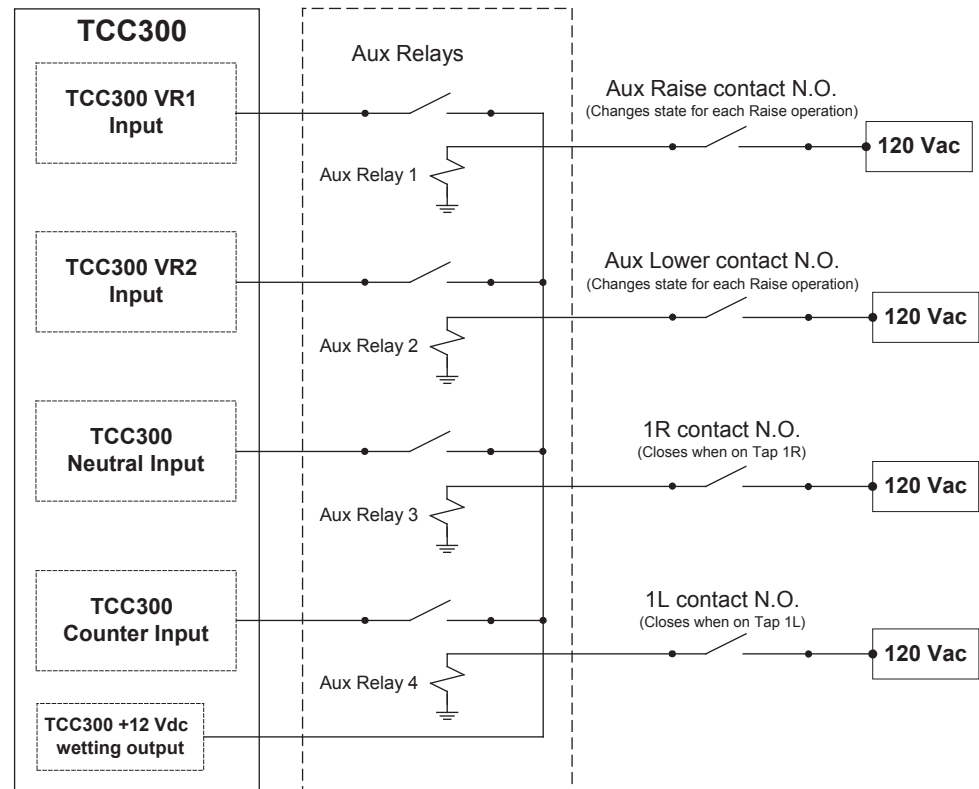


Figure 355: Cam Switches Available With Wetted 120 Vac

Example of Contact KeepTrack Method I – Using 1R/1L Contact Input

In this example, an out-of-band condition occurs which causes the raise output from the TCC300 to turn on. This will cause current to flow to the motor causing it to start a raise operation. The Aux Raise contact will close which will send directional feedback to the VR1 Input of the TCC300. This will tell the control to increment the Contact KeepTrack tap position by 1 tap.

Once the raise operation is completed, the Aux Raise contact will open removing the input to VR1. When the unit no longer requires a raise output the raise output from the control will be turned off. If a lower operation is required then the same steps will occur except that Aux Lower contact will close and VR2 will be used.

Activation of the 1R contact in conjunction with the Aux Raise contact closing, then opening will cause the Contact KeepTrack tap position to be set to 1R. If the next operation results in the 1R contact opening in conjunction with the Aux Lower contact closing then opening, then Contact KeepTrack will increment to Neutral. Once in Neutral, the control will continue to display Neutral until either the 1R or 1L contact operates in conjunction

with the appropriate Aux Raise or Lower contact. That allows the control to compensate for multiple neutrals.

Contact KeepTrack Method II – Using Neutral Contact Input

This method provides Contact KeepTrack for LTC transformers that have dedicated Raise, Lower, and a Neutral contact that stays closed while the LTC is on neutral, including multiple neutrals. A Counter contact may also be required.

This Contact KeepTrack method requires a pulsed input for each tap operation either raise or lower. The raise contact input to the TCC300 must close and open each time the tap position raises by one tap as is the case when the contacts are derived from Cam switches. Likewise the lower contact input to the TCC300 must close and open each time the tap position lowers by one tap.

If the contacts are derived from 84R and 84L relays, an additional contact derived from the operations counter must be placed in series with them to provide the required pulsed input. With these inputs the TCC300 Control can "keep track" of the tap position since it will always receive either a raise or lower pulse as an indication of which direction the tapchanger is moving.

The neutral contact input recalibrates the control tap position to neutral if needed. This provides an extremely positive indication that the tapchanger is performing either a raise or lower operation.

To implement the Contact KeepTrack™ Method II scheme with contacts derived from Cam switches, the Contact KeepTrack method requires that three contacts be available and accessible in the LTC to operate correctly.

- Aux Raise contact – This contact closes when the LTC takes a tap in the Raise direction.
- Aux Lower contact – This contact closes when the LTC takes a tap in the Lower direction.
- Neutral contact – This contact must close when the unit moves onto the Neutral tap position and open when leaving it.

All three contacts must be either dry contacts or run through auxiliary relay contacts if wet. The TCC300 Voltage Reduction inputs, now used for the Aux Raise and Aux Lower contact inputs, and the Neutral input require dry contacts wetted internally with 12 Vdc.

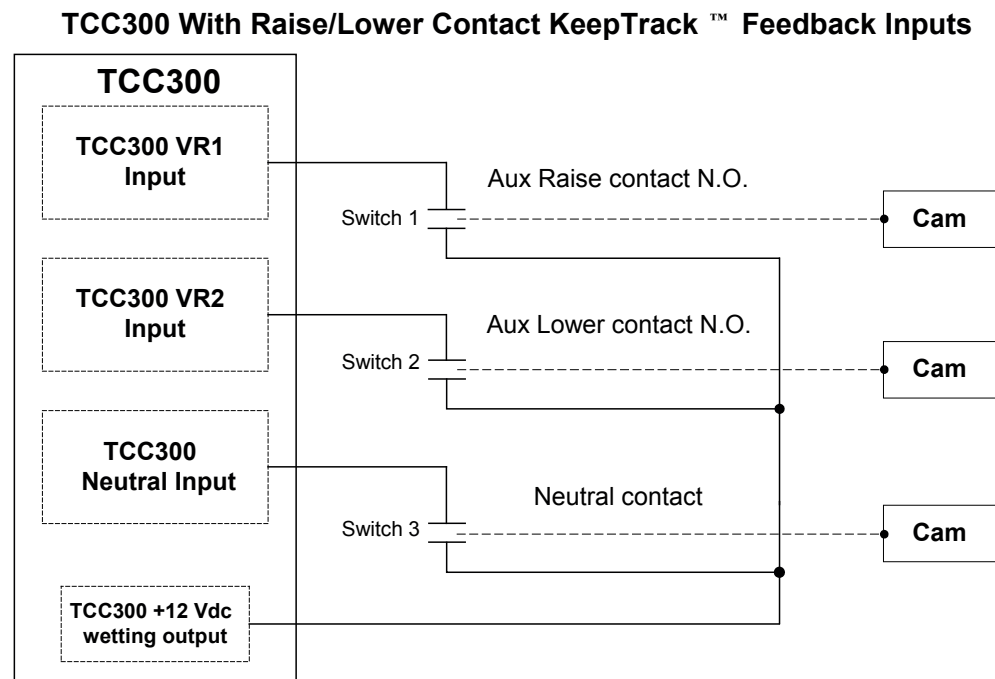


Figure 356: Cam Switches Available

To implement the Contact KeepTrack Method II scheme with 84R and 84L derived contacts, the KeepTrack method requires that four contacts be available and accessible in the LTC to operate correctly.

- Aux Raise contact – This contact closes when the LTC takes a tap in the Raise direction.
- Aux Lower contact – This contact closes when the LTC takes a tap in the Lower direction.
- Counter contact – This contact is only required when using Aux Relays and must close and open when the unit moves in either the Raise or Lower tap position.
- Neutral contact – This contact must close when the unit moves onto the Neutral tap position and open when leaving it.

Auxiliary relays must be connected to the 84R and 84L contacts to provide dry contacts for the Aux Raise and Aux Lower inputs. The Neutral and Counter contacts must be either dry contacts or run through auxiliary relay contacts if wet. The Aux Raise and Aux Lower contacts are connected in series with a dry Operations Counter contact. They are then wetted with the TCC300's internal 12 Vdc wetting voltage thereby providing the required pulsed signals to properly increment tap position.

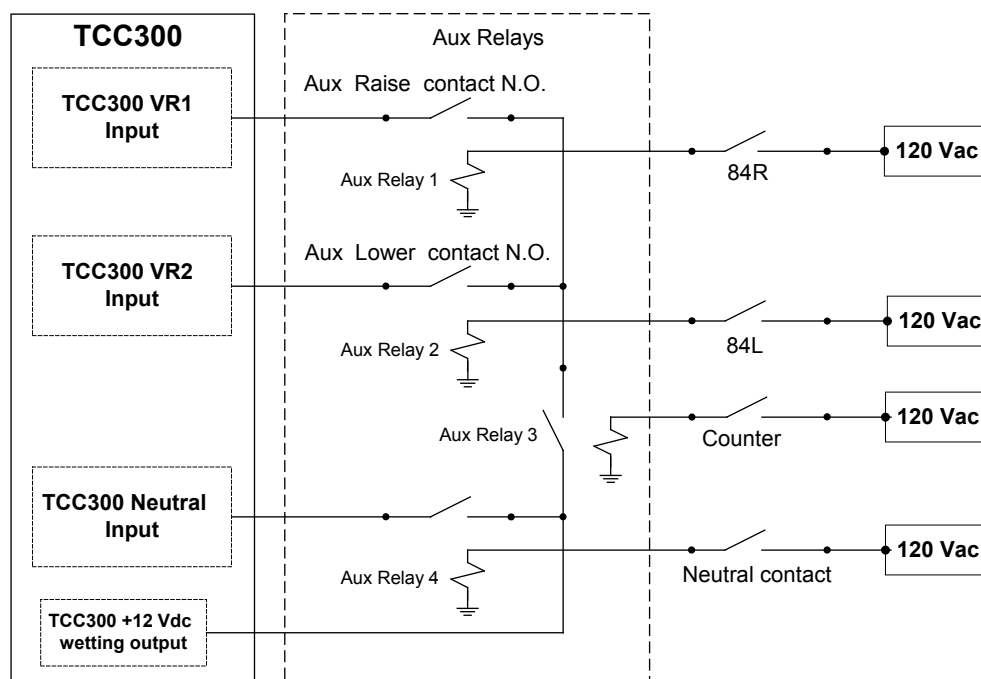


Figure 357: 84R and 84L Aux Relays Available With Wetted 120 Vac

Example of Contact KeepTrack Method II – Using Neutral Contact Input (with 84R/84L derived contacts)

In this example, an out-of-band condition occurs which causes the raise output from the TCC300 to turn on or a manual operation is initiated. This will cause current to flow to the motor and it will start a raise operation. The Aux Raise contact will close and then the counter contact will close once the tap change is in process. When both of these contacts close they will send directional feedback to the VR1 Input of the TCC300. This will tell the control to increment the KeepTrack tap position by 1 tap.

If more than one tap raise is needed, the raise contact will stay closed and the Counter contact is used to open the Aux Raise contact circuit removing the input to VR1 resulting in the correct tap position being kept. When the unit no longer requires a raise output, the raise output from the control will be turned off. If a lower operation is required, then the same steps will occur except that Aux Lower contact will close and VR2 will be used.

As a verification scheme, a contact that closes when the tapchanger is on the neutral position is also used as an input to the TCC300 control. When this Cam operated contact closes, the control recalibrates the tap position to neutral if needed. As an example, if the tap position is on 1R and a lower command is issued, the tapchanger moves to the neutral position, and when the neutral contact closes, the control would recalibrate the tap position if it was not already indicating neutral. If there are multiple neutral positions the neutral contact would need to be closed on all the neutral positions.

6.4.1.3

Shaft Coupled KeepTrack™ tap position knowledge

Applicable controls and accessories for both Shaft Coupled KeepTrack Methods include:

- TCC300 Tapchanger Controls
- M-2025B(D) Current Loop Interface
- M-2948 Tap Position Sensor OR INCON 1292 Synchro Transmitter and 1250 Tap Position Monitor

ABB Shaft Coupled KeepTrack Method

If Cam positions are not available and switches can not be retrofitted, a Shaft Coupled KeepTrack method can be used. Most LTC tapchangers have an output shaft on the tapchanger mechanism whose angular position is a mechanical analog of the tapchanger tap position. For these applications, the following methods can be used to provide positive tap position knowledge.

[Figure 358](#) represents a typical application of the ABB Model M-2948 Tap Position Sensor. The tap position sensor is a rotary shaft encoder with a built-in microprocessor that provides stepped output signals in 9 or 10 degree increments. The tap position sensor is available in both clockwise and counter-clockwise rotation configurations for increasing tap position. It has rotations of 0° to 297°, 306°, 315°, 330°, 340° and 350° degrees to accommodate tapchangers with 32 taps, 9 or 10 degrees per tap, and one to three neutral positions.

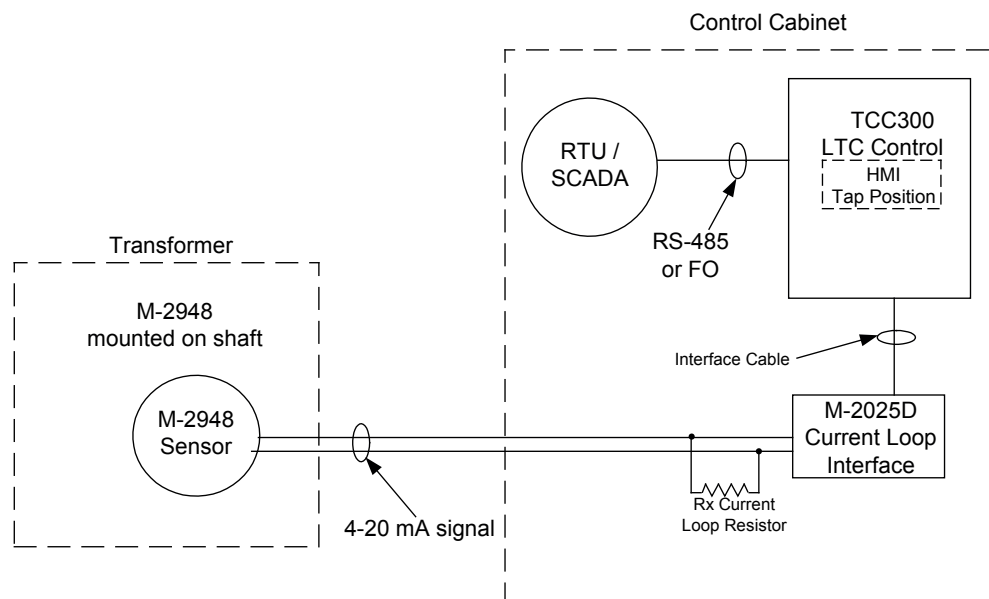


Figure 358: Tap Position Scheme Using Shaft Coupled KeepTrack

Thus, the information needed from an individual transformer is: the number of degrees per tap (always 9 or 10), rotation of the Tap Position Sensor, and the number of neutral tap positions. The sensor requires a +12 Vdc power input that is supplied from the TCC300 control via the M-2025D. The electrical output of the M-2948 Tap Position Sensor is a 4-20 mA current loop that is converted to a voltage signal at the input of the M-2025D Current Loop Interface with the addition of a shunt resistor. The resultant voltage signal is conditioned in the M-2025D Current Loop Interface and routed to the TCC300 Tapchanger Control where the voltage is converted to a corresponding tap position number. The scheme can be used with all TCC300 Tapchanger Controls.

If replacing an INCON Tap Position Monitoring device, the INCON 1292 Synchro Transmitter is removed and the ABB M-2948 Tap Position Sensor mounts in the existing bracket and uses the existing flexible coupling shaft.

ABB-INCON Shaft Coupled KeepTrack Method

If tap position sensors already exist such as the INCON 1292 Synchro Transmitter, the shaft coupled KeepTrack method is still applicable. The INCON 1292 Synchro Transmitter is an electromagnetic device that resembles a small electric motor. Although various configurations of internal windings are used, they typically excite rotor winding(s), and induce AC signal voltages in the stator windings which can be compared in amplitude and polarity to determine the angular position of the rotor shaft.

This application is traditionally used with the INCON 1250 Tap Position Monitoring device. The INCON 1250 supplies the 120 Vac to the INCON 1292 rotor winding(s). It then measures the resulting signals from the stator winding to determine the shaft's rotational position. This information is converted to a tap number and displayed on the front panel numeric readout. An analog current signal is also generated which corresponds to tap position. The M-2025B(D) Current Loop Interface module accepts this current analog. The scheme can be used with all TCC300 Load Tap Changer models.

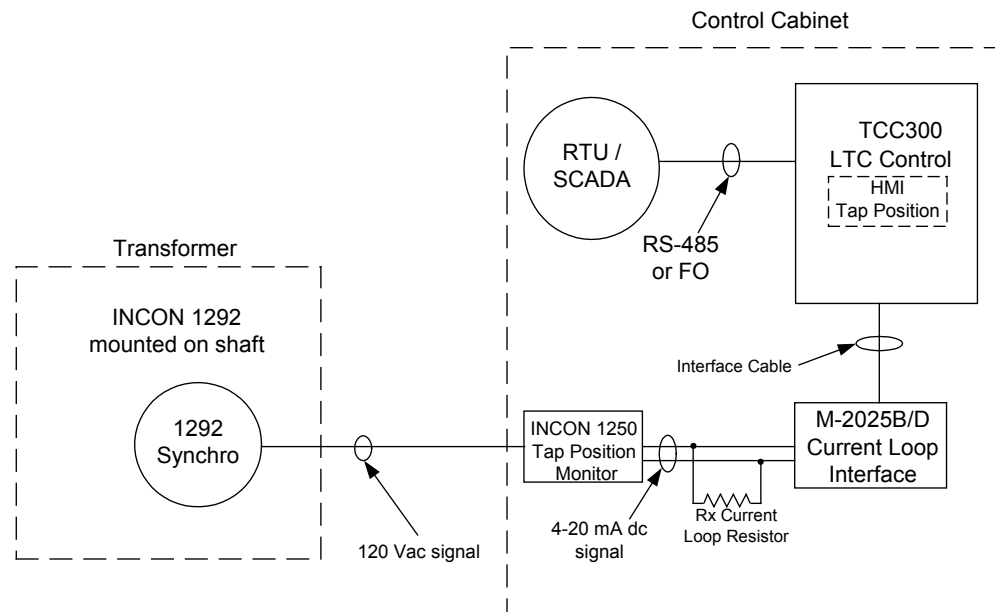


Figure 359: Tap Position Scheme Using INCON Devices

Connection of the optional M-2025B(D) will require either a B-0752 (5 pin to 6 pin) or B-0753 (6 pin to 6 pin) interface cable. See M-2025B(D) Specification for details.

The transformer (XFMR) and regulator (REG) external setting is for use with the Positive Knowledge (current loop) system, except REG #3, which is designed to be used with a Toshiba resistive voltage divider. Selecting either XFMR or REG will determine which screens are disabled, and then selecting either #1, #2, or #3 will depend on the output current or voltage signal from the Tap Position monitor. [Table 54](#) outlines the options available for the Tap Information screen.

The user initializes the control at a given, known, tap position upon installation, by following the steps described later in this section. See "Initializing Tap Position when Regulate (Reg or XFMR) External or Contact KeepTrack™ 1R1L/1N is Active" for detailed steps for entering the tap position using the HMI or TCC600®.



To obtain accurate calibration, it is suggested that the calibration should be performed near the neutral tap for 0 to 1, 0 to 2 and 4 to 20 mA, and at tap position 8 R or 8 L in the case of -1 to +1 mA range.

6.4.1.4

Resistor Divider KeepTrack™ tap position knowledge for LTCs

Applicable controls and accessories for Resistor Divider KeepTrack Method include:

- TCC300 Tapchanger Controls
- ABB M-2025B(D) Current Loop Interface
- Existing installations may use the Crompton Model 253-TRTU transducer or the Rochester Instrument Systems Model PR-2050 transducer (both now obsolete).
- New installations or existing installations with failed transducers use the Carrel Precision Model T-R Series transducer (or equivalent).

The typical application illustrated in [Figure 360](#) uses a resistor string mounted on a separate insulating deck within the tap-changing mechanism. The resistor string is comprised of equal value and wattage resistors. Depending on manufacture and age the resistance varies from 10 to 400 ohms between each tap and can have either the same valued resistors between multiple neutral positions or direct wire connections.

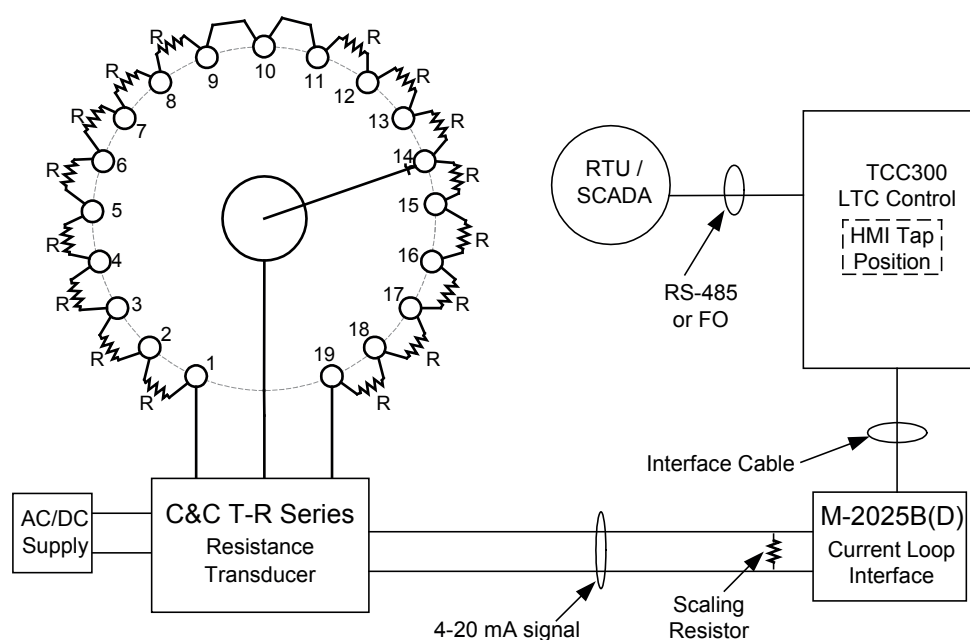


Figure 360: Tap Position Scheme Using Resistor Divider KeepTrack

The application uses a tap position transducer driven from a customer selectable AC or DC voltage source. The transducer provides a low DC voltage of 1 to 10 volts to the resistor string of the tapchanger mechanism. The transducer measures the DC voltage from the wiper on the currently active tap, comparing it to the voltage applied to the string. The transducer then converts that voltage to a current loop value of 0-1 mA or 4-20 mA for transmission of an analog signal. The M-2025B(D) Current Loop Interface module accepts this current analog signal. The scaling to the correct number of taps is achieved by sizing the scaling resistor to obtain a 3.0 V signal at the maximum tap position.

Older installations may use the Crompton Model 253-TRTU transducer or the Rochester Instrument Systems Model PR-2050 transducer, both of which are now obsolete. The

Carrel Precision Model T-R Series transducer (or equivalent) can be used in new installations or to replace failed obsolete transducers. The scheme can be used with all TCC600 Series Load Tap Changer models. This output can then be provided to a M-2025B(D) Current Loop Interface Module and then input to a TCC300 using the XFMR EXT #3 configuration setting.

The regulator (REG #3) setting is designed to be used with a Toshiba resistive voltage divider.

The positive knowledge by voltage divider method (REG External #3) is used on regulators that have +/- 16 taps, a voltage divider tap position sensor, and a separate raise/lower output. The Tap Max and Tap Min can only be set to 16 raise and 16 lower, respectively, while in the REG External #3 tap mode. The voltage divider method is designed to read a tap position sensor that contains 18 resistors in a voltage divider network. Each tap position will give a specific output voltage from the tap position sensor. The voltage from the sensor will only be read into the TCC300 control once one (1) second has elapsed after the counter input has toggled. The tap position sensor will not be read again until another tap change occurs, causing the counter input to toggle once more. Also, an external input to the control will be read to determine if a raise or lower condition exists. The raise/lower input and the voltage from the divider network will be used to determine what position the tap is on.



The tap position calibration must be performed at or above the 4 raise tap, but to obtain the best accuracy, it should be calibrated at or above the 8 raise tap.

6.4.1.5

Motor Direct Drive KeepTrack™

Motor Direct Drive KeepTrack™ tap position knowledge for LTCs

In most Load Tap Changer applications, the TCC300 control does not directly energize the LTC motor. Instead it energizes interposing relays which energize the motor in the raise or lower direction.

Some LTC Transformers however, have been designed such that the control does directly energize the motor similar to a Line or Feeder Voltage Regulator. TCC300 and later ABB controls contain a Motor Direct Drive KeepTrack method for Line and Feeder Regulators which may be applicable to these LTC Transformers.



Reverse Power Operation must NOT be programmed for "Regulate in Reverse" if the "INTERNAL KEEPTRACK" method is used. Incorrect operation will occur.

This can be easily verified on the LTC transformer by setting the Tap Information setting on the TCC300 Control to Motor Direct Drive KeepTrack "INTERNAL KEEPTRACK" in the control and observing the tap position displayed in the control during both automatic and manual tap operation in both the Raise and Lower directions. It is very important that Reverse Power Operation NOT be programmed for "Regulate in Reverse" if this method is used. "Regulate in Reverse" was designed for Line and Feeder Regulators which have fixed impedances. Since LTC Transformer impedances are not predictable, incorrect operation will occur if Reverse Power Operation is set to "Regulate in Reverse".

Motor Direct Drive KeepTrack™ tap position knowledge for regulators



This feature is applicable to single-phase regulators only.



This feature is only applicable for ± 16 tap ranges with neutral tap and neutral indicator. The source voltage will only be applicable with a tap range of ± 16 taps.

This feature allows the control to keep track of the present tap position. The "INTERNAL KEEPTRACK" setting is selected for this method.



Do not rely on the tap position indication on the TCC300 Tapchanger Control display for neutral position when bypassing voltage regulators.

The motor power source for the manual, automatic, or external (SCADA) initiated tap changes must be the same as the motor power input to the control. The operations counter and neutral light circuit should be operational. The counter input and power source is required for detecting tap changes and determining direction of the tap change. Connecting a regulator neutral tap position indicating contact to the control will reset the tap position to neutral each time the tap goes through the neutral position. It is recommended that the indicated tap position be compared to the mechanical tap position indicator at regular intervals, and that the indicated value be corrected, if necessary.

The tap position stored in memory is not affected by a loss of power. The tap position record is checked and corrected to neutral, if necessary, with the closure of a neutral contact (when the neutral tap position contact is connected to the controls).



When the Motor Direct Drive KeepTrack "INTERNAL KEEPTRACK" tap position method is used, it must be calibrated for proper voltage control with reverse power operation.

If desired, the Motor Direct Drive KeepTrack "INTERNAL KEEPTRACK" feature can be disabled in which case the screen will indicate "Disabled".

The user initializes the control at a given, known, tap position upon installation, by selecting "INTERNAL KEEPTRACK" in the Tap Information screen in the Configuration Menu and following the steps described later in this section. See "Initializing Tap Position When Motor Direct Drive KeepTrack 'INTERNAL KEEPTRACK' is Active" for detailed steps for entering the tap position using the HMI or TCC600®.

Or, if the neutral tap position contact is connected to the control, run the regulator to neutral as shown by the tap position indicator on the regulator. The control will recognize the neutral light signal and set the tap position accordingly.

The Motor Direct Drive KeepTrack "INTERNAL KEEPTRACK" procedure recognizes tapchanges commanded via manual, automatic or external (SCADA) contacts. The power source for the manual- or SCADA-initiated tapchanges must be the same as the motor power source used for the automatic tapchangers.

The Motor Direct Drive KeepTrack "INTERNAL KEEPTRACK" position knowledge is based on the detection of a closed switch (manual or automatic), and feedback from the operation counter input.

The method by which Motor Direct Drive KeepTrack "INTERNAL KEEPTRACK" is achieved is as follows:

The control includes two Zero Voltage Detection (ZVD) circuits. These circuits individually monitor the AC voltage across the internal raise and lower triacs. This is done since any external raise or lower contacts or manual switches have to be placed in parallel with the triacs to run the tapchanger motor. When the triacs (or any contact paralleled across the triacs) closes, the voltage measure decreases to almost zero. When a counter input event is received while the raise circuit is activated, the Motor Direct Drive KeepTrack "INTERNAL KEEPTRACK" will increment the tap count by one. When a counter input event is received while the lower circuit is activated, the Motor Direct Drive KeepTrack "INTERNAL KEEPTRACK" will decrement the tap count by one.

If the tapchanger reaches the mechanical tap limits of operation, (± 16), limit switches open up the appropriate circuit so the control cannot force a raise above +16, or force a lower below -16. This is potentially confusing to the ZVD circuits, since they can see zero voltage on the output with a closed triac and also see zero voltage on the other output due to an open limit switch. When this condition is encountered, the control can only make a best guess of which operation really occurs and moves one step in the direction of neutral, which should be away from the side with the open limit switch.

An additional feature is the neutral zero feature. When a regulator passes through the neutral position, a neutral contact closes. This is most often used to drive a neutral light

that is an indicator that the mechanism is in the neutral position, and it is safe to bridge the input and output of the regulator because they are at the same voltage. Upon detection of a neutral circuit closure, Motor Direct Drive KeepTrack "INTERNAL KEEPTRACK" resets the tap position to neutral to resynchronize the circuit.

6.4.1.6

Selecting Tap Position Knowledge from the HMI

To select the Tap Position Knowledge method of tapchange position monitoring, perform the following:



When the Motor Direct Drive KeepTrack™ "INTERNAL KEEPTRACK" tap position method is used, it must be calibrated for proper voltage control with Reverse Power Operation.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.
4. Press the Down arrow as necessary until the "Tap Information" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Tap Information
disable C
6. Utilizing the Up/Down arrow pushbuttons, select the desired "Tap Position Knowledge" method, then press the ENT pushbutton.
7. If "INTERNAL KEEPTRACK" was selected in Step 8, then proceed to "Initializing Tap Position When Motor Direct Drive KeepTrack is Active" in this section.
8. If an External Tap Position or Contact KeepTrack™ 1R1L/1N method was selected in Step 8, then proceed to "Initializing Tap Position when Regulate (Reg or XFMR) External or Contact KeepTrack is Active" in this section.

6.4.1.7

Selecting Tap Position Knowledge from TCC600

1. Select Setup/Tap Settings from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

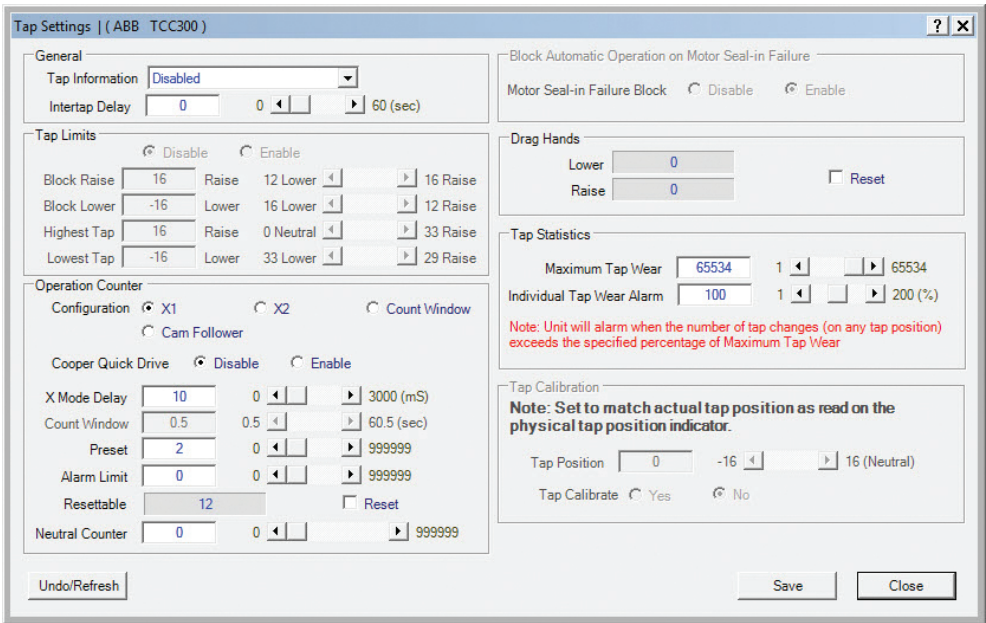


Figure 361: Tap Settings Dialog Screen

2. Select either "Disabled" or the desired Tap Position Knowledge from the "General" section of the dialog screen.
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

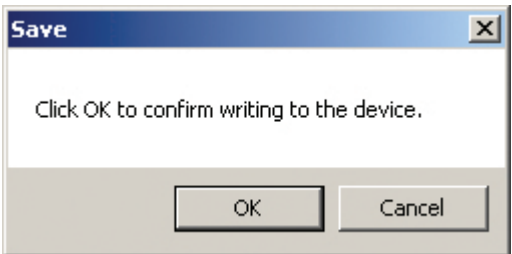


Figure 362: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

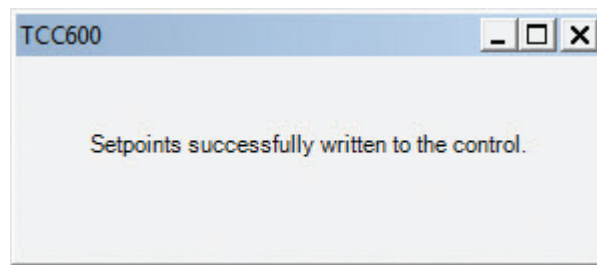


Figure 363: Setpoints Successfully Written To The Control Dialog Screen

5. If "INTERNAL KEEPTRACK" was selected, then proceed to "Initializing Tap Position When Motor Direct Drive KeepTrack™ is Active" in this section.
6. If an External Tap Position or Contact KeepTrack™ 1R1L/1N method was selected in Step 7, then proceed to "Initializing Tap Position when Regulate (Reg or XFMR) External or Contact KeepTrack is Active" in this section.

6.4.1.8

Contact KeepTrack™ 1N – Additional TCC600 settings screen

When Contact KeepTrack 1N is selected as the Tap Information method, an additional Contact KeepTrack 1N Tap Configuration window becomes available. The Contact KeepTrack 1N method of Tap Position knowledge can function with any combination of taps and multiple neutrals, or with the neutral assigned to a non-zero tap.

Figure 364: Contact KeepTrack 1N Neutral Tap Configuration Dialog Screen

This feature will allow the physical neutral input to automatically calibrate the tap position to whatever the Neutral Tap Position setting is set to. The recalibrating "neutral" input can be set for any tap position not just neutral. Also, the Abnormal Tap Position Alarm will function based on this setting instead of 0. For example, if the Neutral Tap position setting is 9R, then an Abnormal Tap Position alarm will occur if the physical neutral input is received with tap position not indicating 8R, 9R, or 10R.

The Neutral Tap Configuration window allows the user to program the following settings:

1. The full tap range of the tapchanger from highest tap to lowest tap (–33...+33)
2. Assign the neutral tap position based on the tapchanger mechanism
3. Assign the number of neutrals based on the tapchanger mechanism
4. Assign a resting tap to communicate tapchanger position when stopped on neutral
5. Assign which neutral taps have an associated closed neutral contact
6. Select Cam Follower as the Operation Counter configuration if desired

6.4.1.9

Initializing Tap Position When Motor Direct Drive KeepTrack "INTERNAL KEEPTTRACK" is Active from the HMI

When the Motor Direct Drive KeepTrack tap position method is used, it must be calibrated for proper voltage control with Reverse Power Operation.

1. Initialize the control at a given, known, tap position upon installation.
2. Enable Internal KeepTrack method of tap knowledge as described in this section.



In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, the Tap Position screen of the TCC300 will display "- - -" instead of "0". When reading the tap position via comms (Modbus and DNP) a value of 32767 will be returned when the tap position is "0", but no neutral input is detected, otherwise a "0" will be returned.

3. Determine and note the actual tap position from the external tap position indicator on the regulator or transformer.
4. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
5. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
6. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.
7. Press the Down arrow pushbutton, as necessary, until the "Tap Position/Cal" screen is displayed.
8. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Tap Position/Cal
0 C
9. Utilizing the Up/Down arrow pushbuttons, enter the tap position noted in Step 3, then press the ENT pushbutton.
10. If a neutral tap position contact is connected to the control, run the regulator to the neutral tap position as indicated on the regulator.
The control will recognize the neutral contact/light signal and set the tap position accordingly.

6.4.1.10

Initializing Tap Position When Motor Direct Drive KeepTrack™ "INTERNAL KEEPTRACK" is Active from TCC600



When the Motor Direct Drive Internal KeepTrack tap position method is used, it must be calibrated for proper voltage control with Reverse Power Operation.

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

Figure 365: Tap Settings Dialog Screen

2. Verify that "INTERNAL KEEPTRACK" is selected in the "General" section of the dialog screen.



In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, the Tap Position screen of the TCC300 will display "- - -" instead of "0". When reading the tap position via comms (Modbus and DNP) a value of 32767 will be returned when the tap position is "0", but no neutral input is detected, otherwise a "0" will be returned.

3. Determine and note the actual tap position from the external tap position indicator on the regulator or transformer.

4. Enter the tap position noted in Step 3, then select "Yes" for Tap Calibrate.
5. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

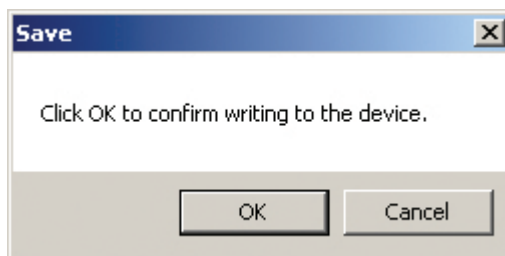


Figure 366: Save to Device Confirmation Screen

6. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

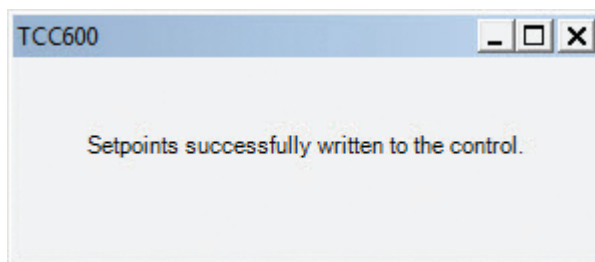


Figure 367: Setpoints Successfully Written To The Control Dialog Screen

7. If a neutral tap position contact is connected to the control, run the regulator to the neutral tap position as indicated on the regulator.
The control will recognize the neutral contact/light signal and set the tap position accordingly.

6.4.1.11

Initializing Tap Position When Regulate (Reg or XFMR) External or Contact KeepTrack™ 1R1L/1N is Active from the HMI



When the Regulate (Reg or XFMR) External tap position method is used, it must be calibrated for proper voltage control with Reverse Power Operation.

1. Initialize the control at a given, known, tap position upon installation.
2. Enable a Regulate External method of tap knowledge as described in this section.



In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, the Tap Position screen of the TCC300 will display "- - -" instead of "0". When reading the tap position via comms (Modbus and DNP) a value of 32767 will be returned when the tap position is "0", but no neutral input is detected, otherwise a "0" will be returned.

3. Determine and note the actual tap position from the external tap position indicator on the regulator or transformer.
4. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
5. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
6. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.
7. Press the Down arrow pushbutton, as necessary, until the "Tap Position/Cal" screen is displayed.
8. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Tap Position/Cal
0 C
9. Utilizing the Up/Down arrow pushbuttons, enter the tap position noted in Step 3, then press the ENT pushbutton.
10. If a neutral tap position contact is connected to the control, run the regulator to the neutral tap position as indicated on the regulator.
The control will recognize the neutral contact/light signal and set the tap position accordingly.

6.4.1.12

Initializing Tap Position When Regulate (Reg or XFMR) External or Contact KeepTrack™ 1R1L/1N is Active from TCC600



When the Regulate (Reg or XFMR) External tap position or Contact KeepTrack method is used, it must be calibrated for proper voltage control with Reverse Power Operation.

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

Tap Settings | (ABB TCC300)

General
 Tap Information: Disabled
 Intertap Delay: 0 0 60 (sec)
 Block Automatic Operation on Motor Seal-in Failure:
 Motor Seal-in Failure Block: ☐ Disable ☒ Enable

Tap Limits
☒ Disable ☐ Enable
 Block Raise: 16 Raise 12 Lower 16 Raise
 Block Lower: -16 Lower 16 Lower 12 Raise
 Highest Tap: 16 Raise 0 Neutral 33 Raise
 Lowest Tap: -16 Lower 33 Lower 29 Raise

Operation Counter
 Configuration: ☒ X1 ☐ X2 ☐ Count Window
☐ Cam Follower
 Cooper Quick Drive: ☒ Disable ☐ Enable
 X Mode Delay: 10 0 3000 (mS)
 Count Window: 0.5 0.5 60.5 (sec)
 Preset: 2 0 999999
 Alarm Limit: 0 0 999999
 Resetttable: 12 ☐ Reset
 Neutral Counter: 0 0 999999

Tap Statistics
 Maximum Tap Wear: 65534 1 65534
 Individual Tap Wear Alarm: 100 1 200 (%)
 Note: Unit will alarm when the number of tap changes (on any tap position) exceeds the specified percentage of Maximum Tap Wear

Tap Calibration
 Note: Set to match actual tap position as read on the physical tap position indicator.
 Tap Position: 0 -16 16 (Neutral)
 Tap Calibrate: ☐ Yes ☒ No

Undo/Refresh Save Close

Figure 368: Tap Settings Dialog Screen

- Verify that a "Regulate (Reg or XFMR) External" mode is selected in the "General" section of the dialog screen.



In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, the Tap Position screen of the TCC300 will display "- - -" instead of "0". When reading the tap position via comms (Modbus and DNP) a value of 32767 will be returned when the tap position is "0", but no neutral input is detected, otherwise a "0" will be returned.

- Determine and note the actual tap position from the external tap position indicator on the regulator or transformer.
- Enter the tap position noted in Step 3, then select "Yes" for Tap Calibrate.
- Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

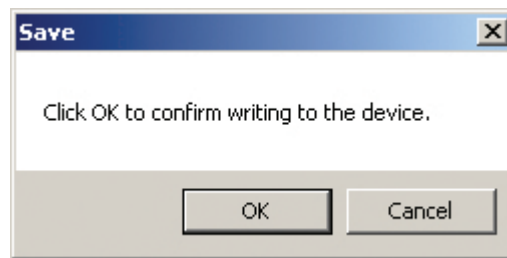


Figure 369: Save to Device Confirmation Screen

6. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

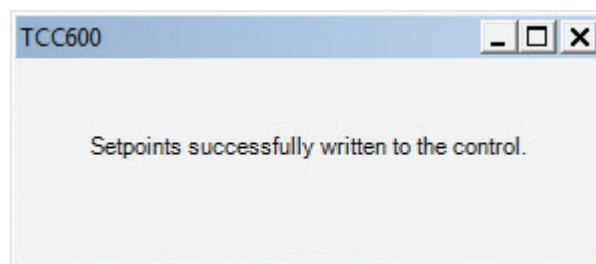


Figure 370: Setpoints Successfully Written To The Control Dialog Screen

7. If a neutral tap position contact is connected to the control, run the regulator to the neutral tap position as indicated on the regulator.
The control will recognize the neutral contact/light signal and set the tap position accordingly.

6.4.1.13

Setting Highest and Lowest Tap from the HMI



This setting is applicable to Reg External #1 and #2, and XFMR External #1, #2 and #3, modes of Tap Information.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.

4. Press the Down arrow as necessary until the "Highest (Lowest) Tap" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Highest (Lowest) Tap
16 C
6. Utilizing the Up/Down arrow pushbuttons, enter the desired Highest (Lowest) Tap value, then press the ENT pushbutton.

6.4.1.14

Setting Highest and Lowest Tap from TCC600

To set the Highest Tap and Lowest Tap setting from TCC600®, perform the following:



This setting is applicable to Reg External #1 and #2, and XFMR External #1, #2 and #3, modes of Tap Information.

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

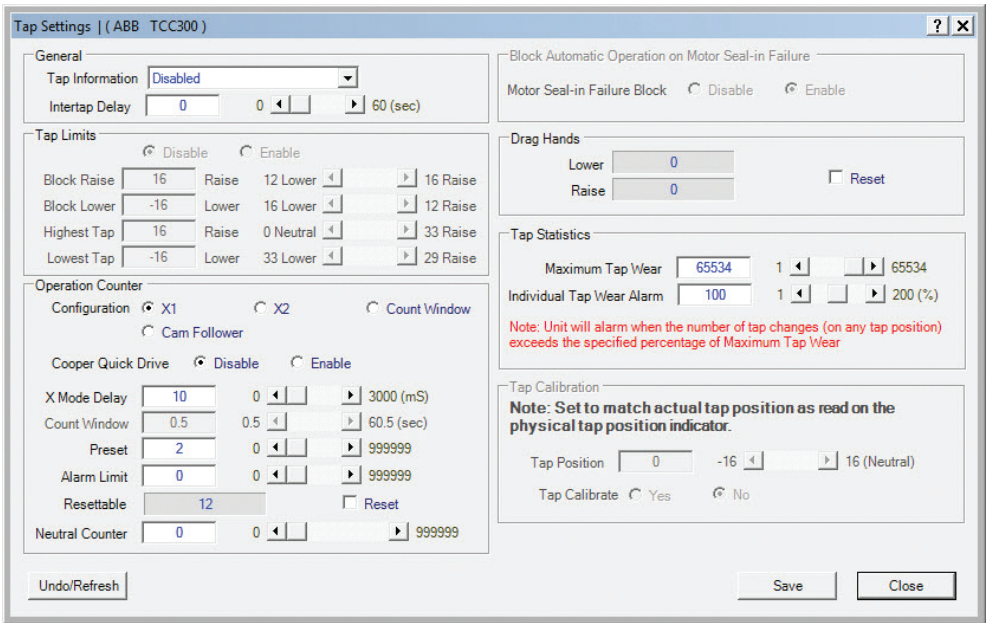


Figure 371: Tap Settings Dialog Screen

2. Enter the desired Highest and Lowest Tap values from the "Tap Limits" section of the dialog screen.
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

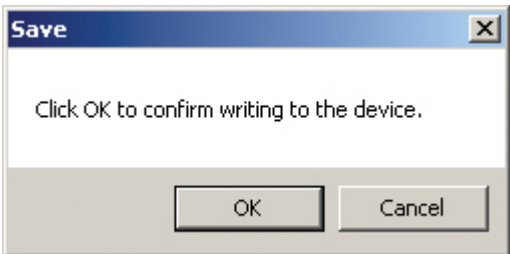


Figure 372: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

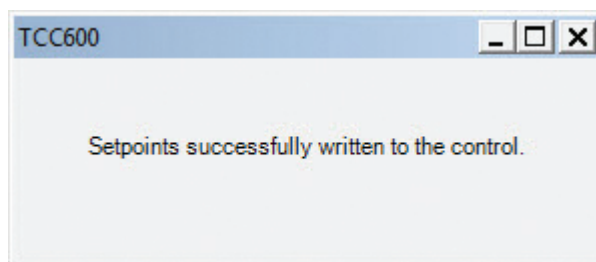


Figure 373: Setpoints Successfully Written To The Control Dialog Screen

6.4.2 Intertap time delay

The intertap time delay may be used in conjunction with sequential operation or pulsed output. The normal operation of this delay timer occurs once a tapchange command is initiated, when there would normally be a continuous command (raise or lower) to run the tapchanger until the voltage has returned to within the band setting, there is now an intertap time delay initiated between tapchanges. When the intertap time delay is set to zero, it is disabled.

The intertap time delay will:

- Recognize that a tapchange has occurred, indicated by the counter contact input or motor hold input.
- Remove the output signal and wait for the intertap time delay, even though the voltage remains outside the designated voltage band.
- Command another tapchange after the intertap time delay has expired, without regard to the basic time delay setting, if the voltage remains out of band in the same direction as the previous tapchange.

If the intertap time delay is enabled on a control where non-sequential operation is enabled, the intertap time delay setpoint is disregarded. The basic time delay setting prevails for subsequent tapchange commands in the non-sequential mode.



The intertap time delay is similar in operation to non-sequential operation, but the two should not be confused. The intertap time delay applies a short delay after every tapchange. The non-sequential operation time delay will be the same as that of the Basic User-Selected Time Delay. Application with pulsed output is also possible.

Sequential/Non-Sequential/Blocking

The control normally operates in Sequential Mode. In this mode, the tapchange output is initiated after the time delay timer has timed out. The tapchange output will remain "on" until the control senses that the voltage has returned in-band. This permits successive tapchanges to be made in a "sequential" mode with no delay between tapchanges.

If a delay between successive tapchanges is desired, an intertap time delay may be used. The value is set from 0 to 60 seconds and will interrupt tapchange outputs for the preset time after a counter-contact closure or motor hold input is detected by the control's operations counter input #1.

If the full initial time delay is desired, the control may be used in the "non-sequential" mode. Enabling non-sequential mode operation is accomplished by setting the Input Selection 2 setting to "non-sequential". Applying a momentary contact closure to the control's Input Selection 2 will activate non-sequential mode operation.

If the closed contact supplied to Input Selection 2 is maintained, instead of momentary, the initial timer will not time out for the duration of the maintained contact, and the outputs of the control will be effectively blocked.

6.4.2.1

Setting the Intertap Delay from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.
4. Press the Down arrow pushbutton, as necessary, to navigate to the "Intertap Delay" menu item.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Intertap Delay
0 Sec C
6. Utilizing the arrow pushbuttons enter the desired Intertap Time Delay value (0 to 60 seconds in 1 second increments), then press the ENT pushbutton.

6.4.2.2

Setting Intertap Time Delay from TCC600

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

The image shows the 'Tap Settings' dialog box for an ABB TCC300. It is divided into several sections:

- General:** Includes 'Tap Information' (set to Disabled), 'Intertap Delay' (0 to 60 seconds), and 'Block Automatic Operation on Motor Seal-in Failure' (Motor Seal-in Failure Block, Disable/Enable).
- Tap Limits:** Includes 'Tap Limits' (Disable/Enable), 'Block Raise' (16), 'Block Lower' (-16), 'Highest Tap' (16), and 'Lowest Tap' (-16). It also has 'Raise' and 'Lower' buttons for each.
- Operation Counter:** Includes 'Configuration' (X1, X2, Count Window), 'Cam Follower' (Disable/Enable), 'Cooper Quick Drive' (Disable/Enable), 'X Mode Delay' (10 to 3000 mS), 'Count Window' (0.5 to 60.5 sec), 'Preset' (2), 'Alarm Limit' (0 to 999999), 'Resetttable' (12), and 'Neutral Counter' (0 to 999999).
- Tap Statistics:** Includes 'Maximum Tap Wear' (65534) and 'Individual Tap Wear Alarm' (100 to 200 %). A note states: 'Note: Unit will alarm when the number of tap changes (on any tap position) exceeds the specified percentage of Maximum Tap Wear'.
- Tap Calibration:** Includes 'Tap Position' (0 to 16 (Neutral)) and 'Tap Calibrate' (Yes/No). A note states: 'Note: Set to match actual tap position as read on the physical tap position indicator.'

Buttons at the bottom include 'Undo/Refresh', 'Save', and 'Close'.

Figure 374: Tap Settings Dialog Screen

- From the General section of the Tap Settings dialog screen enter the desired Intertap Delay (0 to 60 seconds in 1 second increments).
- Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

The image shows a 'Save' confirmation dialog box. It contains the text: 'Click OK to confirm writing to the device.' Below the text are two buttons: 'OK' and 'Cancel'.

Figure 375: Save to Device Confirmation Screen

- Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

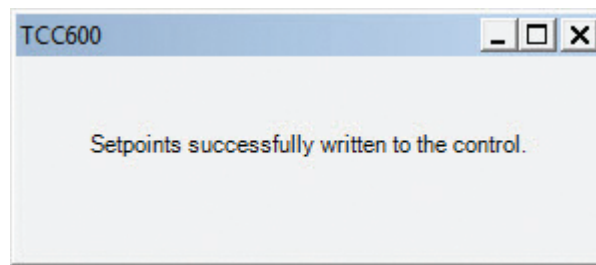


Figure 376: Setpoints Successfully Written To The Control Dialog Screen

6.4.3 Tap limits

Tap Limits, when enabled, include "Block Raise" and "Block Lower" limits which are adjustable from the Tap Maximum configuration point to the Tap Minimum value in 1 step increments.

6.4.3.1 Enabling/Disabling and Setting Tap Limits from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Tap Settings" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Tap Limits" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Tap Limits
disable C
6. Utilizing the Up/Down arrow pushbuttons, select either "Enable" or Disable", then press the ENT pushbutton.
7. Depending on what mode was selected, proceed as follows to complete the Tap Limits setup:
 - If Tap Limits were "DISABLED", no further action is required.
 - If Tap Limits were "ENABLED", proceed as follows.
8. Press the Down arrow pushbutton, as necessary, until the "Tap Block Raise" screen is displayed.
9. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Tap Block Raise

- 16 C
10. Utilizing the arrow pushbuttons, enter the desired Tap Block Raise limit (–12 to +16), then press the ENT pushbutton.
 11. Press the Down arrow once, the "Tap Block Lower" screen is displayed.
 12. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Tap Block Lower
–16 C
 13. Utilizing the arrow pushbuttons, enter the desired Tap Block Lower limit (–16 to +12), then press the ENT pushbutton.

6.4.3.2

Enabling/Disabling and Setting Tap Limits from TCC600

1. Select **Setup/Tap Settings** from the TCC600 toolbar. TCC600 will display the Tap Settings dialog screen.

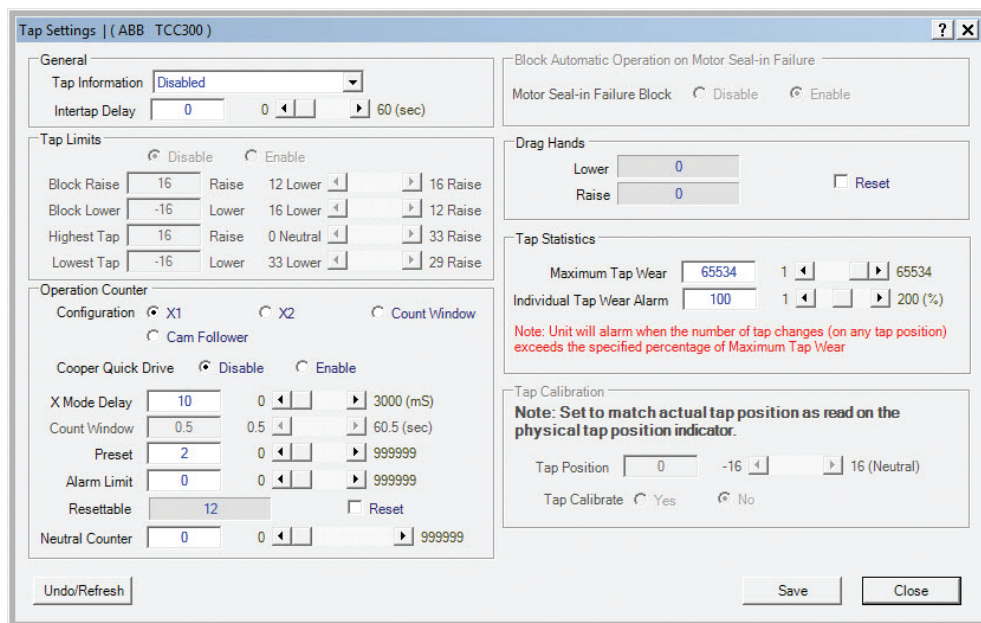


Figure 377: Tap Settings Dialog Screen

2. Select "Enable" from the Tap Limits section of the dialog screen.
3. Enter the desired Block Raise and Block Lower limits.
4. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

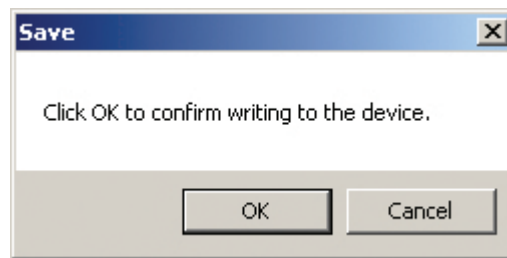


Figure 378: Save to Device Confirmation Screen

5. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

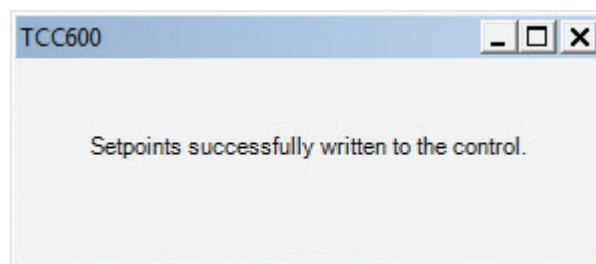


Figure 379: Setpoints Successfully Written To The Control Dialog Screen

6.5 Data logging and harmonics

6.5.1 Data logging



Whenever the TCC300 clock is reset and data logging is enabled, the data log should be cleared.

The Data Logging feature allows the user to record data internally into non volatile memory. The data log is transferred in the Comtrade format. The Comtrade format consists of two files, the configuration file (*.cfg) and the data file (*.dat).

Data logging will continue indefinitely as long as the data Interval is set to a non-zero value. A zero value for the data interval will effectively disable data logging. The data log can be downloaded using MODBUS® (see TCC300 Protocol document) or DNP (using file transfer) protocol. The data can be viewed using any Comtrade compatible viewer.

Data logging interval ranges from 0 to 120 min with an increment of 1 minute. Once data logging is enabled, the control will store the data in a data record at the selected interval. Each data record includes the following data:

- Load Voltage ^[2]
- Compensated Voltage ^[2]
- Load Watts
- Load VA
- Load VAr
- Load Current ^[2]
- Power Factor
- Line Frequency
- Tap Position
- Source Voltage ^[2]
- Primary Current
- Operation Count
- Circulating/DVAr Current
- Meter Out Voltage

The Checksum is used to ensure the integrity of the record stored. Data mask is used to mask off data that the user does not want to retrieve. Due to the internal structure of the Comtrade format, time stamping is always performed. A total of 200,000 data records can be saved in non volatile memory.

6.5.1.1

Setting up Data Logging from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Data Logging" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Data Log Select" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Data Log Select
11111111111111 C

[2] Load Voltage, Compensated Voltage, Load Current and Source Voltage are the average, maximum and minimum value during the data logging interval.



The cursor will be positioned under the far right hand zero which corresponds to LOCAL VOLTAGE. The remaining Data Log parameter selections are displayed by moving the cursor to the left.

6. Utilizing the arrow pushbuttons enter a "1" for those Data Log parameters to be activated and a "0" for those that are to be disabled, then press the ENT pushbutton.
7. Press the Down arrow pushbutton, as necessary, until the "Data Log Interval" screen is displayed.
8. Utilizing the arrow pushbuttons, enter the desired "Data Log Interval" (0 to 120 minutes in 1 minute increments), then press the ENT pushbutton.

6.5.1.2

Setting up Data Logging from TCC600

1. Select **Setup/Data Logging/Setup** from the TCC600 toolbar. TCC600 will display the Data Logging screen.

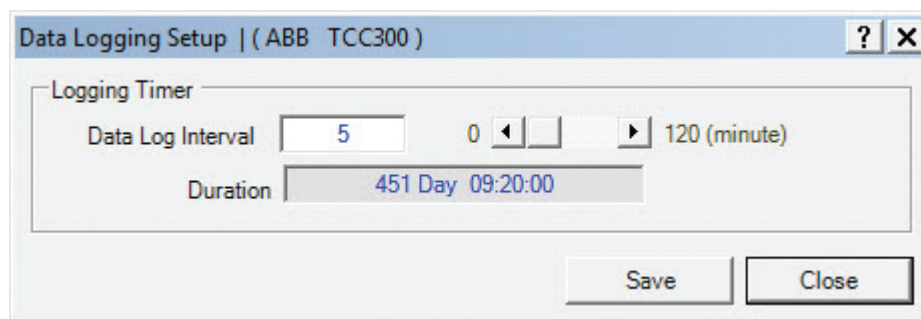


Figure 380: Data Logging Setup Dialog Screen



The Data Logging Setup dialog screen contains a self calculating Duration parameter that represents the number of Days and the specific time when the data logging buffer will be full. The number of parameters selected to log and the Data Log Interval are considered in this calculation.

2. Enter a Data Log Interval (0 to 120 minutes).
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

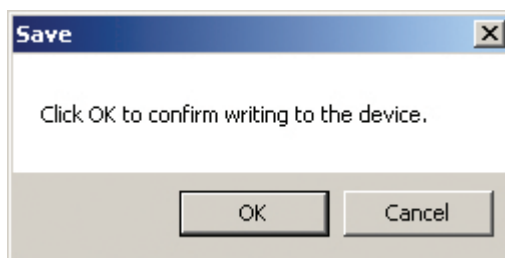


Figure 381: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

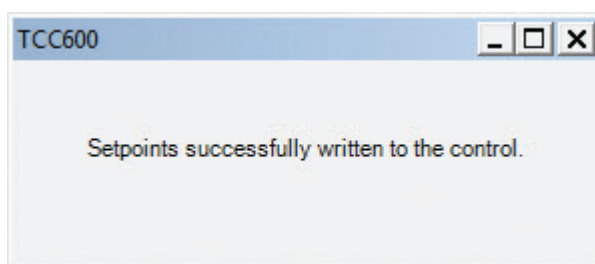


Figure 382: Setpoints Successfully Written To The Control Dialog Screen

6.5.2

Harmonics setup

The Harmonics Calculation feature provides the user with the ability to set predefined harmonic voltage and current thresholds (individual, voltage percent from 0 to 30%, current percent from 0 to 100%) for the selected harmonics. Current Threshold includes a minimum Current Threshold setting from 0 to 200 mA. Also, a common delay setting from 1 to 10 seconds is available.

The Harmonic voltage and/or current threshold Pickup and Dropout can be selected as inputs to trigger the Oscillograph Recorder. The Harmonic voltage/current Pickup or the voltage/current Dropout can be selected to trigger the Sequence of Events Recorder.

6.5.2.1

Setting the Active Harmonics Inputs to the Oscillograph and Sequence of Events Recorders from the HMI

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:

- Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, until "Harmonics Setup" is displayed.
 4. Press the Down arrow pushbutton, as necessary, until the desired Harmonic setting screen is displayed.
 5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Harmonic 2
011101111111111 C



The cursor will be positioned under the far right hand zero which corresponds to Harmonic 2. The remaining Harmonic selections are displayed by moving the cursor to the left.

6. Utilizing the Up/Down arrow pushbuttons enter a "1" for those Harmonics to be activated and a "0" for those that are to be disabled, then press the ENT pushbutton.
7. Repeat the above procedure to setup additional Harmonic Inputs to the Oscillograph and Sequence of Events recorders.
8. Once all Harmonic inputs have been selected, proceed to the Voltage Alarm Threshold, Current Alarm Threshold and Harmonic Alarm Delay settings.

6.5.2.2

Setting the Harmonic Voltage, Current Threshold and Minimum Current Threshold Settings from the HMI



The following sequence of steps are for setting the Voltage Alarm threshold. The steps used to set the Current Alarm Threshold and Minimum Current Threshold are the same.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, until "Harmonics Setup" is displayed.
4. Press the Down arrow pushbutton, as necessary, until the desired "Alarm Threshold" setting screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
V Alarm Threshold
0 % C
6. Utilizing the Up/Down arrow pushbuttons enter the desired Voltage Alarm Threshold value from 1 to 30%, press the ENT pushbutton.

6.5.2.3

Setting the Harmonic Voltage and Current Threshold Delay from the HMI



This delay setting applies to both the Voltage Threshold and the Current Threshold.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left arrow pushbutton, as necessary, until "Harmonics Setup" is displayed.
4. Press the Down arrow pushbutton, as necessary, until the "Harmonic Alarm Delay" setting screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Harmonic Alarm Delay
1 s C
6. Utilizing the Up/Down arrow pushbuttons, enter the desired Threshold Delay value from 1 to 10 Seconds, then press the ENT pushbutton.

6.5.2.4

Setting the Active Harmonics Inputs to the Oscillograph and Sequence of Events Recorders from TCC600

1. Select **Setup/Harmonics Setup** from the TCC600 toolbar. TCC600 will display the Harmonics Setup dialog screen.

Harmonics Setup | (New File)

Voltage Harmonics Selection

<input checked="" type="checkbox"/> 2 nd	<input checked="" type="checkbox"/> 3 rd	<input checked="" type="checkbox"/> 4 th	<input checked="" type="checkbox"/> 5 th	<input checked="" type="checkbox"/> 6 th	<input checked="" type="checkbox"/> 7 th
<input checked="" type="checkbox"/> 8 th	<input checked="" type="checkbox"/> 9 th	<input checked="" type="checkbox"/> 10 th	<input checked="" type="checkbox"/> 11 th	<input type="checkbox"/> 12 th	<input checked="" type="checkbox"/> 13 th
<input checked="" type="checkbox"/> 14 th	<input checked="" type="checkbox"/> 15 th	<input type="checkbox"/> 16 th	<input checked="" type="checkbox"/> 17 th	<input type="checkbox"/> 18 th	<input type="checkbox"/> 19 th
<input type="checkbox"/> 20 th	<input type="checkbox"/> 21 st	<input type="checkbox"/> 22 nd	<input type="checkbox"/> 23 rd	<input type="checkbox"/> 24 th	<input type="checkbox"/> 25 th
<input type="checkbox"/> 26 th	<input type="checkbox"/> 27 th	<input type="checkbox"/> 28 th	<input type="checkbox"/> 29 th	<input type="checkbox"/> 30 th	<input type="checkbox"/> 31 st

Voltage Threshold

Voltage Percent 0.0 30.0 (%)

Current Harmonics Selection

<input checked="" type="checkbox"/> 2 nd	<input checked="" type="checkbox"/> 3 rd	<input checked="" type="checkbox"/> 4 th	<input checked="" type="checkbox"/> 5 th	<input checked="" type="checkbox"/> 6 th	<input checked="" type="checkbox"/> 7 th
<input checked="" type="checkbox"/> 8 th	<input checked="" type="checkbox"/> 9 th	<input type="checkbox"/> 10 th	<input checked="" type="checkbox"/> 11 th	<input type="checkbox"/> 12 th	<input checked="" type="checkbox"/> 13 th
<input checked="" type="checkbox"/> 14 th	<input checked="" type="checkbox"/> 15 th	<input type="checkbox"/> 16 th	<input checked="" type="checkbox"/> 17 th	<input type="checkbox"/> 18 th	<input type="checkbox"/> 19 th
<input type="checkbox"/> 20 th	<input type="checkbox"/> 21 st	<input type="checkbox"/> 22 nd	<input type="checkbox"/> 23 rd	<input type="checkbox"/> 24 th	<input type="checkbox"/> 25 th
<input type="checkbox"/> 26 th	<input type="checkbox"/> 27 th	<input type="checkbox"/> 28 th	<input type="checkbox"/> 29 th	<input type="checkbox"/> 30 th	<input type="checkbox"/> 31 st

Current Threshold

Current Percent 0 100 (%)

Minimum Fundamental Current Threshold

☐ Disable ☒ Enable

Min Current Threshold 0 200 (mA)

Voltage & Current Harmonic Alarm Delay

Delay 1 10 (sec)

Undo/Refresh Save Close

Figure 383: Harmonics Setup Dialog Screen

2. Select the desired Voltage Harmonics and Voltage Threshold setting.
3. Select the desired Current Harmonics, Current Threshold and Minimum Current Threshold setting.
4. Select the desired Voltage & Current Delay setting.
5. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

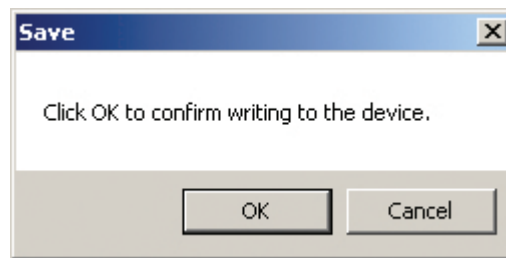


Figure 384: Save to Device Confirmation Screen

6. Select **OK**. TCC600 will display a "Setpoints Successfully Written to the Control" confirmation screen.

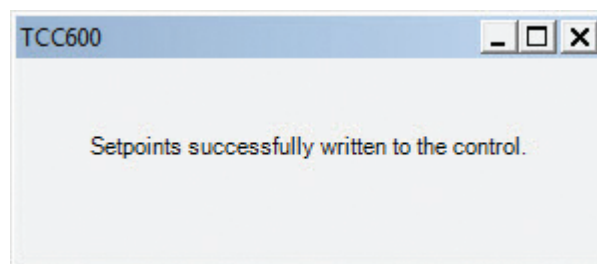


Figure 385: Setpoints Successfully Written To The Control Dialog Screen

6.6 CBEMA configuration

6.6.1 CBEMA functionality

Setpoints

Normal Voltage

CBEMA Event Enable

CBEMA Event Pickup

CBEMA Event Dropout

CBEMA Minimum Duration

Putputs

CBEMA Pickup Status

CBEMA Counters

Triggers

Oscillography

Sequence of Events

Operation

There are a total of 4 Event Monitors in CBEMA (Computer Business Equipment Manufacturers Association). Each CBEMA event monitor has a different minimum duration limit: Event 1, 1 – 60 cycles; Event 2, 1 – 120 cycles; Event 3, 60 – 60000 cycles and Event 4, 1 – 60 cycles. When Pickup is set to less than 100% it operates as a sag (under voltage) function, and when it is greater than 100% it operates as a swell (over voltage) function. Sags and swells can be accurately detected from 90 to 180 Vac.

The following rules need to be followed when setting up CBEMA Setpoints:

- The Dropout should always be greater than Pickup in the Sag case
- The Dropout should be fixed to 100% in the Swell case
- The Pickup cannot be 100%

If any of the above rules are violated, an ERROR message will scroll across the

When the load voltage is sagging or swelling greater than the pickup setting, then a pickup status will be set after the set minimum duration, in addition to incrementing the counter. When the load voltage is back to the dropout level, the status is cleared. Any or all of the Event Pickup statuses can be used to trigger Sequence of Events and/or Oscillography. The CBEMA counters are cleared after it reaches 10,000 counts, or it can also be cleared through the TCC600® Communication Software or the HMI.

Each of the CBEMA Events has a Binary Input DNP point associated with it that will indicate the status of the event, as well as an Analog Input that will indicate the duration in cycles of the most recent event.

6.6.2

Setting up CBEMA from the HMI

Setting CBEMA Normal Voltage, enabling Event 1, and entering Event 1 parameters are described in this procedure. Enabling Events 2, 3 and 4 and entering their respective settings is similar.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tapchanger Type
3. Press the Right or Left Arrow pushbuttons, as necessary until the "CBEMA Setup" screen is displayed.

4. Press the Down arrow pushbutton, as necessary, to navigate to the "Normal Voltage" screen.
5. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Normal Voltage
120.0 Volts C
6. Utilizing the Up/Down arrow pushbuttons, enter the desired "Normal Voltage" (100.0 to 130.0 Volts) value, then press the ENT pushbutton.
7. Press the Down arrow pushbutton, as necessary, to navigate to the "Event 1" screen.
8. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Event 1
ENABLE C
9. Utilizing the Up/Down arrow pushbuttons, select either "Enable" or "Disable", then press the ENT pushbutton.
10. Press the Down arrow pushbutton, as necessary, to navigate to the "Event1 Sag Pickup" screen.
11. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Event1 Sag Pickup
70 % C
12. Utilizing the Up/Down arrow pushbuttons, enter the desired "Event 1 Sag Pickup" (50 to 130 %) value, then press the ENT pushbutton.
13. Follow the procedure above to enter the desired:
 - Event1 Sag Dropout
 - Event1 Sag Min Duration
14. Repeat this procedure to setup Events 2 through 4.

6.6.3

Setting up CBEMA from TCC600

1. Select **Setup/CBEMA Events/Setup** from the TCC600 toolbar. TCC600 will display the CBEMA Sequence of Events Setup dialog screen.

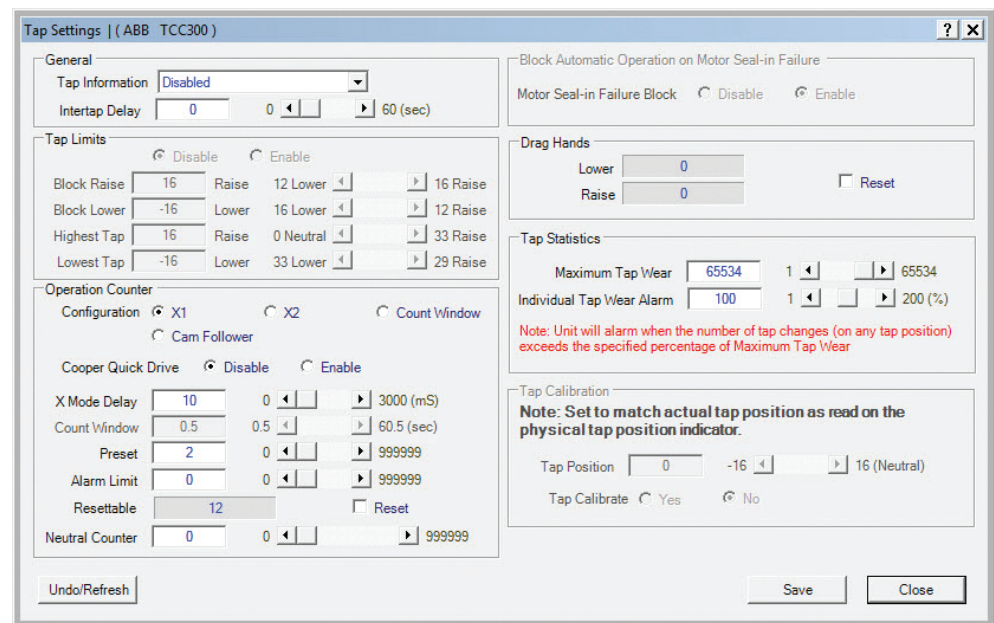


Figure 386: Tap Settings Dialog Screen

2. Enter the desired "Normal Voltage" (100.0 to 130.0 Volts) value.
3. From the "CBEMA Event 1" section of the dialog screen select ENABLE, then enter the following settings:
 - Event 1 Sag Pickup
 - Event 1 Sag Dropout
 - Event 1 Sag Minimum Duration
4. Repeat Step 3 to setup Events 2, 3, 4.
5. Select **Save**. TCC600 will display a "Do you want to enable CBEMA Sequence of events?" confirmation screen.

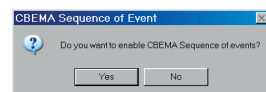


Figure 387: CBEMA Sequence of Event Enable Confirmation Screen

6. If CBEMA Events are to be used to trigger the Sequence of Events recorder, then select "Yes". TCC600 will display the Sequence of Events Setup dialog screen.



CBEMA Event and counter status can be observed on the Metering and Status screen

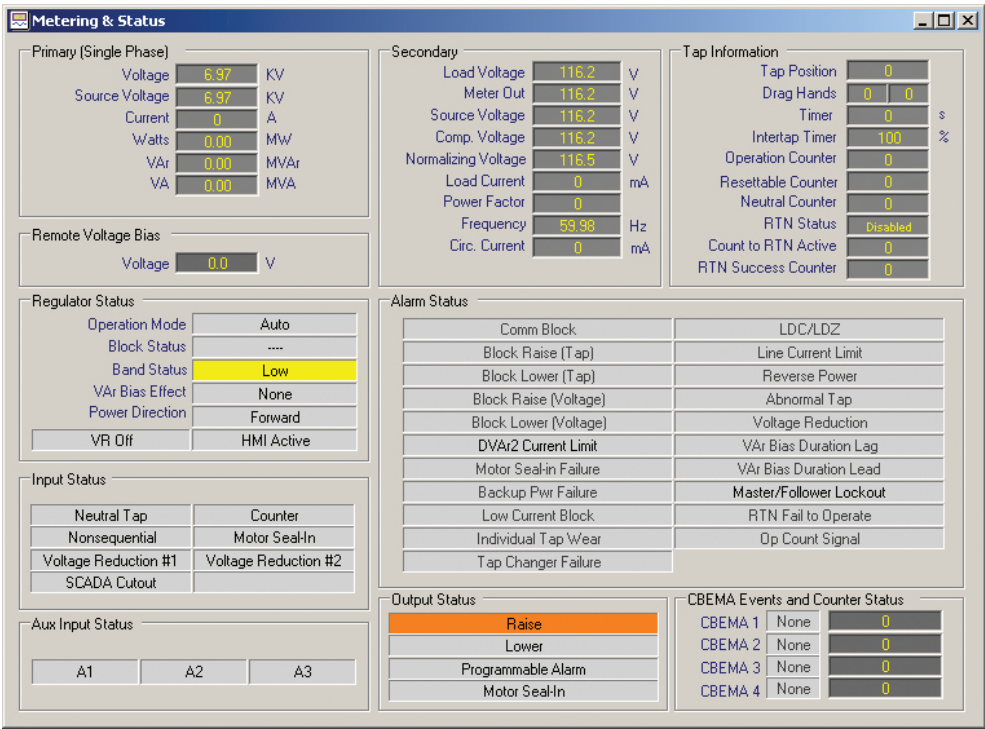


Figure 388: Metering and Status Screen

7. If CBEMA Events are Not to be used to trigger the Sequence of Events recorder, then select "No". TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.
8. If desired, CBEMA Events can be used to trigger the Oscillograph Recorder.

Section 7 Setpoints

7.1 Setpoint profiles

7.1.1 Editing of setpoint profiles

Editing setpoints is accomplished only when the specific setpoint profile has been selected for editing in TCC600® or the HMI. The following setpoint categories are included in the four setpoint profiles:

- Common Settings
- Power Flow Forward
- Power Flow Reverse
- Voltage Reduction
- Limits
- VAr Bias

In TCC600 the setpoint profiles are identified by Tabs on the Setpoints dialog screen. In the HMI, the Common Settings, Power Flow Forward, Power Flow Reverse, Voltage Reduction, Limits, and VAr Bias submenu headers indicate in the upper right hand corner the setpoint profile that is being edited.

If a specific setpoint profile has not been previously selected for editing, then the number in the submenu header will indicate the Active Setpoint Profile. After changing the active setpoint profile the user must exit the Profile Settings sub header for approximately 1 minute to see the Active Setpoint Profile change indicated in the setpoints sub header.



The control will immediately respond to the new Active Setpoint Profile settings.

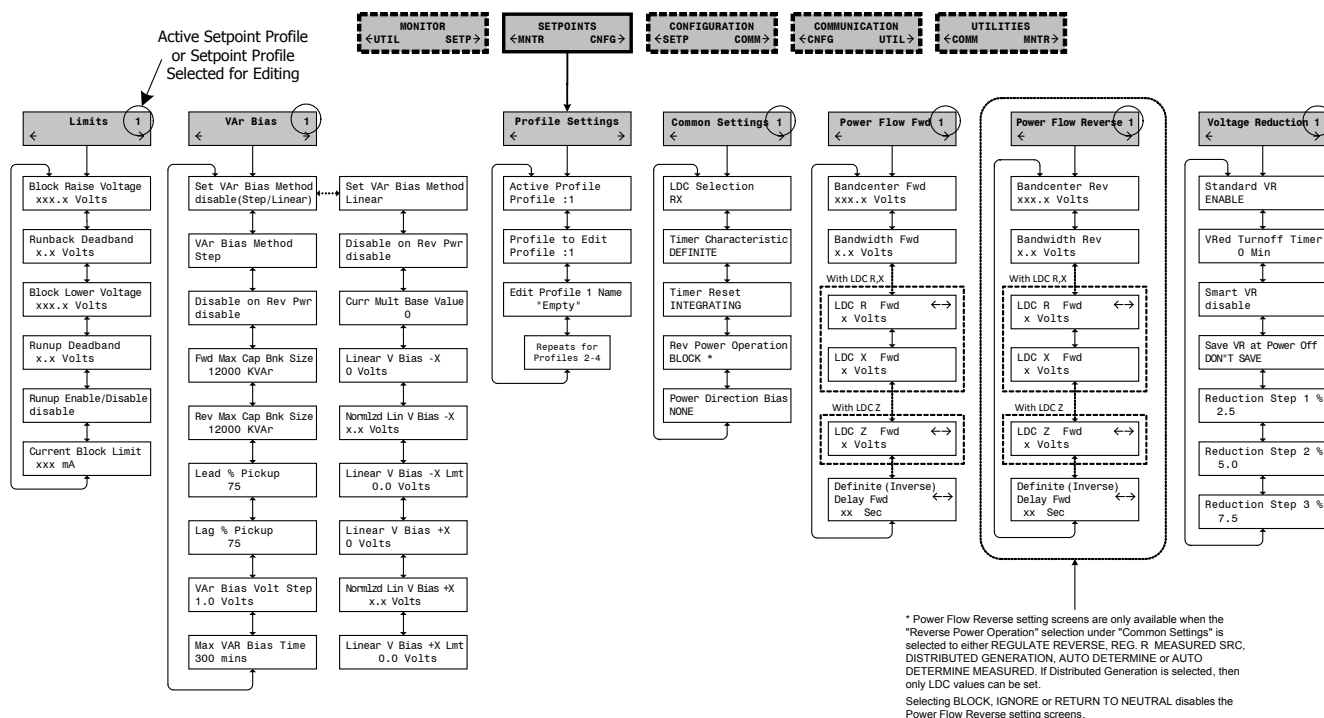


Figure 389: Active Setpoint Profile and Setpoint Profile to Edit Identifier

7.1.1.1

Selecting a setpoint profile for editing from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Down arrow pushbutton as necessary until the unit displays the following:
Profile to Edit
Profile: 1
4. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Profile to Edit
Profile: 1 C
5. Utilizing the arrow pushbuttons, select the desired Setpoint Profile for Editing, then press the ENT pushbutton. The following will be displayed reflecting the Setpoint Profile that was selected for Editing.

7.1.1.2

Selecting a setpoint profile for editing from TCC600

- Editing Setpoint Profiles from TCC600 is accomplished by selecting the desired Profile Tab in the "Setup/Setpoints" dialog screen.

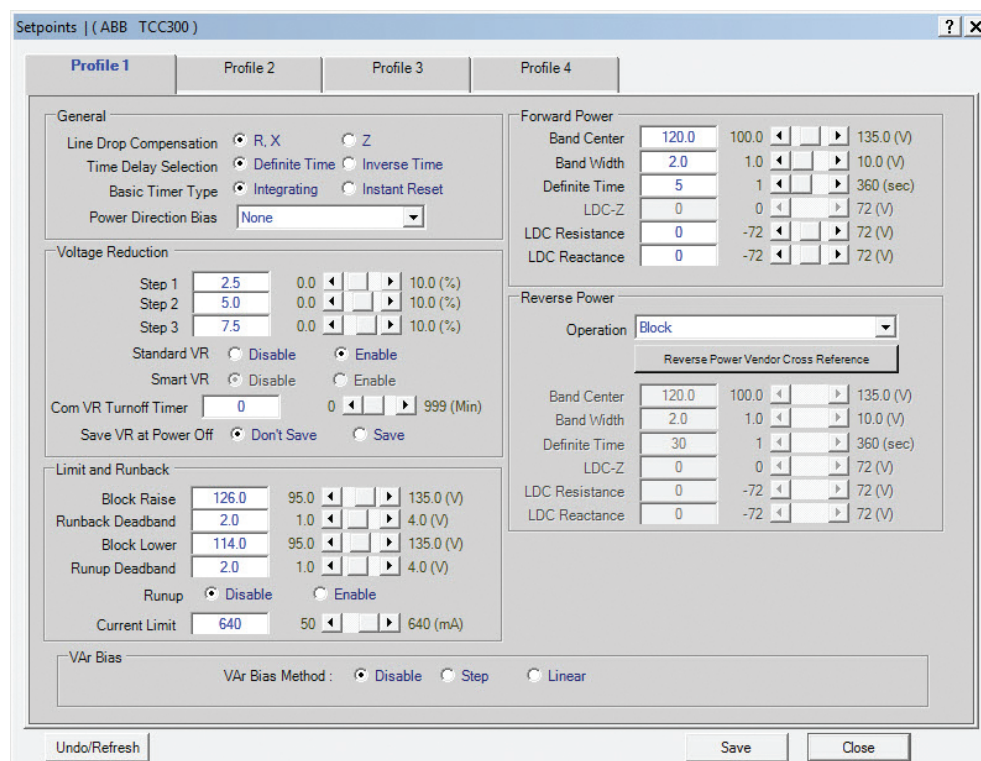


Figure 390: Setpoints Dialog Screen

7.1.2

Naming setpoint profiles

Custom names may be assigned to Setpoint Profiles 1 through 4.

- The Profile name may be up to 16 standard alphanumeric characters.
- Alpha characters may be either upper or lower case.
- The user may Enter/Edit the Profile name from the HMI or TCC600.

7.1.2.1

Assigning a setpoint profile name from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Down arrow pushbutton as necessary until the unit displays the following:
Edit Profile 1 name
0
4. Press the ENT pushbutton. If prompted, enter a valid Level Access Code.
5. Utilizing the arrow pushbuttons, enter the desired Setpoint Profile Name, then press the ENT pushbutton. The following will be displayed reflecting the Setpoint Profile Name that was entered.
Edit Profile 1 name
XXXXXXX

7.1.2.2

Assigning a setpoint profile name from TCC600

1. Select Setup/Profile/Profile Names from the TCC600 toolbar. TCC600 will display the Profile Names dialog screen.

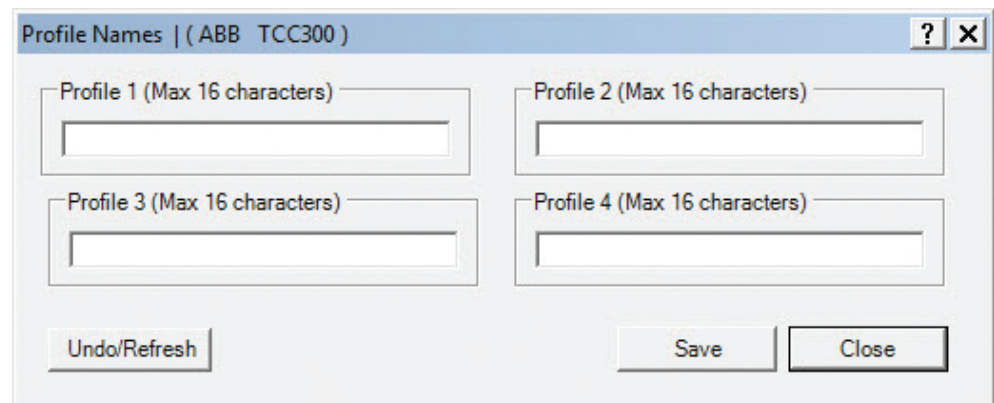


Figure 391: Setpoint Profile Names Dialog Screen

2. Enter the desired names for Setpoint Profiles 1 through 4.
3. Select **Save**. TCC600 will display a "Save to Device" confirmation screen.

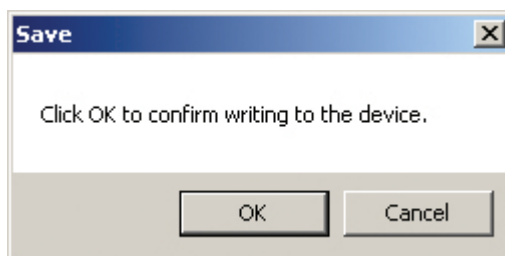


Figure 392: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

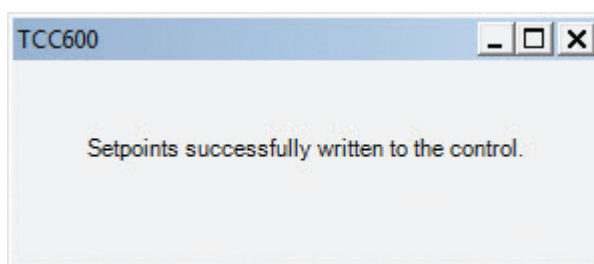


Figure 393: Setpoints Successfully Written To The Control Confirmation Screen

7.2 Regulation limits

Overvoltage Limit and Voltage Runback

Setpoints are available to establish a block raise limit and voltage runback. The overvoltage limit is adjustable from 95.0 V to 135.0 V in 0.1 V increments. The overvoltage limit must be set above the upper control band limit. This limit is one portion of the First Customer Protector to limit overvoltage from line drop compensation action during heavy loading.

The voltage runback level is the Block Raise setting plus the Runback Deadband setting (this establishes the First Customer Protection Level.) This deadband should not be confused with the control deadband above and below the center voltage setpoint, which is generally called the control "bandwidth".

The voltage runback deadband is used to assure that the runback setting is sufficiently above the upper voltage limit setting to limit hunting. It is adjustable from 1.0 to 4.0 V in 0.1 V increments, and must be set greater than the voltage change of one single tapchange,

or hunting will occur. It is suggested that it be set at approximately twice the voltage change of one tap.

If the voltage exceeds the runback limit, as might be caused by combinations of LDC action and load shifts or by a system disturbance without LDC action, the control will immediately call for an "automatic" lower without any time delay. The lower command will continue until the voltage is within the normal control band.

Overvoltage block can be effectively disabled by setting it to 135 V. By setting the runback deadband to 4 V, the runback voltage becomes 139 V which effectively disables the feature. All automatic raise/lower operations are blocked when the input voltage decreases to less than 85.0 V. Manual tapchanges can be initiated if Motor Power is available.

Undervoltage Block and Voltage Runup

Setpoints are also available to establish a block lower limit and voltage runup. This limit is adjustable from 95.0 V to 135.0 V in 0.1 V increments. This limit can be set to limit low customer voltage to safe limits and will block voltage reduction action that could cause motor stalling and other undesirable low voltage effects.

The voltage runup level is the Block Lower setting plus the Runup Deadband setting (this establishes the First Customer Protection Level.)

The voltage runup deadband is used to assure that the runup setting is sufficiently below the lower voltage limit setting to limit hunting. It is adjustable from 1.0 to 4.0 V in 0.1 V increments, and must be set greater than the voltage change of one single tapchange, or hunting will occur. It is suggested that it be set at approximately twice the voltage change of one tap.

If the voltage is lower than the runup limit, as might be caused by combinations of LDC action and load shifts or by a system disturbance without LDC action, the control will immediately call for an "automatic" raise without any time delay. The raise command will continue until the voltage is above the runup voltage limit. After this occurs, the timer will reset. If the voltage is still low, normal control action will bring the voltage up to within the normal control band.

If both "Voltage Runup" and "Fast Voltage Recovery" are enabled, the Fast Voltage Recovery feature has precedence over Voltage Runup operationally.

Undervoltage block can be effectively disabled by setting it to 95 volts. If the voltage is below the Block Lower setpoint, the control will not respond to further lower commands. Raise commands are not affected. All automatic raise/lower operations are blocked when the input voltage decreases to less than 85.0 V. Manual tapchanges can be initiated if Motor Power is available.

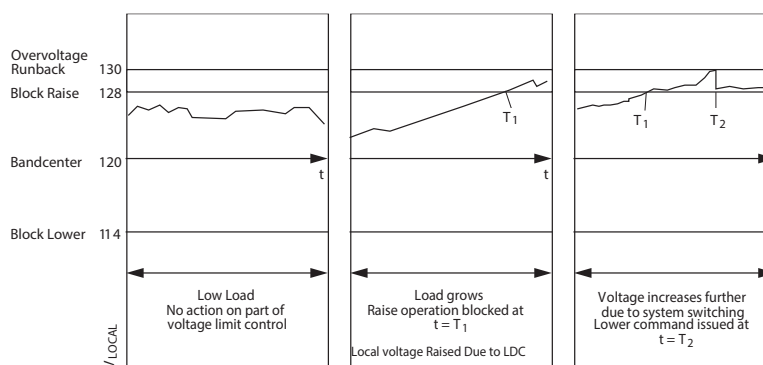


Figure 394: Local Voltage as Function of Load Current When Using Line Drop Compensation/ Action of Overvoltage and Overvoltage Runback Control

Coordination with Backup Relay

The TCC300 Digital Tapchanger Control provides the first customer protection functions. Use of a backup relay, such as the M-0329B, is recommended since the TCC300 (or any independent control) cannot be expected to be its own backup. The backup relay bandcenter setting is usually set the same as the primary control, with the bandwidth setting 1 or 2 volts greater than the primary control bandwidth, the block raise setting 1 volt greater than the primary control, and the deadband setting 1 or 2 volts. These settings create a runback level 1 or 2 volts above the runback level of the primary control.

If primary control operation is desired first, the block raise setting and the resulting runback level of the backup relay must be higher than those of the primary control and the block lower setpoint must be lower than the primary control setting.

Tap Position Block

The Tap Position Block is disabled by setting the Tap Information screen to the Disable condition. If the Tap Information screen is not disabled, the Tap Position block can be disabled by setting the Tap Limits screen to Disable.

When using the M-2025B(D) Current Loop Interface Module, a one-second intertap time delay should be used, due to the time setting of the module.

Overcurrent Block Operation



The current input to the control is rated at 0.2 A continuous, 0.4 A for two hours, and 4.0 A for 1 second.

The Current Block Limit setpoint is available to block operation whenever the current exceeds the setting. The setting is adjustable from 50 to 640 mA in 1 mA increments.

This feature can be used to protect the tapchanger switch during periods of excessive current. This feature can be effectively disabled by setting the blocking current to 640 mA.

Low Current Block

When enabled the control determines if Load Current following a tapchange is less than 4 mA, coincident with Tap Delta Voltage being less than 0.4 Vac. When these conditions exist the control will initiate an alarm and block regulation. The Delta Voltage is measured on every tap operation once Load Current is less than 4 mA.

Regulation will be blocked until one of the following conditions exists:

- Power to the control is cycled
- The control is switched to Manual remotely
- The control is switched to Manual via the Auto/Manual switch on the control adapter panel
- The Low Current Alarm is cleared/reset • Load Current measurement is greater than or equal to 4 mA for 1 second

The Alarm Reset is located on the "Programmable Alarm" dialog screen and in HMI "Configuration/Programmable Alarm/CLR Low Current Block.

7.2.1

Setting the Overvoltage Block Raise and Block Lower Limit from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Limits" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

4. Verify that the desired Setpoint Profile is indicated, then press the Down arrow as necessary to display the following:
Block Raise (Lower) Voltage
128.0 Volts
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Block Raise (Lower) Voltage

128.0 Volts C

6. Utilizing the arrow pushbuttons, enter the desired Block Raise (Lower) Limit (95.0 to 135.0 Volts in 0.1 increments), then press the ENT pushbutton. The following will be displayed reflecting the value that was entered.

7.2.2

Enabling or disabling Voltage Runup from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Limits" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

4. Verify that the desired Setpoint Profile is indicated, then press the Down arrow pushbutton, as necessary, until the following is displayed:
Runup Enable/Disable
disable
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Runup Enable/Disable
disable C
6. Utilizing the arrow pushbuttons, select ENABLE or disable, then press the ENT pushbutton. The following will be displayed reflecting the selection.

7.2.3

Setting the Voltage Runback and Runup Deadband from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Limits" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

4. Verify that the desired Setpoint Profile is indicated, then press the Down arrow pushbutton, as necessary, until the following is displayed:
Runback (Runup) Deadband
2.0 Volts
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Runback (Runup) Deadband
2.0 Volts C
6. Utilizing the arrow pushbuttons, enter the desired Runback (Runup) Deadband (1.0 to 4.0 Volts in 0.1 increments), then press the ENT pushbutton.

7.2.4

Setting the Current Block Limit from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Limits" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

4. Verify that the desired Setpoint Profile is indicated, then press the Down arrow pushbutton, as necessary, until the following is displayed:
Current Block Limit
640 mA
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Current Block Limit
640 mA C
6. Utilize the arrow pushbuttons, to enter the desired Current Block Limit (50 to 640 mA in 1 mA increments), then press the ENT pushbutton.

7.2.5

Enabling or disabling the Low Current Block/Alarm from the HMI



Enabling the Low Current Block feature also enables the Low Current Block/Alarm.

1. Press the Down Arrow (CNFG Hot Button) pushbutton to wake the unit. The menu will advance to "CONFIGURATION".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Tap Settings
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "Nameplate" menu.
4. Press the Down arrow pushbutton, as necessary, until the "Low Current Block" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Low Current Block
disable C
6. Utilizing the arrow pushbuttons select ENABLE or Disable, then press the ENT pushbutton.

7.2.6

Enabling or disabling the Low Current Block/Alarm from TCC600



Enabling the Low Current Block feature also enables the Low Current Block/Alarm.

1. Select **Setup/Configuration** from the TCC600 toolbar. TCC600 will display the Configuration dialog screen.

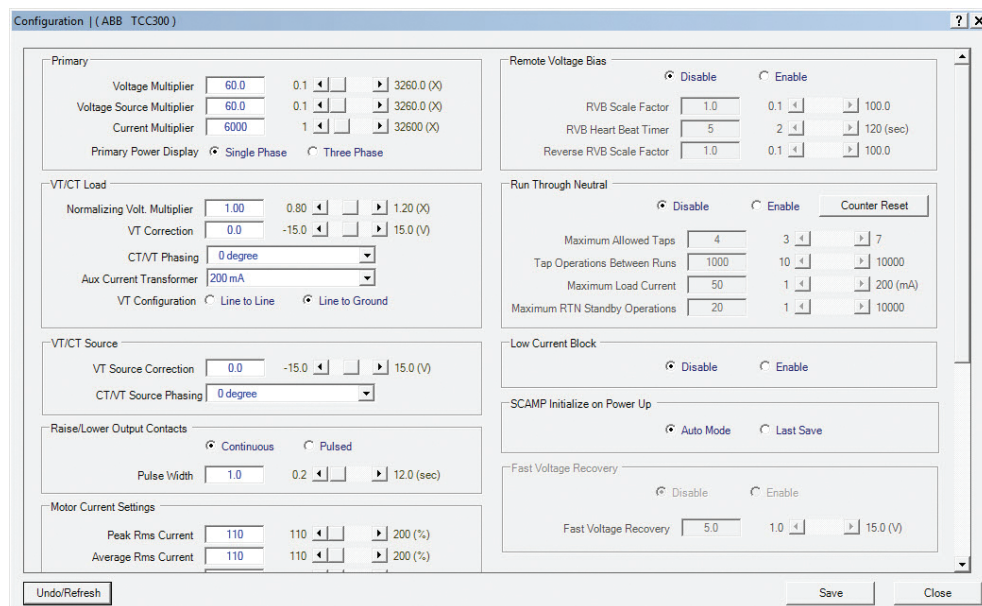


Figure 395: Configuration Dialog Screen

2. From the "Low Current Block" section of the configuration dialog screen select "Enable or Disable".
3. Select **Save**. TCC600 will display a "Save to Device" confirmation screen.

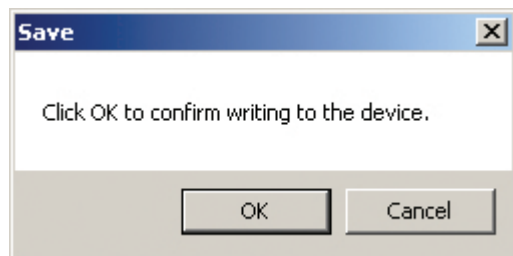


Figure 396: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

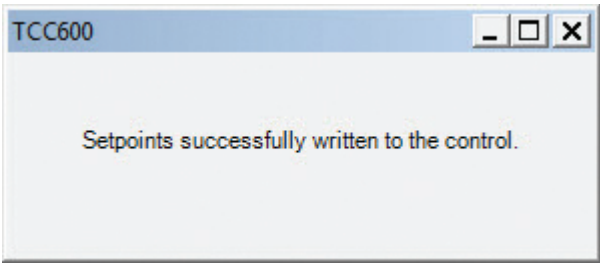


Figure 397: Setpoints Successfully Written To The Control Confirmation Screen

7.2.7 Setting Limits Runback Runup from TCC600

1. Select Setup/Setpoints from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

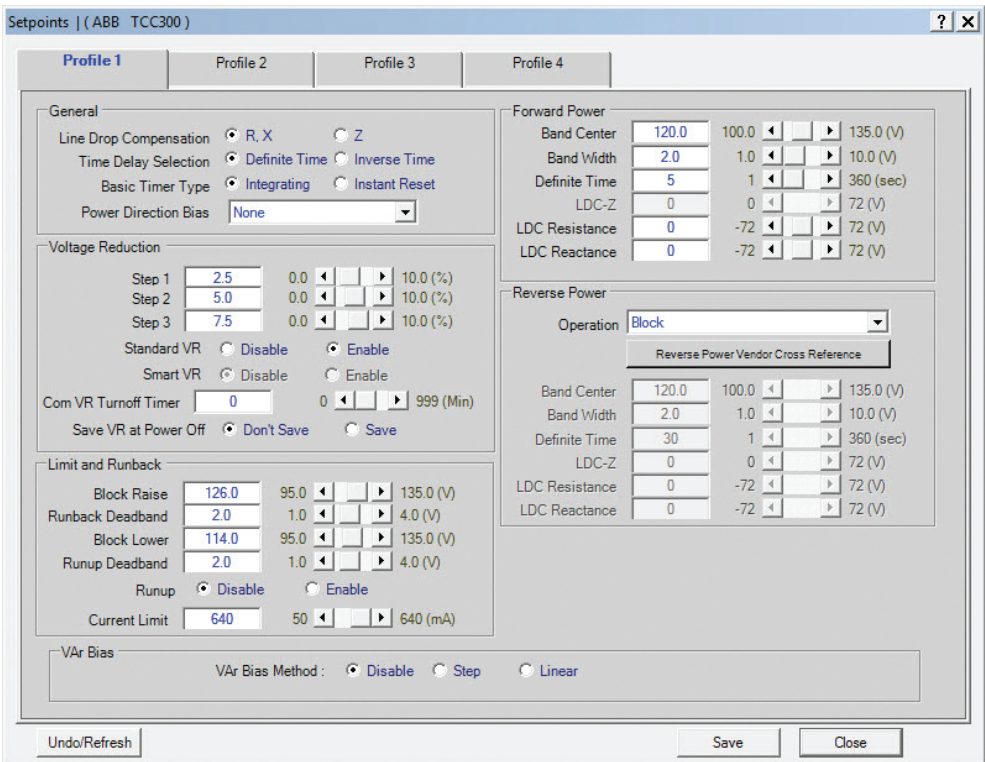


Figure 398: Setpoints Dialog Screen



Selecting "Undo/Refresh" only affects the displayed profile.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

2. Select the desired Setpoint Profile (1–4), then from the "Limit and Runback" section of the Setpoints dialog screen enter the desired settings for the following:
 - Block Raise
 - Runback Deadband
 - Block Lower
 - Runup Deadband
 - Runup Enable/Disable
 - Current Limit



Selecting "Save" saves all profiles to the control.

3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

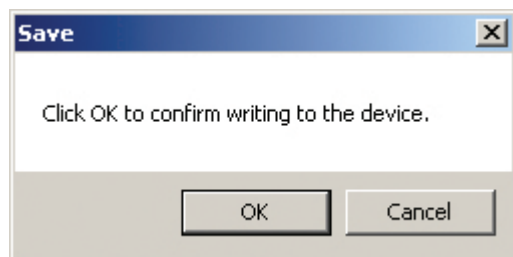


Figure 399: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a Setpoints "Successfully Written to Control" confirmation screen.

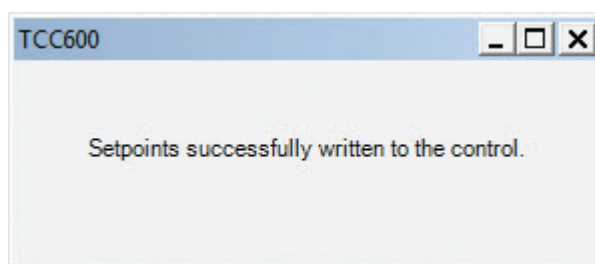


Figure 400: Setpoints Successfully Written To The Control Confirmation Screen

7.3 Voltage reduction

TCC300 allows the selection of either Standard Voltage Reduction or Smart Voltage Reduction. Standard Voltage Reduction lowers the Bandcenter based on a percentage of the existing Bandcenter setting. When initiated, the control immediately begins Lower operations to reduce the voltage until it reaches the new upper band edge (Bandcenter plus $\frac{1}{2}$ the Bandwidth setting). Smart Voltage Reduction will further reduce voltage using a variety of methods .

The control allows three steps of voltage reduction initiated by external dry contacts, front panel pushbutton or SCADA. The percentage voltage reduction at each step is adjustable from 0 to 10% in 0.1% increments. When one or more contacts are closed, the effect is to shift the bandcenter setpoint lower thus causing the control to lower the voltage.

In addition, voltage reduction functionality can be enabled or disabled using Communication MODBUS® and DNP protocols.

The Voltage Reduction feature can be turned off by the Voltage Reduction Turnoff Timer (0 to 999 min). A setting of zero disables the Turnoff Timer.

Recognize that the "effective" bandcenter may have been raised by line drop compensator action when the voltage reduction is initiated and that the resultant voltage setting will be the combination of the two effects. Note also that the undervoltage block setting may limit the lowering of voltage, especially if there is little raising of the local voltage due to LDC action.

When first initiated, or when a subsequent step of voltage reduction is needed, the control will respond immediately to the voltage reduction command without regard to either the intertap time delay setting or the control time delay setting. After the desired voltage reduction, operation will revert back to normal operation with the time delay.

When Voltage Reduction is enabled the front panel pushbutton, wired SCADA dry contacts, RS-485, Fiber Optic port or Ethernet connection can be used to provide stepped voltage reduction as described earlier.

Also, the state of the "Voltage Reduction" communications command can be saved or not saved when power has been lost. The default setting is "DON'T SAVE".

7.3.1

Setting Voltage Reduction Steps 1, 2 and 3 from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbutton as necessary, to navigate to the "Voltage Reduction" menu.



The following sequence of steps are for enabling Voltage Reduction and setting Voltage Reduction Step 1. The steps used to set the Voltage Reduction Steps 2 and 3 are similar.

4. Press the Down arrow pushbutton, as necessary, to navigate to the "Reduction Step 1 %" (Step 2 or 3) menu item.
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Reduction Step 1 %
2.5 C
6. Utilize the arrow pushbuttons to enter the desired Voltage Reduction (0.0 to 10.0 % in 0.1 % increments), then press the ENT pushbutton.

7.3.2

Setting Voltage Reduction Steps 1, 2 and 3 from TCC600

1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

Setpoints | (ABB TCC300)

Profile 1 | Profile 2 | Profile 3 | Profile 4

General

Line Drop Compensation: ☒ R, X ☐ Z

Time Delay Selection: ☒ Definite Time ☐ Inverse Time

Basic Timer Type: ☒ Integrating ☐ Instant Reset

Power Direction Bias:

Voltage Reduction

Step 1: 0.0

Step 2: 0.0

Step 3: 0.0

Standard VR: ☐ Disable ☒ Enable

Smart VR: ☐ Disable ☐ Enable

Com VR Turnoff Timer: 0

Save VR at Power Off: ☒ Don't Save ☐ Save

Limit and Runback

Block Raise: 95.0

Runback Deadband: 1.0

Block Lower: 95.0

Runup Deadband: 1.0

Runup: ☒ Disable ☐ Enable

Current Limit: 50

Forward Power

Band Center: 100.0

Band Width: 1.0

Definite Time: 1

LDC-Z: 0

LDC Resistance: -72

LDC Reactance: -72

Reverse Power

Operation:

Reverse Power Vendor Cross Reference

Band Center: 100.0

Band Width: 1.0

Definite Time: 1

LDC-Z: 0

LDC Resistance: -72

LDC Reactance: -72

VAr Bias

VAr Bias Method: ☒ Disable ☐ Step ☐ Linear

Undo/Refresh Save Close

Figure 401: Setpoints Dialog Screen

2. From the "Voltage Reduction" section of the Setpoints dialog screen enter the desired Voltage Reduction settings (0.0 to 10.0 % in 0.1 % increments) for the following:
 - Step 1
 - Step 2
 - Step 3
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

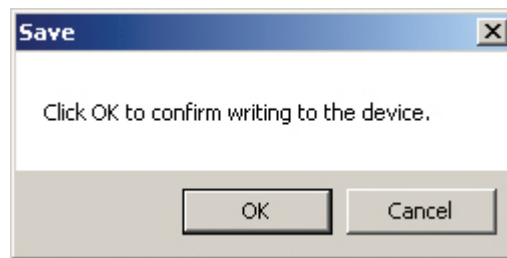


Figure 402: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

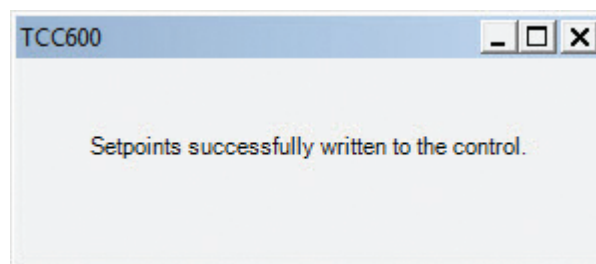


Figure 403: Setpoints Successfully Written To The Control Confirmation Screen

7.3.3 Enabling or disabling Standard Voltage Reduction from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left Arrow pushbuttons as necessary until the following is displayed:
Voltage Reduction
4. Press the Down Arrow pushbutton as necessary to navigate to the "Standard Voltage Reduction" menu item.
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Standard VR
ENABLE C
6. Utilizing the Up/Down arrow pushbuttons, select either "ENABLE" or Disable", then press the ENT pushbutton.

7.3.4 Smart Voltage Reduction

Smart Voltage Reduction, when enabled, will lower voltage to between the new Bandcenter setting and the lower band edge instead of stopping at the upper band edge. It will also disable VAr Bias if it is in effect.

7.3.4.1 Enabling or disabling and setting Smart Voltage Reduction from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left Arrow pushbuttons as necessary until the following is displayed:
Voltage Reduction
4. Press the Down Arrow pushbutton as necessary to navigate to the "Smart Voltage Reduction" menu item.
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Smart VR
disable C
6. Utilizing the Up/Down arrow pushbuttons, select either "ENABLE" or Disable", then press the ENT pushbutton.

7.3.4.2 Enabling or disabling and setting Standard or Smart Voltage Reduction from TCC600

1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

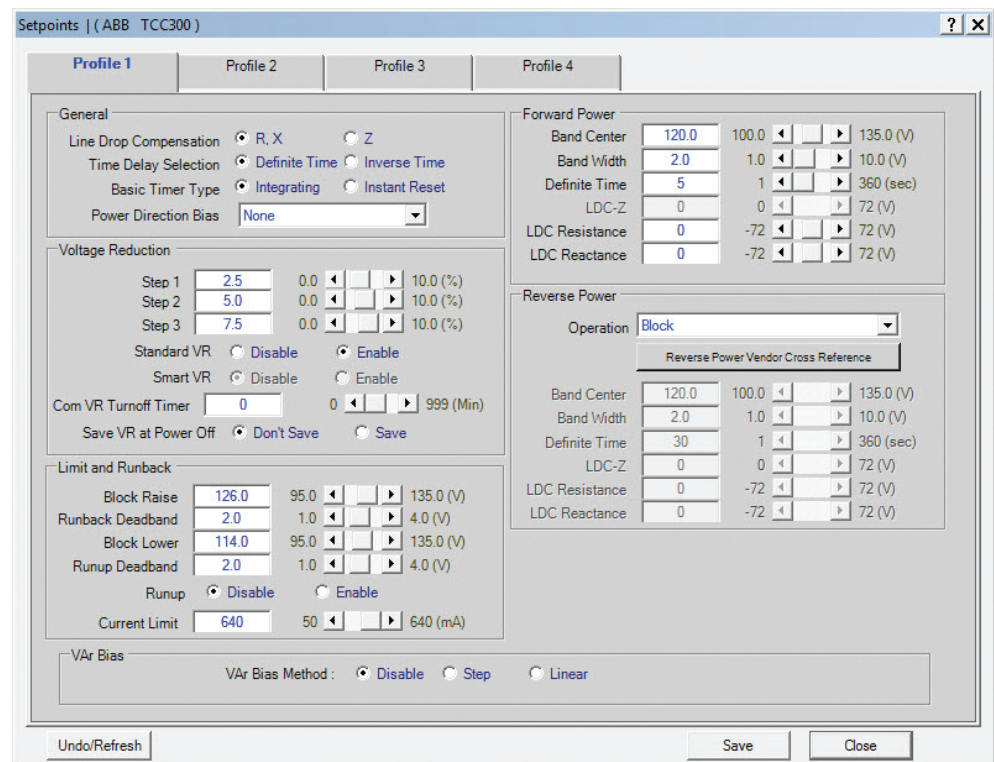


Figure 404: Setpoints Dialog Screen

2. From the "Voltage Reduction" section of the Setpoints dialog screen select "Standard VR" Enable or "Smart VR" Enable. Only one voltage reduction method can be enabled.
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

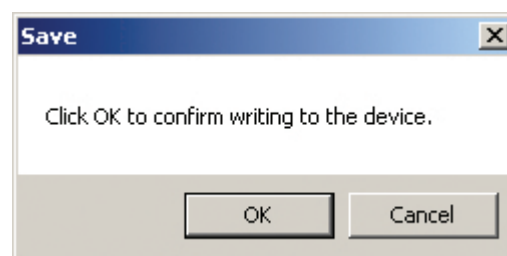


Figure 405: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

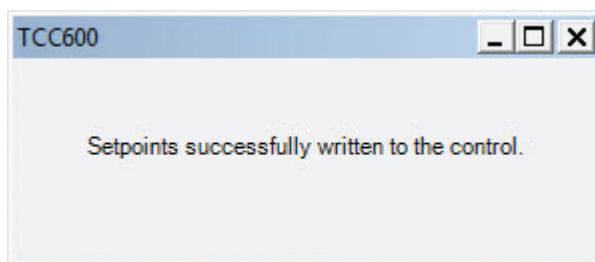


Figure 406: Setpoints Successfully Written To The Control Confirmation Screen

7.3.5 Save Voltage Reduction at power off

Save Voltage Reduction at Power Off allows the state of the "Voltage Reduction" communication command to be saved or not saved when power has been lost. The default setting is "DON'T SAVE".

7.3.5.1 Setting Save Voltage Reduction at Power Off from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left Arrow pushbuttons as necessary until the following is displayed:
Voltage Reduction
4. Press the Down Arrow pushbutton as necessary to navigate to the "Save VR at Power Off" menu item.
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Save VR at Power Off
DON'T SAVE C
6. Utilizing the Up/Down arrow pushbuttons, select "DON'T SAVE or SAVE", then press the ENT pushbutton. The selected setting will be displayed.

7.3.5.2 Selecting Save Voltage Reduction at Power Off from TCC600

1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

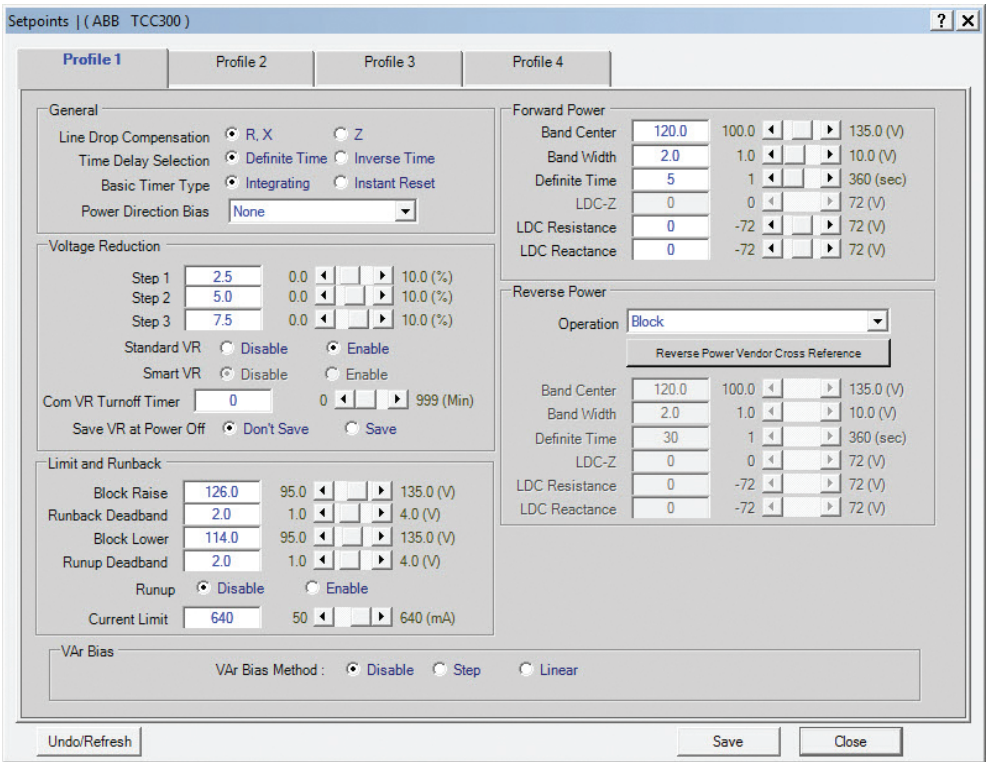


Figure 407: Setpoints Dialog Screen

- From the "Voltage Reduction" section of the Setpoints dialog screen select Save for the "Save VR at Power Off" option.
- Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

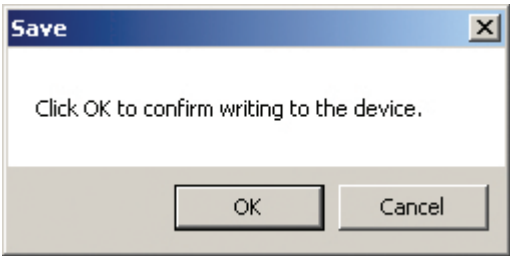


Figure 408: Save to Device Confirmation Screen

- Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

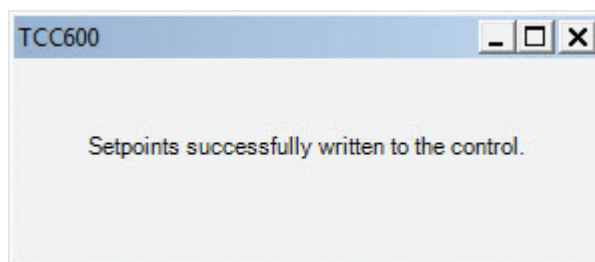


Figure 409: Setpoints Successfully Written To The Control Confirmation Screen

7.3.6 Setting Voltage Reduction Turnoff Timer from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left Arrow pushbuttons as necessary until the following is displayed:
Voltage Reduction
4. Press the Down arrow pushbutton, as necessary, until the "Voltage Reduction Turnoff Timer" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
VRed Turnoff Time
0 Min C
6. Utilizing the arrow pushbuttons, select the desired Voltage Reduction Turnoff Timer value (0 to 999 min), then press the ENT pushbutton.

7.3.7 Setting Voltage Reduction Turnoff Timer from TCC600

1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

Figure 410: Setpoints Dialog Screen



Entering a value of zero disables the Voltage Reduction Turnoff Timer.

2. From the Voltage Reduction section of the dialog screen enter the desired time period (1 to 999 minutes).
3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

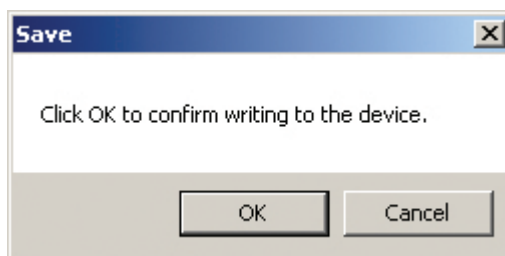


Figure 411: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

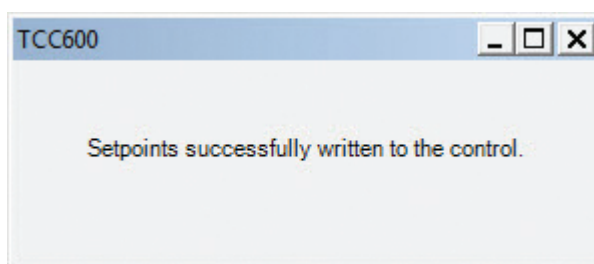


Figure 412: Setpoints Successfully Written To The Control Confirmation Screen

7.4 Line drop compensation

Voltage Regulation Without LDC

When the control is just used to regulate the voltage on the regulator low-side bus, the only input required is voltage from a line-to-line or line-to-ground VT with a nominal 120 Vac secondary.

Voltage Regulation With LDC

When it is desirable to regulate the voltage at some distance from the voltage regulator, or in general to raise the voltage during high load conditions, the Line Drop Compensation (LDC) feature is used.

Two different LDC methods are available in the TCC300 Digital Tapchanger Control. A selection in the Setpoints/General section allows the user to select from either Resistance/Reactance (R/X) or LDC-Z.

The Bandcenter, Bandwidth, and Time Delay functions are set the same as if LDC were not used.

LDC R/X

A classical approach can be used to determine the R/X settings for the LDC, however this assumes a load center point and is usually not applicable to the typical distribution feeder. For more information, contact ABB for Application Note #17.

A simpler method, which will work for most applications, is recommended. This involves looking at the lines leaving the station and determining the resistance/reactance (R/X) ratio for the main line. The resistive and reactive line drop compensation setpoints should then be entered in this same R/X ratio.

If the CT and VT phasing corrections have been made to compensate for any phase angles between measured voltage and load current, only positive values of R and X compensation need to be used.

Table 63: *Approximate Ratio of Line Resistance to Reactance (R/X) of Typical Distribution Circuits*

ACSR		COPPER	
MCM	R/X	MCM	R/X
795	4.0	750	6.0
477	2.5	500	4.5
336	2.0	350	3.3
266	1.5	250	2.4
AVG	R/X	AVG	R/X
4/0	1.2	4/0	2.0
2/0	1.0	2/0	1.5
2	0.5	2	0.7
6	.02	6	0.3

By knowing the ratio of the maximum expected load to the present load, the amount of voltage compensation needed is found as shown in the following example.

Desired

- local voltage @ min load = 120 volts
- local voltage @ max load = 124 volts

Using the following assumptions:

- Desired Bandcenter = 120 volts
- Desired Bandwidth = 2 volts
- The device being controlled is 50% loaded

Setting

Start with $R=0$ and $X=0$ and increase both values using the ratio shown in the table for the feeder conductor. Keeping the R/X ratio, increase R_{set} and X_{set} until the difference between the compensated voltage and the local voltage is 2.0 volts.

This example would let the voltage vary from 119 V at no load to 125 V at maximum load taking into account the bandwidth.

With this simplified method of LDC setting, the first customer's voltage will be limited by the upper voltage limit at the highest daily load, depending on the accuracy of the daily load projection. At the same time, the furthest customer will receive the highest voltage possible under the line and loading conditions. The first customer protection can be set on the control.

Since the daily load projections will likely have a seasonal variation, the best balance of first customer to furthest customer voltage may require seasonal adjustment of the LDC settings. Note that the settings of R and X compensation are proportional to the peak load projection and that new settings can be scaled from the first setting obtained by the experimental process just described.

LDC-Z

The second available compensation method is called Z-compensation (LDC-Z). LDC-Z must be selected in the control setpoint portion of the menu or software and the VOLTAGE RAISE (V_R) setpoint must be set in order for this feature to be implemented. The LDC-Z application is especially useful on systems where several lines exist with different load centers where the proper compensation is not related to any single R & X values as set in R & X compensation.

Basically, LDC-Z compensation consists of designating a target bus voltage increase (line drop compensation) that correlates to the magnitude of the control current rather than to the calculation of input R & X line drop at control current magnitude and angle values.

The setting, (V_R), is the calculated load voltage drop (at maximum load) in the circuit or line that has the ratio of the highest voltage drop at maximum load condition compared to the rated CT output (200 mA).

$V_R = 0$ to 72 volts in increments of 1 volt.

Example:

- Calculated voltage drop = 5 volts at load level of 150 mA control current.
- V_R setting = $200/150 \times 5 = 6.7$ volts (rounded) = 7 volts

To calculate the line drop compensation at any given control current level (I):

- $V = I/200 \times 7$ (setting): If $I = 50$ mA; $V = 50/200 \times 7 = 1.75$ volts

As with R & X compensation applications, the "block raise" and "deadband" settings are used for first house protection on all circuits or lines.



For additional information about LDC-Z applications, contact ABB to obtain Distributech Paper 1/27/05, "Maximizing Automatic Reverse Power Operations with LTC Transformers and Regulators."

Table 64: *Line Drop Compensation Setpoint Ranges*

Function	Setpoint Range	Increment	Default Setting
Bandcenter	100.0 V to 135.0 V	0.1 V	120.0 V
Bandwidth	1.0 V to 10.0 V	0.1 V	2.0 V
Definite Delay	1 second to 360 seconds	1 second	10 seconds
Inverse Delay	1 second to 360 seconds	1 second	10 seconds
LDC Resistance	-72 V to +72 V	1 V	0 V
LDC Reactance	-72 V to +72 V	1 V	0 V
LDC-Z	0 V to 72 V	1 V	0 V

7.4.1

Selecting Line Drop Compensation Type and Settings from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Common Settings" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

4. Verify that the desired Setpoint Profile is indicated, then press the Down arrow pushbutton, as necessary, to navigate to the "LDC Selection" menu item.

5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
LDC Selection
RX C
6. Utilizing the Up/Down arrow pushbuttons, select the desired type of Line Drop Compensation (RX or Z), then press the ENT pushbutton.
7. Depending on the selection, proceed as follows:
 - If "RX" Line Drop Compensation was selected, proceed to "Setting LDC Resistance (R) and Reactance (X) Values".
 - If "Z" Line Drop Compensation was selected, proceed to "Setting LDC-Z" .

7.4.2

Setting Power Flow Forward and Power Flow Reverse LDC Resistance (R) and Reactance (X) values from the HMI



The steps necessary to set the Power Flow Forward LDC Resistance (R) and Reactance (X) values are described here. The steps to set the Power Flow Reverse LDC Resistance (R) and Reactance (X) are similar.

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Common Settings" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

4. Verify that the desired Setpoint Profile is indicated, then press the Right or Left arrow pushbutton, as necessary, to navigate to the "Power Flow Forward" menu.
5. Press the Down arrow pushbutton, as necessary, to navigate to the "LDC R Fwd" (or LDC R Rev) menu item.
6. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
LDC R Fwd
0 Volts C



The double directional arrows in the display indicate that by pressing Right or Left arrow pushbuttons the display will jump to the LDC Selection display in the Common Settings menu. Pressing any

other pushbutton except ENT will then jump back to the LDC R(X) Fwd(Rev) display.

7. Utilize the arrow pushbuttons to enter the desired LDC R value (–72 to +72 in 1 Volt increments), then press the ENT pushbutton. The display will advance to the LDC X Fwd display.
8. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
LDC X Fwd
0 Volts C
9. Utilize the arrow pushbuttons to enter the desired LDC X value (–72 to +72 in 1 Volt increments), then press the ENT pushbutton. The display will return to the LDC R Fwd display.

7.4.3

Setting Power Flow Forward and Power Flow Reverse LDC Z values from the HMI



The steps necessary to set the Power Flow Forward LDC Z value are described here. The steps to set the Power Flow Reverse LDC Z value are similar.

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Common Settings" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

4. Verify that the desired Setpoint Profile is indicated, then press the Right or Left arrow pushbutton, as necessary, to navigate to the "Power Flow Forward" menu.
5. Press the Down arrow pushbutton, as necessary, to navigate to the "LDC Z Fwd" (or LDC Z Rev) menu item.
6. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
LDC Z Fwd
0 Volts C



The double directional arrows in the display indicate that by pressing Right or Left arrow pushbuttons the display will jump to the LDC Selection display in the Common Settings menu. Pressing any other pushbutton except ENT will then jump back to the LDC Z Fwd(Rev) display

- 7. Utilize the arrow pushbuttons to enter the desired LDC Z value (0 to 72 in 1 Volt increments), then press the ENT pushbutton.

7.4.4 Setting Line Drop Compensation from TCC600

- 1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

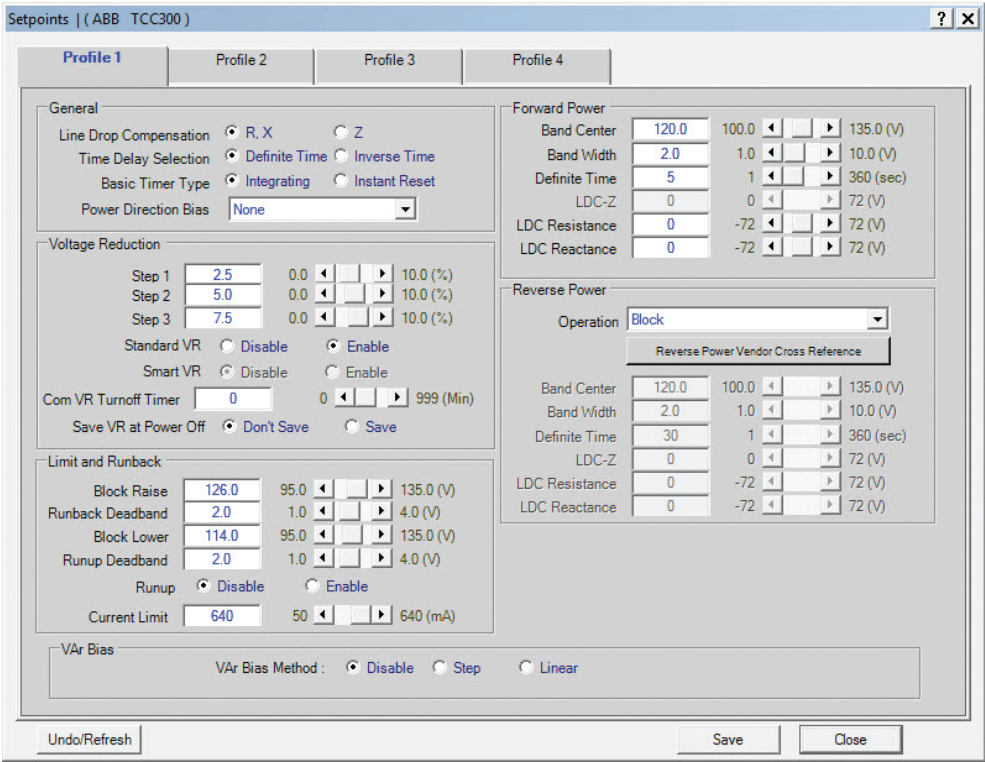


Figure 413: Setpoints Dialog Screen



Selecting "Undo/Refresh" only affects the displayed profile.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

2. Select the desired Setpoint Profile, then from the "General" section of the Setpoints dialog screen, select the desired type of Line Drop Compensation (R, X or Z).
3. From the "Forward Power" section of the Setpoints dialog screen, enter the desired LDC R, X or Z for Forward Power settings for the following:
 - R, X (–72 to +72 in 1 Volt increments)
 - Z (0 to 72 in 1 Volt increments)

If Reverse Power Flow settings are required, enter the desired LDC R, X or Z values in the "Reverse Power" section of the Setpoints dialog screen.



Selecting "Save" saves all profiles to the control.

4. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

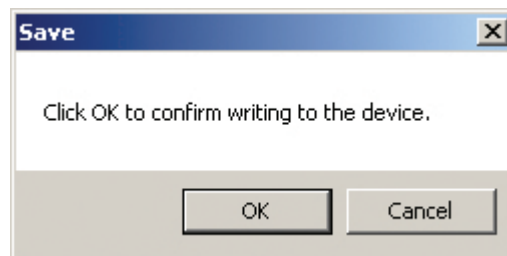


Figure 414: Save to Device Confirmation Screen

5. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

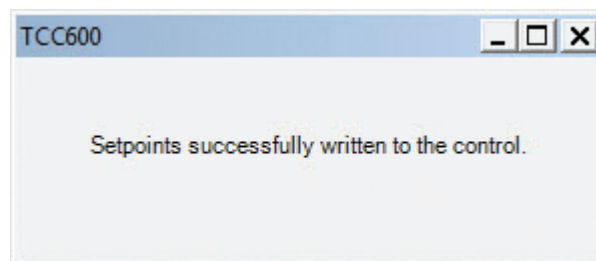


Figure 415: Setpoints Successfully Written To The Control Confirmation Screen

7.5 Basic time delay

The Basic Time Delay setting is required to inhibit the tapchanger from unnecessary operations on temporary voltage excursions and is commonly set at 30 to 60 seconds. The timer includes two selectable elements "Definite/Inverse" and "Integrating/Instant Reset".

The control will only respond to an out-of-band voltage excursion after the Basic Time Delay has timed out. The Basic Time Delay can be set as an integrating timer or an instantaneous reset timer upon the voltage return to an in-band condition. As an integrating timer, it increments during time out-of-band and decrements during time in-band, but not below zero.

The Basic Time Delay can be set to either a Definite or Inverse delay. Both types of delay will work in Forward or Reverse Power Flow. The inverse time delay will follow the curve in [Figure 416](#).

Inverse Time Example

- Bandcenter 120 V
- Bandwidth 3 V
- Inverse Time Delay Setting 120 s
- $\Delta V = (\text{Bandwidth}/2) = 1.5 \text{ V}$
- $V_{\text{in}} = 123 \text{ V}$

Voltage deviation in multiples of ΔV

$$= [V_{\text{in}} - \text{Bandcenter}] / \Delta V$$

$$= (123 - 120) / 1.5$$

$$= 2$$

Time delay from [Figure 416](#)

$$= 50\% \text{ of Inverse Time Delay setting}$$

$$= 60 \text{ sec}$$

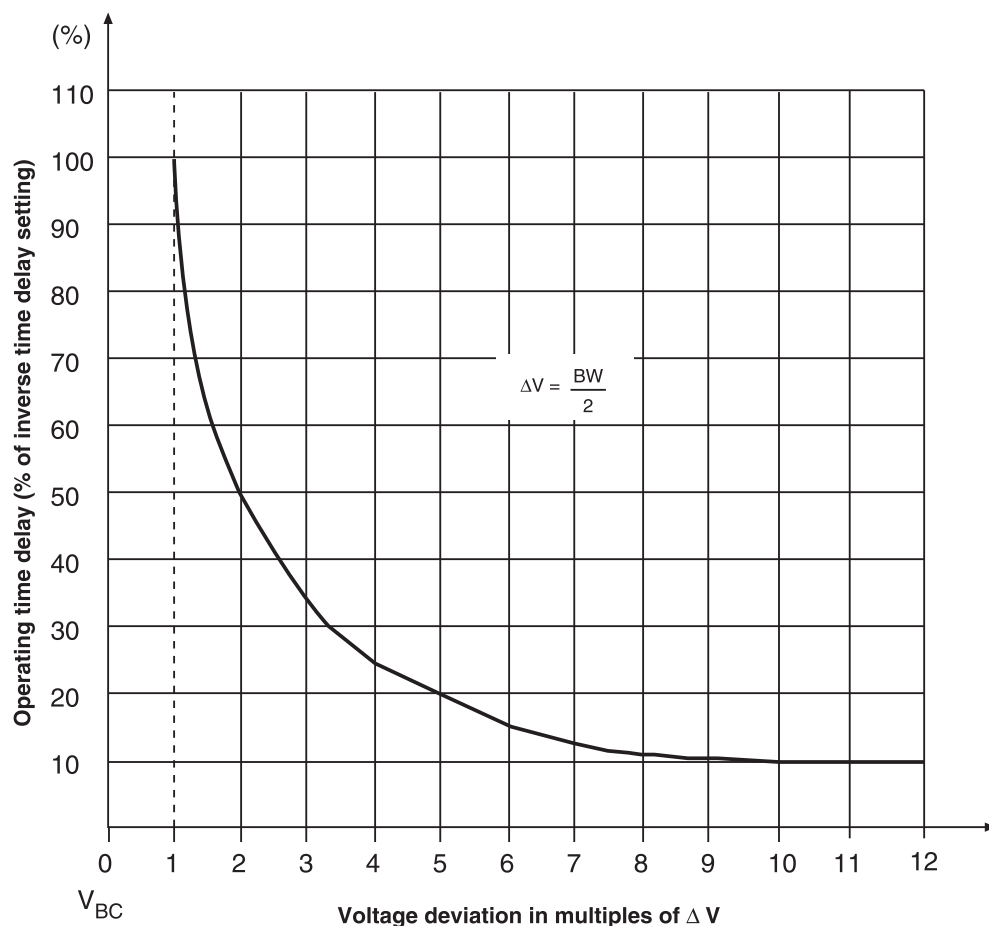


Figure 416: Inverse Time Delay Curve

7.5.1

Setting Basic Time Delay Timer Characteristic and Type from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Common Settings" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

-
4. Verify that the desired Setpoint Profile is indicated, then press the Down arrow pushbutton, as necessary, to navigate to the "Timer Characteristic" menu item.
 5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Timer Characteristic
DEFINITE C
 6. Utilizing the arrow pushbuttons, select the desired Timer Characteristic (DEFINITE or INVERSE), then press the ENT pushbutton.
 7. Press the Down arrow pushbutton, as necessary, to navigate to the "Timer Reset" menu item.
 8. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Timer Reset
INTEGRATING C
 9. Utilizing the arrow pushbuttons, select the desired Timer Reset (INTEGRATING or INSTANT RESET), then press the ENT pushbutton.

7.5.2

Setting Basic Time Delay Timer Characteristic and Type from TCC600

1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

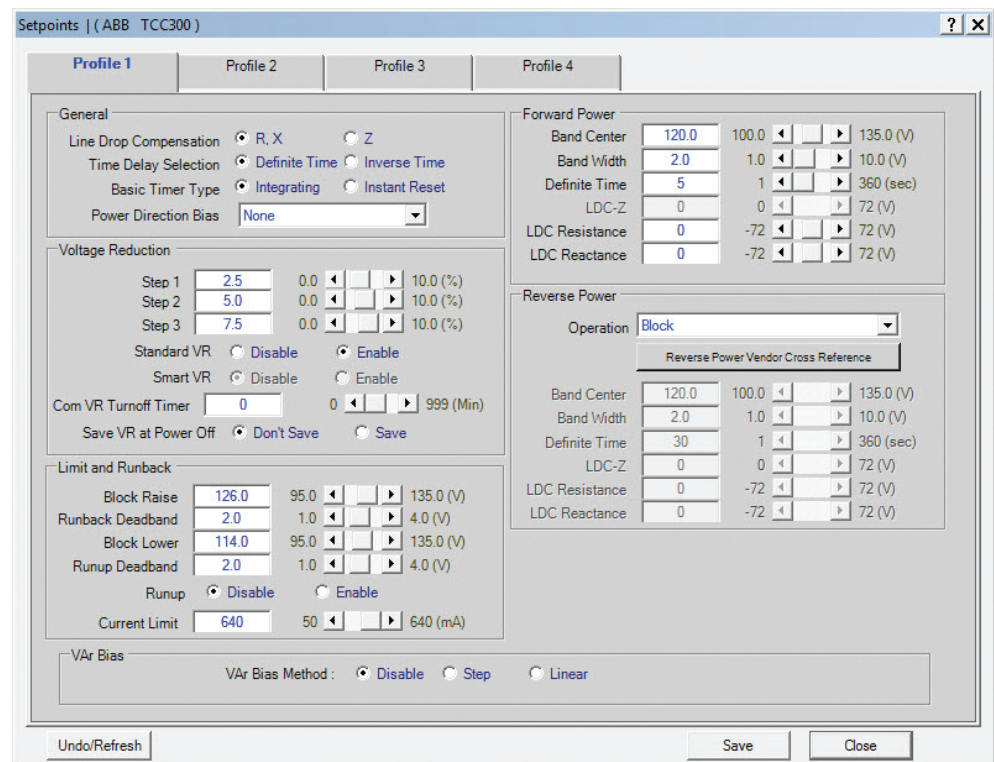


Figure 417: Setpoints Dialog Screen



Selecting "Undo/Refresh" only affects the displayed profile.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

2. Select the desired Setpoint Profile, then from the "General" section of the Setpoints dialog screen select the desired User Selectable Time Delay type (Definite or Inverse).
3. From the "General" section of the Setpoints dialog screen select the desired User Selectable Time Delay timer type (Integrating or Instant Reset).



Selecting "Save" saves all profiles to the control.

4. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

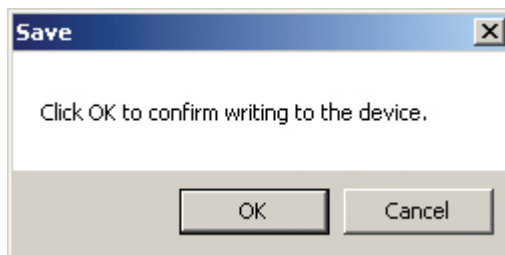


Figure 418: Save to Device Confirmation Screen

5. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

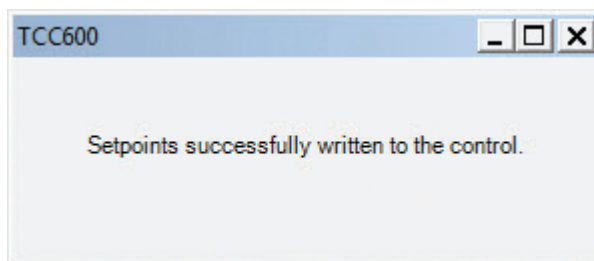


Figure 419: Setpoints Successfully Written To The Control Confirmation Screen

7.6 Reverse power operation

The importance of the correct operation of the counter extends beyond mere counting operations. One additional feature of the control is distinct "reverse power" operations depending on power flow direction. In addition to normal configurations of "block" or "ignore" during automatic reverse power detection, the control may be configured to "regulate in reverse direction" or "return to the neutral position." The control includes a power direction function for detecting the reversal of power flow in the regulator or transformer. The active power direction is based on the flow of real power and is not confused by reactive power flow in either direction.

The directional operation of the control will be reversed whenever the power flow reverses to as little as 2% (4 mA) of the nominal 200 mA rating of the control. For example, to change from a normal forward power to reverse operation, 4 mA of the real component of the load current must be detected in the reverse direction. To then revert back to the normal forward direction operation, 4 mA of the real component must be detected in the forward direction. This establishes an 8 mA "hysteresis" effect.

Additionally, the control can be "biased" in either the forward or reverse direction depending on circuit or system configuration. This essentially removes the 2% requirement from the change to the biased direction. For example, a control biased in the forward direction will change to the reverse direction as described above. It will require only that the power flow be in the forward direction to change back to forward operation. This biasing reduces the "hysteresis" effect to 4 mA from the original 8 mA.

In order for the "regulate in reverse direction" or "return to the neutral position" to implement properly, two prerequisites are required. The first is Tap Position Knowledge. Without knowledge of the tap position it would be impossible for the control to run the tapchanger to the neutral position. The second is source side voltage. Without knowledge of the source side voltage, it would be impossible to regulate it.

Detecting Reverse Power

Reverse power flow exists whenever the real component of the load current changes direction from forward and remains until another reversal to forward power flow occurs. The control reliably determines power direction with as little as 2% of the real component of the nominal 200 mA load current (4.0 mA). A LED on the front panel will illuminate whenever the control senses a reverse power condition.

Power Direction Bias Setpoints

Power Direction Bias includes three settings to determine how the control will switch between forward and reverse power operation. The three settings are None, Forward Bias, and Reverse Bias.

Table 65: *Power Direction Bias settings*

Setting	Description
None	When the Power Direction Bias function is set to "None", the control applies an 8 mA hysteresis band with a bandcenter of 0 load current (+4 mA to –4 mA) to switch between forward and reverse power. The control will switch from forward power to reverse power when the load current exceeds –4 mA (reverse direction). The control will switch from reverse power to forward power when the load current exceeds +4 mA (forward direction).
Forward Bias	When the Power Direction Bias function is set to "Forward Bias", the control applies a 0 mA to –4 mA hysteresis band to switch between forward and reverse power. The control will switch from reverse power to forward power when load current is > 0 mA (forward direction). The control will switch from forward power to reverse power when the load current exceeds –4 mA (reverse direction).
Reverse Bias	When the Power Direction Bias function is set to "Reverse Bias", the control applies a 0 mA to +4 mA hysteresis band to switch between forward and reverse power. The control will switch from forward power to reverse power when load current is < 0 mA (reverse direction). The control will switch from reverse power to forward power when the load current exceeds +4 mA (forward direction).

Reverse Power Operation Mode

Upon detection of power reversal, after a 5 second delay, the control will operate in the selected mode. The operating mode is selected from the following options:

Block – Inhibits automatic tapchange operation. This locks the tapchanger on the tap position in use at the time reverse power flow is detected. It is the recommended setting for independent power producers or in situations when reverse power flow is not expected. The control will revert to normal operation when forward power flow resumes.

Regulate Forward (Ignore) – The control will take no different action than in the forward direction. It essentially does not use the power direction in the control decisions. This is the same as a control which does not have power direction knowledge.

Regulate Reverse and Regulate Reverse Measured –The control will detect reverse power flow and regulate according to reverse power settings as selected in the Setpoint Menu. With tap position knowledge, the control calculates the source-side potential without the use of a source side VT. This feature is designed for use with feeder voltage regulators which continue to operate in a radial mode after system switching causes the power flow reversal.

For Regulate Reverse the source voltage is calculated by knowing the local voltage, the load current, and the tap position using a presumed regulator impedance. That impedance is a function of the tap position. The calculated source voltage is only valid with a 5/8 % step-voltage regulator.

When Reverse power is detected and the Operation Mode is in "Regulate Reverse Measured", the control will energize an internal contact that will switch the input to the VT from Load side to Source side. After a 4 cycle delay, the source side voltage will be measured, the load voltage at this instant will be displayed as zero. In forward power direction, the control will switch the input back to the load side voltage.

With the control recognizing reverse power flow, the following occurs:

- The REV PWR LED is illuminated.
- Reverse power setpoints are used.
- Source voltage is calculated in case of Regulate Reverse and measured in case of Regulate Reverse Measured and motor output commands are reversed. For example, when the voltage is high, the control raises the tap thereby lowering the voltage and a lower is indicated on the front panel LEDs.

Return to Neutral – To use this feature, a counter input must be provided, and KeepTrack™ tap information modes must be enabled.

The Return to Neutral feature will cause the tap position to be driven to neutral when reverse power is detected. Tap position will be driven to neutral regardless of the voltage or currents present at the control. Once neutral is reached, the tap position will remain unchanged as long as reverse power is present. Normal operation will resume when forward power is detected.

This mode is intended as a safe response to a power reversal on a system which can have conflicting situations. As described earlier, a radially operating system with reverse power should be set to "Regulate Reverse Measured" However, if a DG causes a power reversal, the proper setting is usually "Ignore". In an application where both conditions are possible and it is not possible for the control to determine the cause of power reversal, the proper setting of "Return to Neutral" is advised.

Distributed Generation – Distributed Generation allows alternate LDC R and X values to be applied to the control when reverse power is detected. The factory setting is BLOCK. This mode is intended for use on distribution systems that have the possibility of power reversal because of distributed generation (DG) on the feeders. In these applications, the DG usually does not have the capacity to control the voltage with the more powerful system intact.

The condition required for DG to control the voltage is the generation and transmission of large amounts of VARs through the line impedance back towards the system source. Usually two items prohibit this action:

- The ability of the DG to generate those amounts of VARS.
- The contractual obligations enforced by many utilities that the DG only affect KWs on the system.

Smart Reverse Power (Auto Determination)

Due to the increased use and larger capacities of Distributed Generation, it is possible for a regulator to see a reverse power condition requiring more than one reverse power mode depending on the cause of the reverse power condition; either Distributed Generation mode or Regulate In Reverse/Regulate in Reverse Measured. The TCC300 provides two new reverse power modes, "Auto Determination" and "Auto Determination Measured" which allow the control to intelligently choose which reverse power mode applies at the time reverse power is sensed.

Auto Determination and Auto Determination Measured – This feature performs the following sequence when reverse power is detected:

1. Distributed Generation Mode will be applied initially.
2. On the next tap operation, Load Voltage will be measured before and one second after the tap (defined as 1 second after the operation counter has incremented either due to a counter input or motor hold). The absolute magnitude value of this difference is stored internally as the Tap Delta Voltage.
 - 2.1. If the Tap Delta Voltage is greater than 0.4 Vac, the control stays in Distributed Generation Mode and will behave normally in this mode with no further measurements of Load Voltage needed.
 - 2.2. If the Tap Delta Voltage is less than or equal to 0.4 Vac, the control increments an internal counter designed to keep track of how many times the Tap Delta Voltage is less than 0.4 Vac. The next tap operation will again measure Load Voltage in the same manner. If the control sees two consecutive Tap Delta Voltage measurements less than or equal to 0.4 Vac, the control changes from Distributed Generation Mode to either Regulate Reverse if "Auto Determination" has been selected, or Regulate Reverse Measured if "Auto Determination Measured" has been selected.
 - 2.3. If Tap Delta Voltage is greater than 0.4 Vac on the second tap operation, the control does not increment the internal counter, and stays in Distributed Generation Mode. The control will then measure Tap Delta Voltage on the next tap. If that third tap has a Tap Delta Voltage greater than 0.4 Vac, then the control remains in Distributed Generation Mode and the internal counter is cleared. If the third tap has a Tap Delta Voltage less than or equal to 0.4 Vac, the condition meets the requirements of 2b above and the control will respond accordingly.
3. Once the control has determined which Reverse Power mode to apply using the method described above, it will operate in that mode as long as Reverse Power is detected.

TCC600 Reverse Power Vendor Cross Reference

The Reverse Power section of the TCC600 Setpoints screen also contains a link which displays the "Reverse Power Vendor Cross Reference" table showing Cooper/Siemens reverse power names and their ABB equivalents.

Reverse Power Vendor Cross Reference	
Beckwith Reverse Power Mode	Cooper/Siemens Reverse Power Mode
Block	Locked Forward Mode
Regulate Forward (Ignore) *	Reverse Idle Mode
Regulate Reverse	None
Return to Neutral *	Neutral Idle Mode
Regulate in Reverse (Measured) *	Bi-Directional Mode
Distributed Generation	Cogeneration Mode
Auto Determination	None
*Low Current block feature must also be enabled to be equivalent to this Cooper Reverse Power Mode.	
OK	

Figure 420: TCC600 Reverse Power Vendor Cross Reference Table

7.6.1 Setting Reverse Power Operation and Power Direction Bias Mode from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Common Settings" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

4. Verify that the desired Setpoint Profile is indicated, then press the Down arrow pushbutton, as necessary, to navigate to the "Rev Power Operation" menu item.

-
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Rev Power Operation
BLOCK C
 6. Utilizing the arrow pushbuttons select the desired Reverse Power Operation mode and press the ENT pushbutton.
 - BLOCK
 - IGNORE
 - REGULATE REVERSE
 - RETURN TO NEUTRAL
 - REG. R MEASURED SRCC
 - DG Mode
 - AUTO DETERMINE
 - AUTO DETERMINE M
 7. Press the Down arrow pushbutton, as necessary, to navigate to the "Power Direction Bias" menu item.
 8. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Power Direction Bias
NONE C
 9. Utilizing the arrow pushbuttons select the desired Power Direction Bias mode (NONE, FORWARD or REVERSE), then press the ENT pushbutton.

7.6.2

Setting Reverse Power Operation and Power Direction Bias Mode from TCC600

1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

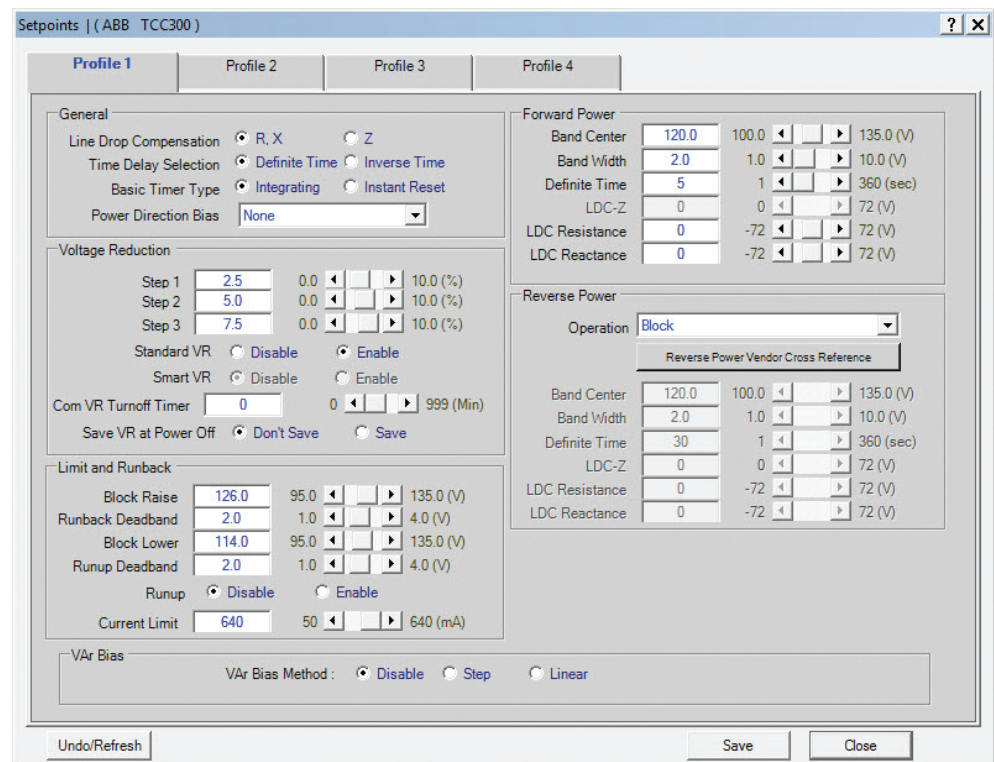


Figure 421: Setpoints Dialog Screen



Selecting "Undo/Refresh" only affects the displayed profile.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

2. Select the desired Setpoint Profile, then from the "General" section of the Setpoints dialog screen select the desired Power Direction Bias mode (None, Forward or Reverse).
3. From the "Reverse Power" section of the Setpoints dialog screen select the desired Reverse Power Operation mode:
 - Block
 - Regulate Forward (Ignore)
 - Regulate Reverse
 - Return to Neutral
 - Regulate Reverse (Measured)

- Distributed Generation
- Auto Determination
- Auto Determination (Measured)



Selecting "Save" saves all profiles to the control.

4. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

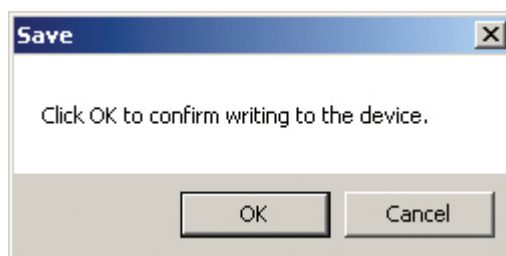


Figure 422: Save to Device Confirmation Screen

5. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

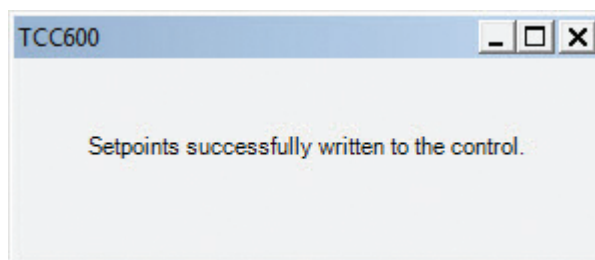


Figure 423: Setpoints Successfully Written To The Control Confirmation Screen

7.7 Power flow settings

Bandcenter

The center of the voltage band is adjustable from 100.0 to 135.0 Vac in 0.1 volt increments (for example, 120.0 Vac).

Bandwidth

The regulator uses discrete steps and the Bandwidth must have a width that allows at least one tapchange position where the control remains satisfied. To minimize excessive operations on the regulator, this bandwidth is usually set to include two or three in-band tap operation positions.

The range is settable from 1.0 to 10.0 volts in 0.1 volt increments, and 2 volts minimum is recommended. This setting is the total bandwidth.

7.7.1

Setting Bandcenter and Bandwidth from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Common Settings" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

4. Verify that the desired Setpoint Profile is indicated, then press the Right or Left arrow pushbutton, as necessary, to navigate to the "Power Flow Forward" menu item.



The steps necessary to set Bandcenter Forward are described here. The steps to set Bandcenter Reverse are similar.

5. Press the Down arrow pushbutton, as necessary, to navigate to the "Bandcenter Fwd" menu item.
6. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Bandcenter Fwd
120.0 Volts C
7. Utilizing the arrow pushbuttons enter the desired Bandcenter Fwd value (100.0 to 135.0 in 0.1 Volt increments), then press the ENT pushbutton. The following will be displayed reflecting the value that was entered.
8. Press the Down arrow pushbutton, as necessary, to navigate to the "Bandwidth Fwd" menu item.
9. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Bandwidth Fwd

2.0 Volts C

10. Utilizing the arrow pushbuttons enter the desired Bandwidth Fwd value (1.0 to 10.0 Volts in 0.1 Volt increments), then press the ENT pushbutton.

7.7.2 **Setting Bandcenter and Bandwidth from TCC600**

1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

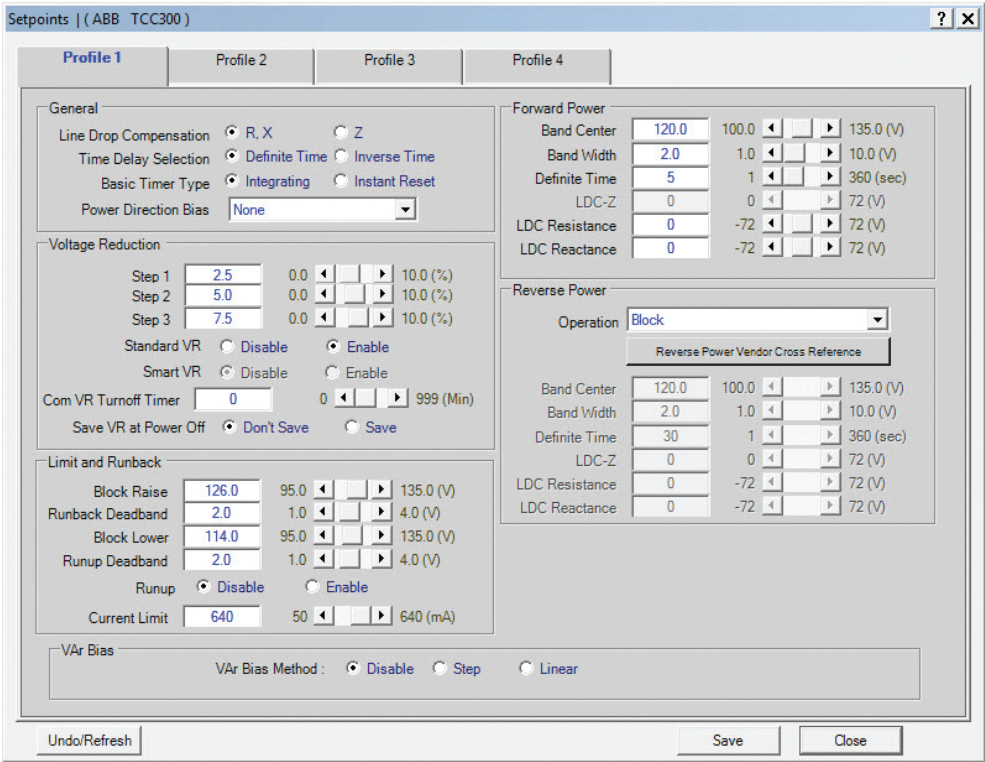


Figure 424: *Setpoints Dialog Screen*



Selecting "Undo/Refresh" only affects the displayed profile.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

2. Select the desired Setpoint Profile, then from the "Forward Power" or "Reverse Power" section of the Setpoints dialog screen enter the desired Bandcenter value (100.0 to 135.0 in 0.1 Volt increments).
3. From the "Forward Power" or "Reverse Power" section of the Setpoints dialog screen enter the desired Bandwidth value (1.0 to 10.0 Volts in 0.1 Volt increments).



Selecting "Save" saves all profiles to the control.

4. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

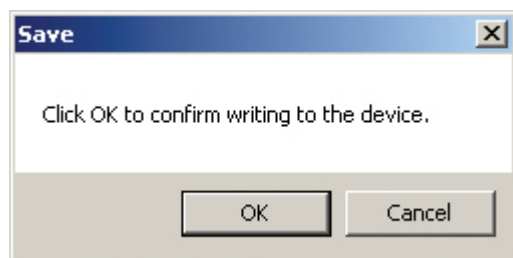


Figure 425: Save to Device Confirmation Screen

5. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

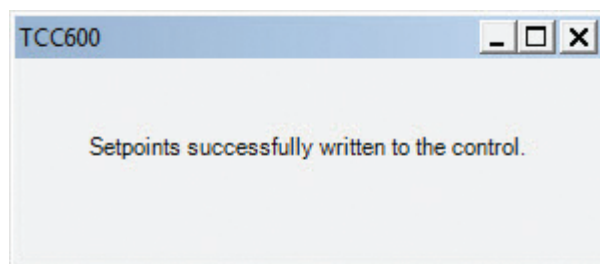


Figure 426: Setpoints Successfully Written To The Control Confirmation Screen

7.7.3

Setting the Definite or Inverse Delay from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbuttons, as necessary, to navigate to the "Common Settings" menu.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

4. Verify that the desired Setpoint Profile is indicated, then press the Right or Left arrow pushbutton, as necessary, to navigate to the "Power Flow Forward" menu item.



The steps necessary to set Power Flow, Forward Definite (Inverse) Delay are described here. The steps to set Power Flow Reverse Definite (Inverse) Delay are similar.

5. Press the Down arrow pushbutton, as necessary, to navigate to the "Definite (Inverse) Delay Fwd" menu item.
6. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Definite Delay Fwd
30 Sec C



The double directional arrows in the display indicate that by pressing Right or Left arrow pushbuttons the display will jump to the Timer Characteristic Selection display in the Common Settings menu. Pressing any other pushbutton except ENT will then jump back to the Definite Delay Fwd (Rev) display.

7. Utilizing the arrow pushbuttons, enter the desired Definite (Inverse) Delay Fwd value (1 to 360 Seconds in 1 Second increments), then press the ENT pushbutton.

7.7.4

Setting the Definite or Inverse Delay from TCC600

1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

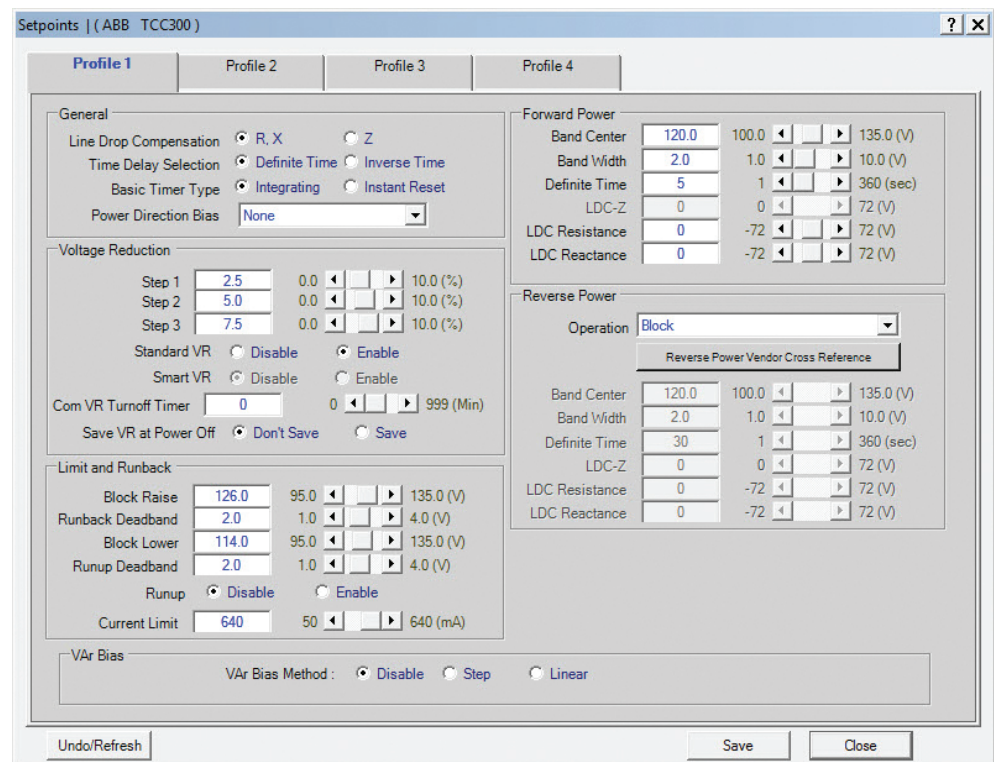


Figure 427: Setpoints Dialog Screen



Selecting "Undo/Refresh" only affects the displayed profile.



Editing Setpoints in the wrong Setpoint Profile can cause the control to operate incorrectly.

2. Select the desired Setpoint Profile, then from the "Forward Power" and/or "Reverse Power" section of the Setpoints dialog screen enter the desired Definite (Inverse) Delay Fwd or Rev value (1 to 360 Seconds in 1 Second increments).



Selecting "Save" saves all profiles to the control.

3. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

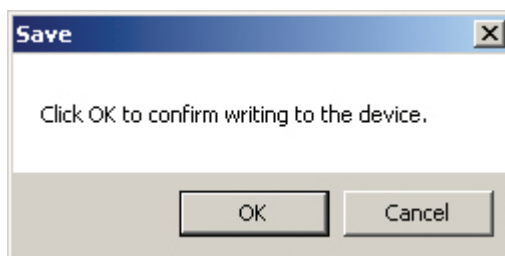


Figure 428: Save to Device Confirmation Screen

4. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

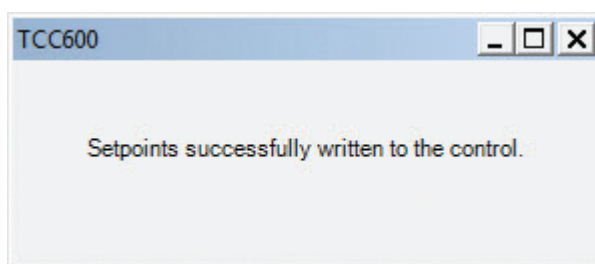


Figure 429: Setpoints Successfully Written To The Control Confirmation Screen

7.8

VAr bias

This feature is intended for but not restricted to use with distribution feeders which have switched capacitor banks controlled by ABB Autodaptive® Capacitor Controls.

The use of VAr Bias allows the TCC300 Tapchanger Control to coordinate its operation with Autodaptive Capacitor Control devices on the distribution system in order to minimize losses, subsequent voltage variations, and equipment capacity requirements of transmitting VArS. This function is enabled through TCC600® Communications Software or from the control HMI.

The VAr Bias feature includes two selectable VAr Bias methods, "Step" and "Linear". When enabled in either "Step" or "Linear" mode, the control will bias the Bandcenter based on the amount of measured reactive load current.

7.8.1 Step VAr bias method

Table 66: *Step VAr Bias method settings*

Setting	Description
Disable on Reverse Power	When selected, the control will disable VAr Bias when Reverse Power is detected.
Forward Power Max 3 Phase Cap Bank Size	Adjustable from 4 to 12000 KVar.
Reverse Power Max 3 Phase Cap Bank Size	Adjustable from 4 to 12000 KVar.
Lead % Bank Size Pickup	Defines a Lower negative VAr limit in percentage of the Max Cap Bank size below which the control will increase the upper band edge by the amount defined by VAr Bias Voltage Step.
Lag % Bank Size Pickup	Defines an Upper positive VAr limit in percentage of the Max Cap Bank size above which the control will decrease the lower band edge by the amount defined by VAr Bias Voltage Step.
VAr Bias Voltage Step	Amount by which the control will increase or decrease the Upper or Lower band edges when there is a VAr Bias out of band situation.
Max VAr Bias Duration	Maximum allowable time in minutes the control will bias the voltage edge.

When the control determines that the reactive power is lower or greater than the limits defined by the Lead or Lag % pickup setting, the control will start an inverse VAr Bias Pickup Trigger timer. After the inverse time expires, the control will either increase or decrease the effective bandcenter by the amount defined by the VAr Bias Step Voltage setting depending on the direction of the reactive power. At this moment VAr Bias becomes active. The use of an inverse timer is to avoid jittering in the VAr Bias detection and also to provide a faster response as the difference between the Upper or Lower VAr Bias band edge and the measure VArS increase. For example, suppose the system is highly inductive (positive VArS) the load voltage will tend to decrease, when VAr Bias is in effect, the control will automatically reduce the lower band edge and thus the control will be back in band, allowing the downstream cap controls to operate.

The longest allowable time delay before VAr Bias comes into effect is 10 seconds. The inverse timer follows the following equation:

$$\text{Time delay} = 10 * (\text{Upper or Lower VAr Limit}) / \text{IVAr measured.}$$

Upper VAr limit is defined as Lag % Bank Size Pickup multiply by a third of Max Cap Bank size.

Lower VAr limit is defined as Lead % Bank Size Pickup multiply by a third of Max Cap Bank size.

The VAr Bias Pickup trigger timer will instantly reset to ZERO if the reactive power measurement returns within the allowable band before VAr Bias becomes active.

Once VAr Bias is active, the control will remove the VAr Bias condition for the following situations.

- When Max VAr Bias Duration is exceeded (see below description). – When reactive power returns back in band within 90% of the VAr limits set by Lag or Lead % Bank Size Pickup settings. For example, if the Upper VAr limit is 75 % of 12000 KVAR bank then the level below which the control will return in band after going out above the Upper VAr limit is $9 \times 3000 / 10 = 2700$ KVAR. Similarly if the Lower VAr limit is at -3000 then the in band limit is -2700 KVAR.

The application of both the TCC300 Tapchanger Control and the Autodaptive Capacitor Control(s) on a circuit provides for an interaction between the devices that provides for faster response in times of rapidly changing conditions on the distribution system. For example, if one regulator is serving 6 feeders, with each feeder using 1200 KVAR pole-top feeder capacitor banks, and if each feeder is correctly compensating to within 400 KVAR, all feeder bank controls would be considered to be operating correctly. However the regulator would still be transforming up to 2400 KVAR (six feeders times 400 KVAR) from the transmission system. The TCC300 Control on the regulator would detect this condition and affect additional line capacitor operation by making a temporary voltage level setting change. By effectively lowering its setting (delaying a voltage tap RAISE for a short time), line capacitor bank control could be biased into operation sooner by the tapchanger control. This would reduce losses of the circuit, provide a better voltage profile and reduce the number of tapchanges.

In effect, when enabled user sets VAr Bias setting values at which bandcenter/bandwidth is shifted to influence downstream Capacitor Control(s) into operation. Shifted bandcenter/bandwidth returns to prior settings after measured VAr level returns within band. If Max VAr bias Duration is exceeded, the shifted bandcenter/bandwidth returns to prior setting and an ALARM is activated if configured to do so. The alarm will also have corresponding communication events reported. When VAr Bias is active the OSC and SOE may be triggered if selected.

7.8.1.1

Enabling Step VAr Bias Method from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "VAr Bias" menu.

4. Press the Down arrow pushbutton, as necessary, until the "VAr Bias Method" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
`Set VAr Bias Method
disable C`
6. Utilizing the Up/Down arrow pushbuttons, select "STEP", then press the ENT pushbutton. The following will be displayed:
`Set VAr Bias Method
STEP`
7. Press the Up/Down arrow pushbuttons, as necessary, to navigate to the "Disable on Rev Pwr" menu item.
8. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
`Disable on Rev Pwr
disable C`
9. Utilizing the Up/Down arrow pushbuttons, select either "Enable or disable", then press the ENT pushbutton.
10. Follow the procedure above to enter the desired:
 - Forward Max Cap Bank Size
 - Reverse Max Cap Bank Size
 - Lead % Pickup
 - Lag % Pickup
 - VAr Bias Voltage Step
 - Max VAr Bias Time

7.8.1.2

Enabling Step VAr Bias Method from TCC600

1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

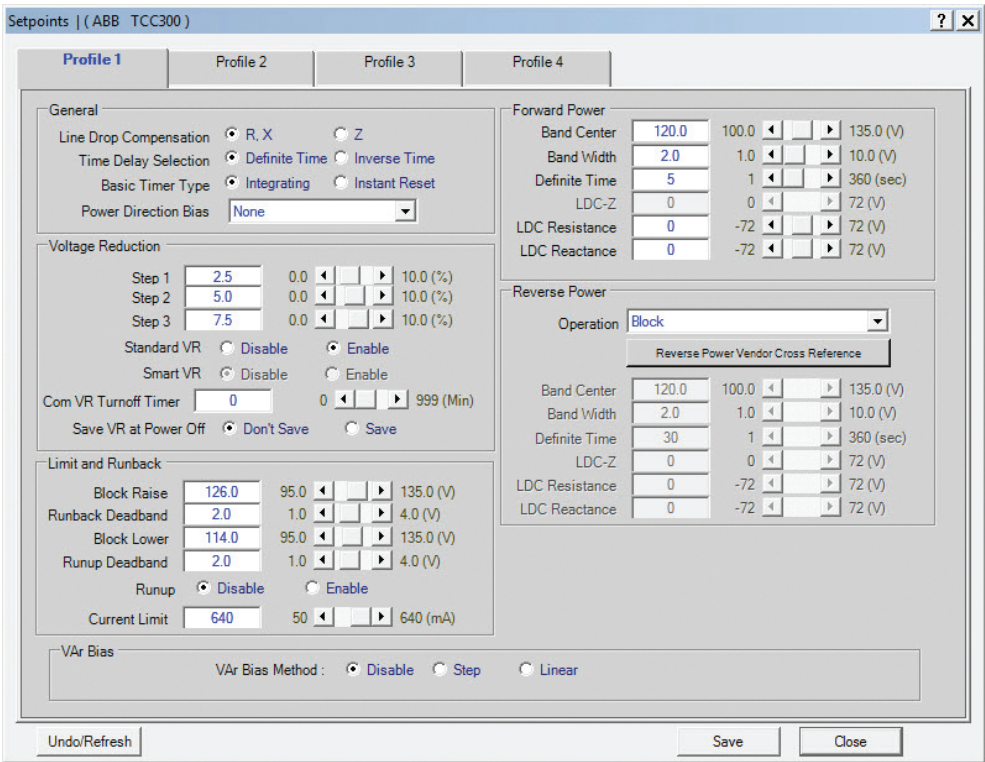


Figure 430: Setpoints Dialog Screen

2. From the VAr Bias section of the dialog screen select "Step". TCC600 will display the Step VAr Bias settings.

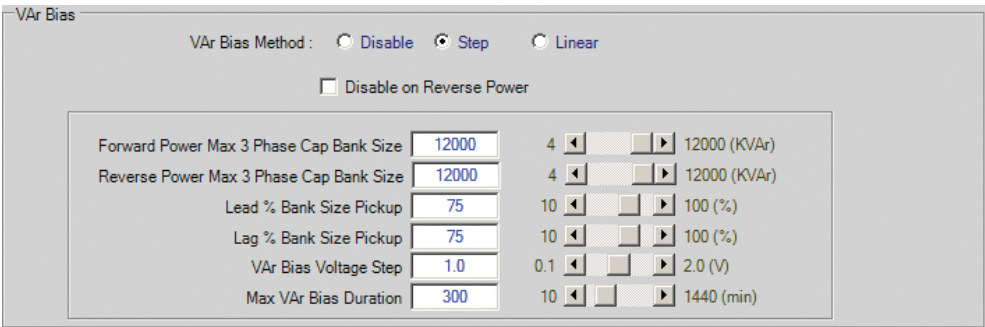


Figure 431: Setpoints Dialog Screen With Step VAr Bias Enabled

3. Enter the desired settings for the following:

- If desired, select "Disable on Reverse Power".
 - Enter a Forward Power Maximum 3 Phase Capacitor Bank Size (4 to 12,000 kVAr)
 - Enter a Reverse Power Maximum 3 Phase Capacitor Bank Size (4 to 12,000 kVAr)
 - Lead % Bank Size Pickup (10 to 100%)
 - Lag % Bank Size Pickup (10 to 100%)
 - VAr Bias Voltage Step (0.1 to 2.0 V)
 - Max VAr Bias Duration (10 to 1440 min)
4. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

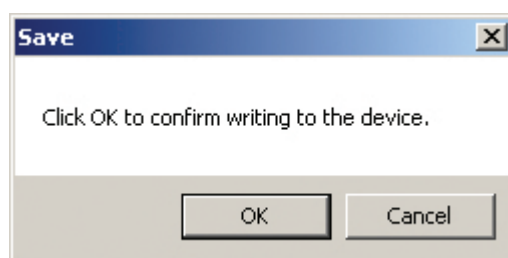


Figure 432: Save to Device Confirmation Screen

5. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

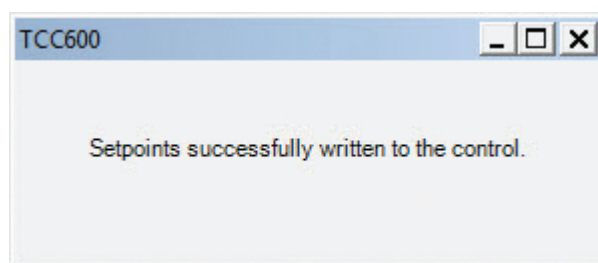


Figure 433: Setpoints Successfully Written To The Control Confirmation Screen

7.8.2

Linear VAr bias method

Table 67: *Linear VAr Bias method settings*

Setting	Description
Disable on Reverse Power	When selected, the control will disable VAr Bias when Reverse Power is detected.
Current Multiplier Base Value	Adjustable from 0 to 32600.
No Voltage Reduction – Linear Voltage Bias (-X)	The Linear Voltage Bias (-X) setting defines the amount of voltage bias to be applied to the Bandcenter when at 1 PU reactive current loading. Adjustable from -72 to 0 Volts at 200 mA Reactive Load.
No Voltage Reduction – Linear Voltage Bias (-X) Limit	The Linear Voltage Bias (-X) Limit, limits the total voltage bias that can affect the control Bandcenter. Adjustable from -5.0 to 0.0 Volts.
During Voltage Reduction – Linear Voltage Bias (+X)	The Linear Voltage Bias (+X) setting defines the amount of voltage bias to be applied to the Bandcenter when at 1 PU reactive current loading. Adjustable from 0 to 72 Volts at 200 mA Reactive Load.
During Voltage Reduction – Linear Voltage Bias (+X) Limit	The Linear Voltage Bias (+X) Limit, limits the total voltage bias that can affect the control Bandcenter. Adjustable from 0.0 to 5.0 Volts.

The Linear VAr Bias feature allows a Regulator or LTC Control to coordinate operations with Capacitor Banks downstream of the Regulator or LTC. The Linear VAr Bias feature utilizes the reactive load current measurement capability of the TCC300 to adjust the Bandcenter of the control in order to bias downstream capacitors to operate to maintain a flat voltage profile.

When enabled the regulator will bias the Bandcenter of the control based on the amount of measured reactive load current. Additionally, if LDC settings are non-zero values in the control, they are disabled while Linear VAr Bias is selected. A Linear Voltage Bias (-X) Setting is created which defines the amount of voltage bias to be applied to the Bandcenter when at 1 PU reactive current loading. A Linear Voltage Bias (-X) Limit is created which limits the total voltage bias that can affect the control Bandcenter.

A Max Bias Duration setting is also included that limits the maximum allowable time in minutes that the control will bias the voltage edge as long as no Voltage Reduction (VR) is in effect.

When a VR is in effect, the Linear Voltage Bias (+X) and a Linear Voltage Bias (+X) Limit are used instead of the (-X) Limits to bias the control Bandcenter. In effect, when enabled the user sets the Linear VAr Bias setting values at which bandcenter/bandwidth is shifted to influence downstream Capacitor Control(s) into operation.

The shifted bandcenter/bandwidth returns to prior settings after the measured VAr level returns within band. If Max VAr Bias Duration is exceeded, the shifted bandcenter/bandwidth returns to prior setting and an ALARM is activated if configured to do so. The alarm will also have corresponding communication events reported. When VAr Bias is active the OSC and SOE may be triggered if selected.

7.8.2.1

Enabling Linear VAr Bias Method from the HMI

1. Press the Up Arrow (SETP Hot Button) pushbutton to wake the unit. The menu will advance to "SETPPOINTS".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Profile Settings
3. Press the Right or Left arrow pushbutton, as necessary, to navigate to the "VAr Bias" menu.
4. Press the Down arrow pushbutton, as necessary, until the "VAr Bias Method" screen is displayed.
5. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Set VAr Bias Method
disable C
6. Utilizing the Up/Down arrow pushbuttons, select "Linear", then press the ENT pushbutton. The following will be displayed:
Set VAr Bias Method
LINEAR
7. Press the Up/Down arrow pushbuttons, as necessary, to navigate to the "Disable on Rev Pwr" menu item.
8. Press the ENT pushbutton. If prompted, enter a valid Level Access Code. The following will be displayed:
Disable on Rev Pwr
disable C
9. Utilizing the Up/Down arrow pushbuttons, select either "Enable or disable", then press the ENT pushbutton.
10. Follow the procedure above to enter the desired:
 - Current Multiplier Base Value
 - Linear Voltage Bias^[1] -X
 - Linear Voltage Bias -X Limit
 - Linear Voltage Bias^[1] +X
 - Linear Voltage Bias +X Limit

[1] Voltage Bias at 200 mA Reactive Load

7.8.2.2

Enabling Linear VAr Bias Method from TCC600

1. Select **Setup/Setpoints** from the TCC600® toolbar. TCC600 will display the Setpoints dialog screen.

The screenshot shows the 'Setpoints' dialog box for an ABB TCC300 device. The dialog is divided into several sections:

- General:** Includes Line Drop Compensation (R, X, Z), Time Delay Selection (Definite Time, Inverse Time), Basic Timer Type (Integrating, Instant Reset), and Power Direction Bias (None).
- Voltage Reduction:** Includes Step 1, Step 2, and Step 3 settings, Standard VR (Disable, Enable), Smart VR (Disable, Enable), Com VR Turnoff Timer, and Save VR at Power Off (Don't Save, Save).
- Limit and Runback:** Includes Block Raise, Runback Deadband, Block Lower, Runup Deadband, Runup (Disable, Enable), and Current Limit.
- VAr Bias:** Includes VAr Bias Method (Disable, Step, Linear).
- Forward Power:** Includes Band Center, Band Width, Definite Time, LDC-Z, LDC Resistance, and LDC Reactance.
- Reverse Power:** Includes Operation (Block), Reverse Power Vendor Cross Reference, Band Center, Band Width, Definite Time, LDC-Z, LDC Resistance, and LDC Reactance.

At the bottom of the dialog, there are buttons for 'Undo/Refresh', 'Save', and 'Close'.

Figure 434: Setpoints Dialog Screen

2. From the VAr Bias section of the dialog screen select "Linear". TCC600 will display the Linear VAr Bias Settings.

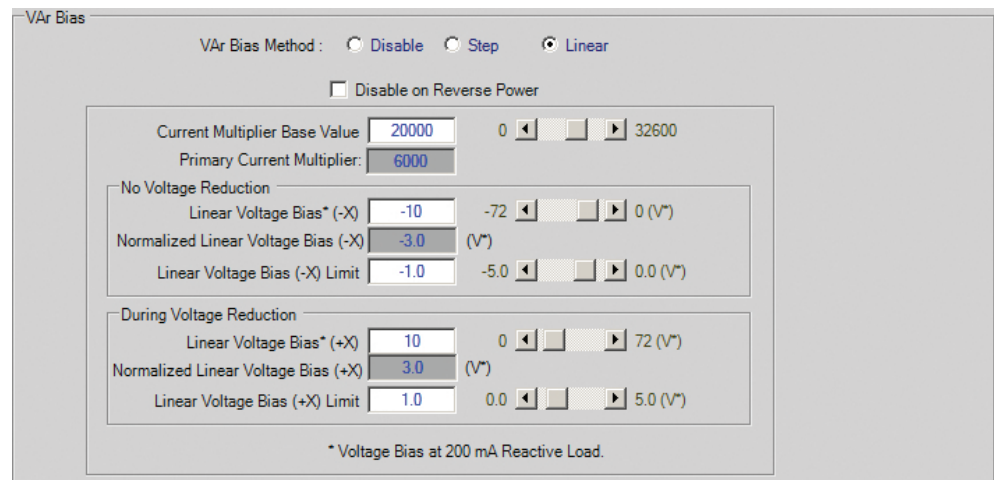


Figure 435: Setpoints Dialog Screen With Linear VAr Bias Enabled

3. Enter the desired settings for the following:
 - If desired, select "Disable on Reverse Power".
 - Enter a Current Multiplier Base Value (0 to 32600)
 - Enter a "No Voltage Reduction" Linear Voltage Bias (-X) setting (-72 to 0 Volts at 200 mA Reactive Load)
 - Enter a "No Voltage Reduction" Linear Voltage Bias (-X) Limit setting (-5.0 to 0.0 Volts).
 - Enter a "During Voltage Reduction" Linear Voltage Bias (+X) setting (0 to 72 Volts at 200 mA Reactive Load)
 - Enter a "During Voltage Reduction" Linear Voltage Bias (+X) Limit setting (0.0 to 5.0 Volts).
4. Select **Save**. TCC600 will display a "Confirm Writing to Device" confirmation screen.

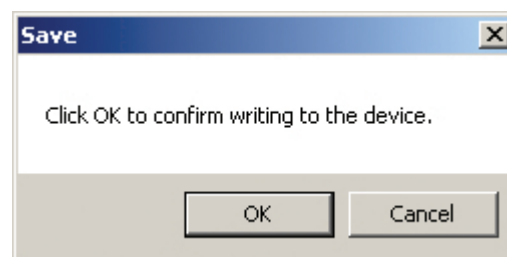


Figure 436: Save to Device Confirmation Screen

5. Select **OK**. TCC600 will display a "Setpoints Successfully Written to Control" confirmation screen.

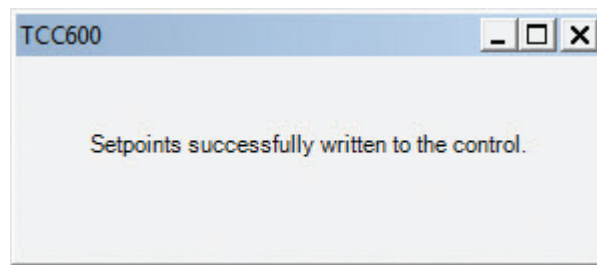


Figure 437: Setpoints Successfully Written To The Control Confirmation Screen

Section 8 Installation

8.1 Installation

An adapter panel or a M-2050 Surface Mounting Kit must be used with the TCC300 Tapchanger Control. Each panel adapts the control as a transformer or regulator control replacement and provides the external connections necessary for operation via terminal blocks on the rear of the adapter panel.

In lieu of using one of the adapter panels to mount the control, the M-2050 Surface Mounting Kit permits surface mounting. The kit consists of two right angle mounting brackets which bolt to the rear top and bottom of the control. All necessary hardware is included in the kit. Also included is a 24-pin, in-line female connector with six-foot pigtails on each pin to facilitate custom connection of the control in original equipment manufacturers' applications.

8.2 External connections

Available connectors include:

- One RS-485
- One Fiber Optic connection
- One RJ-45 (optional)
- One 24-pin blue connector
- One RS-232 DE9S connectors
- In-line, 6-pin connector for the M-2025B(D) Current Loop Module
- Control Power Backup Input option
- Source Voltage Input
- 1 Auxiliary Output
- 3 Auxiliary Inputs

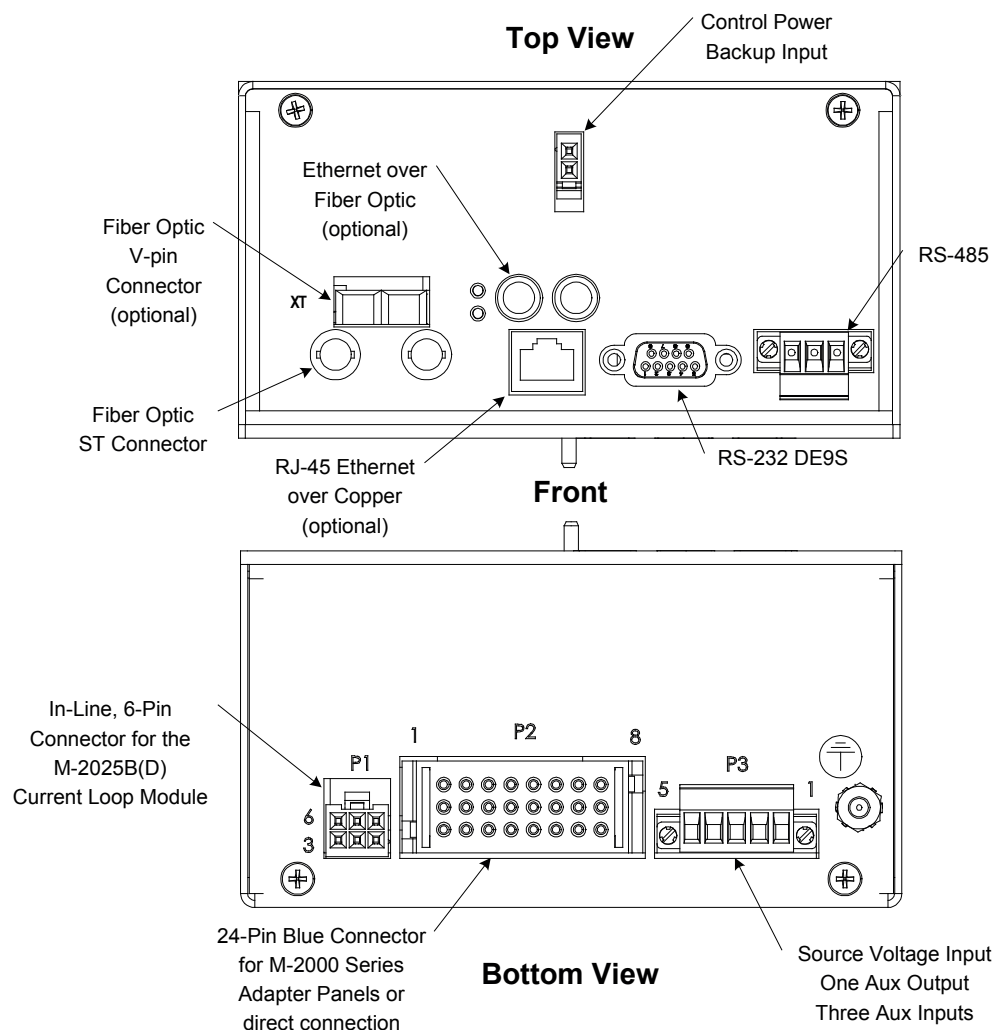


Figure 438: External Connection Locations

The external connections for the control are made to the 24-pin connector, P2. For example, if external dry contacts are being used to control the voltage reduction Step #1 function, connections for these contacts may be made between Pin 10 and Pin 18 as shown in [Figure 440](#). The dry contact inputs for non-sequential input, voltage reduction, motor seal-in, counter input and neutral detection must be "wetted" by connecting to terminal Pin 10.



These binary inputs must be "wetted" by connection to Pin 10 only—a nominal 12 Vdc source. If the contacts are connected to a 120 Vac source, it will result in damage to the control.

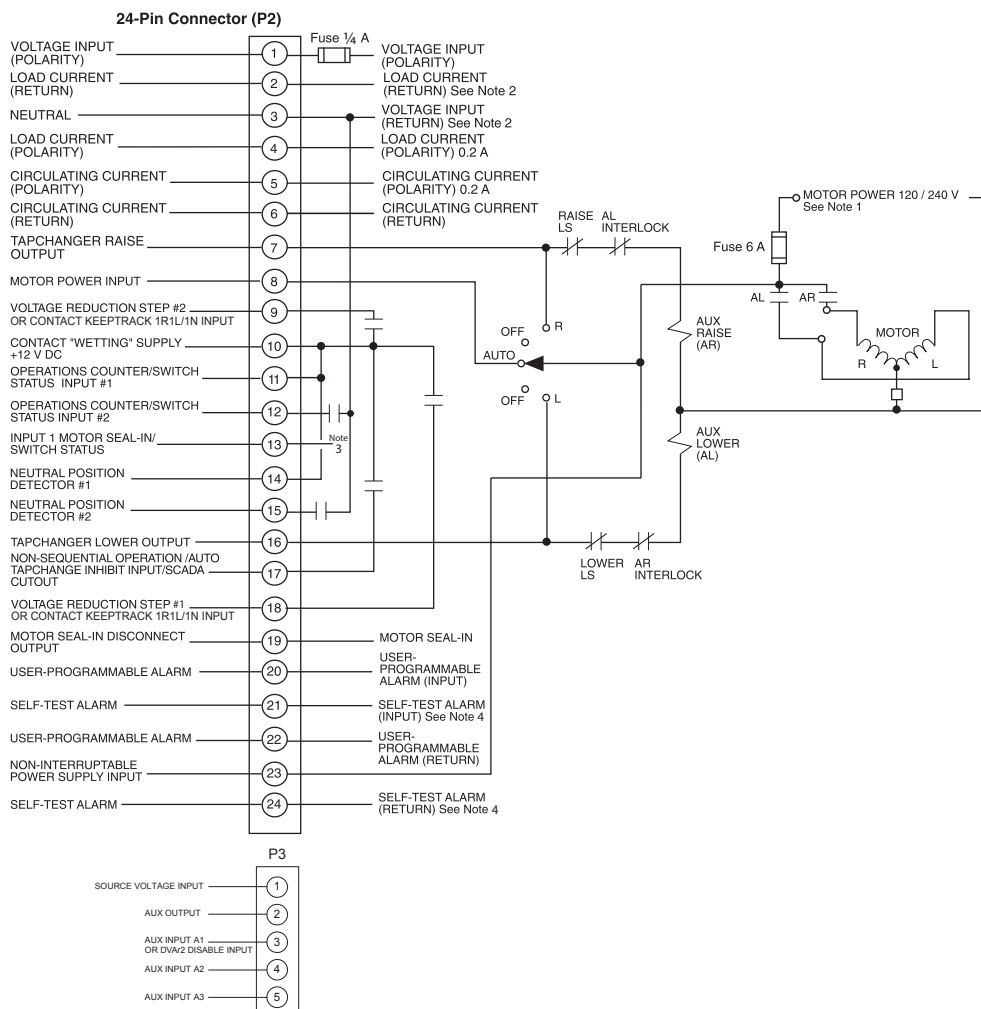


Figure 439: Typical TCC300 Stand-Alone External Connections



1. Motor voltage may be 120 or 240 V to neutral, or 240 V phase-to-phase.
2. The customer is to provide an earth ground connection to the CT/VT's neutral connection, external to the control.
3. To Motor Power Seal-In board.
4. If the TCC300 is configured for the SCAMP pushbutton Auto/Manual Switch type, then the Self-Test Alarm relay is NOT available.



When an adapter panel is not used, automatic shorting of CT inputs is not provided by the TCC300/M-2050; the customer must provide a method for shorting the CT's before the control is disconnected.

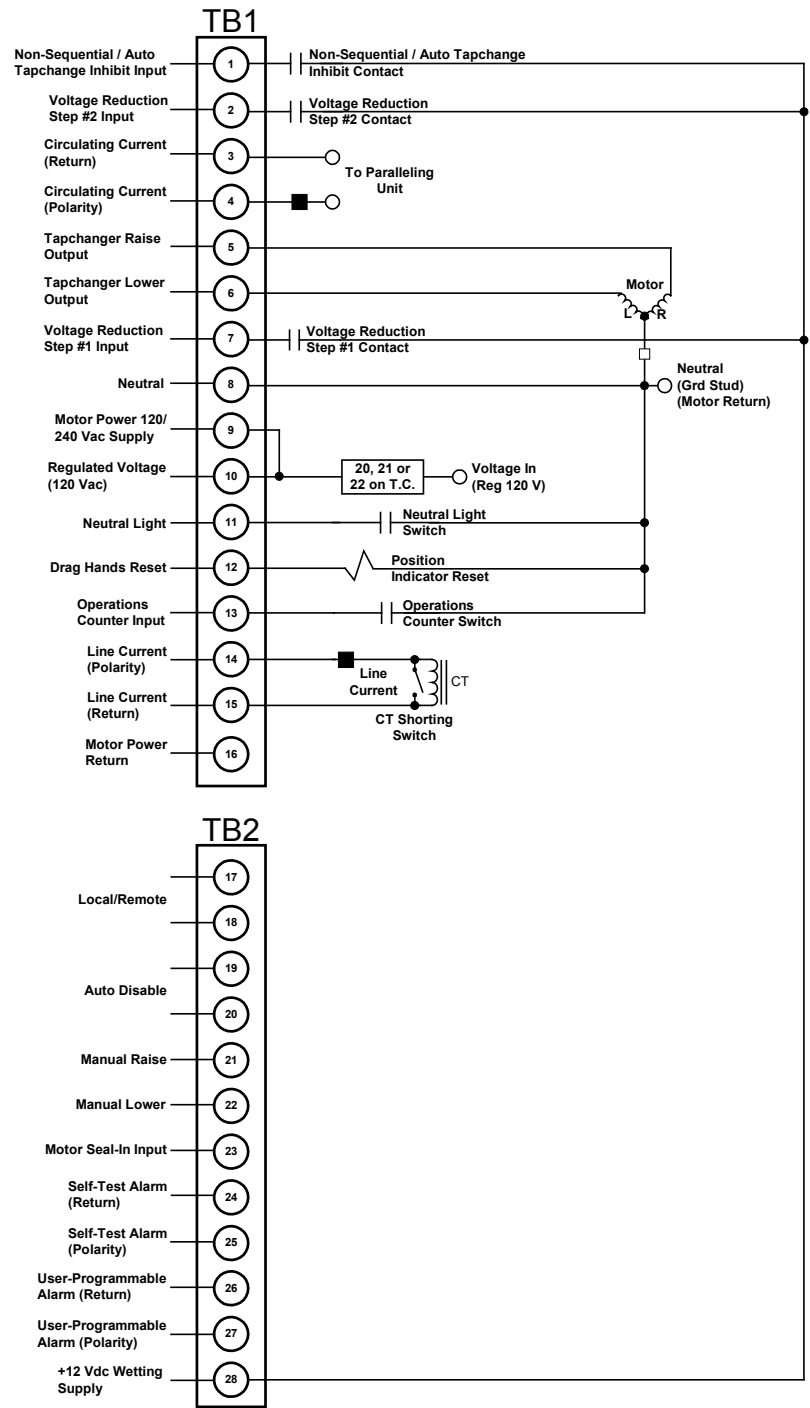


Figure 440: Typical Adapter Panel External Connections



Open CT secondary will result in high voltage at CT terminals. Death, severe injury or damage to equipment can occur.



Do not operate with CT secondary open. Short circuit or apply burden at CT secondary during operation.

The communication ports provide remote access to the tapchanger control using the TCC600® Communications Software.

Pin 1 Voltage Input

This input accepts nominal 120 Vac, 60 Hz (or 50 Hz as ordered) to operate the control's power supply and voltage sensing input. The acceptable voltage range for proper control operation is from 90–140 Vac.

Power consumption is less than 8 VA. The input voltage is referenced to line neutral (Pin 3).

Control users may encounter situations where actuating the Drag Hands Reset pushbutton on one of any of our adapter panels results in the loss of a Voltage Sense fuse. The Drag Hands reset solenoid is powered from the circuit that powers the control, and provides the control with sensing voltage. Initially, a 1/4 Ampere fuse was used in this circuit, and most recently a 1 Ampere fuse was substituted to prevent further loss of the fuse. This phenomenon is due to the fact that, as solenoids age, they may become sticky due to mechanical misalignment, hardened grease, or shortened windings.

The adapter panels include a one ampere fuse in the voltage sense circuit. This value should be adequate for all but the most extreme problems. When a Drag Hands Reset Solenoid that consistently blows a one amp fuse is encountered, it is recommended that the customer either remove the solenoid for cleaning and adjustment, or replace it completely.

Pin 2 Load Current Return

This is the non-polarity input to the load current measuring transformer. The companion polarity input is Pin 4. The line current transformer input is isolated from other pins.

Pin 3 Neutral

This is the return for the Voltage Input (Pin 1), and nominal +12 Vdc "wetting" voltage (Pin 10).

Pin 4 Load Current Polarity

The line current input range is 0–640 mA (200 mA continuous) with 200 mA representing the 1.0 per-unit value. The measured current value is used for line drop compensation and metering calculation.



The current input to the TCC300 is rated at 0.2 A continuous, 0.4 A for two hours, and 4.0 A for 1 second.

Pin 5 Circulating Current Polarity

The circulating current transformer measures a relative reactive current flow between transformers in parallel configuration. Maximum anticipated current input is 200 mA.



The current input to the TCC300 is rated at 0.2 A continuous, 0.4 A for two hours, and 4.0 A for 1 second.

Pin 6 Circulating Current Return

This is the return path for Pin 5. The circulating current transformer input is isolated from other pins.

Pin 7 Tapchanger Raise

This switched output connects the tapchanger raise winding to the source of motor power. When the control calls for a raise, it is capable of switching up to 6 A at 120/240 Vac.

Pin 8 Motor Power Input

The source for powering the tapchanger motor is connected here. It may have a maximum voltage of 240 Vac.

Pin 9

– Voltage Reduction Step #2

This digital input is typically enabled by connecting it to the nominal +12 Vdc wetting source (Pin 10), through an external Form "a" dry contact. The amount of voltage reduction implemented is determined by the setting.

When "Contact KeepTrack™ 1R1L" or "Contact KeepTrack 1N" Tap position knowledge is selected the Voltage Reduction Step 2 Input is utilized as an "Auxiliary Lower Contact Input". In the "Contact KeepTrack" method of Tap Position Knowledge, Voltage Reduction Step 2 is still available through communications.

– Neutral Input Operation

When the parallel configuration mode is set to Δ VAR®2 (KeepTrack™), the VR Step #2 input becomes the neutral input. This is due to the standard neutral input being used for Δ VAR2 (Keeptrack) disable input when Δ VAR2 (Keeptrack) configuration is used.

Pin 10 +12 Vdc Wetting Voltage

This is the output of an unregulated dc power supply internal to the control. It is referenced to neutral and can supply up to 100 mA. It is used for powering the digital inputs of the control through external relays. Depending on the voltage supplied to Pin 1 and loading, its output can vary from +10 to +18 Vdc. It is not fused in the control.

Pins 11 & 12 Operations Counter Inputs 1 and 2



When "Input Selection 1" configuration is set to "Seal-In," the Counter Input is used as the Switch Status Input and the Seal-In Input will cause the counter to increment.

This digital input registers the counter contact closure. The pins are isolated from neutral to permit placing the external contact in series with either the wetting voltage or neutral. The operation count will increment when Pin 12 is grounded via the transformer or regulator dry operation count switch.

This contact is needed for using the intertap time delay. Once the contact is opened, the intertap time delay will begin counting down.



With the "Cam Follower" Operation Counter configuration, the Counter Input is used for the Cam Follower contact input.

Pin 13 Input 1 - Motor Seal-In/Switch Status Input

When the Input Selection (1) screen in the Configuration menu is set to Seal-In Input, this input will operate as a seal-in input and Counter Input. In this configuration, the digital input is referenced to line neutral, but is unique in that it is configured to accept only the output of the motor seal-in current detection transformer, from the B-0553 motor seal-in printed circuit board subassembly. The B-0553 is a supplemental circuit board used in the appropriate adapter panels.

When the Input Selection (1) screen in the Configuration menu is set to Switch Status Input, this input will only operate as a switch status input. All seal-in input functions will be disabled. In this mode, the switch status on the adapter panel can be read to determine if it is in Auto or Manual ON/OFF. The status can be read through the seal-in/switch status data point in the communications protocols.

Pins 14 & 15 Neutral Position Detector Inputs 1 and 2/ Δ VAR2 (KeepTrack) Disable Input



This input will only perform one function, either the Neutral Detect or the Δ VAR2 (KeepTrack) Disable Input.

This digital input registers neutral position switch closures on regulators. The pins are isolated from neutral to permit placement of the external contact in series with either the wetting voltage or neutral. Normally the wetting supply (Pin 10) will be connected to Pin 14.

When using the Δ VAR2 (KeepTrack) paralleling method, this input becomes the disable input for Δ VAR2 (KeepTrack). This is used to keep the paralleled devices from running to their limits (max raise or lower) if they have been un-paralleled for maintenance, etc.

Pin 16 Tapchanger Lower Output

This switched output connects the tapchanger lower winding to the source of motor power. When the control calls for a lower, it is capable of switching up to 6 A at 120/240 Vac.

Pin 17 Input 2 - Non-Sequential Operation/Auto Tapchange Inhibit/Block SCADA

– Non-sequential Operation

When the Input Selection (2) screen (in the Configuration menu) is set to NONSEQ INPUT, non-sequential operation is invoked by momentarily connecting this input to the nominal +12 Vdc wetting source (Pin 10) through an external Form "a" dry contact. When this function is enabled, the tapchanger control times out with the Time Delay setting between every tapchange.

– Auto Tapchange Inhibit

When the Input Selection (2) screen (in the Configuration menu) is set to NONSEQ INPUT, auto tapchange inhibit is invoked by closing and maintaining a Form "a" dry contact connected to this input and to the nominal +12 Vdc wetting source (Pin 10). As long as this contact is closed, the tapchanger will not time out, thereby prohibiting raise and lower commands.

– SCADA Cutout Input

When the Input Selection (2) screen (in the Configuration menu) is set to SCADA CUTOFF INPUT, all writes using SCADA will be blocked when the non-sequential input is present. Any read operations using SCADA will still be allowed regardless of the input state. When the "SCADA Cutout Input" input mode is selected, all non-sequential input functions will be disabled.

Pin 18 Voltage Reduction Step #1

This digital input is typically enabled by connecting it to the nominal +12 Vdc wetting source (Pin 10) through an external Form "a" dry contact. The amount of voltage reduction implemented is determined by the setting.



Enabling both voltage reduction Step #1 and Step #2 inputs simultaneously will result in the level of voltage reduction as specified on the Voltage Reduction Step #3 screen of the control.

When "Contact KeepTrack™ 1R1L" or "Contact KeepTrack 1N" Tap position knowledge is selected the Voltage Reduction Step 1 Input is utilized as an "Auxiliary Raise Contact Input". In the "Contact KeepTrack" method of Tap Position Knowledge, Voltage Reduction Step 1 is still available through communications.

Pin 19 Motor Seal-In Disconnect Output

This output connects to the B-0553 motor seal-in printed circuit board subassembly. When the seal-in detector input is actuated, this output drives a triac on the B-0553 motor seal-in printed circuit board subassembly to temporarily disconnect the motor power to the control. The B-0553 is a supplemental circuit board used in the appropriate adapter panels.

Pins 20 & 22 User-Programmable Alarm

This pair of terminals is a Form "a" alarm relay contact rated for 3 A at 120 Vac, or 100 mA at 120 Vdc. This alarm indicates when any of the programmable alarm conditions are detected.

Pins 21 and 24 Self-Test Alarm



If the TCC300 is configured for the SCAMP pushbutton Auto/Manual Switch type, then the Self-Test Alarm relay is NOT available.

This pair of terminals is a held-open Form "b" alarm relay contact rated for 6 A at 120 Vac, or 100 mA at 120 Vdc. Failure of the power supply or the micro controller results in loss of power to the alarm relay, allowing the contact to close.

Pin 23 Non-Interruptible Power Supply Input

This input is normally connected to Pin 8, the motor power input. The power to Pin 8 is interrupted by the motor seal-in process of the B-0553 motor seal-in printed circuit board. The purpose of Pin 23 is to provide continuous power to the raise and lower KeepTrack™ detection circuits. It should be connected ahead of any motor power interruption (for example, auto/manual, local/remote) of the seal-in circuitry to maintain KeepTrack raise and lower operation. The motor seal-in function is used in the following adapter panels: M-2109, M-2324 and M-2355.

FIVE PIN CONNECTOR (Bottom)

Pin 1 Source Voltage Input

Source Voltage Input when mode of operation is set to "Regulate Reverse with Measured Source Voltage".

Pin 2 Auxiliary Output

Available Auxiliary Output.

Pin 3 Auxiliary Input A1

When using the Δ VAR2 paralleling method, this input becomes the disable input for Δ VAR2. This is used to keep the paralleled devices from running to their limits (max raise or lower) if they have been un-paralleled for maintenance, etc.

Pins 4 and 5, Auxiliary Inputs - A2, A3

Available Auxiliary Inputs.

8.3

Non-sequential operation



Voltage applied through dry contacts to actuate non-sequential input, voltage reduction inputs, counter contacts and neutral contacts must be nominal +12 Vdc obtained from Pin 10 of the TCC300 Tapchanger Control. The use of 120 Vac will result in damage to the TCC300.

The operation of the control can be interrupted during tapchanger operation by applying the "wetting" voltage of Pin 10 to Pin 17 (timer reset for non-sequential operation input) on the control through an external contact. This causes the output to de-energize and re-initialize the time delay circuit when the reset signal is removed. This function can be used to cause the LTC transformer, if so equipped, to wait for the unit to time out between tapchanges.

8.4

Multi-step voltage reduction



Voltage applied through dry contacts to actuate non-sequential input, voltage reduction inputs, counter contacts and neutral contacts must be nominal +12 Vdc obtained from Pin 10 of the TCC300 Tapchanger Control. The use of 120 Vac will result in damage to the control.

On the TCC300 Tapchanger Control, Pin 9 and Pin 18 on connector P2 are used together to provide up to three levels of voltage reduction. The external connections to achieve these steps are shown in [Table 54](#). Voltage reduction amounts are set within the TCC300

Tapchanger Control software. If these voltage reduction steps are instituted by communications, the contacts are not being used simultaneously.

Table 68: *Multi-Step Voltage Reduction External Connections*

Voltage Reduction Setpoint: Multiplier Range	Apply "Wetting Voltage" from Pin 10 to Pin #
Voltage Reduction Setpoint #1: 0 to 10%	Pin 18
Voltage Reduction Setpoint #2: 0 to 10%	Pin 9
Voltage Reduction Setpoint #3: 0 to 10%	Pins 18 and 9

When Contact KeepTrack™ Tap Position Knowledge is selected Voltage Reduction Step 1 (Pin 18) and Voltage Reduction Step 2 (Pin 9) are assigned as Auxiliary Tap position inputs.

8.5 LTC backup control

The M-0329B is a single-phase, solid-state backup control that prevents a defective tapchanger control from running the voltage outside the upper and lower voltage limits. The Block Raise and Block Lower voltage levels are set by accurately calibrated dials. Refer to the M-0329B Instruction Book for details.

The M-0329B LTC Backup Control or M-5329 Multi phase Backup Relay are connected as a two-terminal device to the voltage transformer.

8.6 Communication ports

The control includes three communication ports, COM1, COM 2, and COM3. COM2 supports RS-232 or V-pin, RS-485, and fiber optic lines (ST connector only). COM 3 supports Ethernet using an RJ-45 connector or Fiber ST.

Selection of specific communication parameters may be made through the COM1 or COM2 PORT configuration screen or the COM3 Port screen if the optional Ethernet port is installed. USB is an internal port, and supports only MODBUS® protocol and software updates. COM1 and COM2 support baud rates from 300 to 115200.

Fiber Optic Interface

The COM1 PORT screen allows the user to select the specific communication equipment to be used: RS-485 (2 wire) or Fiber Optics (ST connector).

The control can be connected to fiber optics in two ways. If Fiber Repeat Switch on the right side of control (as viewed from the rear) is set to OFF, the fiber interface is set in a point-to-point configuration.

Example: A PC to one control. If Fiber Repeat Switch is set to ON, the control can be connected in a loop or daisy chain (the TX of one control connected to the RX of the next, etc.). When connecting the control in this manner through TCC600®, Echo Cancel should be set to ON. The type of fiber used with these optical transceivers is multi mode fiber. It was tested with fiber size 62.5/125. A manufacturer of this product is Amphenol Corporation. A typical part number tested by ABB is 943-32255-10030 from Amphenol Corporation, Lisle, Illinois. This is a dual-fiber with a total of four ST connectors.

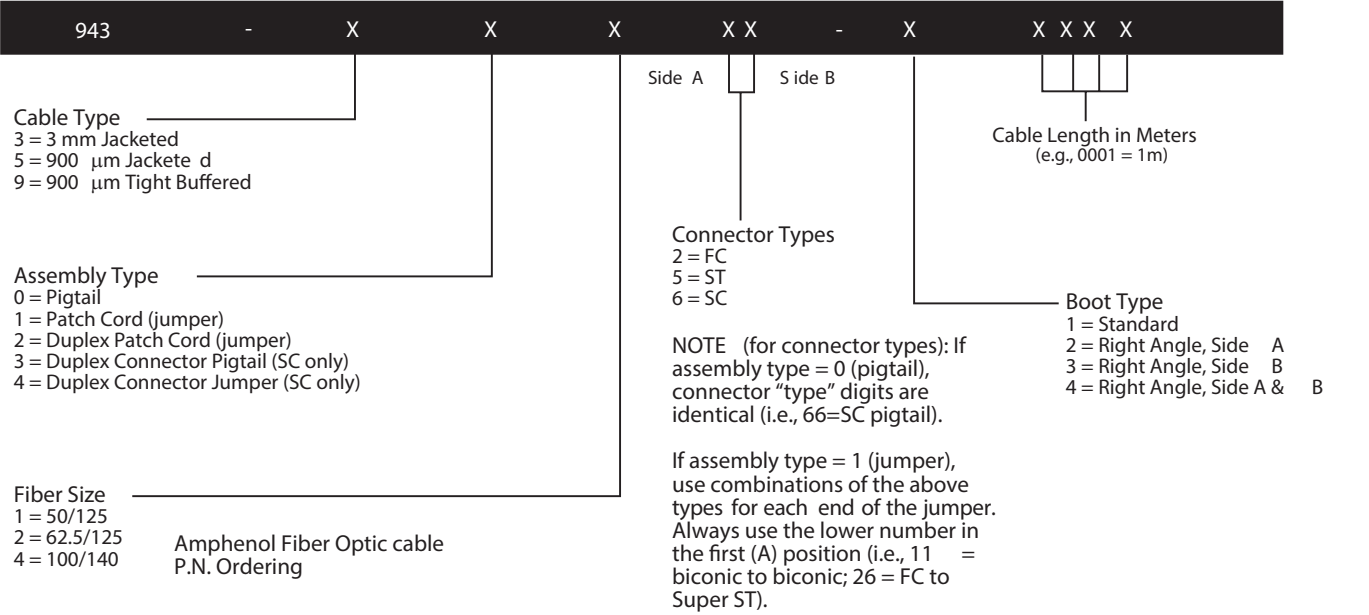


Figure 441: Communication Connections

Ethernet (RJ-45 Interface)

The control includes an optional Ethernet Port (COM3) which is compatible with all protocols in the control. There are eleven configuration screens in the HMI for setting up the ethernet port: DHCP Enable, IP Address, Net Mask, Gateway, MODBUS® Port, DNP Port, Auto Negotiation, Keepalive time, SNTP Enable, SNTP Server Address and Time Zone.

The IP Address screen is used to set the address used to communicate with the control (when DHCP is disabled). The IP Net Mask screen is used for multicasting.

The DHCP Mode screen, when enabled, will allow the control to use any available IP address (which will be shown while booting the Ethernet during control power up. When

DHCP is disabled, it will cause the control to use the IP address from the IP Address screen.

RS-485 Interface (Additional Communication Port)

The MODBUS and DNP3.0 communication protocols were set up to be compatible with a 2-wire, half duplex RS-485 link of the TCC300 COM1.

A port-powered converter made by B & B Electronics of Ottawa, IL (Model 485LP9TB) was used to test the two-wire RS-485 link. This converter is available in commercial and extended temperature ranges. When connecting the RS-485, a 120 Ω resistor must be connected at the last control connector across A/B. The two-wire RS-485 port assigns Pin A (+) and Pin B (-). The SH connection on the RS-485 plug should be connected to the cable shield. The shield should only be connected on one end of the RS-485 cable. If more than one TCC300 control is connected via RS-485, only one shield/SH connection should be made. One screen is directly associated with setting an RS-485 network. COM1 port should be set to RS-485. If using TCC600®, under Communications/Setup/Comm Port menu, RS-485 should be selected. When selecting RS-485 transmission lines, there are cables specifically made for this purpose. These cables have a shunt capacitance of 16 pF or less per foot, and are usually solid wire. Plenum-rated cabling is recommended. The RS-485 connector is designed to hold 12 to 24 AWG wire.

8.7 Communication cables

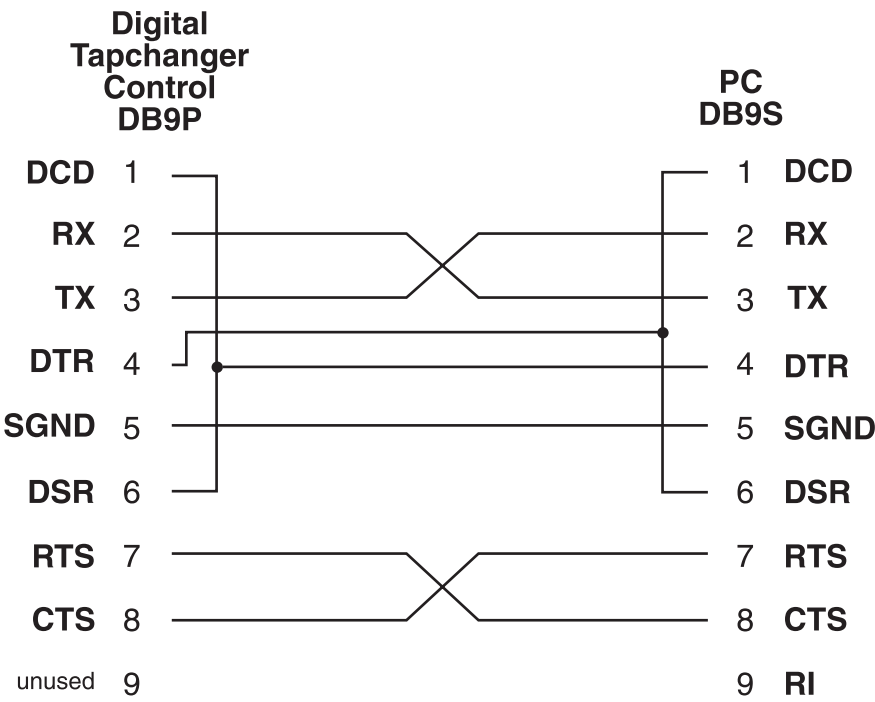


Figure 442: Null Modem Cable 9-Pin to 9-Pin

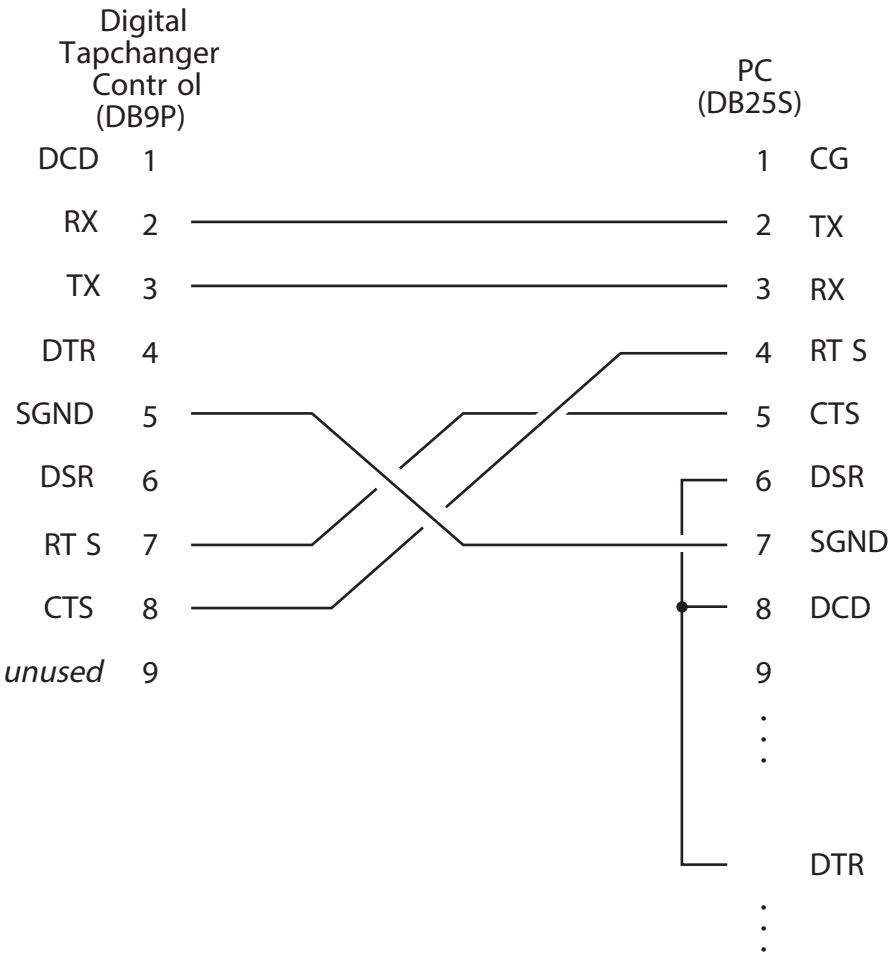


Figure 443: Null Modem Cable 9-Pin to 25-Pin

8.8 Grounding

Ground the control by connecting a suitably sized wire from the ground stud on the bottom of the control case, to a solid connection to ground. Do not rely on mounting screws for grounding.

8.9 Typical LTC connection

[Figure 444](#) illustrates an example of connections for a control with an LTC Transformer Control adapter panel. This example does not cover all situations. Motor Power and

sensing voltage can be obtained from a common source or from independent sources having a nominal 120 Vac output. Normally, this is line-to-neutral voltage, although line-to-line voltage can be used if recognition is made of any phase shift between the voltage and current signals when using line drop compensation, to avoid introducing an unintentional grounding into the control circuitry that could result in shorting a VT secondary. It is strongly recommended that a 1:1 ratio isolation transformer of 25 VA or greater with required voltage accuracy be used between the control and any line-to-line PT connections. ABB has a suitable isolation transformer available in model M-0362. Please consult factory for availability.

Load current must be reduced by an appropriate auxiliary transformer to 0.2 A "full scale" before connecting to the adapter panel currents. Obtain an application guide specific to your LTC control adapter panel and follow those instructions.



In no case should the line current circuit be interrupted with the regulator or transformer energized. Do not remove auxiliary current transformers without shorting the current inputs. Death or severe electrical shock can occur.

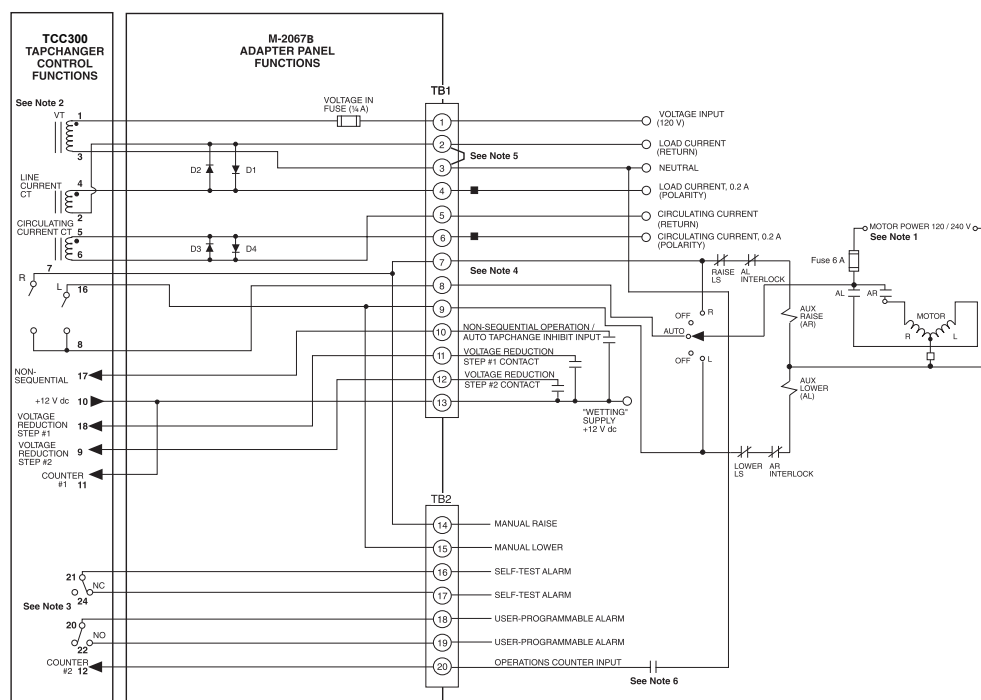


Figure 444: TCC300 and LTC Transformer Control Adapter Panel Typical Connections



1. Motor voltage may be 120 or 240 V to neutral or 240 V phase to phase.
2. The customer is to provide earth ground connection to CT/VT's neutral connection, external to the control.
3. The self-test alarm and user-programmable alarm contacts are shown in the de-energized state (no voltage applied). The self-test alarm contacts open after the control passes the internal self-test.
4. The wiring from terminal 7 and 9 may or may not go directly to the motor. Depending on installation, local codes and standards, the wiring may go to interposing relay contacts, limit switch, seal-in circuits, starters contactors, SCADA, test switches etc.
5. To isolate the load current, remove the jumper from TB1-2 to TB1-3.
6. For counter operation, connect TB2-20 to neutral TB1-3 through an external dry contact. This connection is required for the intertap time delay operation.

8.10

Typical regulator connection

[Figure 445](#) illustrates an example of connections for a control with a Regulator Control adapter panel. This example does not cover all situations. Motor Power and sensing voltage can be obtained from a common source or from an independent source having a nominal 120 Vac output. Normally, this is line-to-neutral voltage, although line-to-line voltage can be used if recognition is made of any phase shift between the voltage and current signals when using line drop compensation, to avoid introducing an unintentional grounding into the control circuitry that could result in shorting a VT secondary. It is strongly recommended that a 1:1 ratio isolation transformer of 25 VA or greater with required voltage accuracy be used between the control and any line-to-line PT connections. ABB has a suitable isolation transformer available in model M-0362. Please consult factory for availability.



The current input to the TCC300 is rated at 0.2 A continuous, 0.4 A for two hours, and 4.0 A for 1 second.

Load current must be reduced by an appropriate auxiliary transformer to 0.2 A "full scale" before connecting to the adapter panel current inputs. Scaling factors may be chosen to resemble 200 mA, 100 mA, or 5 A current transformers in readouts and current magnitude settings. It is important that you obtain an application guide on an adapter panel specific to your regulator application and follow those instructions.

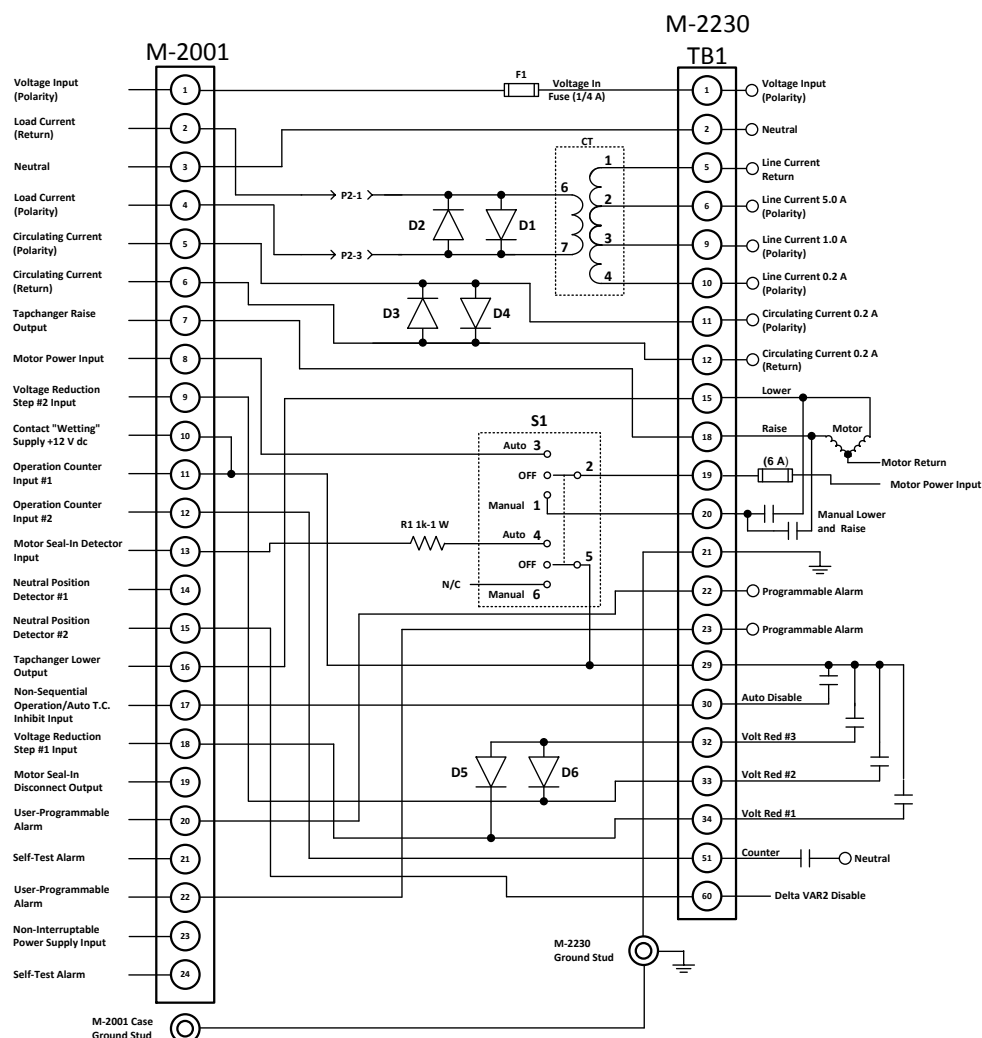


Figure 445: TCC300 and Regulator Control Adapter Panel Typical Connections



1. The wiring from terminal 15-18 may or may not go directly to the motor. Depending on installation, local codes and standards, the wiring may go to interposing relay contacts, limit switch, seal-in circuits, starters contactors, SCADA, test switches etc.
2. The self-test alarm and user-programmable alarm contacts are shown in the de-energized state (no voltage applied). The self-test alarm contacts open after the control passes the internal self-test; the user-programmable alarm contacts close when an alarm is recognized.
3. If the TCC300 is configured for the SCAMP pushbutton Auto/Manual Switch type, then the Self-Test Alarm Relay is not available.

8.11 Control power backup input connection

The Control Power Backup Input option is designed to sustain communication port operation in the event of the loss of AC control power. In the event of a loss of AC input power to the control, the option permits uninterrupted operation of the control by supplying +12 Vdc to the control. In addition, the control retains functionality with the exception of the actual operation of the tapchanger mechanism.

When the AC input voltage drops below approximately 85 Vrms, the Control Power Backup Input will activate and all automatic tapchange operations will then be suspended. If Motor Power is available, manual tapchanges may be initiated.

When the control is being powered from the Control Power Backup Input, it will continue to read any input voltage present.

The control retains full functionality, and if the control's Motor Power remains energized then Raise and Lower commands are possible. Fiber-Optic port operation is maintained. All communication ports, data-logging, status monitoring, configuration, and setpoint capability are also maintained.

The Control Power Backup Input option is installed at the factory, and is wired through the two-pin connector located on the top rear of the control.

ABB offers two Control Power Backup supplies for use with the TCC300 when the Control Power Backup Input option is purchased. The M-2026 AC-DC Control Power Backup Supply is a fused, surge protected and reverse polarity protected AC-DC Control Power Supply that accepts an AC or DC input (21 to 32, 42 to 60 and 105 to 145 V) and outputs regulated +12 Vdc at up to 1.5 Amp.

The M-2027 Control Power Backup Supply - AC Only is a fused and surge protected Control Power Backup Supply that will accept an AC input range of 105 to 140 Vac, 50/60 Hz and output +12 Vdc to 1 A.

Both the M-2026 and M-2027 are housed in non-weathertight enclosures and are equipped with screw terminal blocks for both input and output connections.



Use of Non-ABB converters to provide +12 V to the Control Power Backup Input may compromise system integrity due to a lack of adequate protection of the power converter. For reliability of the TCC300, the power converter must meet certain requirements.

Table 69: *Requirements for the power converter*

Description	Value
Temperature	–40° C to + 80° C IEC 60068-2-1 Cold, –40° C for 96 hours IEC 60068-2-2 Dry Heat, +80° C for 96 hours IEC 60068-2-3 Damp Heat, +40° C @ 95% RH for 96 hours
Transient Protection	High Voltage – All input and output terminals will withstand 1500 Vac rms to chassis or instrument ground for one minute with a leakage current not to exceed 25 mA, for all terminals to ground. Input and output circuits are electrically isolated from each other, from other circuits and from ground.
Surge Withstand Capability	IEEE C37.90.1-2002 2,500 Vpk-pk Oscillatory 4,000 Vpk Fast Transient Burst IEEE C37.90.1-1989 2,500 Vpk-pk Oscillatory 5,000 Vpk Fast Transient
Radiated Electromagnetic Withstand Capability	All units are protected against electromagnetic radiated interference from portable communications transceivers.
Electrostatic Discharge Test	EN 60255-22-2-1997 (EN61000-4-2) Class 4 (8 Kv) – Point Contact Discharge, (15 Kv) – Air Discharge
Fast Transient Disturbance Test	EN 60255-22-4-2002 (EN61000-4-4) Class A (4 Kv, 2.5 kHz)

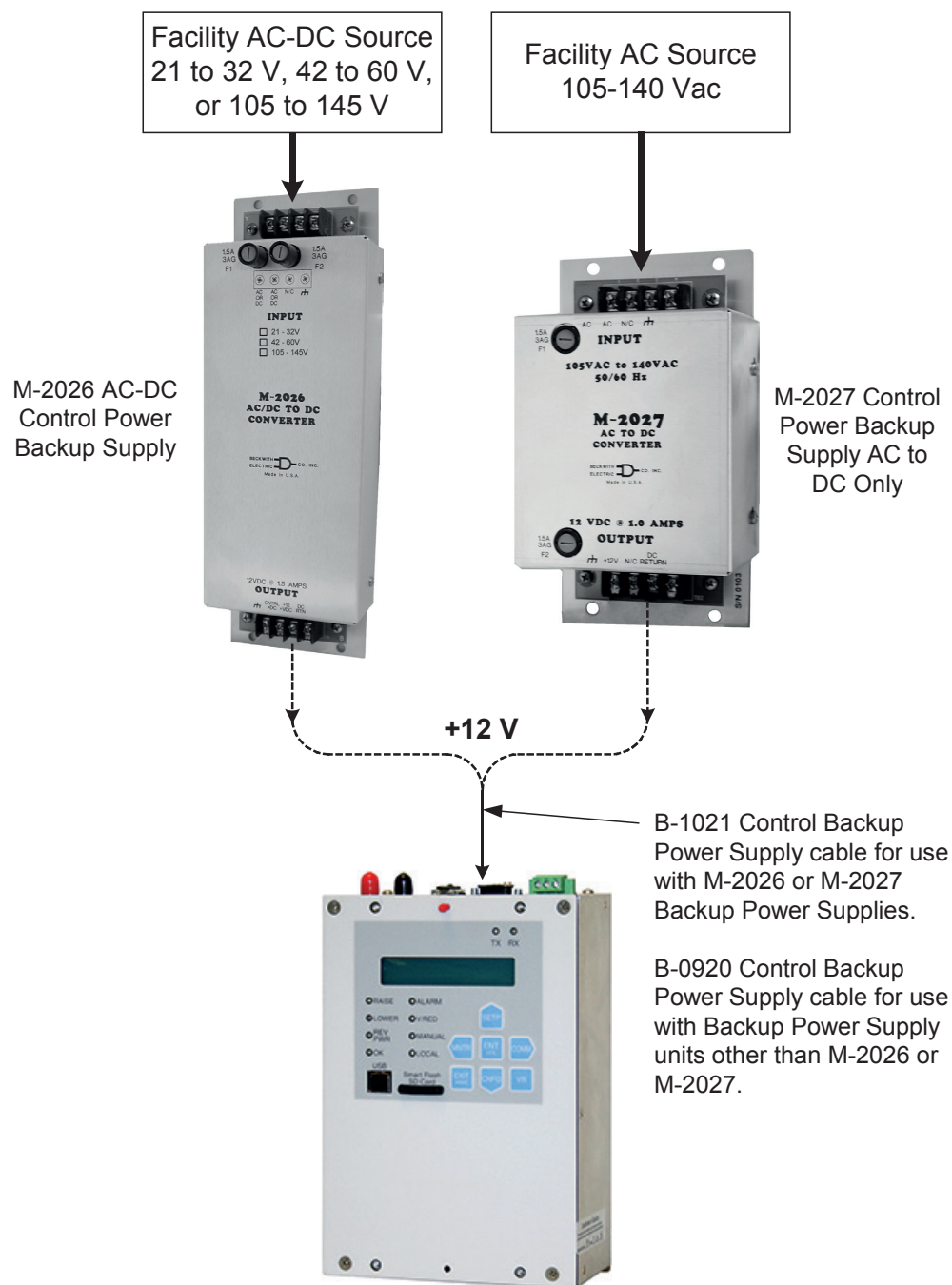


Figure 446: Typical Control Power Backup Connection for TCC300

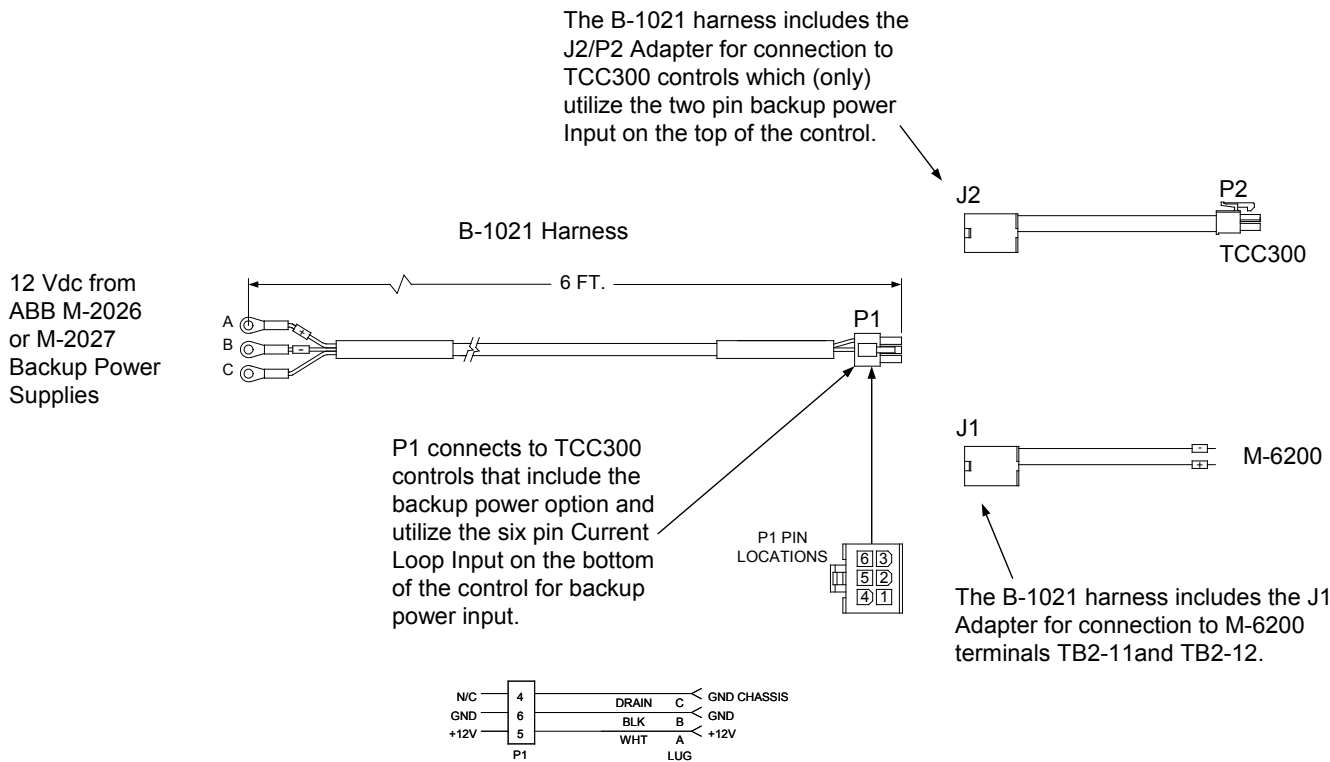


Figure 447: Control Power Backup Input Cable Assembly

8.12 Installation of TCC600 Communications Software and establishment of initial local communications

See [Installing TCC600](#) and [Initial local communications using direct USB connection](#) for detailed instructions.

For additional information, see [Communication](#).

Section 9 Testing

9.1 Set-up procedure

Equipment List

- 0 – 200 mA current supply with phase angle settings of 0° to +90°
- 90 – 145 Vac voltage source at 60 Hz
- High impedance true RMS voltmeter with accuracy on ac of at least ±0.2% of reading
- Accurate stop watch



The current input to the TCC300 is rated at 0.2 A continuous, 0.4 A for two hours, and 4.0 A for 1 second.

Procedure

1. Make electrical connections as shown in [Figure 448](#).



See Appendix A for the locations of screens within the software.



There is a one-second delay between the out-of-band condition and panel LED indication.

2. Enter initial settings.

Table 70: *Initial settings*

Function	Initial setting
Bandcenter	120.0 V
Bandwidth	2.0 V
LDC Resistance	0.0 V
LDC Reactance	0.0 V
Paralleling	Circulating Current Method
Block Raise	135.0 V
Table continues on next page	

Function	Initial setting
Block Lower	105.0 V
Deadband	2.0 V
Time Delay	5.0 Seconds

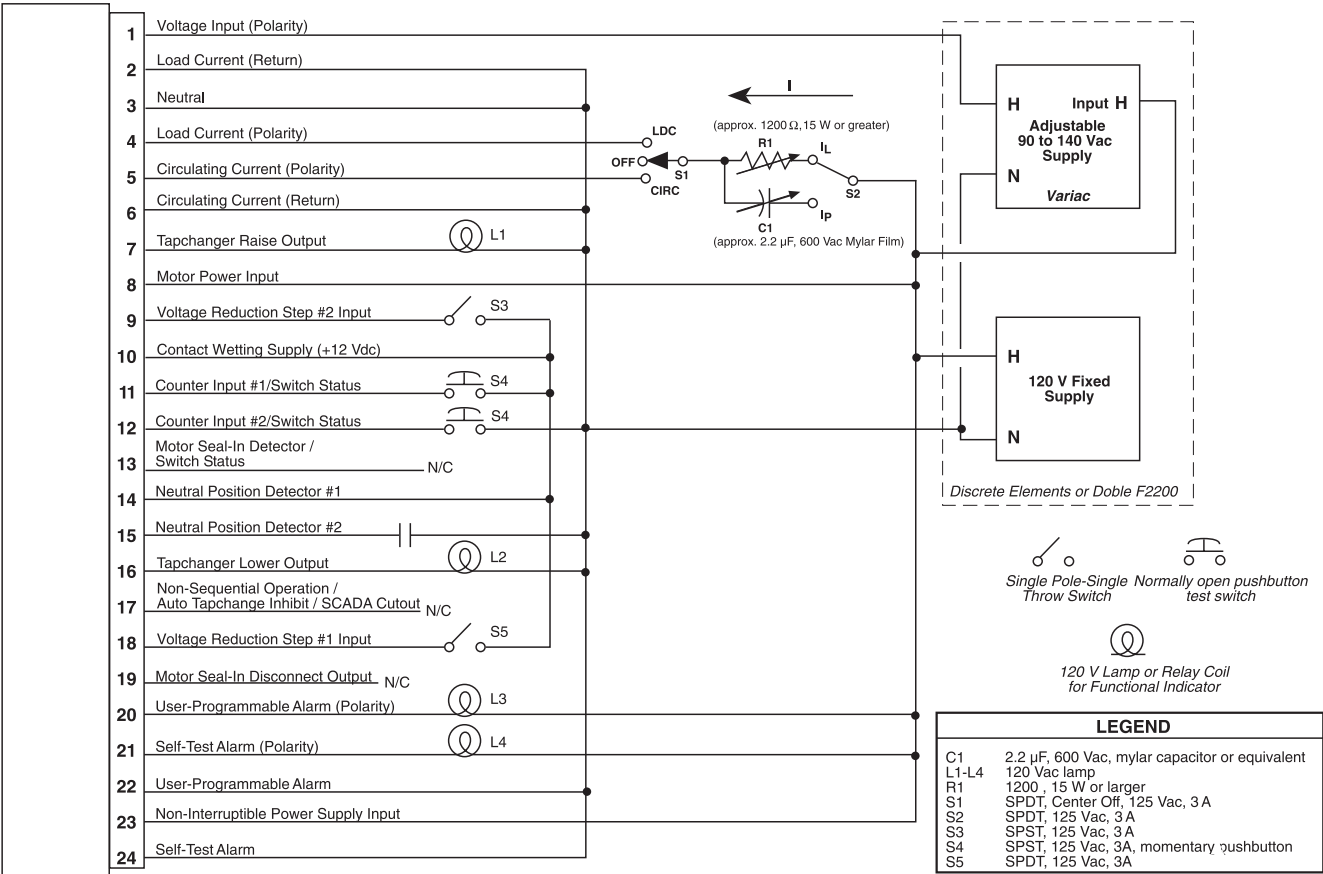


Figure 448: External Connections for Test Procedure

9.2 Bench-testing



Do not reverse the ground and hot wires when connecting an external source.

1. Apply 120 Vac from power source.
2. Increase voltage to 121.2. The LOWER LED should illuminate.
3. Decrease voltage to 118.8. The RAISE LED should illuminate.
4. Set the input voltage to 120.0 Vac. Wait for RAISE and LOWER LEDs to extinguish.
5. Increase voltage to 122.0 Vac, then start timing when voltage passes 121.0 V.
6. Stop timing when the lamp connected to the LOWER output illuminates (should be approximately 5 seconds).
7. Resistance
 - 7.1. Apply a 100.0 mA in-phase current to Pin 4 (load current-polarity) and Pin 2 (load current-return) of the P2 connector.
 - 7.2. Set S_1 to LDC and S_2 to I_L .
 - 7.3. Set LDC Resistance to 24.0 V. The RAISE LED should illuminate.
 - 7.4. Increase the input voltage to 132.0 Vac. The RAISE and LOWER LEDs should be extinguished.
 - 7.5. Set the LDC Resistance to -24.0 V. The LOWER LED should light.
 - 7.6. Decrease the input voltage to 108.0 Vac. Both RAISE and LOWER LEDs should extinguish.
 - 7.7. Set the LDC Resistance to 0.0 V.
 - 7.8. Decrease the input voltage to 120 Vac.
8. Reactance
 - 8.1. Apply 100.0 mA 90° leading current to Pin 4 (load current-polarity) and Pin 2 (load current-return) of the P2 connector.
 - 8.2. Set S_1 to LDC and S_2 to I_L .
 - 8.3. Set LDC Reactance to 24.0 V. The LOWER LED should illuminate.
 - 8.4. Decrease the input voltage to 108.0 Vac. The RAISE and LOWER LEDs should be extinguished.
 - 8.5. Set LDC Reactance to -24.0 V; the RAISE LED should illuminate.
 - 8.6. Increase input voltage to 132.0 Vac. Both RAISE and LOWER LEDs should be extinguished.
 - 8.7. Set the LDC Reactance to 0.0 V.
 - 8.8. Decrease the input voltage to 120 Vac.
9. Voltage Reduction
 - 9.1. Set Voltage Reduction Step #1 to 2.5% (default setting).
 - 9.2. Close S_5 to enable Voltage Reduction Step #1. The LOWER LED should illuminate.
 - 9.3. Decrease the voltage to 117.0 Vac. The LOWER LED should be extinguished.
 - 9.4. Open S_5 and decrease the input voltage to 120.0 V.
 - 9.5. Set Voltage Reduction Step #2 to 5% (default setting).

- 9.6. Close S_3 to enable Voltage Reduction step #2. The LOWER LED should illuminate.
- 9.7. Decrease voltage to 114.0 Vac. The LOWER LED should extinguish.
- 9.8. Open S_3 and decrease the input voltage to 120.0 Vac.
10. Paralleling
 - 10.1. Apply 100.0 mA 90° leading current to Pin 5 (circulating current-polarity) and Pin 6 (circulating current-return) of the P2 connector.
 - 10.2. Set S_1 to CIRC and S_2 to IP. The LOWER LED should illuminate.
 - 10.3. Decrease the voltage to 108.0 Vac. Both RAISE and LOWER LEDs should be extinguished.
 - 10.4. Set S_1 to OFF.
11. Counter
 - 11.1. Set the TCC300 Tapchanger Control to display the Operations Count screen for the Total Operations Counter.
 - 11.2. Verify counter operation by depressing S_4 wired to Pin 11 and Pin 12 (counter in).
 - 11.3. The operations counter should increment.
12. Block Raise/Block Lower/Deadband
 - 12.1. Set Block Raise to 126.0 V.
 - 12.2. Set Block Lower to 114.0 V.
 - 12.3. Set the unit to display the Bias Voltage screen.
 - 12.4. Press ENT.
 - 12.5. Increase voltage to 126.5 V. BR should be displayed on the screen.
 - 12.6. Increase voltage to 128.5 V. FL is displayed on the screen.
 - 12.7. Decrease voltage to 113.5 V. BL is displayed on the screen.

—Bench Test Complete—

9.3 Starting check-out procedure



All ABB units are fully calibrated at the factory. There is no need to recalibrate the units before initial installation.

Follow the steps below to apply power.

1. Remove any external connection between Pin 1 (voltage input) and Pin 8 (motor power input).
2. Using a voltmeter, ensure that the voltage applied to Pin 1 is nominal 120 Vac with respect to Pin 3 (neutral).



Do not reverse the ground and hot wires when connecting an external source.

3. Apply motor auxiliary voltage to Pin 8 (motor power input) and Pin 3 (neutral).
4. Verify that the motor runs in the proper direction when conditions of sensed voltage result in activation of Raise and Lower outputs.



In no case should the load current circuit be interrupted with the regulator or transformer energized.



Do not remove auxiliary current transformers without shorting the current inputs. Death or severe electrical shock can occur.

5. Temporarily place a shorting device across the LDC-CT secondary to short the line drop compensator circuit, and place another shorting device to short the circulating current paralleling output, for the load current check.

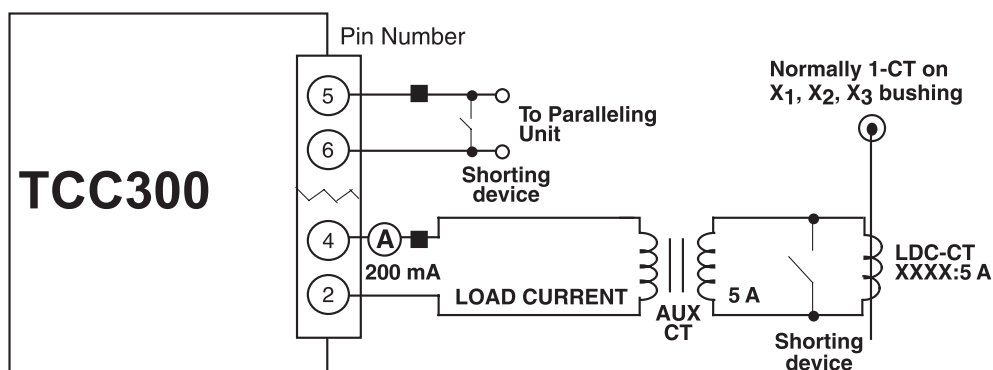


Figure 449: Setup for Current Checkout Procedure



Pin numbers indicated above are accurate for the M-2050B Mounting Kit only; check the Application Guide of the specific adapter panel used for proper pin numbers.

6. Insert an ammeter between the polarity input and Pin 4.
7. Open the load current shorting device and with a known load on the transformer or regulator, measure the current in the load current circuit to ensure that this current is correct for 0.2 A full load.



The current input to the control is rated at 0.2 A continuous, 0.4 A for two hours, and 4.0 A for 1 second.

8. Replace the shorting device across the load current input and remove the ammeter.
9. Reconnect polarity to the unit and remove both jumpers. The Line Drop Compensator will be activated. Correct CT polarity can be checked by simply incorporating sufficient +R compensation. The regulator should time out and run so as to raise the output voltage.

9.4 Performing operational test

1. Set VT Ratio Correction = 0 V; CT/VT phasing = 0° from the appropriate screen in the software.
2. Return to the Local Voltage screen.
3. Apply 120.0 Vac to Pin 1 (hot) and Pin 3 (neutral) of the adapter panel.
4. Verify local voltage = input voltage ± 0.3 V.
5. Apply 100.0 mA in-phase current to Pin 4 (load current-polarity) and Pin 2 (load current-return).
6. Verify Control Load I = 100 mA and Power Factor = 1.0 ± 0.02 from the appropriate software screens.
7. Apply 100.0 mA 90° leading current to Pin 5 (circulating current-polarity) and Pin 6 (circulating current-return).
8. Verify Control Circ I = 100.0 mA ± 2 mA.
9. Verify the Up, Down and ENT pushbuttons function properly.
10. De-energize the current source.

—Checkout Procedure Complete—

9.5 Performing in-service test

1. Set the TCC300 Tapchanger Control to display the Bias Voltage screen.
2. Press ENT.
3. Use the Up and Down push buttons to cause RAISE and LOWER outputs.
If either output is blocked, verify that the unit is not at the maximum tap position.
4. Press ENT to return to the Local Voltage screen.

—In-Service Test Complete—

9.6 Testing bias voltage

The Bias Voltage Status/Test Mode feature permits entering a bias voltage for simulating the raising or lowering of the sensed input voltage. This exercises the control as if the input voltage were being changed. The contacts actually operate.

This feature is valuable in the rapid determination of operating quantities present to influence the normal operation of the control. Items that will block operations or change setpoints are described here and illustrated by LEDs on the face of the control.

The Test Mode/Status screen displays control status information that includes:

- Output Status
- Compensated Voltage
- Band Status
- Runback/Blocking Status
- Voltage Reduction Status

This feature automatically resets on exit or in 15 minutes if not exited.

1. Press the ENT (UTIL Hot Button) pushbutton to awaken the unit. The menu will advance to "UTILITIES".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Calibration/Test
3. Press the Down arrow pushbutton as necessary to navigate to the "Bias Voltage Status Test Mode" menu item.
4. Press the ENT pushbutton. The unit will display the following:
Bias Voltage 0.0
-- XXX.X --

The upper line of the display will initially indicate "0.0" bias volts.

The second line will display the sequence of parameters. By increasing/decreasing the applied bias voltage the control will respond based on the settings entered into the control.

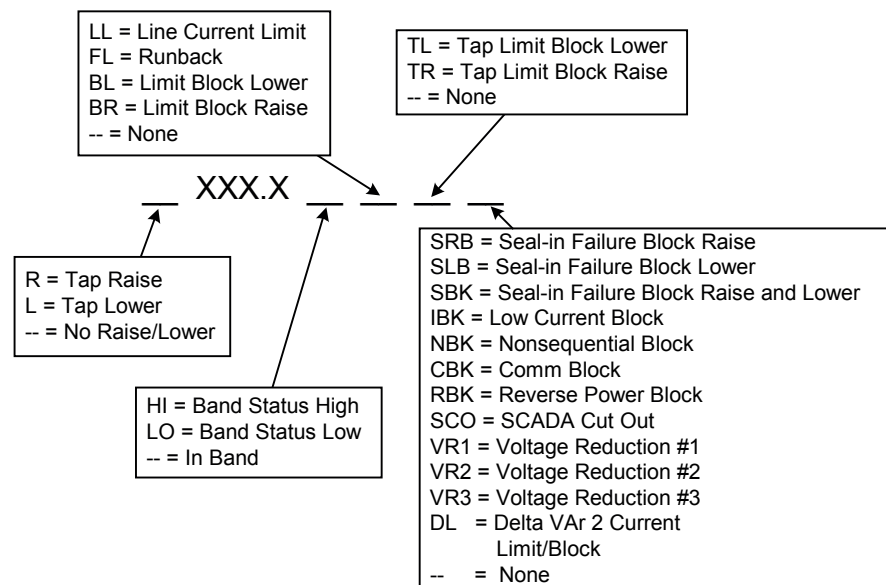


Figure 450: Bias Voltage Test Index

9.7 Testing control front panel LEDs

1. Press the ENT (UTIL Hot Button) pushbutton to awaken the unit. The menu will advance to "UTILITIES".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Calibration/Test
3. Press the Down arrow pushbutton, as necessary, to navigate to the LED Scroll Test menu item.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
LED Scroll Test
Test in Progress...
5. The control will illuminate each of the eight LEDs. To stop the LED test press the EXIT pushbutton.

9.8 Testing control inputs

1. Press the ENT (UTIL Hot Button) pushbutton to awaken the unit. The menu will advance to "UTILITIES".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Calibration/Test
3. Press the Down arrow pushbutton, as necessary, to navigate to the Input Test menu item.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
Input Test ← →
vr1 vr2 ns c n l r t
5. Determine the inputs to be tested and the corresponding position (from left to right) in the input test screen.
 - vr1, Voltage Reduction #1
 - vr2, Voltage Reduction #2
 - ns, Non-Sequential Input
 - c, Operations Counter Contact
 - n, Neutral Light Switch
 - l, Lower Status
 - r, Raise Status
 - t, Current Loop Input
 - a1, Aux Input 1
 - a2, Aux Input 2
 - a3, Aux Input 3
 - ms, Motor Sealin

As each input is activated the corresponding indicator will change from lower case to upper case to indicate that the control has read the input.

6. Verify that the control is in a configuration that supports input testing, then proceed as follows based on control status:
 - If the control is not connected to field connections, then utilize [Figure 448](#) to connect test equipment and test the desired inputs.
 - If the control is connected to field connections, then determine the necessary test method(s) for testing the desired input.

Draghands, Lower and Raise status can be tested by utilizing the corresponding front panel switches.

7. When all input testing has been completed, restore the control back to pre-test conditions.

9.9 Testing control outputs

1. Press the ENT (UTIL Hot Button) pushbutton to awaken the unit. The menu will advance to "UTILITIES".
2. Press the Down Arrow pushbutton once. The unit will display the following:
Calibration/Test
3. Press the Down arrow pushbutton, as necessary, to navigate to the Output Test menu item.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
alarm contact
0000000
The cursor will be located under the far right zero which corresponds to the control "Alarm Contact". Positions 2 through 7 are:
 - Position 2, Raise Contact
 - Position 3, Lower Contact
 - Position 4, Source Contact
 - Position 5, Aux Output 1
 - Position 6, Seal-In Output
 - Position 7, Deadman Output
5. To test output contacts proceed as follows for the desired output:
 - 5.1. Verify that the control is in a configuration that supports output contact testing.
 - 5.2. Utilizing the Up/Down arrow pushbutton for the desired output contact set the value to "1". The contact output will be active. Verify that the desired output is activated.
 - 5.3. Utilizing the Up/Down arrow pushbutton for the desired output contact set the value to "0". The contact output will be deactivated. Verify that the desired output is deactivated.
 - 5.4. Repeat for the remaining outputs.

9.10 Testing front panel push buttons

1. Press the ENT (UTIL Hot Button) pushbutton to awaken the unit. The menu will advance to "UTILITIES".
2. Press the Down Arrow pushbutton once. The unit will display the following:

Calibration/Test

3. Press the Down arrow pushbutton, as necessary, to navigate to the Button Input Test menu item.
4. Press the ENT pushbutton. If prompted, enter a valid Level 2 Access Code. The following will be displayed:
 Button Input Test
 Press A Key...
5. Test the desired pushbutton by pressing and holding the pushbutton. The display will identify the pushbutton if it is working correctly.

9.11 Delta VAr peer to peer paralleling checkout procedure

9.11.1 Performing two transformer verification

1. Verify that the individual controls to be included in the Peer to Peer configuration have been tested in the independent mode of operation.
2. Verify that Peer to Peer (P2P) DeltaVar has been configured in each control and they are ready to be tested.
3. Place all the transformers to be paralleled in Manual mode to keep them from responding to tap change requests.
4. Place all the transformers to be paralleled on the same tap position so that the regulated voltage is near the band center setting.
5. For this verification, assume that the following system conditions exist:
 - All the transformers are the same.
 - The high side sources are all connected together.
 - There is only one high side source for the paralleled transformers.
6. If the high side sources are connected together, then verify that the DeltaVar current in all the transformers is near zero.
7. If the high side sources are not connected together, then it may be necessary to adjust the tap positions to obtain a zero DVAR current, or the minimum value possible. Record the difference in the tap positions, for example Transformer 1 may be two taps higher than Transformer 2.



Write down the Tap Position Difference.

8. Manually raise Transformer 1, one or two taps.
9. Manually lower Transformer 2, one or two taps, then observe the following:

- The regulated voltage should still be in band near the center of the band width.
 - The DVAR current on Transformer 1 should be lagging
 - The DVAR current on Transformer 2 should be leading
 - The DVAR current on Transformers 1 and 2 should have the same magnitude
10. Verify that Transformer 1 is calling for a lower and Transformer 2 is calling for a raise.
 11. If both transformers are not calling for a tap change operation, then manually increase the tap position difference between the transformers by raising Transformer 1, one tap and lowering Transformer 2 one tap until both controls are calling for the correct operation.

This keeps the regulated voltage near the center of the bandcenter setting and therefore any operations by the controls will be caused by the DVAR current.
 12. Simultaneously place both transformers into Automatic operation and observe where the transformers stop initiating tap changes.

The transformers should be on the same tap or one tap part, with the controls not calling for any operations. If the high side is not connected then the tap positions should be the same number of taps apart as noted above.
 13. Place Transformer 1 and Transformer 2 in Manual.
 14. Raise or Lower either Transformer 1 or Transformer 2 by one tap to generate some DVAR current.

The transformer with the higher voltage (typically the higher tap) will have the lagging DVAR current and the other transformer will have the same magnitude but will indicate a leading DVAR current. If the load is not evenly distributed between the transformers, then the voltage on the transformer with the larger load may decrease and the control may call for a raise. The voltage on the transformer with the smaller load may increase and its control may call for a lower.
 15. Open the Tie Breaker between Transformer 1 and Transformer 2 and verify that the controls are not calling for any tap change operations.

The load current does not have to be the same when the Tie Breaker opens and the voltage may change based on the loading of the transformers.
 16. Verify that the DVAR current is at or near zero.
 17. If necessary, manually initiate tap change operations to bring the voltage back into band.
 18. Manually place the transformers to the same tap position (or the same difference as noted above).
 19. Close the Tie Breaker between Transformer 1 and Transformer 2 and verify that the DVAR current in all transformers is at or near zero.

Assuming all the transformers are the same and the high side sources are all connected together, only one high side source for the paralleled transformers. If the high side is not connected together then may need to adjust the tap positions to get zero DVAR current or the minimum value possible.
 20. Manually Lower Transformer 1, one or two taps.
 21. Manually Raise Transformer 2, one or two taps.

The regulated voltage should still be in band near the center of the band width.

22. Verify that the DVAR current on Transformer 1 is Leading and that the DVAR current on Transformer 2 is Lagging with the same magnitude.
23. Raise or Lower either Transformer 1 or Transformer 2 so they are one tap apart to generate some DVAR current.
The transformer with the higher voltage (typically the higher tap) will have the Lagging DVAR current and the other transformer will have the same magnitude but will Leading DVAR current.



Since Transformer 2 will be supplying all the load, its voltage may decrease. Transformer 1 voltage may increase since it has no load (if its PT is between the breaker and the transformer).

24. Open the Low Side Breaker for Transformer 1 and verify that the controls are not calling for any tap change operations.
The load current on Transformer 2 should be doubled and Transformer 1 load should be at or near zero.
25. Verify that the DVAR current is at or near zero.
26. If necessary, manually initiate tap change operations to bring the voltage back into band.
27. Manually place the transformers to the same tap position (or the same difference as noted above).
28. Close the Low Side Breaker for Transformer 1 and verify that the DVAR current in all the transformers is at or near zero.
29. Raise or Lower either Transformer 1 or Transformer 2 by one tap to generate some DVAR current.
The transformer with the higher voltage (typically the higher tap) will have the Lagging DVAR current and the other transformer will have the same magnitude but will Leading DVAR current. Since Transformer 1 will be supplying all the load, its voltage may decrease. Transformer 2 voltage may increase since it has no load (if its PT is between the breaker and the transformer).
30. Open the Low Side Breaker for Transformer 2 and verify that the controls are not calling for any tap change operations.
The load current on Transformer 1 should be doubled and Transformer 2 load should be zero.
31. Verify that the DVAR current is at or near zero.
32. If necessary, manually initiate tap change operations to bring the voltage back into band.
33. Manually place the transformers to the same tap position (or the same difference as noted above).
34. Close the Low Side Breaker for Transformer 2 and verify the DVAR current in all the transformers is at or near zero.

—Test complete.—

Place the desired settings on the controls and set all controls to Automatic.

9.11.2

Performing three transformer verification

1. Verify that the individual controls to be included in the Peer to Peer configuration have been tested in the independent mode of operation.
2. Verify that Peer to Peer (P2P) DeltaVar has been configured in each control and they are ready to be tested.
3. Place all the transformers to be paralleled in Manual mode to keep them from responding to tap change requests.
4. Place all the transformers to be paralleled on the same tap position so that the regulated voltage is near the band center setting.
5. For this verification, assume that the following system conditions exist:
 - All the transformers are the same.
 - The high side sources are all connected together.
 - There is only one high side source for the paralleled transformers.
6. If the high side sources are connected together, then verify that the DeltaVar current in all the transformers is near zero.
7. If the high side sources are not connected together, then it may be necessary to adjust the tap positions to obtain a zero DVAR current, or the minimum value possible. Record the difference in the tap positions, for example Transformer 1 may be two taps higher than Transformer 2 with Transformer 3 one tap lower than Transformer 2.



Write down the Tap Position Difference.

8. Manually raise Transformer 1, one or two taps.
9. Manually lower Transformer 2 and 3, one or two taps, then observe the following:
 - The regulated voltage should still be in band near the center of the band width.
 - The DVAR current on Transformer 1 should lagging
 - The DVAR current on Transformers 2 and 3 should be leading
 - The DVAR current on Transformer 1 will have twice the magnitude of Transformers 2 and 3
 - The DVAR current on Transformers 2 and 3 should both have the same magnitude
10. Verify that Transformer 1 is calling for a lower and Transformers 2 and 3 are calling for a raise.
11. If all transformers are not calling for a tap change operation, then manually increase the tap position difference between the transformers by raising Transformer 1, one

tap and lowering Transformers 2 and 3 one tap until all controls are calling for the correct operation.

This keeps the regulated voltage near the center of the bandcenter setting and therefore any operations by the controls will be caused by the DVAR current.

12. Simultaneously place all transformers into Automatic operation and observe where the transformers stop initiating tap changes.

The transformers should be on the same tap or one tap part, with the controls not calling for any operations. If the high side is not connected then the tap positions should be the same number of taps apart as noted above.

13. Place Transformers 1, 2 and 3 in Manual.

14. Raise Transformer 1, one tap to generate some DVAR current.

The transformer with the high voltage (typically the higher tap) will have the lagging DVAR current and the other two transformers will have the same magnitude but will indicate a leading DVAR current.



If the load is not evenly distributed between the transformers, then the voltage on the transformer with the larger load may decrease and the control may call for a raise. The voltage on the transformer with the smaller load may increase and its control may call for a lower.

15. Open the Tie Breaker between Transformer 1 and Transformer 2 with Transformer 3 still connected to Transformer 2.
16. Verify that the controls are not calling for any tap change operations.
The load current does not have to be the same when the Tie Breaker opens and the voltage may change based on the loading of the transformers.
17. Verify that Transformer 1 DVAR current is at or near zero.
18. If necessary, manually initiate tap change operations to bring the voltage back into band.
19. Verify that Transformer 2 and 3 DVAR current is at or near zero (because they are on the same tap position).
20. Raise Transformer 2, one tap and verify the following:
 - DVAR current on Transformer 2 is lagging
 - Transformer 3 DVAR current is leading
 - The magnitude of the DVAR Current on Transformer 2 and 3 should be the same
 - Transformer 1 DVAR current should be at or near zero
21. Manually place all transformers to the same tap position (or the same difference as noted above).
22. Close the Tie Breaker between Transformer 1 and Transformer 2 and verify that the DVAR current in all transformers is at or near zero.
Assuming all the transformers are the same tap and the high side sources are all connected together, only one high side source for the paralleled transformers. If the

high side is not connected together then may need to adjust the tap positions to get zero DVAR current or the minimum value possible.

23. Manually Lower Transformer 3, one or two taps.
24. Manually Raise Transformers 1 and 2, one or two taps.
The regulated voltage should still be in band near the center of the band width.
25. Verify the following:
 - The DVAR current on Transformer 3 is Leading
 - The DVAR current on Transformers 1 and 2 is Lagging
 - The DVAR current on Transformer 3 will have twice the magnitude of Transformers 1 and 2
 - The DVAR current on Transformers 1 and 2 should have the same magnitude

If the load is not evenly distributed between the transformers, then the voltage on the transformer with the larger load may decrease and the control may call for a raise. The voltage on the transformer with the smaller load may increase and its control may call for a lower.

26. Open the Tie Breaker between Transformer 2 and Transformer 3 with Transformer 1 still connected to Transformer 2.
27. Verify that the controls are not calling for any tap change operations.
The load current does not have to be the same when the Tie Breaker opens and the voltage may change based on the loading of the transformers.
28. Verify that Transformer 3 DVAR current is at or near zero.
29. If necessary, manually initiate tap change operations to bring the voltage back into band.
30. Verify that Transformer 1 and 2 DVAR current is at or near zero (because they are on the same tap position).
31. Raise Transformer 2, one tap and verify the following:
 - DVAR current on Transformer 2 is lagging
 - Transformers 1 DVAR current is leading
 - The magnitude of the DVAR Current on Transformer 1 and 2 should be the same
 - Transformer 3 DVAR current should be at or near zero
32. Manually place the transformers to the same tap position (or the same difference as noted above).
33. Close the Tie Breaker between Transformer 2 and Transformer 3.
34. Verify that the DVAR current in all the transformers is at or near zero.
Assuming all the transformers are the same and the high side sources are all connected together, only one high side source for the paralleled transformers. If the high side is not connected together then it may be necessary to adjust the tap positions to achieve zero DVAR current or the minimum value possible.
35. Manually Lower Transformer 1, one or two taps.
36. Manually Raise Transformers 2 and 3, one or two taps.
The regulated voltage should still be in band near the center of the band width.
37. Verify the following:

- The DVAR current on Transformer 1 is Leading
- The DVAR current on Transformers 2 and 3 is Lagging
- The DVAR current on Transformer 1 will have twice the magnitude of Transformers 2 and 3, and they should both have the same magnitude.
- The DVAR current on Transformers 2 and 3 should have the same magnitude.

Since Transformers 2 and 3 will be supplying all the load, their voltage may decrease. Transformer 1 voltage may increase since it has no load (if its PT is between the breaker and the transformer).

38. Open the Low Side Breaker for Transformer 1 and verify that the controls are not calling for any tap change operations.
The load current on Transformers 2 and 3 should have changed from one third to one half and Transformer 1 load should be at or near zero.
39. Verify that the DVAR current on Transformer 1 is at or near zero.
40. If necessary, manually initiate tap change operations to bring the voltage back into band.
41. Manually raise Transformer 2, one tap.
42. Verify the following:
 - The DVAR current on Transformer 2 is lagging
 - The DVAR current on Transformer 3 is leading
 - The DVAR current on Transformers 2 and 3 have the same magnitude
 - The DVAR current on Transformer 1 should be at or near zero
43. Manually place the transformers to the same tap position (or the same difference as noted above).
44. Close the Low Side Breaker for Transformer 1 and verify that the DVAR current in all the transformers is at or near zero.
Assuming all the transformers are the same and the high side sources are all connected together, only one high side source for the paralleled transformers. If the high side is not connected together then it may be necessary to adjust the tap positions to achieve zero DVAR current or the minimum value possible.
45. Manually Lower Transformer 2, one or two taps.
46. Manually Raise Transformers 1 and 3, one or two taps.
The regulated voltage should still be in band near the center of the band width.
47. Verify the following:
 - The DVAR current on Transformer 2 is leading
 - The DVAR current on Transformers 1 and 3 is lagging
 - The DVAR current on Transformer 2 will have twice the magnitude of Transformers 1 and 3
 - The DVAR current on Transformers 1 and 3 should have the same magnitude

Since Transformers 1 and 3 will be supplying all the load, their voltage may decrease. Transformer 2 voltage may increase since it has no load (if its PT is between the breaker and the transformer).

-
48. Open the Low Side Breaker for Transformer 2 and verify that the controls are not calling for any tap change operations.
The load current on Transformers 1 and 3 should have changed from one third to one half and Transformer 2 load should be at or near zero.
 49. Verify that the DVAR current on Transformer 2 is at or near zero.
 50. If necessary, manually initiate tap change operations to bring the voltage back into band.
 51. Manually raise Transformer 1, one tap.
 52. Verify the following:
 - The DVAR current on Transformer 1 is lagging
 - The DVAR current on Transformer 3 is leading
 - The DVAR current on Transformers 1 and 3 have the same magnitude
 - The DVAR current on Transformer 2 should be at or near zero
 53. Manually place the transformers to the same tap position (or the same difference as noted above).
 54. Close the Low Side Breaker for Transformer 2 and verify that the DVAR current in all the transformers is at or near zero.
Assuming all the transformers are the same and the high side sources are all connected together, only one high side source for the paralleled transformers. If the high side is not connected together then it may be necessary to adjust the tap positions to achieve zero DVAR current or the minimum value possible.
 55. Manually Lower Transformer 3, one or two taps.
 56. Manually Raise Transformers 1 and 2, one or two taps.
The regulated voltage should still be in band near the center of the band width.
 57. Verify the following:
 - The DVAR current on Transformer 3 is leading
 - The DVAR current on Transformers 1 and 2 is lagging
 - The DVAR current on Transformer 3 will have twice the magnitude of Transformers 1 and 2
 - The DVAR current on Transformers 1 and 2 should have the same magnitude

Since Transformers 1 and 2 will be supplying all the load, their voltage may decrease. Transformer 3 voltage may increase since it has no load (if its PT is between the breaker and the transformer).
 58. Open the Low Side Breaker for Transformer 3 and verify that the controls are not calling for any tap change operations.
The load current on Transformers 1 and 2 should have changed from one third to one half and Transformer 3 load should be at or near zero.
 59. Verify that the DVAR current on Transformer 3 is at or near zero.
 60. If necessary, manually initiate tap change operations to bring the voltage back into band.
 61. Manually raise Transformer 1, one tap.
 62. Verify the following:

-
- The DVAR current on Transformer 1 is lagging
 - The DVAR current on Transformer 2 is leading
 - The DVAR current on Transformers 1 and 2 have the same magnitude
 - The DVAR current on Transformer 3 should be at or near zero
63. Manually place the transformers to the same tap position (or the same difference as noted above).
64. Close the Low Side Breaker for Transformer 3 and verify that the DVAR current in all the transformers is at or near zero.
- Assuming all the transformers are the same and the high side sources are all connected together, only one high side source for the paralleled transformers. If the high side is not connected together then it may be necessary to adjust the tap positions to achieve zero DVAR current or the minimum value possible.

—Test complete.—

Place the desired settings on the controls and set all controls to Automatic.

Section 10 Appendix A HMI

10.1 HMI menu flow



At any menu screen, press EXIT to go to the Menu header. Press the left or right arrow push button to move sideways to the adjacent Menu header.

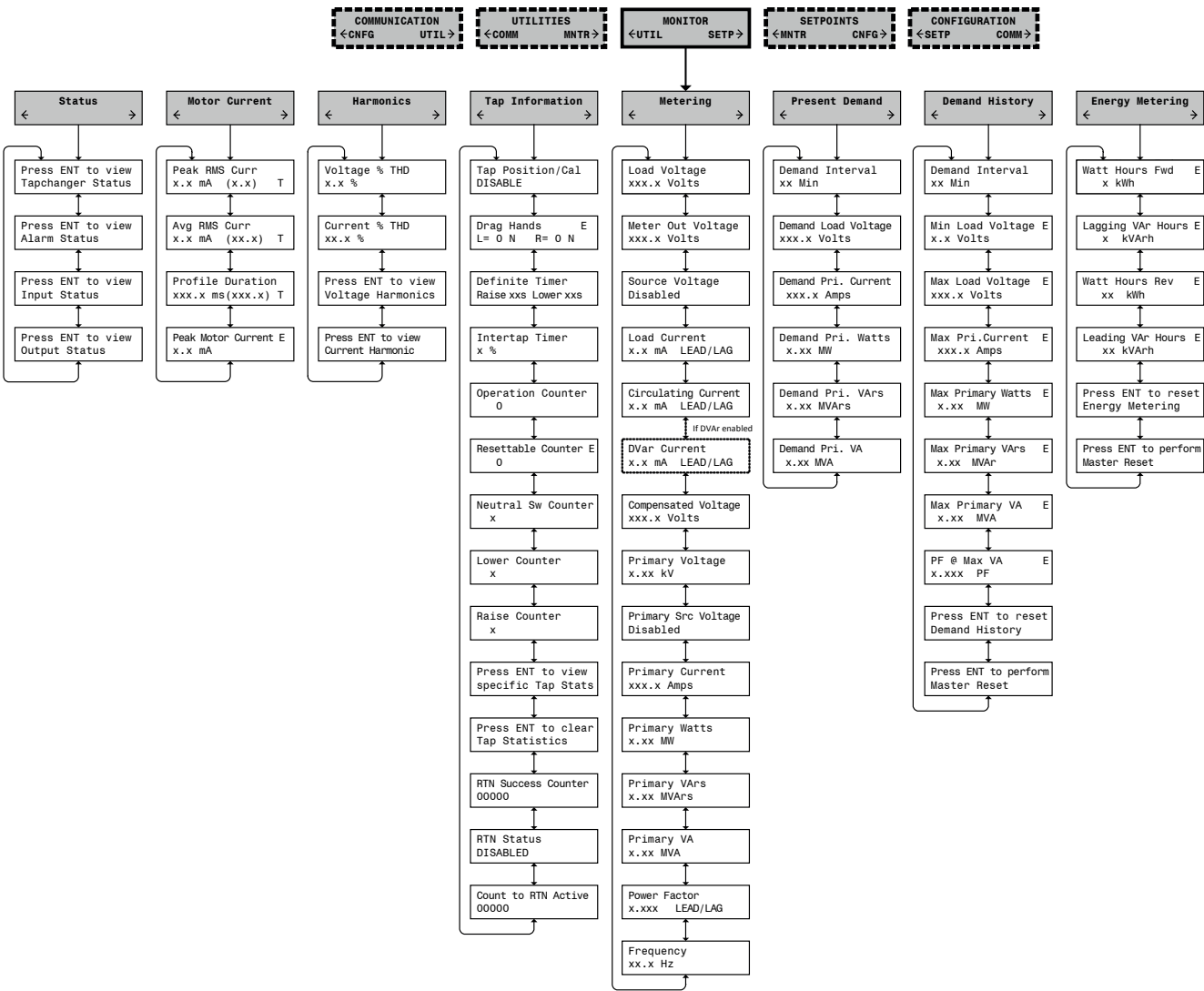


Figure 451: Monitor Menu Flow

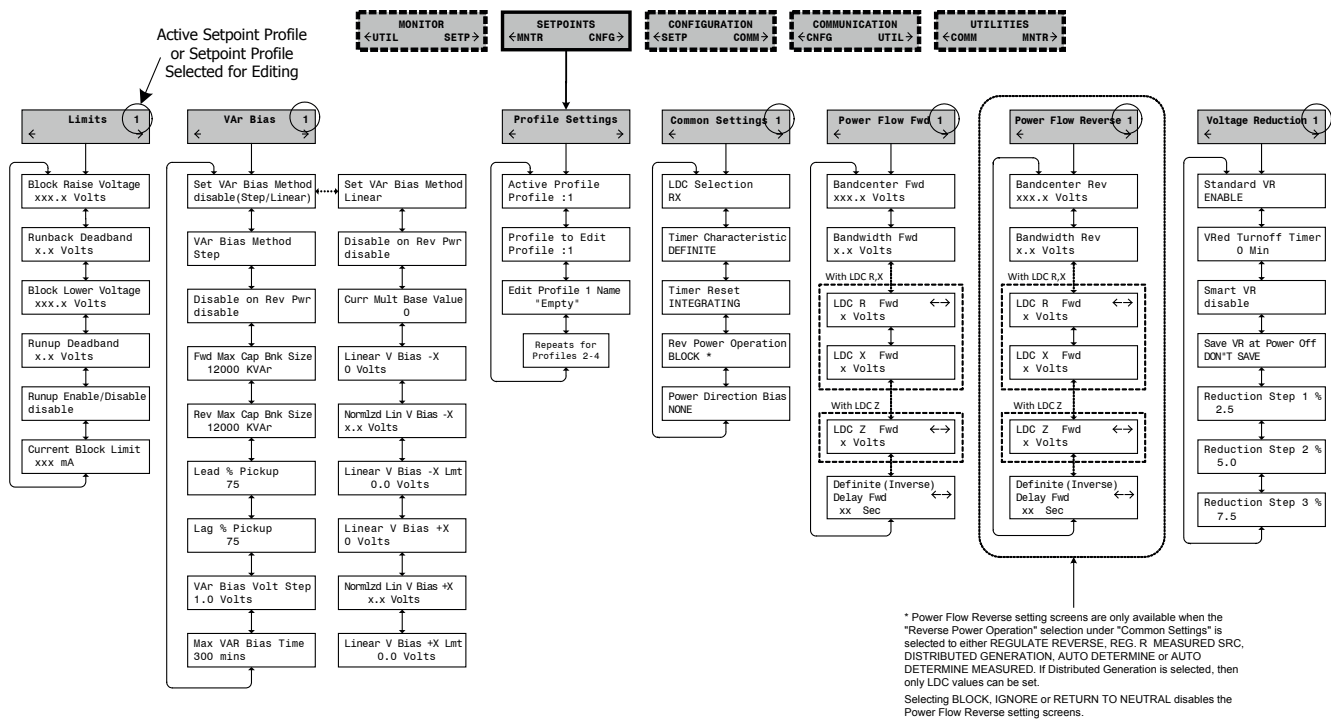


Figure 452: Setpoints Menu Flow

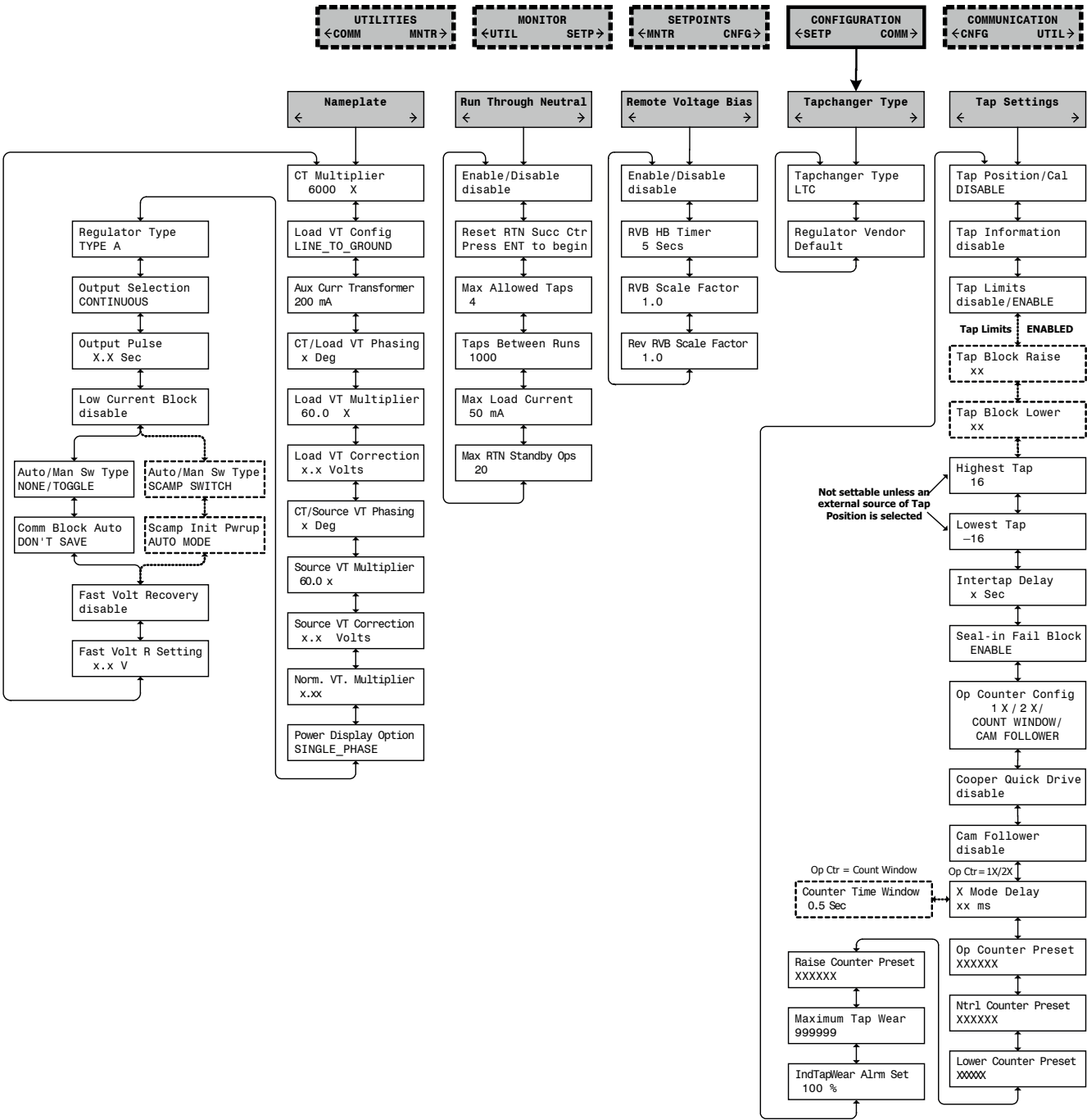


Figure 453: Configuration Menu Flow (1 of 3)

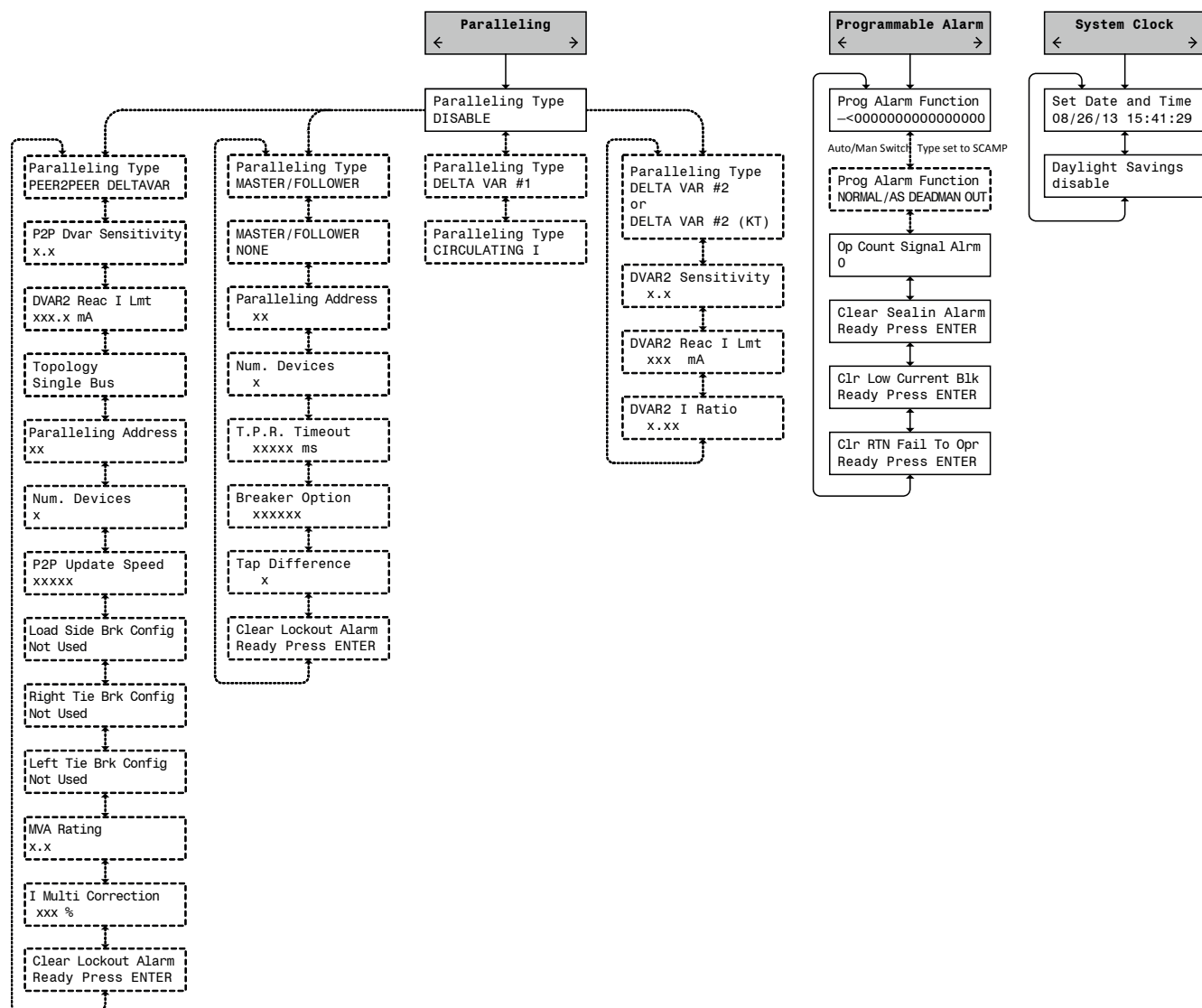


Figure 454: Configuration Menu Flow (2 of 3)

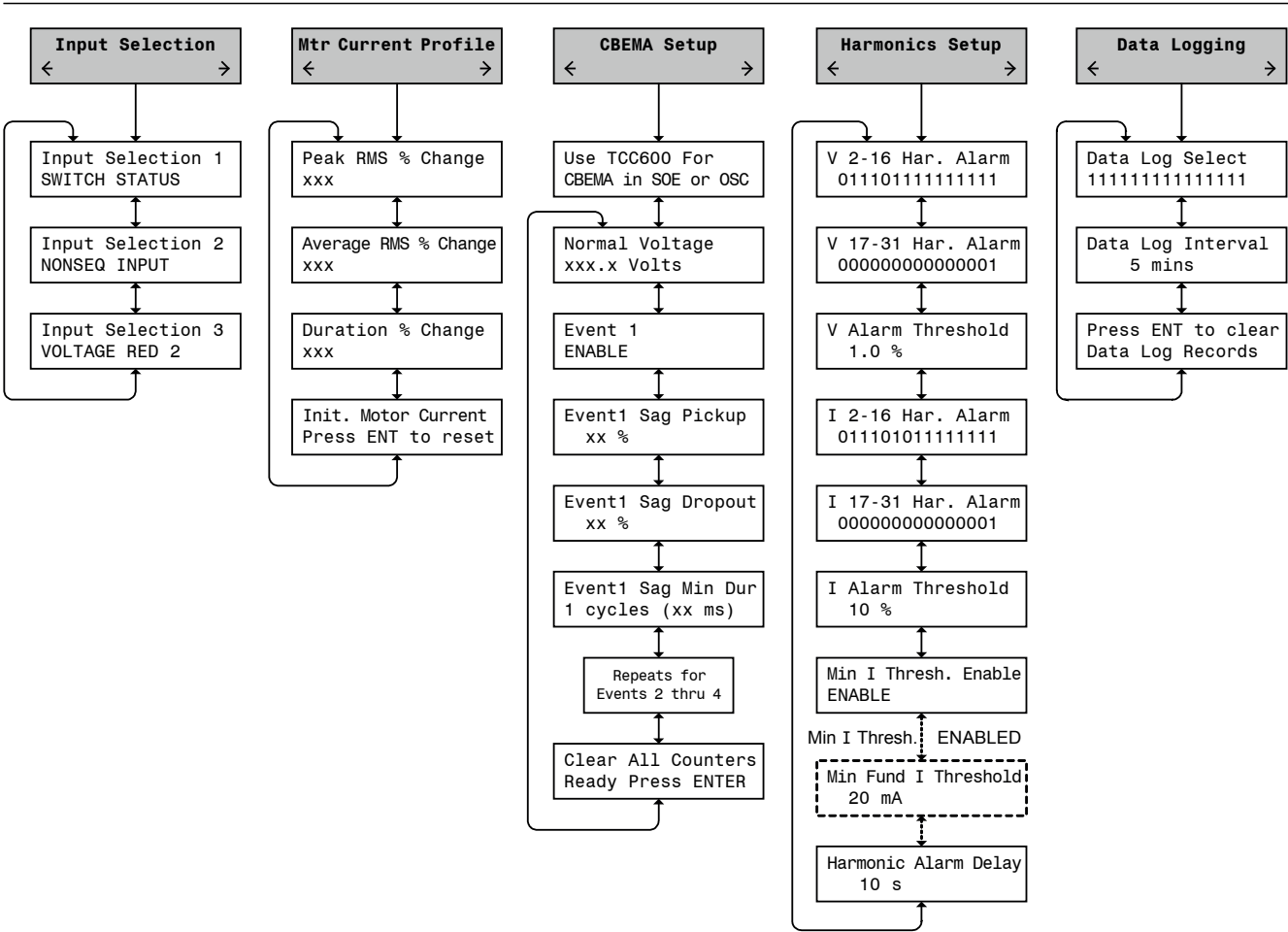


Figure 455: Configuration Menu Flow (3 of 3)

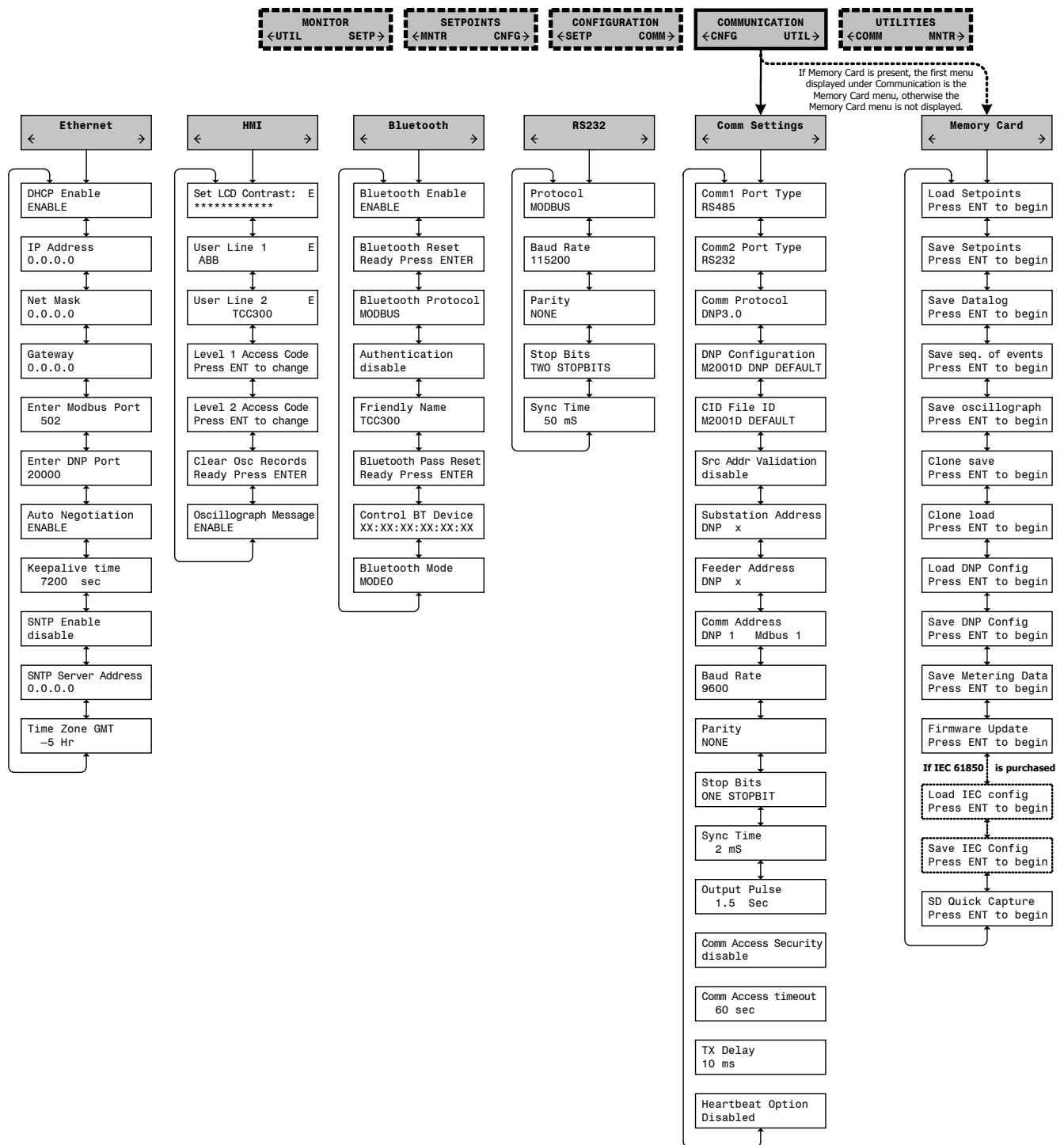


Figure 456: Communication Menu Flow

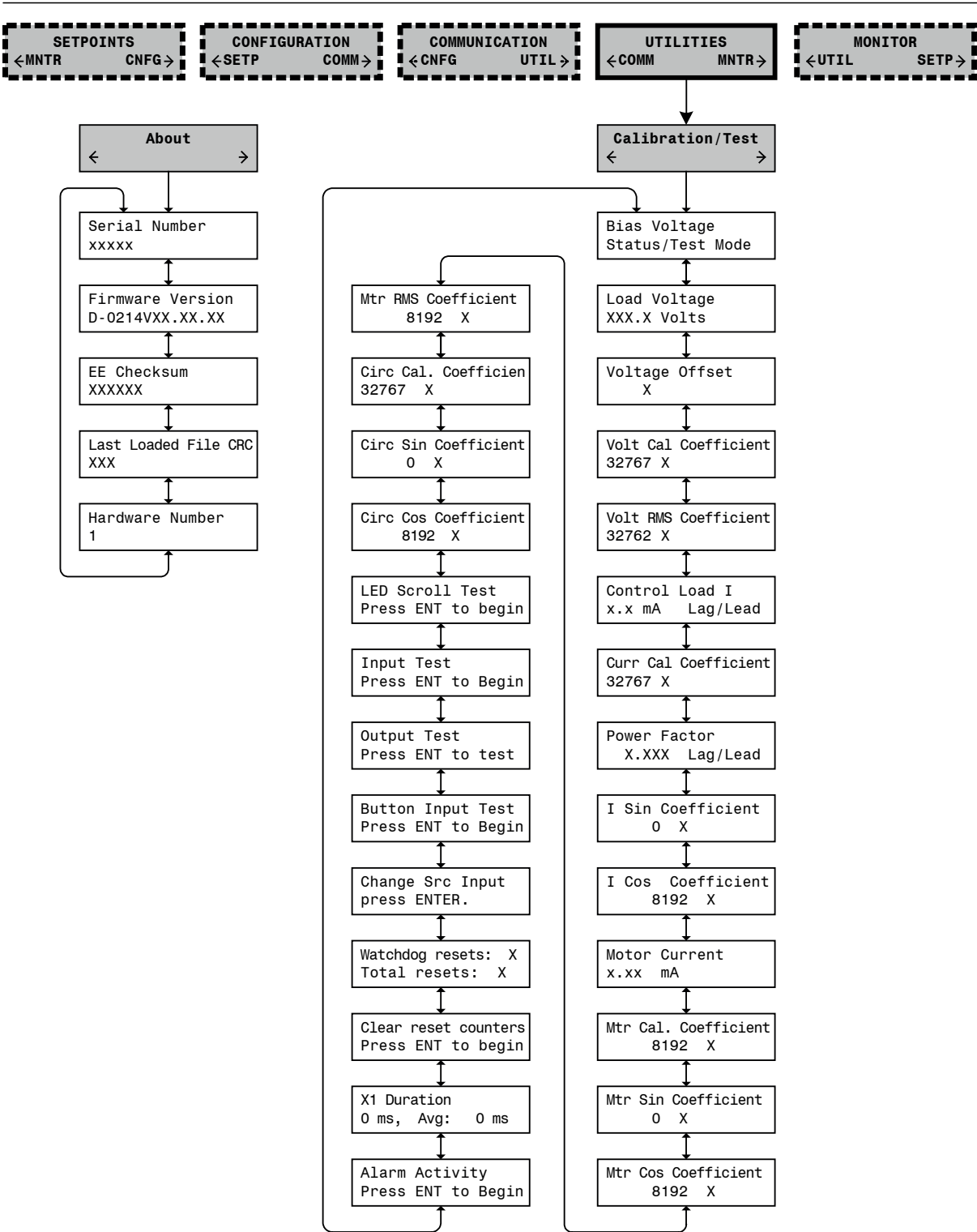


Figure 457: Utilities Menu Flow

10.2 HMI Screen Review

10.2.1 Monitor

10.2.1.1 Metering

Load Voltage

XXX.X Volts

Displays the real-time measured value of voltage at the regulator or the transformer, including the voltage reduction if applicable and any corrections made using the user-selected VT correction voltage.

Meter Out Voltage

XXX.X Volts

Displays the measured voltage at the terminals of the TCC300 without any software modifications. Used as the base for normalizing voltage.

Source Voltage

XXX.X V (Calculated/Measured/disabled)

- Calculated – Displays the real-time calculated source voltage-only applicable in regulator control applications and includes any corrections made using the user-selected VT correction voltage.
- Measured – Displays the real-time measured source voltage when Reverse Power is detected and Reverse Power Operation is "Regulate Rev Measured".

Load Current

x.x mA LEAD/LAG

Displays the real-time measured value of load current related to the scaling factor Current Transformer of 200 mA.

Circulating Current

x.x mA LEAD/LAG

Displays the representable value of circulating current, if the control is used with M-0115A Parallel Balancing Module or equivalent. Displays the value of DVAr Current when DVAr Paralleling method is enabled.

Compensated Voltage

xxx.x Volts

Displays the calculated voltage at the "load center", based on load current and the LDC settings.

Primary Voltage

X.XX kV

Displays the calculated primary voltage based on the user-selected voltage multiplier and measured secondary voltage.

Primary Src Voltage

X.XX kV (or disabled)

Displays Primary Source Voltage based on the user-selected Source VT Correction.

Primary Current

XXX.X Amps

Displays the calculated primary current based on the user-selected current multiplier and measured secondary current.

Primary Watts

X.XX MW

Displays the calculated primary quantity based on the user-selected multipliers and measured secondary voltage and current.

Primary VArS

X.XX MVarS

Displays the calculated primary quantity based on the user-selected multipliers and measured secondary voltage and current.

Primary VA

X.XX MVA

Displays the calculated primary quantity based on the user-selected multipliers and measured secondary voltage and current.

Power Factor

X.XXX LEAD/LAG

Displays the real-time calculated value of power factor.

Frequency

XX.X Hz

Displays the line frequency.

10.2.1.2

Present Demand

Demand Interval

XX Min

Toggles between 5, 10, 15, 30 and 60 minute interval with a factory setting of 15 minutes. The time interval is the amount of time it takes for a thermal meter to indicate 90% of a change of load.

Demand Load Voltage

XXX.X Volts

Displays the real-time measured value of voltage at the regulator or transformer. This value continuously averaged over consecutive 32-second intervals.

Demand Pri. Current

XXX.X Amps

Displays the calculated primary demand current based on the user-selected current multiplier and measured secondary current.

Demand Pri. Watts

X.XX MW

Displays the demand value based on the user-selected voltage and current multipliers or secondary voltage and current.

Demand Pri. VArS

X.XX MVArS

Displays the demand value based on the user-selected voltage and current multipliers and measured secondary voltage and current.

Demand Pri. VA

X.XX MVA

Displays the demand value based on the user-selected voltage and current multipliers and measured secondary voltage and current.

10.2.1.3

Demand History

Demand Interval

XX Min

Toggles between 5, 10, 15, 30 and 60 minute interval with a factory setting of 15 minutes. The time interval is the amount of time it takes for a thermal meter to indicate 90% of a change of load.

Min Load Voltage E

X.X Volts

Displays minimum local voltage at the regulator or transformer. Bottom line toggles between Date & Time/Volts.

Max Load Voltage E

XXX.X Volts

Displays maximum local voltage at the regulator or transformer. Bottom line toggles between Date & Time/Volts.

Max Pri. Current E

XXX.X Amps

Displays maximum primary current. Bottom line toggles between Date & Time/Amps.

Max Primary Watts E

X.XX MW

Displays maximum Watts. Bottom line toggles between Date & Time/W.

Max Primary VArS E

X.XX MVAr

Displays maximum VAr. Bottom line toggles between Date & Time/VAr.

Max Primary VA E

X.XX MVA

Displays maximum VA. Bottom line toggles between Date & Time/VA.

Max Primary VA E

PF @ Max VA

Displays power factor at time of maximum VA. Resets automatically when MAX VA screen, below, is reset.

Press ENT to reset

Demand History

Press ENT to perform

Master Reset

10.2.1.4

Energy Metering

Watt Hours Fwd E

XX.XXX kWh

Displays total forward WHr. Bottom line toggles between Date & Time/WHr.

Lagging VAr Hours E

XX.XXX kVArh

Displays total forward VArHr. Bottom line toggles between Date & Time/VArHr.

Watt Hours Rev E

X kWh

Displays total reverse WHr. Bottom line toggles between Date & Time/WHr.

Leading VAr Hours E

X kVArh

Displays total reverse VArHr. Bottom line toggles between Date & Time/VArHr.

Press ENT to reset

Energy Metering

Press ENT to perform

Master Reset

10.2.1.5

Status

Press ENT to view

Tapchanger Status

TAP BDS PWR BLK VRD

1 OK fwd --- Off

- TAP Tap Position ^[1]
- BDS Band Status (Lo, Hi, OK)
- PWR Power Direction (Fwd, Rev)
- BLK Blocks in Effect
- VRD Voltage Reduction (Off, 1, 2, 3)

Press ENT to view

Alarm Status

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

- A = Block Raise Tap
- B = Block Lower Tap
- C = Block Raise Voltage
- D = Block Lower Voltage
- E = Voltage Reduction
- F = Power Direction
- G = Current Limit
- H = Comm Block
- I = LDC/LDZ
- J = Abnormal Tap
- K = VAr Bias Lag
- L = VAr Bias Lead
- M = Backup Fail (If purchased)
- N (M ^[2]) = DVar2 Over Curr (If purchased)
- O (N ^[5] / M ^[3]) = Seal-in Failure
- P (O ^[5] / N ^[3]) = Low Current Blk

[1] In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, the Tap Position screen will display "- - -" instead of "0".

[2] These parameters will decrement by 1 letter if Backup Power (M) is not purchased.

[3] These parameters will decrement by 2 letters if Backup Power (M) and DVar2 (N) are not purchased.

- $Q(P^{[5]}/O^{[3]}) = \text{RTN Fail}$
- $R(Q^{[5]}/P^{[3]}) = \text{Ind Tap Wear}$
- $S(R^{[5]}/Q^{[3]}) = \text{Op Count Signal}$
- $T(S^{[5]}/R^{[3]}) = \text{Tap Changer Fail}$

Alarm Status Key

- 1 Alarm Enabled/Condition Met
- 0 Alarm Enabled/Condition Not Met
- X Alarm Disabled/Condition Met
- - Alarm Disabled/Condition Not Met

Press ENT to view

Input Status

C NS VR TC KT N MS

00 00 - - 0 RL 0 0

- C = Counter Contact
- NS = Non-Sequential Input
- VR = Voltage Reduction Inputs 1 and 2
- TC = Tap Connection
- KT = Keeptrack Lower and Raise Input
- N = Neutral Tap Position MS = Motor Seal-In

Key

- 1 = True (on)
- 0 = False (off)

Press ENT to view

Output Status

RAISE LOWER ALARM

1 0 0

- RAISE Raise Contact
- LOWER Lower Contact
- ALARM Alarm Contact

Key

- 1 = True (on)
- 0 = False (off)

10.2.1.6

Motor Current

Peak RMS Curr

X.X mA (X.X) T

Displays the Peak RMS Current of the last operation (profile). Also displays the average Peak RMS Current from the Training Mode (x.x). If a "T" is present, the Training Mode is active.

Avg RMS Curr

X.X mA (XX.X) T

Displays the Average RMS Current of the last operation (profile). Also displays the average of the Average RMS Current from the Training Mode (x.x). If a "T" is present, the Training Mode is active.

Profile Duration

XXXXX.X ms (XXXX.X) T

Displays the Profile Duration of the last operation (profile). Also displays the average of the Profile Duration from the Training Mode (x.x). If a "T" is present, the Training Mode is active.

Peak Motor Current E

X.X mA

Displays the Peak Motor Current recorded. This parameter is the highest Peak Motor Current recorded by the control. This parameter is independent of the Peak RMS Current in the Motor Current Profile.

10.2.1.7

Harmonics

Voltage % THD

X.X %

Displays the percent of Voltage THD.

Current % THD

XX.X %

Displays the percent of Current THD.

Press ENT to view

Voltage Harmonics

Allows the user to view individual Voltage Harmonic Values (2-31).

Press ENT to view

Current Harmonic

Allows the user to view individual Current Harmonic Values (2-31).

10.2.1.8

Tap Information

Tap Position/Cal

DISABLE

Displays the tap position of the tapchanger. Recognizes tapchanges commanded via manual, automatic or external (SCADA) means, if tap position is not disabled. The tap position can be calibrated by selecting ENT, then setting the tap position using the Up / Down pushbuttons and selecting ENT to confirm the new tap position.



In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, the Tap Position screen will display "---" instead of "0".

Drag Hands E

L= 0 N R= 0 N

Displays minimum and maximum values of tap position since reset.

Definite Timer

Raise= xxs Lower= xxs

Displays the status of the raise and lower timers (Definite or Inverse).

Intertap Timer

X %

Displays the status of the Intertap Timer.

Operation Counter

0

Records the total number of raise and lower operations. The operation counter will advance based on the Operation Counter Configuration, as set by user. This counter is not resettable, but can be preset to any value between 0 and 999,999.

Resettable Counter E

X

Records the total number of raise and lower operations as does the total operations counter, discussed above. This counter is reset by pressing ENT at this screen. This counter can be used to monitor the number of tapchanges since the last time it was checked.

Neutral Sw Counter

X

The Neutral Switch Counter is updated each time the neutral input is detected. Neutral Switch Counter can also preset to any value. The Neutral Switch Counter is a software counter that is stored in non-volatile memory and has a maximum value of 1,000,000.

Lower Counter

X

Records the number of Lower operations, can be Preset/Reset in Configuration/Tap Settings.

Raise Counter

X

Records the number of Raise operations, can be Preset/Reset in Configuration/Tap Settings.

Press ENT to view

specific Tap Stats

Tap Tap Number

0 0 0.0 A

- TAP = Tap Position
- TAP Number = The number of tapchanges and the Accumulated Primary Current for each individual tap position on the Tapchanger control.

Press ENT to clear

Tap Statistics

Press ENT to confirm clearing tap statistics.

RTN Success Counter

xxxxxx

The RTN counter increments after each successful operation of the Run Through Neutral feature.

RTN Status

Disabled/Enabled

Displays the status of the Run Through Neutral Feature.

Count to RTN Active

xxxxxx

Displays the number of counter operations since the operations between runs setting was set, or since the feature was enabled. The counter will reset to zero if the feature is enabled and successfully runs through neutral.

10.2.2

Setpoints

10.2.2.1

Profile Settings

Active Profile

Profile: 1

Selects the Active Profile (1, 2, 3 or 4).

Profile to Edit

Profile: 1

Selects the Setpoint Profile to be edited (1, 2, 3 or 4).

Edit Profile 1 Name (2, 3 or 4)

"Empty"

Assigns a profile name of up to 16 standard alphanumeric characters. Alpha characters may be either upper or lower case.

10.2.2.2

Common Settings

LDC Selection

RX

Selects Line Drop Compensation Resistance/Reactance or Z.

Timer Characteristic

DEFINITE

Sets control timer for Definite or Inverse time. There are four setpoints associated with this selection: Time Delay F/R, and Inverse Time F/R.

Timer Reset

INTEGRATING

Toggles between integrating timer and instantaneous reset (INST_RESET) timer upon voltage return to in-band condition.

Rev Power Operation

BLOCK

Toggles between eight modes of operation:

- BLOCK – to inhibit automatic tapchange operation (Factory Setting)
- REGULATE REVERSE/ REG. R MEASURED SRC – to detect a reverse power condition and regulate according to reverse power settings
- RETURN TO NEUTRAL – to drive the tap position to Neutral
- IGNORE – continue unit action as though Forward Power Flow continued to exist
- DG Mode (Distributed Generation) – when distribution systems have the possibility of power reversal to control voltage
- Auto Determine/Auto Determine M – to allow the control to intelligently choose which reverse power mode applies at the time reverse power is sensed, either Distributed Generation mode or Regulate In Reverse/Regulate in Reverse Measured

Power Direction Bias

NONE

Allows one of three methods to be used for the control to switch between forward/reverse power operation. The three settings are None, Forward Bias, and Reverse Bias.

10.2.2.3

Power Flow Forward

Bandcenter Fwd

XXX.X Volts

Forward power bandcenter is adjustable from 100.0 V to 135.0 V in 0.1 V increments with a factory setting of 120.0 V.

Bandwidth Fwd

X.X Volts

Forward power bandwidth is adjustable from 1.0 V to 10.0 V in 0.1 V increments with a factory setting of 2.0 V.

LDC RES-REAC

LDC R Fwd ← →

X Volts

Forward power Line Drop Compensation resistance is adjustable from -72 V to +72 V in 1 V increments with a factory setting of 0 V.

LDC X Fwd

X Volts

Forward power Line Drop Compensation reactance is adjustable from -72 V to +72 V in 1 V increments with a factory setting of 0 V.

LDC-Z

LDC-Z Fwd ← →

X Volts

Adjustable from 0 to 72 volts in 1 volt increments.

DEFINITE DELAY

Definite Delay Fwd ← →

XX Sec

Forward power time delay for a tapchange is adjustable from 1 sec. to 360 sec. in 1 second increments with a factory setting of 30 sec.

INVERSE DELAY

Inverse Delay Fwd ← →

XX Sec

Forward power inverse delay for a tapchange is adjustable from 1 sec. to 360 sec. in 1 second increments with a factory setting of 30 sec.

10.2.2.4

Power Flow Reverse

Bandcenter Rev

XXX.X Volts

Reverse power bandcenter is adjustable from 100.0 V to 135.0 V in 0.1 V increments with a factory setting of 120.0 V.

Bandwidth Rev

X.X Volts

Reverse power bandwidth is adjustable from 1.0 V to 10.0 V in 0.1 V increments with a factory setting of 2.0 V.

LDC RES-REAC

LDC R Rev ← →

X Volts

Reverse power Line Drop Compensation resistance is adjustable from -72 V to +72 V in 1 V increments, with a factory setting of 0 V.

LDC X Rev

X Volts

Reverse power Line Drop Compensation reactance is adjustable from -72 V to +72 V in 1 V increments, with a factory setting of 0 V.

LDC-Z

LDC-Z Rev ← →

X Volts

Adjustable from 0 to 72 volts in 1 volt increments.

DEFINITE DELAY

Definite Delay Rev ← →

XX Sec

Reverse power Definite delay for a tapchange is adjustable from 1 sec. to 360 sec. in 1 second increments with a factory setting of 30 sec.

INVERSE DELAY

Inverse Delay Rev ← →

XX Sec

Reverse power inverse delay for a tapchange is adjustable from 1 sec. to 360 sec. in 1 second increments with a factory setting of 30 sec.

10.2.2.5

Voltage Reduction

Standard VR

ENABLE

Enable or disable the Standard Voltage Reduction feature.

VRed Turnoff Timer

0 min

The Voltage Reduction feature can be turned off after a time period of 1 to 999 minutes. A setting of zero disables the Voltage Reduction Turnoff Timer.

Smart VR

disable

Enable or disable Smart Voltage Reduction. Smart Voltage Reduction, when enabled, lowers voltage to between the Bandcenter setting and the lower band edge instead of stopping at the upper band edge. It also disables VAr Bias if it is in effect.

Save VR at Power Off

DON'T SAVE

Allows any Voltage Reduction command communicated to the control to be saved or not saved at power down.

Reduction Step 1 %

2.5

Voltage reduction can be achieved by contact or communication methods. First of three independent steps of voltage reduction adjustable from 0% to 10% in 0.1% increments of the bandcenter setpoint. Factory setting is 2.5%.

Reduction Step 2 %

5.0

Voltage reduction can be achieved by contact or communication methods. Second voltage reduction step. Factory setting is 5.0%.

Reduction Step 3 %

7.5

Voltage reduction can be achieved by contact or communication methods. Third voltage reduction step. Factory setting is 7.5%.

10.2.2.6

Limits

Block Raise Voltage

XXX.X Volts

Overvoltage limit is adjustable from 95.0 V to 135.0 V in 0.1 V increments with a factory setting of 128.0 V. The Block Raise setpoint should always be set above the Block Lower setpoint and above the upper band limit (the bandcenter plus one-half of the bandwidth) for the control to operate. All automatic Raise/Lower tap operations are blocked, when input voltage is less than 85.0 Vdc.

Runback DeadBand

X.X Volts

Runback Deadband is adjustable from 1.0 V to 4.0 V in 0.1 V increments with a factory setting of 2.0 V.

Block Lower Voltage

XXX.X Volts

Undervoltage limit is adjustable from 95.0 V to 135.0 V in 0.1 V increments with a factory setting of 114.0 V. The Block Lower setpoint should always be set below the Block Raise setpoint and below the lower band limit (the bandcenter minus one-half of the bandwidth)

for the control to operate. All automatic Raise/Lower tap operations are blocked, when input voltage is less than 85.0 Vdc.

Runup Deadband

X.X Volts

Runup Deadband is adjustable from 1.0 V to 4.0 V in 0.1 V increments with a factory setting of 2.0 V.

Runup Enable/Disable

disable

Enables or disabled the Voltage Runup feature.

Current Block Limit

XXX mA

Current Block Limit is adjustable from 50 mA to 640 mA in 1 mA increments with a factory setting of 640 mA with hysteresis of 5 mA. If the value of the current exceeds the Current Block Limit setpoint, the unit will not permit automatic control.

10.2.2.7

VAR Bias

Set VAR Bias Method

disable

Enables either "Step" or "Linear" VAR Bias method or disables the VAR Bias feature.

10.2.3

VAR Bias

10.2.3.1

VAR Bias (Step)

Disable on Rev Pwr

disable

Allows Step VAR Bias to be disabled in the reverse power mode.

Fwd Max Cap Bank Size

12000 KVAR

Sets the largest capacitor bank size in the forward mode from 4 to 12,000 KVAR.

Rev Max Cap Bank Size

12000 KVar

Sets the largest capacitor bank size in the reverse mode from 4 to 12,000 KVar.

Lead % Pickup

75

Defines a Lower negative VAr limit in percentage of the Max Cap Bank size below which the control will increase the upper band edge by the amount defined by VAr Bias Voltage Step.

Lag % Pickup

75

Defines an Upper positive VAr limit in percentage of the Max Cap Bank size above which the control will decrease the lower band edge by the amount defined by VAr Bias Voltage Step.

VAr Bias Volt Step

1.0 Volts

Amount by which the control will increase or decrease the Upper or Lower band edges when there is a VAr Bias out of band situation.

Max VAr Bias Time

300 mins

Maximum allowable time in minutes the control will bias the voltage edge.

10.2.3.2

VAr Bias (Linear)

Disable on Rev Pwr

disable

Allows Linear VAr Bias to be disabled in the reverse power mode.

Curr Mult Base Value

0

Allows the Current Multiplier Base Value to be set between 0 and 32600.

Linear V Bias -X

0 Volts

The "No Voltage Reduction" Linear Voltage Bias (-X) setting defines the amount of voltage bias to be applied to the Bandcenter when at 1 PU reactive current loading. Adjustable from -72 to 0 Volts at 200mA Reactive Load.

Normlzd Lin V Bias -X

x.x Volts

The Normalized Linear VAr Bias -X Volts display allows the user to observe the Normalized Linear VAr Bias -X setting as a result of the Normalizing value entered in Configuration.

Linear V Bias -X Lmt

0.0 Volts

The "No Voltage Reduction" Linear Voltage Bias (-X) Limit, limits the total voltage bias that can affect the control Bandcenter. Adjustable from -5.0 to 0.0.

Linear V Bias +X

0 Volts

The "During Voltage Reduction" Linear Voltage Bias (+X) setting defines the amount of voltage bias to be applied to the Bandcenter when at 1 PU reactive current loading. Adjustable from 0 to 72 Volts at 200mA Reactive Load.

Normlzd Lin V Bias +X

x.x Volts

The Normalized Linear VAr Bias +X Volts display allows the user to observe the Normalized Linear VAr Bias +X setting as a result of the Normalizing value entered in Configuration.

Linear V Bias +X Lmt

0.0 Volts

The "During Voltage Reduction" Linear Voltage Bias (+X) Limit, limits the total voltage bias that can affect the control Bandcenter. Adjustable from 0.0 to 5.0 Volts.

10.2.4 Configuration

10.2.4.1 Tapchanger Type



These screens display the Tapchanger settings as selected by the user in TCC600 and are for information purposes only. The settings may not be changed in the HMI.

Tapchanger Type

LTC

Regulator Vendor

Default

10.2.4.2 Tap Settings

Tap Position/Cal

DISABLE

Allows input of known tap position to calibrate the unit tap position. This function is disabled when Tap Information is disabled.



In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, the Tap Position screen will display "---" instead of "0".

Tap Information

disable

Toggles between ten modes of operation: XFMR External #3, XFMR External #2, XFMR External #1, Reg External #3, Reg External #2, Reg External #1, Contact KeepTrack™ 1R1L, Contact KeepTrack 1N, Internal KeepTrack™ and Disable.

Tap Limits

disable

Allows the tap position limits to be enabled/disabled. When enabled, the following Tap Block Raise and Lower setting screens will appear.

Tap Block Raise

XX

When enabled the Tap Block Raise Limit is adjustable from –12 to +16 which includes a neutral tap position. Default setting is 16.

Tap Block Lower

XX

When enabled the Tap Block Lower Limit is adjustable from –16 to +12. Default setting is –16.

Highest Tap

XX

Not settable unless an external source of Tap Position is selected. Selects the range of a specific tapchanger (0 to 33 Taps).

Lowest Tap

XX

Not settable unless an external source of Tap Position is selected. Selects the range of a specific tapchanger (–33 to +29 Taps).

Intertap Delay

XX sec

Adjustable from 0 to 60 Seconds in 1.0 second increments with a factory setting of 0 seconds.

Seal-in Fail Block

ENABLE

When enabled the operation of the tapchanger is blocked when the control determines that a Motor Seal-in Failure has occurred.

Op Counter Config

1 X

Selects the contact operation sequence that will cause the software counter to increment by one. Open/close/open (1X), open/close or close/open contact operation (2X). The Count Window mode registers any activity as a valid input within the count window time setting. The Cam Follower setting is used when a Cam Follower contact input is wired into

the Counter contact input of the TCC300. The counter will increment when the counter input sees the cam follower open and then close.

Cooper Quick Drive

disable

Enable this setting when using a Cooper Quick Drive regulator. For Cooper Spring Drive and Direct Drive, this setting should be disabled.

Cam Follower

disable

Enables or disables the Cam Follower feature.

X Mode Delay

XX ms

When the control is using 1X or 2X Mode counter contact detection method, the X Mode Delay setting in milliseconds can be used to delay the detection of the NEUTRAL position switch.

Counter Time Window

0.5 Sec

When the control is using Count Window Mode counter contact detection method, the counter time window may be set from 0.0 to 60.5 Seconds with a default setting of 0.5.

Op Counter Preset

XXXXXX

The counter cannot be reset, but can be preset to any value up to 999,999 in the Tap Settings menu.

Ntrl Counter Preset

XXXXXX

Preset the Neutral Counter to any value up to 999,999.

Lower Counter Preset

XXXXXX

Either preset or reset the lower counter.

Raise Counter Preset

XXXXXX

Either preset or reset the raise counter.

Maximum Tap Wear

999999

Set a value from 1 to 999,999 for the maximum number of times the regulator has been on each tap before an alarm occurs.

IndTapWear Alrm Set

100 %

A percentage setting with a range from 1 to 200% which is used in conjunction with the Maximum Tap Wear setting to determine when the Individual Tap Wear Alarm is triggered. Default setting is 100%.

10.2.4.3

Paralleling

Paralleling Type

DISABLE

Toggles between seven modes of operation, if purchased: Circulating I, DVAR1, DVAR2, DVAR2 + KeepTrack™, Master/Follower, Delta VAr Peer to Peer, and Disable. Factory setting is Disable.

DVAR2

DVAR2 Sensitivity

XX

(DVAR2 and DVAR2 KT) Provides a method to control how much the voltage bandcenter is shifted relative to the delta VArS present between the circulating current input and the load current input. The settings for this screen are -4.0 to +4.0 in 0.1 increments, which correspond to a sensitivity of 0.5 to 2 times as sensitive (i.e., -4.0 = .5, -2.0 = .75, 0 = 1.00, 2.0 = 1.50, 4.0 = 2.00). The default setting is 0.0, for a sensitivity of 1.

DVAR2 Reac I Lmt

XX mA

(DVAR2 and DVAR2 KT) Provides a method to set a reactive current (VArS) limit between the circulating current input and the load current input. If the reactive current reaches this

setpoint, the operation of the TCC300 will be blocked, and the alarm output function will be activated, if enabled. The settings for this screen are 5 mA to 200 mA in 1 mA increments.

DVAR2 I Ratio

X.XX

(DVAR2 and DVAR2 KT) Provides a method to adjust the sensitivity to the circulating current input versus the load current input. When the setting is 0.50, the control will be 0.50 times as sensitive to the VArS from the circulating current versus the load current input. At 1.00, the control will be equally sensitive to both current inputs. At 2.00, the control will be 2.00 times as sensitive to the VArS from circulating current input versus the load current input. The settings for this screen are 0.50 to 2.00 in 0.01 increments. The default setting is 1.00 to obtain equally sensitive current inputs.

Master/Follower

Master/Follower

None (Master,Follower)

Determines the controls status in the Master/Follower paralleling scheme. A "None" setting allows the control to be removed from the scheme.

Paralleling Address

XX

The Paralleling Address is the unique address for each device in the network. (1-16).

Num. Devices

X

The number of total devices that are in the paralleling scheme (maximum of 16 inclusive of the master).

T.P.R. Timeout

XXXXXX ms

The Tap Position Response Timeout is the period (1000-60000 ms) that the Master waits following a tapchange and subsequent message sent to followers to make the same tapchange that when expired will initiate a lockout if all followers have not issued messages to the master confirming the follower tapchange.

Breaker Option

XXXXXX

The Breaker Option setting includes Line Breaker Status, Right Tie Breaker Status and Left Tie Breaker Status in the Master/Follower scheme. Breaker Polarity (Negative/Positive) is also able to be set.

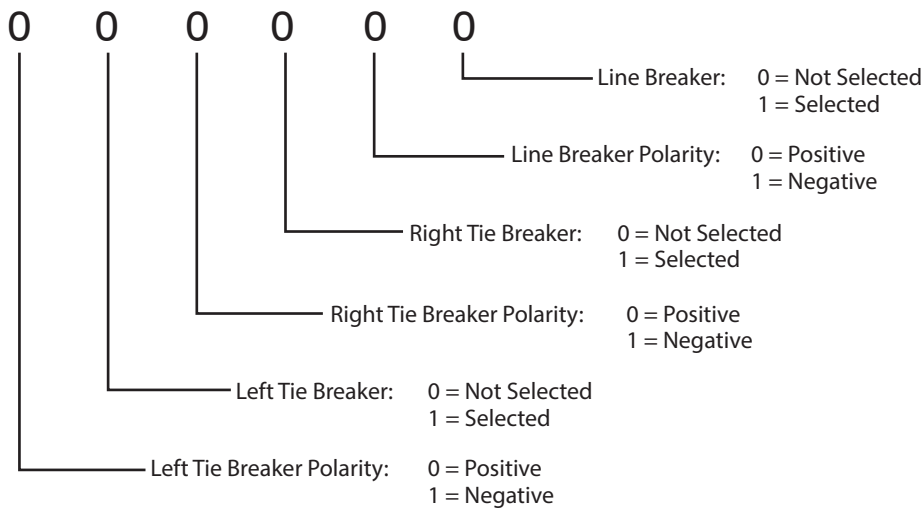


Figure 458: Master/Follower Breaker Option Settings

Tap Difference

X

The Tap Difference setting is the number of tap positions between the Master and Follower tap positions that when exceeded will result in lockout of the control.

Clear Lockout Alarm

Ready Press ENTER

Allows reset of Lockout Alarm from the control front panel.

Delta VAr Peer to Peer

P2P DVar Sensitivity

0.0

Scales the control's reaction to changes in Reactive Circulating Current (Irc). The following data demonstrates the linear relationship between the Sensitivity setting and the % Multiplier (Range -4.0 to +4.0).

- $-4.0 = I_{rc} \cdot 50\%$
- $-2.0 = I_{rc} \cdot 75\%$
- $0.0 = I_{rc} \cdot 100\%$
- $+2.0 = I_{rc} \cdot 150\%$
- $+4.0 = I_{rc} \cdot 200\%$

DVAR2 Reac I Lmt

200.0 mA

The Reactive Circulating Current Limit is the maximum Delta VAr value allowed for bandcenter adjustment. Range and units are dependent on the CT installed in the unit:

Table 71:

CT Rating	Range	Units
200 mA	5...200	mA
1 A	0.02...1.00	A
5 A	0.1...5.0	A

Topology

SINGLE BUS

Single Bus, Ring Bus or Double Bus topologies may be selected.

Paralleling Address

16

The unique address for each device (Range 1 – 16).

The Initiator Paralleling Address must be the highest address in the network. All Non-Initiator addresses must be a value less than the Initiator.

The control's position in the paralleling network is determined by its paralleling address. Position 1 should be assigned a paralleling address of 1, Position 2 a paralleling address of 2 and so on, in an ascending order.

Num. Devices

2

The total number of devices in the paralleling scheme (maximum 16).

P2P Update Speed

1000

The time period allocated to read all the paralleled units' relevant data, make the necessary calculations and disseminate paralleling driven updates to the system (Range 1000 to 10000).

Load Side Brk Config

Not Used

Can be set to Not Used, 52a (positive polarity), or 52b (negative polarity).

Right Tie Brk Config

Not Used

Can be set to Not Used, 52a (positive polarity), or 52b (negative polarity).

Left Tie Brk Config

Not Used

Can be set to Not Used, 52a (positive polarity), or 52b (negative polarity).

MVA Rating

1.0

The MVA rating of the transformer (Range 1.0 to 1000.0).

I Multi Correction

xxx %

A scaling factor to compensate Delta Vars Calculation, if the CT value is not in the ratio to the MVA rating (Range 20 to 500 %).

Clear Lockout Alarm

Ready Press ENTER

Allows reset of lockout alarm at control front panel.

10.2.4.4

Programmable Alarm

Prog Alarm Function

-<0000000000000000

Provides alarm for one or more of the following user-selected conditions: Communication Block, Block Raise Limit exceeded, Block Lower Limit exceeded, Voltage Reduction (any step) invoked, Reverse Power Flow condition detected, Line Limit Current exceeded, Tap Block Raise in effect, Tap Block Lower in effect, LDC/LDZ in effect, Abnormal Tap Position detected, VAr Bias Lag exceeded, VAr Bias Lead exceeded, Backup Power fail detected (if purchased), Tap Wear Limit exceeded, Operation Count Limit exceeded, RTN Fail to Operate and Tap Changer Failure detected. Factory setting is Disable. (Bottom line of display indicates available alarms.)

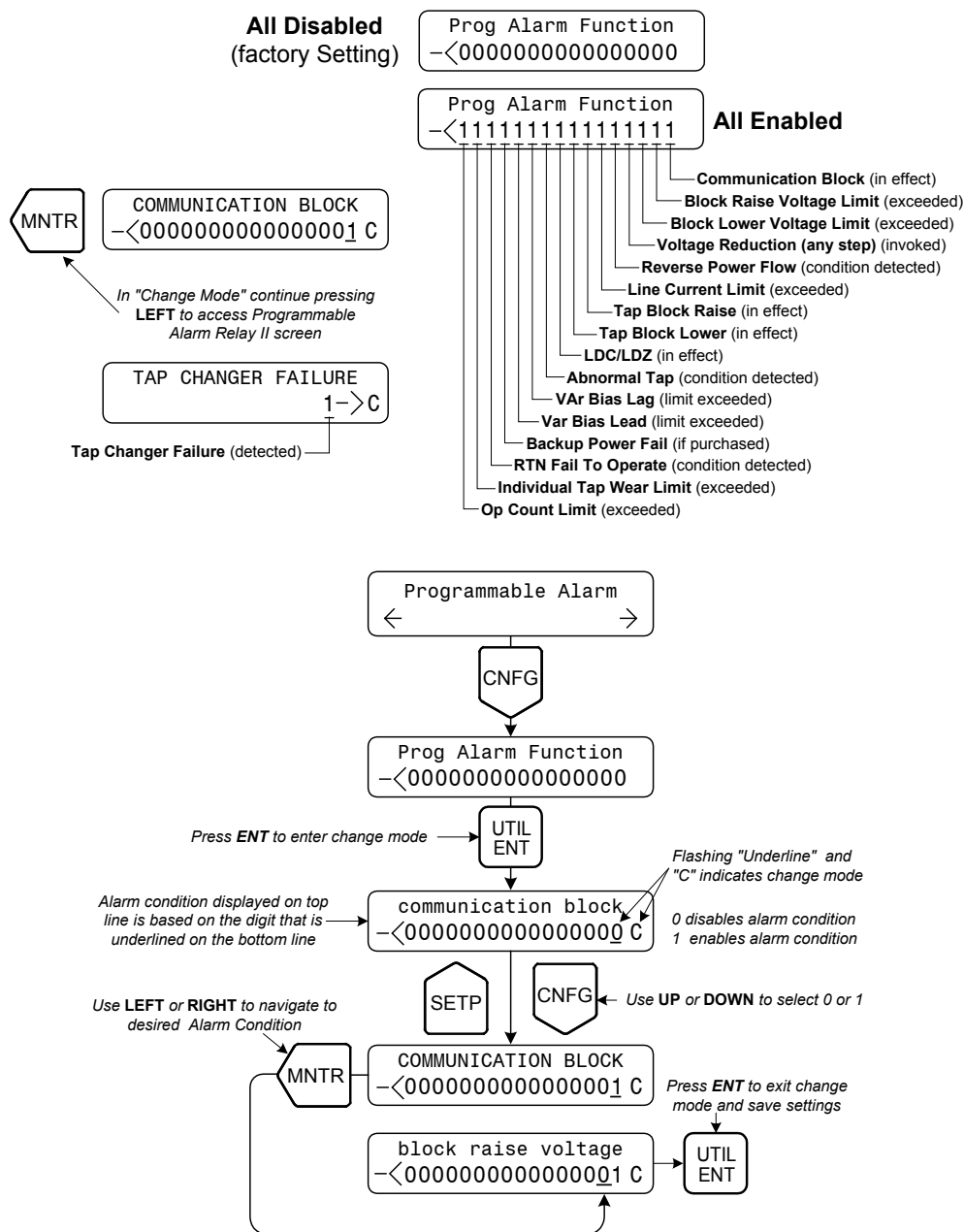


Figure 459: Programmable Alarm Function Programming

Op Count Signal Alarm

0

When the resettable operations counter matches the Op Count Signal Alarm Setting, the control will display a message that the Op Count Signal Alarm Setting has been exceeded.

Clear Sealin Alarm

Ready Press ENTER

Reset the Motor Seal-In Alarm when the motor hold input has been restored.

Clr Low Current Blk

Ready Press ENTER

Clear the Low Current Block Alarm and Block. Alarm and Block occurs when the control determines that load current is less than 4 mA and Tap Delta Voltage is less than .4 Vac.

Clr RTN Fail To Opr

Ready Press ENTER

Clear the Run Through Neutral Failure to Operate Alarm.

10.2.4.5

System Clock

Set Date and Time

03/26/07 15:41:29

Displays and allows resetting of the time and date. Press ENT to set date; change mode indicated by "C". Used in conjunction with drag hands memories where the date/time stamp will be recorded for each drag hand quantity.

Daylight Savings

disable

Enable or disable Daylight Savings time adjustment.

10.2.4.6

Input Selection

Input Selection 1

SWITCH STATUS

Allows the Input Selection 1 to be used as a seal-in input or a switch status input. When the Switch Status input mode is selected, all Seal-In input functions will be disabled (Section 5.2, Configuration). The factory setting is Switch Status. A Switch Status setting is also required for "Contact KeepTrack™ 1R1L" and "Contact KeepTrack 1N" methods of tap knowledge.

Input Selection 2

NONSEQ INPUT

Allows the non-sequential input to be used as the Non-Sequential Input or as a SCADA Cutout input. When SCADA Cutout is selected, all nonsequential functions are disabled. Factory setting is Non-Sequential.

Input Selection 3

VOLTAGE RED 2

Allows VR2 Input to be used as an Aux Status Input that can be read via DNP or MODBUS®.

10.2.4.7**Mtr Current Profile**

Peak RMS % Change

xxx

Setting for Peak RMS current programmable from 110% to 200% of the stored Peak RMS current to activate an alarm.

Average RMS % Change

xxx

Setting for Average RMS current programmable from 110% to 200% of the stored Average RMS current to activate an alarm.

Duration % Change

xxx

Setting for Duration current programmable from 110% to 200% of the stored Duration current to activate an alarm.

Init. Motor Current

Press ENT to reset.

Reset all Motor Current Profiles and initiate the "Training Mode".

10.2.4.8**CBEMA Setup**

Normal Voltage

xxx.x Volts

This parameter establishes the target voltage around which the Event settings determine "Sag" or "Swell" conditions.

Event 1 (2, 3, 4)

ENABLE

Enables/Disables CBEMA Event 1, 2, 3 or 4.

Event 1 (2, 3, 4) Sag (Swell) Pickup

xx %

When pickup is set to less than 100% it operates as a Sag (undervoltage), greater than 100% it operates as a Swell (overvoltage).

Event 1 (2, 3, 4) Sag (Swell) Dropout

xx %

Sag Dropout is always set greater than Sag Pickup. Swell Dropout is fixed at 100%.

Event 1 (2, 3, 4) Sag (Swell) Min Dur

1 cycles (xx ms)

Establishes the minimum duration that Sag or Swell condition exists before an Event is registered.

Clear All Counters

Ready Press ENTER

Clears all CBEMA Event Counters.

10.2.4.9

Harmonics Setup

V 2-16 Har. Alarm

011101111111111

Selects active harmonics for voltage alarm 2-16.

V 17-31 Har. Alarm

000000000000001

Selects active harmonics for voltage alarm 17-31.

V Alarm Threshold

1.0 %

Selects Harmonic Voltage Alarm Threshold value.

I 2-16 Har. Alarm

011101011111111

Selects active harmonics for current alarm 2-16.

I 17-31 Har. Alarm

000000000000001

Selects active harmonics for current alarm 17-31.

I Alarm Threshold

10 %

Provides Current Alarm Threshold value input.

Min I Thresh. Enable

ENABLE

Enables/Disables Minimum Current Threshold feature.

Min Fund I Threshold

20 mA

Establishes minimum fundamental Current Threshold for Current Harmonics 0 to 200 mA.

Harmonic Alarm Delay

10 s

Allows Harmonic Alarm Delay setting which is applicable to both Voltage and Current Threshold settings.

10.2.4.10

Data Logging

Data Log Select

11111111111111

Position From Right

1. Local Voltage
2. Compensated Voltage
3. Line Current
4. Load VA
5. Load W
6. Load VAr
7. Power Factor
8. Line Frequency
9. Tap Position
10. Source Voltage
11. Primary Current
12. Circulating/DVAr Current
13. Operation Count
14. Meter Out Voltage

Key

- 1 = Enabled for Logging
- 0 = Logging Disabled

Data Log Interval

5 mins

Press ENT to clear

Data Log Records

10.2.4.11

Nameplate

CT Multiplier

6000 X

Adjustable from 1 to 32600 in 1 increments with a factory setting of 6000. User selection must include knowledge of CT ratio, from primary rating to 0.2 A rating of control.

Load VT Config

LINE_TO_GROUND

VT configuration toggles between Line-to-Line and Line-to-Ground with a factory setting of Line-to-Ground.

Aux Curr Transformer

200 mA



The current input to the control is rated at 0.2 A continuous, 0.4 A for two hours, and 4.0 A for one second.

Selection of display current can be made to be either 200 mA, 1 A or 5 A. This screen allows load and circulating current displays to be viewed on 200 mA, 1A ^[4] or 5A ^[5] scales. Line Limit I settings also affected.

CT/LOAD VT Phasing

0 Deg

CT/VT phasing correction is adjustable from 0° to 330° in 30° increments with a factory setting of 0°. This setting will advance the current phasor by the indicated value.

Load VT. Multiplier

60.0 X

Adjustable from 0.1 to 3260.0 in 0.1 increments with a factory setting of 60.0. User selection must include knowledge of VT ratio, sensing VT ratio correction.

Load VT Correction

0.0 Volts

VT ratio correction is adjustable from -15 V to +15 V in 0.1 V increments with a factory setting of 0 V.

CT/Source VT Phasing

0 Deg

CT/VT phasing correction is adjustable from 0° to 330° in 30° increments with a factory setting of 0°. This setting will advance the current phasor by the indicated value.

Source VT. Multiplier

60.0 X

Adjustable from 0.1 to 3260.0 in 0.1 increments with a factory setting of 60.0. User selection must include knowledge of Source VT Ratio and sensing Source VT Ratio correction.

[4] 1 A or 5 A displayed values are calculated from the actual 200 mA connected current.

Source VT Correction

0.0 Volts

VT ratio correction is adjustable from -15 V to +15 V in 0.1 V increments with a factory setting of 0 V.

Norm. VT. Multiplier

1.00

Normalizing Voltage Multiplier 0.80 to 1.20 times the Compensating Voltage.

Power Display Option

SINGLE_PHASE

Toggles between two modes of operation: Single-Phase – based on measured inputs, and Three-Phase – based on measured inputs and presumed balanced system. Factory setting is single-phase.

Regulator Type

TYPE A

Allows the regulator type to be selected as Type A or B for correct source voltage calculation. Factory setting is Type A.

Output Selection

CONTINUOUS

Allows choice of output at tapchanger Raise/Lower output terminal. Choices are continuous or pulsed. For continuous, the control must wait to be in band or counter input valid for output to become disabled. For pulsed, an adjustable pulse width will be applied to the output triacs of 0.2 to 12 seconds.

Output Pulse

1.5 Sec

Adjustable from 0.2 to 12 seconds in 0.1 second increments. Factory set at 1.5 seconds.

Low Current Block

disable

Enables and disables the Low Current Block and Alarm feature. When enabled allows the control to determine when load current is less than 4 mA and Tap Delta Voltage is less than .4 Vac to block regulation and initiate the Low Current Block alarm.

Auto/Man Sw Type

NONE

Allows the Auto/Man switch type on the adapter panel to be set to toggle, SCAMP or NONE. NONE is used when no Auto/Manual switch exists.

Comm Block Auto

DON'T SAVE

If Auto/Manual Switch Type is set to "None" or "Toggle" allows the state of the "Block Auto Operation" communication command to be saved or not saved when power has been lost.

SCAMP Init Pwrap

AUTO MODE/LAST SAVE

If Auto/Manual Switch Type is set to "SCAMP" allows the control to initialize the SCAMP status in either "Auto Mode" or the "Last Save" position.

Fast Volt Recovery

disable

Enable or Disable Fast Voltage Recovery on the Control.

Fast Volt R Setting

x.x V

The Fast Voltage Recovery setting range is from 1.0 to 15.0 volts outside the normal band edges in 0.1 V increments.

10.2.4.12

Run Through Neutral

Enable/Disable

disable

Enables and Disables the Run Through Neutral Feature.

Reset RTN Succ Ctr

Press ENT to begin

Resets the Run Through Neutral Success Counter.

Max Allowed Taps

x

The Maximum Allowed Taps Setting (3 to 7) determines the maximum number of taps that can be taken to swipe the reversing switch.

Taps Between Runs

xxxxx

This setting (10 to 10000) establishes the number of taps that must be taken before the Run Through Neutral Feature is activated.

Max Load Current

xx mA

Establishes the Maximum Measured Load current value (1 to 200 mA) that Load Current must be less than to allow the Run Through Neutral feature to activate.

Max RTN Standby Ops

xxxxx

The Maximum RTN Standby Operations setting (1 to 10000) is the number of Tap Operations that when exceeded initiates the "RTN Fail to Operate" alarm.

10.2.4.13

Remote Voltage Bias

Enable/Disable

disable

Enables and Disables the Remote Voltage Bias Feature.

RVB HB Timer

xxx

The Remote Voltage Bias Heartbeat Timer setting (2 to 120 sec) is the period that upon receiving the remote voltage value the voltage bias is applied to the Bandcenter. If no remote voltage value is received and the timer times out the control will revert to existing settings.

RVB Scale Factor

xxx.x

The Forward RVB Scale Factor (0.1 to 100.0) is the scale factor applied to the raw remote voltage value obtained through communications.

Rev RVB Scale Factor

xxx.x

The Reverse RVB Scale Factor (0.1 to 100.0) is the scale factor applied to the raw remote voltage value obtained through communications.

10.2.5 **Communication**

10.2.5.1 **Comm Settings**

Comm1 Port Type

RS485

TCC300 COM Port can be selected for two different configurations: RS-485 or Fiber Optics.

Comm2 Port Type

RS232

TCC300 COM Port can be selected for two different configurations: RS-232 or Bluetooth.

Comm Protocol

DNP3.0

Allows selection between standard protocols, DNP 3.0 or MODBUS®.

DNP Configuration

TCC300 DNP DEFAULT

Displays the current DNP configuration. If no DNP configuration is present, then "File does not exist" will be displayed.

CID File ID

TCC300 DEFAULT

Displays the current CID File name (up to 20 characters) loaded on the control.

Src Addr Validation

disable

Enables or Disables Source Address Validation in the DNP3.0 protocol.

Substation Address

DNP x

The Substation Address is utilized to set a specific communication identification for network addressing. If set to zero the address is not in effect. The address can be set from 1 to 65519.

Feeder Address

DNP x

The Feeder Address is utilized to set a specific communication identification for network addressing. If set to zero the address is not in effect. The address can be set from 1 to 65519.

Comm Address

DNP 1 Mdbus 1

Configures a three-digit numerical address, from 1 to 200, for remote communications. The factory setting is 1.

Baud Rate

9600

Selects baud rate for COM1, located on the top of the control.

Parity

NONE

None, odd or even parity is available.

Stop Bits

ONE STOPBIT

One or two stop bits are available.

Sync Time

2 mS

This time delay improves robust operation when communication lines are intermittent. Communication dead-sync time is the time that the control will wait from the last received character and continue without attempting to resynchronize. Factory setting is 2 msec; range is 0-32000 msec.

Output Pulse

1.5 Sec

Adjustable from 0.2 to 12 seconds in 0.1 second increments. Factory set at 1.5 seconds.

Comm Access Security

disable

When enabled, establishes Level Access security for MODBUS® communications regardless of physical connection.

Comm Access Timeout

60 sec

Establishes the duration at which time communications will be closed with the control when no communication activity is sensed.

TX Delay

10 ms

Delay transmission of a response of a Serial Bus (RS-232, RS 485 or Fiber Optic).

Heartbeat Option

Disabled

Toggles between five modes of operation: LTC (DNP), Regulator (DNP), Profile Switching (DNP), Profile Switching (GOOSE) and Disabled.

10.2.5.2

Memory Card

Load Setpoints

Press ENT to begin

Load setpoint files (Unit or Master) from a Smart Flash SD Card into the unit.

Save Setpoints

Press ENT to begin

Save setpoint files (Unit or Master) to a Smart Flash SD Card from the unit.

Save Datalog

Press ENT to begin

Save data log files to a Smart Flash SD Card from the unit.

Save seq. of events

Press ENT to begin

Save Sequence of Events files to a Smart Flash SD Card from the unit.

Save oscillograph

Press ENT to begin

Save Oscillograph files to a Smart Flash SD Card from the unit.

Clone save

Press ENT to begin

Save the entire control settings to a Smart Flash SD Card with the exception of the serial number.

Clone load

Press ENT to begin

Load a clone file on to a control to duplicate settings. Does not overwrite serial number of the target control.

Load DNP Config

Press ENT to begin

Load DNP configuration files from a Smart Flash SD Card into the unit.

Save DNP Config

Press ENT to begin

Save DNP configuration files to a Smart Flash SD Card from the unit.

Save Metering Data

Press ENT to begin

Save all metering data to a Smart Flash SD Card.

Firmware Update

Press ENT to begin

Update the unit firmware.

Load IEC Config

Press ENT to begin

Load IEC Configuration files (*.cid) when IEC 61850 protocol has been purchased.

Save IEC Config

Press ENT to begin

Save IEC Configuration files (*.cid) when IEC 61850 protocol has been purchased.

SD Quick Capture

Press ENT to begin

Provides the means (in one step) to initiate a save of the following data files to the inserted SD Card (if they exist on the control).

- Control Clone
- Data Logging
- Oscillography
- Sequence of Events
- DNP Map
- Multi-user Access Code
- Multi-user Access Code Log

10.2.5.3

Ethernet

DHCP Enable

ENABLE

Allows DHCP Protocol to be enabled or disabled.

IP Address

0.0.0.0

Either displays the assigned IP Address when DHCP is enabled or allows the IP Address to be manually assigned.

Net Mask

0.0.0.0

Either displays the assigned Net Mask when DHCP is enabled or allows the Net Mask to be manually assigned.

Gateway

0.0.0.0

Either displays the assigned Gateway when DHCP is enabled or allows the Gateway to be manually assigned.

Enter MODBUS Port

502

Allows the MODBUS® port ID to be set. Default value is "502".

Enter DNP Port

20000

Allows the DNP port ID to be set. Default value is "20000".

Auto Negotiation

ENABLE

Set the Ethernet Port to a fixed speed of 100 mbps.

Keepalive time

7200 sec

The Keepalive Time feature applies only to the Ethernet connection. If no communication activity is detected on a previously open Ethernet socket longer than the timeout setting the control will close the socket and make it available for connection. The setting range is from 1 to 50,000 seconds.

SNTP Enable

disable

Enables the SNTP (Simple Network Time protocol) to allow Network Time Synchronization.

SNTP Server Address

0.0.0.0

Enter the IP Address of the network server.

Time Zone GMT

-5 Hr

Select the Time Zone that the control resides in.

10.2.5.4

HMI

Set LCD Contrast: E

Allows contrast to be adjusted from +10 (lightest) to -10 (darkest). Factory setting is 0, which provides a neutral contrast.

User Line 1 E

ABB

Allows input of 20 ASCII characters to configure a unit locator or description. If not configured, a row of 15 asterisks will appear in top row of User Line #1 screen.

User Line 2 E

TCC300

Allows input of 20 ASCII characters to configure a unit locator or description. If not configured, a row of 15 asterisks will appear in bottom row of User Line #2 screen.

Level 1 Access Code

Press ENT to change

Configures a six-digit alpha/numerical Access Code for Level 1. Factory setting is 000000 (disabled).

Level 2 Access Code

Press ENT to change

Configures a six-digit alpha/numerical Access Code for Level 2. Factory setting is 222222.

Clear Osc Records

Ready Press ENTER

Clear Oscillograph records from the HMI.

Oscillograph Message

ENABLE

Feature enables or disables the OSC Triggered Message to be scrolled on the unit display when an OSC record is available.

10.2.5.5

Bluetooth

Bluetooth Enable

ENABLE

Enables or disables the Bluetooth® feature when installed on the control.

Bluetooth Reset

Ready Press ENTER

Reset the Bluetooth Module to "ABB" factory default settings.

Bluetooth Protocol

MODBUS

Select either MODBUS® or DNP3.0 protocol.

Authentication

disable

Enables or disables Authentication and provides the means to enter a Pass Key when set (1 to 16 characters).

Friendly Name

TCC300

Name the unit (maximum of 32 characters).

Bluetooth Pass Reset

Ready Press ENTER

The Bluetooth Passkey can be reset to default conditions (no Passkey and Authentication Disabled) if necessary.

Control BT Device

XX:XX:XX:XX:XX:XX

Displays the Bluetooth MAC address of the control.

Bluetooth Mode

MODE0

The Bluetooth mode can be set to Mode0 in which the control is discoverable and connectable to any client station, or Mode1 in which the control is non-discoverable but is connectable to any client station that knows the control Bluetooth device address.

10.2.5.6

RS232

Protocol

MODBUS

Select between standard protocols: DNP3.0 or MODBUS.

Baud Rate

115200

Selects Baud Rate for the RS232 port.

Parity

NONE

None, odd or even parity is available.

Stop Bits

TWO STOPBITS

One or Two Stop Bits are available.

Sync Time

50 mS

This time delay improves robust operation when communication lines are intermittent. Communication dead-sync time is the time that the control will wait from the last received

character and continue without attempting to resynchronize. Factory setting is 50 msec; range is 0-32000 msec.

10.2.6 **Utilities**

10.2.6.1 **Calibration-Test**

Bias Voltage

Status/Test Mode

When ENT is pressed, the control status can be checked, and a bias test voltage can be entered to test the control’s automatic operation.

Load Voltage

XXX.X Volts

Displays the real-time measured value of voltage at the regulator or the transformer, including the voltage reduction if applicable and any corrections made using the user-selected VT correction voltage.

Voltage Offset

X

Voltage calibration count offset from ADC reference value. [5]

Volt Cal Coefficient

32767 X

Voltage calibration factor. [5]

Volt RMS Coefficient

32762 X

Voltage RMS calibration factor. [5]

Control Load I

x.x mA Lag

Displays the real-time measured value of load current related to the scaling factor Current Transformer of 200 mA, 1 A or 5A.

[5] Requires Level 3 Access to change.

Curr Cal Coefficient

32767 X

Current calibration factor. ^[5]

Power Factor

X.XXX Lag

Displays the real-time Power Factor value.

I Sin Coefficient

0 X

Current Sine Coefficient calibration factor. ^[5]

I Cos Coefficient

8192 X

Displays the PF Factor Cosine correction factor as determined by Autocal. Can also be manually set. However, ABB does not recommend manual setting of this parameter.

Motor Current

x.xx mA

Displays the real-time measured value of motor current.

Mtr Cal. Coefficient

8192 X

Motor Calibration Coefficient calibration factor. ^[5]

Mtr Sin Coefficient

0 X

Motor Sine Coefficient calibration factor. ^[5]

Mtr Cos Coefficient

8192 X

Motor Cosine Coefficient calibration factor. ^[5]

Mtr RMS Coefficient

8192 X

Motor RMS calibration factor. ^[5]

Cir Cal. Coefficient

32767 X

Circulating Current calibration factor. ^[5]

Circ Sin Coefficient

0 X

Circulating Current Sine Coefficient calibration factor. ^[5]

Circ Cos Coefficient

8192 X

Circulating Current Cosine Coefficient calibration factor. ^[5]

LED Scroll Test

Press ENT to begin

Momentarily illuminates each LED on the control panel. Push EXIT to stop.

Input Test

Press ENT to Begin

Test all external inputs to the control.

Output Test

Press ENT to test

Test all outputs from the control.

Button Input Test

Press ENT to Begin

Verify proper operation of each front panel pushbutton from the HMI.

Change Src Input

press ENTER.

Pressing Enter will cause the source side PT voltage to be measured instead of being calculated. The second line on the LCD screen will display: Measured XXXXX V

Pressing Enter will toggle to the calculated source side voltage and the second line on the LCD screen will display: Calculated XXXX V

Watchdog resets: X

Total resets: X

Displays the total number of watchdog resets and total resets which include Power down and watchdog resets.

Clear reset counters

Press ENT to begin

Clears Watchdog Resets and Total Resets counters.

X1 Duration

X1 Duration

When the Operation Counter is configured as X1, the X1 duration is the instantaneous measure of the X1 pulse generated by the counter contact switch. It also displays the average X1 pulse duration over the last 8 tap operations. The user can use this measurement to set the X mode Delay.

When the Operation Counter is configured as X2, the X1 Duration will always display ZERO since this is not applicable to X2 mode of Operation.

Alarm Activity

Press ENT to Begin

The Alarm Activity feature provides the means to display all active screen messages that are active on the control.

10.2.6.2

About

Serial Number

XXXXX

Displays the unit serial number.

Firmware Version

D-0214VXX.XX.XX

Displays the firmware version that is loaded onto the control.

EE Checksum

XXXXXX

Displays EE Prom Checksum value.

Last Loaded File CRC

XXX

Displays the CRC of the Last Loaded Settings file.

Hardware Number

1

The Hardware Number is used for identifying the control hardware type.

- 1 = Pre 180 V Version of TCC300 hardware.
- 3 = 180 V Version of TCC300 hardware.

Section 11

Appendix B Setpoint, Configuration and Communication Record Forms



Default settings are indicated by brackets [].



Default selections are indicated by ☒.

11.1

Setpoints

PROFILE

1 to 4 [1]

()

General

Line Drop Compensation

☐ R, X [R, X]

☐ Z

Time Delay Selection

☐ Definite Time [Definite Time]

☐ Inverse Time

Basic Timer Type

☐ Integrating [Integrating]

☐ Instant Reset

Power Direction Bias

☐ None [None]

☐ Forward

☐ Reverse

Voltage Reduction (VR)

Step 1

0.0 to 10.0 (%) of Bandcenter Setpoint [2.5]

()

Step 2

0.0 to 10.0 (%) of Bandcenter Setpoint [5.0]

()

Step 3

0.0 to 10.0 (%) of Bandcenter Setpoint [7.5]

()

Standard Voltage Reduction

☐ Disable

☐ Enable [Enable]

Smart Voltage Reduction

☐ Disable [Disable]

☐ Enable

Com VR Turnoff Timer

0 to 999 (Min) [0]

()

Save VR at Power Off

☐ Don't Save [Don't Save]

☐ Save

Section 11

Appendix B Setpoint, Configuration and Communication Record Forms

1VAC388793-MB B

Limit and Runback/Runup

Block Raise	95.0 to 135.0 (V) [128.0]	(_____)
Block Lower	95.0 to 135.0 (V) [114.0]	(_____)
Runback Deadband	1.0 to 4.0 (V) [2.0]	(_____)
Runup Deadband	1.0 to 4.0 (V) [2.0]	(_____)
Runup	<input type="checkbox"/> Disable [Disable] <input type="checkbox"/> Enable	
Current Limit	50 to 640 (mA) [640]	(_____)

Forward Power

Band Center	100.0 to 135.0 (V) [120.0]	(_____)
Band Width	1.0 to 10.0 (V) [2.0]	(_____)
Definite Time	1 to 360 (sec) [30]	(_____)
LDC-Z	0 to 72 (V) [0]	(_____)
LDC Resistance	-72 to +72 (V) [0]	(_____)
LDC Reactance	-72 to +72 (V) [0]	(_____)

Reverse Power

Operation	<input type="checkbox"/> Block [Block] <input type="checkbox"/> Regulate Forward (Ignore)	
	<input type="checkbox"/> Regulate Reverse <input type="checkbox"/> Return to Neutral	
	<input type="checkbox"/> Regulate Reverse (Measured) <input type="checkbox"/> Distributed Generation	
	<input type="checkbox"/> Auto Determination (Measured) <input type="checkbox"/> Auto Determination	
Band Center	100.0 to 135.0 (V) [120.0]	(_____)
Band Width	1.0 to 10.0 (V) [2.0]	(_____)
Definite Time	1 to 360 (sec) [30]	(_____)
LDC-Z	0 to 72 (V) [0]	(_____)
LDC Resistance	-72 to +72 (V) [0]	(_____)
LDC Reactance	-72 to +72 (V) [0]	(_____)

VAr Bias

VAr Bias Method	<input type="checkbox"/> Disable [Disable] <input type="checkbox"/> Step <input type="checkbox"/> Linear	
Disable on Reverse Power	<input type="checkbox"/> Disable [Disable] <input type="checkbox"/> Enable	

VAr Bias Step:

Table continues on next page

Appendix B Setpoint, Configuration and Communication Record Forms

Fwd Power Max 3 Ph Cap Bank Size	4 to 12000 (KVAR) [12000]	(_____)
Rev Power Max 3 Ph Cap Bank Size	4 to 12000 (KVAR) [12000]	(_____)
Lead % Bank Size Pickup	10 to 100% [75]	(_____)
Lag % Bank Size Pickup	10 to 100% [75]	(_____)
VAr Bias Voltage Step	0.1 to 2.0 (V) [1.0]	(_____)
Max VAr Bias Duration	10 to 1440 (min) [300]	(_____)
VAr Bias Linear:		
Current Multiplier Base Value	0 to 32600 [20000]	(_____)
Primary Current Multiplier		(_____)
No Voltage Reduction:		
Linear Voltage Bias (-X) -	-72 to 0 (V) [-10]	(_____)
Normalized Linear Voltage Bias (-X)		(_____)
Linear Voltage Bias (-X) Limit -	-5.0 to 0.0 (V) [-1.0]	(_____)
During Voltage Reduction:		
Linear Voltage Bias (+X)	0 to 72 (V) [10]	(_____)
Normalized Linear Voltage Bias (+X)		(_____)
Linear Voltage Bias (+X) Limit	0.0 to 5.0 (V) [1.0]	(_____)

11.2 Configuration

Primary

Voltage Multiplier	0.1 to 3260.0 (X) [60.0]	(_____)
Voltage Source Multiplier	0.1 to 3260.0 (X) [60.0]	(_____)
Current Multiplier	1 to 32600 (X) [6000]	(_____)
Primary Power Display	<input type="checkbox"/> Single Phase [Single Phase] <input type="checkbox"/> Three Phase	

VT/CT Load

Normalizing Voltage Multiplier	0.80 to 1.20 (X) [1.00]	(_____)
VT Correction	-15.0 to +15.0 (V) [0.0]	(_____)
CT/VT Phasing	<input type="checkbox"/> 0 degree [0 degree] <input type="checkbox"/> 30 degrees <input type="checkbox"/> 60 degrees <input type="checkbox"/> 90 degrees <input type="checkbox"/> 120 degrees <input type="checkbox"/> 150 degrees <input type="checkbox"/> 180 degrees <input type="checkbox"/> 210 degrees	

Table continues on next page

	<input type="checkbox"/> 240 degrees	<input type="checkbox"/> 270 degrees	
	<input type="checkbox"/> 300 degrees	<input type="checkbox"/> 330 degrees	
Aux Current Transformer Units Display	<input type="checkbox"/> 200 mA [200 mA]	<input type="checkbox"/> 1 Amp	<input type="checkbox"/> 5 Amp
VT Configuration	<input type="checkbox"/> Line to Line	<input type="checkbox"/> Line to Ground [Line to Ground]	
VT/CT Source			
VT Source Correction	-15.0 to +15.0 (V) [0.0]		(_____)
CT/VT Source Phasing	<input type="checkbox"/> 0 degree [0 degree]	<input type="checkbox"/> 30 degrees	
	<input type="checkbox"/> 60 degrees	<input type="checkbox"/> 90 degrees	
	<input type="checkbox"/> 120 degrees	<input type="checkbox"/> 150 degrees	
	<input type="checkbox"/> 180 degrees	<input type="checkbox"/> 210 degrees	
	<input type="checkbox"/> 240 degrees	<input type="checkbox"/> 270 degrees	
	<input type="checkbox"/> 300 degrees	<input type="checkbox"/> 330 degrees	
Raise/Lower Output Contacts			
	<input type="checkbox"/> Continuous [Continuous]	<input type="checkbox"/> Pulsed	
Pulse Width	0.2 to 12.0 (sec) [1.5]		(_____)
Motor Current Settings			
Peak Rms Current	110 to 200 (%) [110]		(_____)
Average Rms Current	110 to 200 (%) [110]		(_____)
Average Duration	110 to 200 (%) [110]		(_____)
Program Alarm Relay Mode			
	<input type="checkbox"/> Normal [Normal]	<input type="checkbox"/> Deadman Out	
Low Current Block			
	<input type="checkbox"/> Disable [Disable]	<input type="checkbox"/> Enable	

Appendix B Setpoint, Configuration and Communication Record Forms



Input Selection 1 must be set to "Switch Status" if Tap Position Knowledge is to be selected to either "Contact KeepTrack™ 1R1L" or "Contact KeepTrack 1N".

Inputs and Switch

Input Selection 1	<input type="checkbox"/> Switch Status [Switch Status]	<input type="checkbox"/> Seal-In Input
Input Selection 2	<input type="checkbox"/> Non-sequential [Non-sequential]	<input type="checkbox"/> SCADA Cutout
Input Selection 3	<input type="checkbox"/> VR2 [VR2]	<input type="checkbox"/> Aux
Auto/Man Switch Type	<input type="checkbox"/> None [None] <input type="checkbox"/> Toggle	<input type="checkbox"/> SCAMP

Regulator

☐ Type A [Type A] ☐ Type B

Remote Voltage Bias (RVB)

☐ Disable [Disable] ☐ Enable

RVB Scale Factor	0.1 to 100.0 [1.0]	(_____)
RVB Heartbeat Timer	2 to 120 (sec) [5]	(_____)
Reverse RVB Scale Factor	0.1 to 100.0 [1.0]	(_____)

Run Through Neutral (RTN)

☐ Disable [Disable] ☐ Enable

Maximum Allowed Taps	3 to 7 [4]	(_____)
Tap Operations Between Runs	10 to 10000 [1000]	(_____)
Maximum Load Current	1 to 200 (mA) [50]	(_____)
Max RTN Standby Operations	1 to 10000 [20]	(_____)

Fast Voltage Recovery

☐ Disable [Disable] ☐ Enable

Fast Voltage Recovery	1.0 to 15.0 (V) [5.0]	(_____)
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Section 11

Appendix B Setpoint, Configuration and Communication Record Forms

1VAC388793-MB B

Save Comm Block at Power Off

☐

Save

☐

Don't Save [Don't
Save]

SCAMP Initialize on Power Up

☐

Last Save

☐

Auto Mode [Auto
Mode]

Paralleling

Paralleling Type

☐

Disable [Disable]

☐

Circ. Current

☐

DVAr 1

☐

DVAr 2

☐

DVAr 2 (Keep
Track)

☐

Master/Follower

DVAr2/DVAr2 (KeepTrack) Settings

Sensitivity

-4.0 to 4.0 [0.0]

(_____)

Cir. Current Limit (Reactive)

5 to 200 (mA) [200]

(_____)

Input Ratio (Load/parallel)

0.50 to 2.0 [1.00]

(_____)

Master/Follower Settings

Master/Follower Configuration

☐

None [None]

☐

Follower

☐

Master

Paralleling Address

1 to 16 [16]

(_____)

Number of Devices

2 to 16 [2]

(_____)

Tap Difference

2 to 8 [2]

(_____)

Tap Pos. Response Timeout

1000 to 60000 ms [60000]

(_____)

Line Breaker

☐

Not in Use [Not in
Use]

☐

In Use

☐

Positive Polarity
[Positive Polarity]

☐

Negative Polarity

Right Tie Breaker

☐

Not in Use [Not in
Use]

☐

In Use

☐

Positive Polarity
[Positive Polarity]

☐

Negative Polarity

Left Tie Breaker

☐

Not in Use [Not in
Use]

☐

In Use

☐

Positive Polarity
[Positive Polarity]

☐

Negative Polarity

Appendix B Setpoint, Configuration and Communication Record Forms

Delta VAr Peer to Peer Settings

Sensitivity	-4.0 to 4.0 [0.0]	(_____)
Circ. Current Limit (Reactive)	5 to 200 (mA) [200]	(_____)
Number of Devices	2 to 16 [2]	(_____)
Paralleling Address	1 to 16 [1]	(_____)
Peer to Peer Update Speed	1000 to 10000 [1000]	(_____)
MVA Rating	1.0 to 1000.0 [1.0]	(_____)
P2P Current Mult. Correction	20 to 500 (%) [100]	(_____)
Topology	Single Bus/ Ring Bus/Double Bus [Single Bus]	(_____)
Load Side Breaker	Not Used [Not Used] 52A (Positive Polarity) 52B (Negative Polarity)	(_____)
Right Tie Breaker	Not Used [Not Used] 52A (Positive Polarity) 52B (Negative Polarity)	(_____)
Left Tie Breaker	Not Used [Not Used] 52A (Positive Polarity) 52B (Negative Polarity)	(_____)

11.3 Tap settings

General

Tap Information	<input type="checkbox"/> Disabled [Disable] <input type="checkbox"/> Regulate Internal (KeepTrack™)	
	<input type="checkbox"/> Reg external #1 <input type="checkbox"/> Reg external #2	
	<input type="checkbox"/> XFMR external #1 <input type="checkbox"/> XFMR external #2	
	<input type="checkbox"/> XFMR external #3 <input type="checkbox"/> Reg external #3	
	<input type="checkbox"/> Contact Keep Track 1R1L <input type="checkbox"/> Contact Keep Track 1N	
Intertap Delay	0 to 60 (sec) [0]	(_____)

Tap Limits

	<input type="checkbox"/> Disabled [Disable] <input type="checkbox"/> Enable	
Block Raise	12 Lower to 16 Raise [16]	(_____)
Block Lower	16 Lower to 12 Raise [-16]	(_____)
Highest Tap	0 Neutral to 33 Raise [16]	(_____)
Lowest Tap	33 Lower to 29 Raise [-16]	(_____)

Operation Counter

Configuration	<input type="checkbox"/> X1 [X1]	<input type="checkbox"/> X2	<input type="checkbox"/> Count Window	<input type="checkbox"/> Cam Follower
Cooper Quick Drive		<input type="checkbox"/> Disable [Disable]	<input type="checkbox"/> Enable	
X Mode Delay		0 to 3000 (mS) [10]		(_____)
Count Window		0.5 to 60.5 (sec) [0.5]		(_____)
Preset		0 to 999999 [0]		(_____)
Alarm Limit		0 to 999999 [0]		(_____)
Neutral Counter		0 to 999999 [0]		(_____)

Block Automatic Operation on Motor Seal-in Failure

Motor Seal-in Failure Block	<input type="checkbox"/> Disabled	<input type="checkbox"/> Enable [Enable]
-----------------------------	-----------------------------------	--

Tap Statistics

Maximum Tap Wear	1 to 65534 [65534]	(_____)
Individual Tap Wear Alarm	1 to 200% [100%]	(_____)



Set to match actual tap position as read on the physical tap position indicator. In order to verify Neutral Tap Position, when the tap position is "0", but no neutral input is detected, the Tap Position screen of the TCC300 will display "---" instead of "0". When reading the tap position via comms (Modbus and DNP) a value of 32767 will be returned when the tap position is "0", but no neutral input is detected, otherwise a "0" will be returned.

Tap Calibration

Tap Position	-16 to +16 (Neutral) [0]	(_____)
Tap Calibrate	<input type="checkbox"/> Yes	<input type="checkbox"/> No [No] (_____)

Appendix B Setpoint, Configuration and Communication Record Forms

11.4

Alarms

Programmable Alarm Relay

- | | | |
|---|---|--|
| <input type="checkbox"/> Comm Block | <input type="checkbox"/> Max VAr Bias Duration - LEAD | <input type="checkbox"/> Reverse Power |
| <input type="checkbox"/> Block Raise (Tap) | <input type="checkbox"/> Max VAr Bias Duration - LAG | <input type="checkbox"/> Block Lower (Volt) |
| <input type="checkbox"/> Block Lower (Tap) | <input type="checkbox"/> Individual Tap Wear | <input type="checkbox"/> Abnormal Tap Position |
| <input type="checkbox"/> Block Raise (Volt) | <input type="checkbox"/> LDC/LDZ | <input type="checkbox"/> Backup Power Fail |
| <input type="checkbox"/> Voltage Reduction | <input type="checkbox"/> Line Current Limit | <input type="checkbox"/> RTN Fail to Operate |
| <input type="checkbox"/> Op Count Signal | <input type="checkbox"/> Tap Changer Failure | |

11.5

Wakeup screens

- | | | |
|---|---|---|
| <input type="checkbox"/> Load Voltage | <input type="checkbox"/> Operation Counter | <input type="checkbox"/> Maximum Primary Watts |
| <input type="checkbox"/> Source Voltage | <input type="checkbox"/> Resettable Operation Counter | <input type="checkbox"/> Minimum Primary VArS |
| <input type="checkbox"/> Load Current | <input type="checkbox"/> Demand Load Voltage | <input type="checkbox"/> Maximum Primary VArS |
| <input type="checkbox"/> Circulating/DVAr Current | <input type="checkbox"/> Demand Primary Current | <input type="checkbox"/> Minimum Primary VA |
| <input type="checkbox"/> Compensated Voltage | <input type="checkbox"/> Demand Primary Watts | <input type="checkbox"/> Maximum Primary VA |
| <input type="checkbox"/> Primary Voltage | <input type="checkbox"/> Demand Primary VArS | <input type="checkbox"/> Power Factor @Minimum VA |
| <input type="checkbox"/> Primary Current | <input type="checkbox"/> Demand Primary VA | <input type="checkbox"/> Power Factor @Maximum VA |
| <input type="checkbox"/> Primary Watts | <input type="checkbox"/> Energy Metering Watt Hrs Fwd | <input type="checkbox"/> Lag Power Factor |
| <input type="checkbox"/> Primary VArS | <input type="checkbox"/> Energy Metering Watt Hrs Rev | <input type="checkbox"/> Lead Power Factor |
| <input type="checkbox"/> Primary VA | <input type="checkbox"/> Energy Metering VAr Hrs Lag | <input type="checkbox"/> Peak Motor Current |
| <input type="checkbox"/> Power Factor | <input type="checkbox"/> Energy Metering VAr Hrs Lead | <input type="checkbox"/> Normalizing Voltage |
| <input type="checkbox"/> Frequency | <input type="checkbox"/> Minimum Load Voltage | <input type="checkbox"/> Meter Out Voltage |
| <input type="checkbox"/> Voltage % THD | <input type="checkbox"/> Maximum Load Voltage | <input type="checkbox"/> Min Source Voltage |
| <input type="checkbox"/> Current % THD | <input type="checkbox"/> Minimum Primary Current | <input type="checkbox"/> Max Source Voltage |
| <input type="checkbox"/> Tap Position | <input type="checkbox"/> Maximum Primary Current | <input type="checkbox"/> Time and Date |
| <input type="checkbox"/> Tap Drag Hands | <input type="checkbox"/> Minimum Primary Watts | |

11.6 Data logging

Logging Timer

Data Log Interval 0 to 120 (minute) [5] ()
Duration [451 Day 09:20:00] ()

11.7 Harmonics setup

Voltage Harmonics Selection

<input checked="" type="checkbox"/> 2nd	<input checked="" type="checkbox"/> 3rd	<input checked="" type="checkbox"/> 4th	<input checked="" type="checkbox"/> 5th	<input checked="" type="checkbox"/> 6th	<input checked="" type="checkbox"/> 7th	<input checked="" type="checkbox"/> 8th	<input checked="" type="checkbox"/> 9th
<input checked="" type="checkbox"/> 10th	<input checked="" type="checkbox"/> 11th	<input type="checkbox"/> 12th	<input checked="" type="checkbox"/> 13th	<input checked="" type="checkbox"/> 14th	<input checked="" type="checkbox"/> 15th	<input type="checkbox"/> 16th	<input checked="" type="checkbox"/> 17th
<input type="checkbox"/> 18th	<input type="checkbox"/> 19th	<input type="checkbox"/> 20th	<input type="checkbox"/> 21st	<input type="checkbox"/> 22nd	<input type="checkbox"/> 23rd	<input type="checkbox"/> 24th	<input type="checkbox"/> 25th
<input type="checkbox"/> 26th	<input type="checkbox"/> 27th	<input type="checkbox"/> 28th	<input type="checkbox"/> 29th	<input type="checkbox"/> 30th	<input type="checkbox"/> 31st		

Voltage Alarm Threshold V Percent 0.0 to 30.0 % [1.0] ()

Current Harmonics Selection

<input checked="" type="checkbox"/> 2nd	<input checked="" type="checkbox"/> 3rd	<input checked="" type="checkbox"/> 4th	<input checked="" type="checkbox"/> 5th	<input checked="" type="checkbox"/> 6th	<input checked="" type="checkbox"/> 7th	<input checked="" type="checkbox"/> 8th	<input checked="" type="checkbox"/> 9th
<input type="checkbox"/> 10th	<input checked="" type="checkbox"/> 11th	<input type="checkbox"/> 12th	<input checked="" type="checkbox"/> 13th	<input checked="" type="checkbox"/> 14th	<input checked="" type="checkbox"/> 15th	<input type="checkbox"/> 16th	<input checked="" type="checkbox"/> 17th
<input type="checkbox"/> 18th	<input type="checkbox"/> 19th	<input type="checkbox"/> 20th	<input type="checkbox"/> 21st	<input type="checkbox"/> 22nd	<input type="checkbox"/> 23rd	<input type="checkbox"/> 24th	<input type="checkbox"/> 25th
<input type="checkbox"/> 26th	<input type="checkbox"/> 27th	<input type="checkbox"/> 28th	<input type="checkbox"/> 29th	<input type="checkbox"/> 30th	<input type="checkbox"/> 31st		

Current Alarm Threshold I Percent 0 to 100 % [10] ()

Minimum Fundamental Current Threshold ☐ Disable ☐ Enable [Enable] ()

Min Current Threshold 0 to 200.0 mA [20.0] ()

Harmonic Alarm Delay 1 to 10 Sec. [10] ()

Appendix B Setpoint, Configuration and Communication Record Forms

11.8 Oscillograph setup

Number of Partitions	1 to 16 [5]	(_____)
Samples/Cycle	16, 32, 64 [32]	(_____)
Post Trigger Delay	5 to 95 % [50]	(_____)
Front Panel Message	<input type="checkbox"/> Enable [Enable] <input type="checkbox"/> Disable	

Pickup

<input type="checkbox"/> Raise Contact	<input type="checkbox"/> Lower Contact	<input type="checkbox"/> VR Contact 1	<input type="checkbox"/> VR Contact 2
<input type="checkbox"/> Force Lower (Runback)	<input type="checkbox"/> Raise Tap Limit	<input type="checkbox"/> Lower Tap Limit	<input type="checkbox"/> Low Band
<input type="checkbox"/> High Band	<input checked="" type="checkbox"/> Low Voltage Limit	<input checked="" type="checkbox"/> High Voltage Limit	<input type="checkbox"/> Auto Inhibit
<input type="checkbox"/> Non Sequential	<input type="checkbox"/> Reverse Power	<input type="checkbox"/> Peak Motor Current	<input type="checkbox"/> Avg. Motor Current
<input type="checkbox"/> Motor Current Duration	<input type="checkbox"/> Voltage Harmonics	<input type="checkbox"/> Current Harmonics	<input checked="" type="checkbox"/> CBEMA 1
<input checked="" type="checkbox"/> CBEMA 2	<input checked="" type="checkbox"/> CBEMA 3	<input checked="" type="checkbox"/> CBEMA 4	<input type="checkbox"/> VAr Bias Active
<input type="checkbox"/> Sealin Fail Alarm Active	<input type="checkbox"/> Sealin Fail Low Blk Act.	<input type="checkbox"/> Sealin Fail Raise Blk Act.	<input type="checkbox"/> Low Current Blk Act.
<input type="checkbox"/> Motor Seal-in Input	<input type="checkbox"/> Neutral Input	<input type="checkbox"/> Counter Input	<input type="checkbox"/> Op Count Signal
<input type="checkbox"/> Individual Tap Wear Alarm			

Dropout

<input type="checkbox"/> Raise Contact	<input type="checkbox"/> Lower Contact	<input type="checkbox"/> VR Contact 1	<input type="checkbox"/> VR Contact 2
<input type="checkbox"/> Force Lower (Runback)	<input type="checkbox"/> Raise Tap Limit	<input type="checkbox"/> Lower Tap Limit	<input type="checkbox"/> Low Band
<input type="checkbox"/> High Band	<input type="checkbox"/> Low Voltage Limit	<input type="checkbox"/> High Voltage Limit	<input type="checkbox"/> Auto Inhibit
<input type="checkbox"/> Non Sequential	<input type="checkbox"/> Reverse Power	<input type="checkbox"/> Voltage Harmonics	<input type="checkbox"/> Current Harmonics
<input type="checkbox"/> CBEMA 1	<input type="checkbox"/> CBEMA 2	<input type="checkbox"/> CBEMA 3	<input type="checkbox"/> CBEMA 4
<input type="checkbox"/> VAr Bias Active	<input type="checkbox"/> Sealin Fail Alarm Act.	<input type="checkbox"/> Sealin Fail Low Blk Act.	<input type="checkbox"/> Sealin Fail Raise Blk Act.
<input type="checkbox"/> Low Current Blk Act.	<input type="checkbox"/> Motor Seal-in Input	<input type="checkbox"/> Neutral Input	<input type="checkbox"/> Counter Input
<input type="checkbox"/> Op Count Signal			
<input type="checkbox"/> Individual Tap Wear Alarm			

11.9 Sequence of events setup

OR Gate Setup

Pickup (Edge Sensitive)

<input type="checkbox"/> Raise Contact	<input type="checkbox"/> Lower Contact	<input type="checkbox"/> VR Contact 1	<input type="checkbox"/> VR Contact 2
<input checked="" type="checkbox"/> Force Lower (Runback)	<input checked="" type="checkbox"/> Raise Tap Limit	<input checked="" type="checkbox"/> Lower Tap Limit	<input type="checkbox"/> Low Band
<input type="checkbox"/> High Band	<input checked="" type="checkbox"/> Low Voltage Limit	<input checked="" type="checkbox"/> High Voltage Limit	<input checked="" type="checkbox"/> Auto Inhibit
<input checked="" type="checkbox"/> Non Sequential	<input checked="" type="checkbox"/> Reverse Power	<input type="checkbox"/> Peak Motor Current	<input type="checkbox"/> Avg. Motor Current
<input type="checkbox"/> Motor Current Duration	<input type="checkbox"/> Voltage Harmonics	<input type="checkbox"/> Current Harmonics	<input checked="" type="checkbox"/> CBEMA Event 1
<input checked="" type="checkbox"/> CBEMA Event 2	<input checked="" type="checkbox"/> CBEMA Event 3	<input checked="" type="checkbox"/> CBEMA Event 4	<input checked="" type="checkbox"/> VAr Bias Active
<input type="checkbox"/> Sealin Fail Alarm Active	<input type="checkbox"/> Sealin Fail Low Blk Act.	<input type="checkbox"/> Sealin Fail Raise Blk Act.	<input type="checkbox"/> Low Current Blk Act.
<input type="checkbox"/> Motor Seal-in Input	<input type="checkbox"/> Neutral Input	<input type="checkbox"/> Counter Input	<input type="checkbox"/> Op Count Signal
<input type="checkbox"/> HMI Active	<input type="checkbox"/> Individual Tap Wear Alarm		

Dropout (Edge Sensitive)

<input type="checkbox"/> Raise Contact	<input type="checkbox"/> Lower Contact	<input type="checkbox"/> VR Contact 1	<input type="checkbox"/> VR Contact 2
<input checked="" type="checkbox"/> Force Lower (Runback)	<input checked="" type="checkbox"/> Raise Tap Limit	<input checked="" type="checkbox"/> Lower Tap Limit	<input type="checkbox"/> Low Band
<input type="checkbox"/> High Band	<input checked="" type="checkbox"/> Low Voltage Limit	<input checked="" type="checkbox"/> High Voltage Limit	<input checked="" type="checkbox"/> Auto Inhibit
<input type="checkbox"/> Non Sequential	<input type="checkbox"/> Reverse Power	<input type="checkbox"/> Voltage Harmonics	<input type="checkbox"/> Current Harmonics
<input type="checkbox"/> CBEMA Event 1	<input type="checkbox"/> CBEMA Event 2	<input type="checkbox"/> CBEMA Event 3	<input type="checkbox"/> CBEMA Event 4
<input checked="" type="checkbox"/> VAr Bias Active	<input type="checkbox"/> Sealin Fail Alarm Act.	<input type="checkbox"/> Sealin Fail Low Blk Act.	<input type="checkbox"/> Sealin Fail Raise Blk Act.
<input type="checkbox"/> Low Current Blk Act.	<input type="checkbox"/> Motor Seal-in Input	<input type="checkbox"/> Neutral Input	<input type="checkbox"/> Counter Input
<input type="checkbox"/> Op Count Signal			
<input type="checkbox"/> HMI Active	<input type="checkbox"/> Individual Tap Wear Alarm		

AND Gate Setup

Appendix B Setpoint, Configuration and Communication Record Forms

Pickup (Level Sensitive)

<input type="checkbox"/> Raise Contact	<input type="checkbox"/> Lower Contact	<input type="checkbox"/> VR Contact 1	<input type="checkbox"/> VR Contact 2
<input type="checkbox"/> Force Lower (Runback)	<input type="checkbox"/> Raise Tap Limit	<input type="checkbox"/> Lower Tap Limit	<input type="checkbox"/> Low Band
<input type="checkbox"/> High Band	<input type="checkbox"/> Low Voltage Limit	<input type="checkbox"/> High Voltage Limit	<input type="checkbox"/> Auto Inhibit
<input type="checkbox"/> Non Sequential	<input type="checkbox"/> Reverse Power	<input type="checkbox"/> Peak Motor Current	<input type="checkbox"/> Avg. Motor Curent
<input type="checkbox"/> Motor Current Duration	<input type="checkbox"/> Voltage Harmonics	<input type="checkbox"/> Current Harmonics	<input type="checkbox"/> CBEMA Event 1
<input type="checkbox"/> CBEMA Event 2	<input type="checkbox"/> CBEMA Event 3	<input type="checkbox"/> CBEMA Event 4	<input type="checkbox"/> VAr Bias Active
<input type="checkbox"/> Sealin Fail Alarm Active	<input type="checkbox"/> Sealin Fail Low Blk Act.	<input type="checkbox"/> Sealin Fail Raise Blk Act.	<input type="checkbox"/> Low Current Blk Act.
<input type="checkbox"/> Motor Seal-in Input	<input type="checkbox"/> Neutral Input	<input type="checkbox"/> Counter Input	<input type="checkbox"/> Op Count Signal
<input type="checkbox"/> HMI Active	<input type="checkbox"/> Individual Tap Wear Alarm		

Dropout (Level Sensitive)

<input type="checkbox"/> Raise Contact	<input type="checkbox"/> Lower Contact	<input type="checkbox"/> VR Contact 1	<input type="checkbox"/> VR Contact 2
<input type="checkbox"/> Force Lower (Runback)	<input type="checkbox"/> Raise Tap Limit	<input type="checkbox"/> Lower Tap Limit	<input type="checkbox"/> Low Band
<input type="checkbox"/> High Band	<input type="checkbox"/> Low Voltage Limit	<input type="checkbox"/> High Voltage Limit	<input type="checkbox"/> Auto Inhibit
<input type="checkbox"/> Non Sequential	<input type="checkbox"/> Reverse Power	<input type="checkbox"/> Voltage Harmonics	<input type="checkbox"/> Current Harmonics
<input type="checkbox"/> CBEMA Event 1	<input type="checkbox"/> CBEMA Event 2	<input type="checkbox"/> CBEMA Event 3	<input type="checkbox"/> CBEMA Event 4
<input type="checkbox"/> VAr Bias Active	<input type="checkbox"/> Sealin Fail Alarm Act.	<input type="checkbox"/> Sealin Fail Low Blk Act.	<input type="checkbox"/> Sealin Fail Raise Blk Act.
<input type="checkbox"/> Low Current Blk Act.	<input type="checkbox"/> Motor Seal-in Input	<input type="checkbox"/> Neutral Input	<input type="checkbox"/> Counter Input
<input type="checkbox"/> Op Count Signal			
<input type="checkbox"/> HMI Active	<input type="checkbox"/> Individual Tap Wear Alarm		
SOE Final Gate	<input type="checkbox"/> OR [OR]	<input type="checkbox"/> And	

11.10 CBEMA settings

Normal Voltage	100.0 to 130.0 V [120.0]	(_____)
CBEMA Event 1	<input type="checkbox"/> Disable <input type="checkbox"/> Enable [Enable]	
Sag/Swell/Swell Pickup	50 to 130% [70]	(_____)

Table continues on next page

Section 11

Appendix B Setpoint, Configuration and Communication Record Forms

1VAC388793-MB B

Sag/Swell Dropout	71 to 130% [95]	(_____)
Sag/Swell Minimum Duration	1 to 60 Cycles [1]	(_____)
	<input type="checkbox"/> Disable <input type="checkbox"/> Enable [Enable]	
Sag/Swell/Swell Pickup	50 to 130% [80]	(_____)
Sag/Swell Dropout	81 to 130% [95]	(_____)
Sag/Swell Minimum Duration	1 to 120 Cycles [1]	(_____)
	<input type="checkbox"/> Disable <input type="checkbox"/> Enable [Enable]	
Sag/Swell/Swell Pickup	50 to 130% [90]	(_____)
Sag/Swell Dropout	91 to 130% [95]	(_____)
Sag/Swell Minimum Duration	60 to 60000 Cycles [60]	(_____)
	<input type="checkbox"/> Disable <input type="checkbox"/> Enable [Enable]	
Sag/Swell/Swell Pickup	50 to 130% [115]	(_____)
Sag/Swell Dropout	50 to 114% [105]	(_____)
Sag/Swell Minimum Duration	1 to 60 Cycles [1]	(_____)

11.11 Comm settings

RS485/Fiber

Comm Port Type	<input type="checkbox"/> RS485 [RS485]	<input type="checkbox"/> Fiber
Protocol	<input type="checkbox"/> DNP3 [DNP3]	<input type="checkbox"/> MODBUS®
Baud Rate	<input type="checkbox"/> 300 <input type="checkbox"/> 1200 <input type="checkbox"/> 4800 <input type="checkbox"/> 19200 <input type="checkbox"/> 57600	<input type="checkbox"/> 600 <input type="checkbox"/> 2400 <input type="checkbox"/> 9600 [9600] <input type="checkbox"/> 38400 <input type="checkbox"/> 115200
Parity	<input type="checkbox"/> NONE [NONE] <input type="checkbox"/> EVEN	<input type="checkbox"/> ODD
Stop Bit	<input type="checkbox"/> 1 [1]	<input type="checkbox"/> 2
Sync Time	1 to 5000 [2] max 5000 ms	(_____)
Tx Delay	1 to 50 [10] max 50 ms	(_____)

Appendix B Setpoint, Configuration and Communication Record Forms

Serial RS232

Protocol	<input type="checkbox"/> MODBUS [MODBUS]	<input type="checkbox"/> DNP3
Baud Rate	<input type="checkbox"/> 300 <input type="checkbox"/> 1200 <input type="checkbox"/> 4800 <input type="checkbox"/> 19200 <input type="checkbox"/> 57600	<input type="checkbox"/> 600 <input type="checkbox"/> 2400 <input type="checkbox"/> 9600 <input type="checkbox"/> 38400 <input type="checkbox"/> 115200 [115200]
Parity	<input type="checkbox"/> NONE [NONE] <input type="checkbox"/> EVEN	<input type="checkbox"/> ODD
Stop Bit	<input type="checkbox"/> 1	<input type="checkbox"/> 2 [2]
Sync Time	1 to 5000 [50] max 5000 ms	(_____)

Ethernet

Auto Negotiation	<input type="checkbox"/> Disable	<input type="checkbox"/> Enable [Enable]
DHCP Protocol	<input type="checkbox"/> Disable	<input type="checkbox"/> Enable [Enable]
IP Address [0.0.0.0]		(_____)
Net Mask [0.0.0.0]		(_____)
Gateway [0.0.0.0]		(_____)
Keepalive Time	1 to 50,000 (Sec) [7200]	(_____)

Port

MODBUS® Port	0 to 65,535 [502]	(_____)
DNP3.0 Port	0 to 65,535 [20000]	(_____)

Network Time Synchronization

SNTP	<input type="checkbox"/> Disable [Disable]	<input type="checkbox"/> Enable
SNTP Server Name		(_____)
SNTP Server Address [X.X.X.X]		(_____)
Time Zone [GMT -5 Hr]		(_____)

Change Communication Address**Communication Address**

DNP Address	1 to 65519 [1]	(_____)
Modbus Address		(_____)

Substation

Table continues on next page

Section 11

Appendix B Setpoint, Configuration and Communication Record Forms

1VAC388793-MB B

DNP Address 0 to 65519 [0] (_____)

Feeder

DNP Address 0 to 65519 [0] (_____)

Communication Access Security

Communication Access and Timeout

Communication Access ☐ Disable [Disable] ☐ Enable

Communication Access Timeout 1 to 50,000 (max 50,000 sec) [60] (_____)

SCADA Heartbeat Setting

Heartbeat (Failsafe) DNP Option

<input type="checkbox"/> Disabled [Disabled]	<input type="checkbox"/> LTC (DNP)
<input type="checkbox"/> Regulator (DNP)	<input type="checkbox"/> Profile Switching (DNP)
<input type="checkbox"/> Profile Switching (GOOSE)	

Bluetooth®

Protocol	<input type="checkbox"/> MODBUS® [MODBUS]	<input type="checkbox"/> DNP3
Bluetooth Mode	<input type="checkbox"/> Mode 0 [Mode 0]	<input type="checkbox"/> Mode 1
Friendly Name [TCC300]	(_____)	
	<input type="checkbox"/> Bluetooth Enable [Enable]	<input type="checkbox"/> Bluetooth Disable
	<input type="checkbox"/> Enable Authentication	<input type="checkbox"/> Disable Authentication [disable]
Bluetooth Passkey	(_____)	
Bluetooth Device Address	(_____)	

Section 12 Appendix C DNP Configuration Editor

12.1 DNP Configuration Editor

The DNP Configuration Editor includes several features and functions.

Variations

The variation of an object gives a different representation of the same data point, such as the size of the object or whether or not the object has flag information. Accordingly, the Variations section will configure listed objects with the desired and supported variations.

Master Address used for Unsolicited responses and/or Source Address Validation

This address will be used as the address to send unsolicited responses and/or Source Address Validation.

Modem Unsolicit Setting

Applies to RS-232 interface connected to an Ethernet Modem. TCP/IP and UDP/IP unsolicit settings are used when DNP is being deployed over an Ethernet network. The setting elements are described below:

- **Allow Unsolicit:** Determines whether unsolicited null responses will be sent when session comes online. If enabled, subsequent unsolicited responses will be enabled through function code 0×14 (Enable unsolicited responses) and disabled through function code 0×15 (Disable unsolicited responses). If "Allow Unsolicit" is disabled, then function codes 0×14 and 0×15 will be responded to with an error.
- **Class 1 Max Delay (Sec):** If unsolicited responses are enabled, this parameter specifies the maximum amount of time after an event in the corresponding class is received before an unsolicited response will be generated.
- **Class 1 Max Events:** If unsolicited responses are enabled, the parameter specifies the maximum number of events in the corresponding class to be allowed before an unsolicited response will be generated.
- **Class 2 Max Delay (Sec):** If unsolicited responses are enabled, this parameter specifies the maximum amount of time after an event in the corresponding class is received before an unsolicited response will be generated.
- **Class 2 Max Events:** If unsolicited responses are enabled, the parameter specifies the maximum number of events in the corresponding class to be allowed before an unsolicited response will be generated.

Choosing Points

The Available Points window is populated when a DNP source file is opened. The selection of points from the Binary Inputs, Analog Inputs, Binary/Control Outputs and Analog Outputs tabs can be accomplished by either individually selecting, dragging and dropping points in the Selected Points window or utilizing the "Copy All" feature. The Copy All feature only copies the points in the open tab to the Selected Points window. The "Remove All" feature removes all the points displayed in the Selected Points window for the tab that is open.

Ordering Selected Points

Selected points can be reordered to match the users SCADA, RTU or Master setup by selecting, dragging and dropping the desired point within the Selected Points window.

Adding Dummy Points

The purpose of the Dummy Point is to allow the user to match other device DNP maps that contain points that are not supported in the control. This feature allows the user to communicate with the TCC300 control when it is connected to an RTU that contains other brands of controls and eliminates the need to re-configure the RTU or the other controls.

To insert a Dummy point, select "Insert Dummy". The Dummy Point will be inserted at the end of the Selected Points list. To move the Dummy Point, select, drag and drop the point at the desired location in the Selected Points list. The Dummy point will assume the Index Position and the remaining Selected Points will be modified to accommodate the Dummy Point.

Insert Offset

This allows an offset to be created in the DNP map without the point number being transmitted, thus providing the ability to construct a DNP profile that has non-consecutive point numbers within a group.

Additional Mask Values

Four new mask categories have been added.

- **CLASS_NONE:** If a point is defined as CLASS_NONE, then it will not be sent during any CLASS polling although the point is present in the DNP map. The only mean to access this point is by querying the point individually.
- **CLASS_ONE_NOTCLASS0:** If a point is defined as CLASS_ONE_NOTCLASS0, it will be present in a CLASS 1 poll but not an integrity CLASS 0 poll.
- **CLASS_TWO_NOTCLASS0:** If a point is defined as CLASS_TWO_NOTCLASS0, it will be present in a CLASS 2 poll but not an integrity CLASS 0 poll.
- **CLASS_THREE_NOTCLASS0:** If a point is defined as CLASS_THREE_NOTCLASS0, it will be present in a CLASS 3 poll but not an integrity CLASS 0 poll.

Editing Binary Input Points

The Binary Input "Value" and "Mask" values can be edited by double left clicking on the desired point Value or Mask elements. The default value for Value is TRUE, which means that the point will return a High or True when the item being monitored is active in the control. It can be changed to "FALSE" to match a SCADA Master if necessary. The "Mask" value defaults to "CLASS ONE" and defines what polling class type the point is mapped to. The Mask value can also be set to CLASS TWO, CLASS THREE, CLASS NONE, CLASS ONE NOT CLASS 0, CLASS TWO NOT CLASS 0 or CLASS THREE NOT CLASS 0 by double left clicking on the desired point Mask element.

Editing Analog Input Points

The Analog Input "Deadband" and "Mask" values can be edited by double left clicking on the desired point Deadband or Mask elements. The Deadband can be set to define when the point will report by exception under the class type in the Mask setting. When the point change exceeds the deadband value, it will initiate a report by exception to the master. The "Mask" value defaults to "CLASS TWO" and defines what polling class type the point is mapped to. The Mask value can also be set to CLASS ONE, CLASS THREE, CLASS NONE, CLASS ONE NOT CLASS 0, CLASS TWO NOT CLASS 0 or CLASS THREE NOT CLASS 0 by double left clicking on the desired point Mask element.

Editing Binary/Control Output Points

The Binary/Control Output Point "Crob", "Mask" and "Inverse" values can be edited by double left clicking on the desired point Crob, Mask or Inverse elements. The Crob (Control Relay Output Block) setting is used to define what control method will be used to operate the point. The possible settings for "Crob" are listed below:

- Latch On
- Latch Off
- Latch OnOff
- Latch OnOff_TC
- Pulse On
- Pulse Off

- Pulse OnOff
- Pulse OnOff_TC
- Paired Close
- Paired Trip
- Paired TripClose

The "Mask" value defaults to "CLASS ZERO" and defines what polling class type the point is mapped to. The Mask value can also be set to CLASS NONE by double left clicking on the desired point Mask element.

Inverse defines whether the command to be sent would be inverted, meaning that when TRUE is selected, sending a Trip, Close, etc will have the opposite effect. This was implemented due to variations seen in RTU manufacturer's implementation of direct control with DNP to allow full compatibility the widest possible number of RTU's.

The Binary/Control Outputs Tab includes a help selection. When selected TCC600 will launch two pdf documents which provide an explanation of each individual Binary point with respect to different CROB.

Editing Analog Output Points

The Analog Output "Mask" value can be edited by double left clicking on the desired point Mask element. The "Mask" value defaults to "CLASS ZERO" and defines what polling class type the point is mapped to. The Mask value can also be set to CLASS NONE by double left clicking on the desired point Mask element.

Editing Counters

The Counters "Mask" value can be edited by double left clicking on the desired point Mask element. The "Mask" value defaults to "CLASS THREE" and defines what polling class type the point is mapped to. The Mask value can also be set to CLASS ONE, CLASS TWO, CLASS NONE, CLASS ONE NOT CLASS 0, CLASS TWO NOT CLASS 0 or CLASS THREE NOT CLASS 0 by double left clicking on the desired point Mask element.



For security reason, DNP Security tab will only be active when TCC600 is connected to a control with an Access Code of Level 2, otherwise it will be grayed out.

DNP Security

DNP authentication is now available and can be independently enabled in the DNP security tab for either serial or Ethernet (both TCP or UDP) interfaces.

The concepts of the Hashed Message Authentication Code (HMAC) and challenge-response as defined in the DNP3 specification for Secure Authenticate Version 2.0 document is employed.

When authentication is enabled, the following settings should be selected:

- HMAC Algorithm and Update key
- Challenge Response timeout
- Duration of session key
- Aggressive Mode
- Critical Request Function Codes



Before TCC600® allows a user to change the Update key, the user has to enter the old update key.

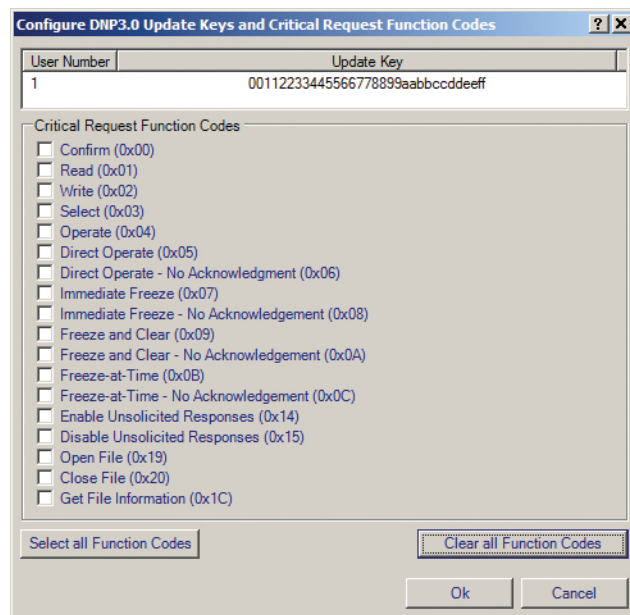


Figure 460: Configure Update Keys and Critical Request Function Codes Dialog Screen

HMAC Algorithm and Update Key

The HMAC algorithm is either SHA1 (4 OCT) or SHA1 (10 OCT). An Update key is necessary to provide secure SESSION key negotiation. Once a SESSION key is obtained any subsequent challenge/ response session will employ that session key. The Update key can be up to 32 hex characters (0123456789ABCDEF) (128 bits).

Challenge Response Timeout

The range is from 0-100 seconds. This is the response time within which the control is expecting a response to a challenge.

Duration of Session Key

This duration must be configured in minutes (0-100) and in count 0-65535. This duration represents the maximum time or the maximum number of challenges a particular session key is used before key negotiation is again performed.

Aggressive Mode

Full challenge/response exchanges increase the number messages in the protocol, which affects throughput performance. Therefore, DNP Secure Authentication provides an aggressive mode in which the data from a single challenge can be used to authenticate many subsequent messages. The sender of the critical message includes the HMAC at the end of the critical message without having to be challenged. At least one challenge must occur, however, before aggressive mode can be used.

Critical Request Function Codes

This represents the function codes that will require authentication if selected. If none is selected, authentication will not be performed on any function code although authentication has been enabled.

Example of DNP Configuration Editor Use

The following sequence of steps provides an example of utilizing the DNP Configuration Editor.

1. From the TCC600® Main Screen select **Utility/DNP Configuration Editor**.
TCC600 will display the DNP Configuration Editor dialog screen.

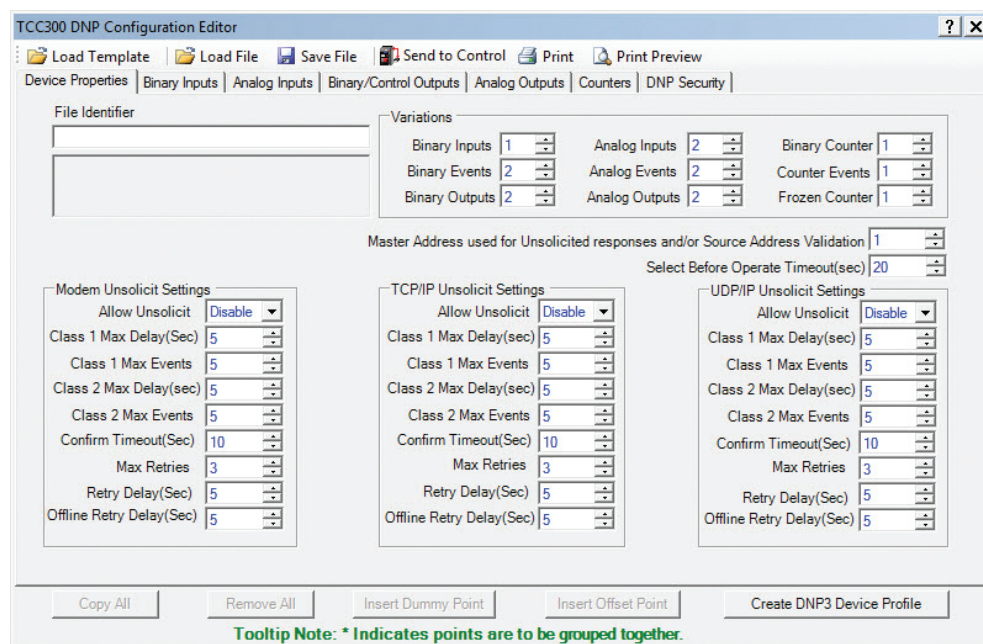


Figure 461: DNP Configuration Editor Dialog Screen

2. Select **Load Template/TCC300 Default** from the DNP Configurator menu bar. The Binary Inputs tab is displayed. The Available Points list for each DNP Points Group tab will also be populated.
3. Select the Binary Input points you wish to include in the DNP map by selecting Copy All or dragging the desired point(s) to the Selected Points window.
4. Edit the Selected Points for each tab as necessary to match your SCADA, RTU or Master setup.
5. Select **Save File** from the DNP Configurator menu bar. TCC600 will display a **Save As** dialog screen with a *.xml file extension.
6. Name the file and then select **Save**.
7. If TCC600 is connected to the target control then the **Send to Control** menu feature can be used as follows:
 - 7.1. Select **Send to Control**. TCC600 will display the "Authentication Key generated successfully".

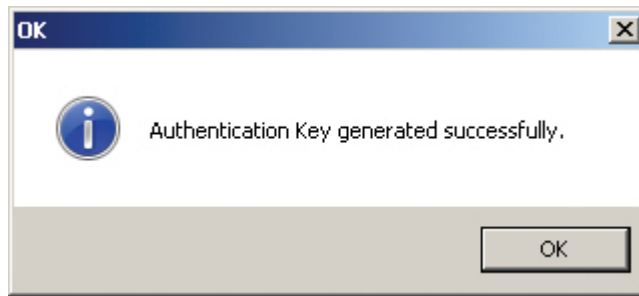


Figure 462: Authentication Key Generated Successfully Confirmation Screen

- 7.2. Select **OK**. TCC600 will display the "Open File" dialog screen with a *.xml file extension.
- 7.3. Select the file to be opened, then select Open. TCC600 will initiate the file transfer as indicated by the "Send" dialog screen, followed by a "DNP Upload" confirmation screen.

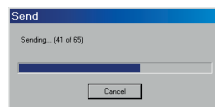


Figure 463: Send Dialog Screen

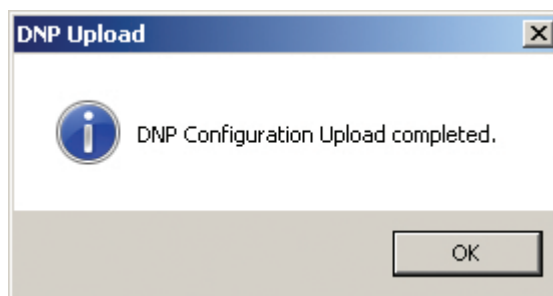


Figure 464: DNP Upload Confirmation Screen

INVERSE CROB

Process	Latch On	Latch Off	Latch On/Off	Set	Clear	Reset
Manual Raise 1 Tap	Lon - Does nothing	Loft - Raise	Lon - Does nothing, Loft - Raise	Trip - Does nothing	Close - Raise	Trip - Does nothing, Close - Raise
Block Automatic Control Via Comm	Lon - Does nothing	Loft - Lower	Lon - Does nothing, Loft - Lower	Trip - Does nothing	Close - Lower	Trip - Does nothing, Close - Lower
Voltage Reduction Step 1	Lon - UnBlock	Loft - block	Lon - UnBlock, Loft - block	Trip - UnBlock	Close - block	Trip - UnBlock, Close - block
Voltage Reduction Step 2	Lon - VR0ff	Loft - VR1	Lon - VR0ff, Loft - VR1	Trip - VR0ff	Close - VR1	Trip - VR0ff, Close - VR1
Voltage Reduction Step 3	Lon - VR0ff	Loft - VR2	Lon - VR0ff, Loft - VR2	Trip - VR0ff	Close - VR2	Trip - VR0ff, Close - VR2
Reset Counter to Zero	Lon - VR0ff	Loft - VR3	Lon - VR0ff, Loft - VR3	Trip - VR0ff	Close - VR3	Trip - VR0ff, Close - VR3
Remote Auto/Manual	Lon - fails	Loft - RST	Lon - fail, Loft - RST	Trip - fail	Close - RST	Trip - fail, Close - RST
Fwd Voltage Level	Lon - Auto	Loft - Man	Lon - Auto, Loft - Man	Trip - Auto	Close - Man	Trip - Auto, Close - Man
Bandwidth Voltage	Lon - dec 0.1	Loft - inc 0.1	Lon - dec 0.1, Loft - inc 0.1	Trip - dec 0.1	Close - inc 0.1	Trip - dec 0.1, Close - inc 0.1
Fwd Time Delay	Lon - dec 5	Loft - inc 5	Lon - dec 5, Loft - inc 5	Trip - dec 5	Close - inc 5	Trip - dec 5, Close - inc 5
Fwd Reactive Comp	Lon - dec 1	Loft - inc 1	Lon - dec 1, Loft - inc 1	Trip - dec 1	Close - inc 1	Trip - dec 1, Close - inc 1
Level 2 Voltage Reduction	Lon - VR0ff	Loft - VR1	Lon - VR0ff, Loft - VR1	Trip - VR0ff	Close - VR1	Trip - VR0ff, Close - VR1
Local Voltage Reduction	Lon - VR0ff	Loft - VR2	Lon - VR0ff, Loft - VR2	Trip - VR0ff	Close - VR2	Trip - VR0ff, Close - VR2
Remote Voltage Reduction	Lon - dec step 0.5	Loft - inc step 0.5	Lon - dec step 0.5, Loft - inc step 0.5	Trip - dec step 0.5	Close - inc step 0.5	Trip - dec step 0.5, Close - inc step 0.5
Fwd Resistive Comp	Lon - dec step 2 0.5	Loft - inc step 2 0.5	Lon - dec step 2 0.5, Loft - inc step 2 0.5	Trip - dec step 2 0.5	Close - inc step 2 0.5	Trip - dec step 2 0.5, Close - inc step 2 0.5
Reset Demands	Lon - dec 1	Loft - inc 1	Lon - dec 1, Loft - inc 1	Trip - dec 1	Close - inc 1	Trip - dec 1, Close - inc 1
Reset Energies	Lon - fails	Loft - RST	Lon - fail, Loft - RST	Trip - fail	Close - RST	Trip - fail, Close - RST
Manual Raise/Lower 1 Tap	Lon - Rise	Loft - Lower	Lon - Raise, Loft - Lower	Trip - Raise	Close - Lower	Trip - Raise, Close - Lower
Scamp Switch	Lon - Man	Loft - Auto	Lon - Man, Loft - Auto	Trip - Man	Close - Auto	Trip - Man, Close - Auto
Voltage Reduction Enable	Lon - Disable	Loft - Enable	Lon - Disable, Loft - Enable	Trip - Disable	Close - Enable	Trip - Disable, Close - Enable
Non-Sequential	Lon - Disable	Loft - Enable	Lon - Disable, Loft - Enable	Trip - Disable	Close - Enable	Trip - Disable, Close - Enable
Clear Sealin Failure Alarm	Lon - fails	Loft - Clear	Lon - Fail, Loft - Clear	Trip - Fails	Close - Clear	Trip - Fails, Close - Clear
Clear Low Current Block Alarm	Lon - fails	Loft - Clear	Lon - Fail, Loft - Clear	Trip - Fails	Close - Clear	Trip - Fails, Close - Clear

Process	Latch On	Latch Off	Latch On/Off	Set	Clear	Reset
Manual Raise 1 Tap	Pon - Does nothing	Poff - Raise	Pon - Does nothing, Poff - Raise	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Block Automatic Control Via Comm	Pon - Does nothing	Poff - Lower	Pon - Does nothing, Poff - Lower	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Voltage Reduction Step 1	Pon - UnBlock	Poff - block	Pon - UnBlock, Poff - block	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Voltage Reduction Step 2	Pon - VR0ff	Poff - VR1	Pon - VR0ff, Poff - VR1	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Voltage Reduction Step 3	Pon - VR0ff	Poff - VR2	Pon - VR0ff, Poff - VR2	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Reset Counter to Zero	Pon - VR0ff	Poff - VR3	Pon - VR0ff, Poff - VR3	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Remote Auto/Manual	Pon - fail	Poff - RST	Pon - fail, Poff - RST	Latch off	Close work	Pulse off and close work
Fwd Voltage Level	Pon - Auto	Poff - Man	Pon - Auto, Poff - Man	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Bandwidth Voltage	Pon - dec 0.1	Poff - inc 0.1	Pon - dec 0.1, Poff - inc 0.1	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Fwd Time Delay	Pon - dec 5	Poff - inc 5	Pon - dec 5, Poff - inc 5	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Fwd Reactive Comp	Pon - dec 1	Poff - inc 1	Pon - dec 1, Poff - inc 1	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Level 2 Voltage Reduction	Pon - VR0ff	Poff - VR1	Pon - VR0ff, Poff - VR1	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Local Voltage Reduction	Pon - VR0ff	Poff - VR2	Pon - VR0ff, Poff - VR2	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Remote Voltage Reduction	Pon - dec step 0.5	Poff - inc step 0.5	Pon - dec step 0.5, Poff - inc step 0.5	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Fwd Resistive Comp	Pon - dec step 2 0.5	Poff - inc step 2 0.5	Pon - dec step 2 0.5, Poff - inc step 2 0.5	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Reset Demands	Pon - dec 1	Poff - inc 1	Pon - dec 1, Poff - inc 1	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Reset Energies	Pon - fail	Poff - RST	Pon - fail, Poff - RST	Latch off	Close work	Pulse off and close work
Manual Raise/Lower 1 Tap	Pon - Raise	Poff - Lower	Pon - Raise, Poff - Lower	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Scamp Switch	Pon - Man	Poff - Auto	Pon - Man, Poff - Auto	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Voltage Reduction Enable	Pon - Disable	Poff - Enable	Pon - Disable, Poff - Enable	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Non-Sequential	Pon - Disable	Poff - Enable	Pon - Disable, Poff - Enable	Latch On/Off and TC work	Pulse on/off and TC work	Pulse on/off and TC work
Clear Sealin Failure Alarm	Pon - fails	Poff - Clear	Pon - Fails, Poff - Clear	Latch off	Close work	Pulse off and close work

Figure 465: Inverse CROB

INVERSE CROB

Function	Setpoint	Setpoint	Setpoint	Setpoint	Setpoint	Setpoint
Manual Raise 1 Tap	Lon - Does nothing	Loff - Raise	Lon - Does nothing, Loff - Raise	Trip - Does nothing	Close - Raise	Trip - Does nothing, close - Raise
Manual Lower 1 Tap	Lon - Does nothing	Loff - Lower	Lon - Does nothing, Loff - Lower	Trip - Does nothing	Close - Lower	Trip - Does nothing, close - Lower
Block Automatic Control via Comm	Lon - Unblock	Loff - block	Lon - Unblock, Loff - block	Trip - Unblock	Close - Block	Trip - Unblock, close - Block
Voltage Reduction Step 1	Lon - VROff	Loff - VR1	Lon - VROff, Loff - VR1	Trip - VROff	Close - VR1	Trip - VROff, close - VR1
Voltage Reduction Step 2	Lon - VROff	Loff - VR2	Lon - VROff, Loff - VR2	Trip - VROff	Close - VR2	Trip - VROff, close - VR2
Voltage Reduction Step 3	Lon - VROff	Loff - VR3	Lon - VROff, Loff - VR3	Trip - VROff	Close - VR3	Trip - VROff, close - VR3
Reset Counter to Zero	Lon - fails	Loff - RST	Lon - fail, Loff - RST	Trip - fail	Close - RST	Trip - fail, close - RST
Remote Auto/Manual	Lon - Auto	Loff - Man	Lon - Auto, Loff - Man	Trip - Auto	Close - Man	Trip - Auto, close - Man
Fid Voltage Level	Lon - dec 0.1	Loff - inc 0.1	Lon - dec 0.1, Loff - inc 0.1	Trip - dec 0.1	Close - inc 0.1	Trip - dec 0.1, close - inc 0.1
Bandwidth Voltage	Lon - dec 0.1	Loff - inc 0.1	Lon - dec 0.1, Loff - inc 0.1	Trip - dec 0.1	Close - inc 0.1	Trip - dec 0.1, close - inc 0.1
Fid Time Delay	Lon - dec 5	Loff - inc 5	Lon - dec 5, Loff - inc 5	Trip - dec 5	Close - inc 5	Trip - dec 5, close - inc 5
Fid Reactive Comp	Lon - dec 1	Loff - inc 1	Lon - dec 1, Loff - inc 1	Trip - dec 1	Close - inc 1	Trip - dec 1, close - inc 1
Level Voltage Reduction	Lon - VROff	Loff - VR1	Lon - VROff, Loff - VR1	Trip - VROff	Close - VR1	Trip - VROff, close - VR1
Level Voltage Reduction	Lon - VROff	Loff - VR2	Lon - VROff, Loff - VR2	Trip - VROff	Close - VR2	Trip - VROff, close - VR2
Local Voltage Reduction	Lon - dec step10.5	Loff - inc step10.5	Lon - dec step10.5, Loff - inc step10.5	Trip - dec step10.5	Close - inc step10.5	Trip - dec step10.5, close - inc step10.5
Remote Voltage Reduction	Lon - dec step2 0.5	Loff - inc step2 0.5	Lon - dec step2 0.5, Loff - inc step2 0.5	Trip - dec step2 0.5	Close - inc step2 0.5	Trip - dec step2 0.5, close - inc step2 0.5
Fid Resistive Comp	Lon - dec 1	Loff - inc 1	Lon - dec 1, Loff - inc 1	Trip - dec 1	Close - inc 1	Trip - dec 1, close - inc 1
Reset Demands	Lon - fails	Loff - RST	Lon - fail, Loff - RST	Trip - fail	Close - RST	Trip - fail, close - RST
Reset Energies	Lon - fails	Loff - RST	Lon - fail, Loff - RST	Trip - fail	Close - RST	Trip - fail, close - RST
Manual Raise/Lower 1 Tap	Lon - Raise	Loff - Lower	Lon - Raise, Loff - Lower	Trip - Raise	Close - Lower	Trip - Raise, close - Lower
Scamp Switch	Lon - Man	Loff - Auto	Lon - Man, Loff - Auto	Trip - Man	Close - Auto, rest fail	Trip - Man, close - Auto
Voltage Reduction Enable	Lon - Disable	Loff - Enable	Lon - Disable, Loff - Enable	Trip - Disable	Close - Enable, rest fail	Trip - Disable, close - Enable
Non-Sequential	Lon - Disable	Loff - Enable	Lon - Disable, Loff - Enable	Trip - Disable	Close - Enable, rest fail	Trip - Disable, close - Enable
Clear Sealin Failure Alarm	Lon - fails	Loff - Clear	Lon - Fail, Loff - Clear	Trip - fails	Close - Clear	Trip - fails, close - Clear
Clear Low Current Block Alarm	Lon - fails	Loff - Clear	Lon - Fail, Loff - Clear	Trip - fails	Close - Clear	Trip - fails, close - Clear

Function	Setpoint	Setpoint	Setpoint	Setpoint	Setpoint	Setpoint
Manual Raise 1 Tap	Pon - Does nothing	Pol - Raise	Pon - Does nothing, Pol - Raise	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Manual Lower 1 Tap	Pon - Does nothing	Pol - Lower	Pon - Does nothing, Pol - Lower	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Block Automatic Control via Comm	Pon - Unblock	Pol - block	Pon - Unblock, Pol - block	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Voltage Reduction Step 1	Pon - VROff	Pol - VR1	Pon - VROff, Pol - VR1	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Voltage Reduction Step 2	Pon - VROff	Pol - VR2	Pon - VROff, Pol - VR2	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Voltage Reduction Step 3	Pon - VROff	Pol - VR3	Pon - VROff, Pol - VR3	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Reset Counter to Zero	Pon - fail	Pol - RST	Pon - fail, Pol - RST	Latch off Close work	Pulse off and close work	Pulse off and close work
Remote Auto/Manual	Pon - Auto	Pol - Man	Pon - Auto, Pol - Man	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Fid Voltage Level	Pon - dec 0.1	Pol - inc 0.1	Pon - dec 0.1, Pol - inc 0.1	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Bandwidth Voltage	Pon - dec 0.1	Pol - inc 0.1	Pon - dec 0.1, Pol - inc 0.1	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Fid Time Delay	Pon - dec 5	Pol - inc 5	Pon - dec 5, Pol - inc 5	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Fid Reactive Comp	Pon - dec 1	Pol - inc 1	Pon - dec 1, Pol - inc 1	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Level Voltage Reduction	Pon - VROff	Pol - VR1	Pon - VROff, Pol - VR1	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Level Voltage Reduction	Pon - VROff	Pol - VR2	Pon - VROff, Pol - VR2	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Local Voltage Reduction	Pon - dec step10.5	Pol - inc step10.5	Pon - dec step10.5, Pol - inc step10.5	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Remote Voltage Reduction	Pon - dec step2 0.5	Pol - inc step2 0.5	Pon - dec step2 0.5, Pol - inc step2 0.5	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Fid Resistive Comp	Pon - dec 1	Pol - inc 1	Pon - dec 1, Pol - inc 1	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Reset Demands	Pon - fail	Pol - RST	Pon - fail, Pol - RST	Latch off Close work	Pulse off and close work	Pulse off and close work
Reset Energies	Pon - fail	Pol - RST	Pon - fail, Pol - RST	Latch off Close work	Pulse off and close work	Pulse off and close work
Manual Raise/Lower 1 Tap	Pon - Raise	Pol - Lower	Pon - Raise, Pol - Lower	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Scamp Switch	Pon - Man	Pol - Auto	Pon - Man, Pol - Auto	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Voltage Reduction Enable	Pon - Disable	Pol - Enable	Pon - Disable, Pol - Enable	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Non-Sequential	Pon - Disable	Pol - Enable	Pon - Disable, Pol - Enable	Latch OnOff and TC work	Pulse onOff and TC work	Pulse onOff and TC work
Clear Sealin Failure Alarm	Pon - fails	Pol - Clear	Pon - fails, Pol - Clear	Latch off Close work	Pulse off and close work	Pulse off and close work

Figure 466: Individual Binary Points and Different CROB

Section 13 Appendix D IEC 61850 Configuration Editor

13.1 IEC 61850 Configuration Editor

The IEC 61850 Configuration Editor includes the following features and functions:

CID IP Address

The IP Address of the Server (control). Setting the proper IP Address to match the control IP Address, will enable a CLIENT software to establish a connection to the control.

File Revision

The file revision allows 0-99 different revisions of the CID file.

Buffered and UnBuffered Control Blocks

The user is able to choose 2 Buffered Report Control Blocks and 2 UnBuffered Report Control Blocks.

Buffered Report Control Block

The events caused by trigger options such as data change, data update, quality change will generate reports immediately. Events not transmitted are buffered to a practical limit for later transmission. Events are not lost due to loss of connection or transport flow constraints.

UnBuffered Report Control Block

The events caused by trigger options such as data change, data update, quality change will generate reports immediately on a best effort basis. The reports are not guaranteed to be delivered if there is loss of connection or if the connection is slow.

RptEna (Report Enable/Disable)

Enables or Disables the report.

RptID (Report Identifier)

The Report Identifier will be the client specified report identifier of the buffered report control block or unbuffered control block that caused the generation of the report.

Having no rptID in the Report Control Block of the CID file will fail validation in Schema 1.4 (as rptID is required) and passes validation for Schema 3.0.

Reporting

SaveClose

Metering Dataset (MX) & Deadbands (db) | Status Dataset (ST)

Buffered Reporting

☒ Buffered

Report ID

Integrity (ms)

0

BufTm (ms)

0

ConfRev

1

Trigger Options

Option Fields

'Data Change', 'Data Up'

'Sequence Number', 'TimeS'

Unbuffered Reporting

☒ UnBuffered

Report ID

Integrity (ms)

0

BufTm (ms)

0

ConfRev

1

Trigger Options

Option Fields

'Data Change', 'Data Up'

'Sequence Number', 'TimeS'

30

☒ Maximum Local Voltage

30

☒ Minimum Local Voltage

50

☒ Maximum Demand Current

30

☒ Maximum Demand VA

30

☒ Maximum Demand VAr

30

☒ Maximum Demand Watts

65535

☒ High VAPF

50

☒ Demand Current

30

☒ Demand VA

30

☒ Meter Out Voltage

30

☒ Demand Power

30

☒ Demand VAr

50

☒ Primary Current

30

☒ Primary VA

30

☒ Primary VArS

50

☒ Primary Voltage

65535

☒ Power Factor

30

☒ Primary Watts

30

☒ Calc. Source Voltage

30

☒ Control Voltage

30

☒ Load Control Voltage

50

☒ Load Current

50

☒ Circulating Current

10

☒ Frequency

65535

☒ Normalizing Voltage

65535

☒ Primary Source Voltage

65535

☒ Voltage Harmonic Distortion

65535

☒ Current Harmonic Distortion

Select All

DeSelect All

Figure 467: IEC 61850 Configuration Editor Reporting Metering Dataset Dialog Screen

682

TCC300
User Manual

Figure 468: IEC 61850 Configuration Editor Reporting Status Dataset Dialog Screen

Reporting Trigger Options – (for both Unbuffered and Buffered report control blocks)



Schema 1.4 does not support General Interrogation. Schema 3.0 does support General Interrogation.

Figure 469: Report Trigger Options Dialog Screen

- Data Change/Data Update – For measurements, if the value of the data attribute exceeds (either lower or higher) the deadband value the report is generated. For status, if the value of the data attributes changes, the report is generated.
- Data Update – is treated the same as Data Change.
- Quality Change – For any measurement or status, the source is a PROCESS. The settings are SUBSTITUTED values.

If system error or checksum error is detected, the validity are questionable and inaccurate. If self test fails, then validity is Invalid. Good means there is no abnormal condition of the

acquisition function or the source. If a value is out of range outofrange is set. Badreference is set when ever error 8198 (voltage reference error) is detected.

Supported Quality bits are:

- Good
 - Invalid
 - Questionable
 - Out of Range
 - Bad Reference
 - Inaccurate
-
- Integrity – For the integrity time period, set in seconds, a snapshot of the dataset with values of the data attributes is reported. If the integrity time period is set to zero, No integrity reports are generated.
 - General Interrogation (GI) – As soon as GI value is set to true, a snapshot of the dataset with values of the data attributes is reported and GI is immediately set to false. Supported in Schema 3.0

BufTm (in Seconds)

Specifies the time in seconds that cause buffering of events caused by trigger options such as data change, data update, quality change. BufTm of 0 is supported.

Configuration Revision

Contains the count of the number of times that the configuration in the dataset has changed either due to deletion or addition or reordering of members in the dataset. The user must keep track of this number.



Buffer Overflow is not supported in Schema 1.4.

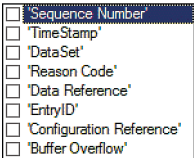


Figure 470: Option Fields For Buffered Report Control Block

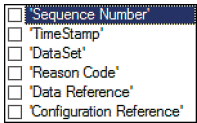


Figure 471: Option Fields For Unbuffered Report Control Block

INTEGRITY and Buffer Time

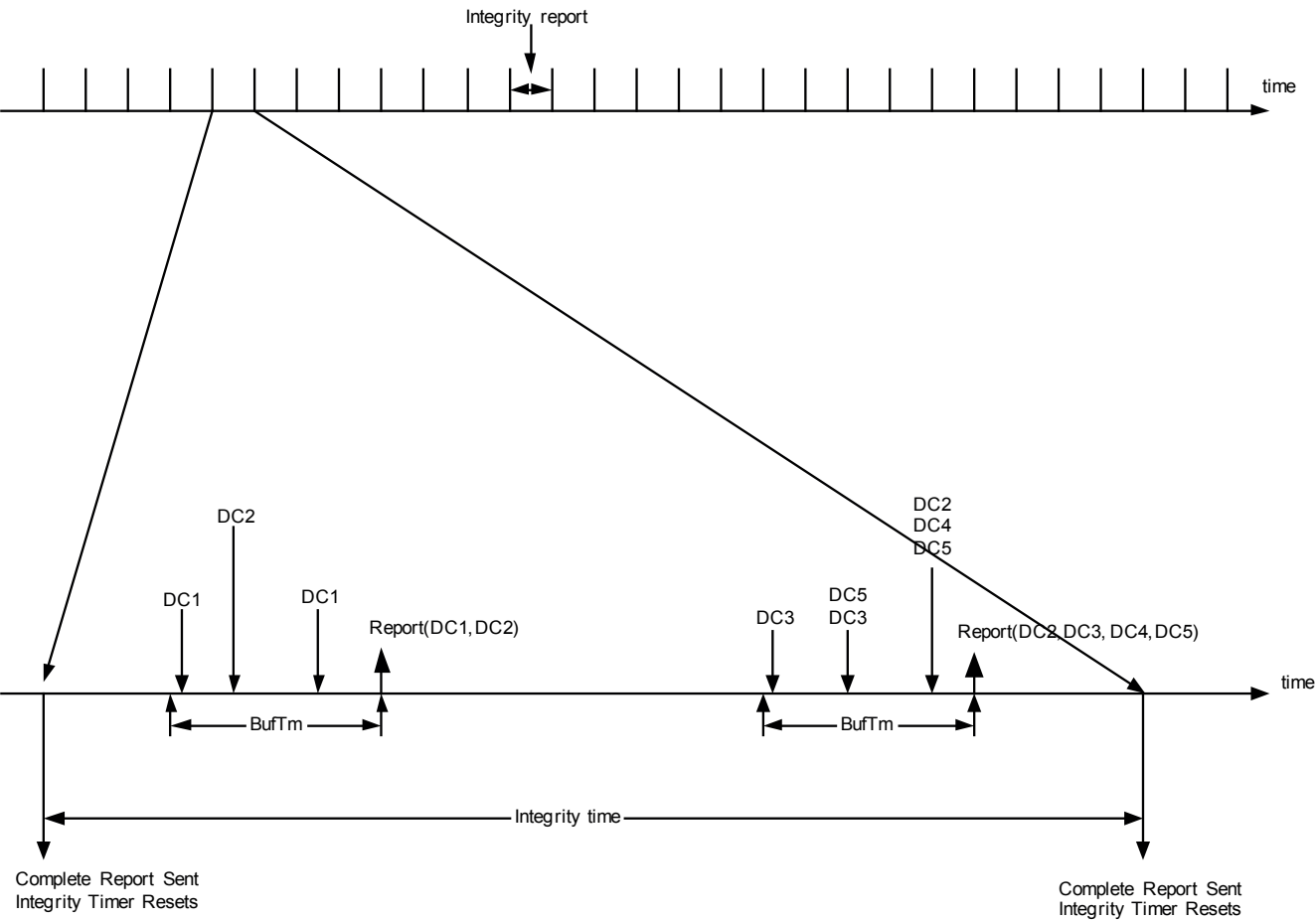


Figure 472: Integrity and Buffer Time

Sequence Number

The Sequence Number is included in the report if the "Sequence Number" bit is set to true. This value is incremented for every report generated. The first report generated as soon as Report Enable is set to true will have the sequence number as zero. The sequence number will rollover to zero at its maximum value.

TimeStamp

A Time Stamp is included in the report if the "TimeStamp" bit is set to true. This parameter tells the time at which the report was generated.

DataSet

Data Set is included in the report if the "DataSet" bit is set to true. The dataset reference shall be included in the report and derived from the member of the dataset.

ReasonCode

A Reason Code is included in the report if the "ReasonCode" bit is set to true. The report will contain the trigger option that is responsible for generation of the report.

DataReference

Data Reference is included in the report if the "DataReference" bit is set to true. It shall contain the Functional Constraint Data (FCD) of the data attribute values included in the report.

EntryID

An Entry ID is included in the report if the "EntryID" bit is set to true. This parameter represents OCTET string which is used to identify the sequence of events in a buffered report control block.

Configuration Revision

It is included in the report if the "Configuration Revision" bit is set to true. This parameter shall contain the corresponding attribute ConfRev of the referenced BRCB.

Buffer Overflow

The Buffer Overflow is included in the report if the "Buffer Overflow" bit is set to true. It indicates to the client that a buffer overflow has occurred. The buffered report control block will set this bit in the first report after the events that occurred after the overflow. The second report will have it set to zero again.

GOOSE (Generic Object Oriented Substation Events)

GOOSE data is directly transmitted on a publisher - subscriber mechanism bases on multicast MAC addresses. Since it is a connectionless network layer protocol, in order to guarantee message delivery, a retransmission scheme is employed.

GOOSE Message Retransmission Timing After Initial GOOSE Message

1. Retransmit after 2 ms with TAL = 2
2. Retransmit after 4 ms with TAL = 4
3. Retransmit after 8 ms with TAL = 8

4. Retransmit after 16 ms with TAL = 16
5. Retransmit after 32 ms with TAL = 32
6. Retransmit after 64 ms with TAL = 64

And so on until a maximum of 65535/2 ms after which it repeats at a fixed interval of 32765 ms.

GOOSE Publisher

The user can configure up to 5 generic goose control blocks. All the GOOSE publishers should have the different mac addresses. The user can select a total of 16 data attributes for each dataset referenced in the goose control block. The Trigger options can be periodic or data change or both.

The user can also select the trigger options for any member in the dataset. The available periodic change for which the goose can be generated is 250 ms - 5000000 ms.

GOOSE Subscriber

The user can configure up to 2 generic goose control blocks. All the GOOSE subscribers should have different mac addresses. The user can select a total of 255 data attributes for each dataset referenced in the goose control block. In the 255 attributes one has to be a command. The list of commands supported include:

- Operation Counter Reset
- Drag Hands Reset
- Block Auto Via Comm
- Voltage Reduction 1
- Voltage Reduction 2
- Voltage Reduction 3
- Tap Position
- Tap Change
- Clear Motor Seal-In Alarm
- Clear Master Follower LockOut Alarm

The user publishing the goose message should configure the appropriate command and its appropriate position in the dataset and configure the remaining data attributes GsSubscOfs (Offset) in the dataset referenced in the goose subscription control block.

GOOSE Parameters (Publisher/Subscriber)

DSRef

Contains the object reference of the members of the dataset whose members of the dataset will be transmitted.

CBRef

Contains the reference of the goose control block.

GoID

Contains the identifier of the logical device in which the goose control block is located.

CfgRev

Contains the count of the number of times that the configuration in the dataset has changed either due to deletion or addition or reordering of members in the dataset.

AppID

The Application Identifier (APPID) is used to select ISO/IEC 8802-3 frames containing sampled value messages and to distinguish the application association. Since the TCC300 does not publish or subscribe to sample value, the value of AppID is limited to 0-0x3FFF.

Validation

The configurator validates against Schema 1.4 or Schema 3.0. The Schema drop down menu allows the user to select either Schema 1.4 and 3.0. Each file saved is validated against the appropriate Schema.

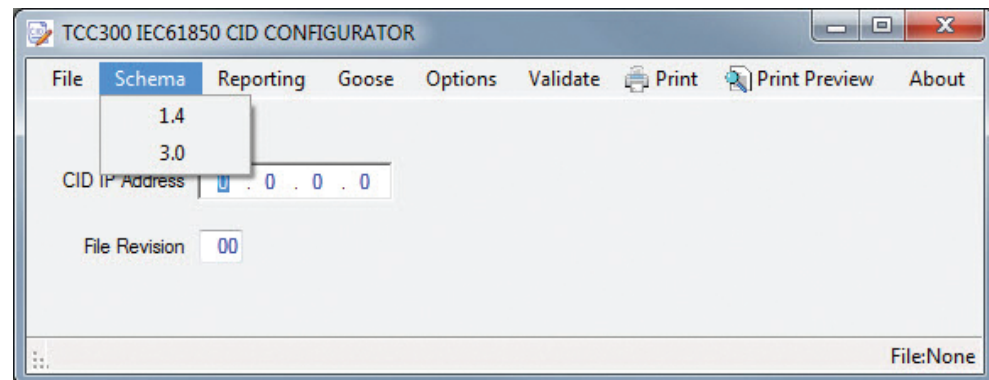


Figure 473: IEC 61850 Configuration Editor Schema Selection Dialog Screen

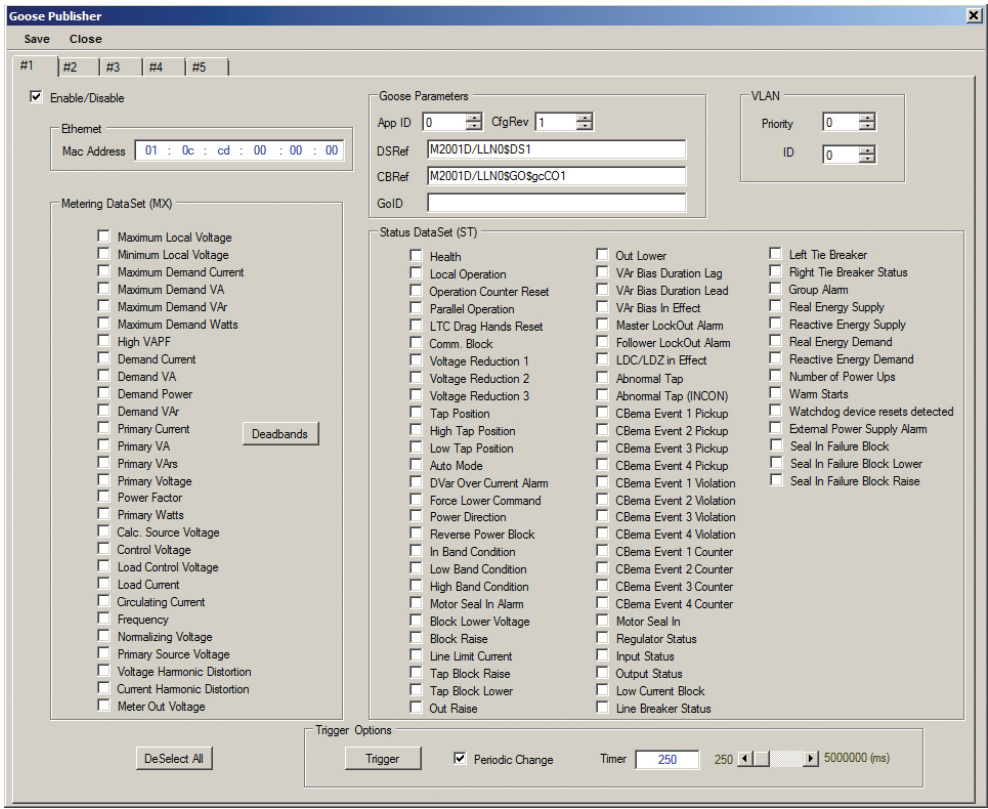


Figure 474: IEC 61850 Configuration Editor GOOSE Publisher Dialog Screen

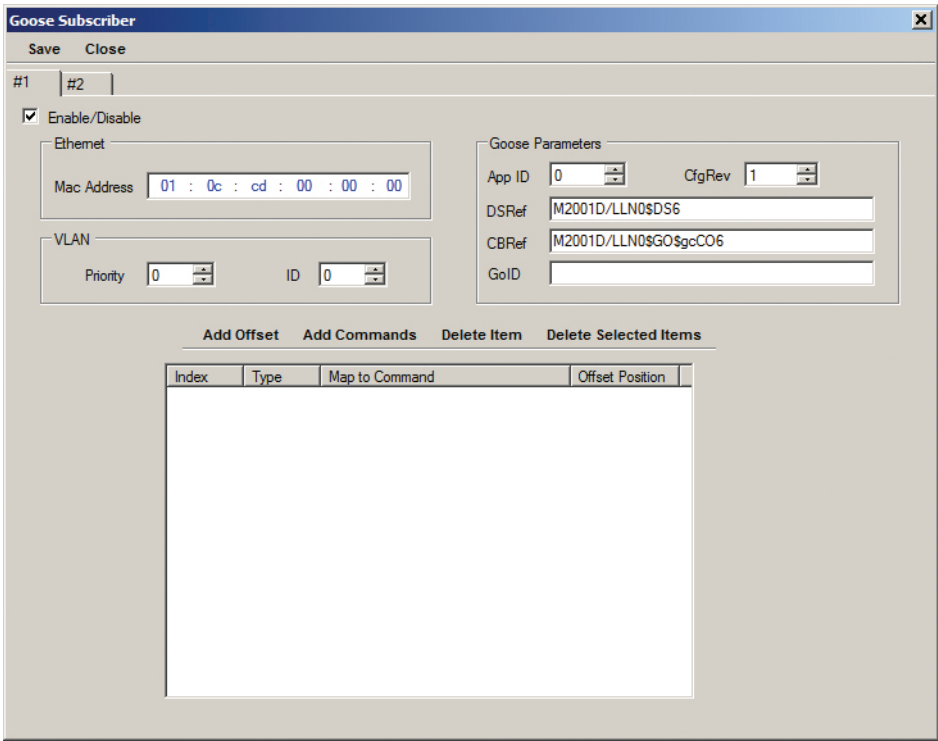


Figure 475: IEC 61850 Configuration Editor GOOSE Subscriber Dialog Screen

The "Validate" selection on the IEC 61850 Configuration Editor Dialog Screen will validate any CID file against Schema 1.4 or Schema 3.0.

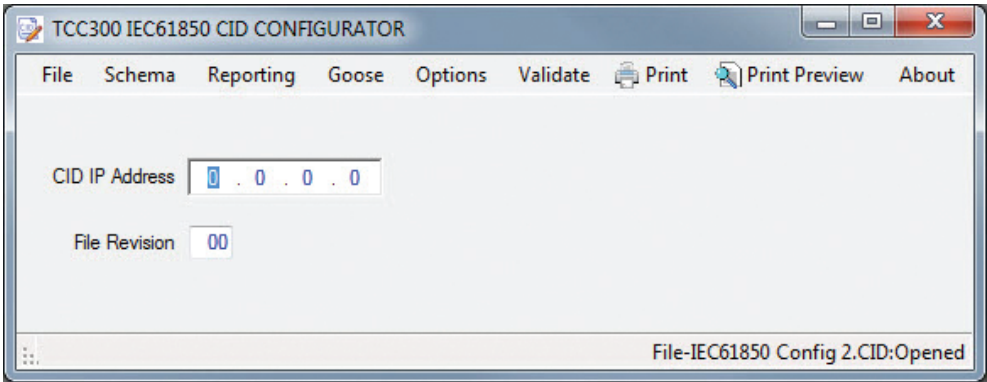


Figure 476: IEC 61850 Configuration Editor Dialog Screen

Section 14 Appendix E Self-test error codes

14.1 Self-test error codes

Table 72: *Error codes*

Error code	Description
8100 ERROR_EE_WR_BYTE	This code is displayed when: <ul style="list-style-type: none"> Writing to EEPROM takes more than 10 ms OS failed to lock eeprom_semaphore No ack from eeprom while it's being accessed
8101 ERROR_EE_WR_WORD	This code is displayed when: <ul style="list-style-type: none"> Writing to EEPROM takes more than 10 ms No ack from eeprom while it's being accessed
8102 ERROR_EE_WR_LONG	This code is displayed when: <ul style="list-style-type: none"> Writing to EEPROM takes more than 10 ms No ack from eeprom while it's being accessed
8103 ERROR_EE_RD_BYTE	This code is displayed when: <ul style="list-style-type: none"> No ack from eeprom while it's being accessed
8104 ERROR_EE_RD_WORD	This code is displayed when: <ul style="list-style-type: none"> No ack from eeprom while it's being accessed
8105 ERROR_EE_RD_LONG	This code is displayed when: <ul style="list-style-type: none"> No ack from eeprom while it's being accessed
8106 ERROR_EE_WR_OUT_OF_MEM	Error code indicates that the buffer used for temporary storage of the eeprom data before it is actually written is full.
8107 ERROR_EE_WR_MSG_CREATE	Error code indicates that eeprom write command message creation has failed (possibly too many writes were done prior to it and buffer got full).
8108 ERROR_EE_WR_PAGE	This code is displayed when: <ul style="list-style-type: none"> Page Writing to EEPROM takes more than 10 ms No ack from eeprom while it's being accessed
Table continues on next page	

Error code	Description
8109 ERROR_EE_RD_PAGE	This code is displayed when: <ul style="list-style-type: none"> No ack from eeprom while it's being accessed
8198 ERROR_VREF	Reference voltage error
2200 ERROR_SDCARD_SPI_TIMEOUT	Error code indicates that OS has failed to lock the spi semaphore.
2300 ERROR_DAT_REC_CURRUPT	Error code indicates that data logging record is corrupted (this error code appears when data log records are being retrieved via communication or being saved to sd card).
2301 ERROR_DAT_REC_STORE	Error code indicates that verification of data log record stored in flash has failed.
2302 ERROR_DAT_REC_BUFF_OVERFLOW	Error code indicates that temporary data log buffer allocated in ram is full and no more records can be saved.
2351 ERROR_SOE_REC_STORE	Error code indicates that verification of SOE record stored in flash has failed.
2352 ERROR_SOE_REC_SIZE_UNDEF	Error code indicates that number of SOE events per flash page is not defined (error appears immediately during boot up process if code is not properly configured).
2353 ERROR_SOE_TEMP_REC_ERROR	SOE temp buffer is not big enough (error appears immediately during boot up process if code is not properly configured).
2354 ERROR_SOE_REC_PER_PAGE_ERROR	Incorrect number of SOE events per flash page (error appears immediately during boot up process if code is not properly configured).
2355 ERROR_SOE_REC_SIZE_ERROR	Not enough space to store temp SOE events in one page (error appears immediately during boot up process if code is not properly configured).
2356 ERROR_SOE_TOTAL_LEN_ERROR	Not enough space to store all the events in the flash section allocated for SOE storage (error appears immediately during boot up process if code is not properly configured).
2401 ERROR_FLASH_WRONG_PG_SIZE	Flash page size in the configuration table is not valid (error appears immediately during boot up process if code is not properly configured).
2402 ERROR_FLASH_ACCESS_TIMEOUT	The response for get flash id command was never received (error appears immediately during boot up process if code is not properly configured).
2403 ERROR_FLASH_CFG_MISSING	Flash chip installed on the board is not supported in configuration table (error appears immediately during boot up process if code is not properly configured).
2404 ERROR_FLASH_WRONG_CFG_FLG	Flash configuration flag is not valid (error appears immediately during boot up process if code is not properly configured).
Table continues on next page	

Error code	Description
2405 ERROR_FLASH_SECTION_MISSING	The requested flash section ID is not defined in the configuration table (error appears immediately during boot up process if code is not properly configured).
2406 ERROR_FLASH_SECTION_RANGE	The requested read/write address in particular section of flash is exceeding the section's size.
2407 ERROR_FLASH_SECTION_OUT_OF_MEM	Not enough space for particular section in the flash configuration table (error appears immediately during boot up process if code is not properly configured).
2408 ERROR_FLASH_CONFIG	Error occurs during firmware update if the program flash is not set to 1024 bytes.
2409 ERROR_FLASH_OUT_OF_MEMORY	Error occurs during firmware update if there is not enough space in RAM for firmware storage.
2500 ERROR_FFS_OUT_OF_MEM_INIT	There is not enough space in flash file system table to hold particular file (error appears immediately during boot up process if code is not properly configured).
2501 ERROR_RECEIVE_FAILED	Error occurs during firmware update if received firmware file doesn't pass certain checks (file length, crc error).
2502 ERROR_PROGRAM_FLASH	Error occurs during firmware update if verification of programmed flash fails.
2503 ERROR_ACCESSING_FLASH	Error occurs if during the firmware update flash memory was accessed by another process.
2600 ERROR_TERM_FLASH_BUFF_ERR	Error occurs in the terminal mode if the allocated temp ram buffer can't fit one page of flash memory.
2700 ERROR_XML_SP_OUT_OF_MEM	Error occurs during setpoint file or password file xml parsing if there is not enough space in ram for parser.
2710 ERROR_TAP_STAT_SIZE	Tap statistic structure has incorrect size.
2800 ERROR_XML_DNPCFG_OUT_OF_MEM	Error occurs during dnp config file xml parsing if there is not enough space in ram for parser.
9020 ERROR_UNAUTH_PROG_FL_ACCESS 9000	Error occurs if unauthorized read/write access from/to program flash memory is detected (during normal operation).

Section 15 Appendix F Remote Ethernet file update utility

15.1 Remote Ethernet file update (REFU) utility

The REFU Utility is a stand alone PC application. The REFU Utility utilizes a file transfer algorithm that ABB has implemented in the TCC300 firmware for transferring such files as DNP device map files. The REFU Utility is capable of operation behind any secure firewall or within any IT security policy imposed by a local administrator.



Figure 477: Remote Ethernet File Update Utility Program Icon

15.2 Remote Ethernet firmware update

The Remote Ethernet Firmware Update element of the Remote Ethernet File Update (REFU) Utility application allows the user to remotely update one or more control's firmware to a new version, utilizing an ethernet connection.

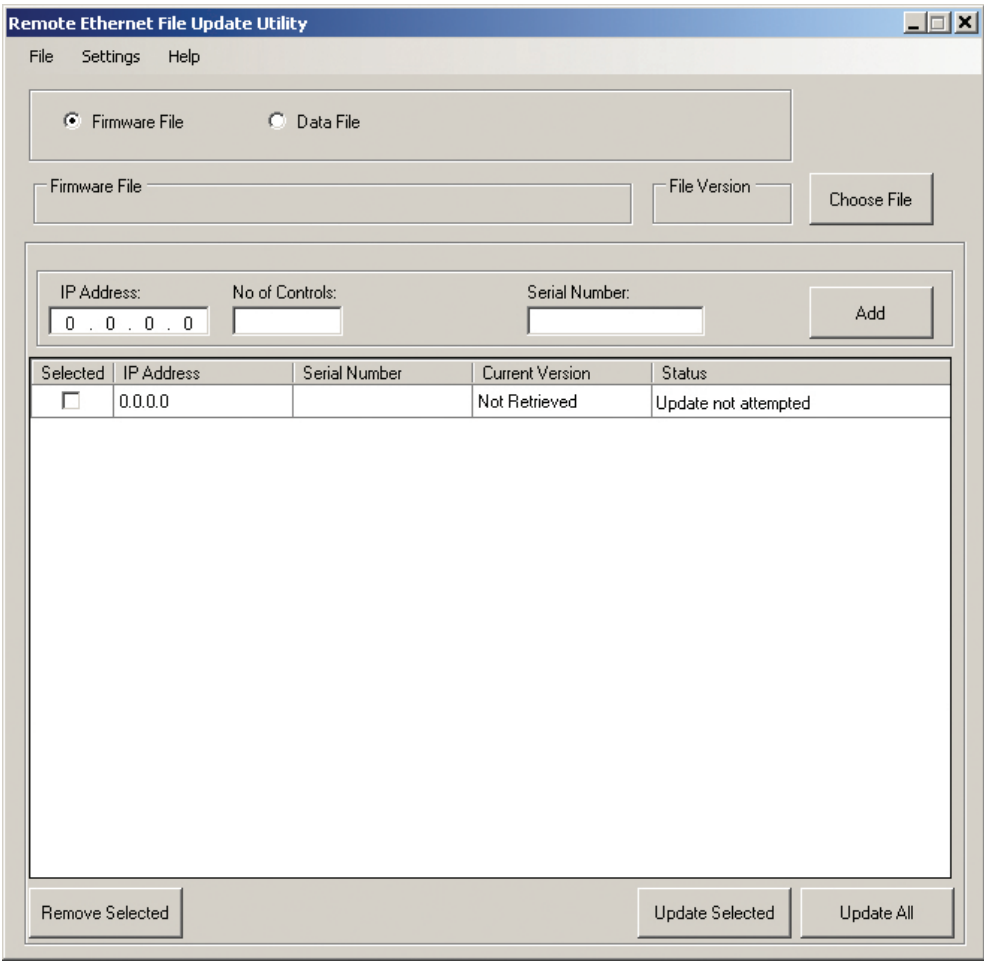


Figure 478: Remote Ethernet File Update Utility Program Icon

15.3 Remote Ethernet file update and cyber security

To comply with Cyber security requirements, the REFU Utility will prompt for a password when launched. The default password is "BecoUpdate". This password is user settable (alphanumeric and special characters) upon launching the program for the first time and can also be changed from the **File/Password** menu.

Due to the sensitive nature of this utility, it is highly recommended not to distribute this application to unauthorized users. Therefore, this application will not be available for download from the ABB website. Furthermore, it is only available upon written request from authorized personnel.

The Remote Ethernet Firmware Update application utilizes a special firmware update file created by ABB that contains both the firmware version number in encrypted form and the regular firmware file with the ".bot" extension and a version filter (optional). The firmware update file format has an extension of ".upd". If the version filter is not included, the application will not perform a version check prior to sending the firmware to the control.

Additional features that apply to both Firmware and Data File modes:

- The user can select for each control, which file(s) to be updated by selecting the appropriate check boxes.
- The utility can automatically generate consecutive IP Addresses, given a start IP Address and the number of controls in that IP Address range. It is important to note that the serial number verification by the utility is not performed when this feature is used.

15.4

Updating Ethernet firmware remotely



These instructions describe the steps necessary to accomplish a remote firmware update utilizing the user interface provided by the Remote Ethernet File Update Utility. The actual dialog between the REFU Utility and the Control is described in detail in the Firmware Update Sequence section of this Appendix.

To remotely update the firmware of a control or a series of controls on an ethernet network proceed as follows:

1. Verify that the following conditions exist:
 - The Remote Ethernet File Update (REFU) Utility is installed and running on a PC with access to the target ethernet network.
 - A ".upd" file created by ABB that contains the firmware to be updated is available.
2. Launch the Remote Ethernet File Update (REFU) Utility. The REFU dialog screen will be displayed.

Remote Ethernet File Update Utility

File Settings Help

☒ Firmware File ☐ Data File

Firmware File File Version Choose File

IP Address: No of Controls: Serial Number: Add

Selected	IP Address	Serial Number	Current Version	Status
<input type="checkbox"/>	0.0.0.0		Not Retrieved	Update not attempted

Remove Selected Update Selected Update All

Figure 479: Remote Ethernet File Update Utility (Firmware File) Dialog Screen

3. Select "Firmware File".
 4. Select "Choose File". The utility will prompt for the desired ".upd" file and location.
 5. Select the ".upd" file. The utility will:
 - Populate the "Firmware File" field with the path/file name
 - Open the selected file and retrieve and decrypt the version information and populate the "File Version" field with the firmware version
 6. Enter the IP Address and the Serial Number of the control to be updated.
 7. Select "Add". The information will be added to the list of controls to be updated. Repeat Step 6 for any other controls to be updated.
- The user can create a list of controls that will have their firmware updated. This list can be saved if desired and can be retrieved for use at a later date. The list of controls and their associated information (except for the "Update to Version") is stored in an encrypted format.

8. From the Settings dropdown menu select the number of "Retries" to be attempted if there is any failure to update the firmware on any control.
The maximum number of retries is 10. The default number of retries is 3. The range is from 0 to 10.
9. Select the controls to be updated.
10. Select either "Update Selected" or "Update All" to start the update sequence.
The REFU Utility will start the update sequence for each control. The sequence is described in detail in the Firmware Update Sequence described below.

Firmware Update Sequence Summary

1. The REFU Utility opens a TCP connection on port 62000.
2. The REFU Utility initiates the Authentication session by sending an encrypted hash signature.
3. The Control verifies the received encrypted hash string.
4. If the Control can not verify the received encrypted hash string, then the connection is automatically closed by the Control.
5. If the received hash string verification is successful, then the Control goes into the programming mode.
6. The REFU Utility will then query the Control for the firmware version installed on the Control and if selected, the serial number of the Control.
7. The REFU Utility will compare the installed firmware version received from the Control, and if selected, the serial number to the REFU Utility internal serial number and version filter, and continue as follows:
 - If the installed firmware version is found to be a firmware version that does not support remote ethernet firmware update, and/or if selected, the serial number does not match, then after the selected number of attempts have also failed then the REFU Utility will close the connection.
 - If the comparison is successful, then update procedure continues.
8. The REFU Utility starts the file upload to the control.
9. When the file is completely uploaded to the Control, the control will verify the digital signature of the firmware.
10. Based on the results of the verification, the control will proceed as follows:
 - If the digital signature verification is unsuccessful, then the Control will send the appropriate error message to the REFU Utility and terminate the update session.
 - If the digital signature verification is successful, then the programming sequence will continue.
11. Prior to programming the flash, the following steps are taken:

- 11.1. A block of all automatic and remote operations is activated, leaving the Control state unchanged.
- 11.2. All ongoing operations are terminated.
- 11.3. All setpoints and calibration data is backed up into internal data flash memory.



The update process, from erasing the Program Flash to complete reprogramming takes approximately 15 seconds. Any error or loss of power after the flash has been erased will be fatal to the control.

12. The flash programming is initiated as follows:

- 12.1. The entire Program Flash is erased.
- 12.2. The new firmware is burned into the program flash.

If for any reason the erasing or programming of the Program Flash is unsuccessful, then the Control will terminate the update process and return to normal program execution without rebooting.

The Control will also notify the REFU Utility by sending the appropriate error message when queried. This type of error can result in the Program Flash not being completely programmed. Therefore, the user should retry to update the firmware again. A power loss in this condition will result in the Control not being able to reboot properly.

13. When the burning of the firmware into the program flash has been completed, the Control will Reboot.
14. When the Control has completed the reboot process, the Control will commence normal operation subject to the previously saved setpoints and calibration data.
15. After the Control has completed its rebooting process the REFU Utility will reopen a TCP connection on port 62000 and query for the firmware version number.
16. If the queried version number does not match the programmed version number, the REFU Utility application will notify the user of the status of the process and allow the user to repeat the update if desired.
17. If the queried version number matches the programmed version number, the programming process has been successful.

15.5 Updating data file remotely

To remotely update selected data files of a control or a series of controls on an ethernet network proceed as follows:

1. Verify that the following conditions exist:

- The Remote Ethernet File Update (REFU) Utility is installed and running on a PC with access to the target ethernet network.
- The desired "DNP Configuration" file is available.



"User Access" and "IPsec Policy" files are not supported at this time.

2. Launch the Remote Ethernet File Update (REFU) Utility. The REFU dialog screen will be displayed.

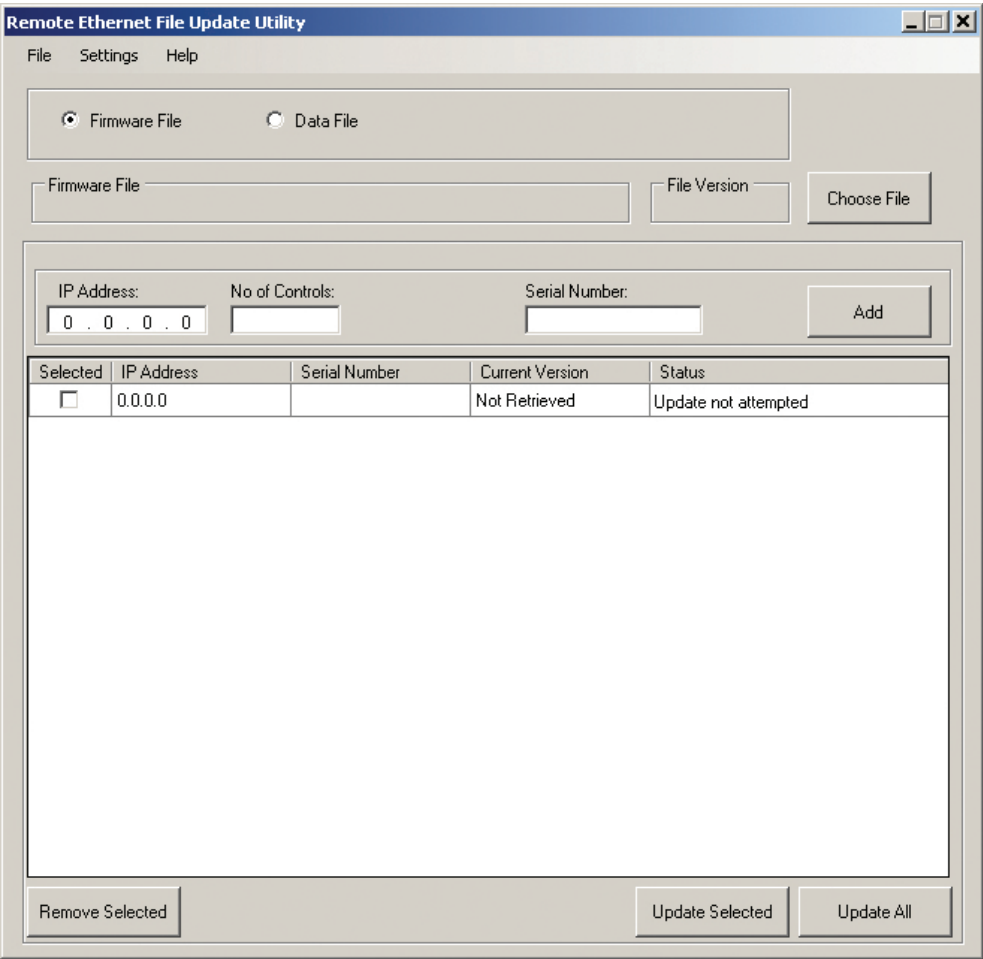


Figure 480: Remote Ethernet File Update Utility (Firmware File) Dialog Screen

3. Select "Data File". The REFU Data File dialog screen will be displayed.

Selected User Access	Selected IPsec	Selected DNP	IP Address	Serial Number	Status UA	Status IPsec	Status DNP
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0.0.0.0		Update not attempted	Update not attempted	Update not attempted

Figure 481: Remote Ethernet File Update Utility (Data File) Dialog Screen

4. Select "Choose File" for the file(s) to be updated. The utility will prompt for the desired file location and file name.
5. Select the desired file. The utility will populate the "DNP Configuration" field with the path/file name.
6. Enter the IP Address and the Serial Number of the control to be updated.
7. Select "Add". The information will be added to the list of controls to be updated. Repeat Step 6 for any other controls to be updated.
The user can create a list of controls that will have their data files updated. This list can be saved if desired and can be retrieved for use at a later date. The list of controls and their associated information (except for the "Update to Version") is stored in an encrypted format.
8. From the Settings dropdown menu select the number of "Retries" to be attempted if there is any failure to update the data files on any control.
The maximum number of retries is 10. The default number of retries is 3. The range is from 0 to 10.
9. Select the controls to be updated.
10. Select the desired file types to be updated on each individual control.
11. Select either "Update Selected" or "Update All" to start the update sequence.

The REFU Utility will start the update sequence for each control. The sequence is described in detail in the File Update Sequence described below.

File Update Sequence Summary

1. The REFU Utility opens a TCP connection on port 62000.
2. The authentication sequence is started with the control. The authentication sequence is similar to the firmware update authentication.
 - If the authentication sequence fails, then the connection is automatically closed by the Control.
 - If the authentication sequence is successful, then the Control starts the update procedure.
3. The REFU Utility starts the file upload.
4. File transfer is complete.

Section 16 Glossary

ANSI	American National Standards Institute
CID	Configured IED description
COMTRADE	Common format for transient data exchange for power systems. Defined by the IEEE Standard.
EMC	Electromagnetic compatibility
HMI	Human-machine interface
IEC 61850	International standard for substation communication and modeling
LTC	1. Local time clock 2. Load tap changer
SCADA	Supervision, control and data acquisition
SD	Secure digital



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