PRODUCT GUIDE

TCC300M2067 Adapter Panel

Digital tapchanger control for power transformers and regulators

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TCC300M2067
Adapter panel

1. Introduction
The ABB TCC300M2067 Adapter Panel, used in conjunction with the TCC300 Tapchanger Control, uses modern electronic digital design and digital processing circuitry to achieve an overall stability and resolution unattainable with electromechanical and analog design tapchanger controls. CMOS semiconductors are used throughout the design.

1.1 Description
The TCC300M2067 Adapter Panel, with the TCC300 Tapchanger Control, provides a solid-state voltage control relay intended for applications involving the control of tapchanging transformers and regulators. The combination of the Tapchanger Control and Adapter Panel includes the following features:

- Voltage waveform sampling and digital processing circuitry ensure accurate rms voltage sensing in the presence of distortion on the input voltage and current.
- Control accuracy is ±0.3 % when tested in accordance with the ANSI/IEEE C57.15.9-1999 standard over a temperature range of –30° C to +65° C. The control accuracy is ±0.5 % when tested over the full operational temperature range of –40° C to +85° C.
- Input and output circuits are protected against system transients. Units pass all requirements of ANSI/IEEE C37.90.1-1989, which defines surge withstand capability. 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.
- The Adapter Panel includes a replaceable Voltage Sensing Fuse. A spare fuse is provides in the fuseholder.

2. Aplication

Typical Connections
In general, the tapchanger motor must be operated from a different transformer than the vt used to measure regulated voltage. If this is not done, hunting at the upper band edge may result. As soon as the motor starts and before it is sealed in, the motor current can drop the voltage within the band and reset the control. Some motor seal-in schemes are fast enough to prevent this, but others are not.

A typical connection for an TCC300M2067 is shown in Figures 2 and 3. Connections are simplified and may not show all functions required in a typical load tapchanging transformer control scheme; for example, limit switches, etc.

External connections
Power and voltage sensing are obtained either 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 also be used if recognition is made of any phase shift between the voltage and current signals when using line drop compensation.

Load current must be reduced by an appropriate auxiliary current transformer to 0.2 A "full scale" before connecting to the TCC300M2067 current inputs. The M-0121 (5.0 A to 0.2 A) or M-0169A (5.0 A or 8.66 A to 0.2 A) Auxiliary Current Transformer can be used for this purpose. The M-0121 can be used with ABB Tapchanger Controls when the only burden present is the Line Drop Compensator circuit of the voltage regulating relay. The M-0169A is used in higher burden circuits, such as are found in paralleling schemes. Outputs of the auxiliary CTs are protected against overvoltage. If the Load Current Input must be isolated, then remove the jumper between TB1-2 and TB1-3.

The external connections for the TCC300M2067 are made to terminal blocks TB1 and TB2 on the printed

circuit board at the base of the adapter panel. The wiring harness and external connections for the TCC300M2067 are shown in Figures 2 and 3.

Lightning protection
For proper protection against system surges, chassis ground must be connected to earth ground.

It has been determined that transient voltages in excess of 1500 Vac rms can exist on the "ground" lead normally tied to TB1-3 on the printed circuit board. In the Tapchanger Controls, these voltages are suppressed by varistors which still permit the unit to pass a 1500 Vac Hi Pot test for one minute with a leakage current of approximately 15 mA, all terminals to ground.

Multiple VT grounds far apart must be avoided since a varying difference in ground voltage could add or subtract from the effective voltage and cause variation in the Tapchanger Control's bandcenter voltage setpoint.

Non-sequential operation
The operation of the TCC300M2067 can be interrupted during tapchanger operation by momentarily applying the "wetting" voltage of terminal TB1-13 to TB1-10 (timer reset for non-sequential operation input) through an external contact. This causes the output to de-energize and reinitialize 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.

Caution
Voltage applied through dry contacts to actuate non-sequential input must be nominal +12 Vdc obtained from pin TB1-13 of the TCC300M2067 adapter panel. If an M-0067B analog-version tapchanger control had previously been installed, the wiring harness must be reconfigured since the TCC300M2067 is not a direct pin-to-pin replacement for the analog M-0067B.

Operations counter input

Caution
Do not apply any voltage to this terminal.

An operations count is registered by momentarily grounding TB2-20 through an external dry contact from the load tapchanger. The input is level-sensitive. Make sure that any "wetting" voltages are removed from the counter contacts before installing the TCC300M2067 Adapter Panel/ TCC300 Tapchanger Control.

Multi-Step Voltage Reduction
On the TCC300M2067, TB1-11 and TB1-12 on the printed circuit board are used together to provide up to three levels of voltage reduction. The external connections to achieve these steps are shown in Table 1 and Figures 1 and 2. Voltage reduction amounts are set within the TCC300 Tapchanger Control software.

Table 1. Multi-step voltage reduction external connections

Voltage reduction setpoint: multiplier range	Apply "wetting voltage" from TB1-13 to terminal #
Voltage reduction setpoint #1:0 to 10%	TB1-11
Voltage reduction setpoint #2:0 to 10%	TB1-12
Voltage reduction setpoint #3:0 to 10%	TB1-11 and TB1-12

Caution
Voltage applied through dry contacts to actuate Voltage Reduction Steps 1, 2, and 3 must be nominal +12 Vdc obtained from pin TB1-13 of the TCC300M2067 adapter panel. If an M-0067B analog-version tapchanger control had previously been installed, the wiring harness must be reconfigured since the TCC300M2067 is not a direct pin-to-pin replacement for the analog M-0067B.

Paralleling
See TCC300 Instruction Book, Section 4.9, Parallel Operation.

Operations counter input

Caution
Do not apply either +12 Vdc or 120 Vac to this terminal.

An operations count is registered by momentarily grounding TB1-13 through an external dry contact from the load tapchanger. The input is level-sensitive. Make sure that any "wetting" voltages are removed from the counter contacts before installing the TCC300M2067 Adapter Panel/ TCC300 Tapchanger Control.

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Figure 01. TCC300 and TCC300M2067 typical connections

TCC300 Tapchanger Control software settings
Adjust the BANDCENTER setting to the nominal voltage desired. Adjust the BANDWIDTH setting to the desired voltage band, centered on the Bandcenter setpoint, that the voltage must exceed before timer and subsequent tapchanger operation occurs. Adjust the TIME DELAY setpoint to a sufficient amount to eliminate excessive tapchanger operations. The LINE DROP COMPENSATOR should be set for the line impedance from the transformer to the load center.

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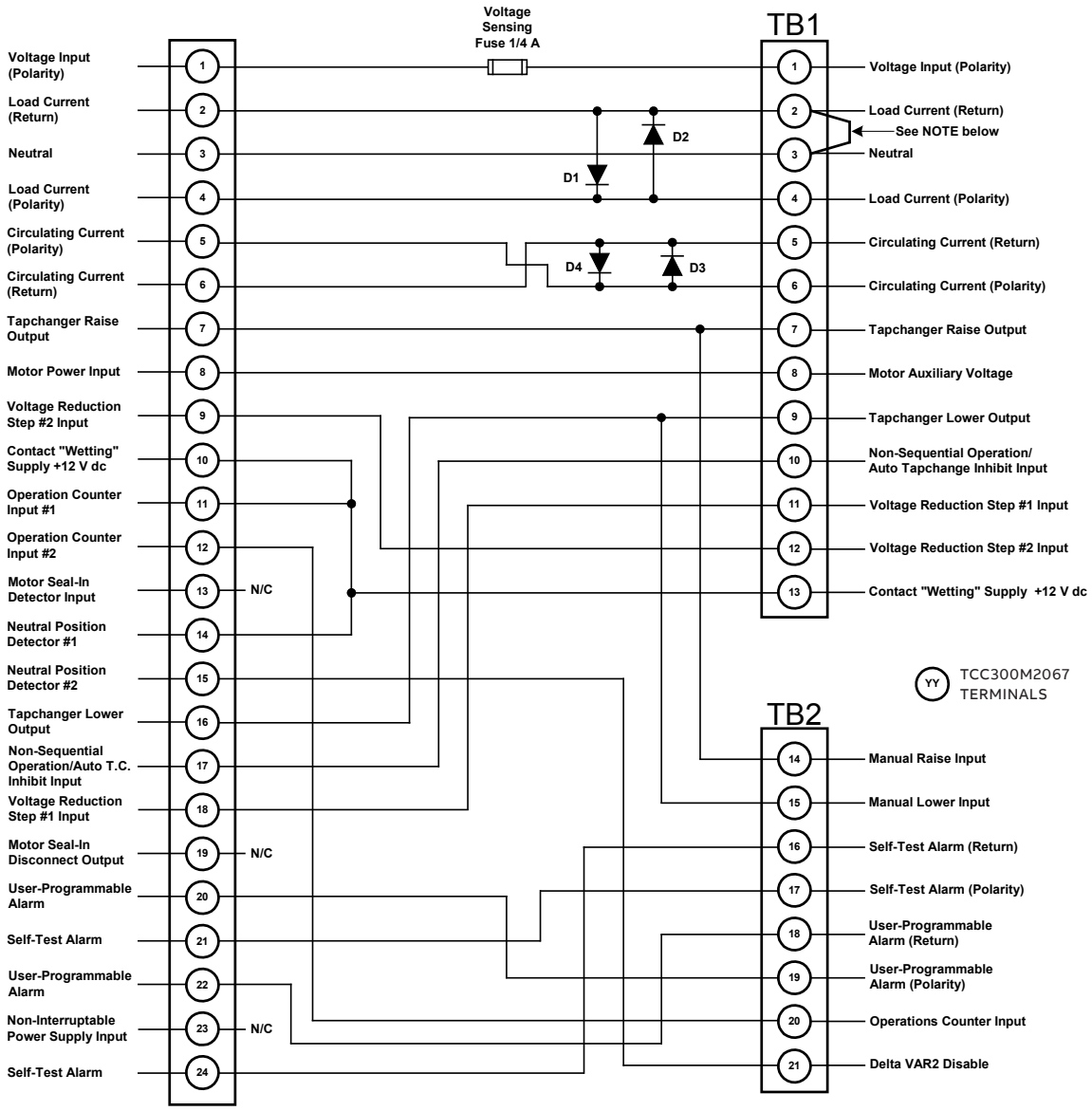

⚠ Warning
In no case should the line current circuit be interrupted with the regulator or transformer energized. Do not remove auxiliary current transformers without shorting the current inputs. Death or severe electrical shock can occur.

Note
To isolate the load current, remove the jumper from between TB1-2 to TB1-3.

Figure 02. External connections

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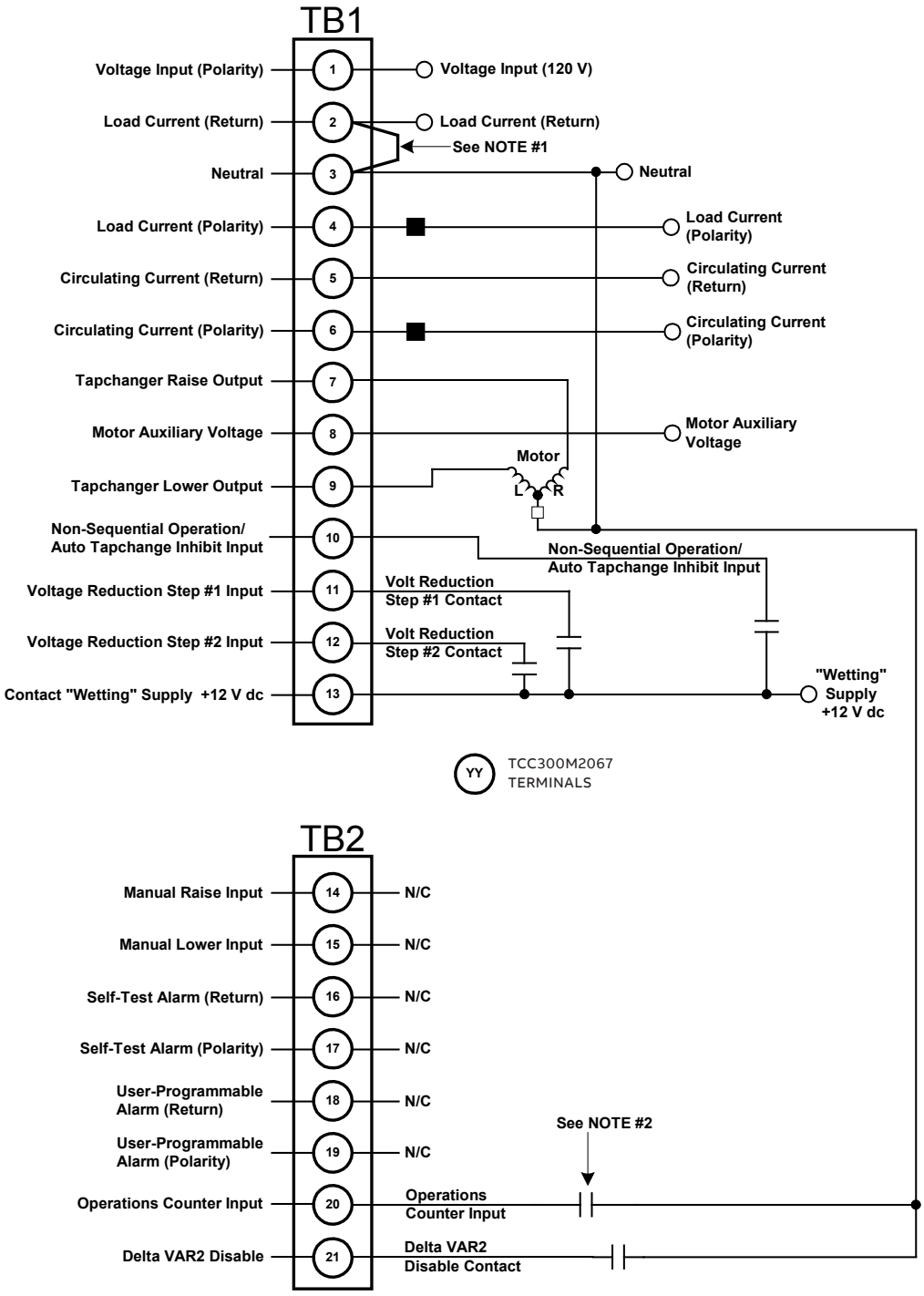

⚠ Warning

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.

Note

1. To isolate the load current, remove the jumper from between TB1-2 to TB1-3.
2. For counter operation, connect TB2-20 to Neutral TB1-3 through an external dry contact.

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Figure 03. TCC300M2067 Wiring Harness and External Connections

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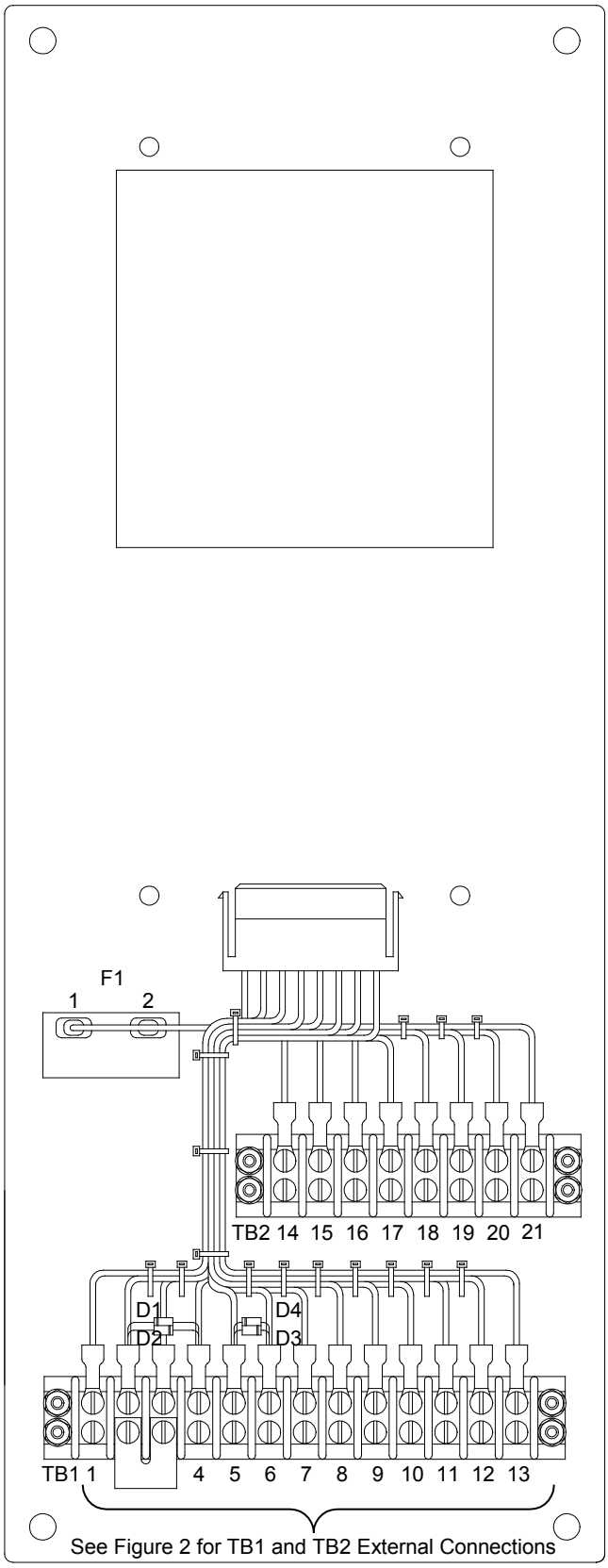

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Figure 04. Tapchanger control and LTC backup control interconnections

Use of the M-0329B LTC Backup Control with the Tapchanger 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.

The M-0329B LTC Backup Control is connected as a two terminal device to the voltage transformer. Figure 4 shows the typical interconnection of the two devices with motor auxiliary relays.

Note
The M-0329B Instruction Book is available on request and gives added details. Please refer to the M-0329B Instruction Book for complete ordering information.

M-0329B LTC Backup Control Settings
The BANDCENTER and BANDWIDTH dials on the M-0329B LTC Backup Control should be set so that the Block Lower limit is a small amount (approximately 2 V) below the lower band limit of the Tapchanger Control, and the Block Raise limit is a similar amount above the upper limit if line drop compensation is not used.

If line drop compensation is used, the M-0329B Block Raise limit should be set at the maximum voltage desired at the transformer secondary under full load.

The M-0329B LTC Backup Control also includes a deadband or runback function that regulates the maximum voltage from the transformer. This "Lower" function operates slightly above the Block Raise limit and is connected to force the tapchanger to lower the voltage if the upper limit is exceeded.

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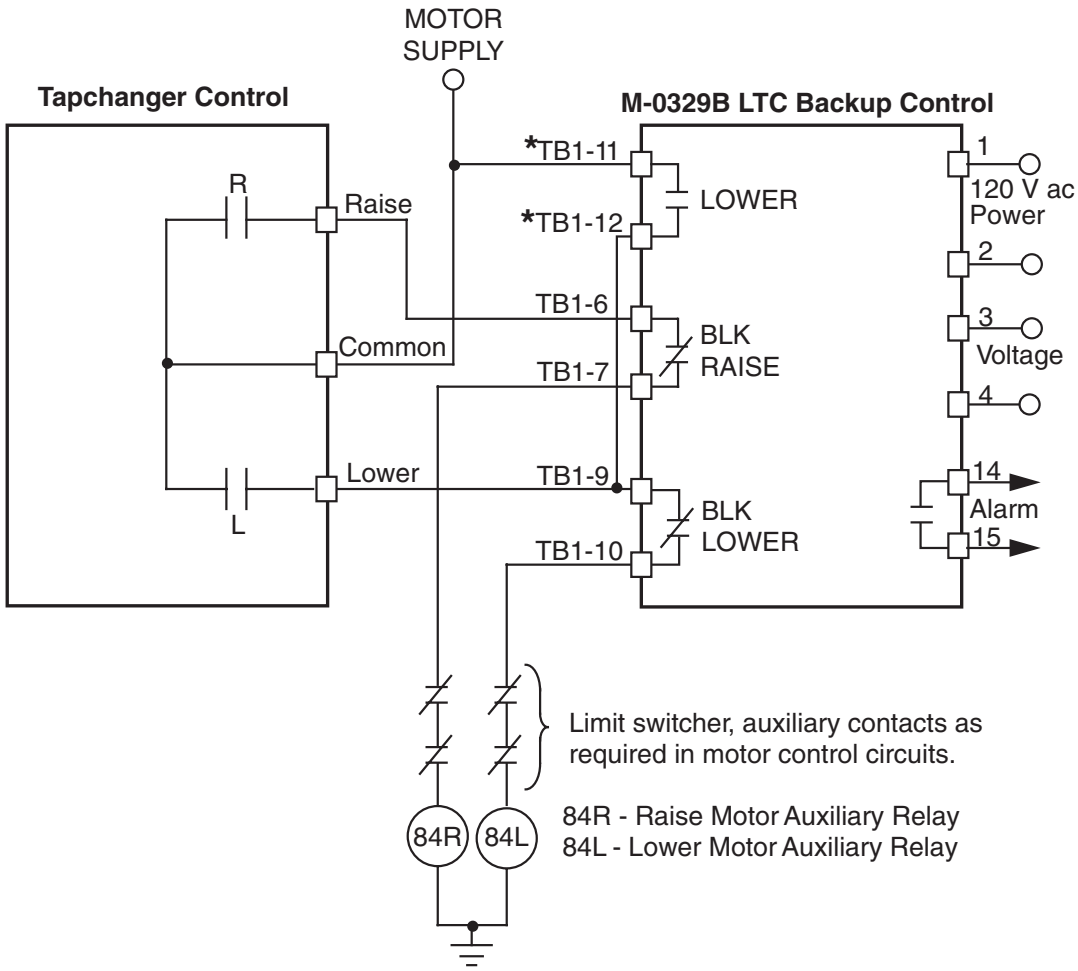
04



Note
If first customer protection is not required, delete these connections.

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Figure 05. TCC300 harness connector

Figure 06. TCC300 v-notch orientation

Figure 07. TCC300M2067 wire terminations for external connections as required for ul listing

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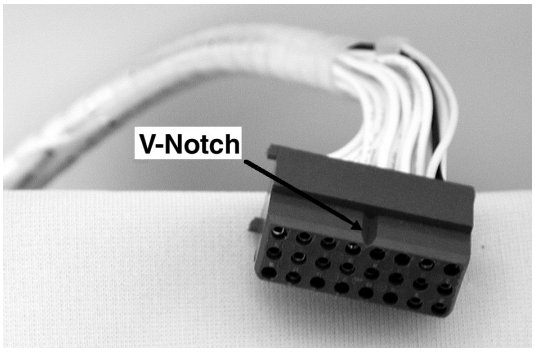
05



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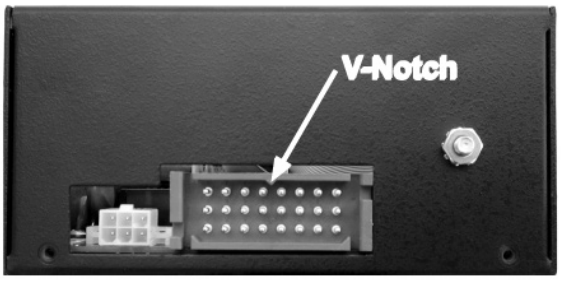

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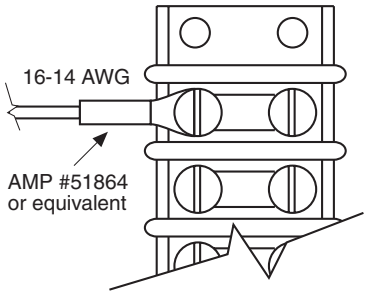


Recommended Wire Terminations

Tighten to 8 inch-pounds

3. Installation

The TCC300M2067 is a general purpose adapter panel that is designed for mounting in a 5-7/8" x 15-1/8" panel cutout. Remove the old control from the cabinet. Refer to Figure 8 for outline dimensions; refer to Figure 9 for panel cutout dimensions of the TCC300M2067.

Installing the TCC300M2067/TCC300

1. Mount the TCC300 to the TCC300M2067 Adapter panel by using the hardware provided in the cloth bag. Use the lock washers supplied between the screws and the top of the front panel.

Note

The blue connector is keyed by a "V" notch in the middle to prevent incorrect mating (Figure 5). Check location of the key before plugging connector into the TCC300.

Installation of the TCC300M2067 Adapter Panel

Mount the TCC300M2067 Adapter Panel (with the TCC300 Tapchanger Control) in the control cabinet. External connections are made to the terminal block on the rear of the adapter panel. Figures 1, 2 and 3 show the TCC300M2067 external connections.

UL-approved terminal block connections

The TCC300M2067 Adapter Panel is listed to UL Standards for Safety by Underwriters Laboratories Inc. (UL). To fulfill the UL requirements, terminal block connections must be made as illustrated in the Figure 7.

The wire should be No. 16-14 AWG inserted in an AMP #51864 (or equivalent) connector, and both screws tightened to 8 inch-pounds torque.

Figure 08. Outline dimensions

08

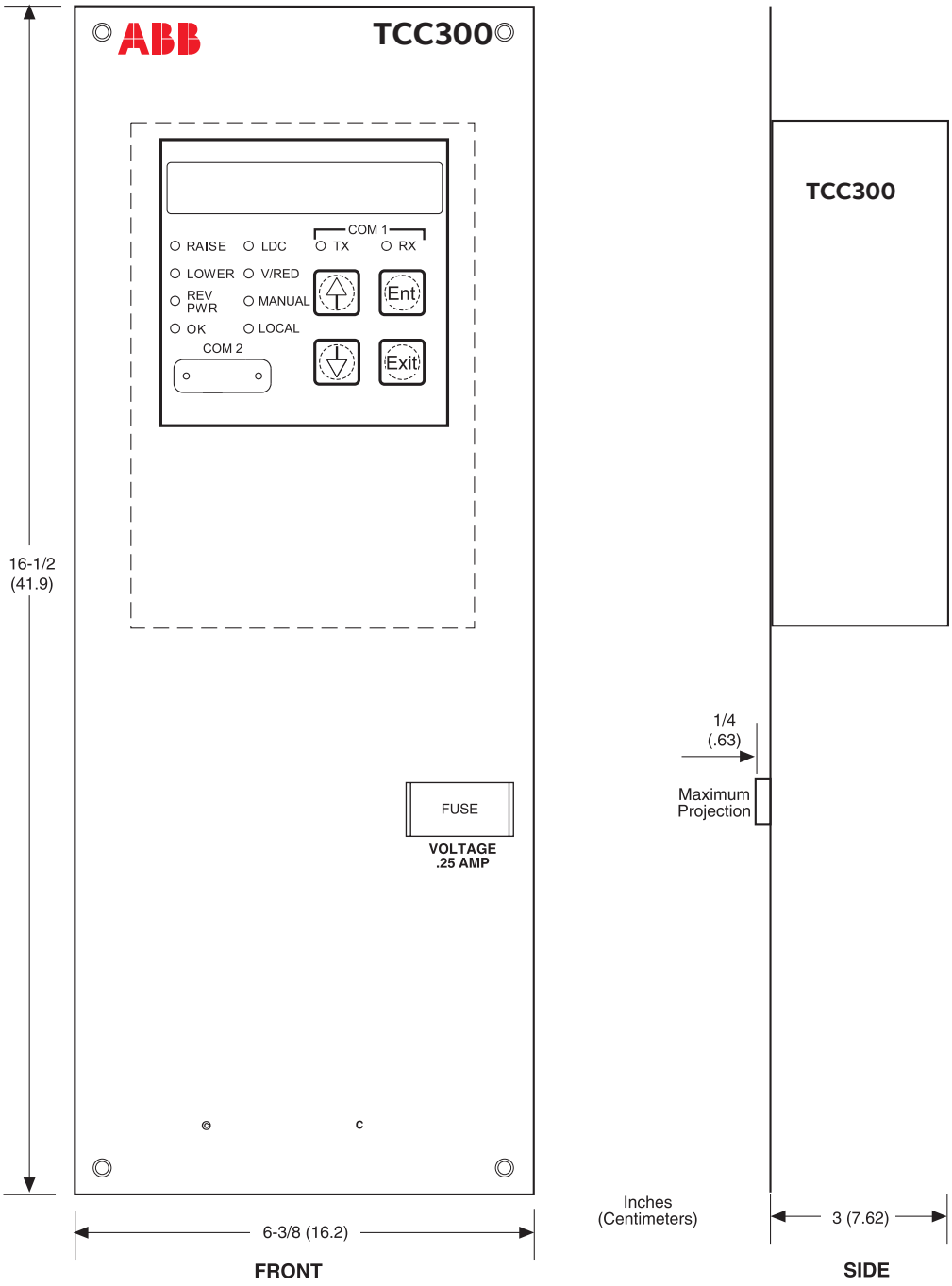
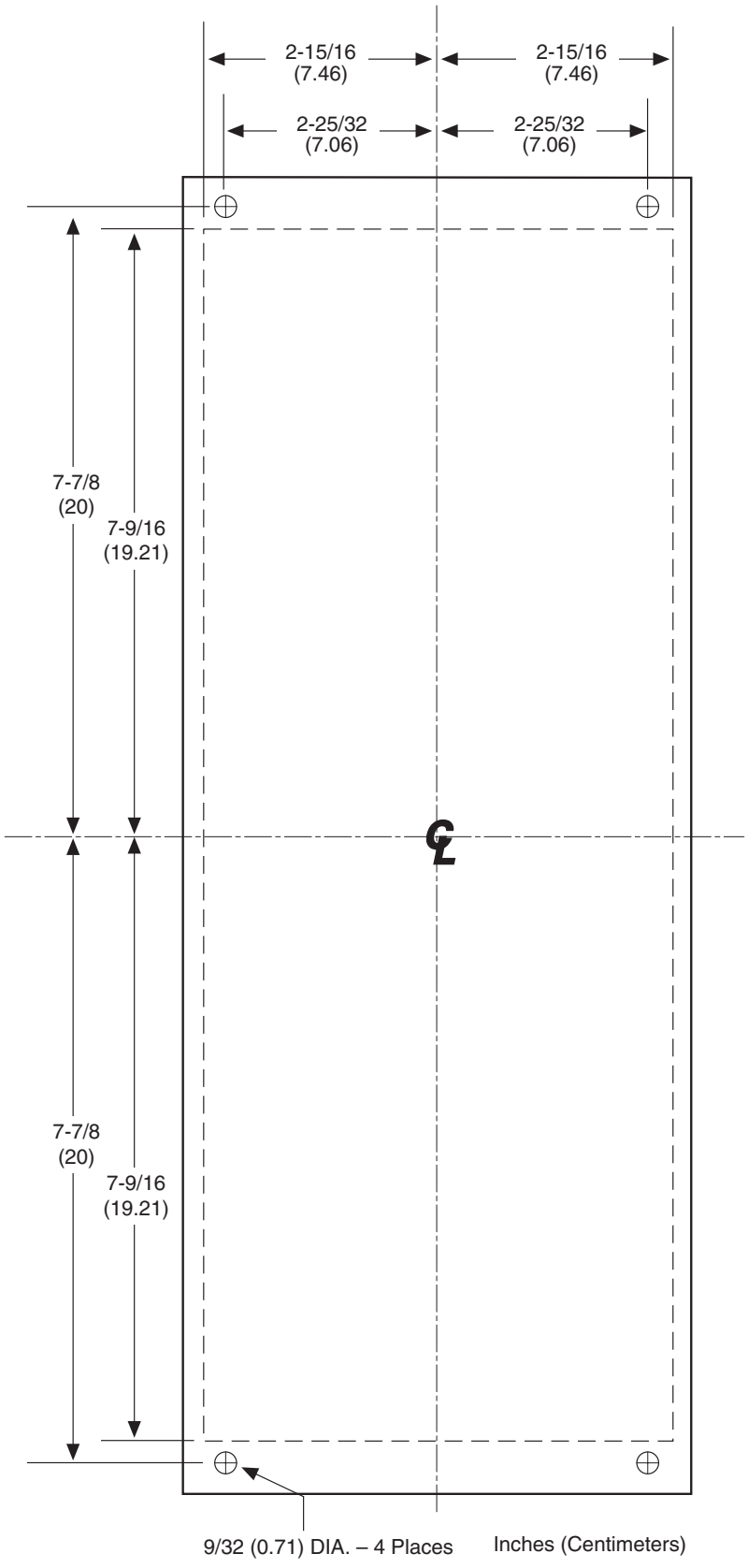


Figure 09. TCC300M2067 panel cutout dimensions

09



4. Bench test (TCC300 Connected to TCC300M2067)

Note
This test assumes that the TCC300 Tapchanger Control is connected to the TCC300M2067 Adapter Panel.

Test equipment
- 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

Setup
1. Make the electrical connections as shown in Figure 10.

Note
Refer to the TCC300 Instruction Book Appendix, Figures A-1 through A-13 for the locations of screens within the software.

Note
There is a one second delay between the out-of-band condition and panel LED indication.

2. Enter initial TCC300 settings:

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Table 2. Initial Settings

Initial settings	
Bandcenter	120.0V
Bandwith	2.0V
LDC resistance	0.0V
LDC reactance	0.0 V
Paralleling	Circuiting current method
Block raise	135.0 V
Block lower	105.0 V
Deadband	2.0 V
Timer	5.0 seconds

Procedure
1. Apply 120.0 Vac from power source.
2. The display of the TCC300 will automatically advance to the **Local Voltage** screen.
3. Increase voltage to 121.2. The **LOWER** LED should illuminate.
4. Decrease voltage to 118.8. The **RAISE** LED should illuminate.
5. Set input voltage to 120.0 Vac. Wait for **RAISE** and **LOWER** LEDs to extinguish.
6. Increase voltage to 122.0 Vac, then start timing when voltage passes 121.0 V.
7. Stop timing when the lamp connected to the **LOWER** output illuminates (should be approximately 5 seconds).

Resistance
1. Apply 100.0 mA in-phase current to TB1-4 (load current-polarity) and TB1-2 (load current-return) of the adapter panel. (Set S1 to LDC and S2 to IL.)
2. Set LDC Resistance to 24.0 V. The **RAISE** LED should illuminate.
3. Increase input voltage to 132.0 Vac. The **RAISE** and **LOWER** LEDs should be extinguished.
4. Set LDC Resistance to –24.0 V. The **LOWER** LED should illuminate.
5. Decrease input voltage to 108.0 Vac. Both **RAISE** and **LOWER** LEDs should extinguish.
6. Set LDC Resistance to 0.0 V.

Reactance
1. Apply 100.0 mA 90° leading current to TB1-4 (load current-polarity) and TB1-2 (load current-return) of the adapter panel.
2. Set S1 to LDC and S2 to IL.
3. Set LDC Reactance to 24.0 V. The **LOWER** LED should illuminate.
4. Decrease input voltage to 108.0 Vac. The **RAISE** and **LOWER** LEDs should be extinguished.
5. Set LDC Reactance to –24.0 V. The **RAISE** LED should illuminate.
6. Increase input voltage to 132.0 Vac. Both **RAISE** and **LOWER** LEDs should be extinguished.
7. Set LDC Reactance to 0.0 V.

Figure 10. TCC300M2067 test procedure external connection

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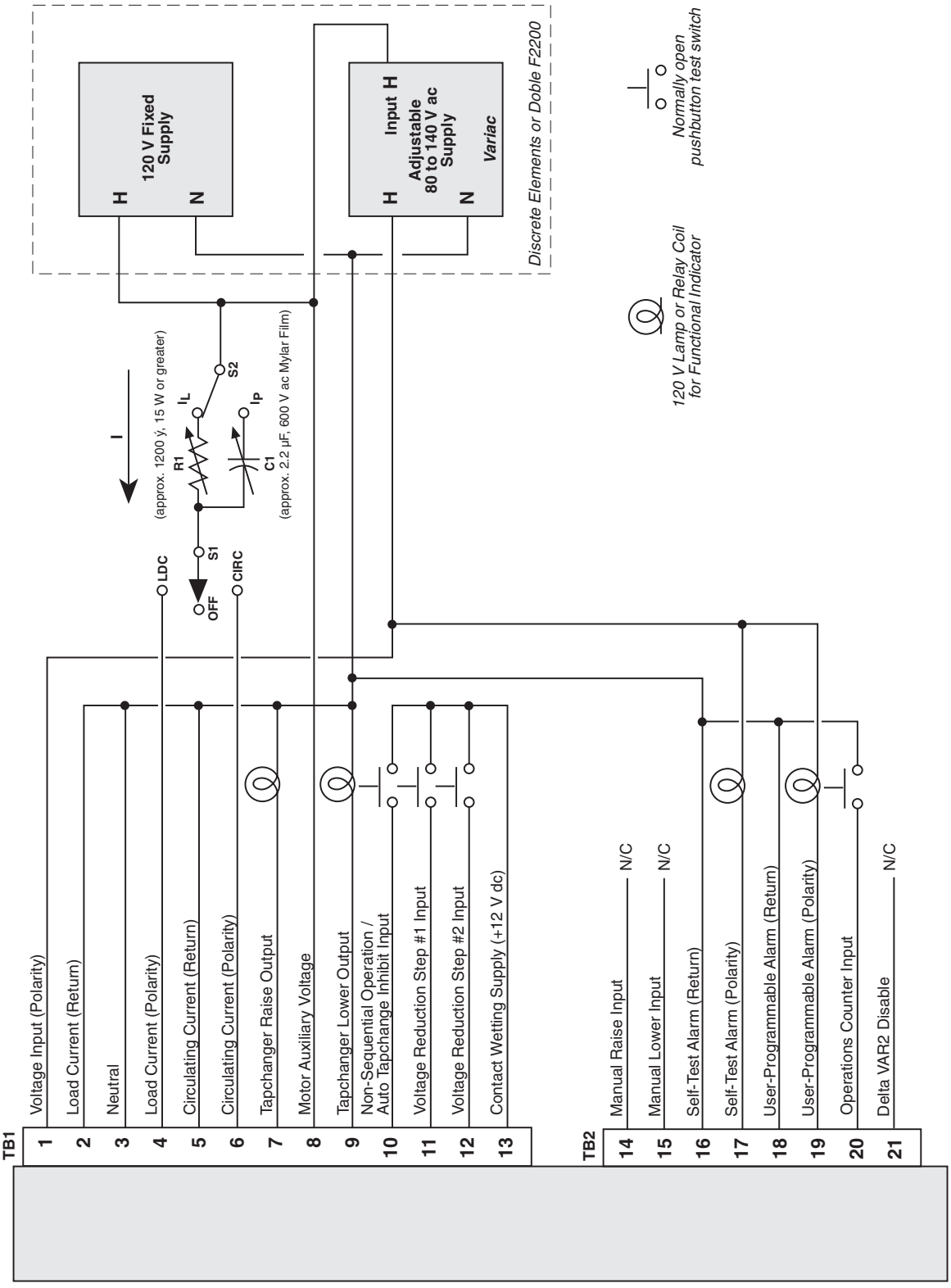


Paralleling

1. Apply 100.0 mA 90° leading current to TB1-6 (circulating current-polarity) and TB1-5 (circulating current-return) of the adapter panel.
2. Set S1 to CIRC and S2 to IP
3. The **LOWER** LED should illuminate.
4. Decrease voltage to 108.0 Vac. Both **RAISE** and **LOWER** LEDs should be extinguished.
5. Set S1 to **OFF**.

Counter

1. Set the TCC300 Tapchanger Control to display the **Operations Count** screen.
2. Verify the counter operation by depressing the switch wired to TB1-20 (operations counter input).
3. The tap position should change.

Block raise/block lower/dead band

1. Set Block Raise to 126.0 V.
2. Set Block Lower to 114.0 V.
3. Set the TCC300 Tapchanger Control to display the **Bias Voltage** screen.
4. Press **Enter**.
5. Increase voltage to 126.5 V. **BR** should be displayed on the screen.
6. Increase voltage to 128.5 V. **BR** extinguishes and FL is displayed on the screen.
7. Decrease voltage to 113.5 V. **BL** is displayed on the screen.

—Bench Test Complete—

4.1 TCC300 checkout procedure

Note

This test of the TCC300 assumes that the unit remains connected to the TCC300M2067 adapter panel.

Basic Operational Test

1. Set VT Ratio Correction = 0 V; CT/VT phasing = 0°
2. Apply 120.0 Vac to TB1-1 (hot) and TB1-3 (neutral) of the adapter panel.
3. Verify local voltage ≈ input voltage ±0.3 V.
4. Apply 100.0 mA in-phase current to TB1-4 (load current-polarity) and TB1-2 (load current-return) of the adapter panel. Verify **Control Load** I ≈ 100 mA and **Power Factor** ≈ 1.0 ±0.02.
5. Apply 100.0 mA 90° leading current to TB1-6 (circulating current-polarity) and TB1-5 (circulating current-return) of the adapter panel.
6. Verify **Control Circ** I ≈ 100.0 mA ±2 mA.
7. Verify **Up, Down** and **Enter** buttons work.

—Checkout Procedure Complete—

4.2 In-service test

1. Set the TCC300 Tapchanger Control to display the **Bias Voltage** screen.
2. Press **Enter**.
3. Use **Up** and **Down** buttons to cause **RAISE** and **LOWER** outputs.

—In-Service Test Complete—

Return unit to desired settings

4.3 TCC300M2067 checkout procedure

All ABB units are fully calibrated at the factory. There is no need to recalibrate the units before initial installation.

Inspect the **VOLTAGE** fuse to ensure that it is correctly sized and has not blown.

POWER

1. Remove any external connection between TB1-1 and TB1-8 which are located on the adapter panel printed circuit board.
2. Using a voltmeter, verify that the voltage applied to TB1-1 is nominal 120 Vac with respect to TB1-3 (neutral).

⚠ Warning

Voltage applied at TB1-1 may energize the regulator or transformer to a high voltage through the voltage transformer. Death or severe electrical shock can occur. Do not connect any voltage source at TB1-1.

Caution

Do not reverse the ground and hot wires when connecting an external source.

3. Apply motor auxiliary voltage to TB1-8 (motor auxiliary voltage) and TB1-3 (neutral). Verify that the motor runs in the proper direction when conditions of sensed voltage result in activation of the **RAISE** and **LOWER** outputs.

⚠ Warning

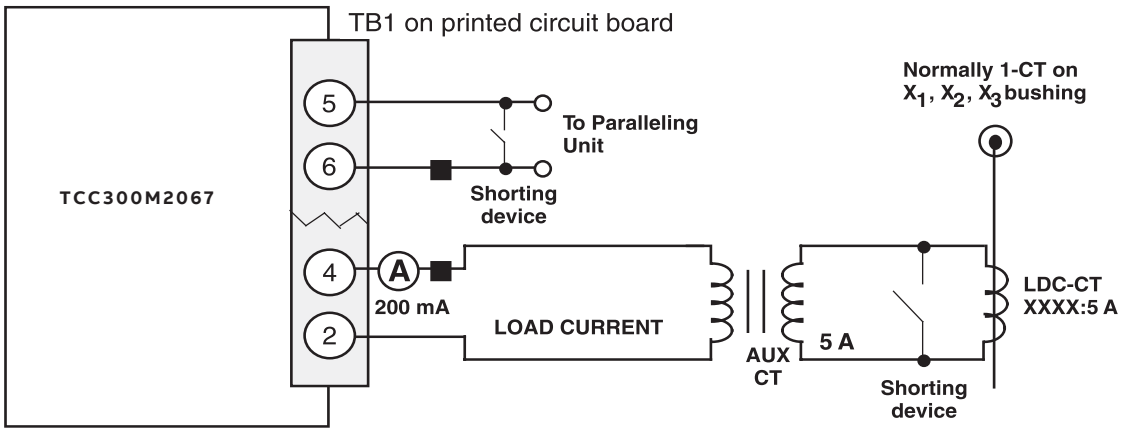
In no case should the load current circuit be interrupted with the regulator or transformer energized. Do not remove auxiliary current transformers without shorting the current inputs. Death or severe electrical shock can occur.

4. As shown in Figure 11, temporarily place a shorting device across the LDC-CT secondary to short the line drop compensator circuit, and place another shorting device across TB1-5 and TB1-6 to short the circulating current paralleling input, for the load current check.
5. Insert an ammeter between the polarity input and TB1-4.
6. 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.
7. Replace the shorting device across the load current input and remove the ammeter.
8. 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.

Figure 11. Setup for current checkout procedure

11



5.0 Converting Westinghouse CVR/CVC
Tapchanger Control to TCC300M2067/TCC300 Tapchanger Control

Introduction
TheABB TCC300M2067/TCC300 Tapchanger Control is a replacement panel for the Westinghouse CVR/CVC control panel on transformers. However, it is not a direct replacement; three additional relays are needed. The TCC300M2067 mounts in the same physical location as the existing control, 4 additional mounting holes will need to be drilled. The user is responsible for determining where and how to mount the required additional relays.

Instructions
1. Insure all local clearance and safety tagging rules and procedures are observed during the performance of this procedure.
2. Place the affected transformer(s) tapchanger existing control switch in the Manual mode of operation.

⚠ Warning
An open CT secondary will result in high voltage at CT terminals. Death, severe injury or damage to equipment can occur.

3. Determine where or if there is a method to short the current input, then proceed as follows:
   - If there is no method to short the current input, then the transformer must be removed from service.
   - If a shorting switch exists, then short the current input by opening the shorting switch.
   - If adding a jumper across the current input is an acceptable method of shorting the current input, then add a properly sized jumper.
4. Determine where or if there is a method to open the voltage input, the proceed as follows:
   - If the voltage input to the control can be isolated by opening a circuit breaker, then open the appropriate breaker.conditions for safe interconnection of two networks.

⚠ Warning
Voltages up to 240 Vac could be present, contact can cause death, severe injury or damage to the control.

   - If no circuit breaker or sliding link terminal block exists, then the voltage input wires can be cautiously removed and taped.

5. Determine where or if there is a method to open the motor power input, then proceed as follows:
   - If the motor power input to the control can be isolated by opening a circuit breaker, then open the appropriate breaker.

⚠ Warning
Voltages up to 240 Vac could be present, contact can cause death, severe injury or damage to the control.

   - If no circuit breaker or sliding link terminal block is present to open the motor power input then, the wires can be cautiously removed and taped.

6. Label the wires coming to the existing control panel with the TCC300M2067 designations listed in Table 3 if they are not already labeled.
7. Remove the wires from the terminal block of the existing CVR/CVC control. All external connections to the control should be disconnected at this time, if not, label and disconnect.
8. Remove the mounting hardware used to mount the existing panel. Save the mounting hardware, as it may be used to mount the TCC300M2067 panel.
9. Cover equipment and wiring below where the holes will be drilled to prevent the metal filings from falling into them.
10. Utilize Figure 9 to locate and drill the 4 mounting holes.
11. Determine where to mount the 3 additional relays. The relays are double pole double throw (DPDT), (use Potter & Brumfield KRP11AG or equivalent).

Table 3. Westinghouse CVR/CVC and TCC300M2067 terminal block designations

Westinghouse CVR/ CVC wire identifier	TCC300M2067 terminal block wire identifier	Comments
6	TB1-1	Regulated voltage, polarity
14	TB1-1	Regulated voltage, polarity
No connection	TB1-2	No external connection to TB1-2. This is Load Current Return on the M-2067, there is a metal jumper from TB1-2 to TB1-3.
9	TB1-3	Regulated voltage, neutral
8	TB1-4	Load current (0.2 A), polarity (load current return is tb1-2)
13	TB1-5	Circulating current, return
12	TB1-6	Circulating current, polarity
4	TB1-7	Raise
5	TB1-8	Motor power
3	TB1-9	Lower
	Auxiliary relay wire identifier	Relay connections are based on the Potter & Brumfield KRP11AG, if different relays are used review their connections.
2	120X-2	Auxiliary relay (coil) for runback
7	120X-7	Auxiliary relay (coil) for runback
6	120X-1	Auxiliary relay contact, voltage source
No connection	120X-3 to AR-1	Runback when motor power lost and returns
16	AR-4 and AL-2	Lower auxiliary relay
15	AR-2 and AR-3	Raise auxiliary relay
9	AL-7 and AR-7	Ground
1	AR-8	Raise output
10	AL-8	Lower output
17	AR-6 and AL-6	Return
18	No connection	Insulate wire end

Caution
Different manufactures of the relay sockets may have mounting patterns that are not the same.

12. Verify the mounting holes for the relay sockets, then mount the relay sockets.
13. Mount the TCC300 to the TCC300M2067 Adapter Panel using the four screws and lock-washers provided in the cloth bag.
14. Plug the keyed blue connector (Figure 5) into the bottom of the TCC300 observing where the key is located (Figure 6).
15. If desired, bench testing may be performed as described in Section 4.0, Bench Test (TCC300 Connected to TCC300M2067).

Warning
An open CT secondary will result in high voltage at CT terminals. Death, severe injury or damage to equipment can occur.

Warning
Voltages up to 240 Vac could be present, contact can cause death, severe injury or damage to the control.

16. Install the TCC300M2067 Adapter Panel using the original hardware.

Note
The terminal block of the CVR/CVC and the TB1 terminal block of the TCC300M2067 are not the same; refer to Table 3 and Figures 12 and 13.

Warning
An open CT secondary will result in high voltage at CT terminals. Death, severe injury or damage to equipment can occur.

Warning
Voltages up to 240 Vac could be present, contact can cause death, severe injury or damage to the control.

17. Reconnect the existing wires to the TCC300M2067 and relays that have been added (relay connections are based on the Potter & Brumfield KRP11AG, if different relays are used review their connections).

Warning
Voltages up to 240 Vac could be present, contact can cause death, severe injury or damage to the control.

18. Restore the motor power input based on the isolation method utilized in Step 5.

Warning
Voltages up to 240 Vac could be present, contact can cause death, severe injury or damage to the control.

19. Restore the voltage input based on the isolation method utilized in Step 4.

Warning
An open CT secondary will result in high voltage at CT terminals. Death, severe injury or damage to equipment can occur.

20. Remove the current input shorting device based on the shorting method utilized in Step 3.

5.1 Check-out Instructions for Westinghouse CVR/CVC conversion to TCC300M2067/TCC300 Tapchanger Control

1. Set the existing control switches to Local and Manual. Use the existing control switches to manually operate the tapchanger.

Warning
Voltages up to 240 Vac could be present, contact can cause death, severe injury or damage to the control.

2. Verify the following:
   - The TCC300 Tapchanger Control displays the **Local Voltage** screen.
   - The **OK** LED is illuminated.
   - No tapchanger operations occur.
   - The TCC300 **RAISE** or **LOWER** LED's may illuminate depending on the voltage present at that time.
3. Set the TCC300 Tapchanger Control settings as indicated in Table 4 (these are factory default settings). Refer to the TCC300 Instruction Book if there are any questions regarding setting the TCC300.

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Figure 12. Westinghouse CVR-1 replacement

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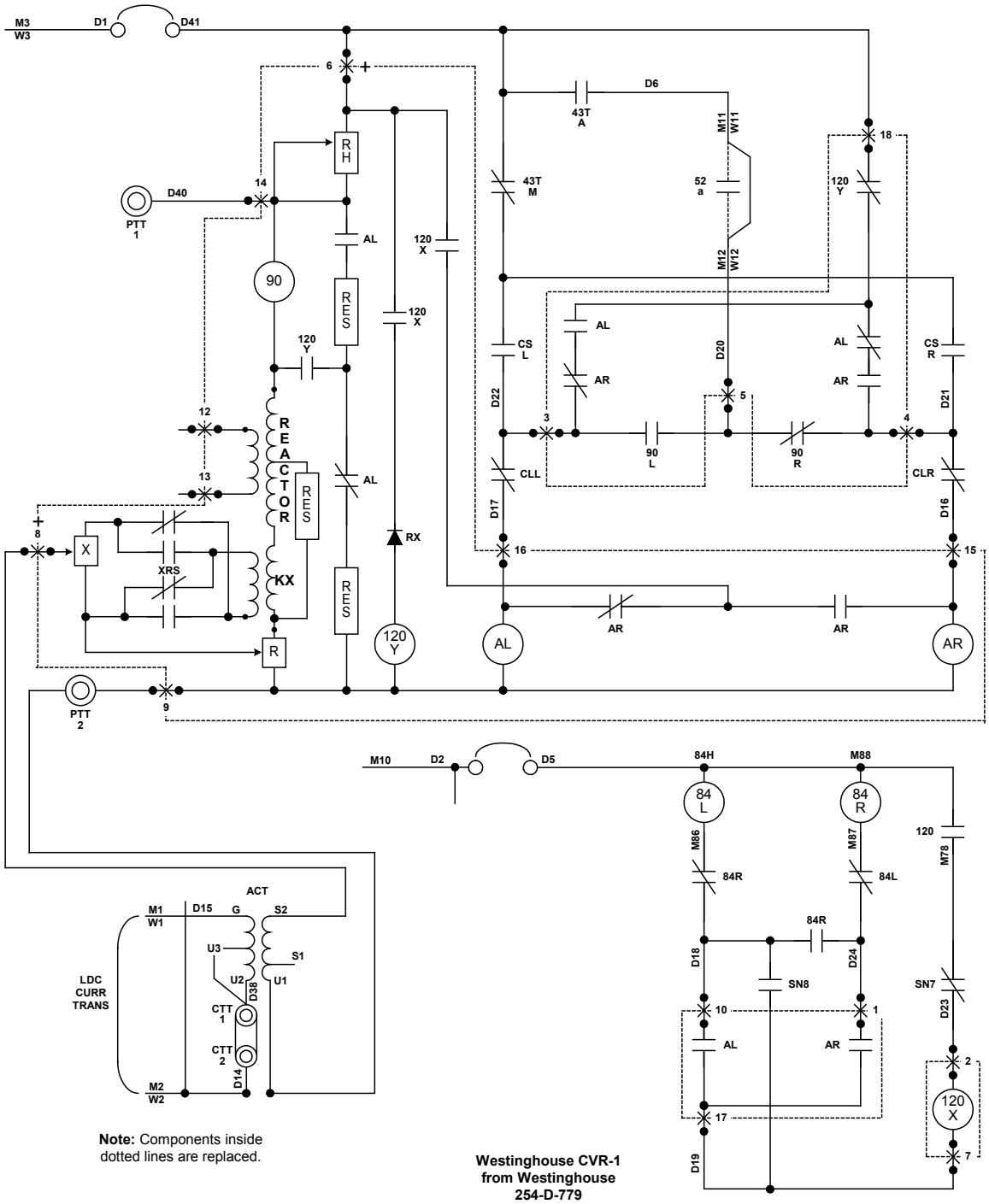

Note: Components inside dotted lines are replaced.

Westinghouse CVR-1 from Westinghouse 254-D-779

Figure 13. Westinghouse CVR-1 replacement with TCC300M2067

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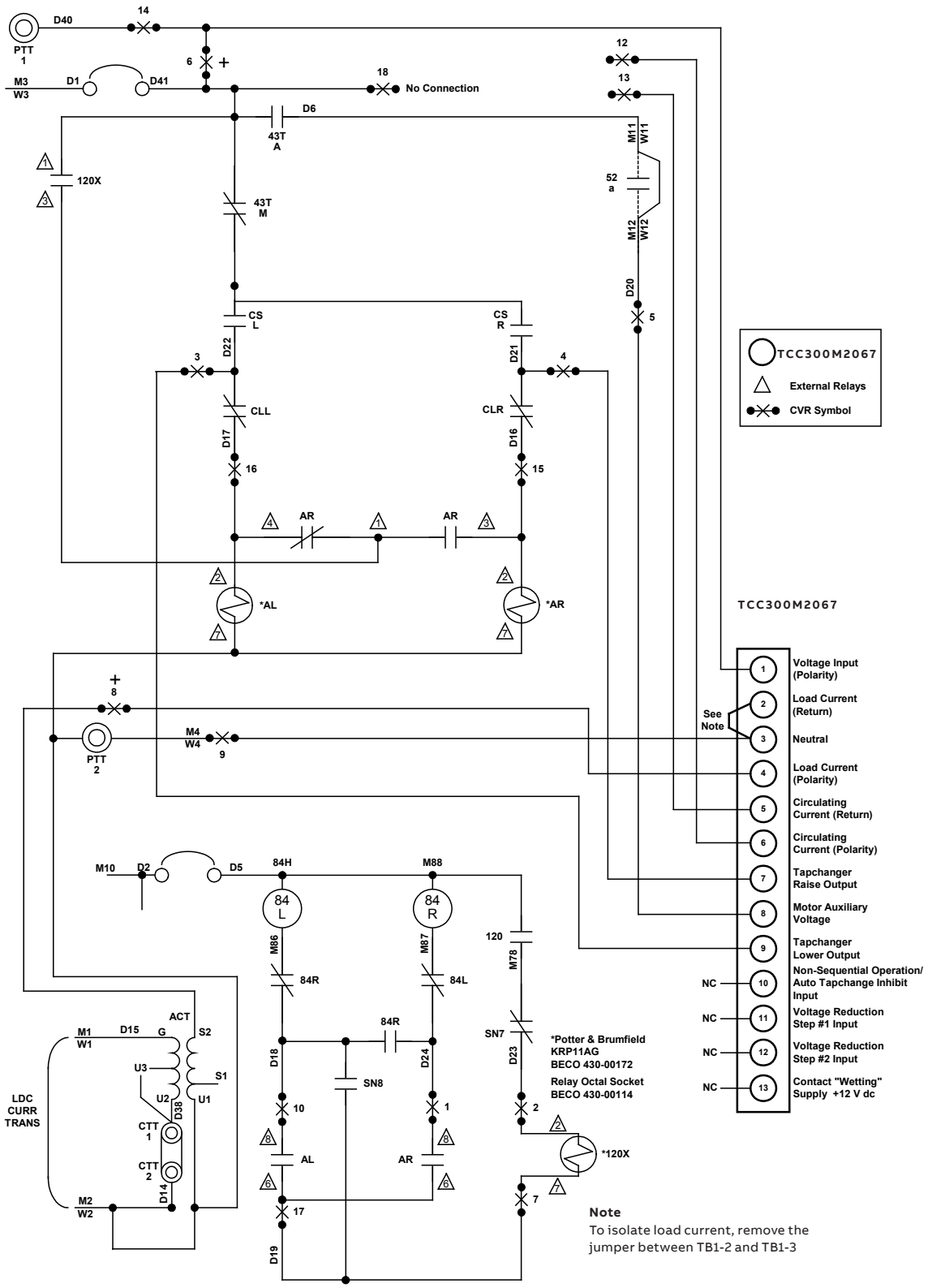

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Table 4. Check-out settings

Check-out settings	
Bandcenter	120.0V forward
Bandwith	2.0V forward
LDC resistance	0.0V forward
LDC reactance	0.0 V forward
Timer	30.0 seconds
Block raise	135.0 V
Block lower	105.0 V
Deadband	2.0V

4. Read the local voltage displayed by the TCC300, then verify that the displayed voltage approximates the actual measured voltage.
5. Set the **Bandcenter** setting to the same value as the measured voltage.
6. Set the existing **AUTO/MANUAL** control switch to the **MANUAL** position.
7. Raise the tapchanger two to three tap positions. The TCC300 **LOWER** LED should illuminate but no operation should occur since the existing **AUTO/MANUAL** control switch is in the **MANUAL** position.
8. Verify the **LOWER** LED illuminates.
9. Set the existing **AUTO/MANUAL** control switch to the **AUTO** position, then verify the following:
   - The tapchanger starts to lower the voltage.
   - The tapchanger stops when it is within the 2 V bandwidth.
10. Set the existing **AUTO/MANUAL** control switch to the **MANUAL** position.
11. Lower the tapchanger two to three tap positions, then verify the following:
    - The TCC300 **RAISE** LED illuminates.
    - No tapchanger operation occurs since the existing **AUTO/MANUAL** control switch is in the **MANUAL** position.
12. Verify the **RAISE** LED illuminates.
13. Set the existing **AUTO/MANUAL** control switch to the **AUTO** position, then verify the following:
    - The tapchanger starts to raise the voltage.
    - The tapchanger stops when it is within the 2 V bandwidth.
14. Set the existing **AUTO/MANUAL** control switch to the **MANUAL** position.

⚠ Warning

An open CT secondary will result in high voltage at CT terminals. Death, severe injury or damage to equipment can occur.

15. Close shorting switch or remove the installed jumper, then verify the **Control Load I** value on the TCC300 is approximately the measured current input to the control.
16. Set the existing **AUTO/MANUAL** control switch to the **MANUAL** position.
17. Set the **LDC Resistance** value to 24, then verify the **RAISE** LED illuminates.
18. Set the **LDC Resistance** value to zero.
19. Return the TCC300 settings to the desired values for operation.
20. Set the existing **AUTO/MANUAL** control switch to the **AUTO** position.

Notes

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