

RELION® PROTECTION AND CONTROL

630 series

Operation Manual





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This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2006/95/EC). This conformity is the result of tests conducted by ABB in accordance with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the product standards EN 60255-1 and EN 60255-27 for the low voltage directive. The product is designed in accordance with the international standards of the IEC 60255 series.

Safety information



Dangerous voltages can occur on the connectors, even though the auxiliary voltage has been disconnected.



Non-observance can result in death, personal injury or substantial property damage.



Only a competent electrician is allowed to carry out the electrical installation.



National and local electrical safety regulations must always be followed.



The frame of the protection relay has to be carefully earthed.



The protection relay contains components which are sensitive to electrostatic discharge. Unnecessary touching of electronic components must therefore be avoided.



Whenever changes are made in the protection relay, measures should be taken to avoid inadvertent tripping.

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Section 1 Introduction

1.1 This manual

The operation manual contains instructions on how to operate the protection relay once it has been commissioned. The manual provides instructions for monitoring, controlling and setting the relay. The manual also describes how to identify disturbances and how to view calculated and measured power grid data to determine the cause of a fault.

1.2 Intended audience

This manual addresses the operator, who operates the protection relay on a daily basis.

The operator must be trained in and have a basic knowledge of how to operate protection equipment. The manual contains terms and expressions commonly used to describe this kind of equipment.

1.3 Product documentation

1.3.1 Product documentation set

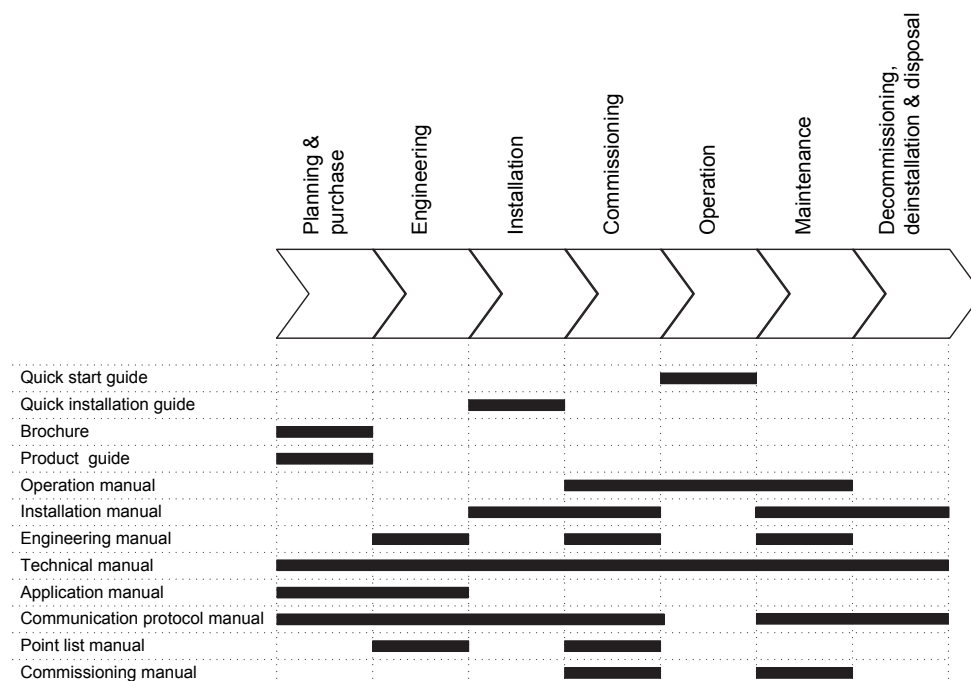


Figure 1: The intended use of documents during the product life cycle



Product series- and product-specific manuals can be downloaded from the ABB Web site <http://www.abb.com/relion>.

1.3.2 Document revision history

Document revision/date	Product series version	History
A/2009-09-15	1.0	First release
B/2011-02-23	1.1	Content updated to correspond to the product series version
C/2012-08-29	1.2	Content updated to correspond to the product series version
D/2014-11-28	1.3	Content updated to correspond to the product series version
E/2019-02-25	1.3	Content updated



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

1.3.3 Related documentation

Product series- and product-specific manuals can be downloaded from the ABB Web site <http://www.abb.com/substationautomation>.

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.
- Push button navigation in the LHMI menu structure is presented by using the push button icons.
To navigate between the options, use  and .
- Menu paths are presented in bold.
Select **Main menu/Settings**.
- WHMI menu names are presented in bold.
Click **Information** in the WHMI menu structure.
- LHMI messages are shown in Courier font.
To save the changes in nonvolatile memory, select Yes and press .
- Parameter names are shown in italics.
The function can be enabled and disabled with the *Operation* setting.
- The ^ character in front of an input or output signal name in the function block symbol given for a function, indicates that the user can set an own signal name in PCM600.
- The * character after an input or output signal name in the function block symbol given for a function, indicates that the signal must be connected to another function block in the application configuration to achieve a valid application configuration.

1.4.3

Functions, codes and symbols

Table 1: *Functions included in the IEDs*

Description	IEC 61850	IEC 60617	ANSI
Protection			
Three-phase non-directional overcurrent protection, low stage	PHLPTOC	3I>	51P-1
Three-phase non-directional overcurrent protection, high stage	PHHPTOC	3I>>	51P-2
Three-phase non-directional overcurrent protection, instantaneous stage	PHIPTOC	3I>>>	50P/51P
Voltage dependent overcurrent protection	PHPVOC	I(U)>	51V
Three-phase directional overcurrent protection, low stage	DPHLPDOC	3I> ->	67-1
Three-phase directional overcurrent protection, high stage	DPHHPDOC	3I>> ->	67-2
Distance protection	DSTPDIS	Z<	21, 21P, 21N
Automatic switch-onto-fault logic	CVRSO	SOTF	SOTF
Fault locator	SCEFRFLO	FLOC	21FL
Autoreclosing	DARREC	O -> I	79
Non-directional earth-fault protection, low stage	EFLPTOC	I0>	51N-1
Table continues on next page			

Description	IEC 61850	IEC 60617	ANSI
Non-directional earth-fault protection, high stage	EFHPTOC	I0>>	51N-2
Non-directional earth-fault protection, instantaneous stage	EFIPTOC	I0>>>	50N/51N
Directional earth-fault protection, low stage	DEFLPDEF	I0> ->	67N-1
Directional earth-fault protection, high stage	DEFHPDEF	I0>> ->	67N-2
Harmonics based earth-fault protection	HAEFPTOC	Io>HA	51NHA
Transient/intermittent earth-fault protection	INTRPTEF	I0> -> IEF	67NIEF
Admittance-based earth-fault protection	EFPADM	Yo> ->	21YN
Multi-frequency admittance-based earth-fault protection	MFADPSDE	I0> ->Y	67YN
Wattmetric earth-fault protection	WPWDE	Po> ->	32N
Stabilised restricted earth-fault protection	LREFPNDF	dI0Lo>	87NL
Third harmonic based stator earth fault protection	H3EFPSEF	dUo(3H)>/ Uo(3H)<	27/59THD
High-impedance based restricted earth-fault protection	HREFPDIF	dI0Hi>	87NH
Rotor earth-fault protection	MREFPTOC	Io>R	64R
Phase discontinuity protection	PDNSPTOC	I2/I1>	46PD
Negative-sequence overcurrent protection	NSPTOC	I2>	46
Negative-sequence overcurrent protection for machines	MNSPTOC	I2>G/M	46G/46M
Phase-reversal protection	PREVPTOC	I2>>	46R
Three-phase thermal overload protection for feeder	T1PTTR	3Ith>F	49F
Three-phase thermal overload protection, two time constants	T2PTTR	3Ith>T/G	49T/G
Three-phase thermal overload protection for motors	MPTTR	3Ith>M	49M
Motor startup supervision	STTPMSU	Is2t n<	48,66,14,51LR
Motor load jam protection	JAMPTOC	Ist>	51LR
Emergency start	ESMGAPC	ESTART	ESTART
Loss of load supervision	LOFLPTUC	3I<	37
Three-phase current inrush detection	INRPHAR	3I2f>	68
Transformer differential protection for two-winding transformers	TR2PTDF	3dI>T	87T
High-impedance or flux-balance based differential protection for machines	MHZPDIF	3dIH>G/M	87GH/87MH
Table continues on next page			

Description	IEC 61850	IEC 60617	ANSI
Stabilized differential protection for machines	MPDIF	3dI>G/M	87G/87M
Three-phase overvoltage protection	PHPTOV	3U>	59
Three-phase undervoltage protection	PHPTUV	3U<	27
Positive-sequence overvoltage protection	PSPTOV	U1>	47O+
Positive-sequence undervoltage protection	PSPTUV	U1<	47U+
Negative-sequence overvoltage protection	NSPTOV	U2>	47O-
Residual overvoltage protection	ROVPTOV	U0>	59G
Directional reactive power undervoltage protection	DQPTUV	Q>-->,3U<	32Q,27
Reverse power/directional overpower protection	DOPDPDR	P>	32R/32O
Underpower protection	DUPDPDR	P<	32U
Frequency gradient protection	DAPFRC	df/dt>	81R
Overfrequency protection	DAPTOF	f>	81O
Underfrequency protection	DAPTUF	f<	81U
Load shedding	LSHDPFRQ	UFLS/R	81LSH
Low voltage ride through protection function	LVRTPTUV	U<RT	27RT
Overexcitation protection	OEPVPH	U/f>	24
Voltage vector shift protection	VVSPAM	VS	78V
Three-phase underexcitation protection	UEXPDIS	X<	40
Three-phase underimpedance protection	UZPDIS	Z< GT	21GT
Circuit breaker failure protection	CCBRBRF	3I>/I0>BF	51BF/51NBF
Tripping logic	TRPPTRC	I -> O	94
Multipurpose analog protection	MAPGAPC	MAP	MAP
Protection-related functions			
Local acceleration logic	DSTPLAL	LAL	LAL
Communication logic for residual overcurrent	RESCPSCH	CLN	85N
Scheme communication logic	DSOCPSCH	CL	85
Current reversal and WEI logic	CRWPSCH	CLCRW	85CRW
Current reversal and WEI logic for residual overcurrent	RCRWPSCH	CLCRWN	85NCRW
Control			
Bay control	QCCBAY	CBAY	CBAY
Interlocking interface	SCILO	3	3
Table continues on next page			

Description	IEC 61850	IEC 60617	ANSI
Circuit breaker/disconnector control	GNRLCSWI	I <-> O CB/DC	I <-> O CB/DC
Circuit breaker	DAXCBR	I <-> O CB	I <-> O CB
Disconnector	DAXSWI	I <-> O DC	I <-> O DC
Local/remote switch interface	LOCREM	R/L	R/L
Synchrocheck	SYNCRSYN	SYNC	25
Tap changer control with voltage regulator	OLATCC	COLTC	90V
Generic process I/O			
Single point control (8 signals)	SPC8GGIO	-	-
Double point indication	DPGGIO	-	-
Single point indication	SPGGIO	-	-
Generic measured value	MVGGIO	-	-
Logic Rotating Switch for function selection and LHMI presentation	SLGGIO	-	-
Selector mini switch	VSGGIO	-	-
Pulse counter for energy metering	PCGGIO	-	-
Event counter	CNTGGIO	-	-
Supervision and monitoring			
Runtime counter for machines and devices	MDSOPT	OPTS	OPTM
Circuit breaker condition monitoring	SSCBR	CBCM	CBCM
Fuse failure supervision	SEQRFUF	FUSEF	60
Current circuit supervision	CCRDIF	MCS 3I	MCS 3I
Trip-circuit supervision	TCSSCBR	TCS	TCM
Station battery supervision	SPVNZBAT	U<>	U<>
Energy monitoring	EPDMMTR	E	E
Measured value limit supervision	MVEXP	-	-
Hot-spot and insulation ageing rate monitoring for transformers	HSARSPTR	3Ihp>T	26/49HS
Tap position indication	TPOSSLTC	TPOSM	84M
Power quality			
Voltage variation	PHQVVR	PQMU	PQMV
Voltage unbalance	VSQVUB	PQMUBU	PQMUBV
Current harmonics	CMHAI	PQM3I	PQM3I
Voltage harmonics (phase-to-phase)	VPPMHAI	PQM3Upp	PQM3Vpp
Voltage harmonics (phase-to-earth)	VPHMHAI	PQM3Upe	PQM3Vpg
Measurement			
Three-phase current measurement	CMMXU	3I	3I
Table continues on next page			

Description	IEC 61850	IEC 60617	ANSI
Three-phase voltage measurement (phase-to-earth)	VPHMMXU	3U _{pe}	3U _{pe}
Three-phase voltage measurement (phase-to-phase)	VPPMMXU	3U _{pp}	3U _{pp}
Residual current measurement	RESCMMXU	I0	I0
Residual voltage measurement	RESVMMXU	U0	U0
Power monitoring with P, Q, S, power factor, frequency	PWRMMXU	PQf	PQf
Sequence current measurement	CSMSQI	I1, I2	I1, I2
Sequence voltage measurement	VSMSQI	U1, U2	V1, V2
Analog channels 1-10 (samples)	A1RADR	ACH1	ACH1
Analog channels 11-20 (samples)	A2RADR	ACH2	ACH2
Analog channels 21-30 (calc. val.)	A3RADR	ACH3	ACH3
Analog channels 31-40 (calc. val.)	A4RADR	ACH4	ACH4
Binary channels 1-16	B1RBDR	BCH1	BCH1
Binary channels 17 -32	B2RBDR	BCH2	BCH2
Binary channels 33 -48	B3RBDR	BCH3	BCH3
Binary channels 49 -64	B4RBDR	BCH4	BCH4
Station communication (GOOSE)			
Binary receive	GOOSEBINRCV	-	-
Double point receive	GOOSEDPRCV	-	-
Interlock receive	GOOSEINTLKRCV	-	-
Integer receive	GOOSEINTRCV	-	-
Measured value receive	GOOSEMVRCV	-	-
Single point receive	GOOSESPRCV	-	-

Section 2 Environmental aspects

2.1 Sustainable development

Sustainability has been taken into account from the beginning of the product design including the pro-environmental manufacturing process, long life time, operation reliability and disposing of the protection relay.

The choice of materials and the suppliers have been made according to the EU RoHS directive (2002/95/EC). This directive limits the use of hazardous substances which are the following:

Table 2: *Maximum concentration values by weight per homogeneous material*

Substance	Proposed maximum concentration
Lead - Pb	0.1%
Mercury - Hg	0.1%
Cadmium - Cd	0.01%
Hexavalent Chromium Cr (VI)	0.1%
Polybrominated biphenyls - PBB	0.1%
Polybrominated diphenyl ethers - PBDE	0.1%

Operational reliability and long life time have been assured with extensive testing during the design and manufacturing processes. Moreover, long life time is supported by maintenance and repair services as well as by the availability of spare parts.

Design and manufacturing have been done under a certified environmental system. The effectiveness of the environmental system is constantly evaluated by an external auditing body. We follow environmental rules and regulations systematically to evaluate their effect on our products and processes.

2.2 Disposal of a protection relay

Definitions and regulations of hazardous materials are country-specific and change when the knowledge of materials increases. The materials used in this product are typical for electric and electronic devices.

All parts used in this product are recyclable. When disposing of a protection relay or its parts contact a local waste handler who is authorized and specialized in disposing of electronic waste. These handlers can sort the material by using dedicated sorting processes and dispose of the product according to the local requirements.

Table 3: *Materials of the protection relay parts*

Protection relay	Parts	Material
Unit	Metallic plates, parts and screws	Steel
	Plastic parts	PC ¹⁾ , LCP ²⁾
	LHMI display module	Various
Package	Box	Cardboard
Attached material	Manuals	Paper

- 1) Polycarbonate
2) Liquid crystal polymer

Section 3 630 series overview

3.1 Overview

630 series consists of IEDs for protection, control, measurement and supervision of utility and industrial distribution substations, medium and large asynchronous motors in industrial power systems, and transformers in utility and industry power distribution networks.

630 series is a part of ABB's Relion[®] product family. The 630 protection and control product series is characterized by functional scalability and flexible configurability. It also features necessary control functions for bay control in different applications.

The supported communication protocols including IEC 61850 offer seamless connectivity to various station automation and SCADA systems.

3.2 Local HMI

The LHMI is used for setting, monitoring and controlling the protection relay. The LHMI comprises the display, buttons, LED indicators and communication port.

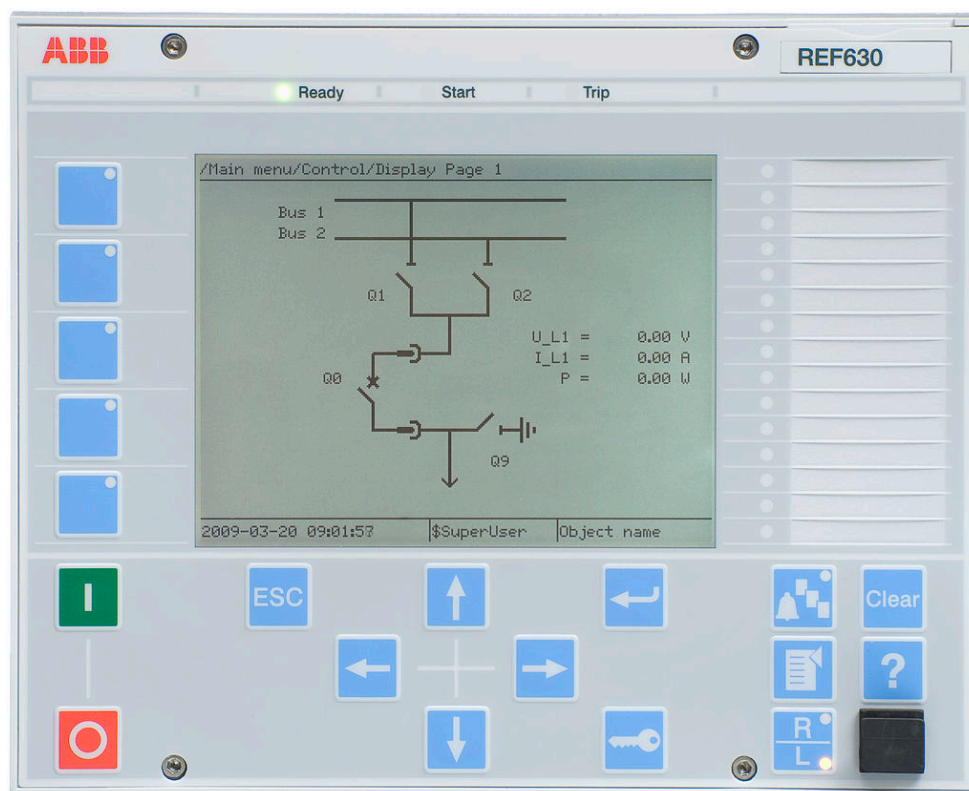


Figure 2: Example of the LHMI

3.2.1

Display

The LHMI includes a graphical monochrome display with a resolution of 320 x 240 pixels. The character size can vary. The amount of characters and rows fitting the view depends on the character size and the view that is shown.

The display view is divided into four basic areas.

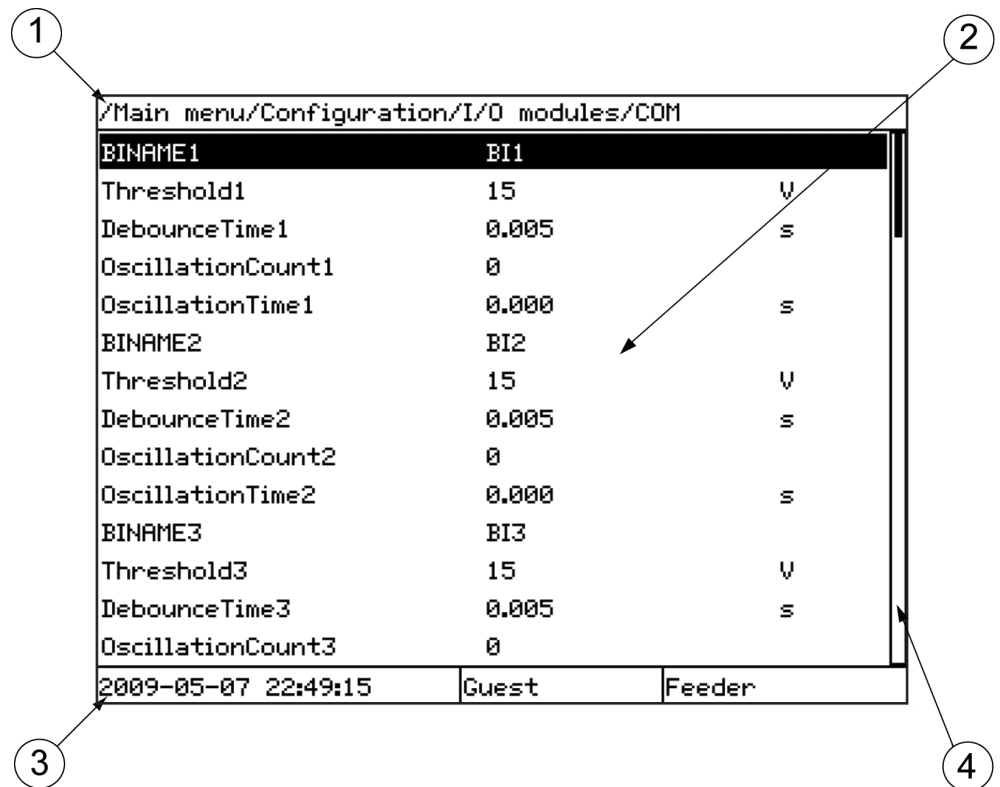


Figure 3: Display layout

- 1 Path
- 2 Content
- 3 Status
- 4 Scroll bar (appears when needed)

- The path shows the current location in the menu structure. If the path is too long to be shown, it is truncated from the beginning, and the truncation is indicated with three dots.
- The content area shows the menu content.
- The status area shows the current IED time, the user that is currently logged in and the object identification string which is settable via the LHMI or with PCM600.
- If text, pictures or other items do not fit in the display, a vertical scroll bar appears on the right. The text in content area is truncated from the beginning if it does not fit in the display horizontally. Truncation is indicated with three dots.

Figure 4: Truncated path

Control LCD_FN1_OFF			
Control LCD_FN2_OFF			
Control LCD_FN3_OFF			
Menu shortcut Events			
Menu shortcut Disturbance records		Guest	Feeder

The alarm LED panel shows on request the alarm text labels for the alarm LEDs.

/Main menu		1	
Control		2	LOCKED_BY_AR
Events		3	
Measurements			TC_ALARM
Disturbance records			
Settings			
Configuration			
Monitoring			
Test			
Information			
Clear			
Language			
2009-04-24 00:53:43		Guest	

Figure 6: Alarm LED panel

The function button and alarm LED panels are not visible at the same time. Each panel is shown by pressing one of the function buttons or the Multipage button. Pressing the ESC button clears the panel from the display. Both the panels have dynamic width that depends on the label string length that the panel contains.

3.2.2 LEDs

The LHMI includes three protection status LEDs above the display: Ready, Start and Trip.

There are 15 programmable alarm LEDs on the front of the LHMI. Each LED can indicate three states with the colors: green, yellow and red. The alarm texts related to each three-color LED are divided into three pages. The pages can be browsed with the Multipage button. Altogether, the 15 physical three-color LEDs can indicate 45 different alarms. The LEDs can be configured with PCM600 and the operation mode can be selected with the LHMI, WHMI or PCM600.

3.2.3 Keypad

The LHMI keypad contains push-buttons which are used to navigate in different views or menus. With the push-buttons you can control objects in the single-line diagram, for example, circuit breakers or disconnectors. The push-buttons are also used to acknowledge alarms, reset indications, provide help and switch between local and remote control mode.

The keypad also contains programmable push-buttons that can be configured either as menu shortcut or control buttons.

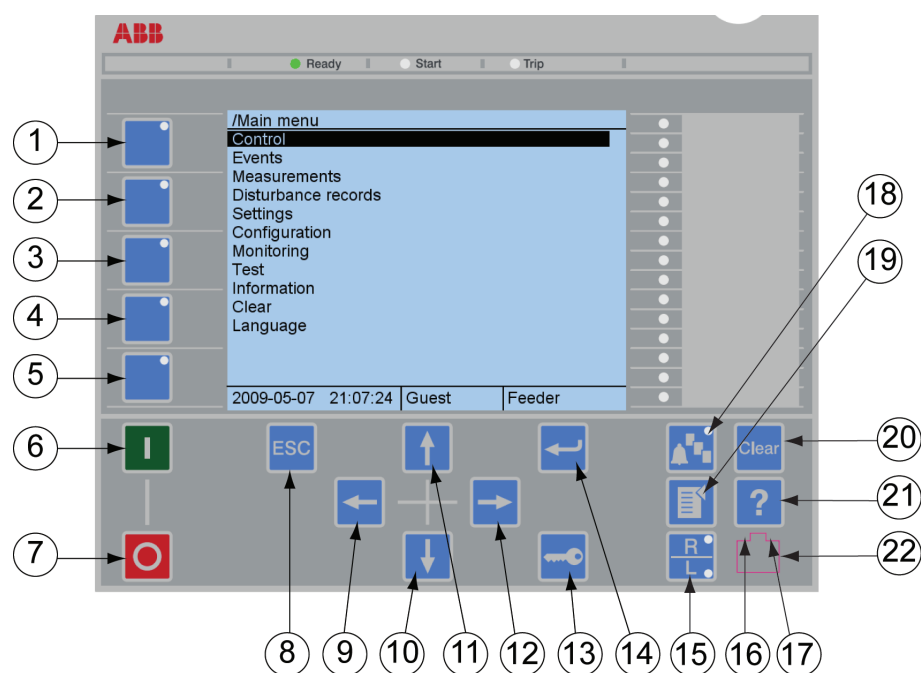


Figure 7: LHM keypad with object control, navigation and command push-buttons and RJ-45 communication port



- 1...5 Function button
- 6 Close
- 7 Open
- 8 Escape
- 9 Left
- 10 Down
- 11 Up
- 12 Right
- 13 Key
- 14 Enter
- 15 Remote/Local
- 16 Uplink LED
- 17 Not in use
- 18 Multipage
- 19 Menu
- 20 Clear
- 21 Help
- 22 Communication port

Object control

If the control position of the IED is set to local with the R/L button, the IED can be controlled using the object control buttons.

Object to be controlled is selected from the single line diagram.















Table 4: *Object control push-buttons*

Name	Description
 Close	Closing the object.
 Open	Opening the object.

Navigation






The arrow buttons are used for navigation. To scroll information, press the arrow button several times or simply keep it pressed down.

Table 5: *Navigation push-buttons*

Name	Description
 ESC	<ul style="list-style-type: none"> Leaving setting mode without saving the values. Cancelling certain actions. Adjusting the display contrast in combination with  or . Changing the language in combination with  or . Running the display test in combination with . Deleting a character in combination with  when editing a string. Inserting a space in combination with  when editing a string.
 Enter	<ul style="list-style-type: none"> Entering parameter setting mode. Confirming a new value of a setting parameter. Confirming selection in dialogs and alarm panel.
 Up  Down	<ul style="list-style-type: none"> Moving up and down in menus. Selecting objects in the SLD. Moving selection in dialogs and alarm panel. Scrolling active digits of a parameter when entering a new setting value.
 Left  Right	<ul style="list-style-type: none"> Moving left and right in menus. Selecting pages in the SLD. Changing the active digit of a parameter when entering a new setting value.
 Key	<ul style="list-style-type: none"> Activating the authorization procedure, when the user is not logged in. Logging out, when the user is currently logged in.


Commands

Table 6: *Command push-buttons*

Name	Description
 Menu	<ul style="list-style-type: none"> Moving directly to Main menu, if currently in any other menu or view. Moving to the default view, if currently in Main menu.
 R/L	<p>Changing the control position (remote or local) of the device.</p> <ul style="list-style-type: none"> When the R LED is lit, remote control is enabled and local control disabled. When the L LED is lit, local control is enabled and remote control disabled. When none of the LEDs are lit, both control positions are disabled.
 Clear	<ul style="list-style-type: none"> Activating the Clear/Reset view.
 Help	Showing the help menu.
 Multipage	Opening alarm panel and selecting alarm page from the view.

Function buttons

Table 7: *Function buttons*

Name	Description
 Function button	Executing the defined function: OFF, menu short cut or binary control.

3.2.4

Local HMI functionality

3.2.4.1

Protection and alarm indication

Protection indicators

The protection indicator LEDs are Ready, Start and Trip.



The start and trip LEDs are configured via the disturbance recorder. See the technical manual for more information on how to configure and set the binary signals of the disturbance recorder.

Table 8: *Ready LED*

LED state	Description
Off	Auxiliary supply voltage is disconnected
On	Normal operation
Flashing	Internal fault has occurred

Table 9: *Start LED*



LED state	Description
Off	Normal operation.
On	<p>A protection function has started and an indication message is displayed.</p> <ul style="list-style-type: none"> The start indication is latching and must be reset via communication or by pressing .
Flashing	<p>The IED is in test mode and protection functions are blocked.</p> <ul style="list-style-type: none"> The indication disappears when the IED is no longer in test mode and blocking is removed.

Table 10: *Trip LED*

LED state	Description
Off	Normal operation.
On	<p>A protection function has tripped and an indication message is displayed.</p> <ul style="list-style-type: none"> The trip indication is latching and must be reset via communication or by pressing .

Alarm indicators

The 15 programmable three-color LEDs are used for alarm indication. The colors of the LEDs are defined by the configuration and they are independent of the LEDs' states.

Table 11: *Alarm indications*

LED state	Description
Off	Normal operation. All activation signals are off.
On	<ul style="list-style-type: none"> Follow-S sequence: The activation signal is on. LatchedColl-S sequence: The activation signal is on, or it is off but the indication has not been acknowledged. LatchedAck-F-S sequence: The indication has been acknowledged, but the activation signal is still on. LatchedAck-S-F sequence: The activation signal is on, or it is off but the indication has not been acknowledged. LatchedReset-S sequence: The activation signal is on, or it is off but the indication has not been acknowledged.
Flashing	<ul style="list-style-type: none"> Follow-F sequence: The activation signal is on. LatchedAck-F-S sequence: The activation signal is on, or it is off but the indication has not been acknowledged. LatchedAck-S-F sequence: The indication has been acknowledged, but the activation signal is still on.

3.2.4.2

Parameter management

The LHMI is used to access the relay parameters. Three types of parameters can be read and written.

- Numerical values
- String values
- Enumerated values

Numerical values are presented either in integer or in decimal format with minimum and maximum values. Character strings can be edited character by character. Enumerated values have a predefined set of selectable values.

3.2.4.3

Front communication

The RJ-45 port in the LHMI enables front communication.

- The green uplink LED on the left is lit when the cable is successfully connected to the port.

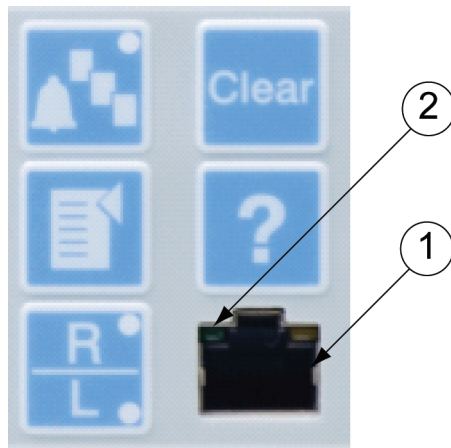


Figure 8: RJ-45 communication port and green indicator LED

- 1 RJ-45 connector
- 2 Green indicator LED

When a computer is connected to the IED front port, the IED's DHCP server for the front interface assigns an IP address to the computer. The default IP address for the front port is 192.168.0.254.



If the IED is ordered without an LHMI, the LAN1 port has to be used for configuration and setting purposes. The default IP address for the LAN1 port is 192.168.2.10. DHCP is not available from the LAN1 port.

3.2.4.4

Single-line diagram

Single-line diagram is used for bay control operations. It shows a graphical presentation of the bay which is configured with PCM600.

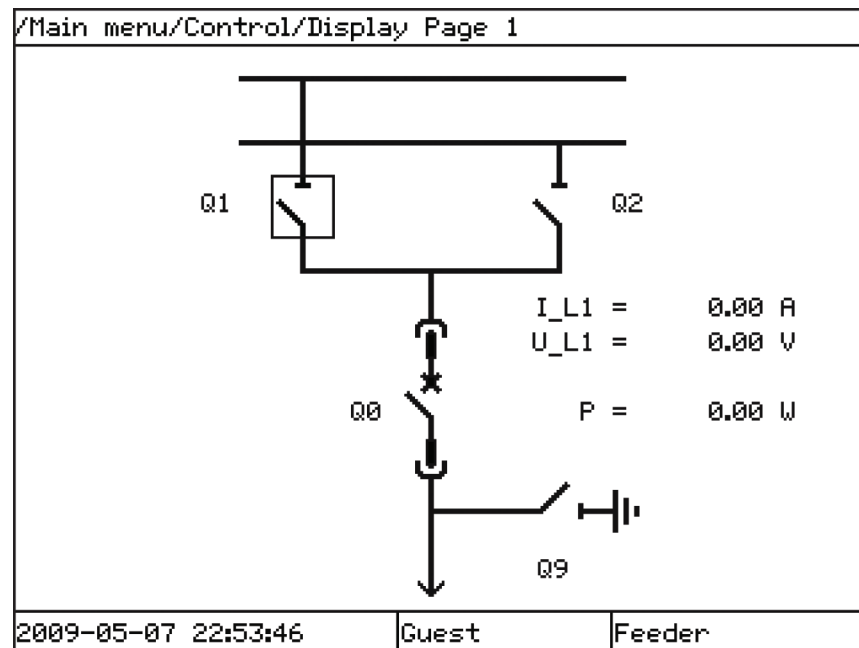


Figure 9: Single-line diagram

3.3

Web HMI

The WHMI enables the user to access the IED via a web browser. The supported Web browser versions are Internet Explorer 8.0, 9.0 and 10.0.



WHMI is disabled by default. To enable the WHMI, select **Main menu/Configuration/HMI/Web HMI/Operation** via the LHMI.

WHMI offers several functions.

- Alarm indications and event lists
- System supervision
- Parameter settings
- Measurement display
- Disturbance records
- Phasor diagram



Viewing phasor diagram with WHMI requires downloading a SVG Viewer plugin.

The menu tree structure on the WHMI is almost identical to the one on the LHMI.

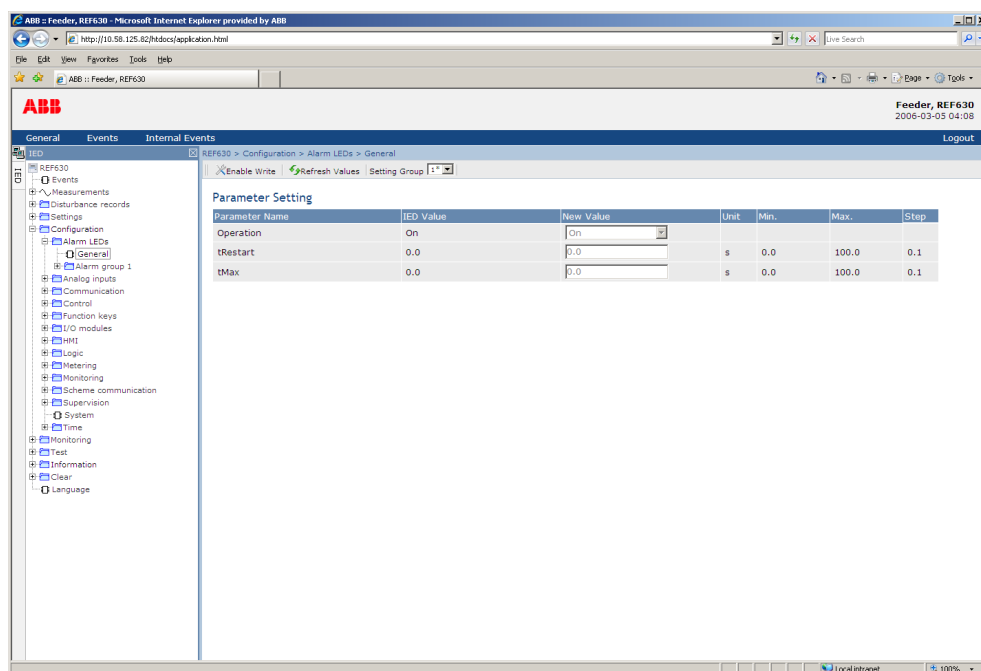


Figure 10: Example view of the WHMI

The WHMI can be accessed locally and remotely.

- Locally by connecting the user's computer to the IED via the front communication port.
- Remotely over LAN/WAN.

3.3.1

Command buttons

Command buttons can be used to edit parameters and control information via the WHMI.

Table 12: Command buttons

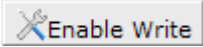

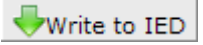
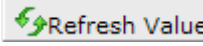


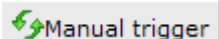
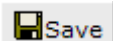

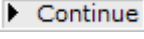
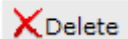
Name	Description
	Enabling parameter editing.
	Disabling parameter editing.
	Writing parameters to the IED.
	Refreshing parameter values.
	Committing changes to IED's non-volatile flash memory.
	Rejecting changes.

Table continues on next page

Name	Description
 Manual trigger	Triggering the disturbance recorder manually.
 Save	Saving the disturbance recording.
 Freeze	Freezing the values so that updates are not displayed.
 Continue	Receiving continuous updates to the monitoring view.
 Delete	Deleting the disturbance record.

3.4 Authorization

At delivery, logging on to the IED is not required to be able to use the LHMI. The IED user has full access to the IED as a SuperUser until users and passwords are created with PCM600 and written into the IED.

The available user categories are predefined for LHMI and WHMI, each with different rights.



Table 13: Available user categories

User category	User rights
SystemOperator	Control from LHMI, no bypass
ProtectionEngineer	All settings
DesignEngineer	Application configuration
UserAdministrator	User and password administration



All changes in user management settings cause the IED to reboot.

3.5 Communication

The protection relay supports communication protocols IEC 61850-8-1, IEC 60870-5-103 and DNP3 over TCP/IP.

All operational information and controls are available through these protocols. However, some communication functionality, for example, horizontal communication (GOOSE) between the protection relays, is only enabled by the IEC 61850-8-1 communication protocol.

Disturbance files are accessed using the IEC 61850 or IEC 60870-5-103 protocols. Disturbance files are also available to any Ethernet based application in the standard COMTRADE format. The protection relay can send binary signals to other protection relays (so called horizontal communication) using the IEC 61850-8-1 GOOSE (Generic Object Oriented Substation Event) profile. Binary GOOSE messaging can, for example, be employed for protection and interlocking-based protection schemes. The protection relay meets the GOOSE performance requirements for tripping applications in distribution substations, as defined by the IEC 61850 standard. Further, the protection relay supports the sending and receiving of analog values using GOOSE messaging. Analog GOOSE messaging enables fast transfer of analog measurement values over the station bus, thus facilitating for example sharing of RTD input values, such as surrounding temperature values, to other relay applications. The protection relay interoperates with other IEC 61850 compliant devices, tools and systems and simultaneously reports events to five different clients on the IEC 61850 station bus. For a system using DNP3 over TCP/IP, events can be sent to four different masters. For systems using IEC 60870-5-103, the protection relay can be connected to one master in a station bus with star-topology.

All communication connectors, except for the front port connector, are placed on integrated communication modules. The protection relay is connected to Ethernet-based communication systems via the RJ-45 connector (10/100BASE-TX) or the fibre-optic multimode LC connector (100BASE-FX).

IEC 60870-5-103 is available from optical serial port where it is possible to use serial glass fibre (ST connector) or serial plastic fibre (snap-in connector).

The protection relay supports the following time synchronization methods with a timestamping resolution of 1 ms.

Ethernet communication based

- SNTP (simple network time protocol)
- DNP3

With special time synchronization wiring

- IRIG-B

IEC 60870-5-103 serial communication has a time-stamping resolution of 10 ms.

3.6 PCM600 tool

Protection and Control IED Manager PCM600 offers all the necessary functionality to work throughout all stages of the protection relay life cycle.

- Planning
- Engineering
- Commissioning
- Operation and disturbance handling
- Functional analysis

The whole substation configuration can be controlled and different tasks and functions can be performed with the individual tool components. PCM600 can operate with many different topologies, depending on the customer needs.



For more information, see the PCM600 documentation.

3.6.1 Connectivity packages

A connectivity package is a software component that consists of executable code and data which enables system tools to communicate with a protection relay. Connectivity packages are used to create configuration structures in PCM600. The latest PCM600 and connectivity packages are backward compatible with older protection relay versions.

A connectivity package includes all the data which is used to describe the protection relay. For example, it contains a list of the existing parameters, data format used, units, setting range, access rights and visibility of the parameters. In addition, it contains code which allows software packages that use the connectivity package to properly communicate with the protection relay. It also supports localization of text even when it is read from the protection relay in a standard format such as COMTRADE.

Update Manager is a tool that helps in defining the right connectivity package versions for different system products and tools. Update Manager is included with the products that use connectivity packages.

3.6.2 PCM600 and IED connectivity package version

- Protection and Control IED Manager PCM600 Ver. 2.5 or later
- ABB REF630 Connectivity Package Ver. 1.3 or later
- ABB REG630 Connectivity Package Ver. 1.3 or later
- ABB REM630 Connectivity Package Ver. 1.3 or later
- ABB RET630 Connectivity Package Ver. 1.3 or later



Download connectivity packages from the ABB Web site
<http://www.abb.com/substationautomation> or directly with Update
Manager in PCM600.

Section 4 Using the HMI

4.1 Using the local HMI

At delivery, logging on is not required and the user has full access until users and passwords are created with PCM600 and written into the IED.

Commands, changing parameter values and resetting indications, for example, are actions requiring password when the password protection is activated. Reading information on the LHMI is always allowed without password.




HMI operations are possible only for authorized users.



Do not switch off the auxiliary power supply to the IED before changes, for example, setting parameter or local/remote control state changes are saved.

A mechanism for limiting the number of writings per time period is included in the IED to prevent the flash memory from wearing out due to too many writings caused by the application configuration. As a consequence, saving application function states may take up to an hour. If the auxiliary power is interrupted before the states are saved, that change is lost. Settings and configuration parameters are saved without delay.





4.1.1 Logging on

1. Press  to activate the logon procedure.
The logon is also activated when attempting a password-protected operation.
2. Select the user name from the list.

Log on	
User:	<input type="text" value="Admin"/>
Password:	*****
OK	Cancel

Figure 11: Selecting the user name

3. Enter the password when prompted digit by digit and select OK.

- Activate the digit to be entered with  and .
- Enter the character with  and .

Upper and lower case letters are also found by scrolling with the vertical arrows.

Log on	
User:	Admin
Password:	*****
OK	Cancel



Figure 12: Entering the password



Passwords are case sensitive.



Only characters A - Z, a - z and 0 - 9 should be used in user names and passwords.

4. Press  to confirm the logon or  to cancel the procedure.
If the logon fails, a message is displayed on the display.

Error
Incorrect password!

Figure 13: Error message indicating an incorrect password



The logon dialog will open if the attempted operation requires another level of user rights.





Once a user is created and written into the IED, logon is possible with the password assigned in the tool. If there is no user created, an attempt to log on causes the display to show a corresponding message.

Log on
No users defined
OK

Figure 14: No user defined

4.1.2 Logging off

The user is automatically logged off after the display timeout. The IED returns to a state where only reading is enabled. Manual logoff is also possible.

1. Press .
2. To confirm logoff, select Yes and press .

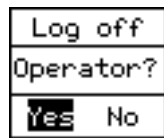



Figure 15: Logging off

- To cancel logoff, press .

4.1.3 Turning the display backlight on

The display backlight is normally off. It turns on at power up.

- To turn on the backlight manually, press any LHMI push button.
The backlight turns on and the panel is ready for further operations.

If the panel has not been used for a predefined timeout period, the backlight is switched off. The user is logged out from the current user level after the display backlight has turned off. The factory default for display timeout is 60 minutes.


The display returns to the default view and all unconfirmed operations, for example parameter editing and breaker selection are cancelled.



Change the backlight timeout period in **Main menu/Configuration/HMI/LHMI/DisplayTimeout**.

4.1.4 Selecting local or remote use

The control position of the protection relay can be changed with the R/L button. In local position primary equipment, such as circuit breakers or disconnectors, can be controlled via the LHMI. In remote position, control operations are possible only from a higher level, that is from a control center.

- Press .
 - When the L LED is lit, local control is enabled and remote control disabled.
 - When the R LED is lit, remote control is enabled and local control disabled.
 - When neither of the LEDs is lit, both control positions are disabled.



By default, the control position cannot be local and remote simultaneously. See the technical manual for more information on local and remote control.



To control the protection relay, log in with the appropriate user rights.

4.1.5

Identifying the device

The IED information includes detailed information about the device, such as revision and serial number.

1. Select **Main menu/Information/Product identifiers**.
2. Select a submenu with and .

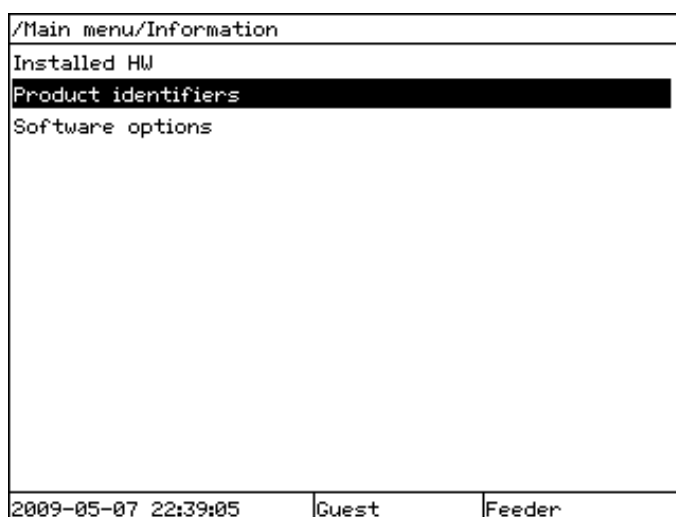


Figure 16: Selecting a submenu





3. Enter the submenu with .
4. Browse the information with and .

/Main menu/Information/Product identifiers		
ProductVer	X.X.X	
ProductDef	X.X.X.X	
SerialNo	1VHRXXXXXXXX	
OrderingNo	XXXXXXXXXXXXXXXXXXXX...	
ProductionDate	YYYY-MM-DD	
2006-08-03 05:13:52	\$SuperUser	Object name

Figure 17: IED information

4.1.6 **Adjusting the display contrast**





Adjust the display contrast anywhere in the menu structure to obtain optimal readability.

- To increase the contrast, press simultaneously  and .
- To decrease the contrast, press simultaneously  and .



To store a selected contrast, change the *ContrastLevel* parameter via **Main menu/Configuration/HMI/LHMI**.

4.1.7 **Changing the local HMI language**

1. Select **Main menu/Language** and press .
2. Change the language using  or .
3. Press  to confirm the selection.
4. Commit the changes.

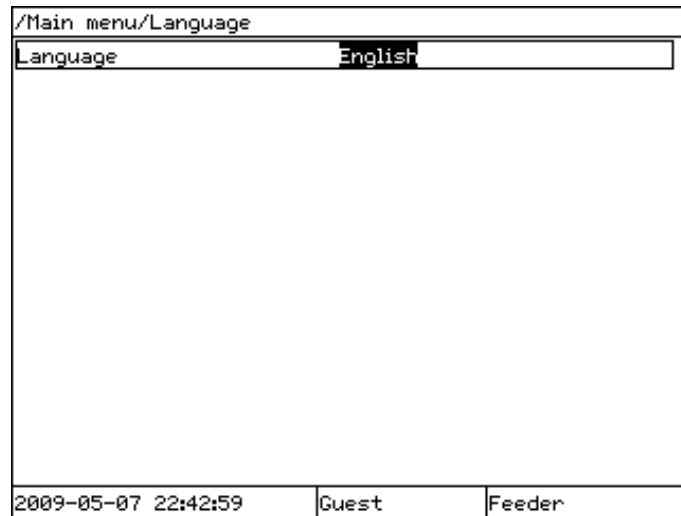









Figure 18: Changing the LHM language

4.1.8 Navigating in the menu

Navigate the menus and change the display views on the screen with the keypad.

- To move to the Main menu or default view, press .
- To move up or down in a menu, press  or .
- To move downwards in the menu tree, press .
- To move upwards in the menu tree, press .
- To enter setting mode, press .
- To leave setting mode without saving, press .

4.1.8.1 Menu structure

The Main menu contains main groups which are divided further into more detailed submenus.





- Control
- Events
- Measurements
- Disturbance records
- Settings
- Configuration
- Monitoring
- Test
- Information
- Clear
- Language

4.1.8.2 Scrolling the display

If a menu contains more rows than the display can show at a time, a scroll bar is displayed on the right.





/Main menu/Configuration/I/O modules/COM		
BatteryVoltage	110	V
BINAME1	BI1	
Threshold1	65	%UB
DebounceTime1	0.010	s
OscillationCount1	0	
OscillationTime1	0.000	s
BINAME2	BI2	
Threshold2	65	%UB
DebounceTime2	0.010	s
OscillationCount2	0	
OscillationTime2	0.000	s
BINAME3	BI3	
Threshold3	65	%UB
DebounceTime3	0.010	s
2012-06-25 14:17:41	\$SuperUser	Feeder

Figure 19: Scroll bar on the right

- To scroll the view upwards, press .
- To scroll the view downwards, press .
- To jump from the last row to the first row, press  again.
 - Press  to jump from the first row to the last row.

4.1.8.3 Changing the default view

The default view of the display is **Main menu** unless set otherwise.

1. Select **Main menu/Configuration/HMI/LHMI/DefaultScreen** and press .
2. Change the default view with  or .
3. Press  to confirm the selection.

4.1.9 Using function buttons

The function buttons can be configured either as menu shortcuts or control buttons. The buttons are functional only when the function button panel is visible.

1. Press any function button to open the function button panel.
On the first press of a button, the panel opens but no other action is taken.

Control LCD_FN1_OFF		
Control LCD_FN2_OFF		
Control LCD_FN3_OFF		
Menu shortcut Events		
Menu shortcut Disturbance records		
	Guest	Feeder

Figure 20: *Function button panel*

2. Press the wanted function button.
 - Press the wanted function button to jump to a certain menu item. The menu opens immediately upon pressing the button.
 - Press the wanted function button for at least 0.5 s to initiate a control signal. The action is taken once. To repeat the action, press the button again. If the button is pressed less than 0.5 s, no action is taken.
3. Press **ESC** to close the function button panel.
The panel is also closed after pressing a function button configured for a menu shortcut.

The function buttons are configured with PCM600.

4.1.10 Using the single-line diagram

The single-line diagram is created with PCM600.

1. Select **Main menu/Control**.
The single-line diagram view is displayed.

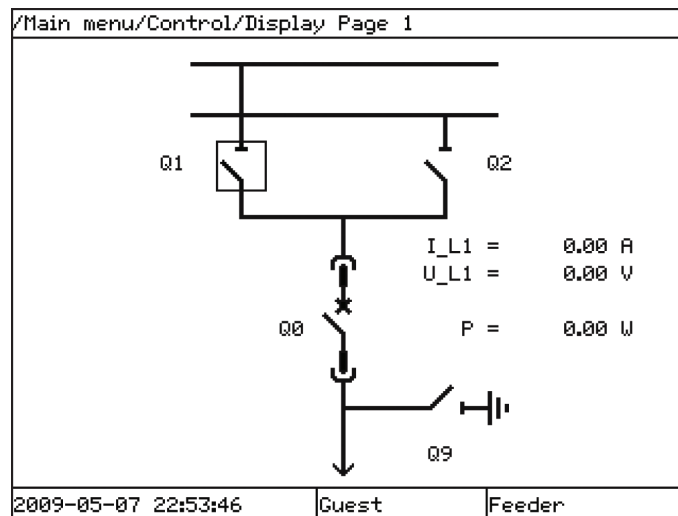












Figure 21: Example of a single-line diagram




2. Make sure that the R/L button is in local position.
3. Select an object with  or .
- Selection of an object is indicated with a square border that moves when  and  are used.
- Switch objects can have additional icons that present the switch object states.
 -  = Switch object is in substituted state.
 -  = Switch object is interlocked.
4. Press  to open or  to close the object.
5. Confirm the control operation in the dialog that opens.
6. To move between the single-line diagram pages, press  or .



Select the single-line diagram for the default view in **Main menu/Configuration/HMI/LHMI/DefaultScreen**.

4.1.11

Browsing setting values

1. Select **Main menu/Settings/Settings** and press .
2. Press  and then  to activate the setting group number selection.



The IED contains only one setting group by default. The number of setting groups can be selected from 1 to 4.

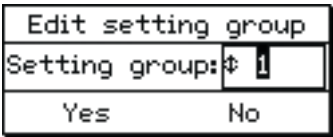










Figure 22: Selecting the setting group number

3. Press  or  to select the setting group number.
4. Press  to confirm the setting group selection and  to return to the Edit setting group dialog.
5. Press  to select Yes and to view the setting group values.
 - Press  or  to select No and  to exit.

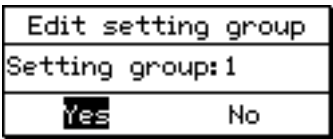






Figure 23: Selecting a setting group

6. To browse the settings, scroll the list with  and  and to select a setting press . To move back to the list, press .

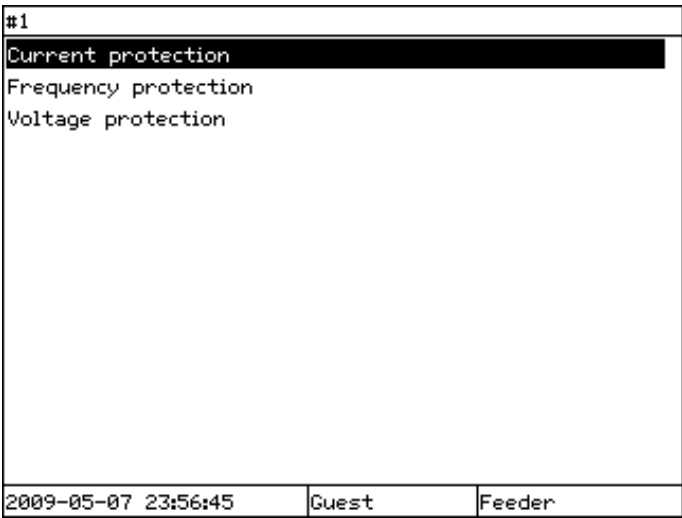


Figure 24: Setting alternatives in the selected setting group

The content of the list depends on the pre-configuration or on the functions configured with PCM600.

4.1.12

Editing values

- To edit values, log in with the appropriate user rights.
If the user rights are not sufficient for editing values, the log on dialog opens.



Parallel editing is not possible. For example, if a value is edited via WHMI or PCM600, the same value cannot be edited via LHMI at the same time.

4.1.12.1

Editing numerical values

1. Select **Main menu/Settings** and then a setting.



The # character on the right indicates that the parameter belongs to a setting group.

The last digit of the value is active.

- When the symbol in front of the value is ↑, the active value can only be increased.
- When the symbol is ↓, the active value can only be decreased.
- When the symbol in front of the value is ↕, the active value can either be increased or decreased.

#1/Current protection/PHHPTOC(51P-2;3I>):1			
INSTNAME	PHHPTOC		
Operation	On		
Base value Sel phase	Phase Grp 1		
Measurement mode	DFT		
Num of start phases	1 out of 3		
Curve parameter A	28.2000		
Curve parameter B	0.1217		
Curve parameter C	2.00		
Curve parameter D	29.10		
Curve parameter E	1.0		
Reset delay time	↑ 0.02	s	
Minimum operate time	0.020	s	
Start value	0.10	pu	#
Start value Mult	1.0		#
2009-05-07 23:59:34	ProtectionEng	Feeder	

Figure 25: Last digit is active and it can be increased or decreased

2. Press ↑ to increase or ↓ to decrease the value of an active digit. One press increases or decreases the value by a certain step. For integer values, the change is 1, 10, 100 or 1000 (...) depending on the active digit. For decimal values, the change can be fractions 0.1, 0.01, 0.001 (...) depending on the active digit.



For parameters with defined steps, digits smaller than the step value cannot be edited.

3. Press or to move the cursor to another digit.
4. To select the minimum or maximum value, select the arrow symbol in front of the value.
 - To set the value to the maximum, press .
 - To set the value to the minimum, press .

After pressing , the previous value can be restored by pressing once, and vice versa. Another press of or sets the value to the lower or higher limit. The symbol in front of the value is , when the previous value is shown.

#1/Current protection/PHHPTOC(51P-2;3I>>):1		
INSTNAME	PHHPTOC	
Operation	On	
Base value Sel phase	Phase Grp 1	
Measurement mode	DFT	
Num of start phases	1 out of 3	
Curve parameter A	28.2000	
Curve parameter B	0.1217	
Curve parameter C	2.00	
Curve parameter D	29.10	
Curve parameter E	1.0	
Reset delay time	0.020	s
Minimum operate time	0.020	s
Start value	0.10	pu #
Start value Mult	1.0	#
2009-05-08 00:01:56	ProtectionEng	Feeder

Figure 26: Restoring the previous value

4.1.12.2

Editing string values



1. Activate the setting mode and select a setting.
When editing string values, the cursor moves to the first character.
2. Press or to change the value of an active character.
One press changes the value by one step.
3. Press or to move the cursor to another character.
 - To insert characters or space, press simultaneously and .
 - To delete characters, press simultaneously and .

4.1.12.3

Editing enumerated values



1. Activate the setting mode and select a setting.

When editing an enumerated value, the selected value is shown inverted.

2. Press  or  to change the value of an active enumerated value. One press changes the enumerated value by one step in the parameter specific order.

4.1.12.4





Changing the time settings in LHMI

1. Select **Main menu/Configuration/Time/System time**. The change takes effect immediately.
2. Press  to confirm the selection.
 - Press  to remove the changes.

4.1.13

Saving settings

Editable values are stored in the non-volatile flash memory. Most of the parameter changes take effect immediately after storing, but some parameter changes require application restart. Values stored in the flash memory remain in effect after reboot as well.

1. Press  to confirm any changes.
2. Press  to move upwards in the menu tree or  to enter the Main Menu.
3. To save the changes in non-volatile memory, select Yes and press .

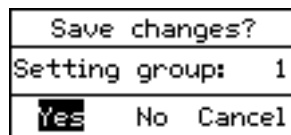




Figure 27: Confirming settings

- To exit without saving changes, select No and press .
- To cancel saving settings, select Cancel and press .



Pressing Cancel in the Save changes dialog closes only the Save changes dialog box, but the IED remains in editing mode. All the changes applied to any setting are not lost and the user can continue to change settings. To leave the change setting mode, select No or Yes in the Save changes dialog.



After changing the parameters marked with !, the IED restarts automatically for the changes to take effect.

4.1.14 Clearing and acknowledging

The Clear button is used to reset, acknowledge or clear all messages and indications, including LEDs and latched outputs as well as registers and recordings. Press the Clear button to activate a selection menu, and select the wanted clearance or reset function. Events and alarms assigned to alarm LEDs are cleared with the Clear button as well.

1. Press **Clear** to activate the Clear view.

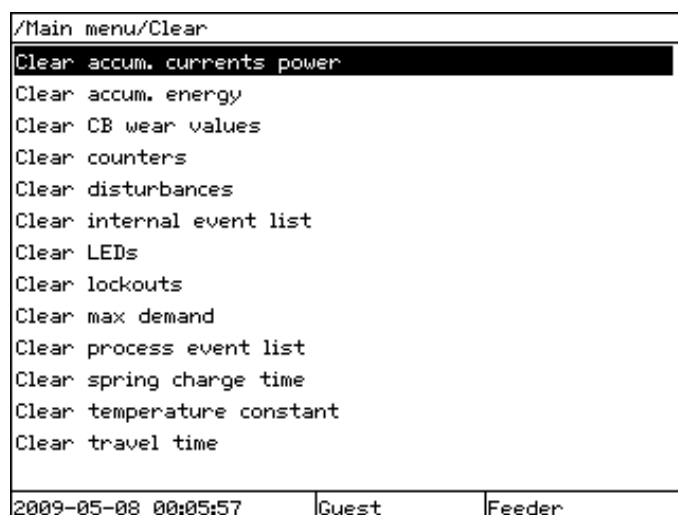


Figure 28: Clear view

The content of the Clear menu depends on the pre-configuration or on the functions configured with PCM600.

2. Select the item to be cleared with **↑** or **↓**.
3. Press **→**, select OK to confirm the selection or Cancel to cancel the selection, and press **←**.
4. Repeat steps 2 and 3 to clear other items.

4.1.15 Using the local HMI help

1. Press **?** to open the help view.
2. Scroll the text with **↑** or **↓** if the help text exceeds the display area.
3. To close the help, press **ESC**.

The help dialog is also closed when the display timeout expires.

4.2 Using the Web HMI

WHMI is disabled by default.

1. To enable the WHMI, select **Main menu/Configuration/HMI/Web HMI/Operation** via the LHMI.
2. To enable writing through the WHMI, select **Main menu/Configuration/HMI/Web HMI/Write mode** via the LHMI.
3. To open the WHMI, write the IED IP address to the address bar of the browser.



Do not use favorites in the web browser. If the user is unauthorized and selects a favorite pointing to a WHMI page, the action can redirect the user to the log in page. With authorization the user is redirected to the startup page.

4.2.1 Logging in

If no users have been created with PCM600, both the default user ID and password is SuperUser.

1. Enter the username.
2. Enter the password.
3. Click **OK**.

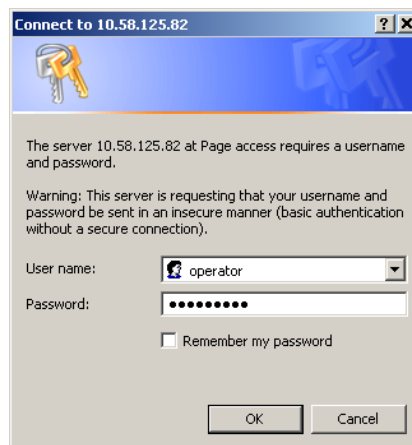


Figure 29: Entering username and password to use the WHMI

4.2.2

Logging out

The user is logged out after a session time-out.

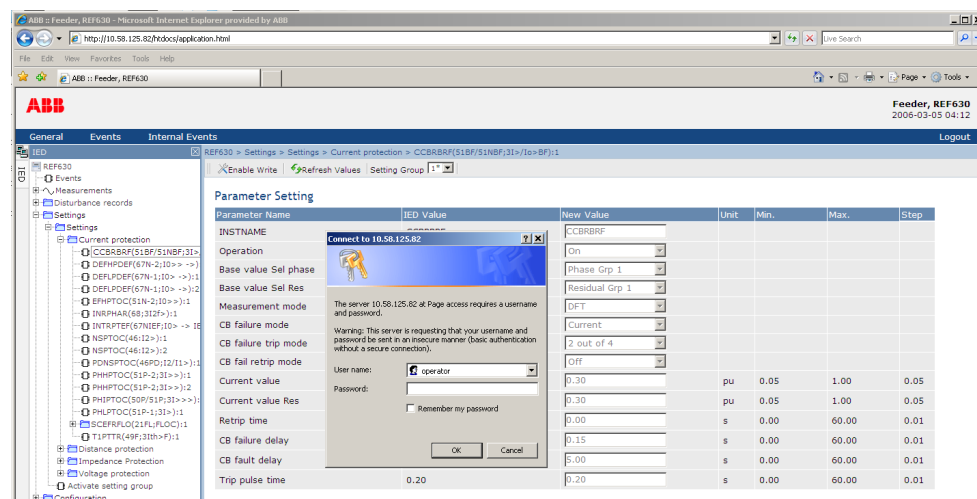


Figure 30: Session time-out

- To log out manually, click **Logout** on the menu bar.

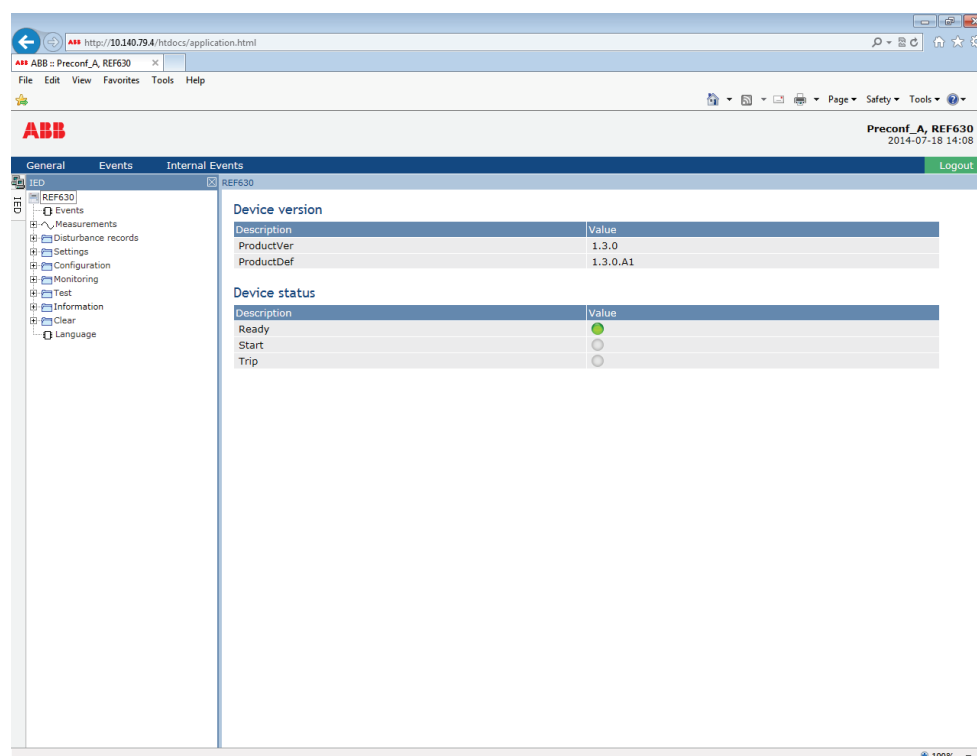


Figure 31: WHMI logout

If the WHMI is closed without properly logging out, the WHMI does not reconnect until the set session time-out.

4.2.3 Identifying the device

The IED information includes detailed information about the device, for example, revision and serial number.

1. Click **Information** in the WHMI menu structure.
2. Click a submenu to see the data.

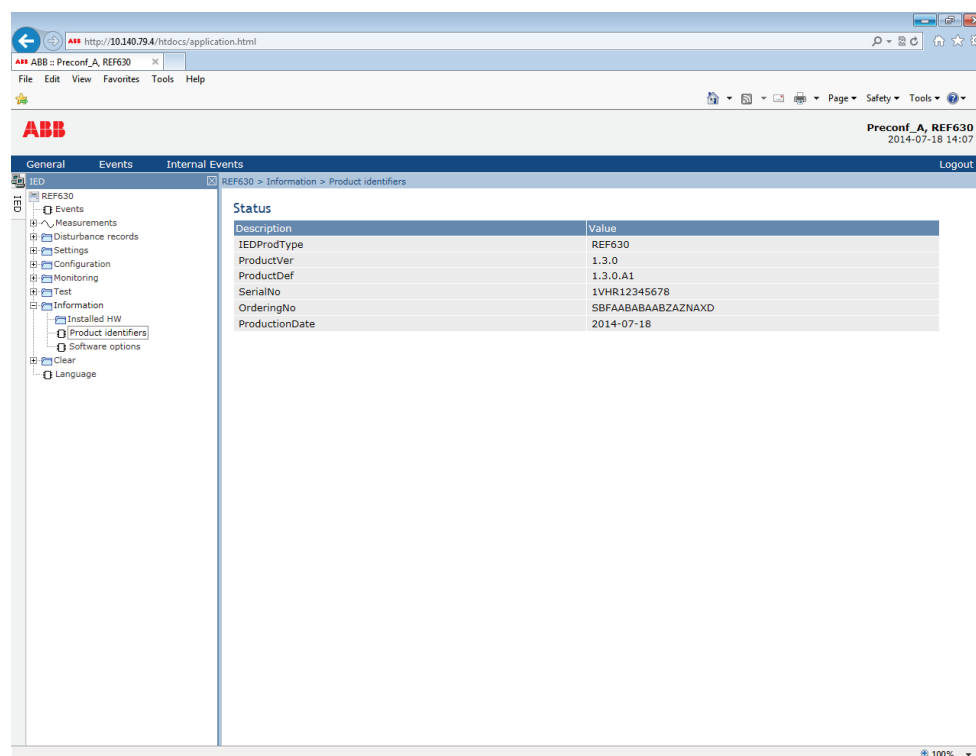


Figure 32: Device information

4.2.4 Navigating in the menu

The menu tree structure on the WHMI is almost identical to the one on the LHMI. Use the menu bar to access different views.

- The **General** view shows the IED version and status.
- The **Events** view contains a list of events produced by the application configuration.
- **Logout** ends the session.

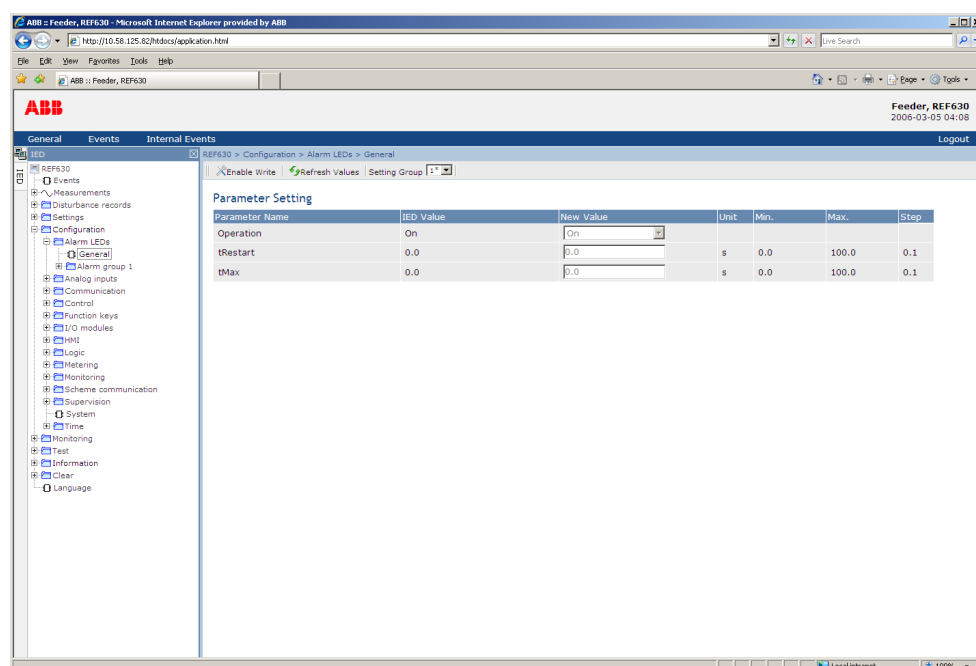


Figure 33: Navigating in the WHMI menus

4.2.4.1

Menu structure

The Main menu contains main groups which are divided further into more detailed submenus.

- Events
- Measurements
- Disturbance records
- Settings
- Configuration
- Monitoring
- Test
- Information
- Clear
- Language

4.2.5

Showing all parameters

1. Click **Parameter list** in the main menu.
2. Click **Print** to print out all parameters on paper.
3. Click **Save** to save all parameters in CSV file format.

4.2.6

Editing values

1. Click the menu in the WHMI tree.
2. Click the submenu to see function blocks.
3. Click a function block to see the setting values.
4. Click **Enable Write**.



Some parameters, for example, the IED test mode, cannot be set via the WHMI.

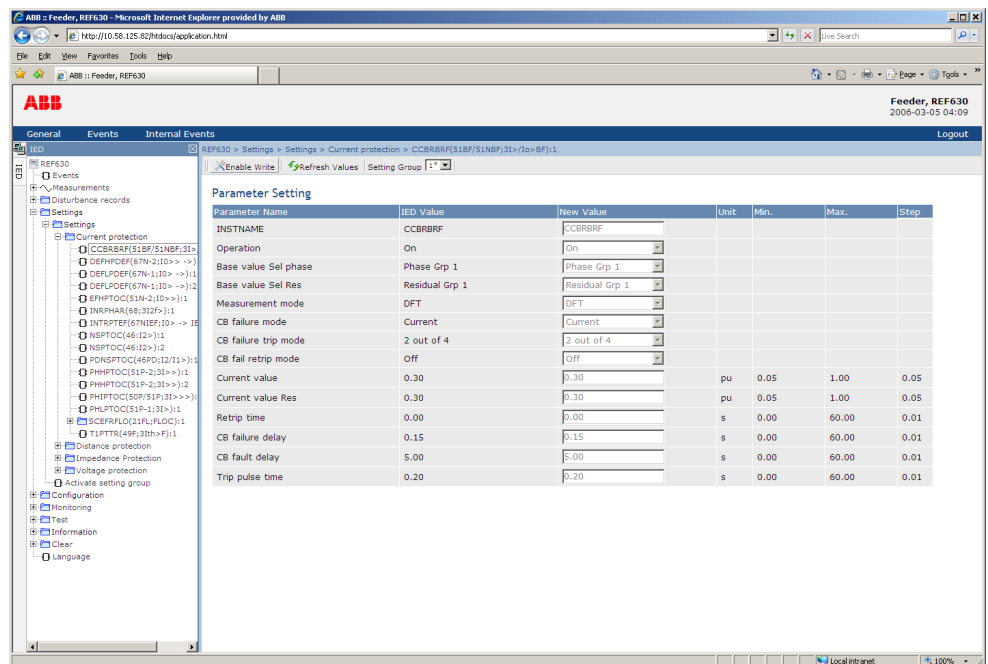


Figure 34: Enable writing to edit a value

The selected setting group is shown in the Setting Group drop-down list. The active setting group is indicated with an asterisk *.

5. Edit the value.
 - The minimum, maximum and step values for a parameter are shown in the Min., Max. and Step columns.
 - Setting group values are indicated with #.

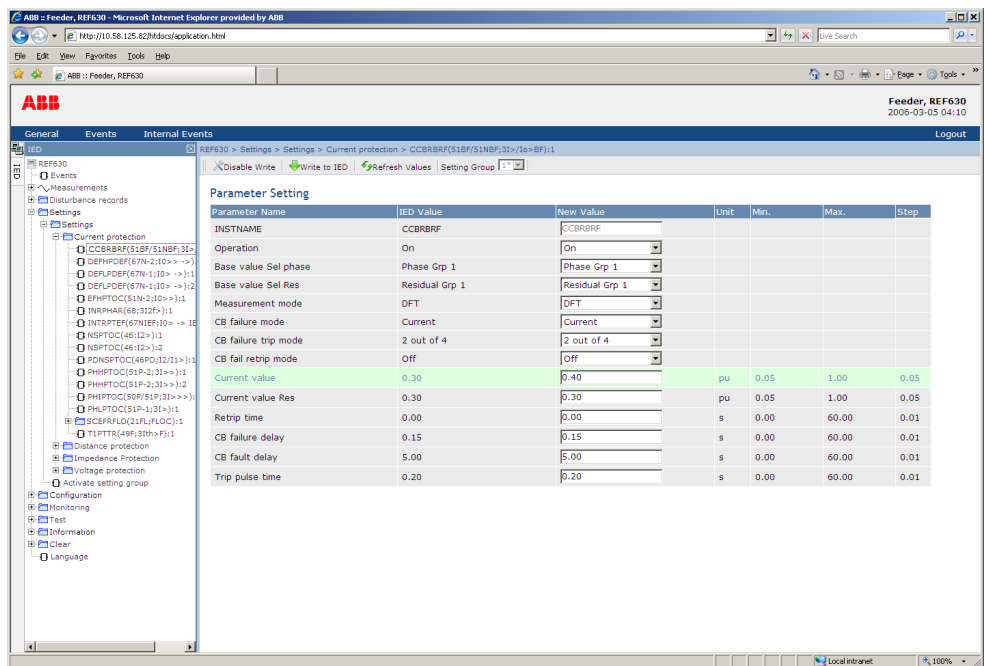


Figure 35: Editing a value

- If the entered value is within the accepted value range, the selection is highlighted in green. If the value is out of range, the row is highlighted in red and a warning dialog box is displayed.



Figure 36: Warning indicating that the entered value is incorrect

- If writing values fails, a warning dialog box is displayed.

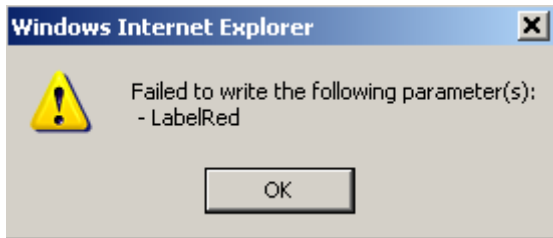


Figure 37: Warning indicating that the values were not written to the IED

If writing is enabled accidentally, click **Disable Write**. **Disable Write** cannot be selected, when a value has already been written to the IED. After clicking **Write to IED**, click either **Commit** or **Reject**.

4.2.7

Committing settings

Editable values are stored in the non-volatile flash memory. Values stored in the flash memory are in effect also after reboot.

1. Edit setting values.
2. Click **Write to IED**.
The values are written into the IED, but not taken into use.

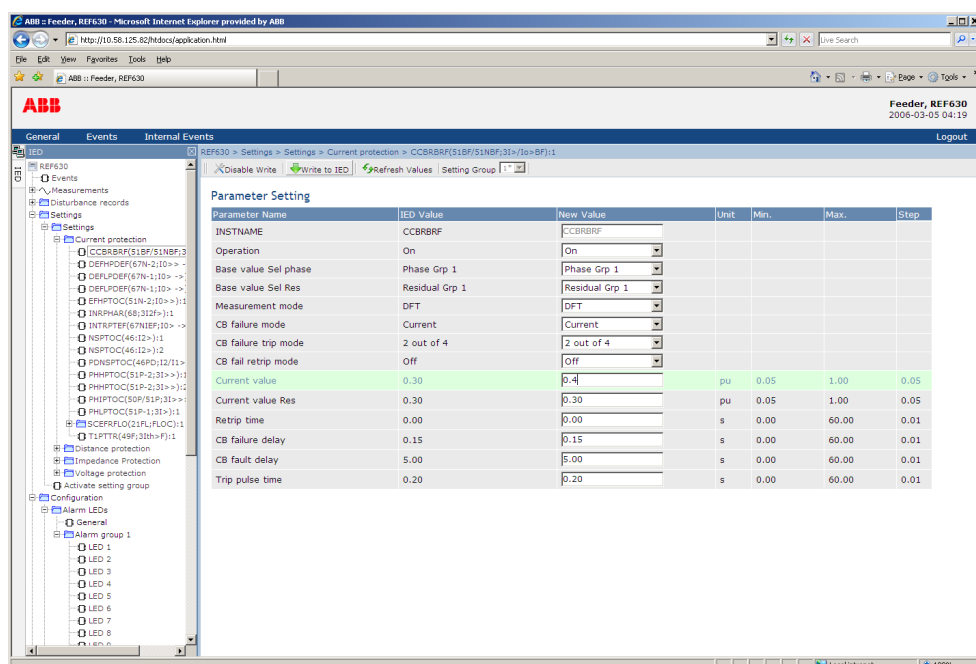


Figure 38: Writing values to the IED

3. Commit or reject new values.
 - Click **Commit** to save the values.
The new values are saved in the non-volatile memory and taken into use.
 - Click **Reject** to cancel saving the settings.

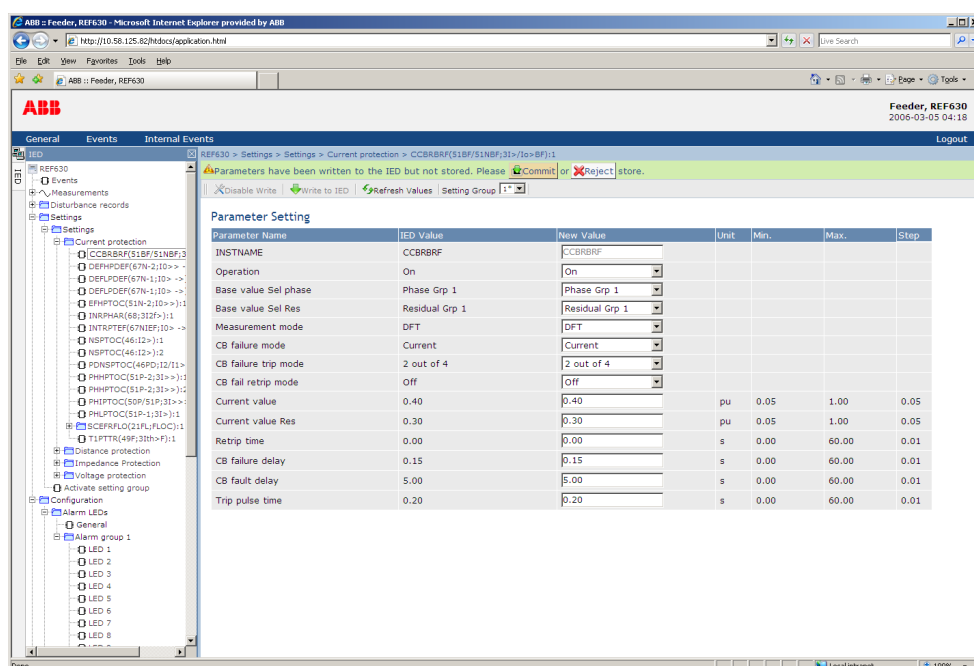


Figure 39: Committing changes



Committing values takes a few seconds.



If the values are not committed, they are not taken into use and they are lost after a reboot. However, in case of changing the time settings in WHMI, the change takes effect immediately without committing the changes.

4.2.8

Clearing and acknowledging

Reset, acknowledge or clear all messages and indications, including LEDs and latched outputs as well as registers and recordings, in the Clear menu.

1. Click the **Clear** menu.
2. In the **New Value** box, click **Clear** to select the item to be cleared.
3. Click **Write to IED**.

4.2.9

Selecting the event view

The event view contains a list of events produced by the application configuration. The default view shows the latest events. The event list is updated if the event count

changes while the user is viewing the latest events. If the user is viewing older events while the event count changes, only the drop-down list is updated.

1. Click **Events** on the menu bar.
Each event view page shows 100 events.

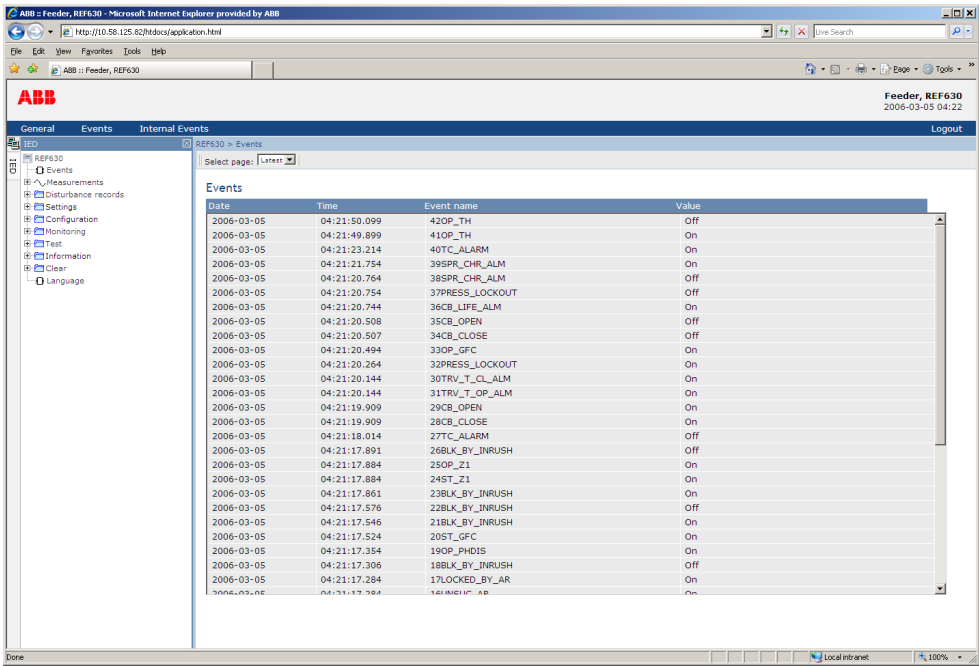


Figure 40: Monitoring events

2. To view older events, select the event range from the drop-down menu on the toolbar.

4.2.10 Selecting the disturbance record view

Disturbance records are listed in the disturbance records view.

- Select **Disturbance records/Recordings**.

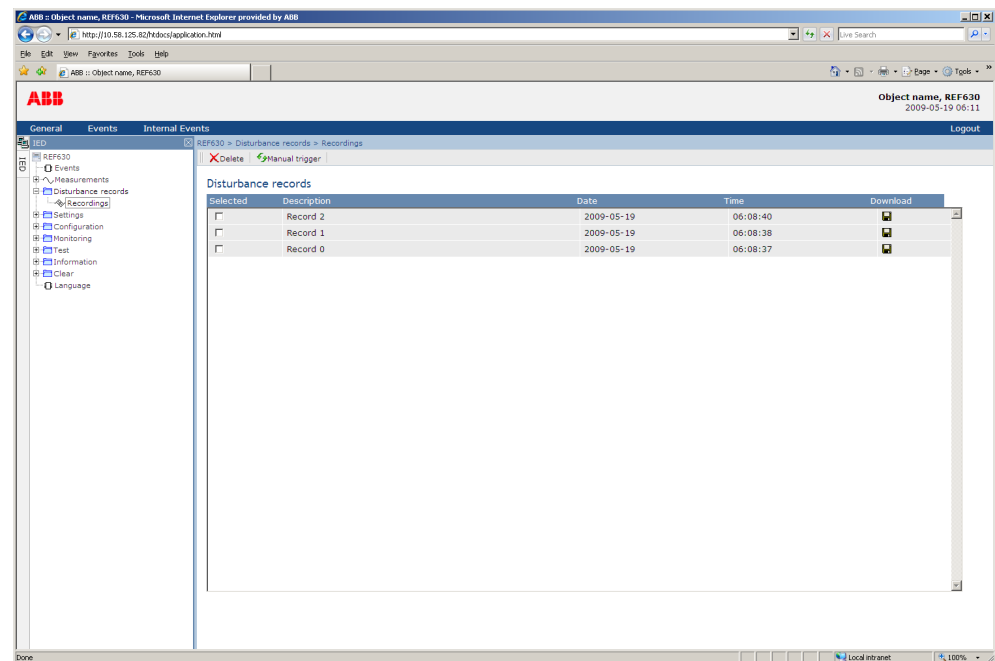


Figure 41: Disturbance record view

4.2.10.1

Reading disturbance records

1. Select **Disturbance records/Recordings**.
2. Click the icon in the Download column of the record to read a disturbance record.

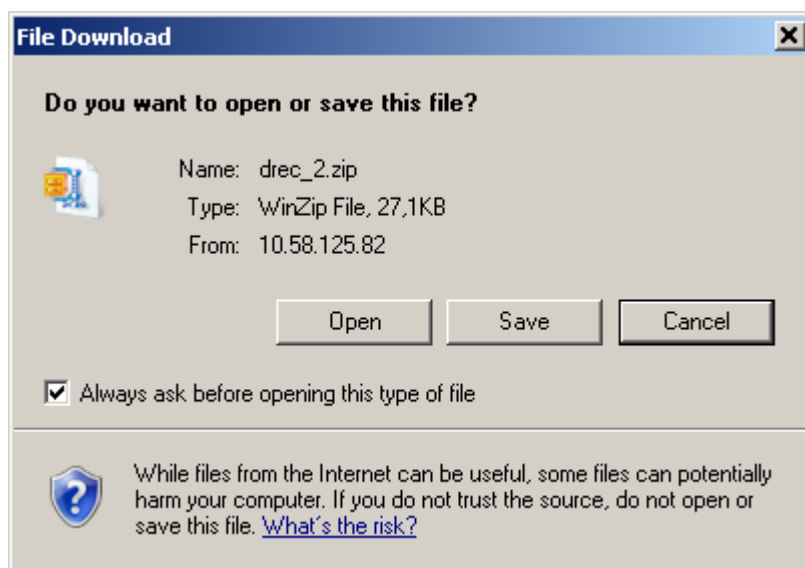


Figure 42: Reading a disturbance record

3. Save the zip file on your computer.
4. Extract the files in the same folder on your computer.
5. Open the disturbance record files with a suitable program.
Files are in standard COMTRADE format.

4.2.10.2

Triggering the disturbance recorder manually

1. Select **Disturbance records/Recordings**.
2. Click **Manual trigger**.

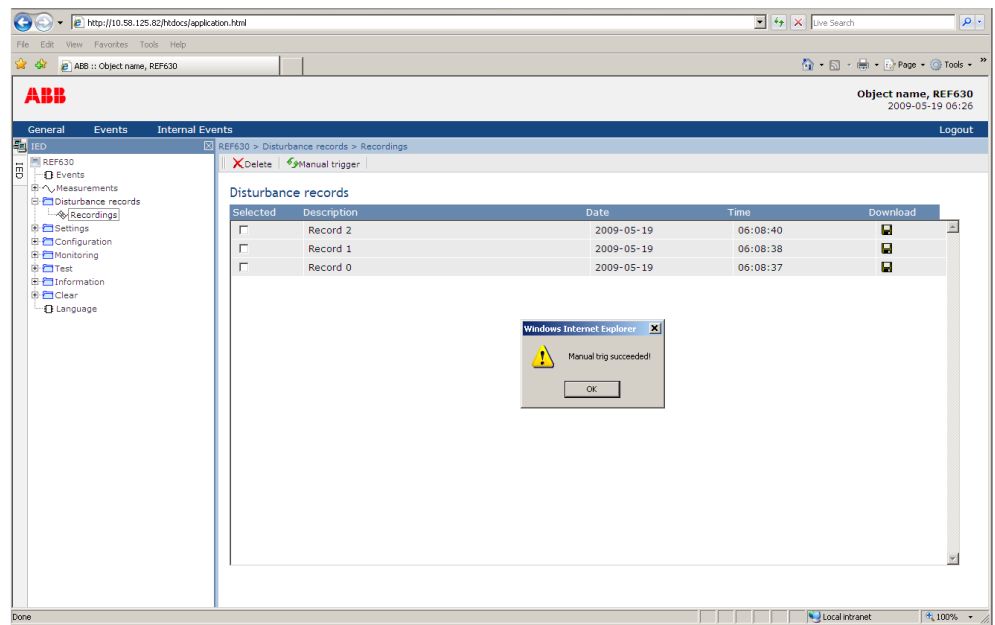


Figure 43: Manual triggering

4.2.10.3

Deleting disturbance records

1. Select **Disturbance records/Recordings**.
2. Select one or more recordings and click **Delete** to delete selected records. To delete all records, select **Clear disturbances** in the **Clear** menu.

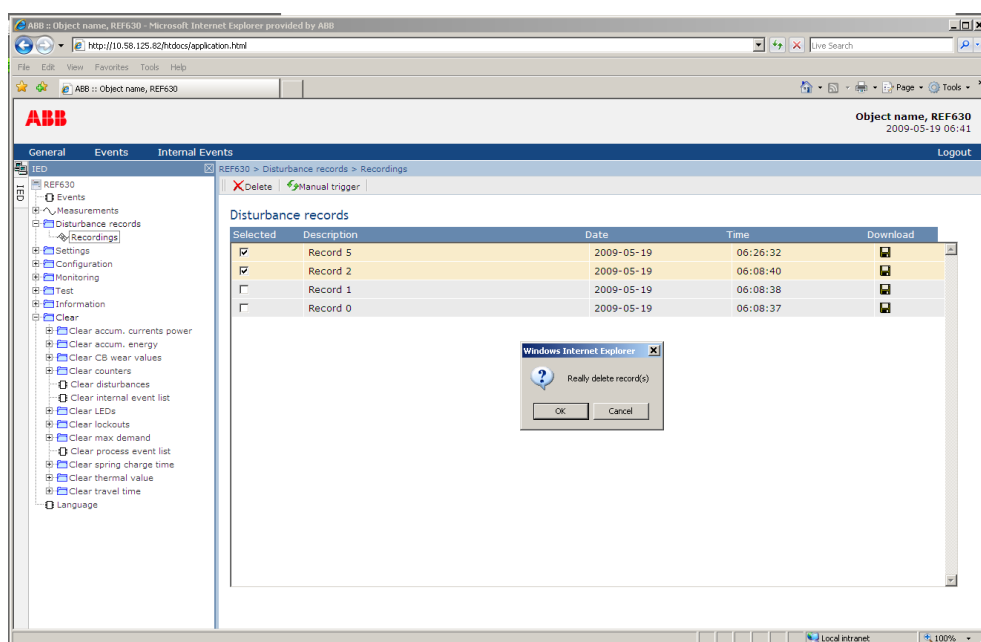


Figure 44: Deleting disturbance records

- Click **OK** to confirm or **Cancel** to cancel the deletion.

4.2.11

Selecting phasor diagrams



Install or enable the SVG plugin to view the phasor diagrams, if needed.

- Click **Phasor diagrams** on the menu bar.

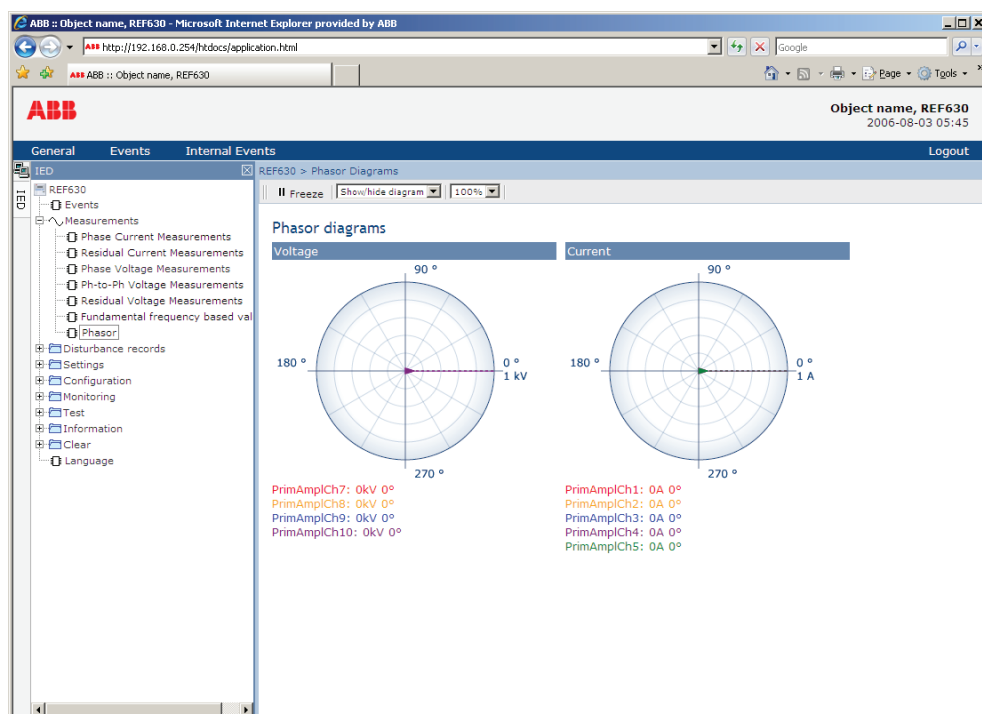


Figure 45: Selecting phasor diagrams

2. Toggle the diagram visibility by selecting the diagram from the drop-down menu.
Visible diagrams are indicated with an asterisk *.
3. Change the size of the diagram by changing the zoom value.
4. Click **Freeze** to stop updating the phasor diagram.
No updates are displayed in the diagram.

Section 5 IED operation

5.1 Normal operation

In a normal protection relay use situation, the basic operation includes monitoring and checking procedures.

- Monitoring measured values
- Checking object states
- Checking function setting parameters
- Checking events and alarms

All basic operations can be performed via the LHMI, WHMI or with PCM600.



For more information, see the PCM600 documentation.

5.2 Disturbance identification

Disturbances and their causes can be identified by indicator LEDs: Ready, Start and Trip. During normal operation, the Ready LED is steady green.

Table 14: *Disturbance indications*

LED	State	Description
Start LED	Yellow, steady	Protection started
Trip LED	Red, steady	Protection operated

Further actions to be taken to identify the disturbance:

- Checking programmable LEDs
- Reading event history
- Checking fault records
- Analyzing disturbance recordings



Document the disturbance before clearing the information from the protection relay.



Only authorized and skilled personnel should analyze possible errors and decide on further actions. Otherwise, stored disturbance data can be lost.

5.2.1 Disturbance recording triggering

Disturbance recordings are normally triggered by protection relay applications when they detect fault events. Disturbance recordings can also be triggered manually or periodically. The manual trigger generates an instant disturbance report. Use this function to get a snapshot of the monitored signals.

5.2.2 Disturbance record analysis

The protection relay collects disturbance records of fault events which are set to trigger the disturbance recorder. Disturbance data is collected and stored for later viewing and analysis. The disturbance recorder data can be read and analyzed with PCM600.



For more information, see the PCM600 documentation.

5.2.3 Disturbance reports

PCM600 can be used for creating reports of disturbance recorder data.



For more information, see the PCM600 documentation.

5.2.4 Relay self-supervision

The relay self-supervision handles internal run-time fault situations. The main indication of an internal fault is a flashing green Ready LED.

More detailed information can be found from **Main menu/Monitoring/IED status** or **Main menu/Monitoring/Internal events**.

Internal faults can be divided to hardware errors, run-time errors in the application or operating system and communication errors. Further actions always depend on the cause of the error.



Only authorized and skilled personnel should analyze the errors and decide on further actions.

The protection relay records relay status data and events.



Document all the recorded data from the protection relay before resetting the tripping and relay lockout functions.

5.3

Relay parametrization

Protection relay parameters are set via the LHMI, WHMI or PCM600.

Setting parameters need to be calculated according to the electrical network conditions and the electrical characteristics of the protected equipment. The protection relay's settings need to be verified before the protection relay is connected to a system.



Document all changes to parameter settings.



For more information, see the PCM600 documentation.



Do not switch off the auxiliary power supply to the protection relay before changes, for example, setting parameter or local/remote control state changes are saved.

A mechanism for limiting the number of writings per time period is included in the protection relay to prevent the flash memory from wearing out due to too many writings caused by the application configuration. As a consequence, saving application function states may take up to an hour. If the auxiliary power is interrupted before the states are saved, that change is lost. Settings and configuration parameters are saved without delay.

5.3.1

Settings for relay functionality

Function settings can be edited one by one by navigating to the individual setting values, for example via the LHMI. The values in other setting groups should be known before editing a certain setting value.

After completing the editing of setting group values, the new values are activated. The user can either commit the edited values or discard them.

5.3.2

Settings for different operating conditions

Protection relay settings can be designed for various operation conditions by defining different setting values to different setting groups. The active setting group can be changed by the relay application or manually via the LHMI, WHMI or PCM600.



The protection relay contains only one setting group by default. The number of setting groups can be selected from 1 to 4.

Section 6 Operating procedures



6.1 Monitoring

6.1.1 Indications

The operation of the IED can be monitored via three different indications on the LHMI.




- Three indicator LEDs with fixed functionality: Ready, Start and Trip
- 15 programmable three-color alarm LEDs which can present 45 virtual LED states
 - Texts which are shown on the alarm view can be programmed for each LED colour and off state. Programming can be done with PCM600, via WHMI and LHMI. These texts are displayed on the LHMI.
- An auto-indicating message on the display.

6.1.1.1 Using auto-indication messages

Auto-indication messages are shown in a dialog box that is displayed when the disturbance recorder is triggered. The indication dialog box shows a list of current disturbance recordings one by one. To scroll the dialog, use  and .



To activate the auto-indication message function, the disturbance recorder function has to be activated and properly configured. Check also that the setting **Main menu/Configuration/HMI/LHMI/AutoIndicationDRP** is set to “On”.






1. Read the auto-indication message in the dialog box.
The message contains the same information that is available for disturbance recordings.
2. Press  to see more detailed information.
3. Press  to close the auto-indication message without clearing it or press  to activate the Clear view and to clear messages.

/Main menu		
Control		
Events		
Measurements		
Disturbance records		
Settings		
Configuration		
Monitoring		
Test		
Information		
Clear		
Language		
Auto-indication		
Record66	2009-05-08 00:17:47	TC_ALARM_3
Record65	2009-05-08 00:17:44	SPR_CHR_ALM
2009-05-08 00:18:53	Guest	Feeder

Figure 46: Auto-indication message

6.1.1.2 Monitoring alarm data

Active alarms are indicated by the alarm LEDs and the LED in the Multipage button. The alarms are configured with PCM600. The alarm type and information depend on the application configuration.

- 1. Press  to open the alarm view.
- 2. Press  or  to move between active alarms in the page, or press  to switch between the three alarm pages.
- 3. Press  to open a dialog box that shows more detailed information about the selected alarm.

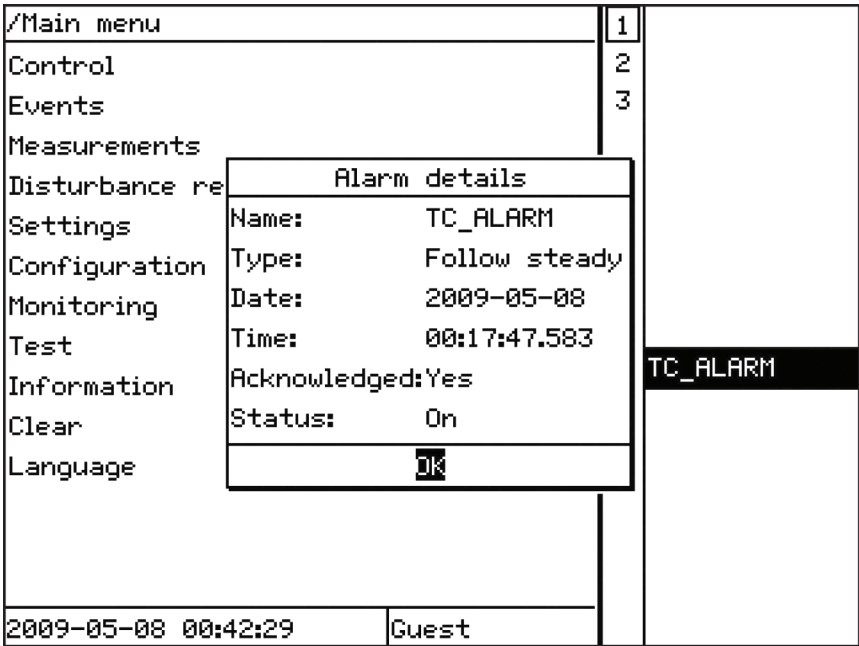






Figure 47: Alarm details

- Press  or  to close the dialog box.
- Press  to close the alarm view.
 - Press  to activate the Clear view and to clear alarms.

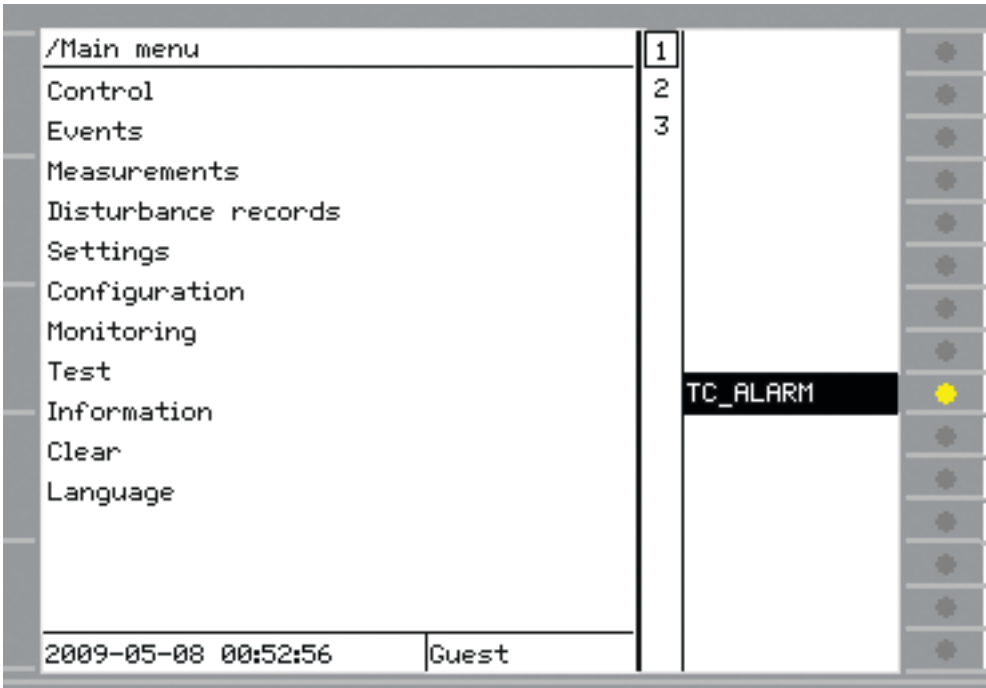




Figure 48: Alarm data

6.1.1.3 **Monitoring an internal IED fault**

The flashing green LED indicates an internal IED fault. The fault messages are found in the LHMI menu.

- 1. Select **Main menu/Monitoring/Internal events** or **Main menu/Monitoring/IED status** to monitor the latest fault indication.
- 2. Press  or  to scroll the view.



/Main menu/Monitoring/IED status		
Item	Status	
Internal fail	Off	
Internal warning	Off	
Time synch	Ready	
Real time clock	Ready	
Application	Ready	
Runtime execution	Ready	
IEC61850	Ready	
DNP3	Ready	
COM1	Ready	
PSM1	Ready	
TRM2	Ready	
RTD3	Ready	
BIO4	Ready	
Battery 1	Ready	
2006-08-03 05:52:17	\$SuperUser	Object name

Figure 49: *Fault indication*



The internal event list is not updated dynamically. To update the list, leave the **Internal events** menu and then select it again.

6.1.1.4 **Monitoring condition monitoring data**

- 1. Select **Main menu/Monitoring/I/O status/Monitoring**.
- 2. Press  or  to scroll the view.

With PCM600 the user can map output signals from condition monitoring related function blocks to the appropriate destinations.

6.1.2 **Measured and calculated values**

All values show the momentary measurement value and some include demand values calculated from a set period.

Measured and calculated values can be accessed through the LHMI, WHMI and PCM600. Measured and calculated values are based on the RMS mode. These values

are also available through the station communication protocols. On LHMI also the fundamental frequency based values (DFT) are available.





Invalid or questionable measurement values are presented in parentheses.

6.1.2.1

Using the local HMI or Web HMI for monitoring

- Select **Main menu/Measurements** to monitor measured and calculated values.
Fundamental frequency based values submenu shows values in the DFT mode. Available measured and calculated values depend on measurement functions which are included in the application configuration.



On the LHMI, the selected submenu can be scrolled with  and .

WHMI supports the phasor diagrams that can be found under the measurement node in the navigation tree. Phasor diagrams are based on values that can be found under Fundamental frequency based values.

6.1.2.2

Using PCM600 for monitoring

1. Start Signal Monitoring tool when connected to the IED.
2. Select the measuring function to be monitored.

Monitored values can also be exported as an Excel worksheet.

See PCM600 documentation for more details about Signal Monitoring.

6.1.3

Recorded data

The protection relay is provided with intelligent and flexible functionality that collects different kinds of data. The recorded data gives substantial information for post fault analysis.




- Disturbance records
- Events

6.1.3.1 **Creating disturbance recordings**

Normally disturbance recordings are triggered by the IED applications but the recording can also be triggered manually.



Set the DRRDRE *Operation* to “On” via the LHMI or PCM600. At least one channel has to be connected.

- 1. Select **Main menu/Disturbance records**.
- 2. Select **Manual Trig** with  or .
- 3. Press  to execute manual triggering.



/Main menu/Disturbance records			
Record66	2009-05-08 00:17:47	TC_ALARM_3	
Record65	2009-05-08 00:17:44	SPR_CHR_ALM	
Record64	2009-05-07 23:56:02	TC_ALARM_3	
Record63	2009-05-07 23:55:59	SPR_CHR_ALM	
Record62	2009-05-07 22:29:14	TC_ALARM_1	
Record61	2009-05-07 22:29:11	SPR_CHR_ALM	
Record60	2009-05-07 22:23:43	TC_ALARM_1	
Record59	2009-05-07 22:23:40	SPR_CHR_ALM	
Record58	2009-05-07 21:57:04	TC_ALARM_1	
Record57	2009-05-07 21:57:01	SPR_CHR_ALM	
Record56	2009-05-07 21:54:34	TC_ALARM_1	
Record55	2009-05-07 21:54:31	SPR_CHR_ALM	
Record54	2009-05-07 21:50:51	TC_ALARM_1	
Record53	2009-05-07 21:50:48	SPR_CHR_ALM	
Manual trig			
2009-05-08 00:57:16	Guest	Feeder	

Figure 50: *Manual triggering*

The disturbance recorder is now triggered.


6.1.3.2 **Monitoring disturbance recorder data**

Read individual disturbance recordings from the IED with the PCM600 software to monitor disturbance recorder data.

- 1. Select **Main menu/Disturbance records**.
All disturbance records are listed.
- 2. Scroll the view with  or .

/Main menu/Disturbance records			
Record66	2009-05-08 00:17:47	TC_ALARM_3	
Record65	2009-05-08 00:17:44	SPR_CHR_ALM	
Record64	2009-05-07 23:56:02	TC_ALARM_3	
Record63	2009-05-07 23:55:59	SPR_CHR_ALM	
Record62	2009-05-07 22:29:14	TC_ALARM_1	
Record61	2009-05-07 22:29:11	SPR_CHR_ALM	
Record60	2009-05-07 22:23:43	TC_ALARM_1	
Record59	2009-05-07 22:23:40	SPR_CHR_ALM	
Record58	2009-05-07 21:57:04	TC_ALARM_1	
Record57	2009-05-07 21:57:01	SPR_CHR_ALM	
Record56	2009-05-07 21:54:34	TC_ALARM_1	
Record55	2009-05-07 21:54:31	SPR_CHR_ALM	
Record54	2009-05-07 21:50:51	TC_ALARM_1	
Record53	2009-05-07 21:50:48	SPR_CHR_ALM	
Manual trig			
2009-05-08 00:59:12	Guest	Feeder	

Figure 51: Monitoring disturbance recorder via the LHMI

- To view a specific disturbance record, press . A list of detail categories is displayed.

/Main menu/Disturbance records/Record66		
Recording number	66	2009-05-08 00:17:47.583
General information		
Indications		
Event recording		
Trip values		
2009-05-08 01:00:27	Guest	Feeder

Figure 52: Disturbance record data categories

4. To select a category and view the items under it, press or and then .

6.1.3.3 Controlling and reading of disturbance recorder data

Disturbance recorder data can be controlled and read with PCM600. It can also be read via WHMI.







For more information, see the PCM600 documentation.

6.1.3.4 Monitoring recorded data

Some functions, for example, distance protection and fault locator, include data recording functionality. All the information required for later fault analysis is recorded when the function is triggered either internally or externally.

One or three sets of recorded data are available saved in data banks 1-3. The data bank 1 always holds the most recent recorded data. When a new triggering occurs, older data is moved into the next banks (from 1 to 2, and from 2 to 3). When all three banks already contain data, and a new triggering occurs, the data in bank 3 is overwritten.

For some functions, only one set of recorded data is available. In this case, the recorded data always overwrites the older data in data bank 1.

1. Select **Main menu/Monitoring/I/O status/Protection/[Protection type]/[Function]/Recorded data**.
2. To navigate between the fault records, press  and .
3. To enter or exit a submenu, press  or .

...protection/DSTPDIS/Recorded data/Recorded data 1 CFG		
INSTNAME	DSTPDIS	
1 Recording time GFC	2009-04-23 01:27:59	
1 RELEASE_PE GFC	No releases	
1 RELEASE_PP GFC	Release PhABC	
1 EARTH_FLT GFC	No	
1 XC_FLT GFC	No	
1 DIR_E_FLT GFC	Unknown	
1 DIRECTION	Forward	
1 Zones OPERATE	Zn1	
2009-04-23 01:29:22	Guest	END

Figure 53: Monitoring fault records




Monitoring fault locator data

When the fault locator function is triggered, fault location data is output. The data is kept unchanged until the next triggering or reset.

- To monitor fault locator data, select **Main menu/Monitoring/I/O status/Protection/Current protection/SCERFLO/Recorded data**.
There are three data banks for the recorded data. The most recent information is always found in the first data bank.

6.1.3.5 Monitoring events

The event view contains a list of events produced by the application configuration. The events are grouped by day, and each event takes one line. Select the order of events with the setting **Main menu/Configuration/HMI/LHMI/EvListSrtOrder**.

- 1. Select **Main menu/Events**.
- 2. Press  to open the event list.
Events are shown grouped by date.
Time, channel, signal name and value of the event are shown.
- 3. Press  or  to scroll the view.

/Main menu/Events		
2009-05-08		
00:17:47.583	42	TC_ALARM_3 On
00:17:44.574	47	SPR_CHR_ALM On
2009-05-07		
23:56:02.437	42	TC_ALARM_3 On
23:55:59.427	47	SPR_CHR_ALM On
22:53:10.179	41	TC_ALARM_2 Off
22:53:10.179	40	TC_ALARM_1 Off
22:29:14.629	42	TC_ALARM_3 On
22:29:14.629	41	TC_ALARM_2 On
22:29:14.629	40	TC_ALARM_1 On
22:29:11.620	47	SPR_CHR_ALM On
22:23:43.598	42	TC_ALARM_3 On
22:23:43.598	41	TC_ALARM_2 On
22:23:43.598	40	TC_ALARM_1 On
2009-05-08 01:04:35	Guest	Feeder

Figure 54: Monitoring events



The event list is not updated dynamically. To update the list, leave the Events menu and then select it again.

6.1.4 Remote monitoring

The protection relay supports comprehensive remote monitoring.

6.1.4.1 Monitoring protection relays remotely

Use the PCM600 tool and WHMI to operate the protection relay remotely.

- Analyze disturbance record data.
- Create disturbance records.
- Monitor protection relay values.
- Read events.



For more information, see the PCM600 documentation.

6.2 Controlling

6.2.1 Controlling circuit breakers and disconnectors

Before the control via LHMI is possible, the R/L button has to be in local position.

The primary equipment can be controlled via the LHMI with the Open and Close buttons when the IED is set to local control mode and the user is authorized to access control operations.

1. Select **Main menu/Control**.
The SLD displays all controllable objects.
 2. Select an object with or .
- Selection of object is indicated with a square border that moves when and are used.
- Switch objects can have additional icons that present the switch object states.
- Switch object is in substituted state.
 - Switch object is interlocked.
3. Press to open or to close the object.

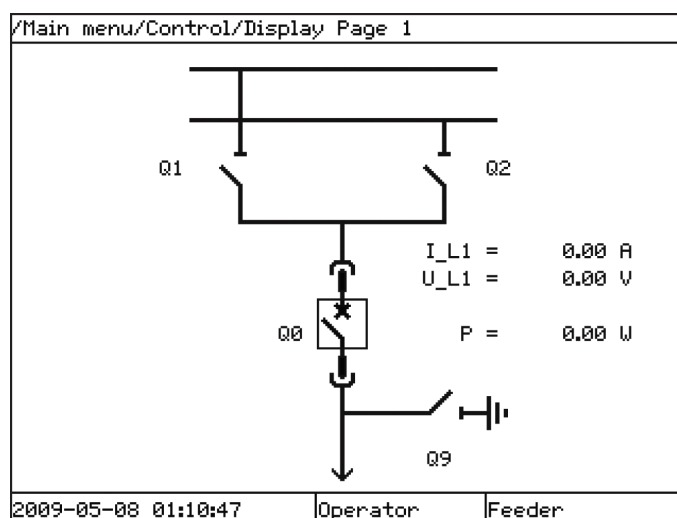


Figure 55: Selecting an object

4. Press to confirm the operation.

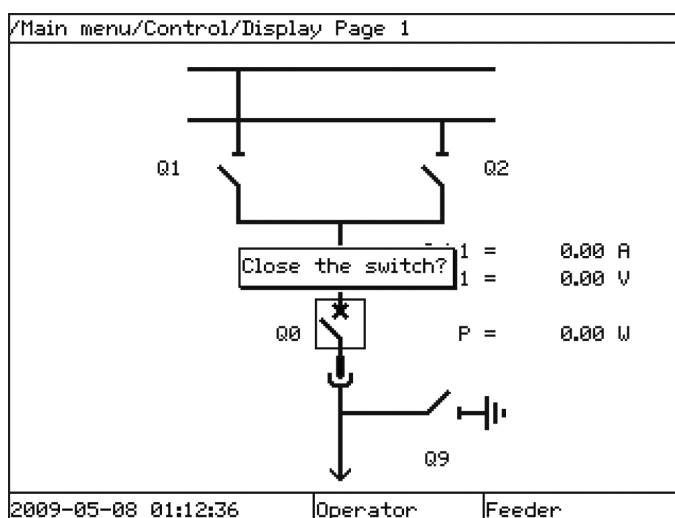


Figure 56: Closing a circuit breaker

- Press **ESC** to cancel the operation.
5. Press **←** or **→** to move between single-line diagram pages.



The time between selecting the object and giving a control command is restricted by an adjustable timeout. When an object is selected, the control command has to be given within this time.

6.3 Resetting the IED

6.3.1 Clearing and acknowledging via the local HMI

Use the Clear button to reset, acknowledge or clear all messages and indications, including LEDs and latched outputs as well as registers and recordings. Pressing the Clear button activates a view for selecting the reset function. Events and alarms assigned to alarm LEDs can also be cleared with the Clear button.

1. Press **Clear** to activate the Clear view.
All the items that can be cleared are shown.

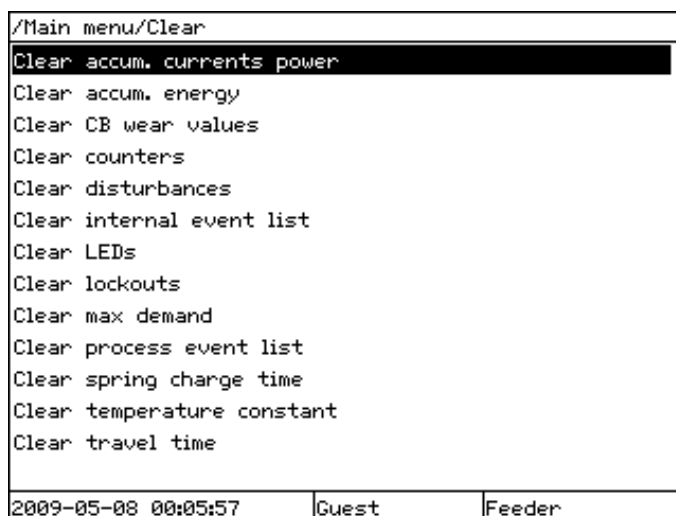


Figure 57: Clear view

The content of the Clear menu depends on the pre-configuration or on the functions configured with PCM600.

2. Select the item to be cleared with or .
3. Press , select OK to confirm the selection or Cancel to cancel the selection.
4. To clear other items, repeat the steps.

6.4 Changing the IED functionality

6.4.1 Defining the setting group



Do not switch off the auxiliary power supply to the IED before the changes, for example, setting parameter or local/remote control state changes are saved.

A mechanism for limiting the number of writings per time period is included in the IED to prevent the flash memory from wearing out due to too many writings caused by the application configuration. As a consequence, saving application function states may take up to an hour. If the auxiliary power is interrupted before the states are saved, that change is lost. Settings and configuration parameters are saved without delay.





6.4.1.1 Activating a setting group

IED settings are planned in advance for different operation conditions by calculating setting values to different setting groups. The active setting group can be changed by the IED application or manually from the menu.

1. Select **Main menu/Settings/Activate setting group/ActiveSetGrp** and press .

/Main menu/Settings/Activate setting group		
ActiveSetGrp	SettingGroup1	
MaxNoSetGrp	4	
2009-05-08 01:16:58	Operator	Feeder

Figure 58: Active setting group

2. Select the setting group with  or .
3. Press  to confirm the selection or  to cancel.

[illegible]


Figure 59: Selecting the active setting group

4. Commit the settings.



Remember to document the changes you make.

6.4.1.2 Browsing and editing setting group values

1. Select **Main menu/Settings/Settings** and press .
Setting group 1 is the default setting group to be edited.

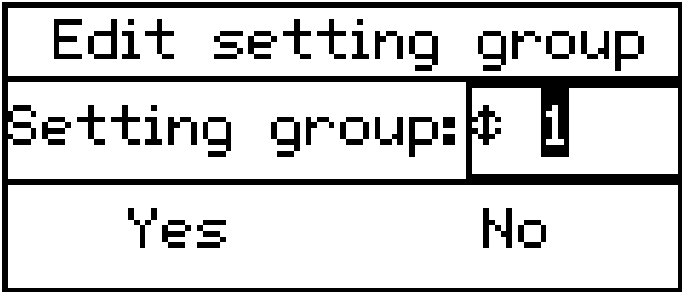






Figure 60: Selecting a setting group for editing

2. Press  on the Setting group line in the dialog box to activate selection mode.
3. Select the wanted setting group with  or  and press .

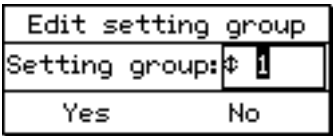










Figure 61: Changing the setting group

4. Select **Yes** in the dialog, and press  to continue.
The current setting group is displayed on the left in the header.
5. Select the application function category in the list with  or , and press  to see the function blocks in that category.
Categories available in the list depend on the pre-configuration or on the functions configured with PCM600.

#1		
Current protection		
Frequency protection		
Voltage protection		
2009-05-08 16:37:23	Guest	Feeder


Figure 62: Selecting the function category

6. To browse the function blocks, scroll the list with  and . Function blocks available depend on the application configuration. To move back to the list, press .
7. To select a function block, press .

#1/Current protection/PHHPTOC(51P-2;3I>>):1			
Num of start phases	1 out of 3		
Curve parameter A	28.2000		
Curve parameter B	0.1217		
Curve parameter C	2.00		
Curve parameter D	29.10		
Curve parameter E	1.0		
Reset delay time	0.020	s	
Minimum operate time	0.020	s	
Start value	0.10	pu	#
Start value Mult	1.0		#
Time multiplier	1.00		#
Operating curve type	IEC Def. Time		#
Type of reset curve	Immediate		#
Operate delay time	0.02	s	#
2009-05-08 16:38:40	Guest	Feeder	




Figure 63: Function block settings

The # character on the right indicates that the parameter belongs to a setting group.

8. To edit the selected setting, press .
 - In case of a parameter that is not part of a setting group, the parameter is activated for editing.
 - In case of a setting group parameter, the editing dialog shows the value of the setting in all available setting groups, but the user can edit only the

#1/Current protection/PHPTOC(51P-2;3I>>):1		
Num of	Start value	
Curve #1 :	0.1	pu
Curve #2 :	0.10	pu
Curve #3 :	0.10	pu
Curve #4 :	0.10	pu
Reset delay time	0.020	s
Minimum operate time	0.020	s
Start value	0.10	pu
Start value Mult	1.0	
Time multiplier	1.00	
Operating curve type	IEC Def. Time	
Type of reset curve	Immediate	
Operate delay time	0.02	s
2009-05-08 16:40:17	DesionEng	Feeder

Figure 64: Changing the setting value

9. Press  or  to change the value.
10. Confirm the change with .

6.4.2 Activating LEDs










To activate the LEDs, they must be configured with PCM600.

1. Select **Main menu/Configuration/Alarm LEDs** and press 

[illegible]

Figure 65: Alarm groups

The list can contain three alarm groups at the maximum. The amount of groups depends on the amount of LEDs taken into use.

2. Select an alarm group with  or  and press .
3. Select an Alarm LED with  or .
4. Press  to confirm the selection and to change the Alarm LED mode.
5. Press  or  to change the value and  to confirm the selection.



For more information, see the PCM600 documentation.

Section 7 Troubleshooting

7.1 Fault tracing

7.1.1 Identifying hardware errors

1. Check the module with an error.
 - Check the general IED status in **Main menu/Monitoring/IED status** for a faulty hardware module.
 - Check the history of changes in internal event list in **Main menu/Monitoring/Internal events**.
2. Inspect the IED visually.
 - Inspect the IED visually to find any physical error causes.
 - If you can find some obvious physical damage, contact ABB for repair or replacement actions.
3. Check whether the error is external or internal.
 - Check that the error is not caused by external origins.
 - Remove the wiring from the IED and test the input and output operation with an external test device.
 - If the problem remains, contact ABB for repair or replacement actions.

7.1.2 Identifying runtime errors

1. Check the error origin from IED's internal event list **Main menu/Monitoring/Internal events**.
2. Reboot the IED and recheck the supervision events to see if the fault has cleared.
3. In case of persistent faults, contact ABB for corrective actions.

7.1.3 Identifying communication errors

Communication errors are normally communication interruptions or synchronization message errors due to communication link breakdown.

- Check the communication status in the internal event list in **Main menu/Monitoring/IED status**.
- In case of persistent faults originating from IED's internal faults such as component breakdown, contact ABB for repair or replacement actions.

7.1.3.1

Checking the communication link operation

There are several different communication links on the product. First check that all communication ports that are used for communication are turned on.



To check that optical serial port hardware is working, check the optical fibres for light. Do not look directly into the transmitter since the direct light can be harmful for the eyes. Point the fibre or transmitter towards a surface where it is possible to observe when the light is on. To turn on the transmitter although there is no actual communication, set *revPolarity* in **Main menu/Configuration/Communication/IEC60870-5-103/General** to "On".

1. Check the front communication port RJ-45.
 - 1.1. Check that the uplink LED is lit with a steady green light.
The uplink LED is located on the LHMI above the RJ-45 communication port on the left. The port is used for direct electrical communication to a PC connected via a crossed-over Ethernet cable.
 - 1.2. Check the communication status of the front port via the LHMI in **Main menu/Monitoring/Ethernet/Front port**.
Check that the "LINKUP" value is 1, that is, the communication is working. When the value is 0, there is no communication link.
2. Check the communication status of the rear port X0 via the LHMI in **Main menu/Monitoring/Ethernet/LAN1**.
The X0 communication port on the rear side of the IED is for electrical communication to a PC connected via a crossed-over Ethernet cable. This communication port is an alternative to the front communication port.
 - Check that the "LINKUP" value is 1, that is, the communication is working. When the value is 0, there is no communication link.
3. Check the communication status of the rear port X1 via the LHMI in **Main menu/Monitoring/Ethernet/LAN1**.
The X1 communication port on the rear side of the IED is for optical Ethernet via LC connector or electrical via RJ-45 connector of the IEC 61850-8-1 station bus communication.
 - Check that the "LINKUP" value is 1, that is, the communication is working. When the value is 0, there is no communication link.

7.1.3.2

Checking the time synchronization




- Select **Main menu/Monitoring/IED status** and check the status of the time synchronization on **Time Synch**.
The *Time synch* value is "Ready" when the synchronization is in order.



Activate the time synchronization source. Otherwise, the value is always "Ready".

7.1.4 Running the display test

To run the display test, either use the push buttons or start the test via the menu.

- Select **Main menu/Test/LED test**.
- Press  or simultaneously  and .

All the LEDs are tested by turning them on simultaneously. The display shows a set of patterns so that all the pixels are activated. After the test, the display returns to normal state.

7.2 Indication messages

7.2.1 Internal faults

When the Ready LED indicates an internal fault by flashing, the message associated with the fault is found in the internal event list in the LHMI menu **Main menu/Monitoring/Internal events**. The message includes the date, time, description and signal state for the fault. The internal event list is not updated dynamically. The list is updated by leaving the **Internal events** menu and then selecting it again. The current status of the internal fault signals can also be checked via the LHMI in **Main menu/Monitoring/IED status**.

The ABB logo together with the IED FAILURE message appear on the screen after a five minutes' communication break between the LHMI and the IED. The LHMI panel displays the message due to a communication failure or a severe functional error in the IED. The protection functionality of the device can be ensured by testing the IRF contact status.

Different actions are taken depending on the severity of the fault. If the fault is found to be permanent, the IED stays in internal fault mode. The IED continues to perform internal tests during the fault situation.

When a fault appears, the fault indication message is to be recorded and stated when requesting support or service.

Table 15: *Internal fault indications*

Fault indication	Additional information
Internal Fault Real Time Clock Error	Hardware error with the real time clock.
Internal Fault Runtime Exec. Error	One or more of the application threads are not working properly.
Internal Fault SW Watchdog Error	This signal will be activated when the terminal has been under too heavy load for at least 5 minutes.
Internal Fault Runtime App Error	One or more of the application threads are not in an expected state.
Internal Fault File System Error	A file system error has occurred.
Internal Fault TRM-Error	A TRM card error has occurred. The instance number is displayed at the end of the fault indication.
Internal Fault COM-Error	A COM card error has occurred. The instance number is displayed at the end of the fault indication.
Internal Fault PSM-Error	A PSM card error has occurred. The instance number is displayed at the end of the fault indication.
Internal Fault RTD Error	An RTD card error has occurred. The instance number is displayed at the end of the fault indication.

7.2.2

Warnings

The warning message associated with the fault is found in the internal event list in the LHMI menu **Main menu/Monitoring/Internal events**. The message includes the date, time, description and signal state for the fault. The current status of the internal fault signals can also be checked via the LHMI in **Main menu/Monitoring/IED status**.

When a fault appears, record the fault indication message and state it when ordering service.

Table 16: *Warning indications*

Warning indication	Description
Warning IEC 61850 Error	IEC 61850 has not succeeded in some actions such as reading the configuration file or startup.
Warning DNP3 Error	Error in DNP3 communication

7.2.3

Additional indications

The additional indication messages do not activate internal fault or warning.

The messages are listed in the LHMI menu under the event list. The signal status data is found under the IED status and in the internal event list.

Table 17: *Additional indications*

Warning indication	Additional information
Time Synch Error	Source of the time synchronization is lost or time system has made a time reset.
BATTERY1 Error	Auxiliary power is disconnected.
Settings Changed	Settings have been changed.
Setting Groups Changed	Setting group has been changed.

7.3 Correction procedures

7.3.1 Factory settings restoration

In case of configuration data loss or error that prevents the IED from working properly, the configuration can be restored to the original factory state. All default settings and configuration files stored in the factory are restored.

For further information on restoring factory settings, contact customer support.

7.3.2 Changing and setting the password

The password can only be set with PCM600.



For more information, see the PCM600 documentation.

7.3.3 Identifying IED application problems

Navigate to the appropriate menu in the LHMI to identify possible problems.

- Check that the function is on.
- Check that the correct setting group (1 to 4) is activated.
- Check the blocking.
- Check the mode.
- Check the measurement value.
- Check the connection to trip and disturbance recorder functions.
- Check the channel settings.

7.3.3.1

Inspecting the wiring

The physical inspection of wiring connections often reveals the wrong connection for phase currents or voltages. Even when the phase current or voltage connections to IED terminals are correct, wrong polarity of one or more measurement transformers can cause problems.

- Check the current or voltage measurements and their phase information from **Main menu/Measurements**.
- Check that the phase information and phase shift between phases is correct.
- Correct the wiring if needed.
 - Change the parameter *ReversePolarity* in **Configuration/I/O modules/ AIM2** for the channel n (n= the number of the channel that has wrong polarity).
 - Change the parameter in PCM600. See PCM600 documentation for more information.
- Check the actual state of the connected binary inputs.
 - In LHMI, select **Main menu/Monitoring/I/O status/Binary input modules**. Then navigate to the board with the actual binary input to be checked.
 - Check the actual state of the connected binary inputs through PCM600. See PCM600 documentation for more information.
- Measure output contacts using the voltage drop method of applying at least the minimum contact load given for the output relays in the technical data, for example, 100 mA at 24 V AC/DC.



Output relays, especially power output relays, are designed for breaking high currents. Due to this, layers of high resistance may appear on the surface of the contacts. Do not determine proper functionality of connectivity or contact resistance by measuring with a regular hand-held ohm meter.

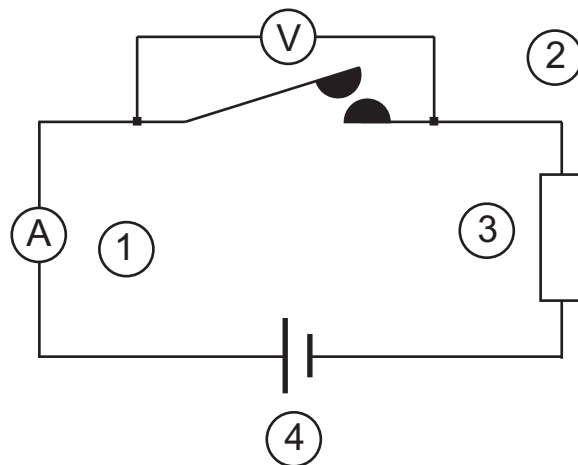


Figure 66: Testing output contacts using the voltage drop method

- 1 Contact current
- 2 Contact voltage drop
- 3 Load
- 4 Supply voltage

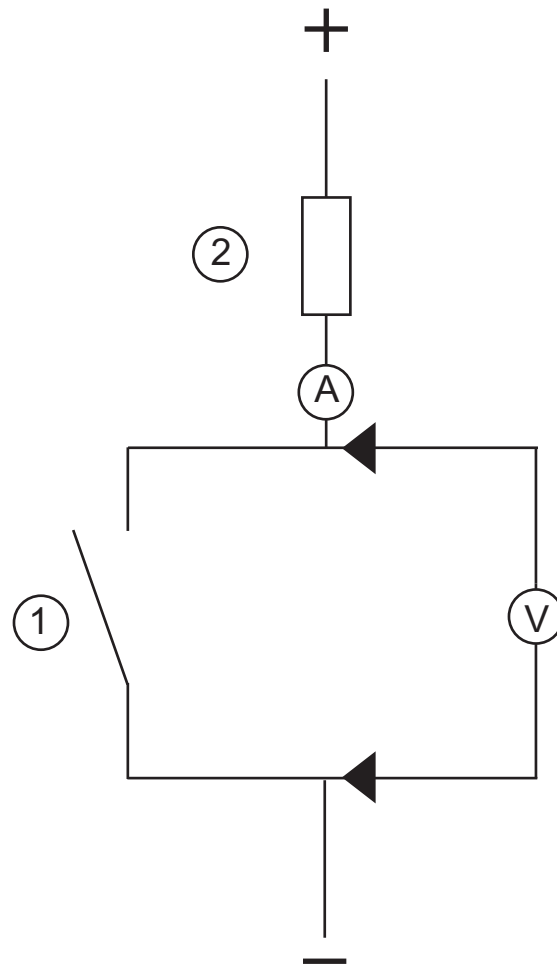





Figure 67: Testing a trip contact

- 1 Trip contact under test
- 2 Current limiting resistor

- To check the status of the output circuits driving the output relay via the LHMI, select **Main menu/Monitoring/I/O status/Binary output modules** and then navigate to the board with the actual binary output to be checked.
- Test and change the relay state manually.
 1. To set the IED to test mode, select **Main menu/Test/IED test mode/TestMode** and set the parameter to "On".
 2. To operate or force the output relay to operate, select **Main menu/Test/Forcing/Binary output values** and then navigate to the board with the actual binary output relay to be operated/forced.
 3. Select the BOn_PO to be operated or forced and press  and  or  to operate the actual output relay.

Each BOn_PO is represented by two signals. The first signal in LHMI is the actual value "1" or "0" of the output, and in PCM600 a lit or dimmed diode.

The second signal is the status Normal or Forced. Forced status is only achieved when the BO is set to “Forced” or operated on the LHMI.



Set the parameter *TestMode* to “Off” after completing these tests. The Start LED stops flashing when the relay is no longer in test mode.

An initially high contact resistance does not cause problems as it is reduced quickly by the electrical cleaning effect of fritting and thermal destruction of layers, bringing the contact resistance back to the mOhm range. As a result, practically the full voltage is available at the load.

7.3.3.2

Inspecting the RTD wiring

- Verify the sensor measuring mode by using a suitable resistor instead of a real sensor.
 - PT100 80...170 Ω
 - PT250 220...430 Ω
 - NI100 80...240 Ω
 - NI120 100...280 Ω
 - CU10 8...16 Ω

Resistance measuring mode can be verified with a resistance from 0...10 K Ω .

Table 18: Examples of temperature and resistance

	PT 100	PT 250	NI 100	NI 120	CU 10
R	°C	°C	°C	°C	°C
7.5	-	-	-	-	-39.8
8.2	-	-	-	-	-21.6
9.1	-	-	-	-	1.7
10	-	-	-	-	25
11	-	-	-	-	50.9
12	-	-	-	-	76.9
13	-	-	-	-	102.8
15	-	-	-	-	154.6
82	-45.8	-	-34.2	-	-
91	-23	-	-16.5	-46.7	-
100	0	-	0	-31.5	-
110	25.7	-	18	-15.5	-
120	51.6	-	35	0	-
150	130.5	-	82.6	43.3	-
160	157.2	-	97.5	56.8	-
180	-	-	125.5	84	-

Table continues on next page

	PT 100	PT 250	NI 100	NI 120	CU 10
R	°C	°C	°C	°C	°C
200	-	-50.8	151.8	107	-
220	-	-30.6	176.3	130	-
240	-	-10.2	199.3	151.8	-
270	-	20.5	-	182.2	-
300	-	51.6	-		-
330	-	82.9	-		-
360	-	114.6	-		-
390	-	146.5	-		-
430	-	189.6	-		-



RTD connector numbering is an example of a 4U case. See the technical manual for complete terminal diagrams.

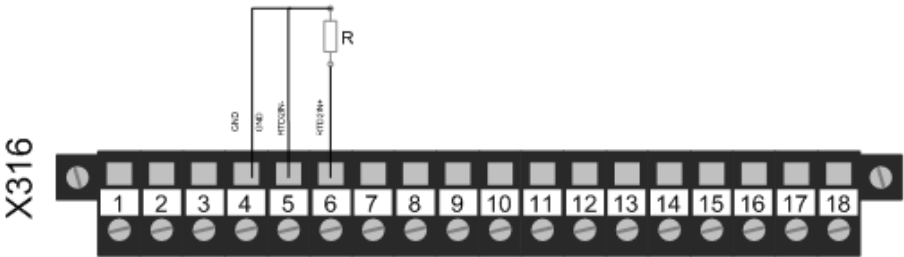


Figure 68: *Testing sensor/resistance input by connecting resistor directly to connector*

Voltage type measurement mode can be verified by connecting a voltage source on the input and measure input voltage at the same time by multimeter, for example, 5 VDC voltage.

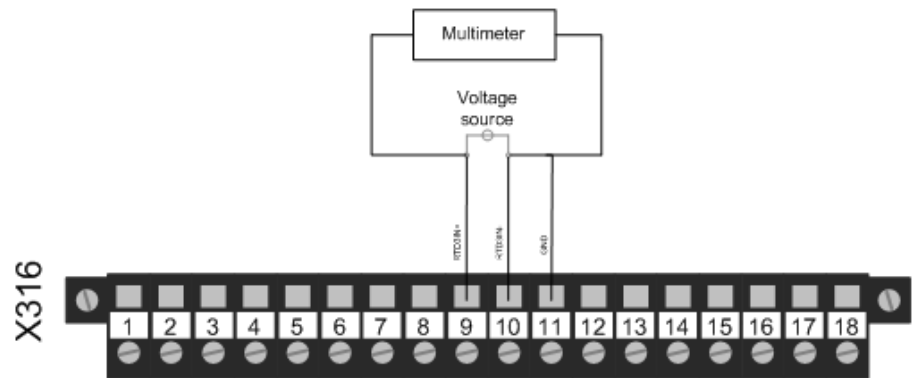


Figure 69: Testing voltage input by connecting voltage source directly to connector and measuring input voltage by multimeter

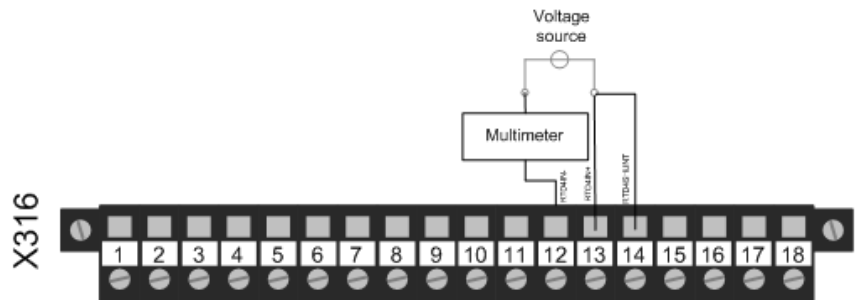


Figure 70: Testing current input by connecting voltage source directly to connector and measuring input current by multimeter

Current type measurement mode can be verified by connecting a voltage source on the input, for example, 1 V DC.

- Verify milliamperere outputs by connecting a multimeter to mA output.

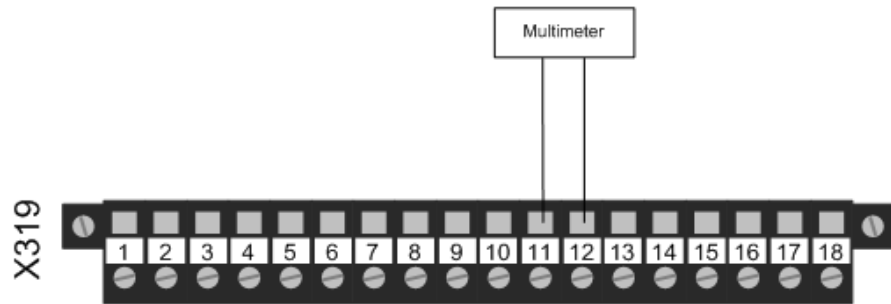





Figure 71: Testing mA output by connecting multimeter directly to connector and measuring output current by multimeter

- Check the status of the output circuits driving the mA outputs via the LHMI. Select **Main menu/Monitoring/I/O status/mA output modules/RTD3** and check the output status and value for the channel under inspection.
- Test and change the output manually.
 1. Select **Main menu/Test/IED test mode/TestMode** and set the parameter to “On”.
 2. Select **Main menu/Tests/Forcing/Analog output values/RTD3**.
 3. Select the AOn to be forced.
 4. Force the actual output using  and  or .

Each AOn is represented by two signals. The first signal in LHMI is the actual primary value of the output. The second signal is the status Normal or Forced. Forced status is only achieved when the AO is set to “Forced” on the LHMI.



When forcing analog output signals the scaling defined by analog output channel configuration is not used. Fixed scaling factor 1000:1 is used instead. This means that forcing value 5.000 A is seen as 5 mA when measured from output.



Do not force or send values to disconnected channels. This results in an out-of-range error.



Forcing feature can be tested only for configured output channels. When mA current values are forced to non-configured output channels, values are not passed to mA output channel HW circuitry.



Set the parameter *TestMode* to "Off" after completing the tests. The Start LED stops flashing when the relay is no longer in test mode.

Section 8 Glossary

100BASE-FX	A physical medium defined in the IEEE 802.3 Ethernet standard for local area networks (LANs) that uses fiber optic cabling
COMTRADE	Common format for transient data exchange for power systems. Defined by the IEEE Standard.
Connectivity package	A collection of software and information related to a specific protection and control IED, providing system products and tools to connect and interact with the IED
CSV	Comma-separated values
DFT	Discrete Fourier transform
DHCP	Dynamic Host Configuration Protocol
DNP3	A distributed network protocol originally developed by Westronic. The DNP3 Users Group has the ownership of the protocol and assumes responsibility for its evolution.
EMC	Electromagnetic compatibility
Ethernet	A standard for connecting a family of frame-based computer networking technologies into a LAN
GOOSE	Generic Object-Oriented Substation Event
HMI	Human-machine interface
HW	Hardware
IEC	International Electrotechnical Commission
IEC 60870-5-103	1. Communication standard for protective equipment 2. A serial master/slave protocol for point-to-point communication
IEC 61850	International standard for substation communication and modeling
IEC 61850-8-1	A communication protocol based on the IEC 61850 standard series
IED	Intelligent electronic device
IP	Internet protocol
IP address	A set of four numbers between 0 and 255, separated by periods. Each server connected to the Internet is assigned a unique IP address that specifies the location for the TCP/IP protocol.

IRF	1. Internal fault 2. Internal relay fault
LAN	Local area network
LC	Connector type for glass fiber cable, IEC 61754-20
LCP	Liquid crystal polymer
LED	Light-emitting diode
LHMI	Local human-machine interface
PC	1. Personal computer 2. Polycarbonate
PCM600	Protection and Control IED Manager
R/L	Remote/Local
REF630	Feeder protection and control relay
REG630	Generator protection and control relay
REM630	Motor protection and control IED
RET630	Transformer protection and control IED
RJ-45	Galvanic connector type
RMS	Root-mean-square (value)
RoHS	Restriction of hazardous substances
RTD	Resistance temperature detector
SLD	Single-line diagram
SVG	Scalable vector graphics
TCP/IP	Transmission Control Protocol/Internet Protocol
WAN	Wide area network
WHMI	Web human-machine interface



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