Relion® 670 series

Transformer protection RET670 ANSI
Operator's 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 IED is designed in accordance with the international standards of the IEC 60255 series and ANSI C37.90.

Table of contents

Section 1 Introduction....11
Introduction to the operator’s manual....11
About the complete set of manuals for an IED....11
About the operator’s manual....12
Intended audience....13
Related documents....13
Revision notes....14

Section 2 Safety information....15
Warnings....15

Section 3 Overview....17
Operator overview....17
Identify the IED....17

Section 4 Understand the local human-machine interface....19
Overview....19
Keypad....19
Key activated screens....21
The Help screen....21
The Reset screen....21
LCD....22
Medium....22
LED....22
Introduction....22
Status indication LEDs....22
Indication LEDs....23
Local HMI setup....23
How to navigate....24
Read....24
Change....24
Control....24

Section 5 Understand the HMI tree....27
Overview....27
Menu-tree for RET670....27

Table of contents

Section 6 Read measured values....29
Overview....29
View analog primary values....30
Overview....30
View analog secondary values....30
Overview....30
View analog mean values....31
Overview....31
mA input module MIM....31
Signal matrix for mA inputs SMMI....31
View monitoring values....32
Service values CVMMXU....32
Current phasors CMMXU....32
Voltage phasors VMMXU/VNMMXU....32
Current sequence component CMSQI....32
Voltage sequence component VMSQI....32
View metering values....33
Pulse counter logic PCGGIO....33
Function for energy calculation and demand handling ETPMMTR....33

Section 7 Event list....35
View events....35
Overview....35

Section 8 Handle disturbances....37
Identify a disturbance....37
View disturbance record details....37
View general information....37
View disturbance indications....37
View event recordings....38
View trip values....38
Trigger a disturbance report manually....38

Section 9 Read and change settings....39
System time and synchronization....39
System time....39
Time synchronization....39
Overview....39
TimeSynch....40

TimeSynchBIN....40
TimeSynchDSTBegin....40
TimeSynchDSTEnd....40
TimeSynchIRIG-B....40
TimeSynchSNTP....40
TimeZone....40
General settings....41
Power system....41
Overview....41
Identifiers....41
Primary values....41
Communication....41
Overview....41
Remote communication....42
SPA, LON and IEC 60870–5–103 settings....42
Station communication....43
Ethernet configuration....44
Analog and I/O modules....45
Overview....45
Analog modules....45
I/O modules....46
HMI....47
Overview....47
LEDs....47
Screen....47
Functions....47
Change lock....47
Differential protection....48
Overview....48
Transformer differential protection, two winding T2WPDIF (87T)....48
Transformer differential protection, three winding T3WPDIF (87T)....48
Control....48
Apparatus control....48
Control commands....50
Monitoring....51
Overview....51
Service values CVMMXU....51
Current phasors CMMXU....51

Table of contents

Voltage phasors VMMXU/VNMMXU....51
Current sequence components CMSQI 52
Voltage sequence components VMSQI 52
Disturbance report DRPRDRE....52
Generic measured value MVGGIO....53
Event function 53
Logical signal status report BINSTATREP....53
IEC 60870–5–103 53
Metering....54
Overview....54
Pulse counter logic PCGGIO....54
Function for energy calculation and demand handling ETPMMTR 54
Setting group N....54
Overview....54
Differential protection....55
Overview....55
Transformer differential protection, two winding T2WPDIF (87T)....55
Transformer differential protection, three winding T3WPDIF (87T)....55
Restricted ground fault protection REFPDIF (87N)....55
High impedance differential protection HZPDIF (87X)....56
Impedance protection....56
Overview....56
Full-scheme distance protection, mho characteristic ZMHPDIS (21)....56
Distance protection zones, quadrilateral characteristics ZMQPDIS, ZMQAPDIS (21)....56
Fullscheme distance protection, quadrilateral for earth faults ZMMPDIS, ZMMAPDIS (21)....56
Faulty phase identification with load enchroachment FMPSPDIS (21)....57
Phase selection, quadrilateral characteristic with fixed angle FDPSPDIS (21)....57
Phase preference logic PPLPHIZ 57
Directional impedance quadrilateral ZDRDIR (21D)....57
Directional impedance element for mho characteristics ZDMRDIR (21D)....57
Additional distance protection directional function for ground faults ZDARDIR 58

Mho impedance supervision logic ZSMGAPC....58
Power swing detection ZMRPSB (78)....58
Power swing logic ZMRPSL 58
Current protection....58
Overview....58
Breaker failure protection CCRBRF (50BF)....59
Broken conductor check BRCPTOC (46)....59
Directional over-power protection GOPPDOP (32)....59
Directional under-power protection GUPPDUP (37)....59
Instantaneous phase overcurrent protection PHPIOC (50)....59
Instantaneous residual overcurrent protection EFPIOC (50N)....59
Four step phase overcurrent protection OC4PTOC (51_67)....60
Pole discrepancy protection CCRPLD (52PD)....60
Four step residual overcurrent protection EF4PTOC (51N67N)....60
Sensitive directional residual over current and power protection SDEPSDE (67N)....60
Thermal overload protection, two time constants TRPTTR (49)....60
Voltage protection....61
Overview....61
Loss of voltage check LOVPTUV (27)....61
Overexcitation protection OEXPVPH (24)....61
Two step overvoltage protection OV2PTOV (59)....61
Two step residual overvoltage protection ROV2PTOV (59N)....61
Two step undervoltage protection UV2PTUV (27)....62
Voltage differential protection VDCPTOV (60)....62
Frequency protection....62
Overview....62
Overfrequency protection SAPTOF (81)....62
Rate-of-change frequency protection SAPFRC (81)....62
Underfrequency protection SAPTUF (81)....63
Multipurpose protection....63
Overview....63
General current and voltage protection CVGAPC....63
Scheme communication....63
Overview....63
Current reversal and weak-end infeed logic for residual overcurrent protection ECRWPSCH (85)....64

Scheme communication logic for residual overcurrent protection ECPSCH (85)....64
Secondary system supervision....64
Overview....64
Current circuit supervision CCSRDIF (87)....64
Fuse failure supervision SDDRFUF....64
Control....65
Overview....65
synchronism-check and energizing check SESRSYN (25)....65
Tap changer control and supervision, 6 binary inputs TCMYLTC (84)....65
Tap changer control and supervision, 32 binary inputs TCLYLTC (84)....65
Automatic voltage control for tapchanger, single control TR1ATCC (90)....65
Automatic voltage control for tapchanger, parallel control TR8ATCC (90)....65
Monitoring....66
Overview....66
Event counter CNTGGIO....66
Logic....66
Overview....66
Tripping logic SMPPTRC (94)....66
Trip matrix logic TMAGGIO....66
LogicGate....66
LogicSRMemory....67
LogicTimerSet....67
Activate setting group....67
Language....67

Section 10 Diagnose IED status....69
Read internal events....69
Find available functions....69

Section 11 Test the IED....71
Overview....71
IED test mode....72
View binary input values....72
Overview....72
Binary Input Module BIM....73
Signal matrix for binary input SMBI....73

View binary output values....73
Overview....73
Binary Output Module BOM....73
Signal matrix for binary outputs SMBO....73
Function test modes....74
Overview....74
Differential protection....74
Impedance protection....74
Current protection....74
Voltage protection....74
Frequency protection....74
Multipurpose protection....75
Scheme communication....75
Secondary system protection....75
Control....75
Monitoring....75
Logic....75
Function status....76
Overview....76
Differential protection....76
Transformer differential protection, two winding T2WPDIF (87T)....76
Transformer differential protection, three winding T3WPDIF (87T)....76
Restricted ground fault protection, low impedance REFPDIF (87N)....76
High impedance differential protection HZPDIF (87)....77
Impedance protection....77
Full-scheme distance protection, mho characteristic ZMHPDIS (21)....77
Distance protection zone, quadrilateral characteristic ZMQPDIS, ZMQAPDIS (21)....77
Fullscheme distance protection, quadrilateral for earth faults ZMMPDIS, ZMMAPDIS (21)....78
Faulty phase identification with load enchroachment FMPSPDIS (21)....78
Phase selection with load encroachment FDPSPDIS (21)....78
Phase preference logic PPLPHIZ....78
Directional impedance ZDRDIR (21D)....78
Directional impedance element for mho characteristic ZDMRDIR (21D)....79

Table of contents

Additional distance protection directional function for ground faults ZDARDIR 79
Mho Impedance supervision logic ZSMGAPC....79
Power swing detection ZMRPSB (78)....79
Power swing logic ZMRPSL....79
Current protection....79
Breaker failure protection CCRBRF (50BF)....80
Broken conductor check BRCPTOC (46)....80
Directional over-power protection GOPPDOP (32)....80
Directional under-power protection GUPPDUP (37)....80
Instantaneous phase overcurrent protection PHPIOC (50)....80
Instantaneous residual overcurrent protection EFPIOC (50N)....80
Four step phase overcurrent protection OC4PTOC(51_67)....81
Pole discordance protection CCRPLD (52PD)....81
Four step residual overcurrent protection EF4PTOC (51N_67N)....81
Sensitive directional residual over current and power protection SDEPSDE (67N)....81
Thermal overload protection, two time constants TRPTTR (49)....81
Voltage protection....82
Loss of voltage check LOVPTUV (27)....82
Overexcitation protection OEXPVPH (24)....82
Two step overvoltage protection OV2PTOV (59)....82
Two step residual overvoltage protection ROV2PTOV (59N)....82
Two step undervoltage protection UV2PTUV (27)....82
Voltage differential protection VDCPTOV (60)....83
Frequency protection....83
Overfrequency protection SAPTOF (81)....83
Rate-of-change frequency protection SAPFRC (81)....83
Underfrequency protection SAPTUF (81)....83
Multipurpose protection....84
General current and voltage protection CVGAPC....84
Scheme communication....84
Current reversal and weak-end infeed logic for residual overcurrent protection ECRWPSCH (85)....84
Scheme communication logic for residual overcurrent protection ECPSCH (85)....84
Secondary system supervision....84

Fuse failure supervision SDDRFUF....85
Control....85
Apparatus control....85
Commands....88
IEC61850 generic communication I/O functions DPGGIO....89
Synchronism check and energizing check SESRSYN (25)....89
Tap changer control and supervision TCMYLTC/TCLYLTC (84)....89
Automatic voltage control for tapchanger, single and parallel control TR1ATCC/TR8ATCC (90)....89
Monitoring....89
Logical signal status report BINSTATREP....89
Disturbance report DRPRDRE....90
Event counter CNTGGIO....90
Generic measured value MVGGIO....90
Global positioning system....90
IEC61850 generic communication I/O functions 16 inputs SP16GGIO....90
LEDs....91
Measured value expander block RANGE_XP....91
IEC61850 generic communication I/O functions SPGGIO....91
Logic....91
Boolean 16 to Integer conversion 91
Integer to Boolean 16 conversion 91
Tripping logic SMPPTRC (94)....92
Trip matrix logic TMAGGIO....92
Logic gate....92
Logic SR/RS memory....92
Logic timer set....92
Communication....92
Remote communication....93
Station communication....93
Setting groups....93
Test 94
Authorization....94
LED Test 94
Line differential test....94

Section 12 Control and supervise the bay....95
Overview....95
Read measured values and check apparatus status....95

Locating and using the single line diagram....96
Control screen messages....97

Section 13 Reset....99
Reset guide....99
Reset counters....99
Circuit breaker SXCBR....99
Circuit switch SXSWI....99
Reset event counter CNTGGIO....99
Reset pulse counter PCGGIO....99
LDCM clear counters....100
Function for energy calculation and demand handling ETPMMTR....100
Tap changer control and supervision TCMYLTC, TCLYLTC (84)....100
Reset disturbances and event list DRPRDRE....100
Reset LEDs....100
Start and trip LEDs....100
All indication LEDs....101
Reset lockout SMPPTRC (94)....101
Reset process eventlist....101
Reset temperature functions....101

Section 14 Authorization....103
Overview....103
Principle of operation....103
LogOn or logOff....105
Authorization handling in the IED....105

Section 15 Glossary....107

Section 1 Introduction

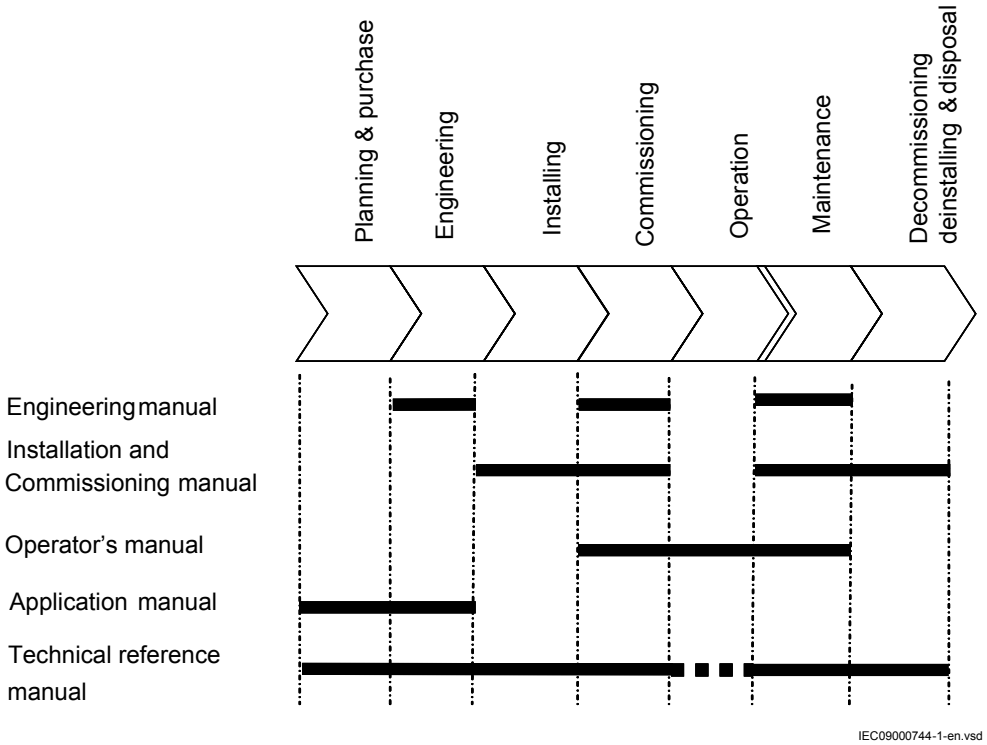
About this chapter

This chapter is an introduction to the operator's manual, its purpose and usage.

1.1 Introduction to the operator's manual

1.1.1 About the complete set of manuals for an IED

The user's manual (UM) is a complete set of five different manuals:



The Application Manual (AM) contains application descriptions, setting guidelines and setting parameters sorted per function. The application manual should be used to find out when and for what purpose a typical protection function could be used. The manual should also be used when calculating settings.

The Technical Reference Manual (TRM) contains application and functionality descriptions and it lists function blocks, logic diagrams, input and output signals, setting parameters and technical data sorted per function. The technical reference manual should be used as a technical reference during the engineering phase, installation and commissioning phase, and during normal service.

The Installation and Commissioning Manual (ICM) contains instructions on how to install and commission the protection IED. The manual can also be used as a reference during periodic testing. The manual covers procedures for mechanical and electrical installation, energizing and checking of external circuitry, setting and configuration as well as verifying settings and performing directional tests. The chapters are organized in the chronological order (indicated by chapter/section numbers) in which the protection IED should be installed and commissioned.

The Operator's Manual (OM) contains instructions on how to operate the protection IED during normal service once it has been commissioned. The operator's manual can be used to find out how to handle disturbances or how to view calculated and measured network data in order to determine the cause of a fault.

The Engineering Manual (EM) contains instructions on how to engineer the IEDs using the different tools in PCM600. The manual provides instructions on how to set up a PCM600 project and insert IEDs to the project structure. The manual also recommends a sequence for engineering of protection and control functions, LHMI functions as well as communication engineering for IEC 61850 and DNP3.

1.1.2 About the operator's manual

Use the operator's manual for instruction on how to perform common tasks during normal service.

The operator's manual contains the following chapters:

- The chapter *"Safety information"* presents warnings and notices, which the user should pay attention to.
- The chapter "*Overview*" describes operations an operator may perform on a daily basis or when the need arises.
- The chapter "*Understand the local human-machine interface"* describes how to use the human-machine interface.
- The chapter *"Understand the HMI tree"* describes the different menu trees.
- The chapter *"Read measured values"* describes how to locate and identify available measurement data.
- The chapter *"Event list"* describes the location and nature of recorded events.
- The chapter "*Handle disturbances"* describes how to retrieve disturbance information and reset alarms.
- The chapter "*Read and change settings"* describes how to locate, and change settings and parameters.

- The chapter *"Diagnose IED status"* describes the location and use of available diagnostic tools.
- The chapter *"Test the IED"* describes the tests applicable to the IED.
- The chapter "*Control and supervise the bay"* describes how to use the Single Line Diagram to open and close primary apparatuses.
- The chapter *"Reset"* describes resetting procedures.
- The chapter *"Authorization"*describes user categories and password procedures.
- The chapter *"Glossary"* describes words and acronyms used in the literature describing the IED.

This manual does not contain any instructions for commissioning or testing.

1.1.3 Intended audience

General

The operator's manual addresses the *operator*, who operates the IED on a daily basis.

Requirement

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.

1.1.4 Related documents

Documents related to RET670	Identity number
Operator's manual	1MRK 504 087-UUS
Installation and commissioning manual	1MRK 504 088-UUS
Technical reference manual	1MRK 504 086-UUS
Application manual	1MRK 504 089-UUS
Buyer's guide	1MRK 504 091-BUS
Sample specification	SA2005-001283
Connection diagram, Two winding transf. Single breaker arrangements	1MRK 002 801-LA
Connection diagram, Two winding transf. Multi breaker arrangements	1MRK 002 801-HA
Connection diagram, Three winding transf. Single breaker arrangements	1MRK 002 801-KA
Connection diagram, Three winding transf. Multi breaker arrangements	1MRK 002 801-GA
Configuration diagram A, Two winding transf. with single or double busbar but with a single breaker arr. on both sides (A30)	1MRK 004 500-93
Configuration diagram B, Two winding transf. in multi breaker arr. on one or both sides (A40)	1MRK 004 500-94
Configuration diagram C, Three winding transf. with single or double busbar but with a single breaker arr. on both sides (B30)	1MRK 004 500-95
Configuration diagram D, Three winding transf. in multi breaker arr. on one or both sides (B40)	1MRK 004 500-96

Table continues on next page

Documents related to RET670	Identity number
Configuration diagram E, Two or three winding transf., back-up protection package (A10)	1MRK 004 500-135
Configuration diagram F. Tap changer control package for two parallel transformers. (A25)	1MRK 004 500-140
Configuration diagram F. Tap changer control package for four parallel transformers. (A25)	1MRK 004 500-140
Setting example 1, 400/230 kV 500 MVA Transformer, YNyn connected	1MRK 504 083-WEN
Setting example 2, 132/230 kV 40 MVA Transformer, YNd1 connected	1MRK 504 084-WEN
Connection and Installation components	1MRK 513 003-BEN
Test system, COMBITEST	1MRK 512 001-BEN
Accessories for IED 670	1MRK 514 012-BEN
Getting started guide IED 670	1MRK 500 080-UUS
SPA and LON signal list for IED 670, ver. 1.1	1MRK 500 083-WEN
IEC 61850 Data objects list for IED 670, ver. 1.1	1MRK 500 084-WEN
Generic IEC 61850 IED Connectivity package	1KHA001027-UEN
Protection and Control IED Manager PCM 600 Installation sheet	1MRS755552
Engineering guide IED 670 products	1MRK 511 179-UEN

More information can be found on www.abb.com/substationautomation.

1.1.5 Revision notes

Revision	Description
C	No functionality added. Changes made in content due to problem reports.

Section 2 Safety information

About this chapter

This chapter lists warnings and cautions that must be followed when handling the IED.

2.1 Warnings

Do not touch circuitry during operation. Potentially lethal voltages and currents are present.

Always connect the IED to protective ground, regardless of the operating conditions. This also applies to special occasions such as bench testing, demonstrations and off-site configuration. Operating the IED without proper grounding may damage both IED and measuring circuitry and may cause injuries in the event of an accident.

Never remove any screw from a powered IED or from a IED connected to powered circuitry. Potentially lethal voltages and currents are present.

Always avoid touching the circuitry when the cover is removed. The product contains electronic circuitries which can be damaged if exposed to static electricity (ESD). The electronic circuitries also contain high voltage which is lethal to humans.

Section 3 Overview

About this chapter

This chapter presents a general overview of the Operator's manual.

3.1 Operator overview

The Human machine interface (HMI) on the IED provides an ideal mechanism for the day to day operation and even advanced use of the IED. The keypad, LCD and LEDs on the front of the IED are what constitute the HMI. Troubleshooting, apparatus control, monitoring, setting and configuring are all possible via this interface. Through the screens and menu elements available, as well as the keypad, the user is able to navigate throughout the menu structure and move from screen to screen. This document is, to a great extent, arranged in the same way as the IED software is structured and describes all aspects of operation via the HMI.

The operator can document disturbances so that their causes can be analyzed and evaluated for future reference. For example, the fault currents and voltages at the time of the fault can be documented. The operator can also retrieve data about protected objects, providing further information for fault analysis. This implies viewing the mean value of current, voltage, power and frequency or primary and secondary measured phasors. The operator can check the IED status at any time.

In some cases the operator may need to change the way the IED operates. This might include changing the active setting group or a parameter value. This must always be done strictly according to applicable regulations because un-authorized changes may lead to severe damage of the protected object especially if a fault is not properly disconnected.

3.2 Identify the IED

To identify the IED, open the diagnostics menu. The identity of the IED along with other data is found under:

Main menu/Diagnostics/IED status/Product Identifiers

The type of IED, the main function type, its serial number, ordering number and production date are found here.

Section 4 Understand the local human-machine interface

About this chapter

This chapter describes the display, its keys (buttons) and LEDs that make up the HMI. How the keys are used to navigate the HMI, how to interpret the graphic information on the LCD and, what the LEDs indicate is explained in the sections that follow.

4.1 Overview

The human machine interface is used to monitor and to some extent control the way the IED operates. The configuration designer can add functions that alert to events requiring the attention of the operator.

Figure 1: 1/1 x 19” case with medium LCD

4.2 Keypad

The keypad is used to monitor and operate the IED. The keypad has the same look and feel in all IEDs. LCD screens and other details may differ but the way the keys function is identical.

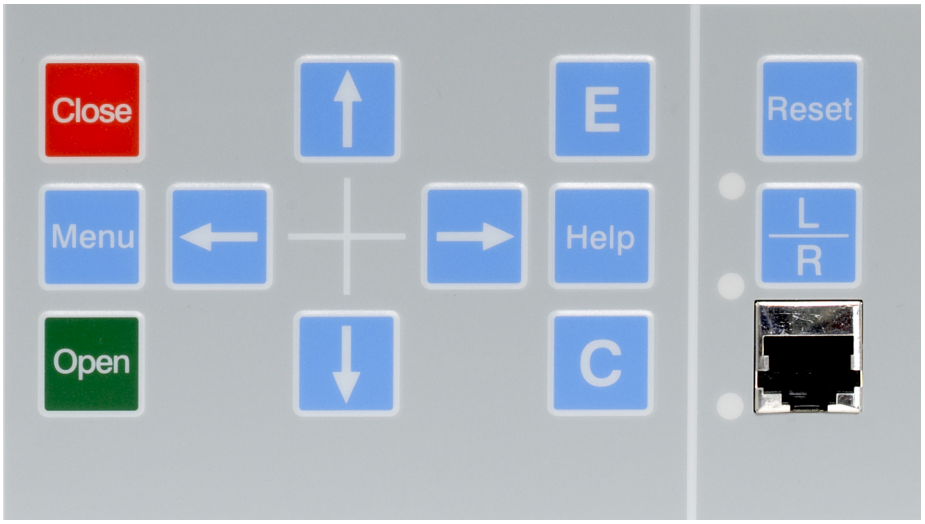


Figure 2: The HMI keypad.

Table 1 describes the HMI keys that are used to operate the IED.

Table 1: HMI keys on the front of the IED

Key	Function
Close	Press to close or energize a breaker or disconnector.
Open	Press to open a breaker or disconnector.
Help	Press to open two sub menus: Key operation and IED information.
C	Press to clear entries, cancel commands or edit.
Menu	Press to open the main menu and to move to the default screen.
L/R	Press to set the IED in local or remote control mode.
Reset	Press to open the reset screen.
E	Press to start the editing mode and confirm setting changes, when in editing mode.

Table continues on next page

Key	Function
	Press to navigate forward between screens and move right in editing mode.
	Press to navigate backwards between screens and move left in editing mode.
	Press to move up in the single line diagram and in the menu tree.
	Press to move down in the single line diagram and in the menu tree.

4.3 Key activated screens

4.3.1 The Help screen

The help screen is activated by pressing the Help key on the front panel of the IED. It includes the submenu listed below:

- General operation

The General Operation submenu provides information about the IED keypad.

The Open and Close keys are used to open (OFF) and close (ON) breakers and disconnectors when using the Single Line Diagram (SLD) in direct control situations.

4.3.2 The Reset screen

The reset screen is activated by the Reset key on the front panel of the IED or via the main menu. The reset screen includes the submenus listed below:

- Reset LEDs
- Reset lockout
- Reset counters
- Reset temperature functions

The Reset LEDs submenu consists of two lower level menus which are the “Start and trip LEDs” and “All indication LEDs” submenus. To reset a counter, the actual counter must first be selected. The submenus and the their structures are discussed in the “Reset” chapter of this document.

4.4 LCD

4.4.1 Medium

The following case sizes can be equipped with the medium size LCD:

- 1/2 x 19”
- 3/4 x 19”
- 1/1 x 19”

This is a fully graphical monochrome LCD which measures 4.7 x 3.5 inches. It has 28 lines with up to 40 characters per line. To display the single line diagram, this LCD is required.

4.5 LED

4.5.1 Introduction

The LED module is a *unidirectional means of communicating*. This means that events may occur that activate a LED in order to draw the operators attention to something that has occurred and needs some sort of action.

4.5.2 Status indication LEDs

The three LEDs above the LCD provide information as shown in the table below.

LED Indication	Information
Green:	
Steady	In service
Flashing	Internal failure
Dark	No power supply
Yellow:	
Steady	Dist. rep. triggered
Flashing	Terminal in test mode
Red:	
Steady	Trip command issued

4.5.3 Indication LEDs

The LED indication module comprising 15 LEDs is standard in 670 series. Its main purpose is to present an immediate visual information for protection indications or alarm signals.

Alarm indication LEDs and hardware associated LEDs are located on the right hand side of the front panel. Alarm LEDs are located on the right of the LCD screen and show steady or flashing light.

- Steady light indicates normal operation.
- Flashing light indicates alarm.

Alarm LEDs can be configured in PCM600 and depend on the binary logic. Therefore they can not be configured on the local HMI.

Typical examples of alarm LEDs

- Bay controller failure
- CB close blocked
- Interlocking bypassed
- Differential protection trip
- SF6 Gas refill
- Position error
- CB spring charge alarm
- Oil temperature alarm
- Thermal overload trip
- Pressure relief/Bucholtz

The RJ45 port has a yellow LED indicating that communication has been established between the IED and a computer.

The Local/Remote key on the front panel has two LEDs indicating whether local or remote control of the IED is active.

4.6 Local HMI setup

The contrast and other settings of the LCD can be adjusted from the local HMI menu tree. The contrast and other factory settings for the local HMI can be adjusted as follows:

Settings/General settings/HMI/Screen

4.7 How to navigate

4.7.1 Read

To read values and access information about the objects being monitored the operator must navigate the menu tree using the arrow keys. The active submenu or value is highlighted.

Navigation is as follows:

- Press the right arrow key to move to the main menu.
- Press the down arrow key to move from the Single line diagram to the desired submenu.
- Use the right arrow key to move downwards in the HMI tree until the desired parameter is displayed.
- Press C and the down arrow key simultaneously to see the next page in the parameter screen.
- Press C and the up arrow key simultaneously to return to the previous parameter screen.
- Use the left arrow key to navigate back up the menu tree.

4.7.2 Change

To change a parameter setting the following steps should be followed:

1. Navigate to the desired parameter or quantity using the arrow keys.
2. Press the E key when the parameter to be changed is highlighted.
3. Move between digits or letters using the left and right arrow keys.
4. Use the up and down arrow keys to change the digit or letter concerned.
5. Press the E key once the desired changes have been made.
6. Press the left arrow key to move up a level in the HMI tree.
7. You will be prompted to confirm the changes, use the left and right arrow keys to toggle between yes and no in the pop up window and press the E key to confirm your choice.
8. Press the left arrow key to move up to the next level in the HMI tree.

4.7.3 Control

The HMI offers the operator the opportunity to exercise direct local control over breakers and other apparatuses in the bay using the graphic display and designated keys on the front panel of the IED.

By pressing the L/R key until the uppermost of the two LEDs next to the key lights up, local operator control can be exercised from the HMI.

An apparatus is selected using the up and down arrow keys. The active apparatus is highlighted in the display.

The Open or Close commands are issued by pressing the Open or Close keys;

The user is requested to confirm the command in a pop-up window.

E confirms a command; C cancels it.

Interlocking or synchronism-check conditions may cause other query windows to pop-up.

Section 5 Understand the HMI tree

About this chapter

This chapter describes the structure of the HMI. The main menu includes submenus such as Measurements, Events, Disturbance Report, Settings, Diagnostics, Test and Reset. These branch out into a typical tree structure.

5.1 Overview

The local HMI has the following main menu:

- Control
- Measurements
- Events
- Disturbance records
- Settings
- Diagnostics
- Test
- Reset
- Authorization
- Language

Each main menu item can have several other submenus.

5.1.1 Menu-tree for RET670

Main menu	Sub menu	Sub-sub menu
Control	Single line diagram Commands	
Measurements	Analog primary values Analog secondary values Analog mean values Monitoring Metering	
Events		
Disturbance records	Manual trig	
Settings	Time	

Table continues on next page

Main menu	Sub menu	Sub-sub menu
	General settings	Power system Communication Analog modules I/O modules HMI Differential protection Current protection Voltage protection Control Monitoring Metering
	Setting group N	Differential protection Impedance protection Current protection Voltage protection Frequency protection Multipurpose protection Scheme communication Secondary system supervision Control Monitoring Logic
	Activate setting group	
Diagnostics	Internal events IED status	
Test	IED test mode Binary input values Binary output values Function test modes Function status LED test Line differential test	
Reset	Reset counters Reset internal eventlist Reset LEDs Reset lockout Reset temperature	
Authorization		
Language		

Section 6 Read measured values

About this chapter

This chapter describes measurement categories and how to locate them using the HMI. Each measurement category has a section of its own that includes a general description of the type of quantity being measured and the path in the local HMI to the measurement.

6.1 Overview

The measurement menu contains primarily analog measurement data. External signals can also be viewed as they are or as they appear in the Signal Matrix Tool (SMT). These signals are a virtual representation of the hard wired signals on the various inputs and outputs. SMT is only accessible via PCM600 and is intended to simplify the configuration of the IED. It allows hardware changes to be made without having to reconfigure the internal logic. Signals that can be used in SMT are indicated with the Suffix SMT.

The functions available under measurements are outlined below.

1. Analog primary values are the quantities measured on the primary side of the current and voltage transformers (CTs and VTs).
2. Analog secondary values are the quantities measured on the secondary side of the current and voltage transformers. These are the quantities measured on the Transformer module (TRM) inputs.
3. Analog mean values are the quantities measured at the inputs of the milliampere module (MIM).
4. Under Monitoring a number of submenus are available. These include Service values, Current phasors, Voltage phasors, Current sequence components and Voltage sequence components.
5. Metering displays the pulse counter and energy calculation and demand handling functions. The measurements available for pulse counter show pulse counter status data.

All measurement descriptions in this document reflect the maximum number of hardware units possible in any application. In reality the hardware in the IED will be chosen according to a particular application. For example, it is possible to equip a 1/1 x 19” case IED with 14 I/O modules. In reality fewer I/O modules may be installed. In

the measurements menu the operator will only see data from the hardware and software installed.

6.2 View analog primary values

6.2.1 Overview

The analog primary values are analog quantities measured on the primary side of the TRM and reflect the actual current or voltage on the primary side of the VTs and CTs. The ratio is adjusted under settings and also depends on the rating of the TRM. 24 primary values and phase angles are displayed in this view.

The analog primary values are values on the input (primary equipment side) of the merging unit (MU). These values are scaled according to a fixed "universal" scaling of 1 mA per LSB and 10 mV per LSB and transmitted to the IED via IEC 61850-9-2 LE protocol.

The analog primary values are values on the input (primary equipment side) of the merging unit (MU) when IEC 61850-9-2LE process bus communication is used. These values are scaled according to a fixed "universal" scaling of 1 mA per LSB and 10 mV per LSB and transmitted to the IED via IEC 61850-9-2LE protocol.

Main menu/Measurements/Analog primary values

Displays the quantities measured by the transformer module (TRM) or received via IEC 61850-9-2 LE process bus. For each channel used the amplitude of the voltage or current and its phase angle is shown. If the amplitude is to low for calculation, the angle will be indicated with "- - -". The status of the module is always shown and channels not in use are indicated with "- - " the abbreviation NC. Data from TRMs and LDCMs as well as Merging Units can be viewed. All currents and voltages are given in RMS values.

6.3 View analog secondary values

6.3.1 Overview

Analog secondary values shows secondary CT currents and VT voltages. These are the actual current and voltage values at the TRM inputs.

For analog values received from Merging Units, no analog secondary values are shown.

Main menu/Measurements/Analog secondary values

Displays up to 24 channels with secondary CT and VT data. RMS values are shown.

6.4 View analog mean values

6.4.1 Overview

Measurements from the Milliampere Input Module (MIM) are found in this part of the measurements menu. Data from either the hard wired mA module or Signal Matrix Tool mA modules are shown here.

6.4.1.1 mA input module MIM

Main menu/Measurements/Analog mean values/mA modules/MIM

Displays input data from the milli-ampere module which has six inputs. Each input has a range of +/- 20 mA. The value displayed on the screen is however dependant on the settings for the Milli-ampere Module. In the menu for settings, the range and a transformation factor can be adjusted to suit the application. This means that an input 3 mA may be displayed as temperature of 45 degrees. The output values shown are without units.

6.4.1.2 Signal matrix for mA inputs SMMI

Main menu/Measurements/Analog mean values/SMT mA modules/Instance

Displays the input signals coming into the Milli-ampere Module. Each module has six physical inputs with an input tolerance of +/- 20mA. The value displayed depends on the settings applied to this board which may for example cause an input of 3mA to show a value 30. The SMT mA modules are the virtual representation of MIMs in Signal Matrix Tool.

6.5 View monitoring values

6.5.1 Service values CVMMXU

Main menu/Measurement/Monitoring/ServiceValues(MMXU)/SVR

Displays up to three instances of CVMMXU with measured values for S, P, Q, PF, U, I, ILead, ILag and F.

6.5.2 Current phasors CMMXU

Main menu/Measurement/Monitoring/CurrentPhasors(MMXU)/CP

All three phase currents and their phase angles are displayed here.

6.5.3 Voltage phasors VMMXU/VNMMXU

Main menu/Measurements/Monitoring/VoltagePhasors(MMXU)/Phase - Phase/VP

Phase to phase voltages and phase angles are displayed here.

Main menu/Measurement/Monitoring/VoltagePhasors(MMXU)/PhaseEarth/VN

Phase to ground voltages and phase angles are displayed here.

6.5.4 Current sequence component CMSQI

Main menu/Measurements/Monitoring/CurrentSequenceComponents(MSQI)/CSQ

The current sequence component under monitoring displays the positive (I1), negative (I2) and zero sequence (I0) current values for a three phase line, both magnitude and phase angle for each component are displayed. These indicate how well balanced a system is. In an ideal balanced system the zero sequence current should be zero, the positive sequence current should be equal to the current of each phase with the same phase angle (relative to GPS) as the A phase signal and the negative sequence current should be zero.

6.5.5 Voltage sequence component VMSQI

Main menu/Measurements/Monitoring/VoltageSequenceComponents(MSQI)/VSQ

The Voltage sequence component displays the positive (V1), negative (V2) and zero (V0) sequence components in the system, and includes the magnitude and phase angle of each component.

6.6 View metering values

6.6.1 Pulse counter logic PCGGIO

Main menu/Measurements/Metering/PulseCounter(PCGGIO)/PC

The output data generated from the pulse counter function include data about the status of the counter and counter values.

6.6.2 Function for energy calculation and demand handling ETPMMTR

Main menu/Measurements/Metering/ThreePhEnergMeas(MMTR)/ETP

The output data generated from the energy measuring function includes active forward/reverse energy and reactive forward/reverse energy.

Section 7 Event list

About this chapter

This chapter describes how to find and read the event list.

7.1 View events

7.1.1 Overview

Events displays recorded events such as trips and breaker opened or closed.

Main menu/Events

Displays a list of events in chronological order and where each event has a time stamp. The latest event is at the top of the list.

Section 8 Handle disturbances

About this chapter

This chapter describes disturbance detection and handling. This includes resetting LED alarms, triggering disturbance reports and the viewing of several fault indicators.

8.1 Identify a disturbance

A disturbance record can be generated manually by using the Manual Trig functionality in the HMI menu. Other disturbance records are generated automatically in the system dependant on the settings made. Disturbance reports generate a disturbance sequence number and are time tagged. The fault location and fault loop are among the data generated in a fault record. Under each fault report there are five categories of information available. These are described in the sections that follow.

8.2 View disturbance record details

8.2.1 View general information

By choosing General information after selecting a disturbance record in the list of disturbance records the screen generated displays information about the disturbance such as its sequence number, time of occurrence, trig-signal, fault location and fault loop. The path in the HMI is shown below.

Main menu/Disturbance records/Manual trig

8.2.2 View disturbance indications

The Indications section of a disturbance record displays the recording number and, the time and date of the disturbance. The path in the HMI is shown below.

Main menu/Disturbance records/Record xx/Indications

8.2.3 View event recordings

The Event recording section in the Disturbance report shows the recording number. The path in the HMI is shown below.

Main menu/Disturbance records/Record xx/Event recording

8.2.4 View trip values

In the Trip values section of a disturbance recording both the pre-fault and the fault values for current, voltage and phase angle can be viewed. The recording number and Trig time are also displayed. The path in the HMI is shown below.

Main menu/Disturbance records/Record xx/Trip Values

8.3 Trigger a disturbance report manually

Using the manual trigger generates an instant disturbance report. Use this function to get a *snapshot* of the monitored line. Follow the path below and answer yes in the Execute manual trig dialog box.

Main menu/Disturbance records/Manual trig

Section 9 Read and change settings

About this chapter

This chapter describes how to find and change settings and parameters. The chapter is divided into two sections which match the way the two categories of settings are divided up in the HMI. The General settings group consists of those parameters that cause an automatic restart of the IED. The Setting group N consists of six groups of settings with default values for all parameters. These do not require or cause a restart once they have been changed. Time, synchronization and the activation of setting groups are also dealt with here.

It takes a minimum of three minutes for the IED to save the new settings, during this time the DC supply must not be turned off.

Do not perform a setting change at the same time as a hardware reconfiguration. Doing so might cause the IED to malfunction.

9.1 System time and synchronization

9.1.1 System time

Main menu/Settings/Time/System time

Under System time, the system clock date and time are set.

9.1.2 Time synchronization

9.1.2.1 Overview

The synchronization settings are divided into categories Time synch, Time synch BIN, Time synch SNTP, Time synch DST Begin, Time synch DST End, Time synch time zone and Time synch IRIG-B. The settable parameters are found under each category.

9.1.2.2 TimeSynch

Main menu/Settings/Time/Synchronization/TimeSynch

Here the parameters FineSyncSource, CourseSyncSrc and SyncMaster are switched on or off.

9.1.2.3 TimeSynchBIN

Main menu/Settings/Time/Synchronization/TimeSynchBIN

Binary input synchronization settings available here are the position of the of the module, the number of the binary input and the detection mode.

9.1.2.4 TimeSynchDSTBegin

Main menu/Settings/Time/Synchronization/TimeSynchDSTBegin

The starting point for Daylight Savings Time is set here.

9.1.2.5 TimeSynchDSTEnd

Main menu/Setttings/Time/Synchronization/TimeSynchDSTEnd

The end point of Daylight Savings Time is set here.

9.1.2.6 TimeSynchIRIG-B

Main menu/Settings/Time/Synchronization

The type of input, time domain, type of encoding and time zone for IRIG-B are set here.

9.1.2.7 TimeSynchSNTP

Main menu/Settings/Time/Synchronization/TimeSynchSNTP

Here the IP addresses for the Simple Network Time Protocol servers are set.

9.1.2.8 TimeZone

Main menu/Settings/Time/Synchronization/TimeSynch

The time zone according to Coordinated Universal Time (UTC) is set here.

9.2 General settings

Setting group 1 must be selected before making any changes to the parameters in General settings menu.

Parameters under General settings that are changed will cause the IED to restart. This occurs automatically and requires no manual intervention.

The IED must be in setting group 1 before changing settings in *General settings*

9.2.1 Power system

9.2.1.1 Overview

Under Power system in General settings there are four parameter categories. These are Identifiers, Primary values, three phase analog group and three phase analog sum group.

9.2.1.2 Identifiers

Main menu/Settings/General settings/Power system/Identifiers

Displays list with Station Name, Station Number, Object Name, Object Number, Unit Name and Unit Number.

9.2.1.3 Primary values

Main menu/Settings/General settings/Power system/Primary values

Displays the system frequency.

9.2.2 Communication

9.2.2.1 Overview

The parameter settings for communications are found under General Settings \Communications. Communication settings cover network interfaces, protocol, remote communication and reception of interlocking information.

9.2.2.2 Remote communication

Main menu/Settings/General settings/Communication/LDCM configuration/ LDCM

Displays settings for Remote Binary Communication (CRB) and for Remote Multi Communication (CRM). The multi communication block can send both binary and analog data whereas the binary can only send binary data.

Each instance of CRB has several settable parameters where the channel mode can be set on or off, terminal numbers can be entered, synchronization can be set to master or slave and opto power can be set high or low.

Each instance of CRM has several settable parameters. These include those above and others such as transmission delay and transmission current.

9.2.2.3 SPA, LON and IEC 60870–5–103 settings

Rear optical LON port

The menu for the rear optical LON port has five submenus for various settings affecting LON parameters. The HMI paths to these submenus and their contents are described below.

Main menu/Settings/General settings/Communication/SLM configuration/Rear optical LON port/General

In the General submenu there are three settings. These are for the Subnet address, the Node address and the NeuronID.

Main menu/Settings/General settings/Communication/SLM configuration/Rear optical LON port/ServicePinMessage

In this submenu a Service pin message can be generated. This is similar to a “ping” in traditional networks. This sends a signal to another node in the system which is then made aware of the Neuron ID of LON port and can respond to that port.

Main menu/Settings/General settings/Communication/SLM configuration/Rear optical LON port/ADE

The Application Data Event (ADE) menu is where operation of LON is set on or off and where the data exchange speed can be set. If LON is used primarily to send event data then the appropriate setting is *slow*. Should LON be used, for example, as a channel for TRIP signals then the setting *fast* would be appropriate.

Main menu/Settings/General settings/Communication/SLM configuration/Rear optical LON port/SPA

Settings for SPA over LON are made here. The *operation* setting is used to switch the function on or off and the *slave address* setting is where the slave address is entered.

Main menu/Settings/General settings/Communication/SLM configuration/Rear optical LON port/Horizontal communication

This setting is used to activate or deactivate horizontal communication.

Rear optical SPA-IEC-DNP port

Main menu/Settings/General settings/Communication/SLM configuration/Rear optical SPA-IEC-DNP port

In this submenu SPA or IEC is chosen and the necessary settings for the respective communication protocols are made.

Main menu/Settings/General settings/Communication/SLM configuration/Rear optical SPA-IEC port/Protocol selection

SPA and IEC cannot run at the same time and in this submenu one of the options is chosen.

Main menu/Settings/General settings/Communication/SLM configuration/Rear optical SPA-IEC port/SPA

When SPA is chosen the baud rate and slave address are set here.

Main menu/Settings/General settings/Communication/SLM configuration/Rear optical SPA-IEC port/IEC60870–5–103

When IEC 60870–5–103 is used the settings *Slave address, Baud rate, RevPolarity and CycMeasRepTime* are done here.

9.2.2.4 Station communication

DNP3.0 for TCP/IP and EIA-485 communication protocol

Main menu/Settings/General settings/Communication/Station communication/ DNP3.0

The DNP 3.0 related parameters are found here.

GOOSE Binary receive

Main menu/Settings/General settings/Communication/Station communication/ GOOSEBinReceive/GB

Includes available instances of GOOSE binary receive (GB) where setting *Operation* can be set *On* or *Off*.

IEC61850–8–1

Main menu/Settings/General settings/Communication/Station communication/ IEC61850–8–1

Includes settings for the IED name, operation (on/off) and GOOSE.

Multicommand send

Main menu/Settings/General settings/Communication/Station communication/ MultiCommandSend/MT

Includes available instances of Multicommand send settings allowing the user to adjust the maximum and minimum cycle time.

Multicommand receive

Main menu/Settings/General settings/Communication/Station communication/ MultiCommandReceive/CM

Includes available instances of Multicommand receive settings allowing the user to adjust the maximum and minimum cycle time, the pulse duration and mode of operation. The mode of operation is either steady or pulsed.

Horizontal communication via GOOSE for interlocking

Main menu/Settings/General settings/Communication/Station communication/ ReceivingInterlInfo/GR

Includes available instances of (GR01–GR59) for horizontal communication via GOOSE. Each instance or set can be switched On or Off via the Operation *On* and *Off* parameter.

9.2.2.5 Ethernet configuration

Main menu/Settings/General settings/Communication/Ethernet configuration/ Front port

The IP Address and IP mask for the ethernet port on the front panel of the IED are set here. These are generally used when connecting a PC directly to the IED. Remember that this is a static IP address and that the appropriate network settings must also be made in the PC.

Main menu/Settings/General settings/Communication/Ethernet configuration/ Rear OEM-Port AB

The IP address, IP mask and Mode for the IEC 61850-8-1 communication using the Optical Ethernet Module (OEM) at the rear of the IED are set here.

Main menu/Settings/General settings/Communication/Ethernet configuration/ Rear OEM-Port CD

The IP address (with different IP address when a second channel is used), IP mask and Mode for the Optical Ethernet Module (OEM) at the rear of the IED are set here. The CD port is used for IEC 61850-9-2LE communication.

Main menu/Settings/General settings/Communication/Ethernet configuration/ Rear OEM - Redundant PRP

Redundant station bus communication IEC61850-8-1 are set here.

Main menu/Settings/General settings/Communication/Ethernet configuration/ Gateway

If a gateway is used to access the system the address to that gateway is entered here.

9.2.3 Analog and I/O modules

9.2.3.1 Overview

Under Analog modules in the General settings menu there are settings for Analog inputs and I/O modules. Within each instance of analog input there are settings for all 12 channels that include the name of the channel, star point of the CT circuit, the primary and secondary values from the measuring transformers (CTs and VTs). The channel type and ratings are shown but cannot be changed.

The settings for binary inputs and outputs even include the milliampere input modules. A mix of up to 14 instances of BIM, BOM and IOM is possible depending on the physical configuration of the IED. Operation ON or OFF can be set for all of these and for the BIMs oscillation release and oscillation block settings are available. These settings are on board level and apply to all binary inputs or outputs on a board.

9.2.3.2 Analog modules

Main menu/Settings/General Settings/Analog modules/AnalogInputs

Displays all variations of analog input modules with parameters. The analog input modules have different combinations of current and voltage inputs. Each channel has

parameters where the type of channel is set, the primary and secondary values from VTs and CTs and for Current Transformers the WYE point location (line side or busbar side) is set.

Main menu/Settings/General Settings/Analog modules/MergingUnit

Displays parameters for the merging units. For the MU channels, no primary or secondary values need to be set, due to the fixed standardized scaling of 1 mA/10 mV per LSB

Main menu/Settings/General Settings/Analog modules/3PhaseAnalogGroup/PR

Here, settings for the Fourier filters, the minimum system voltage required to measure frequency, the item designation of CTs or VTs, and the system voltage are set. These settings are required by the preprocessing blocks and are usually only adjusted during the initial engineering phase.

Main menu/Setting/General Settings/Analog modules/ 3phAnalogSummationGroup/SU

Here is where the settings for the summation block are done. The summation type, Fourier filter reference frequency, minimum voltage for frequency measurement and the system voltage are some of the parameters that can be set here.

Settings/General Settings/Analog modules/Reference channel service values

The phase angle reference is set here.

9.2.3.3 I/O modules

Main menu/Settings/General Settings/I/O Modules

Settings for binary inputs and outputs (BIM, BOM, IOM), and under each binary module there are one or more adjustable parameters. In the I/O modules folder there is also a “reconfigure” setting that starts a dialog box prompting the user to confirm or cancel the command. Since only I/O modules installed in the IED are shown, the parameters available for setting depend on the physical configuration of the IED. All I/O modules include the operation parameter which enables the operator to switch the module on or off.

The milliampere modules (MIMs) are also found in the I/O Modules folder. Parameters possible to set here are dead band settings and various current threshold values.

9.2.4 HMI

9.2.4.1 Overview

Under HMI in General settings there are submenus for LEDs, Screen, Functions, Reference channel service values and the Change lock function. In the LED submenu there are settings for operation, illumination times, and sequence types for the LEDs on the IED front panel. In the Screen submenu Contrast level, Default screen, Auto repeat and Timeout display can be set. In the Functions submenu the Event list sorting order and Distance presentation can be set.

9.2.4.2 LEDs

Settings/General settings/HMI/LEDs

Parameters such as Operation, tRstart, tMax and 15 instances of SeqTypeLED can be set here. The SeqTypeLED offers several options for the type of illumination sequence the LEDs should follow.

9.2.4.3 Screen

Main menu/Settings/General Settings/HMI/Screen

Local HMI setting parameters such as Language, Contrast level and Default menu can be set here.

9.2.4.4 Functions

Main menu/Settings/General Settings/HMI/Functions

The settings here are used to determine the way information is presented in the HMI.

9.2.4.5 Change lock

Main menu/Settings/General settings/HMI/Change lock

The operation of the Change lock function can be activated or deactivated here.

9.2.5 Differential protection

9.2.5.1 Overview

This group of settings covers differential protection of transformers. The system needs rated data to function properly. If the protection object is for example, a transformer, the rated current and voltage per winding as well as other relevant data will be needed. The submenus under differential protection contain many other settable parameters such as connection type (line side or busbar side), tap positions, CT ratings etc. The data required depends on the protected object.

9.2.5.2 Transformer differential protection, two winding T2WPDIF (87T)

Main menu/Settings/GeneralSettings/Differential protection/ TransformerDiff2Wind(PDIF,87T)/T2D

Parameters for available instances of T2WPDIF (87T) can be set here. These include the rated voltages and currents for windings, the connection types, the current transformer ratings and various other parameters.

9.2.5.3 Transformer differential protection, three winding T3WPDIF (87T)

Main menu/Settings/General settings/ Differential protection/ TransformerDiff3Wind(PDIF,87T)/T3D

Parameters for T3WPDIF (87T) can be set here. These include rated voltages and currents, connection types (Y, D), current transformer ratings and various other parameters.

9.2.6 Control

9.2.6.1 Apparatus control

Overview

Under Control in General settings, parameters for Apparatus control can be adjusted. These are the parameters for among others Bay control, Switch controller, Reservation input, Circuit breakers and Circuit switches. The parameters include delay times, dependencies, pulse times and characteristics.

Bay control QCBAY

Main menu/Settings/General settings/Control/ApparatusControl/ BayControl(CBAY)

Displays up to six instances of the bay control function QCBAY with a setting that gives the local operator priority over the remote operator or vice versa.

Bay reserve QCRSV

Main menu/Settings/General settings/Control/ApparatusControl/ BayReserve(CRSV)/CR

Displays up to four instances of the bay reserve function QCRSV with nine parameter settings. The first is for setting the supervision time to cancel a reservation and the other eight are for the reservation of the own bay only at the selection of an apparatus.

Circuit breaker SXCBR

Main menu/Settings/General settings/Control/ApparatusControl/ CircuitBreaker(XCBR)/XC

Displays available instances of the circuit breaker function with parameter settings SXCBR for various time limits and pulse lengths. For example, different circuit breakers may require different pulse lengths to react. The setting *tOpenPulse* is used to set the length of the pulse required to open a breaker.

Circuit switch SXSWI

Main menu/Settings/General settings/Control/ApparatusControl/ CircuitSwitch(XSWI)/XS

Displays available instances of the circuit switch function SXSWI with a number of settable parameters per instance for time and pulse settings, output reset and switch type.

Local/Remote switch LocalRemote, LocRemControl

Main menu/Settings/General settings/Control/ApparatusControl/LocalRemote/LR

Displays available instances of the local/remote function LocalRemote, LocRemControl that permit the user to set the control mode.

Reservation input RESIN

Main menu/Settings/General Settings/Control/Apparatus Control/ ReservationInput/RE

Displays available instances of the Reservation input function RESIN with one settable parameter per function for future use.

Switch controller SCSWI

Main menu/Settings/General settings/Control/ApparatusControl/ SwitchController(CSWI)/CS

Displays instances of the switch controller function SCSWI with eight settable parameters. These are settings for the control model, position dependency and various threshold times.

9.2.6.2 Control commands

Automation bits, command function for DNP3.0 (AutomationBits)

Main menu/Settings/General settings/Control/Commands/Automation bits/ABI

A parameter to enable or disable the function is available.

Single command SINGLECMD

Main menu/Settings/General settings/Control/Commands/SingleCommand/CD

The mode for single command is set here.

Logic rotating switch SLGGIO

Main menu/Settings/General settings/Control/Commands/SelectorSwitch(GGIO)/SL

A number of selector switches SLGGIO can be configured in the system. These are substitutes for rotating physical switches. The parameter setting *StopAt Extremes*is used to disable or enable the end position of the switch.

Versatile switch VSGGIO

Main menu/Settings/General settings/Control/Commands/VersatileSwitch/VS

Parameters such as control model according to IEC61850 and operation mode for the versatile switch is set here.

Tap changer control and supervision TCMYLTC (84)

Main menu/Settings/General settings/Control/TransformerTapControl(YLTC, 84)/TCM

Tap changer parameters such as tap positions for low and high voltage and type of code conversion are set here.

Tap changer control and supervision TCLYLTC (84)

Main menu/Settings/General settings/Control/TransformerTapControl(YLTC, 84)/TCL

Tap changer parameters such as tap positions for low and high voltage and type of code conversion are set here.

Automatic voltage control for tapchanger, parallel control TR8ATCC (90)

Main menu/Settings/General settings/Control/TransformerVoltageControl(ATCC, 90)/VCP

Transformer voltage control parameters such as transformer name, transformer reactance and selections for alarm and block functions are set here.

Automatic voltage control for tapchanger, single control TR1ATCC (90)

Main menu/Settings/General settings/Control/TransformerVoltage Control(ATCC,90)/VCS

Transformer voltage control parameters such as transformer name, transformer reactance and selections for alarm and block functions are set here.

9.2.7 Monitoring

9.2.7.1 Overview

Under monitoring there are parameters for setting Service values, current phasors, Voltage phasors, Disturbance reports and the Measured value expander block.

9.2.7.2 Service values CVMMXU

Main menu/Settings/General Settings/Monitoring/ServiceValues(MMXN)/SVR

Displays available instances of CVMMXU.

9.2.7.3 Current phasors CMMXU

Main menu/Settings/General Settings/Monitoring/CurrentPhasors(MMXU)/CP

Displays available instances of the current phasor function CMMXU with output regarding current magnitude, current range, phase angle, zero sequence current magnitude and negative sequence current magnitude.

9.2.7.4 Voltage phasors VMMXU/VNMMXU

Main menu/Settings/General Settings/Monitoring/VoltagePhasors(MMXU)/Phase-Phase/VP

Displays available instances of the voltage phasor function VMMXU with output data for phase to phase voltage, (amplitude, phase angle). The setting parameters for supervision levels, deadband etc. are set here

Main menu/Settings/General Settings/Monitoring/VoltagePhasors(NMMXU)/ Phase-Earth/VN

Displays available instances of the voltage phasor function VNMMXU with output data for phase to ground voltage, (amplitude, phase angle). The setting parameters for supervision levels, deadband etc. are set here.

9.2.7.5 Current sequence components CMSQI

Main menu/Settings/General settings/Monitoring/Current sequence components(MSQI)/CSQ

The current sequence components are where the user sets the limits and deadband settings for current sequence components. The designation for zero sequence current is 3I0, for positive sequence current it is I1 and for negative sequence current it is I2.

There are sets of settings with some categories of parameter settings per set instance of CMSQI.

9.2.7.6 Voltage sequence components VMSQI

Main menu/Settings/General settings/Monitoring/ VoltageSequenceComponents(MSQI)/VSQ

The voltage sequence components are where the user sets the limits and deadband settings for voltage sequence components. The designation for zero sequence voltage is 3V0, for positive sequence voltage is V1 and for negative sequence voltage is V2.

There are sets of settings with some categories of parameter settings per set instance of VMSQI

9.2.7.7 Disturbance report DRPRDRE

Main menu/Settings/General Settings/Monitoring/Disturbance Report/ DisturbanceReport(RDRE)

Displays available settings.

Binary signals

Main menu/Settings/General settings/Monitoring/Disturbance report/Binary signals(RBDR)/Channel xx-yy

There are some groups of several channels with several binary outputs per channel. Each channel has some settable parameters. These are operation, trig level, indication MA and set LED.

Analog signals

Main menu/Settings/General settings/Monitoring/Disturbance report/Analog signals(RADR)/Channel xx-yy

There are some groups of a number of channels with a number of analog signals per channel. Each signal has some settable parameters such as operation, Nominal value and trig values.

9.2.7.8 Generic measured value MVGGIO

Main menu/Settings/General Settings/Monitoring/GenericMeasuredValue(GGIO)/MV

Displays available instances of settings for the Measured value function MVGGIO with a number of settable parameters. These settings are used to define the range of values used in the function block and to set the threshold values. This is a generic function and therefore the input values depend on the application.

9.2.7.9 Event function

Main menu/Settings/General settings/Monitoring/EventFunction/EV

The Event function menu consists of several sets of settable parameters EV01-EV20 where the SPA channel mask, LON channel mask, Event mask and minimum repetition interval can be set.

9.2.7.10 Logical signal status report BINSTATREP

Main menu/Settings/General settings/Monitoring/BinarySignalStatusReport/SSR

The Binary signal status report BINSTATREP settings consist of some sets of settable parameters with one settable parameter per instance.

9.2.7.11 IEC 60870–5–103

Main menu/Settings/General settings/Monitoring/IEC 60870–5–103

The IEC 60870–5–103 part of the settings menu is divided into two separate submenus. These are Measurements and Disturbance report. In the Measurements menu there are four sets of measurement settings, one with standard settings and three

with user defined settings. The standard settings include some standard service value thresholds.

In the Disturbance report menu Binary signal parameters on up to 96 channels are configured.

9.2.8 Metering

9.2.8.1 Overview

Under metering there are settings for the Pulse counter function. There are some instances of the Pulse counter function. Each instance can be switched on or off and a number of parameters can be adjusted.

9.2.8.2 Pulse counter logic PCGGIO

Main menu/Settings/General settings/Metering/PulseCounter(PCGGIO)/PC

In the Pulse counter PCGGIO folder there are a number of instances of the pulse counter function PCGGIO. Each instance has a setting and some settable parameters. The setting *Operation* is used to turn the function on or off. The parameters are adjusted to change cycle times, pulse counter criteria and the like.

9.2.8.3 Function for energy calculation and demand handling ETPMMTR

Main menu/Settings/General settings/Metering/ThreePhEnergMeas(MMTR)/ETP

Parameters for activating the function, activate accumulation of energy values, selection of time interval for energy calculation and forward/reverse pulse quantities for accumulated energy values are found here.

9.3 Setting group N

9.3.1 Overview

There are some default setting groups. Under general settings, parameters in these groups can be changed to suit the needs of an application. The default settings have been chosen according to established practice in the industry but will usually require a certain amount of adjustment to suit the requirements of individual applications.

9.3.2 Differential protection

9.3.2.1 Overview

The settings available for differential protection in Setting group N are not the same as those under General settings. The main difference is that settings in the Setting group N category can be changed on the fly without the IED requiring a restart. A dialog box appears when attempting to make changes to setting group N. Choose OK to proceed, or cancel to abort.

9.3.2.2 Transformer differential protection, two winding T2WPDIF (87T)

Main menu/Settings/Setting group N/Differential protection/ TransformerDiff2Wind(PDIF,87T)/T2D

There are a number of possible settings for T2WPDIF (87T). These are used to adjust the limits on the curve determining the operation of the function. The slope of the curve in section two and section three of the curve can be adjusted and the end points of section one and section two can be set along the Ibias axis. The slope of the curve in sections two and three can also be adjusted. The unrestrained limit for the operation of the protection can be set as a multiple of rated current for winding one. The cross blocking function that enables a blocking condition on one phase to prevent a trip even if a trip signal is generated by another phase, can be set on or off.

9.3.2.3 Transformer differential protection, three winding T3WPDIF (87T)

Main menu/Settings/Setting group N/Differential protection/ TransformerDiff3Wind(PDIF,87T)/T3D

Displays available instances of T3WPDIF (87T) with a number of settings each. The settings for this function are identical to "Transformer differential protection, two winding T2WPDIF (87T)"

9.3.2.4 Restricted ground fault protection REFPDIF (87N)

Main menu/Settings/Setting group N/Differential protection/LowImpREF(PDIF, 87N))/REF

Displays available instances of REFPDIF (87N) with some settings per instance. These are for the Current transformer ratios, operation, rated current *Ibase*operate angle of the zero sequence directional feature and *Idmin* which is a percentage of *Ibase* and is the current threshold in section one of the characteristic slope.

9.3.2.5 High impedance differential protection HZPDIF (87X)

Main menu/Settings/Setting group N/Differential protection/ HighImpDifferential(PDIF,87)/HZD

Displays available instances of HZPDIF (87X) with settings for operation, the alarm voltage level [V] on the CT secondary side, the time delay to activate the alarm, the operating voltage level [V] on the secondary side of the CT and the value of the series resistor in [Ω].

9.3.3 Impedance protection

9.3.3.1 Overview

Under Impedance protection there are settings for Distance zones, Phase selection, directional impedance, Power swing detection, and Automatic switch onto fault protection. Each instance of a function can be switched on or off with the operation parameter and the remaining parameter settings like rated current and voltage are data required for the function to operate.

9.3.3.2 Full-scheme distance protection, mho characteristic ZMHPDIS (21)

Main menu/Settings/Setting group N/Impedance Protection/MhoDistance(PDIS, 21)/ZMH

Displays available adjustable parameters. These include the impedance and timer settings.

9.3.3.3 Distance protection zones, quadrilateral characteristics ZMQPDIS, ZMQAPDIS (21)

Main menu/Settings/Setting group N/Impedance protection/DistanceZones(PDIS, 21)/ZM

Main menu/Settings/Setting group N/Impedance protection/DistanceZones(PDIS, 21)/ZM

Displays available adjustable parameters. These include the [Ω] per phase for resistive and reactive reach as well as the [Ω] per loop for phase to phase, and phase to ground fault resistance. Zones can also be set on or off.

9.3.3.4 Fullscheme distance protection, quadrilateral for earth faults ZMMPDIS, ZMMAPDIS (21)

Main menu/Setting/Setting Group N/Impedance protection/ QuadEarthDistance(PDIS,21)/ZMM

Main menu/Setting/Setting Group N/Impedance protection/ QuadEarthDistance(PDIS,21)/ZMM

Displays available adjustable parameters. These include the resistive and reactive reach, fault resistance, minimum operate current and timer setting.

9.3.3.5 Faulty phase identification with load enchroachment FMPSPDIS (21)

Main menu/Settings/Setting group N/Impedance protection/PhaseSelection(PDIS, 21)/PHM

Includes current and voltage level settings.

9.3.3.6 Phase selection, quadrilateral characteristic with fixed angle FDPSPDIS (21)

Main menu/Settings/Setting group N/Impedance protection/PhaseSelection(PDIS, 21)/PHS

Displays available settings including minimum operating current for both phase-phase and phase-ground fault loops.

9.3.3.7 Phase preference logic PPLPHIZ

Main menu/Settings/Setting Group N/Impedance protection/ PhasePreferenceLogic(PDIS,21)/PPL1

Parameters such as operation mode, voltage and current levels as well as timer setting are found here.

9.3.3.8 Directional impedance quadrilateral ZDRDIR (21D)

Main menu/Settings/Setting Group N/Impedance protection/ DirectionalImpedance (RDIR)/ZD

Includes settings for base current, voltage and impedance direction angles.

9.3.3.9 Directional impedance element for mho characteristics ZDMRDIR (21D)

Main menu/Settings/Setting group N/Impedance protection/Directional Impedance/ZDM

Includes settings for base current, voltage and impedance direction angles.

9.3.3.10 Additional distance protection directional function for ground faults ZDARDIR

Main menu/Settings/Setting Group N/Impedance protection/ MhoDirectionEF(RDIR)/ZDA

Includes settings for minimum operate currents, polarizing mode and angles for directional measurement.

9.3.3.11 Mho impedance supervision logic ZSMGAPC

Main menu/Settings/Setting Group N/Impedance protection/ MhoSupervisionLogic(GAPC)/ZSM

Parameters for current and voltage change levels are set here.

9.3.3.12 Power swing detection ZMRPSB (78)

Main menu/Settings/Setting Group N/Impedance protection/ PowerSwingDetection(RPSB,78))/PSD

Includes settings for operation, reactive and resistive boundaries, various timers, base settings for current levels and several others.

9.3.3.13 Power swing logic ZMRPSL

Main menu/Settings/Setting Group N/Impedance protection/ PowerSwingLogic(RPSL)/PSL1

Timers are set here.

9.3.4 Current protection

9.3.4.1 Overview

Under Current protection there are settings for Instantaneous phase overcurrent, Phase overcurrent four step, Instantaneous residual overcurrent, Residual overcurrent four step, Thermal overload with two time constants, Pole discrepancy and Breaker failure. There are several instances of each function with parameter settings for rated data, operation and many others. The thermal overload functions have temperature threshold settings as well as many others necessary for adapting the function to a particular application.

9.3.4.2 Breaker failure protection CCRBRF (50BF)

Main menu/Settings/Setting Group N/Current protection/BreakerFailure(RBRF, 50BF)/BFP

Displays some instances of CCRBRF (50BF) with several settings per instance. Settings include operation, base current, function mode, operation mode of retrip logic, time delays and several others.

9.3.4.3 Broken conductor check BRCPTOC (46)

Main menu/Settings/Setting Group N/Current protection/ BrokenCondCheck(PTOC,46)/BRC

Includes current and timer settings.

9.3.4.4 Directional over-power protection GOPPDOP (32)

Main menu/Settings/Setting Group N/Current protection/ DirOverPowerProtection(PDOP,32)/GOP

Includes power, angle and calibration factor settings.

9.3.4.5 Directional under-power protection GUPPDUP (37)

Main menu/Settings/Setting Group N/Current protection/ DirUnderPowerProtection(PDUP,37)/GUP

Includes power, angle and calibration factor settings.

9.3.4.6 Instantaneous phase overcurrent protection PHPIOC (50)

Main menu/Settings/Setting Group N/Current protection/ InstPhaseOvercurrent(PIOC,50)/IOC

Displays some instances of PHPIOC (50) with some settable parameters per instance. Operation mode, operate current multiplier, operation on or off, operate phase current level as a percentage of *IBase*, and *IBase* itself are the settable parameters available here.

9.3.4.7 Instantaneous residual overcurrent protection EFPIOC (50N)

Main menu/Settings/Setting Group N/Current protection/ InstResidualOverCurrent(PIOC,50N)/IEF

Displays some instances of EFPIOC (50N) with settable parameters per instance. The settable parameters are operation (On or Off), base setting for current magnitude, the threshold current as a percentage of *IBase*, and the multiplier for the current threshold level.

9.3.4.8 Four step phase overcurrent protection OC4PTOC (51_67)

Main menu/Settings/Setting Group N/Current protection/ PhaseOverCurrent4Step(PTOC,51_67)/TOC

Displays some instances of OC4PTOC (51_67) each with several settings. The settings range from base current and voltage settings to parameters for customer programmable curves.

9.3.4.9 Pole discrepancy protection CCRPLD (52PD)

Main menu/Settings/Setting Group N/Current protection/PoleDiscordance(RPLD, 52PD)/PD

Displays instances of CCRPLD (52PD) with some settings per instance. The settings are for operation, base current, trip time delay, contact function selection, current function selection, asymmetrical magnitude of current and current release threshold.

9.3.4.10 Four step residual overcurrent protection EF4PTOC (51N67N)

Main menu/Settings/Setting Group N/Current protection/ ResidualOverCurrent4Step(PTOC,51N_67N)/TEF

Displays some instances of EF4PTOC (51N67N) with a large number of settings per instance. Typical settings are those for harmonic restraint, minimum fundamental frequency current level, base settings for current and voltage and several others.

9.3.4.11 Sensitive directional residual over current and power protection SDEPSDE (67N)

Main menu/Settings/Setting group N/Current protection/ SensDirResOvCurr(PSDE,67N)/SDE

Includes voltage, current, operation mode and timer settings.

9.3.4.12 Thermal overload protection, two time constants TRPTTR (49)

Main menu/Settings/Setting Group N/Current protection/ ThermalOverload2TimeConst(PTTR,49)/TTR

Displays some instances of TRPTTR (49) with several settable parameters per instance. Typical settings are length of pulse for trip signal, reference current as a percentage of the base system current and several other related settings.

9.3.5 Voltage protection

9.3.5.1 Overview

For Voltage protection there are settings for Under-voltage, Over-voltage, Residual over-voltage and Overexcitation protection. There are three instances of parameters in each category except in the case of Overexcitation which has two instances. Each instance consists of a number of parameters that make it possible to switch the function On or Off, set rated quantities or make other adjustments necessary for the fine tuning of the function itself.

9.3.5.2 Loss of voltage check LOVPTUV (27)

Main menu/Setting/Setting Group N/Voltage protection/LossOfVoltage(PTUV,27)/LOV

Parameters for voltages and timers are set here.

9.3.5.3 Overexcitation protection OEXPVPH (24)

Main menu/Settings/Setting Group N/Voltage protection/Overexcitation(PVPH, 24)/OEX1

Displays settable parameters for operation, rated current and voltage, time delays for user designed curves and several other related settings.

9.3.5.4 Two step overvoltage protection OV2PTOV (59)

Main menu/Settings/Setting Group N/Voltage protection/ OverVoltage2Step(PTOV,59)/TOV

Displays several settable parameters including settings for Time Overvoltage Curves (TOC) and other function related settings.

9.3.5.5 Two step residual overvoltage protection ROV2PTOV (59N)

Main menu/Settings/Setting Group N/Voltage protection/ ResidualOverVoltage2Step(PTOV,59N)/TRV

Displays up to several settable parameters for characteristics and many related parameters.

9.3.5.6 Two step undervoltage protection UV2PTUV (27)

Main menu/Settings/Setting Group N/Voltage protection/ UnderVoltage2Step(PTUV,27)/TUV

Displays available settable parameters. The operation mode, the operate voltage as percentage of *UbaseVbase* are examples of the settings available here.

9.3.5.7 Voltage differential protection VDCPTOV (60)

Main menu/Settings/Setting Group N/Voltage protection/VoltageDiff(PTOV,60)/ VDC

Includes settings for voltage difference and timers.

9.3.6 Frequency protection

9.3.6.1 Overview

For Frequency protection there are settings for Underfrequency, Overfrequency and Rate of change of frequency. Each category has some instances of parameters. All functions can be set On or Off and have a number of other settable parameters such as rated voltage and time delay before tripping.

9.3.6.2 Overfrequency protection SAPTOF (81)

Main menu/Settings/Setting Group/Frequency protection/OverFrequency(PTOF, 81)/TOF

Displays available instances of SAPTOF (81) with a number of settings per instance. The settings are operation, pickup frequency, base voltage setting, internal blocking level, operate time delay and reset time delay. For the Overfrequency function to operate correctly the *Operation* setting must be *On*.

9.3.6.3 Rate-of-change frequency protection SAPFRC (81)

Main menu/Settings/Setting Group N/Frequency protection/ RateOfChangeOfFrequency(PFRC,81)/RCF

Displays available instances of SAPFRC (81) with some settings per instance. The settings include parameters such as operation, base voltage setting, pickup frequency, internal blocking level, time delay to trip and frequency restoration.

9.3.6.4 Underfrequency protection SAPTUF (81)

Main menu/Settings/Setting Group N/Frequency protection/ Underfrequency(PTUF,81)/TUF

Displays available instances of SAPTUF (81) with a number of settings per instance. These include parameters like operation, base voltage, and pickup frequency. To ensure the proper operation of the Underfrequency function the *Operation* setting must be *On*.

9.3.7 Multipurpose protection

9.3.7.1 Overview

Under Multipurpose protection there are several instances of General current and voltage parameters. This function has current and voltage inputs. The parameters available are based on the data from these inputs. Within each instance operation for the included functions can be set to On or Off and a large number of parameters can be set.

9.3.7.2 General current and voltage protection CVGAPC

Main menu/Settings/Setting Group N/Multipurpose protection/ GeneralCurrentVoltage(GAPC)/GF

Displays available instances of CVGAPC with several settable parameters per instance. These settings are available for the user defined functions configured with the help of the Multipurpose protection function.

9.3.8 Scheme communication

9.3.8.1 Overview

Under Scheme communication there are settings for Zone scheme communication, Zone current reversal, Local acceleration logic, EF Scheme communication and EF Current reversal weak end infeed. In each category the function can be switched On or Off and time delays, ratings and parameters can be set.

9.3.8.2 Current reversal and weak-end infeed logic for residual overcurrent protection ECRWPSCH (85)

Main menu/Settings/Setting Group N/Scheme communication/ EFCurrentReversalWEI(PSCH,85)/EFCA

Displays available settable parameters including operation, rated values, time data and other related settings.

9.3.8.3 Scheme communication logic for residual overcurrent protection ECPSCH (85)

Main menu/Settings/Setting Group N/Scheme communication/ EFSchemeCommunication(PSCH,85)/EFC1

Displays setting parameters for operation, scheme type and coordination time.

9.3.9 Secondary system supervision

9.3.9.1 Overview

Under Secondary circuit supervision there are settings for Current circuit supervision and Fuse failure. There are five instances of Current circuit supervision with parameters for minimum operation current, rated current and operation. There are six instances of Fuse failure supervision parameters for setting rated current, voltage, operation mode and several other parameters.

9.3.9.2 Current circuit supervision CCSRDIF (87)

Main menu/Settings/Setting group N/Secondary system supervision/ CurrentCircuitSupervision(RDIF,87)/CCS

Displays available instances of CCSRDIF (87) with some settings per instance. There are settings for operation, base current setting, blocking of function, and minimum threshold for current differential.

9.3.9.3 Fuse failure supervision SDDRFUF

Main menu/Settings/Setting Group N/Secondary system supervision/ FuseFailure(RFUF)/FSD

Displays available instances of SDDRFUF with several settings per instance. There are parameters for operation, various thresholds and base values.

9.3.10 Control

9.3.10.1 Overview

Under Control in the Setting group N menu settings for synchronism-checkare available. Some instances of settings are available meaning that the settings for all available apparatuses can be made here. The synchronism-check settings include the selection of busses or lines and the configuration parameters for circuit breakers.

9.3.10.2 synchronism-check and energizing check SESRSYN (25)

Main menu/Settings/Setting Group N/Control/Synchronizing(RSYN,25)/SYN

Displays available instances of the synchronism-check function SESRSYN (25) with several settings per instance. There are settings for operation, voltage differences and limits, time delays etc.

9.3.10.3 Tap changer control and supervision, 6 binary inputs TCMYLTC (84)

Main menu/Settings/Setting Group N/Control/TransformerTapControl(YLTC, 84)/TCM

Parameters such as base current, tap changer time out and raise/lower command pulse duration are set here.

9.3.10.4 Tap changer control and supervision, 32 binary inputs TCLYLTC (84)

Main menu/Settings/Setting Group N/Control/TransformerTapControl(YLTC, 84)/TCL

Parameters such as base current, tap changer time out and raise/lower command pulse duration are set here.

9.3.10.5 Automatic voltage control for tapchanger, single control TR1ATCC (90)

Settings/Setting Group N/Control/TransformerVoltageControl(ATCC,90)/VCS

Parameters for current and voltage levels, deadbands, timers and alarm levels are found here.

9.3.10.6 Automatic voltage control for tapchanger, parallel control TR8ATCC (90)

Main menu/Settings/Setting Group N/Control/ TransformerVoltageControl(ATCC,90)/VCP

Parameters for current and voltage levels, deadbands, timers and alarm levels are found here.

9.3.11 Monitoring

9.3.11.1 Overview

Event counter settings are found under Monitoring in the Setting Group N menu.

9.3.11.2 Event counter CNTGGIO

Main menu/Setting/Setting group N/Monitoring/EventCounter(GGIO)/CNT

Here the function can be set on or off.

9.3.12 Logic

9.3.12.1 Overview

Under Logic there are settings for Trip logic, Trip matrix, Logic gate, Logic SR memory and Logic timer set. Under each of these function categories there are a number of instances, each with a parameter set.

9.3.12.2 Tripping logic SMPPTRC (94)

Main menu/Settings/Setting group N/Logic/TripLogic(PTRC,94)/TRP

Displays available instances of the trip logic function SMPPTRC (94) with some settable parameters per instance. The settable parameters include operation, tripping order, trip lockout and minimum duration of trip output signal.

9.3.12.3 Trip matrix logic TMAGGIO

Main menu/Settings/Setting group N/Logic/TripMatrix(GGIO)/TR

Displays available instances of the trip logic function TMAGGIO, each with settable parameters for operation, selections, delay times, and pulse times.

9.3.12.4 LogicGate

Main menu/Settings/Setting group N/Logic/LogicGate/GT

Displays parameter settings for operation (On or Off).

9.3.12.5 LogicSRMemory

Main menu/Settings/Setting group N/Logic/LogicSRMemory/SM

Displays setting parameters for operating mode of memory function.

9.3.12.6 LogicTimerSet

Main menu/Settings/Setting Group N/Logic/LogicTimerSet/TS

Displays settable parameters for operation (On or Off) and delay for settable timer.

9.4 Activate setting group

Main menu/Settings/Activate setting group

Available setting groups can be configured in PCM600. Under *activate setting group* one of these setting groups can be chosen for the application at hand.

9.5 Language

Under the language part of the main menu the language options available in the HMI are located. These vary depending on the configuration ordered.

Section 10 Diagnose IED status

About this chapter

This chapter describes where in the HMI tree to find the cause of an internal IED failure and information about the IED as such.

10.1 Read internal events

Main menu/Diagnostics/Internal events

Internal events in the diagnostics menu of the HMI tree shows a time stamped list of events. These are events internal to the IED and can be used as reference when troubleshooting the system.

10.2 Find available functions

Under general in IED status the functional readiness and status of cards and applications can be viewed.

Main menu/Diagnostics/IED status/General

Messages such as On, Ready and Fail indicate the status of each item on the list.

To identify the type of IED you are confronted with, navigate to identifiers using the keypad. The path to identity parameters is shown below.

Main menu/Diagnostics/IED status/Product identifiers

Under product identifiers, information about the type of IED, the IED main function, the serial number of the IED, its order number and production date are found.

By following the menu path below the configuration of all hardware in the IED is displayed as a list.

Main menu/ Diagnostics/IED status/Installed HW

The list includes the slot number, the module name (Card) and its article number.

By following the menu path below the status signals of the merging units are listed.

Main menu/Diagnostics/IED status/Merging units/MergingUnit:x

The list includes all the status signals of each merging unit.

Main menu/ Diagnostics/Communication/Front port

Displays various communication status signals for front port communication.

Main menu/ Diagnostics/Communication/Rear OEM - port AB

Displays various communication status signals for rear AB port communication.

Main menu/ Diagnostics/Communication/Rear OEM - port CD

Displays various communication status signals for rear CD port communication.

Section 11 Test the IED

About this chapter

This chapter describes the tests that can be performed in the test section of the HMI.

11.1 Overview

The test part of the tree view in the HMI has a number of submenus for test and viewing activities. When IED test mode is set to ON functions are inactivated so that no signals are transmitted during testing. Under Function test modes individual functions can be activated. The LED test are also activated here.

The submenus for binary inputs and outputs as well as the submenu titled Function status are used to view data generated by the system. These categories of data are outlined below.

1. Binary output values has two submenus. These are Binary output modules (BOM) and SMT binary outputs. Under these the status of binary outputs and SMT outputs is displayed.
2. Binary input values has two submenus. These are Binary input modules (BIM) and SMT binary inputs. These screens show the state of all the inputs on the Binary input modules (BIM). These are represented as digits but may also be a number if the input is being used to receive pulses for power measurement.
3. Differential Protection displays a choice of differential functions available to the operator. Function related measurements can be viewed by navigating to the screen for each individual function.
4. Distance protection displays a choice of functions available to the operator. Function related measurements can be viewed by navigating to the screen for each individual function.
5. Current protection displays a choice of functions. To view data related to these functions it is necessary to choose one from the list and navigate to the screen for the function in question.
6. Voltage protection displays a choice of functions available to the operator. Function related measurements can be viewed by navigating to the screen for each of the four functions available. Data shown here is mainly trip and pickup related.
7. Frequency protection includes measurements from frequency functions. Measurements show trip, pickup and similar data.
8. Multipurpose protection includes measurements showing data regarding trip signals, pickup signals, current and voltage values.

9. Secondary system supervision displays a choice of functions, Current circuit supervision and Fuse failure. Current circuit measurements include fail and alarm signals, and fuse failure measurements consist of pickup data.
10. Control displays the Synchronism-checkand Apparatus control functions. The Synchronism-check functions include a number of function related measurements such as calculated differences. Apparatus control includes up to 19 functions each with their own set of measurement data regarding interlocking, breaker and isolator conditions.
11. Scheme communication includes functions that display trip and other signals used when interzone communication is deployed.
12. Logic displays a choice of functions available to the operator. These are Trip logic, Event counter, Logic gate, Logic memory and Logic timer set each with their own set of measurements.
13. Monitoring displays a choice of functions available to the operator. Function related measurements can be viewed by navigating to the screen for each individual function. One of the submenus shows the status of the LEDs on the HMI.
14. Communication displays submenus for Remote communication and Station communication including Receiving interlock information.

All measurement descriptions in this document reflect the maximum number of hardware units possible in any application. In reality the hardware in the IED will be chosen according to a particular application. For example, it is possible to equip a 1/1 x 19” case IED with 14 I/O modules. In reality fewer I/O modules may be installed. In the measurements menu the operator will only see data from the hardware and software installed.

11.2 IED test mode

Main menu/Test/IED test mode

Displays a setting which is used to activate and deactivate functions so that tests can be performed without endangering system stability and a setting with which events can be enabled or disabled.

11.3 View binary input values

11.3.1 Overview

Binary input values display the state of each individual input in the Binary input modules (BIM). These are indicated with a 1 or 0 depending on whether a signal is present or not. Binary input modules with enhanced pulse counting capabilities can

receive pulses used for power measurement. The number of pulses received is used to measure power.

11.3.1.1 Binary Input Module BIM

Main menu/Test/Binary input values/Binary input modules

Displays available binary input modules with several binary values per module.

11.3.1.2 Signal matrix for binary input SMBI

Main menu/Test/Binary Input Values/SMT binary inputs/Instance:x

Displays available instances of SMT binary inputs with several inputs per instance.

11.4 View binary output values

11.4.1 Overview

Binary output values show the status of each individual output in the Binary output module (BOM). If the signal matrix tool is used binary outputs are depicted as virtual outputs. Note, that only modules installed in the IED are shown in the HMI.

11.4.1.1 Binary Output Module BOM

Main menu/Test/Binary output values/Binary output modules

Displays available binary output modules BOM. The status and name of each binary outputs that each module has are displayed here. The name of each output is user defined string. The names of binary outputs are changed in the setting menu.

11.4.1.2 Signal matrix for binary outputs SMBO

Main menu/Test/Binary output values/SMT binary outputs

Displays available sets of binary output values. Each set or *instance* of binary outputs displays the status of all individual binary outputs.

11.5 Function test modes

11.5.1 Overview

With the IED, in test mode the different protections (except line differential protection) can be individually released for test here. Events can be disabled or enabled.

11.5.2 Differential protection

Main menu/Test/Function test modes/Differential protection

Test of the low and high impedance restricted ground fault protection as well as transformer differential protection testing.

11.5.3 Impedance protection

Main menu/Test/Function test mode/Impedance protection

Test of switch onto fault logic, distance protection zones one to five, local acceleration logic, power swing detection and phase selection with load encroachment.

11.5.4 Current protection

Main menu/Test/Function test modes/Current protection

Test of breaker failure protection and phase overcurrent protection, residual overcurrent protection, instantaneous phase overcurrent protection, pole discrepancy protection, instantaneous residual overcurrent protection, thermal overload protection.

11.5.5 Voltage protection

Main menu/Test/Function test modes/Voltage protection

Test of two step overvoltage, two step undervoltage and two step residual overvoltage protection as well as overexcitation protection.

11.5.6 Frequency protection

Main menu/Test/Function test modes/Frequency protection

Test of up to six instances of rate of change of frequency.

11.5.7 Multipurpose protection

Main menu/Test/Function test modes/MultipurposeProtection

Test of up to twelve instances of the general current and voltage function CVGAPC.

11.5.8 Scheme communication

Main menu/Test/Function test modes/Scheme communication

Test of scheme communication logic, for residual overcurrent protection and distance protection, as well as current reversal and weak end infeed logic, for distance protection and residual overcurrent protection.

11.5.9 Secondary system protection

Main menu/Test/Function test modes/Secondary system supervision

Test of current circuit supervision and fuse failure supervision.

11.5.10 Control

Main menu/Test/Function test modes/Control

Test of synchronism-check and energizing check function.

11.5.11 Monitoring

Main menu/Test/Function test modes/Monitoring

Test of monitoring functions such as event counter and disturbance report.

11.5.12 Logic

Main menu/Test/Function test modes/Logic

Test of trip logic and event counter functions.

11.6 Function status

11.6.1 Overview

In the Function status section of the Test menu, data useful to the user in Test mode can be found. The information available here is not limited to test applications alone and provides information about the system as a whole.

11.6.2 Differential protection

The quantities and measurements for differential protections are accessed via the HMI paths provided below. The measurement outputs shown here include various trip and pickup signals. The magnitude of the differential currents are shown here.

11.6.2.1 Transformer differential protection, two winding T2WPDIF (87T)

Main menu/Test/Function status/Differential protection/ TransDifferential2Wind(PDIF,87T)/T2D

Displays available instances of T2WPDIF (87T) with several measured values each. The data available here ranges from the general common trip signal to the magnitude of the bias current. The magnitude of the second and fifth harmonic differential current for all phases, block signals and pickup signals make up the bulk of the data presented in this view.

11.6.2.2 Transformer differential protection, three winding T3WPDIF (87T)

Main menu/Test/Function status/Differential protection/ TransDifferential3Wind(PDIF,87T)/T3D

Displays up to two instances of T3WPDIF (87T) with several measured values each. The data output here is identical to that shown in section "Transformer differential protection, two winding T2WPDIF (87T)" of this document.

11.6.2.3 Restricted ground fault protection, low impedance REFPDIF (87N)

Main menu/Test/Function status/Differential protection/LowImpREF(PDIF,87N)/ REF

Displays available instances of REFPDIF (87N) with several measurements per instance. The data available for this function includes Trip by the restricted ground fault protection function, pickup, operation of directional criteria due to internal fault,

block due to second harmonic, pickup of switch onto fault, activation of second harmonic analysis, various fault detection indicators and the magnitude various current values.

11.6.2.4 High impedance differential protection HZPDIF (87)

Main menu/Test/Function status/Differential protection/ HighImpDifferential(PDIF,87)/HZD

Displays available instances of HZPDIF (87) with some measurements per instance. These are the trip signal, the alarm signal and the measured RMS voltage on the secondary side of the CT.

11.6.3 Impedance protection

Impedance protection values are viewable in the submenus of the Impedance protection folder in the HMI. Information such as trip and pickup signals, trip output, trip categories etc. is provided.

11.6.3.1 Full-scheme distance protection, mho characteristic ZMHPDIS (21)

Main menu/Test/Function status/Impedance Protection/MhoDistance(PDIS,21)/ ZMH

Displays the output data of the selected ZMHPDIS (21) instance.

11.6.3.2 Distance protection zone, quadrilateral characteristic ZMQPDIS, ZMQAPDIS (21)

Main menu/Test/Function status/Impedance Protection/DistanceZones(PDIS,21)/ ZM

Displays instances of ZMQPDIS (21) for zone 1. The output quantities shown here indicate trip and pickup signal status.

Main menu/Test/Function status/Impedance Protection/DistanceZones(PDIS,21)/ ZM

Displays available instance of ZMQAPDIS (21) for zones 2-5. The output quantities shown here indicate trip and pickup signal status.

11.6.3.3 Fullscheme distance protection, quadrilateral for earth faults ZMMPDIS, ZMMAPDIS (21)

Main menu/Test/Function status/Impedance protection/QadEarthDistance(PDIS, 21)/ZMM

Displays the output data of ZMMPDIS (21) for zone 1.

Main menu/Test/Function status/Impedance protection/QadEarthDistance(PDIS, 21)/ZMM

Displays the output data of ZMMAPDIS (21)for zone 2-5.

11.6.3.4 Faulty phase identification with load enchroachment FMPSPDIS (21)

Main menu/Test/Function status/Impedance protection/PhaseSelection(PDIS,21)/ PHM

Includes current and voltage level settings.

11.6.3.5 Phase selection with load encroachment FDPSPDIS (21)

Main menu/Test/Function status/Impedance Protection/PhaseSelection(PDIS,21)/ PHS1

Displays one instance of FDPSPDIS (21) with a number of measurements. These measurements show faults detected per phase as well as pickup conditions.

11.6.3.6 Phase preference logic PPLPHIZ

Main menu/Test/Function status/Impedance protection/ PhasePreferenceLogic(PDIS,21)/PPL

Displays the output data of PPLPHIZ.

11.6.3.7 Directional impedance ZDRDIR (21D)

Main menu/Test/Function status/Impedance protection/ DirectionalImpedance(RDIR)/ZD

Displays one instance of ZDRDIR (21D) showing one measurement indicating the status of pickup signals.

11.6.3.8 Directional impedance element for mho characteristic ZDMRDIR (21D)

Main menu/Test/Function status/Impedance Protection/ DirectionalImpedance(RDIR,21D)/ZDM

Displays instances of ZDMRDIR (21D).

11.6.3.9 Additional distance protection directional function for ground faults ZDARDIR

Main menu/Test/Function status/Impedance protection/MhoDirectionEF(RDIR)/ ZDA

Displays the output data of ZDARDIR function.

11.6.3.10 Mho Impedance supervision logic ZSMGAPC

Main menu/Test/Function status/Impedance protection/ MhoImpSupervisionLogic(GAPC)/ZSM

Displays the output data of ZSMGAPC function.

11.6.3.11 Power swing detection ZMRPSB (78)

Main menu/Test/Function status/Impedance protection/ PowerSwingDetection(RPSB,78)/PSD1

Displays one instance of ZMRPSB (78) with three measurements. These indicate a power swing and show the measured impedances for the inner and outer impedance boundaries.

11.6.3.12 Power swing logic ZMRPSL

Main menu/Test/Function status/Impedance protection/PowerSwingLogic(RPSL)/ PSL

Displays the output data of ZMRPSL.

11.6.4 Current protection

Viewable data under Current protection consists mainly of trip status data under the various categories of current protection which include overcurrent protection, thermal overload, pole discrepancy and variations of these.

11.6.4.1 Breaker failure protection CCRBRF (50BF)

Main menu/Test/Function status/Current protection/BreakerFailure(RBRF, 50BF)/BFP

Displays an application dependent number of instances of CCRBRF (50BF) with some measurements per instance. The measurement outputs include trip status and faulty circuit breaker alarm.

11.6.4.2 Broken conductor check BRCPTOC (46)

Main menu/Test/Function status/Current protection/BrokenConductor(PTOC, 46)/BRC

Displays the output data of BRCPTOC (46).

11.6.4.3 Directional over-power protection GOPPDOP (32)

Main menu/Test/Function status/Current protection/DirOverPowerProt(PDOP, 32)/GOP

Displays the output data of GOPPDOP (32).

11.6.4.4 Directional under-power protection GUPPDUP (37)

Main menu/Test/Function status/Current protection/ DirUnderPowerProtection(PDUP,37)/GUP

Displays the output data of GUPPDUP (37).

11.6.4.5 Instantaneous phase overcurrent protection PHPIOC (50)

Main menu/Test/Function status/Current protection/ InstPhaseOverCurrent(PIOC,50)/IOC1

Displays available instances of PHPIOC (50) with a number of measurements per instance showing the trip status in general and per phase.

11.6.4.6 Instantaneous residual overcurrent protection EFPIOC (50N)

Main menu/Test/Function status/Current protection/ InstResidualOverCurrent(PIOC,50N)/IEF

Displays available instances of EFPIOC (50N) with one trip value per instance.

11.6.4.7 Four step phase overcurrent protection OC4PTOC(51_67)

Main menu/Test/Function status/Current protection/ PhaseOverCurrent4Step(PTOC,51_67)/TOC

Displays available instances of OC4PTOC (51,67) with several measurements per instance. These measurements are primarily trip and pickup signal indications from each phase and from the various steps in the protection scheme.

11.6.4.8 Pole discordance protection CCRPLD (52PD)

Main menu/Test/Function status/Current protection/PoleDiscordance(RPLD, 52PD)/PD

Displays up to two instances of CCRPLD (52PD) with two measurements per instance which contain trip and pickup data.

11.6.4.9 Four step residual overcurrent protection EF4PTOC (51N_67N)

Test/Function status/Current protection/ResidualOverCurrent4Step(PTOC, 51N_67N)/TEF

Displays available instances of EF4PTOC (51N,67N) with a number of measurements per instance. The measurements indicate trip and pickup signal status as well as the 2nd harmonic block signal status.

11.6.4.10 Sensitive directional residual over current and power protection SDEPSDE (67N)

Main menu/Test/Function status/Current protection/SensDirResOvCurr(PSDE, 67N)/SDE

Displays the output data of SDEPSDE (67N).

11.6.4.11 Thermal overload protection, two time constants TRPTTR (49)

Main menu/Test/Function status/Current protection/ ThermalOverload2TimeConst(PTTR,49)/TTR

Displays available instances of TRPTTR (49) with a number of measurements per instance. The measurements show trip data, pickup signal status, time to reset, alarm signals and others.

11.6.5 Voltage protection

The viewable data available under voltage protection are mainly trip related and comprise data regarding undervoltage, overvoltage, residual overvoltage and overexcitation.

11.6.5.1 Loss of voltage check LOVPTUV (27)

Main menu/Test/Function status/Voltage protection/LossofVoltage(PTUV,27)/LOV

Displays the output data of LOVPTUV (27).

11.6.5.2 Overexcitation protection OEXPVPH (24)

Main menu/Test/Function status/Voltage protection/Overexcitation(PVPH,24)/OEX

Displays available instances of OEXPVPH (24) with a number of measurements per instance. These measurements indicate whether values are out of the measuring range (ERROR) and if the overexcitation function has caused a trip (TRIP). The thermal status as a percentage of the trip level and the calculated time to trip are among the other outputs available here.

11.6.5.3 Two step overvoltage protection OV2PTOV (59)

Main menu/Test/Function status/Voltage protection/OverVoltage2Step(PTOV,59)/TOV

Displays available instances of OV2PTOV (59) with several measurements per instance. The measurements include operate/trip and pickup signal data.

11.6.5.4 Two step residual overvoltage protection ROV2PTOV (59N)

Main menu/Test/Function status/Voltage protection/ResidualOverVoltage2Step(PTOV,59N)/TRV

Displays available instances of ROV2PTOV (59N) with some measurements per instance. The measurements include operate/trip and signal data.

11.6.5.5 Two step undervoltage protection UV2PTUV (27)

Main menu/Test/Function status/Voltage protection/UnderVoltage2Step(PTUV, 27)/TUV

Displays available instances of UV2PTUV (27) with several measurements per instance. The measurement data includes operate/trip signals and pickup signals.

11.6.5.6 Voltage differential protection VDCPTOV (60)

Main menu/Test/Function status/Voltage protection/VoltageDiff(PTOV,60)/VDC

Displays the output data of VDCPTOV (60).

11.6.6 Frequency protection

The measurements generated by the Underfrequency, Overfrequency and Rate-of-change of frequency functions are available under the paths outlined below.

11.6.6.1 Overfrequency protection SAPTOF (81)

Main menu/Test/Function status/Frequency protection/OverFrequency(PTOF)/TOF

Displays available instances of SAPTOF (81) with some measurements per instance consisting of trip and pickup signal status. The pickup duration as percentage of the total trip time and a blocking indication as a result of low voltage.

11.6.6.2 Rate-of-change frequency protection SAPFRC (81)

Main menu/Test/Function status/Frequency protection/RateOfChangeOfFrequency(PFRC)/RCF

Displays available instances of SAPFRC (81) with measurement data for trip and pickup signals. There is also a restore signal for load restoring purposes, a pickup duration time and a blocking indication caused by a drop in voltage.

11.6.6.3 Underfrequency protection SAPTUF (81)

Main menu/Test/Function status/Frequency protection/UnderFrequency(PTUF, 81)/TUF

Displays available instances of SAPTUF (81) with some measurements indicating status of trip, pickup, restore signals and showing possible blocking due to low magnitude as well as the pickup duration as a percentage of the total operation time.

11.6.7 Multipurpose protection

The data generated by the multipurpose function comprises various trip and pickup signals, block of second harmonic detection, various measured current values and the angle between current and voltage.

11.6.7.1 General current and voltage protection CVGAPC

Main menu/Test/Function status/Multipurpose protection/ GeneralCurrentVoltage(GAPC)/GFO

Displays available instances of CVGAPC with a number of output quantities per instance. These include error signals from overcurrent functions, trip and pickup signals from overcurrent, undercurrent, overvoltage and undervoltage. There is a block signal caused by second harmonic detection. The directional mode of OC1 and OC2 is shown as is low voltage for directional polarization. The current and voltage as well as measured current multiplied by cos Phi and the angle between voltage and current are also shown here.

11.6.8 Scheme communication

11.6.8.1 Current reversal and weak-end infeed logic for residual overcurrent protection ECRWPSCH (85)

Main menu/Test/Function status/Scheme communication/ EFCurrentReversalWEI(PSCH,85)/EFCA

Displays one instance of ECRWPSCH (85) with four measurements per instance.

11.6.8.2 Scheme communication logic for residual overcurrent protection ECPSCH (85)

Main menu/Test/Function status/Scheme communication/ EFSchemeCommunication(PSCH,85)/EFC

Displays available instances of ECPSCH (85) with some measurements indicating carrier and trip status.

11.6.9 Secondary system supervision

Values for Current circuit supervision and Fuse failure supervision are found under Secondary circuit supervision. Fail and alarm detection information is available together with various pickup and current data.

11.6.9.1 Fuse failure supervision SDDRFUF

Main menu/Test/Function status/Secondary system supervision/ FuseFailure(RFUF)/FSD

Displays available instances of SDDRFUF with some measurements per instance indicating pickup status.

11.6.10 Control

There are large amounts of output data from the control functions. The main categories of data are found under Synchronism-check, and Apparatus control. Apparatus control has by far the largest amount of data since this includes all the interlocking information for several different breaker arrangements.

11.6.10.1 Apparatus control

Interlocking

Main menu/Test/Function status/Control/Apparatus control/Interlocking

Displays available instances of the function with an open and a close parameter for each disconnection device. The enable open (EN_OPEN) parameter will have the output value one if an open operation is allowed and a zero output if an open operation is not allowed. The conditions for an open operation are if the device is closed, intermediate or in a bad state as defined in IEC61850. The enable close (EN_CLOSE) parameter is subject to similar conditions.

Interlock busbarground switch

Main menu/Test/Function status/Control/Apparatus control/ InterlBusbarEarthSwitch/IJ

The information shown here indicates whether or not switching of the ground switch is permitted and also indicates whether the ground switch 89Gis in the open or closed position.

Interlock bus section breaker

Main menu/Test/Function status/Control/Apparatus control/ InterlBusSectionBreaker/IH

Displays the interlocking conditions that apply to the various switches and breakers.

Interlock bus section disconnect

Main menu/Test/Function status/Control/Apparatus control/ InterlBusSectionDisconn/II

Displays conditions for CB opening and closing and the position of the disconnector.

Interlock bus coupler bay

Main menu/Test/Function status/Control/Apparatus control/ InterlBusCouplerBay/IG

Displays available measurements that indicate conditions for breakers, disconnectors and grounding switches in the bay

Interlock, one and a half circuit breaker connection

Main menu/Test/Function status/Control/Apparatus control/Interl11/2CBConn/IK

Displays available measurements per CB arrangement IKx showing the conditions applicable to breakers disconnectors and ground switches in the breaker-and-a-half arrangement.

Interlock, one and a half circuit breaker-and-a-half line A

Main menu/Test/Function status/Control/Apparatus control/Interl11½CBLineA/ IL

Displays available measurements per breaker arrangement (instances of IL). The measurements show the states of the various disconnectors, breakers and grounding switches.

Interlock one and a half circuit breaker-and-a-half line B

Main menu/Test/Function status/Control/Apparatus control/Interl11½CBLineB/ IM

Displays available measurements per arrangement (instance of IM) showing conditions for breakers, disconnectors and grounding switches in the arrangement. For example 152CLREL with boolean output 1 means that the closing of breaker 152 is permitted. (REL=release, ITL=interlock, OPTR=opened transmission, CLTR=closed transmission)

Interlock, double circuit breaker bus A

Main menu/Test/Function status/Control/Apparatus control/ InterlDoubleCBBusA/IB

The outputs from this function show when closing of disconnectors and breakers is allowed and when it is not. It also shows whether 189 is opened or closed and indicates the validity of its switch status. There are several output values.

Interlock, double circuit breaker bus B

Main menu/Test/Function status/Control/Apparatus control/ InterlDoubleCBBusB/IC

The outputs from this function show when closing of disconnectors and breakers is allowed and when it is not. It also shows whether 189 is opened or closed and indicates the validity of its switch status. There are several output values.

Interlock, double circuit breaker line

Main menu/Test/Function status/Control/Apparatus control/InterlDoubleCBLine/ IA

There are some instances of this function with some outputs per instance showing whether switching of disconnectors 989, 389G and 989G is permitted.

Interlock line bay

Main menu/Test/Function status/Control/Apparatus control/InterlLineBay/IF

Displays available instances of the function IF with several boolean outputs per instance. These indicate for which disconnect devices closing and switching of is allowed and also indicate the status and validity of devices. For example, the measurement named 1289OPTR indicates whether or not 189 and 289 are in the open position. If the output for this measurement is 1 then 189 and 289 are in the open position. A zero indicates that they are closed.

Interlock, transformer bay

Main menu/Test/Function status/Control/Apparatus control/ InterlTransformerBay/IE

Shows available instances of the function with several measurements per instance. The measurements indicate which breakers and disconnectors are permitted to open and/or close, the status of the disconnect devices and switch status validity. For example, the measurement named VP289TR indicates with output value 1 that the switch status of disconnector 289 is valid.

Bay reserve QCRSV

Main menu/Test/Function status/Control/Apparatus control/BayReserve(CRSV)/ CR

Displays available instances of the function QCRSV with several measurements per instance. Apart from the measurement for exchange signals between different BayRes blocks the output values are all boolean and indicate the status of processes and devices.

11.6.10.2 Commands

In the commands menu it is possible to view three sets of values. These are found under the submenus menucascade/uicontrol.

Automation bits, command function for DNP3.0 AutomationBits

Main menu/Test/Function status/Control/Commands/Automation Bits/ABI

Displays the output data of the AutomationBits function.

IEC60870-5-103

Main menu/Test/Function Status/Control/Commands/IEC60870-5-103

Under this part of the HMI tree there are the following three submenus:

- IED Commands
- Function Commands
- User Defined Commands

Various IED, function and user defined command data can be viewed here.

Single command SINGLECMD

Main menu/Test/Function status/Control/Commands/SingleCommand/CD

There are OUT signals under the Single command menu.

Selector switch SLGGIO

Main menu/Test/Function status/Control/Commands/SelectorSwitch(GGIO)/SL

An application dependent number of switches can be displayed here. The position of each switch is indicated here. There are up to a number of possible switch positions. The number of switches and switch positions is determined by the configuration in the PCM configuration tool.

Selector mini switch VSGGIO

Main menu/Test/Function status/Control/Commands/VersatileSwitch/VS

Displays the output data of the VSGGIO function.

11.6.10.3 IEC61850 generic communication I/O functions DPGGIO

Main menu/Test/Function status/Control/DoubelPointIndication(DPGGIO)/DP

Displays the output data of the DPGGIO function.

11.6.10.4 Synchronism check and energizing check SESRSYN (25)

Main menu/Test/Function status/Control/Synchronizing(RSYN,25)/SYN

Displays available instances of SESRSYN (25) with a number of measurements per instance. These include information about which lines and buses selected, various voltage and frequency differences and feedback on synchronization status.

11.6.10.5 Tap changer control and supervision TCMYLTC/TCLYLTC (84)

Main menu/Test/Function status/Control/TransformerTapControl(YLTC,84)/TCM

Main menuTestFunction statusControlTransformerTapControl(YLTC,84)TCL

Displays data about available instances of tap changer parameters such as tap positions for low and high voltage and type of code conversion.

11.6.10.6 Automatic voltage control for tapchanger, single and parallel control TR1ATCC/TR8ATCC (90)

Settings/Test/Function status/Control/TransformerVoltageControl(ATCC,90)/VCS

Settings/Test/Function status/Control/TransformerVoltageControl(ATCC,90)/VCS

Displays parameters for current and voltage levels, deadbands, timers and alarm levels.

11.6.11 Monitoring

Monitoring includes large amounts of viewable data including Disturbance report data, Service values, Current phasors, Voltage phasors, Milliampere signal level supervision, Binary signal status report, Events, MVGGIO, MVExpander and LEDs.

11.6.11.1 Logical signal status report BINSTATREP

Main menu/Test/Function status/Monitoring/BinarySignalStatusReport/SSR

Displays sets of output measurements with several outputs per set of measurements.

11.6.11.2 Disturbance report DRPRDRE

Test/Function status/Monitoring/DisturbanceReport(RDRE)

Displays data about disturbance reports. The disturbance report can be switched off, a disturbance report that has been initiated is indicated by a boolean number, as are completed reports and cleared reports. The parameter *MEM USED* indicates that more than 80% of the memory space available for disturbance report data has been used and the need to clear the memory is pressing. The *Memory USED* parameter generates an integer value showing the actual amount of memory used by the disturbance record repository. The maximum number of incoming analog channels is 40 and their Trig status is indicated here. The *Fault number* parameter generates an integer indicating the number of faults recorded since the last clearing of the memory.

11.6.11.3 Event counter CNTGGIO

Main menu/Test/Function status/Monitoring/EventCounter(GGIO)/CNT

Display the output data of the CNTGGIO function.

11.6.11.4 Generic measured value MVGGIO

Main menu/Test/Function status/Monitoring/GenericMeasuredValue(GGIO)/MV

Displays the analog output from the MVGGIO block. The value shown here depends on the settings and the logical configuration of the preprocessing blocks. The measurement displayed may be current, voltage, frequency, phase angle etc.

11.6.11.5 Global positioning system

Main menu/Test/Function status/Monitoring/GPS

Displays the number of satellites supplying positioning and timing data to the GPS module.

11.6.11.6 IEC61850 generic communication I/O functions 16 inputs SP16GGIO

Main menu/Test/Function status/Monitoring/IndicationBits(GGIO)/MP

Displays the output data of the SP16GGIO function.

11.6.11.7 LEDs

Main menu/Test/Function status/Monitoring/LEDs/Start and trip LEDs

Displays the status of pickup and trip LEDs.

Main menu/Test/Function status/Monitoring/LEDs/All indication LEDs

Shows new and accumulated indications and the status of the HMI indication LEDs.

11.6.11.8 Measured value expander block RANGE_XP

Main menu/Test/Function status/Monitoring/MeasValExpander/XP

Displays available instances of the function block RANGE_XP. These show the boolean values assigned to the integer values generated by analog inputs.

11.6.11.9 IEC61850 generic communication I/O functions SPGGIO

Main menu/Test/Function status/Monitoring/SinglePointIndication(GGIO)/SP

Displays the output data of the SPGGIO function.

11.6.12 Logic

Under the Logic function folder there is viewable data for trip logic (showing number of poles that have tripped and trip signal information), event counter values, Logic gate outputs, Logic SR memory output states and Logic timer set output states are also shown here.

11.6.12.1 Boolean 16 to Integer conversion

Main menu/Test/Function status/Logic/Bool16ToInt(GGIO)/BA

Main menu/Test/Function status/Logic/Bool16ToInt/BB

Displays the output data of the Bool16ToInt function.

11.6.12.2 Integer to Boolean 16 conversion

Main menu/Test/Function status/Logic/IntToBool16(FCVB)

Main menu/Test/Function status/Logic/IntToBool16

Displays the output data of the IntToBool16 function.

11.6.12.3 Tripping logic SMPPTRC (94)

Main menu/Test/Function status/Logic/TripLogic(PTRC94)/TRP

Displays available instances of the function SMPPTRC (94) with some measurements per instance. The output data from each measurement is boolean and indicates the existence of various trip signals. For example, if the output from parameter TR_A is one, this indicates that a trip signal from phase A has been generated.

11.6.12.4 Trip matrix logic TMAGGIO

Main menu/Test/Function status/Logic/TripMatrix(GGIO)/TR

Displays available instances of the function TMAGGIO with some boolean output values per instance. The output signals from this function block are typically connected to other logic blocks or directly to IED output contacts.

11.6.12.5 Logic gate

Main menu/Test/Function status/Logic/LogicGate/GT

Displays available instances of the gate output. The output data type is an integer with a possible value from 0 to 255.

11.6.12.6 Logic SR/RS memory

Main memory/Test/Function status/Logic/LogicSRMemory/SM

Displays available instances of the function SM. The output data presented in the HMI is boolean and indicates whether or not a signal is present. For example, an output of one from SM01 OUT indicates that a signal exists on that output.

11.6.12.7 Logic timer set

Main menu/Test/Function status/Logic/LogicTimerSet/TS

Displays available instances of the function (TS). The output data type is boolean and indicates whether the output from the timer pickup is delayed (ON) or if the drop out (OFF) is delayed.

11.6.13 Communication

The communication output data available under Test includes remote communication and station communication.

11.6.13.1 Remote communication

Main menu/Test/Function status/Communication/Remote communication/LDCMx

Displays an application dependent number of instances of CRB (Remote Binary Communication) and CRM (Remote Multi Communication) with measurement data.

11.6.13.2 Station communication

GOOSE binary receive

Main menu/Test/Function status/Communication/Station communication/ GOOSEBinReceive/GB

Available GOOSE binary signals can be viewed here. There are a number of signal indications per set.

MultiCommand send

Main menu/Test/Function status/Communication/Station communication/ MultipleCommandSend/MT

The MultiCommand Send indication is used to display data from the Local Optical network (LON).

MultiCommand receive

Main menu/Test/Function status/Communication/Station communication/ MultipleCommandReceive/CM

The MultiCommand Receive indications displayed here show available sets of output data. Each set of output data has a number of signals. Other information displayed here shows whether there has been a change in data and whether data is valid.

Horizontal communication via GOOSE for interlocking IntlReceive

Main menu/Test/Function status/Communication/Station communication/ ReceivingInterlInfo/GR

The Receiving Interlock information available here indicates the state of various apparatus such as whether they are in a closed or open position and if their status is valid. Several apparatuses can be displayed. There are also indications of reservation requests, reservation granted and the validity of data and communication.

11.6.14 Setting groups

Main menu/Test/Function status/Setting groups

Displays available setting groups and indicates which of them is in use.

11.6.15 Test

Main menu/Test/Function status/Test

Displays the parameters ACTIVE, OUTPUT and SETTING. The ACTIVE parameter indicates whether the IED is in test mode or not, the OUPUT parameter indicates whether test mode has been activated by a binary input and the SETTING parameter indicates whether or not test mode has been activated by a setting. The output data is binary (0 or 1).

11.6.16 Authorization

Main menu/Test/Function status/Authorization

Shows if any user is logged on and if any user is blocked by invalid password.

11.7 LED Test

Main menu/Test/LED test

The Test LEDs menu enables the operator to activate LEDs manually. LEDs that do not light up are defective. Defective LEDs are also logged in Disturbance records under Monitoring.

11.8 Line differential test

Main menu/Test/Line differential test/LineDiffLogic

Settings used during test of line differential protection including test mode setting. With the line differential protection in test mode, it can be tested locally without causing unwanted operation in the remote end.

Main menu/Test/Line differential test/LDCMX

The scale factor for current sent to remote end IED to be echoed back to local IED during test is set here.

Section 12 Control and supervise the bay

About this chapter

This chapter describes the various control and supervision functions available in the HMI. In particular, how the single line diagram available on the display can be used for this purpose. It also describes the Selector switch function available under the control menu.

12.1 Overview

The control menu in the HMI includes the Single line diagram, Single command and Selector switch functions.

The Single Line Diagram (SLD) is used to control and supervise the bay by allowing the operator to close and open apparatuses using keys on the front panel of the IED. This is primarily intended as a backup for higher level control systems. If for example MicroSCADA were to go out of service, then bay level switches and circuit breakers can be controlled directly from the HMI.

The Single command function is used to view LON interlocking data and is only visible if LON is configured and used in the system.

The Selector Switch function is configured in the PCM600 tool and the switch position can be changed in the HMI. The selector switch has the same function as a rotating switch with up to 32 positions. Each position is configured in the PCM600 to match a certain application. Each position number corresponds to the equivalent position of a rotating switch. It is only visible if it has been configured in the PCM600.

12.1.1 Read measured values and check apparatus status

In the single line diagram a number of measured quantities are displayed. These are normally system voltage (V), system current (I), active power (P) and reactive power (Q). They are displayed on the right hand side of the SLD graphic. The quantities shown can be configured in PCM600 and may therefore not always have the same appearance in different IEDs.

12.1.2 Locating and using the single line diagram

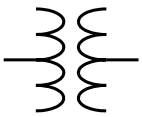
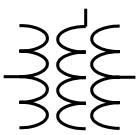
It is possible to navigate the SLD screen using the up and down keys on the IED keypad. The apparatus under control is highlighted as the user moves from symbol to symbol using the keypad. An apparatus is opened using the key and closed using the green Open key.

Main menu/Control/Single Line Diagram

This is the path to the single line diagram from the main menu.

The symbols used in the Single Line Diagram (SLD) are described in the table below

Symbol	Description
xx05000227_ansi.vsd	Autotransformer
xx05000228.vsd	Busbar
xx05000231_ansi.vsd	Capacitor
xx05000232_ansi.vsd	Circuit breaker
xx05000233.vsd	Damping Coil
xx05000234_ansi.vsd	Current Transformer
xx05000235.vsd	Ground
xx05000236.vsd	Feeder system
xx05000237_ansi.vsd	Generator
Table continues on next page	

Symbol	Description
xx05000238.vsd	Disconnector
xx05000240.vsd	Junction
xx05000241_ansi.vsd	Motor
xx05000242_ansi.vsd	Reactor
xx05000243_ansi.vsd	Surge arrestor
 xx05000244_ansi.vsd	Trafo 2 windings
 xx05000245_ansi.vsd	Trafo 3 windings
xx05000248_ansi.vsd	Truck
xx05000247_ansi.vsd	VT 2 windings

12.1.3 Control screen messages

These messages appear at the bottom of the SLD screen and are in the form of a prompt asking the user to confirm an action, such as the opening of a circuit breaker. They can also warn the user as to conditions that are a hindrance to the intended action, such as an interlocking condition. The user may be given the choice to override certain conditions.

Section 13 Reset

About this chapter

This chapter describes how to reset the IED and when this is necessary.

13.1 Reset guide

13.1.1 Reset counters

13.1.1.1 Circuit breaker SXCBR

The circuit breaker counter is reset under Reset counter in the HMI tree.

Main menu/Reset/Reset counters/CircuitBreaker(XCBR)/XC

In the dialog box that appears, choose YES to reset.

13.1.1.2 Circuit switch SXSWI

The circuit switch counter is reset under Reset counters in the HMI tree.

Main menu/Reset/Reset counters/CircuitSwitch(XSWI)/XS

In the dialog box that appears, choose YES to reset.

13.1.1.3 Reset event counter CNTGGIO

The event counter is reset under Reset counters in the HMI tree.

Main menu/Reset/Reset counters/EventCounter(GGIO)/CNT

13.1.1.4 Reset pulse counter PCGGIO

The Pulse counter is reset under Reset counters menu in the HMI tree.

Main menu/Reset/Reset counters/PulseCounter(GGIO)/PC

In the dialog box that appears, choose YES to reset.

13.1.1.5 LDCM clear counters

Main menu/Reset/Reset counters/LDCMCommunication/LDCMX

Activating Reset of LDCM counters sets the counter concerned to zero. A reset can be performed by affirmation in the dialog box. This is done by pressing the E key when YES is highlighted.

13.1.1.6 Function for energy calculation and demand handling ETPMMTR

Main menuReset/Reset counters/ThreePhEnergMeas(MMTR)/ETP

Resetting accumulated energy values and the maximum demand values.

13.1.1.7 Tap changer control and supervision TCMYLTC, TCLYLTC (84)

Main menu/Reset/Reset counters/TransformerTapControl(YLTC,84)/TCM

Main menu/Reset/Reset counters/TransformerTapControl(YLTC,84)/TCL

Resetting the counter for number of tap changer operations and the contact life counter.

13.1.2 Reset disturbances and event list DRPRDRE

Disturbances are reset under Reset menu in the HMI tree.

Main menu/Reset/Reset disturbances

The internal event list is reset under Reset menu in HMI tree.

Main menu/Reset/Reset internal eventlist

13.1.3 Reset LEDs

13.1.3.1 Start and trip LEDs

By activating this reset, the colored LEDs above the LCD, if they are latched, will be reset.

Main menu/Reset/Reset LEDs/Start and trip LEDs

In the dialog box that appears, choose YES to reset.

13.1.3.2 All indication LEDs

Activating the Reset of indication LEDs will zero all fifteen LEDs to the right of the LCD.

Main mnenu/Reset/Reset LEDs/All indication LEDs

In the dialog box that appears, choose YES to reset.

13.1.4 Reset lockout SMPPTRC (94)

Objects that are considered at risk after a trip may be prevented from reconnecting by a lockout condition. The reset lockout facility is used to undo a lockout condition caused by a such a trip.

Main menu/Reset/Reset lockout/TripLogic(PTRC,94)/TRP

In the dialog box that appears, choose YES to reset.

13.1.5 Reset process eventlist

Main menu/Reset/Reset process eventlist

Local HMI setting for resetting the process eventlist.

13.1.6 Reset temperature functions

Main menu/Reset/Reset temperature/ThermalOverload2TimeConstant(PTTR,49)/THL

In the dialog box that appears, choose YES to reset.

Section 14 Authorization

About this chapter

This chapter describes password procedures and levels of access in the system.

14.1 Overview

To safeguard the interests of our customers, both the IED and the tools that are accessing the IED are protected, subject of authorization handling. The concept of authorization, as it is implemented in the IED and in PCM600 is based on the following facts:

There are two types of access points to the IED:

- local, through the local HMI
- remote, through the communication ports

14.2 Principle of operation

There are different levels (or types) of users that can access or operate different areas of the IED and tools functionality. The pre-defined user types are given in table below.

Be sure that the user logged on to the IED has the access required when writing particular data to the IED from PCM600.

The meaning of the legends used in the table:

- R= Read
- W= Write
- - = No access rights

Table 2: Pre-defined user types

Access rights	Guest	Super User	SPA Guest	System Operator	Protection Engineer	Design Engineer	User Administrator
Basic setting possibilities (change setting group, control settings, limit supervision)	R	R/W	R	R/W	R/W	R/W	R
Advanced setting possibilities (for example protection settings)	R	R/W	R	R	R/W	R/W	R
Basic control possibilities (process control, no bypass)	R	R/W	R/W	R/W	R/W	R/W	R
Advanced control possibilities (process control including interlock trigg)	R	R/W	R/W	R/W	R/W	R/W	R
Basic command handling (for example clear LEDs, manual trigg)	R	R/W	R	R/W	R/W	R/W	R
Advanced command handling (for example clear disturbance record)	R	R/W	R	R	R/W	R/W	R/W
Basic configuration possibilities (I/O-configuration in SMT)	R	R/W	R	R	R	R/W	R/W
Advanced configuration possibilities (application configuration including SMT, GDE and CMT)	R	R/W	R	R	R	R/W	R/W
File loading (database loading from XML-file)	-	R/W	-	-	-	R/W	R/W
File dumping (database dumping to XML-file)	-	R/W	-	-	-	R/W	R/W
File transfer (FTP file transfer)	-	R/W	-	R/W	R/W	R/W	R/W
File transfer (limited) (FTP file transfer)	R	R/W	R	R/W	R/W	R/W	R/W
File Transfer (SPA File Transfer)	-	R/W	-	-	-	R/W	-
Database access for normal user	R	R/W	R	R/W	R/W	R/W	R/W
User administration (user management – FTP File Transfer)	R	R/W	R	R	R	R	R/W
User administration (user management – SPA File Transfer)	-	R/W	-	-	-	-	-

The IED users can be created, deleted and edited only with the User Management Tool (UMT) within PCM600. The user can only LogOn or LogOff on the local HMI on the IED, there are no users, groups or functions that can be defined on local HMI.

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

At least one user must be included in the UserAdministrator group to be able to write users, created in PCM600, to IED.

14.3 LogOn or logOff

The Authorization menu allows the user to logOn and, logOff. The HMI path is as follows:

Main menu/Authorization

14.4 Authorization handling in the IED

At delivery the default user is the SuperUser. No Log on is required to operate the IED until a user has been created with the User Management Tool.

Once a user is created and downloaded to the IED, that user can perform a Log on, introducing the password assigned in the tool.

If there is no user created, an attempt to log on will display a message box: “No user defined!”

If one user leaves the IED without logging off, then after the timeout (set in **Main menu/Settings/General Settings/HMI/Screen/Display Timeout**) elapses, the IED returns to Guest state, when only reading is possible. The display time out is set to 60 minutes at delivery.

If there are one or more users created with the User Management Tool and downloaded into the IED, then, when a user intentionally attempts a Log on or when the user attempts to perform an operation that is password protected, the Log on window will appear.

The cursor is focused on the User identity field, so upon pressing the “E” key, the user can change the user name, by browsing the list of users, with the “up” and “down” arrows. After choosing the right user name, the user must press the “E” key again. When it comes to password, upon pressing the “E” key, the following character will show up: “$”. The user must scroll for every letter in the password. After all the letters are introduced (passwords are case sensitive) choose OK and press the “E” key again.

If everything is alright at a voluntary Log on, the local HMI returns to the Authorization screen. If the Log on is OK, when required to change for example a password protected setting, the local HMI returns to the actual setting folder. If the Log

on has failed, then the Log on window opens again, until either the user makes it right or presses “Cancel”.

Section 15 Glossary

About this chapter

This chapter contains a glossary with terms, acronyms and abbreviations used in ABB technical documentation.

AC	Alternating current
ACT	Application configuration tool within PCM600
A/D converter	Analog to digital converter
ADBS	Amplitude dead-band supervision
ADM	Analog digital conversion module, with time synchronization
ANSI	American National Standards Institute
AR	Autoreclosing
AngNegRes	Setting parameter/ZD/
ArgDirAngDir	Setting parameter/ZD/
ASCT	Auxiliary summation current transformer
ASD	Adaptive signal detection
AWG	American Wire Gauge standard
BBP	Busbar protection
BFP	Breaker failure protection
BIM	Binary input module
BOM	Binary output module
BR	External bi-stable relay
BS	British standard
BSR	Binary signal transfer function, receiver blocks
BST	Binary signal transfer function, transmit blocks
C37.94	IEEE/ANSI protocol used when sending binary signals between IEDs
CAN	Controller Area Network. ISO standard (ISO 11898) for serial communication
CB	Circuit breaker

CBM	Combined backplane module
CCITT	Consultative Committee for International Telegraph and Telephony. A United Nations sponsored standards body within the International Telecommunications Union.
CCM	CAN carrier module
CCVT	Capacitive Coupled Voltage Transformer
Class C	Protection Current Transformer class as per IEEE/ ANSI
CMPPS	Combined mega pulses per second
CO cycle	Close-open cycle
Co-directional	Way of transmitting G.703 over a balanced line. Involves two twisted pairs making it possible to transmit information in both directions
COMTRADE	Standard Common Format for Transient Data Exchange format for Disturbance recorder according to IEEE/ANSI C37.111, 1999 / IEC60255-24
Contra-directional	Way of transmitting G.703 over a balanced line. Involves four twisted pairs of with two are used for transmitting data in both directions, and two pairs for transmitting clock signals
CPU	Central processor unit
CR	Carrier receive
CRC	Cyclic redundancy check
CS	Carrier send
CT	Current transformer
CVT or CCVT	Capacitive voltage transformer
DAR	Delayed auto-reclosing
DARPA	Defense Advanced Research Projects Agency (The US developer of the TCP/IP protocol etc.)
DBDL	Dead bus dead line
DBLL	Dead bus live line
DC	Direct current
DFT	Discrete Fourier transform
DIP-switch	Small switch mounted on a printed circuit board
DLLB	Dead line live bus
DNP	Distributed Network Protocol as per IEEE/ANSI Std. 1379-2000

DR	Disturbance recorder
DRAM	Dynamic random access memory
DRH	Disturbance report handler
DSP	Digital signal processor
DTT	Direct transfer trip scheme
EHV network	Extra high voltage network
EIA	Electronic Industries Association
EMC	Electro magnetic compatibility
EMF	Electro motive force
EMI	Electro magnetic interference
EnFP	End fault protection
ESD	Electrostatic discharge
FOX 20	Modular 20 channel telecommunication system for speech, data and protection signals
FOX 512/515	Access multiplexer
FOX 6Plus	Compact, time-division multiplexer for the transmission of up to seven duplex channels of digital data over optical fibers
G.703	Electrical and functional description for digital lines used by local telephone companies. Can be transported over balanced and unbalanced lines
GCM	Communication interface module with carrier of GPS receiver module
GDE	Graphical display editor within PCM600
GI	General interrogation command
GIS	Gas insulated switchgear
GOOSE	Generic object oriented substation event
GPS	Global positioning system
GSM	GPS time synchronization module
HDLC protocol	High level data link control, protocol based on the HDLC standard
HFBR connector type	Plastic fiber connector
HMI	Human machine interface
HSAR	High speed auto reclosing

HV	High voltage
HVDC	High voltage direct current
IDBS	Integrating dead band supervision
IEC	International Electrical Committee
IEC 60044-6	IEC Standard, Instrument transformers – Part 6: Requirements for protective current transformers for transient performance
IEC 60870-5-103	Communication standard for protective equipment. A serial master/slave protocol for point-to-point communication
IEC 61850	Substation Automation communication standard
IEEE	Institute of Electrical and Electronics Engineers
IEEE 802.12	A network technology standard that provides 100 Mbits/s on twisted-pair or optical fiber cable
IEEE P1386.1	PCI Mezzanine card (PMC) standard for local bus modules. References the CMC (IEEE P1386, also known as Common mezzanine card) standard for the mechanics and the PCI specifications from the PCI SIG (Special Interest Group) for the electrical EMF Electro Motive Force.
IED	Intelligent electronic device
I-GIS	Intelligent gas insulated switchgear
IOM	Binary input/output module
Instance	When several occurrences of the same function are available in the IED they are referred to as instances of that function. One instance of a function is identical to another of the same kind but will have a different number in the IED user interfaces. The word instance is sometimes defined as an item of information that is representative of a type. In the same way an instance of a function in the IED is representative of a type of function.
IP	1. Internet protocol. The network layer for the TCP/IP protocol suite widely used on Ethernet networks. IP is a connectionless, best-effort packet switching protocol. It provides packet routing, fragmentation and re-assembly through the data link layer. 2. Ingression protection according to IEC standard
IP 20	Ingression protection, according to IEC standard, level IP20- Protected against solidforeign objects of12.5mm diameter andgreater.

IP 40	Ingression protection, according to IEC standard, level IP40-Protected against solid foreign objects of 1mm diameter and greater.
IP 54	Ingression protection, according to IEC standard, level IP54-Dust-protected,protected againstsplashing water.
IRF	Internal fail signal
IRIG-B:	InterRange Instrumentation Group Time code format B, standard 200
ITU	International Telecommunications Union
LAN	Local area network
LIB 520	High voltage software module
LCD	Liquid crystal display
LDCM	Line differential communication module
LDD	Local detection device
LED	Light emitting diode
LNT	LON network tool
LON	Local operating network
MCB	Miniature circuit breaker
MCM	Mezzanine carrier module
MIM	Milli-ampere module
MPM	Main processing module
MVB	Multifunction vehicle bus. Standardized serial bus originally developed for use in trains.
NCC	National Control Centre
NUM	Numerical module
OCO cycle	Open-close-open cycle
OCP	Overcurrent protection
OEM	Optical ethernet module
OLTC	On load tap changer
OV	Over voltage
Overreach	A term used to describe how the relay behaves during a fault condition. For example a distance relay is over-reaching when the impedance presented to it is smaller than the apparent impedance to the fault applied to the balance point, i.e. the set

	reach. The relay “sees” the fault but perhaps it should not have seen it.
PCI	Peripheral component interconnect, a local data bus
PCM	Pulse code modulation
PCM600	Protection and control IED manager
PC-MIP	Mezzanine card standard
PISA	Process interface for sensors & actuators
PMC	PCI Mezzanine card
POTT	Permissive overreach transfer trip
Process bus	Bus or LAN used at the process level, that is, in near proximity to the measured and/or controlled components
PSM	Power supply module
PST	Parameter setting tool within PCM600
PT ratio	Potential transformer or voltage transformer ratio
PUTT	Permissive underreach transfer trip
RASC	Synchrocheck relay, COMBIFLEX
RCA	Relay characteristic angle
REVAL	Evaluation software
RFPP	Resistance for phase-to-phase faults
	Resistance for phase-to-ground faults
RISC	Reduced instruction set computer
RMS value	Root mean square value
RS422	A balanced serial interface for the transmission of digital data in point-to-point connections
RS485	Serial link according to EIA standard RS485
RTC	Real time clock
RTU	Remote terminal unit
SA	Substation Automation
SC	Switch or push-button to close
SCS	Station control system
SCT	System configuration tool according to standard IEC 61850
SLM	Serial communication module. Used for SPA/LON/IEC communication.

SMA connector	Subminiature version A, A threaded connector with constant impedance.
SMT	Signal matrix tool within PCM600
SMS	Station monitoring system
SNTP	Simple network time protocol – is used to synchronize computer clocks on local area networks. This reduces the requirement to have accurate hardware clocks in every embedded system in a network. Each embedded node can instead synchronize with a remote clock, providing the required accuracy.
SPA	Strömberg protection acquisition, a serial master/slave protocol for point-to-point communication
SRY	Switch for CB ready condition
ST	Switch or push-button to trip
Starpoint	Neutral/Wye point of transformer or generator
SVC	Static VAr compensation
TC	Trip coil
TCS	Trip circuit supervision
TCP	Transmission control protocol. The most common transport layer protocol used on Ethernet and the Internet.
TCP/IP	Transmission control protocol over Internet Protocol. The de facto standard Ethernet protocols incorporated into 4.2BSD Unix. TCP/IP was developed by DARPA for internet working and encompasses both network layer and transport layer protocols. While TCP and IP specify two protocols at specific protocol layers, TCP/IP is often used to refer to the entire US Department of Defense protocol suite based upon these, including Telnet, FTP, UDP and RDP.
TEF	Time delayed gound-fault protection function
TNC connector	Threaded Neill Concelman, A threaded constant impedance version of a BNC connector
TPZ, TPY, TPX, TPS	Current transformer class according to IEC
Underreach	A term used to describe how the relay behaves during a fault condition. For example a distance relay is under-reaching when the impedance presented to it is greater than the apparent impedance to the fault applied to the balance point, i.e. the set

	reach. The relay does not “see” the fault but perhaps it should have seen it. See also Overreach.
U/I-PISA	Process interface components that deliver measured voltage and current values
UTC	Coordinated universal time. A coordinated time scale, maintained by the Bureau International des Poids et Mesures (BIPM), which forms the basis of a coordinated dissemination of standard frequencies and time signals. UTC is derived from International Atomic Time (TAI) by the addition of a whole number of "leap seconds" to synchronize it with Universal Time 1 (UT1), thus allowing for the eccentricity of the Earth"s orbit, the rotational axis tilt (23.5 degrees), but still showing the Earth"s irregular rotation, on which UT1 is based. The Coordinated Universal Time is expressed using a 24-hour clock and uses the Gregorian calendar. It is used for aeroplane and ship navigation, where it also sometimes known by the military name, "Zulu time". "Zulu" in the phonetic alphabet stands for "Z" which stands for longitude zero.
UV	Undervoltage
WEI	Weak end infeed logic
VT	Voltage transformer
X.21	A digital signalling interface primarily used for telecom equipment
$3I_O$	Three times zero-sequence current. Often referred to as the residual or the -fault current
	Three times the zero sequence voltage. Often referred to as the residual voltage or the neutral point voltage

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