



GE VERNOVA

P50 Agile

P154

Technical Manual

Non Dir. O/C and E/F relay (4 elements)

Hardware version: A

Software version: 01

Publication reference: P154/EN M/E



INTRODUCTION

CHAPTER 1

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

- 1 Chapter Overview**
- 2 Introduction**
 - 2.1 Features
 - 2.1.1 Protection & Control
 - 2.1.2 Measurement, Recording & Post Fault Analysis
 - 2.1.3 Front Panel Interface
 - 2.1.4 Communications
 - 2.2 Functional Overview
 - 2.3 Ordering Information

2 INTRODUCTION

2.1 Features

The P154 is a four element (phase A, B, C, N) non-directional overcurrent and earth fault relay with its functions designed to cover a wide range of applications in the protection of cables and overhead lines deployed in industrial installations, public distribution networks, and other substations.

The P154 is an economical choice, designed for deployment in volume, in lower voltage systems, in industrial installations, distribution network substations and as a backup relay in HV systems. P154 can also be applied for direct refurbishment of substations using older generations of non-communicating overcurrent relays.

The principal protection functions in the relay are timed and instantaneous phase and earth fault protection, with up to 3 independent stages available. IEC and IEEE curve types are provided for IDMT functions. Additional versatility is provided thanks to the inclusion of negative sequence overcurrent, thermal overload, cold load pickup, inrush blocking, broken conductor, breaker fail, restricted earth fault, undercurrent/loss of load, and trip circuit supervision functions. Multiple setting groups are included. The hardware capability is broadened by a sensitive earth fault CT option, and a universal auxiliary power supply range to permit standardisation in procurement and inventories.

The user may assign any of the logical/physical statuses to binary inputs, binary outputs and programmable LEDs. This provides flexibility to program the relay as per the application requirements. All the output contacts are changeover type for ease of implementing the desired wiring schematic.

The P154 offers supervision functions including measurement, monitoring and recording. Industry and utility protocols such as MODBUS, IEC 60870-5-103 and DNP3.0 are available for transmitting relay data to a supervisory control system via communication networks. The intuitive operator interface facilitates easy reading of measured values and simple configuration of the relay.

2.1.1 Protection & Control

- Timed and instantaneous phase and earth fault protection (3 independent stages)
- Wide range of IEC/IEEE curves
- Thermal overload
- Cold load pickup
- Inrush blocking
- Undercurrent/Loss of load detection
- Negative sequence overcurrent
- Broken conductor
- Circuit breaker Fail
- Restricted earth Fault
- Trip circuit supervision
- 6 Digital inputs
- 6 Digital output (c/o)
- 1A/5A CTs selection
- SEF option
- Latching of output contacts

- Universal auxiliary power supply range
- 2 Setting groups
- Password protection
- Self-supervision & internal diagnostics

2.1.2 Measurement, Recording & Post Fault Analysis

- Metering of Phase currents
- Metering of Neutral currents-derived and measured
- Measurement of thermal state
- Positive and Negative sequence current
- Ration of negative to positive sequence current
- Breaker operation counter
- Breaker trip counter
- Breaker operating time
- Up to 512 time tagged event records
- Up to 5 Fault records
- Up to 5 disturbance records

2.1.3 Front Panel Interface

- 8 LEDs for status indication
- Backlit LCD display (16 x 2)
- 8 navigation keys for setting and interrogation

2.1.4 Communications

- Front USB port for real-time data viewing, device setting, and upload/download.
- Rear EIA (RS) 485 port for SCADA communication
- Multiple protocols - Modbus/ IEC60870-5-103 or DNP3.0 (ordering option)

2.2 Functional Overview

ANSI	FUNCTION	P154
50	Definite time overcurrent	•
50N	Neutral/Earth definite time overcurrent	•
51	IDMT overcurrent	•
51N	Neutral/Earth IDMT overcurrent	•
68	Inrush Blocking	•
49	Thermal Overload	•
37	Undercurrent detection (aux. power mode)	•
46	Negative sequence overcurrent	•
46BC	Broken conductor	•

ANSI	FUNCTION	P154
50BF	Circuit breaker fail	•
CLP	Cold load pick-up	•
64R	Restricted earth fault	•
86	Latching of output contacts (Lockout)	•
Control Functions		
74	Trip circuit supervision	•
	Watchdog function	•
	Self monitoring & diagnostics	•
	Test/Commissioning facilities	•
HMI		
	Back-Lit LCD display	•
	8 x Touch Keys	•
	8 x status LEDs	•
Communication		
	USB port	•
	Modbus/IEC 60870-5-103 (RS485) (or) DNP3.0	•
Binary Input/Output		
	Binary Input	6
	Binary Output	6 (c/o)
Analogue Input		
	Phase current input 3x1 ph	•
	Earth current input 1x1 ph (or) SEF current input 1x1 ph	•
General		
	Setting Groups	2
	Self diagnostics	•
	Measurements	•
	Event records	•
	Fault records	•
	Disturbance records	•
	Configurable BI/BO/LEDs	•
Hardware		
	Auxiliary supply	24-230 V AC/DC
	Climatic conditions	Operating : - 25°C to + 55°C Storage : -25°C to + 70°C
	Housing	Front IP 52 Rear IP 20

2.3 Ordering Information

Variants		Order Number													
		1 - 4	5	6	7	8	9	10	11	12-13	14	15			
Model Type															
Non Dir. O/C + E/F (4 Element)		P154													
Auxiliary Voltage															
24 – 230 V DC/AC	Binary Input Threshold Voltage	1													
24 – 230 V DC/AC	18V DC / 16V AC	2													
24 – 230 V DC/AC	35V DC / 33V AC	3													
24 – 230 V DC/AC	77V DC / 75V AC	4													
24 – 230 V DC/AC	154V DC / 152V AC														
Current Transformer															
Standard CT		1													
SEF CT		2													
Hardware Options															
EIA RS485 only			1												
I/O Options															
Standard (6 logic inputs + 6 relay outputs)					A										
Communication Protocol															
Modbus / IEC 60870-5-103						1									
DNP3.0						2									
Case															
Non drawout								A							
Language															
English or French (with French via relay HMI only)									1						
Software Reference															
Initial release (v1.xx)										01					
Customisation / Regionalisation															
Default											0				
Customer specific											A				
Hardware design suffix															
Initial release												A			

Figure 1: Ordering information

SAFETY INFORMATION

CHAPTER 2

1 HEALTH AND SAFETY

Personnel associated with the equipment must be familiar with the contents of this Safety Information.

When electrical equipment is in operation, dangerous voltages are present in certain parts of the equipment. Improper use of the equipment and failure to observe warning notices will endanger personnel.

Only qualified personnel may work on or operate the equipment. Qualified personnel are individuals who are:

- familiar with the installation, commissioning, and operation of the equipment and the system to which it is being connected.
- familiar with accepted safety engineering practises and are authorised to energise and de-energise equipment in the correct manner.
- trained in the care and use of safety apparatus in accordance with safety engineering practises
- trained in emergency procedures (first aid).

The documentation provides instructions for installing, commissioning and operating the equipment. It cannot, however cover all conceivable circumstances. In the event of questions or problems, do not take any action without proper authorisation. Please contact your local sales office and request the necessary information.

2 SYMBOLS

Throughout this manual you will come across the following symbols. You will also see these symbols on parts of the equipment.



Caution:
Refer to equipment documentation. Failure to do so could result in damage to the equipment



Warning:
Risk of electric shock



Earth terminal. *Note: This symbol may also be used for a protective conductor (earth) terminal if that terminal is part of a terminal block or sub-assembly.*



Protective conductor (earth) terminal



Instructions on disposal requirements

Note:

The term 'Earth' used in this manual is the direct equivalent of the North American term 'Ground'.

3 INSTALLATION, COMMISSIONING AND SERVICING

3.1 LIFTING HAZARDS

Many injuries are caused by:

- Lifting heavy objects
- Lifting things incorrectly
- Pushing or pulling heavy objects
- Using the same muscles repetitively

Plan carefully, identify any possible hazards and determine how best to move the product. Look at other ways of moving the load to avoid manual handling. Use the correct lifting techniques and Personal Protective Equipment (PPE) to reduce the risk of injury.

3.2 ELECTRICAL HAZARDS



Caution:
All personnel involved in installing, commissioning, or servicing this equipment must be familiar with the correct working procedures.



Caution:
Consult the equipment documentation before installing, commissioning, or servicing the equipment.



Caution:
Always use the equipment as specified. Failure to do so will jeopardise the protection provided by the equipment.



Warning:
Removal of equipment panels or covers may expose hazardous live parts. Do not touch until the electrical power is removed. Take care when there is unlocked access to the rear of the equipment.



Warning:
Isolate the equipment before working on the terminal strips.



Warning:
Use a suitable protective barrier for areas with restricted space, where there is a risk of electric shock due to exposed terminals.



Caution:
Disconnect power before disassembling. Disassembly of the equipment may expose sensitive electronic circuitry. Take suitable precautions against electrostatic voltage discharge (ESD) to avoid damage to the equipment.



Caution:
NEVER look into optical fibres or optical output connections. Always use optical power meters to determine operation or signal level.



Caution:
Testing may leave capacitors charged to dangerous voltage levels. Discharge capacitors by reducing test voltages to zero before disconnecting test leads.



Caution:
Operate the equipment within the specified electrical and environmental limits.



Caution:
Before cleaning the equipment, ensure that no connections are energised. Use a lint free cloth dampened with clean water.

Note:

Contact fingers of test plugs are normally protected by petroleum jelly, which should not be removed.

3.3 UL/CSA/CUL REQUIREMENTS

The information in this section is applicable only to equipment carrying UL/CSA/CUL markings.



Caution:
Equipment intended for rack or panel mounting is for use on a flat surface of a Type 1 enclosure, as defined by Underwriters Laboratories (UL).



Caution:
To maintain compliance with UL and CSA/CUL, install the equipment using UL/CSA-recognised parts for: cables, protective fuses, fuse holders and circuit breakers, insulation crimp terminals, and replacement internal batteries.

3.4 FUSING REQUIREMENTS



Caution:
Where UL/CSA listing of the equipment is required for external fuse protection, a UL or CSA Listed fuse must be used for the auxiliary supply. The listed protective fuse type is: Class J time delay fuse, with a maximum current rating of 15 A and a minimum DC rating of 250 V dc (for example type AJT15).

**Caution:**

Where UL/CSA listing of the equipment is not required, a high rupture capacity (HRC) fuse type with a maximum current rating of 16 Amps and a minimum dc rating of 250 V dc may be used for the auxiliary supply (for example Red Spot type NIT or TIA).

For P50 models, use a 1A maximum T-type fuse.

For P60 models, use a 4A maximum T-type fuse.

**Caution:**

Digital input circuits should be protected by a high rupture capacity NIT or TIA fuse with maximum rating of 16 A. for safety reasons, current transformer circuits must never be fused. Other circuits should be appropriately fused to protect the wire used.

**Caution:**

CTs must NOT be fused since open circuiting them may produce lethal hazardous voltages

3.5 EQUIPMENT CONNECTIONS

**Warning:**

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

**Caution:**

Tighten M4 clamping screws of heavy duty terminal block connectors to a nominal torque of 1.3 Nm.

Tighten captive screws of terminal blocks to 0.5 Nm minimum and 0.6 Nm maximum.

**Caution:**

Always use insulated crimp terminations for voltage and current connections.

**Caution:**

Always use the correct crimp terminal and tool according to the wire size.

**Caution:**

Watchdog (self-monitoring) contacts are provided to indicate the health of the device on some products. We strongly recommend that you hard wire these contacts into the substation's automation system, for alarm purposes.

3.6 PROTECTION CLASS 1 EQUIPMENT REQUIREMENTS



Caution:
Earth the equipment with the supplied PCT (Protective Conductor Terminal).



Caution:
Do not remove the PCT.



Caution:
The PCT is sometimes used to terminate cable screens. Always check the PCT's integrity after adding or removing such earth connections.



Caution:
Use a locknut or similar mechanism to ensure the integrity of stud-connected PCTs.



Caution:
The recommended minimum PCT wire size is 2.5 mm² for countries whose mains supply is 230 V (e.g. Europe) and 3.3 mm² for countries whose mains supply is 110 V (e.g. North America). This may be superseded by local or country wiring regulations.
For P60 products, the recommended minimum PCT wire size is 6 mm². See product documentation for details.



Caution:
The PCT connection must have low-inductance and be as short as possible.



Caution:
All connections to the equipment must have a defined potential. Connections that are pre-wired, but not used, should be earthed, or connected to a common grouped potential.

3.7 PRE-ENERGISATION CHECKLIST



Caution:
Check voltage rating/polarity (rating label/equipment documentation).



Caution:
Check CT circuit rating (rating label) and integrity of connections.



Caution:
Check protective fuse or miniature circuit breaker (MCB) rating.



Caution:
Check integrity of the PCT connection.



Caution:
Check voltage and current rating of external wiring, ensuring it is appropriate for the application.

3.8 PERIPHERAL CIRCUITRY



Warning:
Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation. Short the secondary of the line CT before opening any connections to it.

Note:

For most GE Vernova equipment with ring-terminal connections, the threaded terminal block for current transformer termination is automatically shorted if the module is removed. Therefore external shorting of the CTs may not be required. Check the equipment documentation and wiring diagrams first to see if this applies.



Caution:
Where external components such as resistors or voltage dependent resistors (VDRs) are used, these may present a risk of electric shock or burns if touched.



Warning:
Take extreme care when using external test blocks and test plugs such as the MMLG, MMLB and P990, as hazardous voltages may be exposed. Ensure that CT shorting links are in place before removing test plugs, to avoid potentially lethal voltages.

3.9 UPGRADING/SERVICING



Warning:
Do not insert or withdraw modules, PCBs or expansion boards from the equipment while energised, as this may result in damage to the equipment. Hazardous live voltages would also be exposed, endangering personnel.



Caution:
Internal modules and assemblies can be heavy and may have sharp edges. Take care when inserting or removing modules into or out of the IED.

4 DECOMMISSIONING AND DISPOSAL

**Caution:**

Before decommissioning, completely isolate the equipment power supplies (both poles of any dc supply). The auxiliary supply input may have capacitors in parallel, which may still be charged. To avoid electric shock, discharge the capacitors using the external terminals before decommissioning.

**Caution:**

Avoid incineration or disposal to water courses. Dispose of the equipment in a safe, responsible and environmentally friendly manner, and if applicable, in accordance with country-specific regulations.

5 STANDARDS COMPLIANCE

Compliance with the European Commission Directive on EMC and LVD is demonstrated using a Technical File.



5.1 EMC COMPLIANCE: 2004/108/EC

Compliance with EN60255-26:2009 was used to establish conformity.

5.2 PRODUCT SAFETY: 2006/95/EC

Compliance with EN60255-27:2005 was used to establish conformity.

Protective Class

IEC 60255-27: 2005 Class 1 (unless otherwise specified in equipment documentation). This equipment requires a protective conductor (earth) to ensure user safety.

Installation category

IEC 60255-27: 2005 Overvoltage Category 3. Equipment in this category is qualification tested at 5kV peak, 1.2/50 μ S, 500 Ohms, 0.5 J, between all supply circuits and earth and also between independent circuits.

Environment

IEC 60255-27: 2005, IEC 60255-26:2009. The equipment is intended for indoor use only. If it is required for use in an outdoor environment, it must be mounted in a specific cabinet or housing which will enable it to meet the requirements of IEC 60529 with the classification of degree of protection IP54.

5.3 R&TTE COMPLIANCE

Radio and Telecommunications Terminal Equipment (R&TTE) directive 99/5/EC.

Conformity is demonstrated by compliance to both the EMC directive and the Low Voltage directive, to zero volts.

5.4 UL/CUL COMPLIANCE

If marked with this logo, the product is compliant with the requirements of the Canadian and USA Underwriters Laboratories.

The relevant UL file number and ID is shown on the equipment.



5.5 ATEX COMPLIANCE

If marked with the logo, the equipment is compliant with article 192 of European directive 94/9/EC. It is approved for operation outside an ATEX hazardous area. It is however approved for connection to Increased Safety, "Ex e", motors with rated ATEX protection, equipment category 2, to ensure their safe operation in gas zones 1 and 2 hazardous areas.



Equipment with this marking is not itself suitable for operation within a potentially explosive atmosphere.

Compliance demonstrated by Notified Body Type Examination Certificate.



II (2) G

ATEX Potentially Explosive Atmospheres directive 94/9/EC for equipment.

HARDWARE DESIGN

CHAPTER 3

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

- 1 Chapter Overview**
- 2 Hardware Design**
 - 2.1 Overview of Hardware Design
 - 2.2 Microcontroller with DSP Module
 - 2.2.1 Microcontroller Module (Processor board) Features
 - 2.3 Microcontroller and Analog Measurement
 - 2.4 Digital Input /Output Module
 - 2.5 Power Supply Module
 - 2.6 Communication Module
 - 2.7 Human Machine Interface Module

2 HARDWARE DESIGN

The P154 hardware comprises of following main components:

- Housing, consisting of a front panel and connections at the rear
- Microcontroller module
- Analogue input module
- Digital input module
- Digital output module
- Communication module
- Power supply unit
- Human machine Interface (HMI) module

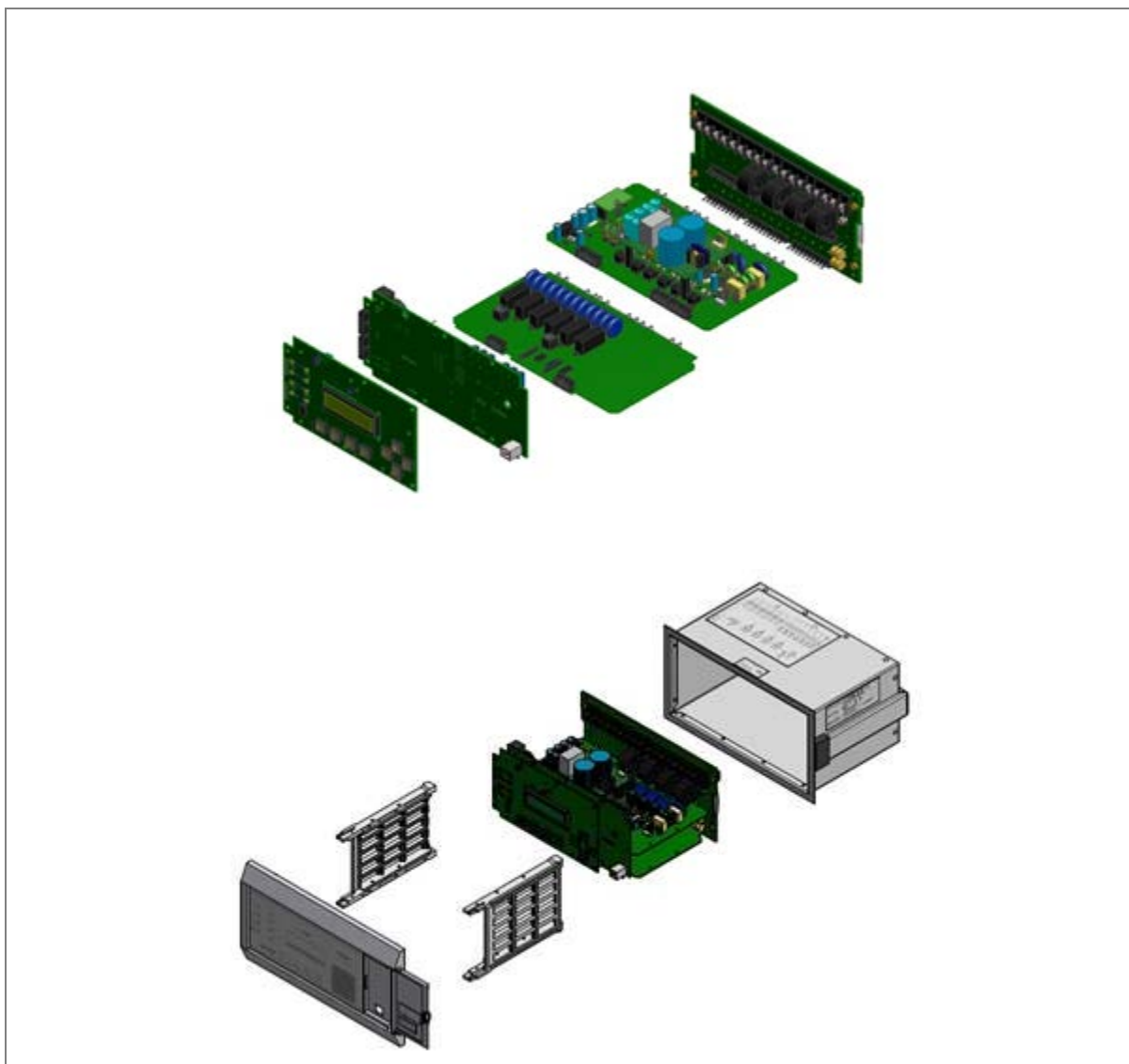


Figure 1: P154 general assembly

2.1 Overview of Hardware Design

The P154 hardware design overview is explained with the help of the schematic diagram. The P154 hardware consists of three sets of internal Current Transformers (CTs). These internal CTs are basically designed to cater to Protection & metering requirements. Dedicated CT is available for the earth fault protection requirements. The relay also has provision for the built-in SMPS unit which accepts power supply input of 24-230 V AC/DC from external source and outputs 12 V and 24 V DC for internal circuitry. The current signals acquired as analogue inputs get processed through operational amplifier, filter circuit, multiplexer, ADC (Analog to digital converter) and finally fed to CPU.

The CPU design is a hybrid of the digital signal processor (DSP) and high speed microcontroller which runs complex algorithm for deriving the fundamental & harmonic component from the input current signals. The digital inputs and outputs modules are designed to interface the monitoring, control and protection signals through optically isolated circuit as per the field requirements. The other peripherals modules like 16x2 LCD display, feather touch keys, USB and RS485 communication interfaces, battery backup for RTC and built in memory circuits are integrated as per the schematic diagram and enclosed in the IP-52 enclosure.

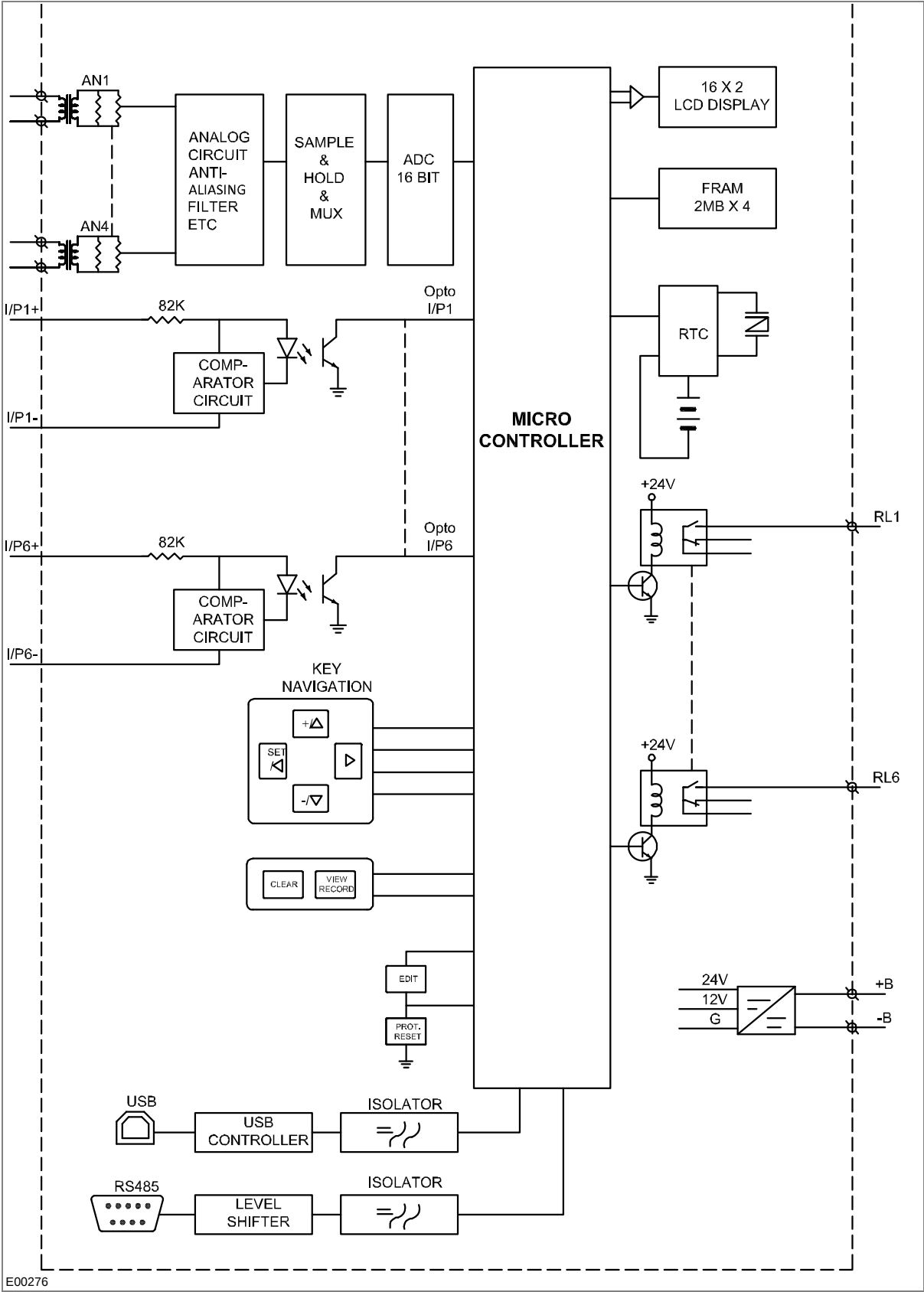


Figure 2: Hardware design overview

2.2 Microcontroller with DSP Module

The hardware is designed around 32 bit controller housed in small 100 pin SMD package. It is an high speed fix point Controller having MIPS's M4K® 32-bit core with 5-stage pipeline capable of operating up to 80 MHz. This controller is referred as MCU (Microcontroller unit).

2.2.1 Microcontroller Module (Processor board) Features

- 512K Flash memory (plus an additional 12 KB of Boot Flash)
- 128K on chip SRAM memory
- Multiple interrupt vectors with individually programmable priority
- Fail-Safe Clock Monitor mode
- Configurable Watchdog Timer with on-chip Low-Power RC oscillator for reliable operation
- Internal 8 MHz and 32 kHz oscillators
- Six UART modules with:
- RS-232, RS-485 , USB and LIN support
- Four SPI modules
- Five I2C™ modules
- Hardware Real-Time Clock and Calendar (RTCC)
- Five 16-bit Timers/Counters

2.3 Microcontroller and Analog Measurement

The P154 hardware supports 4 Analog inputs. The relay hardware uses external 16 bit ADC converter with capability to sample 8 signals simultaneously to avoid any phase angle error and achieve higher accuracy. In P154, only 4 channels of ADC converter are used. This external ADC can measure input in a range of – 10 V to +10 V. The ADC is interfaced using SPI serial interface, to avoid any software delays. The MCU continuously monitors different analog signals like line and E/F currents through CTs, multiplexer and ADC.

The relay is designed for 5 amp and 1 amp CT secondary current signal. These inputs are further scaled down to low voltage signal by using internal current and transformer. The internal current transformer converts nominal current signal to 3.3mA. These analog signals are then passed through protection circuit, anti aliasing filter and amplifier which scales analogue signal to required ADC range. This anti aliasing filter blocks all high frequency components and surges to avoid measurement error. The sample and hold (S/H) circuit and multiplexer sample all analog signals at same instant to avoid and phase angle error and give maximum accuracy.

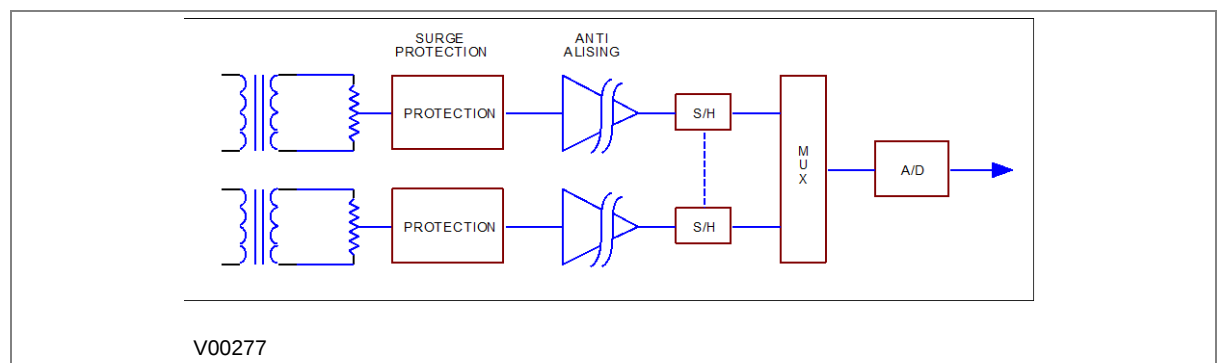


Figure 3: Analog signal processing

The MCU acquires analog values @ 16 samples per cycle. Digital signal processing (DSP) performs powerful numerical algorithms which convert this signal in to equivalent vectors. Once the signal is converted into vectors, number of parameters are derived from it such as phase currents (I_a , I_b , I_c), Positive sequence current (I_1) and Negative sequence current (I_2). The MCU also calculates harmonic contents of the current signals (actual harmonics depend upon type of relay). All measurements are tuned to fundamental frequency i.e. 50 Hz or 60 Hz, so that relay will remain stable during distorted waveform generated by modern electronics load.

The typical frequency response of tuned filter for 50 Hz is as shown in figure 4.

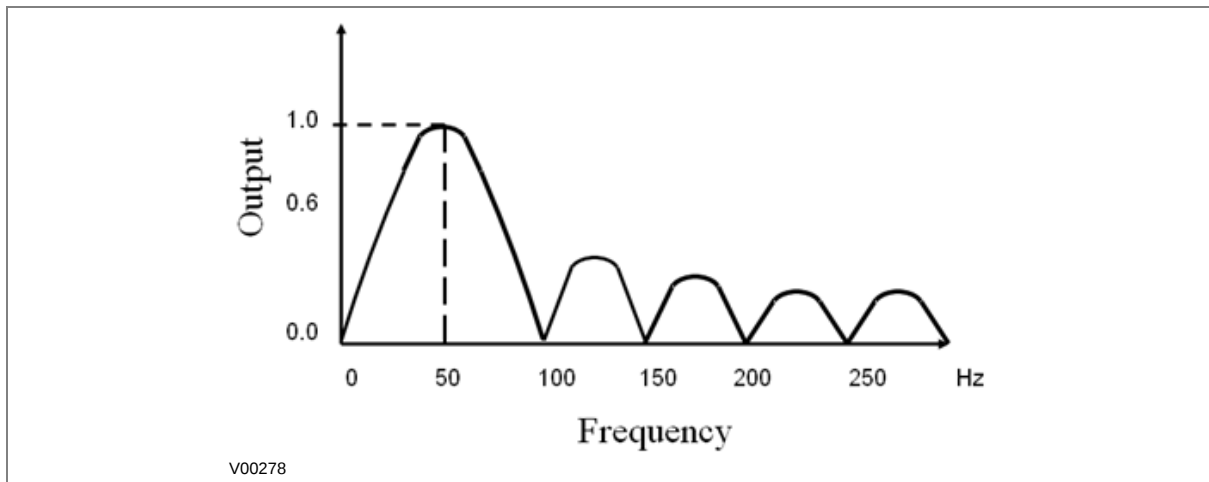


Figure 4: Frequency response of tuned filter for 50 Hz

The measurement is totally immune to all higher harmonics which makes relay operation absolute reliable. All these measured values are then used for different protection functions such as over current/Earth Fault and Negative phase sequences. The actual protection function depends on type of relay and described in the rest of the document.

2.4 Digital Input /Output Module

This module supports 6 numbers of digital input DI and 6 numbers of digital output DO channels for acquiring filed signals or controlling field devices respectively. The DIs are isolated from other circuits by using opto isolators. The threshold voltage at which opto coupler turns ON is controlled by comparator based on the voltage range selected during device ordering.

2.5 Power Supply Module

The power supply module is a designed using modern PWM based switching mode technique. It converts input supply to the 12 V and 24 Vdc low voltage supply for relay electronics and control circuit. It also provides necessary isolation from input power supply. The normal operating voltage range is 24 V – 230 VAC/DC.

2.6 Communication Module

The P154 supports 2 numbers of isolated ports for communication.

- (a) USB port provided on front of the relay
- (b) RS 485 (2 wired) port provided on the rear side of relay.

The relay can be accessed using the P50 Agile Configurator. Rear port supports open protocols like IEC60870-5-103/MODBUS or DNP3.0 (ordering option) and is used for external communication.

2.7 Human Machine Interface Module

The HMI module is provided with 16x2 LCD, 8 numbers of soft feather touch keys and 8 numbers of LEDs for indication. The cover at right side of the front panel houses following:

- Female USB connector
- Serial number of relay.
- Model number of relay.
- Voltage and current ratings.

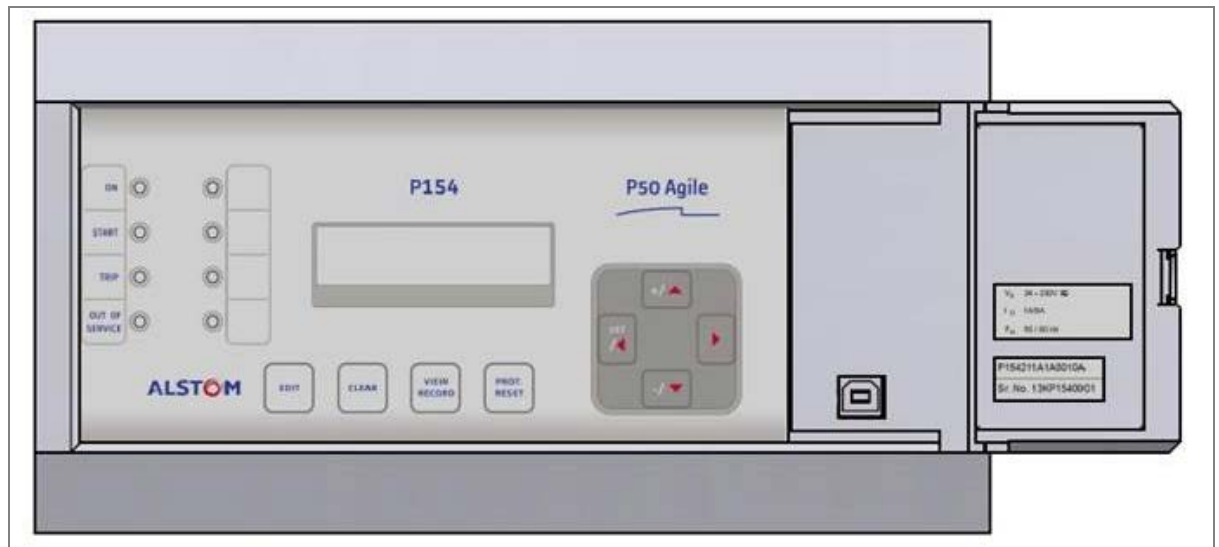


Figure 5: Front panel of P154 relay

FRONT PANEL

CHAPTER 4

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

- 1 Chapter Overview**
- 2 Front Panel**
 - 2.1 User Interface
 - 2.1.1 LCD Display
 - 2.1.2 Touch Keys
 - 2.1.3 LEDs
 - 2.1.4 RS 485 Port
 - 2.1.5 USB Port

2 FRONT PANEL

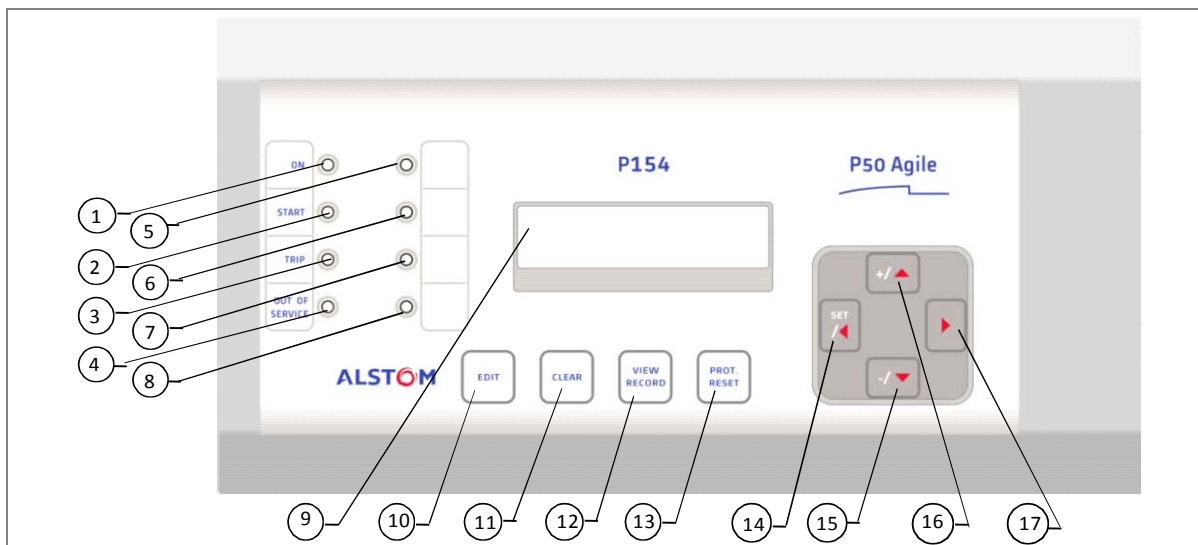


Figure 1: Front panel

SL no	Label	Function
1	ON	Green LED indicates that the IED is in correct working order, and should be ON at all times. It turns red if the unit's self-tests show there is an error in the hardware or software.
2	START	Amber LED flashes when the IED registers an alarm. This may be triggered by a fault, event or maintenance record. The LED flashes until the alarms have been accepted (read) by pressing VIEW RECORD function key, then changes to constantly ON. When the alarms are cleared, the LED switches OFF after pressing CLEAR key.
3	TRIP	Red LED switches ON when the IED issues a trip signal. When the faults are cleared, the LED switches OFF after pressing CLEAR key.
4	OUT OF SERVICE	Amber LED flashes when the IED's protection is unavailable (eg. Setting Error, ADC Error detected by unit's self-test etc)
5	L5	Programmable dual colour LED
6	L6	Programmable dual colour LED
7	L7	Programmable dual colour LED
8	L8	Programmable dual colour LED
9	LCD Display	The LCD display is used to view the settings and parameters of the relay.
10	EDIT	Feather touch key to edit parameter settings.
11	CLEAR	Feather touch key to clear the fault LED indications. Also used to discard the setting changes.
12	VIEW RECORD	Feather touch key to view fault records.
13	PROT. RESET	Feather touch key to reset the hardware. This key to be used along with EDIT key. The relay will reboot when ' PROT. RESET ' + EDIT pressed simultaneously.
14	SET / ◀	Feather touch key SET to save the settings and / ◀ is used for navigating through the menus/submenus.
15	+ / ▲	Feather touch key [+] is used to INCREASE the values and [▲] is used to change the menu level or change between settings in a particular menu.
16	- / ▼	Feather touch key [-] is used to DECREASE the values and [▼] is used to change the menu level or change between settings in a particular menu.
17	▶	Feather touch key [▶] is used to view the settings and to navigate through the menus and submenus.

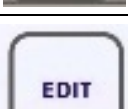
2.1 User Interface

2.1.1 LCD Display

A backlit LCD display of 16 x 2 characters is provided for parameter and setting display, and for easy viewing of measurement, setting, fault records, date & time and error messages. The backlit display will switch off automatically after 100 seconds if no key is pressed. The backlit display will turn **ON** automatically if any tripping occurs.

2.1.2 Touch Keys

The function of the relay is controlled by the following keys on the front panel.

	(+) key is used to INCREASE the values (▲) key is used to change the menu level or change between settings in a particular menu.
	SET key is used to save the settings (◀) key is used for navigating through the menus/submenus.
	(▶) key is used to view the settings and to navigate through the menus and submenus.
	(-) key is used to DECREASE the values (▼) key is used to change the menu level or change between settings in a particular menu.
	EDIT key is used to edit the setting
	CLEAR key is used to clear the fault LED indications. This key is also used to discard the setting changes.
	VIEW RECORD key is used to view the Fault, Maintenance and Event Records.
	PROT. RESET key is used for Hardware reset. This key is interlocked with EDIT key. This key is not required to be pressed in normal operation, but is used to reset the hardware of relay during a relay firmware update.

Note: If changes are not made within 100 s while editing the settings then the display will reset itself and return to the Main Menu.

2.1.3 LEDs

The P154 relay has 8 high-intensity LEDs for easy identification of fault type and ease of user interface.

SL no	Label	Function
LED 1	ON	Green LED indicates that the IED is in correct working order, and should be ON at all times. It turns red if the unit's self-tests show there is an error in the hardware or software.
LED 2	START	Amber LED flashes when the IED registers an alarm. This may be triggered by a fault, event or maintenance record. The LED flashes until the alarms have been accepted (read) by pressing VIEW RECORD function key, then changes to constantly ON. When the alarms are cleared, the LED switches OFF after pressing CLEAR key.
LED 3	TRIP	Red LED switches ON when the IED issues a trip signal. When the faults are cleared, the LED switches OFF after pressing CLEAR key.
LED 4	OUT OF SERVICE	Amber LED flashes when the IED's protection is unavailable (eg. Setting Error, ADC Error detected by unit's self-test etc)
LED 5,6,7,8	-	Programmable dual colour LED

2.1.4 RS 485 Port

RS485 port is provided at the rear of relay (near to terminal block) for permanent SCADA connectivity. The separate 5 Pin connector is used to avoid accidental connection of power wiring to communication input. The RS485 port can be used to download Settings, Fault data, Live Events and Disturbance Records.

2.1.5 USB Port

The USB port is situated on the front panel in the bottom right hand corner, and can be accessed by opening the flap on the front of the relay. This port is used to communicate with a locally connected PC.

It has three main purposes:

- Transferring settings information to/from the PC from/to the device.
- Downloading firmware updates.
- Downloading relay data for analysis.

The port is intended for temporary connection during testing, installation and commissioning. It is not intended to be used for permanent SCADA communications.

You can connect the unit to a PC with a USB cable up to 15 m in length.

The USB port includes a USB full-speed function controller, USB transceiver, oscillator, EEPROM, and synchronous serial data bus (UART). No other external USB components are required.

For configuration/setting, appropriate 'Config port' has to be selected from the **SYSTEM DATA** menu.

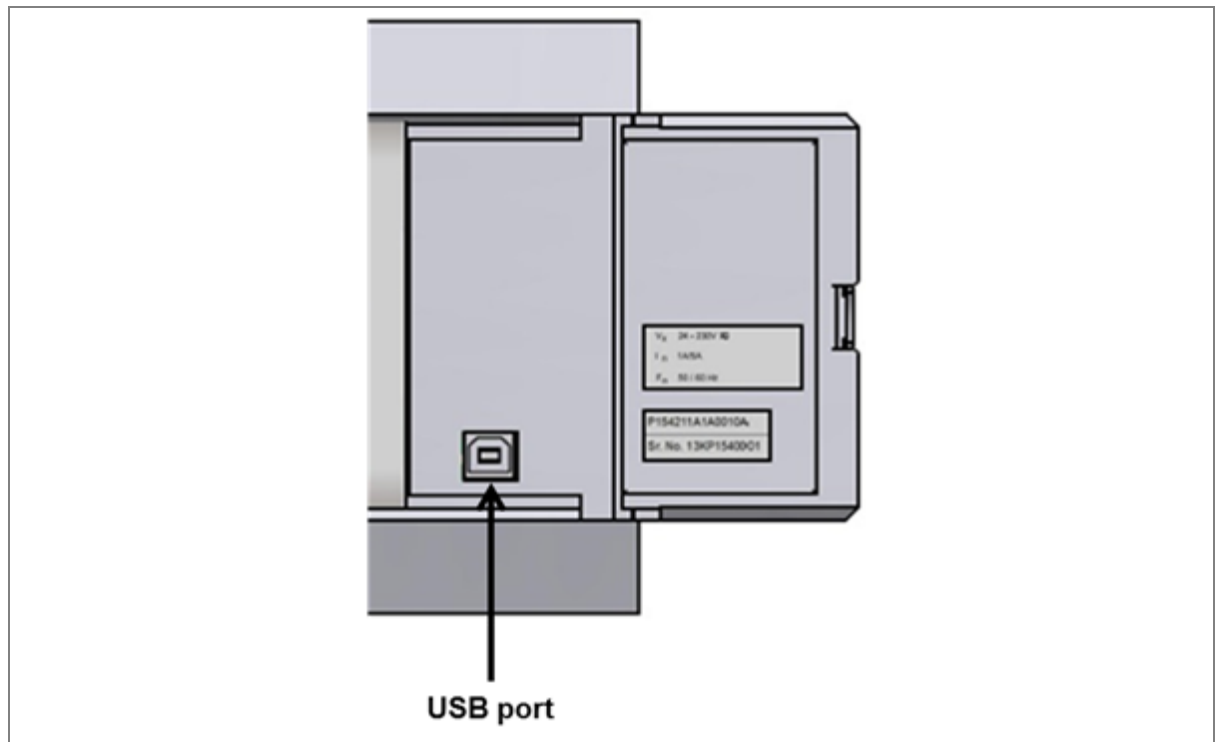


Figure 2: USB port

CONFIGURATION

CHAPTER 5

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

- 1 Chapter Overview**
- 2 Configuration**
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 - 2.2 Password Entry
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 - 2.3.16.8 Group1 –Thermal Overload Submenu
 - 2.3.16.9 Group1 – Cold Load Pickup Submenu
 - 2.3.16.10 Group1 –Undercurrent Submenu
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- 2.4.26 Group 1- CB Fail Submenu
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- 2.4.27 Group 2 Menu
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2 CONFIGURATION

Each product has different configuration parameters according to the functions it has been designed to perform. There is, however, a common methodology used across the entire product to set these parameters.

This chapter describes an overview of this common methodology, as well as providing concise instructions of how to configure the device.

Using the HMI, you can:

- Display and modify settings
- View the digital I/O signal status
- Display measurements
- Display fault records
- Reset fault and alarm indications

The keypad provides full access to the device functionality by means of a range of menu options. Information is displayed on the LCD.

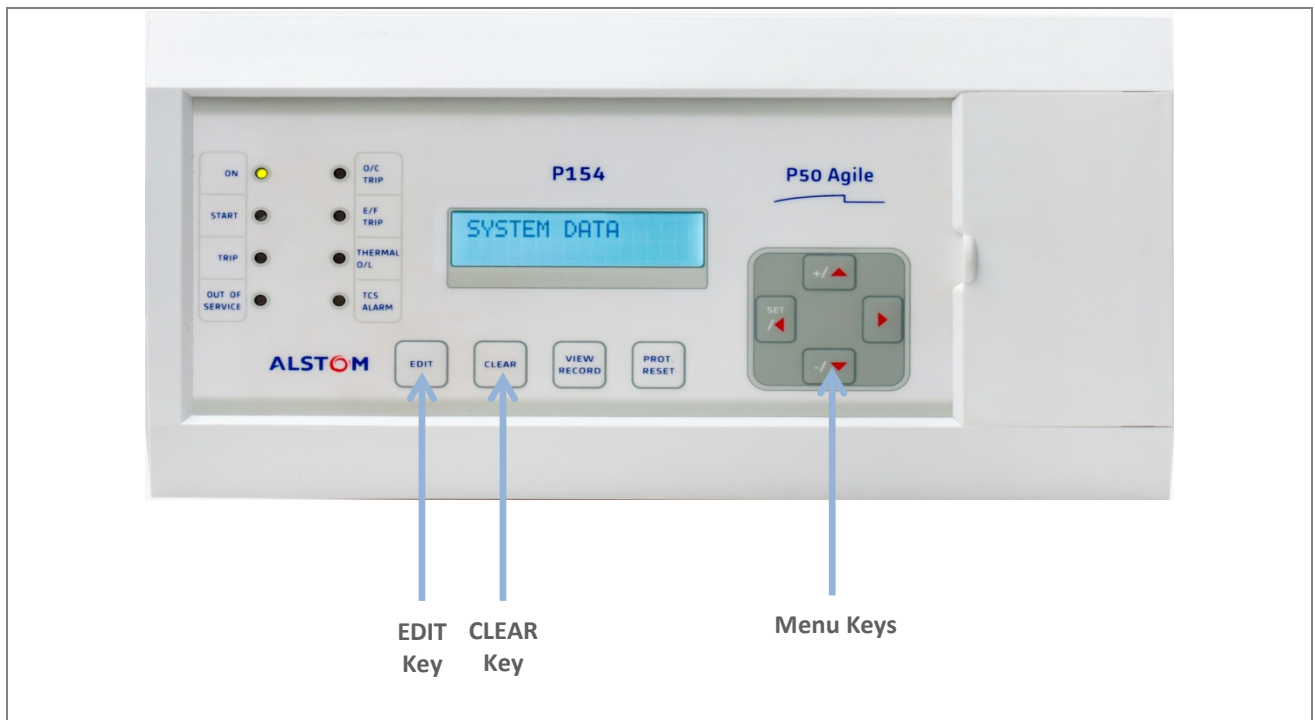


Figure 1: P154 menu/function keys

2.1 Changing the Settings

SYSTEM DATA	Step 1: Press the (▶) key to move to the next option.
Language English	Step 2: Press the (- / ▼) key to move to the next option till the relay displays CB Open/Close setting
:::	:::
CB Open/Close Open	Step 3: Press the (- / ▼) key till the relay displays this option. Press 'EDIT' key to edit the setting.
Password = 0001	[All editable settings are password protected. So when the 'EDIT' key is pressed, it will display the password and the settable number/text will start blinking]. Step 4: Enter the password by using the (+ / ▲) or the (- / ▼) key. The Password is four (4) digits alpha numeric.
Password = 0000 ** Password OK **	Step 5: After editing the Password, press the 'EDIT' key, the Password OK message is displayed and settable number/text will start blinking and the relay will move to the next option. Note: When the password is set, modification can be done in any settings within 15 minutes. After the lapse of 15 minutes, the relay will once again ask to re-enter the password.
CB Open/Close Open	Step 6: By using the (+ / ▲) or (- / ▼) key, the desired selection can be set as shown in the display.
CB Open/Close Close	Step 7: After setting, press the 'EDIT' key, the text will stop blinking and move to the next option. Step 8: Press the (◀) / (▶) key, it will ask if you want to save the settings and move to the next option.
SET For Save CLEAR For Cancel	Step 9: When the 'SET' key is pressed again, it will save the changes and move to the next option.
SAVE Settings	This window will flash for a moment and the control will return to the main menu.
SYSTEM DATA	

*Note: The user can DISCARD SETTINGS by using the **CLEAR** Key.*

SET For Save CLEAR For Cancel	Step 10: When the ' CLEAR ' key is pressed it will discard the changes and the relay will move to the next option.
DISCARD Settings	This window will flash for a moment and the control will return to the main menu.
SYSTEM DATA	

2.2 Password Entry

Modification of the editable settings requires password access. You will be prompted for a password before you can make any changes, as follows. The default password is **0000**.

1. On pressing the **EDIT** key, a flashing cursor appears at the right most character field of the password by default. Press the up or down cursor keys to change each character.
2. Use the left and right cursor keys to move between the character fields of the password.
3. Press the **SET** key to confirm the password. After entering a valid password the **Password OK** message appears indicating that the password is correct. The user can now start editing the settings. If the correct password has not been entered, the password prompt page appears again. To stop this prompt press the **CLEAR** key.
4. A new password can be set using the **Password** cell in the **SYSTEM DATA** menu.
5. If the keypad is inactive for 15 minutes the user will again be prompted for a password entry.

2.3 Menus

2.3.1 Default Display

After **Power ON** or when the '**PROT.RESET + EDIT**' keys are pressed, the relay will display the following message.

P50 Agile P154 Feeder Protect'n	This window will flash momentarily showing the following. Relay Name: P50 Agile P154 , Relay Type: Feeder Protection Then the control will automatically move to next option.
ID = 1 SW = V1.04	This window will flash momentarily showing the following:- Unit ID = 1 Software Version = V1.04 Then the control will automatically move to the default window.

SYSTEM DATA	

2.3.2 Main Menu Contents

SYSTEM DATA	Password protected window for “ SYSTEM DATA ” setting i.e. Language, Description, Model Number, Serial Number, Software Version, Frequency, USB Address, USB Parity, USB Baud Rate, Password, Active Group, Opto I/P Status, Relay O/P Status. CB Open/Close, Opto I/P and Config Port.
VIEW RECORDS	This menu is to view Fault Record, Event Record, Maint Record and Alarm records.
MEASUREMENTS	This menu displays the measurements values of various parameters (i.e. Phase current, measured and derived earth current, negative, positive phase sequence current and I2/I1 ratio as per per phase / earth CT ratio, TC (Trip Counter), BOC (Breaker Operation Counter), BOT (Breaker Operating Time), Th State (Thermal State) and rms value of phase currents.
CB CONTROL	Password protected window for “ CB CONTROL ” settings i.e. TCS Alarm, TCS Timer, CB Open S'vision (Enabled / Disabled), CB Open Time, CB Open Alarm (Enabled / Disabled), CB Open Oper, CB Control By, Close Pulse Time, Open Pulse Time .
DATE AND TIME	Password protected window for “ DATE AND TIME ” settings i.e. Local Time Enable, Local Time Offset, DST Enable, DST Offset, DST Start, DST Start Day, DST Start Month, DST Start Mins, DST End, DST End Day, DST End Month, DST End Mins, RP Time Zone, SET Hours, SET Minutes, SET Seconds, SET Date, SET Month and SET Year.
CONFIGURATION	Password protected window for “ CONFIGURATION ” settings i.e. Restore Defaults, Active Settings, Copy From, Copy To, Setting Group 1 (Enabled/Disabled), Setting Group 2 (Enabled/Disabled), System Config (Enabled/Disabled), Overcurrent (Enabled/Disabled), Neg Sequence O/C (Enabled/Disabled), Broken Conductor (Enabled/Disabled), Earth Fault 1 (Enabled/Disabled), Earth Fault 2 (Enabled/Disabled), Thermal Overload (Enabled/Disabled), Cold Load Pickup (Enabled/Disabled), Measure't Setup, UnderCurr Prot (Enabled/Disabled), CB Fail (Enabled/Disabled) and Setting Values.
TRANS. RATIOS	Password protected window for “ TRANS. RATIO ” settings i.e. Phase CT Primary, Phase CT Sec'y, E/F CT Primary and E/F CT Secondary.
RECORD CONTROL	Password protected window for “ RECORD CONTROL ” settings i.e. Clear Events (Yes/No), Clear Faults (Yes/No), Clear Dist Recs (Yes/No), Clear Maint (Yes/No), Thermal Reset (Yes/No).

COMMUNICATION	Password protected window for “ COMMUNICATION ” settings i.e. RP1 Address, RP1 Baud Rate, RP1 Parity and RP1 Timesync.
IO CONFIGURATION	Password protected window for “ IO CONFIGURATION ” settings i.e. Relay, LED G, LED R, AND Logic and Opto I/P.
O/P RELAY CONFIG	Password protected window for “ O/P RELAY CONFIGURATION ” settings i.e. Contact HR/SR, O/P-1 Open Time, O/P-2 Open Time, O/P-3 Open Time, O/P-4 Open Time, O/P-5 Open Time and O/P-6 Open Time, LED G HR/SR, LED R HR/SR, ANDEQ A Op Time, ANDEQ A Rst Time, ANDEQ B Op Time, ANDEQ B Rst Time, ANDEQ C Op Time, ANDEQ C Rst Time, ANDEQ D Op Time and ANDEQ D Rst Time.
DISTURBANCE REC	Password protected window for “ DISTURBANCE RECORD ” settings i.e. Trigger Position.
COMMISSION. TEST	Password protected window for “ COMMISSIONING TEST ” settings i.e. Test Mode, Test Pattern, Contact Test and Test LEDs.
GROUP 1	Password protected window for “ GROUP 1 ” settings i.e. SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled and set as Active Group in Configuration setting.</i>
GROUP 2	Password protected window for “ GROUP 2 ” settings i.e. SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 2 Setting will be seen only when it is enabled and set as Active Group in Configuration setting.</i>

2.3.3 System Data Menu

2.3.3.1 View / Edit Settings

SYSTEM DATA	Password protected window for “ SYSTEM DATA ” settings i.e. Language, Description, Model Number, Serial Number, Software Version, Frequency, USB Address, USB Parity, USB Baud Rate, Password, Active Group, Opto I/P Status, Relay O/P Status. CB Open/Close, Opto I/P and Config Port..
Language English	Read-only This window shows user interface is in English Language .

Description P50 Agile P154	Read-only This window shows Description of the relay.
Model Number P154121A1A0010A	Read-only This window shows the Model Number of the relay.
Serial Number xxxP154xxxx	Read-only This window shows the Serial Number of the relay.
Software Version P154_1_1_0V1.04	Read-only This window shows the Software Version of the relay.
Frequency 50Hz	Editable setting This window shows the System Frequency . The desired Frequency can be selected to either 50/ 60 Hz.
USB Address 1	Read-only This window shows the USB Address .
USB Parity None	Read-only This window shows the USB Parity .
USB Baud Rate 57600	Read-only This window shows the USB Baud Rate
Password ****	Editable setting This window is for setting the new Password of the relay. The desired alpha numeric case sensitive password can be selected from 0000 to zzzz and each digit can be set i.e. 0 to 9 / A to Z / a to z.
Active Group Group 1	Read-only This window shows the Active Group selected in configuration.

Opto I/P 654321 Status 000000	Read-only This window shows the Opto Input status .
Relay O/P 654321 Status 000000	Read-only This window shows the Relay Output status .

CB Open / Close No operation	Editable setting This window allows selection of the desired CB operation i.e. Open, Close and No operation.
Opto I/P DC	Editable setting This window allows selection of voltage input type for the Opto I/P i.e. AC / DC.
Config Port USB	Editable setting This window allows selection of the Configuration Port of the relay i.e. USB / RP

2.3.4 View Records Menu

2.3.4.1 View Records Menu Contents

VIEW RECORDS	This menu is to view Fault Record, Event Record, Maint Record and Alarm record.
Fault Record	This window is to view the Fault Record
Event Record	This window is to view the Event Record
Maint Record	This window is to view the Maint Record

Alarm Record	This window is to view the Alarm Record
--	--

2.3.4.2 View Fault Records

VIEW RECORDS	This menu is to view Fault Record, Event Record, Maint Record and Alarm record.
Fault Record	This window shows the Fault Record
Fault Num = 1	This window shows the Fault Number of latest fault.
I>1: I<: IN1>1: IN2>1: I2>1:	This window will show trip flag of stage 1: O/C, E/F-1 and E/F-2, Neg Sequence O/C, Under Current, Thermal Trip. Note: This window is seen when relay operates for respective protection function.
I>2: IN1>2: IN2>2: I2>2:	This window will show trip flag of stage 2: O/C, E/F-1 and E/F-2, Neg Sequence O/C. Note: This window is seen when relay operates for respective protection function.
I>3: IN1>3: IN2>3: I2>3:	This window will show trip flag of stage 3: O/C, E/F-1 and E/F-2, Neg Sequence O/C. Note: This window is seen when relay operates for respective protection function.
S1 S2 S3 S4 S5 S6 CLP BC CBF TH EXT TR	This window will show status flag (S1 – Opto Input 1, S2 – Opto Input 2, S3 – Opto Input 3, S4 – Opto Input 4, S5 – Opto Input 5, and S6 – Opto Input 6, CLP – Cold Load Pickup, BC – Broken Conductor, CBF – CB Fail, TH – Thermal Trip, EXT TR – External Trip). Note: This window is seen when status flag operates
ia = 0.00 A ib = 0.00 A	This window will show secondary fault current values.

ic = 0.00 A in1= 0.00 A	This window will show secondary fault current values.
in2 = 0.00 A i2 = 0.00 A	This window will show secondary fault current values.
i1 = 0.00 A I2/I1 =0.00	This window will show secondary fault current values.
Thermal State 0%	This window will show Thermal State.
Trip Counter 0	This window will show Trip counter.
Trip Timing (Sec) 0.000	This window will show Trip time.
21/02/14 16:15:30.225	This window will show date & time of fault.

2.3.4.3 View Event Records

VIEW RECORDS	This menu is to view Fault Record, Event Record, Maint Record and Alarm record.
Fault Record	This window shows the Fault Record

Event Record	This window shows the Event Record
Event Num = 1	This window shows the Event number of latest event. By using the (+ / ▲) or (- / ▼) key, the relay will scroll between Event numbers 1 to 512.
Dt: 21/02/2014 Tm: 16:15:30:225	This window will show date & time of Event.
Event Num = 1 Trip IN1>	This window shows the latest Event and Event number.

2.3.4.4 View Maintenance Records

VIEW RECORDS	This menu is to view Fault Record, Event Record, Maint Record and Alarm record.
Fault Record	This window shows the Fault Record
Event Record	This window will show Event Record
Maint Record	This window will show Maintenance Record contents
Main't Rec Num = 1	This window will show Maintenance Record 1

Errorcode : 0004 RTC Error	This window shows the contents of the Maintenance Record 1.
07/06/2014 17:20:30.596	This window shows the date and time of error.

2.3.4.5 View Alarm Records

VIEW RECORDS	This menu is to view Fault Record, Event Record, Maint Record and Alarm record.
Fault Record	This window shows the Fault Record
Event Record	This window will show Event Record
Maint Record	This window will show Maintenance Record
Alarm Record	This window will show Alarm Record
TCS Alarm	This window will show latest alarm.
24/09/2014 12:35:40:025	This window shows the date and time of alarm.

2.3.5 Measurement Menu

2.3.5.1 View Contents

MEASUREMENTS	This menu displays the measurements values of various parameters (i.e. Phase current, measured and derived earth current, negative, positive phase sequence current and I2/I1 ratio as per per phase / earth CT ratio, TC (Trip Counter), BOC (Breaker Operation Counter), BOT (Breaker Operating Time), Th State (Thermal State) and rms value of phase currents.
IA = 0 A IB = 0 A	This window shows primary value of current in phase A and B taking in to account phase CT ratio.
IC = 0 A IN1 = 0 A	This window shows primary value of current in phase C and measured earth current taking in account phase CT and earth CT ratio respectively.
IN2 = 0 A	This window shows primary value of internally derived earth current.
ia = 0.00 A ib = 0.00 A	This window shows secondary value of current in phase A and phase B.
ic = 0.00 A in1 = 0.00 A	This window shows secondary value of current in phase C and measured earth current.
in2= 0.00 A i1 = 0.00 A	This window shows secondary value of internally derived earth current and positive sequence current.
i2 = 0.00 A I2/I1 =0.000	This window shows secondary value of negative sequence current and ratio of negative and positive sequence current.
TC : 0 BOC : 0	This window shows Trip counter and Breaker operation counter.

BOT : 0 msec Th. State : 0%	This window shows Breaker operating time and actual Thermal State.
Irms A = 0.00 A Irms B = 0.00 A	This window shows secondary value of rms current in phase A and Phase B.
Irms C = 0.00 A	This window shows secondary value of RMS current in phase C.

2.3.6 CB Control Menu

2.3.6.1 View/Edit Settings (if all settings are disabled)

CB CONTROL	Password protected window for “ CB CONTROL ” settings: TCS Alarm, TCS Timer, CB Open S'vision , CB Open Time, CB Open Alarm , CB Open Oper, CB Control By, Close Pulse Time and Open Pulse Time.
TCS Alarm NO	Editable setting By using the (+ / ▲) or (- / ▼) key, TCS Alarm can be set as Yes / No.
CB Open S'vision Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Open Supervision can be Enabled or Disabled.
CB Open Alarm Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Open Alarm can be Enabled or Disabled.
CB Control by Disabled	Editable Setting By using the (+ / ▲) or (- / ▼) key, CB Control By can be set as Disabled / Local / Remote / Local + Remote.

2.3.6.2 View/Edit Settings (if all settings are enabled)

CB CONTROL	Password protected window for "CB CONTROL" settings: TCS Alarm, TCS Alarm, TCS Timer, CB Open S'vision (Enabled/Disabled), CB Open Time, CB Open Alarm (Enabled/Disabled), CB Open Oper, CB Control By, Close Plus Time and Open Pulse Time.
TCS Alarm YES	Editable setting By using the (+ / ▲) or (- / ▼) key, TCS Alarm can be set as Yes / No.
TCS Timer 5.00S	Editable setting By using the (+ / ▲) or (- / ▼) key, TCS Timer can be set. The setting range is from 0.1s to 10.00s in steps of 10ms.
CB Open S'vision Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Open Supervision can be Enabled or Disabled.
CB Open Time 0.30S	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Open Time can be set. The setting range is from 50 ms to 1.0 s in steps of 10 ms
CB Open Alarm Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Open Alarm can be Enabled or Disabled.
CB Open Oper 2000	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Open operations can be set. The setting range is from 1 to 30000 in steps of 1.
CB Control by Local + Remote	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Control By can be set as Disabled / Local / Remote / Local + Remote.

Close Pulse Time 0.50S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired Close Pulse Time can be set. The setting range is from 0.1s to 50s in steps of 0.01s
Open Pulse Time 0.50S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired Open Pulse Time can be set. The setting range is from 0.1s to 50s in steps of 0.01s

2.3.7 Date and Time Menu

2.3.7.1 Edit Settings (if the settings are disabled)

DATE AND TIME	Password protected window for “ DATE AND TIME ” settings : Local Time Enable, Local Time Offset, DST Enable, DST Offset, DST Start, DST Start Day, DST Start Month, DST Start minutes, DST End, DST End Day, DST End Month, DST End minutes, RP Time Zone, SET Hours, SET Minutes, SET Seconds, SET Date, SET Month and SET Year.
Tm: 17:21:50 Dt : 06/06/14 Wed	Read-only This window shows the set Date & Time
Local Time Enable Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Local Time Enable can be set as Disabled / Fixed / Flexible.
DST Enable Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, DST Enable can be set as Enabled/Disabled.
RP Time Zone Local	Editable setting By using the (+ / ▲) or (- / ▼) key, RP Time Zone can be set as Local / UTC
SET Hours 17	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Hours can be set. The setting range is from 0 to 23 in steps of 1.

SET Minutes 21	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Minutes can be set. The setting range is from 0 to 59 in steps of 1.
SET Seconds 50	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Seconds can be set. The setting range is from 0 to 59 in steps of 1.
SET Date 12	Editable setting By using (+ / ▲) or (- / ▼) key, SET Date can be set. The setting range is from 1 to 31 in steps of 1.
SET Month 11	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Month can be set. The setting range is from 1 to 12 in steps of 1.
SET Year 14	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Year can be set. The setting range is from 0 to 99 in steps of 1.

2.3.7.2 Edit Settings (if the settings are enabled)

DATE AND TIME	Password protected window for “ DATE AND TIME ” settings : Local Time Enable, Local Time Offset, DST Enable, DST Offset, DST Start, DST Start Day, DST Start Month, DST Start minutes, DST End, DST End Day, DST End Month, DST End minutes, RP Time Zone, SET Hours, SET Minutes, SET Seconds, SET Date, SET Month and SET Year.
Tm: 17:21:50 Dt : 06/06/14 Fri	Read-only This window shows the set Date & Time
Local Time Enable Fixed	Editable setting By using the (+ / ▲) or (- / ▼) key, Local Time Enable can be set as Disabled / Fixed / Flexible.
Local Time Offset 0 Mins	Editable setting By using the (+ / ▲) or (- / ▼) key, Local Time Offset can be set. The setting range is from -720 mins to 720 mins in step 15 mins

DST Enable Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, DST Enable can be set as Enabled/Disabled.
DST Offset 60 Mins	Editable setting By using the (+ / ▲) or (- / ▼) key, DST Offset can be set as 30Mins / 60Mins.
DST Start Last	Editable setting By using the (+ / ▲) or the Minus / Down arrow key (- / ▼) key, DST Start can be set as First / Second / Third / Fourth / Last.
DST Start Day Sunday	Editable setting By using the (+ / ▲) or (- / ▼) key, DST Start Day can be set from Sunday to Saturday.
DST Start Month March	Editable setting By using the (+ / ▲) or (- / ▼) key, DST Start Month can be set from January to December
DST Start Mins 60 Mins	Editable Setting By using the (+ / ▲) or (- / ▼) key, DST Start minutes can be set. The setting range is from 0 to 1425 mins in steps of 15 mins.
DST End Last	Editable setting By using the (+ / ▲) or (- / ▼) key, DST End can be set as First / Second / Third / Fourth / Last.
DST End Day Sunday	Editable setting By using the (+ / ▲) or (- / ▼) key, DST End Day can be set from Sunday to Saturday.
DST End Month October	Editable setting By using the (+ / ▲) or (- / ▼) key, DST End Month can be set from January to December

DST End Mins 60 Mins	Editable setting By using the (+ / ▲) or (- / ▼) key, DST End minutes can be set. The setting range is from 0 to 1425 mins in steps of 15 mins.
RP Time Zone Local	Editable setting By using the (+ / ▲) or (- / ▼) key, RP Time Zone can be set as Local / UTC
SET Hours 17	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Hours can be set. The setting range is from 0 to 23 in steps of 1.
SET Minutes 21	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Minutes can be set. The setting range is from 0 to 59 in steps of 1.
SET Seconds 50	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Seconds can be set. The setting range is from 0 to 59 in steps of 1.
SET Date 12	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Date can be set. The setting range is from 1 to 31 in steps of 1.
SET Month 11	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Month can be set. The setting range is from 1 to 12 in steps of 1.
SET Year 14	Editable setting By using the (+ / ▲) or (- / ▼) key, SET Year can be set. The setting range is from 0 to 99 in steps of 1.

2.3.8 Configuration Menu

2.3.8.1 View/Edit Settings

CONFIGURATION	Password protected window for “ CONFIGURATION ” settings i.e. Restore Defaults, Active Settings, Copy From, Copy To, Setting Group 1 (Enabled/Disabled), Setting Group 2 (Enabled/Disabled), System Config (Enabled/Disabled), Overcurrent (Enabled/Disabled), Neg Sequence O/C (Enabled/Disabled), Broken Conductor (Enabled/Disabled), Earth Fault 1 (Enabled/Disabled), Earth Fault 2 (Enabled/Disabled), Thermal Overload (Enabled/Disabled), Cold Load Pickup (Enabled/Disabled), Measure't Setup, UnderCurr Prot (Enabled/Disabled), CB Fail (Enabled/Disabled) and Setting Values.
Restore Defaults No Operation	Editable setting By using the (+ / ▲) or (- / ▼) key, Restore Defaults can be set as No Operation / All Settings / Setting Group 1 / Setting Group 2.
Active Settings Group 1	Editable setting By using the (+ / ▲) or (- / ▼) key, Active Setting can be set as Group 1 / Group 2.
Copy From Group 1	Editable setting By using the (+ / ▲) or (- / ▼) key, Copy From can be set as Group 1 / Group 2.
Copy To No Operation	Editable setting By using the (+ / ▲) or (- / ▼) key, Copy To can be set as No Operation / Group 1 / Group 2.
Setting Group 1 Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Setting Group 1 can be Enabled or Disabled.
Setting Group 2 Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Setting Group 2 can be Enabled or Disabled.
System Config Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, System Configuration can be Enabled or Disabled.

Overcurrent Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Over Current can be Enabled or Disabled.
Neg Sequence O/C Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Negative Sequence O/C can be Enabled or Disabled.
Broken Conductor Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Broken conductor can be Enabled or Disabled.
Earth Fault 1 Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Earth Fault 1 can be Enabled or Disabled.
Earth Fault 2 Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Earth Fault 2 can be Enabled or Disabled.
Thermal Overload Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Thermal Overload can be Enabled or Disabled.
Cold Load Pickup Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Cold Load Pickup can be Enabled or Disabled.
Measure't setup ABC	Editable setting By using the (+ / ▲) or (- / ▼) key, Measurement Setup can be set as ABC / RYB.
UnderCurr Prot Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Under Current Protection can be Enabled or Disabled.

CB Fail Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Fail can be Enabled or Disabled.
Setting Values Secondary	Editable setting By using the (+ / ▲) or (- / ▼) key, Setting Values can be set as Primary / Secondary.

2.3.9 Transformer Ratios Menu

2.3.9.1 View/Edit Settings

TRANS. RATIOS	Password protected window for “ TRANS. RATIOS ” settings : Phase CT Primary, Phase CT Secondary, E/F CT Primary and E/F CT Secondary.
Phase CT Primary 100 A	Editable setting By using the (+ / ▲) or (- / ▼) key, Phase CT Primary can be set. The setting range is from 1A to 30000A step 1A.
Phase CT Sec’y 1 A	Editable setting By using the (+ / ▲) or (- / ▼) key, Phase CT Secondary can be set as 1A / 5A.
E/F CT Primary 100 A	Editable setting By using the (+ / ▲) or (- / ▼) key, E/F CT Primary can be set. The setting range is from 1A to 30000A step 1A.
E/F CT Secondary 1 A	Editable setting By using the (+ / ▲) or (- / ▼) key, E/F CT Secondary can be set as 1A / 5A.

2.3.10 Record Control Menu

2.3.10.1 View/Edit Settings

RECORD CONTROL	Password protected window for “ RECORD CONTROL ” settings : Clear Events (Yes/No), Clear Faults (Yes/No), Clear Dist Recs (Yes/No), Clear Maint (Yes/No), Thermal Reset (Yes/No).
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Clear Events No	Editable setting By using the (+ / ▲) or (- / ▼) key, Clear Event Records can be set as Yes / No. (set 'Yes' to clear event data stored in memory)
Clear Faults No	Editable setting By using the (+ / ▲) or (- / ▼) key, Clear Fault Records can be set as Yes / No. (set 'Yes' to clear Fault data stored in memory)
Clear Dist Recs No	Editable setting By using the (+ / ▲) or (- / ▼) key, Clear Disturbance Records can be set as Yes / No. (set 'Yes' to clear Disturbance Record data stored in memory)
Clear Maint No	Editable setting By using the (+ / ▲) or (- / ▼) key, Clear Maintenance Records can be set as Yes / No. (set 'Yes' to clear Maintenance Record data stored in memory)
Thermal Reset No	Editable setting By using the (+ / ▲) or (- / ▼) key, Thermal Reset can be set as Yes / No. (set 'Yes' to reset Thermal State to zero)

2.3.11 Communication Menu

2.3.11.1 View/Edit Settings

COMMUNICATION	Password protected window for "COMMUNICATION" settings : RP1 Address, RP1 Baud Rate, RP1 Parity and RP1 Timesync.
RP1 Address 1	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired RP1 Address can be set. The setting range is from 1 to 247 in steps of 1.
RP1 Baud Rate 57600	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired RP1 Baud Rate can be set as 9600 / 19200 / 38400 / 57600
RP1 Parity Even	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired RP1 Parity can be set as Even / Odd / None.
RP1 Timesync Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, RP1 Timesync can be Enabled / Disabled

2.3.12 I/O Configuration Menu

2.3.12.1 View/Edit Settings

IO CONFIGURATION	Password protected window for “ OP CONTACT CONFIGURATION ” settings: Relay, LED Green, LED Red, AND Logic and Opto I/P.
Relay : 654321 Gen Strt 000000	Editable setting By using the (+ / ▲) or (- / ▼) key, the output relay RL1 – RL6 can be set for desired function. ‘1’ corresponds to RL1, ‘2’ corresponds to RL2,...‘6’ corresponds to RL6 Set the value ‘1’ for assigned / ‘0’ for not assigned under the numbers representing output relay.
LED G : 8765 Gen Strt 0000	Editable setting By using the (+ / ▲) or (- / ▼) key, LED GREEN can be set for desired function. ‘5’ corresponds to LED L5, ‘6’ corresponds to LED L6,...‘8’ corresponds to LED L8 Set the value ‘1’ for assigned / ‘0’ for not assigned under the numbers representing LED GREEN .
LED R : 8765 Gen Strt 0000	Editable setting By using the (+ / ▲) or (- / ▼) key, LED RED can be set for desired function. ‘5’ corresponds to LED L5, ‘6’ corresponds to LED L6,...‘8’ corresponds to LED L8 Set the value ‘1’ for assigned / ‘0’ for not assigned under the numbers representing LED RED .
AND Logic : DCBA Gen Strt 0000	Editable setting By using the (+ / ▲) or (- / ▼) key, the AND Logic function (A,B,C,D) can be set for desired function. Set the value ‘1’ for assigned / ‘0’ for not assigned under the letters representing AND Logic function .
Opto I/P : 654321 Rem. Rst. 000000	Editable setting By using the (+ / ▲) or (- / ▼) key, Opto inputs can be set for desired function. ‘1’ corresponds to Opto I/P S1, ‘2’ corresponds to Opto I/P S2,...‘6’ corresponds to Opto I/P S6 Set the value ‘1’ for assigned / ‘0’ for not assigned under the numbers representing Opto I/Ps .

2.3.12.2 List of the submenus for Relay Output, LEDs and AND Logic configuration

2.3.12.2.1 Relay Output Configuration

Relay outputs can be assigned by selecting any function available in the submenus. There are in all 6 numbers of output Relays identified as RL1 to RL6.

2.3.12.2.2 LED Green Configuration

LED G (Green) can be assigned by selecting any function available in the submenus. There are in all 4 numbers of LEDs identified as L5 to L8.

2.3.12.2.3 LED Red Configuration

LED R (Red) can be assigned by selecting any function available in the submenus. There are in all 4 numbers of LEDs identified as L5 to L8.

2.3.12.2.4 AND Logic

AND Logic can be assigned by selecting any function available in the submenus. There are in all 4 numbers of AND Logic with identifier as A, B, C & D.

The functions assigned to Relay, LED G, LED R and AND Logic are listed in **Chapter 8: Monitoring and Control**.

2.3.13 O/P Relay Configuration Menu

2.3.13.1 View/Edit Settings

O/P RELAY CONFIG	Password protected window for "O/P RELAY CONFIGURATION" settings: Contact HR/SR, O/P-1 Open Time, O/P-2 Open Time, O/P-3 Open Time, O/P-4 Open Time, O/P-5 Open Time and O/P-6 Open Time, LED G HR/SR, LED R HR/SR, ANDEQ A Op Time, ANDEQ Rst Time, ANDEQ B Op Time, ANDEQ B Rst Time, ANDEQ C Op Time, ANDEQ C Rst Time, ANDEQ D Op Time and ANDEQ D Rst Time.
Contact HR/SR 000000	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired Contact HR/SR can be set as '1'=HR / '0'=SR.
O/P-1 Open Time 0.50 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired O/P-1 Open Time can be set. The setting range is from 0 to 1s in steps of 0.01s
O/P-2 Open Time 0.50 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired O/P-2 Open Time can be set. The setting range is from 0 to 1s in steps of 0.01s
O/P-3 Open Time 0.50 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired O/P-3 Open Time can be set. The setting range is from 0 to 1s in steps of 0.01s
O/P-4 Open Time 0.50 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired O/P-4 Open Time can be set. The setting range is from 0 to 1s in steps of 0.01s

O/P-5 Open Time 0.50 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired O/P-5 Open Time can be set. The setting range is from 0 to 1s in steps of 0.01s
O/P-6 Open Time 0.50 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired O/P-6 Open Time can be set. The setting range is from 0 to 1s in steps of 0.01s
LED G HR/SR 0000	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired LED GREEN HR/SR can be set. i.e. '1'=HR / '0'=SR.
LED R HR/SR 0000	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired LED RED HR/SR can be set. i.e. '1'=HR / '0'=SR.
ANDEQ A Op Time 1 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired AND Equation A Operation Time can be set. The setting range is from 1 to 3600s in steps of 1s.
ANDEQ A Rst Time 1 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired AND Equation A Reset Time can be set. The setting range is from 1 to 3600s in steps of 1s.
ANDEQ B Op Time 1 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired AND Equation B Operation Time can be set. The setting range is from 1 to 3600s in steps of 1s.
ANDEQ B Rst Time 1 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired AND Equation B Reset Time can be set. The setting range is from 1 to 3600s in steps of 1s.
ANDEQ C Op Time 1 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired AND Equation C Operation Time can be set. The setting range is from 1 to 3600s in steps of 1s.
ANDEQ C Rst Time 1 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired AND Equation C Reset Time can be set. The setting range is from 1 to 3600s in steps of 1s.

ANDEQ D Op Time 1 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired AND Equation D Operation Time can be set. The setting range is from 1 to 3600s in steps of 1s.
ANDEQ D Rst Time 1 S	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired AND Equation D Reset Time can be set. The setting range is from 1 to 3600s in steps of 1s.

2.3.14 Disturbance Record Menu

2.3.14.1 View/Edit Settings

DISTURBANCE REC	Password protected window for “ Disturbance Record ” settings: Trigger Position
Trigger Position 50%	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired Trigger Position can be set. The setting range is from 10% to 90% in steps of 1.

2.3.15 Commissioning Test Menu

2.3.15.1 View/Edit Settings

COMMISSION. TEST	Password protected window for “ Commissioning Test ” settings: Test Mode, Test Pattern, Contact Test and Test LEDs.
Test Mode Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Test Mode be set as Disabled/Test Mode/Contacts Blocked.
Test Pattern 000000	Editable setting By using the (+ / ▲) or (- / ▼) key, Test Pattern can be set. Setting '1' means that output relay contact will be tested when the Contact Test cell is set to Apply Test. Setting '0' means that output relay contact will not be tested when the Contact Test cell is set to Apply Test. Eg: Setting 100010 will operate RL6 & RL2 during Contact test
Contact Test No Operation	Editable setting By using the (+ / ▲) or (- / ▼) key, Contact Test can be set for No Operation / Apply Test / Remove Test

Test LEDs No Operation	Editable setting By using the (+ / ▲) or (- / ▼) key, Test LEDs can be set for No Operation / Apply Test.
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2.3.16 Group 1 Menu

2.3.16.1 Edit Settings

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
SYSTEM CONFIG	Password protected window for System Configuration i.e. 2nd Harmonic (Disabled/Enabled), 2ndHarm Thresh and I>lift 2H. <i>Note: Setting will be seen only when it is enabled in Configuration</i>
OVERCURRENT	Password protected window for Overcurrent i.e. I>1 Function, I>2 Function and I>3 Function. The functions can be set as Disabled / DT / IDMT. <i>Note: Setting will be seen only when it is enabled in Configuration</i>
NEG SEQUENCE O/C	Password protected window for Negative Sequence O/C i.e. I2>1 Function, I2>2 Function and I2>3 Function. The functions can be set as Disabled / DT / IDMT. <i>Note: Setting will be seen only when it is enabled in Configuration setting.</i>
BROKEN CONDUCTOR	Password protected window for Broken Conductor i.e. BC Alarm (Enable/Disabled), I2/I1 Setting - 1 and I2/I1 Time Dly - 1, BC Trip (Enable/Disabled), I2/I1 Setting - 2 and I2/I1 Time Dly - 2.
EARTH FAULT 1	Password protected window for Earth Fault 1 (measured) i.e. IN1>1 Function, IN1>2 Function and IN1>3 Function. The functions can be set as Disabled / DT / IDMT. <i>Note: Setting will be seen only when it is enabled in Configuration setting.</i>
EARTH FAULT 2	Password protected window for Earth Fault 2 (derived) i.e. IN2>1 Function, IN2>2 Function and IN2>3 Function. The functions can be set as Disabled / DT / IDMT. <i>Note: Setting will be seen only when it is enabled in Configuration setting.</i>
THERMAL OVERLOAD	Password protected window for Thermal Overload i.e. Characteristic (Disabled/Single), Thermal Trip, Thermal Alarm, Time Constant 1 and K. <i>Note: Setting will be seen only when it is enabled in Configuration setting.</i>

COLD LOAD PICKUP	Password protected window for Cold Load Pickup i.e. tcold Time Delay, tclp Time Delay, I>1 Status, I>2 Status, I>3 Status, IN1>1 Status, IN1>2 Status, IN1>3 Status, IN2>1 Status, IN2>2 Status and IN2>3 Status. <i>Note: Setting will be seen only when it is enabled in Configuration setting.</i>
UNDERCURRENT	Password protected window for Undercurrent i.e. I< Status, I< and tI<. <i>Note: Setting will be seen only when it is enabled in Configuration setting.</i>
CB FAIL	Password protected window for CB FAIL i.e. CB Fail Status, CB Fail Timer, CB Reset, I<, IN<, Remove I> Start and Remove IN> Start. <i>Note: Setting will be seen only when it is enabled in Configuration setting.</i>

2.3.16.2 Group1 –System Configuration Submenu

2.3.16.2.1 Edit Settings (if 2nd harmonic is disabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting..</i>
SYSTEM CONFIG	Password protected window for System Configuration i.e. 2nd Harmonic (Disabled/Enabled), 2ndHarm Thresh and I>lift 2H.
2nd Harmonic Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, 2nd Harmonic is Disabled.

2.3.16.2.2 Edit Settings (if 2nd harmonic is enabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
SYSTEM CONFIG	Password protected window for System Configuration i.e. 2nd Harmonic (Disabled/Enabled), 2ndHarm Thresh and I>lift 2H.
2nd Harmonic Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, 2nd Harmonic is Enabled.

2nd Harm Thresh 20%	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired 2ndHarm Thresh can be set. The setting range is 5% to 70% in steps of 1%.
I>lift 2H 10.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired I>lift 2H setting can be done. The setting range is 4.00 to 32.00 In in steps of 0.01 In.

2.3.16.3 Group1 –Overcurrent Submenu

2.3.16.3.1 Edit Settings (if I>1 Function, I>2 Function and I>3 Function are disabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
OVERCURRENT	Password protected window for Overcurrent i.e. I>1 Function, I>2 Function and I>3 Function setting to Disabled / DT/ IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
I>1Function Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1Function can be Disabled
I>2Function Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>2Function can be Disabled
I>3Function Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>3Function can be Disabled

2.3.16.3.2 Edit Settings (if I>1 Function is selected for IEC curve)

GROUP 1	Password protected window for “ GROUP 1 ” setting: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
OVERCURRENT	Password protected window for Overcurrent i.e. I>1 Function, I>2 Function and I>3 Function setting to Disabled / DT/ IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse

I>1 Function IEC S Inverse	Editable Setting By using the (+ / ▲) or (- / ▼) key, I>1Function is set as IEC S Inverse.
I>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Current Setting can be set. The setting range is from 0.05 to 4.00 In in steps of 0.01 In.
I>1 TMS 1.000	Editable setting By using (+ / ▲) or (- / ▼) key, I>1 TMS can be set. The setting range is from 0.025 to 1.2 in steps of 0.005.
I>1 Reset Char DT	Read-only setting I>1 Reset Char is fixed as DT (Definite Time).
I>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.
I>1 2H Blocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>12H Blocking function can be Enabled / Disabled.

2.3.16.3.3 Edit Settings (if I>1 Function is selected for IEEE / US curve)

GROUP 1	Password protected window for “ GROUP 1 ” setting : SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
OVERCURRENT	Password protected window for Overcurrent i.e. I>1 Function, I>2 Function and I>3 Function setting to Disabled / DT/ IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
I>1 Function IEEE M Inverse	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1Function is set as IEEE M Inverse.

I>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Current Setting can be set. The setting range is from 0.05 to 4 In in steps of 0.01 In.
I>1 Time Dial 1.00	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Time Dial can be set. The setting range is from 00.01 to 100.00 in steps of 0.01.
I>1 Reset Char DT	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Reset Char can be set as IDMT / DT (Definite Time).
I>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.
I>1 RTMS 1.000	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 RTMS can be set. The setting range is from 0.025 to 1.200 in steps of 0.005 Note: Above setting available if I>1 Reset Char is set as IDMT
I>1 2H Blocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>12H Blocking function can be Enabled / Disabled.

2.3.16.3.4 Edit Settings (if I>1 Function is selected for DT)

GROUP 1	Password protected window for “ GROUP 1 ” setting: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
OVERCURRENT	Password protected window for Overcurrent i.e. I>1 Function, I>2 Function and I>3 Function setting to Disabled / DT/ IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
I>1 Function DT	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1Function is set as DT.
I>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, the desired I>1 Current Setting can be done. The setting range is from 0.05 to 35.0 In in steps of 0.01 In. Note: For I>3 Function. the setting range is from 1.0 - 35.0 In in steps of 0.01 In.

I>1 Time Delay 01.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Time Delay can be set. The setting range is from 0 to 100s in steps of 0.01s.
I>1 Reset Char DT	Read-only I>1 Reset Char is fixed as DT (Definite Time).
I>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.
I>1 2H Blocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 2H Blocking function can be Enabled / Disabled.

Note: The settings of I>2 Function and I>3 Function should be done in a similar manner as I>1 Function.

2.3.16.4 Group1 –Negative Sequence Overcurrent Submenu

2.3.16.4.1 Edit Settings (if I2>1 Function, I2>2 Function and I2>3 Function are disabled)

GROUP 1	Password protected window for “ GROUP 1 ” setting: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
NEG SEQUENCE O/C	By using the (+ / ▲) or (- / ▼) key, select the NEGATIVE SEQUENCE O/C setting menu in Group 1. Password protected window for NEGATIVE SEQUENCE O/C settings : I2>1 Function, I2>2 Function and I2>3 Function can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
I2>1Function Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 Function is Disabled.
I2>2Function Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>2 Function is Disabled.

I2>3Function Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>3 Function is Disabled.
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2.3.16.4.2 Edit Settings (if I2>1 Function is selected for IEC curve)

GROUP 1	Password protected window for “ GROUP 1 ” setting: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
NEG SEQUENCE O/C	Password protected window for NEGATIVE SEQUENCE O/C settings : I2>1 Function, I2>2 Function and I2>3 Function can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
I2>1 Function IEC S Inverse	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 Function is set as IEC S Inverse.
I2>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 Current Setting can be set. The setting range is from 0.10 to 4.00 In in steps of 0.01.
I2>1 TMS 1.000	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 TMS can be set. The setting range is from 0.025 to 1.200 in steps of 0.005.
I2>1 Reset Char DT	Read-only The I2>1 Reset Char is fixed as DT (Definite Time).
I2>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.
I2>1 2HBlocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>12HBlocking function can be Enabled / Disabled.

2.3.16.4.3 Edit Settings (if I2>1 Function is selected for IEEE / US curve)

GROUP 1	Password protected window for “GROUP 1” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
NEG SEQUENCE O/C	Password protected window for NEGATIVE SEQUENCE O/C settings : I2>1 Function, I2>2 Function and I2>3 Function can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
I2>1 Function IEEE M Inverse	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 Function is set as IEEE M Inverse.
I2>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 Current Setting can be set. The setting range is from 0.10 to 4.00 In in steps of 0.01 In.
I2>1 Time Dial 1.00	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 Time Dial can be set. The setting range is from 0.01 to 100.00 in steps of 0.01.
I2>1 Reset Char DT	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 Reset Char can be set as IDMT / DT.
I2>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.
I2>1 RTMS 1.000	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 RTMS can be set. The setting range is from 0.025 to 1.200 in steps of 0.005 Note: Above setting available if I2>1 Reset Char is set as IDMT
I2>1 2H Blocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>12H Blocking function can be Enabled / Disabled.

2.3.16.4.4 Edit Settings (if I2>1 Function is selected for DT)

GROUP 1	Password protected window for “GROUP 1” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
NEG SEQUENCE O/C	Password protected window for NEGATIVE SEQUENCE O/C settings : I2>1 Function, I2>2 Function and I2>3 Function can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
I2>1 Function DT	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1Function is set as DT (Definite Time).
I2>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 Current Setting can be set. The setting range is from 0.10 to 35.0 In in steps of 0.01 In. <i>Note: For I2>3 Function, the setting range is from 1.0 - 35.0 In in steps of 0.01 In</i>
I2>1 Time Delay 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 Time Delay can be set. The setting range is from 0 to 200s in steps of 0.01s.
I2>1 Reset Char DT	Read-only I2>1 Reset Char is fixed as DT (Definite Time).
I2>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.
I2>1 2H Blocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I2>12H Blocking function can be Enabled / Disabled.

Note: The settings of I2>2 Function and I2>3 Function should be done in a similar manner as I2>1 Function

2.3.16.5 Group1 –Broken Conductor Submenu

2.3.16.5.1 Edit Settings (if function is disabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
BROKEN CONDUCTOR	Password protected window for Broken Conductor i.e. BC Alarm (Enable/Disabled), I2/I1 Setting - 1 and I2/I1 Time Dly – 1, BC Trip (Enable/Disabled), I2/I1 Setting - 2 and I2/I1 Time Dly - 2.
BC Alarm Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, BC Alarm is Disabled.
BC Trip Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, BC Trip is Disabled.

2.3.16.5.2 Edit Settings (if function is enabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
BROKEN CONDUCTOR	Password protected window for Broken Conductor i.e. BC Alarm (Enable/Disabled), I2/I1 Setting - 1 and I2/I1 Time Dly – 1, BC Trip (Enable/Disabled), I2/I1 Setting - 2 and I2/I1 Time Dly - 2.
BC Alarm Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, BC Alarm is Enabled.
I2/I1Set-1 0.50	Editable setting By using the (+ / ▲) or (- / ▼) key, I2/I1 Set-1 can be set. The setting range is from 0.20 to 1.00 in steps of 0.01

I2/I1 Time Dly-1 10.00S	Editable setting By using the (+ / ▲) or (- / ▼) key, I2/I1 Time Dly-1 can be set. The setting range is from 0 to 100s in steps of 0.01s.
BC Trip Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, BC Trip is Enabled.
I2/I1Set-2 0.50	Editable setting By using the (+ / ▲) or (- / ▼) key, I2/I1 Set-2 can be set. The setting range is from 0.20 to 1.00 in steps of 0.01
I2/I1 Time Dly-2 10.00S	Editable setting By using the (+ / ▲) or (- / ▼) key, I2/I1 Time Dly-2 can be set. The setting range is from 0 to 100s in steps of 0.01s.

2.3.16.6 Group 1 – Earth Fault 1 Submenu

2.3.16.6.1 Edit Settings (if IN1>1 Function, IN1>2 Function and IN1>3 Function are disabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
EARTH FAULT 1	Password protected window for Earth Fault 1 (measured) i.e. IN1>1 Function, IN1>2 Function and IN1>3 Function can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
Measured	Read-only Description for Earth Fault 1
IN1>1Function Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 Function is Disabled.
IN1>2Function Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>2 Function is Disabled.

IN1>3Function Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>3 Function is Disabled.

2.3.16.6.2 Edit Settings (if IN1>1 Function is selected for IEC curve)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
EARTH FAULT 1	Password protected window for Earth Fault 1 (measured) i.e. IN1>1 Function, IN1>2 Function and IN1>3 Function which can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
Measured	Read-only Description for Earth Fault 1
IN1>1 Function IEC S Inverse	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1Function is set as IEC S Inverse.
IN1>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 Current Setting can be set. The setting range is from 0.05 to 4 In in steps of 0.01 In. <i>NOTE: For SEF (Ordering option) setting range is 0.002 to 0.200 In in step of 0.001 In.</i>
IN1>1 TMS 1.000	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 TMS can be set. The setting range is from 0.025 to 1.200 in steps of 0.005.
IN1>1 Reset Char DT	Read-only IN1>1 Reset Char is fixed as DT (Definite Time).
IN1>1 tRESET 01.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.

IN1>1 2HBlocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 2HBlocking function can be Enabled / Disabled.
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2.3.16.6.3 Edit Settings (if IN1>1 Function is selected for IEEE / US curve)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
EARTH FAULT 1	Password protected window for Earth Fault 1 (measured) i.e. IN1>1 Function, IN1>2 Function and IN1>3 Function which can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
Measured	Read-only Description for Earth Fault 1
IN1>1 Function IEEE M Inverse	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1Function is set as IEEE M Inverse.
IN1>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 Current Setting can be set. The setting range is from 0.05 to 4 In in steps of 0.01 In. <i>NOTE: For SEF (Ordering option) setting range is 0.002 to 0.200 In in step of 0.001In</i>
IN1>1 Time Dial 1.00	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 Time Dial can be set. The setting range is from 0.01 to 100.00 in steps of 0.01.
IN1>1 Reset Char DT	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 Reset Char can be set as IDMT / DT.
IN1>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.

IN1>1 RTMS 1.000	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 RTMS can be set. The setting range is from 0.025 to 1.200 in steps of 0.005 Note: Above setting is available if IN1>1 Reset Char is set as IDMT
IN1>1 2HBlocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 2HBlocking function can be Enabled / Disabled.

2.3.16.6.4 Edit Settings (if IN1>1 Function is selected for DT)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
EARTH FAULT 1	Password protected window for Earth Fault 1 (measured) i.e. IN1>1 Function, IN1>2 Function and IN1>3 Function which can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse
Measured	Read-only Description for Earth Fault 1
IN1>1 Function DT	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1Function is set as DT.
IN1>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 Current Setting can be set. The setting range is from 0.05 to 35.0 In in steps of 0.01 In. Note: For I>3 Function, the setting range is from 1.0 - 35.0 In in steps of 0.01In. <i>For SEF (Ordering option) setting range is 0.002 to 0.200 In in steps of 0.001In for IN1>1 and IN1>2 and 0.002 to 2.000 In in step of 0.001 In for IN1>3</i>
IN1>1 Time Delay 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 Time Delay can be set. The setting range is from 0 to 200s in steps of 0.01s.
IN1>1 Reset Char DT	Read-only IN1>1 Reset Char is fixed as DT (Definite Time).

IN1>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.
IN1>1 2HBlocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 2HBlocking function can be Enabled / Disabled.

Note: The settings of IN1>2 Function and IN1>3 Function to be set in similar manner as that of IN1>1 Function.

2.3.16.7 Group1 – Earth Fault 2 Submenu

2.3.16.7.1 Edit Settings (if IN2>1 Function, IN2>2 Function and IN2>3 Function are disabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
EARTH FAULT 2	Password protected window for Earth Fault 2 (derived) i.e. IN2>1 Function, IN2>2 Function and IN2>3 Function which can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse.
Derived	<i>Read-only</i> Description for Earth Fault 2
IN2>1Function Disabled	<i>Editable setting</i> By using the (+ / ▲) or (- / ▼) key, IN2>1 Function is Disabled.
IN2>2Function Disabled	<i>Editable setting</i> By using the (+ / ▲) or (- / ▼) key, IN2>2 Function is Disabled.
IN2>3Function Disabled	<i>Editable setting</i> By using the (+ / ▲) or (- / ▼) key, IN2>3 Function is Disabled.

2.3.16.7.2 Edit Settings (if IN2>1 Function is selected for IEC curve)

GROUP 1	Password protected window for “GROUP 1” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
EARTH FAULT 2	Password protected window for Earth Fault 2 (derived) i.e. IN2>1 Function, IN2>2 Function and IN2>3 Function which can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse.
Derived	Read-only Description for Earth Fault 2
IN2>1 Function IEC S Inverse	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1Function is set as IEC V Inverse.
IN2>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 Current Setting can be set. The setting range is from 0.05 to 4 In in steps of 0.01 In.
IN2>1 TMS 1.000	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 TMS can be set. The setting range is from 0.025 to 1.200 in steps of 0.005.
IN2>1 Reset Char DT	Read-only IN2>1 Reset Char is fixed as DT (Definite Time).
IN2>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.
IN2>1 2HBlocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 2HBlocking function can be Enabled / Disabled.

2.3.16.7.3 Edit Settings (if IN2>1 Function is selected for IEEE / US curve)

GROUP 1	Password protected window for “GROUP 1” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
EARTH FAULT 2	Password protected window for Earth Fault 2 (derived) i.e. IN2>1 Function, IN2>2 Function and IN2>3 Function which can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse /US ST Inverse.
Derived	Read-only Description for Earth Fault 2
IN2>1 Function IEEE M Inverse	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 Function is set as IEEE M Inverse.
IN2>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 Current Setting can be set. The setting range is from 0.05 to 4 In in steps of 0.01In.
IN2>1 Time Dial 1.00	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 Time Dial can be set. The setting range is from 0 to 200 in steps of 0.01.
IN2>1 Reset Char DT	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 Reset Char can be set as IDMT / DT.
IN2>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.
IN2>1 RTMS 1.000	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 RTMS can be set. The setting range is from 0.025 to 1.200 in steps of 0.005 Note: Above setting is available if IN2>1 Reset Char is set as IDMT

IN2>1 2HBlocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 2HBlocking function can be Enabled / Disabled.
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2.3.16.7.4 Edit Settings (if IN2>1 Function is selected for DT)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
EARTH FAULT 2	Password protected window for Earth Fault 2 (derived) i.e. IN2>1 Function, IN2>2 Function and IN2>3 Function which can be set as Disabled / DT / IEC S Inverse/ S Inverse (1.3Sec)/ IEC V Inverse/ IEC E Inverse/ UK LT Inverse /IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse /US Inverse
Derived	Read-only Description for Earth Fault 2
IN2>1 Function DT	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1Function is set as DT.
IN2>1 Current Set 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 Current Setting can be set. The setting range is from 0.1 to 35.0 In in steps of 0.01In. Note: For I>3 Function. the setting range is from 1.0 to 35.0 In in steps of 0.01In
IN2>1 Time Delay 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 Time Delay can be set. The setting range is from 0 to 200s in steps of 0.01s.
IN2>1 Reset Char DT	Read-only IN2>1 Reset Char is fixed as DT (Definite Time).
IN2>1 tRESET 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 tRESET can be set. The setting range is from 0 to 100s in steps of 0.01s.

IN2>1 2H Blocking Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 2H Blocking function can be Enabled / Disabled.
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Note: The settings of IN2>2 Function and IN2>3 Function to be done in similar manner as that of IN2>1 Function.

2.3.16.8 Group1 –Thermal Overload Submenu

2.3.16.8.1 Edit Settings (if Thermal overload Characteristic is disabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
THERMAL OVERLOAD	Password protected window for Thermal Overload i.e. Characteristic (Disabled/Single), Thermal Trip, Thermal Alarm, Time Constant 1 and K.
Characteristic Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Characteristic is set as Disabled

2.3.16.8.2 Edit Settings (if Thermal overload Characteristic is set as Single)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
THERMAL OVERLOAD	Password protected window for Thermal Overload i.e. Characteristic (Disabled/Single), Thermal Trip, Thermal Alarm, Time Constant 1 and K.
Characteristic Single	Editable setting By using the (+ / ▲) or (- / ▼) key, Characteristic is set as Single
Thermal Trip 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, Thermal Trip can be set. The setting range is from 0.05 to 4.00 In in steps of 0.01 In.

Thermal Alarm 70%	Editable setting By using the (+ / ▲) or (- / ▼) key, Thermal Alarm can be set. The setting range is from 50% to 100% in steps of 1%.
Time Constant 1 10	Editable setting By using the (+ / ▲) or (- / ▼) key, Time Constant 1 can be set. The setting range is from 1 to 200 in steps of 1.
K 1.05	Editable setting By using the (+ / ▲) or (- / ▼) key, K Constant can be set. The setting range is from 1 to 1.5 in steps of 0.01.

2.3.16.9 Group1 – Cold Load Pickup Submenu

2.3.16.9.1 Edit Settings

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting..</i>
COLD LOAD PKP	Password protected window for Cold Load Pickup i.e. tcold Time Delay, tcpl Time Delay, I>1 Status, I>2 Status, I>3 Status, IN1>1 Status, IN1>2 Status, IN1>3 Status, IN2>1 Status, IN2>2 Status and IN2>3 Status.
tcold Time Delay 7200 S	Editable setting By using the (+ / ▲) or (- / ▼) key, tcold Time Delay can be set. The setting range is from 0 to 14400s in steps of 1s.
tcpl Time Delay 7200 S	Editable setting By using the (+ / ▲) or (- / ▼) key, tcpl Time Delay can be set. The setting range is from 0 to 14400s in steps of 1s.
I>1 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Status can be Enabled / Blocked.
I>2 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>2 Status can be Enabled / Blocked.

I>3 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>3 Status can be Enabled / Blocked.
IN1>1 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN1>1 Status can be Enabled / Blocked.
IN1>2 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>2 Status can be Enabled / Blocked.
IN1>3 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>3 Status can be Enabled / Blocked.
IN2>1 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>1 Status can be Enabled / Blocked.
IN2>2 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, IN2>2 Status can be set as Enabled / Blocked.
IN2>3 Status Enabled	Editable setting By using (+ / ▲) or (- / ▼) key, IN2>3 Status can be Enabled / Blocked.

2.3.16.9.2 Edit Settings (If I>1 Function selected for IEC curve)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. Note: Group 1 Setting will be seen only when it is enabled and set as Active Group in Configuration setting.
COLD LOAD PKP	Password protected window for Cold Load Pickup i.e. tcold Time Delay, tclp Time Delay, I>1 Status, I>2 Status, I>3 Status, IN1>1 Status, IN1>2 Status, IN1>3 Status, IN2>1 Status, IN2>2 Status and IN2>3 Status.
tcold Time Delay 7200 S	Editable setting By using the (+ / ▲) or (- / ▼) key, tcold Time Delay can be set. The setting range is from 0 to 14400s in steps of 1s.
tclp Time Delay 7200 S	Editable setting By using the (+ / ▲) or (- / ▼) key, tclp Time Delay can be set. The setting range is from 0 to 14400 in steps of 1.
I>1 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, desired I>1 Status is Enabled.
I>1 Current Set 1.50 A	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Current Set can be set. The setting range is from 0.05 to 4.00 In in steps of 0.01 In.
I>1 TMS 1.1	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 TMS can be set. The setting range is from 0.025 to 1.2 in steps of 0.005

2.3.16.9.3 Edit Settings (If I>1 Function selected for IEEE / US curve)

GROUP 1	Password protected window for “GROUP 1” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. Note: Group 1 Setting will be seen only when it is enabled and set as Active Group in Configuration setting.
COLD LOAD PKP	Password protected window for Cold Load Pickup i.e. tcold Time Delay, tcpl Time Delay, I>1 Status, I>2 Status, I>3 Status, IN1>1 Status, IN1>2 Status, IN1>3 Status, IN2>1 Status, IN2>2 Status and IN2>3 Status.
tcold Time Delay 7200 S	Editable setting By using the (+ / ▲) or (- / ▼) key, tcold Time Delay can be set. The setting range is from 0 to 14400s in steps of 1s.
tcpl Time Delay 7200 S	Editable setting By using the (+ / ▲) or (- / ▼) key, tcpl Time Delay can be set. The setting range is from 0 to 14400 in steps of 1.
I>1 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Status is Enabled.
I>1 Current Set 1.50 A	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Current Set can be set. The setting range is from 0.05 to 4.00 In in steps of 0.01 In.
I>1 Time Dial 1.00	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Time Dial can be set. The setting range is from 0.01 to 100 in steps of 0.01

Note : The settings of I>2 Status, I>3 Status, IN1>1 Status, IN1>2 Status, IN1>3 Status, IN2>1 Status, IN2>2 Status, IN2>3 Status can be set in similar manner as that of I>1 Status.

2.3.16.9.4 Edit Settings (If I>1 Function if selected for DT)

GROUP 1	Password protected window for “GROUP 1” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.
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COLD LOAD PKP	Password protected window for Cold Load Pickup i.e. tcold Time Delay, tcpl Time Delay, I>1 Status, I>2 Status, I>3 Status, IN1>1 Status, IN1>2 Status, IN1>3 Status, IN2>1 Status, IN2>2 Status and IN2>3 Status.
tcold Time Delay 7200 S	Editable setting By using the (+ / ▲) or (- / ▼) key, tcold Time Delay can be set. The setting range is from 0 to 14400s in steps of 1s.
tcpl Time Delay 7200 S	Editable setting By using the (+ / ▲) or (- / ▼) key, tcpl Time Delay can be set. The setting range is from 0 to 14400s in steps of 1s.
I>1 Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Status can be Enabled / Blocked.
I>1 Current Set 1.50 A	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Current Set can be set. The setting range is from 0.05 to 4.00 In in steps of 0.01 In.
I>1 Time Delay 0.01 S	Editable setting By using the (+ / ▲) or (- / ▼) key, I>1 Time Delay can be set. The setting range is from 0 to 100s in steps of 0.01s.

NoteE: The settings of I>2 Status, I>3 Status, IN1>1 Status, IN1>2 Status, IN1>3 Status, IN2>1 Status, IN2>2 Status, IN2>3 Status can be set in a similar manner as that of I>1 Status.

2.3.16.10 Group1 –Undercurrent Submenu

2.3.16.10.1 Edit Settings (If I< Status is disabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
UNDERCURRENT	Password protected window for Undercurrent i.e. I< Status, I< and tI<.

I< Status Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I< Status can be Enabled / Disabled.
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2.3.16.10.2 Edit Settings (If I< Status is enabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
UNDERCURRENT	Password protected window for Undercurrent i.e. I< Status, I< and tI<.
I< Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, I< Status is Enabled.
I< 1.00 A	Editable setting By using the (+ / ▲) or (- / ▼) key, I< settings can be set. The setting range is from 0.1 to 1 In in steps of 0.01 In.
t I< 1.00 S	Editable setting By using the (+ / ▲) or (- / ▼) key, t I< setting can be set. The setting range is from 0.2 to 100s in steps of 0.01s

2.3.16.11 Group 1 – CB Fail Submenu

2.3.16.11.1 Edit Settings (If CB Fail Status is disabled)

GROUP 1	Password protected window for “ GROUP 1 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
CB FAIL	Password protected window for CB FAIL i.e. CB Fail Status, CB Fail Timer, CB Reset, I<, IN<, Remove I> Start and Remove IN> Start.
CB Fail Status Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Fail Status can be Enabled / Disabled

I< 1.00 A	By using the (+ / ▲) or (- / ▼) key, I< can be set. The setting range is from 0.05 to 3.2 In in steps of 0.01 In
IN< 1.00 A	By using the (+ / ▲) or (- / ▼) key, IN< can be set. The setting range is from 0.05 to 3.2 In in steps of 0.01 In
Remove I> Start Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Remove I> Start can be Enabled / Disabled
Remove IN> Start Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Remove IN> Start can be Enabled / Disabled

2.3.16.11.2 Edit Settings (If CB Fail Status is enabled)

GROUP 1	Password protected window for “ GROUP 1 ” setting i.e. SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 1 Setting will be seen only when it is enabled in Configuration setting.</i>
CB FAIL	Password protected window for CB FAIL i.e. CB Fail Status, CB Fail Timer, CB Reset, I<, IN<, Remove I> Start and Remove IN> Start.
CB Fail Status Enabled	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Fail Status is Enabled.
CB Fail Timer 0.10 S	Editable setting By using the (+ / ▲) or (- / ▼) key, CB Fail Timer can be set. The setting range is from 0 to 50s in steps of 0.01s.
CBF Reset CB Open+ I<	By using the (+ / ▲) or (- / ▼) key, CBF Reset can be set as CB Open + I<, Prot Reset + I<, CB Open, I<

I< 1.00 A	By using the (+ / ▲) or (- / ▼) key, I< can be set. The setting range is from 0.05 to 3.2 In in steps of 0.01In
IN< 1.00 A	By using the (+ / ▲) or (- / ▼) key, IN< can be set. The setting range is from 0.05 to 3.2 In in steps of 0.01In
Remove I> Start Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Remove I> Start can be Enabled / Disabled
Remove IN> Start Disabled	Editable setting By using the (+ / ▲) or (- / ▼) key, Remove IN> Start can be Enabled / Disabled

2.3.17 Group 2 Menu

2.3.17.1 Edit Settings

GROUP 2	Password protected window for “ GROUP 2 ” settings: SYSTEM CONFIG, OVERCURRENT, NEG SEQUENCE O/C, BROKEN CONDUCTOR, EARTH FAULT 1, EARTH FAULT 2, THERMAL OVERLOAD, COLD LOAD PICKUP, UNDERCURRENT and CB FAIL. <i>Note: Group 2 Setting will be seen only when it is enabled in Configuration setting.</i>
SYSTEM CONFIG	Password protected window for System Configuration i.e. 2nd Harmonic Disabled/Enabled, 2ndHarm Thresh and I>lift 2H.
OVERCURRENT	Password protected window for Overcurrent i.e. I>1 Function, I>2 Function and I>3 Function. The functions can be set as Disabled / DT / IDMT.
NEG SEQUENCE O/C	Password protected window for Negative Sequence O/C i.e. I2>1 Function, I2>2 Function and I2>3 Function. The functions can be set as Disabled / DT / IDMT.
BROKEN CONDUCTOR	Password protected window for Broken Conductor i.e. BC Alarm (Enable/Disabled), I2/I1 Setting - 1 and I2/I1 Time Dly – 1, BC Trip (Enable/Disabled), I2/I1 Setting - 2 and I2/I1 Time Dly - 2.

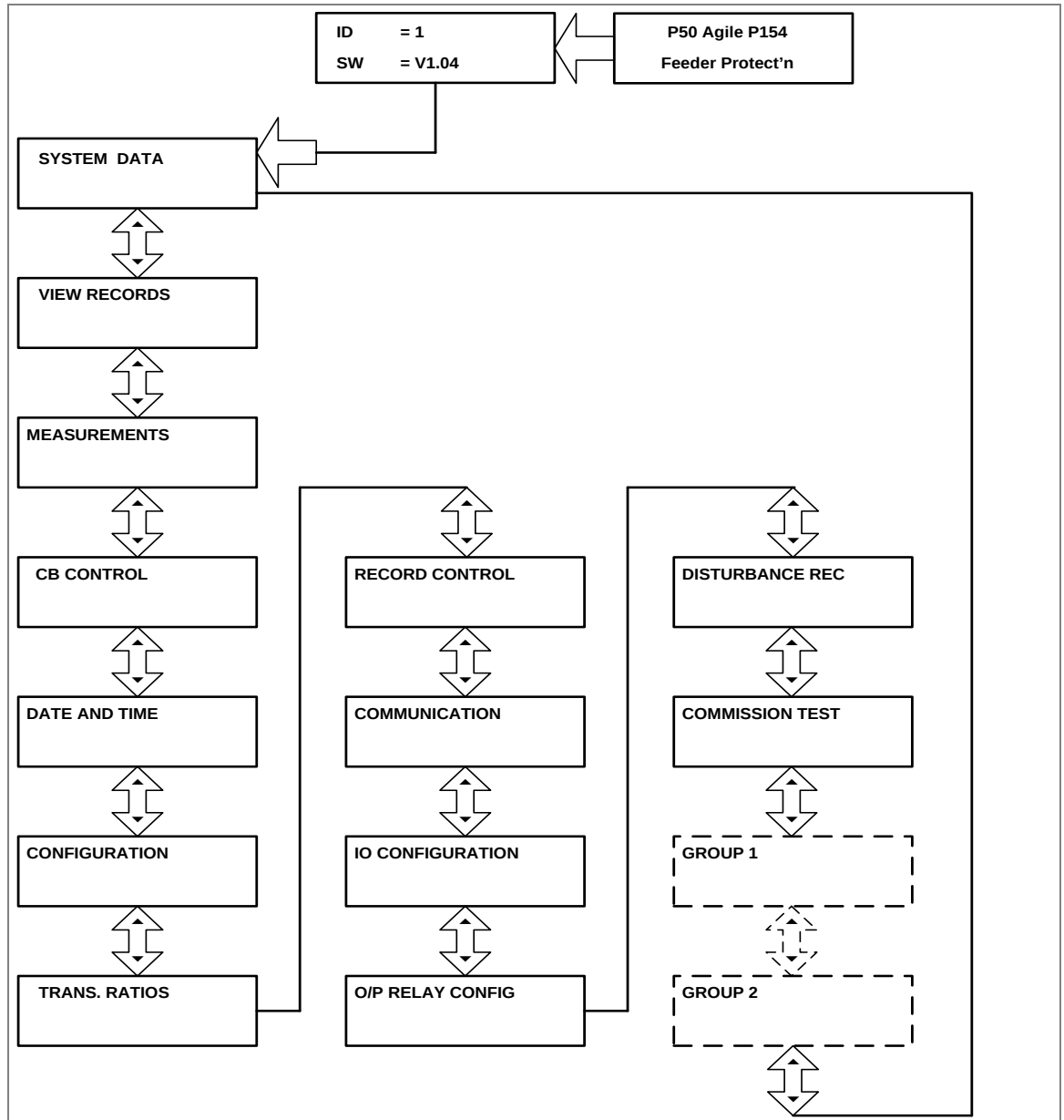
EARTH FAULT 1	Password protected window for Earth Fault 1 i.e. IN1>1 Function, IN1>2 Function and IN1>3 Function. The functions can be set as Disabled / DT / IDMT.
EARTH FAULT 2	Password protected window for Earth Fault 2 i.e. IN2>1 Function, IN2>2 Function and IN2>3 Function. The functions can be set as Disabled / DT / IDMT.
THERMAL OVERLOAD	Password protected window for Thermal Overload i.e. Characteristic (Disabled/Single), Thermal Trip, Thermal Alarm, Time Constant 1 and K.
COLD LOAD PICKUP	Password protected window for Cold Load Pickup i.e. tcold Time Delay, tcip Time Delay, I>1 Status, I>2 Status, I>3 Status, IN1>1 Status, IN1>2 Status, IN1>3 Status, IN2>1 Status, IN2>2 Status and IN2>3 Status
UNDERCURRENT	Password protected window for Undercurrent i.e. I< Status, I< and tI<.
CB FAIL	Password protected window for CB FAIL i.e. CB Fail Status, CB Fail Timer, CB Reset, I<, IN<, Remove I> Start and Remove IN> Start.

Note: The Group 2 settings for System Configuration, Over Current, Negative Sequence O/C, Broken Conductor, Earth Fault – 1, Earth Fault – 2, Thermal Overload, Cold Load Pkp Under Current Protection and CB Fail settings are similar to Group 1.

2.4 Configuration Flowcharts

2.4.1 Main Menu

After the Power ON or when the relay is reset the following windows will be displayed, and the user can scroll through the main menu as below.



2.4.2 View and Edit Settings

Press the Right arrow key (►) to enter the setting menu.

By using the Plus / Up arrow key (+ / ▲) or the Minus / Down arrow key (- / ▼) select the desired setting.

This window shows the set system Frequency.

To change the System Frequency press the EDIT Key.

As soon as the Edit Key is pressed the relay will ask for Password.

By using the Plus / Up arrow key (+ / ▲) or the Minus / Down arrow key (- / ▼) enter the set Password i.e. four (4) digits alpha numeric.

Press the EDIT Key

The display will show password OK message, and display the next option.

The Alpha Numerical value will start blinking.

By using the Plus / Up arrow key (+ / ▲) or the Minus / Down arrow key (- / ▼) select the desired frequency.

Press the EDIT Key.

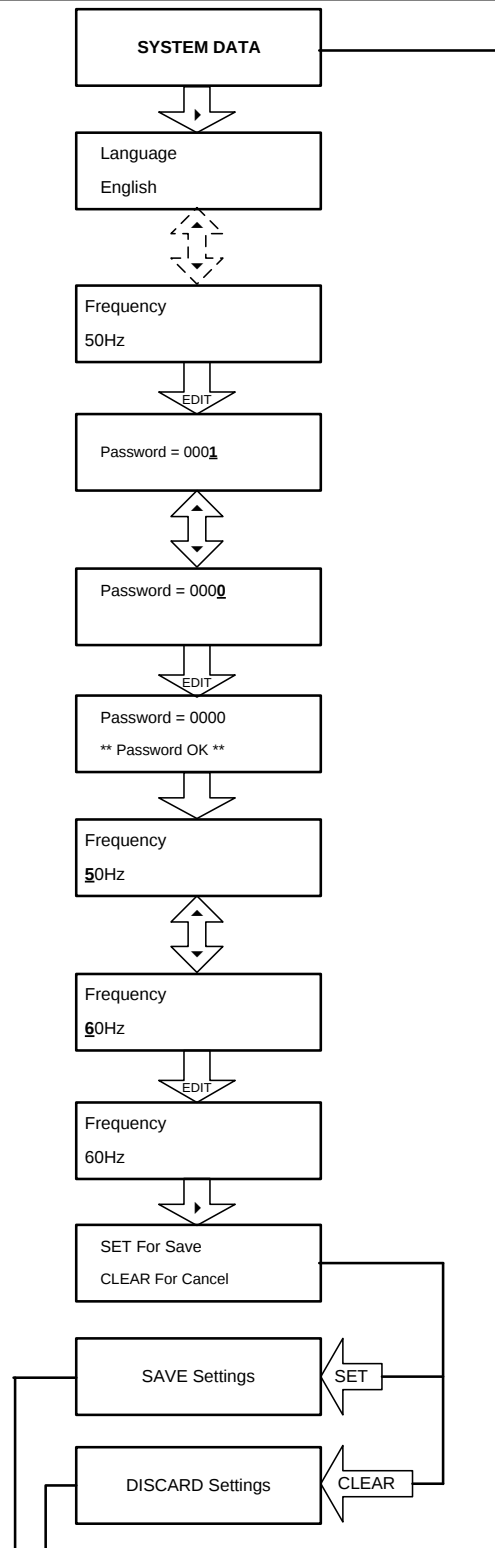
The Alpha Numerical Value will stop blinking.

Press the Right arrow key (►), the relay will ask the user to SAVE or to CANCEL the settings.

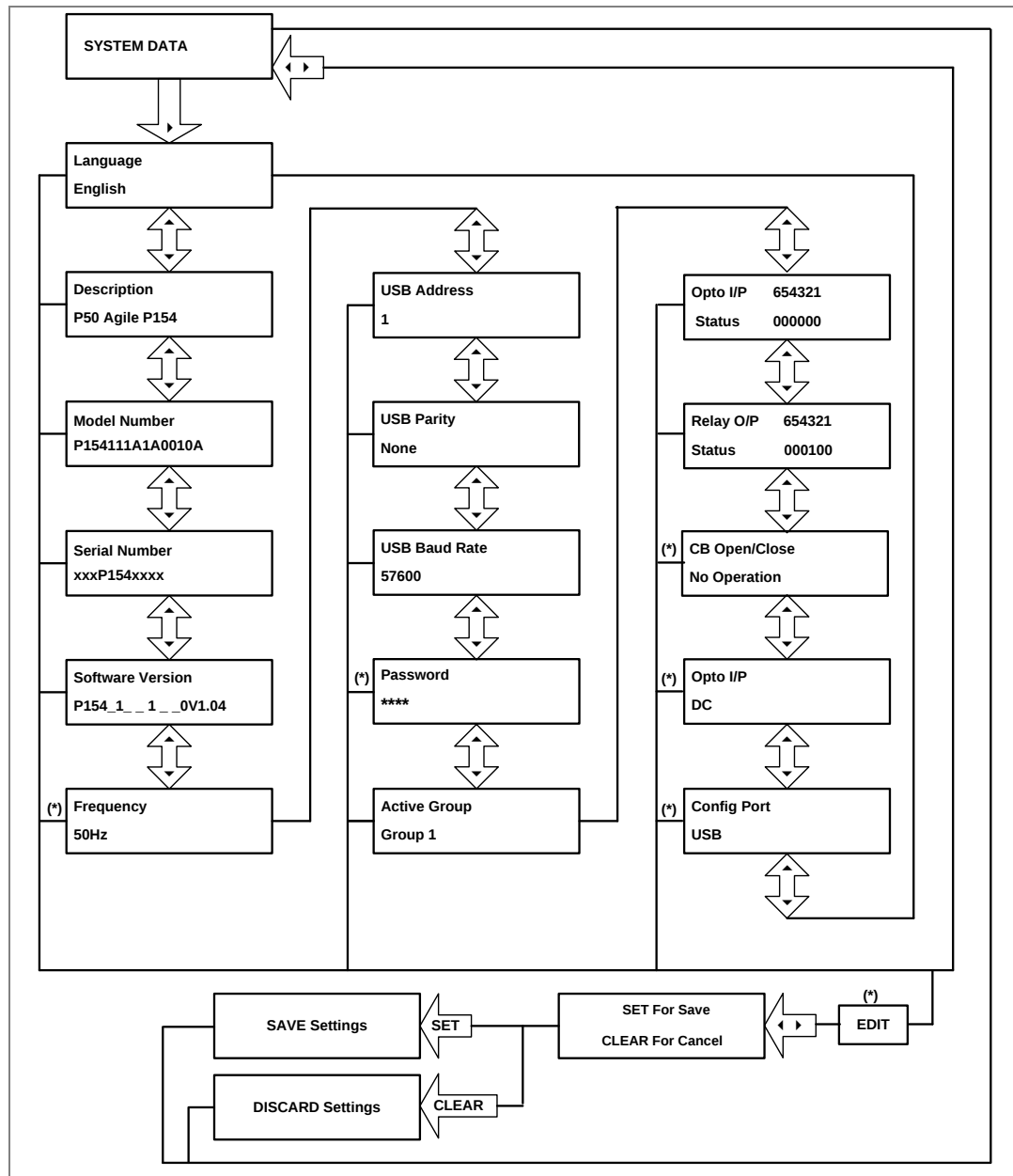
Press the SET Key to SAVE the Changes.

OR

Press the CLEAR Key to DISCARD the Changes.



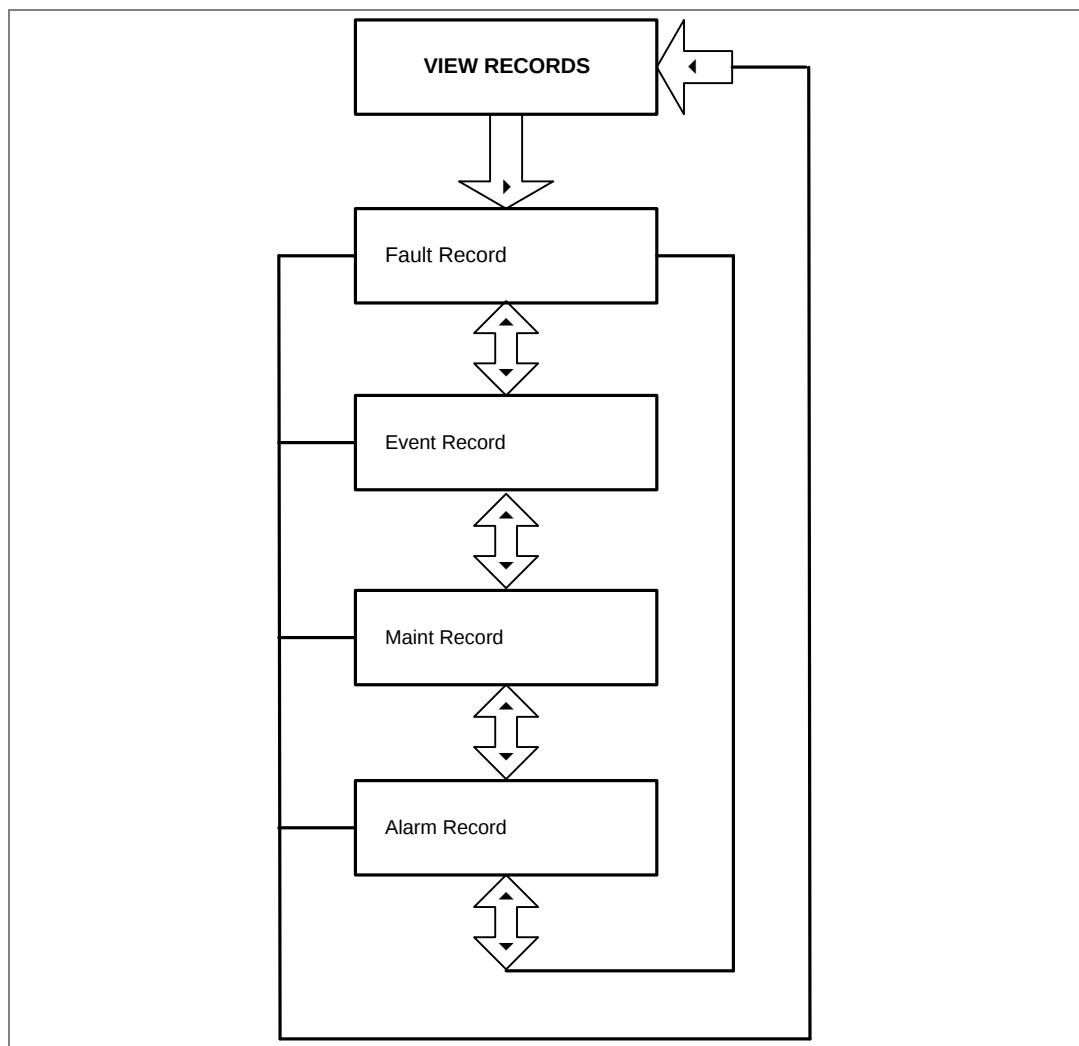
2.4.3 View System Data Menu Settings



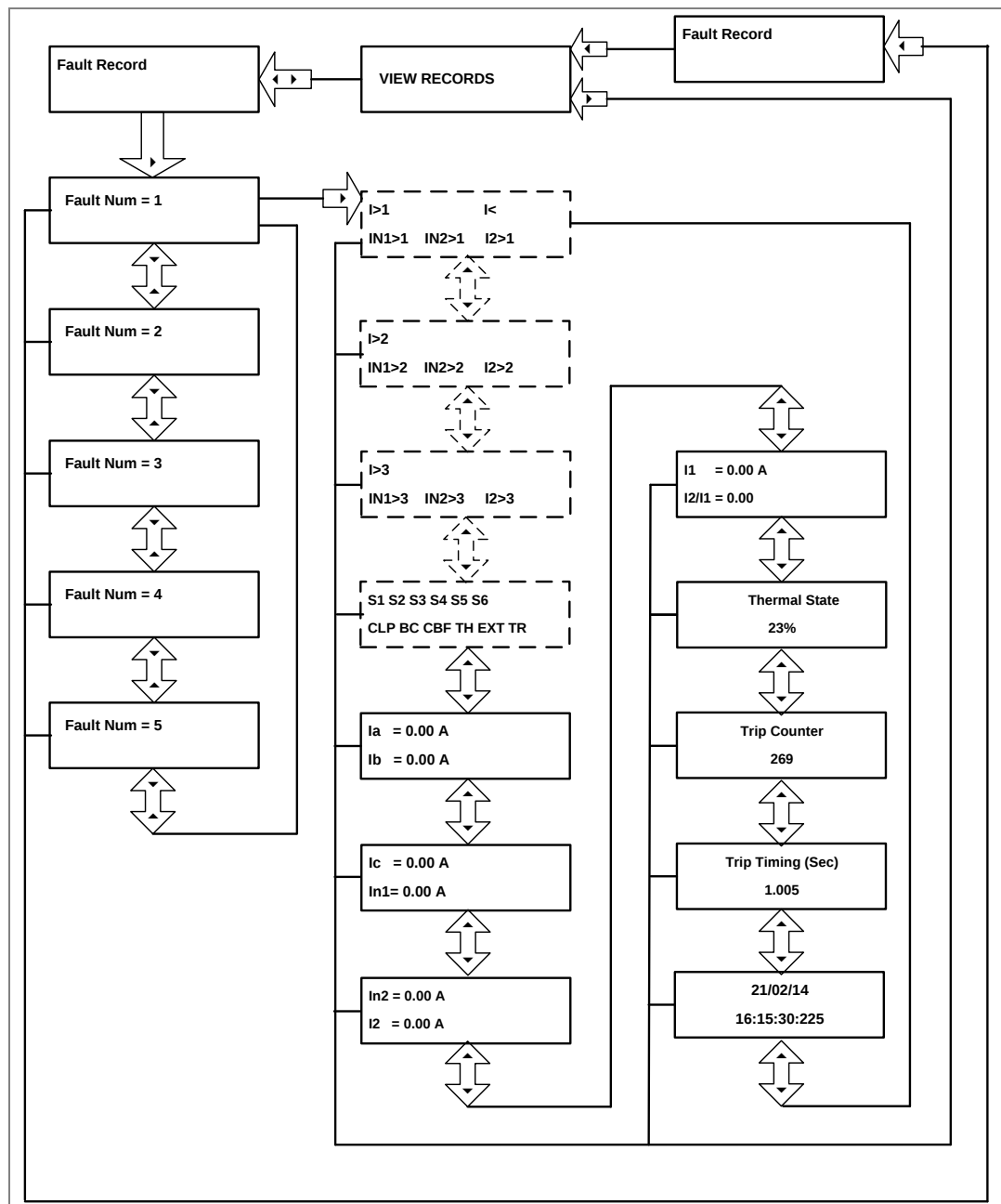
Note: (*) indicates Edit key is used to modify settings. Refer to the View and Edit settings section.

2.4.4 View Records Menu

2.4.4.1 View Content

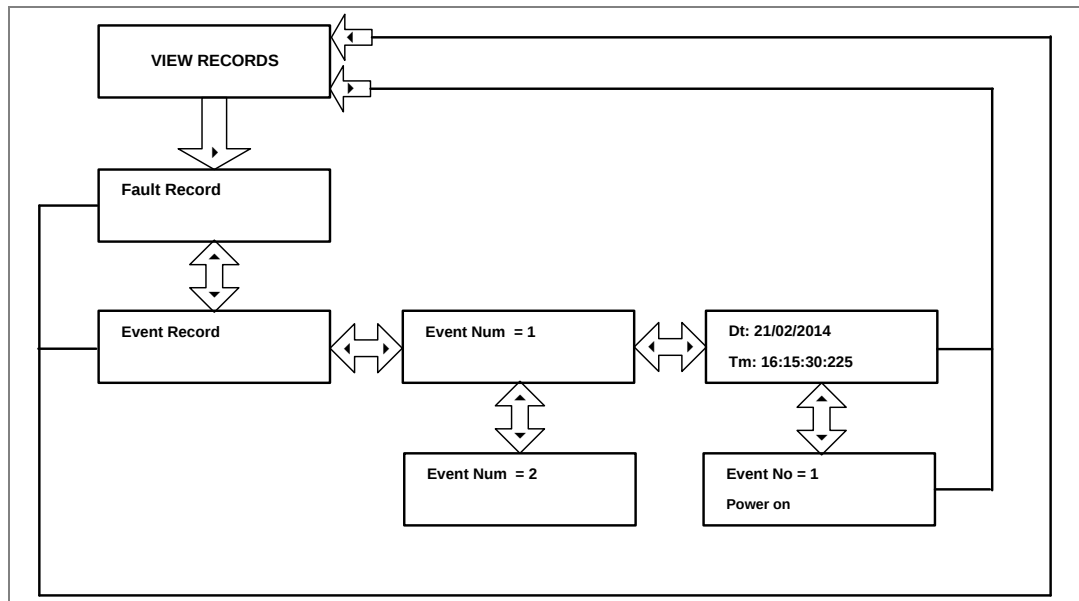


2.4.4.2 View Fault Records

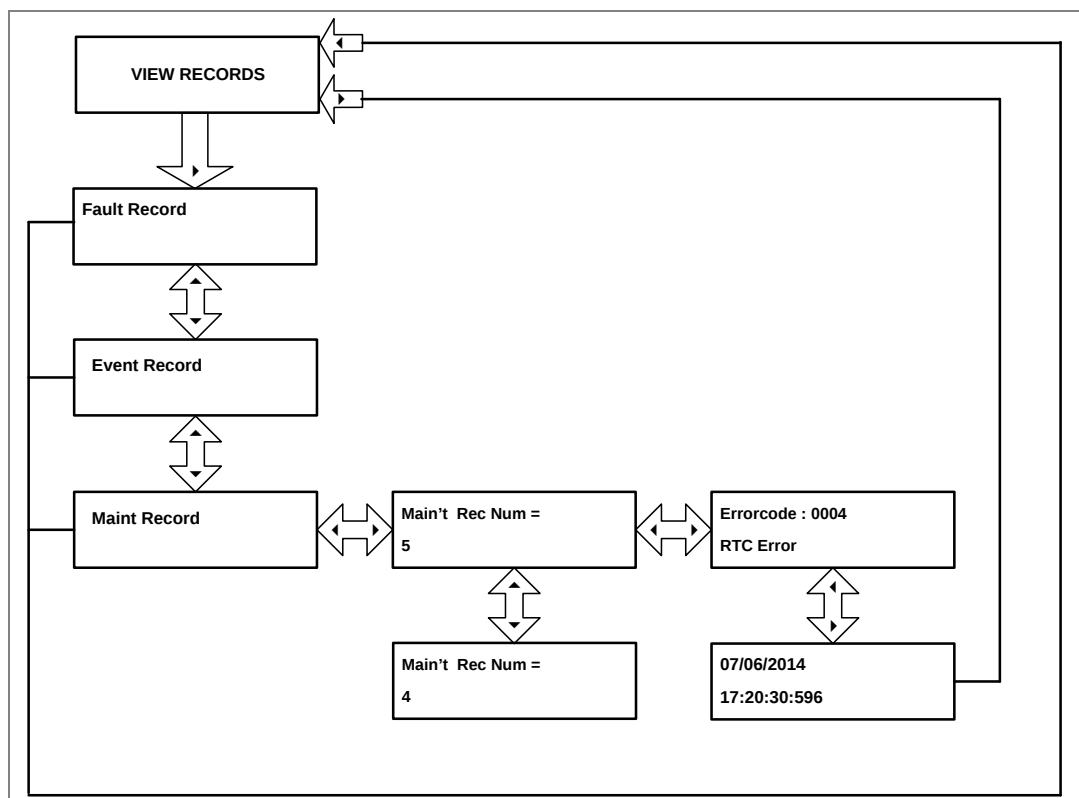


Note: The display windows shown in dashed lines will be seen if the relay operates for respective protection functions.

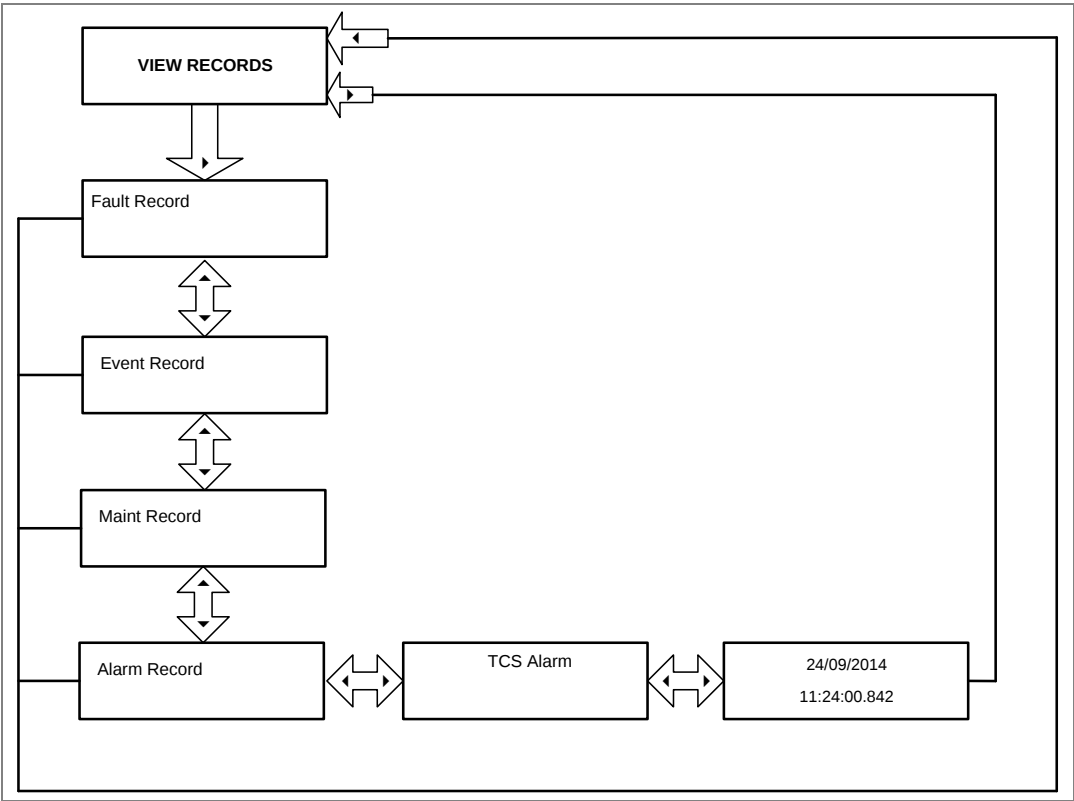
2.4.4.3 View Event Records



2.4.4.4 View Maintenance Records

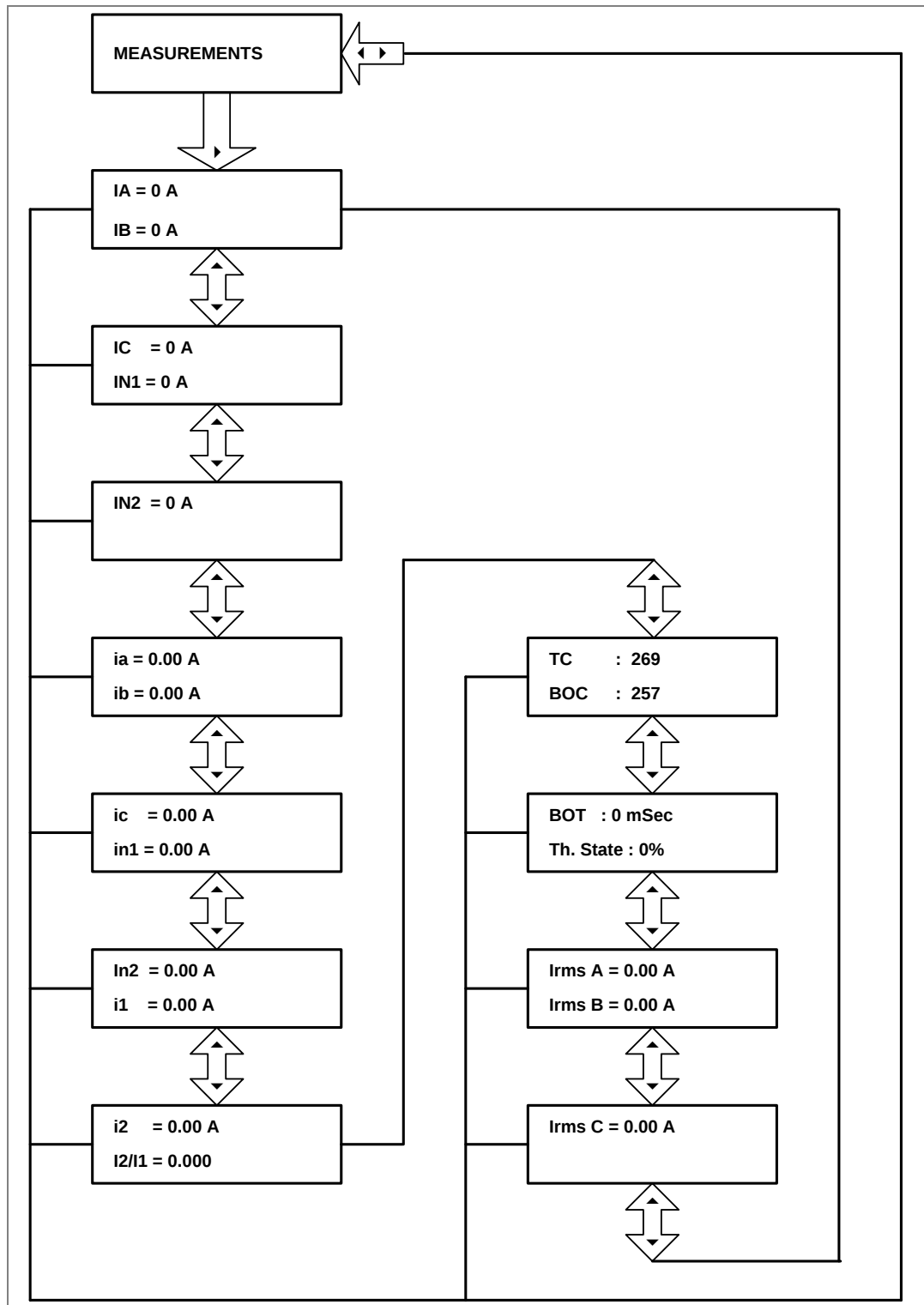


2.4.4.5 View Alarm Records



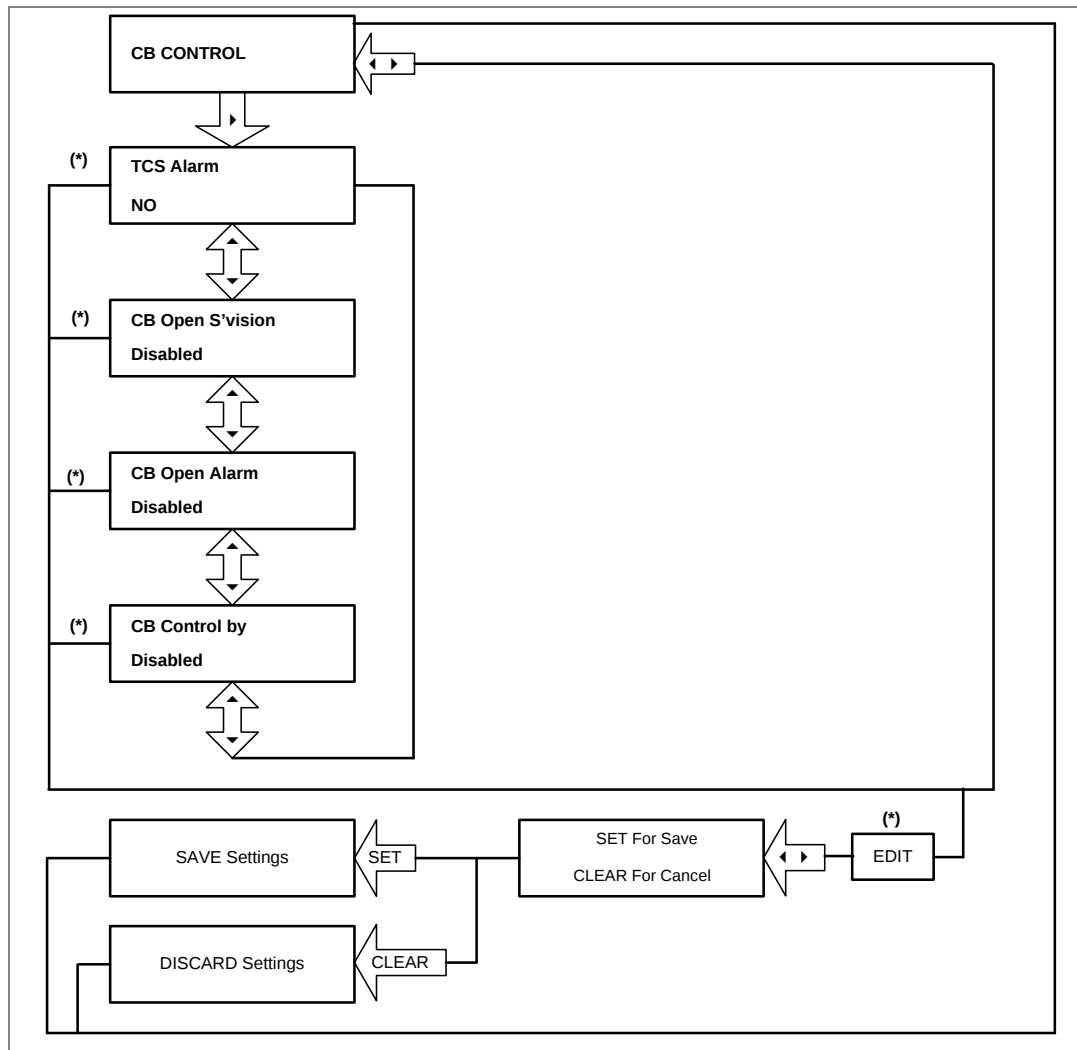
2.4.5 Measurement Menu

2.4.5.1 View Settings



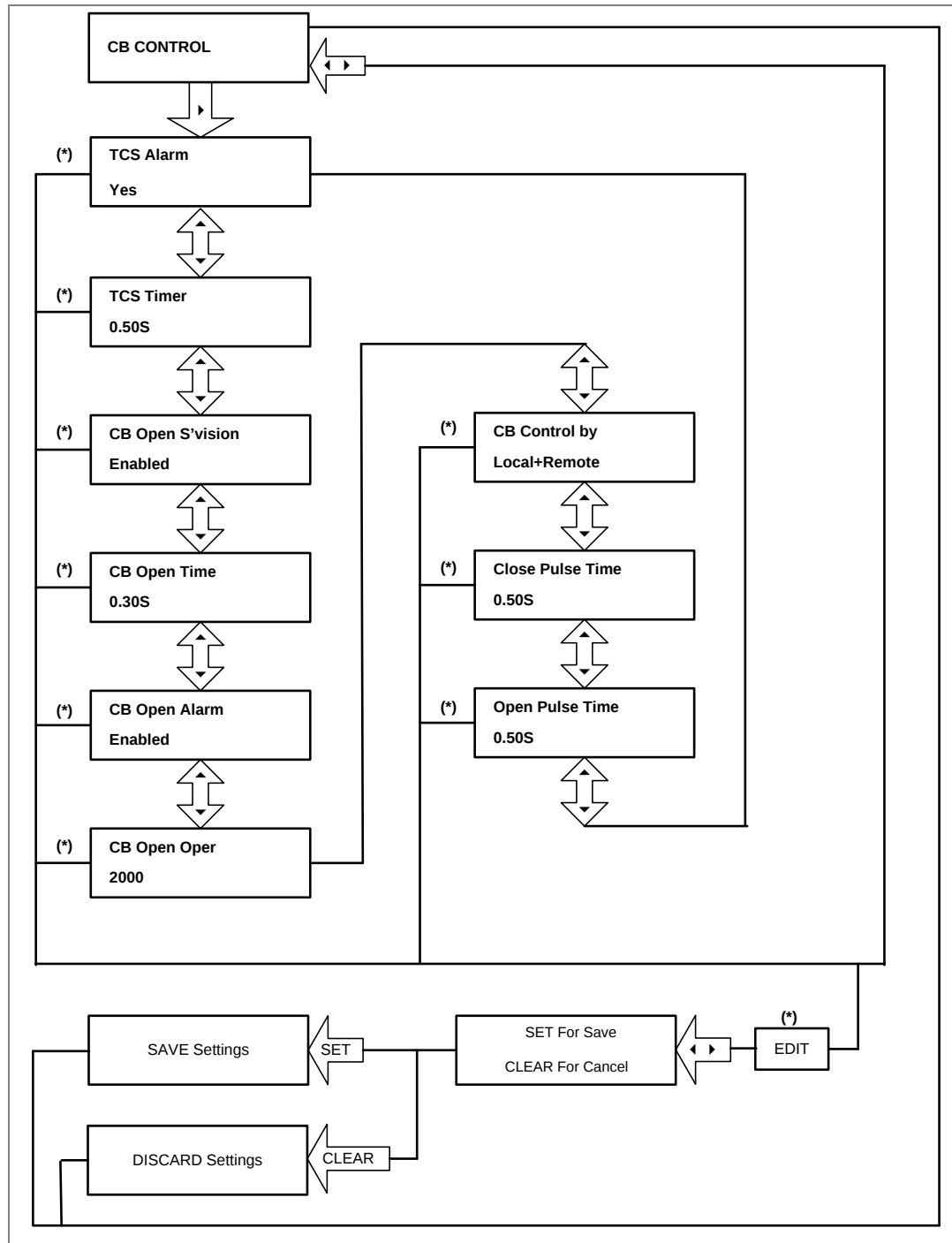
2.4.6 CB Control Menu

2.4.6.1 View/Edit Settings (if all settings are disabled)



Note: () indicates Edit key used to modify settings. Refer to the View and Edit settings section.*

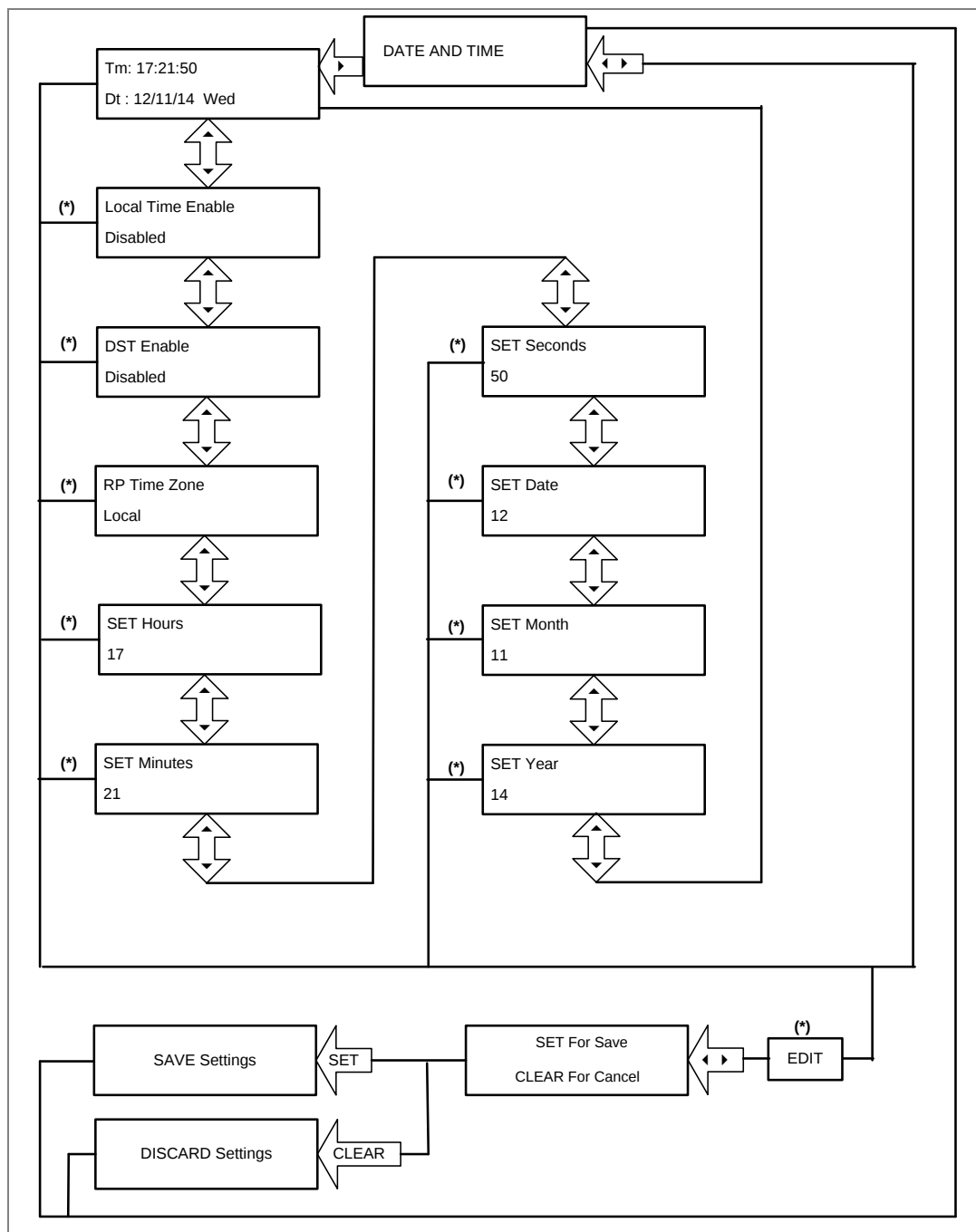
2.4.6.2 View/Edit Settings (if all settings are enabled)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

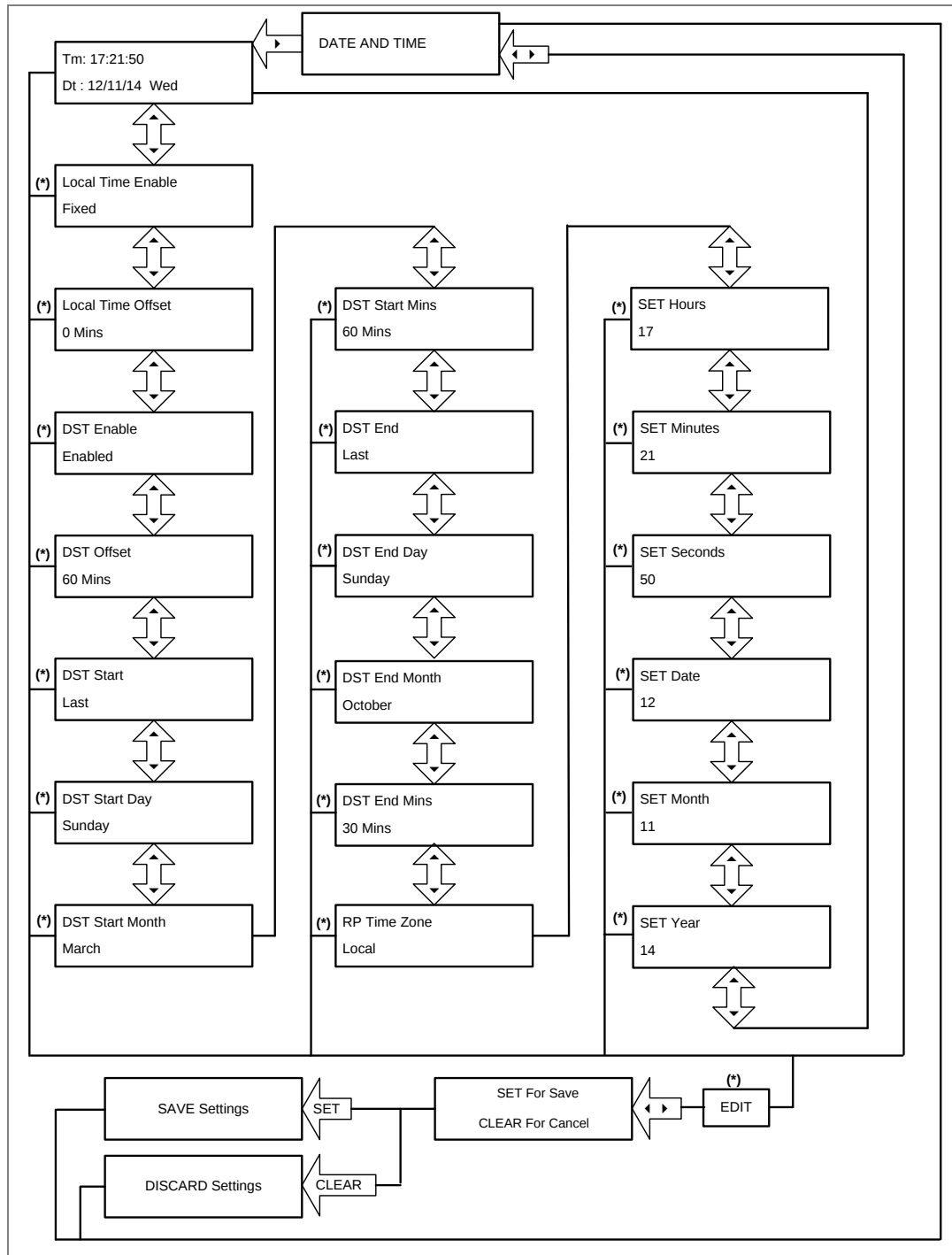
2.4.7 Date and Time Menu

2.4.7.1 View/Edit Settings (if all settings are disabled)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

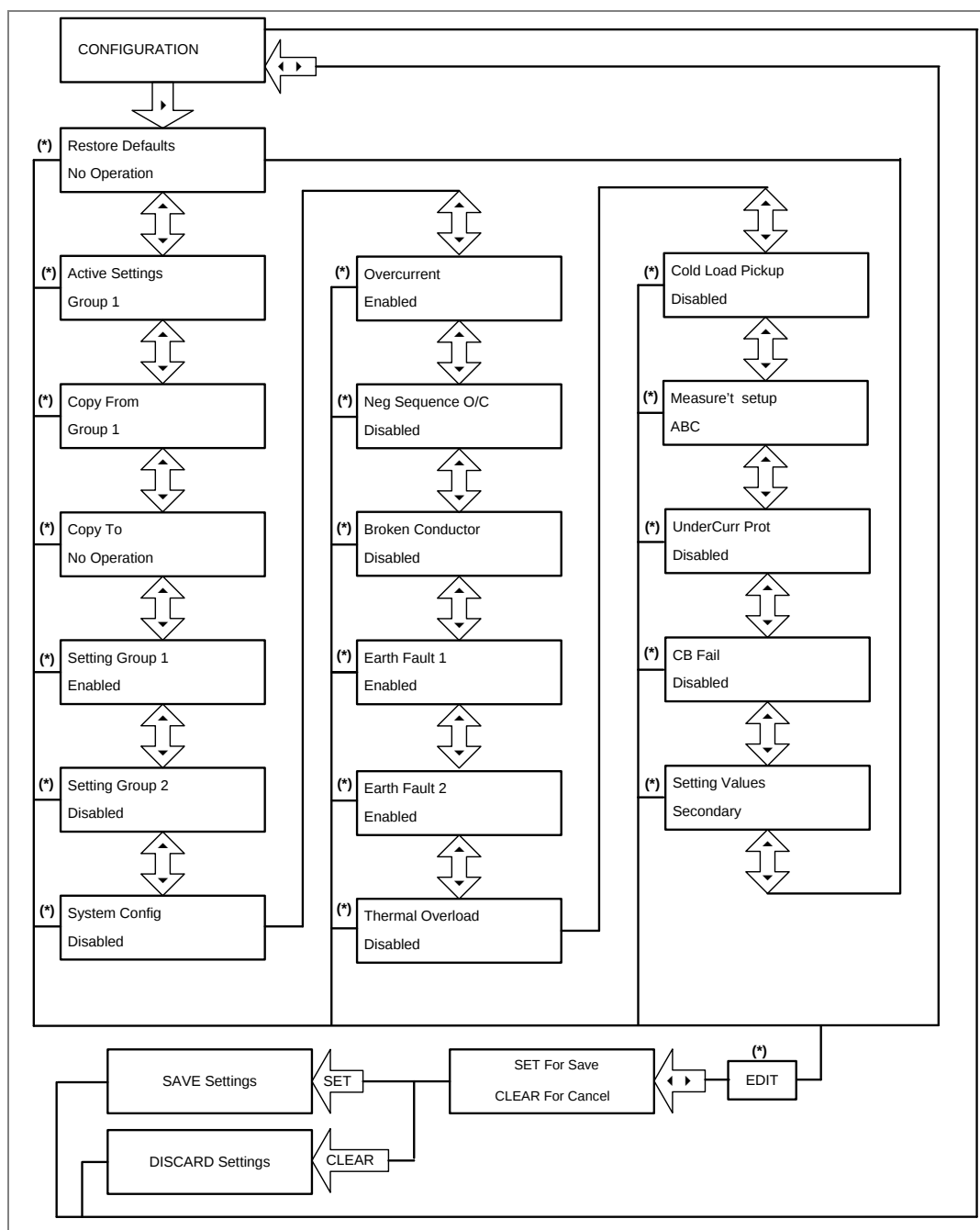
2.4.7.2 View/Edit Settings (if all settings are enabled)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.8 Configuration menu

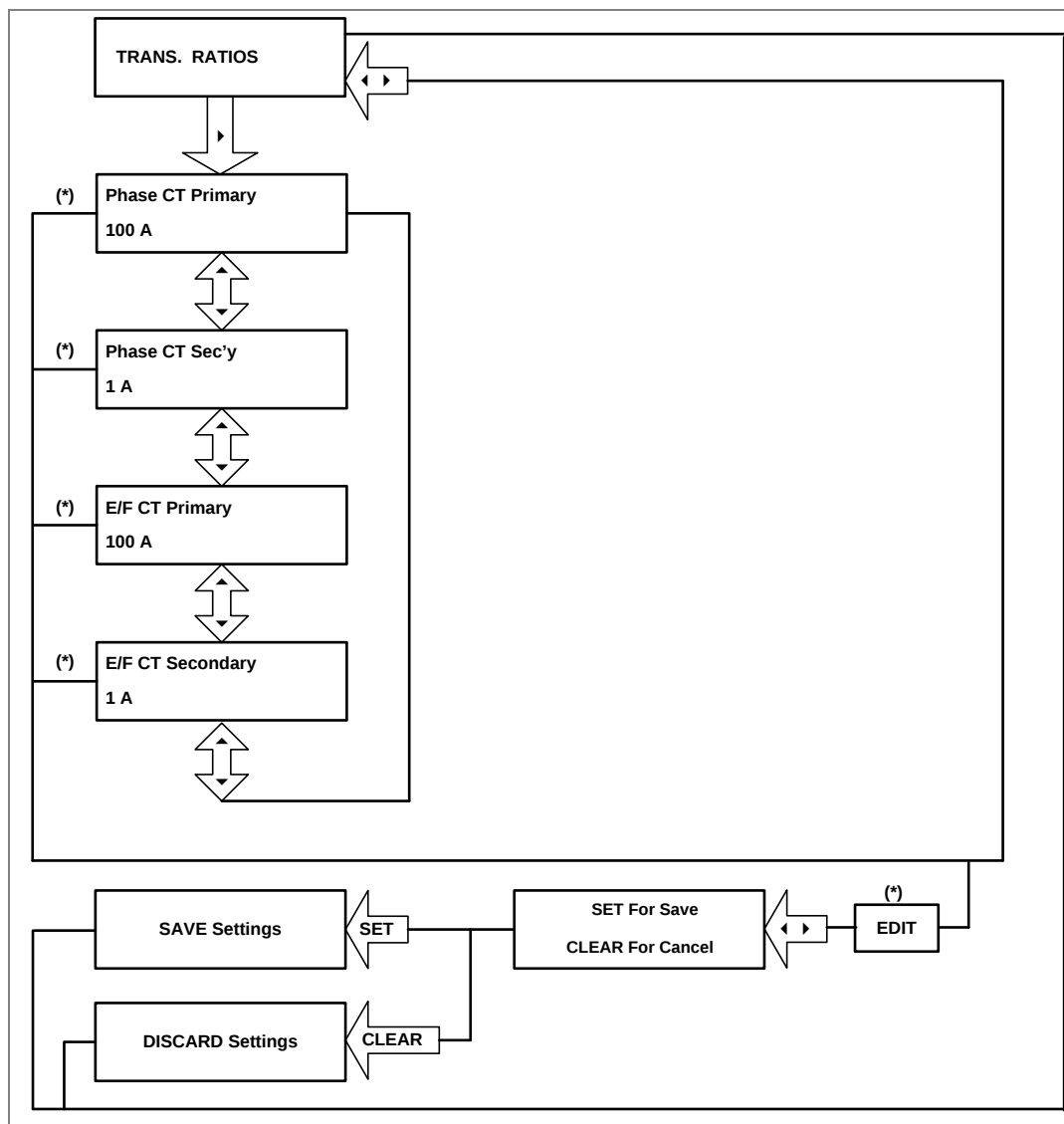
2.4.8.1 View/Edit Settings



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.9 Transformer Ratios Menu

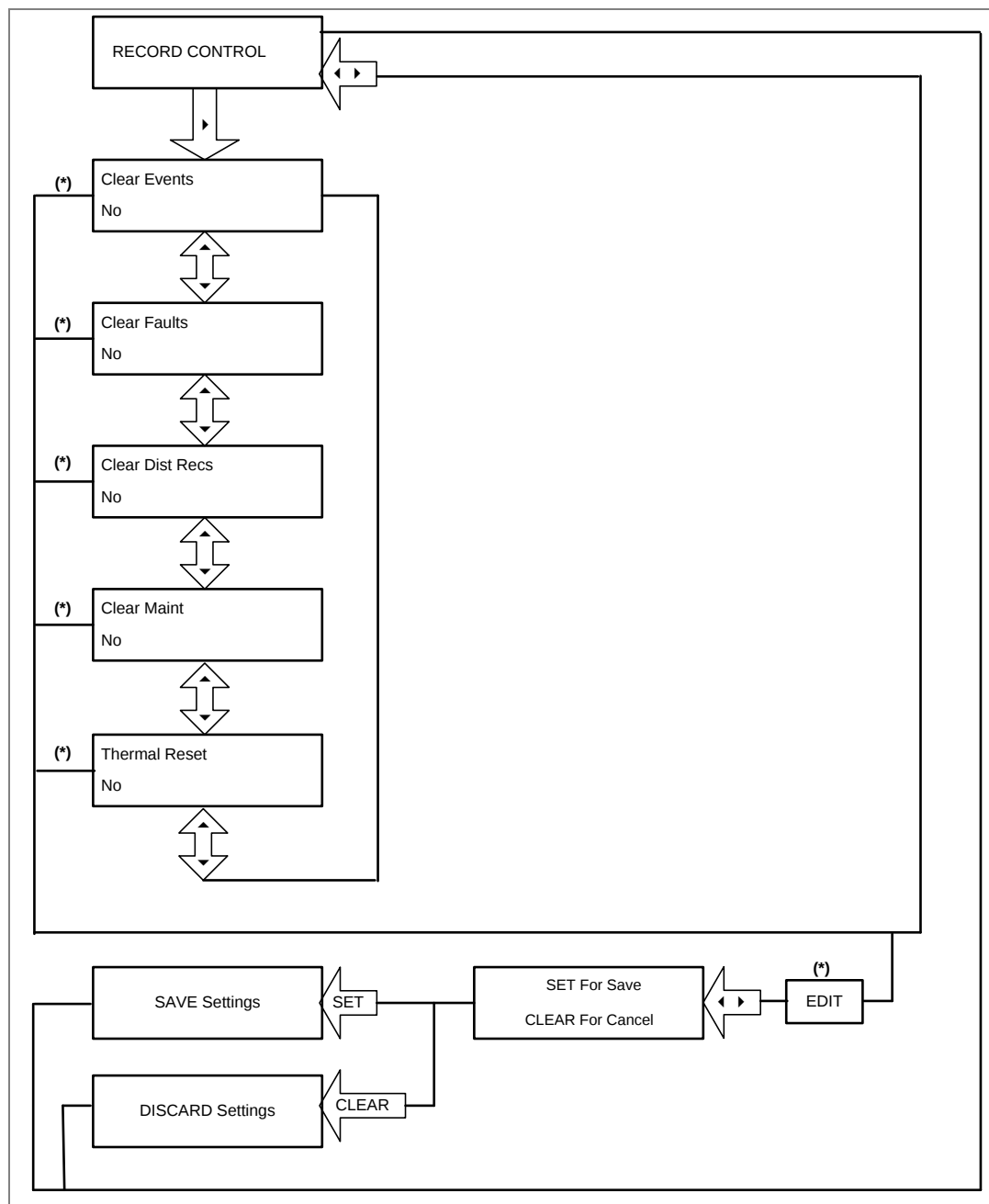
2.4.9.1 View/Edit Settings



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.10 Record Control Menu

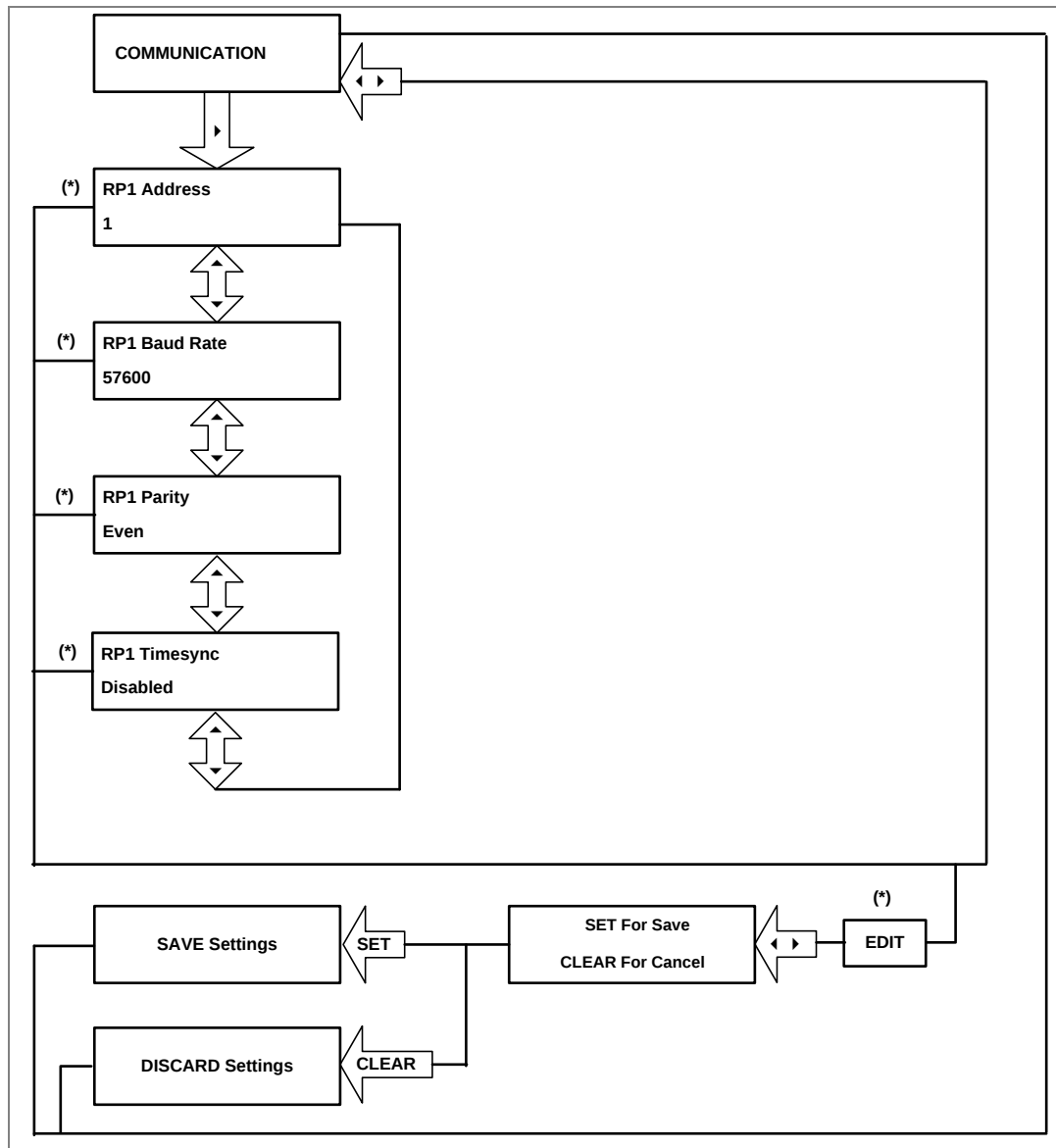
2.4.10.1 View/Edit Settings



Note: () indicates Edit key used to modify settings. Refer to the View and Edit settings section.*

2.4.11 Communication Menu

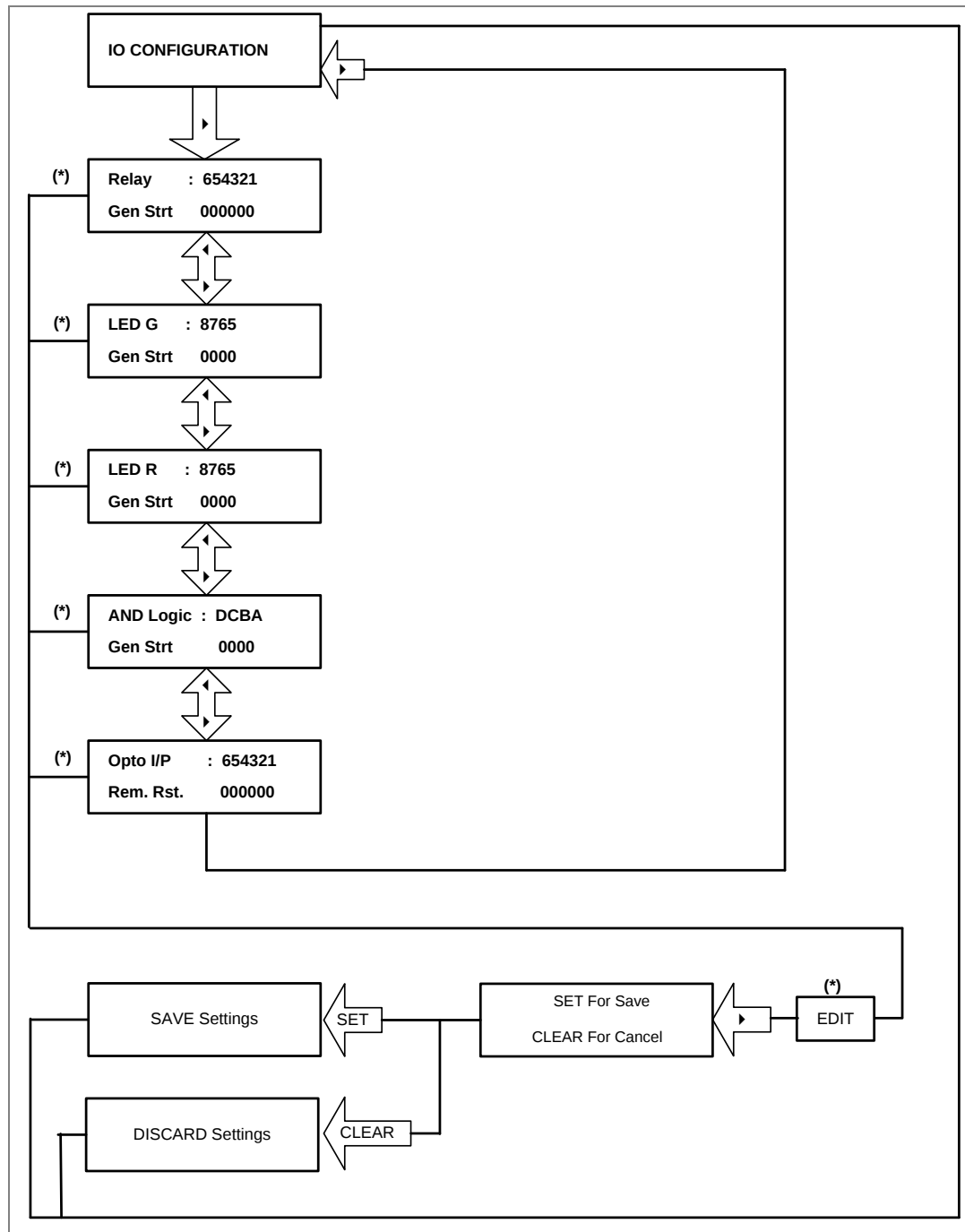
2.4.12 View/Edit settings



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.13 I/O Configuration Menu

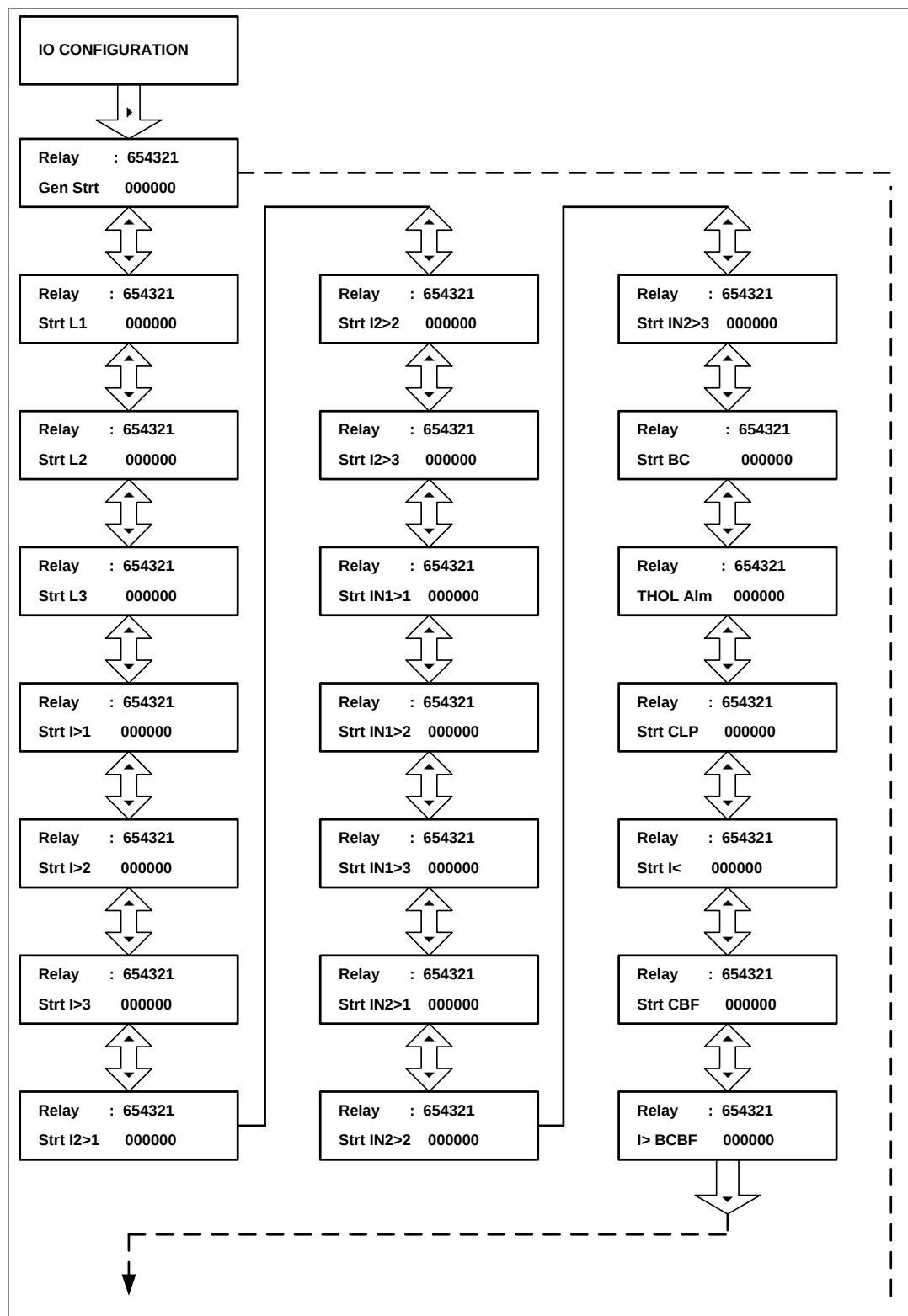
2.4.14 View/Edit Settings

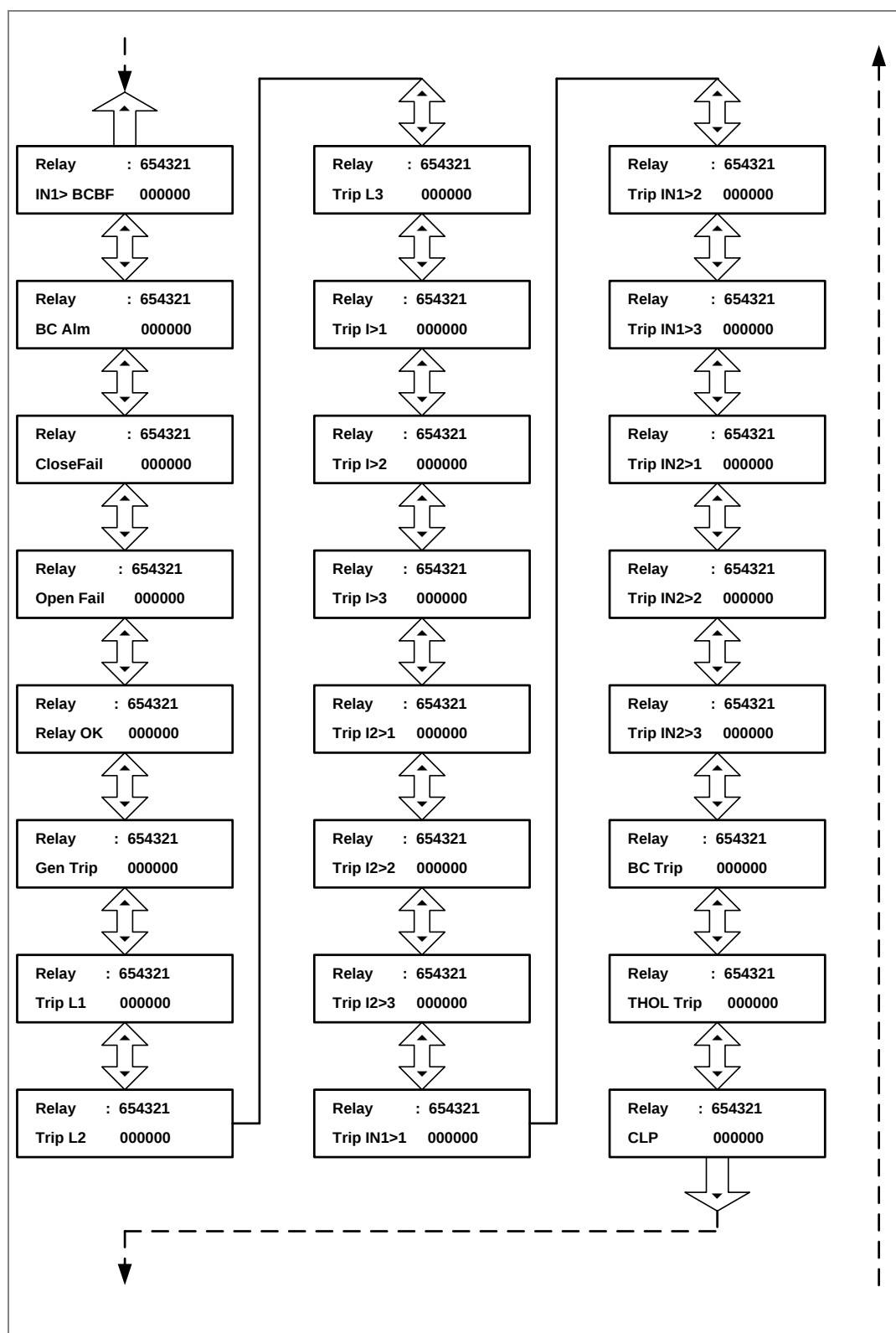


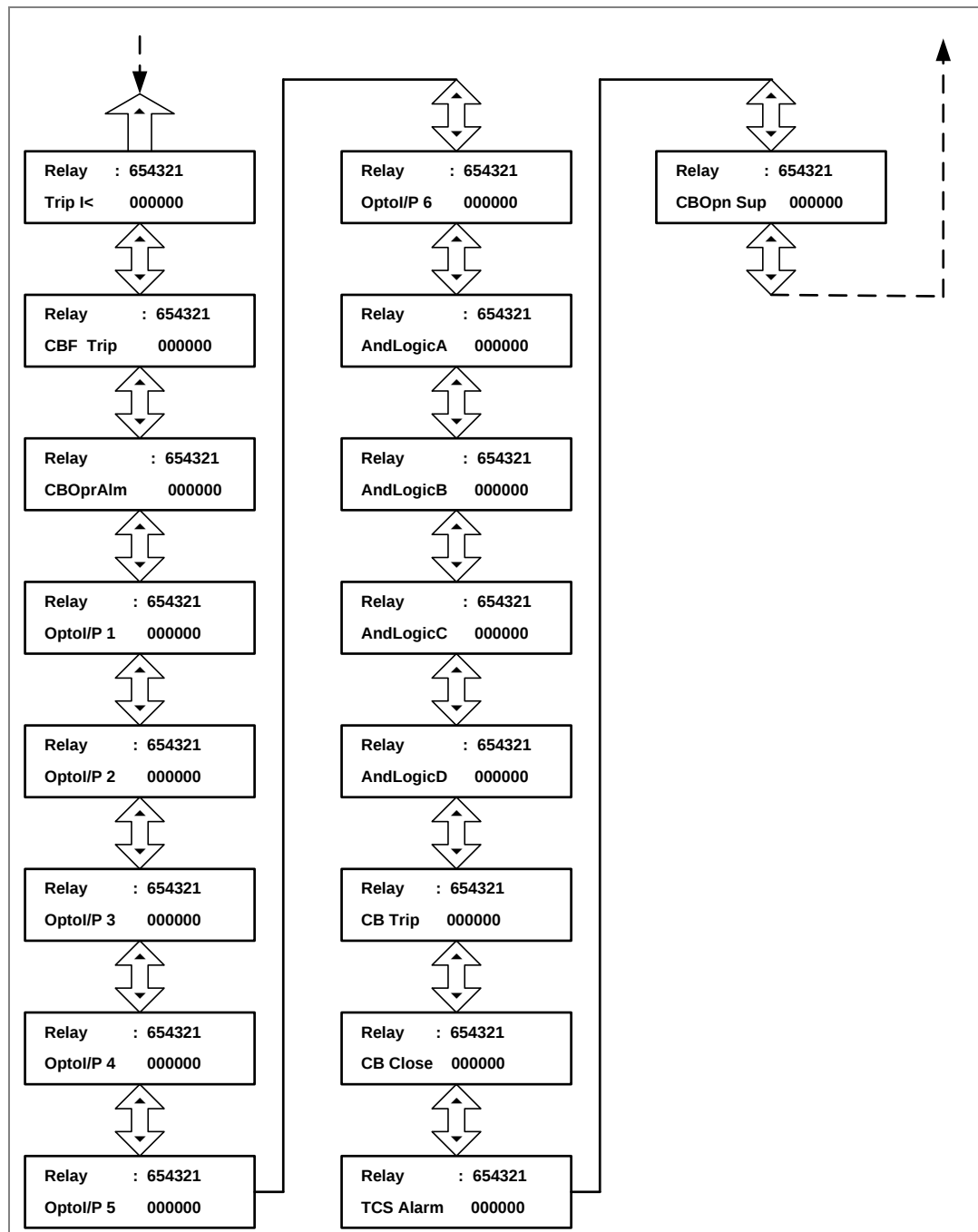
Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.14.1.1 I/O Configuration Submenu Setting

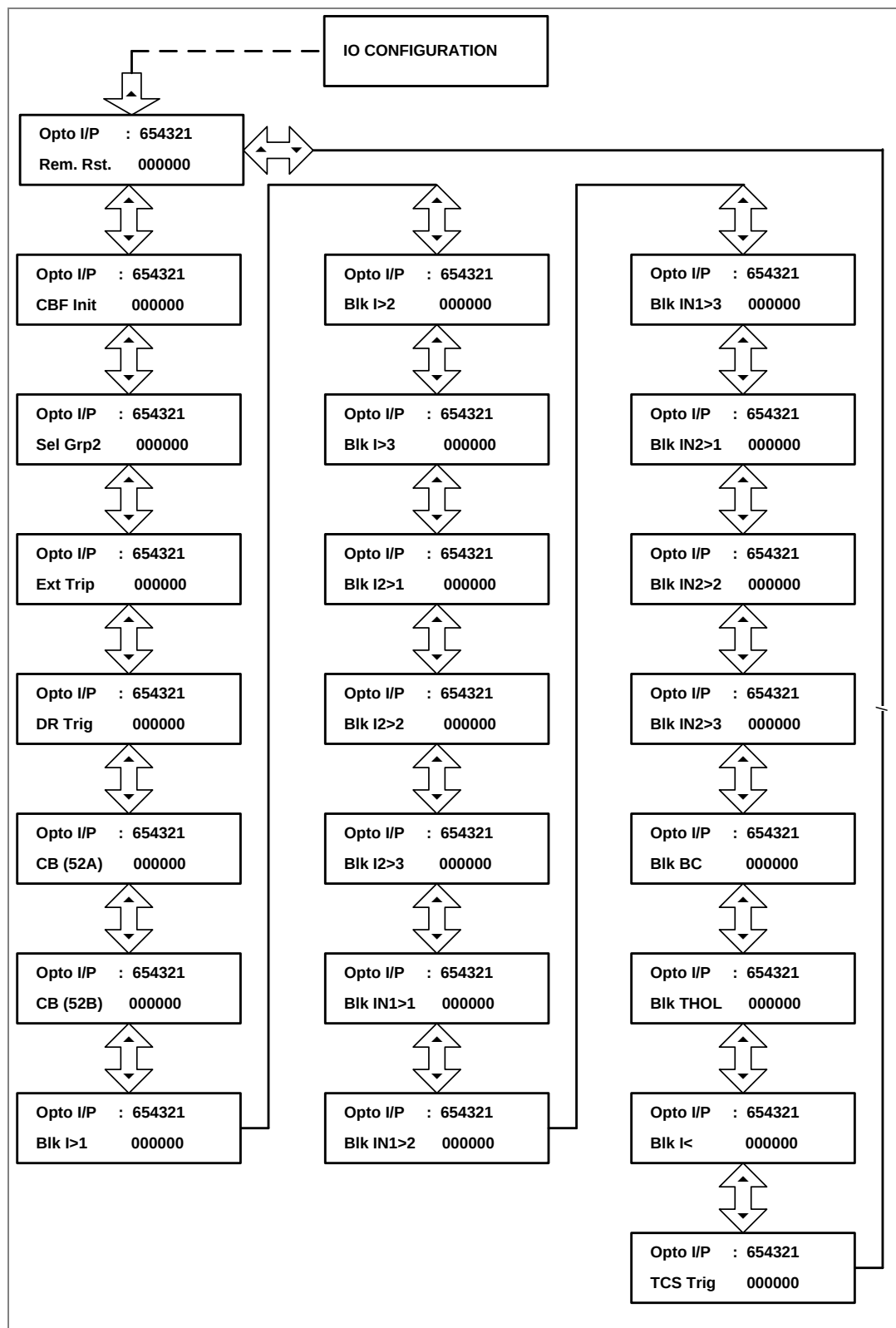
(Output relays, LEDs and AND logic settings)





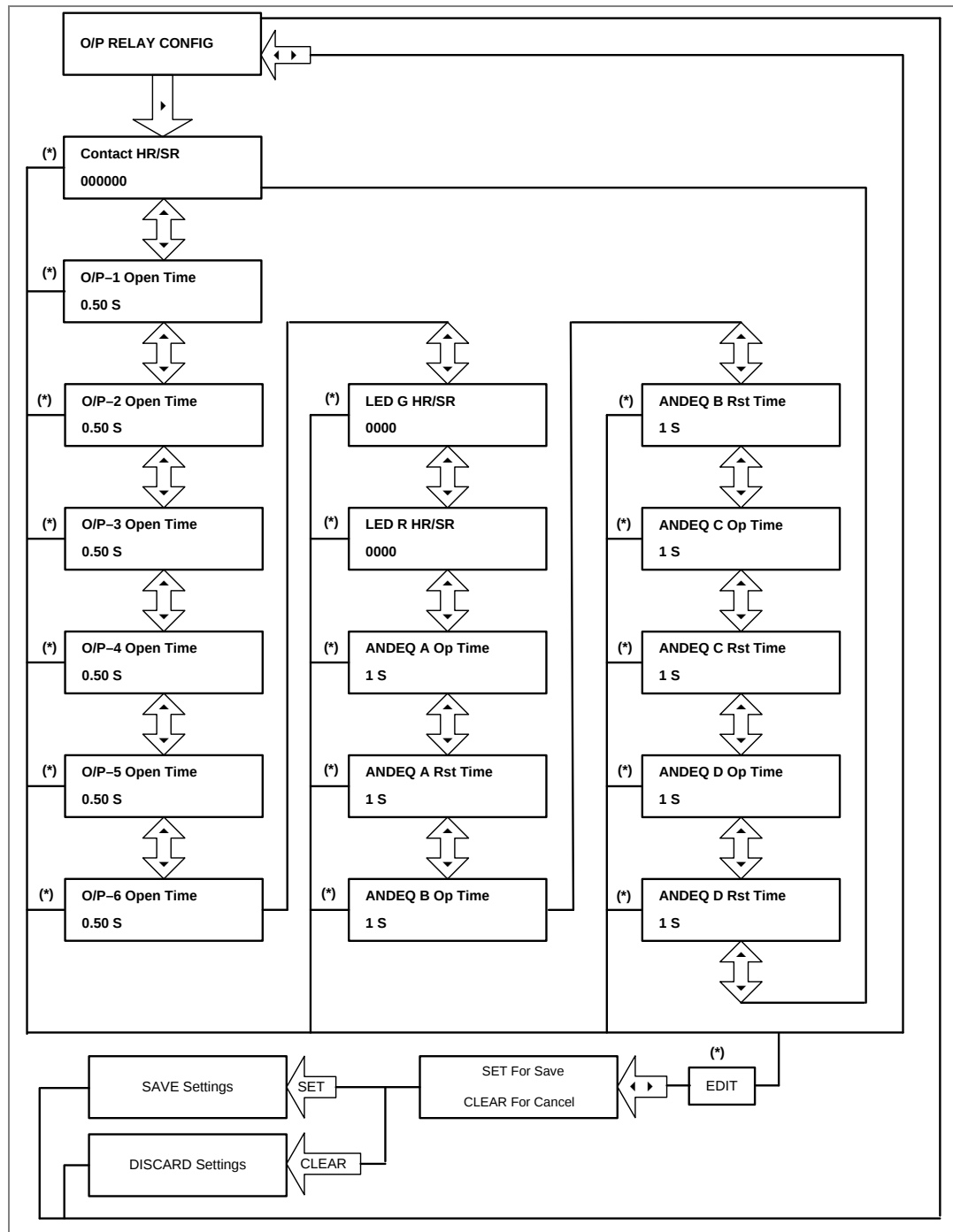


2.4.14.1.2 I/O Configuration Submenu Setting (Opto I/ps)



2.4.15 O/P Relay Configuration Menu

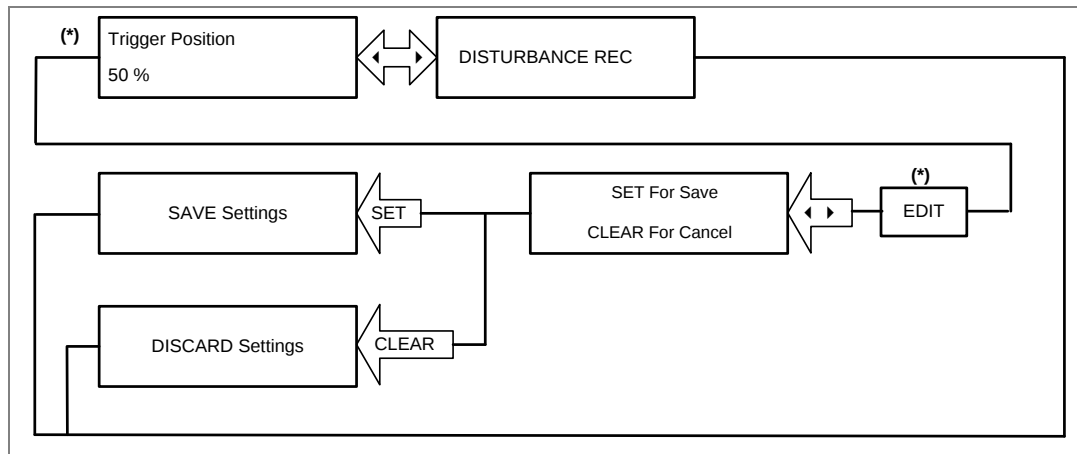
2.4.15.1 View/Edit Settings



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.16 Disturbance Record Menu

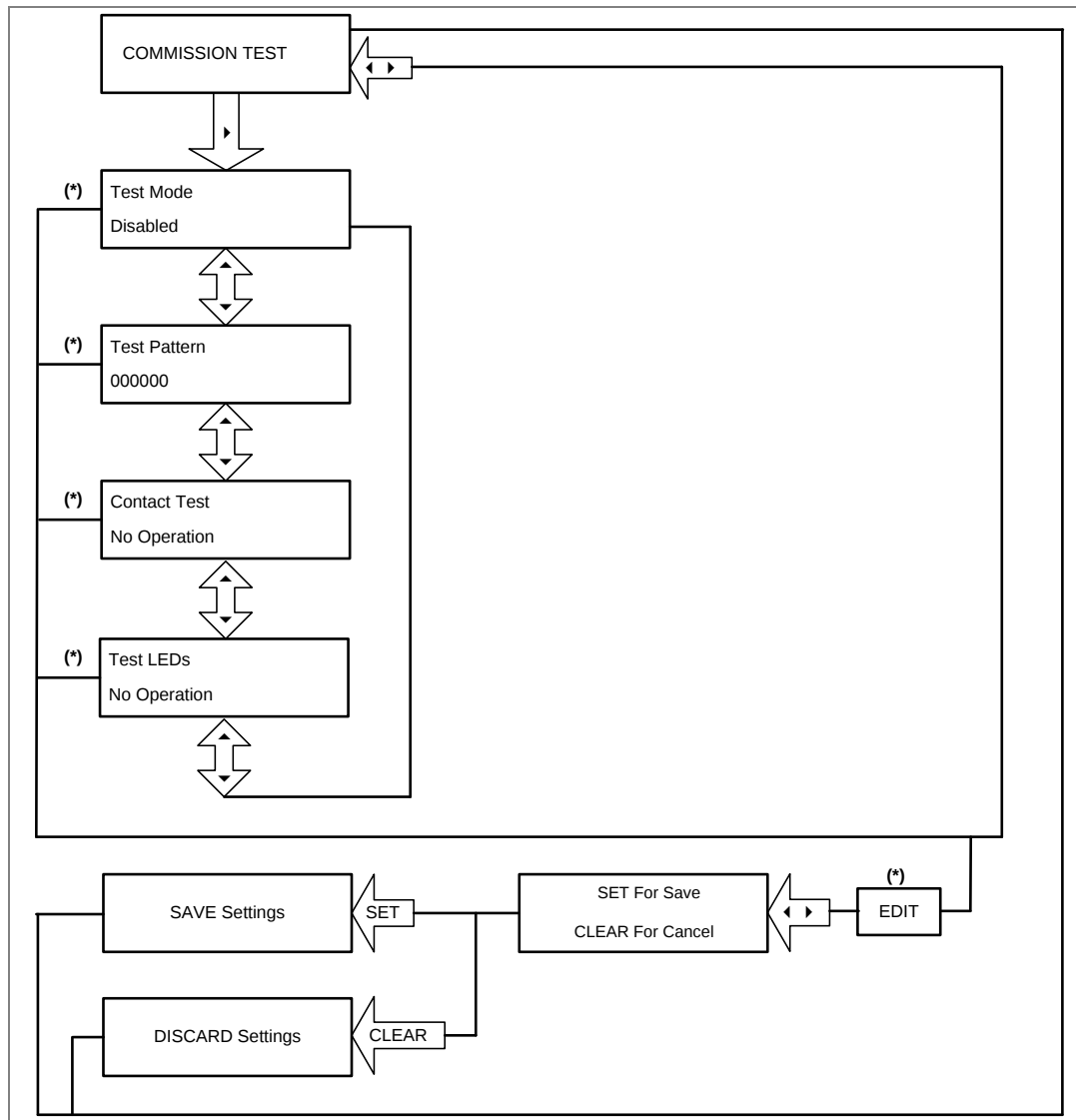
2.4.16.1 View/Edit Settings



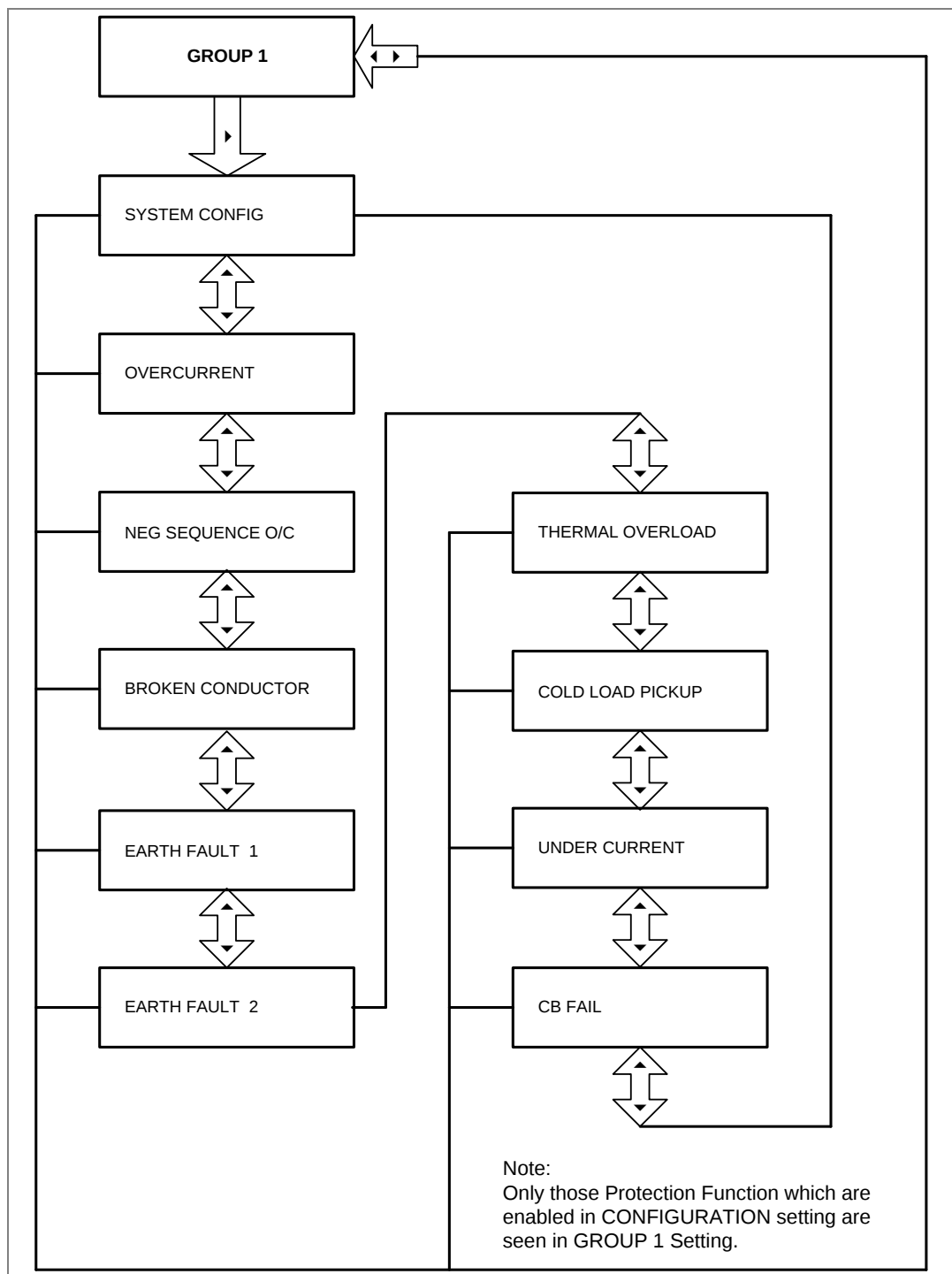
Note: () indicates Edit key used to modify settings. Refer to the View and Edit settings section.*

2.4.17 Commissioning Test Menu

2.4.17.1 View/Edit Settings

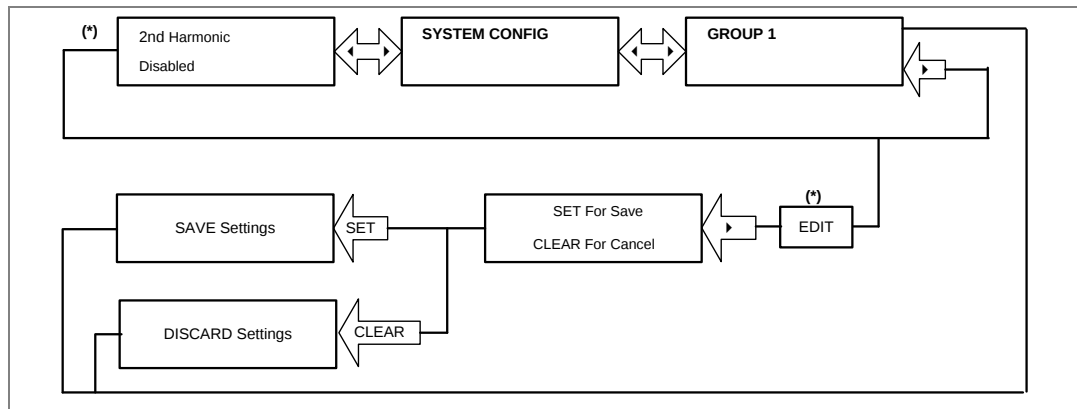


Note: () indicates Edit key used to modify settings. Refer to the View and Edit settings section.*

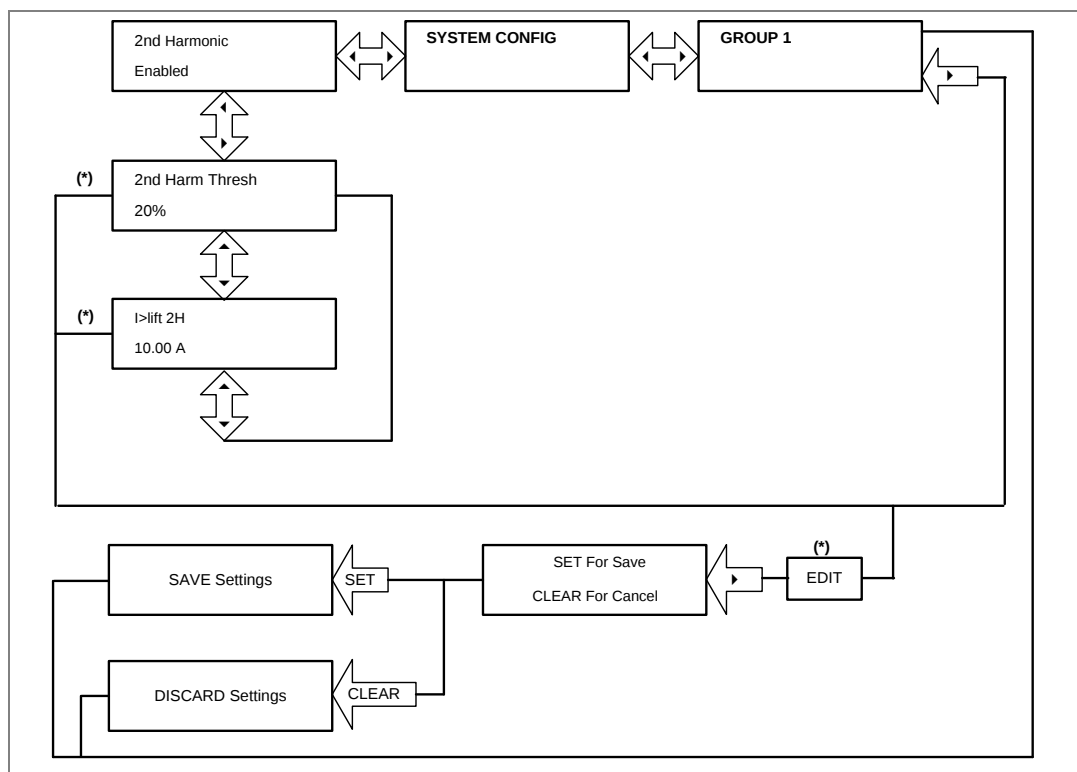
2.4.18 Group1 Menu**2.4.18.1 View/Edit Settings**

2.4.18.2 Group1 System Configuration Submenu

2.4.18.2.1 View/Edit Settings (If the setting is disabled)



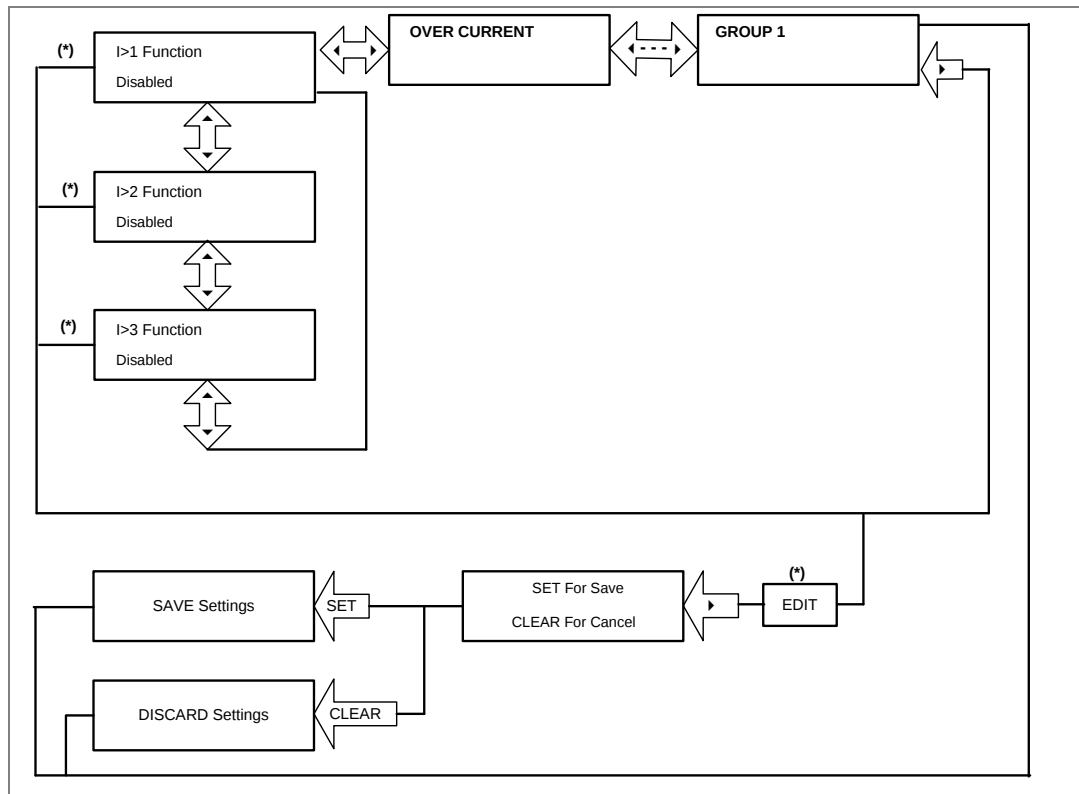
2.4.18.2.2 View/Edit Settings (If the setting is enabled)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

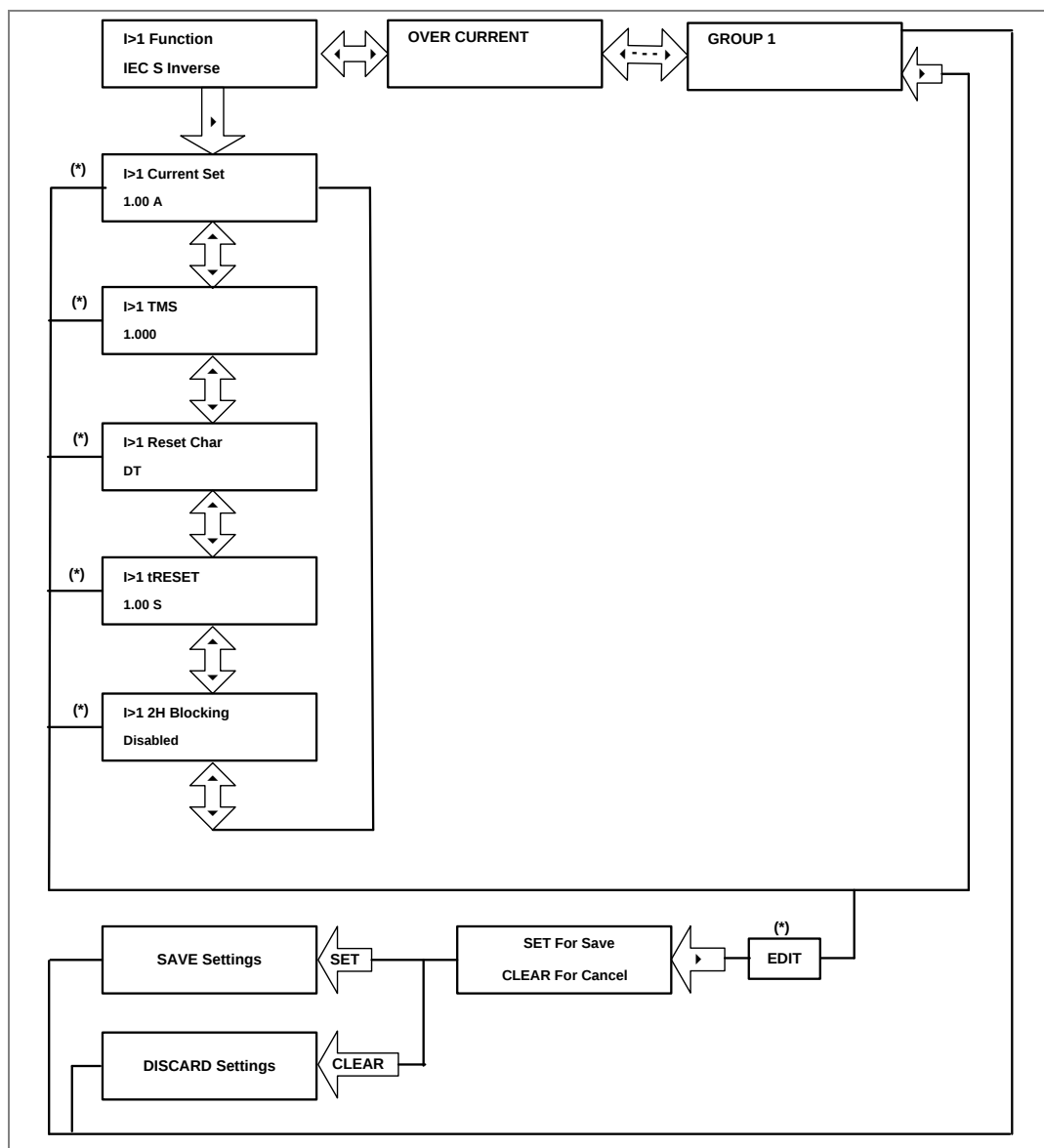
2.4.18.3 Group1 Overcurrent Submenu

2.4.18.3.1 View/Edit Settings (If the setting is disabled)



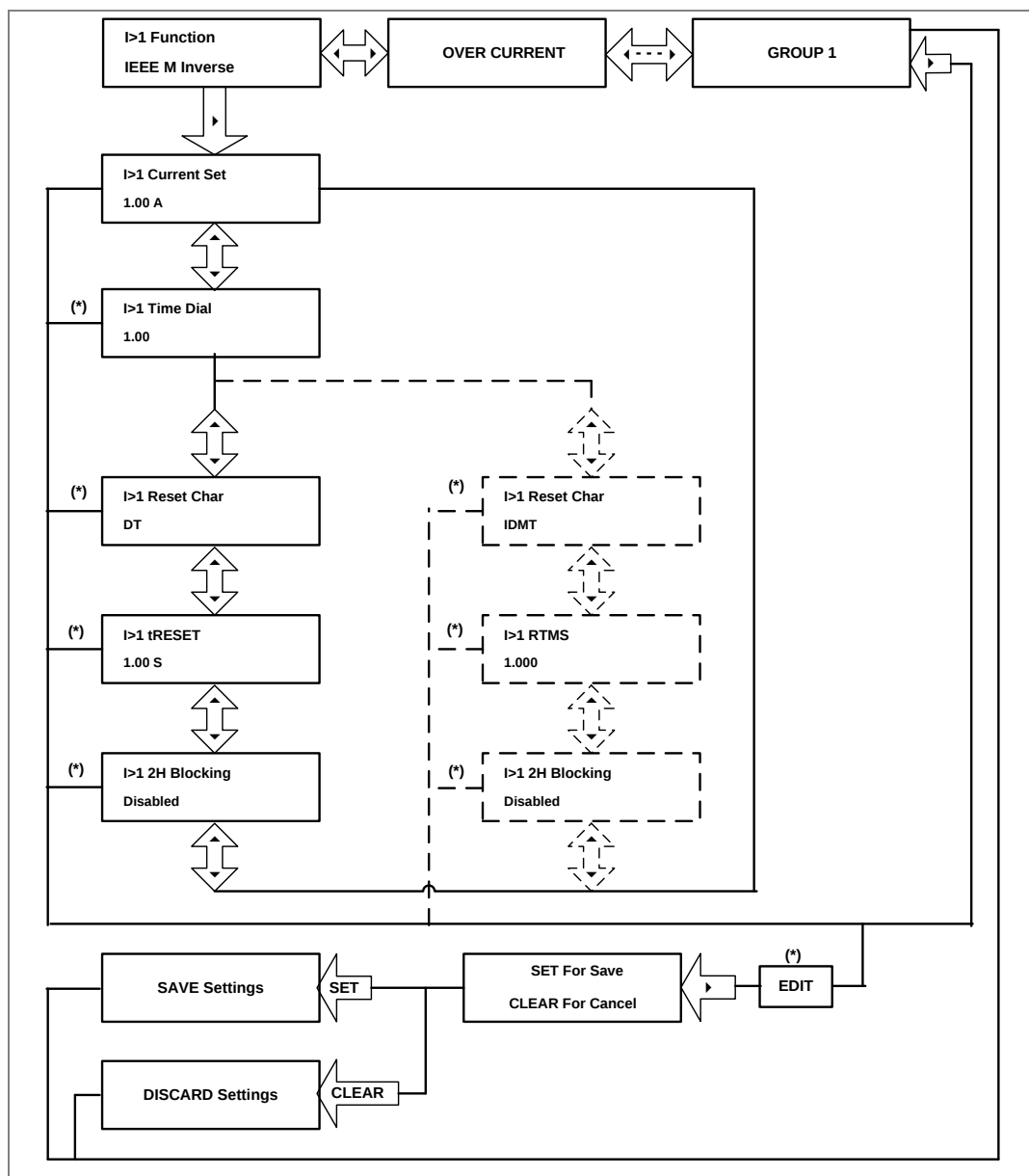
Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.18.3.2 View/Edit Settings (For all types of IEC curves)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

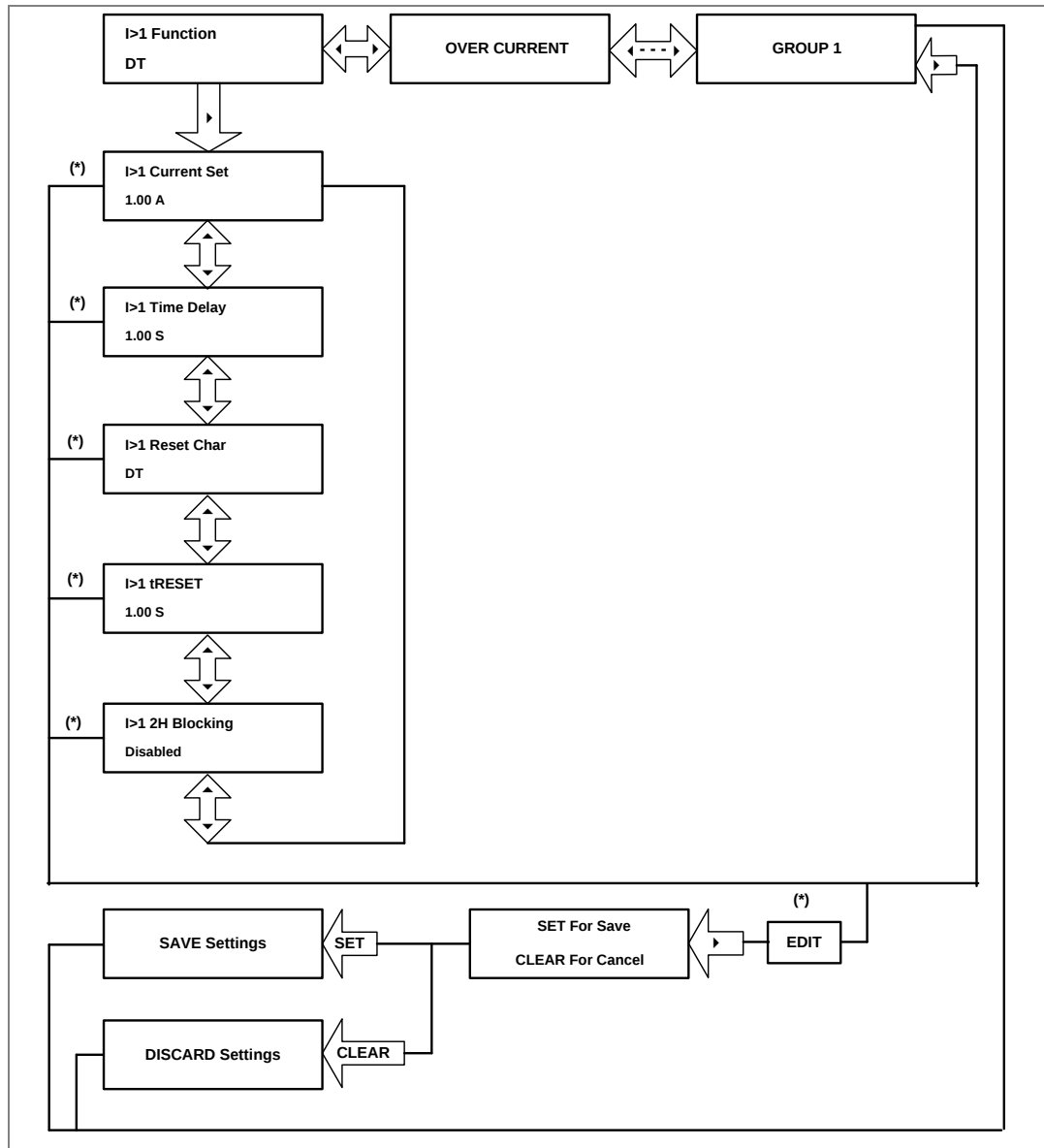
2.4.18.3.3 View/Edit Settings (For all types of IEEE curves)



Note: The display windows shown in dashed lines will be seen if the **I>1 Reset Char** is selected as IDMT.

(*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

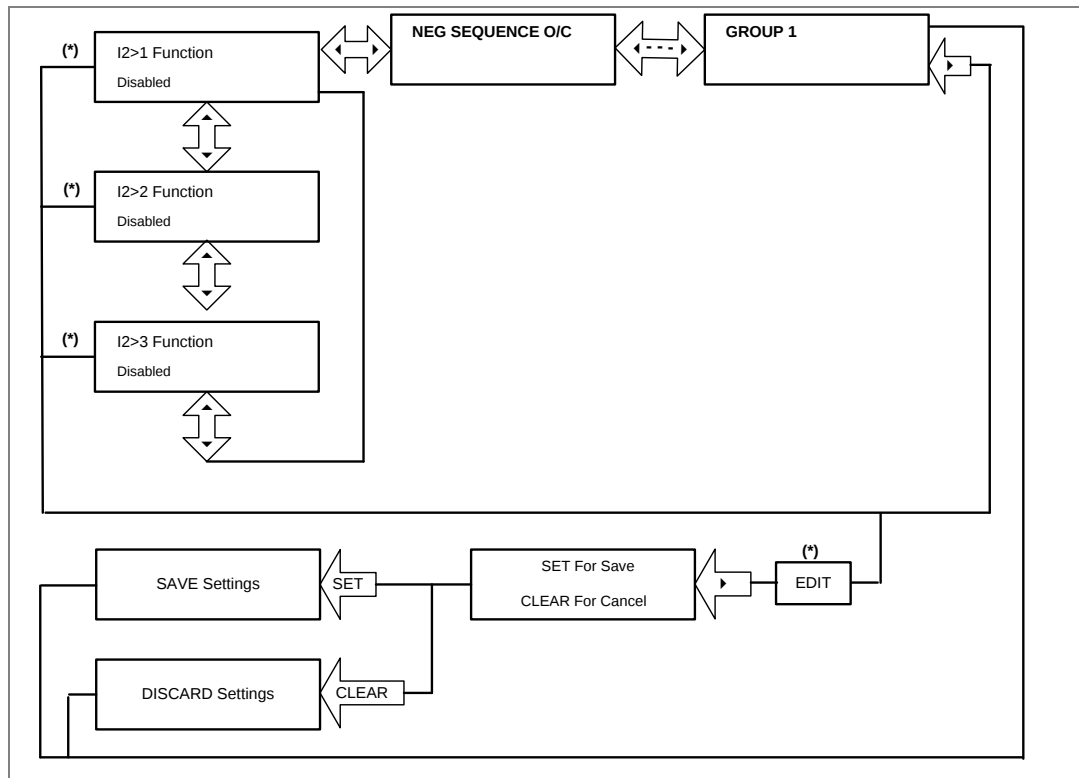
2.4.18.3.4 View/Edit Settings (For DT)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

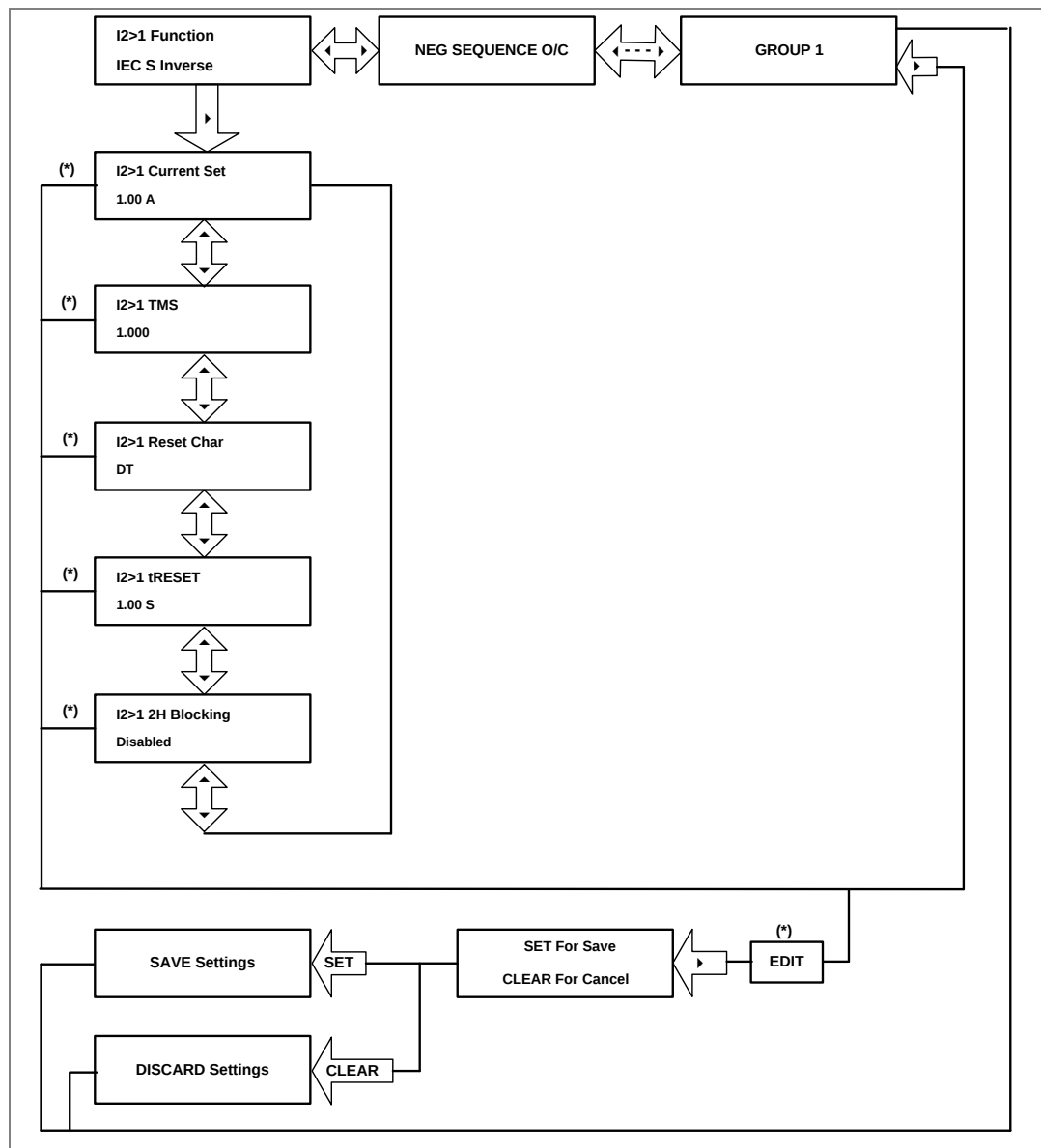
2.4.19 Negative Sequence Overcurrent Menu

2.4.19.1 View/Edit Settings (If setting is disabled)



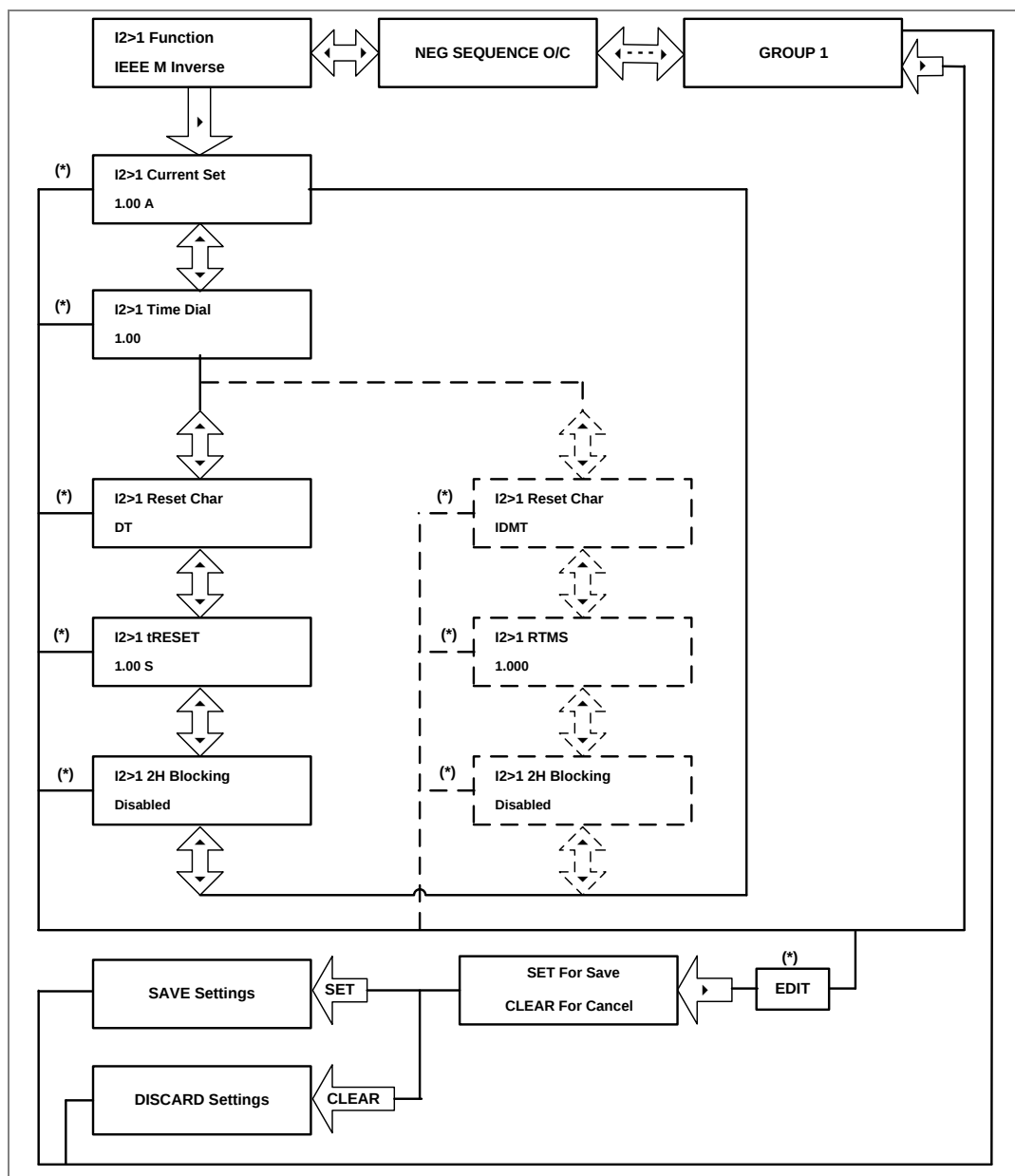
Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.19.2 View/Edit Settings (If setting is enabled for IEC curve)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

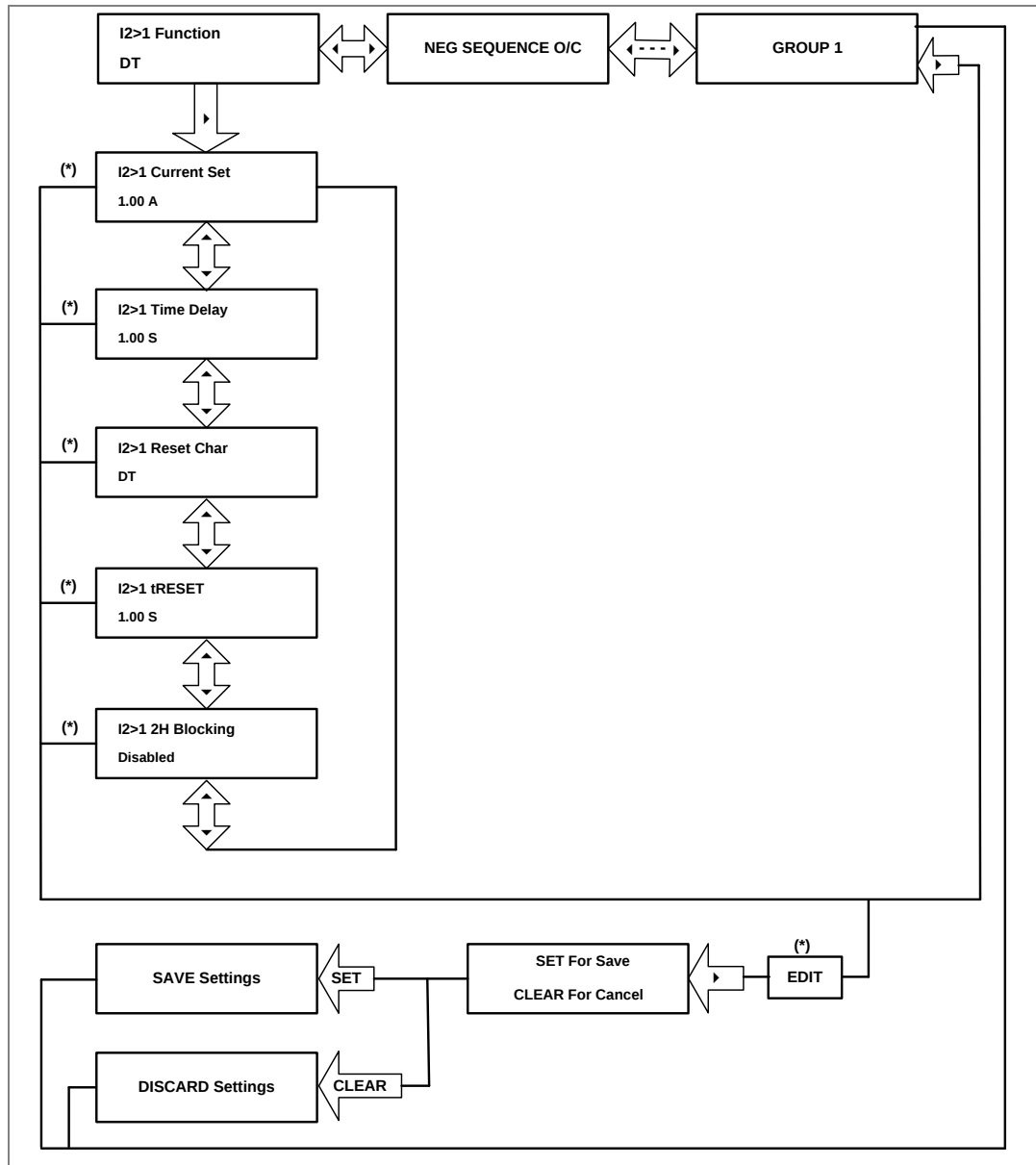
2.4.19.3 View/Edit Settings (If setting is enabled for IEEE curve)



Note: The display windows shown in dashed lines will be seen if the **I2>1 Reset Char** is selected as IDMT.

(*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

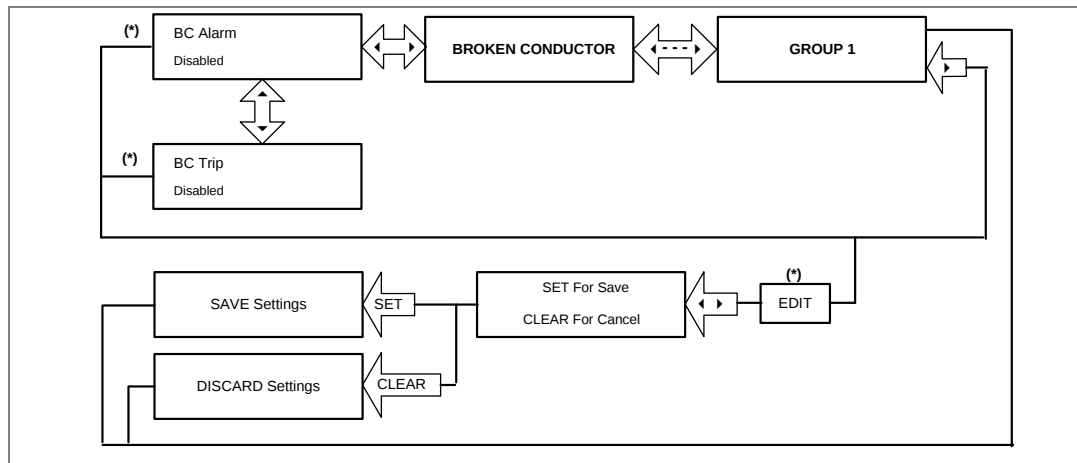
2.4.19.4 View/Edit Settings (If setting is enabled for DT)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

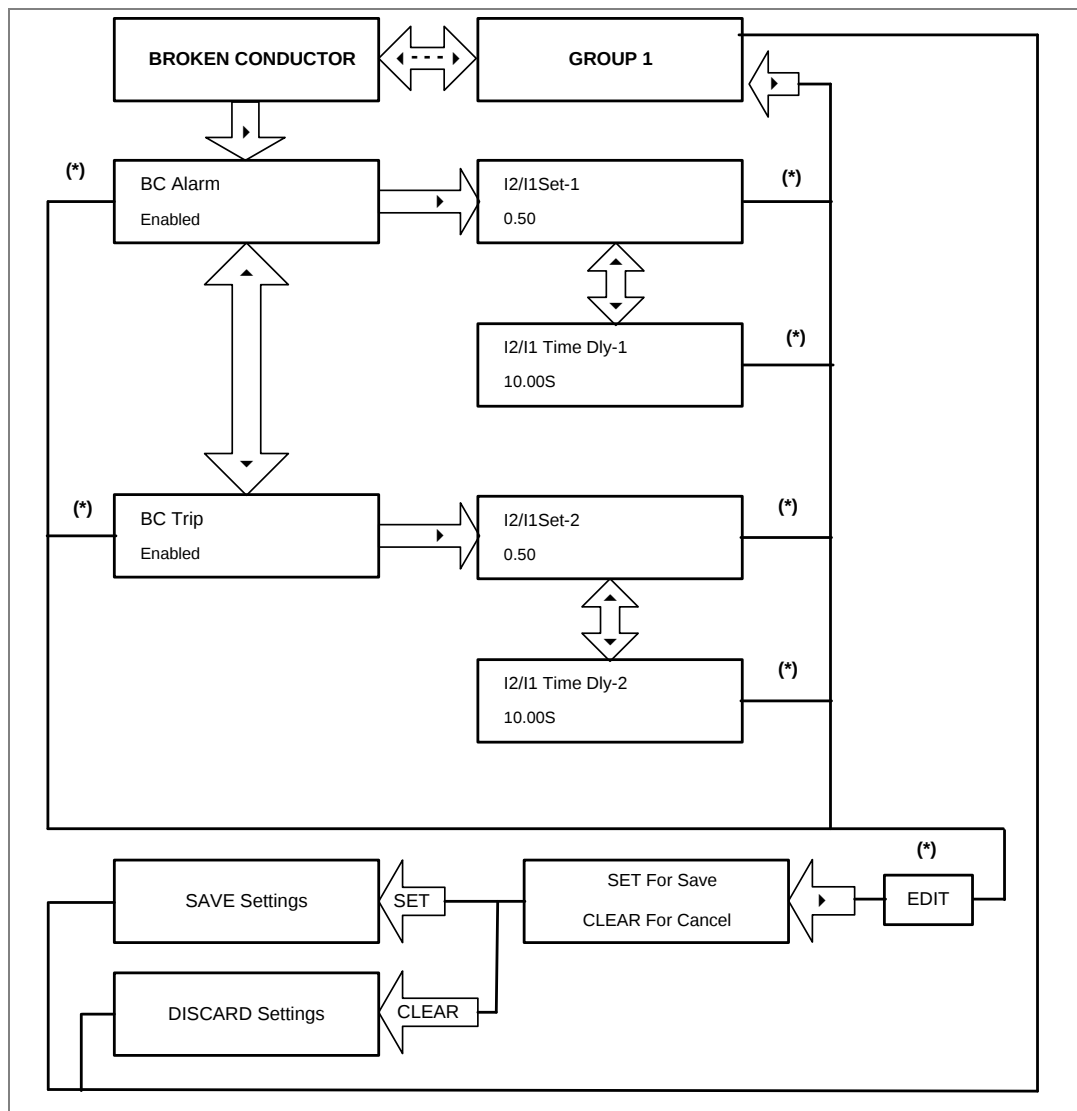
2.4.20 Broken Conductor Menu

2.4.20.1 View/Edit Settings (If setting is disabled)



Note: () indicates Edit key used to modify settings. Refer to the View and Edit settings section.*

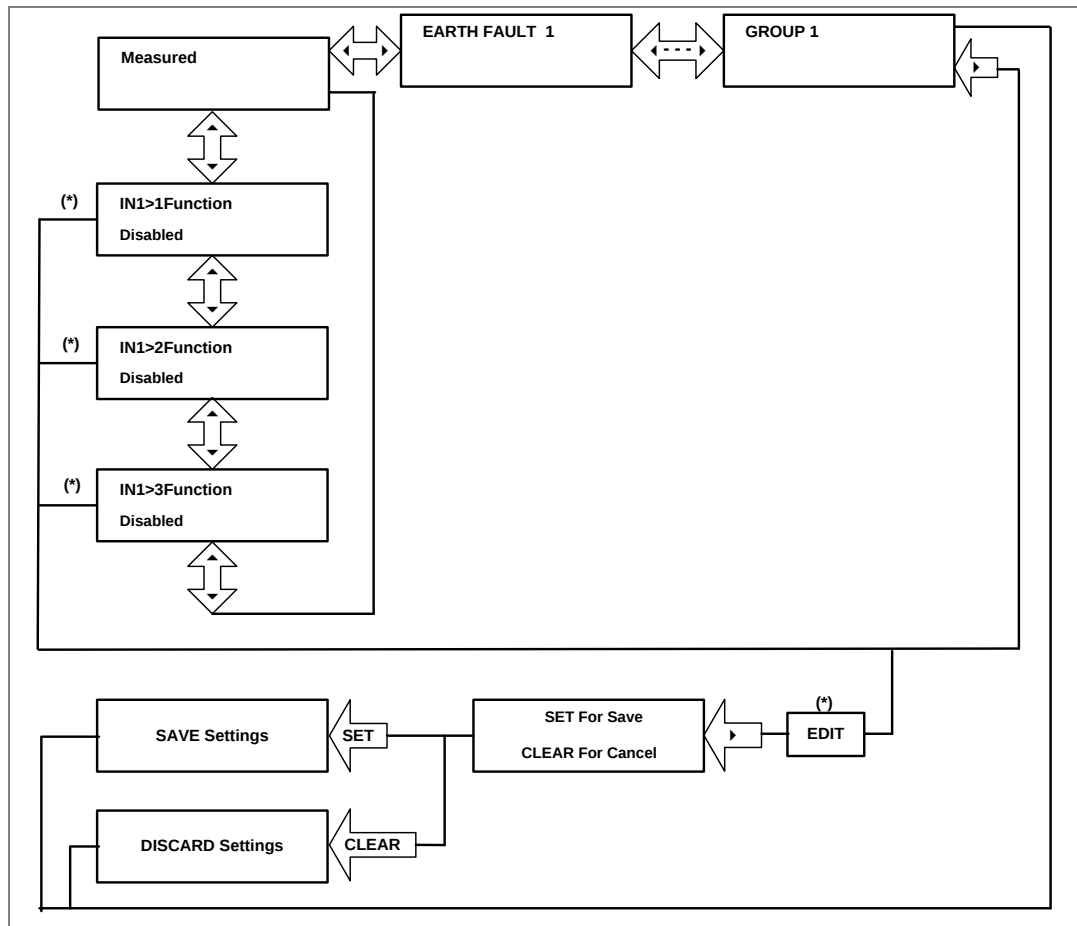
2.4.20.2 View/Edit Settings (If setting is enabled)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

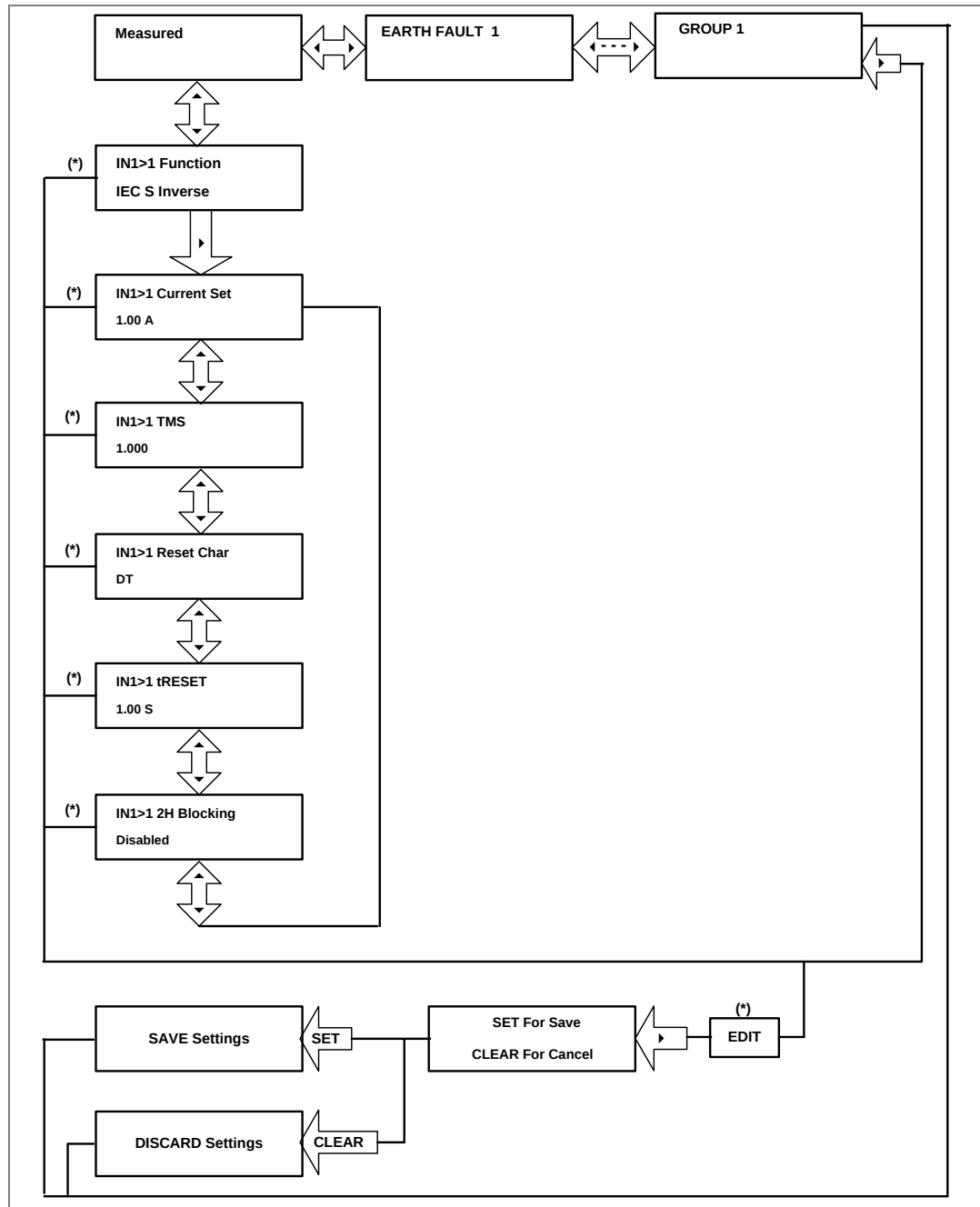
2.4.21 Group 1- Earth Fault 1 Submenu

2.4.21.1 View/Edit Settings (If setting is disabled)



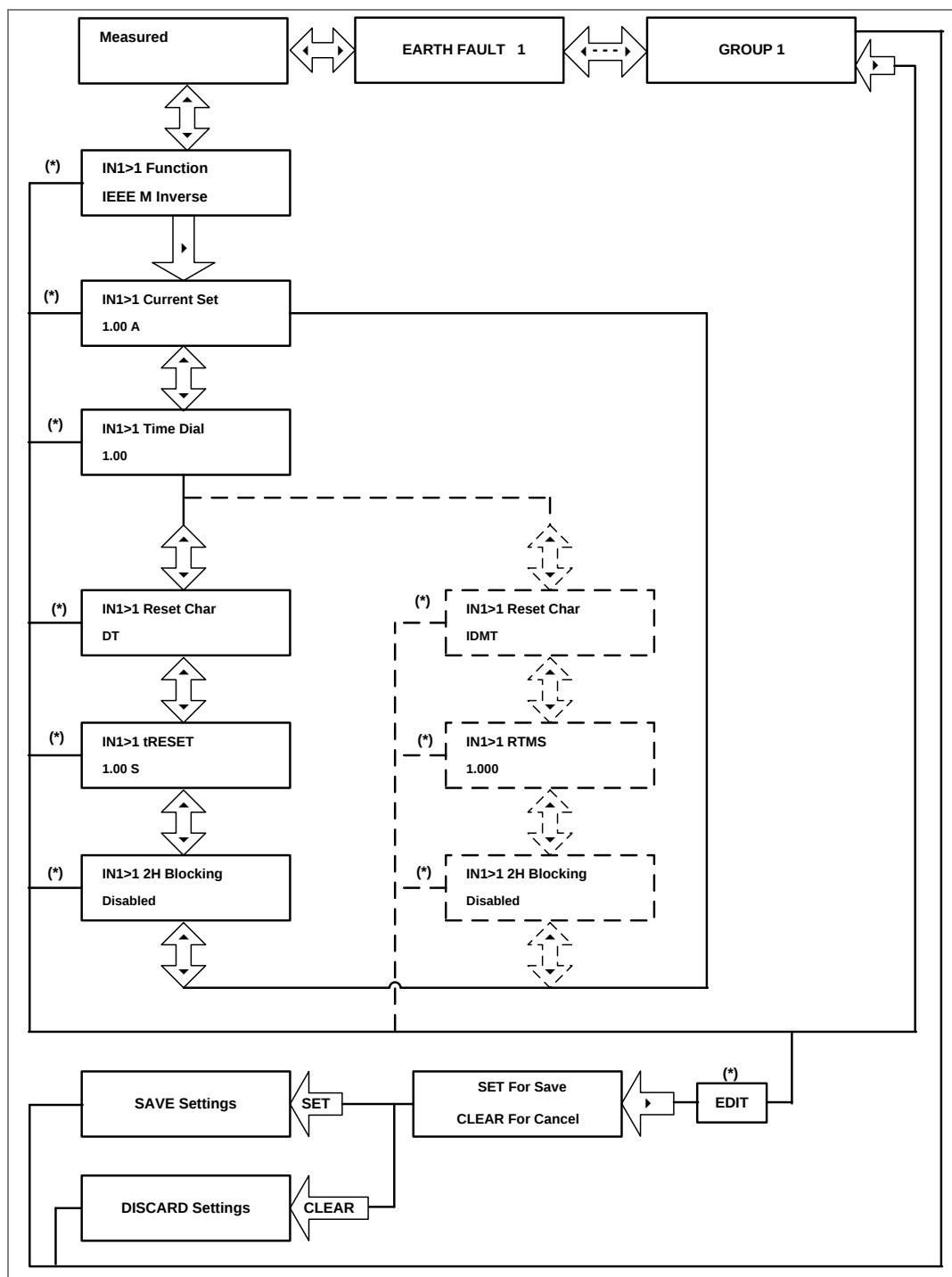
Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.21.2 View/Edit Settings (If setting is enabled for IEC curve)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

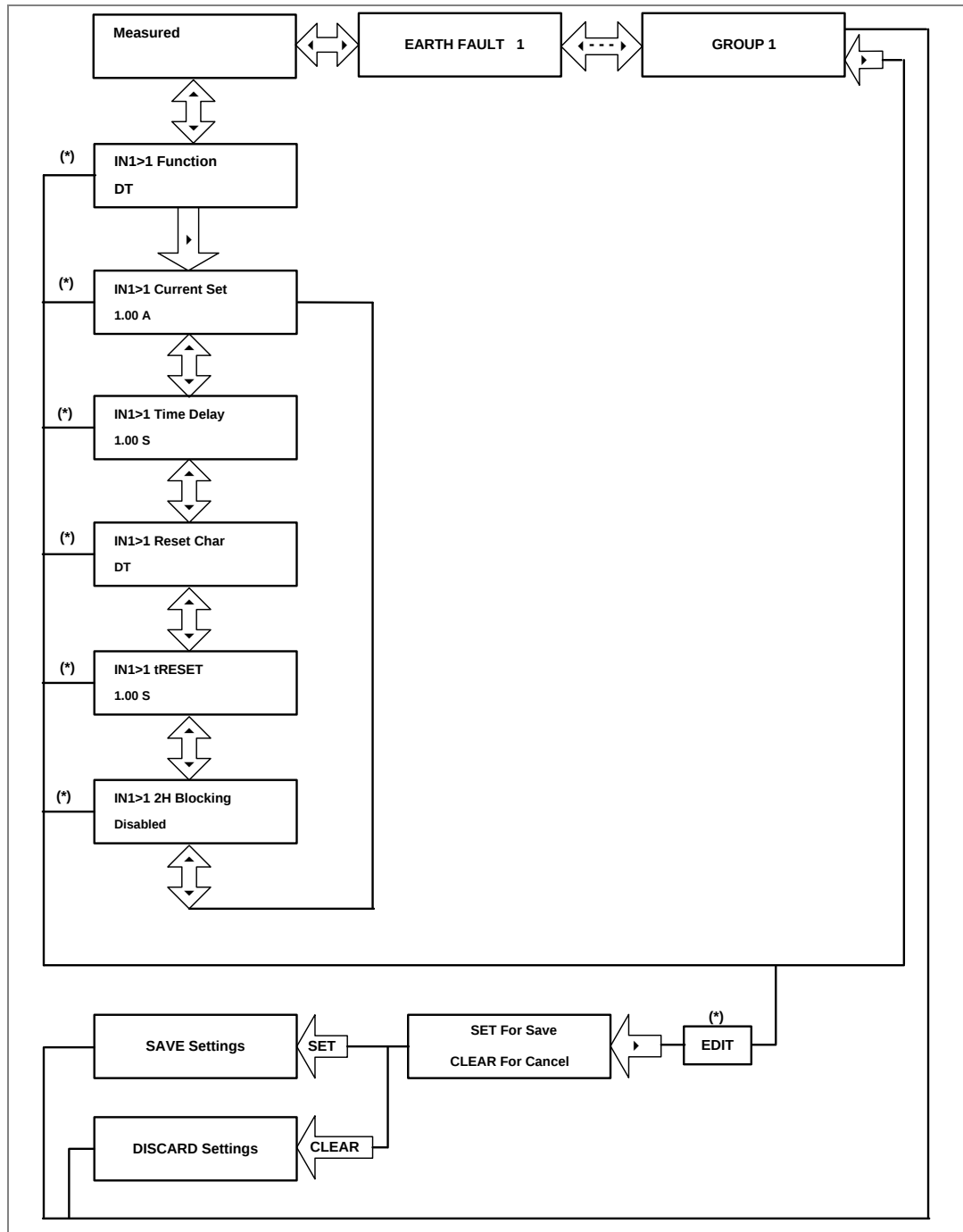
2.4.21.3 View/Edit Settings (If setting is enabled for IEEE curve)



Note: The display windows shown in dashed lines will be seen if the **IN1>1 Reset Char** is selected as **IDMT**.

(*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

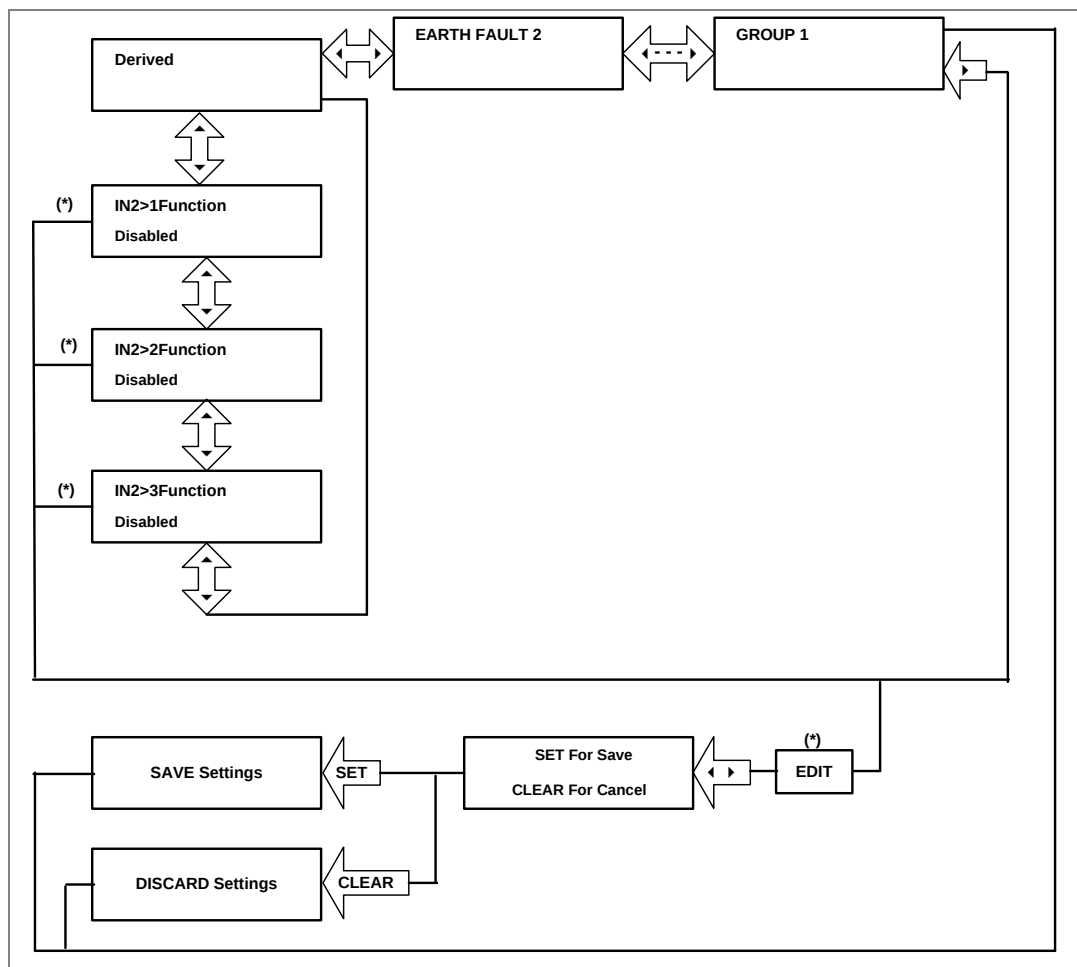
2.4.21.4 View/Edit Settings (If setting is enabled for DT)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

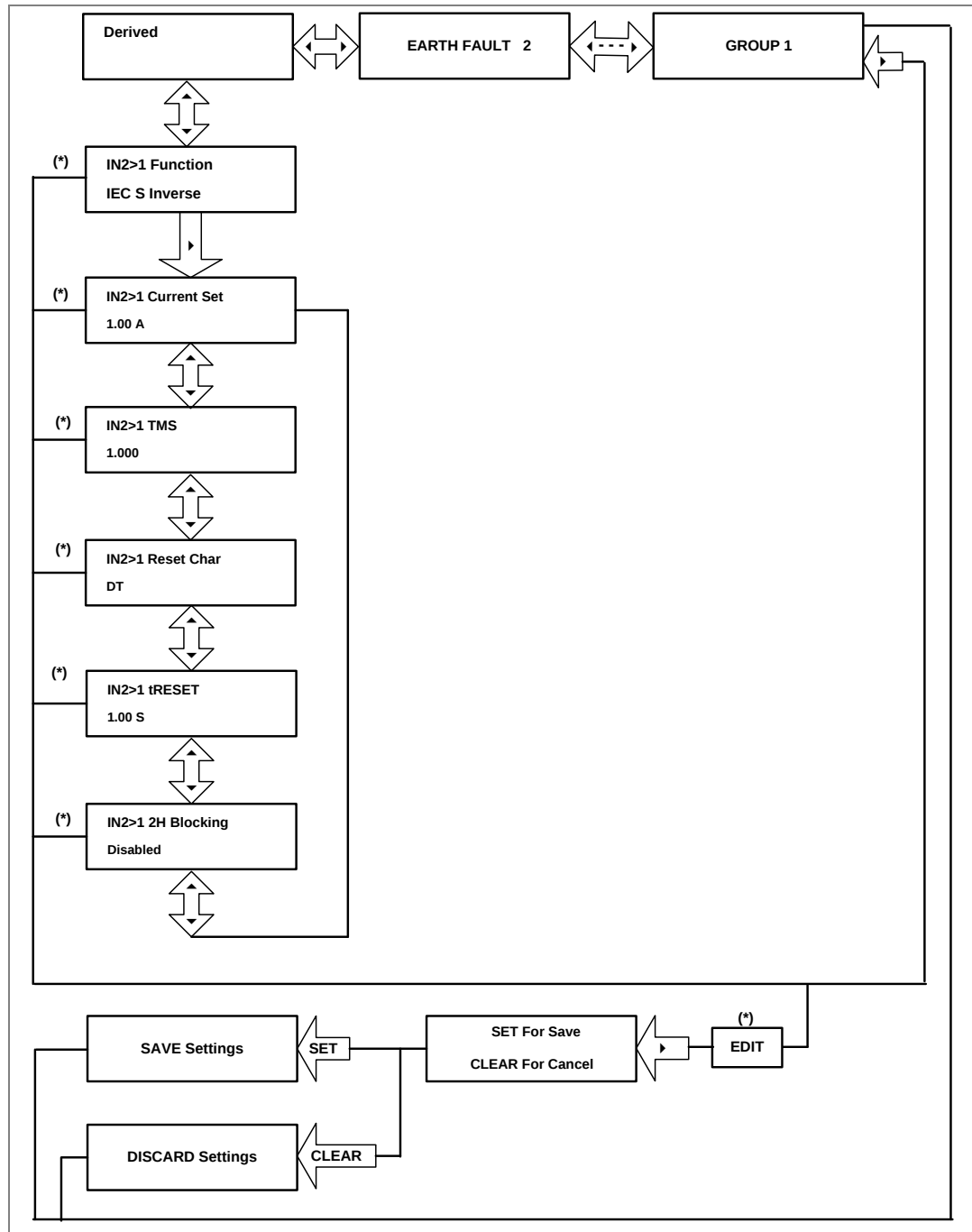
2.4.22 Group 1-Earth Fault 2 Submenu

2.4.22.1 View/Edit Settings (If setting is disabled)



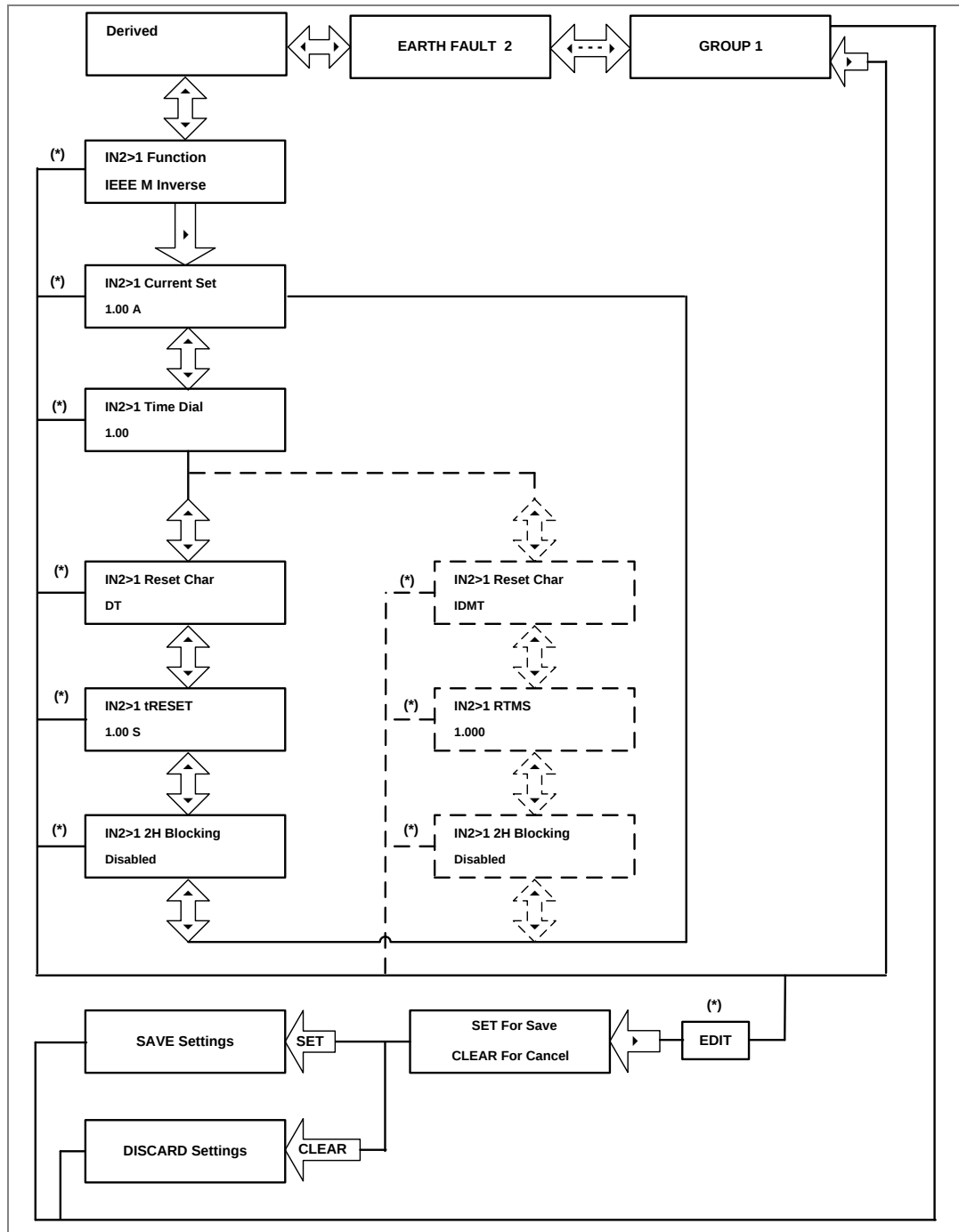
Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.22.2 View/Edit Settings (If setting is enabled for IEC curve)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

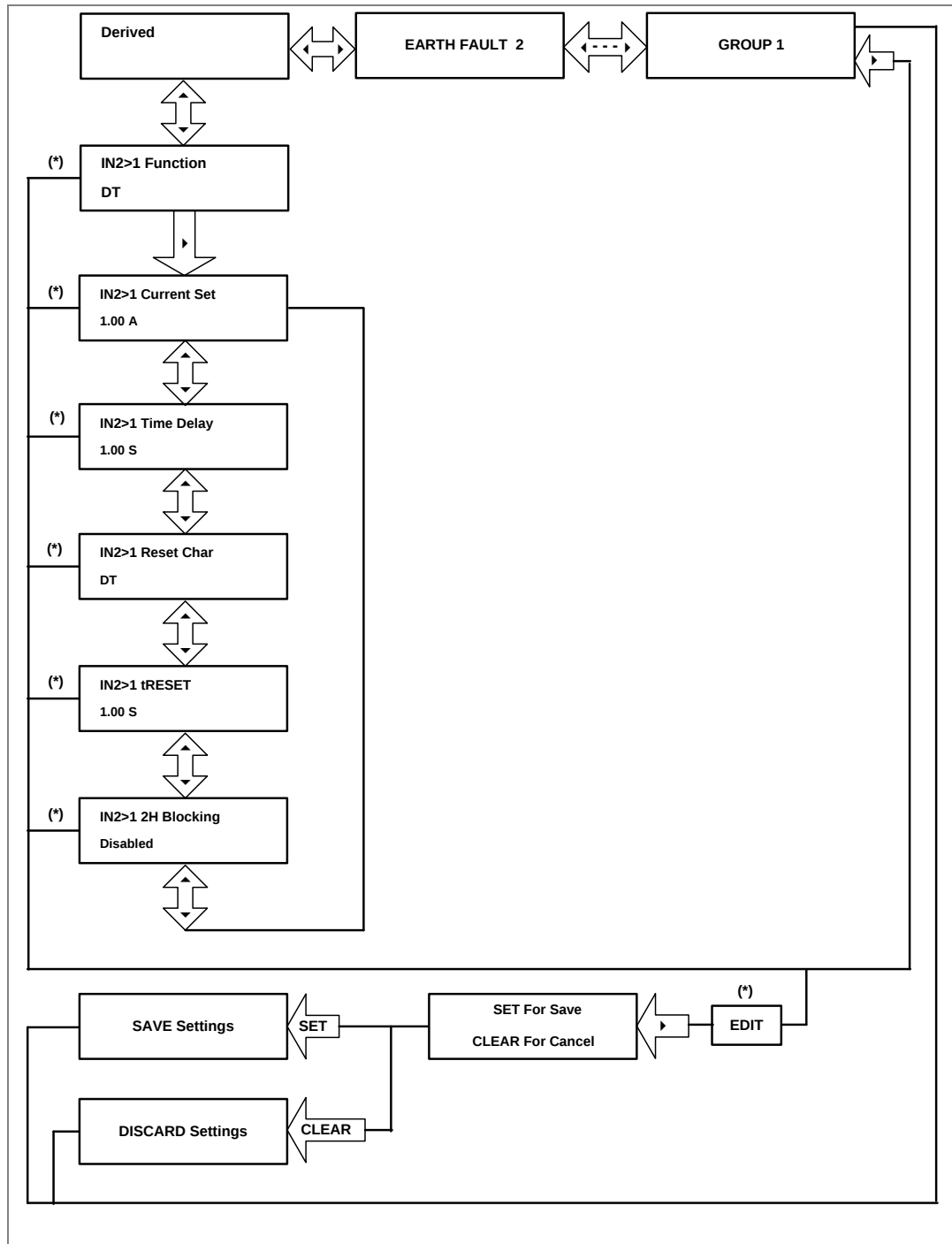
2.4.22.3 View/Edit Settings (If setting is enabled for IEEE curve)



Note: The display windows shown in dashed lines will be seen if the **IN2>1 Reset Char** is selected as **IDMT**.

(*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

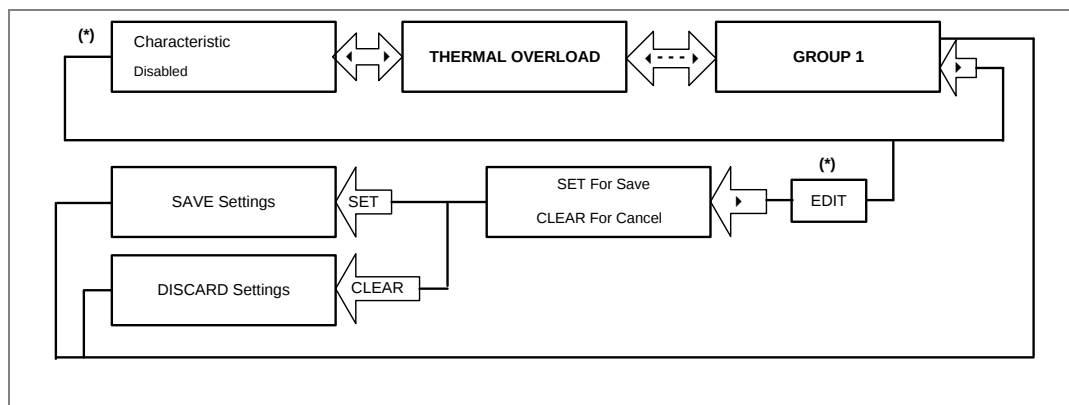
2.4.22.4 View/Edit Settings (If setting is enabled for DT)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

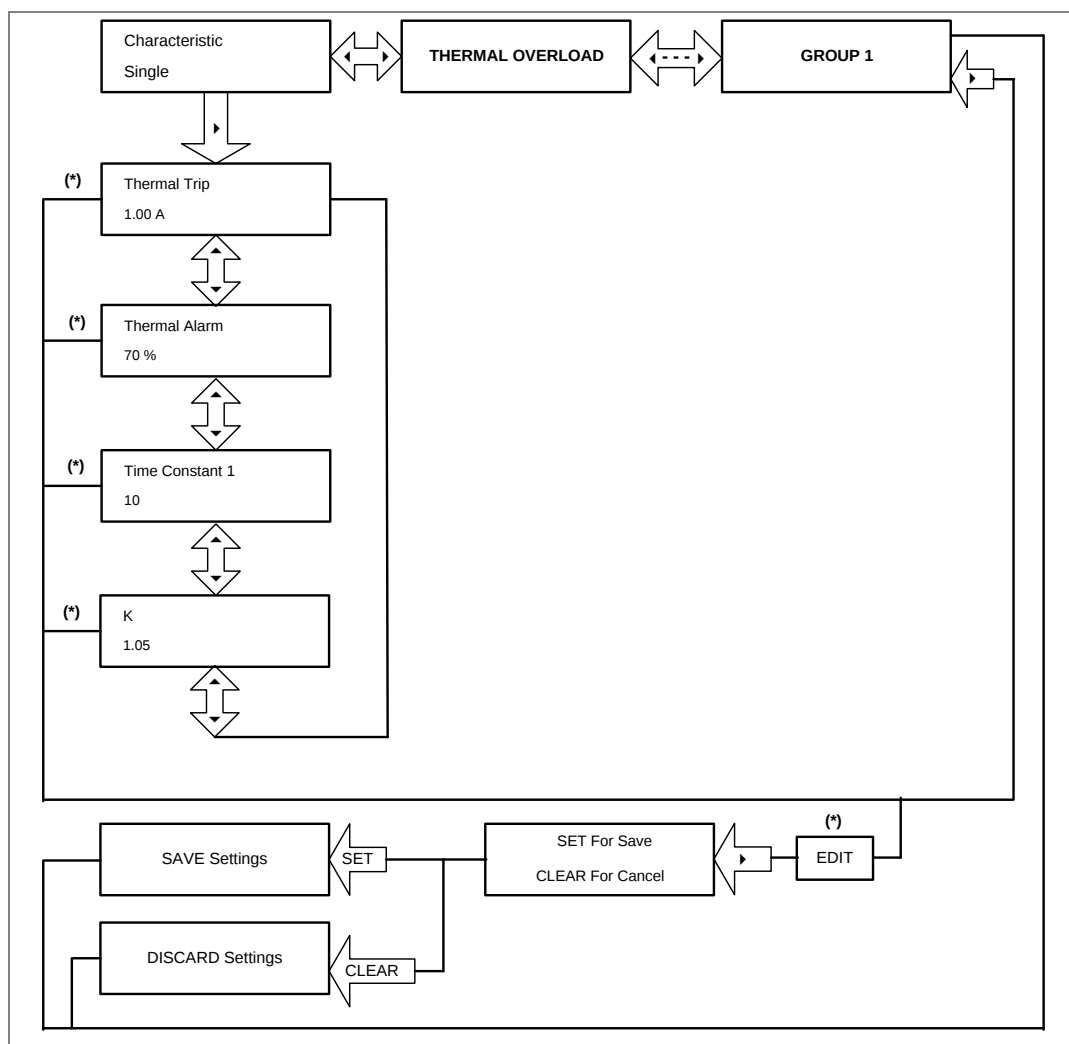
2.4.23 Group 1- Thermal Overload Submenu

2.4.23.1 View/Edit Settings (If Characteristics is disabled)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

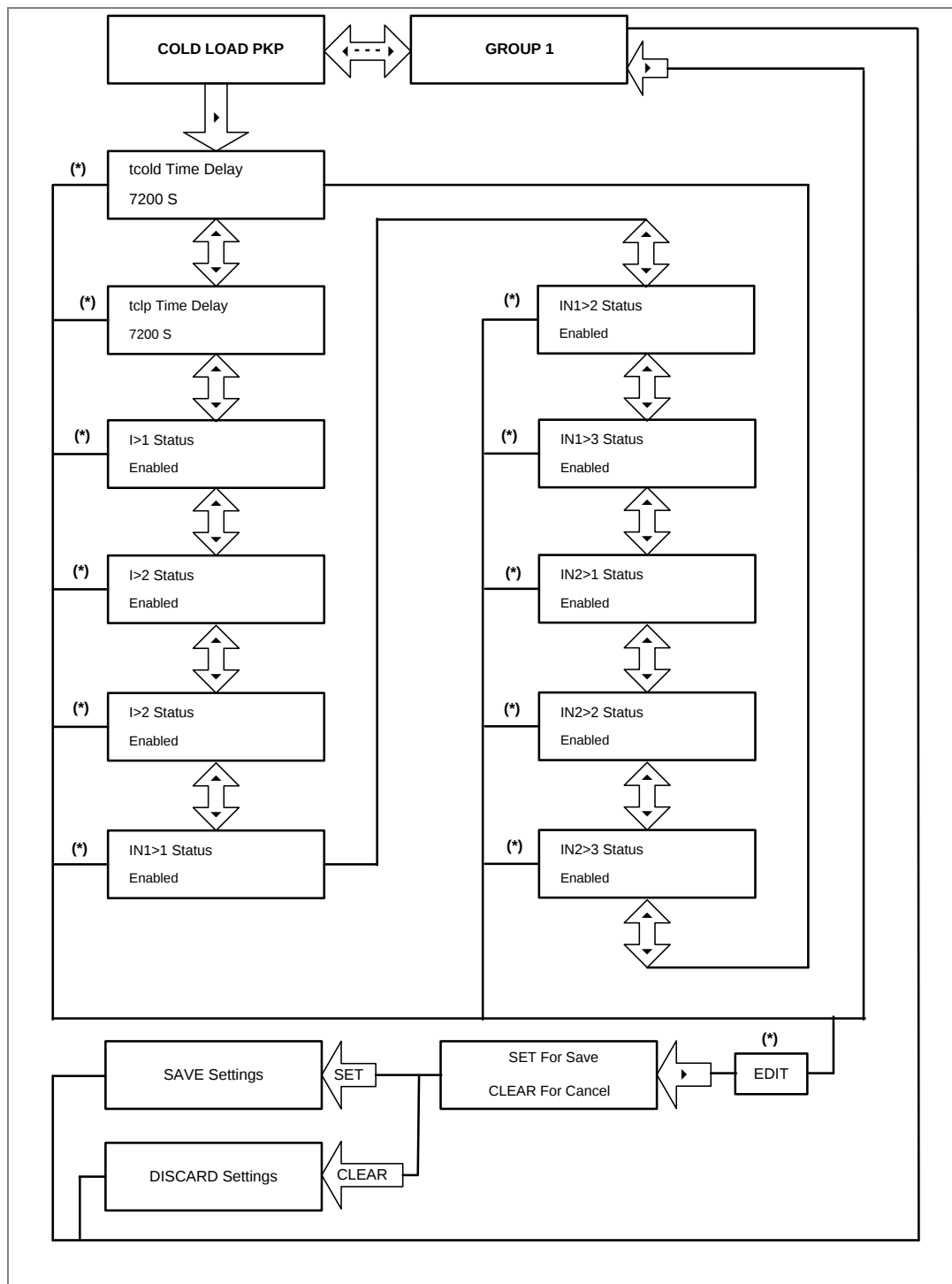
2.4.23.2 View/Edit Settings (If Characteristics is set as Single)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

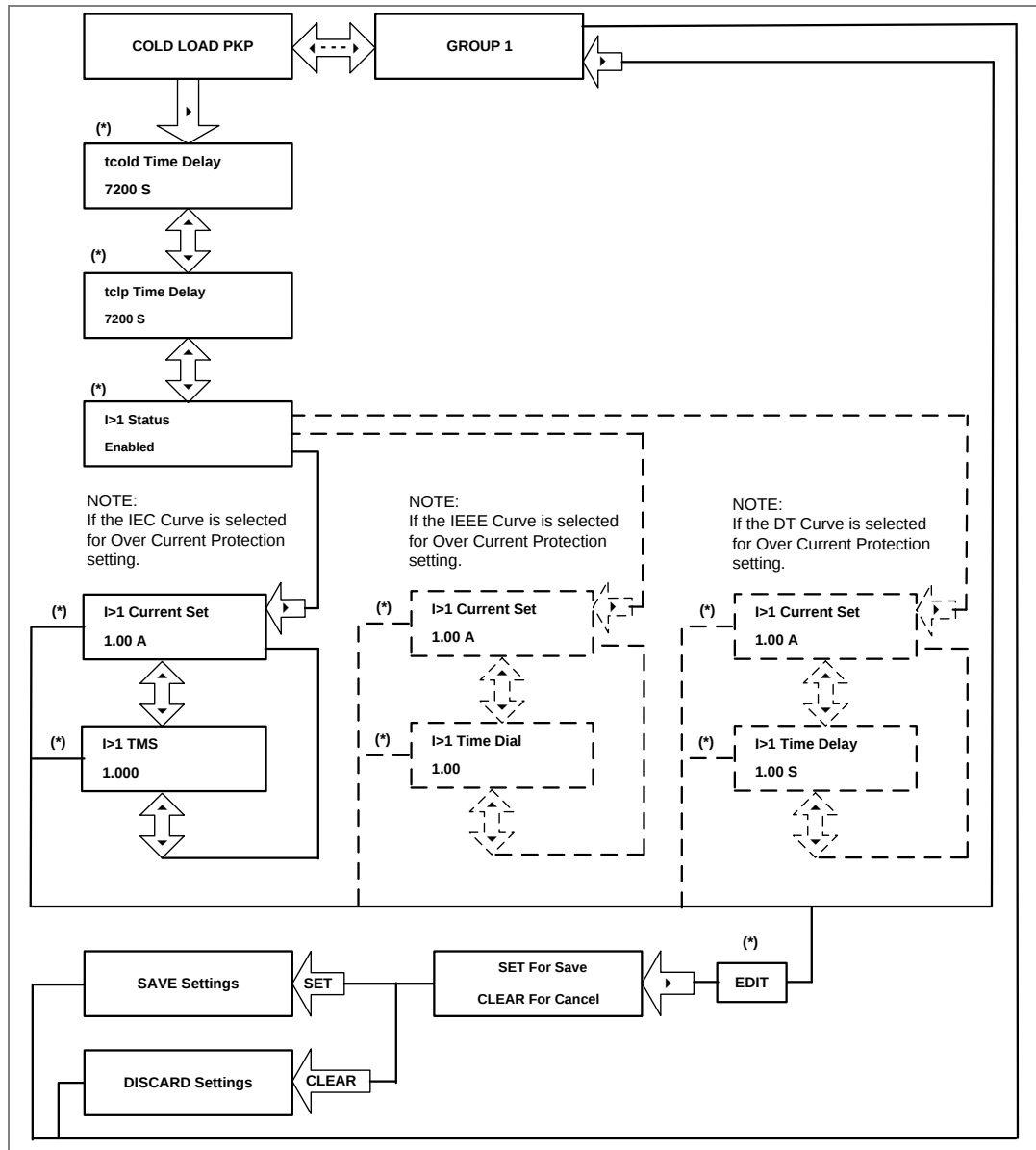
2.4.24 Group 1- Cold Load Pickup Submenu

2.4.24.1 View/Edit Settings



Note: () indicates Edit key used to modify settings. Refer to the View and Edit settings section.*

2.4.24.2 View/Edit Settings (I>1 Function)

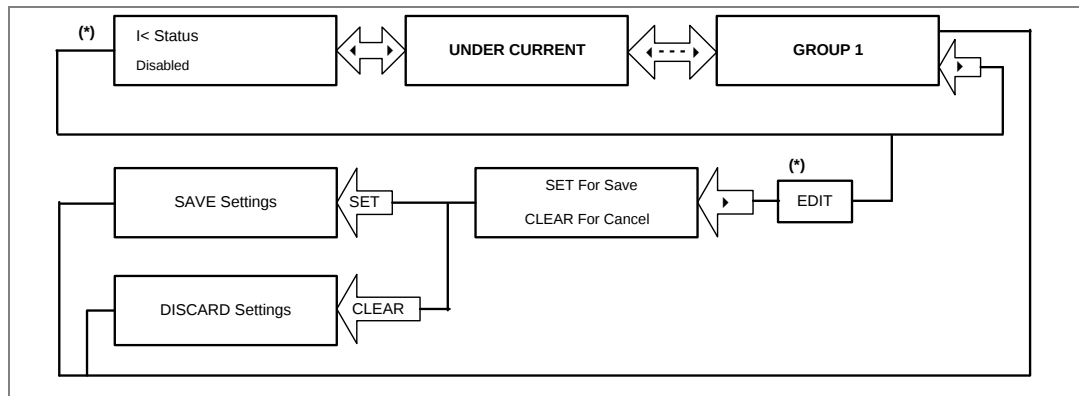


Note: The settings of I>2 Status, I>3 Status, IN1>1 Status, IN1>2 Status, IN1>3 Status, IN2>1 Status, IN2>2 Status, IN2>3 Status can be set in similar manner as that of I>1 Status.

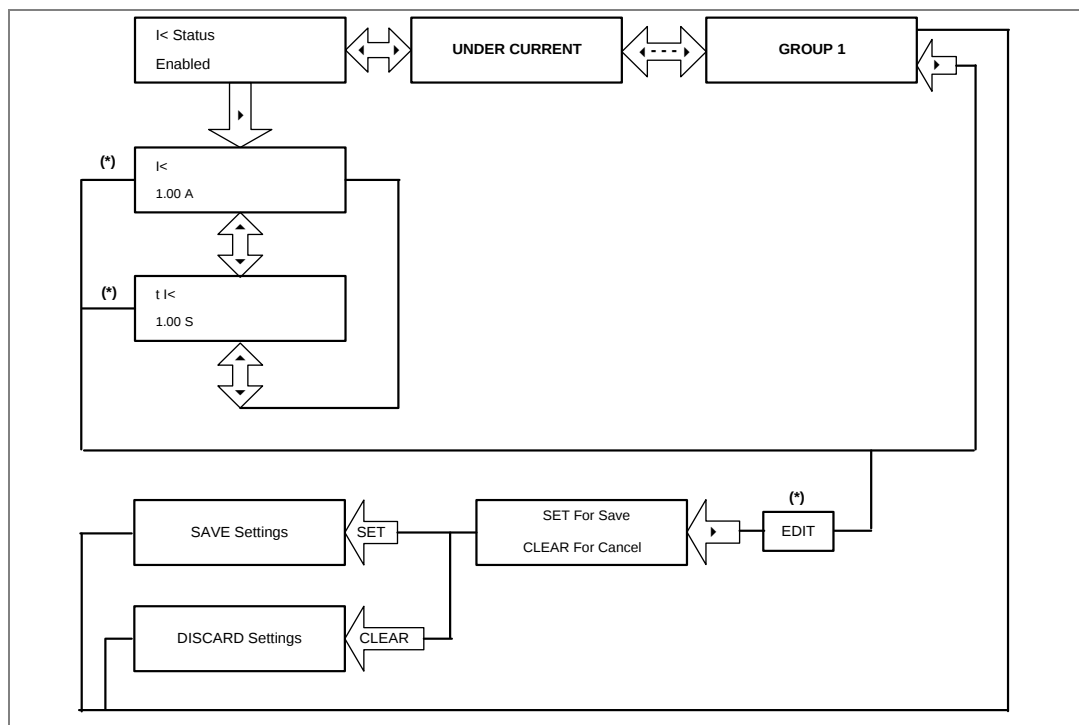
(*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.25 Group 1- Undercurrent Submenu

2.4.25.1 View/Edit Settings (If I< Status is disabled)

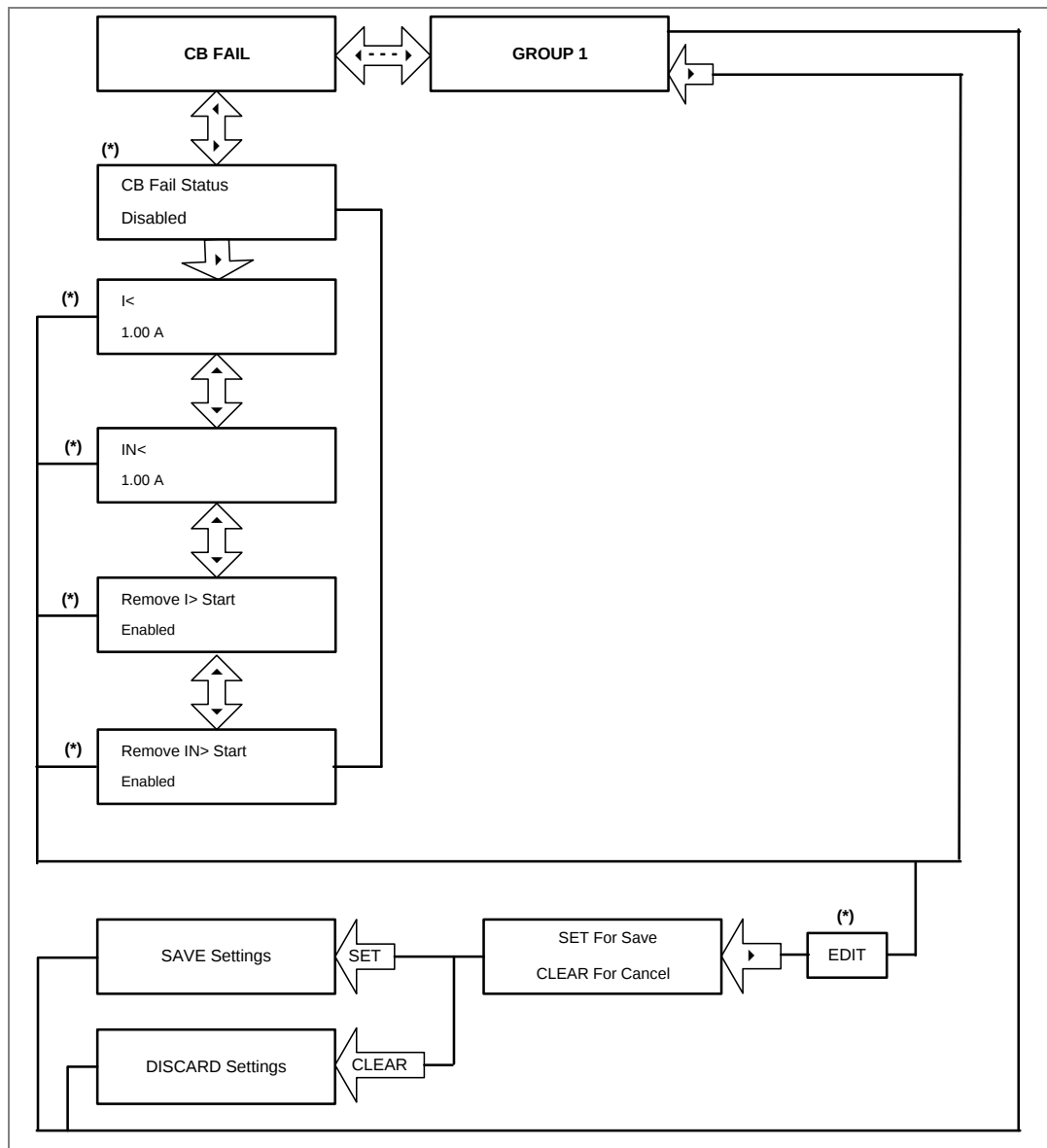


2.4.25.2 View/Edit Settings (If I< Status is enabled)



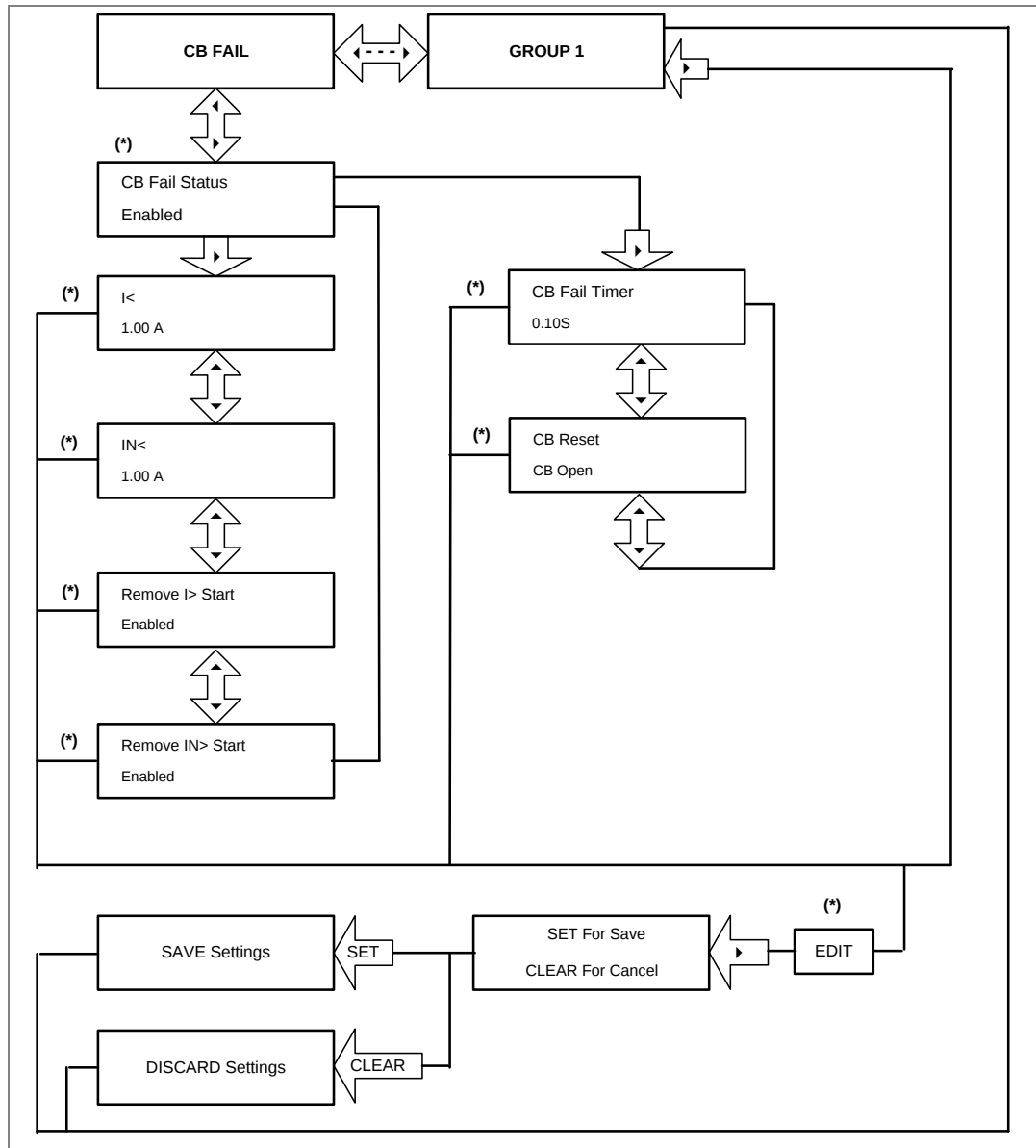
2.4.26 Group 1- CB Fail Submenu

2.4.26.1 View/Edit Settings (If CB FAIL Status is disabled)

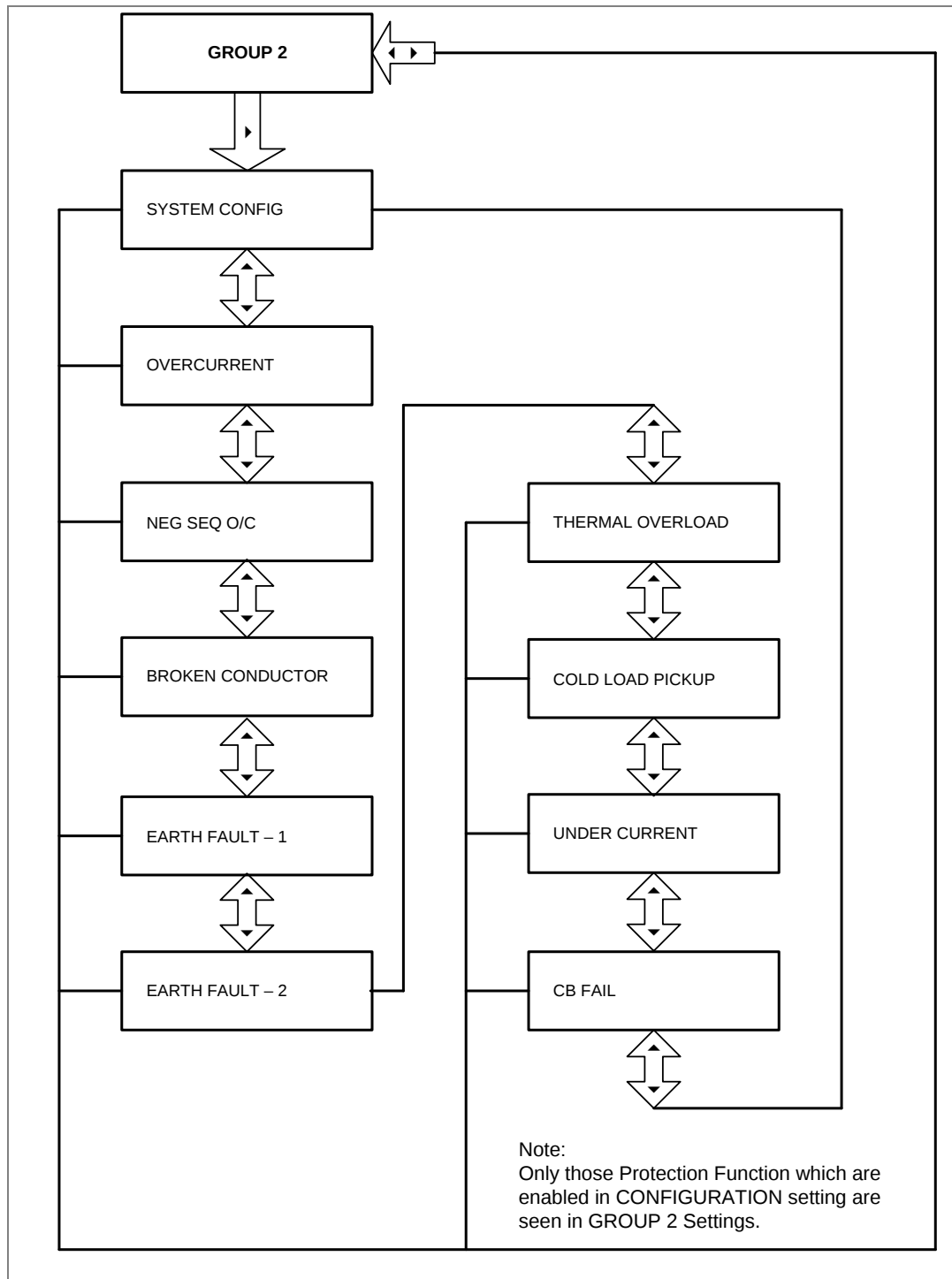


Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.26.2 View/Edit Settings (If CB FAIL Status is enabled)



Note: (*) indicates Edit key used to modify settings. Refer to the View and Edit settings section.

2.4.27 Group 2 Menu**2.4.27.1 View/Edit Settings**

PROTECTION FUNCTIONS

CHAPTER 6

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

1	Chapter Overview
2	Protection functions
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2.1.1	IDMT Characteristics
2.1.2	Principle of Protection Function Implementation
2.1.3	Timer Hold Facility/Reset Characteristics
2.2	Phase Overcurrent Protection
2.2.1	Phase Overcurrent Protection Implementation
2.3	Negative Sequence Overcurrent Protection
2.3.1	Negative Sequence Overcurrent Protection Implementation
2.3.2	Negative Sequence Overcurrent Protection Logic
2.4	Earth Fault Protection
2.4.1	Earth Fault Protection Elements
2.4.2	Earth Fault Protection Logic
2.5	Sensitive Earth Fault Protection
2.5.1	Sensitive Earth Fault Protection (ordering option)
2.6	Restricted Earth Fault Protection
2.6.1	Restricted Earth Fault implementation
2.6.2	Application Note
2.6.2.1	High Impedance REF
2.7	Thermal Overload Function
2.7.1	Thermal Overload Protection Implementation
2.8	Broken Conductor
2.8.1	Broken Conductor Protection Implementation
2.8.2	Broken Conductor Protection Logic
2.9	Undercurrent /Loss of Power Protection Function
2.10	Circuit Breaker Fail Protection
2.10.1	Circuit Breaker Fail Implementation
2.10.2	Circuit Breaker Fail Logic
2.11	Cold Load Pickup Function
2.11.1	Cold Load Pickup Logic
2.11.2	Cold Load Pickup for SWITCH ONTO FAULT Condition
2.12	Inrush Current Blocking Function (2ND Harm Blocking)
2.12.1	Second Harmonic Blocking Implementation

2 PROTECTION FUNCTIONS

2.1 Overcurrent Protection Principles

Most power system faults result in an overcurrent of some kind. It is the job of protection devices, formerly known as relays but now known as Intelligent Electronic Devices (IEDs), to protect the power system from such faults. The general principle is to isolate the faults as quickly as possible to limit the danger and prevent unwanted fault currents flowing through systems, which can cause severe damage to equipment and systems. At the same time, we wish to switch off only the parts of the grid that are absolutely necessary, to prevent unnecessary blackouts. The protection devices that control the tripping of the grid's circuit breakers are highly sophisticated electronic units, providing an array of functionality to cover the different fault scenarios for a multitude of applications.

The described products offer a range of overcurrent protection functions including:

- Phase Overcurrent protection
- Earth Fault Overcurrent protection
- Negative Sequence Overcurrent protection
- Sensitive Earth Fault protection
- Restricted Earth Fault protection

To ensure that only the necessary circuit breakers are tripped and that these are tripped with the smallest possible delay, the IEDs in the protection scheme need to co-ordinate with each other. Various methods are available to achieve correct co-ordination between IEDs in a system.

These are:

- By means of time alone
- By means of current alone
- By means of a combination of both time and current.

Grading by means of current is only possible where there is an appreciable difference in fault level between the two locations where the devices are situated. Grading by time is used by some utilities but can often lead to excessive fault clearance times at or near source substations where the fault level is highest. For these reasons the most commonly applied characteristic in co-ordinating overcurrent devices is the IDMT (Inverse Definite Minimum Time) type.

The relay is designed for three stages programmable OC and EF functions. All three stages of overcurrent and earth fault protection function are programmable as Inverse Definite Minimum Time (IDMT) or Definite Time (DT) delay.

2.1.1 IDMT Characteristics

All three stages of Overcurrent and Earth fault functions are programmable as per IDMT characteristic based on IEC and IEEE standards. The inverse time delay is calculated with the following mathematical formula:

$$t = T * \left(\frac{K}{\left(\frac{I}{I_s} \right)^\alpha - 1} + L \right)$$

where;

t: Operation time

K: Constant (see the table)

I: Measured current

Is: Current threshold setting

α : Constant (see the table)

L: ANSI/IEEE constant (zero for IEC curve)

T: Time multiplier setting (TMS) for IEC curves or Time dial setting (TD) for IEEE curves

Description	Standard	K	α	L
Define Time	DT	-	-	0
Standard Inverse	IEC	0.14	0.02	0
Standard Inverse(1.3sec)	---	0.06	0.02	0
Very Inverse	IEC	13.5	1	0
Extremely inverse	IEC	80	2	0
Long Time Inverse	UK	120	1	0
Moderate Inverse	IEEE	0.0515	0.02	0.114
Very Inverse	IEEE	19.61	2	0.491
Extremely Inverse	IEEE	28.2	2	0.1217
US Inverse	CO8	5.95	2	0.18
US Short Time Inverse	CO2	0.02394	0.02	0.01694

2.1.2 Principle of Protection Function Implementation

An energising quantity is a current input from a system current transformer or another quantity derived from the current input. The energising quantities are extracted from the power system and presented to the IED in the form of analogue signals. These analogue signals are then converted to digital quantities where they can be processed by the IEDs internal processor.

In general, an energising quantity is compared with a threshold value, which may be settable or hard-coded depending on the function. If the quantity exceeds (for overvalues) or falls short of (for undervalues) the threshold, a signal is produced, which when gated with the various inhibit and blocking functions becomes the Start signal for that protection function. This Start signal is generally made available to Fixed Scheme logic for further processing. It is also passed through a timer function to produce the Trip signal. The timer function may be an IDMT curve, or a Definite Time delay, depending on the function. The timer can be configured by a range of settings to define such parameters as the type of curve, The Time Multiplier Setting, the IDMT constants and Definite Time delay.

In P154 there are several independent stages for each of the functions. All the stages (1, 2 and 3) can be set for DT/IDMT timer function. If the DT time delay is set to '0', then the function is known to be "instantaneous". In many instances the term "instantaneous protection" is used loosely to describe Definite Time protection stages even when the stage may not theoretically be instantaneous.

2.1.3 Timer Hold Facility/Reset Characteristics

This feature may be useful in certain applications, such as when grading with upstream electromechanical overcurrent relays, which have inherent reset time delays. If you set the hold timer to a value other than zero, the resetting of the protection element timers will be delayed for this period. This allows the element to behave in a similar way to an electromechanical relay. If you set the hold timer to zero, the overcurrent timer for that stage will reset instantaneously as soon as the current falls below a specified percentage of the current setting (typically 95%).

Another possible situation where the timer hold facility may be used to reduce fault clearance times is for intermittent faults. An example of this may occur in a plastic insulated cable. In this application it is possible for the fault energy to melt and reseal the cable insulation, thereby extinguishing the fault. This process repeats to give a succession of fault current pulses, each of increasing duration with reducing intervals between the pulses, until the fault becomes permanent.

When the reset time is instantaneous, the device will repeatedly reset and not be able to trip until the fault becomes permanent. By using the Timer Hold facility the device will integrate the fault current pulses, thereby reducing fault clearance time.

The timer hold facility is available to all three stages of OC and EF functions.

The Definite Time Reset characteristic is applicable for IEC curves / DT.

The value of the Reset Timer depends on the type of the timer associated to the pick-up phase (Earth) threshold.

Type of timer associated with phase (earth) threshold	Reset Timer	
	DT Reset Characteristic	IDMT Reset Characteristic
- For DT time delay	0 – 100 sec	Not available
- For IDMT IEC time delay	0 – 100 sec	Not available
- For IDMT IEEE or CO time delay	0 – 100 sec	Based on RTMS value (0.025-1.2)

The mathematical formula applicable to the five curves is:

$$t = \frac{RTMS \times K}{1 - (I / I_s)^\alpha}$$

Where:

- t** = Reset time
K = Factor (see table)
I = Value of the measured current
I_s = Value of the programmed threshold (pick-up value)
α = Factor (see table)
RTMS Reset time multiplier (RTMS) setting is between 0.025 and 1.2

Description	Standard	K	α
Moderate Inverse	IEEE	4.85	2
Very Inverse	IEEE	21.6	2
Extremely Inverse	IEEE	29.1	2
US Inverse	CO8	5.95	2
US Short Time Inverse	CO2	2.261	2

2.2 Phase Overcurrent Protection

Phase current faults are faults where fault current flows between two or more phases of a three-phase power system. The fault current may be between the phase conductors only or, between two or more phase conductors and earth. There are three types of phase fault:

- Line to Line (accounting for approximately 8% of all faults)

- Line to Line to Earth (accounting for approximately 5% of all faults)
- Line to Line to Line (accounting for approximately 2% of all faults)

Although not as common as earth faults (single line to earth), phase faults are typically more severe.

An example of a phase fault is where a fallen tree branch bridges two or more phases of an overhead line.

2.2.1 Phase Overcurrent Protection Implementation

Phase Overcurrent Protection is implemented in the **OVERCURRENT** column of the relevant settings group.

The product provides three stages of three-phase overcurrent protection with independent time delay characteristics. All settings apply to all three phases but are independent for each of the three stages.

Stages 1, 2 and 3 provide a choice of operate and reset characteristics, where you can select between:

- A range of standard IDMT (Inverse Definite Minimum Time) curves
- DT (Definite Time)

This is achieved using the cells

- **I>(n) Function** for the overcurrent operate characteristic
- **I>(n) Reset Char** for the overcurrent reset characteristic

where (n) is the number of the stage.

The IDMT-capable stages, (1, 2 and 3) also provide a Timer Hold facility. This is configured using the cells **I>(n) tRESET**, where (n) is the number of the stage. Timer Hold facility is applicable for both IEC and IEEE curves. IEEE & US curves have IDMT reset curve option in addition to DT Phase Overcurrent protection logic.

Phase Overcurrent modules are level detectors that detect when the current magnitude exceeds a set threshold. When this happens, the Phase Overcurrent module in question issues a signal to produce the **Start** signal. This **Start** signal is applied to the IDMT/DT timer module. It is also made available directly to the user for use in the logic functions.

There are three Phase Overcurrent Modules, one for each phase. The three **Start** signals from each of these phases and common **Start** signal for each stage of phase overcurrent function is available for customer use.

The outputs of the IDMT/DT timer modules are the trip signals which are used to drive the tripping output relay. The three **Trip** signals from each of the phases and common **Trip** signal for each stage of phase overcurrent function is available for customer use.

The Phase overcurrent trip signal can be blocked by:

- The Second Harmonic blocking function which is for all three phases. The blocking is activated by setting the **I> (n) 2H Blocking** cell to 'Enabled', where (n) is the number of the stage.
- User defined blocking logic using 'IO Mask' functionality.

The Phase Overcurrent threshold setting can be influenced by the Cold Load Pickup (CLP) function, if this functionality is available and used.

2.3 Negative Sequence Overcurrent Protection

When applying standard phase overcurrent protection, the overcurrent elements must be set significantly higher than the maximum load current, thereby limiting the element's sensitivity. Most protection schemes also use an earth fault element operating from residual current, which improves sensitivity for earth faults.

However, certain faults may arise which can remain undetected by such schemes. Negative Sequence Overcurrent elements can be used in such cases.

Any unbalanced fault condition will produce a negative sequence current component. Therefore, a negative phase sequence overcurrent element can be used for both phase-to-phase and phase-to-earth faults.

Negative Sequence Overcurrent protection offers the following advantages:

- Negative phase sequence overcurrent elements are more sensitive to resistive phase-to-phase faults, where phase overcurrent elements may not operate.
- In certain applications, residual current may not be detected by an earth fault element due to the system configuration. For example, an earth fault element applied on the delta side of a delta-star transformer is unable to detect earth faults on the star side. However, negative sequence current will be present on both sides of the transformer for any fault condition, irrespective of the transformer configuration. Therefore, a negative phase sequence overcurrent element may be used to provide time-delayed back-up protection for any uncleared asymmetrical faults downstream.
- Where rotating machines are protected by fuses, loss of a fuse produces a large amount of negative sequence current. This is a dangerous condition for the machine due to the heating effect of negative phase sequence current. An upstream negative phase sequence overcurrent element could therefore be applied to provide back-up protection for dedicated motor protection relays.
- It may be sufficient to simply trigger an alarm to indicate the presence of negative phase sequence currents on the system. Operators may then investigate the cause of the imbalance.

2.3.1 Negative Sequence Overcurrent Protection Implementation

Negative Sequence Overcurrent Protection is implemented in the **NEG SEQUENCE O/C** column of the relevant settings group.

The product provides three stages of negative sequence overcurrent protection with independent time delay characteristics.

Stages 1, 2 and 3 provide a choice of operate and reset characteristics, where you can select between:

- A range of standard IDMT (Inverse Definite Minimum Time) curves
- DT (Definite Time)

This is achieved using the cells

- **I2>(n) Function** for the overcurrent operate characteristic
 - **I>(n) Reset Char** for the overcurrent reset characteristic
- where (n) is the number of the stage.

The IDMT-capable stages, (1, 2 and 3) also provide a Timer Hold facility. This is configured using the cells **I2>(n) tRESET**, where (n) is the number of the stage. Timer Hold facility is applicable for both IEC and IEEE curves. IEEE & US curves have IDMT reset curve option in addition to DT.

2.3.2 Negative Sequence Overcurrent Protection Logic

For Negative Phase Sequence Overcurrent Protection, the energising quantity **I2>** is compared with the threshold current **I2>(n) Current Set**. If the value exceeds this setting a Start signal (**Strt I2>(n)**) is generated, provided there are no blocks. 5% hysteresis is built into the comparator such that the drop-off value is 0.95 x of the current set threshold.

The Strt I2>(n) signal is fed into a timer to produce the Trip I2>(n) signal.

The Negative Sequence overcurrent trip signal can be blocked by:

- The Second Harmonic blocking function which is for all three phases. The blocking is activated by setting the **I2> (n) 2H Blocking** cell to 'Enabled', where (n) is the number of the stage.
- User defined blocking logic using 'IO Mask' functionality.

2.4 Earth Fault Protection

Earth faults are simply overcurrent faults where the fault current flows to earth (as opposed to between phases). They are the most common type of fault. There are a few different kinds of earth fault, but the most common is the single phase-to-earth fault. Consequently this is the first and foremost type of fault that protection devices must cover.

Typical settings for earth fault IEDs are around 30-40% of the full load current. If greater sensitivity is required, then Sensitive Earth Fault should be used.

Earth faults can be measured directly from the system by means of:

- A separate CT located in a power system earth connection
- A separate Core Balance CT (CBCT)
- A residual connection of the three line CTs, whereby the Earth faults can be derived mathematically by summing the three measured phase currents.

Depending on the device model, it will provide one or more of the above means for Earth fault protection.

2.4.1 Earth Fault Protection Elements

Earth fault protection is implemented in the columns **EARTH FAULT 1** and **EARTH FAULT 2** of the relevant settings group.

Each column contains an identical set of elements, whereby the **EARTH FAULT 1** (IN1) column is used for earth fault current that is measured directly from the system, whilst the **EARTH FAULT 2** (IN2) column contains cells, which operate from a residual current quantity that is derived internally from the summation of the three-phase currents.

The product provides three stages of Earth Fault protection with independent time delay characteristics, for each **EARTH FAULT** column.

Stages 1, 2 and 3 provide a choice of operate and reset characteristics, where you can select between:

- A range of standard IDMT (Inverse Definite Minimum Time) curves
- DT (Definite Time)

For the IN1 column, this is achieved using the cells:

- **IN1>(n) Function** for the overcurrent operate characteristics
- **I>(n) Reset Char** for the overcurrent reset characteristic

For the IN2 column, this is achieved using the cells:

- **IN2>(n) Function** for the overcurrent operate characteristics
- **I>(n) Reset Char** for the overcurrent reset characteristic

where (n) is the number of the stage.

Stages 1, 2 and 3 provide a Timer Hold facility. This is configured using the cells **IN1>(n) tRESET** for Earth Fault 1 and **IN2>(n) tRESET** for Earth Fault 2.

The fact that both EF1 and EF2 elements may be enabled at the same time leads to a number of application advantages.

2.4.2 Earth Fault Protection Logic

The Earth Fault current is compared with a set threshold (**IN1>(n) Current Set**) for each stage. If it exceeds this threshold, a Start signal is triggered, provided there are no blocks.

Earth Fault protection can follow the same IDMT characteristics as described in the Overcurrent Protection Principles section. Please refer to this section for details of IDMT characteristics.

The description also applies to the Earth Fault 2 element (IN2).

The Earth Fault protection trip signal can be blocked by:

- The Second Harmonic blocking function which is for all three phases. The blocking of Earth Fault 1 is activated by setting the **IN1> (n) 2H Blocking** cell to 'Enabled' and blocking of Earth Fault 2 is activated by setting the **IN2> (n) 2H Blocking** cell to 'Enabled', where (n) is the number of the stage.
- User defined blocking logic using 'IO Mask' functionality.

2.5 Sensitive Earth Fault Protection

With some earth faults, the fault current flowing to earth is limited by either intentional resistance (as is the case with some HV systems) or unintentional resistance (e.g. in very dry conditions and where the substrate is high resistance, such as sand or rock).

To provide protection in such cases, it is necessary to provide an earth fault protection system with a setting that is considerably lower than for normal line protection. Such sensitivity cannot be provided with conventional CTs, therefore SEF would normally be fed from a core balance current transformer (CBCT) mounted around the three phases of the feeder cable. Also a special measurement class SEF transformer should be used in the IED.

With SEF protection, settings as low as 0.2% can be used

2.5.1 Sensitive Earth Fault Protection (ordering option)

Sensitive Earth Fault protection is an ordering option and is implemented in the **EARTH FAULT 1** column of the relevant settings group.

The product provides three stages of SEF protection with independent time delay characteristics.

Stages 1, 2 and 3 provide a choice of operate and reset characteristics, where you can select between:

- A range of standard IDMT (Inverse Definite Minimum Time) curves
- DT (Definite Time)

This is achieved using the cells

- **IN1>(n) Function** for the overcurrent operate characteristic
- **I>(n) Reset Char** for the overcurrent reset characteristic
where (n) is the number of the stage.

Stages 1, 2 and 3 also provide a Timer Hold facility. This is configured using the cells **IN1>(n) tRESET**.

2.6 Restricted Earth Fault Protection

Winding-to-core faults in a transformer are quite common due to insulation breakdown. Such faults can have very low fault currents, but they are faults nevertheless and have to be picked up, as they can still severely damage expensive equipment. Often the fault currents are even lower than the nominal load current. Clearly, neither overcurrent nor percentage differential protection is sufficiently sensitive in this case. We therefore require a different type of protection arrangement. Not only should the protection arrangement be sensitive, but it must create a protection zone, which is limited to the transformer windings. Restricted Earth Fault (REF) protection satisfies these conditions.

The first figure shows an REF protection arrangement for the delta side of a delta-star transformer. The current transformers measuring the currents in each phase are connected in parallel. A fault outside the protection zone (i.e. outside the delta winding) will not result in a spill current, as the fault current would simply circulate in the delta windings. However, if any of the three delta windings were to develop a fault, the impedance of the faulty winding would change and that would result in a mismatch between the phase currents, resulting in a spill current, sufficient to trigger a trip command.

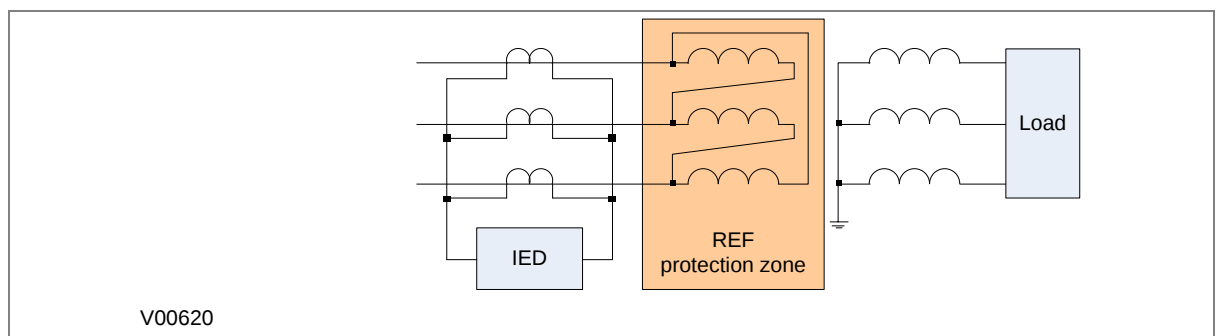


Figure 1: REF protection for delta side

The second figure shows an REF protection arrangement for the star side of a delta-star transformer. Here we have a similar arrangement of current transformers connected in parallel. The only difference is that we need to measure the zero sequence current in the neutral line as well. We know that an external unbalanced fault causes zero sequence current to flow through the neutral line, resulting in uneven currents in the phases, which would cause the IED to malfunction. By measuring this zero sequence current and placing the current transformer in parallel with the other three, the currents are balanced up resulting in stable operation.

Now only a fault inside the star winding can create an imbalance sufficient to cause the IED to issue a trip command.

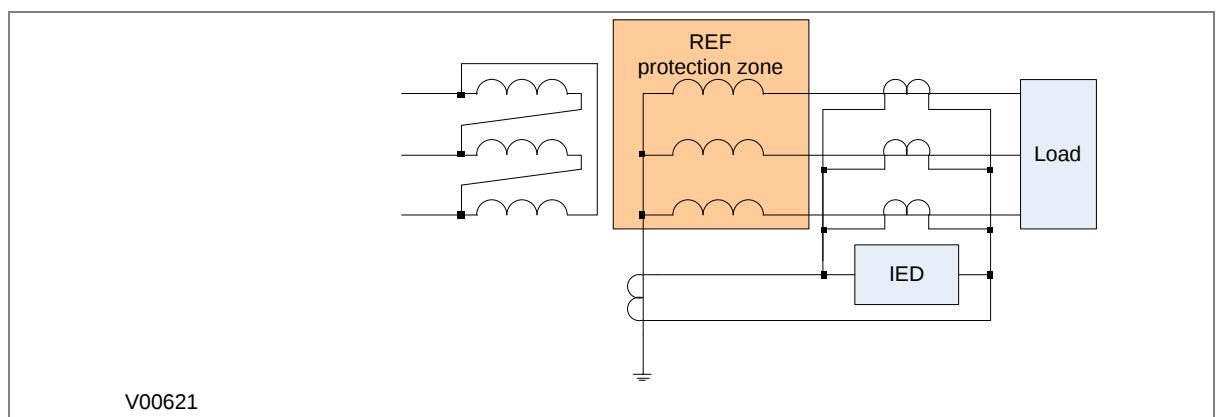


Figure 2: REF protection for star side

The relay uses High Impedance technique for REF. The high impedance technique ensures that the circuit is of sufficiently high impedance such that the differential voltage that may occur under external fault conditions is less than that required to drive setting current through the device.

2.6.1 Restricted Earth Fault implementation

There is no dedicated setting for REF. When P154 relay is ordered with SEF option, IN1 element should be used for REF function.

Note: While using REF function, SEF cannot be used and vice versa.

2.6.2 Application Note

2.6.2.1 High Impedance REF

The high impedance principle is best explained by considering a differential scheme where one CT is saturated for an external fault, as shown below.

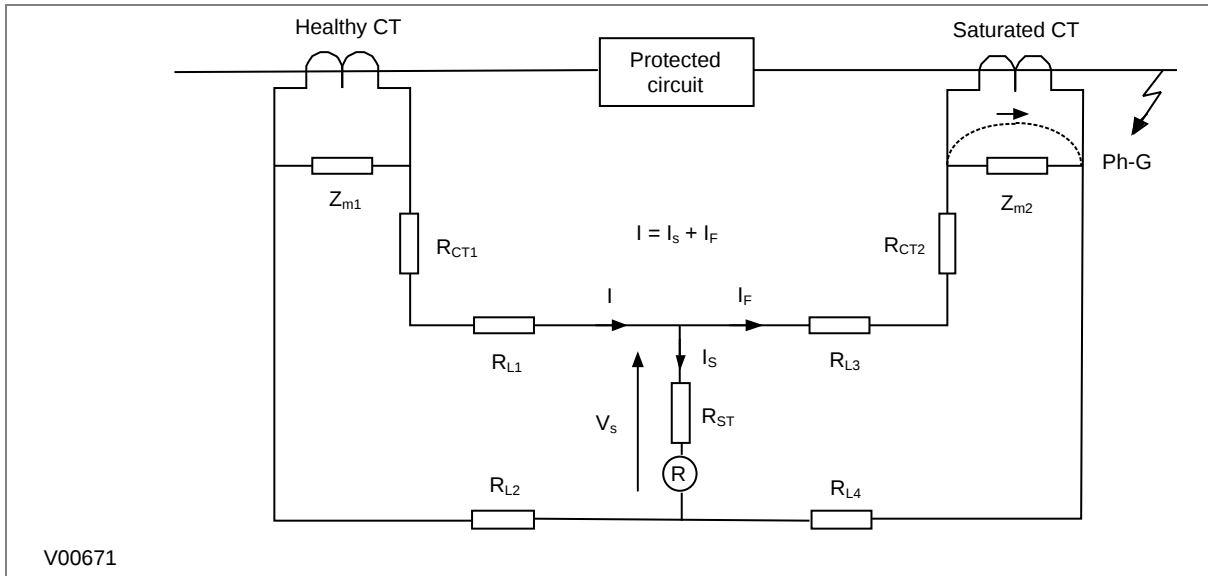


Figure 3: High Impedance principle

If the IED circuit has a very high impedance, the secondary current produced by the healthy CT will flow through the saturated CT. If CT magnetising impedance of the saturated CT is considered to be negligible, the maximum voltage across the circuit will be equal to the secondary fault current multiplied by the connected impedance, $(RL3 + RL4 + RCT2)$.

The IED can be made stable for this maximum applied voltage by increasing the overall impedance of the circuit, such that the resulting current through it is less than its current setting. As the impedance of the IED input alone is relatively low, a series connected external resistor is required. The value of this resistor, R_{ST} , is calculated by the formula shown. An additional non-linear, Metrosil, may be required to limit the peak secondary circuit voltage during internal fault conditions.

Voltage across REF element $V_s = I_F (R_{CT2} + R_{L3} + R_{L4})$

Stabilising resistor $R_{ST} = V_s / I_s - R_R$

where:

- I_F = maximum secondary through fault current

- RR = device burden
- RCT = CT secondary winding resistance
- RL2 and RL3 = Resistances of leads from the device to the current transformer
- RST = Stabilising resistor

To ensure that the protection will operate quickly during an internal fault, the CTs used to operate the protection must have a knee-point voltage of at least 4 Vs.

The necessary connections for high impedance REF are as follows:

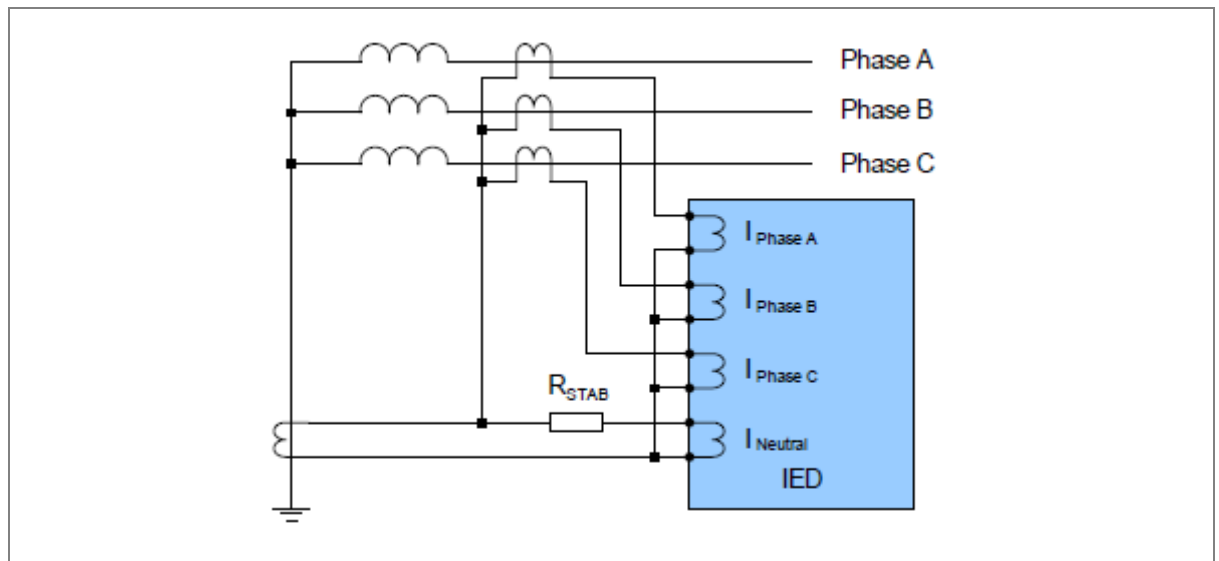


Figure 4: High Impedance REF connection

2.7 Thermal Overload Function

The heat generated within an item of plant, such as a cable or a transformer, is the resistive loss (I^2Rt). The thermal time characteristic is therefore based on the square of the current integrated over time. The device automatically uses the largest phase current for input to the thermal model.

The equipment is designed to operate continuously at a temperature corresponding to its full load rating, where the heat generated is balanced with heat dissipated. Over-temperature conditions occur when currents in excess of their maximum rating are allowed to flow for a period of time. It is known that temperature changes during heating follow exponential time constants.

The device provides single time constant characteristic which is used to protect cables, dry type transformers (e.g. type AN), and capacitor banks.

Thermal overload protection is designed to prevent the electrical equipment when operating temperature is exceeded the maximum designed temperature. The fundamental currents are measured and analysed to monitor the thermal state. In case of thermal overload function the calculation of the Time to Trip is given by:

$$t = \tau \ln ((K^2 - A) / (K^2 - Th. Trip))$$

Where:

- t: Time to trip (in seconds)
- τ : Thermal time constant (T_e , in seconds) of the equipment to be protected
- K: Thermal overload equal to ($I_{rms} / k * IFL$)

Where:

- I_{rms}:

RMS current corresponding to the largest phase current
- IFL:

Thermal Trip or full load current rating (settable)
- k :

Settable (1 to 1.5 step 0.01)
- A:

Initial thermal state. If the initial thermal state is 50% then A =0.5
- Th. Trip:

Trip thermal state. If the trip thermal state is set at 100%, then Th. Trip is 1
- The calculation of the thermal state is given by the following formula:

$$\Theta_{i+1} = (I_{rms} / k \cdot IFLA)^2 \cdot [1 - \exp (-t/T_e)] + \Theta_i \cdot \exp (-t/T_e)$$

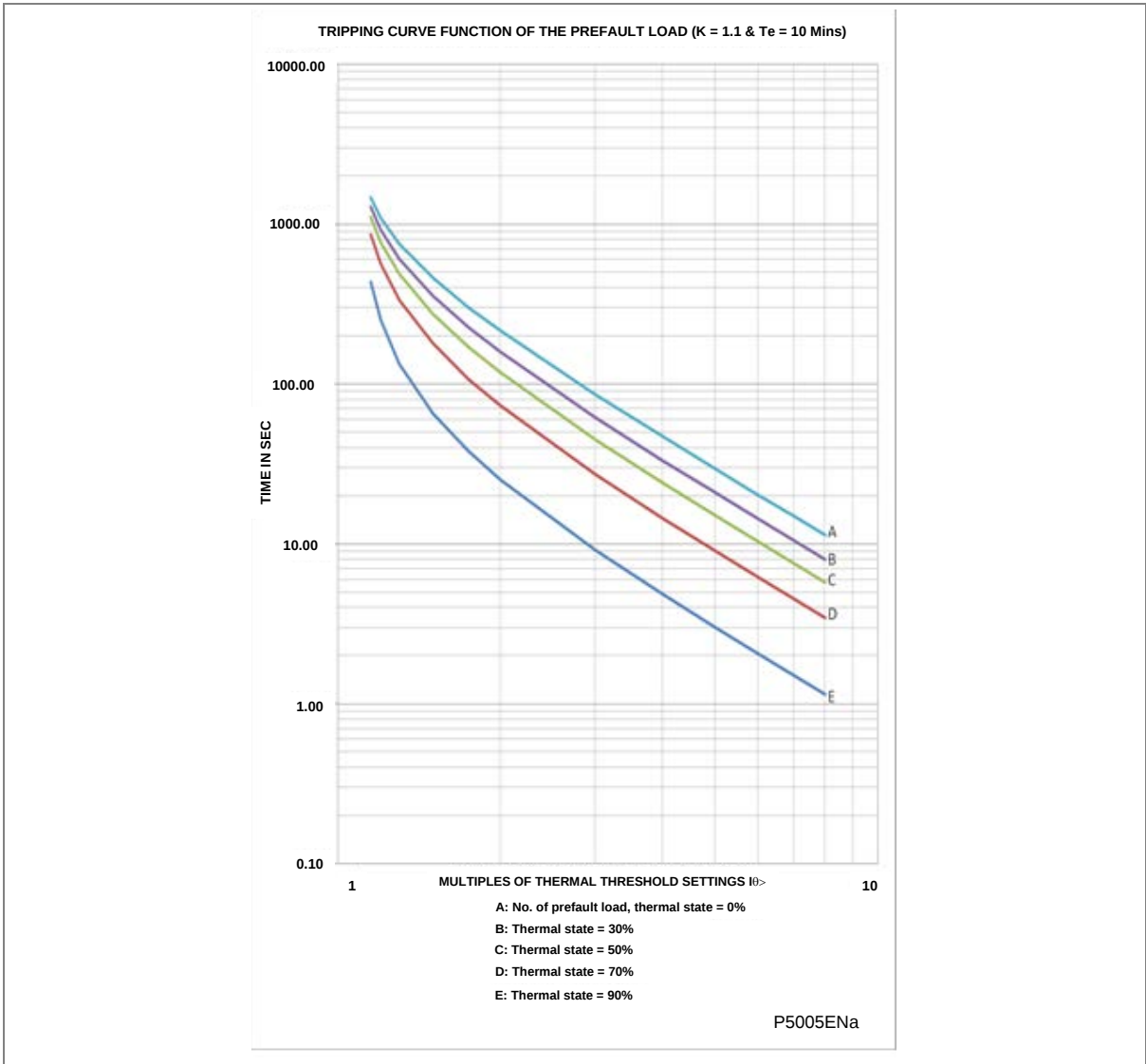


Figure 5: Thermal Overload curve

2.7.1 Thermal Overload Protection Implementation

The device incorporates a current-based thermal characteristic, using fundamental load current to model heating and cooling of the protected plant. The element can be set with both alarm and trip stages.

Thermal Overload protection is implemented in the THERMAL OVERLOAD column of the relevant settings group. The magnitudes of the three phase input currents are compared and the largest magnitude is taken as the input to the thermal overload function.

Thermal over load function supports setting for alarm and trip stages. If the thermal overload function is enabled and thermal state of the protected equipment exceeds the alarm threshold setting, the alarm is issued and indicated by illuminated **START** LED on the relay front panel.

If the thermal overload function is enabled and thermal state of the protected equipment exceeds the Trip threshold setting, a trip command is issued resulting in operation of output contacts. Trip condition is indicated by illuminated **TRIP** LED.

The thermal state measurement is made available in the MEASUREMENTS menu.

The thermal state can be reset from the HMI panel by enabling the **Thermal Reset** setting to 'Yes' under **RECORD CONTROL** menu.

2.8 Broken Conductor

One type of unbalanced fault is the 'Series' or 'Open Circuit' fault. This type of fault can arise from, among other things, broken conductors. Series faults do not cause an increase in phase current and so cannot be detected by overcurrent IEDs. However, they do produce an imbalance, resulting in negative phase sequence current, which can be detected.

It is possible to apply a negative phase sequence overcurrent element to detect broken conductors.

However, on a lightly loaded line, the negative sequence current resulting from a series fault condition may be very close to, or less than, the full load steady state imbalance arising from CT errors and load imbalances, making it very difficult to distinguish. A regular negative sequence element would therefore not work at low load levels. To overcome this, the device incorporates a special Broken Conductor protection element.

The Broken Conductor element measures the ratio of negative to positive phase sequence current (I_2/I_1).

This ratio is approximately constant with variations in load current, therefore making it more sensitive to series faults than standard negative sequence protection.

2.8.1 Broken Conductor Protection Implementation

Broken Conductor protection is implemented in the BROKEN CONDUCTOR column of the relevant settings group.

This column contains the settings to enable the function, for the pickup threshold and the time delay.

Two stages are supported - BC Alarm & BC Trip. The BC Trip function is not part of General trip. Both stages can be configured independently.

2.8.2 Broken Conductor Protection Logic

The ratio of I_2/I_1 is calculated and compared with the threshold. If the threshold is exceeded, the delay timer is initiated.

Note: Broken conductor is activated only if current in any phase is more than 0.1 amp.

2.9 Undercurrent /Loss of Power Protection Function

The relay includes undercurrent elements that can be used to provide additional functions to prevent damage to the power system. This function allows typical applications such as loss of load. The undercurrent protection function is available only if the auxiliary contact of the CB status is connected to the relay, for example, when CB (52A) contact of CB is high.

2.10 Circuit Breaker Fail Protection

When a fault occurs, one or more protection devices will operate and issue a trip command to the relevant circuit breakers. Operation of the circuit breaker is essential to isolate the fault and prevent, or at least limit, damage to the power system. For transmission and sub-transmission systems, slow fault clearance can also threaten system stability.

For these reasons, it is common practise to install Circuit Breaker Failure protection (CBF). CBF protection monitors the circuit breaker and establishes whether it has opened within a reasonable time. If the fault current has not been interrupted following a set time delay from circuit breaker trip initiation, the CBF protection will operate, whereby the upstream circuit breakers are back-tripped to ensure that the fault is isolated.

CBF operation can also reset all start output contacts, ensuring that any blocks asserted on upstream protection are removed.

2.10.1 Circuit Breaker Fail Implementation

Circuit Breaker Failure Protection is implemented in the CB FAIL column of the relevant settings group.

The circuit breaker failure protection incorporates **CB Fail Timer**. For any protection trip, the **CB Fail Timer** is started, and normally reset when the circuit breaker opens to isolate the fault. If breaker opening is not detected, the CB Fail Timer times out and close an output contact assigned to breaker fail (using the I/O assignment feature). This contact is used to back-trip upstream switchgear, generally tripping all infeeds connected to the same busbar section.

2.10.2 Circuit Breaker Fail Logic

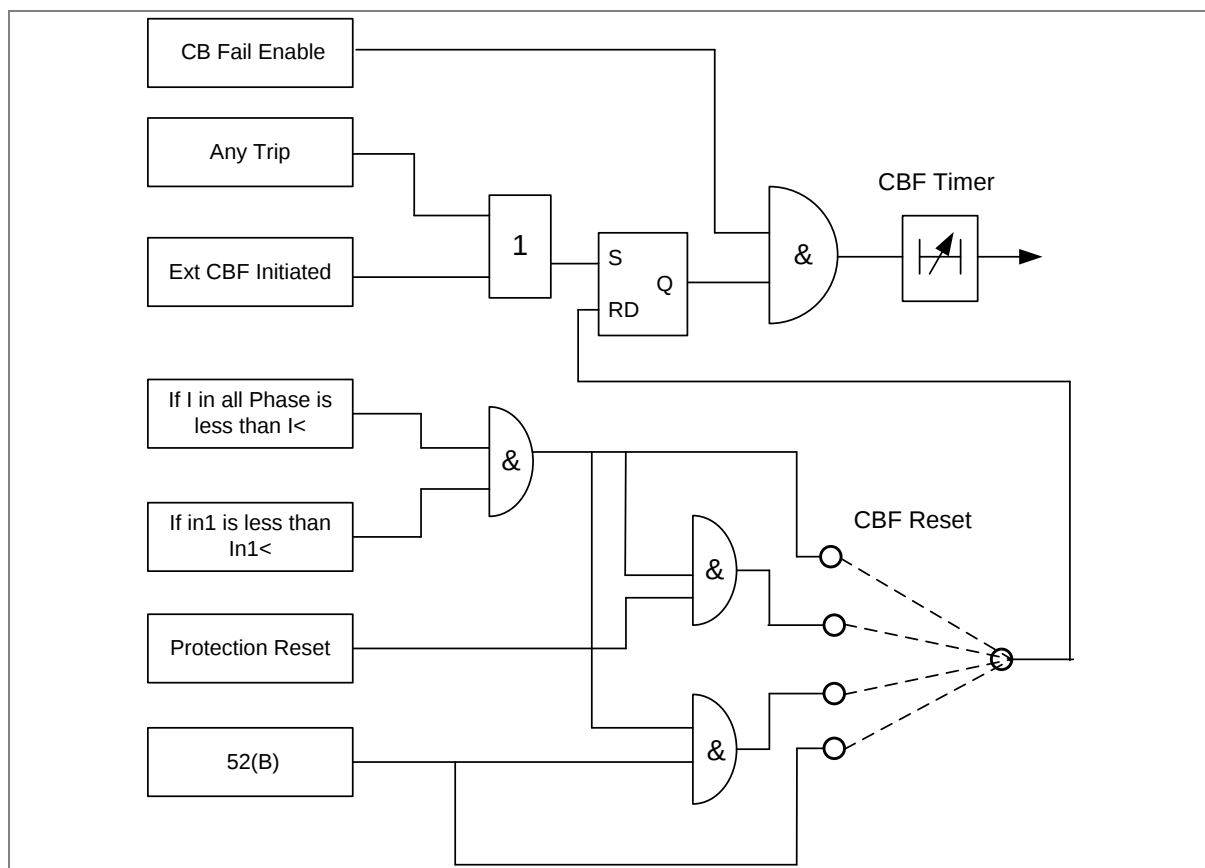


Figure 6: CB Fail Logic

CBF elements **CB Fail Timer** can be configured to operate for trips triggered by protection elements within the device or via an external protection trip. The latter is achieved by allocating one of the opto-isolated inputs to CBF Init signal using the I/O Mask feature.

It is possible to reset the CBF from a breaker open indication from a protection reset. In these cases resetting is only allowed provided the undercurrent elements have also been reset. The resetting options are summarised in the following table:

CBF function Reset options	Description
I<	CBF function will reset when the phase currents and earth current is less than set current
CB Open + I<	CBF function will reset when both conditions are satisfied: • CB is open (i.e. CB(52B) status is active) • The phase currents and earth current is less than set current
Prot Reset + I<	CBF function will reset when both conditions are satisfied: • Protection is reset • Phase currents and earth current is less than set current
CB Open	CBF function will reset when CB is open (i.e. CB(52B) status is active)

The **Remove I> Start** and **Remove IN> Start** settings are used to remove starts issued from the overcurrent and earth elements respectively following a breaker fail time out. The start is removed when the cell is set to 'Enabled'.

2.11 Cold Load Pickup Function

When a feeder circuit breaker is closed in order to energise a load, the current levels that flow for a period of time following energisation may be far greater than the normal load levels. Consequently, overcurrent settings that have been applied to provide overcurrent protection may not be suitable during this period of energisation (cold load), as they may initiate undesired tripping of the circuit breaker. This scenario can be prevented with Cold Load Pickup (CLP) functionality.

The Cold Load Pickup (CLP) logic works by either:

- Inhibiting one or more stages of the overcurrent protection for a set duration
- Raising the overcurrent settings of selected stages, for the cold loading period.

The CLP logic therefore provides stability, whilst maintaining protection during the start-up.

Cold Load Pickup Protection is implemented in the **COLD LOAD PICKUP** column of the relevant settings group.

This function acts upon the following protection functions:

- All overcurrent stages
- All Earth Fault stages

The principle of operation is identical for the 3-phase overcurrent protection and Earth Fault overcurrent protection.

CLP operation occurs when the circuit breaker remains open for a time greater than **tcold** and is subsequently closed. CLP operation is applied after **tcold** and remains for a set time delay of **tclp** following closure of the circuit breaker. The status of the circuit breaker is provided by means of the CB auxiliary contacts. Whilst CLP operation is in force, the CLP settings are enabled. After the time delay **tclp** has elapsed, the normal overcurrent settings are applied and the CLP settings are disabled.

If desired, instead of applying different current setting thresholds for the cold load time, it is also possible to completely block the overcurrent operation during this time, for any of the overcurrent stages.

2.11.1 Cold Load Pickup Logic

The CLP logic is in operation when CLP is enabled AND CLP is initiated from a CB open condition after the **tcold** period has elapsed. The CLP logic becomes inactive when CLP is disabled or when there is a CB closed condition. **tcold** and **tclp** are initiated using the CB status signal produced by connecting CB NO auxiliary contact from the circuit breaker. The CLP logic gets driven from a single breaker contact.

2.11.2 Cold Load Pickup for SWITCH ONTO FAULT Condition

In some feeder applications, fast tripping may be required if a fault is already present on the feeder when it is energized. Such faults may be due to a fault condition not having been removed from the feeder, or due to earthing clamps having been left on following maintenance. In either case, it is desirable to clear the fault condition quickly, rather than waiting for the time delay imposed by IDMT overcurrent protection. The CLP logic can cater for this situation. Selected overcurrent/earth fault stages could be set to instantaneous operation for a defined period following circuit breaker closure (typically 200 ms). Therefore, instantaneous fault clearance would be achieved for a switch onto fault (SOTF) condition

2.12 Inrush Current Blocking Function (2ND Harm Blocking)

When a transformer is initially connected to a source of AC voltage, there may be a substantial surge of current through the primary winding called inrush current. This is analogous to the inrush current exhibited by an electric motor that is started up by sudden connection to a power source, although transformer inrush is caused by a different phenomenon.

In an ideal transformer, the magnetizing current would rise to approximately twice its normal peak value as well, generating the necessary MMF to create this higher-than-normal flux. However, most transformers are not designed with enough of a margin between normal flux peaks and the saturation limits to avoid saturating in a condition like this, and so the core will almost certainly saturate during this first half-cycle of voltage. During saturation, disproportionate amounts of MMF are needed to generate magnetic flux. This means that winding current, which creates the MMF to cause flux in the core, could rise to a value way in excess of its steady state peak value. Furthermore, if the transformer happens to have some residual magnetism in its core at the moment of connection to the source, the problem could be further exacerbated.

We can see that inrush current is a regularly occurring phenomenon and should not be considered a fault, as we do not wish the protection device to issue a trip command whenever a transformer or machine is switched on. This presents a problem to the protection device, because it should always trip on an internal fault. The problem is that typical internal transformer faults may produce overcurrents which are not necessarily greater than the inrush current. Furthermore faults tend to manifest themselves on switch on, due to the high inrush currents. For this reason, we need to find a mechanism that can distinguish between fault current and inrush current. Fortunately this is possible due to the different natures of the respective currents. An inrush current waveform is rich in harmonics, whereas an internal fault current consists only of the fundamental. We can thus develop a restraining method based on the harmonic content of the inrush current. The mechanism by which this is achieved is called second harmonic blocking.

2.12.1 Second Harmonic Blocking Implementation

Second harmonic blocking can be applied to the following overcurrent protection types:

- Phase Overcurrent protection
- Earth Fault protection

Second harmonic blocking is implemented in the GROUP (n) **SYSTEM CONFIG** column, where (n) is the number of the setting group.

Second harmonic blocking is applicable to all stages of each of the elements.

The function works by identifying and measuring the inrush currents present at switch on. It does this by comparing the value of the second harmonic current components to the value of the fundamental component. If this ratio exceeds the set thresholds, then the blocking signal is generated. The threshold is defined by the **2ndHarm Thresh** setting.

We only want the function to block the protection if the fundamental current component is within the normal range. If this exceeds the normal range, then this is indicative of a fault, which must be protected. For this reason there is another settable trigger **I> lift 2H**, which when exceeded, stops the 2nd harmonic blocking function.

Each overcurrent protection element has **I>(n) 2H Blocking** setting with which the type of blocking is defined.

PROTECTION PARAMETER SETTINGS

CHAPTER 7

1 CHAPTER OVERVIEW

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2.6	RECORD CONTROL Settings
2.7	COMMUNICATION Settings
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2.9	O/P RELAY CONFIG Settings
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2.12.10	CB FAIL Settings
2.12.11	VIEW RECORDS

2 PROTECTION PARAMETER SETTINGS

2.1 System Data

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Language	English	Not editable* (*editable in relay models supporting multi-language option)
2.	Description	P50 Agile P154	Not editable
3.	Model Number	P154xxxAXxxxxA	Not editable
4.	Serial Number	xxxP154xxxx	Not editable
5.	Software Version	P154_x_x_0Vx.xx	Not editable
6.	Frequency	50Hz	50Hz / 60Hz
This cell sets the frequency to either 50 Hz or 60 Hz.			
7.	USB Address	1	Not editable
This cell displays the address for the front USB port of the relay.			
8.	USB Parity	None	Not editable
This cell displays the parity format used in the data frames.			
9.	USB Baud rate	57600	Not editable
This cell sets the communication speed between relay and configuration tool.			
10.	Password	0000	0000 to zzzz
This cell allows you to set new password. (Alphanumeric 4- characters)			
11.	Active Group	Group 1	Not editable
This setting displays the active setting group (Group1 / Group2, whichever is selected).			
12.	Opto I/P Status	Status of the Inputs	Not editable
This setting displays the current status of Digital input			
13.	Relay O/P Status	Status of the outputs	Not editable
This setting displays the current status of Digital output			
14.	CB Open/Close	No Operation	No Operation / Open / Close
This setting supports open and close commands if enabled in the Circuit Breaker Control menu.			
15.	Opto I/P	DC	DC/AC
This setting allows selection of auxiliary voltage type AC/DC for opto inputs.			
16.	Config Port	USB	USB/RP
This setting allows selection of communication port for relay configuration using P50 Agile configurator. (For DNP3.0, Config Port setting is fixed as 'USB')			

2.2 CB CONTROL Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Password	0000	0000 to zzzz
This setting specifies to enter the set password			
2.	TCS Alarm	No	Yes / No
This setting is used to enable (activate) or disable (turn off) the Trip Circuit Supervision alarm function			
3.	TCS Timer	5.00 S	0.1s to 10s step 0.01s
This setting is used to set the time delay for the Trip Circuit supervision. If relay detects any discontinuity, then TCS alarm is generated after the set time delay.			

Sr. No	Parameter	Defaults setting	Setting / Ranges
4.	CB Open S'vision	Enabled	Enabled / Disabled
This setting is used to enable (activate) or disable (turn off) the CB Open Supervision function			
5.	CB Open Time	0.30 S	0.05s to 1.0s steps 0.01s
This setting is used to define the circuit breaker opening time threshold.			
6.	CB Open Alarm	Enabled	Enabled / Disabled
This setting is used to enable (activate) or disable (turn off) the CB Open Alarm function.			
7.	CB Open Oper	2000	1 to 30000 step 1
This setting is used to define the threshold for number of CB open operations and an alarm is issued once this threshold is crossed.			
8.	CB Control By	Disabled	Disabled / Local/Remote / Local + Remote
This setting selects the type of circuit breaker control to be used.			
9.	Close Pulse Time	0.50 S	0.1s to 50s step 0.01s
This setting defines duration of the close pulse within which the CB should close after a close command is issued			
10.	Open Pulse Time	0.50 S	0.1s to 50s step 0.01s
This setting defines the duration of the trip pulse within which the CB should trip when a manual or protection trip command is issued			

2.3 DATE AND TIME Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Password	0000	0000 to zzzz
This setting specifies to enter the set password.			
2.	Local Time Enable	Fixed	Fixed / Flexible / Disabled
Setting to turn on/off local time adjustments.			
Fixed - A local time zone adjustment can be defined using the Local Time offset setting and all interfaces will use local time.			
Flexible - A local time zone adjustment can be defined using the Local Time offset setting and each interface can be assigned to the UTC zone or local time zone with the exception of the local interfaces which will always be in the local time zone.			
Disabled - No local time zone will be maintained. Time synchronization from any interface will be used to directly set the master clock and all displayed (or read) times on all interfaces will be based on the master clock with no adjustment.			
3.	Local Time Offset	0 Mins	-720 to + 720 step 15 mins
Setting to specify an offset for local time zone from -12 to +12 hrs in 15 minute intervals. This adjustment is applied to the time based on UTC/GMT master clock.			
4.	DST Enable	Enabled	Enabled / Disabled
Setting to turn on/off daylight saving time adjustment to local time.			
5.	DST Offset	60 Mins	30 mins, 60 mins
Setting to specify daylight saving offset used for the local time adjustment.			
6.	DST Start	Last	First / Second / Third / Fourth / Last
Setting to specify the week of the month in which daylight saving time adjustment starts			
7.	DST Start Day	Sunday	Sunday / Monday / Tuesday / Wednesday / Thursday / Friday/ Saturday
Setting to specify the day of the week in which daylight saving time adjustment starts			
8.	DST Start Month	March	January / February / March / April / May / June / July / August / September / October / November / December
Setting to specify the month in which daylight saving time adjustment starts			
9.	DST Start Mins	60 Mins	0 to 1425 mins step 15mins.
Setting to specify the time of day in which daylight saving time adjustment starts. This is set relative to 00:00 hrs on the selected day when time adjustment is to start			
10.	DST End	Last	First / Second / Third / Fourth / Last
Setting to specify the week of the month in which daylight saving time adjustment ends			

Sr. No	Parameter	Defaults setting	Setting / Ranges
11.	DST End Day	Sunday	Sunday / Monday / Tuesday / Wednesday / Thursday / Friday / Saturday
Setting to specify the day of the week in which daylight saving time adjustment ends			
12.	DST End Month	October	January / February / March / April / May / June / July / August / September / October / November / December
Setting to specify the month in which daylight saving time adjustment ends			
13.	DST End Mins	60 Mins	0 to 1425 mins step 15mins.
Setting to specify the time of day in which daylight saving time adjustment ends. This is set relative to 00:00 hrs on the selected day when time adjustment is to end			
14.	RP Time Zone	Local	UTC / Local
Setting for the rear port 1 interface to specify if time synchronization received will be local or universal time co-ordinated.			
15.	SET Hours	10 *	0 to 23 Hrs step 1
Hour setting needed when relay is not connected to SCADA system			
16.	SET Minutes	35 *	0 to 59 Mins step 1
Minutes setting needed when relay is not connected to SCADA system			
17.	SET Seconds	54 *	0 to 59 Sec. step 1
Seconds setting needed when relay is not connected to SCADA system			
18.	SET Date	28 *	1 to 31 Days step 1
Date setting needed when relay is not connected to SCADA system			
19.	SET Month	10 *	1 to 12 Months step 1
Month setting needed when relay is not connected to SCADA system			
20.	SET Year	14 *	0 to 99 Years step 1
Year setting needed when relay is not connected to SCADA system			

Note: The relay displays the current Date/Time set in the relay.*

2.4 CONFIGURATION Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Password	0000	0000 to zzzz
This setting specifies to enter the set password			
2.	Restore Defaults	No Operation	No Operation / All Settings / Setting Group 1 / Setting Group 2
This setting restores the chosen setting groups to factory default values. To restore the default values to any Group, set the 'restore defaults' cell to the relevant Group number. Alternatively it is possible to set the 'restore defaults' cell to 'all settings' to restore the default values to all of the IED's settings, not just the Group settings. The default settings will be placed in Flash and will only be used by the IED after they have been confirmed by the user. Note: Restoring defaults to all settings includes the rear communication port settings, which may result in communication via the rear port being disrupted if the new (default) settings do not match those of the master station			
3.	Active Settings	Group 1	Group 1 / Group 2
This setting selects the active settings group.			
4.	Copy From	Group 1	Group 1 / Group 2
This setting allows settings to be copied from a selected setting group.			

Sr. No	Parameter	Defaults setting	Setting / Ranges
5.	Copy To	No Operation	No Operation / Group 1 / Group 2
This command allows the displayed settings to be copied to a selected setting group.			
6.	Setting Group 1	Enabled	Enabled / Disabled
This setting enables or disables settings Group 1. If the Setting Group 1 is enabled from the configuration setting, then all associated settings and signals are available in Group 1 setting menu. If the Setting Group1 is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.			
7.	Setting Group 2	Disabled	Enabled / Disabled
This setting enables or disables settings Group 2. If the Setting Group 2 is enabled from the configuration setting, then all associated settings and signals are available in Group 2 setting menu. If the Setting Group 2 is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.			
8.	System Config	Disabled	Enabled / Disabled
This setting hides or unhides the System Config menu. Inside the 2nd Harmonic blocking related parameters are present			
9.	Overcurrent	Enabled	Enabled / Disabled
This setting enables (activate) or disables (turn off) the Phase Overcurrent Protection function. If disabled, then all associated settings and signals are hidden, with the exception of this setting. Same for all other Items.			
10.	Neg Sequence O/C	Disabled	Enabled / Disabled
This setting enables (activate) or disables (turn off) the Negative Sequence Overcurrent Protection.			
11.	Broken Conductor	Disabled	Enabled / Disabled
This setting enables (activate) or disables (turn off) the Broken Conductor Protection.			
12.	Earth Fault 1	Enabled	Enabled / Disabled
This setting enables (activate) or disables (turn off) the Measured Earth Fault Protection function			
13	Earth Fault 2	Enabled	Enabled / Disabled
This setting enables (activate) or disables (turn off) the Derived Earth Fault Protection function.			
14.	Thermal Overload	Disabled	Enabled / Disabled
This setting enables (activate) or disables (turn off) the Thermal Overload function.			
15.	Cold Load Pickup	Disabled	Enabled / Disabled
This setting enables (activate) or disables (turn off) the Cold Load Pickup function.			
16.	Measure't Setup	ABC	ABC /RYB
This setting determines the representation of Phases. Based on this setting, the representation in measurements, records etc shall change. No change is expected for the stored records, (if any)			
17.	UnderCurr Prot	Disabled	Enabled / Disabled
This setting enables (activate) or disables (turn off) the Under Current Protection.			
18.	CB Fail	Disabled	Enabled / Disabled
This setting enables (activate) or disables (turn off) the CB Fail Protection.			
19.	Setting Values	Secondary	Primary/Secondary
This setting determines the reference for all settings dependent on the transformer ratios; either referenced to the primary or the secondary.			

2.5 TRANS. RATIOS Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Password	0000	0000 to zzzz
This setting specifies to enter the set password			
2.	Phase CT Primary	100A	1 to 30000A step 1A
This setting determines the phase current transformer input primary current rating.			
3.	Phase CT Sec'y	1 A	1A or 5 A
This setting determines the phase current transformer input secondary current rating.			

Sr. No	Parameter	Defaults setting	Setting / Ranges
4.	E/F CT Primary	100A	1 to 30000A step 1A
This setting determines the earth current transformer input primary current rating.			
5.	E/F CT Secondary	1 A	1A or 5 A
This setting determines the earth current transformer input secondary current rating.			

2.6 RECORD CONTROL Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Password	0000	0000 to zzzz
This setting specifies to enter the set password			
2.	Clear Events	No	Yes / No
Selecting "Yes" will erase the existing events stored in the relay.			
3.	Clear Faults	No	Yes / No
Selecting "Yes" will erase the existing fault records from the relay.			
4.	Clear Dist Recs	No	Yes / No
Selecting "Yes" will erase the existing disturbance records from the relay.			
5.	Clear Maint	No	Yes / No
Selecting "Yes" will erase the existing maintenance records from the relay.			
6.	Thermal Reset	No	Yes / No
Selecting "Yes" will reset the existing thermal state to zero.			

2.7 COMMUNICATION Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Password	0000	0000 to zzzz
This setting specifies to enter the set password			
2.	RP1 Address	1	1 to 247 step 1
This setting sets the address of RP1.			
3.	RP1 Baud rate	57600	9600 / 19200 / 38400 / 57600
This cell sets the communication speed between relay and master station. It is important that both relay and master station are set at the same speed setting.			
4.	RP1 Parity	Even	Even / Odd / None
This cell sets the parity format used in the data frames. It is important that both relay and master station are set with the same parity setting.			
5.	RP1 Timesync	Disabled	Enabled / Disabled
This setting enables or disables time synchronization with master clock			

2.8 IO CONFIGURATION Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Password	0000	0000 to zzzz
This setting specifies to enter the set password			
2.	Relay Gen Strt*	654321 000000	6→ RL6.....1→RL1 1 = assigned ; 0 = not assigned
This cell sets the output contact RL1 – RL6 for desired function.			
3.	LED G Gen Strt*	8765 0000	8→ LED8.....5→LED5 1 = assigned ; 0 = not assigned

Sr. No	Parameter	Defaults setting	Setting / Ranges
This cell sets the Green LED L5 – L8 for desired function.			
4.	LED R Gen Strt*	8765 0000	8→ LED L8.....5→LED L5 1 = assigned ; 0 = not assigned
This cell sets the RED LED L5 – L8 for desired function.			
5.	AND Logic Gen Strt*	DCBA 0000	D→ AND Logic D.....A→ AND Logic A 1 = assigned ; 0 = not assigned
This cell sets the input for AND Logic equation (A, B, C and D).			
6.	Opto I/P Rem.Rst*	654321 000000	6→ S6.....1→S1 1 = assigned ; 0 = not assigned
This cell sets the Opto I/P 1 – Opto I/P 6 for desired function.			

** Note: The functions which can be assigned to Output Relay, LED Green, LED RED, AND Logic and Opto I/P are listed in **Chapter 8: Monitoring and Control**.*

2.9 O/P RELAY CONFIG Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Password	0000	0000 to zzzz
This setting specifies to enter the set password			
2.	Contact HR/SR	000000	1= HR / 0 = SR
This setting specifies the reset mechanism (manual / hand reset or self reset) for O/P relay contacts.			
3.	O/P-1 Open Time	0.50 S	0s to 1s step 0.01s
4.	O/P-2 Open Time	0.50 S	0s to 1s step 0.01s
5.	O/P-3 Open Time	0.50 S	0s to 1s step 0.01s
6.	O/P-4 Open Time	0.50 S	0s to 1s step 0.01s
7.	O/P-5 Open Time	0.50 S	0s to 1s step 0.01s
8.	O/P-6 Open Time	0.50 S	0s to 1s step 0.01s
This setting specifies the time duration for which the output contacts holds its state after non availability of the command to the O/P contact.			
9.	LED G HR/SR	0000	1= HR / 0 = SR
This setting specifies the reset mechanism (manual/hand reset or self reset) for Green LED.			
10.	LED R HR/SR	0000	1= HR / 0 = SR
This setting specifies the reset mechanism (manual/hand reset or self reset) for RED LED.			
11.	ANDEQ A Op Time	1 S	1s to 3600s step 1s
12.	ANDEQ A Rst Time	1 S	1s to 3600s step 1s
13.	ANDEQ B Op Time	1 S	1s to 3600s step 1s
14.	ANDEQ B Rst Time	1 S	1s to 3600s step 1s
15.	ANDEQ C Op Time	1 S	1s to 3600s step 1s
16.	ANDEQ C Rst Time	1 S	1s to 3600s step 1s
17.	ANDEQ D Op Time	1 S	1s to 3600s step 1s

Sr. No	Parameter	Defaults setting	Setting / Ranges
18.	ANDEQ D Rst Time	1 S	1s to 3600s step 1s
These settings specifies the operating / reset time delay allocated to the logic AND equation.			

Note: In the P50 Agile Configurator, the above settings parameters from serial no 9 to 18 are available under "IO Mask".

2.10 DISTURBANCE RECORD Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Password	0000	0000 to zzzz
This setting specifies to enter the set password			
2.	Trigger Position	50%	10% to 90% step 1%
This setting sets the trigger point as a percentage of the duration. For example, the default setting, which is set to 50% (of 1.0s) gives 0.5s pre-fault and 0.5s post fault recording times.			

2.11 COMMISSION TEST Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	Password	0000	0000 to zzzz
This setting specifies to enter the set password			
2.	Test Mode	Disabled	Disabled, Test Mode, Contacts Blocked
This setting allows secondary injection testing to be performed on the relay itself.			
3.	Test Pattern	000000	0 = not operated , 1 = operated
This setting is used to select the output relay contacts that will be tested when the Contact Test cell is set to Apply Test.			
4.	Contact Test	No Operation	No Operation, Apply Test, Remove Test
This setting is used to test the relay output contact operation.			
5.	Test LEDs	No Operation	No Operation / Apply Test
This setting is used to test the 4 no's programmable LED's.			

2.12 GROUP Settings

The following settings are common to GROUP 1 and 2.

2.12.1 SYSTEM CONFIG SETTINGS

Sr. No	Parameter	Default setting	Setting Range
1.	2nd Harmonic	Disabled	Enabled / Disabled
This setting is used to enable or disable the 2nd Harmonic blocking of the overcurrent protection.			
2.	2ndHarm Thresh	20%	5% to 70% step 1%
This setting is used to specify the 2nd Harm Threshold value. If the level of 2nd harmonic/fundamental in any phase current or neutral current exceeds the setting, the overcurrent protection will be blocked as selected.			

Sr. No	Parameter	Default setting	Setting Range
3.	I>lift 2H	10.00*In	4 to 32*In step 0.01*In
The 2nd harmonic blocking is applied only when the fundamental current is above 2nd Harm Thresh and below I> lift setting. The reset levels are 95% of these thresholds.			

2.12.2 OVERCURRENT Settings

2.12.2.1 I>1 Function

Sr. No	Parameter	Default setting	Setting Range
1.	I>1 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the first stage overcurrent element.			
2.	I>1 Current Set	1.00*In	If DT 0.05 to 35.00*In step 0.01*In If IDMT 0.05 to 4.00*In step 0.01*In
This setting determines the pick-up setting for first stage overcurrent element.			
3.	I>1 Time Delay	1.00 S	0s to 100s step 0.01s
This setting determines the time-delay for the definite time setting if selected for first stage overcurrent element.			
4.	I>1 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	I>1 Time Dial	1.00	0.01 to 100 step 0.01s
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	I>1 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	I>1 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	I>1 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	I>1 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking first stage overcurrent element due to presence of inrush current. If I>1 Blocking and 2nd Harmonic both setting are enabled, then (I>1) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.2.2 I>2 Function

Sr. No	Parameter	Default setting	Setting Range
1.	I>2 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the second stage overcurrent element.			
2.	I>2 Current Set	1.00*In	If DT 0.05 to 35.00*In step 0.01*In If IDMT 0.05 to 4.00*In step 0.01*In
This setting determines the pick-up setting for second stage overcurrent element.			
3.	I>2 Time Delay	1.00 S	0s to 100s step 0.01s
This setting determines the time-delay for the definite time setting if selected for second stage overcurrent element.			

Sr. No	Parameter	Default setting	Setting Range
4.	I>2 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	I>2 Time Dial	1.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	I>2 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	I>2 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	I>2 IRESET	01.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	I>2 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking second stage overcurrent element due to presence of inrush current. If I>2 Blocking and 2nd Harmonic both setting are enabled, then (I>2) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.2.3 I>3 Function

Sr. No	Parameter	Default setting	Setting Range
1.	I>3 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the third stage overcurrent element.			
2.	I>3 Current Set	1.00*In	If DT 1.0 to 35.00*In step 0.01*In If IDMT 0.05 to 4.00*In step 0.01*In
This setting determines the pick-up setting for second third overcurrent element.			
3.	I>3 Time Delay	1.00 S	0s to 100s step 0.01s
This setting determines the time-delay for the definite time setting if selected for third stage overcurrent element.			
4.	I>3 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	I>3 Time Dial	1.00	0.01 to 100 step 0.01s
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	I>3 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	I>3 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	I>3 IRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			

Sr. No	Parameter	Default setting	Setting Range
9.	I>3 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking third stage overcurrent element due to presence of inrush current. If I>3 Blocking and 2nd Harmonic both setting are enabled, then (I>3) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.3 EARTH FAULT 1 (Measured)

2.12.3.1 IN1>1 Function

Sr. No	Parameter	Default setting	Setting Range
1.	IN1>1 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the first stage measured earth fault element.			
2.	IN1>1 Current Set	1.00*In	If DT 0.05 to 35.00*In step 0.01*In If IDMT 0.05 to 4.00*In step 0.01*In
This setting determines the pick-up setting for first stage measured earth fault element.			
3.	IN1>1 Time Delay	1.00 S	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for first stage of measured earth fault element.			
4.	IN1>1 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	IN1>1 Time Dial	1.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	IN1>1 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	IN1>1 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	IN1>1 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	IN1>1 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking first stage measured earth fault element due to presence of inrush current. If IN1>1 Blocking and 2nd Harmonic both setting are enabled, then (IN1>1) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.3.2 IN1>1 Function- Sensitive Earth Fault (ordering option)

Sr. No	Parameter	Default setting	Setting Range
1.	IN1>1 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the first stage measured earth fault element.			
2.	IN1>1 Current Set	0.200*In	If DT 0.002 to 2.00*In step 0.001*In If IDMT 0.002 to 0.200*In step 0.001*In
This setting determines the pick-up setting for first stage measured earth fault element.			
3.	IN1>1 Time Delay	1.00 S	0s to 200s step 0.01s

Sr. No	Parameter	Default setting	Setting Range
This setting determines the time-delay for the definite time setting if selected for first stage of measured earth fault element.			
4.	IN1>1 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	IN1>1 Time Dial	1.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	IN1>1 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	IN1>1 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	IN1>1 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	IN1>1 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking first stage measured earth fault element due to presence of inrush current. If IN1>1 Blocking and 2nd Harmonic both setting are enabled, then (IN1>1) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below > lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.3.3 IN1>2 Function

Sr. No	Parameter	Default setting	Setting Range
1.	IN1>2 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the second stage measured earth fault element.			
2.	IN1>2 Current Set	1.00*In	If DT 0.05 to 35.00*In step 0.01*In If IDMT then 0.05 to 4.00*In step 0.01*In
This setting determines the pick-up setting for second stage measured earth fault element.			
3.	IN1>2 Time Delay	1.00 S	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for second stage of measured earth fault element.			
4.	IN1>2 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	IN1>2 Time Dial	1.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	IN1>2 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	IN1>2 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	IN1>2 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	IN1>2 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking second stage measured earth fault element due to presence of inrush current. If IN1>2 Blocking and 2nd Harmonic both setting are enabled, then (IN1>2) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below > lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.3.4 IN1>2 Function- Sensitive Earth Fault (ordering option)

Sr. No	Parameter	Default setting	Setting Range
1.	IN1>2 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the second stage measured earth fault element.			
2.	IN1>2 Current Set	0.200*In	If DT 0.002 to 2.00*In step 0.001*In If IDMT 0.002 to 0.200*In step 0.001*In
This setting determines the pick-up setting for second stage measured earth fault element.			
3.	IN1>2 Time Delay	1.00 s	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for second stage of measured earth fault element.			
4.	IN1>2 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	IN1>2 Time Dial	01.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	IN1>2 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	IN1>2 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	IN1>2 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	IN1>2 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking second stage measured earth fault element due to presence of inrush current. If IN1>2 Blocking and 2nd Harmonic both setting are enabled, then (IN1>2) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.3.5 IN1>3 Function

Sr. No	Parameter	Default setting	Setting Range
1.	IN1>3 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the third stage measured earth fault element.			
2.	IN1>3 Current Set	01.00*In	If DT 1.0 to 35.00*In step 0.01*In If IDMT 0.05 to 4.00*In step 0.01*In
This setting determines the pick-up setting for third stage measured earth fault element.			
3.	IN1>3 Time Delay	1.00 S	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for third stage of measured earth fault element.			
4.	IN1>3 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	IN1>3 Time Dial	1.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	IN1>3 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			

Sr. No	Parameter	Default setting	Setting Range
7.	IN1>3 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	IN1>3 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	IN1>3 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking third stage measured earth fault element due to presence of inrush current. If IN1>3 Blocking and 2nd Harmonic both setting are enabled, then (IN1>3) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.3.6 IN1>3 Function- Sensitive Earth Fault (ordering option)

Sr. No	Parameter	Default setting	Setting Range
1.	IN1>2 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the third stage measured earth fault element.			
2.	IN1>3 Current Set	0.200*In	If DT 0.002 to 2.000*In step 0.001*In If IDMT 0.002 to 0.200*In step 0.001*In
This setting determines the pick-up setting for third stage measured earth fault element.			
3.	IN1>3 Time Delay	1.00 S	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for third stage of measured earth fault element.			
4.	IN1>3 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	IN1>3 Time Dial	1.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	IN1>3 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	IN1>3 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	IN1>3 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	IN1>3 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking third stage measured earth fault element due to presence of inrush current. If IN1>3 Blocking and 2nd Harmonic both setting are enabled, then (IN1>3) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.4 EARTH FAULT 2 (Derived)

2.12.4.1 IN2>1 Function

Sr. No	Parameter	Default setting	Setting Range
1.	IN2>1 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the first stage derived earth fault element.			

Sr. No	Parameter	Default setting	Setting Range
2.	IN2>1 Current Set	1.00*In	If DT 0.10 to 35.00*In step 0.01*In If IDMT 0.10 to 4.00*In step 0.01*In
This setting determines the pick-up setting for first stage derived earth fault element.			
3.	IN2>1 Time Delay	1.00 S	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for first stage of derived earth fault element.			
4.	IN2>1 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	IN2>1 Time Dial	1.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	IN2>1 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	IN2>1 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	IN2>1 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	IN2>1 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking first stage derived earth fault element due to presence of inrush current. If IN2>1 Blocking and 2nd Harmonic both setting are enabled, then (IN2>1) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting. (Set in SYSTEM CONFIG Menu.)			

2.12.4.2 IN2>2 Function

Sr. No	Parameter	Default setting	Setting Range
1.	IN2>2 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the second stage derived earth fault element.			
2.	IN2>2 Current Set	1.00*In	If DT 0.10 to 35.00*In step 0.01*In If IDMT 0.10 to 4.00*In step 0.01*In
This setting determines the pick-up setting for second stage derived earth fault element.			
3.	IN2>2 Time Delay	1.00 S	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for second stage of derived earth fault element.			
4.	IN2>2 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	IN2>2 Time Dial	01.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	IN2>2 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	IN2>2 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	IN2>2 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			

Sr. No	Parameter	Default setting	Setting Range
9.	IN2>2 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking second stage derived earth fault element due to presence of inrush current. If IN2>2 Blocking and 2nd Harmonic both setting are enabled, then (IN2>2) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.4.3 IN2>3 Function

Sr. No	Parameter	Default setting	Setting Range
1.	IN2>3 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the third stage derived earth fault element.			
2.	IN2>3 Current Set	1.00*In	If DT 1.0 to 35.00*In step 0.01*In If IDMT 0.10 to 4.00*In step 0.01*In
This setting determines the pick-up setting for third stage derived earth fault element.			
3.	IN2>3 Time Delay	1.00 S	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for third stage of derived earth fault element.			
4.	IN2>3 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	IN2>3 Time Dial	1.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	IN2>3 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	IN2>3 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	IN2>3 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	IN2>3 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking third stage derived earth fault element due to presence of inrush current. If IN2>3 Blocking and 2nd Harmonic both setting are enabled, then (IN2>3) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.5 THERMAL OVERLOAD Settings

Sr. No	Parameter	Default setting	Setting Range
1.	Characteristic	Single	Disabled/ Single
This setting determines the operating characteristic of the thermal overload element.			
2.	Thermal Trip	1.00*In	0.05 to 4.00* In step 0.01 In
This setting sets the pick-up threshold of the thermal characteristic. This would normally be the maximum full load current.			
3.	Thermal Alarm	70%	50 to 100% step 1%
This setting sets the thermal state threshold at which an alarm will be generated. This corresponds to a percentage of the trip threshold.			
4.	Time constant 1	10	1 to 200min step 1min
This setting determines the thermal time constant for a single time constant characteristic.			

Sr. No	Parameter	Default setting	Setting Range
5.	K	1.05	1 to 1.5 step 0.01
This setting specify the k constant of thermal over load function			

2.12.6 UNDERCURRENT Settings

Sr. No	Parameter	Default setting	Setting Range
1.	I< Status	Disabled	Enabled / Disabled
This setting is used to enable or disable the Undercurrent protection.			
2.	I<	1.00*I _n	0.10I _n to 1.00*I _n step 0.01*I _n
This setting determines pick-up setting for undercurrent element.			
3.	tl<	1.00 S	0.20s to 100s step 0.01s
This setting determines the time-delay for tripping.			

2.12.7 COLD LOAD PICKUP Settings

Sr. No	Parameter	Default setting	Setting Range
1.	tcold Time Delay	7200 S	0 to 14400s step 1s
This setting determines the time the load needs to be de-energized (dead time) before the new settings are applied.			
2.	tcpl Time Delay	7200 S	0 to 14400s step 1s
This setting controls the period of time for which the relevant overcurrent and earth fault settings are altered or inhibited following circuit breaker closure.			
3.	I>1 Status	Enabled	Blocked / Enabled
The I>1 status cells have two setting options, "Enabled" and "Blocked". Selecting "Enabled" for a particular stage means that the current and time settings programmed in the following cells will be adopted during the "tcpl" time. Selecting "Blocked" simply blocks the relevant protection stage during the "tcpl" time. It also removes the following current and time settings for that stage from the menu.			
4.	I>1 Current Set	1.50*I _n	0.05 to 4.00*I _n step 0.01*I _n
This setting determines the new pick-up setting for first stage overcurrent element during the tcpl time delay.			
5.	I>1 Time Delay	0.01 S	0s to 100s step 0.01s
This setting determines the new operating time delay for the first stage definite time overcurrent element during the tcpl time.			
6.	I>1 TMS	0.100	0.025 to 1.2 in step 0.005
This setting determines the new time multiplier setting for the first stage element to adjust the operating time of the IEC / UK IDMT characteristic during the tcpl time.			
7.	I>1 Time Dial	0.01	0.01 to 100 step 0.01
This setting determines the new time dial setting for the first stage overcurrent element to adjust the operating time of the IEEE / US IDMT characteristic during the tcpl time.			
8.	I>2 Status	Enabled	Block / Enabled
The I>2 status cells have two setting options, "Enabled" and "Blocked". Selecting "Enabled" for a particular stage means that the current and time settings programmed in the following cells will be adopted during the "tcpl" time. Selecting "Blocked" simply blocks the relevant protection stage during the "tcpl" time. It also removes the following current and time settings for that stage from the menu.			
9.	I>2 Current Set	1.50*I _n	0.05 to 4.00*I _n step 0.01*I _n
This setting determines the new pick-up setting for second stage overcurrent element during the tcpl time delay.			
10.	I>2 Time Delay	0.01 S	0s to 100s step 0.01s
This setting determines the new operating time delay for the second stage definite time overcurrent element during the tcpl time.			
11.	I>2 TMS	0.100	0.025 to 1.2 step 0.005
This setting determines the new time multiplier setting for the second stage element to adjust the operating time of the IEC / UK IDMT characteristic during the tcpl time.			
12.	I>2 Time Dial	0.01	0.01 to 100 step 0.01
This setting determines the new time dial setting for the second stage overcurrent element to adjust the operating time of the IEEE / US IDMT characteristic during the tcpl time			

Sr. No	Parameter	Default setting	Setting Range
13.	I>3 Status	Enabled	Blocked / Enabled
The I>3 status cells have two setting options, "Enabled" and "Blocked". Selecting "Enabled" for a particular stage means that the current and time settings programmed in the following cells will be adopted during the "tclp" time. Selecting "Block" simply blocks the relevant protection stage during the "tclp" time. It also removes the following current and time settings for that stage from the menu			
14.	I>3 Current Set	1.50*In	0.05 to 4.00*In step 0.01*In
This setting determines the new pick-up setting for third stage overcurrent element during the tclp time delay.			
15.	I>3 Time Delay	0.01 S	0s to 100s step 0.01s
This setting determines the new operating time delay for the third stage definite time overcurrent element during the tclp time.			
16.	I>3 TMS	0.100	0.025 to 1.2 step 0.005
This setting determines the new time multiplier setting for the third stage element to adjust the operating time of the IEC / UK IDMT characteristic during the tclp time.			
17.	I>3 Time Dial	0.01	0.01 to 100 step 0.01
This setting determines the new time dial setting for the third stage overcurrent element to adjust the operating time of the IEEE / US IDMT characteristic during the tclp time			
18.	IN1>1 Status	Enabled	Blocked / Enabled
The IN1>1 status cells have two setting options, "Enabled" and "Blocked". Selecting "Enabled" for a particular stage means that the current and time settings programmed in the following cells will be adopted during the "tclp" time. Selecting "Blocked" simply blocks the relevant protection stage during the "tclp" time. It also removes the following current and time settings for that stage from the menu.			
19.	IN1>1 Current Set	0.20*In	0.05 to 4.00 step 0.01*In 0.002 to 0.2*In step 0.001*In (for SEF)
This setting determines the new pick-up setting for first stage earth fault element during the tclp time delay.			
20.	IN1>1 Time Delay	0.01 S	0s to 200s step 0.01s
This setting determines the new operating time delay for the first stage definite time element during the tclp time.			
21.	IN1>1 TMS	0.100	0.025 to 1.2 step 0.005
This setting determines the new time multiplier setting to adjust the operating time of the IEC IDMT characteristic during the tclp time.			
22.	IN1>1 Time Dial	0.01	0.01 to 100 step 0.01
This setting determines the new time multiplier setting for the first stage measured earth fault element to adjust the operating time of the IEEE / US IDMT characteristic during the tclp time.			
23.	IN1>2 Status	Enabled	Blocked / Enabled
The IN1>2 status cells have two setting options, "Enabled" and "Blocked". Selecting "Enabled" for a particular stage means that the current and time settings programmed in the following cells will be adopted during the "tclp" time. Selecting "Blocked" simply blocks the relevant protection stage during the "tclp" time. It also removes the following current and time settings for that stage from the menu.			
24.	IN1>2 Current Set	0.20*In	0.05 to 4.00*In step 0.01*In 0.002 to 0.2*In step of 0.001*In (for SEF)
This setting determines the new pick-up setting for second stage earth fault element during the tclp time delay.			
25.	IN1>2 Time Delay	0.01 S	0s to 200s step 0.01s
This setting determines the new operating time delay for the second stage definite time element during the tclp time.			
26.	IN1>2 TMS	0.100	0.025 to 1.2 step 0.005
This setting determines the new time multiplier setting to adjust the operating time of the IEC / UK IDMT characteristic during the tclp time.			
27.	IN1>2 Time Dial	0.01	0.01 to 100 step 0.01
This setting determines the new time multiplier setting for the second stage measured earth fault element to adjust the operating time of the IEEE / US IDMT characteristic during the tclp time.			
28.	IN1>3 Status	Enabled	Blocked / Enabled
The IN1>3 status cells have two setting options, "Enabled" and "Blocked". Selecting "Enabled" for a particular stage means that the current and time settings programmed in the following cells will be adopted during the "tclp" time. Selecting "Blocked" simply blocks the relevant protection stage during the "tclp" time. It also removes the following current and time settings for that stage from the menu.			
29.	IN1>3 Current Set	0.20*In	0.05 to 4.00*In step 0.01*In 0.002 to 0.2*In step 0.001*In (for SEF)

Sr. No	Parameter	Default setting	Setting Range
This setting determines the new pick-up setting for third stage earth fault element during the tclp time delay.			
30.	IN1>3 Time Delay	0.01 S	0s to 200s step 0.01s
This setting determines the new operating time delay for the third stage definite time element during the tclp time.			
31.	IN1>3 TMS	0.100	0.025 to 1.2 step 0.005
This setting determines the new time multiplier setting to adjust the operating time of the IEC / UK IDMT characteristic during the tclp time.			
32.	IN1>3 Time Dial	0.01	0.01 to 100 step 0.01
This setting determines the new time multiplier setting for the third stage measured earth fault element to adjust the operating time of the IEEE / US IDMT characteristic during the tclp time.			
33.	IN2>1 Status	Enabled	Blocked / Enabled
The IN2>1 status cells have two setting options, "Enabled" and "Blocked". Selecting "Enabled" for a particular stage means that the current and time settings programmed in the following cells will be adopted during the "tclp" time. Selecting "Blocked" simply blocks the relevant protection stage during the "tclp" time. It also removes the following current and time settings for that stage from the menu.			
34.	IN2>1 Current Set	00.20*In	0.10 to 4.00 step 0.01*In
This setting determines the new pick-up setting for first stage earth fault element during the tclp time delay.			
35.	IN2>1 Time Delay	0.01 S	0s to 200s step 0.01s
This setting determines the new operating time delay for the first stage definite time element during the tclp time.			
36.	IN2>1 TMS	0.100	0.025 to 1.2 step 0.005
This setting determines the new time multiplier setting to adjust the operating time of the IEC IDMT characteristic during the tclp time.			
37.	IN2>1 Time Dial	0.01	0.01 to 100 step 0.01
This setting determines the new time multiplier setting for the first stage derived earth fault element to adjust the operating time of the IEEE / US IDMT characteristic during the tclp time.			
38.	IN2>2 Status	Enabled	Blocked / Enabled
The IN2>2 status cells have two setting options, "Enabled" and "Blocked". Selecting "Enabled" for a particular stage means that the current and time settings programmed in the following cells will be adopted during the "tclp" time. Selecting "Blocked" simply blocks the relevant protection stage during the "tclp" time. It also removes the following current and time settings for that stage from the menu.			
39.	IN2>2 Current Set	0.20*In	0.10 to 4.00*In step 0.01*In
This setting determines the new pick-up setting for second stage earth fault element during the tclp time delay.			
39.	IN2>2 Current Set	0.20*In	0.10 to 4.00*In step 0.01*In
This setting determines the new pick-up setting for second stage earth fault element during the tclp time delay.			
40.	IN2>2 Time Delay	0.01 S	0s to 200s step 0.01s
This setting determines the new operating time delay for the second stage definite time element during the tclp time.			
41.	IN2>2 TMS	0.1	0.025 to 1.2 step 0.005
This setting determines the new time multiplier setting to adjust the operating time of the IEC / UK IDMT characteristic during the tclp time.			
42.	IN2>2 Time Dial	0.01	0.01 to 100 step 0.01
This setting determines the new time multiplier setting for the second stage derived earth fault element to adjust the operating time of the IEEE / US IDMT characteristic during the tclp time.			
43.	IN2>3 Status	Enabled	Blocked / Enabled
The IN2>3 status cells have two setting options, "Enabled" and "Blocked". Selecting "Enabled" for a particular stage means that the current and time settings programmed in the following cells will be adopted during the "tclp" time. Selecting "Blocked" simply blocks the relevant protection stage during the "tclp" time. It also removes the following current and time settings for that stage from the menu.			
44.	IN2>3 Current Set	0.20*In	0.10 to 4.00*In step 0.01*In
This setting determines the new pick-up setting for third stage earth fault element during the tclp time delay.			
45.	IN2>3 Time Delay	0.01 S	0s to 200s step 0.01s
This setting determines the new operating time delay for the third stage definite time element during the tclp time.			
46.	IN2>3 TMS	0.100	0.025 to 1.2 step 0.005
This setting determines the new time multiplier setting to adjust the operating time of the IEC IDMT characteristic during the tclp time.			

Sr. No	Parameter	Default setting	Setting Range
47.	IN2>3 Time Dial	0.01	0.01 to 100 step 0.01
This setting determines the new time multiplier setting for the third stage derived earth fault element to adjust the operating time of the IEEE / US IDMT characteristic during the tclp time.			

2.12.8 NEG SEQUENCE O/C Settings

2.12.8.1 I2>1 Function

Sr. No	Parameter	Default setting	Setting Range
1.	I2>1 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the first stage Negative sequence overcurrent element.			
2.	I2>1 Current Set	1.00*In	If DT 0.10 to 35.00*In step 0.01*In If IDMT 0.10 to 4.00*In step 0.01*In
This setting determines the pick-up setting for first stage Negative sequence overcurrent element.			
3.	I2>1 Time Delay	1.00 S	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for first stage Negative sequence overcurrent element.			
4.	I2>1 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	I2>1 Time Dial	1.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	I2>2 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics.			
7.	I2>1 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic. IDMT applicable for IEEE curves only.			
8.	I2>1 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	I2>1 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking first stage Negative sequence overcurrent element due to presence of inrush current. If I2>1 Blocking and 2nd Harmonic both setting are enabled, then (I2>1) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.8.2 I2>2 Function

Sr. No	Parameter	Default setting	Setting Range
1.	I2>2 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the second stage Negative sequence overcurrent element.			
2.	I2>2 Current Set	1.00*In	If DT 0.10 to 35.00*In step 0.01*In If IDMT 0.10 to 4.00*In step 0.01*In
This setting determines the pick-up setting for second stage Negative sequence overcurrent element.			
3.	I2>2 Time Delay	1.00 S	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for second stage Negative sequence overcurrent element.			

Sr. No	Parameter	Default setting	Setting Range
4.	I2>2 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	I2>2 Time Dial	1.00	0.01 to 100 step 0.01
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	I2>3 Reset Char	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	I2>2 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	I2>2 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	I2>2 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking second stage Negative sequence overcurrent element due to presence of inrush current. If I2>2 Blocking and 2nd Harmonic both setting are enabled, then (I2>2) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.8.3 I2>3 Function

Sr. No	Parameter	Default setting	Setting Range
1.	I2>3 Function	IEC S Inverse	Disabled / DT / IEC S Inverse / S Inverse 1.3Sec / IEC V Inverse / IEC E Inverse / UK LT Inverse / IEEE M Inverse / IEEE V Inverse / IEEE E Inverse / US Inverse / US ST Inverse
This setting determines the tripping characteristic for the third stage Negative sequence overcurrent element.			
2.	I2>3 Current Set	1.00*In	If DT 1.0 to 35.00*In step 0.01*In If IDMT 0.10 to 4.00*In step 0.01*In
This setting determines the pick-up setting for second third Negative sequence overcurrent element.			
3.	I2>3 Time Delay	1.00 S	0s to 200s step 0.01s
This setting determines the time-delay for the definite time setting if selected for third stage Negative sequence overcurrent element.			
4.	I2>3 TMS	1.000	0.025 to 1.2 step 0.005
This time multiplier setting is used to adjust the operating time of the IEC / UK IDMT characteristic.			
5.	I2>3 Time Dial	1.00	0.01 to 100 step 0.01s
This time multiplier setting is used to adjust the operating time of the IEEE / US IDMT curves.			
6.	tRESET Function	DT	DT/IDMT
This setting determines the type of reset/release characteristics. IDMT applicable for IEEE curves only.			
7.	I2>3 RTMS	1.000	0.025 to 1.2 step 0.005
This setting determines the reset/release time for IEEE IDMT characteristic			
8.	I2>3 tRESET	1.00 S	0s to 100s step 0.01s
This setting determines the reset/release time for Definite Time (DT) and all IDMT curve			
9.	I2>3 2H Blocking	Disabled	Enabled / Disabled
This setting determines the enabling/disabling of blocking third stage Negative sequence overcurrent element due to presence of inrush current. If I2>3 Blocking and 2nd Harmonic both setting are enabled, then (I2>3) trip command will be blocked in case 2nd harmonics content in any phase is above the 2ndHarm Thresh. and fundamental current is below I> lift 2H setting . (Set in SYSTEM CONFIG Menu.)			

2.12.9 BROKEN CONDUCTOR Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	BC Alarm	Disabled	Disabled / Enabled
This setting enables (activate) or disables (turn off) the Broken Conductor alarm.			
2.	I2/I1 Set-1	0.50	0.20 to 1.00 step 0.01
This setting determines the pick-up threshold of the negative to positive sequence current ratio for Broken Conductor alarm.			
3.	I2/I1 Time Dly-1	10.00 S	0s to 100s step 0.01s
This setting sets the time delay for the Broken Conductor alarm.			
4.	BC Trip	Disabled	Disabled / Enabled
This setting enables (activate) or disables (turn off) the Broken Conductor Trip function			
5.	I2/I1 Set-2	0.50	0.20 to 1.00 step 0.01
This setting determines the pick-up threshold of the negative to positive sequence current ratio for Broken Conductor Trip.			
6.	I2/I1 Time Dly-2	10.00 S	0s to 100s step 0.01s
This setting sets the time delay for Broken Conductor Trip.			

2.12.10 CB FAIL Settings

Sr. No	Parameter	Defaults setting	Setting / Ranges
1.	CB Fail Status	Enabled	Disabled / Enabled
This setting enables (activate) or disables (turn off) the CB Fail Status			
2.	CB Fail Timer	0.1 S	0s to 50s step 0.01s
This setting sets the time delay in which the CB opening must be detected.			
3.	CBF Reset	CB Open + I<	1=I< Only 2=CB Open + I< 3=Prot Reset + I< 4= CB Open
This setting determines the elements that will reset the CB fail timer for CB Failures			
4.	I<	1.00*In	0.05*In to 3.20*In step 0.01
This setting determines the current threshold, which will reset the CB Fail timer for Overcurrent based protection			
5.	IN<	1.00*In	0.05*In to 3.20*In step 0.01
This setting determines the current threshold, which will reset the CB Fail timer for Earth fault based protection			
6.	Remove I> Start	Disabled	Disabled / Enabled
This setting for removing phase overcurrent start signal following CBF operation			
7.	Remove IN> Start	Disabled	Disabled / Enabled
This setting for removing earth overcurrent start signal following CBF operation			

2.12.11 VIEW RECORDS

Sr. No	Parameter	Display value on LCD
1.	Fault Record	Display the Records of fault i.e. parameter value, flag of fault & date and time of Fault
2.	Event Record	Display of all digital events with time stamping (max 512 events)
3.	Maint Record	Display of error generated by relay if any, in case of failure of hardware
4.	Alarm Record	Display of alarm generated by relay & date and time of generated alarm.

MONITORING & CONTROL

CHAPTER 8

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

- 1 Chapter Overview**
- 2 Monitoring & Control**
 - 2.1 Monitoring Functions (Event, Fault, Disturbance Record)
 - 2.1.1 Event Record
 - 2.1.2 Alarm Record
 - 2.1.3 Fault Record
 - 2.1.4 Maintenance Record
 - 2.1.5 Disturbance Record
 - 2.2 Record Control
 - 2.3 Display of Measuring Parameters
 - 2.4 Opto Inputs
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 - 2.5.1 Output Relay Function Assignment
 - 2.5.2 O/P Relay Configuration
 - 2.5.3 O/P Contact Open Time
 - 2.6 Programmable LEDs
 - 2.7 Logic Equations
 - 2.8 CB Monitoring
 - 2.8.1 CB Open Supervision
 - 2.8.2 CB Open Operation Alarm
 - 2.9 CB Control
 - 2.9.1 Local Control using IED Menu
 - 2.9.2 Remote Control
 - 2.10 Trip Circuit Supervision
 - 2.10.1 Calculations for External Resistor
 - 2.11 Self-Diagnostic Features
 - 2.12 Watchdog Feature

2 MONITORING & CONTROL

2.1 Monitoring Functions (Event, Fault, Disturbance Record)

The IED logs three different types of record. These are Event, Fault and Disturbance records, which are stored in the IEDs non-volatile memory. It is important to log records because this allows you to establish the sequence of events that occurred, for example following a particular power system condition.

The device is capable of storing up to:

- 512 event records (including Alarm/maintenance records)
- 5 Fault records
- 5 Disturbance records

When the available space is exhausted, the oldest record is automatically overwritten by the new one. The IEDs internal clock provides a time tag for each event, to a resolution of 1 ms.

The VIEW RECORDS column contains details of these Event, Alarm, Fault and maintenance records, which can be displayed on the IEDs front panel, although it is easier to view them using the settings application software.

The device supports IEC 60870-5-103, Modbus and DNP3.0 protocol. In case IEC60870-5-103/Modbus protocol is selected while ordering, then relay auto-detects IEC-60870-5-103 and MODBUS command and responds in respective language. There is no specific setting which defines the protocol selection between IEC60870-5-103 and Modbus.

2.1.1 Event Record

The Event record is generated when certain events happen. A change in any digital input signal or protection element output signal causes an event record to be created. These events are generated by the protection software and immediately time stamped. They are then transferred to non-volatile memory for storage.

The device continuously monitors logical and physical status. There are six physical Binary inputs provided, marked as S1, S2 up to S6. Any physical or logical change is recorded as event. These events are stored in internal, non-volatile memory along with a time stamp. Some of the events recorded include: Protection pickup, Relay Reset and CB Trip. A complete list can be found in protocol document. Up to 512 such events can be stored and downloaded for detailed analysis. Details of the event data are as follows:

Capacity: 512 events (including Alarm/maintenance records)

Time-tag: 1 millisecond

Triggers: Any selected protection alarm and threshold, Logic input change of state, Self-test events and setting changes.

The user can view the event records either using the front panel interface, the USB port or remotely using the rear EIA(RS)485 port.

2.1.2 Alarm Record

The P154 logs any alarm conditions it generates as individual events. Details of the event are displayed in the **Alarm Record** submenu under **VIEW RECORDS** menu.

A Time and Date stamp is always associated with the event in question and is displayed after the event description. The alarms are stored in alarm record till the alarm is acknowledged by **CLEAR** key.

2.1.3 Fault Record

A fault record is triggered by any protection signal which trips the circuit breaker. If there are any fault records, these will appear automatically in the **VIEW RECORDS** column. You can select the fault record in the **VIEW RECORDS** column. A value of '01' corresponds to the latest fault record.

Information about the fault follows in the subsequent cells. The time stamp assigned to the fault record itself is more accurate than the corresponding stamp of the event record, because the event is logged after the actual fault record is generated. The fault measurements in the fault record are given at the time of the protection Start.

After every fault relay latched fault data which can be viewed for detailed analysis. The following details are applicable for fault record.

Capacity: 5 faults

Time-tag: 1 millisecond

Triggers: Any selected protection threshold.

Data: Fault number, Type of fault (stage / Phase / EF etc), Trip counter, Fault current magnitude in Secondary, Trip Timing, Thermal state, Fault date and Fault time.

2.1.4 Maintenance Record

Internal failures detected by the self-monitoring circuitry, such as watchdog failure and alarms related to CB operation are logged as maintenance records. If there are any maintenance records, these will appear automatically in the **VIEW RECORDS** column. You can select the maintenance record in the **Maint Record** submenu in the **VIEW RECORDS** column. The latest maintenance record is always displayed at the top while navigating the **Maint Record** submenu.

The following details are applicable for maintenance data

Capacity : 100 records

Triggers : Any hardware error and CB Operation error

Data : Error Code, Error description and Date & Time

2.1.5 Disturbance Record

The disturbance recorder can record the waveforms of the calibrated analogue channels, as well as the values of the digital signals. The disturbance recorder is supplied with data once per cycle, and collates the received data into a disturbance record. The disturbance records can be extracted using application software or the SCADA system, which can also store the data in COMTRADE format, allowing the use of other packages to view the recorded data.

The integral disturbance recorder has an area of memory specifically set aside for storing disturbance records. Up to 5 such waveforms can be recorded; the duration of each disturbance record is 1sec. The maximum total recording time is 5 seconds.

When the available memory is exhausted, the oldest records are overwritten by the newest ones. The disturbance recorder stores the samples that are taken at a rate of 16 samples per cycle.

Each disturbance record consists of 5 analogue data channels and 37 digital data channels. The relevant CT ratio for the analogue channels is also extracted to enable scaling to primary quantities.

The relay records the waveform of the current along with all digital and logical status during a fault. The disturbance record can be triggered from trip operation of relay. It is not possible to view the

disturbance records locally via the front panel LCD. This waveform can be downloaded via the communication port for further analysis.

The fault recording is set by **Trigger Position** cell. The **Trigger Position** cell sets the trigger point as a percentage of the duration.

The details of the disturbance record are as follows:

Capacity:	5 records of 1 sec each
Pre fault Trigger position:	Programmable
Sampling rate:	16 samples / cycles
Triggers:	Trip signals, external trigger via opto input assignment.
Data:	5 analogue channels and up to 37 digital channels (physical and logical status).

2.2 Record Control

The data stored in Event/Fault/Maintenance/Disturbance Records can be cleared by enabling the settings **Clear Events/Clear Faults/Clear Maint/Clear Dist Recs** in **Record Control** menu. The Thermal State can be reset by enabling the Thermal Reset setting.

2.3 Display of Measuring Parameters

The device directly measures and calculates a number of system quantities, which are updated at regular intervals. These values can be viewed in the MEASUREMENTS menu on the LCD screen using the navigation keys on the front panel or using the P50 Agile configurator tool.

In normal conditions the relay displays Primary and Secondary current value of phases A, B, C and earth current N as per phase/earth CT ratio within $\pm 2\%$ accuracy and Thermal state in %.

The device measures and displays the following quantities:

Parameter	Unit	Description
IA	amp	Primary current in phase A
IB	amp	Primary current in phase B
IC	amp	Primary current in phase C
IN1	amp	Primary earth current (measured)
IN2	amp	Primary earth current (derived)
ia	amp	Secondary current in phase A
ib	amp	Secondary current in phase B
ic	amp	Secondary current in phase C
in1	amp	Secondary earth current (measured)
in2	amp	Secondary earth current (derived)
i2	amp	Secondary -ve phase sequence current
i1	amp	Secondary +ve phase sequence current
I2/I1	%	Ratio of I2/I1
TC	count	Breaker Trip counter (Count of number of trips issued by relay)
BOC	count	Breaker operation counter (Count of total breaker operations-local & relay tripping)
BOT	millisecond	Breaker operating time (Breaker contact opening time for the latest trip)

Parameter	Unit	Description
Th State	%	Thermal state
Ia rms	amp	Secondary true RMS current in phase A
Ib rms	amp	Secondary true RMS current in phase B
Ic rms	amp	Secondary true RMS current in phase C

In the event of a fault, the type of the fault and fault current are displayed on LCD. The IED measures the fault current and stores it in the non-volatile memory.

2.4 Opto Inputs

The device supports 6 numbers of opto-inputs. The use of these opto-inputs depends on the application. There are a number of settings associated with the opto-inputs.

The relays have programmable opto-isolated logic inputs, which can be assigned to any available function which are identified as Opto I/P 1 to Opto I/P 6. These inputs are used to acquire status of external field signals such as CB close, CB open etc or can be programmed for function such as external reset, External trigger to DR etc. by using P50 Configurator as well as relay user interface. On the user interface, the Opto I/P can be assigned to any function from I/O configuration menu. The function can be assigned to any input by entering the values to them either 0 or 1 i.e. 0 = not assigned and 1 = assigned.

The following are the list of functions, which can be assigning to digital input.

Function	Description
Rem. Rst.	Function used to reset Latch type output contact and LED indication
CBF Init.	Function used to Initiate Breaker Fail
Sel Grp2	Function used to enable Group 2 setting
Ext Trip	Function initiates the relay assigned for Gen. Trip to operate and trip the CB.
DR Trig	Function used to trigger Disturbance Record
CB (52A)	Status used to detect CB Close position
CB (52B)	Status used to detect CB Open position
Blk I>1	Function used to block tripping of O/C stage 1
Blk I>2	Function used to block tripping of O/C stage 2
Blk I>3	Function used to block tripping of O/C stage 3
Blk I2>1	Function used to block tripping of NPS stage 1
Blk I2>2	Function used to block tripping of NPS stage 2
Blk I2>3	Function used to block tripping of NPS stage 3
Blk IN1>1	Function used to block tripping of measured E/F stage 1
Blk IN1>2	Function used to block tripping of measured E/F stage 2
Blk IN1>3	Function used to block tripping of measured E/F stage 3
Blk IN2>1	Function used to block tripping of derived E/F stage 1
Blk IN2>2	Function used to block tripping of derived E/F stage 2
Blk IN2>3	Function used to block tripping of derived E/F stage 3
Blk BC	Function used to block tripping of Broken Conductor
Blk THOL	Function used to block tripping of Thermal Overload
Blk I<	Function used to block tripping of Under Current
TCS Trig	Status is used to monitor Trip Circuit Supervision

The Digital inputs are suitable for accepting AC or DC auxiliary supply. The selection for AC or DC auxiliary supply is done from submenu **Opto I/P** under **SYSTEM DATA** menu.

The DI can be selectable for different operating voltage (**ordering option**) depending on the application requirement.

For details regarding the operating voltage and its threshold values, please refer to the Technical Specification section of this manual.

2.5 Output Relays

The device supports 6 numbers of relay output. The use of these relay outputs depends on the application. There are a number of settings associated with the relay outputs.

2.5.1 Output Relay Function Assignment

The relays have configurable logic outputs, which can be assigned to any available function. The logic outputs are identified as RL1 to RL6. All logic outputs have changeover contacts and can be configured to change state on activation of the different functions available in the relay. A basic output matrix is included in the P50 Agile configurator. Different functions can be assigned by using P50 Configurator as well as relay user interface. On the user interface, the output relays can be assigned to any function from I/O configuration menu. The function can be assigned to any input by entering the values to them either 0 or 1 i.e. 0 = not assigned and 1 = assigned.

The following diagram explains the assignment process to relay either by UI or P50 Configuration.

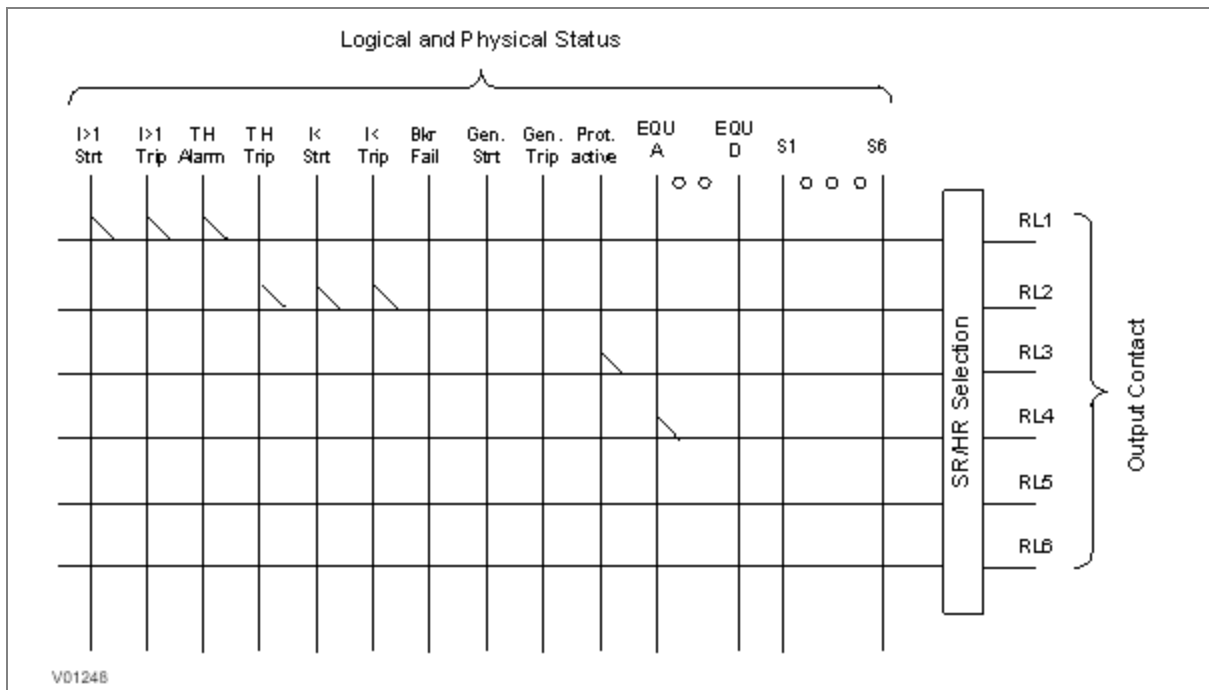


Figure 1: Output contact configuration logic

The following functions can be assigned to the relay contacts.

Function	Description
Gen Strt	General start
Strt L1	Start detected in phase A
Strt L2	Start detected in phase B
Strt L3	Start detected in phase C
Strt I>1	Start O/C stage 1
Strt I>2	Start O/C stage 2

Function	Description
Strt I>3	Start O/C stage 3
Strt I2>1	Start Neg seq. O/C stage 1
Strt I2>2	Start Neg seq. O/C stage 2
Strt I2>3	Start Neg seq. O/C stage 3
StrtIN1>1	Start Measured E/F stage 1
StrtIN1>2	Start Measured E/F stage 2
StrtIN1>3	Start Measured E/F stage 3
StrtIN2>1	Start Derived E/F stage 1
StrtIN2>2	Start Derived E/F stage 2
StrtIN2>3	Start Derived E/F stage 3
Strt BC	Start Broken Conductor
THOL Alm	Start Thermal Alarm
Strt CLP	Start Cold load Pickup
Strt I<	Start Under current
Strt CBF	Start Breaker Failure
I> BCBF	Block O/C protection during CB Fail
IN1> BCBF	Block E/F protection during CB Fail
BC Alm	Broken Conductor Alarm
CloseFail	CB Close Fail Alarm (during control operation)
Open Fail	CB Open Fail Alarm (during control operation)
Relay OK	Relay healthy
Gen Trip	General Trip
Trip L1	Trip in phase A
Trip L2	Trip in phase B
Trip L3	Trip in phase C
Trip I>1	Trip in O/C stage 1
Trip I>2	Trip in O/C stage 2
Trip I>3	Trip in O/C stage 3
Trip I2>1	Trip in Neg seq. O/C stage 1
Trip I2>2	Trip in Neg seq. O/C stage 3
Trip I2>3	Trip in Neg seq. O/C stage 2
TripIN1>1	Trip in Measured EF stage 1
TripIN1>2	Trip in Measured EF stage 2
TripIN1>3	Trip in Measured EF stage 3
TripIN2>1	Trip in Derived EF stage 1
TripIN2>2	Trip in Derived EF stage 2
TripIN2>3	Trip in Derived EF stage 3
BC Trip	Trip in Broken Conductor
THOL Trip	Trip in Thermal overload
CLP	Trip in Cold load pickup
Trip I<	Trip in Under Current
CBF Trip	Trip in Breaker Fail
CBOpr Alm	CB operation Alarm
Opto/P 1	Opto Input 1

Function	Description
OptoI/P 2	Opto Input 2
OptoI/P 3	Opto Input 3
OptoI/P 4	Opto Input 4
OptoI/P 5	Opto Input 5
OptoI/P 6	Opto Input 6
AndLogicA	AND logic equation A
AndLogicB	AND logic equation B
AndLogicC	AND logic equation C
AndLogicD	AND logic equation D
CB Trip	Circuit Breaker Trip
CB Close	Circuit Breaker Close
TCS Alarm	Trip circuit supervision Alarm
CBOPn Sup	CB Open supervision Alarm

Note: The above functions can be assigned to LEDs and AND Logic Equation.

2.5.2 O/P Relay Configuration

All relay contacts can be individually set as self-reset or latching.

The self-reset trip contact remains closed until the fault persists and opens only after fault current become less than reset value. The latching type contact will close when a fault occurs and will remain closed even if there is no fault persisting. The contact can be reset by pressing **CLEAR** key.

The selection of HR/SR type is made by changing bits value from 0 or 1 in **O/P RELAY CONFIG** menu setting.

For Self-reset output contact set bit 0

For Latch type (HR) output contact set bit 1.

The bit position for relay contacts is as shown in following table.

RL-6	RL-5	RL-4	RL-3	RL-2	RL-1	
0	0	0	0	0	0	1 is HR type & 0 is SR type

For example, if you select RL-1 to hand reset (latching) type and all other relay self-reset then you have to select the configuration below.

RL-6	RL-5	RL-4	RL-3	RL-2	RL-1	
0	0	0	0	0	1	1 is HR type & 0 is SR type

2.5.3 O/P Contact Open Time

This timer is used to hold relay contact after executing trip to ensure proper CB opening.

All digital outputs have a separate setting to set the contact open time. This timer is applicable only when output contact is SR type.

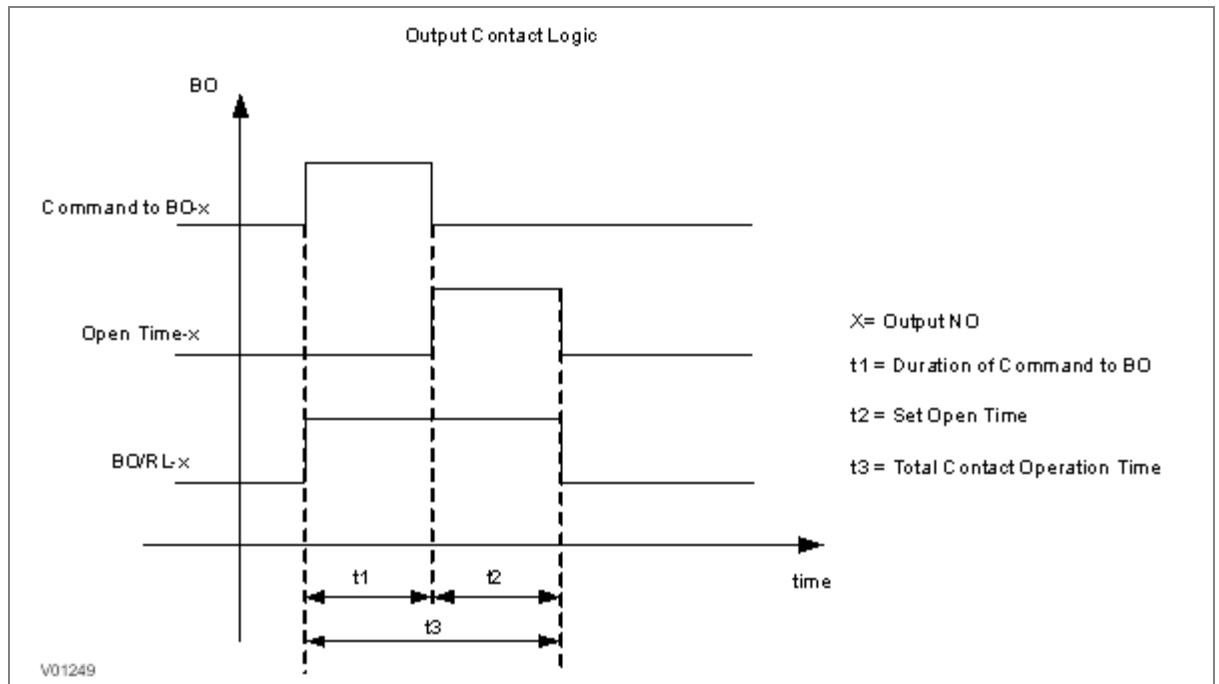


Figure 2: Output contact logic

2.6 Programmable LEDs

The device supports 4 numbers of programmable LEDs. All of the programmable LEDs on the unit are bi-colour and can be set to RED or GREEN. The use of these LEDs depends on the application. There are a number of settings associated with the relay outputs.

The programmable LEDs can be assigned to any available function. The programmable LEDs are identified as L5 to L8. Different functions can be assigned by using P50 Configurator as well as relay user interface. On the user interface, the LEDs can be assigned to any function from **I/O configuration** menu. The function can be assigned to any input by entering the values to them either 0 or 1 i.e. 0 = not assigned and 1 = assigned.

The following diagram explains the assignment process of LEDs by either by UI or P50 Configuration. Here **G** represents **Green** LED and **R** represents **Red** LED. Both are part of one command dual LED.

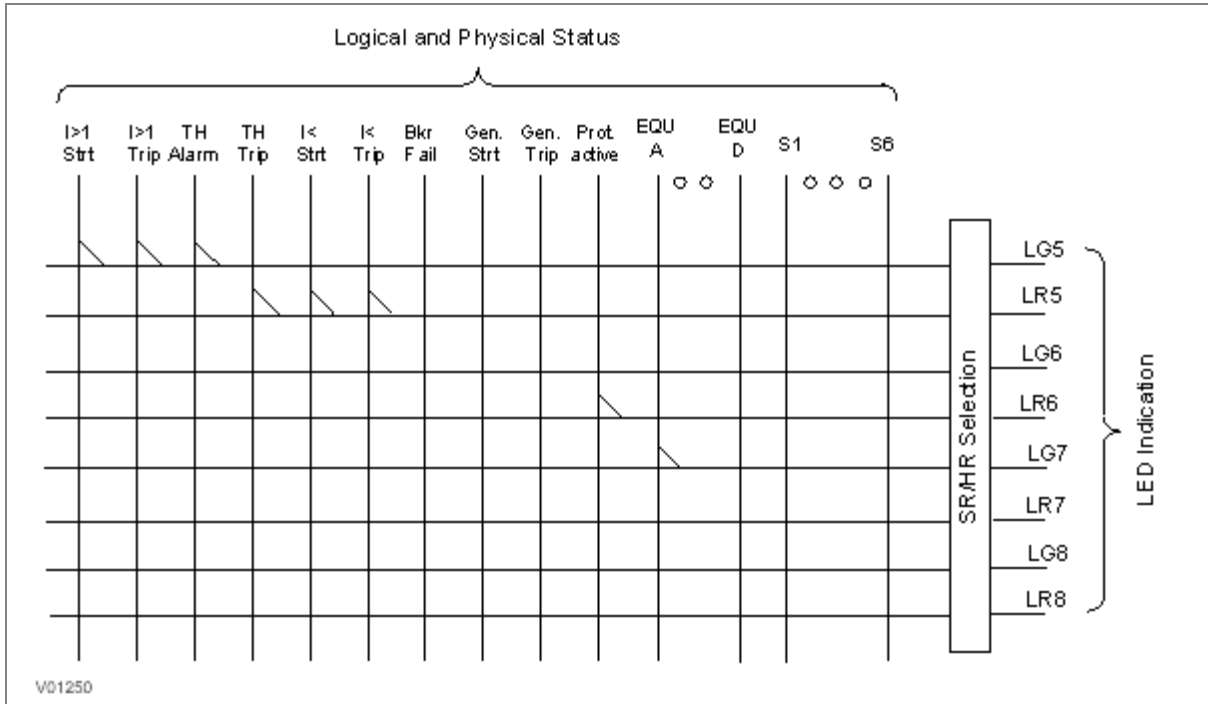


Figure 3: LEDs configuration logic

The functions that can be assigned to Green LED and Red LED are same to relay contact.

All Green LEDs and Red LEDs can be individually set as self-reset or latching

The selection of HR/SR type is made by changing bits value from 0 or 1 in **O/P Contact Configuration** setting.

For Self-reset output contact, set bit 0

For Latch type (HR) output contact, set bit 1.

The bit position for Green LEDs is as shown in following table.

LG-8	LG-7	LG-6	LG-5	
0	0	0	0	1 is HR type & 0 is SR type

The bit position for Red LEDs is as shown in following table.

LR-8	LR-7	LR-6	LR-5	
0	0	0	0	1 is HR type & 0 is SR type

2.7 Logic Equations

The device supports 4 Logic AND equations which can be used to form Boolean functions using AND operators. Any function available in the IO Mask can be assigned to any single equation. Maximum numbers of signals that can be assigned to any equation depends on the number of functions available in IO mask for assignment.

The Logic equations are identified as AndLogicA, AndLogicB, AndLogicC and AndLogicD.

Any protection functions, Control Operation and opto I/Ps can be assigned to the AND logic equations and result of equation can be time delayed and assigned to any output relays and LEDs. The relevant settings are available under **O/P Relay configuration** menu.

The signals available for mapping to an equation are same as available for relay contacts and LEDs.

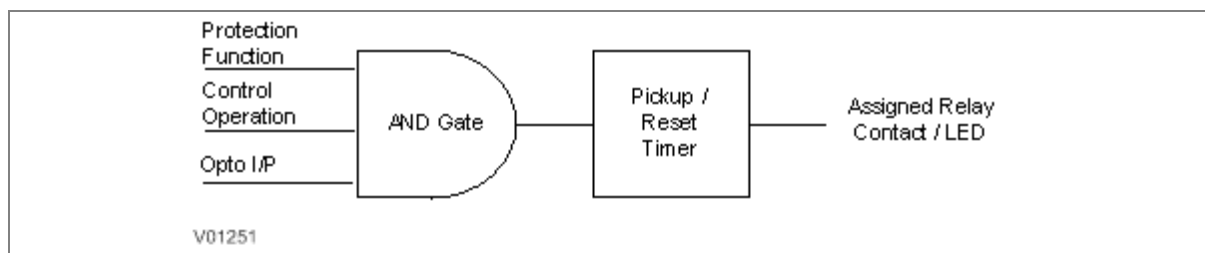


Figure 4: AND logic equation

AND Logic application example

The figure below is an example for AND logic implementation in the relay. There are two inputs to the AND equations, one is SF6 Gas low signal which is externally wired to Opto I/P 1 of relay and other input is TCS Alarm which is internally generated signal. Both signals are assigned to AND logic equation and when both the input signals are high, then the output of AND logic equation will be high. This output can be used to block all protection functions through external wiring.

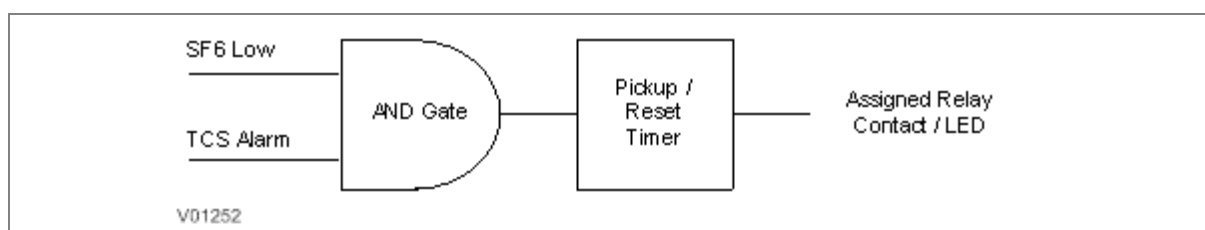


Figure 5: AND logic equation application example

2.8 CB Monitoring

Periodic maintenance of circuit breakers is necessary to ensure that the trip circuit and mechanism operate correctly and also that the breaking capability has not been compromised due to previous fault interruptions. Generally, such maintenance is based on a fixed time interval. These methods of monitoring circuit breaker condition give a rough guide only and can provide early indications of maintenance required. The relays record various statistics related to each circuit breaker trip operation, allowing a more accurate assessment of the circuit breaker condition.

Relay records following circuit breaker operation statistics:-

Record in Measurement	Description
BOT	"Breaker Opening Time"- This is a circuit breaker opening time in ms.
BOC	"Breaker Operation Counter"- This counter indicates numbers of CB operations.
TC	"Trip Counter" -This counter indicates number of protection trips.

The above counters can be reset to zero, after maintenance inspection and overhaul.

2.8.1 CB Open Supervision

Slow CB operation indicates the need for mechanism maintenance. Alarm threshold (**CB Open Time**) is provided to enforce this and can be set in the range of 50msec to 1 sec. This time relates to the interrupting time of the circuit breaker and includes relay trip contact operating time, CB main contact operation time and CB auxiliary contact operating time.

The relay starts internal timer as soon as any protection function is operated. Relay monitors the CB open contact status and stops the timer as soon as the CB open feedback is received by the relay. If this measured time is more than setting "**CB Open Time**", then relay generates **CB Open Supervision** alarm. An alarm message is displayed on LCD display and the START LED starts blinking. The associated event is stored in Event Record. In the event the measured Breaker opening time is less than the setting "**CB Open Time**", the timer is reset and no alarm is generated.

Breaker opening time is displayed on the LCD display under **MEASUREMENTS** menu.

The CB Open Supervision logic is explained in following diagram:

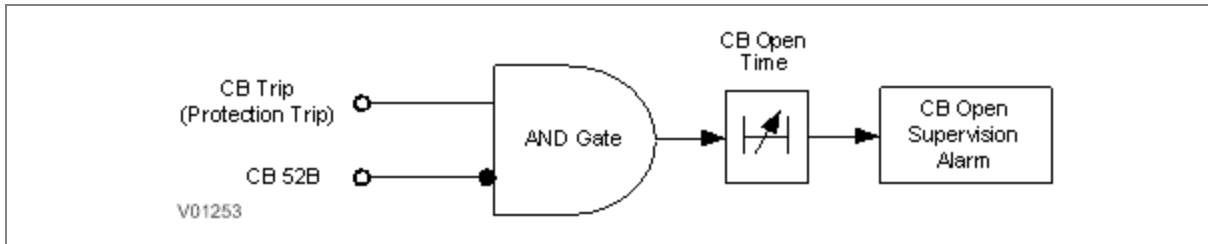


Figure 6: CB open supervision logic

2.8.2 CB Open Operation Alarm

Every circuit breaker operation results in some degree of wear for its components. Therefore routine maintenance, such as oiling of mechanisms, may be based on the number of operations. Suitable setting of the maintenance threshold will allow an alarm to be raised, indicating when preventative maintenance is due.

Some circuit breakers, such as oil circuit breakers (OCBs) can only perform a certain number of fault interruptions before requiring maintenance attention. This is because each fault interruption causes carbonising of the oil, degrading its dielectric properties. The maintenance alarm threshold (setting CB Open operations) may be set to indicate the requirement for oil dielectric testing, or for more comprehensive maintenance.

For each circuit breaker trip operation, the relay records statistics. The relay monitors the number of circuit breaker operation by maintaining two types of counter (1) Breaker Trip counter which is based on the number of trips issued by the relay and (2) Breaker Operation counter which is the count of total breaker operations and based on the status change of CB auxiliary contact wired to one of the relay opto inputs. The relay compares the Breaker Operation Counter (**BOC**) with CB Open Operations (**CB Open Oper**) setting and generates **CB Open Operation** alarm when counter exceeds the set value, indicating that the preventative maintenance is due. The alarm message is displayed on LCD display and **START** LED starts blinking. The associated event is stored in Event Record.

2.9 CB Control

There are several types of circuit breaker;

- CBs with no auxiliary contacts
- CBs with 52A contacts (where the auxiliary contact follows the state of the CB)
- CBs with 52B contacts (where the auxiliary contact is in the opposite state the state of the CB)
- CBs with both 52A and 52B contacts

Circuit Breaker control is only possible if the circuit breaker in question provides auxiliary contacts.

For local control, the **CB control by** cell should be set accordingly.

The length of the trip and close control pulses can be set via the Open Pulse Time and Close Pulse Time settings respectively. These should be set long enough to ensure the breaker has completed its open or close cycle before the pulse has elapsed.

If an attempt to close the breaker is being made, and a protection trip signal is generated, the protection trip command overrides the close command.

If the CB fails to respond to the control command (indicated by no change in the state of CB Status inputs) an **Open Fail** alarm or **Close Fail** alarm is generated after the relevant trip or close pulses have expired. These alarms can be viewed on the LCD display, remotely, or can be assigned to output contacts.

The control operations of CB such as CB Open and CB Close command is controlled locally through relay HMI or Remote operation. Type of Control operation is enabled (i.e. Local, Remote or Local + Remote) in the **CB CONTROL** menu.

The device includes the following options for control of a single circuit breaker:

- Local control using the IED menu
- Remote control using remote communication

2.9.1 Local Control using IED Menu

You can control manual opens and closes with the CB Open/Close cell in the **SYSTEM DATA** menu. This can be set to 'No Operation', 'Open', or 'Close' accordingly.

For this to work you have to set the **CB Control By** cell to option 2: 'Local', or option 4: 'Local+Remote' in the **CB CONTROL** menu.

2.9.2 Remote Control

Remote CB control can be achieved by setting the **CB Open/Close** cell in the **SYSTEM DATA** column to Open or Close by using a **SCADA** command to the rear interface RP1.

For this to work, you have to set the **CB Control By** cell to option 3: 'Remote', or option 4: 'Local+Remote', in the **CB CONTROL** menu.

We recommend that you allocate separate relay output contacts for remote CB control and protection tripping. This allows you to select the control outputs using a simple local/remote selector switch as shown below. Where this feature is not required the same output contact(s) can be used for both protection and remote tripping.

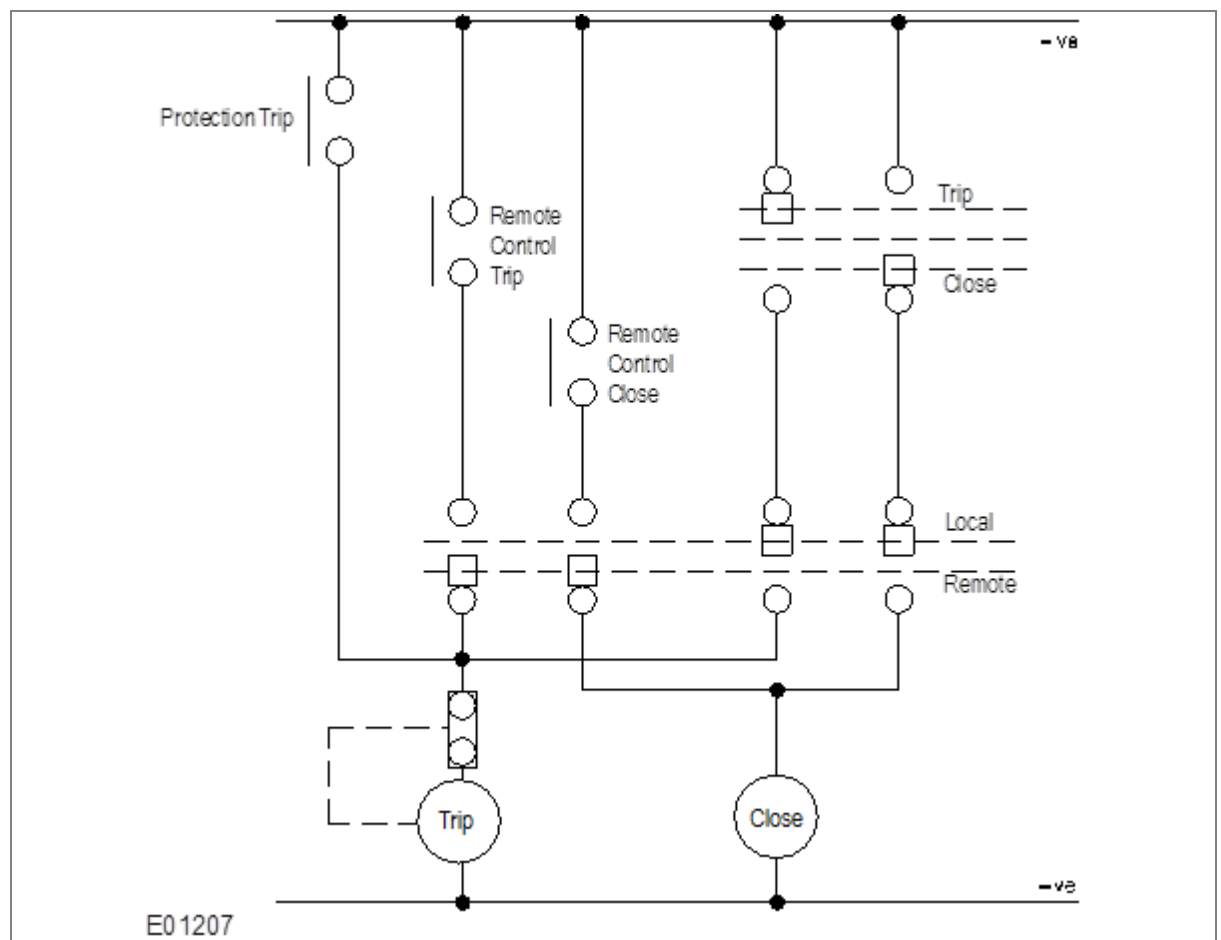


Figure 7: Remote Control of Circuit Breaker

For CB OPEN command:

Once a CB Open command is received from local or remote the assigned relay contact for the CB trip will operate. Simultaneously the relay starts monitoring the status of opto input 52B. If the status of 52B input is not high after the expiry of open pulse time (settable in the range of 0.1 to 50 sec), then the relay output contact, which is assigned to CB Open fail, will operate. Simultaneously the relay will generate an Open Fail alarm on the LCD display and the associated event will be stored in the Event Record.

The operation of Open Fail is explained in following diagram:

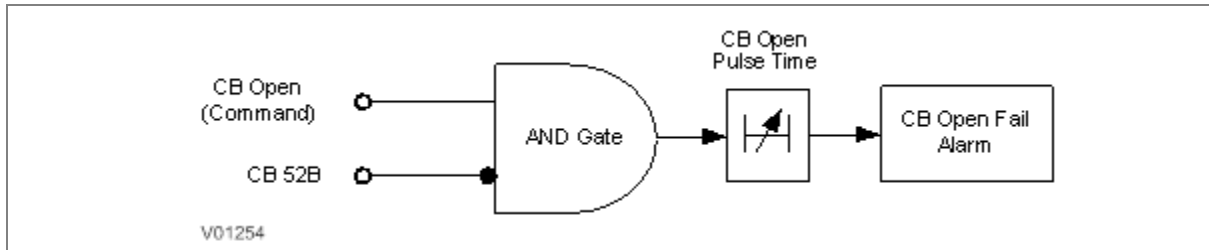


Figure 8: CB open fail alarm

For CB CLOSE command:

Once a CB Close command is received from local or remote the assigned relay contact for the CB close will operate. Simultaneously the relay starts monitoring the status of opto input 52A. If the status of 52A input is not high after the expiry of close pulse time (settable in the range of 0.1 to 50 sec), then the relay output contact, which is assigned to CB Close fail, will operate. Simultaneously the relay will generate **Close Fail** alarm on the LCD display and the associated event will be stored in the Event Record.

The operation of Close Fail is explained in following diagram:

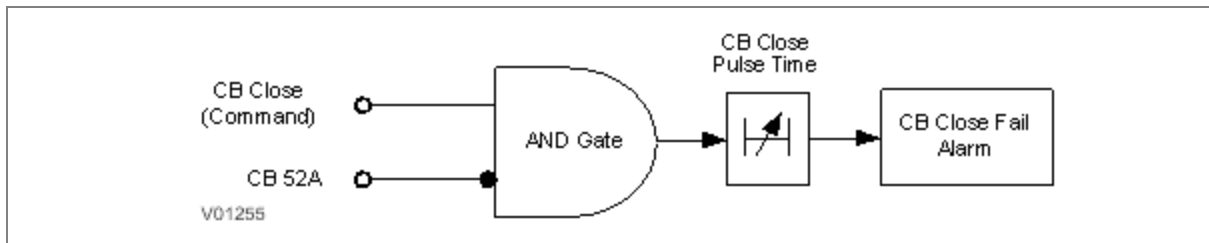


Figure 9: CB close fail alarm

2.10 Trip Circuit Supervision

TCS scheme provides supervision of the trip coil with the breaker open or closed but does not provide pre-closing supervision of the trip path. However, using two opto-inputs allows the IED to correctly monitor the Trip Circuit. This can be done by assigning **TCS Trig** signal to the opto inputs, which are connected to Circuit Breaker auxiliary contacts (52A and 52B).

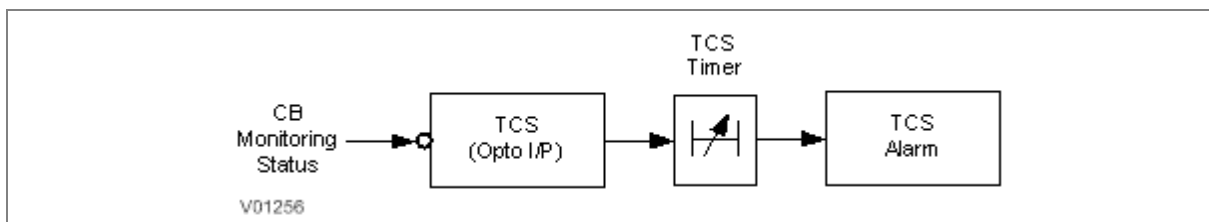


Figure 10: Trip circuit supervision logic

The TCS scheme is also fully compatible with latched contacts as the supervision current will be maintained through the 52B contact when the trip contact is closed.

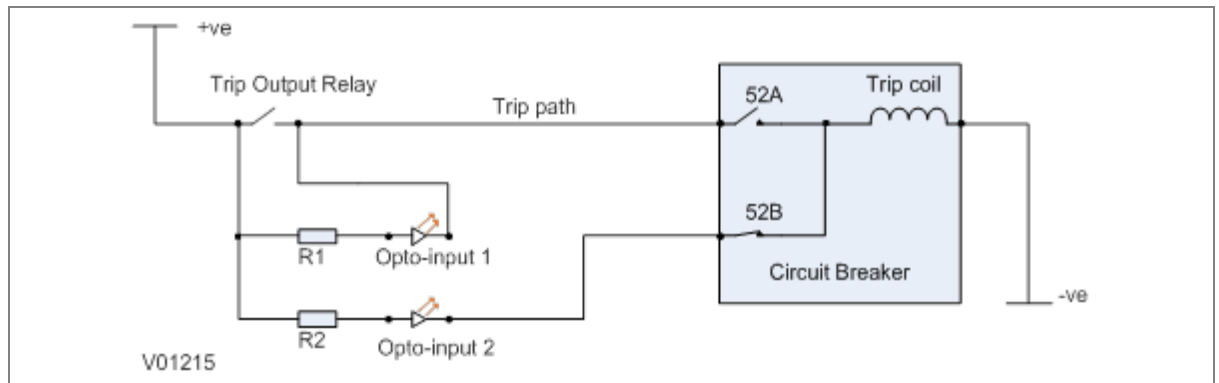


Figure 11: TCS Scheme

When the breaker is closed, supervision current passes through opto input 1 and the trip coil. When the breaker is open current flows through opto input 2 and the trip coil. No supervision of the trip path is provided whilst the breaker is open. Any fault in the trip path will only be detected on CB closing, after the elapse of **TCS timer** available under **CB CONTROL** menu.

2.10.1 Calculations for External Resistor

As shown in the TCS scheme, optional resistors R1 and R2 can be added to prevent tripping of the CB if either opto input is shorted.

The minimum sensing current required by opto coupler is 0.18 mA and the maximum current capacity of opto coupler is 10 mA. For the safe operation, the current should be always between minimum required current and maximum current capacity of opto coupler. The maximum current is limited by internal resistor (RInt.) connected in series with opto coupler. The value of this internal resistor (RInt.) is 82 K Ω (Ohm).

The supervision current is a lot less than the current required by the trip coil to trip a CB. The opto-input limits this supervision current. If the opto-input were to be short-circuited however; it could be possible for the supervision current to reach a level that could trip the CB. For this reason, optional resistors R1 and R2 are often used to limit the current in the event of a short-circuited opto-input. It is recommended to use 2.5 K Ω / 50 W resistor for all type of auxiliary power supply.

2.11 Self-Diagnostic Features

The P154 relay includes self-monitoring function to check the operation of its hardware and software while in service. If there is a problem with the hardware or software, it is able to detect and report the problem.

The relay continuously monitors the hardware and in the event detects any hardware fault/error; corresponding error code is displayed on the LCD. These faults / errors are stored in the '**Main't Rec Num**' and can be viewed from **Maint Record** submenu. Error log is stored as 16 bit integer.

As an example if RTC error occurs, error code/error log will be as under:

Error code : 0000 0000 0000 0100

Error log on LCD: 0004

If the error is cleared during the self-diagnostic procedure the corresponding error bit will be cleared. The P154 internal errors are also indicated by a change in status of **ON** and **OUT OF SERVICE** LEDs.

For more details refer to the Troubleshooting chapter.

2.12 Watchdog Feature

The relay continuously monitors the healthiness of hardware and detects the hardware fault/error. As soon as an internal fault is detected, **ON** LED changes from green to red and contact assigned to '**Relay OK**' signal changes state.

The output contact assigned to '**Relay OK**' signal remains in active state when the relay is Healthy, i.e. NO contact will be in closed position and vice versa.

The output contact assigned to '**Relay OK**' will become inactive in case any error is detected / failure of auxiliary supply.

There are 6 nos. of programmable binary outputs (changeover type contacts) marked as RL1 to RL6. Any binary output can be used as watchdog contact by assigning '**Relay OK**' signal through '**IO CONFIGURATION**' setting or using '**IO Mask**' function in P50 Agile Configurator.

SCADA COMMUNICATIONS

CHAPTER 9

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

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2 SCADA COMMUNICATIONS

2.1 Modbus

This section describes how the MODBUS standard is applied to the Px50 platform. It is not a description of the standard itself. The level at which this section is written assumes that the reader is already familiar with the MODBUS standard.

The MODBUS protocol is a master/slave protocol, defined and administered by the MODBUS Organization. For further information on MODBUS and the protocol specifications please see the Modbus web site (www.modbus.org).

2.1.1 Overview

2.1.1.1 Physical Connection and Link Layer

Only one option is available for connecting MODBUS.

- Rear serial port 1 - for permanent SCADA connection via EIA(RS)485

The MODBUS interface uses 'RTU' mode communication rather than 'ASCII' mode as this provides more efficient use of the communication bandwidth. This mode of communication is defined by the MODBUS standard.

The IED address and baud rate can be selected using the front panel menu or with P50 Agile configurator.

When using a serial interface, the data format is: 1 start bit, 8 data bits, 1 stop bit (a total of 10 bits per character).

2.1.2 MODBUS Functions

2.1.2.1 Protocol Mapping

The following MODBUS function codes are supported:

Code	Function Name	Addresses starts with
02	Read Input Status	1x addresses
03	Read Holding Registers	4x addresses
04	Read Input Registers	3x addresses
05	Force Single Coil	0x addresses
16	Preset Multiple Registers	4x addresses

- Exception Codes generated in case of an error:

Code	MODBUS Response Name	Product interpretation
01	Illegal Function Code	The function code received in query is not supported by the IED.
02	Illegal Data Address	The start address received in the query is not an allowable value.
<i>Note: If the start address received is correct but the range includes unsupported address, then this error is produced.</i>		

Note: The addresses of the MODBUS registers start from 1 and the user may have to subtract 1 from the addresses, depending on the Master station configuration.

Sr. No.		Function Code	Register	No. of Regs	Format	Reg. Type	Address Map
1	Product Information	03					
			Manufacturer Name	10	20-Bytes ASCII	R	40001 – 40010
			Relay Name	10	20-Bytes ASCII	R	40011 – 40020
			Model	10	20-Bytes ASCII	R	40021 – 40030
			Version	10	20-Bytes ASCII	R	40031 – 40040
			Relay Description	10	20-Bytes ASCII	R	40041 – 40050

Sr. No.		Function Code	Register	No. of Regs	Format	Reg. Type	Address Map
2	Relay Configuration	03					
			Num Status (s)	1	16 bit	R	40258
			Num Controls (c)	1	16 bit	R	40259
			Num Parameters (p)	1	16 bit	R	40260
			Num Faults (f)	1	16 bit	R	40261

Sr. No.		Function Code	Register	No. of Regs	Format	Reg. Type	Address Map
3.a	Time Synchronization (Unicast/Broadcast)	03/16					
			Year	1	16 bit	R/W	42049
			Month- Day	1	16 bit	R/W	42050
			Hour, Min	1	16 bit	R/W	42051
			Milliseconds	1	16 bit	R/W	42052

For P50 Agile relays on Modbus, time synchronization is possible via a broadcast command to 800H (4x02049 through 4x02052). The format is inverted IEC 870-5-4 CP56Time2a

Words	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0		
1	0	0	0	0	0	0	0	0	Year								00..99	
2	0	0	0	0	Month				Day of Week				Day of Month			1..12 1..7 1..31		
3	SU 0 0				Hours				lv 0				Minutes			0..23 0..59		
4	Milliseconds Hi								Milliseconds Lo								0..59999 (seconds + milliseconds)	
Su	(=0 Standard , =1 Summer Time)																	
iv	(=0 valid , =1 non valid or non synchronised in system case)																	
	First Day of week is Monday																	

Sr. No.		Function Code	Register	No. of Regs	Format	Reg. Type	Address Map
4	Status and Logical Status	02					
			Gen Strt	1	1 bit	R	12769
			Strt L1	1	1 bit	R	12770
			Strt L2	1	1 bit	R	12771
			Strt L3	1	1 bit	R	12772
			Strt l>1	1	1 bit	R	12773
			Strt l>2	1	1 bit	R	12774
			Strt l>3	1	1 bit	R	12775
			Strt l2>1	1	1 bit	R	12776
			Strt l2>2	1	1 bit	R	12777
			Strt l2>3	1	1 bit	R	12778
			Strt IN1>1	1	1 bit	R	12779
			Strt IN1>2	1	1 bit	R	12780
			Strt IN1>3	1	1 bit	R	12781
			Strt IN2>1	1	1 bit	R	12782
			Strt IN2>2	1	1 bit	R	12783
			Strt IN2>3	1	1 bit	R	12784
			Strt BC	1	1 bit	R	12785
			THOL Alm	1	1 bit	R	12786
			Strt CLP	1	1 bit	R	12787
			Strt l<	1	1 bit	R	12788
			Strt CBF	1	1 bit	R	12789
			l> BCBF	1	1 bit	R	12790
			IN1> BCBF	1	1 bit	R	12791
			Test Mode	1	1 bit	R	12792
			CloseFail	1	1 bit	R	12793
			Open Fail	1	1 bit	R	12794

		Relay OK	1	1 bit	R	12795
		Gen Trip	1	1 bit	R	12796
		Trip L1	1	1 bit	R	12797
		Trip L2	1	1 bit	R	12798
		Trip L3	1	1 bit	R	12799
		Trip I>1	1	1 bit	R	12800
		Trip I>2	1	1 bit	R	12801
		Trip I>3	1	1 bit	R	12802
		Trip I2>1	1	1 bit	R	12803
		Trip I2>2	1	1 bit	R	12804
		Trip I2>3	1	1 bit	R	12805
		Trip IN1>1	1	1 bit	R	12806
		Trip IN1>2	1	1 bit	R	12807

Sr. No.		Function Code	Register	No. of Regs	Format	Reg. Type	Address Map
			Trip IN1>3	1	1 bit	R	12808
			Trip IN2>1	1	1 bit	R	12809
			Trip IN2>2	1	1 bit	R	12810
			Trip IN2>3	1	1 bit	R	12811
			Trip BC	1	1 bit	R	12812
			THOL Trip	1	1 bit	R	12813
			CLP	1	1 bit	R	12814
			Trip I<	1	1 bit	R	12815
			Trip CBF	1	1 bit	R	12816
			Ext Trip	1	1 bit	R	12817
			CBOpr Alm	1	1 bit	R	12818
			Opto I/P 1	1	1 bit	R	12819
			Opto I/P 2	1	1 bit	R	12820
			Opto I/P 3	1	1 bit	R	12821
			Opto I/P 4	1	1 bit	R	12822
			Opto I/P 5	1	1 bit	R	12823
			Opto I/P 6	1	1 bit	R	12824
			TCS Alarm	1	1 bit	R	12825
			Trip LED	1	1 bit	R	12826
			CBOpn Sup	1	1 bit	R	12827
			BC Alarm	1	1 bit	R	12828

Sr.No.		Function Code	Register	No. of Regs	Format	Reg. Type	Address Map
5	Outputs	05					
			LED Reset	1	16 bit	W	03025
			Trip	1	16 bit	W	03026
			Close	1	16 bit	W	03027
			Output 1	1	16 bit	W	03028
			Output 2	1	16 bit	W	03029
			Output 3	1	16 bit	W	03030
			Output 4	1	16 bit	W	03031
			Output 5	1	16 bit	W	03032
			Output 6	1	16 bit	W	03033

Sr.No.		Function Code	Register	No. of Regs	Format	Reg. Type	Address Map
6	Parameters	04					
			IL1	2	32 bit Float	R	33281– 33282
			IL2	2	32 bit Float	R	33283– 33284
			IL3	2	32 bit Float	R	33285 – 33286
			IN1	2	32 bit Float	R	33287 – 33288
			IN2	2	32 bit Float	R	33289 – 33290
			I2	2	32 bit Float	R	33291 – 33292
			I1	2	32 bit Float	R	33293 – 33294
			Th State	2	32 bit Float	R	33295 – 33296
			I2/I1	2	32 bit Float	R	33297 – 33298
			L1-RMS	2	32 bit Float	R	33299 – 33300
			L2-RMS	2	32 bit Float	R	33301– 33302
			L3-RMS	2	32 bit Float	R	33303– 33304
			TC	2	32 bit Float	R	33305– 33306
			BOC	2	32 bit Float	R	33307– 33308
			BOT	2	32 bit Float	R	33309– 33310

Sr.No.		Function Code	Register	No. of Regs	Format	Reg. Type	Address Map
7	Fault Data**	04					
			Fault DUR	2	32 bit Float	R	35401– 35402
			Fault L1 Value	2	32 bit Float	R	35403– 35404
			Fault L2 Value	2	32 bit Float	R	35405– 35406
			Fault L3 Value	2	32 bit Float	R	35407– 35408
			Fault IN1 Value	2	32 bit Float	R	35409– 35410

****Note:** Fault Data is available from software version v1.08 onwards.

2.2 IEC60-870-5-103

2.2.1 Overview

The specification IEC 60870-5-103 (Telecontrol Equipment and Systems Part 5 Section 103: Transmission Protocols), defines the use of standards IEC 60870-5-1 to IEC 60870-5-5, which were designed for communication with protection equipment.

This section describes how the IEC 60870-5-103 standard is applied to the P154 relay. It is not a description of the standard itself. The level at which this section is written assumes that the reader is already familiar with the IEC 60870-5-103 standard.

This section should provide sufficient detail to enable understanding of the standard at a level required by most users.

The IEC 60870-5-103 interface is a master/slave interface with the device as the slave device. The device conforms to compatibility level 2, as defined in the IEC 60870-5-103 standard.

The following IEC 60870-5-103 facilities are supported by this interface:

- Initialization (reset)
- Time synchronisation
- Event record extraction
- General interrogation
- Cyclic measurements
- General commands
- Disturbance record extraction

2.2.2 Physical Connection and Link Layer

There is just one option for IEC 60870-5-103:

- Rear serial port 1- for permanent SCADA connection via RS485

The IED address and baud rate can be selected using the front panel menu or with P50 Agile configurator.

2.2.3 Initialisation

Whenever the device has been powered up, or if the communication parameters have been changed, a reset command is required to initialize the communications. The device will respond to either of the two reset commands; Reset CU or Reset FCB (Communication Unit or Frame Count Bit). The difference between the two commands is that the Reset CU command will clear any unsent messages in the transmit buffer, whereas the Reset FCB command does not delete any messages.

The device will respond to the reset command with an identification message ASDU 5. The Cause of Transmission (COT) of this response will be either Reset CU or Reset FCB depending on the nature of the reset command.

The relay will also produce a power up event, when the relay is powered up.

2.2.4 Time Synchronisation

The time and date can be set using the time synchronisation feature of the IEC 60870-5-103 protocol. The device will correct the transmission delay depending on communication speed. For this, transmission time, required for the time synchronization frame from the Master to IED, considering current baud rate is added in the received time.

The device will correct the transmission delay depending on baud rate. If the time synchronisation message is sent as a send/confirm message then the device will respond with a confirm message. A time synchronisation class 1 event will be generated/produced whether the time-synchronisation message is sent as a send confirm or a broadcast (send/no reply) message.

2.2.5 Spontaneous Events

Events are categorized using the following information:

- Function type
- Information number

The IEC 60870-5-103 profile contains a complete listing of all events produced by the device.

2.2.6 General Interrogation (GI)

The GI request can be used to read the status of the device, the function numbers, and information numbers that will be returned during the GI cycle. These are shown in the IEC 60870-5-103 profile.

2.2.7 Cyclic Measurements

The device will produce measured values using ASDU9 and ASDU9 is reported with information number 148 and 155. This can be read from the device using a Class 2 poll. For every query, the current online data is reported.

The device transmits its measurands at 2.4 times the rated value of the analogue value.

2.2.8 Commands

The list of commands supported P154 relay is given in table below. The device will respond to valid Control Command with ASDU1 and a cause of transmission indicating 'Positive (COT-20) / Negative (COT-21) acknowledgement'. The device will respond to commands with invalid FUN/ INF combination with an ASDU 1, with a cause of transmission indicating 'negative acknowledgement'.

2.2.9 Test Mode

It is possible to enable test mode in the relay using either the front panel menu or with P50 Agile configurator. An event will be produced to indicate both entry to and exit from test mode. Spontaneous events and cyclic measured data transmitted whilst the device is in test mode will have a COT of 'test mode'.

2.2.10 Disturbance Records

The disturbance records are stored in uncompressed format and can be extracted using the standard mechanisms described in IEC 60870-5-103. This relay supports up-to 5 records.

2.2.11 Configuration

To configure the IED for this protocol, please see the Configuration chapter.

2.2.12 Protocol Mapping

Sr. No.	INF	Description	GI	TYP	COT	FUN
1	Semantics of INFORMATION NUMBER : System Functions in monitor direction					
	0	End of general interrogation	-	8	10	255
	0	Time synchronization	-	6	8	255
	2	Reset FCB	-	5	3	160
	3	Reset CU	-	5	4	160
	4	Start/Restart	-	5	5	160
	5	Power on	-	5	6	160

Sr. No.	INF	Description	GI	TYP	COT	FUN
2	Semantics of INFORMATION NUMBER : Status Indications in monitor direction					
	19	Trip LED	X	1	1,7,9,20,21	160
	22	Local parameter setting	X	1	11,12	160
	27	Opto I/P-1	X	1	1,7,9	160

28	Opto I/P-2	X	1	1,7,9	160
29	Opto I/P-3	X	1	1,7,9	160
30	Opto I/P-4	X	1	1,7,9	160
31	Opto I/P-5	X	1	1,7,9	127
32	Opto I/P-6	X	1	1,7,9	127
36	TCS Alarm	X	1	1,7,9	160
134	Password Reset	-	2	1,7	124
135	CBOpr Alm	X	2	1,7,9	124

*Note: 'X' under **GI** heading means DI Status is included in General Interrogation response.*

Sr. No.	INF	Description	GI	TYP	COT	FUN
3	Semantics of INFORMATION NUMBER : Fault indications in monitor direction					
	84	Gen Strt	X	2	1,7,9	160
	64	Strt L1	X	2	1,7,9	160
	65	Strt L2	X	2	1,7,9	160
	66	Strt L3	X	2	1,7,9	160
	117	Strt I>1	X	2	1,7,9	126
	103	Strt I>2	X	2	1,7,9	126
	105	Strt I>3	X	2	1,7,9	126
	126	Strt I2>1	X	2	1,7,9	126
	146	Strt I2>2	X	2	1,7,9	126
	147	Strt I2>3	X	2	1,7,9	126
	143	Strt IN1>1	X	2	1,7,9	126
	144	Strt IN1>2	X	2	1,7,9	126
	145	Strt IN1>3	X	2	1,7,9	126
	140	Strt IN2>1	X	2	1,7,9	126
	141	Strt IN2>2	X	2	1,7,9	126
	142	Strt IN2>3	X	2	1,7,9	126
	25	Strt BC	X	2	1,7,9	124
	200	THOL Alm	-	2	1,7,9	126
	21	Strt CLP	-	2	1,7,9	124
	178	Strt I<	X	2	1,7,9	126
	26	Strt CBF	X	2	1,7,9	124
	154	I> BCBF	-	2	1,7	124
	155	IN1> BCBF	-	2	1,7	124
	22	Test Mode	-	2	1,7	124
	156	CloseFail	-	2	1,7	124
	157	Open Fail	-	2	1,7	124
	145	Relay OK	-	2	1,7	127
	68	Gen Trip	-	2	1,7	160
	69	Trip L1	-	2	1,7	160
	70	Trip L2	-	2	1,7	160
	71	Trip L3	-	2	1,7	160
	90	Trip I>1	-	2	1,7	160
	91	Trip I>2	-	2	1,7	160
	104	Trip I>3	-	2	1,7	126
	158	Trip I2>1	-	2	1,7	124
	127	Trip I2>2	-	2	1,7	126
	128	Trip I2>3	-	2	1,7	126
	123	Trip IN1>1	-	2	1,7	126
	124	Trip IN1>2	-	2	1,7	126
	125	Trip IN1>3	-	2	1,7	126
	92	Trip IN2>1	-	2	1,7	160
	93	Trip IN2>2	-	2	1,7	160

Sr. No.	INF	Description	GI	TYP	COT	FUN
	121	Trip IN2>3	-	2	1,7	126
	9	Trip BC	-	2	1,7	124
	202	THOL Trip	-	2	1,7	126
	225	CLP	-	2	1,7	126
	177	Trip I<	-	2	1,7	126
	85	CBF Trip	-	2	1,7	160
	2	Ext Trip	-	2	1,7	124
	1	CBOpn Sup	-	2	1,7	124
	3	BC Alarm	-	2	1,7	124

Sr. No.	INF	Description	GI	TYP	COT	FUN
5	Semantics of INFORMATION NUMBER : Measurands in monitor direction					
	148	Measurand I _{L1,2,3}	-	9	2, 7	160
	155	IN1, Th State, IN2, I2, I1, I2/I1 Ratio, IrmsR, IrmsY, IrmsB.	-	9	2,7	160
	1	Trip Counter, Breaker Operation Counter, Breaker Operating Time	-	244	2,7	127

Note: The measurands transmitted by the relay are sent as a proportion of 2.4 times of the rated value of the analogue value.

Sr. No.	INF	Description	GI	TYP	COT	FUN
6	Semantics of INFORMATION NUMBER: Fault list in monitor direction					
	0	List of Recorded DR	-	23	31	160

Sr. No.	INF	Description
7	Semantics of Actual Channel : Used for DR Transmission	
	ACC	Description
	1	IL1 - Primary
	2	IL2
	3	IL3
	4	IN2 (Derived)
	74	IN1 (Measured)

Sr. No.	INF	Description	GI	TYP	COT	FUN
8	Semantics of INFORMATION NUMBER : System Functions in control direction					
	0	Initialization of general interrogation	-	7	9	255
	0	Time synchronization	-	6	8	255

Sr. No.	INF	Description	GI	TYP	COT	FUN
9	Semantics of INFORMATION NUMBER : General commands in control direction					
	19	LED Reset	ON	20	20	160
	124	Trip	ON/OFF	20	20	127

	125	Close	ON/OFF	20	20	127
	94	Output 1	ON/OFF	20	20	127
	95	Output 2	ON/OFF	20	20	127
	96	Output 3	ON/OFF	20	20	127
	97	Output 4	ON/OFF	20	20	127
	98	Output 5	ON/OFF	20	20	127
	99	Output 6	ON/OFF	20	20	127

2.3 DNP3.0

2.3.1 Overview

This section describes the specific implementation of the Distributed Network Protocol (DNP 3.0) in P154 – Feeder protection relay.

It uses Triangle MicroWorks, Inc. DNP 3.0 Slave Source Code Library Version 3.17.

This document is to be referred in conjunction with the DNP3.0 Basic 4 Document Set, and the DNP Subset Definitions Document, for complete information on how to communicate with P154 using DNP3.0 protocol.

This implementation of DNP3.0 is fully compliant with DNP3.0 Subset Definition Level 2 and contains many Subset Level 3 features including some functionality beyond Subset Level 3.

2.3.2 DNP V3.00 Device Profile

The following table provides a “Device Profile Document” in the standard format defined in the DNP 3.0 Subset Definition Document. While it is referred to in the DNP 3.0 Subset Definition as a “Document”, it is only a component of a total interoperability guide. This table, in combination with the following should provide a complete interoperability/configuration guide for P154.

This table in combination with the following should provide a complete interoperability/configuration guide for the P154 relays:

- The Implementation Table provided in Section 2.3.3
- The Point List Tables provided in Section 2.3.4

DNP V3.00 DEVICE PROFILE DOCUMENT	
Vendor Name: GE Vernova	
Device Name: P50 Platform using the Triangle MicroWorks, Inc. DNP 3.0 Slave Source Code Library, Version 3.17.	
Highest DNP Level Supported: For Requests: Level 2 For Responses: Level 2	Device Function: ☒ Master ☐ Slave

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels supported (the complete list is described in the attached table):

For static (non-change-event) object requests, request qualifier codes 00 and 01 (start-stop), 07 and 08 (limited quantity), and 17 and 28 (index) are supported in addition to request qualifier code 06 (no range – or all points).

Static object requests received with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. Static object requests received with qualifiers 17 or 28 will be responded with qualifiers 17 or 28.

For change-event object requests, qualifiers 17 or 28 are always responded.

16-bit and 32-bit Analog Change Events with Time may be requested.

The read function code for Object 50 (Time and Date), variation 1, is supported.

Maximum Data Link Frame Size (octets): Transmitted: 292 Received: 292	Maximum Application Fragment Size (octets): Transmitted: 2048 Received: 2048
Maximum Data Link Re-tries: ☒ None ☐ Fixed at 2 ☒ Configurable	Maximum Application Layer Re-tries: ☐ None ☒ Configurable
Requires Data Link Layer Confirmation: ☐ Never ☒ Always ☒ Sometimes ☒ Configurable	
Requires Application Layer Confirmation: ☒ Never ☒ Always (not recommended) ☐ When reporting Event Data (Slave devices only) ☐ When sending multi-fragment responses (Slave devices only) ☒ Sometimes ☒ Configurable	

Timeouts while waiting for:

Data Link Confirm:	☒ None	☐ Fixed at 100ms	☒ Variable	☒ Configurable
Complete Appl. Fragment:	☐ None	☒ Fixed at _____	☒ Variable	☒ Configurable
Application Confirm:	☒ None	☐ Fixed at 1s	☒ Variable	☒ Configurable
Complete Appl. Response:	☐ None	☒ Fixed at _____	☒ Variable	☒ Configurable

Others:

Binary Input change scanning period: 2ms

Analog Input change scanning period: 1s

Sends/Executes Control Operations:

WRITE Binary Outputs	☐ Never	☒ Always	☒ Sometimes	☒ Configurable
SELECT/OPERATE	☒ Never	☐ Always	☒ Sometimes	☒ Configurable
DIRECT OPERATE	☒ Never	☐ Always	☒ Sometimes	☒ Configurable
DIRECT OPERATE - NO ACK	☒ Never	☐ Always	☒ Sometimes	☒ Configurable
Count > 1	☐ Never	☒ Always	☒ Sometimes	☒ Configurable
Pulse On	☒ Never	☐ Always	☒ Sometimes	☒ Configurable
Pulse Off	☐ Never	☒ Always	☒ Sometimes	☒ Configurable
Latch On	☐ Never	☒ Always	☒ Sometimes	☒ Configurable
Latch Off	☐ Never	☒ Always	☒ Sometimes	☒ Configurable
Queue	☐ Never	☒ Always	☒ Sometimes	☒ Configurable
Clear Queue	☐ Never	☒ Always	☒ Sometimes	☒ Configurable

Reports Binary Input Change Events when no specific variation requested:

- ☒ Never
☐ **Only time-tagged**
☒ Only non-time-tagged
☒ Configurable

Reports time-tagged Binary Input Change Events when no specific variation requested:

- ☒ Never
☐ **Binary Input Change With Time**
☒ Binary Input Change With Relative Time
☒ Configurable (attach explanation)

Sends Unsolicited Responses: ☒ Never ☒ Configurable (attach explanation) ☒ Only certain objects ☒ Sometimes (attach explanation) ☐ ENABLE/DISABLE UNSOLICITED Function codes supported	Sends Static Data in Unsolicited Responses: ☐ Never ☒ When Device Restarts ☒ When Status Flags Change No other options are permitted.									
Default Counter Object/Variation: ☒ No Counters Reported ☒ Configurable (attach explanation) ☐ Default Object: 20 ☐ Default Variation: 5 ☒ Point-by-point list attached	Counters Roll Over at: <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="text-align: center;">Point Index</th> <th style="text-align: center;">Name/Description</th> <th style="text-align: center;">Roll Over value</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>BOC</td> <td>Settable up to 30000</td> </tr> <tr> <td style="text-align: center;">1</td> <td>TC</td> <td>9999</td> </tr> </tbody> </table> ☒ No Counters Reported ☒ Configurable (attach explanation) ☒ 16 Bits ☐ 32 Bits ☒ Other Value ☒ Point-by-point list attached	Point Index	Name/Description	Roll Over value	0	BOC	Settable up to 30000	1	TC	9999
Point Index	Name/Description	Roll Over value								
0	BOC	Settable up to 30000								
1	TC	9999								
Sends Multi-Fragment Responses: ☐ Yes ☒ No										

2.3.3 Implementation Table

The following table identifies the variations, function codes, and qualifiers supported by the P154 in both request messages and in response messages.

For static (non-change-event) objects, requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. Static object requests sent with qualifiers 17 or 28 will be responded with qualifiers 17 or 28. For change-event objects, qualifiers 17 or 28 are always responded.

In the table below, the text shaded as indicates Subset Level 3 functionality (beyond Subset Level 2) and text shaded as indicates functionality beyond Subset Level 3.

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
1	0	Binary Input (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
1	1 (default – see note 1)	Binary Input	1 (read) 22	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
1	2	Binary Input with Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
2	0	Binary Input Change (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
2	1	Binary Input Change without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index)
2	2 (default – see note 1)	Binary Input Change with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index)
10	0	Binary Output Status (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
10	2 (default – see note 1)	Binary Output Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
12	1 (default – see note 1)	Control Relay Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir.op,noack)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response)	Echo of request

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
20	0	Binary Counter (Variation 0 is used to request default variation)	1 (read) 7 (freeze) 8 (freezenoack) 9 (freeze clear) 10 (frz. cl. Noack)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
20	1	32-Bit Binary Counter	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. Noack)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
20	2	16-Bit Binary Counter	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. Noack)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
20	5 (default – see note 1)	32-Bit Binary Counter without Flag	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. Noack)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
20	6	16-Bit Binary Counter without Flag	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. Noack)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
22	0	Counter change Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
22	1 (default – see note 1)	32-Bit Counter Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index – see note 2)
22	2	16-Bit Counter Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index – see note 2)
22	5	32-Bit Counter Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index – see note 2)
OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
22	6	16-Bit Counter Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index – see note 2)
30	0	Analog Input (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
30	1	32-Bit Analog Input	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
30	2	16-Bit Analog Input	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)

30	3 (default – see note 1)	32-Bit Analog Input without Flag	1(read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
30	4	16-Bit Analog Input without Flag	1(read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
30	5	Single-precision, floating-point with flag	1(read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
32	0	Analog Change Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
32	1 (default – see note 1)	32-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index)
32	2	16-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index)
32	3	32-Bit Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index)
32	4	16-Bit Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index)
32	7	Single-precision, floating-point with time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index)

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
50	0	Time and Date	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
50	1(default – see note 1)	Time and Date	1 (read) 2 (write)	00, 01 (start-stop) 06 (no range, or all) 07 (limited qty=1) 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
60	0	Class 0, 1, 2, and 3 Data	1 (read)	06 (no range, or all)		
60	1	Class 0 Data	1 (read)	06 (no range, or all)	129 (response)	17,28
60	2	Class 1 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17,28
60	3	Class 2 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17,28
60	4	Class 3 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17,28
80	1	Internal Indications	2 (write)	00 (start-stop) (index must =7)	129 (response)	17,28
		No Object (function code only)	13 (cold restart)			
		No Object (function code only)	14 (warm restart)			
		No Object (function code only)	23 (delay meas.)			

Note 1: A Default variation refers to the variation responded when variation 0 is requested and/or in class 0, 1, 2, or 3 scans.

Note 2: For static (non-change-event) objects, qualifiers 17 or 28 are only responded when a request is sent with qualifiers 17 or 28, respectively. Otherwise, static object requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. (For change-event objects, qualifiers 17 or 28 are always responded.)

2.3.4 Point List

The tables in the following sections identify all the individual data points provided by this implementation of DNP 3.0.

2.3.4.1 Binary Input Points

All Binary Input Status points are included in class 0 polls, because they are included in one of classes 1, 2 or 3.

Binary Input Points

Static (Steady-State) Object Number: **1**

Change Event Object Number: **2**

Request Function Codes supported: **1 (read)**

Static Variation reported when variation 0 requested: **1 (Binary Input without status flags)**

Change Event Variation reported when variation 0 requested: **2**

Point Index	Name/Description	Initial value	Changes Event class(1,2,3)
0	LED Reset	0	2
1	Opto I/P-1	0	2
2	Opto I/P-2	0	2
3	Opto I/P-3	0	2
4	Opto I/P-4	0	2
5	Opto I/P-5	0	2
6	Opto I/P-6	0	2
7	CB Operation Alarm	0	1
8	CB Open Supervision	0	1
9	TCS	0	1
10	Test Mode	0	1
11	General start/ pick-up	0	1
12	Start L1	0	1
13	Start L2	0	1
14	Start L3	0	1
15	Start I>1	0	1
16	Start I>2	0	1
17	Start I>3	0	1
18	Start I2>1	0	1
19	Start I2>2	0	1

20	Start I2>3	0	1
21	Start IN1>1	0	1
22	Start IN1>2	0	1
23	Start IN1>3	0	1
24	Start IN2>1	0	1
25	Start IN2>2	0	1
26	Start IN2>3	0	1
27	Start BRC	0	1
28	Th Alarm	0	1
29	CLP Timer in progress	0	1
30	Start I<	0	1
31	Start CB Fail	0	1
32	I> Blk by CBF	0	1
33	IN1> Blk by CBF	0	1
34	BRC Alarm	0	1
35	CB Close Fail	0	1
36	CB Open Fail	0	1
37	Relay OK	0	1
38	General Trip	0	1
39	Trip L1	0	1
40	Trip L2	0	1
41	Trip L3	0	1
42	Trip I>1	0	1
43	Trip I>2	0	1
44	Trip I>3	0	1
45	Trip I2>1	0	1
46	Trip I2>2	0	1
47	Trip I2>3	0	1
48	Trip IN1>1	0	1
49	Trip IN1>2	0	1
50	Trip IN1>3	0	1
51	Trip IN2>1	0	1
52	Trip IN2>2	0	1
53	Trip IN2>3	0	1
54	Trip BRC	0	1
55	Th Trip	0	1
56	CLP	0	1
57	Trip I<	0	1
58	Trip CB Fail	0	1
59	External Trip	0	1

2.3.4.2 Binary Output Status Points and Control Output Blocks

The following table lists both the Binary Output Status Point (Object 10) and the Control Relay Output Blocks (Objects 12).

Binary Output Status Points

Object Number: **10**Request Function Codes supported: **1 (read)**Default Variation reported when variation 0 requested: **2 (Binary Output Status)**

Control Relay Output Blocks

Object Number: **12**

Request Function Codes supported: 3 (select), 4 (operate), 5 (direct operate), 6 (direct operate, noack)

Point Index	Name/Description	Initial status value	Supported control relay output block fields
0	LED Reset	0	Pulse ON
1	Trip	0	Pulse ON
2	Close	0	Pulse ON
3	Output 1	0	Pulse ON
4	Output 2	0	Pulse ON
5	Output 3	0	Pulse ON
6	Output 4	0	Pulse ON
7	Output 5	0	Pulse ON
8	Output 6	0	Pulse ON

2.3.4.3 Binary Counters

The following table lists Binary Counters (Object 20). All binary counter points are included in class 0 polls, because they are included in one of classes 1, 2 or 3.

Binary Counters

Static (Steady-State) Object Number: **20**Change Event Object Number: **22**Request Function Codes supported: **1 (read)**Static Variation reported when variation 0 requested: **5 (32-bit, unsigned integer count value without flag)**Change Event Variation reported when variation 0 requested: **1 (32-bit, unsigned integer count value, with flag)**

Point Index	Name/Description	Initial value	Initial Change Event Class (1, 2, 3 or none)
0	BOC	0	3
1	TC	0	3

2.3.4.4 Analog Inputs

The following table lists Analog Inputs (Object 30). All Analog Input point is included in class 0 polls, because they are included in one of classes 1, 2 or 3.

Analog Inputs

Static (Steady-State) Object Number: **30**Change Event Object Number: **32**Request Function Codes supported: **1 (read)**Static Variation reported when variation 0 requested: **1 (32-Bit Analog Input without flag)**Change Event Variation reported when variation 0 requested: **1 (32-Bit Analog Change Event without**

Time) Change Event Scan Rate: The scan rate for analog input change events is fixed at 1s			
Point Index	Name/Description	Initial value	Initial Change Event Class (1, 2, 3 or none)
0	IN1	0	3
1	IL 1	0	3
2	IL 2	0	3
3	IL 3	0	3
4	Th State	0	3
5	IN2	0	3
6	I2	0	3
7	I1	0	3
8	I2/I1 (see note 4)	0	3
9	L1-RMS	0	3
10	L2-RMS	0	3
11	L3-RMS	0	3
12	BOT	0	3

Note 3: The measurands transmitted by the relay are sent as primary values.

Note 4: I2/I1 multiplied by 1000.

INSTALLATION

CHAPTER 10

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

- 1 Chapter Overview**
- 2 Installation**
 - 2.1 Handling the Goods
 - 2.1.1 Receipt of the Goods
 - 2.1.2 Unpacking the Goods
 - 2.1.3 Storing the Goods
 - 2.1.4 Dismantling the Goods
 - 2.2 Mounting the Device
 - 2.2.1 Flush Panel Mounting
 - 2.3 Relay Connection
 - 2.3.1.1 Relay Operating Condition
 - 2.3.1.2 Current Transformer (CT) Circuit
 - 2.3.1.3 Insulation and Dielectric Strength Testing
 - 2.3.2 Cables and Connectors
 - 2.3.3 Terminal Blocks
 - 2.3.3.1 CT/Auxiliary Power/Input/ Output Connections
 - 2.3.3.2 Rear Serial Port Connection
 - 2.3.3.3 Power Supply Connections
 - 2.3.3.4 Earth Connection
 - 2.3.3.5 Current Transformers
 - 2.3.3.6 EIA(RS) 485 Connections
 - 2.3.3.7 Output Relay Connections
 - 2.3.3.8 USB Connection
 - 2.4 Case Dimensions

2 INSTALLATION

2.1 Handling the Goods

Our products are of robust construction but require careful treatment before installation on site. This section discusses the requirements for receiving and unpacking the goods, as well as associated considerations regarding product care and personal safety.



Caution: Before lifting or moving the equipment you should be familiar with the Safety Information chapter of this manual.

2.1.1 Receipt of the Goods

On receipt, ensure the correct product has been delivered. Unpack the product immediately to ensure there has been no external damage in transit. If the product has been damaged, make a claim to the transport contractor and notify us promptly.

For products not intended for immediate installation, repack them in their original delivery packaging.

2.1.2 Unpacking the Goods

When unpacking and installing the product, take care not to damage any of the parts and make sure that additional components are not accidentally left in the packing or lost. Do not discard any CDROMs or technical documentation. These should accompany the unit to its destination substation and put in a dedicated place.

The site should be well lit to aid inspection, clean, dry and reasonably free from dust and excessive vibration. This particularly applies where installation is being carried out at the same time as construction work.

2.1.3 Storing the Goods

If the unit is not installed immediately, store it in a place free from dust and moisture in its original packaging. Keep any de-humidifier bags included in the packing. The de-humidifier crystals lose their efficiency if the bag is exposed to ambient conditions. Restore the crystals before replacing it in the carton. Bags should be placed on flat racks and spaced to allow circulation around them. The time taken for regeneration will depend on the size of the bag. If a ventilating, circulating oven is not available, when using an ordinary oven, open the door on a regular basis to let out the steam given off by the regenerating silica gel. On subsequent unpacking, make sure that any dust on the carton does not fall inside. Avoid storing in locations of high humidity. In locations of high humidity the packaging may become impregnated with moisture and the de-humidifier crystals will lose their efficiency.

The device can be stored between -25° to $+70^{\circ}\text{C}$.

2.1.4 Dismantling the Goods

If you need to dismantle the device, always observe standard ESD (Electrostatic Discharge) precautions.

The minimum precautions to be followed are as follows:

- Use an antistatic wrist band earthed to a suitable earthing point.
- Avoid touching the electronic components and PCBs.

2.2 Mounting the Device

The products are available for flush panel mounting only

2.2.1 Flush Panel Mounting

P154 supports flush panel mounting and can be mounted into panels using fitting clamps with M5 X 10 screws.

The fitting clamp and screws are supplied with the relay.

To mount the relay into the panel follow these steps:

1. Loosen the M5 x 10 screws, remove the fitting clamps on the relay and then insert the relay into the panel cut-out as shown below.

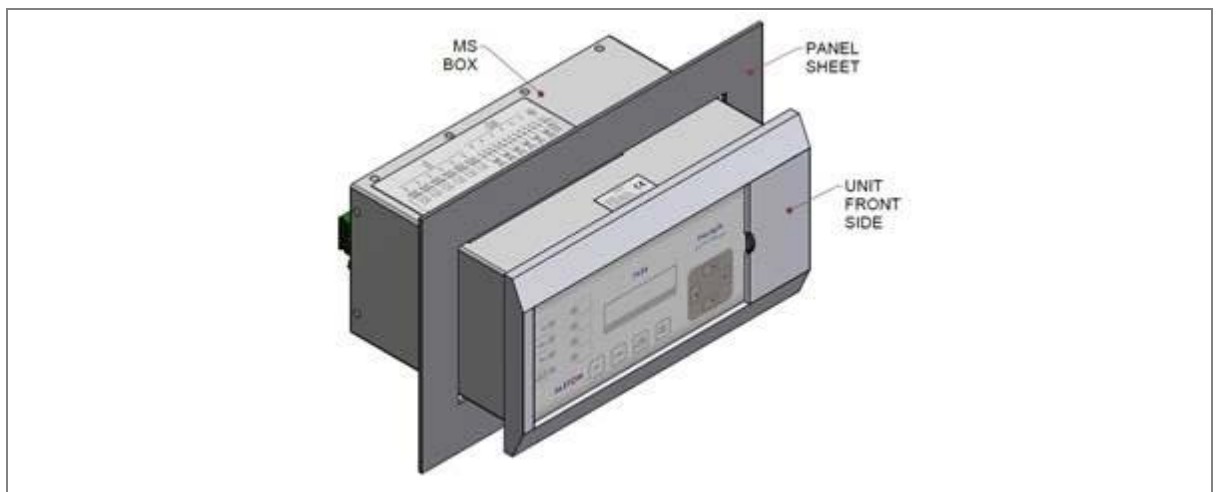


Figure 1: Inserting relay into the panel cutout

2. After inserting the relay into the panel, using the fitting clamps and the M5 x 10 screws, fasten the relay to the panel as shown below.

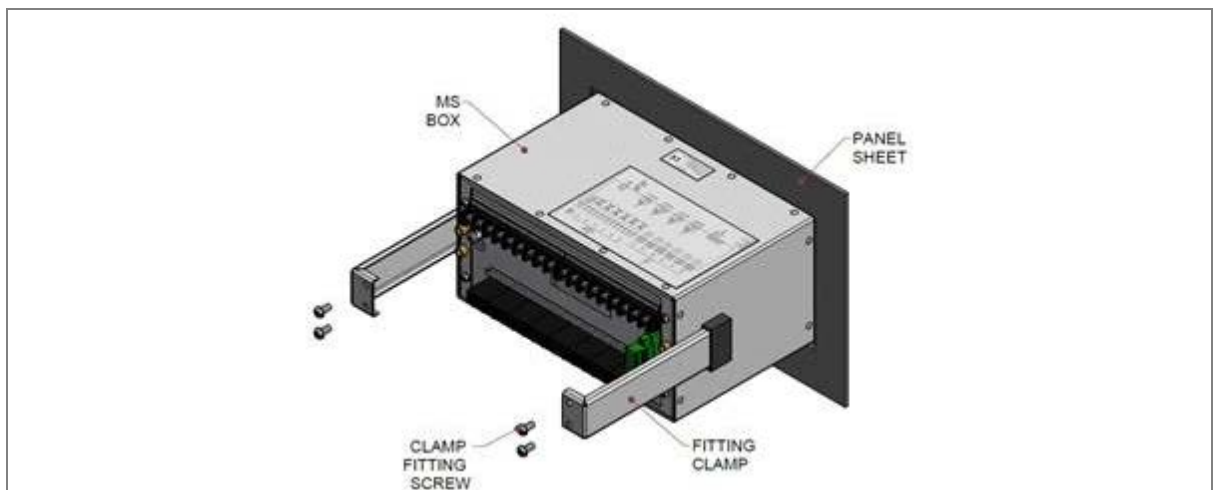


Figure 2: Tightening fitting clamps



Caution: Make sure all screws of fitting clamps are tightened properly. Always use M5x10 screws for fitting the clamps.

3. The relay after fastening to the panel with the help of fitting clamps and the M5 x 10 screws is shown below.

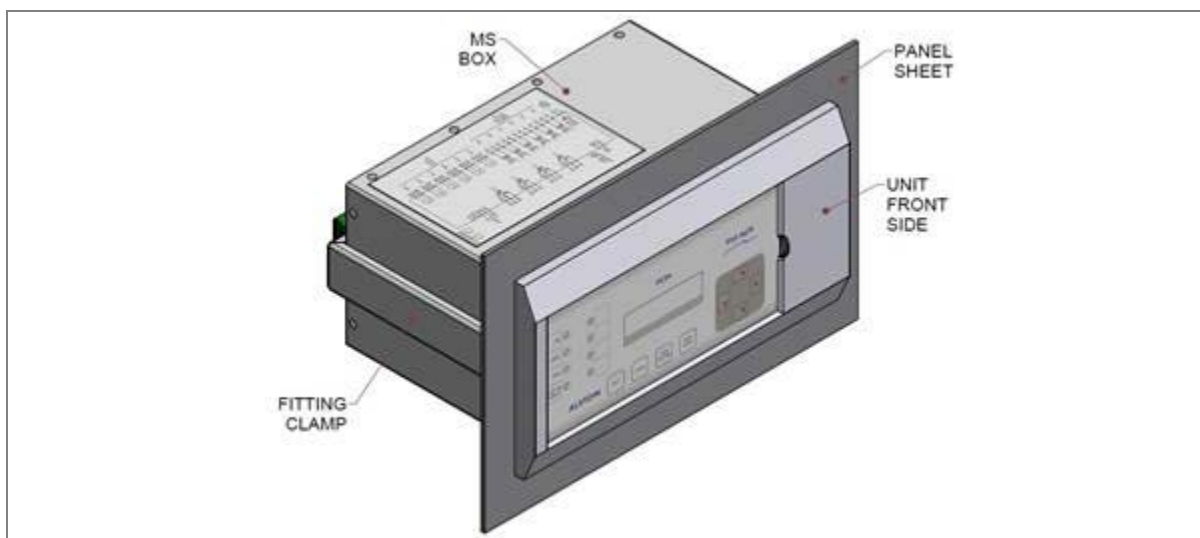


Figure 3: Relay mounted on the panel-front view

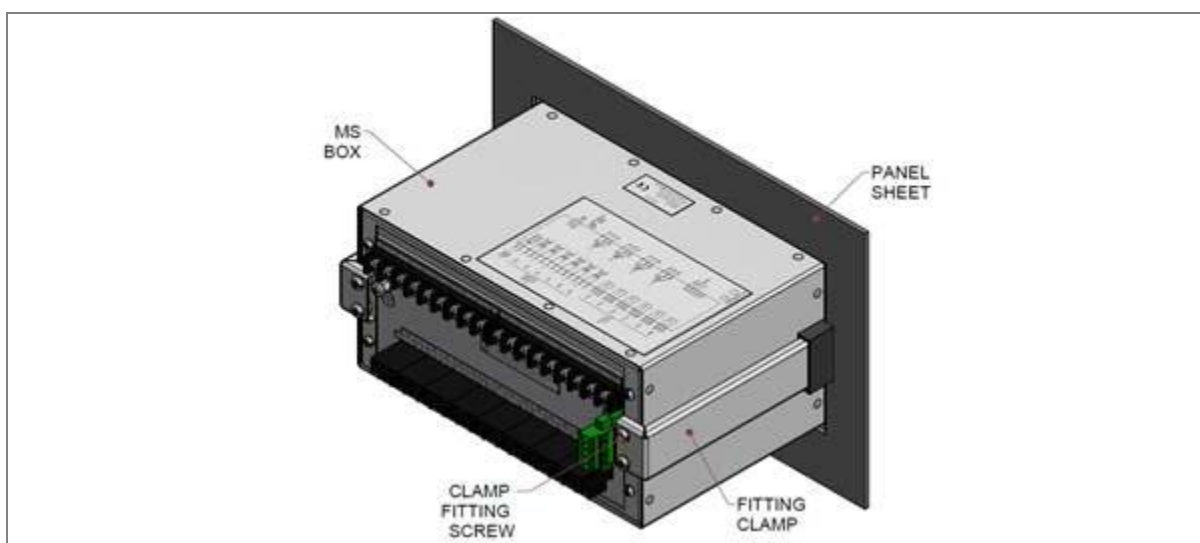


Figure 4: Relay mounted on the panel-rear view

2.3 Relay Connection

Before installation of the relay check the correct working procedure as to ensure safety. The terminal exposed during installation may present a hazardous voltage unless the equipment is electrically isolated. Any disassembly of the equipment may expose parts to hazardous voltage. Electronic parts may be damaged if suitable electrostatic discharge (ESD) precautions are not taken. Voltage and current connection should be made using insulated crimp termination to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated the correct crimp terminal and tool for wire size should be used. The equipment must be connected in accordance with the appropriate connection diagram.

Before energizing following should be checked

1. Voltage rating and polarity.
2. CT circuit rating and integrity of connection.
3. Protective fuse rating.
4. Integrity of the earthing connection.
5. Voltage and current rating of external wiring, applicable as per application.

2.3.1.1 Relay Operating Condition

The equipment should be operated within the specified electrical and environmental limits.

2.3.1.2 Current Transformer (CT) Circuit

Do not open the secondary circuit of a live CT as the high voltage produce may be lethal to personnel and could damage insulation. Generally, for safety, the secondary of the line CT must be shorted before opening any connection to it.

2.3.1.3 Insulation and Dielectric Strength Testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part test, the voltage should be gradually reduced to zero, to discharge capacitors, as this may result in damage.

2.3.2 Cables and Connectors

This section describes the type of wiring and connections that should be used when installing the device. For pin-out details please refer to the wiring diagrams.



Caution: Before carrying out any work on the equipment you should be familiar with the Safety Section and the ratings on the equipment's rating label.

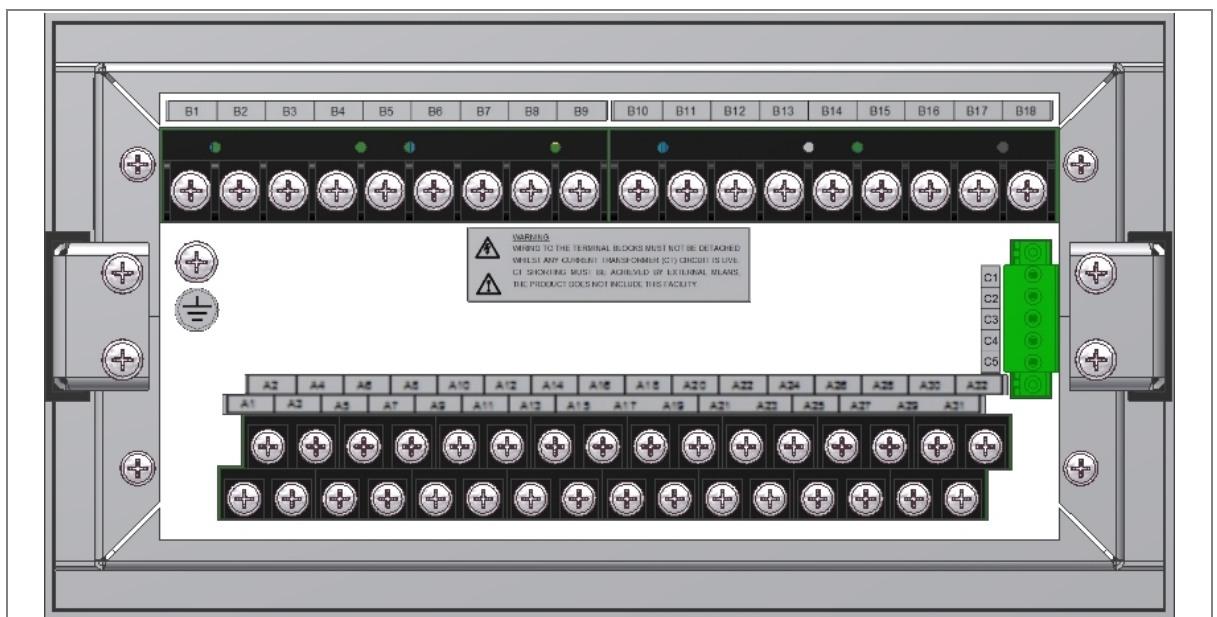


Figure 5: P154 rear view-terminal connection

2.3.3 Terminal Blocks

2.3.3.1 CT/Auxiliary Power/Input/ Output Connections

The P50 Agile devices use terminal blocks as shown below. The terminal block consists of up to 18 x M5 screw terminals and 32 x M4 screw terminals. M5 terminal blocks are used for CT connections and M4 terminal blocks are used for auxiliary power/ input/output connections. The wires should be terminated with rings using 90° ring terminals, with no more than two rings per terminal. The product is supplied with sufficient M5 & M4 screws for proper connection.

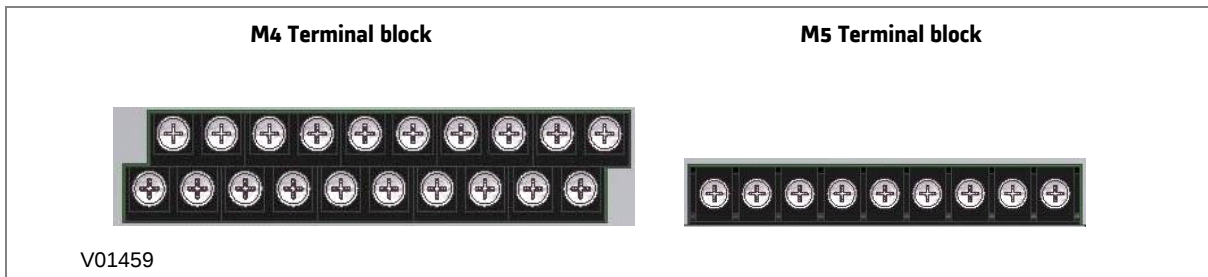


Figure 6: Terminal blocks



Caution: Always fit an insulating sleeve over the ring terminal.

2.3.3.2 Rear Serial Port Connection

The rear serial port is intended for use with a permanently wired connection to a remote SCADA system. The physical connectivity is achieved using three screw terminals: C3, C4 terminals for signal connection, and C5 terminal for connecting cable shield. The terminal block is located at the rear of the relay as shown below.

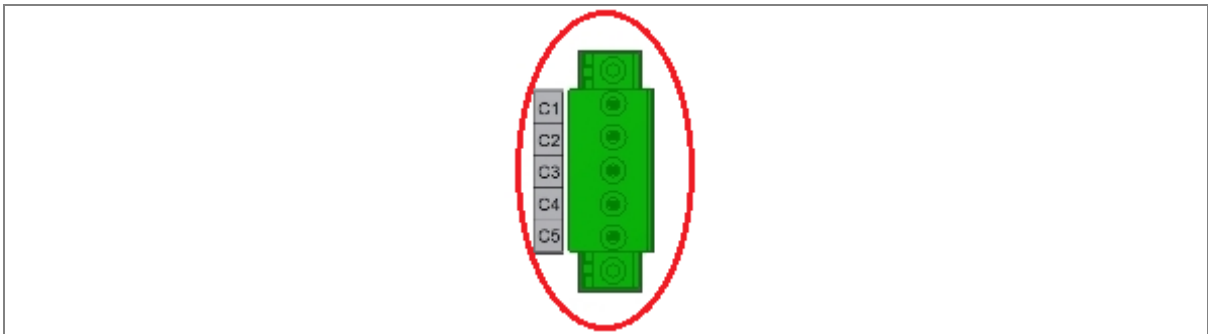


Figure 7: Rear Serial port terminal block

2.3.3.3 Power Supply Connections

These should be wired with 1.5 mm PVC insulated multi-stranded copper wire terminated with M4 ring terminals. The wire should have a minimum voltage rating of 300 V RMS.

As per the application, in case auxiliary supply input of the relay needs to be wired, then adequate care should be taken to wire as per polarity marking on the terminal sticker at the rear of the relay. The supply range is also mentioned on the terminal sticker and before energising, care should be taken to confirm that the auxiliary supply being wired is within range.

2.3.3.4 Earth Connection

Every device must be connected to the cubicle earthing bar. Earthing terminal is provided on back side of the relay. Ensure that the relay earthing is connected to the local earth bar. With several relays present; make sure that the copper earth bar is properly installed for solidity connecting to the earthing terminal of each relay equipment box.

Before energizing the equipment it must be earthed using the protective conductor terminal, (if provided) or the appropriate termination of the supply plug in the case of plug connected equipment. The protective conductor (earth) connection must not be removed since the protection against electric shock provided by the equipment would be lost. The recommended minimum protective conductor (earth) wire size is 2.5 mm² or as per industries standard practice. The protective conductor (earth) connection must be of low-inductance and as short as possible.

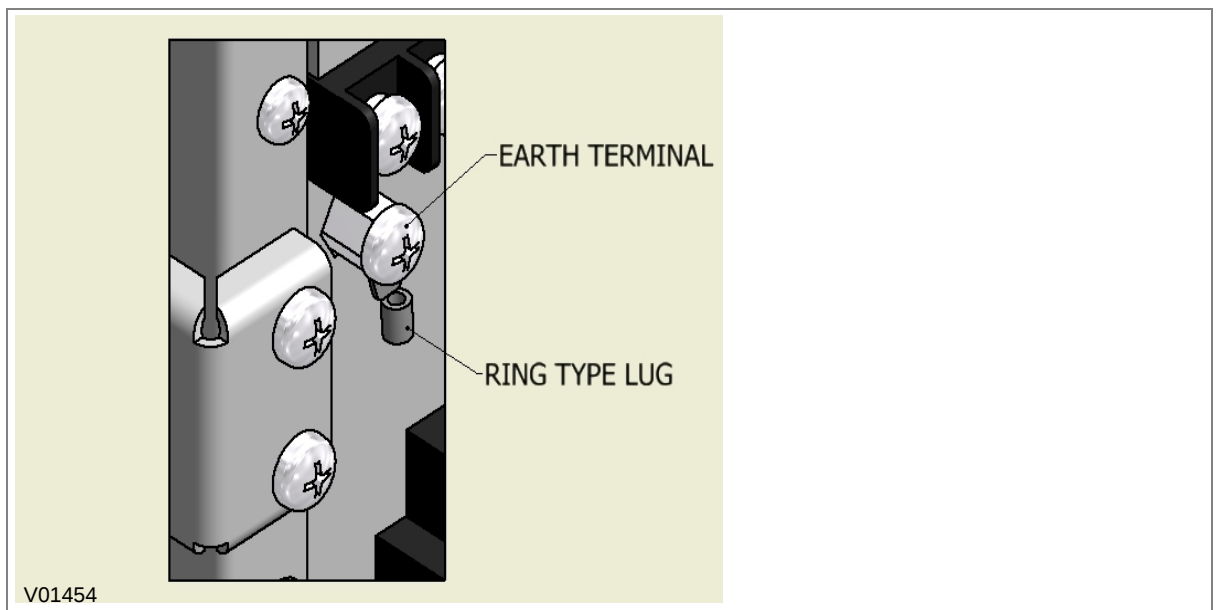


Figure 8: Earthing terminal on the rear side of the relay

Note: To prevent any possibility of electrolytic action between brass or copper ground conductors and the rear panel of the product, precautions should be taken to isolate them from one another. This could be achieved in several ways, including placing a nickel-plated or insulating washer between the conductor and the product case, or using tinned ring terminals.

2.3.3.5 Current Transformers

Current transformers would generally be wired with 2.5 mm² PVC insulated multi-stranded copper wire terminated with M5 ring terminals. The wires should be terminated with rings using 90° rings terminals, with no more than two rings per terminal.

Due to the physical limitations of the ring terminal, the maximum wire size you can use is 4.0 mm² using ring terminals.

The wire should have a minimum voltage rating of 300 V RMS.



Caution: Current transformer circuits must never be fused.

Note 1: Terminal blocks must not be detached whilst any current transformer (CT) circuit is live. CT shorting must be achieved by external means; the product does not include this facility.

Note 2: For 5A CT secondary, we recommend using 2 x 2.5 mm² PVC insulated multi-stranded copper wire.

2.3.3.6 EIA(RS) 485 Connections

For connecting the EIA (RS485), use 2-core screened cable with a maximum total length of 1000 m or 200 nF total cable capacitance.

A typical cable specification would be:

- Each core: 16/0.2 mm² copper conductors, PVC insulated
- Nominal conductor area: 0.5 mm² per core
- Screen: Overall braid, PVC sheathed

There is no electrical connection of the cable screen to the device. The link is provided purely to link together the two cable screens.

2.3.3.7 Output Relay Connections

These should be wired with 1 mm PVC insulated multi-stranded copper wire terminated with M4 ring terminals.

2.3.3.8 USB Connection

The IED has a type B USB socket on the front panel. A standard USB printer cable (type A one end, type B the other end) can be used to connect a local PC to the IED. This cable is the same as that used for connecting a printer to a PC.

2.4 Case Dimensions

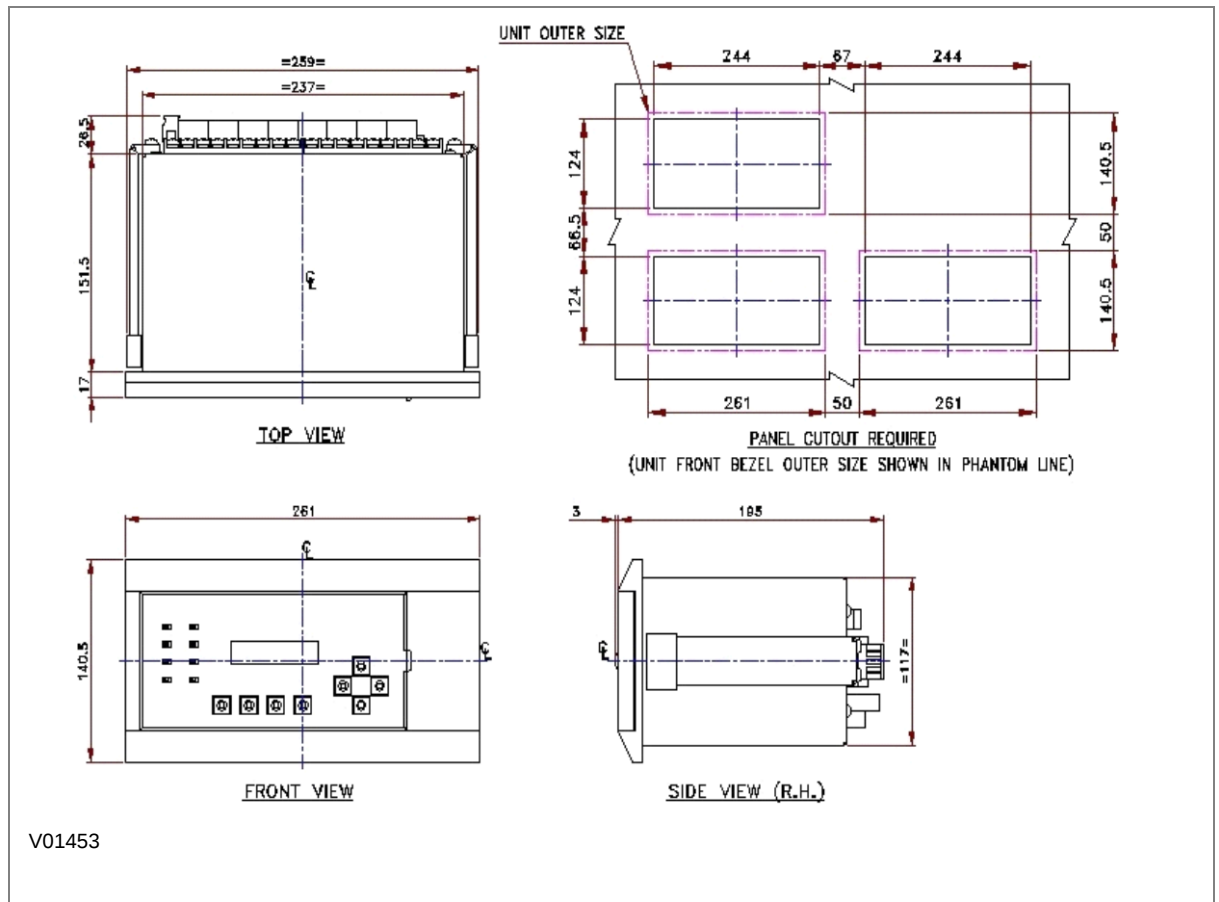


Figure 9: Case dimensions

Note: All dimensions in mm.

COMMISSIONING INSTRUCTIONS

CHAPTER 11

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

- 1 Chapter Overview**
- 2 Commissioning**
 - 2.1 Commissioning Test Menu
 - 2.1.1 Test Mode
 - 2.1.2 Test Pattern
 - 2.1.3 Contact Test
 - 2.1.4 Test LEDs
 - 2.1.5 Opto Input Status Check
 - 2.1.6 Opto Output Status Check
 - 2.1.7 Commissioning Test Equipment Required
 - 2.1.8 Battery Check
 - 2.1.9 External Circuitry Check
 - 2.1.9.1 Earthing
 - 2.1.9.2 CT Polarity
 - 2.1.10 Check Relay Settings
 - 2.1.11 Protection Timing Checks
 - 2.1.11.1 Overcurrent Check
 - 2.1.11.2 Connecting the Test Circuit
 - 2.1.11.3 Performing the Test
 - 2.1.11.4 Checking the Operating Time
 - 2.1.12 Onload Checks
 - 2.1.12.1 Onload Checks
 - 2.1.13 Final Check

2 COMMISSIONING

The P154 is fully numerical in its design. It has a self-supervision function which continuously keeps track of its internal hardware. The P154 displays a message on the LCD screen if it detects the failure of any component. This is why the commissioning tests are less extensive than those for non-numeric electronic devices or electromechanical relays.

2.1 Commissioning Test Menu

The IED provides several test facilities under the **COMMISSION TEST** menu heading. There are menu cells that allow you to monitor the status of the opto-inputs, output relay contacts, and user-programmable LEDs.

This section describes the commissioning tests available in the IED's Commissioning test menu.

2.1.1 Test Mode

The Test Mode menu cell is used to allow secondary injection testing to be performed on the relay itself without operation of the trip contacts. It also enables a facility to test the output contacts by applying menu controlled test signals.

To select test mode, the **Test Mode** menu cell should be set to **Test Mode**, which takes the relay out of service and blocks the maintenance, counters. It also causes an alarm condition to be recorded and the amber **OUT OF SERVICE** LED to illuminate. This also freezes any information stored in the CB Condition column and in IEC 60870-5-103 builds changes the Cause of Transmission, COT, to Test Mode.

To enable testing of output contacts the **Test Mode** cell should be set to **Contacts Blocked**. This blocks the protection from operating the contacts and enables the test pattern and contact test functions which can be used to manually operate the output contacts.

Once testing is complete the cell must be set back to **Disabled** to restore the relay back to service.

2.1.2 Test Pattern

This cell is used to select the output relay contacts that will be tested when the **Contact Test** cell is set to **Apply Test**.

2.1.3 Contact Test

When the **Apply Test** command in this cell is issued, the contacts set for operation (set to 1) in the Test Pattern cell change state. After the test has been applied, the command text on the LCD will change to **No Operation** and the contacts will remain in the Test State until reset issuing the **Remove Test** command. The command text on the LCD will again revert to **No Operation** after the **Remove Test** command has been issued.

2.1.4 Test LEDs

When the Apply Test command in this cell is issued, the 4 programmable LEDs will illuminate for approximately 2 seconds before they extinguish and the command text on the LCD reverts to **No Operation**.

2.1.5 Opto Input Status Check

The **Opto I/P** cell under **SYSTEM DATA** menu can be used to monitor the status of the opto-inputs while they are sequentially energised with a suitable voltage. The cell is a binary string that displays the status of the opto-inputs where '1' means energised and '0' means de-energised.

2.1.6 Opto Output Status Check

The **Opto O/P** cell under **SYSTEM DATA** menu can be used to monitor the status of the relay outputs. The cell is a binary string that displays the status of the relay outputs where '1' means energised and '0' means de-energised. The cell indicates the status of the output relays when the IED is in service. You can check for relay damage by comparing the status of the output contacts with their associated bits.

Note: When the Test Mode cell is set to Contacts Blocked, the relay output status indicates which contacts would operate if the IED was in-service. It does not show the actual status of the output relays, as they are blocked.

2.1.7 Commissioning Test Equipment Required

At the time of commissioning the P154, the following test equipment is required as a minimum:

- Current injection test kit
- Multimeter with suitable AC current range and DC voltage range.
- Timer with precision 1 ms.
- Required auxiliary supply.
- Connecting wire, as per required length extension board etc.
- A portable PC, installed with appropriate software (P50 Agile Configurator)

2.1.8 Battery Check

Check the internal battery if the relay is losing its time or date settings, or you are receiving a message of RTC Error. Follow the steps below:

- Remove all the electrical connection (like SCADA system, current inputs, voltage inputs, etc.) from the relay terminals.
- Reconfigure date and time setting by using the feather touch keys.
- After re-configuring the date and time, switch OFF the relay for some time by disconnecting the auxiliary supply.
- Switch ON the relay, and check its date and time. If you are still receiving the RTC Error message, then replace the lithium coin battery. (Refer to instructions in the **Maintenance and Troubleshooting** chapter)

2.1.9 External Circuitry Check

Check the relay wiring on back terminal of relay against the appropriate wiring diagram:

- CT secondary must be connected to the relay 1A or 5A. All CT wiring screws should be properly tightened.



Warning: An open circuit of the CT secondary wiring can cause high voltage which may be lethal and could damage insulation.

- External supply can be wired to the relay auxiliary supply terminals with proper polarity marking as mentioned on the Terminal sticker at the top of the relay. The supply range is mentioned under the front flap covering the USB port connection. Confirm that the auxiliary supply is in range before energizing the relay.

- Trip Coil contact connection should be as per the given schematic diagram.
- Latching type annunciation contact connection as per requirement of site.

2.1.9.1 Earthing

An earthing terminal is provided at the back of the relay. Ensure that the case earthing connections are used to connect the IED to a local earth bar using an adequate conductor.

With several relays present, make sure that the copper earth bar is properly installed for solidity connecting to the earthing terminal of each relay.

2.1.9.2 CT Polarity

Ensure proper CTs are connected as per required maximum load current and their polarity. When all CTs are connected with proper polarity, unbalance current flowing through earth fault element will be approximately zero. Otherwise the relay will trip on earth fault when the CB is energized.

2.1.10 Check Relay Settings

The relay setting check ensures that all of the application-specific settings for the particular installation have been correctly applied to the relay. Enter all settings manually via the front panel interface or using P50 Agile configurator tool.

2.1.11 Protection Timing Checks

There is no need to check every protection function. Only one protection function needs to be checked as the purpose is to verify the timing on the processor is functioning correctly.

2.1.11.1 Overcurrent Check

If the overcurrent protection function is being used, test the overcurrent protection for stage 1.

1. Check for any possible dependency conditions and simulate as appropriate.
2. In the **CONFIGURATION** menu, disable all protection elements other than the one being tested.
3. Make a note of which elements need to be re-enabled after testing.
4. Connect the test circuit
5. Perform the test
6. Check the operating time

2.1.11.2 Connecting the Test Circuit

1. Identify the function associated with the overcurrent protection stage 1 trip.
2. Use the output relay RL1 for assigning the overcurrent trip function
3. Use the IO Masking function in the P50 Configurator or IO configuration menu on relay HMI to map the protection stage under test directly to an output relay.
4. Connect the output relay so that its operation will trip the test set and stop the timer.
5. Connect the current output of the test set to the A-phase current transformer input.
6. Ensure that the timer starts when the current is applied.

2.1.11.3 Performing the Test

1. Ensure that the timer is reset.

2. Apply a current of twice the setting shown in the **I>1 Current Set** cell in the **OVERCURRENT** menu.
3. Note the time displayed when the timer stops.
4. Check that the red trip LED has illuminated.

2.1.11.4 Checking the Operating Time

Check that the operating time recorded by the timer is within the range shown below.
For all characteristics, allowance must be made for the accuracy of the test equipment being used.

Characteristic	Operating time at twice current setting and time multiplier/ time dial setting of 1.0	
	Nominal (seconds)	Range (seconds)
DT	I>1 Time Delay setting	Setting $\pm 5\%$ or 55ms whichever is greater
IEC S Inverse	10.03	Please refer to the Technical Specifications chapter for operating time accuracy
IEC V Inverse	13.50	
IEC E Inverse	26.67	
UK LT Inverse	20.00	
IEEE M Inverse	3.8	
IEEE V Inverse	7.03	
IEEE E Inverse	9.50	
US Inverse	2.16	
US ST Inverse	12.12	

Note: With the exception of the definite time characteristic, the operating times given are for a Time Multiplier Setting (TMS) or Time Dial Setting (TDS) of 1. For other values of TMS or TDS, the values need to be modified accordingly



Caution: On completion of the tests, you must restore all settings that were disabled

2.1.12 Onload Checks

Onload checks can only be carried out if there are no restrictions preventing the energisation of the plant, and the other devices in the group have already been commissioned.

Remove all test leads and temporary shorting links, then replace any external wiring that has been removed to allow testing.



Caution: If any external wiring has been disconnected for the commissioning process, replace it in accordance with the relevant external connection or scheme diagram.

2.1.12.1 Onload Checks

1. Measure the current transformer secondary values for each input using a multimeter connected in series with the corresponding current input.
2. Check that the current transformer polarities are correct by measuring the negative sequence current magnitude. or derived earth fault current.

3. Ensure the current flowing in the neutral circuit of the current transformers is negligible.
4. Compare the values of the secondary phase currents with the measured values, which can be found in the **MEASUREMENTS** menu.

The 'Secondary' values displayed on the relay should be equal to the applied secondary current. The values should be within 2% of the applied secondary Current. However, an additional allowance must be made for the accuracy of the test equipment being used.

2.1.13 Final Check

1. Remove all test leads and temporary shorting leads.
2. If you have had to disconnect any of the external wiring in order to perform the wiring verification tests, replace all wiring, fuses and links in accordance with the relevant external connection or scheme diagram.
3. Ensure that the IED has been restored to service by checking that the **Test Mode** cell in the **COMMISSION TESTS** menu is set to 'Disabled'.
4. The settings applied should be carefully checked against the required application-specific settings to ensure that they are correct, and have not been mistakenly altered during testing.
5. Ensure that all protection elements required have been set to **Enabled** in the **CONFIGURATION** menu.
6. If the IED is in a new installation or the circuit breaker has just been maintained, the circuit breaker maintenance and current counters should be zero. These counters can be reset using the **Clear Maint** function in the **RECORD CONTROL** menu.
7. If the required access level is not active, the device will prompt for a password to be entered so that the setting change can be made.
8. If a P991/MMLG test block is installed, remove the P992/MMLB test plug and replace the cover so that the protection is put into service.
9. Ensure that all event records, fault records, disturbance records, alarms and LEDs and communications statistics have been reset.

*Note: **Clear Maint** function will clear all Maintenance record memory*

MAINTENANCE AND TROUBLESHOOTING

CHAPTER 12

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

- 1 Chapter Overview**
- 2 MAINTENANCE**
 - 2.1 Maintenance Checks
 - 2.1.1 Opto-Isolators
 - 2.1.2 Output Relays
 - 2.1.3 Measurement Accuracy
 - 2.2 Changing the Battery
 - 2.2.1 Replacing the Lithium Coin Battery
 - 2.3 Replacing the Unit
 - 2.4 Cleaning
- 3 Troubleshooting**

2 MAINTENANCE

2.1 Maintenance Checks

In view of the critical nature of the application, GE Vernova products should be checked at regular intervals to confirm they are operating correctly.

The devices are self-supervising and so require less maintenance than earlier designs of protection devices. Most problems will result in an alarm, indicating that remedial action should be taken. However, some periodic tests should be carried out to ensure that they are functioning correctly and that the external wiring is intact. It is the responsibility of the customer to define the interval between maintenance periods. If your organisation has a Preventative Maintenance Policy, the recommended product checks should be included in the regular program. Maintenance periods depend on many factors, such as:

- The operating environment
- The accessibility of the site
- The amount of available manpower
- The importance of the installation in the power system
- The consequences of failure

Although some functionality checks can be performed from a remote location, these are predominantly restricted to checking that the unit is measuring the applied currents and voltages accurately, and checking the circuit breaker maintenance counters. For this reason, maintenance checks should also be performed locally at the substation.



Caution: Before carrying out any work on the equipment you should be familiar with the contents of the Safety Section or the Safety Guide Pxxx-SG-4LM-2 and the ratings on the equipment's rating label.

2.1.1 Opto-Isolators

Check the opto-inputs by repeating the commissioning test detailed in the Commissioning chapter.

2.1.2 Output Relays

Check the output relays by repeating the commissioning test detailed in the Commissioning chapter.

2.1.3 Measurement Accuracy

If the power system is energised, the measured values can be compared with known system values to check that they are in the expected range. If they are within a set range, this indicates that the A/D conversion and the calculations are being performed correctly. Suitable test methods can be found in Commissioning chapter.

Alternatively, the measured values can be checked against known values injected into the device using the test block, (if fitted) or injected directly into the IED's terminals. These tests will prove the calibration accuracy is being maintained.

2.2 Changing the Battery

The P154 relay has a battery to maintain status data and the correct time when the auxiliary supply voltage fails.

The data maintained includes event, fault and disturbance records and the thermal state at the time of failure. The battery periodically needs changing if there is a low battery condition, to ensure reliability. The lithium coin battery is located on the CPU PCB.



Caution: Before carrying out any work on the equipment you should be familiar with the contents of the Safety Section or the Safety Guide Pxxx-SG-4LM-2 and the ratings on the equipment's rating label.

2.2.1 Replacing the Lithium Coin Battery

1. Remove the relay cover by loosening the screws as shown in figure below.

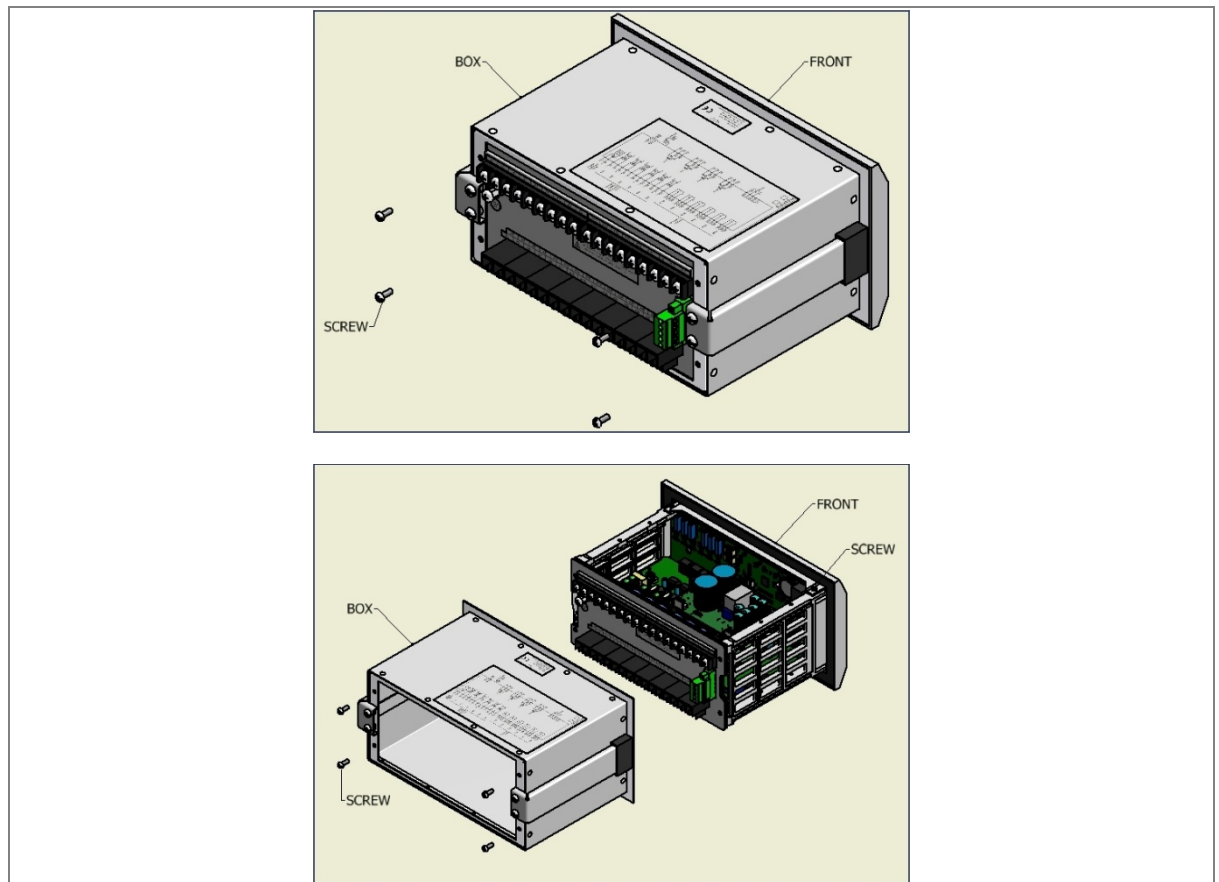


Figure 1: Removal of relay cover

2. Remove the front bezel by loosening the screws as shown in figure below.

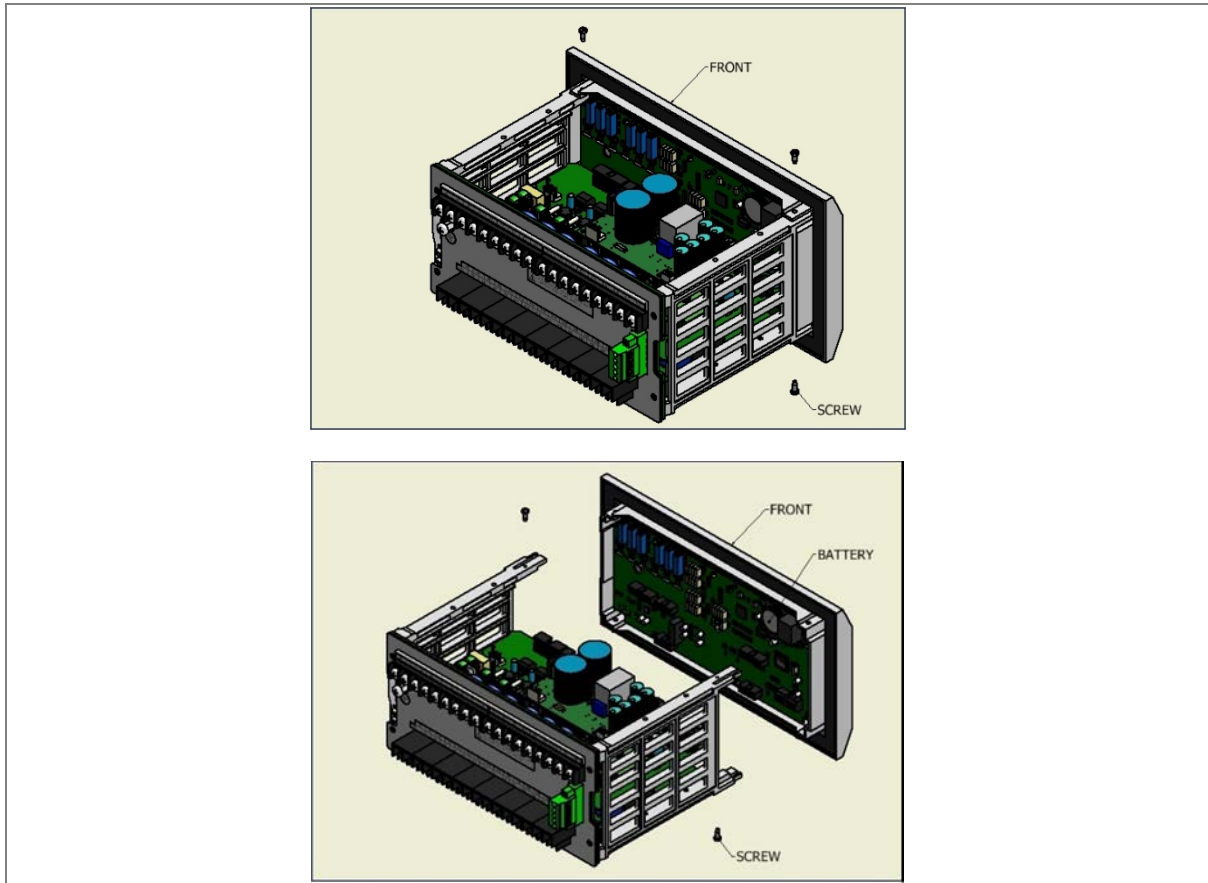


Figure 2: Removal of front bezel

3. Locate the exact position of the lithium coin battery on the CPU PCB

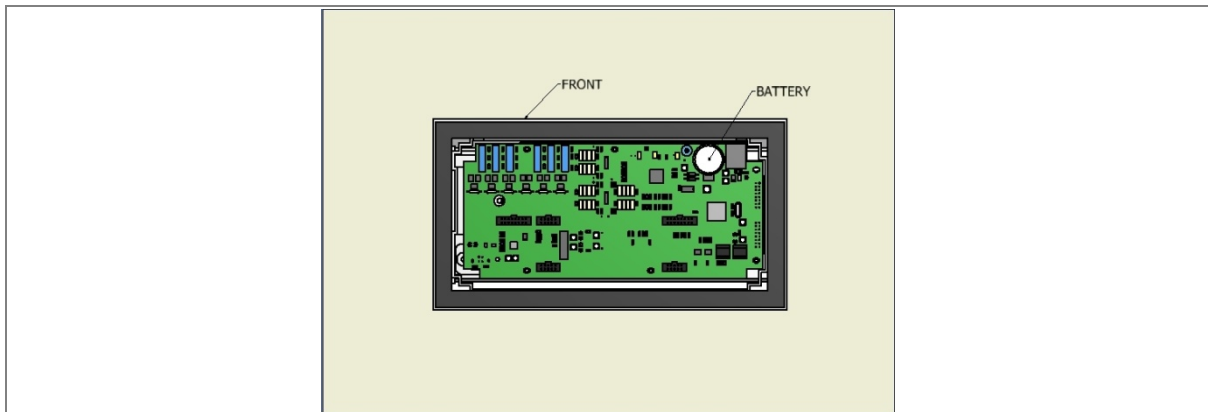


Figure 3: Battery location on CPU PCB

4. Gently remove the battery. If necessary, use a small insulated screwdriver.
5. Make sure the metal terminals in the battery socket are free from corrosion, grease and dust.
6. Remove the replacement battery from its packaging and insert it in the battery holder, ensuring correct polarity. Orient the lithium coin battery so that the positive (+) side is visible.

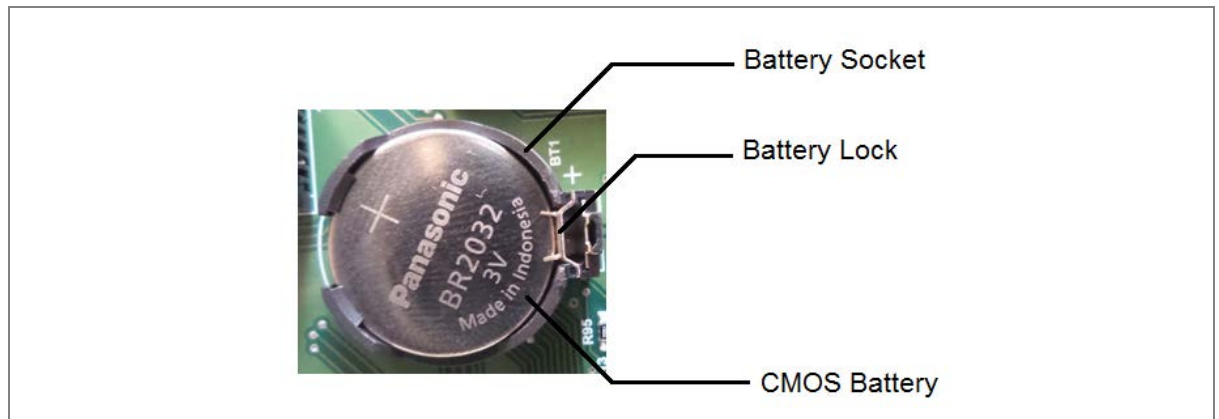


Figure 4: Correct polarity of battery



Only use Panasonic make Lithium battery type BR2032 or equivalent with a nominal voltage of 3 V.

7. Ensure that the battery is held securely in its socket and that the battery terminals make good contact with the socket terminals.
8. Replace the front bezel and relay cover.
9. After replacing the lithium coin battery, you must reconfigure and reset the system date and time.

2.3 Replacing the Unit

If your product should develop a fault while in service, depending on the nature of the fault, the error codes will be generated which can be viewed on the relay HMI. First step is to take actions as suggested in the Troubleshooting section of this manual. In the unlikely event that the problem persist or lies with the wiring and/or terminals, then you must replace the complete device, rewire and re-commission the device.

Once the unit has been reinstalled, it should be re-commissioned.



Caution: If the repair is not performed by an approved service centre, the warranty will be invalidated.



Caution: Before carrying out any work on the equipment, you should be familiar with the contents of the Safety Information section of this guide or the Safety Guide Pxxx-SG-4LM-2 as well as the ratings on the equipment's rating label. This should ensure that no damage is caused by incorrect handling of the electronic components.



Warning: Before working at the rear of the unit, isolate all voltage and current supplying it.

Note: P154 does not support automatic current transformer shorting. Therefore for safety reasons CT terminals to be shorted when the terminal block is removed.

2.4 Cleaning



Warning: Before cleaning the IED, ensure that all AC and DC supplies and transformer connections are isolated to prevent any chance of an electric shock while cleaning.

Only clean the equipment with a lint-free cloth dampened with clean water. Do not use detergents, solvents or abrasive cleaners as they may damage the product's surfaces and leave a conductive residue.

3 TROUBLESHOOTING

The relay continuously monitors the hardware and detects any hardware fault/error. In case of hardware failure relay displays the corresponding error code on the LCD.

- The IED performs continuous periodic self-diagnostic procedure at every one minute for checking of all errors excluding Setting Error.
- If the error is cleared during self-diagnostic procedure, corresponding error bit will be cleared.
- For Setting Error, ADC Error and FRAM1 Error, IED goes in **OUT OF SERVICE** mode (Protection will be blocked). The **OUT OF SERVICE** LED on the front facia will continuously blink at 1 sec interval and **ON** LED indication will turn from GREEN to RED.

The faults errors are stored in the 'Main't Rec Num= "and can be viewed from **Maint Record** submenu. The Error code is stored in 16 bit integer.

The bit definition applicable to P154 is shown as below:

Bit 12 - 15	Bit 11	Bit 10	Bit 6-9	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Unused	Incompatible Firmware	Incompatible CommFirmware	Unused	FRAM 1 Error	ADC Error	Unused	RTC Error	Unused	Setting Error

The Error code descriptions are given below:

Sr. No	Error Code display	Error Data Bitwise	Description	Cause	Action taken by MCU	Proposed action
1	0001	0000 0000 0000 0001	SETTING Error	1. Setting corrupted 2. Change of Setting address in memory	ON LED turns Red and OUT OF SERVICE LED starts blinking. (Protection is blocked)	Go to CONFIGURATION menu, restore default settings and then save settings. Press (EDIT + PROT. RESET).
2	0004	0000 0000 0000 0100	RTC Error	1. I2C Bus Error 2. Damaged RTC 3. Battery backup not functioning	ON LED turns Red	Set correct values for Date & Time and press (EDIT + PROT. RESET).
3	0010	0000 0000 0001 0000	ADC Error	1. ADC device not working. 2. SPI bus error	ON LED turns Red and OUT OF SERVICE LED starts blinking. (Protection is blocked)	Press (EDIT + PROT. RESET)
4	0020	0000 0000 0010 0000	FRAM 1 Error	1. SPI bus error 2. FRAM not working	ON LED turns Red	Press (EDIT + PROT. RESET)
5	Incompatible CommFirmware	0000 0100 0000 0000	Incompatible CommFirmware Error	Firmware being flashed has communication protocol not compatible to the protocol option as per relay model number.	ON LED turns Red	Flash correct FW as per the cortec information on the relay.
6	Incompatible Firmware	0000 1000 0000 0000	Incompatible Firmware Error	Firmware being flashed is not compatible to the hardware as per relay model number. (e.g. mismatch in CT selection/ DI Input threshold voltage etc.)	ON LED turns Red and OUT OF SERVICE LED starts blinking. (Protection is blocked)	Flash correct FW as per the cortec information on the relay.

TECHNICAL SPECIFICATIONS

CHAPTER 13

1

CHAPTER OVERVIEW

This chapter consists of the following sections:

- 1
- Chapter Overview
- 2
- Technical Specification
- 2.1.1
- Standards Compliance

2 TECHNICAL SPECIFICATION

Current Input					
I.	CT secondary	1 A or 5 A (by wiring)			
II.	Nominal burden at rated current (without tripping condition)	< 0.20 VA at rated current (In)			
III.	Thermal withstand capacity	100 x rated current (In) for 1s 50 x rated current (In) for 3s 4 x rated current (In) continuous for Phase and E/F CT 2 x rated current (In) continuous for SEF CT			
IV.	Measurement linearity range (for non – offset AC current)	For O/C : 0.05 – 40 In For E/F : 0.05 – 40 In For SEF : 0.002 – 4 In			
V.	Measurement accuracy	Typical ± 2% at In for Phase and EF CTs			
VI.	Nominal frequency range for current Inputs	50/60 Hz (selectable in P154 Menu)			
VII.	Frequency measurement range	45 Hz – 65 Hz			
Auxiliary Supply					
I.	Nominal auxiliary voltage	24-230 V AC (50 / 60 Hz) or 24-230 V DC			
II.	Operating range	80% of lower nominal range and 120% of upper nominal range for DC supply 80% of lower nominal range and 110% of upper nominal range for AC supply			
III.	Nominal burden on 24 – 230 V auxiliary power supply	24-230 VAC	< 10 VA (no status energized) < 13 VA (with all status and output energised)		
		24-230 V DC	< 3 W (no status energized) < 4.5 W (with all status and output energised)		
IV.	Tolerable ac ripple	Up to 15% of highest dc supply, as per IEC 60255-26: 2013			
V.	Relay power-up time	< 2.50s			
Opto Isolated Input					
I.	Nominal operating voltage range	24-230 V AC (50 / 60 Hz) or 24-230 V DC			
II.	Threshold setting (ordering option)	Option -1*	Option -2	Option -3	Option -4
	Threshold voltage for DC	18V +/- 3V	35V +/- 3V	77V +/- 3V	154V +/- 3V
	Threshold voltage for AC	16V +/- 3V	33V +/- 3V	75V +/- 3V	152V +/- 3V
	Maximum operating voltage range	276VDC / AC	276VDC / AC	276VDC / AC	276VDC / AC
		<i>*Note: The inputs must be connected via screened cable or twisted pair cable.</i>			
III.	Drop out	Within 85% of threshold voltage value			
IV.	VA burden of opto inputs	For each status < 1.5 W / VA			
V.	Filtering time	< 40 ms			
VI.	Logic input recognition time	For all Status Inputs: filtering time + 5 ms ± 5 ms			
Output Contact					
I.	Non Latching contact	Continuous	Continuous 5A/250 V AC		
		Make & carry	30A for 3s		

		Short time withstand capacity	50A for 1s
		Breaking capacity	AC- 1250 VA max. 5A or 250 V (PF= 0.4)
			DC- 100 W resistive max. 5A or 300 V 50 W Inductive (L/R =45 ms) max. 5A or 300 V
		Operating time	<10 ms
		Minimum no. of operations	10,000 operation loaded condition & unloaded 100,000 operations
Accuracy of protection function			
Overcurrent			
I.	Operating value	Pick-up	Setting +10% / - 5%
		Minimum trip level (IDMT)	1.05 x Setting ± 5%
		Drop –off	0.95 x Setting ± 5%
II.	Operating time	IDMT characteristic shape	As per clause 5.2 of IEC60255-151 or 50 ms whichever is greater
		DT operation	± 5% or 55 ms whichever is greater**
		** Reference condition	Currents applied at 2x pick-up level or higher
III.	Reset time	DT	Set delay ±10%
		IDMT (only for IEEE & US curves)	Calculated time ±10%
Earth Fault 1 (Measured)-Standard CT / SEF CT			
I.	Operating value	Pick-up	Setting +10% / - 5%
		Minimum trip level (IDMT)	1.05 x Setting ± 5%
		Drop –off	0.95 x Setting ± 5%
II.	Operating time	IDMT characteristic shape	As per clause 5.2 of IEC60255-151 or 50 ms whichever is greater
		DT operation	± 5% or 55 ms whichever is greater**
		** Reference condition	Currents applied at 2x pick-up level or higher
III.	Reset time	DT	Set delay ±10%
		IDMT (only for IEEE & US curves)	Calculated time ±10%
Earth Fault 2 (Derived)			
I.	Operating value	Pick-up	Setting +10% / - 5%
		Minimum trip level (IDMT)	1.05 x Setting ± 5%
		Drop –off	0.95 x Setting ± 5%
II.	Operating time	IDMT characteristic shape	As per clause 5.2 of IEC60255-151 or 50 ms whichever is greater
		DT operation	± 5% or 55 ms whichever is greater**
		** Reference condition	Currents applied at 2x pick-up level or higher
III.	Reset time	DT	Set delay ±10%
		IDMT (only for IEEE & US curves)	Calculated time ±10%

Negative Phase Sequence Overcurrent			
I.	Operating value	Pick-up	Setting +10% / - 5%
		Minimum trip level (IDMT)	1.05 x Setting ± 5%
		Drop –off	0.95 x Setting ± 5%
II.	Operating time	IDMT characteristic shape	As per clause 5.2 of IEC60255-151 or 50 ms whichever is greater
		DT operation	± 5% or 55 ms whichever is greater**
		** Reference condition	Currents applied at 2x pick-up level or higher
III.	Reset time	DT	Set delay ±10%
		IDMT (only for IEEE & US curves)	Calculated time ±10%
Broken Conductor			
I.	Operating value	Pick-up	1.05 x Setting ± 5%
		Drop –off	0.95 x Setting ± 5%
		DT operation	± 5% or 55 ms whichever is greater
2nd Harmonic			
I.	Operating value	2ndHarm Thresh	Setting ± 15%
		I>lift 2H	Setting ± 15%
Thermal Overload			
I.	Operating time	Thermal Trip	± 10% of calculated time**
		** Reference condition	Currents applied at 1.1x (Thermal Trip* K) or higher
Under current			
I.	Operating value	Pick-up	0.95 x Settings ± 7.50%
		Drop –off	1.05 x Settings ± 7.50%
	Operating time	DT operation	± 5% or 55 ms whichever is greater
Cold Load Pickup			
	tcold operating time	tcold	Setting ± 10%
	tclp operating time	tclp	Setting ± 10%
	Operating value	Pick-up	Setting +10% / - 5%
		Minimum trip level (IDMT)	1.05 x Setting ± 5%
		Drop –off	0.95 x Settings ± 5%
	Operating time	IDMT characteristic shape	As per clause 5.2 of IEC60255-151 or 50 ms whichever is greater
		DT operation	± 5% or 55 ms whichever is greater**
		** Reference condition	Currents applied at 2x pick-up level or higher
CB Fail			
I.	Operating time	DT operation	± 5% or 55 ms whichever is greater
		CBF Reset	<40 ms*
		Reset current	Setting ± 10%
* Note : Filtering time (typically 25ms) is added when CBF initiated by external Binary input			

Note: As per IEC60255-151 clause 5.2 (assigned error 5%), the tolerances are calculated as below.

Value of characteristic quantity as multiple of setting value (Gs)	2-5	5-10	Above 10
Limiting error as multiple of an assigned error	2.5	1.5	1

Operating conditions		
I.	Relative humidity	Humidity (RH) 95% maximum
II.	Operating temperature range	-25 °C to +55 °C
III.	Storage temperature range	-25 °C to +70 °C
Terminals specification		
I.	AC current input terminals	M5 threaded terminals for ring lug connection. Suitable up to 4 mm ²
II.	Auxiliary & input/output Terminals	M4 threaded terminal connection. Suitable up to 2.5 mm ²
III.	Tightening torque for M4/M5 screws	Maximum torque of 1.2 Nm
IV.	Rear communication terminal	Two wire connection. Suitable up to 2.5 mm ²
Mechanical & Environmental specification		
I.	Design	Flush mounting case
II.	Weight	3.50 Kg approximate
III.	Pollution Degree	II

2.1.1 Standards Compliance

SR. NO.	TYPE TEST	STANDARD	TEST SPECIFICATION/METHOD	
1.	Impulse, Dielectric and Insulation tests			
1.1	Impulse voltage test	IEC 60255-27:2005 (incl. corrigendum 2007)	Test voltage	5kv, 1.2/50 μV
			Energy	0.5 J
			Polarity	+ve and –ve
			No. of impulses	3 on each polarity
			Duration between impulses	5s
			EUT condition	Non energised
1.2	Dielectric voltage withstand test	IEC 60255-27:2005 (incl. corrigendum 2007)	1) 2kV rms for 1 minute between all terminals connected together with case earth. 2) 2kV rms for 1 minute between independent circuits with case earth. 3) 1.5kV rms for 1 minute across open contacts of changeover output relays.	
1.3	Insulation resistance test	IEC 60255-27:2005 (incl. corrigendum 2007)	> 100 MΩ at 500V DC	
1.4	Creepage distances and clearances	IEC 60255-27:2005 (incl. corrigendum 2007)	Pollution degree : 2 Overvoltage category : III	

2. Auxiliary Supply tests			
2.1	D.C. voltage dips	IEC 61000-4-29 Class A IEC60255-26(ed3.0)-2013	Residual voltage 1) At 40% for 200ms. 2) At 70% for 500ms.
2.2	DC voltage interruption	IEC 61000-4-29 Class A IEC60255-26(ed3.0)-2013	1) DC auxiliary supply interruptions for 10, 20ms with no loss of protection. 2) DC auxiliary supply interruptions 50ms, 100ms, 200ms, 0.5s, 5s with temporary loss of protection.
2.3	AC voltage dips	IEC 61000-4-11 Class A IEC60255-26(ed3.0)-2013	Residual voltage 1) At 40% for 200ms. 2) At 70% for 500ms. 3) At 80% for 5s.
2.4	A.C. voltage interruption	IEC 61000-4-11 Class A IEC60255-26(ed3.0)-2013	1) AC auxiliary supply interruptions for 10, 20ms with no loss of protection. 2) AC auxiliary supply interruptions for 50ms, 100ms, 200ms, 0.5s, 5s with temporary loss of protection.
2.5	AC (ripple) in DC supply	IEC 60255-11, IEC60255-26(ed3.0)-2013	Level: 15% Frequency: 100/120 Hz
2.6	Gradual shutdown/ start-up test	IEC60255-26(ed3.0)-2013	The unit must power down and up correctly with no mal operation.
			Shut down time 60 s
			Power off time 5 min.
			Startup time 60 s
2.7	Reversal of DC power supply polarity test	IEC 60255-11	Product shall withstand for 1 minute with Reverse polarity of power supply inputs.

3. Emission tests			
3.1	Radiated emission test	EN55022:2006+A1:2007 IEC60255-26(ed3.0)-2013	The EUT shall satisfy the requirement of this specification. Radiation measured at a distance of 10 meter.
			Frequency range Limits
			30 MHz – 230 MHz 40 dB (μV/m)
			230 MHz – 1000 MHz 47 dB (μV/m)
			EUT condition Energised
3.2	Conducted emission test	IEC60255-26(ed3.0)-2013	The EUT shall satisfy the requirement of this specification.
			Frequency range Limits
			0.15 – 0.5 MHz 79 dB/μV (Quasi peak) 66 dB/μV (Average)
			0.5 – 30 MHz 73 dB/μV (Quasi peak) 60 dB/μV (Average)
			EUT Condition Energised

4.	Immunity tests		
4.1	High frequency disturbance test	IEC 60255-22-1 and IEC60255-26(ed3.0)-2013	1) 2.5 kV Common mode a) Between independent circuit and case earth. b) Independent circuit. 2) 1 kV Differential mode a) Independent circuit. EUT condition : Energised
4.2	Electrostatic discharge	EN61000-4-2:2009 Level 3 and Level 4 IEC60255-26(ed3.0)-2013	1) 15kV air discharge 2) 8kV contact discharge 3) 15kV indirect discharge EUT condition : Energised
4.3	Surge immunity test	EN61000-4-5:2006 Level 4 IEC60255-26(ed3.0)-2013	1) 4KV: Power supply common mode 2) 2KV Power Supply differential mode 3) 4KV CT / input / output ports common mode 4) 2KV CT / input / output ports differential mode EUT condition : Energised
4.4	Fast transient	EN 61000-4-4:2004 + A1:2010 Level 4. IEC60255-26(ed3.0)-2013	1) 4kV 5 kHz and 100 kHz, applied to all circuits excluding communication ports 2) 2kV 5 kHz and 100 kHz, applied to communication ports EUT condition: Energised
4.5	Radiated radio frequency electromagnetic field disturbance test	EN 61000-4-3: 2006+A1:2008 Level 4, IEC60255-26(ed3.0)-2013	Voltage level
			10 V/m and 30 V/m
			Frequency range
			- For 10 V/m - For 30V/m
			800 – 1000 MHz , 1.4 – 2.7 GHz 80 – 960 MHz , 1.4 – 2 GHz
4.6	Conducted disturbance induced by radio Frequency field	EN 61000-4-6: 2009 Level 3 IEC60255-26(ed3.0)-2013	Modulation
			80% AM @ 1 KHz
			Spot Frequency
			80, 160, 380, 450, 900,1850 & 2150MHz
			27, 68 MHz
4.7	Power frequency magnetic field immunity	EN61000-4-8:2010 Level 5 IEC60255-26(ed3.0)-2013	Voltage level
			10 V
			Frequency range
			0.15 – 80 MHz
			Modulation
4.8	Pulsed magnetic field immunity	EN 61000-4-9:1993+A1:2001, Level 5	80% AM @ 1 KHz
			Dwell time
			2.85 sec.
			Spot frequency
			27, 68 MHz
4.7	Power frequency magnetic field immunity	EN61000-4-8:2010 Level 5 IEC60255-26(ed3.0)-2013	1) Class 5: 100A/m field applied continuously in all planes for the EUT in a quiescent and tripping state 2) Class 5: 1000A/m field applied for 3s in all planes for the EUT in a quiescent and tripping state EUT condition : Energized
4.8	Pulsed magnetic field immunity	EN 61000-4-9:1993+A1:2001, Level 5	Class 5: 1000A/m field applied continuously in all planes for the EUT in a quiescent and tripping state

4.9	Damped oscillatory magnetic field	EN61000-4-10:1993 + A1:2001, Level 5	Class 5: 100A/m field applied in all planes at 100kHz / 1MHz with burst duration of 2 Sec.
4.10	Damped oscillatory test	EN 61000-4-18: 2007 + A1:2010	1) 100kHz and 1MHz slow damped oscillatory applied in common mode at 2.5 KV 2) 3MHz, 10MHz, 30MHz fast damped oscillatory applied in common mode at 1 KV

5.	Mechanical tests			
5.1	Vibration response test	EN 60255-21-1:1996 Class 2	Frequency range	10 Hz to 150 Hz
			Crossover frequency	58 to 60 Hz
			Peak displacement before crossover	0.075mm
			Peak acceleration after crossover	1 gn
			No. of sweep cycles per axis	1
			EUT condition	Energised
5.2	Vibration endurance test	EN 60255-21-1:1996 Class 2	Frequency range	10 to 250Hz
			Peak acceleration	2 gn
			No. of sweep cycles per axis	20
			EUT condition	Non energised
5.3	Shock response test	EN 60255-21-2:1996 Class 2	Peak acceleration	10 gn
			Pulse duration	11 ms
			No. of pulses in each direction	5
			EUT condition	Energised
5.4	Shock endurance test	EN 60255-21-2:1996 Class 2	Peak acceleration	30 gn
			Pulse duration	11 ms
			No. of pulses in each direction	3
			EUT condition	Non energised
5.5	Bump test	EN 60255-21-2:1996 Class 2	Peak acceleration	20 gn
			Pulse duration	16 ms
			No. of pulses in each direction	1000
			EUT condition	Non energized
5.6	Seismic test	EN 60255-21-3:1995 (Class 2 - 2g peak)	Frequency range	1 to 35 Hz
			Crossover frequency	8 Hz
			Peak displacement before crossover X	7.5 mm
			Peak displacement before crossover Y	3.5 mm
			Peak acceleration after crossover X	2 gn

5.	Mechanical tests			
			Peak acceleration after crossover Y	1 gn
			No. of sweep cycles per axis	1
			EUT condition	Energised
6.	Environmental tests			
6.1	Dry heat test	IEC 60255-1, IEC 60068-2-2: 2007 Bd	Start-up +20°C (EUT energised)	Functional verification tests for 2 hours
			Intermediate +40°C (EUT energised)	Functional verification tests for 2 hours
			High temperature claim +65°C (EUT energised at highest rated voltage)	Operate for 96 hours at highest rated voltage (HRV)
			High temperature claim +70°C (EUT not energised)	Storage for 96 hours
			Hot start +65°C (EUT energised at highest rated voltage)	Operate for 2 hours at highest rated voltage (HRV)
			Last test +20°C (EUT energised)	Functional verification tests for 2 hours
6.2	Cold test	IEC 60255-1, IEC 60068-2-1: 2007	Start-up +20 °C (EUT energised)	Functional verification tests for 2 hours
			Intermediate 0°C (EUT energised)	Functional verification tests for 2 hours
			Intermediate -10°C (EUT energised)	Functional verification tests for 2 hours
			Low temperature - 25°C (EUT energised)	Functional verification tests for 96 hours
			Low temperature -25°C (EUT not energised)	Storage for 96 hours
			Cold start -25°C (EUT energised)	Operate for 2 hours
			Last test +20°C (EUT energised)	Functional verification tests for 2 hours
6.3	Change of temperature test	IEC 60255-1, EN 60068-2-14:2009 Nb	Lower temperature	-25°C
			Higher temperature	+65°C
			Rate of change of temperature	1°C/min
			Duration of exposure	5 cycle
			Duration of cycle	3 + 3 hrs.
			EUT condition	Energised
6.4	Damp heat steady state test	EN 60068-2-78, EN60068-2-30	Operating temperature	+65°C
			Humidity	93%
			Duration of exposure	10 days
			EUT condition	Energised
6.5	Damp heat cyclic test	IEC60068-2-30	Lower temperature	+25°C
			Humidity	97%
			Higher temperature	+65°C
			Humidity	93%
			Duration of exposure	6 cycle
			Duration of cycle	12 + 12 hrs.
			EUT condition	Energised

6.	Environmental tests			
6.6	Enclosure protection	EN 60529:2000	IP52	For Front
			IP20	For Rear
			EUT Condition	Non energised

WIRING DIAGRAMS

CHAPTER 14

1 CHAPTER OVERVIEW

This chapter consists of the following sections:

- 1 Chapter Overview**
- 2 Wiring Diagram**

2 WIRING DIAGRAM

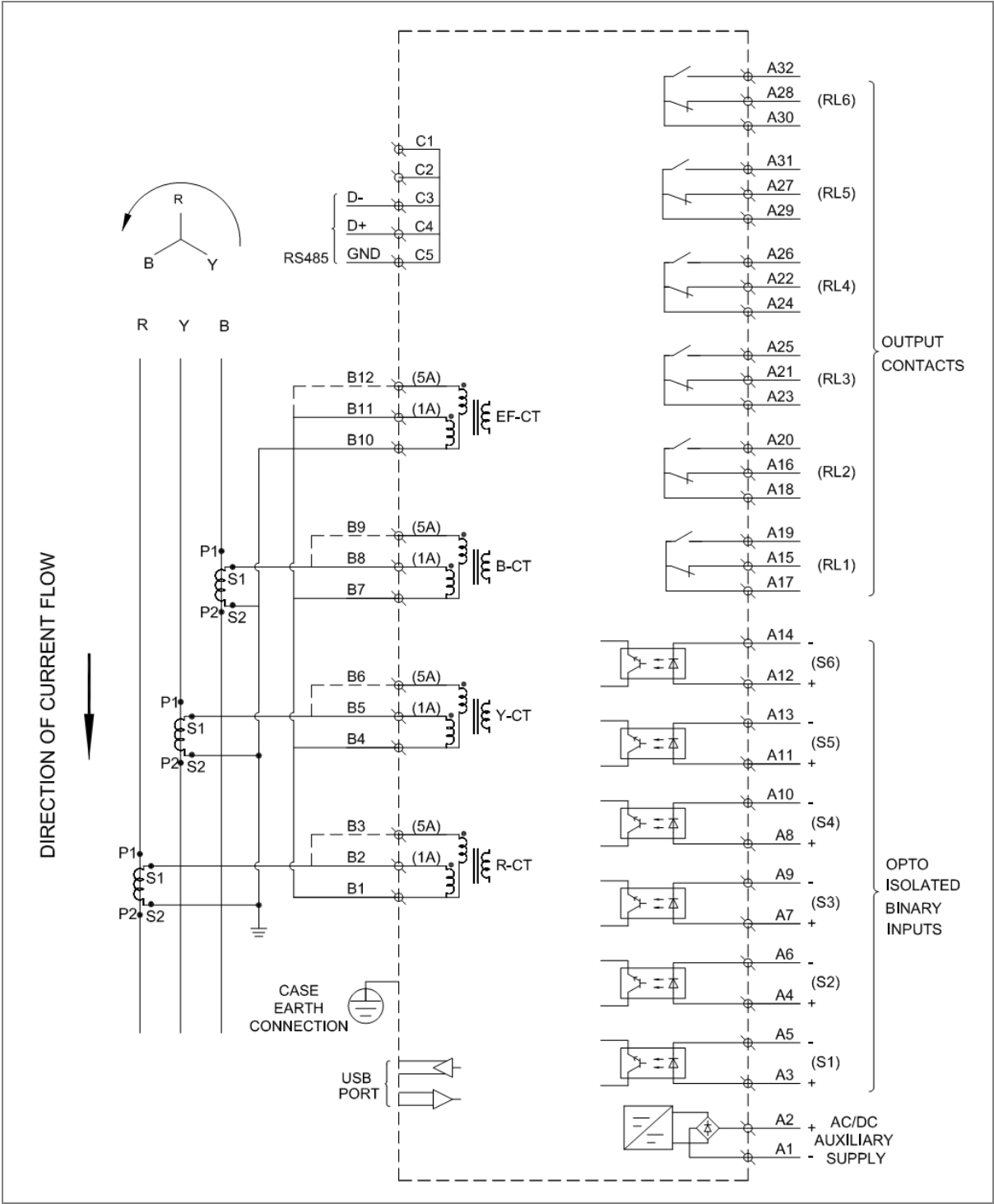


Figure 1: P154 wiring diagram



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Imagination at work

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