

NUMERICAL CURRENT DIFFERENTIAL PROTECTION RELAY AR85 [AN+ SERIES]



USER MANUAL



**ALUMINIUM INDUSTRIES LIMITED
RELAYS DIVISION, THIRUVANANTHAPURAM**

AR85

Numerical Current Differential Protection Relay

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SAFETY REQUIREMENTS

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INTRODUCTION

Before using this product, be sure to read this chapter carefully.

This chapter describes safety precautions when using the relay. Before installing and using the equipment, read and understand this chapter thoroughly.

It's not a secret – electricity can be dangerous and when things go wrong lives can be at stake!

Electrical engineers are Industrial safety doctors, so it's our duty to keep employees health and maintain a quality of life that we all deserve by providing safe work practices to avoid electrical accidents.

How much electricity is dangerous?????

CURRENT	EFFECT
0.5 – 3mA	Tingling sensations
3 – 10mA	Muscle contractions (painful)
10 – 40mA	"can't let go" phenomena
40 – 75mA	Respiratory paralysis (possibly fatal)
75 – 200mA	Ventricular fibrillation (likely fatal)
200 – 500mA	Heart clamps tight
>1.5A	Tissue and organs began to burn

Fact: A 15 amp circuit breaker was designed to protect equipment – not people!

The relay is developed with zero percentage of risk factor by its own design. The current carrying paths and circuits are isolated from the metal case and structure. Suitable clearance depending on the type of insulation required for different classes are provided.

The relay confirms to Product safety requirement standard IEC 60255-27.

HEALTH AND SAFETY

It deals with the handling of relay in proper way. An individual to be considered as 'qualified' with regard to certain equipment in the workplace, but 'unqualified' as to other equipment. "An employee, who is undergoing on the job training and who, in the course of such training, has demonstrated the ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person also considered to be a qualified person for the performance of those duties."

The following requirements must be met, in the order given, before circuits or equipments are re-energized, even temporarily.

- ✚ People handling the equipment should be aware about the relay safety handlet.
- ✚ Ensure that the product is in the off condition before working on the conducting or terminal side.
- ✚ A qualified person must conduct tests and visual inspections, as necessary, to verify that tools electrical jumpers, shorts, grounds and other such devices have been removed, so that the circuits and equipments can be safely re-energized.
- ✚ Employees exposed to the hazards associated with re-energizing the circuit or equipment must be warned to stay clear of the circuits and equipment.
- ✚ Each lock and tag must be removed by the employee who applied it or someone else under that employee's direct supervision.
- ✚ A visual determination that all employees are clear of the circuits and equipments must be made.

For any queries related to relays, feel free to contact ALIND.

SYMBOLS AND LABELS USED IN THE RELAY

1. FRONT SIDE



Caution: refer to equipment documentation



Caution: risk of electric shock



Caution: Over voltage Cat.III

2. REAR SIDE

**WARNING**

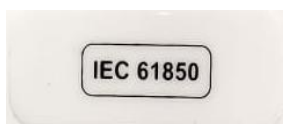
1. No user serviceable components inside.
2. Refer servicing to authorized personnel.



Protective Conductor (*Earth) terminal
Functional/Protective Conductor (*Earth) terminal.



CMOS Battery provided for the RTC (Real Time Clock) purpose. Confirm polarity of the battery while replacing.



IEC 61850 sticker

WARNING**Current transformer circuit**

Never allow the current transformer (CT) secondary circuit connected to this equipment to be opened while the primary system is live. Opening the CT circuit will produce a dangerous high voltage.

**Exposed terminals**

Do not touch the terminals of this equipment while the power is on, as the high voltage generated is dangerous.

**Residual voltage**

Hazardous voltage can be present in the DC circuit just after switching off the DC power supply. It takes about 30 seconds for the voltage to discharge.

CAUTION**Earth**

Earth the earthing terminal of the equipment securely.

**Operation conditions**

Use the equipment within the range of ambient temperature, humidity and dust as detailed in the specification and in an environment free of abnormal vibration.

**Ratings**

Before applying AC voltage and current or DC power supply to the equipment, check that they conform to the equipment ratings.

**Printed circuit board**

Do not attach and remove the printed circuit board while the DC power to the equipment is on, as this may cause the equipment to malfunction.

**External circuit**

When connecting the output contacts of the equipment to an external circuit, carefully check the supply voltage used and prevent the connected circuit from overheating.

**Connection cable**

Carefully handle the connection cable without applying excessive force.



Modification

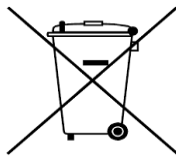
Do not modify this equipment, as this may cause the equipment to malfunction, and any such cases, warranty may be affected.

DECOMMISSIONING AND DISPOSAL



De-commissioning

The supply input (auxiliary) for the equipment may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the equipment, the capacitors should be safely discharged via the external terminals prior to de-commissioning.



Disposal

When disposing of this equipment, do so in a safe manner according to local regulations. It is recommended that incineration and disposal to water courses is avoided. Ensure the relay is in de energized condition and take precautions to avoid short circuits.

TECHNICAL SPECIFICATIONS FOR SAFETY

1. Protective class

IEC 60255-27:2005	Class I	(This equipment requires a protective conductor (earth) connection to ensure user safety.)
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2. Environment

IEC 60255-27:2005	Pollution degree 2	(Normally only non-conductive pollution occurs except occasionally a temporary conductivity caused by condensation is to be expected.)
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3. Overvoltage Category

IEC 60255-27:2005	Category III	(The auxiliary energizing circuits of the equipment are connected to a common battery, common mode transient voltages of a relatively high value may appear on the supply leads, and differential mode voltages may arise from switching in other circuits connected to the same battery)
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4. Contact data

Test voltage across open contact: 1 kV DC for 1 min source.

INTRODUCTION

CONTENTS

AN SERIES DESCRIPTION

PREVIOUS HISTORY OF TRANSFORMER PROTECTION RELAYS

BRIEF DESCRIPTION OF RELAYS

MAIN FUNCTIONS

GENERAL FUNCTIONS

AN+ SERIES (ALIND NUMERICAL SERIES)

- Advanced Digital Fourier Transform based Numerical algorithm design using 32-bit Digital Signal Controller (DSC).
- Compact Construction covering several protection modules saving panel space.
- Man-Machine Communication through 20x4 character LCD display and LEDs.
- Self supervision of both hardware and software units.
- Interface ability with SCADA through IEC 60870-5-103 & IEC 61850 communication protocol.
- Facility for storing fault waveforms (Disturbance recorder) and events with date and Time stamping. At a time a total of 5000 events and 200 latest fault waveforms (Disturbance recorder) will be stored in the relay.
- Graphical User Interface for Harmonic analysis, DC analysis and di/dt analysis can be done on the uploaded fault waveforms with facility for report generation.
- Facility to access/modify the relay settings both online as well as through menu in local PC through SCADA at RCC.
- Relay Indication (LED) reset from RCC.
- Suitable password protection.
- IP 54 grade enclosure protection.
- SNTP (Simple Network Time Protocol) & optional GPS based IRIG -B time code standard Synchronization Facility.
- Settable CT ratios.
- Online primary or secondary current display on relay LCD
- Relay operation counter

PREVIOUS HISTORY OF DIFFERENTIAL PROTECTION RELAYS

TMADT+TDTA

Static Type.

ATD 12

Numerical Integrated transformer differential protection relay

Disturbance & event recorder.

Built in counter facility.

ANTD

The relay is the modified version of our ATD 12 (AN Series) relay. The relay incorporates Instantaneous, IDMT curve, 3 stage definite time over current protection, Post over load protection.

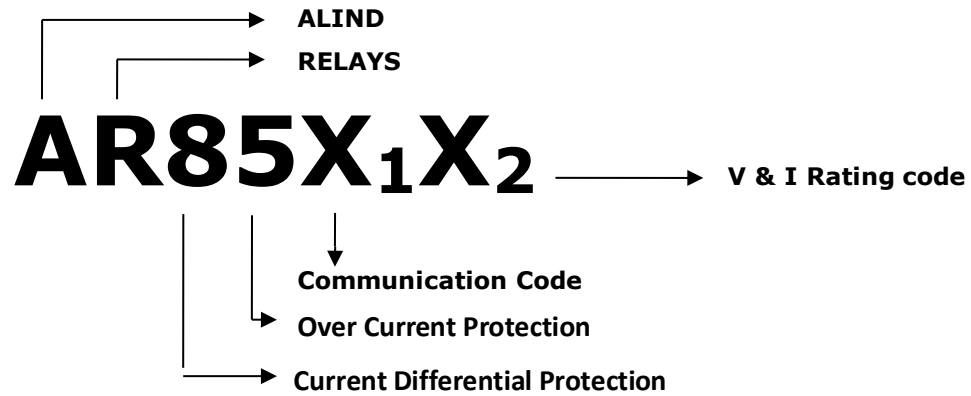
ANTD 201:

The relay conforms to RDSO specification No. TI/SPC/PSI/PROTCT/6071. ANTD 201 (AN Series) relay is a comprehensive Integrated Transformer Differential Protection relay for the protection of conventional 27 KV AC single phase, 50Hz Over Head Equipment (OHE).

ANTD 401:

The relay conforms to RDSO specification No. TI/SPC/PSI/PROTCT/7100(07/2012). ANTD 401 (AN Series) relay is a comprehensive Integrated Transformer Differential Protection relay for the protection of 2x25 KV (AT feeding system) AC single phase, 50Hz Over Head Equipment (OHE).

Designed as per RDSO specification no. TI/SPC/PSI/PROTCT/7101 and 6072.



Protection naming codes	
0.	None
1.	Panto Flash Over Protection
2.	Distance Protection
3.	Under/Over Voltage Protection
4.	Current Unbalance Protection
5.	Over Current Protection
6.	EF/REF Protection
7.	Delta I Protection
8.	Current Differential Protection
9.	Voltage Unbalance Protection

Communication naming codes- X ₁	
A	IEC 60870-5-103
B	IEC 60870-5-103 + IEC61850 (RJ45)
C	IEC 60870-5-103 + IEC61850 (LC)
D	IEC 60870-5-103 + IEC61850 (Redundant RJ45)
E	IEC 60870-5-103 + IEC61850 (Redundant LC)
F	IEC 60870-5-103 + IEC61850 (Redundant RJ45) + IRIG B
G	IEC 60870-5-103 + IEC61850 (Redundant LC) + IRIG B
H	IEC 60870-5-103 + IRIG B
I	IEC 60870-5-103 + IEC61850 (RJ45) + IRIG B
J	IEC 60870-5-103 + IEC61850 (LC) + IRIG B

V & I Rating codes-X ₂	
1	1A CT
2	110V AC& 1A
3	110V AC& 5A
4	230V AC& 110V DC
5	5A CT
6	100AC& 1A
7	100AC& 5A
8	100AC
9	110V AC

AR85: The relay conforms to RDSO specification No. TI/SPC/PSI/PROTCT/7101 and 6072.

AR85 (AN+ Series) relay is a comprehensive Current differential Protection for the protection of 25KV and 2X25KV AC Traction transformers.

MAIN FUNCTIONS

SI No.	PARTICULARS	For TRF.
1.0	PROTECTION FUNCTIONS	
1.1	Differential Protection element	✓
1.1	Inst. Over Current protection element	✓
1.2	Relay Error	✓
2.0	STATUS INPUTS	
2.1	Trip Circuit Supervision	✓
2.2	Buchholz Trip	✓
2.3	Winding Temperature Trip	✓
2.4	Oil Temperature Trip	✓
2.5	PRD Trip	✓
2.6	HIS Trip	✓
2.7	RCC Reset	✓
2.8	Circuit Breaker Status (NO & NC)	✓

DESCRIPTION OF PROTECTION FUNCTIONS

AR85 relay is a comprehensive Current Differential Protection relay for the protection of

- 2x25 KV (AT feeding system) Scott connected Tx. Differential Protection
- 2x25 KV (AT feeding system) V connected Tx. Differential Protection
- 2x25 KV (AT feeding system) AT Differential Protection
- 25KV single phase Tx. protection

Differential 1 & Differential 2 protections are included in the relay. Differential 1 is using for the protection of Secondary earthed and un-earthed Transformers (Scott/V) and Auto Transformers. Differential 2 is using for the protection of LV bus up to transformer LV CB in Secondary Un-earthed Transformer system (Scott).

GENERAL FUNCTIONS

SI No.	PARTICULARS	AR85
1.	Password protection	✓
2.	Event Memory	5000
3.	Disturbance recorder waveforms	200
4.	50 cycles (45 pre and 5 post fault) of fault waveform	✓
5.	COMMUNICATION	
5.1	GUI Interface	RJ 45
5.2	Isolated RS485 & RJ45/ LC Fiber Interface	✓
5.3	Communication Protocol Interface- IEC 60870-5-103 & IEC 61850	✓
5.4	Date/time synchronization through PC & Scada	✓
6.	MONITORING	
6.1	HV Bushing Current	✓
6.2	LV Bushing Current	✓
6.3	Selectable HV CT ratio:5-5000/5A	✓
6.4	Selectable LV CT ratio: 5-5000/5A	✓
6.5	Counters for each element (Differential)	✓
7.	USER INTERFACE	
7.1	Test facility in Relay setting Mode (offline)	✓
7.2	Compact Module	✓
7.3	Plug In Type	✓

HANDLING INSTALLATIONS & CASE DIMENSIONS

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HANDLING OF RELAY

STORAGE

RELAY AND RACK MOUNTING

CASE DIMENSIONS

HANDLING OF RELAY

Protective relays generally of robust construction require careful treatment prior to installation on site. Care must be taken when unpacking and installing the relays so that none of the parts are damaged. Relays must be handled by skilled personnel. The following should be taken into account while handling the relay:

- ✦ The relay use components that are sensitive to electrostatic discharges. The relay comprises of various semi-conductor devices which can damage if touched by means of direct contact. Handle the cards in static free environment since electrostatic discharge can affect performance of the relay or cause damage to the cards.
- ✦ The electronic circuits are well protected by the metal case and the internal module should not be withdrawn unnecessarily.
- ✦ The relay is normally shipped in separately packed condition. After unpacking, see if there is any mechanical damage to the cabinet, the nameplate, terminal blocks etc. Damage of any such sort identified shall be intimated to works.
- ✦ Avoid plugging in/ pulling out the cards when the power is ON.
- ✦ Do not apply CT inputs when auxiliary supply is switched OFF.
- ✦ If the cards are withdrawn for testing, ensure proper positioning while replacing.
- ✦ Keep the relays in well-packed condition in a dust-free dry environment without direct exposure to sunlight.

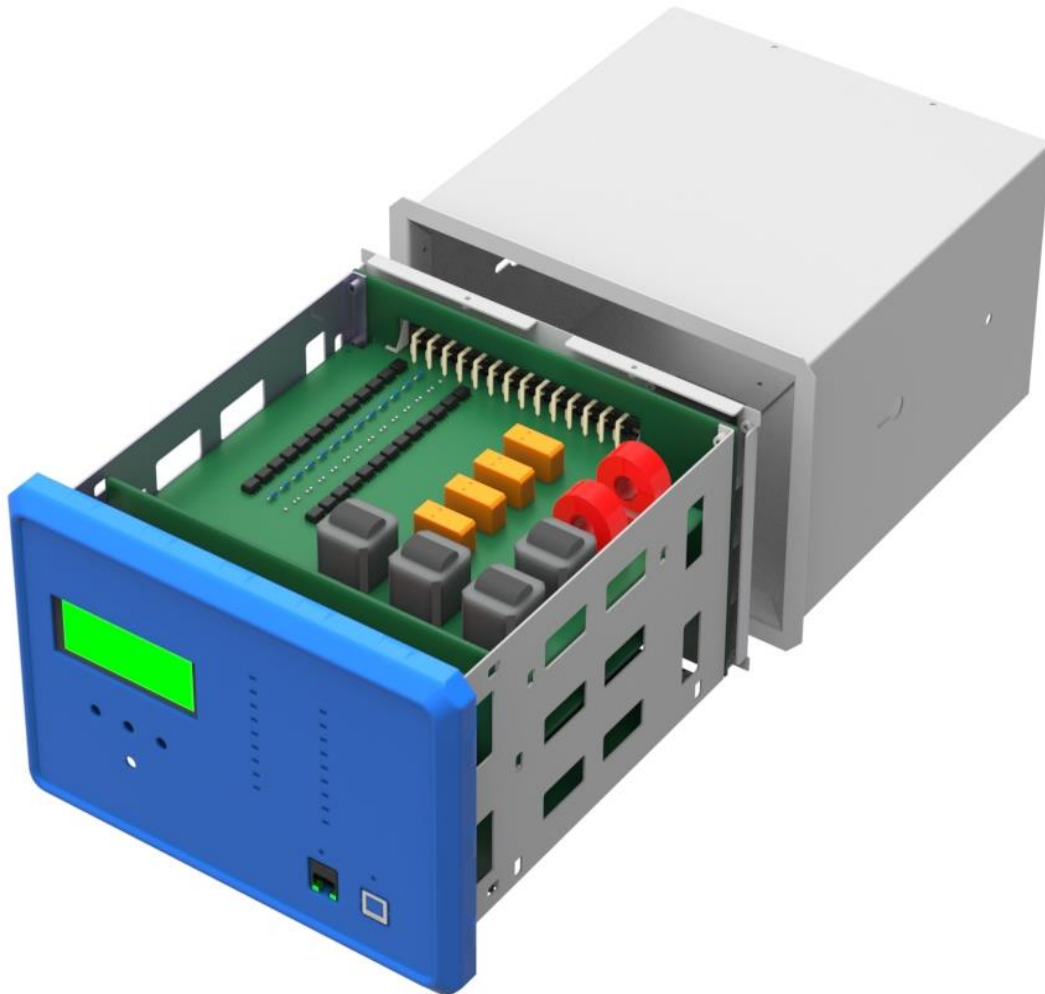
The relay is shipped from factory after detailed testing by our Quality Control Department. However, according to the customer requirement the relay settings/ functions can be verified before commissioning at respective sites with proper testing kits.

STORAGE

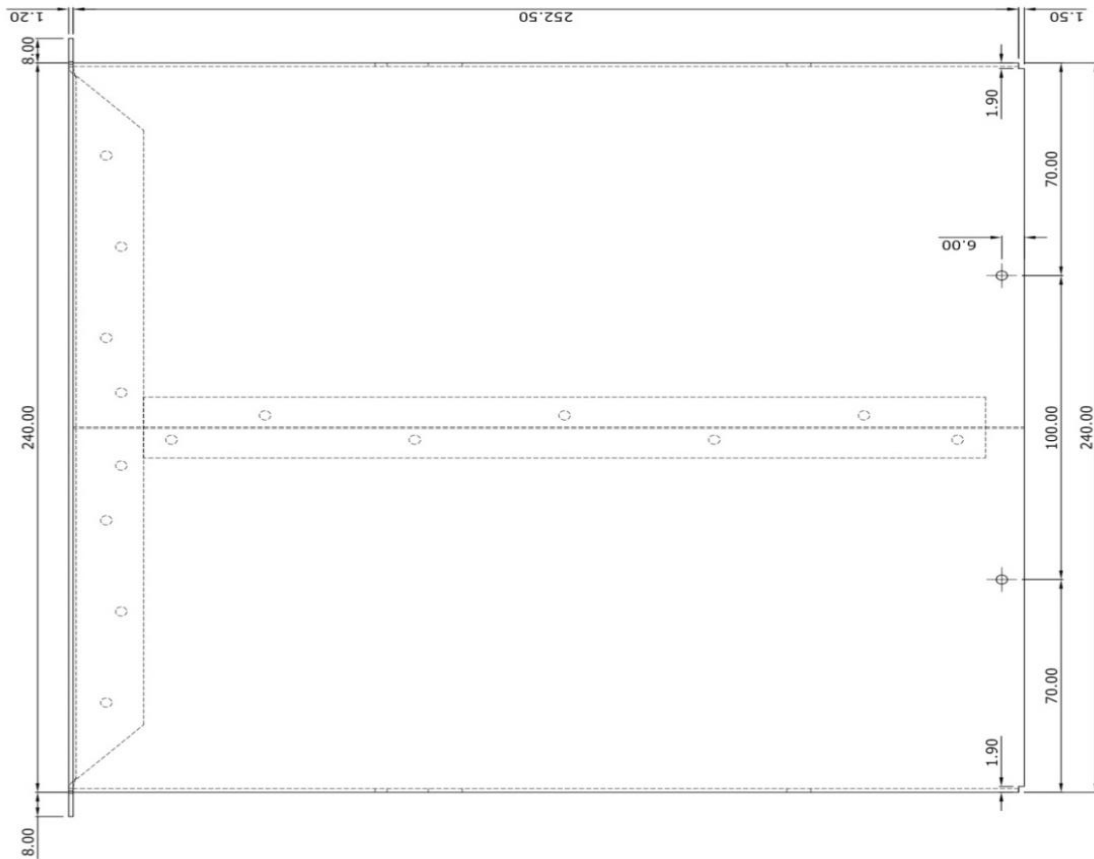
If relays are not to be installed immediately upon receipt, they should be stored in a place free from dust and moisture in their original boxes. At most care should be taken while storage.

Storage temperature: -25°C to +55°C.

RELAY AND RACK MOUNTING



CASE DIMENSIONS



CUT OUT DETAILS

USER GUIDE

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FRONT PANEL INDICATIONS

BACK TERMINAL BLOCK DETAILS

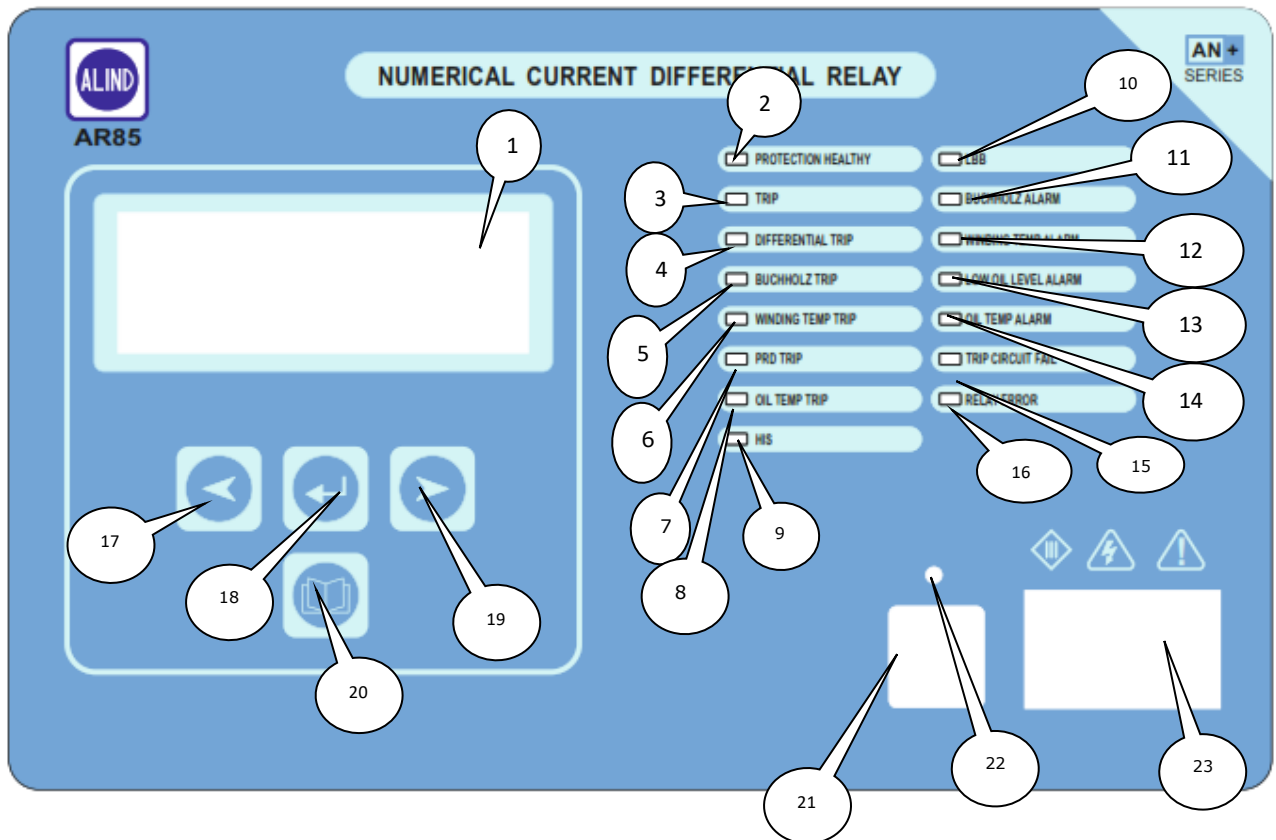
INTERNAL ARCHITECTURE AND BLOCK DIAGRAM

ENERGIZING THE RELAY

PCB DESCRIPTION

RELAY SETTINGS AND ALGORITHM

FRONT PANEL INDICATIONS



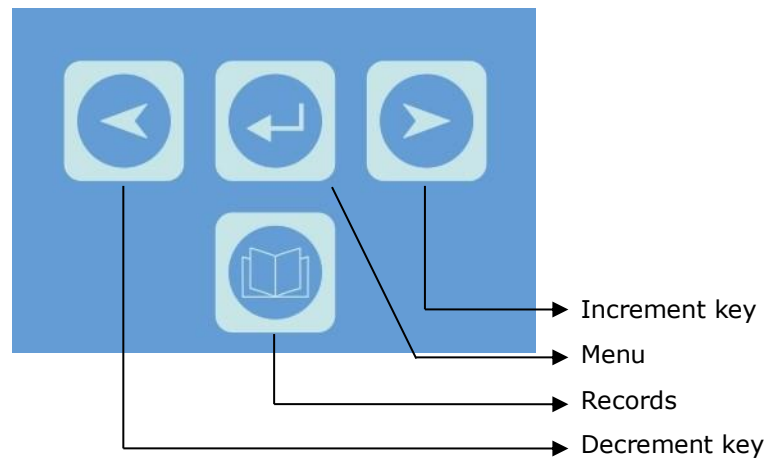
No	Legend	AR85
1	LCD DISPLAY	✓
2	PROTECTION HEALTHY (GREEN/AMBER)	✓
3	TRIP	✓
4	DIFFERENTIAL TRIP (RED)	✓
5	BUCHHOLZ TRIP (RED)	✓
6	WINDING TEMP TRIP (RED)	✓
7	PRD TRIP (RED)	✓
8	OIL TEMP TRIP (RED)	✓
9	HIS TRIP (RED)	✓
10	LBB	✓
11	BUCHHOLZ ALARM (RED)	✓
12	WINDING TEMP ALARM (RED)	✓
13	LOW OIL LEVEL ALARM (RED)	✓
14	OIL TEMP ALARM (RED)	✓
15	TRIP CKT FAIL (RED)	✓
16	RELAY ERROR (RED)	✓
17	>	✓
18	↵	✓
19	<	✓
20	RECORDS	✓
21	RJ45	✓
22	H.RST	✓
23	NAME PLATE	✓

LCD DISPLAY

A 20 x 4 LCD display is provided for easy viewing of parameters, relay settings, fault event records, date& time, error counter etc. The display backlit can be made ON by pressing any push button key except H.Rst key and the display backlit leaves for about 20 seconds. Backlit automatically turns on when any tripping occurs on the relay

Navigation Keys

The relay is provided with four switches.



Menu key

- * Main key for entering relay setting mode.
- * If you want to select anything in the setting mode, we can use this key.
- * To reset the relay from tripping mode.

Increment key

- * If you want to raise any particular setting, we can use this option.
- * For saving any particular changes in the relay, you can use this key.
- * For viewing new options in the relay, we can use this key.

Decrement key

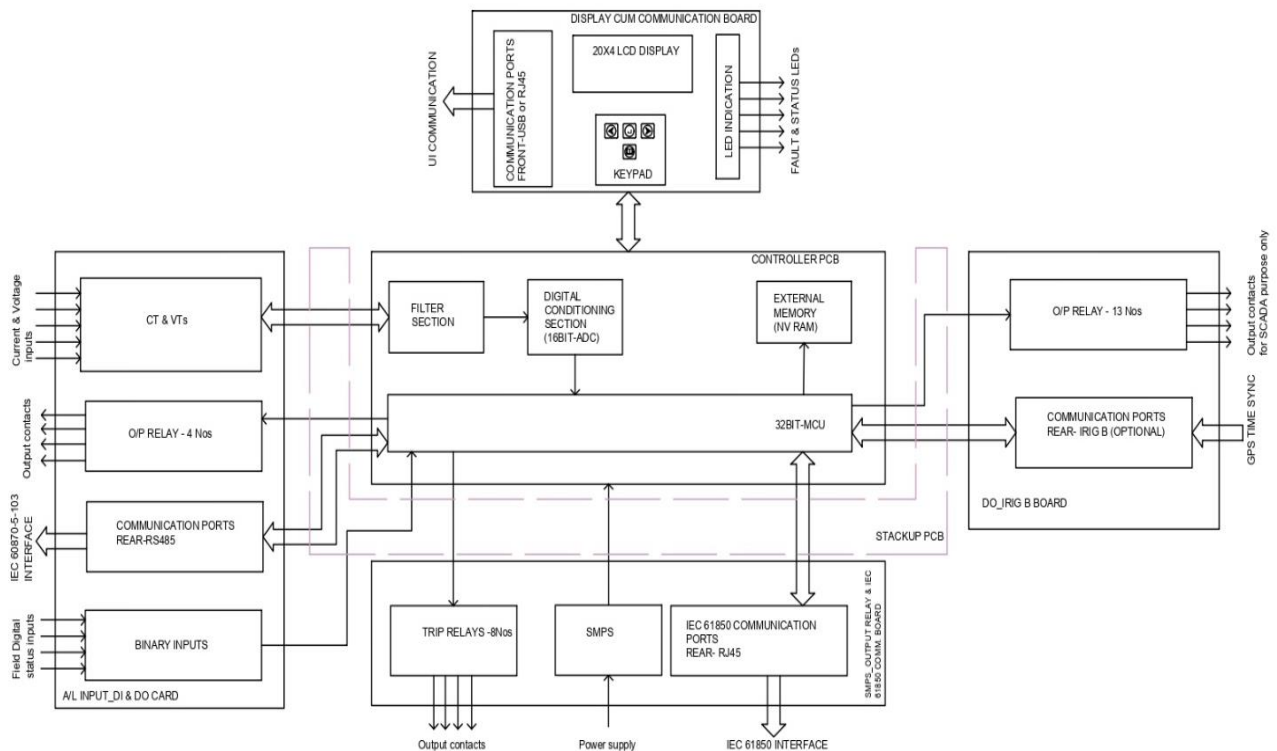
- * If you want to lower any particular setting, we can use this option.
- * No need to save any unwanted mistakes in the relay you can use this key.
- * If you want to verify any previous settings in the relay, you can use this key.

Records key

- * If you want to check the logs and data stored in the relay memory, you can use this key.

INTERNAL ARCHITECTURE AND BLOCK DIAGRAM

The internal system level architecture of relay including card to card architecture in brief is shown below.



1.DSP Controller

The 32bit MCU (Digital Signal Controller) machine that combines the control advantages of a high-performance 32-bit microcontroller with the high computation speed of a fully implemented Digital Signal Processor (DSP).

The MCU controller continuously monitors the currents. Based on this the controller performs different calculations and whenever an abnormal condition occurs it distinguishes the type of fault and issues trip command to the circuit breaker.

2. Data Acquisition

The Current signals are scaled and isolated using Current Transformer (CT). These isolated analog signals are filtered to minimize the effects of electromagnetic interference and noise in the high frequency range.

The analog signals are then fed to the Analog to Digital Converter which has a 16 bit resolution. The DSP controller will take the 32 samples per cycles of Current for the computational purpose. If any fault occurs the parameters will be stored in to the non-volatile memory with date and time stampings and this can be downloaded for further analysis in the disturbance recorder.

3. Power Supply Module

This module gives the necessary regulated voltages like +5V, -5V, and +24V to various cards in the module. The normal operating voltage range is 45 VDC to 170 VDC. The +24V is used for driving the output relays in the I/O card and O/P relay card. The +5V and -5V is supplied to the processor, I/O card and Display PCB for normal relay operations. The isolated +5V is dedicated to the communication ports of the relay.

4. Communication Module

The relay is having three communications port, Front port: RJ45, Rear port: ETHERNET & RS485. The relay is using IEC 60870-5-103 & IEC 61850-communication protocol for communication through RS485 & ETHERNET.

Front Port:

1) Communication Port

RJ 45 port shall be provided for uploading/downloading relay settings and events.

Rear Port:

a) RS 485 Communication Port

RS 485 port shall be provided for SCADA connectivity. Using RS485 port fault online data of critical parameters, disturbance record, and event record (Trip data) etc shall be downloaded. The communication protocol shall comply to IEC 60870-5-103 protocol.

b) Ethernet Communication Port

Ethernet port shall be provided for IEC 61850 connectivity. Using Ethernet port fault online data of critical parameters, disturbance record, event record (Trip data) etc. shall be downloaded. SNTP time synchronization is possible through the same. Ethernet port can either be copper/fiber depending upon the tender requirement.

5. Man Machine Interface

Man Machine Interface is through a 20x4 LCD display and keys in the front panel of the relay. Necessary LEDs are provided in front panel for indicating the operation of different element.

6. Disturbance Recorder

The relay has the facility to record 50 cycles (45 pre-fault and 5 post faults) of fault waveforms. Latest 200 waveforms of Current can be stored in the relay. This data is retrievable through front and rear communication ports using UI software and SCADA respectively.

7. Event Recorder & Disturbance Recorder

The relay is capable of storing 5000 number of events with date and time stamping of 1ms accuracy. The event data comprise of:

Tripping of different protection elements (I, Fault clearing time, Fault date & time)

Trip circuit supervision

Relay pick up

Relay reset

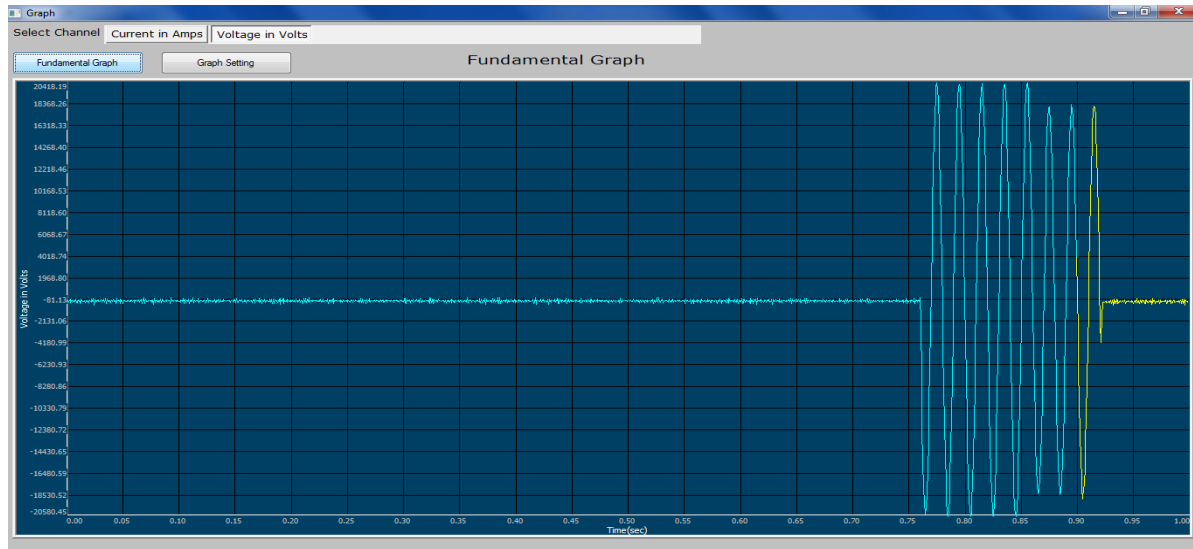
CB Trip

CB Close

Change of status input

Relay setting changed (GUI & Keypad)

Relay Error.



ENERGIZING THE RELAY

1. Before turning ON the relay, proper earthing should be provided.
2. Visual Inspection for any physical damage in housing, display etc shall be checked.
3. Operating voltage range: **45 to 170 VDC.**
Operating voltage: **110 V DC.**
4. Prefer regulated power supply of 110VDC.
5. Auxiliary power supply shall be provided to the corresponding terminals with the help of an MCB.
6. Switch on the power supply. Measure the voltage between the corresponding terminals and ensure that the voltage is within the normal operating range.
7. After the relay is powered ON, the following shall be noticed.

Protection healthy LED glow green in color which indicates that the relay is functioning OK, otherwise it goes amber.

PCB DESCRIPTION

The relay comprises of the following hardware.

Main PCBs. –Display PCB, Controller PCB, Stack PCB, status & CT, PT PCB, SMPS & trip relay PCB, Tele Annu PCB, Back panel PCB

Display cum Communication PCB (640 261): The Display PCB is mounted at the front plate of the unit. It consists of the 20x4 LCD, LED indications, Keyboard circuits, LED controller and front RJ 45 communication port.

Controller PCB (640 262): The Controller PCB is mount on the backside of the Display PCB. This PCB consists of major components such as DSP controllers, ADC and its filter circuits, Memory ICs, RTC etc. The Analog signal get filtered and digitized in this board. The DSP takes decision based on this digital samples and initiates necessary commands.

Stack PCB (640 263): Internal communications between the PCB's are ensured with the help of stack PCB.

Status & CT,PT PCB (640 264): All the CTs, PTs and Input status lines are assembled in this board. IEC 60870-5-103 communication port also provided in this PCB.

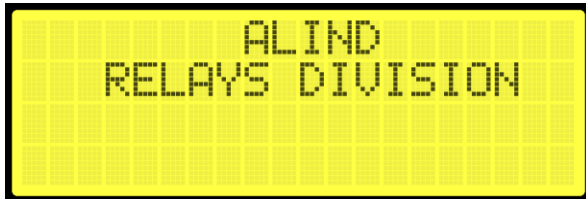
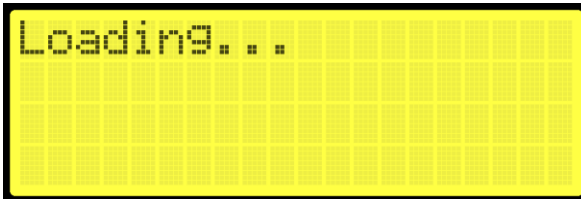
SMPS & Trip Relay PCB (640 265): The SMPS PCB provides the necessary Power supply voltages to the different PCBs mounted inside the relay. The SMPS provides +24V, +5V, -5V and isolated +5 V. The +24 V supply is used for the driving the output relays. The +5V and -5V is supplied to the controller PCB, Display PCB, and I/O PCB for normal operations. The isolated +5V is dedicated to the communications ports of the relay. This board (trip relay PCB) will give necessary trip commands to the master trip relay or breaker, which is installed in the yard. Necessary relay initiating signals are wired to these output relays from the Controller Board.

Tele Annu PCB (640 266): All the Telesignalling output circuits are assembled in this PCB. IRIG B circuit also provided in this PCB.

Back Panel PCB (640 267): This PCB consists of terminal blocks for external interface with the site and power connectors, which connects SMPS, I/O and CT PT PCB's. The RS 485 port is also mounted in this PCB. The terminal block (TB-A) is having CT shorting facility. Since the rack with Terminal Blocks is having the CT shorting facility, the relay can be withdrawn.

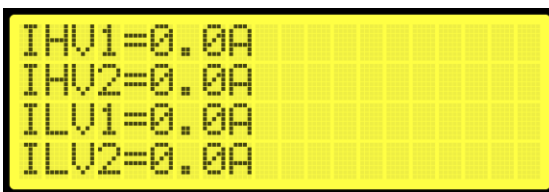
RELAY ONLINE DISPLAY PARAMETERS

After Power ON, the relay boot screen shows

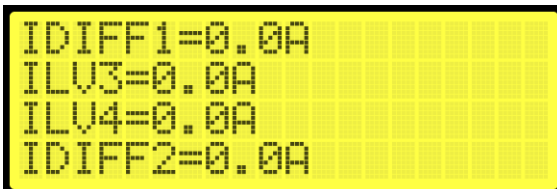


Then comes the online parameter display

Window 1:



Window 2:



To scroll between online displays, press **Right** key after holding \leftarrow key.

Setting Mode

Press and hold \leftarrow for 5 seconds

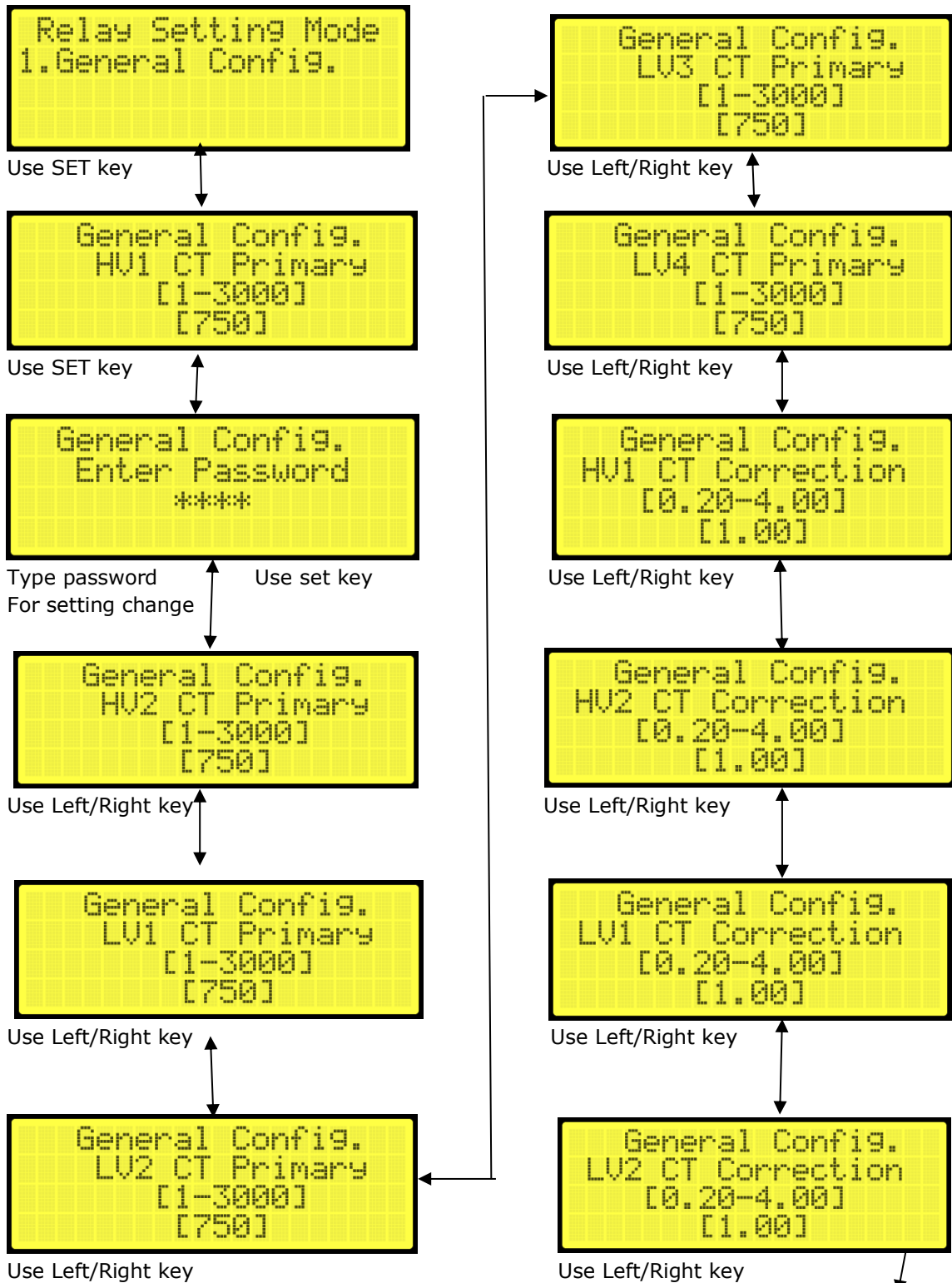
Relay will enter to setting mode.

Enter the password and press \leftarrow key. The default password setting is '1000'

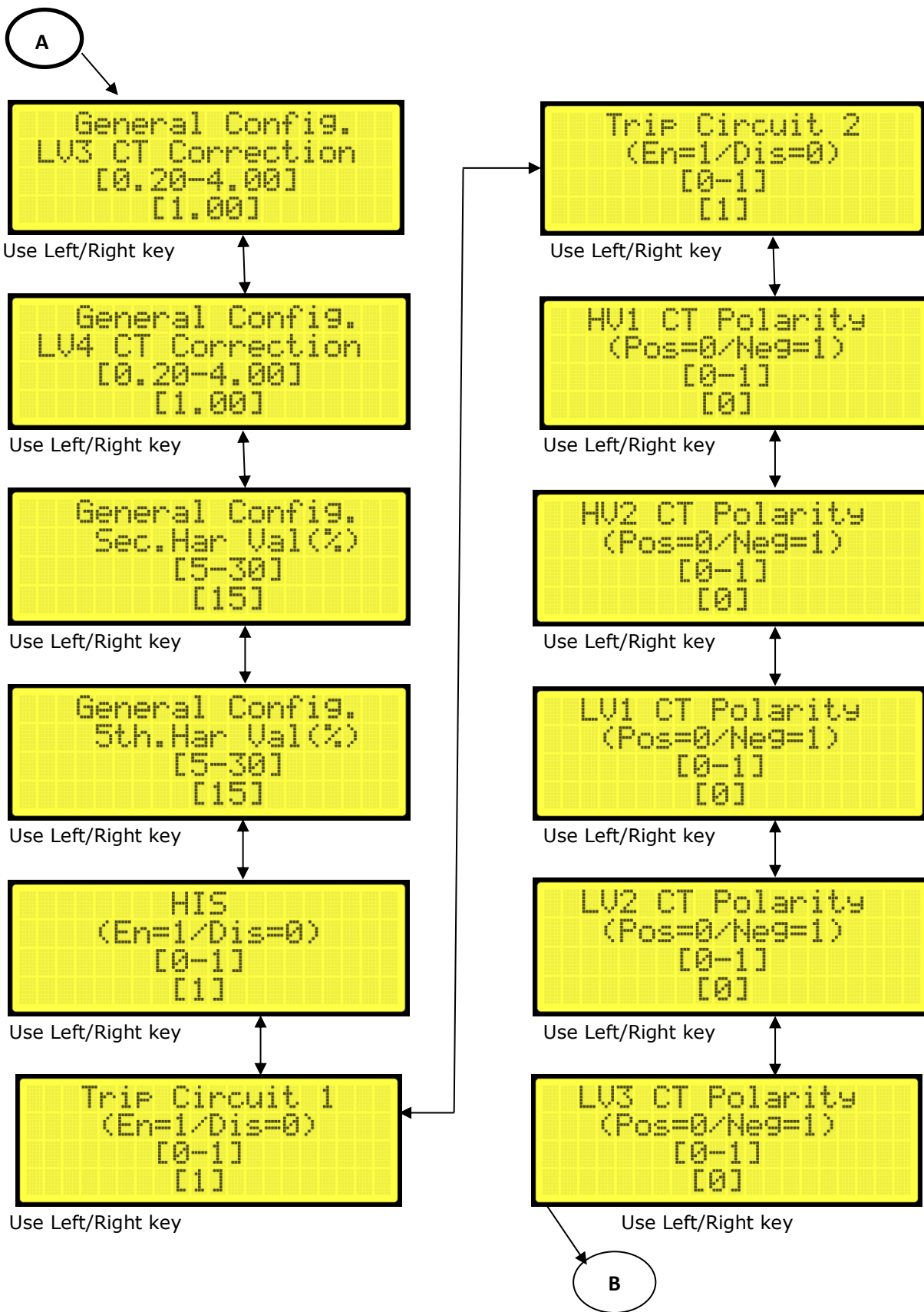
To change settings:

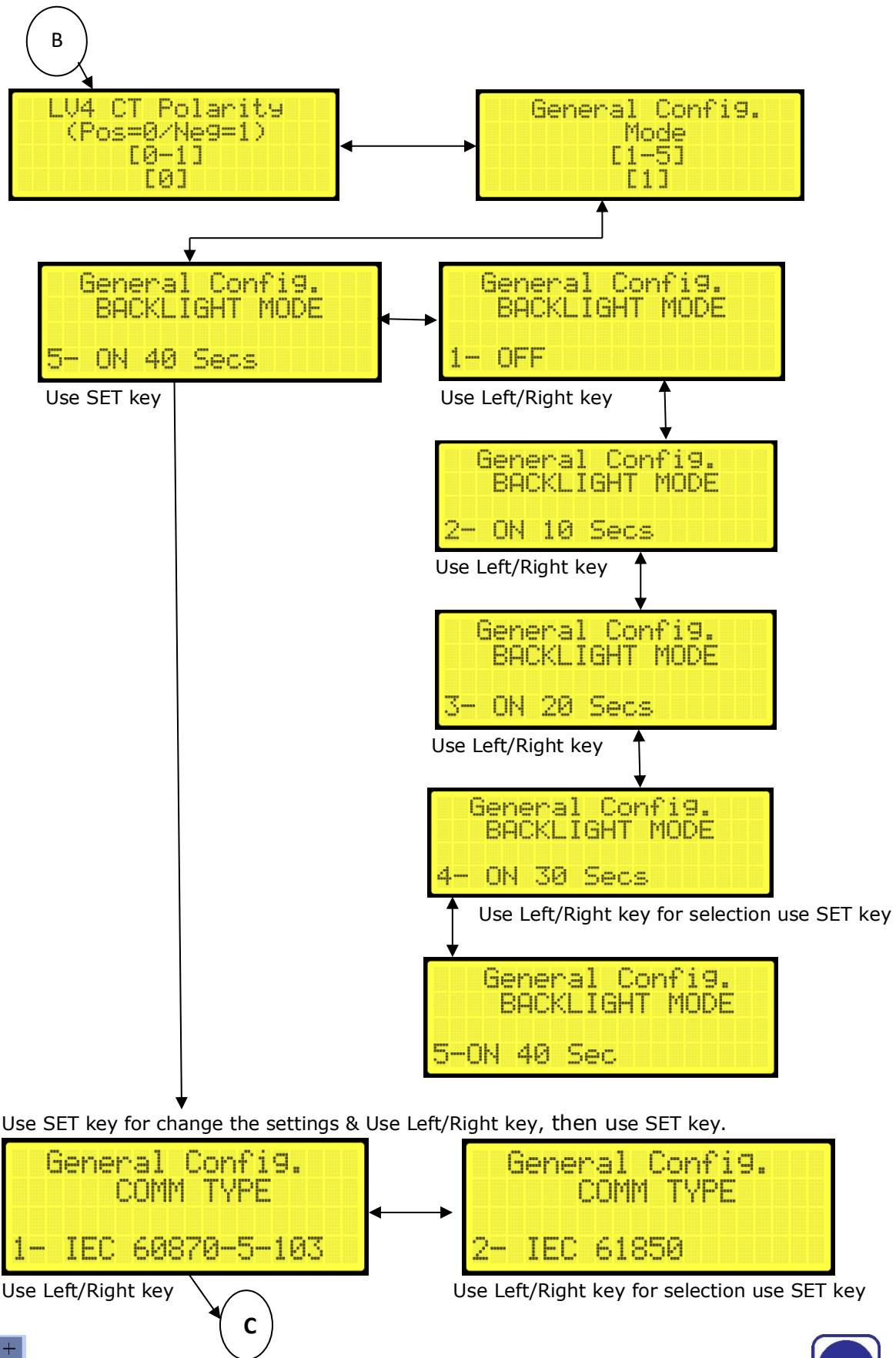
- a) Press \leftarrow to change the settings.
- b) Press **Right** key to increment
- c) Press **Left** key to decrement
- d) Press \leftarrow to accept change.
- e) To coming back to main **MENU** while operating, press **Left** and **Right** key simultaneously.
- f) Repeat the process for all settings
- g) After completing the settings, the relay shows the message '**SETTINGS UPDATED**' and returns to the operating mode.

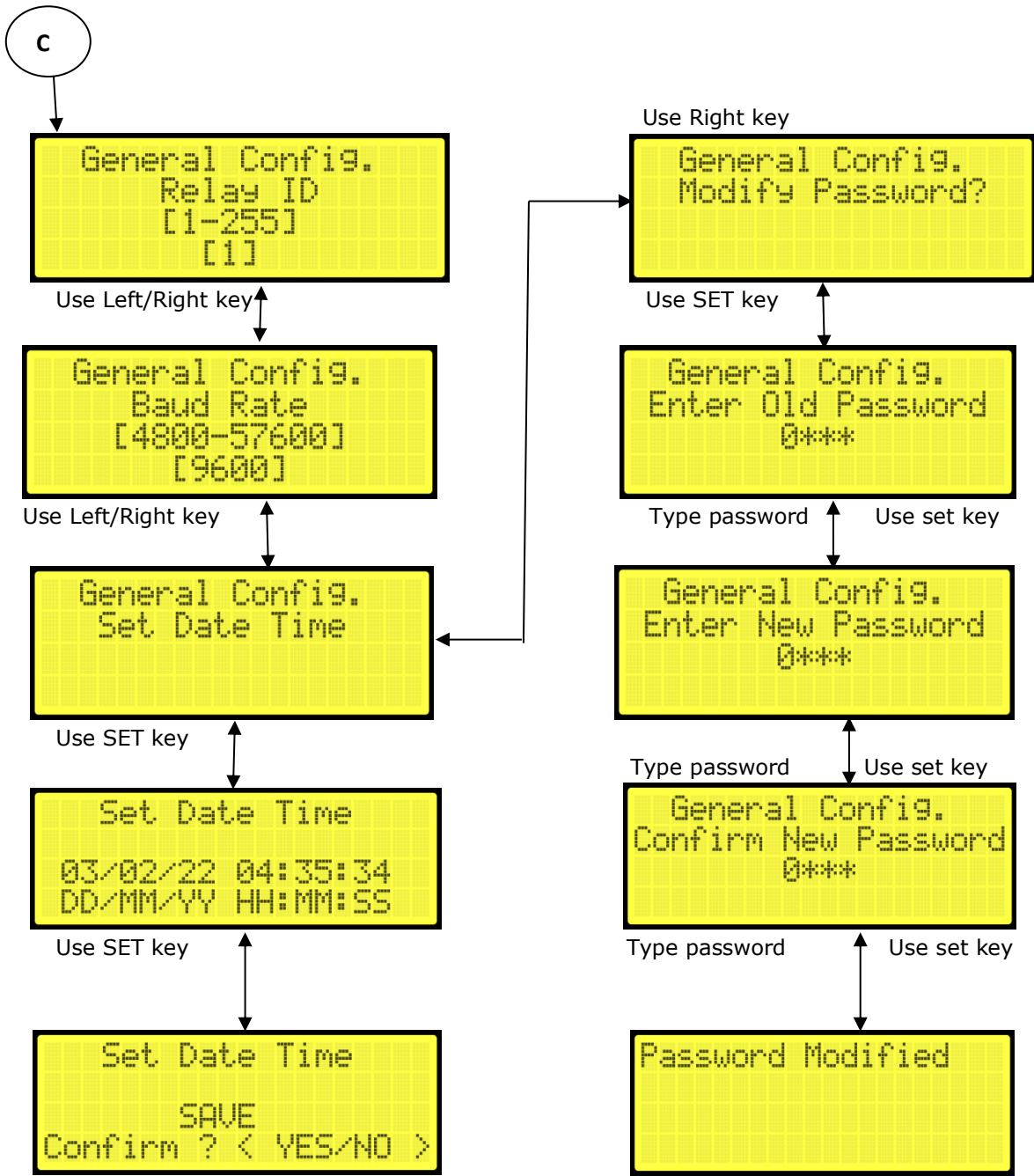
Relay Settings Algorithm



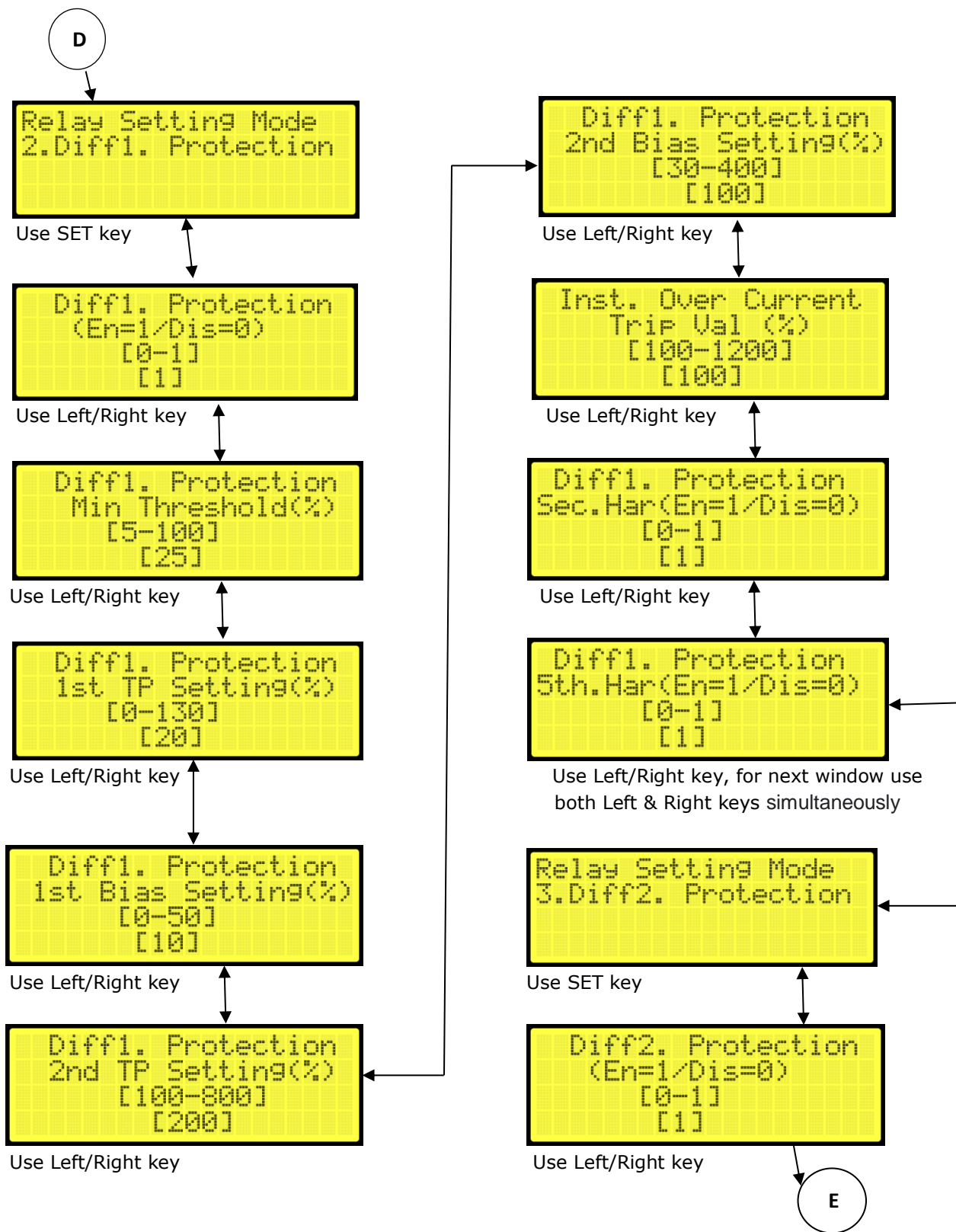
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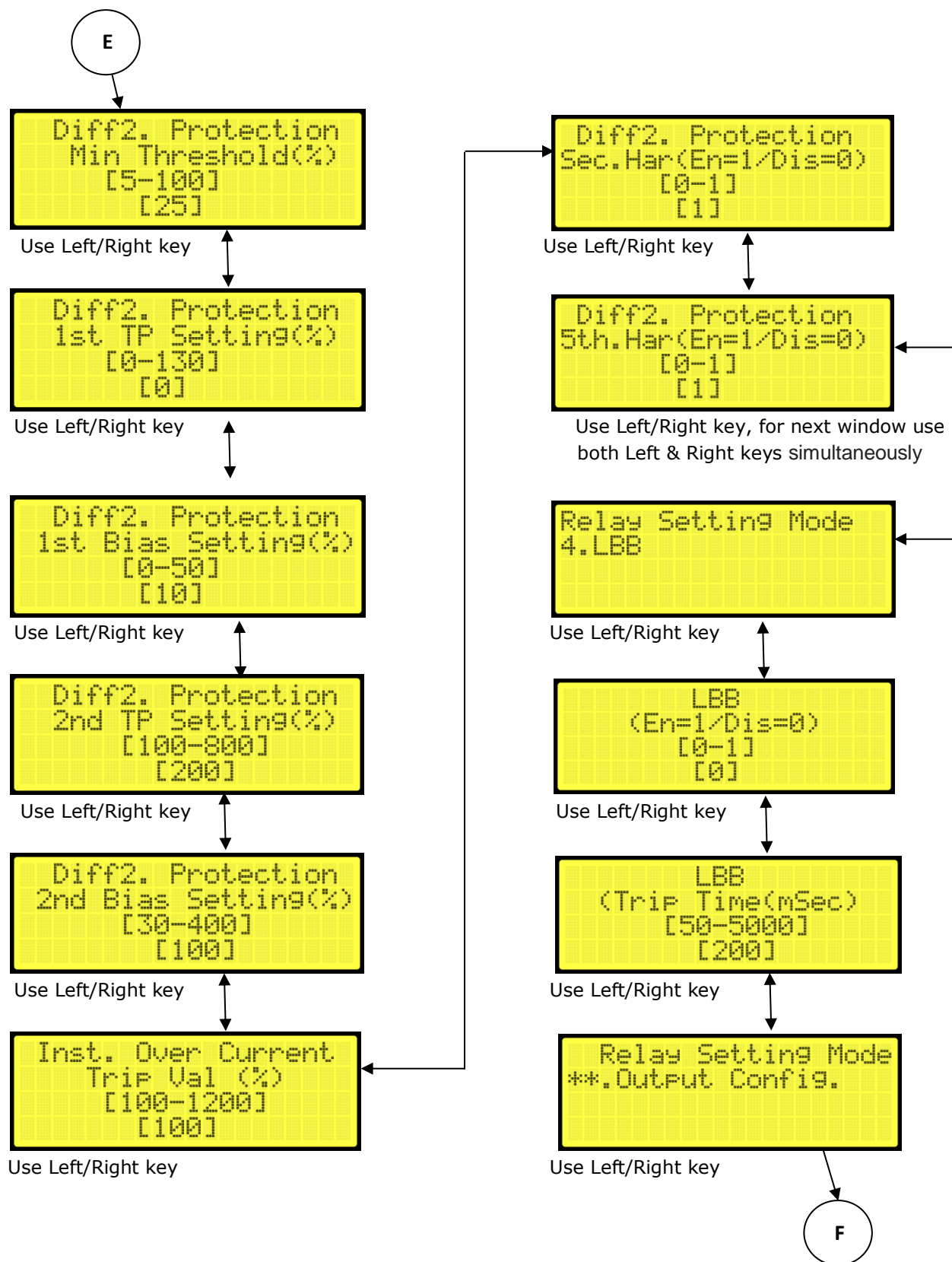






D
Use Left/Right key, for next window press both Left & Right keys simultaneously





To access & clear logs



Use this key

```
1.FAULT RECORDS
```

Use Set Key

```
FAULT RECORDS
FAULT ***
```

Use Set Key

```
*** Diff! Trip
IHU1=***.*A
IHU2=**.*A
DD/MM/YY HH:MM:SS
```

Use Right Key

```
*** Diff! Trip
ILU1=***.*A
ILU2=**.*A
DD/MM/YY HH:MM:SS
```

Use Right Key

```
*** Diff! Trip
IDIFF= ***.*A
Flt Clr Time= ***ms
DD/MM/YY HH:MM:SS
```

Use Set Key

```
2.COUNTERS
```

```
DIFF1=**** LBB=****
DIFF2=**** WT=****
BT=**** PRD=****
OT=**** HIS=****
```

Use Set Key

```
3.CLEAR RECORDS
```

Use Left/Right Key

```
3.CLEAR RECORDS
Confirm ? <YES/NO>
```

Use </> Key

```
4.EXIT
```

Use Set Key

To view device Info.



Use Right Key

```
Series Name: AN+
MODEL NO. AR**
SI No. *****
SW VER. *.**
```

For Relay healthiness check & I/O Verification



Use this key

```
1. DATE AND TIME
```

Use Set Key

```
DATE AND TIME
DD/MM/YY HH:MM:SS
```

Use Right Key

```
2. TEST MODE
```

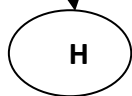
Use Set Key

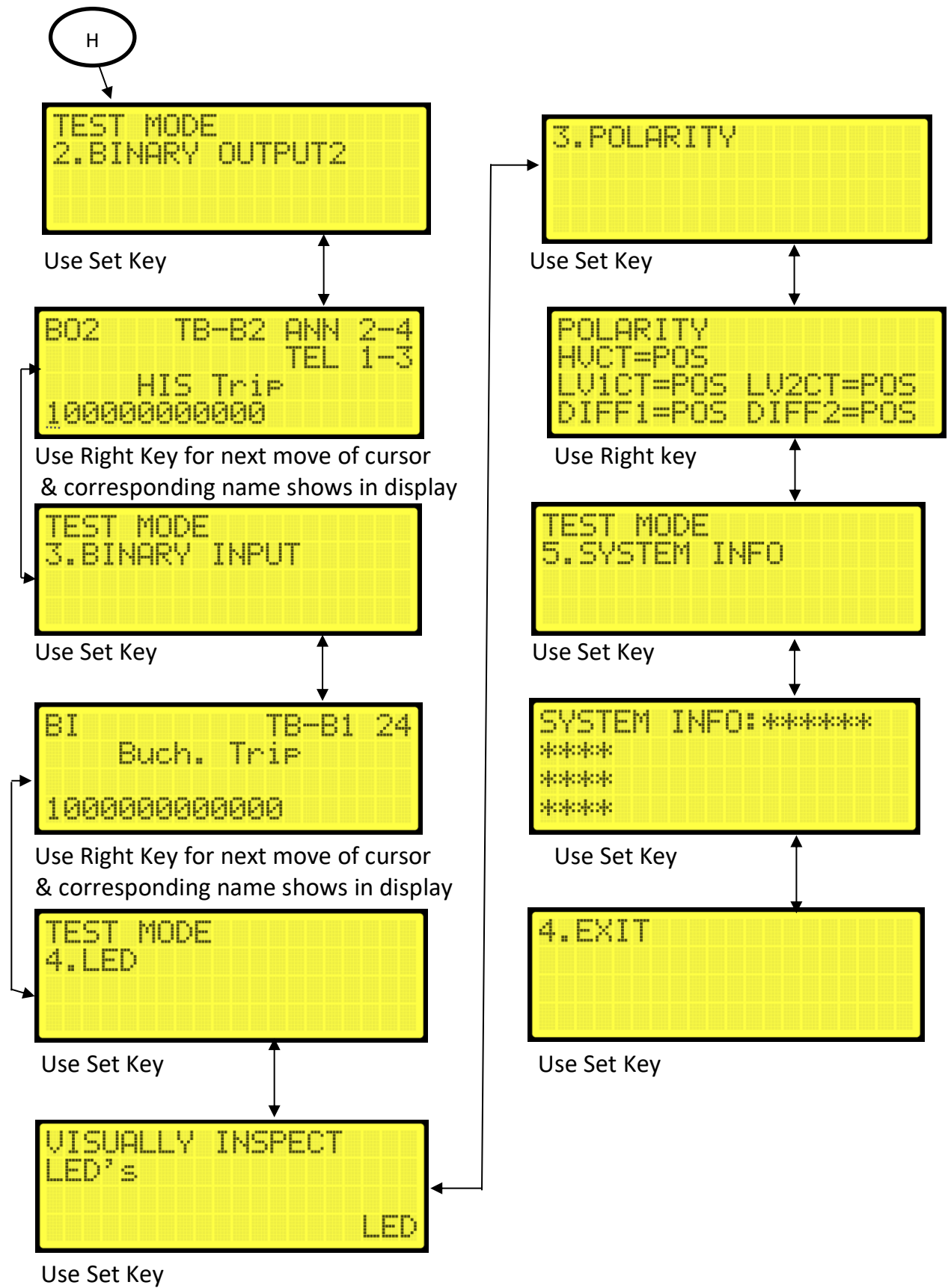
```
TEST MODE
1. BINARY OUTPUT1
```

Use Set Key & Enter password

```
B01 TB-A 8-21
Diff 1 Trip
000000000001
```

Use Right Key for next,
SET key for contact making

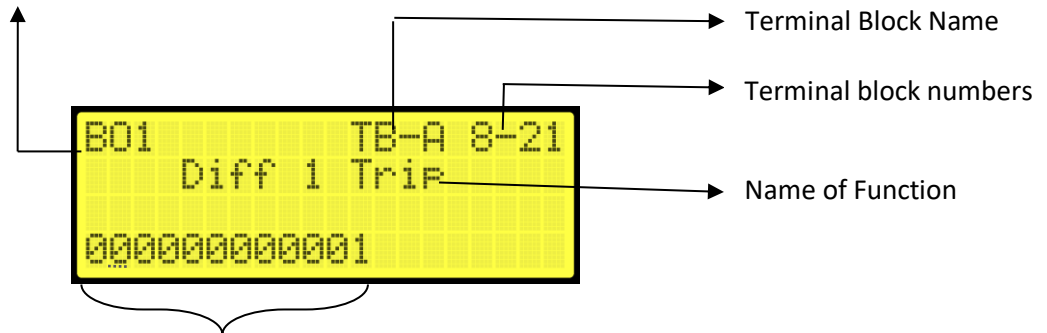




Binary Output & Input Details

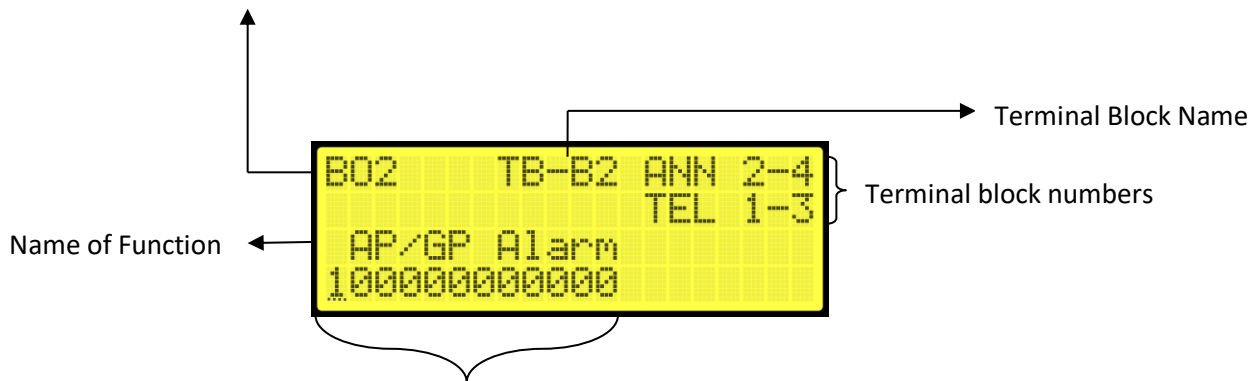
Binary Output 1			Binary Output 2			Binary Input		
BO1	NAME	TB NUMBER	BO2	NAME	TB NUMBER	BI	NAME	TB NUMBER
1	NIL		1	HIS Trip	TB B2 -1 & 3 , 2 & 4	1	Buch. Trip	TB B1- 24
2	Diff 1 Trip	TB A – 8 & 21	2	NIL		2	Wind. Temp Trip	TB B1- 21
3	Diff 2 Trip	TB A – 9 & 20	3	Buch. Alarm	TB B2 -1 & 7 , 2 & 8	3	PRD Trip	TB B1- 22
4	Diff 1 Spare	TB A – 10 & 19	4	Oil Temp Alarm	TB B2 -1 & 9 , 2 & 10	4	CB Open	TB B1- 19
5	Diff 2 Spare	TB A – 11 & 18	5	Wind. Temp Alarm	TB B2 -1 & 11 , 2 & 12	5	CB Close	TB B1- 20
6	LBB	TB A – 12 & 17	6	Low Oil level Alarm	TB B2 -1 & 13 , 2 & 14	6	RCC Reset	TB B1- 17
7	SPARE 1	TB A – 13 & 16	7	NIL		7	Oil Temp Trip	TB B1- 18
8	SPARE 2	TB A – 14 & 15	8	TCS	TB B2 -1 & 17 , 2 & 18	8	HIS /Oil Temp Alarm	TB B1- 15
9	Diff 1 Optd	TB B1 – 3 & 4	9	LBB	TB B2 -1 & 19 , 2 & 20	9	Buch. Alarm	TB B1- 16
10	Diff 2 Optd	TB B1 – 5 & 6	10	NIL		10	Wind. Temp Alarm	TB B1- 13
11	SPARE 3	TB B1 – 7 & 8	11	Diff 1 Optd	TB B2 -23 & 7 , 2 & 24	11	Low Oil level Alarm	TB B1- 14
12	Relay Error	TB B1 – 1 & 2	12	Diff 2 Optd	TB B2 -1 & 25 , 2 & 26	12	TCS 1	TB B1- 11 & 12
						13	TCS 2	TB B1- 9 & 10

Binary Output 1



Binary Output Contacts. Use Left</>Right key for selecting previous or next contact & moving cursor also change the corresponding name in display. For make & reset contact use SET (↵) key.

Binary Output 2

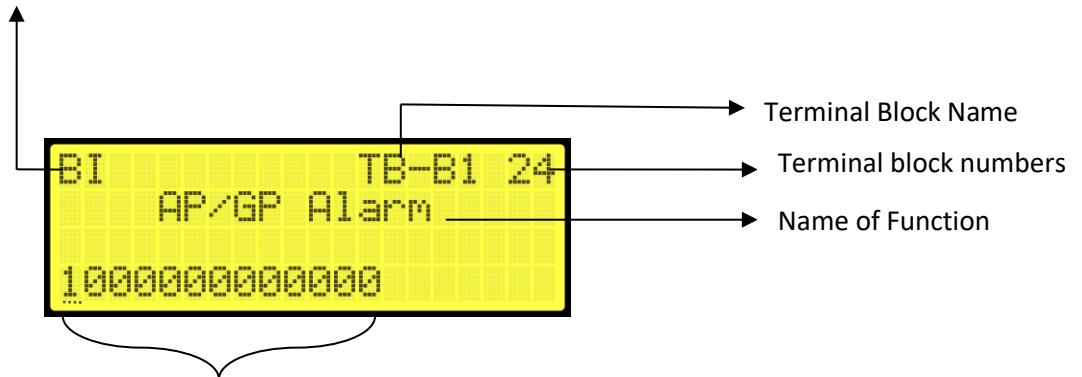


Binary Output Contacts. Use left</>Right key for selecting previous or next contact & moving cursor also change the corresponding name in display. For make & reset contact use SET (↵) key.

NOTE: TB B2 – 1 TELE COMMON (+110Vdc)

TB B2 – 2 ANNU COMMON (+ve common from annunciator)

Binary Input



Use left</>Right key for selecting previous or next contact & moving cursor also change the corresponding name in display. When 110 DC (-ve) permanently supplied to the TB-B1-23 as status common and 110 DC (+ve) is given to the status pulse corresponding TB numbers in TB-B1.

TECHNICAL DATA & CHARACTERISTIC CURVES

CONTENTS

DESCRIPTION OF PROTECTION FUNCTIONS

TECHNICAL SPECIFICATIONS

GENERAL SETTINGS

TB DETAILS

SETTING GUIDELINES

RELAY CONFORMING STANDARDS

DESCRIPTION OF PROTECTION FUNCTIONS

RELAY CHARACTERISTICS

I) Biased differential protection.

Percentage biased differential protection ensures insensitivity to all external faults, including the most severe.

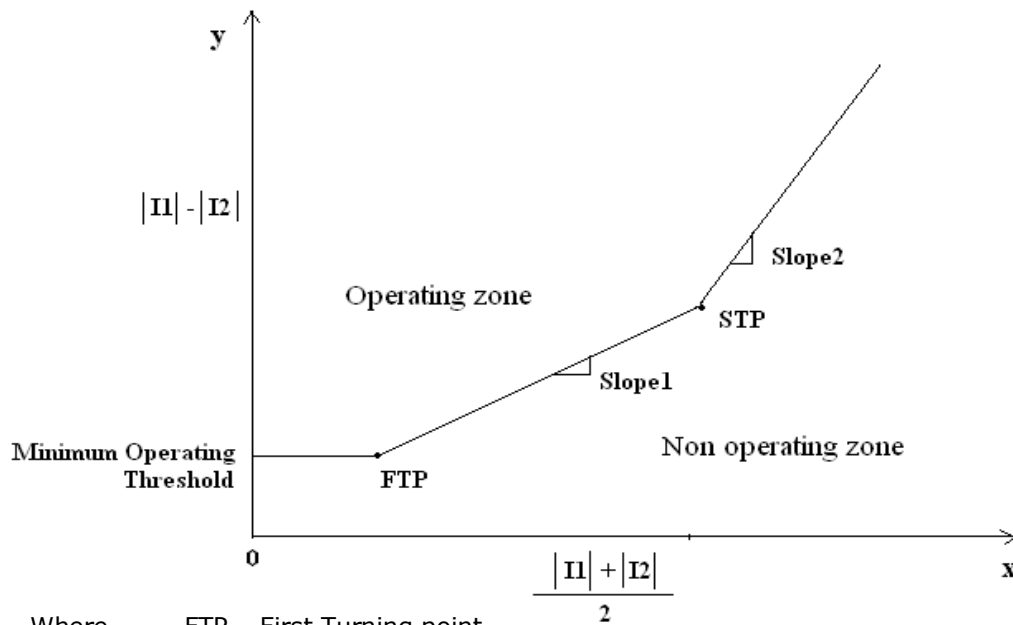
II) Dual slope characteristics

The basic principle of operation involves the comparison of currents at the terminal of the unit to be protected. The relay measures the HV current (I1) and LV current (I2) of the Transformer through the bushing CTs and calculates the Differential current ΔI ($I1 - I2$) and the bias current $((I1 + I2)/2)$. The relay is having dual slope characteristics with bias setting. The relay provide trip command when

$$|I1 - I2| \geq S | (I1 + I2) / 2 |$$

Where S = set bias

BIAS CHARACTERISTICS



Where FTP – First Turning point
STP – Second Turning point

III) Trip Circuit Supervision

Relay consists of two numbers of trip circuit supervisions (Post close and pre close). The relay continuously monitors the tripping coil DC (110V -ve) supply through the NC or NO contacts of the Circuit breaker in both open & closed condition. If any discontinuity is observed, the relay generates alarm signal.

TECHNICAL DETAILS

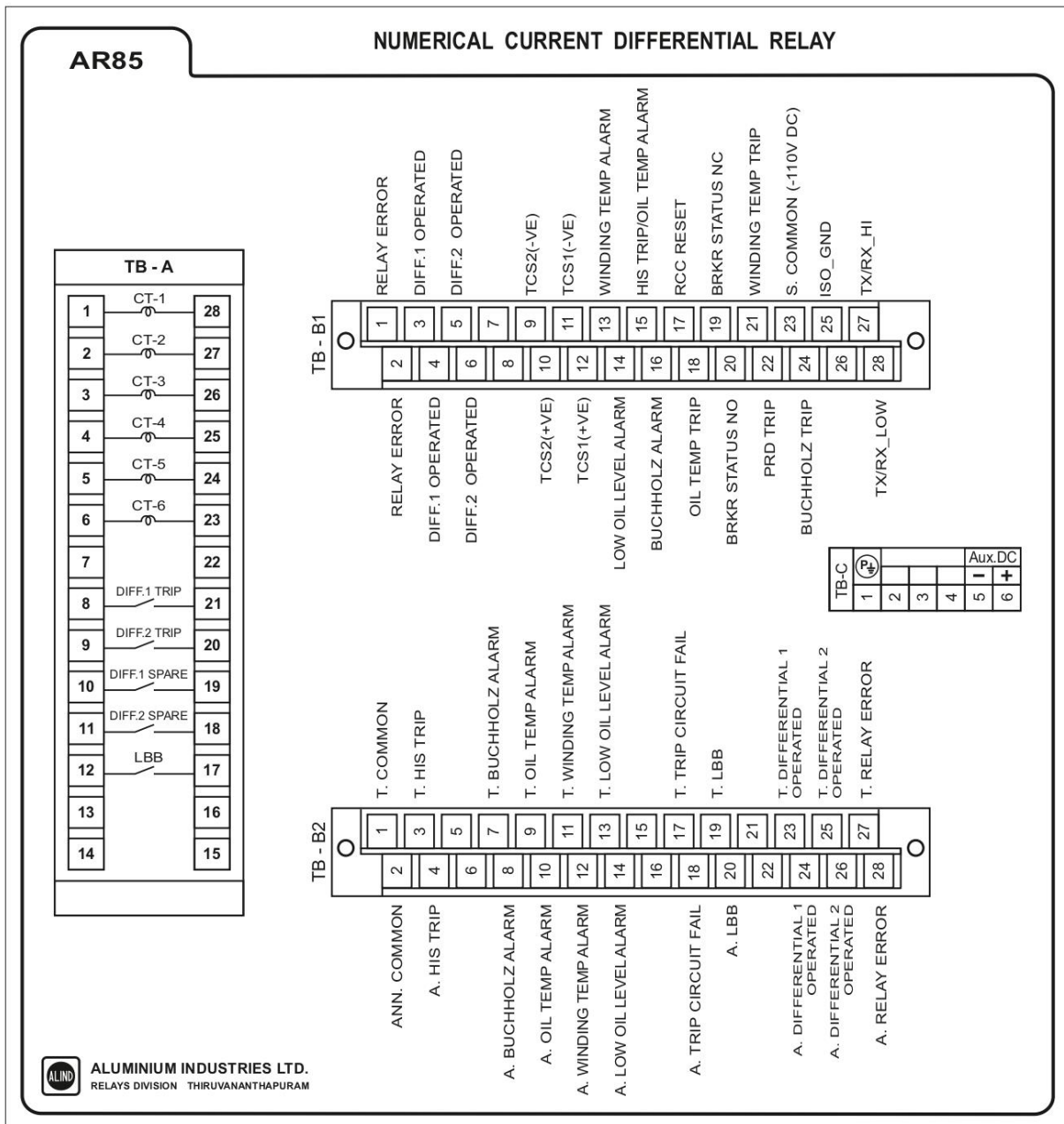
Sl. No	Specification	REF.	Particulars
1.	Auxiliary Supply	V _{DC}	35 to 260 VDC
2.	Current Input(rated)	In	5 Amps
3.	Frequency	Fn	50 Hz
4.	VA burden on CT		Less than 0.5 VA
5.	VA burden on Aux		Less than 15 Watts (for energized condition)
			Less than 10 Watts (for De-energized condition)
6.	Operating Temp Range		-25°C to + 55 °C
7.	Max. & Minimum relative humidity		5% to 95%
8.	Continuous Current Carry Capacity of CT		4In; 20 A
9.	Thermal Withstand for CT		100In for 1 sec
10.	Contact details		
	a) Current carrying capacity		Continuously ≥ 5 Amps at 110 V DC Short time ≥30 Amps for 200 ms at 110 V DC
	b) Making capacity at 110V DC		≥ 1000 W at L/R = 40ms
	c) Breaking Capacity at 110V DC		≥ 30 W at L/R = 40ms
11.	Trip Circuit Test		Yes / No
12.	Type of communication ports		RJ 45 and RS485
13.	Overall dimensions		
	Width		263 mm
	Height		173 mm
	Depth		300 mm
14.	Weight		5.6 kg approx.

RELAY SETTINGS

General Settings	Particulars
Password protection (YES/NO)	0000-9999
1) General Configuration	
HV CT1 Primary	1-3000 in steps of 1
HV CT2 Primary	1-3000 in steps of 1
LV CT1 Primary (For Diff1)	1-3000 in steps of 1
LV CT2 Primary (For Diff1)	1-3000 in steps of 1
LV CT3 Primary (For Diff2)	1-3000 in steps of 1
LV CT4 Primary (For Diff2)	1-3000 in steps of 1
HV CT1 correction factor	0.50-4.00 in steps of 0.01
HV CT2 correction factor	0.50-4.00 in steps of 0.01
LV CT1 correction factor	0.50-4.00 in steps of 0.01
LV CT2 correction factor	0.50-4.00 in steps of 0.01
LV CT3 correction factor	0.50-4.00 in steps of 0.01
LV CT4 correction factor	0.50-4.00 in steps of 0.01
HIS trip	(EN/DIS)
Second Harmonics value	5-30 in steps of 1
Fifth Harmonics value	5-30 in steps of 1
Trip Circuit Supervision 1	(EN/DIS)
Trip Circuit Supervision 2	(EN/DIS)
HV CT1 Polarity	Pos. - 0/ Neg. - 1
HV CT2 Polarity	Pos. - 0/ Neg. - 1
LV CT1 Polarity	Pos. - 0/ Neg. - 1
LV CT2 Polarity	Pos. - 0/ Neg. - 1
LV CT3 Polarity	Pos. - 0/ Neg. - 1
LV CT4 Polarity	Pos. - 0/ Neg. - 1
Post fault cycles	0 to 5 in steps of 1
Back light time	1 - OFF 2 - 10S 3 - 20S 4 - 30S 5 - 40S
Communication type	1 - IEC 60870-5-103 2 - IEC 61850
Relay ID	1-255 in steps of 1
Baud Rate	4800-57600 in steps of 200

Set Date & Time	DD MM YYYY HH MM SS
Modify Password	
2) Differential Protection 1	
i) Minimum Operating Threshold (Pick up)	5 to 100 in steps of 1
ii) First turning point	0 to 130 in steps of 1
iii) Bias Setting	0 to 50 in steps of 1
iv) Second turning point	100 to 800 in steps of 10
v) 2 nd Bias Setting	30 to 400 in steps of 10
vi) Instantaneous OCR	100 to 1200 in steps of 100
vii) 2 nd Harmonic Blocking Feature	EN/DIS
viii) 5 th Harmonic Blocking Feature	EN/DIS
3) Differential Protection 2	EN/DIS
i) Minimum Operating Threshold (Pick up)	5 to 100 in steps of 1
ii) First turning point	0 to 130 in steps of 1
iii) Bias Setting	0 to 50 in steps of 1
iv) Second turning point	100 to 800 in steps of 10
v) 2 nd Bias Setting	30 to 400 in steps of 10
vi) Instantaneous OCR	100 to 1200 in steps of 100
vii) 2 nd Harmonic Blocking Feature	EN/DIS
viii) 5 th Harmonic Blocking Feature	EN/DIS
LBB	(EN/DIS)
LBB TIME	0-5000 in steps of 1

TB DETAILS



RELAY CONFORMING STANDARDS

The relay conforms to the following standards:

SI No.	Standards	Description
I.	IEC 60255-151	FUNCTIONAL REQUIREMENTS FOR OVER/UNDER CURRENT PROTECTION.
II.	IEC 60255-5	INSULATION COORDINATION OF MEASURING RELAYS AND PROTECTION EQUIPMENT- REQUIREMENTS AND TESTS.
III.	IEC 60255-1	MEASURING RELAYS AND PROTECTION EQUIPMENT- COMMON REQUIREMENTS.
IV.	IEC 60255-21-1	VIBRATION TESTS (SINUSOIDAL)
V.	IEC 60255-21-2	SHOCK AND BUMP TESTS
VI.	IEC 60255-21-3	SEISMIC TESTS
VII.	IEC 60255-27	PRODUCT SAFETY REQUIREMENT.
VIII.	IEC 60255-26	ELECTROMAGNETIC COMPATIBILITY REQUIREMENT.
IX.	IEC 60529	DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP CODE)
X.	IEC 61810-2	RELIABILITY.
XI.	IS 2705 (PART II, III&IV)	PROTECTIVE CURRENT TRANSFORMERS.
XII.	IS 3231 (PART 1 TO 3)	ELECTRICAL RELAYS FOR POWER SYSTEM PROTECTION.
XIII.	IS 8686	STATIC PROTECTIVE RELAYS.
XIV.	IEC 60068-2	ENVIRONMENTAL TESTS.
XV.	IEC 60870-5-103	COMMUNICATION PROTOCOL

TROUBLE SHOOTING

Under normal working conditions, the 'PROTECTION HEALTHY LED' provided in the front panel of the relay glows green. The same LED turns amber to recognize any fault inside the relay itself.

Following are certain guidelines for the relay to identify the nature of fault and necessary checking procedures to be adopted at site so that relay can be rectified suitably.

Sl. No.	Faults	Checks	Causes
1	No power ON Indication or No display.	1. Check the auxiliary DC supply to the relay rear terminals 2. Check the continuity of the output terminal, after disconnecting the wires.	1. Due to power supply failure, the LED turns off. 2. The varistor may short circuited to protect internal circuitry on transients
2	Current Not reading/ Out of tolerance limit.	1. Refer TB sticker for CT inputs. 2. Check for the earthing of CT. 3. Check if the terminals of TB-A is connected properly or for any loose contact. 4. Check CT ratio and multiplying factor if any. 5. Check the continuity of the output terminal, after disconnecting the wires. After checking of the above, measure the current using calibrated Clamp-On meter. If not OK, intimate to works.	1. The CT connector is having shorting facility. If the connector is not tight, CT secondary may get some low resistance path through the connector itself. 2. If CT is not properly earthed, there is a chance of leakage current that may cause error in CT reading.
4	Relay Error Indication	1. Intimate to works. 2. Press H.RST key in the relay front panel.	1. Supply variation to internal PCB's. 2. DC supply fail.

**SCADA COMMUNICATION INTERFACE AS PER IEC
60870-5-103 PROTOCOL**

VERSION 1.00

TYPE – AR 85

**RELAY DESIGNED AS PER RDSO SPECIFICATION NO.
TI/SPC/PSI/PROTCT/7101**



**ALUMINIUM INDUSTRIES LIMITED
RELAYS DIVISION**

PROTOCOL MAPPING**SYSTEM FUNCTIONS IN MONITOR DIRECTIONS**

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
End of general interrogation	-	8	255	0	10	GLB
Time synchronization	-	6	255	0	8	GLB
Reset FCB	-	5	176	2	3	According to main FUN
Reset CU	-	5	176	3	4	According to main FUN
Reset CU/Start/Restart	-	5	176	4	5	According to main FUN

STATUS INDICATIONS IN MONITOR DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
Protection Healthy/Active	-	1	176	18	1	↑↓
RCC Reset	-	1	176	19	1	↑
Local Parameter Settings (Change)	-	1	176	22	1	↑
Buchholz Trip	X	1	176	27	1,9	↑↓
Oil Temp. High Trip	X	1	176	28	1,9	↑↓
Winding Temp Trip	X	1	176	29	1,9	↑↓
PRD Trip	X	1	176	30	1,9	↑↓
Buchholz Alarm	X	1	176	200	1,9	↑↓
Winding Temp Alarm	X	1	176	201	1,9	↑↓
Low Oil Level Alarm	X	1	176	202	1,9	↑↓
Oil Temp High Alarm	X	1	176	31	1,9	↑↓
HIS closed	X	1	176	32	1,9	↑↓
CB NC (FDR CB OPEN)	X	1	176	124	1,9	↑↓
CB NO (FDR CB CLOSE)	X	1	176	125	1,9	↑↓
Relay Error	-	1	176	40	1	↑

SUPERVISION INDICATIONS IN MONITOR DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
Trip circuit supervision	X	1	176	36	1,9	↑↓

FAULT INDICATIONS IN (MONITOR DIRECTIONS)

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
Start/Pickup Diff. Relay 1	X	2	176	94	1,9	↑↓
Start/Pickup Diff. Relay 2	X	2	176	95	1,9	↑↓
Start/pickup Inst OCR 1	X	2	176	100	1,9	↑↓
Start/Pickup Inst OCR 2	X	2	176	101	1,9	↑↓
Trip Differential Relay 1	-	2	176	69	1	↑↓
Trip Differential Relay 2	-	2	176	70	1	↑↓
Trip Instantaneous OCR 1	-	2	176	90	1	↑↓
Trip Instantaneous OCR 2	-	2	176	91	1	↑↓
LBB	X	2	176	85	1	↑↓

MEASURANDS IN MONITOR DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT
Measurand supervision HV CT1	-	9	176	148	2
Measurand supervision HV CT2	-	9	176	149	2
Measurand supervision LV CT1	-	9	176	150	2
Measurand supervision LV CT2	-	9	176	151	2
Measurand supervision LV CT3	-	9	176	152	2
Measurand supervision LV CT4	-	9	176	153	2

TIME TAGGED MEASURANDS IN MONITOR DIRECTIONS

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT
Fault Current HV CT1	-	4	176	154	1
Fault Current HV CT2	-	4	176	155	1
Fault Current LV CT1	-	4	176	156	1
Fault Current LV CT2	-	4	176	157	1
Fault Current LV CT3	-	4	176	158	1
Fault Current LV CT4	-	4	176	159	1
Differential Current 1	-	4	176	170	1
Differential Current 2	-	4	176	171	1

STANDARD INFORMATION NUMBERS IN CONTROL DIRECTION**SYSTEM FUNCTIONS IN CONTROL DIRECTION**

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
Initiation of general interrogation	-	7	255	0	9	GLB
Time Synchronization	-	6	255	0	8	GLB

GENERAL COMMANDS IN CONTROL DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
LED (RCC) RESET	-	20	176	19	20	↑ (PULSE)
RCC TRIP	-	20	176	124	20	↑↓ (PULSE)
RCC CLOSE	-	20	176	125	20	↑↓ (PULSE)

ANALOG CHANNEL INFORMATION IN AR 85

AR 85		
FUN	ACC	PARAMETER
176	1	HV CT1
176	2	HV CT2
176	3	LV CT1
176	4	LV CT2
176	5	X
176	6	X
176	7	X
176	8	X
176	64	LV CT3
176	65	LV CT4


DIGITAL CHANNEL (TAGS) INFORMATION IN AR 85

AR 85			
TAG POSITION	FUN/INF NUMBER	SEMANTICS ACCORDING TO TAG POSITION	INPUT/OUTPUT
0	176/84	GENERAL PICKUP	OUTPUT
1	176/68	GENERAL TRIP	OUTPUT
2	176/69	DIFF. TRIP 1 OPERATED	OUTPUT
3	176/70	DIFF. TRIP 2 OPERATED	OUTPUT
4	176/90	INST. OCR 1 I> TRIP	OUTPUT
5	176/91	INST. OCR 2 I> TRIP	OUTPUT
6	176/85	LBB TRIP	OUTPUT
7	176/27	BUCHHOLZ TRIP	INPUT
8	176/28	OIL TEMP. HIGH TRIP	INPUT
9	176/29	WINDING TEMP. TRIP	INPUT
10	176/30	PRD TRIP	INPUT
11	176/32	HIS CLOSED	INPUT
12	176/124	CB NC (OPEN)	INPUT
13	176/125	CB NO (CLOSE)	INPUT
14	176/19	RCC RESET	INPUT
15	176/200	BUCHHOLZ ALARM	INPUT
16	176/201	WINDING TEMP HIGH ALARM	INPUT
17	176/202	LOW OIL LEVEL ALARM	INPUT
18	176/31	OIL TEMP ALARM	INPUT
19	176/36	TRIP CIRCUIT SUPERVISION	INPUT

Model Implementation Conformance Statement
for the IEC 61850 interface in ALIND AR 85 relay version 1.0

Based on
UCA International Users Group
Testing Sub Committee

Template version 1.0
Date: April 24, 2008

TITLE: MICS DOCUMENT FOR AR 85 RELAY	MICS Ver.	1.0
	DATE: 22 SEPTEMBER 2021	
	ALUMINIUM INDUSTRIES LTD RELAYS DIVISION, THIRUVANANTHAPURAM	

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1. Introduction

This model implementation conformance statement is applicable for ALIND AR 85 relay. The definitions of all used Logical Devices, Logical Nodes and their associated Common Data Classes, components and associated enumerated values are also included for completeness.

This MICS document specifies the modelling including extensions compared to IEC 61850 Edition 2.

2. Logical Device

Logical Device	Description
CONTROL	Controls Domain
MEASUREMENT	Measurements Domain
PROTECTION	Protection Domain
RECORDS	Fault Records Domain
SYSTEM	System Domain

Logical Device data model

Logical Device	Logical Node Instance	Logical Node type	Description
CONTROL	LLN0	LLN01	LLN0 for Logical Device CONTROL
	CNTRL_GGIO1	GGIO_DIFF_3C	IED control 3 nos.
MEASUREMENT	LLN0	LLN02	LLN0 for Logical Device MEASURAND
	MTR_STD_MMXN1	MMXN_DIFF_MTR1	Measurand Value IHV1, IHV2, ILV1, ILV2
	MTR_EX_MMXN2	MMXN_DIFF_MTR2	Measurand Value ILV3, ILV4
	FLT_STD_MMXN3	MMXN_DIFF_FLT1	Fault Value IHV1, IHV2, ILV1, ILV2, DIFFERENTIAL 1
	FLT_EX_MMXN4	MMXN_DIFF_FLT2	Fault Value ILV3, ILV4, DIFFERENTIAL 2
PROTECTION	LLN0	LLN03	LLN0 for Logical Device PROTECTION
	DIFF1_PDIF1	PDIF_DIFF	Differential Protection 1
	DIFF2_PDIF2	PDIF_DIFF	Differential Protection 2
	IOC1_PIOC1	PIOC_DIFF	Instantaneous OCR 1
	IOC2_PIOC2	PIOC_DIFF	Instantaneous OCR 2
RECORDS	LLN0	LLN04	LLN0 for Logical Device RECORDS
	RDRE1	RDRE_DIFF	Disturbance recorder
SYSTEM	LLN0	LLN05	LLN0 for Logical Device SYSTEM
	LPHD	LPHD_GENERAL	Physical Device Information
	ALM_GGIO1	GGIO_DIFF_ALM3	Alarms
	IND_GGIO2	GGIO_DIFF_BI13	Binary Inputs

3. Logical Node List

Following list contains list of logical node classes implemented in device

G: Logical Nodes for generic references	
GGIO (Generic Process I/O)	
L: System Logical Nodes	
LLNO (Logical device LN)	
LPHD (Physical device LN)	
M: Logical Nodes for metering and measurement	
MMXN (Non-Phase Related Measurements)	
P: Logical Nodes for protection functions	
PDIF (Differential)	
PIOC (Instantaneous Overcurrent)	
R: Logical nodes for protection related functions	
RBRF (Breaker Failure)	
RDRE (Disturbance Recorder Function)	

4. Logical Nodes

The following table use

- M: Data object is mandatory in the IEC 61850-7-4 ED.2.
- O: Data object is optional in the IEC 61850-7-4 ED.2 and is used in the device
- E: Data object is extension to the IEC 61850-7-4 ED.2 and is used in the device

4.1 Logical Node: GGIO_DIFF_3C

Description: Generic Process I/O

LN Class: GGIO

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Controls			
SPCSO1	SPC	Generic single point controllable status output (RCC Reset)	O
SPCSO2	SPC	Generic single point controllable status output (CB Open Command)	O
SPCSO3	SPC	Generic single point controllable status output (CB Close Command)	O

4.2 Logical Node: GGIO_DIFF_ALM3

Description: Generic Process I/O

LN Class: GGIO

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Status Information			
Alm1	SPS	General Single Alarm (Protection Healthy/Active)	O
Alm2	SPS	General Single Alarm (Local Parameter Setting change)	O
Alm3	SPS	General Single Alarm (Relay Error)	O

4.3 Logical Node: GGIO_DIFF_BI13

Description: Generic Process I/O

LN Class: GGIO

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Status Information			
Ind1	SPS	General Indication (RCC Reset)	O
Ind2	SPS	General Indication (Buchholz Trip)	O
Ind3	SPS	General Indication (Oil Temp High Trip)	O
Ind4	SPS	General Indication (Winding Temp. High Trip)	O
Ind5	SPS	General Indication (PRD Trip)	O

Ind6	SPS	General Indication (Buchholz Alarm)	O
Ind7	SPS	General Indication (Winding Temp Alarm)	O
Ind8	SPS	General Indication (Low Oil Level Alarm)	O
Ind9	SPS	General Indication (Oil Temp High Alarm)	O
Ind10	SPS	General Indication (HIS closed)	O
Ind11	SPS	General Indication (CB NO status)	O
Ind12	SPS	General Indication (CB NC status)	O
Ind13	SPS	General Indication (Trip Circuit Supervision)	O

4.4 Logical Node: LLN01

Description: Logical Node Zero (Logical Node for Logical Device CONTROL)

LN Class: LLN0

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Mod	ENC	Mode	M
Health	ENS	Health	M
NamPlt	LPL	Name Plate	M

4.5 Logical Node: LLN02

Description: Logical Node Zero (Logical Node for Logical Device MEASUREMENT)

LN Class: LLN0

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Mod	ENC	Mode	M
Health	ENS	Health	M
NamPlt	LPL	Name Plate	M

4.6 Logical Node: LLN03

Description: Logical Node Zero (Logical Node for Logical Device PROTECTION)

LN Class: LLN0

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Mod	ENC	Mode	M
Health	ENS	Health	M
NamPlt	LPL	Name Plate	M

4.7 Logical Node: LLN04**Description:** Logical Node Zero (Logical Node for Logical Device RECORDS)**LN Class:** LLN0

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Mod	ENC	Mode	M
Health	ENS	Health	M
NamPlt	LPL	Name Plate	M

4.8 Logical Node: LLN05**Description:** Logical Node Zero (Logical Node for Logical Device SYSTEM)**LN Class:** LLN0

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Mod	ENC	Mode	M
Health	ENS	Health	M
NamPlt	LPL	Name Plate	M

4.9 Logical Node: LPHD_DIFF**Description:** Physical Device Information**LN Class:** LPHD

Data Object	CDC type	Description	M/O
Descriptions			
PhyNam	DPL	Device Name Plate	M
Status Information			
PhyHealth	ENC	Device Health	M
Proxy	ENS	Indicates if this Logical Node is Proxy	M

4.10 Logical Node: MMXN_DIFF_MTR1**Description:** Non-Phase Related Measurement (Metering Values Standard Differential)**LN Class:** MMXN

Data Object	CDC type	Description	M/O/E
Common Logical Node Information			
Beh	ENS	Behavior	M
Measured and Metered Values			
Amp1	MV	HV Measurand Current IHV1	E
Amp2	MV	HV Measurand Current IHV2	E
Amp3	MV	LV Measurand Current ILV1	E
Amp4	MV	LV Measurand Current ILV2	E

4.11 Logical Node: MMXN_DIFF_MTR2**Description:** Non-Phase Related Measurement (Metering Values Extra)**LN Class:** MMXN

Data Object	CDC type	Description	M/O/E
Common Logical Node Information			
Beh	ENS	Behavior	M
Measured and Metered Values			
Amp1	MV	HV Measurand Current ILV3	E
Amp2	MV	HV Measurand Current ILV4	E

4.12 Logical Node: MMXN_DIFF_FLT1**Description:** Non-Phase Related Measurement (Fault Values Standard Differential)**LN Class:** MMXN

Data Object	CDC type	Description	M/O/E
Common Logical Node Information			
Beh	ENS	Behavior	M
Measured and Metered Values			
Amp1	MV	HV Fault Current IHV1	E
Amp2	MV	HV Fault Current IHV2	E
Amp3	MV	LV Fault Current ILV1	E
Amp4	MV	LV Fault Current ILV2	E
Amp5	MV	Fault Current Differential 1	E

4.13 Logical Node: MMXN_DIFF_FLT2**Description:** Non-Phase Related Measurement (Fault Values Extra)**LN Class:** MMXN

Data Object	CDC type	Description	M/O/E
Common Logical Node Information			
Beh	ENS	Behavior	M
Measured and Metered Values			
Amp1	MV	LV Fault Current ILV3	E
Amp2	MV	LV Fault Current ILV4	E
Amp3	MV	Fault Current Differential 2	E

4.14 Logical Node: PDIF_DIFF**Description:** Differential Protection**LN Class:** PDIF

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Status Information			
Str	ACD	Start	O
Op	ACT	Operate	M

4.15 Logical Node: PIOC_DIFF**Description:** Instantaneous Overcurrent Protection**LN Class:** PIOC

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Status Information			
Str	ACD	Start	O
Op	ACT	Operate	M

4.16 Logical Node: RDRE_DIFF**Description:** Disturbance Recorder Function**LN Class:** RDRE

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Status Information			
RcdMade	SPS	TRUE = disturbance recording complete	M
FltNum	INS	Fault Number	M

5. Enum types

Enum types are listed in this clause.

5.1 Mod

Value	Description
1	on
2	blocked
3	test
4	test/blocked
5	off

5.2 ctlModel

Value	Description
0	status-only
1	direct-with-normal-security
2	sbo-with-normal-security
3	direct-with-enhanced-security
4	sbo-with-enhanced-security

5.3 Health

Value	Description
1	Ok
2	Warning
3	Alarm



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