# 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.

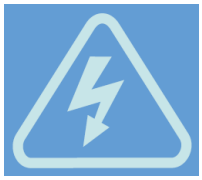
- People handling the equipment should be aware about the relay safety handlet.
- Ensure that the product is in the off condition before working on the conducting or terminal side.
- A qualified person must conduct tests and visual inspections, as necessary, to verify that tools electrical jumpers, shorts, 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

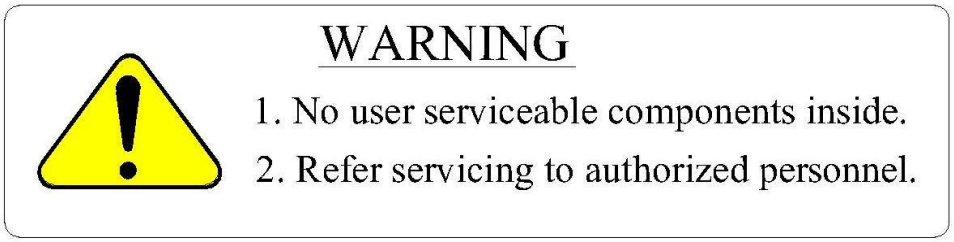
Caution: refer to equipment documentation



Caution: risk of electric shock

Caution: Over voltage Cat.III

### 2. REAR SIDE



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 forc

### Modification

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

## DECOMMISIONING 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. |

### 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.) |

### 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 |

### 4. Contact data

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

# INTRODUCTION

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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.

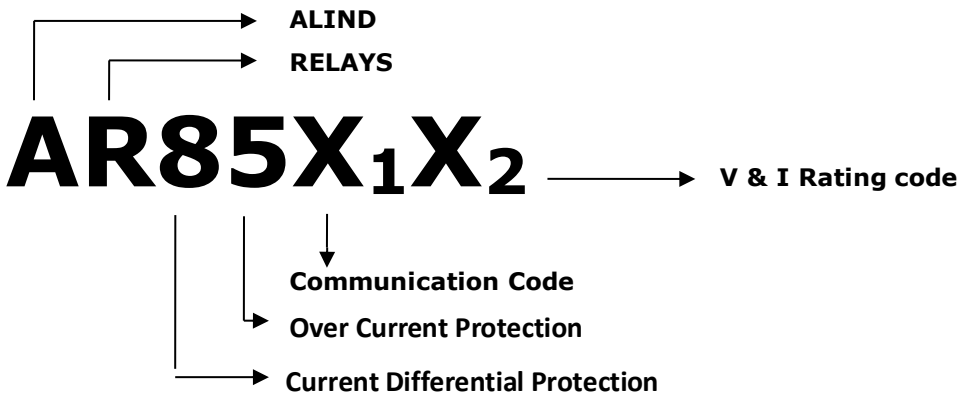
### ANTD 201:

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

| Sl 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

| Sl 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.

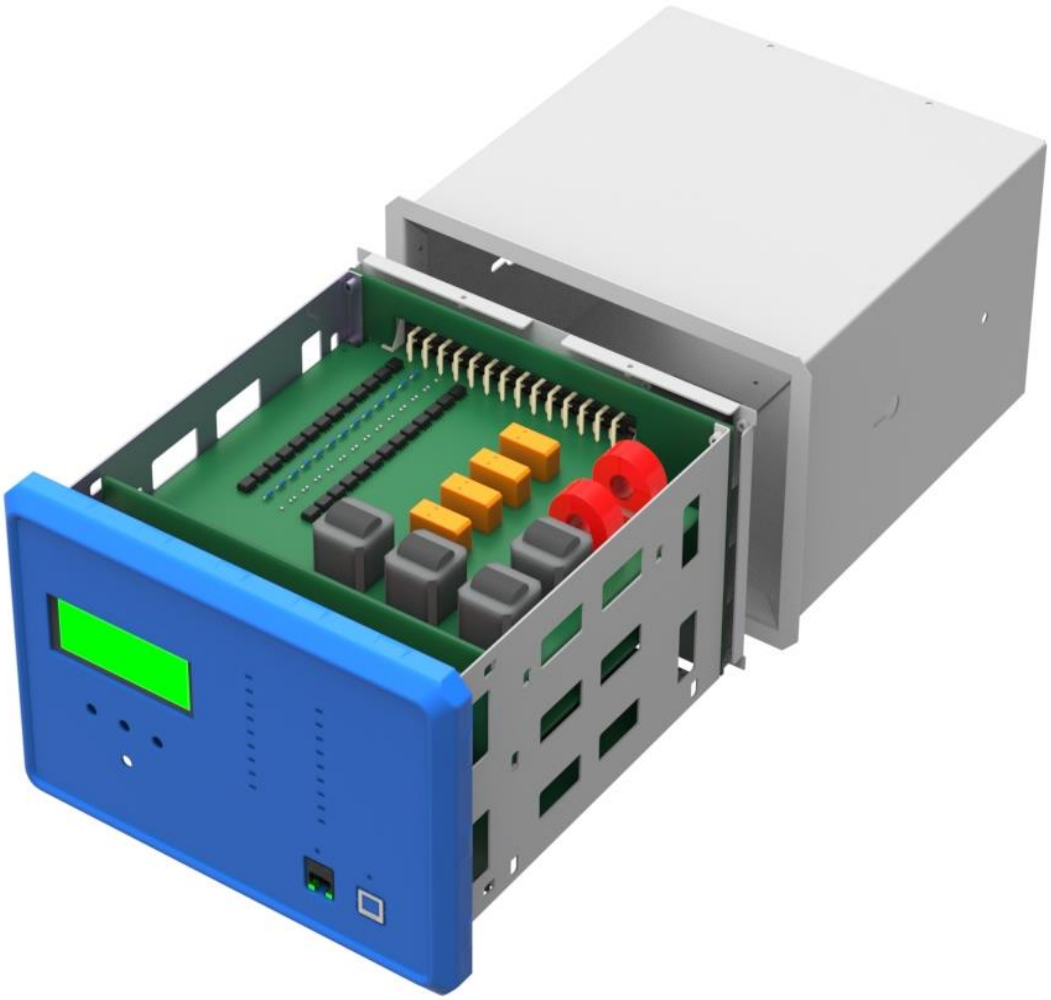
The relay is shipped from factory after detailed testing by our Quality Control Department. However, according to the customer requirement the relay settings/ functions can be verified before commissioning at respective sites with proper testing kits.

## STORAGE

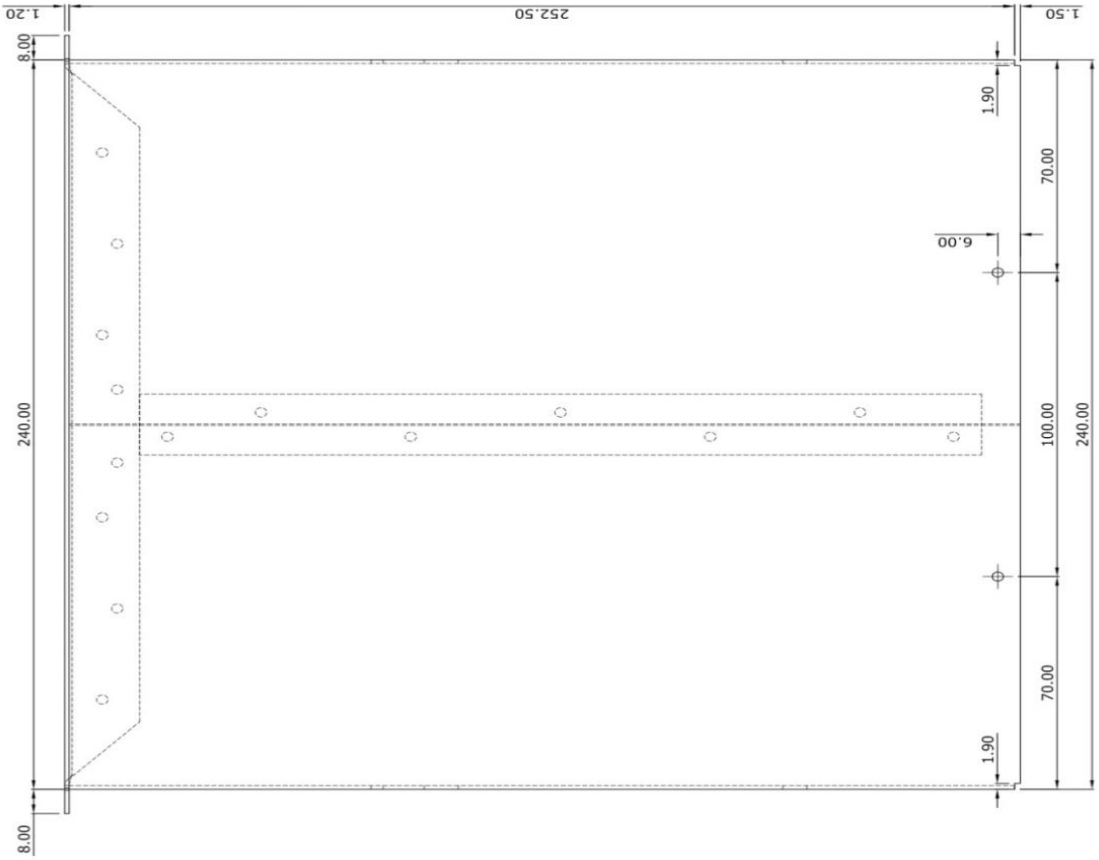
If relays are not to be installed immediately upon receipt, they should be stored in a place free from dust and moisture in their original boxes. At most care should be taken while storage.

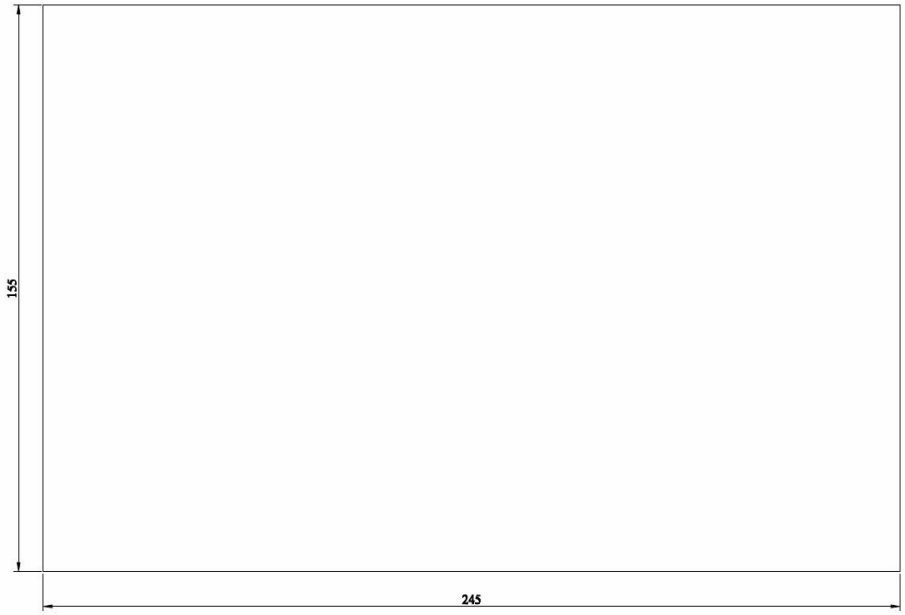
Storage temperature: -25ºC to +55ºC.

## RELAY AND RACK MOUNTING



## CASE DIMENSIONS




CUT OUT DETAILS

# USER GUIDE

AN + SERIES

RELAYS DIVISION

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FRONT PANEL INDICATIONS

BACK TERMINAL BLOCK DETAILS

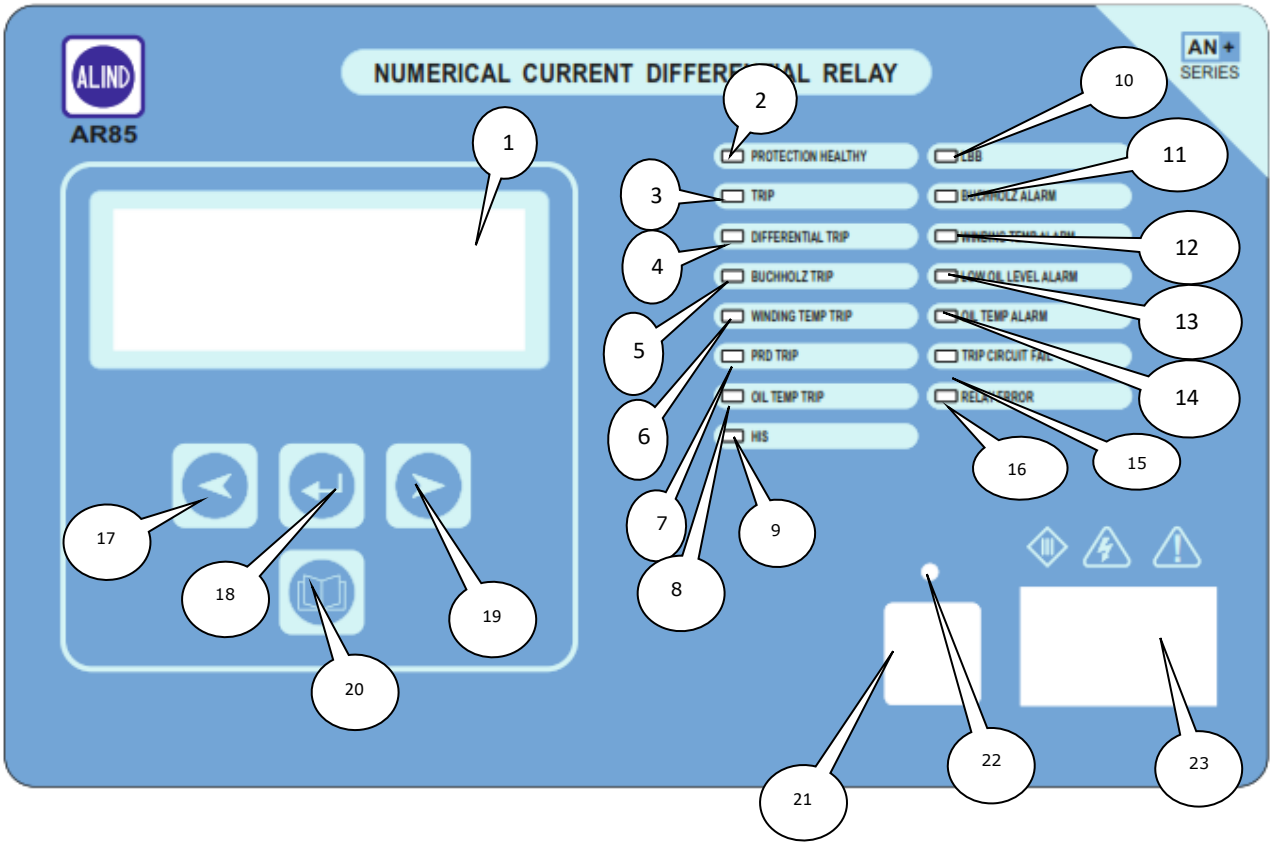
INTERNAL ARCHITECTURE AND BLOCK DIAGRAM

ENERGIZING THE RELAY

PCB DESCRIPTION

RELAY SETTINGS AND ALGORITHM

## FRONT PANEL INDICATIONS



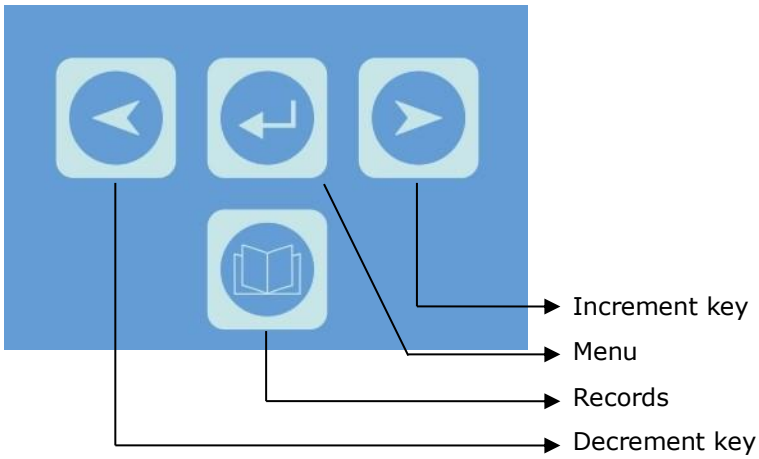
| No | Legend | AR85 |
|---|---|---|
| 1 | LCD DISPLAY | ✓ |
| 2 | PROTECTION HEALTHY (GREEN/AMBER) | ✓ |
| 3 | TRIP | ✓ |
| 4 | DIFFERENTIAL TRIP (RED) | ✓ |
| 5 | BUCHHOLZ TRIP (RED) | ✓ |
| 6 | WINDING TEMP TRIP (RED) | ✓ |
| 7 | PRD TRIP (RED) | ✓ |
| 8 | OIL TEMP TRIP (RED) | ✓ |
| 9 | HIS TRIP (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 hire this key.
* For viewing new options in the relay, we can use this key.

### Decrement key

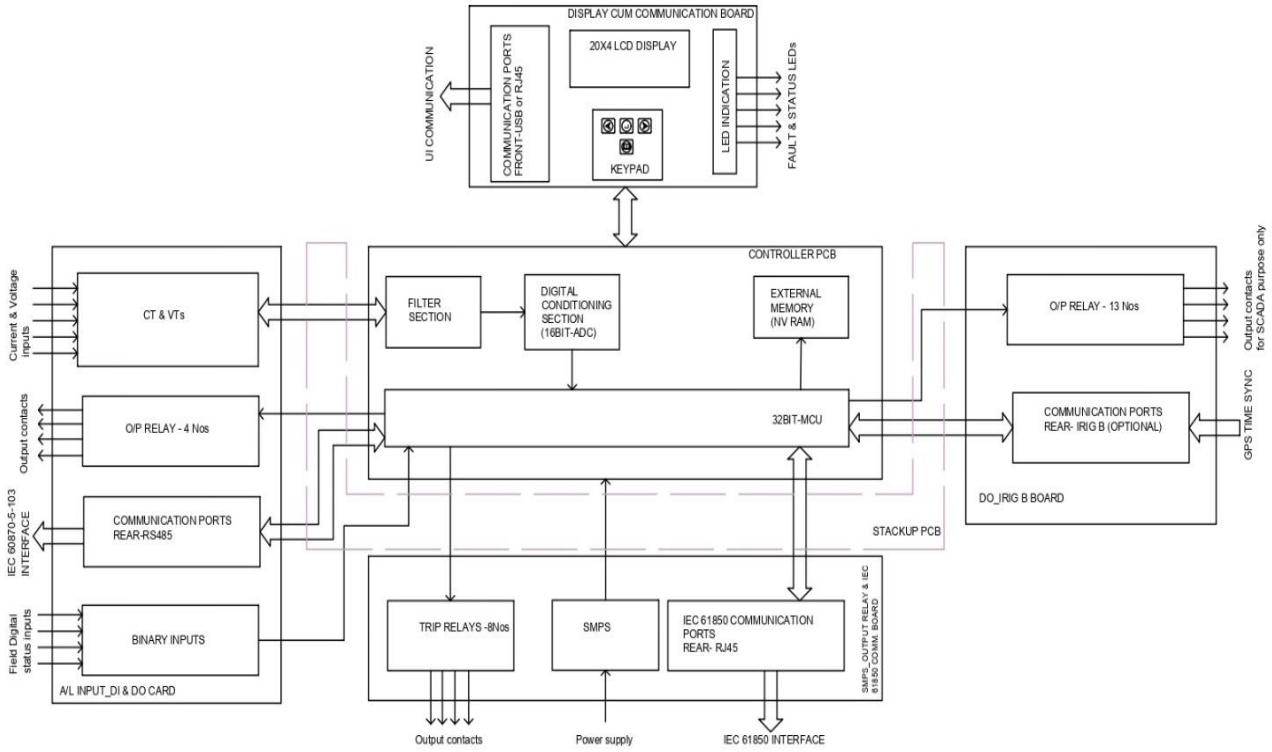
* If you want to lower any particular setting, we can use this option.
* No need to save any unwanted mistakes in the relay you can use this key.
* If you want to verify any previous settings in the relay, you can opt this key.

### 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

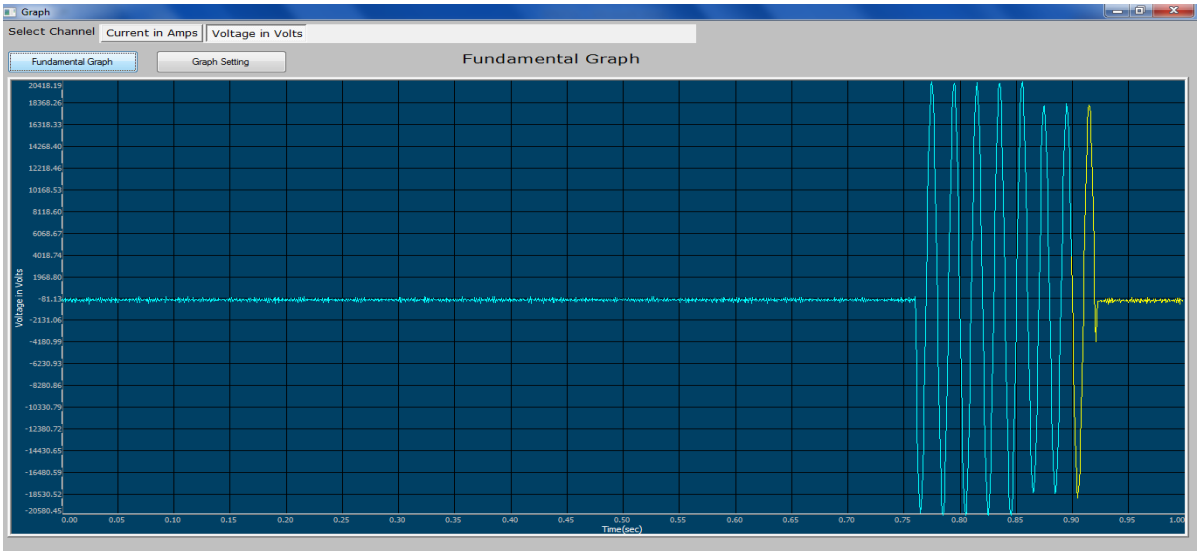
CB Trip

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.

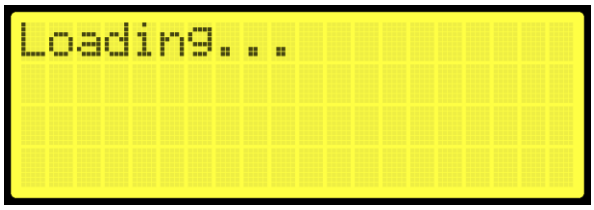
**SMPS & Trip Relay PCB (640 265):** The SMPS PCB provides the necessary Power supply voltages to the different PCBs mounted inside the relay. The SMPS provides +24V, +5V, -5V and isolated +5 V. The +24 V supply is used for the driving the output relays. The +5V and -5V is supplied to the controller 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.

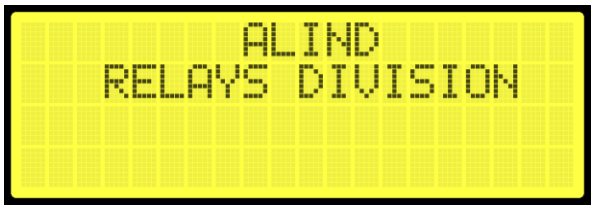
**Tele Annu PCB (640 266)**: All the Telesignalling output circuits are assembled in this PCB. IRIG B circuit also provided in this PCB.

**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

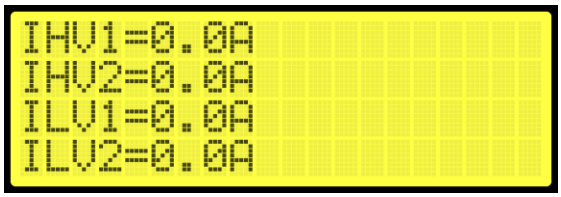
After Power ON, the relay boot screen shows



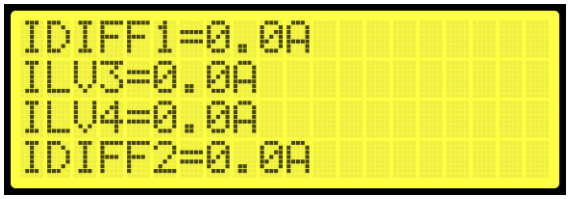




Then comes the online parameter display

Window 1:




Window 2:




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

### Setting Mode

Press and hold ↵ for 5 seconds

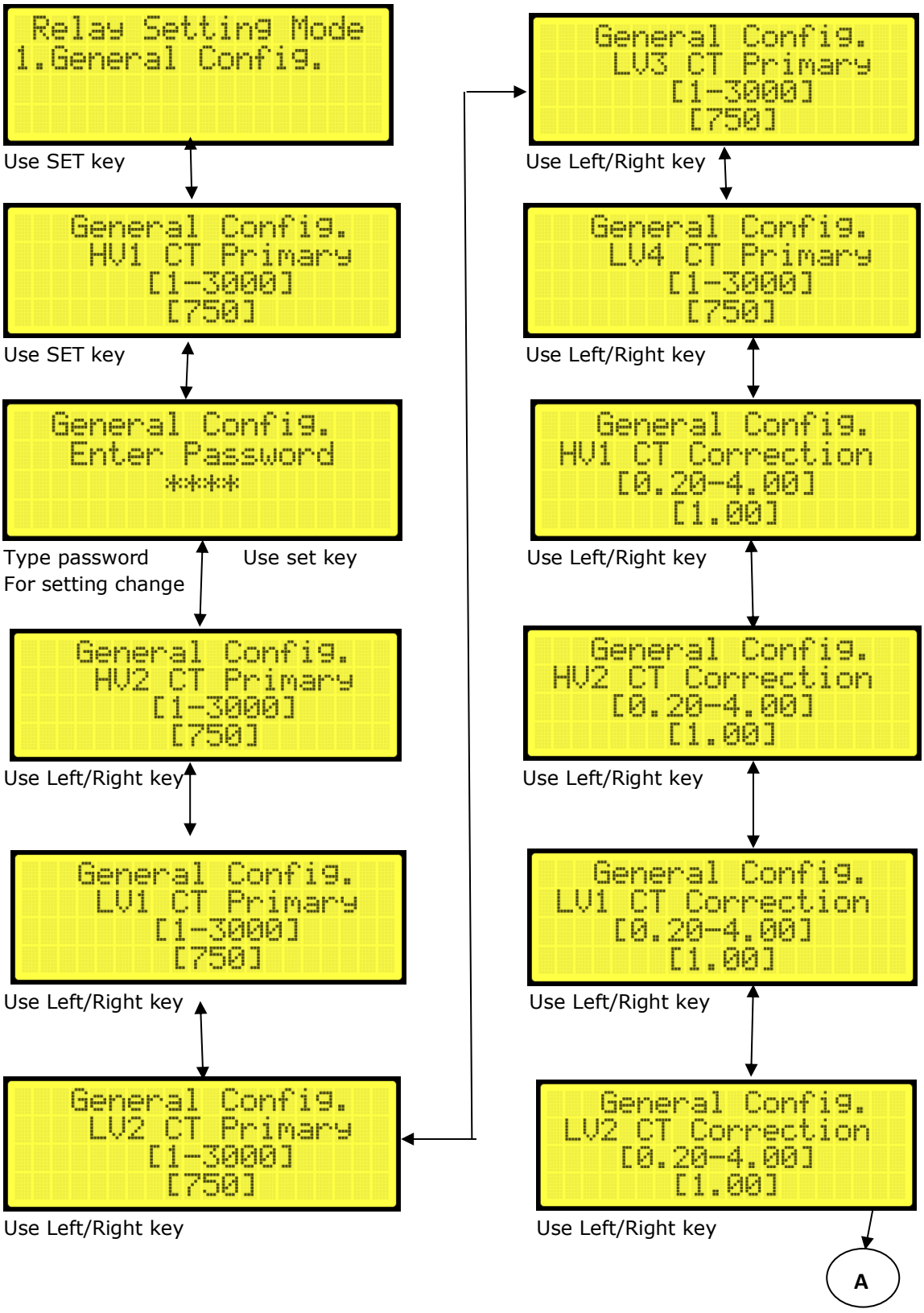
Relay will enter to setting mode.

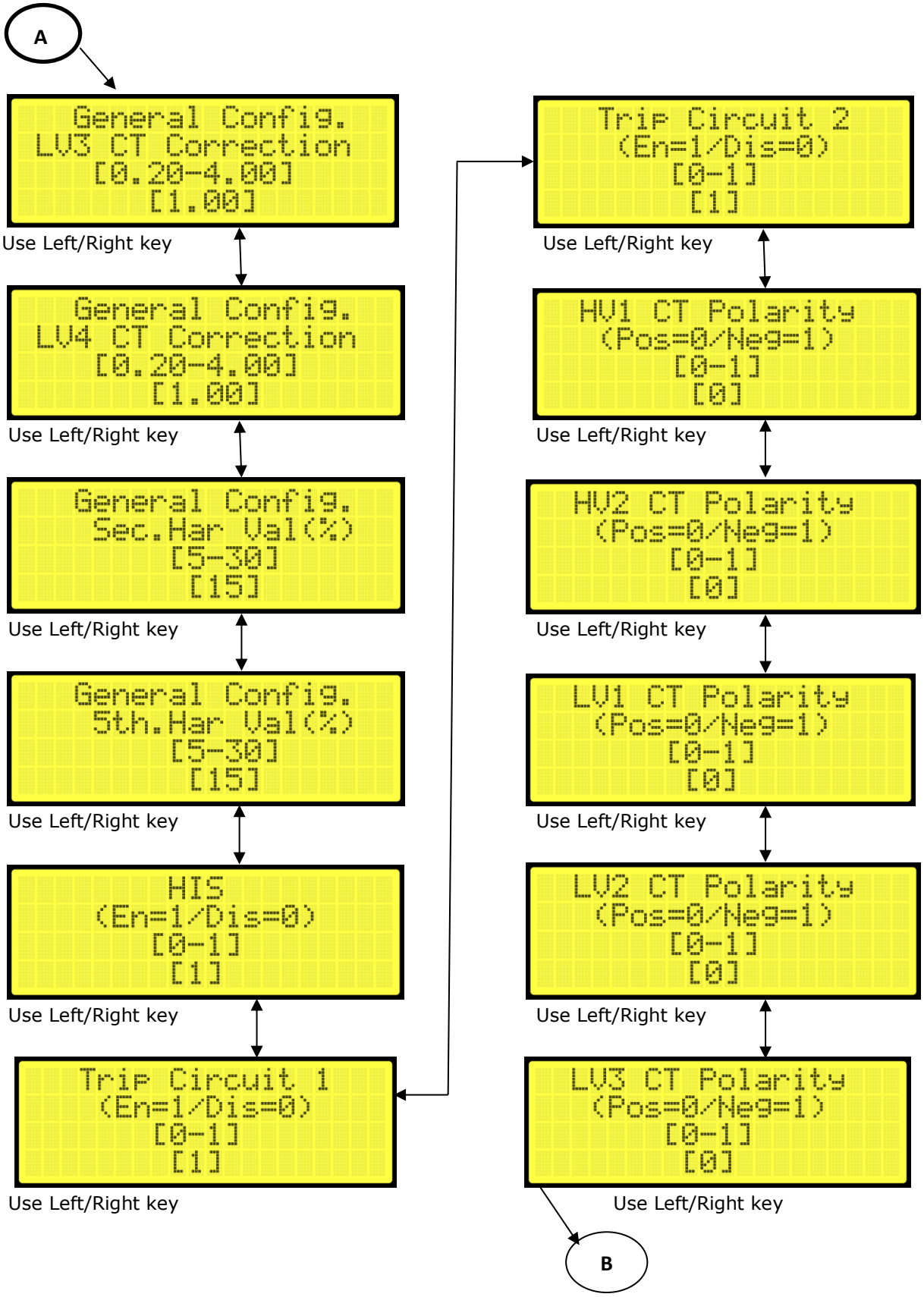
Enter the password and press ↵ key. The default password setting is '1000'

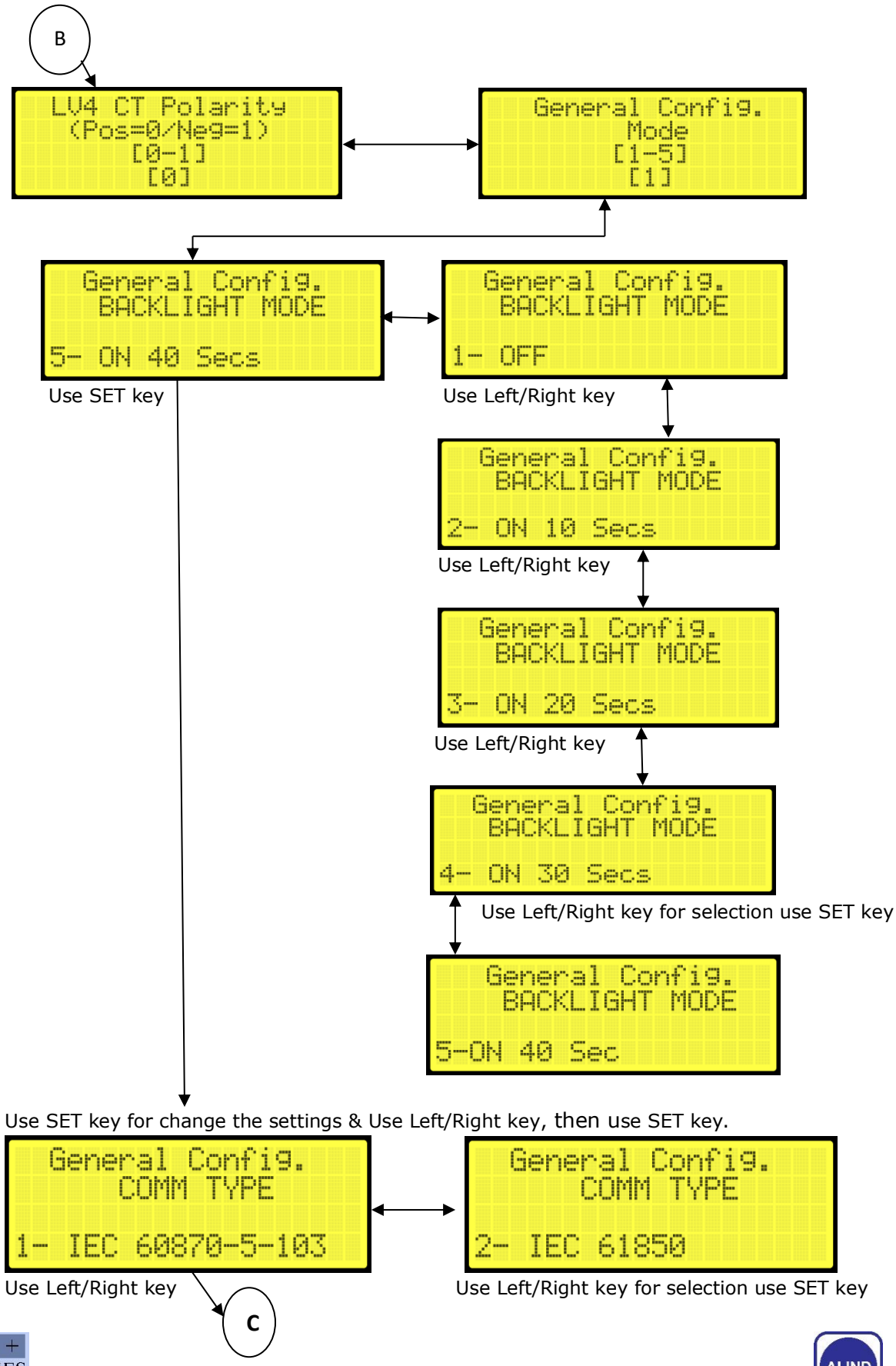
To change settings:

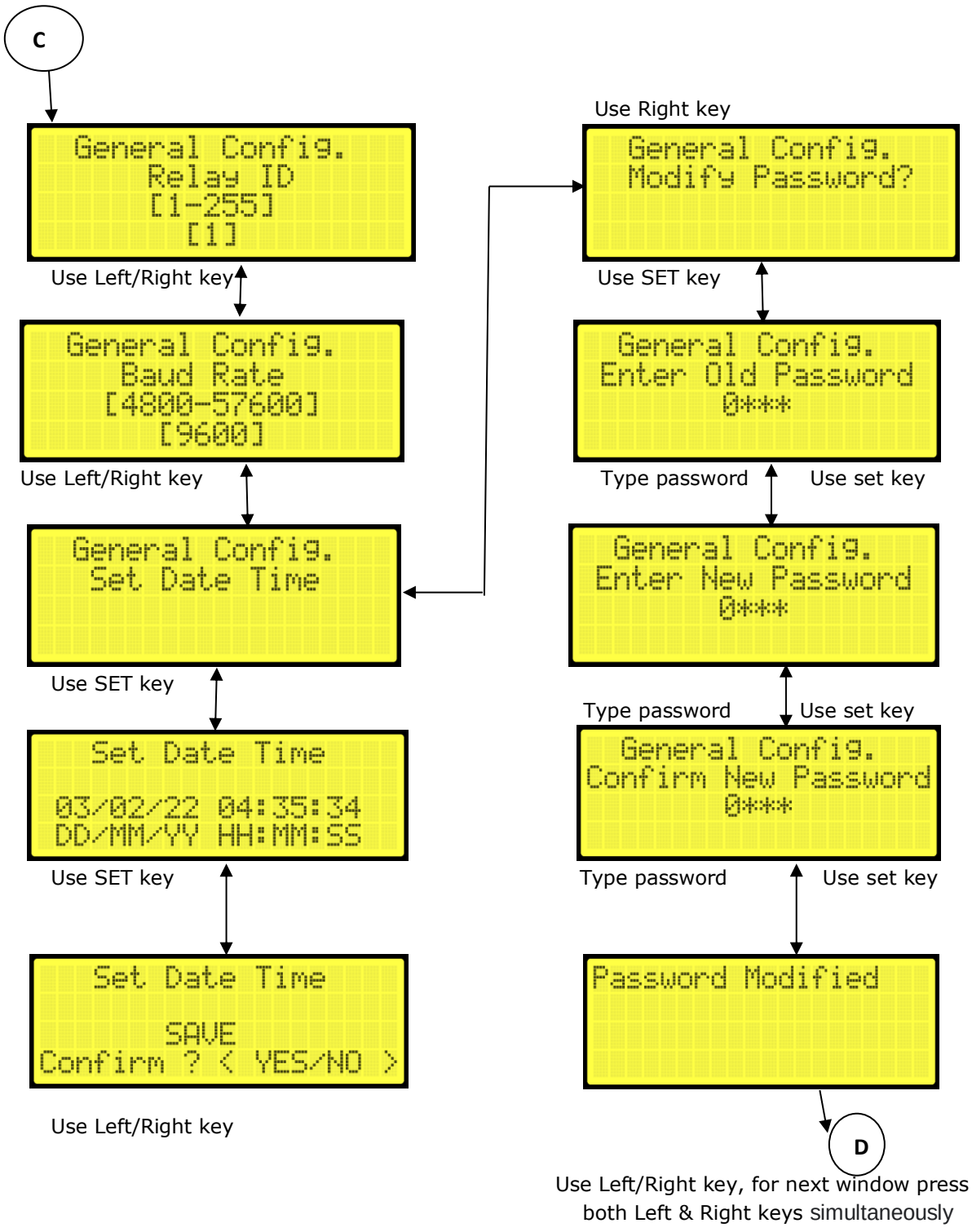
a) Press ↵ to change the settings.
b) Press **Right** key to increment
c) Press **Left** key to decrement
d) Press ↵ to accept change.
e) To coming back to main **MENU** while operating, press **Left** and **Right** key simultaneously.
f) Repeat the process for all settings
g) After completing the settings,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

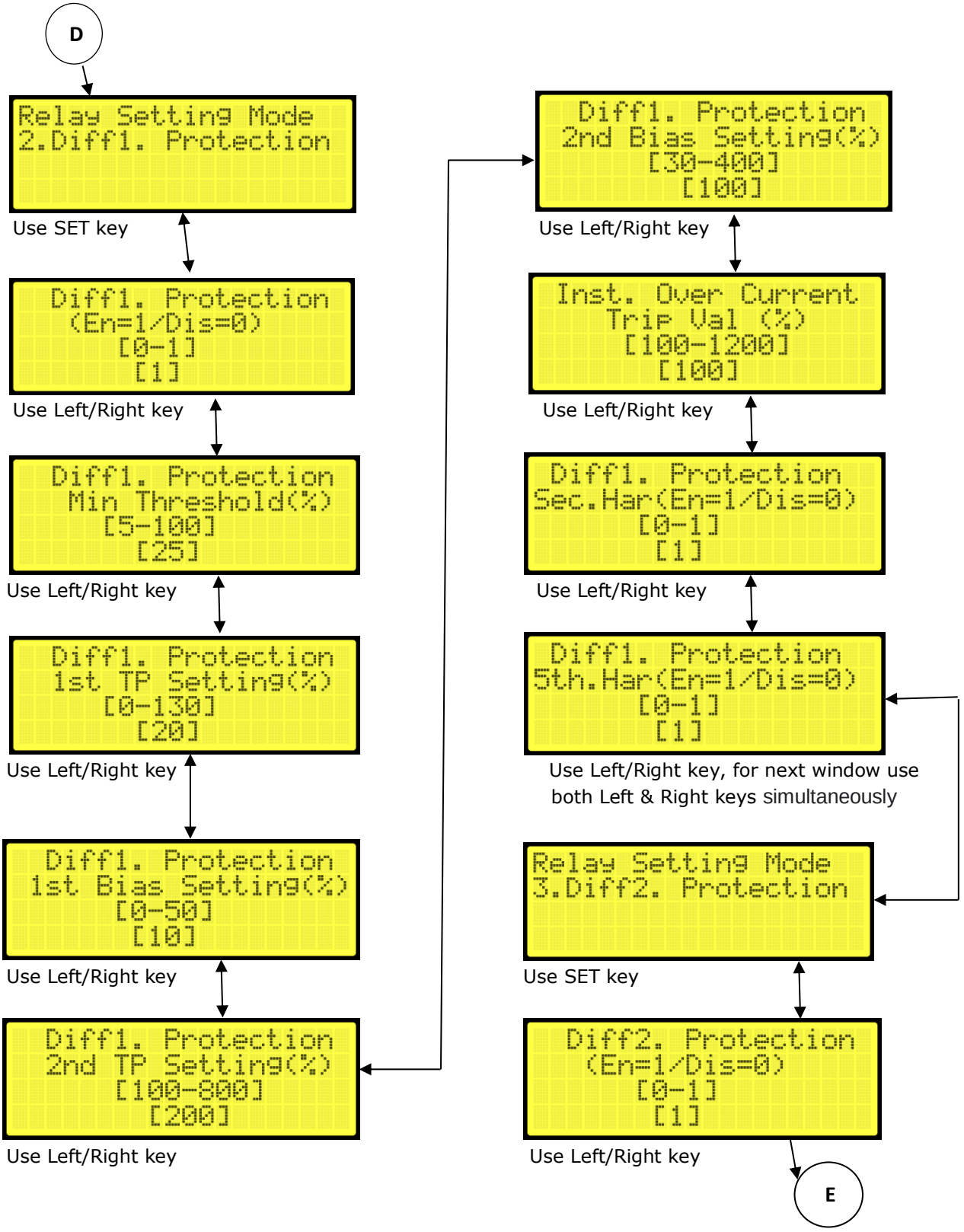
## Relay Settings Algorithm

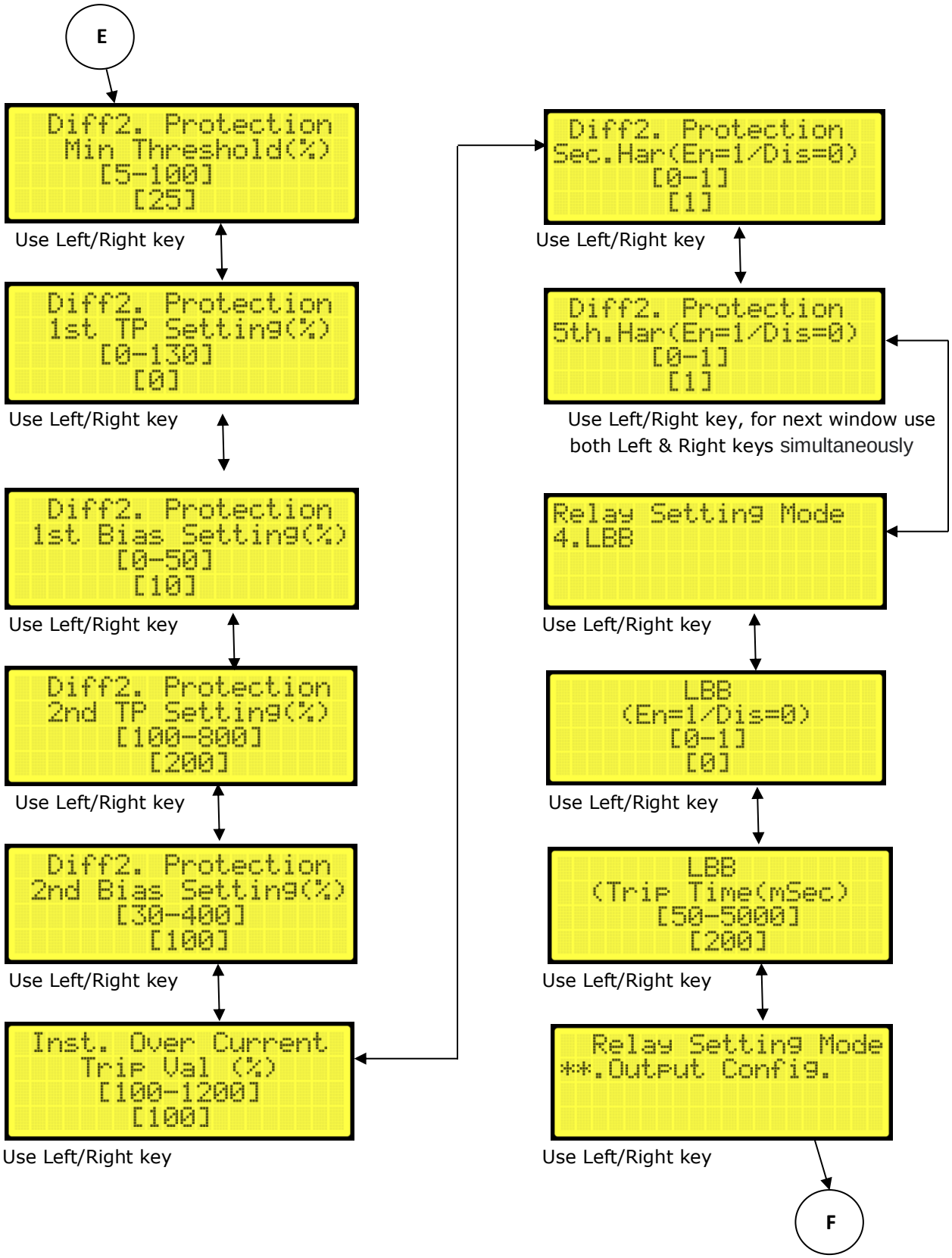



A
General Config.
LV3 CT Correction
[0.20-4.00]
[1.00]
Use Left/Right key
General Config.
LV4 CT Correction
[0.20-4.00]
[1.00]
Use Left/Right key
General Config.
Sec.Har Val(%)
[5-30]
[15]
Use Left/Right key
General Config.
5th.Har Val(%)
[5-30]
[15]
Use Left/Right key
HIS
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
Trip Circuit 1
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
Trip Circuit 2
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
HV1 CT Polarity
(Pos=0/Neg=1)
[0-1]
[0]
Use Left/Right key
HV2 CT Polarity
(Pos=0/Neg=1)
[0-1]
[0]
Use Left/Right key
LV1 CT Polarity
(Pos=0/Neg=1)
[0-1]
[0]
Use Left/Right key
LV2 CT Polarity
(Pos=0/Neg=1)
[0-1]
[0]
Use Left/Right key
LV3 CT Polarity
(Pos=0/Neg=1)
[0-1]
[0]
Use Left/Right key
B


B
LV4 CT Polarity
(Pos=0/Neg=1)
[0-1]
[0]
General Config.
Mode
[1-5]
[1]
General Config.
BACKLIGHT MODE
5- ON 40 Secs
Use SET key
General Config.
BACKLIGHT MODE
1- OFF
Use Left/Right key
General Config.
BACKLIGHT MODE
2- ON 10 Secs
Use Left/Right key
General Config.
BACKLIGHT MODE
3- ON 20 Secs
Use Left/Right key
General Config.
BACKLIGHT MODE
4- ON 30 Secs
Use Left/Right key for selection use SET key
General Config.
BACKLIGHT MODE
5-ON 40 Sec
Use SET key for change the settings & Use Left/Right key, then use SET key.
General Config.
COMM TYPE
1- IEC 60870-5-103
Use Left/Right key
C
General Config.
COMM TYPE
2- IEC 61850
Use Left/Right key for selection use SET key

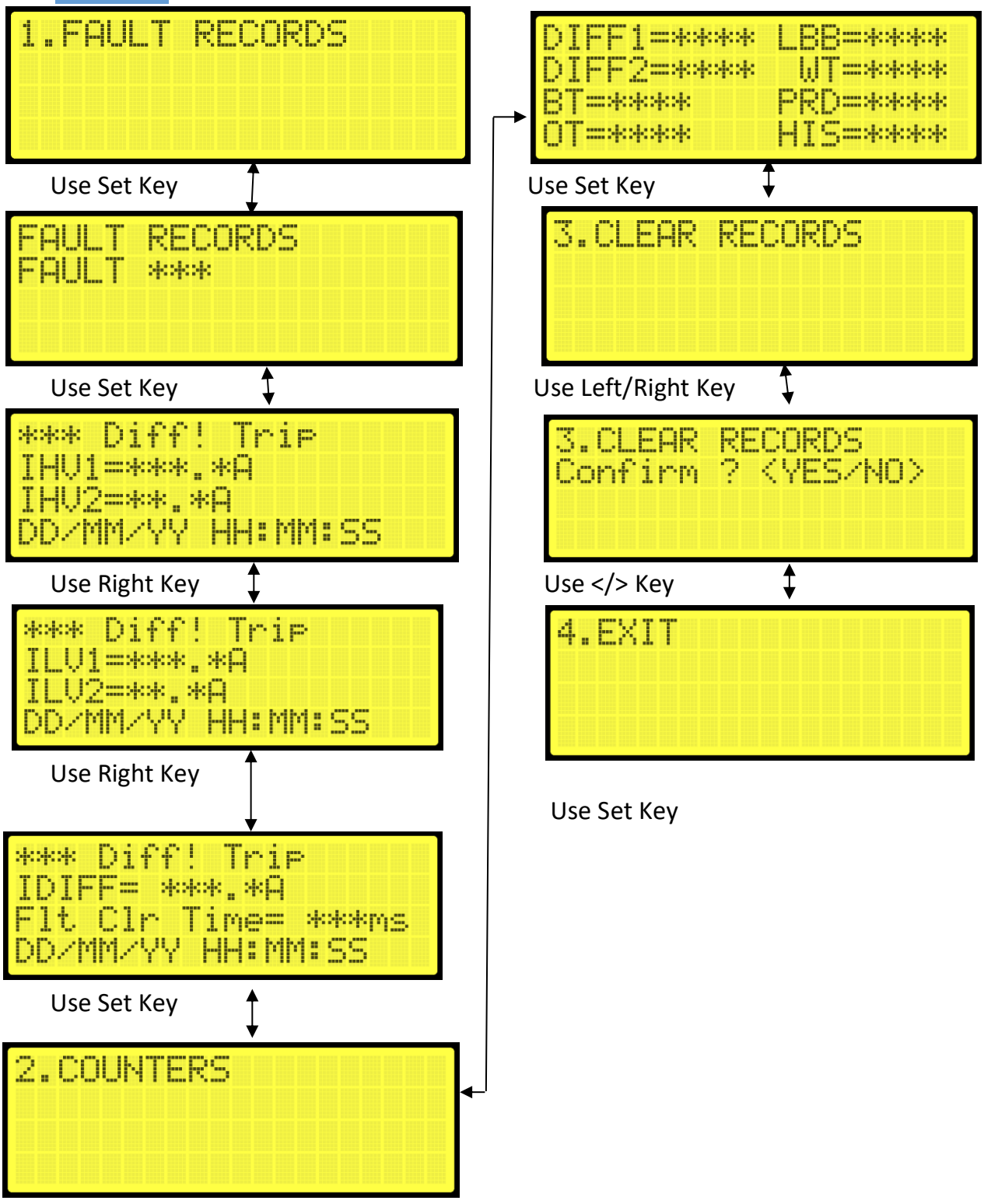

C
General Config.
Relay ID
[1-255]
[1]
Use Left/Right key
General Config.
Baud Rate
[4800-57600]
[9600]
Use Left/Right key
General Config.
Set Date Time
Use SET key
Set Date Time
03/02/22 04:35:34
DD/MM/YY HH:MM:SS
Use SET key
Set Date Time
SAVE
Confirm ? < YES/NO >
Use Left/Right key
Use Right key
General Config.
Modify Password?
Use SET key
General Config.
Enter Old Password
0***
Type password
Use set key
General Config.
Enter New Password
0***
Type password
Use set key
General Config.
Confirm New Password
0***
Type password
Use set key
Password Modified
D
Use Left/Right key, for next window press
both Left & Right keys simultaneously


D
Relay Setting Mode
2.Diff1. Protection
Use SET key
Diff1. Protection
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
Diff1. Protection
Min Threshold(%)
[5-100]
[25]
Use Left/Right key
Diff1. Protection
1st TP Setting(%)
[0-130]
[20]
Use Left/Right key
Diff1. Protection
1st Bias Setting(%)
[0-50]
[10]
Use Left/Right key
Diff1. Protection
2nd TP Setting(%)
[100-800]
[200]
Use Left/Right key
Diff1. Protection
2nd Bias Setting(%)
[30-400]
[100]
Use Left/Right key
Inst. Over Current
Trip Val (%)
[100-1200]
[100]
Use Left/Right key
Diff1. Protection
Sec.Har(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
Diff1. Protection
5th.Har(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key, for next window use
both Left & Right keys simultaneously
Relay Setting Mode
3.Diff2. Protection
Use SET key
Diff2. Protection
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
E

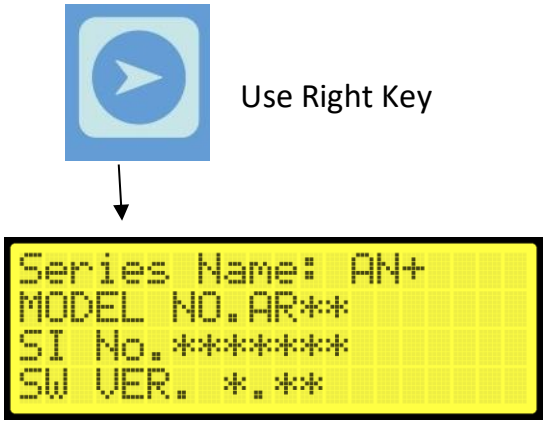

E
Diff2. Protection
Min Threshold(%)
[5-100]
[25]
Use Left/Right key
Diff2. Protection
1st TP Setting(%)
[0-130]
[0]
Use Left/Right key
Diff2. Protection
1st Bias Setting(%)
[0-50]
[10]
Use Left/Right key
Diff2. Protection
2nd TP Setting(%)
[100-800]
[200]
Use Left/Right key
Diff2. Protection
2nd Bias Setting(%)
[30-400]
[100]
Use Left/Right key
Inst. Over Current
Trip Val (%)
[100-1200]
[100]
Use Left/Right key
Diff2. Protection
Sec.Har(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
Diff2. Protection
5th.Har(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key, for next window use
both Left & Right keys simultaneously
Relay Setting Mode
4.LBB
Use Left/Right key
LBB
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
LBB
(Trip Time(mSec)
[50-5000]
[200]
Use Left/Right key
Relay Setting Mode
**.Output Config.
Use Left/Right key
F

## To access & clear logs

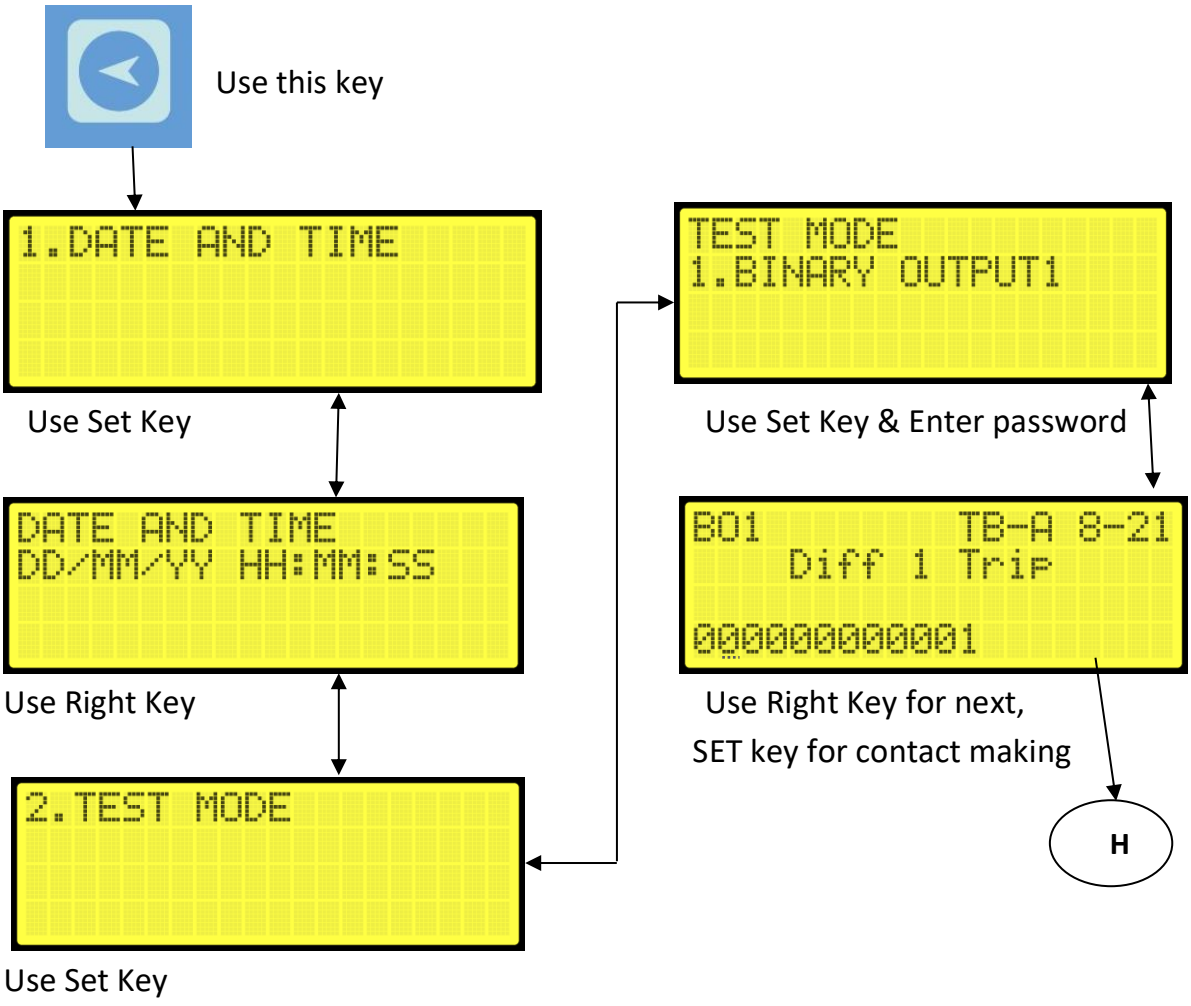
Use this key

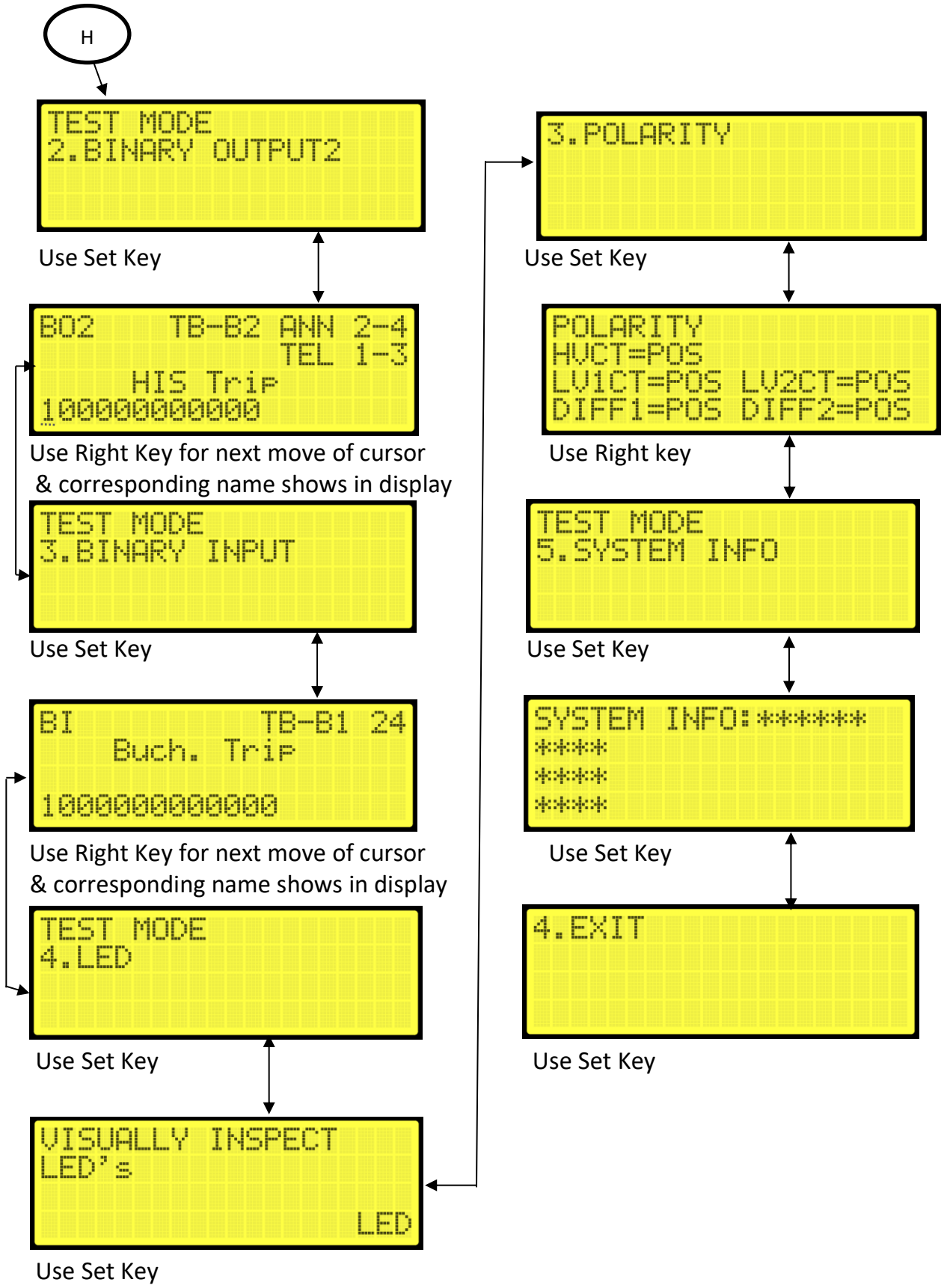


## To view device Info.




## For Relay healthiness check & I/O Verification

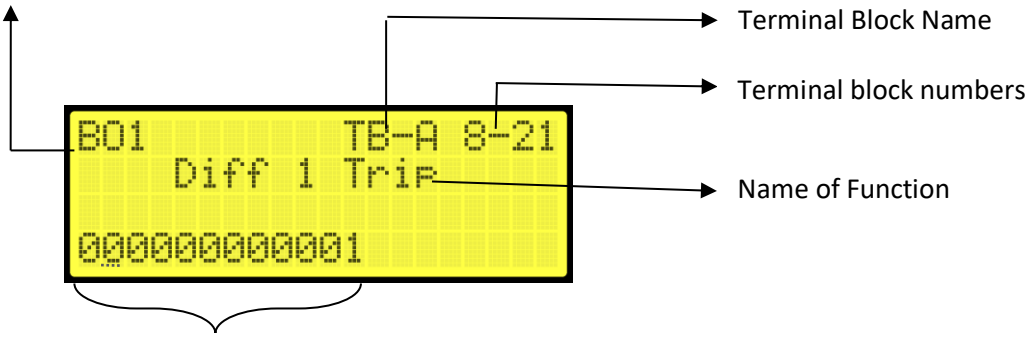



H
TEST MODE
2.BINARY OUTPUT2
Use Set Key
BO2 TB-B2 ANN 2-4
TEL 1-3
HIS TriP
1000000000000
Use Right Key for next move of cursor
& corresponding name shows in display
TEST MODE
3.BINARY INPUT
Use Set Key
BI TB-B1 24
Buch. TriP
1000000000000
Use Right Key for next move of cursor
& corresponding name shows in display
TEST MODE
4.LED
Use Set Key
VISUALLY INSPECT
LED's
LED
Use Set Key
3.POLARITY
Use Set Key
POLARITY
HVCT=POS
LV1CT=POS LV2CT=POS
DIFF1=POS DIFF2=POS
Use Right key
TEST MODE
5.SYSTEM INFO
Use Set Key
SYSTEM INFO:******
****
****
****
Use Set Key
4.EXIT
Use Set Key

# Binary Output & Input Details

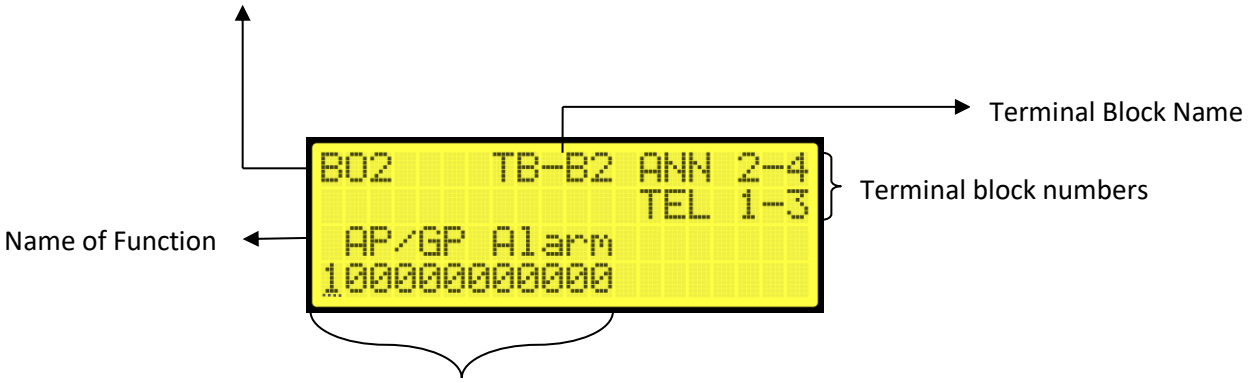
| Binary Output 1 | | | Binary Output 2 | | | Binary Input | | |
|---|---|---|---|---|---|---|---|---|
| **BO1** | **NAME** | **TB NUMBER** | **BO2** | **NAME** | **TB NUMBER** | **BI** | **NAME** | **TB NUMBER** |
| 1 | NIL | | 1 | HIS Trip | TB B2 -1 & 3 , 2 & 4 | 1 | Buch. Trip | TB B1- 24 |
| 2 | 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.

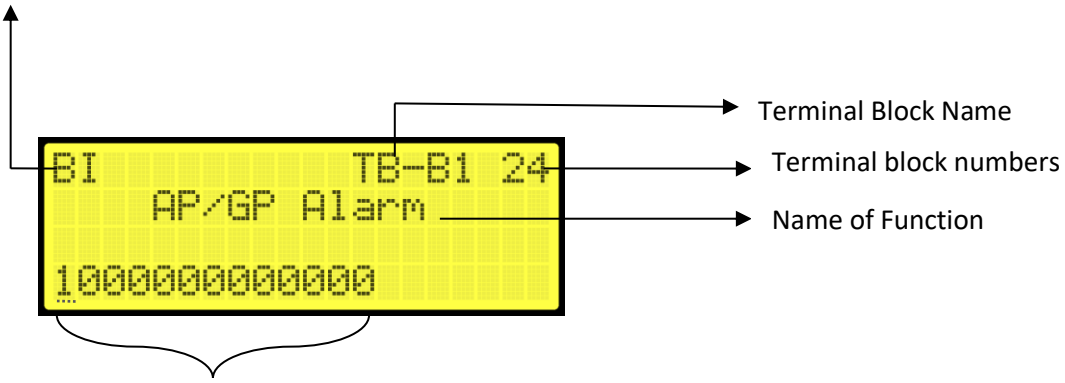
## Binary Output 2




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.

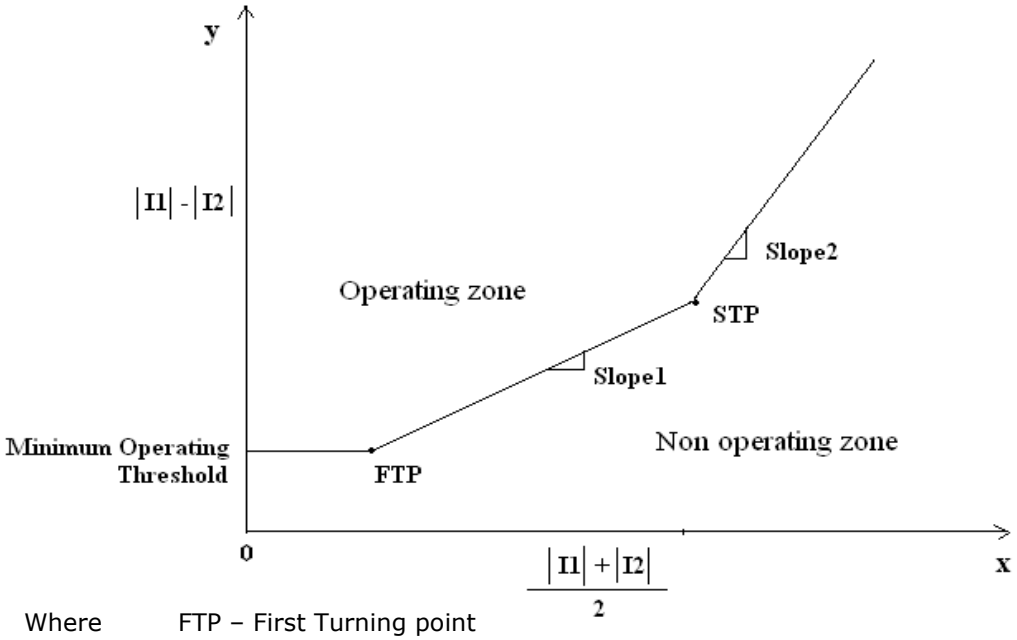
### II) Dual slope characteristics

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

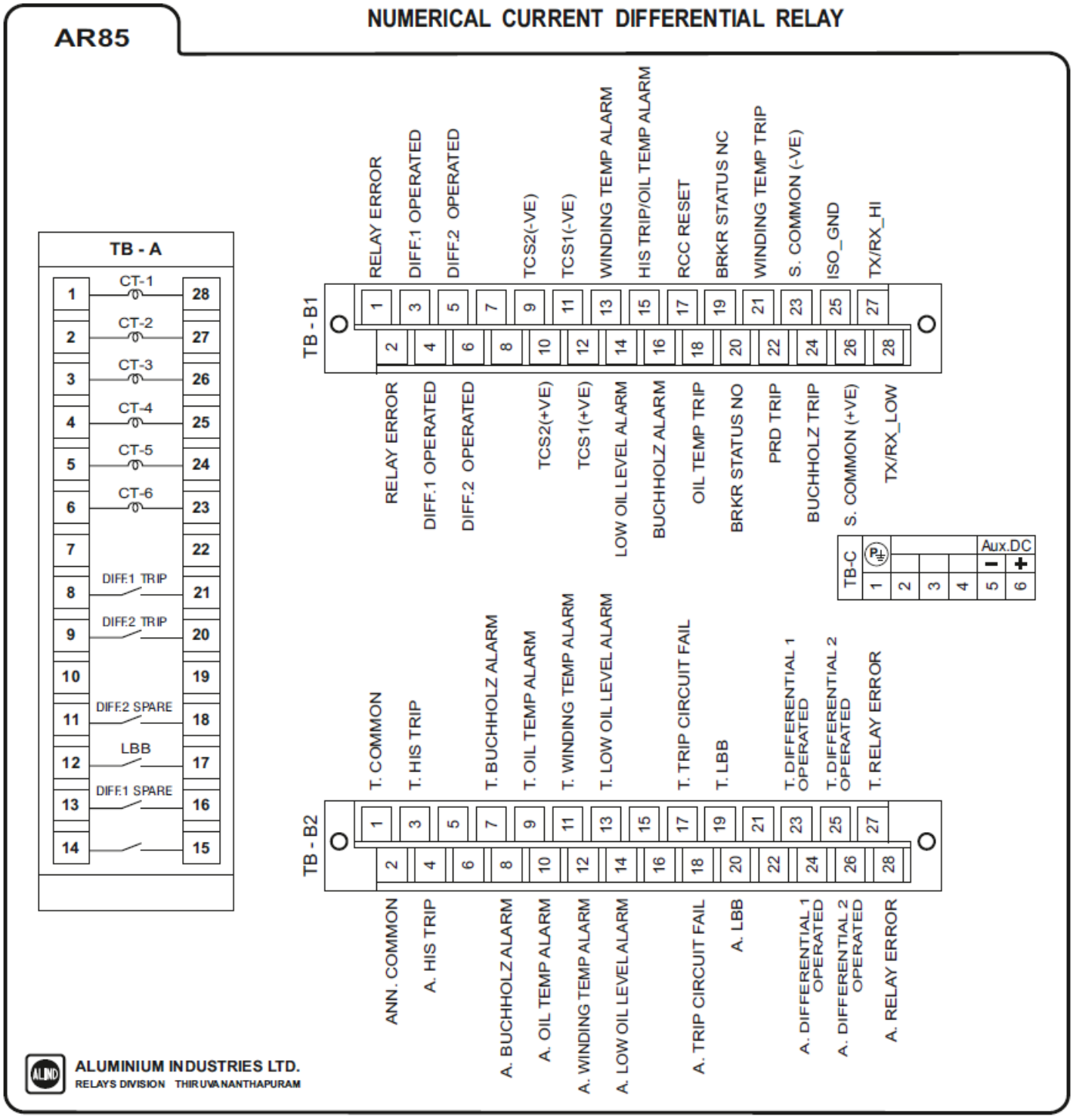
| Sl. No | Specification | REF. | Particulars |
|---|---|---|---|
| 1. | **Auxiliary Supply** | $V_{DC}$ | 35 to 260 VDC |
| 2. | **Current Input(rated)** | In | 5 Amps |
| 3. | **Frequency** | Fn | 50 Hz |
| 4. | **VA burden on CT** | | Less than 0.5 VA |
| 5. | **VA burden on Aux** | | Less than 15 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<br>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**<br>Width<br>Height<br>Depth | | <br>263 mm<br>173 mm<br>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<br>2 – 10S<br>3 – 20S<br>4 – 30S<br>5 – 40S |
| Communication type | 1 – IEC 60870-5-103<br>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<br>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) 2nd Bias Setting | 30 to 400 in steps of 10 |
| vi) Instantaneous OCR | 100 to 1200 in steps of 100 |
| vii) 2nd Harmonic Blocking Feature | EN/DIS |
| viii)5th 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) 2nd Bias Setting | 30 to 400 in steps of 10 |
| vi) Instantaneous OCR | 100 to 1200 in steps of 100 |
| vii) 2nd Harmonic Blocking Feature | EN/DIS |
| viii)5th Harmonic Blocking Feature | EN/DIS |
| **LBB** | (EN/DIS) |
| LBB TIME | 0-5000 in steps of 1 |

## TB DETAILS


AR85
NUMERICAL CURRENT DIFFERENTIAL RELAY
TB - A
CT-1
CT-2
CT-3
CT-4
CT-5
CT-6
DIFF.1 TRIP
DIFF.2 TRIP
DIFF.2 SPARE
LBB
DIFF.1 SPARE
TB - B1
RELAY ERROR
DIFF.1 OPERATED
DIFF.2 OPERATED
TCS2(-VE)
TCS1(-VE)
WINDING TEMP ALARM
HIS TRIP/OIL TEMP ALARM
RCC RESET
BRKR STATUS NC
WINDING TEMP TRIP
S. COMMON (-VE)
ISO_GND
TX/RX_HI
RELAY ERROR
DIFF.1 OPERATED
DIFF.2 OPERATED
TCS2(+VE)
TCS1(+VE)
LOW OIL LEVEL ALARM
BUCHHOLZ ALARM
OIL TEMP TRIP
BRKR STATUS NO
PRD TRIP
BUCHHOLZ TRIP
S. COMMON (+VE)
TX/RX_LOW
TB-C
Aux.DC
TB - B2
T. COMMON
T. HIS TRIP
T. BUCHHOLZ ALARM
T. OIL TEMP ALARM
T. WINDING TEMP ALARM
T. LOW OIL LEVEL ALARM
T. TRIP CIRCUIT FAIL
T. LBB
T. DIFFERENTIAL 1 OPERATED
T. DIFFERENTIAL 2 OPERATED
T. RELAY ERROR
ANN. COMMON
A. HIS TRIP
A. BUCHHOLZ ALARM
A. OIL TEMP ALARM
A. WINDING TEMP ALARM
A. LOW OIL LEVEL ALARM
A. TRIP CIRCUIT FAIL
A. LBB
A. DIFFERENTIAL 1 OPERATED
A. DIFFERENTIAL 2 OPERATED
A. RELAY ERROR
ALUMINIUM INDUSTRIES LTD.
RELAYS DIVISION THIRUVANANTHAPURAM

## RELAY CONFORMING STANDARDS

The relay conforms to the following standards:

| Sl 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<br>2. Check the continuity of the output terminal, after disconnecting the wires. | 1. Due to power supply failure, the LED turns off.<br>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.<br>2. Check for the earthing of CT.<br>3. Check if the terminals of TB-A is connected properly or for any lose contact.<br>4. Check CT ratio and multiplying factor if any.<br>5. Check the continuity of the output terminal, after disconnecting the wires.<br>After checking of the above, measure the current using calibrated Clamp-On meter.<br>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.<br>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.<br>2. Press H.RST key in the relay front panel. | 1. Supply variation to internal PCB's.<br>2. DC supply fail. |

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

MODEL – **AR 85**

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


## ALUMINIUM INDUSTRIES LIMITED
## RELAYS DIVISION



**Version** 1.1
**Date** 21/02/2024

## OVERVIEW

IEC 60870-5-103 is a standard for power system control and associated communications. It defines a companion standard that enables interoperability between protection equipment and devices of a control system in a substation. The device complying with this standard can send the information using two methods for data transfer - either using the explicitly specified application service data units (ASDU) or using generic services for transmission of all the possible information.
The IEC 60870-5 protocol is based on the three-layer reference model 'Enhanced Performance Architecture' (EPA), as specified in clause 4 of IEC 60870-5-3. The physical layer copper-wire based system that provides binary symmetric and memoryless transmission.
The link layer consists of a number of link transmission procedures, using explicit Link Protocol Control Information (LPCI), that are capable of carrying Application Service Data Units (ASDUs) as link user data. The link layer uses a selection of frame formats to provide the required integrity, efficiency, and convenience of transmission.
The application layer contains a number of application functions that involve the transmission of Application Service Data Units (ASDUs) between source and destination.
The application layer of this companion standard does not use explicit Application Protocol Control Information (APCI). This is implicit in the contents of the ASDU Data Unit Identifier and in the type of link service used.

## PHYSICAL LAYER

Connection is possible with IEC 60870-5-103 via rear RS485 port of relay as seen in figure 1 below.

1. TX/RX_HI correspond to Data +ve.
2. TX/RX_LOW correspond to Data -ve.
3. ISO_GND correspond to GND.

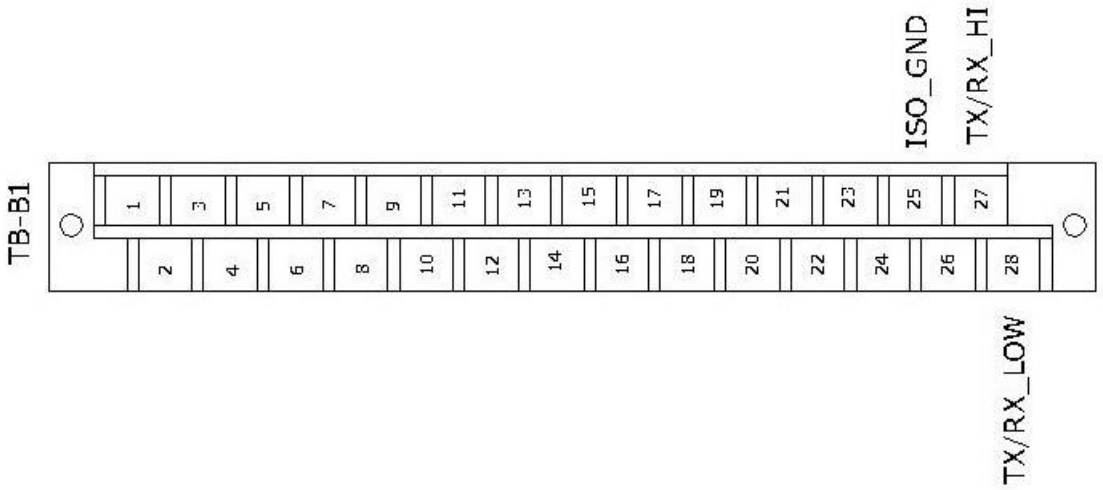



Figure 1

## GENERAL INFORMATION

**Relay ID**: Settable from 1 to 255 via relay HMI.
**Baud Rate**: Settable from 4800 – 57600 via relay HMI.
**No. of data bits**: 8
**No of stop bits**: 1
**Parity**: None
**Measurand Scaling Factor**: 2.4

## PROTOCOL MAPPING

**INFORMATION NUMBER**: INF
**ASDU TYPE**: TYP
**CAUSE OF TRANSMISSION**: COT
**FUNCTION NUMBER**: FUN
**GENERAL INTERROGATION**: GI, marked with '**X**' wherever applicable.
**COM**: Indicates whether relay generated event on rising edge only (0 - 1) indicated by ↑ or both rising and falling edge (0-1 and 1-0) indicated by ↑↓.

### 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

Measurands are scaled with a scaling factor of 2.4. To obtain the actual value from raw value, following formulae can be used.

$$\text{Actual Value} = \left(\frac{\text{Raw Value x } 2.4}{4096}\right) \text{ x Primary CT/PT value}$$

| 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) |

## DISTURBANCE RECORD EXTRACTION

The disturbance record extraction procedure in ALIND relays is in conformance with IEC 60870-5-103 standard definition.

## 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:<br>MICS DOCUMENT FOR AR 85 RELAY | MICS Ver. | 2.0 |
| | DATE: 24 FEBRUARY 2024 | |
| ALUMINIUM INDUSTRIES LTD \| RELAYS DIVISION, THIRUVANANTHAPURAM | | |

# 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 |
| | LBB_RBRF1 | RBRF_DIFF | Breaker Failure |
| 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** | |
| LLN0 (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: CNTRL_GGIO1

**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: ALM_GGIO1

**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: IND_GGIO2

**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: LLN0

**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 |

## 4.9 Logical Node: LPHD1

**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: MTR_STD_MMXN1

**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: MTR_EX_MMXN2

**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: FLT_STD_MMXN3

**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: FLTT_EX_MMXN4

**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: DIFF1_PDIF1

**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: DIFF2_PDIF2

**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 |

## 4.16 Logical Node: IOC1_PIOC1

**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 |

## 4.17 Logical Node: IOC2_PIOC2

**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 |

## 4.18 Logical Node: RBRF1

**Description:** Breaker Failure

**LN Class:** RBRF

| Data Object | CDC type | Description | M/O |
|---|---|---|---|
| **Common Logical Node Information** | | | |
| Beh | ENS | Behavior | M |
| **Status Information** | | | |
| OpEx | ACT | Breaker Failure External Trip | M |

## 4.19 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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