NUMERICAL OVERCURRRENT, CURRENT UNBALANCE AND VOLTAGE PROTECTION RELAY FOR CAPACITOR BANK [AR53]

User Manual

ALIND

ALUMINIUM INDUSTRIES LIMITED

RELAYS DIVISION, THIRUVANANTHAPURAM

AR53

NUMERICAL OVERCURRRENT, CURRENT UNBALANCE AND VOLTAGE PROTECTION RELAY FOR CAPACITOR BANK

CONTENTS

SAFETY REQUIREMENTS	AR53-I
INTRODUCTION	AR53-II
HANDLING INSTALLATIONS & CASE DIMENSIONS	AR53-III
USER GUIDE	AR53-IV
TECHNICAL DATA & CHARACTERISTIC CURVES	AR53-V
TROUBLE SHOOTING	AR53-VI
COMMUNICATION	AR53-VII

SAFETY REQUIREMENTS

CONTENTS

INTRODUCTION

HEALTH AND SAFETY

SYMBOLS AND EXTERNAL LABELS ON THE RELAY

INSTALLING, COMMISSIONING AND SERVICING

DECOMMISSIONING AND DISPOSAL

TECHNICAL SPECIFICATION FOR SAFETY

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.

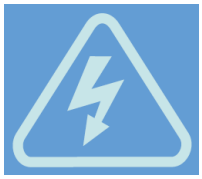
- People handling the equipment should be aware about the relay safety handlet.
- Ensure that the product is in the off condition before working on the conducting or terminal side.
- A qualified person must conduct tests and visual inspections, as necessary, to verify that tools electrical jumpers, shorts,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

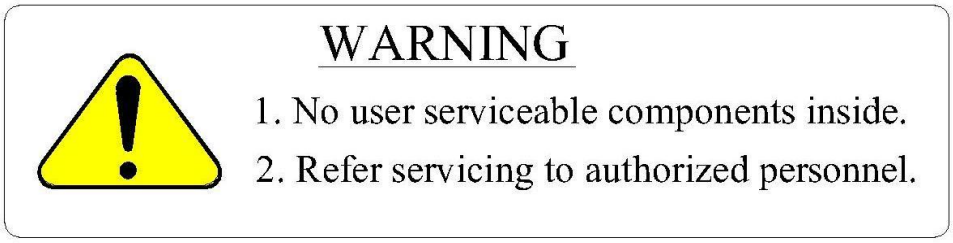
Caution: refer to equipment documentation



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 force.

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 source.

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

INTRODUCTION

CONTENTS

AN SERIES DESCRIPTION

PREVIOUS HISTORY OF CAPACITOR BANK PROTECTION RELAYS

BRIEF DESCRIPTION OF ANC 214/ 402/ 033

MAIN FUNCTIONS

GENERAL FUNCTIONS

AN+ SERIES (ALIND NUMERICAL SERIES)

- Advanced Digital Fourier Transform based Numerical algorithm design using 32-bit Digital Signal Controller.
- Compact Construction covering several protection modules viz Over Current Protection, Earth Fault/ Restricted Earth Fault protection along with Trip Circuit supervision in single module thus saving panel space.
- Display of protection acted, fault current, fault clearing time, fault date & time of latest 200 faults at Relay LCD.
- Man-Machine Communication through 20x4 character LCD display.
- 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 waveform (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
- Relay Indication (LED) reset from RCC
- IP 54 grade enclosure protection.
- SNTP (Simple Network Time Protocol) & optional GPS based IRIG -B time code standard Synchronization Facility.
- Online HV current & LV current display on relay LCD.
- Settable CT ratios.
- Relay operation Counter

PREVIOUS HISTORY OF CAPACITOR BANK RELAYS

AFC 204

Numerical Capacitor Bank relay

Disturbance & event recorder.

Built in counter facility.

ANC 214:

The relay conforms to RDSO specification No. TI/SPC/PSI/PROTCT/6071. ANC 214 (AN Series) relay is a comprehensive Integrated Capacitor Bank Protection relay for the protection of conventional 27 KV AC capacitor bank

ANC 402/ 033:

The relay conforms to RDSO specification No. TI/SPC/PSI/PROTCT/7100(07/2012). ANC 402/ 033 (AN Series) relay is a comprehensive Integrated Feeder Protection relay for the protection of 2x 25 KV (AT feeding system) AC capacitor bank

ANC 303:

ANC 303 (AN Series) relay is a comprehensive Integrated Capacitor Bank switching relay for conventional 27 KV AC capacitor bank

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

AR53:

The relay conforms to RDSO specification No. TI/SPC/PSI/PROTCT/6072. AR53 (AN+ Series) relay is a comprehensive Capacitor Bank Protection Relay using in 25KV TSS.

MAIN FUNCTIONS

Sl No.	PARTICULARS	AR53
1.	**MAIN PROTECTIONS**	
1.1	IDMT OC Protection	✓
1.2	Over Voltage Protection	✓
1.3	Under Voltage Protection	✓
1.4	Current Unbalance Protection	✓
1.5	Time Delay Relay	✓
1.6	LBB	✓
1.7	Relay Error	✓
2.	**STATUS INPUTS**	
2.1	AP/GP LOW ALARM	✓
2.2	AP/GP LOW TRIP & LOCK	✓
2.3	BRKR STATUS NC	✓
2.4	BRKR STATUS NO	✓
2.5	RCC RESET	✓
2.6	TIME SYNC	✓
2.7	UNBALANCE RESET	✓

GENERAL FUNCTIONS

Sl No.	PARTICULARS	AR54
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	RJ45
5.2	Isolated RS 485 Interface	✓
5.3	Communication Protocol Interface- IEC 60870-5-103 & IEC 61850	✓
5.4	GPS Time Sync Facility through IRIG-B	✓
5.5	Date/time synchronization through PC	✓
5.6	Relay programming through Mini USB port	✓
6.	**MONITORING**	
6.1	Line Current (IDMT)	✓
6.2	Unbalance Current	✓
6.5	Counters for each element	✓
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

CONTENTS

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.

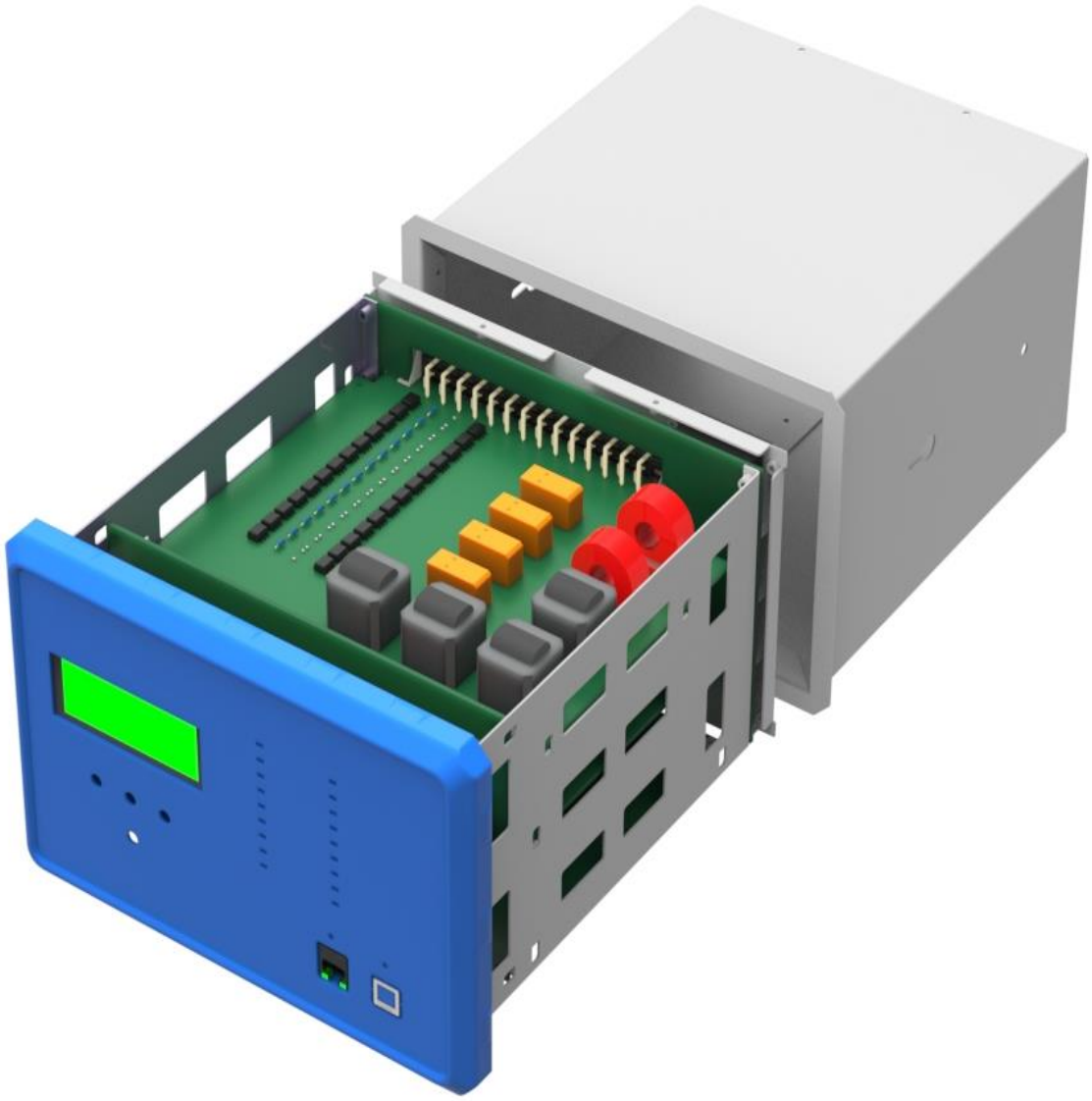
The relay is shipped from factory after detailed testing by our Quality Control Department. However, according to the customer requirement the relay settings/ functions can be verified before commissioning at respective sites with proper testing kits.

STORAGE

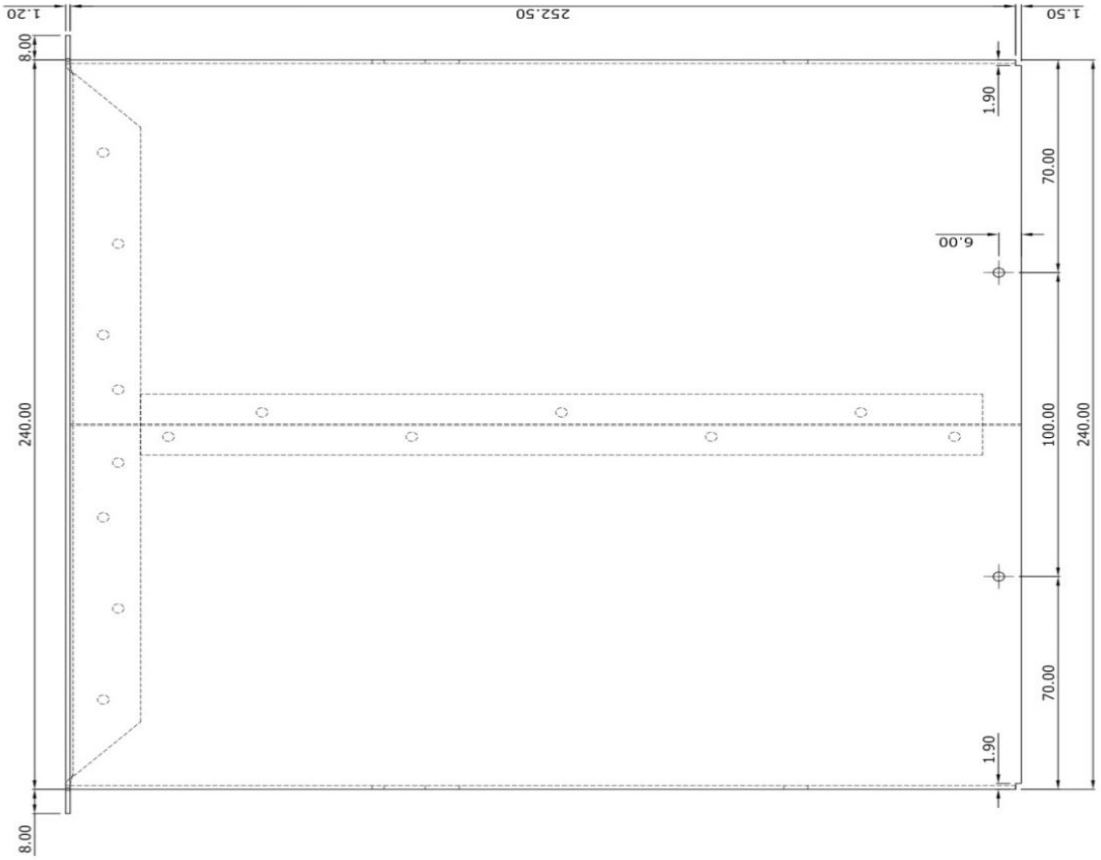
If relays are not to be installed immediately upon receipt they should be stored in a place free from dust and moisture in their original boxes. At most care should be taken while storage.

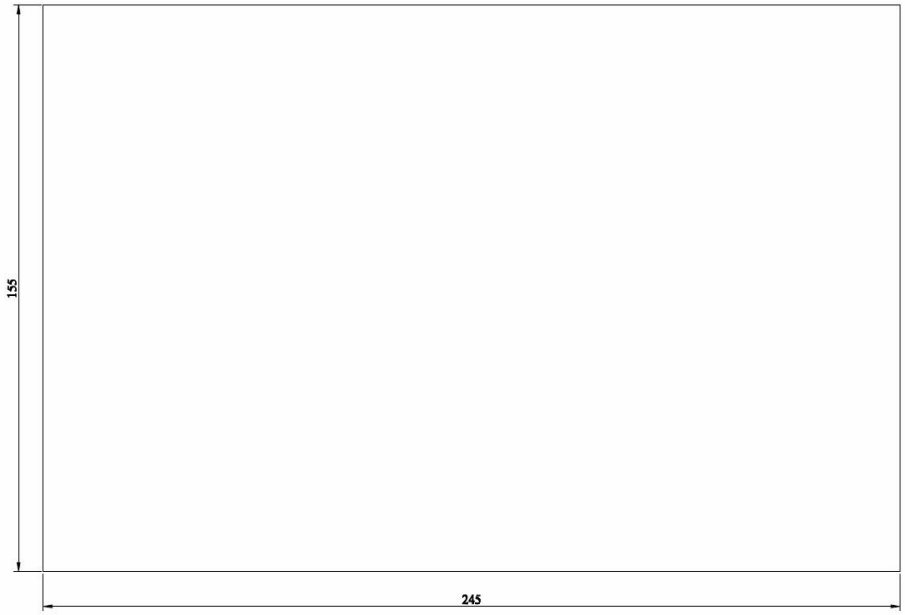
Storage temperature: -25ºC to +55ºC.

RELAY AND RACK MOUNTING



CASE DIMENSIONS





CUT OUT DETAILS

USER GUIDE

AN + SERIES

ALIND

RELAYS DIVISION

CONTENTS

FRONT PANEL INDICATIONS

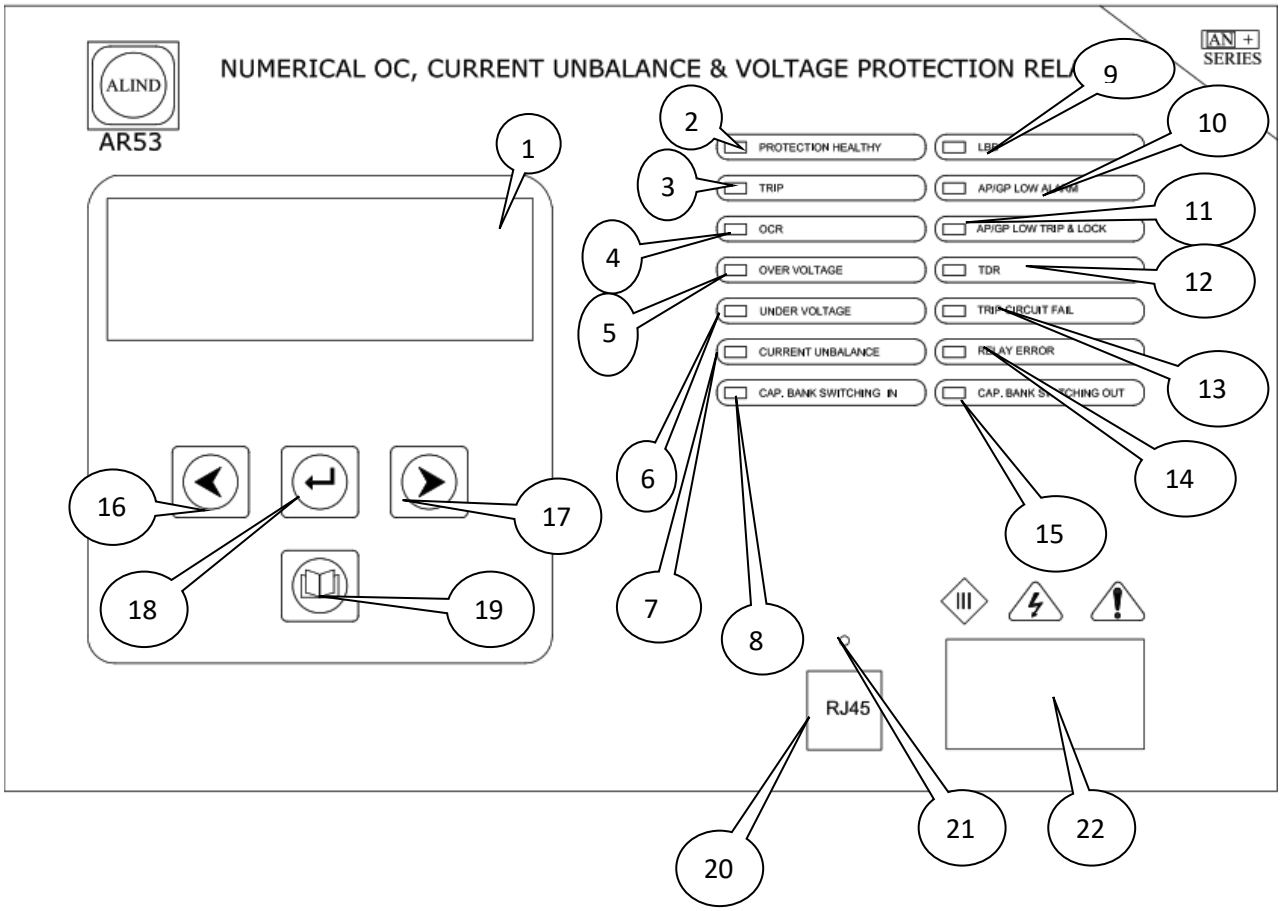
INTERNAL ARCHITECTURE AND BLOCK DIAGRAM

ENERGIZING THE RELAY

PCB DESCRIPTION

RELAY SETTINGS AND ALGORITHM

FRONT PANEL INDICATIONS



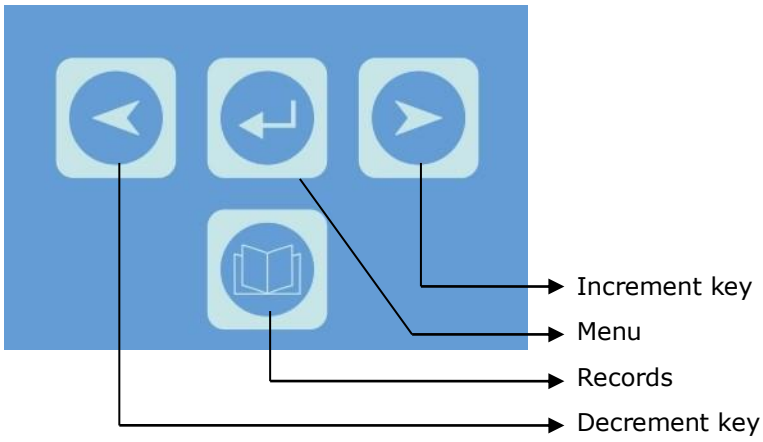
NO	LEGEND	AR53
1.	LCD DISPLAY	✓
2.	PROTECTION HEALTHY (GREEN/AMBER)	✓
3.	TRIP (RED)	✓
4.	OCR (RED)	✓
5.	OVER VOLTAGE (RED)	✓
6.	UNDER VOLTAGE (RED)	✓
7.	CURRENT UNBALANCE (RED)	✓
8.	CAP BANK SWITCHING IN (RED)	✓
9.	LBB (RED)	✓
10.	AP/GP LOW ALARM (RED)	✓
11.	AP/GP LOW TRIP & LOCK (RED)	✓
12.	TDR (RED)	✓
13.	TRIP CIRCUIT FAIL (RED)	✓
14.	RELAY ERROR (RED)	✓
15.	CAP BANK SWITCHING OUT (RED)	✓
16.	<	✓
17.	>	✓
18.	↵	✓
19.	RECORDS	✓
20.	RJ45	✓
21.	H.RST	✓
22.	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 and the display backlit ON time is settable.

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

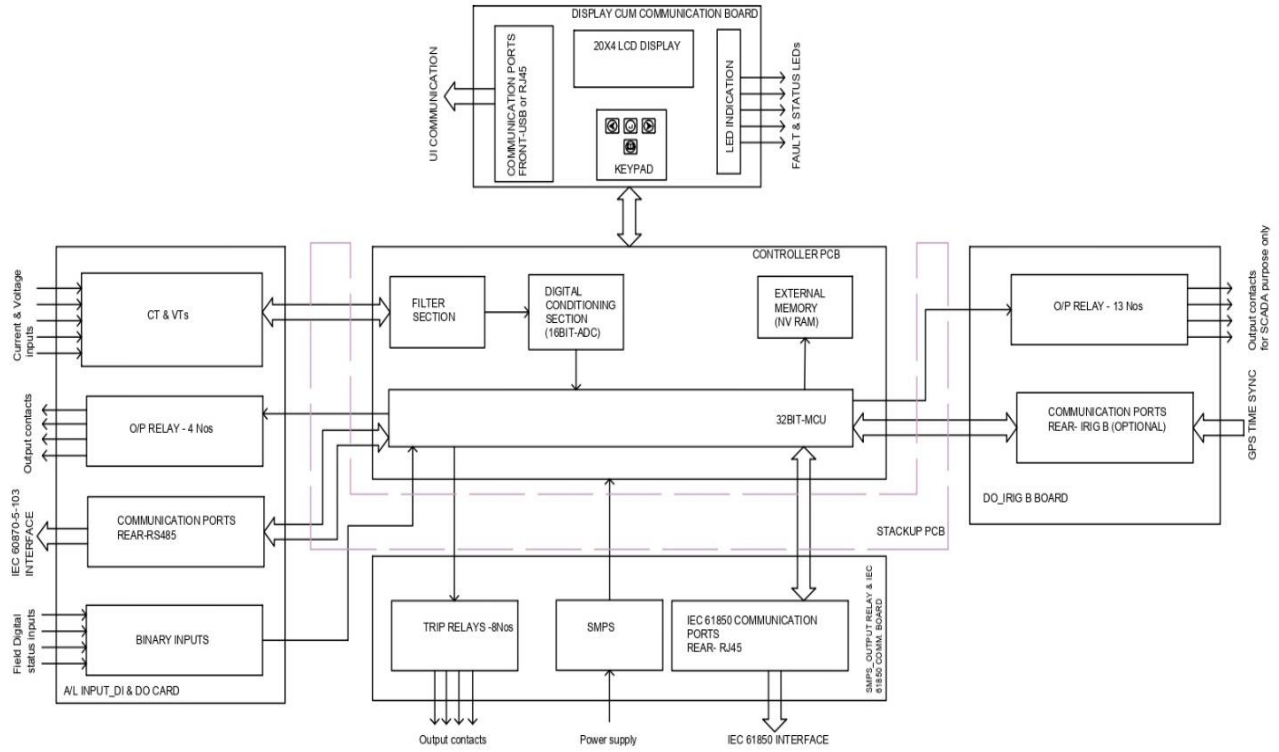
* If you want to lower any particular setting, we can use this option.
* No need to save any unwanted mistakes in the relay you can use this key.
* If you want to verify any previous settings in the relay, you can opt this key.

Records key

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

INTERNAL SYSTEM LEVEL ARCHITECTURE

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

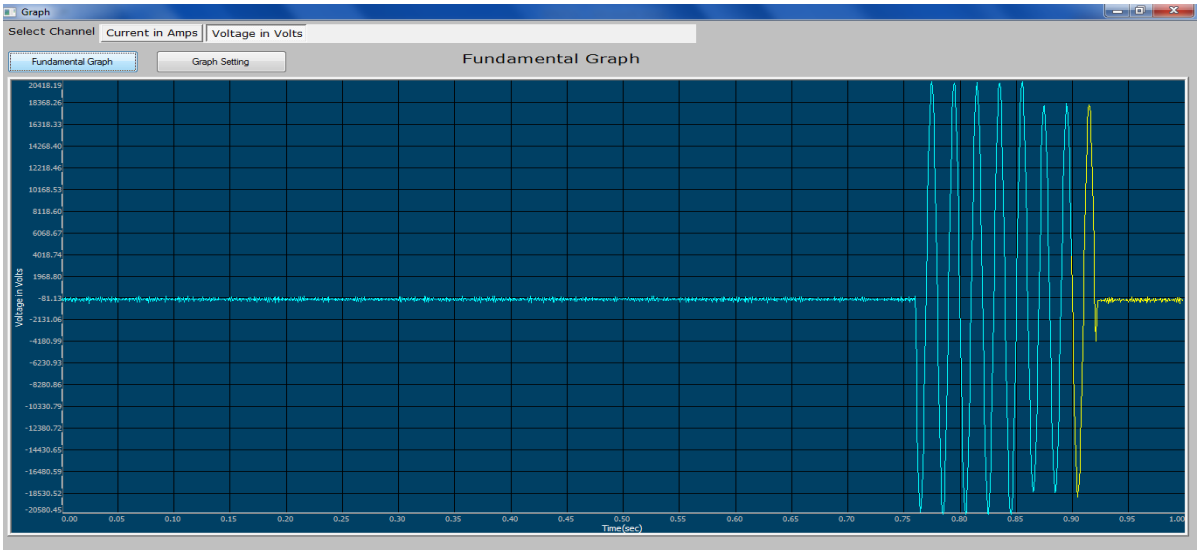
CB Trip

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**. Rated 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.

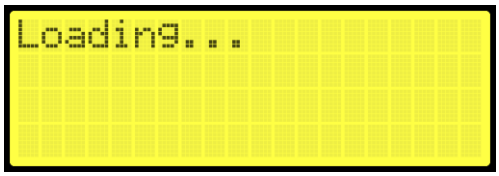
This board (trip relay PCB) will give necessary trip commands to the master trip relay or breaker, which is installed in the yard. Necessary relay initiating signals are wired to these output relays from the Controller Board.

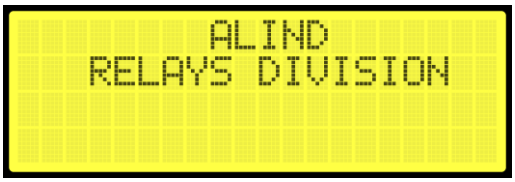
Tele Annu PCB (640 266): All the Telesignalling output circuits are assembled in this PCB. IRIG B circuit also provided in this PCB.

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

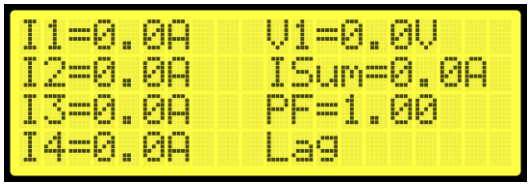
After Power ON, the relay boot screen shows





Then comes the online parameter display

Window:



Setting Mode

Press and hold ↵ for 5 seconds

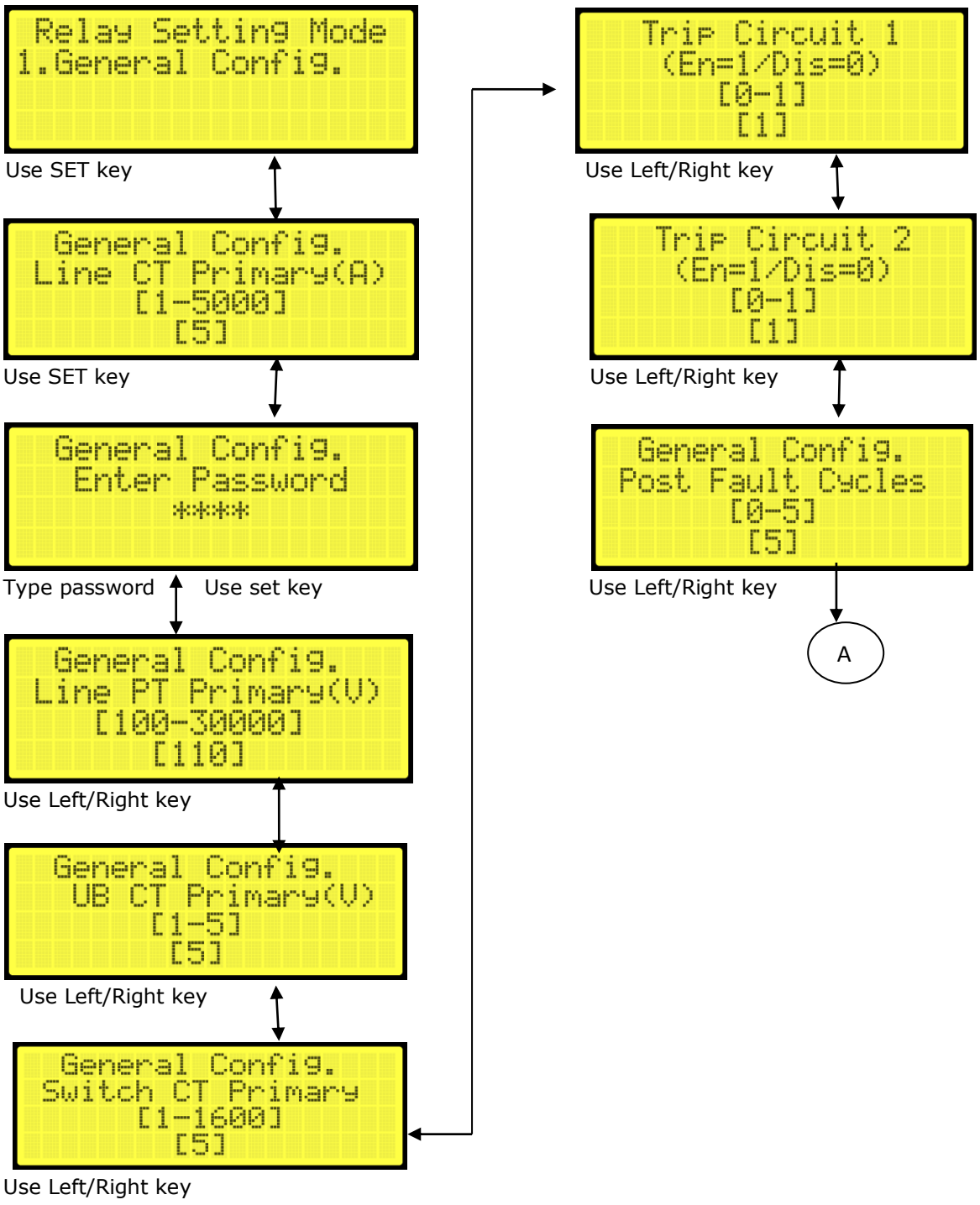
Relay will enter to setting mode.

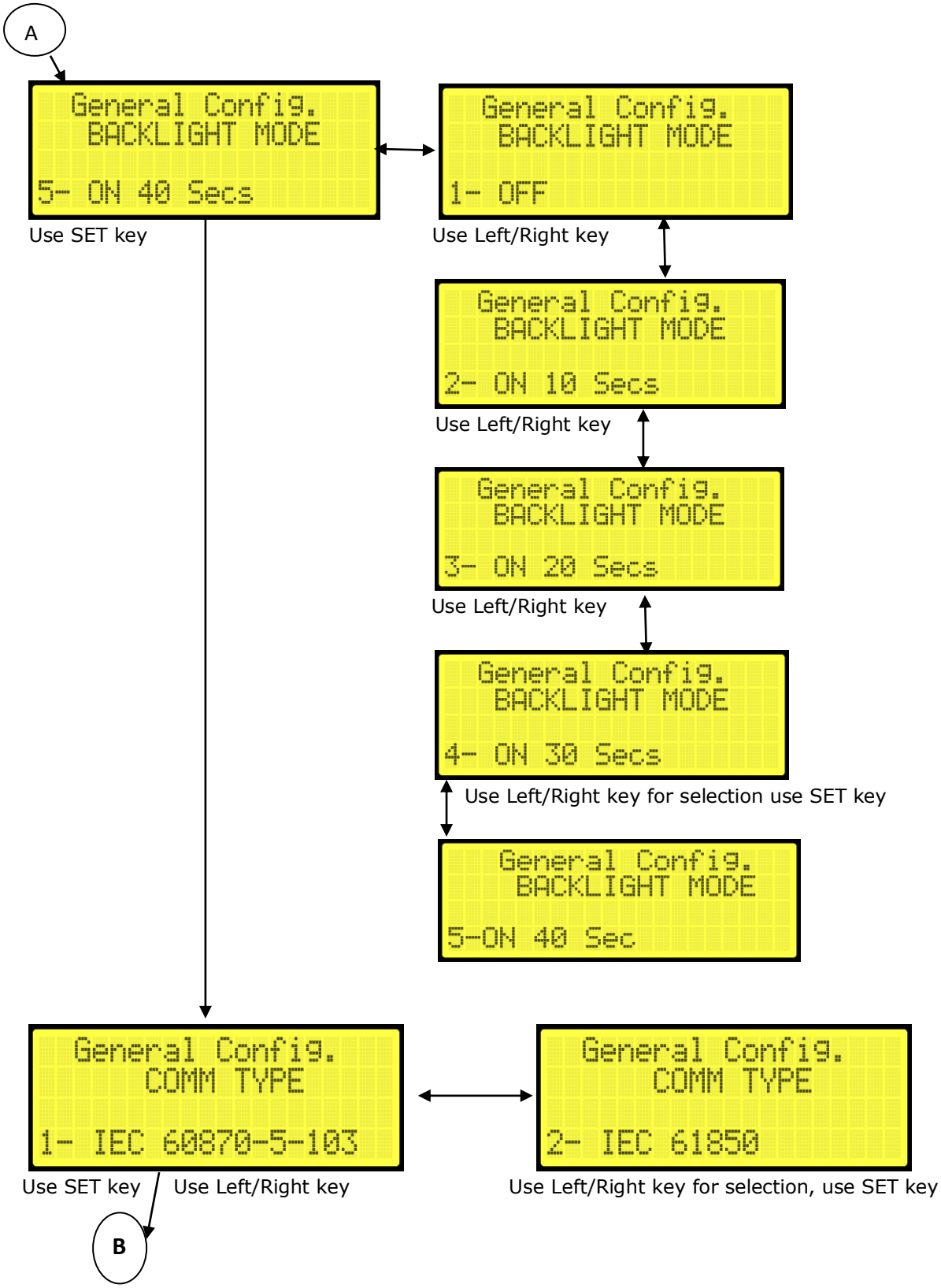
Enter the password and press ↵ key. The default password setting is '1000'

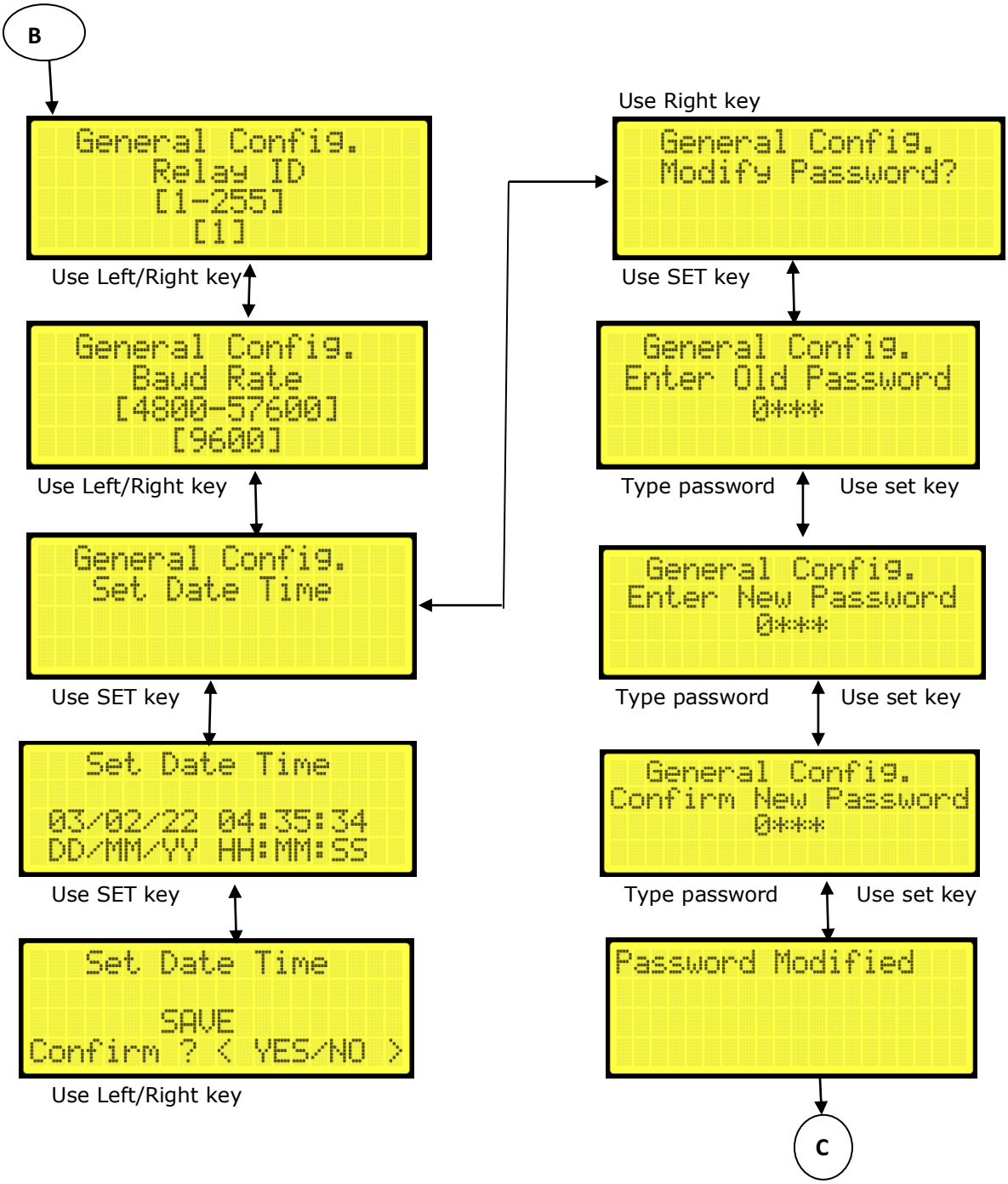
To change settings:

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.

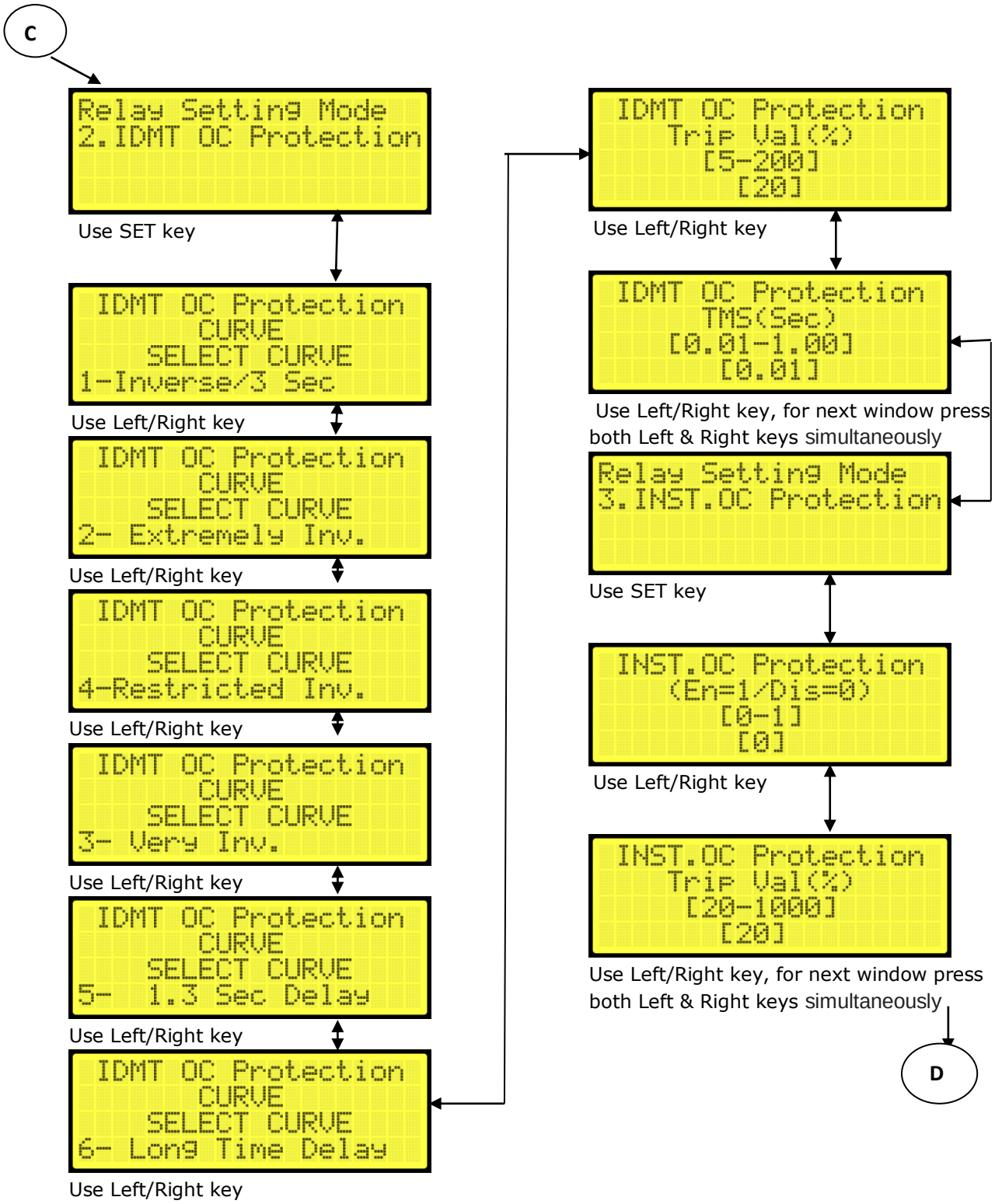
Relay Settings Algorithm

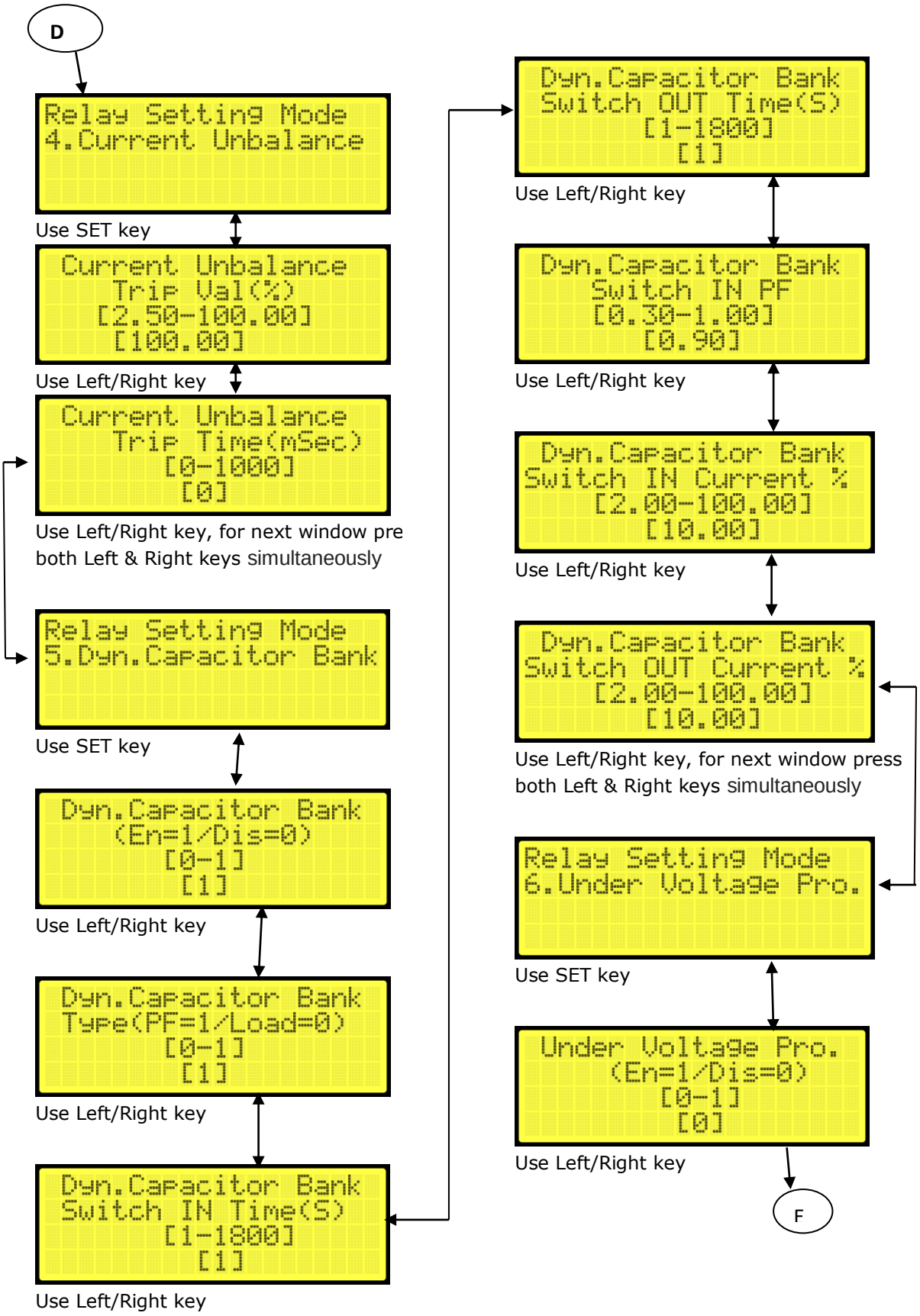


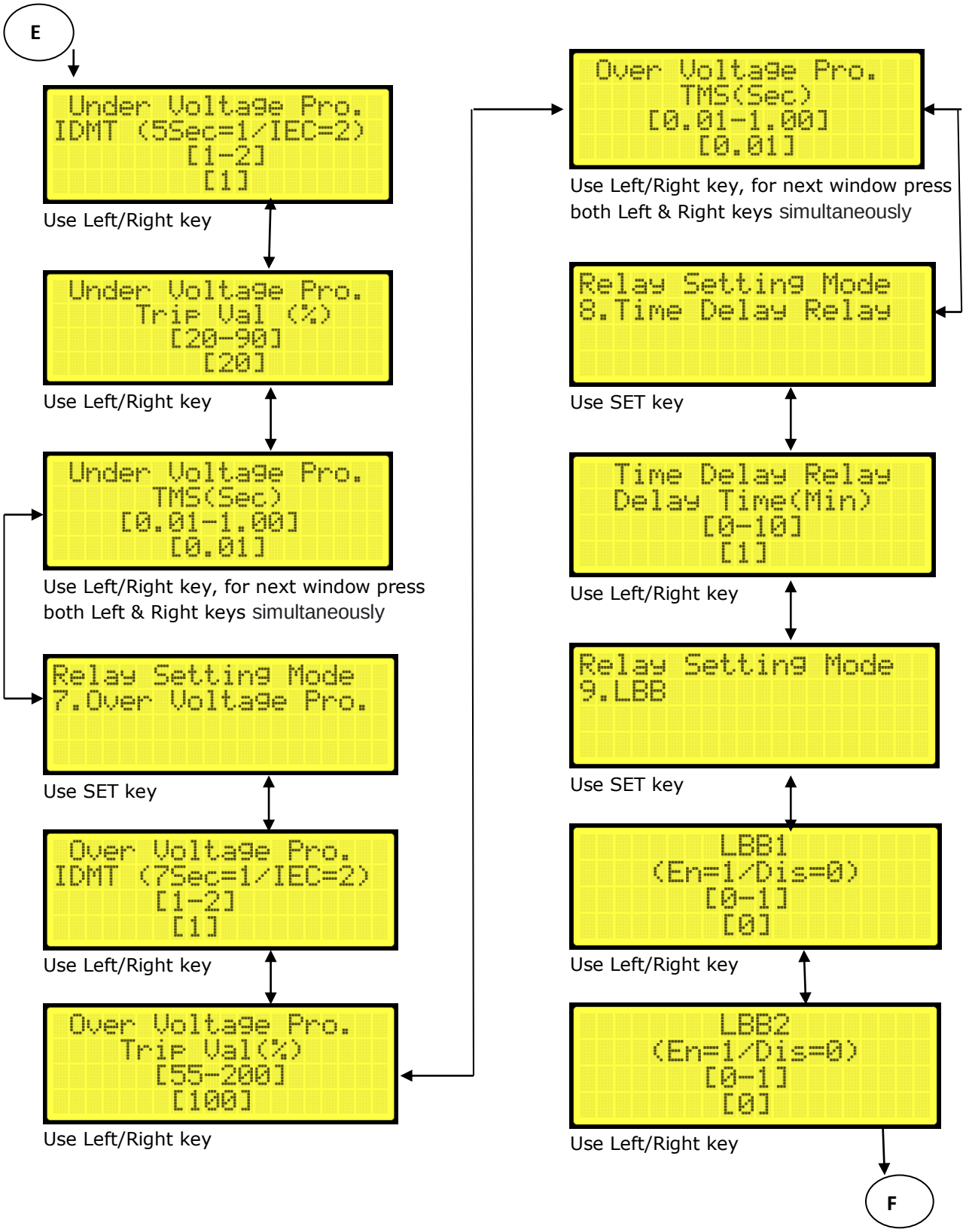

A
General Config.
BACKLIGHT MODE
5- ON 40 Secs
Use SET key
General Config.
BACKLIGHT MODE
1- OFF
Use Left/Right key
General Config.
BACKLIGHT MODE
2- ON 10 Secs
Use Left/Right key
General Config.
BACKLIGHT MODE
3- ON 20 Secs
Use Left/Right key
General Config.
BACKLIGHT MODE
4- ON 30 Secs
Use Left/Right key for selection use SET key
General Config.
BACKLIGHT MODE
5-ON 40 Sec
General Config.
COMM TYPE
1- IEC 60870-5-103
Use SET key
Use Left/Right key
B
General Config.
COMM TYPE
2- IEC 61850
Use Left/Right key for selection, use SET key

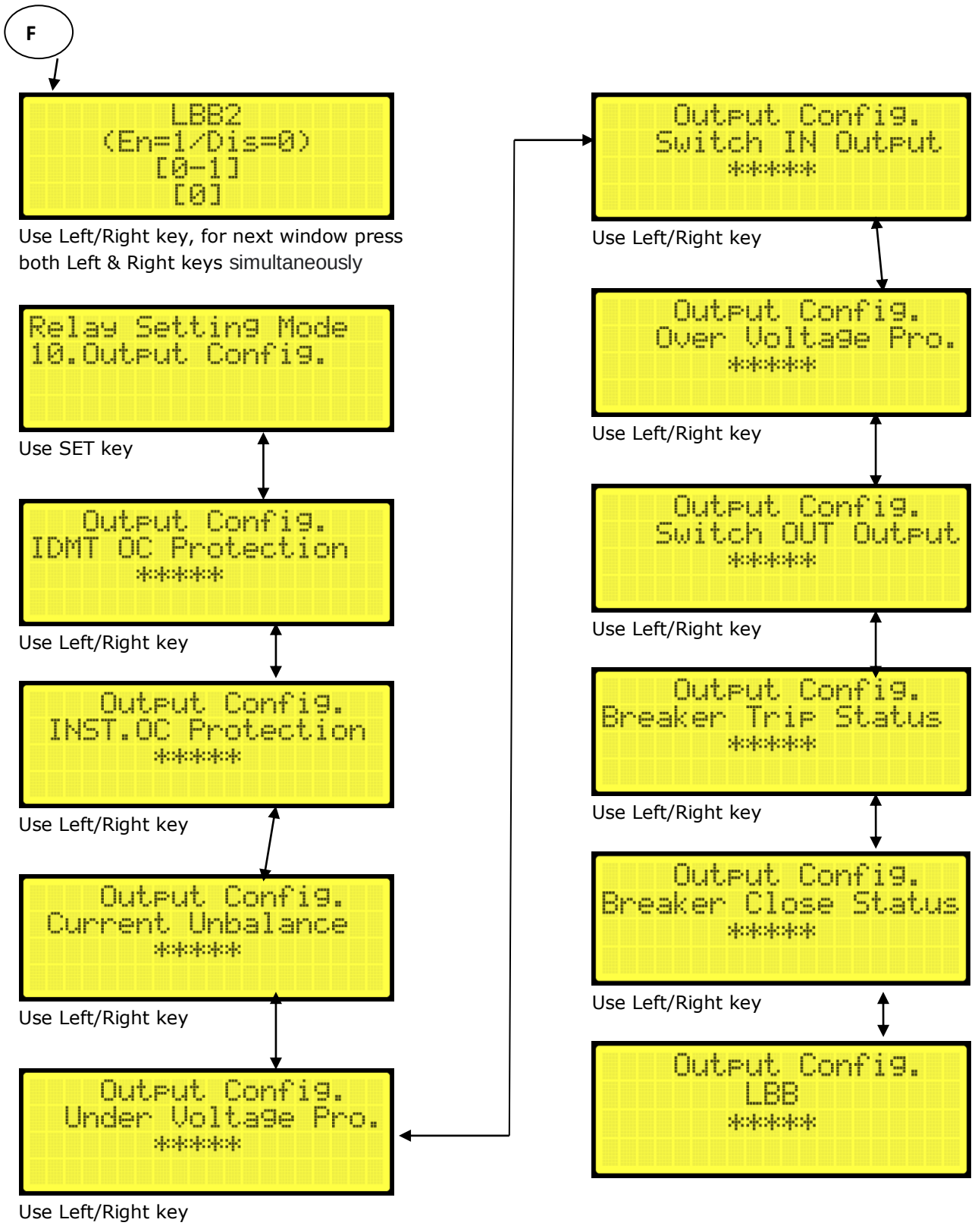


Use Left/Right key, for next window press both Left & Right keys simultaneously


C
Relay Setting Mode
2.IDMT OC Protection
Use SET key
IDMT OC Protection
CURVE
SELECT CURVE
1-Inverse/3 Sec
Use Left/Right key
IDMT OC Protection
CURVE
SELECT CURVE
2- Extremely Inv.
Use Left/Right key
IDMT OC Protection
CURVE
SELECT CURVE
4-Restricted Inv.
Use Left/Right key
IDMT OC Protection
CURVE
SELECT CURVE
3- Very Inv.
Use Left/Right key
IDMT OC Protection
CURVE
SELECT CURVE
5- 1.3 Sec Delay
Use Left/Right key
IDMT OC Protection
CURVE
SELECT CURVE
6- Long Time Delay
Use Left/Right key
IDMT OC Protection
Trip Val(%)
[5-200]
[20]
Use Left/Right key
IDMT OC Protection
TMS(Sec)
[0.01-1.00]
[0.01]
Use Left/Right key, for next window press both Left & Right keys simultaneously
Relay Setting Mode
3.INST.OC Protection
Use SET key
INST.OC Protection
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
INST.OC Protection
Trip Val(%)
[20-1000]
[20]
Use Left/Right key, for next window press both Left & Right keys simultaneously
D

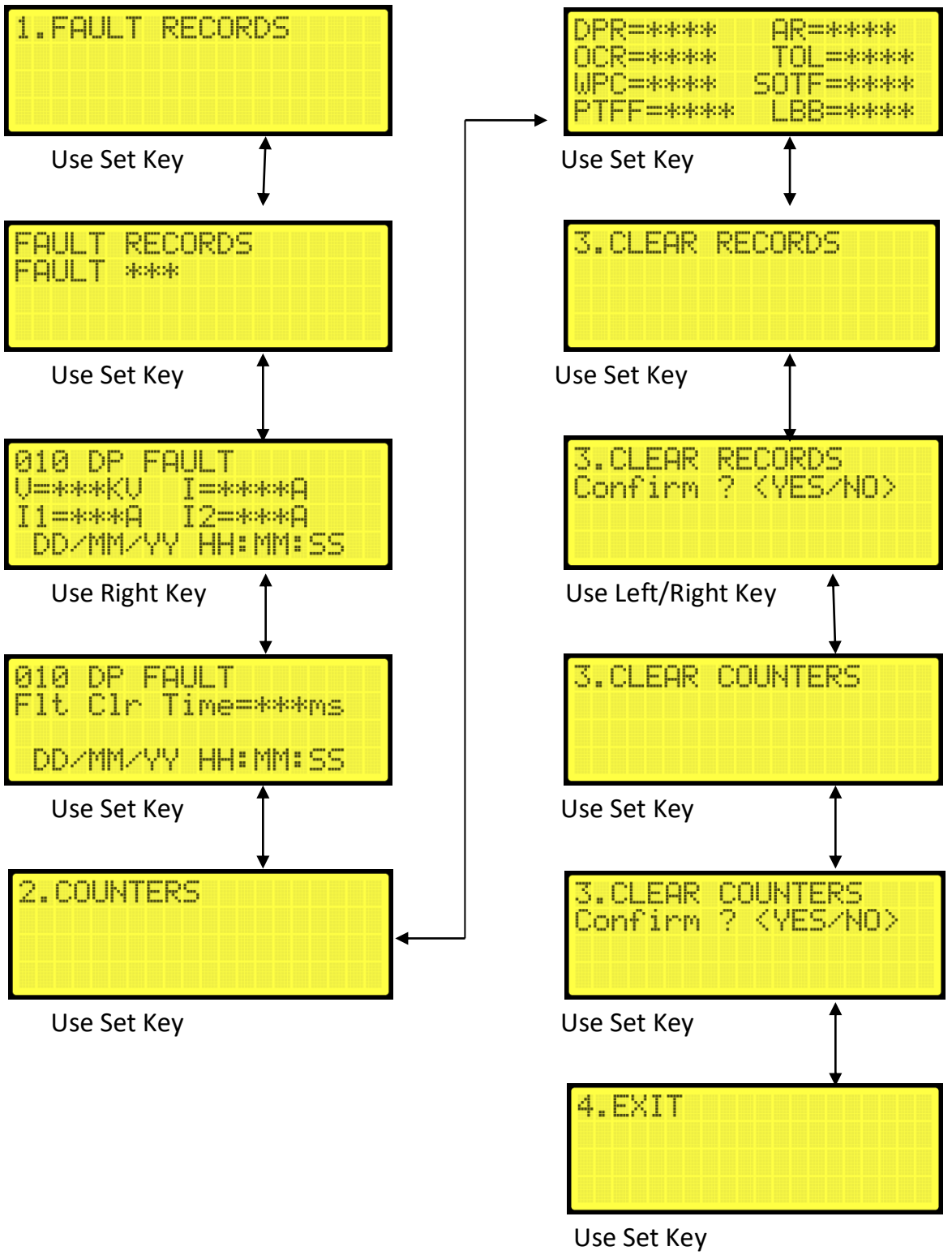

D
Relay Setting Mode
4.Current Unbalance
Use SET key
Current Unbalance
Trip Val(%)
[2.50-100.00]
[100.00]
Use Left/Right key
Current Unbalance
Trip Time(mSec)
[0-1000]
[0]
Use Left/Right key, for next window pre
both Left & Right keys simultaneously
Relay Setting Mode
5.Dyn.Capacitor Bank
Use SET key
Dyn.Capacitor Bank
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
Dyn.Capacitor Bank
Type(PF=1/Load=0)
[0-1]
[1]
Use Left/Right key
Dyn.Capacitor Bank
Switch IN Time(S)
[1-1800]
[1]
Use Left/Right key
Dyn.Capacitor Bank
Switch OUT Time(S)
[1-1800]
[1]
Use Left/Right key
Dyn.Capacitor Bank
Switch IN PF
[0.30-1.00]
[0.90]
Use Left/Right key
Dyn.Capacitor Bank
Switch IN Current %
[2.00-100.00]
[10.00]
Use Left/Right key
Dyn.Capacitor Bank
Switch OUT Current %
[2.00-100.00]
[10.00]
Use Left/Right key, for next window press
both Left & Right keys simultaneously
Relay Setting Mode
6.Under Voltage Pro.
Use SET key
Under Voltage Pro.
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
F


E
Under Voltage Pro.
IDMT (5Sec=1/IEC=2)
[1-2]
[1]
Use Left/Right key
Under Voltage Pro.
Trip Val (%)
[20-90]
[20]
Use Left/Right key
Under Voltage Pro.
TMS(Sec)
[0.01-1.00]
[0.01]
Use Left/Right key, for next window press both Left & Right keys simultaneously
Relay Setting Mode
7.Over Voltage Pro.
Use SET key
Over Voltage Pro.
IDMT (7Sec=1/IEC=2)
[1-2]
[1]
Use Left/Right key
Over Voltage Pro.
Trip Val(%)
[55-200]
[100]
Use Left/Right key
Over Voltage Pro.
TMS(Sec)
[0.01-1.00]
[0.01]
Use Left/Right key, for next window press both Left & Right keys simultaneously
Relay Setting Mode
8.Time Delay Relay
Use SET key
Time Delay Relay
Delay Time(Min)
[0-10]
[1]
Use Left/Right key
Relay Setting Mode
9.LBB
Use SET key
LBB1
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
LBB2
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
F


F
LBB2
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key, for next window press both Left & Right keys simultaneously
Relay Setting Mode
10.Output Config.
Use SET key
Output Config.
IDMT OC Protection
*****
Use Left/Right key
Output Config.
INST.OC Protection
*****
Use Left/Right key
Output Config.
Current Unbalance
*****
Use Left/Right key
Output Config.
Under Voltage Pro.
*****
Use Left/Right key
Output Config.
Switch IN Output
*****
Use Left/Right key
Output Config.
Over Voltage Pro.
*****
Use Left/Right key
Output Config.
Switch OUT Output
*****
Use Left/Right key
Output Config.
Breaker Trip Status
*****
Use Left/Right key
Output Config.
Breaker Close Status
*****
Use Left/Right key
Output Config.
LBB
*****

To access & clear logs

Use this key

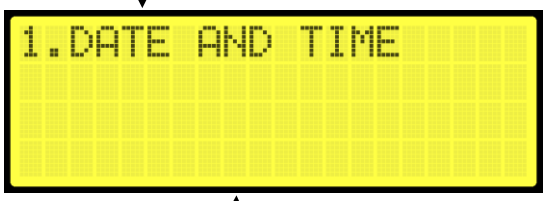


To view device Info.

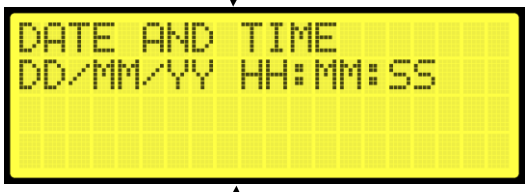
Use Right Key

For Relay healthiness check & I/O Verification

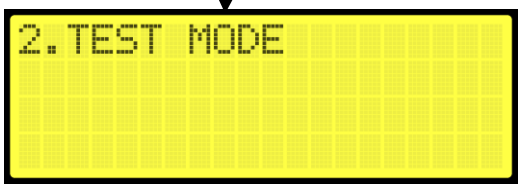
Use this key



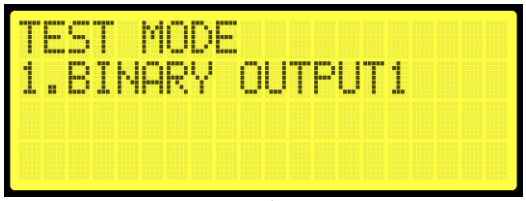
Use Set Key



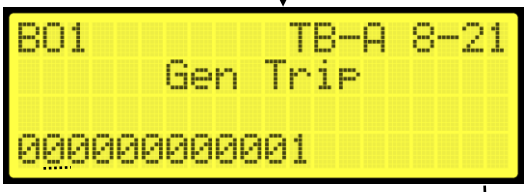
Use Right Key



Use Set Key

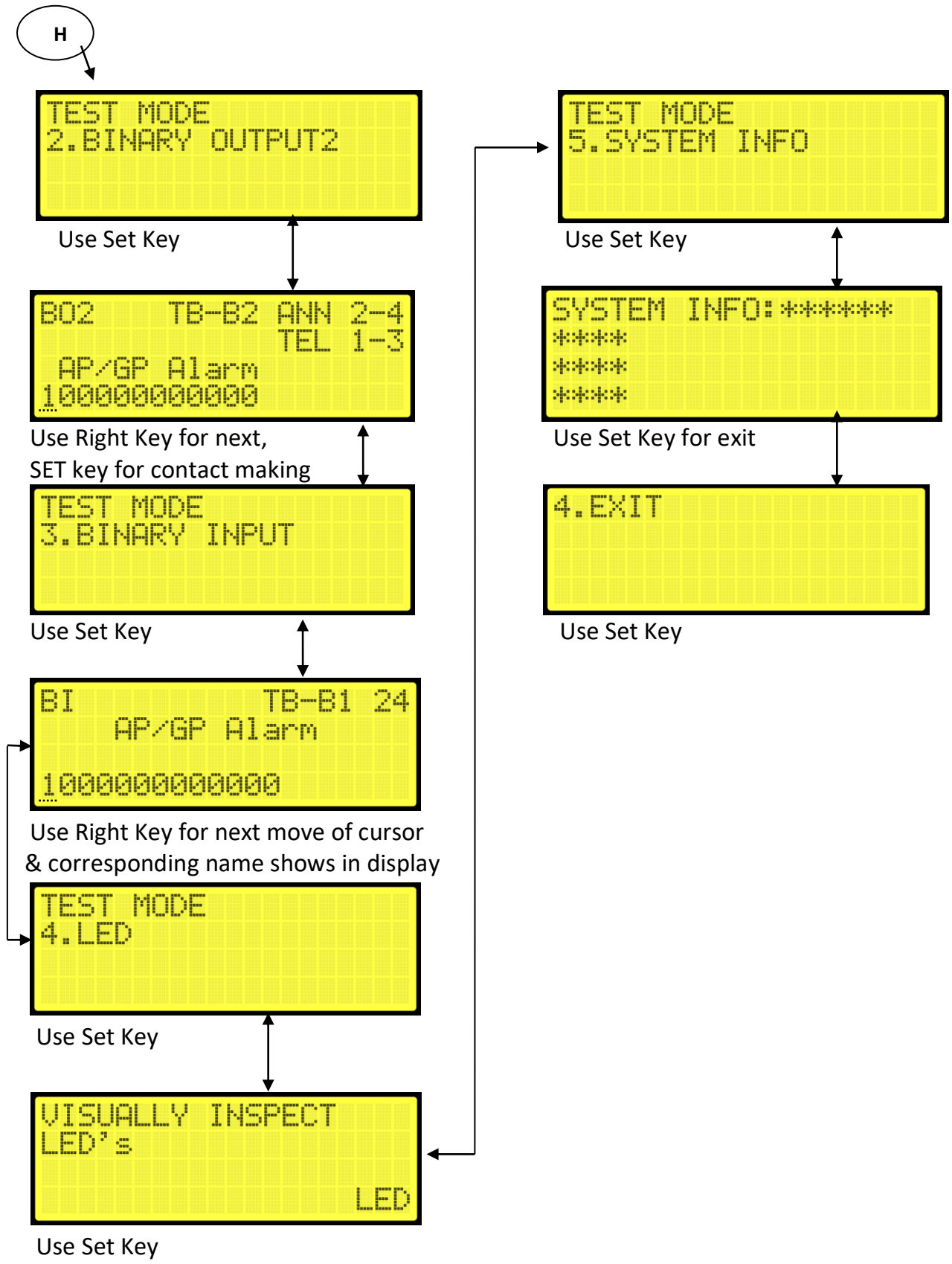


Use Set Key



Use Right Key for next,
SET key for contact making

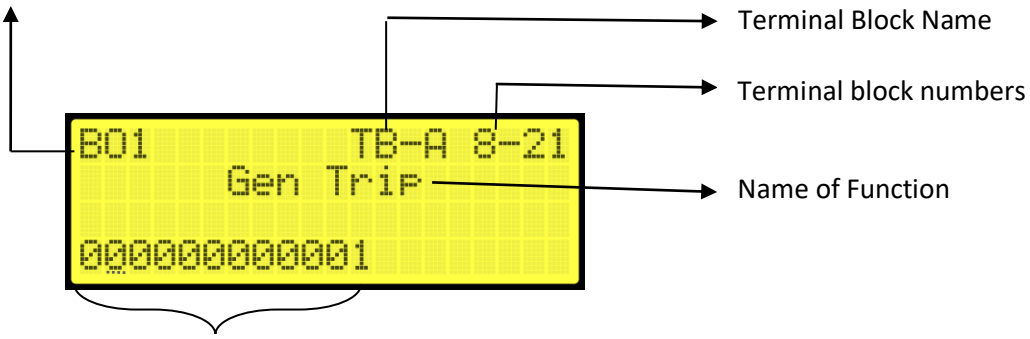
H


H
TEST MODE
2.BINARY OUTPUT2
Use Set Key
BO2 TB-B2 ANN 2-4
TEL 1-3
AP/GP Alarm
1000000000000
Use Right Key for next,
SET key for contact making
TEST MODE
3.BINARY INPUT
Use Set Key
BI TB-B1 24
AP/GP Alarm
1000000000000000
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
TEST MODE
5.SYSTEM INFO
Use Set Key
SYSTEM INFO:******
****
****
****
Use Set Key for exit
4.EXIT
Use Set Key

Binary Output & Input Details

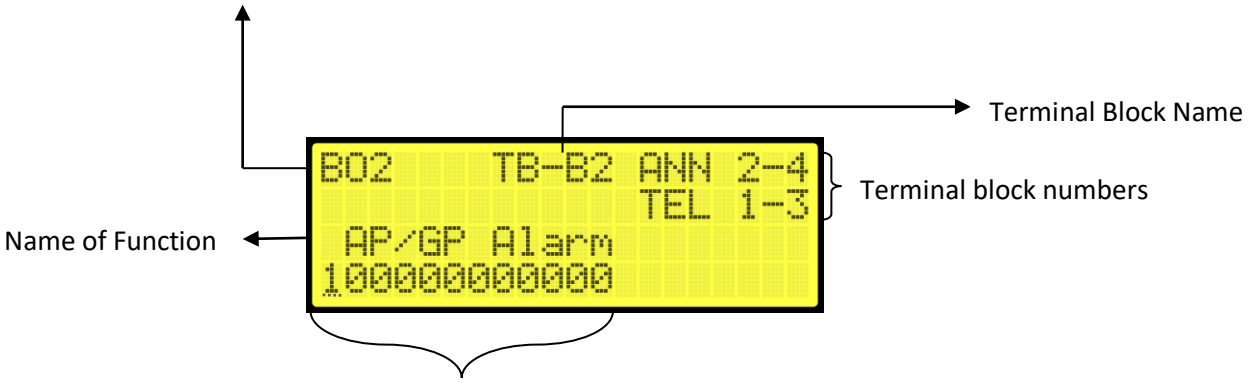
Binary Output 1			Binary Output 2			Binary Input		
BO1	NAME	TB NUMBER	BO2	NAME	TB NUMBER	BI	NAME	TB NUMBER
1	NIL		1	AP/GP Alarm	TB B2 - 1 & 3 , 2 & 4	1	AP/GP Alarm	TB B1 - 24
2	Gen Trip	TB A - 8 & 21	2	AP/GP Trip & LOCK	TB B2 - 1 & 5 , 2 & 6	2	AP/GP Trip & LOCK	TB B1 - 21
3	Trip Spare	TB A- 9 & 20	3	IDMT OCR	TB B2 - 1 & 7 , 2 & 8	3	UB Reset	TB B1 - 22
4	Switch in-1	TB A- 10 & 19	4	UV	TB B2 - 1 & 9 , 2 & 10	4	CB Open	TB B1 - 19
5	Switch out-1	TB A- 11 & 18	5	OV	TB B2 - 1 & 11 , 2 & 12	5	CB Close	TB B1 - 20
6	LBB 1	TB A- 12 & 17	6	UB	TB B2 - 1 & 13 , 2 & 14	6	RCC Reset	TB B1 - 17
7	Switch in-2	TB A- 13 & 16	7	Switch in	TB B2 - 1 & 15 , 2 & 16	7	NIL	
8	Switch out-2	TB A- 14 & 15	8	TCS	TB B2 - 1 & 17 , 2 & 18	8	NIL	
9	Unbalance (NC)	TB B1 - 3 & 4	9	LBB	TB B2- 1 & 19 , 2 & 20	9	NIL	
10	TDR (NC)	TB B1 - 5 & 6	10	Switch out	TB B2 - 1 & 21 , 2 & 22	10	NIL	
11	LBB 2	TB B1 - 7 & 8	11	Inst. OCR	TB B2 - 1 & 23 , 2 & 24	11	NIL	
12	Relay Error	TB B1 - 1 & 2	12	NIL		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.

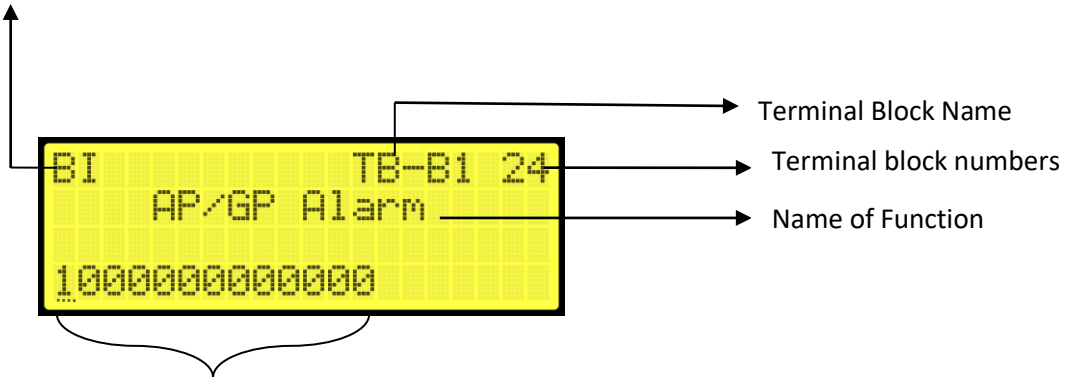
Binary Output 2



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

RELAY CONFORMING STANDARDS

DESCRIPTION OF PROTECTION FUNCTIONS

AR53 Relay is a comprehensive over current, current unbalance and Voltage Protection relay for the protection of 25 KV Capacitor bank

1. IDMT Over Current Protection

1.1 The IDMT element use standard inverse of characteristics (3 sec Delay Curve). It's graphical representation as shown in Figure.

For Standard inverse characteristics, as per IEC trip time is as follows

$t = TMS*K/((PSM)^{\alpha} - 1)$

The values of coefficients K and α for the different curves are as seen in table below

For Railway applications, the Standard Inverse formulae can be modified as,

$t = 3*TMS/\log[PSM]$

TMS= Time Multiplier Setting (TMS)

t = Operating time in second

TMS = Time multiplier setting

PSM=Fault Current/Plug Setting

Relay Operating Characteristics	K	α
Standard Inverse	0.14	0.02
Very Inverse	13.5	1
Extremely Inverse	80	2
Long Time Inverse	120	1

Other than IEC curves the following characteristics also available in the module

1.2 Restricted Inverse curve

$t = TMS/(0.339 - (0.238/PSM))$

where

TMS= Time Multiplier Setting (TMS)

t = Operating time in second

TMS = Time multiplier setting

PSM=Fault Current/Plug Setting

1.3 1.3 second delay curve

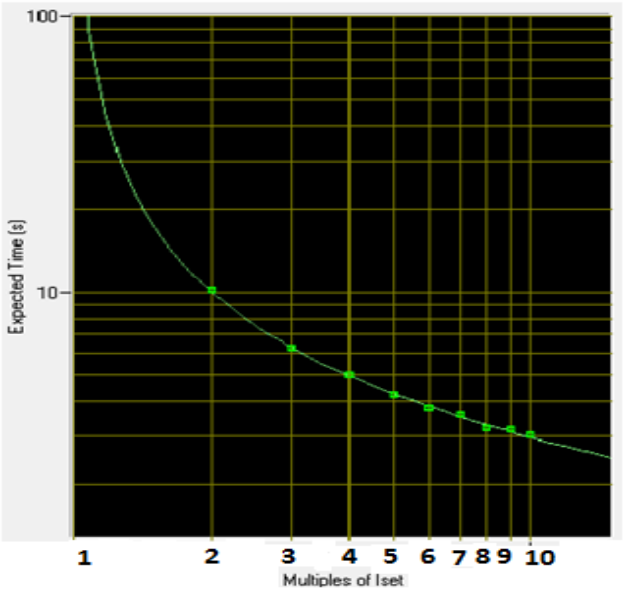
$t = 1.3*TMS/\log[PSM]$

TMS= Time Multiplier Setting (TMS)

t = Operating time in second

TMS = Time multiplier setting

PSM=Fault Current/Plug Setting



2. Inst. Over current Protection

This element provides instantaneous operation for any earth fault condition.

3. Current unbalance Protection

The capacitor bank is protected by means of an unbalance current protection. The capacitor bank is connected as a bridge and an unbalance sensing current transformer is provided. The current is settable from 2.5 to 100% in steps of 0.50 % and operating time from 0 to 1 sec in steps of 1ms.

4. Capacitor Bank Switching IN/OUT

Microcontroller based Intelligent Automatic Power Factor monitoring Relay with on-line monitoring of load current. The Unit uses one of the tried and time tested intelligent algorithms to switch the capacitor banks, in a most optimum combination in a shortest time for any dynamic load conditions without the need to select the switching by user.

The capacitor banks shall be switched ON/OFF based on the current or Power factor to avoid the flow of leading reactive power during no-load/ lightly loaded conditions causing the poor average power factor. Dynamic switching function in relay provided an automatic switching of capacitor banks based on the current or power factor in the section. Relay shall take the magnitude of sum of all the feeder current in the TSS as current input for automatic switching. The power factor shall be monitored based on the cosine of angle between resultant vectors by getting sum of all feeder current with the LV bus voltage. This function shall have an ENABLE/DISABLE setting in the relay. There shall be 2 independent stages with independent output contacts for Switching ON& OFF upto 2 capacitor bank units.

Thus Capacitor banks can be connected to the system based on the above pattern. Switches on/off the necessary capacitor banks depending upon the load current or PF, the target power factor can be achieved effectively.

5. Over voltage protection

The relay provides protection against over voltage with an over voltage element of inverse time characteristics. The over voltage relay is energized from the potential transformer connected to the main bus bar on the incoming side of the circuit breaker. The over voltage setting ranges from 100 to 200 % in steps of 1% and the time multiplier setting from 0.01 to 1.0 in steps of 0.01.

Two types of curves used are,

a) **<u>As per IEC 60255-127</u>**

$$\boldsymbol{Trip\ time} = \frac{T}{\frac{G}{Gs} - 1}$$

b) **<u>As per RDSO spec - 7 sec Delay curve</u>**

Trip time = 7.0 seconds for 1.5 G/Gs at TMS = 1

T= TMS
G/Gs=Injected Voltage/Set Voltage

6. Under voltage protection

An under voltage element with inverse time characteristics is provides protection against under voltage. The voltage setting ranges from 20 to 90% in steps of 1% and TMS from0.01 to 1.0sec in steps of 0.01.

Two types of curves used are,

a) **As per IEC 60255-127**

$$Trip\ time = \frac{T}{1-(\frac{G}{Gs})}$$

b) **As per RDSO spec - 5 sec Delay curve**

Trip time = 5.0 seconds for no Voltage at TMS = 1

T= TMS
G/Gs=Injected Voltage/Set Voltage

TECHNICAL SPECIFICATIONS

Sl.No	Specification	REF.	Particulars
1.	**Auxiliary Supply**	V_{DC}	45 to 260VDC
2.	**Current Input (rated)** **Voltage Input (rated)**	I V	5A AC-Line CT 1A AC- Unbalance CT 110V AC – LINE PT
3.	**Frequency**	Fn	50 Hz
4.	**VA Burden on CT & PT**		Less than 0.5 VA
5.	**VA burden on Aux**		Less than 15 Watts (energized) Less than 10 watts (de-energized)
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; 20A
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		≥1 000 W at L/R = 40 ms
	c) Breaking Capacity at 110V DC		≥30 W at L/R = 40 ms
11.	**Type of communication ports**		RJ45 (front) and RS485& RJ45 (Rear)
12.	**Overall dimensions** Width Height Depth		 263 mm 173 mm 300 mm
13.	**Weight**		4.8 kg approx.

RELAY SETTINGS

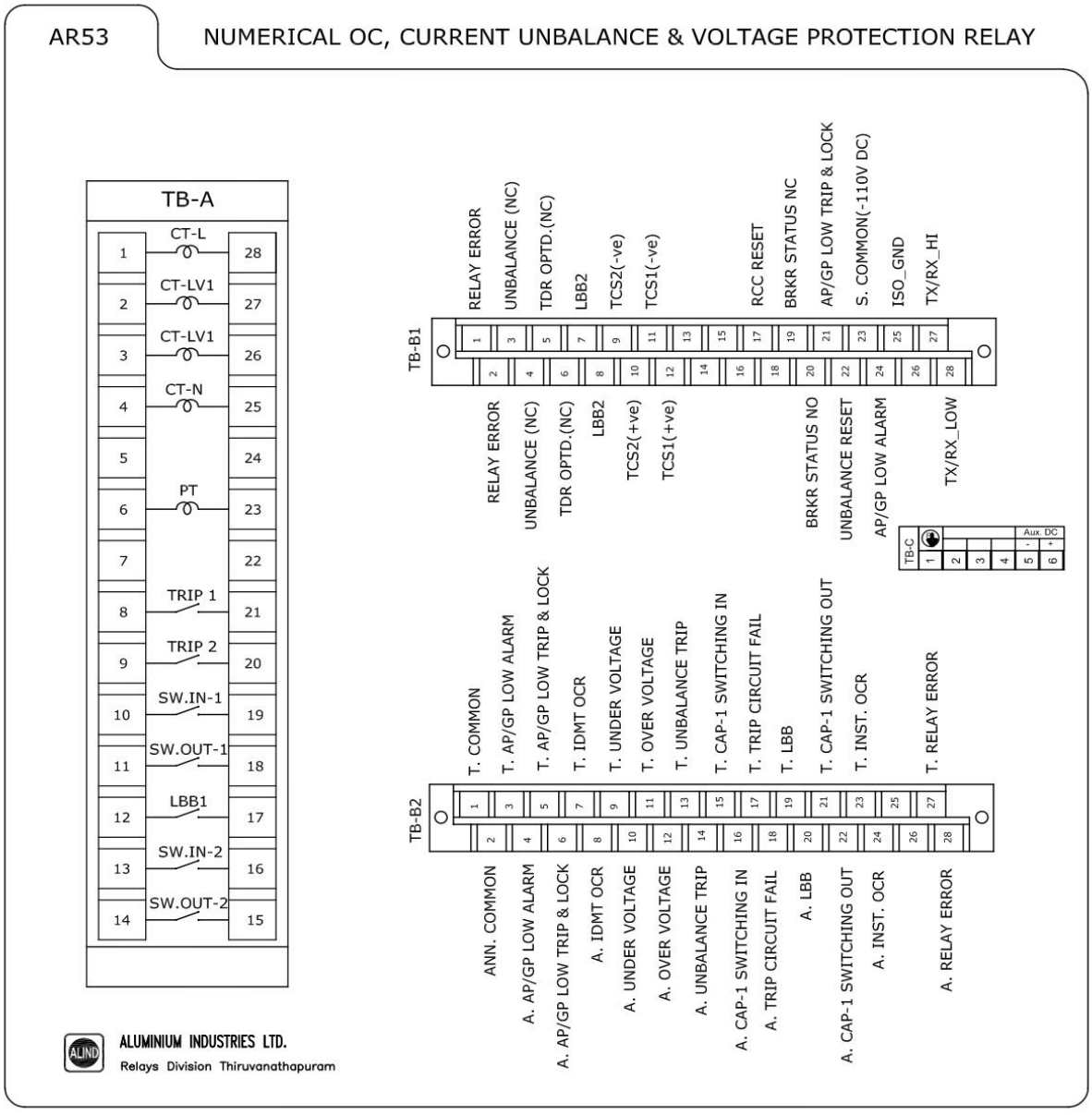
Settings	Particulars
Password protection (YES/NO)	**0000-9999**
1. General config.	
Line CT Primary	5A to 5000A in steps of 5A
Line CT Secondary	1A or 5A
Line PT Primary	100 -30000V in steps of 10V
Line PT Secondary	100V or 110V
Unbalance CT Primary	1A to 5A in steps of 1A
Unbalance CT Secondary	1A to 5A in steps of 1A
Trip Ckt Supervision 1	Enable/Disable
Trip Ckt Supervision 2	Enable/Disable
Post fault cycles	0-5 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	(Yes/No) DD/MM/YY HH:MM:SS
Modify Password	
2. IDMT OC Protection	
IDMT Curve	1- Normal Inverse
	2- Extremely Inverse
	3- Very Inverse
	4- Restricted Inverse
	5- 3 Sec Delay

	6- 1.3 Sec Delay
	7- Long Time Delay
Trip Val (%)	5-200% in steps of 1%
TMS	0.01-1 insteps of 0.01 s
3. INST. OC Protection	
	20 to 1000% in steps of 1%

4.Current Unbalance		
Trip Val (%)		2.50 to 100% in steps of 0.5%
Trip Time (mSec)		0 to 1000 mSec in steps of 1 mSec
5.Dynamic Capacitor Bank Switching		**(EN/DIS)**
Type		PF / Load
Switch IN Time		1-1800Sec in steps of 1Sec
Switch OUT Time		1-1800Sec in steps of 1Sec
PF based Switching	Switch IN PF	0.30 to 1.00 in steps of 0.01
	Switch IN current	2-100% in steps of 1%
	Switch OUT current	2-100% in steps of 1%
Load based Switching	Switching in current	2 to 100% in steps of 0.1%
	Switching out current	2 to 100% in steps of 0.1%
6.Under Voltage protection		
UV		EN/DIS
IDMT characteristics		1 – 5 Sec delay curve 2 – IEC curve
Trip Val (%)		20 to 90% in steps of 1%
TMS (Sec)		0.01 to 1.00 Sec in steps of 0.01 Sec
7.Over Voltage protection		
IDMT characteristics		1 – 7 Sec delay curve 2 – IEC curve

Trip Val (%)	100 to 200% in steps of 1%
TMS (Sec)	0.01 to 1.00 Sec in steps of 0.01 Sec
8. Time Delay Relay	
Delay Time (min)	0 to 10 min in steps of 1 min
9. LBB	
LBB1	EN/DIS
LBB2	EN/DIS
Trip Time	0-5000 in steps of 1mSec
Operating Time	
i) IDMT OCR Protection	Depends on curve & TMS setting
ii) Inst. OCR Protection	Within 25ms for 5 times current
iii) Current Unbalance Protection	As per Time setting
iv) Under Voltage Protection	Depends on curve & TMS setting
v) Over Voltage Protection	Depends on curve & TMS setting
vi) LBB	Depends on Time setting

TB DETAILS


AR53
NUMERICAL OC, CURRENT UNBALANCE & VOLTAGE PROTECTION RELAY
TB-A
CT-L
CT-LV1
CT-LV1
CT-N
PT
TRIP 1
TRIP 2
SW.IN-1
SW.OUT-1
LBB1
SW.IN-2
SW.OUT-2
TB-B1
RELAY ERROR
UNBALANCE (NC)
TDR OPTD.(NC)
LBB2
TCS2(-ve)
TCS1(-ve)
RCC RESET
BRKR STATUS NC
AP/GP LOW TRIP & LOCK
S. COMMON(-110V DC)
ISO_GND
TX/RX_HI
RELAY ERROR
UNBALANCE (NC)
TDR OPTD.(NC)
LBB2
TCS2(+ve)
TCS1(+ve)
BRKR STATUS NO
UNBALANCE RESET
AP/GP LOW ALARM
TX/RX_LOW
TB-C
Aux. DC
TB-B2
T. COMMON
T. AP/GP LOW ALARM
T. AP/GP LOW TRIP & LOCK
T. IDMT OCR
T. UNDER VOLTAGE
T. OVER VOLTAGE
T. UNBALANCE TRIP
T. CAP-1 SWITCHING IN
T. TRIP CIRCUIT FAIL
T. LBB
T. CAP-1 SWITCHING OUT
T. INST. OCR
T. RELAY ERROR
ANN. COMMON
A. AP/GP LOW ALARM
A. AP/GP LOW TRIP & LOCK
A. IDMT OCR
A. UNDER VOLTAGE
A. OVER VOLTAGE
A. UNBALANCE TRIP
A. CAP-1 SWITCHING IN
A. TRIP CIRCUIT FAIL
A. LBB
A. CAP-1 SWITCHING OUT
A. INST. OCR
A. RELAY ERROR
ALUMINIUM INDUSTRIES LTD.
Relays Division Thiruvanathapuram

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
XVI.	IEC 61850	Communication Protocol

TROUBLESHOOTING

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 lose 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.
3	Voltage not reading/Out of tolerance limit.	1. Refer TB sticker for PT inputs. 2. Check if the terminals of TB-A is Connected properly or for any lose contact. 3. Check PT ratio. 4. Check the continuity of the output terminal, after disconnecting the wires. After checking of the above, measure the voltage using calibrated multi-meter. If not OK, intimate to works.	1. The fuse of the PT in the yard may blown out. 2. The varistor may short circuited to protect internal circuitry on transients.
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 53**

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	180	2	3	According to main FUN
Reset CU	-	5	180	3	4	According to main FUN
Reset CU/Start/Restart	-	5	180	4	5	According to main FUN

STATUS INDICATIONS IN MONITOR DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
Protection Healthy/Active	-	1	180	18	1	↑↓
RCC Reset	-	1	180	19	1	↑
Local Parameter Settings (Change)	-	1	180	22	1	↑
AP/GP Low Alarm	X	1	180	29	1,9	↑↓
AP/GP Trip & Lock	X	1	180	30	1,9	↑↓
CB NC (CAP BANK CB OPEN)	X	1	180	136	1,9	↑↓
CB NO (CAP BANK CB CLOSE)	X	1	180	137	1,9	↑↓
Time Delay Relay	-	1	180	34	1	↑↓
Relay Error	-	1	180	40	1	↑

SUPERVISION INDICATIONS IN MONITOR DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
Trip circuit supervision	X	1	180	36	1,9	↑↓

FAULT INDICATION IN (MONITOR DIRECTIONS)

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
Breaker Failure (LBB)	X	2	180	85	1,9	↑↓
Start/pickup Instantaneous Overcurrent	X	2	180	95	1,9	↑↓
Start/pickup IDMT Overcurrent	X	2	180	96	1,9	↑↓
Start/pickup Unbalance Protection	X	2	180	97	1,9	↑↓

Start/pickup Over Voltage Protection	X	2	180	98	1,9	↑↓
Start/pickup Under Voltage Protection	X	2	180	99	1,9	↑↓
Start/pickup Switch In	X	2	180	65	1,9	↑↓
Start/pickup Switch Out	X	2	180	66	1,9	↑↓
Instantaneous OCR trip	-	2	180	103	1	↑↓
IDMT OCR trip	-	2	180	105	1	↑↓
Current Unbalance Operated	-	2	180	106	1	↑↓
Under Voltage Trip Operated	-	2	180	116	1	↑↓
Over Voltage Trip Operated	-	2	180	131	1	↑↓
Switch In operated	-	2	180	119	1	↑↓
Switch Out operated	-	2	180	120	1	↑↓

MEASURANDS IN MONITOR DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT
Measurand supervision I	-	9	180	148	2
Measurand supervision V	-	9	180	149	2
Measurand supervision I1	-	9	180	150	2
Measurand supervision I2	-	9	180	151	2
Measurand supervision I UNBALANCE	-	9	180	152	2
Measurand supervision Power Factor PF	-	9	180	153	2

TIME TAGGED MEASURANDS IN MONITOR DIRECTIONS

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT
Fault Current – I	-	4	180	154	1
Fault Voltage – V	-	4	180	155	1
Fault Current – I LV1	-	4	180	156	1
Fault Current – I LV2	-	4	180	157	1
Fault Current – I UNBALANCE	-	4	180	158	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
RCC RESET	-	20	180	19	20	↑ (PULSE)
Unbalance Reset	-	20	180	35	20	↑ (PULSE)
CB (O/o Open)	-	20	180	124	20	↑ (PULSE)
CB (C/c Close)	-	20	180	125	20	↑ (PULSE)

ANALOG CHANNEL INFORMATION IN AR 53

AR 53		
FUN	ACC	PARAMETER
180	1	I
180	2	I UB
180	3	I1
180	4	I2
180	5	V
180	6	X
180	7	X
180	8	X

DIGITAL CHANNEL (TAGS) INFORMATION IN AR 53

AR 53			
TAG POSITION	FUN/INF NUMBER	SEMANTICS ACCORDING TO TAG POSITION	INPUT/ OUTPUT
0	180/84	GENERAL PICKUP	OUTPUT
1	180/68	GENERAL TRIP	OUTPUT
2	180/103	INST. OCR TRIP	OUTPUT
3	180/105	IDMT OCR TRIP	OUTPUT
4	180/106	CURRENT UNBALANCE TRIP	OUTPUT
5	180/131	OVER VOLTAGE TRIP	OUTPUT
6	180/116	UNDER VOLTAGE TRIP	OUTPUT
7	180/119	SWITCH IN OPERATED	OUTPUT
8	180/120	SWITCH OUT OPERATED	OUTPUT
9	180/85	LBB TRIP	OUTPUT
10	180/19	RCC RESET	INPUT
11	180/136	CB NC (OPEN)	INPUT
12	180/137	CB NO (CLOSE)	INPUT
13	180/31	AP/GP LOW TRIP & LOCK	INPUT
14	180/30	AP/GP LOW ALARM	INPUT
15	128/36	TRIP CIRCUIT SUPERVISION	INPUT

Model Implementation Conformance Statement
for the IEC 61850 interface in ALIND AR 53 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 53 RELAY	MICS Ver.	1.0
	DATE: 22 SEPTEMBER 2021	
ALUMINIUM INDUSTRIES LTD | RELAYS DIVISION, THIRUVANANTHAPURAM		

Index

PAGE

INDEX....2
1. Introduction....4
2. Logical Device....5
3. Logical Node List....6
4. Logical Nodes....7
4.1 CNTRL_GGIO1....7
4.2 CAPALM_GGIO1....7
4.3 CAPIND_GGIO2....8
4.4 LLN01 9
4.5 LLN02 9
4.6 LLN03 9
4.7 LLN04 9
4.8 LLN05 10
4.9 LPHD1....10
4.10 MTR_MMXN1....10
4.11 FLT_MMXN2....10
4.15 CAPINST_PIOC1....11
4.16 CAPIDMT_PTOC1....11
4.17 CAPUB_PTOC2....11
4.18 CAPUV_PTUV1....12
4.19 CAPOV_PTOV1....12
4.20 SWIN_GGIO1....12

4.21 SWOUT_GGIO2.....12

4.22 LBB_RBRF1.....13

4.22 RDRE1.....13

5. Enum types 14

5.1 Mod 14

5.2 ctlModel.....14

5.3 Health.....14

1. Introduction

This model implementation conformance statement is applicable for ALIND AR 53 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 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_CAP_3C	IED control 3 nos.
MEASUREMENT	LLN0	LLN02	LLN0 for Logical Device MEASURAND
	MTR_MMXN1	MMXN_CAP_MTR	Measurands I, I UNBALANCE, V, I1, I2, Power Factor
	FLT_MMXN2	MMXN_FDR_FLT	Feeder Fault values I, I UNBALANCE, SWITCHING, V
PROTECTION	LLN0	LLN03	LLN0 for Logical Device PROTECTION
	LBB_RBRF1	RBRF_CAP	Breaker Failure
	CAPINST_PIOC1	PIOC_CAP	Instantaneous OCR
	CAPIDMT_PTOC1	PTOC_CAP	IDMT OCR
	CAPUB_PTOC2	PTOC_CAP	Current Unbalance Protection
	CAPOV_PTOV1	PTOV_CAP	Overvoltage Protection
	CAPUV_PTUV1	PTUV_CAP	Undervoltage Protection
	SWIN_GGIO1	GGIO_PROT	Capacitor Bank Switch In
	SWOUT_GGIO2	GGIO_PROT	Capacitor Bank Switch Out
RECORDS	LLN0	LLN04	LLN0 for Logical Device RECORDS
	RDRE1	RDRE_CAP	Disturbance recorder
SYSTEM	LLN0	LLN05	LLN0 for Logical Device SYSTEM
	LPHD	LPHD_CAP	Physical Device Information
	CAPALM_GGIO1	GGIO_CAP_ALM4	Alarms
	CAPIND_GGIO2	GGIO_CAP_BI6	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
PIOC (Instantaneous Overcurrent)
PTOC (Time Overcurrent)
PTOV (Over Voltage)
PTUV (Under Voltage)
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 Command)	O
SPCSO2	SPC	Generic single point controllable status output (Unbalance Reset Command)	O

4.2 Logical Node: CAPALM_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 (Time Delay Relay)	O
Alm4	SPS	General Single Alarm (Relay Error)	O

4.3 Logical Node: CAPIND_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 (AP/GP low alarm)	O
Ind3	SPS	General Indication (AP/GP trip & lock)	O
Ind4	SPS	General Indication (CB NC status)	O
Ind5	SPS	General Indication (CB NO status)	O
Ind6	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 Zero 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 (Logical Node Zero for Logical Device RECORDS)

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

Description: Logical Node Zero

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_MMXN1

Description: Non-Phase Related Measurement (Measurand Values)

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	Measurand Current I LINE	E
Amp2	MV	Measurand Current I UNBALANCE	E
Amp3	MV	Measurand Current I 1	E
Amp4	MV	Measurand Current I 2	E
Vol	MV	Voltage V	O
PwrFact	MV	Power Factor	O

4.11 Logical Node: FLT_MMXN2

Description: Non-Phase Related Measurement (Feeder Fault Values)

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	Fault Current I LINE	E
Amp2	MV	Fault Current I LV1	E

Amp3	MV	Fault Current I LV2	E
Amp4	MV	Fault Current IUNBALANCE	E
Vol	MV	Voltage V	O

4.12 Logical Node: CAPINST_PIOC1

Description: Instantaneous Protection

LN Class: PIOC

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

4.13 Logical Node: CAPIDMT_PTOC1

Description: Time Overcurrent Protection

LN Class: PTOC

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

4.14 Logical Node: CAPUB_PTOC2

Description: Time Overcurrent Protection

LN Class: PTOC

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: CAPUV_PTUV1

Description: Under Voltage Protection

LN Class: PTUV

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

4.16 Logical Node: CAPOV_PTOV1

Description: Over Voltage Protection

LN Class: GGIO

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

4.17 Logical Node: SWIN_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			
Ind1	SPS	General Indication (Switch in Pickup acted)	O
Ind2	SPS	General Indication (Switch in acted)	O

4.18 Logical Node: SWOUT_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 (Switch in Pickup acted)	O
Ind2	SPS	General Indication (Switch in acted)	O

4.19 Logical Node: LBB_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

4.20 Logical Node: RDRE1

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 used 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

ALUMINIUM INDUSTRIES LTD
Relays division, Kavinpuram, Vilappilsala (P.O)
Thiruvananthapuram, Kerala, India-695 573
☎: 0471-2379704, 2379503
: www.alindrelays.com
✉: contact@alindrelays.com (enquiry)
✉: service@alindrelays.com (service)