NUMERICAL FEEDER PROTECTION RELAY
AR27 [AN+ SERIES]

USER MANUAL

ALUMINIUM INDUSTRIES LIMITED
RELAYS DIVISION, THIRUVANANTHAPURAM

AR27

Numerical Feeder Protection Relay

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AN + SERIES

ALIND

RELAYS DIVISION

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 60255-27:2013

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 equipments 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 equipment's 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.

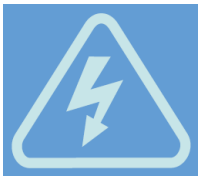
Warning: Before working at the rear of unit, isolate all voltage and current supplies.

Caution: Before carrying out any work on equipment you should be familiar with the contents of the Safety Section or the Safety Guide AR relays and the ratings on the equipment's rating label.**

SYMBOLS AND LABELS USED IN THE RELAY

1. FRONT SIDE

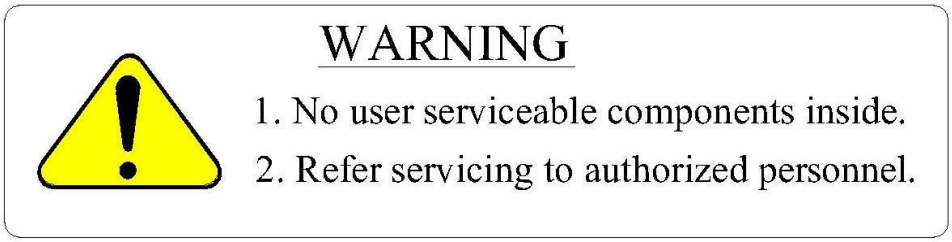
Caution: refer to equipment documentation



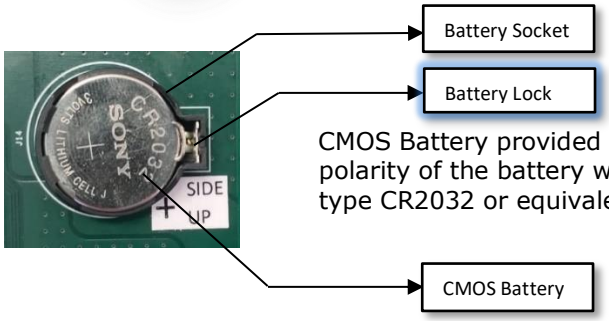
Caution: risk of electric shock

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. Only use Sony make Lithium battery type CR2032 or equivalent with a nominal voltage of 3V.

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 watercourses 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 60255-27:2013	Class I (This equipment requires a protective conductor (earth) connection to ensure user safety.

2. Environment

IEC 60255-27:2013	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 60255-27:2013	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

INTRODUCTION

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AN SERIES DESCRIPTION

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BRIEF DESCRIPTION OF AR27

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 Distance protection, wrong phase coupling, Over Current Protection, PTFF, DELTA I, under voltage 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 Primary or secondary current & voltage display on relay LCD.
- Settable CT ratios.
- Relay operation Counter

PREVIOUS HISTORY OF FEEDER PROTECTION RELAYS

AZ 1114

Distance Relay.
Static Type.
First product in Traction Feeder Protection.
Without reclosing facility.

AZ 1114+

Integrated feeder protection relay
Micro-processor based.
With reclosing facility.

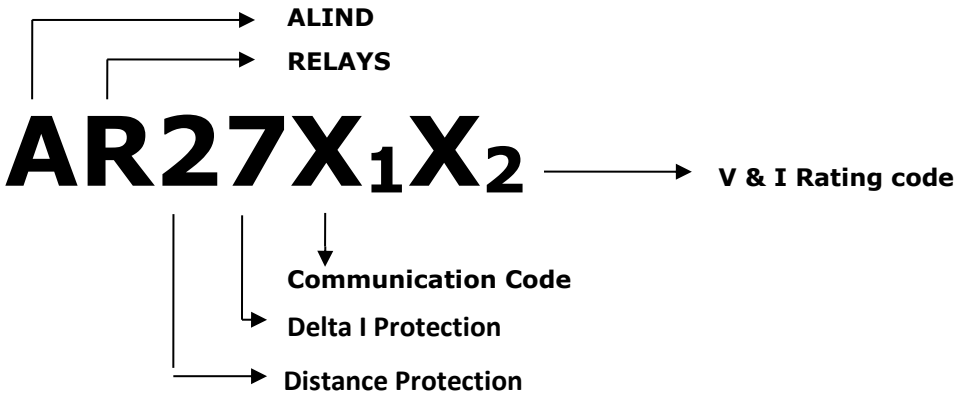
AZM 1114+ (AN Series) AVDI 11CM

Numerical Integrated feeder protection relay
Miniaturized feeder protection module.
Built in counter facility.
Plug in type modular construction.
Disturbance & event recorder.
SCADA Interface (IEC 60870-5-103 Compatible).
Compact Design.

ANZ 114/214/ANPD 112/212 (AN Series)

Numerical Integrated feeder protection & Delta I relay
Miniaturized feeder protection module.
Disturbance & event recorder and detailed fault analyzer.
Cable less hardware design
SCADA Interface (Full-fledged IEC 60870-5-103 protocol).
Compact Design.

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

AR27: The relay conforms to RDSO specification No. TI/SPC/PSI/PROTCT/7101 and TI/SPC/PSI/PROTCT/6072. AR27 (AN+ Series) relay is a comprehensive Integrated Feeder Protection and Delta-I protection relay for the protection of 25KV and 2X25KV AC, 50Hz Over Head Equipment (OHE).

Protection Features based on application

Sl No.	PARTICULARS	Feeder main module	Delta I module
1.	**MAIN PROTECTIONS**		
1.1	Polygon characteristic Distance protection element (DP)	✓	✓
1.1.1	Zone 1 Extension (DP)	✓	✓
1.1.2	Three Zone Distance Protection	✓	✓
1.2	Wrong phase coupling protection (WPC)	✓	-
1.3	PT fuse failure trip/alarm (PTFF)	✓	-
1.4	Over current protection	✓	-
1.4.1	High set instantaneous element (OCR)	✓	-
1.4.2	Two Stage Definite Time OCR	✓	-
1.4.3	Directional Element (DP, Inst.OCR, Def. Time OCR)	✓	✓
1.5	DELTA I protection	-	✓
1.6	Under voltage protection	-	✓
1.7	Regenerative OCR	✓	-
1.8	Current Unbalance Protection	✓	-
2.	**ADDITIONAL FUNCTIONS**		
2.1	Local breaker backup (LBB)	✓	✓
2.2	Auto re-closure and lockout	✓	✓
2.3	Auto reclose Bypass (ARB)	✓	✓
2.4	SOTF (Switch On To Fault) protection	✓	-
2.5	2nd Harmonics	✓	✓
2.6	3rd Harmonics	-	✓
2.7	Thermal Overload	✓	-
3.	**STATUS INPUTS**		
3.1	AP/ GP low Alarm	✓	✓
3.2	AP/ GP Trip and Lock	✓	✓
3.3	ARB Input	✓	-
3.4	Trip Circuit Supervision	✓	✓
3.5	Relay Error	✓	✓
3.6	CB status (NC/NO)	✓	✓
3.7	MTR Status	✓	✓
3.8	Zone 1 ext	✓	-
3.9	Lockout reset from remote	✓	✓
3.10	Ext. AR Trigger	✓	✓
3.11	RCC Reset	✓	✓
3.12	ARB RCC	✓	✓

DESCRIPTION OF PROTECTION FUNCTIONS

AR27 relay is a comprehensive solution for

- 25kV & 2x25 KV (AT feeding system) Integrated FEEDER Protection relay for the protection of Over Head Equipment (OHE).
- 25kV & 2x25 KV (AT feeding system) Delta I Protection relay for the protection of Over Head Equipment (OHE).

GENERAL FUNCTIONS

Sl No.	PARTICULARS	AR27
1.	Password protection	✓
2.	Event Memory	5000
3.	Disturbance recorder waveforms	200
4.	50 cycles (45 pre and 5 post fault) of fault waveform for both V & I	✓
5.	**Communication**	
5.1	GUI Interface	RJ45
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	Z value	✓
6.2	Phase Angle	✓
6.3	Voltage	✓
6.4	Current	✓
6.5	Fault Distance	✓
6.6	Resistance	✓
6.7	Reactance	✓
6.8	Thermal Value	✓
6.9	Selectable CT ratio:5-5000/5A	✓
6.10	Selectable PT ratio:110-30000/110V	✓
6.11	Counters for each element(DP, WPC, PTFF, OCR, TOL, LBB)	✓
7.	**Other features**	
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.

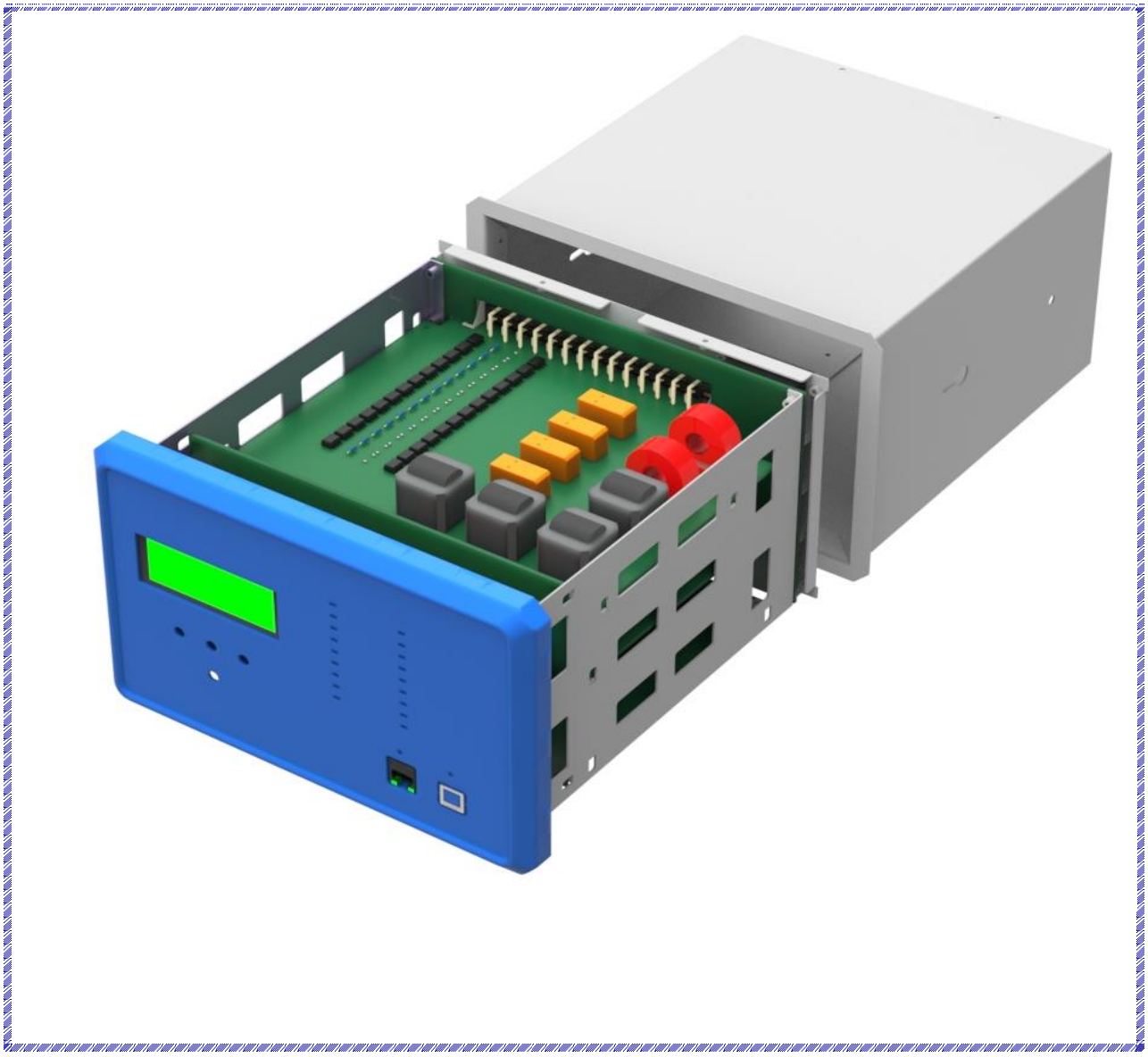
The relay is shipped from factory after detailed testing by our Quality Control Department. However, according to the customer requirement the relay settings/ functions can be verified before commissioning at respective sites with proper testing kits.

STORAGE

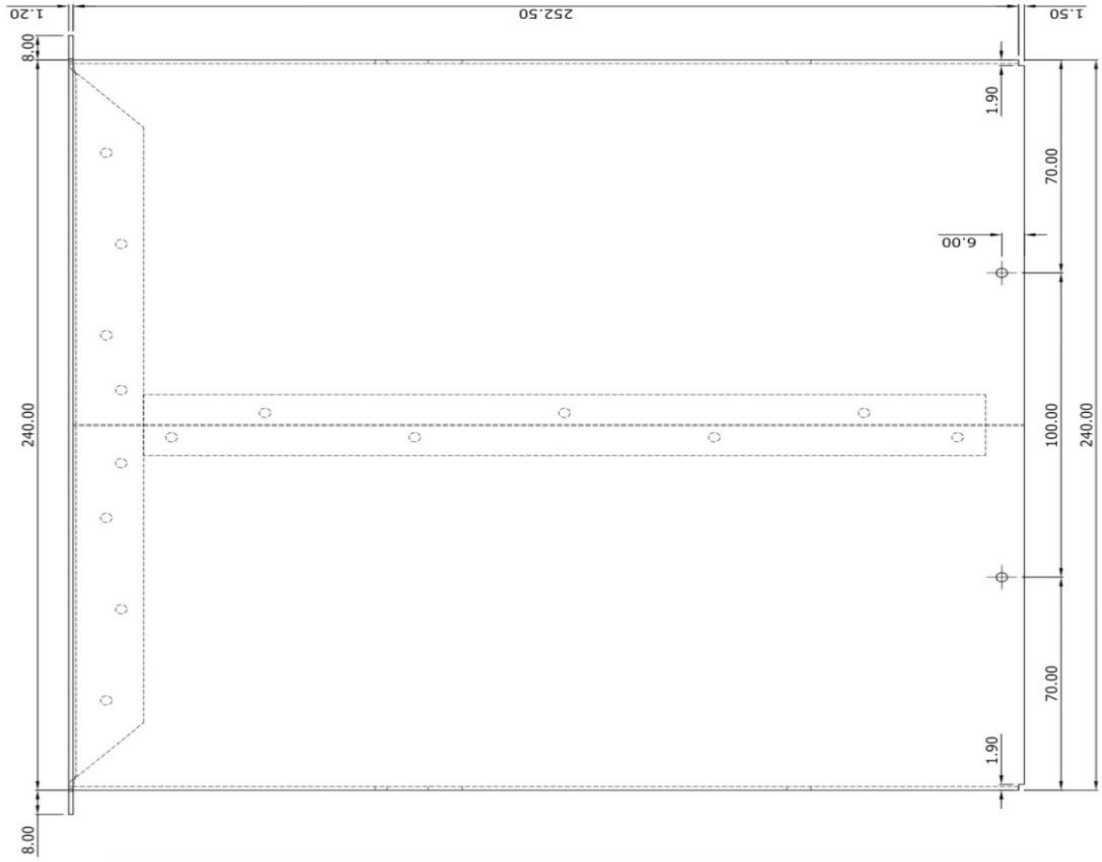
If relays are not to be installed immediately upon receipt they should be stored in a place free from dust and moisture in their original boxes. At most care should be taken while storage.

Storage temperature: -25ºC to +55ºC.

RELAY AND RACK MOUNTING



CASE DIMENSIONS



CUT OUT DETAILS

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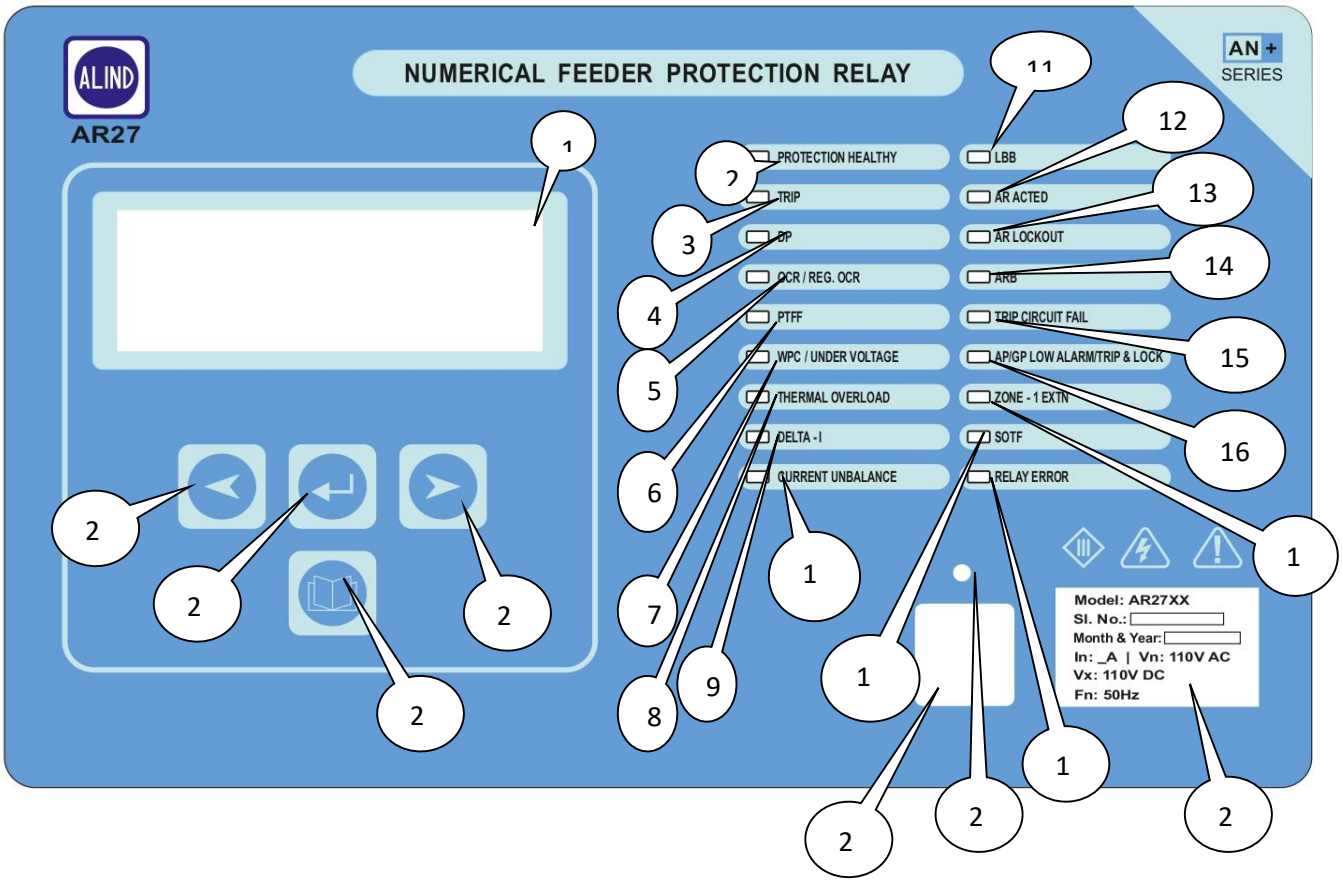
FRONT PANEL INDICATIONS



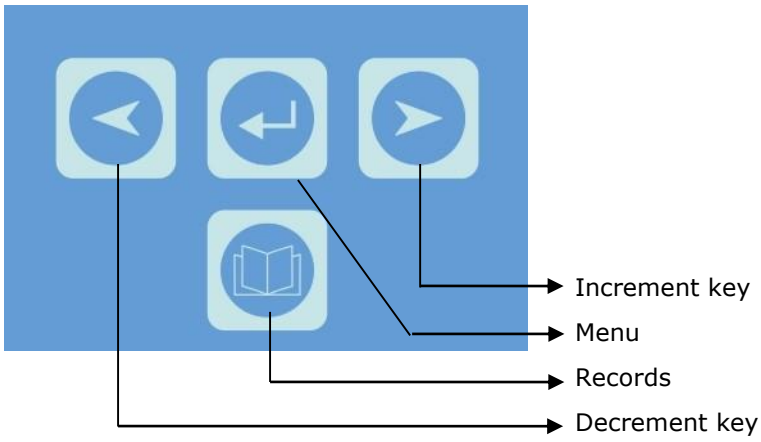
No	Legend
1.	LCD DISPLAY
2.	PROTECTION HEALTHY (Green/Amber)
3.	TRIP (Red)
4.	DP (Red)
5.	OCR (Red)
6.	PTFF (Red)
7.	WPC / UNDER VOLTAGE (Red)
8.	THERMAL OVERLOAD (Red)
9.	DELTA – I (Red)
10.	CURRENT UNBALANCE (Red)
11.	LBB (Red)
12.	AR ACTED (Red)
13.	AR LOCKOUT (Red)
14.	ARB (Red)
15.	TRIP CKT FAIL (Red)
16.	APGP LOW ALARM / TRIP & LOCK (Red)
17.	ZONE1 EXTN (Red)
18.	SOTF (Red)
19.	RELAY ERROR (Red)
20.	>
21.	↵
22.	<
23.	Records
24.	RJ45 PORT
25.	H.RST
26.	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

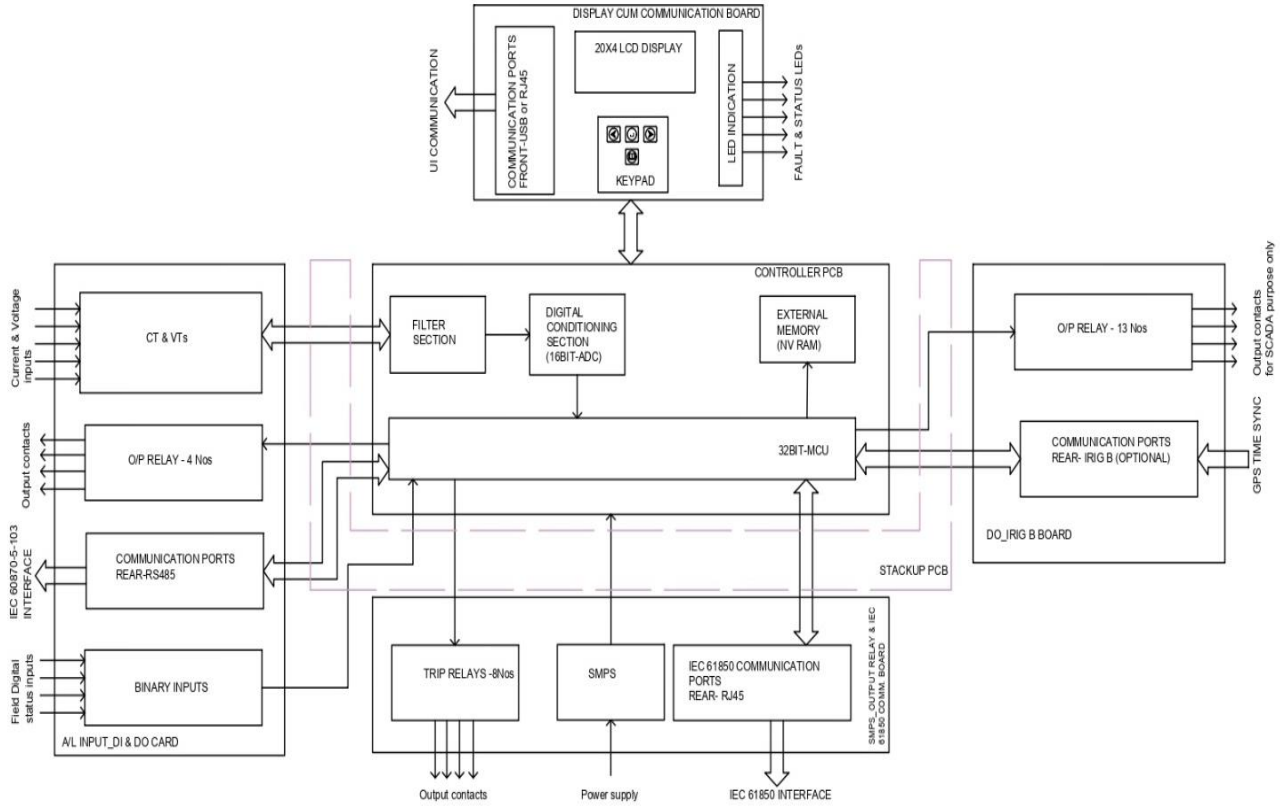
* If you want to lower any particular setting, we can use this option.
* No need to save any unwanted mistakes in the relay you can use this key.
* If you want to verify any previous settings in the relay you can opt this key.

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

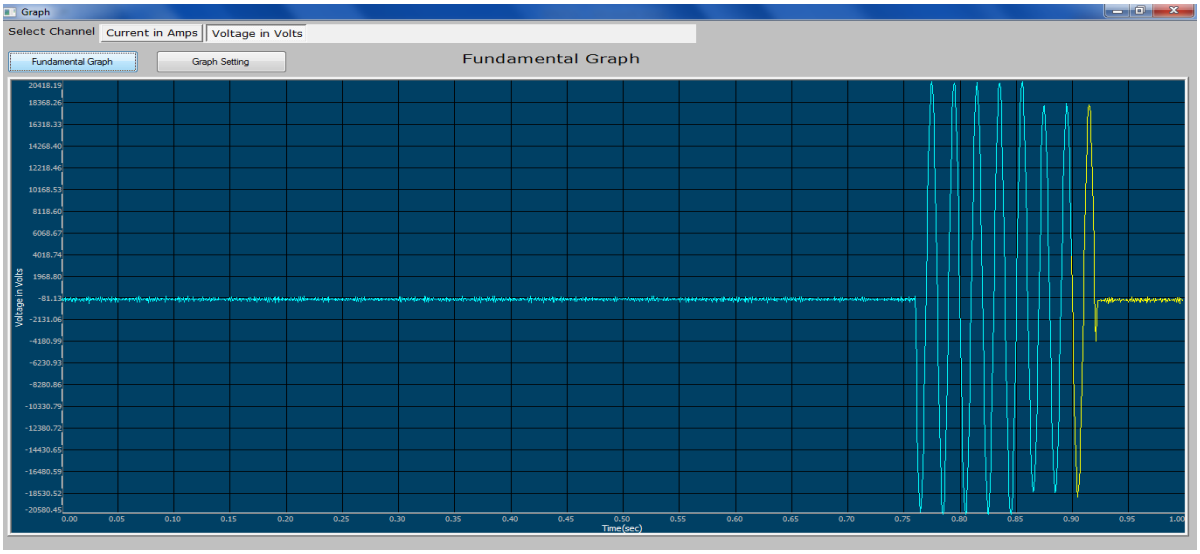
CB Trip

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 terminals 14 & 15 of TB-A with the help of an MCB.
6. Switch on the power supply. Measure the voltage between the terminals 14 & 15 of TB-A, and ensure that the voltage is within the normal operating range.
7. After the relay is powered ON, the following shall be noticed.
8. 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 & transformer PCB, SMPS & trip relay PCB, Tele Annu & IRIG-B PCB, Back panel PCB and 61850 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 mounted on the back side 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 signals are 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 & Transformer 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.

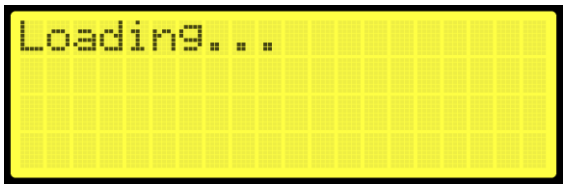
SMPS_Trip Relay& IEC 61850 PCB (640 265): The SMPS PCB provides the necessary Power supply voltages to the different PCBs mounted inside the relay. The SMPS provides +24V, +5V, -5V and isolated +5 V. The +24 V supply is used for the driving the output relays. The +5V and -5V is supplied to the controller 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 & IRIG-B PCB (640 266): All the Telesignalling output circuits are assembled in this PCB. IRIG B circuit also provided in this PCB.

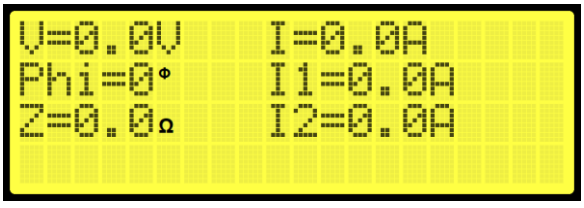
Back PCB (640 267): This PCB consists of terminal blocks for external interface with the site and power connectors which connects SMPS, I/O and CT PT PCB's. The RS 485 port is also mounted in this PCB. The terminal block (TB-A) is having CT shorting facility. Since the rack with Terminal Blocks is having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

RELAY ONLINE DISPLAY PARAMETERS

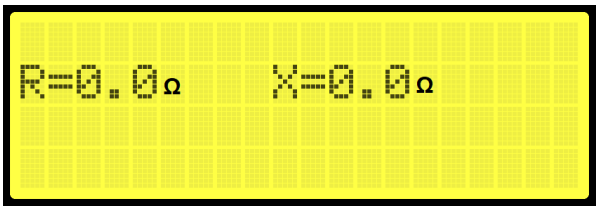
After Power ON, the relay boot screen shows



Then comes the online parameter display
Window 1:



Window 2:



To scroll between online displays, press ↵ key.

Setting Mode

Press and hold ↵ for 5 seconds.

Relay will enter to setting mode.

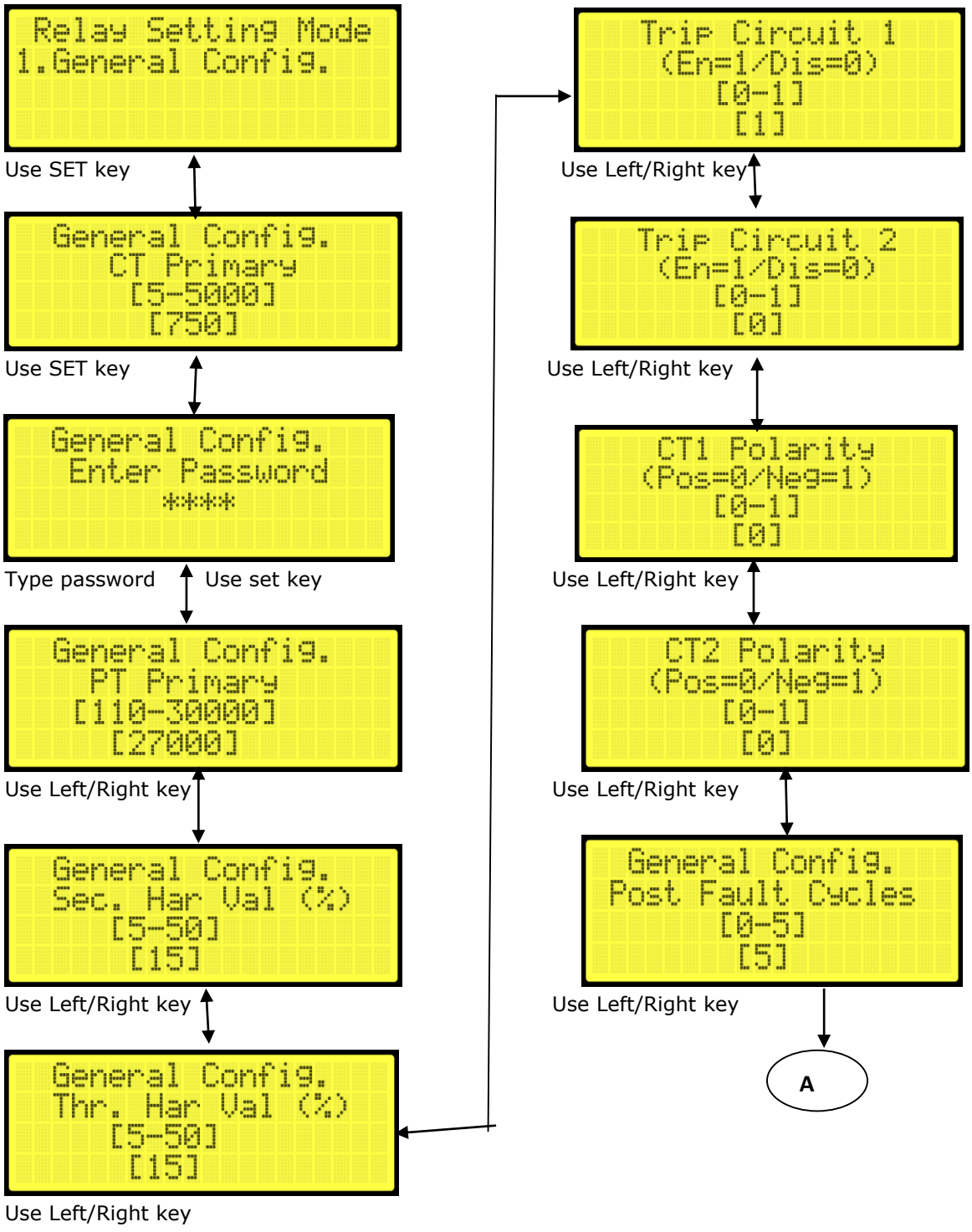
Change settings press ↵ key.

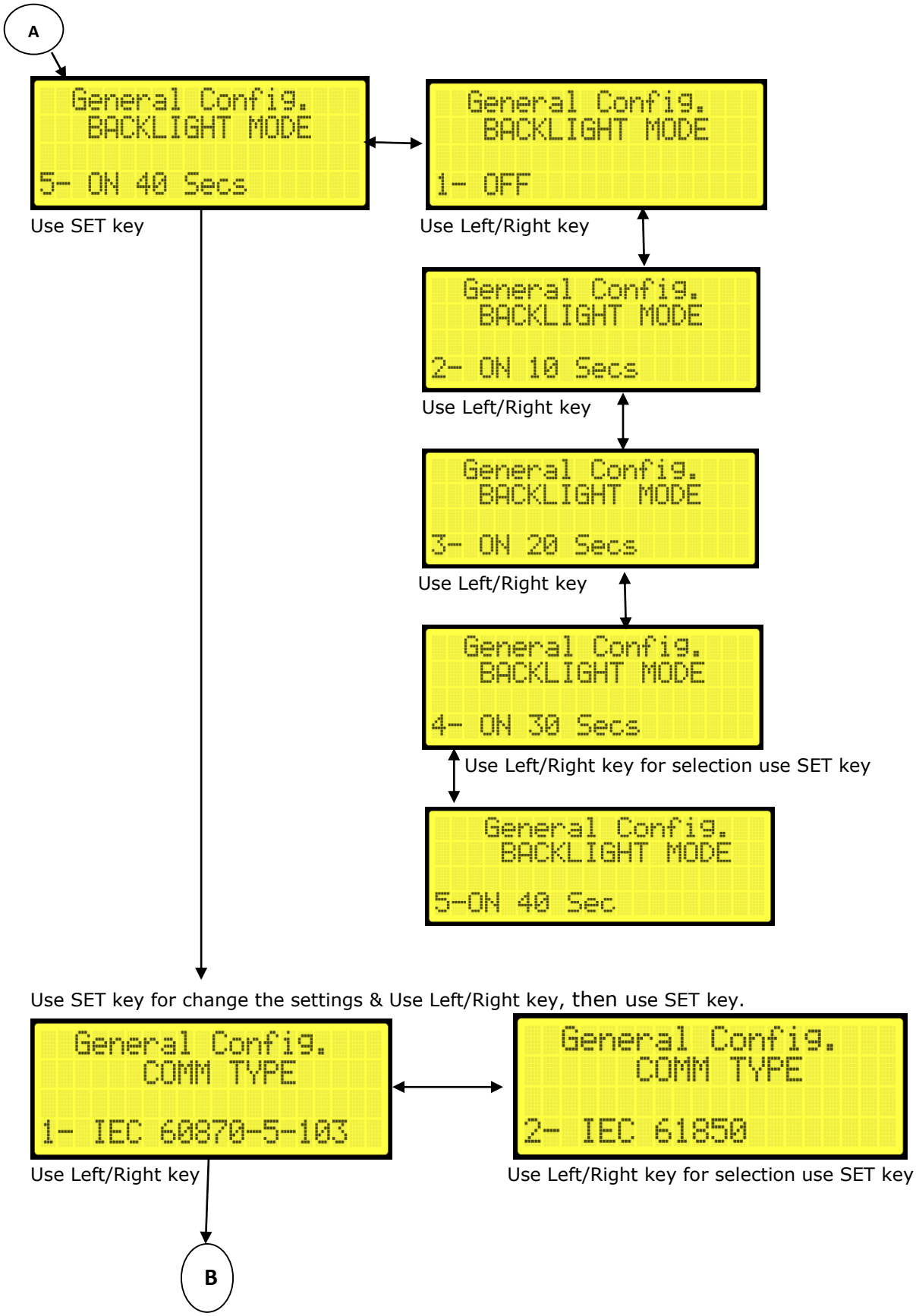
Enter the password and press ↵ key. The default password setting is '1000'.

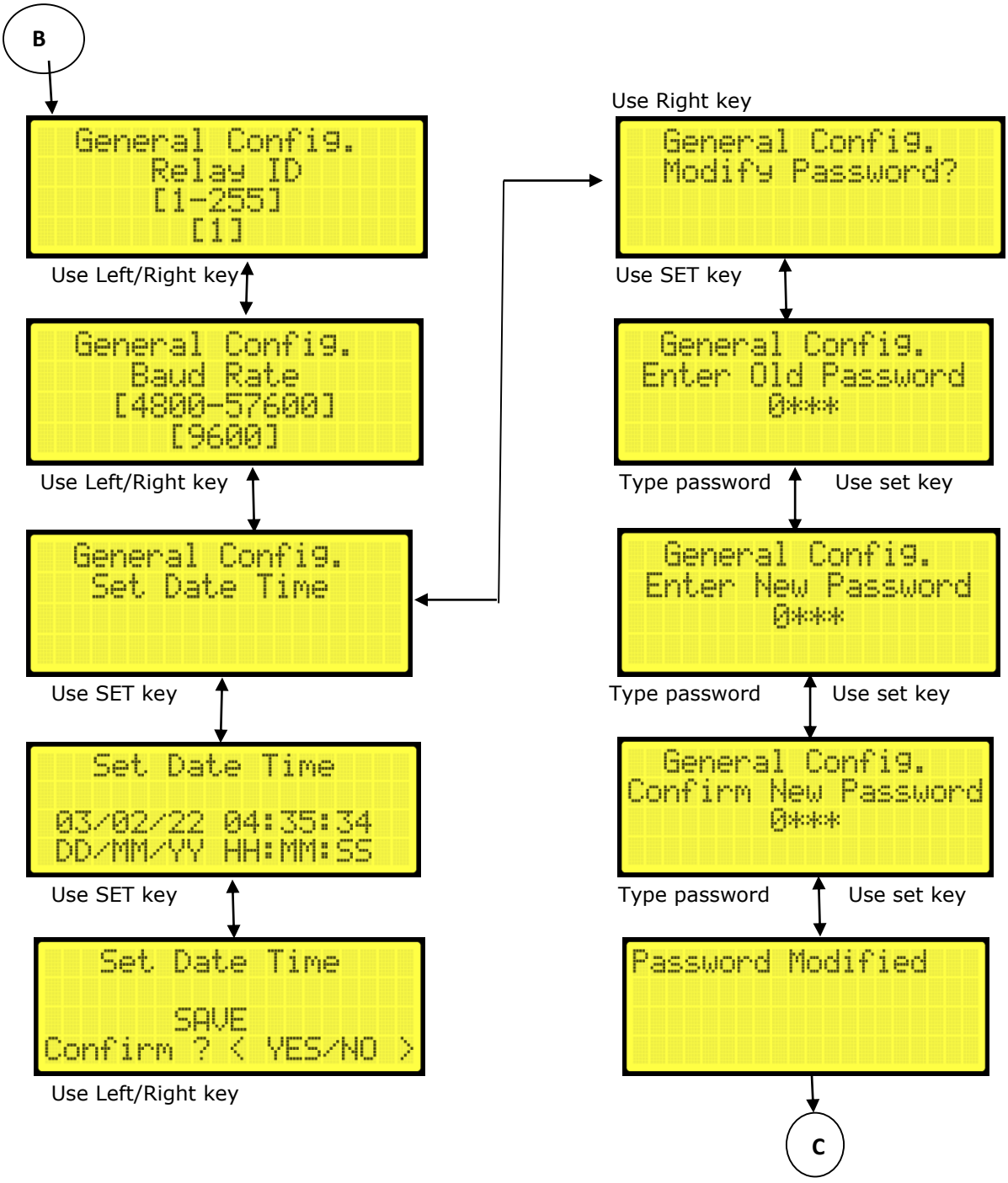
To change settings:

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.

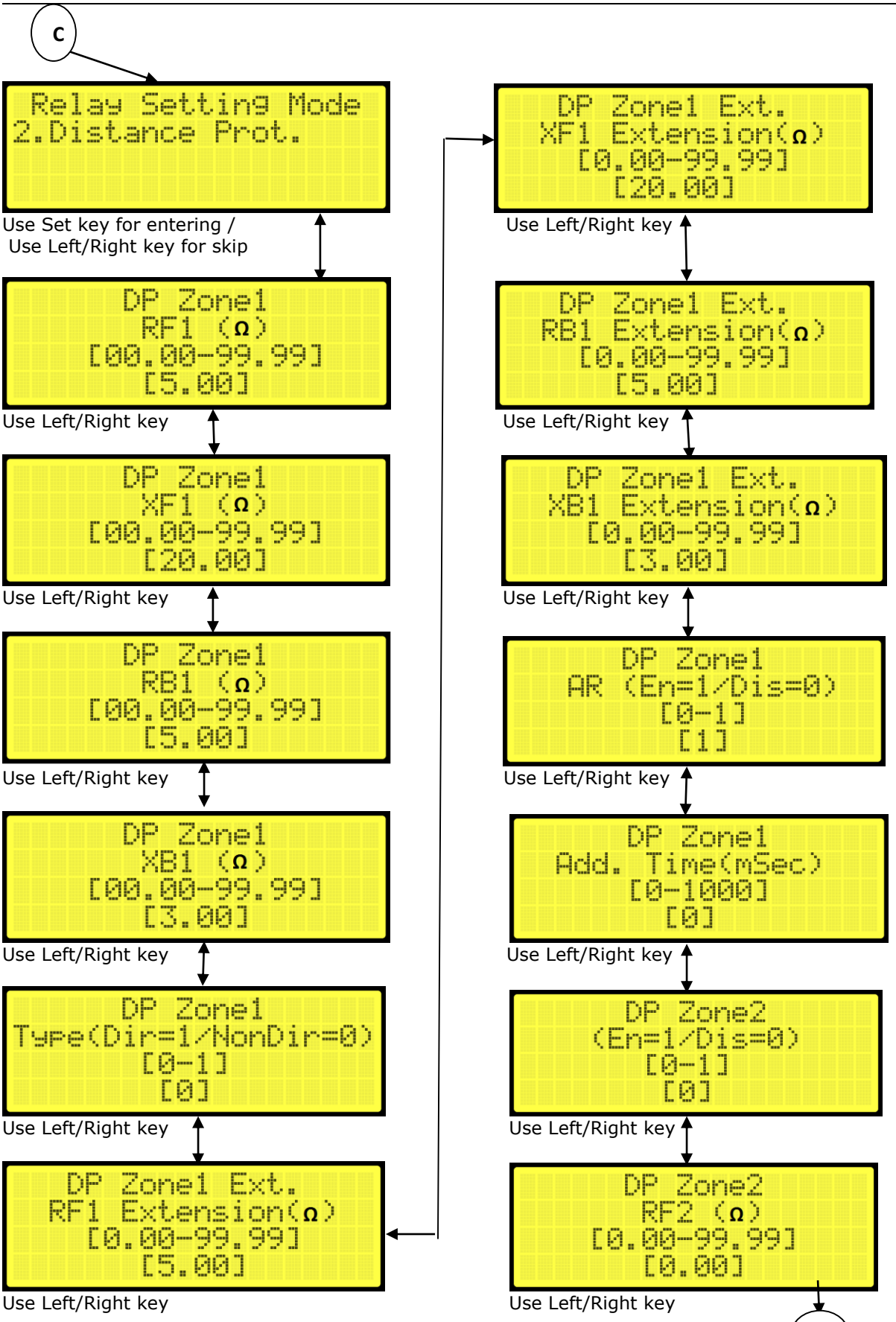
Relay Settings Algorithm

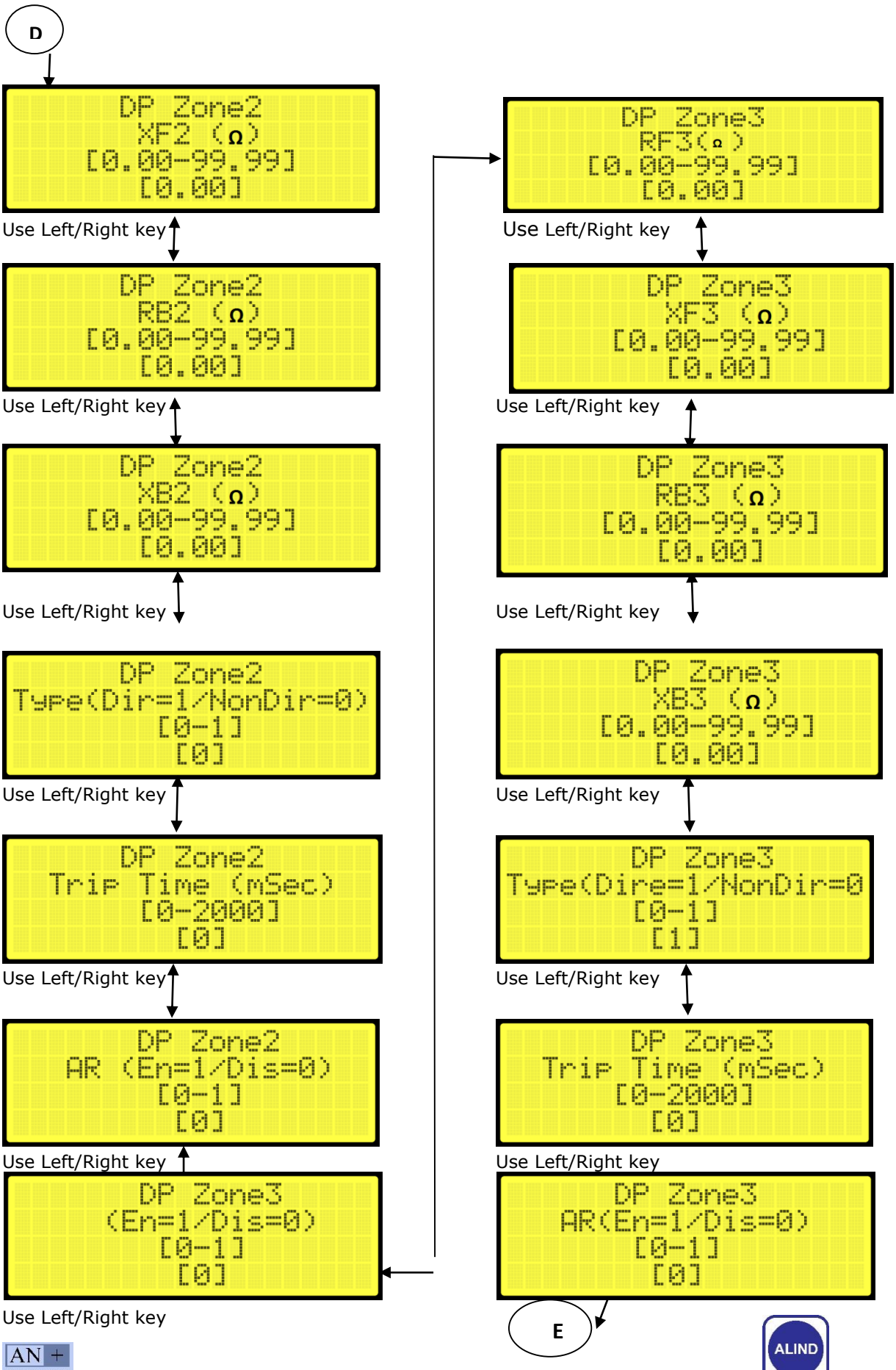


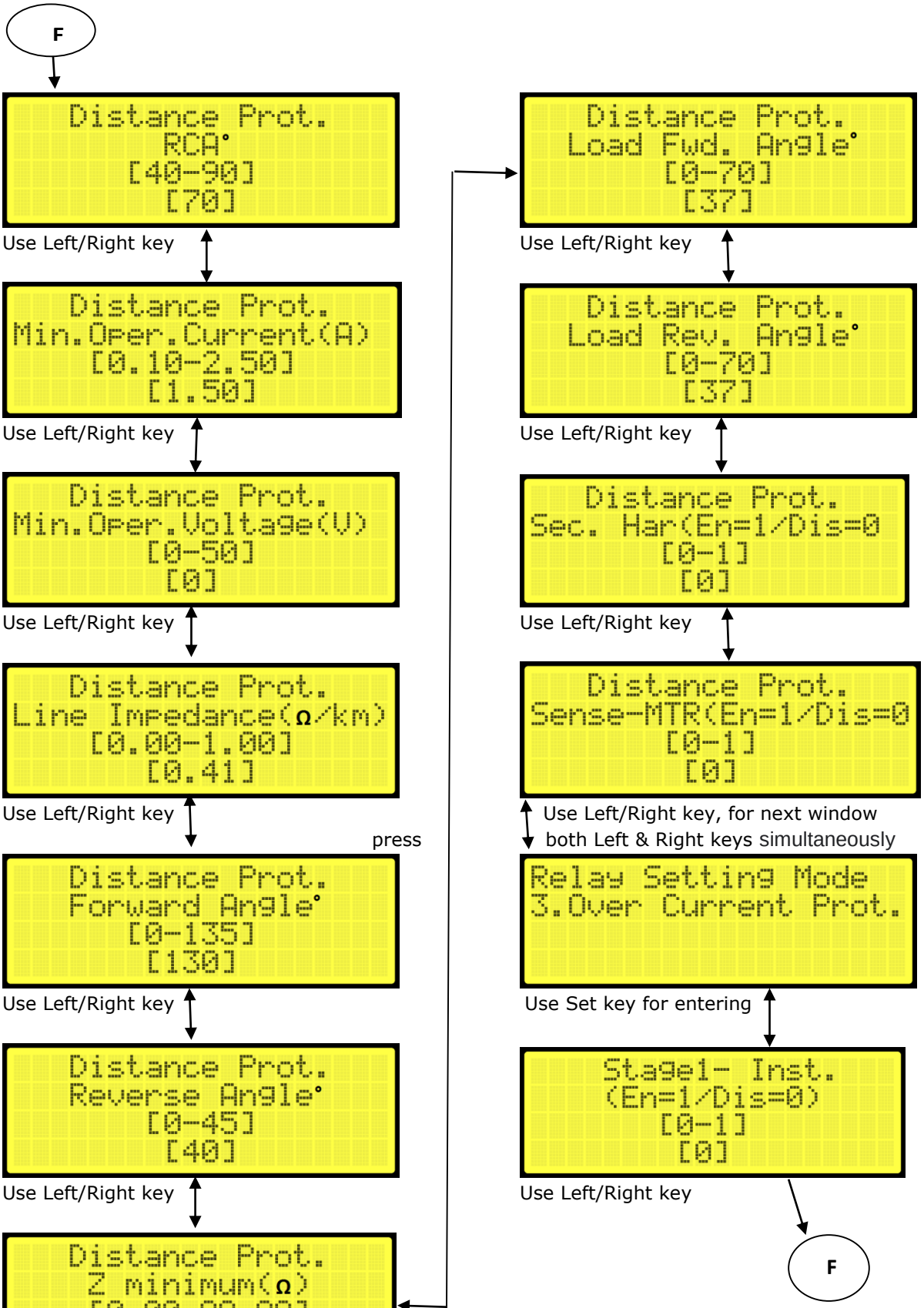

A
General Config.
BACKLIGHT MODE
5- ON 40 Secs
Use SET key
General Config.
BACKLIGHT MODE
1- OFF
Use Left/Right key
General Config.
BACKLIGHT MODE
2- ON 10 Secs
Use Left/Right key
General Config.
BACKLIGHT MODE
3- ON 20 Secs
Use Left/Right key
General Config.
BACKLIGHT MODE
4- ON 30 Secs
Use Left/Right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

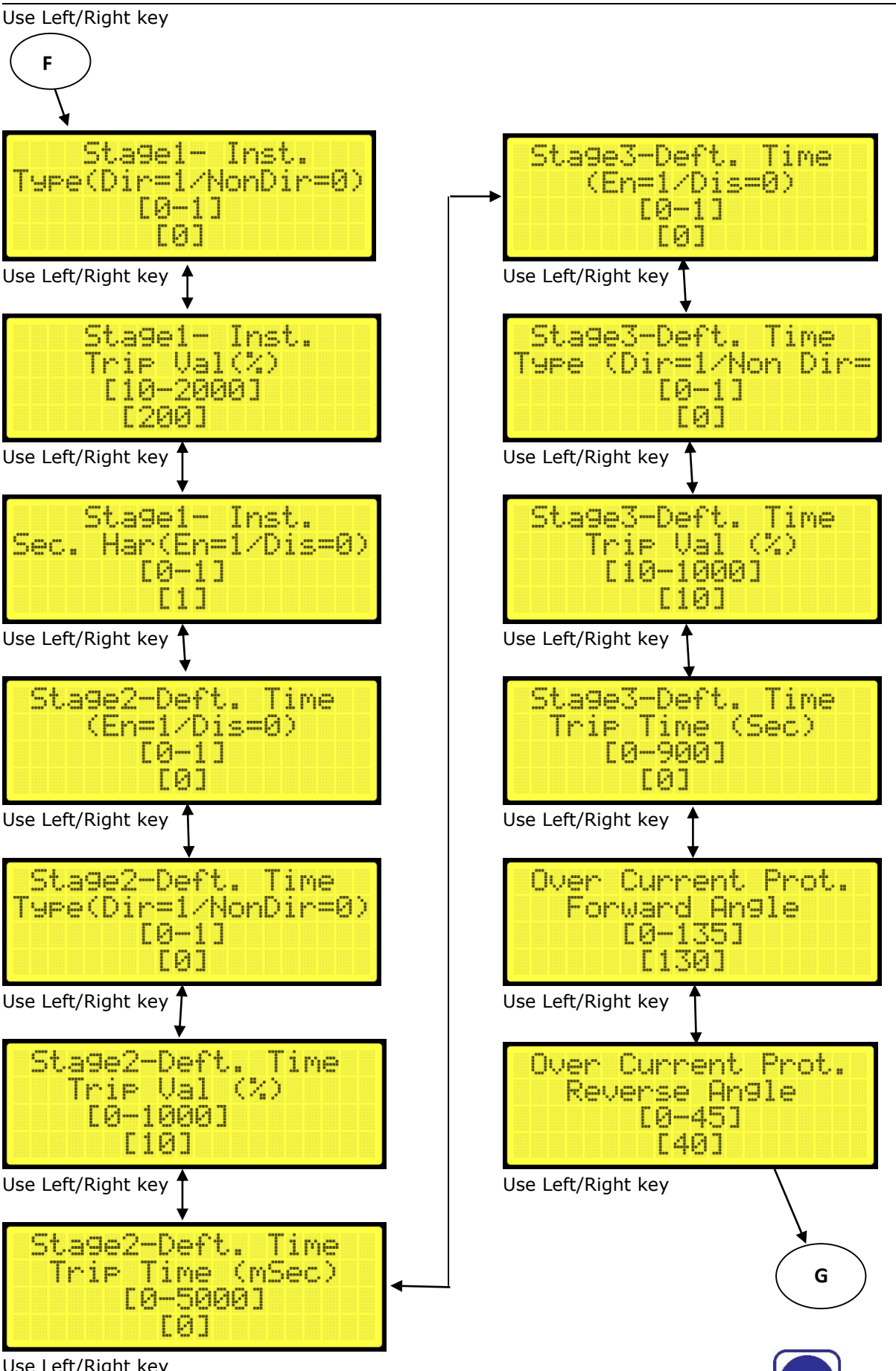


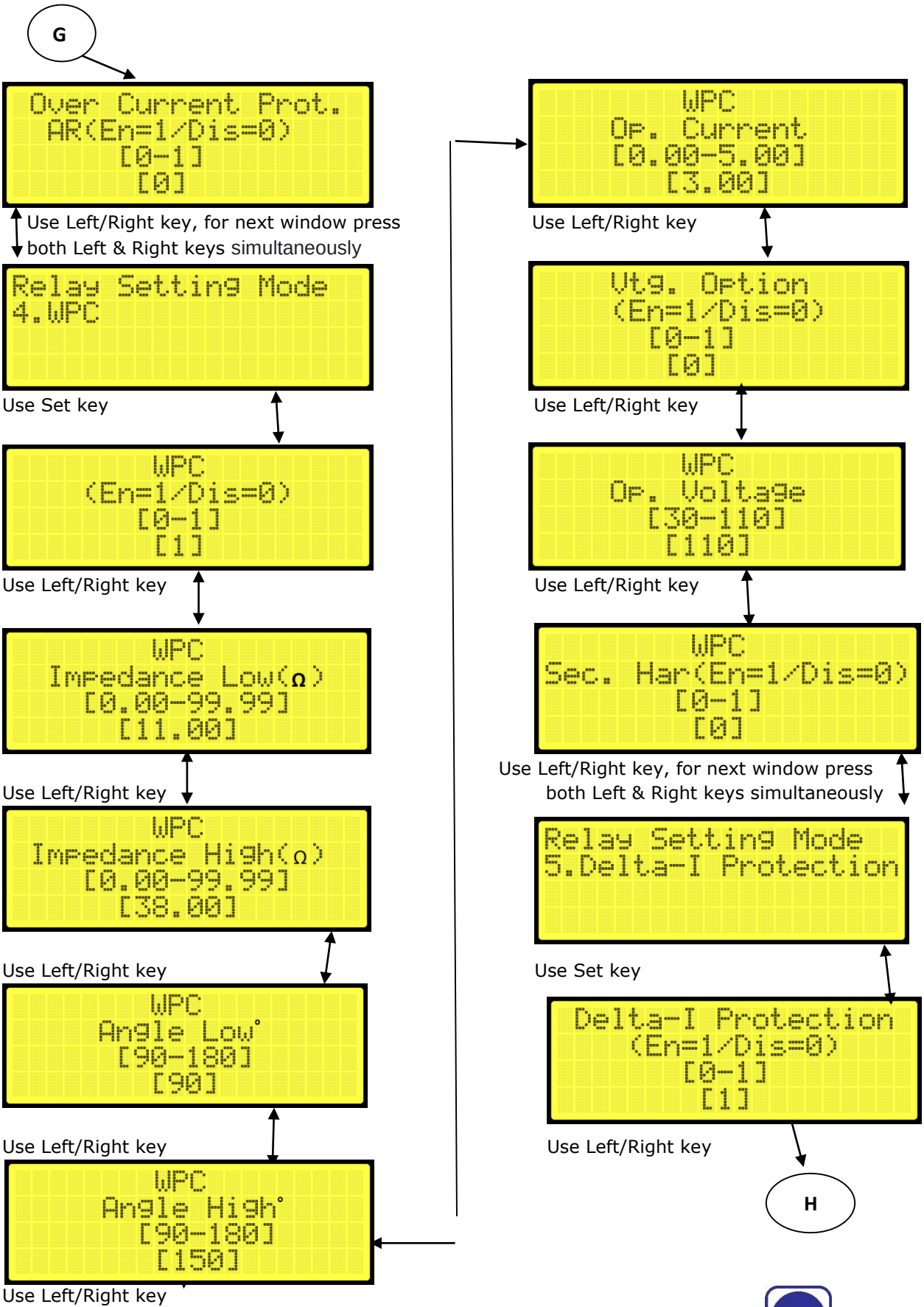
Use Left/Right key, for next window press both Left & Right keys simultaneously

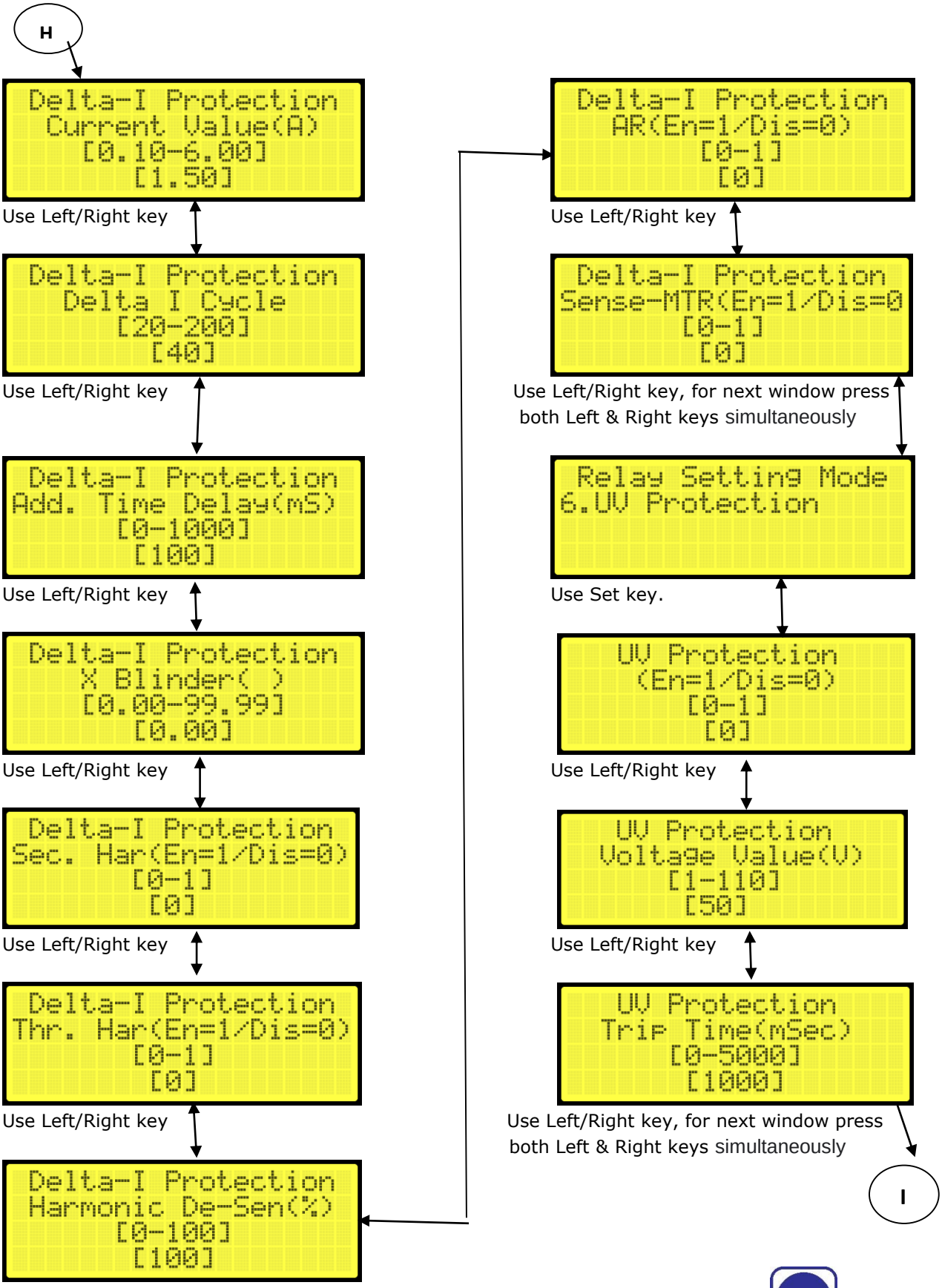

C
Relay Setting Mode
2.Distance Prot.
Use Set key for entering /
Use Left/Right key for skip
DP Zone1
RF1 (Ω)
[00.00-99.99]
[5.00]
Use Left/Right key
DP Zone1
XF1 (Ω)
[00.00-99.99]
[20.00]
Use Left/Right key
DP Zone1
RB1 (Ω)
[00.00-99.99]
[5.00]
Use Left/Right key
DP Zone1
XB1 (Ω)
[00.00-99.99]
[3.00]
Use Left/Right key
DP Zone1
Type(Dir=1/NonDir=0)
[0-1]
[0]
Use Left/Right key
DP Zone1 Ext.
RF1 Extension(Ω)
[0.00-99.99]
[5.00]
Use Left/Right key
DP Zone1 Ext.
XF1 Extension(Ω)
[0.00-99.99]
[20.00]
Use Left/Right key
DP Zone1 Ext.
RB1 Extension(Ω)
[0.00-99.99]
[5.00]
Use Left/Right key
DP Zone1 Ext.
XB1 Extension(Ω)
[0.00-99.99]
[3.00]
Use Left/Right key
DP Zone1
AR (En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
DP Zone1
Add. Time(mSec)
[0-1000]
[0]
Use Left/Right key
DP Zone2
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
DP Zone2
RF2 (Ω)
[0.00-99.99]
[0.00]
Use Left/Right key
D


D
DP Zone2
XF2 (Ω)
[0.00-99.99]
[0.00]
Use Left/Right key
DP Zone2
RB2 (Ω)
[0.00-99.99]
[0.00]
Use Left/Right key
DP Zone2
XB2 (Ω)
[0.00-99.99]
[0.00]
Use Left/Right key
DP Zone2
Type(Dir=1/NonDir=0)
[0-1]
[0]
Use Left/Right key
DP Zone2
Trip Time (mSec)
[0-2000]
[0]
Use Left/Right key
DP Zone2
AR (En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
DP Zone3
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
DP Zone3
RF3(Ω)
[0.00-99.99]
[0.00]
Use Left/Right key
DP Zone3
XF3 (Ω)
[0.00-99.99]
[0.00]
Use Left/Right key
DP Zone3
RB3 (Ω)
[0.00-99.99]
[0.00]
Use Left/Right key
DP Zone3
XB3 (Ω)
[0.00-99.99]
[0.00]
Use Left/Right key
DP Zone3
Type(Dire=1/NonDir=0
[0-1]
[1]
Use Left/Right key
DP Zone3
Trip Time (mSec)
[0-2000]
[0]
Use Left/Right key
DP Zone3
AR(En=1/Dis=0)
[0-1]
[0]
E

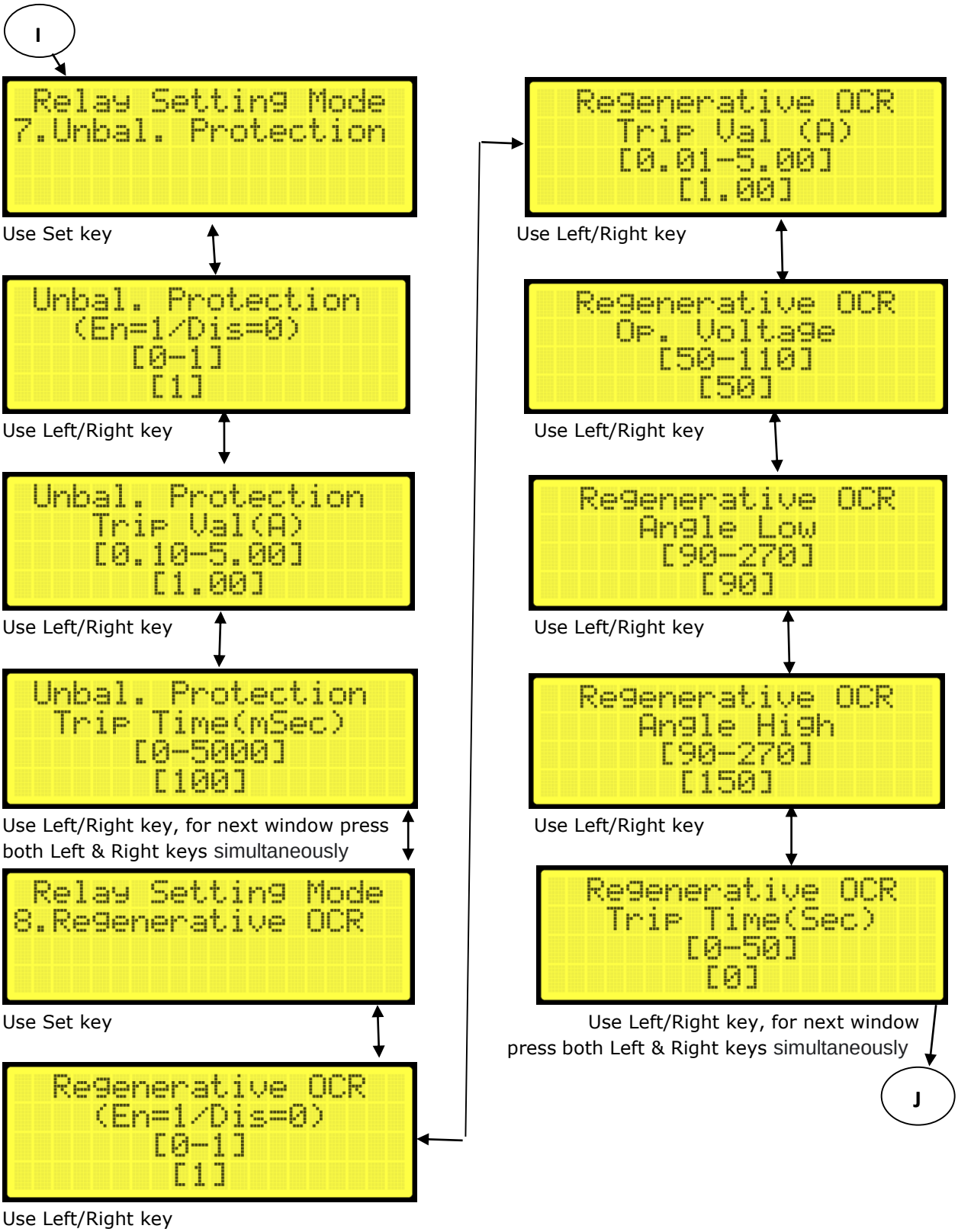

F
Distance Prot.
RCA°
[40-90]
[70]
Use Left/Right key
Distance Prot.
Min.Oper.Current(A)
[0.10-2.50]
[1.50]
Use Left/Right key
Distance Prot.
Min.Oper.Voltage(V)
[0-50]
[0]
Use Left/Right key
Distance Prot.
Line Impedance(Ω/km)
[0.00-1.00]
[0.41]
Use Left/Right key
press
Distance Prot.
Forward Angle°
[0-135]
[130]
Use Left/Right key
Distance Prot.
Reverse Angle°
[0-45]
[40]
Use Left/Right key
Distance Prot.
Z minimum(Ω)
[0.00-99.99]
[5.00]
Distance Prot.
Load Fwd. Angle°
[0-70]
[37]
Use Left/Right key
Distance Prot.
Load Rev. Angle°
[0-70]
[37]
Use Left/Right key
Distance Prot.
Sec. Har(En=1/Dis=0
[0-1]
[0]
Use Left/Right key
Distance Prot.
Sense-MTR(En=1/Dis=0
[0-1]
[0]
Use Left/Right key, for next window
both Left & Right keys simultaneously
Relay Setting Mode
3.Over Current Prot.
Use Set key for entering
Stage1- Inst.
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
F

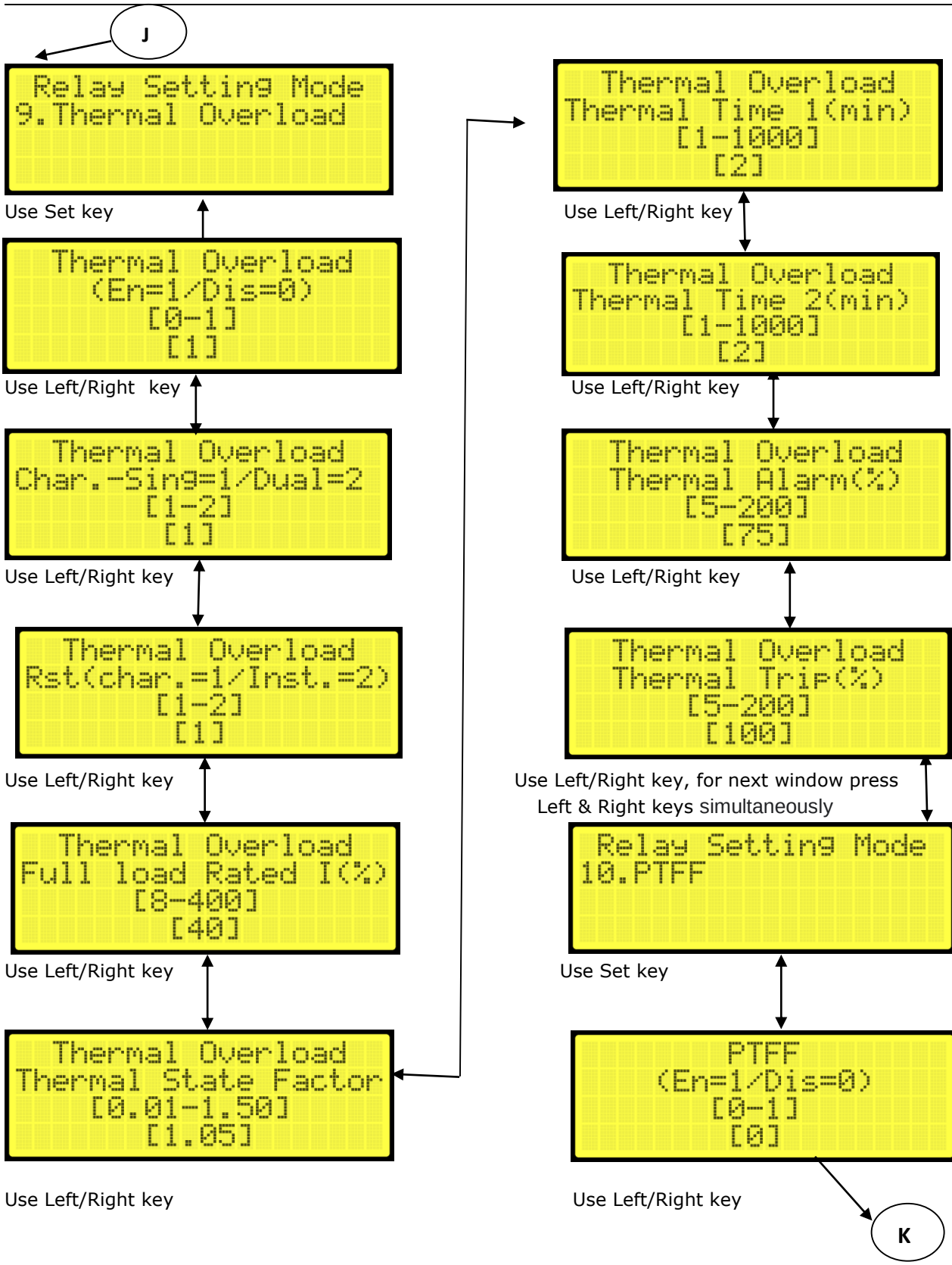

Use Left/Right key
F
Stage1- Inst.
Type(Dir=1/NonDir=0)
[0-1]
[0]
Use Left/Right key
Stage1- Inst.
Trip Val(%)
[10-2000]
[200]
Use Left/Right key
Stage1- Inst.
Sec. Har(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
Stage2-Deft. Time
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
Stage2-Deft. Time
Type(Dir=1/NonDir=0)
[0-1]
[0]
Use Left/Right key
Stage2-Deft. Time
Trip Val (%)
[0-1000]
[10]
Use Left/Right key
Stage2-Deft. Time
Trip Time (mSec)
[0-5000]
[0]
Use Left/Right key
Stage3-Deft. Time
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
Stage3-Deft. Time
Type (Dir=1/Non Dir=
[0-1]
[0]
Use Left/Right key
Stage3-Deft. Time
Trip Val (%)
[10-1000]
[10]
Use Left/Right key
Stage3-Deft. Time
Trip Time (Sec)
[0-900]
[0]
Use Left/Right key
Over Current Prot.
Forward Angle
[0-135]
[130]
Use Left/Right key
Over Current Prot.
Reverse Angle
[0-45]
[40]
Use Left/Right key
G

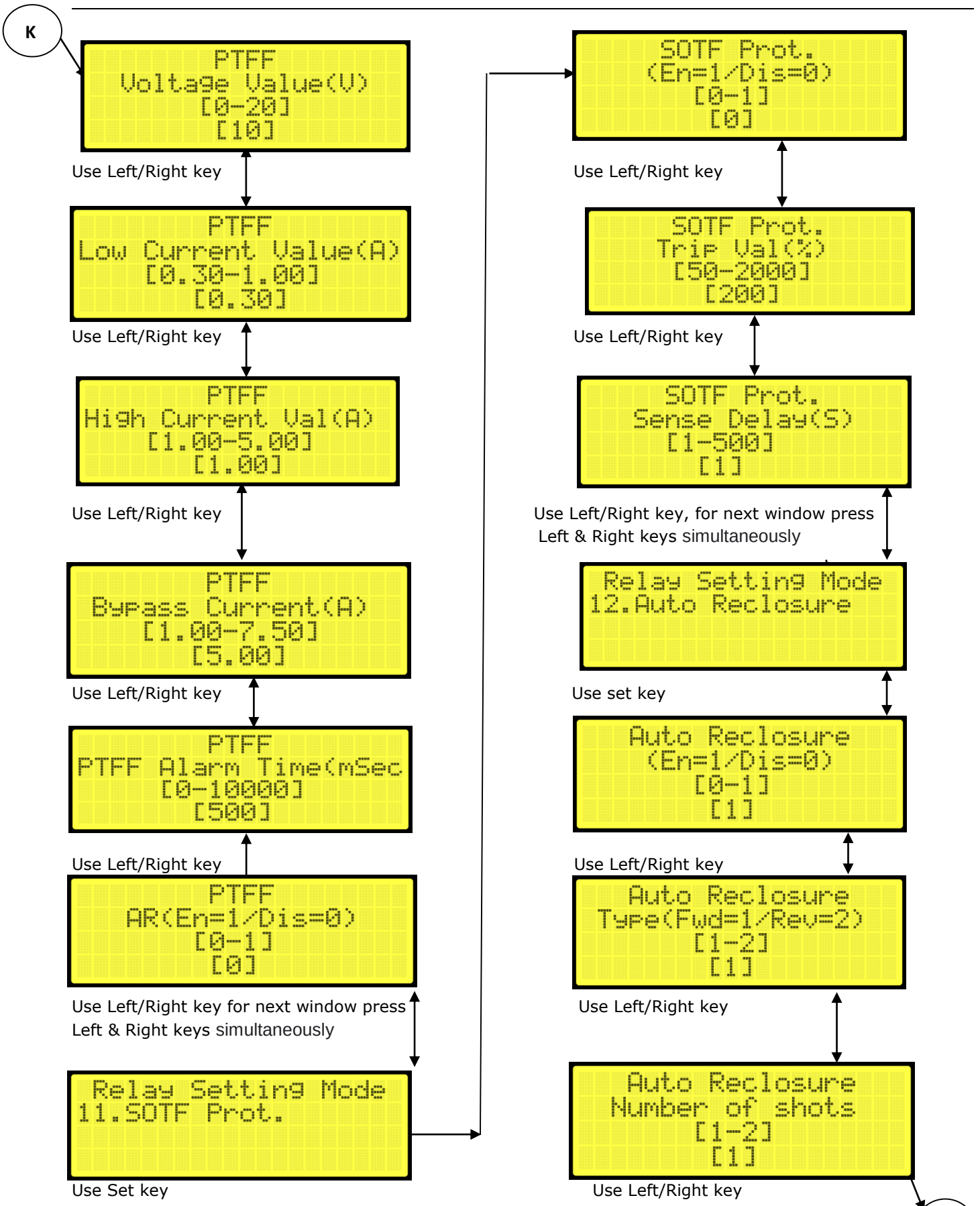

G
Over Current Prot.
AR(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key, for next window press
both Left & Right keys simultaneously
Relay Setting Mode
4.WPC
Use Set key
WPC
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
WPC
Impedance Low(Ω)
[0.00-99.99]
[11.00]
Use Left/Right key
WPC
Impedance High(Ω)
[0.00-99.99]
[38.00]
Use Left/Right key
WPC
Angle Low°
[90-180]
[90]
Use Left/Right key
WPC
Angle High°
[90-180]
[150]
Use Left/Right key
WPC
Op. Current
[0.00-5.00]
[3.00]
Use Left/Right key
Vtg. Option
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
WPC
Op. Voltage
[30-110]
[110]
Use Left/Right key
WPC
Sec. Har(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key, for next window press
both Left & Right keys simultaneously
Relay Setting Mode
5.Delta-I Protection
Use Set key
Delta-I Protection
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
H

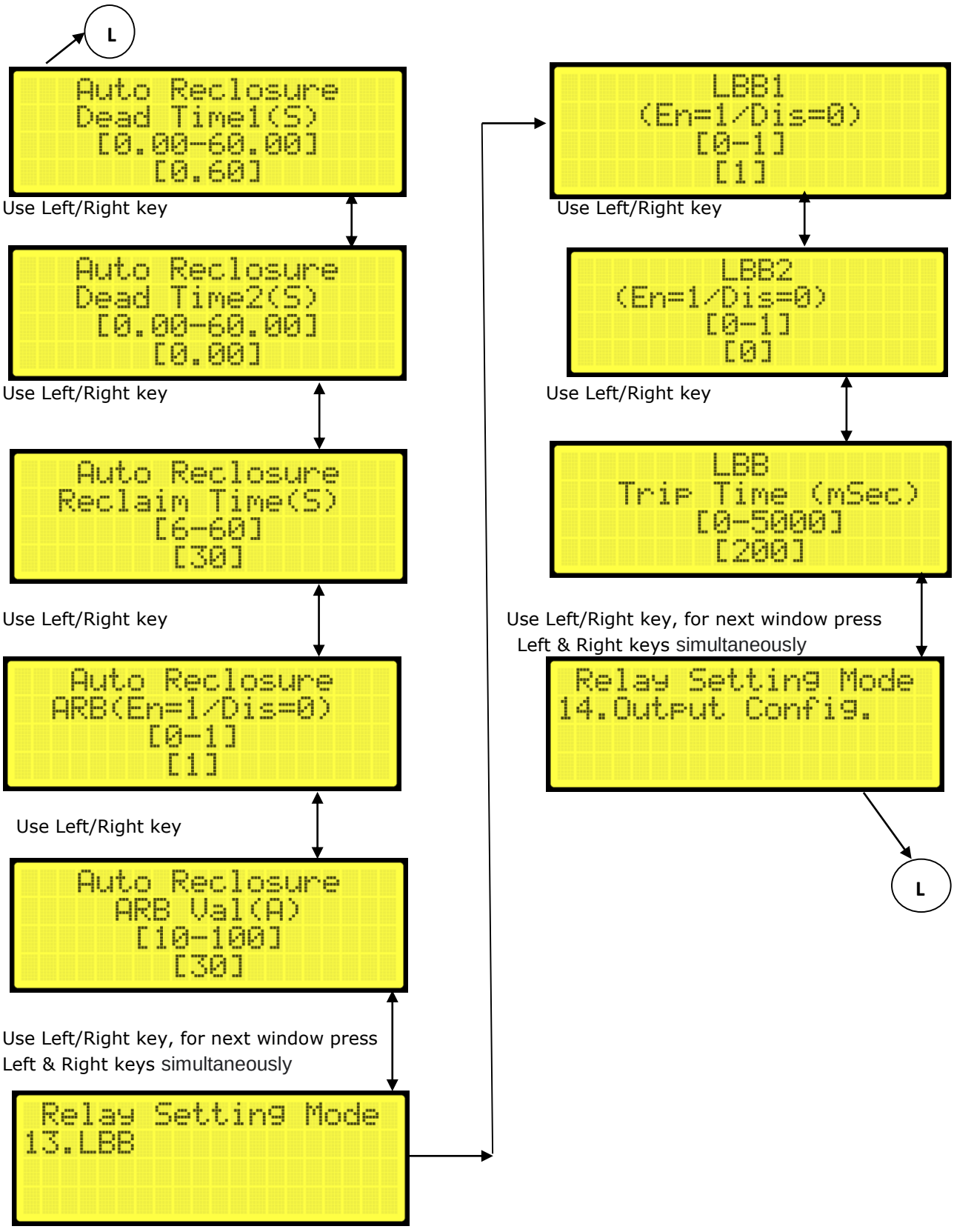

H
Delta-I Protection
Current Value(A)
[0.10-6.00]
[1.50]
Use Left/Right key
Delta-I Protection
Delta I Cycle
[20-200]
[40]
Use Left/Right key
Delta-I Protection
Add. Time Delay(mS)
[0-1000]
[100]
Use Left/Right key
Delta-I Protection
X Blinder( )
[0.00-99.99]
[0.00]
Use Left/Right key
Delta-I Protection
Sec. Har(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
Delta-I Protection
Thr. Har(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
Delta-I Protection
Harmonic De-Sen(%)
[0-100]
[100]
Delta-I Protection
AR(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
Delta-I Protection
Sense-MTR(En=1/Dis=0
[0-1]
[0]
Use Left/Right key, for next window press
both Left & Right keys simultaneously
Relay Setting Mode
6.UV Protection
Use Set key.
UV Protection
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
UV Protection
Voltage Value(V)
[1-110]
[50]
Use Left/Right key
UV Protection
Trip Time(mSec)
[0-5000]
[1000]
Use Left/Right key, for next window press
both Left & Right keys simultaneously
I

Use Left/Right key



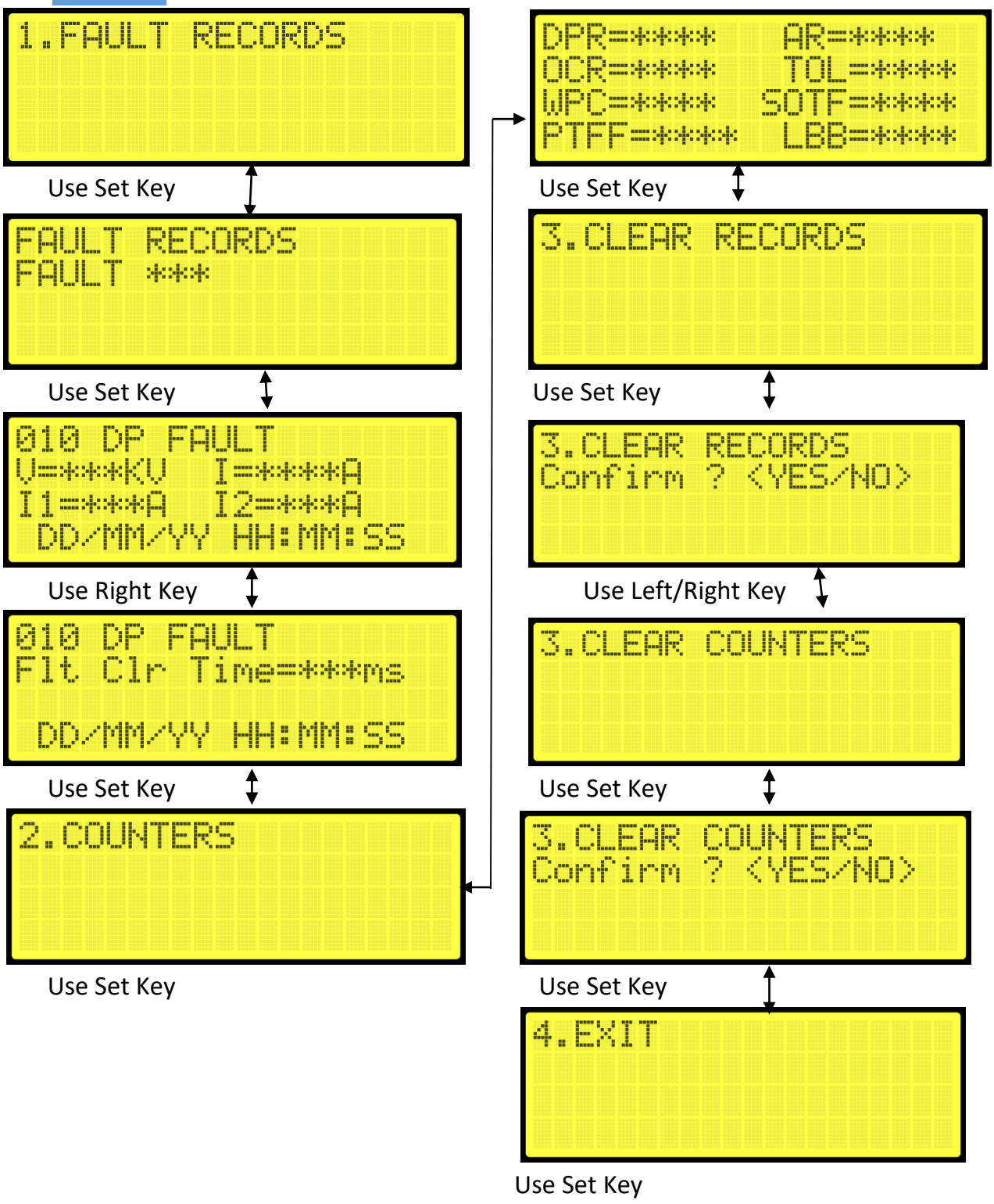

J
Relay Setting Mode
9.Thermal Overload
Use Set key
Thermal Overload
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
Thermal Overload
Char.-Sing=1/Dual=2
[1-2]
[1]
Use Left/Right key
Thermal Overload
Rst(char.=1/Inst.=2)
[1-2]
[1]
Use Left/Right key
Thermal Overload
Full load Rated I(%)
[8-400]
[40]
Use Left/Right key
Thermal Overload
Thermal State Factor
[0.01-1.50]
[1.05]
Use Left/Right key
Thermal Overload
Thermal Time 1(min)
[1-1000]
[2]
Use Left/Right key
Thermal Overload
Thermal Time 2(min)
[1-1000]
[2]
Use Left/Right key
Thermal Overload
Thermal Alarm(%)
[5-200]
[75]
Use Left/Right key
Thermal Overload
Thermal Trip(%)
[5-200]
[100]
Use Left/Right key, for next window press
Left & Right keys simultaneously
Relay Setting Mode
10.PTFF
Use Set key
PTFF
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
K


K
PTFF
Voltage Value(V)
[0-20]
[10]
Use Left/Right key
PTFF
Low Current Value(A)
[0.30-1.00]
[0.30]
Use Left/Right key
PTFF
High Current Val(A)
[1.00-5.00]
[1.00]
Use Left/Right key
PTFF
Bypass Current(A)
[1.00-7.50]
[5.00]
Use Left/Right key
PTFF
PTFF Alarm Time(mSec
[0-10000]
[500]
Use Left/Right key
PTFF
AR(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key for next window press
Left & Right keys simultaneously
Relay Setting Mode
11.SOTF Prot.
Use Set key
SOTF Prot.
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
SOTF Prot.
Trip Val(%)
[50-2000]
[200]
Use Left/Right key
SOTF Prot.
Sense Delay(S)
[1-500]
[1]
Use Left/Right key, for next window press
Left & Right keys simultaneously
Relay Setting Mode
12.Auto Reclosure
Use set key
Auto Reclosure
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
Auto Reclosure
Type(Fwd=1/Rev=2)
[1-2]
[1]
Use Left/Right key
Auto Reclosure
Number of shots
[1-2]
[1]
Use Left/Right key
L


L
Auto Reclosure
Dead Time1(S)
[0.00-60.00]
[0.60]
Use Left/Right key
Auto Reclosure
Dead Time2(S)
[0.00-60.00]
[0.00]
Use Left/Right key
Auto Reclosure
Reclaim Time(S)
[6-60]
[30]
Use Left/Right key
Auto Reclosure
ARB(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
Auto Reclosure
ARB Val(A)
[10-100]
[30]
Use Left/Right key, for next window press
Left & Right keys simultaneously
Relay Setting Mode
13.LBB
Use Set key
LBB1
(En=1/Dis=0)
[0-1]
[1]
Use Left/Right key
LBB2
(En=1/Dis=0)
[0-1]
[0]
Use Left/Right key
LBB
Trip Time (mSec)
[0-5000]
[200]
Use Left/Right key, for next window press
Left & Right keys simultaneously
Relay Setting Mode
14.Output Config.
L

To access & clear logs

Use this key

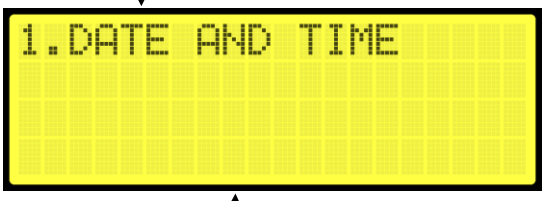


To view device Info.

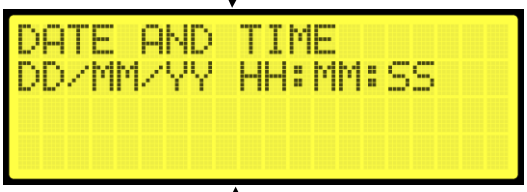
Use Right Key

For
Relay healthiness check & I/O Verification

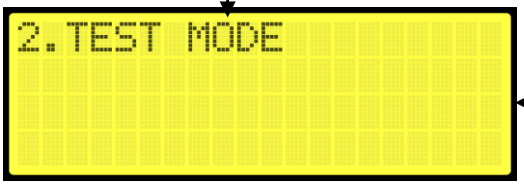
Use this key



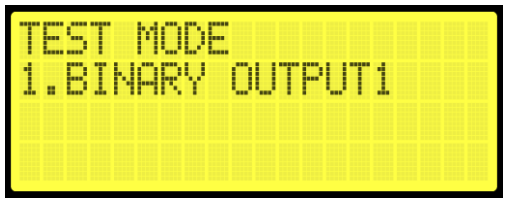
Use Set Key



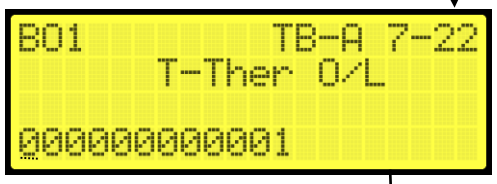
Use Right Key



Use Set Key



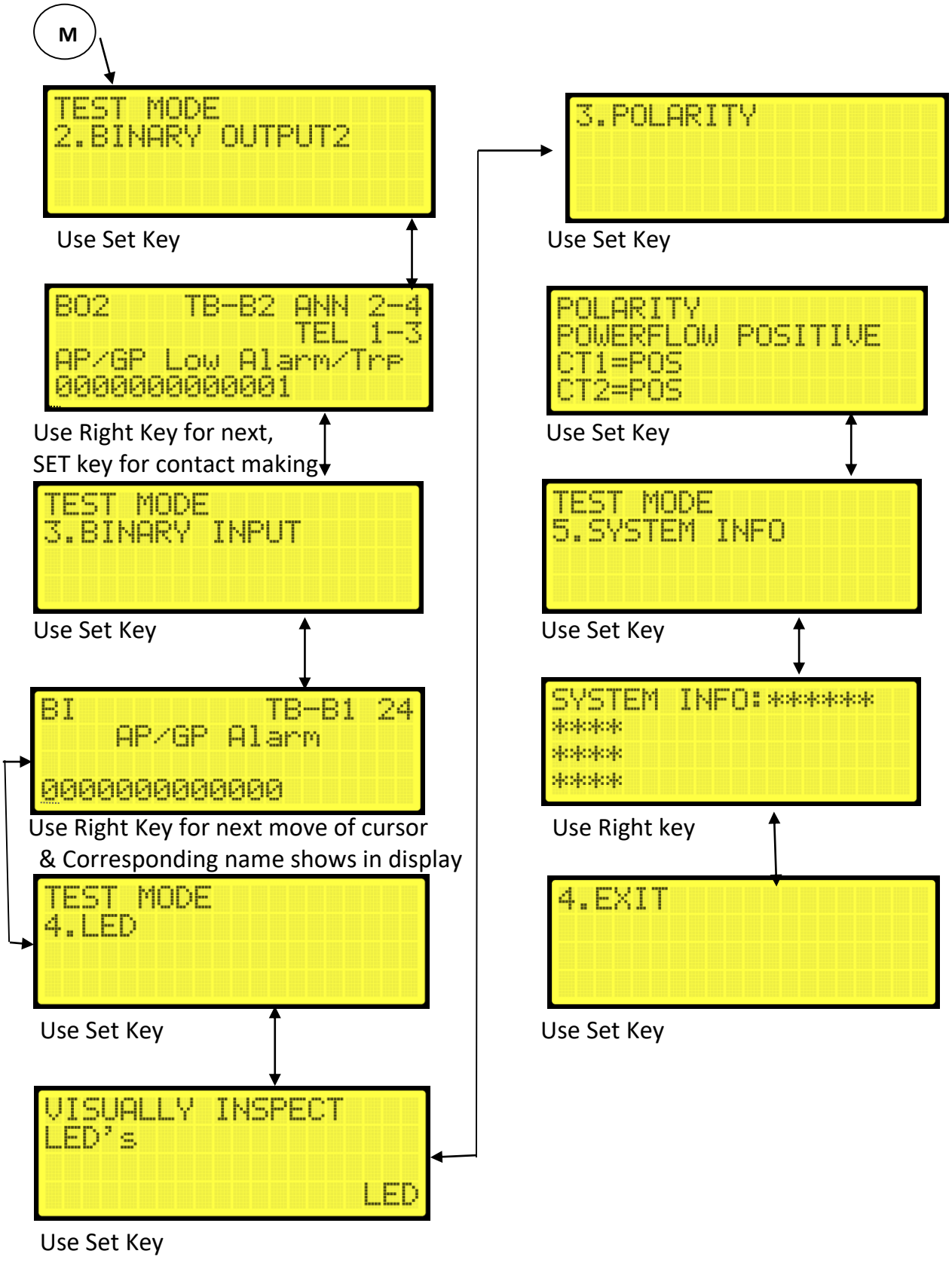
Use Set Key & enter password 1000



Use Right Key for next

SET key for contact making

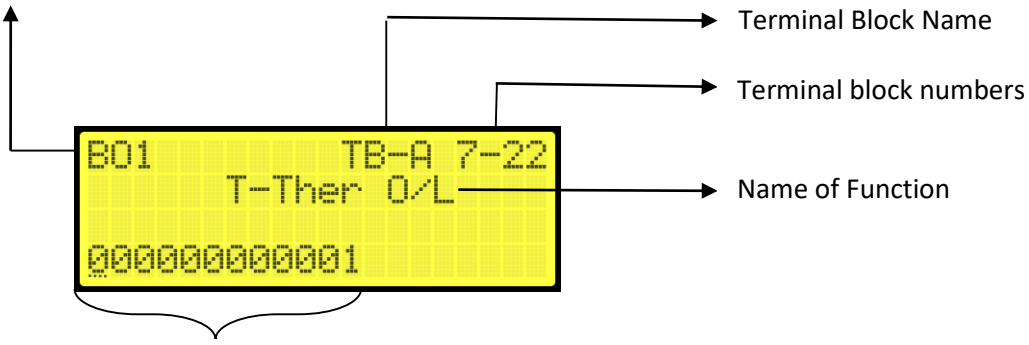
M


M
TEST MODE
2.BINARY OUTPUT2
Use Set Key
BO2 TB-B2 ANN 2-4
TEL 1-3
AP/GP Low Alarm/Trp
0000000000001
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
0000000000000
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
POWERFLOW POSITIVE
CT1=POS
CT2=POS
Use Set Key
TEST MODE
5.SYSTEM INFO
Use Set Key
SYSTEM INFO:******
****
****
****
Use Right key
4.EXIT
Use Set Key

Binary Output & Input Details

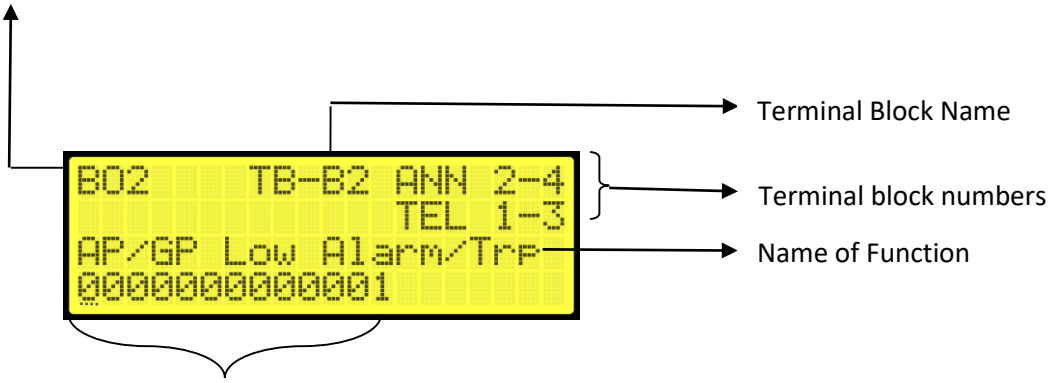
Binary Output 1			Binary Output 2			Binary Input		
BO 1	NAME	TB NUMBER	BO 2	NAME	TB NUMBER	BI	NAME	TB NUMBER
1	T- Ther O/L	TB A - 7 & 22	1	AP/GP Alarm/Trip	TB B2 - 1 & 3 , 2 & 4	1	AP/GP Alarm	TB B1 - 24
2	Gen Trip	TB A - 8 & 21	2	PTFF Alarm/Trip	TB B2 - 1 & 5 , 2 & 6	2	AP/GP Trip & LOCK	TB B1 - 21
3	T- Reg OCR	TB A- 9 & 20	3	Lockout	TB B2 - 1 & 7 , 2 & 8	3	MTR Optd	TB B1 - 22
4	Reclose	TB A- 10 & 19	4	DP	TB B2 - 1 & 9 , 2 & 10	4	CB Open	TB B1 - 19
5	UV Close	TB A- 11 & 18	5	WPC	TB B2 - 1 & 11 , 2 & 12	5	CB Close	TB B1 - 20
6	LBB 1	TB A- 12 & 17	6	OCR	TB B2 - 1 & 13 , 2 & 14	6	RCC Reset	TB B1 - 17
7	SPARE 1	TB A- 13 & 16	7	Delta I	TB B2 - 1 & 15 , 2 & 16	7	Z1 Extn	TB B1 - 18
8	SPARE 2	TB A- 14 & 15	8	TCS	TB B2 - 1 & 17 , 2 & 18	8	ARB I/P	TB B1 - 15
9	DP	TB B1 - 3 & 4	9	LBB	TB B2- 1 & 19 , 2 & 20	9	ARB RCC	TB B1 - 16
10	OCR/Delta I	TB B1 - 5 & 6	10	UV	TB B2 - 1 & 21 , 2 & 22	10	EXT. A/R Trigger	TB B1 - 13
11	LBB 2	TB B1 - 7 & 8	11	Reclose	TB B2 - 1 & 23 , 2 & 24	11	Spare	TB B1 - 14
12	Relay Error	TB B1 - 1 & 2	12	ARB	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 next or previous contact & moving cursor also change the corresponding name in display. For making contact use SET key.

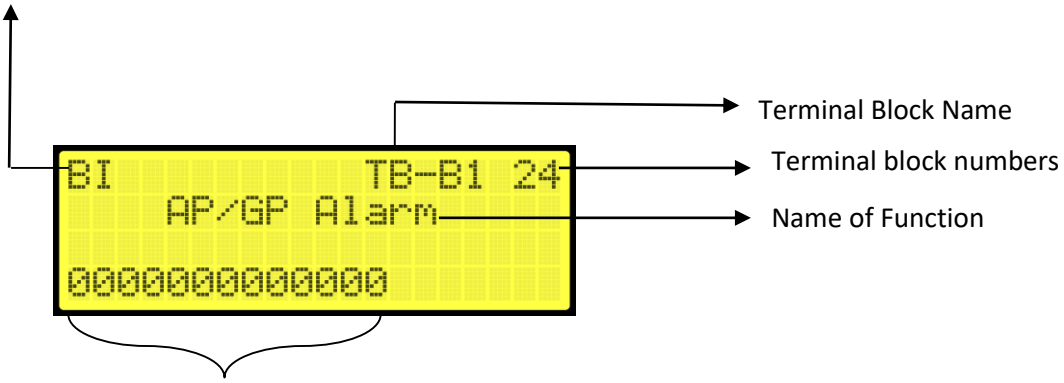
Binary Output 2



Binary Output Contacts. Use left/Right key for selecting next or previous 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 next or previous 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

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DESCRIPTION OF PROTECTION FUNCTIONS

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GENERAL SETTINGS

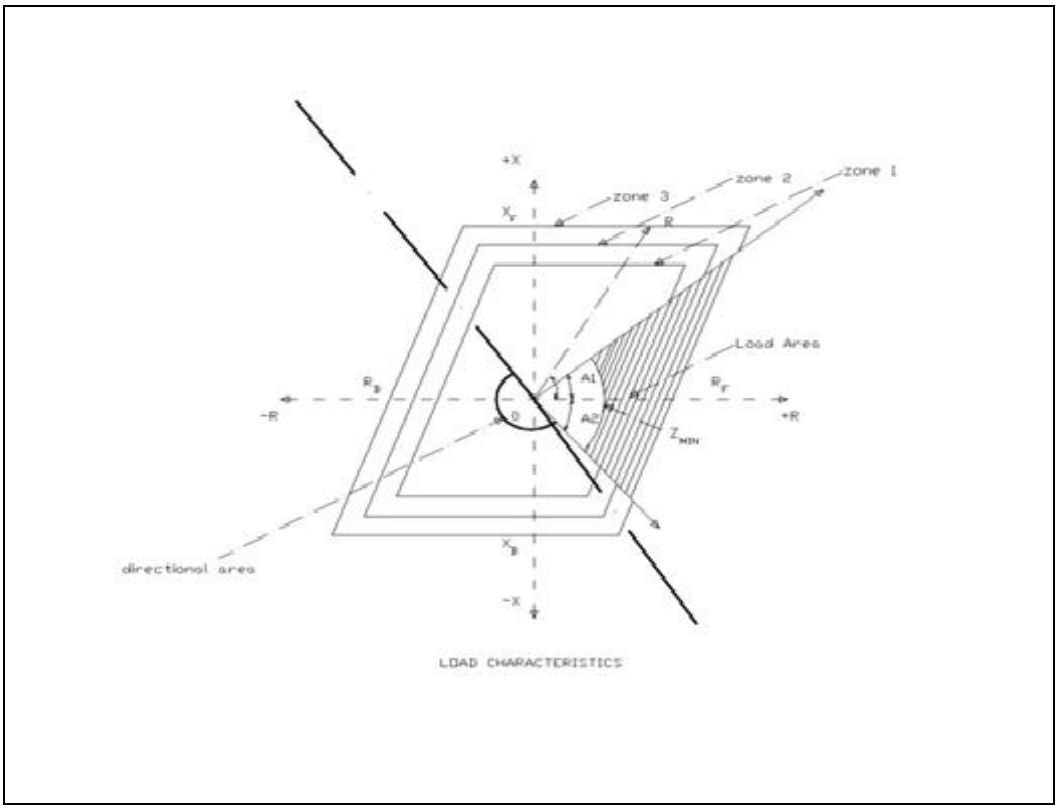
TB DETAILS

SETTING GUIDELINES

RELAY CONFORMING STANDARDS

DESCRIPTION OF PROTECTION FUNCTIONS

I) Distance protection



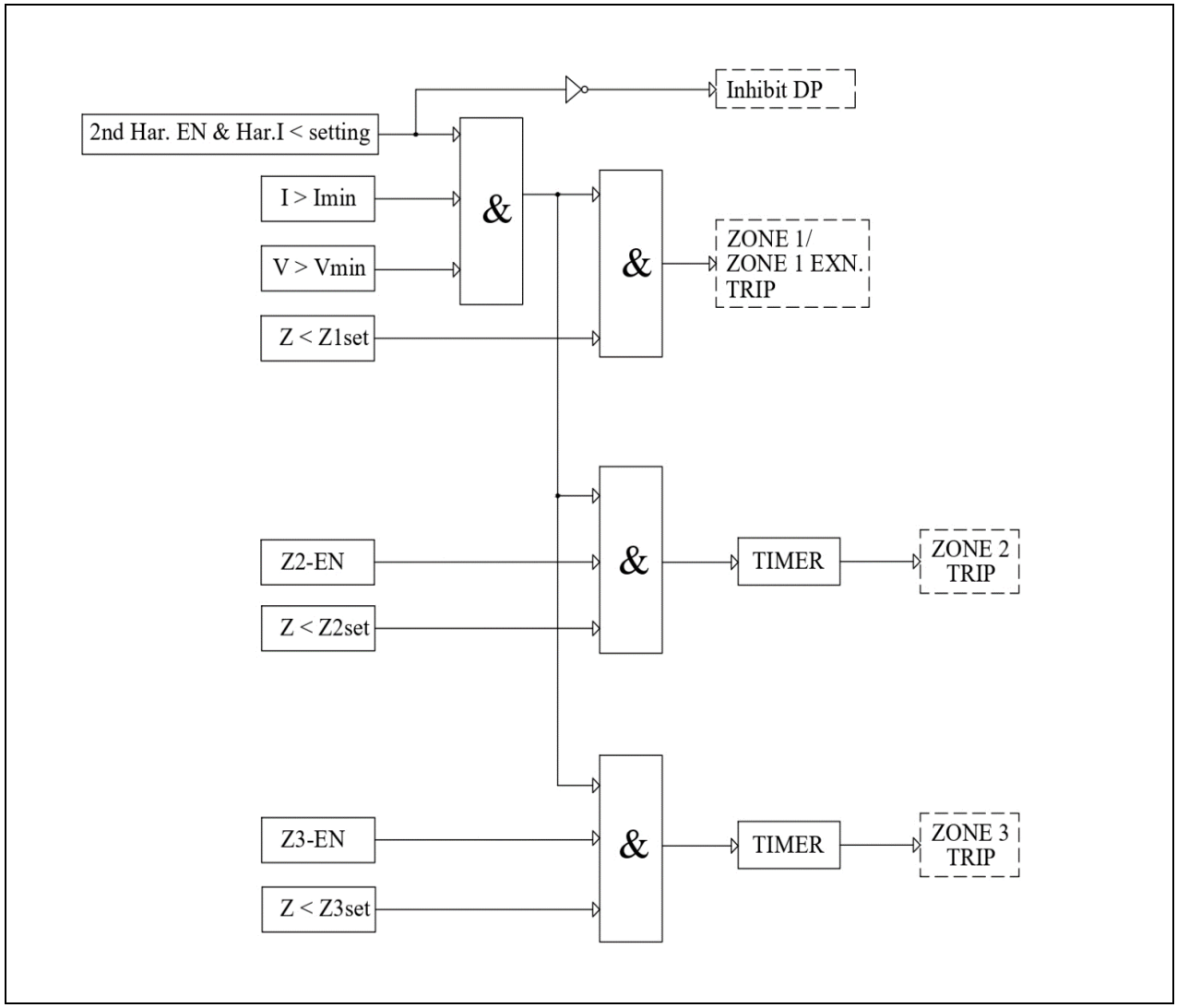
DESIGNATION	DESCRIPTION
R	Resistance axis in the Polygon
X	Reactance axis in the Polygon
Zone1	
RF1	Forward resistance in zone1
RB1	Reverse resistance in zone 1
XF1	Forward reactance in zone 1
XB1	Reverse reactance in zone 1
Zone2	
RF2	Forward resistance in zone 2
RB2	Reverse resistance in zone 2
XF2	Forward reactance in zone 2
XB2	Reverse reactance in zone 2
Zone3	
RF3	Forward resistance in zone 3
RB3	Reverse resistance in zone 3
XF3	Forward reactance in zone 3
XB3	Reverse reactance in zone 3
RCA	Relay characteristics angle
Z min	Minimum impedance
A1	Forward Angle
A2	Reverse Angle

The relay is an impedance based relay with three zone distance protection with polygonal characteristics with four impedances settings- Forward resistance (RF), Reverse resistance (RB), Forward reactance (XF), Reverse reactance (XB) Minimum Impedance, Forward and Reverse angle which can be set independently. The R and X values are calculated by sampling the current and voltage waveforms and compared with the polygonal characteristics. If they fall within the characteristics, then the relay will provide the tripping command. The Relay is having an add-on feature of Load encroachment that shall avoid unwanted tripping of relay in load area while feed extension condition.

Zone-1 Extension

The relay has special feature of Zone Extension in which the reach of the Distance protection can be extended. There is separate setting for Zone1 Extension. This feature is very useful when one of the TSS is bypassed for maintenance and the protection zone is to be increased.

FUNCTIONAL BLOCK DIAGRAM

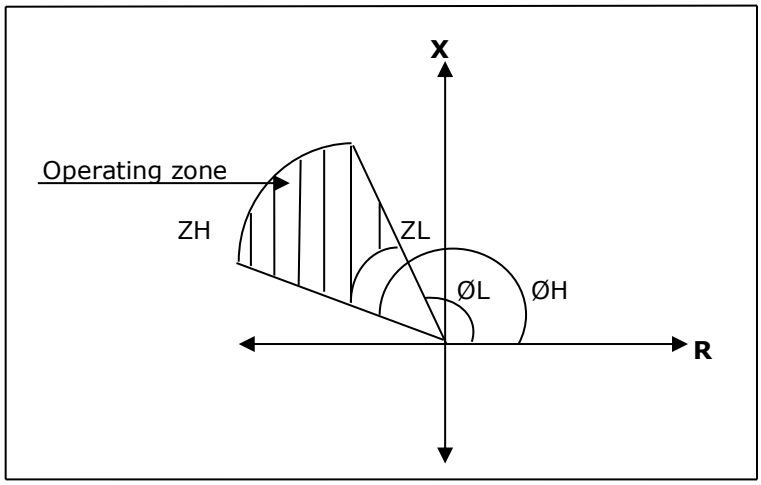


II) Wrong Phase Coupling Protection (for 25kV only)

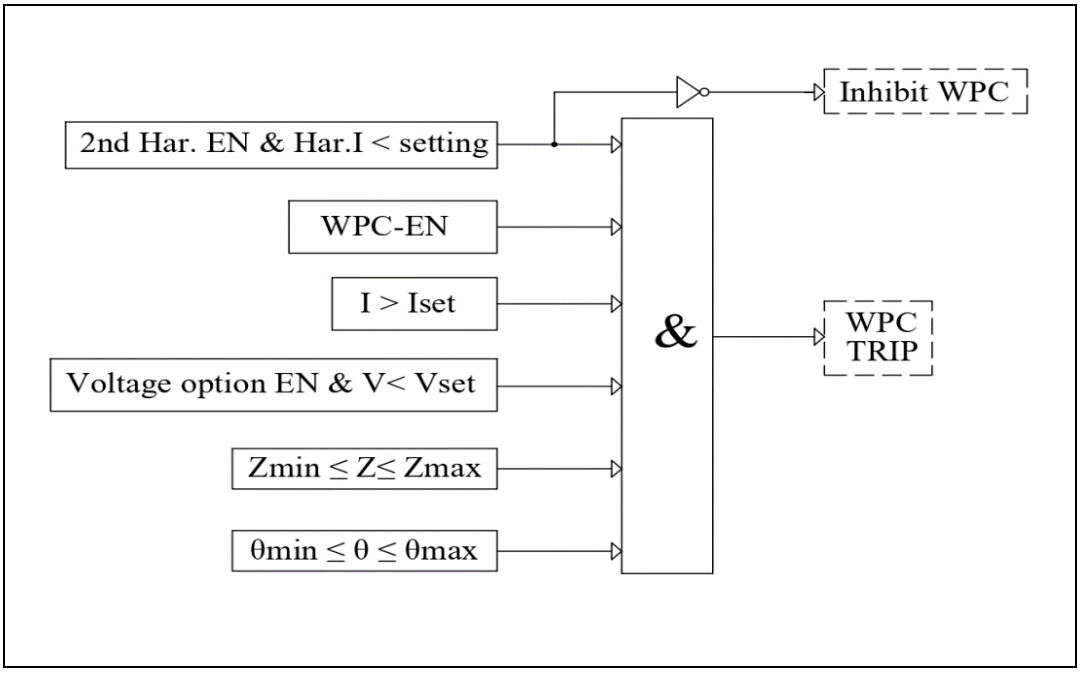
If two traction substations are fed with two different power supply phases, then there is always possibility of phase-to-phase short circuit in SP. In such case, measured impedance angle falls in the second quadrant. The relay has three separate settings for WPC condition.

i) Current (0-3A)
ii) Angle (90-180)
iii) Impedance-low limit and high limit (0-70)

If all the preset condition is satisfying, then the relay will initiate the trip command



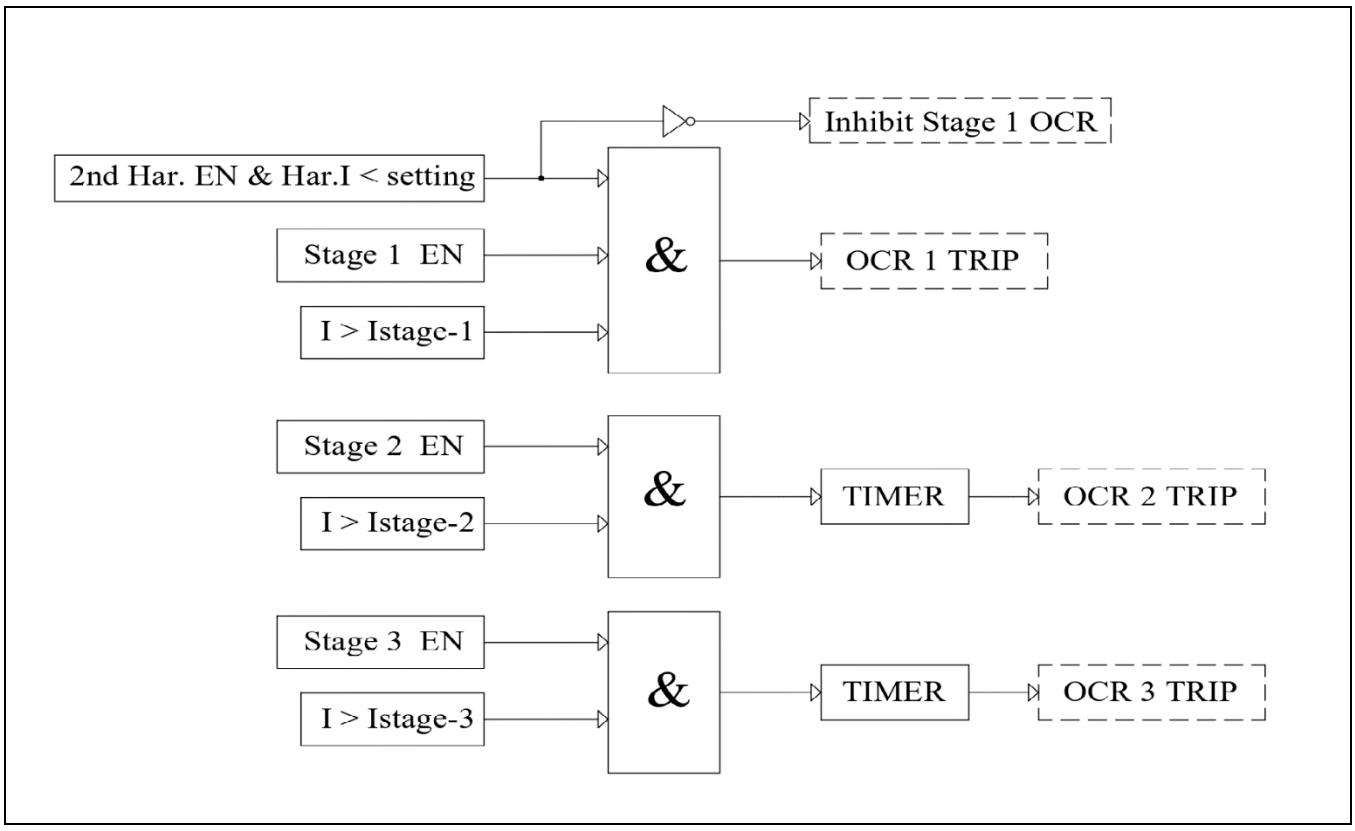
FUNCTIONAL BLOCK DIAGRAM



III) Over current protection

The relay is having three stages of over current setting (Stage1 instantaneous and stage 2&3 are definite time for overload protection of OHE). When current value gets more than the setting value the relay initiates trip command in the time set.

FUNCTIONAL BLOCK DIAGRAM



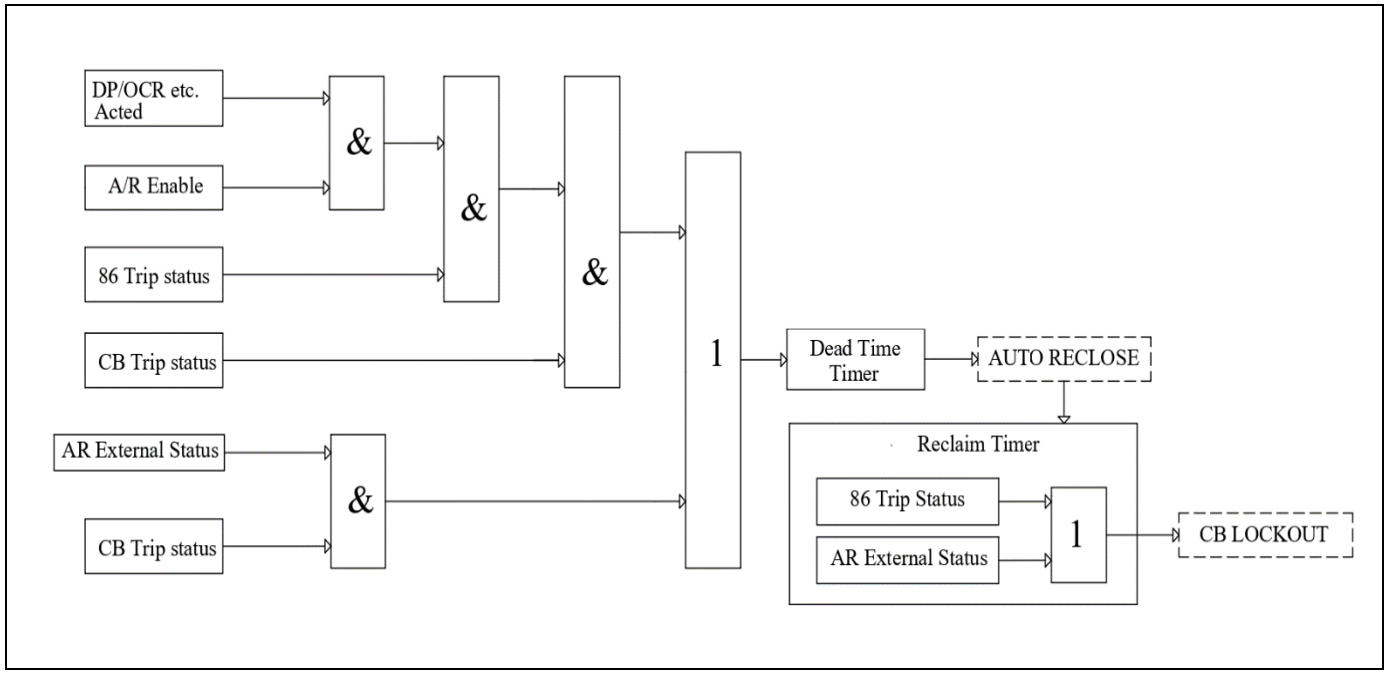
IV) Auto Reclose and Lockout Logic

The relay is provided with selectable (1 or 2) shot auto reclose function with enable/disable option. Once auto reclosed the relay starts the dead timer. After dead time the reclose command is executed and the reclaim time starts.

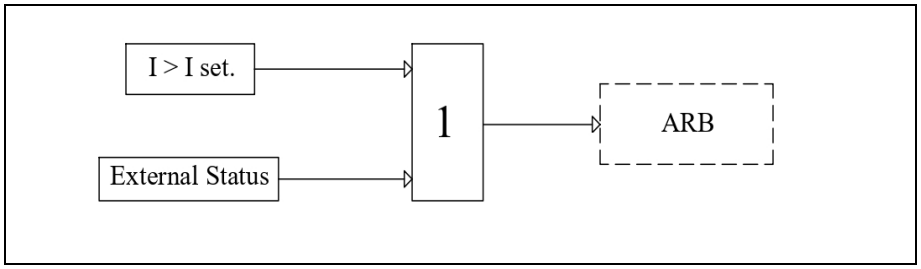
During reclaim time if the relay trips further, then the relay goes to lockout condition.

FUNCTIONAL BLOCK DIAGRAM

1. Auto Reclose & Lockout



2. ARB



3. PT Fuse Failure Logic

The PT Fuse Failure protection is by monitoring the PT voltage and Current.

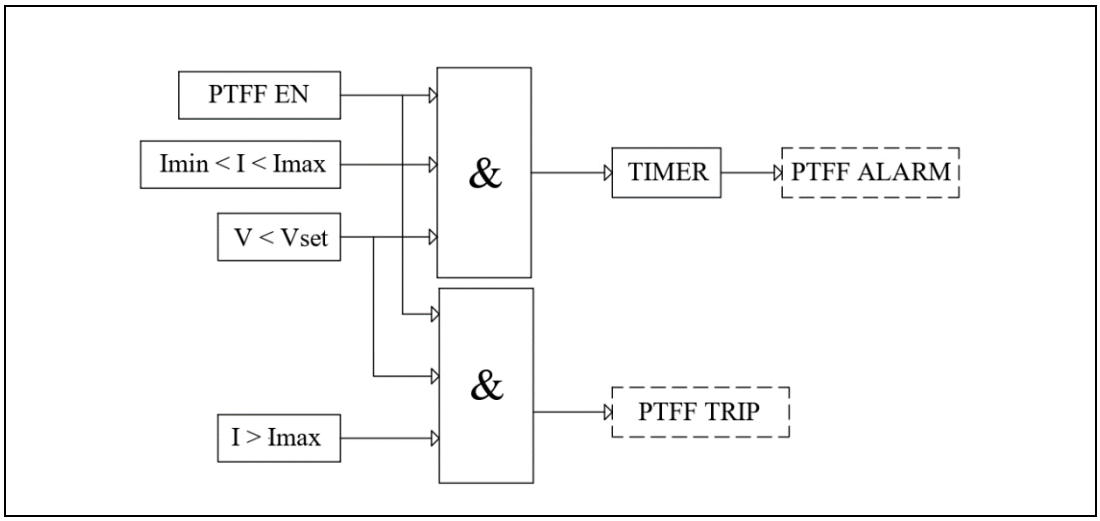
PTFF alarm logic

When PT voltage is less than set voltage and line current in between set limit for set time delay then PTFF alarm contact will make.

PTFF Trip logic

when PT voltage is less than the set value but the current is more than higher set limit of PTFF alarm, then PTFF trip contact will make.

FUNCTIONAL BLOCK DIAGRAM



4. Thermal Overload protection

Thermal overload protection prevents the electrical equipment when the operating temperature exceeds the maximum designed temperature.

The thermal level calculation of the protected equipment is based on the equivalent heating phase current measurement and the recursive computation of a discrete-time equation of a differential first-order thermal model.

The thermal level $H(t)$ of the protected equipment is calculated by the following equation:

$$\mathbf{H(t)=[Ieq(t)/(K.IB)]^2.[\Delta t/(\zeta+\Delta t)] + [\zeta/(\zeta+\Delta t)].[H(t-\Delta t)]}$$

Trip time is calculated by the following equation:

$$\mathbf{t(Ieq) = \zeta \ln[(Ieq^2 - Ip^2)/(Ieq^2 - (K.IB)^2)]}$$

where,
$H(t)$ is the thermal level at time t;
$H(t-\Delta t)$ is the thermal level at time $t-\Delta t$;
Δt is the sample period which is the time interval between two consecutives samples of input currents;
$Ieq(t)$ is the equivalent heating phase current at time t
ζ is the heating/cooling thermal time constant of the equipment to be thermally protected

Ip is the steady-state load current prior to the overload for a duration

$t(Ieq)$ is the theoretical operate time,

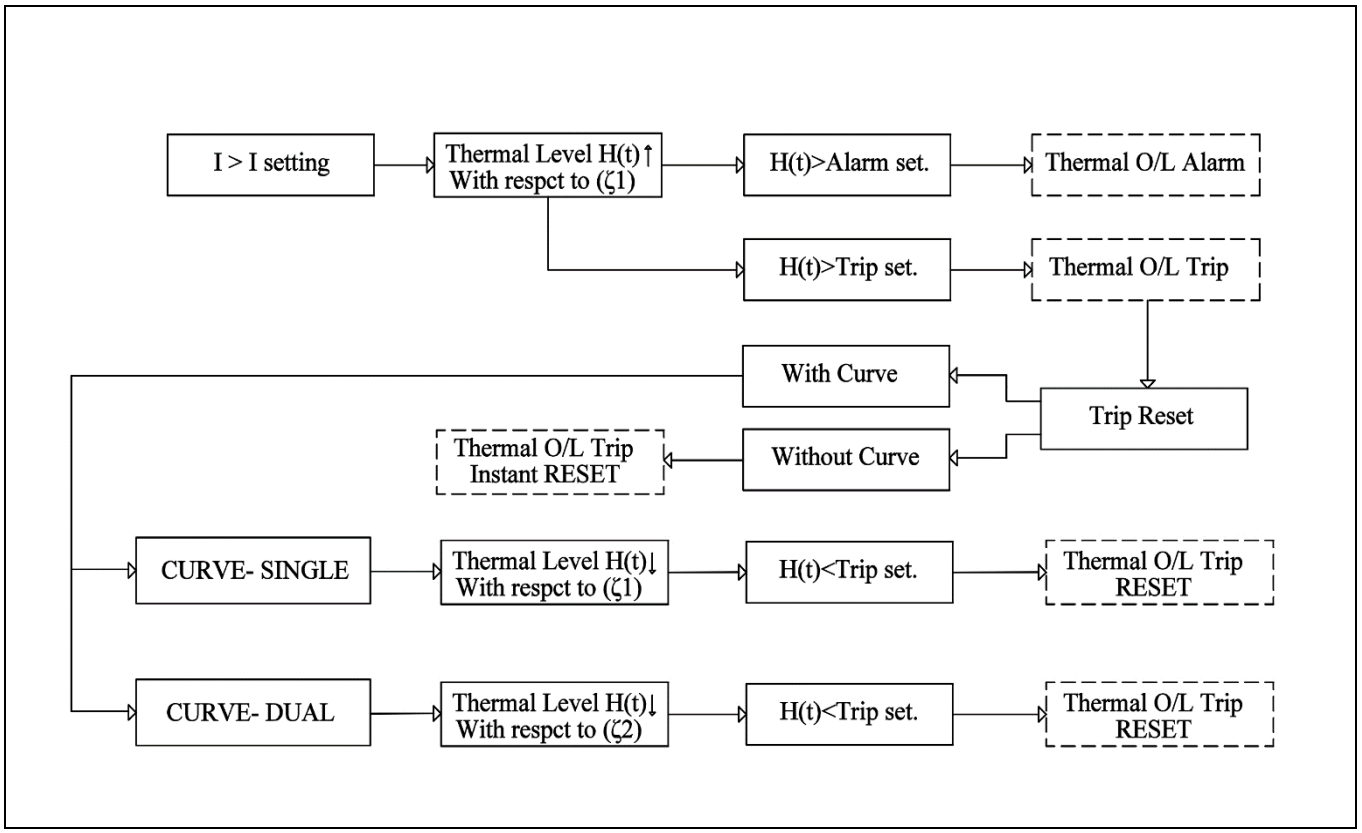
Ieq is the equivalent heating current;

k is a constant (fixed) value or a setting, declared by the thermal relay manufacturer;

*I*B is the basic current value expressed as permissible current of the equipment to be thermally protected.

According to the mechanical design of the electrical equipment to be thermally protected, the heating thermal time constant and cooling thermal time constant can have different values (ζ1& ζ2 instead of ζ in thermal level equation).

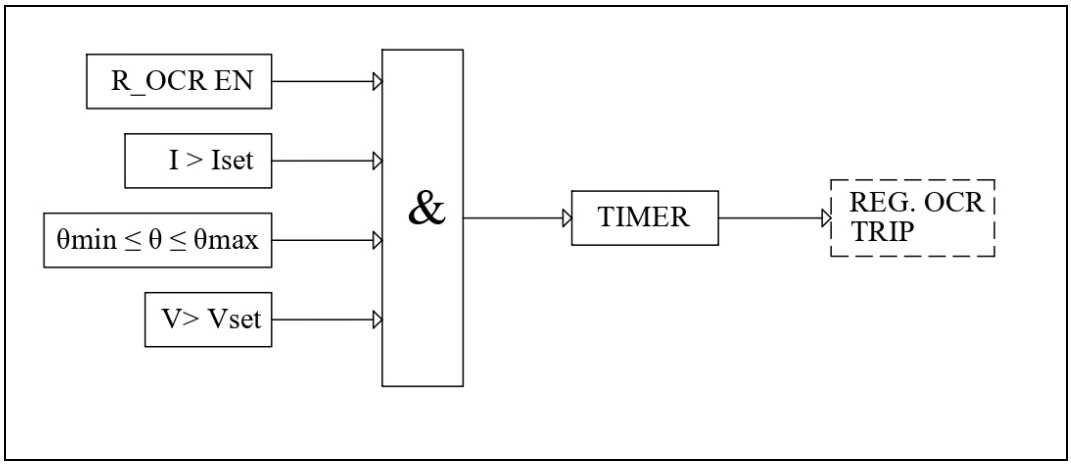
FUNCTIONAL BLOCK DIAGRAM



5. Regenerative Over Current Protection (for 25kV only)

Relay will monitor the Regenerative breaking current from locomotives or reverse power flow and trip if it exceeds the setting after set time.

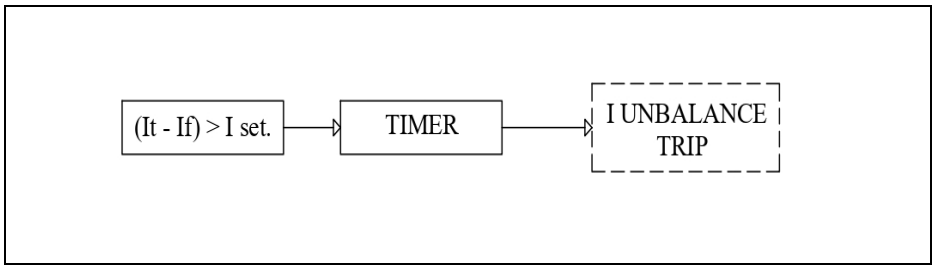
FUNCTIONAL BLOCK DIAGRAM



6. Current Unbalance Protection (for 2X25kV only)

In the case of 2X25kV system, traction current and feeder current are almost equal, if any unbalance is happened for a fault, then relay will initiate trip command.

FUNCTIONAL BLOCK DIAGRAM



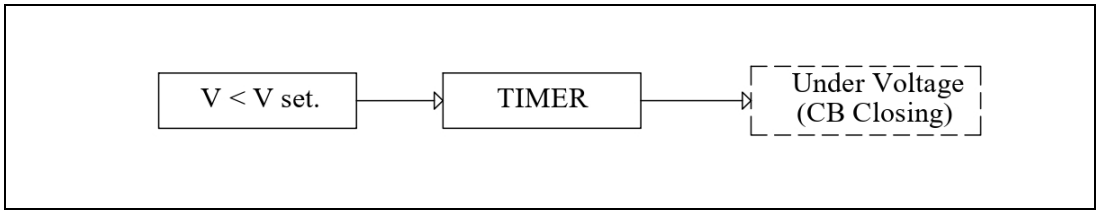
7. Under Voltage Protection (for 2X25kV only)

Under-voltage relay is provided to prevent closing of Feeder CB under extended feed conditions. The under-voltage relay prevents closing of the concerned feeder circuit breaker, when the OHE is already in the energized condition (for example, during a feed extension) to avoid any wrong phase coupling between different sub-stations.

Under voltage setting : 1 to 110 V in steps of 1V

Operating time : 0 to 5 sec in the steps of 20 ms.

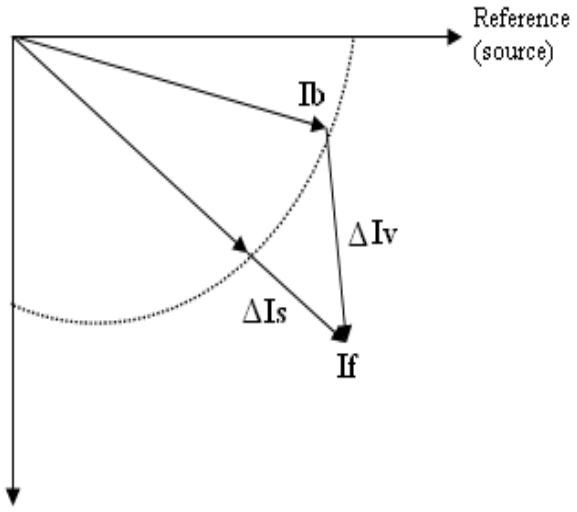
FUNCTIONAL BLOCK DIAGRAM



8. Delta I protection

The Delta I relay works on the principle of Vectorial difference between the base load current and fault current. The relay has a feature to prevent unnecessary operation by the Inrush current of power transformer and due to switching of multiple numbers of electric locos in the section. The inrush currents of power transformers contain significantly high 2nd harmonics currents and switching of Locos generate 3rd harmonics currents. If the harmonic component is larger than permitted range, the relay blocks out, thus preventing unnecessary operation of the relay.

The relay is operated by Vectorial delta I current at the same value as of setting current not withstanding the magnitude of base current. There is a provision of differentiation between fault current and load current. The load current normally has got a high percentage of 3rd harmonic distortion as compared to the fault current. The relay sensitivity restrains according to the de-sensitivity setting at set current when Vectorial delta I current include more than preset value of 3rd harmonic current.



Where I_b *: Base current*

I_f *: Fault current*

ΔIs : Scalar change in current

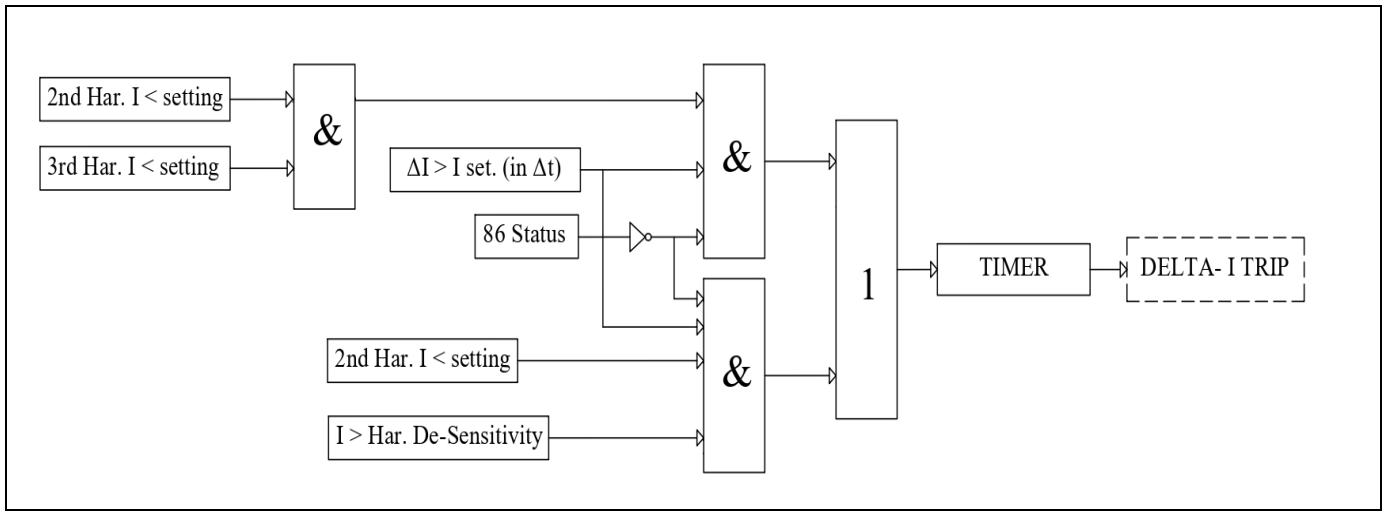
ΔIv : Vectorial change in current

$\Delta Is = |If| - |Ib|$

$|\Delta Iv| = |If| - |Ib|$

ΔIv > Set current

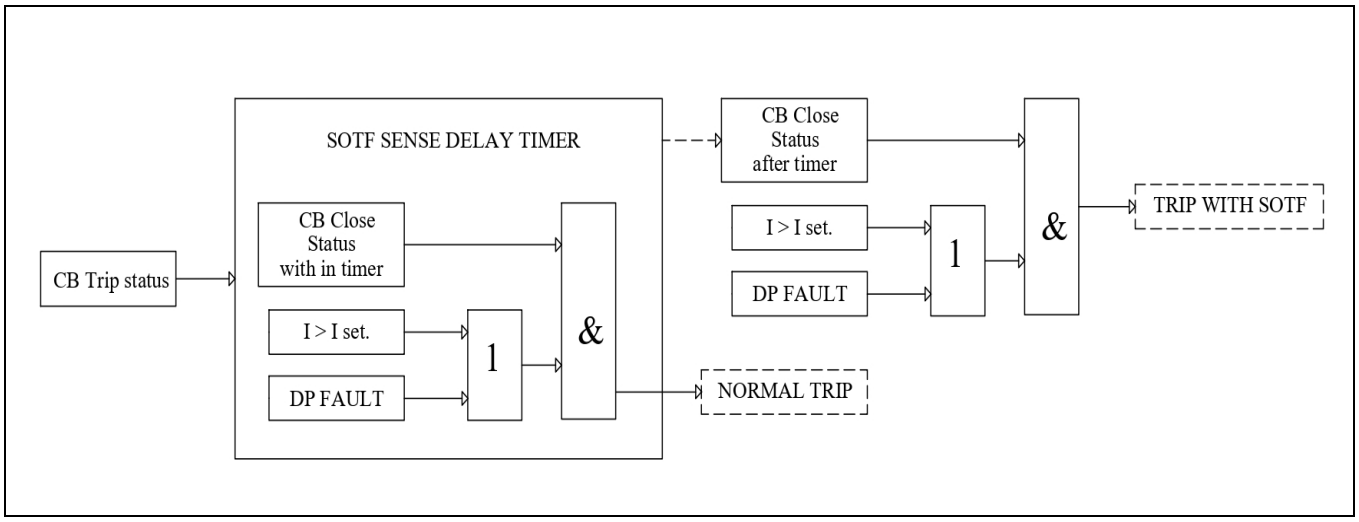
FUNCTIONAL BLOCK DIAGRAM



9. Switch On to Fault (SOTF):

If the breaker is trip for a set time and the breaker is closing to an existing fault condition after that time, the relay will immediately sense this condition and will trip the respective breaker in the order of one cycle. For this, the relay monitors the fault current. In the case of distance protection also SOTF will act in such condition.

FUNCTIONAL BLOCK DIAGRAM

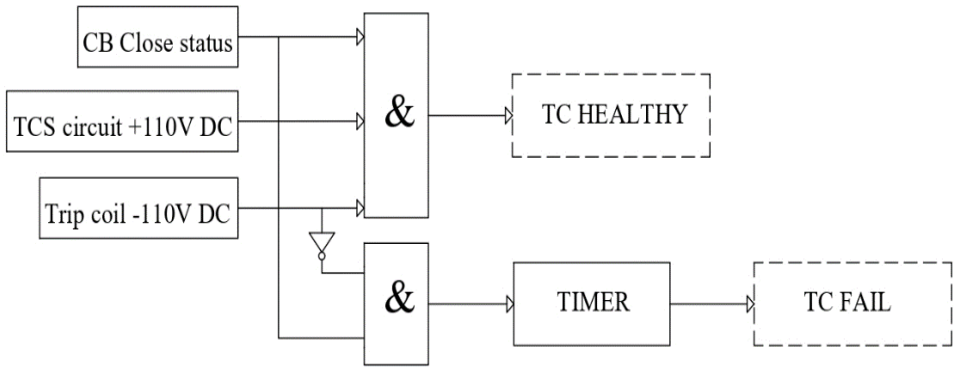


10.Trip Circuit Supervision (TCS)

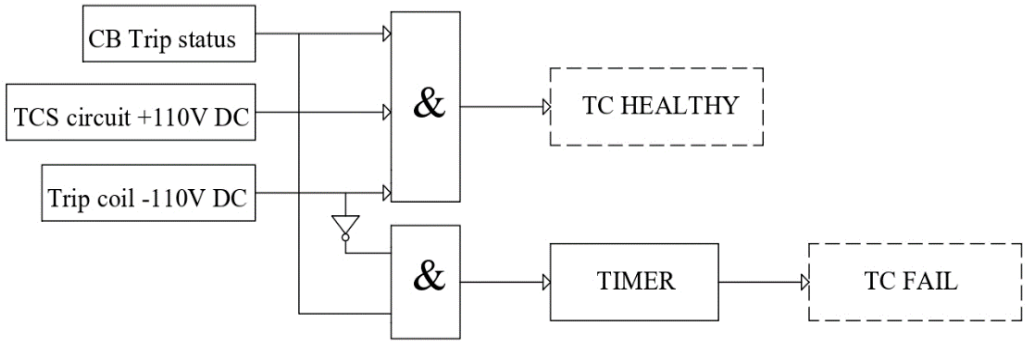
Two types of trip circuit supervision (Post close & Pre close) is available in Relay. The relay continuously monitors the breaker trip coil supply through the NC and NO contact of the Circuit breaker in both closed and open condition. If any discontinuity is observed in both condition, the relay generates alarm signal.

FUNCTIONAL BLOCK DIAGRAM

1. POST CLOSE TC SUPERVISION



2. PRE CLOSE TC SUPERVISION



TECHNICAL SPECIFICATIONS

Sl. No	Specification	REF.	Particulars
1.	**Auxiliary Supply**	V_{DC}	35 to 260VDC
2.	**Current Input (rated)**	I	5A AC
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 (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; 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		≥ 1000 W at L/R = 40ms
	c) Breaking Capacity at 110V DC		≥ 77 W at L/R = 40ms
11.	**Type of communication ports**		RJ45 (front) and RS 485& RJ45/Fiber (Rear)
12.	**Overall dimensions** Width Height Depth		 263 mm 173 mm 300 mm
13.	**Weight**		5.6 kg approx.

RELAY SETTINGS

Settings		Particulars
Password protection (YES/NO)		**0000-9999**
1. General settings		
CT Primary		5-5000A in steps of 5A
PT Primary		110 to 30000
Second Harmonic Setting		5% to 50% in steps of 1%
Third Harmonics Setting		5% to 50% in steps of 1%
TCS 1		Enable/Disable
TCS 2		Enable/Disable
CT1 Polarity		Pos - 0/ Neg - 1
CT2 Polarity		Pos - 0/ Neg - 1
Post fault cycles		0-5 in steps of 1
Back light time		1 – 10S 2 – 20S 3 – 30S 4 – 40S
Communication Type		1 – IEC 60870-5-103 2 – IEC 61850
Relay ID		1-255
Baud Rate		4800-57600 in steps of 200
Set Date & Time		DD MM YYYY HH:MM:SS
Modify Password		
2. Distance Protection		
i) Zone 1	Forward Resistance RF1	00.00 to 99.99 in steps of 0.01 ohm
	Forward Reactance XF1	00.00 to 99.99 in steps of 0.01 ohm
	Backward Resistance RB1	00.00 to 99.99 in steps of 0.01 ohm
	Backward Reactance XB1	00.00 to 99.99 in steps of 0.01 ohm
	Dir/Non Dir	0-Dir / 1-Non Dir
ii) Zone1 Extension	Forward Resistance RF1Extn	00.00 to 99.99 in steps of 0.01 ohm
	Forward Reactance XF1 Extn	00.00 to 99.99 in steps of 0.01 ohm
	Backward Resistance RB1Extn	00.00 to 99.99 in steps of 0.01 ohm
	Backward Reactance XB1Extn	00.00 to 99.99 in steps of 0.01 ohm
	Zone 1 AR	(Enable/Disable)
	Zone 1 time (m Sec)	0-1000 in steps of 10
iii) Zone 2	EN - 1/ DIS - 0	
	Dir/Non Dir	0 – Dir / 1 - Non Dir
	Forward Resistance RF2	00.00 to 99.99 in steps of 0.01 ohm
	Forward Reactance XF2	00.00 to 99.99 in steps of 0.01 ohm
	Backward Resistance RB2	00.00 to 99.99 in steps of 0.01 ohm
	Backward Reactance XB2	00.00 to 99.99 in steps of 0.01 ohm
	Zone 2 Time Z2T	0 to 2000 ms in steps of 10 ms
	Zone 2 AR	(Enable/Disable)

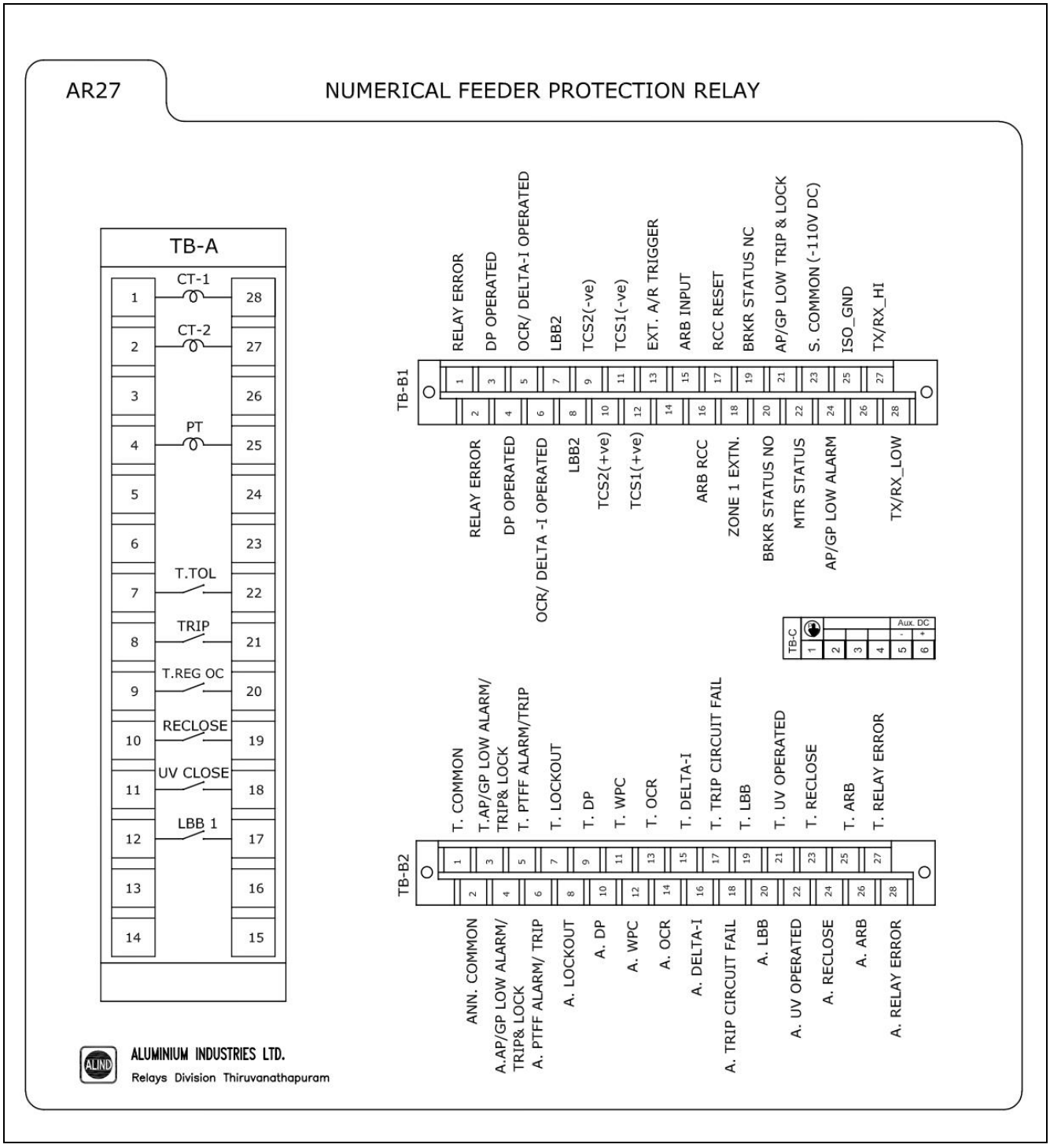
iv) Zone 3	EN - 1/ DIS - 0	
	Dir/Non Dir	0 – Dir / 1 - Non Dir
	Forward Resistance RF3	00.00 to 99.99 in steps of 0.01 ohm
	Forward Reactance XF3	00.00 to 99.99 in steps of 0.01 ohm
	Backward Resistance RB3	00.00 to 99.99 in steps of 0.01 ohm
	Backward Reactance XB3	00.00 to 99.99 in steps of 0.01 ohm
	Zone 3 Time Z3T	0 to 2000ms in steps of 10 ms
	Zone 3 AR	(Enable/Disable)
v) Relay Characteristics Angle		40 to 90º in steps of 1º
vi) Minimum Operating Current		0.1 to 2.5A in steps of 0.01 A
vii) Minimum operating Voltage		0-50 in steps of 1
viii) Line Impedance		0.00 to 1.0 in steps of .01ohm
ix) DP Forward Angle		0-135º in steps of 1°
x) DP Reverse Angle		0-45º in steps of 1°
xi) Z Minimum		00.00 to 99.99 in steps of 0.01 ohm
xii) Load Forward Angle A1		0-70º in steps of 1°
xiii) Load Reverse Angle A2		0-70º in steps of 1°
xiv) DP Sec Harmonics		EN - 1/ DIS - 0
xv) DP Sense MTR		EN - 1/ DIS - 0
3. OCR Protection		
i) Instantaneous OCR – stage 1		(Enable/Disable)
DIR/NON DIR		
Setting range		10% – 2000% in steps of 1%
Second Harmonics		(Enable/Disable)
ii) Definite Time OCR – Stage 2		(Enable/Disable)
DIR/NON DIR		
Setting range		10% -1000% in steps of 1%
Time Setting		0 to 5000ms in steps of 10msec
iii) Definite Time OCR – Stage 3		(Enable/Disable)
DIR/NON DIR		
Setting range		10% – 1000% in steps of 1%
Time Setting		1 to 900 sec in steps of 1sec
iv) Forward Angle Setting		0-135 in steps of 1 Deg
v) Reverse Angle Setting		0-45 in steps of 1 Deg
vi) AR		(Enable/Disable)
4. Wrong Phase Coupling Protection (EN/DIS)		
i) WPC Impedance Low		00.00 to 99.99 in steps of 0.01 ohm
ii) WPC Impedance High		00.00 to 99.99 in steps of 0.01 ohm
iii) WPC Angle Low		90 – 180 in steps of 1°
iv) WPC Angle High		90 – 180 in steps of 1°
v) WPC Operating Current		0.1A to 5A in steps of 0.1A
vi) WPC voltage option		EN/DIS
Operating Voltage (V)		30-110 in steps of 1
vii) Sec. Harmonics		(Enable/Disable)
5. Delta I Protection (EN/DIS)		
Current value		0.10 to 6.00A in steps of 0.1A
Delta I cycle		20-200ms in steps of 5ms
Additional Time Delay		0-1000ms in steps of 10ms

X blinder	00.00 to 99.99 in steps of 0.01 ohm
Second Harmonics Value	(Enable / Disable)
Third Harmonics Value	(Enable / Disable)
3rd Harmonic De-sensitivity	0-100% in steps of 1%
AR	(Enable/Disable)
Sense MTR	EN - 1/ DIS - 0
6. UV Protection (EN/DIS)	
Voltage value	1-110V in steps of 1V
Trip time	0-5000ms in steps of 10ms
7. UB Protection (EN/DIS)	
Trip Value	0.1 - 5 in steps of 0.01
Trip time	0-5000ms in steps of 10ms
8. Re-generative OCR (Enable / Disable)	
Trip Value	0.1 to 5 A in steps of 0.01 A
Operating Voltage	50 to 110V in steps of 1
Angle Low	90 – 270 in steps of 1°
Angle High	90 – 270 in steps of 1°
Operating trip time	0 to 50 in steps of 1
9. Thermal overload protection (Enable/Disable)	
Thermal overload Characteristic	(Single /Dual)
Thermal overload Reset	(Chara /Inst.)
i) IFLA (Full Load Current)	8 to 400% in steps of 1
ii) k (Thermal State Factor)	0.01 to 1.5 in steps of 0.01
iii) Te (Thermal Time 1)	1 to 1000 min in steps of 1 min.
iv) Te (Thermal Time 2)	1 to 1000 min in steps of 1 min.
v) Thermal alarm	5 to 200% in steps of 1%
vi) Thermal Trip	5 to 200% in steps of 1%
10. PT Fuse Protection (Enable/Disable)	
i) PTFF Voltage	0 to 20 in steps of 1 V
ii) PTFF Low Current	0.3 to 1.0 in steps of 0.1 A
iii) PTFF High Current	1 to 5 in steps of 0.1 A
iv) PTFF Alarm Time	0-10,000 m sec in steps of 10 m sec
v) PTFF AR	(Enable/Disable)
11. Switch On To Fault Protection (SOTF) (Enable/Disable)	
i) SOTF trip	50% to 2000% in steps of 10%
ii) SOTF Sense Delay (S)	1 to 500 in steps of 1.
12. Auto Re-closure Section (Enable / Disable)	
i) Re-closure Type	Fwd/Rev
ii) Number of Shots	1- 2
iii) Dead Time 1	0 to 60.0 sec in steps of 0.1 sec
iv) Dead Time 2	0 to 60 sec in steps of 0.1 sec
v) Reclaim Time	6 to 60 Sec in steps of 1Sec
vi) ARB	(Enable / Disable)

vii) ARB operating value	1A to 100A in steps of 1A
13. Local Breaker Backup	
Local Breaker Backup (LBB1)	Enable/Disable
Local Breaker Backup (LBB2)	Enable/Disable
LBB Trip time	0 to 5000msec in steps of 1msec

Operating Time	
i) Distance Protection (Zone 1, Zone 1 Extn, Zone 2, Zone 3)	Less than 40ms – Zone 1 & Zone 1 ext. As per delay setting – Zone 2 & Zone 3
ii) Instantaneous OCR Protection	Less than 25ms for 5 times current
iii) PTFF Trip	30+/- 10 msec
iv)PTFF alarm	As per delay setting
v) SOTF Protection	Within 20 ms
vi) DELTA 1	Within 80ms
vii)WPC	Less than 40ms
viii)Thermal overload Trip	As per the chara
ix)Under Voltage Trip	As per delay setting

TB DETAILS


AR27
NUMERICAL FEEDER PROTECTION RELAY
TB-A
CT-1
CT-2
PT
T.TOL
TRIP
T.REG OC
RECLOSE
UV CLOSE
LBB 1
TB-B1
RELAY ERROR
DP OPERATED
OCR/ DELTA-I OPERATED
LBB2
TCS2(-ve)
TCS1(-ve)
EXT. A/R TRIGGER
ARB INPUT
RCC RESET
BRKR STATUS NC
AP/GP LOW TRIP & LOCK
S. COMMON (-110V DC)
ISO_GND
TX/RX_HI
RELAY ERROR
DP OPERATED
OCR/ DELTA -I OPERATED
LBB2
TCS2(+ve)
TCS1(+ve)
ARB RCC
ZONE 1 EXTN.
BRKR STATUS NO
MTR STATUS
AP/GP LOW ALARM
TX/RX_LOW
TB-C
Aux. DC
TB-B2
T. COMMON
T.AP/GP LOW ALARM/ TRIP& LOCK
T. PTFF ALARM/TRIP
T. LOCKOUT
T. DP
T. WPC
T. OCR
T. DELTA-I
T. TRIP CIRCUIT FAIL
T. LBB
T. UV OPERATED
T. RECLOSE
T. ARB
T. RELAY ERROR
ANN. COMMON
A.AP/GP LOW ALARM/ TRIP& LOCK
A. PTFF ALARM/ TRIP
A. LOCKOUT
A. DP
A. WPC
A. OCR
A. DELTA-I
A. TRIP CIRCUIT FAIL
A. LBB
A. UV OPERATED
A. RECLOSE
A. ARB
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 60255-16	IMPEDANCE MEASURING RELAY.
II.	IEC 60255-151	FUNCTIONAL REQUIREMENTS FOR OVER/UNDER CURRENT PROTECTION.
III.	IEC 60255-5	INSULATION COORDINATION OF MEASURING RELAYS AND PROTECTION EQUIPMENT- REQUIREMENTS AND TESTS.
IV.	IEC 60255-1	MEASURING RELAYS AND PROTECTION EQUIPMENT- COMMON REQUIREMENTS.
V.	IEC 60255-21-1	VIBRATION TESTS (SINUSODIAL)
VI.	IEC 60255-21-2	SHOCK AND BUMP TESTS
VII.	IEC 60255-21-3	SEISMIC TESTS
VIII.	IEC 60255-27	PRODUCT SAFETY REQUIREMENT.
IX.	IEC 60255-26	ELECTROMAGNETIC COMPATIBILITY REQUIREMENT.
X.	IEC 60529	DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP CODE)
XI.	IEC 61810-2	RELIABILITY.
XII.	IS 2705 (PART II, III&IV)	PROTECTIVE CURRENT TRANSFORMERS.
XIII.	IS 3156 (PART II/III)	MEASURING/PROTECTIVE VOLTAGE TRANSFORMERS.
XIV.	IS 3231 (PART 1 TO 3)	ELECTRICAL RELAYS FOR POWER SYSTEM PROTECTION.
XV.	IS 8686	STATIC PROTECTIVE RELAYS.
XVI.	IEC 60068-2	ENVIRONMENTAL TESTS.
XVII.	IEC 60529	IP 54 TEST
XVIII.	IEC 60870-5-103	COMMUNICATION PROTOCOL
XIX	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 TB C-6: +110VDC TB C-5: -110VDC 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 Fail 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 27**

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	128	2	3	According to main FUN
Reset CU	-	5	128	3	4	According to main FUN
Reset CU/Start/Restart	-	5	128	4	5	According to main FUN

STATUS INDICATIONS IN MONITOR DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
Protection Healthy/Active	-	1	128	18	1	↑↓
RCC Reset	-	1	128	19	1	↑
Local Parameter Settings (Change)	-	1	128	22	1	↑
AP/GP Low Alarm	X	1	128	30	1,9	↑↓
AP/GP Trip & Lock	X	1	128	31	1,9	↑↓
MTR Status	X	1	128	28	1,9	↑↓
CB NC (FDR CB OPEN)	X	1	128	136	1,9	↑↓
CB NO (FDR CB CLOSE)	X	1	128	137	1,9	↑↓
Zone 1 EXTN. (Enable/Disable)	X	1	128	29	1,9	↑↓
Relay Error	-	1	128	40	1	↑

SUPERVISION INDICATIONS IN MONITOR DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
Trip circuit supervision	X	1	128	36	1,9	↑↓
VT Fuse failure (ALARM)	X	1	128	38	1,9	↑↓
Thermal Over Load Alarm	X	1	128	42	1,9	↑↓

AUTO RECLOSER INDICATIONS IN (MONITOR DIRECTION)

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
AR Operated	X	1	128	131	1,9	↑↓
ARB acted (Local)	X	1	128	132	1,9	↑↓
ARB Input	X	1	128	27	1,9	↑↓
ARB RCC Input	X	1	128	135	1,9	↑↓

FAULT INDICATION IN (MONITOR DIRECTIONS)

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
Breaker Failure (LBB)	X	2	128	85	1,9	↑↓
Start/pickup Zone 1	X	2	128	110	1,9	↑↓
Start/pickup Zone 2	X	2	128	111	1,9	↑↓
Start/pickup Zone 3	X	2	128	112	1,9	↑↓
Start/pickup Zone 1 EXT.	X	2	128	113	1,9	↑↓
Start/Pickup OCR Stage 1 I> Instantaneous	X	2	128	115	1,9	↑↓
Start/Pickup OCR Stage 2 I>>Definite Time	X	2	128	116	1,9	↑↓
Start/Pickup OCR Stage 3 I>>> Definite Time	X	2	128	117	1,9	↑↓
Thermal Over Load Start/Pickup	X	2	128	118	1,9	↑↓
Start/Pickup PTFF	X	2	128	119	1,9	↑↓
Start/Pickup WPC	X	2	128	120	1,9	↑↓
Start/Pickup Delta I	X	2	126	95	1,9	↑↓
Start/Pickup Under Voltage	X	2	126	97	1,9	↑↓
Start/Pickup Regenerative OCR	X	2	126	98	1,9	↑↓
Start/Pickup Current Unbalance	X	2	126	99	1,9	↑↓
SOTF	-	2	128	100	1	↑↓
Trip Zone 1	-	2	128	78	1	↑↓
Trip Zone 2	-	2	128	79	1	↑↓
Trip Zone 3	-	2	128	80	1	↑↓
Trip Zone 1 EXTN.	-	2	128	81	1	↑↓
AR Lockout	X	2	128	138	1,9	↑↓
Thermal over Load Trip	-	2	128	202	1	↑↓
Trip PTFF	-	2	128	106	1	↑↓
I> OCR Stage 1 Instantaneous	-	2	128	90	1	↑↓
I>> OCR Stage 2 Definite Time	-	2	128	91	1	↑↓
I>>> OCR Stage 3 Definite Time	-	2	128	104	1	↑↓
Trip WPC	-	2	128	108	1	↑↓
Trip Delta I	-	2	126	121	1	↑↓
Trip Under Voltage	-	2	126	123	1	↑↓
Trip Regenerative OCR	-	2	126	124	1	↑↓
Trip Current Unbalance	-	2	126	125	1	↑↓

MEASURANDS IN MONITOR DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT
Measurand supervision I –Total	-	9	128	148	2
Measurand supervision V	-	9	128	149	2
Measurand supervision I1	-	9	128	150	2
Measurand supervision I2	-	9	128	151	2

TIME TAGGED MEASURANDS IN MONITOR DIRECTIONS

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT
Fault Reactance - X in OHMS	-	4	128	73	1
Phase angle – Φ in degrees	-	4	128	74	1
Fault Resistance - R	-	4	128	75	1
Fault Current – I1	-	4	128	152	1
Fault current – I2	-	4	128	153	1
Fault current – I- Total	-	4	128	154	1
Fault Voltage – V	-	4	128	155	1
Fault Impedance – Z	-	4	128	156	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	128	19	20	↑ (PULSE)
CB (O/o Open)	-	20	128	124	20	↑ (PULSE)
CB (C/c Close)	-	20	128	125	20	↑ (PULSE)
ARB Enable/Disable	-	20	128	122	20	↑↓ (PULSE)
Zone 1 – Extension Enable/Disable	-	20	128	123	20	↑↓ (PULSE)

ANALOG CHANNEL INFORMATION IN AR 27

AR 27		
FUN	**ACC**	**PARAMETER**
128	**1**	**I1**
128	**2**	**I2**
128	3	X
128	4	X
128	**5**	**V**
128	6	X
128	7	X
128	8	X

DIGITAL CHANNEL (TAGS) INFORMATION IN AR 27

AR 27			
TAG POSITION	**FUN/INF NUMBER**	**SEMANTICS ACCORDING TO TAG POSITION**	**INPUT/ OUTPUT**
0	**128/84**	**GENERAL PICKUP**	**OUTPUT**
1	**128/68**	**GENERAL TRIP**	**OUTPUT**
2	**128/78**	**ZONE 1 TRIP**	**OUTPUT**
3	**128/79**	**ZONE 2 TRIP**	**OUTPUT**
4	**128/80**	**ZONE 3 TRIP**	**OUTPUT**
5	**128/81**	**ZONE 1 EXT. TRIP**	**OUTPUT**
6	**128/90**	**INST. OCR I> TRIP**	**OUTPUT**
7	**128/91**	**DEF. OCR STAGE 1 I>> TRIP**	**OUTPUT**
8	**128/104**	**DEF. OCR STAGE 3 I>>> TRIP**	**OUTPUT**
9	**128/106**	**VT (PTFF) TRIP**	**OUTPUT**
10	**128/202**	**THERMAL OVERLOAD TRIP**	**OUTPUT**
11	**128/100**	**SOTF**	**OUTPUT**
12	**128/108**	**WPC TRIP**	**OUTPUT**
13	**128/131**	**AR OPERATED**	**OUTPUT**
14	**128/132**	**ARB OPERATED**	**OUTPUT**
15	**126/121**	**DELTA I TRIP**	**OUTPUT**
16	**126/123**	**UNDER VOLTAGE TRIP**	**OUTPUT**
17	**126/124**	**REGENERATIVE OCR TRIP**	**OUTPUT**
18	**126/125**	**CURRENT UNBALANCE TRIP**	**OUTPUT**
19	**128/85**	**LBB TRIP**	**OUTPUT**
20	**128/34**	**AUTO RECLOSE BYPASS INPUT**	**INPUT**
21	**128/135**	**AUTO RECLOSE BYPASS RCC**	**INPUT**
22	**128/28**	**ZONE 1 EXT. ENABLE**	**INPUT**
23	**128/19**	**RCC RESET**	**INPUT**
24	**128/136**	**CB NC (OPEN)**	**INPUT**
25	**128/137**	**CB NO (CLOSE)**	**INPUT**

26	128/29	MTR STATUS	INPUT
27	128/31	AP/GP LOW TRIP & LOCK	INPUT
28	128/30	AP/GP LOW ALARM	INPUT
29	128/36	TRIP CIRCUIT SUPERVISION	INPUT

Model Implementation Conformance Statement
for the IEC 61850 interface in ALIND AR 27 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 27 RELAY	MICS Ver.	1.0
	DATE: 22 SEPTEMBER 2021	
ALUMINIUM INDUSTRIES LTD | RELAYS DIVISION, THIRUVANANTHAPURAM		

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1. Introduction

This model implementation conformance statement is applicable for ALIND AR 27 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_FDR_5C	IED control 5 nos.
MEASUREMENT	LLN0	LLN02	LLN0 for Logical Device MEASURAND
	MTR_MMXN1	MMXN_FDR_MTR	Feeder Measurand I1, I2, I, V
	FLT_MMXN2	MMXN_FDR_FLT	Feeder Fault values I1, I2, I, V, X, R, Z
PROTECTION	LLN0	LLN03	LLN0 for Logical Device PROTECTION
	Z1_PDIS1	PDIS_FDR	Distance protection Zone 1
	Z2_PDIS2	PDIS_FDR	Distance protection Zone 2
	Z3_PDIS3	PDIS_FDR	Distance protection Zone 3
	Z1_EXT_PDIS4	PDIS_FDR	Distance protection Zone1 Extension
	OCR_ PIOC1	PIOC_FDR	Instantaneous OCR
	PTFF_PIOC2	PIOC_FDR	PT fuse failure
	WPC_PIOC3	PIOC_FDR	Wrong Phase Coupling Protection
	SOTF_PIOC4	PIOC_FDR_SOTF	Switch On To Fault Protection
	DEF1_PTOC1	PTOC_FDR	Definite time OCR stage 1
	DEF2_PTOC2	PTOC_FDR	Definite time OCR stage 2
	REG_OC_PTOC3	PTOC_FDR	Regenerative OCR
	DLT_I_PTOC4	PTOC_FDR	Delta Current Protection
	CUR_UB_PTOC5	PTOC_FDR	Unbalance Current Protection

	TH_OL_PTTR1	PTTR_FDR	Thermal Overload protection
	UV_PTUV1	PTUV_FDR	Under Voltage Protection
	LBB_RBRF1	RBRF_FDR	Breaker Failure
RECORDS	LLN0	LLN04	LLN0 for Logical Device RECORDS
	RDRE1	RDRE_FDR	Disturbance recorder
SYSTEM	LLN0	LLN05	LLN0 for Logical Device SYSTEM
	LPHD	LPHD_FDR	Physical Device Information
	ALM_GGIO1	GGIO_FDR_ALM8	Alarms
	IND_GGIO2	GGIO_FDR_BI10	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
PDIS (Distance)
PIOC (Instantaneous Overcurrent)
PTOC (Time Overcurrent)
PTTR (Thermal Overload)
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: GGIO_FDR_5C

Description: Generic Automatic Process Control

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 (CB Open Command)	O
SPCSO3	SPC	Generic single point controllable status output (CB Close Command)	O
SPCSO4	SPC	Generic single point controllable status output (Auto Reclose Bypass Enable/Disable)	O
SPCSO5	SPC	Generic single point controllable status output (Zone 1 Extension Enable/Disable Command)	O

4.2 Logical Node: GGIO_FDR_ALM8

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 (Relay Error)	O
Alm3	SPS	General Single Alarm (VT Fuse Failure)	O
Alm4	SPS	General Single Alarm (Thermal Overload Alarm)	O
Alm5	SPS	General Single Alarm (Auto Reclose Bypass acted)	O
Alm6	SPS	General Single Alarm (Auto Reclose Lockout)	O
Alm7	SPS	General Single Alarm	O

		(Auto Reclose Operated)	
Alm8	SPS	General Single Alarm (Local Parameter Setting Change)	O

4.3 Logical Node: GGIO_FDR_BI10

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)	
Ind3	SPS	General Indication (AP/GP trip & lock)	O
Ind4	SPS	General Indication (MTR status)	O
Ind5	SPS	General Indication (CB NC status)	O
Ind6	SPS	General Indication (CB NO status)	O
Ind7	SPS	General Indication (Zone 1 extension status)	O
Ind8	SPS	General Indication (ARB Input)	O
Ind9	SPS	General Indication (ARB RCC Input)	O
Ind10	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: LPHD_FDR

Description: Physical Device Information

LN Class: LPHD

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

4.10 Logical Node: MMXN_FDR_MTR

Description: Non-Phase Related Measurement (Feeder Metering 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 I1	E
Amp2	MV	Measurand Current I2	E
Amp3	MV	Measurand Current I (where I=I1+I2)	E
Vol	MV	Voltage V	O

4.11 Logical Node: MMXN_FDR_FLT

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 I1	E
Amp2	MV	Fault Current I2	E
Amp3	MV	Fault Current I (where I = I1+I2)	E
Vol	MV	Voltage V	O

Imp1	CMV	Fault Resistance R	E
Imp2	CMV	Fault Reactance X	E
Imp3	CMV	Fault Impedance Z	E

4.12 Logical Node: PDIS_FDR

Description: Distance Protection

LN Class: PDIS

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: PIOC_FDR

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

4.14 Logical Node: PIOC_FDR_SOTF

Description: Instantaneous Overcurrent Protection (Switch On To Fault Protection)

LN Class: PIOC

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Status Information			
Op	ACT	Operate (SOTF Trip)	M

4.15 Logical Node: PTOC_FDR

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	M
Op	ACT	Operate	M

4.16 Logical Node: PTTR_FDR

Description: Thermal Overload Protection

LN Class: PTTR

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: PTUV_FDR

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

4.18 Logical Node: RBRF_FDR

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_FDR

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)