NUMERICAL OVER CURRENT AND CURRENT UNBALANCE PROTECTION RELAY
AR54 [AN+ SERIES]

USER MANUAL

ALUMINIUM INDUSTRIES LIMITED
RELAYS DIVISION, THIRUVANATHAPURAM

AR54

Numerical Over Current and Current Unbalance Protection Relay

CONTENTS

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.

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.

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SYMBOLS AND LABELS USED IN THE RELAY

1.   FRONT SIDE

| Caution: refer to equipment documentation | Caution: risk of electric shock | Caution: Over voltage Cat.III |

2.   REAR SIDE

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

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

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

IEC 61850 sticker

WARNING

Current transformer circuit

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

Exposed terminals

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

Residual voltage

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

CAUTION

Earth

Earth the earthing terminal of the equipment securely.

Operation conditions

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

Ratings

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

Printed circuit board

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

External circuit

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

Connection cable

Carefully handle the connection cable without applying excessive force.

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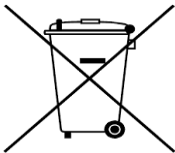
Disposal
When disposing of this equipment, do so in a safe manner according to local regulations. It is recommended that incineration and disposal to water courses is avoided. Ensure the relay is in de energized condition and take precautions to avoid short circuits.

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.

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INTRODUCTION

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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

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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 single phase, 50Hz Over Head Equipment (OHE).

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 single phase, 50Hz Over Head Equipment (OHE).

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

$$AR54X_1X_2$$

- ALIND
- RELAYS
- V & I Rating code
- Communication Code
- Current Unbalance Protection
- Over Current Protection
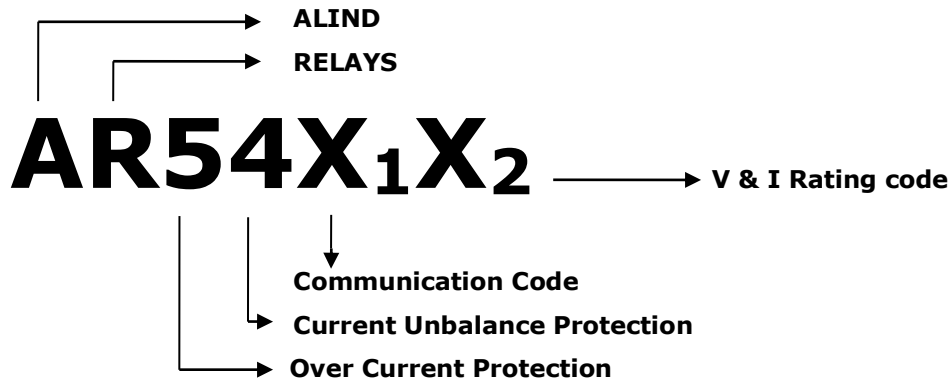
	Protection naming codes
0.	None
1.	Panto Flash Over Protection
2.	Distance Protection
3.	Under/Over Voltage Protection
4.	Current Unbalance Protection
5.	Over Current Protection
6.	EF/REF Protection
7.	Delta I Protection
8.	Current Differential Protection
9.	Voltage Unbalance Protection

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

PROTECTION FEATURES

AR54 conforms to RDSO specification no. TI/SPC/PSI/PROTCT/7101. AR54 (AN+ Series) relay is a comprehensive Capacitor Bank protection relay using in 2X25KV AC Traction substation.

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MAIN FUNCTIONS

Sl No.	PARTICULARS	AR54
1.	**MAIN PROTECTIONS**	
1.1	IDMT OC 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	✓
2.8	TRIPCIRCUIT FAIL	✓

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	✓

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HANDLING INSTALLATIONS & CASE DIMENSIONS

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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
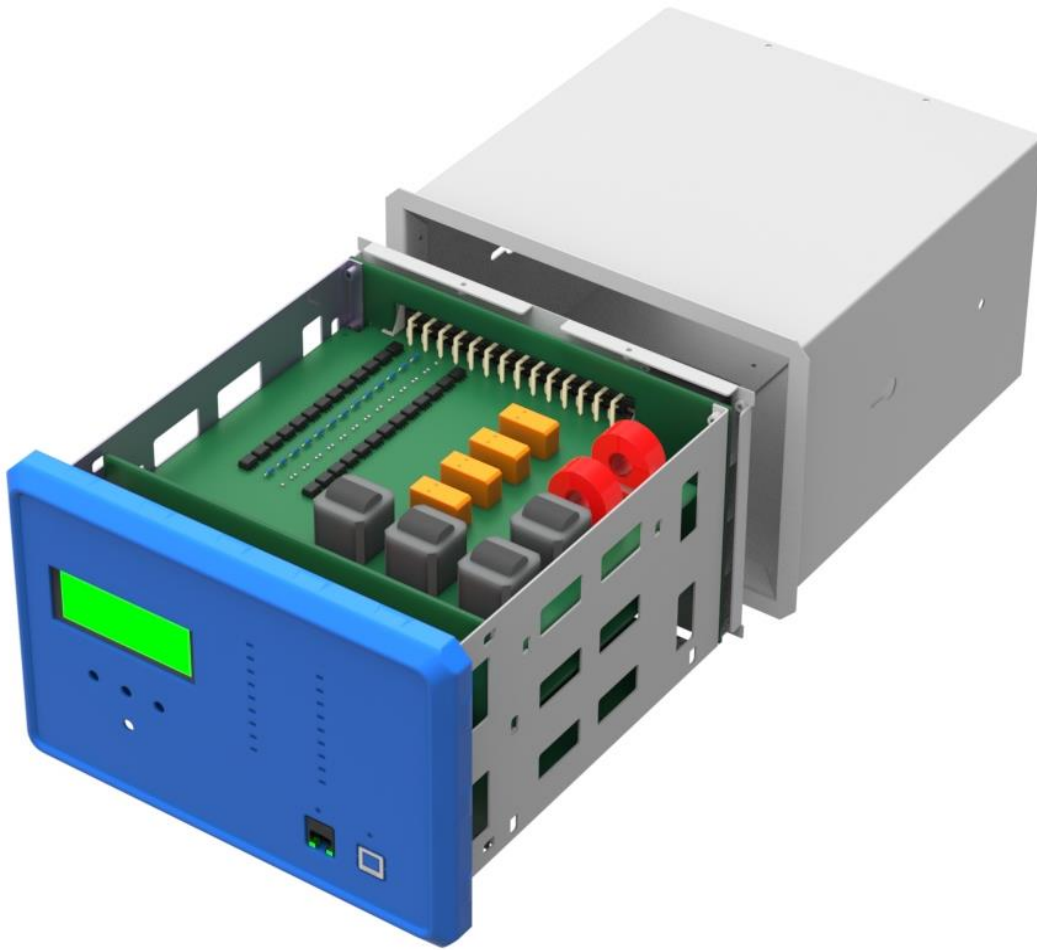
CASE DIMENSIONS
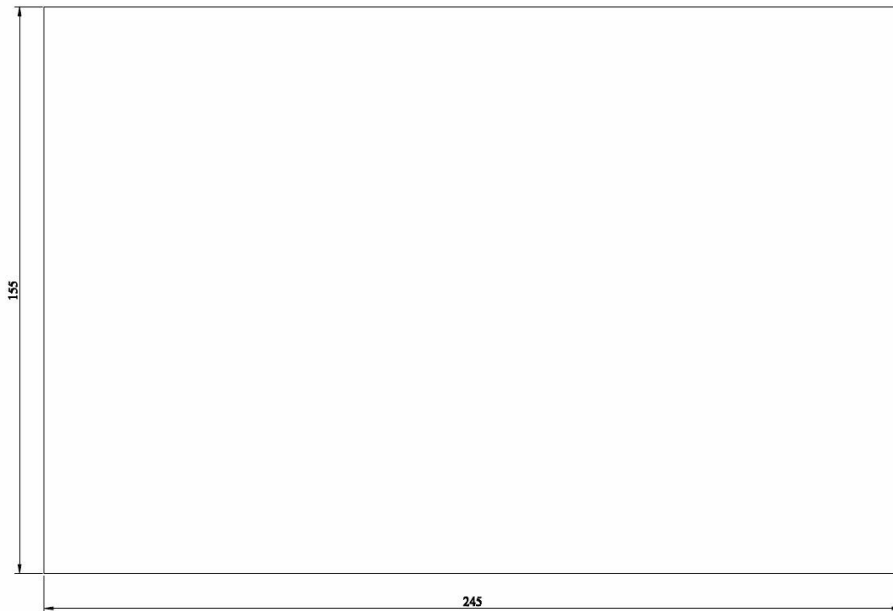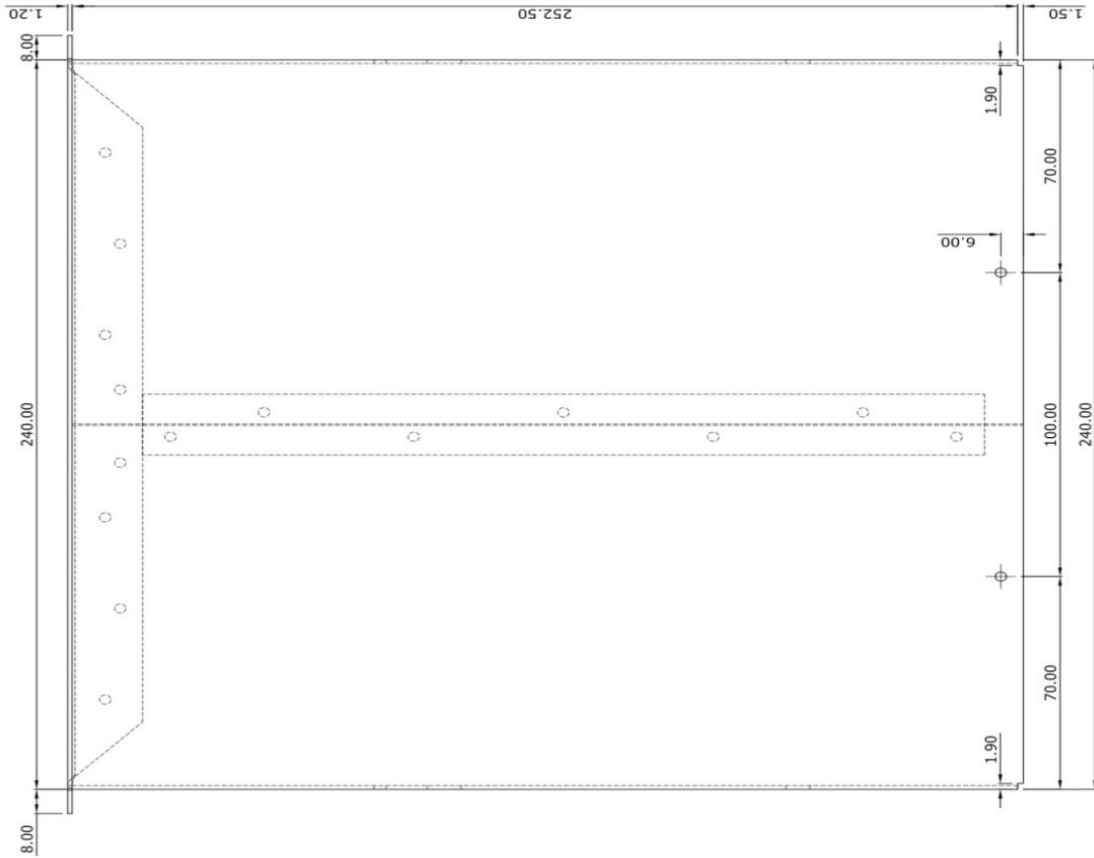
CUT OUT DETAILS

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FRONT PANEL INDICATIONS

NUMERICAL OC + CURRENT UNBALANCE PROTECTION RELAY

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- PROTECTION HEALTHY
- TRIP
- OCR
- UNBALANCE - N1
- UNBALANCE - N2
- LBB
- AP/GF LOW ALARM
- AP/GF LOW TRIP & LOCK
- TDR
- TRIP CIRCUIT FAIL
- RELAY ERROR

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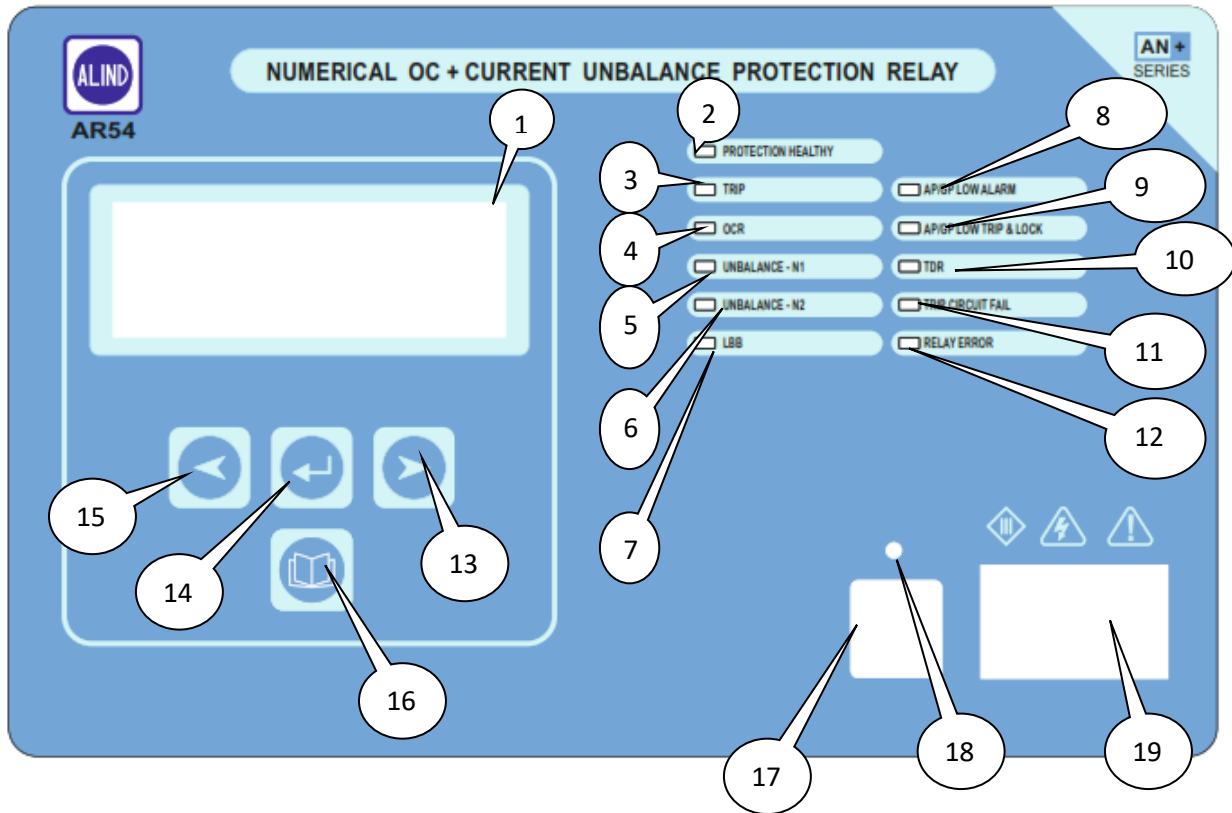
No	Legend
1.	LCD DISPLAY
2.	PROTECTION HEALTHY (GREEN/AMBER)
3.	TRIP (RED)
4.	OCR TRIP (RED)
5.	UNBALANCE-1 TRIP (RED)
6.	UNBALANCE-2 TRIP (RED)
7.	LBB TRIP (RED)
8.	AP/GP LOW ALARM (RED)
9.	AP/GP TRIP & LOCK (RED)
10.	TDR (RED)
11.	TRIP CKT FAIL (RED)
12.	RELAY ERROR (RED)
13.	>
14.	↵
15.	<
16.	RECORDS
17.	RJ45 PORT
18.	H.RST
19.	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.

Increment key
Menu
Records
Decrement key
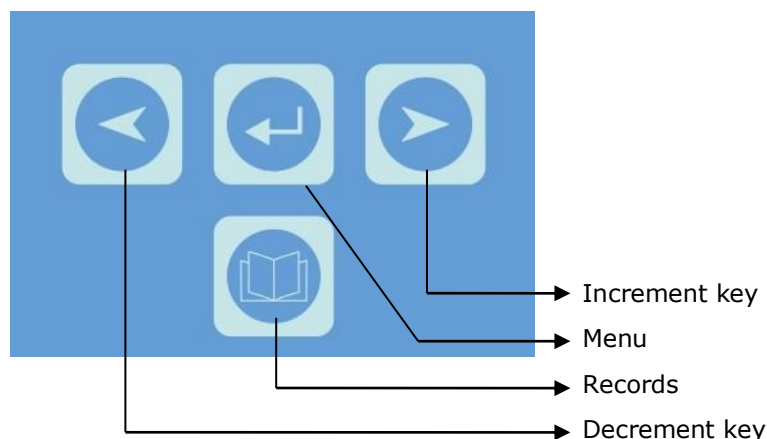
Menu key

∗   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.

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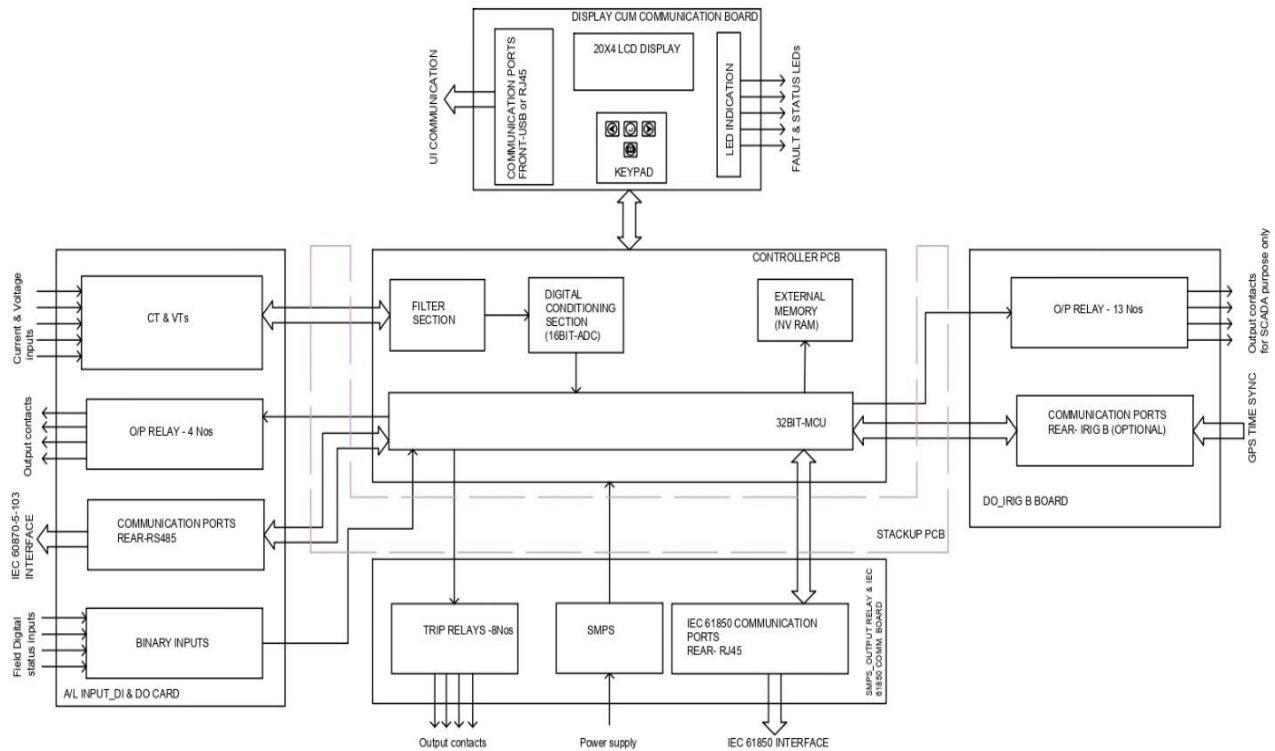
The MCU controller continuously monitors the currents. Based on this the controller performs different calculations and whenever an abnormal condition occurs it distinguishes the type of fault and issues trip command to the circuit breaker.

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.
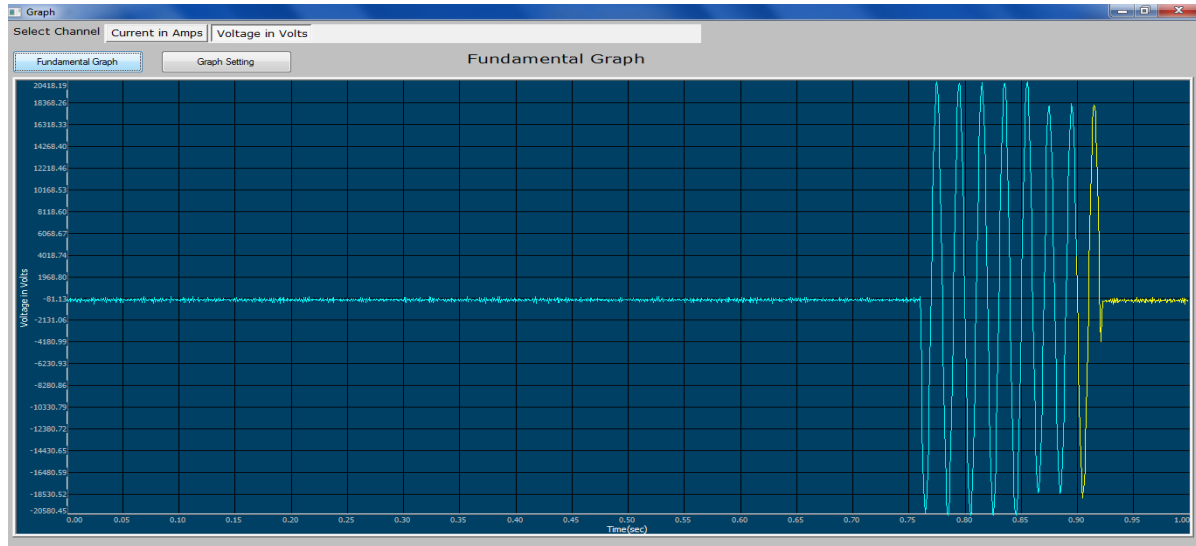
ENERGIZING THE RELAY

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.

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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

```
Loading...
```

```
        ALIND RELAYS
          DIVISION
```
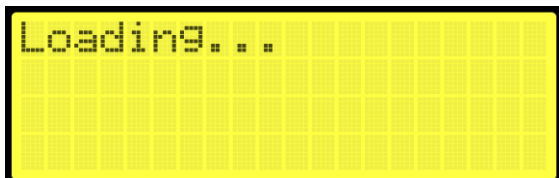
Then comes the online parameter display

Window:

```
I1=0.0A    In1=0.00A
I2=0.0A    In2=0.00A
```
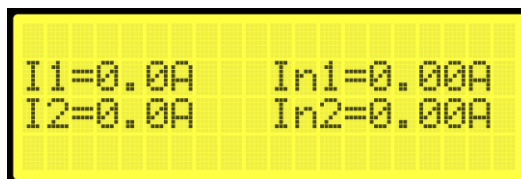
Setting Mode

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.

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Relay Settings Algorithm

```
Relay Setting Mode
1.General Config.
```

Use SET key

```
General Config.
  CT Primary
   [5-5000]
    [750]
```

Use SET key

```
General Config.
 Enter Password
     ****
```

Type password   Use set key
For setting change

```
General Config.
 UB CT Primary
    [1-5]
     [5]
```

Use Left/Right key

```
General Config.
   UB CT Sec.
    [1-5]
     [5]
```

Use Left/Right key

```
Trip Circuit 1
 (En=1/Dis=0)
    [0-1]
     [1]
```

Use Left/Right key

```
Trip Circuit 2
 (En=1/Dis=0)
    [0-1]
     [0]
```

Use Left/Right key

```
General Config.
Post Fault Cycles
    [0-5]
     [5]
```

Use Left/Right key   (A)

Ⓐ

```
General Config.
 BACKLIGHT MODE

6- ALWAYS ON
```
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

Ⓑ

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B

General Config.
    Relay ID
    [1-255]
    [1]

Use Left/Right key

General Config.
    Baud Rate
    [4800-57600]
    [9600]

Use Left/Right key

General Config.
Set Date Time

Use SET key

Set Date Time

03/02/22 04:35:34
DD/MM/YY HH:MM:SS

Use SET key

Set Date Time

SAVE
Confirm ? < YES/NO >

Use Left/Right key

Use Right key

General Config.
Modify Password?

Use SET key

General Config.
Enter Old Password
0***

Type password   Use set key

General Config.
Enter New Password
0***

Type password   Use set key

General Config.
Confirm New Password
0***

Type password   Use set key

Password Modified

C

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

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C

```
 Relay Setting Mode
 2.OC IDMT Protection
```

Use Set Key

```
 OC IDMT Protection
    IDMT CURVE
   SELECT CURVE
 1-    Normal Inv.
```

Use Left/Right key

```
 OC IDMT Protection
    IDMT CURVE
   SELECT CURVE
 2- Extremely Inv.
```

Use Left/Right key

```
 OC IDMT Protection
    IDMT CURVE
   SELECT CURVE
 3- Restricted Inv.
```

Use Left/Right key

```
 OC IDMT Protection
    IDMT CURVE
   SELECT CURVE
 4.     Very Inv.
```

Use Left/Right key

```
 OC IDMT Protection
    IDMT CURVE
   SELECT CURVE
 5-   1.3 Sec Delay
```

Use Left/Right key

```
 OC IDMT Protection
    IDMT CURVE
   SELECT CURVE
 6- Long Time Delay
```

Use Left/Right key

```
 OC IDMT Protection
    Trip Val(%)
     [20-320]
       [40]
```

Use Left/Right key

```
 OC IDMT 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.Current Unbalance
```

Use Set Key

```
 Current Unbalance
    Tri[p Val(%)
   [2.50-100.00]
     [100.00]
```

Use Left/Right key

```
 Current Unbalance
   Trip Time(mSec)
     [0-1000]
      [1000]
```

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

E

E

```
 Relay Setting Mode
4.Time Delay Relay
```

Use Set Key

```
 Time Delay Relay
 Delay Time (Min)
     [0-10]
      [1]
```

Use Left/Right key

```
 Relay Setting Mode
5.LBB
```

Use Set Key

```
      LBB1
  (En=1/Dis=0)
     [0-1]
      [1]
```

Use Left/Right key

```
      LBB2
  (En=1/Dis=0)
     [0-1]
      [1]
```

Use Left/Right key

```
      LBB
  Trip Time (mSec)
    [0-5000]
     [200]
```

Use Left/Right key

To access & clear logs

Use this key

```
1.FAULT RECORDS
```

Use Set Key

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

Use Set Key

```
*** IDMT1 Trip
I1=***.*A In1=-*.**A
I2=*.*A   In2=*.**A
 DD/MM/YY HH:MM:SS
```

Use Right Key

```
*** IDMT1 Trip
Flt Clr Time=***.*S

 DD/MM/YY HH:MM:SS
```

Use Set Key

```
2.COUNTERS
```

Use Set Key

```
IDMT=****
CURUB=****
LBB=****
```

Use Set Key

```
3.CLEAR RECORDS
```

Use Set Key

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

Use Left/Right Key

```
3.CLEAR COUNTERS
```

Use Set Key

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

Use Set Key

```
4.EXIT
```

Use Set Key

RELAYS DIVISION

To view device Info.

Use Right Key

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

For Relay healthiness check & I/O Verification

Use this key

```
1.DATE AND TIME
```

Use Set Key

```
DATE AND TIME
DD/MM/YY HH:MM:SS
```
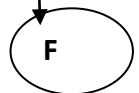
Use Right Key

```
2.TEST MODE
```

Use Set Key

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

Use Set Key & Enter password

```
BO1          TB-A 8-21
        Trip L1

000000000001
```

Use Right Key for next &
SET key for contact making

F

F

```
TEST MODE
2.BINARY OUTPUT2
```

Use Set Key

```
BO2     TB-B2 ANN 2-4
              TEL 1-3
 AP/GP Alarm
100000000000
```

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

1000000000000
```

Use Right Key for next move of cursor
& corresponding name shows in display

```
TEST MODE
4.LED
```

Use Set Key

```
VISUALLY INSPECT
LED's

              LED
```

Use Set Key

```
TEST MODE
5.SYSTEM INFO
```

Use Set Key

```
SYSTEM INFO:******
****
****
****
```
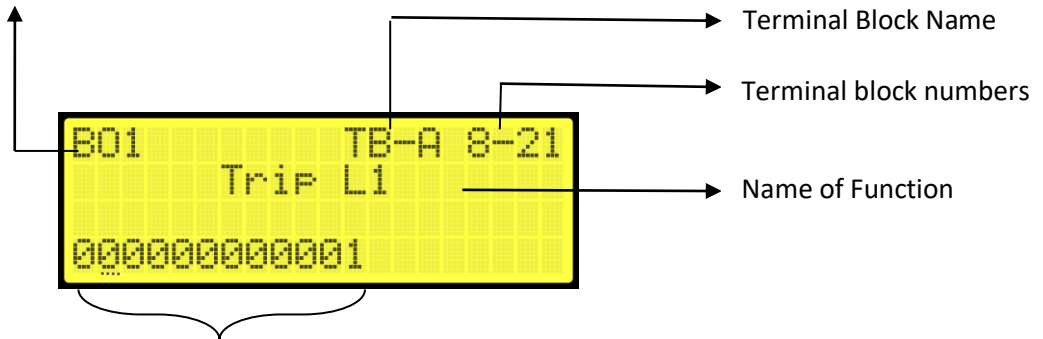
Use Set Key for exit

```
4.EXIT
```

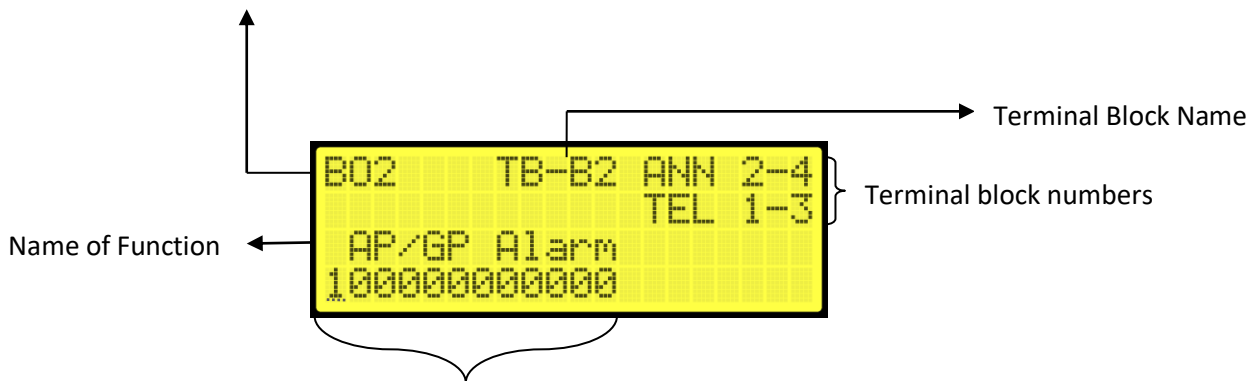Use Set Key

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	Trip L1	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 L2	TB A- 9 & 20	3	OC - L1	TB B2 - 1 & 7 , 2 & 8	3	UB Reset	TB B1 - 22
4	NIL		4	OC - L2	TB B2 - 1 & 9 , 2 & 10	4	CB Open	TB B1 - 19
5	NIL		5	UB TRIP1	TB B2 - 1 & 11 , 2 & 12	5	CB Close	TB B1 - 20
6	LBB 1	TB A- 12 & 17	6	UB TRIP2	TB B2 - 1 & 13 , 2 & 14	6	RCC Reset	TB B1 - 17
7	SPARE 1	TB A- 13 & 16	7	NIL		7	NIL	
8	SPARE 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	NIL		10	NIL	
11	LBB 2	TB B1 - 7 & 8	11	NIL		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

Terminal Block Name

Terminal block numbers

```
BO1          TB-A 8-21
      Trip L1

000000000001
```

Name of Function

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

Terminal Block Name

```
BO2     TB-B2 ANN 2-4
              TEL 1-3
     AP/GP Alarm
100000000000
```

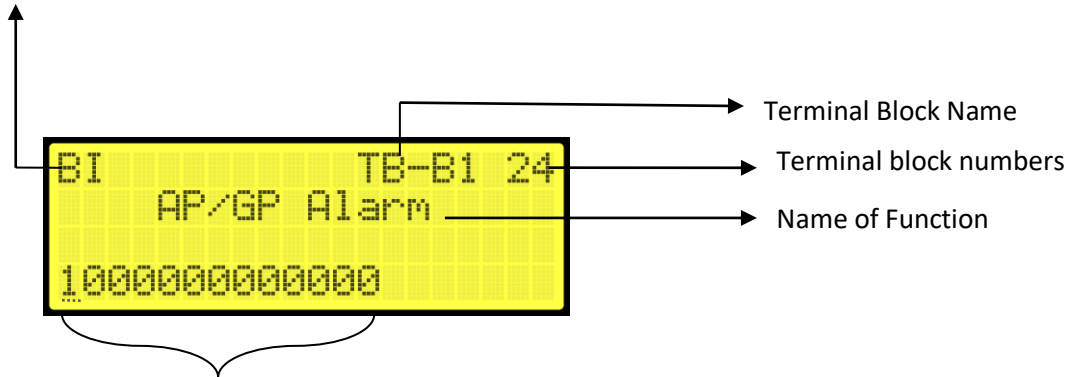Terminal block numbers

Name of Function

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)

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Binary Input

```
BI              TB-B1 24
    AP/GP Alarm

100000000000
```

Terminal Block Name

Terminal block numbers

Name of Function

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

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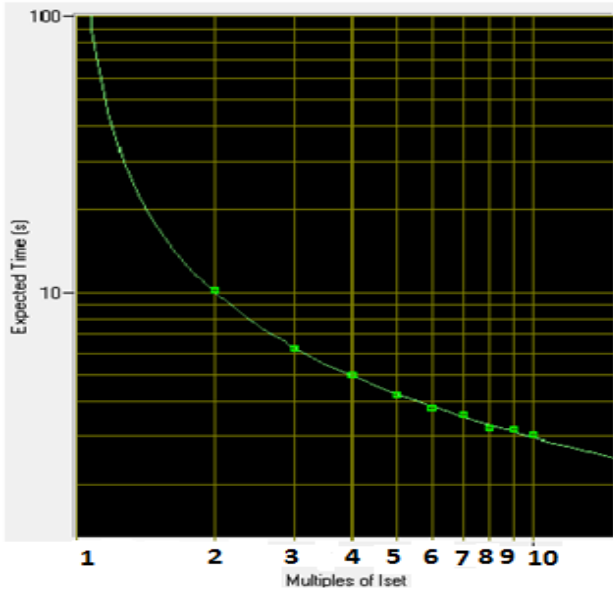
CONTENTS

DESCRIPTION OF PROTECTION FUNCTIONS

AR54relay is a comprehensive Over current and Unbalance Protection relay for the protection of **2x25 KV (AT feeding system) Capacitor bank**

1. IDMT Over Current Protection

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

Relay Operating Characteristics	K	α
Inverse/3 Sec delay	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. 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

2. 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. 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.

3. Trip Circuit Supervision

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

TECHNICAL SPECIFICATIONS

Sl.No	Specification	REF.	Particulars
1.	**Auxiliary Supply**	V_{DC}	35 to 260VDC
2.	**Current Input (rated)**	I	5A AC-Line CT 1A AC- Unbalance CT
3.	**Frequency**	Fn	50 Hz
4.	**VA Burden on CT**		Less than 0.5 VA
5.	**VA burden on Aux**		Less than 15 Watts (for energized condition) Less than 10 Watts (for de-energized condition)
6.	**Operating Temp Range**		-25ºC to + 55 ºC
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**		
11.	a)Current carrying capacity		Continuously ≥ 5 Amps at 110 V DC Short time ≥30 Amps for 200 ms at 110 V DC
	b) Making capacity at 110V DC		≥ 1000 W at L/R = 40ms
	c)Breaking Capacity at 110V DC		≥ 30 W at L/R = 40ms
12.	**Type of communication ports**		RJ45 (front) and RS485& RJ45 (Rear)
13.	**Overall dimensions** Width Height Depth		 263 mm 173 mm 300 mm
14.	**Weight**		5.6 kg approx.

RELAY SETTINGS

Settings	Particulars
Password protection (YES/NO)	**0000-9999**
1. General configuration	
Line CT Primary	5A to 5000A in steps of 1
Unbalance CT Primary	1A to 5A in steps of 1
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 – 10mSec. 2 – 20mSec. 3 – 30mSec. 4 – 40mSec.
Communication Type	1 – IEC 60870-5-103 2 – IEC 61850
Relay ID	1-255 in steps of 1
Baud Rate	4800-57600 in steps of 200
Set Date & Time	DD MM YYYY HH MM SS
Modify Password	
2. OC IDMT Protection	
IDMT Curve	1 - Inverse/ 3 Sec delay
	2 - Extremely Inverse
	3 - Very Inverse
	4 - Restricted Inverse
	5 - 1.3 Sec Delay
	6 - Long Time Delay
Trip Val (%)	20-320% in steps of 1
TMS	0.01-1 insteps of 0.01
3. Current Unbalance	
Trip Val (%)	2.50 to 100% in steps of 0.5
Trip Time (mSec)	0 to 1000 mSec in steps of 1
4. Time Delay Relay	
Delay Time (min)	0 to 10 min in steps of 1

5. LBB	
LBB 1	EN/DIS
LBB 2	EN/DIS
Trip Time (mSec)	0-5000 in steps of 1
Operating Time	
i) IDMT OCR Protection	Depends on curve & TMS setting
iii) LBB	Depends on Time setting

TB DETAILS

NUMERICAL OC + CURRENT UNBALANCE PROTECTION RELAY

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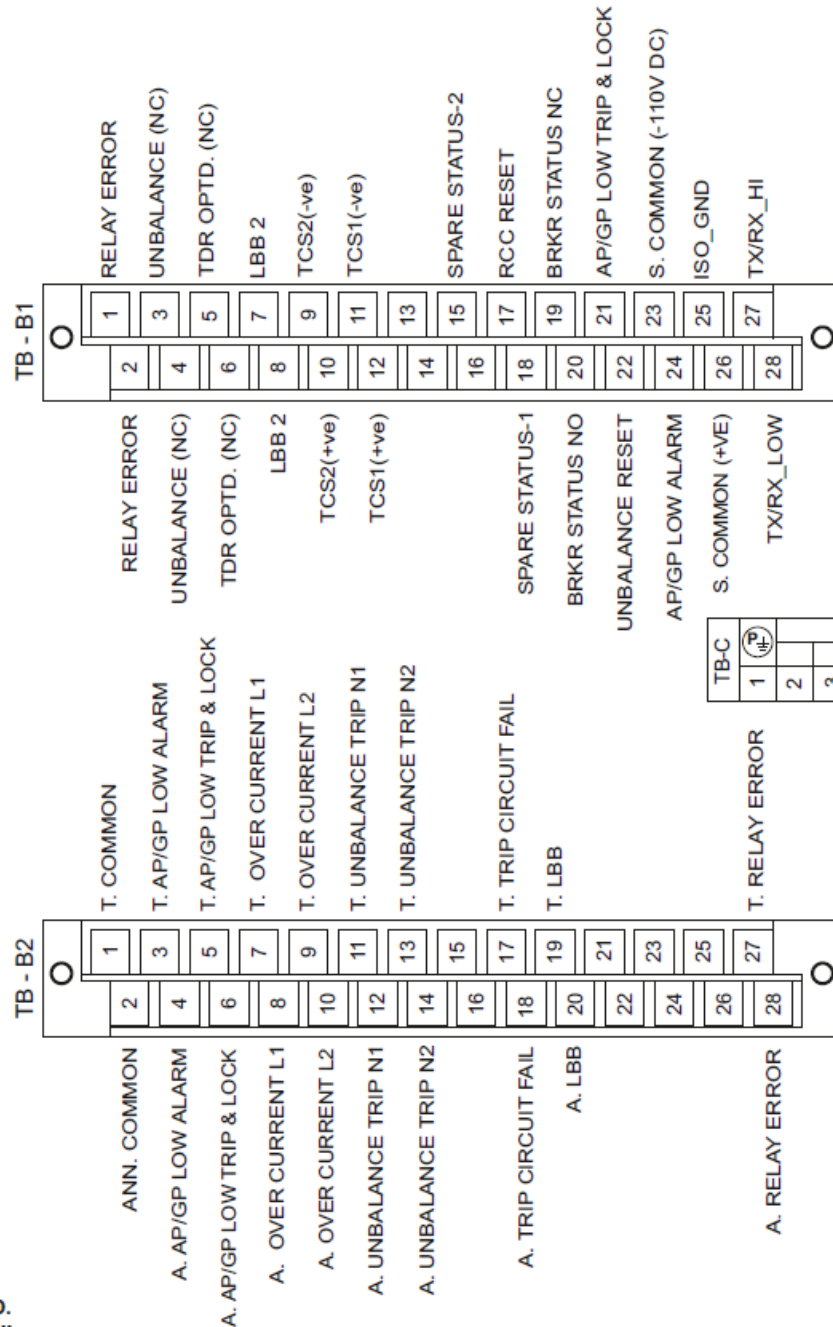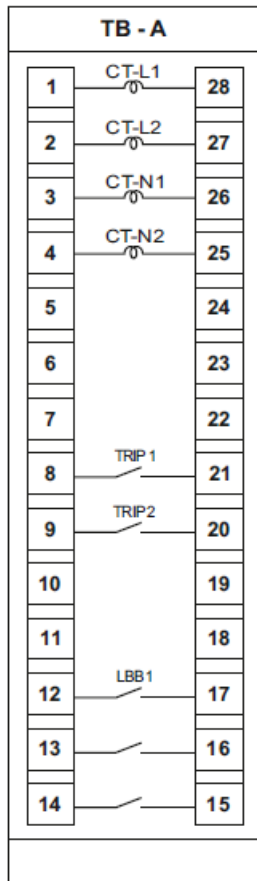
RELAY CONFORMING STANDARDS

The relay conforms to the following standards:

SI No.	Standards	Description
I.	IEC 60255-151	FUNCTIONAL REQUIREMENTS FOR OVER/UNDER CURRENT PROTECTION.
II.	IEC 60255-5	INSULATION COORDINATION OF MEASURING RELAYS AND PROTECTION EQUIPMENT- REQUIREMENTS AND TESTS.
III.	IEC 60255-1	MEASURING RELAYS AND PROTECTION EQUIPMENT- COMMON REQUIREMENTS.
IV.	IEC 60255-21-1	VIBRATION TESTS (SINUSOIDAL)
V.	IEC 60255-21-2	SHOCK AND BUMP TESTS
VI.	IEC 60255-21-3	SEISMIC TESTS
VII.	IEC 60255-27	PRODUCT SAFETY REQUIREMENT.
VIII.	IEC 60255-26	ELECTROMAGNETIC COMPATIBILITY REQUIREMENT.
IX.	IEC 60529	DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP CODE)
X.	IEC 61810-2	RELIABILITY.
XI.	IS 2705(PART II, III&IV)	PROTECTIVE CURRENT TRANSFORMERS.
XII.	IS 3231(PART 1 TO 3)	ELECTRICAL RELAYS FOR POWER SYSTEM PROTECTION.
XIII.	IS 8686	STATIC PROTECTIVE RELAYS.
XIV.	IEC 60068-2	ENVIRONMENTAL TESTS.
XV.	IEC 60870-5-103	COMMUNICATION PROTOCOL
XVI.	IEC 61850	COMMUNICATION PROTOCOL

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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.
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

MODEL – AR 54

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

ALUMINIUM INDUSTRIES LIMITED
RELAYS DIVISION

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

OVERVIEW

IEC 60870-5-103 is a standard for power system control and associated communications. It defines a companion standard that enables interoperability between protection equipment and devices of a control system in a substation. The device complying with this standard can send the information using two methods for data transfer - either using the explicitly specified application service data units (ASDU) or using generic services for transmission of all the possible information.

The IEC 60870-5 protocol is based on the three-layer reference model 'Enhanced Performance Architecture' (EPA), as specified in clause 4 of IEC 60870-5-3. The physical layer copper-wire based system that provides binary symmetric and memoryless transmission.

The link layer consists of a number of link transmission procedures, using explicit Link Protocol Control Information (LPCI), that are capable of carrying Application Service Data Units (ASDUs) as link user data. The link layer uses a selection of frame formats to provide the required integrity, efficiency, and convenience of transmission.

The application layer contains a number of application functions that involve the transmission of Application Service Data Units (ASDUs) between source and destination.

The application layer of this companion standard does not use explicit Application Protocol Control Information (APCI). This is implicit in the contents of the ASDU Data Unit Identifier and in the type of link service used.

PHYSICAL LAYER

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

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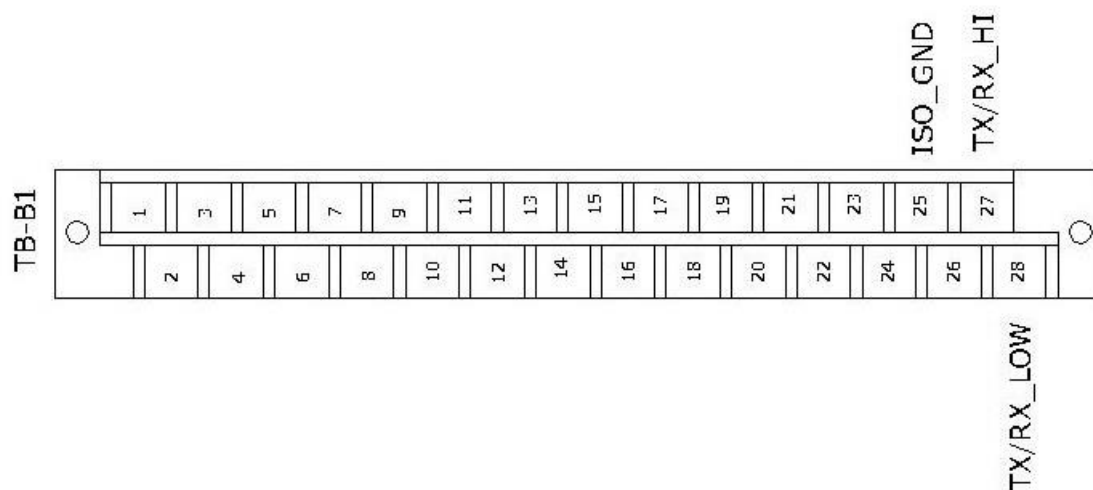2. TX/RX_LOW correspond to Data -ve.
3. ISO_GND correspond to GND.

Figure 1

GENERAL INFORMATION

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

PROTOCOL MAPPING

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

SYSTEM FUNCTIONS IN MONITOR DIRECTIONS

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
End of general interrogation	-	8	255	0	10	GLB
Time synchronization	-	6	255	0	8	GLB
Reset FCB	-	5	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	↑
Unbalance reset	-	1	180	27	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	↑↓
Time Delay Relay	X	1	180	31	1,9	↑↓
CB NC (CB open)	X	1	180	136	1,9	↑↓
CB NO (CB close)	X	1	180	137	1,9	↑↓
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 IDMT – 1	X	2	180	64	1,9	↑↓
Start/Pickup IDMT – 2	X	2	180	65	1,9	↑↓
Start/Pickup Unbalance CT – 1	X	2	180	66	1,9	↑↓
Start/Pickup Unbalance CT – 2	X	2	180	67	1,9	↑↓
IDMT Trip – 1	-	2	180	103	1	↑↓
IDMT Trip – 2	-	2	180	105	1	↑↓
Unbalance Trip – 1	-	2	180	107	1	↑↓
Unbalance Trip – 2	-	2	180	109	1	↑↓

MEASURANDS IN MONITOR DIRECTION

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

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

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT
Measurand supervision I1	-	9	180	148	2
Measurand supervision I2	-	9	180	149	2
Measurand supervision I3	-	9	180	150	2
Measurand supervision I4	-	9	180	151	2

TIME TAGGED MEASURANDS IN MONITOR DIRECTIONS

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT
Fault Current – I1	-	4	180	152	1
Fault Current – I2	-	4	180	153	1
Fault Current – I3	-	4	180	154	1
Fault Current – I4	-	4	180	155	1

STANDARD INFORMATION NUMBERS IN CONTROL DIRECTION

SYSTEM FUNCTIONS IN CONTROL DIRECTION

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

GENERAL COMMANDS IN CONTROL DIRECTION

DESCRIPTION	GI	ASDU TYPE	FUN	INF	COT	COM
LED (RCC) RESET	-	20	180	19	20	↑ (PULSE)
CB Open	-	20	180	124	20	↑↓ (PULSE)
CB Close	-	20	180	125	20	↑↓ (PULSE)
Unbalance (RCC) Reset	-	20	180	35	20	↑ (PULSE)

DISTURBANCE RECORD EXTRACTION

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

ANALOG CHANNEL INFORMATION IN AR 54

AR 54		
FUN	ACC	PARAMETER
180	**1**	**I1**
180	**2**	**I2**
180	**3**	**I3**
180	**4**	**I4**
180	5	X
180	6	X
180	7	X
180	8	X

DIGITAL CHANNEL (TAGS) INFORMATION IN AR 54

TAG POSITION	FUN/INF NUMBER	SEMANTICS ACCORDING TO TAG POSITION	INPUT/ OUTPUT
		AR 54	
0	180/84	GENERAL PICKUP	OUTPUT
1	180/68	GENERAL TRIP	OUTPUT
2	180/103	IDMT -1 TRIP	OUTPUT
3	180/105	IDMT – 2 TRIP	OUTPUT
4	180/107	UNBALANCE -1 TRIP	OUTPUT
5	180/109	UNBALANCE – 2 TRIP	OUTPUT
6	180/85	LBB TRIP	OUTPUT
7	180/31	TDR (Time Delay Relay)	OUTPUT
8	180/27	UNBALANCE (RCC) RESET	INPUT
9	180/19	RCC RESET	INPUT
10	180/136	CB NC	INPUT
11	180/137	CB NO	INPUT
12	180/30	AP/GP LOW TRIP & LOCK	INPUT
13	180/29	AP/GP LOW ALARM	INPUT
14	180/36	TRIP CIRCUIT SUPERVISION	INPUT

Model Implementation Conformance Statement
for the IEC 61850 interface in ALIND AR 54 relay version 1.0

Based on

UCA International Users Group

Testing Sub Committee

Template version 1.0
Date: April 24, 2008

TITLE:	MICS Ver.	1.0
MICS DOCUMENT FOR AR 54 RELAY	DATE: 21 FEBUARY 2024	
ALIND ALUMINIUM INDUSTRIES LTD | RELAYS DIVISION, THIRUVANANTHAPURAM		

1. Introduction

This model implementation conformance statement is applicable for ALIND AR 54 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_CAP2_4C	IED output 4 contacts
MEASUREMENT	LLN0	LLN02	LLN0 for Logical Device MEASURAND
	MTR_MMXN1	MMXN_CAP2_MTR	Measurand Value I1, I2, IUB1, IUB2
	FLT_MMXN2	MMXN_CAP2_FLT	Fault Value I1, I2, IUB1, IUB2
PROTECTION	LLN0	LLN03	LLN0 for Logical Device PROTECTION
	IDMT1_PTOC1	PTOC_CAP2	IDMT OCR 1
	IDMT2_PTOC2	PTOC_CAP2	IDMT OCR 2
	CUR_UB1_PTOC3	PTOC_CAP2	Current Unbalance Trip 1
	CUR_UB2_PTOC4	PTOC_CAP2	Current Unbalance Trip 2
	LBB_RBRF1	RBRF_CAP2	Breaker Failure
RECORDS	LLN0	LLN04	LLN0 for Logical Device RECORDS
	RDRE1	RDRE_CAP2	Disturbance recorder
SYSTEM	LLN0	LLN05	LLN0 for Logical Device SYSTEM
	LPHD	LPHD_CAP2	Physical Device Information
	ALM_GGIO1	GGIO_CAP2_ALM4	Alarms
	IND_GGIO2	GGIO_CAP2_BI7	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 Measurands)	
P: Logical Nodes for protection functions	
PTOC (Time Overcurrent)	
R: Logical nodes for protection related functions	
RBRF (Breaker Failure)	
RDRE (Disturbance Recorder Function)	

4. Logical Nodes

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

4.1 Logical Node: CNTRL_GGIO1

Description: Generic Process I/O

LN Class: GGIO

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Controls			
SPCSO1	SPC	Generic single point controllable status output (RCC Reset)	O
SPCSO2	SPC	Generic single point controllable status output (CB Open Command)	O
SPCSO3	SPC	Generic single point controllable status output (CB Close Command)	O
SPCSO4	SPC	Generic single point controllable status output (Unbalance Reset RCC)	O

4.2 Logical Node: ALM_GGIO1

Description: Generic Process I/O

LN Class: GGIO

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Status Information			
Alm1	SPS	General Single Alarm (Protection Healthy/Active)	O
Alm2	SPS	General Single Alarm (Local Parameter setting change)	O
Alm3	SPS	General Single Alarm (Time Delay Relay)	O
Alm4	SPS	General Single Alarm (Relay Error)	O

4.3 Logical Node: IND_GGIO2

Description: Generic Process I/O

LN Class: GGIO

Data Object	CDC type	Description	M/O
Common Logical Node Information			
Beh	ENS	Behavior	M
Status Information			
Ind1	SPS	General Indication (RCC Reset)	O
Ind2	SPS	General Indication (Unbalance Reset)	O
Ind3	SPS	General Indication (AP/GP low alarm)	O

Ind4	SPS	General Indication (AP/GP trip & lock)	O
Ind5	SPS	General Indication (Trip Circuit Supervision)	O
Ind6	SPS	General Indication (CB NC status)	O
Ind7	SPS	General Indication (CB NO status)	O

4.4 Logical Node: LLN0

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

4.5 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

4.6 Logical Node: MTR_MMXN1

Description: Non-Phase Related Measurements

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 IUB1	E
Amp4	MV	Measurand Current IUB2	E

4.7 Logical Node: FLT_MMXN2

Description: Non-Phase Related Measurements
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 IUB1	E
Amp4	MV	Fault Current IUB2	E

4.8 Logical Node: IDMT1_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	M
Op	ACT	Operate	M

4.9 Logical Node: IDMT2_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	M
Op	ACT	Operate	M

4.10 Logical Node: CUR_UB1_PTOC3

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

4.11 Logical Node: CUR_UB2_PTOC4

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

4.12 Logical Node: RBRF_CAP2

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

4.13 Logical Node: RDRE_CAP2

Description: Disturbance Recorder Function

LN Class: RDRE

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

5. Enum types

Enum types are listed in this clause.

5.1 Mod

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

5.2 ctlModel

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

5.3 Health

Value	Description
1	Ok
2	Warning
3	Alarm

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