# NUMERICAL SWITCHING RELAY
# ANS 321 [AN SERIES]

# User Manual

THE ALUMINIUM INDUSTRIES LIMITED
RELAYS DIVISION, TRIVANDRUM

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# SAFETY REQUIREMENTS

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## INTRODUCTION

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

This chapter describes safety precautions when using the relay.

Before installing and using the equipment, read and understand this chapter thoroughly.

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

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

**How much electricity is dangerous?????**

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

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

The relay is developed with zero percentage of risk factor by its own design. The current carrying paths and circuits are isolated from the metal case and structure. Suitable clearance depending on the type of insulation required for different classes are provided. The relay confirms to Product safety requirement standard IEC 60255-27.

## HEALTH AND SAFETY

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

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

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

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

## SYMBOLS AND LABELS USED IN THE RELAY

1. FRONT SIDE

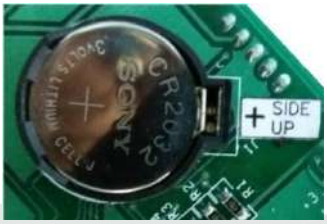
Caution: refer to equipment documentation

Caution: risk of electric shock

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.

## WARNING

**Current transformer circuit**

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

**Exposed terminals**

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

**Residual voltage**

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

## CAUTION

**Earth**

Earth the earthing terminal of the equipment securely.

**Operation conditions**

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

**Ratings**

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

**Printed circuit board**

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

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

**Connection cable**
Carefully handle the connection cable without applying excessive force.

**Modification**

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

## DECOMMISIONING AND DISPOSAL

**De-commissioning**

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

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

# TECHNICAL SPECIFICATIONS FOR SAFETY

## 1. Protective class

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

## 2. Environment

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

## 3. Overvoltage Category

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

## 4. Contact data

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

# INTRODUCTION

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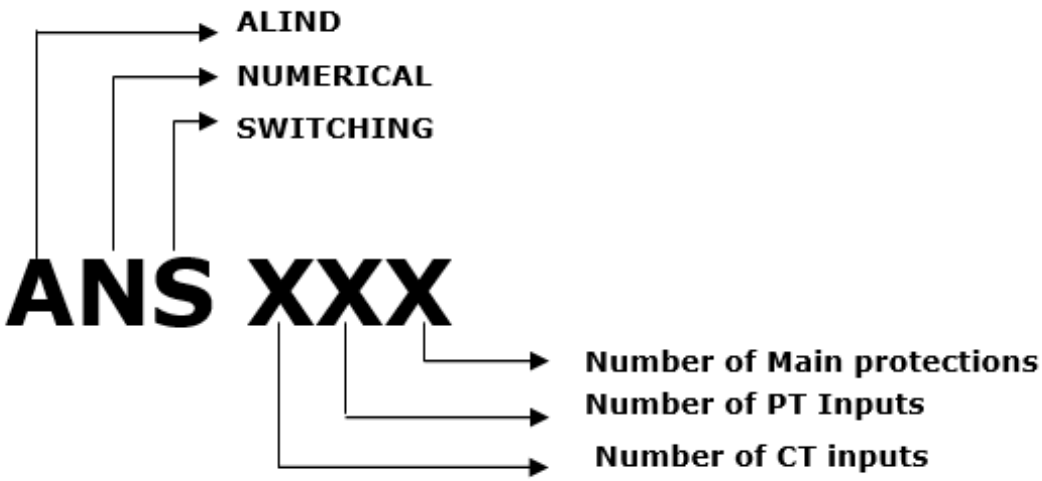
## AN SERIES (ALIND NUMERICAL SERIES)

- Advanced Digital Fourier Transform based Numerical algorithm design using 16-bit Digital Signal Controller (DSC).
- Compact Construction covering several protection modules saving panel space.
- Man-Machine Communication through 20x4 character LCD display and LEDs.
- Self supervision of both hardware and software units.
- Interface ability with SCADA is achieved through IEC 60870-5-103 communication protocol.
- Facility for storing fault waveforms (Disturbance recorder) and events with date and Time stamping. At a time a total of 5000 events and 200 latest fault waveforms (Disturbance recorder) will be stored in the relay.
- Graphical User Interface for Harmonic analysis, DC analysis and di/dt analysis can be done on the uploaded fault waveforms with facility for report generation.
- Facility to access/modify the relay settings both online as well as through menu in local PC through SCADA at RCC.
- Relay Indication (LED) reset from RCC.
- Suitable password protection.
- IP 54 grade enclosure protection.
- GPS time Synchronization Facility.

- Settable CT and PT ratio.
- CB close and open command initiation from relay through RCC.

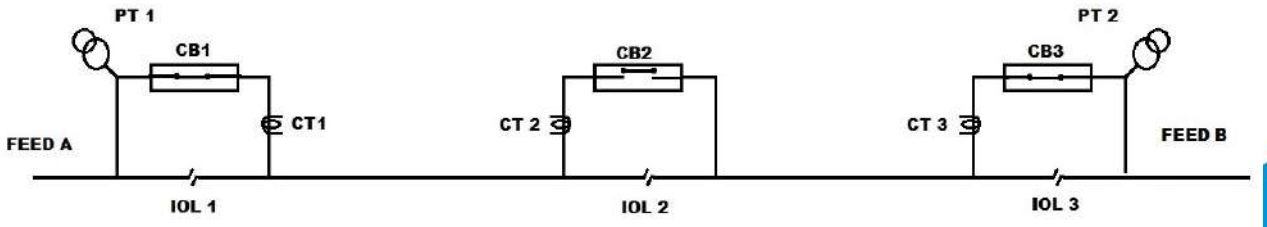
## ANS RELAYS

**ANS** series relays are designed for" **ON LOAD SWITCHING**" of feeding power supply alternatively in the "**NEUTRAL SECTION**" which is separated by the two sets of sections with TSS and SP, so that voltage available within the neutral section is of same phase at any given time.




## DESCRIPTION

The General arrangement of Automatic switching Neutral Section for IR is shown below:



**ANS 321** relay monitor current through three CT's for detecting the presence of traction load and changeover the supply of neutral section by controlling connected Circuit Breakers .The changeover of supply in Neutral Section are controlled by three Circuit Breakers.

ANS relay facilitate in automatic changeover at high speed so as to allow the loco to pass the neutral section and it's also possible for the loco to run the neutral section without reducing the speed or driver's intervention in doing DJ off at phase break. The general arrangement of neutral section is shown in above scheme.

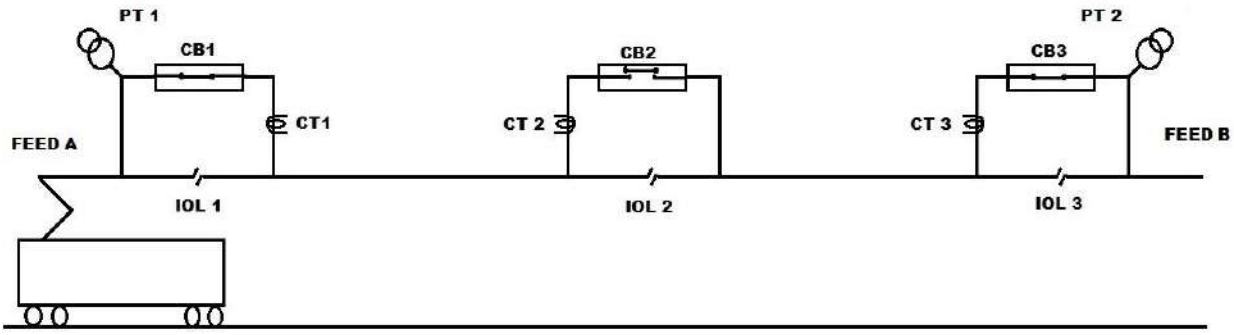
Initial Conditions :

- CB1 close condition
- CB2 open condition
- CB3 close condition
- PT1 & PT2 healthy

In above scheme, Feed A and Feed B are of two separate phases. The above diagram indicates 3 IOLs. CB1 bridges IOL1, CB2 bridges IOL2 and CB3 bridges IOL3. Current Transformers CT1, CT2 & CT3 are provided at bus bridging IOL1, IOL2 and IOL3 respectively. The relay constantly monitors all CT currents and PT voltages as well as the status of all CB's. Depending on which CT reads first, the sequence of operation is depicted below.

## SEQUENCE OF OPERATIONS WHEN CT1 READS FIRST

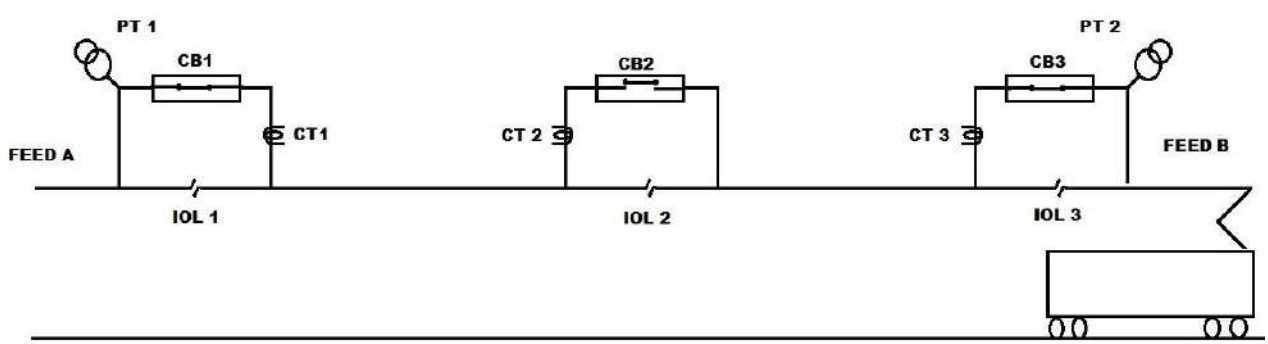
| | CT1 | CT2 | CT3 | CB1 | CB2 | CB3 |
|---|---|---|---|---|---|---|
| 1. | 0 | 0 | 0 | 1 | 0 | 1 |
| | 1 | 0 | 0 | 1 | 0 | 1→0 (After CB3 trips relay) |
| | | | | 1 | 0→1 (After getting CB3 trip status+ CB2 close delay) | 0 |
| | Final Condition | | | 1 | 1 | 0 |
| 2. | 1 | 1 | 0 | 1→0(After CB1 trip delay) | 1 | 0 |
| | | | | 0 | 1 | 0→1(After getting CB1 trip status + CB1 close delay) |
| | Final Condition | | | 0 | 1 | 1 |
| 3. | 0 | 0 | 1 | 0 | 1 | 1 |
| 4. | 0 | 0 | 0 | 0 | 1→0 (Forwad under current delay + CB2 trip delay) | 1 |
| | | | | 0→1(After getting CB2 trip status + CB1 delay) | 0 | 1 |
| | Final Condition | | | 1 | 0 | 1 |




If all PT's were in healthy condition, CB1 and CB3 will be in close condition and CB2 will be in tripped condition allowing the locomotive to enter the three IOLs in both directions. Initially all CT's reads zero current as no loco is present in any IOL. When loco comes from feed A (forward direction) and approaching IOL1, CT1 starts reading. When CT1 reads above switching current setting, relay will trip CB3 (after CB3 trip delay). After analysing condition of CB3, relay will close CB2 (after CB2 close delay). As loco continues its motion, CT2 starts reading on approaching IOL2. When CT1& CT2 reads above the switching current setting, relay will trip CB1 (after CB1 trip delay). After analysing condition of CB1, relay will close CB3 (after CB3 close delay) and the loco will be fed from feed B. When loco crosses the IOL3, CT3 current falls below the under current setting, relay will trip CB2 (after forward undercurrent delay + CB2 trip delay ) and closes CB1 (after CB1 close delay) after analysing the condition of CB2 .

## SEQUENCE OF OPERATIONS IF CT3 READS FIRST

| | CT1 | CT2 | CT3 | CB1 | CB2 | CB3 |
|---|---|---|---|---|---|---|
| 1. | 0 | 0 | 0 | 1 | 0 | 1 |
| | 0 | 0 | 1 | 1→0 (After CB1 trips relay) | 0 | 1 |
| | | | | 0 | 0→1 (After getting CB1 trip status+ CB2 close delay) | 1 |
| | Final Condition | | | 0 | 1 | 1 |
| 2. | 0 | 1 | 1 | 0 | 1 | 1→0(After CB3 trip relay) |
| | | | | 0→1(After getting CB3 trip status + CB1 close delay) | 1 | 0 |
| | Final Condition | | | 1 | 1 | 0 |
| 3. | 1 | 0 | 0 | 1 | 1 | 0 |
| 4. | 0 | 0 | 0 | 1 | 1→0 (Reverse under current delay + CB2 trip delay) | 0 |
| | | | | 1 | 0 | 0→1(After getting CB2 trip status + CB3 close delay |
| | Final Condition | | | 1 | 0 | 1 |




Initially all CT's reads zero current as no loco is present in any IOL. When loco comes from feed B (Reverse direction) and approaching IOL3, CT3 starts reading. When CT3 current reads above switching current setting the relay will trip CB1 (after CB1 trip delay). After analysing the condition of CB1, the relay will close CB2 (after CB2 close time delay). As loco continues its motion, CT2 starts reading on approaching IOL2. When CT3 and CT2 reads above switching current setting, the relay will trip CB3 (after CB3 trip delay). After analysing the condition of CB3, relay will close CB1 (after CB1 close delay) and the loco will get feed from feed A. When loco crosses the IOL1, CT1 current falls below the under current setting, the relay trip CB2 (after reverse undercurrent delay + CB2 trip delay) and closes CB3 (after CB3 close delay) after analysing the condition of CB2.

## RELAY BYPASS CONDITION

Necessary potential free auxiliary contacts is available for bypass the relay. Control supply for operating breakers shall made available in bypass condition. A separate contact are provided in the relay to enable getting indication at RCC, that the relay is disabled. In addition, indication is also available in the front panel of the relay.

## PT FAILURE

| PT | | CB | | |
|---|---|---|---|---|
| **1** | **2** | **1** | **2** | **3** |
| 0 | 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |

In case of any PT failure, all CB's are tripped on the set delay (0-2000ms) without considering any other factors.

In case of PT dead condition or DJ OFF condition, the loco pilot shall put down the pantograph.

On restoring of the PT after failure, the ANS relay will restore the CBs status as defined in the table given below.

FORWARD DIRECTION

| STATE | ANS321 CONDITION BEFORE PT fail | | | Remarks | ANS 321 CONDITION ON RESTORING PT | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | CB1 | CB2 | CB3 | | CB1 | CB2 | CB3 | |
| 1 | 1 | 0 | 1 | Initial condition (no loco present in ASNS). | 1 | 0 | 1 | Relay restores to initial condition after restoring of PT. |
| 2 | 1 | 1 | 0 | Forward sequence started and loco crossed IOL1. | 0 | 1 | 1 | Relay restores to 0 1 1 condition of forward sequence and allow loco to complete the sequence. |
| 3 | 0 | 1 | 1 | Loco Crossed IOL2. | | | | |

REVERSE DIRECTION

| STATE | ANS321 CONDITION BEFORE PT fail | | | Remarks | ANS 321 CONDITION ON RESTORING PT | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | CB1 | CB2 | CB3 | | CB1 | CB2 | CB3 | |
| 1 | 1 | 0 | 1 | Initial condition (no loco present in ASNS). | 1 | 0 | 1 | Relay restores to initial condition after restoring of PT. |
| 2 | 0 | 1 | 1 | Forward sequence started and loco crossed IOL3. | 1 | 1 | 0 | Relay restores to 1 1 0 condition of forward sequence and allow loco to complete the sequence. |
| 3 | 1 | 1 | 0 | Loco Crossed IOL2. | | | | |

**CB FAIL & SEQUENCE BREAK CONDITION**

The relay shall monitor the close/trip statuses of circuit breakers during sequence operation. In case of a failure in circuit breaker or relay failing to sense the feedback from circuit breaker, relay will trip all breakers without considering any parameters after set delay.

The relay will reset to initial condition if all current inputs are absent for a set delay in between a sequence.

## MAIN FUNCTIONS

| Sl No. | PARTICULARS | ANS 321 |
|---|---|---|
| **1.** | **MAIN FUNCTIONS** | |
| 1.1 | AUTOMATIC SWITCHING | ✓ |
| 1.2 | PT_ FAILURE | ✓ |
| 1.3 | RELAY FAIL | ✓ |
| **2.** | **STATUS INPUTS** | |
| 2.1 | Breaker status 1 NC | ✓ |
| 2.2 | Breaker status 1 NO | ✓ |
| 2.3 | Breaker status 2 NC | ✓ |
| 2.4 | Breaker status 2 NO | ✓ |
| 2.5 | Breaker status 3 NC | ✓ |
| 2.6 | Breaker status 3 NO | ✓ |
| 2.7 | RCC RESET | ✓ |
| 2.8 | TIME SYNC | ✓ |
| 2.9 | RELAY BYPASS | ✓ |
| 2.10 | STATUS SPARE | ✓ |

## GENERAL FUNCTIONS

| Sl No. | PARTICULARS | ANS 321 |
|---|---|---|
| 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 | Mini USB |
| 5.2 | Isolated RS 485 Interface | ✓ |
| 5.3 | Communication Protocol Interface- IEC 60870-5-103 | ✓ |
| 5.4 | GPS Time Sync Facility | ✓ |
| 5.5 | Date/time synchronization through PC | ✓ |
| 5.6 | Relay programming through Mini USB port | ✓ |
| 6. | **MONITORING** | |
| 6.1 | LINE CT 1 | ✓ |
| 6.2 | LINE CT 2 | ✓ |
| 6.3 | LINE PT 3 | ✓ |
| 6.4 | LINE PT 1 | ✓ |
| 6.5 | LINE PT 2 | ✓ |
| 7. | **USER INTERFACE** | |
| 7.1 | Test facility in Relay setting Mode (offline) | ✓ |
| 7.2 | Compact Module | ✓ |
| 7.3 | Plug In Type | ✓ |

## RELAY SETTINGS DESCRIPTION

1. **Automatic Switching**(Common for CT1 in forward direction and CT3 in reverse direction)

- Switching In current-The current above which the Switching operation starts.
- Guard setting-If both CT1 & CT3 currents rise above the set value, the relay will trip all CBs.
- Under Current-The current below which all the breakers get back to initial condition
- CB2 trip delay
- CB close delay (Common for CB1 & CB3)

2. **PT failure protection**

PT threshold

Setting above which relay sense PT as healthy.

- Above which PT healthy indication will be shown by relay.
- Above which CB1 & CB3 will be closed and CB2 will be tripped after set delay (Initial condition).
- Below which trip command will be issued to all breaker.

# 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.

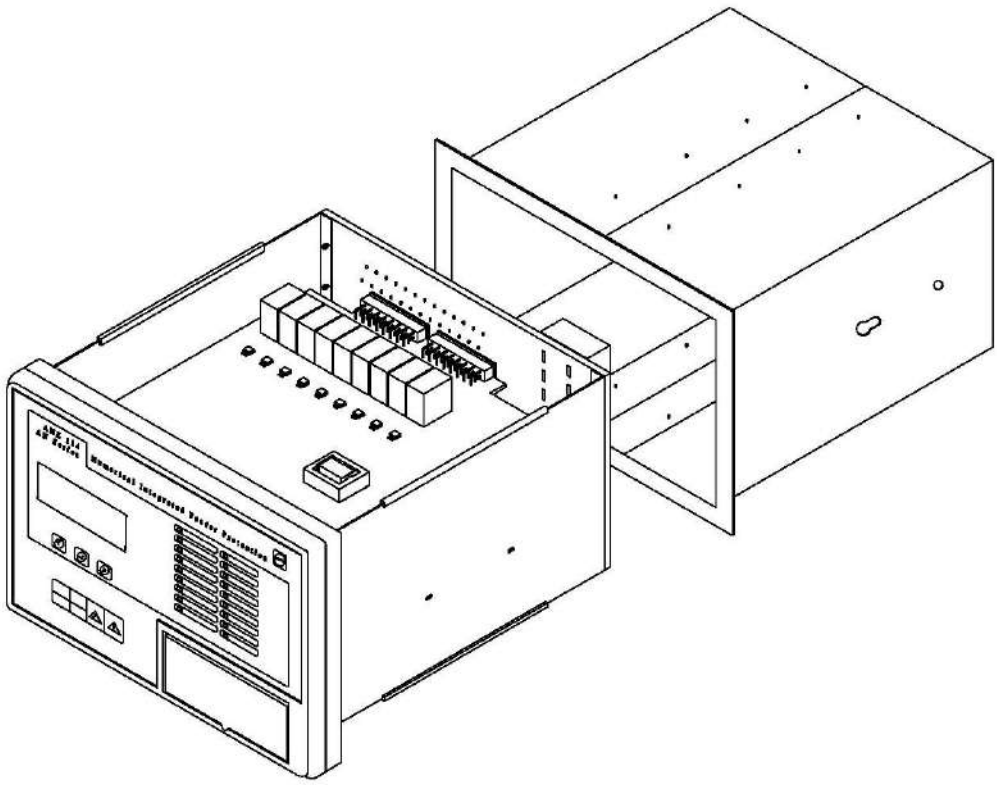
The relay is shipped from factory after detailed testing by our Quality Control Department. However, according to the customer requirement the relay settings/ functions can be verified before commissioning at respective sites with proper testing kits.

## STORAGE

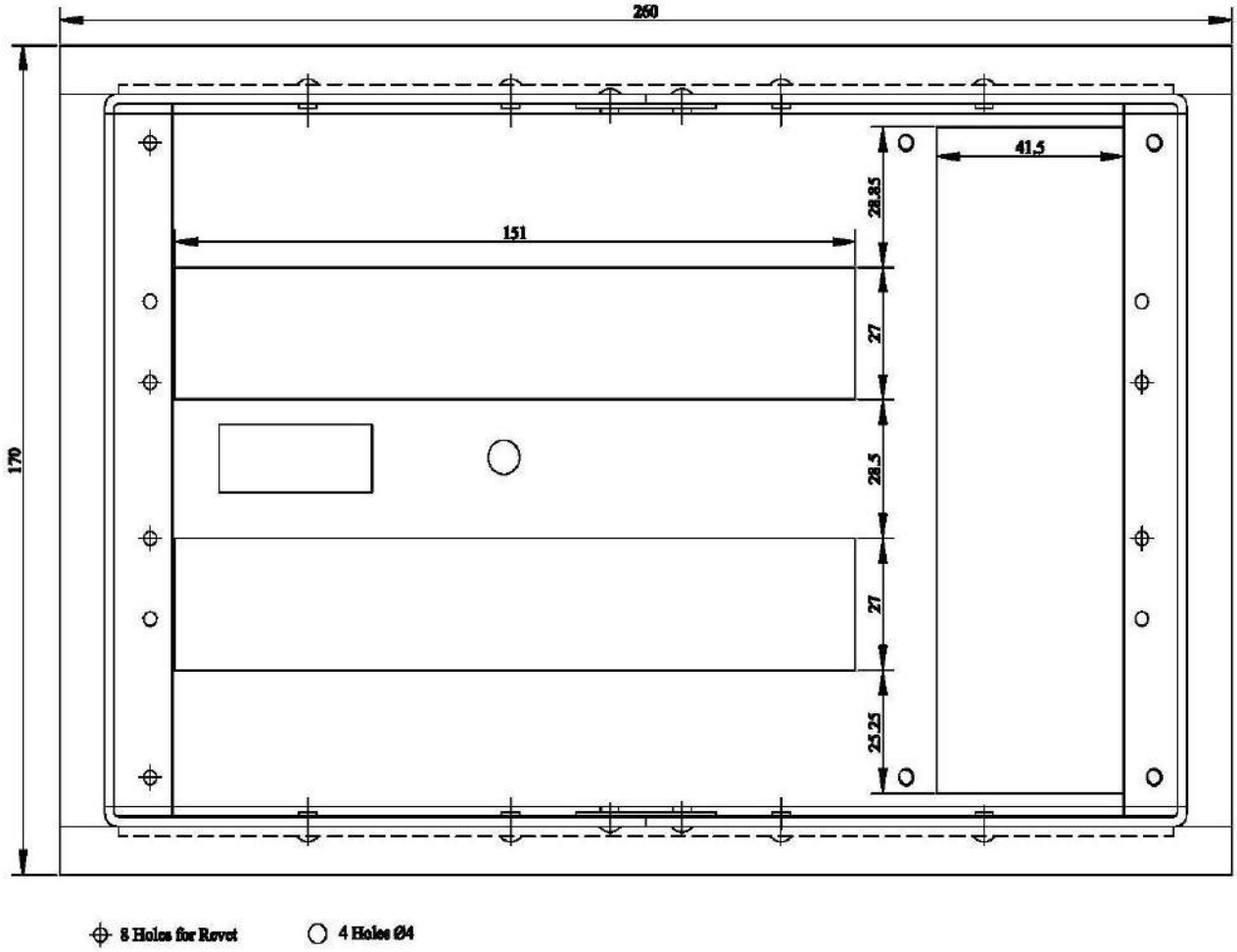
If relays are not to be installed immediately upon receipt, they should be stored in a place free from dust and moisture in their original boxes. At most care should be taken while storage.

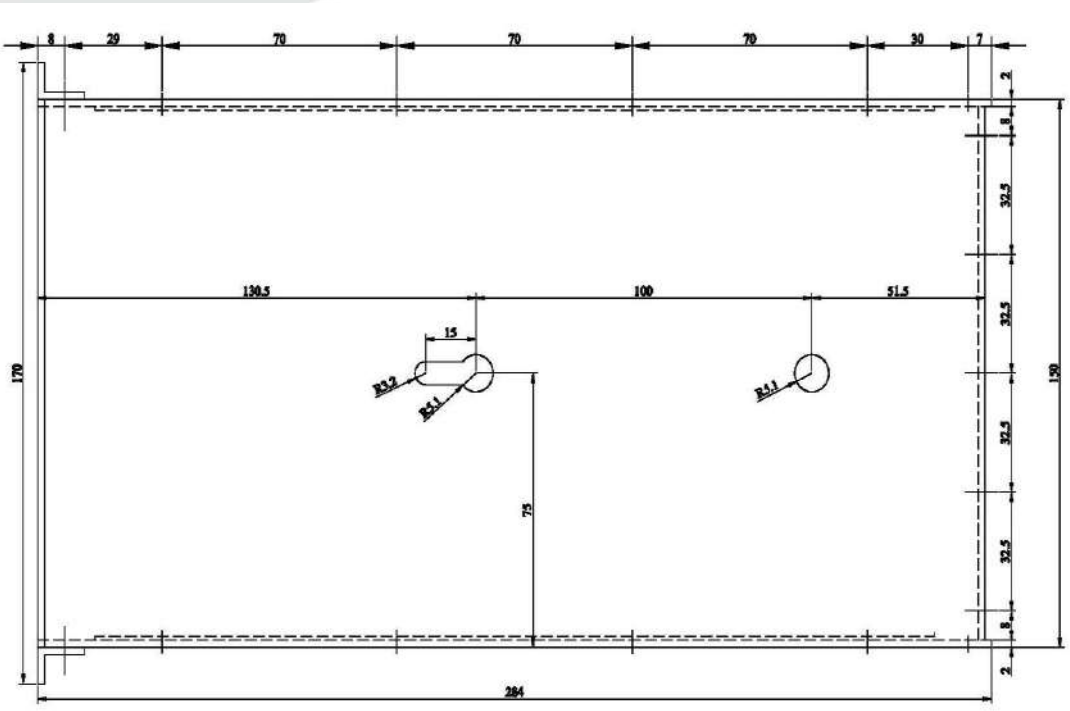
Storage temperature: -25ºC to +70ºC.

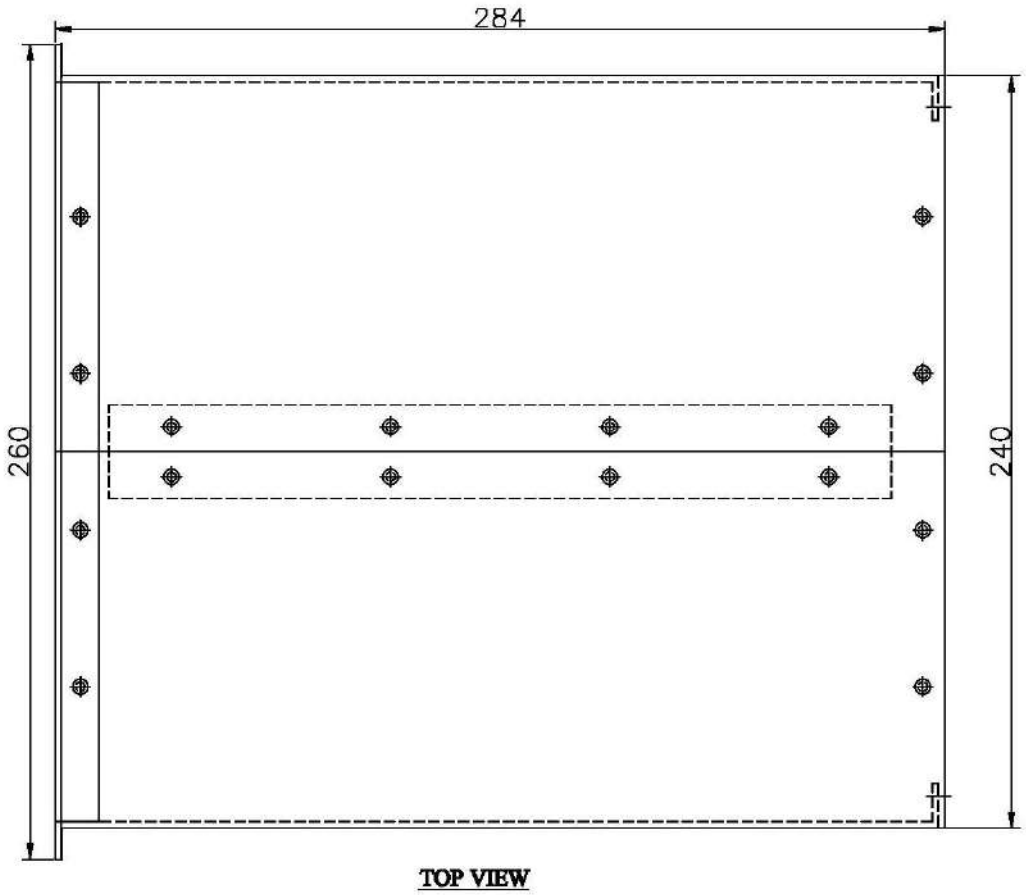
## RELAY AND RACK MOUNTING



## CASE DIMENSIONS




8
29
70
70
70
30
7
2
8
32.5
32.5
32.5
32.5
8
2
130.5
100
51.5
15
R3.2
R5.1
R3.1
75
170
150
284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260
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TOP VIEW

# USER GUIDE

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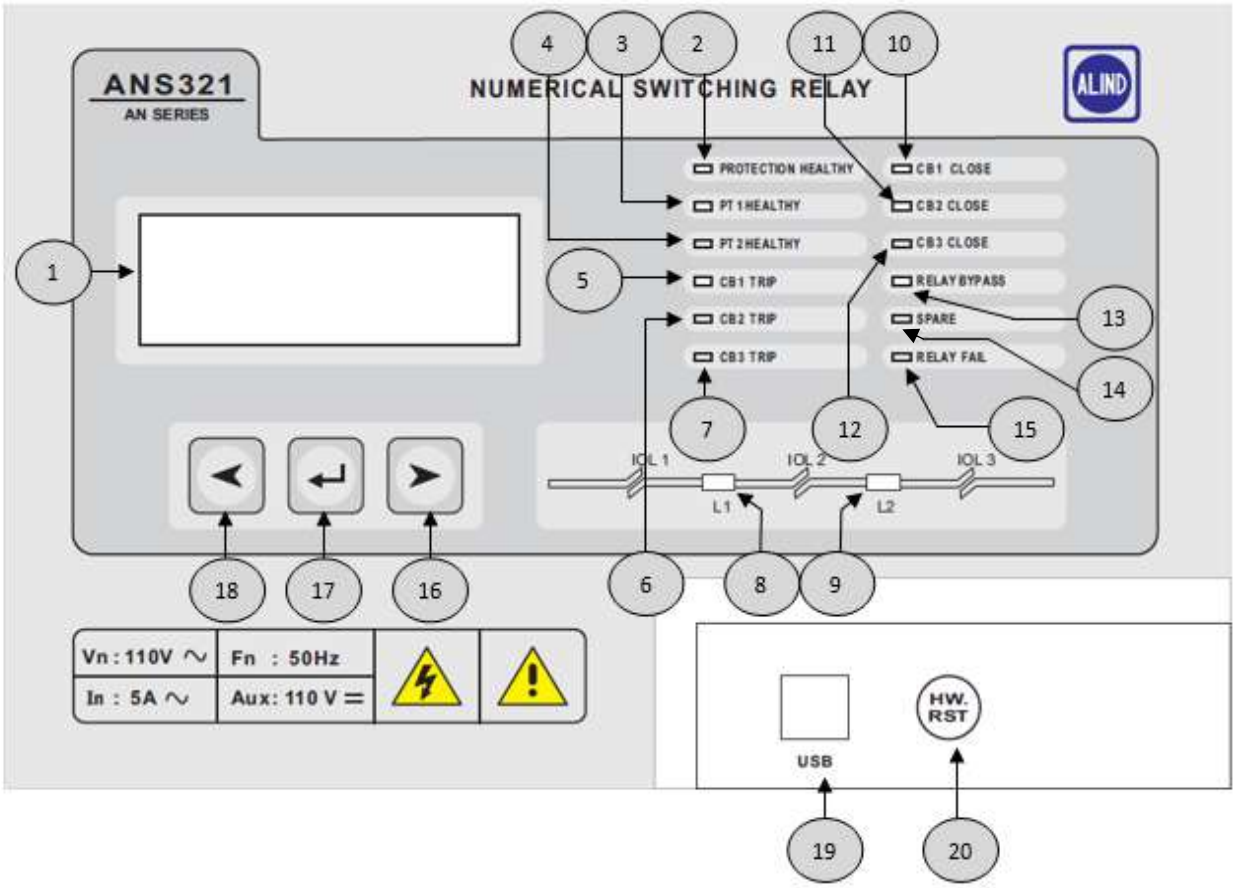
## FRONT PANEL INDICATIONS



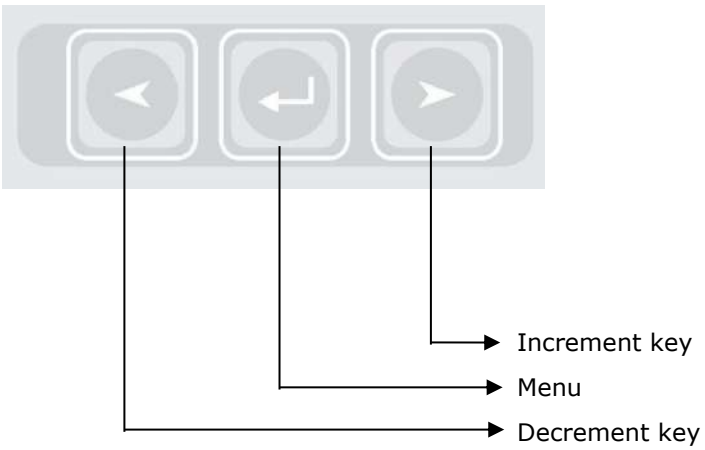
| No | Legend | ANS 321 |
|---|---|---|
| 1. | LCD DISPLAY | ✓ |
| 2. | PROTECTION HEALTHY (Green/Amber) | ✓ |
| 3. | PT 1 HEALTHY | ✓ |
| 4. | PT 2 HEALTHY | ✓ |
| 5. | CB1 TRIP | ✓ |
| 6. | CB2 TRIP | ✓ |
| 7. | CB3 TRIP | ✓ |
| 8. | L1 | ✓ |
| 9. | L2 | ✓ |
| 10. | CB1 CLOSE | ✓ |
| 11. | CB2 CLOSE | ✓ |
| 12. | CB3 CLOSE | ✓ |
| 13. | RELAY BYPASS | ✓ |
| 14. | SPARE | ✓ |
| 15. | RELAY FAIL | ✓ |
| 16. | > KEY | ✓ |
| 17. | ↵ KEY | ✓ |
| 18. | < KEY | ✓ |
| 19. | USB | ✓ |
| 20. | H.RST | ✓ |

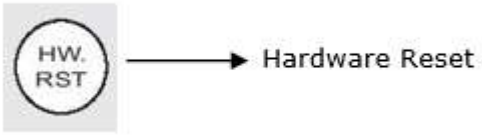
**LCD DISPLAY**

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

**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.

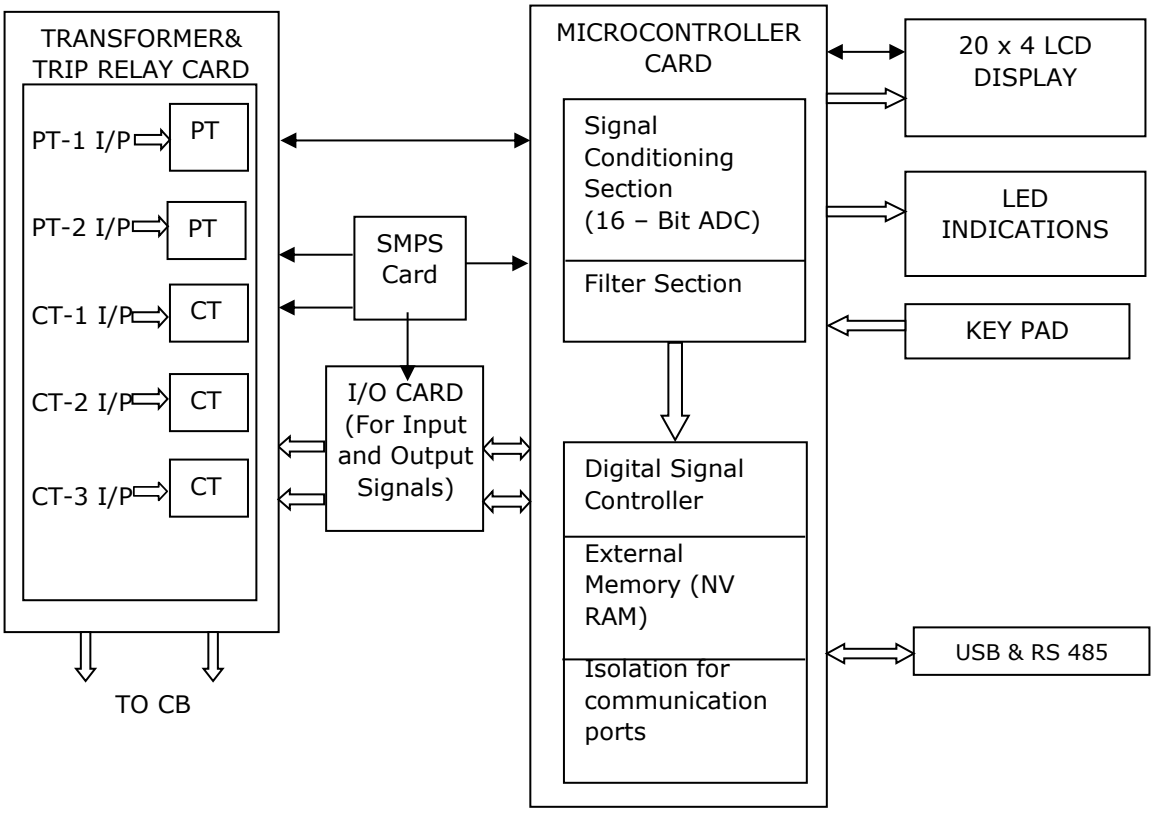
**Decrement key**

* 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.

# INTERNAL ARCHITECTURE AND BLOCK DIAGRAM

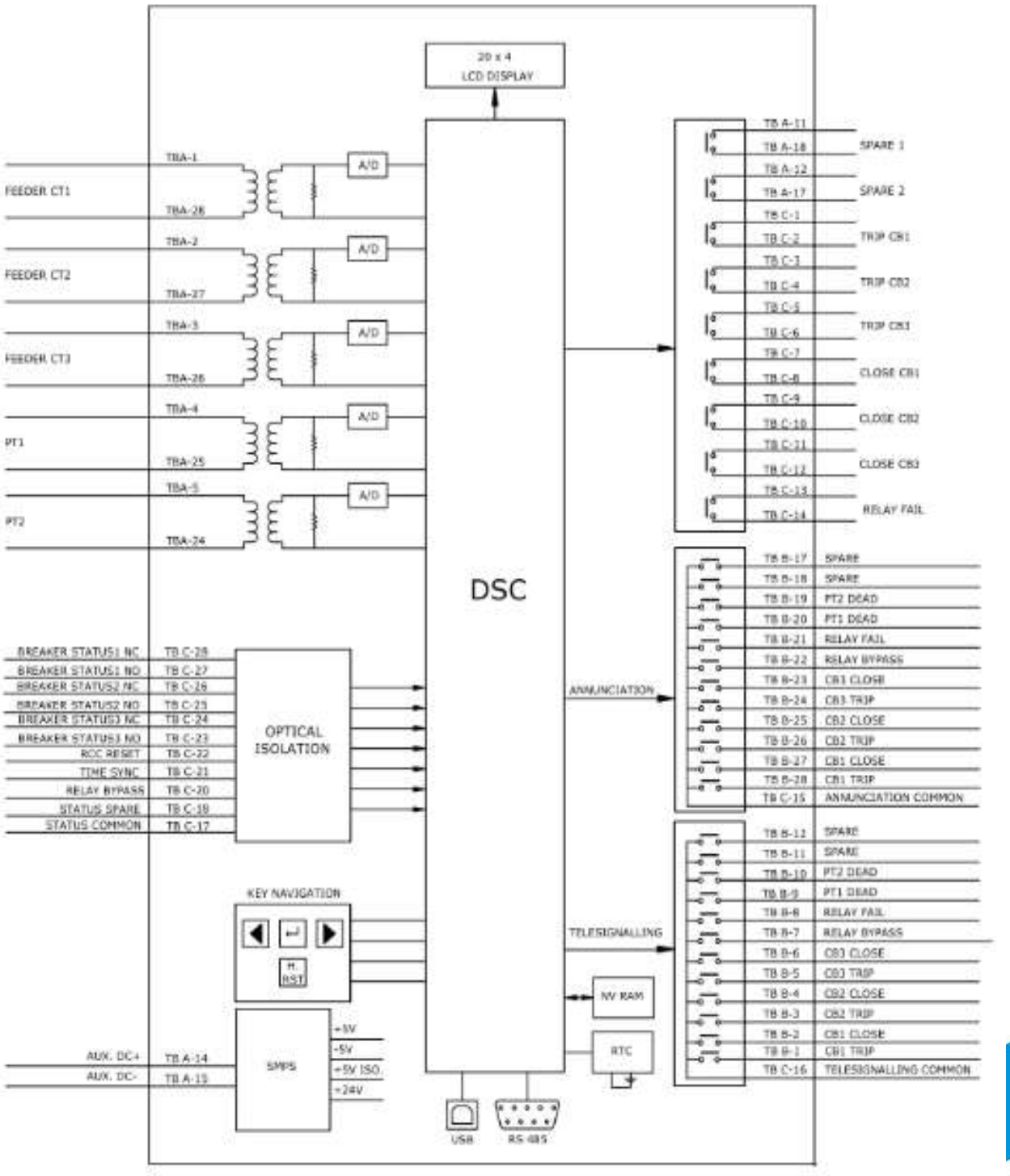
## INTERNAL SYSTEM LEVEL ARCHITECTURE- ANS 321

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



## BLOCK DIAGRAM

### ANS 312



**1. DSP Controller**

The dsPIC DSC (Digital Signal Controller) is a 16-bit modified Harvard RISC (Reduced Instruction Set Computer) machine that combines the control advantages of a high-performance 16-bit microcontroller with the high computation speed of a fully implemented Digital Signal Processor (DSP).

The DSP controller continuously monitors the currents and voltages. 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). The Voltage signals are scaled and isolated using Potential Transformer (PT). 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 each Current and Voltage 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 2 communications port, USB and RS 485. The relay is using IEC 60870-5-103 communication protocol for communication through RS485 and USB (Proprietary).

**USB Communication Port**

USB port is provided for uploading/downloading relay settings and events.

1. The software is capable of analyzing the peak, RMS & average values of current & voltage, Harmonic analysis of current & voltage waveforms and determination of fault clearing time, resistance, reactance, and phase angle of waveforms.

2. Waveform pointed by user displays the voltage, current & sample value of the particular point.

**RS 485 Communication Port**

RS 485 port is provided for SCADA connectivity. Using RS485 port online fault data of critical parameters, disturbance record (Waveform), event record (Trip data, R, X, FD, etc.), Automatic Supervision and Control (healthiness of Relay), Alarm and Event Handling, Data Acquisition, Calculating and Reporting, Parameter Setting, Resetting Indicating LEDs, Trip Circuit supervision, Relay Fail Indication etc can be downloaded. The communication complies with IEC 60870-5-103 protocol.

**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 Voltage and Current can be stored in the relay. This data is retrievable through USB & RS485 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, V, R, X, PA, DI, Fault clearing time, Fault date & time)

Trip circuit supervision

Relay pick up

Relay reset

Relay blocked due to harmonics or any other restraints

Auto-reclose acted

Auto-reclose lockout

Auto-reclose bypass

CB Trip

CB Close, Change of status input , Relay setting changed (GUI & Keypad) & Relay Fail.

## ENERGIZING THE RELAY

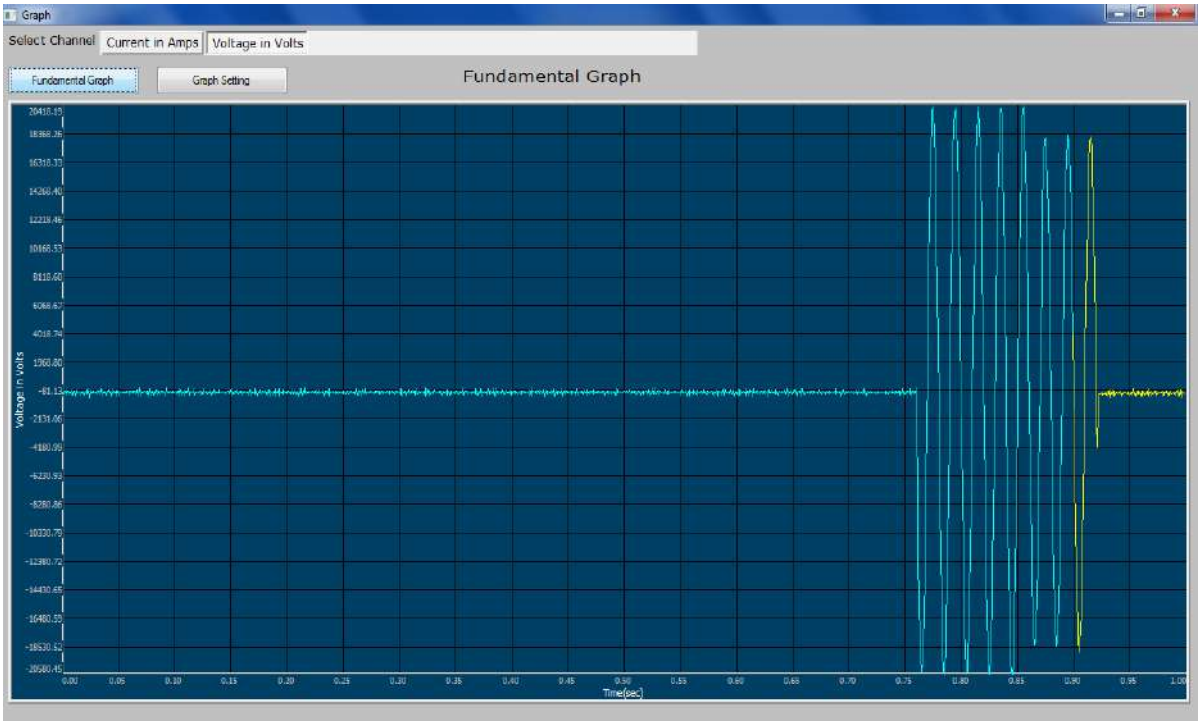
1. Before turning ON the relay, proper earthing should be provided.
2. Visual Inspection for any physical damage in housing, display etc. shall be checked.
3. Operating voltage range: **45 to 170 VDC.**
   Operating voltage: **110 V DC.**
4. Prefer regulated power supply of 110VDC.
5. Auxiliary power supply shall be provided to the 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, Communication PCB, Controller PCB, Stack PCB, Trip relay & transformer PCB, SMPS PCB, I/O & status PCB, Back panel PCB.

**Display PCB**: The Display PCB is mounted at the front plate of the unit. It consists of the 20x4 LCD, LED indications, Keyboard circuits, and LED controller.




**Controller PCB:** 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. The Analog signals are filtered and digitized in this board. The DSP takes decision based on this digital samples and initiates necessary commands.

**PCB:** The communication PCB is mounted at the front side. This PCB supports the communication through USB for data exchange. Also the Hardware Reset Switch is mounted in this PCB.

**Stack PCB:** Internal communications between the PCB's are ensured with the help of stack PCB.

**Trip relay &Transformer PCB**: All the CTs, PTs and Tripping Relays are assembled in this board. This board 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.

**SMPS PCB:** The SMPS PCB provides the necessary Power supply voltages to the different PCBs mounted inside the relay. The SMPS is a DC-DC converter. The SMPS provides +24V, +5V, -5V and isolated +5 V. The +24 V supply is used for the driving the output relays in the I/O PCB and Trip Relay PCB. 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.

**I/O & status PCB**: The I/O PCB deals with the necessary I/O lines such as Input status lines and Digital Output contacts. A separate controller provided in this board performs the necessary I/O operations in conjunction with the DSP controller in the Processor PCB. The I/O PCB is mounted vertically on to the stack PCB.

**Back PCB:** 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.

# TECHNICAL DATA

# CONTENTS

## TECHNICAL SPECIFICATIONS

| Sl No | Specification | Particulars |
|---|---|---|
| 1. | **Current Input(rated)** | 5 Amps |
| 2. | **Auxiliary Supply** | 45 to 260 VDC |
| 3. | **VA burden on CT** | Less than 0.5 VA |
| 4. | **VA burden on PT** | Less than 0.5 VA |
| 5. | **VA burden on Aux** | Less than 15 Watts(energized)<br>Less than 10 watts( de-energized) |
| 6. | **Operating Temp Range** | -10 Deg to + 65 Deg |
| 7. | **Continuous Current Carry Capacity of CT** | 3In; 15A |
| 8. | **Thermal Withstand for CT** | 40In for 1 sec |
| 9. | **Continuous voltage carrying capacity of PT** | 1.15 of rated value |
| 10. | **Thermal withstand for PT** | 2 times rated value for 10 sec |
| | **Contact details** | |
| | a)Current carrying capacity | 5A |
| | b) Making and carry for 3 sec at 250V,50Hz | 30A |
| | c) Making capacity at 250V,50-60Hz AC | 5A |
| | d)Breaking Capacity<br>i) AC 220V, 50-60Hz, CosØ=0.4<br>ii) DC 220V, L/R= 45ms | <br>5A<br>0.5A |
| 11. | **Type of communication ports** | USB and RS485 |
| 12. | **Overall dimensions**<br>**Width**<br>**Height**<br>**Depth** | <br>264 mm<br>174 mm<br>280 mm |
| 13. | **Weight** | 4.8 kg approx.kg |

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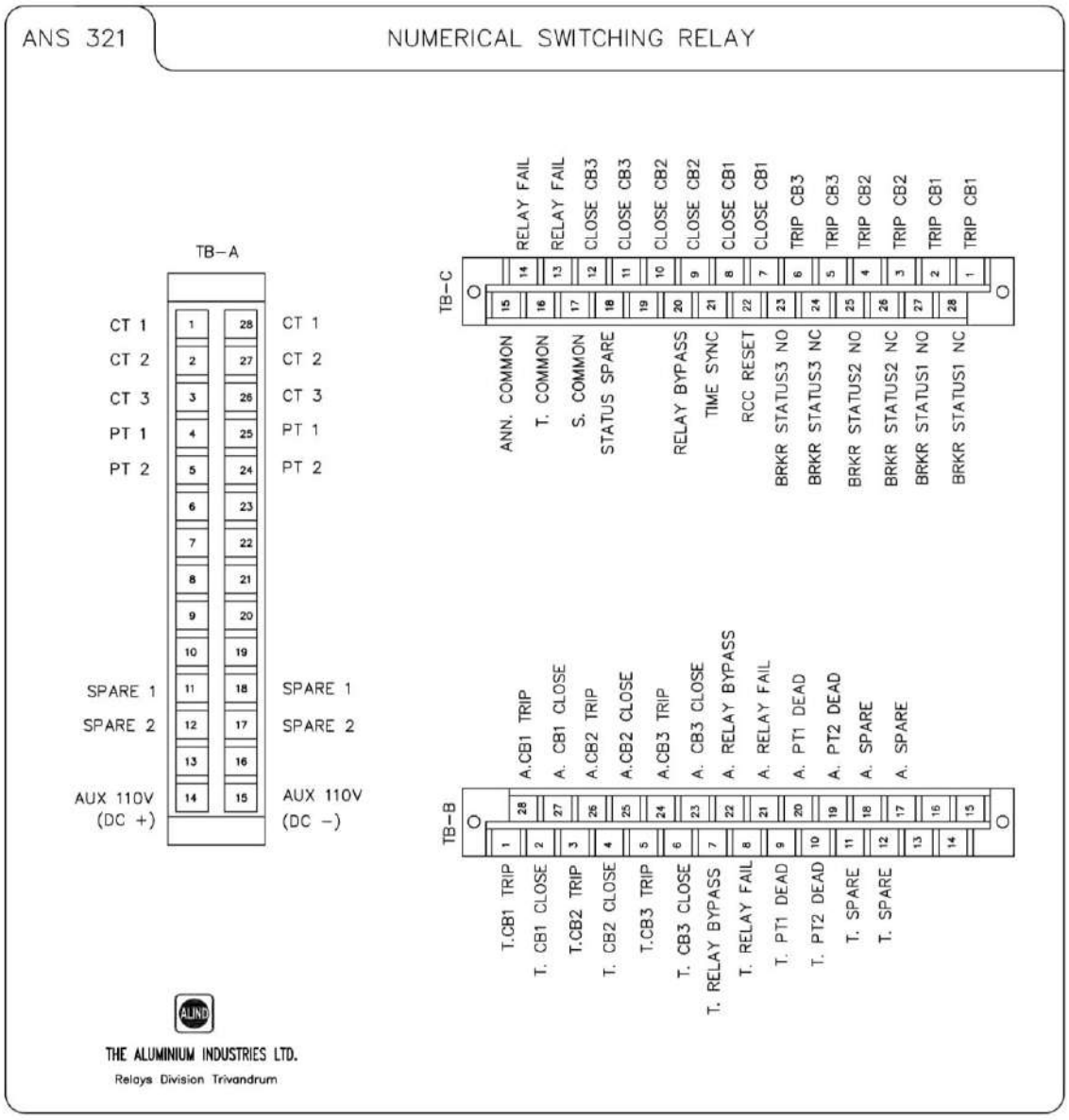
## GENERAL SETTINGS

| General Settings | Particulars |
|---|---|
| **Password protection (YES/NO)** | **0000-9999** |
| **1. General settings** | |
| 1. CT Primary | 5-5000A in steps of 5A |
| 2. CT Secondary | 1-5A in steps of 1A |
| 3. PT Primary | 110 to 30000V in steps of 10V |
| 4. PT Secondary | 10-110V in steps of 10V |
| 5. Trip counter Reset | Yes/No |
| 6. Post fault cycles | 0-5 in steps of 1 |
| 7. Relay ID | 1-255 |
| 8. Baud Rate | 4800-57600 in steps of 200 |
| 9. Trip Relay Test | (Yes/No) |
| 10. Date & Time setting | (Yes/No)<br>DD/MM/YY<br>HH:MM:SS |
| **2. Automatic Switching** | |
| 1. Switching In current | 1-50% in steps of 1% |
| 2. Guard setting | 1-20% in steps of 1% |
| 3. Guard Trip | EN/DIS |
| 4. Under current | 0-50% in steps of 1% |
| 5. Forward undercurrent delay | 0-300s in steps of 1sec |
| 6. Reverse undercurrent delay | 0-300s in steps of 1sec |
| 7. Sequence reset delay | 0-300s in steps of 1sec |
| 8. CB1 trip delay | 0-60S in steps of 10ms |
| 9. CB2 trip delay | 0-60S in steps of 10ms |
| 10. CB3 Trip delay | 0-60S in steps of 10ms |
| 11. CB1 Close delay | 0-60S in steps of 10ms |
| 12. CB2 Close delay | 0-60S in steps of 10ms |
| 13. CB3 Close delay | 0-60S in steps of 10ms |
| 14. CB trip sense delay | 0-60S in steps of 10ms |
| 15. CB close sense delay | 0-60S in steps of 10ms |

| **3) PT_FAILURE** | |
|---|---|
| 1. PT Threshold | 0-110V in steps of 1V |
| 2. CB Trip delay | 0-60000ms in steps of 10ms |
| 3. CB close delay | 0-60000ms in steps of 10ms |

## TB DETAILS

## ANS 321



## 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 |

# 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<br>TB A-14: +110VDC<br>TB A-15: -110VDC<br>2. Check the continuity of the output terminal, after disconnecting the wires. | 1. Due to power supply failure, the LED turns off.<br>2. The varistor may short circuited to protect internal circuitry on transients |
| 2 | Current Not reading/ Out of tolerance limit. | 1. Refer TB sticker for CT inputs.<br>2. Check for the earthing of CT.<br>3. Check if the terminals of TB-A is connected properly or for any lose contact.<br>4. Check CT ratio and multiplying factor if any.<br>5. Check the continuity of the output terminal, after disconnecting the wires.<br>After checking of the above, measure the current using calibrated Clamp-On meter.<br>If not OK, intimate to works. | 1. The CT connector is having shorting facility. If the connector is not tight, CT secondary may get some low resistance path through the connector itself.<br>2. If CT is not properly earthed, there is a chance of leakage current that may cause error in CT reading. |
| 3 | Voltage not reading/Out of tolerance limit. | 1. Refer TB sticker for PT inputs.<br>2. Check if the terminals of TB-A is Connected properly or for any lose contact.<br>3. Check PT ratio.<br>4. Check the continuity of the output terminal, after disconnecting the wires.<br>After checking of the above, measure the voltage using calibrated multi-meter.<br>If not OK, intimate to works. | 1. The fuse of the PT in the yard may blown out.<br>2. The varistor may short circuited to protect internal circuitry on transients. |
| 4 | Relay Fail Indication | 1. Intimate to works.<br>2. Press H.RST key in the relay front panel. | 1. Supply variation to internal PCB's.<br>2. DC supply fail. |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