PROK DEVICES PRIVATE LIMITED

B-80, 2nd & 3rd Floor, KSSIDC Industrial estate, 4th Main Road,
6th Block, Rajaji Nagar, Bengaluru -560010
Ph no: 080-41480777, 080-41157700,
Email: enquiry@prokdvs.com,www.prokdvs.com, www.prokdvs.in

NUMERICAL UNDER+OVER VOLTAGE RELAY AND NEGATIVE PHASE SEQUENCE PROTECTION (TYPE: PNV-NSP)

Introduction

Prok dv's make micro-controller based PNV Series, PNV-NSP Voltage Relay is a combination of Over Voltage and Under voltage with the detection of Negative and Positive sequence voltage with instantaneous elements on under, over & negative sequence. The relay offers reliable and flexible solutions for the protection of Power Plants, Feeders, Motors, Generators, Transformers, grounded and ungrounded systems etc., against voltage variations. It incorporates IDMT characteristics, Definite time characteristics and High Speed/Instantaneous feature for over voltage and under voltage settings and also the negative sequence protection. It has user-friendly feature for entry of parameters by using membrane key pad and LCD display having 2 line, 16 character alpha-numeric display.

It operates on the principle of detection of Negative and Positive sequence voltages to measure the degree of unbalance in the system voltages. Once the unbalance voltages exceed the set limit, time delay required to issue the trip command is evaluated.

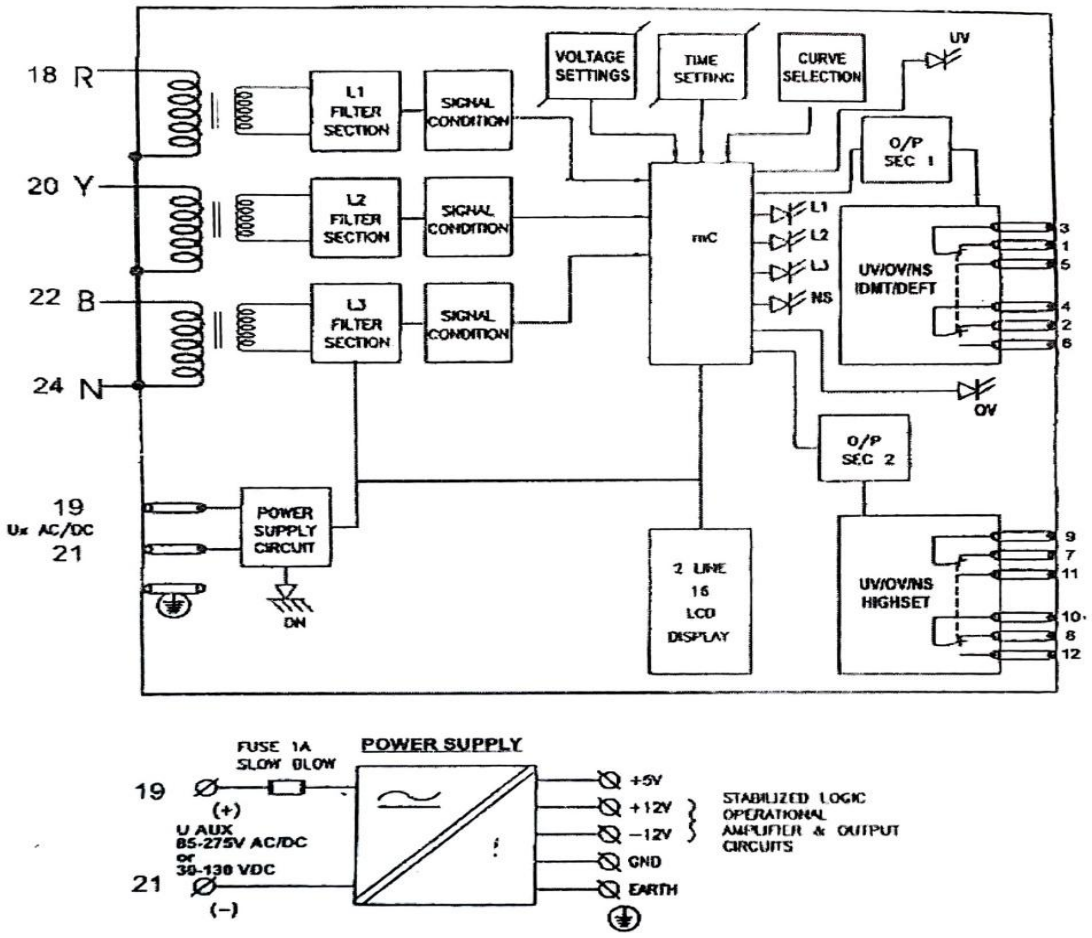
Over voltage, Under voltage and relay trip conditions are indicated by LED's Aux. Supply is provided by Universal Switch Mode Power Supply(SMPS) with input voltage being either AC or DC, 85- 275 AC/DC or 30V to 110V DC.

In case of AC voltages the power supply is designed to operate from 47Hz to 53 HZ.

The relay has been housed in a non draw-out case with front transparent poly carbonate cover for dust proof and the relay has both LCD and LED indications for Fault identifications, along with external mechanical reset switch.

The relay confirms to IEC 60255.

BLOCK DIAGRAM



Features:

- IDMT & Definite Time Characteristics
- High Pick up/ Drop off ratio
- EEPROM-memory for data retention
- Wide range of system voltages
- High speed feature for Under, Over Voltages & Negative sequence
- 2 LINE, 16-character LCD display and Membrane keypad
- Very low burden on AC and DC(Auxiliary and Sensing)
- Accurate and reliable measurement of voltages by measuring negative sequence voltages by using DFT
- Built in test facility
- Magnitude of Fault & Nature of Fault Indication in LCD Display(RMS Value of Voltages)
- LED Indication for nature of faults
- Site selectable voltages 0-220/0-230/0-240/0-250 Volts, 50Hz, 3 Phase 4 wire system

Working Principle

The relay employs DFT-technique for the detection and measurement of negative and positive sequence voltages. The system voltages that is to be monitored is stepped to a suitable level by the input of built in potential transformers. This signal is passed through a low pass filter (LPF) to band/limit the signal, the output of the LPF is passed through a variable gain amplifier and level shifter, this process of signal conditioning prepares the signal to be applied to the Microcontroller.

The microprocessor samples the signal and converts it to a digital value.. Once the signal is in the form of digital data, DFT- technique is employed to extract magnitude and phase angle of the input signal.

When the measured values of voltages and negative sequence component, crosses the set values entered by the user, tripping times for the relay are calculated according to the characteristic selected and trip command is issued by the relay for necessary action. The schematic diagram of the relay is as shown in the following block diagram.

Setting procedure:

The following block shows keypad, display and LEDs in the front fascia, Keypad is used for accessing and making setting for the relay.

The following section gives the complete setting procedure for the relay:

- Connect the rated Auxiliary Voltage for the relay(marked on the rear side of the relay) and when connecting a DC-Voltage Source observe the correct polarity
- Use 

I OR 

Key to change the setting values
- Press 

Key to change the setting values will not be registered in the memory of the relay unit.
- While entering values/making changes the process has to be completed within a span of 30seconds. Failing to observe this will force the relay to come out of the setting mode.
- Once the Aux. Voltage is connected, the display shows the following:

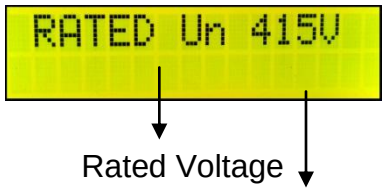
PNV-NSP → Model Name

Un → System Voltage

- Also the GREEN LED marked as ON will be indicating the presence of Aux. Input voltage.

Setting procedure details:

- **Accessing the relay:** Press SET F - RST and START key simultaneously, the release SET/F-RST key first then release START key, display shows the following:



- **Select a suitable system voltage** by operating > key and < key, Press SET F - RST to register the selected value.
- After selection of the system voltage the display shows over voltage-Low setting option.

- Now enter the **Over Voltage[O>]** settings for the system(step of 0.01).

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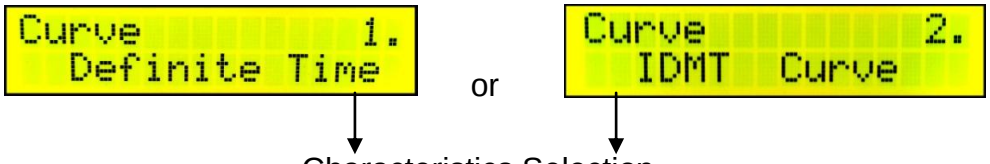
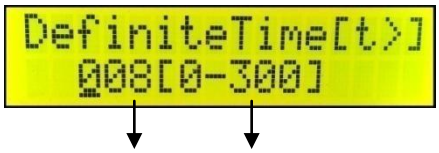
- After the selection of the Over Voltage the user will be given the to select either the



- Select either Definite Time or IDMT Characteristic by operating the SET F - RST key.
- If the selected characteristics is Definite Time, then the display Shows:



- Now the time **of operation of the relay (in Secs.)** is selected in the given range(step of 1sec.) After the selection press SET F - RST to register the selected time. Now the display changes
- This is **High-set** option for the system, the user has to select suitable High-set voltage within the range(step of 0.01) and press SET F - RST key to register the value. Now the display changes to

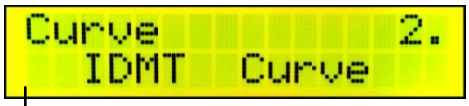
- This is the permitted **time range (in Secs.)** for High set, select a suitable time for high set operation and enter SET F - RST to record the selected time(step 0.01). This completes the entry of the parameters for Over voltage conditions. After the selection of time for the High set, display changes to

Previous or Factory set value

Range of Under voltage to be selected (Lowest)

- With display showing the range of **low-set under voltage for the system[U<]**, Under voltage conditions for system are selected and this value is recorded by pressing SET F - RST key. After this display shows the option for selection of Definite Time or IDMT Curve

or



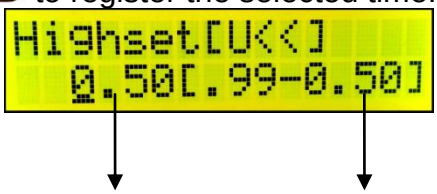
Characteristics Selection

- If the selected characteristic is Definite Time, then display shows

Previous or Factory set

Range of time to be selected

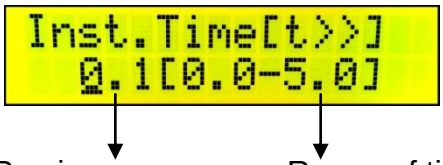
Now the **time for operation of the relay(in Secs.)** is selected in the given range. After selection press SET F - RST to register the selected time. Now the display changes



Previous or Factory set value

Range of High set to be selected

- This is the **High-set/Instantaneous** option for the system, the user has to select suitable High-set voltage within the range and press SET F - RST to record the selected time. Now the display changes to



Previous or Factory set Value

Range of time to be selected

- This is the permitted **time range(in Secs.)** for High set, select a suitable time for high set operation and enter SET F - RST to record the selected time. This completes the entry of the parameters for Under voltage conditions. After the selection of time for the High set display changes to

Previous or Factory set value

Range of % -ve to be selected

- Here user will have to select **%age negative sequence voltage (Va2/Vn-Rated Voltage)** that can persist in the system in steps of 1%. After selecting the %age negative sequence, press SET F - RST key to register the value selected, now the display changes to

Previous or Factory set value

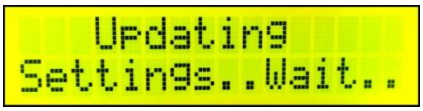
Rate of time to be selected

- Now the time of operation for %age negative sequence voltage in definite time mode is to be selected in the given range and press SET F - RST key, display momentarily shows

Previous or Factory set value

Rate of time to be selected

- Here, the user can select the **time of operation(Definite time) of the relay** if the **negative sequence crosses more than 25%** in the system, after the time
- selection, press SET F - RST key, display momentarily shows

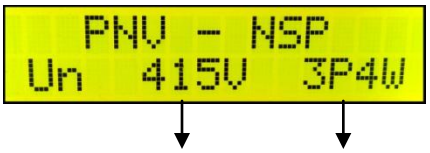


After the momentary display of updating the data, display will show the **system voltage selected along with the model of the relay and type of system**

This completes the procedure for setting the relay when the selected model of operation of the relay is in definite time for over and under voltage conditions.

The relay can also be programmed to act as IDMT relay for Over and Under Voltage conditions by following almost similar setting procedure. The complete steps are indicated below:

- **Accessing the relay:** Press SET F - RST and START key simultaneously, the release SET F - RST key first then release START key, display shows the following:



This system voltage is selectable by the user

System Voltage 3 Phase 4 Wire system

- **Select a suitable voltage** by operating Increment key and Decrement key

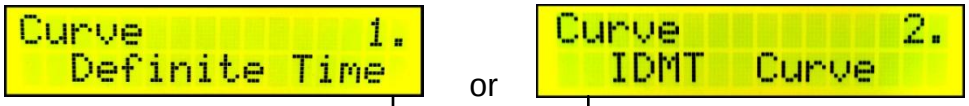
  Press SET F - RST key to register the selected value. After selection of the system voltage the display shows

Previous Factory set value

Range of Low set

  Now the user can enter the **Over Voltage[0>]** setting for the system

- After the selection of the Over Voltage limit press SET F - RST key, the user will be given the option to select either the



Characteristics Selection

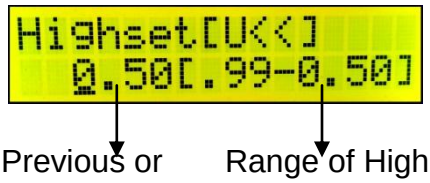
III. Now select the relay to function as **IDMT relay by selecting the IDMT characteristics**, for this operate > / < key and when the display shows IDMT-option select it by pressing SET F - RST key. After selecting the IDMT characteristics the display shows

Previous or Factory set Value

Time multiplier range to be selected

- **Now the time multiplier for Over Voltage IDMT- curve** can be selected. After

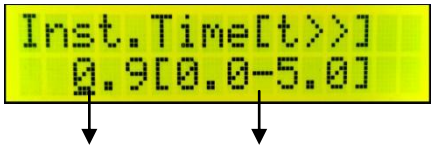
the selection of Time multiplier press the SET F - RST key to enter the value. The display changes to



Previous or Factory set Value

Range of High set to be selected

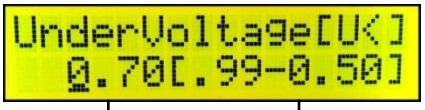
- This is the **High-set** option for the system, the user has to select High-set voltage within the range and press SET F - RST key to register the value. Now the display changes to



Previous or Factory set

Range of time to be selected

- This is the permitted **time range (in Secs.) For High set**, select a suitable time for high set operation and enter SET F - RST to record the selected time. This completes the entry of the parameters for Over voltage conditions. After the selection of time for the High set, display changes to

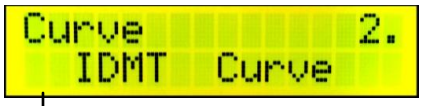


Previous or Factory set Value

Range of Under voltage to be selected

- With display showing the range of **Under Voltage conditions for the system [U<]** Under voltage conditions for system are selected and this value is recorded by pressing SET F - RST key. After this the display shows the option for selection of

or



Characteristics Selection

Select IDMT-characteristics for Under voltage by operating > / < keys, once the IDMT- option is shown, select it by pressing SET F - RST key

IV. If the selected characteristic is IDMT Curve for Under voltage, then, display shows

Previous or Factory set — Time multiplier range to be selected

- Now the time multiplier for the IDMT curve is selected in the given range. After selection, press SET F - RST to register the selected time. Now the display changes to

Previous or Factory set — Range of High set to be selected

- This is the **High-set option for the system**, the user has to select a suitable High-set Voltage within the range and press SET F - RST key to register the value. Now the display changes to

Previous or Factory set — Range of Time to be selected

- This is the permitted **time range(in Secs.) for High set**, select a suitable time for high set operation and enter SET F - RST to record the selected time. This completes the entry parameters for Under voltage conditions. After the selection of time for High set, display changes to

Previous or Factory Set

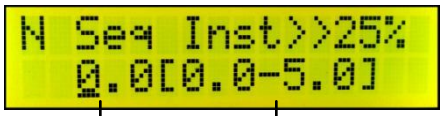
Range of % -ve Sequence to be selected

- Here, user will have to select **%age negative sequence voltage(Va2/Vm)** that can persist in the system in steps of 1%. After selecting the %age negative sequence, press SET F - RST key to register the value selected, now the display changes to

Previous or Factory set value

Range of time to be selected

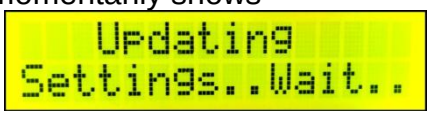
- Now the time **of operation for %age negative sequence voltage in definite time** mode is to be selected in the given range and press SET F - RST key, display will show



Previous or Factory set value

Range of time to be selected

- Here, the user can select the time of operation(Definite time) of the relay if the negative sequence crosses more than 25% in the system, after the time selection press SET F - RST key, display momentarily shows



- After the momentary display of updating the data, display will show the **system voltage selected along with the model of the relay and type of system**
- After the above display is displayed

This completes the procedure for setting the relay when the selected mode of operation of the relay is IDMT relay for Over voltage and Under voltage conditions.

Then it displays all the voltages with respect to neutral & RMS value, then the display is as follows

SPECIFICATIONS:

- **Rated Un** 380V, 400V, 415V, 433V
- **System voltages** 0-220, 0-230,0-240& 0-250V AC
  50 Hz, 3 phase 4 wire system
- **Frequency Range** 47.00Hz to 53.00Hz AC

SETTING RANGE:

- **Under voltage** U<0.99 to 0.5Un[IDMT-Curve] in steps of 0.01
  TMS-0.1 to 1.00(step-0.1)
  DEFT Time 0 to 300sec(step-1 sec)
- **High speed UV** U<<0.99 to 0.50Un [High speed] in steps of 0.01
- **Over voltage** U>1.01 to1.30Un[IDMT-Curve] in steps of 0.01
  TMS- 0.01 to 1.00(Step-0.1)
- **High Speed OV** U>>1.01 to 1.30Un[High Speed] in steps of 0.01
  Time 0.0 to 5.0sec
- **Negative Sequence [Unbalance Voltage]** 1 to 25% in steps of 1%
  DEFT Time 0 to 300sec(Step-1 sec)
  Above 25% Instantaneous <30ms
  Time for NS>> 0.0 to 5.0 sec(Step-0.1 sec)

PICK-UP & DROP OUT:

- **Pick Up** Over Voltage: 101% of the set value
  Under Voltage: 99% of the set value
- **Drop Out** Over Voltage: 99% below pick-up value
  Under Voltage: 101% above pick-up value
  Desired drop off value can be tailored as per customer request
- **Instantaneous Response time** < 30ms +/- 5%
- **Aux. Supply** 85 to 275V AC/DC or 21 to 110V DC

- **AC Burden** <1VA
- **DC Burden** 10Watt operation condition, 6Watt un-operated condition
- **Contacts** 2 pair of Changeover contacts for IDMT/DFT/NSP
  2 pair of Changeover contacts for High speed
- **Contact Rating** Making:
  5A make & carry at 240V AC
  Breaking:
  5A make & carry at 24V DC
- **Casing** Front Poly carbonate
  Transparent cover with external hand reset
- **Dimension** W 155mm X H 180mm X D 200mm, Tolerance +/- 1mm
- **Panel Cut out** W 151mm X H 157mm Tolerance +/-1mm

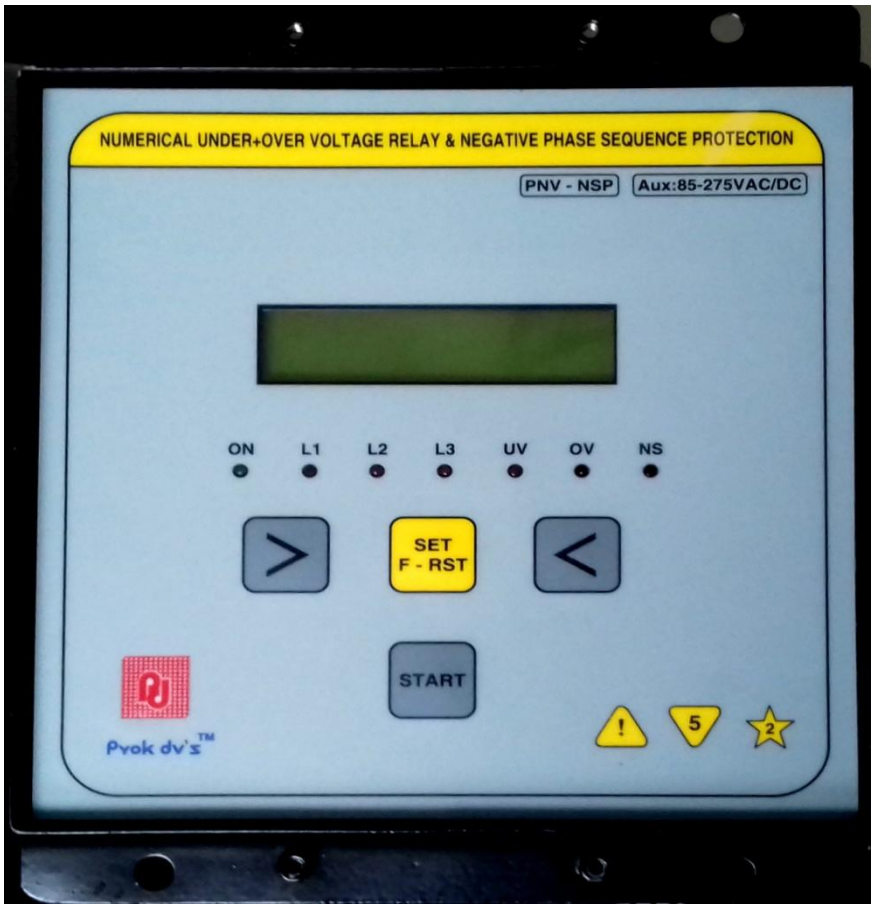
TESTS:

- **Insulation** 2kV RMS 50Hz for 1minute
  As per IEC 60255-5, clause 5 & 6
- **HFD** As per IEC 6025-22-1, CL-3
- **Impulse Voltage** As per IEC 60255-5 Clause 5 & 8
- **Temperature** -5 degree to + 55 degree Cent.

CHARACTERISTICS:

- **IDMT** Over Voltage , t=k/log[ovf]
  Under Voltage t=k/log[2-uvf]
  K= time dial setting with range 0.1 to 1.0sec in steps of 0.1
  Ovf= Measured Value / (Set value x Rated Voltage)
  Uvf= Measured Value / (Set Value x Rated Voltage)
- **Definite Time** 0 to 300sec. [Time setting in steps of 1]
- **High Speed** 0.0 to 5sec [Time Setting in steps of 0.1]

FRONT FASCIA



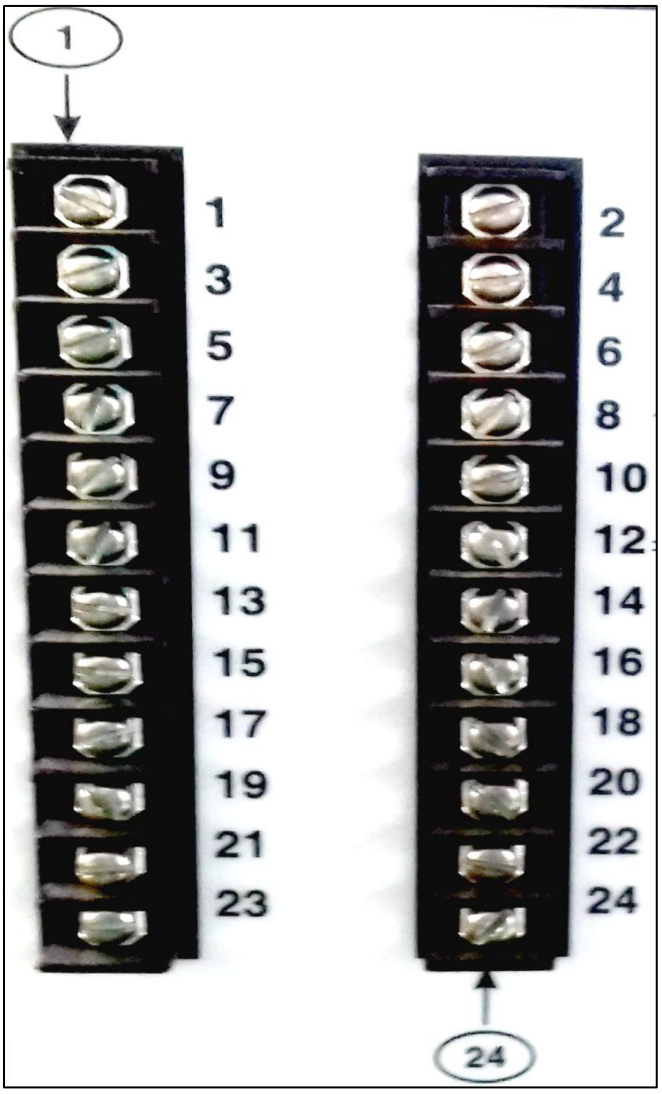
Represents that the relay withstood and tested for High voltage dielectric and inside number represents the level of voltage

Represents that relay withstood and tested for High voltage impulse and inside the number represents the level of voltage

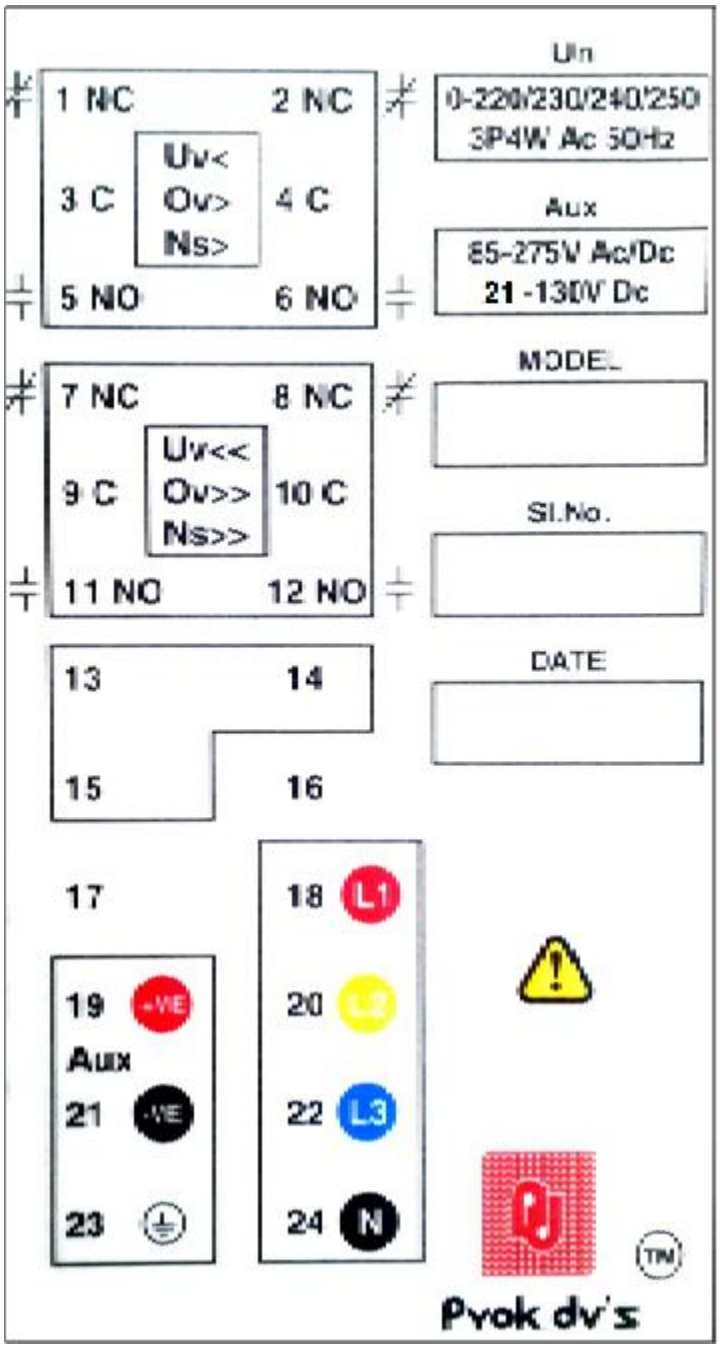
Represents that ‘refers to Manual’

TERMINAL DIAGRAM FOR PNV-NSP

NON-DRAWOUT TERMINAL & WIRING DETAILS

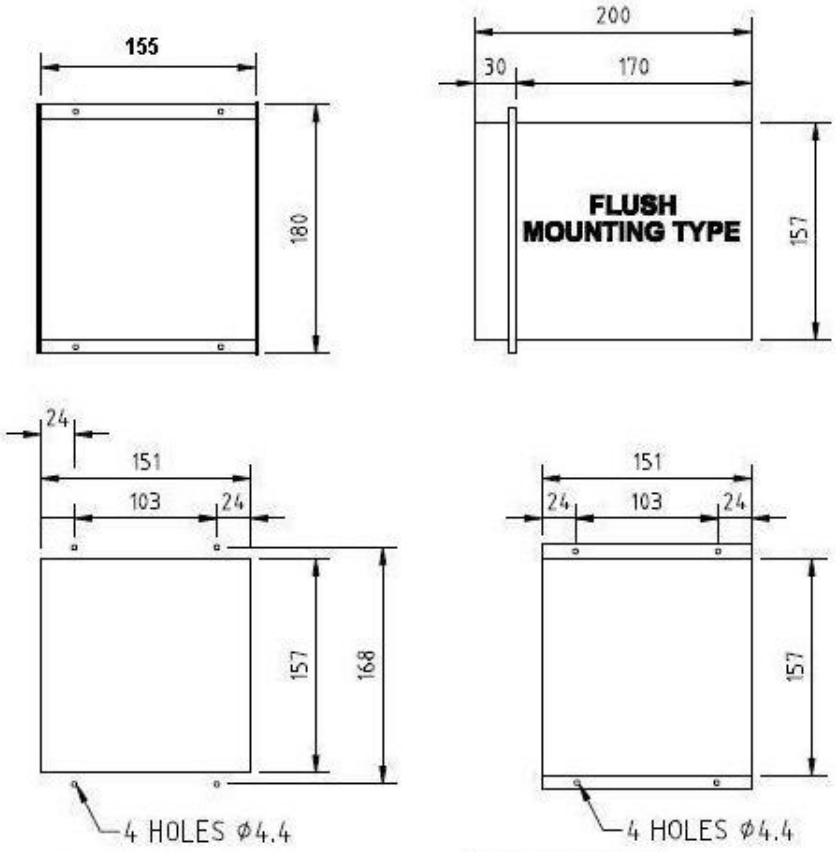


TERMINAL WIRING DIAGRAM



MECHANICAL DIAGRAM

DIMENSIONAL DRAWING
NUMERICAL UNDER AND OVER VOLTAGE RELAY WITH NEGATIVE SEQUENCE PROTECTION PNVNSP



Cut out Dimension
151 x 157
w x h

Over all Dimension
155 x 180 x 200
w x h x d

NOTE: All Dimensions are in mm
Tolerance +/- 1 mm

PROK DEVICES PRIVATE LIMITED
TYPE: PNVNSP
REV: 1.0 DATE:12-10-14

WIRING DIAGRAM