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MICRO CONTROLLER BASED MOTOR PROTECTION RELAY-PDMMPR-303

IEEE Device Code 49, 51, 46, 49S, 37 & 47

Introduction:

Prok dv's make Microcontroller Based Motor Protection Relay PD-MMPR-303 uses the state-of-the-art Microcontroller based measurement techniques for providing protection for Motors up-to 75HP. The comprehensive protection features of the relay make it ideal for Motor protection. The heart of the relay is microcontroller based reliable hardware with special algorithms to calculate the tripping time. The relay continuously monitors the Three Phase Currents to build the thermal replica of the Motor. This thermal replica is used to protect the Motor against Thermal over Loads.

The Microcontroller Based Motor Protection Relay does not require external Current Transformer (CT) for its operation for within the bandwidth of I_m ranges. The three phase R, Y and B cables are made to pass through the CT hole which is in the relay. The built in CT's takes care of stepping down of the Currents to the required level. The stepped down three phase Currents are continuously monitored by the relay to detect any abnormal behavior of the Motor and to make tripping decision.

The following protections offered by Prokdv's make Microcontroller Based Motor Protection Relay PD-MMPR-303:

- ❖ Thermal Over Load Protection
- ❖ Single Phasing /Phase Fail Protection
- ❖ Phase Reversal Protection
- ❖ Unbalance Protection
- ❖ Earth Fault Protection
- ❖ Locked Rotor Protection
- ❖ Under Current Protection
- ❖ Instantaneous Short Circuit protection during Run mode

FEATURES

- ❖ Accurate and Real Time TRUE RMS measurements.
- ❖ Motor Rated Current (I_m) Selection by means of Pot meter with markings.
- ❖ Earth Fault Setting provided by means of Pot meter with markings.
- ❖ Selectable Thermal Trip Time characteristics Class - 10A, 10, 20 & 30.
- ❖ $I >$ Thermal over load above 105 % of I_m - provided through visual led indication
- ❖ Provided the Thermal replica for motor overload condition.
- ❖ Continuous monitoring of Motor IDLE/Stop, COLD, WARM, HOT, $I >$ & Various Fault status through visual LED indication.
- ❖ Motor protections – UB (Unbalance), UC (Under current), LR (Locked rotor), EF (Earth fault) can be enabled or disabled using Dip switch setting.
- ❖ Motor Trip class – Class 10A, Class 10, Class 20, Class 30 can be configured using dipswitch
If none of the trip class selected, Default: CLASS 20 Selected internally
- ❖ Potential free Relay changeover output contacts C& NC and C& NO provided for all Fault TRIP
- ❖ Instantaneous short circuit protection $>$ 10 times of I_m , during Run mode
- ❖ Front end Communication through Mod bus protocol with RS-485 Port for Fixed slave I.D- (optional).
- ❖ Various Models with Current ratings.
- ❖ Compact and Reliable.
- ❖ Manual TEST / RESET Facility.

Applications: Protection of LV Motors up-to 75HP in Motor Control Center

Specifications:

- 1) Thermal over Load Protection:
 - ❖ Over Load Current Setting Range 1.0Amps – 96.0Amps in 4 ranges as explained in SL.13
 - ❖ Trip Time Characteristics Class -10A, 10, 20 &30 as per IEC 947-4-1(Default: Trip class 20) if none of the trip class selected by means of Dip switch.
 - ❖ Thermal overload pick up above 105 % of I_m indication through blinking of TOL led
 - ❖ Provided the Thermal Replica for Motor over load
 - ❖ Thermal overload pick up status $I >$ indicated through visual LED indication
- 2) Instantaneous Short circuit Protection $> 10 (I_m)$ During Run mode
 - ❖ If Short circuit Current above 10 times the Motor Rated Current (I_m) during Run mode or Status Instantaneous trip initiated irrespective of Trip class indicated through by switching on all the Fault LED'S Permanently
- 3) Earth Fault Protection
 - ❖ Earth Fault Current Setting Range - 10% to 50% of I_m , in steps of 10%
 - ❖ Fixed Trip Time Delay - 0.5Sec
 - ❖ Enable / Disable Option using Dip switch
- 4) Unbalance Protection
 - ❖ Fixed Unbalance current setting - 40% of I_{avg}
 - ❖ Fixed Trip Time Delay - 5.0Sec
 - ❖ Enable / Disable Option using Dip switch
- 5) Locked Rotor Protection
 - ❖ Locked Rotor Current -Greater than 3 times of I_m
 - ❖ Fixed Trip Time Delay –0.5S
 - ❖ Enable / Disable Option using Dip switch
- 6) Under Current Protection
 - ❖ Fixed Under Current Setting - 15% of I_m
 - ❖ Fixed Trip Time Delay – 1 Sec
 - ❖ Enable / Disable Option using Dip switch
- 7) Loss of Phase / Single Phasing
 - ❖ Applicable when one or two line currents falls below the 50% of motor rated current
 - ❖ Fixed Trip Time 3.0 Sec
- 8) Phase Reversal Monitoring
 - ❖ When Power sequence reversed
 - ❖ Fixed Trip Time Delay 0.1 Sec
- 9) Contacts: C & NC and C & NO 240V@5A AC, 30V@5A DC Potential-Free Output Contacts for trip circuits for all Seven faults
- 10) Auxiliary Power Supply: 85-275V AC / DC
- 11) Trip Accuracy: As per IEC 947-4-1, for Trip Class 10A, 10, 20, & 30
- 12) Pick-Up Accuracy: +/- 12.5%
- 13) Reset: Manual
- 14) Models: PD-MMPR-303-1(1.0A-10.0Amps)
 - PD-MMPR-303-2 (10.0Amps-32.0Amps)
 - PD-MMPR-303-3 (20.0Amps-64.0Amps)
 - PD-MMPR-303-4 (30.0Amps-96.0Amps)
- 15) Front end Communication is through RS-485 MODBUS Protocol (HALF DUPLEX), fixed Baud rate: 9600 bps & For fixed device i.d- 10, Data: 8Bit, stop bit:1, (optional)
- 16) Mounting: DIN Rail
- 17) Dimensions in mm: 70X55X108 (WXHxD) ± 1 mm
- 18) Operating Temp: 0°C to +55°C

Protections Offered By PD-MMPR-303 Series

Prok dv's make Microcontroller Based Motor Protection Relay PD-MMPR-303 Series is designed to offer the following protections to Low Voltage (LV) 3-Phase induction motors rated up to 75HP. Whenever a Relay detects any of the following faults,

Prok dv's make Microcontroller Based Motor Protection Relay having two set of potential free output changeover contact (C & NC) and (C & NO) for TRIP circuit

⚡ Thermal Over Load Protection:

Prok dv's make Microcontroller Based Motor Protection Relay continuously monitoring Real Time Motor Current of all the Three Phases. When the Motor Current exceeds the set value I_m , the relay issues a trip command after the calculated time elapse (Based on selection of trip Class). The relay visually indicating the fault trip status by means of LED's

Two Set of potential free output changeover contact is provided in the relay C & NC and C & NO for trip circuit. The relay continuously monitors the Currents and using this data it builds Thermal replica of the Motor and monitoring the Thermal status of the Motor. This information is used to protect the Motor against Thermal over Loading.

⚡ Instantaneous short circuit Protection- (Run Mode)

Prok dv's make Microcontroller Based Motor Protection Relay continuously monitoring Real Time Motor Current of all the Three Phases during Run mode, When the Motor Current exceeds the 10 times the set value I_m , the relay issues a instantaneous trip command, irrespective of selection of trip Class The relay visually indicating the short circuit fault trip status by means of glowing all fault LED's

⚡ Earth Fault Protection:

Prok dv's make Microcontroller Based Motor Protection Relay senses the Zero sequence components of the TRUE RMS Currents are measured simultaneously and detecting the Earth Faults. The moment the Earth Fault crosses the Threshold Set value, a trip command is given by the relay to the trip circuit with a time elapse. The Earth Fault phenomenon is predominant in the Motor and Motor Control Centers, Hence protection against Earth Fault is necessary. Microcontroller Based Motor Protection Relay uses the proven Holmgren technique for detection of Earth Fault in the Motor.

⚡ Unbalance Protection:

Prok dv's make Microcontroller Based Motor Protection Relay measures and monitors all the Three Phase Currents and extracts the Unbalance Currents presents in the Three Phase Motor circuit. The moment an Unbalance Current is detected and if it crosses the Set value, the relay is activated in tripping the circuit.

⚡ Locked Rotor Protection:

Prok dv's make Microcontroller Based Motor Protection Relay detects Locked Rotor condition i.e. Motor not withstanding over loads beyond 3 times as per Thermal withstand time characteristics and this is predominantly observed in old unused and rewind Motors. In the Locked Rotor Condition if the Motor Current crosses 3 times of I_m , the relay is activated in tripping the circuit with a time elapse.

⚡ Under Current Protection:

Prok dv's make Microcontroller Based Motor Protection Relay detects the Under Current Fault in a situation that sudden load Throw-Off or Loss of load, resulting in dry run of Motor. During the sudden loss of load the Motor takes low Current i.e. Under Current and if this value crosses the Set value, the relay trips the circuit with a time elapse.

⚡ Loss of Phase / Single Phasing:

Prok dv's make Microcontroller Based Motor Protection Relay detects the Loss of Phase / Single Phasing in a Motor circuit. Motor burnouts are predominant due to Single Phasing or Loss of Phase at the main source / HT side and Fuse failure at the Motor Circuit. The Single Phasing / Loss of Phase is sensed by the relay and trip the circuit with a time elapse.

⚡ Phase Reversal:

Prok dv's make Microcontroller Based Motor Protection Relay monitors the Phase Sequence Currents and detects the Phase reversal and trips the circuit with a time elapse.

Setting Procedure for PDMMPR303

Step1: Connect the suitable Auxiliary supply in the range from 85-275vac/dc to the terminal 1 & 2 of Relay by Referring to the PDMMPR-303-1/2/3/4 wiring diagram

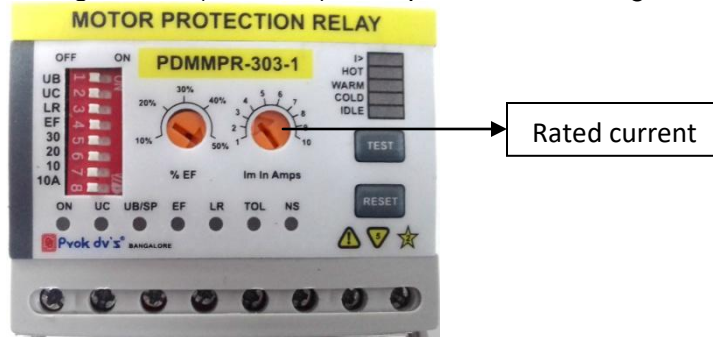
Step2: Select the required motor rated current I_m using the Trim pot with steps markings

For PDMMPR303-1, I_m Ranges from (1A-10A) in steps 1A -10 markings

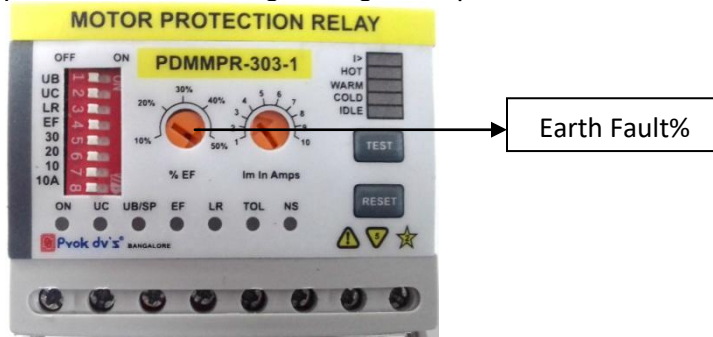
PDMMPR303-2, I_m Ranges from (10A-32A) in steps 2A -12 markings

PDMMPR303-3, I_m Ranges from (20A-64A) in steps 4A -12 markings

PDMMPR303-4, I_m Ranges from (30A-96A) in steps 6A -12 markings



Step3: After selecting the Motor rated current I_m in Amps Select the % EF setting in the ranges from 10% to 50% in steps of 10%- 5 markings using Trim pot

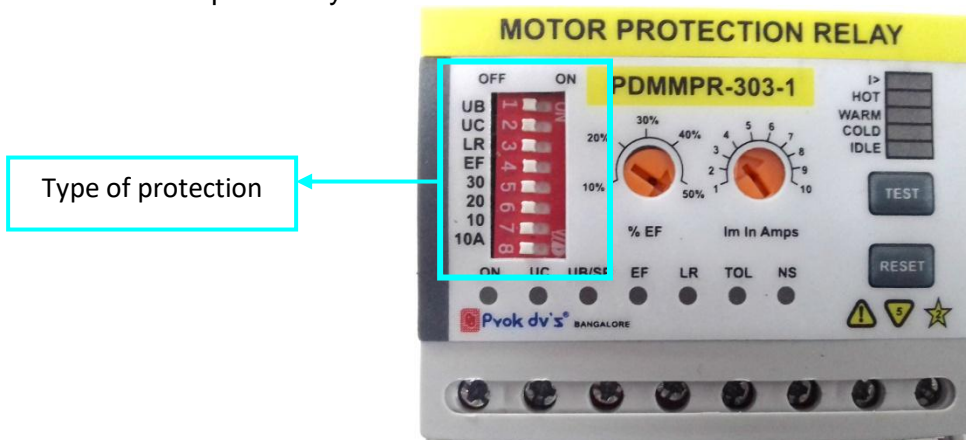


Note : Earth Fault Protection is user selectable by means of DIP SWITCH selection

Set the EF switch to ON position to enable the Earth Fault Protection

Set the EF switch to OFF position to disable the Earth Fault Protection

Earth Fault trip time is by default fixed 0.5Sec



Step4: Unbalance protection is user selectable by means of DIP SWITCH selection

Set the UB switch to ON position to enable the Unbalance protection

Set the UB switch to OFF position to disable the Unbalance protection

Unbalance protection is by default fixed 40% of I_m

Unbalance trip time is by default fixed 5 Sec

Step5: Under current protection is user selectable by means of DIP SWITCH selection

Set the UC switch to ON position to enable the under current protection

Set the UC switch to OFF position to disable the under current protection

Under current protection is by default fixed 15% of I_m

Under current trip time is by default fixed 1 Sec

Step6: Locked Rotor protection is user selectable by means of DIP SWITCH selection

Set the LR switch to ON position to enable the Locked Rotor protection

Set the LR switch to OFF position to disable the Locked Rotor protection

If Locked Rotor protection is enabled, Motor current exceeds the 3 times the Rated current I_m and not Stabilizes to motor rated current level within 1sec during motor start

Step7: Select the Required Trip class for motor by means of DIP SWITCH selection

Set the 10A switch to ON position to enable the TRIP CLASS 10A

Set the 10 switch to ON position to enable the TRIP CLASS 10

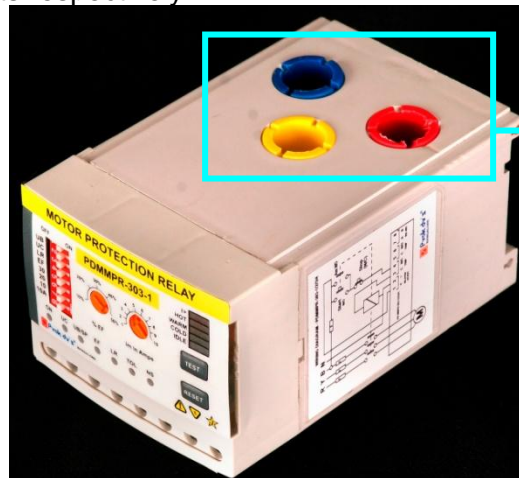
Set the 20 switch to ON position to enable the TRIP CLASS 20

Set the 30 switch to ON position to enable the TRIP CLASS 30

Note if all of these trip class switch in OFF position, By Default TRIP CLASS 20 selected for Thermal overload protection of motor

Step8: Pass the Load current carrying cable R, Y, B of 3 phase Motor

Through Red, yellow, Blue slots respectively



Slots to insert the cable carrying load current

If R, Y, B sequence for Motor & PDMMPR-303 found o.k.

Relay initiates a successful Motor start

Or else Relay Trips for Phase Reversal Fault or Negative Sequence Fault (NS) with visual LED indication

To correct this situation interchange the any of the two Conductors carrying the motor current

And then press the Reset key to resume back to Normal working state of motor

Incase during Motor Start condition, Motor current doesn't reduce

Below 3 times the Set Motor Rated Current within 1 sec

Locked Rotor Trip shall initiate with visual LED indication of LR

If Phase fail or Unbalance condition exists in the system results in to Un- Balance (UB) or Single phase (SP) Fault, Trip shall initiate with visual LED indication of UB/SP

If under current situation exists in the system results in to under current (UC) Fault.

Trip shall initiate with visual LED indication of UC

If Motor Reaches the 100% Thermal state by continuous overload above the set motor rated current (I_m) level in Amps Thermal overload (TOL) fault initiates with visual LED indication of TOL

Motor Stop or IDLE state indicated by means of Visual LED indication

During Motor RUN state, COLD condition indicated by means of Visual LED indication

During Motor WARM state, WARM condition indicated by means of Visual LED indication

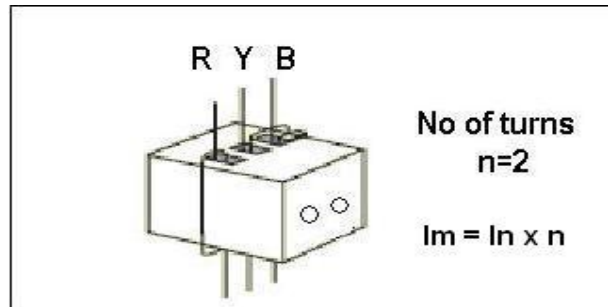
During Motor HOT state, HOT condition indicated by means of Visual LED indication



Note: Potential free Relay changeover output contacts C& NC and C& NO provided for all seven Faults TRIP

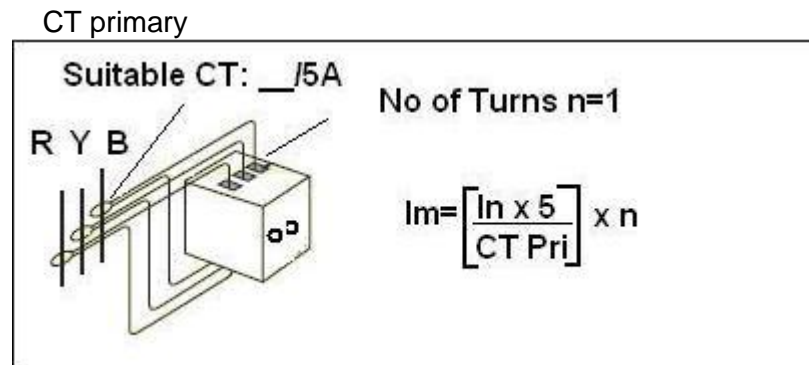
Note: 1) For Motor Rated Current (I_n) within the range of the Relay (I_m), Set $I_m = I_n$

2) For Motor Rated Current (I_n) below the range of the Relay (I_m), Set $I_m = I_n \times \text{number of turns}$



3) For Motor Rated Current (I_n) above the range of the Relay (I_m), Use three $5/5A$ CT'S

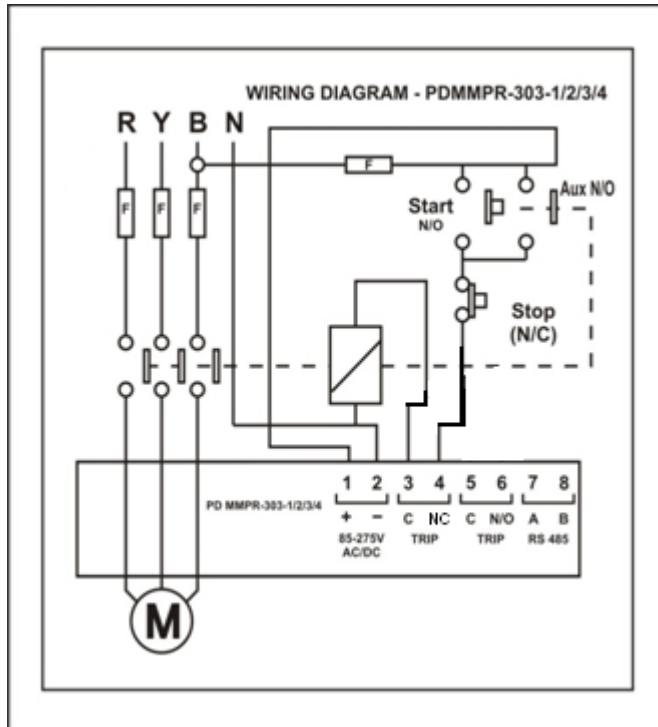
Set $I_m = \{ \text{Motor Rated current}(I_n) \times 5 \} \times \text{number of turns}$



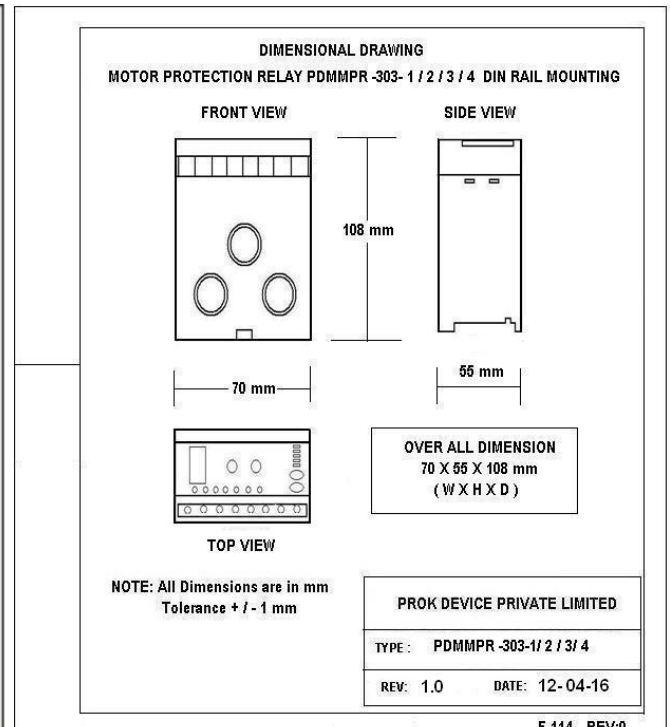
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Wiring Diagram



Mechanical Dimensional Drawing



Mod bus address Format

Function code: 04,

Device address-10, Fixed Baud rate: 9600 bps, Data bits: 8, Parity: none, Stop bit: 1

Address	Description	Type	Action	Data & Range
30001	Soft ware version no	Float	Read Only	Ex:1.0
30003	Maximum Rating current of Motor in Amps (Range)	Float	Read Only	Ex: 10.0, 32.0,64.0,96.0
30005	Set Motor Rated Current in Amps (Im)	Float	Read Only	For Im<10.0A: 1.0 to 10.0A in steps of 1.0A For Im>10.0 & <32.0 10.0 to 32.0A in steps of 2.0A For Im>20.0 & <64.0 20.0 to 64.0A in steps of 4.0A For Im>30.0 & <96.0 30.0 to 96.0A in steps of 6.0A
30007	Set Earth Fault Current Level in % of Im	Float	Read Only	Ex: 10.0 % ,20.0%,30.0%,40.0%, 50.0%
30009	R Phase Magnitude in Amps	Float	Read Only	Direct Reading
30011	Y Phase Magnitude in Amps	Float	Read Only	Direct Reading
30013	B Phase Magnitude in Amps	Float	Read Only	Direct Reading
30015	Neutral Current in Amps	Float	Read Only	Direct Reading
30017	Thermal state in %	Float	Read Only	Direct Reading
30019	DIP Switch settings	16 bit data	Read only	See the Dip switch configuration Format

Dip Switch configuration Format

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5
-	-	-	-	-	-	-	-	CL30 0/1	CL10 0/1	CL20 0/1

Note: D0: 0 – Unbalance Protection Enable, 1- Unbalance Protection Disable
D1: 0 – Under current Protection Enable, 1- Undercurrent Protection Disable
D2: 0 – Locked Rotor Protection Enable, 1- Locked Rotor Protection Disable
D3: 0 – Earth Fault Protection Enable, 1- Earth Fault Protection Disable
D4: 0 – Trip class 10A selected
D5: 0 – Trip class 20 selected
D6: 0 – Trip class 10 selected
D7: 0 – Trip class 30 selected
If D4 to D7 – All are 1 or All are 0, Trip Class 20 selected by Default