We touch your electricity everyday!

mPRO-90

Motor Protection Relay

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Catalogue

C&S electric

CE

PMD Division

CONTENT

Introduction

The mPRO-90 protective relay is an advanced current based numeric relay that provides multi protection and monitoring.
The relay offers reliable protection for LV and MV motors which are either operated via power contactors or power circuit breakers.

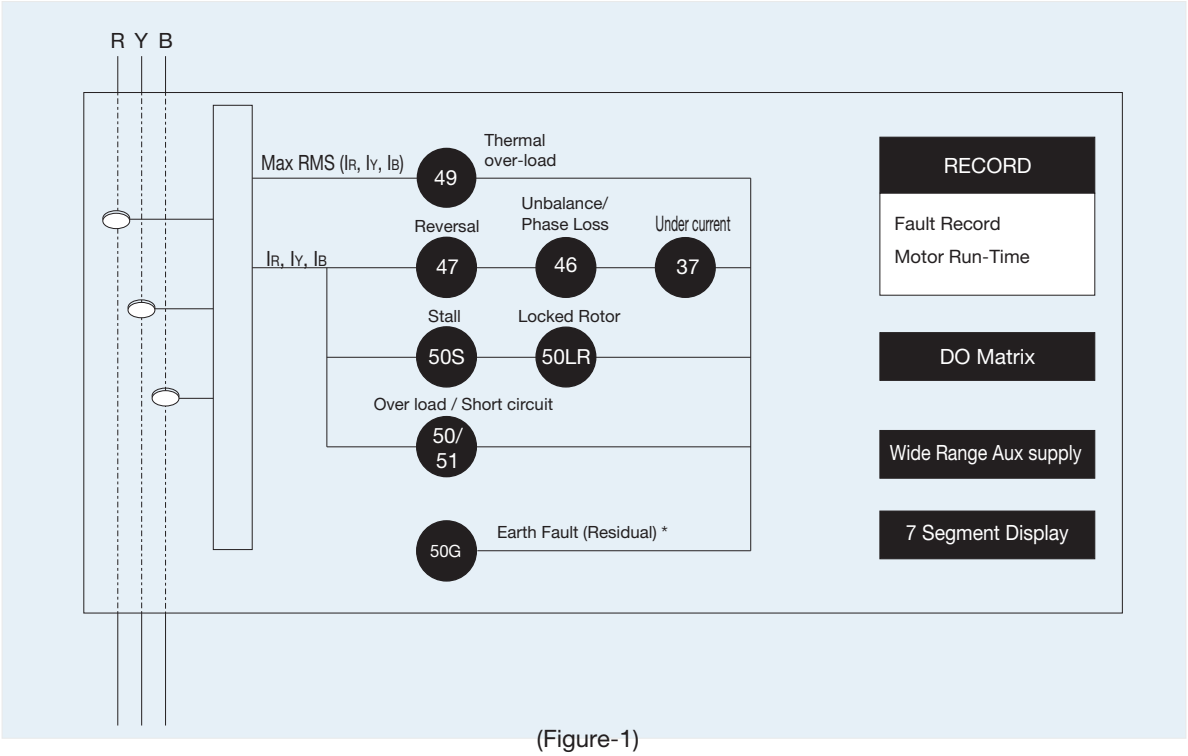
Main Features	Protection	Metering & monitoring	Record
Small & compact in size	Over-Load	3 Phase RMS Current	Fault Record
User selectable external CTs (04 types)	Short Circuit	Earth Current (Residual) *	Accumulated Motor Run Time
7 Segment Display (4 x 1 row)	Under current	Thermal content (%)	
2 Trip Relay (Fail Safe operation)	Unbalance	Unbalance (%)	
	Phase Reversal		
	Locked Rotor		
	Earth Fault (Residual) *		
	Stall		
	Phase Loss		

Application

Every motor failure causes a production stop and costs for service. A cable cut, phase failure, short circuit or overload can destroy the motor or pose danger for the whole production line and for the people who work there.
This is the reason why a reliable motor protection is very important and thus mPRO works as a safe guard. It can be used in following areas :

- Motor Control Center (MCC) application.
- Integrated Process & Electrical Control with Protection.

Functional Diagram



(Figure-1)

* = Model Dependent

Functional Description

Motor State Recognition

The mPRO monitors the flow of the current from which the following operational conditions of the motor are gathered.

■ STOP ■ START ■ RUNNING

Fail Safe Operation

mPRO allows user to enable fail safe operation for Trip Relay contacts. Following occurs when trip relay fail safe mode is enabled.

- Trip relay coil is energized.
- When mPRO generates a trip signal, the trip relay coil is de-energized.
- Trip relay is also de-energized, if the auxiliary power is removed or fails.

If trip contact is appropriately connected to the motor breaker or contactor, the motor is automatically tripped, if auxiliary power fails.

Failsafe Mode		Non Failsafe Mode	
NO contact	NC contact	NC contact	NO contact

PROTECTIVE FUNCTION DESCRIPTION

Under Current Protection

This protection covers the Loss of load condition like V-belt split or shaft failure or a pump running un-primed.

If in running condition, the phase currents in all the three phases are below the selected value of undercurrent setting (U-C) for Under current trip time (3 Sec), then mPRO will trip to stop the motor.

Over Current Protection

Over-current protection is provided by tripping the relay when motor operating current in any of the three phases exceeds over-current setting (O-L) of mPRO for a period greater than the selected operating time (td) under DEFT (definite time over-current protection) characteristics.

Short Circuit Protection

Short circuit protection is provided by tripping the relay when the motor operating current in any of the three phases exceeds the value corresponding to Short circuit setting (S-C) for the set interval (50 mSec).

Phase Loss / Single Phase Protection

During a phase loss, the motor winding current will increase by 150% or more. As the motor winding current increases, the winding temperature will increase and possibly damage the winding insulation. When the relay detects loss of phase it will trip after expiry of set time (3 Sec). The quick trip time on mPRO helps to prevent over-current damage to the windings.

Phase Unbalance

The phase unbalance condition is checked only during running condition of the motor. The unbalance % between the three phase currents is calculated by [(MAX Current-MIN current)/MAX current] x 100[%] .If the calculated value exceeds the set unbalance value (UNB) for the set time (3 Sec) the relay will trip.

Phase Reversal

In the event of phase reversal, the relay trips after set time (500 mSec). It helps to protect a three phase motor while installation.

Locked Rotor

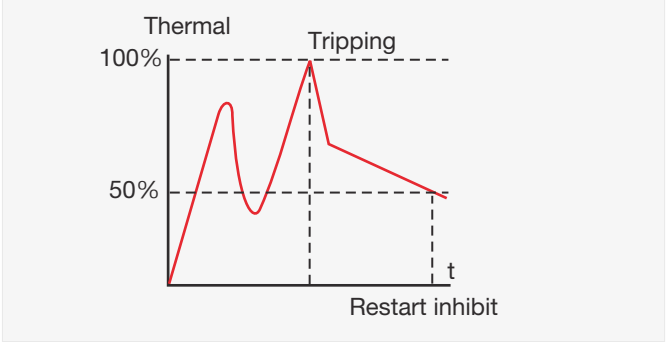
During motor start-up, a locked rotor is detected with the state of increased phase current above the set value (LOC) after the set trip time (1 Sec).

Earth / Ground Fault *

A large percentage of motor insulation failures result in ground/earth fault currents. Early detection keeps damage to a minimum, thereby shortening repair times and minimizing repair costs. This fault will be detected with the help of internal residual method (model dependent). Once fault is detected (Earth current > E-F setting), the relay will trip after expiry of set time.

Thermal Over load

Provides reliable protection for motor against over-heating (See Figure-2).



(Figure-2)

* = Model Dependent

The protection feature is based on mathematical model of motor thermal image. The motor thermal overload protection function calculates the heat accumulated in the rotor and stator based on the effective heating current , integrated over a time (ti) .The relay appropriately takes in to account cooling of the winding by gradually emptying the accumulated current bucket. The relay displays the status of thermal condition of motor windings as a % of maximum permissible **Thermal capacity**. If inverse overload characteristic (INV) is selected then only the effect of thermal memory phenomenon is enabled. If current in any of the three phases exceeds over-current setting I> as well as accumulated thermal capacity (**t**) is >=100% then mPRO will trip the motor. If thermal memory is accumulated then Trip Relay Contact Reset depends on Thermal Reset selection (Disable/Enable) as given in following table.

Thermal Reset	Trip Relay Output Contact Reset
Enable (ON)	When Thermal capacity (Thermal MEM) <90% & Front Reset key is pressed
Disable (OFF)	When Front Reset key is pressed

Stall

Mechanical equipments such as pumps or fans can be quickly damaged if it jams, resulting in a locked rotor stall. The mPRO will trip when the running current exceeds the set value (StL) after the Stalled Rotor Time (3 Sec). Set this value to 'OFF', if stall protection of driven equipment is not required since the thermal overload protection will protect the motor. This feature is blocked during the inrush of motor starting.

Records

mPRO-90 Model stores following records in it's non-volatile memory.

(a) Fault Record

mPRO records last fault in its non-volatile memory :

- Phase and * Earth fault current level
- Origin of fault (over current, short circuit, stall etc.)

* = Model Dependent

(b) Motor Run Time Record

mPRO accumulates the total RUN Time of motor. Update time resolution is 5 min.

Setting Parameters (Common)

Parameter	Display	Setting Range		Step Size	Unit	Default Setting
		Min.	Max.			
External CT Selection	CT	C 10.0	C 125	---	---	C 10.0
Full Load Current (IFL-CT1)	I FL	0.2	10.0	0.01	Amp	2.0
Full Load Current (IFL-CT2)	I FL	0.8	25.0	0.01	Amp	2.0
Full Load Current (IFL-CT3)	I FL	2.0	62.5	0.01	Amp	2.0
Full Load Current (IFL-CT4)	I FL	4.0	125.0	0.01	Amp	8.0
Motor Start Time	StrT	1.0	200.0	1.0	Sec	8
Thermal Memory Reset (Enable : ON/ Disable : OFF)	tHrS	OFF	On	---	---	On
Trip Relay Fail Safe (Enable : ON/ Disable : OFF)	FLSF	OFF	On	---	---	On
Auto Scroll (Enable: ON/Disable: OFF)	SCrL	OFF	On	---	---	On
Relay Reset Time **	rSt	1	999	1	Sec	OFF

** If the Relay trips than to reset the relay, user have to long press the RESET/ENTER button and the relay will get reset after the relay reset time lapse.

Setting Parameters (Protection)

Parameter	Display	Setting Range		Step Size	Unit	Default Setting
		Min.	Max.			
Overload Pickup	o-L	50	150	1	% IFL (Amp)	110
Overload Characteristic	CHA	dEFt	InU	---	---	InU
Overload Definite Time [1]	td	0.1	60.0	0.1	Sec	10
Overload Operating Time [2]	t1	5	60	5	Sec	10
Short Circuit Pickup	S-C	200	800 [4]	50	% IFL (Amp)	OFF
*Earth Fault Pick up (Residual) [3]	E-F	10	50	1	% IFL (Amp)	20
Earth Fault Trip Time (Residual) [3]	tE	0.2	10	0.1	Sec	2.0
Under Current Pick up	u-C	30	90	5	% IFL (Amp)	OFF
Unbalance Current Pick up	unb	4	50	2.0	%	OFF
Phase Reversal	rEU	On	OFF	---	---	On
Locked Rotor Pick up	LoC	200	800[5]	50	% IFL (Amp)	800
Phase Loss	P-F	On	OFF	---	---	On
Stall Rotor Pick up	StL	150	600	5	x IFL (Amp)	150

Note:

- mPRO will allow change in IFL setting only if motor is in stop condition and there is no fault pickup.
- [1] Definite time is applicable when DEFT characteristic is selected.
- [2] Operating time is applicable when INV characteristic is selected.
  This is the tripping time at I = 6 x I>.
- [3] Earth Fault Residual Internal Calculation.
- [4] Max. protection setting : 800%
- [5] Max. protection setting : 800%
- * = Model Dependent

Trip Time for Protection

Parameter		Description
Trip Time		
	Over-Load	According to setting time
	Short Circuit	50 mSec
	Earth Fault	According to setting time
	Under current	3 Sec
	Phase Unbalance	3 Sec
	Phase Reversal	500 mSec
	Lock Rotor	1 Sec
	Phase Loss	3 Sec
	Stall	3 Sec

Technical Data

Parameter		Description
Operational Current		0.3 - 8.0 x IFL
Nominal Frequency		50 / 60 Hz
Protection		Over-Load, Under-Current, Short Circuit, Lock Rotor, Stall, Unbalance, Phase Loss, Phase Reversal, Earth Fault *
Design Standards (As per IEC 60947)		
	IEC 60947-4-1	Radiated Electromagnetic Field (Class A)
		Mains Terminal Disturbance Voltage (Class A)
	IEC 61000-3-2	Harmonic Current Emissions
	IEC 61000-3-3	Voltage changes, Voltage fluctuations & Flicker
		Electrostatic Discharge Immunity (Class A)
	IEC 60947-4-1	Radiated RF E-Field (80 to 1000 MHZ) (Class A)
		Electrical Fast Transient / Burst Immunity (Class A)
		Surge Immunity (Class A)
Accuracy		
	Trip Time	± 5% (or ± 100 mSec)
	Current	± 3% (or ± 0.01 Amp)
Display		
	7 Segment	Metering and Fault information
	LED	R : current in R Phase
		Y : current in Y Phase
		B : current in B Phase
		RUN : Flashing for ‘Motor Start’ / Steady for ‘Motor Run’
		FAULT : Flashing for ‘Fault Pick up’ / Steady for Trip
		THERMAL % : Thermal
		K : kiloAmp, LED glows for Current > 999 Amp
Auxiliary Supply		170 - 280V AC
Contact Rating		
	Trip Relay Contact	1 C/O Contact, 10A / 250V AC or 5A, 30V DC
	Alarm Relay Contact	1 N/O Contact, 10A / 250V AC or 5A, 30V DC
Relay Reset		Trip Relay Reset : Manual
Temperature		
	Operation	0^{0}C to 70^{0}C
	Storage	-10^{0}C to 85^{0}C
Wiring Connection		
	For current	Screwed Terminal
	For Others (Aux supply, Relay contact etc.)	Screwed Terminal

* = Model Dependent

Current Range Selection

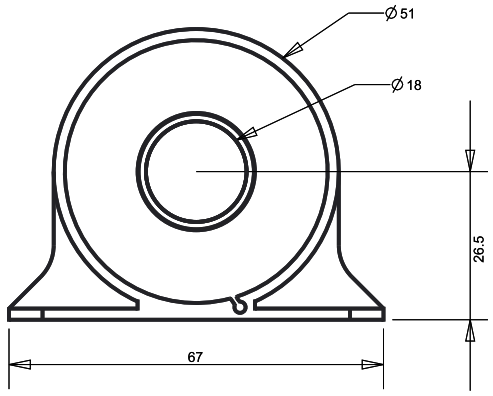
mPRO-90 supports 0.2 to 125 Amp Full Load current as per following CTs configuration: -

Description (External CTs)	Min. Value	Max. Value
CT1 IFL (Current in Amp)	0.2	10.0
CT2 IFL (Current in Amp)	0.8	25.0
CT3 IFL (Current in Amp)	2.0	62.5
CT4 IFL (Current in Amp)	4.0	125.0

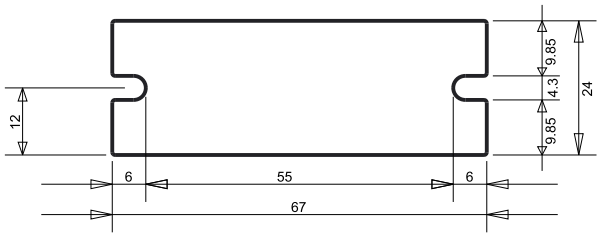
Note : Before doing any IFL / Protection Settings, first select the CT type in the relay menu
As soon as user change the CT type value, IFL sets to default value.

Dimensional Drawing of CT1, CT2 & CT3 (common size)

All the dim. are in mm (Gen. Tol ± 1.0 mm)

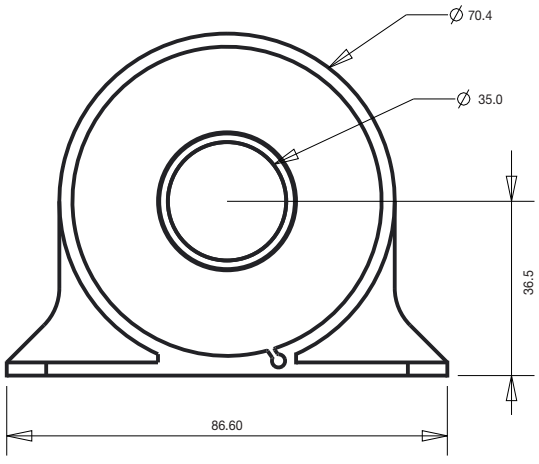


(Figure-3)

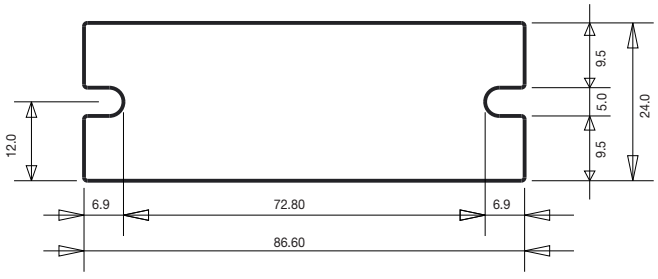


(Figure-4)

Dimensional Drawing of CT4

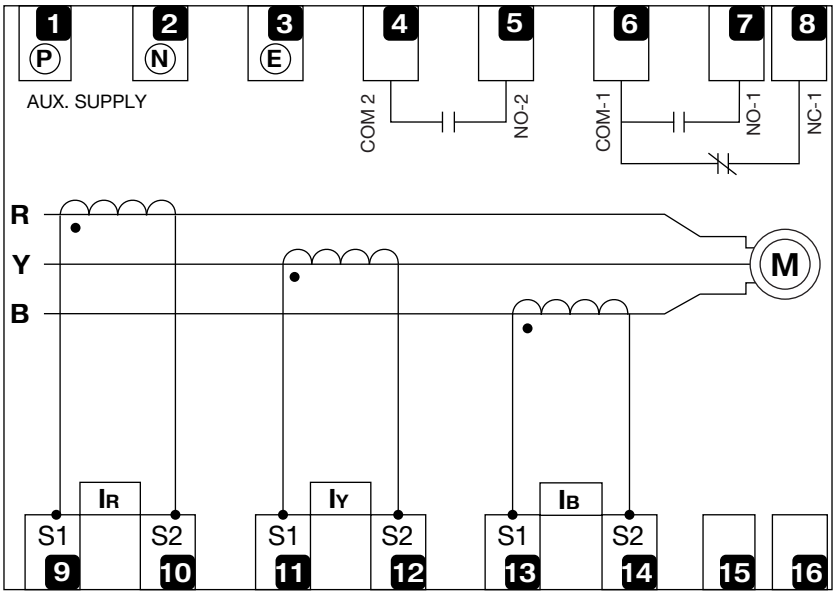


(Figure-3)



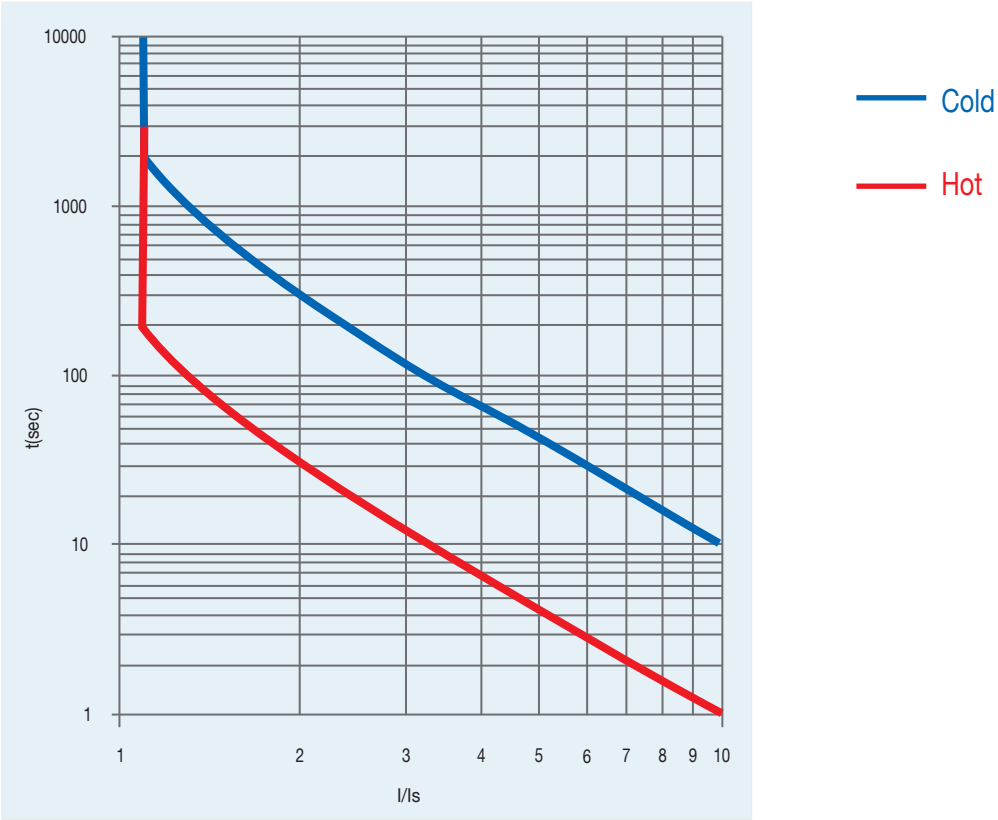
(Figure-4)

Connection Diagram



(Figure-5)

Thermal (inverse) Characteristic



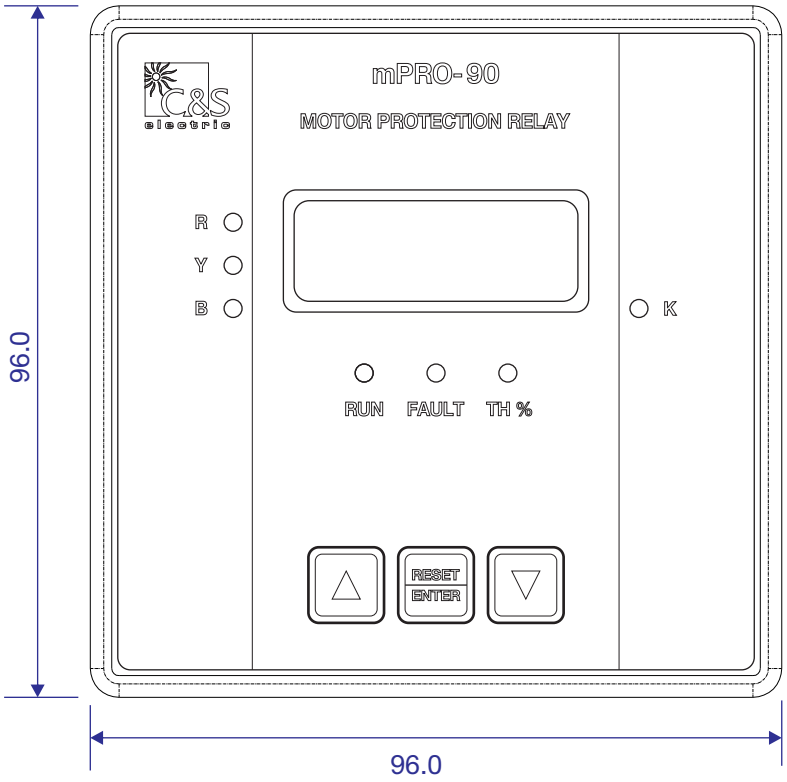
(Figure-6)

Dimension Details

(All the dimensions are in mm, Gen Tol ± 1.0mm)

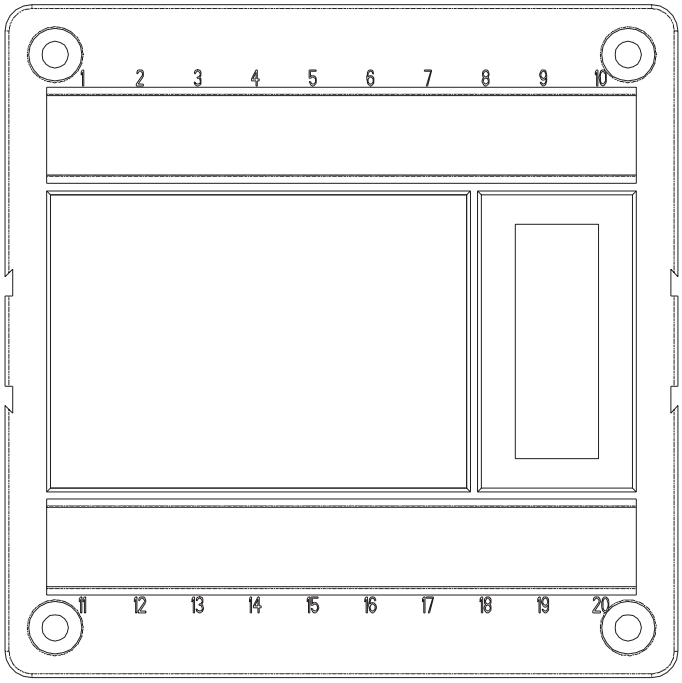
Dimension Details	
Mounting	Flush on Panel
Dimensions	96 x 96 mm
	Panel cut out : 91 x 91 mm
	Depth : 79.5 mm behind bezel
Terminal connector	Pluggable Type
Weight	0.3 Kg (Approx)

Front View



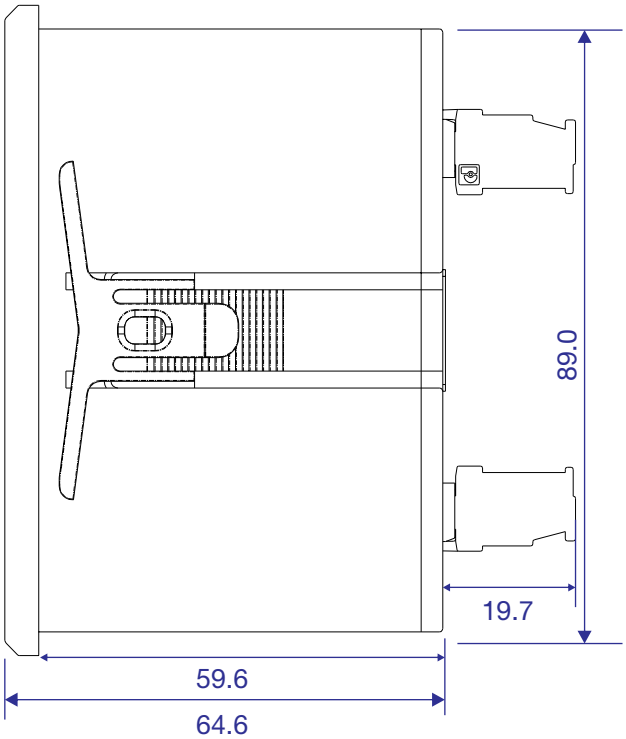
(Figure-7)

Back View



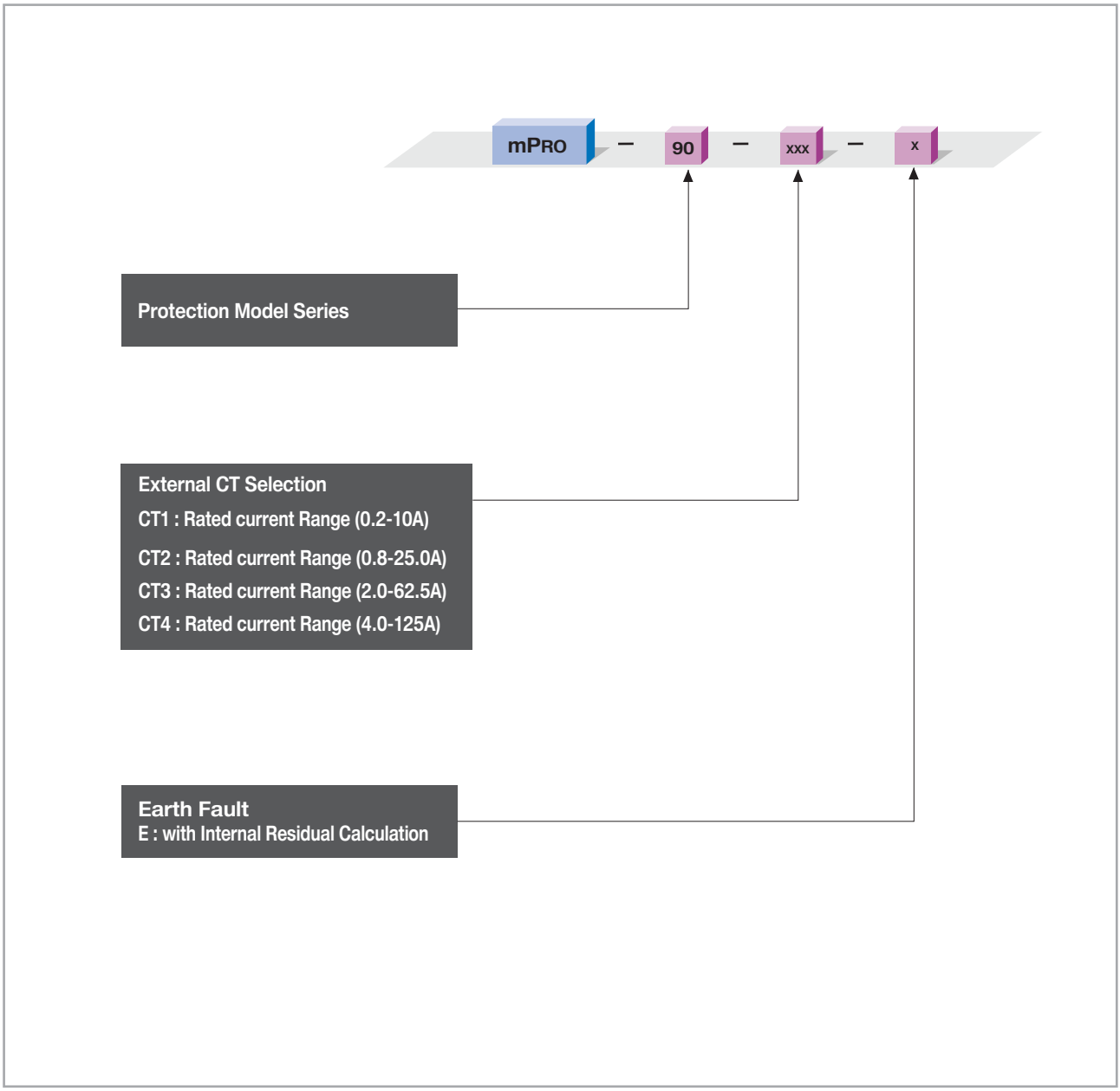
(Figure-8)

Side View



(Figure-9)

Ordering Information



Revision History

S.No.	Rev.No.	Details	Date
01	01	Change in Default setting of Setting parameters (Protections) on page 6	27.03.17
02	02	Change in Setting parameters common on page 5	24.04.17
03	03	Change in Setting parameters common on page 5	12.05.17
04	04	Change in Features, Technical Data, Locked Rotor description etc.	16.05.17
05	05	Change in Setting Parameters (common) on Page - 5	12.09.17

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