# We touch your electricity everyday!

**mPRO-90**

## Motor Protection Relay

mPRO-90
MOTOR PROTECTION RELAY

R
Y
B

K

RUN    FAULT    TH %

RESET
ENTER

Motor Protection Relay

Motor Protection Relay

Motor Protection Relay

Motor Protection Relay

**Catalogue**

CELEBRATING

**50**

YEARS

**C&S**
electric

**PMD Division**

CE
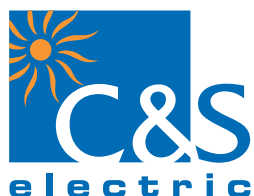
## CONTENT

### Description

## 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 |
| | Short Circuit | Earth Current Residual | Accumulated Motor Run Time |
| User selectable external CTs (03 types) | Under current | Thermal content (%) | |
| | Unbalance | Unbalance (%) | |
| 7 Segment Display (4 x 1 row) | Phase Reversal | | |
| | Locked Rotor | | |
| 2 Trip Relay (Fail Safe operation) | 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)
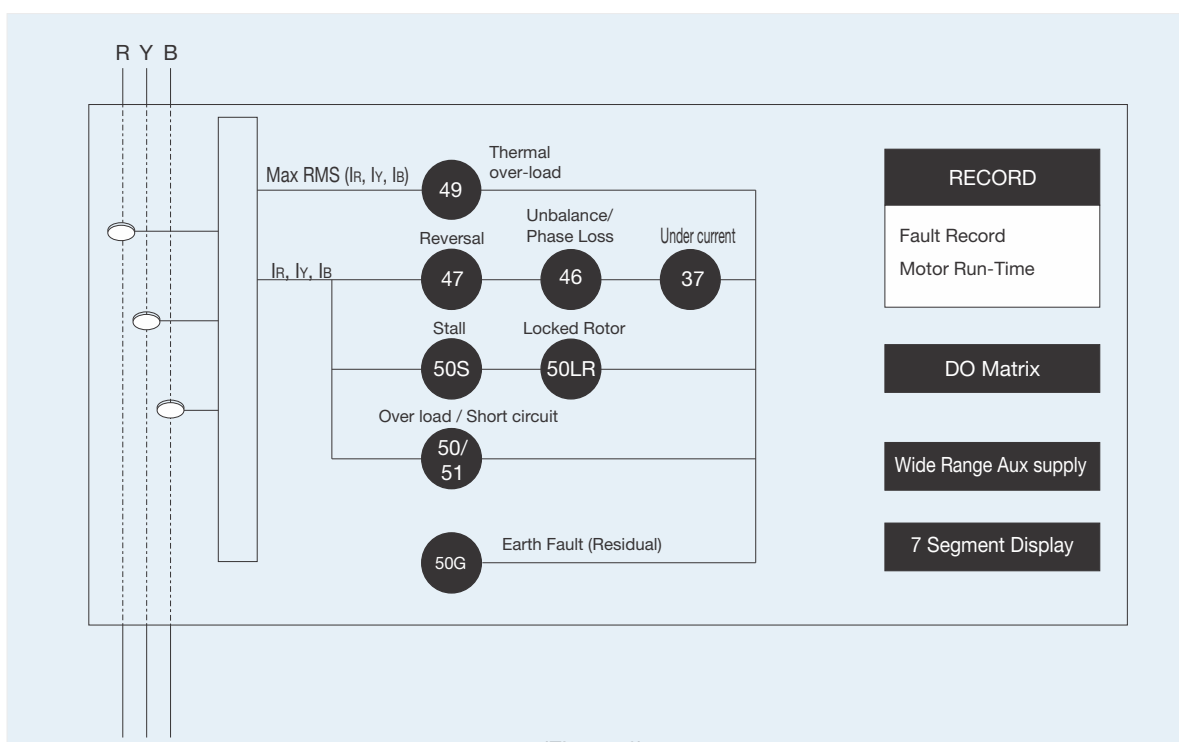
# Functional Description

## 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 (200 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 (500 mSec).

### 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).
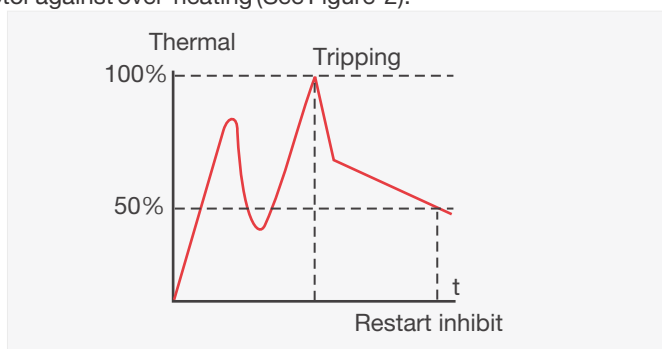


(Figure-2)

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 with time stamp :

•      Phase and earth fault current level
•      Origin of fault (over current, short circuit, stall etc.)

**(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 | C62.5 | - - - | - - - | C 10.0 |
| Full Load Current (IFL-CT1) | iFL | 0.2 | 10.0 | 0.01 | Amp | 5.0 |
| Full Load Current (IFL-CT2) | iFL | 0.8 | 25.0 | 0.01 | Amp | 5.0 |
| Full Load Current (IFL-CT3) | iFL | 2.0 | 62.5 | 0.01 | Amp | 5.0 |
| Full Load Current (IFL-CT4) | iFL | 4.0 | 125.0 | 0.01 | Amp | 5.0 |
| 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 |

# 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 | 1 nU | --- | --- | 1 nu |
| Overload Definite Time [1] | td | 0.1 | 60.0 | 0.1 | Sec | 10 |
| Overload Operating Time [2] | t 1 | 5 | 60 | 5 | Sec | 5 |
| Short Circuit Pickup | 5-C | 200 | 800 [4] | 50 | % IFL (Amp) | OFF |
| *Earth Fault Pick up (Residual) [3] | E-F | 10 | 50 | 1 | % IFL (Amp) | 10 |
| Earth Fault Trip Time (Residual) [3] | tE | 0.2 | 10 | 0.1 | Sec | 1.0 |
| Under Current Pick up | u-C | 30 | 90 | 5 | % IFL (Amp) | OFF |
| Unbalance Current Pick up | unb | 4 | 50 | 2.0 | % | 20 |
| Phase Reversal | rEU | On | OFF | --- | --- | On |
| Locked Rotor Pick up | LoC | 200 | 800 [5] | 50 | % IFL (Amp) | 500 |
| 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%

## 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 | 200 mSec |
| | Lock Rotor | 500 mSec |
| | 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 | $\pm$ 5% (or $\pm$ 100 mSec) |
| | Current | $\pm$ 3% (or $\pm$ 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, 6A / 250V AC or 24V DC |
| | Alarm Relay Contact | 1 N/O Contact, 3A / 250V AC or 24V 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 |

## Current Range Selection

mPRO-90 supports 0.2 to 62.5 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 |

## Dimensional Drawing of CT1, CT2 & CT3 (common size)     All the dim. are in mm (Gen. Tol ± 1.0 mm)
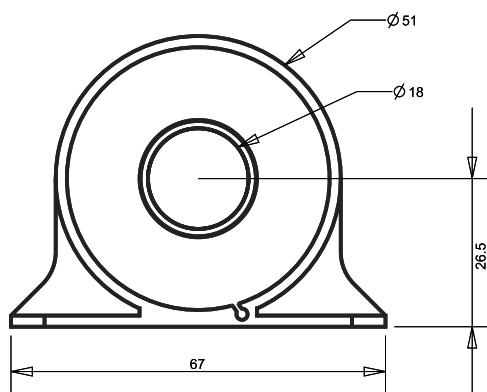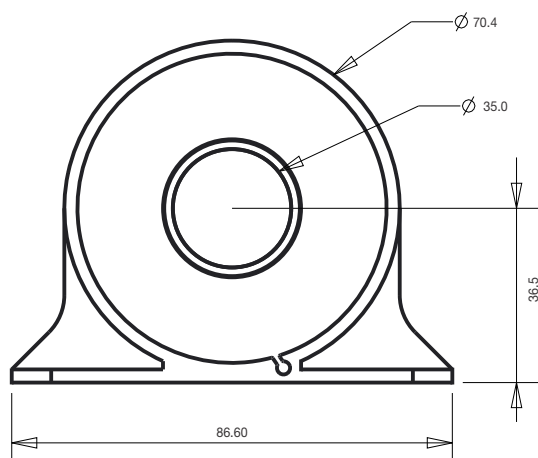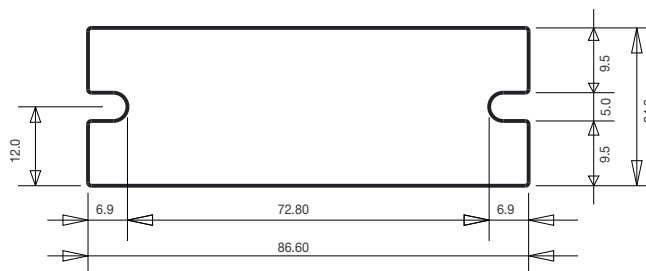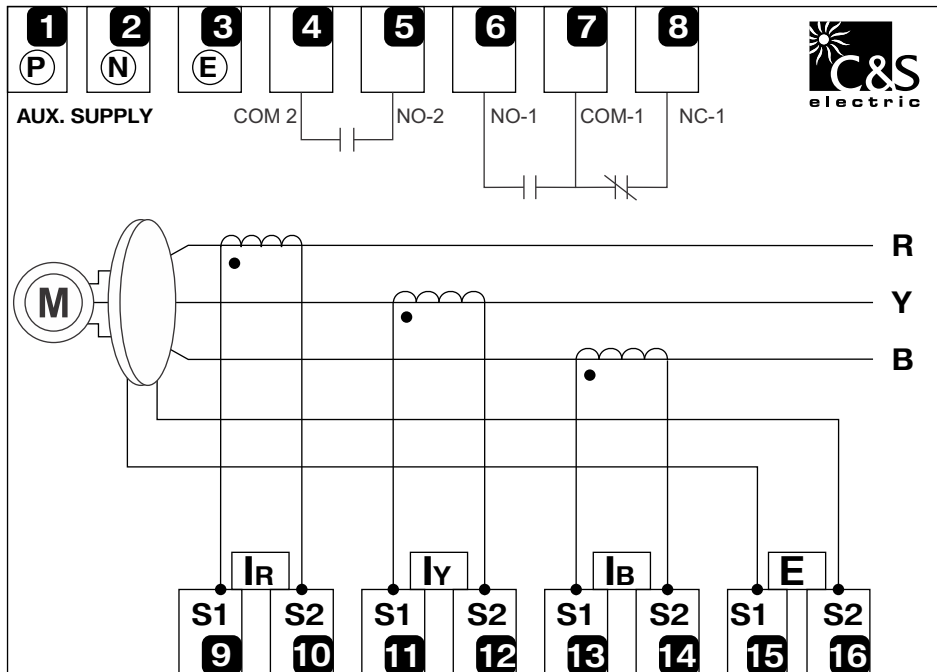


(Figure-3)
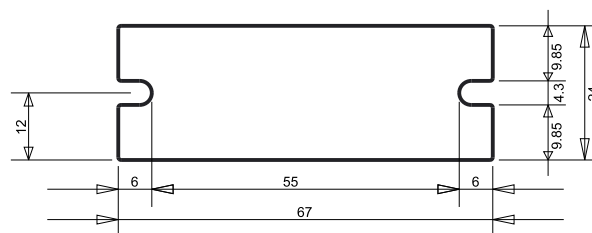


(Figure-4)

## Dimensional Drawing of CT4



(Figure-3)



(Figure-4)

## Connection Diagram



(Figure-5)

## Thermal (inverse) Characteristic
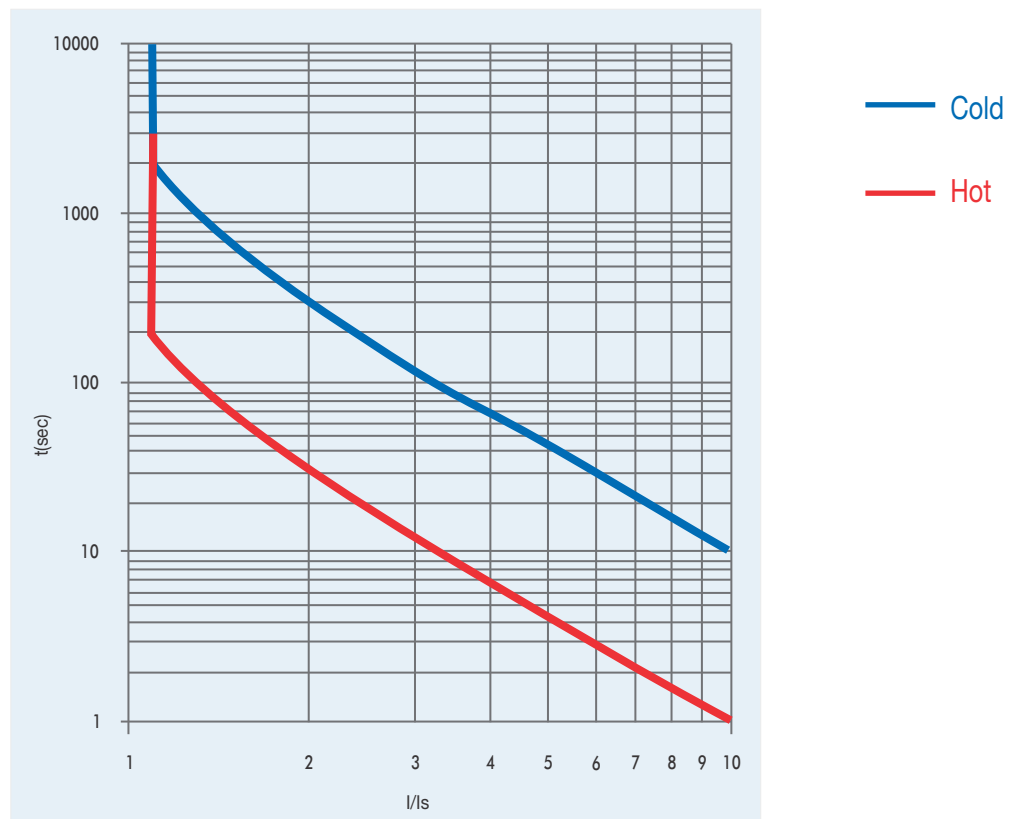


(Figure-6)

## 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
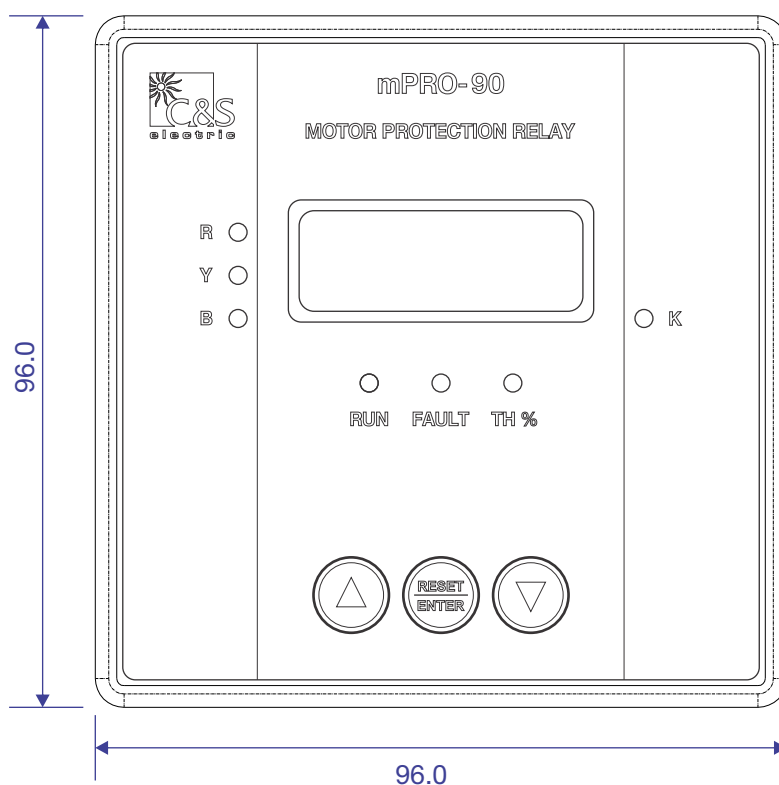


(Figure-7)

### Back View
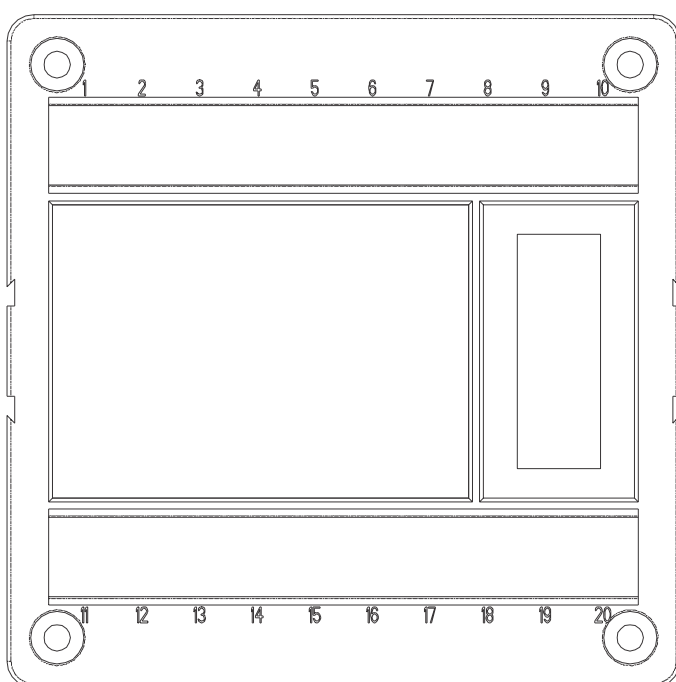


(Figure-8)

### Side View



(Figure-9)

10

## Ordering Information

mPRO — 90 — xxx — x

**Protection Model Series**

**External CT Selection**
CT1 : Rated current Range (0.2-10A)
CT2 : Rated current Range (0.8-25.0A)
CT3 : Rated current Range (2.0-62.5A)
CT4 : Rated current Range (4.0-125A)

**Earth Fault**
E : with Internal Residual Calculation

## Revision History

| S.No. | Rev.No. | Details | Date |
|-------|---------|---------|------|
| 01 | 01 | Change in Default setting of Setting parameters (Protections) on page 6 | 27.03.17 |
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