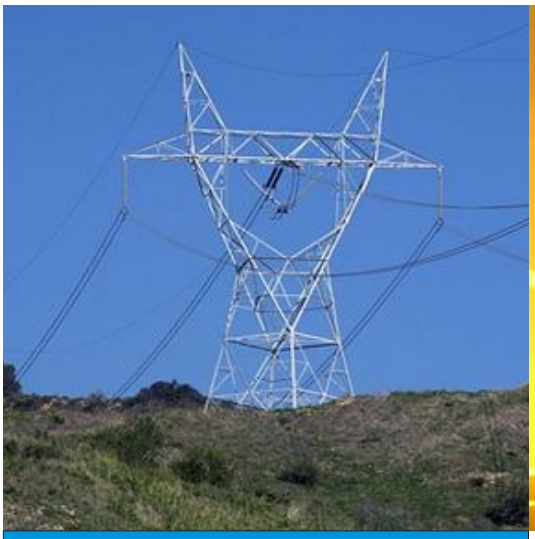
We touch your electricity everyday!

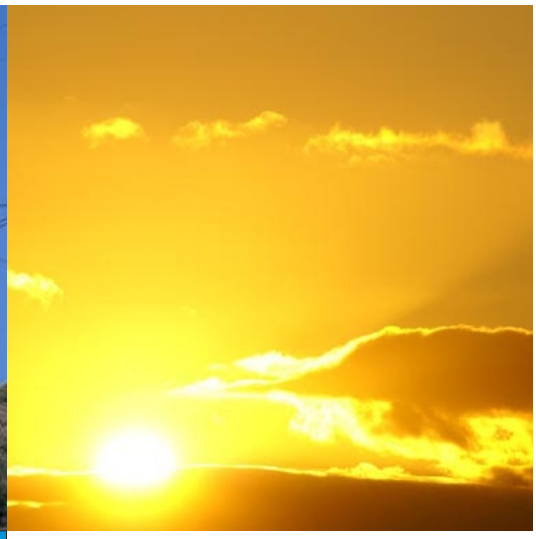
mPRO-200

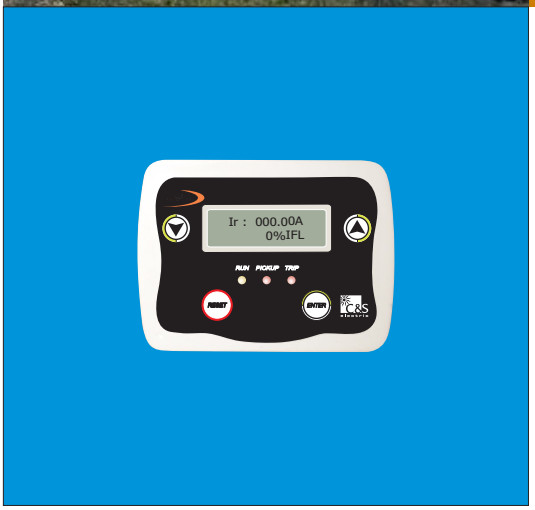
Electronic Motor Protection Relay

C&S electric

Electronics Division







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mPRO-200

Introduction

The **mPRO-200** protective relay is an advanced current based numeric relay that provides multi protection and monitoring in compact Din-rail enclosure. The relay offers reliable protection for LV and MV motors which are either operated via power contactors or power circuit breakers.
mPRO-200 comprises of DIN Rail mounted **Base Module** and Panel mounted **Display Module**.

mPRO-200 offers following features in a compact, modular & smart design.

Main Features	Protection	Metering & Monitoring	Communication	Record
Small & compact in size 35mm DIN Rail mounting In-built CT Module User selectable wide range rated current LCD Display 2 Programmable DO (Alarm Relay) 1 Trip Relay (with Fail Safe) 2 Programmable DI Input 1 4-20mA Output	Over Load Short Circuit Under Current Unbalance Phase Loss Phase Reversal Stall Locked Rotor Earth Fault (Residual/ZCT) Over Temperature* (with PTC Thermistor) External Fault	3 Phase RMS current Earth Current monitoring (via ZCT* /Residual) Thermal Content (%) Unbalance (%)	MODBUS RTU over RS-485 interface*	Fault Records Motor Start-Stop * Records Accumulated Motor Run-Hours Accumulated Trip * Counter Max Motor Starting * Current

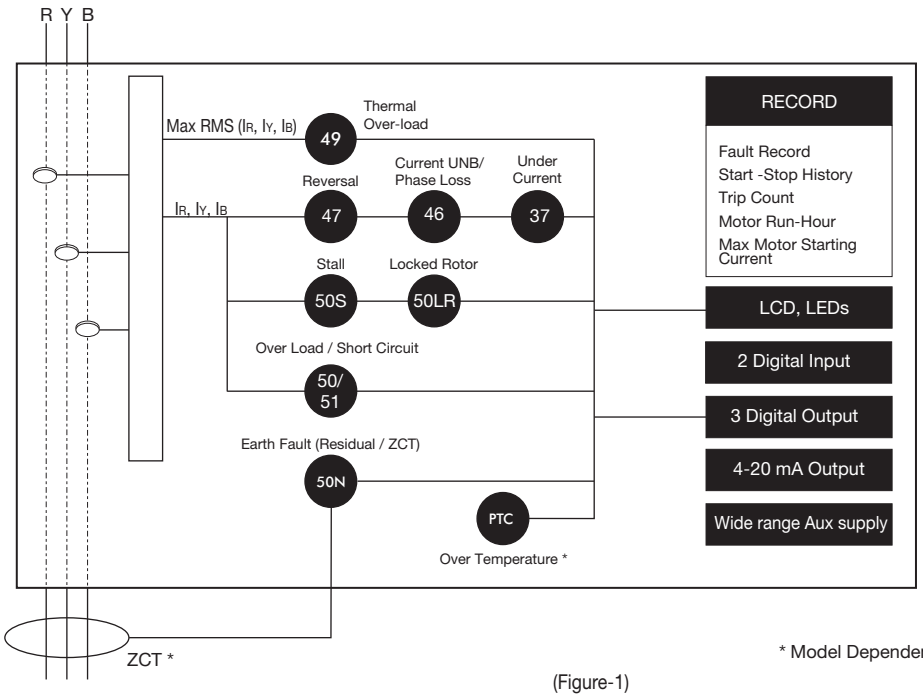
* Model Dependent

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.
- Can be used in inverter control circuit (20-200Hz)

Functional Diagram



* Model Dependent

(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	
B1-B3	B4-B3	B1-B3	B4-B3
NO contact	NC contact	NC contact	NO contact

PROTECTION FUNCTION DESCRIPTION

Under Current Protection (I<)

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 I< for a t< (Under current trip delay time) selected delay, then mPRO will trip to stop the motor.

Over Current Protection (I>)

Over-current protection is provided by tripping the relay when motor operating current in any of the three phases exceeds over-current setting I> of mPRO for a period greater than the selected operating time t> under DEFT (Definite time over-current protection).

Short Circuit Protection (I>>)

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 I>> for the set interval (t>>).

Phase Loss or 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 tPhLos. The quick trip time on mPRO helps to prevent over-current damage to the windings.

Phase Unbalance (46)

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] x100[%] .If the calculated value exceeds the set unbalance value Iub for the selected time tIub the relay will trip.

Phase Reversal (47)

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

Locked Rotor (50LR)

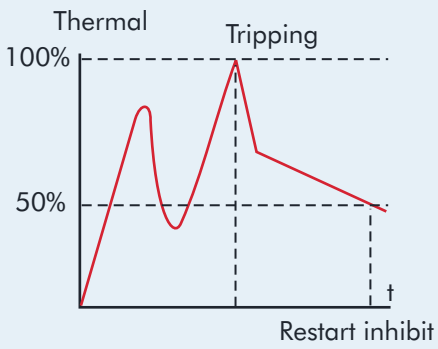
During motor start-up, a locked rotor is detected with the state of increased phase current above the set value (LKR) even after the set start time (tLKR).

Earth / Ground Fault (50N)

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 “ZCT” or internal residual method (model dependent). Once fault is detected (Ie above the set value), the relay will trip after expiry of set time (te).

Thermal Over load (49)

Provides reliable protection for motor against over-heating.



(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 tInv>. 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 (**Thermal MEM**) is >=100% then mPRO will trip the motor. If thermal memory is accumulated then Relay Contact Reset depends on Relay Reset selection (AUTO/MANUAL) and Thermal Reset selection (Disable/Enable) as given in following table.

Relay Reset	Thermal Reset	Relay Trip Output Contact Reset
Auto	Enable	When Thermal capacity (Thermal MEM) <50%
Auto	Disable	When Thermal capacity (Thermal MEM) =0%
Manual	Enable	When Thermal capacity (Thermal MEM) <50% & Front Reset key is pressed
Manual	Disable	When Front Reset key is pressed

The effect of thermal memory can be erased by using the 'Thermal Memory Erase' option from RECORD MENU.

CAUTION: * Make sure that at the time of installation of mPRO relay, motor is in complete cold state having no thermal content otherwise thermal modeling of relay will not be in synchronization with actual thermal state of motor.

Stall (50S)

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 (Stall) value after the Stalled Rotor Time (tStall). 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.

External Fault *

External Fault is sensed through Digital Input (DI). Once this DI is active relay will trip after expiry of set time (tExtFlt).

All the protection functions are effective after the expiry of start time except Phase loss, Phase reversal, Locked rotor & Earth fault which are effective on the motor START condition also.

Circuit Breaker Failure (CBFAIL)

After a fault is detected mPRO generates a trip signal via trip relay to stop the motor. If motor current does not get cutoff on expiration of CB Fail set time (tCBFL), mPRO will declare it as CBFail.

In this condition trip contact will be released only after manual acknowledgment by RESET push button / External RESET option of DI.

Records

mPRO-200 Model stores following records in it's non-volatile memory.

(a) Fault Record (b) Motor Start-Stop Record (c) Motor Run Hour (d) Motor Trip Count (e) Max Starting Current.

(a) Fault Record

mPRO records last 5 faults in its non-volatile memory with time stamp :

- Phase and earth fault current level
- Date and time of fault
- Origin of fault (over current, short circuit, stall etc.)
- Faulty phase

Fault Records helps the user to identify and analyze the cause of fault. User can view the complete fault information by entering the Fault Record No. 1 to 5. When the available memory space is exhausted, the new fault automatically overwrites the oldest Fault.

When the relay trips, the description of fault in the motor will appear on the LCD screen automatically.

(b) Motor Start-Stop Record *

The mPRO stores the last 3 Start-Stop time events in non volatile memory. When the available memory space is exhausted, the new event automatically overwrites the oldest record.

(c) Motor Run-Hour

mPRO accumulates the total RUN Hour of motor. Update time resolution is 1 min.

(d) Motor Trip Count *

mPRO accumulates the total Trip Count of motor.

(e) Max Starting Current *

mPRO logs max current during Motor Start.

Man-Machine Interfaces

It comprises of bright Alpha-numeric LCD display with 3 Push buttons for setting and other operations for local access and 1 Push button for fault acknowledgment / Reset.

2 LEDs for PICKUP & TRIP on fault, which require Manual reset through 'RESET' key.

1 LED for "Power On" and 1 LED for "Display Module" Connection availability.

Motor State Indicator: Flashing of "START" LED for Motor Start & glowing steady of "RUN" LED for run condition.

*** Model Dependent**

(Figure-3)

Setting Parameters (Common)

Parameter	Display	Setting Range Min.	Setting Range Max.	Step Size	Unit	Default Setting
Max. Rated Current Range Selection	IR		[1]* 5 / 10 / 60 / EXCT [2]* 1.25 / 2.5 / 5.0 / EXCT		Amp	60 5
Full Load Current [3]	IFL	1.00 [1]*/ 0.25[2]*	60.00[1]* / 5.00[2]*	0.01	Amp	60/5
Motor start time	tstart	1.0	200.0	1.0	Sec	8
External CT Ratio [4]	CT_RATIO	1	999	1	-	1
Trip Relay Reset (ATO: Auto, MAN: Manual)	TpRlyRes	ATO	MAN	-	-	MAN
Annunciation Relay Reset (ATO: Auto, MAN: Manual)	AnRlyRes	ATO	MAN	-	-	ATO
Thermal Memory Reset (Enable: ON, Disable: OFF)	ThmRes	OFF	ON	-	-	OFF
Trip Relay Fail Safe Mode (Enable: ON, Disable: OFF)						
Trip Relay Fail Safe (Enable: ON, Disable: OFF)	TpRyFlSf	OFF	ON	-	-	ON
Analog Output (4-20mA) selection	4_20mA	Ir, Iy, Ib, Ie, Iub				Ir

Note:

- *Model Dependent [1]* : - 60A model, [2]* : 5A model.
- [3] Max.Current Selection & Full Load Current setting will be model dependent. Refer section **" Current Range Selection".**
- [4] CT ratio parameter will come into picture only when external primary CT is required to be used This settings will only be displayed, when EXCT is selected in Max. Current Selection.

Setting Parameters (RTC)

Date and Time can be set by editing HOUR, MIN, SEC, DATE, MONTH & YEAR parameters.

Setting Parameters (Communication)

Parameter	Display	Setting Range Min.	Setting Range Max.	Step Size	Unit	Default Setting
Slave Address	SlaveAdd	1	247	1	-	1
Baud Rate	Baudrt	9600	19200	-	bps	19200
Parity	Parity	NONE or ODD or EVEN			-	NONE

Setting Parameters (Protections)

Parameter	Display	Setting Range		Step Size	Unit	Default Setting
		Min.	Max.			
Overload Pickup	I>	50%	150%	1%	x IFL (Amp)	110%
Overload Characteristic	Char	DEFT	INV	-	-	DEFT
Overload Definite Time [5]	t>	0.1	60.0	0.1	Sec	10
Overload Operating Time [6]	tInv>	5	60.0	5	Sec	5
Short Circuit Pickup	I>>	200%	1500%[9]	50%	x IFL (Amp)	OFF
Short Circuit Trip Delay Time	t>>	0.05	5.0	0.01	Sec	0.08
Earth Fault Pick up (Residual)[7]	Ie>	10%	50%	5%	x IFL (Amp)	OFF
Earth Fault Trip Time (Residual)[7]	te>	0.2	10	0.1	Sec	1
Earth Fault Pick up (ZCT) [7]	Ie>	0.10	5.00	0.01	Amp	OFF
Earth Fault Trip Time (ZCT) [7]	te>	0.05	10	0.01	Sec	1
Under Current Pick up	I<	20%	90%	5%	x IFL (Amp)	OFF
Under Current Trip Delay Time	t<	1.0	300.0	0.1	Sec	30
Unbalance Current Pick up	Iub	5%	50%	2.5%	%	OFF
Unbalance Current Trip Delay Time	tIub	1	30	1	Sec	5
Phase Reversal Trip Delay Time	tPhRev	0.2	10.0	0.1	Sec	OFF
Locked Rotor Pick up	ILR	200%	1000%[10]	50%	x IFL (Amp)	OFF
Locked Rotor Trip Delay Time	tLKR	0.05	5.0	0.1	Sec	0.1
Phase Loss Trip Delay Time	tPhLos	0.3	5.0	0.1	Sec	OFF
Stall Rotor Pick up	IStl	150%	600%	5%	x IFL (Amp)	OFF
Stall Rotor Trip Delay time	tStall	1	20	1	Sec	5
External Fault Trip Delay Time*	tExFlt	0.5	60	0.1	Sec	1
PTC Trip Value*	PtcTrp	2700	3600	50	Ohm	OFF
PTC Reset Value	Ptc Rst	1500	1650	10	Ohm	1600
PTC Trip Time	tPtc	1.0	10.0	0.1	Sec	1.0
Trip CB Fail Detection Time	tCBFAIL	0.1	10	0.1	Sec	0.5

Note:

- All above protection are available with disable option (OFF) & in % of IFL (except Earth Fault with ZCT).
- mPRO will allow change in IFL setting only if motor is in stop condition and there is no fault pickup.
- [5] Definite time is applicable when DEFT characteristic is selected.
- [6] Operating time is applicable when INV characteristic is selected.

  This is the tripping time at I = 6 x I>.

- [7] Earth Fault Residual Internal Calculation.
- [8] Earth Fault calculation using externally connected ZCT.
- [9] Max. protection setting :

  60A Model 1500% for external primary CT selection (EXCT)
  800% for built in CT selection.

  5A Model 800%
- [10] Max. protection setting :

  60A Model 1000% for external primary CT selection (EXCT)
  800% for built in CT selection.

  5A Model 800%

Setting Parameters (DO Matrix)

There are 2 programmable DO (Alarm Relay 1 & 2) available which can be assigned to different Motor Fault as per the table below:

Fault	Display	Display Assignment	
Short Circuit	I>>		
Overload	I>	DO 1 will be set as 1_	
Earth Fault	Ie>	DO 2 will be set as _2	
Unbalance	Iunb	DO 1&2 will be set as 12	
Phase Reversal	PhRev		
Lock Rotor	LKR		
Stall	Stall		
Under Current	I<		
Phase Loss	PhLoss		
External Fault	ExFlt		
Over Temperature	OvTemp		
Trip CB Fail	CBFAIL		

Setting Parameters (DI Matrix)

There are 2 programmable Digital Input (DI) available which can be used as External Fault, External Reset & Protection Blocking purpose

Function	Display	DI Assignment	
External Fault	ExFlt	DI1 will be set as 1_	
External Reset	ExRes	DI2 will be set as _2	
Over load Block	I> Blk	DI1 & DI 2 will be set as 12	
Short circuit Block	I>> Blk		
Earth Fault Block	Ie> Blk		
Locked Rotor Block	LKR Blk		
Stall Block	Stal Blk		
Under current Block	I< Blk		
Phase Loss Block	PhLos Blk		
Phase Reversal Block	Rev Blk		
Unbalance Block	Unb Blk		
Thermal Block	Thml Blk		
External Fault Block	ExFltBlk		
Over Temperature Block	OvTempBlk		

mPRO-200

Technical Data

Parameter		Description
Operational Current		0.2 - 8.0 x IFL
Frequency Range		50 / 60 Hz
Protection		Over-Load, Under-Current, Short Circuit, Lock Rotor, Stall, Unbalance,
		Phase Loss, Phase Reversal, Earth Fault, Over Temperature, CB Failure
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) (which ever is higher)
	Current	± 3% (or ± 0.01 Amp) (which ever is higher)
Display		
	LCD Display	Metering and Fault information
	LED	RUN : Flashing for 'Motor Start', RUN: Steady for 'Motor Run'
		PICKUP : for 'Fault Pick up'.
		TRIP : Steady for Motor tripped.
Auxiliary Supply		80 - 280V AC / 110 - 300V DC
Power Consumption		Approx. 6W
Contact Rating		
	Trip Relay Contact	1 C/O Contact, 6A / 250V AC or 24V DC
	Alarm Relay Contact	2 N/O Contact with 1 common, 3A / 250V AC or 24V DC
ZCT Input		100mA / 50 mV (available when ZCT is used)
Relay Reset		Automatic / Manual
DI Input		Active : 80 - 260V AC / 40 - 300V DC
Analog Output (4-20mA)		Max Load Resistance 400 Ohm
Temperature Sensor (PTC)		Total Resistance in cold State : 1500 Ohm
		Return Value:1.5 kOhm to 1.65 kOhm, Response Value:2.7kOhm to 3.6 kOhm
Mounting		35 mm Din-rail / Panel mount
Temperature	Operation	0^{0}C to 70^{0}C
Temperature	Storage	-10^{0}C to 85^{0}C
Wiring Connection		
	For current	Penetration / Tunnel Type
	For Others (Aux supply, Relay contact etc.)	Screwed Terminal

Rated Current Range Selection

mPRO-200 supports 0.25 to 60 Amp rated current (built-in-CT) and supports CT ratio upto 999 external CT as per following configuration: -

Model 1(1.0 to 60 Amp)		Model 2(0.25 to 5 Amp)		No of times wire passes through Built-in CT
Max Rated Current	Rated Current Range	Max Rated Current	Rated Current Range	
5	1 - 5 Amp	0.25	0.25 - 1.25 Amp	4 times
10	2.5 - 10 Amp	0.5	0.5 - 2.5 Amp	2 times
60	5 - 60 Amp	5	1 to 5 Amp	Once
Ext CT	5 Amp	Ext CT	5 Amp	Once

mPRO-200 supports motor current above 60 Amp with external CT with rated secondary current of 5 Amp.
e.g : 100 : 5, 200:5, 800 : 5 etc.

Note : C&S recommend to use Model-2, when using External CT.

Cable Selection

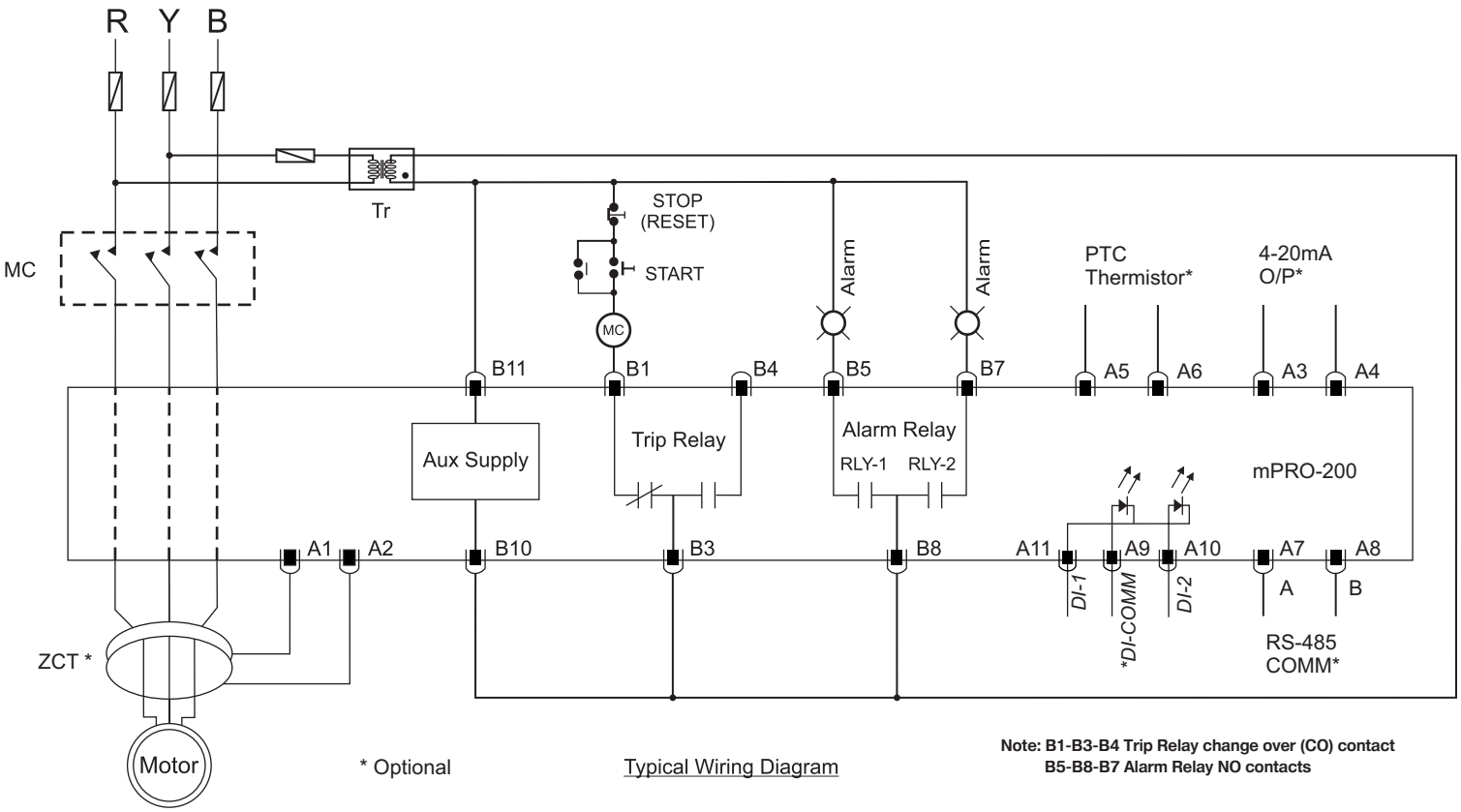
The mPRO relay is provided with built-in CT operated for current up to 60 Amp. Following are the recommended cable size

Material	Size (mm^2)	Current (A)
Copper PVC	1.5	23
	2.5	30
	4	38
	6	48
	10	64
	13	70

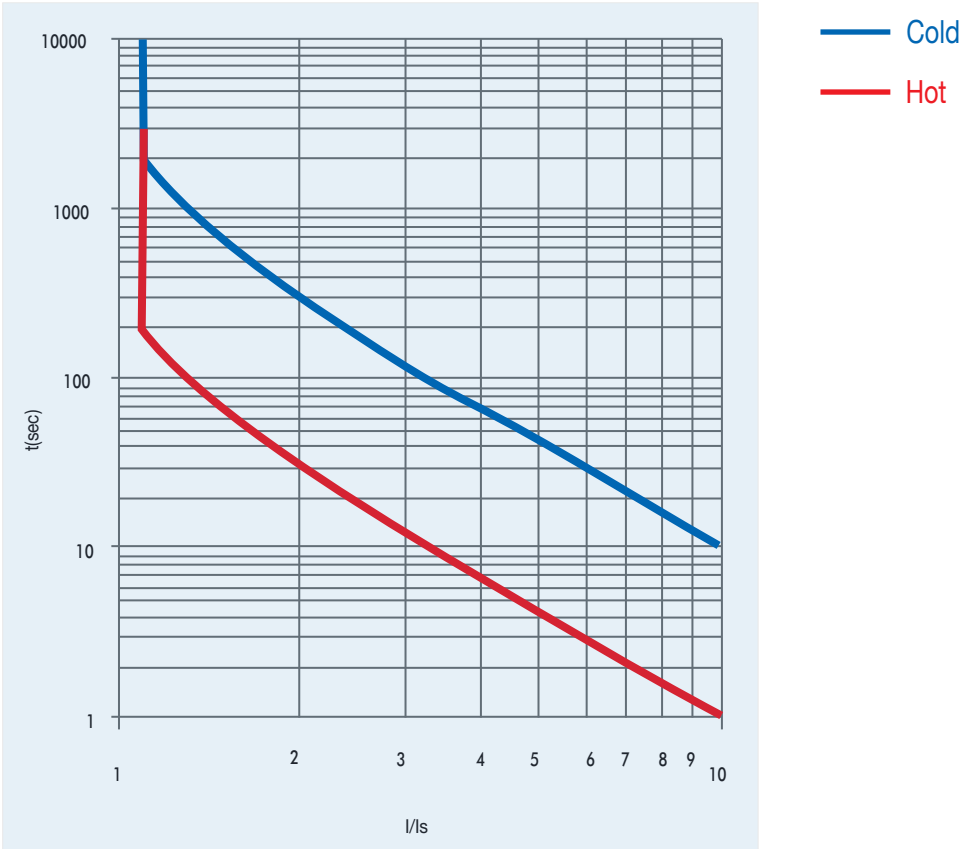
mPRO with external Three Phase CT

(Figure-4)

Connection Diagram



(Figure-5)



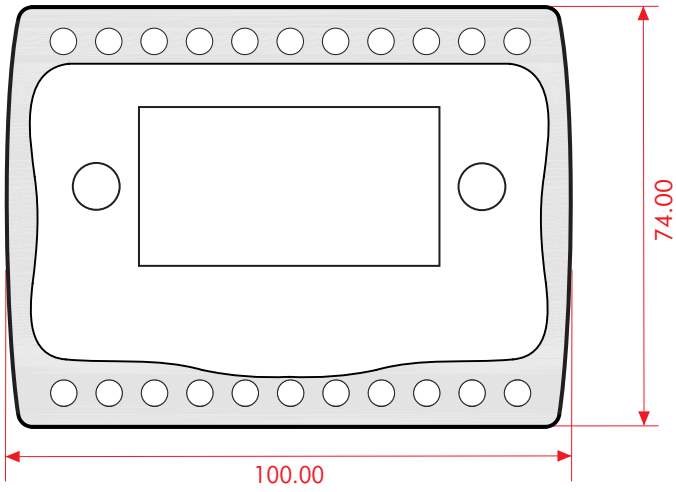
(Figure-6)

Dimensional Details

Base Module

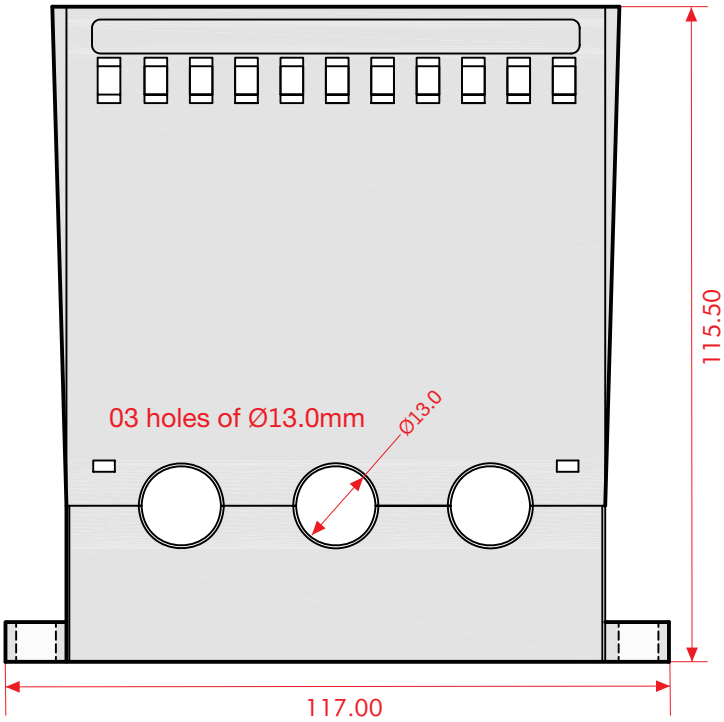
(WxHxD : 100x74x115.5) / Weight: 700 gm (Approx)
All the Dimensions are in mm.

Top View



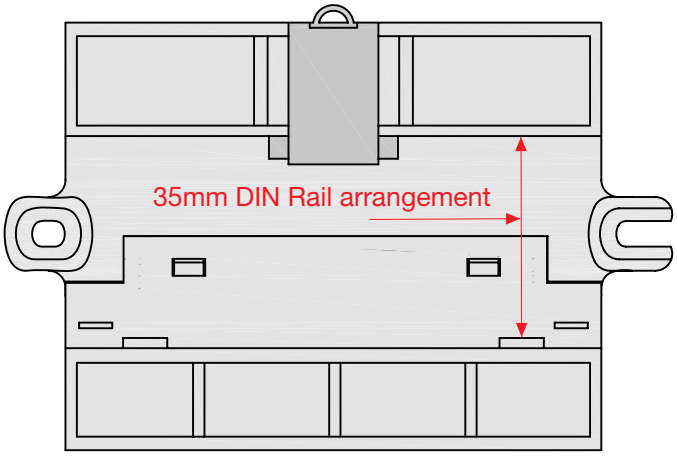
(Figure-7)

Side View



(Figure-8)

Bottom View

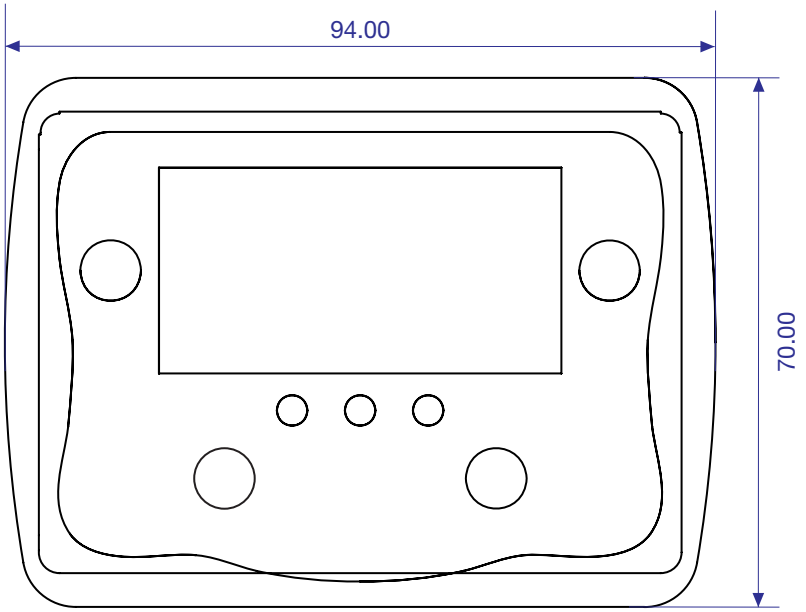


(Figure-9)

Display Module

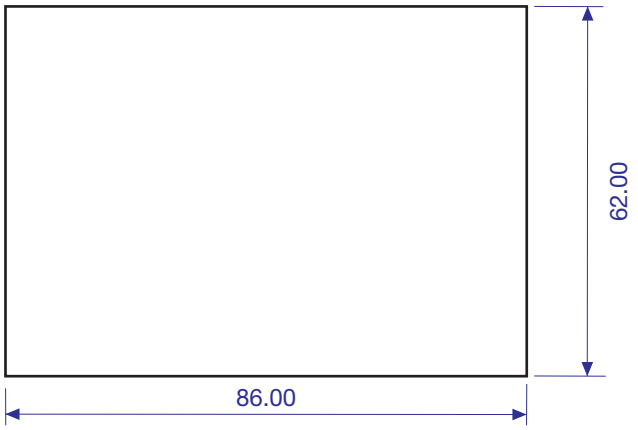
(WxHxD : 70x94x44.5) / Weight : 100 gm (Approx)
All the Dimensions are in mm.

Top View



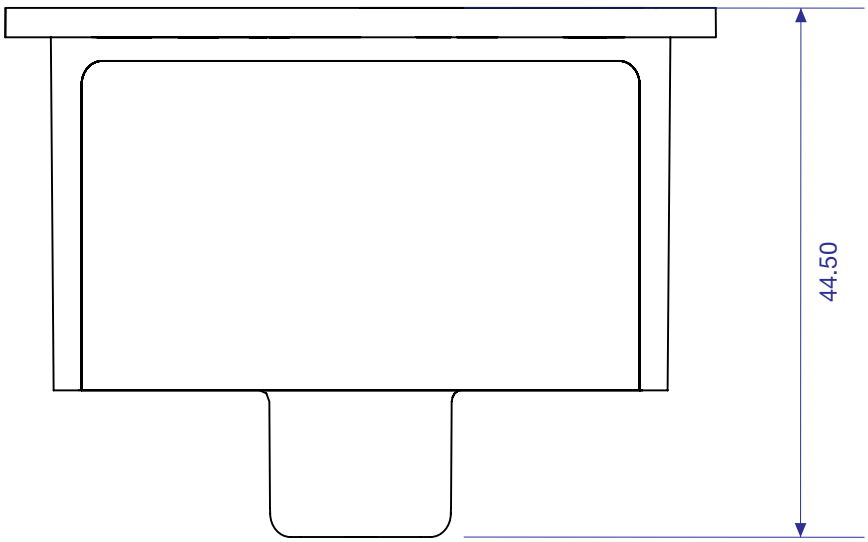
(Figure-10)

Cut Out Dimensions



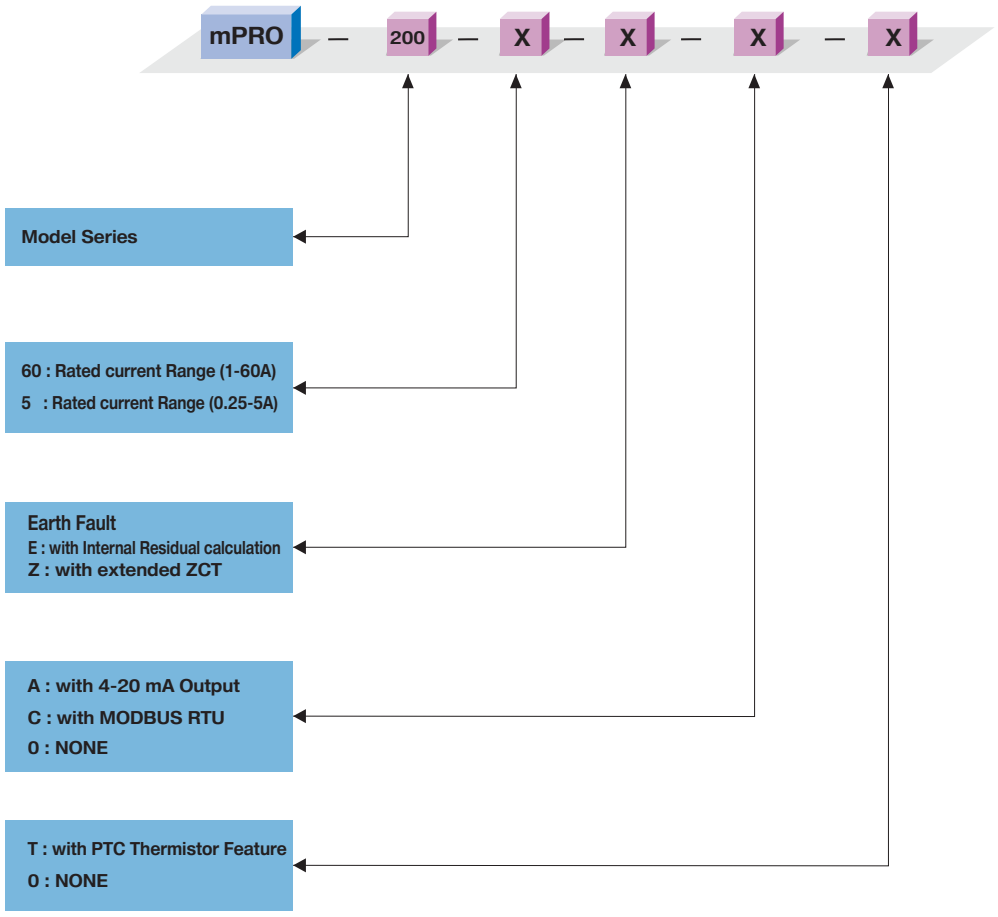
(Figure-11)

Side View



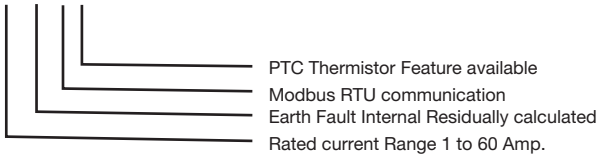
(Figure-12)

Ordering Information



Note: mPRO-200-60/5-Z/E-0-0 model, 2-Digital Input Trip Counter, Start-Stop History, Max Starting Current will not be available.

Example: mPRO-200-60-E-C-T



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NOT PUBLISHED

Issue Date : 16.10.12
Rev. No : 00
Rev. Date: -----