We touch your electricity everyday!

CSEPROM-240

Intelligent Measuring and Protection Device

Catalogue

C&S electric

Advance Motor Protection
& Monitoring Solution

INDEX

1.0 Introduction

CSEPRO series offers a multi functional comprehensive smart protection solution for Feeder, Generator, Motor & Transformer segment.

CSEPRO family of protective relays are advance numerical relays that provide multi protection and monitoring with reliable and fast protection solutions in a single unit.

In this family of CSEPRO series, the CSEPROM-240 is an advanced motor protection solution which has fast, sensitive and secure protection for LV & MV motors, which are either operated via power contactors or power circuit breakers.

CSEPROM-240 also provides an automation solution of power control. It complies with IEC60870-5-103, IEC61850, Modbus protocol for high integration of protection & control.

CSEPROM-240 offers following features in a compact & smart flush mounting enclosure.

- ❖ 1A & 5A Programable rated current.
- ❖ Measurement & Metering like 3 Phase current,
- ❖ 3 Phase Star voltage
- ❖ 3 Phase Delta voltage
- ❖ 3 Phase Active power
- ❖ 3 Phase Reactive power
- ❖ 3 Phase Apparent Power
- ❖ Individual Power Factor
- ❖ 3 Phase Power Factor
- ❖ Forward Active Energy
- ❖ Reverse Active Energy
- ❖ Forward Reactive Energy
- ❖ Reverse Reactive Energy & Energy Counters (1 Energy Counter is equivalent to 999.9 Gwh/GVarh) Total energy calculation (999.9 x energy counter + displayed energy thermal content) Maxi meter for both current & volt, Motor starting current
- ❖ Percentage of harmonic
- ❖ Motor run hour
- ❖ Thermal equivalent
- ❖ Ratio of I1/I2, Load value
- ❖ Negative/positive/zero phase sequence, Frequency
- ❖ Draw out enclosure have modular design with CT shorting
- ❖ Protection like: thermal overload, over-current, undercurrent, short circuit, under/over voltage etc.
- ❖ Communication
- ❖ 10 Fault records
- ❖ 500 Event records
- ❖ Motor start/ Stop record
- ❖ Oscilloscope record
- ❖ Programmable input / Output
- ❖ CSEPROM-240 relays are equipped with self supervision function.

(Figure-1)

2.0 Application

The CSEPROM-240 relay is the ideal answer to problems requiring more versatile or accurate protection for a motor than can be offered by standard thermal overload relay. It employs the latest micro controller techniques to provide the complete solution for the protection of medium & large sized three phase motors with high inertia load in all type of ordinary contactors controlled or circuit breaker controlled motor drives. It handles fault condition during motor start up, normal run, idling and cooling down at standstill in, for example pump, fan, mill, crusher applications.

Uses:

- ❖ helps in extending life time of motor
- ❖ helps in optimizing motor size
- ❖ helps in planning maintenance work
- ❖ protects the drive for mechanical damage

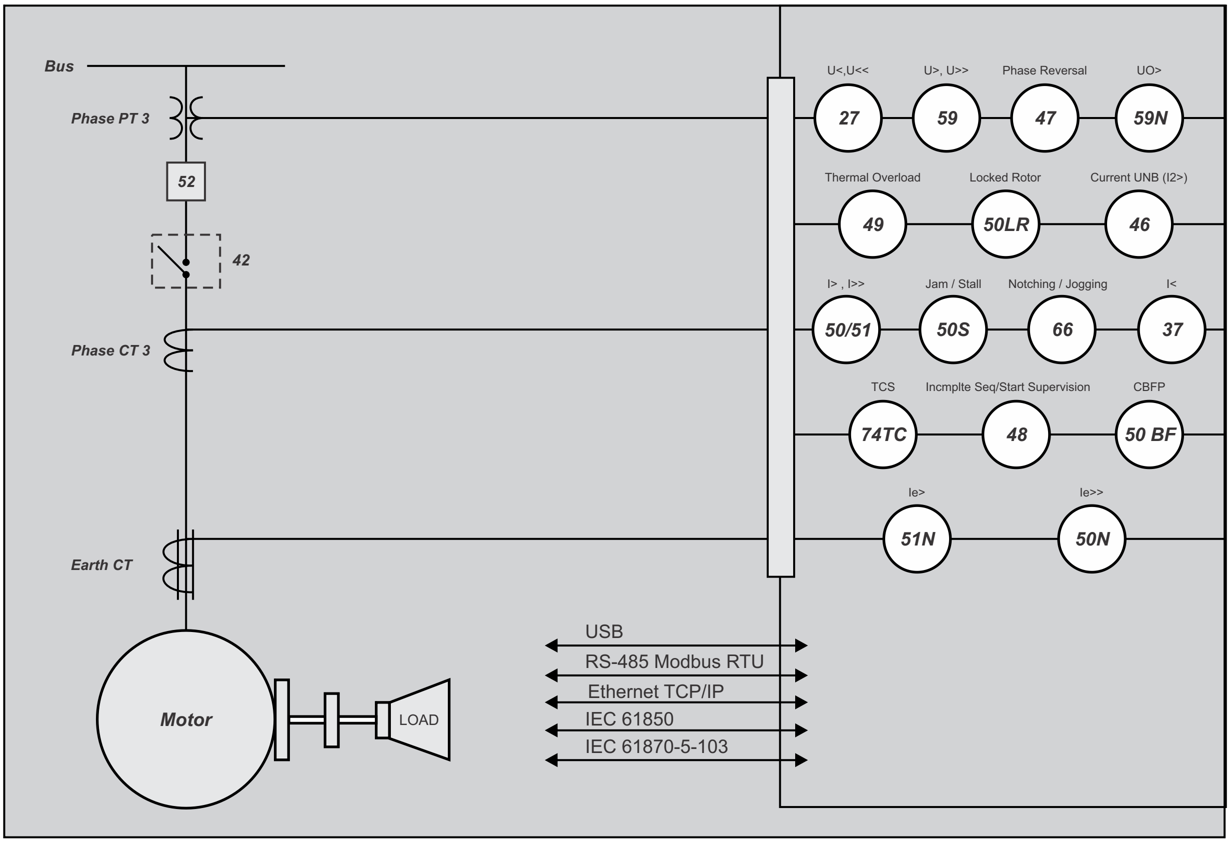
3.0 Hardware

- ❖ Digital Signal Processor based numeric design
- ❖ Measures true RMS with DFT filter
- ❖ 1A & 5A common current terminal & programmable
- ❖ 4 Current input
- ❖ 3 Voltage input
- ❖ 6 Change over digital output contact
- ❖ 6 Digital Inputs for protection & supervision
- ❖ 8 LEDs at pickup & trip on fault + 3 LED's with special function of 3 control keys.
- ❖ USB/RS-485/RJ-45/Fiber communications for automation
- ❖ 16x4 Alpha numeric LCD

4.0 Protection Features

- ❖ Phase reversal
- ❖ Current unbalance with DEFT & INV (46)
- ❖ Phase Over current (51)
- ❖ Thermal Over load protection (49)
- ❖ Locked rotor (50LR)
- ❖ Short circuit protection (50)
- ❖ Under current (37)
- ❖ Stall (50S)
- ❖ Earth fault (50N/51N)
- ❖ Anti-backspining protection(Start Interval)
- ❖ CBFP (50BF)
- ❖ Trip circuit supervision (74TC)
- ❖ Phase loss
- ❖ Under/Over voltage (27/59)
- ❖ Load monitoring
- ❖ CT secondary supervision
- ❖ Zero sequence protection (59N)
- ❖ Harmonic restrain

5.0 Functional Diagram



(Figure-2) CSEPROM-240 Functional Diagram

6.0 Protection Functions

Undercurrent Protection (I<)

The under current function is used to detect a decrease in motor current caused by decrease in motor load. This is especially useful for indication of condition such as loss of suction for pumps, loss of air flow for fans, V-belt split or shaft failure or a pump running unprimed or Running dry Protection, Broken conveyer belt.

while running condition, if at least one of the three phase current goes below the adjusted current level (but not below than motor stop current) for a defined time, CSEPRO-M will trip the assigned DO to stop the motor.

Phase Over-current (51)

This protection gives backup protection for motor external faults. If the external faults are not cleared by the primary protections, this over current unit will actuate, otherwise the motor will be seriously damaged due to overloads. Each winding has overload as well as short-circuit protection. Refer Table 1 for these protection settings. Over current Protection is active only in motor Run condition.

Earth Over-current (50/51N)

Over-heating of the stator winding is likely to lead to insulation deterioration. Since the windings are surrounded by an earthed metal case, Stator faults usually manifest themselves as earth faults.

To protects against this, two independent earth fault (low set and high set protection) over current element with defined settable time delays are provided. Refer Table 3 for these protection settings. This protection is active both in Start & Run condition of motor.

Phase Loss or Single Phase Protection

During a Phase loss, Voltage & Current are monitored continuously, when any or all the three phase voltage below 5% of the rated voltage or when any of the phase current falls below 3% of rated current or when all phase current falls below 3% of rated current provided all the three phase voltage are also less than 5% of the rated voltage. CSEPRO-M will issue a stop command via assignable DO after a set defined time. Refer Table 4 for these protection settings.

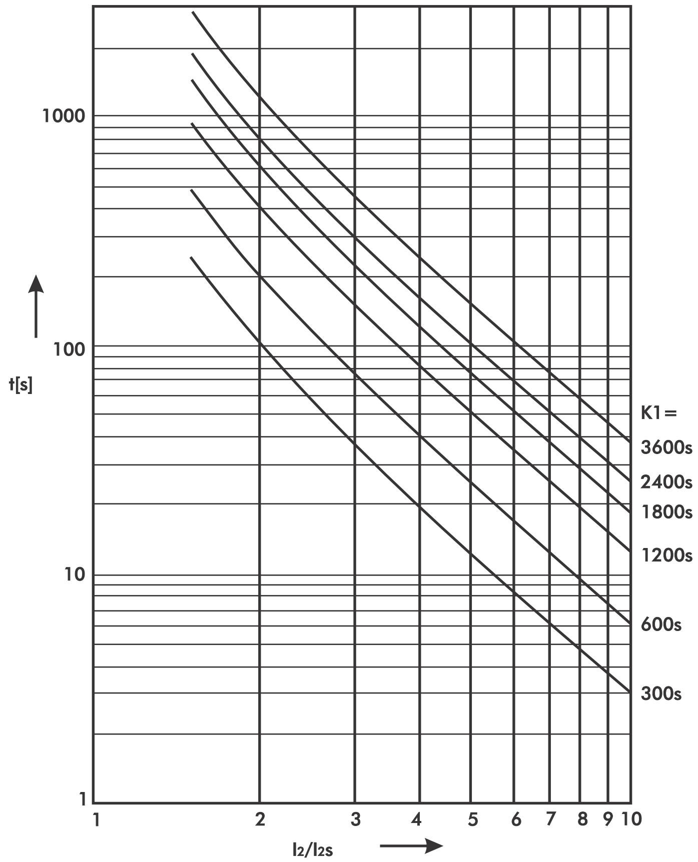
Negative Phase Sequence (46)

Running motors at unbalance conditions results in overheating. They are often fed through fuses and may be energized with one fuse blown causing single phasing of motor, the relay detects the negative phase sequence & trip according to set characteristics(DEFT/INV). Under normal motor running conditions only positive sequence current components flow. The presence of a negative sequence component produces a field revolving in an opposite direction to that of the rotor. which will increase the resistance of the rotors and this imposes additional heating of the stator that is excess of the manufactures rating. This protection is also active in both Start & Run condition of motor. Refer Table 16 for these protection settings.

Negative Phase Sequence Equation

$$t = \frac{K1}{(I_2/I_{2s})^2 - 1}$$

K1 : TMS for Inverse characteristics of NPS
t : Expected Trip Time
I_2 : Measured negative sequence value
I_{2s} : Permissible NPS value



(Figure-3)

Locked Rotor (50LR)

This protection is enabled only during motor start-up, a locked rotor is detected with the state of increased phase current above the set value within the defined start time. Once the start time expires, lock rotor condition is not be protected. The common application is on motors used on crushers, chippers or conveyors. Motor Start-up is detected on crossing full load current when previous state was STOP under the motor startup time. Refer Table 4 for these protection settings.

Short Circuit

A Phase to phase short circuit at the terminal of the motor or in the feeder cables, draws very large current capable of damaging the motor and its feeder cable. This also poses the threat of fire within the motor room, It is essential to detect the fault and to send the tripping command immediately to the breaking device. This protection is active in both Start & Run state of the motor. Refer Table 1 for these protection settings.

Thermal Overload Protection (49)

Overload can result in excessive stator temperature rises in excess of the thermal limit of the winding insulation. Whilst this may not cause the motor to burn out immediately, it has been shown that life of the motor can be shortend if the over load condition persists. The life of the motor is not purely dependent on the temperature of the winding but on the time that is exposed to these temperatures. Refer Table 2 for these protection settings.

CSEPRO-M Provides reliable protection for motor starting as well as for heavy and repeated starting.

CAUTION: * Make sure that at the of installation of relay, motor is in complete cold state having no thermal content otherwise thermal modeling of relay will not be in synchronisation with actual thermal state of motor.
(Changing this, M1 model will immediately affect the thermal of motor, take caution when use this M1 setting)

Thermal memory is saved all to selection in HMI
M1: On power Reset thermal memory becomes 0.
M2: On power Reset thermal memory starts from the same value as at the time of power off.
M3: On power Reset thermal memory subtracts for the time it is in off state & starts from the remaining value.

The formula for calculating the trip characteristics is as follows:

$$\text{Trip time } (t_{aus}) = \tau . \ln \left[\frac{\left(\frac{I2}{Ib2}\right) - p2}{\left(\frac{I2}{Ib2}\right) - k2} \right] \quad \text{for } p2 < \frac{I2}{(Ib2)} \cap p2 \leqslant k2$$

with τ = thermal time constant of the object to be protected.
I_b= Basic current
I_P= Initial load current
P= Initial load factor (p= 0 means cold operating component)
k= constant
for thermal characteristics user has two choices
(1) Thermal based on highest measured RMS current

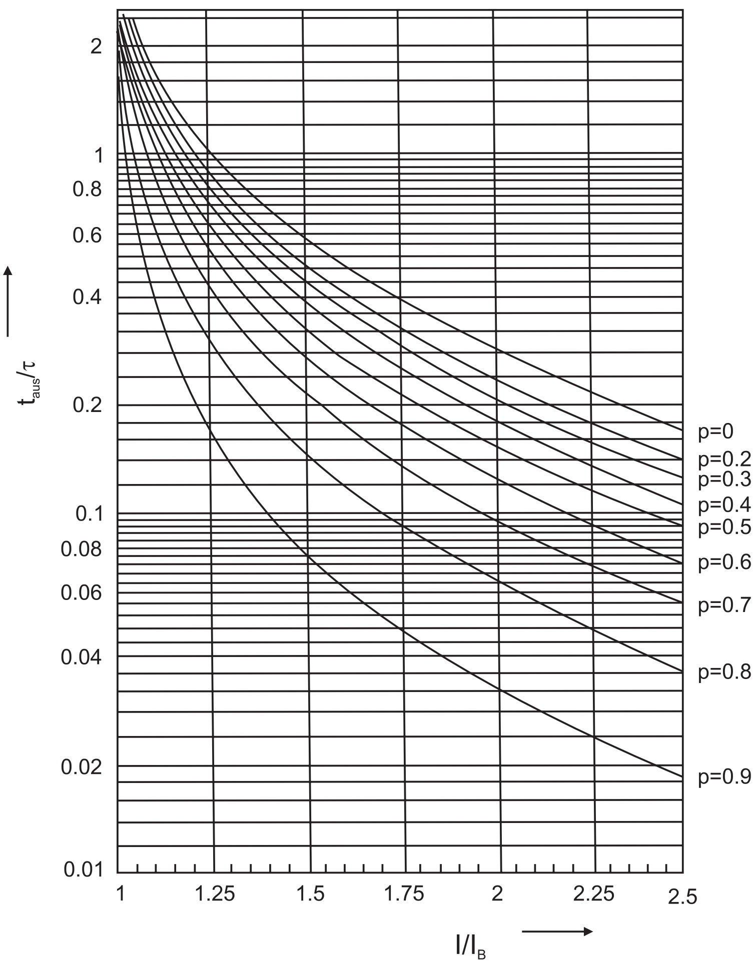
$$I = \sqrt{I_1^2 + I_2^2 + I_0^2}$$

OR

(2) Thermal based on positive & negative sequence measured.

$$I = \sqrt{I_1^2 + Neg\_k \times I_2^2}$$

where
I_0 = Zero phase sequence current (ZPS)
I_1 = Positive phase sequence current (PPS)
I_2 = Negative phase sequence current (NPS)
Neg_k= is weighting factor of NPS (constant value)
Presentation of the Trip with variable initial load factor:



Phase Reversal (47)

Reversing any two of the three phases will cause a three phase motor to run in opposite direction. This may cause damage to the machinery. CSEPRO-M relay uses the voltage (which should be greater then 10% of the rated voltage) to determine that the phase rotation of the signal applied to the relay are in proper order, if finds out of order, the relay trips in after a defined settable time. It helps to protect a three phase motor while installation. Refer Table 4 for these protection settings.

Jam / Stall (50S)

Mechanical equipment such as pumps or fans can be quickly damaged if it jam, resulting in a locked rotor stall. Protect the motor. Load jam protection is available only when the CSEPROM-240 relay detects the motor in RUNNING state. During the load- jam condition the motor stalls and the phase current rises near to the locked rotor value .when the load jam tripping is enabled and the phase current exceeds the jam trip level setting for longer than the delay set time, the relay trips. Set the Jam trip level greater than the expected normal load current but less than the rated locked rotor current. Refer Table 4 for these protection settings.

VOLTAGE PROTECTION

The relay is equipped with an independent (U>) and under voltage supervision (U<)simultaneously with separately adjustable tripping values and delay times. Voltage measuring is 3-phase. In this process there is a continuous comparison of the line conductor voltages in case of a delta connection and of the phase voltages in case of a star connection with the preset limit values.

a) Under / Over voltage (27/59)

Two thresholds are available for each function: each one can be independently activated or deactivated. Refer Table 5 for under/over voltage protection settings .

b) Zero Sequence (59N)

CSEPROM-240 relays will operate from the zero sequence voltage, which is calculated internally and measured as below:-

$U0=1/3\,(U1+U2+U3)$

Refer Table 6 for zero sequence protection settings.

c) Negative Sequence

This function is based on the negative sequence component of the voltage, which is calculated internally and displayed on the screen of the front panel. It is designed to detect any voltage unbalance condition.

$U2=1/3(U1+a^2U2+aU3)$

Refer Table 6 for negative sequence over voltage protection setting .

d) Positive Sequence

This function is based on the positive sequence component of the voltage, which is calculated internally and displayed on the screen of the front panel. It is designed to detect any voltage unbalance condition.

$U1=1/3(U1+aU2+a^2U3)$

Refer Table 6 for negative sequence over voltage protection setting .

CT secondary open supervision

The relay supervise the external wiring between the relay terminals and current transformers (CT) and the CT themselves. further more, this is a safety functions as well. since an open secondary of a CT, causes dangerous voltages.

The CT supervisor function measures phase currents. if one of the three currents drops below IminSet, while another phase current is exceeding the ImaxSet, the function will issue an alarm after the operation delay has elapsed. Refer Table 7 for these protection settings.

Harmonic Restrain

Harmonic component of the differential current (2nd for each phase, whereas 2nd is for earth) is calculated & extracted using

Digital Fourier transforms. The magnitude of these current is used to discriminate between faults and inrush conditions that will restrain differential function during inrush caused by energization and over excitation. If blocking on harmonic setting is enabled then the relay blocks all the tripping operations when if 2nd harmonic for phase & 2nd for earth are higher than set values. Refer Table 8 for these protection settings.

7.0 Monitoring Function

Trip Circuit Supervision (74TC)

One or Two binary inputs can be used for monitoring the circuit breaker trip coil including its incoming cables. This feature detects any anomalies in the circuit with the switch open or close. It detects trip circuit supply failure of circuit breaker, tripping mechanism failure like circuit breaker contact degeneration in wires, contacts and coils. Refer Table 9 for these protection settings.

Anti backspin Protection (With the name Start interval)

For certain applications, such as pumping a fluid up a pipe, the motor may be driven backward for a period of time after it stops. The CSEPROM-240 provides an start interval timer (minimum time between stop and restart) to prevent starting the motor while it is spinning in the reverse direction. The relay starts the timer countdown form the moment a stop is declared by the relay except in blocking state.

Circuit Breaker Failure Protection (50BF)

The CB Failure Protection is based on supervision of current after fault tripping events. If the motor is not disconnected when a trip command is issued to a circuit breaker, another trip command is initiated using the breaker failure protection which trip the circuit breaker. The test criterion is whether all phase/earth currents have dropped to less than 5% of In within the set time (tCBFP). If one or more of the phase currents have not dropped to specified current within this time, CB failure is detected and the assigned output relay is activated. Refer Table 15 for these protection setting.

Load Monitoring

If the load value (in terms of %FLC) increased the set limit, then after the set delay assigned relay gets trip to avoid the damage of motor and load. Refer Table 10 for these protection setting .

Circuit Breaker Controlling

Through function key, by selecting CB control option (Refer Table-15), circuit breaker can be operated by assignable CB control DO.

START WORKING PRINCIPLE

START RECOGNISATION:

CSEPROM-240 monitors the flow of current from which the following operational conditions of the motor are gathered

1) STOP
2) START (Resistance Start, Direct Start, Star Delta switch-over, Start-up via inverter control)
3) RUNNING

STOP- CONDITION:

If no current is measured (I<3% of Ip) STOP conditions are recognized after expiry of the stop time. The stop time is adjustable in order to tolerate a brief – off time of the current flow.

START CONDITION:

Start is only recognized if the previous condition was STOP and the motor current has exceeded 3% of Ip. if the STOP or RUNNING conditions are recognized, the start condition is terminated.

RUNNING -CONDITION: RUNNING can be recognized in different ways:

1) If the start has been successfully completed. This is the case when motor current has dropped below KxIb setting (Full load current) & the start time has elapsed (direct start).
2) If the motor is connected across several resistance steps, it is possible that KxIb setting is crossed repeatedly. Running conditions are recognized when the start time has run out after the last step & current has settled between KxIb and 3% of Ip. (Resistance start).
3) If after STOP a motor current has settled between 3% of Ip and KxIb and the start recognization time has elapsed. (Soft start)
4) If Motor Running Identification input was activated and current is 3% of Ip, then start time is bypassed, it will go in run state.

START-STOP PARAMETERS

1. Start Limiting Time
2. Start Attempt
3. Start Time
4. Start Intervals
5. Start Blocking time
6. Stop Time

1) **Start Limiting Time:** This is the time in which max start attempts as per settings are allowed, if start attempt has crossed its set value within this time period then next start is blocked, for the period of set start blocking time. While motor running if attempts doesn't cross the set value and motor is still running and start limiting time elapsed then attempts get reset.

2) **Start Attempt:** These are the max attempts which are allowed within start limiting time.

3) **Start Time:** This adjustable time has only to be extended for special start procedures in order to prevent that the running conditions are indicated too early in advance. The time is running from the instance the current flow exceeded 3% of Ip. Running is only accepted by the supervision after the time has elapsed.
Case-1: If once motor starts & I falls below 3% of Ip for the time less than stop time and again exceeds 3% of Ip then the motor comes to run state not after the set start time but after the time which was left in preceding case.

   Case-2: If I falls below 3% of Ip before the expiry of start time (i.e. before run state) and remains in the state then the start timer expires after the motor get stopped (i.e. after the expires of stop timer).

4) **Start Interval:** This is the time allowed between two consecutive starts.

5) **Start Blocking Time:** This time inhibit the start process and assigned relay will block the start for the set blocking time.

6) **Stop Time**: If current goes below 3% of Ip, then motor stops after set stop time.

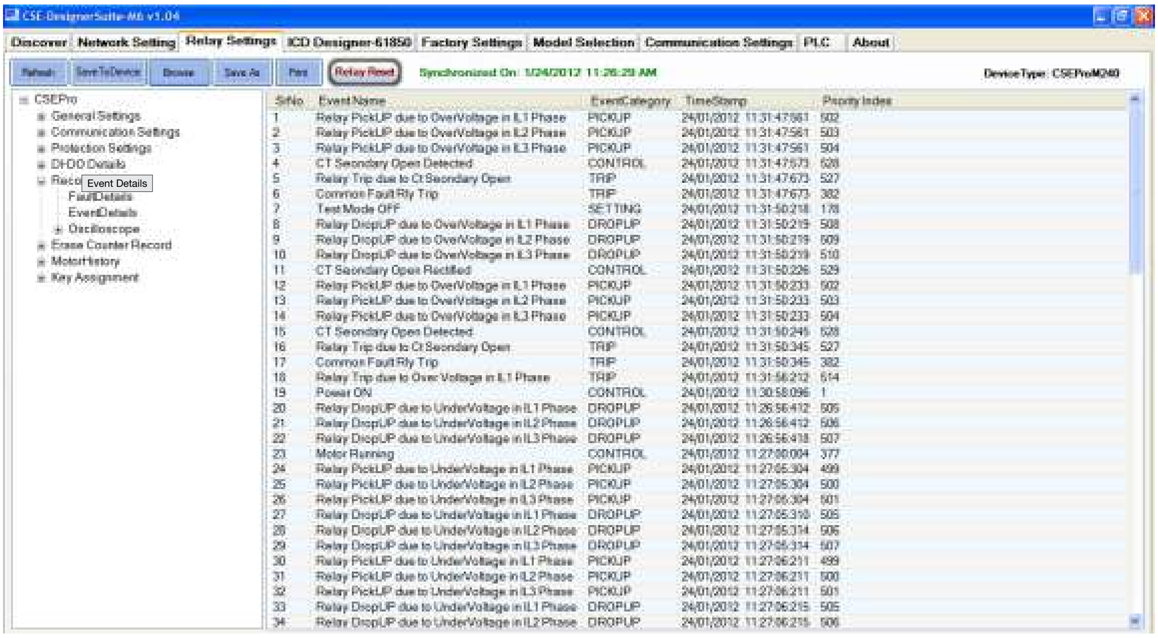
8.0 Event Record

The unit stores in non volatile memory the last 500 events. When the available memory space is exhausted, the new event automatically overwrites the oldest event. Which can be retrieved from a PC, with the following data:

❖ Date and time of the event

❖ Descriptive text of the event

The user can view event records via the front USB interface software



(Figure-5) Event Data recording on PC Software

Output Contacts

No. of digital outputs	:	6 (DO1, DO2, DO3, DO4, DO5, DO6) for CSEPROM 200, 240 & 270 model
Type of outputs	:	Relay
Programmable (DO Assignment)	:	Yes
DO reset type inputs	:	Programmable (Auto/Manual)

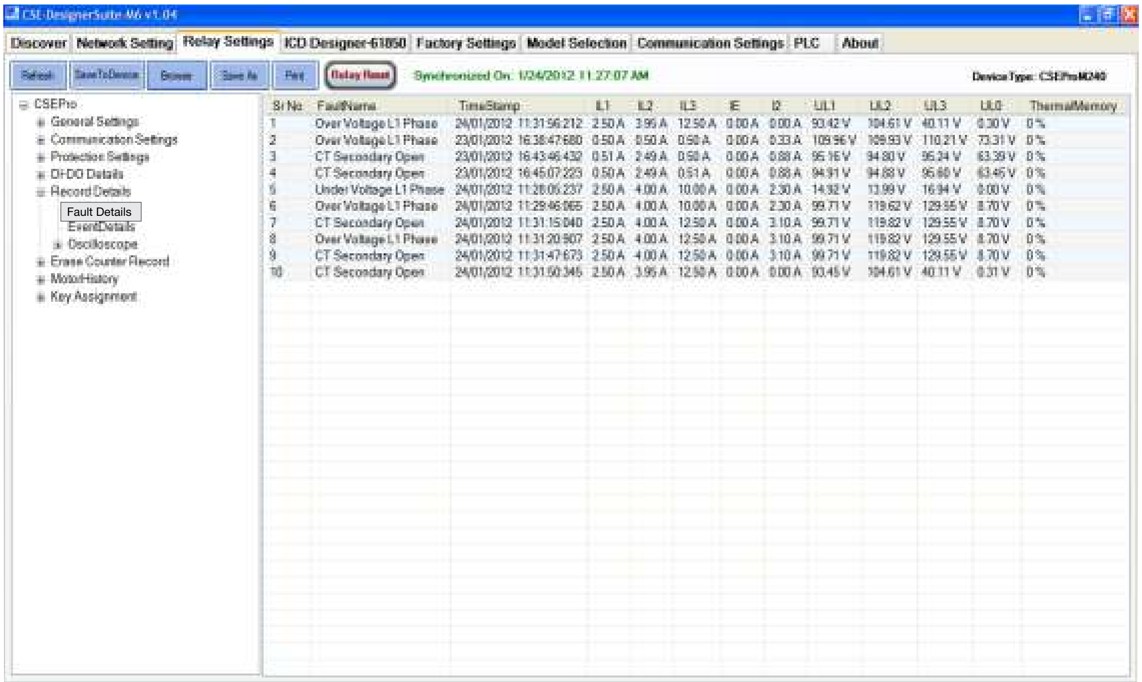
Input Contacts

No of digital inputs	:	6 (DI1, DI2, DI3, DI4, DI5, DI6) for CSEPROM 200, 240 & 270 model
Type of inputs	:	AC/DC Voltage
Programmable (DI Assignment)	:	Yes

9.0 Fault Record

The data recorded during the fault sequence is called Fault Record. CSEPROM-240 records last 10* faults in its non volatile memory with time stamp. Each record has following information :

- ❖ Phase, Earth & NPS fault currents, voltage, zero sequence voltage
- ❖ Date and time of fault
- ❖ Origin of fault (over current, thermal .... etc.)



(Figure-6) Fault Data recording on PC Software

Fault indicator helps the user to identify clearly the fault and to monitor relay setting and operation.
When the available memory space is exhausted, the new fault automatically overwrites the oldest Fault.
The user can view fault records either from the front panel or remotely via the RS-485 communication.
(*Feature as per Model Selection Table)

DATA ACQUISITION FUNCTION

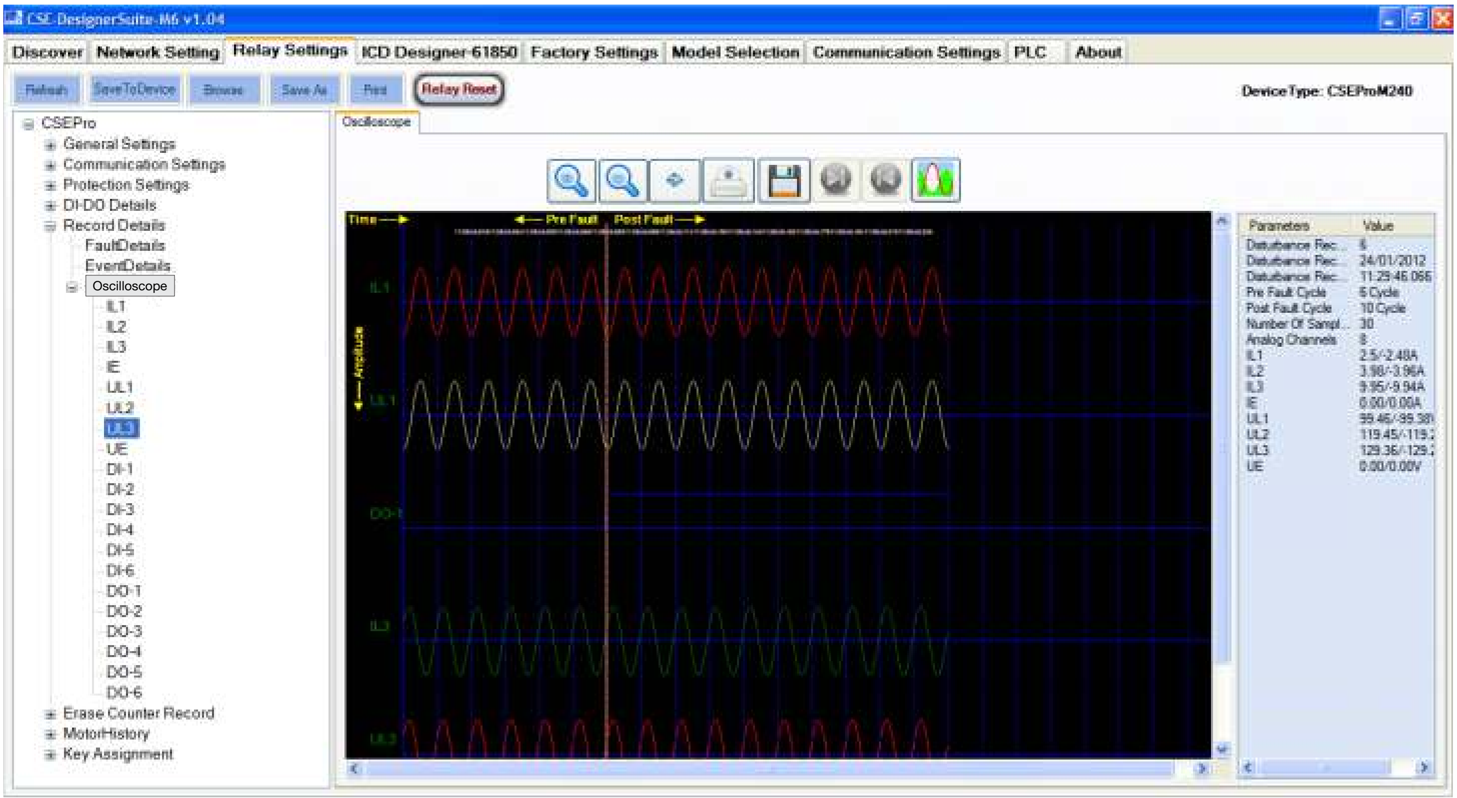
Measurements

- ❖ L1, L2, L3 phase current measurements
- ❖ L1, L2, L3 phase Star, Delta voltage measurements
- ❖ Earth current measurement
- ❖ Negative Sequence current
- ❖ Frequency
- ❖ Negative/Positive/Zero Phase Sequence
- ❖ Percentage of Harmonics
- ❖ Thermal Memory
- ❖ Trip Counter
- ❖ Origin of Faults
- ❖ Motor Run Hour
- ❖ Thermal Equivalent (It is the max phase current which contribute in thermal content and measured only when thermal protection is enable.
- ❖ Three Phase Active/Reactive/Apparent Power
- ❖ Three Phase/Single Phase Power Factor
- ❖ Forward/Reverse Active Energy
- ❖ Forward/Reverse Re-active Energy
- ❖ Maxi-meter for both voltage & current
- ❖ Ratio of I1/I2
- ❖ % of Load Value
- ❖ Motor Start current

Disturbance Record

The CSEPROM-240 relay has an oscillograph data recorder with the following characteristics:

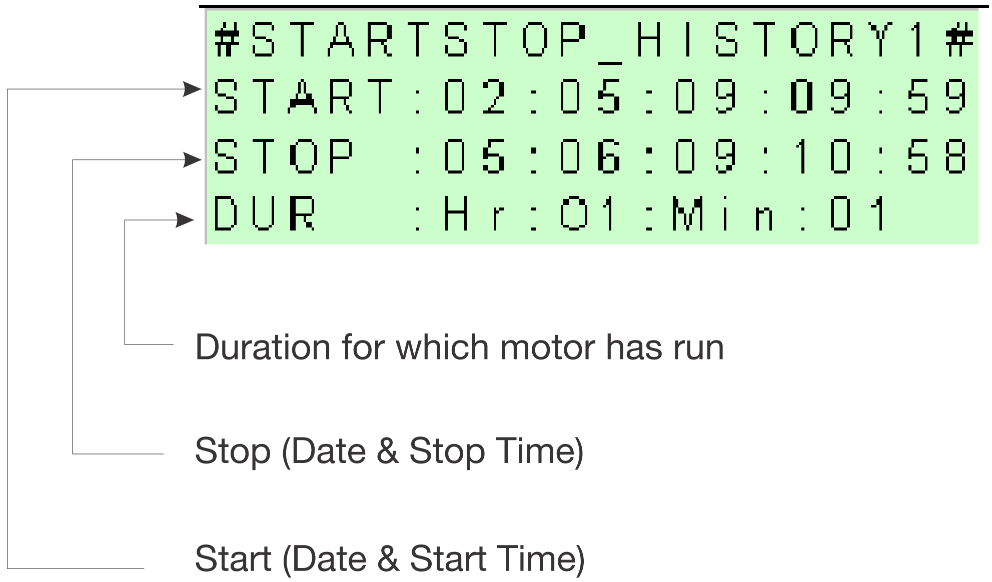
- Oscilloscopic recording can trigger on Pickup or on trip or via DI or on start i.e. change from pre-fault to post-fault stage. It is programmable (Refer Table 19).
- Each record comprises the samples from 8 analog signals and the status of 6 digital inputs and 6 digital outputs. There will be 30 samples per cycle.
- Relay saves maximum 1200 cycles, and the number of cycles per record is programmable (for example: if 40 cycles are selected, then there will be maximum 30 records of 40 cycles each).
- The pre-fault and post-fault cycles are programmable (Refer Table 19 of oscilloscope (disturbance) record setting).
- Records are in the non volatile memory.
- The records are transferred to PC using USB interface. The data is graphically displayed & can be taken on printer (See Fig-7).
- Record 1 is always latest record. 2nd record is older than 1st...... and so on.



(Figure-7) Oscilloscope recording on PC software

Motor Start-up Record

The CSEPROM-240 stores the last 10 start-stop time records in non-volatile memory. when one available memory space is exhausted, the new record automatically overwrites the oldest record.



(Figure-8)

Incomplete Sequence Record

CSEPROM-240 records the incomplete sequence of the Motor start. If after Motor starting, RUN state doesn't come (i.e motor stops) then that will be called as incomplete sequence and increments the counter by one.

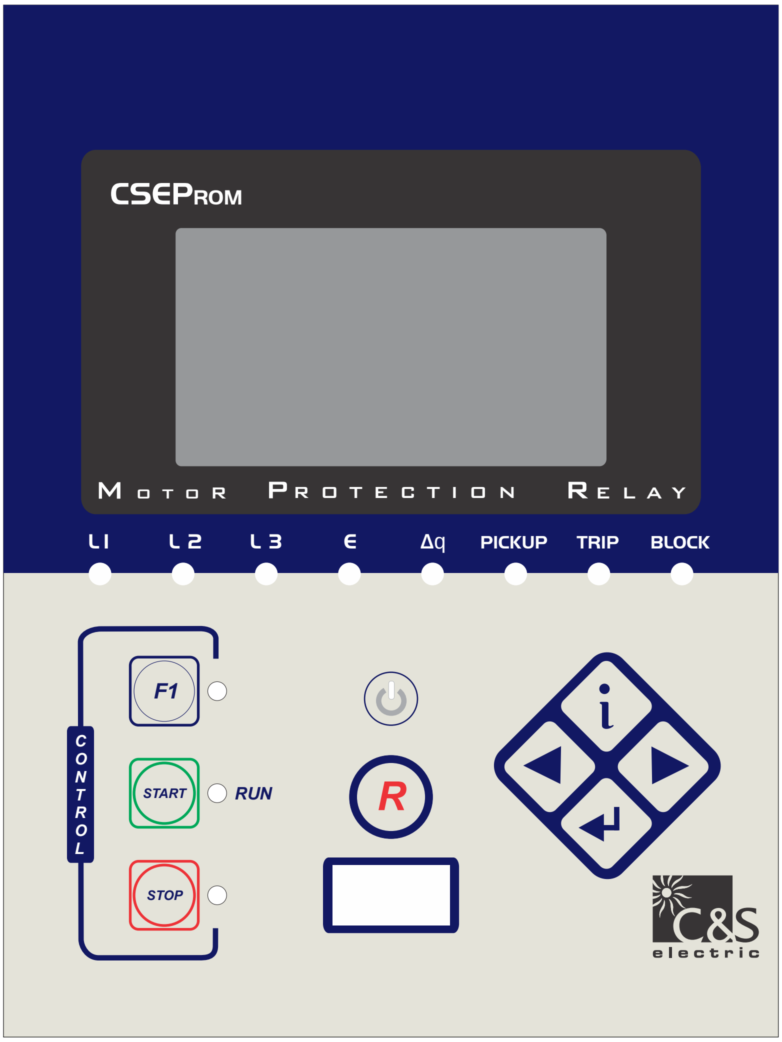
Maxi-meter

The unit stores the maximum current value and maximum voltage value for the moment when it occurs.

10.0 Human Machine Interface

It comprises bright Alpha-numeric display with 5 push buttons for setting and other operations for local access:

- Two push switches for set values of normal tripping characteristics.
- One 'RESET' push switch and one "Enter" push switch.
- One push switch for the function assigned in the 'HMI' to 'F1' Key, 2 push switches for the starting and stopping of motor.
- Eight LEDs for pickup or tripping on fault's & events in any phase.



(Figure-9) HMI

Keys	Manual Key
i	is used as intelligent key to see the details of the last fault, fault pickup status, digital input & output status.
↵	is used as a “ENTER” key.
R	is used to manual reset (after pressing for 2 sec)
◀	is used to scroll in upward direction and for decrement of parameters.
▶	is used to scroll in downward direction and for increment of parameters.
F1	To perform the assigned task either DO Trip, DO Reset or thermal reset.
START	To start the motor (via assignable DO).
STOP	To stop the motor (via assignable DO).

11.0 Communication (Local & Remote)

The unit has:

- 1 Front USB port for direct connection to a PC.
- 1 Rear RS-485 communication port.
- 1 Rear terminal can be for: RJ-45 or plastic F.O (optional).

Rear Communication (RS-485/RJ-45/Fiber optics (based on ordering model))

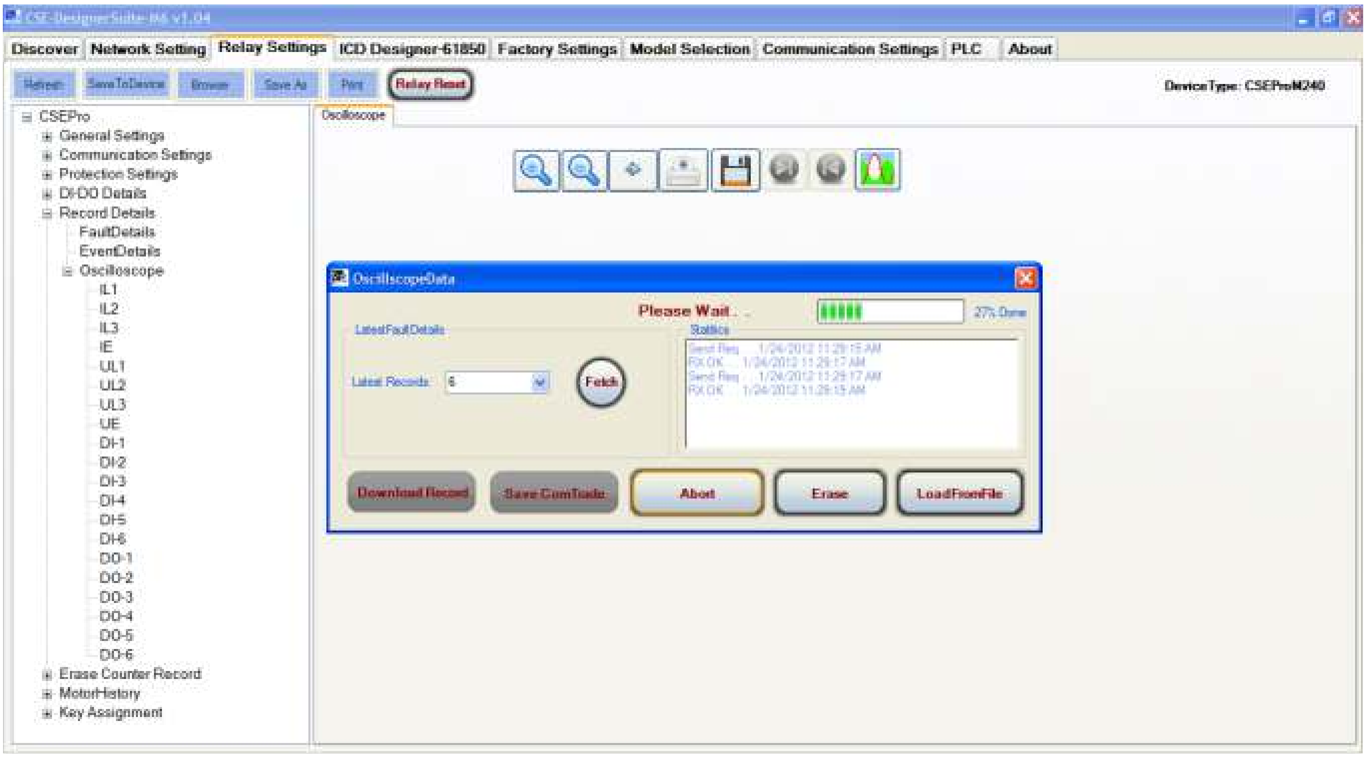
The protocol for the rear port is programmable. The user can choose either MODBUS or IEC 870-5-103 protocol for RS-485/RJ-45 communication.(Refer Table 20 for detailed description)

Front Communication (USB)

The entire setting including protection parameter setting for both group, Fault, Event & Disturbance record are available on 'A' type USB (female) interface with CSE LIVELINK with saving & printing option (See Figure-10). This unit also has Front-end Live Link simulation support for testing of relay even without any three phase injection source.

PC interface

All the group's setting, Fault, Event & Disturbance record is available on USB interface with CSE LIVELINK with saving & printing option. This unit also has Front-end Live Link simulation support for testing of relay even without any three phase injection source.



(Figure-10)

12.0 Setting Ranges

Current Protection

Parameters	Display	Setting Range		Step Size
		Min	Max	
Phase trip characteristics	Curve	DEFT	EINV, VINV, LINV NINV1.3, NINV3.0	1
Over-load pickup setting	I>	0.2xIp	4xIp	0.05xIp
Over-load inverse timing	ti>	0.04 sec	260 sec	0.01 sec
Over-load definite timing	t>	0.05 sec	260 sec	0.01sec
Under-current pickup setting	I<	0.20xIp	1.00xIp	0.01xIp
Under-current timing	t<	0.05 sec	260 sec	0.01 sec
Short circuit pickup setting	I>>	0.2xIp	30xIp	0.02xIp
Short circuit definite timing	t>>	0.04 sec	20 sec	0.02 sec

(Table-1)

Thermal Over-load

Parameters	Display	Setting Range		Step Size
		Min	Max	
Thermal memory mode	ThMode	M1	M2, M3	1
Permissible basic current	Ib	0.2xIp	4xIp	0.02xIp
Constant	k	0.5	2	0.01
Heating time constant	Th	0.5 Min	180 Min	0.1 Min
Cooling constant	Tc	1xTH	8xTH	0.01xTH
Thermal alarm	ThAlrm	20%	99%	1%
NPS weighting factor	I2_Wgt	0.05	2.5	0.05
Thermal reset	ThmRst	0%	99%	1%
Thermal trip characteristic	ThmChr	th1	th2	1

(Table-2)

Earth Protection

Parameters	Display	Setting Range		Step Size
		Min	Max	
Earth trip characteristics	Curve	DEFT	EINV, VINV, LINV NINV1.3, NINV3.0	1
Earth in start	Ie>Strt	NO	YES	1
Earth pickup setting	Ie>	0.05xIn	2.5xIn	0.05xIn
Earth inverse timing	tie>	0.05 sec	20.00 sec	0.05 sec
Earth definite timing	te>	0.03 sec	260 sec	0.01 sec
Earth High set in Start	Ie>>Str	NO	YES	1
Earth Hi-set pickup setting	Ie>>	0.5xIn	8xIn	0.05xIn
Earth Hi-set definite timing	te>>	0.02 sec	20 sec	0.01 sec

(Table-3)

(1) Refer following formula for EINV, VINV, LINV, NINV1.3, NINV3.0 characteristics:

Very Inverse $t = \dfrac{13.5}{(I / I_S) - 1}$ ti [s]

Extremely Inverse $t = \dfrac{80}{(I / I_S)^{2} - 1}$ ti [s]

Long time Inverse $t = \dfrac{120}{(I / I_S) - 1}$ ti [s]

Normal Inverse 3.0/1.3 $t = \dfrac{0.14/0.061}{(I / I_S)^{0.02} - 1}$ ti [s]

Where t =Tripping time ti =Time multiplier
I =Fault current I_S =Setting value of current

Motor Control Setting

Parameters	Display	Setting Range		Step Size
		Min	Max	
Start limit time (Notching/Jogging)	StrtLmtTim	1 min	300 min	1 min
Start attempt	StrtAtmpt	1	20	1
Starting time	StrtTim	0.20 sec	500 sec	0.01 sec
Start interval time	StrtIntrvl	1 min	240 min	1 min
Start blocking selection	StrtBlkSl	Thermal	Start, Both	1
Start blocking time	StrtBlkTim	1 min	60 min	1 min
Stop time (stop recognition delay)	StopTim	0.05 sec	10 sec	0.01 sec
Phase loss trip time	tPhLs	0.10 min	10 min	0.01 min
Lock rotor pickup setting	LckRtrl	2xIp	30xIp	2xIp
Lock rotor trip time	LckRtrT	0.04 sec	20 sec	0.01 sec
Stall / Jam pickup setting	StallI	0.5xIp	30xIp	0.1xIp
Stall trip time	StallT	1 sec	60 sec	1 sec
Phase reversal	PhsRvr	Disable	Enable	1
Phase reversal trip time	PhRvTm	0.1 sec	30 sec	0.1 sec
External trip delay	TrpDly	000.1 sec	260 sec	0.1 sec

(Table-4)

Under Voltage / Over Voltage Setting

Parameters	Display	Setting Ranges		Step Size
		Min.	Max.	
Blocking on loss of voltage	UlosBlk	Enable	Disable	1
Under voltage threshold setting	UV-THRE	5%Un	100%Un	1%Un
Under voltage characteristics	U<Char	DEFT	IDMT	1
Under Voltage in start	U<Start	NO	YES	1
Under voltage pickup setting	U<Pkup	20%Un	130%Un	1%Un
Under voltage TMS setting	U<Ti	0.05	2	0.01
Under voltage definite setting	U<Td	0.01 sec	300 sec	0.01 sec
Under voltage High set in start	U<<Strt	NO	YES	1
Under voltage High set pickup setting	U<<Pkup	5% Un	120% Un	1% Un
Under voltage definite setting	U<<Td	0.01 sec	300 sec	0.01 sec
Over voltage characteristics	U>Char	DEFT	IDMT	1
Over voltage pickup setting	U>Pkup	20%Un	150%Un	1%Un
Over voltage TMS setting	U>Ti	0.05	2	0.01
Over voltage definite time	U>Td	0.01 sec	300 sec	0.01 sec
Over voltage High set pickup setting	U>>Pkup	20%Un	150%Un	1%Un
Over voltage definite time	U>>Td	0.01 sec	300 sec	0.01 sec

(Table-5)

U0 / U1 / U2 Setting

Parameters	Display	Setting Range		Step Size
		Min	Max	
Neutral voltage pickup setting	U0>Pkup	2%Un	100%Un	1%
Neutral voltage characteristic	U0>Char	DEFT	IDMT	1
Neutral voltage TMS setting	U0>Ti	0.05	2	0.01
Neutral voltage definite time	U0>Td	0.03 sec	20.00 sec	0.01 sec
Positive sequence voltage pickup setting	U1<Pkup	10%Un	100%Un	1%Un
Positive sequence voltage definite time	U1<Td	0.03 sec	10.00 sec	0.01 sec
Negative sequence voltage pickup setting	U2>Pkup	10%Un	100%Un	1%Un
Negative sequence voltage definite time	U2>Td	0.03 sec	10.00 sec	0.01 sec

(Table-6)

CT Secondary Open Supervision

Parameters	Display	Setting Ranges		Step Size
		Min.	Max.	
CtSecondaryOpenSupervisionBlock	BLOCK	No	Yes	1
Current minimum setting	IminSet	0.0xIp	10.0xIp	0.1xIp
Current maximum setting	ImaxSet	0.0xip	10.0xIp	0.1xIp
Current supervision delay	CtSprDl	0.05 sec	600 sec	0.01 sec

Note: Current maximum setting should not be > current minimum setting.

(Table-7)

Harmonic Restrain

Parameters	Display	Setting Range		Step Size
		Min	Max	
Phase 2nd harmonic block	P2ndH	10%If	50%If	2%If
Earth 2nd harmonic block	E2ndH	10%If	50%If	2%If
Phase blocking time	tPHASE	0 sec	20 sec	0.1 sec
Earth blocking time	tEARTH	0 sec	20 sec	0.1 sec

(Table-8)

Trip Circuit Supervision Protection

Parameters	Display	Setting Range		Step Size
		Min	Max	
Trip circuit supervision time delay	td	0.03 sec	2 sec	0.01 sec

(Table-9)

Load Monitoring

Parameters	Display	Setting Ranges		Step Size
		Min.	Max.	
Load increase setting	LoadIncSet	10%FL	200%FL	1%FL
Load increase supervision delay	LdSprDly	0.1 sec	30.0 sec	0.1 sec

(Table-10)

DO Assignment

Parameters	Display
Over-current protection	I>
Short circuit protection	I>>
Under-current	I<
Earth timed protection	Ie>
Earth instant protection	Ie>>
Negative phase sequence protection	I2>
Circuit breaker failure protection	CBFP
Start block	StrtBlck
Common fault	CommonFlt
Start relay	StartRly
Stop relay	StopRly
Thermal relay	ThrmlRly
Thermal alarm	ThrmlAlrm
Phase loss	PhLoss
Stall	Stall
Lock rotor	LockRotr
Phase reversal	PhsRvrsl
External trip1	ExtTrp1
Trip circuit supervision	TCS
Motor running	MotorRun
Self supervision	SlfSpvn
Under-voltage	U<
Under voltage Hi-set	U<<
Over-voltage	U>
Over voltage Hi-set	U>>
CT Secondary supervision	CtSpvsn
Load supervision	LoadAlrm
Zero sequence over voltage protection	U_0>
Positive sequence over voltage protection	U_1<
Negative sequence over voltage protection	U_2>
Circuit breaker control	CBCntrl
External trip2	ExtTrp2
External trip3	ExtTrp3
External trip4	ExtTrp4
External trip5	ExtTrp5
External trip6	ExtTrp6

(Table-11)

DI Assignment

Parameters	Display
Circuit breaker open	CB_Open
Circuit breaker close	CB_Close
Remote start	RmtStart
Remote stop	RmtStop
Remote reset	Rmt RST
Over-current blocking	OC BLK
Short circuit blocking	SC BLK
Earth timed blocking	EL BLK
Earth instant blocking	EH BLK
Lock rotor blocking	LkRtrBLK
Stall blocking	StallBLK
Phase loss blocking	PhLosBLK
Phase reversal blocking	PhRvrBLK
Thermal blocking	ThrmlBLK
NPS blocking	NPS_BLK
Under-current blocking	UC_BLK
External delay trigger	XDlTrip
External un-delay trigger-1	XUnDTp1
Motor running identification	MtrRunng
Oscilloscope record triggering	OSCTrig
Group toggling	GRPtogg
Emergency start	EmrgStrt
Start blocking	StartBLK
Under-voltage blocking	U<Blk
Under-voltage Hi-set blocking	U<<Blk
Over-voltage blocking	U>Blk
Over-voltage Hi-set blocking	U>>Blk
Zero sequence over voltage blocking	U_0>Blk
Positive sequence over voltage blocking	U_1<Blk
Negative sequence over voltage blocking	U_2>Blk
External un-delay trigger-2	XUnDTp2
External un-delay trigger-3	XUnDTp3
External un-delay trigger-4	XUnDTp4
External un-delay trigger-5	XUnDTp5
External un-delay trigger-6	XUnDTp6

(Table-12)

Function Reset

Parameters	Display	Setting Ranges	
		Min.	Max.
Over-current protection	I>	Auto	Manual
Short circuit protection	I>>	Auto	Manual
Under-current	I<	Auto	Manual
Earth timed protection	Ie>	Auto	Manual
Earth instant protection	Ie>>	Auto	Manual
Negative phase sequence protection	I2>	Auto	Manual
Start block	StrtBlck	Auto	Manual
Common fault	CommonFlt	Auto	Manual
Thermal relay	ThrmlRly	Auto	Manual
Thermal hooter	ThrmlAlrm	Auto	Manual
Phase loss	PhLoss	Auto	Manual
Stall	Stall	Auto	Manual
Lock rotor	LockRotr	Auto	Manual
Phase reversal	PhsRvrsl	Auto	Manual
External trip-1	ExtnTRP1	Auto	Manual
Trip circuit supervision	TCS	Auto	Manual
Motor running	MotorRun	Auto	Manual
Under-voltage protection	U<	Auto	Manual
Under-voltage High set protection	U<<	Auto	Manual
Over-voltage protection	U>	Auto	Manual
Over-voltage High set protection	U>>	Auto	Manual
CT supervision protection	CtSprvsn	Auto	Manual
Load alarm	LoadAlrm	Auto	Manual
Zero seq. over voltage protection	U_0>	Auto	Manual
Positive seq. over voltage protection	U_1<	Auto	Manual
Negative seq. over voltage protection	U_2>	Auto	Manual
External trip-2	ExtnTRP2	Auto	Manual
External trip-3	ExtnTRP3	Auto	Manual
External trip-4	ExtnTRP4	Auto	Manual
External trip-5	ExtnTRP5	Auto	Manual
External trip-6	ExtnTRP6	Auto	Manual

(Table-13)

Key Assignment

Relay is having one function key (F1). It can be assign to trip any of 6 DO or to Relay reset, Thermal reset of the relay.

Parameters	Display	Setting Range	Step Size
Function key	F1	DO1/DO2/DO3/DO4/DO5/DO6 Relay Reset, Thermal Reset, CB Control	1

(Table-14)

Circuit Breaker Failure Protection

Parameters	Display	Setting Range		Step Size
		Min	Max	
Circuit breaker failure protection time delay	tCBFP	0.03 Sec	2 Sec	0.01 Sec

(Table-15)

Negative Phase Sequence Setting

Parameters	Display	Setting Range		Step Size
		Min	Max	
NPS trip characteristic	CHAR	DEFT	NPS_INV	1
NPS pickup setting	I2s	0.10xIp	1.00xIp	0.01xIp
Time multiple	K1	5 sec	600 sec	1 sec
Definite time delay	td	0.1 sec	600 sec	0.1 sec

(Table-16)

Erase Counter Record

Parameters	Display	Setting Range		Step Size
		Min	Max	
Trip count	TripCntr	NO	YES	1
Incomplete sequence	InCmplSqCnt	NO	YES	1
Thermal memory reset	ThrmMemRset	NO	YES	1
Run Hour reset	RunHourRset	NO	YES	1
Erase maxi meter	MaxMetrRset	NO	YES	1
Erase energy counter	EnrgCntrRst	NO	YES	1
Erase starting current	Strtng_IRst	NO	YES	1
Events erase	EventsErase	NO	YES	1
Faults erase	FaultsErase	NO	YES	1
Oscilloscope record erase	OscRcrdEras	NO	YES	1

(Table-17)

Common Setting

These are the setting's common for all the protections:

Parameters	Display	Setting Range		Step Size
		Min	Max	
Rated phase current	Ip	1.00 Amp	5.00 Amp	1.00 Amp
Rated earth current	In	1.00 Amp	5.00 Amp	1.00 Amp
Phase CT ratio	PhsCTRatio	1	9999	1
Earth CT ratio	ErthCTRto	1	9999	1
PT ratio	PT Ratio	1	9999	1
Protection *	Prtcn Selc	1	3	1
Wiring configuration	Wire config	STAR	DELTA	1
Full load	IFL	10%Ip	200%Ip	1%Ip
Nominal frequency	Nominl Frq	50 Hz	60 Hz	1 Hz
Fault message status	[F]Stats	DISABLE	ENABLE	1

(Table-18)

*** Note: Protection selection setting is applicable only on under/over voltage protection.**
By changing CT/PT ratio, Energy content will change accordingly, before changing CT/PT ratio Erase energy counter.

Oscilloscope (Disturbance) Record Setting

These are the settings for Oscilloscope recording:

Parameters	Display	Setting Range		Step Size
		Min	Max	
Oscilloscope recording selection	RECORD	No	Yes	1
Pre-fault cycle	PRE CYCLE	2	298	1
Post-fault cycle	POST CYCLE	2	298	1
Triggering mode	TRIG. MODE	Pickup	Trip, DI, anyone, start	1

(Table-19)

Rear Port Communication Setting (*Availability as per model selection)

RS-485 Communication		
Protocol	:	MODBUS RTU / IEC-103
Baud rate selection (Programmable)	:	9600 / 19200 / 38400 / 57600 bps
Parity selection (Programmable)	:	Even / Odd / None
Stop bit	:	1 Bit
Data bit	:	8 Bit
Remote Address (Programmable)	:	247/254
Cable required for interface	:	Two wire twisted shielded cable

(Table-20)

USB Communication		
Protocol	:	CSE Proprietary Protocol: available with front software
Baud rate	:	19200 bps
Cable required for Interface	:	USB cable type (A to A)

(Table-21)

13.0 Technical Data

Measuring Input

Rated Data	:	Rated Current Ip : 1A & 5A
		Rated Frequency Fn : 50Hz / 60Hz
		Rated Voltage : 63.5V & 110V
Thermal withstand capability in current circuit	:	At Ip : 1A
		Continuous=5 x Ip
		for 10 Sec = 30 x Ip
		for 1Sec = 100 x Ip
	:	At Ip : 5A
		Continuous = 3 x Ip
		for 10 Sec = 10 x Ip
		for 1Sec = 20 x Ip
Nominal Burden	:	For Phase = < 0.2VA
		For Earth = < 0.2VA

(Table-22)

Measurement Accuracy

Parameters	Range	Frequency Range	Accuracy
Current in Ampere	1.0-30.0xIn	50-60Hz	Less than ±2%
Voltage	5-150%Un	50-60Hz	Less than ±2%
Power	—	—	Less than ±5%
Power Factor	—	—	Less than ±0.02

(Table-23)

Trip Time Accuracy for Current Protections

Parameters	Accuracy
Trip time accuracy for protections except NPS	±30mSec OR ±5% (whichever is higher)
Trip time accuracy for NPS	±60mSec OR ±7.5% (whichever is higher)

(Table-24)

Trip Time Accuracy for Voltage Protections

Parameters	Accuracy
Trip time accuracy for voltage protections	Inaccuracy in Trip Timing in reference to ±2% error in measured voltage OR ±30mSec

(Table-25)

Relay Contact Rating

Contact Rating	
Contact Relay	Dry contact Ag Ni
Make current	Max. 30A & carry for 3 sec
Carry capacity	8A continuous
Rated voltage	250V AC/30V DC
Breaking Characteristics	
Breaking capacity AC	1500VA resistive
	1500VA inductive (PF=0.5)
	220V AC, 5A(cosø<=0.6)
Breaking capacity DC	135V DC, 0.3A (L/R=30mSec)
	250V DC, 50W resistive or
	25W inductive (L/R=40mSec)
Operating time	<10ms
Durability	
Loaded contact	30000 operation minimum
Unloaded contact	10000 operation minimum

(Table-26)

Auxiliary Supply

Rated auxiliary voltage UH	:	For 'L' Model	18V-60V DC
		For 'H' Model	85V-280V AC / 110V-300V DC
Rated supply for digital input	:	Normal Voltage UN For 'H' Model	80V-260V AC (Active)
			48V-300V DC (Active)
			<30V DC (Inactive)
			<50V AC (Inactive)
		Normal Voltage UN For 'L' Model	24V - 60V DC (Active)
			<18V DC (Inactive)
Power consumption	:	Quiescent approx. 3W	Operating approx. <7W

(Table-27)

Common Data

Dropout ratio	:	> 96%
Relay Reset time	:	30 mSec
Minimum operating time	:	30 mSec
Transient overreach at instantaneous operation	:	≤5 %

(Table-28)

14.0 Standards

Design Standards

IEC 60255-22-[1-6]
IEC 60255-5

14.1 HIGH VOLTAGE TESTS

High Frequency Interference Test

IEC 60255-22-1	:		
Class 3	:	Auxiliary Supply	2.5 kV/2 s
	:	Circuit to Earth	2.5 kV/2 s
Dielectric Voltage Test			
IEC 60255-5/EN 50178	:	I) All Input 342/ Output Circuits to Earth	2.5 kV (eff)/50Hz, 1 min.
		ii) Between Input & Output Circuits	
Impulse Voltage Test			
IEC 60255-5	:	I) All Input / Output Circuits to Earth	5kV / 0.5J, 1.2/50 μs
		ii) Between Input & Output Circuits	

14.2 EMC IMMUNITY TESTS

Fast Transient Disturbance Immunity Test (Burst)

IEC 60255-22-4	:	Power Supply, Mains Inputs	±4 kV, 2.5 kHz
IEC 61000-4-4			
Class 4	:	Other in and outputs	±2 kV, 5 kHz

Surge Immunity Test

IEC 61000-4-5	:	Within one circuit	2 kV, Differential Mode, Level 4
Class 4			
	:	Circuit to Earth	4 kV, Common Mode, Level 4

Electrical Discharge Immunity Test

IEC 60255-22-2	:	Air Discharge	8 kV
IEC 61000-4-2			
Class 3	:	Contact Discharge	6 kV

Radiated Immunity Test

EN 61000-4-3 / IEC 60255-22-3 : Level 3, 10V/m 80MHz to 1GHz @ 1kHz 80% AM

Conducted Immunity Test

EN 61000-4-6 / IEC 60255-22-6 : Level 3, 10V RMS @ 1kHz 80% AM, 150kHz to 80MHz

Power Frequency Magnetic Field Immunity Test

IEC 61000-4-8 : Level 5, 100A/m applied continuously, 1000A/m for 3s.

EMC Emission Tests

Radio Interference Suppression Test

IEC 60255-25/EN 55011/CISPR11 Limit value class A

0.15 - 0.5MHz, 79dBμV (quasi peak) 66dBμV (average)

0.5 - 30MHz, 73dBμV (quasi peak) 60dBμV (average)

Radio Interference Radiation Test

IEC 60255-25/EN 55011/CISPR11	Limit value class A
30 - 230MHz, 40dB V/m at 10m measurement distance	
230 - 1GHz, 47dB V/m at 10m measurement distance	

14.3 ENVIRONMENTAL TESTS

Temperature

IEC 60068-2-1	:	Storage: –25°C to +85°C	
IEC 60068-2-2	:	Operation: –25°C to +70°C	

Test Bd: Dry Heat

IEC 60068-2-2	:	Temperature	55°C
	:	Relative humidity	<50%
	:	Test duration	72 h

Test Bd: Dry Heat

IEC 60068-2-2	:	Temperature	70°C
	:	Relative humidity	<50%
	:	Test duration	2 h
		(The clearness of the display is constricted)	

Test Db: Damp Heat (Cyclic)

IEC 60068-2-30	:	Temperature	55°C
	:	Relative humidity	95%
	:	Cyclic duration (12 + 12 Hours)	2

14.4 MECHANICAL TESTS

Test: Vibration Response Test

IEC 60068-2-6	:	(10Hz-59Hz)	0.035 mm
IEC 60255-21-1		Displacement	
Class 1	:	(59Hz-150Hz)	0.5 gn
		Acceleration	
	:	No. of cycles in each axis	1

Test: Vibration Endurance Test

IEC 60068-2-6	:	(10Hz-150Hz)	1.0 gn
IEC 60255-21-1		Acceleration	
Class 1	:	No. of cycles in each axis	20

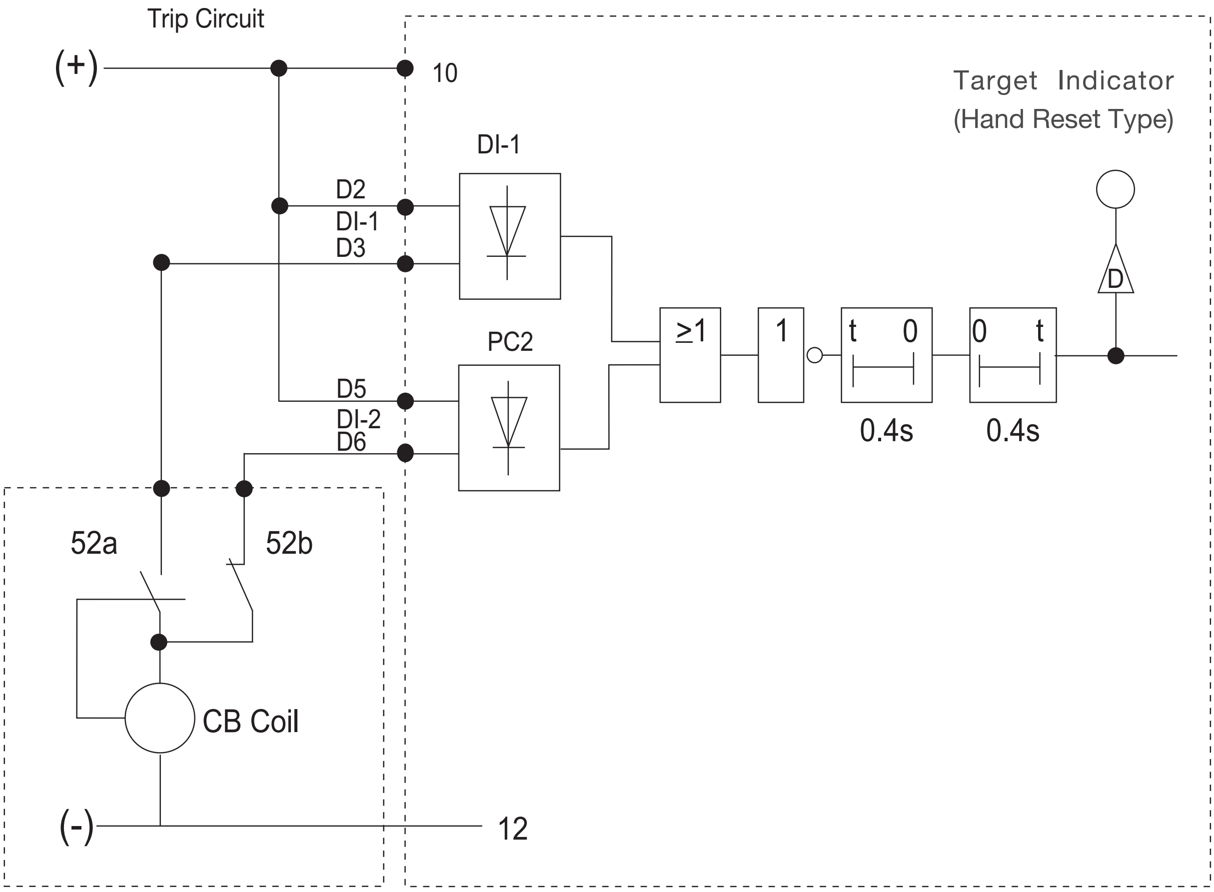
Test: Shock Tests

IEC 60068-2-27	:	Shock response test	5 gn, 11 ms, 3 impulses in each direction
IEC 60255-21-2			
Class 1	:	Shock resistance test	15 gn, 11 ms, 3 impulses in each direction

Test: Shock Endurance Test

IEC 60068-2-29	:	Shock endurance test	10 gn, 16 ms, 1000 impulses in each direction
IEC 60255-21-2			
Class 1			

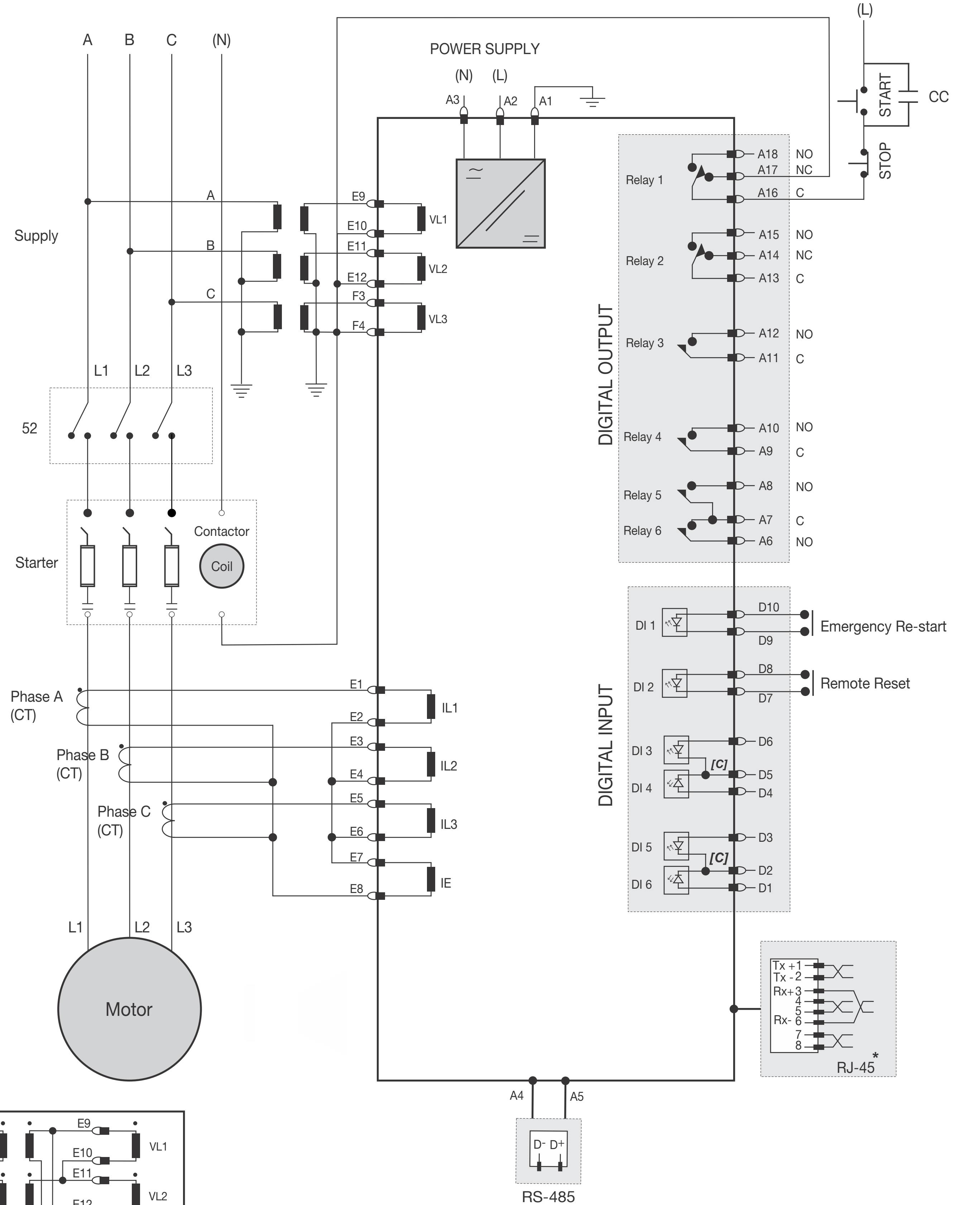
15.0 Trip Circuit Supervision Diagram

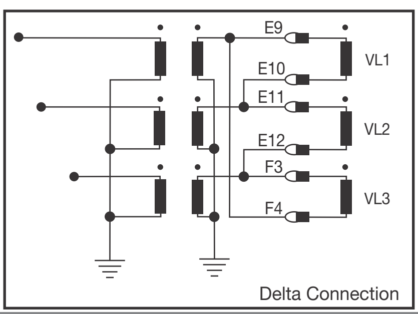


(Figure 11) (Trip Circuit Supervision Function)

16.0 Connection Diagram

CSEPROM-240



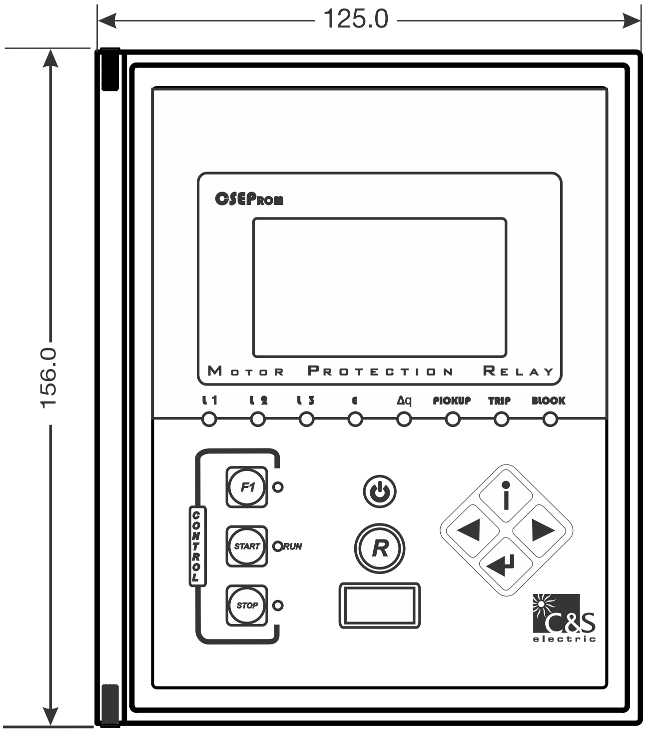


(Figure-12)

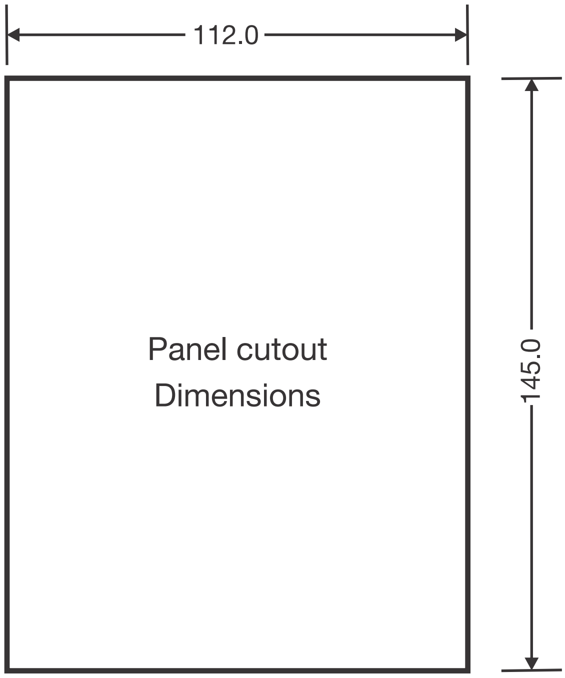
17.0 Dimensional Details

Panel cutout dimensions: WxH =112.0x145.0mm

Front View

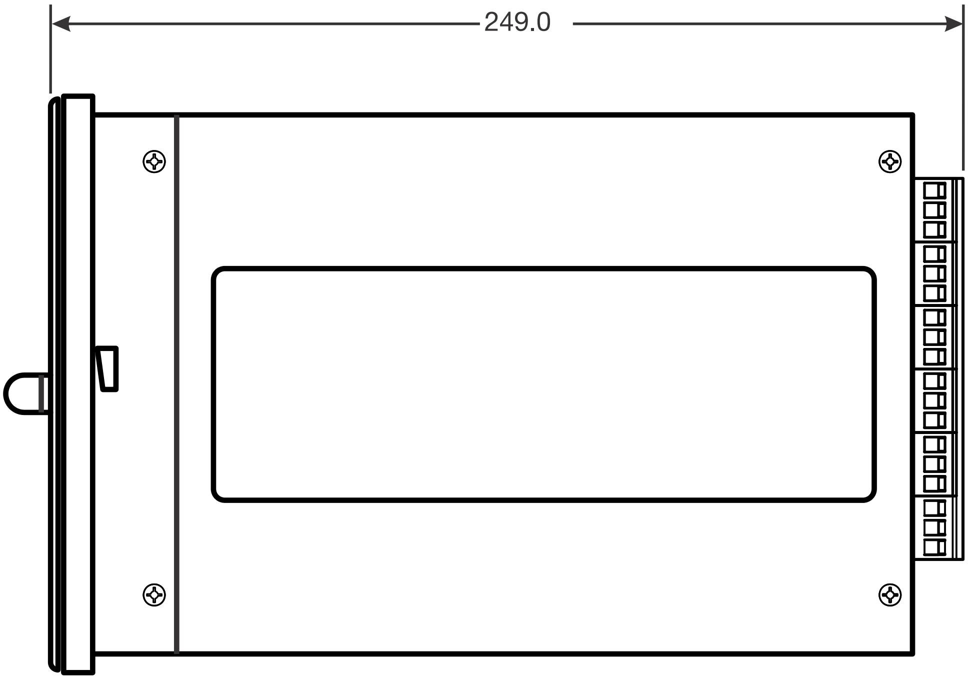


(Figure-13)



(Figure-14)

Side View



(Figure-15)

18.0 Model Selection Table

CSEPRO-M Model Selection Table

CSEPROM-xxx-Series	ANSI	CSEPROM200	CSEPROM240	CSEPROM270
CT inputs		4	4	6
VT inputs		-	3	-
Opto inputs (Max)		6	6	6
Output contacts (Max)		6	6	6
Function keys / Hot keys		●	●	●
Programming logic		-	●	●
	Protection			
Motor protection				
Motor differential	87M	-	-	●
Locked rotor	50LR	●	●	●
Stall	50S	●	●	●
Startup monitoring / Excessive long start	66/48	●	●	●
Negative sequence over-voltage	47	-	●	-
Loss of load	37	●	●	●
Under-current	37P	●	●	●
Anti backspin (start interval)	---	●	●	●
Phase over-current	50P/51P	●	●	●
Earth fault	50N/51N	●	●	-
Negative sequence over-current	46	●	●	●
Thermal over-load	49	●	●	●
Under / Over voltage	27/59	-	●	-
Residual over voltage	59N	-	●	-
Circuit breaker failure	50BF	●	●	●
Trip circuit supervision	74TC	●	●	●
	Communication			
Front (USB)		●	●	●
Rear RS-485 Modbus		●	●	●
Modbus on fiber optics		O	O	O
RJ-45 Modbus TCP/IP		O	O	O
IEC 60870-5-103 on fiber optics		O	O	O
RJ-45 IEC 60870-5-101		O	O	O
RS-485 IEC 60870-5-103		O	O	O
RJ-45 IEC 61850		O	O	O
SNTP-Time Synch RJ-45		O	O	O
Web server on RJ-45		O	O	O

O Optional-Based on Ordering Information

19.0 Ordering Information

CSEPROM - X - X - X - X

MODEL NO.
240

PT SECONDARY	
110V	1
400	3

COMMUNICATION PROTOCOL	
MODBUS on RS-485	M
IEC60870-5-103 on RS-485	I 103
IEC 61850 on Ethernet	I 650

AUXILIARY SUPPLY	
18 - 60V DC	L
85-280V AC / 110-300V DC	H

Example : CSEPROM-240-1-M-H

Revision History

S.No.	Rev.No.	Details	Date
01	18	Inclusion of TCS Diagram	05.08.14

For further information, please contact:

C&S Electric Ltd.

(Protection & Measurement Devices)

C-60, Wing-A, Phase-II, Noida-201 305, Dist: Gautam Budh Nagar (U.P) INDIA

Phone : +91-120-30577 00 / 01, Fax: +91-120-30577 04 E-mail: cspc@cselectric.co.in

Issue Date: 06.01.12

Rev. No: 18

Rev. Date: 05.08.14

Branch office

Branch	Phone	Fax	E-mail
Ahmedabad:	+91 79 30074534/35/36	+91 79 30074519	cspc.ahmedabad@cselectric.co.in
Bangalore:	+91 80 3057 0372/73, 3057 0347	+91 2558 4839	cspc.bangalore@cselectric.co.in
Bhubaneswar:	+91 674 2507265	+91 674 2507265	cspc.bhubaneswar@cselectric.co.in
Chennai:	+91 44 3918 0531-35	+91 44 39180514	cspc.chennai@cselectric.co.in
Cochin:	+91 0484 3071717	+91 0484 3071716	cspc.cochin@cselectric.co.in
Delhi:	+91 11 30838822-25	+91 11 30838826	cspc.delhi@cselectric.co.in
Hyderabad:	+91 40 3918 2496/97	+91 40 3910 3631	cspc.hyderabad@cselectric.co.in
Kolkata:	+91 33 22275850/51	+91 33 2227 5849	cspc.kolkata@cselectric.co.in
Mumbai:	+91 22 30487146/47/48	+91 22 2412 6631	cspc.mumbai@cselectric.co.in
Pune:	+91 20 30283244/45	+91 20 30283244	cspc.pune@cselectric.co.in