We touch your electricity everyday!

CSEPROM-200

Advance Motor Protection & Monitoring Solution

Catalog

C&S electric

PMD Division

CONTENTS

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 CSEPRO-Mxxx 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.

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

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

- 1A & 5A Programable rated current.
- Measurement & Metering
- Draw-out enclosure with Self CT shorting
- Protection like: Thermal overload, over-current, undercurrent, short circuit etc.
- 10 Fault record & 100 Event records
- Motor start / Stop record
- Disturbance record
- Programmable input / Output
- Maxi-meter with time stamp
- Relays are equipped with self supervision function

2.0 Application

The CSEPRO-M 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 and 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

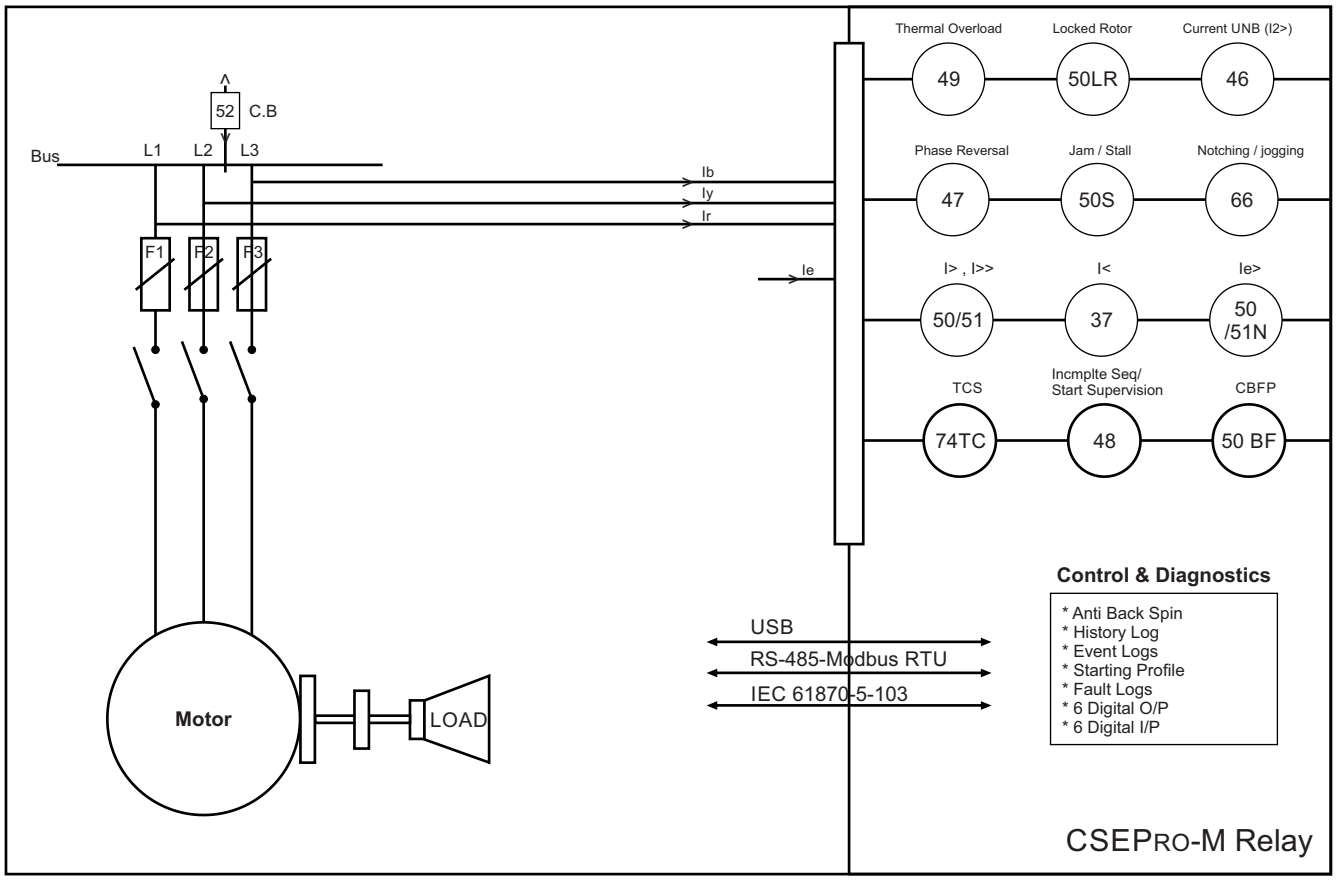
3.0 Hardware

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

4.0 Protection Features

- Phase reversal
- Current unbalance with DEFT & INV
- Phase Over current
- Thermal Over load protection
- Locked rotor
- Short circuit protection
- Under current
- Stall
- Earth fault
- Anti-backspining protection (Start Interval)
- CBFP
- Trip circuit supervision
- Phase loss

5.0 Functional Diagram



(Figure-2) CSEPRO-M Functional Diagram

6.0 Protection Functions

Undercurrent Protection

This protection covers the Loss of load condition like V-belt split or shaft failure or a pump running unprimed or Running dry Protection, Broken conveyer belt.

If while running condition, the phase current goes below the adjusted current level for a defined time, CSEPRO-M will trip to stop the motor.

Phase Over-current

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.

Earth Over-current

This is an over current function used on the current measured at the grounding of a motor in order to detect faults to earth. Each winding features has Earth low and Earth hi-set protections.

Phase Loss or Single Phase Protection

During a phase loss, the motor winding current may increase by 150% or more. As the motor winding current increases, the winding temperature may also increase and possibly damage the winding insulation.

The quick trip time on CSEPRO-M helps to prevent over-current damage to the windings

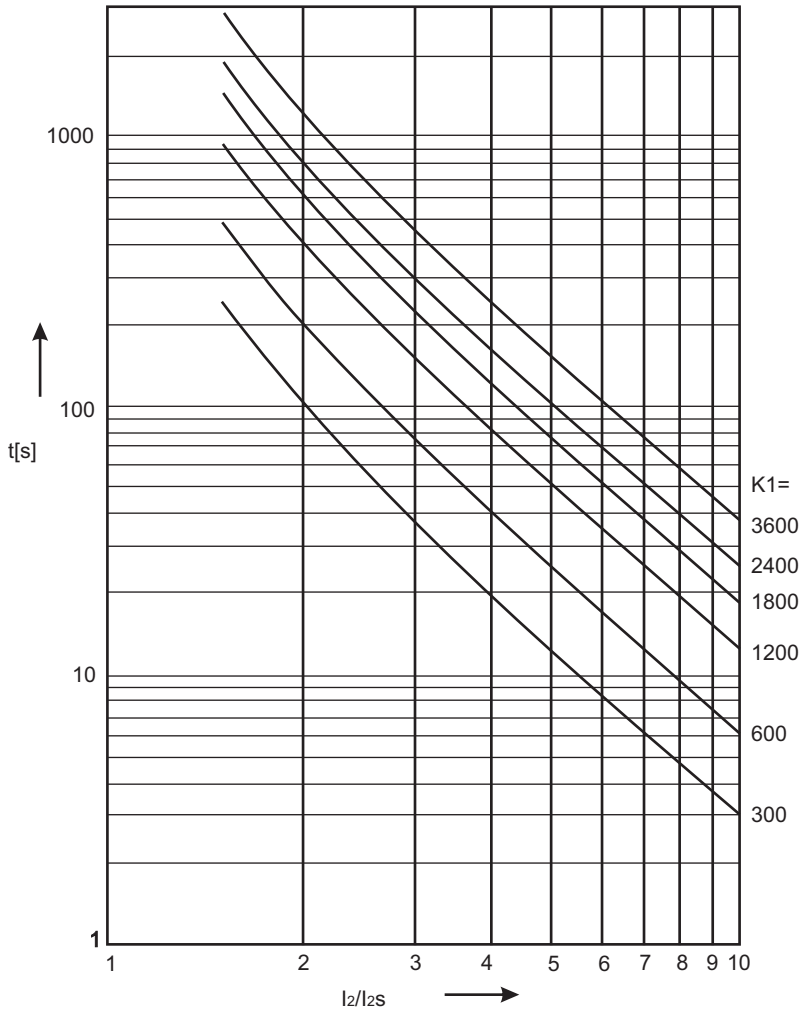
Negative Phase Sequence

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).

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

During motor start-up, a locked rotor is detected with the state of increased phase current above the set value for above the defined start time. 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.

Short Circuit Protection

The stage with definite time delay protects against phase short circuit faults, which are responsible of overheating damages.

Thermal Overload Protection

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.

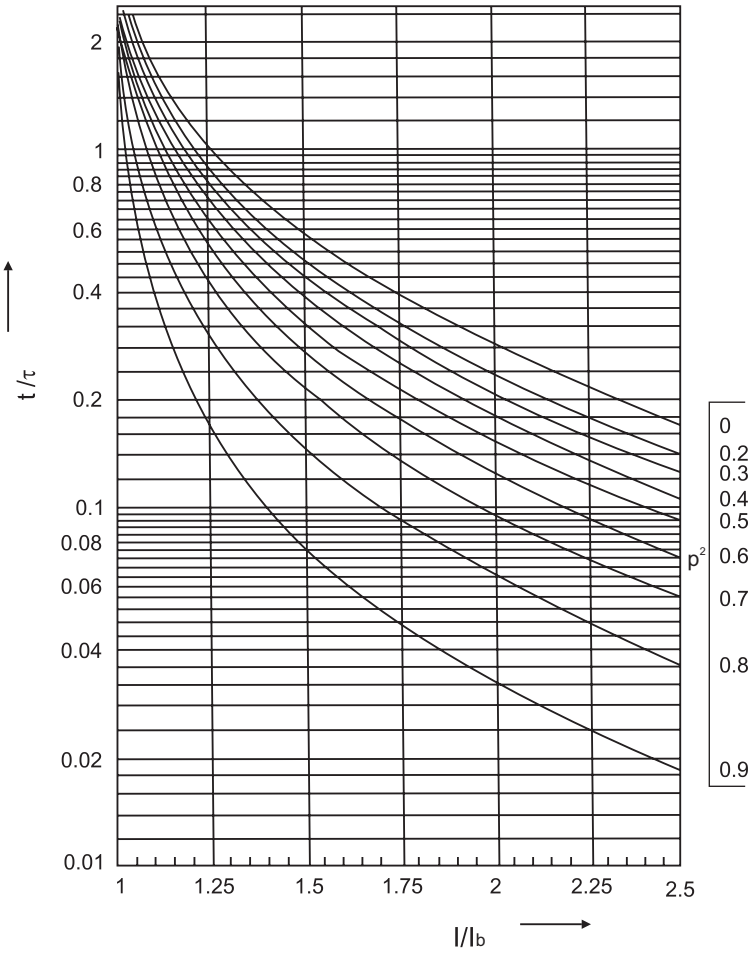
M3: On power Reset thermal memory subtracts for the time it is in off state & starts from the remaining value.

The formula for calculating the trip characteristics is as follows:

$$\text{Trip time (taus)} = \tau \ln \left[\frac{\left(\frac{I^2}{Ib^2} \right) - p^2}{\left(\frac{I^2}{Ib^2} \right) - k^2} \right] \quad \text{for } p^2 < \frac{I^2}{(Ib^2)} \cap p^2 \leqslant k^2$$

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
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:



(Figure-4)

The formula below describe how the thermal model operates from cold and hot, For Setting ranges please see Thermal overload table.

For Trip time (taus) =1 sec at I/Ib=6 we should set Th=35.7 Sec. (0.595 Min.) , k=1, Thermal Trip characteristics=Th1, Tc=1, For I=6.0A we are setting Ib=1.0A then

During Cold Condition : p=0

$$\text{Trip time (taus)} = Th.IN \left[\frac{\left(\frac{I^2}{Ib^2}\right)}{\left(\frac{I^2}{Ib^2}\right) - k^2} \right]$$

During Running (Hot) Condition

For Trip time (taus) =1 sec at I/Ib=6 we should set Th=35.7 Sec. (0.595 Min.) , k=1, Thermal Trip characteristics=Th1, Tc=1, For I=6.0A we are setting Ib=1.0A then

$$\text{Trip time (taus)} = Th.IN \left[\frac{\left(\frac{I^2}{Ib^2}\right) - p^2}{\left(\frac{I^2}{Ib^2}\right) - k^2} \right]$$

$p^2 = (1-H/C)$

For H/C=80% P=1-0.8=0.2 so p=0.447

Similarly for H/C=50% P=1-0.5=0.5 so p=0.7071

Similarly for H/C=20% P=1-0.2=0.8 so p=0.894

Thermal Overload Trip Times

The table below shows the trip times for Thermal Overload when t6x is set to 1 second (I/Ib=6*In & trip time is 1 second)

Multiple of Permissible Basic current	Trip Time Cold Condition	Trip Time when H/C =80%	Trip Time when H/C =50%	Trip Time when H/C =20%
1.1	62.520	56.077	43.489	23.952
1.2	42.327	36.994	27.100	13.419
1.3	31.980	27.488	19.457	9.117
1.4	25.481	21.643	14.968	6.779
1.5	20.984	17.664	12.012	5.317
1.6	17.683	14.782	9.925	4.322
1.7	15.161	12.603	8.380	3.604
1.8	13.177	10.904	7.193	3.064
1.9	11.580	9.547	6.257	2.646
2	10.270	8.441	5.503	2.313
2.1	9.181	7.525	4.885	2.042
2.2	8.262	6.757	4.370	1.819
2.3	7.480	6.106	3.936	1.633
2.4	6.808	5.547	3.566	1.475
2.5	6.224	5.064	3.248	1.340
2.6	5.715	4.644	2.972	1.223
2.7	5.267	4.275	2.731	1.122
2.8	4.871	3.950	2.519	1.033
2.9	4.519	3.661	2.331	0.954
3	4.205	3.403	2.164	0.885
3.1	3.923	3.173	2.015	0.823
3.2	3.669	2.965	1.881	0.767
3.3	3.439	2.778	1.761	0.717
3.4	3.230	2.608	1.652	0.672
3.5	3.040	2.453	1.552	0.631
3.6	2.867	2.312	1.462	0.594
3.7	2.708	2.183	1.380	0.560
3.8	2.562	2.065	1.304	0.529
3.9	2.428	1.956	1.235	0.501
4	2.304	1.855	1.171	0.475
4.1	2.190	1.763	1.112	0.450

4.2	2.083	1.677	1.057	0.428
4.3	1.985	1.597	1.006	0.407
4.4	1.893	1.523	0.959	0.388
4.5	1.808	1.454	0.915	0.370
4.6	1.728	1.390	0.875	0.354
4.7	1.654	1.329	0.837	0.338
4.8	1.584	1.273	0.801	0.324
4.9	1.519	1.220	0.767	0.310
5	1.457	1.171	0.736	0.297
5.1	1.400	1.124	0.707	0.285
5.2	1.345	1.081	0.679	0.274
5.3	1.294	1.039	0.653	0.264
5.4	1.246	1.000	0.628	0.254
5.5	1.200	0.964	0.605	0.244
5.6	1.157	0.929	0.583	0.235
5.7	1.116	0.896	0.562	0.227
5.8	1.077	0.865	0.543	0.219
5.9	1.041	0.835	0.524	0.211
6	1.006	0.807	0.506	0.204
6.1	0.973	0.780	0.490	0.197
6.2	0.941	0.755	0.474	0.191
6.3	0.911	0.731	0.458	0.185
6.4	0.882	0.708	0.444	0.179
6.5	0.855	0.686	0.430	0.173
6.6	0.829	0.665	0.417	0.168
6.7	0.804	0.645	0.404	0.163
6.8	0.781	0.626	0.392	0.158
6.9	0.758	0.608	0.381	0.153
7	0.736	0.590	0.370	0.149
7.1	0.715	0.574	0.359	0.145
7.2	0.695	0.558	0.349	0.141
7.3	0.676	0.542	0.340	0.137
7.4	0.658	0.527	0.331	0.133
7.5	0.640	0.513	0.322	0.129
7.6	0.623	0.500	0.313	0.126
7.7	0.607	0.487	0.305	0.123
7.8	0.592	0.474	0.297	0.120
7.9	0.577	0.462	0.289	0.117
8	0.562	0.451	0.282	0.114
8.1	0.548	0.439	0.275	0.111
8.2	0.535	0.429	0.268	0.108
8.3	0.522	0.418	0.262	0.105
8.4	0.510	0.408	0.256	0.103
8.5	0.498	0.399	0.250	0.100
8.6	0.486	0.389	0.244	0.098
8.7	0.475	0.380	0.238	0.096
8.8	0.464	0.372	0.233	0.094
8.9	0.454	0.363	0.228	0.092
9	0.443	0.355	0.222	0.089
9.1	0.434	0.347	0.218	0.088
9.2	0.424	0.340	0.213	0.086
9.3	0.415	0.333	0.208	0.084
9.4	0.406	0.326	0.204	0.082
9.5	0.398	0.319	0.199	0.080
9.6	0.389	0.312	0.195	0.079
9.7	0.381	0.306	0.191	0.077

9.8	0.374	0.299	0.187	0.075
9.9	0.366	0.293	0.184	0.074
10	0.359	0.287	0.180	0.072
10.1	0.352	0.282	0.176	0.071
10.2	0.345	0.276	0.173	0.069
10.3	0.338	0.271	0.169	0.068
10.4	0.332	0.266	0.166	0.067
10.5	0.325	0.261	0.163	0.066
10.6	0.319	0.256	0.160	0.064
10.7	0.313	0.251	0.157	0.063
10.8	0.307	0.246	0.154	0.062
10.9	0.302	0.242	0.151	0.061
11	0.296	0.237	0.148	0.060
11.1	0.291	0.233	0.146	0.059
11.2	0.286	0.229	0.143	0.058
11.3	0.281	0.225	0.141	0.057
11.4	0.276	0.221	0.138	0.056
11.5	0.271	0.217	0.136	0.055
11.6	0.266	0.213	0.133	0.054
11.7	0.262	0.210	0.131	0.053
11.8	0.257	0.206	0.129	0.052
11.9	0.253	0.203	0.127	0.051
12	0.249	0.199	0.125	0.050
12.1	0.245	0.196	0.123	0.049
12.2	0.241	0.193	0.121	0.048
12.3	0.237	0.190	0.119	0.048
12.4	0.233	0.187	0.117	0.047
12.5	0.229	0.184	0.115	0.046
12.6	0.226	0.181	0.113	0.045
12.7	0.222	0.178	0.111	0.045
12.8	0.219	0.175	0.109	0.044
12.9	0.215	0.172	0.108	0.043
13	0.212	0.170	0.106	0.043
13.1	0.209	0.167	0.104	0.042
13.2	0.205	0.165	0.103	0.041
13.3	0.202	0.162	0.101	0.041
13.4	0.199	0.160	0.100	0.040
13.5	0.196	0.157	0.098	0.040
13.6	0.194	0.155	0.097	0.039
13.7	0.191	0.153	0.095	0.038
13.8	0.188	0.150	0.094	0.038
13.9	0.185	0.148	0.093	0.037
14	0.183	0.146	0.091	0.037
14.1	0.180	0.144	0.090	0.036
14.2	0.177	0.142	0.089	0.036
14.3	0.175	0.140	0.088	0.035
14.4	0.173	0.138	0.086	0.035
14.5	0.170	0.136	0.085	0.034
14.6	0.168	0.134	0.084	0.034
14.7	0.166	0.133	0.083	0.033
14.8	0.163	0.131	0.082	0.033
14.9	0.161	0.129	0.081	0.032
15	0.159	0.127	0.080	0.032

Phase Reversal

The CSEPRO-M relay uses the current to determine that the phase rotation of the signal applied to the relay are in proper order, if finds out of order then in the event of phase reversal, the relay trips in after set time. It helps to protect a three phase motor while installation.

Jam / Stall

Mechanical equipment such as pumps or fans can be quickly damaged if it jams, resulting in a locked rotor stall. Protect the motor. Load jam protection is available only when the CSEPRO-M 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.

7.0 Monitoring Function

Trip Circuit Supervision

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 – 5 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 CSEPRO-M 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

The CB Failure Protection is based on supervision of current after fault tripping events. 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 – 10 for this protection setting.

START WORKING PRINCIPLE

START RECOGNISATION:

CSEPRO-M 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 In) 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 In. 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 In. (Resistance start).

3. If after STOP a motor current has settled between 3% of In and KxIb and the start recognized time has elapsed. (Soft start)

4. If Motor Running Identification input was activated and current is 3% of In, 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 doesnt 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 In. Running is only accepted by the supervision after the time has elapsed.

   Case-1: If once motor starts & I falls below 3% of In for the time less than stop time and again exceeds 3% of In 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 In 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.

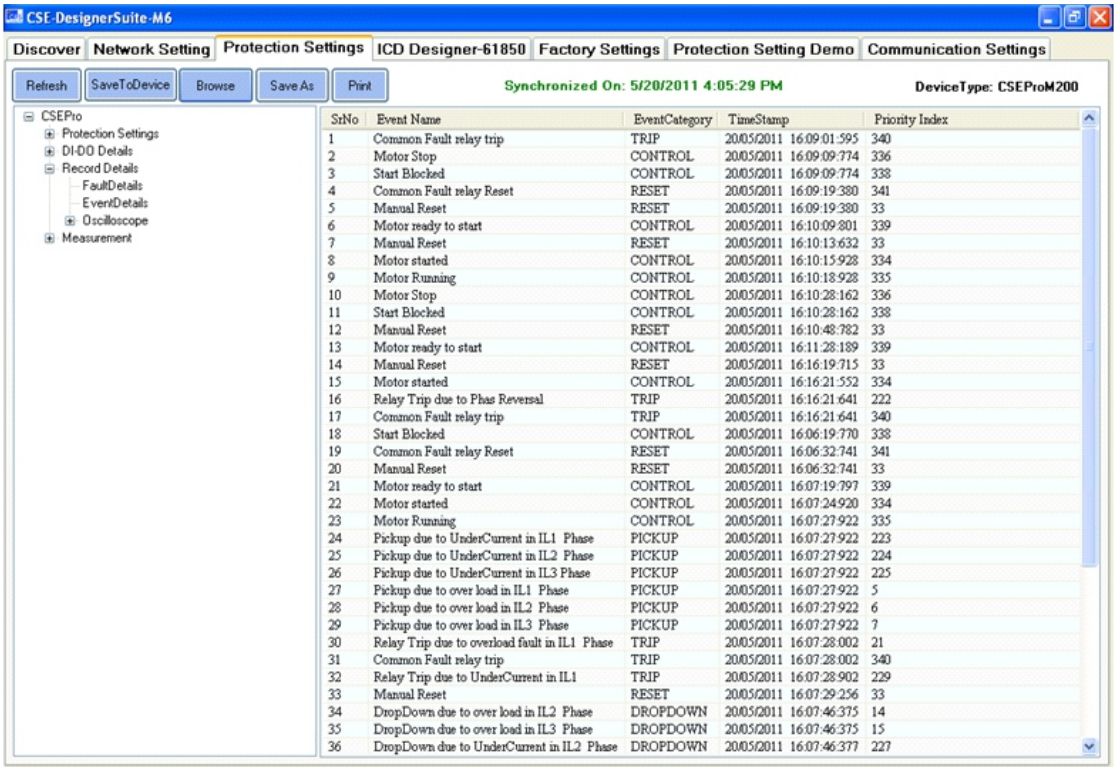
5) **Start Blocking Time**: This time inhibit the start process and assigned relay will block the start for the set blocking time.
6) **Stop Time**: If current goes below 3% of In, then motor stops after set stop time.

8.0 Event Record

The unit stores in non volatile memory the last 100 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



SrNo	Event Name	EventCategory	TimeStamp	Priority Index
1	Common Fault relay trip	TRIP	20/05/2011 16:09:01:595	340
2	Motor Stop	CONTROL	20/05/2011 16:09:09:774	336
3	Start Blocked	CONTROL	20/05/2011 16:09:09:774	338
4	Common Fault relay Reset	RESET	20/05/2011 16:09:19:380	341
5	Manual Reset	RESET	20/05/2011 16:09:19:380	33
6	Motor ready to start	CONTROL	20/05/2011 16:10:09:801	339
7	Manual Reset	RESET	20/05/2011 16:10:13:632	33
8	Motor started	CONTROL	20/05/2011 16:10:15:928	334
9	Motor Running	CONTROL	20/05/2011 16:10:18:928	335
10	Motor Stop	CONTROL	20/05/2011 16:10:28:162	336
11	Start Blocked	CONTROL	20/05/2011 16:10:28:162	338
12	Manual Reset	RESET	20/05/2011 16:10:48:782	33
13	Motor ready to start	CONTROL	20/05/2011 16:11:28:189	339
14	Manual Reset	RESET	20/05/2011 16:16:19:715	33
15	Motor started	CONTROL	20/05/2011 16:16:21:552	334
16	Relay Trip due to Phas Reversal	TRIP	20/05/2011 16:16:21:641	222
17	Common Fault relay trip	TRIP	20/05/2011 16:16:21:641	340
18	Start Blocked	CONTROL	20/05/2011 16:06:19:770	338
19	Common Fault relay Reset	RESET	20/05/2011 16:06:32:741	341
20	Manual Reset	RESET	20/05/2011 16:06:32:741	33
21	Motor ready to start	CONTROL	20/05/2011 16:07:19:797	339
22	Motor started	CONTROL	20/05/2011 16:07:24:920	334
23	Motor Running	CONTROL	20/05/2011 16:07:27:922	335
24	Pickup due to UnderCurrent in IL1 Phase	PICKUP	20/05/2011 16:07:27:922	223
25	Pickup due to UnderCurrent in IL2 Phase	PICKUP	20/05/2011 16:07:27:922	224
26	Pickup due to UnderCurrent in IL3 Phase	PICKUP	20/05/2011 16:07:27:922	225
27	Pickup due to over load in IL1 Phase	PICKUP	20/05/2011 16:07:27:922	5
28	Pickup due to over load in IL2 Phase	PICKUP	20/05/2011 16:07:27:922	6
29	Pickup due to over load in IL3 Phase	PICKUP	20/05/2011 16:07:27:922	7
30	Relay Trip due to overload fault in IL1 Phase	TRIP	20/05/2011 16:07:28:002	21
31	Common Fault relay trip	TRIP	20/05/2011 16:07:28:002	340
32	Relay Trip due to UnderCurrent in IL1	TRIP	20/05/2011 16:07:28:902	229
33	Manual Reset	RESET	20/05/2011 16:07:29:256	33
34	DropDown due to over load in IL2 Phase	DROPDOWN	20/05/2011 16:07:46:375	14
35	DropDown due to over load in IL3 Phase	DROPDOWN	20/05/2011 16:07:46:375	15
36	DropDown due to UnderCurrent in IL2 Phase	DROPDOWN	20/05/2011 16:07:46:377	227

(Figure-5) Event Data recording on PC Software

Output Contacts

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

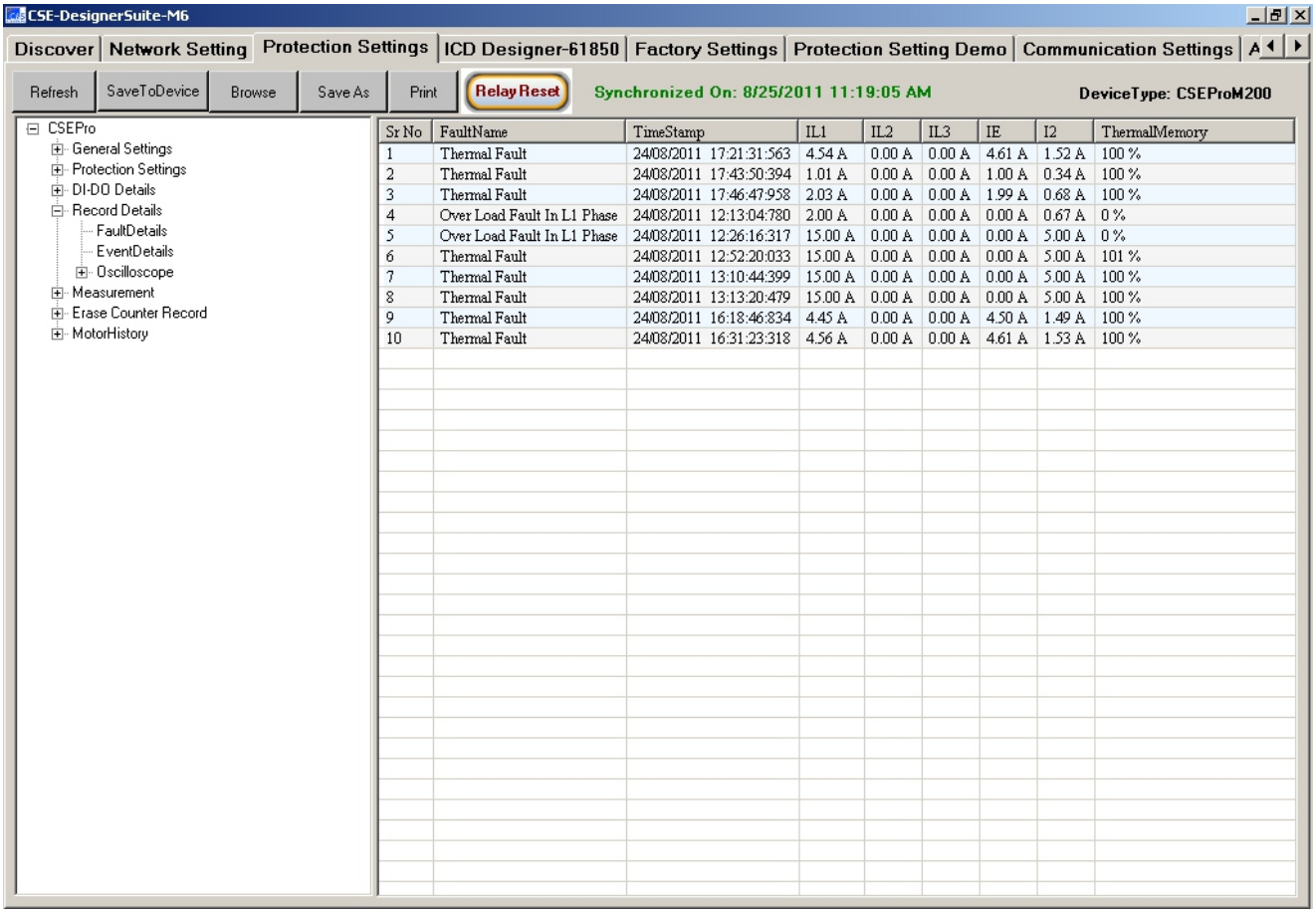
Input Contacts

No of digital inputs	:	6 (DI1, DI2, DI3, DI4, DI5, DI6)
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. CSEPRO-M records last 10* faults in its non volatile memory with time stamp. Each record has following information :

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



Sr No	FaultName	TimeStamp	IL1	IL2	IL3	IE	I2	ThermalMemory
1	Thermal Fault	24/08/2011 17:21:31:563	4.54 A	0.00 A	0.00 A	4.61 A	1.52 A	100 %
2	Thermal Fault	24/08/2011 17:43:50:394	1.01 A	0.00 A	0.00 A	1.00 A	0.34 A	100 %
3	Thermal Fault	24/08/2011 17:46:47:958	2.03 A	0.00 A	0.00 A	1.99 A	0.68 A	100 %
4	Over Load Fault In L1 Phase	24/08/2011 12:13:04:780	2.00 A	0.00 A	0.00 A	0.00 A	0.67 A	0 %
5	Over Load Fault In L1 Phase	24/08/2011 12:26:16:317	15.00 A	0.00 A	0.00 A	0.00 A	5.00 A	0 %
6	Thermal Fault	24/08/2011 12:52:20:033	15.00 A	0.00 A	0.00 A	0.00 A	5.00 A	101 %
7	Thermal Fault	24/08/2011 13:10:44:399	15.00 A	0.00 A	0.00 A	0.00 A	5.00 A	100 %
8	Thermal Fault	24/08/2011 13:13:20:479	15.00 A	0.00 A	0.00 A	0.00 A	5.00 A	100 %
9	Thermal Fault	24/08/2011 16:18:46:834	4.45 A	0.00 A	0.00 A	4.50 A	1.49 A	100 %
10	Thermal Fault	24/08/2011 16:31:23:318	4.56 A	0.00 A	0.00 A	4.61 A	1.53 A	100 %

(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

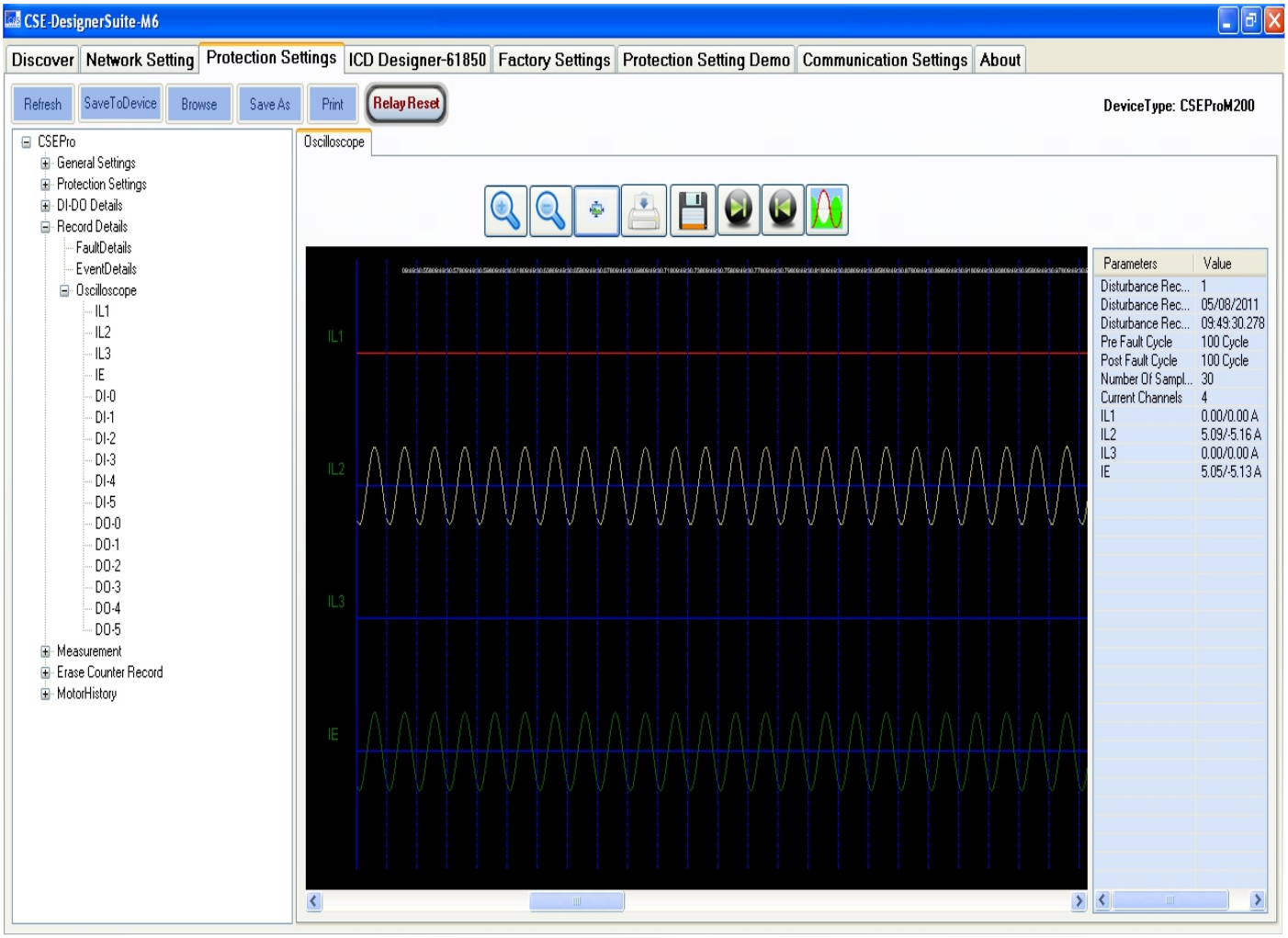
Measurements

- L1, L2, L3 phase current measurements
- Earth current measurement
- Negative Sequence current
- Frequency

Disturbance Record

The CSEPRO-M relay has an oscillograph data recorder with the following characteristics:

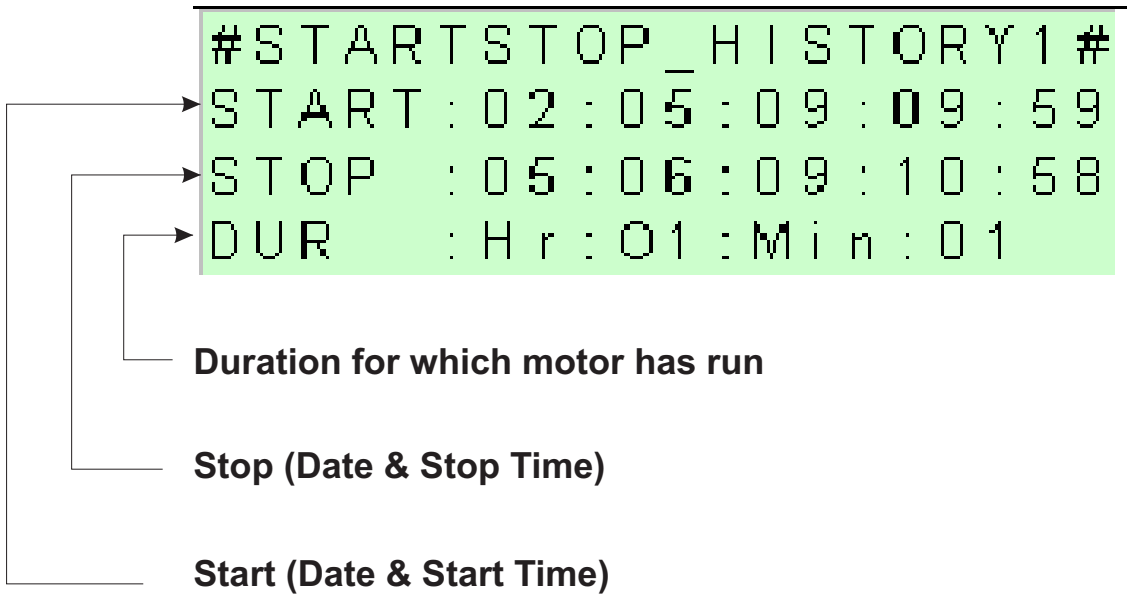
- Oscilloscope recording can trigger on Pickup or on trip or via DI i.e. change from pre-fault to post-fault stage. It is programmable.
- Each record comprises the samples from 4 analog signals and the status of 6 digital inputs and 6 digital outputs. There will be 30 samples per cycle.
- Relay saves 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-13 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.
- Record 1 is always latest record. 2nd record is older than 1st..... and so on.
- Disturbance record in comtrade format as per IEC60255-24



(Figure-7) Oscilloscope recording on PC software

Motor Start-up Record

The CSEPRO-M 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

CSEPRO-M 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.

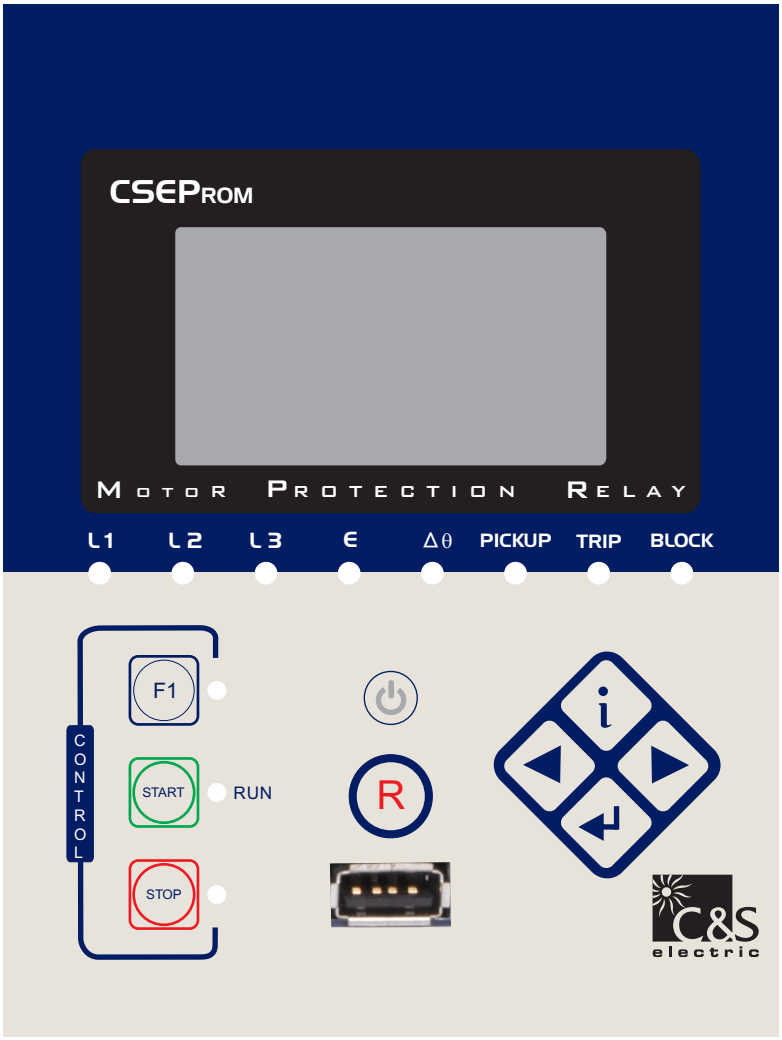
Maxi-meter

The unit stores the maximum current value, plus the time tag 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:

- Four push switches for set values of normal tripping characteristics.
- One RESET 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 faults & events in any phase.



(Figure-9) HMI

Keys	Manual Key
	is used as intelligent key to see the details of the last fault and fault pickup status.
	is used as a ENTER key.
	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.
	To perform the assigned task either DO Trip, DO Reset or thermal reset.
	To start the motor (via assignable DO).
	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.

Rear Communication (RS-485 - based on ordering model)

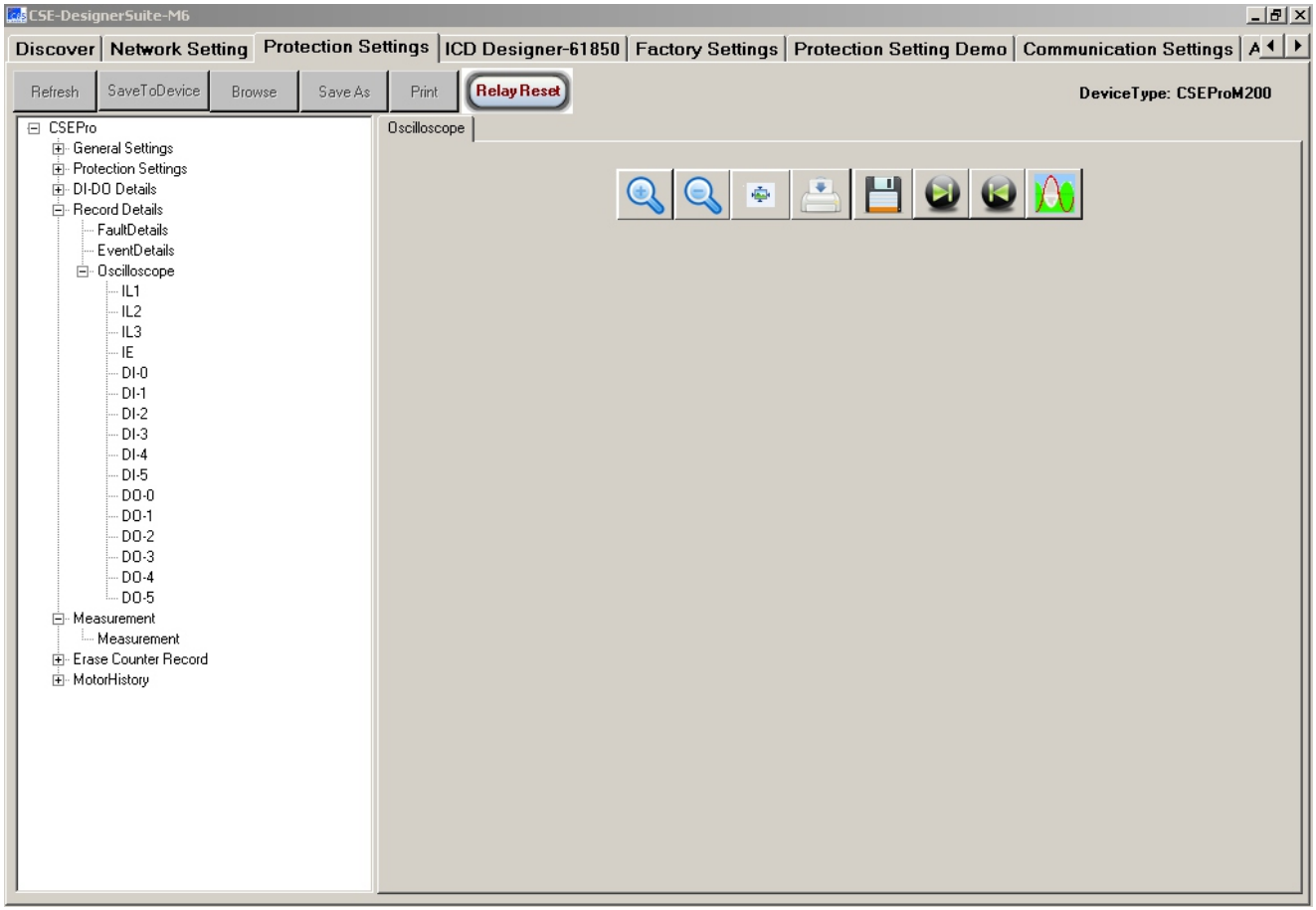
The protocol for the rear port is programmable. The user can choose either MODBUS or IEC 870-5-103 protocol for RS-485 communication.

Front (USB) Communication

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. 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 groups 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	-
Over-load pickup setting	I>	0.2	4xIp	0.05
Over-load inverse timing	ti>	0.04	260	0.01
Over-load definite timing	t>	0.05s	260s	0.01
Under-current pickup setting	I<	0.20	1.00xIp	0.01
Under-current timing	t<	0.05	260s	0.01
Short circuit pickup setting	I>>	0.2	30xIp	0.02
Short circuit definite timing	t>>	0.04s	20s	0.02

(Table-1)

Thermal Over-load

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

(Table-2)

Earth Protection

Parameters	Display	Setting Range		Step size
		Min	Max	
Earth trip characteristics	CURVE	DEFT	EINV, VINV, LINV NINV1.3, NINV3.0	-
Earth pickup setting	Ie>	0.05	2.5xIn	0.05xIn
Earth inverse timing	tie>	0.05	20.00	0.05
Earth definite timing	te>	0.03	260 Sec	0.01Sec
Earth Hi-set pickup setting	Ie>>	0.5	8xIn	0.05xIn
Earth Hi-set definite timing	te>>	0.02	20 Sec	0.01Sec

(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]

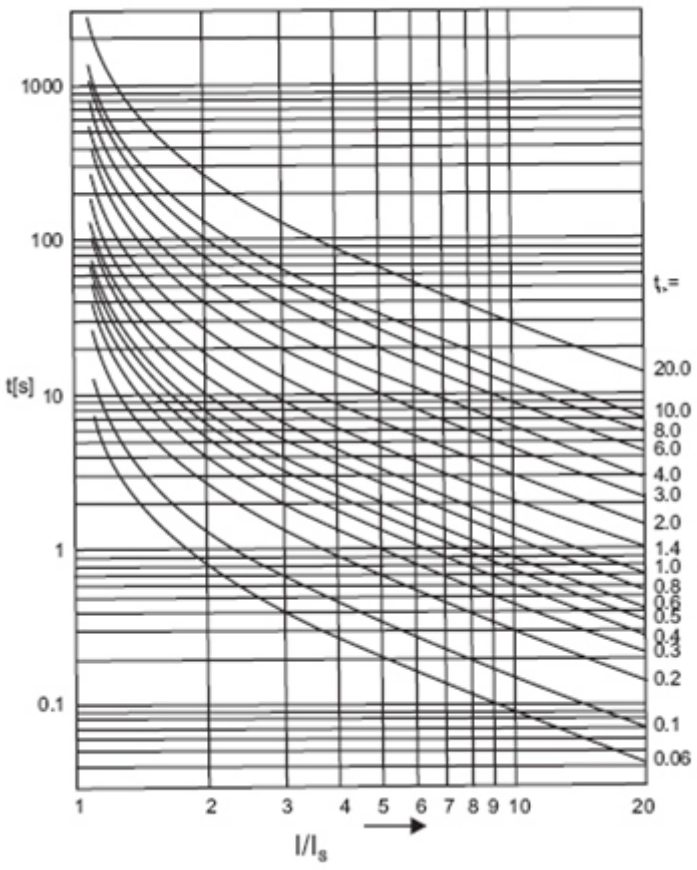
Extremely Inverse $t = \dfrac{80}{(I / I_s)^2 - 1}$ ti [s]

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]

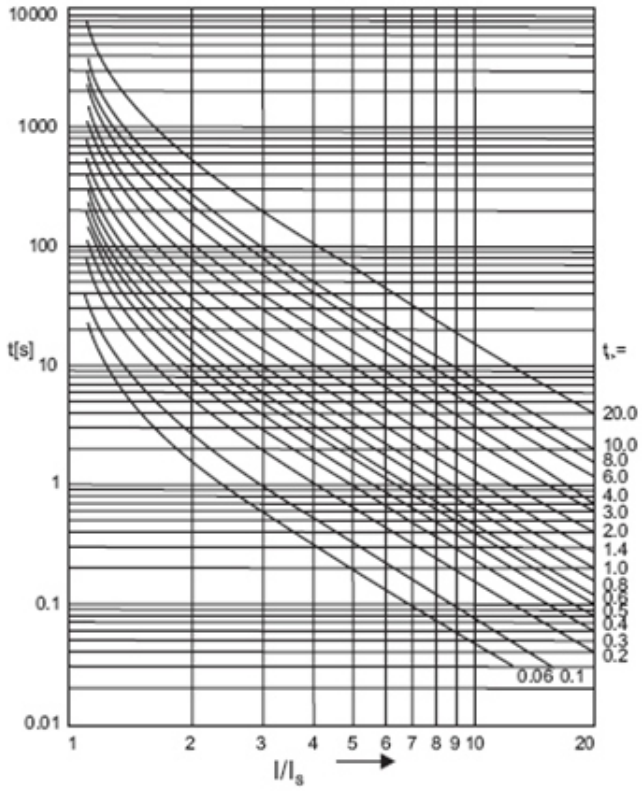
Where t =Tripping time ti =Time multiplier
I =Fault current I_s =Setting value of current

Very Inverse



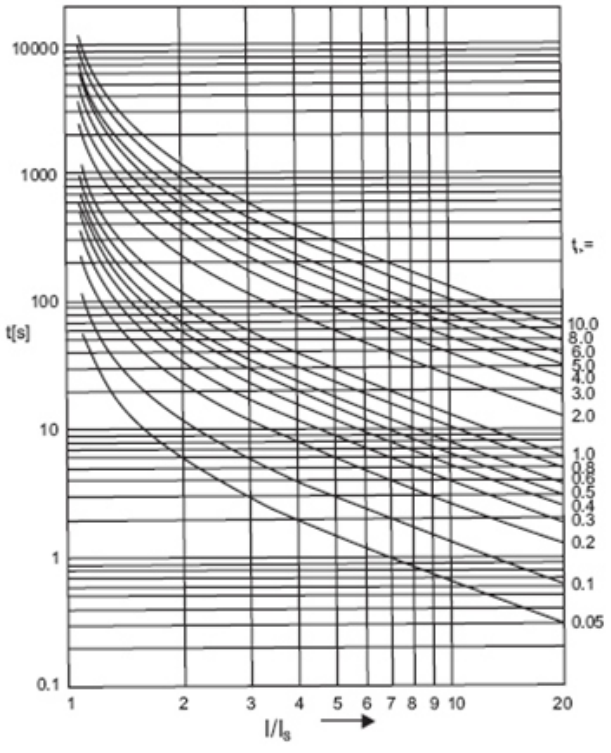
(Figure-11)

Extremely Inverse



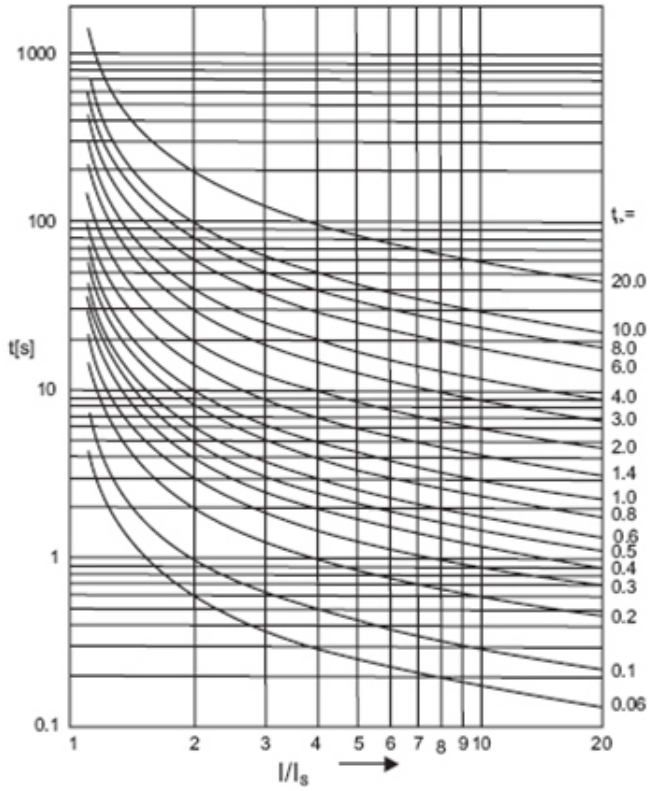
(Figure-12)

Long Time Inverse



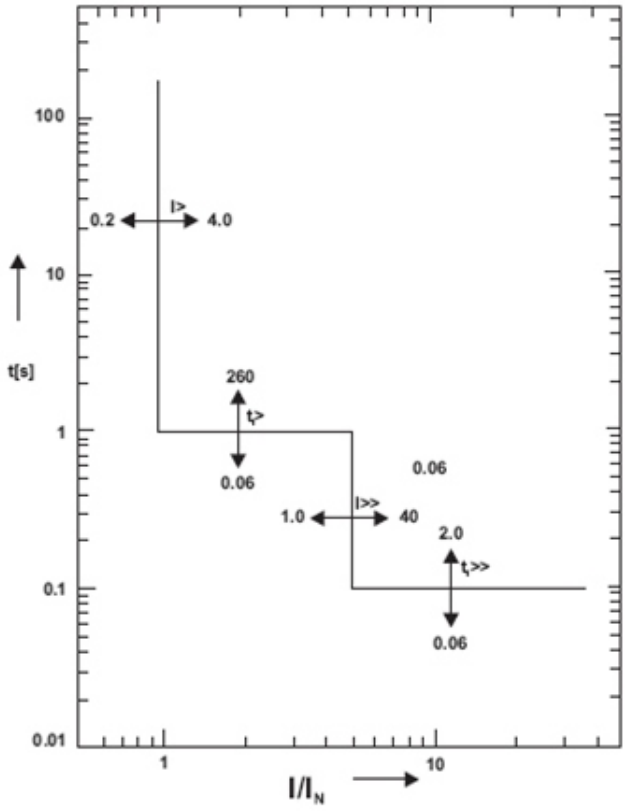
(Figure-13)

Normal Inverse



(Figure-14)

Definite Trip Characteristics



(Figure-15)

Motor Control Setting

Parameters	Display	Setting Range		Step size
		Min	Max	
Start limit time (Notching/Jogging)	STRLMTTIM	1 Min	300Min	1Min
Start attempt	STRTATEMPT	1	20	1
Starting time	START TIME	0.20Sec	500Sec	0.01Sec
Start interval time	STRT INTRVL	1	240Min	1Min
Start blocking selection	STRTBLKSEL	Thermal	Start, Both	-
Start blocking time	STRT BLKTIM	1	60Min	1Min
Stop time (stop recognition delay)	STOP TIME	0.05Sec	10Sec	0.01 Sec
Phase loss trip time	TPHLS	0.10Sec	10Sec	0.01Sec
Lock rotor pickup setting	LCKRTR_I	2xIp	30xIp	2xIp
Lock rotor trip time	LCKRTR_T	0.04Sec	20Sec	0.01Sec
Stall / Jam pickup setting	STALL_I	0.5xIp	30xIp	0.1xIp
Stall trip time	STALL_T	1Sec	60Sec	1Sec
Phase reversal	PHRVRBLK	Disable	Enable	-
Phase reversal trip time	PHRVRTIM	0.1Sec	30Sec	0.1Sec
External trip delay	TRIPDLY	000.1Sec	260Sec	0.1Sec

(Table-4)

Trip Circuit Supervision Protection

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

(Table-5)

DO Assignment

Parameters	Display
Overload protection	I>
Short circuit protection	I>>
Undercurrent	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 trip	ExtrnlTrp
Trip circuit supervision	TCS
Motor running	MotorRun
Self supervision	SlfSpvsn

(Table-6)

DI Assignment

Parameters	Display
Circuit breaker open	CB_open
Circuit breaker close	CB_close
Remote start	Rmtstart
Remote stop	Rmtstop
Remote reset	RmtRSET
Overload blocking	OL_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	ThrmBLK
NPS blocking	NPS_BLK
Under current blocking	UC_BLK
External delay trigger	ExDlyTrp
External un-delay trigger	ExUnDITrp
Motor running identification	MtrRunng
Oscilloscope record triggering	OSCTrig
Group toggling	GRP_Togg
Emergency start	EmrgStrt
Start blocking	StartBLK

(Table-7)

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 Ranges
Function key	F1	DO1/DO2/DO3/DO4/DO5/DO6 Relay Reset, Thermal Reset

(Table-8)

Function Reset

Parameters	Display	Setting Ranges	
		Min.	Max.
Overload protection	I>	Auto	Manual
Short circuit protection	I>>	Auto	Manual
Undercurrent	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	ExtrnlTrp	Auto	Manual
Trip circuit supervision	TCS	Auto	Manual
Motor running	MotorRun	Auto	Manual

(Table-9)

Circuit Breaker Failure Protection

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

(Table-10)

Negative Phase Sequence Setting

Parameters	Display	Setting Range		Step size
		Min	Max	
NPS trip characteristic	CHAR	DEFT	NPS_INV	-
NPS pickup setting	I_2s	0.10xIp	1.00xIp	0.01xIp
Time multiple	K1	5 Sec	600 Sec	1Sec
Definite time delay	td	0.1 Sec	600 Sec	0.1Sec

(Table-11)

Common Setting

These are the settings common for all the protections:

Parameters	Display	Setting Range		Step size
		Min	Max	
Rated phase current	Ip	1.00 Amp	5.00 Amp	-
Rated earth current	In	1.00 Amp	5.00 Amp	-
Phase CT ratio	PhCTRatio	1	9999	1
Earth CT ratio	ECTRatio	1	9999	1
Nominal frequency	Nom.FREQ	50 Hz	60 Hz	-

(Table-12)

Disturbance Record Setting

These are the settings for Oscilloscope recording:

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

(Table-13)

Rear Port (RS-485) Communication Setting (*Availability as per model selection)

Protocol	MODBUS RTU / IEC-103
Baud rate selection (Programmable)	4800 / 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-14)

Front 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-15)

13.0 Technical Data

Measuring Input

Rated Data	Rated Current Ip : 1A & 5A
	Rated Frequency Fn : 50Hz / 60Hz
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-16)

Measurement Accuracy

Parameters	Range	Frequency Range	Accuracy
Current in Ampere	1.0x30xIp	50-60Hz	Less than ±2%

(Table-17)

Trip Time Accuracy

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

(Table-18)

Trip Contact Rating

Contact Rating	
Contact relay	Dry contact Ag Ni
Make current	Max. 30A & carry for 3S
Carry capacity	8A continuous
Rated voltage	250V AC/30V DC
DC Current Carrying Capacity	8A@30VDC / 0.3A@110VDC/ 0.2A@220VDC.
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=30ms)
	250V DC, 50W resistive or
	25W inductive (L/R=40ms)
Operating time	<10ms
Durability	
Loaded contact	10,000 operation minimum
Unloaded contact	30,000 operation minimum

(Table-19)

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	80V-260V AC (Active)
	For H Model	48V-300V DC (Active)
		<30V DC (Inactive)
		<50V AC (Inactive)
	Normal Voltage UN	24V - 60V DC (Active)
	For L Model	<18V DC (Inactive)
Power consumption	Quiescent approx. 3W	Operating approx. <7W

(Table-20)

Common Data

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

(Table-21)

14.0 Standards

Type Test			
F1	Functional Tests	Internal Design	Performance in line with Specification & Standards
		Specifications & IEC60255-6 IEC60255-3	Pickup/Drop down/ Power consumption in Current/Voltage/Aux Supply/ Trip timing accuracy: OC/ Directional/ NPS/ Thermal / OV/ Zero Seq/ Over Power/ freq/ Rate of change of Freq

Climatic Test			
C1	Temperature Dry Cold (Relay operational)	IEC 60068-2-1	-20 deg C, 96 hours
C2	Temperature Dry Cold Transportation & Storage	IEC 60068-2-1	-25 deg C, 96 hours
C3	Temperature Dry Heat (Relay operational)	IEC 60068-2-2	55 deg C, 96 hours
C4	Temperature Dry Heat Transportation & Storage	IEC 60068-2-2	70 deg C, 96 hours
C5	Damp Heat Test (Relay operational)	IEC 60068-2-3	95% @ +55 / +25 deg C, 6 cycle (12hr + 12hr each)

Enclosure			
C6	Enclosure	IEC 529	Front IP54 (Dust5x + Water x4)

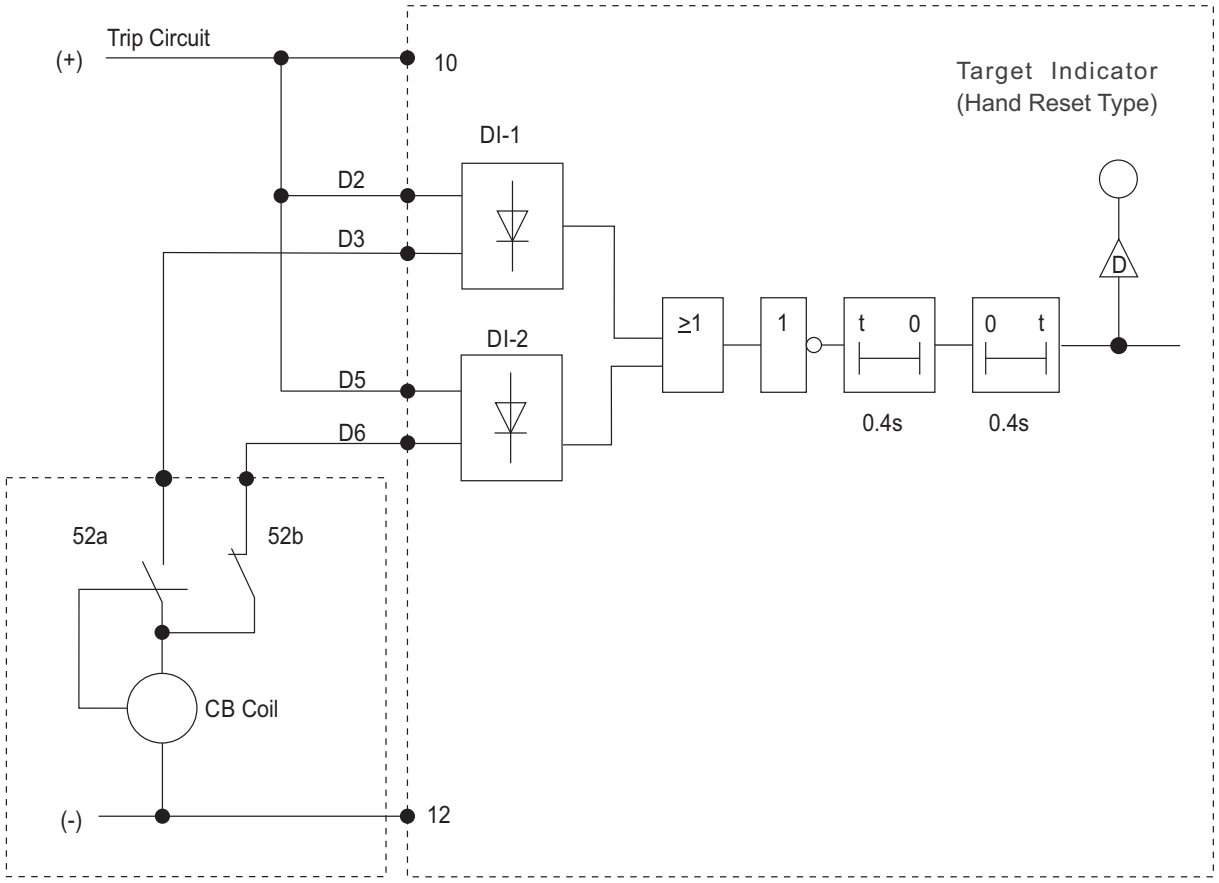
Mechanical Test

Relay Operational			
M1	Vibration response / Endurance test	IEC 60255-21-1	Class I Vibration response (Relay operational) 10Hz~150 Hz - peak displacement 0.035 mm below 58/60 Hz, 0.5 g above, 1 sweep cycle in each axis Vibration endurance (Relay de-energised) 10 Hz~150 Hz 1g, 20 sweep cycles in each axis
M2	Shock response / Withstand Test	IEC 60255-21-1	Class I Shock response (Relay operational) 5g 11mS 3 pulse in each axis Shock withstand (Relay de-energised) 15g 11mS 3 pulses in each axis
M3	Bump	IEC 60255-21-1	Bump (Relay de-energised) 10g 16mS 1000 pulses in each axis
M4	Seismic	IEC 60255-21-3	Class I Method A single axis sine sweep 1 Hz~35 Hz–below 8/9 Hz 3.5 mm peak displacement horizontal axis, 1.5 mm vertical axis above 8/9 Hz 1g horizontal, 0.5 g vertical 1 sweep cycle in each axis

Electrical Test			
E1	Insulation Resistance >100MΩ	IEC 60255-5	500V DC, 5 sec between all terminals & case earth, between terminals of independent circuits including contact circuits and across open contacts
E2	DC & AC Supply Voltage (Relay operational)		IEC60255-6Voltage range, upper & lower limit continuous withstand, ramp up & down over 1 minute
E3	Voltage Dips, Short Interruptions & Voltage variations immunity (Relay operational)	IEC 1000-4-11	IEC60255-113 Dips & 3 Interruptions at 10 sec intervals of duration between 10mS and 500mS at zero crossings & at other points on wave Variation: 100% to 40% over 2s, hold for 1s, return to 100% over 2s
E4	Ripple in DC supply (Relay operational)	IEC 60255-11	12% AC ripple
E5	Dielectric Test (Relay de-energised) No breakdown or flash over Test voltage 45~65 Hz sinusoidal or with DC voltage at 1.4x the stated AC values	IEC 60255-5	2.0 KV @ 1min All circuit to Earth / Between IP & OP except communication terminals
E6	High Voltage Impulse (Relay de-energised)	IEC 60255-5	5 kV peak 1.2/50uS, 0.5 J-3 positive, 3 negative between all terminals to case earth between independent circuits
E7	VT Input Thermal Withstand		1.5xVn, continuous
E8	CT Input Thermal Withstand		250xIn half wave 100xIn for 1 second 30xIn for 10 second 4xIn continuously
E9	Contact performance & endurance tests	IEC 60255-14,15 IEC 60255-23	

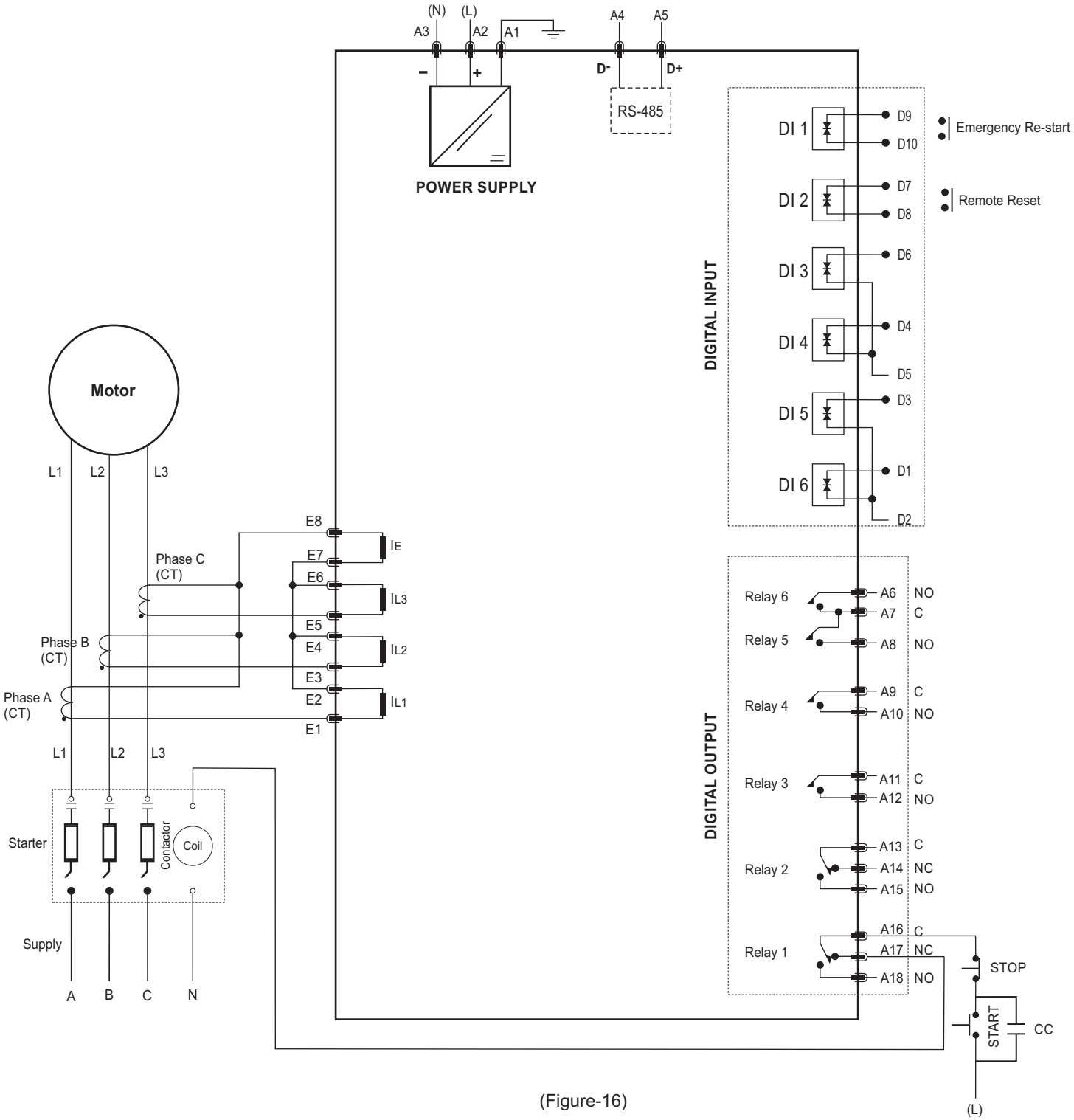
Electro-magnetic Compatibility			
R1	Electrical fast Transient/Burst (Relay operational)	IEC 60255-22-4 IEC 60100-4-4	Class IV- ±4.0 kV All Circuits. Pulse 5/50msec / Duration 15msec / Period: 300msec/Pulse Freq: 5KHz / 2KV at I/O
R2	HF Disturbance Test (Oscillatory Waves) 1 MHZ Burst (Relay operational)	IEC 60255-22-1	Class III Longitudinal 2.5 kV peak, 2sec between independent circuits & case earth
R3	Electrostatic Discharge (Relay operational)	IEC 60255-22-2 IEC 61000-4-2	Class III 8kV air discharge, 6KV contact No of Discharge : 10 both polarities at 1 sec intervals
R4	Conducted Disturbance RF fields (Relay operational)	IEC 61000-4-6 IEC 60255-22-6	0.15 to 80 MHZ (Level-3) Severity Level 10V RMS + sweeps 0.05-0.15 MHZ & 80-100 MHZ
R5	Radiated RF E-M field immunity test (Relay operational)	IEC 60255-22-3 IEC 61000-4-3	Class III Test method A + sweep 80-1000 MHZ or IEC 1000-4-3 80-1000 MHZ severity 10 V/m 80% modulated 1 kHz
R6	Surge Immunity capacitively coupled (Relay operational)	IEC 61000-4-5 Class 5 Test level 4 IEC 60255-22-5: 2008 Latest: IEC 60255-26:2013	Short circuit combination wave generator 1.2 uS/50 uS open circuit repetition rate 1 per minute Power supply, CT & VT circuits – 4kV common mode 2 Ohm source 2kV differential mode 12 Ohm source
R7	Power Frequency Magnetic Field (Relay operational)	IEC 61000-4-8	100 A/m for 1 minute in each of 3 axes
R8	Conducted & Radiated RF Interference Emission (Relay operational)	EN 55011 IEC 60255-25	CISPR11 / Class A
R9	Power Frequency, conducted common mode	IEC 1000-4-16 IEC 60255-22-7	D.C. to 150 kHz Test Level 4 300V at 16 2/3 Hz and 50 Hz

15.0 Trip Circuit Supervision Diagram



(Figure 5) (Trip Circuit Supervision Function)

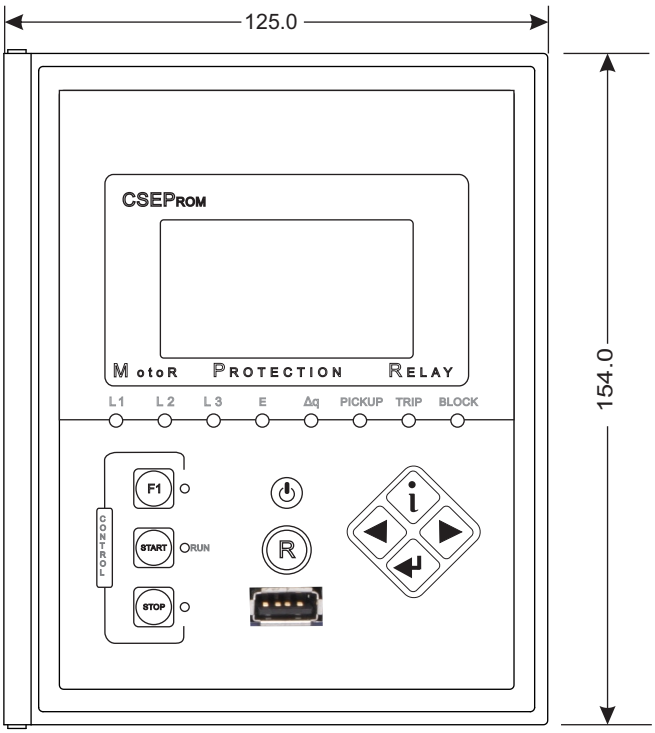
16.0 Connection Diagram



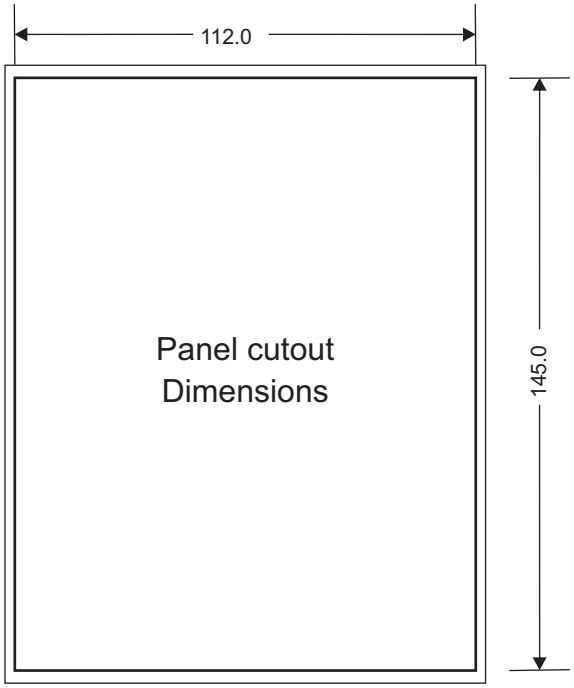
(Figure-16)

17.0 Dimensional Details (All the dim. are in mm, Gen. Tol : ± 1.0 mm)

Front View

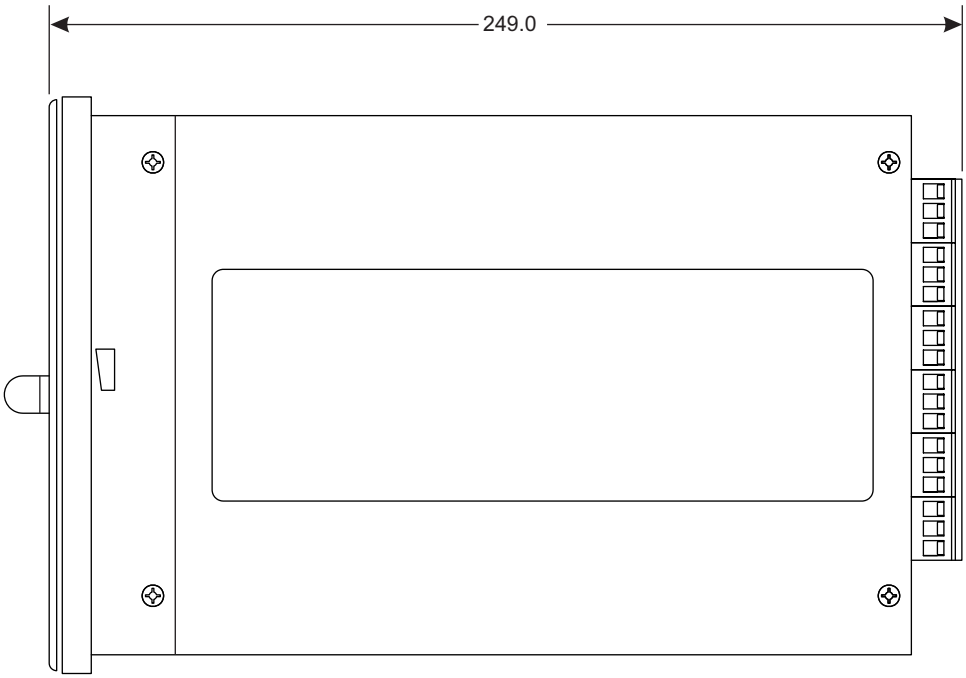


(Figure-17)



(Figure-18)

Side View



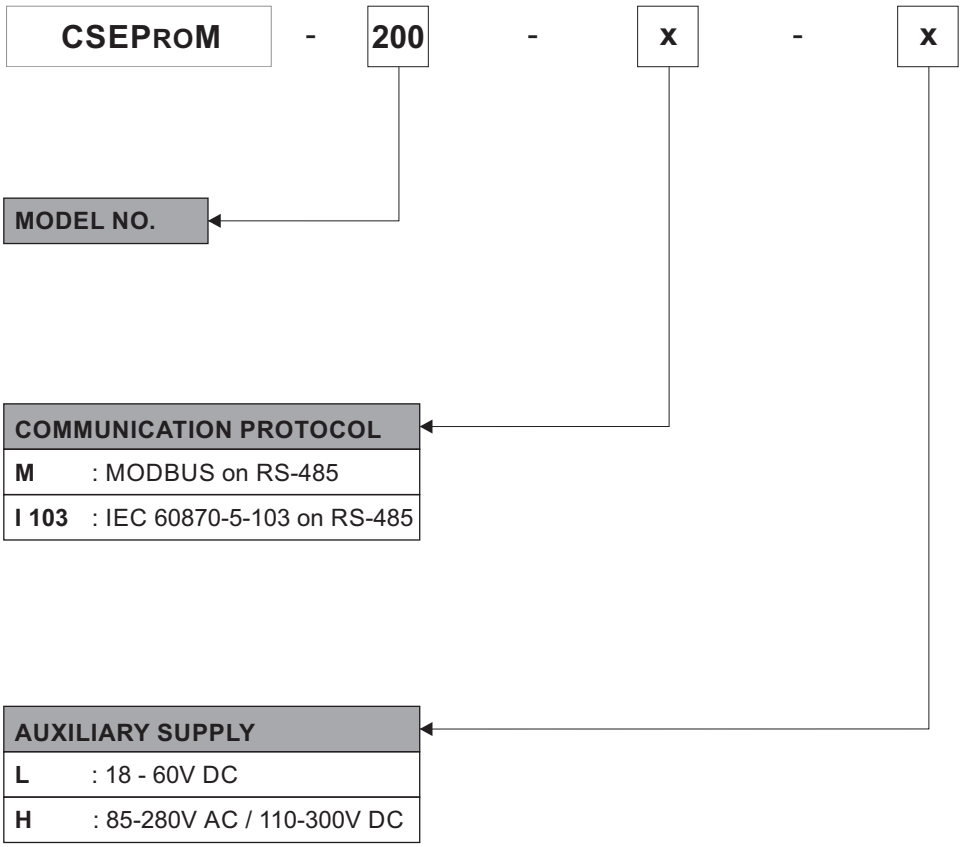
(Figure-19)

18.0 Model Specification Table

Desciption	ANSI	CSEProM200
CT inputs		4
Opto inputs (Max)		6
Output contacts (Max)		6
Function keys / Hot keys		●
Protection		
Motor protection		
Locked rotor	50LR	●
Stall	50S	●
Acceleration	27LV	-
Startup monitoring / Excessive long start	66/48	●
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	●
Circuit breaker failure	50BF	●
Trip circuit supervision	74TC	●
Communication		
Front (USB)		●
Rear RS-485 Modbus		●
RS-485 IEC 60870-5-103		○

○ Optional-Based on Ordering Information

19.0 Ordering Information



CSEPRO-M200

Revision History

S.No.	Rev.No.	Details	Date
01	11	Inclusion of TCS Diagram	05.08.14
02	12	Removed M-240 & M-270 details from Model selection table and from ordering information	28.03.16
03	13	Include paged 7, 8, 9 of Thermal over load Trip times	01.11.17
04	14	Include Cold load & hot load condition on page 7	06.11.17
05	15	Step size included in setting ranges	31.07.19
06	16	RJ-45 & IEC 61850 details removed from the catalog	06.06.24

NOTE

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C&S reserves the right to change the design, content or specification contained in this without prior notice.

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Issue Date: 25.08.11, Rev. No: 16, Rev. Date: 06.06.24

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