![C&S electric logo]

CSEPRO-F 300

Intelligent measuring & protection device

CSEPRO
CSEPRO
CSEPRO
CSEPRO
Series

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 CSEPROFxxx is an advanced feeder protection solution which has fast, sensitive and secure protection for feeder faults.

CSEPROFxxx also provides an automation solution of power control. It complies with IEC 60870-5-103, IEC 61850, Modbus protocol for high integration of protection & control.
CSEPROFxxx offers following model based features to cover requirements of the wide range of users.

- ❖ 1A & 5A Programmable Rated Current.
- ❖ Draw out enclosure have modular design with CT shorting.
- ❖ Modular design with self CT shorting.
- ❖ Measurement, Protection & Metering.
- ❖ SCADA Communication (Local & Remote).
- ❖ Disturbance Record.
- ❖ DI/DO Matrix Programmability.
- ❖ Intelligent key for DI status & DO status, details of fault pickup & status of last fault occurred.
- ❖ Last 10 fault record (non-volatile memory) with time stamp.
- ❖ Last 100 event record (non-volatile memory) with time stamp.
- ❖ CSEPRO-F relays are equipped with self supervision function.
- ❖ Star & Delta configuration 63.5/110V.

2.0 Application

The CSEPRO-F relay has been designed for controlling, protecting and monitoring industrial, utility distribution networks and substations. They can also be used as part of a protection scheme for feeders, transformers and generators.

CSEPROF Model
CSEPROF is available in following models: -
CSEPROF120: Voltage Protection
CSEPROF220: Non Directional Sensitive Current Protection
CSEPROF240: Non Directional Current Protection
CSEPROF300: Current + Voltage Protection
CSEPROF350: Directional Current + Voltage Protection
CSEPROF400: Voltage + Frequency Protection
CSEPROF500: Current + Voltage + Frequency Protection

3.0 Hardware

- ❖ Digital Signal Processor based numeric design
- ❖ Measures true RMS with DFT filter.
- ❖ 1A & 5A common current terminal & programmable.
- ❖ 4 Current Analog Input.
- ❖ 3 Voltage Analog Input.
- ❖ Max. 6 Digital Inputs.
- ❖ Max. 6 Digital Outputs.
- ❖ 8 LED's at Pkup & Trip on fault + 3 LED's with special function of 3 control keys.
- ❖ LAN-RJ45/RS-485/USB ports for Communication.
- ❖ 16x4 Alpha numeric LCD.
- ❖ 8 Push button on the front for MMI.

4.0 Protection Features

- ❖ Three Phase Time Over Current Protection (50/51)
- ❖ Three Phase Instantaneous Protection (50)
- ❖ Ground Time Over Current (51N)
- ❖ Ground Instantaneous Over Current (50N)
- ❖ Current Unbalance (46)
- ❖ Broken Conductor Detection (46BC)
- ❖ Auto Recloser (79)
- ❖ Cold Load Pickup
- ❖ Thermal Overload (49)
- ❖ Under / Over Voltage (27/59)
- ❖ Residual Voltage / Voltage Unbalance (59N/47)
- ❖ Trip Circuit Supervision Function (74TC)
- ❖ Voltage Controlled Over Current (51V)
- ❖ Under Current (37P)
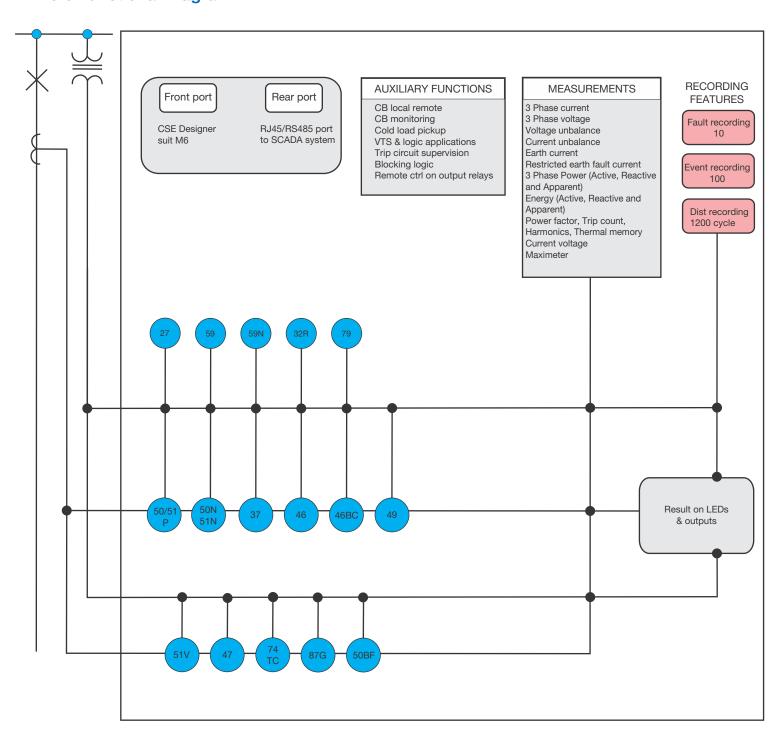- ❖ Restricted Earth (87G)
- ❖ Reverse Power (32R)

(Figure-1)

5.0 Supervision Functions

❖ Lock out Relay

❖ Open-Close Breaker Command

❖ Trip Circuit Supervision (74TC)

❖ CBFP (50 BF)

6.0 Functional Diagram

Front port

CSE Designer
suit M6

Rear port

RJ45/RS485 port
to SCADA system

AUXILIARY FUNCTIONS

CB local remote
CB monitoring
Cold load pickup
VTS & logic applications
Trip circuit supervision
Blocking logic
Remote ctrl on output relays

MEASUREMENTS

3 Phase current
3 Phase voltage
Voltage unbalance
Current unbalance
Earth current
Restricted earth fault current
3 Phase Power (Active, Reactive and Apparent)
Energy (Active, Reactive and Apparent)
Power factor, Trip count, Harmonics, Thermal memory
Current voltage
Maximeter

RECORDING FEATURES

Fault recording 10

Event recording 100

Dist recording 1200 cycle

27   59   59N   32R   79

50/51 P   50N 51N   37   46   46BC   49

Result on LEDs & outputs

51V   47   74 TC   87G   50BF

(Figure-2) CSEPROF Functional Diagram

7.0 Protection Functions

1) Restricted Earth Protection (87G)

REF is based on comparing the vector sum of the phase currents to neutral point current. If the difference (Iref) is greater than the calculated value then tripping occurs. Refer table–10 for restricted earth fault protection settings.

$$\frac{\text{Restricted Earth}}{\text{Fault Current}} = \frac{\text{Phase CT Ratio}}{\text{Earth CT Ratio}} \times I[\vec{L1}] + I[\vec{L2}] + I[\vec{L3}] - \frac{Ie}{ECTCorr}$$

Where ECTCorr = Earth CT correction factor

2) Three Phase Over-current (50/51)

The independent three stages are available for phase fault protection. For I> the user may independently select definite time delay or inverse time delay with different type of curves. The second & third Hi-Set stage can be configured with definite time only. For three phase over current protections settings refer table 5.

3) Neutral Over current (50N/51N)

The independent two stages (Ie> & Ie>>) are available for earth fault protection. For first stage (Ie>) the user can select definite time delay or inverse time delay with different type of curves. The second Hi-Set stage can be configured with definite time only. For neutral over current protections settings refer table 4.

4) Negative Phase Sequence(46)

This function protects against current unbalances resulting from anomalies in the power system or unbalanced loads. For current unbalance protections settings refer table 3.
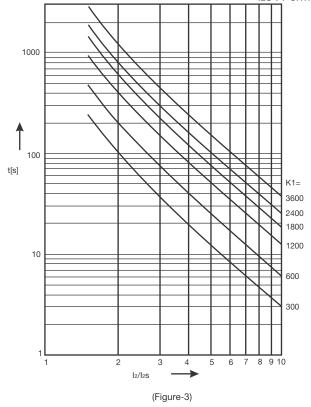
Negative Phase Sequence Equation

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

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

(Figure-3)

5) Cold Load Pickup

In CSEPRO unit, this feature is provided to avoid non desired trips, when line de-energised for a period of time and re-energised later, the load exceed the protection setting without the presence of a fault.

During cold load conditions protections setting values are replaced by group3 setting values whereas during normal conditions active group setting values will get applicable to all protections.

In group3 cold load settings will be same as those in active group so in group3 except cold load settings all other protection setting values are programmable.

6) Thermal Image (49)

Protect elements such as lines, transformers etc. against thermal overloads, calculating the temperature according to the present and recent load conditions of the protected device. For these setting refer table no. 19.

Thermal Memory Mode
There are following three modes for thermal protection: -
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 and starts from the remaining value.

The formula for calculating the trip characteristics is as follows:

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

With Ä = thermal time constant of the object to be protected.

I_b = Basic 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.

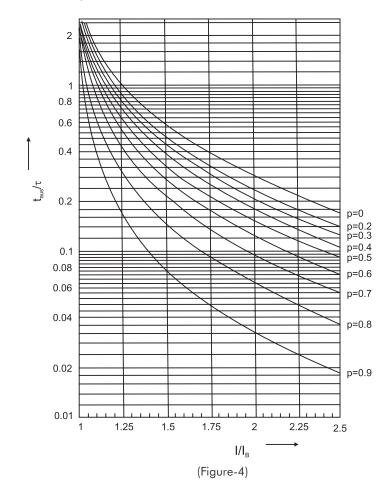$$I = \sqrt{I_1^2 + \text{Neg\_k} \times I_2^2}$$

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)

7) Voltage Protection

The relay is equipped with an independent over, 2 step over (U>, U>>) and under voltage supervision (U<, 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.

7.1) Under / Over voltage (27/59)

Two thresholds are available for each function: each one can be independently activated or deactivated. For under / over voltage protections settings refer table 6.

7.2) Zero Sequence (59N)

Over voltage CSEP$_{RO}$-F relays will operate from the zero sequence voltage, which is calculated internally, or from the residual voltage, which is measured directly or internally

$U0=1/3|(U_1+U_2+U_3)|$

For zero sequence protections settings refer table 8.

7.3) Negative Sequence over voltage (47)

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.

$U2=1/3|(U_1+a^2U_2+aU_3)|$

for negative sequence over voltage protections settings refer table 8.

7.4) Positive Sequence Over voltage

This function is based on the positive phase sequence component of the voltage, which is calculated internally.

$U1=1/3|(U_1+aU_2+a^2U_3)|$

for positive sequence over voltage protections settings refer table 8.

8) Reverse Power Protection (32R)

The protection actuates when the power flow gets reversed and the power exceeds the set value in this situation the protection trips the relay or relays programmed for it. This function is also got two units with different settings for timing ranges.

9) Voltage Control Over current protection

The CSEPRO-F units provide effective protection against short circuits and over-current in electrical machines requiring a time dependent unit voltage control or restraint. An application example would be the protection of generators' with power>5 MW.
This lowers the pickup level of the over current unit depending on the voltage level. This reduces the tripping time in case of voltage fall.
This protection has two modes of operation:-

MODE1 :
In this mode of operation protection (I>, I>>, I>>>) occurs when the input current exceeds the set value of pickup and input voltage is less than the set value of control voltage.
MODE2 :
In this mode of operation protection (I>, I>>, I>>>) occurs when the input current exceeds the calculated pickup value derived from the set value of pickup current   and control voltage. This calculation is valid between 20 - 90% of control voltage setting. If control voltage is more than 90% then calculated value of pickup is same as set value of pickup.
For voltage control over current protection setting refer table no. 20.

Calculated Pickup Value = (Iset - (Iset x (100 - Vset)/100))
Where
Iset	=	Current pickup setting (in over current protection menu)
Vset	=	Control voltage setting

10) Under current (I<)

This protection covers the loss of load condition like V-belt split of shaft failure or a pump running unprimed or running dry protection, broken conveyor belt. For under current setting refer table no. 13.
If while running condition, the phase current goes below the adjusted current level for a defined time, CSEPRO-F will trip to stop the feeder.

11) Circuit Breaker Failure Protection (50BF)

The CB Failure Protection is based on supervision of phase currents and earth current after tripping events. The test criterion is whether all phase 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 protections settings.

12) Broken Conductor Protection (46BC)

For giving this protection the ratio of -ve phase sequence current and +ve phase sequence current is measured. The delay timer starts when the ratio exceeds the set value and tripping is initiated as soon as set time is elapsed. Refer table–17 for this protections settings.

13) Trip Circuit Supervision (74TC)

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–2 for this protections settings.

14) Auto Re-closer Strategy (79)

As 80% of faults in overhead lines are transient, the use of the auto recloser is very advantageous. Automatic auto-recloser allows a substation to operate unattended. The number of visits on site to manually reclose a circuit breaker after a fault, can then be substantially reduced. This feature gives an important advantage for substations supervised remotely.

Typically this auto reclose (AR) sequence of Instantaneous Trip(s) and Reclose Delays (Dead times) followed by Delayed Trip(s) provide the automatic optimum method of clearing all types of faults i.e. both Transient and Permanent, as quickly as possible and helps in improving the up time of the network in service.

DI Inputs:
AR Blocking - To block the auto recloser through remote DI
CB Close DI - To get the circuit breaker status
CB Ready - To get the CB ready or to give the
closing command
Configurable Outputs:
      79 AR Close CB
      79 Lockout

AR - Blocked:
Unit changes immediately to "AR-blocked" status when an external AR Blocking DI is applied or internal EXIT is chosen for AR cycle in MMI. No Auto reclosing is possible in "AR-blocked" status.

Activating of AR:
Prior to every AR it is possible to select which kind of tripping (I> or I>>, Ie> etc.) will lead to automatic reclosing. This can be separately fixed for each protection.

Dead time (td):
Starts with the off signal of the circuit breaker. No closing command to the circuit breaker is given till expiry of the set dead time.

User programmable dead times are available for each protection trip operation.
The dead time is initiated when the trip output contact resets, the pickup is reset and the CB is open.
The CB close output relay is energized after the dead time has elapsed If CB ready input is present.
The dead time (dead time td1, dead time td2 dead time td3 dead time td4) starts when the feedback on 'CB CLOSE DI' is not available.

Reclaim time (tr):
This is the time during which after switching on or after AR a subsequent reclosing is prevented.
If the number of the set shots is reached, the relay is locked for this time after the last reclosing attempt.
If CB Ready DI is not available relay will not generate closing command.
If the circuit breaker dose not trip again, the auto reclose cycle resets to original STATE-1 at the end of the reclaim time.
 successful reclosure the relays goes to the lock out state.

If the protection operates during the reclaim time of the relay:

❖ either advances to the next AR cycle that is expected in next auto reclose state or

❖ if all the programmed recloser attempts have been accomplished,   it locks out.

The reclaim time is started with the automatic closing command.

Once a CB has reclosed and remained closed for a specified time period (the reclaim time), the AR sequence is reinitialized and a successful close output issued. A single common reclaim time is used (Reclaim Timer). when an auto reclose sequence does not result in a Starting Condition for Auto recloser

1) AR should be enabled by manual setting.

2) AR blocked DI is not available

3) Respective protection AR cycle should not in exit condition.
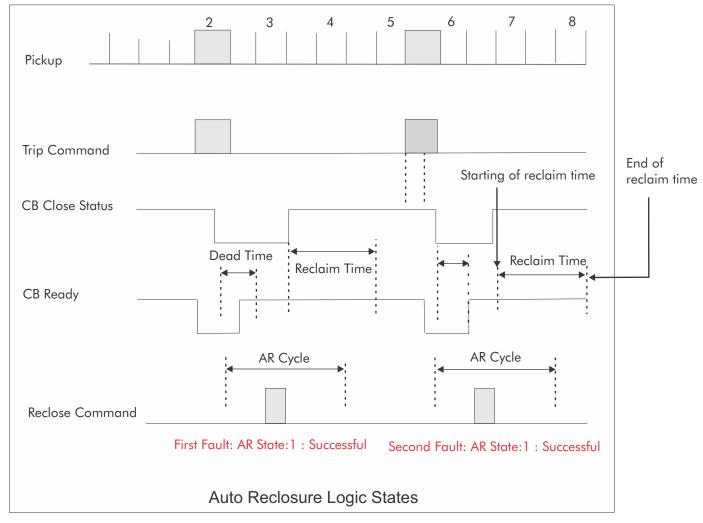
Lock out State:

Lockout state of the breaker meansno further attempts to AR in these conditions

1) Lockout occurs when all auto reclosure attempts are over and protection operates during the final Reclaim Time.

2) If CBFP failure appeared in relay (if CBFP enable).

3) At the end of the each reclaim timer if the CB is in the open position (Close DI is not present).

4) If a Close pulse of AR relay is given and the CB fails to close through close DI input or expiry of Trip Contact Sense time.

5) If a open pulse given to CB and CB fails to open in between Trip Contact Sense time.

In any of these cases, Manual reset will be required to reinitiate the AR. Refer table–18 for this protections settings.

Auto Reclosure Logic States

(Figure-5)

Automation

Protection Function Locking

Each protection function can be locked via a digital input as selected and assigned in HMI.

8.0 Data Acquisition Function

Measurement
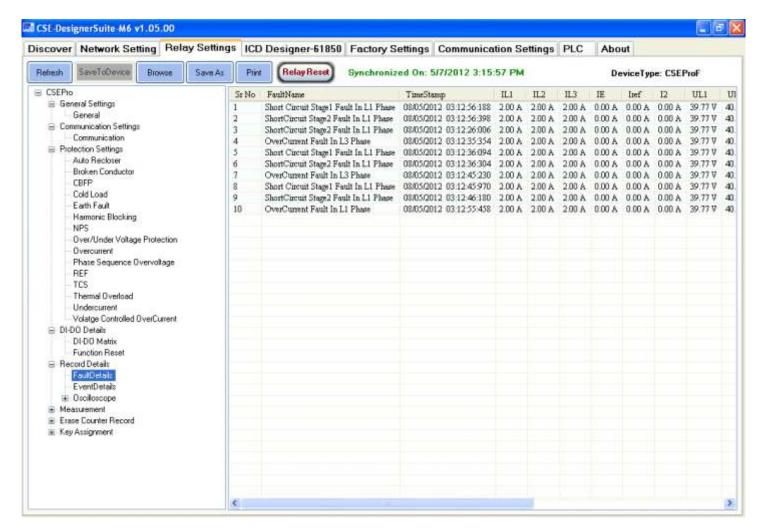
- ❖ 3 Phase Current, 3 Phase Star Voltage, 3Phase Delta Voltage, 3 Phase Active Power, 3 Phase Reactive Power, 3 Phase Apparent Energy, Individual Power Factor, 3 Phase Power Factor, Forward Active Energy, Reverse Active Energy, Forward reactive Energy, Reverse Reactive Energy & Energy Counters (1 Energy Counter is equivalent to 6553.5 Gwh/GVarh) Total Energy Calculation (6553.5 x energy counter + displayed energy)

- ❖ Earth current measurement

- ❖ Restricted earth current measurement

- ❖ Negative / Positive / Zero phase sequence

- ❖ Trip counter

- ❖ Origin of last fault

- ❖ Percentage of harmonics

- ❖ Thermal memory

- ❖ Maxi meter

- ❖ AR cycles

9.0 Fault Record

CSEPRO-F records last 10 faults in its non volatile memory with its time stamp. Each record has the following information:

Fault Format			UI23	:	XX.XXV
IL1	:	XX.XXA	UL31	:	XX.XXV
IL2	:	XX.XXA	U0	:	XX.XXV
IL3	:	XX.XXA	U1	:	XX.XXV
Ie	:	XX.XXA	U2	:	XX.XXV
Iref	:	XX.XXA	Rpwr	:	XX.XXW
I2	:	XX.XXA	Them_mem	:	XXXX%
UL1	:	XX.XXV	HR MIN	:	HH:MIN
UL2	:	XX.XXV	SEC Ms	:	Sec: mSec
UL3	:	XX.XXV	DATE	:	DD:MM:YR
UI12	:	XX.XXV	F-TYPE	:	Type of fault

(Figure-6) Fault Data recording on PC software

10.0 Event Record

The unit stores in non volatile memory the last 100 events with it's time stamp. 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 format:

EVENT   :   EVENT NUMBER
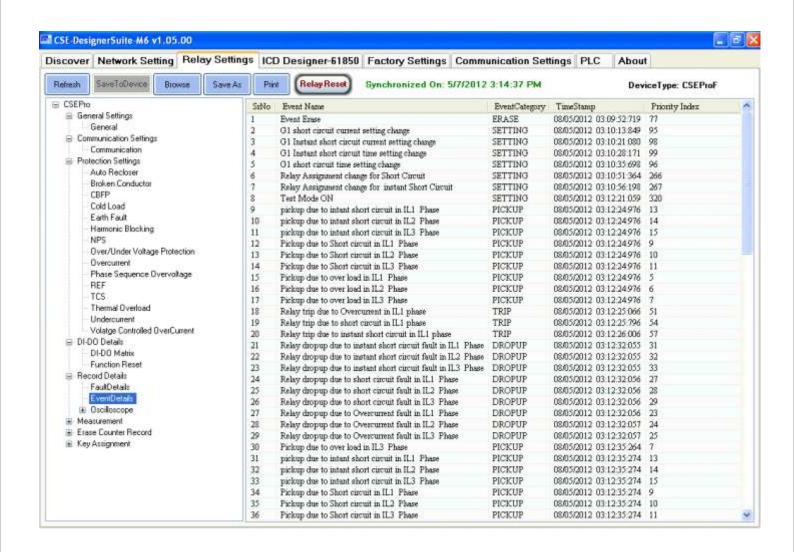
HOUR   :   HH.MM

SEC mSEC   :   SEC: mSEC

DATE   :   DD/MM/YY

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

• Description of event number available in event list or in front end software.
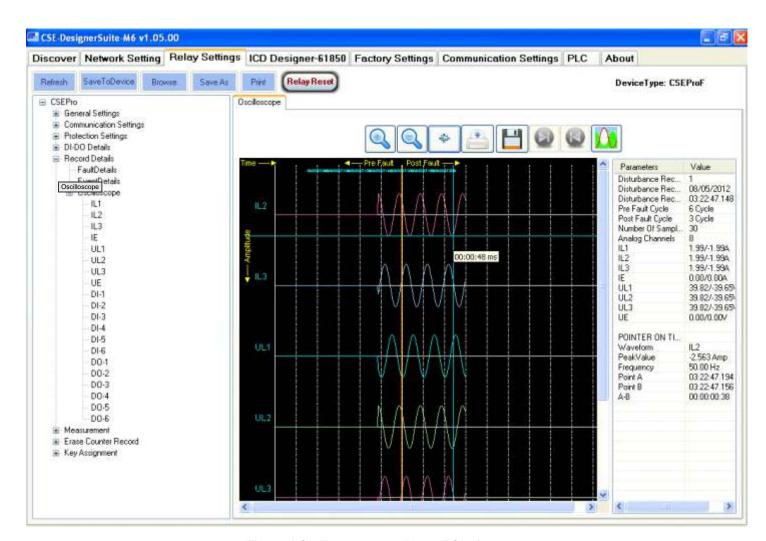
(Figure-7) Event Data recording on PC Software

11.0 Disturbance Record

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

❖ Oscilloscopic 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 max. 8 analog signals (depends upon the different models) 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.

❖ Records are in the non volatile memory.

❖ The records are transferred to PC using USB interface. The data is graphically displayed and 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-8) Oscilloscope 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   :   Programmable (Auto/Manual)

Inputs Contacts

No of digital inputs   :   6 (DI1, DI2, DI3, DI4, DI5, DI6)

Type of inputs   :   AC/DC Voltage

Programmable (DI Assignment)   :   Yes

12.0 Human Machine Interface
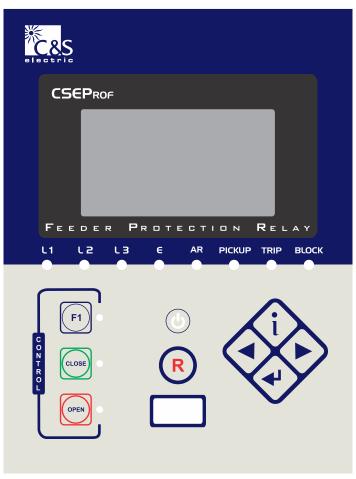
CSEPRO-F offers a variety of front user interfaces, including:

Human-Machine Interface (HMI)

It comprises of alphanumeric display of 16x4 and 8 push buttons for setting and other operations for local access:

❖   Two push switches for set values of normal tripping characteristics.

❖   One 'RESET' push switch & One 'ENTER' push switch.

❖   One intelligent (I) Key.

❖   One push switch for the tripping of relay assigned to 'F1' Key.

❖   Two push switches for the tripping of relay assigned to Circuit breaker open & Circuit breaker close.

❖   Eight LEDs for pickup or tripping on fault's & events in any phase (See Figure-9).

In order to change any setting first press enter (↵) then only (t / u) key will act as decrement/increment else these key will function as scroll in backward/forward direction.

(Figure-9) HMI

Keys	Manual Key
(i)	is used as intelligent key to see the details of the fault pickup / digital input / output status & last fault details.
(↵)	is used as a "ENTER" key.
(R)	is used to manual reset (after pressing for 2 sec).
(◀)	is used to scroll in backward direction and for decrement of parameters.
(▶)	is used to scroll in forward direction and for increment of parameters.
F1	To perform the assigned task DO Trip, Relay reset or thermal reset.
OPEN	To open the circuit breaker.
CLOSE	To close the circuit breaker.

13.0 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.

Rear Communication (RS-485)

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 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. This unit also has Front-end Live Link simulation support for testing of relay even without any three phase injection source.

14.0 Setting Ranges

Active Group Setting

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Active Group	ACTIVE	Group1	Group3	1	Group1
Group Toggle Step	TOGLE STEP	+1	+2	1	+1

(Table-1)

Trip Circuit Supervision

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Trip circuit supervision	TCS	0.03 Sec	2 Sec	0.01 Sec	0.03 Sec

(Table-2)

Negative Phase Sequence Protection Setting

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
NPS pickup setting	I$_2$	0.1xIp	1.0xIp	0.01xIp	Disbale
NPS trip characteristic	CHAR	DEFT	INVERSE	-	DEFT
Time multiple	K1	5	600	1	5
Definite time delay	td	0.1 Sec	600 Sec	0.1 Sec	0.2 Sec

(Table-3)

Earth Fault Protection

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Earth characteristic	E-CURVE	DEFT	EINV, VINV, LIINV, NINV1.3, NINV3.0, NINV0.6	-	DEFT
Earth pickup setting	Ie>	0.05xIn	2.5xIn	0.01xIn	Disable
Earth inverse timing	tie>	0.01	1.5	0.005	0.01
Earth definite timing	te>	0.03 Sec	150 Sec	0.01 Sec	0.03 Sec
Earth hi-set pickup setting	Ie>>	0.5xIn	8xIn	0.05xIn	Disable
Earth hi-set definite timing	te>>	0.02 Sec	20 Sec	0.01Sec	0.02 Sec

(Table-4)

Over current Protection

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Phase trip characteristic	PCURVE	DEFT	EINV,VINV,LIINV,NINV1.3, NINV3.0,NINV0.6	-	DEFT
I> pickup setting	I>	0.2xIp	4xIp	0.01xIp	Disable
I> inverse timing	ti>	0.01	1.5	0.005	0.01
I> definite timing	t>	0.1 Sec	150 Sec	0.01Sec	0.1 Sec
I>> pickup setting	I>>	0.5xIp	30xIp	0.5xIp	Disable
I>> definite timing	t>>	0.02 Sec	20 Sec	0.01 Sec	0.02 Sec
I>>> pickup setting	I>>>	0.5xIp	30xIp	0.5xIp	Disable
I>>> definite timing	t>>>	0.02 Sec	20 Sec	0.01Sec	0.02 Sec

(Table-5)

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

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

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

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

Normal Inverse 3.0/1.3/0.6 $\qquad t = \dfrac{0.14/0.061/0.028}{(I / I_s)^{0.02} - 1}$ ti [s]

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

(2) Refer following formula for IDMT characteristics for over/under voltage

Very Inverse $\qquad t = \dfrac{TMS}{(V/ V_s) - 1}$

Where   t   =   Operating time in seconds
       TMS =   Time multiplier setting
       V   =   Applied Input Voltage
       VS =   Relay Setting Voltage

Note: This equation is only valid for V/Vs ratio < than 0.95 (under voltage) of ratio > 1.1 (over voltage)

Under Voltage / Over Voltage Setting

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Under voltage characteristics	U<char	DEFT	IDMT		DEFT
Blocking on loss of voltage	UlossBlk	Enable	Disable		Disable
Under voltage threshold setting	UV-THRE	5%Un	100%Un	1%Un	10%Un
Under voltage pickup setting	U<Pkup	5%Un	120%Un	1%Un	Disable
Under voltage TMS setting	U<Ti	0.05	2	0.01	0.05
Under voltage definite time	U<Td	0.03 sec	20.00 sec	0.01 sec	0.03 sec
Under voltage hi-set pickup setting	U<<Pkup	5%Un	120%Un	1%Un	Disable
Under voltage definite time	U<<Td	0.03 sec	20.00 sec	0.01 sec	0.05 sec
Over voltage characteristics	U>char	DEFT	IDMT		DEFT
Over voltage pickup setting	U>Pkup	20%Un	150%Un	1%Un	Disable
Over voltage TMS setting	U>Ti	0.05	2	0.01	0.05
Over voltage definite time	U>Td	0.03 sec	20.00 sec	0.01 sec	0.05 sec
Over voltage hi-set pickup setting	U>>Pkup	20%Un	150%Un	1%Un	Disable
Over voltage definite time	U>>Td	0.03 sec	20.00 sec	0.01 sec	0.05 sec

Reverse Power Protection (32R)   (Table-6)

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Reverse power>	Rev>P	Disable	Enable	1	Disable
Reverse power>set value	Rev_P>Set	5%In	200%In	1	100%Pn
Reverse power> time setting	t_Rev_P>	0.1 Sec	200 Sec	0.1Sec	0.1Sec
Reverse power>>	Rev_P>>	Disable	Enable	1	Disable
Reverse power set value	Rev_P>>Set	5%Pn	200%Pn	1	100%Pn
Reverse power time setting	t_Rev_P>>	0.1 Sec	200 Sec	0.1 Sec	0.1 Sec

(Table-7)

U0 / U1 / U2 Setting

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Neutral voltage pickup setting	U0>Pkup	2%Un	100%Un	1%Un	Disable
Neutral voltage characteristic	U0>Char	DEFT	IDMT	-	DEFT
Neutral voltage TMS setting	U0>Ti	0.05	2	0.01	0.05
Neutral voltage definite time	U0>Td	0.03 sec	20.00 sec	0.01 sec	0.05 sec
Positive sequence voltage pickup setting	U1>Pkup	10%Un	100%Un	1%Un	Disable
Positive sequence voltage definite time	U1>Td	0.03 sec	10.00 sec	0.01 sec	0.10 sec
Negative sequence voltage pickup setting	U2>Pkup	10%Un	100%Un	1%Un	Disable
Negative sequence voltage definite time	U2>Td	0.03 sec	10.00 sec	0.01 sec	0.10 sec

(Table-8)

Circuit Breaker Failure Protection

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

(Table-9)

Harmonic Restrain

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Phase 2nd harmonic block	P2ndH	10%If	50%If	2	Disable
Phase 3rd harmonic block	P3rdH	10%If	50%If	2	Disable
Earth 2nd harmonic block	E2ndH	10%If	50%If	2	Disable
Earth 3rd harmonic block	E3rdH	10%If	50%If	2	Disable
Phase blocking time	tPHASE	0 Sec	20 Sec	0.1 Sec	0 Sec
Earth block time	tEARTH	0 Sec	20 Sec	0.1 Sec	0 Sec

(Table-10)

Restricted Earth Fault Protection

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
REF pickup current	Iref>	0.2xIn	30xIn	0.01xIn	Disable
REFtrip time	tref>	0 Sec	10 Sec	0.01Sec	1.0 Sec
Earth CT correction factor	ECTcorr	0.1	4.0	0.01	1.0

(Table-11)

Under Current Protection

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Under Current Pickup Setting	I<	0.2xIp	1xIp	0.01xIp	Disable
Under Current Timing	td<	1 Sec	260 Sec	0.01 Sec	1Sec
Under Current Threshold	ThrsSet	0.50xIp	1xIp	0.05xIp	Disable

(Table-12)

Cold Load Protection

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Mode of Trigger	MODE	Cold Load	DI, Inrush	1	Disable
Cold load time	tCold	0 Sec	10000 Sec	1 Sec	20 Sec
Cold load pickup time	tClp	1 Sec	3600 Sec	1 Sec	20 Sec
Inrush percentage setting	If2/If1	20%	100%	5%	20%

(Table-13)

DO Assignment

Parameters	Display
Over current protection	I>
Short circuit stage1 protection	I>>
Short circuit stage2 protection	I>>>
Earth protection	Ie>
Earth high protection	Ie>>
Under current protection	I<
Restricted earth fault protection	Iref>
Negative phase sequence protection	I2>
Under voltage protection	U<
Under voltage hi set protection	U<<
Over voltage protection	U>
Over voltage hi set protection	U>>
Zero sequence over voltage protection	U0>
Positive sequence over voltage protection	U1>
Negative sequence over voltage protection	U2>
Reverse Power Protection	RP>
Thermal relay	ThrmlRly
Thermal alarm	ThrmAlrm
Trip circuit supervision	TCS
Circuit breaker failure protection	CBFP
Self supervision	SELF SUP
Broken conductor protection	BrknCond
Auto reclose	AR CLOSE
Autro reclose lockout	Arlckout
Circuit breaker open	CB open
Circuit breaker close	CB close
Remote trip-1	Rmt Trp1
Remote trip-2	Rmt Trp2
Remote trip-3	Rmt Trp3
Remote trip-4	Rmt Trp4
Remote trip-5	Rmt Trp5
Remote trip-6	Rmt Trp6

(Table-14)

DI Assignment

Parameters	Display
Circuit breaker close	CB Close
Circuit breaker open	CB Open
Circuit breaker ready	CB Ready
Remote trip-1	Rmt Trp1
Remote trip-2	Rmt Trp2
Remote trip-3	Rmt Trp3
Remote trip-4	Rmt Trp4
Remote trip-5	Rmt Trp5
Remote trip-6	Rmt Trp6
Group toggle	GRP togg
Remote reset	RMT RSET
Oscillator trigger	OSC Trig
Cold load	CLD LOAD
Over current block	I>BLK
Short circuit stage1 block	I>>BLK
Short circuit stage2 block	I>>>BLK
Earth block	E>BLK
Earth high block	E>>BLK
Under current block	UC BLK
Restricted earth fault block	REF BLK
Negative phase sequence block	NPS BLK
Under voltage block	U< BLK
Under voltage hi set block	U<<BLK
Over voltage block	U>BLK
Over voltage hi set block	U>>BLK
Zero phase sequence block	U0>BLK
Positive phase sequence block	U1>BLK
Negative phase sequence block	U2>BLK
Reverse Power Protection block	RP>BLK
Thermal block	ThrmlBLK
Broken conductor block	BC BLK
Cold load pickup block	CLP BLK
Auto reclose block	AR BLK

(Table-15)

Function Reset

Parameters	Display
Over current protection	I>
Short circuit stage1 protection	I>>
Short circuit stage2 protection	I>>>
Earth protection	Ie>
Earth high protection	Ie>>
Under current protection	I<
Restricted earth fault protection	Iref>
Negative phase sequence protection	I2
Under voltage protection	U<
Under voltage hiset protection	U<<
Over voltage protection	U>
Over voltage hi set protection	U>>
Zero sequence over voltage protection	U0>
Positive sequence over voltage protection	U1>
Negative sequence over voltage protection	U2>
Reverse Power protection	RP>
Thermal relay	Thermal
Thermal alarm	ThrmAlrm
Trip circuit supervision	TCS
Broken conductor protection	BrknCond
Auto reclose	AR CLOSE
Remote trip-1	Rmt Trp1
Remote trip-2	Rmt Trp2
Remote trip-3	Rmt Trp3
Remote trip-4	Rmt Trp4
Remote trip-5	Rmt Trp5
Remote trip-6	Rmt Trp6

(Table-16)

Broken Conductor Protection

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
NPS to PPS ratio	I2/I1 Ratio	0.1	0.5	0.01	Disable
Definite time for broken conductor fault	td(BC)	0.05 Sec	20 Sec	0.01 Sec	0.10 Sec

(Table-17)

Auto Recloser Setting

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Blocking of Auto-recloser	ENABLE	NO	YES	-	NO
Set Dead Time-1	D1	0.2 Sec	300 Sec	0.01 Sec	0.2 Sec
Set Dead Time-2	D2	0.2 Sec	300 Sec	0.01 Sec	0.2 Sec
Set Dead Time-3	D3	0.2 Sec	300 Sec	0.01 Sec	0.2 Sec
Set Dead Time-4	D4	0.2 Sec	300 Sec	0.01 Sec	0.2 Sec
Set Reclaim Time	tR	0.2 Sec	300 Sec	0.01 Sec	0.2 Sec
Cycle I>	Cycle I>	2	4/Disable	1	2
Cycle I>>	Cycle I>>	2	4/Disable	1	2
Cycle I>>>	Cycle I>>>	2	4/Disable	1	2
Cycle Ie>	Cycle Ie>	2	4/Disable	1	2
Cycle Ie>>	Cycle Ie>>	2	4/Disable	1	2
Trip sense time	t_TST	0.05 Sec	2 Sec	0.01Sec	0.05 Sec

(Table-18)

Thermal Over-load setting

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Thermal memory mode	TMemMod	M1	M3	1.0	M1
Permissible basic current	Ib	0.2xIp	4xIp	0.02xIp	Disable
Constant	K	0.5	2	0.01	1
Heating time constant	Th	0.5 Min	180 Min	0.10 min	0.5 Min
Cooling constant	Tc	1xTh	8xTh	0.01xTh	1xTh
Thermal alarm	Alarm_R	20%	99%	1%	20%
NPS weighting factor	I2_Wgt	0.05	2.5	0.05	2.5
Thermal reset	TH_RST	0%	99%	1%	70%
Thermal trip characteristics	ThChar	th1	th2	1	th1

(Table-19)

Voltage Control Over-current

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Voltage control over current type	VCTOTyp	MODE1	MODE2	1	MODE1
Control volt	CtrlVlt	20%Un	100%Un	1	20%Un
Block over-current	BlockI>	NO	YES	-	YES
Over current pickup	I>	0.20xIp	4.00xIp	0.01xIp	0.20xIp
Block short circuit stage1current	BlockI>>	NO	YES	-	YES
Short circuit stage1current	I>>	0.50xIp	30.00xIp	0.5xIp	0.50xIp
Block short circuit stage2 current	BlockI>>>	NO	YES	-	YES
Short circuit stage2 current	I>>>	0.50xIp	30.00xIp	0.5xIp	0.50xIp

(Table-20)

Erase Counter Record

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Trip Count	Trip-Cntr	NO	YES	1	NO
Thermal Memory Reset	ThrmMemRset	NO	YES	1	NO
Erase Events	EventsErase	NO	YES	1	NO
Erase Faults	FaultErase	NO	YES	1	NO
Oscillator Record Erase	OscRcrdEras	NO	YES	1	NO
Energy Counter Erase	EnrgCntrRst	NO	YES	1	NO

(Table-21)

Common Setting

These are the setting's common for all the

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Rated phase current	Ip	1.00 Amp	5.00 Amp	-----	1.0 Amp
Rated earth current	In	1.00 Amp	5.00 Amp	-----	1.0 Amp
Phase CT ratio	Ph CTRatio	1	9999	1	1
Earth CT ratio	E CT Ratio	1	9999	1	1
PT ratio	PTRatio	1	9999	1	1
Phase selection	PHASE	1	3	-	1
Wire configuration	Wire config	STAR	DELTA	-	star
Nominal frequency	FREQ(Fn)	50 Hz	60 Hz	-----	50 Hz
Fault Message Status	[F]Stats	DISABLE	ENABLE	1	ENABLE

(Table-22)

Oscilloscope (Disturbance) Record Setting

These are the settings for Oscilloscope recording:

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Oscilloscope recording selection	RECORD	NO	YES	1	NO
Pre-fault cycle	PRE CYCLE	2 cycles	298 cycles	1	2 Cycle
Post-fault cycle	POST CYCLE	2 cycles	298 cycles	1	2 Cycle
Triggering mode	TRIG. MODE	PK-UP	PK-UP/TRIP/DI/ Anyone	1	PK-UP

(Table-23)

Communication

RS-485 Communication		Default Setting
Baud rate selection (programmable)	9600 / 19200 / 38400 bps	19200 bps
Parity selection (programmable)	Even / Odd / None	None
Stop bit	1 Bit	1 Bit
Data bit	8 Bit data	8 Bit data
Remote address (programmable)	247/254	1
Cable required for Interface	Two wire twisted shielded cable	------

(Table-24)

* For MODBUS : Remote Address Setting Range is 1 - 247
  & For IEC 103 : Remote Address Setting Range is 1 - 254

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-25)

15.0 Technical Data

Measuring Input

Rated data	Rated current Ip : 1A & 5A, Rated voltage Vn 63.5/110V Rated frequency Fn : 50Hz / 60Hz
Thermal withstand capability in current circuit	At Ip : 1A Continuous=5xIp for 10 Sec=30xIp for 1 Sec=100xIp
	At Ip : 5A Continuous=3xIp for 10 Sec=10xIp for 1 Sec=20xIp
Nominal burden	For phase=<0.2VA For earth=<0.2VA

(Table-26)

Trip Time Accuracy for Current Protections

Parameters	Accuracy
Trip time accuracy for protections except NPS & REF	$\pm$30mSec OR $\pm$5% (whichever is higher)
Trip time accuracy for NPS	$\pm$60mSec OR $\pm$7.5% (whichever is higher)
Trip time accuracy for REF	Corresponding to error generated by inaccuracies in each phase $\pm$30mSec OR $\pm$5% (whichever is higher)

(Table-27)

Trip Time Accuracy for Voltage Protections

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

(Table-28)

Measurement Accuracy

Parameters	Range	Frequency Range	Accuracy
Current in Ampere	1.0-30xIn	50-60Hz	Less than$\pm$2%
Voltage	5-150%Un	50-60Hz	Less than$\pm$2%
Power	—	—	Less than$\pm$5%
Power Factor	—	—	Less than$\pm$0.02

(Table-29)

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
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)
Operation time	<10ms
Durability	
Loaded contact	30000 operation minimum
Unloaded contact	10000 operation minimum

(Table-30)

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

(Table-31)

Common Data

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

(Table-32)

Date & Time setting

Parameters	Display	Setting Range		Step Size	Default Setting
		Min	Max		
Hour	HOUR	0	23	1	---
Minute	MIN	0	59	1	---
Second	SEC	0	59	1	---
Date	DATE	1	31	1	---
Day	DAY	SUN	SAT	1	---
Month	MONTH	1	12	1	---
Year	YEAR	0	99	1	---

(Table-33)

16.0 Standards

Design Standards

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

16.1 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 / 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	

16.2 EMC IMMUNITY TESTS
Fast Transient Disturbance Immunity Test (Burst)

IEC 60255-22-4	:	Power supply, mains inputs	$\pm$4 kV, 2.5 kHz
IEC 61000-4-4			
Class 4	:	Other in and outputs	$\pm$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 / IEC60255-22-3 :   Level 3, 10V/m 80MHz to 1GHz @ 1kHz 80% AM

Conducted Immunity Test
EN 61000-4-6 / IEC60255-22-6 :   Level 3, 10V rms @ 1kHz 80% AM, 150KHz to 80Mhz

Power Frequency Magnetic Field Immunity Test
IEC61000-4-8 :   Level 5, 100A/m applied continuously, 1000A/m for 3s.

EMC Emission Tests
Radio Interference Suppression Test
IEC-60255-25/EN55011/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 / EN55011 / CISPR11   Limit value class A

30 - 230 MHZ, 40 dB V/m at 10m measurement distance

230 - 1 GHz, 47 dB V/m at 10m measurement distance

16.3 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	2h
		(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

16.4 MECHANICAL TESTS

Test: Vibration Response Test

IEC 60068-2-6	:	(10Hz – 59 Hz)	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
IEC 60255-21-2			each direction
Class 1	:	Shock resistance test	15 gn, 11 ms, 3 impulses in
			each direction

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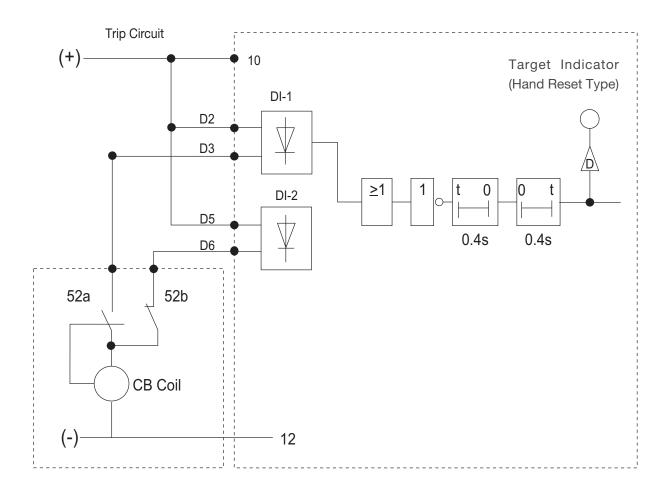
IEC 60068-2-29	:	Shock endurance test	10 gn, 16 ms, 1000 impulses
IEC 60255-21-2			in each direction
Class 1			

17.0 Trip Circuit Supervision Diagram
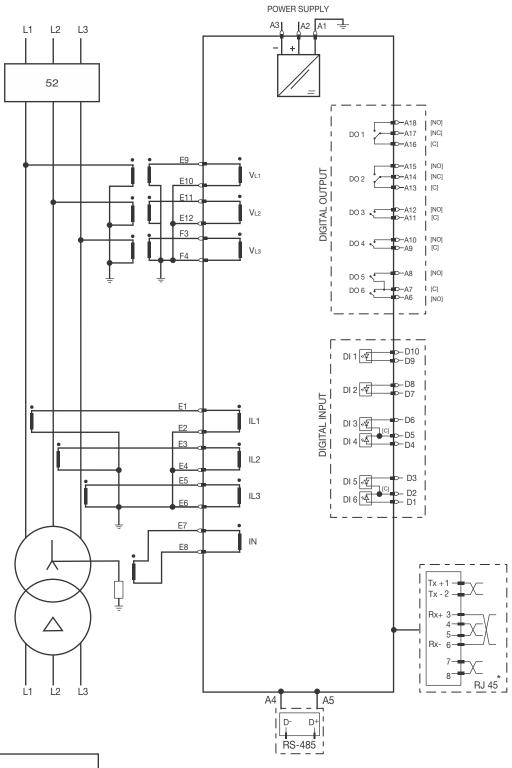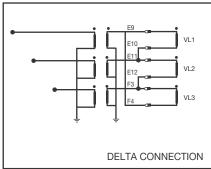
(Figure-10) (Trip Circuit Supervision Function)

3 Phase Over current & Restricted Earth Protection

POWER SUPPLY

(Figure-11)

DELTA CONNECTION
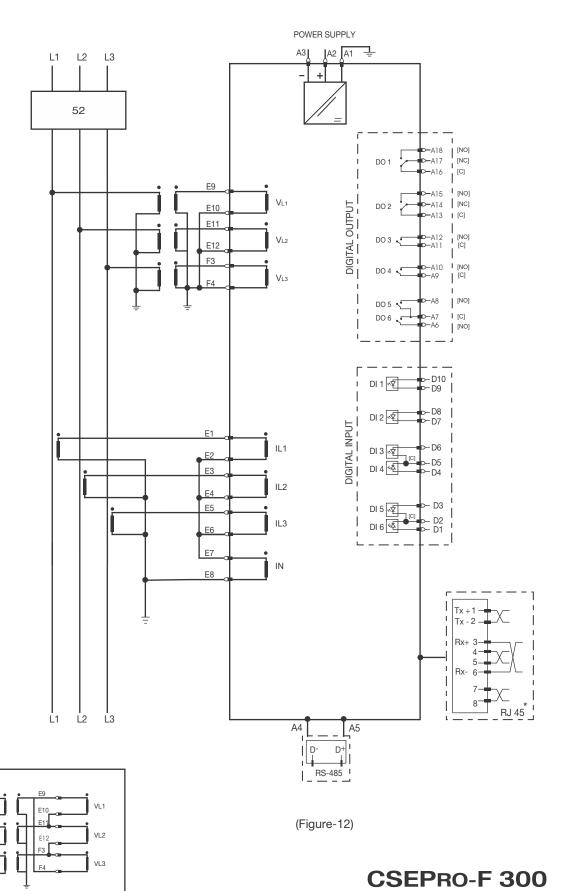
CSEPRO-F 300

3 Phase & Neutral Over current Protection

POWER SUPPLY

A3   A2   A1

L1   L2   L3

52

		[NO] A18
DO 1		[NC] A17
		[C] A16
DO 2		[NO] A15
		[NC] A14
		[C] A13

E9   V$_{L1}$
E10
E11   V$_{L2}$
E12
F3   V$_{L3}$
F4

DIGITAL OUTPUT

DO 1   A18 [NO] A17 [NC] A16 [C]
DO 2   A15 [NO] A14 [NC] A13 [C]
DO 3   A12 [NO] A11 [C]
DO 4   A10 [NO] A9 [C]
DO 5   A8 [NO]
DO 6   A7 [C] A6 [NO]

DIGITAL INPUT

DI 1   D10 D9
DI 2   D8 D7
DI 3   D6
DI 4   [C] D5 D4
DI 5   D3
DI 6   [C] D2 D1

E1   IL1
E2
E3   IL2
E4
E5   IL3
E6
E7   IN
E8

Tx + 1
Tx - 2
Rx+ 3
4
5
Rx- 6
7
8
RJ 45 *

A4   A5

D-   D+

RS-485

(Figure-12)

E9   VL1
E10
E11   VL2
E12
F3   VL3
F4

DELTA CONNECTION

CSEPRO-F 300
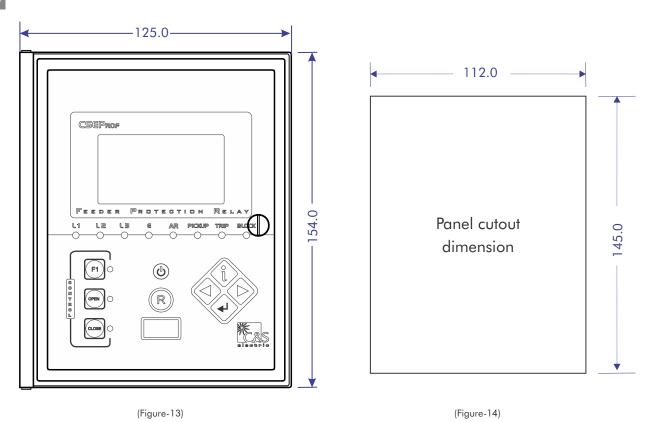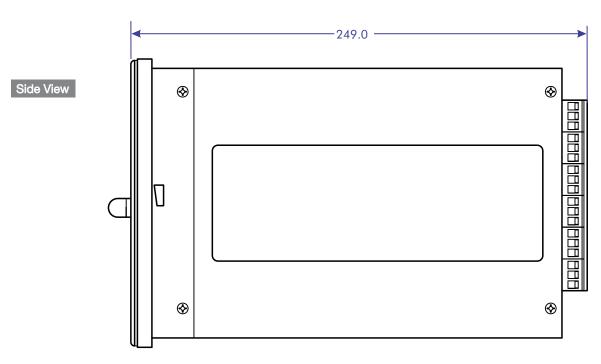
19.0 Dimension Details   (All the dim. are in mm)

(Figure-13)

Panel cutout
dimension

(Figure-14)
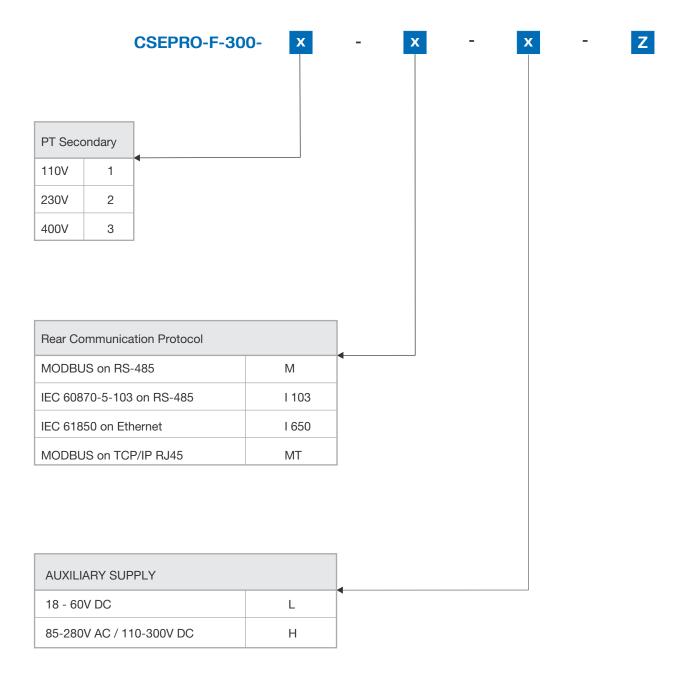
(Figure-15)

20.0 Ordering Information

CSEPRO-F-300- [X] **-** [X] **-** [X] **-** [Z]

PT Secondary	
110V	1
230V	2
400V	3

Rear Communication Protocol	
MODBUS on RS-485	M
IEC 60870-5-103 on RS-485	I 103
IEC 61850 on Ethernet	I 650
MODBUS on TCP/IP RJ45	MT

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

Example : CSEPROF-300-1-M-L-Z

CSEPRO-F

Revision History

S.No.	Rev.No.	Details	Date
01	01	Reverse power protection (table-7) min. value changes & Fault Record information addition on Page11	02.04.14
02	02	Inclusion of TCS Diagram	06.08.14

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REVISE
OR ELSE

Issue Date : 04.03.14
Rev. No : 02
Rev. Date : 06.08.14

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We touch your electricity everyday!