

We touch your **electricity** everyday!

CSPR-V5

RMU Over current Protection Relay

CSPR
Series



Catalogue



PMD Division

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1. Introduction

In the family of protection relay, CSPR is numeric multi powered Over-current relay specially designed for ring main units & feeder protection. It combines the following functions in one unit:

CSPR is a high tech and cost optimized protection relay for MV switchboards. Specifically in compact switchboards, the CSPR can replace the combination of load break switch.

- Relay get energize either from Current, Aux. voltage, front USB or internal battery (whichever is available)
- DEFT and Inverse characteristics for O/C and E/F individually selected for phase and earth fault
- O/C, S/C, E/F and E/F High set protection
- Circuit breaker failure protection (50BF)
- Cold load pickup protection
- Unbalance / Asymmetric protection
- Potential pulse output for direct triggering the circuit breaker coil.
- Two set of setting group
- Two Potential Relay Output contact
- Remote Trip DI
- Last 5 Fault & 10 Event records with Time stamp
- Wide operating ranges of the auxiliary supply voltage (AC/DC)
- USB port for PC / Laptop interface

2. Design

Relay will get energized from any of the following available sources

- Aux. Supply
- CT Current
- Internal Battery
- USB Port

In the absence of Aux supply/Battery voltage/USB, LCD will get energized, if CT current is 10% of rated current or above. Trip coil will be operated, if CT current in single phase is at least 20% of rated current or 15% of rated current in three phases. Relay is not powered from Earth CT, so for earth fault protection, phase current is mandatory.

Note: Battery works when no other supply is present i.e. in the absence of Aux Supply and Current.

2.1 Operation

The CSPR is a CT operated protection relay with inverse time and definite time protection characteristics.

CSPR works with standard CTs with secondary current and with defined VA burden.

CSPR provides following protection functions:

- 3 Phase definite time over current and short circuit protection with variable tripping times (ANSI 50/51)
- 3 Phase over current protection with selectable inverse time characteristics and definite time short circuit current element (ANSI 50/51)
- Definite time and inverse time earth over current protection (ANSI 50N/51N).
- Cold Load Pickup
- Circuit Breaker Protection

CSPR is provided with three analogue measuring inputs.

The CSPR is provided with an input for remote tripping. Tripping is realized via the electric impulse output.

A flag indicator can be installed for signaling occurrence of trip conditions.

Pickup activation of the relay is signaled by a LED on front panel.

2.2 Analog Input



The analog input signal of the CT secondary currents as per the terminal detail in Section 8, are fed to the protective device via separate input transformers. The continuously measured current values are galvanically isolated, analog & digitally filtered and finally fed to the analog/digital converter to get the True RMS value.


2.3 Front Panel

The front panel of the protective device CSPR-V5 comprises the following operation and indication elements:


- LCD display with Back light.
- Keypad for setting of the parameters of the relay.
- 2 LED's, 1 LED for Trip Ready/Hardware error annunciation and other LED for Trip/Pickup indication.


2.4 Keypads

The front panel keypad consists of five soft-touch keys. These keys are marked as “▲”, “▼”, “RESET/ENTER”,  “ & “”. The “RESET/ENTER” key provides reset function to the relay on long press and “RESET/ENTER” also act as Enter key for MMI.

“” key is used to turn ON the LCD and back light. When available source (Aux supply, CT current, USB port) is present and no key is pressed for 1 min then LCD gets off.

“” Key is used to ON the LCD when the available source is only battery.

Note: Under Self powered condition (i.e. absence of Auxiliary Supply), Back-light will be available in product if current is more than 20% in all phases or 40% in single phase by pressing “” Key.

Note: Relay goes into sleep mode, user has to press  key to see the display.

2.5 LEDs

There are 2 LEDs on the front panel, In which one is bi-color LEDs (Green/LED).

Trip ready/HW error LED flashes green when it has sufficient energy to operate the Trip coil. Red is the steady indication for HW error

Trip/Pickup LED: Red flashing indicates the Pickup of protection. Red steady indicates the Trip on faulty conditions.

2.6 Fault Recording

CSPR-V5 records last 5 Faults. In Fault, it saves following information in non-volatile memory.

Value at fault	:	L1, L2, L3, E in Amps
Type of fault	:	SC / OC / Unb / CBFP
Time stamp	:	HH:MM:Sec
Date stamp	:	DD:MM:YY
Trip time of fault	:	xxxxxx Sec

2.7 Event Recording CSPR-V5 records last 10 events. It saves following information:

Event Type	:	01
Date	:	DD:MM:YY
Time stamp	:	HH:MM:Sec

* Event Type = 01 (Power ON)

2.8 Trip Output

Potential O/P (24V@0.2Ws). Duty cycle will depend upon the strength of available current.
(In presence of only adequate CT current)

2.9 Flag Indicator

An output similar to above but with same energy is provided for operating a magnetic flag.
(24V@0.02 joules)

2.10 DI : Remote Trip

Irrespective of any pickup or fault user can trip the Circuit breaker, by applying voltage to Remote trip DI also.

2.11 Assignment of the Output DOs

CSPR-V5 have 2 output Relays which are user programmable and available only with auxiliary supply. Relay reset operation can be configurable in automatic reset or manual reset mode from MMI. In automatic reset mode Relay will be reset after the current goes below the pick-up level. In manual mode Relay will be reset by pressing reset button.

3. Communication

3.1 RS-485 Communication

The CSPR-V5 includes an RS-485 communication port. This port is available for MODBUS protocol / IEC-60870-5-103 (as per model selection). CSPR-V5 relay has feature to transmit the data such as settings, measurements and faults to the SCADA system. For this communication auxiliary supply is required. A communication failure does not affect protection function.

3.2 USB Front Communication

The front USB communication port is designed for "CSE LIVELINK" for which the front end Software is provided. The S/w has features of retrieving the records and changing the settings

Note: Relay is plug & play on USB port. It automatically gets energized from USB port itself.

4. Protection Functions

CSPR offers 50/51 / 50N/51N / Unbalance / CBFP protections / Cold load pickup.

Over-current Characteristic : DEFT/VINV/EINV/ NINV3.0 /NINV1.3, LINV, RI, HV-FUSE.

Unbalance Protection(46):

This is provided by the relay tripping in phase unbalance greater than setting % difference in terms of maximum phase current Unb:
 $[(IMAX - IMIN) / IMAX] \times 100[\%]$

Circuit Breaker Failure Protection [CBFP]

The C.B. failure protection is based on supervision of phase current during tripping events. This protective function becomes active only after tripping. The criteria is whether all phase currents are dropped to below $5\% \times I_n$ within set time of tCBFP. If not, then CB failure is detected.

Cold Load Pickup

In CSPR unit, this feature is provided to avoid non desired trips, when line de-energized for a period of time and re-energized later, the load exceeds the protection setting without the presence of a fault. To avoid such condition, CSPR switches from one protection setting group to another setting group for settable time. After expiry of settable time, it will shift back to original group.

5. Display Mode

CSPR-V5 works in two modes (AutoOFF/Live)

AutoOFF Mode: LCD gets on by pressing back light key & gets off after 1 minute if no key is pressed.

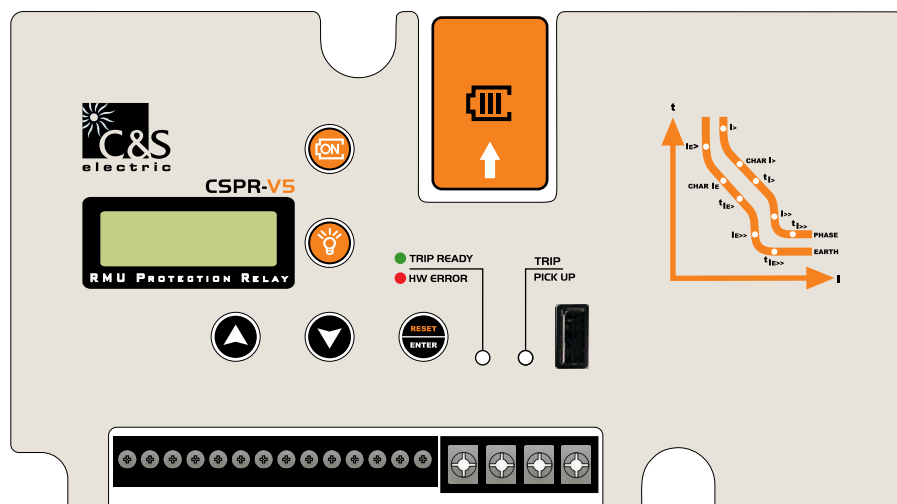
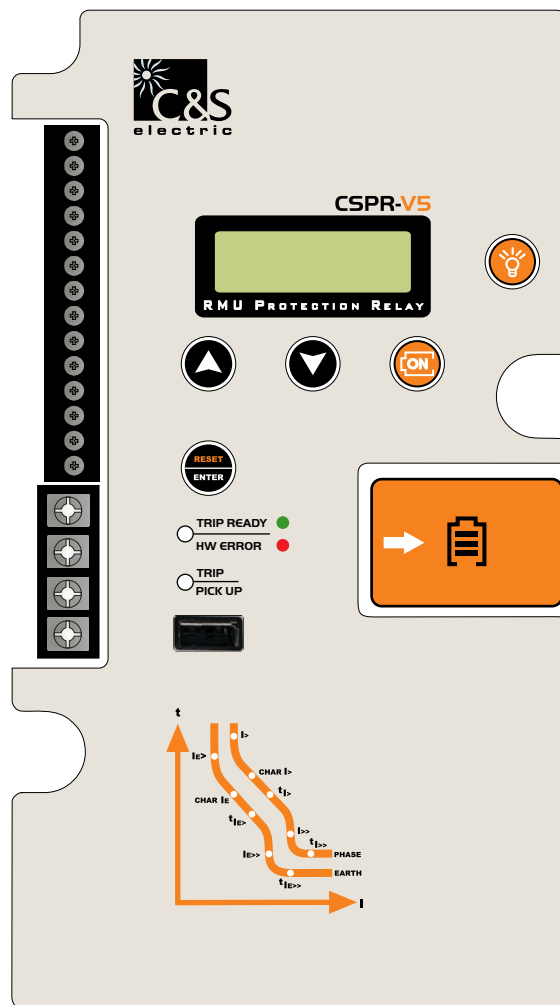
Live Mode: LCD remains on as long as auxiliary supply / phase current is available.

6. Battery Pack

CSPR-V5 comes with internal lithium battery pack, which energizes its LCD display to view and set the parameters at the time of initial installation especially when the current/voltage is not available in the RMU/switchgear. This battery has a life and so it is not meant for long future use. If the battery is dead, the operator can fetch the fault record data or edit/view the settings using a external USB powerpack which can be plugged to front USB of the relay. User can operate the relay using USB power source. USB powerpack can be supplied as an optional item or the user can use a standard USB power source.

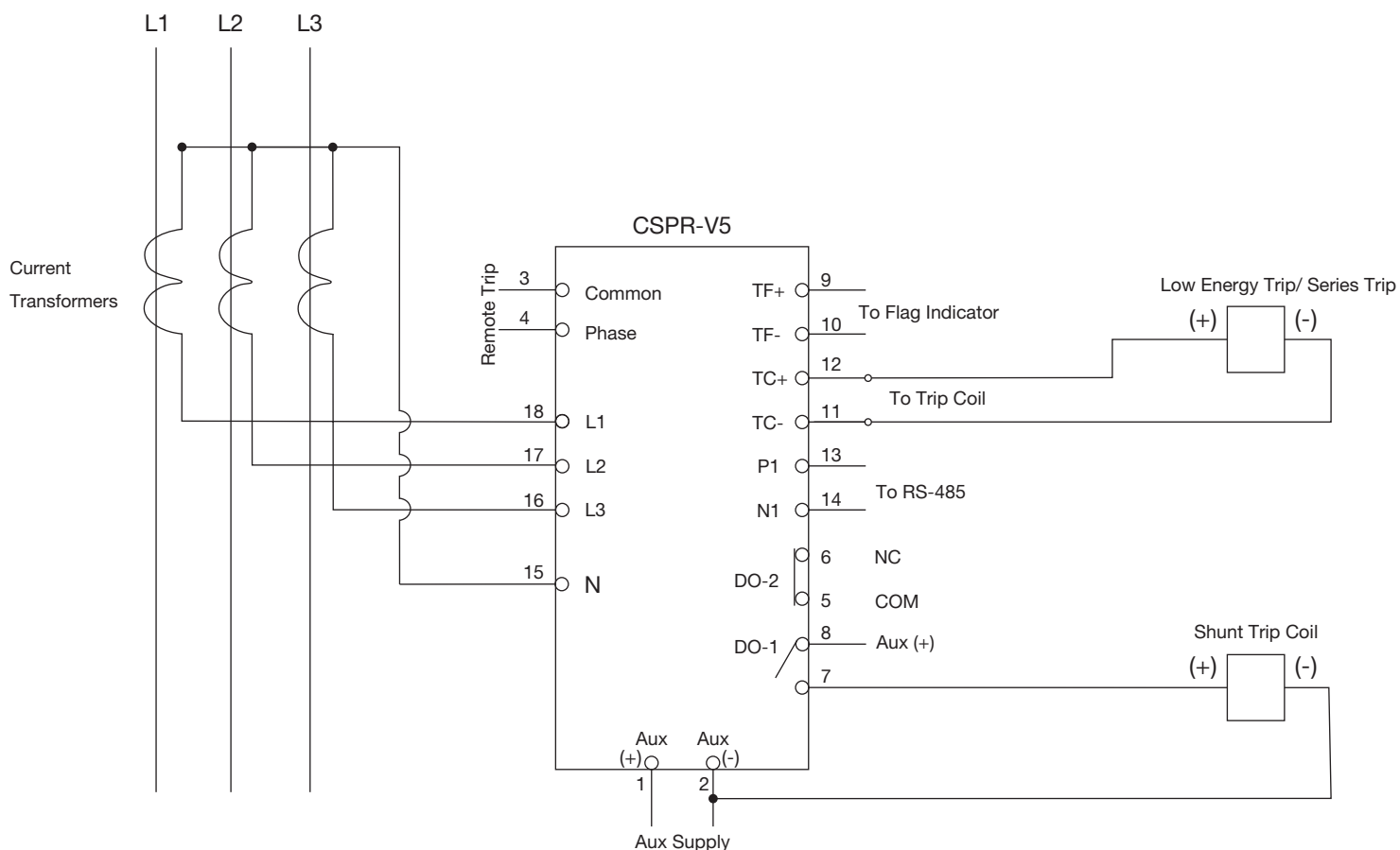
Note : Please note that the CSPR-V5 will not charge the battery

7. Front Interface of CSPR-V5



8. Connection Diagram & Terminal Details

The following shows the terminals back of CSPR



Terminal Description

Terminal No.	Terminal Description
1	Auxiliary Supply (P)
2	Auxiliary Supply (N)
3	Remote Trip Digital Input (Common)
4	Remote Trip Digital Input (Phase)
5	DO-2 (Common)
6	DO-2 (NC)
7	DO-1 (Common)
8	DO-1 (NO)
9	Trip Flag (+)
10	Trip Flag (-)
11	Trip Coil (-)
12	Trip Coil (+)
13	RS-485 (Com+)
14	RS-485 (Com-)
15	Neutral
16	L3 Phase
17	L2 Phase
18	L1 Phase

9. Technical Data

9.1 Measuring Input

Rated data	Rated current I_N (1A)	
Frequency	FN: 50/60 Hz	
Thermal withstand capacity (for $I_N=1A$)	Continuous	2.5A
	10s	15A
	1s	80A

VA Burden: (2.5VA @ Rated Current)

9.2 General Data

Rated auxiliary voltage U_H	Universal	L1: (18V - 40V DC)
		H: (85V - 260V AC / 100V to 300V DC)
Rated supply for digital input	Normal voltage U_N	L1: (18V - 40V DC)
		H: (85V - 260V AC / 100V to 300V DC)
Power consumption of Aux supply	Quiescent approx. 3W	Operating approx. 6W
Dropout pickup ratio	> 95 %	

Note: Connect Aux. Supply for using Digital Inputs (DI).

9.3 Protection Settings

Parameter	Display	Setting Range	Step
CT Ratio for primary current display	Ct Rt	1-2500	1
Frequency	Freq	50/60Hz	1
Phase Characteristics	PChr	DEFT, EINV, VINV, NINV3.0, NINV1.3 LINV, RI, HV-FUSE	1
Earth Characteristics	EChr	DEFT, EINV, VINV, NINV3.0, NINV1.3 LINV, RI, HV-FUSE	1
1 st Stage phase pickup	l>	0.20 – 2.5 x I_N	0.01 x I_N
DEFT Trip time for 1 st stage over-current	t>	0.1 – 150 s	0.01 s
Inverse TMS for 1 st stage phase over-current	ti>	0.01 – 1.500	0.005
2 nd Stage phase pickup	l>>	0.5 – 30 x I_N	0.05 x I_N
2 nd Stage phase trip time	t>>	0.03 – 20 s	0.01 s
Earth fault 1 st stage pickup	le>	0.05 - 2.5 x I_N	0.01 x I_N
DEFT trip time for 1 st stage earth fault	te>	0.05 - 150 s	0.01s
Inverse TMS for 1 st stage earth fault over-current	tie>	0.01 – 1.500	0.005
2 nd Stage earth fault pickup	le>>	0.5 – 15 x I_N	0.05 x I_N
2 nd Stage earth fault trip time	te>>	0.04 – 20 s	0.01s
Phase unbalance pickup	Unb	5 - 80%	1%
Phase unbalance trip time	tUnb	0.1-150 s	0.01 s
Enable CBFP protection	CBFP	YES / NO	-
CBFP time	tCBFP	0.05-2.0 s	0.01 s

9.4 Front Communication

Front Port	CSE protocol with “CSE LIVELINK” on USB cable type A/A
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9.5 Group Setting

Parameter	Display	Setting Range
Group No.	ACT.GRP	Group1 / Group2

9.6 Cold Load pickup Setting

Parameter	Display	Setting Range	Step	Unit
Selection of Cold Load Protection	CldLdPr	DISABLE/ENABLE	-	-
Cold Load Active Time	tCdLd	0.1-20	0.01	Sec

9.7 Display Mode Setting

Parameter	Display	Setting Range	Step	Unit
Display Mode	MOD	AutoOFF/Live	1	-

9.8 DO Assignment

Parameter	Display	Setting Range
Over Current	I>	DISABLE/DO1/DO2/DO1DO2
Short Circuit	I>>	DISABLE/DO1/DO2/DO1DO2
Earth Low set	le>	DISABLE/DO1/DO2/DO1DO2
Earth High set	le>>	DISABLE/DO1/DO2/DO1DO2
Unbalance	Unb	DISABLE/DO1/DO2/DO1DO2
Circuit Breaker Failure Protection	CBFP	DISABLE/DO1/DO2/DO1DO2
Digital Input	Remote	DISABLE/DO1/DO2/DO1DO2
All Fault	AIFlt	DISABLE/DO1/DO2/DO1DO2

9.9 DO Reset

Parameter	Display	Setting Range
Digital output1	DO1	Auto/Manual
Digital output2	DO2	Auto/Manual

9.10 Communication Setting

Parameter	Display	Setting Range
Slave Address	SLV Add	1-32
Baud Rate	BD Rate	9600/19200
Parity	Parity	NONE/EVEN/ODD

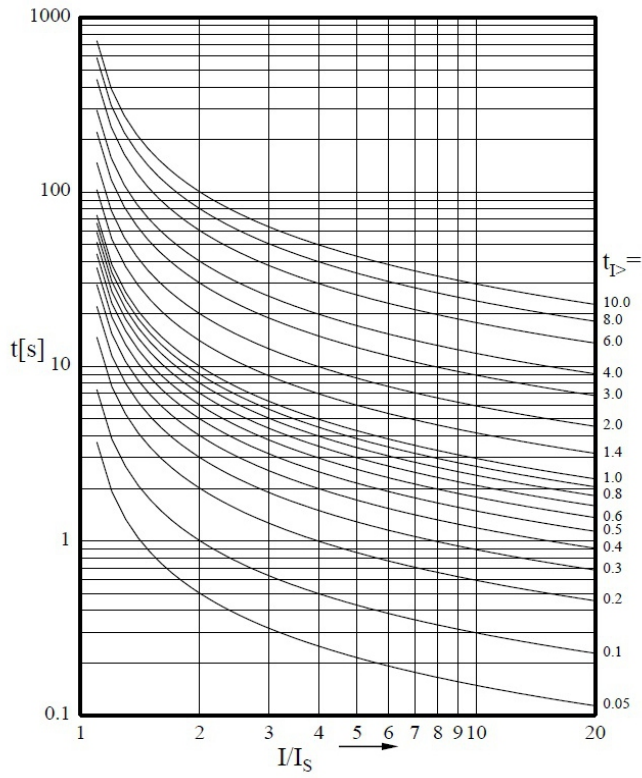
9.11 Accuracy

Tripping times with pre-fault	DMT : $\pm 5\%$ of the setting value or ± 40 mSec
	IDMT : Accuracy as per IEC-255-3 (2 x Is to 20 Is)
	For VINV / NINV / RI : $\pm 5\%$ or ± 40 mSec
	For LINV / EINV / HV-Fuse : $\pm 7.5\%$ or ± 60 mSec
Pickup accuracy	+5%
Boot up time in self powered mode	≤ 100 mSec (with Event Recorder ≤ 300 mSec)

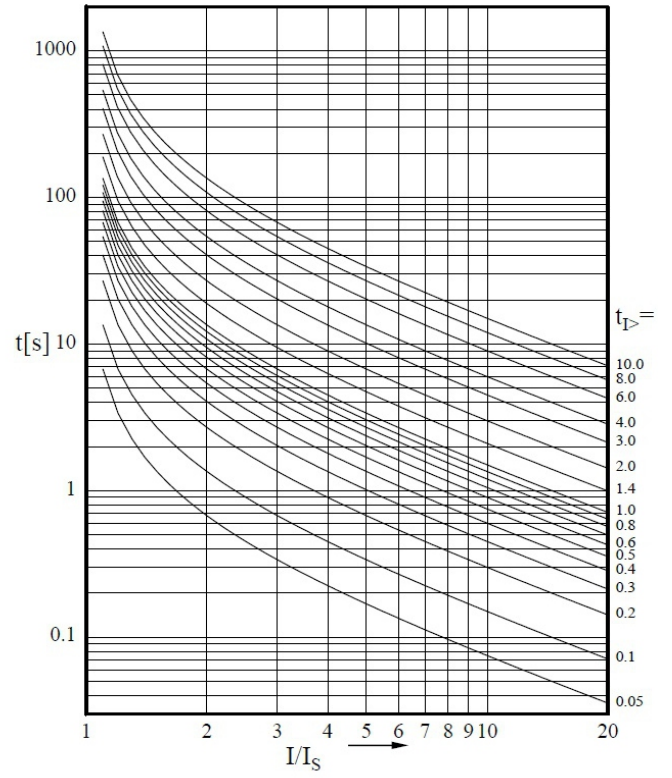
9.12 Measurement Accuracy

Description	Range	Frequency Range	Accuracy
Current	0.05 - 20 xIp	50 / 60 Hz	$\pm 2\%$ / ± 10 mAmp

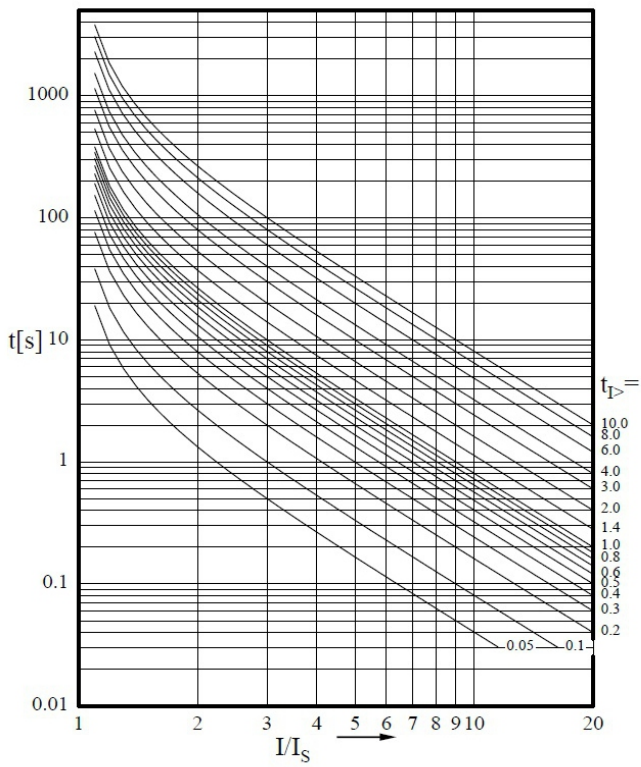
Inverse Time Characteristics



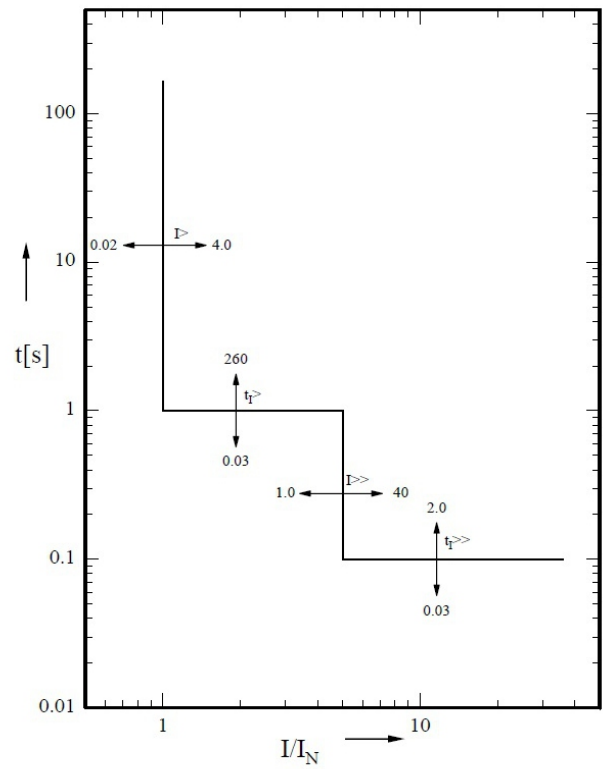
Normal Inverse



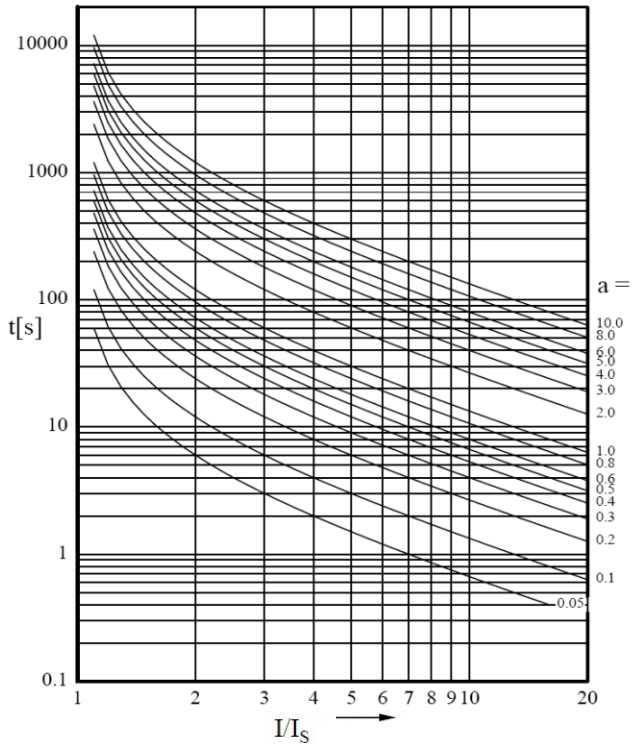
Very Inverse



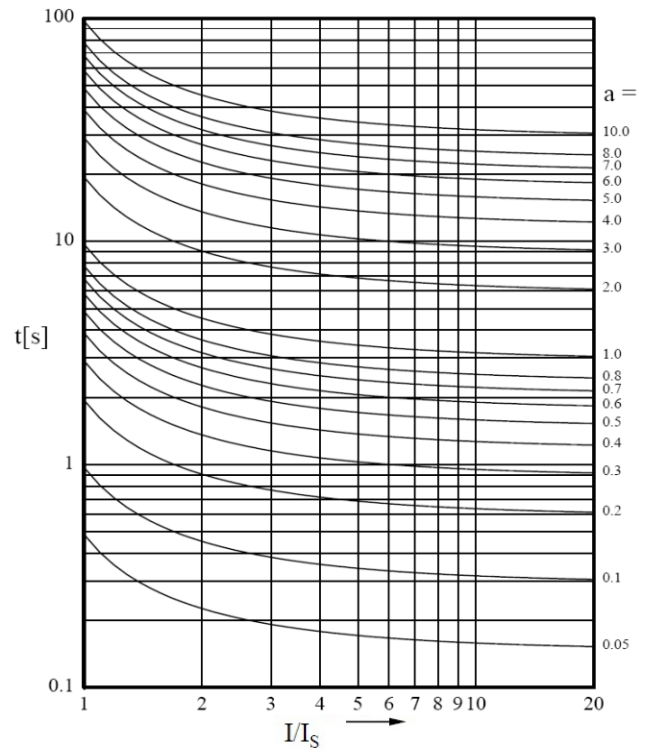
Extremely Inverse



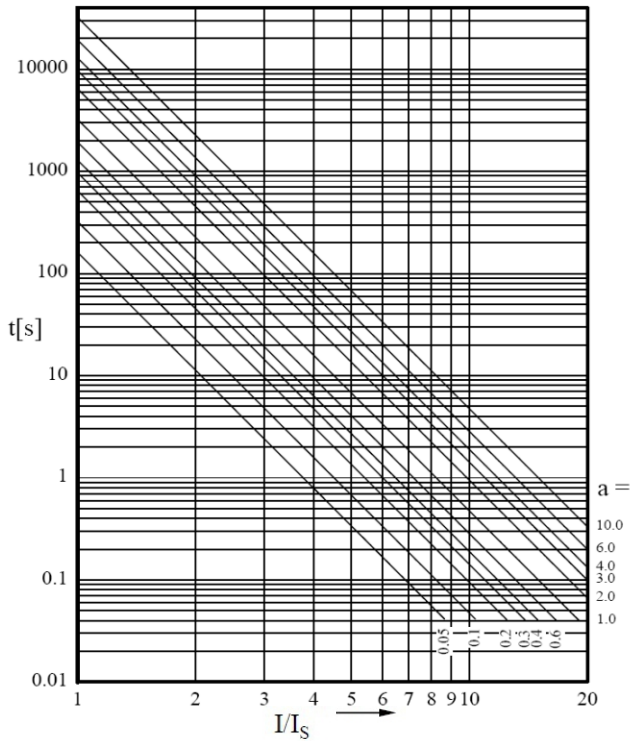
Definite time overcurrent relay



Long time inverse



RInverse



HV-fuse

9.13 Relay Contact Rating

Contact rating	
Contact relay	Dry contact Ag Ni
Make current	Max. 16A for 1s
Carry capacity	6A continuous for All contacts
	Rated voltage : 260V AC/ 30V DC
Breaking characteristics	
Breaking capacity AC	1500VA resistive
	1500VA inductive (PF=0.5) 220V AC, 6A (cos ϕ <=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	10,000 operation minimum
Unloaded contact	30,000 operation minimum

9.14 Features available in CSPR-V5

Model	CSPR V5
CT Rated Current (x In)	1A
Series Trip	Yes
Dual Power Supply (Self Powered + Auxiliary Powered)	Yes
Cold Load Pickup	Yes
Phase & Earth Over Current Protection	Yes
Circuit Breaker Failure Protection	Yes
USB Front Communication	Yes
Event/Fault Recorder	Yes
LCD display for current values & fault recording	Yes
Potential Free contacts	2
Remote Trip DI	Yes
Battery Backup	Yes
Output Trip Energy	24V@0.2Ws

9.15 Tripping Characteristics (IEC 255-3 or BS 142)



- I : Injected current
- I_s : Pickup set level
- t_i : TMS for inverse characteristic
- t : Definite delay in DEFT characteristic

$$\begin{aligned} \text{Normal Inverse 3.0/1.3} &= \frac{0.14/0.06}{(I / I_s)^{0.02} - 1} \times t_i \text{ [s]} \\ \text{Very Inverse} &= \frac{13.5}{(I / I_s) - 1} \times t_i \text{ [s]} \\ \text{Extremely Inverse} &= \frac{80}{(I / I_s)^2 - 1} \times t_i \text{ [s]} \\ \text{Long Time Inverse} &= \frac{120}{(I / I_s) - 1} \times t_i \text{ [s]} \\ \text{RI Inverse} &= \frac{1}{(0.339 - \frac{0.236}{(I / I_s)})} \times t_i \text{ [s]} \\ \text{HV Fuse} &= \frac{10^{(\log(2 I/I_s) - 3.832) + 3.66}}{0.1} \times t_i \text{ [s]} \end{aligned}$$

9.16 Standards

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)

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

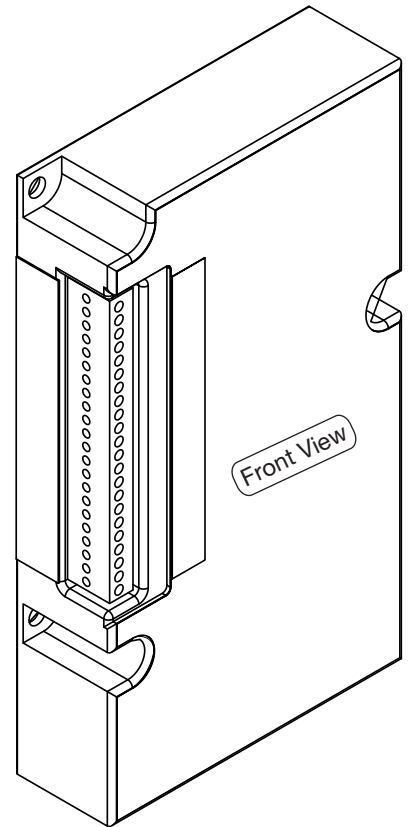
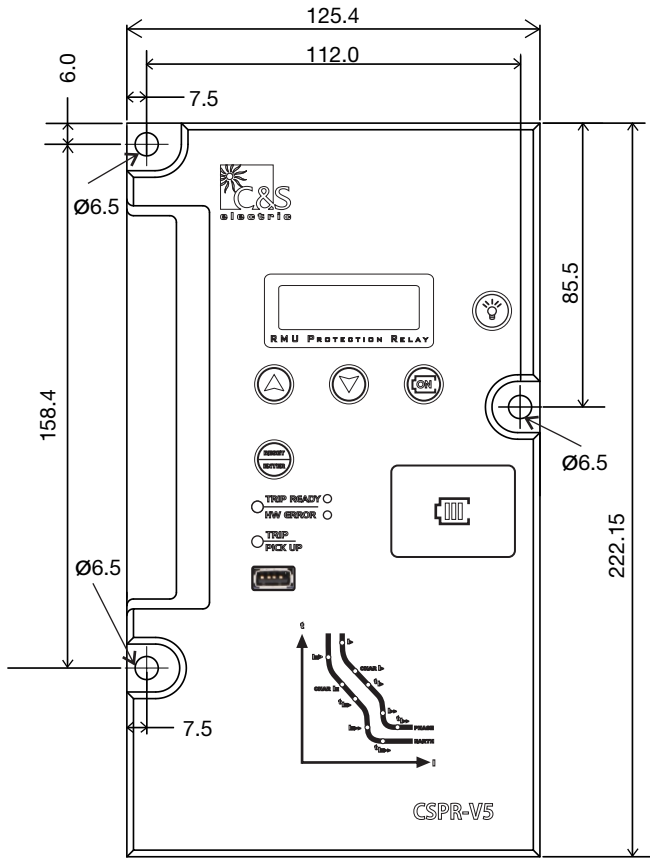
Electrical Test			
E1	Insulation Resistance >100MΩ	IEC 60255-5	500V DC, 5 sec between all terminals & case earth, between terminals of independent circuits including contact circuits and across open contacts
E2	DC & AC Supply Voltage (Relay operational)		IEC 60255-6 Voltage range, upper & lower limit continuous withstand, ramp up & down over 1 minute
E3	Voltage Dips, Short Interruptions & Voltage variations immunity (Relay operational)	IEC 1000-4-11	IEC 60255-113 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	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
E5	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 5/50nsec/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)	EN55011 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

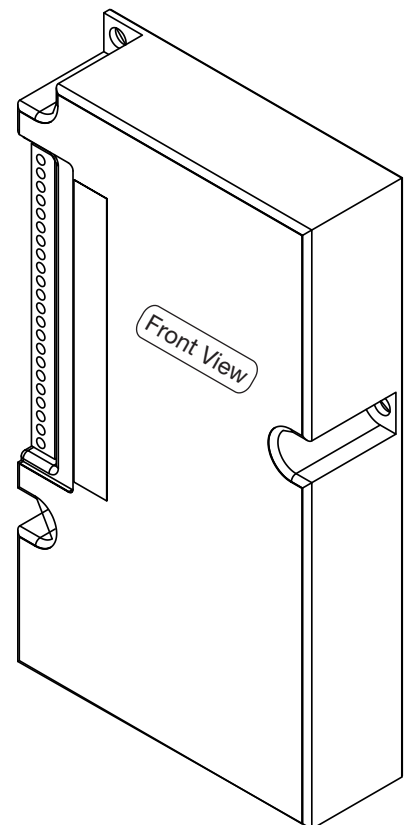
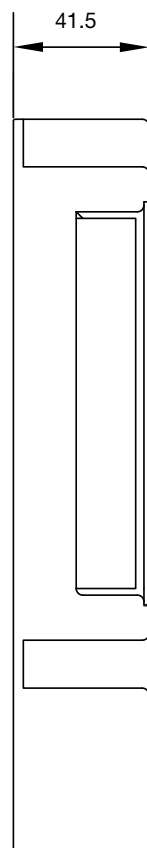
10. Dimensional Details of Vertical Model

(Gen. Tol. : ±1.0 mm)

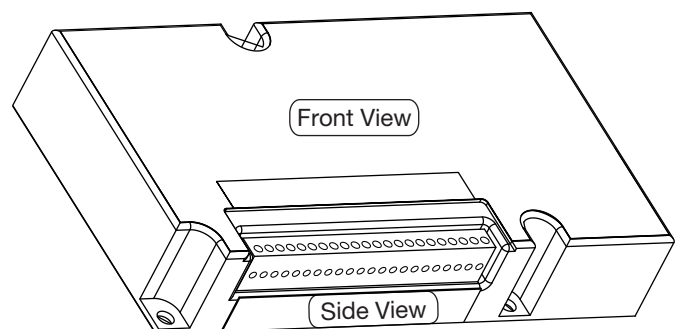
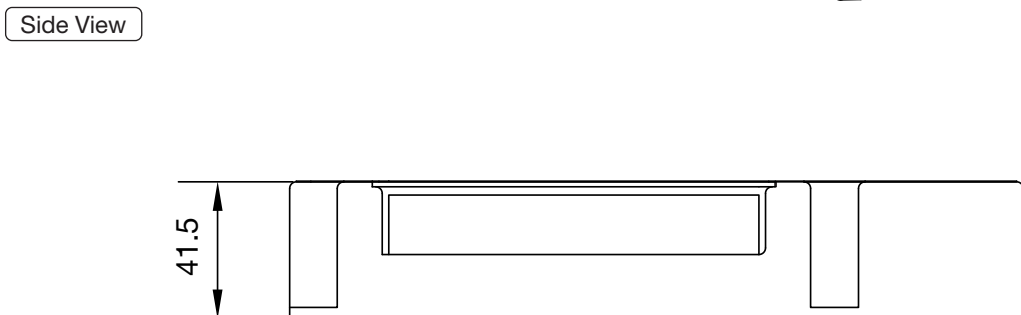
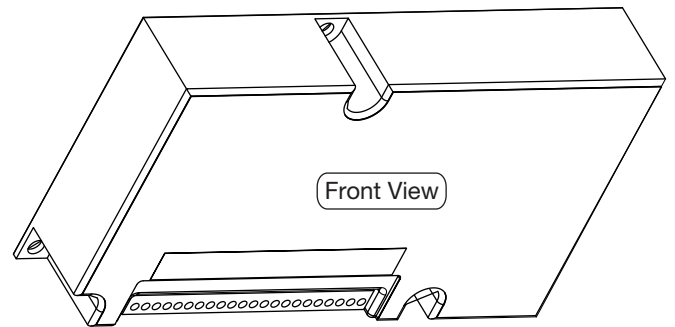
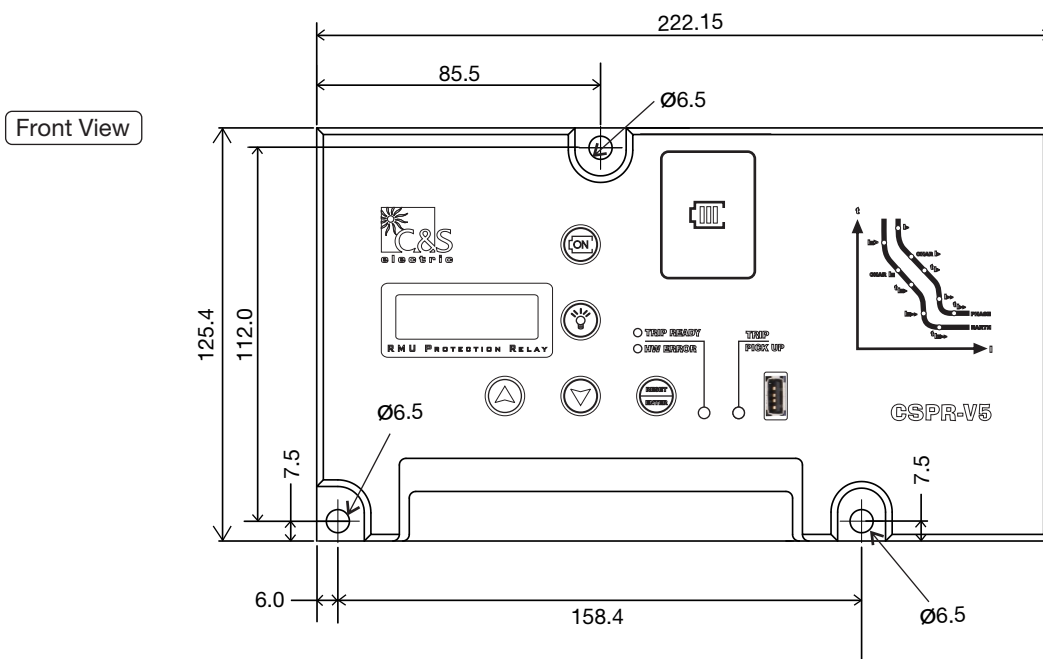
Front View



Side View



11. Dimensional Details of Horizontal Model



12. Ordering Information

CSPR - V5 - X - 1 - P2 - X - X

H : - Horizontal
V : - Vertical

1 : - Rated 1 Amp

P2 : - Trip Output 24V

Aux Supply: -
L1 : 18-40V DC
H : 85-260V AC/ 110V-300V DC

Communication: -
M : Modbus protocol
I : IEC-60870-5-103

Example: CSPR-V5-H-1-P2-L1-M

Revision History

S.No.	Rev.No.	Details	Date
01	21	Measurement Accuracy table (9.13) inserted	24.06.14
02	22	Change in "DI: Remote Trip" Clause 2.10 heading	28.06.14
03	23	Change in "Measurement Accuracy" Clause 9.13	07.07.14
04	24	Change in Dimension details Width 41 is now 41.5 & change in clause 9.2 "General data"	09.07.14
05	25	Change in "Front Panel" & Battery Pack.	23.07.14
06	26	Change in Accuracy $\pm 5\%$ to $\pm 2\%$ of "Measurement Accuracy" Clause 9.13 7 & change in Design "Note"	26.07.14
07	27	Change in Clause 3 "Communication"	30.07.14
08	28	Aux Supply Low Range change from 7-35V Dc to 18-40V DC	30.08.14
09	29	NOTE included in the clause 2.4 'Keypads' & and clause 2.9 'Assignment of output Relays'.	17.09.14
10	30	NOTE included in the clause 4 'Harmonic based protection blocking' on Page no. 5.	17.09.14
11	31	Removed details about 5A current in Clause no. 9.1 Measuring Input on Page 8	24.08.15
12	32	Removed Harmonic Blocking Details & included IEC etc "standards" details.	24.05.17
13	33	Include Note in the S.no. 9.2 on page 8 for digital input	21.08.17

For further information, please contact:

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Issue Date: 27.04.13

Rev. No: 33

Rev. Date: 21.08.17

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