

CSPR1-V24 Self Powered Relay



C&S Electric Limited
(Protection & Control Division)

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1. Introduction

CSE offers a wide range of CT powered relays which provide over current, short circuit, instantaneous phase and earth fault functions. CSPR-V1--1 is a compact relay specifically designed for compact MV switchboards with circuit breakers. CSPR-V1 uses CTs with secondary rated for 1A.

2. Features & Characteristics

- CT powered relay.
- O/C, S/C, E/F and E/F High Set protection
- DEFT and Inverse characteristics for O/C and E/F
- Impulse output for tripping coil
- Impulse output for hand reset type magnetic flag. (Magnetic flag is not a part of standard supply)
- Remote Trip input
- Fault value memory
- Serial communication for remote read-out on MODBUS RTU
- Parameter setting by rotary switches
- Inverse characteristics can be individually selected for phase and earth fault

3. Product Description

The CSPR-V1 is a CT-powered protection relay with inverse time and definite time protection characteristics.

CSPR-V1 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 by internal calculation (ANSI 50N/51N).

3.1 Operation

CSPR-V1 is a high tech and cost optimised protection relay for MV switchboards. Specifically in compact switchboards, the CSPR-V1 can replace the combination of load break switch.

CSPR-V1 is provided with four analogue measuring inputs [Phase current CTs and CBCT]. Setting of parameters is done by means of HEX switches.

The CSPR-V1 is provided with an input for remote tripping to which 110 VAC or 230 VAC can be connected. Tripping is realised via the electric impulse output even without presence of phase current.

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

As a CT powered relay CSPR1 takes the energy from phase CTs[not from CBCT] for energizing the internal circuit. Relay gets energized as soon as CT current in single phase is at least 45% of rated current. In case of three phases, relay will get energize from 25% of rated current.

[For CBCT/Earth fault protection, minimum required current must flow in any or all phases].

3.2 Installation of the Relay

The requirements on MS distribution stations with circuit breakers call for a robust protection relay which is optimized accordingly and an integral part of the respective switchboard. CSPR-V1 with minimal space requirements, simple but safe wiring, high electromagnetic immunity, and uncomplicated adjustments complies with the highest demands on a digital protection device.

4. Inputs and Outputs

4.1 Inputs

The analog input signal of the conductor currents are fed to the protective device via separate input transformers. The continuously measured current values are galvanically isolated, analog filtered and finally fed to the analog/digital converter.

There are two optionally selectable terminals CBCT1 and CBCT2 connected to terminal number for use of earth fault protection.

4.2 Outputs

4.2.1 Impulse Output (TC+ / TC-)

CSPR1 relay provides a tripping pulse output for tripping coil of breaker. It generates 24V DC Pulse for duration of 50ms (as long as adequate excitation is present). The repetition rate of pulses depends on the energy consumed by the trip coil and the fault current level.

$$\text{TRIP Energy} = \underline{24\text{VDC}} @ \underline{0.2\text{Ws}}$$

4.2.2 Flag indicator output (TF+ / TF-)

An output similar to above but with less energy is provided for operating a magnetic flag.

$$\text{TRIP Energy} = \underline{24\text{VDC}} @ \underline{0.02\text{Ws}}$$

DF1 flag unit works in conjunction with Self Powered Relay CSPR-1. It consists of an electromechanical relay, a non-rechargeable battery and a flasher circuit housed in a DIN standard flush mounting enclosure. DF1 is not a part of the standard supply, it is an accessory.



4.3 LED

A bicolor LED indication is provided in the front panel of the relay CSPR-V1. The two colors are green and red. Green flashing indicates the healthy or pickup state of relay. Applying of Ext DC supply or applying of current greater than 0.495A starts the green flashing. This green flashing incorporates the watchdog feature of relay as a check of its internal processor healthiness. Red indicates the unhealthiness of relay. Internal processor is not working

5. Fault value memory

A fault value memory is integrated in the relay CSPR-V1, where data of the last fault occurrence is stored. The stored information can be read out via the Data Retrieval Device DR1 or through PC interface on MODBUS. The following fault information is available.

- The protective element causing the trip or an externally triggered trip.
- Values of the trip current in the individual phases and earth fault current.

6. Communication

CSPR-V1 serially communicates with data retrieval device type DR1/DR2. DR1 is an externally powered unit housed in a DIN standard 96 x 96 mm flush mounting enclosure, while DR-2 is a +9V battery powered unit housed in a DIN standard 72x72mm. Both can be used for data /fault retrieval. DR-1 has additional four relays which can be used for annunciation. DR1/2 is wired to CSPR-V1 on RS485 port. DR1 has a RS232 port on the front panel and supporting software for connection to a PC. Ext supply of +12V is required for CSPR-V1 communication with DR-1/DR-2 . DR-1/DR-2 is not a part of the standard supply, it is an accessory.



Figure: DR1

CSPR-V1 supports External MODBUS communication on RS485 with following settings.

Baud rate	:	9600 baud
Parity	:	Even
Stop Bit	:	1 bit
Data Bit	:	8 bit data
Remote Address	:	1-32(settable through PC with default factory setting of 2)

All parameters of CSPR-V1 relay can be accessed through “MODBUS” using external RS485 to RS232 converter.

6.1 Circuit Breaker Trip Counter

CSPR-V1 maintains a counter for running count of the number of times a circuit breaker has been tripped. CSPR-V1 permanently stores this number in its EEPROM. CSPR-V1 can maintain maximum upto 65535 trip counts in its internal memory after that counter gets automatically reset. This information is accessible through MODBUS / PC front end software/DR1/DR2. Similarly one can also reset this count through MODBUS / PC front end software / DR1/DR2.

7. Technical Data

7.1 Characteristics

Hex switches are provided for parameter setting.

Switch	Setting Parameter	
1	$\underline{I}>$	Characteristics for O/C
2	$I>$	Pick-up value of phase O/C
3	$tI>$	Tripping time of the definite time over current element or time multiplier of the inverse time characteristic
4	$I>>$	Pick-up value of the phase S/C element
5	$tI>>$	Tripping time of the short-circuit element
6	$\underline{I}_E>$	Characteristic for E/F
7	$I_E>$	Pick-up value of the definite time Earth O/C element
8	$tI_E>$	Tripping time of the definite

		time earth over current element or time multiplier of Earth O/C element
9	$I_E>>$	Pick up value of E/F high set
10	$tI_E>>$	Tripping time of the definite time Earth High Set element

7.2 Assignment of terminals

The protection relay CSPR-V1 is equipped with 22 screw-type plug in terminals. For Details see section 9 terminal details.

7.3 Setting Ranges and Steps

HEX - Switch 1

HEX 1	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
CHAR	DEFT	N-INV	V-INV	E-INV	L-INV	RI-INV	HV-Fuse	X	X	X	X	X	X	X	X	X

I>: HEX - Switch 2

HEX 3	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
x I_s	0.5	0.6	0.7	0.8	0.9	1	1.15	1.3	1.4	1.5	1.6	1.8	2	2.25	2.5	Exit

t_{I>}: HEX – Switch 3

HEX 3	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Time(s) (DEFT)	0.04	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.5	2.0	3.0	10	20	100	300
Factor “a”	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1	2	3	4	5	6	8	10

I>>: HEX – Switch 4

HEX 4	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
x I_s	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	Exit

t_{I>>}: HEX – Switch 5

HEX5	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Time(s)	0.04	0.07	0.1	0.15	0.2	0.25	0.3	0.4	0.6	0.8	1.0	1.4	1.8	2.2	2.6	3.0

HEX - Switch 6

HEX 6	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
CHAR	DEFT	N-INV	V-INV	E-INV	L-INV	RI-INV	HV-Fuse	X	X	X	X	X	X	X	X	X

I_E>: HEX – Switch 7

HEX 7	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
x I_s	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.2	1.4	1.6	2.0	2.5	Exit

t_{I_E>}: HEX – Switch 8

HEX 8	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Time(s) (DEFT)	0.06	0.1	0.2	0.4	0.6	1	2	4	6	10	20	40	60	100	200	300
Factor “a”	0.05	0.07	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1	2	3	4	6	8	10

I_E>>: HEX – Switch 9

HEX 9	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
x I_s	0.5	0.7	1.0	1.2	1.8	2	2.5	3.0	3.5	4	5	6	7	8	10	Exit

t_{I_E>>}: HEX – Switch 10

HEX10	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Time(s)	0.03	0.04	0.05	0.06	0.08	0.1	0.15	0.20	0.25	0.3	0.4	0.6	0.8	1	1.5	2

Steps for changing Nominal Frequency:

Step1. Put the front switch 1 on 50Hz or 60Hz position, as per requirement.

Step2. Power ON the CSPR-V1 (through current or external DC supply)

Note: Once after getting energized, change of Freq selector switch position will not be effected.

Caution: Selection of wrong nominal freq can result in wrong pickup/trip.

Steps for Modbus Slave Address Configuration:

Step1. SW1 (Phase Characteristic Selection Switch) & SW2 (Overload Pickup

Selection Switch) will be used for Slave Address configuration as per following table

SW1 Position	SW2 Position	Slave Address for CSPR-V1
0	X	1
1	X	2
2	X	3
3	X	4
4	X	5
5	X	6
6	X	7
7	X	8
8	X	9
9	X	10
A	X	11
B	X	12
C	X	13
D	X	14
E	X	15
F	0	16
F	1	17
F	2	18
F	3	19
F	4	20
F	5	21
F	6	22
F	7	23
F	8	24
F	9	25
F	A	26
F	B	27
F	C	28
F	D	29

F	E	30
F	F	31

X: Don't Care Condition

Step2: Now do the settings of SW1 & SW2 as per above selection chart & put the front switch 2 on Slave Address position.

Step3: Switch ON the unit for one 1sec & put the switch back on back position.

Note: If the switch2 remains in S.ADD position, then CSPR-V1 will keep changing the Slave address as per current position of SW1 & SW2 switches.

Caution: Change in S.ADD will not effect any protection, but selection of wrong Slave address can halt the running communication of Modbus.

7.4 Calculation formula for IDMT characteristics

Normal Inverse:

$$t = \frac{0.14}{\left(\frac{I}{I_s}\right)^{0.02} - 1} \cdot a [s]$$

Very Inverse:

$$t = \frac{13.5}{\left(\frac{I}{I_s}\right) - 1} \cdot a [s]$$

Extremely Inverse:

$$t = \frac{80}{\left(\frac{I}{I_s}\right)^2 - 1} \cdot a [s]$$

Long time inverse:

$$t = \frac{120}{\left(\frac{I}{I_s}\right) - 1} \cdot a [s]$$

RI- Inverse :

$$t = \frac{1}{0.339 - 0.236 \left\{ \frac{I}{I_s} \right\}} \cdot a [s]$$

HV Fuse Curve:

$$t = 10^{\left(\log \left(2 \cdot \frac{I}{I_s} \right) \cdot (-3.832) + 3.66 \right)} \cdot \frac{a}{0.1} [s]$$

8. Product Specific Features

8.1 Earthing

The fourth terminal (PE) of the top terminal block is the central earth connection point of the protection system.

9. Terminals Details

Terminal No.	Terminal Name	Description Details
1	E	Earth
2	N	Neutral
3	110 V	Remote trip Input 110V AC
4	230 V	Remote trip Input 230V AC
5	P1	RS 485 Comm (Positive)
6	N1	RS 485 Comm (Negative)
7	GND	Ext Supply GND
8	+12 V	Ext Supply +12 V
9	TF+	Trip Flag (+ ve)
10	TF-	Trip Flag (- ve)
11	TC-	Trip Coil (- ve)
12	TC+	Trip Coil (+ ve)
13	E1	CT Inter Connection
14	CS2	CT Inter Connection
15	CBCT2	CBCT2
16	CBCT1	CBCT1
17	B2	B phase
18	B1	B phase
19	Y2	Y phase
20	Y1	Y phase
21	R2	R phase
22	R1	R phase

10. System Data

10.1 EMC

Interference immunity against discharges of static electricity		
DIN EN 60255-22-2 [05/97]	Air discharge	8 kV
DIN EN 61000-4-2 [03/96]	contact discharge	6 kV
Class 3		
Interference immunity against high-speed transient interference quantities		
DIN IEC 60255-22-4 [10/93]	power supply, mains inputs	± 4 kV, 2.5 kHz
DIN EN 61000-4-4 [03/96]	other inputs and outputs	± 2 kV, 5 kHz
Class 4		
Interference immunity against 1 MHz burst disturbance tests		
DIN EN 60255-22-6 [11/94]	differential mode	2.5 kV, 1 MHz
DIN IEC 60255-22-1 [05/91]	common mode	1 kV, 2 s
Interference immunity against surge immunity test		
DIN EN 61000-6-2 [03/00]		4 kV/2 kV
DIN EN 61000-4-5 [09/96]		
Interference immunity against high-frequent electromagnetic fields		
DIN EN 61000-4-3 [08/97]		10 V/m
Class 3		
Interference immunity against magnetic fields of energy based frequency		
DIN EN 61000-4-8 [05/94]	continuously	100 A/m
Class 5	3 s	1000 A/m
Interference immunity against line conducted interference quantities induced by high-frequent fields		
DIN EN 61000-4-6 [04/97]		10 V/m
Class 3 (0.15-230 MHz)		
Interference immunity against surge voltage		
DIN EN 61000-4-5 [09/96]	within a current circuit	2 kV
Class 4	current circuit to earth	4 kV
Measuring of the radio interference voltage		
DIN EN 55011 [10/97]		Limit. value class B
Measuring of the radio interference radiation		
DIN EN 55011 [10/97]		Limit. value class B

10.2 Accuracy

Tripping times with prefault :	DMT: $\pm 3\%$ of the setting value & absolutely ± 30 ms
	IMT: Accuracy as per IEC-255-3 (2 x In to 20 In)
	For VINV / NINV: $\pm 5\% + 30$ msec
	For EINV/LI-INV/RI-INV/HV : $\pm 7.5\% + 30$ msec
Pickup Accuracy:	$\pm 5\%$
Tripping time without prefault	Standard time + (≤ 100 msec)

Technical data subject to change without notice!

10.3 Technical Datasheet CSPR1

Frequency:	50 Hz ± 2 Hz / 60Hz ± 2 Hz
Thermal load capacity:	Continuously : 2 x In 1s 20 x In 5s 10 x In Dynamically current withstand 60 x In (half wave)
Dropout Ratio :	> 95%
Burden	1 VA @ In
Ext. Aux. Supply +12V DC Range	+7V to +14V DC
Impulse Output	<u>24VDC@0.2Ws</u>

10.4 Ambient Conditions

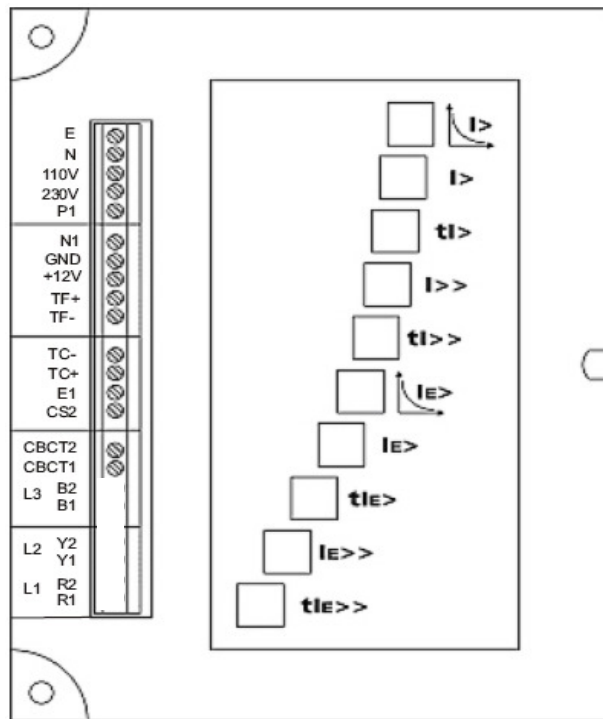
Vibration and continuous vibration test		
DIN EN 60255-21-1 [05/96]		1/2 gn
Class 2		
Shock and continuous shock test		
DIN EN 60255-21-2 [05/96]		10/20 gn
Class 2		
Test Ad: Cold		
DIN EN 60068-2-1 [03/95]	Temperature	-40°C
	Period of stress	16 h
Test Bd: Dry heat		
DIN EN 60068-2-2 [08/94]	Temperature	+85°C
	Rel. humidity	<50%
	Period of stress	72 h
Test Ca: Humid heat (constantly)		
DIN IEC 60068-2-3 [12/86]	Temperature	+40°C
	Rel. humidity	93%
	Period of stress	56 d
Test Db :Humid heat (cyclic)		
DIN IEC 60068-2-30 [09/86]	Temperature	+70°C
	Rel. humidity	95%
	Cycle (12 + 12-hours)	2
Class of protection		
	Relay housing	IP 40
	Terminals	IP 20

10.5 Insulation voltage withstand

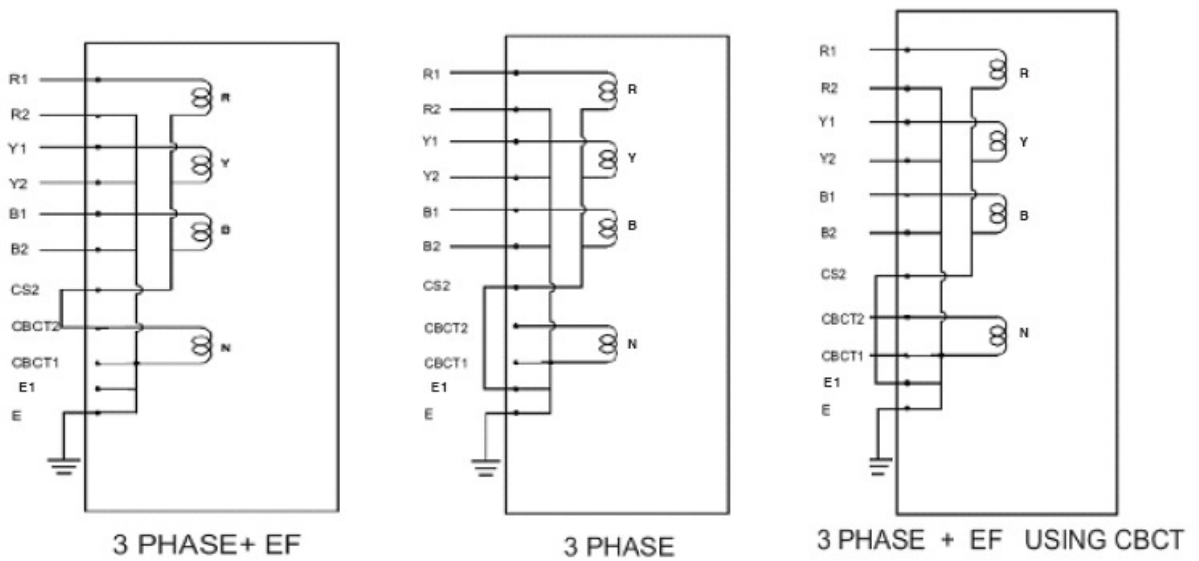
Test of withstand alternating voltage for 1 min:	IEC 60255-5	2.5 kV
Test of lightning surge voltage 1.2/50 µs, 0.5 J	IEC 60255-5	5 kV

11. Connection Diagram

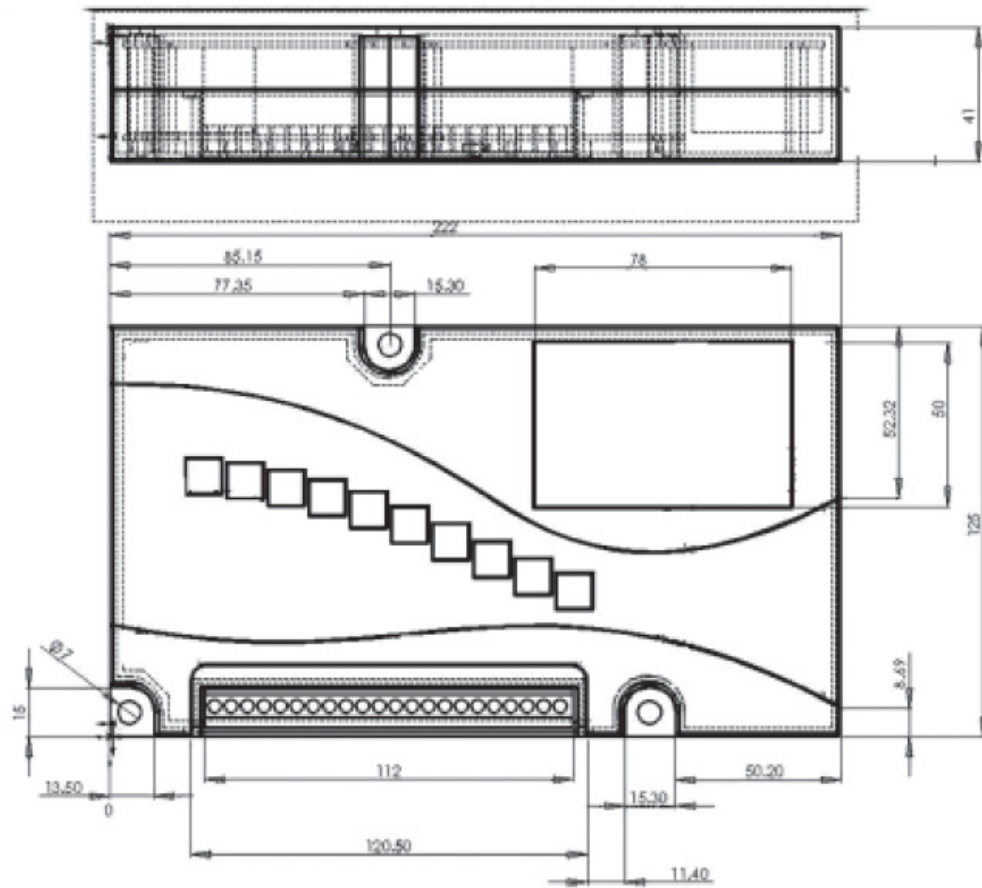
11.1 Terminal Block



11.2 Connections



11.3 Dimensional Details.



All Dimensions are in mm.

Weight : 1kg (Approx.)
Dimensions (W x H x T): 125x222x41mm

Ordering information

CSPR1-V24