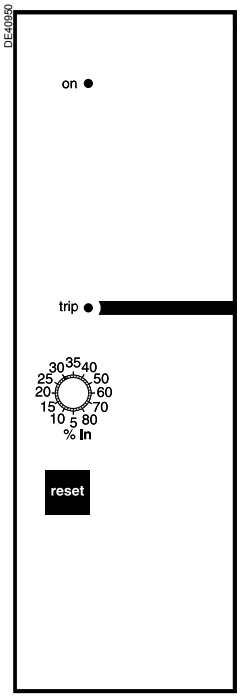
Contents

Presentation	2
High impedance differential protection	3
Specifying the sensors	4
Surge limiter	6
Description and connection	7
Connection diagrams of the accessories	8
Example of applications	9
Characteristics	10
Installation	11
Commissioning	13
Order from	14

Presentation

Sepam 100 LD



Sepam 100 LD: front panel

Sepam 100

Sepam 100 is a group of modules that may be used:
- separately to perform a function
- in combination with a Sepam protection relay.
- Each module has been designed to perform a complete function.
- It includes all the elements required, such as:
- tripping output relays
- annunciation, settings
- connections.

Sepam 100 LD

Sepam 100 LD is a high impedance differential relay.
It provides restricted earth fault, busbar and machine protection.

Advantages

- stability with respect to external faults
- sensitivity to internal faults
- speed (typical response time: 15 ms to 5 Is)
- outputs with or without latching
- local and remote acknowledgment
- high level of immunity to electromagnetic interference.

Description

Sepam 100 LD is available in 4 versions:
- single-phase for restricted earth protection
- three-phase for busbar and machine protection
- 50 or 60 Hz

50 Hz single-phase: 100 LD X 51
50 Hz three-phase: 100 LD X 53
60 Hz single-phase: 100 LD X 61
60 Hz three-phase: 100 LD X 63.

The front of Sepam 100 LD includes:
- 2 signal lamps:
  - power “on” indicator
  - latching “trip” indicator indicating output relay tripping
- protection setting dial
- “reset” button for acknowledging output relays and the “trip” indicator.

When the button is activated, the “trip” indicator undergoes a lamp test.

The back of Sepam 100 LD includes:
- input/output connectors:
  - an 8-pin connector for toroid inputs and remote acknowledgment
  - an 8-pin connector for “tripping” outputs and power supply
  - a 4-pin connector for “tripping” outputs
- a microswitch used to configure the relay “with” or “without” latching.

Sepam 100 LD has:
- 1 or 3 current inputs with a common point according to whether it is a single-phase or three-phase version
- a logic input (isolated) for remote acknowledgment
- “tripping” output relay with 5 contacts

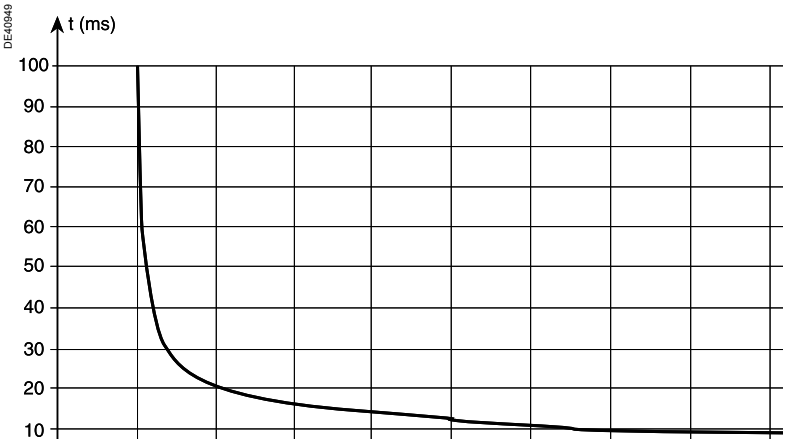
3 normally open contacts and 2 normally closed contacts).

Sepam 100 LD operates in 5 voltage ranges (please specify when ordering):
- 24-30 Vdc
- 48-125 Vdc
- 220-250 Vdc
- 100-127 Vac
- 220-240 Vac.

Sepam 100 LD is associated with a stabilization plate (or 3 plates) with variable resistance, enabling operation with 1 A or 5 A transformers.

High impedance differential protection

Operation curve



Settings

Settings	Setting values	
Setting current Is	5 to 40 % In by steps of 5 % In	
	40 to 80 % In by steps of 10 % In	
	The dial on the front of the device is used for setting	
Stabilizing resistor plate	Rs = 0 Ω to 68 Ω	P = 280 W
	Rs = 0 Ω to 150 Ω	P = 280 W
	Rs = 0 Ω to 270 Ω	P = 280 W
	Rs = 0 Ω to 470 Ω	P = 180 W
	Rs = 0 Ω to 680 Ω	P = 180 W
Accuracy / performance		
Setting	±5 %	
Pickup (%)	93 % ±5 %	
Response time	≤ 10 ms for I ≥ 10 Is	
	≤ 16 ms for I ≥ 5 Is	
	≤ 25 ms for I ≥ 2 Is	
Memory time	≤ 30 ms	

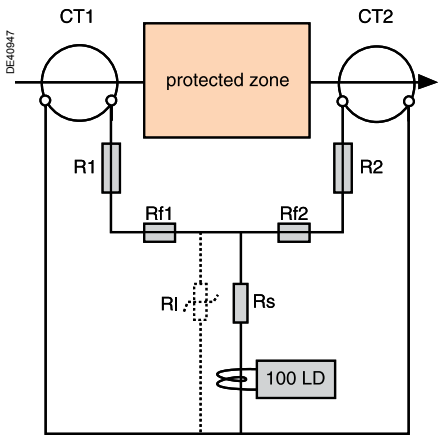
Parameter setting

Microswitch SW1, accessible on the back of Sepam 100 LD, is used to choose “with” or “without” latching.

Without latching:

With latching:

Specifying the sensors



n:	*CT transformation ratio*
p:	*Number of CTs*
Rf1, Rf2:	*Wiring resistance on either side of Rs* *Rf = max (Rf1, Rf2)*
R1, ...Rp:	*CT secondary resistances* *R = max (R1, ...Rp)*
Rs:	*Stabilizing resistor*
RI:	*Surge limiter*
isc:	*Maximum external short-circuit current in CT secondary winding*
is :	*Protection setting (A)*
if:	*Current in RI*
i_m1, i_mp:	*CT magnetizing currents*
Vk1, Vkp:	*CT knee-point voltages* *Vk = min (Vk1,...Vkp)*

Current transformers

To ensure the stability and sensitivity of Sepam 100 LD, the stabilization resistor and characteristics of the current transformers (CTs) are calculated as follows.

Choice of current transformers

- all the CTs must have the same transformation ration
- the knee-point voltages are chosen so that:

Vk > 2 x (R + Rf) x isc

Choice of stabilizing resistor

$$\frac{R + Rf}{is} \times isc < Rs \leq \frac{Vk}{2 \times is}$$

Surge limiter

The approximate voltage developed by a CT in the event of an internal fault is:

$V = 2\sqrt{2} \times Vk \times (isc \times (R + Rf + Rs) - Vk)$

If the value exceeds 3 kV, it is necessary to add an RI surge limiter in parallel with the relay and stabilizing resistor in order to protect the CTs (see: surge limiter).

Protection sensitivity

The CTs consume magnetizing current and the surge limiter, when installed, creates fault current. The minimum residual primary current detected by the protection is therefore:

$Id = n \times (i_m1 + \ldots i_mp + if + is)$

with

- $i_m1, \ldots i_mp$ are read on the CT magnetization curves at V = Rs x is
- if is the total earth leakage current of the surge limiter for Vs = Rs x is, i.e. the sum of the earth leakage currents of the N limiter units installed in parallel: if = N x ib (see: surge limiter).

Example 1: Restricted earth (single-phase relay)

Data:

- Isc primary = 8 kA
- n: 400/1 A
- R = 2,4 Ω
- CTs situated 60 m from the relays
- connected by 6 mm2 wiring (copper)

$$Rf = 0{,}020 \times \frac{(2 \times 60)}{6} = 0{,}4\ \Omega$$

- number of sensors in parallel: 4 (same)
- setting: Is = 20 % In, is = 0.2 A.

CT knee-point voltage

isc = 8000/400 = 20 A
(R + Rf) x isc = (2,4 + 0,4) x 20 = 56 V
Vk > 2 x 56 = 112 V
e.g.: Vk = 140 V.

Stabilizing resistor

$$\frac{56}{0{,}2} < Rs \leq \frac{140}{(2 \times 0{,}2)}$$

280 < Rs ≤ 350
The resistance is adjustable from 0 to 470 Ω. It is set to 300 Ω.

Surge limiter ?

$V = 2\sqrt{2} \times 140\ (20\ (2.4 + 0.4 + 300) - 140)$
V = 2574 V < 3 kV
It's not necessary to install a surge limiter in parallel.

Minimum primary default current detected by the protection

For V = Rs x is = 60 V
The CT magnetization curve indicates im = 10 mA
Id = 400 (4 x 0.01 + 0.2) = 96 A

Specifying the sensors

Example 2: Busbar differential protection (three-phase relay)

Data:

- switchboard with 10 cubicles incomer and feeder, without coupling
- Isc = 30 kA
- n: 2000/5 A
- R = 1.76 Ω
- CTs situated 15 m from the relays
- connected by 2.5 mm^2 wiring (copper):

$$\mathbf{Rf = 0,02 \times \frac{(2 \times 15)}{2,5} = 0,24\ \Omega}$$

- number of sensors in parallel: 10 (same)
- setting: is = 50 % In, is = 2.5 A.

CT knee-point voltage

isc = 30000 x 5/2000 = 75 A
(R + Rf) x isc = (1.76 + 0.24) x 75 = 150 V
Vk > 2 x 150 = 300 V
e.g.: Vk = 320 V.

Stabilizing resistor

$$\mathbf{\frac{150}{2,5} < Rs \leq \frac{320}{(2 \times 2,5)}}$$

60 Ω < Rs ≤ 64 Ω
The resistance is adjustable from 0 to 68 Ω. It is set to 64 Ω.

Surge limiter ?

V = 2√ 2 x 320 (75 (1.76 + 0.24 + 64) - 320)
V = 3443 V > 3 kV
It's not necessary to install a surge limiter in parallel.

Minimum primary default current detected by the protection
For V = Rs x is = 160 V
The CT magnetization curve indicates im = 20 mA.
The leakage current curve of the surge limiter indicates i_l = 4 mA.
The number of surge limiters is:

$$\mathbf{N \geq \frac{75}{40}} = 2, \text{ hence}$$

$$\mathbf{Id = \frac{2000}{5}(10 \times 0,02 + 0,004 + 2,5) = 1083\ A}$$

Surge limiter

If the calculations have shown that it is necessary to install a surge limiter in parallel with the relay and Rs to protect the CTs, it is determined as follows..

Choice

Standard references

■ the surge limiters on offer consist of limiter blocks which are independent of each other. Each block accepts a maximum current of 40 A RMS for 1 s. By installing the blocks in parallel, it is possible to obtain the appropriate limiter for the application.

■ there are two standard references:
□ a single module, comprising one block
□ a triple module, comprising three independent blocks which are aligned.

Calculation of the number of blocks per phase

According to i, max. RMS short-circuit current in the secondary winding of a CT, the number of blocks required per phase is calculated: $N \geq \frac{I}{40}$

■ for a three-phase relay, N triple modules should be ordered
■ for a single-phase relay, N blocks, made up of triple and single modules.

Example 1

■ max. RMS short-circuit current in the primary winding of a CT with a ratio of 1000: 60 kA
■ calculation of the number of blocks per phase:

$N \geq \frac{60000}{(1000 \times 40)} = 1,5$, hence $N = 2$

■ modules to be ordered:
□ 2 triple modules for a three-phase relay
□ 2 single modules for a single-phase relay.

Example 2

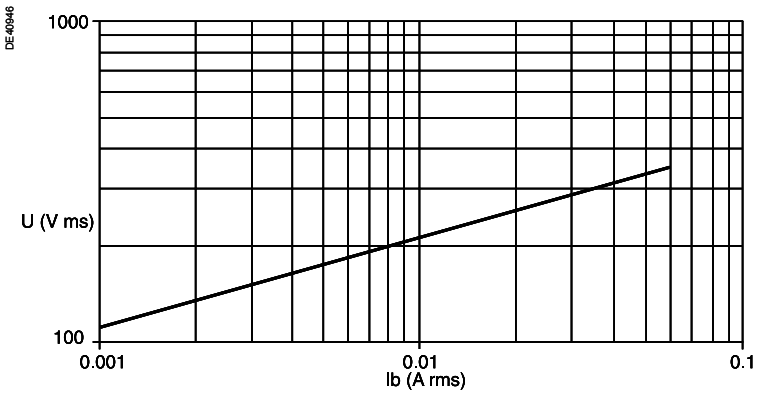
■ max. RMS short-circuit current in the primary winding of a CT with a ratio of 400: 50 kA
■ single-phase relay.
■ calculation of the number of blocks per phase:

$N \geq \frac{50000}{(400 \times 40)} = 3,1$, hence $N = 4$

■ modules to be ordered:
1 triple module + 1 single module to have 4 blocks in all.

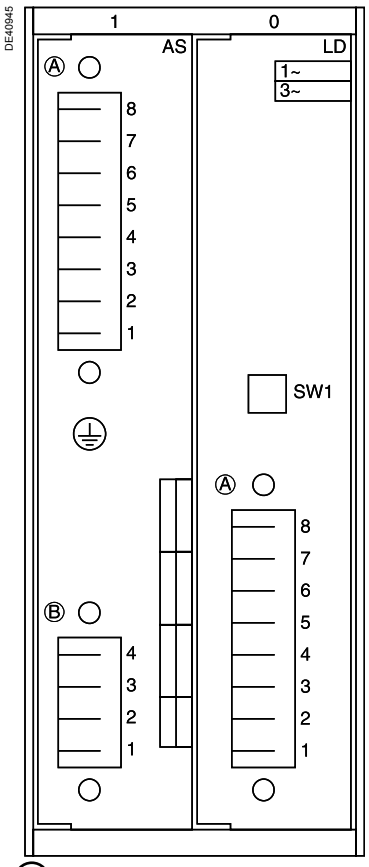
Earth leakage current

A limiter block accepts a max. steady state voltage of 325 V RMS and presents an earth fault current Ib:



Description and connection

Rear panel

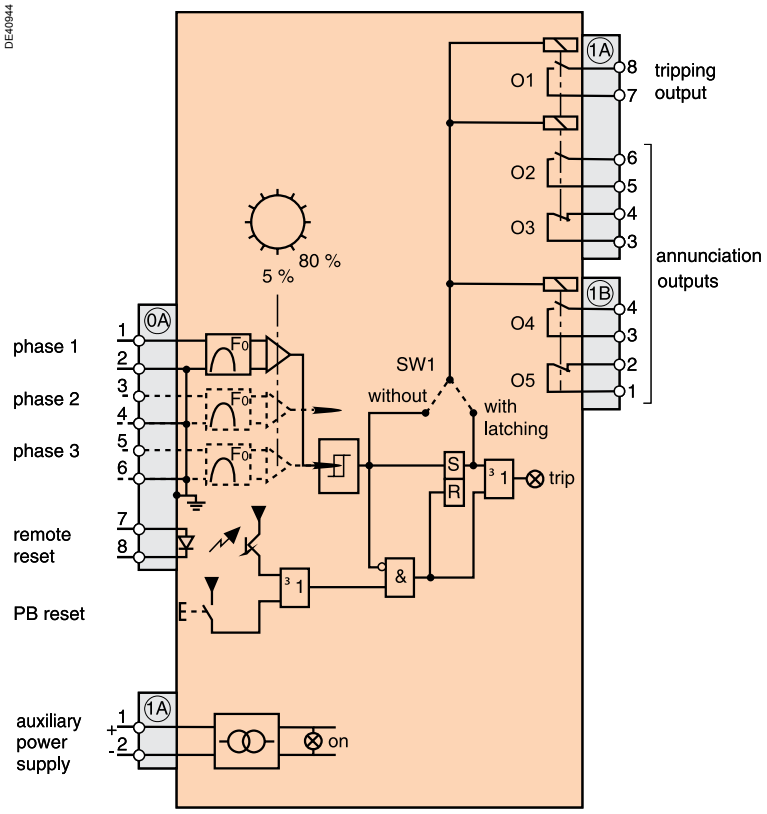


0A : 8-pin CCA608 connector (torold and remote reloading inputs); screw terminal wiring with 0.6 to 2.5 mm2 wires, each terminal being capable of receiving two 1.5 mm2 wires.

1A : 8-pin CCA608 connector (power supply and "annunciation and tripping" outputs); screw terminal wiring with 0.6 to 2.5 mm2 wires, each terminal being capable of receiving two 1.5 mm2 wires.

1B : CCA604 connector ("annuciation" outputs); screw terminal wiring with 0.6 to 2.5 mm2 wires, each terminal being capable of receiving two 1.5 mm2 wires.

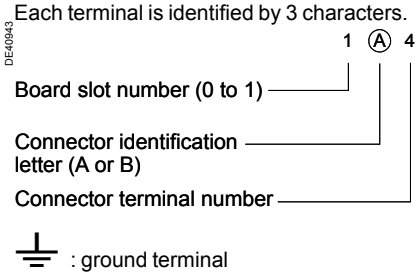
Functional and connection diagram



Note: *only 0A1 and 0A2 terminals are available in the single-phase version.*

Terminal identification

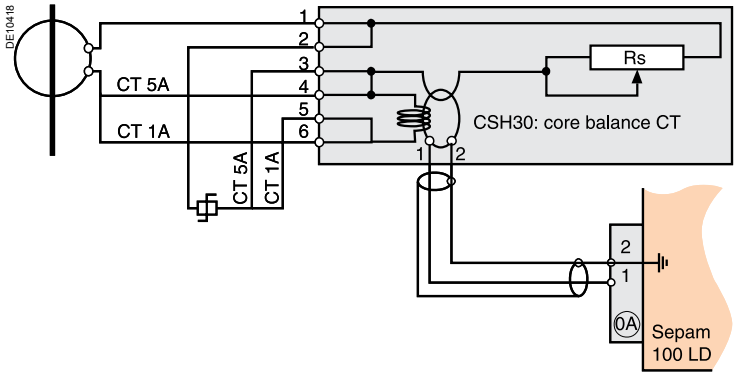
Each terminal is identified by 3 characters.



Connexion diagrams of the accessories

Stabilization plate

Connection of CTs and surge limiters:
- 5 A rating: between terminals 1-2 and 3-4
- 1 A rating: between terminals 1-2 and 5-6



- items 1 to 6: clamp screw connections for 6 mm² wire
- items 1, 2: secondary of CSH30 core balance CT, connected to (0A)

Wire to be used:
- sheathed, shielded wire
- min. cross-section 0.93 mm² (AWG 18) (max. 2.5 mm²)
- resistance load per unit length < 100 mΩ/m
- min. dielectric strength: 1000 V
- max. length: 2 m.

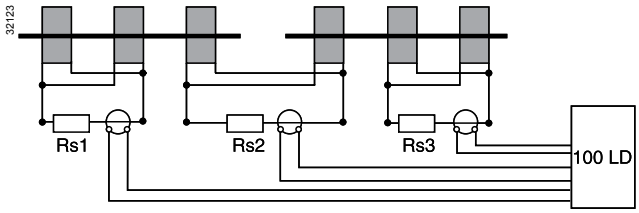
Connect the wire shielding in the shortest way possible to (0A).
The shielding is grounded in Sepam 100 LD. Do not ground the wire by any other means.
Press the wire against the metal frame of the cubicle to improve immunity to radiated interference.

Surge limiter

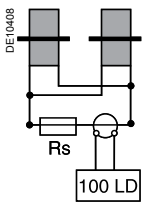
- single unit = outputs with screw M10
- triple unit = outputs with holes ø 10.4

(see,"installation").

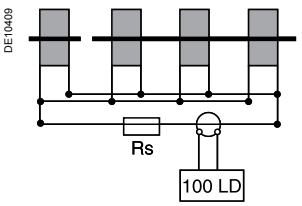
- **Example 1** (N = 2 blocks per phase): 2 triple modules for a three-phase relay.



- **Example 2** (N = 2 blocks per phase): 2 single modules for a single-phase relay.



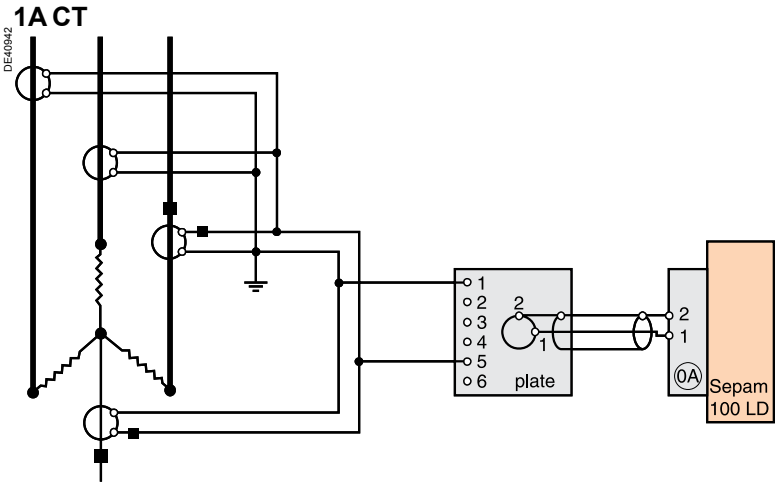
- **Example 3** (N = 4 blocks per phase) 1 triple module + 1 single module for a single-phase relay.



Example of applications

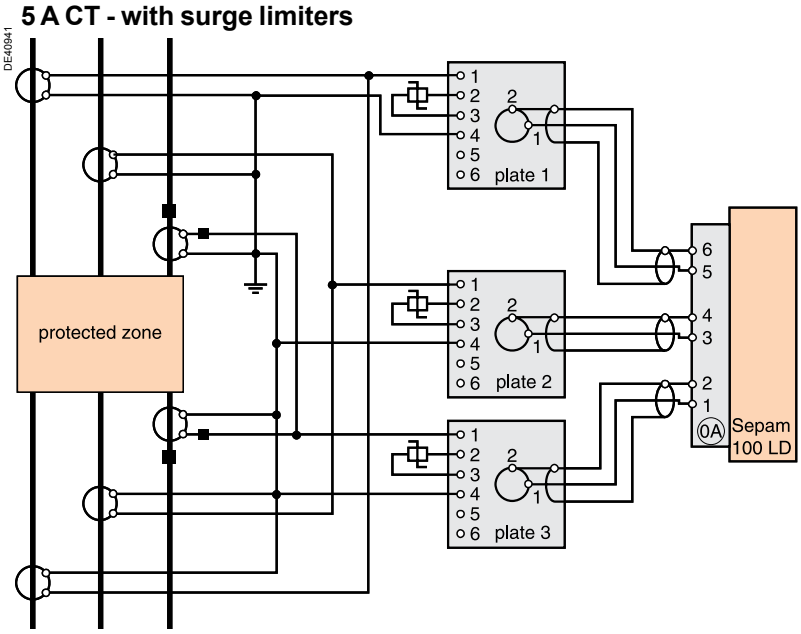
Restricted earth protection (single-phase)

1A CT



Busbar protection (three-phase)

5 A CT - with surge limiters



Note: ■ = *correspondence between primary and secondary connections (e.g. P1, S1).*

Characteristics

Electrical characteristics

Analog inputs (with plate)

Constant current	10 In
3 sec. current	500 In

Logic input (remote reset)

Voltage	24/250 Vdc	127/240 Vac
Maximum power consumption	3.5 W	3.7 VA

Logic outputs

Constant current		8 A			
Voltage		24/30 Vdc	48 Vdc	127 Vdc/Vac	220 Vdc/Vac
Breaking capacity (contact 01)	Resistive dc load	7 A	4 A	0.7 A	0.3 A
	Resistive dc load			8 A	8 A
	Resistive dc load	3.4 A	2 A	0.3 A	0.15 A
	Resistive dc load			4 A	4 A

Power supply

	Range	Consumption when inactive	Max. consumption	Inrush current
24/30 Vdc	±20 %	2.5 W	6 W	< 10 A for 10 ms
48/125 Vdc	±20 %	3 W	6 W	< 10 A for 10 ms
220/250 Vdc	-20 % +10%	4 W	8 W	< 10 A for 10 ms
100/127 Vac	-20 % + 10 %	6 VA	10 VA	< 15 A for 10 ms
220/240 Vac	-20 % + 10 %	12 VA	16 VA	< 15 A for 10 ms
Operating frequency		47.5 to 63 Hz		

Environmental characteristics

Climatic

Operation	IEC 60068-2		-5 °C to 55 °C
Storage	IEC 60068-2		-25 °C to 70 °C
Damp heat	IEC 60068-2		95% to 40 °C
Influence of corrosion	IEC 60654-4	Class I	

Mechanical

Degree of protection	IEC60529	IP41	On front
Vibration	IEC 60255-21-1	Class I	
Shocks and bumps	IEC 60255-21-2	Class I	
Earthquakes	IEC 60255-21-3	Class I	
Fire	IEC 60695-2-1		Glow wire

Electrical insulation

Power frequency	IEC 60255-5	2 kV - 1 mn
1.2/50 µs impulse wave	IEC 60255-5	5 kV

Electromagnetic compatibility

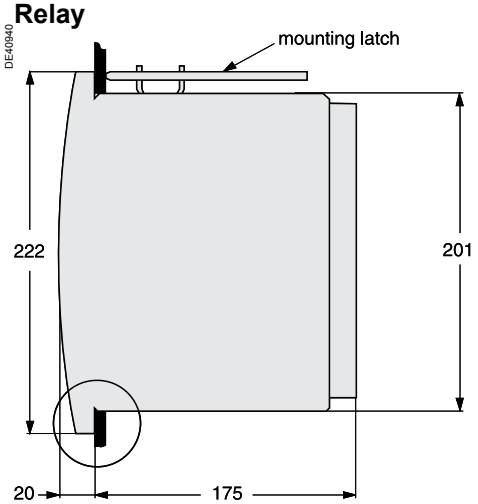
Immunity to radiation	IEC 60255-22-3	Class X	30 V/m
Electrostatic sicharges	IEC 60255-22-2	Class III	
Single-direction transients	IEC 61000-4-5		
Damped 1 MHz wave	IEC 60255-22-1	Class III	
5 ns fast transients	IEC 60255-22-4	Class IV	

Note: *"CE" marking on our product guarantees their conformity to European directives.*

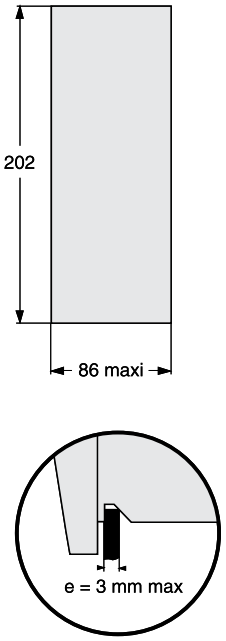
Installation

Sepam 100 LD

Relay

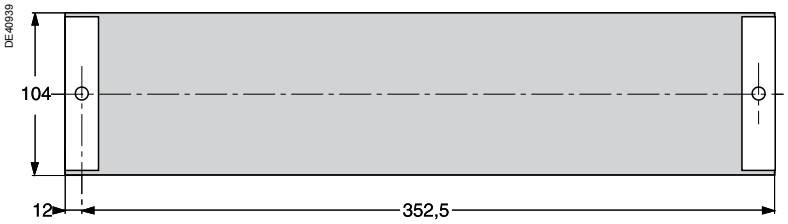


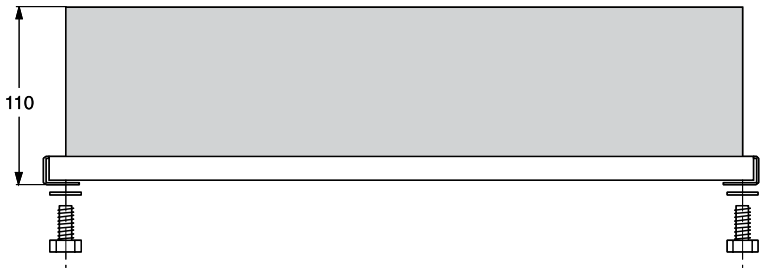
Cutout



Weight: 1.9 kg

Stabilization plate

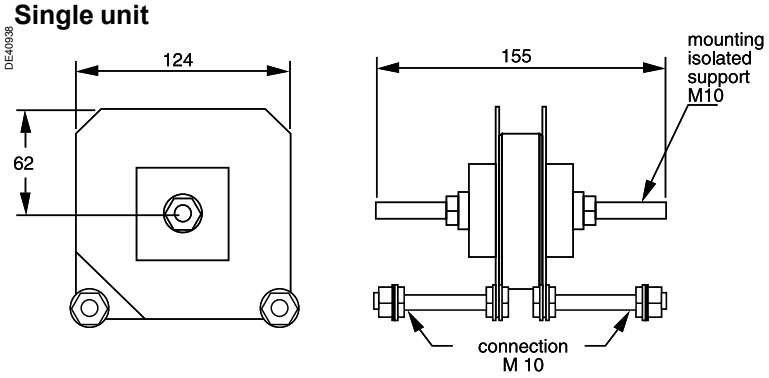




Weight: 1.7 kg

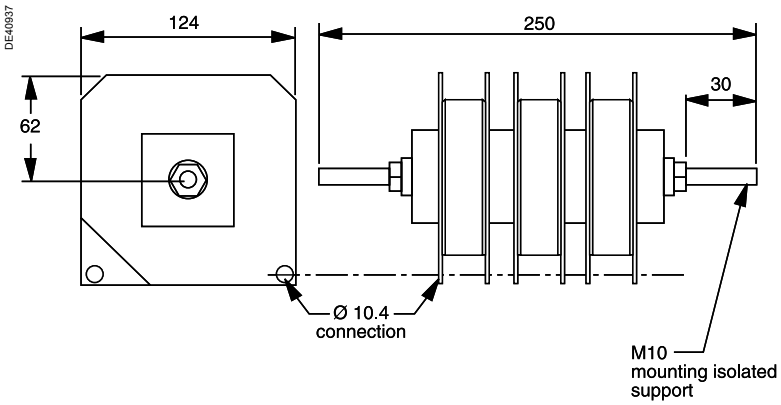
Surge limiter

Single unit



Weight: 1.2 kg max.

Triple unit



Weight: 3.1 kg max.

Commissioning

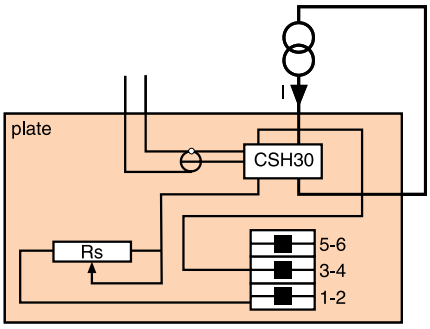
Plate

■ before installing the plate, set the required resistance using the ohmmeter
■ wire the current transformers to the terminals that correspond to their current rating, in parallel with surge limiters:
□ between 1-2 and 3-4 for 5 A
□ between 1-2 and 5-6 for 1 A.

Relay

■ set microswitch SW1, located on the back, to “with” or “without” latching (see page 3)
■ adjust the front dial to the required setting.

DE40936



Testing

Using a temporary connection (1 turn), inject a current 20 % above the setting (5 A rating) into the toroid primary and check that the relay trips.

Example: Is = 40 % In.
I = 0.4 x 5 A x 1.2 = 2.4 A.

The test is carried out on each of the three plates if a three-phase relay is being used.

Order form

When ordering Sepam 100 LD, stabilization plate and/or surge limiters, please enclose a photocopy of this page with your order, filling in the requested quantities in the spaces provided ☐ and ticking off the boxes ☐ to indicate your choices.

Sepam 100 S01 LD (supplied with connections and mounting lugs)

Quantity		☐
Rated frequency	50 Hz	☐
	60 Hz	☐
Version	Single-phase	☐
	Three-phase	☐
Auxiliary power supply	24 to 30 Vdc	☐
	48 to 125 Vdc	☐
	220 to 250 Vdc	☐
	100 to 127 Vac	☐
	220 to 240 Vac	☐

Stabilization plate

Resistance	68 Ω - 280 W	☐
	150 Ω - 280 W	☐
	270 Ω - 280 W	☐
	470 Ω - 180 W	☐
	680 Ω - 180 W	☐

Surge limiters

Single unit	☐
Triple unit	☐