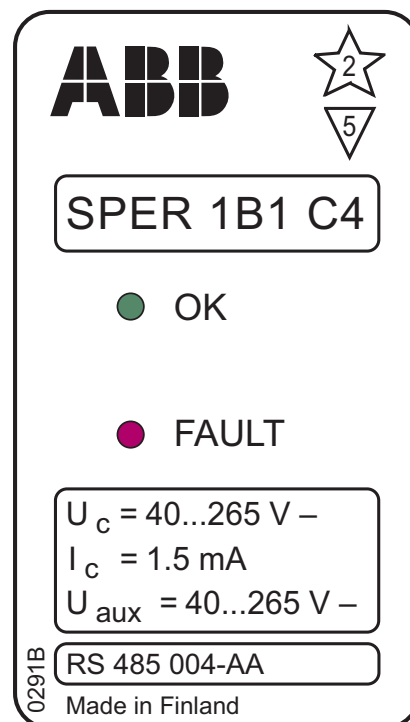


SPER 1B1 C4, SPER 1C1 and SPER 1C2 Supervision relay

User's Manual and Technical Description



SPER 1B1 C4

SPER 1C1 and 1C2

Supervision relay

Data subject to change without notice

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Features	Continuous monitoring of circuit breaker trip circuits and other control circuits	Continuous self-supervision of the auxiliary supply voltage of the relay
	Preset operate time preventing unwanted alarm signals at circuit-breaker operation	High immunity to interference and galvanically isolated electronics
	Indication of relay operation with LED indicator on the front panel, output relay for signalling	COMBIFLEX design or base mounting, depending on relay type
	Indicates bad contact, contact welding and auxiliary voltage failures in the circuit monitored	

Application	SPER series supervision relays are used for monitoring important control circuits such as circuit breaker and disconnecter control circuits, signalling circuits, etc., in power installations. One contact circuit is monitored by one relay. If several branches of a circuit are to be monitored, the required number of relays can be connected to the same control circuit.	of the control contact, disappearing control voltage and voltage failures in the relay itself.
	The supervision relay detects interruptions, too high resistances caused by galvanically bad connections, increased transfer resistance in the contacts, welding	The relay is available in three versions: two COMBIFLEX versions with different supply voltage ranges, to be mounted in a rack, and one version provided with a base to be mounted on a rail or on a plane surface.

Description of operation

(modified 2007-03)

The supervision relay contains the following functional units:

- constant current generator
- triggering circuit
- time circuit
- LED indicators
- opto-isolator
- output relay

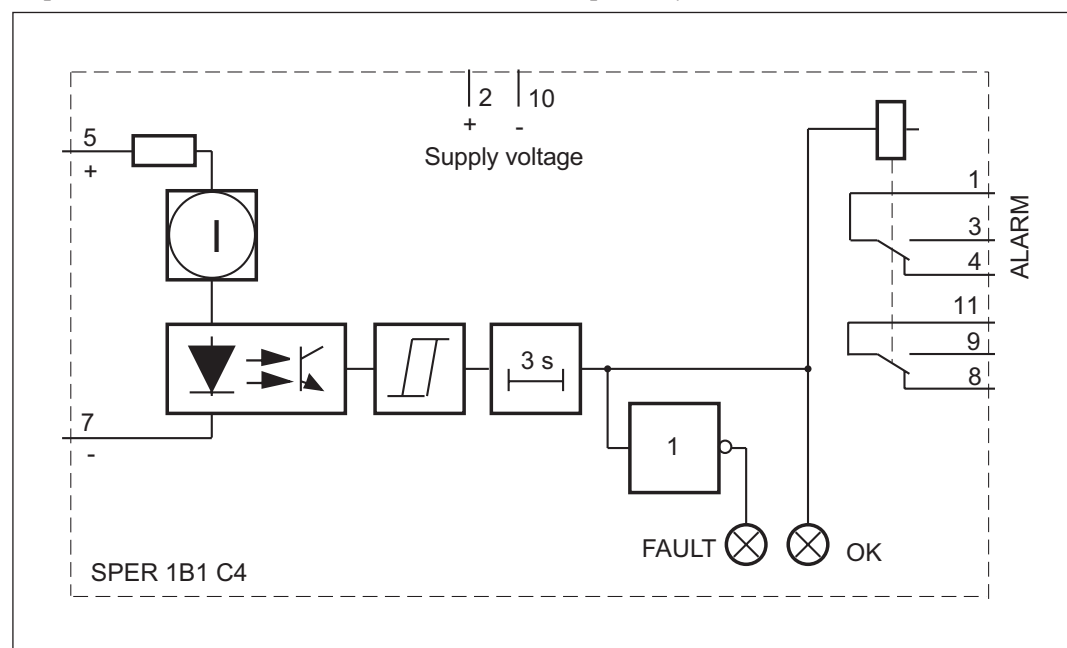


Fig. 1. Block diagram for supervision relay SPER 1B1 C4

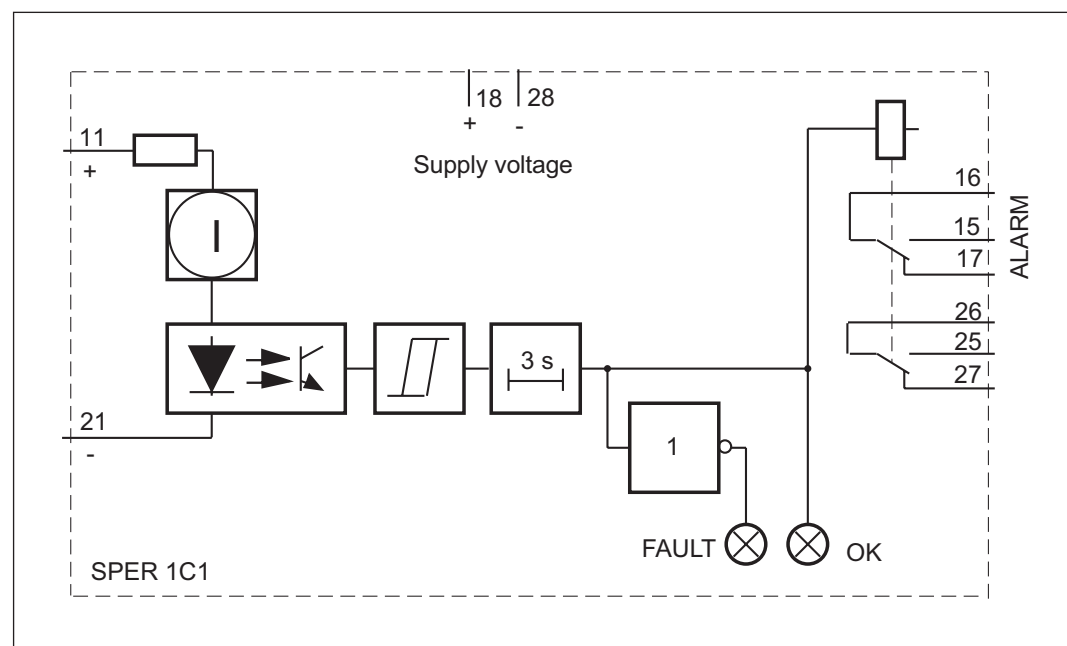


Fig. 2. Block diagram for supervision relays SPER 1C1 and SPER 1C2

The circuit to be monitored and the constant current generator, the measuring circuit and the change-over contacts of the

output relay are galvanically isolated from each other, isolation level 2 kV, 50 Hz, 1 min.

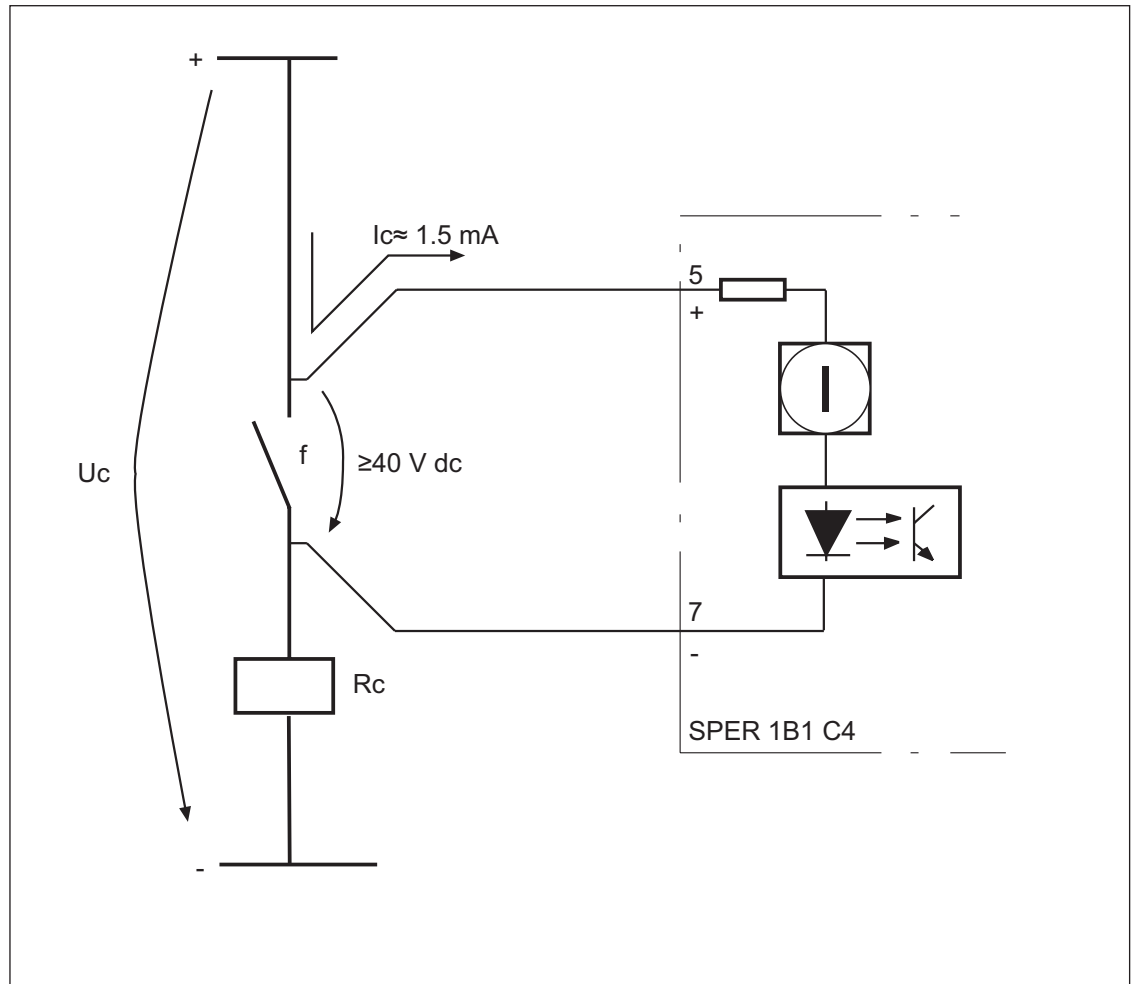


Fig. 3. Current and voltages of the circuit monitored. For further information about relay types see next page

The constant current generator (I) of the driver circuit feeds a small I_c current of some 1.5-5 mA, depending on the relay type used, through the circuit to be monitored. The contact inputs 5-7 of SPER 1B1 C4 or 11-21 of SPER 1C1 or SPER 1C2 are connected over the NO control contact (f) and so the measuring current flows between the poles of the control voltage (see Figs 1, 2 and 3).

To avoid spurious CB tripping, for instance, in the event of a short circuit in the control circuit, the constant current generator circuit of SPER relays contain an internal current limiting series resistor.

To secure operation, the control voltage over the driver circuit is not allowed to fall below 40 V dc for SPER 1B1 C4 and SPER 1C1 type relays. For the SPER 1C2 relay the minimum control voltage is 20 V dc.

The control voltage over the driver circuit can be calculated using the following expression:

$$U_c - (R_c \times I_c) > 40 \text{ V dc for SPER 1B1 C4 and SPER 1C1 or}$$

$$U_c - (R_c \times I_c) > 20 \text{ V dc for SPER 1C2,}$$

where

U_c = control voltage

I_c = measuring current

R_c = resistance of the coil controlled

The measuring current is measured by an optoisolator circuit in the measuring circuit of the relay. In normal service the green LED "OK" on the front panel is lit and the output relay of SPER 1B1 C4 is operated, the change-over contacts 1-3 and 9-11 being closed. In the same way the output relay of SPER 1C1 and SPER 1C2 is operated, and the change-over contacts 15-16 and 25-26 are closed. Should the control voltage fall below the minimum

value permitted due to interruption, unreliable connection or activated trip contact, the output relay will drop off when a time delay of about 3 s has expired. The red LED indicator "FAULT" is lit, the green LED indicator "OK" goes out and the contacts 1-4 and 8-11 of SPER 1B1 C4 close. The output relay of the relays SPER 1C1 and SPER 1C2 operates in the same manner and the contacts 16-17 and 26-27 are closed.

Fault situations

Table 1. Faults normally detected by the supervision relays.

Type of fault	Fault reason
The circuit monitored is interrupted or the resistance in the circuit increases	Broken wire, incorrect control operation, galvanically bad contact, increased contact resistance, etc.
The voltage over the circuit monitored disappears.	A fuse has blown, battery failure, etc.
Failure in the auxiliary voltage supply.	See section "Auxiliary voltage" later in the text.
The NO contact of the monitored circuit, through which the supervision relay is connected, remains closed longer than required for the operation.	Contact welding if the tripping protection relay does not reset in time.

Auxiliary voltage (modified 2025-02)

To operate the supervision relay needs a continuous auxiliary voltage. The supply voltage range of the relays type SPER 1B1 C4 and SPER 1C1 is 40-265 V dc, whereas that of the relay type SPER 1C2 is 20-60 V dc. In general, the auxiliary supply voltage and the voltage of the circuit monitored are identical. The circuits are galvanically separated. Separate voltage sources can be used for the auxiliary voltage supply to the relay and for the voltage of the circuit monitored.

The driver circuit of the relay operates independently of the measuring circuit and the output circuit so different voltage levels are permitted. Should the auxiliary voltage supply be interrupted, the indicator LEDs of the supervision relay go out and the change-over contacts of the operated output relay operate without time delay in the measuring circuit. The contact operation of the relay is the same as for a fault in the circuit monitored. The supervision relay can be connected to receive the supply voltage from the control circuit monitored, over the connection wires of the driver circuit. A condition, however, is that the control coil of the circuit monitored is not affected by the increased current consumption of about 7-16 mA, depending on the type of supervision relay, and that the residual voltage over the circuit monitored is above 40 V dc

when SPER 1B1 C4 or SPER 1C1 is used and 20 V dc, when SPER 1C2 is used.

Note!

With the voltage supply described above the supervision relay operates instantaneously and the red LED indicator "FAULT" remains dark. An undelayed alarm signal is obtained via the output relay, also at normal control contact operation.

The connection of the auxiliary voltage supply for the different types of supervision relay is illustrated in Figs 5 and 6 and in Table 2 in the section "Connections".

Note2! High voltage level in the monitored circuit like 220-230 V dc is causing higher temperature and faster aging of the electronics in the device.

Risk of shortened lifetime can be lowered by adding series resistance to the SPER voltage measuring input. For example, a 28.8 k Ω resistor will drop voltage about 46 V, which is approximately 20% in 220 V dc system.

This can be realized by using SPE-ZR3 resistor unit (terminals 1 - 4 give 28.8 k Ω), or some other external resistor with 4-5 W power dissipation capacity.

For applications where auxiliary voltage is in the range 220 – 230 V dc, lowering the internal enclosure temperature by 20 to 30 % is also recommended by adding another SPE-ZR3 connected (terminals 1-2 give 6.8 k Ω) or similar resistance in series with SPER auxiliary voltage input.

The SPE-ZR3 is used with SPER 1B1 C4 and SPER 1C1 type trip circuit supervision units as external (current limiting or voltage dropping) resistor, Rext.

It contains just 3 resistors: 1.2 k Ω , 5.6 k Ω and 22 k Ω , all 4W. The SPE-ZR3 unit can be mounted on a G-type DIN rail.

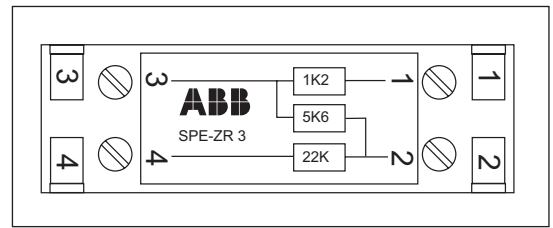


Fig. 4. Resistor unit SPE-ZR3

Connection diagram

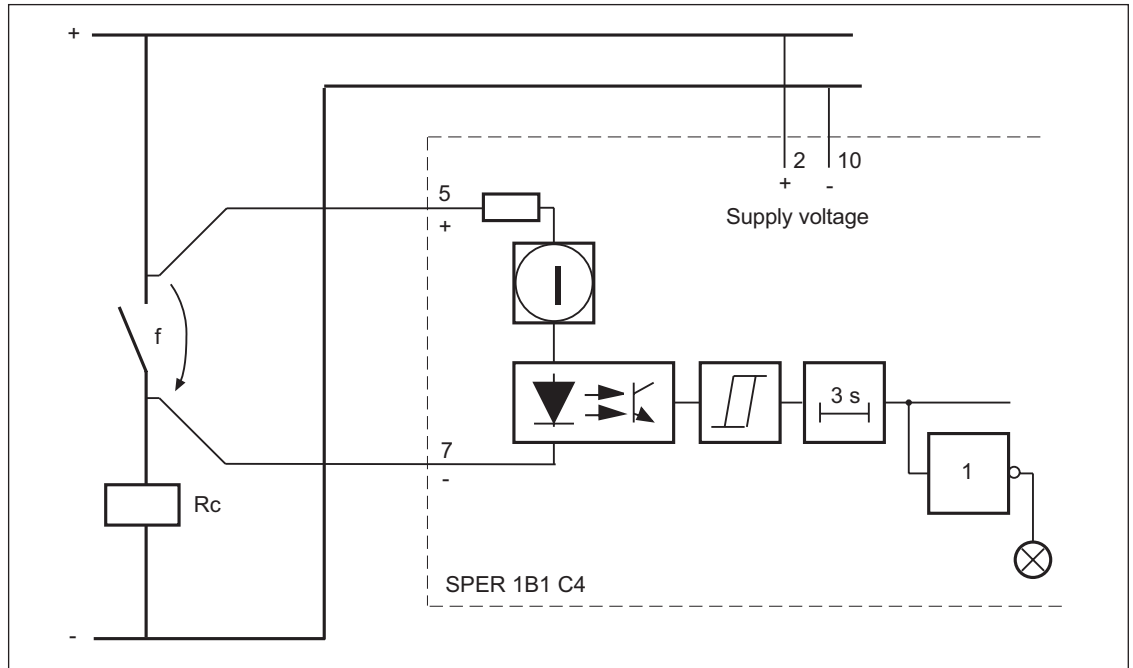


Fig. 5. Supervision relay SPER 1B1 C4 receiving its auxiliary voltage from the control circuit and the monitored circuit

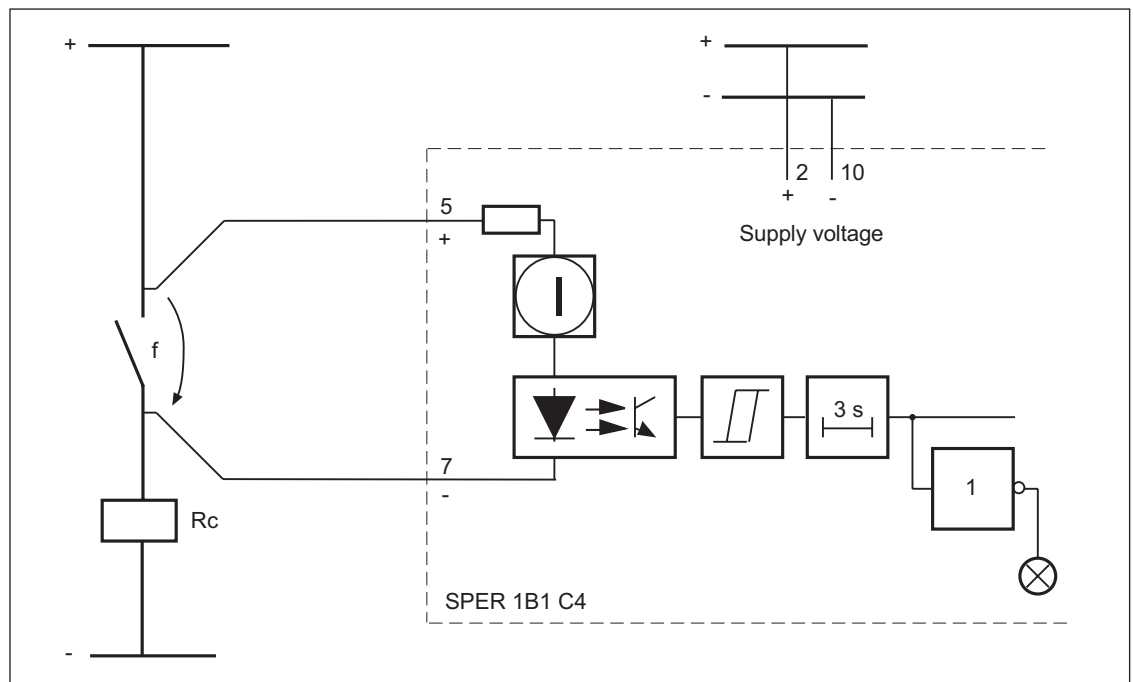


Fig. 6. Supervision relay SPER 1B1 C4 supplied from a separate voltage source

It should be noted that the connection for the relays SPER 1C1 and SPER 1C2 is the same but for the terminals used, see "Connections".

Connections

Table 2. Connection of relays SPER 1B1 C4, SPER 1C1 and SPER 1C2.

Relay type	Terminal No.	Function
SPER 1B1 C4	2 (+) and 10 (-)	Supply voltage 40-265 V dc. The positive pole (+) of the dc voltage is connected to terminal 2.
SPER 1C1	18 (+) and 28 (-)	Supply voltage 40-265 V dc. The positive pole (+) of the dc voltage is connected to terminal 18
SPER 1C2	18 (+) and 28 (-)	Supply voltage 20-60 V dc. The positive pole (+) of the dc voltage is connected to terminal 18
SPER 1B1 C4	5 (+) and 7 (-)	Voltage of the circuit monitored (control circuit) 40-265 V dc. The positive pole (+) of the dc voltage supply is connected to terminal 5.
SPER 1C1	11 (+) and 21 (-)	Voltage of the circuit monitored (control circuit) 40-265 V dc. The positive pole (+) of the dc voltage supply is connected to terminal 11.
SPER 1C2	11 (+) and 21 (-)	Voltage of the circuit monitored (control circuit) 20-60 V dc. The positive pole (+) of the dc voltage supply is connected to terminal 11.
SPER 1B1 C4	1 - 3 - 4 and 8 - 9 - 11	Output relay with two change-over contacts. The relay operates on the closed circuit principle and in normal duty the contacts 1 - 3 and 9 - 11 are closed. When a fault occurs, the contacts 1 - 4 and 8 - 11 of the output relay are closed.
SPER 1C1 and SPER 1C2	15 - 16 - 17 and 25 - 26 - 27	Output relay with two change-over contacts. The relay operates on the closed circuit principle and in normal duty the contacts 15 - 16 and 25 - 26 are closed. When a fault occurs, the output relay contacts 16 - 17 and 26 - 27 close.

Technical data

(modified 2025-02)

Circuit monitored

Voltage of the circuit monitored

- SPER 1B1 C4 and SPER 1C1 40-265 V dc
- SPER 1C2 20-60 V dc

Measuring current

- SPER 1B1 C4 and SPER 1C1 1.5 mA, typ.
- SPER 1C2 5 mA, typ.

Min. residual voltage over the circuit monitored

- SPER 1B1 C4, terminal 5-7 >40 V dc
- SPER 1C1, terminal 11-21 >40 V dc
- SPER 1C2, terminal 11-21 >20 V dc

Typical resistance of current limiting resistor
in the control circuit at different voltage levels

SPER 1B1 C4 and SPER 1C1 (SPE-ZR3)

- 48 V dc 1.2 k Ω /4 W
- 60 V dc 5.6 k Ω /4 W
- 110 V dc 22 k Ω /4 W
- 220 V dc 28.8 k Ω or (33 k Ω)/4 W

SPER 1C2

- 30 V dc 680 Ω /4 W
- 48 V dc 2.2 k Ω /4 W

Time circuit

Operate delay, typ.

3 s

Reset time, typ

1 s

Auxiliary supply voltage and current

SPER 1B1 C4 and SPER 1C1

- rated voltage U_n 48/60/110/220 V dc
- operation voltage 40-265 V dc

SPER 1C2

- rated voltage U_n 24/48 V dc
- operation voltage 20-60 V dc

Current drain, typ.

- SPER 1B1 C4 and SPER 1C1 7 mA
- SPER 1C2 16 mA

Output relay

Contact outputs, change-over contact

- SPER 1B1 C4 1-3-4/8-9-11
- SPER 1C1 and SPER 1C2 15-16-17/25-26-27

Rated voltage

250 V ac/dc

Carry continuously

Breaking capacity for dc when the control circuit
time constant $L/R \leq 40$ ms at the control voltage levels

- 220 V dc 0.15 A
- 110 V dc 0.25 A
- 48 V dc 1 A

Test voltages

Insulation test voltage acc. to IEC 60255-5
and SS 436 15 03

2 kV, 50 Hz, 1 min

Impulse test voltage acc. to IEC 60255-5
and SS 436 15 03

5 kV, 1.2/50 μ s, 0.5 J

Disturbance tests

High-frequency test voltage acc. to IEC 60255-5
and SS 436 15 03

2.5 kV, 1 MHz

Fast transients acc. to IEC 61000-4-4

2 kV, 5/50 ns, 1 min.

Spark interference test voltage acc. to SS 436 15 03

4-8 kV

Environmental conditions

Service temperature range

-10°C...+55°C

Transport and storage temperature range (IEC 60068-2-2)

-40°C...+70°C

Damp heat test (IEC 60068-2-30)

RH = 92-96%

+25°C/+55°C, 6 x 24 h

Mounting and weight

Degree of protection by enclosure

Not specified

Mounting

- SPER 1B1 C4

11-pole base for rail mounting
acc. to DIN 50022, or screw
fastening

- SPER 1C1 and SPER 1C2

COMBIFLEX design,
mounting space 2U-6U

Weight

- SPER 1B1 C4

about 0.2 kg

- 11-pole base

about 0.05 kg

- SPER 1C1 and SPER 1C2

about 0.2 kg

Applications

One supervision relay is able to monitor one circuit. When separate, parallel contact circuits of the same control circuit are to be monitored,

each of these circuits has to be provided with its own relay.

Example 1

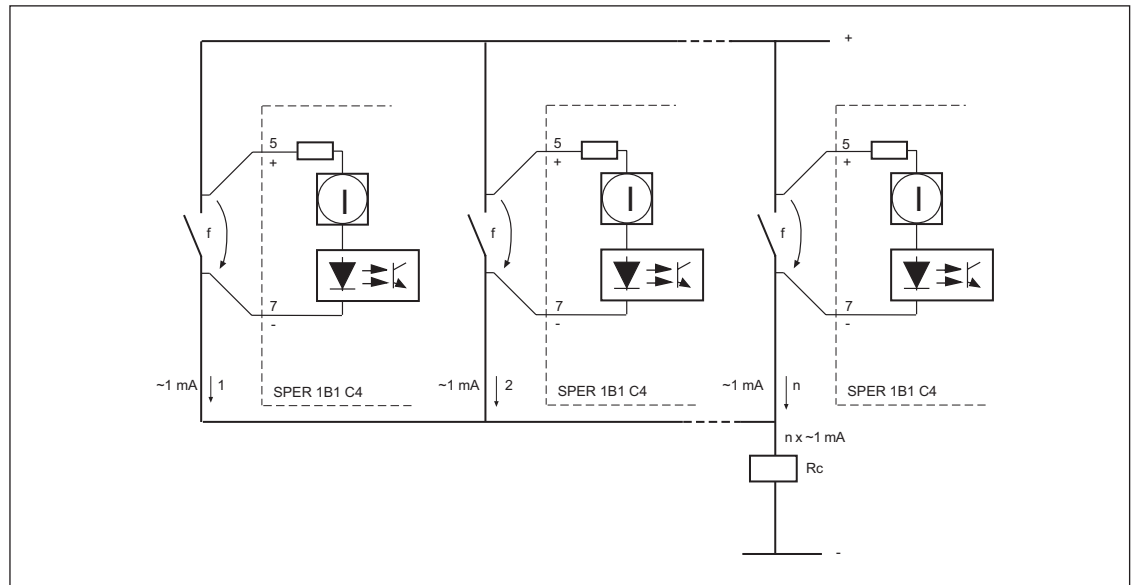


Fig. 7. Monitoring of parallel contact circuits with separate supervision relays

When the supervision relays are connected in parallel, it should be noticed that each relay drives a current of about 1.5-5 mA, depending on the type of relay used, through the control circuit monitored. The currents are summed up in the trip or relay coil controlled by the circuit. To avoid the operation of the control relay coil being affected by these currents, the number of parallel supervision relays has to be limited. The voltage drop over the control coil increases with the number of supervision relays connected in parallel. The voltage drop has

to be kept on such a level that the difference between the auxiliary voltage of the control circuit and the voltage drop over the control coil, that is, the residual voltage over the circuit monitored, is below 40 V dc or 20 V dc, depending on the relay type used.

Lower voltage values are an indication of a fault in the circuit, for instance, poor galvanic contact, and will produce an alarm signal via the contact of the output relay.

Example 2

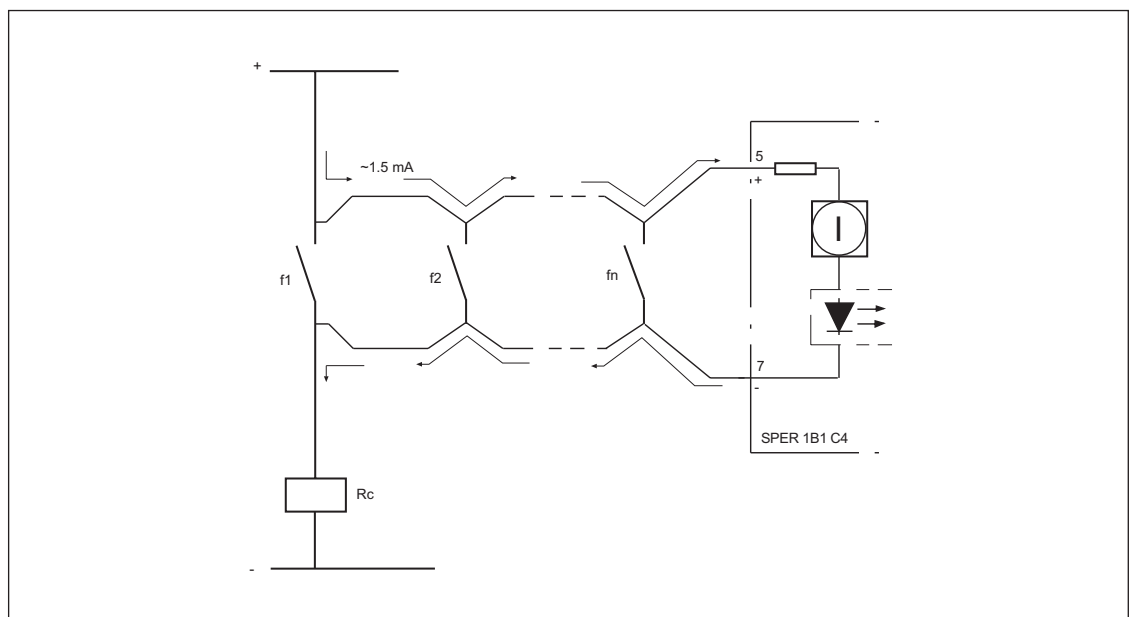
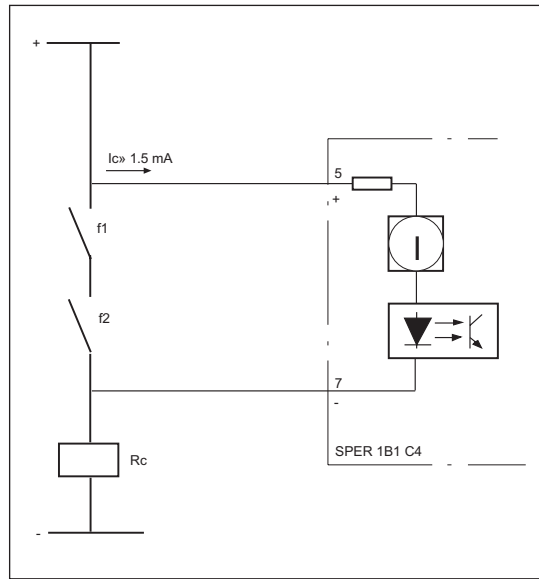


Fig. 8. Simplified supervision of parallel contact circuits using one common supervision relay

To a certain extent, the number of supervision relays can be reduced by parallelling the contacts of the control circuit as illustrated in example 2. Then the wiring of the installation

should be carried out accordingly. Unless the system is continuously supervised, this method reduces the reliability of the system.

Example 3



When the control circuit includes two or more NO contacts in series, the supervision relay is connected over all of the contacts. The supervision relay is connected to the plus pole (+) of the control voltage at the first of the contacts and to the control coil side at the last of the contacts in series, see Fig. 8. The circuit between the contacts will not, however, be monitored in this application of the relay.

Fig. 9. Monitoring of a control circuit with series-connected contacts using one supervision relay

Example 4 (modified 97-09)

If the control voltage of the circuit monitored is high enough, several supervision relays can be connected in series in the same circuit, as illustrated in Fig. 10. With such a connection all the control contacts connected in series are monitored. Then the control voltage has to be high enough to prevent the residual voltage distributed between the separate series-connected circuits from falling below 40 V dc or 20 V dc at a 1.5-5 mA current flowing through the control coil.

The control voltage through a separate driver circuit can be calculated using the following expression:

$$U_c - (R_c \times I_c) / n \geq 40 \text{ V ls}$$

for SPER 1B1 C4 and SPER 1C1 or

$$U_c - (R_c \times I_c) / n$$

for SPER 1C2,

where

U_c = control voltage

I_c = measuring current

R_c = resistance of the coil controlled and

n = number of relays connected in series

To achieve the same operate time for each supervision relay the auxiliary voltage for the separate relays and the voltage of the circuit monitored (control voltage of the series connection) should be supplied from the same source.

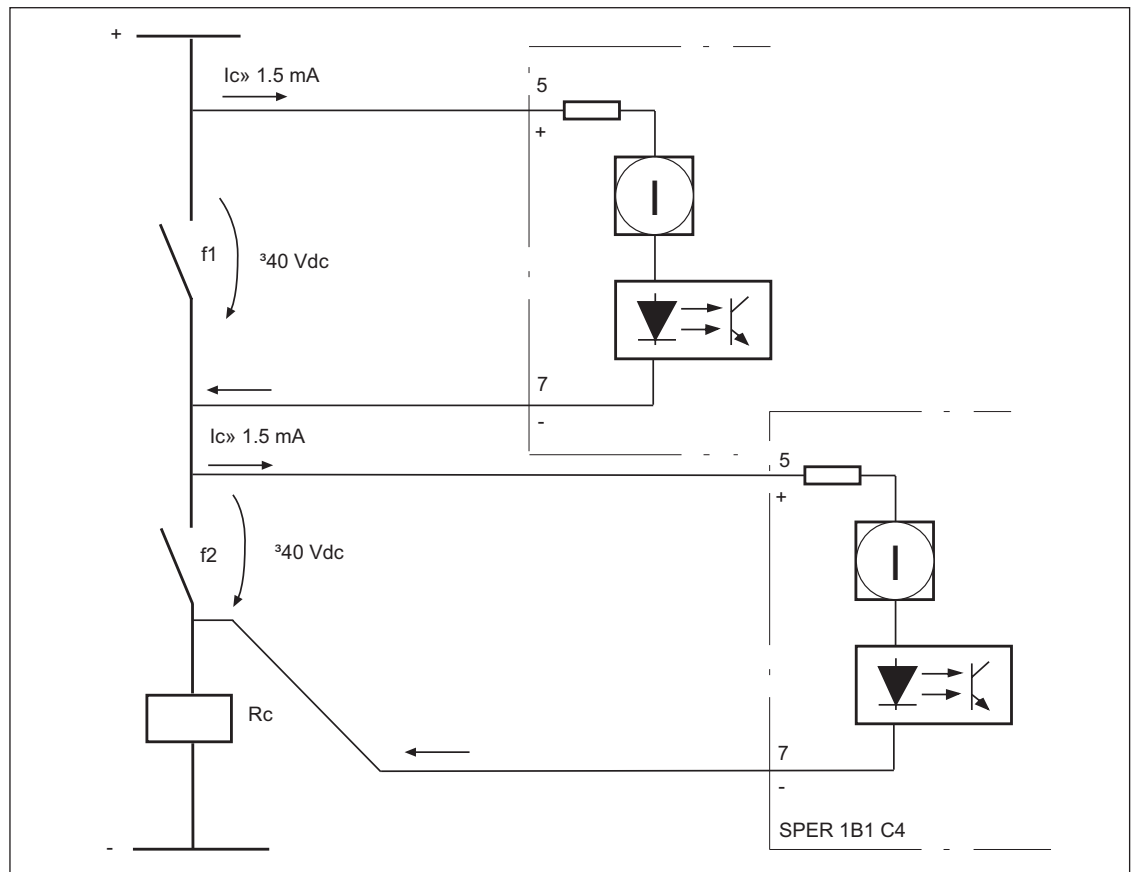


Fig. 10. Monitoring of a control circuit with series-connected contacts and one relay for each control contact

Example 5

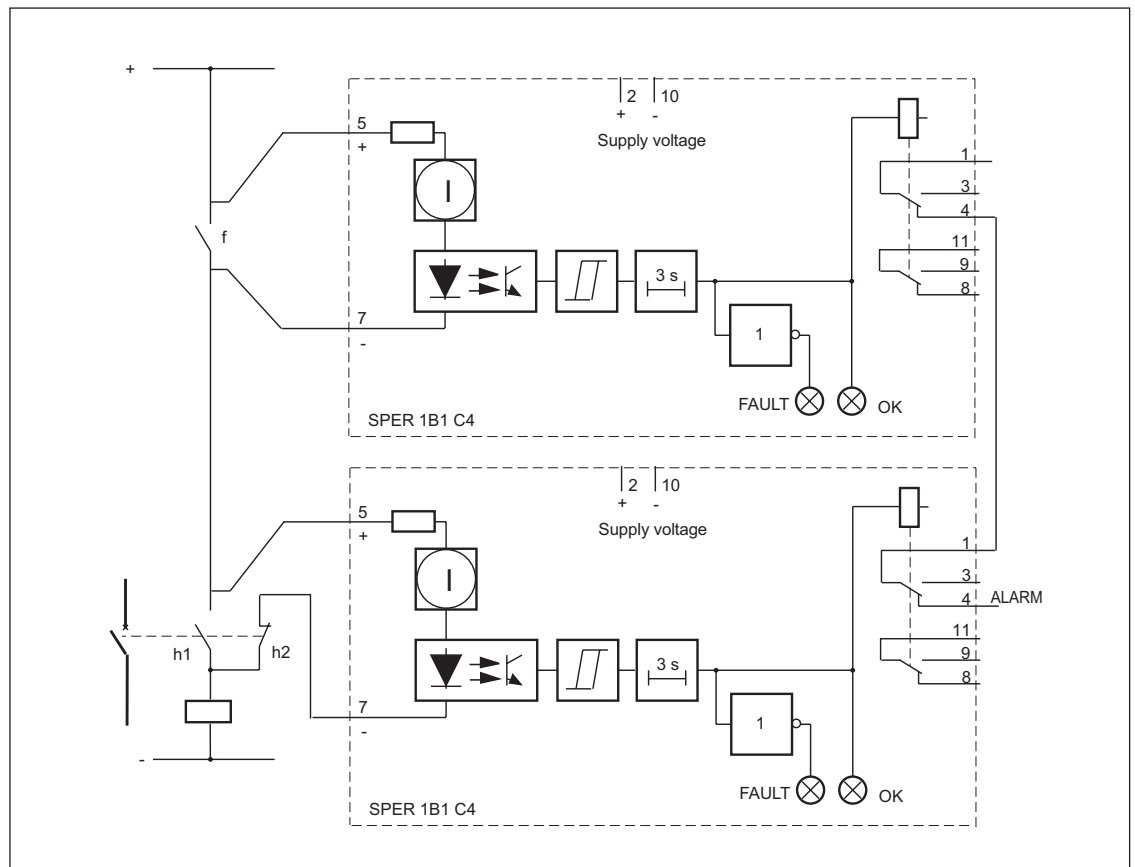


Fig. 11. Two supervision relays in series with series-connected contacts with self-holding.

Example 6

For breaking the control voltage the circuit breaker control circuit includes an auxiliary contact (h1) connected in series with the control coil.

To prevent the supervision relay from providing spurious alarm signals, for instance, at circuit breaker operation, the measuring current of the control circuit is routed so as to bypass the break contact (h1), through the auxiliary contact (h2) and a current limiting resistor R_y .

The resistance is calculated so that the current over the auxiliary contact and the resistor does not affect the operation of the control coil, when the control contact is closed. The voltage drop over the resistor and the coil must be low enough, to prevent the residual voltage over the driver circuit of the supervision relay from falling below the minimum values specified for the different relay types.

The external current limiting resistor R_y is depending on the auxiliary voltages of the supervision relays. The resistances for the most commonly used voltages are given in "Technical data".

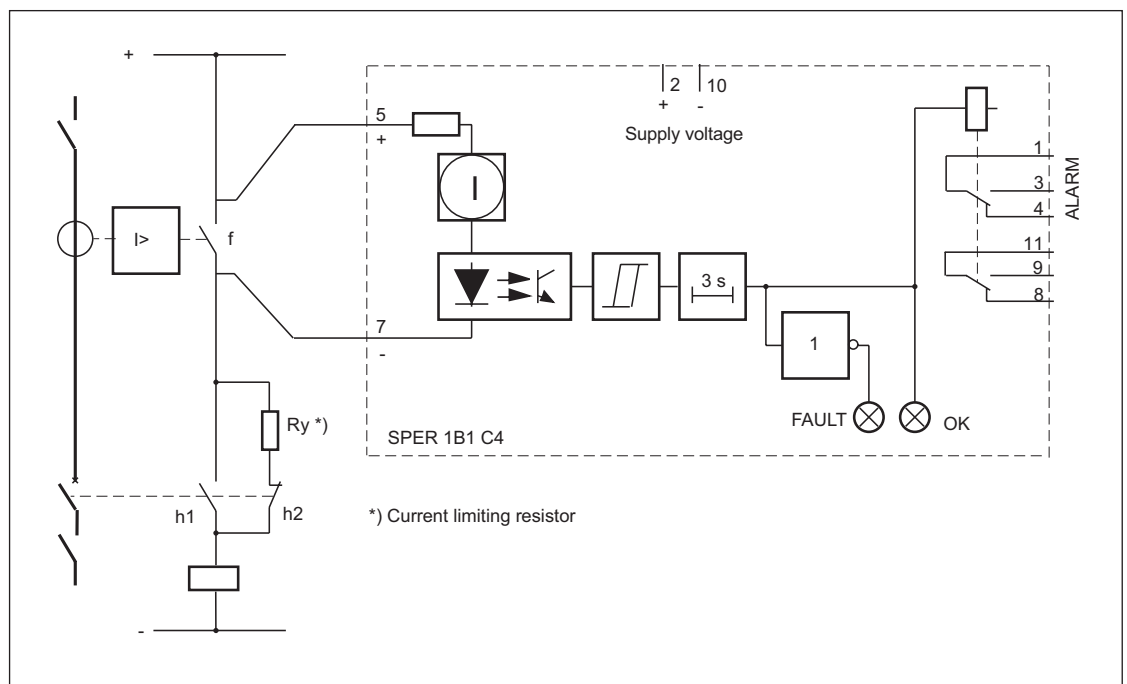


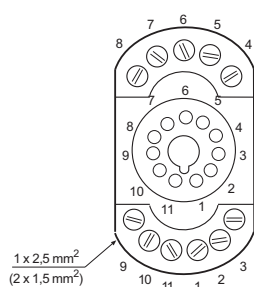
Fig. 12. Supervision relay with an auxiliary contact (h) and an external current limiting resistor R_y .

Dimension drawing and mounting (modified 2025-25)

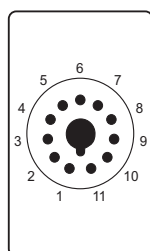
The supervision relay is available in three versions: SPER 1B1 C4, SPER 1C1 and SPER 1C2. The relay type SPER 1B1 C4 is enclosed in a plastic case to be installed with an 11-pole terminal base PC-ZL 2 with screw terminals for the connections. The base is fitted on a rail (DIN 50022) or screwed to a plane surface. The terminal base meets the same requirements concerning insulation test voltage as the supervision relay.

The relay types SPER 1C1 and SPER 1C2 are designed for COMBIFLEX mounting. The relays require a mounting height corresponding to 2U (1U = 44.45) and a mounting width corresponding to 6C (1C = 7 mm). Separate terminal bases to be mounted in an apparatus frame or on a rail in a frame, are used for connecting the relays. The frames and the terminal bases are part of the COMBIFLEX system and are available on separate order from Hitachi Energy .

Supervision relay SPER 1B1 C4

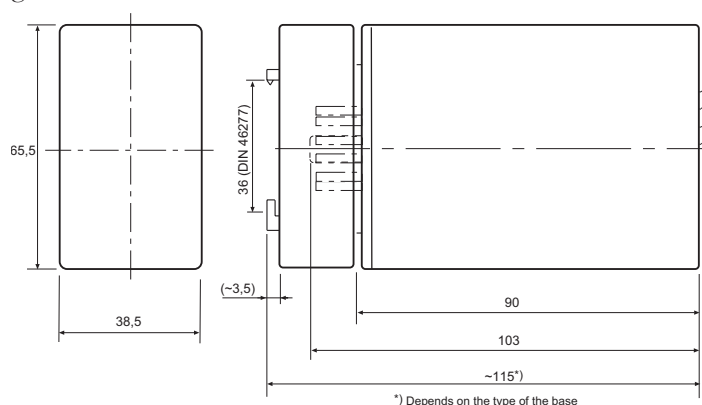


Terminal base PC-ZL 2 type A



Terminal base PC-ZL 2 type B,
superseded type A in March 2025

Back connector of SPER 1B1 C4 with pin arrangement



Dimensions

Dimensions in mm.
Width = 38,5 mm

Fig. 13. Dimension and mounting base types for SPER 1B1 C4.

Maintenance and repairs

When the supervision relay is used under the conditions specified in "Technical data", it requires practically no maintenance. The relay includes no parts or components that are sensitive to physical or electrical wear under normal operating conditions and the input and output circuits are galvanically separated from the other electronic circuitry of the relay.

Should the temperature and humidity at the operating site differ from the values specified, or the atmosphere contain chemically active gases or dust, the relay should be visually inspected in association with the secondary testing of the relay. This visual inspection should focus on:

- Signs of mechanical damage to relay case and terminals
- Collection of dust inside the relay case or on terminal bases; remove with compressed air
- Signs of corrosion on terminals, case or terminal bases

If the relay malfunctions or the operating values differ from those specified, the relay should be overhauled. Minor measures can be taken by the customer but any major repair involving the electronics has to be carried out by the manufacturer. Please contact the manufacturer or his nearest representative for further information about checking, overhaul and recalibration of the relay.

Note!

Protective relays are measuring instruments and should be handled with care and protected against moisture and mechanical stress, especially during transport.

Ordering information

(modified 2025-02)

Please state:

Type	Auxiliary voltage	Order number
SPER 1B1 C4 Supervision relay	40-265 V dc	RS 485 004-AA
SPER 1C1 Supervision relay	40-265 V dc	RS 485 002-AA
SPER 1C2 Supervision relay	20-60 V dc	RS 485 003-AA
PC-ZL 2 Terminal base for SPER 1B1 C4		RS 961 051-AA
When required, current limiting resistor SPE-ZR 3 for SPER 1B1 and SPER 1C1		RS 961 015-AA
Quantity		

Spares and exchange parts

Type	Order number
PC-ZL 2 Terminal base for SPER 1B1 C4	RS 961 051-AA

Reference data

(modified 2025-02)

Connection and installation components COMBIFLEX	1MRK513003-BEN
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