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Insulation monitoring relay CM-IWS.1

For unearthed AC, DC and mixed AC/DC systems up to $U_n = 250 \text{ V AC}$ and 300 V DC

The CM-IWS.1 serves to monitor insulation resistance in accordance with IEC 61557-8 in unearthed IT AC systems, IT AC systems with galvanically connected DC circuits, or unearthed IT DC systems with a voltage up to 250 V AC and 300 V DC. It can be configured to the requirements of the applications and therefore used multi-functional.

All devices are available with two different terminal versions. You can choose between the proven screw connection technology (double-chamber cage connection terminals) and the completely tool-free Easy Connect Technology (push-in terminals).



Characteristics

- For monitoring the insulation resistance of unearthed IT systems up to $U_n = 250 \text{ V AC}$ and 300 V DC
- According to IEC/EN 61557-8 "Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems"
- Rated control supply voltage 24-240 V AC/DC
- Prognostic measuring principle with superimposed square wave signal
- One measuring range 1-100 k Ω
- Precise adjustment of the threshold value in 1 k Ω steps
- Interrupted wire detection
- Fault storage / latching configurable by control input
- Precise adjustment by front-face operating controls
- Screw connection technology or Easy Connect Technology available
- Housing material for highest fire protection classification UL 94 V-0
- Tool-free mounting on DIN rail as well as demounting
- 1 c/o (SPDT) contact, closed-circuit principle
- 22.5 mm (0.89 in) width
- 3 LEDs for the indication of operational states

Approvals / Marks



Classifications:

EN 50155, IEC 60571, NF F 16-101/102, EN 45545-2

EN 50155, IEC 60571

Temp. class	Voltage supply		Vibration and shock acc to IEC/EN 61373		Coated pcb.	
	S1	S2	C1	C2		
T3	■	■	■	■	Cat 1, Class B	no

NF F 16-101/102

Flammability index	Opticity and toxicity of smoke index	EN 45545-2 Risk level achieved
I2	F2	HL3

Order data

Insulation monitoring relay

Type	Nominal voltage U_n of the distribution system to be monitored	Rated control supply voltage	Connection technology	Order code
CM-IWS.1P	0-250 V AC / 0-300 V DC	24-240 V AC/DC	Push-in terminals	1SVR 740 660 R0100
CM-IWS.1S			Screw type terminals	1SVR 730 660 R0100

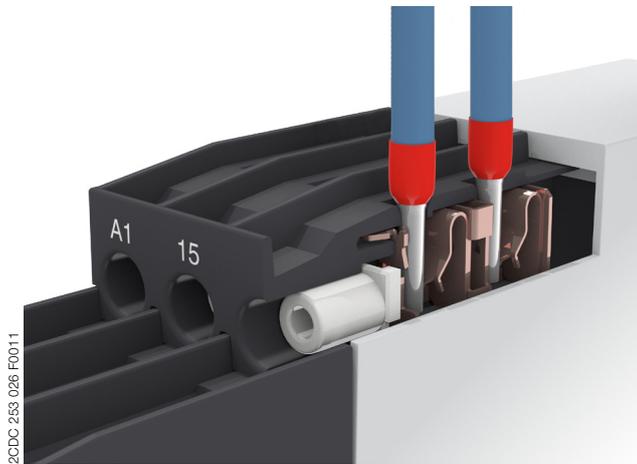
Accessories

Type	Description	Order code
ADP.01	Adapter for screw mounting	1SVR 430 029 R0100
MAR.01	Marker label for devices without DIP switches	1SVR 366 017 R0100
COV.11	Sealable transparent cover	1SVR 730 005 R0100

Connection technology

Maintenance free Easy Connect Technology with push-in terminals

Type designation CM-xxS.yyP

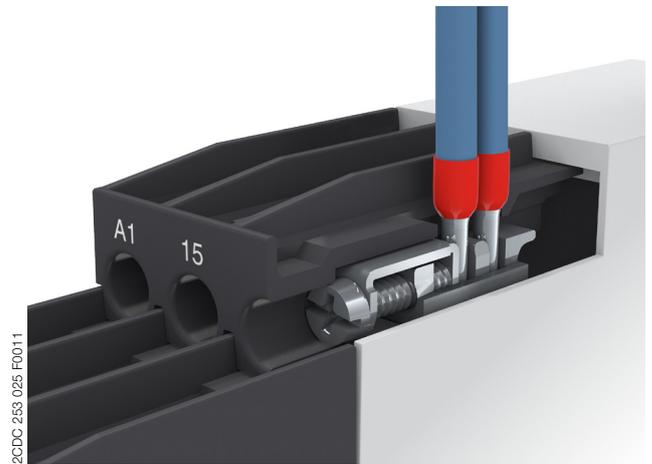


Push-in terminals

- Tool-free connection of rigid and flexible wires with wire end ferrule according to DIN 46228-1-A, DIN 46228-4-E
Wire size: 2 x 0.5-1.5 mm², (2 x 20 - 16 AWG)
- Easy connection of flexible wires without wire end ferrule by opening the terminals
- No retightening necessary
- One operation lever for opening both connection terminals
- For triggering the lever and disconnecting of wires you can use the same tool (Screwdriver according to DIN ISO 2380-1 Form A 0.8 x 4 mm (0.0315 x 0.157 in), DIN ISO 8764-1 PZ1 ø 4.5 mm (0.177 in))
- Constant spring force on terminal point independent of the applied wire type, wire size or ambient conditions (e. g. vibrations or temperature changes)
- Opening for testing the electrical contacting
- Gas-tight

Approved screw connection technology with double-chamber cage connection terminals

Type designation CM-xxS.yyS



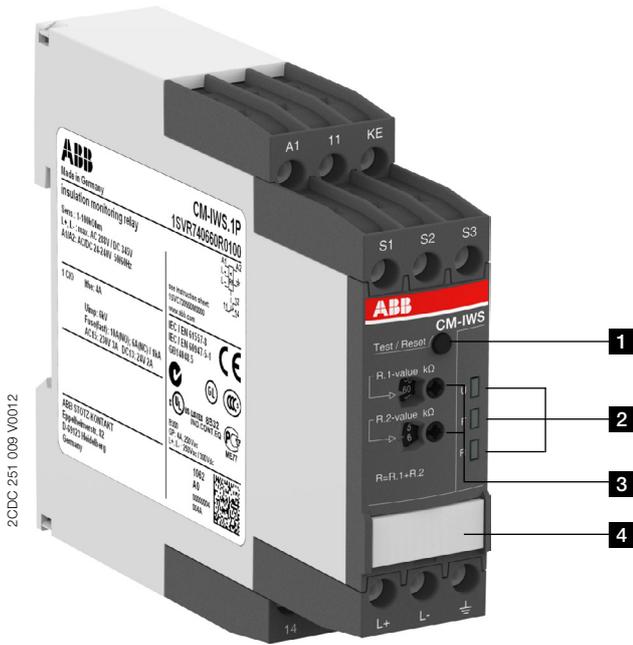
Double-chamber cage connection terminals

- Terminal spaces for different wire sizes:
fine-strand with/without wire end ferrule:
1 x 0.5-2.5 mm² (2 x 20 - 14 AWG),
2 x 0.5-1.5 mm² (2 x 20 - 16 AWG)
rigid:
1 x 0.5-4 mm² (1 x 20 - 12 AWG),
2 x 0.5-2.5 mm² (2 x 20 - 14 AWG)
- One screw for opening and closing of both cages
- Pozidrive screws for pan- or crosshead screwdrivers according to DIN ISO 2380-1 Form A 0.8 x 4 mm (0.0315 x 0.157 in), DIN ISO 8764-1 PZ1 ø 4.5 mm (0.177 in)

Both the Easy Connect Technology with push-in terminals and screw connection technology with double-chamber cage connection terminals have the same connection geometry as well as terminal position.

Functions

Operating controls



- 1** Test and reset button
- 2** Indication of operational states
U: green LED - control supply voltage
F: red LED - fault message
R: yellow LED - relay status
- 3** Configuration and setting
Front-face rotary switches for threshold value adjustment:
R.1 for R1 tens figures:
0, 10, 20, 30, 40, 50, 60, 70, 80, 90 kΩ in ten kΩ steps
R.2 for R1 units figures:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10 kΩ in one kΩ steps
- 4** Marker label for devices without DIP switches

Application / monitoring function

The CM-IWS.1 serves to monitor insulation resistance in accordance with IEC 61557-8 in unearthed IT AC systems, IT AC systems with galvanically connected DC circuits, or IT DC systems.

The insulation resistance between system lines and system earth is measured. If this falls below the adjustable threshold values, the output relay de-energizes.

The device can monitor control circuits (single-phase) and main circuits (3-phase).

Supply systems with voltages $U_n = 0-250$ V AC (15-400 Hz) or 0-300 V DC can be directly connected to the measuring inputs and their insulation resistance being monitored. For systems with voltages above 250 V AC and 300 V DC the insulation monitoring relay CM-IWN.x with or without the coupling unit CM-IVN can be used.

Measuring principle

A pulsating measuring signal is fed into the system to be monitored and the insulation resistance calculated.

This pulsating measuring signal alters its form depending on the insulation resistance and system leakage capacitance. From this altered form the change in the insulation resistance is forecast.

When the forecast insulation resistance corresponds to the insulation resistance calculated in the next measurement cycle and is smaller than the set threshold value, the output relay de-energizes. This measuring principle is also suitable for the detection of symmetrical insulation faults.

Additional monitoring functions

The CM-IWS.1 cyclically monitors the measuring circuit connections \perp and KE for wire interruption. In case of a wire interruption in one of the connections, the output relay de-energizes.

In addition, the unearthed AC-, DC- or AC/DC system is monitored for inadmissible system leakage capacitance. If the system leakage capacitance is too high, the output relay de-energizes.

Operating mode

The system to be monitored is connected to terminals L+ and L-. The earth potential is connected to terminals \perp and KE. The device operates according to the closed-circuit principle (fault state: relay de-energized). Once the control supply voltage has been applied the insulation monitoring relay runs through a system test routine. The system is diagnosed and the settings are tested. If no internal or external faults are found after this test routine is completed, the output relay energizes.

If the measured value drops below the set threshold value, the output relay de-energizes. If the measured value exceeds the threshold value plus hysteresis, the output relay re-energizes.

All operating states are signalled by the front-face LEDs. See table "LEDs, status information and fault messages" on page 8.

Test function

The test function is only possible when there is no fault.

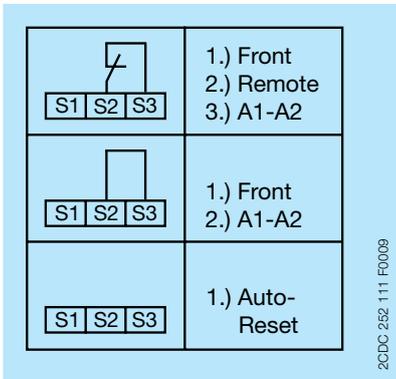
By pressing the front-face combined test/reset button a system test routine is executed. The output relay remains de-energized as long as the test/reset button is pressed, the control contact S1-S3 is closed or the test functions are processed.

The test function can be activated either with the front-face combined test/reset button or with a remote test button connected as shown in the picture.



Fault storage, reset function and remote reset

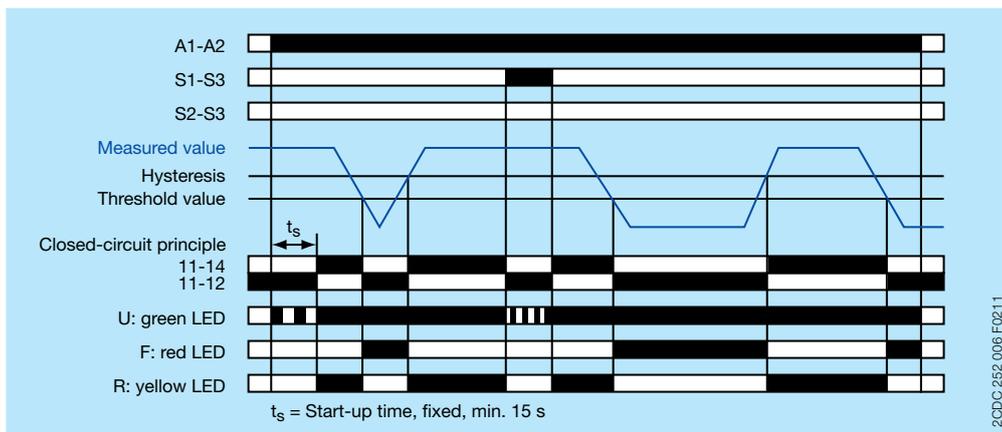
The output relay remains de-energized and only energizes after the combined test/reset button is pressed or after the remote reset (terminals S2-S3) is activated, and when the insulation resistance is higher than the set threshold value plus hysteresis.



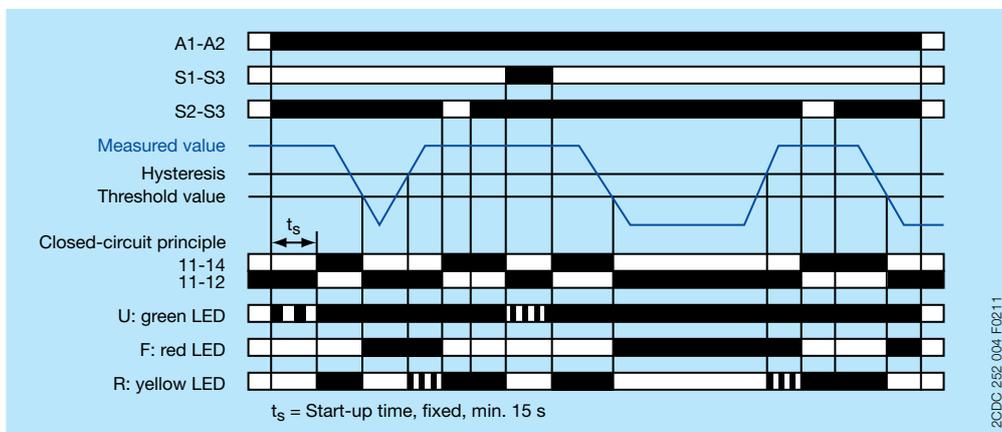
Function descriptions/diagrams

□ Control supply voltage not applied / Output contact open / LED OFF

■ Control supply voltage applied / Output contact closed / LED ON



Insulation resistance monitoring w/o fault storage, auto reset



Insulation resistance monitoring with fault storage, manual reset

Connection and wiring

Connection diagram

A1	11	KE
S1	S2	S3

L+	L-	KE
14	12	A2

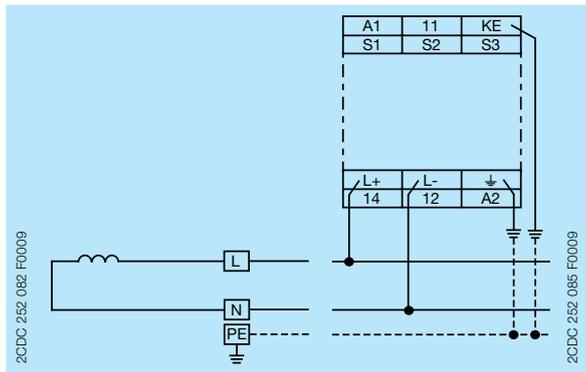
2CDC 252 103 F0009

A1-A2	Control supply voltage
S1-S3	Remote test
S2-S3	Remote reset
L+, L-	Measuring circuit/input, system connection
⊥, KE	Measuring circuit/input, earth connections
11-12/14	Output relay, closed-circuit principle

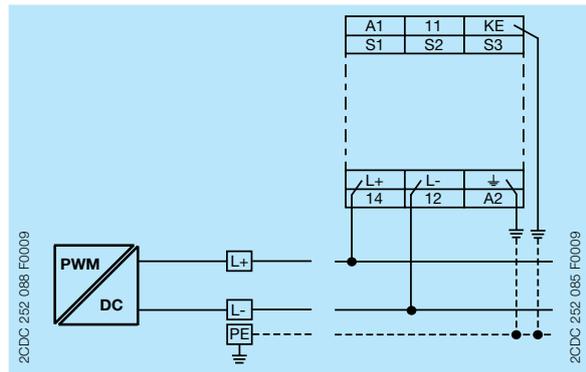
Wiring diagrams

Always connect L+ and L- to different conductors. L+ and L- can be connected to any of the conductors.

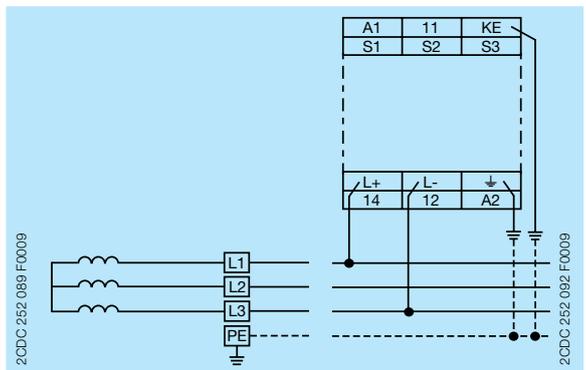
$U_n \leq 250 \text{ V AC}; 300 \text{ V DC}$



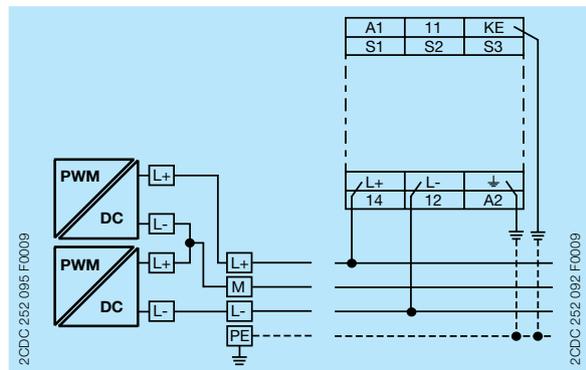
2-wire AC system



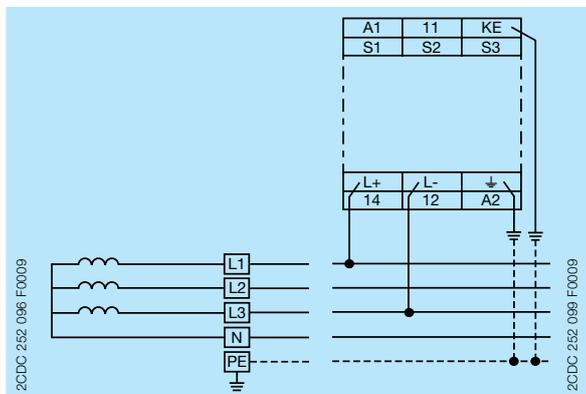
2-wire DC system



3-wire AC system



3-wire DC system



4-wire AC system

Configuration and settings

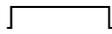
Rotary switches R.1 and R.2 (threshold value)

By means of two separate 10 position rotary switches  with direct reading scales, the threshold value for the insulation resistance R_F of the systems to be monitored can be adjusted.

With the R.1 rotary switch the tens figure is set and with the R.2 rotary switch the units figure is set. The set threshold value is then the addition of the two values. For example, R1.1 set to 70 and R1.2 set to 8 leads to a threshold value for R1 of 78 k Ω .

Indication of operational states

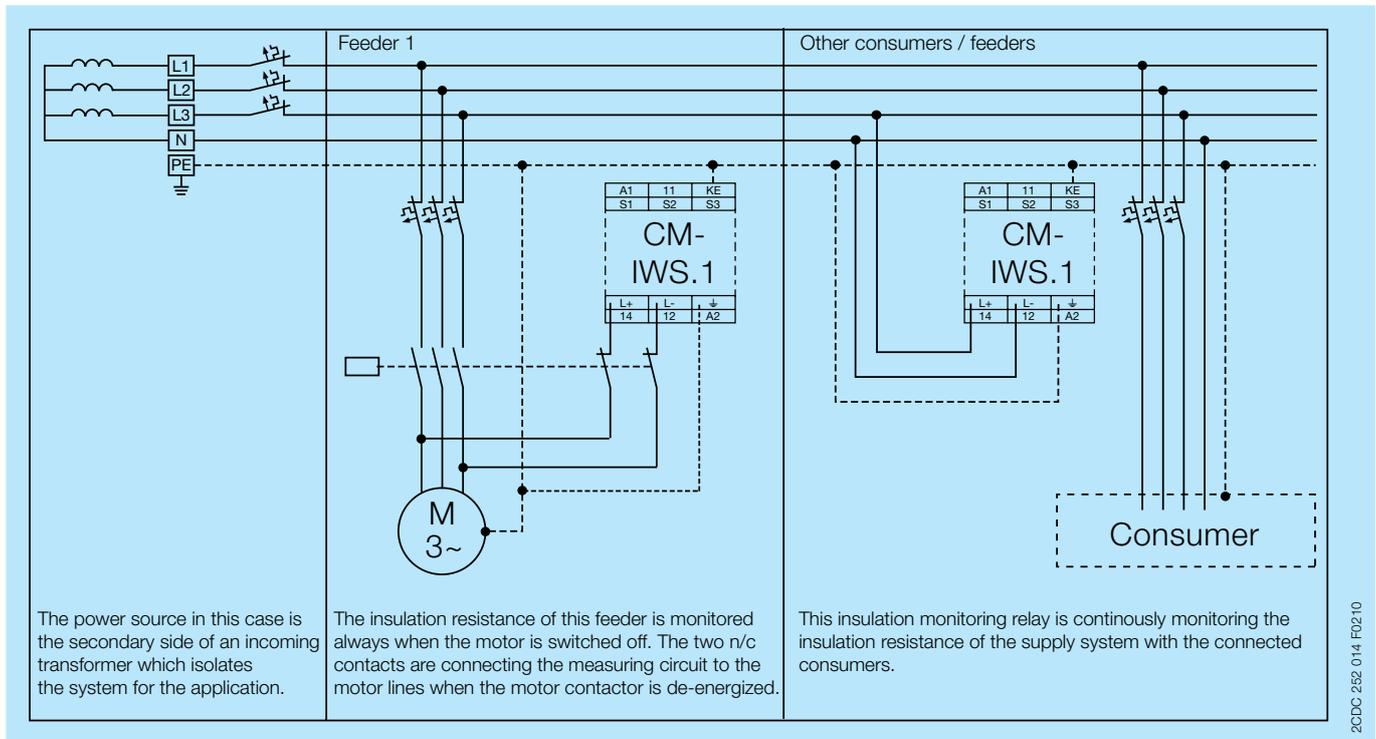
LEDs, status information and fault messages

Operational state	LED U (green)	LED F (red)	LED R (yellow)
Start-up		OFF	OFF
No fault		OFF	
Insulation fault (below threshold value)			OFF
KE/⚡ wire interruption			OFF
System leakage capacitance during operation too high / invalid measurement result			OFF
Internal system fault	OFF		OFF
Test function		OFF	OFF
No fault after fault storage ¹⁾		²⁾	

¹⁾ The device has triggered after an insulation fault. The fault has been stored and the insulation resistance has returned to a higher value than the threshold value plus hysteresis.

²⁾ Depending on the fault.

Application examples



Earth fault / insulation resistance monitoring of different feeder circuits with fault localization

Technical data

Data at $T_a = 25\text{ °C}$ and rated values, unless otherwise indicated

Input circuits

Input circuit - Supply circuit	A1 - A2	
Rated control supply voltage U_s	24-240 V AC/DC	
Rated control supply voltage tolerance	-15...+10 %	
Typical current / power consumption	24 V DC	35 mA / 0.9 VA
	115 V AC	17 mA / 2.0 VA
	230 V AC	14 mA / 3.2 VA
Rated frequency f_s	DC or 15-400 Hz	
Frequency range AC	13.5-440 Hz	
Power failure buffering time	min.	20 ms
Start-up time t_s , fixed	min.	15 s

Input circuit - Measuring circuit	L+, L-, $\underline{\text{L}}$, KE	
Monitoring function	insulation resistance monitoring of IT systems (IEC/EN 61557-8)	
Measuring principle	prognostic measuring principle with superimposed square wave signal	
Nominal voltage U_n of the distribution system to be monitored	0-250 V AC / 0-300 V DC	
Voltage range of the distribution system to be monitored	0-287.5 V AC / 0-345 V DC (tolerance +15 %)	
Rated frequency f_N of the distribution system to be monitored	DC or 15-400 Hz	
Tolerance of the rated frequency f_N	13.5-440 Hz	
System leakage capacitance C_e	max.	10 μF
Extraneous DC voltage U_{fg} (when connected to an AC system)	max.	290 V DC
Number of possible response / threshold values	1	
Adjustment range of the specified response value R_{an} (threshold)	min.-max.	1-100 k Ω
Adjustment resolution	1 k Ω	
Tolerance of the adjusted threshold value / Relative percentage uncertainty A	at 1-10 k Ω R_F (yellow marked scale)	$\geq 15\%$; max $\pm 0.5\%$
at -5...+45 °C, $U_n = 0-115\%$, $U_s = 85-110\%$, $f_N, f_s, C_e = 1\mu\text{F}$	at 10-100 k Ω R_F	$\pm 6\%$
Hysteresis related to the threshold value	25 %; min. 2 k Ω	
Internal impedance Z_i	at 50 Hz	100 k Ω
Internal DC resistance R_i	115 k Ω	
Measuring voltage U_m	22 V	
Tolerance of measuring voltage U_m	+10 %	
Measuring current I_m	max.	0.3 mA
Response time t_{an}	0.5 x R_{an} and $C_e = 1\mu\text{F}$	
pure AC system	max. 10 s	
DC system or AC system with connected rectifiers	max. 15 s	
Repeat accuracy (constant parameters)	< 0.1 % of full scale	
Accuracy of R_a (measured value) within the rated control supply voltage tolerance	< 0.05 % of full scale	
Accuracy of R_a (measured value) within the operation temperature range	at 1-10 k Ω R_F	5 Ω / K
	at 10-100 k Ω R_F	0.05 % / K
Transient overvoltage protection ($\underline{\text{L}}$ - terminal)	avalanche diode	

Input circuit - Control circuits		S1 - S2 - S3
Control inputs - volt free	S1-S3	remote test
	S2-S3	remote reset
Maximum switching current in the control circuit		1 mA
Maximum cable length to the control inputs		50 m - 100 pF/m (164 ft - 30.5 pF/ft)
Minimum control pulse length		150 ms
No-load voltage at the control input		≤ 24 V DC

User interface

Indication of operational states	
Control supply voltage	U green LED
Fault message	F red LED
Relay status	R yellow LED

Details see table "LEDs, status information and fault messages" on page 8 and "Function descriptions/diagrams" on page 6.

Operating elements and controls		
Adjustment of threshold value R_{an}	R.1	rotary switch, 10 kΩ steps for the tens figure
	R.2	rotary switch, 1 kΩ steps for the units figure

Output circuits

Kind of output		relay, 1 c/o (SPDT) contact
Operating principle		closed-circuit principle ¹⁾
Contact material		AgNi alloy, Cd free
Rated operational voltage		250 V AC / 300 V DC
Min. switching voltage / Min. switching current		24 V / 10 mA
Max. switching voltage / Max. switching current		see "Load limits curves" on page 13
Rated operational current I_e	AC-12 (resistive) at 230 V	4 A
	AC-15 (inductive) at 230 V	3 A
	DC-12 (resistive) at 24 V	4 A
	DC-13 (inductive) at 24 V	2 A
AC rating (UL 508)	Utilization category (Control Circuit Rating Code)	B 300, pilot duty general purpose (250 V, 4 A, cos phi 0.75)
	max. rated operational voltage	250 V AC
	max. continuous thermal current at B 300	4 A
	max. making/breaking apparent power at B 300	3600/360 VA
	Mechanical lifetime	
Electrical lifetime	AC-12, 230 V, 4 A	0.1 x 10 ⁶ switching cycles
Max. fuse rating to achieve short-circuit protection	n/c contact	6 A fast-acting
	n/o contact	10 A fast-acting
Conventional thermal current I_{th}		4 A

¹⁾ Closed-circuit principle: Output relay(s) de-energize(s) if measured value falls below the adjusted threshold value R_{an}

General data

MTBF	on request	
Duty time	100 %	
Dimensions (W x H x D)	product dimensions	22.5 x 85.6 x 103.7 mm (0.89 x 3.37 x 4.08 in)
	packaging dimensions	97 x 109 x 30 mm (3.82 x 4.29 x 1.18 in)
Weight		Screw connection technology
		Easy Connect Technology (push-in)
	net weight	0.148 kg (0.326 lb)
	gross weight	0.173 kg (0.382 lb)
Mounting	DIN rail (IEC/EN 60715), snap-on mounting without any tool	
Mounting position	any	
Minimum distance to other units	not necessary	
Material of housing	UL 94 V-0	
Degree of protection	housing	IP50
	terminals	IP20

Electrical connection

		Screw connection technology	Easy Connect Technology (Push-in)
Connecting capacity	fine-strand with(out) wire end ferrule	1 x 0.5-2.5 mm ² (1 x 18-14 AWG)	2 x 0.5-1.5 mm ² (2 x 18-16 AWG)
		2 x 0.5-1.5 mm ² (2 x 18-16 AWG)	
	rigid	1 x 0.5-4 mm ² (1 x 20-12 AWG)	2 x 0.5-1.5 mm ² (2 x 20-16 AWG)
		2 x 0.5-2.5 mm ² (2 x 20-14 AWG)	
Stripping length	8 mm (0.32 in)		
Tightening torque	0.6 - 0.8 Nm (7.08 lb.in)		

Environmental data

Ambient temperature ranges	operation	-25...+60 °C (-13...+140 °F)
	storage	-40...+85 °C (-40...+185 °F)
	transport	-40...+85 °C (-40...+185 °F)
Climatic class	IEC/EN 60721-3-3	3K5 (no condensation, no ice formation)
Damp heat, cyclic	IEC/EN 60068-2-30	6 x 24 h cycle, 55 °C, 95 % RH
Vibration, sinusoidal	25 Hz: 2.5 g	

Isolation data

Rated impulse withstand voltage U_{imp}	supply circuit / measuring circuit	6 kV
	supply circuit / output circuit	6 kV
	measuring circuit / output circuit	6 kV
Rated insulation voltage U_i	supply circuit / measuring circuit	300 V
	supply circuit / output circuit	300 V
	measuring circuit / output circuit	300 V
Basic insulation	supply circuit / measuring circuit	250 V AC / 300 V DC
	supply circuit / output circuit	250 V AC / 300 V DC
	measuring circuit / output circuit	250 V AC / 300 V DC
Protective separation (IEC/EN 61140, EN 50178)	supply circuit / output circuit	250 V AC / 250 V DC
	supply circuit / measuring circuit	250 V AC / 250 V DC
	measuring circuit / output circuit	250 V AC / 250 V DC
Pollution degree	3	
Overvoltage category	III	

Standards / Directives

Standards	IEC/EN 60947-5-1, IEC/EN 61557-1, IEC/EN 61557-8
Low Voltage Directive	2014/35/EU
EMC Directive	2014/30/EU
RoHS Directive	2011/65/EU

Railway application standards

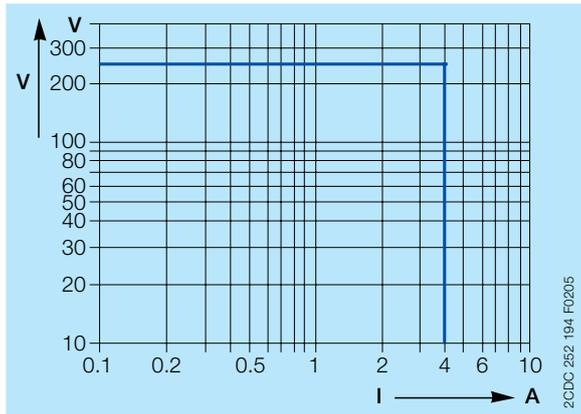
EN 50155, IEC 60571	temperature class	T3
“Railway applications – Electronic equipment used on rolling stock”	supply voltage category	S1, S2, C1, C2
IEC/EN 61373		Category 1, Class B
“Railway applications – Rolling stock equipment – Shock and vibration tests”		
EN 45545-2 Railway applications – Fire protection on railway vehicles – part 2: Requirements for fire behavior of materials and components		HL3
	ISO 4589-2	LOI 32.3 %
	NF X-70-100-1	C.I.T. (T12) 0.45
	EN ISO 5659-2	Ds max (T10.03) 104
NF F 16-101: Rolling stock. Fire behaviour. Materials choosing		I2 / F2
NF F 16-102: Railway rolling stock. Fire behaviour. Materials choosing, application for electric equipment		
DIN 5510-2 Preventive fire protection in railway vehicles. Part 2: Fire behaviour and fire side effects of materials and parts		fulfilled

Electromagnetic compatibility

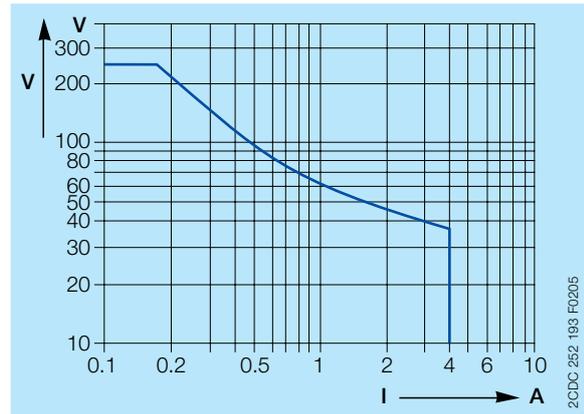
Interference immunity to		IEC/EN 61000-6-1, IEC/EN 61000-6-2, IEC/EN 61326-2-4
electrostatic discharge	IEC/EN 61000-4-2	Level 3, 6 kV / 8 kV
radiated, radio-frequency, electromagnetic field	IEC/EN 61000-4-3	Level 3, 10 V/m (1 GHz) / 3 V/m (2 GHz) / 1 V/m (2.7 GHz)
electrical fast transient/burst	IEC/EN 61000-4-4	Level 3, 2 kV / 5 kHz
surge	IEC/EN 61000-4-5	Level 3, installation class 3, supply circuit and measuring circuit 1 kV L-L, 2 kV L-earth
conducted disturbances, induced by radio-frequency fields	IEC/EN 61000-4-6	Level 3, 10 V
voltage dips, short interruptions and voltage variations	IEC/EN 61000-4-11	Class 3
harmonics and interharmonics	IEC/EN 61000-4-13	Class 3
Interference emission		IEC/EN 61000-6-3, IEC/EN 61000-6-4
high-frequency radiated	IEC/CISPR 22, EN 55022	Class B
high-frequency conducted	IEC/CISPR 22, EN 55022	Class B

Technical diagrams

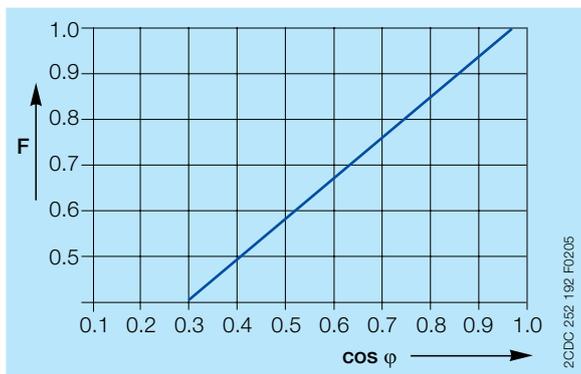
Load limits curves



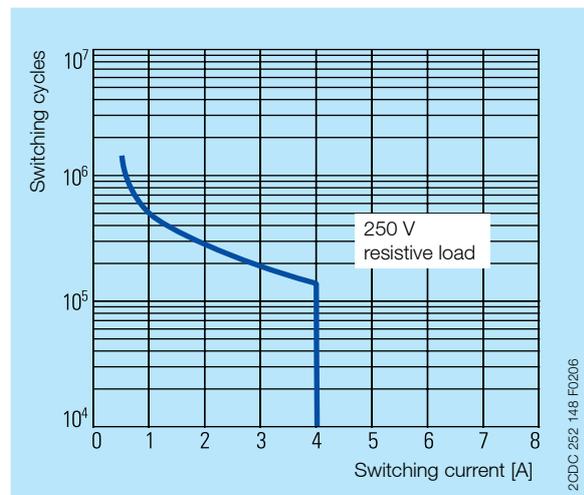
AC load (resistive)



DC load (resistive)



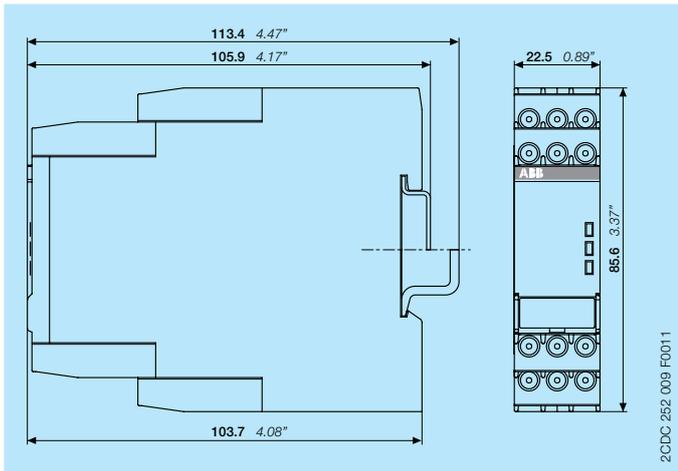
Derating factor F at inductive AC load



Contact lifetime

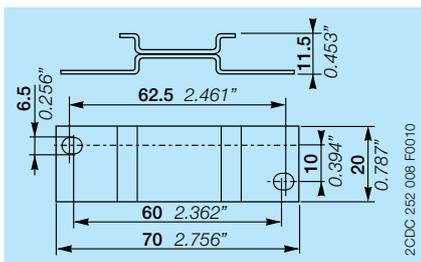
Dimensions

in **mm** and inches

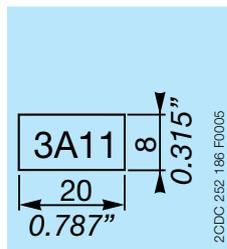


CM-IWS.1 - Insulation monitoring relay

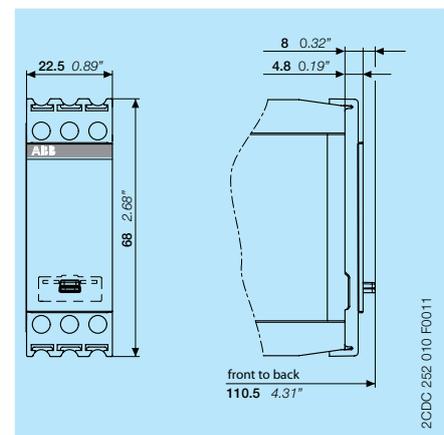
Accessories



ADP.01 - Adapter for screw mounting



MAR.01 - Marker label for devices without DIP switches



COV.11 - Sealable transparent cover

Further documentation

Document title	Document type	Document number
Electronic products and relays	Catalog	2CDC 110 004 C02xx
CM-IWS.1, CM-IWS.2	Instruction sheet	1SVC 730 550 M0000

You can find the documentation on the internet at www.abb.com/lowvoltage -> Automation, control and protection
-> Electronic relays and controls -> Measuring and monitoring relays

CAD system files

You can find the CAD files for CAD systems at <http://abb-control-products.partcommunity.com>
-> Low Voltage Products & Systems -> Control Products -> Electronic Relays and Controls

Contact us

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