Thermistor motor protection relays

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Thermistor motor protection relays CM-MSE, CM-MSS, CM-MSN
Benefits and advantages, Selection table

Operating principle and fields of application for thermistor motor protection relays

The CM range of thermistor motor protection relays are used to control motors equipped with PTC temperature sensors. The PTC temperature sensors are incorporated in the motor windings to measure the motor heating. This enables direct control and evaluation of the following operating conditions:

- heavy duty starting
- increased switching frequency
- single-phase operation
- high ambient temperature
- insufficient cooling
- break operation
- unbalance

The relay is independent of the rated motor current, the insulation class and the method of starting.

The PTC sensors are connected in series to the terminals T_a and T_b (or T_a and T_{bx} without short-circuit detection). The number of possible PTC sensors per measuring circuit is limited by the sum of the individual PTC sensor resistances: $R_G = R_1 + R_2 + R_N \leq 1.5\ k\Omega$.

Under normal operating conditions the resistance is below the response threshold. If only one of the PTC resistors heats up excessively, the output relay de-energizes. If the autoreset function is configured, the output relay energizes automatically after cooling down.

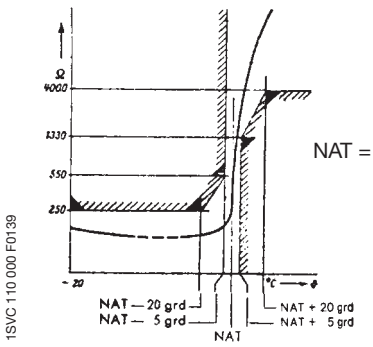
Devices with manual (pushbutton on front-side) or remote reset configuration have to be controlled via the control input by the required signal.

Further applications:

Temperature monitoring of equipment with PTC sensors integrated, such as

- machine rolling bearings,
- hot-air ventilators,
- oil,
- air,
- heating installations, etc.

Resistance characteristic
for one single temperature sensor acc. to DIN 44 081.



NAT = Nominal response temperature

Selection table thermistor motor protection relays

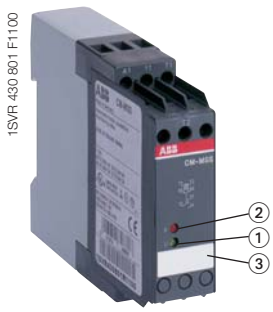
Type	CM-MSE	CM-MSS (1)	CM-MSS (2)	CM-MSS (3)	CM-MSS (4)	CM-MSS (5)	CM-MSS (6)	CM-MSS (7)	CM-MSN
Function									
Measuring range									
Number of sensor circuits	1	1	1	1	1	1	2	3	6
Wire break monitoring	●	●	●	●	●	●	●	●	●
Short-circuit detection	–	–	–	● 1)	●	●	●	●	●
Non-volatile fault storage	–	–	–	–	● 2)	● 2)	–	● 2)	● 2)
Operation/Reset									
Auto reset	●	●	●	●	● 2)	● 2)	● 2)	● 2)	● 2)
Manual reset	–	–	●	●	●	●	●	●	●
Remote reset	–	–	●	●	●	●	●	●	●
Test button	–	–	–	–	●	●	●	●	●
Output contacts									
Operational principle	closed-circuit principle								
Number / type	1 c/o	1 n/o	2 c/o	2 c/o	1 n/o + 1 n/c	2 c/o	1 c/o per sensor circuit	1 n/o + 1 n/c accumulative evaluation	1 n/o + 1 n/c accumulative evaluation
Width of enclosure	22.5 mm								45 mm
Supply voltages and order codes									
24 V AC	**1SVR550805R9300**		**1SVR430811R9300**						
24 V AC/DC		**1SVR430800R9100**	**1SVR430810R9300**	**1SVR430710R9300**					
110-130 V AC	**1SVR550800R9300**		**1SVR430811R0300**	**1SVR430711R0300**					
220-240 V AC	**1SVR550801R9300**	**1SVR430801R1100**	**1SVR430811R1300**	**1SVR430711R1300**					
380-440 V AC				**1SVR430711R2300**					
24-240 V AC/DC					**1SVR430720R0400**	**1SVR430720R0300**	**1SVR430710R0200**	**1SVR430720R0500**	**1SVR450025R0100**

1) configurable via terminals
2) Auto reset without non-volatile fault storage configurable by permanent jumpering of connecting terminals S1-T2 or S1/X1-S2/X2

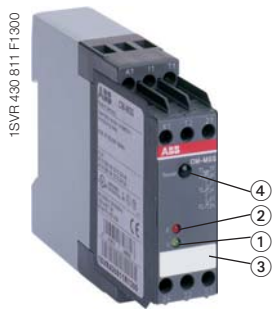
Thermistor motor protection relays CM-MSE, CM-MSS
Ordering details



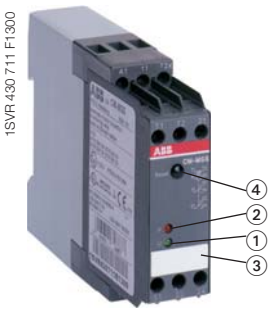
CM-MSE



CM-MSS (1)



CM-MSS (2)

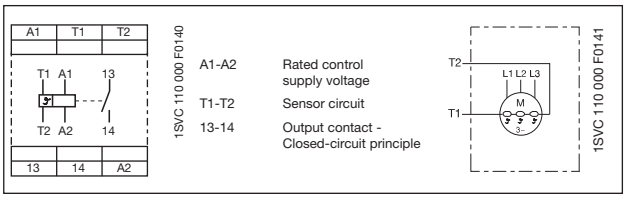


CM-MSS (3)

① F: red LED - fault tripping
② U: green LED - control supply voltage
③ Marker label
④ Reset button

CM-MSE

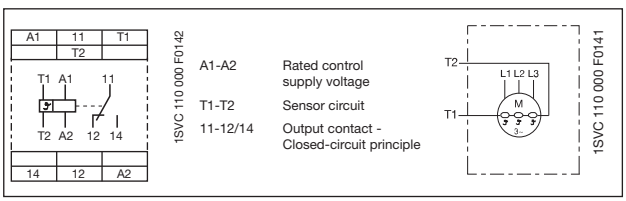
- Auto reset
- Connection of several sensors (max. 6 sensors conn. in series)
- Monitoring of bimetals
- 1 n/o contact
- Excellent cost / performance ratio



Type	Rated control supply voltage	Order code	Pack. unit pieces	Price 1 piece	Weight 1 piece kg / lb
CM-MSE	24 V AC	**1SVR 550 805 R9300**	1		0.11 / 0.24
	110-130 V AC	**1SVR 550 800 R9300**	1		0.11 / 0.24
	220-240 V AC	**1SVR 550 801 R9300**	1		0.11 / 0.24

CM-MSS (1), 1 c/o contact

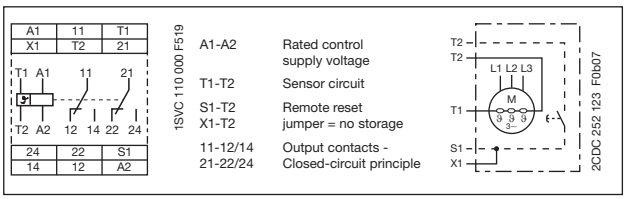
- Auto reset
- Connection of several sensors
- Monitoring of bimetals
- 1 c/o contact
- 2 LEDs for status indication



Type	Rated control supply voltage	Order code	Pack. unit pieces	Price 1 piece	Weight 1 piece kg / lb
CM-MSS (1)	24 V AC/DC [1]	**1SVR 430 800 R9100**	1		0.15 / 0.33
	220-240 V AC	**1SVR 430 801 R1100**	1		0.15 / 0.33

CM-MSS (2), 2 c/o contacts

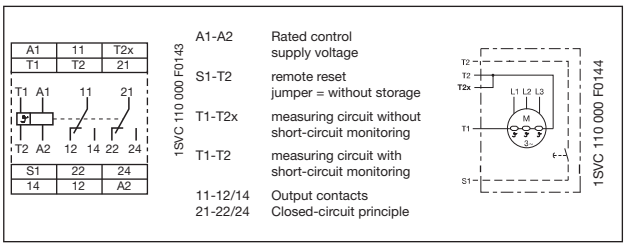
- Fault storage can be switched off
- Auto reset configurable
- Reset button
- Remote reset
- Monitoring of bimetals
- 2 c/o contacts
- 2 LEDs for status indication



Type	Rated control supply voltage	Order code	Pack. unit pieces	Price 1 piece	Weight 1 piece kg / lb
CM-MSS (2)	24 V AC/DC [1]	**1SVR 430 810 R9300**	1		0.15 / 0.33
	24 V AC	**1SVR 430 811 R9300**	1		0.15 / 0.33
	110-130 V AC	**1SVR 430 811 R0300**	1		0.15 / 0.33
	220-240 V AC	**1SVR 430 811 R1300**	1		0.15 / 0.33

CM-MSS (3), 2 c/o contacts, short-circuit monitoring configurable

- Fault storage can be switched off
- Auto reset configurable
- Reset button
- Remote reset
- Monitoring of bimetals
- Short-circuit monitoring of the sensor circuit configurable
- 2 c/o contacts
- 2 LEDs for status indication



Type	Rated control supply voltage	Order code	Pack. unit pieces	Price 1 piece	Weight 1 piece kg / lb
CM-MSS (3)	24 V AC/DC [1]	**1SVR 430 710 R9300**	1		0.15 / 0.33
	110-130 V AC	**1SVR 430 711 R0300**	1		0.15 / 0.33
	220-240 V AC	**1SVR 430 711 R1300**	1		0.15 / 0.33
	380-440 V AC	**1SVR 430 711 R2300**	1		0.15 / 0.33

[1] not electrically isolated

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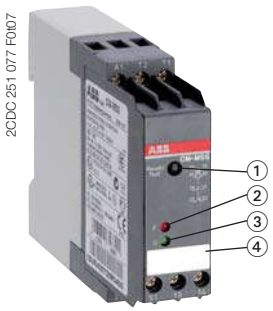
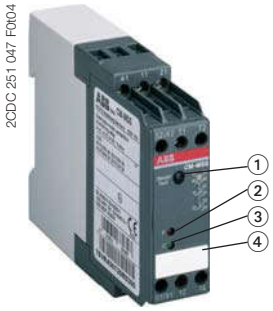
Thermistor motor protection relays CM-MSS
Ordering details

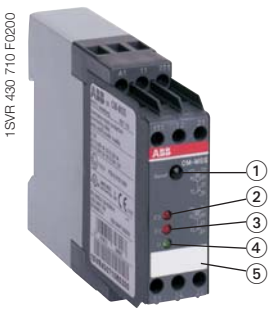


CM-MSS (4)



CM-MSS (5)

① Reset / test button
② F: red LED - fault tripping
③ U: green LED - control supply voltage
④ Marker label



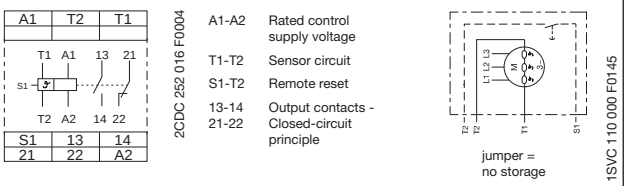
CM-MSS (6)

① Reset button
② to ③ F1-F2: red LED - fault tripping 1 to 2
④ U: green LED - control supply voltage
⑤ Marker label

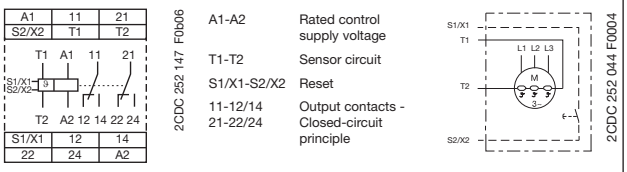
CM-MSS (4) + CM-MSS (5), 1-channel

- Short-circuit monitoring of the sensor circuit
- Wide supply voltage range: 24-240 V AC/DC
- Non-volatile fault storage selectable
- Reset and test button
- Remote reset
- Auto reset configurable
- Output contacts: 1 n/c and 1 n/o or 2 c/o contacts
- 2 LEDs for status indication

CM-MSS (4)



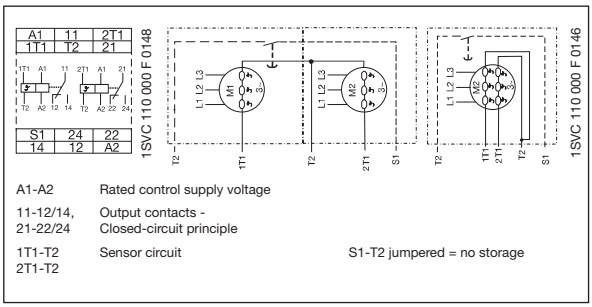
CM-MSS (5)



Type	Rated control supply voltage	Order code	Pack. unit pieces	Price 1 piece	Weight 1 piece kg / lb
CM-MSS (4) 1-channel 1n/c, 1n/o	24-240 V AC/DC	**1SVR 430 720 R0400**	1		0.15 / 0.33
CM-MSS (5) 1-channel 2 c/o	24-240 V AC/DC	**1SVR 430 720 R0300**	1		0.15 / 0.33

CM-MSS (6), 2-channel, single evaluation

- Short-circuit monitoring for the sensor circuits
- Wide supply voltage range: 24-240 V AC/DC
- 2 separate sensor circuits for monitoring of two motors or one motor with 2 sensor circuits (prewarning and final switch off)
- Reset button
- Auto reset configurable
- Output contacts: 2 x 1 c/o contact
- 3 LEDs for status indication



Type	Rated control supply voltage	Order code	Pack. unit pieces	Price 1 piece	Weight 1 piece kg / lb
CM-MSS (6)	24-240 V AC/DC	**1SVR 430 710 R0200**	1		0.15 / 0.33

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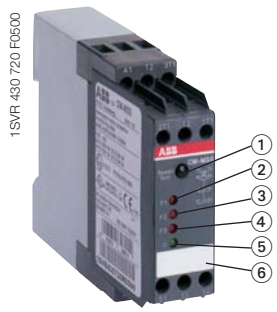
Thermistor motor protection relays CM-MSS, CM-MSN
Ordering details

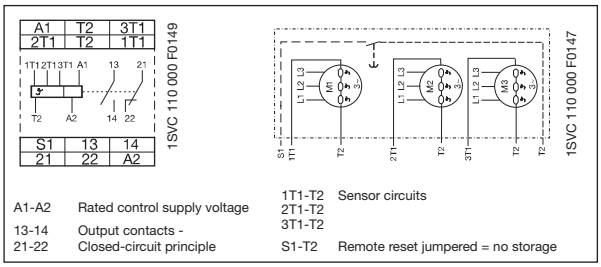


CM-MSS (7)

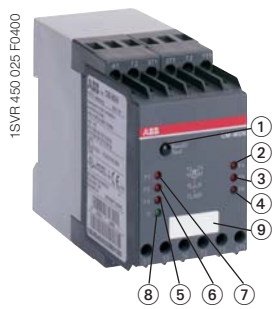
① Reset / test button
② to ④
F1-F3: red LED - fault tripping 1 to 3
⑤ U: green LED - control supply voltage
⑥ Marker label

CM-MSS (7), 3 sensor circuits, accumulative evaluation

- Short-circuit monitoring for the sensor circuits
- Wide supply voltage range 24-240 V AC/DC
- Non-volatile fault storage configurable
- Remote reset
- Auto reset configurable
- Reset and test button
- Output contacts: 1 n/c and 1 n/o contact
- 4 LEDs for status indication



Type	Rated control supply voltage	Order code	Pack. unit pieces	Price 1 piece	Weight 1 piece kg / lb
CM-MSS (7)	24-240 V AC/DC	**1SVR 430 720 R0500**	1		0.15 / 0.33

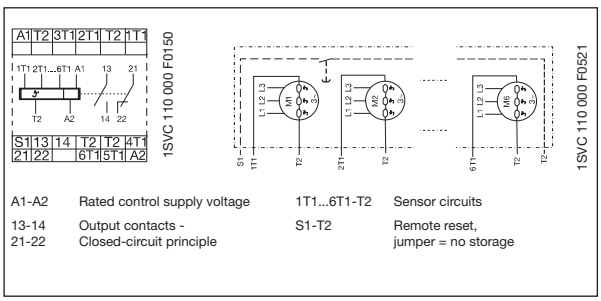


CM-MSN

① Reset / Test button
② to ⑦
F1-F6: red LED - fault tripping F1 to F6
⑧ U: green LED - control supply voltage
⑨ Marker label

CM-MSN, 6 sensor circuits, accumulative evaluation

- Short-circuit monitoring of the sensor circuit
- Wide supply voltage range: 24-240 V AC/DC
- Non-volatile fault storage configurable
- Remote reset
- Auto reset configurable
- Reset and test button
- Output contacts: 1 n/c, 1 n/o contact
- 7 LEDs for status indication



Type	Rated control supply voltage	Order code	Pack. unit pieces	Price 1 piece	Weight 1 piece kg / lb
CM-MSN	24-240 V AC/DC	**1SVR 450 025 R0100**	1		0.23 / 0.51

accumulative evaluation = if any input exeeds the threshold, the output relay will trip

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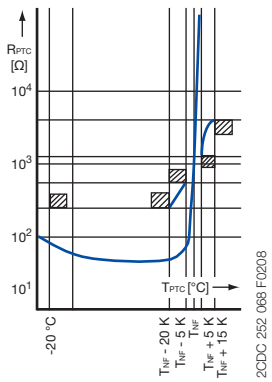
Thermistor motor protection
PTC temperature sensors C011
Ordering details, technical data

Temperature sensor characteristic





The PTC temperature sensors (temperature-dependent with positive temperature coefficient) are selected by the manufacturer of the motor depending on:

- the motor insulation class according to IEC/EN 60034-11,
- the special characteristics of the motor, such as the conductor cross-section of the windings, the permissible overload factor etc.
- special conditions prescribed by the user, such as the permissible ambient temperature, risks resulting from locked rotor, extent of permitted overload etc.

One temperature sensor must be embedded in each phase winding. For instance, in case of three-phase squirrel cage motors, three sensors are embedded in the stator windings. For pole-changing motors with one winding (Dahlander connection), 3 sensors are also sufficient. Pole-changing motors with two windings, however, require 6 sensors.

If an additional warning is required before the motor is switched off, separate sensors for a correspondingly lower temperature must be embedded in the winding. They have to be connected to a second control unit.

The sensors are suitable for embedding in motor windings with rated operating voltages of up to 600 V AC.
Conductor length: 500 mm per sensor.

A 14 V varistor can be connected in parallel to protect the sensors from overvoltage.

Due to their characteristics, the thermistor motor protection relays can also be used with PTC temperature sensors of other manufacturers which comply with DIN 44 081 and DIN 44 082.

Type	Rated response temperature T_{NF}	Color coding	Order code	Pack. unit set	Price 1 set	Weight 1 piece kg / lb
Temperature sensor C011, standard version acc. to DIN 44081						
1 set = 3 pieces						
C011-70	70 °C	white-brown	**GHC 011 0003 R0001**	1		0.02/0.044
C011-80	80 °C	white-white	**GHC 011 0003 R0002**	1		0.02/0.044
C011-90	90 °C	green-green	**GHC 011 0003 R0003**	1		0.02/0.044
C011-100	100 °C	red-red	**GHC 011 0003 R0004**	1		0.02/0.044
C011-110	110 °C	brown-brown	**GHC 011 0003 R0005**	1		0.02/0.044
C011-120	120 °C	gray-gray	**GHC 011 0003 R0006**	1		0.02/0.044
C011-130	130 °C	blue-blue	**GHC 011 0003 R0007**	1		0.02/0.044
C011-140	140 °C	white-blue	**GHC 011 0003 R0011**	1		0.02/0.044
C011-150	150 °C	black-black	**GHC 011 0003 R0008**	1		0.02/0.044
C011-160	160 °C	blue-red	**GHC 011 0003 R0009**	1		0.02/0.044
C011-170	170 °C	white-green	**GHC 011 0003 R0010**	1		0.02/0.044

Type	Rated response temperature T_{NF}	Color coding	Order code	Pack. unit pieces	Price 1 piece	Weight 1 piece kg / lb
Triple temperature sensor C011-3						
C011-3-150	150 °C	black-black	**GHC 011 0033 R0008**	1		0.05/0.11

Technical data

Characteristic data	Sensor type C011
Cold-state resistance	50 -100 Ω at 25 °C
Warm-state resistance ± 5 up to 6 K of rated response temperature T_{NF}	10 000 Ω
Thermal time constant, sensor open [1]	< 5 s
Permitted ambient temperature	+180 °C

Rated response temperature ± tolerance $T_{NF} \pm \Delta T_{NF}$	PTC resistance R from -20 °C to T_{NF} - 20 K	PTC resistance R at PTC temperatures of:		
		$T_{NF} - \Delta T_{NF}$ ($U_{PTC} \leq 2.5$ V)	$T_{NF} + \Delta T_{NF}$ ($U_{PTC} \leq 2.5$ V)	$T_{NF} + 15$ K ($U_{PTC} \leq 7.5$ V)
70 ±5 °C	≤ 100 Ω	≤ 570 Ω	≥ 570 Ω	-
80 ±5 °C				
90 ±5 °C		≤ 550 Ω	≥ 1330 Ω	≥ 4000 Ω
100 ±5 °C				
110 ±5 °C				
120 ±5 °C				
130 ±5 °C				
140 ±5 °C				
150 ±5 °C				
160 ±5 °C				
170 ±7 °C		≤ 570 Ω	≥ 570 Ω	-

[1] Not embedded in windings.

[2] For triple temperature sensor take values x 3.

Thermistor motor protection relays CM-MSE, CM-MSS, CM-MSN
Technical data

Type			CM-MSE	CM-MSS	CM-MSN
Input circuit					
Rated control supply voltage U_S - power consumption	**A1-A2**		24 V AC	approx. 1.5 VA	
	A1-A2		24 V AC/DC	approx. 1.1 VA / 0.6 W	
	A1-A2		110-130 V AC	approx. 1.5 VA	
	A1-A2		220-240 V AC	approx. 1.5 VA	
	A1-A2		380-440 V AC	approx. 1.7 VA	
	A1-A2		24-240 V AC/DC	approx. 1.4-1.7 W / approx. 3.5-5.7 VA	
Rated control supply voltage U_S tolerance			-15 % ... +10 %		
Rated frequency			AC: 50-60 Hz / 24-240 V AC/DC versions: 15-400 Hz		
Duty time			100 %		
Measuring circuit			**T1-T2**	**T1-T2/T2x, 1T1...6T1-T2**	**1T1...6T1-T2**
Monitoring function			temperature monitoring by means of PTC sensors		
Number of senor circuits			1	1, 2 oder 3 (see order. details)	6
Short-circuit monitoring			-	see ordering details	yes
Non-volatile fault storage			-	see ordering details	configurable
Test function			-	see ordering details	yes
Sensor circuit					
Temperature threshold (relay de-energizes)			2.7-3.7 kΩ	CM-MSS (1+2): 3050±550 Ω CM-MSS (3-7): 3.6 kΩ ±5 %	3.6 kΩ ±5 %
Temperature hysteresis (relay energizes)			1.7-2.3 kΩ	CM-MSS (1+2): 1900±400 Ω CM-MSS (3-7): 1.6 kΩ ±5 %	1.6 kΩ ±5 %
Short circuit threshold (relay de-energizes)			<20 Ω		
Short circuit hysteresis (relay energizes)			>40 Ω		
Maximum total resistance of sensors connected in series (cold state)			≤1.5 kΩ		
Maximum sensor cable length for short-circuit detection			2 x 100 m at 0.75 mm², 2 x 400 m at 2.5 mm²		
Response time			<100 ms		
Control circuit for storage and hysteresis function					
Remote reset	**S1-T2 or S1/X1-S2/X2**		-	n/o contact	
Maximum no-load voltage			-	approx. 25 V, 24-240 V; AC/DC versions: 5.5 V	
Maximum cable length			-	≤ 50 m, 100-200 m if shielded	
Indication of operational states					
Control supply voltage		U: green LED	-	⌠‾‾‾‾‾⌡: control supply voltage applied	
Fault indication		F: red LED	-	⌠‾‾‾‾‾⌡: output relay de-energized	
Output circuits			**13-14**	**11-12/14, 21-22/24, 13-14, 21-22**	**13-14, 21-22**
Kind of output			1 n/o contact	CM-MSS (1): 1 c/o contact CM-MSS (2,3,5): 2 c/o contacts CM-MSS (4, 7): 1 n/o + 1 n/c CM-MSS (6): 2x1 c/o contact	1 n/o + 1 n/c contact
Operational principle			closed-circuit principle (output relay de-energizes if the measured value exceeds/drops below the adjusted threshold)		
Contact material			AgCdO	CM-MSS (1+2+6): AgCdO CM-MSS (3+4+5+7): AgNi	AgNi
Rated voltage	(VDE 0110, IEC 664-1, IEC 60947-1)		250 V		
Maximum switching voltage			250 V		
Rated operational current I_e (IEC/EN 60947-5-1)	AC12 (resistive)	230 V	4 A		
	AC15 (inductive)	230 V	3 A		
	DC12 (resistive)	24 V	4 A		
	DC13 (inductive)	24 V	2 A (1.5 A - n/c contact[1])		
AC rating (UL 508)	Utilization category (Control Circuit Rating Code)		B 300		
	max. rated operational voltage		300 V AC		
	max. continuous thermal current at B 300		5 A		
	max. making/breaking apparent power at B 300		3600/360 VA		
Mechanical lifetime			30 (10 [1]) x 10^6 switching cycles		
Electrical lifetime (AC12, 230 V, 4 A)			0.1 x 10^6 switching cycles		
Max. fuse rating to achieve short circuit protection		n/c contact	10 A fast-acting	4 A (10 A[1]) fast-acting	10 A fast-acting
		n/o contact	10 A fast-acting	6 A (10 A[1]) fast-acting	10 A fast-acting
General data					
Dimensions (W x H X D)			22.5 x 78 x 78.5 mm (0.89 x 3.07 x 3.09 in)	22.5 x 78 x 100 mm (0.89 x 3.07 x 3.94 in)	45 x 78 x 100 mm (1.77 x 3.07 x 3.94 in)
Weight			approx. 0.11 kg (0.24 lb)	approx. 0.15 kg (0.33 lb)	approx. 0.23 kg (0.51 lb)
Mounting position			any		
Degree of protection		enclosure / terminals	IP50 / IP20		
Ambient temperature range		operation	-20...+60 °C		-25...+65 °C
		storage	-40...+85 °C		
Mounting			DIN rail (IEC/EN 60715)		

[1] 1SVR 430 710 R 0200, 1SVR 430 8xx R xxxx

Thermistor motor protection relays CM-MSE, CM-MSS, CM-MSN
Technical data

Type		CM-MSE	CM-MSS	CM-MSN
Electrical connection				
Wire size	fine strand with wire end ferrule	2 x 1.5 mm² (2 x 16 AWG)	2 x 2.5 mm² (2 x 14 AWG)	
	fine strand without wire end ferrule	2 x 0.75-1.5 mm² (2 x 18-16 AWG)	2 x 0.75-2.5 mm² (2 x 18-14 AWG)	
	rigid	2 x 1-1.5 mm² (2 x 18-16 AWG)	2 x 0.75-2.5 mm² (2 x 18-14 AWG)	
Stripping length		2 x 0.75-1.5 mm² (2 x 18-16 AWG)	2 x 0.5-4 mm² (2 x 20-12 AWG)	
Tightening torque		10 mm (0.39 inch)	7 mm (0.28 inch)	
Standards				
Product standard		IEC 255-6, EN 60255-6		
Low Voltage Directive		2006/95/EC		
EMC Directive		2004/108/EC, 91/263/EEC, 92/31/EEC, 93/68/EEC, 93/67/EEC		
Electromagnetic compatibility		EN 61000-6-2, EN 61000-6-4		
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)		
electrical fast transient / burst	IEC/EN 61000-4-4	Level 3 (2 kV / 5 kHz)		
surge	IEC/EN 61000-4-5	Level 3/4 (1/2 kV)		
conducted disturbances, induced by radio-frequency fields	IEC/EN 61000-4-6	Level 3 (10 V)		
Operational reliability (IEC 68-2-6)		6 g	4 g	5 g
Resistance to vibration (IEC 68-2-6)		10 g	6 g	10 g
Environmental testing (IEC 68-2-30)		24 h cycle time, 55 °C, 93 % rel., 96 h		
Isolation data				
Rated voltage between supply, measuring and output circuit		250 V		
Rated impulse withstand voltage between all isolated circuits		4 kV / 1.2 - 50 µs		
Test voltage between all isolated circuits		2.5 kV, 50 Hz, 1 min.		
Pollution degree		3		
Overvoltage category		III		

• **Approvals** 2/6