

Motor load monitoring relays

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Motor load monitoring relays

Fields of application

The motor load monitor relay monitors the load states of single-phase and three-phase asynchronous motors. The evaluation of the phase angle between current and voltage allows a very precise monitoring of the load states. Compared with other conventional measuring principles

(e.g. pressure transducers, current measurement), $\cos \varphi$ monitoring is a more precise and economical alternative. The motor is used as a sensor for its own load status.

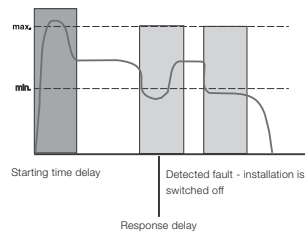
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Main applications

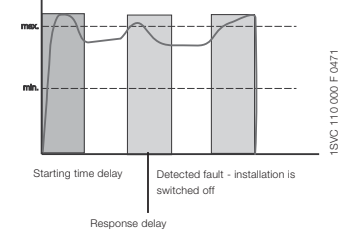
- Pump monitoring
 - Dry-running protection (underload)
 - Closed valves (overload)
 - Pipe break (overload)
- Heating, air-conditioning, ventilation
 - Monitoring of filter pollution
 - V-belt breakage (underload)
 - Closed shutters/valves (overload)
 - Air ventilating volume
- Agitating machines
 - High consistency within the tank (overload)
 - Pollution of the tank (overload)
- Transport/Conveyance
 - Congested conveyor belts (overload)
 - Jamming of belts (overload)
 - Material accumulation in spiral conveyors (overload)
 - Lifting platforms
- Machine installation
 - Wear of tools, e.g. worn saw blades in circular saws, etc. (overload)
 - Tool breakage (underload)
 - V-belt drives (breakage underload)

Pump control

Dry-running protection

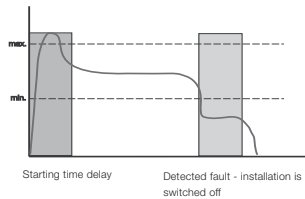


Filter pollution

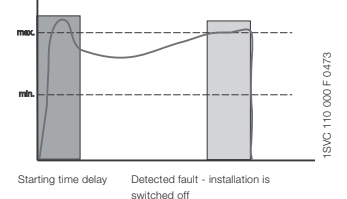


Ventilator monitoring

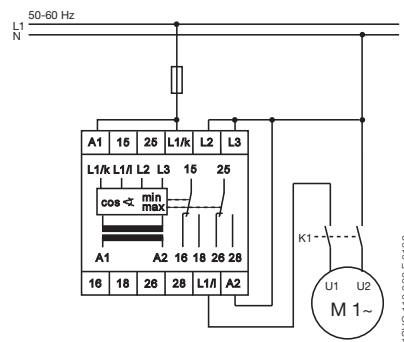
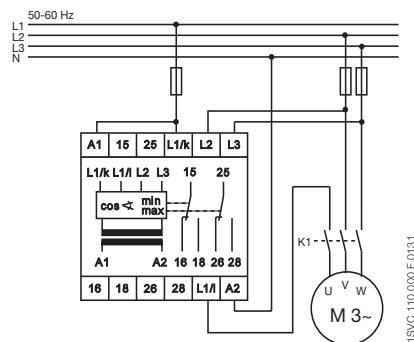
V-belt monitoring



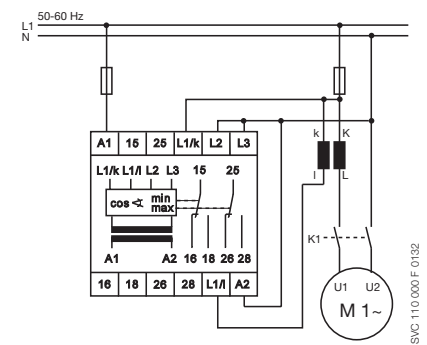
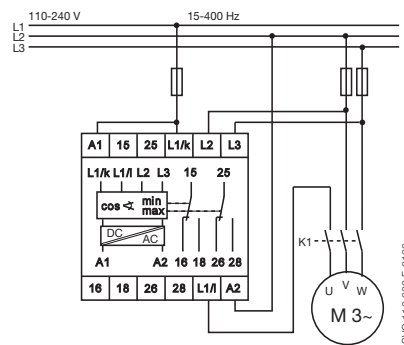
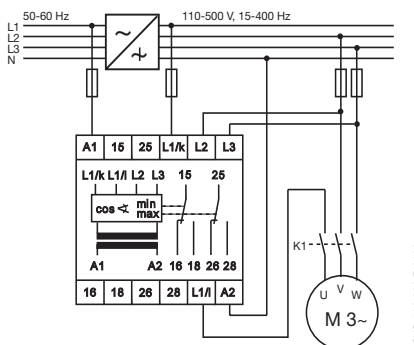
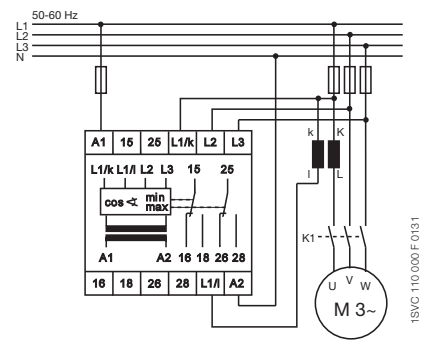
Filter pollution



Wiring examples (for motor currents ≤ 20 A)



Wiring examples (for motor currents ≥ 20 A)



Motor load monitoring relays

Ordering details



CM-LWN

1SVR 450 335 F0100



Further documentation motor load monitoring relays on www.abb.com

Description

The CM-LWN monitors the motor load of single-phase and three-phase asynchronous motors. The evaluation of the phase angle between current and voltage ($\cos \varphi$ monitoring) allows a very precise monitoring of the motor load status.

Ordering details

Rated control supply voltage	Current range	Type	Order code	Price	Weight (1 pce)
				1 pce	kg (lb)
24-240 V AC/DC	0.5-5 A	CM-LWN	1SVR450335R0000		0.30 (0.66)
110-130 V AC			1SVR450330R0000		0.30 (0.66)
220-240 V AC			1SVR450331R0000		0.30 (0.66)
380-440 V AC			1SVR450332R0000		0.30 (0.66)
480-500 V AC			1SVR450334R0000		0.30 (0.66)
24-240 V AC/DC	2-20 A		1SVR450335R0100		0.30 (0.66)
110-130 V AC			1SVR450330R0100		0.30 (0.66)
220-240 V AC			1SVR450331R0100		0.30 (0.66)
380-440 V AC			1SVR450332R0100		0.30 (0.66)
480-500 V AC			1SVR450334R0100		0.30 (0.66)

Current transformers "Ordering details - CM-CT current transformers" on page 177"

Characteristics

- Pump monitoring
- Under- and overload monitoring $\cos \varphi$ in one unit
- Adjustable starting delay 0.3-30 s
- Direct measurement of currents up to 20 A
- Adjustable response time delay 0.2-2 s
- Single-phase or three-phase monitoring
- 2 x 1 c/o contact, closed-circuit principle
- 3 LEDs for status indication



2CDC 253 010 F0013

- Starting delay „Time S“
- Response delay „Time R“
- Threshold for load limit $\cos \varphi_{\max}$
- Threshold for load limit $\cos \varphi_{\min}$
- Reset button
- Indication of operational states
 U: green LED – control supply voltage
 $\cos \varphi_{\max}$: red LED – $\cos \varphi_{\max}$ exceeded
 $\cos \varphi_{\min}$: red LED – below $\cos \varphi_{\min}$
- Marker label

Motor load monitoring relays

Technical information

The CM-LWN module monitors the load status of inductive loads.

The primary application is the monitoring of single- or three-phase asynchronous motors (squirrel cage) under varying load conditions. The measuring principle is based on the evaluation of the phase shift (φ) between the voltage and the current in one phase.

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The phase difference is nearly inversely proportional to the load. Therefore, $\cos \varphi$, measured relatively from 0 to 1, measures the relationship of effective power to apparent power. A value towards 0 indicates low load and a value towards 1 indicates high load.

Threshold values can be set individually for $\cos \varphi_{\max}$ and $\cos \varphi_{\min}$. If the set threshold value is reached, a LED lights up and the relay is de-energized.

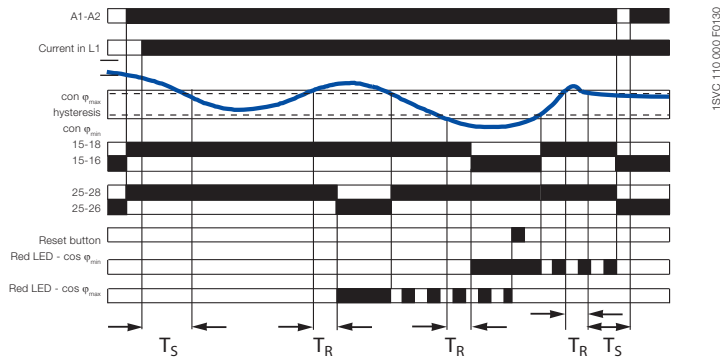
If $\cos \varphi$ returns to the acceptable limits (taking into account the hysteresis), the relay is reset to its original state and the LED flashes permanently to indicate the occurrence of the trip event. This message can be deleted using the reset button or by switching off the supply.

A time delay (Time S) of 0.3 to 30 s can be set for the starting phase of the motor. It is also possible to set a response delay time (Time R) of 0.2 to 2 s to suppress unwanted tripping due to unavoidable short load changes during normal operation.

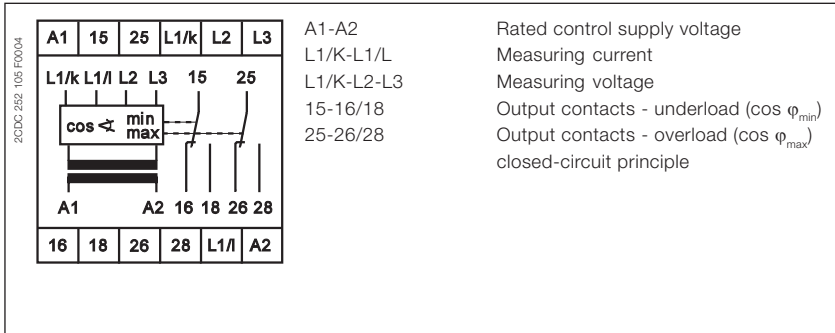
To guarantee correct operation of the response delay (Time R), the adjusted value for $\cos \varphi_{\max}$ has to be higher than the value for $\cos \varphi_{\min}$ plus the hysteresis. Consequently, the overload and underload indication must not be active at the same time.

Due to the internal electrical isolation of the supply circuit and the measuring circuit, it is also possible to use the device in systems with different supply voltages.

Function diagram - CM-LWN



Connection diagram CM-LWN



Motor load monitoring relays

Technical data

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Type		CM-LWN
Input circuit - Supply circuit		
Rated control supply voltage U_s - power consumption	A1-A2	24-240 V AC/DC approx. 8.4 VA/W
	A1-A2	110-130 V AC approx. 3.6 VA
	A1-A2	220-240 V AC approx. 3.6 VA
	A1-A2	380-440 V AC approx. 3.6 VA
	A1-A2	480-500 V AC approx. 3.6 VA
Rated control supply voltage U_s tolerance		-15 %...+10 %
Rated frequency	AC versions	50-60 Hz
	AC/DC versions	15-400 Hz or DC
Duty time		100 %
Measuring circuit		L1/L-L1/K-L2-L3
Monitoring function		Motor load monitoring by $\cos \varphi$
Voltage range	L1/K-L2-L3	110-500 V AC single-phase or three-phase
Current range	L1/L-L1/K	0.5-5 A version 2-20 A version
Permissible overload of current input		25 A for 3 s 100 A for 3 s
Thresholds		$\cos \varphi_{\min}$ and $\cos \varphi_{\max}$ adjustable from 0 to 1
Hysteresis (related to phase angle φ in °)		4°
Frequency of measuring voltage		15-400 Hz
Response time		300 ms
Timing circuits		indication of over- and undervoltage fault
Start-up time (Time S)		0.3-30 s, adjustable
Response delay (Time R)		0.2-2 s, adjustable
Accuracy within the rated control supply voltage tolerance		$\Delta t \leq 0.5 \%$
Accuracy within the temperature range		$\Delta t \leq 0.06 \%$ / °C
Indication of operational states		
Control supply voltage		U: green LED
below $\cos \varphi_{\min}$		$\cos \varphi_{\min}$: red LED
$\cos \varphi_{\max}$ exceeded		$\cos \varphi_{\max}$: red LED
Output circuits		15-16/18, 25-26/28
Kind of output		2 x 1 c/o contact
Operational principle		closed-circuit principle ¹⁾
Contact material		AgCdO
Rated voltage (VDE 0110, IEC 664-1, IEC 947-1)		250 V
Max. switching voltage		400 V AC, 300 V DC
Rated operational current I_o (IEC/EN 60947-1)	AC-12 (resistive) 230 V	4 A
	AC-15 (inductive) 230 V	3 A
	DC-12 (resistive) 24 V	4 A
	DC-13 (inductive) 24 V	2 A
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 x 10 ⁶ switching cycles
Electrical lifetime	at AC-12, 230 V, 4 A	0.1 x 10 ⁶ switching cycles
Max. fuse rating to achieve short-circuit protection	n/c / n/o contact	10 A fast-acting / 10 A fast-acting
General data		
Dimensions (W x H x D)		45 mm x 78 mm x 100 mm (1.77 inch x 3.07 inch x 3.94 inch)
Mounting position		any
Degree of protection	housing / terminals	IP50 / IP20
Ambient temperature range	operation / storage	-25...+65 °C / -40...+85 °C
Mounting		DIN rail (IEC/EN 60715)
Electrical connection		
Wire size	fine-strand with wire end ferrule	2 x 2.5 mm ² (2 x 14 AWG)
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 4 (2 kV L-L)
conducted disturbances, induced by radio-frequency fields	IEC/EN 61000-4-6	Level 3 (10 V)
Operational reliability (IEC 68-2-6)		5 g
Mechanical resistance (IEC 68-2-6)		10 g
Environmental testing (IEC 68-2-30)		24 h cycle time, 55 °C, 93 % rel., 96 h
Isolation data		
Rating (HD 625.1 S1, VDE 0110, IEC 664-1, IEC 60255-5)		
Rated insulation voltage between supply-, measuring- and output circuit		250 V, 400 V, 500 V depending on the version
Rated impulse withstand voltage between all isolated circuits		4 kV / 1.2 - 50 μ s
Test voltage between all isolated circuits		2.5 kV, 50 Hz, 1 min.
Pollution category		3
Overvoltage category		III

¹⁾ Open-circuit principle: Output relay is energized if the measured value exceeds/drops below the adjusted threshold.
 Closed-circuit principle: Output relay is de-energized if the measured value exceeds/drops below the adjusted threshold.

Motor control and protection

Product group picture

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Motor control and protection

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Motor control and protection

Benefits and advantages

2

UMC100.3 is a flexible, modular and expandable motor management system for constant-speed low-voltage range motors. It's most important tasks include motor protection, prevention of plant standstills and the reduction of down time. This is made possible by early information relating to possible motor problems which avoids unplanned plant standstills. Even if a motor trips, quick diagnosis of the cause of the fault serves to reduce downtime.

UMC100.3 combines in a very compact unit:

Motor protection

- Overload, underload
- Overvoltage, undervoltage
- Blocked rotor, low / high current
- Phase failure, imbalance, phase sequence
- Earth leakage
- Thermistor protection
- Limitation of starts per time
- One single version with integrated measuring system covers the rated motor current from 0.24 to 63 A

Motor control

- Integrated and easy to parametrize motor starter functions like direct, reverse, star-delta,...
- Additionally free programmable logic for application specific control functions
- Expansion modules DX111, DX122 for more I/Os
- Expansion modules VI150, VI155 for 3-phase voltage measuring
- Analog and temperature module AI111

Motor diagnostics

- Quick and comprehensive access to all relevant data via fieldbus and/or operator panel
- Current, thermal load
- Phase voltages
- Power factor
- Energy

Communication

- Communication-independent basic device
- Freely selectable fieldbus protocol with FieldBusPlug
- Profibus DP
- DeviceNet
- Modbus RTU
- Ethernet Modbus TCP
- Profinet

Typical application segments

- Oil & gas
- Cement
- Paper
- Mining
- Steel
- Chemical industry

Further information

UMC Catalog 2CDC 190 022 C0206
UMC Brochure 2CDC 135 011 B0203

Motor control and protection

Technical data



Basic device UMC100.3

Main power

Voltage	max 1000 V AC
Frequency	45...65 Hz
Rated motor current	0.24...63 A, without accessories Higher currents with external transformer
Tripping classes	5E, 10E, 20E, 30E, 40E in accordance with EN/IEC 60947-4-1
Short-circuit protection	Separate fuse on network side

Control unit

Supply voltage	24 V DC, 110-240 V AC/DC
Inputs	6 digital inputs 24 V DC 1 PTC input
Outputs	3 digital relay outputs 1 digital transistor output

Expansion modules

The UMC100.3 can be expanded with maximum 4 expansion modules: One digital expansion module DX111 or DX122, one module VI150 or VI155 and 2 analog modules AI111. Communication takes place via a simple two-wire line. The maximum distance allowed between the UMC100.3 and the expansion module is 3 m.



Digital expansion modules DX111 / DX122

Expands the UMC100.3 to include additional digital inputs and outputs and an analog output

Supply voltage	24 V DC
Inputs	DX111: 8 digital inputs 24 V DC DX122 8 digital inputs 110/230 V AC
Outputs	4 digital relay outputs 1 analog output, 0/4...20 mA, / 0...10 V configurable

Voltage modules VI150/VI155

Voltage modules for determining phase voltages, power factor (cos ϕ), active power, apparent power, energy, harmonic content (THD)

VI150 for use in grounded networks

VI155 for use in grounded and ungrounded networks

Supply voltage	24 V DC
Voltage inputs	L1, L2, L3
Rated voltage range	150 ... 690 V AC
Outputs	1 digital relay output



Analog module AI111

Expand the UMC100.3 with analog and temperature inputs

Supply voltage	24 V DC
Inputs	0-10 V, 0/4-20 mA PT100, PT1000, 2- or 3-wire connection KTY83, KTY84, NTC

Motor control and protection

Technical data

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Ethernet communication interfaces

Mounted in the MCC cable chamber; connection of 1 to 4 motor controllers UMC100.3 via simple cables

MTQ22	for Modbus TCP
PNQ22	for Profinet IO



Fieldbus communication interfaces

Can be mounted direct on the UMC100.3 or separate in the cable chamber of the MCC. Connection for standard fieldbus cables with 9-pole Sub-D (Profibus DP) or terminal blocks

PDP32	for Profibus DP
DNP31	for DeviceNet
MRP31	for Modbus RTU



CEM11 earth leakage sensors

Summation current transformer for connecting to a digital input
Mounting with bracket on DIN busbar or wall
Models

CEM11-FBP.20	80 – 1.700 mA	20 mm Ø
CEM11-FBP.35	100 – 3.400 mA	35 mm Ø
CEM11-FBP.60	120 – 6.800 mA	60 mm Ø
CEM11-FBP.120	300 – 13.600 mA	120 mm Ø



Current transformer CT4L / CT5L

Only required for rated motor currents >63 A
Linear transformer, 3-phase with terminal block, designed for connecting leads Cu 2.5 mm²



UMC100-PAN control panel

Installation on the device or on the switching cabinet door
Graphics-enabled and backlit display, 3 LEDs for status indication
Freely configurable error messages
USB port for PC connection
Multilingual: German, English, French, Italian, Polish, Portuguese, Spanish, Russian

Motor control and protection

Notes

Thermistor motor protection relays

Product group picture

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Thermistor motor protection relays

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Thermistor motor protection relays

Benefits and advantages, Applications

The thermistor motor protection relays of the CM-MSx range protect motors with PTC sensors against high temperature. These sensors are incorporated in the motor windings thus measuring the motor heat directly.

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Direct temperature measuring

Generally, motor damages caused by overload or overheating situations can be prevented in different ways. Compared to the indirect temperature measuring which monitors the motor current, the temperature inside the motor can be measured by direct temperature measuring.

This enables direct control and evaluation of the following operating conditions like:

- Heavy duty starting
- Increased switching frequency
- Single phase operation
- Phase unbalance
- High ambient temperature
- Insufficient cooling
- Breaking operation

Therefore the consequences from overheating like abrasion as well as electrical failures can be prevented.

The direct measuring principle is carried out by a combination of the thermistor motor protection relay and 3 PTC sensors which are installed directly in the motor by the manufacturer. Those 3 PTC sensors are placed directly at the thermal hotspots, the motor windings.

Characteristics CM-MSS¹⁾

- Different types of contacts available
 - 1 x 2 c/o (SPDT) contacts
 - 2 x 1 c/o (SPDT) contact
 - 1 n/o and 1 n/c contact
- 1 or 2 measuring circuits
- Different types of reset functions
 - Automatic
 - Manual
 - Remote
- Rated control supply voltages
 - 24 V AC/DC
 - 24-240 V AC/DC
 - 110-130 V AC, 220-240 V AC
- Approvals / Marks



Characteristics CM-MSE

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

Monitoring the motor

The thermistor motor protection relay measures the resistance of the PTC sensors which reflects the internal motor temperature permanently.

If the temperature in the motor windings rises excessively and reaches the nominal response temperature (NRT), the thermistor motor protection relay detects this situation and the output relay switches off.

By doing so the motor contactor gets triggered and switches off the motor.

CM-MSS functionality video



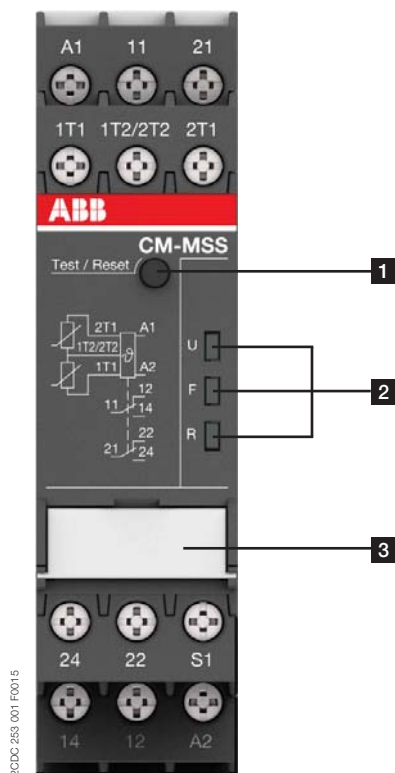
Features ¹⁾

- Additional functions:
 - Dynamic interrupted wire detection
 - Short-circuit monitoring of the sensor circuit
 - Non-volatile fault storage
 - Single or sum evaluation
- Easy configuration via DIP switches
- LEDs to distinguish between different failure causes
- Screw connection technology or Easy Connect Technology available
- Test/Reset button available

¹⁾ Depending on device the characteristics vary, for detailed overview see "Selection table CM-MSx range" on page 139.

Thermistor motor protection relays

Operating controls



- 1 Test / Reset button**
Reset - only possible if measured value < switch-on resistance
- 2 Indication of operational states with LEDs**
U: green LED - Status indication of control supply voltage
Control supply voltage applied
F: red LED - Fault message
R: yellow LED - Status indication of the output relay
- 3 Marker label / DIP switches (depending on device) e.g.**
 - Single evaluation 2 x 1 c/o (SPDT) contact
 - Accumulative evaluation 1 x 2 c/o (SPDT) contacts
 - Short-circuit detection de-activated
 - Short-circuit detection activated
 - Non-volatile fault storage activated
 - Non-volatile fault storage de-activated

LEDs, status information and fault messages CM-MSS

Operational state	U: green LED	F: red LED	R: yellow LED
Absence of control supply voltage	OFF	OFF	OFF
No fault		OFF	
Short circuit			OFF
Interrupted wire			OFF
Measuring circuit 1: Overtemperature			OFF
Measuring circuit 2: Overtemperature			OFF
Test function		OFF	OFF
Fault rectified but not confirmed		-- ¹⁾	
Change of configuration not confirmed		OFF	
Control supply voltage not within the tolerance range			OFF
Internal fault ²⁾	OFF		
Internal fault ²⁾			

¹⁾ Depending on the fault with the highest priority
²⁾ Restart the device. If after restart the same fault is indicated, replace the device.

In case of several faults, the fault with the higher priority is shown. The reset can be made after rectification and confirmation of the last fault.