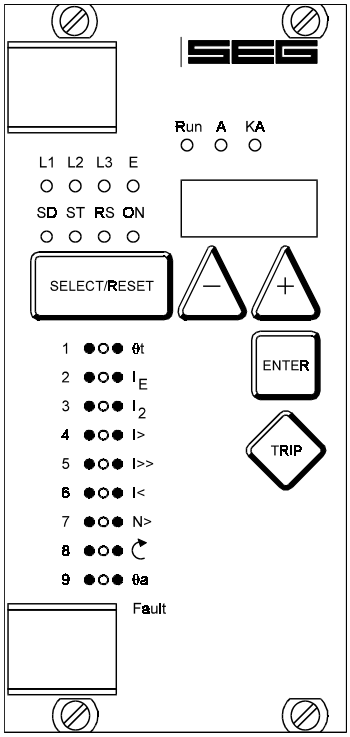
MRM10 - Motor protection relay



Contents

1 Application

The *MRM10* offers comprehensive protection for low or distribution voltage, contactor or circuit breaker controlled, motors. To enable the protection of various motors the thermal overload characteristic is adjustable in terms of pick-up above FLC, cold curve, hot curve and cooling constant.
Earth (Ground) fault protection can be residually or core balance CT's connected. Undercurrent protection is also provided. Motors with limited duty cycles can be controlled by the use of the start limiter or hot restart feature. An RS485 communication link is provided to enable the user to set or review the last six measuring and fault values. The relay can be supplied with a rated current of 1A or 5A.

2 Features and characteristics

- Thermal overload protection with adjustable current/time curves and selectable hot/cold ratios
- Overload pre-alarm with separate output relay
- High set overcurrent protection (Instantaneous or definite time)
- Earth fault protection
- Negative phase sequence protection with inverse time characteristic
- Incorrect phase rotation protection
- Undercurrent protection (definite time)
- Limiting of motor starts
- Speed switch input for stall protection
- Setting and measured parameters available via RS485 serial link
- High accuracy and wide setting range
- Universal power supply AC or DC
- Selectable auto/manual reset of the output relays
- Programmable relay operation
- Hot/cold thermal current/times with thermal memory and trip times dependant on prior loading
- Variable low set overcurrent activated after the start time
- Settings via front plate keypad and numerical display
- Withdrawable modules with automatic short circuit of C.T. inputs

3 Design

3.1 Connections

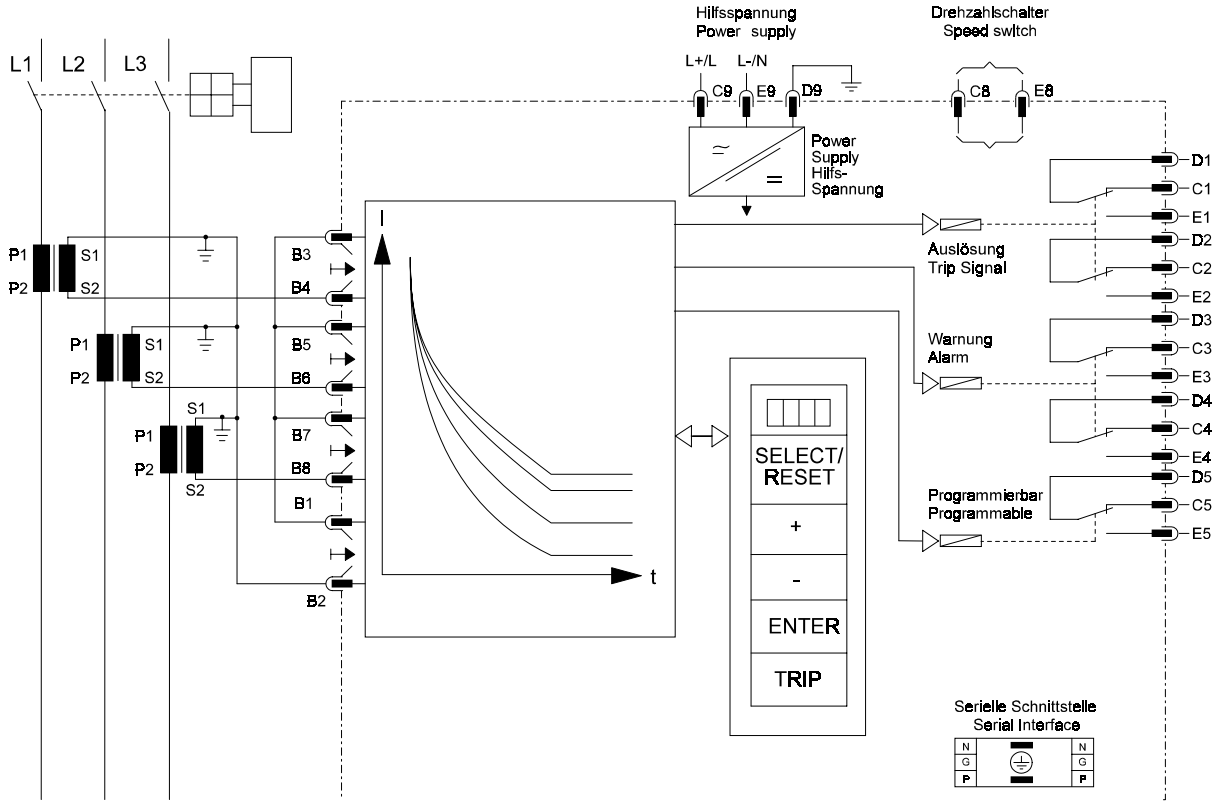


Fig. 3.1: Connection diagram MRM10 with earth fault detection in Holmgreen circuit.

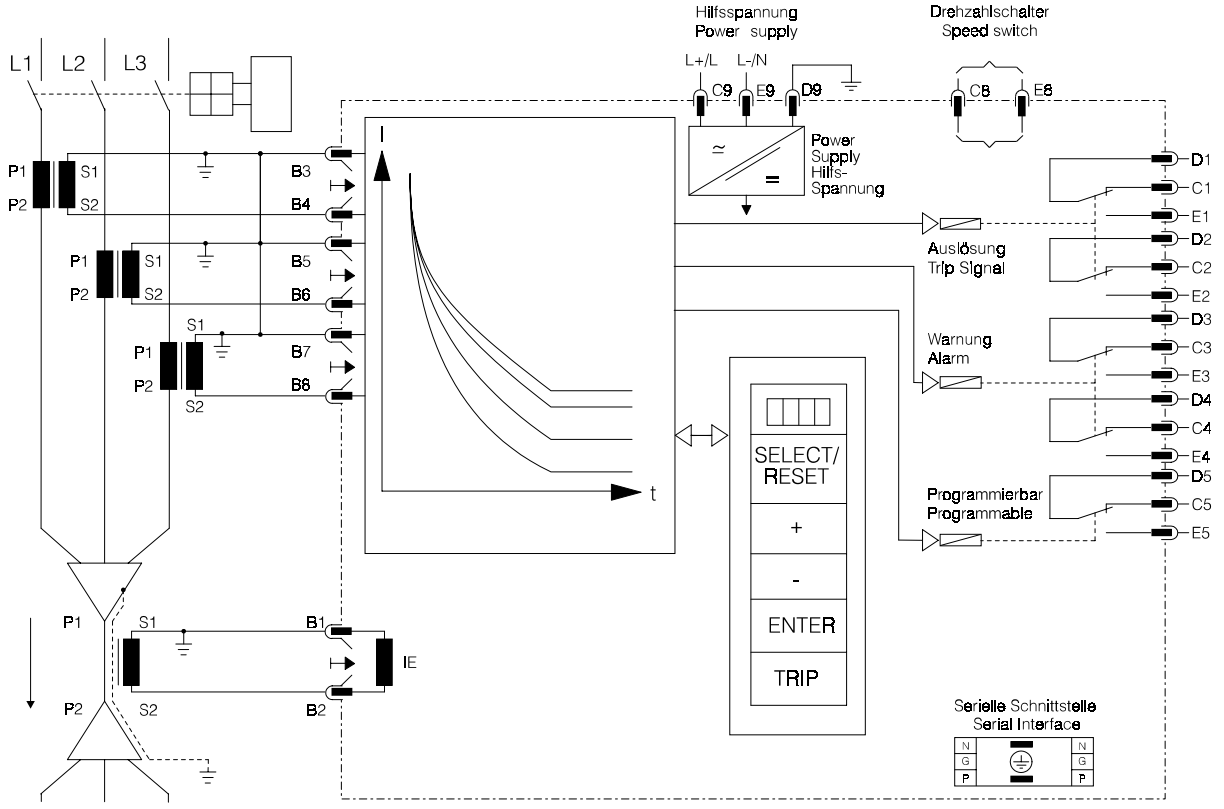


Fig. 3.2: Connection diagram MRM10 with core balance C.T

3.2 Requirements of the main current transformers

In order to ensure the correct operation of the *MRM10* range of relays, protection class CT's must be utilised. Instrument CT's are generally not a suitable alternative.

CT's should be chosen such that saturation, or loss of accuracy does not occur within the settings and operation ranges of the relays. In the absence of known settings the following may be regard as an approximate guide.

For 1A secondary CT class 5P10 or 10P10: 2.5VA
For 5A secondary CT class 5P10: 2.5VA
For core balance CT (CBCT), CT class 3, 2,5 VA

3.3 Front plate

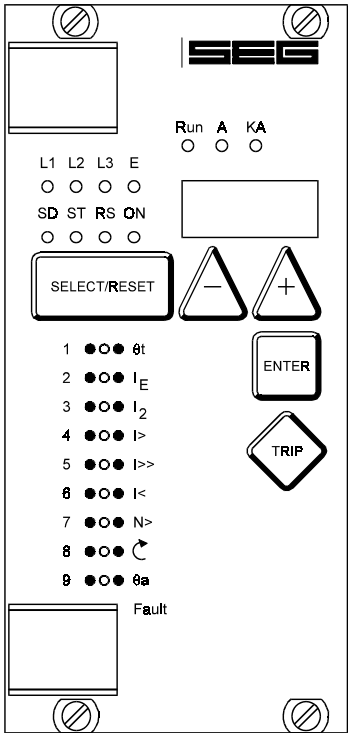


Fig. 3.3: Front plate ***MRM10***

L1	Line 1 current, in amps
L2	Line 2 current, in amps
L3	Line 3 current, in amps
E	Earth or ground current, in amps
SD	Number of starts/hours run
ST	Starting time
Run	Starting/Running
RS	RS485 communications
ON	Power to unit connected
Θt	Thermal overload
I_E	Earth/ground fault current
I_2	Negative phase sequence current
I>	Low set overcurrent
I>>	High set overcurrent
I<	Undercurrent
N>	Start limiter
↻	Phase rotation
Θa	Thermal overload pre-alarm
A	Value in amps
kA	Display value in kilo-amps or 1000 hrs

4 Operation and setting

4.1 Layout of the control elements

All control elements required for the operation and adjustment of the *MRM10* are located on the front plate. They are divided according to function into the three following groups:

- Alphanumeric display: Indication of parameter set values, actual measured values and recorded fault data.
- LED's: Indication of selected parameters and measured quantities.
- Pushbuttons: Selection of parameter to be adjusted, quantity to be measured and adjustment of parameter values. Where:

  <SELECT / RESET>: Selection of the parameter to be set and the relay quantities to be measured. Continuous pressing as the reset function.

  <+>: Increment of the setting values for the parameter selected.

  <->: Decrement of the setting values for the parameter selected parameter.

  <ENTER>: Storage of the setting values for the selected parameter.

  <Trip>: Testing of the output relay circuits.

By pressing the <SELECT/RESET> pushbutton, it is possible to step through the parameters in each display mode. The corresponding LED illuminates, and the measured or present set value of the selected parameter is indicated on the display.
This set value may then be increased or decreased by pressing the <+> or <-> buttons respectively. The selected set value is only stored after pressing the <ENTER> pushbutton and inputting the correct password. This means that adjustment of the unit is only possible by authorised users. In addition by pressing the button for 3 seconds or more the relay may be reset, providing the thermal capacity has reduced to a value sufficient to enable a restart.

Note:
It is only possible to adjust settings under mode 2, during mode 1 the <+>, <->, <ENTER>, & <TRIP> buttons are inactive.

4.2 Display mode 1

Here a subset of parameters are available for viewing and are accessed using the <SELECT/RESET> pushbutton in a cyclic manner. Parameters available are:

Data displayed	LEDs illuminated
Actual line current L1	L1 (green)
Actual line current L2	L2 (green)
Actual line current L3	L3 (green)
Actual earth fault current	E (green)
Starting/Pre-Trip Current L1*	L1 (green - red alternating)
Starting/Pre-Trip Current L2*	L2 (green - red alternating)
Starting/Pre-Trip Current L3*	L3 (green - red alternating)
Pre-trip earth fault current*	E (green)
Load current as a percentage*	L1, L2, und L3 (green)
Thermal capacity as a percentage	L1, L2, und L3 (green -flashing)
Unbalance as a percentage*	I_2 (green)
Number of starts	SD (green)
Total hours run	SD (green - flashing)
Latest start time in second	ST (green)
Relay address for communication	RS (green) if selected
t6x - setting	1 (green)
Full load current in amps	1 (green - flashing)

Table 4.1: Display mode 1

Motor starting	Run (green - flashing)
Motor running	Run (green)

Tabelle 4.2: Status indication

* *Following a relay trip this value is the stored pre-trip fault value. To reset the relay following a trip and cancel the stored trip values, (except the stored max. starting current L1, L2 and L3) press the <SELECT/RESET> button for more than 3 seconds, or restart the motor.*

The value of motor load is held after a trip and update when the next start is detected. Total hours run is the total time the relay has detected a running motor. The KA LED will illuminate to indicate hours run in 1000's of hours.

4.3 Display mode 2

In order to enter mode 2 the user must be in mode 1, by use of the <SELECT/RESET> pushbutton move through the indications until „|SEG" is shown on the display, then enter the correct password (default „++++„). To return to mode1 the user may press <TRIP>, followed by <SELECT/RESET> or alternatively wait for the automatic return which occurs after approximately 2 minutes of inactivity on the pushbuttons.

The setting parameters may be changed in mode 2 using the procedure detailed above, the parameters are detailed in table mode 2:

Data displayed	LEDs colour	Parameter range	Step	Default	LED no.
t6x setting	green	1 - 120 s	1 s	10 s	1
Full load current FLC	green - flashing	0.5 - 1.25 x C.T. primary (A)	0.01 or 0.05	1,00 (A)	1
C.T. primary setting	green - flashing	0.5 - 9.5 10 - 2500 A	0,5 A 5 A	1 A or 5 A	9
Hot / cold ratio	green	20 - 80 %	10 %	50 %	9
Thermal O/L pre-alarm	green orange alternating	50 - 99 %; OFF	1%	90 %	1
Earth fault current , % I_N	green	OFF 5 - 40 %,	1 %	OFF	2
Earth fault time	green - flashing	0.0 - 1.0 s	0,1 s	0,1 s	2
NPS current, % FLC	green	OFF, 15 %, 30 %		15 %	3
Low set O/C, % FLC	green	OFF, 200 %, 300 %, 400 %		OFF	4
Low set O/C time	green - flashing	0.5 - 5 s	0,5 s	0,5 s	4
High set O/C, x I_N	green	OFF, 200 - 1200 % I_N	50 % I_N	OFF	5
High set O/C time	green - flashing	0.0 - 1.0 s	0,1 s	0,1 s	5
Undercurrent, % FLC	green	20 - 95 %, OFF	5 %	OFF	6
Undercurrrent time	green - flashing	1 - 120 s	1 s	30 s	6
Number of starts/hr	green	OFF, 1 - 20	1	OFF	7
Start inhibit time	green - flashing	1 - 60 min	1 min	10 min	7
Set password	green	any 4 characters		++++	8
Serial link address	green - flashing	OFF, RS01 - RS32	1	OFF	8
Set trip relay action	Tnnn on display	0 - 255 (see matrix)		T255	
Set program. relay	Pnnn on display	0 - 255 (see matrix)		P254	
Set alarm relay action	Annn on display	0 - 255 (see matrix)		A255	
Set E/Fault parameters	Ennn on display	0 or 129 - 255		E000	
Set trip reset action	Rnnn on display	0 - 255 (see matrix)		R000	
Set thermal O/L curve	Cnnn on display	1 - 255 (see matrix)		C008	
Set speed switch	Snnn on display	0 - 255 (see matrix)		S000	
Advanced matrix 1	Xnnn on display	3 - 12, 131 - 140		X003	
Advanced matrix 2	Ynnn on display	0 - 127, 128 - 255		Y000	

Table 4.3: Setting parameters

FLC = Full Load Current
I_N = Rated current 1 or 5A (depending on relay type)

4.3.1 Definition of parameters

t6x
This setting specifies the time will take to trip at 6 times FLC, with respect to the cold characteristic curve, and therefore determines the basic thermal characteristic. The starting time for FLC additional 20% can be set if this time is unknown.

CT primary setting
This setting determines the primary current for the phase CTs. This parameter has to be set before FLC setting.

Full load current setting (FLC)
Determines the normal running full load current of the machine. This is set in terms of the CT primary rating. This setting is limited to the usable range of the CT (50 - 125% of CT rating).

Hot/cold ratio setting
This setting determines the amount of available thermal capacity for a motor running at FLC, i.e. hot condition. This is set as a percentage ratio of the amount of thermal capacity available at the cold condition which is always 100%.

Thermal overload pre-alarm setting
When the running current exceeds the overload level, the thermal capacity will increase eventually reaching the thermal pre-alarm level. When this happens, the relay will alarm.

Number of starts
The number of starts the motor will make can be limited. This parameter can also be set to off in which case the number of starts is unlimited.

Start inhibit time
This details the time that must elapse before the motor can be restarted after previously exceeding the preset numbers of starts.

Earth fault current
This setting specifies the pickup level of earth fault current as a percentage of I_N.

Earth fault trip time
This setting determines the trip time following the measured earth fault current exceeding the pickup value. A setting of 0.0 indicates instantaneous operation, i.e. 40 - 50 ms.

NPS current
This setting determines the pick-up level of NPS current as a percentage of FLC before a trip occurs. A setting of OFF here will disable the feature.

Undercurrent setting
This setting determines the pickup upon an undercurrent. This is generally used to protect against an unloaded machine, e.g. drive belt failure. A setting of OFF here will disable the feature.

Undercurrent time
This sets a time between the unit registering an undercurrent level and the actual triping of the unit.

High set overcurrent
This feature is normally enabled when the motor is being controlled by a circuit breaker allowing a much quicker trip time for high fault currents. A setting of OFF here will disable the feature. It is recommended that this feature is disabled for fuse contractors. During starting procedure the relay doubles the pickup value. Because of this sensitive settings for normal operation are possible.

High set overcurrent time
This setting determines the trip time following the measured current exceeding the pickup value. A setting of 0.0 indicates instantaneous operation, i.e. 40 - 50 ms.

Low set overcurrent
This feature allows a quicker trip time for fault currents, or overloads of a medium magnitude. A setting of OFF here will disable the feature.

Low set overcurrent time
This setting determines the trip time following the measured current exceeding the pickup value.

NOTE:
The low set feature is not in service during starting. This feature can therefore be used to provide a quick operating definite time stall protection once the motor is running.

4.4 Fault indication

When the relay has tripped, the display will show „TRIP" and the relevant LED will be illuminated red. On cycling through the displays in mode 1, a four letter menmonic describing the trip will be diplayed.

The mnemonics are listedin the table following.

Trip element	Mnemonic
Overload	OVLD
Earth Fault	EFLT
High set overcurrent	HSOC
Low set overcurrent	LSOC
Unbalance	NPSC
Undercurrent	UCUR
Too many starts	STLM
Phase reversal	ROTN
Stalled	STLD
Single phasing	SPHA

Table 4.4: Fault codes

Should an internal fault occur causing the relay to alarm, then the mnemonic „IRF" followed by a number will be displayed. If this occurs, or any other indication such as „UDEF" then the indication/number should be noted and reported to the SEG engineering.

4.5 Trip relay matrix, Tnnn

This matrix sets the faults that will cause the trip relay to be either energized or deenergized upon activating.

A thermal overload trip will always operate i.e. change the state of the trip relay. To configure the relay, a brief example is shown below.

Only overload trip, earth fault trip and low set trip are required and the relay is to energize upon tripping. Therefore the set value would be 161.

Action	Numerical value	Set Y/N	Value
Earth fault trip	128	Y	128
High set trip	64		
Low set trip	32	Y	32
NPS trip	16		
Number of starts trip	8		
Undercurrent trip	4		
Phase rotation	2		
Relay energizes on trip	1	Y	1
			161

Table 4.5: Trip relay matrix

By default the trip is set to 255, i.e. all trips enabled, energize on trip.

4.6 Programmable relay marix, Pnnn

This matrix sets the faults that will cause the programmable relay to be energized as well as acting upon commands from the serial link.

Example:
Only earth fault and low set are required to be acted upon, therefore the set value would be: 160

Action	Numerical value	Set Y/N	Value
Earth fault alarm	128	Y	128
High set alarm	64		
Low set alarm	32	Y	32
NPS alarm	16		
Number of starts alarm	8		
Undercurrent alarm	4		
Phase rotation	2		
Activate upon serial link commands	1		
			160

Table 4.6: Programmable relay matrix

If serial link is selected then none of the bits have any effect. Also unlike the trip relay, the programmable relay does not automatically pick-up for thermal overload.

4.7 Alarm relay matrix, Annn

This matrix sets the faults that will cause the alarm relay to be either energized or de-energized upon activating.

Example:
Only thermal pre-alarm, earthfault alarm and low set alarm are required and the relay is to de-energize upon alarm. Therefore the set value would be: 161

Action	Numerical value	Set Y/N	Value
Earth fault alarm	128	Y	128
High set alarm	64		
Low set alarm	32	Y	32
NPS alarm	16		
Number of starts alarm	8		
Undercurrent alarm	4		
Phase rotation	2		
Relay de-energizes on alarm	1	Y	1
			161

Table 4.7: Alarm relay matrix

A thermal pre-alarm and the pickup of the watchdog will always operate i.e. change the state of the alarm relay.

4.8 Earth fault parameters matrix, Ennn

This matrix sets the earth fault source (core balanced or residual connection), and if core balanced, the ratio of the core balanced CT to 1 A..

Example:
To configure the relay such that operation is via a core balanced CT with a ratio of 1500:1, then the value set would be: 203

Action	Numerical value	Set Y/N	Value
Core balanced C.T.	128	Y	128
1280	64	Y	64
640	32		
320	16		
160	8	Y	8
80	4		
40	2	Y	2
20	1	Y	1
			203

Table 4.8: Earth fault parameter matrix

When the most significant bit is set to a „0", the relay is configured for residual earth fault. Entry of numbers between 1 and 128 is not possible. The core balanced CT ratio is entered as a ratio of XXXX to 1 regardless of whether the relay is wired as 1A or 5A CT. I_N the example above, a setting of 203 would also be used if a 1500/5A CT was used with a 5A rated relay.

4.9 Trip/Reset matrix, Rnnn

This matrix sets which trips are to be auto-reset; those not selected have to be manually reset.

Example
To configure the relay such that only earth fault trips, low set trips and thermal overload trips are auto-reset, then the following value would be set : 161

Action	Numerical value	Set Y/N	Value
Earth fault	128	Y	128
High set	64		
Low set	32	Y	32
NPS	16		
Number of starts	8		
Undercurrent	4		
Phase rotation	2		
Thermal overload	1	Y	1
			161

Table 4.9: Trip/Reset Matrix

All other trips would need to be manually reset although a serial link reset always resets the relay regardless of whether set to manual or auto-reset.

4.10 Thermal O/L matrix, Cnnn

This matrix enables/disables the hot restart and selects the cooling time constant.

Example
To configure the relay such that a hot restart is allowed and the cooling time constant is 20 times the heating constant, then the value set would be: 168

Action	Numerical value	Set Y/N	Value
Enable hot restart	128	Y	128
32	64		
16	32	Y	32
8	16		
4	8	Y	8
2	4		
1	2		
0,5	1		
			168

Table 4.10: Thermal O/L matrix

4.11 Speed switch matrix, Snnn

This matrix enables/disables the speed switch operation and selects the reduction in t6x time for a stalled motor.

Example
To configure the relay such that the speed switch is enabled with the effect of decreasing the t6x time by 75%, then the value set would be: 192

Action	Numerical value	Set Y/N	Value
50 %	128	Y	128
25 %	64	Y	64
reserved	32		
reserved	16		
reserved	8		
reserved	4		
reserved	2		
reserved	1		
			192

Table 4.11: Speed switch matrix

Of neither 50% or 25% are selected then speed switch is assumed to the disabled.

4.12 Advanced matrix 1, Xnnn

This matrix sets the Overload pick-up point at either 1.05 times FLC or 1.10 times FLC, depending whether the bit is enabled or not. The cold and hot trip characteristics are the same at both settings, except that if an overload pickup of 1.10 times FLC is selected then the characteristics commences at this point.

Contactor application
In order to avoid the possibility of a contactor attempting to break a short cicuit current in excess of ist rating when this is the duty of the short circuit protection device e.g. HRC fuses, the facility ist provided to inhibit a fault trip above a set current level. This level should normally be no greater than the rated short-circuit breaking capacity of the contactor, with allowance for a suitable safety margin. The inhibit level can be selected in the range from 400 % - 1200 % I_N in steps of 100 % by setting the last 4 bits in the matrix below. Note that the thermal overload is always enabled irrespective of this fault inhibit setting.

Example
To configure the relay such that pick up occurs at 1.1 x FLC with a fault inhibit above 900 % I_N, then the value set would be: 137

Action	Numerical value	Set Y/N	Value
Overload pickup point = 1.1 x FLC	128	Y	128
reserved	64		
reserved	32		
reserved	16		
Fault inhibit value 800 %	8	Y	8
Fault inhibit value 400 %	4		
Fault inhibit value 200 %	2		
Fault inhibit value 100 %	1	Y	1
			137

Table 4.12: Advanced relay matrix

Circuit breaker applications
For circuit-breaker controlled motors, the fault trips should be enabled and this is done by setting the last 4 bits to the value 3.

If an overload pick-up point of 1.1 times FLC current is required then bit 128 is set to ON (1), if 1.05 times FLC is required then the bit is set to OFF (0).

4.13 Advanced matrix 2, Ynnn

By means of this matrix it is possible to switch over between Modbus protocol and RS485. A value of Y000 switches over to RS485 protocol, whereas by a value of Y128 the Modbus protocol is selected.

4.14 Test Trip

The whole tripping circuit of the protection system may be tested by simulating a fault with the <TRIP> pushbutton. This button is also used to interrogate the relay for its software version number. In order to enter the test trip mode the user must be in display mode 2, upon pressing the <TRIP> button the display responds with <PSW?>. The password must then be entered, upon entering the correct passwort the display indicates the software version number, and the output relays are operated in a cyclic manner illuminating the S/R, A, & KA LEDs in sympathy. In order to reset the relay, a single press of the <SELECT/RESET> pushbutton will return to mode 2, alternatively after approximately 2 minutes the relay will automatically return to the normal mode (blank display) if no activity is noted on the front pushbuttons.

4.15 Reset

There are three ways in which to reset the *MRM10* relay:

Hand reset
By pressing the <SELECT/RESET> pushbutton for approximately 3 s the relay is reset.

Auto-reset at power up
After loss of supply voltage and upon its reconnection the unit resets itself and displays |SEG. This resetting of the unit does not effect the set parameters which are stored in an EEPROM.

Automatic reset
Refer to reset matrix (chapter 4.9).

4.16 DIP-switch settings

DIP- switch	Function
1	reserved
2	phase sequence trip, on = trip
3	single-phase/three-phase motor, on = single phase
4	reserved
5	reserved
6	Statistical data reset, on = clear all statistical data only
7	Statistical data and parameter reset, on = clear all statistical data set defaults
8	Lamp test, on = flash all LEDs with a blank display
9	reserved
10	reserved

Table 4.13: DIP-switch settings

Phase sequence trip enables checking of the phase rotation, sequence should be L1, L2, L3.

Single phase operation allows undercurrent trips on one phase (L1), in 3-phase operation use undercurrent is based on the lowest of the 3 phase currents.

Statistical reset (on power up) will clear down the following data:
- number of starts
- hours run
- thermal capacity
- start thermal
- start time
- trip currents / % load
- trip record/last fault
- start since trip
- start to trip time

No other parameters are altered.

5 Housing

The *MRM10* can be supplied in an individual housing for flush-mounting or as a plug-in module for installation in a 19" mounting rack according to DIN 41494. Both versions have plug-in connections.
Relays of variant D are complete devices for flush mounting, whereas relays of variant A are used for 19" rack mounting. Housing variant A to be installed in switchboards of protection class IP51. For switchboards of lower protection classes housing variant D can be used.

5.1 Individual housing

The individual housing of the *MRM10* is constructed for flush-mounting. The dimensions of the mounting frame correspond to the requirements of DIN 43700 (72 x 144 mm). The cut-out for mounting is 68 x 138 mm.

The front of the *MRM10* is covered with a transparent, sealable flap (IP54).

The individual housing is fixed with the supplied clasps from the rear of the switchboard panel.

5.2 Rack mounting

The *MRM10* is in general suitable for installation in a modular carrier according to DIN 41494. The installation dimensions are: 12 TE; 3 HE.

According to requirements, the *MRM10*-devices can be delivered mounted in 19" racks.

5.3 Terminal connections

The plug-in module has a very compact base with plug connectors and screw-type connectors.

- max. 15 poles screw-type terminals for voltage and current circuits (terminal connectors series A and B with a short time current capability of 500 A / 1 s).
- 27 poles tab terminals, supply voltage etc.(terminal connectors series C, D and E, max. 6 A current carrying capacity). Connection with tabs 6.3 x 0.8 mm for cable up to max. 1.5 mm^2 or with tabs 2.8 x 0.8 mm for cable up to max. 1 mm^2.

By using 2.8 x 0.8 mm tabs a bridge connection between different poles is possible.
The current terminals are equipped with self-closing short-circuit contacts. Thus, the *MRM10*-module can be unplugged even with current flowing, without endangering the current transformers connected.

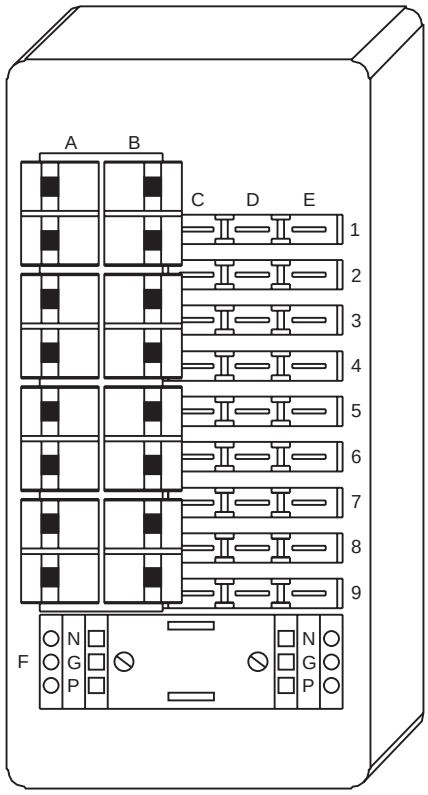


Fig. 5.1: Terminal block

6 Technical Data

Phase current energising inputs
Rated current: 1 A / 5 A
Thermal withstand capability
in current circuit:

Dynamic current current withstand (half wave)		250 x I_N
for 1 s		100 x I_N
for 10 s		30 x I_N
continous		4 x I_N
Input burden:	at I_N = 1 A	0.1 VA
	at I_N = 5 A	0.2 VA
Frequency range:	40 -70 Hz	

Thermal overload protection function

Range of FLC setting:	0.5 - 1.25 x primary Setting
Range of t6x setting:	1 - 120 s
Pre trip alarm level:	50 -100 % of thermal capacity
Cooling time factor:	variable

Negative phase sequence protection function

NPS:	15 % or 30 % of pickup	
for 15 % pickup:	15 % NPS	20 s
	30 % NPS	5 s
	57 % NPS	1.5 s

Phase reversal function

Expected rotation:	L1, L2, L3

High set overcurrent protection function

High set setting:	2 - 12 x I_N
High set time:	0 - 1 s or OFF

Undercurrent protection function

Range of setting:	20 - 100 % of FLC
Undercurrent time:	1 - 120 s

Earth fault protection

Range of setting:	5 - 40 % of I_N
Earth fault time:	0 - 1 s

Auxiliary voltage

Rated aux. voltage U_H:	working range	16 - 270 V AC / 16 - 360 V DC
Power consumption:	quiescent approx. 3 W	operating approx. 6 W
	quiescent approx. 3 W	operating approx. 6 W

Output relays

max. breaking capacitiy: 250 V AC / 1500 VA / continuous current 6 A
max. breaking capacitiy
for DC voltage:

	ohmic	L/R = 40 ms	L/R = 70 ms
300 V DC	0.3 A / 90 W	0,2 A / 63 W	0,18 A / 54 W
250 V DC	0.4 A / 100 W	0,3 A / 70 W	0,15 A / 40 W
110 V DC	0.5 A / 55 W	0,4 A / 40 W	0,2 A / 22 W
60 V DC	0.7 A / 42 W	0,5 A / 30 W	0,3 A / 17 W
24 V DC	6 A / 144 W	4,2 A / 100 W	2,5 A / 60 W

Max. rated making current:	64 A (VDE 0435/0972 and IEC 65 / VDE 0860/8.86)
Making current:	min. 20 A (16 ms)
mech. life span:	30×10^6 operating cycles
electrical life span:	2×10^5 operating cycles at 220 V AC / 6 A
Contact material:	silver-cadmium-oxide (AgCdO)

Specified ambient service

• Storage temperature range:	- 40°C to +85°C
• Operating temperature range:	- 20°C to +70°C

GL-Approbation: 99 359-97 HH

6.1 Setting ranges and steps

Function	Tolerance
Thermal curve Time delay at 6 x FLC	±3% of setting ±3% or ±40 ms
I> Time delay $t_{I>}$	±3% of setting ±3% or ±40 ms
I>> Time delay $t_{I>>}$	±3% of setting above 2 x I_N ±10% at 2 x I_N ±3% or ±40 ms
I_E Time delay $t_{IE>}$	±3% of setting ±3% or ±40 ms

Minimum operating time or settings below 50 ms, typical 70-80 ms

6.2 Characteristic curve

The *MRM10* simulates the thermal condition of the motor by means of a thermal register. The heating of the register is related to the square of the largest of the three line currents. The rate of cooling of the thermal register is directly related to the rate of heating. The value of the thermal register is called thermal capacity and it is used to simulate motor temperature.

100 % thermal capacity means the motor temperature has reached the maximum allowed and is the level at which an overload trip will occur.

When the motor is stopped for a long period of time, the thermal capacity used is zero. This is known as the "cold condition" and the motor has 100 % of its thermal capacity available for heating before a trip occurs.

When a motor starts and is running, its temperature increases. After running at normal FLC for a period of time, the motor will have reached a hot condition and a lower value of thermal capacity will be available. The thermal reserve (remaining thermal capacity) called K_{HC} at previous operation with FLC is a characteristic value of the respective motor. A value of K_{HC} = 20 % means that a motor loaded with FLC has still 20 % of his thermal capacity. The trip delay at overload will be calculated as follows:

$$\frac{t}{t_{6x}} = 32 \cdot \ln\left[\frac{I^2 - \left(1 - K_{HC}\right) \cdot I^2_{preload}}{\left(I^2 - IB^2\right)}\right]$$

Where: t = Trip delay
t_{6x} = Trip delay at 6 x FLC
I = Overload current/FLC
$I_{preload}$ = Current before overload/FLC
I_{MN} = Full Load Current (FLC)
K_{HC} = Hot / cold ratio
IB = Overcurrent pickup value (1.05)

Curve	Type	Overload setting	Hot/ cold ratio	FLC before overload
1	Cold curve	105 %	100 %	
2	Hot curve	105 %	80 %	100 %
3	Hot curve	105 %	50 %	100 %
4	Hot curve	105 %	20 %	100 %

Table 6.1: Setting values acc. to figure 6.1

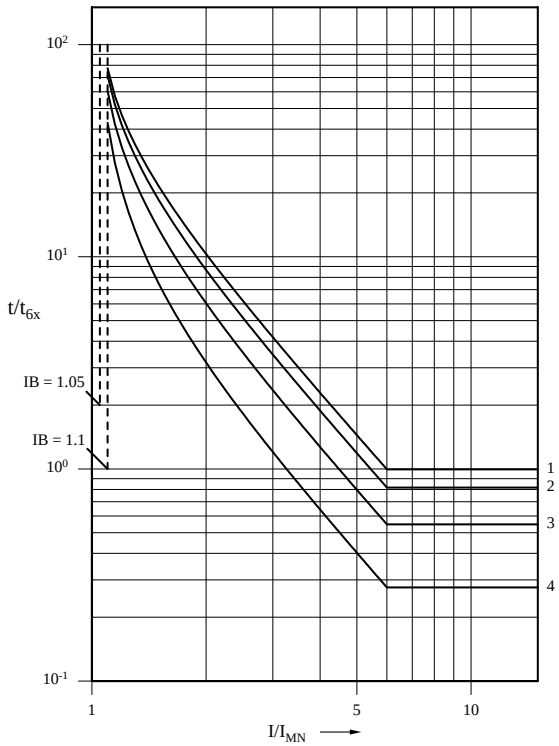


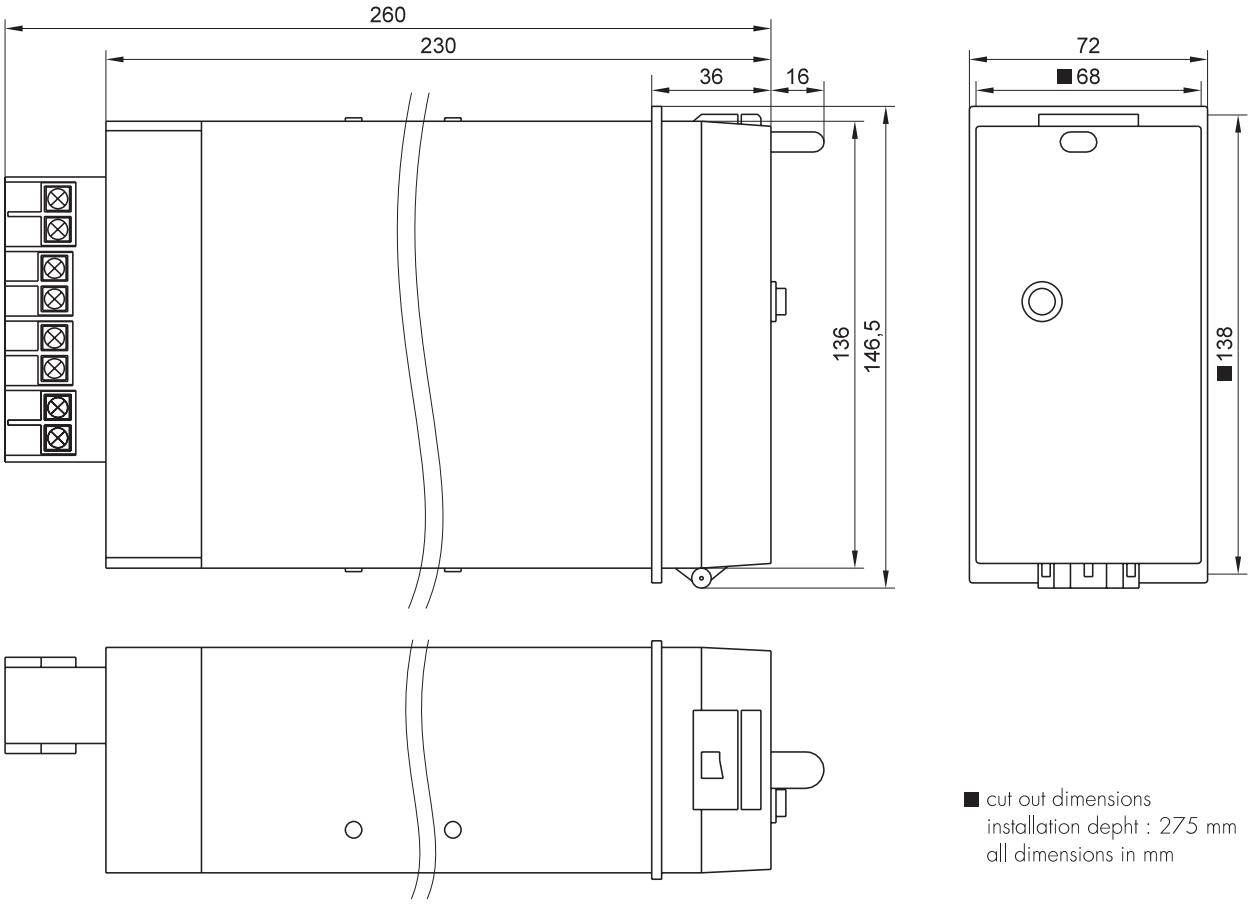
Figure 6.1: Tripping characteristics overload setting 105 %

Measuring range of > 6 x FLC for thermal characteristic, above which time delay is definite time. This time corresponds to an overload of 6 times FLC. The given equation is not valid for currents above 6 x FLC.
When the running current exceeds the overload setting, the thermal capacity will eventually reach 100 % and trip the motor. The time taken depends on the present value of thermal capacity used and the t6x setting, which is set as the time to trip for a motor in cold condition when the current is at 6 times the motor rated FLC. The heating constant is equal to t6x setting x 32 seconds.

The cooling time constant of a motor, i.e. the time taken for its temperature to drop, is usually much longer than the heating constant. The Cool Time Factor setting determines the rate of cooling and is set as a ratio of the heating time factor between 1 and 15times the heating factor. The higher the value of this setting, the longer it will take for the thermal capacity to reduce to the 50% level required to enable a restart.

Providing the motor running current does not exceed the overload setting (e. g. 105% FLC default), the thermal capacity used will never reach 100 % and therefore will never trip on overload.

Dimension diagram



Please observe!

A distance of 50 mm is necessary when the units are mounted one below the other for the front cover to be easily opened. The front cover can be opened downwards.

7 Order form

Motor protection Relay	***MRM10 -***		
Rated Current:			
1 A Phase current, 1 A Earth current	**11**		
5 A Phase current, 5 A Earth current	**55**		
5 A Phase current, 1 A Earth current	**51**		
Earth fault current:			
5 – 40 % of I_N		**E**	
1 – 5 % of I_N		**X**	
Housing (12TE):			
19"-rack			**A**
Flush mounting			**D**

Setting-list *MRM10*

Project: _____ SEG job.-no.: _____

Function group: = _____ Location: + _____ Relay code: - _____

Relay functions: _____ Password: _____

Date: _____

Parameter	Setting range	Step	Default settings	Actual settings
t6x setting	1 - 120 s	1 s	10 s	
Full load current FLC	0.5 - 1.25 x C.T. primary (A)	0.01 or 0.05	1.00 (A)	
C.T. primary setting	0.5 - 9.5 10 - 2500 A	0.5A 5 A	1.0 (A) or 5 A	
Hot / cold ratio	20 - 80%	10%	50%	
Thermal O/L pre-alarm	OFF, 50 - 99%	1%	90%	
Earth Fault current , % I_N	OFF, 5 - 40%	1%	OFF	
Earth fault time	0,0 - 1.0 s	0.1 s	0.1 s	
NPS current, % FLC	OFF, 15%, 30%		15%	
Low set O/C, % FLC	OFF, 200%, 300%, 400%		OFF	
Low set O/C time	0.5 - 5 s	0.5 s	0.5 s	
High set O/C x I_N	OFF, 2.0 - 12 x I_N	0.5 x I_N	OFF	
High set O/C time	0.0 - 1.0 s	0.1 s	0.1 s	
Undercurrent, % FLC	OFF, 20 - 95%	5%	OFF	
Undercurrrent time	1 - 120 s	1 s	30 s	
Number of starts/hr	OFF, 1 - 20	1	OFF	
Start inhibit time	1 - 60 min	1 min	10 min	
Set password	any 4 characters		++++	
Serial link address	OFF, 1 - 32	1	OFF	
Set trip relay action	0 - 255		T255	
Set program. relay	0 - 255		P254	
Set alarm relay action	0 - 255		A255	
Set E/Fault parameters	0 - 255		E000	
Set trip reset action	0 or 129 - 255		R000	
Set thermal O/L curve	0 - 255		C008	
Set speed switch	0 - 255		S000	
Advanced matrix 1	3 - 12, 131 - 140		X003	
Advanced matrix 2	0 - 127 or 128 - 255		Y000	

Schaltanlagen-Elektronik-Geräte GmbH & Co. KG
Abteilung Gerätevertrieb / Electronic Devices Sales Department
Krefelder Weg 47 · D - 47906 Kempen (Germany)
Postfach 10 07 67 (P.O.B.) · D - 47884 Kempen (Germany)
Tel.: +49 (0)21 52 1 45-1 · Fax.: +49 (0)21 52 1 45-3 54
e-mail: electronics@avkseg.com