

## VARIMETER

### Current Relay

BA 9053, MK 9053N



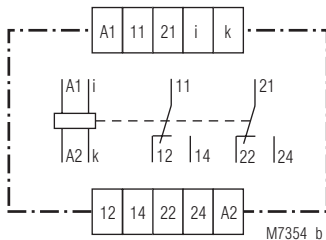
#### Your Advantages

- Preventive maintenance
- For better productivity
- Quicker fault locating
- Precise and reliable

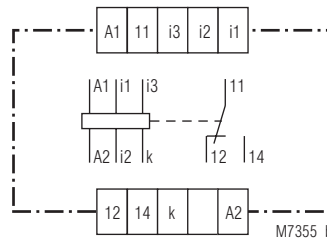
#### Features

- According to IEC/EN 60 255-1, IEC/EN 60 947-1
- to: monitor DC and AC
- BA 9053 with measuring ranges from 2 mA to 25 A
- BA 9053 optionally with 3 measuring ranges 0.1 up to 25 A
- MK 9053N with measuring ranges from 2 mA up to 10 A
- High overload possible
- Input frequency up to 5 kHz
- Galvanic separation between auxiliary circuit - measuring circuit
- Auxiliary supply AC/DC; BA 9053 with AC
- BA 9053 optionally with start-up delay (MK = standard)
- with time delay, up to max. 100 sec
- BA 9053 optionally with safe separation to IEC/EN 61 140
- MK 9053N optionally with remote potentiometer
- As option with manual reset
- Option with fixed settings possible
- LED indicators for operation and contact position
- MK 9053N as option with pluggable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- Width BA 9053: 45 mm
- Width MK 9053N: 22.5 mm

#### Circuit Diagrams

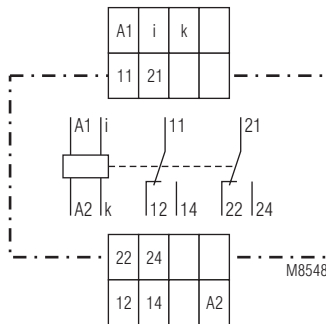


BA 9053

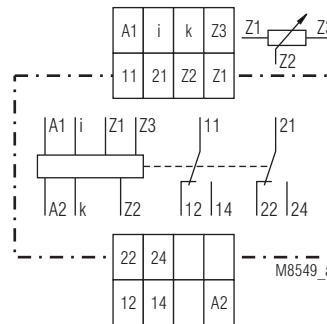


BA 9053/4\_\_ z. B.:

- Terminals i1/k: 0.1 ... 1 A
- Terminals i2/k: 0.5 ... 5 A
- Terminals i3/k: 1 ... 10 A



MK 9053N



MK 9053N/1\_\_

#### Connection Terminals

Terminal designation	Signal description
A1, A2	Auxiliary voltage
i, k	Current measuring input
11, 12, 14	1st changeover contact
21, 22, 24	2nd changeover contact
at MK 9053/1__: Z1, Z2, Z3	Remote potentiometer for response value

#### Safety Notes

**Please observe when connecting a remote potentiometer to MK 9053N/1\_\_:**



Measuring circuit and remote potentiometer not galvanically separated. The voltage on on measuring circuit i, k / PE has connection to the remote potentiometer. The remote potentiometer has to be connected volt- and ground-free.

#### Approvals and Markings



\* see variants

#### Applications

- Monitoring current in AC or DC systems
- For industrial and railway applications

#### Function

The relays measure the arithmetic mean value of the rectified measuring current. The AC units are adjusted to the r.m.s value. They have settings for response value and hysteresis. The units work as overcurrent relays but can also be used for undercurrent detection. The hysteresis is dependent on the response value.

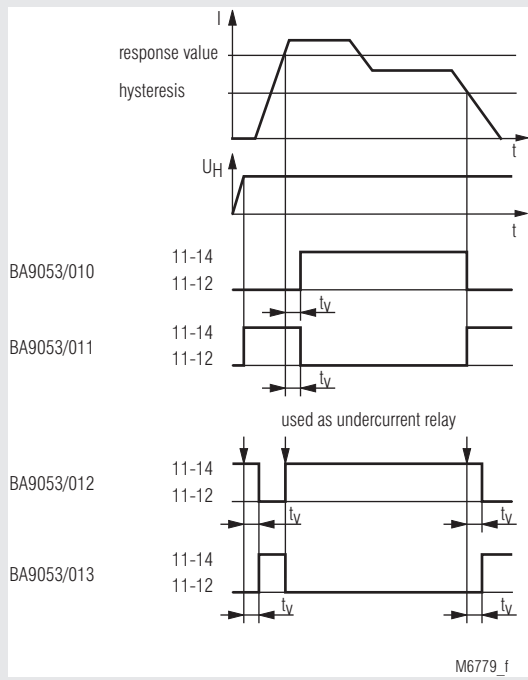
2 time delays are possible in different variants:

The start up delay  $t_a$  operates only when connecting the auxiliary supply. It disables tripping e.g. caused by an increased starting current of a motor. The response delay  $t_v$  is active after exceeding a response value. On overcurrent relays the delay is active when the current goes over the tripping value, on undercurrent relays when the current drops below the hysteresis value.

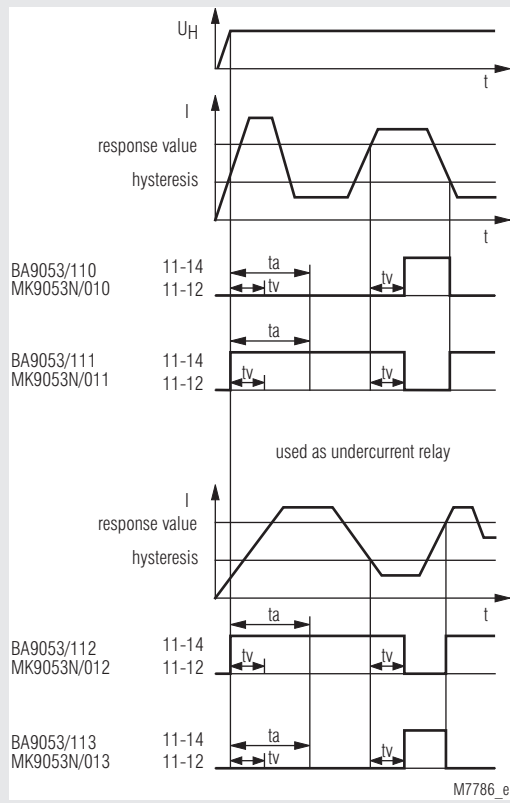
#### Indicators

- green LED: on, when auxiliary supply connected
- yellow LED: on, when output relay activated

### Function Diagram without Start-up Delay



### Function Diagram with Start-up Delay



On model BA 9053/6\_ \_ with manual reset the contacts remain in the fault state after detecting a fault or after  $t_a$  has elapsed. The contacts are reset by disconnecting the supply voltage.

## Technical Data

### Input (i, k)

BA 9053 for AC <b>and</b> DC					
Measuring range <sup>*)</sup>		RM (internal measuring resistor (shunt))	max. perm. cont. current		max. perm. current 3 s On, 100 s Off
AC	DC		Device mounted without distance		
2 - 20 mA	1.8 - 18 mA	1.5 Ω	0.7 A		1 A
20 - 200 mA	18 - 180 mA	0.15 Ω	2 A		4 A
30 - 300 mA	27 - 270 mA	0.1 Ω	2.5 A		8 A
50 - 500 mA	45 - 450 mA	0.1 Ω	2.5 A		8 A
80 - 800 mA	72 - 720 mA	40 mΩ	4 A		12 A
0.1- 1 A	0.09 - 0.9 A	30 mΩ	4 A		12 A
0.5- 5 A	0.45 - 4.5 A	6 mΩ	10 A		30 A
1 - 10 A	0.9 - 9 A	3 mΩ	20 A		40 A
1.5- 15 A	1.35 - 13.5 A	3 mΩ	25 A		40 A
2 - 20 A	1.8 - 18 A	3 mΩ	25 A		40 A
2.5 - 25 A	2.25 - 22.5 A	3 mΩ	25 A		40 A

\* DC or AC current 50 ... 5000 Hz  
(other frequency ranges of 10 ... 5000 Hz, e.g. 16 <sup>2</sup>/<sub>3</sub> Hz on request)

BA 9053/4 __ with 3 measuring ranges:			
Range:	Terminals i1/k	Terminals i2/k	Terminals i3/k
AC 20 mA / 200 mA / 1A:	AC 2.0 ... 20 mA	AC 20 ... 200 mA	AC 0.1 ... 1 A
	DC 1.8 ... 18 mA	DC 18 ... 180 mA	DC 0.09 ... 0.9 A
AC 1 / 5 / 10A:	AC 0.1 ... 1 A	AC 0.5 ... 5 A	AC 1.0 ... 10 A
	DC 0.09 ... 0.9 A	DC 0.45 ... 4.5 A	DC 0.9 ... 9 A
AC 5 / 10 / 25A:	AC 0.5 ... 5 A	AC 1.0 ... 10 A	AC 2.5 ... 25 A
	DC 0.45 ... 4.5 A	DC 0.9 ... 9 A	DC 2.25 ... 22.5 A

MK 9053N with 1 Measuring range for AC <b>and</b> DC					
Measuring range <sup>*)</sup>		RM (internal measuring resistor (shunt))	max. perm. cont. current		max. perm. current 3 s On, 100 s Off
AC	DC		Device mount. without distance	with 5 mm distance	
2 - 20 mA	1.8 - 18 mA	1.5 Ω	0.5 A	0.7 A	1 A
20 - 200 mA	18 - 180 mA	0.15 Ω	1.5 A	2 A	4 A
30 - 300 mA	27 - 270 mA	0.1 Ω	2 A	2.5 A	8 A
50 - 500 mA	45 - 450 mA	0.1 Ω	2 A	2.5 A	8 A
0.1- 1 A	0.09 - 0.9 A	30 mΩ	3 A	4 A	8 A
0.5- 5 A	0.45 - 4.5 A	6 mΩ	8 A	11 A	20 A
1 - 10 A	0.9 - 9 A	3 mΩ	12 A	15 A	20 A

\* DC or AC current 50 ... 5000 Hz  
(Other frequency ranges of 10 ... 5000 Hz, e.g. 16 <sup>2</sup>/<sub>3</sub> Hz on request)

### Extending of measuring range:

For DC-current higher then the highest measuring range the current relay BA 9053 or MK 9053N measuring range 15 ... 150 mV or 6 ... 60 mV can be used with external Shunt.

For AC current higher then the highest measuring range can be used a current transformer e. g. with secondary winding of 1 A or 5 A together with BA 9053 or MK 9053N. The nominal load of the CT should be ≥ 0.5 VA.

### Measuring principle:

arithmetic mean value

### Adjustment:

The AC - devices can also monitor DC current. The scale offset in this case is:

$$(I = 0.90 I_{\text{eff}})$$

### Temperature influence:

$$< 0.05 \% / K$$

## Technical Data

### Setting Ranges

#### Setting

Response value: infinite variable 0.1 I<sub>N</sub> ... 1 I<sub>N</sub>  
relative scale

#### Hysteresis

at AC: infinite variable 0.5 ... 0.98 of setting value  
at DC: infinite variable 0.5 ... 0.96 of setting value

#### Accuracy:

Response value at

Potentiometer right stop (max): 0 ... + 8 %

Potentiometer left stop (min): - 10 ... + 8%

**Repeat accuracy:** ≤ ± 0.5 %

#### Recovery time

at devices with manual reset

(Reset by braking

of the auxiliary voltage)

BA 9053/6 \_\_; MK 9053N/6 \_\_: ≤ 1 s

(dependent to function and auxiliary voltage)

#### Time delay t<sub>d</sub>:

infinite variable at logarithmic scale

from 0 ... 20 s, 0 ... 30 s, 0 ... 60 s, 0 ... 100 s  
setting 0 s = without time delay

#### Start-up delay t<sub>a</sub>:

BA 9053/1 \_\_:

1 ... 20 s; 1 ... 60 s; 1 ... 100 s,

adjustable on logarithmic scale.

t<sub>a</sub> is started when the supply voltage

is connected. During elapse of time

the output contact is in good state

MK 9053N:

0.1 ... 20 s; 0.1 ... 60 s; 0.1 ... 100 s

### Auxiliary Circuit BA 9053 and MK 9053N

#### Auxiliary voltage U<sub>H</sub> (A1, A2)

BA 9053, Nominal voltages: AC 24, 42, 110, 127, 230, 400 V

**Voltage range:** 0.8 ... 1.1 U<sub>H</sub>

**Nominal frequency:** 50 / 60 Hz

**Frequency range:** ± 5 %

**Nominal consumption:** 2.5 VA

BA 9053:		
Nominal voltage	Voltage range	Frequency range
AC/DC 24 ... 80 V	AC 18 ... 100 V	45 ... 400 Hz; DC 48 % W
	DC 18 ... 130 V	W ≤ 5 %
AC/DC 80 ... 230 V	AC 40 ... 265 V	45 ... 400 Hz; DC 48 % W
	DC 40 ... 300 V	W ≤ 5 %
DC 12 V	DC 10 ... 18 V	battery voltage

MK 9053N:		
Nominal voltage	Voltage range	Frequency range
AC/DC 24 ... 80 V	AC 18 ... 100 V	45 ... 400 Hz; DC 48 % W
	DC 18 ... 130 V	W ≤ 5 %
AC/DC 80 ... 230 V	AC 60 ... 265 V	45 ... 400 Hz; DC 48 % W
	DC 60 ... 300 V	W ≤ 5 %

#### Nominal consumption:

4 VA; 1.5 W at AC 230 V Rel. energized  
1 W at DC 80 V Rel. energized

## Technical Data

### Output

#### Contacts

BA 9053:	2 changeover contacts
MK 9053N:	2 changeover contacts

#### Thermal current $I_{th}$ :

BA 9053:	2 x 5 A
MK 9053N:	2 x 4 A

#### Switching capacity

BA 9053 to AC 15:		
NO contact:	2 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
MK 9053N to AC 15:	1.5 A / AC 230 V	IEC/EN 60 947-5-1
BA 9053, MK 9053N to DC 13:	1 A / DC 24 V	IEC/EN 60 947-5-1

#### Electrical life

BA 9053 to AC 15 at 3 A, AC 230 V:	5 x 10 <sup>5</sup> switch. cycl.	IEC/EN 60 947-5-1
MK 9053N to AC 15 at 3 A, AC 230 V:	10 <sup>5</sup> switching cycles	IEC/EN 60 947-5-1

#### Short-circuit strength

<b>max. fuse rating:</b>	6 A gG (gL)	IEC/EN 60 947-5-1
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#### Mechanical life

BA 9053:	50 x 10 <sup>6</sup> switching cycles
MK 9053N:	30 x 10 <sup>6</sup> switching cycles

## General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	
BA 9053 (operation):	
≤ 10 A:	- 40 ... + 60°C
≥ 15 A:	- 40 ... + 50°C (higher temperature with limitations on request)
MK 9053N (operation):	
	- 20 ... + 50°C (higher temperature with limitations on request)
BA 9053, MK 9053N (storage):	- 40 ... + 70°C
<b>Altitude:</b>	< 2,000 m

#### Clearance and creepage distances

rated impulse voltage / pollution degree		
BA 9053 meas. range ≤ 10 A:	6 kV / 2	IEC 60 664-1
BA 9053 meas. range ≥ 15 A:	4 kV / 2	IEC 60 664-1
MK 9053N:	4 kV / 2	IEC 60 664-1

#### EMC

Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation		
80 MHz ... 1 GHz:	20 V/m	IEC/EN 61 000-4-3
1 GHz ... 2.7 GHz:	10 V/m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltages between		
wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
HF wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011

#### Degree of protection

Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529

#### Housing:

Thermoplastic with V0 behaviour  
according to UL subject 94

#### Vibration resistance:

Amplitude 0.35 mm IEC/EN 60 068-2-6  
frequency 10 ... 55 Hz

#### Climate resistance

BA 9053		
≤ 10 A:	40 / 060 / 04	IEC/EN 60 068-1
≥ 15 A:	40 / 050 / 04	IEC/EN 60 068-1
MK 9053N:	20 / 060 / 04	IEC/EN 60 068-1

#### Terminal designation:

EN 50 005

## Technical Data

### Wire connection

BA 9053:	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve
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### MK 9053N:

#### Screw terminals (integrated):

	1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated) or 2 x 1.5 mm <sup>2</sup> stranded ferruled (isolated) or 2 x 2.5 mm <sup>2</sup> solid
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Insulation of wires or sleeve length:	8 mm
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#### Plug in with screw terminals

max. cross section for connection:	1 x 2.5 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated)
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Insulation of wires or sleeve length:	8 mm
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#### Plug in with cage clamp terminals

max. cross section for connection:	1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated)
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min. cross section for connection:	0.5 mm <sup>2</sup>
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Insulation of wires or sleeve length:	12 ±0.5 mm
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#### Wire fixing:

BA 9053:	Plus-minus terminal screws M3.5 with self-lifting clamping piece IEC/EN 60 999-1
MK 9053N:	Plus-minus terminal screws M3.5 box terminals with wire protection or cage clamp terminals

<b>Stripping length:</b>	10 mm
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<b>Fixing torque:</b>	0.8 Nm
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<b>Mounting:</b>	DIN-rail
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#### Weight

BA 9053:	AC-device: 280 g AC/DC-device: 200 g
MK 9053N:	150 g

## Dimensions

### Width x height x depth

BA 9053:	45 x 75 x 120 mm
MK 9053N:	22.5 x 90 x 97 mm

## Classification to DIN EN 50155 for BA 9053

### Vibration and

**shock resistance:** Category 1, Class B IEC/EN 61 373

**Ambient temperature:** T1, T2 compliant  
T3 and TX with operational limitations

**Protective coating of the PCB:** No

## UL-Data

### Auxiliary voltage $U_H$ (A1, A2)

BA 9053: AC 24, 42, 48, 110, 115, 120 V

### Thermal current $I_{th}$ :

BA 9053: 2 x 5 A

MK 9053N: 2 x 4 A

### Clearance and creepage distances

BA 9053, MK 9053N: 4 kV / 2 IEC 60 664-1

### HF irradiation

BA 9053 (80 MHz ... 2.7 GHz) 10 V/m IEC/EN 61 000-4-3

**Switching capacity:** Pilot duty B150

**Ambient temperature:** - 40 ... + 60°C



Technical data that is not stated in the UL-Data, can be found in the technical data section.

## CCC-Data

### Switching capacity

to AC 15: 1.5 A / AC 230 V IEC/EN 60 947-5-1

to DC 13: 1 A / DC 24 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Type

BA 9053/010 AC 0.5 ... 5 A AC 230 V

Article number: 0053128

- for Overcurrent monitoring
- Measuring range: AC 0.5 ... 5 A
- Auxiliary voltage  $U_H$ : AC 230 V
- Time delay by  $I_{an}$ : 0 ... 20 s
- Width: 45 mm

BA 9053/012 AC 0.5 ... 5 A AC 230 V

Article number: 0053192

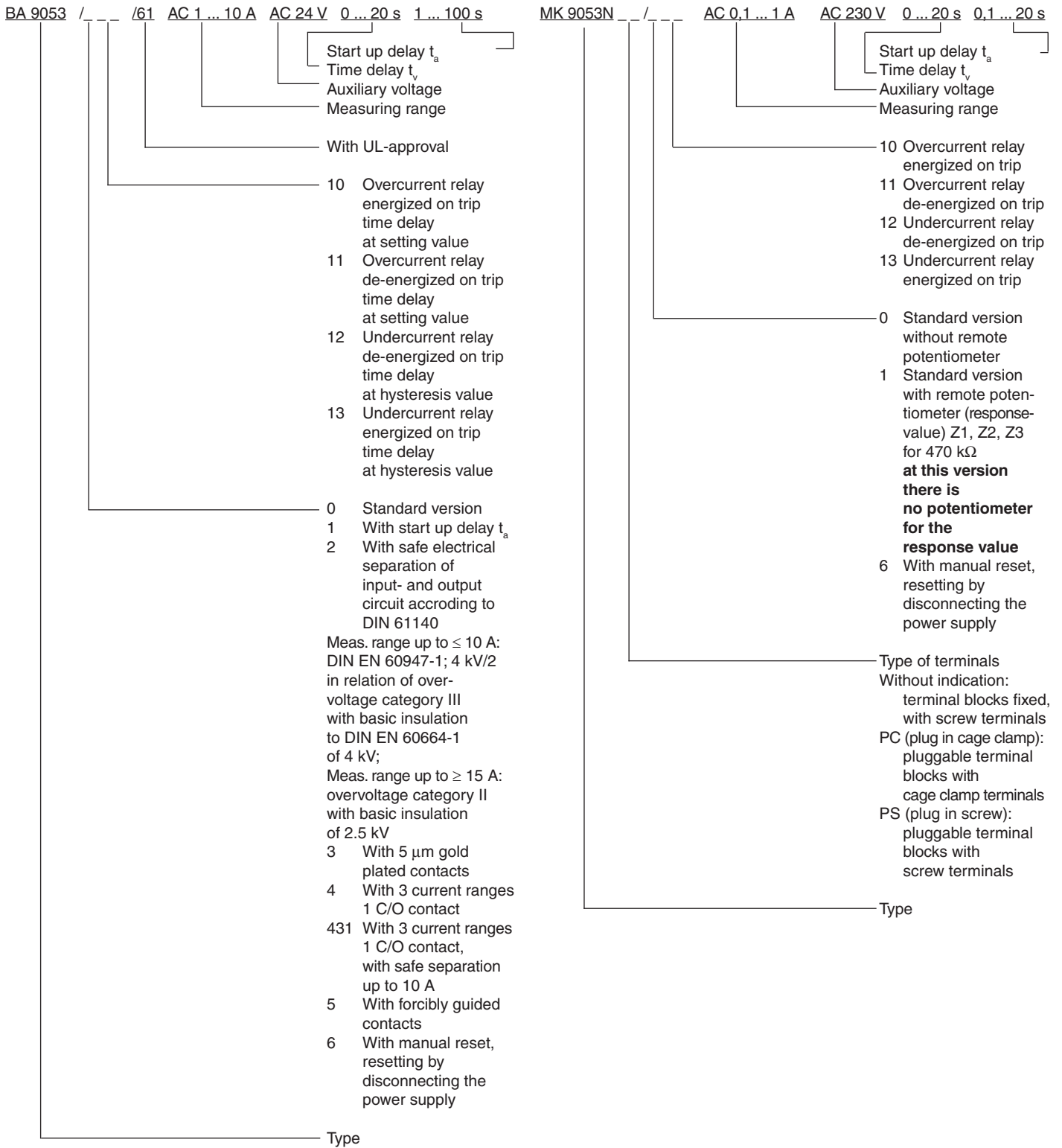
- for Undercurrent monitoring
- Measuring range: AC 0.5 ... 5 A
- Auxiliary voltage  $U_H$ : AC 230 V
- Time delay by  $I_{ab}$ : 0 ... 20 s
- Width: 45 mm

MK 9053N.12/010 AC 0.5 ... 5 A AC/DC 80 ... 230 V  $t_v$  0 ... 20 s  $t_a$  0.1 ... 20 s

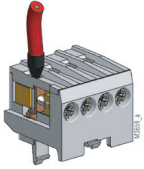
Article number: 0063176

- for Overcurrent monitoring
- Measuring range: AC 0.5 ... 5 A
- Auxiliary voltage  $U_H$ : AC/DC 80 ... 230 V
- Time delay by  $t_v$ : 0 ... 20 s
- Start up delay  $t_a$ : 0.1 ... 20 s
- Width: 22.5 mm

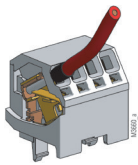
Ordering Example for Variants



## Options with Pluggable Terminal Blocks



Screw terminal  
(PS/plugin screw)

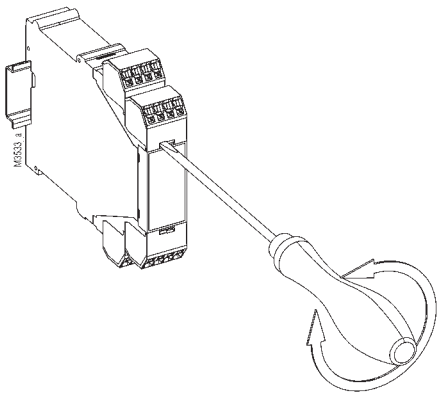


Cage clamp  
(PC/plugin cage clamp)

## Notes

Removing the terminal blocks with cage clamp terminals

1. The unit has to be disconnected.
2. Insert a screwdriver in the side recess of the front plate.
3. Turn the screwdriver to the right and left.
4. Please note that the terminal blocks have to be mounted on the belonging plug in terminations.



## Accessories

AD 3: Remote potentiometer 470 K $\Omega$   
Article number: 0050174

## Setting

Example:  
Current relay BA 9053 / MK 9053N AC 0.5 ... 5 A

AC according to type plate:  
i.e. the unit is calibrated for AC  
0.5 ... 5 A = measuring range

Response value AC 3 A  
Hysteresis AC 1.5 A

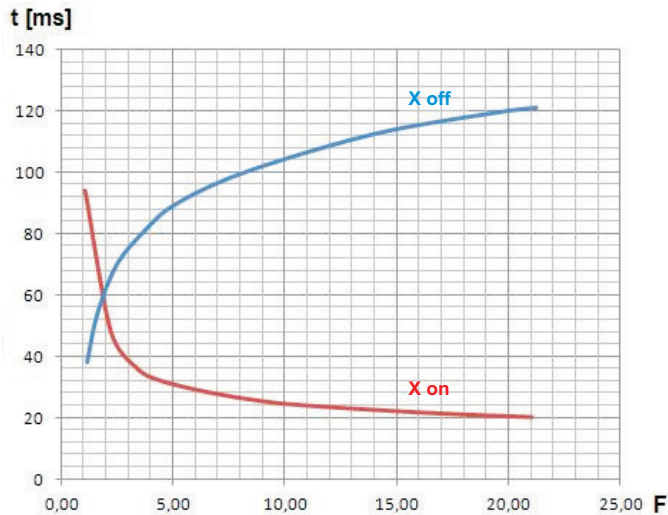
Settings:  
upper potentiometer: 0.6 (0.6 x 5 A = 3 A)  
lower potentiometer: 0.5 (0.5 x 3 A = 1.5 A)

The AC - devices can also monitor DC current. The scale offset in this case is:  $\bar{I} = 0.90 \times I_{\text{eff}}$

AC 0.5 ... 5 A is equivalent to DC 0.45 ... 4.5 A

Response value DC 3 A  
Hysteresis DC 1.5 A

Settings:  
upper potentiometer: 0.66 (0.66 x 4.5 A = 3 A)  
lower potentiometer: 0.5 (0.5 x 3 A = 1.5 A)



M11504 a

**Time delay of measuring circuit**

X on: Measured value rise  $F = \frac{\text{Measured value (after rise of measured value)}}{\text{Setting value}}$

X off: Measured value drops  $F = \frac{\text{Measured value (before measured value drops)}}{\text{Setting value (hysteresis)}}$

The diagram shows the typical delay of a standard devices depending on the measured values "X on and X off" at sudden rise or drop of the signal. At slow change of the measured value the delay is shorter. The total reaction time of the device results from the adjustable delay  $t_d$  and the delay created by the measuring circuit.

The diagram shows an average delay. The delay times could differ on the different variants.

**Example for "X on" (overcurrent detection with BA9053/010):**

Adjusted setting value X on = 2 A.

Due to a stalled motor the current rises suddenly to 10 A.

$$F = \frac{\text{Measured value (after rise of measured value)}}{\text{Setting value}} = \frac{10 \text{ A}}{2 \text{ A}} = 5$$

Reading from the diagram:

The output relay switches on after 31 ms at a setting  $t_d=0$ .

**Example for "X off" (undercurrent detection with BA9053/012):**

Adjusted hysteresis setting value is 10 A.

The current drops suddenly from 23 A to 0 A.

$$F = \frac{\text{Measured value (before measured value drops)}}{\text{Setting value (hysteresis)}} = \frac{23 \text{ A}}{10 \text{ A}} = 2.3$$

Reading from the diagram:

The output relay switches off after 70 ms at a setting  $t_d=0$ .