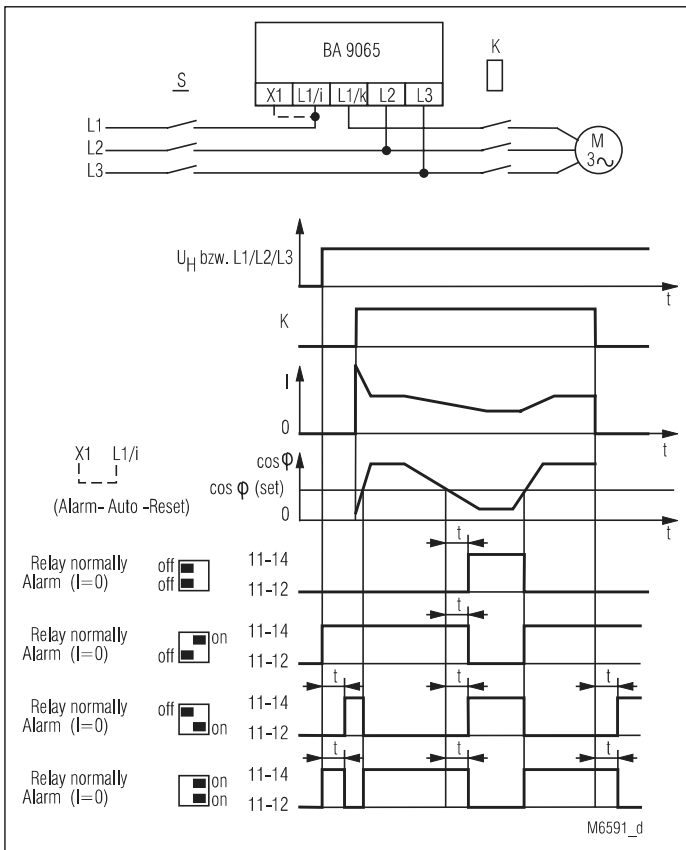


## Underload monitor (cos φ) BA 9065 varimeter



- According to IEC 255, EN 60 255, VDE 0435
- Detection of underload (cos φ)
- Current ranges up to 10 A, for higher values a CT must be used
- Adjustable response value
- Programmable functions:
  - alarm when I = 0
  - automatic or manual reset
  - closed or open circuit operation
- Manual remote reset
- Adjustable operate delay
- Independent of phase sequence
- Also for 400 Hz systems
- Optionally for motors with frequency converters (10 ... 100 Hz) (see notes)
- Width 45 mm

### Function diagram



### Approvals and marking



### Applications

- Monitors underload and no load on squirrel cage motors e.g.
- fan monitoring (broken belt)
- filter monitoring (blocked filter)
- pump monitoring (blocked valve, dry running)

### Function

The underload monitor BA 9065 measures the phase shift between voltage and current. The phase angle changes with changing load. This measuring method is suitable to monitor asynchronous motors on underload and no load independent of motor size. The change of cos φ has to be bigger than the hysteresis of the monitor (see diagram). In some cases the cos φ does not change much with load change on the motor, e.g.:

- small load change on oversized motor
  - single phase chaded-pole and collector motors
- In these cases we recommend the use of motor load monitor BA 9067. The BA 9065 can also be used on systems with variable frequency because of it's frequency independent measuring principle. The BA 9065.20 does not need a separate auxiliary supply as it takes the required energy from the monitored mains. A yellow LED indicates operation. If the cos φ goes under the setting value the device reacts after a settable time delay. A green LED shows the state of the output relay.

Functions programmable with DIP-switches:

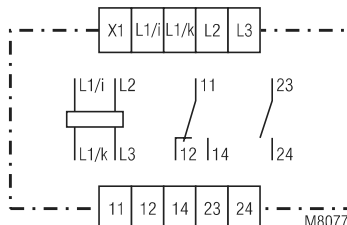
- open circuit operation (relay normally off)
- alarm when no current is flowing (Alarm at I = 0 on)
- closed circuit operation (relay normally on)
- no alarm when no current is flowing (Alarm at I = 0 off)

Function programmable with bridge X1-L1/i:

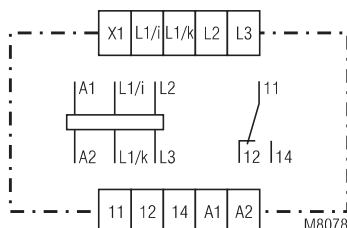
bridge  
X1-L1/i

- manual reset, reset with built-in reset button or remote reset with button connected to X1-L1/i
- Automatic reset when system returns to correct load (cos φ)

### Circuit diagram



BA 9065.20



BA 9065.11/001

## Notes

To terminal X1 only the potential of L1/i must be connected.  
When setting the response value on BA 9065 with frequency converters please note that the  $\cos \varphi$  of the motor changes with the frequency. The measurement of the  $\cos \varphi$  is made by detecting the phase angle between current and voltage by monitoring the shift of the zero passage of current and voltage. Therefore the measurement is independent of frequency and voltage amplitude.  
When using the model BA 9065.11/001 with separate auxiliary supply, the measuring circuit (L1/i-L1/k; L2-L3) can also monitor variable frequencies and voltages on the output of a frequency converter. As the  $\cos \varphi$  of squirrel cage motors varies with the frequency and with the load, it must be checked for each application if the BA 9065 is suitable. When a current transformer is used with variable frequency, this must also be a special one, that can transmit also low frequencies.

Please note when using a current transformer:

- the phase position must be correct (see connection examples), if not there will be no or permanent alarm
- there must be a connection from L1 to the secondary side of the CT (see connection examples)

## Technical data

### Input circuit

<b>Nominal voltage <math>U_N</math>:</b>	AC / 3 AC 220 ... 254 V, 380 ... 440 V, 480 ... 550 V, 600 ... 690 V
<b>Voltage range:</b>	0,8 ... 1,1 $U_N$
<b>Nominal frequency of <math>U_N</math>:</b>	45 ... 400 Hz
<b>Nominal consumption:</b>	2,5 VA (terminals L1/i-L2, A1-A2)
<b>Current range (L1/i-L1/k):</b>	0,1 ... 2 A      0,5 ... 10 A *
<b>Internal resistance L1/i-L1/k:</b>	approx. 30 m $\Omega$ approx. 10 m $\Omega$
<b>Consumption L1/i-L1/k:</b>	max. 0,12 VA      max. 1,1 VA * (higher currents using external current transformers, see connection examples)
<b>Short time overload:</b>	see diagram short time overload
<b>Usable current transformers:</b>	1 A or 5 A type Class 3 or better with necessary power
<b>Setting range <math>\cos \varphi</math>:</b>	0 ... 0,9; infinite variable
<b>Operate delay <math>t_v</math>:</b>	1 ... 40 s; infinite variable

### Output

<b>Contacts</b>	
BA 9065.20:	1 changeover contact, 1 NO contact
BA 9065.11/001:	1 changeover contact
<b>Thermal current <math>I_{th}</math>:</b>	6 A (up to 25°C, see also derating curve)
<b>Switching capacity</b>	
to AC 15	
NC contact:	1 A / AC 230 V      EN 60 947-5-1
NO contact:	3 A / AC 230 V      EN 60 947-5-1
<b>Electrical life</b>	EN 60 947-5-1
to AC 15 at 1 A, AC 230 V:	1,5 x 10 <sup>5</sup> switching cycles
<b>Short-circuit strength</b>	
<b>max. fuse rating:</b>	4 A gL      EN 60 947-5-1
<b>Mechanical life:</b>	30 x 10 <sup>6</sup> switching cycles

### General data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b>	
overvoltage category / contamination level:	4 kV / 2      IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	8 kV (air)      EN 61 000-4-2
HF irradiation:	10 V / m      EN 61 000-4-3
Fast transients:	2 kV      EN 61 000-4-4
Surge voltages between wires for power supply:	1 kV      EN 61 000-4-5
between wire and ground:	2 kV      EN 61 000-4-5
Interference suppression:	Limit value class B      EN 55 011

## Technical data

<b>Degree of protection:</b>	Housing: IP 40      EN 60 529
	Terminals: IP 20      EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0,35 mm, frequency 10 ... 55 Hz, EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04      EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	2 x 2,5 mm <sup>2</sup> solid or 2 x 1,5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece      EN 60 999
<b>Mounting:</b>	DIN rail      EN 50 022
<b>Weight:</b>	270 g

### Dimensions:

<b>Width x height x depth:</b>	45 x 74 x 124 mm
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## Standard type

BA 9065.20	3 AC 380 ... 440 V	0,5 ... 10 A
Article number:	0039727	stock item
• Output:	1 changeover contact, 1 NO contact	
• Nominal voltage $U_N$ :	3 AC 380 ... 440 V	
• Current range:	0,5 ... 10 A	
• Width:	45 mm	

## Variant

BA 9065.11/001:	for motors with frequency converters, separate auxiliary supply is necessary
<b>Auxiliary voltage <math>U_H</math>:</b>	AC 220 ... 254 V AC 380 ... 440 V
<b>Nominal frequency of <math>U_H</math>:</b>	45 ... 400 Hz
<b>Motor voltage <math>U_M</math>:</b>	3 AC 40 ... 660 V without neutral
<b>Nominal frequency of <math>U_N</math>:</b>	10 ... 100 Hz
<b>Contacts:</b>	1 changeover contact

### Ordering example for variants

BA 9065	.20	AC / 3 AC 380 ... 440 V	0,5	... 10 A	45	... 400 Hz
						Nominal frequency
						Current range
						Nominal voltage
						Contacts
						Type

## Accessories

ET 4762-5:	Adapter for screw fixing
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## Characteristics

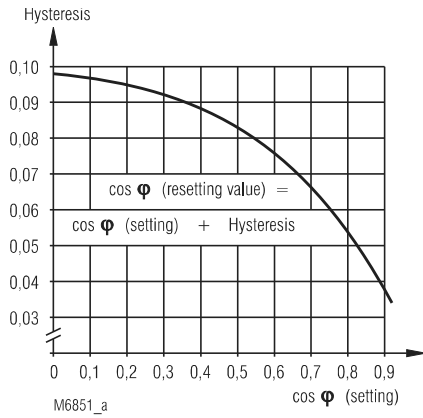


Diagram for hysteresis

Hysteresis depending on adjusted  $\cos \varphi$  setpoint. The hysteresis is the switching difference between alarm on ( $\cos \varphi$  setting) and alarm off ( $\cos \varphi$  reset value).

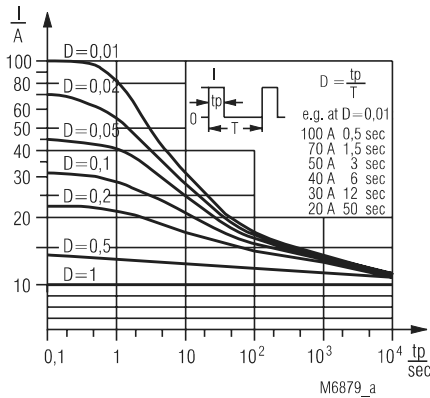
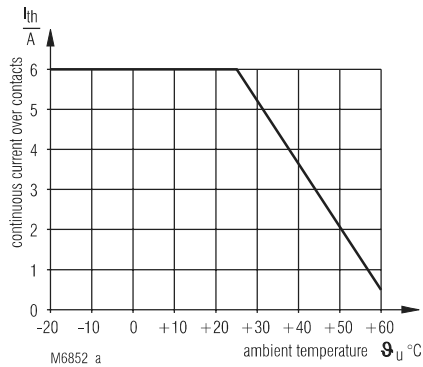


Diagram for short-time overload of the current input L1/i-L1/k (0,5 ... 10 A)



Continuous current limit curve for contacts

## Operating instructions

The example of a frequency controlled fan motor shows how to set up the unit.

### 1) Setting on BA 9065

- set BA 9065 to automatic restart (bridge X1-L/i; or while doing below mentioned tests press the reset button continuously)
- adjust time delay to minimum (left position)
- adjust  $\cos \varphi$  potentiometer to 0 (left position)

### 2) Setting on Motor:

- simulate broken belt (motor runs without load)
- run motor on lowest frequency

When the motor runs without load and lowest possible frequency, this is the worst case to detect broken belt.

### 3) Keep the conditions of 2) and turn the $\cos \varphi$ potentiometer

slowly (because of time delay) to the right (to higher value) until the contact switches. Please note this setting and keep it.

### 4) - remount the belt (normal working condition)

- at the lowest frequency and automatic reset or pressed reset button the monitor should show "good" condition, because the  $\cos \varphi$  rises.

If the Monitor does not show "good" condition the change of  $\cos \varphi$  is obviously smaller than the hysteresis.

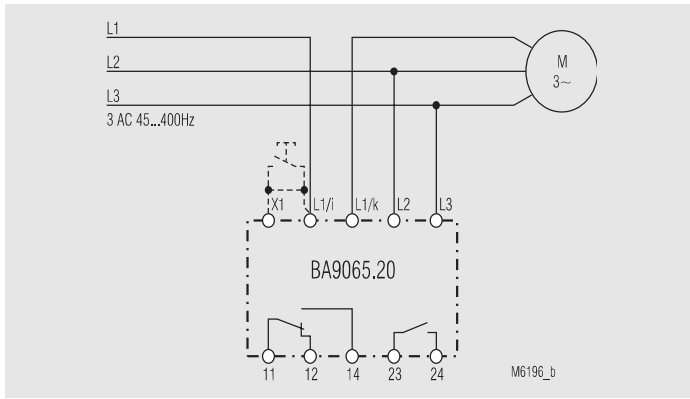
Now set potentiometer back to 0 again and turn it slowly to higher values to check the alarm value.

Finally turn the potentiometer again to 0 and then set it to the value found under 3) as this is the optimum setting.

### 5) Rise the frequency under normal conditions to maximum. The Alarm

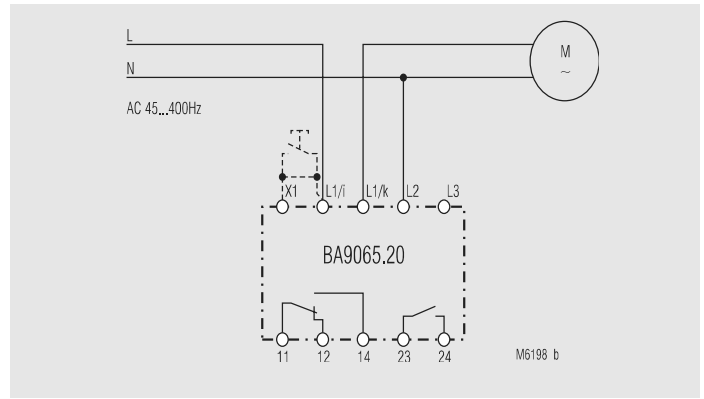
state should reset. Lower the frequency to minimum, no alarm should occur. At last set the time delay to a higher value, because the motor runs as generator for a short time when the frequency is lowered and the BA 9065 would react immediately.

### Connection examples

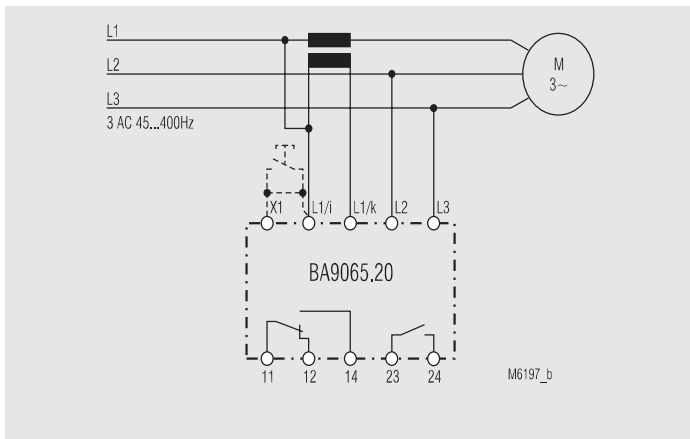


Without current transformer ( $I_{Mot} = 0,5 \dots 10 \text{ A}$ )  
 Please note:  
 The nominal voltage is the phase to phase voltage

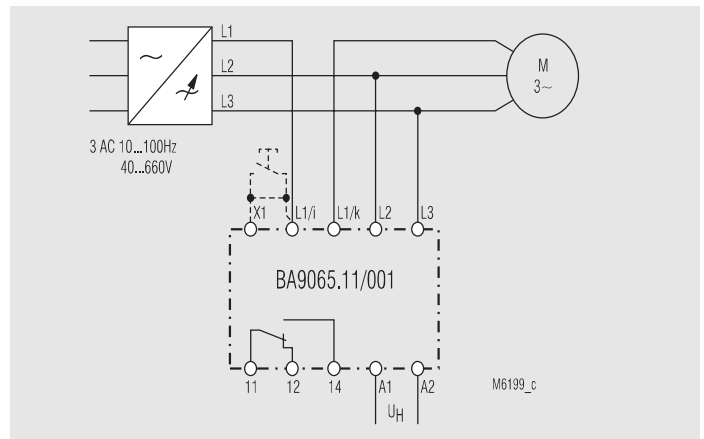
### Connection examples



Single phase connection  
 Please note:  
 The nominal voltage is the phase to neutral voltage



With current transformer ( $I_{Mot} > 10 \text{ A}$ )  
 Please note:  
 The nominal voltage is the phase to phase voltage.  
 The sens of winding of the CT is of importance!



Connection with CT or single phase see BA 9065.20