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- Multifunctional motor control units

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Product range
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- Remote switches
- Specific installation electronics
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- Power generation/distribution
- Oil and gas industry
- Automation
- Transport and material handling systems
- Rail technology
- Aviation/marine industry
- Paper and printing industry
- Food industry
- Rubber/plastics industry
- Heating and refrigeration
- Automotive
- Mining/metal working
- Chemical/pharmaceutical applications
- Medical technology
- Water/waste water treatment
- Cable cars/ski lifts

... and wherever safety has high priority.
We can cover your industrial applications as well!
The DOLD philosophy, “Our experience. Your safety” constitutes our program: Offering solutions based on over 80 years of experience with a workforce of more than 400 employees, we manufacture high quality products using state-of-the-art production plant at our Furtwangen facility in Germany.

The comprehensive product range includes relay modules, safety relays with positively-driven contacts and electronic housings with virtually unparalleled production detail. The combination of know-how, innovation and experience makes us one of the leading worldwide manufacturers.

Apart from standard solutions, we are also the right partner when individual industrial solutions with that special touch are required.

Staying in close contact with our customers is very important to us. We listen, analyze and act by offering flexible, custom high-tech solutions, from a single source.

Thanks to our own development laboratory, highly automated production facilities with a modern tool & die shop in addition to injection moulding facility together with a well organized sales and marketing department, we guarantee high quality and short delivery times. Your benefits: Increased plant and machine availability, planning reliability and low production costs.
Smart Drive Solutions

Demanding drive tasks call for high-performance and flexible device solutions. High-performing electronics by DOLD include a wide range of products such as solid state contactors, motor starters, soft start and braking devices, as well as reversing contactors, speed controllers, and multifunctional motor control devices.

3-phase controlled soft starter device with integrated monitoring function for soft starting motors. With just 67.5 mm width, the intelligent motor controller offers soft starting, motor protection, start-up current limiting, voltage and phase sequence monitoring in a single device.

With soft starters by DOLD, you’ll have an intelligent, reliable, and user-friendly motor start and motor management system.

MINISTART
– Powerful soft-starter device
The intelligent, hybrid motor starter offers up to 6 functions in a compact enclosure with just 22.5 mm width. It combines the functions of reversing, soft starting, soft run-down, and protection of 3-phase motors up to 4 kW in a single device.

Semiconductor contactors from DOLD have a long service life and are used everywhere that high switching frequencies and switching cycle are required.
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Solid-state relay: For screwing on the heat sink.
Solid-state contactors: With integrated heat sink, top hat rail mounting

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<td>Switch cabinet</td>
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<td>+</td>
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<td>BI 9254</td>
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Zero-voltage switching with integrated electrical interlock and heat sink, top hat rail mounting.
## Power electronics

### Product selection

#### Softstarters MINISTART

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<td>Softstarter</td>
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<td>230</td>
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<td></td>
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<td>IL 9017</td>
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<td>T</td>
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<td>45</td>
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<td>T; M</td>
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## Power electronics

### Product selection

#### Motor brake relays MINISTOP

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<td>IN 9017</td>
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<td>1</td>
<td>+</td>
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<td>+</td>
<td>For outdoor installations</td>
<td>100; 122</td>
<td>SX 9240.01</td>
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<td>For outdoor installations</td>
<td>100; 122; 168</td>
<td>SX 9240.03</td>
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#### Speed and phase controllers

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#### Multifunctional motor control unit MINISTART

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<td>+</td>
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<td>22,5</td>
<td>UG 9256</td>
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<td>Smart motorstarter with autom. phase sequence correction</td>
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Solid-State Contactors

Solid-state Contactors - Basics and applications

Application fields
Solid-state contactors and relays proved to be good in industrial applications where high switching frequencies or a large number of switching cycles are required. With their long service life and wearless switching they solve switching and control tasks in specific applications in an extremely economical manner. Fields of application include:

- Extrusion and injection moulding plants
- Heating controls
- Soldering lines
- Hot-melt gluing robots
- Oven controls
- Three-phase motors
- Lighting controls
- Materials handling installations
- Dispensing equipment
- Packaging machines
- Automats
- Pumps
- Automated self-service machines
- Traffic lights
- ... and many more

Technology
Like mechanical contactors or relays, solid-state relays provide a full electrical isolation between control and load circuit thanks to optocouplers. In contrast to mechanical contact controls the solid-state relay in the load circuit has a finite, although high resistance even in blocked (opened) state through which low leakage currents may flow to the load. Two antiparallel connected thyristors suited to switch alternating voltage in a range up to 100 Hz are used as semiconductors.

Advantages compared to contacts include:
- Long service life, >10⁹ switching cycles
- No wearing -> high reliability
- Noiseless switching
- Insensitive to surge currents
- Resisting to mechanical shocks and vibrations
- High resistance to dirt and chemicals
- Very low control power, logic compatible
- Low electromagnetic radiation
- No contact bounce, high switching frequencies

This is opposed by following disadvantages:
- Power loss in ON state, that means a heat sink is required
- Leakage current in OFF state; negligible in industrial practice
- Limited resistance to voltage spikes. Normally, this is counteracted by integrated RC combinations or MOVs.

1. Zero crossover switches
In practice, zero crossover switching solid-state relays became widely prevalent. The thyristors are switched on at the zero crossing of the alternating mains voltage. A special control electronic is used for this. That means the load current only flows 10 ms after application of the control voltage. Switching off occurs in a similar way. Due to physical laws the load current continues to flow after the control power is removed until the zero crossing is reached. The delay time between OFF command and OFF state is 10 ms as a maximum.

Zero crossover switching solid-state relays are mainly used for switching ohmic loads. These include all types of electric heaters in industrial installations. Less often they are used to switch inductive loads such as motors and transformers.

2. Instantaneous / peak voltage switches
There are only a few applications for instantaneously and peak voltage switching solid-state relays. Therefore, DOLG manufactures these devices only on request.

3. Full-wave control
Analogue full-wave control is an interesting control method, but for ohmic loads only. In contrast to phase-angle control, this method is EMC-conform. Thanks to switching at full sinusoidal half-waves the electromagnetic radiation and conducted interference are reduced to a minimum. Such devices generate a corresponding number of half-waves on the load output in proportion to an analogue signal on the control input. In combination with a set-point adjuster, temperature controllers can be easily built in this way.

4. Load circuit monitoring
The merger of power electronics and monitoring equipment is an interesting device combination. Solid-state relays with load circuit monitoring can signal following faults:
- Broken load circuits
- Partial-load faults
- Broken thyristor
- Thyristor short-circuit (failed thyristor)
- Missing load voltage
- Threshold over/underrun

In this way, changes in the load circuit can be exactly monitored. In particular, resistance variations of ohmic loads such as heating cartridges in plastic injection molding machines are interesting in this connection. In these cases, it is crucial to know when the condition of the plant deteriorates before a failure occurs, which would cause reject production. If a solid-state relay fails and is no longer able to cut off the heaters in injection molding machines, they will be cut off by mechanical contactors that are arranged upstream of the solid-state relays. For this, the signal output on the solid-state relay is used, which signals the failure to an overriding control system. This method outclasses the temperature monitoring in terms of swiftness and may prevent fire.

5. Reversing contactor
Solid-state relays can be qualified for universal use if combined to reversing contactors. Together with further functions such as load monitoring, integrated soft start and alarms they are perfect control units for electric motors. Integrated thermal monitoring and electrical interlocking of both directions of rotation top the function range off. Thanks to their compact design, these devices can be a proper alternative to frequency converters for simple applications.
Solid-State Contactors

Notes for users
To ensure a trouble-free operation users have to consider following issues: cooling, protection by fuses and isolation of solid-state contactors.

1. Cooling
Heat sinks have to be selected because of the heat loss arising in the semiconductor. The thermal resistance $R_t$ is the characteristic parameter of a heat sink and is measured in [K/W] ($K = \text{Kelvin}, W = \text{Watt}$). Where: The higher the thermal resistance the poorer is the solid-state relay cooling. The relation between temperature of the solid-state relay, loss power and heat sink is as follows:

$$T_{\text{HLR}} = P_L R_t + T_{\text{amb.}}$$

$T_{\text{HLR}} [K]$: Temperature on the bottom of the solid-state relay
$T_{\text{amb.}} [K]$: Ambient temperature
$P_L [W]$: Loss power
$R_t [K/W]$: Thermal resistance of the heat sink

The loss power “struggles” through the thermal resistance $R_t$ between bottom of the solid-state relay and environment and causes a corresponding overheating in the semiconductor. The user can only influence the overtemperature by selecting a suited heat sink that affects the thermal resistance. The objective should be to keep the temperature within the semiconductor below 125 °C. To exempt users from carrying out calculations by their own the data sheets include selection recommendations for heat sinks. These have to be mounted on the solid-state relay by means of heat transfer compound or graphite foil. However, many devices are available ready-to-use complete with heat sink. The loss power within the semiconductor can be calculated according to the equation below:

$$P_L = I_L U_{\text{TO}}$$

$P_L [W]$: Loss power
$I_L [A]$: Load current
$U_{\text{TO}} [V]$: Forward voltage of the semiconductor (typically approx. 1.3 V)

Using this equation users can quickly determine the heat to be carried off from the switch cabinet enabling them to properly rate the cabinet ventilation.

2. Semiconductor protection by fuses
The $I^2 t$ value measured in [A$^2$s] is an essential parameter of a semiconductor. It measures the heat development in case of a short circuit that would destroy the semiconductor. To protect the semiconductor a high-speed fuse has to be selected the $I^2 t$ value of which is smaller than that of the semiconductor.

$$I^2 t_{\text{FUSE}} < I^2 t_{\text{Semiconductor}}$$

For detailed information see the data sheets for our products. In recent time, users more and more prefer to use normal miniature circuit breakers instead of expensive semiconductor fuses. This requires a higher rating (higher $I^2 t$ value) of the semiconductors to ensure that they can withstand a short-circuit without damages. After a failure, it is then possible to restart the installation very quickly.

3. Disconnecting device for isolation from power
In OFF state, semiconductors cannot establish an electric isolation from the mains. Therefore, the miniature circuit breaker described under 2. has the additional function of being a disconnecting device for isolation from the system. This is required by VDE standards to be able to perform maintenance work safely.
Softstarters

Why are softstarters used?

1. Starting motors
   Three-phase asynchronous motors are most common as drives in today’s machinery and installations. In the power range up to 5.5 kW, such motors are mostly started by a direct-online starter, and by star/delta starters above this power. When doing so, it may happen that the driving elements and thus the driven machine connected to them are suddenly loaded and therefore overloaded in the moment of starting. Also work pieces and handled parts may be damaged. These problems can be perfectly solved by the use of softstarters. By phase-angle control of the mains voltage they provide for a slow increase of motor voltage. The torque developed by the motor is built up gradually and allows a smooth and thus gentle start. This reduces wear and tear and extends the service life of the whole installation.

2. Stopping motors
   There are three options for stopping drives:

   2.1 The motor is cut off and coasts to a standstill.

   2.2 Drives that must not come to a sudden standstill when cut off can be softly stopped using a softstop function. That means the coasting time is extended. For this, the voltage applied to the motor is gradually decreased. This may be required for conveyor drives or pumps, for example. These can come to a sudden standstill after a cut-off due to large counter-torques.

   2.3 Drives with a large centrifugal mass (e.g. centrifuges, planing machines) that coast for a long time after cut-off must be quickly decelerated for safety and time reasons in the most cases.

   2.3.1 For this, devices (BI 9028) are offered that have a brake function integrated rather than a softstop function. The braking effect is obtained by injection of a direct current in the motor windings.

   2.3.2 Using a trick, the braking effect can also be obtained in a different way. For soft plugging, two mains phases are interchanged upstream of the injection of a direct current in the motor windings.

3. Three types of softstarters
   From the technical aspect there is one main distinctive feature between the devices, namely whether one, two or all three mains phases to the motor are controlled by a power semiconductor. For this, see the figures 1 through 3.

   3.1 1-phase controlled
   3.2 2-phase controlled
   3.3 3-phase controlled

4. Starting currents of three-phase motors
   Furthermore, softstarters are used to reduce the motor starting current by more than 50 %. This is more and more frequently required, not only for weak systems. Weak systems include separate networks, emergency generating sets, dead-end feeders (spurs) or underdimensioned fuses. However, the starting current can not be reduced with single-phase controlled softstarters because a high current flows in both directly connected phases, which is even higher than with direct-online starter. Therefore, such devices are similar to the KUSA connection that was usual in former times. Instead of a resistor, now the thyristor is arranged in the motor branch. For that reason, single-phase controlled softstarters must always be started using a mains contactor, and therefore they have no softstop function as well. Only two-phase or three-phase controlled devices can also reduce the starting current. Therefore, they are suited as replacement for star-delta motor starters.

5. Starting currents of single-phase motors
   The motor current of these motors can also be reduced by means of a softstarter. For this, there are dedicated devices such as the IL 9017. But the single-phase controlled model BA 9010 mainly designed for three-phase motors can also be used. It must be specifically connected (see the data sheet).

6. Installation
   Normally, semiconductor fuses are no longer required for equipment protection. The motor protection switch, that is already installed in the most cases, is sufficient.

   6.1 According to IEC 947.4.2, mains filter and reactor are not required for the EMC conformity during operation because in all DOLD products the power semiconductors are jumpered by an integrated bypass contactor after the soft start.

   6.2 A mains contactor is only required for single-phase controlled devices and for the model IR 9027 for technical reasons. All remaining products can be started directly online without contactor and only via a potential-free contact.

   **Attention:** Bear in mind that the motor is still electrically connected to the mains, even if it does not rotate. Therefore, isolate the installation from the power supply using the assigned motor protection switch before any work on the motor or installation.

7. Driving issues
   Geared motors with small power rating (up to 0.75 kW) and a very large reduction ratio may not show the desired starting behaviour because the motor works approximately at no load and starts even with small voltage applied.

   Drives with a large centrifugal mass and/or strong counter-torque have a so called high-interia starting. Their starting time is longer than normal. This results in a higher heating of motor and equipment. This is critical and therefore the switching frequency must be reduced or a larger motor selected.

   For pole-changing motors (e.g. acc. to Dahlander) the softstarter must be rated according to the higher power rating. To start the motor it is useful to adjust the soft coasting time to zero.

8. Example
   **Task:**
   Select a suited softstarter that perfectly meets the following requirements:

   1. An existing installation is to be modified.
   2. Three fan motors (centrifugal mass) with 1.5 kW each have to be simultaneously reversed at an interval of 4 minutes.
   3. So far, motor reversal was only allowed at standstill. Otherwise the mains and the contactor would be overloaded with too high currents.
   4. Now, the coasting time is too long, that means a braking would be desirable.

   **Solution:**
   BA 9018 / 5.5 kW
**Motor Braking Units**

**Safe braking of three-phase motors**
The wish for more safety of industrial machines requires reliable braking devices. However, economic considerations often matter when it comes to their purchasing apart from the safety aspect. By quick stopping of dangerous machine parts braking devices prevent both industrial accidents and also damages to equipment. Therefore, accident prevention rules require them for some machinery and plants, e.g. in the wood and textile industries. Moreover, braking devices help to reduce cost by shortening the deceleration times of machines. Today, mainly three-phase asynchronous motors are used for drive engineering. They can be decelerated both mechanically and also electrically.

**Mechanical brakes**
The mechanical brake as the most simple and oldest braking device has still a right to exist up to the present day. It is always indispensable when an accidental movement of a de-energized motor must be safely prevented. Moreover it relieves the motor from the heat loss that arises during electrical braking. This advantage becomes particularly important for motors with high switching and braking frequency.

Disadvantages of mechanical braking methods include wearing and vulnerability to failures due to wear and tear as well as abrasion and noise.

**Electrical braking**
When it comes to electrical braking methods for three-phase asynchronous motors a distinction is made between braking by plugging and d. c. injection braking.

**Braking by plugging**
In former times, braking by plugging was the most common and most simple electrical braking method. It is initiated by interchanging two mains conductors of the stator winding. This changes the direction of the motor’s rotating field and generates a torque working against the direction of rotation and decelerating the motor up to a dead stop. When the motor is not cut off on time by suited means such as a zero-speed switch or frequency relay it accelerates in the reverse direction after its dead stop.

Disadvantages of braking by plugging:
- Relatively high braking torque
- Inconvenient braking torque adjustment via resistors
- High power consumption
- Heavy stress to switching devices

**Direct current injection braking**
With respect to the losses arising in the rotor, the d. c. injection braking is the more advantageous type of electrical motor braking. For this, via 2 or 3 terminals, direct current is fed into the stator winding that is disconnected from the three-phase system. This causes a stationary field within the motor. The rotation of the rotor makes that an alternating voltage is induced from the three-phase system. This causes a stationary field within the motor braking device. Selection recommendations included there refer to the selection of the correct motor braking device. The selection should be based on the documentation from the relevant manufacturer of the braking device. Selection recommendations indicate there refer to the maximum at this current intensity. Higher braking currents only result in saturation current, i.e. the magnetic field required for braking reaches its maximum at this current intensity. Higher braking currents only result in a thermal motor overload. The allowed braking current has to be tested using an r.m.s. measuring instrument.

**Advanced motors** are equipped with automatic zero-speed monitors for which no additional sensors are required. Such an automatic zero-speed monitor cuts off the braking current at the dead stop of the motor after a short delay time (< 1 sec.). Additionally, an adjustable braking timer as a safety device is started when the braking process starts. When lapsed it stops the braking process unless the zero-speed monitor has already terminated the braking process.

Disadvantages:
- Heavy stress to switching devices
- Vulnerability to failures due to wear and tear as well as abrasion and noise.

**To protect the power semiconductors against overtemperature also motor braking devices with thermal protection are available.** With these devices the braking contactor drops out when the allowed temperature of the power semiconductor is exceeded.

There are two designs of electronic motor braking devices: Typically, devices for smaller power with braking currents up to approx. 25 A have a compact enclosed design. For these devices, the functional modules braking electronic, braking contactor and power part are typically accommodated in a plastic case for DIN rail mounting.

Such a compact design is not possible for motor braking devices for higher power ratings due to the high temperatures in the power section. They are either mounted on a carrier board as open-type assembly or built in a properly sized sheet metal housing.

**Disadvantages of mechanical braking methods include wearing and vulnerability to failures due to wear and tear as well as abrasion and noise.**

**Functional sequence**
For the conventional type of d. c. injection braking the control system of the installation controls the functional sequence. In contrast to this, electronic motor braking devices have an integrated time program providing for the correct sequence of the switching operations. This ensures that mains and braking contactor do not close at the same time. Moreover, this allows a flexible applicability and a reliable function of the braking device. Typically, the function sequence with standard braking devices is as follows:

Once the motor is disconnected from the three-phase system, the braking is initiated after a delay. On the one hand, this braking delay time is used to allow a decay of induction voltages, that are still present after motor disconnection, to a value that is harmless to the power semiconductors. On the other hand, it is used to switch the braking contactor at zero crossing if possible. This considerably reduces contact wearing.

**Engineering**

To obtain an optimal braking torque the braking current I collaborate should be higher than the rated motor current by the factor 1.8 to 2. This corresponds to the saturation current, i.e. the magnetic field required for braking reaches its maximum at this current intensity. Higher braking currents only result in a thermal motor overload. The allowed braking current has to be tested using an r.m.s. measuring instrument.

Apart from the braking current, also other criteria are essential for the selection of the correct braking device. The selection should be based on the documentation from the relevant manufacturer of the braking device. Selection recommendations indicate there refer to the maximum braking current, duration and frequency of braking operations and to the method of connection of the motor to be decelerated.

To safely prevent thermal motor overload by too frequent braking it is recommended to equip them with thermal protection devices. Thermal motor protection relays are suitable for this. Comfortable motor braking devices have this thermistor motor protection already integrated.

(Fig. 1) Schematic diagram for a motor with electronic braking

K1 = mains contactor; K2 = braking contactor

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**Motor Braking Units**

**Safe braking of three-phase motors**
The wish for more safety of industrial machines requires reliable braking devices. However, economic considerations often matter when it comes to their purchasing apart from the safety aspect. By quick stopping of dangerous machine parts braking devices prevent both industrial accidents and also damages to equipment. Therefore, accident prevention rules require them for some machinery and plants, e.g. in the wood and textile industries. Moreover, braking devices help to reduce cost by shortening the deceleration times of machines. Today, mainly three-phase asynchronous motors are used for drive engineering. They can be decelerated both mechanically and also electrically.

**Mechanical brakes**
The mechanical brake as the most simple and oldest braking device has still a right to exist up to the present day. It is always indispensable when an accidental movement of a de-energized motor must be safely prevented. Moreover it relieves the motor from the heat loss that arises during electrical braking. This advantage becomes particularly important for motors with high switching and braking frequency.

Disadvantages of mechanical braking methods include wearing and vulnerability to failures due to wear and tear as well as abrasion and noise.

**Electrical braking**
When it comes to electrical braking methods for three-phase asynchronous motors a distinction is made between braking by plugging and d. c. injection braking.

**Braking by plugging**
In former times, braking by plugging was the most common and most simple electrical braking method. It is initiated by interchanging two mains conductors of the stator winding. This changes the direction of the motor’s rotating field and generates a torque working against the direction of rotation and decelerating the motor up to a dead stop. When the motor is not cut off on time by suited means such as a zero-speed switch or frequency relay it accelerates in the reverse direction after its dead stop.

Disadvantages of braking by plugging:
- Relatively high braking torque
- Inconvenient braking torque adjustment via resistors
- High power consumption
- Heavy stress to switching devices

**Direct current injection braking**
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(Fig. 1) Schematic diagram for a motor with electronic braking

K1 = mains contactor; K2 = braking contactor
Motor Braking Units

PTC thermistors specifically offered for motor protection are suited as temperature probes. The signal output contact of the thermal monitoring should arranged so that the motor is stopped for safety reasons when the control contact trips, but can not be restarted afterwards until the thermal data allow a restarting.

Softstarters extend the motor service life
To extend the service life of three-phase motors brake devices are often used in combination with softstarters. They allow a more economic design of the driving components and can also be retrofitted in existing installations like brake devices.

Apart from providing both control functions, softstarters with already integrated brake functionality also save a lot of wiring (see Fig. 2).

Features of electronic d. c. braking with phase-angle control:
- Continuous adjustment of the braking force and time to the machine's characteristic
- Soft start of the braking effect and thus avoidance of mechanical stresses to bearings, gears or V-belts
- No maintenance needed
- No mechanical wearing
- Easy installation (also later)
- Environmentally compatible

Fields of application
Two reasons require a quick stopping of rotating parts on machinery and plants by brake devices:

1) Prevent industrial accidents by emergency stop or safety braking. Accident prevention rules, e.g. those of the wood working (VBG 7j) and textile industries (VBG 7v) require the use of brake devices.

2) Reduce costs by shortening the coasting times of machines.

Moreover, motor brake devices are used:
- For deceleration of positioning drives
- For braking machines that would reach their resonance frequency when coasting without braking, e.g. shaking troughs
- For lifting and conveying equipment where a run over end positions must be prevented
- For reversal mills, centrifuges and the like
Power Electronics

POWERSWITCH
Solid-State Contactor
BF 9250, BH 9250

- According to IEC/EN 60 947-4-2, IEC/EN 60 947-4-3
- 1-, 2- and 3-pole models
- Load current up to 50 A
- For AC load up to 480 V
- Switching at zero crossing
- Protected by varistors
- As option temperature protection of the power semiconductors with monitoring output
- Mounting on DIN-rail
- As option with control input X1 with low current consumption e.g. to be controlled by a PLC
- As option up to 3 separate semiconductor contactors in one unit
- BF 9250: width 22.5 mm, 45 mm and 90 mm
- BH 9250: width 45 mm, 67.5 mm and 112.5 mm

Applications
- Fast and noiseless switching of:
  - heating elements
  - motors
  - valves
  - lighting

Indicators
BF 9250/001, BH 9250/001, BH9250/006
green LED "A1-A2": on, when voltage on A1/A2
yellow LED "x1": on, when voltage on X1
red LED "ϑ>": on, when overtemperature

BF 9250/003
- green LED "T1": on, when A1 connected
- green LED "T2": on, when A3 connected
- green LED "T3": on, when A5 connected

BF 9250/004
- green LED "T1": on, when A1 connected
- green LED "T2": on, when A2 connected
- green LED "T3": on, when A3 connected

BF 9250
- green LED "A1-A2": on, when voltage on A1

Approvals and Markings

Function Diagram

* The latching function of the overtemperature monitoring is resetted by disconnecting A1/A2 for a short moment
** after the cool down time
\[ \Delta t = \text{switching delay} \]
### Connection Terminals

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1, A2, A3, A4, A5, A6, COM, X1</td>
<td>Control or operating voltage</td>
</tr>
<tr>
<td>18</td>
<td>Indicator output</td>
</tr>
<tr>
<td>11, 12</td>
<td>NC contact</td>
</tr>
<tr>
<td>L1, L2, L3</td>
<td>Mains connections</td>
</tr>
<tr>
<td>T1, T2, T3</td>
<td>Load outputs</td>
</tr>
<tr>
<td>T1b, T2b</td>
<td>Load outputs</td>
</tr>
</tbody>
</table>

### Circuit Diagrams

- **BF 9250.02/004**
- **BF 9250.03/004**
- **BH 9250.01/001**
- **BH 9250.02/001**
- **BH 9250.03/001**
- **BH 9250.03/006**
Technical Data

Input

BF 9250/001, BH 9250/001:
Operation voltage A1/A2: DC 24 V
Voltage tolerance: ± 10 %
Input current: 35 mA
Control voltage X1/A2: DC 3 ... 48 V
Making voltage: DC 3 V
Switch off voltage: DC 2 V
Start current: 0.5 mA at DC 3 ... 10 V
10 mA at DC 10 ... 48 V
Start up delay [ms]: ≤ 2 + 1/2 Periode
Release delay [ms]: ≤ 1 + 1/2 Periode

BF 9250/003:
Control voltage A1/A2: DC 24 V, control of \( T_a \)
Control voltage A3/A4: DC 24 V, control of \( T_b \)
Control voltage A5/A6: DC 24 V, control of \( T_c \)
Start up delay [ms]: ≤ 1 + 1/2 Periode
Release delay [ms]: ≤ 1 + 1/2 Periode

BF 9250/004:
Control voltage A1/COM: DC 24 V, control of \( T_a \)
Control voltage A2/COM: DC 24 V, control of \( T_b \)
Control voltage A3/COM: DC 24 V, control of \( T_c \)
Start up delay [ms]: ≤ 1 + 1/2 Periode
Release delay [ms]: ≤ 1 + 1/2 Periode

BF 9250:
Control voltage A1/A2: AC/DC 110 ... 230V, AC/DC 24 V
Start up delay [ms]: ≤ 3 + 1/2 Periode
Release delay [ms]: ≤ 35 + 1/2 Periode

BH 9250/006:
Operation voltage A1+/-A2: DC 24 V
Control voltage X1+/A2: DC 3 ... 48 V
Control voltage X2+/A3: DC 24 V

Output

Load output T1, T2, T3; \( T_a, T_b, T_c \)
Load currents at 100 % duty cycle ED, AC 51:

<table>
<thead>
<tr>
<th>BF 9250</th>
<th>Ambient temperature</th>
<th>Device without heat sink</th>
<th>Device with small heat sink</th>
<th>Device with large heat sink</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH 9250</td>
<td>25°C</td>
<td>13 A</td>
<td>30 A</td>
<td>55 A</td>
</tr>
<tr>
<td></td>
<td>40°C</td>
<td>10 A</td>
<td>25 A</td>
<td>50 A</td>
</tr>
<tr>
<td>1-pole</td>
<td>25°C</td>
<td>7 A</td>
<td>17,5 A</td>
<td>28 A</td>
</tr>
<tr>
<td></td>
<td>40°C</td>
<td>6,5 A</td>
<td>15 A</td>
<td>25 A</td>
</tr>
<tr>
<td>3-pole</td>
<td>25°C</td>
<td>6 A</td>
<td>14 A</td>
<td>20 A</td>
</tr>
<tr>
<td></td>
<td>40°C</td>
<td>5 A</td>
<td>10 A</td>
<td>15 A</td>
</tr>
</tbody>
</table>

BH 9250.03/006:
Load output T1a, T2a, T3a
AC-51 3 X 3 A
Load output T1b, T2b
AC-51 2 X 1 A

Current reduction over 40°C

<table>
<thead>
<tr>
<th>BF 9250</th>
<th>Device without heat sink</th>
<th>Device with small heat sink</th>
<th>Device with large heat sink</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH 9250</td>
<td>0.2 A / °C</td>
<td>0.4 A / °C</td>
<td>0.6 A / °C</td>
</tr>
<tr>
<td></td>
<td>0.3 A / °C</td>
<td>0.4 A / °C</td>
<td></td>
</tr>
<tr>
<td>1-pole</td>
<td>0.2 A / °C</td>
<td>0.2 A / °C</td>
<td>0.3 A / °C</td>
</tr>
<tr>
<td></td>
<td>0.2 A / °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-pole</td>
<td>0.2 A / °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.3 A / °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-pole</td>
<td>0.2 A / °C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Technical Data

Short circuit current
at t=10 ms
BF 9250.01, .02, .92;
BH 9250.01, .02:
600 A
BF 9250.03, .93;
BH 9250.03:
400 A
Power dissipation:
\( P = 1.2 \text{ [V]} \times I \text{ [eff. [A] / k [W]]} \)
with k as formfactor and
k = 1.1 for sinusoidal current

Semiconductor fuse

<table>
<thead>
<tr>
<th>BF 9250</th>
<th>( I_n )</th>
<th>load limit integral of the semiconductor</th>
<th>Type</th>
<th>Article-No.</th>
<th>Brand</th>
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</thead>
<tbody>
<tr>
<td>BH 9250</td>
<td>10 A</td>
<td>1800 A's</td>
<td>fuse 10 x 38</td>
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<td>SIBA</td>
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<td>1800 A's</td>
<td>fuse 10 x 38</td>
<td>6003434.20</td>
<td>SIBA</td>
</tr>
<tr>
<td>1-pole</td>
<td>2x6,5 A</td>
<td>1800 A's</td>
<td>fuse 10 x 38</td>
<td>6003434.10</td>
<td>SIBA</td>
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<td>1800 A's</td>
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<td>6003434.30</td>
<td>SIBA</td>
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<td>2x25 A</td>
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<td>SIBA</td>
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<tr>
<td>2-pole</td>
<td>3x3 A</td>
<td>800 A's</td>
<td>fuse 10 x 38</td>
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<td>SIBA</td>
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<td></td>
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<td>800 A's</td>
<td>fuse 10 x 38</td>
<td>6003434.20</td>
<td>SIBA</td>
</tr>
</tbody>
</table>

Varistor voltage:
AC 510 V

Semiconductor Monitoring Output

Output (Terminal 18):
transistor, plus switching
switched auxiliary voltage:
DC 24 V
Switching capacity:
100 mA, short circuit proof
Residual voltage:
typ. 0.6 V

Output (NC contact 11, 12):
Switching capacity:
AC 240 V* / 2.0 A cos \( \varphi = 1 \)
AC 240 V* / 1.0 A cos \( \varphi = 0.6 \) inductive
DC 24 V / 1.0 A

General Data

Fitting position:
cooling ribs vertically
Operating mode:
Continuous operation
Temperature range:
Operation: 0 ... 40°C
max. 60°C (with current derating factor see table)
Storage temperature:
-20 ... +80°C

Clearance and creepage distances
rated impulse voltage / pollution degree:
4 kV / 3
IEC 60 664-1
EMC:
IEC/EN 61 000-6-4, IEC/EN 61 000-6-1
Electrostatic discharge:
8 kV air / 6 kV contact
IEC/EN 61 000-4-2
HF-irradiation:
8 kV / m
IEC/EN 61 000-4-3
Surge voltages between
wires for power supply:
1 kV
IEC/EN 61 000-4-5
between wire and ground:
2 kV
IEC/EN 61 000-4-5
HF-wire guided:
10 V
IEC/EN 61 000-4-5
Interference suppression:
Limit value class A
IEC 60 947-4-3
A higher suppression class can be reached by connecting capacitors of
0.47 \( \mu \)F / 600 V AC across the phases
or across phase and neutral.

Power dissipation:
\( P = 1.2 \text{ [V]} \times I \text{ [eff. [A] / k [W]]} \)
with k as formfactor and
k = 1.1 for sinusoidal current

Min. load current:
AC 40 mA
Load voltage range:
AC 24 ... 480 V
Frequency range:
50 / 60 Hz
Leakage current in off state
at nominal voltage U0 and
nominal frequency
(\( T_j = 125°C \), max.):
1.0 mA
at load voltage up to:
AC 480 V
Peak inverse voltage:
±1200 Vp
### Technical Data

#### Insulation voltages
- Input to Output: 2.5 kV
- Input to semiconductor monitoring output (NC contact): 2.0 kV
- Output to Output: 2.5 kV
- Output to heat sink: 2.5 kV

#### Degree of protection
- Housing: IP 40 IEC/EN 60 529
- Terminals: IP 20 IEC/EN 60 529

#### Vibration resistance
- Amplitude: 0.35 mm
- Frequency: 10 ... 55 Hz, IEC/EN 60 068-2-6

#### Climate reseistance
- 0 / 060 / 04 IEC/EN 60 068-1

#### Terminal designation
- EN 50 005

#### Wire connection:
- DIN 46 228-1/-2/-3/-4

#### Load terminals:
- BF 9250: 1 x 10 mm² solid
- 1 x 6 mm² stranded ferruled
- BH 9250: 1 x 0.75 mm² stranded ferruled (isolated)
- 1 x 1.5 mm² stranded ferruled
- DIN 46 228-1/-2/-3/-4

#### Control terminals and indicator outputs
- BF 9250: DIN 46 228-1/-2/-3/-4

#### Wire fixing
- Load terminals:
  - Terminal screws M 4
  - Box terminal with wire protection

#### Mounting
- BF 9250: DIN rail IEC/EN 60 715

#### Weight
- BF 9250: Width 22.5 mm: 350 g
- Width 45 mm: 580 g
- Width 90 mm: 1 050 g
- BH 9250: Width 45 mm: 394 g
- Width 67.5 mm: 638 g
- Width 112.5 mm: 1 094 g

#### Dimensions
- Width x height x depth:
  - BF 9250: 22.5 x 85 x 120 mm
  - 45 x 85 x 120 mm
  - 90 x 85 x 120 mm
  - BH 9250: 45 x 85 x 120 mm
  - 67.5 x 85 x 120 mm
  - 112.5 x 85 x 120 mm

### UL-Data according to UL508

#### Input
- Wire connection: 60°C / 75°C copper conductors only
- BF 9250: AWG 28 - 14 Sol/Str
- BF 9250/001: AWG 24 - 14 Sol/Str
- BH 9250: AWG 20 - 12 Sol, 20 - 14 Str. Torque 0.8 Nm

#### Load circuit
- Fixed screw terminal: 75°C copper conductors only
- AWG 18 - 8 Sol Torque 0.8 Nm or
- AWG 18 - 10 Str Torque 0.8 Nm
  (only possible at variants up to 30 A)

#### Temperature range
- 0 ... 40 °C

#### Frequency range
- 50 / 60 Hz

#### Pollution degree
- 2

In the final circuit an overvoltage protector R/CSPD (VZCA2/8) with min. 480V AC, 50/60Hz, VPR=2500V, Type 3 has to be installed.

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

#### Standard Types

<table>
<thead>
<tr>
<th>Type</th>
<th>DC 24 V</th>
<th>AC 24 ... 480 V</th>
<th>50/60 Hz</th>
<th>10 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>BF 9250.01/001</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>BF 9250.03/001</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>BF 9250.02/004</td>
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<thead>
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<th>Type</th>
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<th>AC 24 ... 480 V</th>
<th>50/60 Hz</th>
<th>3 x 10 A</th>
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<tr>
<th>Article number</th>
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</tr>
</thead>
</table>

### Variants

<table>
<thead>
<tr>
<th>Type</th>
<th>Without low current input X1</th>
</tr>
</thead>
<tbody>
<tr>
<td>BF 9250.0</td>
<td>With bigger diameter for control wires</td>
</tr>
<tr>
<td>BH 9250.0/003</td>
<td>2 or 3 power semiconductor controlled by a separate input with galvanic isolation, without temperature monitoring of the semiconductors</td>
</tr>
</tbody>
</table>

#### Odering example for variants

```
BF 9250.01/... DC 24 V AC 24 ... 480 V 50/60 Hz 10 A
```

#### Installation

Recommended distance:
- upper / lower side to cable duct: 20 mm

Distance on left and right: 10 mm; with max. load current and 100 % duty cycle
Single phase load switched by 1-pole semiconductor contactor controlled from PLC or Temperature controller output.

<table>
<thead>
<tr>
<th>Width (mm)</th>
<th>22.5</th>
<th>45</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&lt;sub&gt;ph&lt;/sub&gt;</td>
<td>10 A</td>
<td>25 A</td>
<td>50 A</td>
</tr>
</tbody>
</table>

3-phase load, switched by 2 single-pole semiconductor contactors (left side) or by 1 2-pole semiconductor contactor (right side).

<table>
<thead>
<tr>
<th>Width (mm)</th>
<th>22.5</th>
<th>45</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&lt;sub&gt;ph&lt;/sub&gt;</td>
<td>10 A</td>
<td>25 A</td>
<td>50 A</td>
</tr>
</tbody>
</table>

BF 9250. _ _/001
3-phase system, 3-phases controlled

3-phase load switched by 3 single-pole semiconductor contactors

3-phase load switched by 1 3-pole semiconductor contactor

<table>
<thead>
<tr>
<th>Width mm</th>
<th>22.5</th>
<th>45</th>
<th>90</th>
<th>22.5</th>
<th>45</th>
<th>90</th>
<th>22.5</th>
<th>45</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_1 / phase</td>
<td>10 A</td>
<td>25 A</td>
<td>50 A</td>
<td>6.5 A</td>
<td>15 A</td>
<td>25 A</td>
<td>5 A</td>
<td>10 A</td>
<td>15 A</td>
</tr>
</tbody>
</table>

BF 9250._/001
BF 9250.03
3-phase load, controlled by a 3-pole semiconductor contactor with AC/DC 110-230 V control voltage.

BF 9250.03/004
3 semiconductor contactors in one housing control 3 different loads
• According to IEC/EN 60 947-4-2, IEC/EN 60 947-4-3
  • 1-, 2- and 3-pole versions
  • Load current up to 50 A at $T_u = 40^\circ C$
  • For AC load up to 530 V
  • Switching at zero crossing, optionally immediate switching
  • Protected by varistors
  • Mounting on DIN-rail
  • As option with high $I_{2t}$ of the semiconductor for high switching current
    (variant /1_8)
  • Widths: 22.5 mm, 45 mm and 90 mm

Applications
Fast and noiseless switching of:
- heating elements
- motors
- valves
- lighting

LED green: on, when voltage on A1/A2
Input:

Control voltage A1/A2: DC 24 V
Control voltage range:
1-pole: DC 4 ... 32 V
2-pole: DC 7 ... 32 V
3-pole: DC 9 ... 32 V
Start up delay [ms]: ≤ 1 + 1/2 period *)
Release delay [ms]: ≤ 1 + 1/2 period *)
*) for variant with immediate switching only
1 period for on and off delay

Output

Load output T1, T2, T3
Load currents at 100 % duty cycle:

<table>
<thead>
<tr>
<th>Width</th>
<th>Ambient temperature</th>
<th>22.5 mm</th>
<th>45 mm</th>
<th>90 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-pole</td>
<td>25°C</td>
<td>13 A</td>
<td>30 A</td>
<td>55 A</td>
</tr>
<tr>
<td></td>
<td>40°C</td>
<td>10 A</td>
<td>25 A</td>
<td>50 A</td>
</tr>
<tr>
<td>2-pole</td>
<td>25°C</td>
<td>7 A</td>
<td>17.5 A</td>
<td>28 A</td>
</tr>
<tr>
<td></td>
<td>40°C</td>
<td>6.5 A</td>
<td>15 A</td>
<td>25 A</td>
</tr>
<tr>
<td>3-pole</td>
<td>25°C</td>
<td>6 A</td>
<td>14 A</td>
<td>20 A</td>
</tr>
<tr>
<td></td>
<td>40°C</td>
<td>5 A</td>
<td>10 A</td>
<td>15 A</td>
</tr>
</tbody>
</table>

Current reduction over 40°C

<table>
<thead>
<tr>
<th>Width</th>
<th>Device without heat sink</th>
<th>Device with small heat sink</th>
<th>Device with large heat sink</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-pole</td>
<td>0.2 A / °C</td>
<td>0.4 A / °C</td>
<td>0.6 A / °C</td>
</tr>
<tr>
<td>2-pole</td>
<td>0.2 A / °C</td>
<td>0.3 A / °C</td>
<td>0.4 A / °C</td>
</tr>
<tr>
<td>3-pole</td>
<td>0.2 A / °C</td>
<td>0.2 A / °C</td>
<td>0.3 A / °C</td>
</tr>
</tbody>
</table>

Min. load current: AC 40 mA
Load voltage L1, L2, L3: AC 230 V, AC 480 V
Load voltage range: AC 24 ... 264 V, AC 24 ... 530 V
Frequency range: 50 / 60 Hz
Leakage current in off state: approx. 1.0 mA
Peak reverse voltage: ± 1200 Vp
Short circuit current at t=10 ms:
BF 9250.91, BF 9250.92: 600 A
BF 9250.93: 400 A
Power dissipation: \[ P = 1.2 \times I_{eff} \times k [W] \]
with k as formfactor and k = 1.11 for sinusoidal current

Semiconductor fuse

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
<th>Type</th>
<th>Art.-No.</th>
<th>Brand</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 (+), A2</td>
<td>Control or operating voltage</td>
<td>fuse 10 x 38</td>
<td>6003434.16</td>
<td></td>
</tr>
<tr>
<td>L1, L2, L3</td>
<td>Mains connections</td>
<td>fuse 10 x 38</td>
<td>6003434.30</td>
<td></td>
</tr>
<tr>
<td>T1, T2, T3</td>
<td>Load output</td>
<td>fuse 10 x 38</td>
<td>6003434.30</td>
<td></td>
</tr>
</tbody>
</table>

Varistor voltage: AC 510 V
**Technical Data**

### General Data
- **Mounting position:** cooling ribs vertically
- **Operating mode:** Continuous operation
- **Temperature range:** 0 ... 40 °C (with current derating factor)
- **max. temperature:** see table
- **Storage temperature:** - 20 ... + 80 °C
- **Clearance and creepage distances**
  - rated impulse voltage / pollution degree: 4 kV / 3 IEC 60 664-1
  - EMC: IEC/EN 61 000-6-4, IEC/EN 61 000-6-1
  - Electrostatic discharge: 8 kV Vair / 6 kV contact IEC/EN 61 000-4-2
  - Fast transients: 2 kV IEC/EN 61 000-4-3
  - Surge voltages between wires for power supply: 1 kV IEC/EN 61 000-4-5
  - between wire and ground: 2 kV IEC/EN 61 000-4-5
  - HF-irradiation: 10 V / m IEC/EN 61 000-4-3
  - Interference suppression: Limit value class A IEC/EN 60 947-4-3
  - A higher suppression class can be reached by connecting capacitors of 0.47 μF / 600 V AC across the phases

### Insulation voltages
- **Input to Output:** 2.5 kV
- **Input to semiconductor monitoring output (NC contact):** 2.0 kV
- **Input to heat sink:** 2.5 kV
- **Output to Output:** 2.5 kV
- **Output to heat sink:** 2.5 kV

### Degree of protection
- **Housing:** IP 40 IEC/EN 60 529
- **Terminals:** IP 20 IEC/EN 60 529

### Vibration resistance
- **Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6**
- **Climate resistance:** 0 / 060 / 04 IEC/EN 60 068-1

### Terminal designation
- **EN 50 005**

### Wire connection
- **Load terminals:**
  - 1 x 10 mm² solid
  - 1 x 6 mm² stranded ferruled
  - 1 x 0.75 mm² stranded ferruled (isolated)
  - 1 x 1.5 mm² stranded ferruled
  - DIN 46 228-1/-2/-3/-4
- **Control terminals:**
  - DIN 46 228-1/-2/-3

### Wire fixing
- **Load terminals:** Terminal screws M 4
- **Control terminals:** cage clamp terminals

### Mounting
- **DIN rail** IEC/EN 60 715

### Weight
- **Width 22.5 mm:** 350 g
- **Width 45 mm:** 580 g
- **Width 90 mm:** 1050 g

### Dimensions
- **Width x height x depth:**
  - Dependent of contacts and load current
  - (see table load current): 22.5 x 85 x 120 mm
  - 45 x 85 x 120 mm
  - 90 x 85 x 120 mm

---

**UL-Data according to UL508**

### Input
- **Wire connection**
  - BF 9250/008: 60°C / 75°C copper conductors only
  - AWG 24 - 14 Sol/Str

### Load circuit
- **Fixed screw terminal:**
  - 75°C copper conductors only
  - AWG 18 - 8 Sol Torque 0.8 Nm or
  - AWG 18 - 10 Str Torque 0.8 Nm
  - (only possible at variants up to 30 A)
- **Temperature range:** 0 ... 40 °C
- **Frequency range:** 50 / 60 Hz
- **Pollution degree:** 2

In the final circuit an overvoltage protector R/CSPD (VZCA2/8) with min. 480V AC, 50/60Hz, VPR=2500V, Type 3 has to be installed.

---

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

### Standard Type
- **BF 9250.91/008**
  - DC 24 V
  - AC 480 V
  - 50/60 Hz
  - 10 A
- **Article number:** 0056823
  - 1-pole
  - Control voltage range: DC 4 ... 32 V
  - Load voltage range: AC 24 ... 530 V
  - Load voltage: 10 A (bei T U = 40° C)
  - with indicator output

### Ordering Example
- **BF 9250 50/60 Hz 50 A**
  - 0: Switch. at zero crossing
  - 1: Immediate switching
  - with high I 2t
  - Type

### Installation

Recommended distance:
- upper / lower side to cable duct: 20 mm
- distance on left and right: 10 mm; with max. load current and 100 % duty cycle
### Application Examples

**Single phase system**

Single phase load switched by 1-pole semiconductor contactor controlled from PLC or Temperature controller output.

<table>
<thead>
<tr>
<th>Width mm</th>
<th>22.5</th>
<th>45</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>I, / phase</td>
<td>10 A</td>
<td>25 A</td>
<td>50 A</td>
</tr>
</tbody>
</table>

**3-phase system, 2 phases controlled**

3-phase load, switched by 2 single-pole semiconductor contactors (left side) or by 1 2-pole semiconductor contactor (right side)

<table>
<thead>
<tr>
<th>Width mm</th>
<th>22.5</th>
<th>45</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>I, / phase</td>
<td>10 A</td>
<td>25 A</td>
<td>50 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>22.5</th>
<th>45</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>I, / phase</td>
<td>6.5 A</td>
<td>15 A</td>
<td>25 A</td>
</tr>
</tbody>
</table>
3-phase system, 3-phases controlled

3-phase load switched by 3 single-pole semiconductor contactors

3-phase load switched by 1 single-pole an 1 2-pole semiconductor contactor

3-phase load switched by 1 3-pole semiconductor contactor

<table>
<thead>
<tr>
<th>Width mm</th>
<th>22.5</th>
<th>45</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_p / phase</td>
<td>10 A</td>
<td>25 A</td>
<td>50 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Width mm</th>
<th>22.5</th>
<th>45</th>
<th>90</th>
</tr>
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<tbody>
<tr>
<td>I_p / phase</td>
<td>6.5 A</td>
<td>15 A</td>
<td>25 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Width mm</th>
<th>22.5</th>
<th>45</th>
<th>90</th>
</tr>
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<tbody>
<tr>
<td>I_p / phase</td>
<td>5 A</td>
<td>10 A</td>
<td>15 A</td>
</tr>
</tbody>
</table>
Power Electronics

POWERSWITCH
Semiconductor Contactor With Analogue Input
For Pulsed Output BF 9250/0_2

- Analogue controller for accurate process temperature control
- Burst firing control of heaters
- Control input optional with DC 0 ... 10 V, DC 4 ... 20 mA, 0 ... 10 kΩ
- Reverse action operation possible
- Rated operational voltage range up to 480 V
- Rated operational current is up to AC 50 A
- Zero cross switching
- Protected by varistors
- Temperature protection of the power semiconductors
- LED indications for supply, output status and alarm status
- Alarm indication on mains synchronisation failure
- Alarm indication on control input failure
- Alarm indication on over temperature of power semiconductors
- DIN-rail mountable
- BF 9250/0_2 to 10 A: Width 22.5 mm
  - BF 9250/0_2 to 25 A: Width 45 mm
  - BF 9250/0_2 to 50 A: Width 90 mm

Block Diagram

Circuit Diagrams

Connection Terminals

<table>
<thead>
<tr>
<th>Terminal Designation</th>
<th>Signal Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 (+)</td>
<td>+ / L</td>
</tr>
<tr>
<td>A2</td>
<td>- / N</td>
</tr>
<tr>
<td>X1</td>
<td>Control input</td>
</tr>
<tr>
<td>L1, N</td>
<td>Mains connection</td>
</tr>
<tr>
<td>T1, N</td>
<td>Load output</td>
</tr>
</tbody>
</table>
### Technical Data

**Input**

<table>
<thead>
<tr>
<th>Supply voltage UH</th>
<th>AC/DC 24 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1/A2:</td>
<td>AC/DC 24 V</td>
</tr>
<tr>
<td>Supply current:</td>
<td>&lt; 26 mA at DC 24 V</td>
</tr>
</tbody>
</table>

**Control Input**

<table>
<thead>
<tr>
<th>Current controlled input</th>
<th>DC 0 ... 20 mA or DC 4 ... 20 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowable input current:</td>
<td>&lt; 35 mA</td>
</tr>
<tr>
<td>Over current protection:</td>
<td>YES</td>
</tr>
<tr>
<td>Alarm for over current:</td>
<td>YES</td>
</tr>
<tr>
<td>Reverse polarity protection:</td>
<td>YES</td>
</tr>
<tr>
<td>Voltage drop:</td>
<td>1.02 V at 20 mA</td>
</tr>
</tbody>
</table>

**Voltage controlled input**

| Control voltage range: | DC 0 ... 5 V or DC 0 ... 10 V |
| Control input current: | < 0.01 mA at DC 10 V           |

**Potentiometer controlled input**

| Potentiometer value: | 10 kΩ ±10 % |
| Control accuracy     |             |
| Range:               | 0 ... 100 % |
| Step:                | 1.5625 %   |

**Output**

| Nominal load voltage: | AC 24 ... 115 V; AC 110 ... 240 V or AC 230 ... 480 V |
| Load current I_l:    | AC 10 A, 25 A, 50 A |
| Minimum operational current: | AC 40 mA |
| Operating mode:      | Continuous |
| Current reduction over 40°C |             |
| I_l, AC 10 A:        | 0.2 A / °C |
| I_l, AC 25 A:        | 0.4 A / °C |
| I_l, AC 50 A:        | 0.6 A / °C |
| Frequency range:     | 45 ... 65 Hz |
| Varistor voltage:    | AC 510 V   |
| Load types:          | Resistive  |
| Power loss:          | 1.2 (V) x I_l (A) approx. |
| Average power output:| 0 ... 100 % |
| Output power resolution: | at BF 9250/002: 1.5625 % |
|                      | at BF 9250/042: 5 % |
| Zero crossing detection: | YES          |
| Off state leakage current at rated voltage and frequency: | 1.0 mA (\(T_f = 125^\circ C\) max.) |
|                  | Pit for fusing t = 1 to 10 ms |
|                  | I_l, AC 10 A, 25 A: 800 A/s |
|                  | I_l, AC 50 A: 1800 A/s       |
|                  | Peak inverse voltage: ±1200 V_p |

Note: Higher current capacities on request

**Installation**

| Recommended distance with max. load current and 100 % duty cycle upper / lower side |
| to cable duct: 20 mm |
| left / right: 10 mm |

### Technical Data

**General Data**

| Maximum humidity: | 75 %, no condensation |
| Operating temperature: | 0 ... 40°C |
| Maximum temperature: | 60°C (using appropriate derating) |
| Storage temperature: | - 20 ... + 80°C |
| Cooling:            | Natural convection |
| Junction temperature: | < 125 °C |
| Rated withstand voltage input to output: | 3500 V |
| Degree of protection |
| Housing:            | IP 40 |
| Terminals:          | IP 20 |
| Mounting:           | DIN rail |
| Wire fixing:        | IEC/EN 60 715 |
| Wire connection:    |                |
| Load terminals:     | 1 x 10 mm² solid |
| Control terminals:  | cage clamps |
| Fixing torque:      | 1.2 Nm |
| Weight:             |                |
| BF 9250/0_2 to 10 A: | 350 g |
| BF 9250/0_2 to 25 A: | 580 g |
| BF 9250/0_2 to 50 A: | 1094 g |

**Dimensions**

| Width x height x depth |
| BF 9250/0_2 to 10 A: Width | 22.5 x 85 x 120 mm |
| BF 9250/0_2 to 25 A: Width | 45 x 85 x 120 mm |
| BF 9250/0_2 to 50 A: Width | 90 x 85 x 120 mm |

**UL-Data according to UL508**

| Input |
| Wire connection: | 60°C / 75°C copper conductors only |
|                | AWG 24 - 14 Sol/Str |

| Control input | Current input: DC 4 ... 20 mA |
| Voltage input: | DC 0 ... 5 V bzw. DC 0 ... 10 V |
| Potentiometer input: | 10 kOhm ±10 % |

| Load circuit |
| Fixed screw terminal: | 75°C copper conductors only |
|                | AWG 18 - 8 Sol Torque 0.8 Nm or |
|                | AWG 18 - 10 Str Torque 0.8 Nm |
| (only possible at variants up to 30 A) |

| Temperature range: | 0 ... 40 °C |
| Frequency range: | 50 / 60 Hz |
| Pollution degree: | 2 |

In the final circuit an overvoltage protector R/CSPD (VZCA2/8) with min. 480V AC, 50/60Hz, VPR=2500V, Type 3 has to be installed.

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

**Standard Type**

<table>
<thead>
<tr>
<th>BF 9250.91/042</th>
<th>UH, AC/DC 24 V</th>
<th>DC 0 ... 10 V</th>
<th>AC 230 ... 480 V</th>
<th>AC 10 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article number:</td>
<td>0059168</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 1-pole</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Control input:</td>
<td>DC 0 ... 10 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Auxiliary voltage:</td>
<td>AC/DC 24 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Load voltage:</td>
<td>AC 230 ... 480 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Load current:</td>
<td>AC 10 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Width:</td>
<td>22.5 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Variants**

| BF 9250/002: | Output control with fixed period of 64 cycles, pulse-space ratio according to input signal |
| BF 9250/042: | Self optimising, to achieve as short as possible control periods, suitable for infrared lamps |
Characteristics

![Graph showing load power and control signal relationship]

**Variant BF 9250/042**

**Variant BF 9250/002**

**Example of load power and control signal relationship:**
- 100% load power
- 75% load power
- 50% load power
- 25% load power

**Control signals:**
- ON every cycle
- 48 cycles ON - 16 cycles OFF
- 32 cycles ON - 32 cycles OFF
- 16 cycles ON - 48 cycles OFF

**Characteristics:**
- Each cycle combination is specified.
- Variants BF 9250/002 and BF 9250/042 differ in ON/OFF cycle ratios.
Application Examples

- L
- N
- DC 24V

- 0...10kΩ
- 4-20mA
- 0-10V

- e.g. electric ovens, resistive load, platen heaters, extruders

- M9170_a
Your Advantages
- High switching frequency and long life
- Space saving, only 22.5 mm width
- To be mounted on cooling surface with only 2 screws
- With heat sink for DIN-rail mounting
- Silent
- Vibration- and shock resistance

Features
- AC solid-state relay / -contactor
- PK 9260/_ _ _ according to IEC/EN 62314
- PK 9260/_ _ _ / _ _ according to IEC/EN 60947-4-2 and -4-3
- Load current up to 88 A, AC-51
- Switching at zero crossing for resistive loads
- 2 anti-parallel thyristors
- DCB technology (direct bonding method) for excellent heat transmission properties
- As option with:
  - M4 flat terminal or
  - M5 screw terminal for cable lug
- LED status indicator
- Peak reverse voltage up to ±1600 V
- Insulation voltage 4000 V
- As option with heat sink, for DIN rail mounting

Approvals and Markings

Applications
Solid-state relays switching at zero crossing:
For frequent no-wear and no-noise switching of:
- heating systems
- cooling systems
- valves
- lighting systems
The solid-state relay switches at zero crossing and is suitable for many applications e.g. extrusion machines for plastic and rubber, packaging machines, solder lines, machines in food industry.

Function
The solid-state relay PK 9260 is designed with 2 anti-parallel connected thyristors switching at zero crossing for resistive loads (e.g. heating systems). When connecting the control voltage the output of the solid-state relay is activated at the next zero crossing of the sinusoidal voltage. When disconnecting the control voltage the output is switched off at the next zero crossing of the load current. The LED shows the state of the control input.

Operation Notes
EMC disturbance during operation has to be reduced by corresponding measures and filters. If several solid-state relays are mounted together sufficient cooling and ventilation has to be provided.
Control Circuit

<table>
<thead>
<tr>
<th>Control voltage range [V]:</th>
<th>DC 4 ... 32</th>
<th>AC/DC 18 ... 30</th>
<th>AC 100 ... 230</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making voltage [V]:</td>
<td>3.0</td>
<td>10</td>
<td>80</td>
</tr>
<tr>
<td>Switch off voltage [V]:</td>
<td>1.0</td>
<td>6.0</td>
<td>25</td>
</tr>
<tr>
<td>Max. input current [mA]:</td>
<td>12</td>
<td>25 at 24 V AC</td>
<td>20 at 230 V AC</td>
</tr>
<tr>
<td>Start up delay [ms]:</td>
<td>≤ 1.0 + ½ cycle*</td>
<td>≤ 5 + ½ cycle*</td>
<td>≤ 10 + ½ cycle*</td>
</tr>
<tr>
<td>Release delay [ms]:</td>
<td>≤ 1.0 + ½ cycle*</td>
<td>≤ 20 + ½ cycle*</td>
<td>≤ 35 + ½ cycle*</td>
</tr>
</tbody>
</table>

*½ cycle delay only when switching at 0-crossing, at instantaneous switching the delay = 0

Output

<table>
<thead>
<tr>
<th>Load voltage AC [V]:</th>
<th>24 ... 230</th>
<th>48 ... 460</th>
<th>48 ... 600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak reverse voltage [V]:</td>
<td>650</td>
<td>1200</td>
<td>1600</td>
</tr>
<tr>
<td>Frequency range [Hz]:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solid-state relays, heat sink see table</th>
<th>Load current $I_{120}$ [A] / AC-51:</th>
<th>24</th>
<th>32</th>
<th>48</th>
<th>48*</th>
<th>72</th>
<th>72*</th>
<th>88</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid-state contactor at $T_J = 40 \degree C$:</td>
<td>Designation heat sink:</td>
<td></td>
<td>/03</td>
<td>/04</td>
<td>/05</td>
<td>/06</td>
<td>/06</td>
<td>/06</td>
</tr>
<tr>
<td>Load current $I_{120}$ [A] / AC-51:</td>
<td>10 20</td>
<td>40 60</td>
<td>60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current reduction above $T_J = &gt; 40 \degree C$ [A/\degree C]:</td>
<td></td>
<td>0.3</td>
<td>0.4</td>
<td>0.6</td>
<td>0.8</td>
<td>0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. overload current [A], t = 10 ms:</td>
<td>≤ 350</td>
<td>≤ 400</td>
<td>≤ 400</td>
<td>≤ 620</td>
<td>≤ 1300*</td>
<td>≤ 1050</td>
<td>≤ 1150</td>
<td>≤ 1150</td>
</tr>
<tr>
<td>Load limit integral $I^2t$ [A^2s]:</td>
<td>612 800 800 1920 8500* 5500 6600 6600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leakage current in off state [mA]:</td>
<td>≤ 1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. current [mA]:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Forward voltage [V] at nominal current:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.1 1.2 1.2 1.2 1.1 1.2 1.2 1.2</td>
</tr>
<tr>
<td>Off-state voltage [V/\mu s]:</td>
<td>500 500 1000 1000 1000 1000 1000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of rise of current [A/\mu s]:</td>
<td>150 150 100 150 150 150 150 150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thermal Data - Solid-State Relays -

<table>
<thead>
<tr>
<th>Solid-state relays without heat sink</th>
<th>Load current $I_{120}$ [A] / AC-51:</th>
<th>24</th>
<th>32</th>
<th>48</th>
<th>48*</th>
<th>72</th>
<th>72*</th>
<th>88</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal resistance</td>
<td>Junction ambient [K/W]:</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal resistance</td>
<td>Junction housing [K/W]:</td>
<td>0,55 0,48 0,36 0,25 0,25 0,25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junction temperature [\degree C]:</td>
<td>≤ 125</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes on Sizing for Selection of a Heat Sink

The heat generated by the load current must be dissipated by a suitable heat sink. It is imperative that the junction temperature of the semiconductor is maintained for all potential environmental temperatures of under 125\degree C. For this reason, it is important to keep the thermal resistance between the base plate of the solid-state relay and the heat sink to a minimum.

To protect the solid-state relay effectively from excess heating, a thermally conducting paste or a graphit gasket (see Accessories) should be applied before installation to the base plate of the heat sink between semiconductor relay and heat sink.

From the table, select a suitable heat sink with the next lowest thermal resistance. Thus, it is ensured that the maximum junction temperature of 125\degree C is not exceeded. The load current in relation to the environmental temperature can be seen from the table.
### Selection of a Heat Sink

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>PK 9260 32 A Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>32.0</td>
<td>2.0 1.9 1.6 1.3 1.1 0.8</td>
</tr>
<tr>
<td>28.8</td>
<td>2.5 2.2 1.9 1.6 1.3 1.0</td>
</tr>
<tr>
<td>25.6</td>
<td>3.0 2.7 2.3 2.0 1.6 1.3</td>
</tr>
<tr>
<td>22.4</td>
<td>3.7 3.3 2.8 2.4 2.0 1.6</td>
</tr>
<tr>
<td>19.2</td>
<td>4.5 4.0 3.5 3.1 2.6 2.1</td>
</tr>
<tr>
<td>16.0</td>
<td>5.8 5.2 4.5 3.9 3.3 2.7</td>
</tr>
<tr>
<td>12.8</td>
<td>7.6 6.8 6.1 5.3 4.5 3.7</td>
</tr>
<tr>
<td>9.6</td>
<td>- 9.7 - 8.6 7.5 6.4 5.3</td>
</tr>
<tr>
<td>6.4</td>
<td>- - - - - 8.5</td>
</tr>
<tr>
<td>3.2</td>
<td>- - - - -</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient temperature (°C)</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
</table>

#### Solid-State Contactor

**Solid-state with optimised heat sink**

We recommend the following combination of solid-state relay and heat-sink depending on the load current and an ambient temperature of 40°C.

If the solid-state relays are used at ambient temperature above 40°C the load current has to be reduced according to the current reduction (A/°C see table).

**Example:**

Operation at $T_u = 45°C$; heat sink for 10 A with 0.3 A / °C

Current reduction: $5°C \times 0.3 A / °C = 1.5 A$

Max. load current: $10 A - 1.5 A = 8.5 A$

---

**Selection of a Heat Sink**

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>PK 9260 48 A / 48 A Hi I t Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>48.0</td>
<td>1.3 1.2 1.0 0.8 0.6 0.5</td>
</tr>
<tr>
<td>43.2</td>
<td>1.6 1.4 1.2 1.0 0.8 0.6</td>
</tr>
<tr>
<td>38.4</td>
<td>1.9 1.7 1.5 1.2 1.0 0.8</td>
</tr>
<tr>
<td>33.6</td>
<td>2.4 2.1 1.8 1.6 1.3 1.0</td>
</tr>
<tr>
<td>28.8</td>
<td>3.0 2.6 2.3 2.0 1.6 1.3 1.0 1.3 1.0</td>
</tr>
<tr>
<td>24.0</td>
<td>3.8 3.4 3.0 2.6 2.2 2.2 1.8</td>
</tr>
<tr>
<td>19.2</td>
<td>5.1 4.6 4.0 3.5 3.0 2.4</td>
</tr>
<tr>
<td>14.4</td>
<td>7.2 6.5 5.8 5.0 4.3 3.6</td>
</tr>
<tr>
<td>9.6</td>
<td>- - 9.3 8.1 7.0 5.8</td>
</tr>
<tr>
<td>4.8</td>
<td>- - - - - -</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient temperature (°C)</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
</table>

---

**Selection of a Heat Sink**

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>PH 9260 72 A Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72.0</td>
<td>0.7 0.6 0.5 0.4 0.3 -</td>
</tr>
<tr>
<td>64.8</td>
<td>0.9 0.8 0.7 0.5 0.4 0.3</td>
</tr>
<tr>
<td>57.6</td>
<td>1.1 1.0 0.8 0.7 0.5 0.4</td>
</tr>
<tr>
<td>50.4</td>
<td>1.5 1.3 1.1 0.9 0.7 0.5</td>
</tr>
<tr>
<td>43.2</td>
<td>1.9 1.6 1.4 1.2 1.0 0.7</td>
</tr>
<tr>
<td>36.0</td>
<td>2.4 2.2 1.9 1.6 1.3 1.1</td>
</tr>
<tr>
<td>28.8</td>
<td>3.3 3.0 2.6 2.2 1.9 1.5</td>
</tr>
<tr>
<td>21.6</td>
<td>4.8 4.3 3.8 3.3 2.8 2.3</td>
</tr>
<tr>
<td>14.4</td>
<td>7.8 7.0 6.2 5.5 4.7 3.9</td>
</tr>
<tr>
<td>7.2</td>
<td>- - - - - -</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient temperature (°C)</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
</table>

---

**Selection of a Heat Sink**

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>PK 9260 88 A Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>88.0</td>
<td>0.6 0.5 0.4 0.3 - -</td>
</tr>
<tr>
<td>79.2</td>
<td>0.7 0.6 0.5 0.4 0.3 -</td>
</tr>
<tr>
<td>70.4</td>
<td>0.9 0.8 0.7 0.6 0.4 0.3</td>
</tr>
<tr>
<td>61.6</td>
<td>1.2 1.0 0.9 0.7 0.6 0.4</td>
</tr>
<tr>
<td>52.8</td>
<td>1.5 1.3 1.1 1.0 0.8 0.6</td>
</tr>
<tr>
<td>44.0</td>
<td>2.0 1.8 1.5 1.3 1.1 0.9</td>
</tr>
<tr>
<td>35.2</td>
<td>2.7 2.4 2.1 1.8 1.5 1.2</td>
</tr>
<tr>
<td>26.4</td>
<td>3.9 3.5 3.1 2.7 2.3 1.9</td>
</tr>
<tr>
<td>17.6</td>
<td>6.3 5.7 5.0 4.4 3.8 3.1</td>
</tr>
<tr>
<td>8.8</td>
<td>- - - - - -</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient temperature (°C)</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
</table>
### General Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating mode</td>
<td>Continuous operation (Current reduction above 40 °C)</td>
</tr>
<tr>
<td>Temperature range operation</td>
<td>-25 ... 60 °C</td>
</tr>
<tr>
<td>storage</td>
<td>-25 ... 85 °C</td>
</tr>
<tr>
<td>Relative air humidity</td>
<td>&lt; 95 % non-condensing at 40 °C</td>
</tr>
<tr>
<td>Clearance and creepage distances</td>
<td></td>
</tr>
<tr>
<td>rated impulse voltage / pollution degree</td>
<td>6 kV / 2 IEC/EN 60 664-1</td>
</tr>
<tr>
<td>EMC</td>
<td>IEC/EN 61 000-6-4</td>
</tr>
<tr>
<td>Electrostatic discharge (ESD)</td>
<td>8 kV air / 6 kV contact</td>
</tr>
<tr>
<td>HF irradiation</td>
<td>10 V / m IEC/EN 61 000-4-3</td>
</tr>
<tr>
<td>Fast transients</td>
<td>2 kV IEC/EN 61 000-4-4</td>
</tr>
<tr>
<td>Surge voltages</td>
<td></td>
</tr>
<tr>
<td>Control circuit between A1 / A2:</td>
<td>1 kV IEC/EN 61 000-4-5</td>
</tr>
<tr>
<td>between output and ground:</td>
<td>2 kV IEC/EN 61 000-4-5</td>
</tr>
<tr>
<td>HF-wire guided</td>
<td>10 V IEC/EN 61 000-4-6</td>
</tr>
<tr>
<td>Interference suppression</td>
<td>Limit value class A IEC/EN 60 947-4-3</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 10 IEC/EN 60 529</td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>Frequency 0.35 mm</td>
</tr>
<tr>
<td>Housing material</td>
<td>PBT/PC flame resistant; UL 94 V0</td>
</tr>
<tr>
<td>Base plate</td>
<td>Aluminum, copper nickle-plated</td>
</tr>
<tr>
<td>Mounting screws</td>
<td>M4 x 20 mm</td>
</tr>
<tr>
<td>Mounting torque</td>
<td>2.5 Nm</td>
</tr>
<tr>
<td>Connections load circuit / 0</td>
<td>Mounting screws M4 Pozidrive 1 PT</td>
</tr>
<tr>
<td>Mounting torque</td>
<td>2.5 Nm</td>
</tr>
<tr>
<td>Wire cross section</td>
<td>2 x 1.5 ... 2.5 mm² solid or 2 x 2.5 ... 6 mm² solid or 2 x 1.0 ... 2.5 mm² stranded wire with sleeve 2 x 2.5 ... 6 mm² stranded wire with sleeve 1 x 10 mm² stranded wire with sleeve</td>
</tr>
<tr>
<td>Connections load circuit / 1</td>
<td>Mounting screws M5</td>
</tr>
<tr>
<td>Mounting torque</td>
<td>2.5 Nm</td>
</tr>
<tr>
<td>cable lug (DIN 46234):</td>
<td>5 - 2.5; 5 - 6; 5 - 10; 5 - 16; 5 - 25</td>
</tr>
<tr>
<td>Connections control circuit</td>
<td>Mounting screws M3 Pozidrive 2 PT</td>
</tr>
<tr>
<td>Mounting torque</td>
<td>0.6 Nm</td>
</tr>
<tr>
<td>Wire cross section</td>
<td>1 x 0.5 ... 2.5 mm² solid or 2 x 0.5 ... 1.0 mm² solid or 1 x 0.5 ... 2.5 mm² stranded wire with sleeve</td>
</tr>
<tr>
<td>Nominal insulation voltage</td>
<td>4 kVeff.</td>
</tr>
<tr>
<td>Load circuit – base plate</td>
<td>4 kVeff.</td>
</tr>
<tr>
<td>Overvoltage category</td>
<td>III</td>
</tr>
<tr>
<td>Weight without heat sink</td>
<td>approx. 80 g</td>
</tr>
<tr>
<td>with heat sink</td>
<td></td>
</tr>
<tr>
<td>Load current</td>
<td></td>
</tr>
<tr>
<td>10 A:</td>
<td>approx. 225 g</td>
</tr>
<tr>
<td>20 A:</td>
<td>approx. 305 g</td>
</tr>
<tr>
<td>40 A:</td>
<td>approx. 575 g</td>
</tr>
<tr>
<td>60 A:</td>
<td>approx. 785 g</td>
</tr>
<tr>
<td>Dimensions</td>
<td></td>
</tr>
<tr>
<td>Width x height x depth</td>
<td></td>
</tr>
<tr>
<td>without heat sink</td>
<td>22.5 x 85 x 50 mm</td>
</tr>
<tr>
<td>with cable lug terminals</td>
<td>22.5 x 139 x 50 mm</td>
</tr>
<tr>
<td>with heat sink</td>
<td></td>
</tr>
<tr>
<td>Load current</td>
<td></td>
</tr>
<tr>
<td>10 A:</td>
<td>22.5 x 99 x 92 mm</td>
</tr>
<tr>
<td>20 A:</td>
<td>22.5 x 99 x 131 mm</td>
</tr>
<tr>
<td>40 A:</td>
<td>45 x 105 x 135 mm</td>
</tr>
<tr>
<td>60 A:</td>
<td>67.5 x 136 x 127 mm</td>
</tr>
</tbody>
</table>

### Standard Type

<table>
<thead>
<tr>
<th>PK 9260.91 AC 48 ... 460 V 24 A DC 4 ... 32 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article number:</td>
</tr>
<tr>
<td>• Load voltage:</td>
</tr>
<tr>
<td>• Load current:</td>
</tr>
<tr>
<td>• Control voltage:</td>
</tr>
<tr>
<td>• Width:</td>
</tr>
</tbody>
</table>

### Variants

<table>
<thead>
<tr>
<th>PK 9260 .91 / _ _ _ /0 _</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Without heat sink</td>
</tr>
<tr>
<td>3 With heat sink 10 A</td>
</tr>
<tr>
<td>4 With heat sink 20 A</td>
</tr>
<tr>
<td>5 With heat sink 40 A</td>
</tr>
<tr>
<td>6 With heat sink 60 A</td>
</tr>
<tr>
<td>0 M4 flat terminal</td>
</tr>
<tr>
<td>1 M5 screw terminal (cable lug)</td>
</tr>
<tr>
<td>2 M5 cable lug terminal (cable lug)</td>
</tr>
<tr>
<td>0 Switching at zero crossing</td>
</tr>
<tr>
<td>1 Instantaneous switching</td>
</tr>
<tr>
<td>0 Standard</td>
</tr>
<tr>
<td>1 With high I²t-value</td>
</tr>
</tbody>
</table>

### Ordering example for variants

<table>
<thead>
<tr>
<th>PK 9260 91 / 0 0 /04 AC 48 ... 460 V 20 A DC 4 ... 32 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control voltage</td>
</tr>
<tr>
<td>Load current</td>
</tr>
<tr>
<td>with heat sink</td>
</tr>
<tr>
<td>M4 flat terminal</td>
</tr>
<tr>
<td>M5 cable lug terminal (cable lug)</td>
</tr>
<tr>
<td>Switching at zero crossing</td>
</tr>
<tr>
<td>Instantaneous switching</td>
</tr>
<tr>
<td>standard</td>
</tr>
<tr>
<td>With high I²t-value</td>
</tr>
</tbody>
</table>

### Connection Example

- **PK9260**
- **0** M4 flat terminal
- **1** M5 screw terminal (cable lug)
- **2** M5 cable lug terminal (cable lug)
- **3** Switching at zero crossing
- **4** Instantaneous switching
- **5** Standard
- **6** With high I²t-value

- **single-phase**
Connection Example

Flat terminals
PK 9260.91/_0

Screw terminals / cable lug terminals
PK 9260.91/_1

PK 9260.91/_0/03

PK 9260.91/_0/04
Connection Example

PK 9260.91/0/05

PK 9260.91/0/06
According to IEC/EN 60 947-1, IEC/EN 60 947-4-2
Switching at zero crossing
To switch single-phase AC load up to 400 V
Compensates voltage fluctuations of ± 20%
Load current up to 40 A
Monitors:
- Undercurrent
- Overcurrent
- Interrupted load circuit
- Monitors temperature to protect the power semiconductor
De-energized on fault
One relay output with changeover contact
LED Indicators
No auxiliary supply
Galvanically separated control input X1-X2 with wide voltage range
Adjustable current response value
With integrated heat sink
DIN-rail mounting
45 mm, 67.5 mm and 112.5 mm width

Additional Information About This Topic
- Data sheet BF 9250, Semiconductor contactor

Approvals and Markings

Applications
To monitor max. 12 parallel connected heating elements in packaging machines, plastic moulding machines, blister packaging machines etc.

Number-/load of heating elements to be connected to BH 9251, at load voltage AC 230 V

<table>
<thead>
<tr>
<th>BH 9251</th>
<th>Load current up to:</th>
<th>5 A</th>
<th>10 A</th>
<th>20 A</th>
<th>40 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. total load of heating elements:</td>
<td>1150 W</td>
<td>2300 W</td>
<td>4600 W</td>
<td>9200 W</td>
<td></td>
</tr>
<tr>
<td>Max. no. of heating elements:</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Load of one element:</td>
<td>95 W</td>
<td>190 W</td>
<td>380 W</td>
<td>760 W</td>
<td></td>
</tr>
</tbody>
</table>

Monitors:
- Failure of a heating element ≥ 190 W / 380 W / 760 W
- Broken wire detection
- Short circuits between windings of a heating element

Circuit Diagrams
Function

Voltage compensation:
The unit includes voltage compensation of ± 20%. Only fault caused by defective heating elements are detected. Current changes caused by voltage fluctuations are ignored.

Failure of one heating element:
If the current decreases from the adjusted value by 8 % of the total value the monitoring output switches off. The failure of one heating element ≥ 190 W will be detected. The control input X1-X2 has to be closed at least 100 ms to allow current sensing.

Broken wire detection in the load circuit:
A broken line in the load circuit is monitored. The output relay switches off.

Overcurrent in the load circuit:
If the current increases from the adjusted value by 10 % of the total value the semiconductor remains active. If the overcurrent decreases to normal current the output relay switches off. This function is used to protect the device against overload.

Temperature monitoring:
The temperature detection gets active when the temperature on the semiconductor is too high. The monitoring output switches off together with the power semiconductor. If the temperature goes back to normal the semiconductor remains active again.

Temperature range:
0.8 ... 1.2 UN

Operating mode:
Continuous operation

Temperature range:
0 °C ... + 40 °C

max. temperature:
60 °C (with current reduction)

Storage temperature:
-20 °C ... + 80 °C

Clearance and creepage distances:
rated impulse voltage / distances
between wire and ground: 2 kV IEC/EN 61 000-4-5
between wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
HF-wire-guided: 10 V IEC/EN 61 000-4-6

Surge voltages:
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

Vibration resistance:
amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6
Climate resistance:
0 / 060 / 04 IEC/EN 60 068-1

Terminal designation:
EN 50 005

Wire connection:
Load terminals: 1 x 10 mm² solid, or 1 x 6 mm² stranded ferruled
Control terminals: 2 x 1.5 mm² stranded ferruled

Mounting:
DIN rail IEC/60 715

Weight:
45 mm 400 g

Dimensions:
width x height x depth: 45 x 84 x 121 mm (10 A)
67.5 x 84 x 121 mm (20 A)
112.5 x 84 x 121 mm (40 A)

Technical Data

Output

Load output I₄:

<table>
<thead>
<tr>
<th>Load current</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 mm</td>
<td>67.5 mm</td>
</tr>
<tr>
<td>10 A</td>
<td>20 A</td>
</tr>
</tbody>
</table>

Values at Tu = 40 °C und 100 % ED

Current reduction:
40 °C

| 0.2 A / °C | 0.4 A / °C | 0.6 A / °C |

Load voltage:
230 V ± 20 %

Cut-off voltage:
1200 Vp

Leakage current:
< 1 mA

Switching delay:
< 100 ms

Semiconductor fuse:
BH 9251, 10 A + 20 A: 800 A² s
BH 9251, 40 A: 1800 A² s

Monitoring output:

Contacts:
BH 9251.11 1 changeover contact

Thermal continuous current I₄:
4 A

Switching capacity:
to AC 15
NO: 3 A / AC 230 V IEC/EN 60 947-5-1
NC: 1 A / AC 230 V IEC/EN 60 947-5-1

Electrical life:
to AC 15 at 3 A, AC 230 V: 2 x 10⁶ switching cycles IEC/EN 60 947-5-1

Short circuit strength:
max. fuse rating: 4 A gL IEC/EN 60 947-5-1

General Data

Operating mode:
Continuous operation

Temperature range:
0 °C ... + 40 °C

max. temperature:
60 °C (with current reduction)

Storage temperature:
-20 °C ... + 80 °C

Clearance and creepage distances:
rated impulse voltage /
distances
between wire and ground: 2 kV IEC/EN 61 000-4-5
between wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
HF-wire-guided: 10 V IEC/EN 61 000-4-6

Surge voltages:
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

Vibration resistance:
amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6
Climate resistance:
0 / 060 / 04 IEC/EN 60 068-1

Terminal designation:
EN 50 005

Wire connection:
Load terminals: 1 x 10 mm² solid, or 1 x 6 mm² stranded ferruled
Control terminals: 2 x 1.5 mm² stranded ferruled

Mounting:
DIN rail IEC/60 715

Weight:
45 mm 400 g

Dimensions:
width x height x depth: 45 x 84 x 121 mm (10 A)
67.5 x 84 x 121 mm (20 A)
112.5 x 84 x 121 mm (40 A)

Technical Data

Input

Nominal voltage U₄:
L - N: AC 230 V / 48 V
L1 - L2: AC 400 V on request

Voltage range:
0.8 ... 1.2 U₄

Nominal consumption:
0.8 W / 3.2 VA

Nominal frequency:
50 / 60 Hz

Control input X1-X2:
galvanically separated

Input voltage:
AC/DC 9.6 ... 270 V

Input current:
approx. 1 mA

Impulse length:
≥ 100 ms

Current Sensing

Measuring range:
1 ... 10 A / 2 ... 20 A / 4 ... 40 A

Measuring accuracy:
1 % of end scale value

Setting accuracy:
± 2.5 % of end scale value

Repeat accuracy:
< ± 1 %

Adjustment of current value:
infinite within measuring range

Response value for overcurrent:
≥ 10 % of end scale value, fixed

Response value for undercurrent:
- 8 % of end scale value, fixed

Voltage compensation:
± 20 %

Sample time:
≤ 100 ms

Indicators

green LED, continuous light:
Voltage connected, load current and setting value are identical

green LED, flashing:
Voltage connected, load current and setting value are not identical

yellow LED X1, continuous light:
Control input X1, X2 active

red LED > 0, flashing:
Temperature detection active.

> 1, continuous light:
Overcurrent ≥ 10 %

red LED < 1, continuous light:
Failure of one heating element or broken wire in load circuit

Voltage compensation:
The unit includes voltage compensation of ± 20%. Only fault caused by defective heating elements are detected. Current changes caused by voltage fluctuations are ignored.

Failure of one heating element:
If the current decreases from the adjusted value by 8 % of the total value the monitoring output switches off. The failure of one heating element ≥ 190 W will be detected. The control input X1-X2 has to be closed at least 100 ms to allow current sensing.

Broken wire detection in the load circuit:
A broken line in the load circuit is monitored. The output relay switches off.

Overcurrent in the load circuit:
If the current increases from the adjusted value by 10 % of the total value the semiconductor remains active. If the overcurrent decreases to normal current the output relay switches off. This function is used to protect the device against overload.

Temperature monitoring:
The temperature detection gets active when the temperature on the semiconductor is too high. The monitoring output switches off together with the power semiconductor. If the temperature goes back to normal monitoring output and the semiconductor are switched on again. The time disconnection depends on the ambient temperature.

Temperature range:
0.8 ... 1.2 UN

Operating mode:
Continuous operation

Temperature range:
0 °C ... + 40 °C

max. temperature:
60 °C (with current reduction)

Storage temperature:
-20 °C ... + 80 °C

Clearance and creepage distances:
rated impulse voltage /
distances
between wire and ground: 2 kV IEC/EN 61 000-4-5
between wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
HF-wire-guided: 10 V IEC/EN 61 000-4-6

Surge voltages:
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

Vibration resistance:
amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6
Climate resistance:
0 / 060 / 04 IEC/EN 60 068-1

Terminal designation:
EN 50 005

Wire connection:
Load terminals: 1 x 10 mm² solid, or 1 x 6 mm² stranded ferruled
Control terminals: 2 x 1.5 mm² stranded ferruled

Mounting:
DIN rail IEC/60 715

Weight:
45 mm 400 g

Dimensions:
width x height x depth: 45 x 84 x 121 mm (10 A)
67.5 x 84 x 121 mm (20 A)
112.5 x 84 x 121 mm (40 A)
46

Standard Type
BH 9251.11  AC 230 V  50/60 Hz  10 A
Article number:  0052267
- Nominal voltage:  AC 230 V
- Load current:  10 A
- Width:  45 mm

Ordering Example
BH 9251  11  AC 230 V  50 / 60 HZ  10 A

Notes for Installation
Suggested distance:
- between relay and cable duct: 20 mm
- to neighbour device: 10 mm; at max. load current and 100 duty cycle

Set-up Procedure
1.) Switch on heating elements by activating control input X1.
2.) When the potentiometer is in left hand position the red LED >I must be
    on because the unit detects an overcurrent. At the same time the green
    LED is flashing. Turning the potentiometer slowly clockwise the red LED
    >I goes off and contact 11-14 closes. The green LED is still flashing.
    When the potentiometer is turned further clockwise the LED will change
    from flashing to continuous light. At this point the window indicating the
correct current is reached. Turning further clockwise will make the LED
    flash again. The width of the window is ± 2.5 % of the setting range.
    To adjust the unit to the optimum setting the potentiometer should be
    set in the middle between the 2 points where the green LED starts
    flashing. At this point the actual current flowing and the setting value
    are identical. Current changes of > ± 2.5 % will make the green LED
    flash again. An undercurrent of 8 % will make the red LED <I light up
    and an overcurrent of 10 % will turn the red LED >I on.
    The settings can be done also while the voltage is fluctuating within 20
    % from the nominal voltage as changes in these limits are compensa-
    ted.
3.) Simulating the failure of one heating element by disconnecting the
element. The output relay switches off and the LED <I goes on.

Safety Notes
- Failures in the circuit must only be removed when the unit is disconnected.
- The user has to make sure, that the units and the corresponding
  components are connected and operated according to the local, legal
  and technical standards (e.g. TÜV, BG, VDE).
- Adjustment must only be done by educated personnel according to the
  appropriate safety standards. For work in the circuit and on the product
  the unit must be disconnected form the mains.

Application Examples

<table>
<thead>
<tr>
<th>BH 9251 .11   AC 230 V   50/60 Hz   10 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article number:  0052267</td>
</tr>
<tr>
<td>0052267</td>
</tr>
<tr>
<td>• Nominal voltage:  AC 230 V</td>
</tr>
<tr>
<td>• Load current:  10 A</td>
</tr>
<tr>
<td>• Width:  45 mm</td>
</tr>
</tbody>
</table>

Suggested distance:
- between relay and cable duct: 20 mm
- to neighbour device: 10 mm; at max. load current and 100 duty cycle

Set-up Procedure
1.) Switch on heating elements by activating control input X1.
2.) When the potentiometer is in left hand position the red LED >I must be
    on because the unit detects an overcurrent. At the same time the green
    LED is flashing. Turning the potentiometer slowly clockwise the red LED
    >I goes off and contact 11-14 closes. The green LED is still flashing.
    When the potentiometer is turned further clockwise the LED will change
    from flashing to continuous light. At this point the window indicating the
correct current is reached. Turning further clockwise will make the LED
    flash again. The width of the window is ± 2.5 % of the setting range.
    To adjust the unit to the optimum setting the potentiometer should be
    set in the middle between the 2 points where the green LED starts
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    are identical. Current changes of > ± 2.5 % will make the green LED
    flash again. An undercurrent of 8 % will make the red LED <I light up
    and an overcurrent of 10 % will turn the red LED >I on.
    The settings can be done also while the voltage is fluctuating within 20
    % from the nominal voltage as changes in these limits are compensa-
    ted.
3.) Simulating the failure of one heating element by disconnecting the
element. The output relay switches off and the LED <I goes on.

Safety Notes
- Failures in the circuit must only be removed when the unit is disconnected.
- The user has to make sure, that the units and the corresponding
  components are connected and operated according to the local, legal
  and technical standards (e.g. TÜV, BG, VDE).
- Adjustment must only be done by educated personnel according to the
  appropriate safety standards. For work in the circuit and on the product
  the unit must be disconnected form the mains.
Application examples

M7896_a

M8455
### Function Diagram

The solid-state relay switches at zero crossing and is suitable for many applications e.g. extrusion machines for plastic and rubber, packaging machines, solder lines, machines in food industry.

### Circuit Diagram

The solid-state relay PH 9260 is designed with 2 anti-parallel connected thyristors switching at zero crossing.

When connecting the control voltage the output of the solid-state relay is activated at the next zero crossing of the sinusoidal voltage. When disconnecting the control voltage the output is switched off at the next zero crossing of the load current.

The LED shows the state of the control input.

As option the solid-state relay is available with heatsink to be mounted on DIN rail. This provides optimum heat transmission.

### Connection Terminals

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1(+), A2</td>
<td>Control input</td>
</tr>
<tr>
<td>L1</td>
<td>Mains connections</td>
</tr>
<tr>
<td>T1</td>
<td>Load output</td>
</tr>
</tbody>
</table>

### Overtemperature protection

Optionally, the solid-state relay has an overtemperature protection to monitor the temperature of the heat sink. To this end, a thermal release switch (NC contact) can be inserted into the respective pocket at the bottom of the solid-state relay. As soon as the temperature of the heat sink exceeds for example 100°C, the thermal release switch. For thermal protection of the solid-state relay, a thermal release switch of UCHIYA type UP62 – 100 can be installed.
General Data
Operating mode: Continuous operation
Temperature range:
operation: -20 ... 40°C
storage: -20 ... 80°C
Clearance and creepage distances
rated impulse voltage / pollution degree: 6 kV / 3 IEC/EN 60 664-1
EMC:
IEC/EN 61000-6-4, IEC/EN 61000-4-1
Electrostatic discharge (ESD): 8 kV air / 6 kV contact IEC/EN 61000-4-2
HF irradiation: 10 V / m IEC/EN 61000-4-3
Fast transients: 2 kV IEC/EN 61000-4-4
Surge voltages between wires for power supply: 1 kV IEC/EN 61000-4-5
between wire and ground: 2 kV IEC/EN 61000-4-5
HF-wire guided 10 V IEC/EN 61000-4-6
Degree of protection
Housing: IP 40 IEC/EN 60529
Terminals: IP 20 IEC/EN 60529
Vibration resistance:
Amplitude 0.35 mm
frequency 10 ... 55 Hz, IEC/EN 60-068-2-6
Housing material:
Fiberglass reinforced polycarbonate
Flame resistant: UL 94 V0
Base plate:
Aluminum, copper nickle-plated
Potting compound:
Polyurethane
Mounting screws:
M5 x 8 mm
Fixing torque: 2.5 Nm
Connections control circuit:
Mounting screws M3 Pozidrive 2 PT
Fixing torque: 0.5 Nm
1) Only for pulse operation: Please make sure, that the mean value of
the current does not exceed 50 A on these devices.
2) Variant PH 9260.91/1_ __
3) Variant PH 9260.91/120

Control Circuit

<table>
<thead>
<tr>
<th>Control voltage range [V]:</th>
<th>DC</th>
<th>AC/DC</th>
<th>AC/DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH 9260:</td>
<td>4 ... 32</td>
<td>18 ... 36</td>
<td>100 ... 240</td>
</tr>
<tr>
<td>Max. nominal input current [mA]:</td>
<td>12</td>
<td>25 (AC)</td>
<td>5 bel</td>
</tr>
<tr>
<td>PH 9260/020:</td>
<td>12 (DC)</td>
<td>240 V AC (regulated)</td>
<td></td>
</tr>
<tr>
<td>Max. nominal input current [mA]:</td>
<td>20</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Turn-on delay [ms]:</td>
<td>5 + 1/2 cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-off delay [ms]:</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>at AC/DC 18 ... 36 V:</td>
<td>20 + 1/2 cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>at AC/DC 85 ... 265 V:</td>
<td>30 + 1/2 cycle</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Output
Load voltage AC [V]:
PH 9260: 24 ... 240, 48 ... 480, 48 ... 600
PH 9260/020: 100 ... 240, 200 ... 480
Frequency range [Hz]:
47 ... 63
Load current [A], AC-51:
PH 9260, PH 9260/020:
25 50 100(1) 125(1)
Load current [A], AC-56a:
PH 9260/020:
- 20 - -
Load limit integral /T [A²s]:
800 1800 6600 6600 18000
Max. overload current [A]
10 ms:
400 600 1150 1150 1900
Periodic overload current
1 s [A]:
40 120 150 150 200
Min. current [mA]:
20
On-state voltage at nominal current [V]:
1.2 1.4 1.4 1.3
Rate of rise of off-state voltage [V/μs]:
500 500 1000 1000
Rate of rise of current [A/μs]:
100 100 100 150

Temperature Data
Thermal resistance junction - housing [K/W]:
0.6 0.5 0.3 0.3
Thermal resistance housing - ambient [K/W]:
12 12 12 12
Junction temperature [°C]:
≤ 125

Technical Data
Output
Load voltage AC [V]:
PH 9260: 24 ... 240, 48 ... 480, 48 ... 600
PH 9260/020: 100 ... 240, 200 ... 480
Frequency range [Hz]:
47 ... 63
Load current [A], AC-51:
PH 9260, PH 9260/020:
25 50 100(1) 125(1)
Load current [A], AC-56a:
PH 9260/020:
- 20 - -
Load limit integral /T [A²s]:
800 1800 6600 6600 18000
Max. overload current [A]
10 ms:
400 600 1150 1150 1900
Periodic overload current
1 s [A]:
40 120 150 150 200
Min. current [mA]:
20
On-state voltage at nominal current [V]:
1.2 1.4 1.4 1.3
Rate of rise of off-state voltage [V/μs]:
500 500 1000 1000
Rate of rise of current [A/μs]:
100 100 100 150

Temperature Data
Thermal resistance junction - housing [K/W]:
0.6 0.5 0.3 0.3
Thermal resistance housing - ambient [K/W]:
12 12 12 12
Junction temperature [°C]:
≤ 125

UL-Data
Control voltage:
DC 4 ... 32 V, Class 2 or current / voltage limiting acc. to UL 508
Load type:
Resistive
Wire connection:
Copper conductors only
3A1+ / 4A2:
AWG 18 - 14 Torque 0.5 Nm (4.4 lb-in)
1L1 / 2T1:
AWG 16 - 8 Torque 1.2 Nm (10.6 lb-in)

Dimensions

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

#### Contents of Article Numbers

<table>
<thead>
<tr>
<th>Type</th>
<th>PH 9260</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variant</strong> (Designation)</td>
<td><strong>PH 9260.000.01</strong> with heat sink</td>
</tr>
<tr>
<td>Load current</td>
<td>25 A</td>
</tr>
<tr>
<td>Load voltage</td>
<td>Control voltage</td>
</tr>
</tbody>
</table>

| PH 9260 | 0056653 | 0056955 | 0056654 | 0056956 | 0057700 | 0058196 | 0058221 | 0059737 |
| PH 9260 | 0056690 | 0061943 | 005691 | 0059074 | 0058956 | 0058960 | 0059631 | 0059677 |
| PH 9260 | 0058676 | 0058958 | 0058678 | 0058960 | 0059631 | 0059677 | 0059690 | 0061943 |

At devices without heatsink the necessary heatsink has to be chosen according to the dimensioning notes.

* On request

**Units with UL-Approval**

3) for stepping operation with 80 % ED

### Standard Type

**PH 9260.91** AC 48 ... 480 V 50 A DC 4 ... 32 V

- Article number: 0056654
- Load voltage: AC 48 ... 480 V
- Load current: 50 A
- Control voltage: DC 4 ... 32 V
- Width: 45 mm

**PH 9260.91**

<table>
<thead>
<tr>
<th>Variant</th>
<th>PH 9260.91</th>
<th>_ _ _</th>
<th>0 _</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Without heat sink</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>With heat sink 1.5 K / W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>With heat sink 0.95 K / W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Low-Noise-Version with reduced HF-emission (Leakage current in off state: 18 mA at AC 480 V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Switching at zero crossing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Switching at voltage maximum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>With heigh I²t-value</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Ordering example for variants

**PH 9260.91** /101/02 AC 48 ... 480 V 50 A DC 4 ... 32 V

**Accessories**

**PH 9260-012:** Graphite foil 55 x 40 x 0.25 mm to be fitted between device and heat sink, for better heat transmission

Article number: 0058395

For the 100 A- and 125 A-variants we recommend a 25 mm² adapter terminal type 802/115S, Brand FTG.
The heat generated by the load current must be dissipated by a suitable heat sink. It is imperative that the junction temperature of the solid-state is maintained for all potential environmental temperatures of under 125°C. For this reason, it is important to keep the thermal resistance between the base plate of the solid-state relay and the heat sink to a minimum.

To protect the solid-state relay effectively from excess heating, a thermally conducting paste should be applied before installation to the base plate of the heat sink between solid-state relay and heat sink.

From the tables below, select a suitable heat sink with the next lowest thermal resistance. Thus, it is ensured that the maximum junction temperature of 125°C is not exceeded. The load current in relation to the environmental temperature can be seen from the table.

### Selection of a Heat Sink

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>PH 9260 25 A</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.0</td>
<td>2.8</td>
<td>2.5</td>
</tr>
<tr>
<td>22.5</td>
<td>3.2</td>
<td>2.8</td>
</tr>
<tr>
<td>20.0</td>
<td>3.7</td>
<td>3.3</td>
</tr>
<tr>
<td>17.5</td>
<td>4.3</td>
<td>3.8</td>
</tr>
<tr>
<td>15.0</td>
<td>5.1</td>
<td>4.6</td>
</tr>
<tr>
<td>12.5</td>
<td>6.3</td>
<td>5.6</td>
</tr>
<tr>
<td>10.0</td>
<td>8.0</td>
<td>7.2</td>
</tr>
<tr>
<td>7.5</td>
<td>11.0</td>
<td>9.9</td>
</tr>
<tr>
<td>5.0</td>
<td>16.8</td>
<td>15.0</td>
</tr>
<tr>
<td>2.5</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient-temperature (°C )</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
</table>

### Notes on Sizing for Selection of a Heat Sink

The heat generated by the load current must be dissipated by a suitable heat sink. It is imperative that the junction temperature of the solid-state is maintained for all potential environmental temperatures of under 125°C. For this reason, it is important to keep the thermal resistance between the base plate of the solid-state relay and the heat sink to a minimum.

To protect the solid-state relay effectively from excess heating, a thermally conducting paste should be applied before installation to the base plate of the heat sink between solid-state relay and heat sink.

From the tables below, select a suitable heat sink with the next lowest thermal resistance. Thus, it is ensured that the maximum junction temperature of 125°C is not exceeded. The load current in relation to the environmental temperature can be seen from the table.

### Application Examples

![Application Diagram]

**PH9260**

L+ L- N

3/A1 4/A2 1/L1 2/T1

DC AC

![Thermal Resistance Tables](image)
General Information

The service life and long-time reliability of a solid-state relay depends on its installation and use. Load type, load current, switching frequency, mains voltage and ambient temperature must be taken into account during the project design. To ensure the reliable operation of the devices, an exact analysis of the application and a calculation of the heat sink must be conducted in advance. Solid-state relays constantly produce heat during operation. The ambient conditions therefore require special attention. The choice of the correct heat sink is especially important since the constant overtemperature significantly reduces the service life of the devices. The use of a temperature switch is recommended if neither the load conditions nor the ambient temperatures are known. This switch is available as accessory and is inserted in a pocket on the bottom side.

Attention: The load output is not electrically separated from the mains even if no drive is present.

Overload protection (Fig. 1)
The solid-state relay must be protected against short circuit by a separate solid-state fuse of coordination type 2. Choosing the I2t value (switch-off integral) of the fuse half as large as the I2t value of the solid-state is recommended.

Overvoltage protection (Fig. 1)
Although the solid-state relays can withstand high peak voltages, it is better to switch an external varistor parallel to the load output. This is particularly recommended when switching inductive loads. The varistor voltage must be selected appropriate for the mains voltage. A wrong selection can create hazardous situations. As an option, the varistor is factory-installed.

Assembly on the heat sink (Fig. 2, Fig. 3)
A small amount of silicon-containing heat transfer compound is to be applied to the base plate to ensure a good thermal bond between solid-state relay and heat sink. As an alternative, a graphite foil can be placed between solid-state relay and heat sink.

Attention! Heat transfer compounds without silicon should not be used, since they may attack the plastic of the housing.

The solid-state relay is mounted to the heat sink using two M5x8 screws and matching washers. Both screws should be tightened in alternating fashion until a torque of 1 Nm is reached. After approx. one hour the screws need to be tightened further with a final torque of 2.5 Nm. This ensures that all excess heat transfer compound is squeezed out or that the graphite foil can well adapt to the contours of the surfaces.

Installation of the complete unit (Fig. 4)
The fins of the heat sink must be aligned in a manner allowing the unobstructed circulation of air. Without external fan, the fins must be aligned vertically to support natural convection.

Connection

<table>
<thead>
<tr>
<th>Control terminals</th>
<th>Load terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw: M3 Pozidrive</td>
<td>M4 Pozidrive</td>
</tr>
<tr>
<td>Tightening torque: 0.5 Nm</td>
<td>1.2 Nm</td>
</tr>
<tr>
<td>Wire gauge: 1.5 mm²</td>
<td>10 mm²</td>
</tr>
</tbody>
</table>

Attention! When using pneumatic or electric power screwdrivers, their torque limit must be set correctly.
Power Electronics

POWERSWITCH
Solid-State Relay / - Contactor, 2-POLES
PH 9260.92

Your Advantages
- Free from wearing, noiseless, economic
- Excellent EMC-performance, because of switching at zero crossing
- Separate control of both poles
- Available with heatsink to be mounted on DIN rail
- Easy connection via cage clamp terminals

Features
- AC solid-state relay / -contactor
- According to IEC/EN 60947-4-3
- As option load current up to 2 x 32 A or 2 x 48 A
- As option with hight I²t up to 6600 A²s
- Load voltages up to AC 480 V
- 2 anti-parallel thyristors for each pole
- DCB technology (direct bonding method) for excellent heat transmission properties
- Touch protection IP20
- Box terminals for load connections
- LED status indicator for both poles
- Peak reverse voltage up to ±1200 V
- Insulation voltage 4000 V
- Width 45 mm

Approvals and Markings

Applications
Solid state relays switching at zero crossing:
For frequent no-wear and no-noise switching of
- heating systems
- motors
- valves
- lighting systems

The solid-state relay switches at zero crossing and is suitable for many applications e.g. extrusion machines for plastic and rubber, packaging machines, solder lines, machines in food industry.

Function
The solid-state relay PH 9260 is designed with 2 anti-parallel connected thyristors switching at zero crossing.

When connecting the control voltage the output of the solid-state relay is activated at the next zero crossing of the sinusoidal voltage. When disconnecting the control voltage the output is switched off at the next zero crossing of the load current.

The LED shows the state of the control input.
As option the solid-state relay is available with heatsink to be mounted on DIN rail. This provides optimum heat transmission.
### Technical Data

#### Output
- Load voltage AC [V]: 24 ... 240, 48 ... 480
- Frequency range [Hz]: 47 ... 63
- Load current [A], AC-51: 800, 1800
- Load limit integral I2t [A²s]: 6600
- Max. Overload current [A] t = 10 ms: 400, 1150
- Periodic overload current [A] t = 1 s: 40, 150
- Min. current [mA]: 20
- On-state voltage at nominal current [V]: 1.2, 1.4
- Rate of rise of off-state voltage [V/µs]: 500, 500
- Rate of rise of current [A/µs]: 100, 100

#### Thermische Daten
- Thermal resistance junction - housing [K/W]: 0.6, 0.5
- Thermal resistance housing - ambient [K/W]: 12, 12
- Junction temperature [°C]: ≤ 125

#### General Data
- Operating mode: Continuous operation
- Temperature range: operation: -20 ... 40°C, storage: -20 ... 80°C
- Clearance and creepage distances rated impulse voltage / pollution degree: 6 kV / 3, IEC/EN 60 664-1, IEC/EN 61 000-6-4, IEC/EN 61 000-4-1
- Electric charge (ESD): 8 kV air, IEC/EN 61 000-4-2
- Fast transients: 2 kV, IEC/EN 61 000-4-3
- Surge voltages between wires for power supply: 10 V, IEC/EN 61 000-4-5
- between wire and ground: 2 kV, IEC/EN 61 000-4-5
- HF interference suppression: 10 V, IEC/EN 61 000-4-6

#### Degree of protection
- Housing: IP 40, IEC/EN 60 529
- Terminals: IP 20, IEC/EN 60 529
- Vibration resistance: Amplitude 0.35 mm, frequency 10 ... 55 Hz, IEC/EN 60-068-2-6
- Housing material: Fiberglass reinforced polycarbonate, Flame resistant; UL 94 V0
- Base plate: Aluminum, copper nickel-plated
- Potting compound: Polyurethane
- Mounting screws: M5 x 8 mm
- Fixing torque: 2.5 Nm
- Connections control circuit: cage clamp terminals
- Wire cross section: 0.2 ... 1.5 mm² wire

#### Controls
- Control voltage range [V]: DC 18 ... 30
- max. input current [mA]: 15
- Turn-on delay [ms]: 0.5 ... 10.5
- Turn-off delay [ms]: 0.5 ... 10.5

#### Dimensions
- Width x height x depth with heat sink: 45 x 80 x 127 mm
- PH 9260.92/.../01: 45 x 100 x 127 mm
- PH 9260.92/.../02: 45 x 100 x 127 mm

#### Accessories
- Graphite foil 55 x 40 x 0.25 mm to be fitted between device and heat sink, for better heat transmission
- Article number: 0058395

#### Standard Type
- PH 9260.92 AC 48 ... 480 V 2 x 48 A DC 18 ... 30 V
- Article number: 0064252
- Load voltage: AC 48 ... 480 V
- Load current: 2 x 48 A
- Control voltage: DC 18 ... 30 V
- Width: 45 mm

#### Connections load circuit:
- Mounting screws M4 Pozidrive 2 PT
- Fixing torque: 1.2 Nm
- Wire cross section: 10 mm² wire

#### Nominal insulation voltage
- Control circuit - load circuit: 4 kV
- Load circuit - base plate: 4 kV
- Control circuit A1/A2 - A3/A4: 250 V
- Overvoltage category: II
- Weight without heat sink: approx. 107 g
- PH 9260.92/.../01: approx. 537 g
- PH 9260.92/.../02: approx. 657 g

#### Weight
- without heat sink: approx. 75 g
- With heat sink: approx. 280 g

#### Interference suppression
- Limit value class A
- The device is designed for the usage under industrial conditions
- (Class A, EN 55011)
- To avoid this, appropriate measures have to be taken.

#### Ordering example for variants
- PH 9260.92 /.../00/02 AC 48 ... 480 V 2 x 48 A DC 18 ... 30 V
- Control voltage
- Load current
- Load voltage
- With heat sink 0.95 K / W
- With height Pt-value
- Type

#### Interference suppression
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- Base plate: Aluminum, copper nickel-plated
- Potting compound: Polyurethane
- Mounting screws: M5 x 8 mm
- Fixing torque: 2.5 Nm
- Connections control circuit: cage clamp terminals
- Wire cross section: 0.2 ... 1.5 mm² wire

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- Control voltage range [V]: DC 18 ... 30
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Notes on Sizing for Selection of a Heat Sink

The heat generated by the load current must be dissipated by a suitable heat sink. It is imperative that the junction temperature of the semiconductor is maintained for all potential environmental temperatures of under 125°C. For this reason, it is important to keep the thermal resistance between the base plate of the solid-state relay and the heat sink to a minimum.

To protect the solid-state relay effectively from excess heating, a thermally conducting paste should be applied before installation to the base plate of the heat sink between solid-state relay and heat sink.

From the tables below, select a suitable heat sink with the next lowest thermal resistance. Thus, it is ensured that the maximum junction temperature of 125°C is not exceeded. The load current in relation to the environmental temperature can be seen from the table.

### Selection of a Heat Sink

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Version for 2 x 32 A</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>0.9 0.8 0.6 0.55 0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>56</td>
<td>1.1 0.9 0.8 0.65 0.55</td>
<td>0.4</td>
</tr>
<tr>
<td>48</td>
<td>1.3 1.1 1.0 0.85 0.6</td>
<td>0.5</td>
</tr>
<tr>
<td>40</td>
<td>1.6 1.4 1.2 1.1 0.9</td>
<td>0.7</td>
</tr>
<tr>
<td>32</td>
<td>2.1 1.9 1.6 1.4 1.2</td>
<td>0.9</td>
</tr>
<tr>
<td>26</td>
<td>2.7 2.4 2.1 1.8 1.5</td>
<td>1.2</td>
</tr>
<tr>
<td>16</td>
<td>4.7 4.2 2.7 3.2 2.7</td>
<td>2.2</td>
</tr>
<tr>
<td>8</td>
<td>10.0 8.5 7.8 6.8 5.9</td>
<td>5.0</td>
</tr>
</tbody>
</table>

| Ambient-temperature (°C ) | 20 | 30 | 40 | 50 | 60 | 70 |

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Version for 2 x 48 A</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>96</td>
<td>0.6 0.5 0.4 0.35 0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>84</td>
<td>0.7 0.6 0.55 0.45 0.35</td>
<td>0.25</td>
</tr>
<tr>
<td>72</td>
<td>0.9 0.8 0.65 0.55 0.45</td>
<td>0.35</td>
</tr>
<tr>
<td>60</td>
<td>1.1 1.0 0.85 0.75 0.6</td>
<td>0.45</td>
</tr>
<tr>
<td>48</td>
<td>1.5 1.3 1.1 1.0 0.8</td>
<td>0.65</td>
</tr>
<tr>
<td>36</td>
<td>2.1 1.9 1.6 1.44 1.2</td>
<td>0.9</td>
</tr>
<tr>
<td>24</td>
<td>3.3 3.0 2.6 2.3 1.9</td>
<td>1.6</td>
</tr>
<tr>
<td>12</td>
<td>7.0 6.0 5.5 4.9 4.0</td>
<td>3.5</td>
</tr>
</tbody>
</table>

| Ambient-temperature (°C ) | 20 | 30 | 40 | 50 | 60 | 70 |

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Version for 2 x 48 A at I²t = 6600 A²s</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>96</td>
<td>0.8 0.7 0.6 0.5 0.4 0.3</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>0.9 0.8 0.7 0.61 0.5 0.4</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>1.1 1.0 0.85 0.75 0.6 0.45</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>1.4 1.2 1.1 0.9 0.75 0.6</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>1.8 1.6 1.4 1.2 1.0 0.8</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>2.5 2.2 1.9 1.65 1.4 1.2</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>3.5 3.4 3.0 2.6 2.2 1.85</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>7.5 7.0 6.0 5.5 4.5 4.0</td>
<td></td>
</tr>
</tbody>
</table>

| Ambient-temperature (°C ) | 20 | 30 | 40 | 50 | 60 | 70 |
Your advantages
• Self-optimized impulse distribution with minimized cycle times
• Allows for precise temperature regulation
• Switching at zero crossing, providing outstanding EMC properties
• Protection from thermal overload with optional excess temperature protection

Features
• AC solid-state relay / -contactor for pulse package control of heating systems
• Control input DC 4 ... 20 mA
• According to IEC/EN 60947-4-2
• Nominal voltage AC 48 ... 480 V
• Load current 25A, 50 A, AC-51
• LED status indicator for control and failure
• Box terminals
• Degree of protection IP20
• As option with heat sink, for DIN rail mounting
• Width: 45 mm

Applications
The zero crossing solid-state relay switches with 4 ... 20 mA analogue input for pulse package control is ideal for the control of heating elements and infrared lamps. It allows for precise temperature regulation, and offers a wide variety of potential applications with fast and noiseless switching, e.g. extrusion machines for plastic and rubber, at thermoforming machines, packaging machines or machines in food industry.

Functions
The solid-state relay PH 9260/042 is designed with 2 anti-parallel connected thyristors switching at zero crossing. The output of the solid-state relay is activated at the next zero crossing of the sinusoidal voltage. When disconnecting the control signal the output is switched off at the next zero crossing of the load current.

The on/off switching ratio of the output is set proportional to the control current. The control voltage range of 4 to 20 mA is converted into an on/off switching ratio of 0 to 100%. Two LEDs indicate the device status.

As option the solid-state relay is available with heatsink to be mounted on DIN rail. This provides optimum heat transmission.

Indication
yellow LED „A1-A2“: Operating voltage and control current available. The flashing cycle corresponds to the on/off switching ratio specified by the control current. At a control current < 4 mA or > 25 mA, activation does not occur and the LED does not illuminate.

red LED „Alarm“:
- flashes slowly: at control current < 4 mA
- flashes fast: at control current > 21 mA

Notes
Overtemperature protection
Optionally, the solid-state relay has an overtemperature protection to monitor the temperature of the heat sink. To this end, a thermal release switch (NC contact) can be inserted into the respective pocket at the bottom of the solid-state relay. As soon as the temperature of the heat sink exceeds for example 100°C, the thermal release switch. For thermal protection of the solid-state relay, a thermal release switch of UCHIYA type UP62 – 100 can be installed.
**Technical Data**

**Control Input**

Operation voltage A1/A2: max. 35 V DC  
Burden voltage: max. 8 V (< 400 Ω at 20 mA)  
Current range: DC 4 ... 20 mA  
Overcurrent protection: limit to 35 mA  
Resolution: 5 %

**Output**

Load voltage AC [V]: 48 ... 480  
Frequency range [Hz]: 25 ... 50  
Load current [A], AC-51: 800 ... 1800  
Load limit integral I.T [A's]: 6600  
Max. overload current [A] t = 10 ms: 400 ... 600  
Periodic overload current t = 1 s [A]: 40 ... 120  
Min. current [mA] at nominal current [V]: 1.2 ... 1.4  
Peak reverse voltage [V]: 1200  
On-state voltage [V/μs]: 500  
Rate of rise of current [A/μs]: 100

**Temperature Data**

Thermal resistance junction - housing [K/W]: 0.6  
Thermal resistance housing - ambient [K/W]: 0.5  
Junction temperature [°C]: ≤ 125

**General Data**

Operating mode: Continuous operation  
Temperature range: operation: - 20 ... 40° C, storage: - 20 ... 80° C  
Clearance and creepage distances rated impulse voltage / pollution degree: 6 kV / 3  
EMC: IEC/EN 61 000-6-4, IEC/EN 61 000-4-1  
Electrostatic discharge (ESD): 8 kV air / 4 kV contact  
HF irradiation: 10 V / m  
Fast transients: 2 kV  
Surge voltages between wires: 1 kV  
between wire and ground: 2 kV  
HF-wire guided: 10 V  
Interference suppression: Limit value class A^1

**Degree of protection**

Housing: IP 40  
Terminals: IP 20  
Vibration resistance: Amplitude 0.35 mm, frequency 10 ... 55 Hz, IEC/EN 60-068-2-6  
Housing material: Fiberglass reinforced polycarbonate  
Flame resistant: UL 94 V0  
Base plate: Aluminum, copper nickle-plated  
Potting compound: Polyurethane  
Mounting screws: M5 x 8 mm  
Fixing torque: 2.5 Nm  
Connections control circuit: Mounting screws M3 Pozidrive 2 PT  
Fixing torque: 0.5 Nm

---

**Dimensions**

Width x height x depth: 45 x 59 x 32 mm  
PH 9260.91/1/01: 45 x 80 x 124 mm  
PH 9260.91/1/02: 45 x 100 x 124 mm

---

**Accessories**

PH 9260-0-12: Graphite foil 55 x 40 x 0.25 mm to be fitted between device and heat sink, for better heat transmission  
Article number: 0058395

---

**Notes**

1) Variant PH 9260.91/142

^1) The device is designed for the usage under industrial conditions (Class A, EN 55011)  
When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken.
### Characteristics

- **Load power:**
  - 100%
  - 75%
  - 50%
  - 25%

- **Control characteristic**
  - 100% ON every cycle
  - 75% 3 cycles ON - 1 cycles OFF
  - 50% 1 cycles ON - 1 cycles OFF
  - 25% 1 cycles ON - 3 cycles OFF

- **Cycle diagram with self-optimizing pulse packaging**

### Notes on Sizing for Selection of a Heat Sink

The heat generated by the load current must be dissipated by a suitable heat sink. It is imperative that the junction temperature of the semiconductor is maintained for all potential environmental temperatures under 125°C. For this reason, it is important to keep the thermal resistance between the base plate of the solid-state relay and the heat sink to a minimum.

To protect the solid-state relay effectively from excess heating, a thermally conducting paste should be applied before installation to the base plate of the heat sink between solid-state relay and heat sink.

From the tables below, select a suitable heat sink with the next lowest thermal resistance. Thus, it is ensured that the maximum junction temperature of 125°C is not exceeded. The load current in relation to the environmental temperature can be seen from the table.

### Selection of a Heat Sink

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>PH 9260 25 A</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.0</td>
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</tr>
<tr>
<td>22.5</td>
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<td>17.5</td>
<td>4.3</td>
<td>3.8</td>
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<td>15.0</td>
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<td>2.5</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>PH 9260 50 A</th>
<th>Thermal resistance (K/W)</th>
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</thead>
<tbody>
<tr>
<td>50</td>
<td>0.9</td>
<td>0.7</td>
</tr>
<tr>
<td>45</td>
<td>1.0</td>
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<td>6.0</td>
</tr>
<tr>
<td>5</td>
<td>14.0</td>
<td>12.9</td>
</tr>
</tbody>
</table>

### Application Example

L N

L+ 4-20mA

L- AC

---

**Standard Type**

PH 9260.91/042  AC 48 ... 480 V  50 A  DC 4 ... 20 mA

- **Article number:** 0062777
- **Load voltage:** AC 48 ... 480 V
- **Load current:** 50 A
- **Control current:** DC 4 ... 20 mA
- **Width:** 45 mm

### Variants

- **PH 9260.91 / 42 / 0**
  - 0 without heat sink
  - 1 with heat sink 1.5 K/W
  - 2 with heat sink 0.95 K/W

### Ordering example for variants

- **PH 9260.91 / 142 / 02**
  - AC 48 ... 480 V  50 A  DC 4 ... 20 mA
  - Control voltage
  - Load current
  - Load voltage
  - With heat sink 0.95 K/W
  - With height f't-value
  - Type
Power Electronics

POWERSWITCH
Solid-state Relay / - Contactor
With Load Circuit Monitoring PH 9270

- AC solid-state relay /-contactor
- With integrated load circuit monitoring
- Settable load limit value
- According to IEC/EN 60947-4-3
- Load current 40 A, AC 51
- Switching at zero crossing
- 2 anti-parallel thyristors
- DCB technology (direct bonding method) for excellent heat transmission properties
- Two-colours LED status indicator
- Touch protection IP20
- PLC compatible alarm output (PNP; NPN on request)
- As option closed circuit operation or open circuit operation
- As option with optimized heat sink, for DIN rail mounting
- Width 45 mm

Solid-state relay
PH 9270.91
Solid-state contactor
PH 9270.91/000/02

Circuit Diagram

Connection Terminals

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1+, A2</td>
<td>Control input</td>
</tr>
<tr>
<td>A3+, A2</td>
<td>Operating voltage, load circuit monitoring</td>
</tr>
<tr>
<td>Alarm</td>
<td>Solid-state outputs</td>
</tr>
<tr>
<td>L1</td>
<td>Network</td>
</tr>
<tr>
<td>T1</td>
<td>Load output</td>
</tr>
</tbody>
</table>

Indication

The LED „A1/A2“ shows the state of the control input
yellow: controlled semiconductor relays
off: not controlled semiconductor relays

The LED „Alarm“ shows the state of the unit
green: no failure
dead: failure (thyristor defective with open or short circuit, open load, current value to high or to low or supply voltage < 100 V AC)
off: no auxiliary voltage (A3+/A2)

Notes

Overtemperature protection
Optionally, the solid-state relay has an overtemperature protection to monitor the temperature of the heat sink. For this purpose, a thermal switch (NC contact) can be inserted into the respective pocket at the bottom of the solid-state relay. As soon as the temperature of the heat sink exceeds for example 100°C, the thermal switch opens. For thermal protection of the solid-state relay, a thermal switch of UCHIYA type UP62 – 100 can be installed.

Applications

For high frequency wear free and noiseless switching of
- heating systems
- motors
- valves*
- lighting systems

The semiconductor switches at zero crossing. The integrated load monitoring provides fast fault finding e.g. broken load elements (part load failure), broken load circuit, overcurrent, missing load voltage, blown fuse and thyristor faults.

The PH 9270 is suitable for many applications e. g. extrusion machines for plastic and rubber, packaging machines, solder lines, machines in food industry.

* On overcurrent monitoring a start up delay must be integrated in the control.

Function

The solid-state relay PH 9270 monitors with applied auxiliary voltage (A3+/A2) the load voltage and the load current. On broken load circuit, deviations of the load current from setting value or defective semiconductor an alarm output is controlled. The failure state is indicated on an 2-color LED (see Function Diagrams).

The PH 9270 with 2 antiparallel connected thyristors switches at zero crossing. When connecting the control voltage the semiconductor is switched on with the next zero crossing of the sinusoidal voltage. After disconnecting the control voltage the semiconductor switches off with the next zero crossing of the load current.

As option the PH 9270 is available with heat sink for DIN rail mounting and immediately “ready to use”. In addition the heat dissipation is optimised.
## Function Diagram

### Normal operation and failure status

<table>
<thead>
<tr>
<th>Normal operation</th>
<th>Failure status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td></td>
</tr>
<tr>
<td>Control input</td>
<td></td>
</tr>
<tr>
<td>LED &quot;A1/A2&quot;</td>
<td></td>
</tr>
<tr>
<td>Normal load current</td>
<td></td>
</tr>
<tr>
<td>LED &quot;alarm&quot; green</td>
<td></td>
</tr>
<tr>
<td>Alarm output</td>
<td></td>
</tr>
</tbody>
</table>

- SSR OFF
- SSR ON
- Detective SSR short circuit
- Interrupted load circuit or failure of supply voltage
- Detective SSR interrupted
- Interrupted load circuit or failure of supply voltage
- Setting value exceeded
- Supply voltage missing

*On overcurrent variant is only detected when SSR is not activated.

### Overcurrent detection variant /000

- Alarm output
- Load current
- Setting value
- Alarm output

* $t_1 = 220 \text{ms}$

### Undercurrent detection variant /001

- Alarm output
- Load current
- Setting value
- Alarm output

* $t_1 = 220 \text{ms}$

### Overcurrent detection variant /002

- Alarm output
- Load current
- Setting value
- Alarm output

* $t_1 = 220 \text{ms}$
**Technical Data**

### Output

- **Load voltage AC [V]:** 200 ... 480
- **Frequency range [Hz]:** 47 ... 63
- **Load current [A], (AC 51):** 40
- **Load limit integral I2t [A²s]:** 1800; 6600*
- **Max. overload current [A] t = 10 ms:** 600; 1150*)
- **Period underload current [A] t = 1 s:** 120; 150*)
- **Forward-voltage [V] at nominal current:** 1.4
- **Off-state voltage [V/μs]:** 500
- **Rate of rise of current [A/μs]:** 100
- **Measuring range:** 0.5 ... 40 A
- **Response value:** continuously variable
- **Hysteresis:** 2 % of response value

### Temperature Data

- **Thermal resistance junction - housing [K/W]:** 0.5
- **Thermal resistance housing - ambient [K/W]:** 12
- **Junction temperature °C:** ≤ 125

### Alarm Output

- **Auxiliary supply A3+/A2 [V]:** 20 ... 32 (DC)
- **Max. input current [mA]:** 15 bei 24 V DC
- **PNP transistor outputs max. output current [mA]:** 100
- **Output voltage (open) [V]:** 0 (DC)
- **Auxiliary supply -2 V DC (max.)
- **Time delay [ms]:** 220

### Control Circuit

- **Control voltage A1+/A2 [V]:** 20 ... 32 (DC)
- **Switch off voltage [V]:** 0 ... 5 (DC)
- **Max. input current [mA]:** 10 at 24 V DC
- **Turn-on delay [ms]:** 5 + 1/2 Periode
- **Turn-off delay [ms]:** 20 + 1/2 Periode

### General Data

- **Operating mode:** Continuous operation
- **Temperature range operation:** - 20 ... 40° C
- **Temperature range storage:** - 20 ... 80° C
- **Clearance and creepage distances:** rated impulse voltage / pollution degree: 6 kV / 3 IEC/EN 60 664-1
- **Electrostatic discharge (ESD):** 8 kV air / 6 kV contact IEC/EN 61 000-4-2
- **Fast transients:** 2 kV IEC/EN 61 000-4-3
- **Surge voltages between wires for power supply:** 1 kV IEC/EN 61 000-4-6
- **Between wire and ground:** 2 kV IEC/EN 61 000-4-5
- **HF-wire guided:** 10 V IEC/EN 61 000-4-6
- **Interference suppression:** Limit value class A*
- **The device is designed for the usage under industrial conditions (Class A, EN 55011)**
- **When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken.**

### Degree of protection

- **Housing:** IP 40 IEC/EN 60 529
- **Terminals:** IP 20 IEC/EN 60 529
- **Vibration resistance:** Amplitude 0.35 mm
- **Frequency 10 ... 55 Hz. IECEN60-068-2-6
- **Housing material:** Fiberglass reinforced polycarbonate
- **Flame resistant: UL 94 V0
- **Base plate:** Aluminum, copper nickel-plated
- **Potting compound:** Polyurethane
- **Mounting screws:** M 5 x 8 mm

### Accessories

- **PH 9260-0-12:** Graphite foil 55 x 40 x 0.25 mm to be fitted between device and heat sink, for better heat transmission
- **Article number:** 0058395

### Dimensions

- **Width x height x depth without heat sink:** 45 x 58 x 35 mm
- **PH 9270.91/.../01:** 45 x 80 x 127 mm
- **PH 9270.91/.../02:** 45 x 100 x 127 mm

### Standard Type

- **PH 9270.91 AC 200 ... 480 V 40 A DC 20 ... 32 V**
- **Article number:** 0060425
- **Load voltage:** AC 200 ... 480 V
- **Load current:** 40 A
- **Auxiliary voltage:** DC 20 ... 32 V
- **Alarm output:** PNP, closed circuit operation
- **Monitoring:** Under- and overcurrent
- **Width:** 45 mm

---

*variant /1 ...*
Setting Facilities
Potentiometer to adjust tripping point in the range of 0.5 A up to nominal current.

Setting and Adjustment

Setting for the standard type (over- and undercurrent)

When the SSR is activated to pass the normal load current, start turning the setting knob fully anticlockwise (Alarm LED = Red), then begin to turn it clockwise until the Alarm LED changes to Green. Note the knob setting. Keep turning the knob clockwise until the Alarm LED changes to Red again. Note the knob setting. Take the average of these two settings and set the knob at this value. The SSR is now set up to detect over- and undercurrents of ±20%. The LED should change to Green.

Setting for variant /_01 (undercurrent)

When the SSR is activated to pass the normal load current, start turning the setting knob fully clockwise (Alarm LED = Red), then begin to turn it anticlockwise until the Alarm LED turns Green. The alarm current equals the load current. Note the setting and turn the knob by 10% below the previous setting. The SSR is now set up with the necessary margins to prevent false alarms due to line voltage fluctuations. The LED should remain Green.

Setting for variant /_02 (overcurrent)

When the SSR is activated to pass the normal load current, start turning the setting knob fully anticlockwise (Alarm LED = Red), then begin to turn it clockwise until the Alarm LED changes to Green. The alarm current equals the load current. Note the setting and turn the knob by 10% above the previous setting. The SSR is now set up with the necessary margins to prevent false alarms due to line voltage fluctuations. The LED should remain Green.

Ordering example for variants

PH 9270.91 /_ _ _ / 0 _

Control via A1/A2
0 = with under- and over current monitoring and PNP transistor output with de-energized on trip
1 = with under current monitoring and PNP transistor output with energized on trip
2 = with over current monitoring and PNP transistor output with de-energized on trip
5 = with under- and over current monitoring and PNP transistor output with energized on trip
6 = with under current monitoring and PNP transistor output with energized on trip
7 = with over current monitoring and PNP transistor output with energized on trip

0 = Switching at zero crossing
0 = Standard
1 = With high I2t-value

PH 9270.91 /1 0 0 / 02   AC 200 ... 480 V   40 A   DC 20 ... 32 V
Notes on Sizing for Selection of a Heat Sink

The heat generated by the load current must be dissipated by a suitable heat sink. It is imperative that the junction temperature of the semiconductor is maintained for all potential environmental temperatures of under 125°C. For this reason, it is important to keep the thermal resistance between the base plate of the solid-state relay and the heat sink to a minimum.

To protect the solid-state relay effectively from excess heating, a thermally conducting paste or a graphit gasket (see Accessories) should be applied before installation to the base plate of the heat sink between solid-state relay and heat sink.

From the table below, select a suitable heat sink with the next lowest thermal resistance. Thus, it is ensured that the maximum junction temperature of 125°C is not exceeded. The load current in relation to the environmental temperature can be seen from the table.

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>PH 9270 40 A Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>1.2 1.0 0.9 0.7 0.5 0.3</td>
</tr>
<tr>
<td>35</td>
<td>1.5 1.3 1.0 0.9 0.7 0.5</td>
</tr>
<tr>
<td>30</td>
<td>1.9 1.6 1.4 1.1 0.9 0.7</td>
</tr>
<tr>
<td>25</td>
<td>2.4 2.0 1.8 1.5 1.2 0.9</td>
</tr>
<tr>
<td>20</td>
<td>3.0 2.7 2.4 2.0 1.7 1.3</td>
</tr>
<tr>
<td>15</td>
<td>4.4 3.9 3.4 2.9 2.5 2.0</td>
</tr>
<tr>
<td>10</td>
<td>6.9 6.0 5.4 4.7 4.0 3.3</td>
</tr>
<tr>
<td>5</td>
<td>14.0 12.9 11.5 10.0 8.6 7.2</td>
</tr>
</tbody>
</table>

Ambient-temperature (°C)

Application Example

When using versions with normally open alarm output, several PH9270 can be connected to one PLC input.

1) at NPN output
2) at PNP output

Auxiliary voltage and control input must have common ground!
Power Electronics

**POWERSWITCH**

**Solid-State Relay / Contacto**

**With Load Current Measurement PH 9270/003**

### Your Advantages
- Free from wearing, noiseless, economic
- High productivity by integrated monitoring functions
- Accurate AC / DC measurement up to 45 A
- Analogue output for easy working with signals to PLC or displays
- Excellent EMC- performance, because of switching at zero crossing
- As option protection against thermal overload

### Features
- AC solid-state relay /-contactor with load current measurement (runs value)
- Analogue output DC 0 ... 10 V
- According to IEC/EN 60947-4-3
- Nominal voltage up to AC 480 V
- Load current up to 45 A, AC-51
- Switching at zero crossing
- DCB technology (direct bonding method) for excellent heat transmission properties
- LED indicator for control
- As option with optimized heat sink, for DIN rail mounting
- Width: 45 mm

### Approvals and Markings

![CE Mark]

### Applications
The solid-state relay switches at zero crossing and with its analogue output 0 ... 10 V. It is suitable for heating applications where failures must be detected as early as possible. It allows continuous monitoring of the load circuit and offers many solutions where fast and silent switching actions are required e.g. in plastic molding and rubber processing machines as well as in thermal forming and packaging machines and also in food industry.

### Function
When voltage is applied to A3+/A2 the solid-state relay PH 9270 monitors continuously the load current and transmits it to a proportional analogue output signal of either 0 ... 10 V. This signal can be easily monitored by a PLC or display module with analogue input.

The PH 9270 with 2 antiparallel connected thyristors switches at zero crossing. When connecting the control voltage the solid-state is switched on with the next zero crossing of the sinusoidal voltage. After disconnecting the control voltage the solid-state switches off with the next zero crossing of the load current.

As option the PH 9270 is available with heat sink for DIN rail mounting and immediately “ready to use”. In addition the heat dissipation is optimised.

### Indication
The LED „A1/A2“ shows the state of the control input:
- yellow: controlled solid-state relays
- off: not controlled solid-state relays

---

#### Circuit Diagram

**PH 9270.91/003 DC 0 ... 10 V**

#### Connection Terminal

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1+, A2</td>
<td>Control input</td>
</tr>
<tr>
<td>A3+, A2</td>
<td>Auxiliary supply, load current measurement</td>
</tr>
<tr>
<td>V_out</td>
<td>Analogue output</td>
</tr>
<tr>
<td>L1</td>
<td>Network</td>
</tr>
<tr>
<td>T1</td>
<td>Load output</td>
</tr>
</tbody>
</table>

---

---
Notes

Overtemperature protection
As option, the solid-state relay has an overtemperature protection to monitor the temperature of the heat sink. For this purpose, a thermal switch (NC contact) can be inserted into the respective pocket at the bottom of the semiconductor relay. As soon as the temperature of the heat sink exceeds for example 100°C, the thermal switch opens. For thermal protection of the solid-state relay, a thermal switch of UCHIYA type UP62 – 100 can be installed.

Technical Data

Output
Load voltage AC [V]: 24 ... 240, 48 ... 480
Frequency range [Hz]: 47 ... 63
Load current measuring range [A], (AC-51): 25  45
Min. load current [A]: 0.02
Load limit integral I1 [Asec]: 1800; 6600
Max. overload current [A] t = 10 ms: 600; 1150
Period. overload current [A] t = 1 s: 120; 150
Forward-voltage [V] at at nominal current: 1.2  1.4
Peak reverse voltage [V]: 800 (24 ... 240 VAC), 1200 (48 ... 480 VAC)
Off-state voltage [V/μs]: 500
Rate of rise of current [A/μs]: 100
Residual current at off state at nominal voltage and nominal frequency [mA]: ≤ 1

Thermoregulation Data
Thermal resistance junction - housing [K/W]: 0.6  0.5
Thermal resistance housing - ambient [K/W]: 12
Junction temperature [°C]: ≤ 125

Control Circuit
Control voltage A1+/A2: 20 ... 32 V DC
Max. input current [mA]: 10 at 24 V DC
Analogue output 0 ... 10 V Operation voltage A3+/A2: 18 ... 32 V DC
Min. input current [mA]: 5 (dependent to load on analogue output)
Output voltage V_{out} = 10 V equivalent of measuring range (e.g. 25 A)

Min. load resistance [Ω]: 300
Min. measuring current: 1 % of measuring range
Delay of measurement tr [ms]: < 120
Delay of measurement tf [ms]: < 300
Measuring accuracy: ± 5 % of measuring range (nominal current)
Max. cable length [m]: 10 (twisted and shielded)

General Data
Operating mode: Continuous operation
Temperature range operation: - 20 ... 40° C
storage: - 20 ... 80° C
Clearance and creepage distances:
rated impulse voltage / pollution degree: 6 kV / 3 IEC/EN 60 664-1
EMC: IEC/EN 61 000-6-4, IEC/EN 61 000-4-1
Electrostatic discharge (ESD): 8 kV air / 6 kV contact IEC/EN 61 000-4-2
HF irradiation: 10 V / m IEC/EN 61 000-4-3
Fast transients: 2 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply L1, T1: 1 kV IEC/EN 61 000-4-5
wires A1, A2 and ground: 1 kV IEC/EN 61 000-4-5
measuring output and ground: 1 kV IEC/EN 61 000-4-5
wires L1, T1 and ground: 2 kV IEC/EN 61 000-4-5
HF-wire guided: 10 V IEC/EN 61 000-4-6

Technical Data

Interference suppression: Limit value class A

Degree of protection
Housing: IP 40
Terminals: IP 20
Vibration resistance: Amplitude 0.35 mm
Frequency 10 ... 55 Hz, IEC/EN 60-068-2-6
Housing material Fiberglass reinforced polycarbonate
Flame resistant: UL 94 V0
Base plate: Aluminum, copper nickel-plated
Potting compound: Polyurethane
Mounting screws: M 5 x 8 mm
Fixing torque: 2.5 Nm
Connections control circuit: Mounting screws M3 Pozidriv 1 PT
Fixing torque: 0.5 Nm
Wire cross section: 1.5 mm² solid
Connections load circuit: Mounting screws M4 Pozidriv 2 PT
Fixing torque: 1.2 Nm
Wire cross section: 10 mm² solid
Connections monitoring circuit: Weidmüller - Omnimate Range connecting pair BL 3.50/03 (included in delivery)

Nominal insulation voltage Control circuit – load circuit: 4 kV eff.
Load circuit – base plate: 4 kV eff.
Overvoltage category: II

Weight
without heat sink: approx. 110 g
PH 9270.91/.../01: approx. 540 g
PH 9270.91/.../02: approx. 650 g

Dimensions
Width x height x depth
without heat sink: 45 x 59 x 32 mm
PH 9270.91/.../01: 45 x 80 x 124 mm
PH 9270.91/.../02: 45 x 100 x 124 mm
Accessories

PH 9260-0-12: Graphite foil 55 x 40 x 0.25 mm to be fitted between device and heat sink, for better heat transmission. Article number: 0058395

Notes on Sizing for Selection of a Heat Sink

The heat generated by the load current must be dissipated by a suitable heat sink. It is imperative that the junction temperature of the semiconductor is maintained for all potential environmental temperatures of under 125°C. For this reason, it is important to keep the thermal resistance between the base plate of the semiconductor relay and the heat sink to a minimum.

To protect the solid-state relay effectively from excess heating, a thermally conducting paste or a graphit gasket (see Accessories) should be applied before installation to the base plate of the heat sink between semiconductor relay and heat sink.

From the table below, select a suitable heat sink with the next lowest thermal resistance. Thus, it is ensured that the maximum junction temperature of 125°C is not exceeded. The load current in relation to the environmental temperature can be seen from the table.

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>PH 9270 25 A Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.0</td>
<td>2.8 2.5 2.1 1.8 1.5 1.1</td>
</tr>
<tr>
<td>22.5</td>
<td>3.2 3.0 2.8 2.6 2.0 1.7</td>
</tr>
<tr>
<td>20.0</td>
<td>3.7 3.3 3.0 2.8 2.4 2.0</td>
</tr>
<tr>
<td>17.5</td>
<td>4.3 3.8 3.4 2.8 2.5 1.9</td>
</tr>
<tr>
<td>15.0</td>
<td>5.1 4.6 4.0 3.5 2.9 2.4</td>
</tr>
<tr>
<td>12.5</td>
<td>6.3 5.6 5.0 4.3 3.6 2.8</td>
</tr>
<tr>
<td>10.0</td>
<td>8.0 7.2 6.4 5.6 4.7 3.9</td>
</tr>
<tr>
<td>7.5</td>
<td>11.0 9.9 8.7 7.6 6.5 5.4</td>
</tr>
<tr>
<td>5.0</td>
<td>16.8 15.0 13.5 12.0 10.0 8.5</td>
</tr>
<tr>
<td>2.5</td>
<td>-    -    -    -    21.0 17.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>PH 9270 45 A Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>1.0 0.9 0.7 0.5 0.4 0.2</td>
</tr>
<tr>
<td>40</td>
<td>1.2 1.0 0.9 0.7 0.5 0.3</td>
</tr>
<tr>
<td>35</td>
<td>1.5 1.3 1.0 0.9 0.7 0.5</td>
</tr>
<tr>
<td>30</td>
<td>1.9 1.6 1.4 1.1 0.9 0.7</td>
</tr>
<tr>
<td>25</td>
<td>2.4 2.0 1.8 1.5 1.2 0.9</td>
</tr>
<tr>
<td>20</td>
<td>3.0 2.7 2.4 2.0 1.9 1.3</td>
</tr>
<tr>
<td>15</td>
<td>4.4 3.9 3.4 2.9 2.5 2.0</td>
</tr>
<tr>
<td>10</td>
<td>6.9 6.0 5.4 4.7 4.0 3.3</td>
</tr>
<tr>
<td>5</td>
<td>14.0 12.9 11.5 10.0 8.6 7.2</td>
</tr>
</tbody>
</table>

| PH 9270.91 /03/0 0 = without heat sink 1 = with heat sink 1.5 K/W 2 = with heat sink 0.95 K/W
| 0 = Standard 1 = With high I2t-value

Application Example

<table>
<thead>
<tr>
<th>Load voltage: AC 24 ... 240 V</th>
<th>Load current / measuring range: 25 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH 9270</td>
<td>DC 0 ... 10 V</td>
</tr>
<tr>
<td>Article number: 0062432</td>
<td>Width: 45 mm</td>
</tr>
</tbody>
</table>

Variants

0 Standard
1 With high I2t-value

Ordering example for variants

PH 9270.91 /103/02 AC 24 ... 240 V 25 A DC 0 ... 10 V

Analogue output
Load current
Load voltage
With heat sink 0.95 K/W
With high I2t-value

Type

Standard Type

PH 9270.91/003 AC 24 ... 240 V 25 A DC 0 ... 10 V

Article number: 0062432
- Load voltage: AC 24 ... 240 V
- Load current / measuring range: 25 A
- Analogue output: DC 0 ... 10 V
- Width: 45 mm
Power Electronics

POWERSWITCH
Solid-State Relay / - Contactor
PI 9260

Your Advantages
- High switching frequency and long life
- With heat sink for DIN rail mounting
- Silent vibration and shock resistance
- Providing outstanding EMC properties

Features
- Three Phase AC solid-state contactor
- Meets generally the requirements of IEC/EN 60947-4-3
- Zero cross or immediate switching
- 2 anti-parallel thyristors for each pole
- Direct copper bonded (DCB) technology
- Self-lifting box contact terminals
- Peak reverse voltage up to ±1600Vp
- Wide range AC and DC input control voltage
- Delivered with integrated heat sink for DIN rail mounting
- IP20 Touch protection

Product Description
The solid-state relay PI 9260 was developed for switching resistive and inductive three-phase A.C. current loads, and therefore serves as a replacement for an electronic contactor. Both 2-phase and 3-phase controlled versions are available. The DCB technology (direct copper bonding) ensures very good thermal transmission, so that high load currents are possible. The solid-state relay can be mounted on a variety of cooling surfaces. The device is also available as a ready-to-use version with a pre-dimensioned heat sink. This can simply be snapped onto a wide DIN rail. An LED display signals the status of the control input.

Applications
Solid state relays switching at zero crossing:
For frequent no-wear and no-noise switching of:
- heating systems
- cooling systems
- valves
- lighting systems
The solid-state relay switches at zero crossing and is suitable for many applications e.g. extrusion machines for plastic and rubber, packaging machines, solder lines, machines in food industry.

Function Notes
EMC disturbance during operation has to be reduced by corresponding measures and filters. If several solid-state relays are mounted together sufficient cooling and ventilation has to be provided.

Notes
Depending on the application it may be useful to protect the solid-state relay with special superfast semiconductor fuses against shortcircuit.

Without heat sink
The solid-state relay can be mounted on existing cooling surfaces. Depending on the load, sufficient ventilation has to be provided.

With heat sink
For optimised heat dissipation the solid-state relay can be delivered with special dimensioned heat sinks. Depending on the ambient conditions and the load this helps to select the correct solid-state relay and heat sink. The heat sinks can be clipped on DIN-rail.
The PI 9260 range of three phase AC solid-state relay, better known as Solid-state relay (SSR) is designed with two anti-parallel thyristors for each pole and mounted on a direct copper bonded (DCB) substrate ensuring a high degree of reliability and robustness. The SSR’s triggering circuit can be configured to switch resistive loads or inductive loads. Its fast response, high vibration and shock resistance, high current surge capabilities, low electromagnetic interference together with its inherent long life makes the SSR the obvious choice for many applications. Applications would be for heating and cooling systems, lighting displays, process control, plastic injection machines, motorised valves and many more uses.

Two modes of switching are available for the PI9260 range; the zero-cross switching and instant-on switching (also known as random switching). Zero-cross switching is the preferred mode, because the switching of the relay is synchronised with the mains voltage so that the switching is done at the point where the voltage across the relay is nearly zero. This reduces the electrical switching noise. Due to its low input current requirements the relay can be directly operated from most of the logic systems and computer interfaces. An LED indication shows when the relay is activated.

Two-phase controlled versions – PI 9260.92
In many three-phase applications where the neutral connection is not present in either wye or delta circuits, it is possible to switch on and off loads with only two of the three phases. By means of an internal shunted middle phase, the PI 9260.92 provides all the three phases to the load. Because only two phases are being switched, the internal power loss is reduced and hence more current can be accommodated for a given heatsink. It has also the advantage of using a smaller heat sink for the same current when compared to a three-switched phase contactor.

Three-phase controlled version PI 9260.93
This version is used in three-phase applications where all phases have to be switched on and off due to system requirements or in applications having wye connected loads with a neutral conductor. Since the SSR dissipates about 1W per ampere of load current, it is of great importance that an effective means of removing heat from the SSR is provided. Proper choice of heat sink is essential to fully utilise the SSR’s current capability for a given ambient temperature. A well ventilated cabinet or panel is recommended. If this point is overlooked overheating will result, causing the SSR to lose control or be permanently damaged. The ratings listed below are valid only when the SSR is mounted alone. If more than one SSR is mounted side by side on the DIN rail then the current derating is necessary to keep the working temperature within acceptable limits. As a rule of thumb, 25% current derating is normally adequate. It is recommended that the spacing between two adjacent SSRs should be at least 30 mm.
Control Circuit

<table>
<thead>
<tr>
<th>Control voltage range [V]:</th>
<th>DC 10 ... 32</th>
<th>AC 100 ... 230</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. Pick-up voltage [V]:</td>
<td>8.0</td>
<td>80</td>
</tr>
<tr>
<td>Max. Drop out voltage [V]:</td>
<td>3.0</td>
<td>25</td>
</tr>
<tr>
<td>Max. input current [mA]:</td>
<td>12</td>
<td>20 at 230 V AC</td>
</tr>
<tr>
<td>Response time - turn on [ms]:</td>
<td>≤ 1.0 + ½ cycle*</td>
<td>≤ 10 + ½ cycle*</td>
</tr>
<tr>
<td>Response time - turn off [ms]:</td>
<td>≤ 1.0 + ½ cycle*</td>
<td>≤ 35 + ½ cycle*</td>
</tr>
</tbody>
</table>

*½ cycle delay only when switching at 0-crossing, at instantaneous switching the delay = 0

Output

<table>
<thead>
<tr>
<th>Load voltage AC [V]:</th>
<th>24 ... 230</th>
<th>48 ... 480</th>
<th>48 ... 600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak reverse voltage [V]:</td>
<td>650</td>
<td>1200</td>
<td>1600</td>
</tr>
<tr>
<td>Frequency range [Hz]:</td>
<td>47 ... 63</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Rated Operational current per pole at 40°C [A]</th>
<th>AC 51:</th>
<th>AC 53a:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>60</td>
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<td>60</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Rated Operational current at 40°C mounted on /06 heat sink(^1) [A]</th>
<th>AC 51:</th>
<th>AC 53a:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 x 20 / 2 x 20</td>
<td>3 x 20 / 2 x 20</td>
</tr>
<tr>
<td></td>
<td>3 x 20 / 2 x 20</td>
<td>3 x 12 / 2 x 12</td>
</tr>
<tr>
<td></td>
<td>3 x 20 / 2 x 20</td>
<td>3 x 20 / 2 x 20</td>
</tr>
<tr>
<td></td>
<td>3 x 20 / 2 x 20</td>
<td>3 x 20 / 2 x 20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. overload current [A]; t = 10 ms:</th>
<th>≤ 300</th>
<th>≤ 400</th>
<th>≤ 620</th>
<th>≤ 1050</th>
<th>≤ 1150</th>
<th>≤ 1900</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load limit integral I²t [A²s]:</td>
<td>450</td>
<td>800</td>
<td>1900</td>
<td>5500</td>
<td>6600</td>
<td>18 000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leakage current in off state [mA]</th>
<th>≤ 1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-state-voltage [V] at nominal current:</td>
<td>1.0</td>
</tr>
<tr>
<td>Off-state voltage [V/μs]:</td>
<td>200</td>
</tr>
<tr>
<td>Rate of rise of current [A/μs]:</td>
<td>100</td>
</tr>
</tbody>
</table>

\(^1\) Only available in 2 switched-pole versions
\(^2\) Current derating factors for heat sink /06 above 40 °C: Three phase controlled versions = 0.32 A/K; Two phase controlled versions = 0.47 A/K

Thermal Data - Solid-state relay -

<table>
<thead>
<tr>
<th>Thermal resistance</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>junction-ambient [K/W]:</td>
<td></td>
</tr>
<tr>
<td>Thermal resistance</td>
<td>0.6</td>
</tr>
<tr>
<td>junction housing [K/W]:</td>
<td></td>
</tr>
<tr>
<td>Junction temperature [°C]:</td>
<td>≤ 125</td>
</tr>
</tbody>
</table>
General Technical Data

Operating mode: Continuous operation (Current reduction above 40 °C)

Temperature range:
- operation: -40 ... 80 °C
- storage: -40 ... 80 °C

Relative air humidity:
- < 50 % for < +40 °C and
- < 90 % for < + 20 °C

Altitude:
1.000 m

Clearance and creepage distances:
rated impulse voltage / pollution degree: 6 kV / 2
Over voltage category: III

EMC:
- IEC/EN 61 000-6-4, IEC/EN 61 000-4-1
- IEC/EN 60 664-1

Electrostatic discharge (ESD):
8 kV air / 6 kV contact

HF irradiation:
10 V / m

Fast transients:
2 kV

Surge voltages:
Control circuit between A1 / A2: 1 kV
between output and ground: 2 kV

HF-wire guided:
10 V

Interference suppression:
Limit value class A*)
*) The device is designed for the usage under industrial conditions (Class A, EN 55011)
When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken.

Degree of protection: IP 20
Vibration resistance: 2 g

Housing material: PBT/PC flame resistant; UL 94 V0

Base plate: Nickel plated aluminium

Mounting screws:
M4 x 20 mm (with conical and plain washers)

Fixing torque:
1.8 Nm

Connections load circuit:
Mounting screws M4 Pozidrive PZ 2
Fixing torque: 1.2 Nm
Wire cross section:
2 x 1.5 ... 2.5 mm² solid or
2 x 2.5 ... 6 mm² solid oder
2 x 1.0 ... 2.5 mm² stranded wire with sleeve
2 x 2.5 ... 6 mm² stranded wire with sleeve
1 x 10 mm² stranded wire with sleeve

Connections control circuit:
Mounting screws M3 Pozidrive PZ 1
Fixing torque: 0.6 Nm
Wire cross section:
1 x 0.5 ... 2.5 mm² solid oder
2 x 0.5 ... 1.0 mm² solid oder
1 x 0.5 ... 2.5 mm² stranded wire with sleeve

Nominal insulation voltage:
Control circuit – load circuit: 4 kV eff.
Load circuit – base plate: 4 kV eff.
Overvoltage category: III

Weight:
PI9260.9X/.../06: 970 g

Dimensions:
Width x height x depth: 67.5 x 120 x 50 mm

Standard Type
PI 9260.92/000/06 AC 48 ... 480 V 2 x AC 30 A DC 10 ... 32 V
Article number: 0067462
- Load voltage: AC 48 ... 480 V
- Load current AC-51: 2 x 30 A
- Load current AC-53a: 2 x 12 A
- Control voltage: DC 10 ... 32 V
- With heat sink 0.75 kW
- Width: 67.5 mm

PI 9260.93/000/06 AC 48 ... 480 V 3 x AC 30 A DC 10 ... 32 V
Article number: 0067464
- Load voltage: AC 48 ... 480 V
- Load current AC-51: 3 x 20 A
- Load current AC-53a: 3 x 12 A
- Control voltage: DC 10 ... 32 V
- With heat sink 0.75 kW
- Width: 67.5 mm

Variants

<table>
<thead>
<tr>
<th>PI 9260.9...</th>
<th>00</th>
<th>06</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without heat sink</td>
<td>With heat sink 0.75 kW</td>
<td>With heat sink 0.75 kW and fan kit (on request)</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Switching at zero crossing</td>
<td>with temperature protection</td>
<td>Immediate switching</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>With high I²t-value &gt; 6600 A²s</td>
<td>With high I²t-value &gt; 18000 A²s</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Ordering example for variants

PI 9260.92/200/06 AC 48 ... 480V 2 x AC 30 A AC 100 ... 230 V
Article number: 0067688
Load current AC-51: 2 x 30 A
Load current AC-53a: 2 x 30 A

PI 9260.93/000/06 AC 48 ... 480V 3 x AC 20 A AC 100 ... 230 V
Article number: 0067687
Load current AC-51: 3 x 20 A
Load current AC-53a: 3 x 12 A

PI 9260.93/100/06 AC 48 ... 480V 3 x AC 20 A DC 10 ... 32 V
Article number: 0067686
Load current AC-51: 3 x 20 A
Load current AC-53a: 3 x 20 A

Other variants on request.

Notes on Sizing for Selection of a Heat Sink
The heat generated by the load current flowing through the SSR has to be removed by a suitably chosen heat sink. It is essential that the junction temperature of the semiconductor is kept below 125 °C for all possible ambient temperatures. It is of paramount importance that the thermal resistance between the SSR base plate and the heat sink is kept to a minimum. A small amount of thermally conductive compound (or a similar interface material) should be applied to the base plate before assembly to the heat sink. The tables shown below can be used as a guide to select a suitable heat sink for various load currents and ambient temperatures situations.
### Selection of a Heat Sink

#### a) 3 Phase SSR Rating 20A/pole

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>2.2</td>
</tr>
<tr>
<td>18</td>
<td>2.5</td>
</tr>
<tr>
<td>16</td>
<td>3.0</td>
</tr>
<tr>
<td>14</td>
<td>3.5</td>
</tr>
<tr>
<td>12</td>
<td>4.3</td>
</tr>
<tr>
<td>10</td>
<td>5.3</td>
</tr>
<tr>
<td>8</td>
<td>6.2</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient temperature (°C)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

#### b) 3 Phase SSR Rating 30A/pole

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>1.0</td>
</tr>
<tr>
<td>27</td>
<td>1.3</td>
</tr>
<tr>
<td>24</td>
<td>1.5</td>
</tr>
<tr>
<td>21</td>
<td>1.9</td>
</tr>
<tr>
<td>18</td>
<td>2.3</td>
</tr>
<tr>
<td>15</td>
<td>3.0</td>
</tr>
<tr>
<td>12</td>
<td>4.0</td>
</tr>
<tr>
<td>9</td>
<td>5.5</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
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<tr>
<td>3</td>
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</table>

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<thead>
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<th>Ambient temperature (°C)</th>
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<td>20</td>
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</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

#### c) 3 Phase SSR Rating 50A/pole

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0.6</td>
</tr>
<tr>
<td>45</td>
<td>0.7</td>
</tr>
<tr>
<td>40</td>
<td>0.9</td>
</tr>
<tr>
<td>35</td>
<td>1.1</td>
</tr>
<tr>
<td>30</td>
<td>1.4</td>
</tr>
<tr>
<td>25</td>
<td>1.8</td>
</tr>
<tr>
<td>20</td>
<td>2.4</td>
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<tr>
<td>15</td>
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<tr>
<td>10</td>
<td>5.6</td>
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</table>

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<th>Ambient temperature (°C)</th>
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<tbody>
<tr>
<td>20</td>
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</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

#### d) 3 Phase SSR Rating 60A/pole

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>0.5</td>
</tr>
<tr>
<td>52</td>
<td>0.6</td>
</tr>
<tr>
<td>48</td>
<td>0.8</td>
</tr>
<tr>
<td>42</td>
<td>0.9</td>
</tr>
<tr>
<td>36</td>
<td>1.2</td>
</tr>
<tr>
<td>30</td>
<td>1.5</td>
</tr>
<tr>
<td>24</td>
<td>2.0</td>
</tr>
<tr>
<td>18</td>
<td>3.0</td>
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<tr>
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<thead>
<tr>
<th>Ambient temperature (°C)</th>
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<tbody>
<tr>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
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</tbody>
</table>

#### e) 2 Phase SSR Rating 20A/pole

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>1.9</td>
</tr>
<tr>
<td>18</td>
<td>2.5</td>
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<tr>
<td>16</td>
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<td>14</td>
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<td>12</td>
<td>4.3</td>
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<td>10</td>
<td>5.3</td>
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<td>8</td>
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</tr>
<tr>
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<table>
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<tr>
<th>Ambient temperature (°C)</th>
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<tbody>
<tr>
<td>20</td>
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</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

#### f) 2 Phase SSR Rating 30A/pole

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0.9</td>
</tr>
<tr>
<td>27</td>
<td>1.0</td>
</tr>
<tr>
<td>24</td>
<td>1.3</td>
</tr>
<tr>
<td>21</td>
<td>1.7</td>
</tr>
<tr>
<td>18</td>
<td>2.1</td>
</tr>
<tr>
<td>15</td>
<td>2.5</td>
</tr>
<tr>
<td>12</td>
<td>3.2</td>
</tr>
<tr>
<td>9</td>
<td>4.2</td>
</tr>
<tr>
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<td>-</td>
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<tr>
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<td>-</td>
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</tbody>
</table>

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<th>Ambient temperature (°C)</th>
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<tbody>
<tr>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

#### g) 2 Phase SSR Rating 50A/pole

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0.4</td>
</tr>
<tr>
<td>45</td>
<td>0.5</td>
</tr>
<tr>
<td>40</td>
<td>0.6</td>
</tr>
<tr>
<td>35</td>
<td>0.7</td>
</tr>
<tr>
<td>30</td>
<td>0.8</td>
</tr>
<tr>
<td>25</td>
<td>0.9</td>
</tr>
<tr>
<td>20</td>
<td>1.0</td>
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<tr>
<td>15</td>
<td>1.2</td>
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<tr>
<td>10</td>
<td>1.4</td>
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<tr>
<td>5</td>
<td>-</td>
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</table>

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<th>Ambient temperature (°C)</th>
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<tbody>
<tr>
<td>20</td>
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</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

#### h) 2 Phase SSR Rating 60A/pole

<table>
<thead>
<tr>
<th>Load current (A)</th>
<th>Thermal resistance (K/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>0.5</td>
</tr>
<tr>
<td>52</td>
<td>0.6</td>
</tr>
<tr>
<td>48</td>
<td>0.8</td>
</tr>
<tr>
<td>42</td>
<td>0.9</td>
</tr>
<tr>
<td>36</td>
<td>1.2</td>
</tr>
<tr>
<td>30</td>
<td>1.5</td>
</tr>
<tr>
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<td>2.0</td>
</tr>
<tr>
<td>18</td>
<td>3.0</td>
</tr>
<tr>
<td>12</td>
<td>4.8</td>
</tr>
<tr>
<td>6</td>
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</tr>
</tbody>
</table>

<table>
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<th>Ambient temperature (°C)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>
Connection Example

Typical applications

Three phase motor application
According to IEC/EN 60 947-1, IEC/EN 60 947-4-2
- Switching at zero-crossing
- To reverse 3 phase asynchronous motors up to 5.5 kW / 400 V (7.5 HP / 460 V)
- Electrical interlocking of both directions
- Temperature monitoring to protect the power semiconductors
- Measured nominal current up to 20 A
- LEDs for status indication
- Galvanic separation between control circuit and power circuit
- 45 mm; 67.5 mm; 112.5 mm width

The reversing contactor BH 9253 is used to reverse the direction of 3-phase asynchronous motors by switching 2 phases. An electrical interlocking disables the control of both directions at the same time. The reversing contactor has a short on and off delay time. When reversing the phases a switchover delay is guaranteed.

Temperature sensing
To protect the power semiconductors the unit incorporates temperature monitoring. When overtemperature is detected the power semiconductors switch off and an output relay as well as a red LED is activated. This state is stored. When the temperature is back to normal the semiconductors can be activated again by switching off and on the control voltage.

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 (l), A2</td>
<td>Auxiliary voltage, control anti-clockwise</td>
</tr>
<tr>
<td>A3 (r), A2</td>
<td>Auxiliary voltage, control clockwise</td>
</tr>
<tr>
<td>L1, L2, L3</td>
<td>Mains connection</td>
</tr>
<tr>
<td>T1, T2, T3</td>
<td>Motor connection</td>
</tr>
<tr>
<td>11, 12, 14</td>
<td>Contacts output relays, active when overtemperature</td>
</tr>
</tbody>
</table>

Indicators
- yellow LED "l": on, when left direction active
- yellow LED "r": on, when right direction active
- red LED: on, when overtemperature

Connection Terminal

Function Diagram

Circuit Diagrams

Approvals and Markings
Cycle diagram to calculate the operating frequency

Formula for selection of unit and motor

\[
I_2 = \frac{I_1}{1 + \left( I_1 T - I_1 \right)}
\]

Device selection

\[
I_2 = \frac{I_1}{1 + \left( I_1 T - I_1 \right)}
\]

Motor selection

\[
I_2 = \frac{I_1}{1 + \left( I_1 T - I_1 \right)}
\]

Load terminals: 1 x 6 mm² stranded ferruled
Control terminals: 2 x 2.5 mm² solid or
2 x 1.5 mm² stranded ferruled
DIN 46 228-1/-2/-3/-4

Wire fixing: terminal screws M3.5; box terminals with self-lifting wire protection

Fixing torque: 1.2 Nm
Control terminals: 0.8 Nm
Mounting: DIN rail

Weight:
BH 9253 with 4 A: 420 g
BH 9253 with 12 A: 640 g
BH 9253 with 20 A: 1 040 g

Dimensions

Width x height x depth:
BH 9253 with 4 A: 45 x 84 x 121 mm
BH 9253 with 12 A: 67.5 x 84 x 121 mm
BH 9253 with 20 A: 112.5 x 84 x 121 mm

Modern motors with efficiency class IE3 may have an inrush peak current of 10-12 times of the nominal motor current.
### UL-Data

<table>
<thead>
<tr>
<th>Switching capacity</th>
<th>Relay</th>
<th>NC-contact</th>
<th>[Vac]</th>
<th>230; 3A; GP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short circuit current rating</td>
<td>[Arms]</td>
<td>5000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Ambient conditions

For usage at pollution degree 2; To be used in circuits that allows a max. current of 5000Arms at 460 V. The device has to be fused with a fuse class RK5 25A.

<table>
<thead>
<tr>
<th>Rated continuous current $I_e$</th>
<th>[A]</th>
<th>4</th>
<th>12</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>[°C]</td>
<td>40</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>max. motor power at 460 V</td>
<td>[HP]</td>
<td>1.5</td>
<td>0.75</td>
<td>5</td>
</tr>
<tr>
<td>Nominal motor current FLA</td>
<td>[A]</td>
<td>3.0</td>
<td>1.6</td>
<td>7.6</td>
</tr>
<tr>
<td>max. locked rotor motor current LRA</td>
<td>[A]</td>
<td>20</td>
<td>12.5</td>
<td>46</td>
</tr>
</tbody>
</table>

1) The rated continuous current $I_e$ is the max. permissible current of the unit in continuous operation.

### Wire connection

<table>
<thead>
<tr>
<th>Load terminals</th>
<th>L1, L2, L3, T1, T2, T3:</th>
<th>60°C / 75°C copper conductors only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AWG 18 - 8 Sol Torque 0.8 Nm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AWG 18 - 10 Str Torque 0.8 Nm</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control terminals</th>
<th>A1, A2, A3, 11, 12, 14:</th>
<th>60°C / 75°C copper conductors only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AWG 20 - 12 Sol Torque 0.8 Nm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AWG 20 - 14 Str Torque 0.8 Nm</td>
<td></td>
</tr>
</tbody>
</table>

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

### Standard Type

BH 9253.11/61  AC 220 ... 240 V  4 A  100 ms

- Output: 1 changeover contact
- Nominal voltage $U_n$: AC 220 ... 240 V
- Rated continuous current: 4 A
- Switchover delay: 100 ms
- Width: 45 mm

### Ordering Example

BH 9253 .11 /61 AC 220...240 V  4 A  100 ms
ATTENTION!

A1 and A3 has to be connected to the same phase. The common connection is terminal A2.

Connecting a parallel loud between A1 and A2 as well as A3 and A2 is not allowed.
Power Electronics

POWERSWITCH
Reversing Contactor With Current Monitor
BH 9255

- According to IEC/EN 60 947-1, IEC/EN 60 947-4-2
- Switching at zero crossing
- To reverse 3 phase asynchronous motors up to 5.5 kW / 400 V (7.5 HP / 460 V)
- Electrical interlocking of both directions
- Temperature monitoring to protect the power semiconductors
- Measured nominal current up to 20 A
- LEDs for status indication
- Galvanic separation between control circuit and power circuit
- With current monitor
- 45 mm; 67.5 mm; 112.5 mm width

The reversing contactor BH 9255 is used to reverse the direction of 3-phase asynchronous motors by switching 2 phases (L1 and L2). An electrical interlocking disables the control of both directions at the same time. The reversing contactor has a short on and off delay time. When reversing the phases a switchover delay is guaranteed.

The motor current is monitored in phase L1. If the current rises above the tripping value the device is able to switch off the motor.

The start up delay runs. If the start up delay is finished and the current is still over the adjusted value the relay contacts switch back to 11-12. This state is stored. It resets by switching off the motor on the control input.

If the motor current rises above the adjusted value during operation the time tv (switching delay) runs down. If the switching delay is finished and the current is still over the adjusted value the relay contacts switch back to 11-12. This state is stored. It resets by switching off the motor on the control input.

Without bridge x3-x4 (plc control)
Same function as without bridge, but in addition to the relay contact 11-12 also the motor is switched off at the same time.

Bridge x1-x2: Switchover delay t, 20 or 100 ms

Temperature sensing
To protect the power semiconductors the unit incorporates temperature monitoring. When overtemperature is detected e.g. because of reversing to often the power semiconductors switch off and an and the enabling relay switches back in position 11-12. This state is stored. When the temperature is back to normal the semiconductors can be activated again by switching off and on the control voltage.
**Indicators**

- **green LED „ON”** on when auxiliary supply connected
  flushes if „tₐ” abläuft
- **yellow LED „r”** on, when right direction active
- **yellowLED „l”** on, when left direction active
- **red LED „i>”** on, when overtemperature and
  flushes during time elaspe of „tₐ”
- **red LED „ϑ>”** on, when overtemperature
  flushes if a system fault is detected.

A motor current is measured and while the semiconductors are off. The motor cannot be started.
Technical Data

Input

Auxiliary voltage Uₜₐₚ:\n\ AC/DC 24 V;\n\ AC 110 ... 127 V, AC 230 V, AC 288 V, AC 400 V (no UL-devices)\n\ DC: 0.8 ... 1.1 Uₜₐₚ

Voltage range:\n\ AC: 0.8 ... 1.1 Uₜₐₚ
\ DC: 0.8 ... 1.25 Uₜₐₚ

Nominal consumption\n\ at AC 230 V: 5 VA, 1.1 W\n\ at AC 24 V: 0.6 W

Nominal frequency: 50 / 60 Hz

Control input r+ / r- / l+:\n\ DC 24 V preferred for plc control (short response time)\n\ AC/DC 24 ... 80 V
\ AC/DC 80 ... 230 V

Start up delay \( t_{\text{u}} \):\n\ ≤ 10 ms\n\ + max. 1 half-wave
\ ≤ 15 ms\n\ + max. 1 half-wave

Release delay: \( \leq 10 \text{ ms} \)\n\ + max. 1 half-wave\n\ ≤ 60 ms\n\ + max. 1 half-wave

Switching delay \( t_{\text{a}} \):\n\ with bridge: 100 ms
\ without bridge: 20 ms

Switching delay \( t_{\text{a}} \):\n\ 0.1 ... 5 s, adjustable via potentiometer
\ 0.1 ... 5 s, adjustable via potentiometer

Current measuring range:\n\ 2 ranges programmable via bridge on terminals Z1 - Z2
\ 2 ranges programmable via bridge on terminals X1 - X2

Unit for measured nominal current: 4 A 12 A 20 A

Load Output

<table>
<thead>
<tr>
<th>unit without heat sink</th>
<th>with heat sink width 67.5 mm</th>
<th>with heat sink width 112.5 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated continuous current ( I_{\text{c}} )\n1) [A]</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Current reduction above 40 °C [A/°C]</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>max. motor power at 400 V [kW]</td>
<td>( \leq 5.5 )</td>
<td>( \leq 6 )</td>
</tr>
<tr>
<td>Nominal motor current ( I_{\text{M}} ) [A]</td>
<td>2.6</td>
<td>8.5</td>
</tr>
<tr>
<td>max. locked rotor motor current ( I_{\text{LRM}} )\n2) [A]</td>
<td>15.6</td>
<td>51</td>
</tr>
</tbody>
</table>

Example for max. operat. freq. at rated continuous current of 10 A for 1 s, 85 A for 2 s and 70 A for 5 s must not be exceeded.

Clearance and creepage distances rated impulse voltage / pollution degree: 4 kV / 2 IEC 60 664-1

Cycle diagram to calculate the operating frequency

Closed loop control

Load Output

Cycle diagram to calculate the operating frequency

Formula for selection of unit and motor

\[ I_{\text{M}} \leq 6 I_{\text{TH}} \]

Iₜ₁: Starting current / Blocking current

Please take into account the motor data.

Modern motors with efficiency class IE3 may have an inrush peak current of 10-12 times of the nominal motor current.

Monitoring Output

Contacts

BH 9255.11: 1 changeover contact

Thermal current \( I_{\text{TH}} \): 5 A

Switching capacity at AC 15:

NO: 3 A / AC 230 V IEC/EN 60 947-5-1
NC: 1 A / AC 230 V IEC/EN 60 947-5-1

Short circuit strength:

max. fuse rating: 4 A gG / gL IEC/EN 60 947-5-1

General Data

Continuous operation

Temperature range:

-20 ... + 60 °C

Current reduction over 40 °C: see table

Storage: -25 ... + 70 °C

Altitude: < 2,000 m

Clearance and creepage distances

rated impulse voltage / pollution degree: 4 kV / 2 IEC 60 664-1

EMC

Surge voltages: 5 kV / 0.5 J IEC/EN 61 000-4-4

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages between wires for power supply: 1 kV IEC/EN 61 000-2-5

HF wire guided: 10 V / m IEC/EN 61 000-4-3

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

Climate resistance: 20 / 040 / 04 IEC/EN 60 068-1

Terminal designation: EN 50 005

Cycle diagram to calculate the operating frequency

1) \( I_{\text{LRM}} \): \( \text{max. locked rotor motor or starting current} \)

2) The max. locked rotor motor or starting current of 100 A for 1 s, 85 A for 2 s and 70 A for 5 s must not be exceeded.

Note: The max. permissible operating frequency of the motor can be less. See motor data!
### Technical Data

#### Wire connection
- **Load terminals:** 1 x 10 mm² solid or 1 x 6 mm² stranded ferruled
- **Control terminals:** 2 x 2.5 mm² solid or 2 x 1.5 mm² stranded ferruled

#### Wire fixing:
- **Load terminals:** terminal screws M3.5; box terminals with self-lifting wire protection
- **Control terminals:**
- **DIN 46 228-1/-2/-3/-4**

#### Fixing torque:
- **Load terminals:** 1.2 Nm
- **Control terminals:** 0.8 Nm

#### Weight:
- **BH 9255 with 4 A:** 460 g
- **BH 9255 with 12 A:** 700 g
- **BH 9255 with 20 A:** 1160 g

#### Dimensions
- **Width x height x depth:**
  - **BH 9255 with 4 A:** 45 x 84 x 121 mm
  - **BH 9255 with 12 A:** 67.5 x 84 x 121 mm
  - **BH 9255 with 20 A:** 112.5 x 84 x 121 mm

#### Switching capacity
- **NO-contact: [Vac]**
- **NC-contact: [Vac]**

#### Short circuit current rating **[Arms]**
- **230:** 3A; GP
- **230:** 1A; GP
- **5000**

#### Ambient conditions
- **Rated continuous current Ie**
  - **Unit without heat sink**
  - **Width 67.5 mm**
  - **Width 112.5 mm**

#### Rated continuous current Ie **[A]**
- **4 A**
- **12 A**
- **20 A**

#### Ambient temperature **[°C]**
- **40**
- **60**

#### Max. motor power at 460 V **[HP]**
- **1.5**
- **0.75**

#### Nominal motor current FLA **[A]**
- **3.0**
- **1.6**

#### Max. locked rotor motor current LRA **[A]**
- **20**
- **12.5**

#### Standard Type
- **BH 9255.11 /61 AC 230 V 50 / 60 Hz 4 A AC/DC 80 ... 230 V**
- **Artikelnummer:** 0064648
- **Output:** 1 changeover contact
- **Auxiliary voltage UH:** AC 230 V
- **Rated continuous current:** 4 A
- **Control input:** AC/DC 80 ... 230 V
- **Width:** 45 mm

#### Ordering Example
- **BH 9255 .11 /61 AC 220...240 V 4 A AC/DC 24 ... 80 V**
Application Examples

BH 9255 with A1/A2 = AC 230 V and control input AC/DC 80 ... 230 V

BH 9255 with A1/A2 = AC/DC 24 V and control input AC/DC 24 V or DC 24 V
Power Electronics

POWERSWITCH
Reversing Contactor With Softstart And
Active Power Monitoring BI 9254

- According to IEC/EN 60 947-1, IEC/EN 60 947-4-2
- To reverse 3 phase motors
- Electrical interlocking of both directions
- 2-phase softstart
- Active power monitoring after softstart
- Temperature monitoring of power semiconductors
- LED indicator
- Internal auxiliary voltage are made from phase voltage
- Galvanic separation of control circuit and power circuit
- Space and cost saving with 3 functions in one compact unit
- Reducing of wiring and wiring failure
- Width 90 mm

Function Diagrams

Approvals and Markings

Applications
- Reversing operation for door and gate controls, bridge drives and lifting applications with monitoring of blockage
- Conveyor systems with monitoring of blockage
- Actuating drives in process controls with blockage monitoring

Circuit Diagram
Function

The reversing contactor BI 9254 is used to reverse the direction and to monitor the effective power on 3-phase asynchronous motors. An electrical interlock blocks the simultaneous control of both directions. To monitor the effective power correctly the current in the 3 phases has to be symmetric. The monitoring function only gets active after an adjustable start up delay. The 3 phases L1, L2 and L3 are connected continuously to the unit.

Temperature monitoring

To protect the semiconductors their temperature is monitored. If overtemperature is detected, the power semiconductors switch off, the signalling relay 1 de-energises and the red LED flashes Code 1. This state is latched. After the temperature is back to normal the status can be reset by switching the control input on and off.

Softstart

Two phases are controlled by thyristors in order to let the current rise slowly and to limit it. The motor torque reacts accordingly during start-up. This allows to reduce shock and stress for the mechanical parts of the drive. Start-up time and starting torque can be set with potentiometers.

Effective load measuring

After an adjustable start up time, but at the earliest after end of ramp up time, the effective power of the connected motor is monitored. Effective power is defined as \( P = U \times I \times \cos \phi \). The maximum motor load is adjustable with potentiometer. A yellow LED indicates overload, but only as long as the motor is actually in overload state. After an adjustable time delay of 1...10 s a relay contact switches on until the effective load drops again under the adjusted value.

Control inputs

With 2 control inputs left and right rotation is selected. When both inputs are activated the first signal will be accepted as valid. The inputs can be controlled by volt free contacts or with external DC 24 V. With activation of a control input the ramp up time and the start up delay is started again. The unit does not create any extra interlocking times for reversing operation except a short delay that is necessary to control the semiconductors. If one or both control inputs are active when applying auxiliary supply, a failure code “Control input active when unit switched on” is displayed. The Error LED flashes code 6. By disconnecting the control inputs the failure state is reset.

Monitoring relay 1 (contact 11-12-14)

The relay energises as soon as the unit is ready for operation after auxiliary supply is connected. On overtemperature, phase failure or wrong phase sequence the relay de-energises and the power semiconductor switches off.

Monitoring relay 2 (contact 21-22-24)

The relay energises, when after the adjusted time delay the effective power exceeds the setting value (energized on trip). The relay de-energises as soon as the effective power drops below the adjusted value. In the case of any other failure the relay de-energises.

Indication

| green LED ON: | permanent on - supply connected |
| yellow LED r: | permanent on - start up delay active |
| yellow LED l: | permanent on - after start clockwise |
| yellow LED >Pmax: | permanent on - effective power overload, relay 2 energized |
| red LED ERROR: | flashing - delay active |
| 1*: | - overtemperature on semiconductors |
| 2*: | - wrong mains freqency |
| 3*: | - incorrect phase sequence, exchange connections on L1 and L2 |
| 4*: | - phase failure |
| 5*: | - Temperature monitoring of power semiconductors defect or device temperature < -20°C |
| 6*: | - control input energized on power up |

1* - 6* = Number of flashing pulses in sequence

Setting Facilities

| Poti M: | - starting torque at softstart 20 ... 80 % |
| Poti t: | - ramp up time 1 ... 10 s |
| Poti t: | - start up time delay 1 ... 20 s |
| Poti t: | - on delay 1 ... 10 s |
| Poti P: | - response value for max. effective power 0,1 ... 6 kW |

The setting of the effective power is infinite adjustable on absolute scale. The most accurate setting is achieved by turning the pot slowly from min to required value without changing the turning direction.

Set-up Procedure

1. Connect motor and device according to application example. Turn potentiometer \( M_{\text{m}} \) fully anticlockwise, potentiometers \( t_{\text{r}} \), \( t_{\text{s}} \), \( t_{\text{f}} \) and \( P_{\text{max}} \) fully clockwise.
2. Connect voltage and begin softstart by control of input X2 or X3. Turn potentiometer clockwise until motor starts immediately after switching on. This avoids unnecessary heating and humming of the motor.
3. Adjust the start up time by turning \( t_{\text{r}} \) to the required value.
4. At correct setting, the motor should ramp up continuously to full speed. Adjust the start up time delay with potentiometer \( t_{\text{r}} \), time delay with potentiometer \( t_{\text{s}} \) and response value for max. effective power with potentiometer \( P_{\text{max}} \) to the required value.

Safety Remarks

- Never clear a fault when the device is switched on.

Attention: This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains via the corresponding manual motor starter.

- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards (VDE, TÜV,BG).

- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.
Technical Data

Nominal voltage L1/L2/L3: 3 AC 400 V ± 10 %
Nominal frequency: 50 / 60 Hz automatische Erkennung

Load Output

<table>
<thead>
<tr>
<th>with heat sink width: 67.5 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated continuous current Ie</td>
</tr>
<tr>
<td>Ambient temperature [°C]</td>
</tr>
<tr>
<td>max. motor power at 400 V  [kW]</td>
</tr>
<tr>
<td>Nominal motor current Ie</td>
</tr>
<tr>
<td>max. locked rotor motor current</td>
</tr>
</tbody>
</table>

Example for max. oper. freq. at 100 % duty cycle, 80 % motor load, starting time t1, 2s, starting current Ie = 6 x Ie

Operation mode ACS3a acc. to IEC/EN 60947-4-2

1) The rated continuous current Ie is the max. permissible current of the unit in continuous operation.
2) The max. locked rotor motor or starting current of 100 A for 1 s, 85 A for 2 s and 70 A for 5 s must not be exceeded.

Note: The max. permissible operating frequency of the motor can be less. See motor data!

Peak reverse voltage: 1200 V
Overvoltage limiting: AC 510 V
Surge current 10 ms: 300 A
Semiconductor fuse: e.g. TRS 25R, Fa. Ferraz
Leakage current in off state: < 3 x 5 mA
Internal resistance current measuring system: 7 mΩ
Starting voltage: 20 ... 80 %
Ramp up time: 1 ... 10 s
Consumption: 3 W
Interlocking time t1: 50 ms
Start up delay: max. 25 ms
Release delay: max. 30 ms
Effective power monitoring Measuring accuracy: ± 4 % max. scale value
Reaction time: 80 ms

Cycle diagram to calculate the operating frequency

Formula for selection of unit and motor

- l1 = 6 x Ie
- l2 = 0.8 x Ie

- Ie = starting time
- T = cycle time

Device selection

- \[ T_i = \frac{l_1 + l_2 (T-T_i)}{l_2} \]

Motor selection

- \[ T_i = \frac{l_1 + l_2 (T-T_i)}{l_2} \]

Inputs

Control input right, left: DC 24 V "volt free contact"
Rated current: 5 mA
Softstart: DC 10 ... 30 V
Softstop: DC 0 ... 6 V
Connection: polarity protected diode, overvoltage protection
Volt free contact: NO contact

Technical Data

Contacts:
- 2 x 1 change over contacts
Thermal current Ith:
- 5 A
Switching capacity to AC 15
- NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1
- NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1
Electrical life to AC 15 at 3 A, AC 230 V: 2 x 10⁶ switch. cycles IEC/EN 60 947-5-1
Mechanical life:
- Permissible switching frequency: 1800 switching cycles/h
Short circuit strength
- max. fuse rating: 4 A gL IEC/EN 60 947-5-1

General Data

Operating mode: Continuous operation
Temperature range: - 20 ... + 60 °C
Current reduction over 40 °C: see table
Clearance and creepage distances
overvoltage category / contamination level
Motor voltage-heat sink: 6 kV / 2 EN 50 178
Motor voltage-control voltage: 4 kV / 2 EN 50 178
EMC
Electrostatic discharge (ESD): 8 kV (Luftentladung) IEC/EN 61 000-4-2
Fast transients: 2 kV IEC/EN 61 000-4-4
Surge voltage between wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
HF-wire guided: 10 V IEC/EN 61 000-4-6
Radio interference: EN 55 011
Harmonics: EN 55 011
Degree of protection
Housing: IP 40 IEC/EN 60 529
Terminals: IP 20 IEC/EN 60 529
Vibration resistance:
- Amplitude 0.35 mm
- frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
Climate resistance:
- 20 / 055 / 04 IEC/EN 60 068-1
Wire connection
Load terminals: 1 x 10 mm² solid or
- 1 x 6 mm² stranded wire with sleeve
Control terminals: 1 x 4 mm² solid or
- 1 x 2,5 mm² stranded ferruled (isolated) or
- 2 x 2,5 mm² stranded ferruled (isolated) or
- 1 x 2,5 mm² stranded wire with sleeve DIN 46 228-1/-2/-3/-4

Wire fixing
Load terminals: Captive plus-minus-terminal screws M4;
- Box terminals with self-lifting wire protection
Control terminals: Captive plus-minus-terminal screws M3,5;
- Box terminals with self-lifting wire protection
Mounting:
- Hutschiene IEC/EN 60 715

Dimensions

Width x height x depth: 90 x 85 x 121 mm
Application Examples

BI 9254 with control input DC 24 V

BI 9254 with volt free contact

UL-Data

<table>
<thead>
<tr>
<th>Switching capacity</th>
<th>with heat sink width: 67.5 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor (Motor circuit)</td>
<td>400; 3-phase 50/60 Hz</td>
</tr>
<tr>
<td>Relay NO-contact</td>
<td>230; 3 A; GP</td>
</tr>
<tr>
<td>Relay NC-contact</td>
<td>230; 3 A; GP</td>
</tr>
<tr>
<td>Short circuit current rating [Arms]</td>
<td>5000</td>
</tr>
</tbody>
</table>

Ambient conditions

- Rated continuous current $I_{n}$ [A] 12
- Ambient temperature [°C] 40 60
- max. motor power at 400 V [HP] 3 2
- Nominal motor current FLA (Full load current) [A] 6,1 4,3
- max. locked rotor motor current LRA [A] 43 34

Example for max. operat. freq. at 100 % duty cycle, 80 % motor load, starting time $t_1$, 2 s, starting current $I_1 = 6 \times I_n$, 245

1) The rated continuous current $I_{n}$ is the max. permissible current of the unit in continuous operation.

2) The max. locked rotor motor or starting current of 100 A for 1 s, 85 A for 2 s and 70 A for 5 s must not be exceeded.

Wire connection

Load terminals: 60°C / 75°C copper conductors only
- AWG 18 - 8 Sol Torque 0.8 Nm
- AWG 18 - 10 Str Torque 0.8 Nm

Control terminals: 60°C / 75°C copper conductors only
- AWG 20 - 12 Sol Torque 0.8 Nm
- AWG 20 - 14 Str Torque 0.8 Nm

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

Standard Type

BI 9254.38 3 AC 400 V 50 / 60 Hz 12 A

Order Reference

BI 9254 38 3 AC 400 V 50 / 60 Hz 12 A

Rated continuous current
Nominal frequency
Nominal voltage
Contacts
Type

BI 9254 with control input DC 24 V

BI 9254 with volt free contact
Your Advantages

- Simple and time-saving commissioning as well as user-friendly operation through setting via potentiometers
- Hybrid relay combines benefits of relay technology with non-wearing semiconductor technology
- High availability by
  - Temperature monitoring of semiconductors
  - High withstand voltage up to 1500 V

Features

- According to IEC/EN 60 947-4-2
- 2-phase softstart and softstop of 3-phase motors up to 4 KW
- 4 potentiometer for setting of starting torque, deceleration torque, softstart /-stop
- 3 LEDs for status indication
- Reset button on front
- Connection facility for external reset button
- Relay indicator output for operation
- Galvanic separation between control circuit and power circuit
- Width 22.5 mm

Approvals and Markings

Canada / USA

Applications

- Motors with gear, belt or chain drive
- Fans, pumps, conveyor systems, compressors
- Woodworking machines, centrifuges
- Packaging machines, door drives
- Start current limiting on 3 phase motors

Circuit Diagram
**Connection Terminals**

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 (+)</td>
<td>Auxiliary voltage + DC 24 V</td>
</tr>
<tr>
<td>A2</td>
<td>Auxiliary voltage 0 V</td>
</tr>
<tr>
<td>X1+</td>
<td>Control input Start/Stopp</td>
</tr>
<tr>
<td>X2</td>
<td>Earth connection control input</td>
</tr>
<tr>
<td>MAN</td>
<td>Input for remote reset</td>
</tr>
<tr>
<td>RES</td>
<td>Output for remote reset</td>
</tr>
<tr>
<td>11, 12, 14</td>
<td>Indicator relay for operation</td>
</tr>
<tr>
<td>L1</td>
<td>Phase voltage L1</td>
</tr>
<tr>
<td>L2</td>
<td>Phase voltage L2</td>
</tr>
<tr>
<td>L3</td>
<td>Phase voltage L3</td>
</tr>
<tr>
<td>T1</td>
<td>Motor connection T1</td>
</tr>
<tr>
<td>T2</td>
<td>Motor connection T2</td>
</tr>
<tr>
<td>T3</td>
<td>Motor connection T3</td>
</tr>
</tbody>
</table>

**Function**

**Soft start**

Two motor phases are impacted through thyristor phase-fired control to allow a steady increase of the currents. The motor torque behaves in the same manner when ramping up. This ensures that the drive can start without jerking and the drive elements are not damaged. Starting time and starting torque can be adjusted via rotary switch \( t_{\text{on}} \) and \( M_{\text{on}} \).

**Softstop**

The softstop function shall extend the natural running down time of the drive to also prevent jerky stopping. The deceleration time is set with rotary switch \( t_{\text{off}} \), the running-down torque with rotary switch \( M_{\text{off}} \).

**Phase failure**

To make sure the motor is not loaded with asymmetric currents, a check takes place during motor start whether phases L1, L2 and L3 are present. If one or several phases are absent, the device switches to fault 4. The fault can be acknowledged via the reset button or reset input.

**Control inputs**

If a voltage of more than 10 V DC is connected to terminals X1/X2, the device begins with softstart. If the voltage falls lower than DC 8 V the device will softstop.

**Signalling output “Ready”**

Contact 11/14 is closed if no device fault is present.

**Indication**

- green LED "ON": permanent on - auxiliary supply connected
- yellow LED "RUN": permanent on - power semiconductors bridged - ramp operation
- red LED "ERROR": flashing
  - 1*: Error
  - 2*: Overtemperature on semiconductors
  - 3*: Wrong mains frequency
  - 4*: Phase reversal detected
  - 7*: Incorrect temperature measurement circuit

1* - 7* = Number of flashing pulses in sequence

**Reset Function**

2 options are available to acknowledge the fault

- Manual (reset button): Acknowledgement is performed by operating the reset button at the front of the device. If the button is still actuated after 2 seconds, the device resumes the fault state.
- Manual (remote acknowledgement): Remote acknowledgement can be realised by connecting a button (N/O contact) between the terminals MAN and RES. Acknowledgement is triggered as soon as the contact of the button closes. If the button is still actuated after 2 seconds, the device resumes the fault state since a defect in the acknowledgement circuit cannot be ruled out.

**Setting Facilities**

- Rotary switch \( M_{\text{on}} \): - Starting torque at softstart 30 ... 80 %
- Rotary switch \( M_{\text{off}} \): - Deceleration torque at softstop 80 ... 30 %
- Rotary switch \( t_{\text{on}} \): - Start ramp 1 ... 10 s
- Rotary switch \( t_{\text{off}} \): - Deceleration ramp 1 ... 10 s

**Set-up Procedure**

1. Connect motor and device according to application example. A clockwise rotating field is assumed for operation. A anti-clockwise rotating field triggers a fault message
2. Turn rotary switch \( t_{\text{on}} / t_{\text{off}} \) fully clockwise, \( M_{\text{on}} \) e.g. \( M_{\text{off}} \) fully anticlockwise and rotary switch \( M_{\text{on}} \) e.g. \( M_{\text{off}} \) of the required current.
3. Connect voltage and starting via input R- or softstop L-.
4. The starting time is set by turning the rotary switch \( t_{\text{on}} \) anti-clockwise and the starting torque is set by turning the rotary switch \( M_{\text{on}} \) clockwise to the desired value. If set correctly, the motor shall swiftly accelerate to the nominal speed.
Nominal voltage L1/L2/L3: 3 AC 200 ... 480 V ± 10%
Nominal frequency: 50 / 60 Hz, automatic detection
Auxiliary voltage: DC 24 V ± 10%
Min. motor power: 50 W
Operating mode: 6.9 A (3 kW / 400 V): AC 53a: 3-5: 100-30 IEC/EN 60947-4-2
Surge current: 200 A ( tp = 20 ms )
Load limit integral: 200 A²s ( tp = 10 ms )
Peak reverse voltage: 1500 V
Overvoltage limiting: AC 550 V
Leakage current in off state: < 3 x 0.5 mA
Starting voltage: 30 ... 80 %
Start / deceleration ramp: 1 ... 10 s
Consumption: 2 W
Start up delay for master tick: max. 100 ms
Release delay for master tick: max. 50 ms
Short circuit strength: 25 A gG / gL IEC/EN 60 947-5-1
Assignment type: 1
Electrical life: > 10 x 10⁶ switching cycles
Inputs
Control input X1+/X2: DC 24V
Rated current: 4 mA
Response value ON: DC 10 V ... 30 V
Response value OFF: DC 0 V ... 8 V
Connection: polarity protected diode
Manuel: DC 24 V (connect button on terminals "MAN" and "RES")
Indicator Outputs
RES: DC 24 V, semiconductor, short circuit proof, rated continuous current 0.2 A
Ready: Changeover contact 250 V / 5 A
Contact: 1 changeover contact
Switching capacity to AC 15: 3 A / AC 230 V IEC/EN 60 947-5-1
NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1
Thermal current Ith: 5 A
Electrical life to AC 15 at 3 A, AC 230 V: 2 x 10⁴ switch. cyclesIEC 60 947-5-1
Mechanical life: 30 x 10⁴ switching cycles
Permissible switching frequency: 1800 switching cycles/h
Test voltage
Coil - Contact: 4000 V AC
Open Contact: 1000 V AC
Short circuit strength max. fuse rating: 4 A gG / gL IEC/EN 60 947-5-1
Technical Data
Device type: Hybrid Motor Controller H1B
Operating mode: Continuous operation
Temperature range: 0 ... + 60 °C (see derating curve)
Relative air humidity: 93 % at 40 °C
Altitude: < 1.000 m
Clearance and creepage distances Rated insulation voltage / overvoltage category / contamination level between control input, auxiliary voltage and Motor voltage respectively indicator contact: 4 kV / 2 IEC/EN 60 664-1
Overvoltage category: III
EMC
Interference resistance
Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2
HF-irradiation
80 MHz .... 1.0 GHz: 10 V / m IEC/EN 61 000-4-3
1.0 GHz .... 2.5 GHz: 3 V / m IEC/EN 61 000-4-3
2.5 GHz .... 2.7 GHz: 1 V / m IEC/EN 61 000-4-3
Fast transients: 2 kV IEC/EN 61 000-4-4
Surge voltage between wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
HF-wire guided: 10 V IEC/EN 61 000-4-6
Voltage dips: IEC/EN 61 000-4-11
Interference emission
Wire guided: Limit value class B IEC/EN 60 947-4-2
Radio irradiation: Limit value class B IEC/EN 60 947-4-2
Degree of protection:
Housing: IP 40 IEC/EN 60 529
Terminals: IP 20 IEC/EN 60 529
Vibration resistance: Amplitude 0.35 mm frequency 10 ... 55 Hz, IEC/EN 60 688-2-6
Climate resistance:
Wire connection: 0 / 060 / 04 IEC/EN 60 688-1 DIN 46 228-1/-2/-3/-4
Screw terminal (fixed):
Control terminals
Cross section: 1 x 0.14 ... 2.5 mm² solid or stranded wire with sleeve
Power terminals
Cross section: 1 x 0.25 ... 2.5 mm² solid or stranded wire with sleeve
Insulation of wires or sleeve length: 8 mm
Fixing torque: 0.5 Nm
Wire fixing: captive slotted screw
Mounting: DIN rail IEC/EN 60 715
Weight: 220 g
Dimensions
Width x height x depth: 22.5 x 105 x 120.3 mm
UL-Data

Standards:
for all products:
- U.S. National Standard UL508, 17th Edition

with restrictions at motor switching power:
- ANSI/UL 60947-4-2, 1st Edition (Low-Voltage Switchgear and Controlgear Part 4-2: Contactors and Motor-Starters - AC Semiconductor Motor Controllers and Starters)
- CSA-C22.2 No. 60947-4-2-14, 1st Edition (Low-Voltage Switchgear and Controlgear - Part 4-2: Contactors and Motor-Starters - AC Semiconductor Motor Controllers and Starters)

Motor data:
UL 508, CSA C22.2 No. 14-13
3 AC 200 ... 480 V,
3-phase, 50 / 60 Hz:
- up to 7.6 FLA, 45.6 LRA at 40 °C
- up to 4.8 FLA, 28.8 LRA at 50 °C
- up to 2.1 FLA, 12.6 LRA at 60 °C

UL 60947-4-2, CSA 60947-4-2
3 AC 200 ... 300 V,
3-phase, 50 / 60 Hz:
- up to 7.6 FLA, 45.6 LRA at 40 °C
- up to 4.8 FLA, 28.8 LRA at 50 °C
- up to 2.1 FLA, 12.6 LRA at 60 °C

3 AC 301 ... 480 V,
3-phase, 50 / 60 Hz:
- up to 2.1 FLA, 12.6 LRA at 60 °C

Indicator output relay:
5A 240Vac Resistive

Wire connection:
60°C / 75°C copper conductors only

Connections
A1+, A2, X1+, X2, MAN, RES, NE, 11, 12, 14: AWG 22 - 14 Sol/Str Torque 3.46 Lb-in (0.39 Nm)
L1, L2, L3, T1, T2, T3: AWG 30 - 12 Str Torque 5-7 Lb-in (0.564-0.79 Nm)

Additional Notes:
- This device is intended for use on supply systems with a maximum voltage from phase to ground of 300V (e.g. for a three phase-four wire system 277/480 V or on a three phase-three wire systems of 240V), rated impulse withstand voltage of max. 4 kV
- Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical Amperes, 480 Volts maximum when protected by class CC, J or RK5 fuse rated maximum 20 A
- For use in pollution degree 2 Environment or equivalent
- The control circuits of this device shall be supplied by an isolated 24 Vdc power supply which output is protected with a fuse rated max. 4 A dc
- For installations according to Canadian National Standard C22.2 No. 14-13 (cUL Mark only) and supply voltages above 400V:
  - Transient surge suppression devices shall be installed on the line side of this equipment and shall be rated 240 V (phase to phase), 415 V (phase to phase), suitable for overvoltage category III, and shall provide protection for a rated impulse withstand voltage peak of 4 kV
  - Transient surge suppression devices shall be installed on the line side of this equipment and shall be rated 277 V (phase to ground), 480 V (phase to phase), suitable for overvoltage category III, and shall provide protection for a rated impulse withstand voltage peak of 4 kV

Technical data that is not stated in the UL-Data, can be found in the technical data section.
MinisStart
Softstarter
IL 9017, SL 9017

- Increases life of 1-phase squirrel motors and mechanical drives
- Devices available in 2 enclosure version:
  - IL 9017: depth 61 mm with terminals at the bottom for installations systems and industrial distribution systems according to DIN 43 880
  - SL 9017: depth 100 mm with terminals at the top for cabinets with mounting plate and cable duct
- For single phase motors up to 1.5 kW
- Adjustable ramp time and starting torque
- Semiconductors will be bridged after start up
- LED indication
- Width 35 mm

Function Diagram

Function
Softstarters are electronic devices designed to enable 1-phase induction motors to start smoothly IL 9017. Slowly ramps up the current, allowing the motor torque to build up slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material. When the motor is up to full speed the semiconductors in IL 9017 are bridged to prevent internal power losses and heat build up.

Indication
- LED green: supply connected on softstarter
- LED yellow: softstart is finished

Applications
- Drives with gears, belts or chains
- Conveyor belts, fans
- Pumps, compressors

Principle of Operation
Terminal L1 is connected to the mains contactor, terminal N to neutral, the motor is connected to terminals T1, T2. As soon as power is connected to terminal L1, the softstart will commence. Potentiometer “tH” (1 - 10 sec.) adjusts the ramp time (time the motor takes to get to full speed) and potentiometer “MN” adjusts the start voltage (20 - 70 % Vnom). When the softstart is complete the internal semiconductor is automatically bridged.

Block Diagram

**Approvals and Markings**

CE
Notes

The motor load must always be connected as continuous operation of the softstart with no load may cause overheating of the motor and softstart. It is recommended that the softstart is protected by superfast semiconductor fuses rated as per the current rating of the softstart or motor. However, standard line and motor protection is acceptable, but for high starting frequencies motor winding temperature monitoring is recommended.

Technical Data

<table>
<thead>
<tr>
<th>Nominal voltage $U_n$:</th>
<th>AC 230 V</th>
<th>-20 % +10 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal frequency:</td>
<td>50 / 60 Hz</td>
<td></td>
</tr>
<tr>
<td>Nominal motor power $P_n$:</td>
<td>1.5 kW</td>
<td></td>
</tr>
<tr>
<td>Min. motor power:</td>
<td>approx. 10 % of rated motor power</td>
<td></td>
</tr>
<tr>
<td>Nominal current:</td>
<td>10 A</td>
<td></td>
</tr>
<tr>
<td>External fuse (optional)</td>
<td>superfast:</td>
<td>20 A</td>
</tr>
<tr>
<td>Starting voltage:</td>
<td>20 ... 70 %</td>
<td></td>
</tr>
<tr>
<td>Acceleration time at starting voltage 20 %:</td>
<td>0.1 ... 10 s</td>
<td></td>
</tr>
<tr>
<td>Recovery time:</td>
<td>200 ms</td>
<td></td>
</tr>
<tr>
<td>Switching frequency:</td>
<td>10/h at 3 x $I_r$, $\varphi = 20$ °C</td>
<td></td>
</tr>
<tr>
<td>Power consumption:</td>
<td>1.4 VA</td>
<td></td>
</tr>
</tbody>
</table>

General Data

| Operating mode: | continuous operation |
| Temperature range: | 0 ... + 55 °C |
| Storage temperature: | - 25 ... + 75 °C |
| Clearance and creepage distances |
| rated impulse voltage / pollution degree: | 4 kV / 2 IEC 60 664-1 |
| EMC |
| Electrostatic discharge: | 8 kV (air) IEC/EN 61 000-4-2 |
| HF irradiation: | 10 V / m IEC/EN 61 000-4-3 |
| Fast transients: | 2 kV IEC/EN 61 000-4-4 |
| Surge voltages between wires for power supply: | 1 kV IEC/EN 61 000-4-5 |
| between wire and ground: | 2 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 |
| Vibration resistance: Amplitude 0.35 mm, frequency 10 ... 55 Hz |
| Climate resistance: | 0 / 055 / 04 IEC/EN 60 068-1 |
| Terminal designation: | EN 50 005 |
| Wire connection: | 2 x 2.5 mm² solid or 2 x 1.5 mm² stranded ferruled DIN 46 228-1/-2/-3 |
| Wire fixing: | Flat terminals with self-lifting clamping piece IEC/EN 60 999-1 |
| Mounting: | DIN rail IEC/EN 60 715 |
| Weight |
| IL 9017: | 135 g |
| SL 9017: | 164 g |

Dimensions

| Width x height x depth |
| IL 9017: | 35 x 90 x 61 mm |
| SL 9017: | 35 x 90 x 100 mm |

Application Example

<table>
<thead>
<tr>
<th>Nominal motor power Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL 9017 AC 230 V 1.5 kW</td>
</tr>
<tr>
<td>Article number:</td>
</tr>
<tr>
<td>SL 9017 AC 230 V 1.5 kW</td>
</tr>
<tr>
<td>Article number:</td>
</tr>
</tbody>
</table>

Ordering Example

- Nominal voltage $U_n$:
- Nominal current:
- For motors up to 1.5 kW
- Width: 35 mm

Installation

These units must be mounted on a vertical mounting area with the connections in a vertical plane, i.e. top to bottom. Ensure that no external heat source is placed below the unit and a 40 mm air gap is maintained above and below. Other devices may be directly mounted either side of the unit.

Set-up Procedure

1. Set potentiometer $M_{an}$ to minimum (fully anti-clockwise)
2. Start the motor and turn potentiometer $t_{an}$ to maximum (fully clockwise)
3. Adjust potentiometer $t_{an}$ to give the desired ramp time.

- Attention: If the ramp-up time is adjusted to short, the internal bridging contact closes before the motor is on full speed. This may damage the bridging contactor or bridging relay.

Safety Notes

- Never clear a fault when the device is switched on
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.

Application Example

- EN 50 005
- DIN 46 228-1/-2/-3
MINISTART
Softstarter With Softstop
IL 9017/300

Function Diagram

- Increases life of 1-phase squirrel motors and mechanical drives
- For single phase motors up to 1.5 kW
- Adjustable ramp time/deceleration time and starting torque/deceleration torque
- Semiconductors will be bridged after start up
- LED indication
- Width 35 mm

Approvals and Markings

Applications
- Drives with gears, belts or chains
- Conveyor belts, fans
- Pumps, compressors

Function

These softstart units are electronic devices designed to enable 1-phase induction motors to start and stop smoothly. By phase control the current is slowly ramped up and down allowing the motor torque to build up and decrease slowly. It provides shock free start and stop of the motor. Sudden changes of the torque as on direct start and stop do not appear any more. This feature allows an economic construction of the mechanical connected elements and prevents damage to conveyed material on conveyor systems.

When the motor is up to full speed the semiconductors in IL 9017 are bridged to prevent internal power losses and heat build up.

Indication

- LED green: softstart active
- LED yellow: softstart is finished, short flashing when mains frequency is outside limits

Block Diagram
**Technical Data**

- **Nominal voltage** $U_{N}$: AC 230 V -15 % +10 %
- **Nominal frequency**: 50 / 60 Hz
- **Nominal motor power** $P_{N}$: 1.5 kW
- **Min. motor power**: approx. 10 % of rated motor power
- **Nominal current**: 10 A
- **External fuse (optional)** superfast: 20 A
- **Starting torque/ deceleration torque**: 20 ... 70 %
- **Ramp-up time/ deceleration time**: 0.1 ... 10 s
- **Recovery time**: 200 ms
- **Switching frequency**: 10/h at $\vartheta = 20 \degree$ C
- **Power consumption**: 1.4 VA

**General Data**

- **Operating mode**: continuous operation
- **Temperature range**: 0 ... + 55 °C
- **Storage temperature**: -25 ... + 75 °C
- **Clearance and creepage distances**
  - rated impulse voltage / pollution degree: 4 kV / 2 IEC 60 664-1
- **EMC**
  - Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2
  - HF irradiation: 10 V / m IEC/EN 61 000-4-3
  - Fast transients: 2 kV IEC/EN 61 000-4-4
  - Surge voltages between wires for power supply: 1 kV IEC/EN 61 000-4-5
  - between wire and ground: 2 kV IEC/EN 61 000-4-5
  - 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
- **Vibration resistance**
  - According to UL subject 94
- **Climate resistance**
  - 0 / 055 / 04 IEC/EN 60 068-1
- **Terminal designation**: EN 50 005
- **Wire connection**: 2 x 2.5 mm² solid or 2 x 1.5 mm² stranded ferruled DIN 46 228-1/-2/-3
- **Wire fixing**: Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
- **Mounting**: DIN rail IEC/EN 60 715
- **Weight**: 135 g

**Dimensions**

- Width x height x depth: 35 x 90 x 61 mm

**Notes**

The motor load must always be connected as continuous operation of the softstart with no load may cause overheating of the motor and softstart. It is recommended that the softstart is protected by superfast semiconductor fuses rated as per the current rating of the softstart or motor. However, standard line and motor protection is acceptable, but for high starting frequencies motor winding temperature monitoring is recommended.

**Adjustment Facilities**

- Ramp up/deceleration time: With potentiometer $t_{\text{on-off}}$ the ramp up and deceleration time can be adjusted within the range 0.1 to 10 s.
- Starting and deceleration torque: With potentiometer $M_{\text{on-off}}$ the starting torque and the deceleration torque can be adjusted in the range of 20 to 70 % of the max. value.

**Set-up Procedure**

1. Set potentiometer $M_{\text{on-off}}$ fully anti-clockwise
2. Start motor by closing contact input Q1-Q2. If the motor does not start, interrupt the process and adjust $M_{\text{on-off}}$ to a higher value. New start.
3. Adjust potentiometer $t_{\text{on-off}}$ to give the desired ramp time.

**Safety instruction**

- Never clear a fault when the device is switched on
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.

**Application Example**

![Application Diagram](attachment:image.png)
MINISTART
Softstarter
BA 9010, BN 9011

- Increases the life of squirrel cage motors and mechanical drives
- Easily fitted to existing installations
- 1 phase control
- For motors up to 5.5 kW (BA 9010) and to 11 kW (BN 9011)
- Semiconductors bridged after softstart
- Adjustable ramp time and starting torque
- LED indication
- DIN-rail mounting
- BA 9010: width 45 mm
  BN 9011: width 100 mm

Function
Softstarters are electronic devices designed to enable 1-phase or 3-phase induction motors to start smoothly. BA 9010 / BN 9011 slowly ramps up the current on one phase, therefore allowing the motor torque to build up slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material.

When the motor is up to full speed the semiconductors in BA 9010 / BN 9011 are bridged to prevent internal power losses and heat build up.

Indication
- LED green ON = power connected
- LED yellow ON = softstart complete

Principle of Operation
For direct on line or star delta applications at 400 V, terminals L1, L2, L3 are connected to the mains contactor, terminals X3, X4 should be bridged and the motor connected to terminals T1, T2, T3. As soon as power is connected to terminals L1, L2, L3 the softstart will commence. Potentiometer "t1" (0.5 - 5 sec.) adjusts the ramp time (time the motor takes to get to full speed) and potentiometer "Mmot" adjusts the start voltage (0 - 70 % nomV). When the softstart is complete the internal semiconductor is automatically bridged.

Notes
When using BA 9010 / BN 9011 on 230 V 3-phase motors the power rating of the unit must be reduced, i.e. BA 9010 3 kW at 400 V would be rated 1.5 kW at 230 V. To allow softstarting the motor load must always be connected as continuous operation of the softstart with no load may cause overheating of the motor and softstart.

It is recommended that the softstart is protected by superfast semiconductor fuses rated as per the current rating of the softstart or motor. However, standard line and motor protection is acceptable, but for high starting frequencies motor winding temperature monitoring is recommended.
Technical Data

Model: BA 9010 BN 9011
Nominal voltage: 3 AC 230 / 400 V
Voltage range: 160 ... 240 V ± 10 %
380 ... 480 V ± 10 %
Nominal frequency: 50 / 60 Hz
Nominal motor power \( P_{\text{N}} \) at
400 V: 3 kW 5,5 kW 7,5 kW 11 kW
230 V: 1,5 kW 3 kW 4 kW 5,5 kW
Min. motor power: approx. 10 % of rated motor power
Start torque: 0 ... 70 %
Ramp time: 0,5 ... 5 s
Recovery time: 200 ms
Switching frequency: 100/h 80/h 50/h 30/h
Power consumption: 1,5 VA 3,5 VA 3,5 VA 3,5 VA
Operating temperature: 0 ... + 45 °C
Storing temperature: - 25 ... + 75 °C
Protection class: IP 30 IEC/EN 60 529
Wire connection: up to 2,5 mm² stranded ferruled
Mounting: DIN-rail mounting
Weight: 300 g 300 g | 500 g 500 g

Dimensions

Width x height x depth:
BA 9010: 45 x 74 x 121 mm
BN 9011: 100 x 74 x 121 mm

Standard Type

BA 9010 3 AC 230 V / 400 V 50/60 Hz 1,5 kW / 3 kW
Article number: 0045241 stock item
• Nominal voltage: 3 AC 230 V / 400 V
• Nominal motor power: 1,5 kW / 3 kW
• Width: 45 mm

Ordering Example

BN 9011 AC 230 / 400 V 50/60 Hz 3 / 5,5 kW

Installation

These units must be mounted on a vertical mounting area with the connections in a vertical plane, i.e. top to bottom. Ensure that no external heat source is placed below the unit and a 40 mm air gap is maintained above and below. Other devices may be directly mounted either side of the unit.

Control Input

To operate the device at AC 230 V it’s necessary to bridge the terminals X1, X2. For change pole motor applications the terminals X3, X4 have to be connected via a contact. Otherwise they have to be bridged.

Set-up Procedure

1. Set potentiometer "M an" to minimum (fully anti-clockwise)
Set potentiometer "t an" to maximum (fully clockwise)
2. Start the motor and turn potentiometer "M an" up until the motor starts to turn without excessive humming. Stop the motor and restart.
3. Adjust potentiometer "t an" to give the desired ramp time.
Stop and restart the motor, readjusting the potentiometers until the desired starting characteristics are achieved.

- Attention: If the ramp-up time is adjusted to short, the internal bridging contact closes before the motor is on full speed. This may damage the bridging contactor or bridging relay.

Safety Notes

- Never clear a fault when the device is switched on
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.
BN 9011 connected to a 3 phase multi-pole (Dahlander) motor with reversing
Softstarters are electronic devices designed to enable 3-phase induction motors to start smoothly. The BA 9019 slowly ramps up the current on two phases, therefore allowing the motor torque to build up slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material. When the motor is up to full speed the semiconductors in BA 9019 are bridged to prevent internal power losses and heat build up. In addition BA 9019 allows a softstop function prolonging the stop time of the motor, preventing high counter torques from abruptly stopping the motor.

**Indication**

- LED green: on, when power connected
- LED yellow: on, when power semiconductors bridged
- LED red: on, when temperature monitoring active

**BA 9019/100**

- LED green: on, when auxiliary supply connected
- LED yellow: flashing, during ramp up or down continuously on, when power semiconductors bridged

**Notes**

Motor load must always be connected as continuous operation of the softstart with no load may cause overheating of the motor and softstart. It is recommended that the softstart is protected by superfast semiconductor fuses rated as per the current rating of the softstart or motor. However, standard line and motor protection is acceptable, but for high starting frequencies motor winding temperature monitoring is recommended.
### Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage L1/L2/L3</td>
<td>3 AC 200 V -10% ... 460 V +10%</td>
</tr>
<tr>
<td>Nominal frequency</td>
<td>50 / 60Hz</td>
</tr>
<tr>
<td>Nominal motor power $P_n$  at 400 V:</td>
<td>3 kW</td>
</tr>
<tr>
<td></td>
<td>1.5 kW</td>
</tr>
<tr>
<td>Rated current</td>
<td>8 A</td>
</tr>
<tr>
<td>Switching frequency up 3 x $L_5$, $\theta_A = 20 ^\circ$ C:</td>
<td>20 h</td>
</tr>
<tr>
<td>Min. motor power</td>
<td>approx. 10 % of rated motor power</td>
</tr>
<tr>
<td>Start torque</td>
<td>50 ... 80 %</td>
</tr>
<tr>
<td>Ramp time</td>
<td>0.5 ... 5 s</td>
</tr>
<tr>
<td>Deceleration torque</td>
<td>30 ... 80 %</td>
</tr>
<tr>
<td>Deceleration time</td>
<td>0.5 ... 5 s</td>
</tr>
<tr>
<td>Recovery time</td>
<td>200 ms</td>
</tr>
<tr>
<td>Auxiliary voltage A1 + / A2:</td>
<td>DC 24 V</td>
</tr>
<tr>
<td>Power consumption</td>
<td>3 W</td>
</tr>
<tr>
<td>Residual ripple</td>
<td>5 %</td>
</tr>
</tbody>
</table>

#### Voltage range X1/X2:
DC: 0 ... 28.8 V
Softstart: > 13 V
Softstop: < 5 V

#### General Data

- **Operating mode:** Continuous operation
- **Temperature range:**
  - Operation: 0 ... + 55 °C
  - Storage: -25 ... + 75 °C
- **Relative air humidity:** 93 % at 40 °C
- **Altitude:** < 1,000 m
- **Clearance and creepage distance:**
- **Rated insulation voltage:** AC 500V
- **Overvoltage category:** III
- **Rated impulse voltage / pollution degree:**
- **auxiliary voltage/circuit nominal voltage:** 4 kV / 2
- **EMC**
  - Electrostatic discharge (ESD): 8 kV (air)
- **HF-irradiation**
  - 80 Mhz ... 1.0 Ghz: 10 V / m
  - 1.0 GHz ... 2.5 GHz: 3 V / m
  - 2.5 GHz ... 2.7 GHz: 1 V / m
- **Fast transients:** 2 kV
- **Surge voltage between wires for power supply:** 1 kV
- **HF-wire guided:** 2 kV
- **Voltage dips:** 10 V
- **Interference emission**
  - Wire guided: Limit value class A¹
  - Radio irradiation: Limit value class B
- **Degree of protection:**
  - Housing: IP 40
  - Terminals: IP 20
- **Vibration resistance:** Amplitude 0.35 mm
- **Climate resistance:** 0 / 055 / 04
- **Wire connection:** 2 x 2.5 mm² solid or 1 x 1.5 mm² stranded wire with sleeve DIN 46 228-1/-2/-3/-4
- **Stripping length:** 10 mm
- **Fixing torque:** 0.8 Nm
- **Wire fixing:** Flat terminals with self-lifting clamping piece
- **Mounting:** DIN rail
- **Weight:** 300 g
- **Dimensions:** Width x height x depth: 45 x 74 x 121 mm

### Standard Type

<table>
<thead>
<tr>
<th>Model</th>
<th>Voltage Range</th>
<th>Nominal Frequency</th>
<th>Nominal Motor Power</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA 9019</td>
<td>3 AC 200 ... 460 V</td>
<td>50 / 60 Hz</td>
<td>3 kW</td>
<td>45 mm</td>
</tr>
</tbody>
</table>

#### Installation

This unit must be mounted on a vertical mounting area with the connections in a vertical plane, i.e. top to bottom. Ensure that no external heat source is placed below the unit and a 40 mm air gap is maintained above and below. Other devices may be directly mounted either side of the unit.

#### Control Input

If a voltage of more than 13 V DC is connected to terminals X1/X2, the device begins with softstart. If the voltage falls lower than DC 5 V the device will softstop.

### Adjustment Facilities

<table>
<thead>
<tr>
<th>Potentiometer</th>
<th>Description</th>
<th>Initial setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M_s$</td>
<td>Starting voltage</td>
<td>fully anti-clockwise</td>
</tr>
<tr>
<td>$t_{on}$</td>
<td>Ramp-up time</td>
<td>fully clockwise</td>
</tr>
<tr>
<td>$M_d$</td>
<td>Deceleration voltage</td>
<td>fully clockwise</td>
</tr>
<tr>
<td>$t_{off}$</td>
<td>Deceleration time</td>
<td>fully clockwise</td>
</tr>
</tbody>
</table>

#### Set-up Procedure

Set potentiometer $M_s$ to minimum (fully anti-clockwise).
Set potentiometer $M_s$ to maximum (fully clockwise).
Set potentiometer $t_{on}$ to maximum (fully clockwise).
Set potentiometer $t_{off}$ to minimum (fully clockwise).
Start the motor and turn potentiometer $M_s$ up until the motor starts to turn without excessive humming.
Stop the motor and restart.
Adjust potentiometer $t_{on}$ to give the desired ramp time.
Stop and restart the motor.
Adjust potentiometer $t_{off}$ until the motor starts to visibly slow down at the initiation of the softstop cycle.
Stop and restart the motor.
Adjust potentiometer $t_{on}$ to give the desired deceleration time.
Stop and restart the motor.
Adjust potentiometer $t_{off}$ to redetermine the potentiometers until the desired starting/stopping characteristics are achieved.

- **Attention:** If the ramp-up time is adjusted to short, the internal bridging contact closes before the motor is on full speed. This may damage the bridging contactor or bridging relay.

### Temperature Monitoring

BA 9019 features overtemperature monitoring of its internal power semiconductors. When the safe running temperature is exceeded the power semiconductors will turn off and a red LED on the front of the unit will illuminate. BA 9019 can be reset after the semiconductors have cooled down by momentarily removing the auxiliary supply voltage.

### Ordering example for variant

<table>
<thead>
<tr>
<th>Variant</th>
<th>Voltage Range</th>
<th>Nominal Frequency</th>
<th>Nominal Motor Power</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA 9019/60:</td>
<td>3 AC 200 ... 460 V</td>
<td>50 / 60 Hz</td>
<td>3 kW</td>
<td>45 mm</td>
</tr>
<tr>
<td>BA 9019/100:</td>
<td>3 AC 200 ... 460 V</td>
<td>50 / 60 Hz</td>
<td>3 kW</td>
<td>45 mm</td>
</tr>
</tbody>
</table>
Safety Notes

- Never clear a fault when the device is switched on.
- **Attention:** This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains via the corresponding manual motor starter.
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.

Application Example

**Softstart and softstop**
MINISTART
Softstarter With Softstop
BA 9026

Function Diagram

Appointments and Markings

Applications
- Motor with gear, belt or chain drive
- Fans, pumps, conveyor systems, compressors
- Packaging machines, door-drives
- Start current limiting on 3-phase motors
- Reduces on/off current on transformers and P.S.U's
- According to IEC/EN 60947-4-2
- Softstart and softstop function
- 3-phase motor control
- For motors up to 5.5 kW
- Adjustable ramp time, starting torque and deceleration time
- Wide motor voltage range
- Galvanic separation of control input
- Galvanic separation of auxiliary power supply
- Integrated overtemperature monitoring
- 45 mm Baubreite

Function
Softstarts are electronic devices designed to enable 1-phase or 3-phase induction motors to start smoothly. The BA 9026 slowly ramps up the current on three phases, therefore allowing the motor torque to build up slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material.

When the motor is up to full speed the semiconductors in BA 9026 are bridged to prevent internal power losses and heat build up to addition BA 9026 allows a softstop function prolonging the stop time of the motor preventing high counter torques from abruptly stopping the motor.

Indication
- LED green ON = power connected
- LED yellow ON = power semiconductors bridged
- LED red ON = overtemperature

Principle of Operation
For direct on line or star delta applications, terminals L1, L2, L3 are connected to the mains contactor, with the motor connected to terminals T1, T2, T3. A 24V DC auxiliary supply is connected to terminals A1, A2 and a 24V DC control signal connected to terminals X1-X2.

When power is connected to terminals L1, L2, L3 and 24V DC is present at terminals X1-X2, the softstart will commence. Potentiometer $t_0$ (0.5 - 5 s) adjusts the ramp time (time motor takes to get to full speed) and potentiometer $U_{st}$ adjusts the start voltage (50-80% nomV).

When the softstart is complete the internal semiconductors are automatically bridged. When 24 V DC is removed from terminals X1-X2, the softstop function will commence for the deceleration time period set on potentiometer $t_1$ (0.5 - 5 s) and deceleration voltage level set on potentiometer $U_{ab}$ (30-80% nomV).

Notes
Motor load must always be connected as continuous operation of the softstart with no load may cause overheating of the motor and softstart. It is recommended that the softstart is protected by superfast semiconductor fuses rated as per the current rating of the softstart of motor. However, standard line and motor protection is acceptable, but for high starting frequencies motor winding temperature monitoring is recommended.
Technical Data

<table>
<thead>
<tr>
<th>Nominal voltage:</th>
<th>AC 200 ... 460 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal frequency:</td>
<td>50 / 60 Hz</td>
</tr>
<tr>
<td>Nominal motor power $P_n$ at 400 V:</td>
<td>3 kW</td>
</tr>
<tr>
<td>200 V:</td>
<td>1.5 kW</td>
</tr>
<tr>
<td>Rated current:</td>
<td>8 A</td>
</tr>
<tr>
<td>Switching frequency:</td>
<td>$3 \times I_{\text{ip}} \times I_{\text{acc}} = 5 \text{ s} \times 10^3 \text{ } \</td>
</tr>
<tr>
<td>Min. motor power:</td>
<td>approx. 10% of rated motor power</td>
</tr>
<tr>
<td>Start torque:</td>
<td>50 ... 80%</td>
</tr>
<tr>
<td>Ramp time:</td>
<td>0.5 ... 5 s</td>
</tr>
<tr>
<td>Deceleration time:</td>
<td>0.5 ... 5 s</td>
</tr>
<tr>
<td>Recovery time:</td>
<td>200 ms</td>
</tr>
<tr>
<td>Auxiliary voltage A1/A2:</td>
<td>DC 24 V ± 20%</td>
</tr>
<tr>
<td>Power consumption:</td>
<td>3 W</td>
</tr>
<tr>
<td>Residual ripple:</td>
<td>5%</td>
</tr>
</tbody>
</table>

Control input

| Voltage range X1+/X2: | DC: 0 ... 28.8 V |
| Softstart: | > 13 V |
| Softstop: | < 5 V |

General Data

| Operating mode: | Continuous operation |
| Temperature range: |
| Operation: | 0 ... + 55°C |
| Storage: | -25 ... + 75°C |
| Relative air humidity: | 93% at 40°C |
| Altitude: | < 1,000 m |
| Clearance and creepage distance |
| Rated insulation voltage: | AC 500V |
| Overvoltage category: | III |
| Rated impulse voltage / pollution degree |
| between auxiliary voltage/control circuit nominal voltage: | 4 kV / 2 IEC/EN 60 664-1 |

EMC

| Electrostatic discharge (ESD): | 8 kV (air) IEC/EN 61 000-4-2 |
| 80 MHz ... 1.0 Ghz: | 10 V / m IEC/EN 61 000-4-3 |
| 1.0 GHz ... 2.5 GHz: | 3 V / m IEC/EN 61 000-4-3 |
| 2.5 GHz ... 2.7 GHz: | 1 V / m IEC/EN 61 000-4-3 |
| Fast transients: | 2 kV IEC/EN 61 000-4-4 |
| Surge voltage between wires for power supply: | 1 kV IEC/EN 61 000-4-5 |
| between wire and ground: | 2 kV IEC/EN 61 000-4-5 |
| Voltage dips: | 10 V IEC/EN 61 000-4-6 |
| Interference emission |
| Wire guided: | Limit value class B IEC/EN 60 947-4-2 |
| Radio irradiation: | Limit value class B IEC/EN 60 947-4-2 |
| Degree of protection: |
| Housing: | IP 40 IEC/EN 60 529 |
| Terminals: | IP 20 IEC/EN 60 529 |
| Vibration resistance: | Amplitude 0.35 mm frequency 10 ... 55 Hz, IEC/EN 60 068-1 |
| Climate resistance: | 0 / 055 / 04 IEC/EN 60 068-1 |
| Wire connection: | 2 x 2.5 mm² solid or 1 x 1.5 mm² stranded wire with sleeve DIN 46 228-1/-2/-3/-4 |
| Stripping length: | 10 mm |
| Fixing torque: | 0.8 Nm |
| Wire fixing: | Flat terminals with self-lifting clamping piece IEC/EN 60 999-1 |
| Mounting: | DIN rail |
| Weight: | 300 g |

Dimensions

| Width x height x depth: | 45 x 74 x 121 mm |

Technical Data

| Nominal voltage: | AC 200 ... 460 V |
| Nominal frequency: | 50 / 60 Hz |
| Nominal motor power: | 3 kW |
| Width: | 45 mm |

Ordering example for variant

| BA 9026 3 AC 200 ... 460 V 50/60 Hz 3 kW |

Installation

This unit must be mounted on a vertical mounting area with the connections in a vertical plane, i.e. top to bottom. Ensure that no external heat source is placed below the unit and a 40 mm air gap is maintained above and below. Other devices may be directly mounted either side of the unit.

Control Input

If a voltage of more than 13 V DC is connected to terminals X1/X2, the device begins with softstart. If the voltage falls lower than DC 5 V the device will softstop.

Set-up Procedure

Set potentiometer $M_{\text{m}}$ to minimum (fully anti-clockwise).
Set potentiometer $M_{\text{a}}$ to maximum (fully clockwise).
Set potentiometer $t_{\text{r}}$ to maximum (fully clockwise).
Set potentiometer $t_{\text{d}}$ to maximum (fully clockwise).
Start the motor and turn potentiometer $M_{\text{m}}$ up until the motor starts to turn without excessive humming.
Stop the motor and restart.
Adjust potentiometer $t_{\text{r}}$ to give the desired ramp time.
Stop and restart the motor.
Adjust potentiometer $t_{\text{d}}$ to give the desired deceleration time.
Stop and restart the motor, readjusting the potentiometers until the desired starting/Stopping characteristics are achieved.

Attention: If the ramp-up time is adjusted to short, the internal bridging contact closes before the motor is on full speed. This may damage the bridging contactor or bridging relay.

Temperature Monitoring

BA 9026 features overtemperature monitoring of its internal power semiconductors. When the safe running temperature is exceeded the power semiconductors will turn off and a red LED on the front of the unit will illuminate. BA 9026 can be reset after the semiconductors have cooled down by momentarily removing the auxiliary supply voltage.
Safety Notes

- Never clear a fault when the device is switched on
- **Attention:** This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains via the corresponding manual motor starter.
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.

Connection Example

![Connection Diagram](image-url)

Softstart and softstop
For soft and shockfree start of your asynchronous motors
• Less wearing and longer life for your motors and components
• Space saving and easy fitting
• Reduce load from supply mains by reducing of starting current
• According to IEC/EN 60 947-4-2
• Softstart with softstop
• For motors up to 37 kW
• 2-phase control
• Adjustable start up and deceleration time as well as starting voltage, optionally with kickstart
• Without auxiliary voltage
• W3 connection is possible
• As option current control on softstart
• Up to 15 kW: width 45 mm
• Up to 22 kW: width 52.5 mm

Softstarters are electronic devices designed to enable 1-phase or 3-phase induction motors to start smoothly. The GF 9016 slowly ramps up the current on two phases, therefore allowing the motor torque to build up slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material.

When the motor is up to full speed the power semiconductors in GF 9016 are bridged to prevent internal power losses and heat build up. In addition GF 9016 allows a softstop function prolonging the stop time of the motor, preventing high counter torques from abruptly stopping the motor.

Applications
• Motors with gear, belt or chain drive
• Fans, pumps, conveyor systems, compressors
• Packaging machines, door drives
• Start current limiting on 3 phase motors

Function

Softstarters are electronic devices designed to enable 1-phase or 3-phase induction motors to start smoothly. The GF 9016 slowly ramps up the current on two phases, therefore allowing the motor torque to build up slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material.

When the motor is up to full speed the power semiconductors in GF 9016 are bridged to prevent internal power losses and heat build up. In addition GF 9016 allows a softstop function prolonging the stop time of the motor, preventing high counter torques from abruptly stopping the motor.
### Technical Data

<table>
<thead>
<tr>
<th>Nominal voltage:</th>
<th>3 AC 400 V ± 15 % (others on request)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal frequency:</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Rated current:</td>
<td>16 25 32 45 50 65 75 A</td>
</tr>
<tr>
<td>Nominal motor power at $P_n$, at 400 V:</td>
<td>7.5 11 15 22 25 30 37 kW</td>
</tr>
<tr>
<td>Min. motor power:</td>
<td>approx. 0.2 $P_n$</td>
</tr>
<tr>
<td>Start torque:</td>
<td>40 ... 80 %</td>
</tr>
<tr>
<td>Ramp time:</td>
<td>0.5 ... 10 s</td>
</tr>
<tr>
<td>Deceleration time:</td>
<td>0.5 ... 10 s</td>
</tr>
<tr>
<td>Staring current:</td>
<td>200 ... 500 %</td>
</tr>
<tr>
<td>Recovery time:</td>
<td>200 ms</td>
</tr>
<tr>
<td>Switching frequency:</td>
<td>60 45 35 10 35 25 30 1/h</td>
</tr>
<tr>
<td>$I^2t$-Power semiconductor fuse</td>
<td>4900 4900 6050 6600 6600 11200 25300 A²s</td>
</tr>
</tbody>
</table>

### General Data

- **Temperature range:** 0 ... + 45°C
- **Storage temperature:** - 25 ... + 70°C
- **Overvoltage category / pollution degree:** III / 2
- **Insulation class:** 3
- **Peak voltage resistance:** 4 kV
- **Degree of protection:** IP 20 IEC/EN 60 529

### Wire connection

- **Load terminals up to 22 kW:** plug in screw terminal
- **Stranded wire:** 6 6 16 16 25 25 25 mm²
- **Control terminals:**
  - up to 22 kW: 1.5 mm² cage clamp terminals
  - to 25 kW: 2.5 mm² screw terminal

### Mounting

- **DIN-rail mounting**
- **IEC/EN 60 715**
- **Weight:** 1.0 1.0 1.0 1.0 1.5 1.5 2.2 kg

### Dimensions

<table>
<thead>
<tr>
<th>Width x height x depth (incl. terminals)</th>
<th>7.5 / 11 / 15 kW:</th>
<th>45 x 173 x 158 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 kW:</td>
<td>52.5 x 178 x 158 mm</td>
<td></td>
</tr>
<tr>
<td>25 / 30 kW:</td>
<td>103 x 230 x 125 mm</td>
<td></td>
</tr>
<tr>
<td>37 kW:</td>
<td>103 x 230 x 140 mm</td>
<td></td>
</tr>
</tbody>
</table>

### Standard Type

- **GF 9016 3 AC 400 V 50/60 Hz 7.5 kW**
  - **Nominal voltage:** 3 AC 400 V
  - **Nominal motor power:** 7.5 kW
  - **Width:** 45 mm

### Ordering Example

- **GF 9016 3 AC 400 V 50/60 Hz 7.5 kW AC 230 V**

---

**Indication**

- **LED green ON** = power connected
- **LED yellow ON** = power semiconductors bridged

Flashes with rising or falling speed at softstart - soft-stop

Flashes with same frequency at error (see table)

**LED red** ON, when failure detected (only on devices ≥ 25 kW)

**Failure codes up to 22 kW-devices**

<table>
<thead>
<tr>
<th>Fault</th>
<th>LED yellow</th>
<th>Operating state</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>yellow LED flashes 2 x times with short space</td>
<td>device overloaded / heat sink temperature to high</td>
</tr>
<tr>
<td>2</td>
<td>yellow LED flashes 3 x times with short space</td>
<td>failure in electronics</td>
</tr>
<tr>
<td>3</td>
<td>yellow LED flashes 4 x times with short space</td>
<td>firing error in phase 1</td>
</tr>
<tr>
<td>4</td>
<td>yellow LED flashes 5 x times with short space</td>
<td>firing error in phase 3</td>
</tr>
<tr>
<td>5</td>
<td>yellow LED flashes 6 x times with short space</td>
<td>error in motor phase/ power semicond. defective in phase 1</td>
</tr>
<tr>
<td>6</td>
<td>yellow LED flashes 7 x times with short space</td>
<td>error in motor phase/ power semicond. defective in phase 3</td>
</tr>
<tr>
<td>7</td>
<td>yellow LED flashes 8 x times with short space</td>
<td>general synchronising error</td>
</tr>
</tbody>
</table>

**Failure codes from 25 kW-devices**

<table>
<thead>
<tr>
<th>Fault</th>
<th>LED yellow</th>
<th>Operating state</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>yellow LED flashes 1 x times with short space</td>
<td>low supply voltage</td>
</tr>
<tr>
<td>1</td>
<td>yellow LED flashes 2 x times with short space</td>
<td>device overloaded / heat sink temp. to high; motor overtemper.</td>
</tr>
<tr>
<td>2</td>
<td>yellow LED flashes 3 x times with short space</td>
<td>current control time out</td>
</tr>
<tr>
<td>3</td>
<td>yellow LED flashes 4 x times with short space</td>
<td>phase failure 1</td>
</tr>
<tr>
<td>4</td>
<td>yellow LED flashes 5 x times with short space</td>
<td>phase failure 2</td>
</tr>
<tr>
<td>5</td>
<td>yellow LED flashes 6 x times with short space</td>
<td>phase failure 3</td>
</tr>
<tr>
<td>6</td>
<td>yellow LED flashes 7 x times with short space</td>
<td>frequency failure</td>
</tr>
<tr>
<td>7</td>
<td>yellow LED flashes 8 x times with short space</td>
<td>firing error in phase 1</td>
</tr>
<tr>
<td>8</td>
<td>yellow LED flashes 10 x times with short space</td>
<td>firing error in phase 3</td>
</tr>
<tr>
<td>9</td>
<td>yellow LED flashes 11 x times with short space</td>
<td>mains failure</td>
</tr>
</tbody>
</table>

Motor load must always be connected as continuous operation of the soft-start with no load may cause overheating of the motor and softstart. It is recommended that the softstart is protected by superfast semiconductor fuses rated as per the current rating of the softstart or motor. However, standard line and motor protection is acceptable, but for high starting frequencies motor winding temperature monitoring is recommended.
Control Input

Up to 22 kW
Connect contact to X1, X2 and select softstart (close contact) or softstop (open contact). As option the unit can also be started by an external control voltage of DC 10-24 V. This has to be connected to terminals X2, X3, X4 connecting means starting up, disconnection stopping. On terminal X3 a kickstart function can be activated. This is useful on motors that have a high starting load as e.g. mills, breakers, conveyors. Kickstart takes 0.5 sec at fully switched thyristors.

From 25 kW
X5, X6: Connection for motor thermistor, must be linked, when not used
X7, X8: Connection for current transformer with current control
Input is only active, if a current transformer is connected

Indicator Outputs

Up to 22 kW
X5, X6: error at phase failure, frequency variation, thyristor failure, overtemperature of the unit, disconnected motor. Reset by switching the unit off and on.
X7, X8: softstart finished, semiconductors bridged.

≥ 25 kW
X9, X10: motor runs, device on operation
X11, X12: end of softstart, semiconductor bridged
X13, X14: interference (common alarm)

Adjustment Facilities

<table>
<thead>
<tr>
<th>Potentiometer</th>
<th>Description</th>
<th>Initial setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>U&lt;sub&gt;start&lt;/sub&gt;</td>
<td>Starting voltage</td>
<td>fully anti-clockwise</td>
</tr>
<tr>
<td>t&lt;sub&gt;r&lt;/sub&gt;</td>
<td>Ramp-up time</td>
<td>fully clockwise</td>
</tr>
<tr>
<td>t&lt;sub&gt;d&lt;/sub&gt;</td>
<td>Deceleration time</td>
<td>fully clockwise</td>
</tr>
<tr>
<td>I (only for 25 kW)</td>
<td>Current controlled start</td>
<td>fully anti-clockwise</td>
</tr>
</tbody>
</table>

Set-up Procedure

Set potentiometer "U<sub>start</sub>" to minimum (fully anti-clockwise).
Set potentiometer "t<sub>r</sub>" to maximum (fully clockwise).
Set potentiometer "t<sub>d</sub>" to mid position.
Start the motor and turn potentiometer "U<sub>start</sub>" up until the motor starts to turn without excessive humming.
Stop the motor and restart.
Adjust potentiometer "t<sub>r</sub>" to give the desired ramp time.
Stop and restart the motor.
Adjust potentiometer "t<sub>d</sub>" to give the desired deceleration time.
Stop and restart the motor, readjusting the potentiometers until the desired starting/stopping characteristics are achieved.

- Attention: If the ramp-up time is adjusted to short, the internal bridging contact closes before the motor is on full speed. This may damage the bridging contactor or bridging relay.

Safety Notes

- Never clear a fault when the device is switched on
- Attention: This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains via the corresponding manual motor starter.
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.

Application Examples

Softstart in a √3-circuit up to 22 kW
Start only by connecting the mains voltage, terminals X1-X2 bridged

Softstart with softstop

Set-up with softstop
Softstart and softstop function from 25 kW with controlled current on start up.
Power Electronics

MINISTART
Softstarter
UH 9018

Your Advantages
- Protection of the drive unit
- Integrated bridging contactor (Bypass)
- Easy operation
- Comprehensive diagnostic via LED-flashing codes possible

Features
- Softstart with softstop
- For motors from 1.5 kW to 7.5 kW
- 2-phase control
- Adjustable ramp time, starting torque and starting voltage
- Kickstart-(Boost-)function
- DIN-rail mounting
- Width: 45 mm

Product Description
The softstarter UH 9018 is an electronic device designed to enable 1-phase or 3-phase induction motors to start smoothly. The devices slowly ramps up the current on two phases, therefore allowing the motor torque to build up slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material. These features allow cost saving constructions of mechanical gear.

When the motor is up to full speed the power semiconductors in UH 9018 are bridged to prevent internal power losses and heat build up. In addition UH 9018 allows a softstop function prolonging the stop time of the motor, preventing high counter torques from abruptly stopping the motor.

Approvals and Markings

Applications
- Motors with gear, belt or chain drive
- Fans, pumps, conveyor systems, compressors
- Woodworking machines, centrifuges
- Packaging machines, door drives
- Start current limiting on 3 phase motors

Indication
green LED: power connected
yellow LED: flashes with rising or falling speed at softstart-softstop
flashes with same frequency at error

Notes
The motor load must always be connected as continuous operation of the softstart with no load may cause overheating of the motor and softstart. It is recommended that the softstart is protected by superfast semiconductor fuses rated as per the current rating of the softstart or motor. However, standard line and motor protection is acceptable, but for high starting frequencies motor winding temperature monitoring is recommended.

Function Diagram

<table>
<thead>
<tr>
<th>X1 / X2</th>
<th>L1/L2/L3</th>
<th>T2</th>
<th>T1/T3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M_Mot</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td></td>
<td>t0</td>
<td>t1</td>
<td>t2</td>
</tr>
<tr>
<td></td>
<td>t3</td>
<td>t_M1445</td>
<td></td>
</tr>
</tbody>
</table>

X1: start
X2: ramp time
L1/L2/L3: stop time

0273638
### Block Diagram

![Block Diagram](image)

### Circuit Diagram

![Circuit Diagram](image)

### Connection Terminals

#### UH9018/0

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1, L2, L3</td>
<td>Connection nominal voltage (L1, L2, L3)</td>
</tr>
<tr>
<td>T1, T2, T3</td>
<td>Connection Motor (U, V, W)</td>
</tr>
<tr>
<td>X1, X2</td>
<td>Control input (Start/Stop)</td>
</tr>
<tr>
<td>X1, X3</td>
<td>Control input (Kickstart (Boost))</td>
</tr>
<tr>
<td>X4</td>
<td>Earth connection</td>
</tr>
<tr>
<td>11, 14</td>
<td>Indicator relay K1, NO contact (error)</td>
</tr>
<tr>
<td>21, 24</td>
<td>Indicator relay K2, NO contact (operating condition)</td>
</tr>
</tbody>
</table>

#### UH9018/1

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1, L2, L3</td>
<td>Connection nominal voltage (L1, L2, L3)</td>
</tr>
<tr>
<td>T1, T2, T3</td>
<td>Connection Motor (U, V, W)</td>
</tr>
<tr>
<td>X1, X2</td>
<td>Control input (Start/Stop)</td>
</tr>
<tr>
<td>X3, X4</td>
<td>Connection for Motor PTC</td>
</tr>
<tr>
<td>11, 14</td>
<td>Indicator relay K1, NO contact (error)</td>
</tr>
<tr>
<td>21, 24</td>
<td>Indicator relay K2, NO contact (operating condition)</td>
</tr>
</tbody>
</table>
Technical Data

Nominal voltage: 3 AC 400 V ± 10 %
Special voltages: 230 V; 480 V;
Wide voltage input 200 ... 480 V only with
external voltage DC 24 V on X1 / X4

Nominal frequency: 50/60 Hz
Rated current: 3.5; 6.5; 12; 16 A
Nominal motor power
at P_n at 400 V: 1.5; 3; 5.5; 7.5 kW
Min. motor power:
approx. 0.2 P_n
Staring voltage
(at devices with
electric ramp): 40 ... 80 % U_n
Setting range
current limit (at devices
with current control): 2 ... 5 I_n
Setting range
starting time (at devices
with voltage ramp): 0.5 ... 10 s
Deceleration time: 0.25 ... 10 s
Setting range of the
gradient of current rise
(at devices with
current control): 0 ... 100 %
Recovery time: 300 ms
Switching frequency
at 3 x I_n and t_ = 5 s: 150/h; 70/h; 30/h; 15/h
Semiconductor fuse
I^2t-value: 390 A^2s; 720 A^2s; 4000 A^2s; 4000 A^2s;

General Data

Temperature range: 0 ... + 45°C
Storage temperature: -25 ... + 70°C
Altitude: up to 1.000 m
Degree of protection: IP 20
Climate resistance: 25 / 075 / 04 IEC/EN 60 068-1
Wire connection
Load terminals: up to 2.5 mm²
Control terminals: 1 x 1.5 mm² solid
Mounting: DIN-rail mounting

Dimensions

Width x height x depth: 45 x 107 x 121 mm

Standard Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Nominal voltage</th>
<th>Nominal frequency</th>
<th>Nominal motor power</th>
</tr>
</thead>
<tbody>
<tr>
<td>UH 9018</td>
<td>3 AC 400 V 50/60 Hz</td>
<td>1.5 kW</td>
<td></td>
</tr>
<tr>
<td>UH 9018/100</td>
<td>3 AC 400 V 50/60 Hz</td>
<td>7.5 kW</td>
<td></td>
</tr>
</tbody>
</table>

Ordering example

UH 9018 /__-_ 3 AC 400 V 50/60 Hz 1.5 kW
- Nominal voltage
- Nominal frequency
- Nominal motor power
- Width
- With Kickstart- (Boost-) function
- With voltage ramp
- Starting time
- Deceleration time
- Starting voltage

Control Inputs

As described in Principles of operation UH 9018 are normally controlled
by a voltfree contact on terminals X1-X2
However, if external DC voltage control is desired UH 9018 can be set at the
factory to accept a DC control voltage of 10 ... 42 V DC at terminals X2, X4.

When the voltfree contact across terminals X1 and X2 is closed, the soft-
start function will commence. When the contact is opened, the softstop
function will commence.

The motor can be started with a boost (variants UH 9018/_0_) with the
help of a potential-free contact on X1, X3. Thereby at the beginning of the
soft starting, the motor voltage increases for a short impulse (500ms) to
85% of the nominal voltage. This function effects an increased breakaway
torque in the drive and makes possible the starting of the drives with a high
holding torque at standstill. Afterwards, the soft starting continues with the
adjusted voltage ramp.

Optionally, the boost function can be started also with external control
voltage of DC 10 ... 24 V on X3, X4.

The device variants UH 9018/_1_ do not have a boost function. A motor
PTC can be connected there to the control terminals X3, X4 for monitoring
the motor temperature.
Troubleshooting

In the case of a fault it is proceeded as follows:

**Fault 1:** Defect in the internal control electronics. The device must be checked by the manufacturer.

**Fault 2:** Check the starting frequency and the starting current or the maximum ambient temperature. Leave the device to cool off. The dissipation of the heat can be improved by forced cooling-off with a fan installed under the device.

**Fault 3:** The motor does not reach the end speed with the preset maximum starting current. The value of the starting current can be increased with the potentiometer xIN.

**Attention!**
After a performed disconnection due to a timeout, the device and the motor must be given a chance to cool off. An immediate start-up can lead to destruction.

**Fault 4-7:** The power supply is missing, the motor circuit is interrupted, the power semiconductor is defective, the motor is defective;
Check the motor and the wiring. Send the device to be checked by the manufacturer.

**Fault 8-9:** Check the motor wiring or defective thyristor module. Send the device to be checked by the manufacturer.

**Fault 10:** Send the device to be checked by the manufacturer.

### Fault Description

<table>
<thead>
<tr>
<th>Fault</th>
<th>yellow LED flashes</th>
<th>operating condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 x time with short space</td>
<td>undervoltage Electronic power supply</td>
</tr>
<tr>
<td>2</td>
<td>2 x times with short space</td>
<td>heat sink temperature to high</td>
</tr>
<tr>
<td>3</td>
<td>3 x times with short space</td>
<td>Device thermally overloaded or motor overtemperature (at connected motor-PTC) variant / <em>1</em></td>
</tr>
<tr>
<td>4</td>
<td>4 x times with short space</td>
<td>Zero crossings error Network or motor circuit is faulty</td>
</tr>
<tr>
<td>5</td>
<td>5 x times with short space</td>
<td>phase failure in phase 1</td>
</tr>
<tr>
<td>6</td>
<td>6 x times with short space</td>
<td>phase failure in phase 2</td>
</tr>
<tr>
<td>7</td>
<td>7 x times with short space</td>
<td>phase failure in phase 3</td>
</tr>
<tr>
<td>8</td>
<td>8 x times with short space</td>
<td>firing error in phase 1</td>
</tr>
<tr>
<td>9</td>
<td>10 x times with short space</td>
<td>firing error in phase 3</td>
</tr>
<tr>
<td>10</td>
<td>11 x times with short space</td>
<td>failure in electronics</td>
</tr>
</tbody>
</table>

### Setting facilities

**Devices with voltage ramp UH 9018/0_ _:**

<table>
<thead>
<tr>
<th>Potentiometer</th>
<th>Description</th>
<th>Initial setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>U_{start}</td>
<td>starting voltage ramp up time</td>
<td>fully anti-clockwise middle of scale</td>
</tr>
<tr>
<td>t_{on}</td>
<td>deceleration time</td>
<td>fully anti-clockwise</td>
</tr>
</tbody>
</table>

**Devices with current control UH 9018/1_ _:**

<table>
<thead>
<tr>
<th>Potentiometer</th>
<th>Description</th>
<th>Initial setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>x_{IN}</td>
<td>Current limit gradient of current rise</td>
<td>middle of scale</td>
</tr>
<tr>
<td>t_{off}</td>
<td>deceleration time</td>
<td>middle of scale</td>
</tr>
</tbody>
</table>

### Set up Procedure

**Softstart with voltage ramp:**

1. Start the motor via control input X1/X2 and turn potentiometer "U_{start}" up until the motor starts to turn without excessive humming.

2. Adjust potentiometer "t_{on}" to give desired ramp time.

**Attention:** If the ramp-up time is adjusted to short, the internal bridging contact closes before the motor is on full speed. This may damage the bridging contactor or bridging relay.

**Softstart with current control:**

The motor is accelerated to the motor nominal speed at the preset current limit of 2 ... 5 x_{IN}. To this purpose, the desired start-up current is set with the potentiometer x_{IN} with respect to the nominal speed of the device. The gradient of the increase of the current can be adjusted with the potentiometer tint and thus the control characteristics and the motor acceleration can be adapted to the drive. The motor current is measured in the uncontrolled phase L2/T2 which in the case of two-phase-controlled soft-start devices, for technical reasons, conducts the highest current. The preset current limit is related to the motor current in phase L2/T2. The current in the two other motor phases is lower by about 35 %.

**Attention:** If the current limit is set too low, the motor will not accelerate to full speed and will remain in a state of intermediate speed. After a certain time, the device will interrupt the starting process and will change to fault mode in order not to overload the device and the motor. What is important in the selection of the current limit is to pay attention to the changes in the load, e.g. with the time (mechanical change, wear, ...) or also the thermal changes, etc. The adjustment must be such that also in the worst-case scenario the drive can accelerate to full speed without problems.

**Softstop:**

- During softstop the device has to be connected to the voltage.
- Select softstop by opening control input X1/X2.
- Adjust t_{off} until the required stopping time is achieved.

**Fault:**

The UH 9018 monitors different fault states. If a fault is recognised, the device signalises the error by blinking of the yellow LED at a constant frequency. When there is a fault, the signal relay K1 is opened. The different error states are indicated by different blinking sequences of the yellow LED.
Resetting the fault

There are two possibilities for resetting a device fault.

1. As default, the resetting of the fault message takes place by turning off and then on the power supply.
2. The device can be programmed in such a way that a fault reset is possible by a new start-up (opening and then closing the start input). To this purpose, the following approach must be observed.

First the device must be wired according to the following connection diagrams:

- Device without external control supply voltage
- Device with external control supply voltage

![Connection Diagrams]

Then the power supply is turned on. After a short time, the yellow LED starts blinking with different frequency depending on the preset reset mode.

- Low flasher frequency: Fault reset by turning on and off of the power supply voltage (standard setting)
- High flasher frequency: Fault reset by restarting

By opening and closing the start input, the reset mode is changed and the yellow LED starts blinking with the corresponding blinking frequency. The new mode is permanently stored.

Now the power supply can be again turned off and the device is incorporated in the application.

Warning message!

In any case, the cause of the fault must be determined and corrected by trained personnel. Only then the device can be put again into operation.

Monitoring Output

- Indicator relay K1 (11, 14): Fault: Contact are closed
- Indicator relay K2 (21, 24): Bypass: After the end of the start ramp, energizes the bypass relay

Safety Note

- Never clear a fault when the device is switched on.
- **Attention:** This device can be started by potential-free contact or control with DC 10 ... 24 V while connected directly to the mains without contactor (see application example).
  
  Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains via the corresponding manual motor starter.

- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.
Connection Examples

Softstart- and softstop function
(Devices without external control voltage)

Softstart- and softstop function (Devices with external control voltage)

Softstart- and softstop function at UH 9018/-1-
Your Advantages
- For starting current limitation in heat pumps to provide stable mains conditions
- Only one small device 67.5 mm for softstart, motor protection, voltage- and phase sequence monitoring
- Soft start and minimized staring current
- Extended service life of AC - motors and mechanical drive system
- Motor power up to 18.5 kW
- Short ramp up time
  - 25 A: < 200 ms
  - 36 A: < 300 ms
- Energy saving by bridging of the semiconductors after softstart
- Symmetrical staring current

Features
- According to IEC/EN 60 947-4-2
- 3-phase controlled with integrated bypass relays
- Phase sequence monitoring
- Undervoltage monitoring
- Overvoltage monitoring
- Blocked motor monitoring in bypass mode
- Integrated motor protection to class 10 acc. to IEC/EN 60947-4-2
- Starting current limitation
- Thyristor monitoring
- Detection of missing load
- Automatic frequency detection of supply voltage
- Temperature monitoring of power semiconductors

Approvals and Markings

Applications
- Softstarter for compressor motors

Product Description
The PF 9029 from the MINISTART-family is a robust electronic control unit for soft starting of compressor motors with integrated monitoring functions. After successful starting the semiconductors are bridged by relays to minimize the power dissipation of the units.

Function Notes
Variation of speed is not possible with this device.
Failure Mode
The softstarter is monitoring different parameters. If failure is detected the unit switches off. In failure mode a red LED with flash code signals the fault. The failure mode can be reset by pressing the reset button or by disconnecting the power supply.

Undervoltage monitoring
To make sure the motor is operated with the correct voltage the voltage is monitored. The voltage is not monitored in ramp up mode. If the voltage drops below 330 V for longer than 1 s the unit switches to failure mode.

Overvoltage detection
To make sure the motor is operated with the correct voltage the voltage is monitored. The voltage is not monitored in ramp up mode. If the voltage rises above 470 V for longer than 1 s the unit switches to failure mode.

Phase sequence monitoring
The phase sequence monitoring function monitors clockwise phase sequence of the 3-phase system. An anti-clockwise sequence forces the unit to failure mode.

Shortcircuited Thyristor
Before each softstart the power-semiconductors are tested for short circuit. A detected short circuit forces the unit to failure mode. For short circuit test the motor must be connected.

Motor not connected
Before each softstart it is tested that the motor is correctly connected to the unit. This test avoids that the motor starts on 2 phases and gets faulty. Wrong connection forces the unit to failure mode.

Overtemperature
The temperature of the semiconductors is measured by NTC sensor. Overtemperature forces the unit into failure mode.

Frequency detection
To achieve a correct function the actual frequency has to be known. The frequency is monitored after power on or reset. If the frequency is outside the limits 50 Hz ± 5 Hz or 60 Hz ± 5 Hz the unit switches to failure mode.

Blocking protection
In Bypass mode a blocking of the motor is detected by current monitoring. If the current exceeds 4 times the nominal current of the motor, the unit recognizes motor blocking. The unit switches to failure mode.

Overload protection
The unit incorporates an electronic overload protection, which is realized by monitoring the current in one phase. Overload protection class 10 is a fix setting. The response current can be adjusted with a potentiometer by adjusting the motor rated current. When the I2t value is overridden the unit switches into failure mode. The I2t value is reset with the reset function.

Note: At loss of the auxiliary supply the actual I2t-value is stored. At restart the I2t-value is recalled and used for operation independent how long the motor was cooling down.

Limitation of starting current
By starting current limitation the peak current can be limited. The load on the supply network is lower. The time limit of the current is monitored and if the starting time exceeds the limit of 5 s a failure signal is indicated. The current limit is fixed to 2.5 times the motor nominal current.

Indication
The device status is indicated with different colored LEDs and flash code

<table>
<thead>
<tr>
<th>LED color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Device ready</td>
</tr>
<tr>
<td>Yellow</td>
<td>On, when bridging relay active</td>
</tr>
<tr>
<td>Red</td>
<td>Flashes if error (see flash codes)</td>
</tr>
</tbody>
</table>

Control Elements

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potentiometer Ie</td>
<td>Nominal current for overload protection and starting current limitation.</td>
</tr>
<tr>
<td>Note:</td>
<td>The potentiometer setting is only read when connecting the power supply or on reset at failure mode.</td>
</tr>
<tr>
<td>Reset-button</td>
<td>Reset of failure mode after failure is removed and confirming potentiometer setting.</td>
</tr>
</tbody>
</table>

Control Circuit
The control input works with a voltage of AC/DC 20 ... 300 V.

After reset or disconnecting the power supply the unit initiates a softstart, if voltage is connected to control input.

Outputs
One output relay is available. The monitoring contact “operation” closes when the start signal is connected. It opens after the signal is disconnected or when an error occurs.

Auxiliary Supply
To monitor phase failure on all 3 phases an external auxiliary supply of AC 230 V is necessary.
During normal operation failure messages may occur. The messages are indicated by a flashing sequence of the red LED.

<table>
<thead>
<tr>
<th>Flashes *)</th>
<th>Fault</th>
<th>Possible cause</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x fast</td>
<td>Motor voltage is missing</td>
<td>Defective fuse, faulty wiring</td>
<td>Check fuses and wiring</td>
</tr>
<tr>
<td>1</td>
<td>Device temperature to high</td>
<td>Duty cycle exceeded</td>
<td>Reduce operating time, use heat sink if possible</td>
</tr>
<tr>
<td>2</td>
<td>Mains frequency out of tolerance</td>
<td>Wrong frequency</td>
<td>Device is not suitable for actual frequency. Contact manufacturer</td>
</tr>
<tr>
<td>3</td>
<td>Phase sequence incorrect</td>
<td>Load voltage incorrect. Clockwise phase sequence is mandatory for correct function</td>
<td>Check wiring, change 2 phases</td>
</tr>
<tr>
<td>4</td>
<td>Undervoltage detected</td>
<td>Load voltage under 330V</td>
<td>Check load voltage</td>
</tr>
<tr>
<td>5</td>
<td>Overload detected</td>
<td>Motor overloaded</td>
<td>Reduce operating time, Motor rough-running? Adjust nominal current</td>
</tr>
<tr>
<td>6</td>
<td>Motor blocked in Bypass-Mode</td>
<td>Motor stalled in operation</td>
<td>Check motor</td>
</tr>
<tr>
<td>7</td>
<td>Thyristor short-circuit</td>
<td>Faulty thyristor detected</td>
<td>Device has to be repaired</td>
</tr>
<tr>
<td>9</td>
<td>Motor connected incorrectly</td>
<td>One or more wires to the motor are interrupted</td>
<td>Check wiring to motor</td>
</tr>
<tr>
<td>10</td>
<td>Temperature sensor defective</td>
<td>Interruption or short circuit in temperature sensor of power semiconductors</td>
<td>Device has to be repaired</td>
</tr>
</tbody>
</table>

*) No.: Number of flash pulses in a series
Technical Data

Auxiliary supply: AC 230 V ± 10%
Overvoltage protection: Varistor AC 275 V
Starting voltage: 3 AC 220 V
Ramp up time: 0.2 s 0.3 s
Undervoltage protection: 3 AC 330 V, for more than 1s
Overvoltage protection: 3 AC 470 V, for more than 1s
Resolution of voltage measurement: AC 1.5 V
Nominal consumption: 4 VA
Short circuit detection 5 ... 25 A 10 ... 36 A
Mode 1: 35 A gL / gG 50 A gG / gL
Mode 2: 5510 A gG 2s 5500 A gG 2s
Control Input
Control voltage: AC/DC 20 ... 300 V
Control input current: 0.2 mA ... 3.1 mA
Start up delay: 10 ... 50 ms
Release delay: 200 ms
Indicator output
Contacts: 1 changeover contact
Switching capacity to AC 15
NO contacts: 3 A / AC 230 V IEC/EN 60 947-5-1
NC contacts: 1 A / AC 230 V IEC/EN 60 947-5-1
Electrical life to AC 15 at 3 A AC 230 V: 2 x 10^6 switching cycles
Permissible switching frequency: max. 1 800 switching cycles / h
Short circuit strength max. fuse rating: 4 A gG / gL IEC/EN 60 947-5-1
Mechanical life: ≥ 10^6 switching cycle
Output / Load Circuit
Load circuit
Nominal operating voltage L1-L3: 3 AC 340 ... 460 V
Peak reverse voltage: 1200 V
Overvoltage protection: Varistor 510 V
Nominal frequency: 50 Hz ± 5 Hz or 60 Hz ± 5 Hz
Nominal operating current Ie: 25 A (AC-53b) 36 A
Setting range Ie: 5 A ... 25 A 10 A ... 36 A
Stoßstrom: 1050 A (tp = 10 ms)
Load limit integral: 5500 A/s
Resolution current measurement: 0.1 A 0.2 A
Usage category Ie: AC-53b: 2.5 - 0.5: 60
Number of starts per hour: 10
Overload protection: Class 10
Blocking protection, response value: 4 x Ie, for longer than 1 s in bypass mode
Current limiting: 2.5 x Ie ± 10% during ramp up
General Data
Temperature range operation: 0 ... + 50 °C
storage: - 20 °C ... +75 °C
Relative air humidity: < 95%, no condensation at 40°C
Altitude: < 1.000 m
Clearance and Creepage distances
rated impulse voltage / pollution degree
Mains-/Motor voltage-heat sink: 6 kV / 2 IEC/EN 60 947-4-2
Mains-/Motor voltage - control voltage: 6 kV / 2 IEC/EN 60 947-4-2
Mains-/Motor voltage-indicator relay: 6 kV / 2 IEC/EN 60 947-4-2
Overvoltage category: III
EMC
Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2
HF-irradiation 80 MHz ... 1.0 GHz: 10 V / m IEC/EN 61 000-4-3
1.0 GHz ... 2.5 GHz: 3 V / m IEC/EN 61 000-4-3
2.5 GHz ... 2.7 GHz: 1 V / m IEC/EN 61 000-4-3
Fast transients: 2 kV IEC/EN 61 000-4-4
Technical Data
Surge voltage between wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
HF-wire guided: 10 V IEC/EN 61 000-4-6
Voltage dips: IEC/EN 61 000-4-11
Interference emission
Wire guided: Limit value class B IEC/EN 60 947-4-2
Radio irradiation: Limit value class B IEC/EN 60 947-4-2
Harmonics in bypass mode: IEC/EN 61 000-3-11
Degree of Protection
Enclosure: IP 40 IEC/EN 60 529
Terminals: IP 20 IEC/EN 60 529
Housing: thermostatic with V0 behaviour acc. to UL subject 94
Vibration resistance
frequency 10 ... 55 Hz
Climate resistance: 0 / 050 / 04 IEC/EN 60 068-1
Wire connections
Load terminals: Box terminals with self-lifting wire protection
Captive M4 Pozidriv-terminal screws
0.5 ... 16 mm² solid
0.5 ... 16 mm² mit stranded wire with sleeve DIN 46228/1
0.5 ... 16 mm² stranded ferruled (isolated) DIN 46228/4
21 - 6 AWG
Insulation of wires or sleeve length:
Mounting torque: 2.5 Nm
Control terminals
pluggable terminal blocks with cage clamp terminals
0.2 - 2.5 mm² solid
0.2 - 2.5 mm² ferruled
0.2 - 2.5 mm² stranded wire with sleeve DIN 46228/1
0.2 - 2.5 mm² stranded ferruled (isolated) DIN 46228/4
26 - 12 AWG
Insulation of wires or sleeve length:
Weight
without DIN rail mounting: 500g
with DIN rail mounting: 600g
Dimensions
Width x height x depth 67.5 mm x 122.5 mm x 86.5 mm
without DIN rail mounting:
67.5 mm x 140 mm x 95.5 mm
with DIN rail mounting:
### Characteristics

<table>
<thead>
<tr>
<th>Time [s]</th>
<th>Response current value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>200</td>
</tr>
<tr>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>9</td>
<td>400</td>
</tr>
<tr>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>11</td>
<td>600</td>
</tr>
<tr>
<td>12</td>
<td>700</td>
</tr>
<tr>
<td>13</td>
<td>800</td>
</tr>
<tr>
<td>14</td>
<td>900</td>
</tr>
<tr>
<td>15</td>
<td>1000</td>
</tr>
</tbody>
</table>

### Accessories

The devices can be mounted on DIN-rail according to IEC/EN 60715 with a fixing plate.

**Type:** KX4840-20  
**Article number:** 0066204

### Operation

1. Connect unit as shown in wiring example  
2. Adjust Potentiometer setting \( I_e \) to nominal motor current.

### Connection Example

![Connection Diagram]

### Trigger characteristics

**Standard Type**

<table>
<thead>
<tr>
<th>PF 9029.11</th>
<th>3 AC 400 V</th>
<th>50 Hz</th>
<th>( U_H )</th>
<th>230 V</th>
<th>Hz</th>
<th>25 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article number:</td>
<td>0065815</td>
<td>Load voltage:</td>
<td>3 AC 400 V</td>
<td>Auxiliary voltage ( U_H ):</td>
<td>230 V</td>
<td>Nominal operating current ( I_e ):</td>
</tr>
<tr>
<td>Setting range ( I_e ):</td>
<td>5 A ... 25 A</td>
<td>Width:</td>
<td>67.5 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<tr>
<th>PF 9029.11</th>
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<th>Hz</th>
<th>36 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article number:</td>
<td>0067298</td>
<td>Load voltage:</td>
<td>3 AC 400 V</td>
<td>Auxiliary voltage ( U_H ):</td>
<td>230 V</td>
<td>Nominal operating current ( I_e ):</td>
</tr>
<tr>
<td>Setting range ( I_e ):</td>
<td>10 A ... 36 A</td>
<td>Width:</td>
<td>67.5 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Ordering Example

**PF 9029**

- Nominal operating current
- Auxiliary voltage \( U_H \)
- Nominal frequency
- Load voltage
- Contacts
- Type

![Ordering Diagram]

### Safety Instruction

**Dangerous voltage.**  
Electric shock will result in death or serious injury.

Disconnect all power supplies before servicing equipment.

- Never clear a fault when the device is switched on  
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards  
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.  
- Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains.
Drilling pattern
Power Electronics

MINISTART
Softstart / Softstop With Reverse Function
RP 9210/300

Your advantages
- 3 functions in one unit
- Easy setup
- No EMC-filter necessary

Features
- According to EN 60 947-4-2
- For controlling of 3-phase motors up to 750 W
- With 2-phase softstart and softstop
- Temperature monitoring of the motors with PTC or thermal switch
- 3 potentiometer for adjustment of softstart, softstop and starting - deceleration time
- 3 LED-indicators
- Reversing with relays, softstart and softstop with thyristors
- 2 x 24 V-inputs for clockwise rotation, anticlockwise rotation
- Short circuit proof for 24 V monitoring output
- Galvanic separation of control circuit and power circuit
- Width 72 mm

Product description

The softstart/softstop devices with reversing function are mainly used for soft reversing of motors. The softart/sofstop function reduces the inertia when reversing, giving less stress to the mechanical components. Less wearing and lower maintenance cost are the result. The parameters for ramp up time and ramp down time as well as start and stop inertia are set via potentiometers. A thermistor or thermal switch can be connected to monitor the motor temperature. Non-wearing reversing by hybrid-technology.

Approvals and Markings

Application
- Conveyors
- Packaging machines
- Door and gate drives

Function Diagram

Connection Terminals

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1(+), A2</td>
<td>Auxiliary voltage DC</td>
</tr>
<tr>
<td>L1, L2, L3</td>
<td>Load voltage AC</td>
</tr>
<tr>
<td>T1, T2, T3</td>
<td>Motor connection</td>
</tr>
<tr>
<td>L, R</td>
<td>Control inputs direction of rotation</td>
</tr>
<tr>
<td>GND, Ready</td>
<td>Earth connection control inputs</td>
</tr>
<tr>
<td>P1, P2</td>
<td>Indicator output DC</td>
</tr>
<tr>
<td>P1+</td>
<td>Thermo indicator output</td>
</tr>
<tr>
<td>P2</td>
<td>Thermo sensor</td>
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Circuit Diagram

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<tr>
<td>P2</td>
<td>Thermo sensor</td>
</tr>
</tbody>
</table>
The Softstart unit RP 9210/300 includes the functions softstart, softstop and reversing. The reversing is done with relays.

Temperature monitoring
To protect the motor the temperature can be monitored by PTC or thermal switch. When overtemperature is detected the power semiconductors as well as the ready output switch off. The green Ready-LED flashes code 1. This failure state is stored. After the motor cooled down a reset can be made by temporarily disconnecting the power supply to the unit.

Softstart, Softstop
The unit ramps up or down the current on two phases, therefore allowing the motor torque to build up or to be reduced slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material. The starting e.g. deceleration time is adjustable by potentiometer.

Control inputs
Right and left rotation is selected via 2 control inputs. If both inputs are activated the one that came first has priority. When the control signal is disconnected the motor is braked for the adjusted braking time. Now the sense of rotation is inverted and the motor is softstarted in the opposite direction.

Monitoring output Ready
If no failure is indicated this short circuit proof output is on +24V.

<table>
<thead>
<tr>
<th>Function</th>
<th>Indication</th>
<th>Setting facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature monitoring</td>
<td>green LED-Ready ON: continuous - supply connected flashes - with failure code yellow LED R: continuous - Motor turns right flashes - softstarting or braking at right rotation yellow LED L: continuous - Motor turns left flashes - softstarting or braking at left rotation</td>
<td>Potentiometer $t_{\text{on}}$: - Ramp up time 1 ... 10 s Potentiometer $t_{\text{off}}$: - Braking delay time 1 ... 10 s Potentiometer $I_{\text{max}}$: - motor current control 0 ... 3.0 A eff.</td>
</tr>
<tr>
<td>Softstart, Softstop</td>
<td>Failure codes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1* ) - Motor overtemperature 2* ) - Wrong frequency 3* ) - Phase reversal 4* ) - Phase failure 5* ) - Motor overcurrent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1* - 5* = Number of flashing pulses in sequence</td>
<td></td>
</tr>
<tr>
<td>Safety Notes</td>
<td>Set-up Procedure</td>
<td></td>
</tr>
<tr>
<td>- Never clear a fault when the device is switched on</td>
<td>1. Connect motor and device according to application example. The 3 phases must be connected in correct sequence, wrong phase sequence will lead to failure (see failure code)</td>
<td></td>
</tr>
<tr>
<td>- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.</td>
<td>2. If the motor temperature sensor is not required the inputs P1 and P2 must be bridged. Turn potentiometer $t_{\text{on}}$ and $t_{\text{off}}$ fully clockwise, potentiometer $I_{\text{max}}$ fully anticlockwise.</td>
<td></td>
</tr>
<tr>
<td>- Installation and maintenance must only be carried out when the supply is disconnected.</td>
<td>3. Power up the unit and begin softstart via inputs R or L</td>
<td></td>
</tr>
<tr>
<td>- There is no galvanic separation between auxiliary supply (A1, A2) and measuring circuit (P1, P2). Necessary insulation measures have to be provided according to the application.</td>
<td>4. Turn potentiometer $I_{\text{max}}$ fully clockwise, up to motor starts</td>
<td></td>
</tr>
<tr>
<td>- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards (VDE, TÜV,BG).</td>
<td>5. Adjust the start up time by turning $t_{\text{on}}$ to the required value. At correct setting, the motor should ramp up continuously to full speed.</td>
<td></td>
</tr>
<tr>
<td>- Attention: This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains via the corresponding manual motor starter.</td>
<td>6. Adjust the deceleration time to the required value.</td>
<td></td>
</tr>
</tbody>
</table>
### Technical Data

**Nominal voltage L1/L2/L3:** 3 AC 200 ... 400 V ± 10 %

**Nominal frequency:** 50 / 60 Hz auto detection

**Auxiliary voltage A1, A2:** 24 V DC ± 10 %

**Nominal motor power:** 750 W at AC 400 V

**Min. motor power:** 25 W

**Measured thermal current:** 1.5 A

**Operation mode:**
- 1.5 A: AC 53a: 6-2: 100-30 acc. to IEC/EN 60 947-4-2

**Measured nominal current:** 1.5 A

1) The measured thermal current is the arithmetic mean of starting and measured nominal current of the motor in a turn cycle.

<table>
<thead>
<tr>
<th>Current reduction from 40°C</th>
<th>0.05 A / °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surge current (T_s = 45°C)</td>
<td>65 A (t = 20 ms)</td>
</tr>
<tr>
<td>Load limit integral</td>
<td>21 A/s (t = 10 ms)</td>
</tr>
<tr>
<td>Peak reverse voltage</td>
<td>1000 V</td>
</tr>
<tr>
<td>Overvoltage limiting</td>
<td>460 V</td>
</tr>
<tr>
<td>Leakage current in off state</td>
<td>&lt; 3 x 0.5 mA</td>
</tr>
</tbody>
</table>

**Starting/deceleration voltage:** 30 ... 80 %

**Ramp up time:** 1 ... 10 s

**Declaration ramp:** 1 ... 10 s

**Consumption**
- Weight: 185 g
- Dimensions:
  - Width x height x depth: 72 x 90 x 72 mm

**Input**

- **Control input**
  - right, left: DC 24 V
  - Nominal current: 5 mA
  - Softstart: DC 15 ... 30 V
  - Softstop: DC 0 ... 5 V
  - Connection: PTC-Sensor acc. to DIN 44 081 / 082
  - Motor temperature sensor: approx. 0.5 mA
  - Switching current: max. 5 V

**Indicator Output**

- Semiconductor, short circuit proof: DC 24 V

**General Data**

<table>
<thead>
<tr>
<th>Nominal operating mode</th>
<th>Continuous operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature range</td>
<td>0 ... 55 °C</td>
</tr>
<tr>
<td>Clearance and creepage distance</td>
<td></td>
</tr>
<tr>
<td>rated impulse voltage / pollution degree</td>
<td></td>
</tr>
<tr>
<td>Motor voltage - control voltage:</td>
<td>2.5 kV / 2 EN 50 178</td>
</tr>
<tr>
<td>EMC</td>
<td></td>
</tr>
<tr>
<td>Electrostatic discharge (ESD):</td>
<td>8 kV (air) IEC/EN 61 000-4-2</td>
</tr>
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<td>Fast transients:</td>
<td>2 kV IEC/EN 61 000-4-4</td>
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<tr>
<td>Surge voltage between wires for power supply:</td>
<td>1 kV IEC/EN 61 000-4-5</td>
</tr>
<tr>
<td>between wire and ground:</td>
<td>2 kV IEC/EN 61 000-4-5</td>
</tr>
<tr>
<td>HF-wire guided:</td>
<td>10 V IEC/EN 60 000-4-6</td>
</tr>
<tr>
<td>Voltage dips:</td>
<td>IEC/EN 61 000-4-11</td>
</tr>
<tr>
<td>Radio interference:</td>
<td>IEC/EN 60 947-4-2</td>
</tr>
<tr>
<td>Radio interference voltage:</td>
<td>IEC/EN 60 947-4-2</td>
</tr>
</tbody>
</table>

**Degree of protection**

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

**Vibration resistance:**
- amplitude 0.35 mm
- frequency 10 ... 55 Hz IEC/EN 60 068-2-6

### Technical Data

**Climate resistance:** 0 / 055 / 04 IEC/EN 60 068-1

**Wire connection**
- fixed screw terminal (S), 0.2 ... 4 mm² solid or 0.2 ... 1.5 mm² stranded wire with sleeve DIN 46 228-1/-2/-3/-4
- captive Plus-minus terminal screws

**Wire fixing**
- captive Plus-minus terminal screws
- M3.5 box terminals with wire protection

**Mounting**
- DIN-rail IEC/EN 60 715

**Weight:** 185 g

### Dimensions

**Width x height x depth:** 72 x 90 x 72 mm

### Standard type

**RP 9210/300**
- 3 AC 400 V
- 50 / 60 Hz
- 750 W

**Article number:** 0062931

| Nominal motor power at AC 400 V: | 750 W |
| Control input:                   | right, left |
| With softstart, softstop and reversing |
| Width:                           | 72 mm |

### Variants

**RP 9210/100:**
- with softstart, without softstop without reversing

**RP 9210/200:**
- with softstart, with softstop, without reversing

### Ordering example for variants

<table>
<thead>
<tr>
<th>Type</th>
<th>Nominal voltage</th>
<th>Nominal power</th>
<th>Variants</th>
</tr>
</thead>
<tbody>
<tr>
<td>RP 9210 / _ _ _ 3 AC 400 V 50 / 60 Hz 750 W</td>
<td>Nominal motor power</td>
<td>Nominal frequency</td>
<td></td>
</tr>
<tr>
<td>Nominal voltage</td>
<td>Nominal variant, if required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Application Example

Monitoring of motor temperature with PTC-sensor

Monitoring of motor temperature with bi-metal contact
Power Electronics

MINISTART
Softstarter
BI 9025, BL 9025

- Softstart and softstop function
- 2-phase control
- For motors up to 15 kW at 3 AC 400 V
- Acceleration and deceleration time resp. starting and switch-off torque are separately adjustable
- Wide input voltage range of the power semiconductors
- Galvanic isolation of control input with wide voltage range up to AC/DC 480 V control input
- 3 auxiliary voltages at the device up to AC 230 V
- Integrated overtemperature monitoring
- LED indication
- According to EN 60 947-4-2
- 90 mm width

Additional Information About This Topic

For motors up to 5.5 kW we recommend the softstarter BA 9018 or BA 9019.

Approvals and Markings

Applications

- Motor with gear, belt or chain drive
- Fans, pumps, conveyor systems, compressors
- Packaging machines, door-drives
- Start current limiting on 3-phase motors

Function

Softstarters are electronic devices designed to enable 1-phase or 3-phase induction motors to start smoothly. The devices slowly ramp up the current on two phases, therefore allowing the motor torque to build up slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material. When the motor is up to full speed the semiconductors in the device are bridged to prevent internal power losses and heat build up. In addition the device allows a softstop function prolonging the stop time of the motor, preventing high counter torques from abruptly stopping the motor.

Block Diagram

For motors up to 5.5 kW we recommend the softstarter BA 9018 or BA 9019.
Nominal voltage: 3 AC 200 V - 15 % ... 480 V + 15 %
Nominal frequency: 50 / 60 Hz
Width: 90 mm 90 mm
Nominal motor power PN at 480 V: 400 V: 18.5 kW 15 kW
400 V: 7.5 kW 5.5 kW
Nominal current IN: 32 A 25 A
Switching frequency at 3 x IN, 10 s, ϑU = 45 °C: 30 / h 10 / h
Time between 2 starts min.110 s min. 350 s
Min. motor power: approx. 0.1 PN
Start torque: 30 ... 80 %
Ramp time: 1 ... 10 s
Deceleration time: 1 ... 20 s
Recovery time: 200 ms
Auxiliary voltage: A1/A2, AC 115 V +10%, -15%: bridge A1 - Y1
A1/A2, AC 230 V +10%, -15%: bridge A2 - Y2
A3/A4, DC 24 V +10%, -15%: polarity protected
Power consumption: 3 W
Residual ripple: 5 %
Semiconductor fuse: 50 A superfast

Control Input
Voltage range X1/X2: AC/DC 24 - 480 V
Softstart: > 20 V
Softstop: < 5 V

General Data
Temperature range: 0 ... + 40°C
Storage temperature: - 25 ... + 75°C
Usage category: according to EN 60 947-4-2, AC-53 b
Clearance and creepage distances
rated impulse voltage / pollution degree
Control voltage to auxiliary voltage, motor voltage: 6 kV / 2
Auxiliary voltage to motor voltage: 4 kV / 2

Technical Data
EMC
Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2
HF-irradiation: 10 V/m IEC/EN 61 000-4-3
Fast transients: 2 kV IEC/EN 61 000-4-4
Surge voltages between wire for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
Degree of protection
Housing: IP 40 IEC/EN 60 529
Terminals: IP 20 IEC/EN 60 529
Vibration resistance: Amplitude 0.35 mm IEC/EN 60 069-1
frequency: 10 ... 55 Hz
Climate resistance: 0 / 055 / 04 IEC/EN 60 068-1
Wire connection
Load terminals: 1 x 10 mm² solid
1 x 6 mm² stranded ferruled
1 x 4 mm² solid or
1 x 2.5 mm² stranded ferruled (isolated) or
2 x 1.5 mm² stranded ferruled (isolated)
DIN 46 228-1/-2/-3/-4 or
2 x 2.5 mm² stranded ferruled
DIN 46 228-1/-2/-3
Wire fixing
Load terminals: Plus-minus terminal screws M4
box terminals with wire protection
Control terminals: Plus-minus terminal screws M3.5
box terminals with wire protection
Mounting: DIN rail mounting IEC/EN 60 715
Weight
BI 9025: 870 g
BL 9025: 835 g
Dimensions
Width x height x depth: 90 x 85 x 121 mm
Standard Type
BL 9025 3 AC 200 ... 480 V 50/60 Hz 11 kW
Article number: 0050957
Nominal voltage: 3 AC 200 ... 480 V
Nominal motor power at AC 400 V: 11 kW
Width: 90 mm

Ordering Example
BI 9025 3 AC 200 ... 480 V 50/60 Hz 11 kW

Adjustment Facilities
<table>
<thead>
<tr>
<th>Potentiometer</th>
<th>Description</th>
<th>Initial setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>M_on</td>
<td>Starting voltage</td>
<td>fully anti-clockwise</td>
</tr>
<tr>
<td>t_on</td>
<td>Ramp-up time</td>
<td>fully clockwise</td>
</tr>
<tr>
<td>M_off</td>
<td>Deceleration torque</td>
<td>fully clockwise</td>
</tr>
<tr>
<td>t_off</td>
<td>Deceleration time</td>
<td>fully clockwise</td>
</tr>
</tbody>
</table>
Temperature Monitoring

BH/BL/BI 9025 features overtemperature monitoring of its internal power semiconductors. When the safe running temperature is exceeded the power semiconductors will turn off and a red LED on the front of the unit will illuminate. BI/BL 9025 can be reset after the semiconductors have cooled down by momentarily removing the auxiliary supply voltage. An LED indicates the fault (see fault detection).

- Never clear a fault when the device is switched on
- Attention: This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor be disconnected from the mains via the corresponding manual motor starter.
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.

Set-up Procedure

Set potentiometer "M on" to minimum (fully anti-clockwise).
Set potentiometer "M off" to maximum (fully clockwise).
Set potentiometer "t on" to maximum (fully clockwise).
Set potentiometer "t off" to maximum (fully clockwise).
Start the motor and turn potentiometer "M on" up until the motor starts to turn without excessive humming.
Stop the motor and restart.
Adjust potentiometer "t on" to give the desired ramp time.
Stop and restart the motor.
Adjust potentiometer "M on" until the motor starts to visibly slow down at the initiation of the softstop cycle.
Stop and restart the motor.
Adjust potentiometer "t on" to give the desired deceleration time.
Stop and restart the motor, readjusting the potentiometers until the desired starting/stopping characteristics are achieved.
During softstop the device must be connected to the 3-phase system.

- Attention: If the ramp-up time is adjusted to short, the internal bridging contact closes before the motor is on full speed. This may damage the bridging contactor or bridging relay.

Safety Notes

Connection Example

Softstart and softstop
Phase: 3 AC 400 V
MINISTART
Softstarter With DC-Brake
BI 9028

Your Advantages
• Softstart and brake in one unit
• Easy wiring
• Space saving

Features
• According to IEC/EN 60 947-4-2
• 2-phase motor control
• For motors up to 15 kW at 3 AC 400 V
• Separate settings for start and brake time, as well as starting and braking torque
• Galvanic isolation of control input with wide voltage range up to AC/DC 230 V
• No external motor or braking contactor necessary
• 3 auxiliary voltages up to 230 V
• Monitors undervoltage and phase sequence
• 2 relay outputs for indication of status and fault
• LED-indication
• As option without auxiliary supply
• As option withvoltfree contacts for start and stop
• As option withinput to detect motor temperature
• BI 9028 up to 7.5 kW: 67.5 mm width
  BI 9028 up to 15 kW: 90 mm width

Approvals and Markings

Applications
• Motor with gear, belt or chain drive
• Fans, pumps, conveyor systems, compressors
• Woodworking machines, centrifuges
• Packing machines, door-drives

Block Diagrams

BI 9028 up to 15 kW

BI 9028 up to 15 kW, U_{in} = AC 400 V
### Circuit Diagrams

#### BI 9028.38

- **Signal Description**
  - X1, X2, X3, X4: Start-, Stopp signal
  - P1, P2, P3: Thermistor
  - 11, 12, 14: Indicator relay Motor on
  - 21, 22, 24: Indicator relay device ready
  - A1, A2: Auxiliary voltage main
  - A3(+), A4: Auxiliary voltage DC 24 V
  - Y1, Y2: Switching 115 V / 230 V
  - L1: Phase voltage L1
  - L2: Phase voltage L2
  - L3: Phase voltage L3
  - T1: Motor connection T1
  - T2: Motor connection T2
  - T3: Motor connection T3

#### BI 9028.38/001

#### BI 9028.38/001, UH = AC 400 V

#### BI 9028.38/010

#### BI 9028.38/011
### Function Diagrams

**Diagram Description:**
- **t₀:** start
- **t₀-t₁:** ramp up time
- **t₁-t₂:** braking time
- **t₂-t₃:** deceleration time

**DIAGRAM 1:**
- X1/X2 Q₁/Q₂
- X1 Start
- X3 Stop
- L1/L2/L3
- A1/A2 A3/A4
- 17-18, 11-14
- 11-12
- /₈_ _ 11-14
- /₈_ _ 11-12
- 17-28, 21-24
- 21-22
- T1
- T2/T3
- /₈_ _ T2/T3
- M Mot

**DIAGRAM 2:**
- X1 motor on
- X3 motor brake
- L1/L2/L3
- A1/A2 A3/A4
- 11-14
- 11-12
- 17-28, 21-24
- 21-22
- T1
- T2/T3
- M Mot

**Notes:**
- t₀: start
- t₀-t₁: softstart time
- t₁-t₂: braking delay time
- t₂-t₃: deceleration time

**References:**
- BI 9028.38/1
- BI 9028.38/5
Function

Softstarters are electronic devices designed to enable 1-phase or 3-phase induction motors to start smoothly. The devices slowly ramp up the current on two phases, therefore allowing the motor torque to build up slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material. These features allow cost saving constructions of mechanical gear. External motor or brake contactors are not necessary.

Start/Stop switch

When the motor is on full speed after the starting with start/stop switch S the semiconductors are bridged with internal relay contacts to prevent internal power losses and heat built up. When stopping the motor via start/stop switch S braking is started. The braking current flows for the adjusted time through the motor windings. On variant B1_ the start and stop function is realised via bush buttons. On variant B2_ the softstart and brake function are separate switching via control input X1, X3.

Monitoring relay 1 (contact 11-12-14 / 17-18)
The relay energises with the start command and de-energises after finish of braking. When a fault occurs the relay de-energises when the semiconductors switch off. The monitoring relay 1 can be used to activate a mechanical holding brake. With the variant BI 9028/0_ and BI 9028/5_ the relay switches when the semiconductors are bridged.

Monitoring relay 2 (contact 21-22-24 / 17-28)
This relay energises as soon as the unit is ready for operation after connecting it to power. On internal overtemperature, phase failure, wrong phase sequence and overtemperature on the motor (variant BI 9028/1_) the relay 2 de-energises. The power semiconductors are switched off. The internal temperature monitoring protects the thyristors. The temperature monitoring of the motor (variant BI 9028/1_) has an input for a bimetallic contact or PTCs. The fault is reset by disconnecting the power supply temporarily after the temperature is down again.

Phase failure and phase sequence monitoring protect motor and plant. The fault is reset by disconnecting the power supply temporarily.

Input P1 / P2 / P3 to monitor the motor temperature on variant BI 9028/1_

To monitor overtemperature on the motor a bimetallic contact can be connected to P1 / P2 / P3. When overtemperature is detected the power semiconductors switch off and relay 2 de-energises.

On P1 / P2 up to 6 PTC sensors can be connected. On detection of overtemperature, short circuit or broken wire (in sensor circuit) the power semiconductors switch off and relay 1 + 2 de-energise.

The fault is reset by disconnecting the power supply temporarily after the temperature on the motor is down again. After every reset the unit has to be started again via control input or start/stop button.

Indication

green LED: Continuous light: when auxiliary supply connected Flashing light: while starting and braking

yellow LED: Continuous light: when contact 11-12-14 / 17-18

Monitoring relay 2

yellow LED: Continuous light: when contact 21-22-24 / 17-28

Flashing light: when contact 21-22-24 / 17-28

1°: overtemperature on thyristor (internal)

2°: overtemperature on motor or broken wire in sensor circuit P1/P2, only at variant /01_

3°: short circuit on sensor circuit P1/P2, only at variant /01_

4°: phase failure

5°: incorrect phase sequence, exchange connections on L1 and L2

6°: incorrect frequency

7°: heat sink temperature sensor defective

8°: braking time exceeded

1-8° = Number of flashing pulses in short sequence

Notes

Variation of speed is not possible with this device. Without load a softstart cannot be achieved. It is recommended that the softstart is protected by superfast semiconductor fuses rated as per the current rating of the soft-start or motor. However, standard line and motor protection is acceptable, but for high starting frequencies motor winding temperature monitoring is recommended. The softstarter must not be operated with capacitive load e.g. power factor compensation on the output.

The current in the 3 phases is different due to 2-phase control. To avoid false tripping of the motor overload it is recommended to select a suitable overload for this application.

In respect to safety of persons and plant only qualified staff is allowed to work on this device.

Technical Data

<table>
<thead>
<tr>
<th>Phase / motor voltage</th>
<th>with auxiliary voltage</th>
<th>without auxiliary voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1/L2/L3</td>
<td>3 AC 200 V -10% ... 480V + 10%</td>
<td>3 AC 200 V + 10%</td>
</tr>
</tbody>
</table>

Nomial frequency: 50 / 60 Hz

Switching frequency

at 3 x Iₘₕ, 5 s, θₐ = 20°C: 10 / h 45 / h 30 / h

Permissible braking current

35 A 50 A 65 A

Min. motor power: approx. 0.1 Pₙ

Start torque: 20 ... 80 %

Ramp time: 1 ... 20 s

Braking time: 1 ... 20 s

Braking delay: 0.5 s

Deceleration torque

BI 9028/8_ : 20 ... 80 %

Deceleration time

BI 9028/8_ : 1 ... 20 s

Recovery time: 200 ms

Auxiliary voltage:

Model AC 115/230 V:

A1/A2, AC 115 V, +10%, -15%:

bridge A1 - Y1

bridge A2 - Y2

A1/A2, AC 230 V, +10%, -15%:

bridge Y1 - Y2

A3(+)/A4, DC 24 V, +10%, -15%:

polarity protected

Model AC 400 V:

A1/A2, AC 400 V, +10%, -15%:

no bridge

Power consumption:

3 W

Residual ripple max.: 5 %

Short circuit strength 7.5 kW

Line protection: Assignment type 1 acc. to IEC 60947-4-1 max 50 A Typ gG

Semiconductor fuse: Assignment type 2 acc. to IEC 60947-4-1 max. 1800 A²'s

11 kW

Line protection: Assignment type 1 acc. to IEC 60947-4-1 max 65 A Typ gG

Semiconductor fuse: Assignment type 2 acc. to IEC 60947-4-1 max. 6600 A²'s

15 kW

Line protection: Assignment type 1 acc. to IEC 60947-4-1 max. 80 A Typ gG

Semiconductor fuse: Assignment type 2 acc. to IEC 60947-4-1 max. 6600 A²'s

Inputs

Control input X1/X2 voltage: AC/DC 24 - 230 V

Softstart when: > 20 V

Braking when: < 5 V

BI 9028/0_ 1:

Control input X1/X4, X3/X4: volt free contact

Control input X1/X2, X3/X2 Voltage: AC/DC 24 V

Softstart when: > 15 V

Braking when: < 5 V

Control input Q1/Q2: volt free contact

Switching current: DC 10 mA
Technical Data

Switching voltage: \( DC \ 24 \ \text{V} \)

Input \( P_i / P_e \) for bimetallic contact

Current: approx. 1 mA (= switch closed)

Voltage: approx. 5 V (= switch open)

Input \( P_i / P_e \) for PTC-sensor

Temperature sensor: according to DIN 44081/082

Number of sensors: 1 ... 6 in series

Response value: 3.2 ... 3.8 kΩ

Reset value: 1.5 ... 1.8 kΩ

Load in measuring circuit: < 5 mW (at R = 1.5 kΩ)

Broken wire detection: > 3.1 kΩ

Measuring voltage: \( \leq 2 \ \text{V} \) (at R = 1.5 kΩ)

Measuring current: \( \leq 1 \ \text{mA} \) (at R = 1.5 kΩ)

Voltage, when broken wire in sensor circuit: DC approx. 5 V

Current, when short circuit in sensor circuit: DC approx. 0.5 mA

Monitoring Output

Contacts

BI 9028.38: 2 x 1 changeover contacts

BI 90.28.38 (U_e = AC 400 V): 2 x 1 NO contacts

Thermal continuous current \( I_{t_c} \): 4 A

Switching capacity to AC 15

NO contact: 3 A / 230 V IEC/EN 60 947-5-1

NC contact: 1 A / 230 V IEC/EN 60 947-5-1

Electrical life: to AC 15 at 3 A, AC 230 V:

1 x 10^6 switching cycles

Short circuit strength max. fuse rating: 4 A gG / gl IEC/EN 60 947-5-1

Mechanical life: 1 x 10^6 switching cycles

General Data

Operating mode: Continuous operation

Temperature range

Operation: 0 ... + 45 °C

Storage: - 25 ... + 75 °C

Relative air humidity: max. 95 %

Altitude: < 1,000 m

Clearance and creepage distances

rated impulse voltage / pollution degree between

Motor voltage, heat sink: 6 kV / 2 IEC/EN 60 664-1

Control voltage to auxiliary voltage, motor voltage: 4 kV / 2 IEC/EN 60 664-1

Auxiliary to motor voltage: 4 kV / 2 IEC/EN 60 664-1

Overvoltage category: III

EMC

Interference resistance

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF-irradiation:

80 Mhz ... 1.0 GHz 10 V / m IEC/EN 61 000-4-3

1.0 GHz ... 2.5 GHz 3 V / m IEC/EN 61 000-4-3

2.5 GHz ... 2.7 GHz 1 V / m IEC/EN 61 000-4-3

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages between

wire for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Voltage dips: IEC/EN 61 000-4-11

Interference emission

Wire guided: Limit value class B IEC/EN 60 947-4-2

Radio irradiation: Limit value class B IEC/EN 60 947-4-2

Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

Vibration resistance: Amplitude 0.35 mm frequency: 10 ... 55 Hz

Climate resistance: 0 / 045 / 04 IEC/EN 60 068-1

Technical Data

Wire connection

Load terminals: 1 x 10 mm² solid

1 x 6 mm² stranded ferruled

Stripping length: 11 mm

Control terminals: 1 x 4 mm² solid or

1 x 2.5 mm² stranded ferruled (isolated)

2 x 1.5 mm² stranded ferruled (isolated)

DIN 46 228-1/2-3/4 or

2 x 2.5 mm² stranded ferruled

DIN 46 228-1/2-3

Stripping length: 10 mm

Wire fixing

Load terminals: Plus-minus terminal screws M4

Control terminals: Plus-minus terminal screws M4

Fixing torque

Load terminals: 1.2 Nm

Control terminals: 0.8 Nm

Mounting:

DIN rail mounting IEC/EN 60 715

Weight:

Width 67.5 mm: 630 g

Width 90 mm: 780 g

Dimensions

Width x height x depth:

BI 9028 up to 7.5 kW: 67.5 x 85 x 121 mm

BI 9028 up to 15 kW: 90 x 85 x 121 mm

Standard type

BI 9028.38 3 AC 200 ... 480 V 50/60 Hz 7.5 kW

Article number: 0054984

- Motor voltage: 3 AC 200 ... 480 V

- Nominal motor power at AC 400 V: 7.5 kW

- Control input X1/X2

- Width: 67.5 mm

Variants

BI 9028.38/...: volt free contacts for start and stop X1, X2, X3, X4

BI 9028.38/...: input \( P_i / P_e / P_o \) to monitor the motor temperature

BI 9028.38/...: Softstop function instead of brake

BI 9028.38/...: softstart and brake function switching via control input X1, X3

Ordering example for variants:

BI 9028.38/... 3 AC 200 ... 480 V 50/60 Hz 11 kW
Control Input

With BI 9028 softstart begins by closing switch S and braking starts when opening switch S. When closing S during braking, softstart begins again.

With BI 9028/0_1 softstart begins by pressing the "Start" button (X1). By actuating the "Stop" button (X3) braking is started. Pressing the "Start" button during braking activates the softstart again. If "Start" and "Stop" are activated simultaneously within 0.1 s the stop function has priority.

On BI 9028/ _2 softstarts begins when closing the contact on Q1/Q2. By opening this contact braking or softstop is started. If Q1/Q2 is permanently closed softstart is started when applying the mains voltage on L1/L2/L3. Start of braking or softstop can only be started by opening Q1/Q2.

With B9028/5/ _ softstart begins with activation of input X1. The motor is connected to voltage until the signal is disconnected from the control input. With the signal on control input X3 the braking cycle is started (DC-brake) The braking cycle is finished when the signal on X3 is disconnected or on BI 9028/S11 latest 60 seconds after start of the braking cycle the user has to make sure that only one control input is active.

Adjustment Facilities

<table>
<thead>
<tr>
<th>Potentiometer</th>
<th>Description</th>
<th>Initial setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>M_m</td>
<td>Starting voltage</td>
<td>fully anti-clockwise</td>
</tr>
<tr>
<td>t_m</td>
<td>Ramp-up time</td>
<td>fully clockwise</td>
</tr>
<tr>
<td>I_m</td>
<td>Braking current</td>
<td>fully anti-clockwise</td>
</tr>
<tr>
<td>t_m</td>
<td>Braking time</td>
<td>fully clockwise</td>
</tr>
<tr>
<td>M_off</td>
<td>Deceleration voltage time</td>
<td>fully anti-clockwise</td>
</tr>
<tr>
<td>t_off</td>
<td>Deceleration time</td>
<td>fully clockwise</td>
</tr>
</tbody>
</table>

Set-up Procedure

Softstart:
1. Start the motor via control input X1/X2 and turn potentiometer "M_m" up until the motor starts to turn without excessive humming.
2. Adjust potentiometer "t_m" to give desired ramp time.
3. On correct setting the motor should accelerate up to nominal speed.
   - If the start takes too long fuses may blow, especially on motors with high inertia.
   - **Attention:** If the ramp-up time is adjusted to short, the internal bridging contact closes before the motor is on full speed. This may damage the bridging contactor or bridging relay.

Softstop:
- During softstop the device has to be connected to the voltage.
- Select softstop by opening control input X1/X2; Q1/Q2
- Turn potentiometer M_m to the left, until the motor starts visibly to slow down at the initiation of the softstop cycle.
- Adjust t_m until the required stopping time is achieved.

Braking:
The braking time t_m and the braking current I_m (max. 2 I_m with star connected and max. 2.8 I_m with delta connected motors, do not exceed max. permissible braking current!) is adjusted on BI 9028. The time has to be adjusted in a way that the current is flowing until the motor is on standstill. To avoid overload of braking device and motor, the braking current should be checked with a moving iron instrument (see connection diagram). The procedure for BI 9028/001 is the same.

Temperature Monitoring

BI 9028 features overtemperature monitoring of its internal power semiconductors. The unit is therefore protected against overheating during the set up procedure. BI 9028 can be reset after the semiconductors have cooled down by momentarily removing the auxiliary supply voltage.

Safety Notes

- Never clear a fault when the device is switched on.
- **Attention:** This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains via the corresponding manual motor starter.
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.

Connection Example

BI 9028 softstart and brake function with switch S
Connection Examples

BI 9028/010 softstart and brake function with motor temperature monitoring

BI 9028/001, U_{AC} = AC 400 V

BI 9028/001 softstart with start-button, brake function with stop-button

BI 9028/010 softstart and brake function with motor temperature monitoring

BI 9028/010 softstart - softstop with monitoring of motor temperature without auxiliary voltage.
BI 9028/5_ softstart and brake function switching via separate control inputs, auxiliary voltage $U_h = \text{AC} \ 230 \text{ V}$

**Connection Examples**

**BI 9028/5XX**

- Without monitoring of motor temperature
  - M11075

- Monitoring of motor temperature with bi-metal contact

- Monitoring of motor temperature with PTC-sensor

**BI 9028/5XX**

- Without monitoring of motor temperature
  - M11073

- Monitoring of motor temperature with bi-metal contact

- Monitoring of motor temperature with PTC-sensor
MINISTART
Softstarter For 1-phase Motors
BI 9028/900

- Softstart and softstop function
- According to IEC/EN 60 947-4-2
- 1-phase motor control
- For motors up to 5 kW at AC 230 V
- Separate settings for start and deceleration time, as well as starting and deceleration torque
- Galvanic isolation of control input with wide voltage range up to AC/DC 230 V
- 3 auxiliary voltages up to 230 V
- Phase failure detection
- 2 relay outputs for indication of status and fault
- LED-indication
- 90 mm width

Function Diagram

- Motor with gear, belt or chain drive
- Fans, pumps, conveyor systems, compressors
- Woodworking machines, centrifuges
- Packing machines, door-drives

Approvals and Markings

Applications

Block Diagram

Circuit Diagram

135
Function

Softstarters are electronic devices for smooth start and stop of motors. The device ramps the motor current up and down by phase chopping therefore allowing the motor torque built up and reduce slowly. This reduces mechanical stress on the machine during start and stop. This prevents the connected mechanical equipment against damage caused by mechanical shock of the starting and stopping torque of a direct started motor. These features allow cost savings of mechanical gear.

Monitoring relay 1 (contact 11-12-14)
The relay indicates the status of the bridged semiconductor.

Monitoring relay 2 (contact 21-22-24)
This relay energises as soon as the unit is ready for operation after connecting it to power. On internal overtemperature, phase failure, or wrong mains frequency the relay 2 de-energises. The power semiconductors are switched off. The internal temperature monitoring protects the thyristors. The fault is reset by disconnecting the power supply temporarily after the temperature is down again.

Indication

<table>
<thead>
<tr>
<th>LED Color</th>
<th>Continuous Light</th>
<th>Flashing Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>green</td>
<td>when auxiliary supply connected</td>
<td>while starting and braking</td>
</tr>
</tbody>
</table>

Monitoring relay 1
yellow LED: Continuous light: when contact 11-12-14 switched on

Monitoring relay 2
yellow LED: Continuous light: when contact 21-22-24 switched on
Flashing light: when contact 21-22-24 switched off
1*: overtemperature on thyristor (internal)
4*: phase failure in load circuit
6*: incorrect frequency
1-6*) = Number of flashing pulses in sequence

Notes
Variation of speed is not possible with this device. Without load a softstart cannot be achieved. It is recommended that the softstart is protected by superfast semiconductor fuses rated as per the current rating of the softstart or motor. However, standard line and motor protection is acceptable, but for high starting frequencies motor winding temperature monitoring is recommended. The softstarter must not be operated with capacitive load e.g. power factor compensation on the output.

In respect to safety of persons and plant only qualified staff is allowed to work on this device.

Technical Data

Phase / motor voltage L1 / N: 1 AC 100 V - 10 % ... 480V + 10 %
Nominal frequency: 50 / 60 Hz
Nominal motor power Pn at 230 V: 5 kW
Switching frequency at 3 x I<sub>n</sub>, 5 s, θ<sub>n</sub> = 20°C: 45 / h
Min. motor power: approx. 0.1 Pn
Starting voltage: 20 ... 80 %
Deceleration voltage: 20 ... 80 %
Ramp time: 0,25 ... 20 s
Deceleration time: 0,25 ... 20 s
Auxiliary voltage:
Model AC 115/230 V:
A1/A2, AC 115 V, +10%, -15%:
bridge A1 - Y1
bridge A2 - Y2
A1/A2, AC 230 V, +10%, -15%:
bridge Y1 - Y2
A3(+)/A4, DC 24 V, +10%, -15%:
polarity protected
Power consumption:
2 W
Residual ripple max.:
5 %
Max. semiconductor fuse: 1800 A<sup>2</sup> s

Notes
Phase / motor voltage L1 / N: 1 AC 100 V - 10 % ... 480V + 10 %
Nominal frequency: 50 / 60 Hz
Nominal motor power Pn at 230 V: 5 kW
Switching frequency at 3 x I<sub>n</sub>, 5 s, θ<sub>n</sub> = 20°C: 45 / h
Min. motor power: approx. 0.1 Pn
Starting voltage: 20 ... 80 %
Deceleration voltage: 20 ... 80 %
Ramp time: 0,25 ... 20 s
Deceleration time: 0,25 ... 20 s
Auxiliary voltage:
Model AC 115/230 V:
A1/A2, AC 115 V, +10%, -15%:
bridge A1 - Y1
bridge A2 - Y2
A1/A2, AC 230 V, +10%, -15%:
bridge Y1 - Y2
A3(+)/A4, DC 24 V, +10%, -15%:
polarity protected
Power consumption:
2 W
Residual ripple max.:
5 %
Max. semiconductor fuse: 1800 A<sup>2</sup> s

Technical Data

Inputs

Control input X1/X2 voltage: AC/DC 24 - 230 V
Softstart when: > 20 V
Stopstart when: < 5 V

Monitoring Output

Contacts: 2 x 1 changeover contacts
Thermal continuous current I<sub>n</sub>: 4 A
Switching capacity to AC 15
NC contact: 3 A / 230 V IEC/EN 60 947-5-1
NO contact: 1 A / 230 V IEC/EN 60 947-5-1
Electrical life:
To AC 15 at 3 A,
AC 230 V: 2 x 10<sup>6</sup> switching cycles
Short circuit strength
max. fuse rating: 4 A gL IEC/EN 60 947-5-1

General Data

Temperature range: 0 ... + 45 °C
- 25 ... + 75 °C
Storage temperature: 0 ... + 45 °C
Clearance and creepage distances
rated impulse voltage / pollution degree
Control voltage to auxiliary voltage, motor voltage: 6 kV / 2
Auxiliary to motor voltage: 4 kV / 2
EMC
Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2
HF-irradiation: 10 V/m IEC/EN 61 000-4-3
Fast transients: 2 kV IEC/EN 61 000-4-4
Surge voltages between wire for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
Degree of protection
Housing: IP 40 IEC/EN 60 529
Terminals: IP 20 IEC/EN 60 529
Vibration resistance: Amplitude 0,35 mm frequency: 10 ... 55 Hz
Climate resistance: 0 / 055 / 04 IEC/EN 60 068-1
Wire connection
Load terminals:
1 x 10 mm<sup>2</sup> solid
1 x 6 mm<sup>2</sup> stranded ferruled
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)
DIN 46 228-1/-2/-3/4 or
2 x 2,5 mm<sup>2</sup> stranded ferruled
DIN 46 228-1/-2/-3

Wire fixing
Load terminals:
Plus-minus terminal screws M4
Control terminals:
box terminals with wire protection
Plus-minus terminal screws M3.5
box terminals with wire protection
Mounting:
DIN rail mounting IEC/EN 60 715
Weight: 780 g
Dimensions
Width x height x depth: 90 x 85 x 121 mm
BI 9028.38/900 1 AC 100 ... 480 V 50/60 Hz 5 kW

Article number: 0058687

- Nominal motor power at AC 400 V: 5 kW
- Control input X1/X2
- Width: 90 mm

Control Input

The softstart begins by closing contact S connected to BI 9028/900. By opening contact S the deceleration begins. If contact S closes during deceleration the unit starts to ramp up again.

Adjustment Facilities

<table>
<thead>
<tr>
<th>Potentiometer</th>
<th>Description</th>
<th>Initial setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>M&lt;sub&gt;m&lt;/sub&gt;</td>
<td>Starting voltage</td>
<td>fully anti-clockwise</td>
</tr>
<tr>
<td>t&lt;sub&gt;r&lt;/sub&gt;</td>
<td>Ramp-up time</td>
<td>fully clockwise</td>
</tr>
<tr>
<td>M&lt;sub&gt;d&lt;/sub&gt;</td>
<td>Deceleration voltage</td>
<td>fully anti-clockwise</td>
</tr>
<tr>
<td>t&lt;sub&gt;d&lt;/sub&gt;</td>
<td>Deceleration time</td>
<td>fully clockwise</td>
</tr>
</tbody>
</table>

Set-up Procedure

Softstart:
1. Start the motor via control input X1/X2 and turn potentiometer "M<sub>m</sub>" up until the motor starts to turn without excessive humming.
2. Adjust potentiometer "t<sub>r</sub>" to give desired ramp time.
3. On correct setting the motor should accelerate up to nominal speed.
   If the start takes too long fuses may blow, especially on motors with high inertia.

- **Attention:** If the ramp-up time is adjusted to short, the internal bridging contact closes before the motor is on full speed. This may damage the bridging contactor or bridging relay.

Softstop:
- During softstop the device has to be connected to the voltage.
- Select softstop by opening control input X1/X2
- Adjust the voltage at which the deceleration stops with Pot. M<sub>d</sub>
- Adjust the deceleration time t<sub>d</sub>

Temperature Monitoring

BI 9028/900 features overtemperature monitoring of its internal power semiconductors. The unit is therefore protected against overheating during the set up procedure. BI 9028/900 can be reset after the semiconductors have cooled down by momentarily removing the auxiliary supply voltage.

Safety Notes

- Never clear a fault when the device is switched on.

- **Attention:** This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains via the corresponding manual motor starter.

- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.

- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.

Connection Example

![Connection Diagram](image)
**Your Advantages**
- Protection of the drive unit
- Space and cost saving because of integrated motor protection:
  - motor overload, phase failure and exceed acceleration time
- Integrated bridging contactor
- Limiting of starting current prevents against mains and equipment overload
- Productivity by shortened stating times on heavy duty stating and high permissible switching frequency
- Individual configuration for every application
- Easy operation
- Comprehensive diagnostic via LED-flashing codes possible

**Features**
- 2-phase soft starter for asynchronous motors up to 110 kW (400 V)
- Integrated current control time
- Integrated motor protector
- Integrated bridging contactor
- Volt free control input for softstart / -stop
- Connection for motor thermistor
- With two monitoring outputs, one is programmable
- Communication interfaces for Profibus, DeviceNet, Modbus and pump controls (optional)
- Start and stop via separate push buttons or control switch
- Motor voltage range 3 AC 200 ... 440V or 3 AC 200 ... 575V

**Adjustable functions:**
- Starting time monitoring
- Nominal motor current
- Current ramp
- Current limit
- Softstopp - ramp time
- Motor protection class
- Phase sequence
- Programmable relay output for indicators

**Approvals and Markings**

**Application**
- Escalator
- Pumps
- Fans and ventilation systems
- Conveyor systems and elevators
- Compressors
- Mills, crushers, presses
- ... and for all applications with ambitious start-up and deceleration
Technical Data

Nominal voltage:
- 3 AC 200 ... 440 V (+10 % / -15 %)
- 3 AC 200 ... 575 V (+10 % / -15 %)

Nominal frequency: (at start):
- 45 ... 66 Hz

Rated current IN (A): 18, 34, 42, 48, 60, 75, 85, 100, 140, 170, 200

Motor power at 400 V (kW):
- 7,5
- 15
- 18,5
- 22
- 30
- 37
- 45
- 55
- 75
- 90
- 110

Stromrampe: 2 s, 5 s, 15 s with 150 %; 200 % and 250 % I\textsubscript{IN}

Stromgrenze: 250%, 275%, 300%, 350%, 375%, 400%, 425%, 450% I\textsubscript{IN}

Motor protection class: adjustable

Deceleration time: 2 s ... 20 s

Motor protection class: adjustable

Auxiliary voltage (A1, A2, A3) optionally:
- AC 380 to 440 V (+10 % / -15 %)
- AC 110 to 240 V (+10 % / -15 %)
- AC/DC 24 V

Current consumption at operation: < 100 mA

Current consumption at starting:
- at auxiliary voltage AC 110...440 V: 10 A for 10 ms
- at auxiliary voltage AC/DC 24 V: 2 A for 10 ms

Inputs
- Start (terminal 01)
  - NO contact: 150 k\text{\textohm} at AC 300 V and 5.6 k\text{\textohm} at DC 24 V
- Stop (terminal 02)
  - NC contact: 150 k\text{\textohm} at AC 300 V and 5.6 k\text{\textohm} at DC 24 V

Outputs
- Main contactor (terminals 13, 14)
  - NO contact: 6 A, DC 30 V resistive / 2 A, AC 400 V, AC11
  - programmable relay (terminal 23, 24)
    - NO contact: 6 A, DC 30 V resistive / 2 A, AC 400 V, AC11

General Data

Degree of protection
- at 7.5 ... 55 kW: IP 20 IEC/EN 60 529
- at 75 ... 110 kW: IP 66 IEC/EN 60 529
- IIP 20 with additional finger guard kit (see accessories)

Temperature range operation:
- -10 °C to +60 °C
- (over +40 °C see derating at Commissioning Instructions)

Storage temperature:
- -25 °C to +60 °C
- (to +70 °C for max. 24 h)

Humid:
- 5% ... 95% relative humid

Rated voltage of insulation:
- 600 V

Pollution degree:
- 3

Vibration resistance:
- 4 Hz ... 13.2 Hz: ± 1 mm Amplitude
- 13.2 Hz ... 200 Hz: ± 0.7 g

EMC
- Electrostatic discharge (ESD): 4 kV (contacts) IEC/EN 61 000-4-2
- 8 kV (air) IEC/EN 61 000-4-2
- Conducted radio frequency emission: 0.15 MHz to 1000 MHz: 140 dB (μV)

Indication
- LED “On”: Indicate the device state
- LED “Bypass”: Indicate the motor state
- Flashes with same frequency at error
- Failure codes see in operating manual GI 9014

Surge voltage
- between wires for power supply: 1 kV IEC/EN 61 000-4-5
- between wire and ground: 2 kV IEC/EN 61 000-4-5

Fast transients: 5/50 μs

Voltage dip and short time interruption: 100 ms (at 40 % nominal voltage)

Harmonics and distortion: IEC 61000-2-4 (class 3), IEC/EN61800-3

Short circuit
- Short circuit current: 7.5 ... 37 kW: 5 kA
- 55 ... 110 kW: 10 kA

Heat dissipation:
- during start: 3 W\text{A}
- during operation: 10 W

Dimensions

Width x height x depth:
- 7.5 / 15 / 18.5 / 22 / 30 kW: 98 x 203 x 165 mm
- 37 / 45 / 55 kW: 145 x 215 x 193 mm
- 75 / 90 / 110 kW: 202 x 240 x 214 mm

Standard type

GI 9014
- 3 AC 200 ... 440 V
- 45 ... 66 Hz
- 7.5 kW

- Article number: 0062420
- Nominal voltage: 3 AC 200 ... 440 V
- Auxiliary voltage: DC 24 V
- Nominal motor power: 7.5 kW
- Width: 98 mm

Ordering Example

GI 9014
- 3 AC 200 ... 440 V
- 45/66 Hz
- 7.5 kW
- 3 AC 380 bis 440 V

Accessories

- GW 5310: Remote control
- GW 5311: Interface for remote control
- GW 5312: DeviceNet-Module
- GW 5313: Modbus-Module
- GW 5314: Profibus-Module
- GW 5316: Finger guard kit and touch protection
Connection Examples

Connection Diagram:

- L1
- L2
- L3

Auxiliary voltage:
- M

Motor - PTC:
- GI9014
- main contact
- prog. relay

Voltage Specifications:
- AC 380-440V
- AC 110-240V
- AC/DC 24V

Connection Options:

1. 2-wire function
   - A3 A2 A1
   - 110-240VAC
   - 24VAC/24VDC
   - 380-440VAC

2. 3-wire function
   - A3 A2 A1
   - ON/STOP

Note: 0102 02

M10905

140
**Your Advantages**
- Simple and time saving as well as user friendly operation because of
  - "Adaptive acceleration control" (self learning acceleration control)
  - Graphical LCD display for parameterization and visualisation
- Adjustable bus bars for units from 360 A ... 1600 A for easy connection
- Comprehensive and customer specific motor protection functions because thermal motor modell - external motor protection is not necessary
- Emergency operation, i.e. in the case of failure a 2-phase control allows motor operation
- Slow motion operation forward and reverse
- DC brake (contact free), therefore no brake contactor necessary

**Features**
- 3-phase softstarter for asynchronous motors up to 800 kW (400 V)
- W3 connection up to 1300 kW (400V)
- Nominal current 23 ... 1600 A
- Integrated bridging contactor up to 220 A
- Programmable input- and outputs for fault indication and operation
- Motor-PTC connection possible
- Communication interfaces as option for Profibus, DeviceNet or Modbus
- Start and stop via separate push buttons or control switch

**Adjustable functions:**
- Emergency operation
- Slow motion operation forward and reverse
- Control input (3 x fixed, 1 x programmable)
- Relay output (3 x programmable)
- 24 V DC output
- Analogue output
- Different softstart / stop modes
- 690 V units on request

**Approval and Markings**

**Application**
- Pumps
- Fans and ventilation systems
- Conveyor systems and elevators
- Compressors
- Mills, crushers, presses
- ... and for all applications with ambitious start-up and deceleration

**Indication**
- Graphical LCD display for parameterization and visualisation
Technical Data

Nominal voltage: 3 AC 200 ... 525 V (± 10 %)
3 AC 380 ... 690 V (± 10 %)

Nominal frequency: (at start): 45 ... 66 Hz

Rated current IN (A): 23 43 53 76 105 145 170
Motor power at 400 V (kW): -11 -18.5 -30 -45 -55 -75 -90
FT-Power semiconductor fuse (kA’s): 1.15 8 15 15 125 125 320
Weight (kg): 3.2 3.2 3.2 3.5 4.8 16 16

Rated current IN (A): 220 255 380 430 650 790 930
Motor power at 400 V (kW): -110 -132 -200 -250 -310 -400 -500
FT-Power semiconductor fuse (kA’s): 320 320 320 320 1200 2530 4500
Weight (kg): 16 25 50.5 50.5 53.5 53.5 53.5

Softstart mode: Constant current, voltage ramp,
"Adaptive acceleration control", kick start

Deceleration mode: Softstopp, braking, free wheeling

Operating frequency 3 x Ie and 10 s:
Switching capacity relay output: AC53b 3.0 - 10:350 10 h
ambient-temperature: - 10 °C ... + 40 °C (+60 °C Derating)
Auxiliary voltage (A4, A5, A6)
either: AC 110 and 220 V (+ 10% / - 15%; 600 mA)
or: AC/DC 24 V (± 20%)

Inputs Nominal value for "active input": DC 24 V, 8 mA
Start (54,55): normally open
Stopp (56,57): normally closed
Reset (58,57): normally closed
programmable input (53,55): NO contact
Motor thermistor (64, 65) response > 3.6 kΩ;
reset < 1.6 kΩ

Outputs Relay outputs 10 A at
AC 250 V ohmic, 5 A at
AC 250 V AC15 Lf 0.3
programmable outputs
relay A (13, 14): normally open
relay B (21, 22, 24): change-over
relay C (33, 34): normally open
Analogue output (40, 41):
Max. load: 600 W (DC 12 V at 20 mA)
Accuracy: ± 5 %
DC 24 V-output (P24, COM) max. load: 200 mA
Accuracy: ± 10 %

Technical Data

Short circuit capability
Coordination with semiconductor fuses: Typ 2
Coordination with HRC fuses: Typ 1
23 ... 105 A prospective current: 10 kA
145 ... 255 A prospective current: 18 kA
360 ... 930 A prospective current: 85 kA
1200 ... 1600 A prospective current: 100 kA

General Data

Degree of protection
at 23 ... 105 A: IP 20 IEC/EN 60 529
at 145 ... 1600 A: IP 00 IEC/EN 60 529
at 145 ... 220 A: IP 20 with additional finger guard kit
(see accessories)

Temperature range
operation: - 10 °C ... + 60 °C
storage temperature: over 40 °C with low nominal value
- 25 ... + 60°C
Altitude:
over 1000 m
Humid:
5% ... 95% relative humid
Pollution degree:
3

Rated insulation voltage
to earth: AC 600 V
rated impulse voltage fuse: 4 kV
Form designation:
Bypassed or continuous,
semiconductor motor starter form 1

EMC
Surge voltage between
wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
Fast transients: 5/50 μs
Voltage dip and
short time interruption: 100 ms (at 40 % nominal voltage)
Harmonics and distortion: IEC 61000-2-4 (class 3), IEC/EN61800-3

Heat dissipation:
during start: 4.5 Watt / Ampere
during operation
23 ... 53 A: ≤ 39 Watt (approx.)
76 ... 105 A: ≤ 51 Watt (approx.)
145 ... 220 A: ≤ 120 Watt (approx.)
1200 ... 1600 A: 4.5 Watts / Ampere (approx.)
### Technical Data

#### Dimensions

<table>
<thead>
<tr>
<th>Unit</th>
<th>A mm</th>
<th>B mm</th>
<th>C mm</th>
<th>D mm</th>
<th>E mm</th>
<th>Weight kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 A</td>
<td>156</td>
<td>124</td>
<td>295</td>
<td>278</td>
<td>192</td>
<td>3.2</td>
</tr>
<tr>
<td>43 A</td>
<td>145</td>
<td>282</td>
<td>438</td>
<td>380</td>
<td>250</td>
<td>16</td>
</tr>
<tr>
<td>76</td>
<td>380</td>
<td>530</td>
<td>760</td>
<td>650</td>
<td>530</td>
<td>105</td>
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<tr>
<td>105</td>
<td>505</td>
<td>725</td>
<td>930</td>
<td>830</td>
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<td>145</td>
<td>550</td>
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<td>950</td>
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<td>170</td>
<td>575</td>
<td>805</td>
<td>1100</td>
<td>1000</td>
<td>805</td>
<td>535</td>
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<tr>
<td>220</td>
<td>574</td>
<td>804</td>
<td>1100</td>
<td>1000</td>
<td>804</td>
<td>534</td>
</tr>
</tbody>
</table>

#### Ordering Example

GI 9015 3 AC 200...525 V 105 A AC 110 V and 220 V

### Accessories

- GW 5312: DeviceNet-Module
- GW 5313: Modbus-Module
- GW 5314: Profibus-Module
- GW 5316: Finger guard kit and touch protection
**Your advantages**
- Higher safety level and more economic by short stopping cycle
- Cost saving
- Compact design
- Easily appliance, no need for current measuring instrument

**Features**
- According to IEC/EN 60947-4-2
- For all single and 3-phase asynchronous motors
- DC-brake with one way rectification up to max. 32 A_{eff}
- Controlled by microcontroller
- Easily fitted to existing installations
- Wear free and maintenance free
- Integrated braking contactor
- DIN-rail mounting
- Adjustable braking current (controlled current)
- With automatic standstill detection
- Variante /100
  - with braking time control
  - without detection of standstill
- Width: 45 mm

**Applications**
- Saws
- Centrifuges
- Woodworking machines
- Textile machines
- Conveyors

**Function**
The supply voltage is connected to terminals L1-L2 and the interlock contact X5-X6 closes to enable the motor contactor. A green LED indicates operation. The motor can be started with the start button. The braking DC-voltage is generated on terminals T1 and T2. The braking sequence is as follows: Pressing the stop button de-energises the motor contactor. The closing of X3-X4 (contact of the motor contactor) starts the braking. After a safety time the braking contactor closes for the adjusted braking time and the braking current flows through the motor.

**Notes**
Terminal 3 is the measuring input for standstill detection. The BA 9034N can be also used without connecting T3. Standstill will be detected by the current measuring. It is important to make sure, that the braking current will flow longer than 2 s before stopping the motor. If the motor stops to early, the standstill will not be detected on the braking current will flow for the maximum braking time.

To have an optimal standstill detection make sure that the braking current is greater than the nominal current of the motor.

If the back-EMF of the motor drops only slowly the unit may have a braking delay of up to 2 s.

On variant /100 the braking current flows for the adjusted time $t_B$. 
LED green "RUN": READY, PERMANENT ON

LED red "Error":
- Mains frequency out of tolerance: Flashes 1 times
- Braking current is not present: Flashes 2 times
- Power semiconductors overheated: Flashes 3 times
- Synchronisation signal is not present: Flashes 4 times
- Temperature measuring circuit defective: Flashes 5 times
- Motor voltage not disconnected: Flashes 6 times

LED yellow "IB":
- Max. braking time 11 s: Braking current is present, permanent on
- Max. braking time 31 s: Braking current is present, flashes

Technical Data
- Nominal Voltage $U_{N}$: AC 230 V ± 10 %, AC 400 V ± 10 %
- Nominal frequency: 50/60 Hz ± 3 Hz
- Permissible braking current: 2 ... 10 A<sub>eff</sub>, 5 ... 25 A<sub>eff</sub>, 5 ... 32 A<sub>eff</sub>
- Duty-cycle at max. braking current: 8 %
- Braking voltage: DC 10 ... 190 V
- Max. braking time: 11 s
- Braking delay for fade out of back EMF: Auto optimising (0.2 ... 2 s)
- Nominal consumption for control circuit: 5 VA
- Line protection:
  - max. fuse rating: 20 A gG / gL IEC/EN 60 947-5-1
  - Assignment type: 1 IEC/EN 60 947-4-1
  - Semiconductor fuse: max. 1200 A/s Typ gR IEC/EN 60 947-4-1
  - Assignment type: 2 IEC/EN 60 947-4-1
- Output
  - Contacts: 1 changeover contact 5 A / AC 250 V
  - Switching capacity:
    - to AC 15: 5 A / AC 230 V IEC/EN 60 947-5-1
    - NC contact: 2 A / AC 230 V IEC/EN 60 947-5-1
- Electrical life: 1 x 10<sup>6</sup> switching cycles
- Mechanical life: 50 x 10<sup>6</sup> switching cycles
- Operating mode: Continuous operation
- Temperature range:
  - Operation: 0 °C ... + 45 °C
  - Storage: - 25 °C ... + 75 °C
- Relative air humidity: 93 % at 45 °C
- Altitude: < 2,000 m
- Rated impulse voltage / pollution degree
  - Relay contacts to supply voltage: 4 kV / 2 IEC 60 664-1
  - Overvoltage category: III
- Electromagnetic compatibility (EMC)
  - Uniform field, magnetic field
  - Frequency 10 MHz to 1 GHz: 10 V / m IEC/EN 61 000-4-3
  - Frequency 1 GHz to 2 GHz: 3 V / m IEC/EN 61 000-4-3
  - Frequency 2 GHz to 3 GHz: 1 V / m IEC/EN 61 000-4-3
  - Fast transients: 2 kV IEC/EN 61 000-4-4
  - Surge between wires for power supply: 1 kV IEC/EN 61 000-4-5
  - Surge between wire and ground: 2 kV IEC/EN 61 000-4-5
  - Surge for HF wire guided: 10 V IEC/EN 61 000-4-6
- Interference suppression: Limit value class B IEC/EN 55 011
- Degree of protection
  - Housing: IP 40 IEC/EN 60 529
  - Terminals: IP 20 IEC/EN 60 529
- Vibration resistance:
  - Amplitude: 0.35 mm, Frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
- Climate resistance:
  - 25 / 075 / 04 IEC/EN 60 068-1
- Terminal designation: EN 50 005
- Wire connection:
  - Cross section: 2 x 2.5 mm<sup>2</sup> solid or 1 x 1.5 mm<sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4
  - Stripping length: 10 mm
  - Wire fixing:
    - Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
    - 0.8 Nm
  - Mounting: DIN rail IEC/EN 60 715
  - Weight: 600 g
- Dimensions
  - Width x height x depth: 45 x 73 x 122 mm
If the connection between X3-X4 is opened, the device turns into standby mode. After closing the connection, the device starts with braking. The device can be started also without control on X3-X4. In this case the braking delay is slightly longer up to 1.5 s.

X5, X6: Interlock contact for motor contactor. This contact will be open at system error, this means that the motor cannot be started!
X5, X7: Activation of the star contactor in a star-delta circuit during braking

**Control Input**

**Adjustment Facilities**

<table>
<thead>
<tr>
<th>Potentiometer</th>
<th>Description</th>
<th>Initial setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>$l_b$</td>
<td>Braking current</td>
<td>Fully anti-clockwise</td>
</tr>
<tr>
<td>$T_b$</td>
<td>Braking delay</td>
<td>Fully clockwise</td>
</tr>
</tbody>
</table>

The braking current is controlled according to the adjusted value in Ampere.

For optimum braking the setting of the current should be max. 1.8 to 2 times the motor current. This corresponds to the saturation current of the magnetic field used to brake the motor. A higher current only overheats the motor. A higher braking efficiency can be obtained by using 2 or more stator windings. The permitted duty cycle is depending on the actual braking current and the ambient temperature.
Connection Example

BA 9034N/100 simultaneous braking of 2 motors in parallel connection for lower motor loads

BA 9034N/100 simultaneous braking of 2 motors in serial connection for higher motor loads
- Connect the motor braking relay BA 9034N in accordance to the connection example and make sure to connect the same phases between (L1, L2) and /T1, T2). Make sure that the interlocking contact X5, X6 is wired in series to the coil of the motor contactor so that the motor contactor cannot switch on, while the braking current is flowing.

- Set the braking current in the potentiometer scale. To avoid overloading of the motor set the current to max. two times the nominal motor current.

- The braking time of the BA 9034N cannot be adjusted. Due to the standstill detection it is self-optimizing. If L3 is not connected to T3 standstill detection is provided by measuring the braking current.

- If no standstill is detected, the BA 9034N stops braking after 10 s.

### Fault Indication by Flashing Code

During normal operation failure messages may occur. The messages are indicated by a flashing sequence of the „Error“ LED.

<table>
<thead>
<tr>
<th>Flashes</th>
<th>Fault</th>
<th>Reason</th>
<th>Failure recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x</td>
<td>Mains frequency out of tolerance</td>
<td>Wrong mains frequency</td>
<td>Device not suitable for the frequency. Contact manufacturer</td>
</tr>
<tr>
<td>2 x</td>
<td>Breaking current circuit broken</td>
<td>Braking current circuit broken</td>
<td>Check the wiring</td>
</tr>
<tr>
<td>3 x</td>
<td>Power semiconductors overheated</td>
<td>Permitted duty cycle exceeded</td>
<td>Decrease current and set the braking time longer. Wait till heat sink cools down</td>
</tr>
<tr>
<td>4 x</td>
<td>Synchronisations signal is not present</td>
<td>Unit defective or temporary interruption of power supply</td>
<td>The unit has to be repaired</td>
</tr>
<tr>
<td>5 x</td>
<td>Temperature measuring circuit defective</td>
<td>Unit defective or overtemperature on power semiconductors while switching on</td>
<td>The unit has to be repaired</td>
</tr>
<tr>
<td>6 x</td>
<td>Motor is still connected to voltage while braking should start already</td>
<td>Motor contactor welded</td>
<td>Change motor contactor</td>
</tr>
<tr>
<td>7 x</td>
<td>Braking relay is welded</td>
<td>Unit defective</td>
<td>The unit has to be repaired</td>
</tr>
</tbody>
</table>
Your advantages
• Higher safety level and more economic by short stopping cycle
• Cost saving
• Compact design
• Easy to set-up, no need for current measuring instrument

Features
• According to IEC/EN 60947-4-2
• For all single and 3-phase asynchronous motors
• DC-brake with one way rectification up to max. 60 A
• Controlled by microcontroller
• Easily fitted to existing installations
• Wear free and maintenance free
• Integrated braking contactor
• DIN-rail mounting
• Adjustable braking current up to max. 60 A (controlled current)
• With integrated star-delta starting function
• With automatic standstill detection
• Variant /800 with short circuit contactor control for reduced brake delay time
• 90 mm Width

Approvals and Markings

Applications
• Saws
• Centrifuges
• Woodworking machines
• Textile machines
• Conveyors

Function
The supply voltage is connected to terminals L1-L2 and the interlock contact X5-X6 closes to enable the motor contactor. A green LED indicates operation. The motor can be started with an ON push button. Depending on the position of the rotary selector switch the motor starts direct on line or with star-delta start. The braking DC-voltage is generated on terminals T1 and T2. The braking sequence is as follows:

Pressing the stop button de-energises the motor contactor. The closing of X3-X4 (contact of the motor contactor) starts the braking. After a safety time the braking contactor closes for the adjusted braking time and the braking current flows through the motor.

To reduce the brake delay time there is a variant /800 with a short circuit contactor control. By using a contactor controlled by relay 2, the motor windings are shortcircuited on motor stop. This cuts down the back emf very fast. The braking of the motor can be started faster. The braking cycle is time controlled, no standstill detection.

Notes
Terminal 3 is the measuring input for standstill detection. The BI 9034 can be also used without connecting T3. Standstill will be detected by the current measuring. It is important to make sure that the braking current will flow longer than 2 s before stopping the motor. If the motor stops to early, the stillstand will not be detected and the braking current will flow for the maximum braking time.

To have an optimum standstill detection make sure that the braking current is higher than the nominal current of the motor.

If the back-EMF of the motor drops only slowly the unit may have a braking delay of up to 2 s.

The variant /800 allows to reduce the brake delay time down to 250 ms.
Connection Terminals

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Phase voltage L1</td>
</tr>
<tr>
<td>L2</td>
<td>Phase voltage L2</td>
</tr>
<tr>
<td>T1</td>
<td>Motor connection T1</td>
</tr>
<tr>
<td>T2</td>
<td>Motor connection T2</td>
</tr>
<tr>
<td>T3</td>
<td>Motor connection T3 (stand still detection)</td>
</tr>
<tr>
<td>X3</td>
<td>(+) Feed back motor contactor</td>
</tr>
<tr>
<td>X4</td>
<td>Feed back motor contactor</td>
</tr>
<tr>
<td>13, 14</td>
<td>Monitoring relay 1</td>
</tr>
<tr>
<td>23, 24</td>
<td>Monitoring relay 2</td>
</tr>
<tr>
<td>33, 34</td>
<td>Monitoring relay 3</td>
</tr>
<tr>
<td>43, 44</td>
<td>Monitoring relay 4</td>
</tr>
<tr>
<td>X6</td>
<td>(+) Feed back short circuit contactor (/800 only)</td>
</tr>
<tr>
<td>X7</td>
<td>Feed back short circuit contactor</td>
</tr>
</tbody>
</table>

Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED green „RUN“</td>
<td>- ready: permanent on</td>
</tr>
<tr>
<td>LED red „Error“</td>
<td>- Mains frequency out of tolerance</td>
</tr>
<tr>
<td></td>
<td>- Braking current is not present:</td>
</tr>
<tr>
<td></td>
<td>- Power semiconductors overheated:</td>
</tr>
<tr>
<td></td>
<td>- Synchronisation signal is not present:</td>
</tr>
<tr>
<td></td>
<td>- Temperature measuring circuit defective:</td>
</tr>
<tr>
<td></td>
<td>- Motor voltage not disconnected:</td>
</tr>
<tr>
<td></td>
<td>- Variant /800 only short circuit contactor not de-energized:</td>
</tr>
<tr>
<td>LED yellow „Ibr“</td>
<td>- max. braking time 11 s</td>
</tr>
<tr>
<td></td>
<td>- Braking current is present:</td>
</tr>
<tr>
<td></td>
<td>- max. braking time 31 s</td>
</tr>
<tr>
<td></td>
<td>- Braking current is present:</td>
</tr>
</tbody>
</table>

Technical Data

<table>
<thead>
<tr>
<th>Nominal Voltage $U_n$</th>
<th>AC 230 V ± 10 %, AC 400 V ± 10 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal frequency</td>
<td>50/60 Hz ± 3 Hz</td>
</tr>
<tr>
<td>Permissible braking current</td>
<td>10 ... 60 A $\text{eff}$</td>
</tr>
<tr>
<td>Duty-cycle at max. braking current</td>
<td>40 %</td>
</tr>
<tr>
<td>$I_t$-value of power semiconductors</td>
<td>6600 A$^2$s</td>
</tr>
<tr>
<td>Braking voltage</td>
<td>DC 10 ... 190 V</td>
</tr>
<tr>
<td>Braking delay for fade out of back EMF:</td>
<td>BI 9034: auto optimising (0.2 ... 2 s)</td>
</tr>
<tr>
<td></td>
<td>BI 9034/800: 0.25 s via short circuit contactor</td>
</tr>
<tr>
<td>Nominal consumption for control circuit:</td>
<td>5 VA</td>
</tr>
<tr>
<td>Fuses according to rule 1:</td>
<td>Type GL / 60 A</td>
</tr>
<tr>
<td>Fuses according to rule 2:</td>
<td>Type GR / $I_t$ 6600 A$^2$s</td>
</tr>
</tbody>
</table>

Output

| Contacts              | 4 NO contacts 2 A / AC 400 V |
| Switching capacity to AC 15 | 3 A / AC 250 V IEC/EN 60 947-5-1 |
| NO contact:           | 3 A / AC 250 V IEC/EN 60 947-5-1 |
| Electrical life:      | 10$^6$ switch. cycles IEC/EN 60 947-5-1 |
| Mechanical life:      | 10$^6$ switch. cycles IEC/EN 60 947-5-1 |
| Permissible switching frequency: | 1800 switching cycles / h |
| Short circuit strength | max. fuse rating: 4 A gG / gL IEC/EN 60 947-5-1 |

General Data

| Operating mode:       | Continuous operation            |
| Temperature range:    | 0 ... + 45 °C                   |
| Storage:              | - 25 °C ... + 75 °C             |
| Altitude:             | < 1.000 m                       |
| Clearance and creepage distance: | rated impulse voltage / pollution degree |
| Nominal voltage-heat sink: | 6 kV / 2 IEC 50 178 |
| Relay contacts to supply voltage: | 4 kV / 2 IEC 60 664-1 |
| Overvoltage:          | III                             |
| EMC                   | Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2 |
|                       | HF irradiation:                 |
|                       | 80 MHz ... 1.0 GHz: 10 V / m IEC/EN 61 000-4-3 |
|                       | 1.0 GHz ... 2.5 GHz: 3 V / m IEC/EN 61 000-4-3 |
|                       | 2.5 GHz ... 2.7 GHz: 1 V / m IEC/EN 61 000-4-3 |
| Fast transients:      | 2 kV IEC/EN 61 000-4-4          |
Technical Data

Surge between wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
HF-wire guided: 10 V IEC/EN 61 000-4-6
Voltage dips: IEC/EN 61 000-4-11
Interference emission
Wire guided: Limit value class A\(^\text{\textregistered}\) IEC/EN 60 947-4-2
Radio irradiation: Limit value class A\(^\text{\textregistered}\) IEC/EN 60 947-4-2
* The device is designed for the usage under industrial conditions (Class A, EN 55011). When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken.

Degree of protection
Housing: IP 40 IEC/EN 60 529
Terminals: IP 20 IEC/EN 60 529

Vibration resistance: Thermoplastic with V0 behaviour according to UL subject 94
Climate resistance: Frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
25 / 075 / 04 IEC/EN 60 068-1
Terminal designation: EN 50 005

Wire connection
Load terminals: 1 x 10 mm\(^2\) solid
1 x 6 mm\(^2\) stranded ferruled
A current of 60 A or 80 A is permitted at a.m. duty cycles for 6 mm\(^2\) wiring
Control terminals: 1 x 4 mm\(^2\) solid or
1 x 2.5 stranded ferruled (isolated) or
2 x 1.5 mm\(^2\) stranded ferruled (isolated)
DIN 46 228-1/2/3/4 or
2 x 2.5 mm\(^2\) stranded ferruled
DIN 46 228-1/2/3

Wire fixing
Load terminals: Plus-minus terminal screws M 4
box terminals with self-lifting clamping piece
Fixing torque: 1.2 Nm
Control terminals: Plus-minus terminal screws M 3,5
box terminals with self-lifting clamping piece
Fixing torque: 0.8 Nm
Mounting: DIN rail IEC/EN 60 715
Rail standard: EN 50 022
Weight: 780 g

Dimensions
Width x height x depth: 90 x 85 x 120 mm

Standard Type
BI 9034 60 A  AC 400 V  50 / 60 Hz  2 ... 11 s
Article number: 0062127
• Integrated braking contactor
• DIN-rail mounting
• Width: 90 mm

Ordering Example

<table>
<thead>
<tr>
<th>BI 9034 60 A AC 400 V 50 / 60 Hz 2 ... 11 s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braking time Nominal frequency Nominal voltage Max. braking current Type</td>
</tr>
</tbody>
</table>

Variants on Request

- Second control input e.g. to interrupt braking cycle
- 2 galvanic separated DC 24 V inputs e.g. for control via PLC
- Braking time 1 ... 31 s or to customers specification
- Relay function to customers specification
- Special voltages on request
- Device with time controlled braking cycle, without stand still monitoring, without star-delta-control on request

Control Input

By opening a contact (motor contactor switches on) on terminals X3 (+24V) and X4 (signal) star-delta starting begins when function 1...4 is selected. After the adjusted time delay the delta contactor comes on and the brake units waits for the closing of the contact on X3-X4 (stop button is pressed). After closing of this contact the braking cycle starts.

The variant /800 has an extra input X6 (+24V) and X7 (signal) to give feedback from the short circuit contactor K2. The braking cycle is only started when the feedback circuit after operation of the short circuit contactor is closed again.

Monitoring Output

13, 14: Interlock contact for motor contactor.
23, 24: Control of star contactor of a star delta starter during start and braking.
33, 34: a) Control of delta contactor when function 1...4 is selected
b) ready signal when function 5 is selected
43, 44: Standstill signal, resets on motor start or in case of a failure.

Variante /800

13, 14: Interlocking for motor contactor
23, 24: Control of short circuit contactor
33, 44: Ready signal
43, 44: No function
On device failure all contacts open
The braking current is controlled according to the adjusted value in Ampere.

For optimum braking the setting of the current should be max. 1.8 to 2 times the motor current. This corresponds to the saturation current of the magnetic field used to brake the motor. A higher current only overheats the motor. A higher braking efficiency can be obtained by using 2 or more stator windings. The permitted duty cycle is depending on the actual braking current and the ambient temperature.

The different functions of the brake unit can be selected with rotary switch Fkt

- Fkt 1 ... 4: Star-Delta-control with internal timing
  - Relay 1 - Motor contactor
  - Relay 2 - Star-contactor
  - Relay 3 - Triangle contactor
  - Relay 4 - Stand still

  Acceleration time (star-contactor): Fkt 1 - 20 s
  Fkt 2 - 15 s
  Fkt 3 - 10 s
  Fkt 4 - 5 s

- Fkt 5: Star-Delta-control with external timing
  - Relay 1 - Motor contactor
  - Relay 2 - Star-contactor
  - Relay 3 - Ready
  - Relay 4 - Stand still

Set-up Procedure

- Connect the motor brake relay BI 9034 in accordance to the connection example and make sure to connect the same phases between (L1, L2) and /T1, T2). Make sure that the interlocking contact 13, 14 is wired in series to the coil of the motor contactor so that the motor contactor cannot switch on, while the braking current is flowing
- Select function with rotary switch Fkt
- Set the braking current on potentiometer I_{br} (braking time at variant /800).
  To avoid overloading of the motor set the current to max. two times the nominal motor current
- The braking time of the BI 9034 (except for BI 9034/800) cannot be adjusted. Due to the standstill detection it is self-optimizing. If L3 is not connected to T3, standstill detection is provided by measuring the braking current.
- If no standstill is detected, the BI 9034 stops braking after 10 s e.g. 30 s

Fault Indication by Flashing Code

During normal operation failure messages may occur. The messages are indicated by a flashing sequence of the „Error“ LED

<table>
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<th>Flashes</th>
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<th>Reason</th>
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<td>Mains frequency out of tolerance</td>
<td>Wrong mains frequency</td>
<td>Device not suitable for the frequency. Contact manufacturer</td>
</tr>
<tr>
<td>2 x</td>
<td>Breaking current not present</td>
<td>Braking current circuit broken - Motor coil resistance is too high</td>
<td>Check the wiring. Set braking current lower until the error disappears</td>
</tr>
<tr>
<td>3 x</td>
<td>Power semiconductors overheated</td>
<td>Permitted duty cycle exceeded</td>
<td>Decrease current and set the braking time longer. Wait till heat sink cools down</td>
</tr>
<tr>
<td>4 x</td>
<td>Synchronisations signal is not present</td>
<td>Unit defective or temporary interruption of power supply</td>
<td>The unit has to be repaired. Switch unit Off and On</td>
</tr>
<tr>
<td>5 x</td>
<td>Temperature measuring circuit defective</td>
<td>Unit defective or overtemperature on power semiconductors while switching on</td>
<td>The unit has to be repaired. Wait till heat sink cools down</td>
</tr>
<tr>
<td>6 x</td>
<td>Motor is still connected to voltage while braking should start already</td>
<td>Motor contactor welded</td>
<td>Change motor contactor</td>
</tr>
<tr>
<td>7 x</td>
<td>Short circuit contactor not de-energised when braking cycle should be started</td>
<td>Short circuit contactor welded, faulty wiring</td>
<td>Exchange short circuit contactor, check wiring</td>
</tr>
</tbody>
</table>
BI 9034 without star-delta-control

BI 9034 with external star-delta-control
Connection Example

BI 9034 with internal star-delta-control

BI 9034/800 with reduced brake delay time
**Power Electronics**

**MINISTOP**

Motor Brake Relay

BN 9034, GB 9034

- DC brake with one way rectifier up to 600 A
- Can be used on all asynchronous motors
- Easy to fit also into existing control circuits
- Wear and maintenance free
- Integrated braking contactor for devices up to 60 A
- Mounting on 35 mm DIN-rail for 25 A units
- Adjustable braking current
- With automatic standstill monitoring
- as option with start-delta start function
- as option with thermistor motor protection
- as option with wide voltage input
  - BN 9034: 200 ... 575 V
  - GB 9034: 200 ... 690 V
- width max. 310 mm

**Function Diagram**

The supply voltage is connected to terminals L1-L2. The interlock contact for the motor contactor closes. The LED „ready“ indicates that the supply voltage is connected. The motor can be started with the start button.

The DC voltage for the motor windings UV is supplied from T1-T2.

The external braking contactor (Devices for > 60 A) is controlled by contact 1-2. This contact is timed in a way, that a safety time is provided between reset of the motor contactor and start of the brake contactor. This is necessary to avoid damage of the semiconductors by induced back EMF voltage.

The timing of the different functions during braking is as follows:

- The motor contactor is switched off and disconnects the motor.
- After elapse of the safety time, the brake contactor is energized and shortly after that the brake current is switched on for the adjusted braking time.

**Circuit Diagrams**

- BN 9034
- GB 9034

**Approvals and Markings**

- Saws
- Centrifuges
- Woodworking machines
- Textile machines
- Transportation conveyors

**Application**

Function

The supply voltage is connected to terminals L1-L2. The interlock contact for the motor contactor closes. The LED „ready“ indicates that the supply voltage is connected. The motor can be started with the start button.

The DC voltage for the motor windings UV is supplied from T1-T2.

The external braking contactor (Devices for > 60 A) is controlled by contact 1-2. This contact is timed in a way, that a safety time is provided between reset of the motor contactor and start of the brake contactor. This is necessary to avoid damage of the semiconductors by induced back EMF voltage.

The timing of the different functions during braking is as follows:

- The motor contactor is switched off and disconnects the motor.
- After elapse of the safety time, the brake contactor is energized and shortly after that the brake current is switched on for the adjusted braking time.
**Indicators BN 9034**

LED „ready“: On, when supply voltage connected flashing, when braking current is adjusted too high.

LED „I“: On, when braking current is flowing.

### Notes

For optimum braking effect, the braking current should be 1.8 ... 2 times the nominal motor current. This current corresponds to the necessary saturation current of the magnetic field needed for braking. Higher currents show not much more effect, but will heat up the motor. A better braking effect is achieved by using more than one motor winding for braking. The permitted braking ration relates to the braking current, the ambient temperature and the brake model.

**ATTENTION**

The terminal W or T3 serves as measuring input for the standstill monitoring, with 2.5 mm² max. cross section. With devices for > 40 A a fuse must be used to protect this connection wire at the point where the wire with smaller cross section is connected to the motor line. The choice of the fuse is suited to the used crossed section and serves the short circuit protection of the line.

### Technical Data

#### Nominal voltage [Uₕ]:

<table>
<thead>
<tr>
<th>Nom. frequency [Hz]</th>
<th>BN 9034</th>
<th>GB 9034</th>
</tr>
</thead>
<tbody>
<tr>
<td>50/60</td>
<td>400 V</td>
<td>400 V</td>
</tr>
</tbody>
</table>

**Motor power [kW] at 400 V:**

<table>
<thead>
<tr>
<th>BN 9034</th>
<th>GB 9034</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5</td>
<td>7.5</td>
</tr>
<tr>
<td>7.5</td>
<td>15</td>
</tr>
<tr>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td>22</td>
<td>55</td>
</tr>
<tr>
<td>55</td>
<td>110</td>
</tr>
<tr>
<td>110</td>
<td>160</td>
</tr>
</tbody>
</table>

**Max. adjustable braking current [A]:**

<table>
<thead>
<tr>
<th>BN 9034</th>
<th>GB 9034</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>200</td>
<td>600</td>
</tr>
</tbody>
</table>

**ED at max. braking current [%]:**

<table>
<thead>
<tr>
<th>BN 9034</th>
<th>GB 9034</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

**Fuse, superfast [A]:**

<table>
<thead>
<tr>
<th>BN 9034</th>
<th>GB 9034</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>200</td>
<td>600</td>
</tr>
</tbody>
</table>

**Braking voltage:**

<table>
<thead>
<tr>
<th>BN 9034</th>
<th>GB 9034</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC 0</td>
<td>230 V</td>
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</tbody>
</table>

**Max. braking time [s]:**

<table>
<thead>
<tr>
<th>BN 9034</th>
<th>GB 9034</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>320</td>
</tr>
</tbody>
</table>

**Back-EMF braking time delay:**

Selfoptimizing (100 ... 2500 ms)

**Connection diameter**

<table>
<thead>
<tr>
<th>BN 9034</th>
<th>GB 9034</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>16</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>35</td>
<td>M12</td>
</tr>
<tr>
<td>M12</td>
<td>M12</td>
</tr>
</tbody>
</table>

**Power consumption for electronic [VA]:**

6

**Contacts:**

2 NO contacts

6 A / AC 250 V

**Temperature range [°C]:**

0 ... + 45

**Storage temperature [°C]:**

- 25 ... + 75

**Degree of protection:**

IP 20

(25 A)

IP 20

(40 ... 600 A)

**Mounting:**

To 25 A mounting on DIN-rail

To 40 A screw fixing M5

**Weight [kg]:**

<table>
<thead>
<tr>
<th>BN 9034</th>
<th>GB 9034</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8</td>
<td>2.1</td>
</tr>
<tr>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>2.1</td>
<td>3.1</td>
</tr>
</tbody>
</table>
### Standard Type

**BN 9034** 25 A AC 400 V 50/60 Hz 15 s  
- Integrated braking contactor  
- Mounting on 35 mm DIN-rail  
- Width: 100 mm  

#### Variant

**GB 9034** 100 A AC 400 V 50/60 Hz  
- Screw fixing M5  
- Width: 110 mm  

#### Outputs BN 9034

- X5, X6: Interlock for monitor contactor  
- X16, X17: Standstill indication (option)  
- X7, X8: Fault indicating output  
- X11, X12: Control of Y-actor (option)  
- X12, X13: Control of Δ-actor (option)  

#### Inputs BN 9034

- Z3, Z4: Motor PTC  
- Z1, Z2: Braking interrupt  
- Z1, X3: 2. braking time  
- 6,7: Start of braking  

#### Setting facilities BN 9034

<table>
<thead>
<tr>
<th>Potentiometer</th>
<th>function</th>
<th>initial setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>braking current</td>
<td>left end of scale</td>
</tr>
<tr>
<td>t&lt;sub&gt;1&lt;/sub&gt;</td>
<td>braking time</td>
<td>middle of scale</td>
</tr>
<tr>
<td>n&lt;sub&gt;0&lt;/sub&gt;</td>
<td>standstill level</td>
<td>middle of scale</td>
</tr>
<tr>
<td>t&lt;sub&gt;2&lt;/sub&gt;</td>
<td>2. braking time</td>
<td>left end of scale</td>
</tr>
</tbody>
</table>

#### Outputs GB 9034

- 1, 2: External braking contactor  
- 3,34: Fault indication output  
- 43,44: Control of Y-actor (option)  
- 43,45: Control of Δ-actor (option)  
- 13,14: Standstill indication (option)  
- 13,24: Braking current too low (option)  

#### Set-up Procedure

The braking time cannot be set on the unit BN 9034. It is limited by the standstill detection. If the feedback input T3 is not connected to terminal W of the motor the standstill detection is disabled and the internal max. braking time of 15 s is valid. The GB 9034 allows to set different braking times and can be used for standstill depending as well as time depending braking function. More details are available in the operating manual.

With potentiometer I the braking current can be adjusted. With a current meter (true RMS) the current should be measured so that 2 times the braking current is not exceeded in order not to overheat the motor. The braking device cannot be overloaded, as it limits the current even on full potentiometer setting to the nominal current of the unit. This status is indicated by the flashing „ready“ LED.
Connection Example

for BN 9034 25 A

Connection Examples

for GB 9034 40 A, 60 A

for GB 9034 from 100 A
**MINISTART**

**Phase Controller**

IN 9017

---

- **Phase controller for resistive and motor load**
- for permanent power up to 300 W
- Interference suppression limit value class B
- LED indication
- Devices available in 3 versions:
  - IN 9017/100: with current interface 4 ... 20 mA and broken wire detection
  - IN 9017/200: with voltage interface 0 ... 10 V
  - IN 9017/211: with voltage interface 0 ... 10 V, $U_{\text{min}}$ adjustable, control input for max. output current
- Width: 53 mm

---

### Block Diagrams

#### IN 9017/100

- **Supply voltage**
- Phase gating control
- LED green: supply voltage is present
- LED yellow: at IN 9017/100:
  - permanent on, when control current $> 4$ mA
  - flashes 1 time, when control current $< 4$ mA
  - (cable break)
  - flashes 2 times, when mains frequency is outside limits

#### IN 9017/200

- **Supply voltage**
- Phase gating control
- LED green: supply voltage is present
- LED yellow: at IN 9017/200:
  - permanent on, when full voltage on motor is present
  - flashes 1 time, when phase gating is active
  - flashes 2 times, when mains frequency is outside limits
  - Permanent on, when full voltage on motor is present
  - flashes 1 time, when phase gating is active
  - flashes 2 times, when mains frequency is outside limits
  - flashes 3 times, when setpoint $< 3$ volt and Q1, Q2 are open

#### IN 9017/211

- **Supply voltage**
- Phase gating control
- LED green: supply voltage is present
- LED yellow: at IN 9017/211:
  - permanent on, when control current $> 4$ mA
  - flashes 1 time, when control current $< 4$ mA
  - (cable break)
  - flashes 2 times, when mains frequency is outside limits
  - Permanent on, when full voltage on motor is present
  - flashes 1 time, when phase gating is active
  - flashes 2 times, when mains frequency is outside limits
  - flashes 3 times, when setpoint $< 3$ volt and Q1, Q2 are open

---

### Approvals and Markings

- **CE**

---

**Application**

- Resistive load
- Infrared heating
- Fan
- Volume compressor

---

**Function**

Phase controllers robust electronic units to control the voltage by phase chopping. The Phase chopping angle is adjusted on a control input. (IN 9017/100: 4 ... 20 mA, IN 9017/200: 0 ... 10 V) verstellt.

The variant IN 9017/211 is realised with 0...10V input and voltfree contact input Q1, Q2.

When contact input Q1, Q2 is open the output remains off at 0-3 V. With 3V control voltage the voltage adjusted on potentiometer $U_{\text{min}}$ is switched on. When rising the control voltage continuously up to 10 V on the input, the output voltage increases up to AC 230 V. By closing the contact on Q1,Q2 the the output supplies the max. voltage.
Notes
If the power semiconductor should be protected against short circuit or ground fault during operation a superfast fuse needs to be installed (see technical details). If not the standard line protection fuses must be used. The phase controller must not be operated with capacitive load on the output. To provide safety for people and equipment, only trained staff must work on this unit.

Technical Data
Motor voltage
IN 9017/100: AC 48 V ±10 %
IN 9017/100: AC 115 V ±10 %
IN 9017/100: AC 230 V ±10 %
IN 9017/200: AC 115 V ±10 %
IN 9017/200: AC 230 V ±10 %
IN 9017/211: AC 230 V ±10 %
Nominal frequency: 50 / 60 Hz
Setting range output voltage
IN 9017/100: AC 12 ... 36 V
IN 9017/100: AC 29 ... 86 V
IN 9017/200: AC 20 ... 115 V
IN 9017/211: AC 80 ... 200 V
Min. power: approx. 0.1 P_n
Rated current: 1.3 A
Semiconductor fuse (superfast): 20 A

Control input
IN 9017/100: 4 ... 20 mA R_i = 82.5
IN 9017/200: 0 ... 10 V R_i = 50 k

General Data
Nominal operating mode: continuous operation
Temperature range: -25 ... +75 °C
Storage temperature: -25 ... +75 °C
Clearance and creepage distance
Rated impulse voltage / pollution degree: 4 kV / 3 IEC 60 664-1
EMC Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2
Fast transients: 2 kV IEC/EN 61 000-4-3
Surge voltage between wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 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 VO behaviour according to UL subject 94
Vibration resistance: Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 682-6
Climate resistance: 0 / 055 / 04 IEC/EN 60 068-1
Terminal designation: EN 50 005
Wire connection: 2 x 2.5 mm² solid or 2 x 1.5 mm² stranded wire with sleeve DIN 46 228-1/3-3/4
Wire fixing: Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
Mounting: DIN-rail IEC/EN 60 715
Weight: 210 g

Dimensions
Width x height x depth: 53 x 90 x 61 mm

Standard Types
IN 9017/100 AC 48 V 75 W
IN 9017/100 AC 115 V 150 W
IN 9017/100 AC 230 V 300 W
IN 9017/200 AC 115 V 150 W
IN 9017/200 AC 230 V 300 W
IN 9017/211 AC 230 V 300 W

Set-up Procedure
1. Wiring of the component according to connection example
2. Adjust required output voltage

Safety remarks
- Never clear fault when the device is switched on
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- After disconnection of the device dangerous voltages may be sensed for several minutes on the connection terminals caused by filter capacitors.

Attention: This device can be started by potential-free contact, while connected directly to the mains without contactor. Please note, that the load is not physically separated from the mains. Because of this the load must be disconnected from the mains via the corresponding manual motor starter.

Control Characteristics
### Application

- Speed control of fans and pumps.
- Speed control only works if the torque of the driven load rises with a quadratic function relative to the speed. Usually this is given with fans and pumps.

### Function

Speed controllers are electronic devices designed to enable the speed control of 3-phase induction motors. The SX 9240 is a phase chopper device based on a thyristor circuit. The control input "Kickstart", bridge X7-X8, allows to ramp up the motor voltage to nominal value after start. After that the voltage is ramped down again to the required value with corresponding speed. The speed adjustment is made by a potentiometer on the front or by an external 0 ... 10 V input. The adjustment with the higher setting will take the control of the voltage/speed.

### Temperature sensing

The temperature of the power semiconductors are monitored. If the permitted highest temperature is exceeded, motor, relay 1 and relay 2 are switched off. The red LED flashes code 1. This Alarm can only be reset after cooling down the device and temporarily cutting the auxiliary supply of the unit.

### Motor temperature monitoring

A thermistor can be connected to terminals X 9 - X 10. If the permitted motor temperature is exceeded the motor, relay 1 and relay 2 are switched off. The red LED flashes code 4. The unit remains in fault status until the failure is removed and the power supply is switched off and on again. If no thermistor is connected, X 9 - X 10 must be bridged.

### Adjustment of \( U_{\text{min}} \) and \( U_{\text{max}} \)

With the potentiometers \( U_{\text{min}} \) and \( U_{\text{max}} \) the speed setting can be limited to a certain minimum and a maximum speed. The potentiometers are accessible behind a screw cover on the front of the unit.

On 230 V units the minimum voltage can be adjusted between 25 V\(_\text{rms}\) and 140 V\(_\text{rms}\) and the maximum voltage between 140 V\(_\text{rms}\) and 230 V\(_\text{rms}\).
**Function**

**ON-OFF switch**
The ON-OFF switch is not edge triggered. If the switch is in position ON, the motor will start after the voltage is connected.

**Frequency test**
When the unit is connected to voltage, the frequency is measured. If the frequency is out of the permitted limits 50/60 Hz ± 10 %, relay 1 and relay 2 are switched off. The red LED flashes code 2. The unit remains in fault status until the failure is removed and the power supply is switched off and on again.

**Relay function**
Relay 1 (11-12-14): Energises when the unit is switched on and de-energises when the unit is switched off or goes into failure mode.
Relay 2 (21-22-24): Energises when the unit is switched on and de-energises when the unit is switched off or goes into failure mode.

**Connection Diagrams**

- **SX 9240.01/0_005**
- **SX 9240.01/0_015**
- **SX 9240.01/2_005**

**Indication**
- green LED: On, when supply connected
- yellow LED: On, when motor connected to supply voltage
- red LED: flashing code 1: power semiconductors overheated
- flashing code 2: wrong mains frequency
- flashing code 3: motor overtemperature

**Notes**

**Protection against short circuit**
It is recommended to use superfast semiconductor fuses to protect the speed controller in the case of short circuits on the output side.

**Thermal protection**
The speed controllers are designed to operate motors up to the nominal load. To protect the motor against thermal overload a thermal overload device, a motor protection device or thermistor motor protection is required.

To select the right motor the following instructions must be observed: Between 0.6 and 1.0 of the nominal speed the current could be rise up to 50 % higher than the nominal current. This effect is caused by the voltage control. To avoid overheating of the motor it must be declassified. I.e. a 3.3 kW motor can only loaded up to 2.2 kW. In spite of this measure a higher temperature cannot be avoided. Because of this the motor should be of isolation class F or H. In addition the windings should be monitored by means of a thermal contact or thermistor for over temperature.

**Block Diagram**

**Connection Diagrams**

- SX 9240.01/0_005
- SX 9240.01/0_015
- SX 9240.01/2_005

**Notes**

Motor noise
When the motor is running on low speed resonance can cause noise that may be disturbing.

**Technical Data**

**Phase / motor voltage:**
- L - N: AC 230 V ± 10 %

**Nominal frequency:**
- 50 / 60 Hz

**Motor power**

<table>
<thead>
<tr>
<th>Type</th>
<th>SX 9240.01/01005</th>
<th>SX 9240.01/02005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>heat sink</strong></td>
<td>without</td>
<td>22.5 mm</td>
</tr>
<tr>
<td><strong>power loss</strong></td>
<td>5 W</td>
<td>12 W</td>
</tr>
<tr>
<td><strong>Nominal current</strong></td>
<td>5.0 A</td>
<td>11.5 A</td>
</tr>
<tr>
<td><strong>at ( \theta _1 = 40 ) °C:</strong></td>
<td>continuous operation</td>
<td>continuous operation</td>
</tr>
</tbody>
</table>

**Ramping cycle**

| Min. motor power    | 0.2 A            |
| Ramp up time after  | 7.5 s            |
| Kickstart:          |                   |
| Hold time after Kickstart: | 1 s            |
| Ramp down time after |                   |
| Kickstart:          | max. 7.5 s       |
| Kickstart voltage:  | AC 230 V         |
| Power consumption:  | 1.2 W            |
Technical Data

Relay contacts
Thermal continuous current Ith: 5 A

Switching capacity to AC 15
NO contacts: 3 A / 230 V IEC/EN 60 947-5-1
NC contacts: 1 A / 230 V IEC/EN 60 947-5-1

Semiconductor fuse: 1800 A 2 s

External control input:
Reference voltage: 10 V / 15 mA
Input impedance: 20 kΩ

Input impedance:
Reference voltage: 10 V / 15 mA
Setting potentiometer: 22 kΩ

Input impedance:
Reference voltage: 10 V / 15 mA
Setting potentiometer: 22 kΩ

Thermistor input NC contact, switching voltage: 24 V

Ramp time: approx. 5 sec from min. speed to max. speed or max. speed to min. speed

Variation of motor voltage at AC 230 V:
25 Veff ... 230 Veff

General Data

Temperature range: 0 ... + 40°C
(If the temperature (20 ... 60°C) exceeds the a. m. range the nominal current can be increased by 2 % / °C on lower temperature or must be decreased by 2 % / °C on higher temperature.)

Storage temperature: - 25 ... + 75°C

Clearance and creepage distances
rated impulse voltage / pollution degree
Control voltage to motor voltage:
Auxiliary voltage to motor voltage:
EMC
Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2
HF-irradiation: 10 V / m IEC/EN 61 000-4-3
Fast transients: 2 kV IEC/EN 61 000-4-4
Surge voltages between wire for power supply:
Interference suppression:
Limit value class B EN 55 011
Radiated interference:
Limit value class B EN 55 011
Degree of protection: IP 65 IEC/EN 60 529
Vibration resistance: Amplitude 0,35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6
Climate resistance: 0 / 055 / 04 IEC/EN 60 068-1
Terminal designation:
EN 50 005
Wire connection
Load terminals:
4 mm² solid, or
2.5 mm² stranded
Control terminals:
1.5 mm² stranded
Relay terminals: 2.5 mm² stranded

Net weight:
5.0 A: 1280 g
11.5 A: 1500 g

Dimensions
Width x height x depth:
5 A: 100 x 160 x 165 mm
11.5 A: 122 x 160 x 165 mm

Standard Types
SX 9240.01/01005
Article number 0058991
1.) 1-pole
2.) for motor currents up to 5 A
3.) with EMC-filter, Housing, ON/OFF switch and setting potentiometer
4.) without heat sink
5.) Control input for 0 ... 10 V
6.) Thermistor input
7.) with internal transformer
8.) 100 mm width

Variants
Ordering example for variants
SX 9240 .01 / _ _ _ _ _
0: without special function
4: Adjustment potentiometers Umin, Umax
5: Thermistor, adjustment potentiometers Umin, Umax
0: Internal supply AC 230 V
1: External supply AC 20 V, DC 24 V
2.) 1: 5.0 A
3: 11.5 A
1: 0: with EMC-filter, housing, ON/OFF switch and setting potentiometer
2: 0: without EMC-filter, housing, ON/OFF switch and setting potentiometer
3: 1: with EMC-filter, without housing, ON/OFF switch and setting potentiometer
2: 0: without EMC-filter, without housing, ON/OFF switch and setting potentiometer

Set-up Procedure
1.) Open enclosure. Connect device and motor according to circuit diagram.
2.) Remove bridge X8 / X7 when "Kickstart" is not required.
3.) Close enclosure and apply auxiliary voltage.
4.) Start unit with ON/OFF switch.
5.) Turn speed setting potentiometer fully anticlockwise. Adjust Umin potentiometer high enough, so that the motor starts. A humming motor at standstill should be avoided inorder not to heat up the motor unnecessarily. Turn speed setting potentiometer fully clockwise. Adjust Umax potentiometer until the required max. speed is reached. The motor temperature should be checked on low and medium speed. If necessary the motor must be cooled.

Safety Instructions
- Never clear fault when the device is switched on.
Attention: This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains via the corresponding manual motor starter.
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments, e.g. adjustment of Umin, Umax may only be carried out by qualified specialist staff and the applicable safety rules must be observed. Wiring and disconnection work must only be made when the unit is isolated from the mains.
- After disconnection of the device dangerous voltages may be sensed for several minutes on the connection terminals caused by filter capacitors.
Application Example

Kickstart thermistor

0...10V relay 1 relay 2

SX9240

M8320
• According to IEC/EN 60 947-1, IEC/EN 60 947-4-2
• For speed control of 3-phase asynchronous motors up to 5.5 kW
• Speed adjustment by potentiometer on the front
• Additional galvanic separated control input for external speed control 0 ... 10 V, 0 ... 20 mA, 4 ... 20 mA
• U_{\text{min}} and U_{\text{max}} setting accessible behind screw cover
• Large motor voltage range
• Integrated temperature monitoring
• Fullfills the EMC requirement according to IEC/EN 61 000-6-4 limit class B, therefore screened wires are not necessary between motor and controller
• 2 changeover monitoring contacts
• LED indicators for alarm and status
• Connection for thermistor to monitor temperature
• 100 mm, 122 mm and 168 mm width

**Function**

Speed controllers are electronic devices designed to enable the speed control of 3-phase induction motors. The SX 9240 is a phase chopper device based on a thyristor circuit. The control input "Kickstart", bridge X7-X8, allows to ramp up the motor voltage to nominal value after start. After that the voltage is ramped down again to the required value with corresponding speed. The speed adjustment is made by a potentiometer on the front or by an external 0 ... 10 V input. The adjustment with the higher setting will take the control of the voltage/speed.

**Temperature sensing**

The temperature of the power semiconductors are monitored. If the permitted highest temperature is exceeded, motor, relay 1 and relay 2 are switched off. The red LED flashes code 1. This Alarm can only be reset after cooling down the device and temporarily cutting the auxiliary supply of the unit.

**Motor temperature monitoring**

A thermistor can be connected to terminals X 9 - X 10. If the permitted motor temperature is exceeded the motor, relay 1 and relay 2 are switched off. The motor cools down and the power supply is switched off and on again. If no thermistor is connected, X 9 - X 10 must be bridged.

**Adjustment of U_{\text{min}} and U_{\text{max}}**

With the potentiometers U_{\text{min}} and U_{\text{max}} the speed setting can be limited to a certain minimum and a maximum speed. The potentiometers are accessible behind a screw cover on the front of the unit.

On 400 V units the minimum voltage can be adjusted between 110 V_{\text{rms}} bis 160 V_{\text{rms}} and the maximum voltage between 160 V_{\text{rms}} bis 400 V_{\text{rms}}.

**Phase monitoring L1, L2, L3**

The phases L1, L2 and L3 are monitored internally. If one of the 3 phases fails, motor, relay 1 and relay 2 are switched off. The red LED flashes code 3. The unit remains in fault status until the failure is removed and the power supply is switched off and on again. If 2 or 3 phases fail, the unit is no longer supplied. All LEDs go off, the relays de-energise and the motor is switched off.
**Function**

**Phase sequence monitoring**
For normal operation a right sequence is necessary. If wrong sequence is detected, the unit goes into failure mode. The red LED flashes code 6. The unit remains in fault status until the failure is removed and the power supply is switched off and on again.

**ON-OFF switch**
The ON-OFF switch is not edge triggered. If the switch is in position ON, the motor will start after the voltage is connected.

**Frequency test**
When the unit is connected to voltage, the frequency is measured. If the frequency is out of the permitted limits 50/60 Hz ± 10 %, relay 1 and relay 2 are switched off. The red LED flashes code 2. The unit remains in fault status until the failure is removed and the power supply is switched off and on again.

**Relay function**
Relay 1 (11-12-14): Energises when the unit is switched on and de-energises when the unit is switched off or goes into failure mode.
Relay 2 (21-22-24): Energises when the unit is switched on and de-energises when the unit is switched off or goes into failure mode.

**Connection Diagrams**

![Connection Diagrams](image-url)
**Indication**

- green LED: On, when supply connected
- yellow LED: On, when motor connected to supply voltage
- red LED: flashing code 1: power semiconductors overheated
  - flashing code 2: wrong mains frequency
  - flashing code 3: phase failure
  - flashing code 4: motor overtemperature
  - flashing code 6: wrong phase sequence

**Notes**

**Protection against short circuit**
It is recommended to use superfast semiconductor fuses to protect the speed controller in the case of short circuits on the output side.

**Thermal protection**
The speed controllers are designed to operate motors up to the nominal load. To protect the motor against thermal overload a thermal overload device, a motor protection device or thermistor motor protection is required.

To select the right motor the following instructions must be observed: Between 0.6 and 1.0 of the nominal speed the current could be rise up to 50 % higher than the nominal current. This effect is caused by the voltage control. To avoid overheating of the motor it must be declassified. I.e. a 3.3 kW motor can only loaded up to 2.2 kW. In spite of this measure a higher temperature cannot be avoided. Because of this the motor should be of isolation class F or H. In addition the windings should be monitored by means of a thermal contact or thermistor for overtemperature.

**Motor noise**
When the motor is running on low speed resonance can cause noise that may be disturbing.

**Technical Data**

<table>
<thead>
<tr>
<th>Type</th>
<th>SX 9240.03/00005</th>
<th>SX 9240.03/01005</th>
<th>SX 9240.03/02005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase / motor voltage:</td>
<td>3 AC 400 V ± 10 %</td>
<td>3 AC 400 V ± 10 %</td>
<td>3 AC 400 V ± 10 %</td>
</tr>
<tr>
<td>Nominal frequency:</td>
<td>50 / 60 Hz</td>
<td>50 / 60 Hz</td>
<td>50 / 60 Hz</td>
</tr>
<tr>
<td>Motor power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type sink</td>
<td>without</td>
<td>22.5 mm</td>
<td>67.5 mm</td>
</tr>
<tr>
<td>Heat sink</td>
<td>10 W</td>
<td>20 W</td>
<td>50 W</td>
</tr>
<tr>
<td>Power loss</td>
<td>2.5 A</td>
<td>5.0 A</td>
<td>11.5 A</td>
</tr>
<tr>
<td>Nominal current at $\vartheta_u = 40^\circ C$:</td>
<td>continuous</td>
<td>continuous</td>
<td>continuous</td>
</tr>
<tr>
<td>Switching cycle</td>
<td>operation</td>
<td>operation</td>
<td>operation</td>
</tr>
<tr>
<td>Min. motor power:</td>
<td>0.2 W</td>
<td>0.2 W</td>
<td>0.2 W</td>
</tr>
<tr>
<td>Ramp up time after Kickstart:</td>
<td>7.5 s</td>
<td>7.5 s</td>
<td>7.5 s</td>
</tr>
<tr>
<td>Hold time after Kickstart:</td>
<td>1 s</td>
<td>1 s</td>
<td>1 s</td>
</tr>
<tr>
<td>Ramp down time after Kickstart:</td>
<td>7.5 s</td>
<td>7.5 s</td>
<td>7.5 s</td>
</tr>
<tr>
<td>Kickstart voltage:</td>
<td>AC 400 V</td>
<td>AC 400 V</td>
<td>AC 400 V</td>
</tr>
<tr>
<td>Power consumption:</td>
<td>1.2 W</td>
<td>1.2 W</td>
<td>1.2 W</td>
</tr>
<tr>
<td>Relay contacts</td>
<td>Thermal continuous current $i_T$:</td>
<td>5 A</td>
<td>5 A</td>
</tr>
<tr>
<td>Switching capacity to AC 15:</td>
<td>NO contacts:</td>
<td>3 A / 230 V</td>
<td>IEC/EN 60 947-5-1</td>
</tr>
<tr>
<td></td>
<td>NC contacts:</td>
<td>1 A / 230 V</td>
<td>IEC/EN 60 947-5-1</td>
</tr>
<tr>
<td>Semiconductor fuse:</td>
<td>25 A superfast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External control input:</td>
<td>0 ... + 10 V, 0 ... 20 mA</td>
<td>0 ... + 10 V, 0 ... 20 mA</td>
<td>0 ... + 10 V, 0 ... 20 mA</td>
</tr>
<tr>
<td>Input impedance:</td>
<td>20 kΩ</td>
<td>82.5 kΩ</td>
<td>82.5 kΩ</td>
</tr>
<tr>
<td>Reference voltage:</td>
<td>10 V / 15 mA</td>
<td>10 V / 15 mA</td>
<td>10 V / 15 mA</td>
</tr>
<tr>
<td>Setting potentiometer:</td>
<td>22 kΩ</td>
<td>22 kΩ</td>
<td>22 kΩ</td>
</tr>
<tr>
<td>Input impedance:</td>
<td>20 kΩ</td>
<td>20 kΩ</td>
<td>20 kΩ</td>
</tr>
<tr>
<td>Thermistor input</td>
<td>NC contact, switching voltage:</td>
<td>24 V</td>
<td>24 V</td>
</tr>
<tr>
<td>Input impedance:</td>
<td>50 kΩ</td>
<td>50 kΩ</td>
<td>50 kΩ</td>
</tr>
</tbody>
</table>

**Technical Data**

| Ramp time: | approx. 5 sec from min. speed to max. speed or max. speed to min. speed |
| Variation of motor voltage at AC 400 V | SX 9240.03/0005: 110 $V_{st}$ ... 400 $V_{st}$ |

**General Data**

| Temperature range: | 0 ... + 40°C |
| Variation of motor voltage at AC 400 V | SX 9240.03/0005: 110 $V_{st}$ ... 400 $V_{st}$ |

| Temperature range: | -25 ... + 75°C |
| Interference: | Limit value class B |
| Radiated interference: | EN 55 011 |
| Degree of protection: | IP 65 |
| Vibration resistance: | EN 60 529 |
| Climate resistance: | EN 50 005 |
| Terminal designation: | EN 60 068-1 |
| Wire connection | Load terminals: 4 mm² solid, or 2.5 mm² stranded |
| | Control terminals: 1.5 mm² stranded |
| | Relay terminals: 2.5 mm² stranded |
| Net weight: | 2.5 A: 1280g |
| | 5.0 A: 1500 g |
| | 11.5 A: 1680 g |

**Dimensions**

<p>| Width x height x depth: | 2.5 A: 100 x 160 x 165 mm |
| | 5.0 A: 122 x 160 x 165 mm |
| | 11.5 A: 168 x 160 x 165 mm |</p>
<table>
<thead>
<tr>
<th>Standard Types</th>
<th>Variants</th>
</tr>
</thead>
<tbody>
<tr>
<td>SX 9240.03/01005</td>
<td>Article number 0059141</td>
</tr>
<tr>
<td>- 3-pole</td>
<td></td>
</tr>
<tr>
<td>- for motor currents up to 5 A</td>
<td></td>
</tr>
<tr>
<td>- with EMC-filter, Housing, ON/OFF switch and setting potentiometer</td>
<td></td>
</tr>
<tr>
<td>- with heat sink 22.5 mm</td>
<td></td>
</tr>
<tr>
<td>- Control input for 0 ... 10 V</td>
<td></td>
</tr>
<tr>
<td>- Thermistor input</td>
<td></td>
</tr>
<tr>
<td>- with internal transformer</td>
<td></td>
</tr>
<tr>
<td>- 122 mm width</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SX 9240.03/02005</th>
<th>Article number 0057511</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 3-pole</td>
<td></td>
</tr>
<tr>
<td>- for motor currents up to 11.5 A</td>
<td></td>
</tr>
<tr>
<td>- with EMC-filter, Housing, ON/OFF switch and setting potentiometer</td>
<td></td>
</tr>
<tr>
<td>- with heat sink 67.5 mm</td>
<td></td>
</tr>
<tr>
<td>- Control input for 0 ... 10 V</td>
<td></td>
</tr>
<tr>
<td>- Thermistor input</td>
<td></td>
</tr>
<tr>
<td>- with internal transformer</td>
<td></td>
</tr>
<tr>
<td>- 168 mm width</td>
<td></td>
</tr>
</tbody>
</table>

**Set-up Procedure**

1. Open enclosure. Connect device and motor according to circuit diagram.
2. Remove bridge X8 / X7 when *Kickstart* is not required.
3. Close enclosure and apply auxiliary voltage.
4. Start unit with ON/OFF switch.
5. Turn speed setting potentiometer fully anticlockwise. Adjust $U_{\text{max}}$ potentiometer high enough, so that the motor starts. A humming motor at standstill should be avoided inorder not to heat up the motor unnecessarily. Turn speed setting potentiometer fully clockwise. Adjust $U_{\text{max}}$ potentiometer until the required max. speed is reached. The motor temperature should be checked on low and medium speed. If necessary the motor must be cooled.

**Safety Instructions**

- Never clear fault when the device is switched on.
- **Attention:** This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains via the corresponding manual motor starter.

- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments, e.g. adjustment of $U_{\text{min}}$, $U_{\text{max}}$ may only be carried out by qualified specialist staff and the applicable safety rules must be observed. Wiring and disconnection work must only be made when the unit is isolated from the mains.
- After disconnection of the device dangerous voltages may be sensed for several minutes on the connection terminals caused by filter capacitors.

**Application Example**

```
L1
L2
L3

Q1

M

0...10V
0...20mA
4...20mA

Relais 1 Relais 2
```

```
SX9240
```

```
M8916_a
```
The smart motor starter UG 9410 can be used for soft start, soft stop, reversing and protecting 3-phase asynchronous motors. By measuring the line current a thermal model is used to calculate the motor temperature, and in the case of overtemperature the motor is disconnected. In addition also a thermo switch can be used. The reversing is done via relays. The relays are switched without current flow, this provides long service life.

**Your Advantages**
- Widely used measuring and automation protocol
- Up to 7 functions in one device
  - Reversing anticlockwise
  - Reversing clockwise
  - Softstart
  - Softstop
  - Motor protection
  - Phase sequence monitoring
  - Phase failure monitoring
- 80% less space
- Simple and time-saving commissioning as well as user-friendly
- Operation through parameterization via modbus
- Blocking protection
- Hybrid relay combines benefits of relay technology with non-wearing semiconductor technology
- High availability by
  - Temperature monitoring of semiconductors
  - High withstand voltage up to 1500 V
  - Load free relay reversing function
  - Device overload
- Pluggable clamps
- TWIN-connection terminals to loop auxiliary supply and Bus

**Features**
- According to IEC/EN 60 947-4-2
- Modbus RTU-interface
- To reverse 3-phase motors up to 0.18 kW ... 2.2 kW at 400 V
- 2-phase soft start, soft stop
- 3 potentiometer for setting the modbus address and baud rate
- 5 LEDs for status indication
- Reversing with relays without current, soft start, soft stop with thyristor
- Galvanic separation between control circuit and power circuit
- Width: 22.5 mm

**Applications**
- Reversing operation for door and gate controls, bridge drives and lifting applications with monitoring of blockage
- Conveyor systems with monitoring of blockage
- Actuating drives in process controls with blockage monitoring
Softstart
2 motor phases are controlled using thyristors, so that the motor current rises continuously. The starting torque behaves in the same way. This provides shock free starting and reduces mechanical failures. Starting time and starting voltage can be adjusted via Modbus.

Softstop
2 motor phases are controlled using thyristors, so that the motor current drops continuously. The motor torque behaves in the same way on rundown. This provides shock free stopping and reduces mechanical failures. Stopping time and stopping voltage can be adjusted via Modbus.

Motor protection
The thermal load of the motor is calculated using a thermal model. The current is measured in phase T3. A symmetric current load of all 3 phases of the motor is assumed for flawless functioning. When the trigger value – stored in the trigger characteristics – is reached, the motor is switched off and the device switches to fault 8. The fault and motor leading can be acknowledged via Modbus.

Attention: The data of the thermal model is cleared through reset. In this case, the user must provide adequate cooling time of the motor.

Phase sequence detection
For correct function of the unit a clockwise phase sequence is required. The phase sequence monitoring feature checks on power up the sequence of the connected voltage and signals on anticlockwise sequence the fault 3. This fault can be cleared via Modbus.

Phase failure monitoring
After connecting the auxiliary supply, the unit checks if all 3 phases are correct. If one or more phases are missing, the unit indicates fault 4. This fault can be reset via Modbus.

Connection Terminals

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 (+)</td>
<td>Auxiliary voltage + DC 24 V</td>
</tr>
<tr>
<td>A2</td>
<td>Auxiliary voltage 0 V</td>
</tr>
<tr>
<td>A</td>
<td>Modbus signal A</td>
</tr>
<tr>
<td>B</td>
<td>Modbus signal B</td>
</tr>
<tr>
<td>L1</td>
<td>Phase voltage L1</td>
</tr>
<tr>
<td>L2</td>
<td>Phase voltage L2</td>
</tr>
<tr>
<td>L3</td>
<td>Phase voltage L3</td>
</tr>
<tr>
<td>T1</td>
<td>Motor connection T1</td>
</tr>
<tr>
<td>T2</td>
<td>Motor connection T2</td>
</tr>
<tr>
<td>T3</td>
<td>Motor connection T3</td>
</tr>
</tbody>
</table>

Function

Indicators

green LED "On": permanent on - supply connected
red LED "ERR": flashing - Failure code of the device
yellow LED "Bus": flashing - When receiving or transmitting Modbus data
yellow LED "L": permanent on flashing - Motor turns anti-clockwise softstart or softstop active on anti-clockwise turn
yellow LED "R": permanent on flashing - Motor turns clockwise softstart or softstop active on clockwise turn

Failure code: 1 - Overtemperature on semiconductors 2 - Wrong mains freqency 3 - Phase reversal detected 4 - Phase failure detected 7 - Incorrect temperature measurement circuit 8 - Motor protection has responded 9 - Modbus communication failure 10 - Checksum failure EEPROM 1*l - 10*l = Number of flashing pulses in sequence

Reset Function
By sending a reset command a reset can be operated via Modbus

Modbus RTU
For communication between motor controller and a supervising control the Modbus RTU protocol according to Specification V 1.1b3 is used.

Setting

![Connection Terminals Diagram]

<table>
<thead>
<tr>
<th>Position</th>
<th>Potentiometer BAUD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1200</td>
</tr>
<tr>
<td>2</td>
<td>2400</td>
</tr>
<tr>
<td>3</td>
<td>4800</td>
</tr>
<tr>
<td>4</td>
<td>9600</td>
</tr>
<tr>
<td>5</td>
<td>19200</td>
</tr>
<tr>
<td>6</td>
<td>38400</td>
</tr>
<tr>
<td>7</td>
<td>57600</td>
</tr>
<tr>
<td>8</td>
<td>115200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Baud rate</th>
<th>Response Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td>&lt; 50 ms</td>
</tr>
<tr>
<td>2400</td>
<td>&lt; 25 ms</td>
</tr>
<tr>
<td>4800</td>
<td>&lt; 12 ms</td>
</tr>
<tr>
<td>9600</td>
<td>&lt; 10 ms</td>
</tr>
<tr>
<td>19200</td>
<td>&lt; 5 ms</td>
</tr>
<tr>
<td>38400</td>
<td>&lt; 5 ms</td>
</tr>
<tr>
<td>57600</td>
<td>&lt; 5 ms</td>
</tr>
<tr>
<td>115200</td>
<td>&lt; 5 ms</td>
</tr>
</tbody>
</table>
Technical Data

Nominal voltage L1/L2/L3: 3 AC 200 ... 480 V ±10%
Nominal frequency: 50 / 60 Hz, automatic detection
Auxiliary voltage: DC 24 V ±10%
Motor power: 0.5 A ... 5.0 A adjustable via Modbus
Operating mode
5.0 A: AC 53a: 6-2: 100-30 IEC/EN 60947-4-2
Surge current: 200 A (tp = 20 ms)
Load limit integral: 200 A/s (tp = 10 ms)
Peak reverse voltage: 1500 V
Overvoltage limiting: AC 510 V
Leakage current in off state: < 3 x 0.5 mA
Start / deceleration voltage: 30 ... 80 % adjustable via Modbus
Start / deceleration ramp: 0 ... 10 s adjustable via Modbus
Release delay for master tick: min. 30 ms
Current measurement: AC 0.5 ... 30 A
Measuring accuracy: ± 5% of end of scale value
Measuring value update time
at 50 Hz: 100 ms
at 60 Hz: 83 ms
Motor protection
up to 5.0 A: Class 10 A
Electronically, with thermal memory
Reset: manual via Modbus
Short circuit strength
max. fuse rating: 25 A gG / gL IEC/EN 60 947-5-1

General Data

Operating mode: Continuous operation
Operation: 0 ... + 65 °C (see derating curve)
Storage: - 40 ... + 70 °C
Relative air humidity: 93 % at 40 °C
Altitude: < 1.000 m
Clearance and creepage distances rated impuls voltage / pollution degree
Motor voltage- control voltage: 6 kV / 2 IEC 60 664-1
Motor voltage- Modbus: 6 kV / 2 IEC 60 664-1
Overvoltage category: III
EMC
Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2
HF-irradiation 80 MHz ... 1.0 GHz: 10 V / m IEC/EN 60 664-3
1.0 GHz ... 2.5 GHz: 3 V / m IEC/EN 60 664-3
2.5 GHz ... 2.7 GHz: 1 V / m IEC/EN 60 664-3
Fast transients: 2 kV IEC/EN 60 000-4-4
Surge voltages between wires for power supply: 1 kV IEC/EN 60 000-4-5
between wire and ground: 2 kV IEC/EN 60 000-4-5
HF wire guided: 10 V IEC/EN 60 000-4-6
Voltage dips: IEC/EN 60 664-4-11
Interference emission
Wire guided: Limit value class B IEC/EN 60 947-4-2
Radio irradiation: Limit value class B IEC/EN 60 947-4-2
Harmonics: EN 61 000-3-2
Degree of protection:
Housing: IP 40 IEC/EN 60 529
Terminals: IP 20 IEC/EN 60 529
Vibration resistance: Amplitude 0.35 mm
Climate resistance: Frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
Wire connection:
DIN 46 228-1/-2/-3/-4
Removable terminal blocks
Wire connection
Phase voltage and motor pluggable screw terminal (S): 0.25 ... 2.5 mm² solid or 0.25 ... 2.5 mm² stranded ferruled
Wire connection:
Bus and auxiliary supply pluggable Twin-cage-clamp-
terminal (PT): 0.25 ... 1.5 mm² solid or 0.25 ... 1.5 mm² stranded ferruled
Insulation of wires or sleeve length: 8 mm
Fixing torque: 0.5 ... 0.6 Nm

Technical Data

Mounting: DIN rail IEC/EN 60 715
Weight: 220 g

Dimensions

Width x height x depth: 22.5 x 105 x 120.3 mm

Standard Type

UG 9410PM 3 AC 200 ... 480 V 50/60 Hz 5.0 A
Article number: 0067521
• Nominal voltage: 3 AC 200 ... 480 V
• Nominal motor current: 5.0 A
• Modbus RTU
• Adjustable baud rate
• Width: 22.5 mm

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• Modbus RTU
• Adjustable baud rate
• Width: 22.5 mm

Characteristics
Motor control with UG 9410 and PLC via Modbus

**Potentiometer ADR10:** - Unit adress x 10
**Potentiometer ADR1:** - Unit adress x 1
**Potentiometer BAUD:** - Baud rate

The module address and baud rate is only read after connecting the auxiliary supply!

**Group fusing**

Several motor starters can be wired in parallel on the supply side. Please make sure, that the total current cannot exceed 16 A. If several starters are use together and require more than 16 A, groups have to be split up for max 16 A.

**Set-up Procedure**

1. Connect motor and device according to application example. The 3 phases must be connected in correct sequence, wrong phase sequence will lead to failure (see failure code)
2. Setting unit adress and baud rate via potentiometer.
3. Power up the unit.
4. Parametrization via Modbus
5. At correct setting, the motor should ramp up continuously to full speed.

**Safety Notes**

- Never clear a fault when the device is switched on

**Attention:** This device can be started directly on the phase voltage without a contactor. Please be aware that the motor is still connected to the supply voltage also when it is not running. Therefore for work on motor and controller the supply has to be disconnected via E-stop.

- The user must ensure that the device and the necessary component are mounted and connected according to the locally applicable regulations and technical standards (VDE, TÜV,BG).
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.
- Touch proof security is only provided when the power connection terminals are plugged into the unit.

---

**Application Example**

Motor control with UG 9410 and PLC via Modbus

**Bus Interface**

- **Protocol:** Modbus Seriel RTU
- **Adress:** 1 bis 99
- **Baud rate:** 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
- **Data bit:** 8
- **Stop bit:** 2
- **Parity:** none

More information about the interface, wiring rules, device identification and communication monitoring can be found in the Modbus user manual.

**Function-Codes**

At UG 9410 the following function codes are implemented:

<table>
<thead>
<tr>
<th>Function-Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x03</td>
<td>Read Holding Register</td>
<td>Device parameter read word by word</td>
</tr>
<tr>
<td>0x04</td>
<td>Read Input Register</td>
<td>Actual values read word by word</td>
</tr>
<tr>
<td>0x05</td>
<td>Write Single Coil</td>
<td>Outputs write individually</td>
</tr>
<tr>
<td>0x06</td>
<td>Write Single Register</td>
<td>Device parameter write word by word</td>
</tr>
<tr>
<td>0x10</td>
<td>Write Multiple Register</td>
<td>Device parameter write in blocks</td>
</tr>
</tbody>
</table>

**Device configuration**

If required the device configuration data can be saved permanently by setting the the Bit "WriteKonfig to EEPROM". The data is copied from the EEPROM to the relevant register when connecting the auxiliary voltage. As the numbers of write cycles of an EEPROM are limited, the writing must not be done in cycles. In addition it is not possible to receive modbus telegrams during a period of 50 ms while writing the EEPROM.
Every slave owns an output-configuration- and actual value table. In these tables it is defined under which address the parameters can be found.

### Single Coils (Control signals):

<table>
<thead>
<tr>
<th>Register-Adresse</th>
<th>Protocol-Adresse</th>
<th>Name</th>
<th>Value range</th>
<th>Description</th>
<th>Data type</th>
<th>Access rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>RunRight</td>
<td>0x0000 0xFF00</td>
<td>Motor turns right off</td>
<td>BIT write</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Motor turns right on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>RunLeft</td>
<td>0x0000 0xFF00</td>
<td>Motor turns left off</td>
<td>BIT write</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Motor turns left on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Reset</td>
<td>0x0000 0xFF00</td>
<td>No function</td>
<td>BIT write</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Device reset</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>WriteKonfig to EEPROM</td>
<td>0x0000 0xFF00</td>
<td>No function</td>
<td>BIT write</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Save parameter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Holding Register (Device configuration):

<table>
<thead>
<tr>
<th>Register-Adresse</th>
<th>Protocol-Adresse</th>
<th>Name</th>
<th>Value range</th>
<th>Description</th>
<th>Data type</th>
<th>Access rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>40001</td>
<td>0</td>
<td>Control word 1</td>
<td>0 … 2</td>
<td>Bit 0 = Reset Bit 1 = WriteKonfig to EEPROM</td>
<td>UINT16 write / reading</td>
<td></td>
</tr>
<tr>
<td>40002</td>
<td>1</td>
<td>Control word 2</td>
<td>0 … 2</td>
<td>Bit 0 = RunRight Bit 1 = RunLeft</td>
<td>UINT16 write / reading</td>
<td></td>
</tr>
<tr>
<td>40003</td>
<td>2</td>
<td>ie *)</td>
<td>50 … 500</td>
<td>Nominal motor current in 1/100 A</td>
<td>UINT16 write / reading</td>
<td></td>
</tr>
<tr>
<td>40004</td>
<td>3</td>
<td>Mon *)</td>
<td>30 … 80</td>
<td>Softstart voltage in % from nominal voltage</td>
<td>UINT16 write / reading</td>
<td></td>
</tr>
<tr>
<td>40005</td>
<td>4</td>
<td>Ton *)</td>
<td>0 … 100</td>
<td>Softstart ramp time in 1/10 Sec</td>
<td>UINT16 write / reading</td>
<td></td>
</tr>
<tr>
<td>40006</td>
<td>5</td>
<td>Moff *)</td>
<td>80 … 30</td>
<td>Softstop voltage in % from nominal voltage</td>
<td>UINT16 write / reading</td>
<td></td>
</tr>
<tr>
<td>40007</td>
<td>6</td>
<td>Toff *)</td>
<td>0 … 100</td>
<td>Softstop ramp time in 1/10 s</td>
<td>UINT16 write / reading</td>
<td></td>
</tr>
<tr>
<td>40008</td>
<td>7</td>
<td>Timeout release</td>
<td>0 … 1</td>
<td>0 = Disable 1 = Enable</td>
<td>UINT16 write / reading</td>
<td></td>
</tr>
<tr>
<td>40009</td>
<td>8</td>
<td>Timeout</td>
<td>0 … 10000</td>
<td>Timeout value in ms</td>
<td>UINT16 write / reading</td>
<td></td>
</tr>
</tbody>
</table>

*) Parameters can be stored permanently in the EEPROM by setting the Bit “WriteKonfig to EEPROM”

### Input Register (Device state and measuring values):

<table>
<thead>
<tr>
<th>Register-Adresse</th>
<th>Protocol-Adresse</th>
<th>Name</th>
<th>Value range</th>
<th>Description</th>
<th>Data type</th>
<th>Access rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>30001</td>
<td>0</td>
<td>State word 1</td>
<td>0 … 10</td>
<td>0: No failure 1: Overtemperature LT 2: Wrong freqency 3: Phase reversal 4: Phase failure 5: Motor blocked 6: 7: Temperatur circuit fault 8: Motor protection device actuated 9: Communication fault Modbus 10: Checksum failure EEPROM</td>
<td>UINT16 reading</td>
<td></td>
</tr>
<tr>
<td>30002</td>
<td>1</td>
<td>State word 2</td>
<td>0 … 6</td>
<td>0: Device initialize 1: Wait for start 2: Softstart ramp 3: Clockwise On 4: Anti-clockwise On 5: Softstop ramp 6: Device in errormode</td>
<td>UINT16 reading</td>
<td></td>
</tr>
<tr>
<td>30003</td>
<td>2</td>
<td>Actual motor current</td>
<td>0 … 3000</td>
<td>Actual motor current in 1/100 A</td>
<td>UINT16 reading</td>
<td></td>
</tr>
<tr>
<td>30004</td>
<td>3</td>
<td>Motor load</td>
<td>0 … 100</td>
<td>Motor load in % from rated motor power</td>
<td>UINT16 reading</td>
<td></td>
</tr>
</tbody>
</table>
Your Advantages
- Up to 6 functions in one device
  - Reversing anticlockwise,
  - Reversing clockwise
  - Softstart
  - Softstop
  - Motor protection
  - Phase failure monitoring
- Widely used measuring and automation protocol
- 80 % less space
- Simple and time-saving commissioning as well as user-friendly
- Operation through parameterization via modbus
- Blocking protection
- Hybrid relay combines benefits of relay technology with non-wearing semiconductor technology
- High availability by
  - Temperature monitoring of semiconductors
  - High withstand voltage up to 1500 V
  - Load free relay reversing function
  - Device overload
- Pluggable clamps
- TWIN- connection terminals to loop auxiliary supply and Bus

Features
- According to IEC/EN 60 947-4-2
- Modbus RTU-interface
  - To reverse 1-phase motors up to 50 ... 180 W or
  - 180 W ... 1.1 kW at 230 V
- 1-phase softstart, softstop
- 3 potentiometer for setting the modbus adress and baud rate
- 5 LEDs for status indication
- Reversing with relays without current, softstart, softstop with thyristor
- Galvanic separation between control circuit and power circuit
- Width: 22.5 mm

Approvals and Markings

Applications
- Reversing operation for door and gate controls, bridge drives and lifting applications with monitoring of blockage
- Conveyor systems with monitoring of blockage
- Actuating drives in process controls with blockage monitoring

Circuit Diagram
**Connection Terminals**

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 (+)</td>
<td>Auxiliary voltage DC 24 V</td>
</tr>
<tr>
<td>A2</td>
<td>Auxiliary voltage 0 V</td>
</tr>
<tr>
<td>A</td>
<td>Modbus signal A</td>
</tr>
<tr>
<td>B</td>
<td>Modbus signal B</td>
</tr>
<tr>
<td>L</td>
<td>Phase connection L</td>
</tr>
<tr>
<td>N</td>
<td>Neutral</td>
</tr>
<tr>
<td>T1</td>
<td>Motor connection T1</td>
</tr>
<tr>
<td>T2</td>
<td>Motor connection T2</td>
</tr>
<tr>
<td>T3</td>
<td>Motor connection T3</td>
</tr>
</tbody>
</table>

**Indicators**

- green LED "On": permanent on - supply connected
- red LED "ERR": flashing - Failure code of the device
- yellow LED "Bus": flashing - When receiving or transmitting Modbus data
- yellow LED "L": permanent on - Motor turns anti-clockwise
- yellow LED "R": permanent on - Motor turns clockwise

Failure code:
1 - Overtemperature on semiconductors
2 - Wrong mains frequency
4 - Phase failure detected
7 - Incorrect temperature measurement circuit
8 - Motor protection has responded
10 - Checksum failure EEPROM

1* - 10* = Number of flashing pulses in sequence

**Modbus RTU**

For communication between motor controller and a supervising control the Modbus RTU protocol according to Specification V 1.1b3 is used.

**Reset Function**

By sending a reset command a reset can be operated via Modbus

**Setting**

<table>
<thead>
<tr>
<th>Position Potentiometer</th>
<th>Potentiometer</th>
<th>Baud rate</th>
<th>Baud</th>
<th>Response Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAUD 1</td>
<td>1</td>
<td>1200</td>
<td>1200</td>
<td>&lt; 50 ms</td>
</tr>
<tr>
<td>BAUD 2</td>
<td>2</td>
<td>2400</td>
<td>2400</td>
<td>&lt; 25 ms</td>
</tr>
<tr>
<td>BAUD 3</td>
<td>3</td>
<td>4800</td>
<td>4800</td>
<td>&lt; 12 ms</td>
</tr>
<tr>
<td>BAUD 4</td>
<td>4</td>
<td>9600</td>
<td>9600</td>
<td>&lt; 10 ms</td>
</tr>
<tr>
<td>BAUD 5</td>
<td>5</td>
<td>19200</td>
<td>19200</td>
<td>&lt; 5 ms</td>
</tr>
<tr>
<td>BAUD 6</td>
<td>6</td>
<td>38400</td>
<td>38400</td>
<td>&lt; 5 ms</td>
</tr>
<tr>
<td>BAUD 7</td>
<td>7</td>
<td>57600</td>
<td>57600</td>
<td>&lt; 5 ms</td>
</tr>
<tr>
<td>BAUD 8</td>
<td>8</td>
<td>115200</td>
<td>115200</td>
<td>&lt; 5 ms</td>
</tr>
</tbody>
</table>
Technical Data

Nominal voltage L1/N: AC 230 V ± 10%
Nominal frequency: 50 / 60 Hz, automatic detection
Auxiliary voltage: DC 24 V ± 10%
Motor power: 1.5 A ... 7.0 A adjustable via Modbus
Operating mode: 7.0 A: AC 53a: 4-2: 100-30 IEC/EN 60947-4-2
Surge current: 200 A ( tp = 20 ms )
Peak reverse voltage: 1500 V
Overvoltage limiting: AC 510 V
Leakage current in off state: < 0.5 mA
Start / deceleration voltage: 30 ... 80 % adjustable via Modbus
Start / deceleration ramp: 0 ... 10 s adjustable via Modbus
Consumption: 2 W
Switchover delay time: 500 ms dependent of Ie
Switchover delay time: 150 ms
Start up delay for master tick: min. 25 ms
Release delay for master tick: 150 ms
Current measurement: 7 A device: AC 0.5 ... 25 A
2 A device: AC 0.2 ... 10 A
Measuring accuracy: ± 5% of end of scale value
Measured value update time
at 50 Hz: 100 ms
at 60 Hz: 83 ms
Motor protection
up to 6.9 A: Class 10 A
6.9 to 7.0 A: Class 5
Electronically, with thermal memory
Reset: manual via Modbus
Short circuit strength
max. fuse rating: 25 A gG / gL IEC/EN 60 947-5-1

General Data

Operating mode: Continuous operation
Operation: 0 ... + 65 °C (see derating curve)
Storage: - 40 ... + 70 °C
Relative air humidity: 93 % at 40 °C
Altitude: < 1.000 m
Clearance and creepage distances
rated impuls voltage / pollution degree
Motor voltage- control voltage: 6 kV / 2 IEC 60 664-1
Motor voltage- Modbus: 6 kV / 2 IEC 60 664-1
Overvoltage category: Ill
EMC
Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2
HF-irradiation
80 MHz ... 1.0 GHz: 10 V / m IEC/EN 61 000-4-3
1.0 GHz ... 2.5 GHz: 3 V / m IEC/EN 61 000-4-3
2.5 GHz ... 2.7 GHz: 1 V / m IEC/EN 61 000-4-3
Fast transients: 2 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
HF wire guided: 10 V IEC/EN 61 000-4-6
Voltage dips
Wire guided: Limit value class B IEC/EN 60 947-4-2
Radio irradiation: Limit value class B IEC/EN 60 947-4-2
Harmonics:
Degree of protection:
Housing: IP 40 IEC/EN 60 529
Terminals: IP 20 IEC/EN 60 529
Vibration resistance: Amplitude 0.35 mm
Climate resistance:
Frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
Consumption: 2 W
Switchover delay time: 500 ms dependent of I e
Switchover delay time: 150 ms
Start up delay for master tick: min. 25 ms
Release delay for master tick: min. 30 ms
Current measurement: 7 A device: AC 0.5 ... 25 A
2 A device: AC 0.2 ... 10 A
Measuring accuracy: ± 5% of end of scale value
Measured value update time
at 50 Hz: 100 ms
at 60 Hz: 83 ms
Motor protection
up to 6.9 A: Class 10 A
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Electronically, with thermal memory
Reset: manual via Modbus
Short circuit strength
max. fuse rating: 25 A gG / gL IEC/EN 60 947-5-1

Standard Types

UG 9411PM AC 230 V 50/60 Hz 7.0 A
Article number: 0067523
• Nominal voltage: AC 230 V
• Nominal motor current: 7.0 A
• Modbus RTU
• Adjustable baud rate
• Width: 22.5 mm
UG 9411PM AC 230 V 50/60 Hz 2.0 A
Article number: 0067522
• Nominal voltage: AC 230 V
• Nominal motor current: 2.0 A
• Modbus RTU
• Adjustable baud rate
• Width: 22.5 mm

Dimensions

Width x height x depth: 22.5 x 105 x 120.3 mm
**Characteristics**

- **Motor overload protection**

**Derating curve:**
Rated continuous current depending on ambient temperature and distance
Enclosure without ventilation slots

**Response time [s]**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>10 x Ie</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>500</td>
<td>300</td>
<td>200</td>
<td>100</td>
<td>50</td>
</tr>
</tbody>
</table>

**Setup Procedure**

1. Connect motor and device according to application example. The 3 phases must be connected in correct sequence, wrong phase sequence will lead to failure (see failure code)
2. Setting unit address and baud rate via potentiometer.
3. Power up the unit.
4. Parametrization via Modbus
5. At correct setting, the motor should ramp up continuously to full speed.

**Setting Facilities**

- Potentiometer ADR10: - Unit adress x 10
- Potentiometer ADR1: - Unit adress x 1
- Potentiometer BAUD: - Baud rate

The module address and baud rate is only read after connecting the auxiliary supply!

**Group fusing**

Several motor starters can be wired in parallel on the supply side. Please make sure, that the total current cannot exceed 16 A. If several starters are use together and require more than 16 A, groups have to be split up for max 16 A.

**Safety Notes**

- Never clear a fault when the device is switched on

**Attention:** This device can be started directly on the phase voltage without a contactor. Please be aware that the motor is still connected to the supply voltage also when it is not running. Therefore for work on motor and controller the supply has to be disconnected via E-stop.

- The user must ensure that the device and the necessary component are mounted and connected according to the locally applicable regulations and technical standards (VDE, TÜV,BG).

- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.

- Touch proof security is only provided when the power connection terminals are plugged into the unit.

---

**Trigger characteristics**

**Motor overload protection**
Motor control with UG 9411 and PLC via Modbus

**Bus Interface**

- **Protocol**: Modbus Seriell RTU
- **Address**: 1 bis 99
- **Baud rate**: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
- **Data bit**: 8
- **Stop bit**: 2
- **Parity**: none

More information about the interface, wiring rules, device identification and communication monitoring can be found in the Modbus user manual.

**Function-Codes**

At UG 9411 the following function codes are implemented:

<table>
<thead>
<tr>
<th>Function-Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x03</td>
<td>Read Holding Register</td>
<td>Device parameter read word by word</td>
</tr>
<tr>
<td>0x04</td>
<td>Read Input Register</td>
<td>Actual values read word by word</td>
</tr>
<tr>
<td>0x05</td>
<td>Write Single Coil</td>
<td>Outputs write individually</td>
</tr>
<tr>
<td>0x06</td>
<td>Write Single Register</td>
<td>Device parameter write word by word</td>
</tr>
<tr>
<td>0x10</td>
<td>Write Multiple Register</td>
<td>Device parameter write in blocks</td>
</tr>
</tbody>
</table>

**Device configuration**

If required the device configuration data can be saved permanently by setting the the Bit “WriteKonfig to EEPROM”. The data is copied from the EEPROM to the relevant register when connecting the auxiliary voltage. As the numbers of write cycles of an EEPROM are limited, the writing must not be done in cycles. In addition it is not possible to receive modbus telegrams during a period of 50 ms while writing the EEPROM.
Every slave owns an output-configuration- and actual value table. In these tables it is defined under which address the parameters can be found.

### Single Coils (Control signals):

<table>
<thead>
<tr>
<th>Register-Adress</th>
<th>Protocol-Adress</th>
<th>Name</th>
<th>Value range</th>
<th>Description</th>
<th>Data type</th>
<th>Access rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>RunRight</td>
<td>0x0000</td>
<td>Motor turns right off</td>
<td>BIT</td>
<td>write</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0xFF00</td>
<td>Motor turns right on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>RunLeft</td>
<td>0x0000</td>
<td>Motor turns left off</td>
<td>BIT</td>
<td>write</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0xFF00</td>
<td>Motor turns left on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Reset</td>
<td>0x0000</td>
<td>No function</td>
<td>BIT</td>
<td>write</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0xFF00</td>
<td>Device reset</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>WriteKonfig to EEPROM</td>
<td>0x0000</td>
<td>No function</td>
<td>BIT</td>
<td>write</td>
</tr>
</tbody>
</table>

### Holding Register (Device configuration):

<table>
<thead>
<tr>
<th>Register-Adress</th>
<th>Protocol-Adress</th>
<th>Name</th>
<th>Value range</th>
<th>Description</th>
<th>Data type</th>
<th>Access rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>40001</td>
<td>0</td>
<td>Control word 1</td>
<td>0 … 2</td>
<td>Bit 0 = Reset Bit 1 = WriteKonfig to EEPROM</td>
<td>UINT16</td>
<td>write / reading</td>
</tr>
<tr>
<td>40002</td>
<td>1</td>
<td>Control word 2</td>
<td>0 … 2</td>
<td>Bit 0 = RunRight Bit 1 = RunLeft</td>
<td>UINT16</td>
<td>write / reading</td>
</tr>
<tr>
<td>40003</td>
<td>2</td>
<td>Ie Typ 2A</td>
<td>30 … 200</td>
<td>Nominal motor current in 1/100 A</td>
<td>UINT16</td>
<td>write / reading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ie Typ 7A</td>
<td>150 … 700</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40004</td>
<td>3</td>
<td>Mon</td>
<td>30 … 80</td>
<td>Softstart voltage in % from nominal voltage</td>
<td>UINT16</td>
<td>write / reading</td>
</tr>
<tr>
<td>40005</td>
<td>4</td>
<td>Ton</td>
<td>0 … 100</td>
<td>Softstart ramp time in 1/10 s</td>
<td>UINT16</td>
<td>write / reading</td>
</tr>
<tr>
<td>40006</td>
<td>5</td>
<td>Moff</td>
<td>80 … 30</td>
<td>Softstop voltage in % from nominal voltage</td>
<td>UINT16</td>
<td>write / reading</td>
</tr>
<tr>
<td>40007</td>
<td>6</td>
<td>Toff</td>
<td>0 … 100</td>
<td>Softstop ramp time in 1/10 s</td>
<td>UINT16</td>
<td>write / reading</td>
</tr>
<tr>
<td>40008</td>
<td>7</td>
<td>Timeout release</td>
<td>0 … 1</td>
<td>0 = Disable 1 = Enable</td>
<td>UINT16</td>
<td>write / reading</td>
</tr>
<tr>
<td>40009</td>
<td>8</td>
<td>Timeout</td>
<td>0 … 10000</td>
<td>Timeout value in ms</td>
<td>UINT16</td>
<td>write / reading</td>
</tr>
</tbody>
</table>

*) Parameters can be stored permanently in the EEPROM by setting the Bit "WriteKonfig to EEPROM"

### Input Register (Device state and measuring values):

<table>
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<tr>
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<th>Access rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>30001</td>
<td>0</td>
<td>State word 1 Device failure</td>
<td>0 … 10</td>
<td>0: No failure 1: Overtemperature LT 2: Wrong freqency 3: Phase reversal 4: Phase failure 5: Motor blocked 6: 7: Temperatur circuit fault 8: Motor protection device actuated 9: Communication fault Modbus 10:Checksum failure EEPROM</td>
<td>UINT16</td>
<td>reading</td>
</tr>
<tr>
<td>30002</td>
<td>1</td>
<td>State word 2 State of device</td>
<td>0 … 6</td>
<td>0: Device initialize 1: Wait for start 2: Softstart ramp 3: Clockwise On 4: Anti-clockwise On 5: Softstop ramp 6: Device in errormode</td>
<td>UINT16</td>
<td>reading</td>
</tr>
<tr>
<td>30003</td>
<td>2</td>
<td>Actual motor current</td>
<td>0 … 3000</td>
<td>Actual motor current in 1/100 A</td>
<td>UINT16</td>
<td>reading</td>
</tr>
<tr>
<td>30004</td>
<td>3</td>
<td>Motor load</td>
<td>0 … 100</td>
<td>Motor load in % from rated motor power</td>
<td>UINT16</td>
<td>reading</td>
</tr>
</tbody>
</table>
The smart motorstarter function is a softstart, reversal and protection of 3-phase asynchronous motors. Overcurrent is detected when the set current is exceeded longer than 2 sec. Direction reversal takes place via relay switching. The relays are de-energised at this. This ensures a long service life.

**Features**
- According to IEC/EN 60 947-4-2
- To reverse 3 phase motors up to 550 W to 4 kW
- 2-phase softstart
- max. 4 potentiometer for setting of starting torque, deceleration torque, softstart /-stop, overcurrent limit or rated motor current
- 4 LEDs for status indication
- Reversing with relays without current, softstart, softstop with thyristor
- Galvanic separated 24V-inputs for clockwise- and anticlockwise
- Reset button on front
- Connection facility for external reset button
- Relay indicator output for operation
- Indicator output at customers specification (on request)
- Galvanic separation between control circuit and power circuit
- Width: 22.5 mm

**Approvals and Markings**

**Applications**
- Reversing operation for door and gate controls, bridge drives and lifting applications with monitoring of blockage
- Conveyor systems with monitoring of blockage
- Actuating drives in process controls with blockage monitoring
Function

Soft start
Two motor phases are impacted through thyristor phase-fired control to allow a steady increase of the currents. The motor torque behaves in the same manner when ramping up. This ensures that the drive can start without jerking and the drive elements are not damaged. Starting time and starting torque can be adjusted via rotary switch.

Softstop (variant / 1_ _)
The softstop function shall extend the natural running down time of the drive to also prevent jerky stopping. The deceleration time is set with rotary switch ton, the running-down torque with rotary switch Meff.

Motor protection (variant / 1_ _)
The thermal load of the motor is calculated using a thermal model. The nominal motor current can be adjusted via potentiometer Ie. To calculate the thermal load the current is measured in phase T3. A symmetric current load of all 3 phases of the motor is assumed for flawless functioning. When the trigger value – stored in the trigger characteristics – is reached, the motor is switched off and the device switches to fault 8. The fault can be acknowledged via the reset button or reset input.

Attention: The data of the thermal model is cleared through reset or voltage failure. In this case, the user must provide adequate cooling time of the motor.

Phase failure
To make sure the motor is not loaded with asymmetric currents, a check takes place during motor start. This ensures that the device can start without jerking and the drive elements are not damaged. Starting time and starting torque can be adjusted via rotary switch.

Motor current protection (variant / 0_ _)
To ensure blocking protection is in place, the motor current is monitored in T3. The switching threshold can be adjusted via potentiometer Imax. In the event of overcurrent, the power semiconductors deactivate and the signal relay for normal operation is reset. The red “ERR” LED flashes and the device switches to fault 8. The fault can be acknowledged via the reset button or reset input.

Motor connection (variant / 0_ _)
In off state or fault condition the motor terminals are isolated from the mains voltage by a 4 pole, forcibly guided contact relay. The contact opening is min. 0.5 mm.

Control inputs
Clockwise rotation and anticlockwise rotation can be selected via two control inputs. The input signal detected first is executed if both inputs are selected simultaneously. After the detected signal is cancelled, the rotational direction is reversed via the soft start function. The control inputs have a common isolated ground connection NE.

Signalling output “Ready”
Contact 11/14 is closed if no device fault is present.

Reset Function
2 options are available to acknowledge the fault

Manual (reset button):
Acknowledgement is performed by operating the reset button at the front of the device. If the button is still actuated after 2 seconds, the device resumes the fault state.

Manual (remote acknowledgement):
Remote acknowledgement can be realised by connecting a button (N/O contact) between the terminals MAN and RES. Acknowledgement is triggered as soon as the contact of the button closes. If the button is still actuated after 2 seconds, the device resumes the fault state since a defect in the acknowledgement circuit cannot be ruled out.

Setting Facilities

Rotary switch Meff:
- Starting torque at softstart 30 ... 80 %

Rotary switch Meff(enterprise / 1_ _):
- Deceleration torque at softstop 60 ... 30 %

Rotary switch tcan / ton:
- Start / deceleration ramp 1 ... 10 s

Rotary switch tcan / ton (variant / 2_ _):
- Start / deceleration ramp 0 ... 1 s

Rotary switch Ilim (variant / 1_ _):
- Nom. motor current 1.6 Aeff ... 9.0 Aeff

Setting of start / deceleration ramp

Set-up Procedure
1. Connect motor and device according to application example. A clockwise rotating field is assumed for operation. An anti-clockwise rotating field triggers a fault message.
2. Turn rotary switch tcan / ton fully clockwise, Meff e. g. M100 fully anti-clockwise and rotary switch Imax e. g. Ie of the required current.
3. Connect voltage and starting via input R+ or softstop L-.
4. The starting time is set by turning the rotary switch ton anti-clockwise and the starting torque is set by turning the rotary switch Meff clockwise to the desired value. If set correctly, the motor will swiftly accelerate to the nominal speed.
**Safety Notes**

**Attention!**

- Never clear a fault when the device is switched on.
- The user must ensure that the device and the necessary component are mounted and connected according to the locally applicable regulations and technical standards (VDE, TÜV,BG).
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.
- After a short circuit the motor starter is defective and has to be replaced (Assignment type 1).
- Group supply:
- If several motor starters are protected together, the sum of the motor currents must not exceed 25 A.

**Mounting Notes**

The phase current in the device is measured with a hall effect sensor. Due to this principle also magnetic fields next to the sensor may have an influence. When designing circuits with this motor starter components that generate magnetic fields like contactors, transformers, high current wires should not be placed close to the sensor.

![Position of the current sensor](M11633.png)

**Technical Data**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage L1/L2/L3:</td>
<td>3 AC 200 ... 480 V ± 10%</td>
</tr>
<tr>
<td>Nominal frequency:</td>
<td>50 / 60 Hz , automatic detection</td>
</tr>
<tr>
<td>Auxiliary voltage:</td>
<td>DC 24 V ± 10%</td>
</tr>
<tr>
<td>Motor power:</td>
<td>4 kW at AC 400 V</td>
</tr>
<tr>
<td>Min. motor power:</td>
<td>25 W</td>
</tr>
<tr>
<td>Nominal operating mode:</td>
<td>9 A: AC 51</td>
</tr>
<tr>
<td></td>
<td>9 A: AC 53a: 6-2: 100-30 IEC/EN 60947-4-2</td>
</tr>
<tr>
<td>Surge current:</td>
<td>200 A (tp = 20 ms )</td>
</tr>
<tr>
<td>Load limit integral:</td>
<td>200 A/s ( tp = 10 ms )</td>
</tr>
<tr>
<td>Peak reverse voltage:</td>
<td>1500 V</td>
</tr>
<tr>
<td>Overvoltage limiting:</td>
<td>AC 550 V</td>
</tr>
<tr>
<td>Leakage current in off state:</td>
<td>&lt; 3 x 0.5 mA</td>
</tr>
<tr>
<td>Starting voltage:</td>
<td>30 ... 80 %</td>
</tr>
<tr>
<td>Start / deceleration ramp:</td>
<td>1 ... 10 s</td>
</tr>
<tr>
<td>Start up delay</td>
<td>for master tick: min. 100 ms</td>
</tr>
<tr>
<td>Release delay</td>
<td>for master tick: min. 50 ms</td>
</tr>
<tr>
<td>Overcurrent measuring device:</td>
<td>AC 5 ... 50 A at variant /_0</td>
</tr>
<tr>
<td>Nominal motor current Ie:</td>
<td>1.6 A ... 9.0 A at variant /_1</td>
</tr>
<tr>
<td>Measuring accuracy:</td>
<td>± 5% of end of scale value</td>
</tr>
<tr>
<td>Measured value update time</td>
<td>at 50 Hz: 100 ms</td>
</tr>
<tr>
<td></td>
<td>at 60 Hz: 83 ms</td>
</tr>
<tr>
<td>Motor protection:</td>
<td>Ie 1.5 A bis 6.8 A: Class 10 A</td>
</tr>
<tr>
<td></td>
<td>Ie 6.9 A bis 9.0 A: Class 5</td>
</tr>
<tr>
<td>Electronically, without thermal memory:</td>
<td></td>
</tr>
<tr>
<td>Reset:</td>
<td>manual</td>
</tr>
<tr>
<td>Short circuit strength:</td>
<td>25 A gG / gL IEC/EN 60 947-5-1</td>
</tr>
<tr>
<td>max. fuse rating:</td>
<td>1 IEC/EN 60 947-4-1</td>
</tr>
<tr>
<td>Assignment type:</td>
<td>&gt; 10 x 10⁶ switching cycles</td>
</tr>
<tr>
<td>Electrical life:</td>
<td>30 x 10⁶ switching cycles</td>
</tr>
</tbody>
</table>

**Inputs**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control input right, left:</td>
<td>DC 24V</td>
</tr>
<tr>
<td>Rated current:</td>
<td>4 mA</td>
</tr>
<tr>
<td>Response value ON:</td>
<td>DC 15 V ... 30 V</td>
</tr>
<tr>
<td>Response value OFF:</td>
<td>DC 0 V ... 5 V</td>
</tr>
<tr>
<td>Connection:</td>
<td>polarity protected diode</td>
</tr>
<tr>
<td>Manuel:</td>
<td>DC 24 V</td>
</tr>
<tr>
<td></td>
<td>(connect button on terminals &quot;MAN&quot; and &quot;RES&quot;)</td>
</tr>
</tbody>
</table>

**Indicator Outputs**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RES:</td>
<td>DC 24 V, semiconductor, short circuit proof, rated continuous current 0.2 A programmable at customers specification (on request)</td>
</tr>
<tr>
<td>Ready:</td>
<td>Changeover contact 250 V / 5 A</td>
</tr>
<tr>
<td>Contact:</td>
<td>1 changeover contact</td>
</tr>
<tr>
<td>Switching capacity</td>
<td>to AC 15</td>
</tr>
<tr>
<td>NO contact:</td>
<td>3 A / AC 230 V IEC/EN 60 947-5-1</td>
</tr>
<tr>
<td>NC contact:</td>
<td>1 A / AC 230 V IEC/EN 60 947-5-1</td>
</tr>
<tr>
<td>Thermal current Ith:</td>
<td>5 A</td>
</tr>
<tr>
<td>Electrical life to AC 15 at 3 A, AC 230 V:</td>
<td>2 x 10⁶ switch. cycles IEC/EN 60 947-5-1</td>
</tr>
<tr>
<td>Mechanical life</td>
<td>30 x 10⁶ switching cycles</td>
</tr>
<tr>
<td>Permissible switching frequency:</td>
<td>1800 switching cycles/h</td>
</tr>
<tr>
<td>Short circuit strength</td>
<td>max. fuse rating: 4 A gG / gL IEC/EN 60 947-5-1</td>
</tr>
</tbody>
</table>
## Technical Data

### General Data

<table>
<thead>
<tr>
<th>Device type:</th>
<th>Hybrid Motor Controller H1B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating mode:</td>
<td>Continuous operation</td>
</tr>
<tr>
<td>Temperature range:</td>
<td>0 ... + 60 °C (see derating curve)</td>
</tr>
<tr>
<td>Storage:</td>
<td>- 25 ... + 75 °C</td>
</tr>
<tr>
<td>Relative air humidity:</td>
<td>93 % at 40 °C</td>
</tr>
<tr>
<td>Altitude:</td>
<td>&lt; 1.000 m</td>
</tr>
<tr>
<td>Clearance and creepage distances</td>
<td></td>
</tr>
<tr>
<td>Rated insulation voltage / overvoltage category / contamination level between control input, auxiliary voltage and Motor voltage respectively indicator contact:</td>
<td>4 kV / 2 IEC/EN 60 664-1</td>
</tr>
<tr>
<td>Overvoltage category:</td>
<td>III</td>
</tr>
</tbody>
</table>

### EMC

<table>
<thead>
<tr>
<th>Electrostatic discharge (ESD):</th>
<th>8 kV (air) IEC/EN 61 000-4-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF-irradiation 1.0 GHz ... 1.0 GHz:</td>
<td>10 V / m IEC/EN 61 000-4-3</td>
</tr>
<tr>
<td>1.0 GHz ... 2.5 GHz:</td>
<td>3 V / m IEC/EN 61 000-4-3</td>
</tr>
<tr>
<td>2.5 GHz ... 2.7 GHz:</td>
<td>1 V / m IEC/EN 61 000-4-3</td>
</tr>
<tr>
<td>Fast transients:</td>
<td>2 kV IEC/EN 61 000-4-4</td>
</tr>
<tr>
<td>Surge voltage between wires for power supply:</td>
<td>1 kV IEC/EN 61 000-4-5</td>
</tr>
<tr>
<td>between wire and ground:</td>
<td>2 kV IEC/EN 61 000-4-5</td>
</tr>
<tr>
<td>HF-wire-guided:</td>
<td>10 V IEC/EN 61 000-4-6</td>
</tr>
<tr>
<td>Voltage dips:</td>
<td>IEC/EN 61 000-4-11</td>
</tr>
</tbody>
</table>

### Interference emission

<table>
<thead>
<tr>
<th>Wire guided:</th>
<th>Limit value class B IEC/EN 60 947-4-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio irradiation:</td>
<td>Limit value class B IEC/EN 60 947-4-2</td>
</tr>
<tr>
<td>Housing:</td>
<td>IP 40 IEC/EN 60 529</td>
</tr>
<tr>
<td>Terminals:</td>
<td>IP 20 IEC/EN 60 529</td>
</tr>
<tr>
<td>Vibration resistance:</td>
<td>Amplitude 0.35 mm frequency 10 ... 55 Hz, IEC/EN 60 068-2-6</td>
</tr>
<tr>
<td>Climate resistance:</td>
<td>0 / 060 / 04 IEC/EN 60 068-1 DIN 46 228-1/-2/-3/-4</td>
</tr>
</tbody>
</table>

### Screw terminals (fixed):

<table>
<thead>
<tr>
<th>Cross section:</th>
<th>1 x 0.14 ... 2.5 mm² solid or stranded wire with sleeve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power terminals Cross section:</td>
<td>1 x 0.25 ... 2.5 mm² solid or stranded wire with sleeve</td>
</tr>
<tr>
<td>Insulation of wires or sleeve length:</td>
<td>8 mm</td>
</tr>
<tr>
<td>Fixing torque:</td>
<td>0.5 Nm</td>
</tr>
<tr>
<td>Wire fixing:</td>
<td>captive slotted screw</td>
</tr>
<tr>
<td>Mounting:</td>
<td>DIN rail IEC/EN 60 715</td>
</tr>
<tr>
<td>Weight:</td>
<td>220 g</td>
</tr>
</tbody>
</table>

### Dimensions

| Width x height x depth: | 22.5 x 105 x 120.3 mm |

## UL-Data

### Standards:
- for all products:
  - U.S. National Standard UL508, 17th Edition

### with restrictions at motor switching power:
- ANSI/UL 60947-4-2, 1st Edition (Low-Voltage Switchgear and Controlgear Part 4-2: Contactors and Motor-Starters - AC Semiconductor Motor Controllers and Starters)
- CAN/CSCA-C22.2 No. 60947-1-07, 1st Edition (Low-Voltage Switchgear and Controlgear - Part1: General rules)
- CSA-C22.2 No. 60947-4-2-14, 1st Edition (Low-Voltage Switchgear and Controlgear - Part 4-2: Contactors and Motor-Starters - AC Semiconductor Motor Controllers and Starters)

### Motor data:

<table>
<thead>
<tr>
<th>Hybrid Motor Controller H1B</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 508, CSA C22.2 No. 14-13</td>
</tr>
<tr>
<td>3 AC 200 ... 480 V, 3-phase, 50 / 60 Hz:</td>
</tr>
<tr>
<td>up to 4.8 FLA, 28.8 LRA at 50 °C up to 2.1 FLA, 12.6 LRA at 60 °C</td>
</tr>
<tr>
<td>UL 60947-4-2, CSA 60947-4-2</td>
</tr>
<tr>
<td>3 AC 200 ... 300 V, 3-phase, 50 / 60 Hz:</td>
</tr>
<tr>
<td>up to 4.8 FLA, 28.8 LRA at 50 °C up to 2.1 FLA, 12.6 LRA at 60 °C</td>
</tr>
<tr>
<td>3 AC 301 ... 480 V, 3-phase, 50 / 60 Hz:</td>
</tr>
</tbody>
</table>

### Motor protection:
- I1, 1.5 A bis 6.8 A: Class 10 / 10 A
- I1, 6.9 A bis 9.0 A: Class 5
- Electronically, without thermal memory
- Reset: manual

### Indicator output relay:
- 5 A 240 V ac Resistive

### Wire connection:
- Connections A1+, A2, X1+, X2, MAN, RES, NE, 11, 12, 14: AWG 22 - 14 Sol/Str Torque 3.46 Lb-in (0.39 Nm)
- L1, L2, L3, T1, T2, T3: AWG 30 - 12 Str Torque 5-7 Lb-in (0.564-0.79 Nm)

### Additional Notes:
- This device is intended for use on supply systems with a maximum voltage from phase to ground of 300 V (e.g. for a phase-four phase wire system 277/480 V or on a three phase-three wire systems of 240 V), rated impulse withstand voltage of max. 4 kV
- Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical Amperes, 480 Volts maximum when protected by class CC, J or RKS fuse rated maximum 20 A
- For use in pollution degree 2 Environment or equivalent
- The control circuits of this device shall be supplied by an isolated 24 Vdc power supply which output is protected with a fuse rated max. 4 A dc
- For installations according to Canadian National Standard C22.2 No. 14-13 (cUL Mark only) and supply voltages above 400V:
  - Transient surge suppression devices shall be installed on the line side of this equipment and shall be rated 240 V (phase to ground), 415 V (phase to phase), suitable for overvoltage category III, and shall provide protection for a rated impulse withstand voltage peak of 4 kV
  - Transient surge suppression devices shall be installed on the line side of this equipment and shall be rated 277 V (phase to ground), 480 V (phase to phase), suitable for overvoltage category III, and shall provide protection for a rated impulse withstand voltage peak of 4 kV

---

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

![Derating curve](image)

**Derating curve:**
Rated continuous current depending on ambient temperature and distance
Enclosure without ventilation slots

**Standard Type**

<table>
<thead>
<tr>
<th>UG 9256.11/010/61</th>
<th>3 AC 200 ... 480 V</th>
<th>9,0 A</th>
<th>1 ... 10 s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article number:</td>
<td>0064445</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal voltage:</td>
<td>3 AC 200 ... 480 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal current:</td>
<td>9,0 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramp time:</td>
<td>1 ... 10 s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control input R, L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With softstart</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without mains isolating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With overcurrent protection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width:</td>
<td>22.5 mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Ordering Example**

UG 9256.11 / 010 / 61 3 AC 200 ... 480 V 9 A 1 ... 10 s

- Ramp time
- Nominal current
- Nominal voltage
- UL approval
- 0 = Overcurrent protection
- 1 = Motor protection
- 0 = with mains isolating relay, on when no failure
- 1 = without mains isolating relay, on when no failure
- 3 = without mains isolating relay, indicator relay at beginning to softstart on till end of softstop
- 4 = with mains isolating relay, indicator relay on while bridging relay on

- 0 = with softstart
- 1 = with softstart / softstop
- 2 = with softstart / softstop, with ramp off at time potentiometer
- 3 = with softstart, with ramp off at time potentiometer
- 4 = without softstart / softstop

**Variant / _ _ 1:**
- Trigger characteristics
- Motor overload protection

**Variant / _ _ _ 1:**
- Trigger characteristics
- Motor overload protection

**Variant / _ _ _ _ 1:**
- Trigger characteristics
- Motor overload protection

**Variant / _ _ _ _ _ 1:**
- Trigger characteristics
- Motor overload protection

**Variant / _ _ _ _ _ _ 1:**
- Trigger characteristics
- Motor overload protection

**Variant / _ _ _ _ _ _ _ 1:**
- Trigger characteristics
- Motor overload protection

**Variant / _ _ _ _ _ _ _ _ 1:**
- Trigger characteristics
- Motor overload protection
Motor control with UG 9256 and PLC

Motor control with UG 9256 and switch
The smart motorstarter UG 9256/804 and is used to provide always a clockwise phase sequence and to start asynchronous motors. Independent of the phase sequence on the input it will always provide clockwise sequence on the output to the motor. The unit also protects the motor against phase failure and motor overload. The relays of the reversing circuit switch without current. This provides a long electrical life.

Your Advantages
• Up to 3 functions in one unit
  - Providing clockwise phase sequence at the motor connection terminals
  - Phase failure detection
  - Motorprotection Class 10 A, Class 5
• Galvanic mains separation by forcibly guided contacts contact opening min. 0.5 mm (UG 9256/807)
• 66 % less space
• Simple and time-saving commissioning as well as user-friendly operation through setting via potentiometer on absolute scale
• Hybrid relay combines benefits of relay technology with non-wearing semiconductor technology
• High availability by
  - Temperature monitoring of semiconductors
  - High withstand voltage up to 1500 V
  - Load free relay reversing function

Features
• According to UL 60 947-4-2
• To reverse the rotary field
• For 3-phase motors with rated motor current from Ie 1,5 A ... 9,0 A
• 1 potentiometer für setting of rated motor current
• 3 LEDs for status indication
• Reversing with relays without current, switching with thyristor
• Reset button on front
• Connection facility for external reset button
• Relay indicator output for operation
• Galvanic separation between control circuit and power circuit
• Galvanic separation of motor terminals from mains voltage in off state or fault condition (UG 9256/807)
• Width 22.5 mm

Approvals and Markings

Application
- Conveyor systems with preferred direction of rotation
- Actuating drives in process controls with preferred direction of rotation
Motor protection (variant / 1_ _)
The thermal load of the motor is calculated using a thermal model. To calculate the thermal load the current is measured in phase T3. A symmetric current load of all 3 phases of the motor is assumed for flawless functioning. When the trigger value – stored in the trigger characteristics – is reached, the motor is switched off and the device switches to fault 8. The fault can be acknowledged via the reset button or reset input.

Attention: The data of the thermal model is cleared through reset or voltage failure. In this case, the user must provide adequate cooling time of the motor.

Phase failure
To make sure the motor is not loaded with asymmetric currents, a check takes place during motor start whether phases L1, L2 and L3 are present. If one or several phases are absent, the device switches to fault 4. The fault can be acknowledged via the reset button or reset input.
Phase failure is detected when he phase is missing for at least 1 second.

Motor connection (UG 9256/807)
In off state or fault condition the motor terminals are isolated from the mains voltage by a 4 pole, forcibly guided contact relay. The contact opening is min. 0.5 mm

Control inputs
Clockwise rotation can be selected via one control input. The reference connection for the control input is the terminal NE. The control input is galvanically separated from the rest of the unit.

Signalling output “Ready”
Contact 11/14 is closed if no device fault is present.

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 (+)</td>
<td>Auxiliary voltage + DC 24 V</td>
</tr>
<tr>
<td>A2</td>
<td>Auxiliary voltage 0 V</td>
</tr>
<tr>
<td>R+</td>
<td>Control input clockwise</td>
</tr>
<tr>
<td>L+</td>
<td>Control input anti-clockwise</td>
</tr>
<tr>
<td>NE</td>
<td>Earth connection control input</td>
</tr>
<tr>
<td>MAN</td>
<td>Output for remote reset</td>
</tr>
<tr>
<td>RES</td>
<td>Input for remote reset</td>
</tr>
<tr>
<td>11, 12, 14</td>
<td>Indicator relay for operation</td>
</tr>
<tr>
<td>L1</td>
<td>Phase voltage L1</td>
</tr>
<tr>
<td>L2</td>
<td>Phase voltage L2</td>
</tr>
<tr>
<td>L3</td>
<td>Phase voltage L3</td>
</tr>
<tr>
<td>T1</td>
<td>Motor connection T1</td>
</tr>
<tr>
<td>T2</td>
<td>Motor connection T2</td>
</tr>
<tr>
<td>T3</td>
<td>Motor connection T3</td>
</tr>
</tbody>
</table>

Reset Function
2 options are available to acknowledge the fault

Manual (reset button):
Acknowledgement is performed by operating the reset button at the front of the device. If the button is still actuated after 2 seconds, the device resumes the fault state.

Manual (remote acknowledgement):
Remote acknowledgement can be realised by connecting a button (N/O contact) between the terminals MAN and RES. Acknowledgement is triggered as soon as the contact of the button closes. If the button is still actuated after 2 seconds, the device resumes the fault state since a defect in the acknowledgement circuit cannot be ruled out.

Setting Facilities
Rotary switch Ie: Nom. motor current 1.5 Aeff ... 9.0 Aeff
### Set-up Procedure
1. Connect motor and device according to application example. The unit works with clockwise or anticlockwise phase sequence.
2. Adjust the nominal current of the connected motor with potentiometer I<sub>e</sub>
3. Connect device to power and start motor via control input R.

### Safety Notes
- Never clear a fault when the device is switched on
- The user must ensure that the device and the necessary component are mounted and connected according to the locally applicable regulations and technical standards (VDE, TÜV,BG).
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.
- After a short circuit the motor starter is defective and has to be replaced (Assignment type 1).
- Group supply:
  - If several motor starters are protected together, the sum of the motor currents must not exceed 25 A.

### Mounting Notes
When operated with rated continuous current the devices must not be placed closer than 10 mm side-by-side.

The phase current in the device is measured with a hall effect sensor. Due to this principle also magnetic fields next to the sensor may have an influence. When designing circuits with this motor starter components that generate magnetic fields like contactors, transformers, high current wires should not be placed close to the sensor.

### Technical Data

<table>
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<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
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<td>Nominal voltage L1/L2/L3:</td>
<td>3 AC 200 ... 480 V ± 10%</td>
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<td>Nominal frequency:</td>
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<td>DC 24 V ± 10%</td>
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<td>Motor power:</td>
<td>4 kW at AC 400 V</td>
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<td>Min. motor power:</td>
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<td>Load limit integral:</td>
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<td>Peak reverse voltage:</td>
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<td>Leakage current in off state:</td>
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<tr>
<td>Consumption:</td>
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<td>Start up delay for master tick:</td>
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<td>Release delay for master tick:</td>
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<td>Measuring accuracy:</td>
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<td>at 60 Hz:</td>
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<td>I&lt;sub&gt;e&lt;/sub&gt; 6.9 A to 9.0 A:</td>
<td>Class 5</td>
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<td>max. fuse rating: 25 A gL IEC/EN 60 947-5-1</td>
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### Inputs

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<td>Response value ON:</td>
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### Indicator Outputs

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<td>RES:</td>
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<tr>
<td>Contact:</td>
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<td>NO contact:</td>
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<td>2 x 10&lt;sup&gt;6&lt;/sup&gt; switching cycles IEC/EN 60 947-5-1</td>
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<td>Mechanical life:</td>
<td>15 x 10&lt;sup&gt;5&lt;/sup&gt; switching cycles</td>
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<td>Permissible switching frequency:</td>
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<td>Short circuit strength max. fuse rating:</td>
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</table>
Technical Data

General Data

Operating mode: Continuous operation
Temperature range: 0 … + 60 °C (see derating curve)

Clearance and creepage distances
overvoltage category / contamination level between control input, auxiliary voltage and Motor voltage respectively indicator contact: 4 kV / 2 IEC/EN 60 664-1

EMC
Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2
HF irradiation: 10 V / m IEC/EN 61 000-4-3
Fast transients: 2 kV IEC/EN 61 000-4-4
Surge voltage between wires for power supply: 1 kV IEC/EN 61 000-4-5
between wire and ground: 2 kV IEC/EN 61 000-4-5
HF-wire guided: 10 V IEC/EN 61 000-4-6
Voltage dips: IEC/EN 61 000-4-11
RF interference emission: Limit Class value B IEC/EN 60947-4-2
Radio interference, Measurement procedures EN 55 011
Radio interference voltage, Measurement procedures EN 55 011
Harmonics: EN 61 000-3-2

Degree of protection:
Housing: IP 40 IEC/EN 60 529
Terminals: IP 20 IEC/EN 60 529

Vibration resistance: Amplitude 0.35 mm frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
Climate resistance: 0 / 055 / 04 IEC/EN 60 068-1
Wire connection: DIN 46 228-1/-2/-3/-4

Screw terminal (fixed):
Cross section: 1 x 0.34 ... 2.5 mm² solid or stranded ferruled (isolated)
Insulation of wires or sleeve length: 8 mm
Fixing torque: 0.5 Nm
Wire fixing: captive slotted screw
Mounting: DIN rail IEC/EN 60 715
Weight: 220 g

Dimensions
Width x height x depth: 22.5 x 105 x 120.3 mm

Characteristics

Derating curve:
Rated continuous current depending on ambient temperature and distance
Enclosure without ventilation slots

Trigger characteristics
Motor overload protection
### Standard Types

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<tr>
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### Application Example

Motor control with UG 9256/804 and PLC

![Application Diagram](Image)
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## Time control technique

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