# Power Electronics

## MINISTOP
## Motor Brake Relay
## BI 9034

## Product Description

The BI 9034 electronic braking relay enables the wear-free braking of asynchronous motors. The braking relay is used for drives that must be reliably braked for safety and functional reasons. An integrated standstill detection switches off the braking current after the motor has come to a standstill.

## Block Diagrams



M10015_a

BI 9034



M11848_a

BI 9034/800

### Your advantages
- Higher safety level and more economic by short stopping cycle
- Cost saving
- Compact design
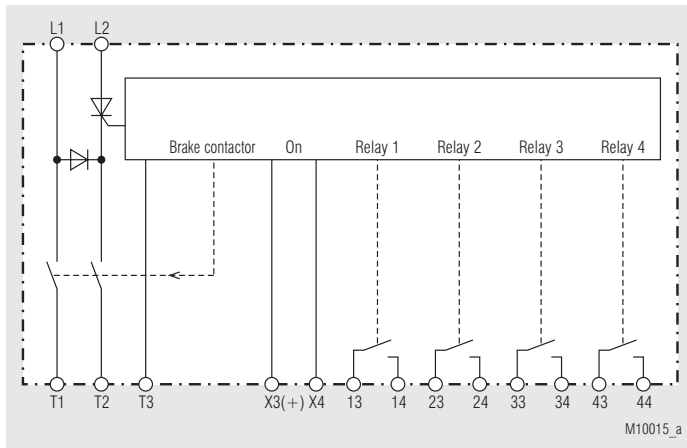- Easy to set-up, no need for current measuring instrument

### 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
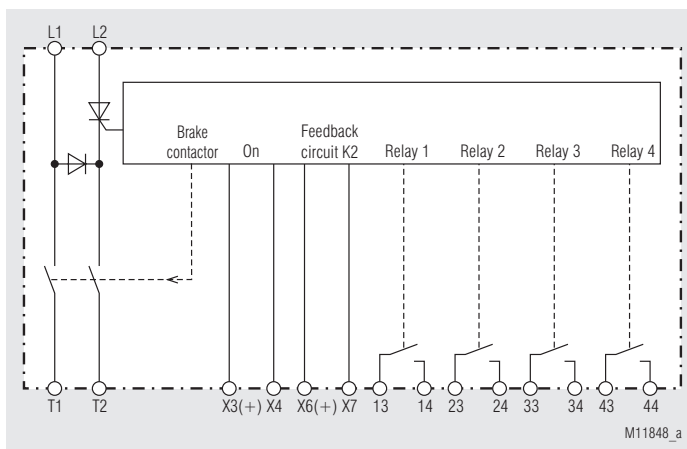- Width 90 mm

### Approvals and Markings

CE

### Applications
- Saws
- Centrifuges
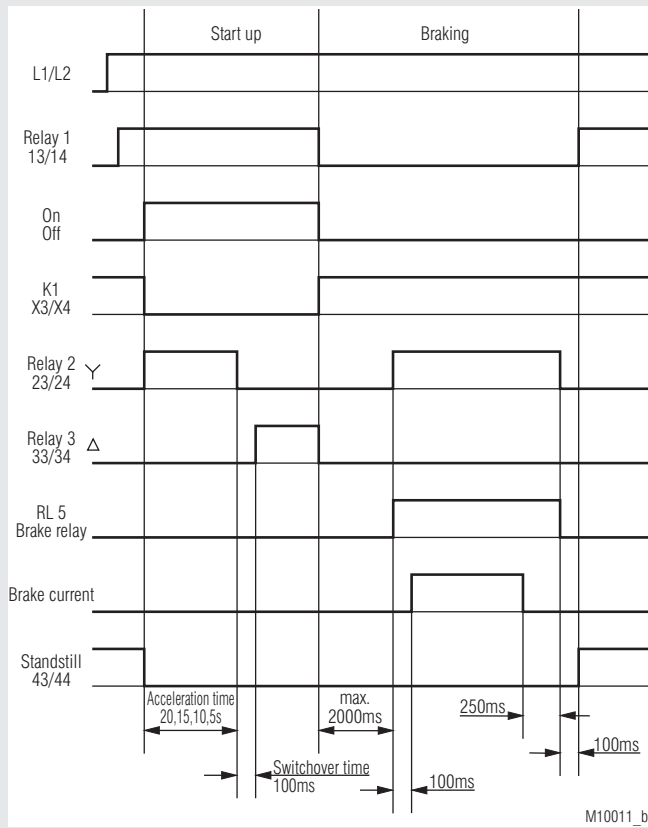- Woodworking machines
- Textile machines
- Conveyors

### 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 satrted 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 $T_1$ and $T_2$. The braking sequence is as follows:
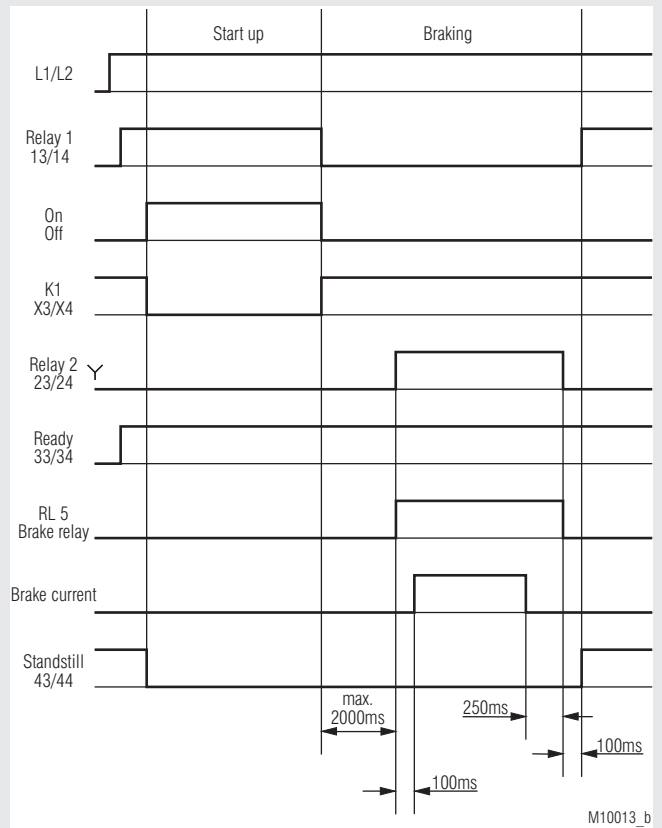
Pressing the stop button de-energises the motor contactor. The closing of X3-X4 (contact of the motor contactor) starts the braking. After a safety time the braking contactor closes for the adjusted braking time and the braking current flows through the motor.

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.

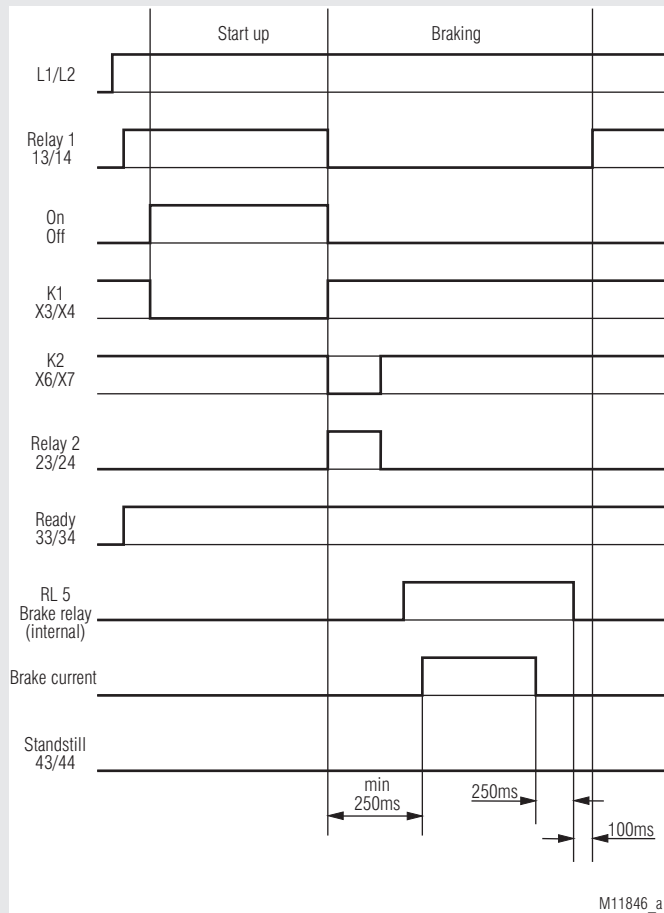All technical data in this list relate to the state at the moment of edition. We reserve the right for technical improvements and changes at any time.

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24.07.23 en / 772A

**Function Diagrams**



BI 9034 Function 1 ... 4



BI 9034 Function 5



BI 9034/800

## Circuit Diagrams



BI 9034



BI 9034/800

## Indicators

| | | |
|---|---|---|
| LED green „RUN": | - Ready: | Permanent on |
| LED red „Error" | - Mains frequency out of tolerence: | 1 flash |
| | - Braking current is not present: | 2 flashes |
| | - Power semiconductors overheated: | Flashes 3 times |
| | - Synchronisation signal is not present: | Flashes 4 times |
| | - Temperature measuring circuit defective: | Flashes 5 times |
| | - Motor voltage not diconnected: | Flashes 6 times |
| | - Variant /800 only short circuit contactor not de-energized: | Flashes 7 times |
| LED yellow „I$_{Br}$" | - Max. braking time 11 s Braking current is present | Permanent on |
| | - Max. braking time 31 s Braking current is present | Flashes |

## 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.

**Installation Error!**
- To avoid overloading the motor, the braking current sould not exceed twice the rated motor current

- The use of capacitive loads can lead to the destruction of switching components of the motor control unit. Do not operate capacitive loads on the motor control unit.

## Connection Termials

| Terminal designation | Signal description |
|---|---|
| L1 | Phase voltage L1 |
| L2 | Phase voltage L2 |
| T1 | Motor connection T1 |
| T2 | Motor connection T2 |
| T3 | Motor connection T3 (stand still detection) |
| X3 | (+) Feed back motor contactor |
| X4 | Feed back motor contactor |
| 13, 14 | Monitoring relay 1 |
| 23, 24 | Monitoring relay 2 |
| 33, 34 | Monitoring relay 3 |
| 43, 44 | Monitoring relay 4 |
| X6 | (+) Feed back short circuit contactor (/800 only) |
| X7 | Feed back short circuit contactor (/800 only) |

**Nomial Voltage U$_N$:**   AC 400 V ± 10 %
**Nomial frequency:**   50/60 Hz ± 3 Hz
**Permissing
braking current:**   10 ... 60 A $_{eff}$
**Duty-cycle at
max. braking current:**   40 %
**Application category:**   60A:AC-53a:1-31:40-140

**Info**   High ambiant temperatures in combination with high breaking currents may require a distance to adjacent devices or a reduction of the duty cycle.

**Braking voltage:**   DC 10 ... 190 V
**Max. braking time:**   11 s, 31 s
**Braking delay for
fade out of back EMF:**
BI 9034:   Auto optimising (0.2 ... 2 s)
BI 9034/800:   0.25 s via short circuit contactor
**Nominal consumption
for control circuit:**   5 VA
**Fuses**
Line protection
(Coordination type 1):   Typ gL / 60 A
Semiconductor fuse
(Coordination type 2):   Type gR / I²t 6600 A²s

**Info**
**Coordination Type!**
- Coordination type 1 according to IEC 60947-4-1: The engine control unit is defective following a short circuit and must be replaced.

- Coordination type 2 according to IEC 60947-4-1: The engine control unit is still suitable for continued use following a short circuit.

## Output

**Contacts:**   4 NO contacts   2 A / AC 400 V
**Switching capacity**
to AC 15
NO contact:   3 A / AC 250 V   IEC/EN 60947-5-1
**Electrical life:**   10$^5$ switch. cycles   IEC/EN 60947-5-1
**Mechanical life:**   10$^6$ switch. cycles   IEC/EN 60947-5-1
**Permissible switching
frequency:**   1800 switcing cycles / h
**Short circuit strength**
Max. fuse rating:   4 A gG / gL   IEC/EN 60947-5-1

## General Data

**Operating mode:**   Continuous operation
**Temperature range**
Operation:   0 ... + 45 °C
At an altitude of > 1000 m the maximum permissible temperature reduces by 0.5 °C / 100 m
Storage:   - 25 °C ... + 75 °C
**Altitude:**   ≤ 2000 m
**Clearance and creepage
distance**
Rated impulse voltage /
pollution degree
Nominal voltage-heat sink:   6 kV / 2   EN 50178
Relay contacts to supply voltage:   4 kV / 2   IEC 60664-1
Control voltage to auxiliary
voltage, motor voltage:   4 kV / 2   IEC 60664-1
Overvoltage:   III
**EMC**
**Interference resistance**
Electrostatic discharge (ESD):   8 kV (air)   IEC/EN 61000-4-2
HF irradiation:
80 MHz ... 1.0 GHz:   10 V / m   IEC/EN 61000-4-3
1.0 GHz ... 2.5 GHz:   3 V / m   IEC/EN 61000-4-3
2.5 GHz ... 2.7 GHz:   1 V / m   IEC/EN 61000-4-3
Fast transients:   2 kV   IEC/EN 61000-4-4
Surge 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
Voltage dips   IEC/EN 61000-4-11

**Interference emission**
Wire guided:   Limit value class B   IEC/EN 60947-4-2
Radio irradiation:   Limit value class A*)   IEC/EN 60947-4-2

**Info**
**Danger of emitted interference!**
May cause property damage
*) The device is designed for use in an industrial environment (class A, EN 55011). Connecting the device to a low voltage supply grid (class B, EN 55011) may cause radio frequency interference. Take suitable measures to avoid this.

**Degree of protection**
Housing:   IP 40   IEC/EN 60529
Terminals:   IP 20   IEC/EN 60529
**Housing:**   Thermoplastic with V0 behaviour according to UL subject 94
**Vibration resistance:**   Amplitude 0.35 mm, Frequency 10 ... 55 Hz,   IEC/EN 60068-2-6
**Climate resistance:**   25 / 075 / 04   IEC/EN 60068-1
**Terminal designation:**   EN 50005
**Wire connection**
Load terminals:   1 x 10 mm² solid
1 x 6 mm² stranded ferruled
A current of 60 A or 80 A is permitted at a.m. duty cycles for 6 mm² wiring
Control terminals:   1 x 4 mm² solid or
1 x 2.5 stranded ferruled (isolated) or
2 x 1.5 mm² stranded ferruled (isolated)
DIN 46228-1/-2/-3/-4 or
2 x 2.5 mm² stranded ferruled
DIN 46228-1/-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 60715
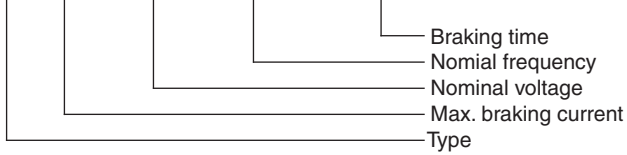**Rail standard:**   EN 50022
**Weight:**   780 g

**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

BI 9034   60 A   AC 400 V   50 / 60 Hz   2 ... 11 s

- Braking time
- Nomial frequency
- Nominal voltage
- Max. braking current
- Type

## 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 (+ 24 V) and X4 (signal) star-delta starting beginns 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 braking process can also be started without a contact at X3-X4. This is the case if no closed contact is detected at X3-X4 when the auxiliary voltage is switched on. In this case, the braking process is started as soon as the opening of the mains contactor is detected by the voltage dropping at the motor connection terminals. This can significantly increase the braking delay time.

The variant /800 has an extra input X6 (+ 24 V) and X7 (signal) to give feed back from the short circuit contactor K2. The braking cycle is only started when the feed back 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<br>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

## Adjustment Facilities

BI 9034:

| Potentiometer | Description | Grundeinstellung |
|---|---|---|
| $I_{Br}$ | Braking current | Fully anti-clockwise |
| Fkt | Function | Fully anti-clockwise |

BI 9034/800:

| Potentiometer | Benennung | Grundeinstellung |
|---|---|---|
| $t_{Br}$ | Braking time | Fully clockwise |

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<br>Relay 1 - Motor contactor<br>Relay 2 - Star-contactor<br>Relay 3 - Triangle contactor<br>Relay 4 - Stand still |
| Acceleration time (star-contactor): | Fkt   1 - 20 s<br>Fkt   2 - 15 s<br>Fkt   3 - 10 s<br>Fkt   4 -   5 s |
| Fkt 5: | Star-Delta-control with external timing<br>Relay 1 - Motor contactor<br>Relay 2 - Star-contactor<br>Relay 3 - Ready<br>Relay 4 - Stand still |
| Fkt. 6-8: | Not occupied. Are treated as fkt. 5. |

## 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 (exept 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

| Flashes | Fault | Reason | Failure recovery |
|---|---|---|---|
| 1 x | Mains frequency out of tolerance | Wrong mains frequency | Device not suitable for the frequency. Contact manufacturer |
| 2 x | Breaking current is not present | Braking current circuit broken | Check the wiring |
| | | Motor coil resistance is too high | Set braking current lower until the error disappears |
| 3 x | Power semiconductors overheated | Permitted duty cycle exceeded | Decrease current and set the braking time longer. Wait till heat sink cools down |
| 4 x | Synchronisa-tions signal is not present | Unit defective | The unit has to repaired |
| | | Or temporary interruption of power supply | Switch unit Off and On |
| 5 x | Temperature measuring circuit defective | Unit defective | The unit has to repaired |
| | | Or overtemperature on power semiconductors while switching on | Wait till heat sink cools down |
| 6 x | Motor is still connected to voltage while braking should start already | Motor contactor welded | Change motor contactor |
| | | Wiring incorrect | Check wiring |
| 7 x | Short circuit contactor not de-energised when braking cycle should be started | Short circuit contactor welded, faulty wiring | Exchange short circuit contactor, check wiring |

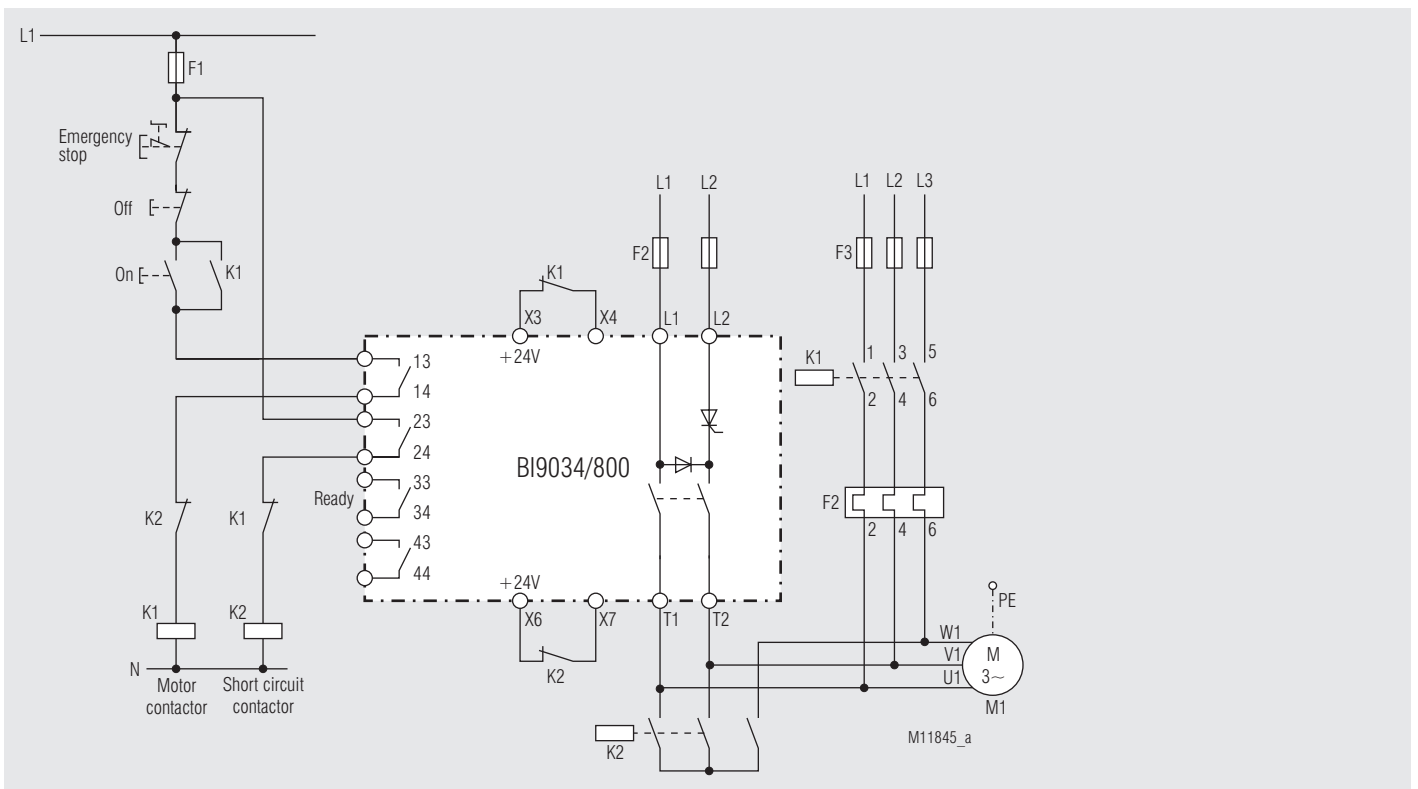**Connection Examples**
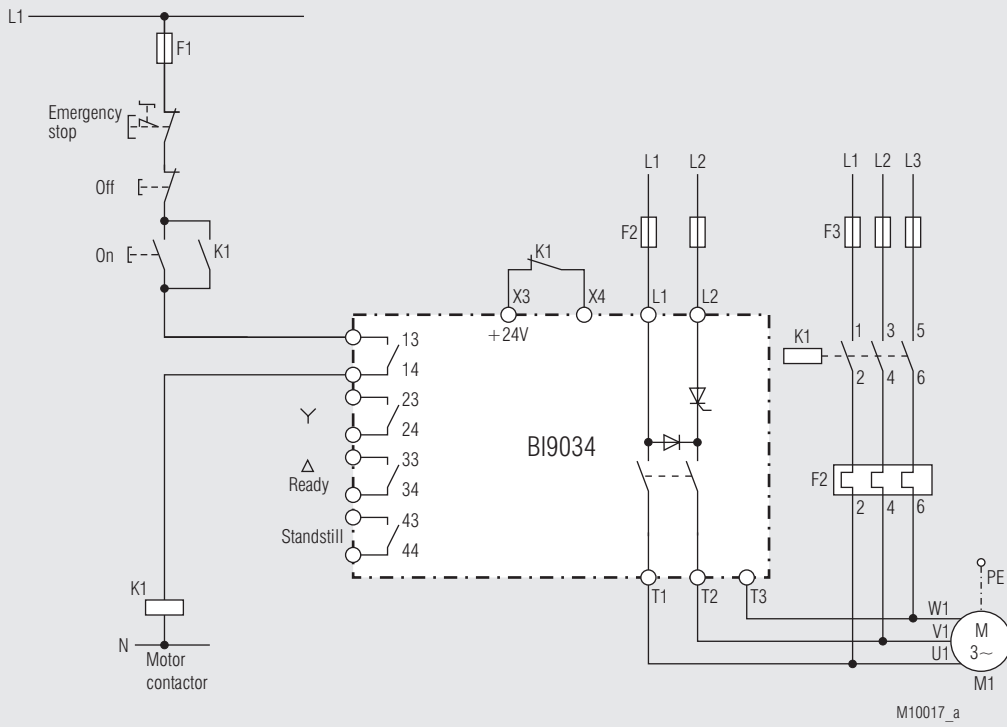


BI 9034 without star-delta-control
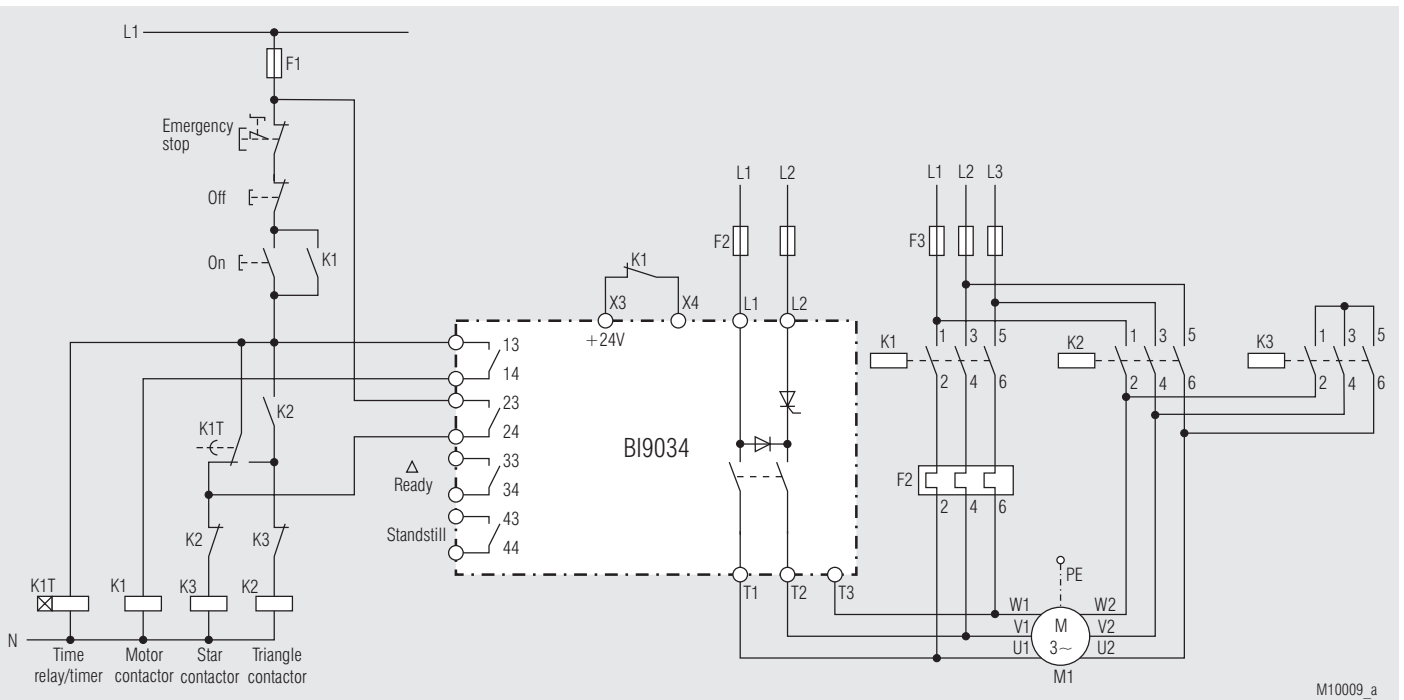


BI 9034 with external star-delta-control
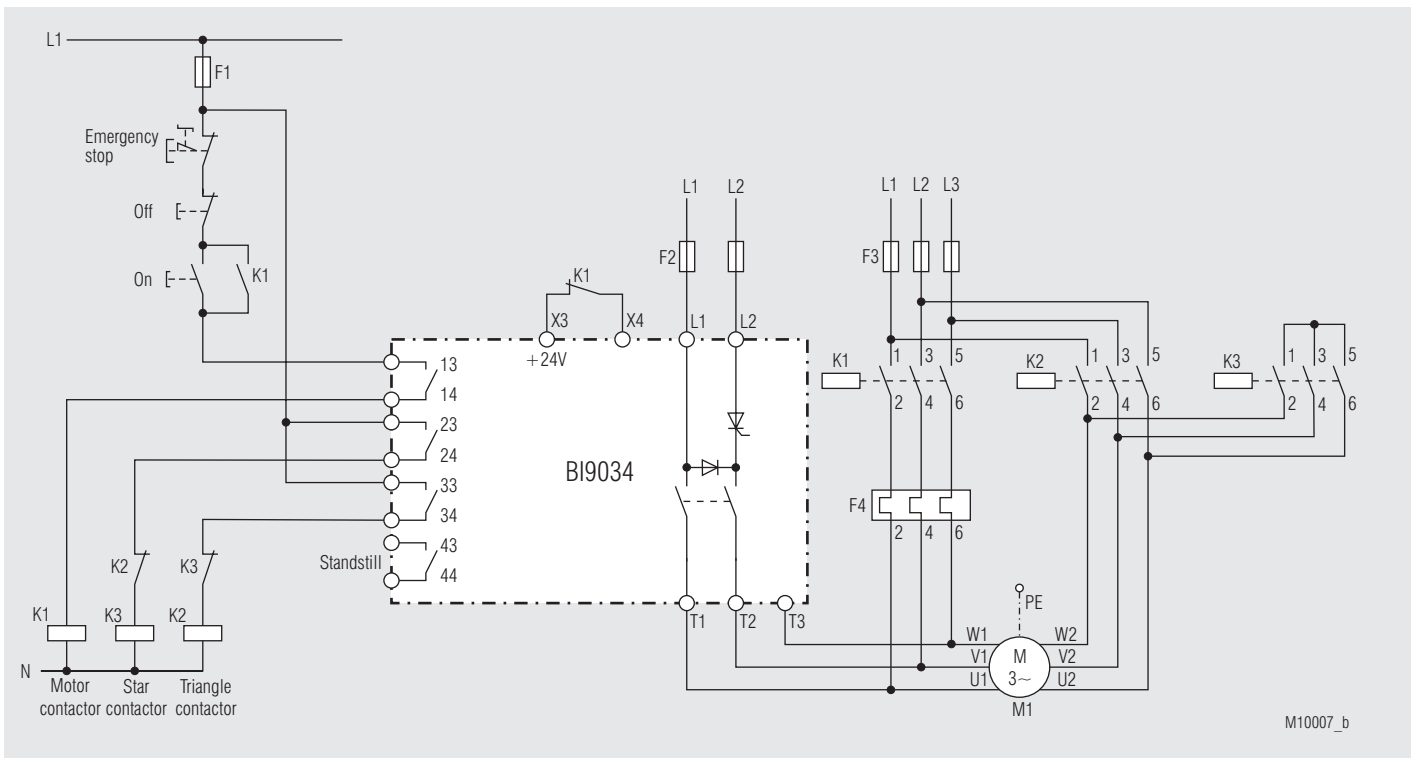
BI 9034 with internal star-delta-control

BI 9034/800 with reduced brake delay time