# SAFEMASTER
# Emergency Stop Module with voltage failure detection
# BH 5903, BL 5903

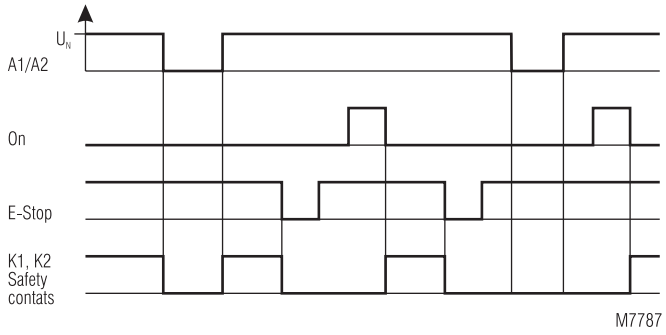
0235200

BH 5903.03

BL 5903

- **According to**
  - **Performance Level (PL) e and category 4 to EN ISO 13849-1: 2008**
  - **SIL Claimed Level (SIL CL) 3 to IEC/EN 62061**
  - **Safety Integrity Level (SIL 3) to IEC/EN 61508**
  - **Category 4 to EN 954-1**
- **E-stop with latching function**
- **Automatic start when voltage returns after phase failure when no E-Stop was operated before phase failure.**
- Reset after E-stop with push button
- Output max. 3 NO contacts, see contacts
- B_ 5903._ _ /00000: 1 E-stop loop 2-channel operated
- B_ 5903._ _ /00020: 2 E-stop loops single channel operated
- Cross fault monitoring
- Feedback loop for external contact reinforcement
- Short circuit and broken wire detection on all inputs
- LED indication for channel 1 and 2 and for diagnostics
- Removable terminal strips
- Wire connection: also 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
- BH 5903: width 45 mm
  BL 5903: width 90 mm

## Function Diagram




## Approvals and Marking

Functional Safety Type Approved
TÜVRheinland
FS
c UL us LISTED
Canada / USA
*

* see variants

## Indication

upper yellow LEDs
run 1, run 2: on when unit works correct, fault signal via flashing code

lower green LEDs
K1, K2: on when K1, K2 energized

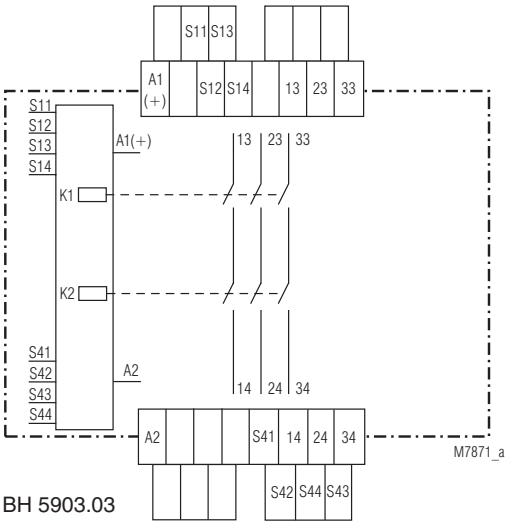
## Applications

- For plants, that should start automatically at return of voltage after phase failure. E.g. Compressor plants, water and sewage water plants.

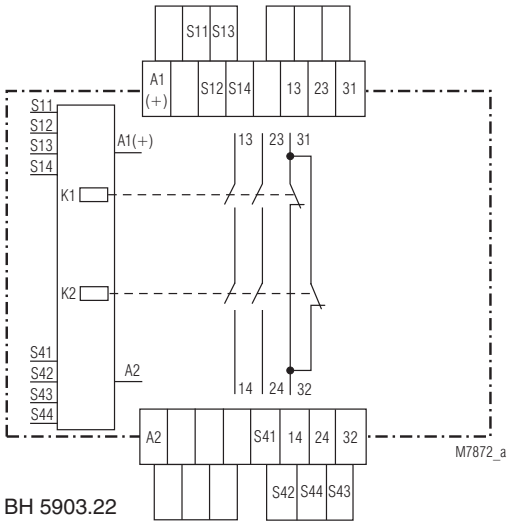
## Notes

- **The BH 5903 e.g. BL 5903 stores the state of emergency stop. After pressing and releasing the e-stop button the unit can only be reset by pressing the button. If the unit switches off because of phase failure it resets automatically when the voltage returns**
- The unit monitors how long the on button is pressed. Is the duration longer then 3 sec it does not switch on.
- The NC contact 31-32 (BH 5903.22 e.g. BL 5903.22) is only a monitoring contact.

## Circuit Diagrams

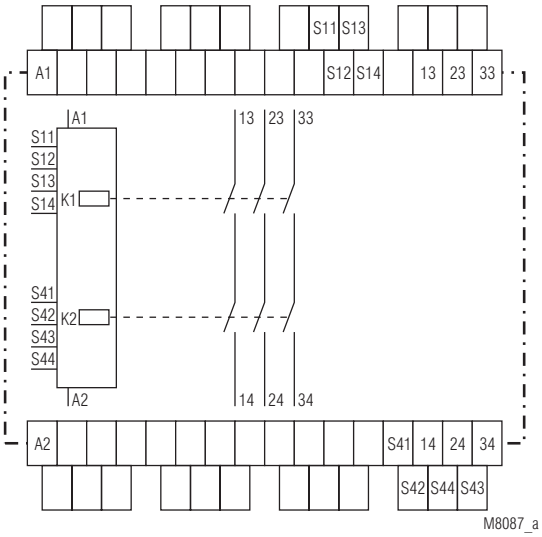



BH 5903.03

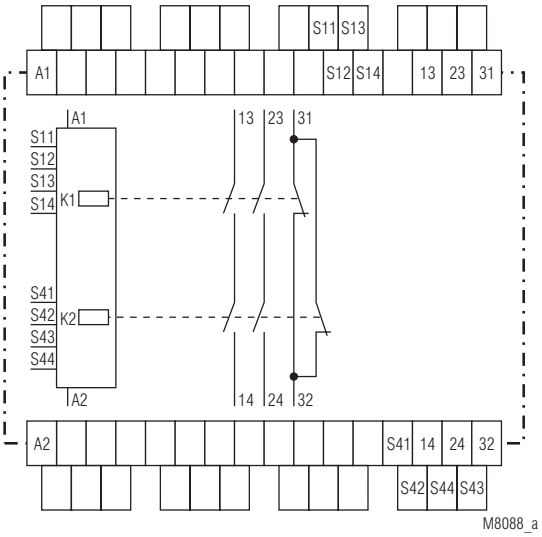



BH 5903.22

## Circuit Diagrams




BL 5903.03




BL 5903.22

## Technical Data

### Input

| | BH 5903 | BL 5903 |
|---|---|---|
| **Nominal voltage $U_N$:** | DC 24 V | AC 24, 110, 230 V |
| **Voltage range:** | - | 0.8 ... 1.1 $U_N$ |
| at max. 5 % residual ripple: | 0.85 ... 1.15 $U_N$ | - |
| **Nominal consumption:** | max. 170 mA | max. 7 VA |
| **Nennfrequenz:** | - | 50 / 60 Hz |
| **Control voltage over S11, S13, S41, S43:** | pulses max. 23 V at $U_N$ | |
| **Control current over S12, S14, S42, S44:** | je 4.5 mA bei $U_N$ | |
| **Min. voltage at terminals S12, S14, S42 S44:** | DC 16 V | |
| **Short circuit protection:** | internal with PTC | |

### Output

| | | |
|---|---|---|
| **Contact** | | |
| BH 5903.03: | 3 NO contacts | |
| BH 5903.22: | 2 NO, 1 NC contacts (only to be used as monitoring contact) | |
| **Operate delay typ. at $U_N$:** | | |
| Manual start: | max. 45 ms | |
| Automatic start: | max. 800 ms, if voltage failure > approx. 150 ms<br>max. 7 s, if voltage failure < approx. 150 ms | |
| **Release delay typ. at $U_N$:** | | |
| Disconnecting the supply: | max. 18 ms | |
| Disconnecting S12, S22: | 15 ms | |
| **Contact type:** | Relay, forcibly guided | |
| **Output rated voltage:** | AC 250 V<br>DC: see continuous limit curve | |
| **Switching of low loads:** | ≥ 100 mV | |
| **Thermal current $I_{th}$:** | 5 A | |
| **Switching capacity** | | |
| to AC 15: | | |
| NO contact: | AC 3 A / 230 V | IEC/EN 60 947-5-1 |
| NC contact: | AC 2 A / 230 V | IEC/EN 60 947-5-1 |
| to DC 13 at 0.1 Hz: | 8 A / DC 24 V | IEC/EN 60 947-5-1 |
| **Electrical life** | | |
| to AC 15 at 2 A, AC 230 V: | $10^5$ switching cycles | IEC/EN 60 947-5-1 |
| **Permissible switching frequency:** | max. 1 200 switching cycles / h | |
| **Short circuit strength** | | |
| max. fuse rating: | 6 A gL | IEC/EN 60 947-5-1 |
| line circuit breaker: | C 8 A | |
| **Mechanical life:** | 10 x $10^6$ switching cycles | |

### General Data

| | | |
|---|---|---|
| **Operating mode:** | Continuous operation | |
| **Temperature range** | | |
| operation: | ± 0 ... + 50 °C | |
| storage : | - 25 ... + 85 °C | |
| **altitude:** | < 2.000 m | |
| **Clearance and creepage distances** | | |
| rated impuls voltage / pollution degree: | 4 kV / 2 (basis insulation) | 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 |
| **Housing:** | Thermoplastic with V0 behaviour according to UL subject 94 | |
| **Vibration resistance:** | Amplitude 0.35 mm<br>frequency 10 ... 55 Hz | IEC/EN 60 068-2-6 |
| **Shock resistance:** | | |
| Acceleration: | 10 g | |
| Duration of impuls: | 16 ms | |
| Number of shocks: | 1000 per axis on all three axes | |
| **Climate resistance:** | 0 / 050 / 04 | IEC/EN 60 068-1 |
| **Terminal designation:** | EN 50 005 | |
| **Wire connection:** | 1 x 4 mm² solid or<br>1 x 2.5 mm² stranded ferruled (isolated) or<br>2 x 1.5 mm² stranded ferruled (isolated) DIN 46 228-1/-2/-3/-4 or<br>2 x 2.5 mm² stranded ferruled DIN 46 228-1/-2/-3 | |
| **Wire fixing:** | Box terminal with wire protection, removable terminal strips | |
| **Mounting:** | DIN rail | IEC/EN 60 715 |
| **Weight:** | 320 g | |

### Dimensions

| | |
|---|---|
| **Width x height x depth** | |
| BH 5903: | 45 x 84 x 121 mm |
| BL 5903: | 90 x 84 x 121 mm |

## Technical Data

### Safety Related Data

**Values according to EN ISO 13849-1:**

| | | |
|---|---|---|
| Category: | 4 | |
| PL: | e | |
| $MTTF_d$: | 180.9 | a |
| $DC_{avg}$: | 97.9 | % |
| $d_{op}$: | 365 | d/a (days/year) |
| $h_{op}$: | 24 | h/d (hours/day) |
| $t_{Zyklus}$: | 3600 | s/Zyklus |
| | ≙ 1 | /h (hour) |

**Values according to IEC/EN 62061 / IEC/EN 61508:**

| | | |
|---|---|---|
| SIL CL: | 3 | IEC/EN 62061 |
| SIL | 3 | IEC/EN 61508 |
| HFT*): | 1 | |
| $DC_{avg}$: | 97.9 | % |
| SFF | 99.4 | % |
| $PFH_D$: | 5.57E-10 | $h^{-1}$ |

*) HFT = Hardware-Failure Tolerance

The values stated above are valid for the standard type.
Safety data for other variants are available on request.
The safety relevant data of the complete system has to be determined by the manufacturer of the system.

## UL-Data

**The safety functions were not evaluated by UL. Listing is accomplished according to requirements of Standard UL 508, "general use applications"**

**Nominal voltage $U_N$:** DC 24 V

**Ambient temperature:** 0 … +50°C

**Switching capacity:**

| | |
|---|---|
| Ambient temperature 50°C: | Pilot duty B300<br>5A 250Vac G.P.<br>5A 24Vdc |
| Semiconductor outputs: | 24Vdc, 100 mA |

**Wire connection:** 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

BL 5903.03/00000 AC 230 V

| | |
|---|---|
| Article number: | 0053510 |
| • Output: | 3 NO contacts |
| • for 1 E-stop loop, 2 channel operated | |
| • Nominal voltage $U_N$: | AC 230 V |
| • Width: | 45 mm |

## Variants

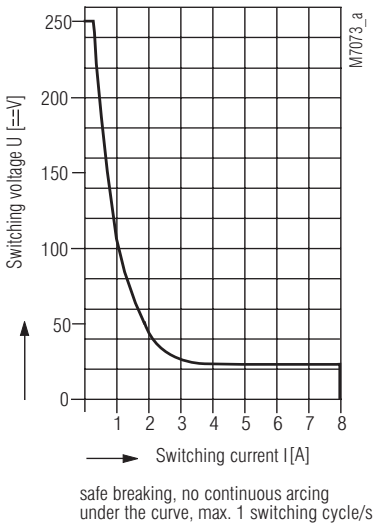
| | |
|---|---|
| B_ 5903._ _/00000: | for 1 E-stop loop 2- channel operated |
| B_ 5903._ _/00020: | for 2 E-Stop loops singel channel operated |
| BH 5903._ _/_ _ _ _ _/61: | with UL-approval |

**Ordering example for variant**

B_ 5903. _ _ /_ _ _ _ _ _ _ _ _ _ V

- Nominal voltage:
  - DC 24 V (BH 5903)
  - AC 24 V (BH 5903)
  - AC 110 V (BL 5903)
  - AC 230 V (BL 5903)
- Variant
- Contacts:
  - .03 3 NO contacts
  - .22 2 NO contacts, 1 NC contact
- Type:
  - BH: width 45 mm
  - BL: width 90 mm

## Characteristics




Continuous limit curve

## Fault Indication by flashing code

The failure codes are displayed by a flashing sequence of the upper yellow LEDs run 1, run 2. Flashing frequence: env. 0.5 s on, 0.05 s off, end od the sequence: env. 2 s off. It is possible that the two processors show different failure codes. If a failure is displayed, the relays K1 and K2 are switched off.
The module BH 5904 shows 2 types of failure codes:

**1. FAILURE type 1:**
These failures are serious and do not allow further operation of the module. The module can only be reset by switching the power supply off and on again.

**2. FAILURE type 2:**
This failure is concerning the function faults in conjunction with the safety controller. The module can be reset by pressing the reset button.

### Failure type 1

| No*) | Description | Mesures et conseils |
|---|---|---|
| 0 | Internal module failure (LEDs are continuously off) | If both LEDs stay off, the module is defective and has tobe repaired. |
| 6 | Undervoltage detection or Overvoltage detection | 1) Left LED is flashing: The supply voltage dropped below the permitted value (< approx.0.85 $U_N$) 2) Right LED is flashing: The supply voltage went over the permitted value (> approx.1.15 $U_N$ + 5 % residual ripple) |
| 7 | Input failure | A short circuit has been detected on the inputs ofthe unit ou the 2 signals of a 2-channel sensor (feed backcircuit, start signal ofcontroller, valve) do not correspond (short circuit,broken wire or other fault) |
| 8 | Failure on relay output | Output relay defective 1) Check circuit and current. 2) The relay service life is crossing |
| 9 10 11 | Internal module failure | Please try to evaluate the circumstances that lead to this10 fault and check with the supplier or manufacturer. |
| 12 13 14 | Internal module failure | The module has to be repaired |

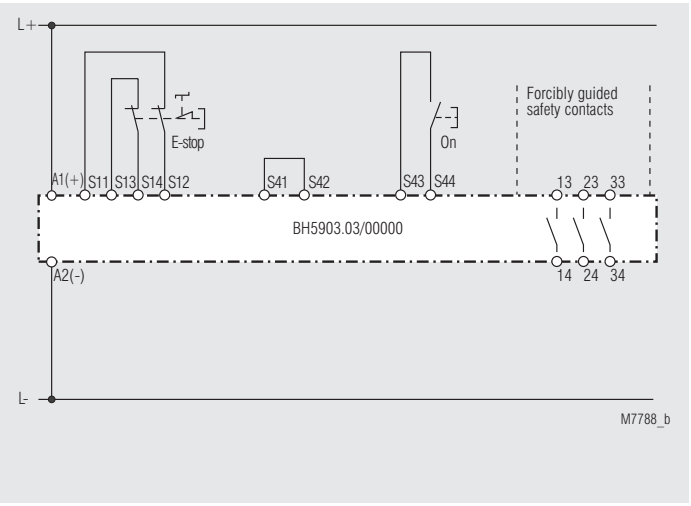
*) No.: Number of flash pulses in a series

### Failure type 2

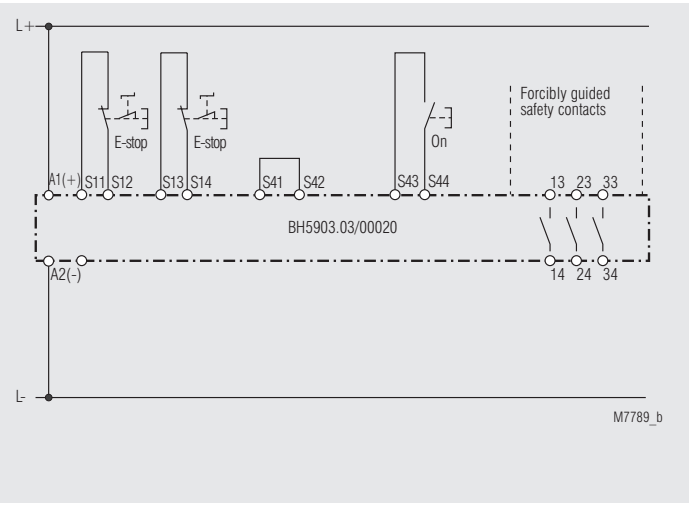
| No*) | Description | Mesures et conseils |
|---|---|---|
| 1 | E-stop acitvated | |
| 2 | Fault on reset button | 1) The start button must no be pressed longer then 3 sec. 2) During start up of the unit and initialising the start button must not be pressed |
| 4 | Switch off fault | The unit showed already a fault before switching off |
| 6 | Feedback failure | Both LED are flashing Feedback on S41/S42 not closed |

*) No.: Number of flash pulses in a series

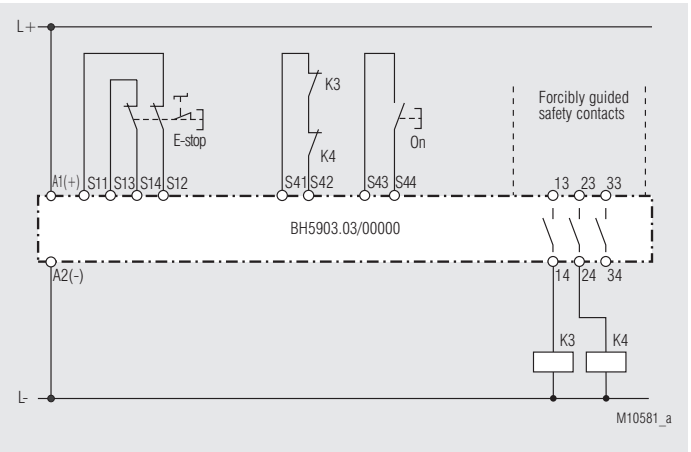
## Application Examples




BH 5903.03/00000 with one E-Stop loop (2-channel), automatic restart after phase failure and manual restart after E-stop.
Automatic reset ist only active when no E-Stop was operated before phase failure.




BH 5903.03/00020 with two E-Stop loops (single-channel), automatic restart after phase failure and manual restart after E-stop.
Automatic reset ist only active when no E-Stop was operated before phase failure.
Max. Cat. 3, PL d because of faullt exclusion in the wiring.




BH 5903 with external contact reinforcement