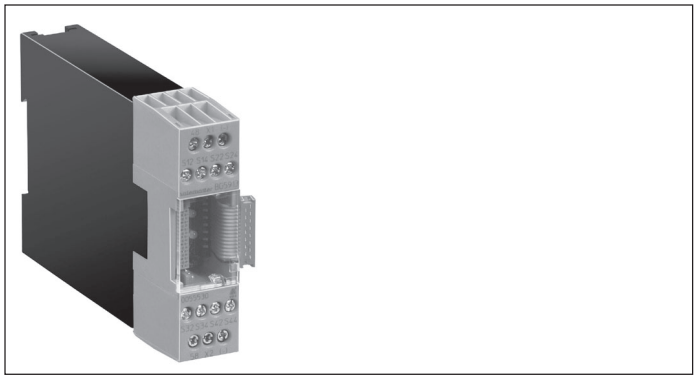
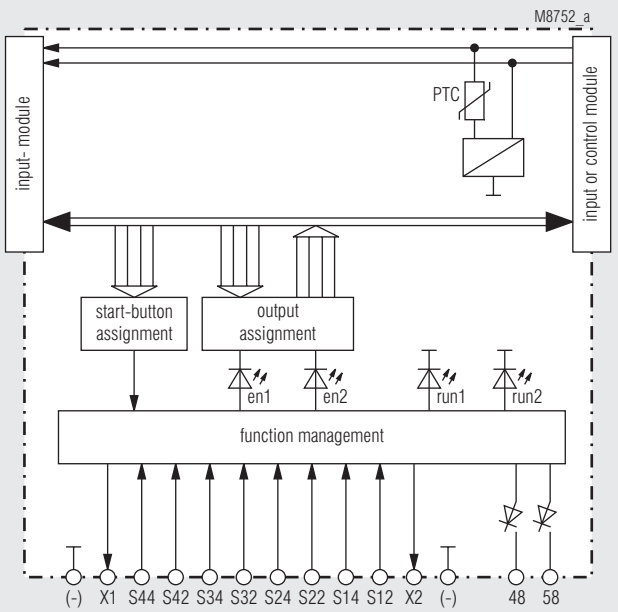
Multi-Function Safety System Safemaster M
Input Module BG 5913.08/_2_ _ _

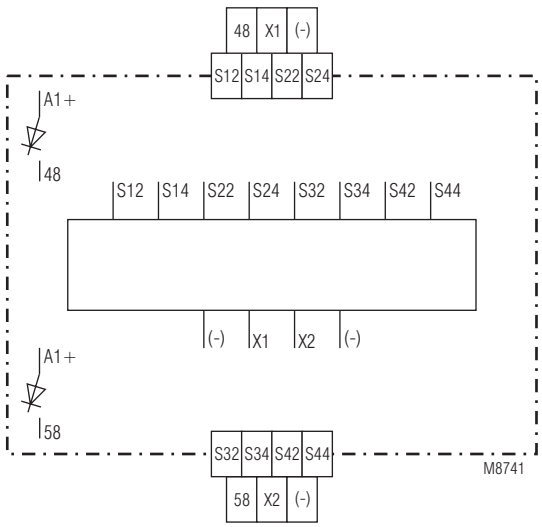


- According to the Machine Directive 98/37/EC
- According to IEC/EN 60 204-1, EN 954-1, DIN/EN 574
- Safety category 4 according to EN 954-1
- Input module for combination of 4 of the following functions to be set via rotary switch:
  - safety gate monitoring function (2 x 2 changeover contacts)
  - Light curtain (LC type 4) with manual or automatic start
  - Emergency stop (2-channel) with manual or automatic start
  - Two-hand controls type IIIC acc. to DIN/EN 574
- Functions can be selected via rotary switches
- 8 inputs for safety sensors
- Broken wire and short circuit monitoring function with error indication
- 2 semiconductor outputs for status indication
- LEDs for status indication
- Overall width: 22.5 mm

Block Diagram



Circuit diagram



Approvals and Marking

C US Canada/USA

Applications

Realization of fail-safe control circuits for protection of people and machinery

Note: This module is intended for applications in which mixed safety functions affect one common output and in which the gates are equipped with changeover contacts.

Further input modules with other combinations of functions are provided (e.g. BG 5913.08/_0_ _ _, BG 5913.08/_1_ _ _, BG 5913.08/_3_ _ _, BG 5914.08/_0_ _ _, BH 5914.08/_0_ _ _ or BG 5914.08/_1_ _ _).

General information safemaster M

The maximum configuration of the safemaster M multi-function safety system is as follows:

- the control unit BH 5911
- up to 3 input modules BG 5913, or BG/BH 5914
- up to 3 output modules BG 5912
- 1 diagnostic module BG 5551 for CANopen, or
- 1 diagnostic module BG 5552 for Profibus-DP

The BH 5911 controls the whole system.

The input/output modules can be used to expand the control unit in a modular way into a multi-functional safety system.

To transmit status messages of the individual modules to a monitoring or control unit, one of the following diagnostic modules may be connected:

- BG 5551 for CANopen
- BH 5552 for Profibus-DP

Indication

Green LEDs: on, when all inputs are present and start button activated.

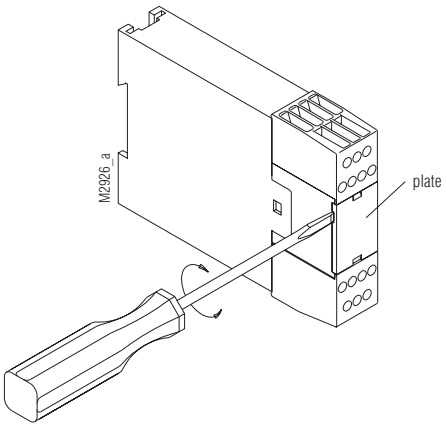
Yellow LEDs Run1/ Run 2 and outputs 48 and 58: indicate the current status of the module.

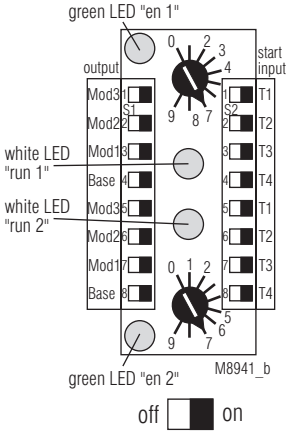
	Permanently OFF	Pulsing	Permanent ON
Output 48	all relays inactive due to system error	one input function not available	Activation of the assigned safety outputs is permissible
LED Run 1	Two-hand control not activated (LED run 2 ON) or all relays inactive due to system error	one input function not available (LED run 2 ON) or system error when LED Run 2 is OFF or flashing	Activation of the assigned safety outputs is permissible
Output 58	Activation of the assigned safety outputs is permis-sible or system error	Error exists no more, waiting for Start input	one input function not available
LED Run2	all relays inactive due to system error	all relays inactive due to system error	No system error

Setting of the Module

The module is assigned to the start inputs and the safety outputs via the DIP switches.

The combinations of individual functions are set via the rotary switches. To prevent accidently adjustments, these elements are covered by a front plate and are redundant.





Note:

- Settings to the unit must be performed by skilled personnel while the unit is disconnected.
- Before the front cover is removed, antistatic precautions must be observed.

Sw.	Function at terminals: S12-S14	S22-S24	S32-S34	S42-S44	Start behavior of the LC or of Emergency stop	
0	Safety gate		Emer.stop	LC	Autostart	
1	Safety gate		Emer.stop	LC	Man. start	
2	Emer.stop	Emer.stop	Emer.stop	Emer.stop	Autostart	Enabling only when all other modules permit enabling
3	Emer.stop	Emer.stop	Emer.stop	Emer.stop	Man. start	
4	Emer.stop	Emer.stop	Emer.stop	Emer.stop	Autostart	
5	Emer.stop	Emer.stop	Emer.stop	Emer.stop	Man. start	
6	Emer.stop	Emer.stop	Two-hand IIIC		Autostart	
7	Emer.stop	Emer.stop	Two-hand IIIC		Man. start	
8	Safety gate		Two-hand IIIC			
9	LC	LC	Two-hand IIIC		Autostart	

Functional Principle of combined inputs

Each function activates an enabling signal in the module software. The control unit is permitted to enable the assigned safety outputs only after all 3 (for two-hands control) or 4 enablings have been given.

With the exception of two-hand control, each function works independently. The assigned safety outputs are enabled if the precondition for enabling has been met for all functions.

Function of the Two-Hand Control

This function will only work when the other two functions have already permitted enabling. To provide for enabling, the two buttons must be pressed within 0.5 s. As soon as one of the other function reacts, the two buttons must turn inactive before the others can be enabled again. Only after that, the buttons can be activated once more from an inactivated state.

The unit must be connected as specified in the application examples. When the operating contacts are connected in parallel or in series, safe functioning of the unit is cancelled.

The two-hand buttons must be designed and arranged in such a way as to ensure that they cannot be disabled with easily, or pressed unintentionally.

The safety distance between the push buttons and the place of danger must be large enough to make sure that after releasing a button, the place of danger can only be reached after the dangerous movement has stopped.

The safety distance “S” is calculated according to the following formula:

S = V x T + C, where

a) gripping velocity V = 1 600 mm/s
b) overtravel time T (s)
c) and safety factor C = 250 mm.

When any access into the danger area, with operating keys pressed, is safely prevented, e.g. by a protective cover for the keys, the safety factor C may be set to the value 0. Generally, the minimum safety distance must be 100 mm. In this respect, also see DIN/EN 574.

The two-hand control must be released when another function module which affects the same outputs does not permit enabling.
The system may comprise only one function module with two-hand control.

Safety gate function

The safety gate function always permits enabling if both contacts change from inactive to active state within 3 seconds. If the second contact reacts later, both changeover contacts must turn inactive before they can be enabled again.

When activating the system, press the start button to simulate the compulsory opening and re-closing of safety gates which have been kept closed since the system has started.

This simulation is possible only before enabling has been permitted for the first time, and as long as both safety gate contacts remain closed as well. As soon as a contact opens, simulation of the safety gate function is no longer possible.

Emergency Stop or Light Curtain Function (LC)

In the Emergency stop or LC functions, both signals have to change from inactive state into active state within 250 ms. If the second signal reacts later than that, both changeover contacts must turn inactive before they can be enabled again.

With manual start, all safety inputs must be active before the start key can be pressed to trigger enabling.
To start the system, do not keep the start button pressed for more than 3 seconds. A module may also be assigned several start buttons.

Special with rotary switch settings 2 and 3:
With these settings, enabling is permitted only after all the other input modules in the system have permitted enabling. In this case, however, the module must not be assigned to an output module to which another module with the same behavior or with selected two-hand-function has been assigned as well.

Note: The difference between light curtain (LC) and Emergency stop function is that the LC does not recognize short-circuits. For this reason, connect only self-testing LC of the type 4 acc. to EN 61496 to the module. Short-circuit monitoring of the outputs of the LC must take place in the LC itself.

Special with Emergency stop (function setting 2 or 3):
Output status: No Emergency stop has been activated, and the start button has been properly pressed on munual start. Another module fails to permit enabling, irrespective of the output module it is assigned to.
⇒ Output 48 and the yellow LED Run 1 are permanently OFF, and output 58 is permanently ON.
In this state, the module will automatically permit enabling as soon as **all other modules** permit enabling together.

Indication of System Errors:

These errors are indicated by flashing codes of the white LEDs Run 1 and/or Run 2. The green LEDs and all outputs turn inactive. The system will only restart after the supply voltage has been switched off and on again.

Error codes*

0) (both white LEDs are off):
   Another input module indicates a system error.
1) To 4): not used
5) Incorrect setting of function:
   · The rotary switches have different or incorrect positions
6) LED Run 1 flashes: Undervoltage
   LED Run 2 flashes: Overvoltage
7), 8) Not used
9) Connection error between the input modules
   · No terminating connector available.
   · Control or input module defective
10), 11), 12), 13) a. 14) Internal errors

* number of short flashing impulses, followed by a longer space

Indication of Function Errors

Function errors are indicated by the white LED Run 1 and by output 48; the white LED Run 2 remains on. Output 58 remains on as long as the error is pending; it flashes regularly as soon as enabling via the assigned start buttons is possible again:

Error codes*

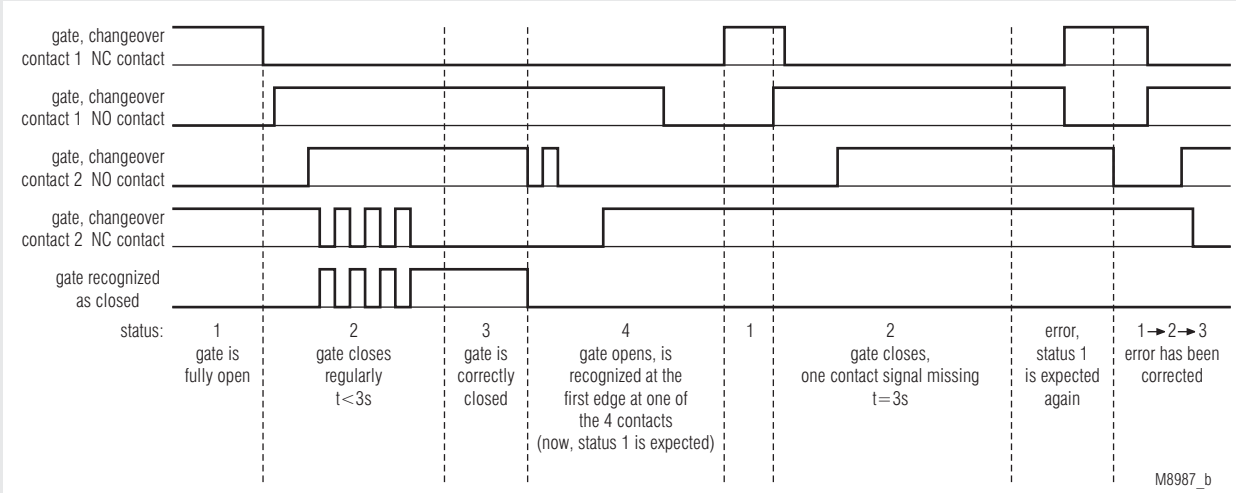
1) Gate open
2) Interruption of LC, or Emergency stop has been pressed
3) Time error: The signals of a function have not become active within the specified time. (250 ms for Emergency stop or LC, 0.5 s with two-hand control, 3 s with gates)
4) Error at the start input (kept pressed for more than 3 s, pressed already when the system is switched on, or pressed in the event of error)
5) Input error (short-circuit, interruption)
6) Error in the control unit (input or output error detected in the control unit)

* number of short flashing impulses, followed by a longer space

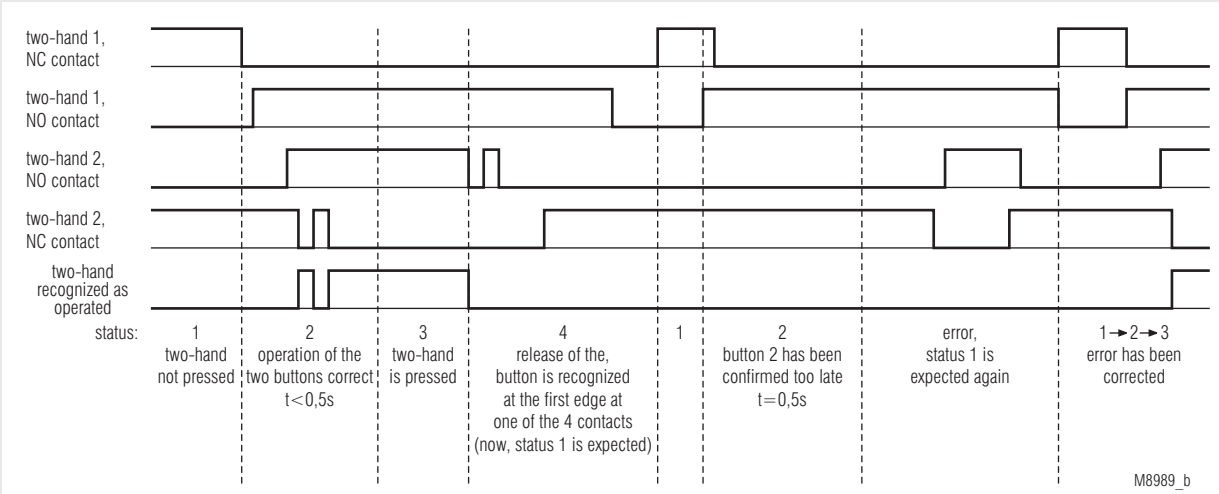
Special with two-hand control:
Output status: Both two-hand buttons of the module are inactive and all other functions are active and enabled either by autostart or via start button. ⇒ Output 48 and the white LED Run 1 remain OFF permanently, and the output 58 remains ON permanently.

Function Diagrams

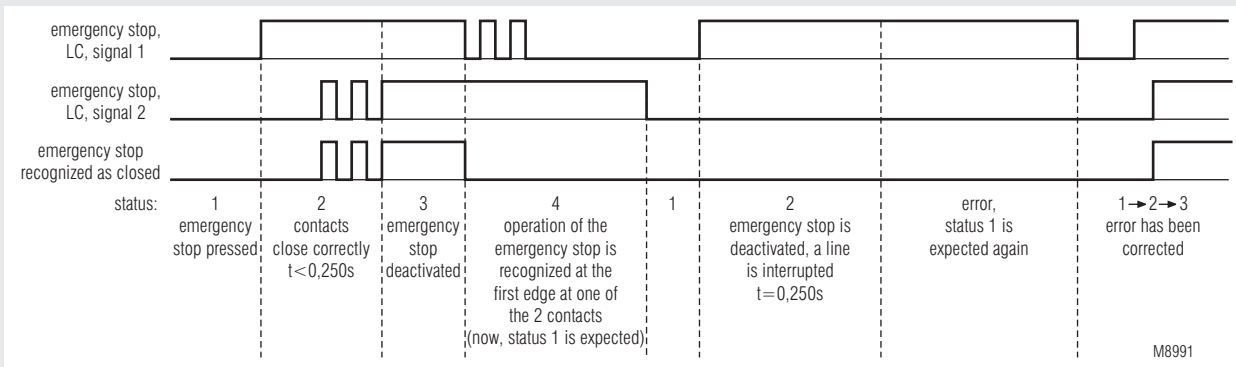
Note: The times specified in a pulse diagram also apply to the same function in other applications.



Safety gate control



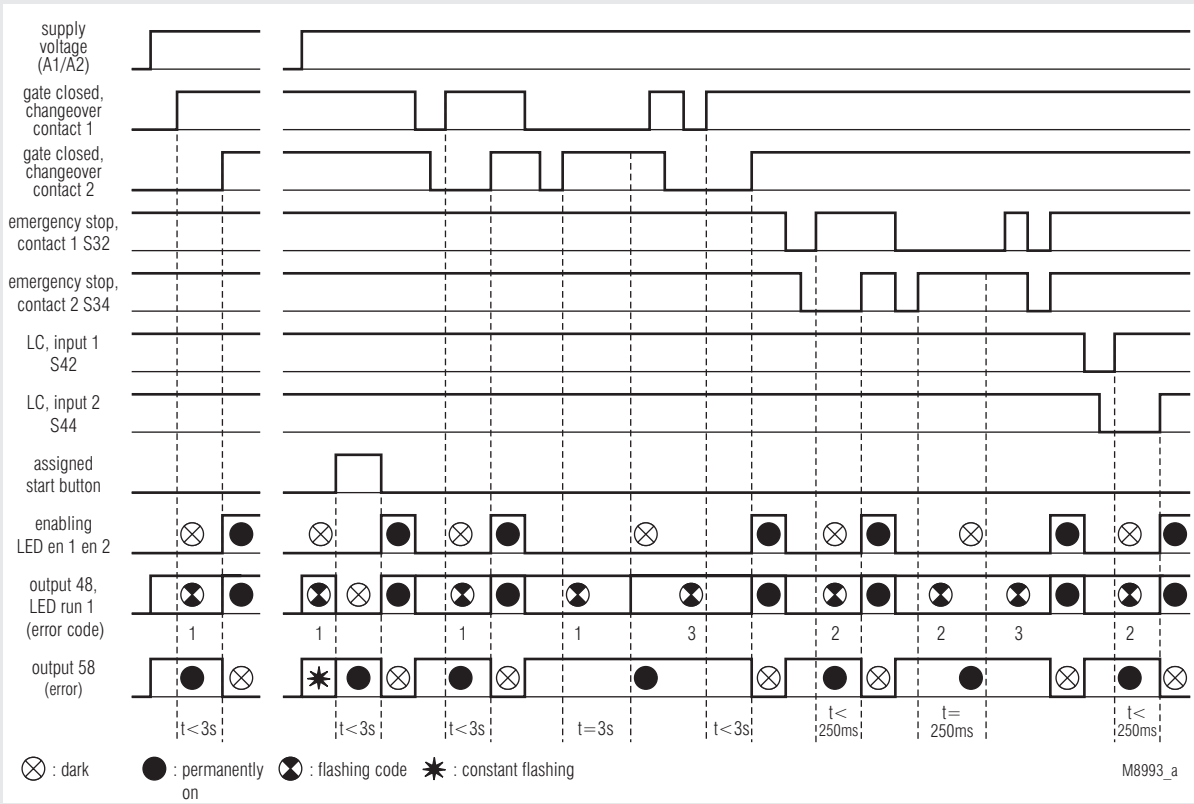
Two-hand control type IIIC



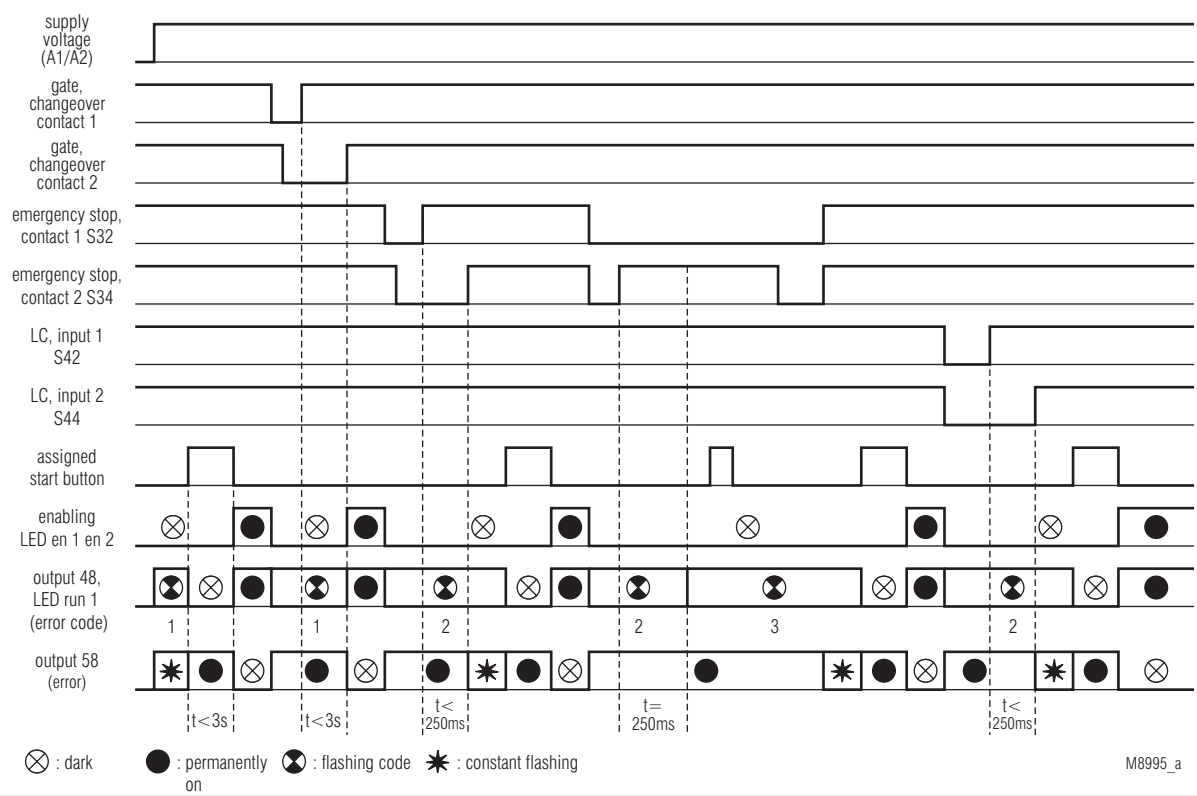
Emergency stop or light curtains

Function Diagrams

Note: The times specified in a pulse diagram also apply to the same function in other applications.



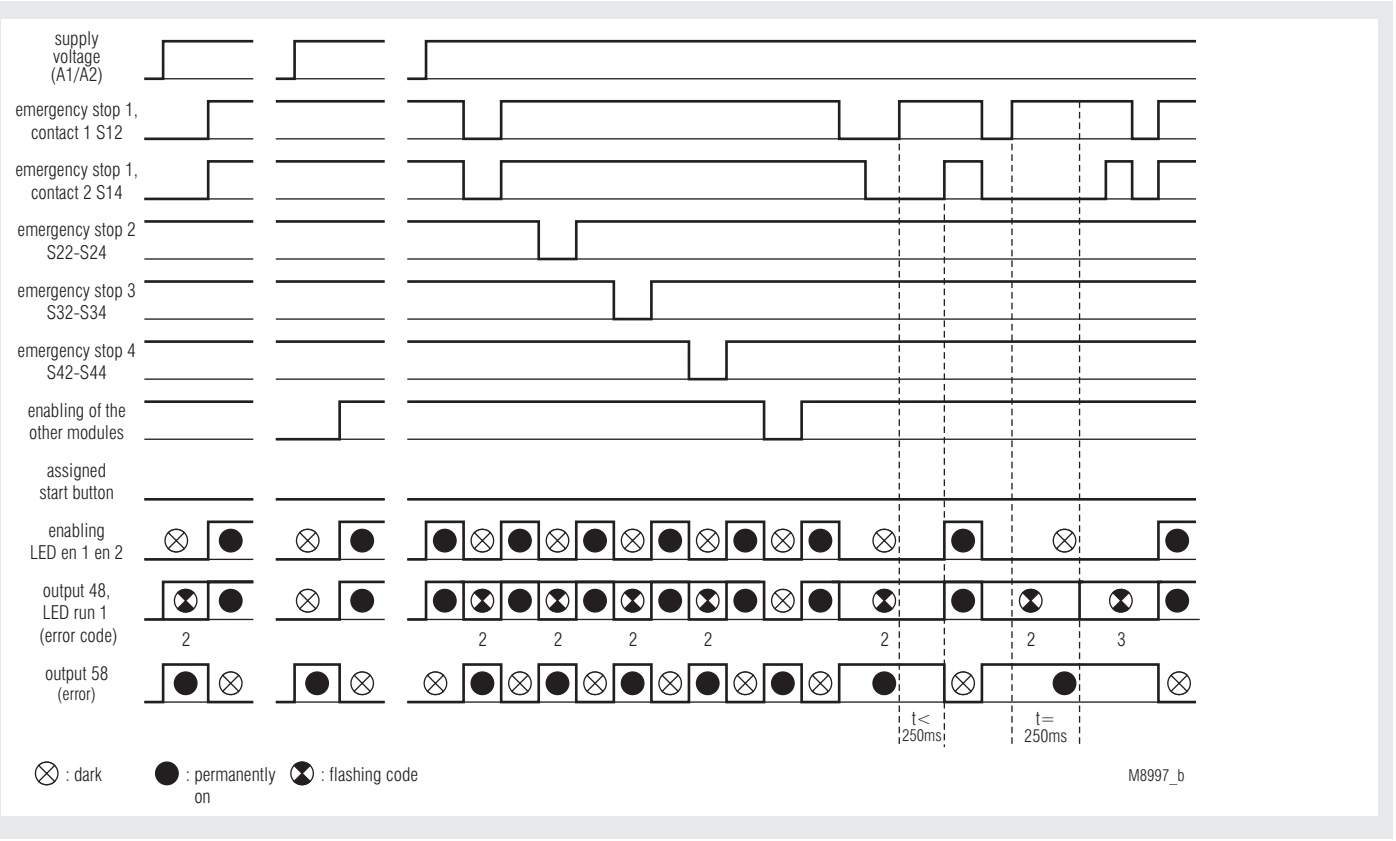
1 Safety gate, 1 Emergency stop, 1 light curtain, Autostart; function: 0



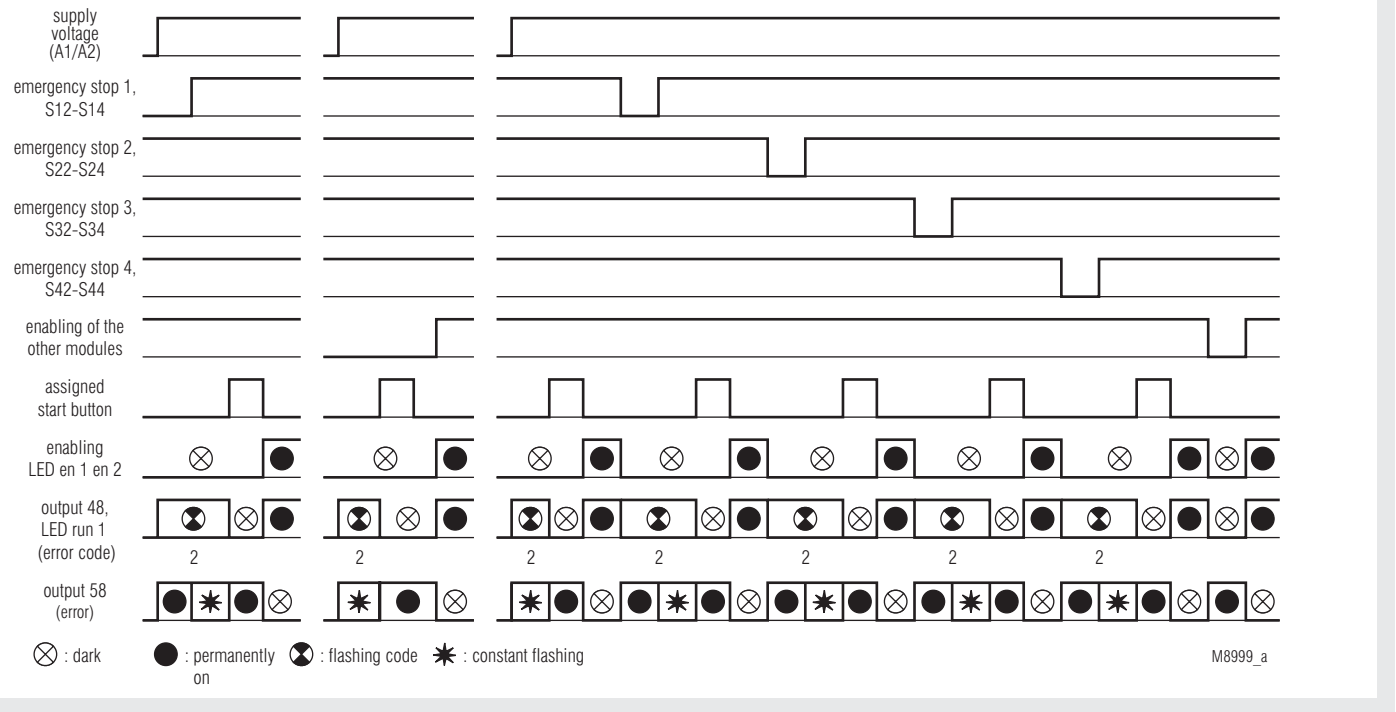
1 Safety gate, 1 Emergency stop, 1 light curtain, manual start; function: 1

Function Diagrams

Note: The times specified in a pulse diagram also apply to the same function in other applications.



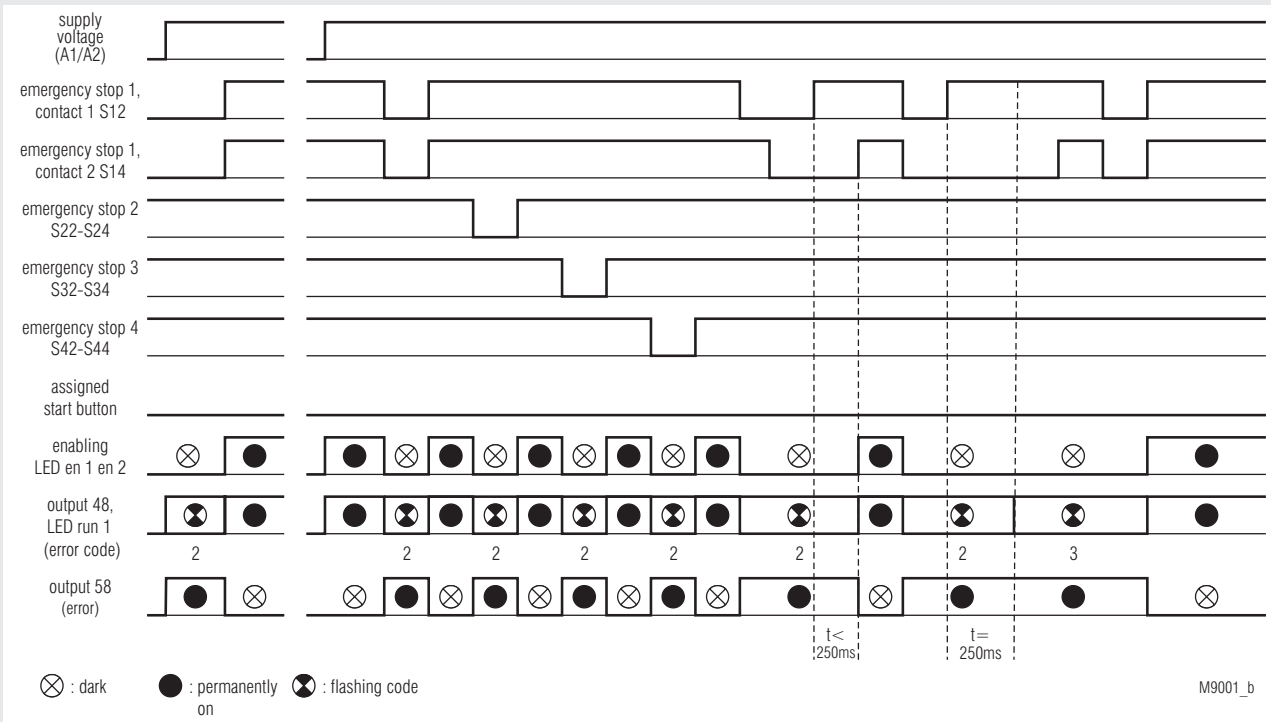
4 Emergency stop, Autostart, only enabling when all the other modules are enabled; function: 2



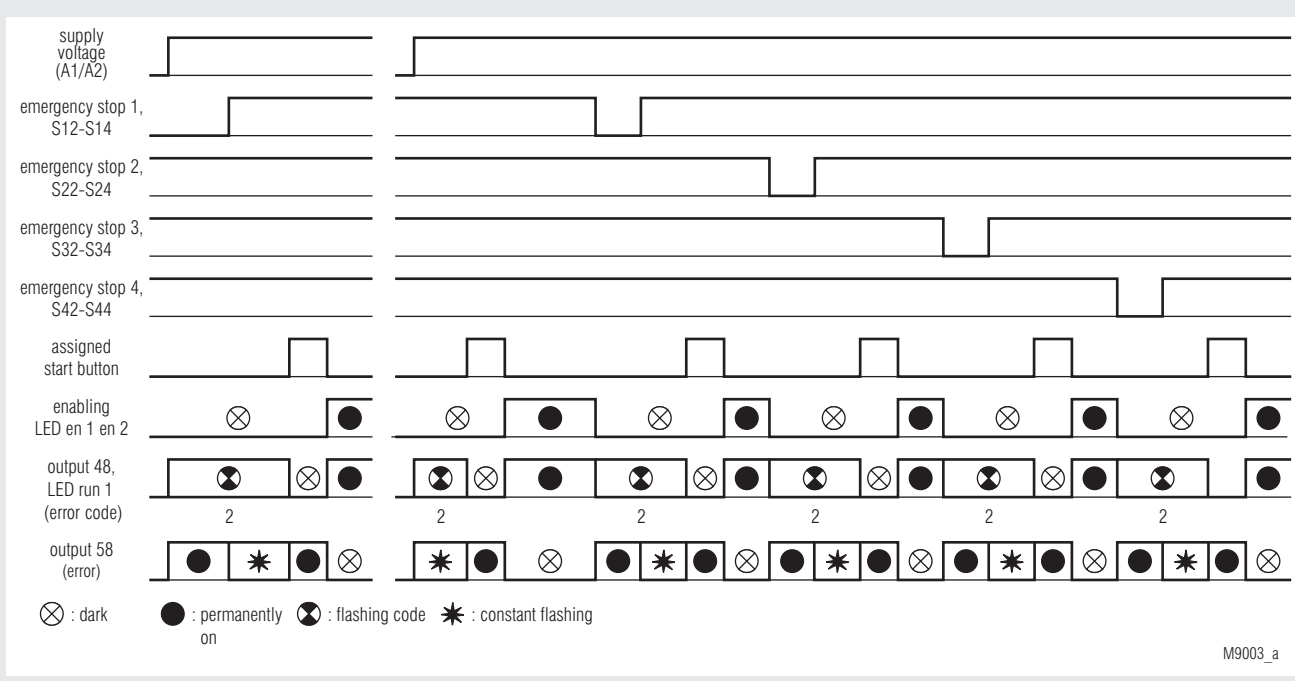
4 Emergency stop, manual start, only enabling when all the other modules are enabled; function: 3

Function Diagrams

Note: The times specified in a pulse diagram also apply to the same function in other applications.



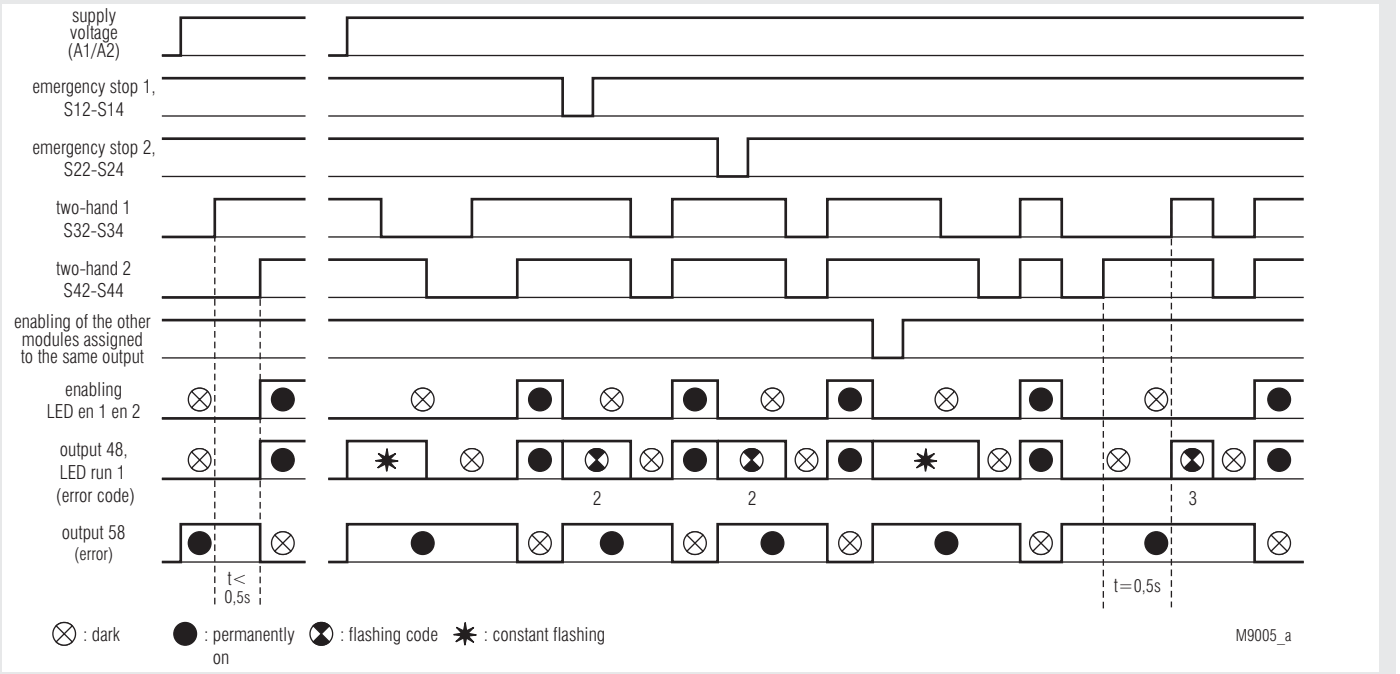
4 Emergency stop, Autostart; function: 4



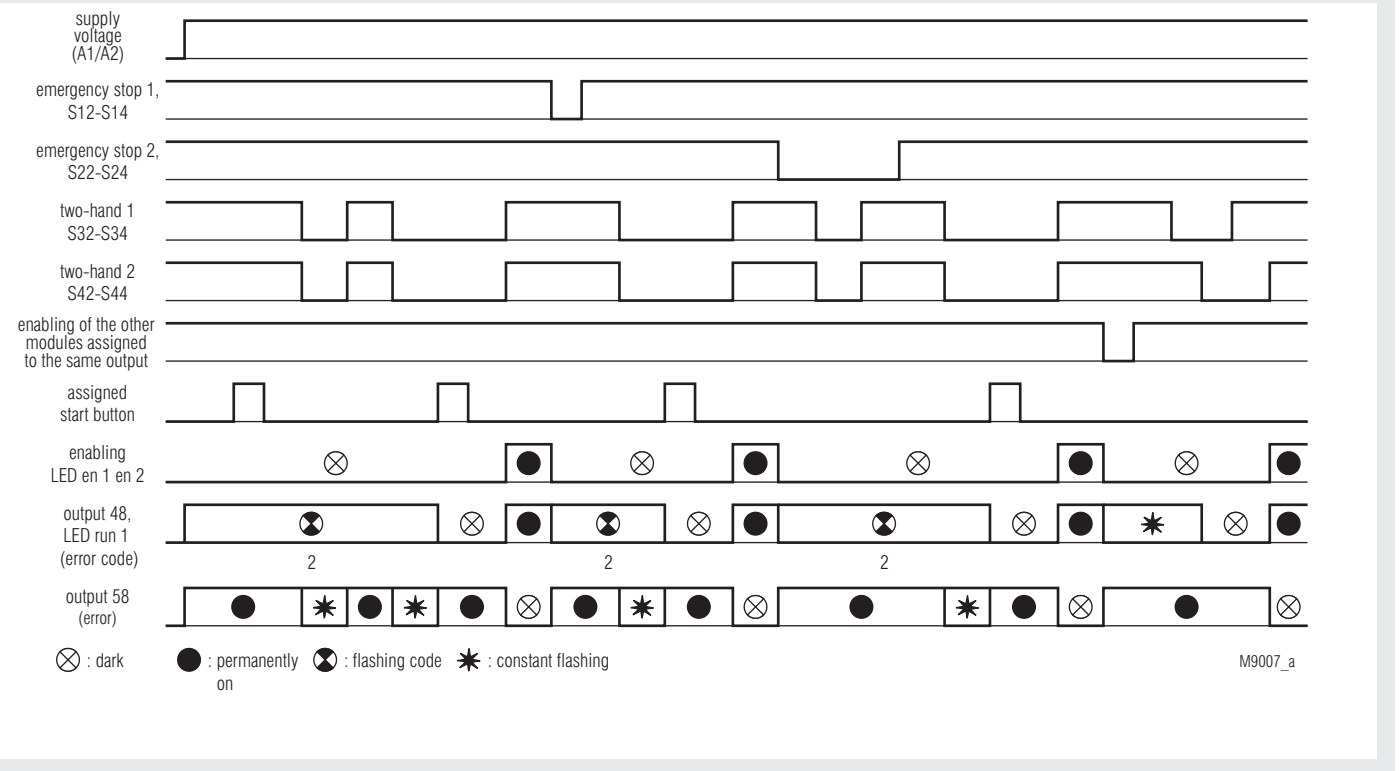
4 Emergency stop, manual start; function 5

Function Diagrams

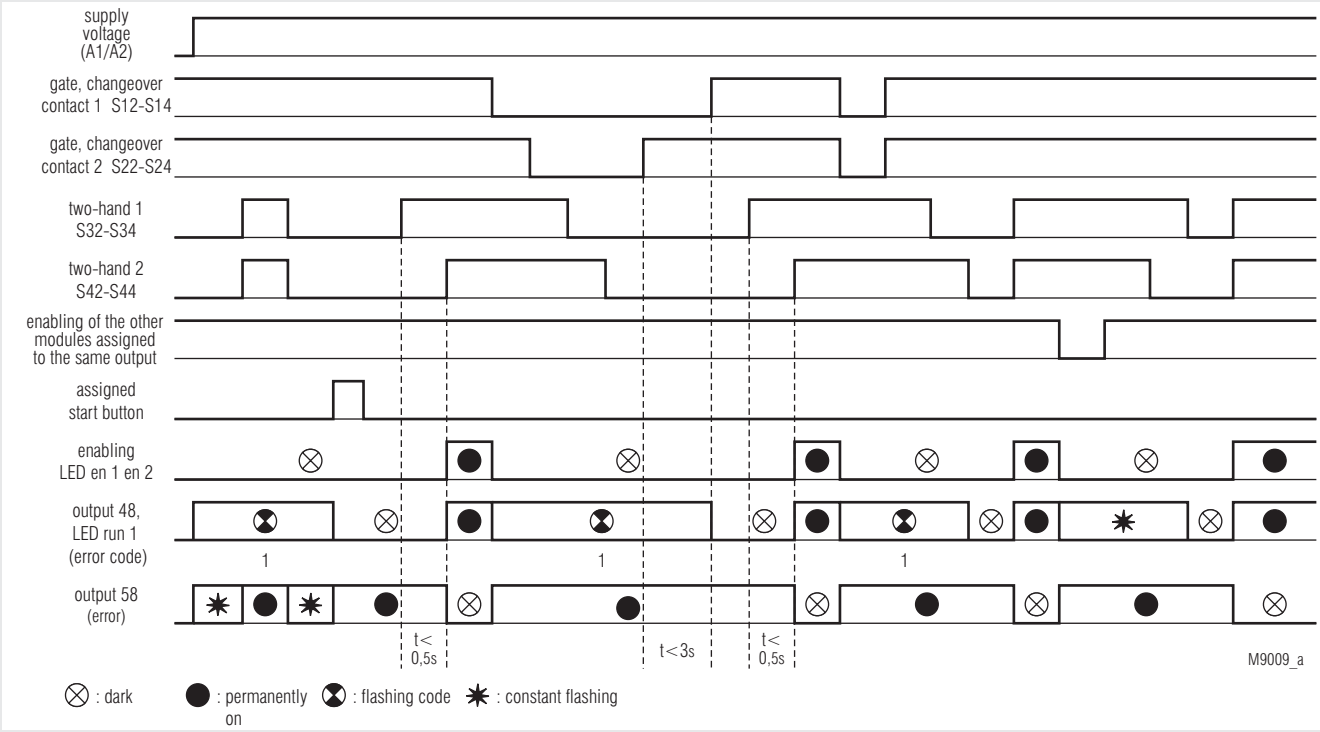
Note: The times specified in a pulse diagram also apply to the same function in other applications.



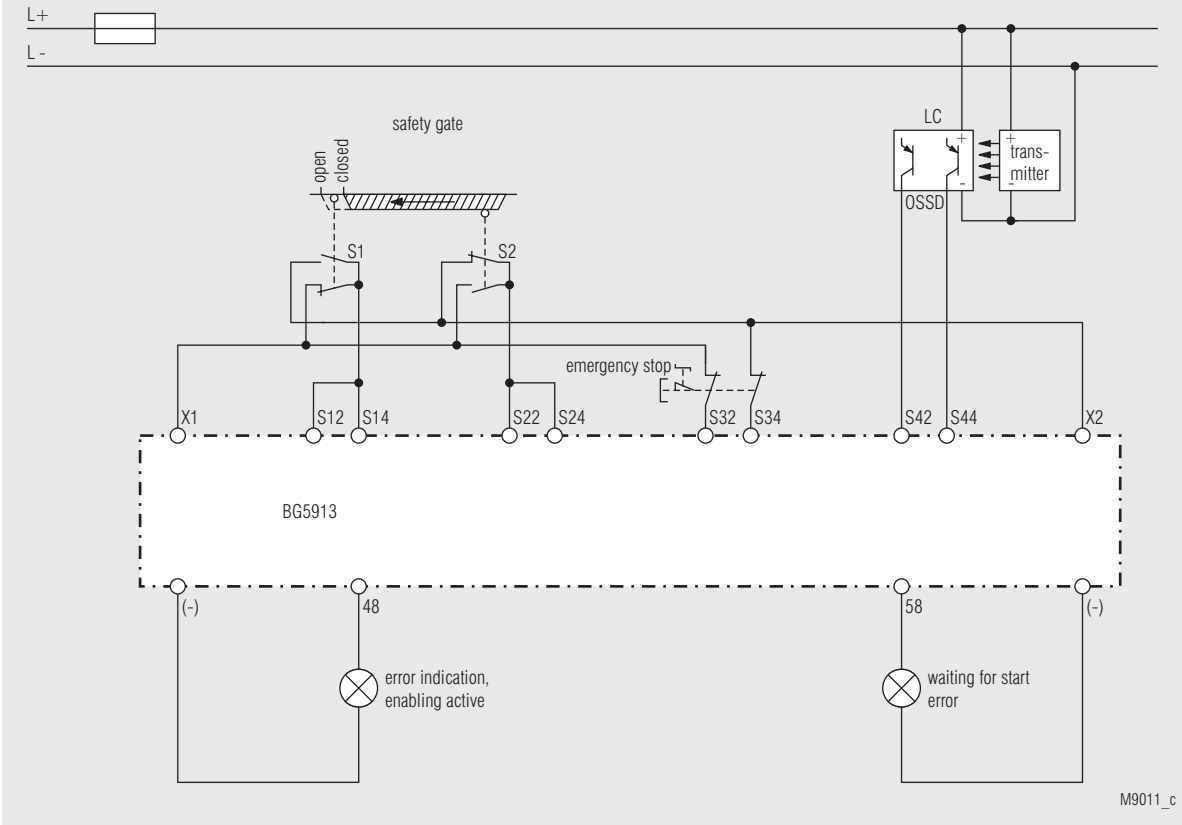
2 Emergency stop, Autostart, 1 two-hand control type IIIC; function: 6



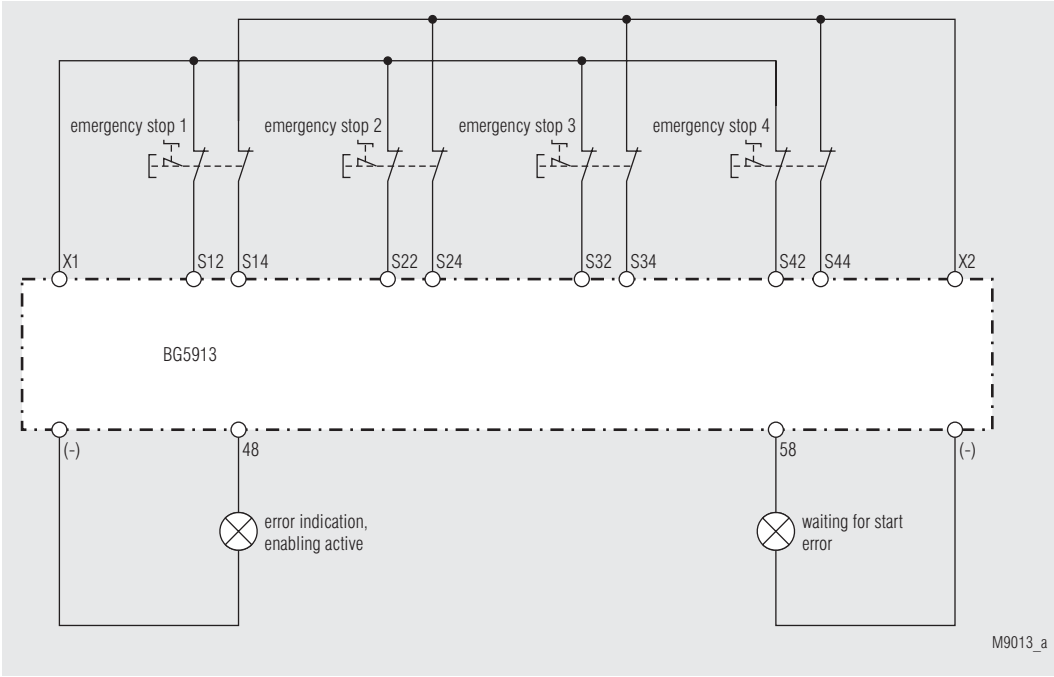
2 Emergency stop, manual start, 1 two-hand control type IIIC; function: 7 or 9



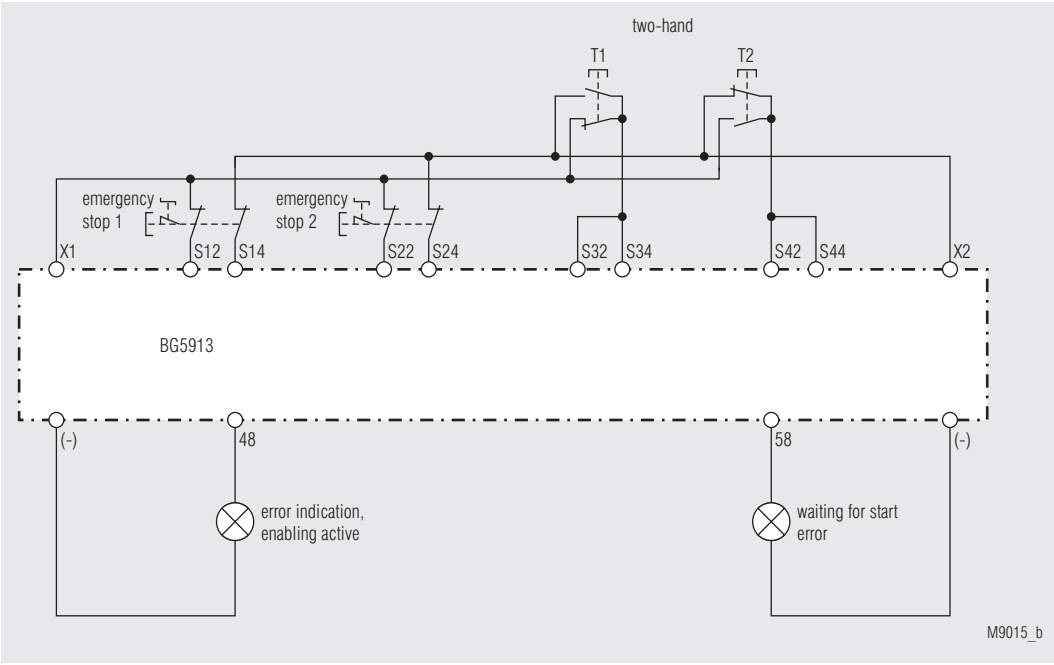
1 Safety gate, 1 two-hand control type IIIC; function: 8



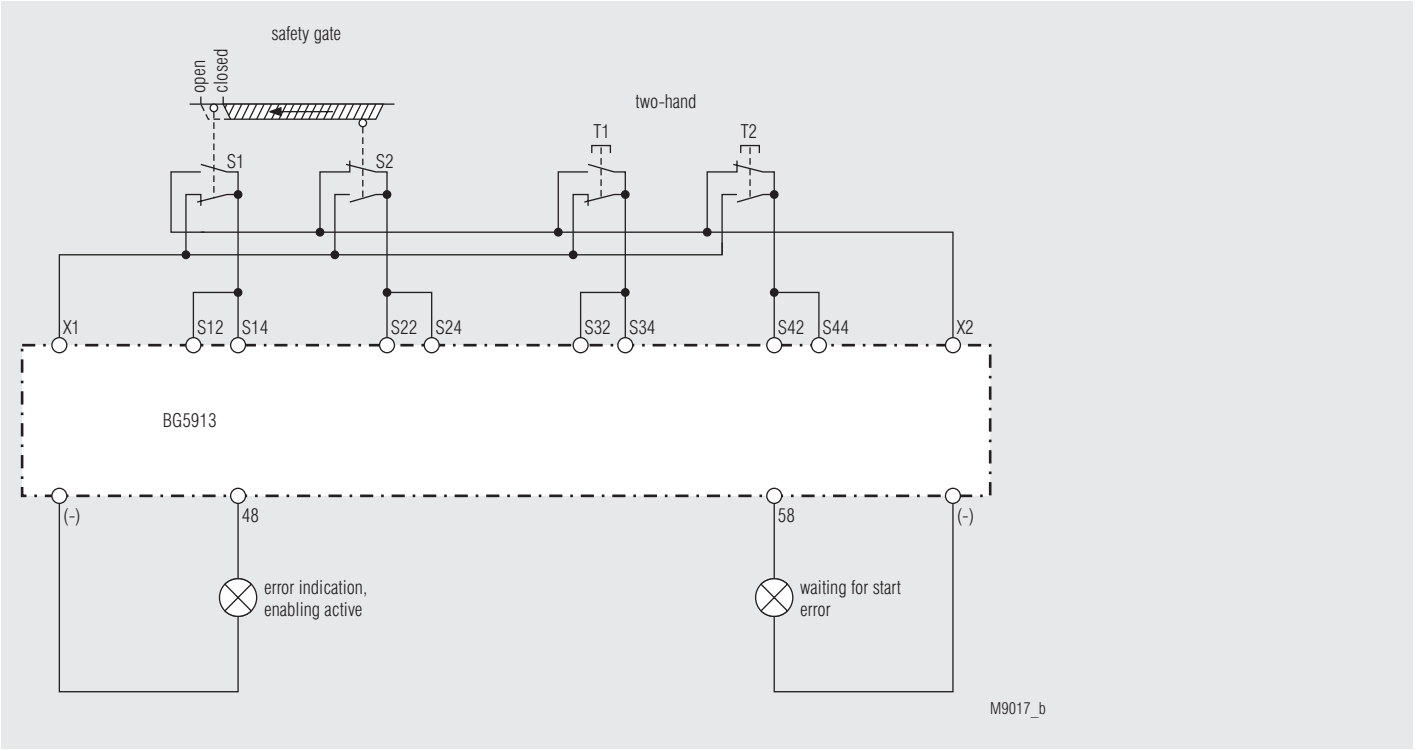
BG 5913.08/_2_ _ _, 1 safety gate, 1 Emergency stop, 1 light curtain; functions: 0 or 1



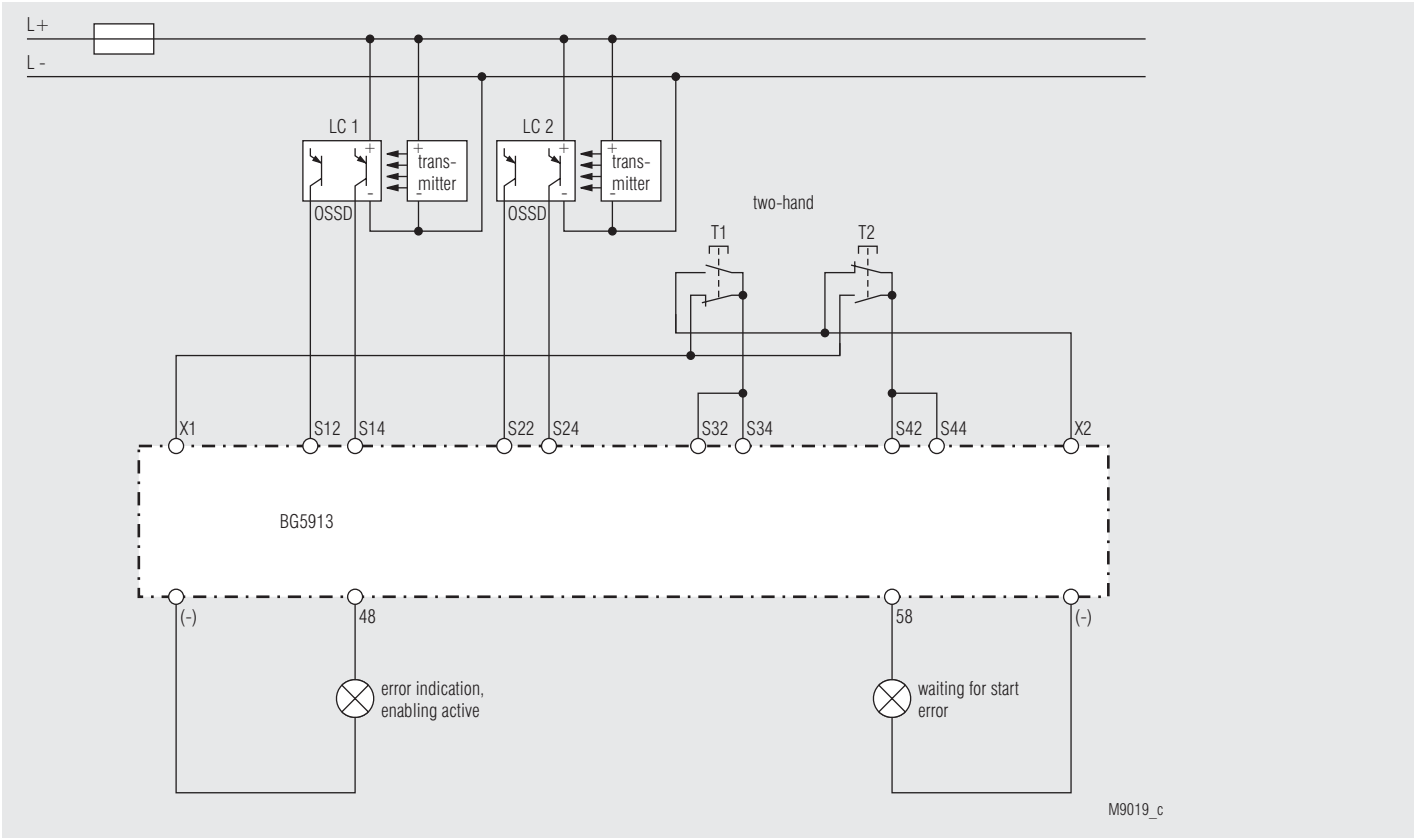
BG 5913.08/_2_ _ _, 4 Emergency stop; functions: 2, 3, 4 or 5



BG 5913.08/_2_ _ _, 2 Emergency stop; 1 two-hand control type IIIC functions: 6 or 7



BG 5913.08/_2_ _ _, 1 safety gate, 1 two-hand control type IIIC (EN 574); function: 8



BG 5913.08/_2_ _ _, 2 light curtains, 1 two-hand control type IIIC (EN 574); function: 9

Technical Data

Voltage Supply

Nominal voltage U_N: DC 24 V (coming from the control unit BH 5911)

Voltage range:
with max. 5% residual ripple: 0,85 ...1,15 U_N
Nominal consumption: max. 60mA
(no load on semiconductor outputs)

Short-circuit protection
of the modules: internally with PTC

Inputs:

Control voltage
via X1, X2, 48.58: DC 23 V at U_N

Control voltage
via S12, S14, S22, S24,
S32, S34, S42, S44: 4.5 mA each at U_N

Minimum voltage
on S12, S14, S22, S24,
S32, S34, S42, S44: DC 16 V

Semiconductor outputs

Output on terminal
48 and 58: Transistor outputs, plus-connected
Output nominal voltage: DC 24 V, max. 100 mA constant current, max. 400 mA for 0.5 s
Internal short circuit, overtemperature, and overload protection

Reaction times (time till reaction of the assigned output):

Typ. operating time with U_N:

Input modules BG 5913	Manual start	Automatic start	
		First start	Restart
Emergency stop	max. 80ms	max. 850ms	max. 115ms
Light barriers	max. 80ms	max. 850ms	max. 115ms
Safety gates	or simulation max. 80ms		Gate closing: max. 115ms
Two-hand control	max. 850ms		

Break time (reaction time):

Input modules BG 5913	
Emergency stop	max. 33ms
Light barriers	max. 33ms
Safety gates	max. 33ms
Two-hand control	max. 33ms

General Data

Operating mode: Continuous
Temperature range: ± 0 ...+ 50 °C
At an operating temperature of 50 °C the modules must be mounted with a distance of 3 - 5 mm.
Clearance and creepage distances
Overvoltage category/
contamination level: 4 kV / 2 IEC 60 664-1
EMC
HF irradiation: 10 V / m IEC/EN 61 000-4-3
Fast transients:
on supply line A1-A2 2 kV IEC/EN 61 000-4-4
on signal and control lines: 2 kV IEC/EN 61 000-4-4

Technical Data

Surge between
supply lines: 1 kV IEC/EN 61 000-4-5
between supply
line and ground: 2 kV IEC/EN 61 000-4-5
HF voltage driven: 10 V IEC/EN 61 000-4-6
Radio interference
suppression: Limit value class B EN 55 011
Degree of protection:
Housing: IP 20 IEC/EN 60 529
Terminals: IP 20 IEC/EN 60 529
Housing: Thermoplast with VO behavior according to UL Subject 94

Vibration resistance: Amplitude 0.35 mm
Frequency 10...55 Hz,
IEC/EN 60 068-2-6
Shock resistance
Acceleration: 10 g
Pulse duration: 16 ms
Number of shocks: 1000 per axis on three axes
Climate resistance: 0 / 050/ 04 IEC/EN 60 068-1
Terminal designation: EN 50,005
Wire connection: 1 x 2.5 mm² stranded wire with sleeve, or
1 x 4 mm² massive or
2 x 1.5 mm² stranded wire with sleeve
DIN 46 228-1/-2/-3/-4
Wire fixing: Box terminals with wire protection, removable terminal strips
Mounting: on DIN rail IEC/EN 60715

Dimensions

Width x height x depth

BG 5913.08/_2_ _ _ 22.5 x 84 x 121 mm

Ordering designation

BG 5914.08/02MF0 DC 24 V