Safety technique

SAFEMASTER M Multi-Function Safety System Diagnostic Module for Profibus DP
## BH 5552

DOLD

- For transmitting the status information from the control unit and the input modules, e.g. input and error states, start button and safety output assignments, to a control system or bus-capable display
- Electrical isolation
- Automatic recognition of transmission speed
- LED indicators for operating voltage and status
- Width of 45 mm

Circuit Diagram

M8796

## Connection Example

M8794
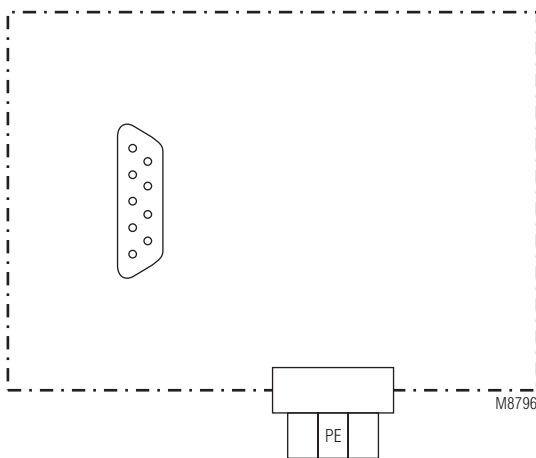
Approvals and Markings

CE

Applications

For connection to a Profibus DP network for visualizing the status of the multi-function safety system SAFEMASTER M.

Indicators

Red LED "err":	lights in the event of an error
Yellow LED "run":	lights if data is transmitted correctly
Green LED "rdy":	to indicate operational readiness
Red and green LED:	flash if device address 0 is set (reserved for master).
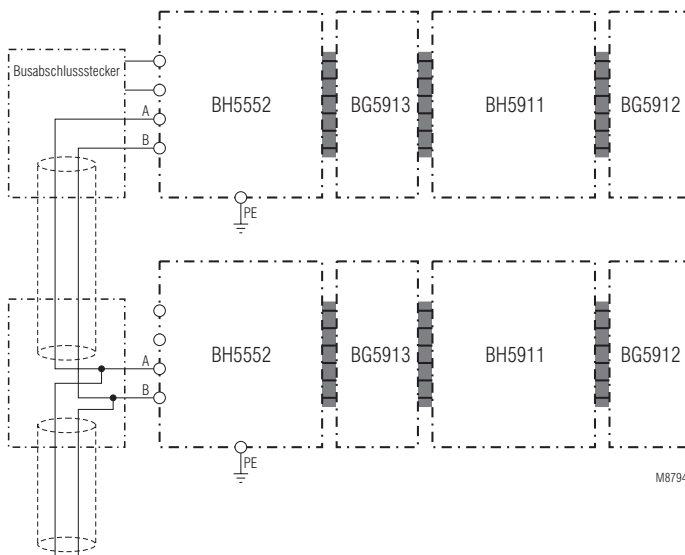
Device Connection

The diagnostic module is simply connected via flatcable instead of the left termination plug of the safety system. This connection is used for the power supply and for receiving the data to be evaluated.
The Profibus DP network is connected via the SubD connector on the device. The installation guidelines based on the PNO document "Installation Guideline for Profibus DP/FMS" must be followed.

Device Setting

The address (01 to 99) of the module in the Profibus DP system is set on the rotary switches ADR 10 and ADR 1.
To configure the network, the device master file "EDS080F.gsd" is needed, which is located on the DOLD-CD PN 5501, in directory Profibus/GSD.
Order designation: PN 5501, item number: 0052860

Attention:

⚠ Work on the device must be carried out by specialist personnel when the device is in a deenergized state.
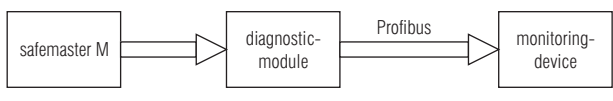
Input

Nominal voltage U_N:	DC 24 V (power is supplied - by the safemaster M)
Voltage range:	
at max. 5% residual ripple:	0.85 ... 1.15 U_N
Nominal consumption:	max. 100 mA
Profibus DP interface	
Transmission medium:	Twisted, shielded two-wire line
	IEC 61 158
Protocol:	Profibus DP-V0
Maximum length:	1200 m at 9.6 Kbit/s...45.45 Kbit/s
	1000 m at 93.75 Kbit/s...137.5 Kbits/s
	400 m at 500 Kbit/s
	200 m at 1500 Kbit/s
	100 m at 3000 Kbit/s...12000 Kbit/s

The installation guidelines based on the PNO document "Installation Guideline for Profibus DP/FMS" must be followed for the maximum linear expansion of a bus segment. The PE connector must be grounded.

General Data

Nominal mode of operation:	Continuous operation
Temperature range:	$\pm$ 0 ... + 50° C
	At an operating temperature of 50 °C the modules must be mounted with a distance of 3 - 5 mm.
EMC	
HF irradiation:	10 V / m IEC 61 000-4-3
Fast transients	
on supply line:	2 kV IEC 61 000-4-4
on signal and control lines:	2 kV IEC 61 000-4-4

Surge voltage		
between supply lines:	1 kV	IEC 61 000-4-5
between supply line and ground:	2 kV	IEC 61 000-4-5
HF wire guided:	10 V	IEC 61 000-4-6
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:	Thermoplastic with V0 behaviour according to UL subject 94	
Vibration resistance:	Amplitude 0.35 mm frequency 10 ... 55 Hz	IEC/EN 60068-2-6
Resistance to shock		
Acceleration:	10 g	
Impulse length:	16 ms	
Number of shocks:	1000 per axis on 3 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 solid or 2 x 1.5 mm² stranded wire with sleeve DIN 46 228-1/-2/-3/-4	
Wire fixing:	Terminal screws M3,5, box terminals with wire protection	
Mounting:	on DIN rail	IEC/EN 60 715
Weight:	240 g	

Dimensions

Width x height x depth	45 x 84 x 121 mm

Standard Type

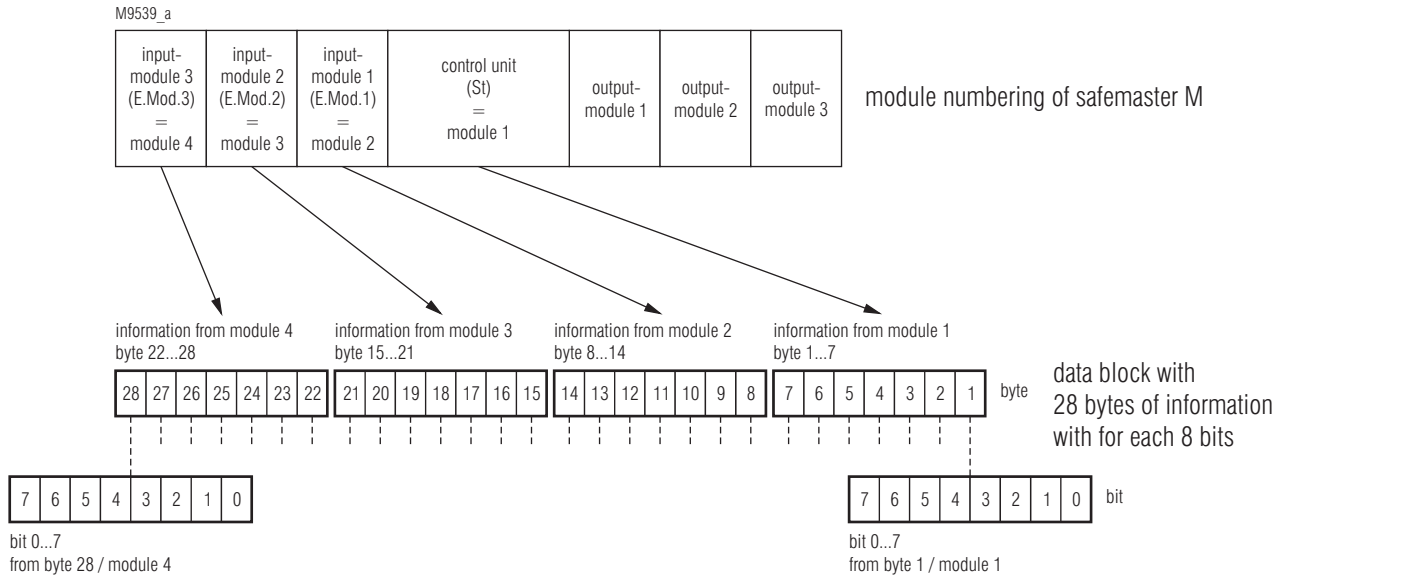BH 5552   DC 24 V
Article number: 0056874

Information on System Diagnostics

M9538

Information flow for data evaluation

Information Structure

The diagnostic module delivers a packet of 28 information bytes. 7 bytes each for the control unit and the 3 connectable input modules. The assignment of the individual bytes is given in the descriptions of the different control or input modules.

Structure of Diagnostic Information

Contents	Profibus DP byte no.	Mod.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Module number	1 / 8 / 15 / 22	Ct* / I.Mod1* / I.Mod2* / I.Mod3*	0	0	0	0 = OK 1 = system error	Module number, if module available 0001 = module 1 0010 = module 2 0011 = module 3 0100 = module 4			
			0000 0000: Module not available or another module reports errors. In this case, all 7 bytes have the value 0000 0000.							
Assignments	2 / 9 / 16 / 23	Ct* / I.Mod1* / I.Mod2* / I.Mod3*	Which start button effects this module?				Which output module does this module have an effect on?			
			1 = T4	1 = T3	1 = T2	1 = T1	1 = output module 3	1 = output module 2	1 = output module 1	1 = Control unit
			If bit 4 is set in the module number: system error code							
Status of inputs	3	Ct*	Only if the button concerned is assigned to the control unit				if T4 = start button: 0 if T4 = stop button: 1 = stop activated	0	1 = input S14 inactive	1 = input S12 inactive
			1 = T4 activated	1 = T3 activated	1 = T2 activated	1 = T1 activated				
	10 / 17 / 24	I.Mod1* / I.Mod2* / I.Mod3*	1 = input S42 inactive	1 = input S32 inactive	1 = input S22 inactive	1 = input S12 inactive	1 = input S44 inactive	1 = input S34 inactive	1 = input S24 inactive	1 = input S14 inactive
Status of outputs	4	Ct*	1 = output module 3 activated	1 = output module 2 activated	1 = output module 1 activated	1 = safety outputs of control unit activated	0	Status of output 48 (error code)	1 = activation of assigned output modules released (green LEDs left)	Status of yellow LED run 1 (error code)
			Comment: These bits show the activation signal, which is transmitted to the modules. In the case of delayed outputs, the progress of the delay time is not visible.							
	11 / 18 / 25	I.Mod1* / I.Mod2* / I.Mod3*	0	0	0	0				
Status byte 1	5	Ct*	1 = error on a safety output	1 = release of assigned safety outputs enabled	1 = waiting for activation of assigned start button (error has been eliminated)	1 = short circuit on the inputs	Position of function switch (0000 to 1001 for function 0 to 9)			
	12 / 19 / 26	I.Mod1* / I.Mod2* / I.Mod3*	1 = control unit reports errors (bit 4 or 7 of module status byte 1 set) see comments below							
Status byte 2	6 / 13 / 20 / 27	Ct* / I.Mod1* / I.Mod2* / I.Mod3*	The assignment of this byte depends on the function of the control unit or the respective input module (see the following pages)							
Start button and safety outputs	7 / 14 / 21 / 28	Ct* / I.Mod1* / I.Mod2* / I.Mod3*	1 = start button T4 activated	1 = start button T3 activated	1 = start button T2 activated	1 = start button T1 activated	1 = activation of output module 3 enabled	1 = activation of output module 2 enabled	1 = activation of output module 1 enabled	1 = activation of safety outputs of Ct* enabled

Comment: Bit 7 and bit 4 of the bytes 5, 12, 19 or 26 (**status byte 1**) are saved from the time when the error appears until when the module is restarted. The fact that the fault was corrected is indicated by bit 5 in the case of a manual start; and by bit 6 in the case of an automatic start. If these errors are detected in the control unit, the entire **safemaster M** system is locked. If the input modules are error-free in the „automatic start" mode, their bits 7 and 6 flash in the **status byte 1** (byte 12, 19 or 26) as well as their green LEDs until the error has been corrected in the control unit or in the safety outputs.

Structure of Diagnostic Information
Assignment of "status byte 2" in the different modules of safemaster M

Control unit BH 5911:

Contents	Profibus DP byte no.	Mod.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status byte 2	6	Ct*	1 = start button activated for too long (>3s)	1 = one of the assigned start buttons has been activated	1 = emergency stop S14 activated	1 = emergency stop S12 activated	1 = error on output module 3	1 = error on output module 2	1 = error on output module 1	1 = error on the safety outputs of the Ct*

Comment 1: All signals are saved from the time when the error is detected until the safety outputs are released for activation again. The fact that the error was corrected is indicated in **status byte 1** (byte 5), bits 5 and 6.
Comment 2: In the case of a 2-channel emergency stop, bits 5 and 4 change together. For more precise diagnostics of the input signals, byte 3 (status of the inputs) must be evaluated.

Input module BG 5913.08/_0_ _ _:

Contents	Profibus DP byte no.	Mod.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status byte 2	13 20 or 27 dep. on I.Mod. in safemaster M	I.Mod1* I.Mod2* I.Mod3*	1 = time error[2]	1 = one of the assigned start buttons has been activated	1 = one of the assigned simulation buttons has been activated	0 (unused)	1 = function group 4 of module does not grant release[1]	1 = function group 3 of module does not grant release[1]	1 = function group 2 of module does not grant release[1]	1 = function group 1 of module does not grant release[1]

Comments: Except for bit 6 and 5, all signals are saved from the time when the error is detected until the assigned safety outputs are released for activation again. The fact that the error was corrected is indicated in **status byte 1** (no. 19, 20 or 26), bits 5 and 6.
1) The numbers of the different function groups match the numbering of the safety functions in the application examples of the data sheet of input module BG 5913.08/_0_ _ _. If less than 4 functions are possible as a result of the input module setting (e.g. max. 2 with two-hand control type IIIC), the surplus bits are set to 0.
2) Time error is detected if the start or simulation buttons (>3s) are activated for too long. A time error message is also generated if two sensors of a function are not activated in the required time window (e.g. in the case of gates or two-hand controls).

Input module BG 5913.08/_1_ _ _ and BG 5913.08/_2_ _ _ , BG 5913.08/_2_ _ _ and BG 5913.08/_3_ _ _

Contents	Profibus DP byte no.	Mod.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status byte 2	13 20 or 27 dep. on I.Mod. in safemaster M	I.Mod1* I.Mod2* I.Mod3*	1 = time error[2]	1 = one of the assigned start buttons or simulation buttons has been activated	0 (unused)	0 (unused)	1 = function group 4 of module does not grant release[1]	1 = function group 3 of module does not grant release[1]	1 = function group 2 of module does not grant release[1]	1 = function group 1 of module does not grant release[1]

Comments: Except for bit 6, all signals are saved from the time when the error is detected until the assigned safety outputs are released for activation again. The fact that the error was corrected is indicated in **status byte 1** (no. 19, 20 or 26), bits 5 and 6.
1) The numbers of the different function groups match the numbering of the safety functions in the applications examples of the data sheet from input module. If a function combination with two-hand type IIIC is set on the input module, only 3 function groups are available and bit 3 is then always 0.
2) Time error is detected if the start or simulation buttons (>3s) are activated for too long. A time error message is also generated if two sensors of a function are not activated in the required time window (e.g. in the case of gates or two-hand controls).

Structure of Diagnostic Information

Input module BG 5914.08/_0_ _ _, BH 5914.08_0_ _ _, BG 5914.08_1_ _ _ and BH 5914.08/_1_ _ _

Contents	Profibus DP byte no.	Mod.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status byte 2	13 20 or 27 dep. on I.Mod. in safemaster M	I.Mod1* I.Mod2* I.Mod3*	1 = start button activated for too long (>3s)	1 = one of the assigned start buttons has been activated	1 = emergency stop on S14, S24, S34 or S44 does not grant release[1]	Double contact error on S42 - S44[2]	1 = emergency stop on S42 or S44 does not grant release[1]	1 = emergency stop on S32 or S34 does not grant release[1]	1 = emergency stop on S22 or S24 does not grant release[1]	1 = emergency stop on S12 or S14 does not grant release[1]

Comments: Except for bit 6, all signals are saved from the time when the error is detected until the assigned safety outputs are released for activation again. The fact that the error was corrected is indicated in **status byte 1** (no. 12, 19 or 26), bits 5 and 6.

1) The emergency stop function which actually prevented the release can only be recognized from the combination of bit 5 with the bits 0 to 3. The current status of the inputs is always visible in byte 10, 17 or 24 (status of the inputs).

2) Bit 4 is only set if S42 and S44 are set for 2-channels for the emergency stop function, and both signals do not match.

We have a safemaster M system with the following components:
- 1 control unit BH 5911.03/00MF0
- 1 output module BG 5912.04
- 1 diagnostic module BH 5552 for Profibus DP

The transmitted information from diagnostic module BH 5552 is to be used in order to observe how and why the outputs of output module 1 change.

The available diagnostic information of the control unit and its changes are shown here:

1. Normal state: Safety outputs are activated, all EMERGENCY STOP buttons are released

		Bit no.	76543210
Byte 1: Module number:	Hex: 01	Bin:	00000001
Byte 2: Assignments:	Hex: 13	Bin:	00010011
Byte 3: Status of inputs:	Hex: 00	Bin:	00000000
Byte 4: Status of outputs:	Hex: 00	Bin:	00000000
Byte 5: Status byte 1:	Hex: 45	Bin:	01000101
Byte 6: Status byte 2:	Hex: 00	Bin:	00000000
Byte 7: Start button and safety outputs:	Hex: 0B	Bin:	00000011

Module number 01 with deleted bit 4 shows that the entire safemaster M system is working properly.
The set bits 0 to 3 of status byte 1 show that the function switch of the control unit (module1) is set to position "5". That means that the following mode of operation is set:

2 x 1 channel emergency stop, manual start, 4 start buttons

The set assignments in byte 2 shows you that the control unit is started by the start button 1 (bit 4), and it has an effect on its own outputs (bit 0) and the outputs of output module 1 (bit 1). Since no input module is available, the outputs of both modules must always have the same status.

The set bit 6 in status byte 1 means the control unit grants the release for setting the safety outputs which are assigned to it. The fact that the outputs are actually set can be seen in byte 4.

2. Emergency stop button on S12 activated

		Bit no.	76543210
Byte 1: Module number:	Hex: 01	Bin:	00000001
Byte 2: Assignments:	Hex: 13	Bin:	00010011
Byte 3: Status of inputs:	Hex: 01	Bin:	0000000**1**
Byte 4: Status of outputs:	Hex: 0x	Bin:	00**000x0x**x = flash
Byte 5: Status byte 1:	Hex: 05	Bin:	0**0**000101
Byte 6: Status byte 2:	Hex: 10	Bin:	000**1**0000
Byte 7: Start button and safety outputs:	Hex: 00	Bin:	000000**00**

Bit 6 in status byte 1 shows that the control unit does not release the safety outputs which are assigned to it.
The reason for this is indicatedby bit 0 in byte 3 (input S12 inactive) and by bit 4 in status byte 2 (emergency stop activated). The set bit 4 in byte 6 is saved until the release is granted again.
Byte 4 signals that the outputs have actually dropped out (bit 4 and 5) and the output 48 (bit 2) as well as the LED run 1 (bit 0) flash.

3. Emergency stop button is unlocked again

		Bit no.	76543210
Byte 1: Module number:	Hex: 01	Bin:	00000001
Byte 2: Assignments:	Hex: 13	Bin:	00010011
Byte 3: Status of inputs:	Hex: **00**	Bin:	0000000**0**
Byte 4: Status of outputs:	Hex: 0x	Bin:	00000x0x
Byte 5: Status byte 1:	Hex: **25**	Bin:	00**1**00101
Byte 6: Status byte 2:	Hex: 10	Bin:	00010000
Byte 7: Start button and safety outputs:	Hex: 00	Bin:	00000000

Since all inputs are in quiescent state again, only the status bytes 1 and 2 as well as byte 4 (status of outputs) still indicate that safemaster M was switched off. However, the saved bit 4 in status byte 2 still shows the reason for switch-off.

4. Start button T1 is activated

		Bit no.	76543210
Byte 1: Module number:	Hex: 01	Bin:	00000001
Byte 2: Assignments:	Hex: 13	Bin:	00010011
Byte 3: Status of inputs:	Hex: **01**	Bin:	000**1**0000
Byte 4: Status of outputs:	Hex: **00**	Bin:	00000**00**0
Byte 5: Status byte 1:	Hex: **05**	Bin:	00100101
Byte 6: Status byte 2:	Hex: **00**	Bin:	000**0**0000
Byte 7: Start button and safety outputs:	Hex: 00	Bin:	00000000

If the start button was activated properly (< 3 s), the system returns to the normal state described under section 1. If the start button is activated for too long (> 3 s), bit 7 would signal in byte 6.

Comment:
If a system was already put into operation, it is often sufficient just to evaluate status bytes 1 and 2.
Depending on the depth and degree of detail of the diagnostics, e.g. in the case of troubleshooting when placing the system into operation, the other bytes can also be included if required.

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