Non-contact Interlock Switches

HS3A

New RFID non-contact interlock switch.
Category 4, PLe (ISO 13849-1) compliant.

• See website for details on approvals and standards.

HS3A satisfies the requirements of:	
EN/ISO 13849-1	Category 4 PL e
EN 62061 (Note)	SIL CL3

Note: EN 62061 is machine sector specific within the framework of EN 61508.

Safety Function

HS3A satisfies the requirements of PLe, Category 4, and SIL CL3. Does not require designated safety relay module or safety controller.

No designated safety module required.

The HS3A non-contact interlock switches detect internal error automatically. Requires no designated safety relay module or safety controller. Compliant with Category 4 (EN/ISO 13849-1), PLe, and SIL CL3 (EN 62061).

Detection

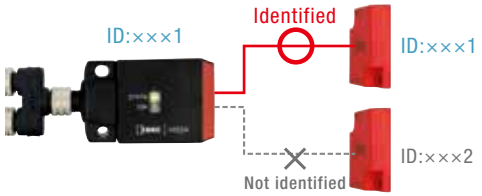
Stable detection of slow moving doors

Hinged doors, sliding doors, and rattling doors can be detected

RFID ensures detection of slow-moving doors.
(L-shaped mounting bracket must be supplied by the user.)

Identification

Tamper-proof
(unicode model)



An actuator with an electronic code is assigned to a sensor head. This prevents tampering by using an unassigned spare actuator. For details, see “System Status Table” in the system manual B-1223.

Clean Surface

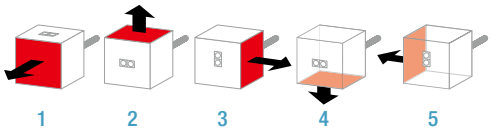
RFID prevents the buildup of metal residue

Suitable for harsh environment applications

The nonmagnetic actuator is resistant against buildup of metal particles.

Mounting

Can be installed in five directions



The interlock switch can be installed in five directions, allowing for flexible installation.

LED

Door status indication

LED shows the error of doors connected in series

LED on the sensor head shows the door status. For details, see “System Status Table” in system manual B-1221 or B-1223.

HS3A Non-contact Interlock Switches

RFID non-contact interlock switch, Category 4 and PLe (EN/ISO 13849-1) compliant.

HS3A Non-contact Interlock Switch (sensor head)

Package Quantity: 1

Outputs	Type		Part No. (Ordering No.)
Safety output: 2 Monitor output: 1	Multicode	 Interlock Switch (Sensor Head) Actuator	HS3A-H21M4
	Unicode		HS3A-H21U4

• Actuator (HS9Z-ZH31) is not supplied with the switch and must be ordered separately.

Accessories

Name			Part No. (Ordering No.)	Package Quantity	Remarks
Actuator 			HS9Z-ZH31	1	• Actuator for both multicode and unicode sensor heads. • Supplied with two M5 × 10 mounting screws (stainless steel)
Terminal Plug (For serial connection) 			HS9Z-H3TP	1	• Used on Y-branch connector when connecting two or more switches in series.
Y-branch Connector (For serial connection) 			HS9Z-H3YD	1	• Used when connecting two or more switches in series. • Plug connector: 8-pin (switch side), 5-pin (cable side)
M12 Plug Connection Cable 	For connecting two or more switches in series 	5-pin, 5m	HS9Z-H3F505	1	• Used when connecting two or more switches in series. • **5-pin plug connector is provided at one end.**
		5-pin, 10m	HS9Z-H3F510		
	For connecting a single switch 	8-pin, 5m	HS9Z-H3F805	1	• Used when connecting a single switch. • **8-pin plug connector is provided at one end.**
		8-pin, 10m	HS9Z-H3F810		
M12 Plug Connection Cable (For serial connection) 		5-pin, 5m	HS9Z-H3F5M05	1	• Used when connecting two or more switches in series. • **5-pin plug connectors are provided at both ends.**
		5-pin, 10m	HS9Z-H3F5M10		

• See below for an example of accessories required when connecting N number of HS3A switches in series.
HS3A non-contact interlock switch (HS3Z-H21*4): N pcs.
Actuator (HS9Z-ZH31): N pcs.
Terminal plug (HS9Z-H3TP): 1 pc.
Y-branch connector (HS9Z-H3YD): N pcs.
M12 plug connection cable, open end (HS9Z-H3F5**): 1 pc.
M12 plug connection cable, plug connectors at both ends (HS9Z-H3F5M**): N–1 pcs.

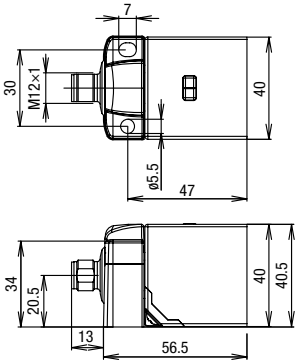
Specifications

Applicable Standards		EN60947-5-3 (IFA approval) EN954-1, EN ISO13849-1, EN62061 GS-ET-14 (IFA approval) UL508 (UL listed) CSA C22.2 No.14 (c-UL listed)
Operating Temperature		–20 to +55°C (no freezing)
Relative Humidity		5 to 80% (no condensation)
Storage Temperature		–25 to +70°C
Pollution Degree		3
Sensor Classification		PDF-M (EN60947-5-3)
Performance Level (PL)		e (EN ISO 13849-1)
Safety Category		4 (EN ISO 13849-1)
Safety Integrity Level (SIL)		3 (EN 62061)
Type (EN ISO14119)		Type 4
Levels of Coding (EN ISO14119)		Unicode: high level coded
		Multicode: low level coded
Degree of Protection	Interlock Switch (sensor head)	IP67
	Actuator	IP67, IP69K (Note)
Rated Voltage (U_B)		24V DC ±15%
Current Consumption		80mA (at no load)
Dielectric Strength		500V AC
Output Specifications	Safety Output	Semiconductor output, P-channel Output voltage: Max: U_B [V], Min.: U_B-1.5 [V] Maximum output current per safety output: 400 mA
	Monitor Output	Semiconductor output, P-channel Output voltage: Max: U_B [V], Min.: 0.8×U_B [V] Maximum output current: 200 mA
Operation Distance	Turn-on Distance	15 mm (typ.)
	Assured Turn-on Distance (Sao)	13 mm
	Maximum Turn-off Distance (Sar)	58 mm
Response Time	When using a single switch	260 ms (actuator removed)
		150 ms (non-identical input signal at IA/IB)
		150 ms (non-identical enabling input state at IA/IB)
		300 ms (short-circuit or cross-circuit at 0A/0B, or internal error)
	When using two or more switches (max.)	360 ms (actuator removed)
		250 ms (non-identical input signal at IA/IB)
		400 ms (non-identical enabling input state at IA/IB)
		400 ms (short-circuit or cross-circuit at 0A/0B, or internal error)
Shock Resistance		Operating extremes: 300 m/s^2 (11 ms)
Vibration Resistance		10 to 55 Hz, amplitude 0.5 mm
Material		PBT
Cable		M12 plug connection cable, 8-pin
Weight (approx.)		400g (HS3A-H21**)
Attachment		System Manual (CD-ROM)

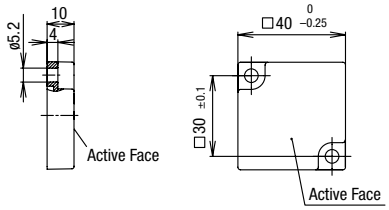
Note: IP69K is a degree of protection specified by Deutsches Institüt für Normung (DIN), DW 40050 Part 9 for hot and high-pressure water.

Dimensions

Sensor Head

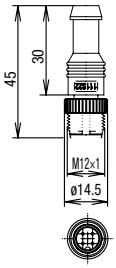


Actuator

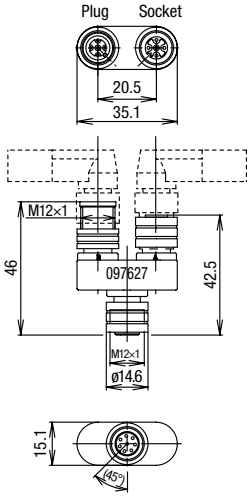


Supplied with two mounting screws (M5 × 10).

Terminal Plug
HS9Z-H3TP



Y-branch Connector
HS9Z-H3YD

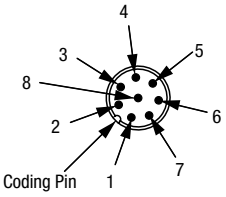


All dimensions in mm.

Plug Connection Cable Colors

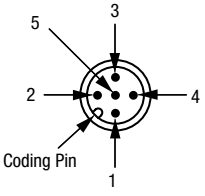
HS9Z-H3F8

Pin	Wire	Legend	Description
1	White	IB	Enabling input (channel 2)
2	Brown	UB	Power supply (24V DC)
3	Green	OA	Safety output (channel 1)
4	Yellow	OB	Safety output (channel 2)
5	Gray	OUT	Monitoring output
6	Pink	IA	Enabling input (channel 1)
7	Blue	0V	0V
8	Red	RST	Reset input for hardware



HS9Z-H3F5

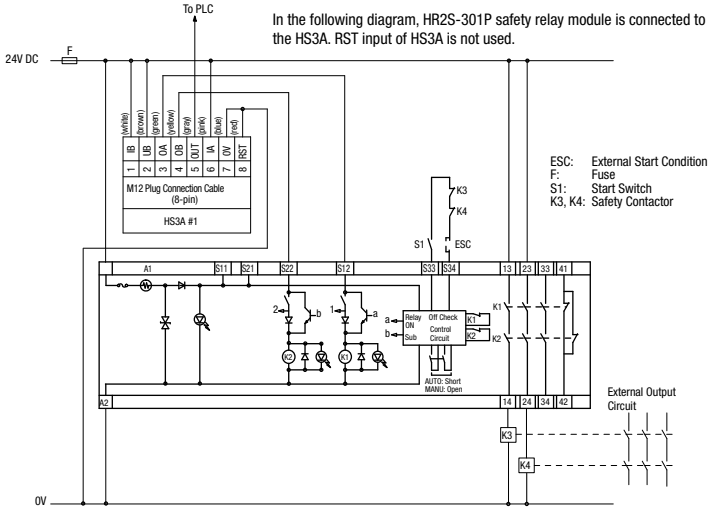
Pin	Wire	Legend
1	Brown	UB
2	White	OA
3	Blue	0V
4	Black	OB
5	Gray	RST



Wiring Diagram

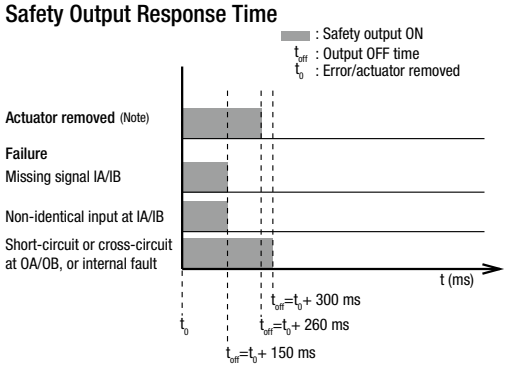
When using a single HS3A

When using a single HS3A, connect as shown in the figure below (Note). The OUT output can be connected to a control system, to a PLC for example, as a monitoring output.
The HS3A can be reset via the RST input. To reset, apply 24V DC for at least 3 seconds. When not using the RST input, connect the RST input to 0V.



For details of HR2S-301P safety relay module, see the instruction sheet.

Safety Output Response Time



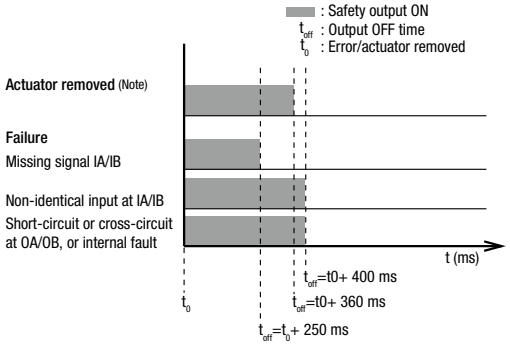
Note: The time required for the safety output to turn off after the actuator moves outside the operating distance of the HS3A switch.

When using two or more HS3A in series

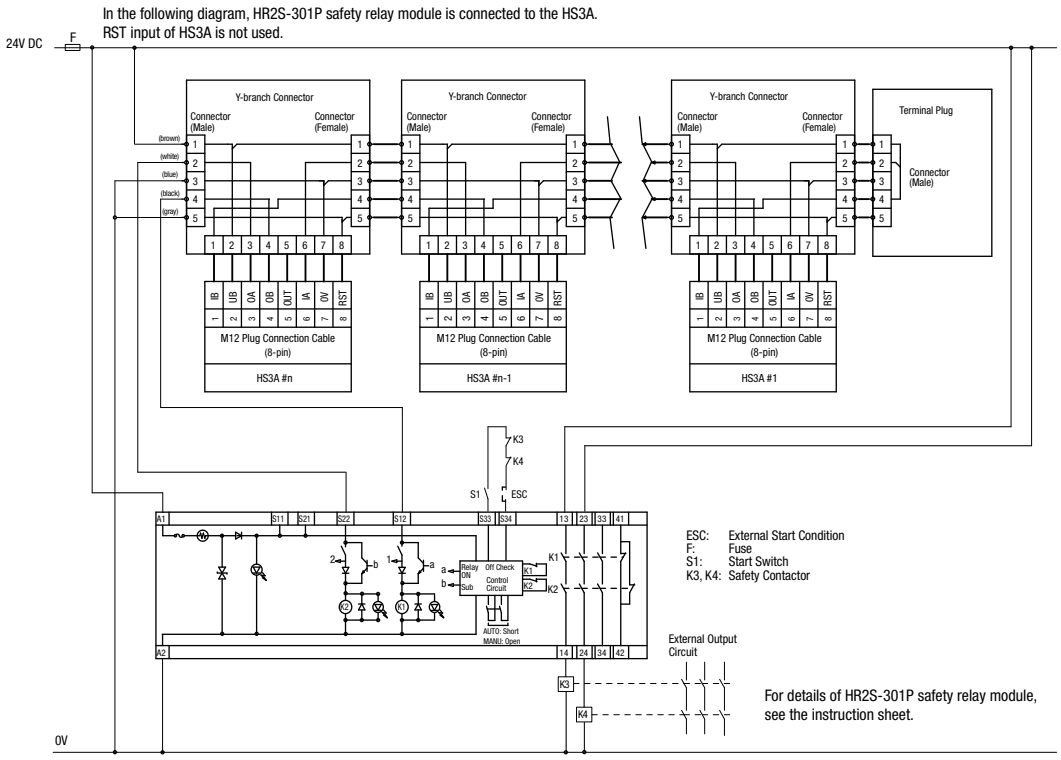
- A maximum of 20 can be connected in series.
- Pay attention to the contact resistance at the connection points.

The HS3A switches can be connected in series using plug connection cables and Y-branch connectors as shown in the figure below (Note). When any of the HS3A switches detects that the safety guard is open, or when a failure has occurred on any of the switches, the system turns off the machine. However, the external control system cannot detect which safety guard is open or where a failure has occurred.
The HS3A can be reset via the RST input. To reset, apply 24V DC for at least 3 seconds. When not using the RST input, connect the RST input to 0V.

Safety Output Response Time



Note: The time required for the safety output to turn off after the actuator moves outside the operating distance of the HS3A switch.



⚠ Safety Precautions

- Read the instruction manual before installation and wiring of the HS3A non-contact interlock switch. Observe the safety standards and regulations of relevant countries and regions where operating the HS3A. Perform a risk assessment before operation.
- Do not disassemble, modify, or repair the HS3A. Also do not disable the safety function of the interlock switch, otherwise failure or accident will occur.
- In order to avoid electric shocks or fire, turn power off to the HS3A before installation, removal, wiring, maintenance, or inspection.
- The HS3A has functions to ensure operators' safety. Make sure that the interlock switch is installed correctly, and that safety functions are not disabled. Otherwise serious injury may occur. Check the safety function of each door. Also, perform checks periodically according to a maintenance schedule.
  - When starting up the system
  - When replacing the sensor head or accessories
  - When the system has not been operated for a prolonged period of time.

Instructions

- Do not store the HS3A in a dusty, humid, organic-gas atmosphere, or areas subject to direct sunlight.
- Regardless of door types, do not use the HS3A as a door stop. Install a mechanical door stop on the edge of the door to protect the interlock switch against excessive force.
- Do not apply excessive force to the HS3A. A shock to the door exceeding 300 m/s^2 may cause a failure to the switch (shock resistance 300 m/s^2)
- Be sure to use the HS3A in combination with the proper accessories and connection cable. Failure to do so will result in the damage or failure of the switch.
- The HS3A may only be installed and operated by personnel who are skilled/familiar with the followings:
  - Operation of safety products
  - Relevant EMC standards
  - Relevant regulations and standards of safety and health
  - Descriptions in instruction sheet and system manual
- Check the following daily in order to ensure correct operation and long service life of the HS3A.
  - ON/OFF of safety outputs
  - Wiring and installation of connected equipment
  - Clean and free from smudge

Mounting Screws Recommended Torque

- Sensor head: 1 N·m (M5)
- Actuator: 1 N·m (M5)
  - Mounting screws are not supplied with the sensor head and must be provided by the user.
  - Use the actuator mounting screws supplied with the HS3A. When using other screws, use stainless steel or nonmetallic screws. Otherwise operating distance may be affected.

Operation Distance and Response Time

- When installing the HS3A, ensure the safety of the door opening area by paying attention to the operation distance (Table 1) and response time (Table 2) shown below.

Table 1: Operation Distance (Note 1)

Distance	Value (mm)		
	Min.	Typ.	Max.
Turn-on distance	—	15 (Note 2)	—
Assured turn-on distance S_{ao}	13	—	—
Switching hysteresis	1.5	2.5	—
Assured turn-off distance S_{ar}	—	—	58

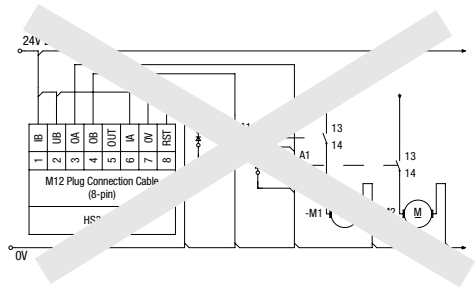
Note 1: When the off-center displacement of the interlock switch (sensor head) and actuator is 0 mm.

Note 2: When surface-mounted on aluminum. When using by embedding in metal, pay attention to the operation distance affected by the metal. In non-metallic environment, the typical turn-on distance increases to 30mm.

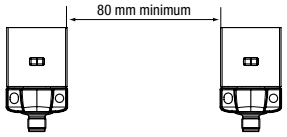
Table 2: Response Time

Response Time	When connecting a single switch (max.)	260 ms (actuator removed)
		150 ms (missing enabling input IA/IB)
		150 ms (non-identical enabling input state at IA/IB)
		300 ms (short-circuit or cross-circuit at OA/OB, or internal fault)
	When connecting two or more switches (max.)	360 ms (actuator removed)
		250 ms (missing signal enabling input IA/IB)
		400 ms (non-identical enabling input state at IA/IB)
		400 ms (short-circuit or cross circuit at OA/OB or internal fault)

Note: To ensure safety, both safety outputs (OA and OB) must always be evaluated. Single-channel use of the safety outputs as shown above right leads to a reduction of safety category stipulated in EN954-1.

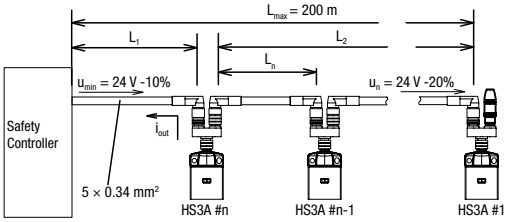


- Do no use the monitor output (OUT) as a safety output.
- The HS3A supplies +24V to dual safety outputs while in turn-on state. Inputs of the connected safety controller and safety PLC must be positive-switching.
- All electrical connections must either be isolated from the main power supply by a safety transformer according to EN IEC 61558-2-6 with limited output voltage in the event of a fault, or by other equivalent isolation measures.
- Use a power supply rated for Class 2 circuits or of equivalent function.
- All electrical outputs, including monitor outputs, must have an adequate protective circuit for inductive loads. Protecting of the outputs using a free-wheeling diode is recommended.
- Power devices which can cause interference must be installed away from the input and output circuits for signal processing. Provide sufficient distance between the wirings of safety circuits and power circuits.
- Use the HS3A with the proprietary actuator (HS9Z-ZH31) only, and do not use any other actuator.
- Provide the power supply with fuse protection depending on the number of sensor heads and the required output current. For details, refer to "Fuse protection for power supply" in system manual B-1223.
- The HS3A switch generates its own pulses (up to 1 ms) on the safety outputs OA and OB for confirming the safety function. Use a downstream control system that tolerates these test pulses. When using a system with pulsing function, defeat the pulsing function. Note that pulse is generated even when the safety output is off.
- When installing the HS3A switches adjacently, provide at least 80 mm intervals to avoid mutual interference.



Operating distance can be affected by the operating environment. Check the actual operating distance before installing the HS3A switch and actuator.

- Do not exert excessive force, twist or pull on the connection cable, otherwise the cable may be broken.
- The maximum total cable length is 200 m for connecting two or more HS3A switches in series.

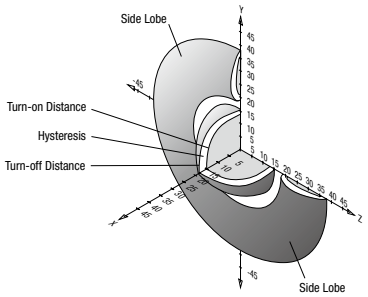


- After installing the HS3A, check function and operation.
- For teach-in procedure of HS3A-H21U4 (unicode), refer to system manual B-1223.

Instructions

Operating Area (typical data)

(When using the HS3A non-contact interlock switch in combination with a surface-mounted actuator HS9Z-ZH31)



Note: To avoid entering the area of possible side lobes, a minimum distance of 6 mm between the active surface of the HS3A switch and the actuator must be maintained in case of an approach from the side.

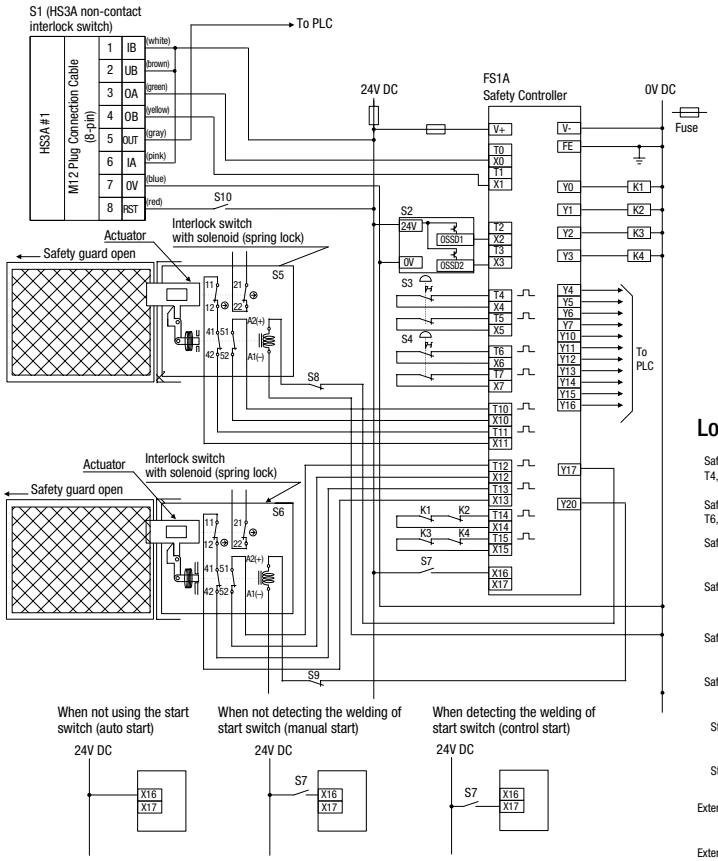
Connecting HS3A Non-contact Interlock Switch to an FS1A Safety Controller

HS3A non-contact interlock switches can be connected to the FS1A safety controller (FS1A-C11S/FS1A-C21S). Connect OA and OB safety outputs to the dual channel safety input of FS1A.

For more details of the FS1A, see the user's manual at http://www.idec.com/download/.

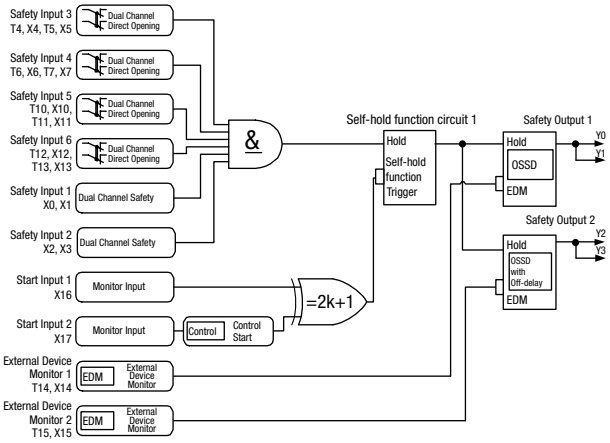
Connection example to logic No. 11C of FS1A-C11S (category 4 example) (Note)

The following safety products are used in this example. HS3A non-contact interlock switch (1 pc.), light curtain (1 pc.), emergency stop switch (2 pcs.), interlock switch with solenoid (spring lock) (2 pcs.)



- S1: HS3A non-contact interlock switch
- S2: Light curtain
- S3, 4: Emergency stop switch
- S5, 6: Interlock switch with solenoid (spring lock)
- S7: Start switch
- S8, 9: Solenoid control switch (Pressing this switch after closing the safety guard turns on 41-42 and 51-52 of S5 or S6, enabling the FS1A to restart.)
- S10: RST input switch of HS3A non-contact interlock switch
- K1 to 4: Contactor
- M1, 2: Motor

Logic Circuit using FS1A-C11S safety controller logic No. 11C



Note: In actual system or equipment, various factors such as hazard type, safeguarding measure, and danger level depending on operation modes need to be taken into consideration for risk assessment, in order to reduce the risk to an acceptable level. Therefore, safety category must be evaluated on the entire safety related system.

For the time chart of logic no. 11C, see the user's manual of FS1A-C11S safety controller (http://www.idec.com/download/).