

INSTRUCTION SHEET

Intrinsically Safe EB3N Safety Relay Barrier

Confirm that the delivered product is what you have ordered. Read this instruction sheet to make sure of correct operation. Make sure that the instruction sheet is kept by the end user.

SAFETY PRECAUTIONS

In this operation instruction sheet, safety precautions are categorized in order of importance to Warning and Caution.

Warning

Warning notices are used to emphasize that improper operation may cause severe personal injury or death.

On product safety:

- Special expertise is required to install, wire, operate, maintain, and inspect the Safety Relay Barrier. People without such expertise and knowledge in the installation of electrical equipment used in potentially explosive atmospheres and safety of machinery, electric systems, relevant regulations, principle, function, and skill must not use the Safety Relay Barrier.
- Do not disassemble, repair, or modify the Safety Relay Barrier. This will cause impairment of the safe operability of the Safety Relay Barrier.
- Turn off the power to the Safety Relay Barrier before installation, removing, wiring, maintenance, or inspection of the Safety Relay Barrier.
- Use the specified power supply voltage only.

On explosion-proof safety:

- Install the Safety Relay Barrier in a safe area (non-hazardous area) in accordance with intrinsic safety ratings and parameters. To avoid mechanical shocks, install the Safety Relay Barrier in an enclosure which suppresses shocks.
- The voltage applied on the general circuit connected to the non-intrinsically safe circuit terminals of the Safety Relay Barrier must be 250V AC, 50/60Hz, or 250V DC (UL :125V AC, 125V DC)at the maximum under any conditions, including the voltages of the input power and the internal circuit.

On machinery safety:

- An operational check must be performed daily on the Safety Relay Barrier by actuating the input device (e.g. EMO-pushbutton).
- Use safety input and output devices conforming to the applicable safety standards and/or requirements (see chapter 6).
- Calculate respective safety distances, taking into consideration the response time of the Safety Relay Barrier, safety devices to be connected to the Safety Relay Barrier, and other devices that comprise the safety system.

Caution

Caution notices are used where inattention might cause personal injury or damage to equipment.

On product safety:

- Before operating the Safety Relay Barrier, carefully read this instruction sheet, and ensure that the environment conforms to the requirements of the Safety Relay Barrier specifications.
- Use insulation tubes on bare crimping terminals.
- A polymer resettable circuit protector is installed in the power circuit for prevention of over current. If the circuit protector has tripped, turn off the power and remove the cause of the trouble before turning on the power again.

On explosion proof safety:

- When installing or wiring the Safety Relay Barrier, prevent electromagnetic and electrostatic inductions in the intrinsically safe circuit from contacting with another intrinsically safe circuit and any other circuits. Maintain at least 50mm clearance, or provide a metallic separating board between the intrinsically safe circuits.
- Maintain at least 3mm clearance between the terminal of intrinsically safe circuit and the grounded metal part of metal enclosure, and between the relay terminal block of an intrinsically safe circuit and the grounded metal part of a metal enclosure.
- Make sure that IP20 is achieved when wiring.
- To prevent disconnected wires from contacting with other intrinsically safe circuits, bind together the wires of one intrinsically safe circuit.

On machinery safety:

- Wire the inputs and outputs so that they are separated from power lines.
- The installation must be in a way that a short-circuit across any safety input contact and across any safety output contact is prevented.
- Inputs shall be wired using screened cables in accordance with chapter 5.1. Cable lengths to be considered as specified in chapter 5.2. Connect the screen (shield) with the frame ground terminal of equipment (control box) in which the Safety Relay Barrier is installed.
- The safety output contacts must be protected by a protective device as specified (fast-blow fuse F2A, 5×20mm, IEC 60127-2).
- For the ISO 13849-1 Category and Performance Level of the complete control system the entire equipment must be evaluated. Make sure that the safety control requirements are considered carefully and the requirements specified in the application examples (chapter 9) are satisfied.

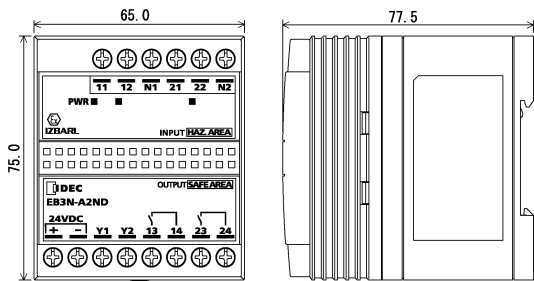
1 Types

Type	Safety output	Auxiliary output	Reset function
EB3N-A2ND	2ch	-	Auto
EB3N-M2ND	2ch	-	Manual
EB3N-A2R5D	2ch	5ch	Auto
EB3N-M2R5D	2ch	5ch	Manual

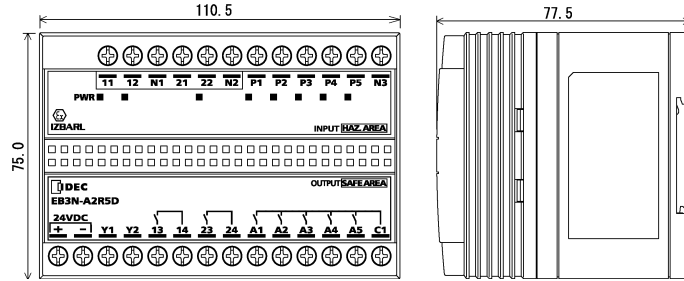
2 Dimensions

2.1 Dimensions

EB3N-A2ND, EB3N-M2ND



EB3N-A2R5D, EB3N-M2R5D



All dimensions in mm.

3 Specifications

3.1 Certificate

Certification	Applicable Standard	Performance	Manual
JAPAN	IEC standard compliant	[Ex ia Ga]IIC [Ex ia Da]IIIC	B-2284-1
IEC-Ex	IEC 60079-0, -11	[Ex ia Ga]IIC	B-2284-2
ATEX	EN 60079-0, -11	[Ex ia Da]IIIC	B-2284-3
UKCA	EN 60079-0, -11		B-2284-3
UL	UL913 UL60079-0, -11	Class I, Zone 0, [AEx ia] II C	B-2284-7
c-UL	CSA C22.2 No.157 CAN/CSA E60079-0, -11	Class I, II, III, Div. 1, Grps A, B, C, D, E, F, G	
FM	Class 3600, 3610, 3810 ANSI/IEC60079-0, -11		B-2284-4
Ex-CCC	GB/T 3836.1, 3836.4	[Ex ia Ga]IIC	B-2284-5
KCS	IEC 60079-0, -11	[Ex ia Da]IIIC	B-2284-6
TS	IEC 60079-0, -11		B-2284-8
TÜV Rheinland	GS-ET-20:2016	Category 4, PL e	This instruction sheet

3.2 General specifications

Standard for Equipment	IEC/EN 60947-5-1 GS-ET-20 ISO 13849-1, ISO 13849-2 IEC/EN 61326-3-1, EN 55011 IEC/EN 60204-1 UL61010-1, CSA C22.2 61010-1
Overvoltage Category	III
Degree of Protection	IP20
Pollution Degree	2
Operating Temperature	-20°C to +60°C (no freezing) (Note) UL: -20°C to +40°C (no freezing)
Operating Humidity	45 to 85%RH (no condensation)
Rated Voltage	24V DC (-15%, +10%) (Note) UL: Class2 power supply
Voltage interruptions	10ms max.
Rated Power Consumption	5.5W max. (EB3N-A2ND, EB3N-M2ND) 7.0W max. (EB3N-A2R5D, EB3N-M2R5D)
Inrush Current	20A max.
Control Category and PL	Category 4 PL e (ISO 13849-1)
Function	Safety output turns off when safety input turns off. When input terminals 11 and 12 or input terminals 12 and 22 are interconnected, safety outputs are turned off. When either output circuit 13-14 or 23-24 is closed, the other output circuit is forced off to prevent restart.
Response time	ON -> OFF: 20 ms max. OFF -> ON: 100 ms max.
Input terminals: 11-12 Input terminals: 21-22	12V DC, 10 mA (source)
Output terminals: 13-14 Output terminals: 23-24	2NO (Dual channel output) Inductive load: DC-13 24V, 1A Resistive load: 30V DC, 1A Number of electrical cycles : 100,000 min.(1200h ⁻¹) Number of mechanical cycles:10,000,000 min.(10800h ⁻¹) Insulation resistance: 100MΩ min. Minimum applicable load: 5V DC, 1 mA (reference value)
Auxiliary Circuit	Function Response time
	ON -> OFF: 10 ms max. OFF -> ON: 15 ms max.

Input terminals: P-N	12V DC, 10mA (source)	
Output terminals: A-C	5NO (5 outputs/common) Resistive load: 24V DC, 3A (common terminal 5A max.) Number of electrical cycles : 100,000 min.(1200h ⁻¹) Number of mechanical cycles:20,000,000 min.(10800h ⁻¹) Insulation resistance: 100MΩ min. Minimum applicable load: 0.1V DC, 0.1 mA (reference value)	
Reset Circuit	Function Input terminals: Y1-Y2	
	Manual: With a reset input monitoring function, the safety output turns on at the trailing edge of the reset input. 24V DC, 5 mA	
Indicator	Power (Green LED) Signal (Orange LED)	
Dielectric strength	Between intrinsically safe circuit and non-intrinsically safe circuit.	1,527V AC
	Between power supply and safety output terminals. Between power supply and auxiliary output terminals.	1,000V AC
	Between safety output terminals and auxiliary output terminals.	1,000V AC
Vibration resistance	Panel mounting	1.5mm p-p 10-55Hz
	DIN rail mounting	0.7mm p-p 10-55Hz
Shock resistance	Panel mounting	500m/s ² (X · Y · Z axis)
	DIN rail mounting	300m/s ² (X · Y · Z axis)
External connection terminals	M3 screw	
Tightening torque	0.6 to 1.0 N · m	
Applicable wire	0.5 to 2.1 mm ²	
Installation	35mm-wide DIN rail or panel mounting (M4 screw)	
Weight	Without auxiliary output (EB3N-A2ND, EB3N-M2ND)	Approx. 220g
	With auxiliary output (EB3N-A2R5D, EB3N-M2R5D)	Approx. 300g

3.3 Terminal specification

Marking	Signal	Remark
+	Power 24V DC input	
-	Power 0V input	
Y1	Reset input	Auto reset type : Jumper-wired is necessary Manual reset type : Non-voltage contact input only (Note1)
Y2	Reset input	
11	Safety input 1	Non-voltage contact input only (Note2)
12	Safety input 1	Non-voltage contact input only (Note2)
N1	Signal ground	When connecting a movable cable to safety input terminals, connect the screen of each wire to this terminal.
21	Safety input 2	Non-voltage contact input only (Note2)
22	Safety input 2	Non-voltage contact input only (Note2)
N2	Signal ground	When connecting a movable cable to safety input terminals, connect the screen of each wire to this terminal.
13	Safety output 1	Resistive load: 30V DC, 1.0A Inductive load: DC-13 24V, 1.0A
14	Safety output 1	
23	Safety output 2	Resistive load: 30V DC, 1.0A Inductive load: DC-13 24V, 1.0A
24	Safety output 2	
P*	Auxiliary input	Non-voltage contact input only
N3	Auxiliary input common	
A*	Auxiliary output	Resistive load: 24V DC, 3A Common terminal 5A max.
C1	Auxiliary output common	

Note1: EB3N-M has a reset input monitoring function. The safety output turns on at the trailing edge of the reset input. When using a reset switch, use a momentary NO switch.

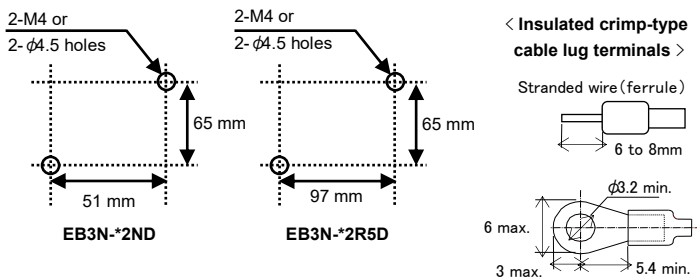
Note2: The safety input terminals must be connected the input device with two NC contacts. One NC contact of input device cannot be connected to the safety input 1 and input 2 simultaneously.

4 Installation

4.1 Mounting

- The Safety Relay Barrier can be installed in any direction.
- Install the Safety Relay Barrier securely to withstand vibrations.
- When mounting the Safety Relay Barrier onto a DIN rail, make sure to press in the clamp completely. Use the BNL6 end clips to prevent the Safety Relay Barrier from moving sideways.

Mounting Hole Layout (Panel mounting)



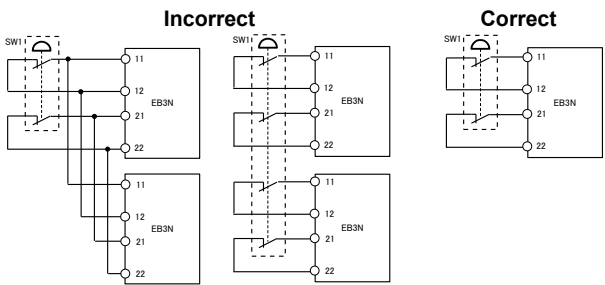
4.2 Terminal Connection

- For safety reasons the use of insulated crimp-type cable lug terminals is necessary. It is important to do the installation accordingly that the IP-degree IP20 will be maintained.
- Use a φ5.5mm (or smaller) screw driver, tighten the screws with a torque of 0.6 to 1.0 N · m.

5 Wiring

5.1 Wiring

- Use screened cables for safety input (11-12, 21-22) wiring and auxiliary input (P*-N) wiring to assure electromagnetic compatibility and to maintain the safety function (see chapter 9). Connect the screen (shield) with the frame ground terminal of equipment (control box) in which the Safety Relay Barrier is installed.
- Multiple EB3N cannot be connected with one input device. See drawings below.



Note: In the same way for each EB3N and individual reset switch must be provided.

- When a flexible cable subjected to movements is connected to the safety input terminals, use a cable with individually screened core. Connect the screen (shield) to the signal ground (N1, N2) of the Safety Relay Barrier (see chapter 9).

5.2 Wiring length

The external wiring lengths of safety inputs and outputs, auxiliary inputs and outputs, and reset input are specified as follows. Normal operation cannot be assured when the length of the wire exceeds these values.

Safety input:	Interconnection resistance ≤10Ω (recommended cable 1.25 mm ² , total loop length ≤ 500m)
Auxiliary input:	Interconnection resistance ≤600/(n-1) Ω (n: Number of common channels)
Reset input:	Total loop length ≤ 60m
Safety output and Auxiliary output:	For cables connected between the Safety Relay Barrier and connected devices with total loop lengths of over 60m, use screened cables to assure electromagnetic compatibility. Connect the screen (shield) to the frame ground terminal of an enclosure in which the Safety Relay Barrier is installed.

6 Applicable control devices

6.1 Emergency stop switches (input devices)

One device with direct opening action and two positive opening NC contacts, in compliance with IEC/EN 60947-5-5.

6.2 Interlock switches / Enabling switches (input devices)

One device with direct opening action and two positive opening NC contacts, in compliance with IEC/EN 60947-5-1, IEC 60947-5-8.

6.3 Electromagnetic contactors / Relays (output devices)

Electromechanical contactors with mirror contacts in accordance with IEC/EN 60947-4-1. Relays with forcibly guided contacts in accordance with EN 50205 (Safety relays). Connect the mirror contact of contactors (NC contact) of safety relays with the Y1-Y2 terminals of the EB3N, as an feedback loop.

6.4 Safety related devices connected to the EB3N output (output devices)

The two-channel outputs of EB3N can connect to the safety devices which is equipped with the detective function of non-equivalent inputs such as safety relay modules and safety controllers.

6.5 Reset switch (input devices)

Manual reset type: Connect a momentary NO reset switch to terminals Y1 and Y2.

7 Safety output protection fuse

Protect the safety output contacts by a device as specified (fast-blow fuse F2A, 5×20mm, IEC 60127-2).

8 Safety performance

8.1 ISO 13849-1 Category and Performance Level (PL)

For the ISO 13849-1 Category and Performance Level of the complete control system the entire equipment must be evaluated. Make sure that the safety control requirements are considered carefully and the requirements specified in the application examples (chapter 9) are satisfied.

The Safety Relay Barrier comply with ISO 13849-1 category 4 and PL e.

MTTF_d and DC are described in the table shown below. They are necessary for the calculation of Performance Level (PL) which is applied to a system containing the Safety Relay Barrier.

Mean time to dangerous failure of each channel (MTTF _d)	100 years (n _{op} =5,500)
Diagnostic coverage (DC)	99%
Restricted Operation Time (Life) T _{10a}	10 years (n _{op} =5,500)

Condition of MTTF_d calculation is followings;

$$MTTF_d(n_{op}) = \frac{2}{3} \left(\frac{1}{A_1 n_{op} + B_1} + \frac{1}{A_2 n_{op} + B_2} + \frac{1}{A_3 n_{op} + B_3} \right)$$

<Definitions>

- A₁ :1.71×10⁻⁶, A₂ :1.71×10⁻⁶
- A₃ :3.43×10⁻⁶, B₁ :4.99×10⁻⁴
- B₂ :4.99×10⁻⁴, B₃ :9.99×10⁻⁴
- n_{op} : the mean operation per year (n_{op} = h_{op} × d_{op} + t_{cycle})
- t_{cycle} : the mean time between the beginning of two successive cycles of the component
- h_{op} : the mean operation, in hours per day
- d_{op} : the mean operation, in days per year

<Another Conditions>				
n _{op} (cycles/year)	t _{cycle} (seconds/cycle)	h _{op} (hours/day)	d _{op} (days/year)	MTTF _d (years)
8,760	3,600	24	365	64.5
12	2.6×10 ⁶	24	365	100(1,923)
158,400	60	12	220	3.7

Note:
 - A higher frequency of operation will cause a reduction of the MTTF_d value.
 - T₁₀₀ is 10% of MTTF_d. The Safety Relay Barrier should be replaced before this time has elapsed.

9 Application example

9.1 Application example

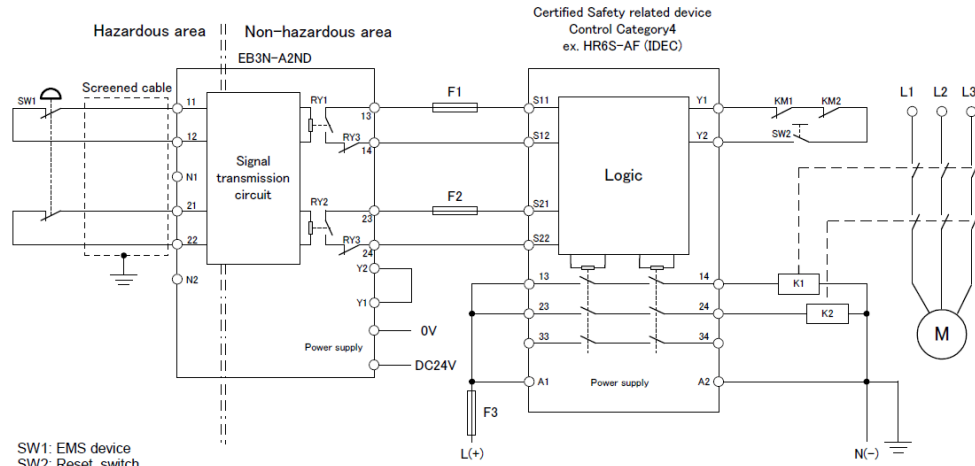
Note1. EMS device or safety switch connected to the input terminals 11-12 and 21-22 must be one device with direct opening action and two positive opening NC contacts.

Note2. Short circuit between the conductors of terminals 11 and 12 as well as between 21 and 22 must be prevented in the final application.

Note3. The specified ISO 13849-1 category as well as the performance level (PL) can be only achieved with the combination of both safety outputs (13-14 and 23-24). When each safety outputs connected serial, wire not to be the short circuited between cables.

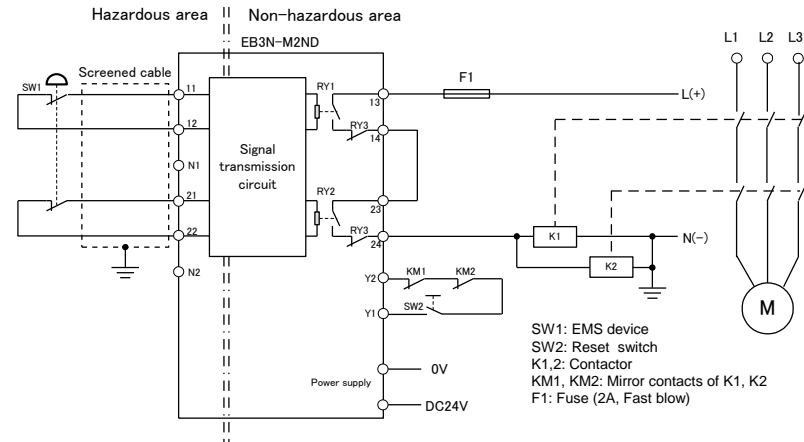
●EB3N-A2ND
 ISO 13849-1 Category 4

Note. The safety related device must check the outputs of EB3N. If it detects the non-equivalence of two channels, it must shut off the final elements, e.g. K1 and 2 (see chapter 6.4). An operational check must be performed on the Safety Relay Barrier by actuating the input device at suitable intervals.



SW1: EMS device
 SW2: Reset switch
 K1,2: Contactor
 KM1, KM2: Mirror contacts of K1, K2
 F1,2: Fuse (2A, Fast blow)

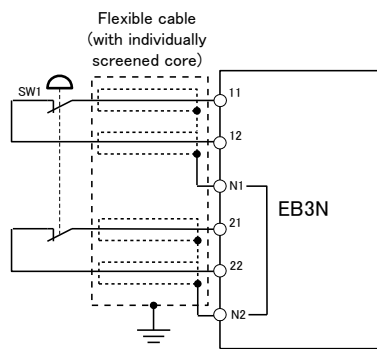
●EB3N-M2ND
 ISO 13849-1 Category 4



SW1: EMS device
 SW2: Reset switch
 K1,2: Contactor
 KM1, KM2: Mirror contacts of K1, K2
 F1: Fuse (2A, Fast blow)

Note. Any possibility of a short-circuit between the conductors connected to the output terminals 13 and 24 must be excluded by constructive measures in the equipment design.

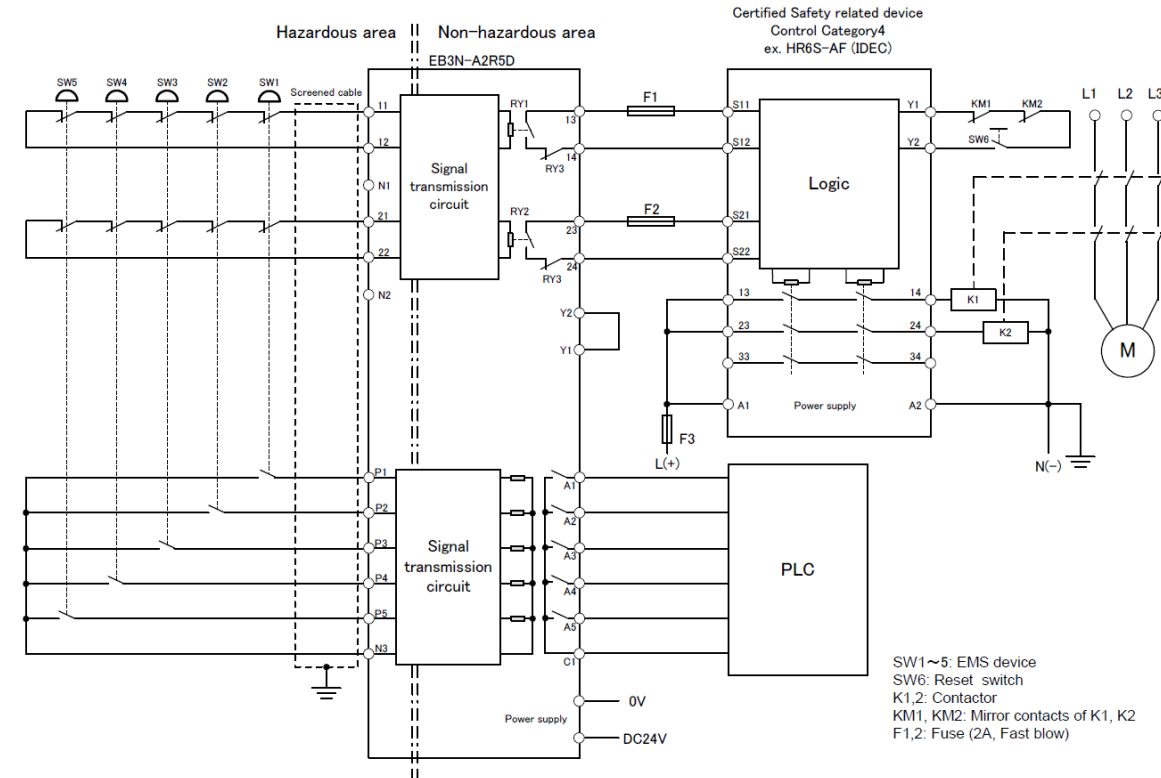
●Flexible cable subjected to movements should be connected to the safety input terminals



Note4. ISO 13849-1 category and PL need to be evaluated on the entire safety system.
 Note5. The contactors K1, K2 must provide mirror contacts in accordance with IEC 60947-4-1 Annex F.

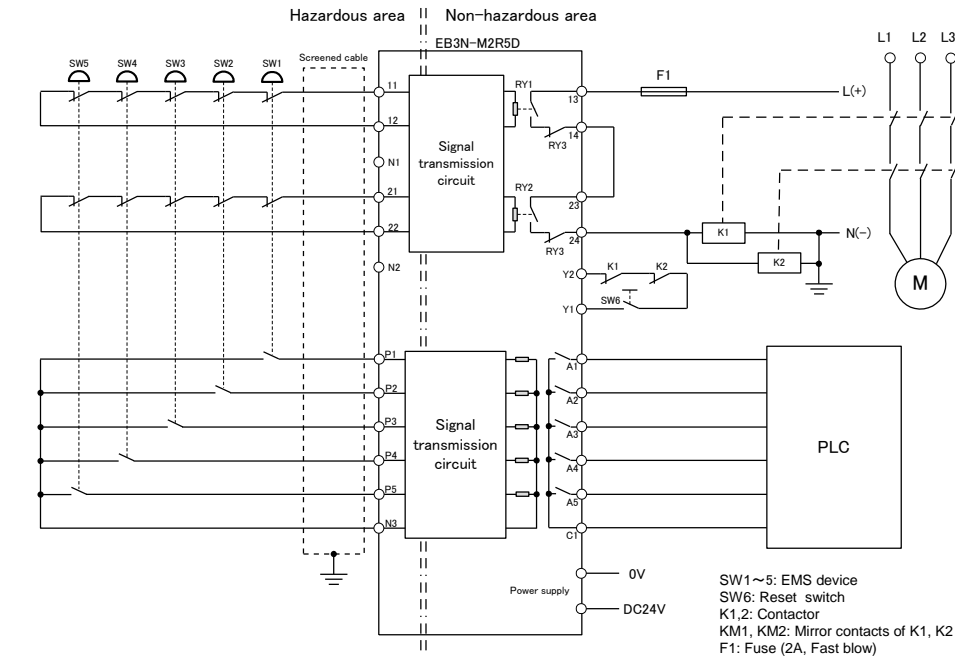
●EB3N-A2R5D
 ISO 13849-1 Category 3

Note. The safety related device must check the outputs of EB3N. If it detects the non-equivalence of two channels, it must shut off the final elements, e.g. K1 and 2 (see chapter 6.4). An operational check must be performed on the Safety Relay Barrier by actuating the input device at suitable intervals.



SW1~5: EMS device
 SW6: Reset switch
 K1,2: Contactor
 KM1, KM2: Mirror contacts of K1, K2
 F1,2: Fuse (2A, Fast blow)

●EB3N-M2R5D
 ISO 13849-1 Category 3

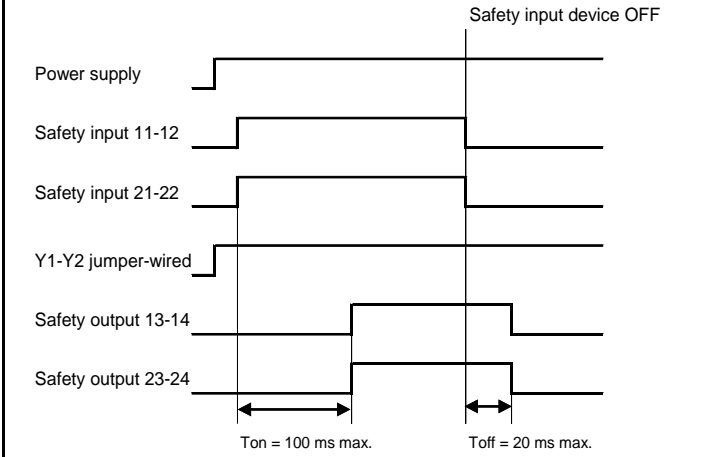


SW1~5: EMS device
 SW6: Reset switch
 K1,2: Contactor
 KM1, KM2: Mirror contacts of K1, K2
 F1: Fuse (2A, Fast blow)

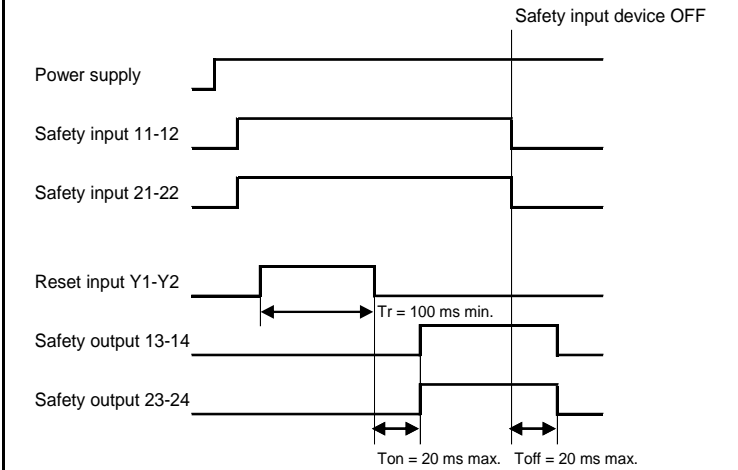
Note. Any possibility of a short-circuit between the conductors connected to the output terminals 13 and 24 must be excluded by constructive measures in the equipment design.

9.2 Operation chart

Functional diagrams EB3N auto reset type (EB3N-A2ND, EB3N-A2R5D)



Functional diagrams EB3N manual reset type (EB3N-M2ND, EB3N-M2R5D)



Please check the instruction manual including other languages at the following

URL : <https://product.idec.com/?product=EB3N>



IDEC CORPORATION

<http://www.idec.com>

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