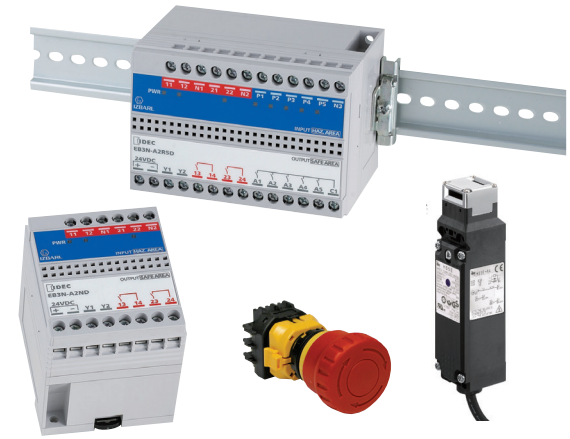
EB3N Discrete Input Barrier with Redundant Output

Build a safety system in an explosive atmosphere.
Key features:

Safety Performance	Performance level e Category 4

- [Exia] II C
- Ensures safety and machine safety in an explosive atmosphere
- Machine safety system can be built in compliance with ISO13849-1 Category 4, Performance level e.
- Safety input devices applicable in any explosive gas and hazardous areas are available.
- Available with auxiliary inputs (5 points) used to monitor the operating status of safety input devices
- Global usage
  USA (UL),
  Global IEC-Ex,
  Europe (ATEX),
  Japan (TIIS),
  China (CQST)
  Machine safety: TÜV Rheinland
- No grounding required



Entity Barrier Parameters

Ta= 60°C, Um= 250V, (Um=125V UL only), Uo=13.2V, Io= 14.2mA, Po= 46.9mW at each channel
Pn-Nn Io=227.2mA, Po= 750mW at max 16 channels Pn-Nn

Io(mA)	14.2	28.4	42.6	56.8	71.0	85.2	99.4	113.6	127.8	142.0	156.2	170.4	184.6	198.8	213.0	227.2	Combined Lo(mH)
Po(mW)	46.9	93.8	140.6	187.5	234.3	281.2	328.1	375.9	421.8	468.7	515.5	562.4	609.2	656.1	702.9	750	
Co(μF)	0.67	0.65	0.63	0.61	0.59	0.57	0.55	0.53	0.51	0.49	0.47	0.44	0.42	0.39	-	-	1.0
	0.79	0.77	0.76	0.75	0.73	0.72	0.70	0.69	0.67	0.66	0.64	0.62	0.61	0.59	0.57	0.55	0.5
	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.93	0.92	0.91	0.90	0.88	0.87	0.86	0.85	0.84	0.2
	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.1

Note 1 Added to above table, the next values combined Lo and Co are allowable;

Io(mA)	14.2						28.4						227.2					
Lo(mH)	175*	87.5	30.0	2.5	0.55	0.25	43.5*	21.5	20.0	3.5	0.43	0.25	0.68*	0.34	0.68	0.6	0.22	0.13
Co(μF)	0.90*	0.45	0.33	0.54	0.77	0.90	0.90*	0.45	0.30	0.48	0.80	0.90	0.90*	0.45	0.45	0.49	0.80	0.90

TIISI only
Ta=60°C, Um=250V

	1 ch Seperate	5 ch Common
Uo	13.2V	13.2V
Io	14.2mA	227.2mA
Po	46.9mW	750mW
Co	0.47μF	0.28μF
Lo	87.5mH	0.56mH

Note 2 The intrinsic safe apparatus and wirings shall be accordance to following formulas; for example: Ui ≥ Uo Ii ≥ Io Pi ≥ Po Ci+Cc ≤ Co Li+Lc ≤ Lo
*: Therefore, the values are allowable only at Li ≤ 1%Lo and Ci ≤ 1%Co of the intrinsic safe apparatus. (In the case of 50% of Co and Lo parameters are applicable,the maximum capacitance allowed shall not be more than Co = 1 μF for IIB and Co= 600 nF for IIC.)

Discrete Input Barrier with Redundant Output

2	2NO	Without	Without	Auto reset (Auto start)	EB3N-A2ND
				Manual reset (Manual start)	EB3N-M2ND
2	2NO	5 (1 common)	5NO (1 common)	Auto reset (Auto start)	EB3N-A2R5D
				Manual reset (Manual start)	EB3N-M2R5D

1. A maximum of five monitor contacts from safety input devices can be connected to the auxiliary input terminals. In addition, non-safety input devices can also be connected to the auxiliary input terminals.
2. On auto reset (auto start) models, when the safety condition is met (two safety inputs are both on), safety outputs are turned on automatically.
   Connect the reset (start) input terminals Y1 and Y2 together except for the following cases:
   When connecting a contactor or force guided relay to the safety output of the EB3N, connect the NC contacts of the contactor or force guided relay to the reset (start) input terminals Y1 and Y2 of the EB3N for use as a backcheck input signal.
3. On manual reset (manual start) models, while the safety condition is met (two safety inputs are both on), safety outputs are turned on at the falling edge of the reset switch (start switch) signal (OFF → ON → OFF) (start off check).
   Manual reset (manual start) models have a monitoring function of reset switch contacts (detection of welded contacts). Use NO contacts of a momentary switch for the reset (start) input.
   When connecting a contactor or force guided relay to the safety output of the EB3N, connect the NC contacts of the contactor or force guided relay to the reset (start) input terminals Y1 and Y2 of the EB3N for use as a backcheck input signal.

Selection Guide

1. Selecting the reset (start) function

Auto reset (auto start): Select this model when connecting safety control devices, such as safety relay modules or safety controllers, to the EB3N safety outputs to set up a safety system, using the reset (start) function of the safety control device.

Select this model when connecting contactors or force guided relays to the EB3N safety outputs to set up a safety system, and a risk assessment on the entire system has not found any safety problem in using auto reset (auto start).

Manual reset (manual start): Select this model when connecting contactors or force guided relays to the EB3N safety outputs to set up a safety system, and a risk assessment on the entire system has found that manual reset (manual start) is necessary.

2. Selecting the auxiliary outputs

Without auxiliary outputs: Select this model when the operating status of safety input devices are not monitored.

With auxiliary outputs: Select this model when the operating status of safety input devices are monitored or when non-safety input devices are also connected.

Specifications

EB3N General Specifications

Rated Power Voltage			24V DC
Power Voltage Range			20.4 to 26.4V DC
Operating Temperature			–20 to +60°C (no freezing) UL: –20 to +40°C (no freezing)
Operating Humidity			45 to 85% RH (no condensation)
Power Consumption	Without auxiliary output		5.5W maximum
	With auxiliary output		7.0W maximum
Safety Output	Contacts	13-14, 23-24	2NO
	Rated Load	Resistive	30V DC, 1A
		Inductive	DC-13, 24V, 1A
	Response (rated voltage)	Turn on	100 ms maximum
		Turn off	20 ms maximum
Auxiliary Output	Contacts	A* - C1	5NO/1 common
	Rated Load	Resistive	24V DC, 3A, common terminal 5A max.
	Response (rated voltage)	Turn on	15 ms maximum
		Turn off	10 ms maximum
Mounting			DIN rail or panel mounting

*: Channel Numbers: 1 to 5

EB3N Safety Specifications

Category	4
Performance Level (PL)	e
Mean Time to Dangerous Failure (MTTFd)	100 years
Diagnostic Range	99% minimum

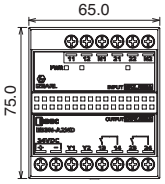
Calculation conditions for MTTFd
t_{cycle}: Mean operation cycle = 1 hour
h_{op}: Mean operation hours per day = 24 hours
d_{op}: Mean operation days per year = 365 days
Note: When t_{cycle} is shorter than 1 hour, MTTFd will decrease

EB3N Certifications

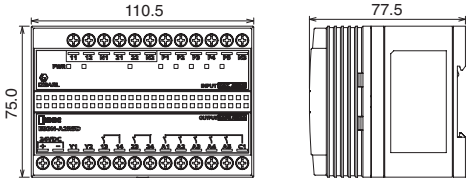
Certification Organization	Ratings	Certification Number
UL	Class I, Zone 0, [AExia] II C Class I, II, III, Div. 1, Groups A, B, C, D, E, F and G	E234997
PTB (IEC-Ex)	[Exia] II C, [Exia D]	IEC Ex PTB 10.0015
PTB (ATEX)	II (1) G [Exia] II C II (1) D [Exia D]	PTB 09 ATEX 2046
TIIS	Discrete Input Barriers with Redundant Output [Exia] II C Switch (EB9Z-A) Exia II CT6 Switch (EB9Z-A1) Exia II BT6	TC18753 TC15758 TC15961
CQST	[Exia] IIC	CNEx11.0038

Dimensions (mm)

EB3N-A2ND
EB3N-M2ND



EB3N-A2R5D
EB3N-M2R5D



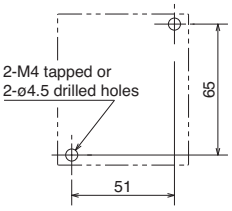
Terminal Functions

24V DC	Power
Y1-Y2	Reset input (Start input)
11-12	Safety input 1
21-22	Safety input 2
N1, N2	Signal ground
P*-N3	Auxiliary input
13-14	Safety output 1
23-24	Safety output 2
A*-C1	Auxiliary output

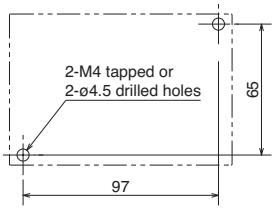
*: 1 to 5

Mounting Hole Layout

EB3N-A2ND
EB3N-M2ND

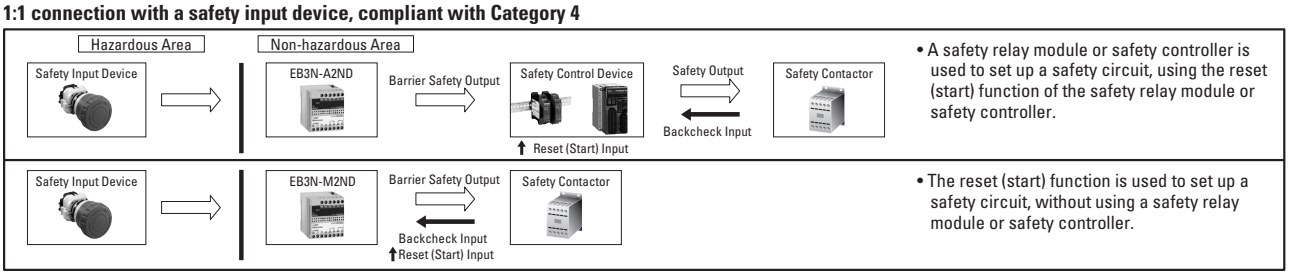


EB3N-A2R5D
EB3N-M2R5D



EB3N System Configuration Examples

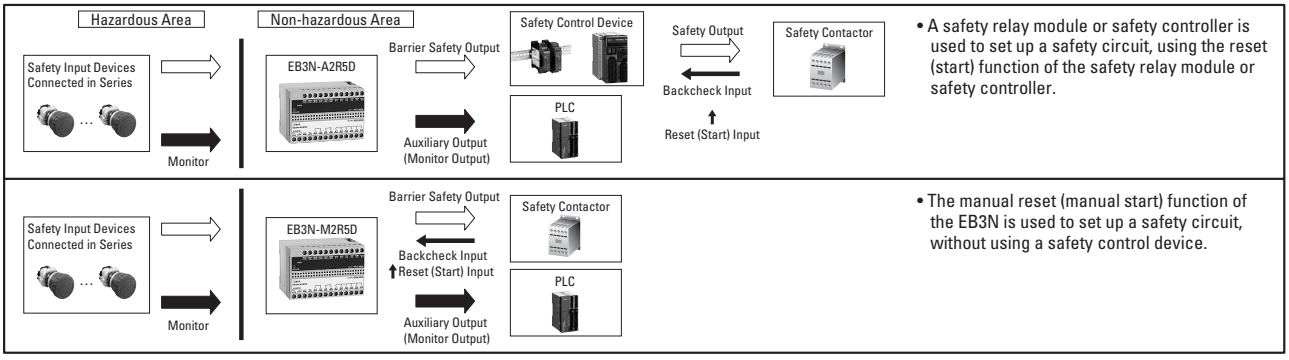
1:1 connection with a safety input device, compliant with Category 4



- A safety relay module or safety controller is used to set up a safety circuit, using the reset (start) function of the safety relay module or safety controller.
- The reset (start) function is used to set up a safety circuit, without using a safety relay module or safety controller.

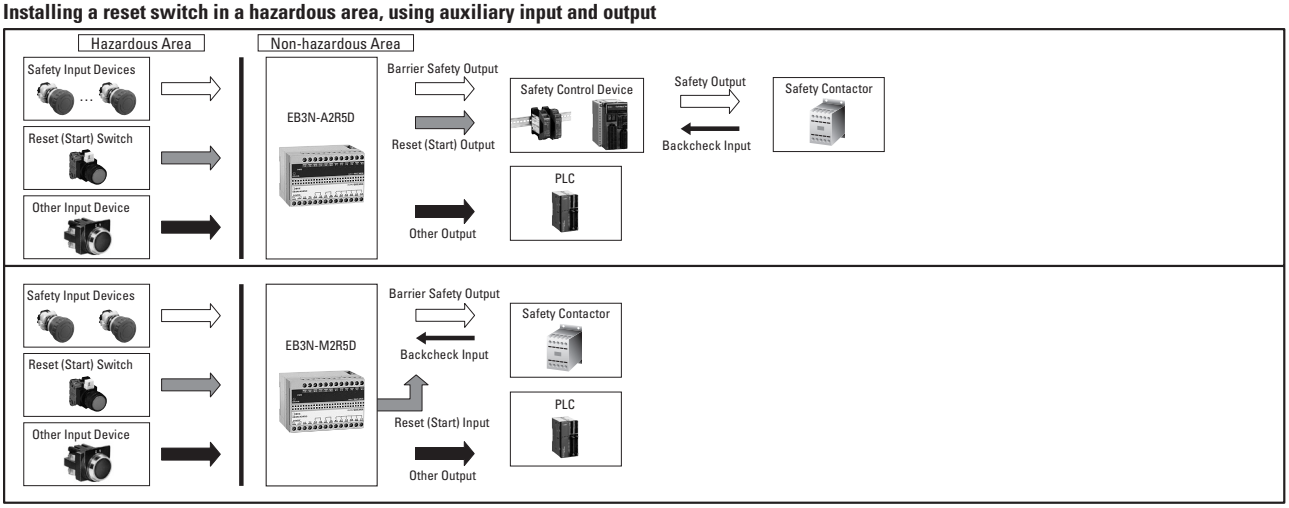
Connection with multiple safety input devices, capable of monitoring up to 5 contact operations, compliant with Category 3

For monitoring operating statuses of safety input devices located in a non-hazardous area



- A safety relay module or safety controller is used to set up a safety circuit, using the reset (start) function of the safety relay module or safety controller.
- The manual reset (manual start) function of the EB3N is used to set up a safety circuit, without using a safety control device.

Installing a reset switch in a hazardous area, using auxiliary input and output



Safety Input Devices Connectable to Safety Input Terminals (Examples)

Emergency stop switch: (Non-illuminated) XW1E-BV402M-R, XN4E-BL412MRH
Safety switch: HS6B-02B05, HS1B-02R

Instructions

Notes for Operation

1. Do not disassemble, repair, or modify the EB3N discrete input barrier with redundant output, otherwise the safety characteristics may be impaired.
2. Use the EB3N within its specification values.
3. The EB3N can be mounted in any direction.
4. Mount the EB3N on a 35-mm-wide DIN rail or directly on a panel surface using screws. When mounting on a DIN rail, push in the clamp and use end clips to secure the EB3N. When mounting on a panel surface, tighten the screws firmly.
5. Excessive noise may cause malfunction or damage to the EB3N. When the internal voltage limiting circuit (thyristor) has shut down the power due to noise, remove the cause of the noise before powering up again.
6. The internal power circuit contains an electronic fuse to suppress overcurrents. When the electronic fuse has tripped, shut down the power, remove the cause of the overcurrent before powering up again.
7. Use crimping terminals with insulation sheath for wiring. Tighten the terminal screws, including unused terminal screws, to a recommended tightening torque of 0.6 to N·m using a screwdriver of ø5.5 mm in diameter.
8. Before inspecting or replacing the EB3N, turn off the power.

Notes for Machine Safety

1. Operate the safety input device to check the EB3N functionality everyday.
2. For safety input devices, such as safety switches or emergency stop switches, connected to the EB3N, use safety standard-compliant devices with direct opening action and 2NC contacts.
3. Do not use the auxiliary input as a safety input.
4. For safety control devices connected with the EB3N, use machine safety standard-compliant devices with a disparity detection function.
5. Use safety inputs and safety outputs in a circuit configuration compliant with safety requirements.
6. To calculate the safety distance, take into consideration the response time of all devices comprising the system, such as the EB3N and safety devices connected to the EB3N.
7. Separate the input and output wiring from power lines and motor lines.
8. When using multiple EB3N discrete input barriers with redundant output, do not connect one switch to more than one EB3N. Use separate switches for each EB3N.
9. To ensure EMC, use shielded cables for safety inputs and auxiliary inputs. Connect the shield to the FG of the control panel on which the EB3N is mounted.
10. For protection against overcurrents, connect an IEC60127-2-compliant 2A fast-blow fuse (5 × 20 mm).
11. Evaluate the ISO 13849-1 category and performance level in consideration of the entire system.

Safety Notes

1. Install the EB3N in an enclosure capable of protecting against mechanical shocks at a hazardous location in accordance with intrinsic safety ratings and parameters.
2. Install and wire the EB3N so that the EB3N is not subject to electromagnetic and electrostatic induction and does not contact with other circuits.
   For example, keep a minimum spacing of 50 mm between intrinsically safe and non-intrinsically safe circuits, or provide a metallic separating board between the intrinsically safe circuit and non-intrinsically safe circuit. When providing a metallic separating board, make sure that the board fits closely to the enclosure (top, bottom, and both sides). Allowable clearance between the board and the enclosure is 1.5 mm at the maximum.
   When a motor circuit or high-voltage circuit is installed nearby, keep a wider spacing than 50 mm between intrinsically safe and non-intrinsically safe circuits.
3. Keep a minimum spacing of 3 mm between the terminal or relay terminal block of the intrinsically safe circuit and the grounded metal parts of the metal enclosure.
4. Connect the terminals so that IP20 is ensured.
5. To prevent disengaged wires from contacting with other intrinsically safe circuits, bind together the end of wires.
6. Make sure that the voltage of the power supply for the devices connected to the non-intrinsically safe circuit or the internal voltage of such devices does not exceed 250V AC/DC 50/60 Hz (UL rating: 125V AC 50/60 Hz) or 250V DC (UL rating: 200V DC) under any normal and abnormal conditions.
7. Make sure that the wiring of intrinsically safe circuits does not contact with other circuits or is not subject to electromagnetic and electrostatic inductions, otherwise protection from hazards is not ensured.
8. When identifying intrinsically safe circuits by color, use light blue terminal blocks and cables.
9. When wiring the intrinsically safe circuit, determine the distance to satisfy the wiring parameters shown below.
   a) Wiring capacitance $Cw \leq Co - Ci$
      Co: Intrinsically safe circuit allowable capacitance
      Ci: Internal capacitance of switches
   b) Wiring inductance $Lw \leq Lo - Li$
      Lo: Intrinsically safe circuit allowable inductance
      Li: Internal inductance of switches
   c) Wiring resistance $\leq Rw$
      Rw: Allowable wiring resistance

Switches in the Hazardous Area

1. A switch contains the switch contact, enclosure, and internal wiring. A switch contact refers to an ordinary switching device which consists of contacts only.
2. When the switch has internal wiring or lead wire, make sure that the values of internal capacitance (Ci) and inductance (Li) are within the certified values.
3. Enclose the bare live part of the switch contact in an enclosure of IP20 or higher protection.