

## EB3N Discrete Input Barrier with Redundant Output

Build a safety system in an explosive atmosphere.

Key features:

<b>Explosion Protection</b>	Discrete Input Barrier with Redundant Output	[Exia] II C	<b>Safety Performance</b>	Performance level e Category 4
-----------------------------	--	-------------	---------------------------	--------------------------------

- Ensures explosion protection 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
- A wide variety of Japan TIIS-rated emergency stop switches and interlock switches are available
- Global usage
- Explosion protection: Japan (TIIS), USA (UL), Europe (ATEX), China (CQST), IEC Ex
- Machine safety: TÜV Rheinland
- No grounding required



### Discrete Input Barrier with Redundant Output

Safety Input Points	Safety Output Points	Auxiliary Input Points <sup>1</sup>	Auxiliary Output Points (Relay Output)	Reset (Start) <sup>2,3</sup>	Part Number
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


General

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	
	Rated Load	5NO/1 common	
	Response (rated voltage)	Resistive	24V DC, 3A, common terminal 5A max.
		Turn on	15 ms maximum
Turn off	10 ms maximum		
Mounting		DIN rail or panel mounting	

 \*: Channel Numbers: 1 to 5


Explosion-protection

Explosion Protection		[Exia] II C
Non-intrinsically Safe Circuit Maximum Voltage (Um)		250V (UL: 125V)
Intrinsically Safe Circuit Maximum Voltage (Uo)		13.2V
Intrinsically Safe Circuit Maximum Current (Io)		227.2 mA
Intrinsically Safe Circuit Maximum Power (Po)		750 mW
Intrinsically Safe Circuit Allowable Capacitance (Co)		0.49 µF (TIIS: 0.28 µF)
Intrinsically Safe Circuit Allowable Inductance (Lo)		0.60 mH (TIIS: 0.56 mH)
Intrinsically Safe Circuit Wiring Resistance (Rw)	Safety circuit	(Note 1)
	Auxiliary circuit	(Note 2)

-  1. 10Ω maximum (500m maximum using a 1.25 mm2 cable)
- 2. 600/(N+1)Ω maximum, where N = the number of common channels

Safety

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

Certification Number

Certification Organization	Explosion Protection	Certification Number
TIIS	Discrete Input Barriers with Redundant Output [Exia] II C Switch (EB9Z-A) Exia II CT6 Switch (EB9Z-A1) Exia II BT6	TC18753 TC15758 T15961
PTB	[Exia] II C, [Exia D] II (1) G [Exia] II C II (1) D [Exia D]	IEC Ex PTB 10.0015 PTB 09 ATEX 2046
CQST	[Exia] II C	CNEx 11.0038
UL	Class I, Zone 0, [AExia] II C Class I, II, III, Div. 1, Groups A, B, C, D, E, F and G	E234997

01 Touchscreens

PLCs

Automation Software

Power Supplies

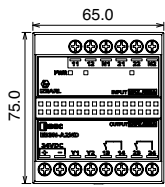
Sensors

Communication

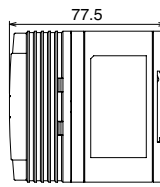
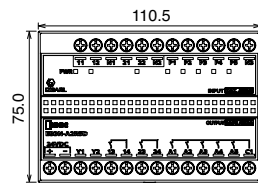
Barriers

## Dimensions (mm)

EB3N-A2ND  
EB3N-M2ND



EB3N-A2R5D  
EB3N-M2R5D



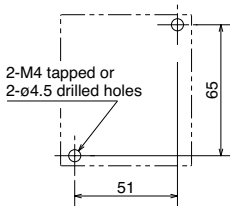
## Terminal Functions

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

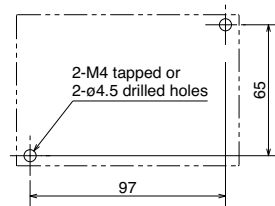
\*: 1 to 5

## Mounting Hole Layout

EB3N-A2ND  
EB3N-M2ND

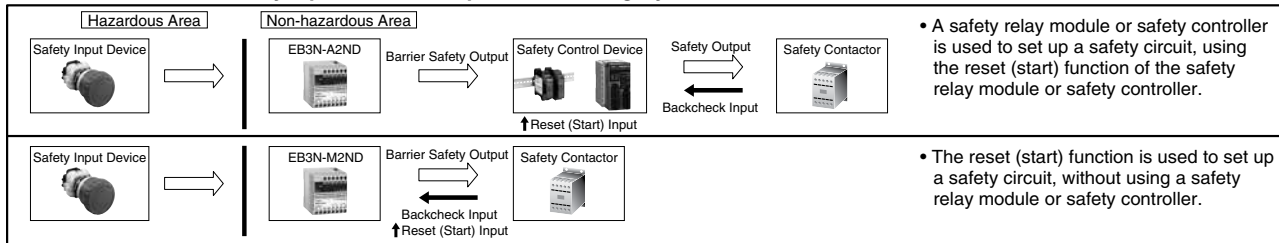


EB3N-A2R5D  
EB3N-M2R5D



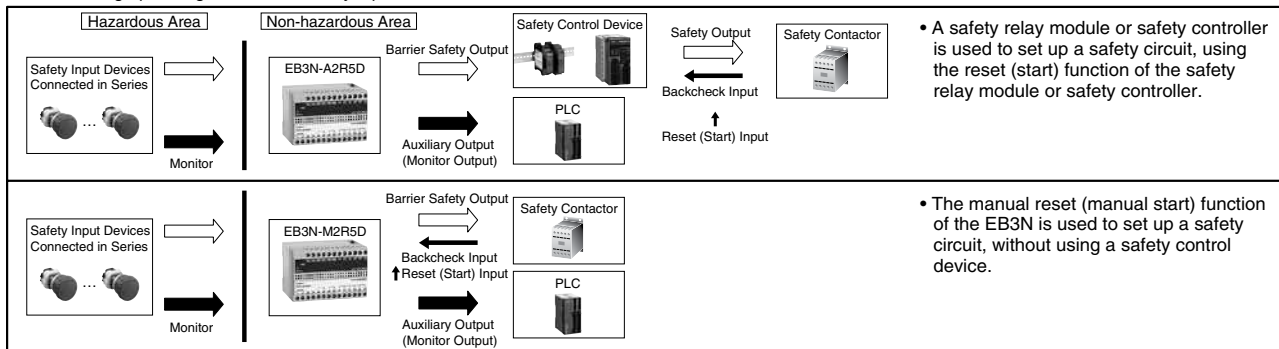
## EB3N System Configuration Examples

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

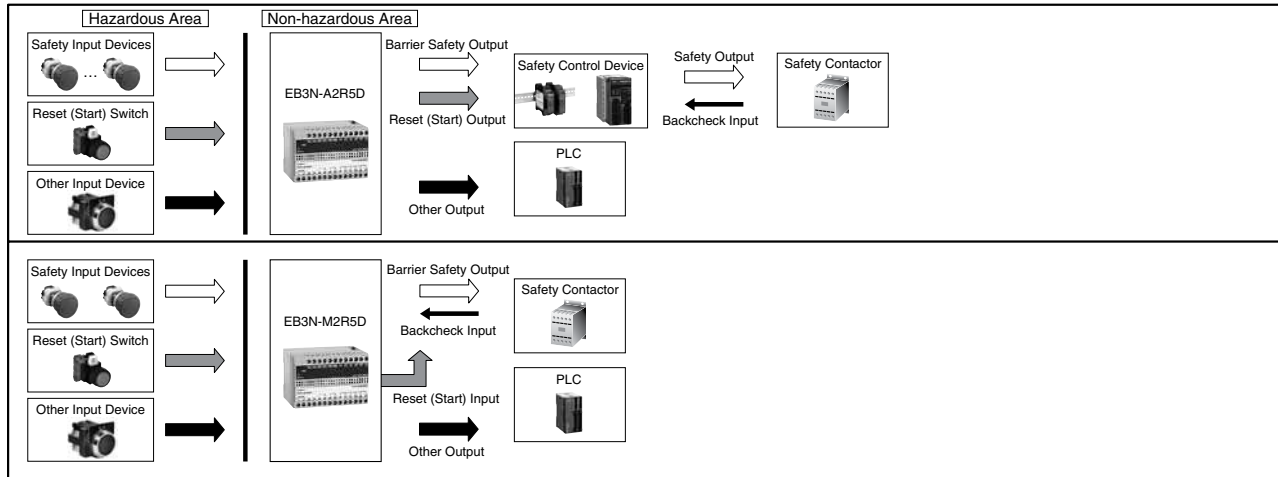


### Connection with multiple safety input devices, capable of monitoring up to 5 contact operations, compliant with Category 3

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



## 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, XN4E  
 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  $\phi 5.5$  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.

## Notes for Explosion Protection Safety

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 explosion protection 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  $C_w \leq C_o - C_i$ 
    - Co: Intrinsically safe circuit allowable capacitance
    - Ci: Internal capacitance of switches
  - b) Wiring inductance  $L_w \leq L_o - L_i$ 
    - Lo: Intrinsically safe circuit allowable inductance
    - Li: Internal inductance of switches
  - c) Wiring resistance  $\leq R_w$ 
    - 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.
4. Depending on the explosion-protection specifications of TIS, the exposed area of plastic switch operator, when installed in Japan, is limited as follows:

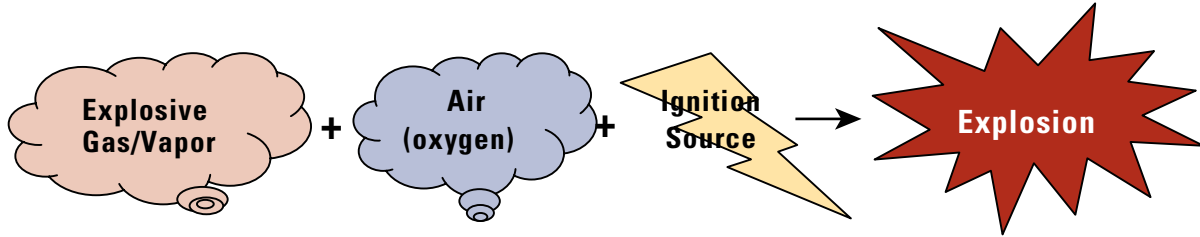
Certification	Explosion Protection	Exposed Area
TC15758	Exia II CT6	20 cm <sup>2</sup> maximum
TC15961	Exia II BT6	100 cm <sup>2</sup> maximum

**General Information**

**What is Explosion Protection?**

**Explosion Mechanism**

For an explosion to occur, both hazardous atmosphere (mixture of explosive gas/vapor and air) and ignition source from electrical equipment must exist. The first step for explosion prevention is to prevent the three factors (explosive gas/vapor, air, and ignition source) from existing at the same time.



Ignition source: Electrical equipment which originates electrical sparks or has a high temperature, capable of causing ignition in a hazardous atmosphere.

Explosion protection types:

1. Separation of explosive gas/vapor and ignition source
  - Flameproof explosion protection
  - Pressurized explosion protection
2. Low power on ignition source → Intrinsically safe explosion protection

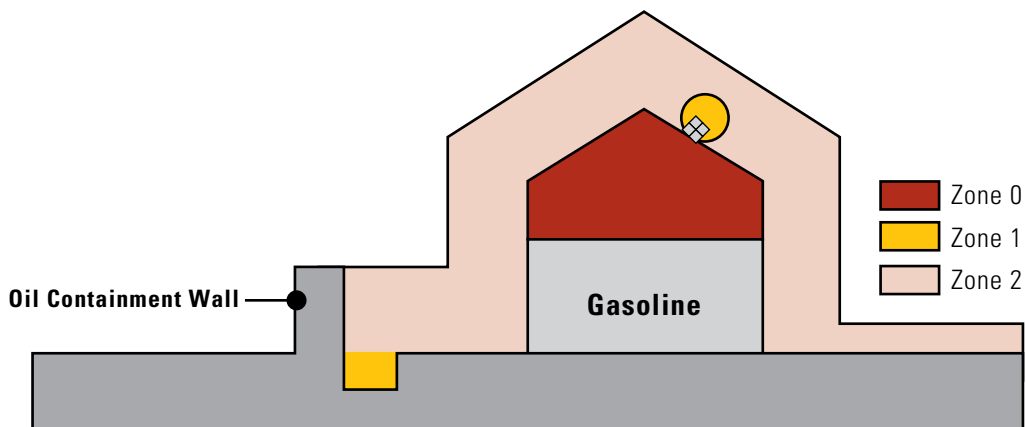
**Classification of Hazardous Areas**

- Required when selecting explosion protection electrical equipment and wiring methods.
- Determined by user.
- Hazardous areas are classified depending on the frequency of the occurrence of hazardous atmosphere.

**IEC Classification**

- Zone 0: Where hazardous atmosphere may exist for 1,000 hours or longer per year.
- Zone 1: Where hazardous atmosphere may exist for 10 to 1,000 hours per year.
- Zone 2: Where hazardous atmosphere may exist for less than 1 hour per year.

**Gasoline Tank Example**



OT Touchscreens

PLCs

Automation Software

Power Supplies

Sensors

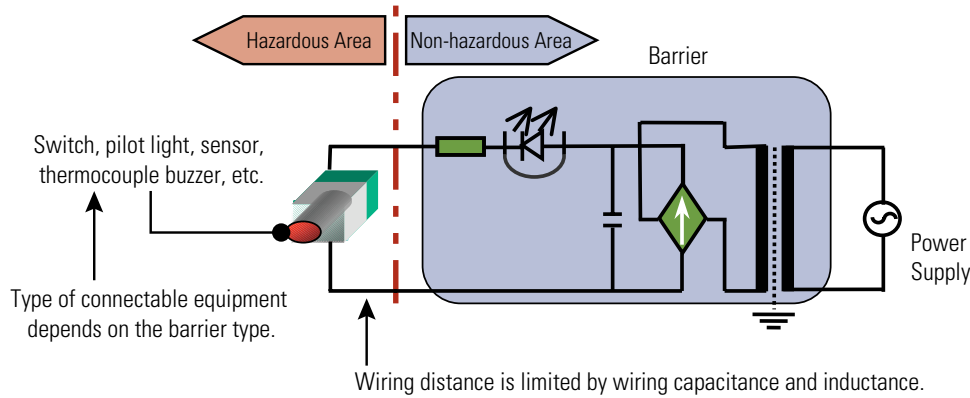
Communication

Barriers

**Explosion Protection Types**

**Intrinsically Safe Structure**

- Structure in which voltage and current are limited so that no sparks, arc, and thermal effect produced by electric equipment (switch, pilot light, etc) in hazardous areas are capable of causing ignition of explosive gas/vapor.



**Features:**

- Barrier is installed in non-hazardous area, and is connected to the switches or pilot lights in hazardous area.
- The intrinsically safe system can be used in zone 0.
- Because voltage and current to the electric equipment are limited, the variety of devices that can be connected to the barrier is restricted.
- Wiring is required between hazardous and non-hazardous areas.
- Grounding (grounding resistance 10Ω max.) may be required (EB3C, EB3L do not require grounding).

**Grounding** - The procedure to achieve required resistance value by inserting a grounding wire into a hole in the ground and furnishing the surrounding with material of superior electrical conductivity.

**Non-insulated barrier (Zener barrier):** grounding resistance 10Ω max.

- While the voltage difference between the circuits is limited in Zener barriers, the voltage difference between the circuits and grounding is unlimited. When a short-circuit occurs between the circuits and ground, high voltage/current may be generated in the circuits, causing a possible explosion. The OV line of circuits, therefore, must be provided with grounding (resistance 10Ω max.) so that the voltage/current can be shunted to the ground.

**Insulated barrier:** grounding resistance 100Ω max.

- Intrinsically safe and non-intrinsically safe parts are electrically isolated by an isolation transformer. If a sufficient isolation distance is not provided on the isolation transformer, however, the transformer may short-circuit between primary and secondary when an abnormal voltage occurs. This may generate high voltage/current in the intrinsically safe circuit, causing a possible explosion. A transformer with metallic isolator must be used between primary and secondary, and grounding (resistance 100Ω max.) must be provided.

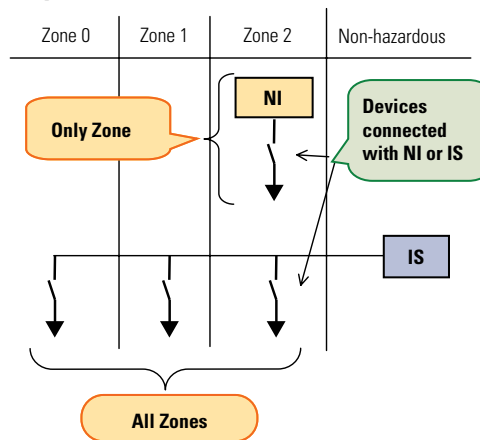
**Difference between NI (Non-incendive) & IS (Intrinsic Safety)**

**Standard**

- NI: Installed in areas that are Zone 2 hazardous locations.
- IS: Installed in areas that are non-hazardous.

**Advantages & Disadvantages**

- NI: Small and inexpensive. Devices connected with NI are also installed only in the Zone 2 area.
- IS: Small but more expensive. Devices connected with IS can be used in the Zone 0, 1 and 2 areas (all zones).

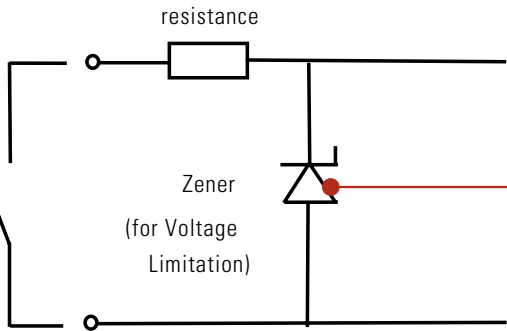


Structure

NI Structure

0I Touchscreens

PLCs

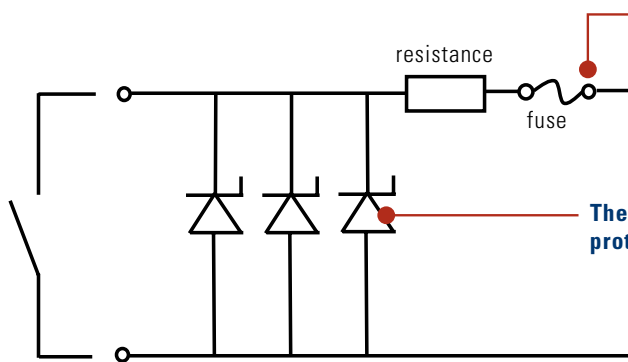


When the zener is broken, the voltage cannot be limited: high voltage is applied to the connecting device side, which could lead to explosion.

IS Structure

Automation Software

Power Supplies



The fuse is for current limitation

These 3 zeners make redundant protection (voltage)

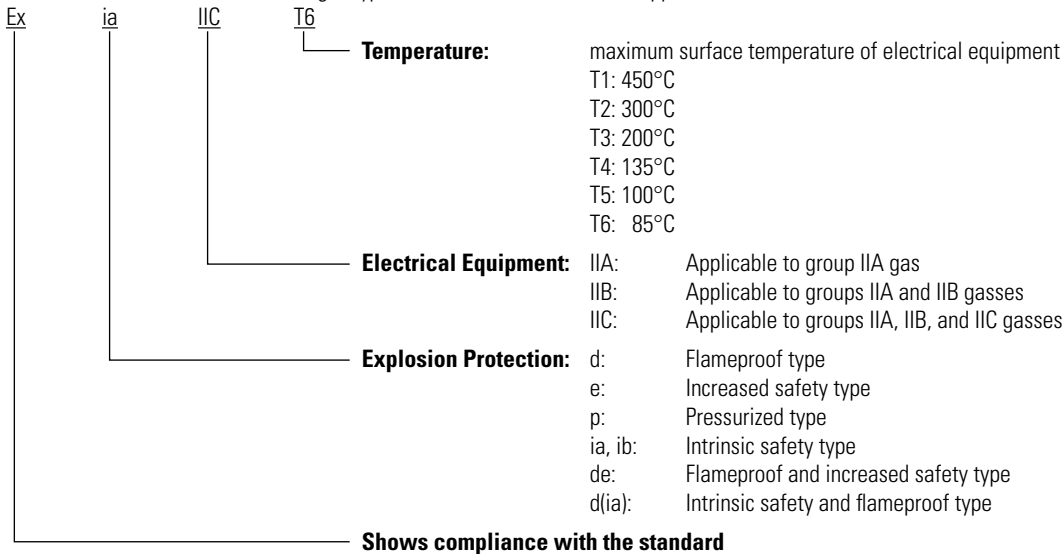


Note : Instead of zeners, thyristors are used in EB3C for better energy efficiency.

Explosion Protection Marking

Gas is categorized into groups by explosiveness and ignition temperature.

Technical standard: Determines the gas type which can be used with the apparatus.



Examples: ExdellBT4, EXellCT4, ExllBT4, ExialICT5



## EB3C/EB3L Features

## Small and lightweight

EB3C (10-circuit)	Weight: 380g Dimensions: 171.5 L × 75 W × 77.5 H (mm)	<ul style="list-style-type: none"> <li>• Plastic housing</li> <li>• Small system design</li> </ul>
EB3L (10-circuit)	Weight: 360g Dimensions: 171.5 L × 75 W × 77.5 H (mm)	

## No grounding required: less labor, less cost

No explosion protection grounding.

Isolation transformer is used. All isolations – not only between primary and secondary, but also cores and bobbins – are reinforced.



No isolator = No grounding

No electrical equipment grounding.

Power supply part: Electric shock is prevented with reinforced isolation. Conforms to IEC standard.

Output part: The small power & EMC design requires no grounding. Conforms to IEC switch output standard.

Shield wire treatment

Shield wires of intrinsically safe circuits are grounded to the panel in non-hazardous area, and not connected to the N terminal on the barrier.

## Common Type and Connector Type

1. Common type → For 8 and 16 circuits. Easy connection to PLC.
2. Connector type
  - Flat cable connection between non-intrinsically safe part and PLC.
  - Connectable to IDEC's FC5A, FC4A and Mitsubishi's AIS.

Oil Touchscreens

PLCs

Automation Software

Power Supplies

Sensors

Communication

**Standards**

1. CE  
 Conforms to EMC directive and LVD.  
 EMC directive:  
 Electromagnetism generated by the barrier does not affect other communication equipment. Also, electromagnetism generated by other communication equipment does not affect the barrier.  
 LVD (Low Voltage Directive):  
 For rated voltages 50 to 1000V AC, 75 to 1500V DC.
2. ATEX  
 Adopted by EU, this directive covers electrical and mechanical equipment and protective systems, which may be used in potentially explosive atmospheres (Europe). EN50014 series is adopted.
3. FM (Factory Mutual Approval)  
 A private US certification organization for waterproof and intrinsic safety. Widely recognized for more intrinsic safety than UL.
4. CSA (Canadian Standards Association)  
 A Canadian certification organization for electrical equipment.
5. NK: Class NK (Nippon Kaiji Kyokai)  
 Required for ships with Japanese ship registration.
6. Underwriters Laboratories (UL) - A US certification agency for all electrical and hazardous location products.

**Equipment connectable to EB3L**

- Common wiring: Only EB3P-L type pilot lights, which have been approved, can be connected to the EB3L discrete output barrier.
- Separate wiring: No approval is required for pilot lights and buzzers to be connected to the EB3L discrete output barrier. However, users must make sure that the temperature rise of the equipment is below the rated value with the current and voltage supplied from the discrete input barrier. Also take the ratings of intrinsically safe circuit into consideration. IDEC's EB3P-L type pilot light lights and EB3P-Z type buzzers satisfy the ratings.

EB3P-L Pilot light:  $\varnothing 22$  and  $\varnothing 30$ , a total of 78 types

- Super LED installed
- Lens colors: amber, blue, green, red, white, and yellow
- Accessories and maintenance parts are the same as standard control units. See IDEC's control units catalogs.

IPL1 Miniature pilot light:  $\varnothing 6$ ,  $\varnothing 8$ , and  $\varnothing 10$ , a total of 40 types

- Low price
- Illumination colors: amber, green, red, white, and yellow

EB3P-Z buzzer: Continuous and intermittent sound,  $\varnothing 30$  mounting hole, terminal block type

- Degree of protection: IP20
- Common wiring is not available due to high inductance value.
- Approved by THS only

**Less labor**

1. Finger-safe spring-up terminal  
 The finger-safe, captive spring-up terminals prevent electric shock (IP20), and make installation easy. No screw loss.
2. Universal voltage  
 100 to 240V AC (UL rating 100 ~ 120VAC).
3. Installation  
 Direct and DIN-rail mountable.

**EB3 series: Screws cannot be touched by fingers even when loosened.**

**Switches connectable to EB3C**

Switches which are configured only with mechanical contacts (dry contacts) can be connected to the EB3C.

Pushbutton, selector, cam, toggle, limit, micro, reed, foot, pressure, and temperature switches can be used.



Note: Contact rating must be 13.2V, 14.2 mA minimum. Contact material such as silver oxide cadmium and silver tungsten may cause conduction failure at 10 mA due to the film generated on the surface.

$\varnothing 30$ : APN, UPQN equivalent  
 $\varnothing 22$ : APW, HW, LW, UPQW equivalent



When connecting one buzzer and 15 pilot lights to EB3L-S16CSD, do not connect the negative lines of buzzer and pilot lights in common. Connect the buzzer and pilot lights to the barrier using separate lines (15 pilot lights can be wired with one common line).

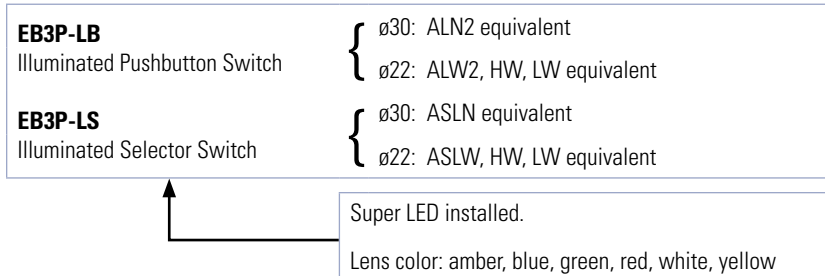
## Connecting Illuminated Switches

Made possible with the combination of EB3L and EB3C.

User benefits

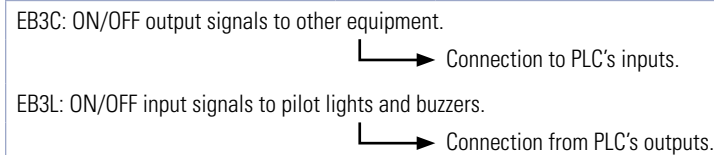
- Flexibility of control panel design  
Explosion protected panels can be designed in a similar manner to non-explosion protected panels (non-explosion protected panels can be used as explosion protected panels without any changes).
- Control panel becomes smaller.

Connectable illuminated switch: 134 types



Connection Method

### 1. Difference between EB3C and EB3L



### 2. Sink and Source

Available combination: Sink Output + Source Input or Source Output + Sink Input. Sink output (source input) is mainly adopted in Japan (Europe: source output).

Other information

- Up to 16 channels, including both pilot lights and contacts, can be connected in common wiring.
- Connect the common wires of pilot lights and contacts separately to the N terminals of each barrier.
- Use two wires to connect the common terminals (N terminals) EB3C and EB3L barriers.
- Accessories and maintenance parts are the same as the standard control units. See IDEC's control units catalogs for details.

## Safety Precautions

### Electrostatic protection: Prevention of fire ignition and explosion caused by electrostatic charges.

- As required by IEC60079-11, limit the exposed surface of plastic equipment (switch, pilot light) installed in hazardous areas.
- 20 cm<sup>2</sup> max. for IIC gas atmosphere.
- 100 cm<sup>2</sup> max. for IIB and IIA gas atmosphere.
- When the surface area of other than operating parts exceeds the limit, attach a caution plate.
- Pushbutton, knob, or other parts which are frequently touched by operators.

## EB3C Separate and Common Types

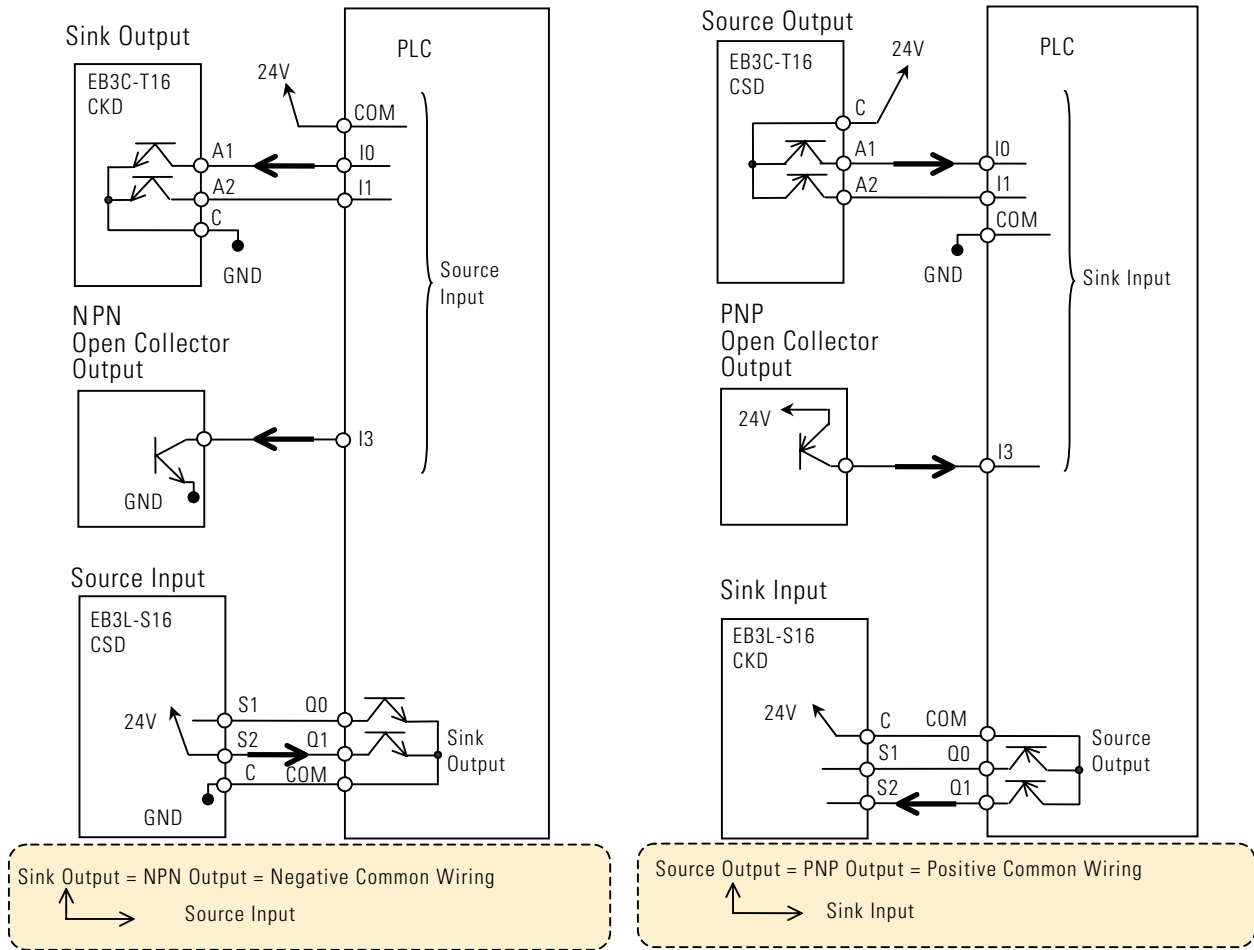
### 1. Separate Wiring Type

The output circuit is isolated for each channel. Both sink and source outputs can be connected.

### 2. Common Wiring Type

The output circuit is not isolated from each other and uses common terminal C. Sink and source outputs are available on different modules.

Sink/Source Definition



Relay Terminal Block

When connecting a discrete input barrier to the switches and pilot lights installed in hazardous area, use a relay terminal block.



A relay terminal block can be eliminated when using EB3C and EB3L, as these barriers are considered as relay terminal blocks.

Cable Extension and Intrinsic Safety Parameter

- For wiring between the barrier and the switches and pilot lights installed in hazardous area, use a cable of 2.0 mm<sup>2</sup>. The cable can be extended up to approximately 1 km.
- For EB3L of common wiring type, use a cable of 2.0 mm<sup>2</sup>. The cable can be extended up to approximately 600 m. Longer cables cause dim LED lighting.

Make sure that wiring parameters (inductance, capacitance, resistance) do not exceed the maximum limit.

Noise Countermeasure

- The LED connected to the EB3L may blink due to noises.
- Check the wiring so that noise is not imposed on the EB3L (eg. separation from power line).
- Noise can be avoided also by inserting a noise filter for AC line into the barrier's power input part.

Recommended noise filters:

DENSEI-LAMBDA		TDK	Schaffner
MBW-1202-22	PBF-1202-22	ZCB2203-11	FN670-3/06
MBW-1203-22	PBF-1203-22	ZCB2206-11	
MBW-1206-22	PBF-1206-22		

OI Touchscreens

PLCs

Automation Software

Power Supplies

Sensors

Communication

Barriers