Technical Data

Allen-Bradley

Zener Barriers

Bulletin 937Z

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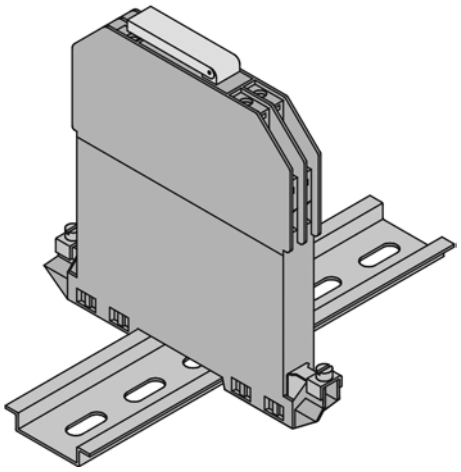
Introduction

Allen-Bradley Zener barriers are a cost-effective solution for providing an intrinsically safe interface with field devices in a hazardous area. The barriers provide protection for electrical signals within hazardous areas and feature a narrow profile of 12.5 mm to maximize control panel space. Barriers prevent the transfer of unacceptably high energy from the safe area into the hazardous area. These barriers have a positive polarity, which means the anodes of the Zener diodes are grounded. Depending on the application, increased or decreased intrinsic safety parameters apply for serial or parallel connection.

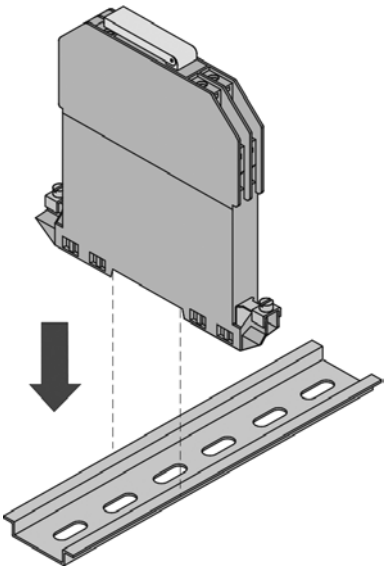
Figure 1 - Bulletin 937 Zener Barrier System



Mounting

The 937 barriers snap on standard 35 mm DIN rail and are ideal for racks or control cabinets. They can be installed in Class I Division 2 and Zone 2 hazardous areas when installed in enclosures with the appropriate protection category.

Figure 2 - Mounting the Zener Barrier



Housing

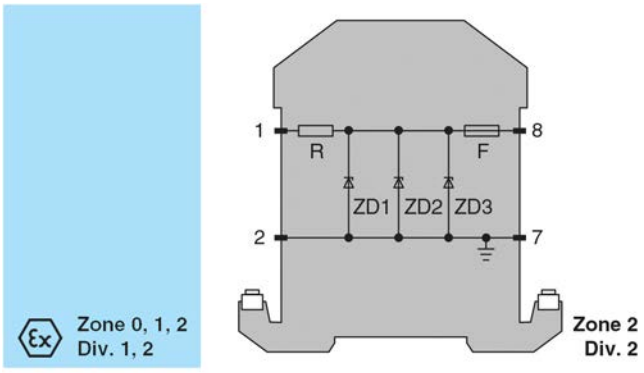
The barriers are epoxy filled, constructed to a protection classification of IP20, and are equipped with cage clamp terminals, that accept wire up to 2.5 mm^2 (14 AWG).

Figure 3 - 12.5 mm Housing

Operating Principle

The Zener diodes within the barriers are connected in the reversed biased direction. In normal operation the barrier will remain virtually transparent to the control loop.

Figure 4 - Wiring Diagram



Terminals 7 and 8 are typically connected to a control circuit in the safe area. The single condition that the control circuitry must satisfy, is that it must not contain a source whose potential relative to earth is greater than 250V AC or 250V DC. Terminals 1 and 2 are connected to the intrinsically safe circuits (field device) in the hazardous area. Intrinsically safe apparatus consists of Complex Apparatus which requires certification and Simple Apparatus which must meet the following electrical characteristics: 1.5 V, 0.1 A, 25 mW. Zener barriers are identified in terms of voltage, resistance and polarity, for example, 10 V, 50 Ω,positive polarity. These figures correspond to the zener voltage Uz and the total resistance of all barrier components. They therefore represent the safety values. The values stated on the type identification label correspond to the worst case data for Uz (Uo, Voc) and Ik (Io, Isc) determined during certification; Ik is obtained by dividing Uz by the resistance R. It should be noted once again, however, that these values do not correspond to the operating range of the Zener barrier. Ideally, zener diodes would not allow any current in the reverse direction until the zener voltage has been attained. In practice, zener diodes do allow a small leakage current, the value of which increases as

the applied voltage is increased. The operating range of a Zener barrier must therefore be such that it is below the zener voltage, so that the leakage current is restricted to a minimum. Zener barriers are normally tested to check that at the prescribed voltage the leakage current is smaller than 10 µA.

Figure 5 - Leakage Current Through the Zener Diodes

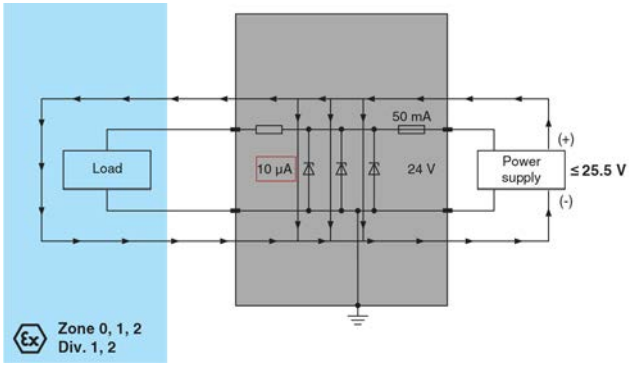


Figure 5 shows the flow of leakage current through the zener diodes under normal circumstances. The Zener barrier conducts a maximum of 10 µA (1 µA) leakage current so long as the supply voltage is less than 25.5 V. This is normal and has very little effect on the load. If the voltage exceeds 25.5 V, the zener diodes start to conduct more current. This can have an effect on the operating current and the accuracy. It is recommended that a regulated voltage source be used, which maintains the voltage under the value at which the diodes will start to conduct. (A 24 V, 300 Ω barrier is represented here as an example.)

Figure 6 - Total Current Drains Through the Zener Diodes

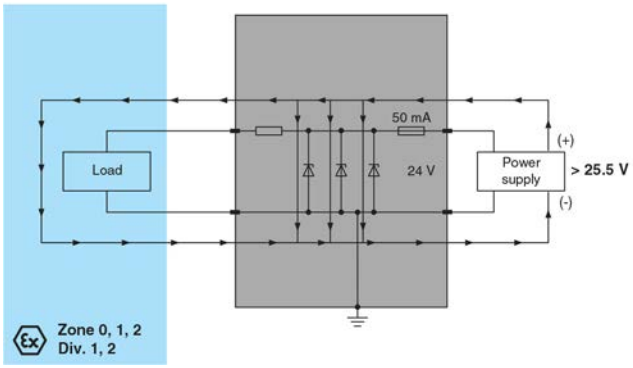


Figure 6 shows that if the maximum permissible input (supply) voltage is exceeded, the total current drains through the zener diodes, without reaching the hazardous area.

Zener barriers have a low series resistance, given by the sum of the resistance R and the resistance value of the fuse F (See Figure 4 on page 3). Due to the low series resistance, an inadvertent short-circuiting of terminals 1 and 2 can cause the fuse to open. If the Zener barriers are provided with a resistance, this limits the short circuit current to a safe value in the event of a short circuit of the connecting wiring in the hazardous area or a connection to earth of the wiring attached to terminal 1.

Some barriers are available with a resistance connected between the output terminals. These are used in 4...20 mA transmitter circuits. The resistance converts the current in the intrinsically safe circuit into a voltage that can be measured in the safe area.

Zener barriers can be used in many applications. In the simplest case, a single channel barrier with a ground connection is used. But in many applications it is not desirable that the intrinsically safe circuit is connected directly to ground. If the circuit in the safe area is grounded, under some circumstances grounding of the intrinsically safe circuit can lead to faults within the system. In this case, quasi ground- free intrinsically safe circuits can be constructed with two or more Zener barrier channels. Double grounding of intrinsically safe circuits is not permitted. The insulation voltage of the wiring and field devices, measured with respect to ground, must be greater than 500 V AC. The permissible ambient temperature of the Zener barriers is between -20...+60 °C (-4...+140 °F).

Intrinsically safe circuits with Zener barriers without galvanic isolation must be grounded. The cross-section of the ground connection, using a copper conductor, must be at least 4 mm^2 (12 AWG) (for further details see NEC 504-50 and EN

60079-14). The maintenance of these requirements prevents the occurrence of a dangerous potential with respect to ground.

A fault of the type illustrated in Figure 7 can cause a dangerous spark if the Zener barrier is not grounded. If a fault occurs (Figure 8), the zener diode conducts and the current is shunted to ground. The fuse opens.

Figure 7 - Non-grounded Zener Diodes

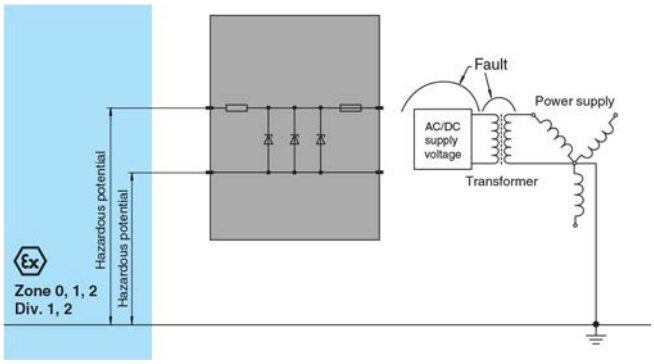
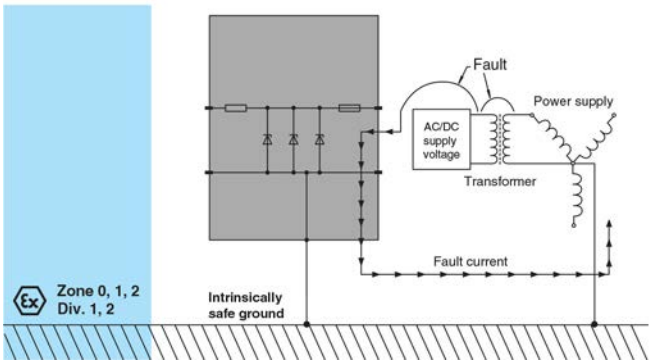


Figure 8 - Grounded Zener Diodes



The system must have its own independent ground conductor, through which no supply system current flows.

Grounding with Zener Barriers

Bulletin 937 grounding is made simple by an integrated IS ground connection in the base of each barrier. By simply connecting each barrier to a standard 35 mm DIN rail, the total system can be grounded via a single point. Figure 9 and Figure 10 illustrate several grounding schemes. In summary, grounding may be achieved in 3 different arrangements: equipotential bonding via standard rail, group grounding through insulated mounting or individual grounding through insulated mounting. Each installation method can be done with the appropriate accessories.

Figure 9 - Equipotential Bonding via the Standard Rail

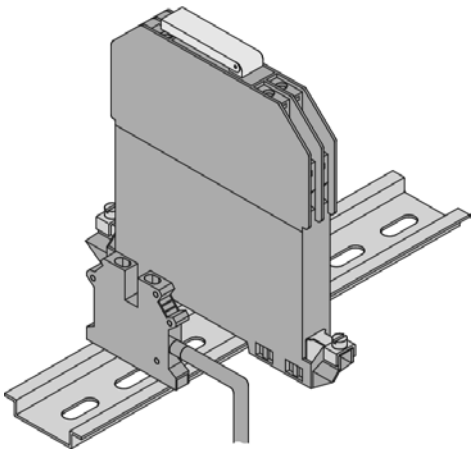
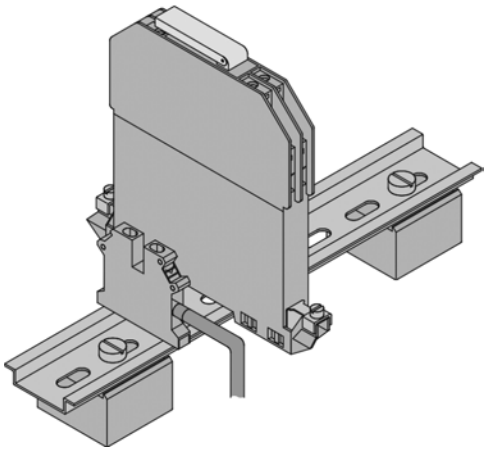


Figure 10 - Insulated Mounting (Group Grounding)



Multi-channel Barriers

Analog circuits are often connected to two-channel barriers (Figure 12). Since there is no grounding on this type of circuit, the system is a quasi-floating one. It is termed quasi floating, because it is one zener voltage above the ground potential. Although it does not actually float, the signal-to-noise ratio is improved.

A further advantage of multi-channel Zener barriers is that a higher packing density can be achieved.

Figure 11 - Single-channel Zener Barrier

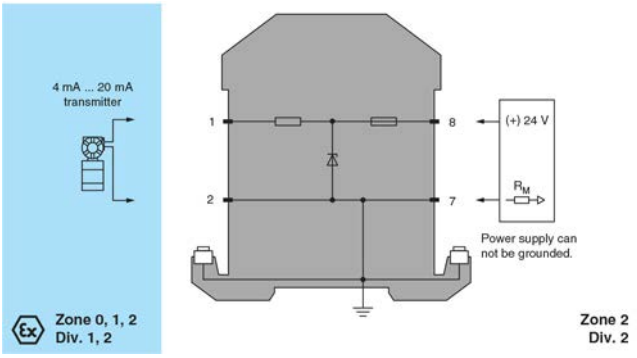
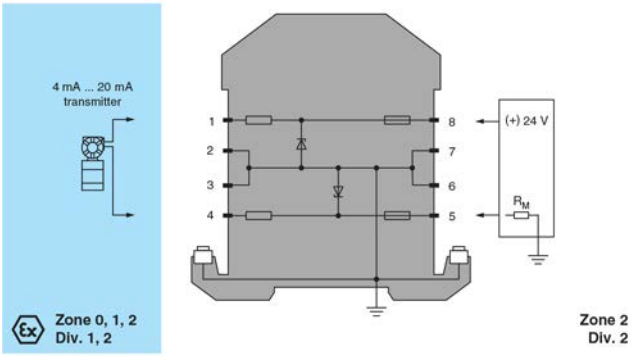


Figure 12 - Two-channel Zener Barrier



Specifications

The following are typical data used in the description of a barrier.

Working Voltage at 10 µA

The maximum voltage that can be applied between the contacts in the safe area and ground at a defined leakage current. This is the upper value of the recommended operating range.

Maximum Series Resistance (Ω)

This is the maximum resistance that can be measured between the two end terminals of a barrier channel. It is obtained from the sum of any resistors and the resistance value of the fuse at an ambient temperature of 20 °C (68 °F).

Maximum Supply Voltage

The maximum voltage that can be supplied between the terminals in the safe area and ground without the fuse responding. This value is determined for an intrinsically safe circuit and an ambient temperature of 20 °C (68 °F).

Fuse Rating (µA)

The function of the fuse is to create an open circuit in the event of a power supply fault. It also protects the zener diodes from damage in the event of an abnormal operating condition.

Polarity

Zener barriers are available in positive polarity, this means the anodes of the Zener barriers are grounded.

Intended Use

Devices that have intrinsically safe control circuits are used to operate field devices within hazardous areas. Zener barriers are not suitable for the isolation of signals in power engineering unless specified in the respective data sheet.

Intrinsic safety circuits that were operated with circuits of other types of protection may not be used as intrinsically safe circuits afterwards.

Installation of the interface Devices in the Safe Area

ATTENTION: Only qualified personnel must install or commission this product.

The devices are constructed to satisfy the IP20 protection classification and must be protected accordingly from adverse environmental conditions such as water spray or dirt exceeding the pollution degree 2.

ATTENTION: The device must be installed outside the hazardous area.

Depending on the level of protection, the intrinsically safe circuits of the devices (light blue identification on the device) can be located in the hazardous area. It is especially important to verify that the intrinsically safe circuits are safely separated from all non-intrinsically safe circuits. The installation of the intrinsically safe circuits is to be conducted in accordance with the relevant installation regulations.

The respective peak values of the field device and the associated device with regard to explosion protection should be considered when connecting intrinsically safe field devices with the intrinsically safe circuits of Zener barriers (demonstration of intrinsic safety). EN 60079-14/ IEC 60079-14 or NEC and CEC electrical codes for US and Canada respectively must be observed (where appropriate). If available, also the product certification control drawing must be observed.

If more channels of one device are to be connected in parallel, it must be verified that the parallel connection is made directly at the terminals. For the demonstration of intrinsic safety, the maximum values of the parallel connection are to be regarded.

The EC-Type Examination Certificates or standard certificates/approvals should be observed. It is especially important to observe the “special conditions” if these are included in the certificates. Installation and commissioning of the interface devices within Zone 2/Div. 2 of the hazardous area Only devices with the corresponding manufacturer's Declaration of Conformity or separate certificate of conformity can be installed in Zone 2/Div. 2. The individual specifications for each modules indicate whether these conditions are met.

For US and Canada installations, in Zone 2/Div. 2 follow the NEC and CEC wiring methods. The enclosure must be able to accept Zone 2/Div. 2 wiring methods. The referenced product certification control drawing must be observed. For all other applications, the devices should be installed in a switch or junction box that meets the following requirements:

- At least IP54 in accordance to EN 60529
- Resistance to light and resistance to impact according to EN 60079-0/IEC 60079-0
- Thermal endurance according to EN 60079-15/IEC 60079-15
- Must not cause ignition danger by electrostatic charge during intended use, maintenance and cleaning

Depending on the level of protection, the intrinsically safe circuits of the devices (light blue identification on the device) can be located in the hazardous area. It is especially important to verify that the intrinsically safe circuits are safely separated from all non-intrinsically safe circuits.

The installation of the intrinsically safe circuits is to be conducted in accordance with the relevant installation regulations.

The respective peak values of the field device and the associated device with regard to explosion protection should be considered when connecting intrinsically safe field devices with the intrinsically safe circuits of Zener barriers (demonstration of intrinsic safety). EN 60079-14/ IEC 60079-14 or NEC and CEC electrical codes for US and Canada respectively must be observed (where appropriate). If available, also the product certification control drawing must be observed.

If more channels of one device are to be connected in parallel, check that the parallel connection is made directly at the terminals. For the demonstration of intrinsic safety, the maximum values of the parallel connection are to be regarded.

The EC-Types Examination Certificates or standard certificates/approvals should be observed. It is especially important to observe the special conditions if these are included in the certificates.

Repair and Maintenance

The transfer characteristics of the devices remain stable over long periods of time. This eliminates the need for regular adjustment. Maintenance is not required.

Fault Elimination

No changes can be made to devices that are operated in hazardous areas. Repairs on the device are also not allowed. Isolation coordinates for devices with Ex-certificate according to EN 50020 and EN 60079-11.The devices are assessed for pollution degree 2 and overvoltage category II according to EN 50178.

Technical Specifications

Attribute	Value
Directive conformity	Directive 94/9/EC
Mounting	Snap-on 35 mm standard DIN Rail according to EN 60715
Protection degree	IP20 according to EN 60529
Housing material	Polycarbonate
Temperature	
Operating	-20…60 °C (-4…+140 °F)
Storage	-25…70 °C (-13…+158 °F)
Relative humidity, max	75 % without moisture condensation

Connection Options

The barriers have self-opening terminals, max core cross section 2 x 2.5 mm^2 (2 x 14 AWG). They are usually installed in racks or control cabinets. Barriers can be built into housings under production conditions, with the provision that the housing must allow for adequate protection. They can also be employed in hazardous areas, when it has been ascertained that the housing has been certified for this purpose. The installation must be carried out in such a way that the intrinsic safety is not compromised by the following factors:

- Danger of mechanical damage
- Non-authorized changes or influence exerted by external personnel
- Humidity, dust or foreign bodies
- Ambient temperature exceeding the permissible level
- The connection of non-intrinsically safe circuits to intrinsically safe circuits

Ground the mounting rail by connecting both ends to the intrinsically safe ground. This also simplifies checking the grounding. Many installations provide the option of subsequent expansion.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Intrinsic Safety Modules Selection Guide, publication 937-SG001	Product Selection, Specifications and Dimension information on Intrinsic Safety Modules.
Intrinsic Safety Modules, Isolated and Converter barriers Technical Data, publication 937-TD002	Product information, operation modes, installation types and specifications for Bul. 937 isolated barriers and converter barriers.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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