Introduction

The Z-System Zener Barriers have a full range of products for AC and DC intrinsic safety applications with over 75 different models. Single-, dual- and 3-channel versions are available for quick and easy installation. These Zener Barriers conveniently mount on standard 35 mm DIN rail. The process of mounting each barrier on the DIN rail makes an electrical connection to the internal earth/ground network necessary to maintain the intrinsic safety rating of the barrier. Replaceable fuse versions are also available to help facilitate circuit loop checks and reduce installation cost and space.

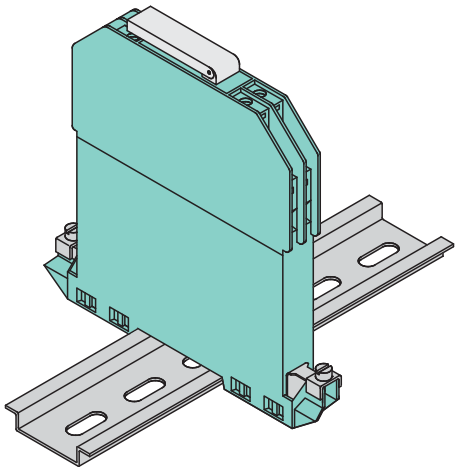

Figure 1 Zener Barrier Z-System

Housing

Z-System is a modular product range that features a space saving 12.5 mm wide housing and can incorporate up to 3 channels. The Z-System barriers are epoxy filled, and 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).

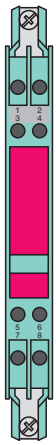

Figure 2 12.5 mm housing

Mounting

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

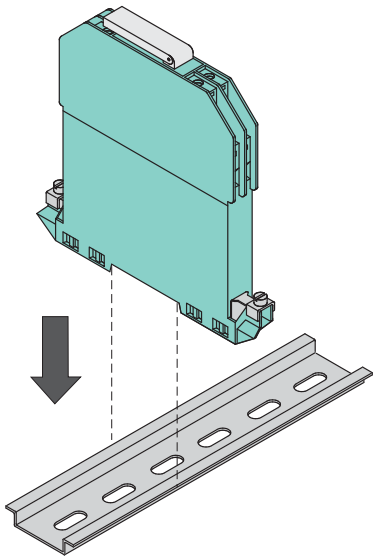

Figure 3 Mounting Zener Barrier Z-System

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.

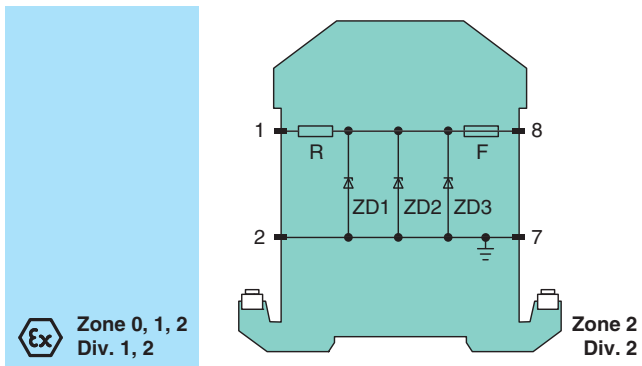

Figure 4 Circuit diagram

If the diode breakdown voltage is exceeded, due to a fault in the safe area, the diodes start to conduct, causing the fuse to open, thus preventing the transfer of unacceptably high energy into the hazardous area.

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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 250 V AC or 250 V DC.

Terminals 1 and 2 are connected to the intrinsically safe circuits (field device) in the hazardous area. These types of devices are referred to as the intrinsically safe apparatus and must be certificated unless the electrical values do not exceed any of the following values: 1.5 V, 0.1 A, 25 mW. Pepperl+Fuchs Zener Barriers are identified in terms of voltage, resistance and polarity, e. g., 10 V, 50 Ω, positive polarity.

These figures correspond to the zener voltage U_z 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 U_z (U_o, V_{oc}) and I_k (I_o, I_{sc}) determined during certification; I_k is obtained by dividing U_z 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 ensure that at the prescribed voltage the leakage current is smaller than 10 µA.

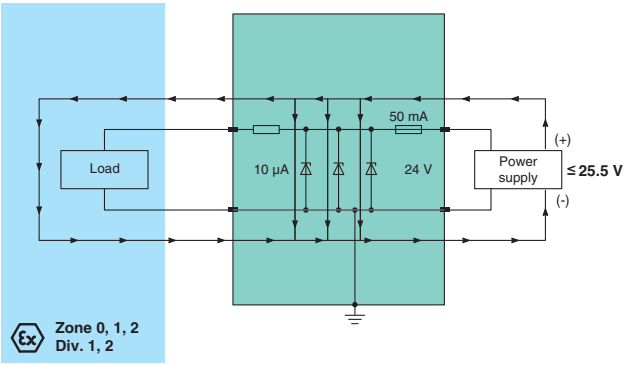

Figure 5 Leakage current through the zener diodes

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.)

These voltages are stated in the data sheet for a given barrier, together with the leakage current. If the leakage current for a given voltage differs from 10 µA, this is specifically stated.

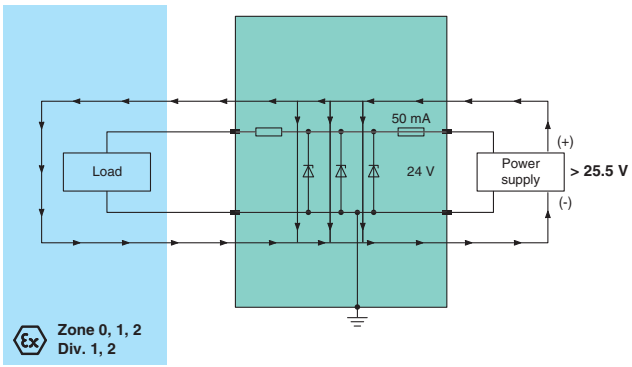

Figure 6 Total current drains through the zener diodes

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.

Pepperl+Fuchs 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). 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 mA to 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.

Pepperl+Fuchs 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. Pepperl+Fuchs offers 2- and 3-channel barriers in the same housing as the single channel barriers.

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 °C to +60 °C (-4 °F to +140 °F).

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Grounding of Zener Barriers

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 (see Figure 8), the zener diodes conducts and the current is shunted to ground. The fuse opens.

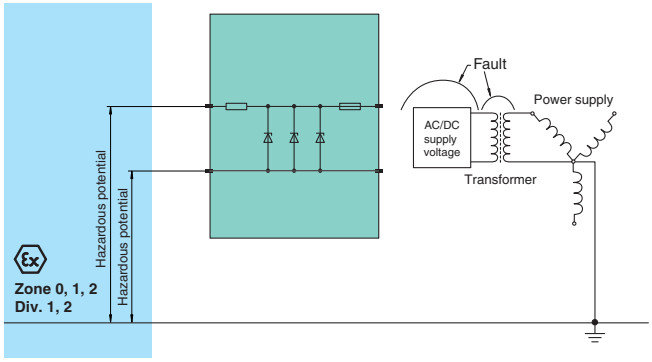

Figure 7 Non-grounded Zener Barrier

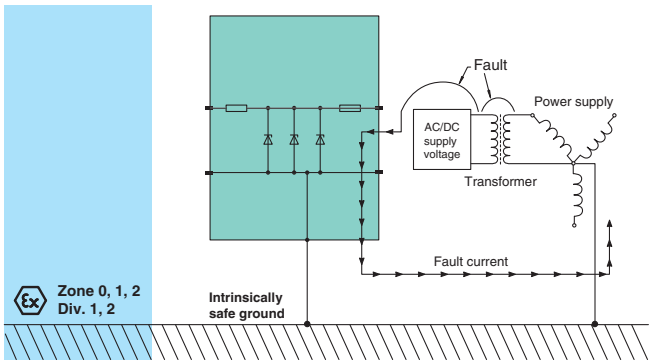

Figure 8 Grounded Zener Barriers

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

Grounding with Z-System

The Z-system grounding is made simple by an integrated IS ground connection in the base of each Z-system barrier. By simply connecting each Z-System barrier to a standard 35 mm DIN rail, the total system can be grounded via a single point. Figure 9 to Figure 11 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.

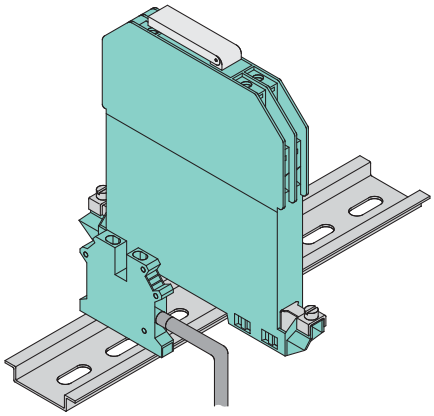

Figure 9 Equipotential bonding via the standard rail

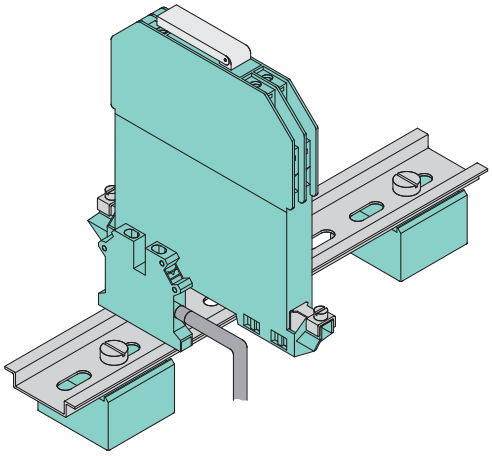

Figure 10 Insulated mounting (group grounding)

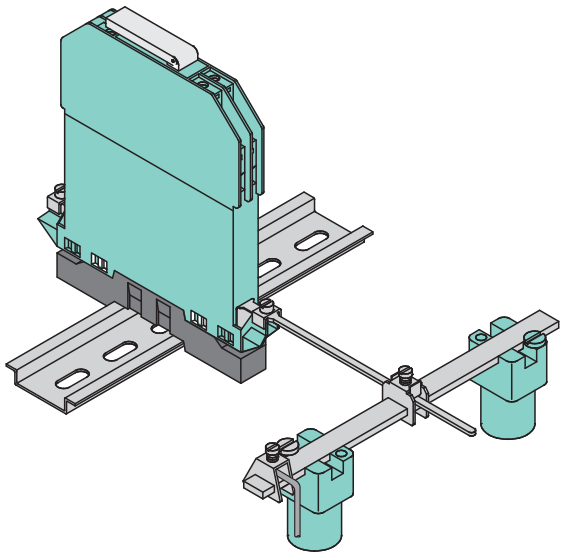

Figure 11 Insulated mounting (individual grounding)

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Multi-channel barriers

Analog circuits are often connected to two-channel barriers (see Figure 13). 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.

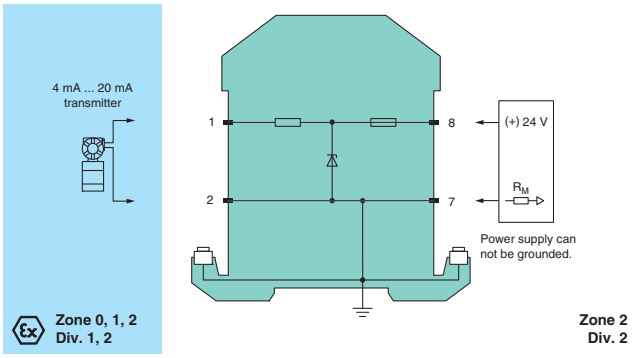

Figure 12 Single-channel Zener Barrier

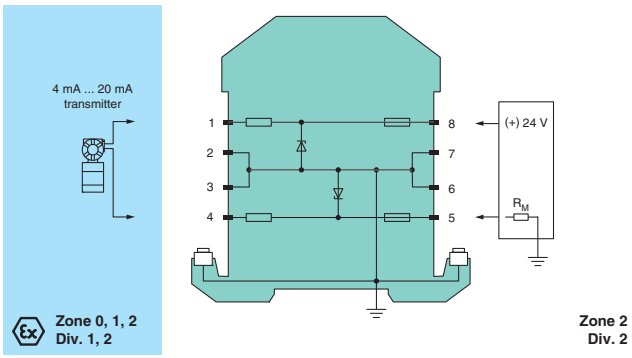

Figure 13 Two-channel Zener Barrier

Z-System 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 (mA)

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 various versions. On Zener Barriers for positive polarity the anodes of the zener diodes are grounded. On barriers for negative polarity the cathodes are grounded. On barriers for alternating polarity (AC), interconnected zener diodes are employed and one side is grounded. These barriers can be used for both alternating voltage signals and direct voltage signals.

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Safety information

The corresponding data sheets, the Declaration of Conformity, the EC-Type Examination Certificate and applicable certificates (see data sheet) are an integral part of this document.

Intended use

Laws and regulations applicable to the usage or planned purpose of usage must be observed. Devices are only approved for proper usage in accordance with intended use. Improper handling will result in voiding of any warrantee or manufacturer's responsibility.

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.

Protection of operating personnel and the system is not ensured if the product is not used in accordance with its intended use.

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

Installation and commissioning

Commissioning and installation must by carried out by specially trained qualified personnel only.

Installation of the interface devices in the safe area

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.

The devices 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 ensure 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 ensured 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 data sheets 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 at least IP54 in accordance to EN 60529.
- meets the requirements of resistance to light and resistance to impact according to EN 60079-0/ IEC 60079-0.
- meets the requirements of 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 ensure that the intrinsically safe circuits are safely separated from all non-intrinsically safe circuits.

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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.

For additional details, see data sheets.

Technical data

Electrical data

Directive conformity

Directive 94/9/EC, associated standards see valid EC-Type Examination Certificates and/or EU statements of conformity or other appropriate certificates.

Please refer to data sheets.

Mechanical data

Mounting

Snap-on 35 mm standard DIN rail acc. to EN 60715

Protection degree

IP20 acc. to EN 60529

Housing material

Polycarbonate (PC)

Connection options

Self-opening terminals, max. core cross section 2 x 2.5 mm^2 (2 x 14 AWG)

The barriers are usually installed in racks or control cabinets.

They 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

Grounding of the mounting rail is of the normal type, i. e. where both ends are connected to the intrinsically safe ground. This also simplifies checking the grounding.

Many installations provide the option of subsequent expansion.

Replacement cable for this spare cable can be connected to the Z 799 dummy barrier and unused cable can be connected to the intrinsically safe ground.

Ambient conditions

Ambient temperature

-20 to 60 °C (253 K to 333 K)

Storage temperature

-25 °C to 70 °C (248 K to 343 K)

Relative humidity

max. 75 % without moisture condensation

Terminal designations

Please refer to application guide and data sheets.

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