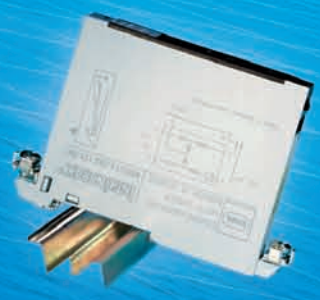
automation catalog 9100

Hazardous Location Automation Products
Barriers & Isolators



STAHL

Innovative Global Explosion Protection by R. STAHL

Contents

R. STAHL in North America

R. STAHL, INC. has been in North America for almost 30 years. Located in Houston, Texas and Alberta, Canada, we have expanded to include over 40 representatives throughout the Americas. Our service is unmatched, with qualified technical experts that can be reached in real time, not seven hours away in Europe.

Expertise

where safety knows no compromise

One hundred thirty years after our founding, with facilities strategically located on five continents, R. STAHL is acknowledged as the world's foremost innovator in explosion-protected components and systems for Automation, Control and distribution, Operations and monitoring, Lighting and Signals & Alarms.

Our commitment to the Americas commenced in 1979 when R. STAHL introduced intrinsic safety technology to the North American market. It rose to greater prominence in the mid-1990s, when R. STAHL played a leading advocacy role in the harmonization of the U.S. National Electrical Code (NEC) and the International Electrical Code (IEC). Changes made at that time yielded increased global standardization, and produced heightened efficiencies and maintenance benefits for international markets.

Our expertise also covers related areas of safety engineering such as functional safety, SIL and FDA. International certifications, approvals, and patents underline our expertise and make it possible for R. STAHL products to be used anywhere in the world. One thing is certain: on the basis of experience and international synergies, we continue to deliver technological innovations tailored to your individual needs.

Benefits

- *All protection methods available*
- *Over 3000 certificates for explosion protection issued*
- *More than 70 active patents*
- *Technical training*
- *Member of many international committees, technical commissions and research groups (Profibus, Fieldbus Foundation, HART etc.)*
- *In-house testing laboratory*

More Than Protection

STAHL

Our Mission

"We provide products and services to protect the most valuable – and often irreplaceable – assets of some of the most critical industries on Earth."

Applications

- *Petroleum and natural gas deliveries*
- *Petroleum and natural gas storage and transporters*
- *Petrochemical industry*
- *Chemical industry*
- *Pharmaceutical industry*
- *Food product, beverage and tobacco industries*
- *Shipbuilding and offshore industries*
- *Food processing industry*
- *Water purification*
- *Automotive*
- *Original equipment manufacture*

In the production, processing, transportation and storage of many materials, grave danger can exist. Flammable gasses, vapors, mists and dusts can occur that, when combined with oxygen in the air, form an explosive atmosphere. Given a source of ignition, these substances can detonate and destroy life and property in seconds.

Our job at R. STAHL is to create products and deliver services to eliminate the possibility of such an incident. And in fulfilling this role, we offer More than Protection. Peace of Mind. Our products are the most innovative in the world.

Promises to our customers

- We provide you the best engineering minds available to protect your people and property from explosions.
- We offer you only products we know to embody the finest technology and craftsmanship.
- We carefully develop and engineer the right solutions for your individual applications.
- We deliver your products and services quickly and efficiently.
- We serve you in a manner that places Stahl above our competitors in providing you "peace of mind" concerning the safety of your people and property.

Production Plants:

- *Houston*
- *Waldenburg*
- *Weimar*
- *Cologne*
- *Hengelo*
- *Stavanger*
- *Chennai*
- *Shanghai*

R. STAHL's global headquarters is located in Waldenburg Germany. Located in Houston, Texas, R.STAHL Inc. is proud of it's world class manufacturing, engineering and technical service competency. Here our engineers work together in teams to develop tailor-made, reliable and cost-effective solutions for complex systems worldwide. Project management and production departments work side by side in state of the art facilities to foster communication and cooperation between all departments throughout the entire production process. Flat hierarchies, flexibility, and open dialog describe our culture. Our large portfolio of components and systems, one of the most comprehensive in the world, is the basis for our explosion protection system solutions, all of which are carefully designed to work seamlessly with each other. This guarantees our customers the reliability they require and the assurance that a project will be successful. Our expert representatives will update you on your project status at any time. Our other manufacturing facilities located in Weimar and Cologne (Germany), Stavanger (Norway), Hengelo (Netherlands), Chennai (India) and Shanghai (China) adhere to the same high standards.

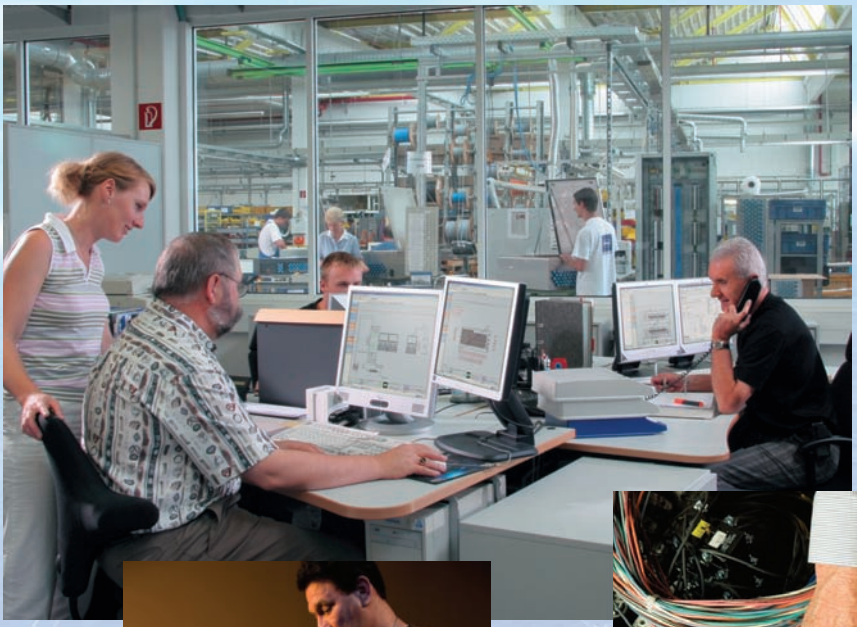
Development and Laboratory/Certification

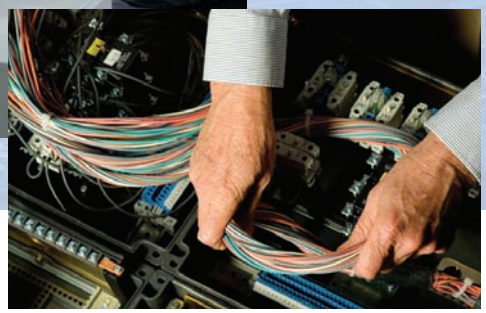
Development

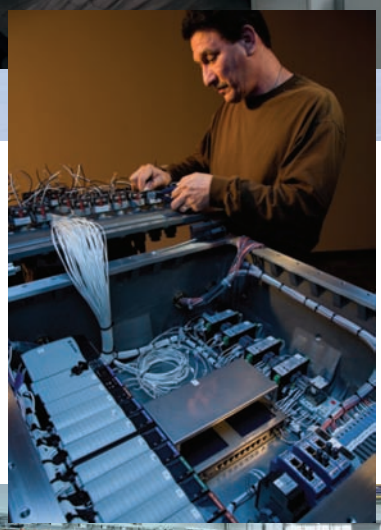
- 6% of our annual revenue is reinvested in the innovation process
- 40% of our revenue has been generated with products launched into the market in the past five years
- We actively participate in international committees
- We use state of the art CAD systems and provide rapid prototyping

Laboratory/Certification

- All key tests are performed on site in our own state of the art testing facilities
- We hold over 3,000 international certificates for explosion protection, shipping vessel approvals and functional safety
- We offer factory accepted testing for domestic and international projects







Project Planning

- *Extensive cooperation with customers to develop the optimal solution*
- *Highly skilled engineers with international experience design solutions based on your individual needs*

Production

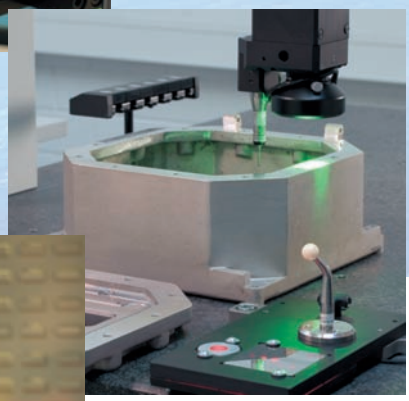
- *Manufacturing plants located in: Houston, Texas (USA), Waldenburg, Weimar & Cologne (Germany), Hengelo (Netherlands) Stavanger (Norway), Shanghai (China) and Chennai (India)*
- *Flexible production and organized manufacturing provides effective communication between all departments*
- *In-house occupational training center with educated trainers*
- *In-house tool-and-die manufacturing facilities*

Capabilities

Quality Management & On-site Acceptance Testing

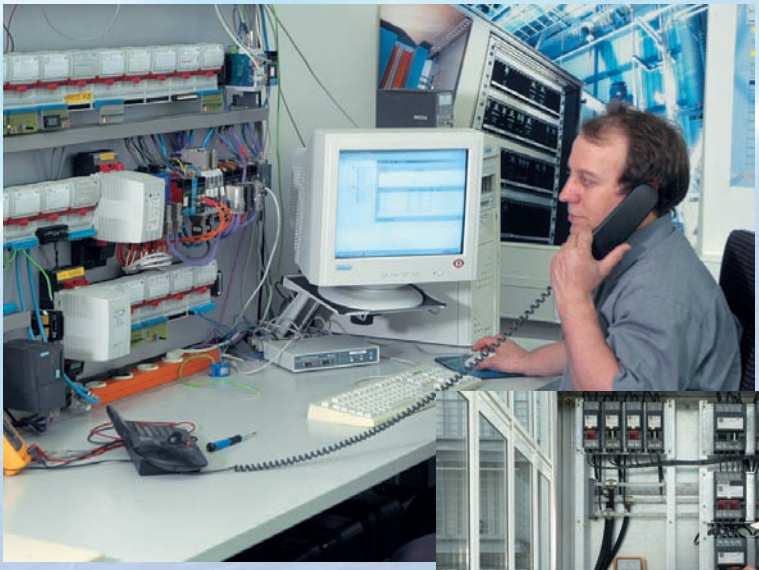
Quality Management

- ISO 9000 certified in 1993 and ISO 9001 in 2004
- Quality management process covers the whole supply chain
- Quality management system is approved by PTB
- Calibration laboratory monitors over 2,000 items of electrical and mechanical test equipment
- Production process is covered by quality assurance



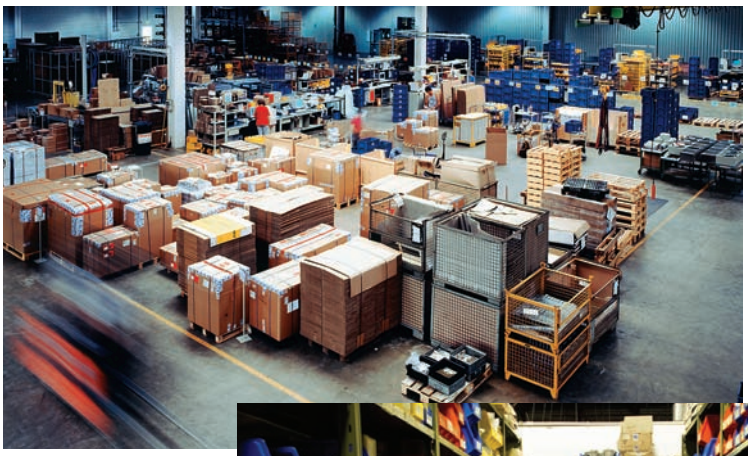
On-site Acceptance Testing

- State of the art testing and inspection equipment
- Intensive technical support
- Personnel are continuously trained on the latest technology
- On-site consultants are in direct contact with development product managers



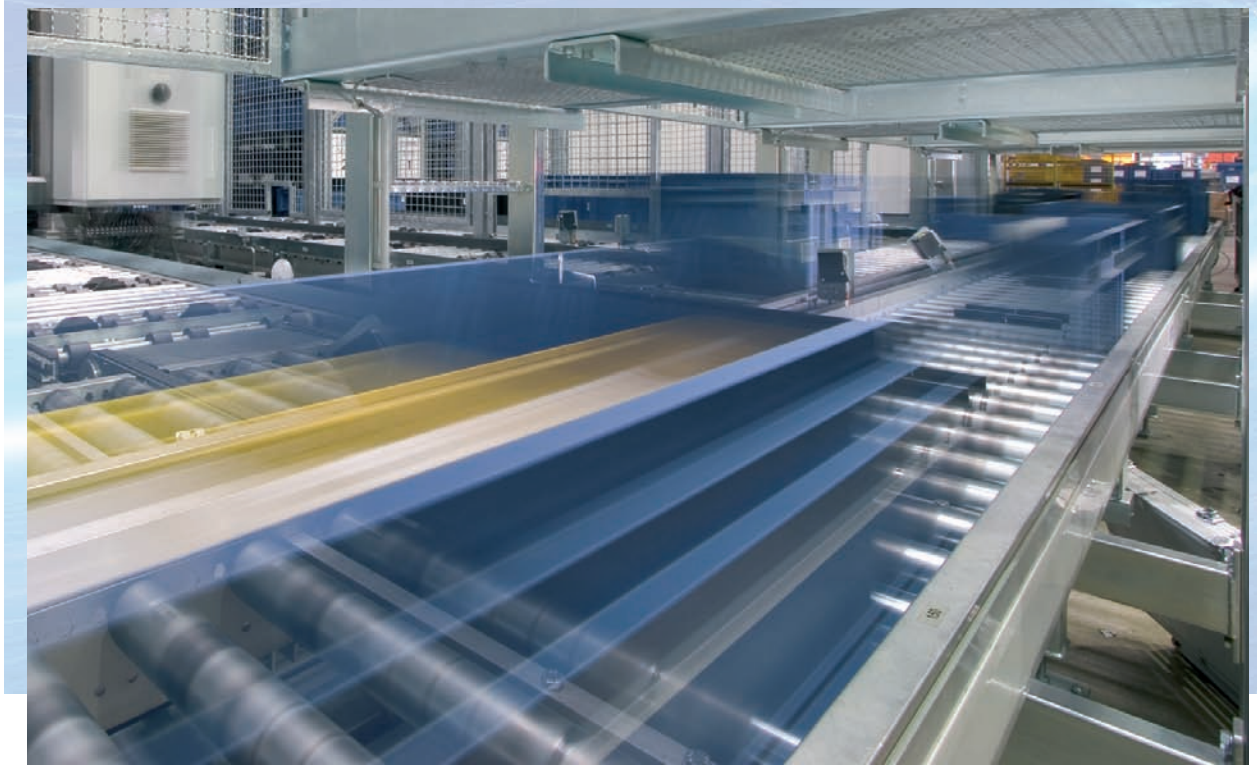
After-Sales Service

- *Extended warranty on products and services*
- *Field service engineers available*
- *Competent information given by telephone and email*



Logistics

- *Efficient and economical workflow*
- *Modern, fully automatic high-bay warehouse*
- *Production organized on the kanban principle*



Protecting lives and equipment is R. STAHL's highest priority. When you partner with R. STAHL in this endeavor you can be assured that our customized, technically advanced, comprehensive products and services receive the highest quality of service.

OEM service

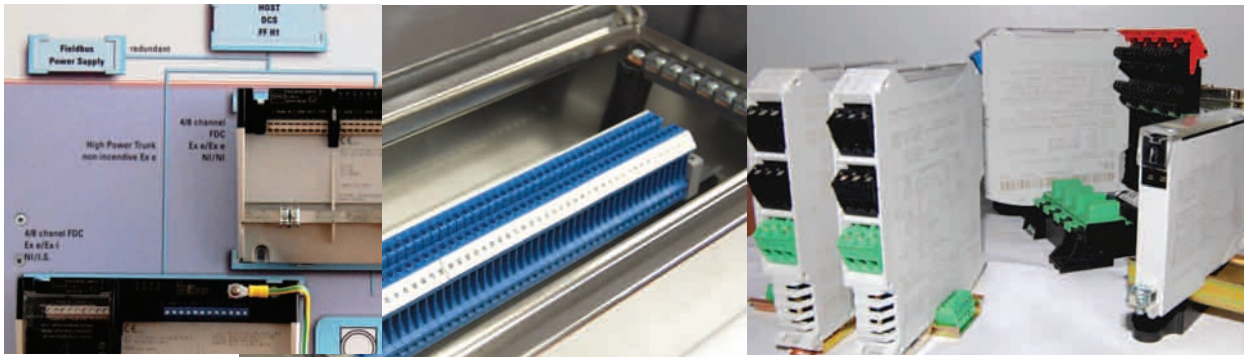
On a worldwide basis, Original Equipment Manufacturers are continuously looking to expand their markets for existing and new system designs. When market opportunities arise that require ATEX or IEC certification for markets, such as Europe, the Middle East, Asia and Russia, R. STAHL is the preferred partner. In North America, producing custom, quality products — often with extremely tight turnaround — is an R. STAHL specialty.

With our more than fifty years of Experience, we stand ready to guide and educate OEMs and their engineering teams in meeting global electrical codes and standards in all harsh environments and hazardous (classified) locations.

- *Development of individual solutions*
- *Technical service*
- *After-sales service*
- *Expert information available via hotlines*
- *Global distribution network*
- *Relevant information via www.rstahl.org*
- *Permanent order status updates*
- *Flexibility*
- *Quality management*
- *Fast, reliable shipping*
- *24-hour turnaround on pick-and-pull items*
- *International customer support*
- *International shipping*
- *Training*

- *Training programs*
- *In-house training center*
- *Training classes conducted at the customer's facility*

Competent and trained employees are the most important link in a safe production chain. Remaining at the top of an industry requires committed employees who work diligently with new technologies and implement new safety regulations. At R. STAHL, we are aware of this and make our expert knowledge available to you by conducting training classes. Individuals may choose to take advantage of a basic or advanced training class. Theory and practice are conveyed in equal measure by our specialists. Individuals may choose to have training classes at their own location or at our facility. R. STAHL training classes provide participants with valuable knowledge pertaining to engineering, scientific principals and implementation of the NEC, CEC and ATEX requirements.



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Basics of Explosion Protection

HAZARDOUS LOCATIONS
Hazardous locations are defined as premises, buildings or parts thereof where fire or explosion hazards may exist due to the presence of flammable gases or vapors, flammable liquids, combustible dusts, or easily ignitable fibers or flyings.

Although, flammable gases, vapors and combustible dusts exist almost everywhere, fortunately, they are present only in minute quantities. Simply because flammable gases or vapors, or combustible dusts are present, there is not necessarily a hazardous location. The quantities or concentrations must be sufficient to present a potential explosion hazard.

The electrical codes that deal with these types of hazardous location areas do not deal with materials such as high explosives, such as dynamite, munitions, or fireworks. Other rules and regulations deal with areas involving these materials.

Understanding "Global" Hazardous Location Requirements
The evolution of hazardous location electrical codes and standards throughout the world has taken two distinct paths. In North America, a "Class, Division" System has been used for decades as the basis for area classification of hazardous (classified) locations. Because the hazards and methods of protecting electrical equipment against these hazards differ for different materials, hazardous locations are divided into three Classes, and two Divisions. The Classes are based on the type of hazard and the explosive characteristics of the material with the Divisions being based on the occurrence or risk of fire or explosion that the material presents. While the United States and Canada have some differences in acceptable wiring methods and product standards, their systems are very similar.

In other parts of the world, areas containing explosive atmospheres are dealt with using the "Zone System". Zones are based predominantly on the International Electrotechnical Commission (IEC) and European Committee for Electrotechnical Standardization (CENELEC) standards. Whereas North America deals with multiple types of hazardous atmospheres.

HAZARDOUS LOCATION BASICS
In North America, hazardous locations are separated into three "Classes" or types based on the explosive characteristics of the materials. The Classes or type of material is further separated into "Divisions" or "Zones" based on the release of the flammable material. The Zone system has three levels of hazard versus the Division System's two levels.

Hazardous Materials	Class/Division System	Zone System
Gases or Vapors [1]	Class I, Division 1 Class I, Division 2	Zone 0 Zone 1 Zone 2
Combustible Dusts [2]	Class II, Division 1 Class II, Division 2	Zone 20 Zone 21 Zone 22
Fibers or Flyings	Class III, Division 1 Class III, Division 2	Zone 20 Zone 21 Zone 22

[1] The United States and Canada have adopted Zones for Gases and Vapors
[2] Zones 20, 21 and 22 for Dust are adopted by Europe and the U.S. but not by Canada.

Class I Locations

Class I locations are those in which flammable "gases or vapors" are, or may be, present in the air in quantities sufficient to produce explosive or ignitible mixtures. The terms, "gases or vapors" differentiates between materials that are in a gaseous state under normal atmospheric conditions, such as hydrogen or methane, and a vapor that is flashed off from a liquid, under normal atmospheric conditions, such as gasoline.

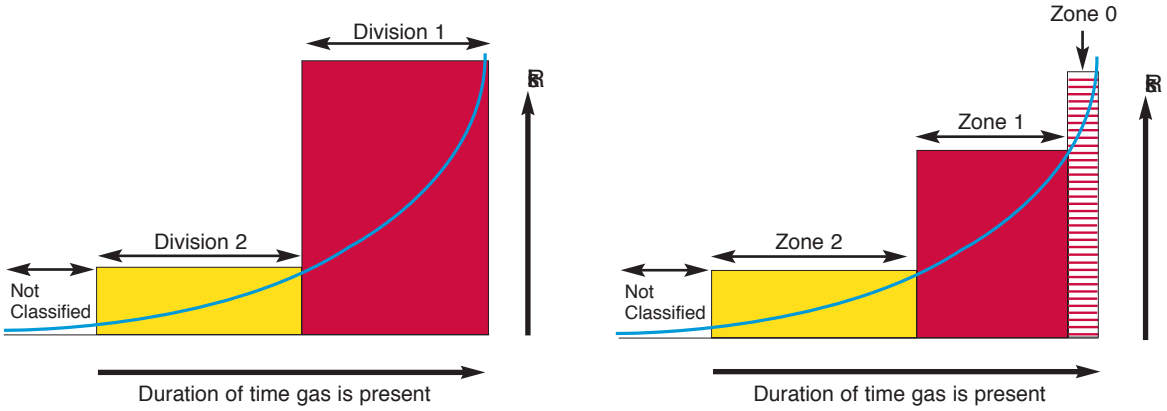
The subdivision of Class I, locations into "Divisions" or "Zones" is based on the probability that an explosive gas atmosphere may be present in a location. If the risk is extremely low, the location is considered unclassified. A good example of a low risk area is a single family home with natural gas or propane furnace for heating. The gas could, and does on extremely rare occasions, leak into the home, encounter an ignition source and an explosion occurs, usually with devastating results. However, since the risk is so low, because of the safety systems built into the gas supply and heating equipment, these areas are not "hazardous (classified) locations".

Recent editions of the NEC® (National Electrical Code) and CEC® (Canadian Electrical Code) have incorporated the international definitions for "Zones" for Class I, locations. The two codes continue to address the "Division" system although the methods are somewhat different.

The frequency of occurrence determines the level of hazard for a location. Simply stated, the longer the material is present, the greater the risk.

Frequency of Occurrence	Division System	Zone System
Continuous	Class I, Division 1	Zone 0
Intermittent Periodically		Zone 1
Abnormal Condition	Class I, Division 2	Zone 2

The charts below compare the Division and Zone systems in terms of risk assessment.



The abnormal conditions of occurrence, or lower risk areas, in the Zone and Division system are basically identical. However, in areas where a hazard is expected to occur in normal operation, the Zone system deals with highest risk areas separately, and risk associated with the remaining location is considered lower. The Division system tends to be less specific in its consideration of Division 1. The Division system treats all areas where a hazard is expected to occur in normal operation the same.

The following chart illustrates the differences between the various Zones.

Grade of Release	Zone	Flammable Mixture Present
Continuous	0	1000 hours per year or more (10%)
Primary	1	Between 10 and 1000 hours per year or more (0.1% to 10%)
Secondary	2	Less than 10 hours per year (0.01% to 0.1%)
Unclassified	-	Less than 1 hour per year (Less than 0.01%)[1]

This is a combination of Tables 2 and 3 from API RP505

[1] The 1-hour per year used in API RP505 is considered to be high by some industry experts. Conservative estimates of this figure should be 0.01 hours per year.

Class I Locations, continued

Class I locations are further divided into Groups based on the explosive properties of the materials present. North America under the Class & Div. System uses four Gas groups while the IEC/CENELEC and the U.S. and Canada under the Zone System use three.

The chart below compares the two systems.

Typical Gas	Class/Division Gas Groups	Zone Gas Groups
Acetylene	A	II C
Hydrogen	B	
Ethylene	C	II B
Propane	D	II A

(The US has added a “IIB + hydrogen” group to address certain construction limitations.)

Class II Locations

Class II locations are those which are hazardous due to the presence of combustible or electrically conductive dusts. The dust must be present in sufficient quantities for a fire or explosion hazard to exist. The fact that there is some combustible dust present does not mean a Class II hazardous location exists.

Class II substances are divided into three groups for similar reasons to those of Class I materials: equipment design and area classification. Class II groups are based on different characteristics than those of Class I, given the requirements for an explosion to occur and the protection methods required for equipment. In Class II locations the ignition temperature, the electrical conductivity, and the thermal blanketing effect of the dust are critical when dealing with heat-producing equipment, such as lighting fixtures and motors. It is these factors which are the deciding factors in determining the Class II groups.

Groups	Type of Material	Examples
E	Metal Dusts	Powdered Metals such as Aluminum or Magnesium
F	Carbonaceous Dusts	Carbon Black, Coal Dust or Coke Dust
G	Agricultural Dusts	Grain, Flour, Sugars, Spices and certain Polymers

(The IEC has developed Zones for atmospheres containing combustible dusts, which again separates areas in to three Zones 20, 21 and 22.)

Zone 20, 21 and 22 Locations
The IEC/CENELEC and the U.S. introduced the three-Zone system for combustible dust locations. These have not been included in the CEC yet.
The definitions are as follows:

Zone 20 - an area in which a combustible dust, as a cloud, is present continuously or frequently during normal operations in sufficient quantities to produce an explosive mixture.

Zone 21 - an area in which a combustible dust, as a cloud, is likely to occur during normal operations in sufficient quantities to produce an explosive mixture.

Zone 22 - an area in which combustible dust clouds may occur infrequently and persist for only short periods of time or in which accumulations or layers may be present under abnormal conditions.

Class III Locations

Class III locations are those which are hazardous due to the presence of easily ignitable fibers or flyings. However, the material is not suspended in the air in quantities sufficient to produce ignitable mixtures.

Easily ignitable fibers and flyings present a serious fire risk, not normally an explosion hazard. The greater danger with Class III materials is that if a layer forms throughout a facility, an ignition will cause a flash fire which moves at near explosive speeds.

In the Zone System fibers and flyings are treated under Zone 20, 21 and 22.

Temperature Classes

Ignition temperature or auto-ignition temperature (AIT) is the minimum temperature of a surface at which an explosive atmosphere ignites. Flammable vapors and gases can be classified into temperature classes according to their ignition temperature. The maximum temperature of a piece of equipment must always be lower than the ignition temperature of the gas - air mixture or vapor - air mixture in which it is placed. Equipment shall be marked to show the operating temperature or temperature class referenced to a +40°C (+104°F) ambient. The temperature class (T code) is indicated on the manufacturers nameplate and is based on the table below.

AMBIENT TEMPERATURE
The ambient temperature is the surrounding temperature of the environment in which a piece of equipment is installed, whether it is indoors or outdoors. The standard temperature range for equipment design in the Zone system is –20°C to +40°C; and in the Class and Division System -25°C to +40°C for these ranges no ambient temperature marking is required on the product. Electrical equipment that is designed for use in a range of ambient temperature other than stated, the actual ambient temperature range shall be marked on the equipment nameplate.

The R. STAHL product lines, in most cases, exceed the above mentioned temperature requirements. Refer to the appropriate catalog pages for the product-specific **"Ambient Temperature Range"**. Any ranges outside of the above stated ranges are marked on the product nameplate.

North American Temperature Code	IEC/CENELEC/NEC 505 Temperature Classes	Maximum Temperature	
		˚C	˚F
T1	T1	450˚C	842˚F
T2	T2	300˚C	572˚F
T2A	-	280˚C	536˚F
T2B	-	260˚C	500˚F
T2C	-	230˚C	446˚F
T2D	-	215˚C	419˚F
T3	T3	200˚C	392˚F
T3A	-	180˚C	356˚F
T3B	-	165˚C	329˚F
T3C	-	160˚C	320˚F
T4	T4	135˚C	275˚F
T4A	-	120˚C	248˚F
T5	T5	100˚C	212˚F
T6	T6	85˚C	185˚F

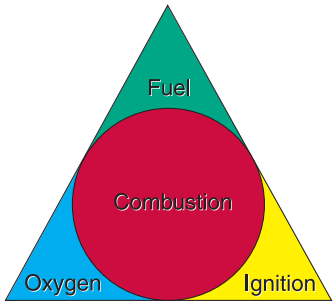
Applications requiring product with extreme ambient temperature ranges outside those standard ranges stated under the heading **"Ambient Temperature Range"** are specified under the heading of **"Special Ambient Temperature Range"**. Only products with this additional catalog information can be customized for extreme temperature applications. Please consult the factory for your special needs.

Explosive Gas Protection Methods

There are a number of methods of protecting electrical equipment, which prevent an explosion when used in a flammable gas atmosphere.

Three elements are required for an explosion to occur - fuel, oxygen and a heat or ignition source must be present. The fuel and oxygen must be in the correct mixture. Too little fuel, or a lean mixture, or too much fuel, a rich mixture cannot ignite. These explosive limits are defined as the "Lower Explosive Limit" (LEL) and the "Upper Explosive Limit" (UEL).

Each method of protection addresses the Fire Triangle in some manner. Either by containing an internal explosion or eliminating one or more of the components necessary for an explosion to occur.



The most common North American methods of protection are explosionproof equipment for Class I locations, and dust-ignition proof equipment for Class II locations. R. STAHL produces a wide range of equipment for use in hazardous locations using various methods of protection.

METHODS OF PROTECTION (GAS)

Flameproof Type of Protection "d"- or Explosionproof Equipment

Although the North American term "explosionproof" and IEC term "flameproof" are SIMILAR concepts, the requirements in the product standards are different. Explosionproof is a Div. 1 technology which can be used in a NEC or CEC defined Zone 1 environment. Flameproof is a Zone 1 technology and cannot be used in a Div. 1 environment.

Since flammable gases and vapors are expected inside an enclosure, the equipment must be capable of withstanding an explosion caused by sparking contacts of devices, high temperatures, or an electrical fault. The enclosure is designed so that hot gases generated during an internal explosion are cooled below the ignition temperature of the surrounding flammable atmosphere as they escape through the joints of the unit.

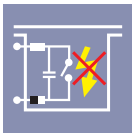
In addition, the external surfaces of the enclosure must not become hot enough to ignite the surrounding atmosphere due to heat energy within the unit. This heat energy may be the result of normal operation of heat-producing equipment, or the result of an electrical arc to the enclosure from an arcing ground fault. Safety factors are applied to all testing of this type of enclosure to ensure the unit will not rupture as a result of an internal explosion.

Encapsulation - Type of Protection “ma” for use in Zone 0 and “mb” for use in Zone 1

Encapsulation is a type of protection in which the parts that can ignite an explosive atmosphere are enclosed in a resin. The resin must be sufficiently resistant to environmental influences so that the explosive atmosphere cannot be ignited by either sparking or heating, which may occur within the device. This is typically used with electronic devices.

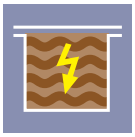
Increased Safety - Type of Protection “e” for use in Zone 1

Type of protection applied to electrical equipment that does not produce arcs or sparks in normal service and under specified abnormal conditions, in which additional measures are applied so as to give increased safety against the possibility of excessively high temperatures and of the occurrence of arcs and sparks.



Intrinsic Safety - Types of Protection “i”, “ia” and “ib”

North America now identifies three versions of this protection method. Types “i” (NEC 504) and “i_a” (NEC 505) are identical since type “i” is based on the IEC 60 079-11 Standard. In Zone 0 the only acceptable type of equipment is types “i” and “i_a”. Type “i_b” is acceptable in Zone 1 and 2 locations.



Oil Immersion - Type of Protection “o” for use in Zone 1

Type of protection where electrical equipment is immersed in a protective liquid in such a way that an explosive atmosphere that may be above the liquid or outside the enclosure cannot be ignited.

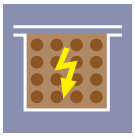
Pressurization - Types of Protection “px” for use in Zone 1, “py” for use in Zone 1 and “pz” for use in Zone 2

This type of protection prevents the surrounding atmosphere from entering an enclosure by maintaining a positive pressure within the unit. Clean air or inert gas is used to maintain a higher pressure than the surrounding atmosphere. In pressurization, the electrical equipment is interlocked with a system which cycles clean air within the unit to remove explosive gases before start up.

Purged and Pressurized -

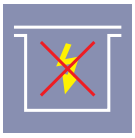
For the Class and Division System the following table applies

Type	Explanation
X	Changes the area within the unit from Class I, Division 1 to unclassified
Y	Changes the area within the unit from Class I, Division 1 to Class I, Division 2
Z	Changes the area within the unit from Class I, Division 2 to unclassified



Powder Filling - Type of Protection “q” for use in Zone 1

Type of protection where electrical parts capable of igniting an explosive atmosphere are fixed in position and completely surrounded by filling material (glass or quartz powder) to prevent the ignition of an external explosive atmosphere.



Nonsparking Equipment - Type of Protection “nA” for Use in Zone 2

Sparking Equipment - Type of Protection “nC” for Use in Zone 2

Equipment in which the contacts are suitably protected other than by restricted breathing enclosure.

Hermetically Sealed for use in Class I, Division 2 or Zone 2

A common type of hermetically sealed equipment is a contact block or reed switch. In this method, the arcing components of the switch are encased in a glass tube. The connecting wires are fused to the glass sealing the unit to prevent any ingress of flammable gases.

Restricted Breathing Enclosure - Type of Protection “nR” for Use in Zone 2

Combustible Dust Protection Methods

CLASS II EQUIPMENT

Dusttight equipment is designed to exclude dust from entering the enclosure, to prevent hot particles, arcs, sparks or heat generated inside of the enclosure from igniting an exterior accumulation or atmospheric suspension of dusts on or in the vicinity of the enclosure. Nonmetallic enclosures must also prevent the accumulation of static charges on the enclosure itself.

The primary function of the joints of these enclosures is to seal dust out and keep the hot particles etc. inside, therefore, typically the joints are gasketed.

Since this protection method keeps the combustible dusts outside, the enclosure is not expected or designed to contain an internal explosion. The design must be sufficient though to withstand mechanical abuse.

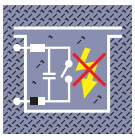
The ignition temperature of dusts is usually lower than that of gases and vapors, and therefore the control of external surface temperatures is more rigorous for Class II equipment than for Class I equipment. Dust layers on the equipment can act as insulation for the heat generated inside the equipment, which in turn can increase the surface temperature of the unit even under normal operating conditions.

The NEC defines "Dust-ignition proof" as the protection for Class II, Division 1 and 2 locations for which it is approved, and "Dusttight" as a type of enclosure that is constructed so that dusts will not enter the enclosing case under specific test conditions. In the NEC, some applications for Class II, Division 1 require Dust-ignition proof enclosures.

The NEC, in Article 506 introduced the Zone Classification System, Zones 20, 21 and Zone 22 for Combustible Dust or Ignitible Fibers and Flyings, as an alternative to the Class and Division Classification System covered in Articles 500, 502 and 503.

The Zone Classification System is based on the modified IEC Area Classification System as defined in ANSI/ISA 61241-10.

Methods of Protection (Dust)

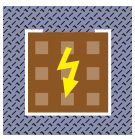


Intrinsic Safety - Type of Protection iaD for Zone 20, 21 and 22

Intrinsic Safety - Type of Protection ibD for Zone 21 and 22

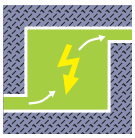
Associated Apparatus - Type of Protection [iaD] - Unclassified

Associated Apparatus - Type of Protection [ibD] - Unclassified

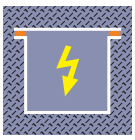


Encapsulation - Type of Protection maD for Zone 20, 21 and 22

Encapsulation - Type of Protection mbD for Zone 21 and 22



Pressurization - Type of Protection pD for Zone 20, 21 and 22



Enclosure - Type of Protection tD for Zone 20, 21 and 22

Environmental Protection

NEMA and CSA Type Enclosure

NEMA or CSA Type 1 Enclosures are intended for indoor use primarily to provide a degree of protection against limited amounts of falling dirt. This type is not specifically identified in the CSA Standard.

NEMA or CSA Type 2 Enclosures are intended for indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt.

NEMA or CSA Type 3 Enclosures are intended for outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust; and damage from external ice formation.

NEMA or CSA Type 3R Enclosures are intended for outdoor use primarily to provide a degree of protection against rain, sleet; and damage from external ice formation, and must have a drain hole.

NEMA or CSA Type 3S Enclosures are intended for outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust; and to provide for operation of external mechanisms when ice laden.

NEMA or CSA Type 4 Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, hose directed water; and damage from external ice formation.

NEMA or CSA Type 4X Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, hose directed water; and damage from external ice formation.

NEMA or CSA Type 5 Enclosures are intended for indoor use primary to provide a degree of protection against settling airborne dust, falling dirt, and dripping non-corrosive liquids.

NEMA or CSA Type 6 Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against hose-directed water, the entry of water during occasional temporary submersion at a limited depth; and damage from external ice formation.

NEMA or CSA Type 6P Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against hose-directed water, the entry of water during prolonged submersion at a limited depth; and damage from external ice formation.

NEMA or CSA Type 12 Enclosures are intended for indoor use primarily to provide a degree of protection against circulating dust, falling dirt, and dripping non-corrosive liquids.

NEMA or CSA Type 12K Enclosures with knockouts are intended for indoor use primarily to provide a degree of protection against circulating dust, falling dirt, and dripping non-corrosive liquids.

NEMA or CSA Type 13 Enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and non-corrosive coolant.

Definitions Referring to NEMA Requirements for Hazardous Location

The following NEMA type enclosures occasionally appear on specifications and product literature

NEMA 7 Enclosures are intended for indoor use in locations classified as Class I, Groups A, B, C, or D, as defined in the NEC.

NEMA 8 Enclosures are for indoor or outdoor use in locations classified as Class I, Groups A, B, C, or D, as defined in the NEC.

NEMA 9 Enclosures are intended for indoor use in locations classified as Class II, Groups E, F, and G, as defined in the NEC.

.

NEMA 10 Enclosures are constructed to meet the applicable requirements of the Mine Safety and Health Administration. (MSHA)

The designations are considered to be historical terminology approaching obsolescence and are incomplete designations at best. Types 7 and 9 are not mentioned anywhere in the National Electrical Code, the controlling document for installations. All hazardous location products must be marked with the Class, Division, Group, and Temperature Class to provide to an installer all of the information needed to complete an installation in accordance with Article 500 of the National Electrical Code.

Comparison of Specific Applications of Enclosures for Indoor Unclassified Locations

Provides A Degree Of Protection Against The Following Environmental Conditions	Type of Enclosure									
	1*	2*	4	4x	5	6	6P	12	12K	13
Incidental contact with the enclosed equipment	x	x	x	x	x	x	x	x	x	x
Falling dirt	x	x	x	x	x	x	x	x	x	x
Falling liquids and light splashing	-	x	x	x	x	x	x	x	x	x
Circulation dust, lint, fibers, and flyings**	-	-	x	x	-	x	x	x	x	x
Settling airborne dust, lint, fibers, and flyings**	-	-	x	x	x	x	x	x	x	x
Hosedown and splashing water	-	-	x	x	-	x	x	-	-	-
Oil and coolant seepage	-	-	-	-	-	-	-	x	x	x
Oil and coolant spraying and splashing	-	-	-	-	-	-	-	-	-	x
Corrosive agents	-	-	-	x	-	-	-	-	-	-
Occasional temporary submersion	-	-	-	-	-	x	x	-	-	-
Occasional prolonged submersion	-	-	-	-	-	-	-	-	-	-

* These enclosures may be ventilated. However, Type 1 may not provide protection against small particles of falling dirt when ventilation is provided in the enclosure top.

** These fibers and flyings are not explosive materials and are not considered as Class III type ignitable fibers or combustible flyings. For Class III type ignitable fibers or combustible flyings see the National Electrical Code®, Article 500.

Comparison of Specific Applications of Enclosures for Outdoor Unclassified Locations

Provides A Degree Of Protection Against The Following Environmental Conditions	Type of Enclosure						
	3*	3R***	3S	4	4X	6	6P
Incidental contact with the enclosed equipment	x	x	x	x	x	x	x
Rain, snow, sleet*	x	x	x	x	x	x	x
Sleet**	-	-	x	-	-	-	
Windblown dust	x	-	x	x	x	x	
Hosedown	-	-	-	x	x	x	
Corrosive agents	-	-	-	-	x	-	
Occasional temporary submersion	-	-	-	-	-	x	
Occasional prolonged submersion	-	-	-	-	-	-	x

* External operating mechanisms are not required to operate when the enclosure is ice covered.

** External operating mechanisms are operable when the enclosure is ice covered.

***These enclosures may be ventilated.

Comparison of Specific Applications of Enclosures for Indoor Hazardous (Classified) Locations

Provides a Degree of Protection Against Atmospheres Typically Containing Hazardous Gases, Vapors, and Dusts***	Type of Enclosure: NEMA 7 & 8, Class I Groups**					NEMA 9 & 10, Class II Groups**			
	Class	A	B	C	D	E	F	G	10
Acetylene	I	x	-	-	-	-	-	-	-
Hydrogen, manufactured gases	I	-	x	-	-	-	-	-	-
Diethyl ether, ethylene, cyclopropane	I	-	-	x	-	-	-	-	-
Gasoline, hexane, butane, naphtha, propane, acetone	I	-	-	-	x	-	-	-	-
Toluene, isoprene	I	-	-	-	x	-	-	-	-
Metal dusts	II	-	-	-	-	x	-	-	-
Carbon black, coal dust, coke dust	II	-	-	-	-	-	x	-	-
Flour, starch, grain dust	II	-	-	-	-	-	-	x	-
Fibers, flyings	III	-	-	-	-	-	-	-	-
Methane with or without coal dust	MSHA	-	-	-	-	-	-	-	x

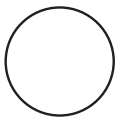
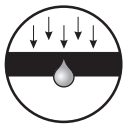
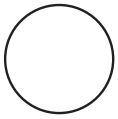
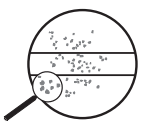
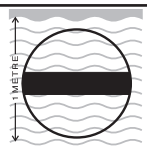
* Due to the characteristics of the gas, vapor, or dust, a product suitable for one Class or Group may not be suitable for any other Class or Group unless so marked on the product.

** For Class III type ignitable fibers or combustible flyings refer to the National Electrical Code® Article 500.

***For a complete listing of flammable liquids, gases, or vapors refer to NFPA 497 - 1997 (Recommended Practice for the Classification of Flammable Liquids. Gases, or Vapors and of Hazardous (Classified) Locations for Electrical installations in Chemical Process Areas and NFPA 325 - 1994 (Fire Hazard Properties of Flammable Liquids. Gases, and Volatile Solids). Reference also NFPA 499 -1997 Classifications of Combustible Dusts and of Hazardous (Classified) Locations for Electrical installations in Chemical Process Areas.

Ingress Protection (IP)

The IEC uses the term “Ingress Protection” to identify the environmental protection of a device. This is defined in IEC Standard 60 529 and the following chart illustrates the two-digit code used.

IP The IP classification system designates, by means of a number, the degree of protection provided by a device against ingress of dust and water.		**SECOND NUMBER** Degree of protection against water	
FIRST NUMBER Degree of protection against solid objects		0 	Non-protected.
		1 	Protected against water dripping vertically, such as condensation.
0 	Non-protected.	2 	Protected against dripping water when tilted up to 15°.
1 	Protected against a solid object greater than 50mm such as a hand.	3 	Protected against water spraying at an angle of up to 60°.
2 	Protected against a solid object greater than 12mm, such as a finger.	4 	Protected against water splashing from any direction.
3 	Protected against a solid object greater than 2.5mm, such as wire or a tool.	5 	Protected against jets of water from any direction.
4 	Protected against a solid object greater than 1.0 mm, such as wire or thin strips.	6 	Protection against heavy seas or powerful jets of water.
5 	Dust-protected. Prevents ingress of dust sufficient to cause harm.	7 	Protected against harmful ingress of water when immersed between a depth of 150mm to 1 meter.
6 	Dust tight. No dust ingress.	8 	Protected against submersion. Suitable for continuous immersion in water.

Equipment Certification

Equipment for use in hazardous locations must be certified to an appropriate National Standard and marked as such by an accredited third party testing organization. Follow-up inspection to ensure conformance is part of the program. Products may carry multiple markings for multiple countries. The following is a brief description of the National Requirements.

Important Listing Information

The specific requirements for product certification vary from country to country. While UL, FM and CSA are similar in their approach, subtle differences still exist.

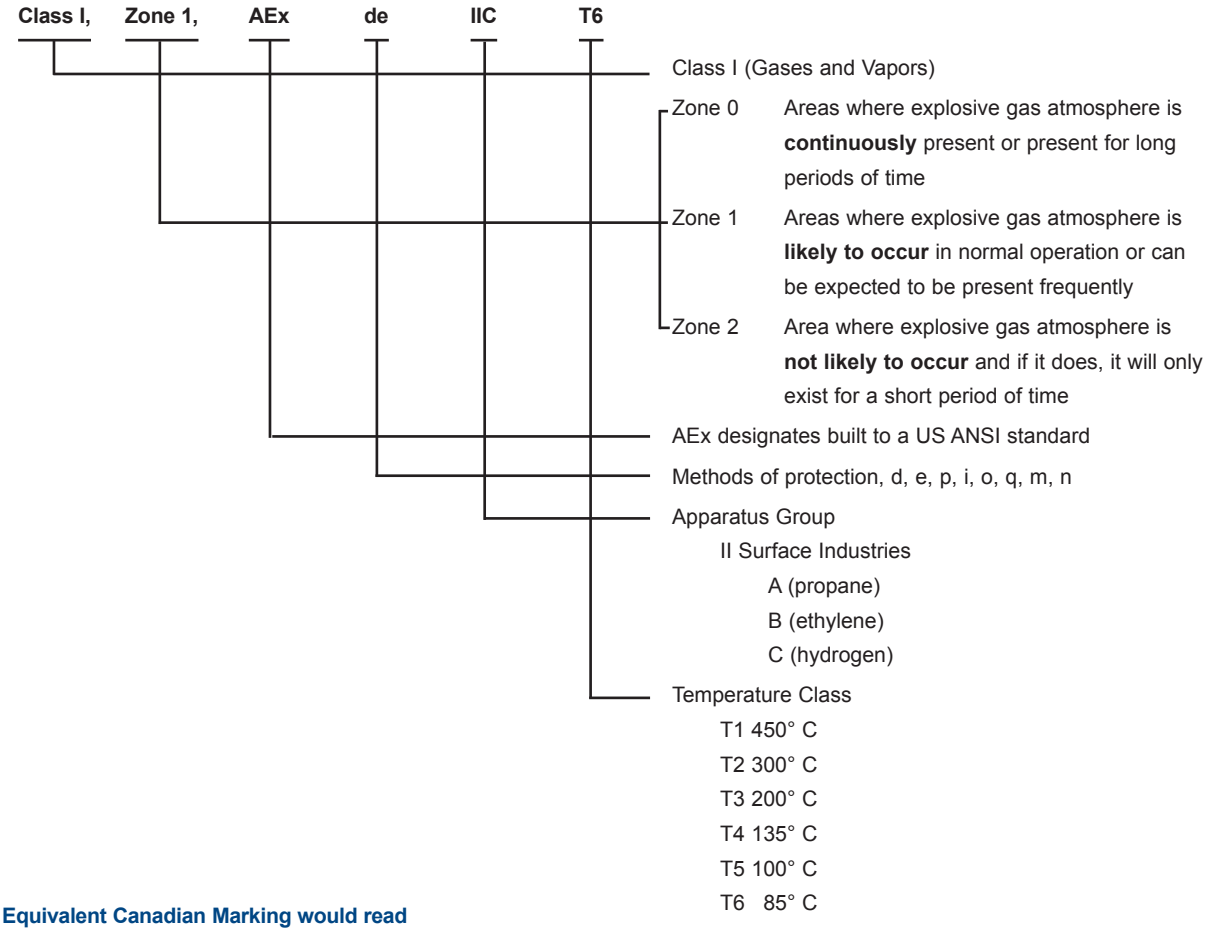
North American certifications permit conduit or cable entries to be field installed provided appropriate bonding and grounding requirements are followed.

Marking

Typical North American Marking to NEC 500

Class I, Divisions 1 or 2, Groups A, B, C & D, T4 (T-Code)
Class II, Divisions 1 or 2, Groups E, F & G, T4 (T-Code)
Class III,
Enclosure Type 3, 4, 4X

Typical U.S. Marking to NEC 505

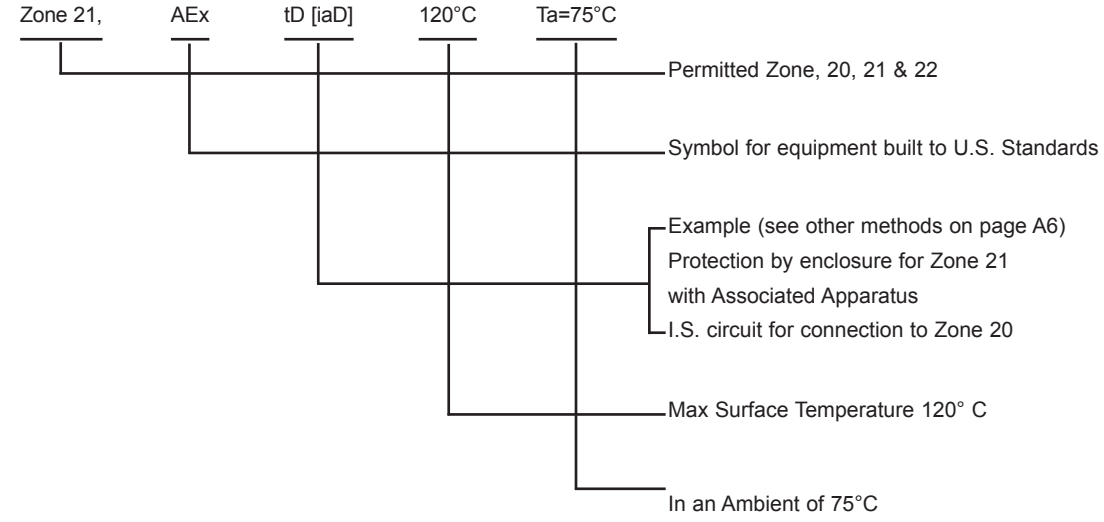


Equivalent Canadian Marking would read

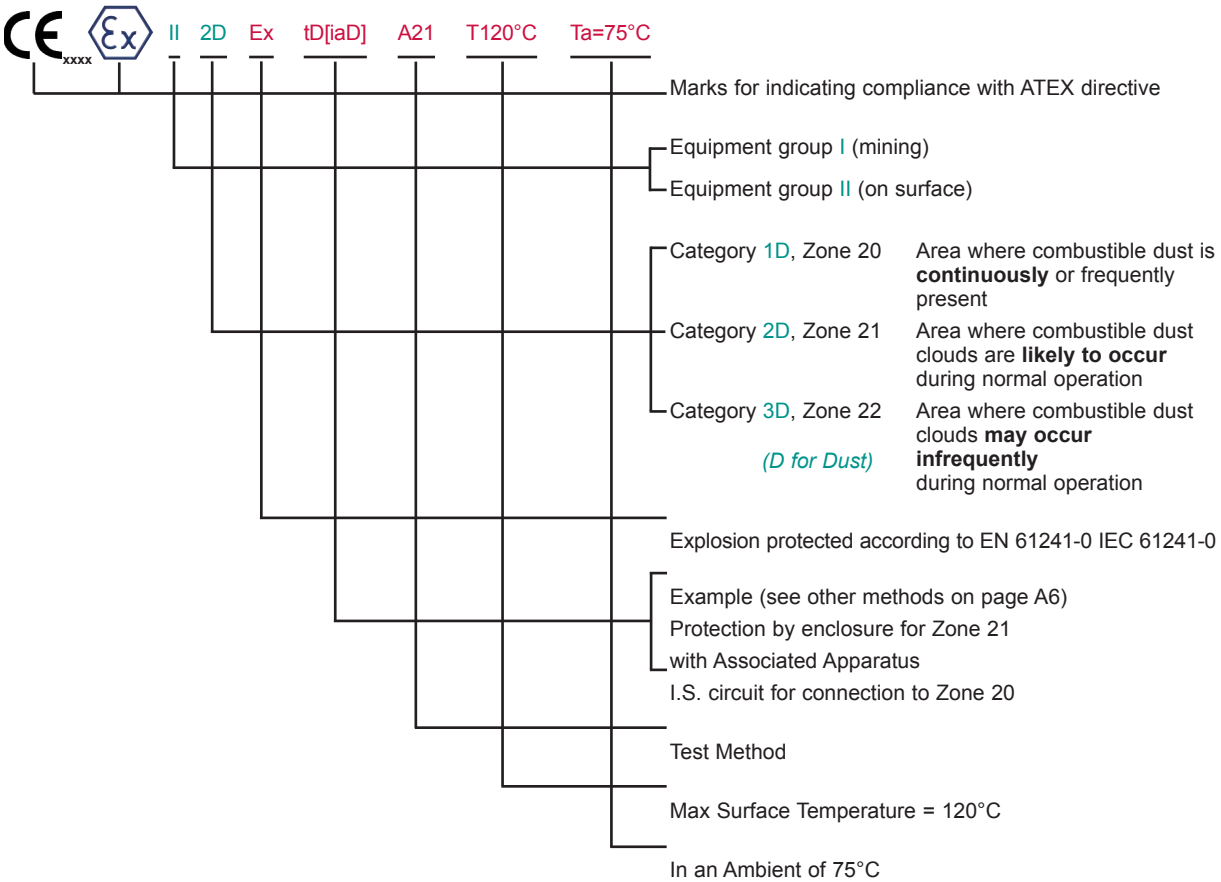
Ex de IIC T6

Typical U.S. Marking to NEC 506

(Dust Zones not adopted by Canada yet)



Typical European ATEX/CENELEC Marking for Dust Explosion Protection



Typical European ATEX/CENELEC Marking for Gas Explosion Protection

II 2G Ex de IIC T6

Marks for indicating compliance with ATEX directive

Equipment group I (mining)
Category M1 and M2

Equipment group II (on surface)

Category 1G, Zone 0	Areas where explosive gas atmosphere is **continuously** present or present for long periods of time
Category 2G, Zone 1	Areas where explosive gas atmosphere is **likely to occur** in normal operation or can be expected to be present frequently
Category 3G, Zone 2 *(G for Gas)*	Area where explosive gas atmosphere is **not likely to occur** and if it does, it will only exist for a short period of time

Explosion protected according to CENELEC standards EN 60079…

Methods of protection, d, e, p, i, o, q, m, n

Apparatus Group
- I Mining - Underground (methane)
- II Surface Industries
- A (propane)
- B (ethylene)
- C (hydrogen)

Temperature Class
- T1 450° C
- T2 300° C
- T3 200° C
- T4 135° C
- T5 100° C
- T6 85° C

ATEX DIRECTIVE

The ATEX Directive 94/9/EC is a directive adopted by the European Union (EU) to facilitate free trade in the EU by aligning the technical and legal requirements in the Member States for products intended for use in potentially explosive atmospheres.

This Directive applies to electrical and non-electrical equipment/components and protective systems. The ATEX Directive became mandatory on July 1, 2003.

Equipment located outside potentially explosive atmospheres are also covered by the ATEX Directive under the following conditions:

- The equipment is a safety device, controller or regulatory device; and
- The equipment is required for the safe function of equipment or protective systems with respect to the risk of explosion.

All equipment under its scope is required to bear the European CE Marking as verification of compliance with the Directive (the CE Marking will not appear on components defined by this Directive). The ATEX Directive specifically defines procedures for the evaluation of a product's design and production based on Equipment Groups and Categories. This is briefly outlined below.

Equipment Group I Overview

Equipment intended for use in underground parts of mines, and to those parts of surface installations of such mines, liable to be endangered by firedamp and/or combustible dust.

Equipment Category	Protection	Comparison To Current IEC Classification
M1	2 levels of protection; or 2 independent faults	Group I
M2	1 level of protection based on normal operation	Group I

Equipment Group II Overview

Equipment intended for use in other than Equipment Group I places that are liable to be endangered by explosive atmospheres.

Equipment Category	Protection	Comparison To Current IEC Classification
1G 1D	2 levels of protection; or 2 independent faults	Group II, Zone 0 (gas) Zone 20 (dust)
2G 2D	1 level of protection based on frequent disturbances; or equipment faults	Group II, Zone 1 (gas) Zone 21 (dust)
3G 3D	1 level of protection based on normal operation	Group II, Zone 2 (gas) Zone 22 (dust)

ATEX Marking

The equipment for ATEX identifies the category which indicates a risk of the equipment becoming a source of ignition. The table on the right shows the relationship between Categories and Zones. Note that the Zone represents only the risk of a release of flammables into the area.

NOTE: As an alternative to the relationship given in the table on the right between Categories and Zones, the required Category of equipment may be selected on the basis of risk, i.e. taking into account the consequences of an ignition. This may, under circumstances, require a higher Category or permit a lower Category than defined in the table.

Zone	Categories
0	1G
1	2G
2	3G
20	1D
21	2D
22	3D

Differences Between the Old and New Directives

The main differences are:

- The inclusion of non-electrical equipment
- The inclusion of dust atmospheres
- Additional quality system requirements
- The need to produce a 'Technical File'
- Requirements for safety related devices (flame arrestors, suppression systems etc) and safe area equipment

Products Covered

The Directive includes equipment and safety or control devices installed outside the potentially explosive area but having an explosion protection function. A wide range of products comes within the definition of equipment, including electric motors, compressors, diesel engines, lighting fittings, control and communication devices and monitoring and detection equipment, to name but a few. "Protective Systems" are also included, and include items that prevent an explosion that has been initiated from spreading or causing damage. They include flame arrestors, quenching systems, pressure relief panels and fast-acting shut-off valves to name but a few.

Product Exclusions

The Directive, however, does exclude the following product types:

- Medical devices
- Products for use in the presence of explosives
- Products for domestic use
- Means of transport by air or on road or rail or water networks. Vehicles intended for use in an explosive atmospheres are not excluded.
- Sea-going vessels and mobile offshore units
- Military equipment
- Personal protective equipment covered by directive 89/686/EEC

For more info about ATEX, visit www.europa.eu.int/comm/enterprise/atex/

CE MARKING

The CE mark is a mandatory European marking for certain product groups to indicate conformity with the essential health and safety requirements set out in European Directives. The letters 'CE' are an abbreviation of Conformité Européenne, French for European conformity. The CE mark must be affixed to a product if it falls under the scope of the so called 'New Approach' Directives. Without the CE marking, and thus without complying with the provisions of the Directives, the product may not be placed in the market or put into service in the fifteen member states of the European Union and Norway, Iceland and Liechtenstein. However, if the product meets the provisions of the applicable European Directives, and the CE mark is affixed to a product, these countries may not prohibit, restrict or impede the placing in the market or putting into service of the product. Thus, CE marking can be regarded as the products trade passport for Europe. For more info about CE marking, visit www.eurunion.org/legislat/standard/standard.htm

IECEx SCHEME

The objective of the IECEx Scheme is to facilitate global trade in electrical equipment intended for use in explosive atmospheres by eliminating the need for multiple national certification.

The IECEx Scheme provides the means for manufacturers of Ex equipment to obtain certificates of conformity that will be accepted at national level in all participating countries. A certificate of conformity may be obtained from any certification body accepted into the Scheme. The certificate will attest that the equipment design conforms to the relevant IEC Standards. The final objective of the IECEx Scheme is world-wide acceptance of one standard, one certificate and one mark.

For the IECEx Scheme to achieve its long term objective, every national Standard for which application is made by participating countries will need to be identical to the corresponding IEC Standard. For countries whose national Standards are not yet identical to the IEC Standards, a transitional period will be necessary to allow time for participating IECEx Scheme member countries to adjust their national standards to the IEC standards and work toward national acceptance of IECEx Certificates of conformity and the IECEx mark.

For more info about IECEx Scheme, visit www.IECEx.com

Temperature Conversion Table
Degree Celsius vs. Degree Fahrenheit

The equation for converting Fahrenheit to Celsius is: (Deg. F - 32) x (5/9) = Deg. C

°C	°F	°C	°F
-59.4	-75		-103.0
-58.9	-74		-101.2
-58.3	-73		-99.4
-57.8	-72		-97.6
-57.2	-71		-95.8
-56.7	-70		-94.0
-56.1	-69		-92.2
-55.6	-68		-90.4
-55.0	-67		-88.6
-54.4	-66		-86.8
-53.9	-65		-85.0
-53.3	-64		-83.2
-52.8	-63		-81.4
-52.2	-62		-79.6
-51.7	-61		-77.8
-51.1	-60		-76.0
-50.6	-59		-74.2
-50.0	-58		-72.4
-49.4	-57		-70.6
-48.9	-56		-68.8
-48.3	-55		-67.0
-47.8	-54		-65.2
-47.2	-53		-63.4
-46.7	-52		-61.6
-46.1	-51		-59.8
-45.6	-50		-58.0
-45.0	-49		-56.2
-44.4	-48		-54.4
-43.9	-47		-52.6
-43.3	-46		-50.8
-42.8	-45		-49.0
-42.2	-44		-47.2
-41.7	-43		-45.4
-41.1	-42		-43.6
-40.6	-41		-41.8
-40.0	-40		-40.0
-39.4	-39		-38.2
-38.9	-38		-36.4
-38.3	-37		-34.6
-37.8	-36		-32.8
-37.2	-35		-31.0
-36.7	-34		-29.2
-36.1	-33		-27.4
-35.6	-32		-25.6
-35.0	-31		-23.8
-34.4	-30		-22.0
-33.9	-29		-20.2
-33.3	-28		-18.4
-32.8	-27		-16.6
-32.2	-26		-14.8
-31.7	-25		-13.0
-31.1	-24		-11.2
-30.6	-23		-9.4
-30.0	-22		-7.6
-29.4	-21		-5.8
-28.9	-20		-4.0
-28.3	-19		-2.2
-27.8	-18		-0.4
-27.2	-17		1.4
-26.7	-16		3.2

°C	°F	°C	°F
-26.1	-15		5.0
-25.6	-14		6.8
-25.0	-13		8.6
-24.4	-12		10.4
-23.9	-11		12.2
-23.3	-10		14.0
-22.8	-9		15.8
-22.2	-8		17.6
-21.7	-7		19.4
-21.1	-6		21.2
-20.6	-5		23.0
-20.0	-4		24.8
-19.4	-3		26.6
-18.9	-2		28.4
-18.3	-1		30.2
-17.8	0		32.0
-17.2	1		33.8
-16.7	2		35.6
-16.1	3		37.4
-15.6	4		39.2
-15.0	5		41.0
-14.4	6		42.8
-13.9	7		44.6
-13.3	8		46.4
-12.8	9		48.2
-12.2	10		50.0
-11.7	11		51.8
-11.1	12		53.6
-10.6	13		55.4
-10.0	14		57.2
-9.4	15		59.0
-8.9	16		60.8
-8.3	17		62.6
-7.8	18		64.4
-7.2	19		66.2
-6.7	20		68.0
-6.1	21		69.8
-5.6	22		71.6
-5.0	23		73.4
-4.4	24		75.2
-3.9	25		77.0
-3.3	26		78.8
-2.8	27		80.6
-2.2	28		82.4
-1.7	29		84.2
-1.1	30		86.0
-0.6	31		87.8
-0.0	32		89.6
0.6	33		91.4
1.1	34		93.2
1.7	35		95.0
2.2	36		96.8
2.8	37		98.6
3.3	38		100.4
3.9	39		102.2
4.4	40		104.0
5.0	41		105.8
5.6	42		107.6
6.1	43		109.4
6.7	44		111.2

°C	°F	°C	°F
7.2	45		113.0
7.8	46		114.8
8.3	47		116.6
8.9	48		118.4
9.4	49		120.2
10.0	50		122.0
10.6	51		123.8
11.1	52		125.6
11.7	53		127.4
12.2	54		129.2
12.8	55		131.0
13.3	56		132.8
13.9	57		134.6
14.4	58		136.4
15.0	59		138.2
15.6	60		140.0
16.1	61		141.8
16.7	62		143.6
17.2	63		145.4
17.8	64		147.2
18.3	65		149.0
18.9	66		150.8
19.4	67		152.6
20.0	68		154.4
20.6	69		156.2
21.1	70		158.0
21.7	71		159.8
22.2	72		161.6
22.8	73		163.4
23.3	74		165.2
23.9	75		167.0
24.4	76		168.8
25.0	77		170.6
25.6	78		172.4
26.1	79		174.2
26.7	80		176.0
27.2	81		177.8
27.8	82		179.6
28.3	83		181.4
28.9	84		183.2
29.4	85		185.0
30.0	86		186.8
30.6	87		188.6
31.1	88		190.4
31.7	89		192.2
32.2	90		194.0
32.8	91		195.8
33.3	92		197.6
33.9	93		199.4
34.4	94		201.2
25.0	95		203.0
35.6	96		204.8
36.1	97		206.6
36.7	98		208.4
37.2	99		210.2
37.8	100		212.0
38.3	101		213.8
38.9	102		215.6
39.4	103		217.4
40.0	104		219.2

Temperature Conversion Table
Degree Celsius vs. Degree Fahrenheit

The equation for converting Fahrenheit to Celsius is: (Deg. F - 32) x (5/9) = Deg. C

°C	°F → °C ←	°F
40.6	**105**	221.0
41.1	**106**	222.8
41.7	**107**	224.6
42.2	**108**	226.4
42.8	**109**	228.2
43.3	**110**	230.0
43.9	**111**	231.8
44.4	**112**	233.6
45.0	**113**	235.4
45.6	**114**	237.2
46.1	**115**	239.0
46.6	**116**	240.8
47.2	**117**	242.6
47.8	**118**	244.4
48.3	**119**	246.2
48.9	**120**	248.0
49.4	**121**	249.8
50.0	**122**	251.6
50.6	**123**	253.4
51.1	**124**	255.2
51.7	**125**	257.0
52.2	**126**	258.8
52.8	**127**	260.6
53.3	**128**	262.4
53.9	**129**	264.2
54.4	**130**	266.0
55.0	**131**	267.8
55.6	**132**	269.6
56.1	**133**	271.4
56.7	**134**	273.2
57.2	**135**	275.0
57.8	**136**	276.8
58.3	**137**	278.6
58.9	**138**	280.4
59.4	**139**	282.2
60.0	**140**	284.0
60.6	**141**	285.8
61.1	**142**	287.6
61.7	**143**	289.4
62.2	**144**	291.2
62.8	**145**	293.0
63.3	**146**	294.8
63.9	**147**	296.6
64.4	**148**	298.4
65.0	**149**	300.2
65.6	**150**	302.0
66.1	**151**	303.8
66.7	**152**	305.6
67.2	**153**	307.4
67.8	**154**	309.2
68.3	**155**	311.0
68.9	**156**	312.8
69.4	**157**	314.6
70.0	**158**	316.4
70.6	**159**	318.2
71.1	**160**	320.0
71.7	**161**	321.8
72.2	**162**	323.6
72.8	**163**	325.4
73.3	**164**	327.2
73.9	**165**	329.0
74.4	**166**	330.8
75.0	**167**	332.6
75.6	**168**	334.4
76.1	**169**	336.2
76.7	**170**	338.0
77.2	**171**	339.8
77.8	**172**	341.6
78.3	**173**	343.4
78.9	**174**	345.2
79.4	**175**	347.0
80.0	**176**	348.8
80.6	**177**	350.6
81.1	**178**	352.4
81.7	**179**	354.2
82.2	**180**	356.0
82.8	**181**	357.8
83.3	**182**	359.6
83.9	**183**	361.4
84.4	**184**	363.2
85.0	**185**	365.0
85.6	**186**	366.8
86.1	**187**	368.6
86.7	**188**	370.4
87.2	**189**	372.2
87.8	**190**	374.0
88.3	**191**	375.8
88.9	**192**	377.6
89.4	**193**	379.4
90.0	**194**	381.2
90.6	**195**	383.0
91.1	**196**	384.8
91.7	**197**	386.6
92.2	**198**	388.4
92.8	**199**	390.2
93.3	**200**	392.0
93.9	**201**	393.8
94.4	**202**	395.6
95.0	**203**	397.4
95.6	**204**	399.2
96.1	**205**	401.0
96.7	**206**	402.8
97.2	**207**	404.6
97.8	**208**	406.4
98.3	**209**	408.2
98.9	**210**	410.0
99.4	**211**	411.8
100.0	**212**	413.6
100.6	**213**	415.4
101.1	**214**	417.2
101.7	**215**	419.0
102.2	**216**	420.8
102.8	**217**	422.6
103.3	**218**	424.4
103.9	**219**	426.2
104.4	**220**	428.0
105.0	**221**	429.8
105.6	**222**	431.6
106.1	**223**	433.4
106.7	**224**	435.2
107.2	**225**	437.0
107.8	**226**	438.8
108.3	**227**	440.6
108.9	**228**	442.4
109.4	**229**	444.2
110.0	**230**	446.0
110.6	**231**	447.8
111.1	**232**	449.6
111.7	**233**	451.4
112.2	**234**	453.2
112.8	**235**	455.0
113.3	**236**	456.8
113.9	**237**	458.6
114.4	**238**	460.4
115.0	**239**	462.2
115.6	**240**	464.0
116.1	**241**	465.8
116.7	**242**	467.6
117.2	**243**	469.4
117.8	**244**	471.2
118.3	**245**	473.0
118.9	**246**	474.8
119.4	**247**	476.6
120.0	**248**	478.4
120.6	**249**	480.2
121.1	**250**	482.0
121.7	**251**	483.8
122.2	**252**	485.6
122.8	**253**	487.4
123.3	**254**	489.2
123.9	**255**	491.0
124.4	**256**	492.8
125.0	**257**	494.6
125.6	**258**	496.4
126.1	**259**	498.2
126.7	**260**	500.0
127.2	**261**	501.8
127.8	**262**	503.6
128.3	**263**	505.4
128.9	**264**	507.2
129.4	**265**	509.0
130.0	**266**	510.8
130.6	**267**	512.6
131.1	**268**	514.4
131.7	**269**	516.2
132.2	**270**	518.0
132.8	**271**	519.8
133.3	**272**	521.6
133.9	**273**	523.4
134.4	**274**	525.2
135.0	**275**	527.0
135.6	**276**	528.8
136.1	**277**	530.6
136.7	**278**	532.4
137.2	**279**	534.2
137.8	**280**	536.0
138.3	**281**	537.8
138.9	**282**	539.6
139.4	**283**	541.4
140.0	**284**	543.2

Dimensions of Copper Conductors
Standard Cross-Sections of Copper Conductors

Metric Size ISO mm²	Comparison Between AWG/kcmil and metric sizes	
	Size AWG/kcmil	Equivalent Metric Area mm²
0,2	24	0,205
—	22	0,324
0,5	20	0,519
0,75	18	0,82
1	—	—
1,5	16	1,3
2,5	14	2,1
4	12	3,3
6	10	5,3
10	8	8,4
16	6	13,3
25	4	21,2
35	2	33,6
50	0	53,5
70	00	67,4
95	000	85
—	0000	107,2
120	250 kcmil	127
150	300 kcmil	152
185	350 kcmil	177
240	500 kcmil	253
300	600 kcmil	304
350	700 kcmil	355
380	750 kcmil	380
400	800 kcmil	405
450	900 kcmil	456
500	1 000 kcmil	507
630	1 250 kcmil	634
750	1 500 kcmil	760
890	1 750 kcmil	887
1 000	2 000 kcmil	1 01

Useful Conversion Factors

Linear Measures

1 inch (in.) = 2.54 cm
1 foot (ft.) = 30.48 cm
1 yard (yd.) = 91.44 cm
1 mile = 1609.344 m
1 centimeter (cm) = 0.0328084 ft.
= 0.393701 in.
= 0.01 m
= 10.00 mm
1 meter (m) = 3.28084 ft.
= 39.3701 in.
= 1.09361 yd.

Weights

1 ounce (oz. av.) = 28.35 g.
1 pound (lb.) = 0.453 kg or 16 oz.
1 kilogram (kg) = 2.20462 lb.

Power

1 kilowatt (kW) = 1.34102 hp.
1 horsepower (hp.) = 0.745700 kW

Moment Force (Torque)

1 Newton meter (Nm) = 8.85075 lbf in. or
= 0.73756 lbf ft.
1 Inch pound (lbf in.) = 0.11299 Nm
1 Foot pound (lbf ft.) = 1.35582 Nm

Introduction to Intrinsic Safety

By definition, intrinsic safety is an explosion protection technique applied to electrical equipment and wiring intended for installation in hazardous locations. The technique is based upon limiting both electrical and thermal energy under normal and abnormal conditions to levels which are incapable of igniting a hazardous mixture which is present in it's most easily ignitable concentration. These levels have been established through extensive laboratory testing and are called ignition curves. They are available in both table and graph form. These can be found in all relevant intrinsic safety standards including ANSI/ISA-12.12.01-200, FM 3610 and CSA 22.2 No. 157.

The three most widely referenced curves are shown on the right. The Resistance Circuits Ignition Currents, Figure 1, depicts the levels of energy required to ignite various hazardous gas-to-air mixtures in their most easily ignited concentrations. The four curves shown are representative of all tested hazardous mixtures. A complete listing of these hazardous mixtures defined by Groups can be found in the National Fire Protection Association document NFPA 497 M.

Because all electrical circuits store energy, which may be released under certain conditions, capacitance and inductance must be considered as potential energy sources capable of igniting a hazardous mixture. Figures 2 and 3 plot those capacitive and inductive levels at which ignition of a hazardous mixture will occur.

In the case of all three referenced curves, fault energy levels below those shown by the curves are of insufficient magnitude to ignite the referenced hazardous mixture. In order to provide a secure factor for the application of intrinsic safety, safety factors are applied to the energy levels depicted by the curves. It should also be noted that these curves are only applicable to circuits which use resistance as the means of current limitation. As technology progresses, many intrinsically safe circuits are being constructed with semiconductors to provide current limitation. Since the output characteristics of these devices are not linear, they require the use of special ignition curves or testing. For more information, please see the documents referenced in paragraph 1.

When intrinsically safe systems are discussed as being safe under normal or abnormal conditions it is inferred that regardless of a circuit's condition, power levels will not be of sufficient magnitude to ignite a specific hazardous mixture. When discussing an electrical measurement or control circuit in hazardous location, abnormal conditions, commonly referred to as fault conditions, would generally be considered to be those circumstances in which the circuit has failed in an unsafe manner creating the risk of explosion. With intrinsic safety, these fault conditions are considered to be normal and expected. Fault conditions may be opening, shorting or grounding of field wiring as well as the application of higher voltages than were intended for the circuit. Each would collectively increase the potential of igniting a flammable or combustible mixture.

When viewing the curves to the right it becomes apparent that the usable energy levels are inherently low. In general, a circuit can only be made intrinsically safe if it requires less than 2 Watts of power. It is for this reason that intrinsic safety is limited to measurement and control circuits. Any circuit powered by higher energy levels requires the use of other explosion protection techniques.

Intrinsic safety reduces the risk of ignition by electrical apparatus or connecting wiring in hazardous locations. Requirements for an intrinsically safe system do not include reducing the risk of explosion related to mechanical or electrostatic sparking, chemical action, radio waves or lightning strikes. Protection against such events should be employed as well.

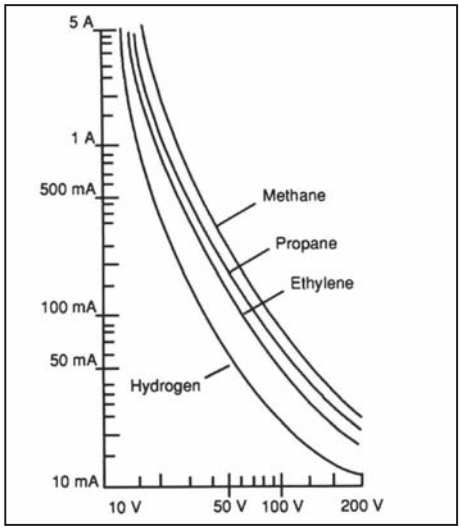


Figure 1. Resistance Circuits Ignition Currents.

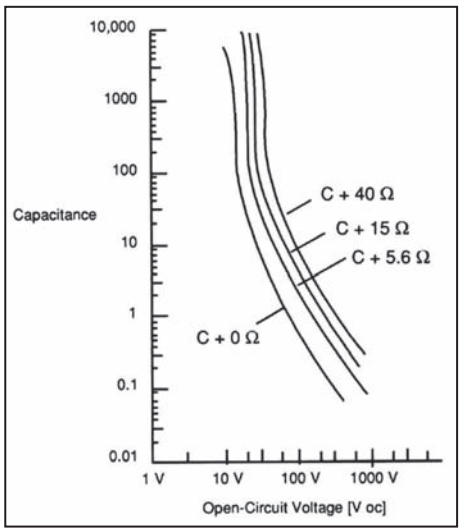


Figure 2. Capacitance Circuits Ignition Voltages.

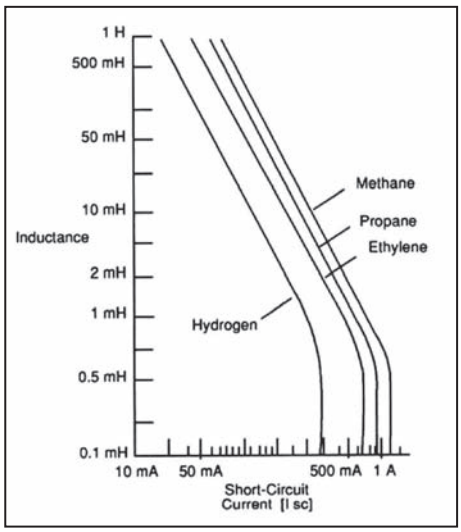


Figure 3. Inductance Circuits Ignition Currents.

The Intrinsically Safe System

For all practical reasons no electrical circuit is inherently intrinsically safe. An intrinsically safe system consists of an Associated Apparatus, either a simple apparatus or Intrinsically Safe Electrical Apparatus, and interconnecting wiring. When properly installed, the incidence of abnormal spark-causing conditions such as electrical equipment failure, miswiring, overvoltage application to the circuit, or the grounding, shorting, or open-circuitry of any lead(s) in the presence of a hazardous mixture, shall not be of sufficient energy to cause ignition.

The standards relative to intrinsic safety include three types of apparatus:
- Associated Apparatus
- Simple Apparatus
- Intrinsically Safe Electrical Apparatus

Associated Apparatus

An associated apparatus is a device typically placed in the nonhazardous location between the automation system input/output modules and the connected field device in the hazardous location. This device limits the power, which can be introduced into the hazardous location, to intrinsically safe energy levels. The traditional means of supplying these connections is through the use of an intrinsic safety barrier. This barrier is a simple, passive device consisting of a zener diode, resistor, and fuse network.

Another type of associated apparatus is the galvanic isolator. Along with providing intrinsically safe connections, these devices also isolate, transformer, electro-mechanically or optically, the hazardous and nonhazardous location circuits. These devices sometimes provide signal conditioning functions as well. Due to their active nature, most require an external source of power and most are designed to be application specific.

Simple Apparatus

A simple apparatus is a device which will not generate or store more than 1.5V, 0.1A, 25mW, or 20µJ. Some examples include switches, RTDs, thermocouples, and LEDs. Since these devices cannot contribute energy of sufficient magnitude to ignite a hazardous mixture under a fault condition, they may be connected to a certified intrinsically safe circuit via an associated apparatus. The evaluation by a testing agency already includes the connection of an intrinsically safe circuit to associated apparatus.

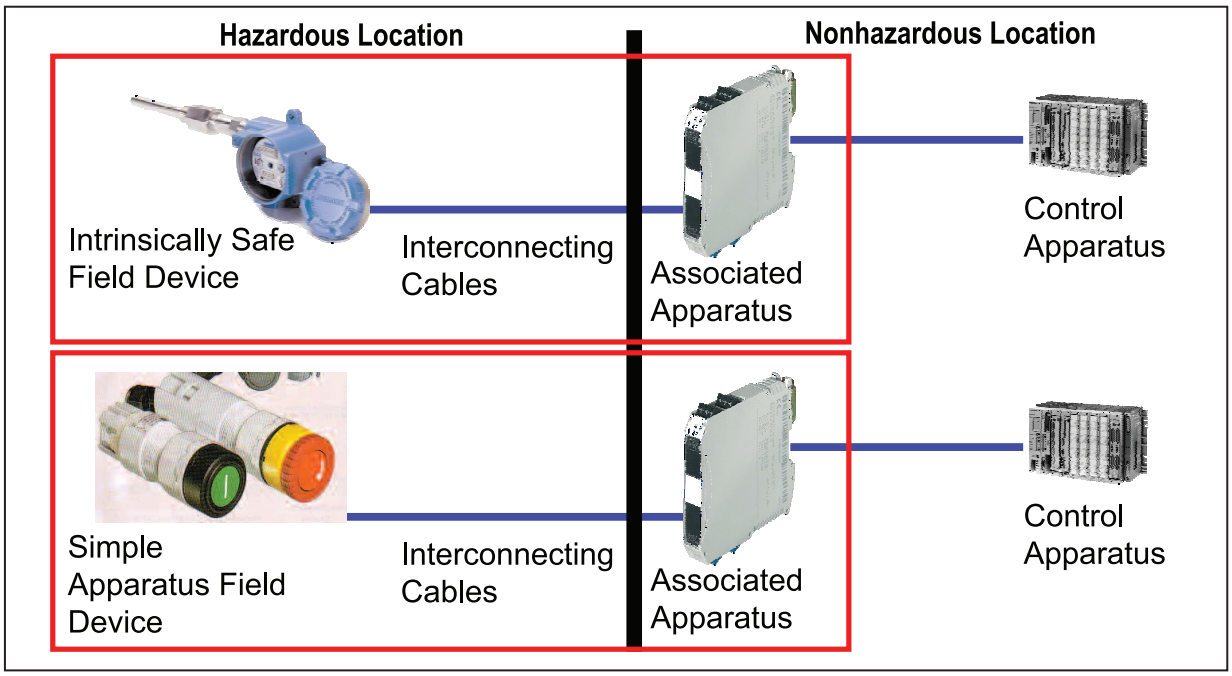


Figure 4. Block Diagram of an intrinsically safe system.

Intrinsically Safe Electrical Apparatus

When the device being installed in the hazardous location has electrical characteristics in excess of those parameters listed for a simple apparatus, they are considered to be energy storing and require evaluation by an appropriate testing agency. Such devices include transmitters, positioners, and solenoid valves. When in doubt about the classification of a device, consult with its' manufacturer for clarification.

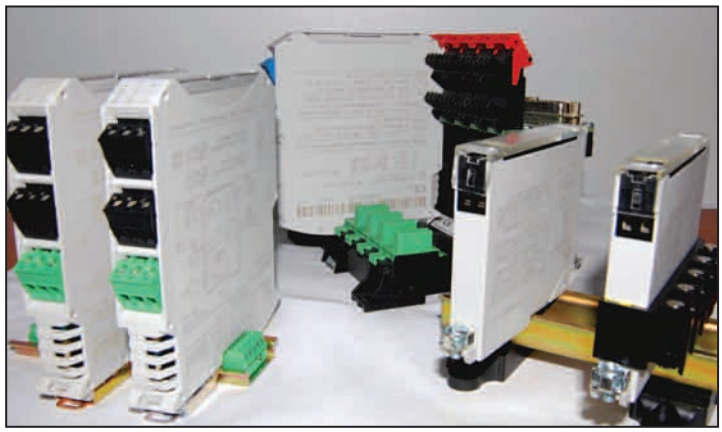


Figure 5. Examples of R. STAHL intrinsic safety interface devices.

The construction of the associated and intrinsically safe electrical apparatus are governed by standards generated by nationally recognized testing laboratories (NRTL). Upon successful evaluation of a product, a report is generated which states the applicable product model numbers, description, testing procedures, and referenced standards. A control drawing is also generated which depicts the manner in which the product is intended to be used. Deviation from this drawing is not permitted unless approved by the authority having jurisdiction. An approval mark will be applied to the product to identify it as meeting the standards of that agency. Some agencies publish a comprehensive listing of products which have been approved for hazardous location use. The availability of products approved as either intrinsically safe or as associated apparatus is widespread within the instrumentation industry.

Figure 6 shows typical listings of approved products.

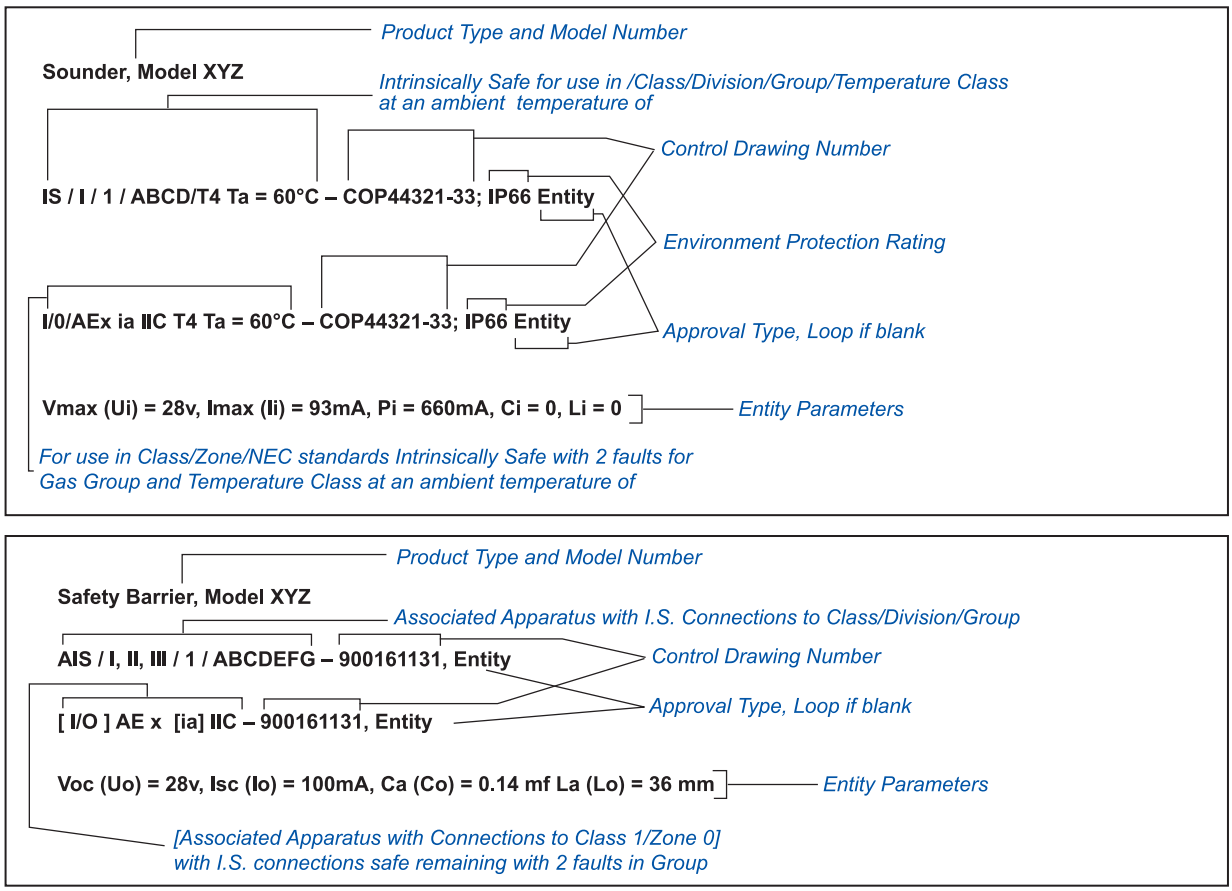


Figure 6. Typical Listings of Intrinsically Safe Apparatus and Associated Apparatus

Associated apparatus are evaluated for the maximum energy levels capable of being discharged through its circuit under fault conditions. These faults include the opening, shorting, and grounding of the intrinsically safe leads. The information is represented in the form of Entity Parameters (safety data) and consists of some combination of the following values.

- Open circuit voltage, V_{OC} (U_O) or V_t
- Short circuit current, I_{SC} (I_O) or I_t
- Power transfer, P_O
- Allowable external capacitance, C_a (C_O)
- Allowable external inductance, L_a (L_O)

Those products designed to be connected to an intrinsically safe circuit, such as transmitters, positioners, etc., may be approved under either the Loop or Entity Concepts. Under both systems, such products are evaluated for the maximum voltage and current they are able to withstand before internal component failures begin, resulting in an excessive buildup of heat and subsequent ignition of the surrounding hazardous fuel-air mixture. They are also evaluated for the amount of stored capacitance and inductance which may be discharged under predefined fault conditions. Circuit modifications may be required to either limit or prevent such a condition.

Where the approval types differ lies in how they may be installed in an intrinsically safe system. A Loop Approval will define specific associated apparatus by manufacturer and model number along with specific instructions on how the two devices should be connected. This type of approval requires a reevaluation by the testing agency if it becomes necessary to make any circuit modifications in the future.

Under the Entity Concept, the Intrinsically Safe Electrical Apparatus will be assigned Entity Parameters which, when properly matched to those of an associated apparatus, will constitute an intrinsically safe system. Such values include the following while Table 1 defines how they are to be compared to associated apparatus values.

- Maximum voltage, V_{max} (U_i)
- Maximum current, I_{max} (I_i)
- Maximum Power, P_{max}
- Total unprotected capacitance, C_i
- Total unprotected inductance, L_i

IS Field Device	Cable		Associated Apparatus	Combinations
V_{max} (U_i)		≥	V_{OC} (U_O)	V_t
I_{max} (I_i)		≥	I_{SC} (I_O)	I_t
P_i		≥	P_O	P_O
C_i	+ C_{cable}	≤	C_a (C_O)	C_a (C_O)
L_i	+ L_{cable}	≤	L_a (L_O)	L_a (L_O)

Table 1. Comparison of Entity Parameters

Interconnecting Wiring

Since wiring is also capable of discharging energy, in the form of stored capacitance and inductance, it must also be considered when installing an intrinsically safe system. When available the actual values of capacitance and inductance for the specific wiring being used should be referenced. If these are not available, values of 60 pF/foot for capacitance per wire pair and 0.2 µH/foot for inductance are accepted and may be used. Typically, an evaluation is not necessary unless the lead runs exceed 1,000 feet.

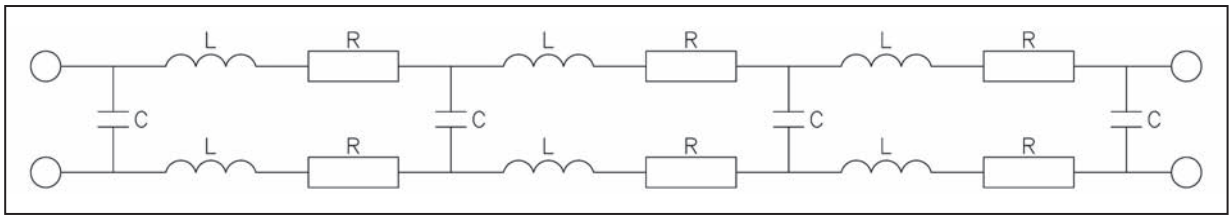


Figure 7. Equivalent schematic of a connecting cable

Selecting the Right Intrinsic Safety Interface

Today, the specifier of intrinsic safety interface devices has many options, both technical and commercial, to review. Aside from specific features offered by individual manufacturers, there are two basic types available –zener diode barrier and galvanic isolator. Determining which to use may be aided by the illustration in Figure 9 and the descriptions under options 1 through 3.

Option 1

This solution uses either the traditional zener diode safety barrier or a galvanic isolator. A zener diode safety barrier is a passive device which uses a fuse, zener diode, and resistor network to provide intrinsically safe connections. Depending on the makeup of the I/O system and type of field device, either a single or dual channel version would be used. Note that when referring to zener diode type safety barriers, a channel refers to only one conductor relative to ground, not one field device. Since they are resistive devices, the key factor during the selection process is the internal resistance of the barrier. Other technical factors include short-circuit proof connections, replaceable fuse, grounding method, and physical size.

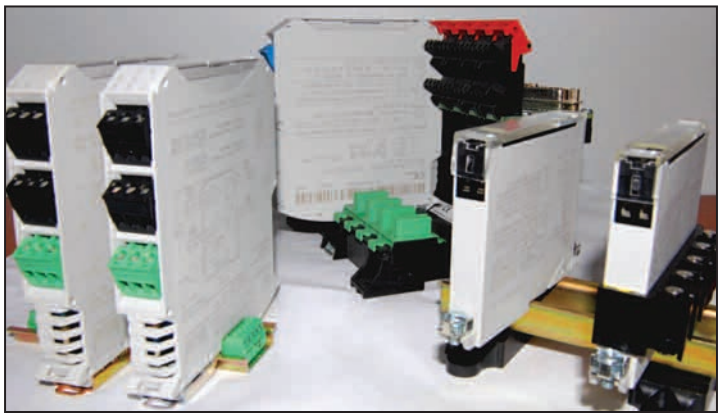


Figure 8. Option 1

A galvanic isolator eliminates the need to tie the power supply to ground as is the requirement with zener diode type safety barriers. The result is a system with better noise immunity and ground loop protection. This is desirable for installations which are susceptible to transients and “dirty” grounds. Since they are active devices, an external source of power is required –normally 24VDC. Where applicable many types will incorporate a variety of signal conditioning functions as well –i.e. mV to 4/20mA, 4/20mA to 1/5V, etc.

Key technical features to look for when specifying an intrinsic safety isolator are response time, power consumption, size, and multi-channel options.

The decision whether to use a zener barrier or galvanic isolator is dependent on installation considerations, grounding availability and customer preference. The table below may assist in the decision process:

Comparison of Barriers and Isolators

Barriers	Isolators
Lower cost	Higher cost
Multiple applications	Application specific
Insulated I.S. ground required	No I.S. ground required
Loop powered	Separate power supply required
1:1 signal transfer	Signal conditioning
Internal resistance may impact the voltage available in the hazardous location	No voltage impact due to internal resistance
Smaller	Larger
Vulnerable to noise, lightning strikes and voltage spikes	Not as vulnerable to noise, lightning strikes and voltage spikes

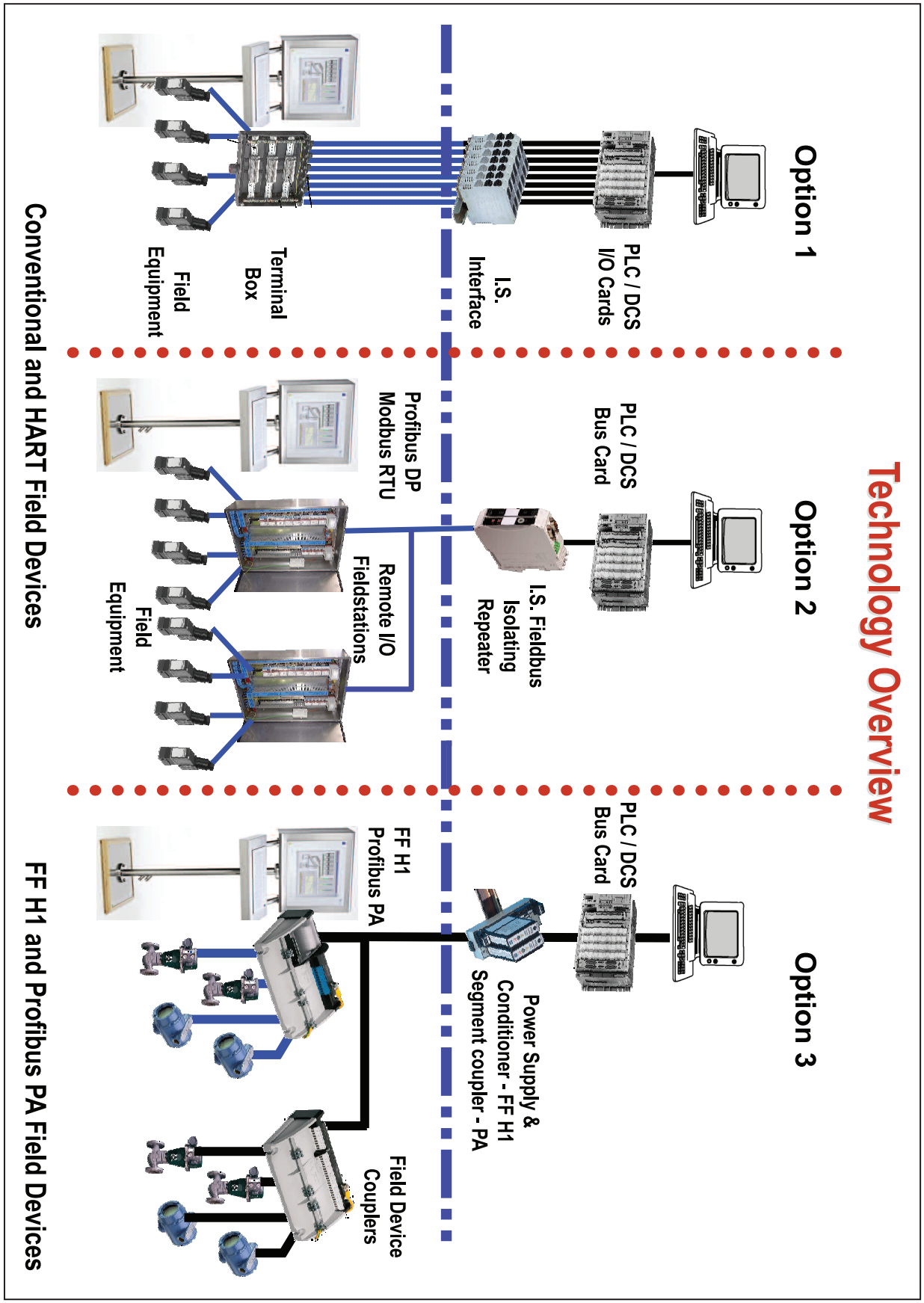


Figure 9. Comparison of four intrinsic safety interface options.

Option 2

This solution is a departure from the traditional point-to-point wiring scheme. Rather than use general purpose I/O and a separate intrinsic safety interface, the two are combined and designed in a manner which permits installation directly in the hazardous location. The I/O, now housed in a remote field station, are linked to the local controller via a field bus. Using Modbus RTU, or Profibus DP protocols, communication with the controller is easily achieved.

The advantages of such a system are quite apparent. Hardware costs are dramatically reduced by eliminating long runs of cable, raceways, cable tray, etc. between the control room and field devices. Connection of low-level devices such as RTD's and thermocouples directly to the I/O module are now possible eliminating the need for a 4/20mA transmitter or long runs of compensating cable. Engineering, installation, and maintenance time is also reduced with such a system. For more information please see the catalog RST-75 Hazardous Location Remote I/O.

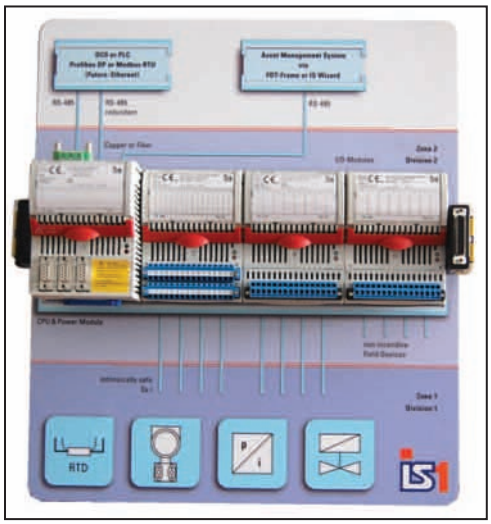


Figure 10. Option 2

Option 3

This solution is for installations that use FFH1 and Profibus PA field devices in a hazardous location. The field device couplers can be installed in Class 1/Division 2/ Zone 2 or Zone 1. One interface provides intrinsically safe connections to an I.S. field device and the other type provides Ex e/ non-incendive connections to an Ex e / nonincendive field device. The devices are 4 or 8 channels and have features such as short circuit protection, LED diagnostic information and power management. For more information, please contact R. Stahl.

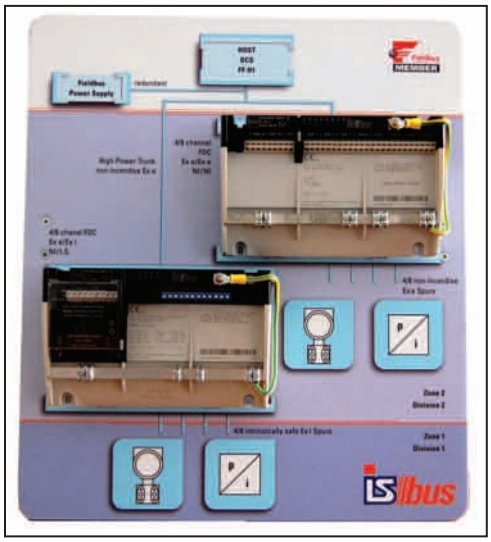


Figure 11. Option 3

Table 2. I.S. Interface Selection Overview

This catalog has application notes and data sheets for the R. STAHL range of zener barriers and galvanic isolators. Table 2 details the most popular applications and where they can be found.

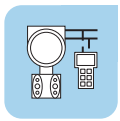
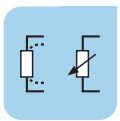
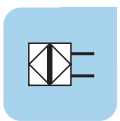
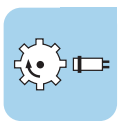
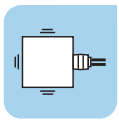
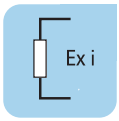
Symbol	Application	Interface Type					
		Isolator Part No.	Application	Data Sheet Page(s)	Barrier Part No.	Application Note Page(s)	Data Sheet
 06319E00	2-wire transmitter standard and HART	9160	3-9 to 3-11	3-39 to 3-44	9001/51-280-110-141	2-13	2-41
		9162 (with trip points)	3-15	3-45 to 3-47	9001/51-280-091-141	2-13	2-40
 06329E00	3-wire transmitter	9160	3-12	3-39 to 3-44	9002/13-280-110-001	2-14	2-55
		9162 (with trip points)	3-15	3-45 to 3-47			
 06329E00	4-wire transmitter standard and HART, current source	9163	3-13	3-48 to 3-51	9002/34-280-000-001	2-15	2-63
		9164	3-14	3-52 to 3-53			
 06321E00	I/P converter, HART Control valve indicator	9165	3-16	3-54 to 3-57	9001/01-280-110-101	2-15	2-32
		9167 (loop powered)	3-17	3-58 to 3-59	9002/13-280-110-001	2-16	2-55
 06331E00	RTD, potentiometer	9182	3-26 to 3-29	3-84 to 3-88	9002/22-032-300-111	2-25	2-59
		9180	3-30 to 3-31	3-80 to 3-83	9002/77-093-040-001	2-26	2-64
 06332E00	Thermocouple	9182	3-26 to 3-29	3-84 to 3-88	9002/77-093-300-001	2-24	2-64
 06333E00	Contact, Optocoupler output	9170	3-18 to 3-22	3-60 to 3-67	9001/01-252-057-141	2-17	2-37
					9001/01-252-060-141	2-17	2-38
					9002/13-280-110-001	2-17 to 2-18	2-55
 06334E00	NAMUR proximity detector	9170	3-18 to 3-22	3-60 to 3-67			
 06326E00	Speed Control, flow measurement	9146		3-34 to 3-38			
 06324E00	Solenoid Valve	9175	3-23 to 3-25	3-72 to 3-75	9001/01-252-100-141	2-20	2-39
		9176 (loop powered)	3-23 to 3-25	3-76 to 3-79	9001/01-280-110-101	2-20	2-32
 06327E00	Fire and gas detection	9167 (loop powered)		3-58 to 3-59	9001/01-280-165-101		2-32

Table 2. I.S. Interface Selection Overview

This catalog has application notes and data sheets for the R. STAHL range of zener barriers and galvanic isolators. Table 2 details the most popular applications and where they can be found.

Symbol	Application	Interface Type					
		Isolator Part No.	Application	Data Sheet Page(s)	Barrier Part No.	Application Note Page(s)	Data Sheet
 06317E00	Trip Amplifier	9146 (frequency)		3-34 to 3-38			
		9162 (4/20mA I/P with HART)	3-15	3-45 to 3-47			
		9182 (temperature)	3-28 to 3-29	3-84 to 3-88			
 06892E00	Vibration Sensor				9002/00-260-138-001	2-27	2-47
 06328E00	I.S. RS 485	9185 (copper)	3-31	3-89 to 3-92	9002/22-240-160-001	2-28	2-60
		9186 (Fiber Optic)	3-31	3-93 to 3-96			
 07428E00	Strain Gauge Load Cells				9002 Combinations	2-22 to 2-24	2-47
 06318E00	I.S. power feed of a load	9143	3-31	3-32 to 3-33	9004		2-67

Installation of Intrinsically Safe Systems

With the correct interface (associated apparatus) selected, the installation phase may begin. In general the requirements for the installation of intrinsically safe systems are more flexible than those of explosion-proof or purged systems. The user should have good knowledge of the National Electrical Code with specific focus on Articles 504 and 505 which deal with intrinsically safe systems. Since many companies may have their own set of standards which are in addition to the NEC, R. STAHL recommends that the user also refer to the installation requirements of the "authority having jurisdiction" at the installation site. A second, and valuable source of information is the ANSI/ISA RP-12.6 document available through the ISA organization. The user should also refer to the control drawings supplied by the manufacturer of both the associated and the intrinsically safe apparatus.

The associated apparatus themselves are normally installed in the nonhazardous location using general purpose enclosures or panels. If the physical plant layout requires their installation in the hazardous location, then the use of either explosion-proof or purged enclosures becomes necessary. The exception would be for Class I, Division 2/ Zone 2 hazardous locations in which a general purpose enclosure may be used – providing the associated apparatus is approved as nonincendive.

The wiring between the associated apparatus and the intrinsically safe apparatus may be installed using any of the methods suitable for unclassified locations with the exceptions noted below. For example, it is acceptable to use PLTC cable run in the open, cable trays, or raceways along with general purpose junction boxes.

Figure 12. Intrinsically safe wiring shall be identified as such using labels placed at no more than 25 foot intervals. R. STAHL recommends that when using zener diode type safety barriers that the I.S. ground conductor be labeled as well.

1. Intrinsically safe wiring not run in raceways or cable trays shall be separated and secured from nonintrinsically safe wiring by at least 2 inches (50mm). Exception: when Type MI or MC cables are used and properly grounded.
2. Intrinsically safe wiring shall never be placed in raceway or cable tray with nonintrinsically safe wiring unless they are separated by at least 2 inches (50mm) using tiedowns, grounded metal partitions, or approved insulating partition.
3. Intrinsically safe wiring in enclosures shall be separated by at least 2 inches (50mm) and secured to prevent inadvertent contact. Wiring ducts may be used provided they maintain a 3/4 inch (19mm) separation between intrinsically safe and nonintrinsically safe wiring.
4. Different intrinsically safe circuits shall be run in separate cables or separated by either a grounded shield or insulation with a minimum thickness of 0.01 inches (254µm).
5. Intrinsically safe wiring shall be identified as such with labels placed no more than 25 feet (7.62m) apart. Terminals shall be identified as well.
6. The color light blue is recognized internationally as identifying intrinsically safe wiring. It is recommended that cables, terminal blocks, raceways, cable ducts, and junction boxes be light blue in color.
7. Gas tight seals shall be used where intrinsically safe wiring transitions nonhazardous and hazardous locations. Seals are also required when transitioning Divisions.
8. Intrinsically safe, associated apparatus, cable shields, enclosures, and raceways (metal) shall be grounded in accordance with the requirements of Section 250 of the NEC .
9. Nonhazardous location electrical equipment must not contain a source voltage greater than 250V unless sufficient means have been employed to prevent the shorting of a source voltage greater than 250V onto the intrinsically safe terminals of the associated apparatus.
10. As all wiring contains stored energy (capacitance and inductance), all conductors must be considered when determining the length of intrinsically safe circuits. When available, the actual values of capacitance and inductance for the specific wire being used should be referenced. If these are not available, values of 60pF/foot for capacitance per wire pair and 0.2µH/foot for inductance are accepted and may be used.

The following items apply only to installations using zener diode type safety barriers.

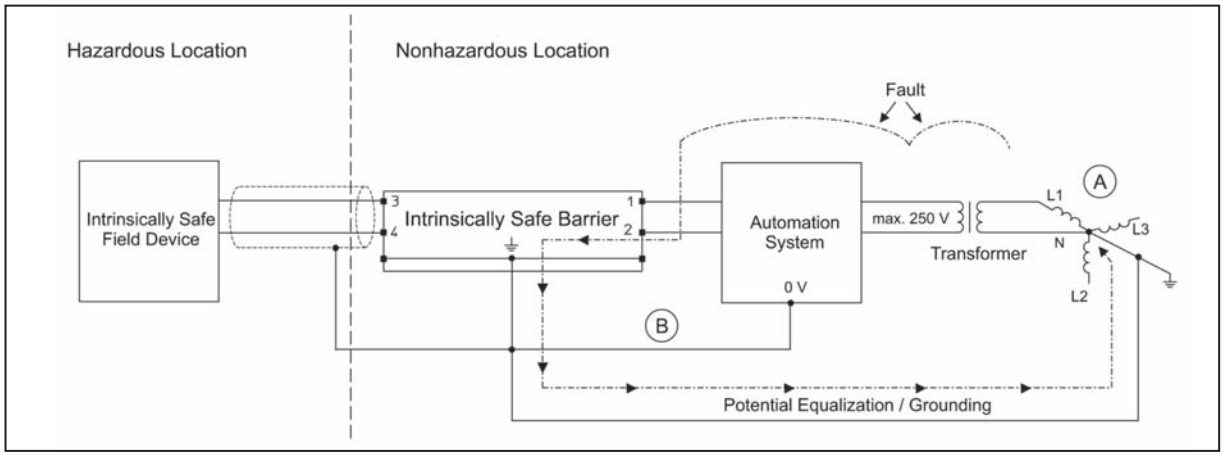


Figure 13. Typical installation of intrinsically safe system using zener diode type of associated apparatus. The I.S. Ground Conductor is not necessary when using an intrinsic safety isolator as the associated apparatus.

11. To ensure correct operation of a safety barrier installation under fault conditions, the system must have an insulated, properly maintained, independent, low impedance I.S. ground connection. This is a connection from the barrier busbar to the star point (A) of the incoming power supply through which no supply system current flows.
12. The ground conductor must be < 1 ohm minimum 12 AWG (4 mm^2) and connected using shake proof terminals. It should also be secure, visible, clearly identified and accessible for routine inspections and maintenance.
13. To prevent potential differences and provide correct operation during normal conditions, it is also recommended to connect the barrier busbar to the common / 0 V (B) of the equipment in the nonhazardous location.
14. In the hazardous location all cables should only be grounded at one point and it is recommended that this is at the barrier busbar.
15. Where shielded cables- are used, they must be bonded to ground and taped back. For installation options, please refer to the ISA 12.6 standard.

In all installations the national applicable standards should be followed.

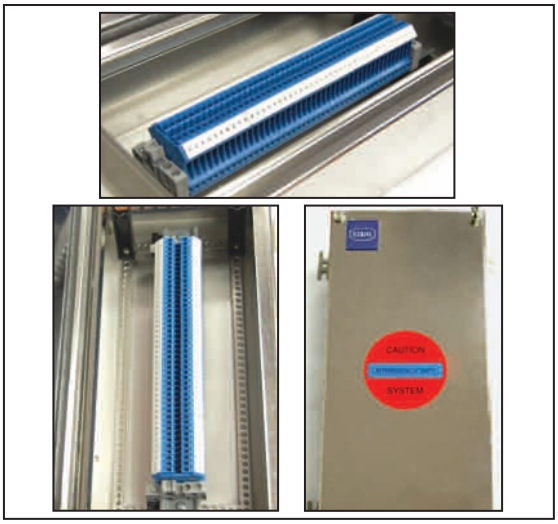


Figure 14. When using junction boxes to distribute intrinsically safe wiring the terminal strips shall be clearly marked to prevent the inadvertent connection of a nonintrinsically safe circuit. R. STAHL recommends that the terminal blocks be blue in color and the enclosure lid contain a label identifying the presence of intrinsically safe circuits. The example above is a type 8146 as provided by R.

Prestartup and Inspection of Intrinsically Safe Systems

In general, there are no special measures which need to be taken by the user relative to the maintenance of intrinsically safe systems. R. STAHL does recommend that a periodic inspection program be initiated to monitor the condition of the associated apparatus, intrinsically safe apparatus, and interconnecting wiring. This inspection program should include the following items.

1. Associated and Intrinsically Safe apparatus must be certified by a nationally recognized testing laboratory, NRTL, and installed per the manufacturer's control drawing.
2. Ensure that the intrinsically safe apparatus and connections from the associated apparatus be applicable for the gas group being installed into.
3. Ensure that the interconnecting wiring be positively separated from any nonintrinsically safe wiring and labeled per the applicable standards.
4. Over a period of time it may become necessary to tighten any connections which may have come loose due to vibration. Any accumulated dust or corrosion should be removed as well.

Introduction to Nonincendive

Under the protection technique concept known as energy release limitation, there are two approaches – intrinsic safety and nonincendive. The two approaches are similar in basic principle but differ greatly in detail with two major differences.

The first difference is that nonincendive circuits are only evaluated under normal conditions so no faults need to be considered. Any equipment that meets the criteria for nonincendive can only be used in Division 2 locations where the atmosphere is only hazardous under abnormal conditions due to a breakdown in the process or process equipment.

The second difference is that, in reference to the components used, few detailed requirements must be met other than those that are applicable to nonhazardous location use in relation to personnel shock and fire hazard. Typically, all parts that can potentially interrupt a circuit such as switches, relays and connectors are itemized and analyzed or tested to see if they can ignite the specified flammable atmosphere.

Nonincendive Equipment

For equipment to be listed it has to be assessed and tested under normal conditions. The assessment and testing for thermal conditions is also conducted under normal conditions. Normal conditions include extremes of supply rating, ambient temperature rating and operator adjustments. For nonincendive fieldwiring circuits, normal conditions include opening, shorting and/or grounding.

Nonincendive equipment may contain any or all of the following:
- Nonincendive circuits
- Nonincendive components (enclosed break)
- Hermetically sealed or sealed components
- Fuses

For the definitions of the above, please see the glossary or ANSI/ISA-12.12.01.

Installation in Class 1 Division 2

There are two ways to install nonincendive equipment in a Class 1 Division 2 location.
1. Using Class 1 Division 2 wiring requirements
2. Using nonincendive field wiring

1. Using Class 1 Division 2 Wiring Requirements

If the field device has been approved as nonincendive equipment it can be installed and connected to a piece of equipment in the nonhazardous location that has no approvals using the types of cable listed below and following the installation guidelines in the NEC Article 501-4(b):

All wiring methods approved for Class 1 Division 1, Zone 1
Enclosed gasketed busways/wireways
Type PLTC cable per Article 725
Type ITC cable per Article 727.4
Type MC cable
Type MV cable
Type TC cable
Flexible connections, where provision has to be made for limited flexibility, then the following may be used:
Flexible metal fittings
Flexible metal conduit
Liquidtight flexible metal conduit
Liquidtight flexible nonmetallic conduit
Flexible cord (where permitted)

2. Using Nonincendive Field Wiring

This concept is very similar to the Entity Concept used in intrinsic safety except that no component faults are imposed upon the circuits in the apparatus to raise energy levels. This concept can be used in both Class 1 Division 2 and Class 1 Zone 2.

The components in this type of system are associated nonincendive field wiring apparatus, nonincendive field wiring apparatus and cable. This method can only be used when both the field apparatus and associated nonincendive field wiring apparatus respectively.

As with intrinsic safety, when using this concept the cable can be of any type suitable for use in nonhazardous locations. The associated nonincendive field wiring apparatus and the nonincendive field wiring apparatus both have parameters associated with them which are shown on, and must be installed per, a control drawing.

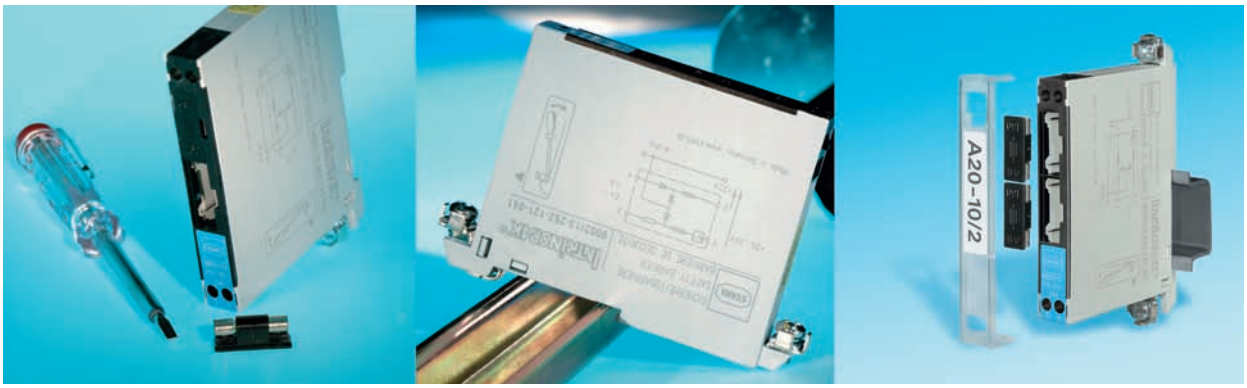
Nonincendive Field Wiring Apparatus		Associated Nonincendive Field Wiring Apparatus
V_{max} (U_i)	≥	V_{OC} (U_O)
I_{max} (I_i)	≥	I_{SC} (I_O)
$C_i + C_{cable}$	≤	C_a (C_O)
$L_i + L_{cable}$	≤	L_a (L_O)

The difference to the Entity Concept in intrinsic safety is when the nonincendive field wiring apparatus controls either the voltage or current or both. In these cases the respective controlled value need not be greater than or equal to that supplied by the associated nonincendive field wiring apparatus. For example, when connecting to a 4/20mA transmitter, this unit controls the current and therefore it is not necessary to evaluate the current parameter. In these instances the control drawing should be checked to find details of the permitted connections.

As with intrinsic safety there are ignition curves that can be used in evaluating circuits and these can be found in ANSI/ISA-12.01.2007.

Additional differences between Intrinsic Safety and Nonincendive is that the simple apparatus rule may not be used in a nonincendive field wiring system and live maintenance is also not permitted.

For additional information please see the NEC or ANSI documents.



Safety Barriers

Safety Barriers


09964E00

- Simplest type of intrinsically safe interface
- Broad product range for all standard applications in the world of instrumentation
- Flexible and space saving with single and dual channel versions available
- Installation possible in Division 2 and Zone 2
- Short circuit proof
- Installation and grounding on DIN rail in one single operation
- Approvals to worldwide standards
- Single value replaceable fuse for all barriers

General Description

Since its introduction, the 9000 Series, INTRINSPAK has quickly become the industry standard for intrinsic safety barrier design. Within the series the user can choose from the Type 9001 single channel, Type 9002 dual channel or, for applications requiring up to 3/4 W of power, the Type 9004 single channel with electronic current limitation.

All three types share a common 1/2“ wide housing which snaps directly onto a 35 mm DIN rail. Once mounted, an electrical connection is formed between the barrier and the rail. This rail now serves as the intrinsic safety ground bus when connected to the designated grounding point. Two additional ground lugs are provided and may be used as a redundant grounding method or for terminating shields.

Each barrier also contains a replaceable 160 mA fuse cartridge for each channel. This fuse is located within the front faceplate and protects the barrier from polarity reversal and voltage spikes at the input side (terminals 1 and 2). This fuse will not blow should the field wiring be shorted to ground.

Safety barriers are polarity sensitive devices therefore they are available in +DC, -DC, and AC voltage ratings.

Many voltage and resistance value combinations are available within the 9000 Series INTRINSPAK. However, 80% of instrumentation applications can be handled by just 10 units. Please refer to the application section for more details.

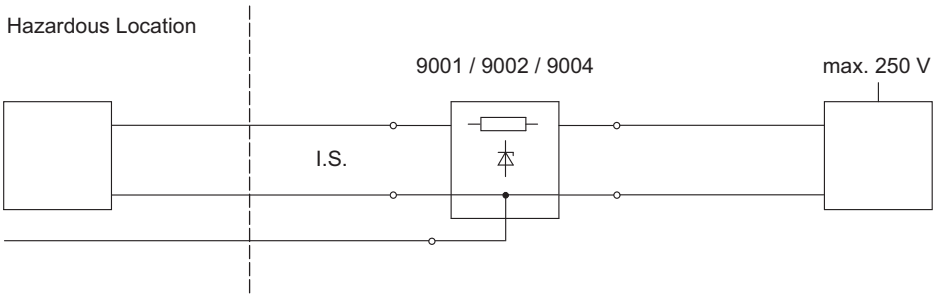
Application

Safety barriers are single, or dual channel, passive devices. They pass an electrical signal in either direction between hazardous and nonhazardous location equipment without changing it. They are designed to limit the transfer of energy from the nonhazardous to the hazardous location, under fault conditions, to a level that cannot ignite explosive atmosphere.

They are classed as associated apparatus and, as they contain non-intrinsically safe circuits, must be installed in the nonhazardous location or, if approved, in Division 2 / Zone 2.

Installation in Division 1 / Zone 1 is only permitted if an additional method of explosion protection is used, for example explosion proof / flameproof (Ex d) enclosure.

Electrical apparatus in the nonhazardous location that is connected to the barrier, cannot be powered from or contain any source of potential exceeding the value specified on the barrier approval document. In most cases this is 250 V_{RMS}.

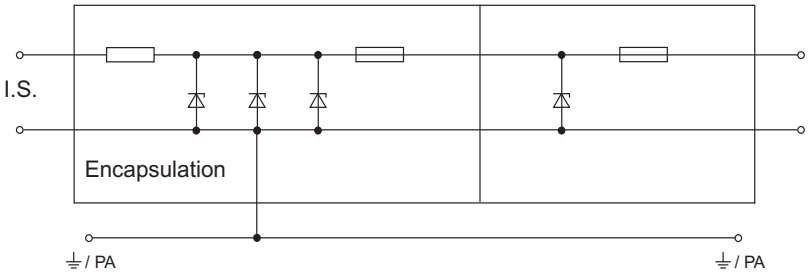


09911E03

Please note that when referring to zener diode type safety barriers, a channel refers to only one conductor relative to ground and not to one field device.

Function

A safety barrier contains three essential elements:
- Zener diodes for limiting the voltage
- Resistor or components for limiting the current
- Fuse for the protection of zener diodes



R. STAHL safety barriers also contain a protective circuit with a replaceable fuse which is easily accessible and protects the internally encapsulated non-accessible fuse of the safety barrier. The protective circuit prevents both fuses tripping at the same time.

In order to cover the complete spectrum of instrumentation applications a few types of safety barriers include function blocks e.g. electronic current limitations, amplifier, etc.

Potential Equalization / Grounding

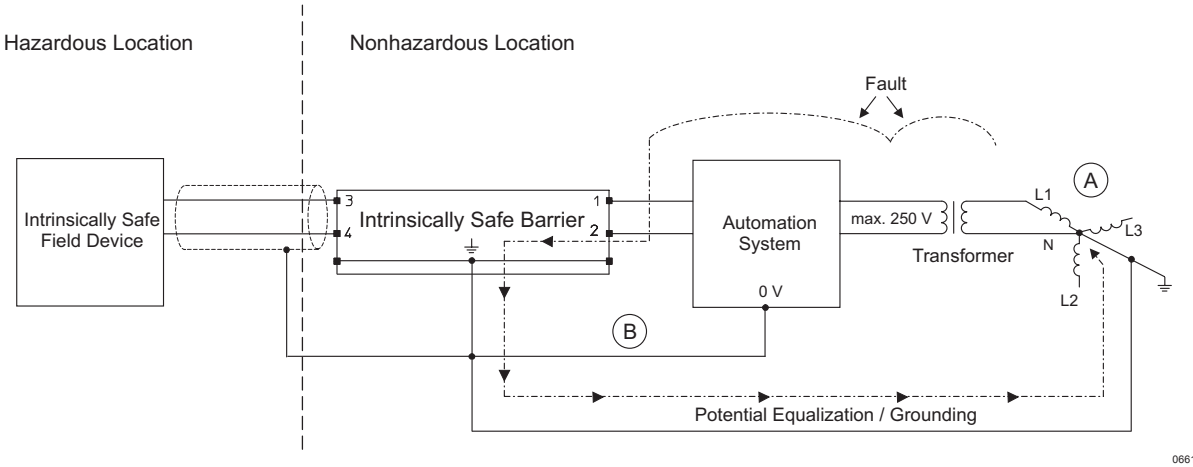
To ensure correct operation of a safety barrier installation under fault conditions, the system must have an insulated, properly maintained, independant, low impedance I.S. ground connection. This is a connection from the barrier busbar to the star point (A) of the incoming power supply through which no supply system current flows.

The ground conductor must be < 1 Ω, minimum 12 AWG (4 mm^2) and connected using shake proof terminals. It should also be secure, visible, clearly identified and accessible for routine inspections and maintenance.

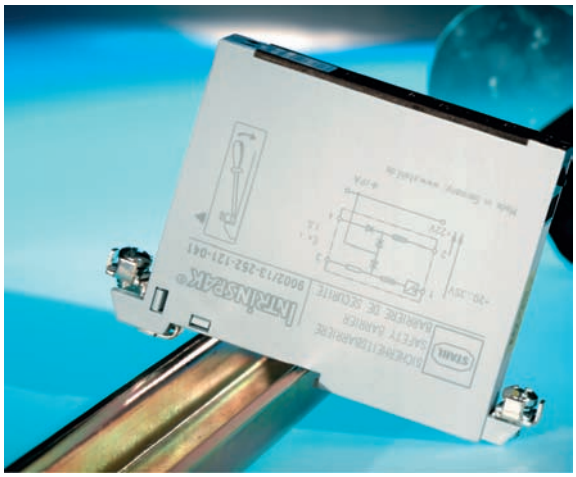
To prevent potential differences and provide correct operation during normal conditions, it is also recommended to connect the barrier busbar to the common / 0 V (B) of the equipment in the nonhazardous location.

In the hazardous location all cables should only be grounded at one point and it is recommended that this is at the barrier busbar.

In all installations the national applicable standards should be followed.



Installation and Grounding



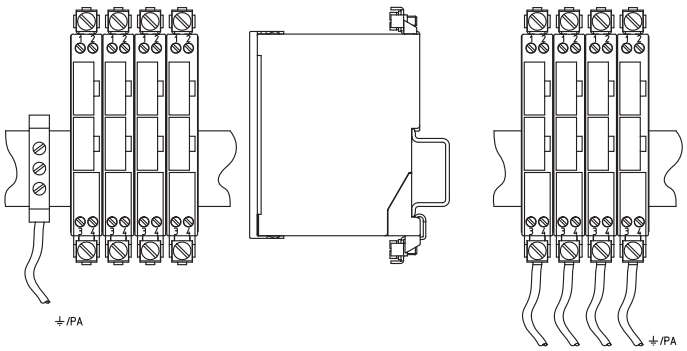
09940E00

R. STAHL safety barriers have a simple mounting mechanism. They snap directly on to 35 mm DIN rail (NS35/15 to EN 50022) without additional mounting attachments.

At the same time a conducting connection between ⏚ / PA of the barrier and the rail is established. Several barriers can be collectively grounded by connecting the rail with the potential equalization / grounding system.

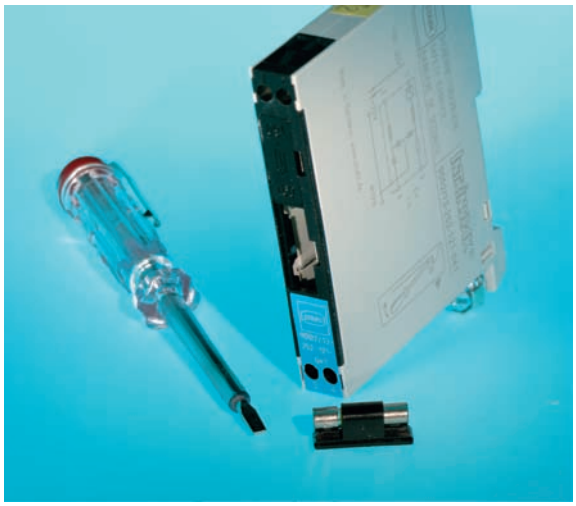
The safety barriers can alternatively be grounded individually by using the ⏚ / PA terminal on the intrinsically safe side.

For correct operation of a safety barrier under fault conditions, the DIN rail must be insulated from the surface it is mounted on. For this purpose the insulating stand off can be used.



09913E00

Replaceable Fuse



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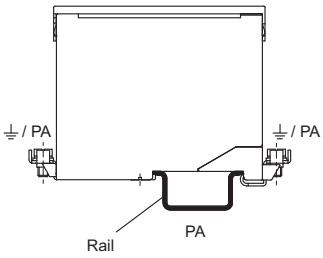
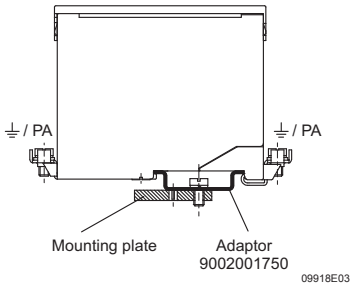
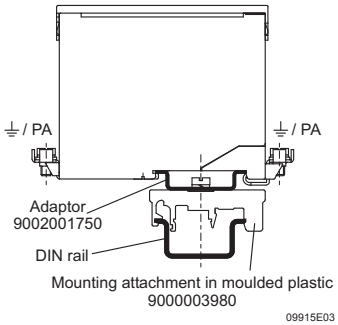
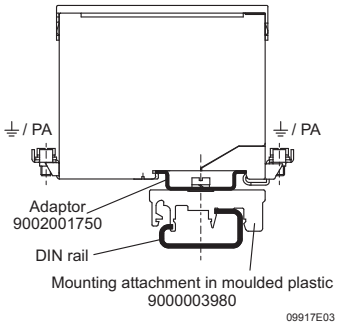
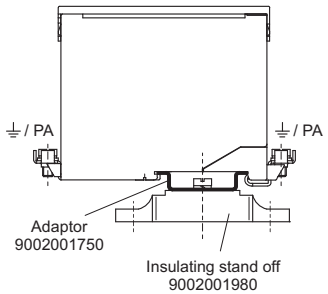
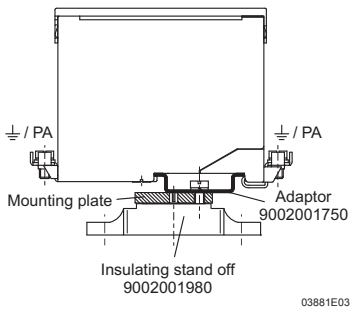
All R. STAHL safety barriers have a replaceable fuse. Dual channel safety barriers have a replaceable fuse per channel. This fuse protects the internal, non-accessible fuse. A protective circuit prevents tripping of both fuses at the same time. It is therefore ensured that the safety barrier is protected against destruction resulting from reverse polarity of the operating voltage or excessively high operational voltages.

The replaceable fuse provides three advantages for maintenance and repair.

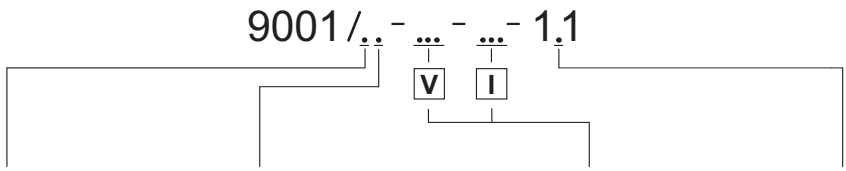
- The barrier does not have to be discarded upon reverse polarity or voltage overload. The replaceable fuse can be replaced without removing the barrier or disturbing the wiring.
- The replaceable fuse can be replaced in Division 2 or Zone 2 without turning off the signal or power supply. Except in installations requiring CSA approval.
- The replaceable fuse and its associated protective circuit is designed such that only one value fuse (160 mA) is required whichever barrier is installed. Spare parts are therefore kept to a minimum. In addition, a five fuse, fuse holder is available which can be snapped to the side of a barrier, increasing availability and reducing downtime.

Additional Mounting Possibilities

	DIN rail NS35/15 acc. to EN 50022	DIN rail NS32 acc. to EN 50035	Mounting plate or flat bar
non insulated			
insulated from DIN rail			
insulated from back panel			

Part No. Breakdown

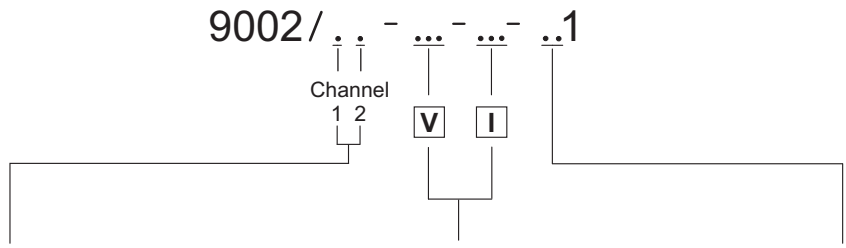
Single Channel Safety Barrier



Version	Polarity	Entity Parameters	Option
0 = standard 5 = for HART transmitter	0 = negative polarity 1 = positive polarity 2 = AC polarity 3 = positive polarity diode 4 = negative polarity diode	V = Voltage, e.g. 160 = 16 V I = Current, e.g. 093 = 93 mA	0 = standard 1 = resistor tolerance ±0,5 % 4 = input voltage 20 ... 35 V

06809E03

Dual Channel Safety Barrier



Polarity	Entity Parameters	Option
0 = negative polarity 1 = positive polarity 2 = AC polarity 3 = positive polarity diode 4 = negative polarity diode 7 = star connected	V = Voltage, e.g. 160 = 16 V I = Current, e.g. 093 = 93 mA	0 = standard 1 = resistor tolerance ±0,5 % 2 = load resistor 4 = input voltage 20 ... 35 V

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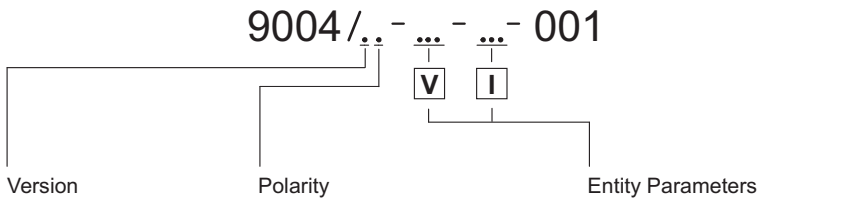
Safety Barrier with Electronic Current Limitation



Version	Polarity	Entity Parameters
0 = standard 5 = with voltage limitation	0 = negative polarity 1 = positive polarity	V = Voltage, e.g. 160 = 16 V I = Current, e.g. 093 = 93 mA

06811E03

Selection Criteria

The selection of safety barriers is carried out in two steps:

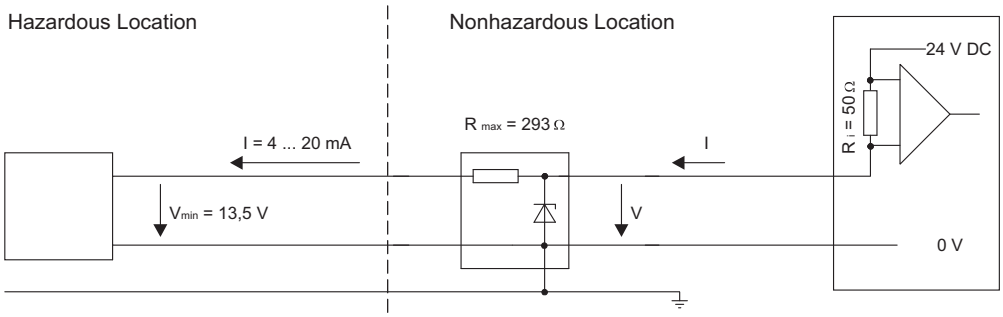
1. Operational characteristics
2. Safety characteristics

1. Operational Characteristics

Safety barriers are selected according to the electrical requirements of the circuit. It is therefore necessary to know the electrical data of all the connected apparatus.

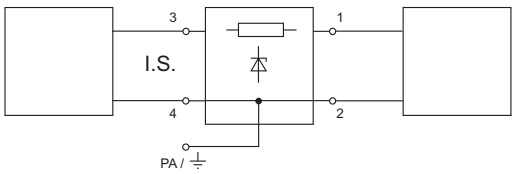
For example:

- Type of signal - voltage or current. Voltage signals can only be transmitted via barriers with a purely resistive line resistance. This limitation does not apply to current signals.
- Polarity and voltage (V_{nom}) to be applied to the barrier.
- Maximum, minimum and operating voltages and current required in the circuit.
- Load resistances in the circuit.



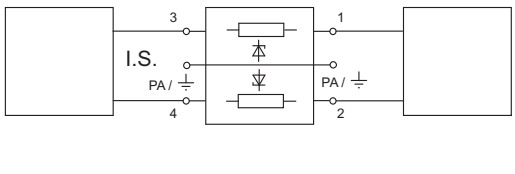
06663E03

- Is the return signal connected directly to ground or does it need to be “floating“ (at a potential above ground) due to electrical or measurement reasons?
- A floating circuit can be established by using a dual channel barrier or interconnecting two single channels.



09935E03

Grounded circuit



09936E03

Floating circuit

2. Safety Characteristics

If a device is to be used in an intrinsically safe system it must have an approval certificate (certificate of compliance) from a national recognized test laboratory (NRTL) - FM, CSA, PTB ..... (unless classed as simple apparatus).

The approval certificate lists the Entity Parameters (safety data) for the device.

Simple apparatus is included on the approval certificate for the associated apparatus. Simple apparatus are components that do not store or generate more than 1.5 V, 100 mA, 25 mW.

All installations must be in accordance with the control drawing.

The approval certificate and control drawings will give the following details:

➢ Intrinsically Safe Field Device:

Maximum Voltage (V_{max}), Current (I_{max}) and Power (P_i) that can be supplied to it under fault conditions to maintain safety. Also listed is the Internal Capacitance (C_i) and Inductance (L_i) of the field device.

➢ Intrinsically Safe Associated Apparatus:

Maximum Voltage (V_{OC}), Current (I_{SC}) and Power (P_O) that will be supplied to the field device under fault conditions to maintain safety. Also listed is the total Capacitance (C_a) and Inductance (L_a) that can be used in the system.

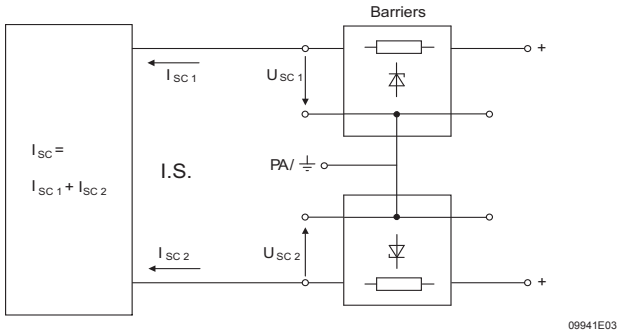
To ensure a safe interconnection:

IS Field Device	Cable		Associated Apparatus	Combinations
V_{max} (U_i)		≥	V_{OC} (U_o)	V_t
I_{max} (I_i)		≥	I_{SC} (I_o)	I_t
P_i		≥	P_O	P_O
C_i	+ C_{cable}	≤	C_a (C_o)	C_a (C_o)
L_i	+ L_{cable}	≤	L_a (L_o)	L_a (L_o)
If cable parameters are unknown, then the following values can be used: C = 60 pF /ft L = 0.2 µH / ft				

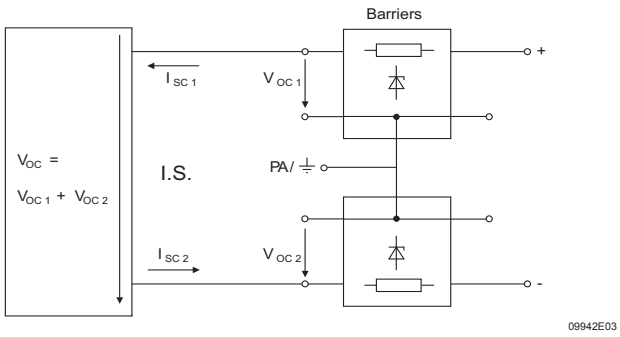
Interconnection of Safety Barriers

If several safety barriers are interconnected to one field device then current and / or voltage addition has to be taken into consideration from the safety standpoint (example 1 and 2). The maximum values for V_{OC} and I_{SC} permissible for an interconnection as well as the resulting permissible maximum values for C_a and L_a for the various explosion groups can be referred to in the ignition curves (see the applicable national standards).

Example 1 Interconnection of two safety barriers for positive potential.
From a safety point of view a current addition results, i.e. $I_{SC} = I_{SC1} + I_{SC2}$
The new voltage V_{OC} is assumed to be the higher of the two values V_{OC1} and V_{OC2}, thus V_{OC} = max. (V_{OC1}, V_{OC2})



Example 2 Interconnection of two safety barriers for positive and negative potential.
From a safety point of view a voltage addition results, i.e. $V_{OC} = V_{OC1} + V_{OC2}$
The new current I_o is assumed to be the higher of the two values I_{SC1} and I_{SC2}, thus I_{SC} = max. (I_{SC1}, I_{SC2})



Addition possibilities

I = current addition
V = voltage addition

Example: When interconnecting two safety barriers for alternating potential, I + V results, thus a current addition as well as a voltage addition is to be taken into consideration.

Polarity	-	+	~
-	I	V	I and V
+	V	I	I and V
~	I and V	I and V	I and V

Once the new combination of entity parameters is found, then these must be checked with the ignition curves, found in the national standards that apply for the installation, to ensure a safe combination. These ignition curves will also provide the allowed capacitance and inductance that the new entity parameters allow.

This type of intrinsic safety assessment is not allowed in the case where a barrier with electronic current limitation is required. Please refer to the applicable national standards.

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Any device to be used in a hazardous location must be approved for use in that hazardous location. If intrinsic safety is the installation protection method to be used then the device must be approved to meet the requirements for intrinsic safety. Any connections between the field device and the nonhazardous location must be connected through an associated interface device. Two types of associated apparatus are zener barriers and galvanic isolators.

In all cases, including the standard applications that follow, an evaluation of the safety and operational characteristics should be carried out to ensure compatibility between the field device, the zener barrier and the control system. Use the worksheet on the following page for your own system verification or send to R. STAHL via fax or e-mail and the Automation Department will assist you.

For instrumentation systems, there are key barriers that will accomplish 80% of the applications required. These units are listed below, however all aspects of the control system loop must be checked, safety and operational characteristics, to ensure that these are the most suitable for the application at hand.

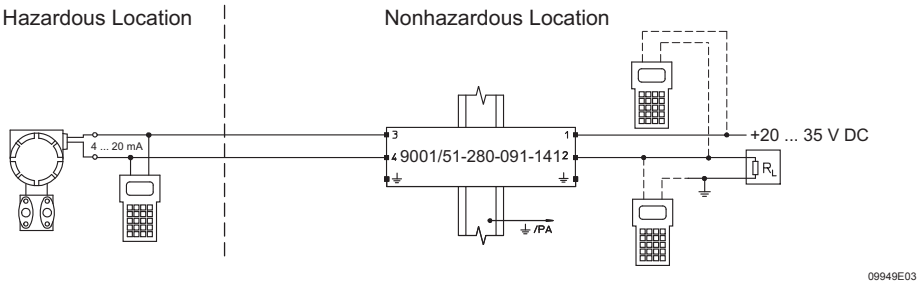
Key Barriers	
Analog Input:	9001/51-280-091-141
	9002/13-280-110-001
Analog Output:	9001/01-280-110-101
	9002/13-280-110-001
Digital Input:	9002/13-280-110-001
	9001/01-252-060-141
Digital Output:	9001/01-280-110-101
	9001/01-252-100-141
T/C Input:	9002/77-093-300-001
RTD Input:	9002/22-032-300-111

Application Worksheet

Contact Details:					
Company:		Contact name:			
Address:					
Phone:		Fax:			
Cell:		E-mail:			
Field Device:					
Approved intrinsically safe:	or	Simple apparatus:			
Manufacturer:					
Model no.:					
Description:					
Certificate no.:					
NRTL:					
Safety Data:					
Field device:		Associated apparatus:			
			Barrier	or	Isolator
V_{max} (U_i) =	≥	V_{OC} (U_o) =			
I_{max} (I_i) =	≥	I_{SC} (I_o) =			
P_i =	≥	P_O =			
Cable Parameters:					
C_i =	$+C_{cable}$ =		≤	C_a (C_o) =	
L_i =	$+L_{cable}$ =		≤	L_a (L_o) =	
Operational Data:					
Input or Output:		Analog or Discrete:			
Total no. of field devices of the same type:		Return (signal): grounded or floating:			
Supply voltage:		Maximum current:			
Min. voltage required @ field device:		Min. current required @ field device:			
Output: driving capability of the control system		Input: is the control system input isolated from other inputs			
Load impedance in the nonhazardous location:		Load impedance of field device:			
Transmitter: 2-, 3- or 4-wire		Discrete input: proximity detector or dry contact			
T/C: grounded or ungrounded		RTD: 2-, 3- or 4-wire			

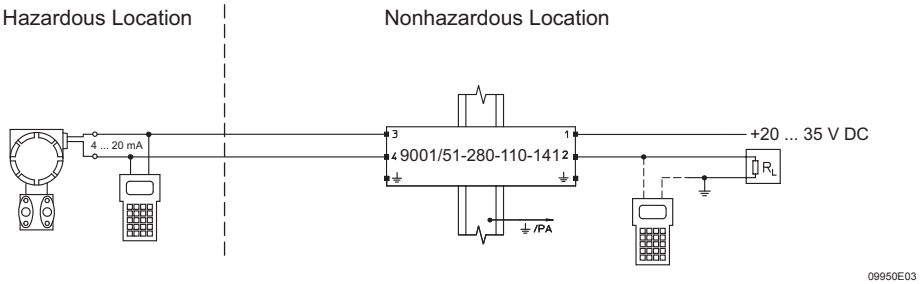
Please provide a diagram showing the field device, control system and interconnecting wiring on a separate sheet.
Please provide as much relevant documentation as possible to support the application.
Fax: 832-476-1840
E-mail: automation@rstahl.com

2-wire, 4/20 mA Transmitters - Standard and HART

Order Code	Schematic
9001/51-280-091-141	

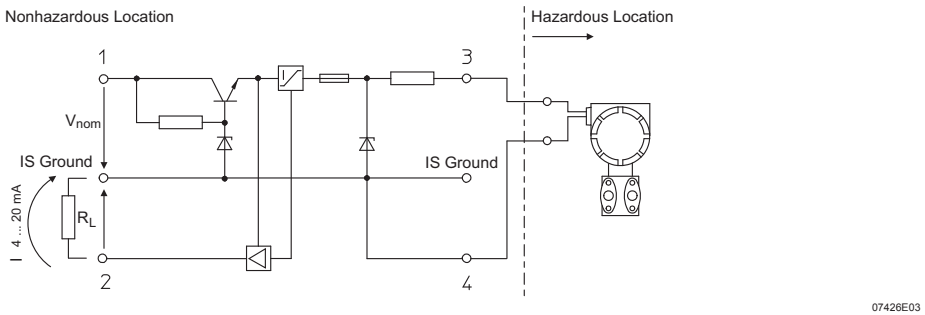
Application Note	This safety barrier enables 2-way communication between SMART transmitters and a hand held communicator or DCS / PLC system. The barrier provides 14 V to the transmitter and can drive loads up to 350 Ω in the nonhazardous location. The transmitter is connected directly to ground while the input to the control system is connected to ground via a load resistor. Compatible with: Honeywell DE protocol All HART compatible transmitters

2-wire, 4/20 mA Transmitters - Standard and HART

Order Code	Schematic
9001/51-280-110-141	

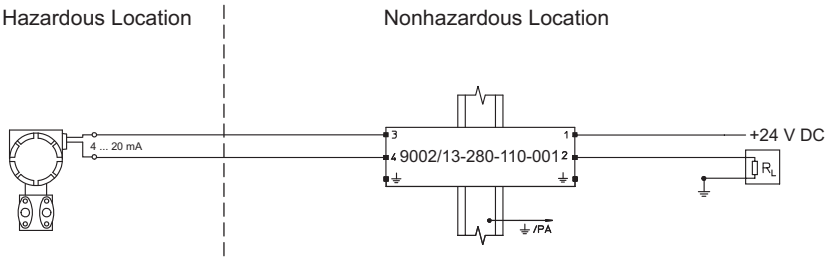
Application Note	This safety barrier enables 2-way communication between HART transmitters and a hand held communicator or DCS / PLC system. The barrier provides 15 V to the transmitter and can drive loads up to 750 Ω in the nonhazardous location (V_{nom} > 23.5 V). The transmitter is connected directly to ground while the input to the control system is connected to ground via a load resistor. Compatible with: All HART compatible transmitters

NOTE



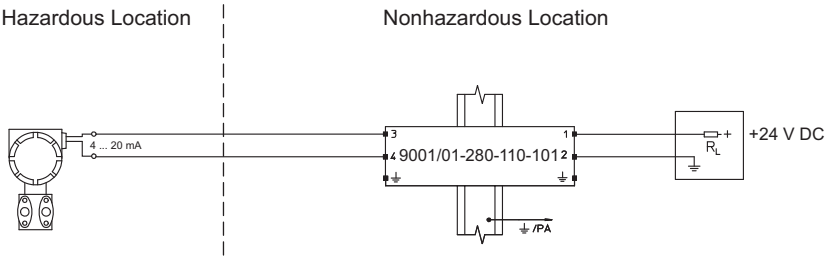
The two barriers, 9001/51-280-091-141 and 9001/51-280-110-141, have an internal layout as shown above. the nominal supply voltage to these barriers is 20 -35 V DC at a maximum supply current of 50 mA. The 4/20 mA current signal in the nonhazardous location is derived from the current that flows through the transmitter via a built in “current mirror“ amplifier. This amplifier has unity current gain and so repeats the exact current across R_L as is in the transmitter.

2-wire, 4/20 mA Transmitters - Standard and HART

Order Code	Schematic
9002/13-280-110-001	

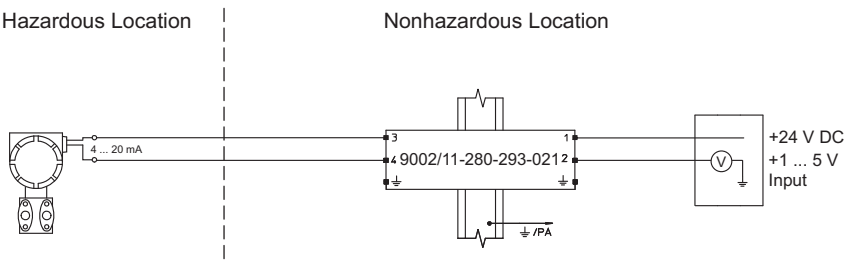
Application Note	This safety barrier provides an economical solution when regulated 24 V DC power supplies are used. The nonhazardous load should be ≤ 250 Ω and the minimum operating voltage of the transmitter should be ≤ 11 V DC.

2-wire, 4/20 mA Transmitters - Standard and HART

Order Code	Schematic
9001/01-280-110-101	

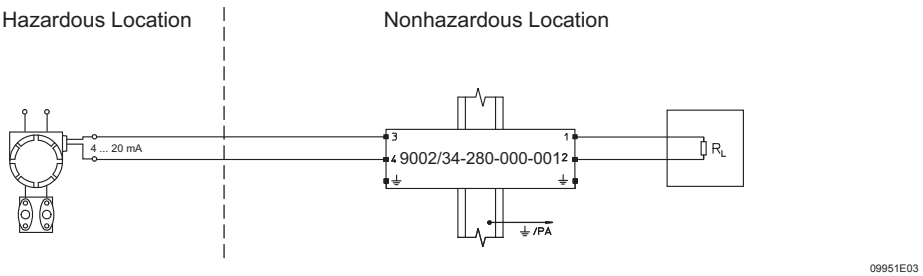
Application Note	This safety barrier is for use when the control system measures the input in the supply line. The transmitter and control system are both connected to ground and a regulated power supply must be used.

2-wire, 4/20 mA Transmitters - Standard and HART

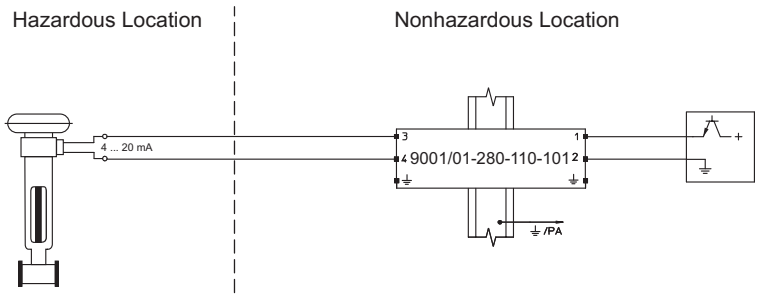
Order Code	Schematic
9002/11-280-293-021	

Application Note	This safety barrier is for use when the control system only accepts a 1 ... 5 V signal. This barrier contains a 250 Ω resistor to convert the signal to 1 ... 5 V.

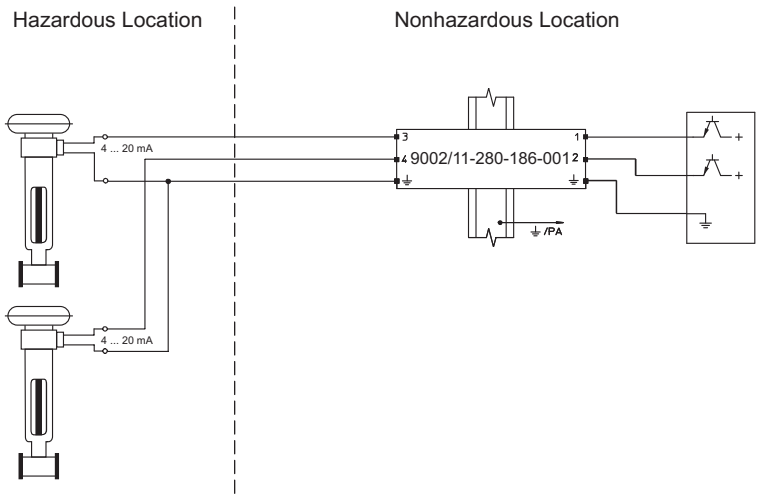
4-wire, 4/20 mA Transmitters - Standard and HART

Order Code	Schematic
9002/34-280-000-001	
Application Note	This safety barrier is for use when the control system requires a floating, isolated input. The power supply to the transmitters should be addressed separately. Each channel has a 2.5 - 3.5 volt drop. If the control system input is not isolated from other channels then the 9001/03-280-000-101 should be used.

2-wire, 4/20 mA I/P Converters and Control Valves - Standard and HART, 4/20 mA Digital Indicators

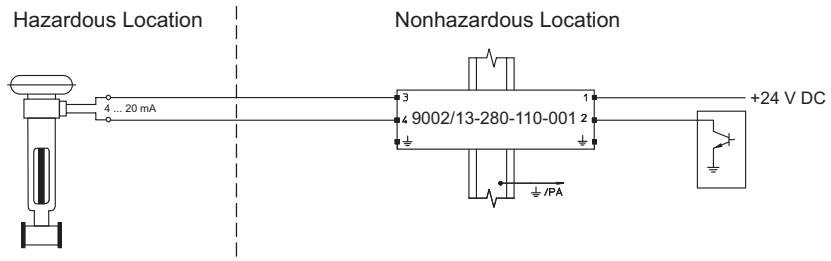
Order Code	Schematic
9001/01-280-110-101	
Application Note	This safety barrier is for use when the control system regulates the output in the supply line. The field device and control system are both connected to ground and a regulated power supply must be used. At a nominal operating current of 0 ... 22 mA the maximum volt drop across the barrier will be 6.5 V.

2-wire, 4/20 mA I/P Converters and Control Valves - Standard and HART, 4/20 mA Digital Indicators

Order Code	Schematic
9002/11-280-186-001	

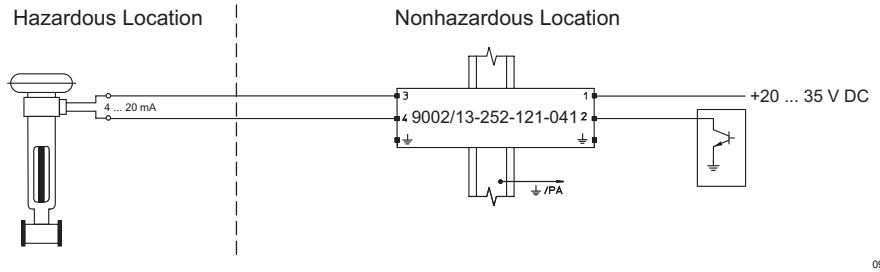
Application Note	This safety barrier is for use with two independent field devices when the control system regulates the output in the supply line. The field devices and control system are both connected to ground and a regulated power supply must be used. At a nominal operating current of 0 ... 22 mA the maximum volt drop across each channel of the barrier will be 7.9 V.

2-wire, 4/20 mA I/P Converters and Control Valves - Standard and HART, 4/20 mA Digital Indicators

Order Code	Schematic
9002/13-280-110-001	

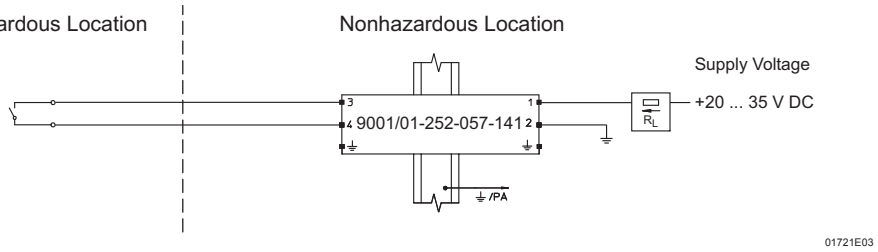
Application Note	This safety barrier is for use when the control system regulates the output in the return (negative) line. The field device and control system are both floating and a regulated power supply must be used. At a nominal operating current of 0 ... 22 mA the maximum volt drop across the barrier will be 8.4 V.

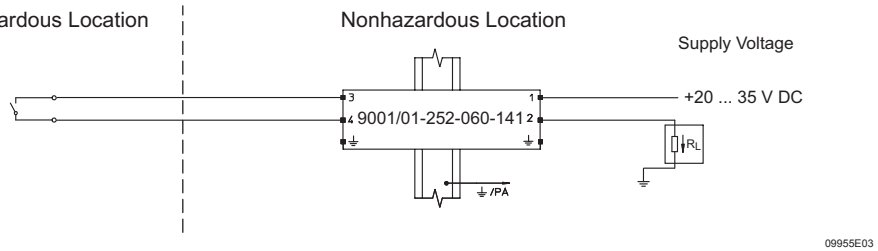
2-wire, 4/20 mA I/P Converters and Control Valves - Standard and HART, 4/20 mA Digital Indicators

Order Code	Schematic
9002/13-252-121-041	

Application Note	This safety barrier is for use when the control system regulates the output in the return (negative) line. The field device and control system are both floating and an unregulated power supply can be used. At a nominal operating current of 0 ... 22 mA the maximum volt drop across the barrier will be 8.9 V. Not for use with HART field devices.

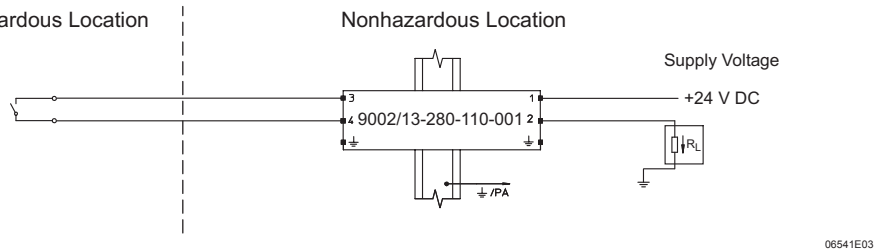
2-wire Discrete Input from Dry Contacts

Order Code	Schematic
9001/01-252-057-141	

9001/01-252-060-141	

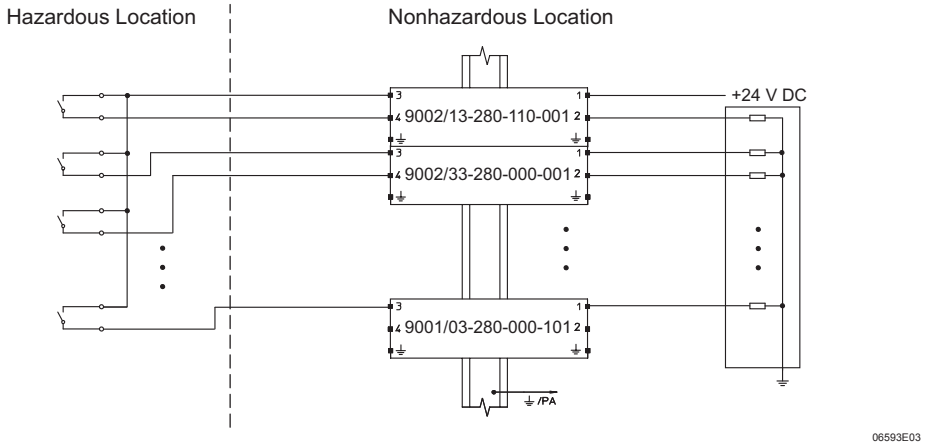
Application Note	These safety barriers are application specific for dry contacts and are suitable for driving relays or optocoupler inputs of an automation system. The supply voltage is + 20 ... 35 V and the voltage available for the relay is V_{supply} - 3 V. The return (signal) wire of the dry contact is connected to ground and therefore these barriers should not be used in fail safe applications. The 9001/01-252-057-141 has the load connected in the supply line and the 9001/01-252-060-141 has the load connected in the return (signal) line.

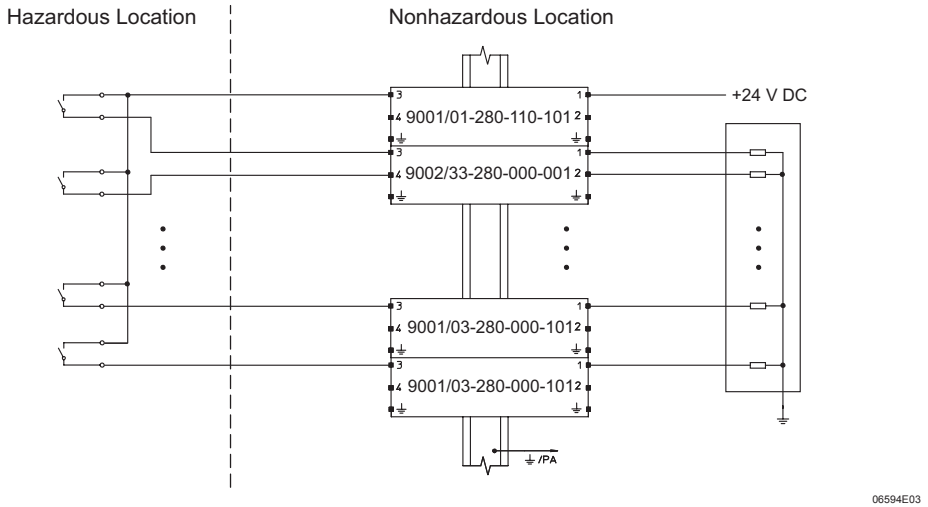
2-wire Discrete Input from Dry Contacts

Order Code	Schematic
9002/13-280-110-001	

Application Note	This safety barrier can be used in a fail safe application as the return (signal) wire is not connected to ground. In this application, when using zener barriers with an electromechanical relay in the nonhazardous location, it is important to select a relay with the following characteristics: 1. Approx. ½ the supply voltage 2. Resistance ≥ to that of the barrier chosen i.e. 12 V, 300 Ω

2-wire Discrete Input from Dry Contacts

Order Code	Schematic
9002/13-280-110-001 plus 9002/33-280-000-001 or 9001/03-280-000-101	

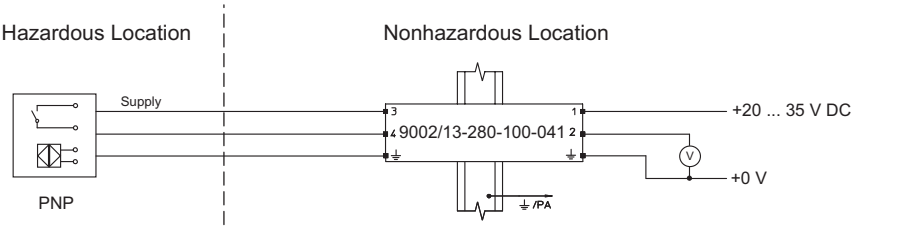
9001/01-280-110-001 plus 9002/33-280-000-001 or 9001/03-280-000-101	

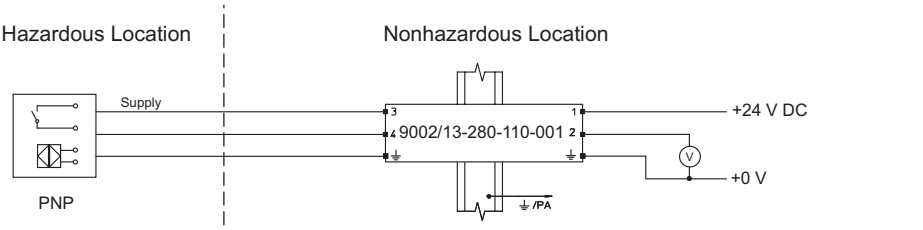
Application Note	These barriers can be used together for applications where multiple switches are used with a common power supply. The combination of barriers depends on the number of switches to be used. To measure the voltage, in these applications, the input in the nonhazardous location must have a high impedance (≥ 3 kΩ). In this application, care should also be taken to calculate the combined entity parameters of the barriers to ensure that it remains a safe combination in the gas group in which it is to be used. Always remember to keep it as simple as possible.

2-wire NAMUR Proximity Sensors

Application Note	It is recommended to use galvanic isolators instead of zener barriers for this application.

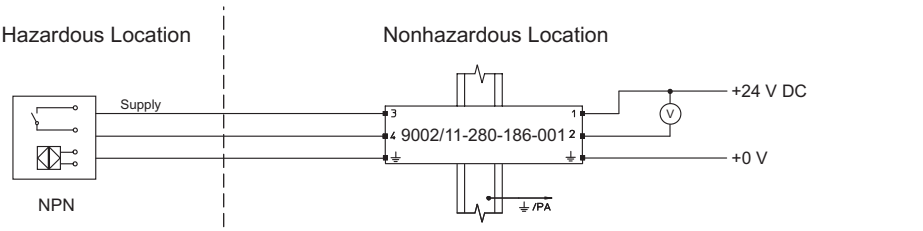
3-wire PNP Inputs (Positive Switching) from Proximity Sensors, Photocells and Encoders

Order Code	Schematic
9002/13-280-100-041	

9002/13-280-110-001	

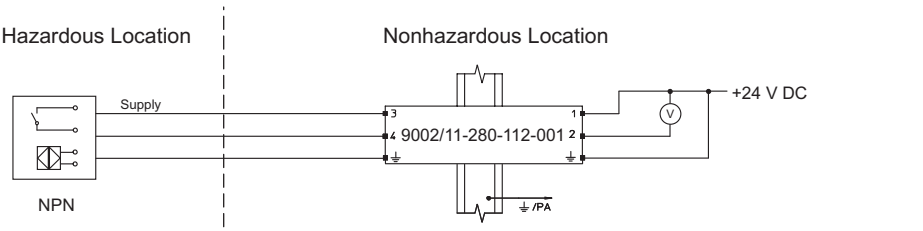
Application Note	These barriers allow a 24 V DC, 300 Ω relay to be used. The sensor chosen should have a minimum operating voltage of 10 V DC. For unregulated power supplies use the 9002/13-280-110-001. With these barriers all loop voltages must be checked to ensure correct operation.

3-wire NPN Inputs (Negative Switching) from Proximity Sensors, Photocells and Encoders

Order Code	Schematic
9002/11-280-186-001	

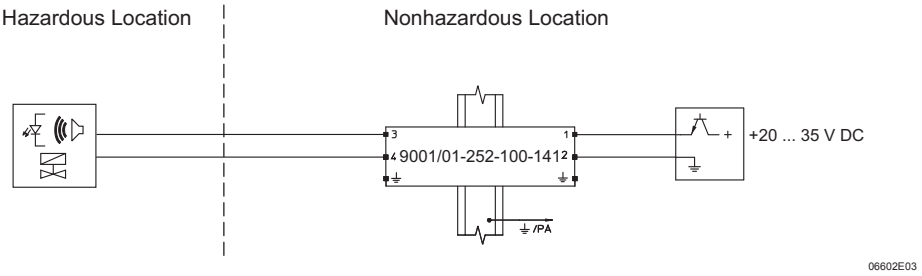
Application Note	The load specification should not exceed 12 V, 30 mA. This installation is not allowed in gas groups A and B. The sensor chosen should have a minimum operating voltage of 10 V DC. With this barrier all loop voltages must be checked to ensure correct operation.

3-wire NPN Inputs (Negative Switching) from Proximity Sensors, Photocells and Encoders

Order Code	Schematic
9002/11-280-112-001	

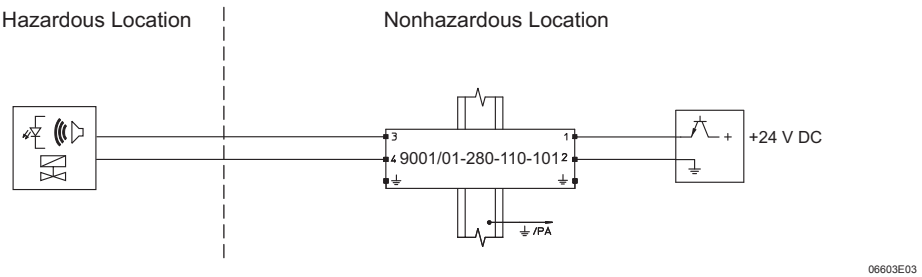
Application Note	With this barrier all loop voltages must be checked to ensure correct operation.

2-wire Discrete Output for Solenoids, LEDs and Audible Alarms

Order Code	Schematic
9001/01-252-100-141	

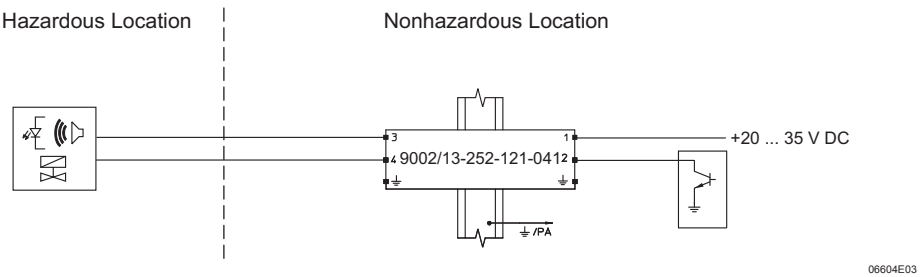
Application Note	This barrier is for use with unregulated power supplies and grounded return lines. Nominal voltage is 20 V ... 35 V and when supplied with more than 24 V DC, the open circuit output voltage V_L = 21 V. If $V_{nom} \leq$ 24 V DC, $V_L = V_{nom}$ - 3 V. The operating current depends on the resistance (R_L) of the field device where $I = V_L / (268\ \Omega + R_L)$.

2-wire Discrete Output for Solenoids, LEDs and Audible Alarms

Order Code	Schematic
9001/01-280-110-101	

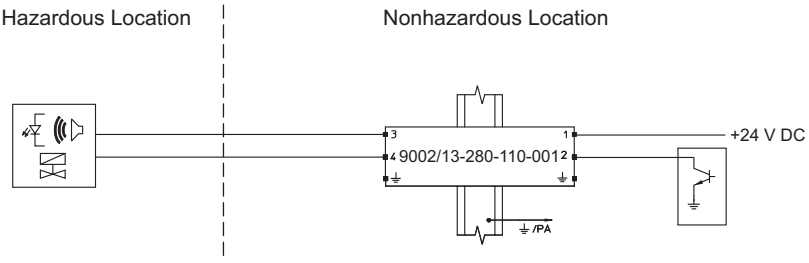
Application Note	This barrier is for use with regulated power supplies and grounded return lines. Nominal voltage is 24 V. For applications that require higher power, for use only in gas groups C and D, then the 9001/01-280-165-101 and 9001/01-280-280-101 may be used.

2-wire Discrete Output for Solenoids, LEDs and Audible Alarms

Order Code	Schematic
9002/13-252-121-041	

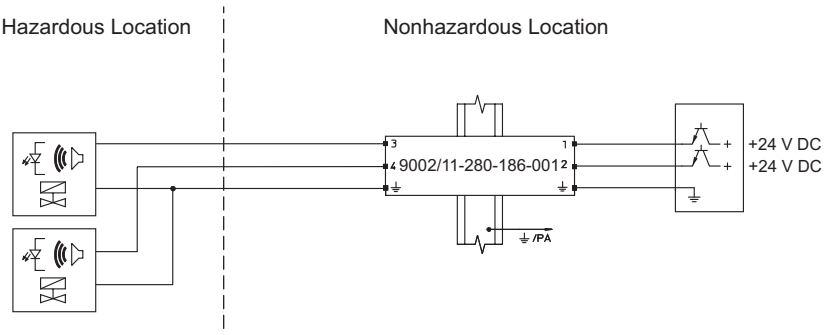
Application Note	This barrier is for use with unregulated power supplies and floating return lines. Nominal voltage is 20 V ... 35 V and when supplied with more than 24 V DC, the open circuit output voltage V_L = 21 V. If $V_{nom} \leq$ 24 V DC, $V_L = V_{nom}$ - 3V. The operating current depends on the resistance (R_L) of the field device where $I = V_L / (243\ \Omega + R_L)$.

2-wire Discrete Output for Solenoids, LEDs and Audible Alarms

Order Code	Schematic
9002/13-280-110-001	

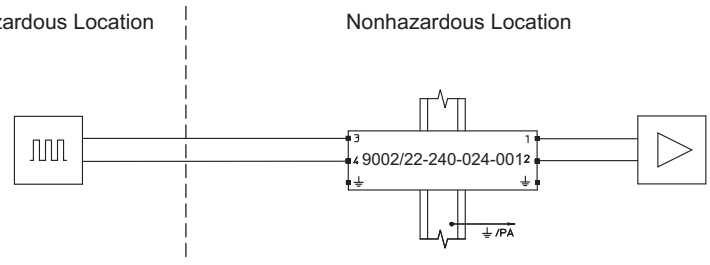
Application Note	This barrier is for use with regulated power supplies and grounded return lines. Nominal voltage is 24 V.

2-wire Discrete Output for Solenoids, LEDs and Audible Alarms

Order Code	Schematic
9002/11-280-186-001	

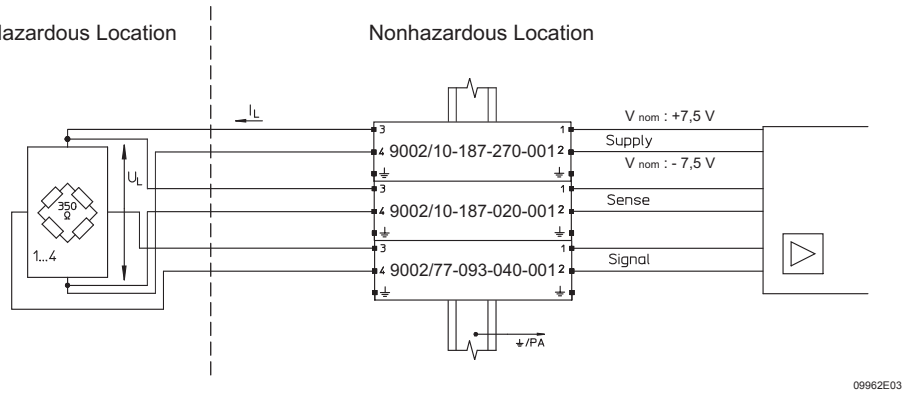
Application Note	This barrier is for use with regulated power supplies and grounded return lines when there are two field devices. Nominal voltage is 24 V.

Voltage Pulse Inputs

Order Code	Schematic
9002/22-240-024-001	

Application Note	This barrier will pass voltage pulse inputs up to 20 V. Maximum switching frequency of 50 k Hz

Strain Gauge Load Cells

Order Code	Schematic
9002/10-187-270-001 **9002/10-187-020-001** **9002/77-093-040-001**	

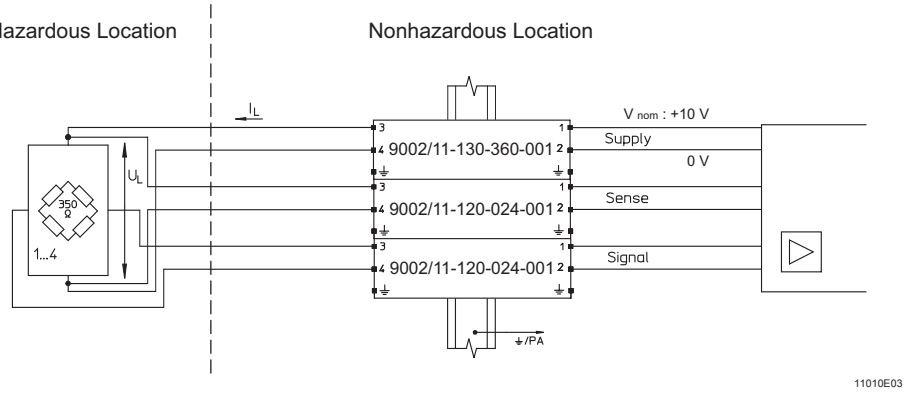
Application Note	For use with ± 7.5 V excitation voltage, 350 Ω or 700 Ω strain gauge load cells.

Combination Entity Parameters

	V_{OC}	I_{SC}	P_{max}
With sense:	18.7 V	330 mA	1.45 W
Without sense:	18.7 V	310 mA	1.36 W

Excitation Voltage and Current available at the Strain Gauge

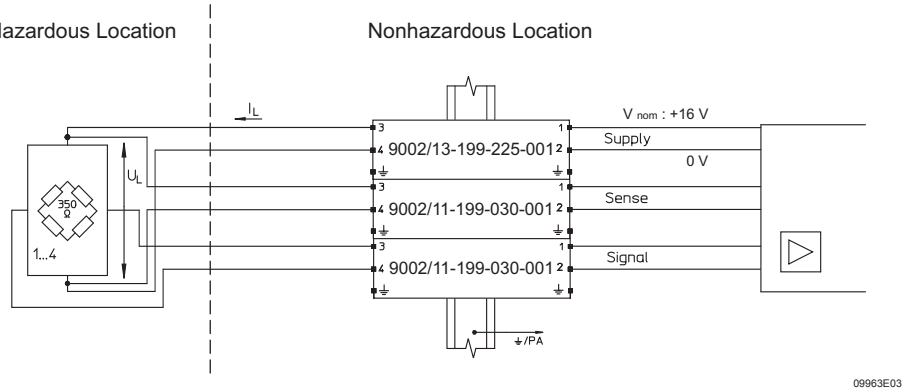
Number of strain gauges in parallel	350 Ω		700 Ω	
	V	mA	V	mA
1	11.6	35	13.2	19
2	9.6	55	11.6	35
3	8	70	10.6	45
4	7	80	9.6	55

Strain Gauge Load Cells	
Order Code	Schematic
9002/11-130-360-001 **9002/11-120-024-001** **9002/11-120-024-001**	
Application Note	For use with + 10 V excitation voltage, 350 Ω strain gauge load cells.

Combination Entity Parameters			
	V_{OC}	I_{SC}	P_{max}
With sense:	13 V	408 mA	1.2 W
Without sense:	13 V	384 mA	1.13 W

Excitation Voltage and Current available at the Strain Gauge		
Number of strain gauges in parallel	350 Ω	
	V	mA
1	7.7	22
2	6.2	35
3	5.2	44.5
4	4.5	51

Strain Gauge Load Cells

Order Code	Schematic
9002/13-199-225-001 **9002/11-199-030-001** **9002/11-199-030-001**	

Application Note	For use with + 16 V excitation voltage, 350 Ω or 700 Ω strain gauge load cells.

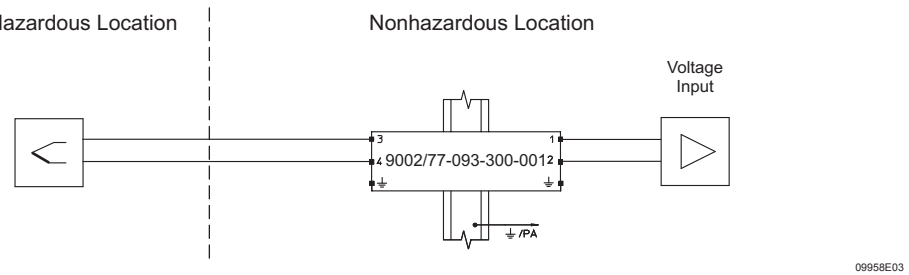
Combination Entity Parameters

	V_{OC}	I_{SC}	P_{max}
With sense:	19.9 V	285 mA	1.42 W
Without sense:	19.9 V	255 mA	1.3 W

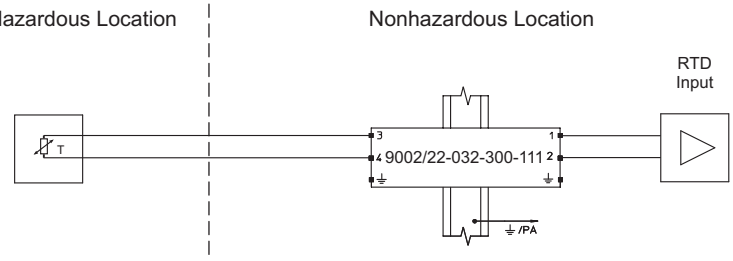
Excitation Voltage and Current available at the Strain Gauge

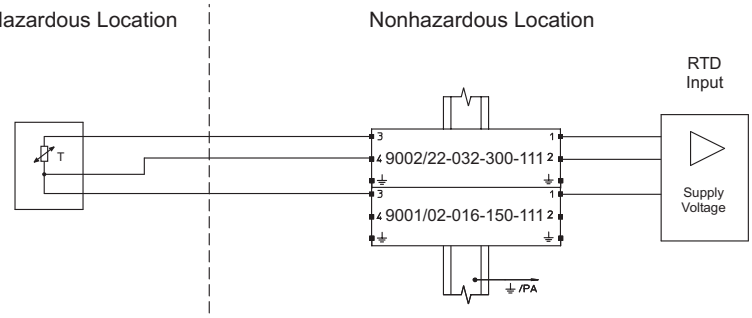
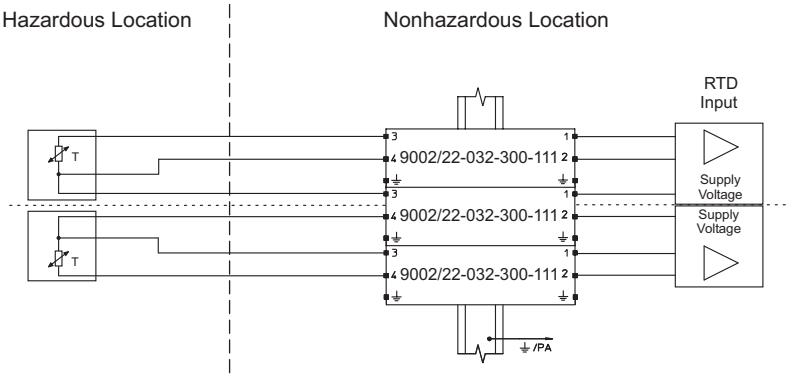
Number of strain gauges in parallel	350 Ω		700 Ω	
	V	mA	V	mA
1	10.4	30	12.1	17
2	8.3	47	10.4	30
3	6.9	60	9.5	41
4	5.9	67	8.3	47

Thermocouples

Order Code	Schematic
9002/77-093-300-001	

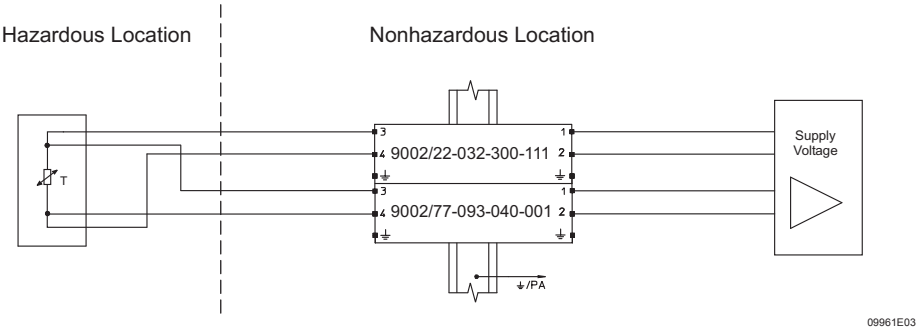
Application Note	With zener barriers it is recommended that ungrounded thermocouples be used. For grounded thermocouples it is recommended to use galvanic isolators or a potential equalizing conductor between the thermocouple ground and the barrier ground connections. It is recommended that compensating cable is used on both sides of the zener barrier to compensate for the creation of cold junctions at the barrier terminals. Adequate electrostatic shielding should also be provided to divert any noise that should occur in the circuit. The low resistance of this barrier allows for the connection of any thermocouple type.

RTDs	
Order Code	Schematic
9002/22-032-300-111	
Application Note	Although 2-wire RTD circuits are the least accurate when used with zener barriers, due to the additional barrier resistance, the above barrier has a precision resistor with a tolerance of ± 0.1 Ω to limit the loss of accuracy. It is recommended to use 3- or 4-wire RTD circuits, with 4-wire RTD circuits maintaining the maximum accuracy.

RTDs	
Order Code	Schematic
9002/22-032-300-111 **9001/02-016-150-111**	
9002/22-032-300-111 **9002/22-032-300-111** **9002/22-032-300-111**	
Application Note	For a single 3-wire RTD configuration, the first combination can be used. Where multiple 3-wire RTDs are used, then the second combination is a more economical solution.

Measurement Range		
Operating Current ≤	5 mA	3 mA
Temperature ≤	752 °F (400 °C)	1562 °F (850 °C)

Combination Entity Parameters	
V_{OC}	I_{SC}
3.2 V	450 mA

RTDs		
Order Code	Schematic	
9002/22-032-300-111 **9002/77-093-040-111**		
Application Note	For a 4-wire RTD configuration, the combination above is recommended.	

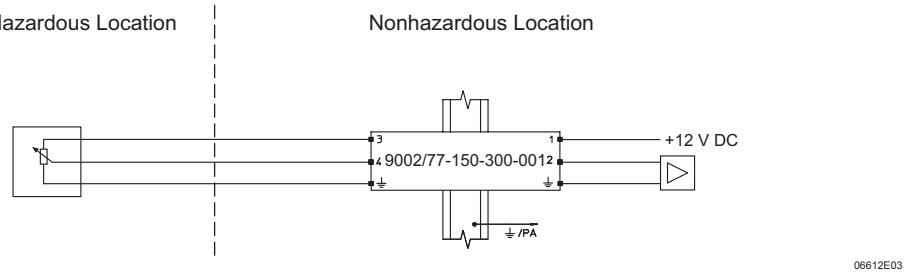
Measurement Range		
Operating Current ≤	5 mA	3 mA
Temperature ≤	752 °F (400 °C)	1562 °F (850 °C)

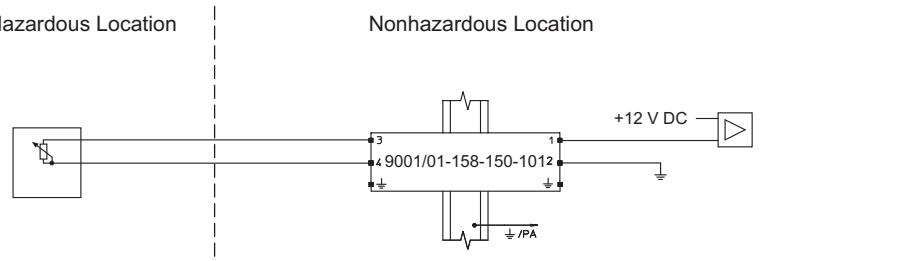
Combination Entity Parameters	
V_{OC}	I_{SC}
10.9 V	340 mA

DC Potentiometers

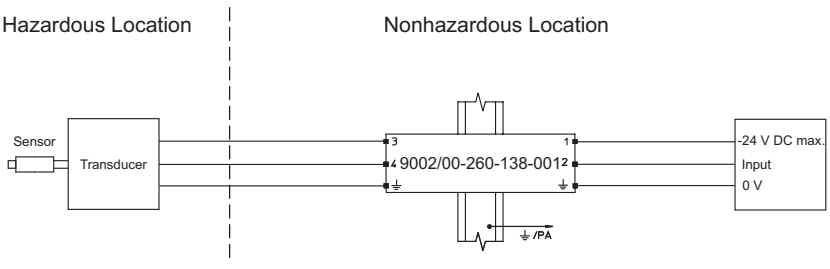
Potentiometer applications with barriers:
For intrinsically safe operation, a comparison must be done to ensure the safe operation of the potentiometer. The power dissipation and surface of the potentiometer must be in accordance with the standards. The potentiometer must be classified to a temperature class.

The galvanic isolators 9180 and 9182 are recommended for potentiometers and both have low power outputs.

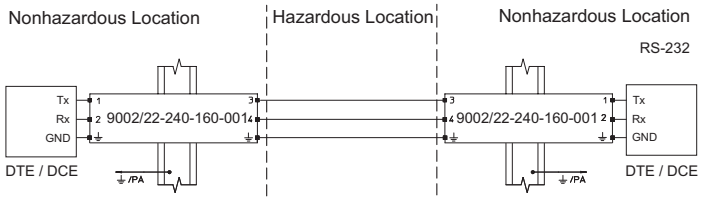
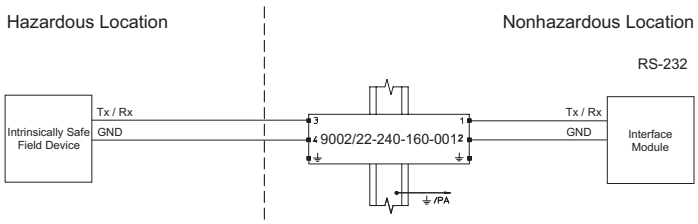
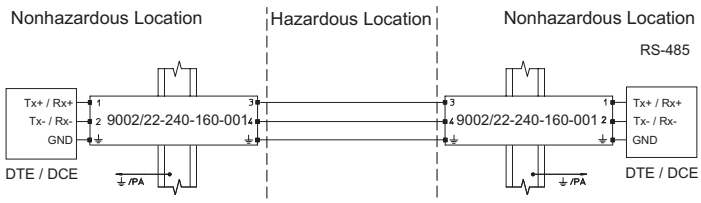
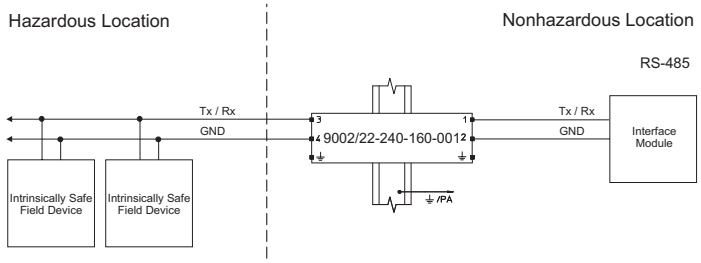
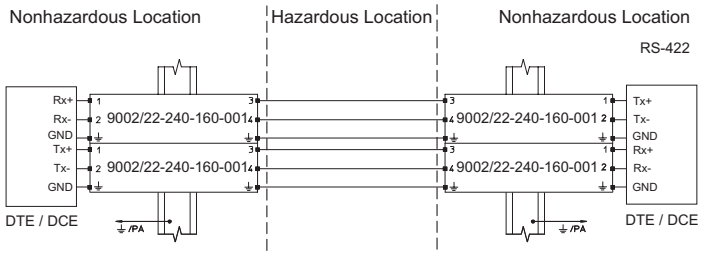
Order Code	Schematic
9002/77-150-300-001	
Application Note	This barrier is for use with DC non inductive potentiometers with an operating voltage of + 12 V.

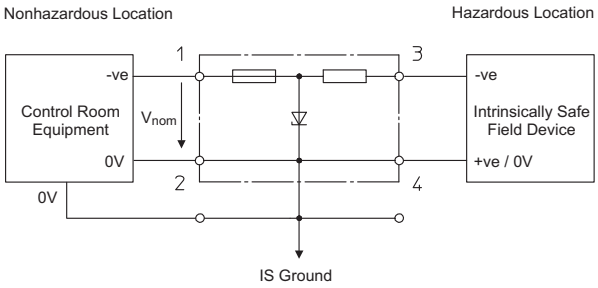
Order Code	Schematic
9001/01-158-150-101	
Application Note	This barrier is for use with DC non inductive potentiometers with an operating voltage of + 12 V and the measuring circuit in the supply line.

Displacement Sensors

Order Code	Schematic
9002/00-260-138-001	
Application Note	This barrier is for use with either a Bentley Nevada or Metrix displacement sensor. The potential of the above barrier is negative. The operating voltage is - 24 V DC and the end-to-end resistance is 358 Ω. If a positive potential is required then it may be possible to use the 9002/11-260-138-001.

Data Communication

Order Code	Schematic
9002/22-240-160-001	 06616E03  06624E03  06625E03  06627E03  06626E03
Application Note	This barrier is used for communicating with intrinsically safe field devices using serial interfaces, RS 232, RS 485, RS 422, or for taking them across a hazardous location. The barrier has been tested up to 152 kb/s with RS 232 and RS 422. In multidrop configurations with RS 485, the barrier has been tested up to 115.2 kb/s. This barrier has an operating voltage of 9 V. The safety of the above combinations must be calculated and checked for each particular application. It is recommended to test each solution to ensure functionality as the above solution will only work in certain cases. **It is recommended to use the galvanic isolator, 9185, instead of a zener barrier.**



- Grounded circuit
- Allows the connection of regulated power supplies, V_{nom}, as listed in the table below
- Various safety and operational characteristics as listed in the table below
- Approved for installation in Division 2 and Zone 2

Technical Tips

- T_a = 140 °F (60 °C) except for 9001/00-280-165-101 in FM / UL installations where T_a = 122 °F (50 °C)
- 9001/00-280-165-101 is not allowed to interface to field devices in gas groups A, B, E or IIC

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
								A, B, E or IIC		C, D, F, G or IIB, IIA	
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	mA	V	mA	mW				
9001/00-050-150-101	1 ... 3	42	49	61	5	150	187.5	1.3	100	7	1000
9001/00-083-442-101	6	24	28	214	8.3	442	917.2	0.12	7.2	0.5	73
9001/00-086-010-101	6	864	963	6	8.6	10	21.5	300	6.2	1000	55
9001/00-086-020-101	6	452	501	11	8.6	20	43	90	6.2	330	55
9001/00-086-050-101	6	195	218	27	8.6	50	107.5	15	6.2	56	55
9001/00-086-100-101	6	92	103	58	8.6	100	215	4	6.2	15	55
9001/00-086-150-101	6	64	73	82	8.6	150	322.5	1.3	6.2	7	55
9001/00-086-390-101	6	27	32	187	8.6	390	838.5	0.16	6.2	0.89	55
9001/00-137-065-101	10	215	240	41	13.7	65	16.25	8.8	0.79	34	5
9001/00-158-150-101	12	120	135	88	15.8	150	592.5	1.3	0.478	7	2.88
9001/00-199-010-101	16	2096	2321	6	19.9	10	49.75	330	0.223	1000	1.42
9001/00-199-020-101	16	1052	1165	13	19.9	20	99.5	90	0.223	330	1.42
9001/00-199-038-101	16	539	598	26	19.9	38	189.1	26	0.223	95	1.42
9001/00-199-150-101	16	149	168	95	19.9	150	746.3	1.3	0.223	7	1.42
9001/00-280-020-101	24	1435	1590	15	28	20	140	50	0.083	50	0.65
9001/00-280-050-101	24	599	666	36	28	50	350	8.5	0.083	25	0.65
9001/00-280-085-101	24	340	375	64	28	85	595	2.4	0.083	16	0.65
9001/00-280-100-101	24	286	319	75	28	100	700	1.6	0.083	11	0.65
9001/00-280-110-101	24	263	294	81	28	110	770	1.2	0.083	9	0.65
9001/00-280-165-101	24	177	198	121	28	165	1155	- -	- -	3.5	0.65

CSA Information - Connections to Class I, II, III, Division 1

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/00-050-150-101	1 ... 3	42	49	61	4.9	133.2	187.5	2	1000	8	3000
9001/00-083-442-101	6	24	28	214	8.4	442	917.2	0.19	6.9	0.8	20.8
9001/00-086-010-101	6	864	963	6	8.6	9.6	21.5	346	5.9	1000	17.6
9001/00-086-020-101	6	452	501	11	8.6	18.3	43	97.5	5.9	350	17.6
9001/00-086-050-101	6	195	218	27	8.6	43.5	107.5	18	5.9	67.6	17.6
9001/00-086-100-101	6	92	103	58	8.6	99.6	215	3.6	5.9	14	17.6
9001/00-086-150-101	6	64	73	82	8.6	146.2	322.5	1.7	5.9	6.7	17.6
9001/00-086-390-101	6	27	32	187	8.6	377.6	838.5	0.16	5.9	1	17.6
9001/00-137-065-101	10	215	240	41	13.6	65.3	– –	8.1	1.1	31.2	3.2
9001/00-158-150-101	12	120	135	88	15.7	138.2	592.5	1.6	0.67	7.5	2
9001/00-199-010-101	16	2096	2321	6	19.9	9.1	49.75	382	0.34	1000	1
9001/00-199-020-101	16	1052	1165	13	19.9	16.6	99.5	117	0.34	421	1
9001/00-199-038-101	16	539	598	26	19.9	37.4	189.1	24.2	0.34	90	1
9001/00-199-150-101	16	149	168	95	19.9	139.6	746.3	1.6	0.34	7.3	1
9001/00-280-020-101	24	1435	1590	15	28	19.6	140	85	0.14	306	0.43
9001/00-280-050-101	24	599	666	36	28	47.5	350	15.1	0.14	57	0.43
9001/00-280-085-101	24	340	375	64	28.5	77	595	5	0.14	19.3	0.43
9001/00-280-100-101	24	286	319	75	28.5	100	700	3.6	0.14	13.9	0.43
9001/00-280-110-101	24	263	294	81	28.5	111	770	3.6	0.14	11.7	0.43
9001/00-280-165-101	24	177	198	121	28.5	163.7	1155	- -	- -	5.4	0.43

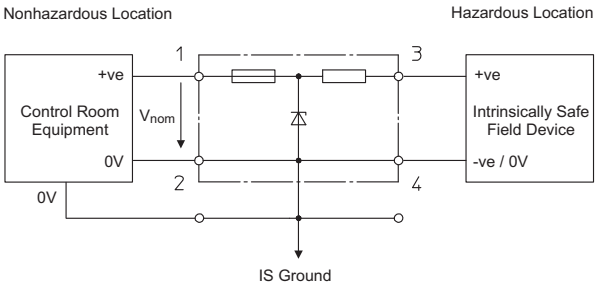
CSA Information - Connections to Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/00-050-150-101	1 ... 3	42	49	61	5	150	187.5	1.3	100	7	1000
9001/00-083-442-101	6	24	28	214	8.3	442	917.2	0.12	7.2	0.5	73
9001/00-086-010-101	6	864	963	6	8.6	10	21.5	300	6.2	1000	55
9001/00-086-020-101	6	452	501	11	8.6	20	43	90	6.2	330	55
9001/00-086-050-101	6	195	218	27	8.6	50	107.5	15	6.2	56	55
9001/00-086-100-101	6	92	103	58	8.6	100	215	4	6.2	15	55
9001/00-086-150-101	6	64	73	82	8.6	150	322.5	1.3	6.2	7	55
9001/00-086-390-101	6	27	32	187	8.6	390	838.5	0.16	6.2	0.89	55
9001/00-137-065-101	10	215	240	41	13.7	65	– –	8.8	0.79	34	5
9001/00-158-150-101	12	120	135	88	15.8	150	592.5	1.3	0.478	7	2.88
9001/00-199-010-101	16	2096	2321	6	19.9	10	49.75	330	0.223	1000	1.42
9001/00-199-020-101	16	1052	1165	13	19.9	20	99.5	90	0.223	330	1.42
9001/00-199-038-101	16	539	598	26	19.9	38	189.1	26	0.223	95	1.42
9001/00-199-150-101	16	149	168	95	19.9	150	746.3	1.3	0.223	7	1.42
9001/00-280-020-101	24	1435	1590	15	28	20	140	50	0.083	50	0.65
9001/00-280-050-101	24	599	666	36	28	50	350	8.5	0.083	25	0.65
9001/00-280-085-101	24	340	375	64	28	85	595	2.4	0.083	16	0.65
9001/00-280-100-101	24	286	319	75	28	100	700	1.6	0.083	11	0.65
9001/00-280-110-101	24	263	294	81	28	110	770	1.2	0.083	9	0.65
9001/00-280-165-101	24	177	198	121	28	165	1155	- -	- -	3.5	0.65

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
								IIC		IIB	
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	mA	V	mA	mW				
9001/00-050-150-101	1 ... 3	42	49	61	5	150	187.5	1.3	100	7	1000
9001/00-083-442-101	6	24	28	214	8.3	442	917.2	0.1	7.2	0.5	73
9001/00-086-010-101	6	864	963	6	8.6	10	21.5	300	6.2	1000	55
9001/00-086-020-101	6	452	501	11	8.6	20	43	90	6.2	330	55
9001/00-086-050-101	6	195	218	27	8.6	50	107.5	15	6.2	56	55
9001/00-086-100-101	6	92	103	58	8.6	100	215	4	6.2	15	55
9001/00-086-150-101	6	64	73	82	8.6	150	322.5	1.3	6.2	7	55
9001/00-086-390-101	6	27	32	187	8.6	390	839	0.16	6.2	1	55
9001/00-137-065-101	10	215	240	41	13.7	65	222.6	8.8	0.79	34	5
9001/00-158-150-101	12	120	135	88	15.8	150	593	1	0.478	7	2.88
9001/00-199-010-101	16	2096	2321	6	19.9	10	50	330	0.223	1000	1.42
9001/00-199-020-101	16	1052	1165	13	19.9	20	100	90	0.223	330	1.42
9001/00-199-038-101	16	539	598	26	19.9	38	189	26	0.223	95	1.42
9001/00-199-150-101	16	149	168	95	19.9	150	746	1.3	0.223	7	1.42
9001/00-280-020-101	24	1435	1590	15	28	20	140	50	0.083	50	0.65
9001/00-280-050-101	24	599	666	36	28	50	350	8.5	0.083	25	0.65
9001/00-280-085-101	24	340	375	64	28	85	595	2.4	0.083	16	0.65
9001/00-280-100-101	24	286	319	75	28	100	700	1.6	0.083	11	0.65
9001/00-280-110-101	24	263	294	81	28	110	770	1.2	0.083	9	0.65
9001/00-280-165-101	24	177	198	121	28	165	1155	– –	– –	3.5	0.65

9001 Series, Single Channel - Positive Polarity



- Grounded circuit
- Allows the connection of regulated power supplies, V_{nom}, as listed in the table below
- Various safety and operational characteristics as listed in the table below
- Approved for installation in Division 2 and Zone 2

Technical Tips

- T_a = 140 °F (60 °C) except for 9001/00-280-165-101 in FM / UL / ATEX installations where T_a = 122 °F (50 °C)
- 9001/01-280-165-101 is not allowed to interface to field devices in gas groups A, B, E, and IIC

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
								A, B, E or IIC		C, D, F, G or IIB, IIA	
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	mA	V	mA	mW				
9001/01-050-150-101	1 ... 3	42	49	61	5	150	187.5	1.3	100	7	1000
9001/01-083-442-101	6	24	27	222	8.3	442	917.2	0.12	7.2	0.5	73
9001/01-086-010-101	6	864	963	6	8.6	10	21.5	300	6.2	1000	55
9001/01-086-020-101	6	452	501	11	8.6	20	43	90	6.2	330	55
9001/01-086-050-101	6	195	218	27	8.6	50	107.5	15	6.2	56	55
9001/01-086-075-101	6	129	144	41	8.6	75	161.3	6.7	6.2	25	55
9001/01-086-150-101	6	64	73	82	8.6	150	322.5	1.3	6.2	7	55
9001/01-086-270-101	6	39	44	136	8.6	270	580.5	0.23	6.2	2.2	55
9001/01-086-390-101	6	27	32	187	8.6	390	838.5	0.16	6.2	0.89	55
9001/01-126-020-101	8	681	698	11	12.6	20	63	90	1.15	330	7.4
9001/01-126-050-101	8	263	294	27	12.6	50	157.5	15	1.15	56	7.4
9001/01-126-075-101	8	178	199	40	12.6	75	236.3	6.7	1.15	25	7.4
9001/01-126-150-101	8	93	106	75	12.6	150	472.5	1.3	1.15	7	7.4
9001/01-137-065-101	10	215	240	41	13.7	65	16.25	8.8	0.79	34	5
9001/01-158-150-101	12	120	135	88	15.8	150	592.5	1.3	0.478	7	2.88
9001/01-168-020-101	12	872	965	12	16.8	20	84	90	0.39	330	2.29
9001/01-168-050-101	12	377	420	28	16.8	50	210	15	0.39	56	2.29
9001/01-168-075-101	12	235	262	45	16.8	75	315	6.7	0.39	25	2.29
9001/01-199-010-101	16	2096	2321	6	19.9	10	49.75	330	0.223	1000	1.42
9001/01-199-020-101	16	1052	1165	13	19.9	20	99.5	90	0.223	330	1.42
9001/01-199-038-101	16	539	598	26	19.9	38	189.1	26	0.223	95	1.42
9001/01-199-050-101	16	415	462	34	19.9	50	248.8	15	0.223	56	1.42
9001/01-199-100-101	16	241	282	66	19.9	100	497.5	4	0.223	15	1.42
9001/01-199-150-101	16	149	168	95	19.9	150	746.3	1.3	0.223	7	1.42
9001/01-252-070-101	20	378	421	47	25.2	70	441	4.5	0.107	25	0.82
9001/01-280-020-101	24	1435	1590	15	28	20	140	50	0.083	50	0.65
9001/01-280-050-101	24	599	666	36	28	50	350	8.5	0.083	25	0.65
9001/01-280-075-101	24	415	462	51	28	75	525	3.3	0.083	21	0.65
9001/01-280-085-101	24	340	375	64	28	85	595	2.4	0.083	16	0.65
9001/01-280-100-101	24	286	319	75	28	100	700	1.6	0.083	11	0.65
9001/01-280-110-101	24	263	294	81	28	110	770	1.2	0.083	9	0.65
9001/01-280-165-101	24	177	198	121	28	165	1155	- -	- -	3.5	0.65

CSA Information - Connections to Class I, II, III, Division 1

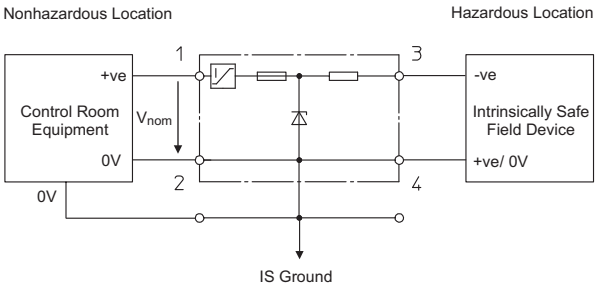
Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-050-150-101	1 ... 3	42	49	61	4.9	133.2	187.5	2	1000	8	3000
9001/01-083-442-101	6	24	27	222	8.4	442	917.2	0.19	6.9	0.8	20.8
9001/01-086-010-101	6	864	963	6	8.6	9.6	21.5	346	5.9	1000	17.6
9001/01-086-020-101	6	452	501	11	8.6	18.3	43	97.5	5.9	350	17.6
9001/01-086-050-101	6	195	218	27	8.6	43.5	107.5	18	5.9	67.6	17.6
9001/01-086-075-101	6	129	144	41	8.6	69.7	161.3	7.2	5.9	27.5	17.6
9001/01-086-150-101	6	64	73	82	8.6	146.2	322.5	1.7	5.9	6.7	17.6
9001/01-086-270-101	6	39	44	136	8.6	251.8	580.5	0.26	5.9	2.4	17.6
9001/01-086-390-101	6	27	32	187	8.6	377.6	838.5	0.16	5.9	1	17.6
9001/01-126-020-101	8	681	698	11	12.6	18.7	63	93.7	1.4	336	4.1
9001/01-126-050-101	8	263	294	27	12.6	49.1	157.5	14.2	1.4	53.6	4.1
9001/01-126-075-101	8	178	199	40	12.6	73.7	236.3	6.4	1.4	4.1	4.1
9001/01-126-150-101	8	93	106	75	12.6	145.7	472.5	1.3	1.4	6.8	4.1
9001/01-137-065-101	10	215	240	41	13.6	65.3	– –	8.1	1.1	31.2	3.2
9001/01-158-150-101	12	120	135	88	15.7	138.2	592.5	1.6	0.67	7.5	2
9001/01-168-020-101	12	872	965	12	16.8	18.7	84	93.9	0.55	337	1.7
9001/01-168-050-101	12	377	420	28	16.8	45.3	210	16.6	0.55	62.4	1.7
9001/01-168-075-101	12	235	262	45	16.8	73.7	315	6.4	0.55	24.8	1.7
9001/01-199-010-101	16	2096	2321	6	19.9	9.1	49.75	382	0.34	1000	1
9001/01-199-020-101	16	1052	1165	13	19.9	16.6	99.5	117	0.34	421	1
9001/01-199-038-101	16	539	598	26	19.9	37.4	189.1	24.2	0.34	90	1
9001/01-199-050-101	16	415	462	34	19.9	48.7	248.8	14.4	0.34	54.4	1
9001/01-199-100-101	16	241	282	66	19.9	95.2	497.5	3.9	0.34	15.2	1
9001/01-199-150-101	16	149	168	95	19.9	139.6	746.3	1.6	0.34	7.3	1
9001/01-252-070-101	20	378	421	47	25.2	68	441	7.5	0.18	28.9	0.55
9001/01-280-020-101	24	1435	1590	15	28	19.6	140	85	0.14	306	0.43
9001/01-280-050-101	24	599	666	36	28	47.5	350	15.1	0.14	57	0.43
9001/01-280-075-101	24	415	462	51	28	68.5	525	7.4	0.14	28.4	0.43
9001/01-280-085-101	24	340	375	64	28.5	77	595	5	0.14	19.3	0.43
9001/01-280-100-101	24	286	319	75	28.5	100	700	3.6	0.14	13.9	0.43
9001/01-280-110-101	24	263	294	81	28.5	111	770	3.6	0.14	11.7	0.43
9001/01-280-165-101	24	177	198	121	28.5	163.7	1155	- -	- -	5.4	0.43

CSA Information - Connections to Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
								IIC		IIA, IIB	
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	mA	V	mA	mW				
9001/01-050-150-101	1 ... 3	42	49	61	5	150	187.5	1.3	100	7	1000
9001/01-083-442-101	6	24	27	222	8.3	442	917.2	0.12	7.2	0.5	73
9001/01-086-010-101	6	864	963	6	8.6	10	21.5	300	6.2	1000	55
9001/01-086-020-101	6	452	501	11	8.6	20	43	90	6.2	330	55
9001/01-086-050-101	6	195	218	27	8.6	50	107.5	15	6.2	56	55
9001/01-086-075-101	6	129	144	41	8.6	75	161.3	6.7	6.2	25	55
9001/01-086-150-101	6	64	73	82	8.6	150	322.5	1.3	6.2	7	55
9001/01-086-270-101	6	39	44	136	8.6	270	580.5	0.23	6.2	2.2	55
9001/01-086-390-101	6	27	32	187	8.6	390	838.5	0.16	6.2	0.89	55
9001/01-126-020-101	8	681	698	11	12.6	20	63	90	1.15	330	7.4
9001/01-126-050-101	8	263	294	27	12.6	50	157.5	15	1.15	56	7.4
9001/01-126-075-101	8	178	199	40	12.6	75	236.3	6.7	1.15	25	7.4
9001/01-126-150-101	8	93	106	75	12.6	150	472.5	1.3	1.15	7	7.4
9001/01-137-065-101	10	215	240	41	13.7	65	– –	8.8	0.79	34	5
9001/01-158-150-101	12	120	135	88	15.8	150	592.5	1.3	0.478	7	2.88
9001/01-168-020-101	12	872	965	12	16.8	20	84	90	0.39	330	2.29
9001/01-168-050-101	12	377	420	28	16.8	50	210	15	0.39	56	2.29
9001/01-168-075-101	12	235	262	45	16.8	75	315	6.7	0.39	25	2.29
9001/01-199-010-101	16	2096	2321	6	19.9	10	49.75	330	0.223	1000	1.42
9001/01-199-020-101	16	1052	1165	13	19.9	20	99.5	90	0.223	330	1.42
9001/01-199-038-101	16	539	598	26	19.9	38	189.1	26	0.223	95	1.42
9001/01-199-050-101	16	415	462	34	19.9	50	248.8	15	0.223	56	1.42
9001/01-199-100-101	16	241	282	66	19.9	100	497.5	4	0.223	15	1.42
9001/01-199-150-101	16	149	168	95	19.9	150	746.3	1.3	0.223	7	1.42
9001/01-252-070-101	20	378	421	47	25.2	70	441	4.5	0.107	25	0.82
9001/01-280-020-101	24	1435	1590	15	28	20	140	50	0.083	50	0.65
9001/01-280-050-101	24	599	666	36	28	50	350	8.5	0.083	25	0.65
9001/01-280-075-101	24	415	462	51	28	75	525	3.3	0.083	21	0.65
9001/01-280-085-101	24	340	375	64	28	85	595	2.4	0.083	16	0.65
9001/01-280-100-101	24	286	319	75	28	100	700	1.6	0.083	11	0.65
9001/01-280-110-101	24	263	294	81	28	110	770	1.2	0.083	9	0.65
9001/01-280-165-101	24	177	198	121	28	165	1155	- -	- -	3.5	0.65

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
								IIC		IIB	
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	mA	V	mA	mW				
9001/01-050-150-101	1 ... 3	42	49	61	5	150	187.5	1.3	100	7	1000
9001/01-083-442-101	6	24	27	222	8.3	442	917.2	0.1	7.2	0.5	73
9001/01-086-010-101	6	864	963	6	8.6	10	21.5	300	6.2	1000	55
9001/01-086-020-101	6	452	501	11	8.6	20	43	90	6.2	330	55
9001/01-086-050-101	6	195	218	27	8.6	50	107.5	15	6.2	56	55
9001/01-086-075-101	6	129	144	41	8.6	75	161.3	6.7	6.2	25	55
9001/01-086-150-101	6	64	73	82	8.6	150	322.5	1.3	6.2	7	55
9001/01-086-270-101	6	39	44	136	8.6	270	580.5	0.23	6.2	2.2	55
9001/01-086-390-101	6	27	32	187	8.6	390	839	0.16	6.2	1	55
9001/01-126-020-101	8	681	698	11	12.6	20	63	90	1.15	330	7.4
9001/01-126-050-101	8	263	294	27	12.6	50	158	15	1.15	56	7.4
9001/01-126-075-101	8	178	199	40	12.6	75	236	6.7	1.15	25	7.4
9001/01-126-150-101	8	93	106	75	12.6	150	473	1.3	1.15	7	7.4
9001/01-137-065-101	10	215	240	41	13.7	65	222.6	8.8	0.79	34	5
9001/01-158-150-101	12	120	135	88	15.8	150	593	1	0.478	7	2.88
9001/01-168-020-101	12	872	965	12	16.8	20	84	90	0.39	330	2.29
9001/01-168-050-101	12	377	420	28	16.8	50	210	15	0.39	56	2.29
9001/01-168-075-101	12	235	262	45	16.8	75	315	7	0.39	25	2.29
9001/01-199-010-101	16	2096	2321	6	19.9	10	50	330	0.223	1000	1.42
9001/01-199-020-101	16	1052	1165	13	19.9	20	100	90	0.223	330	1.42
9001/01-199-038-101	16	539	598	26	19.9	38	189	26	0.223	95	1.42
9001/01-199-050-101	16	415	462	34	19.9	50	249	15	0.223	56	1.42
9001/01-199-100-101	16	241	282	66	19.9	100	498	4	0.223	15	1.42
9001/01-199-150-101	16	149	168	95	19.9	150	746	1.3	0.223	7	1.42
9001/01-252-070-101	20	378	421	47	25.2	70	441	4.5	0.107	25	0.82
9001/01-280-020-101	24	1435	1590	15	28	20	140	50	0.083	50	0.65
9001/01-280-050-101	24	599	666	36	28	50	350	8.5	0.083	25	0.65
9001/01-280-075-101	24	415	462	51	28	75	525	3.3	0.083	21	0.65
9001/01-280-085-101	24	340	375	64	28	85	595	2.4	0.083	16	0.65
9001/01-280-100-101	24	286	319	75	28	100	700	1.6	0.083	11	0.65
9001/01-280-110-101	24	263	294	81	28	110	770	1.2	0.083	9	0.65
9001/01-280-165-101	24	177	198	121	28	165	1155	– –	– –	3.5	0.65



- Grounded circuit
- Current limitation to < 100 mA
- Various safety and operational characteristics as listed in the table below
- Approved for installation in Division 2 and Zone 2

Technical Tips

- 9001/01-199-390-101 and 9001/01-280-280-101 are not allowed for interfacing to field devices in gas groups A, B, E and IIC.
- T_a = 140 °F (60 °C) except for 9001/01-280-280-101 in FM / UL / ATEX installations where T_a = 122 °F (50 °C)

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-158-270-101	12	64	73	< 100	< 1.4	15.8	270	1067	0.23	0.478	2.2	2.88
9001/01-158-390-101	12	46	53	< 100	< 1.4	15.8	390	1541	0.16	0.478	0.89	2.88
9001/01-199-390-101	16	57	66	< 100	< 1.4	19.9	390	1940	- -	- -	0.89	1.42
9001/01-280-280-101	24	111	124	< 100	< 1.4	28	280	1960	- -	- -	0.6	0.65

CSA Information - Connections to Class I, II, III, Division 1

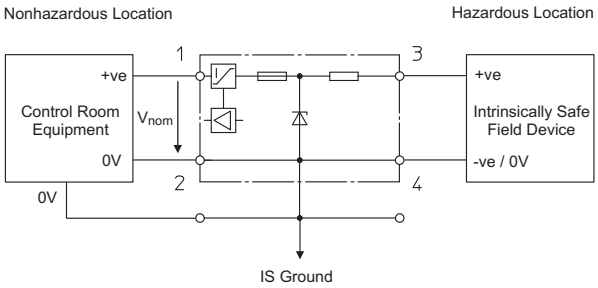
Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-158-270-101	12	64	73	< 100	< 1.4	15.7	267.1	1067	0.23	0.67	2.1	2
9001/01-158-390-101	12	46	53	< 100	< 1.4	15.7	386.8	1541	0.15	0.67	0.9	2
9001/01-199-390-101	16	57	66	< 100	< 1.4	19.8	382.7	1940	- -	- -	0.9	1.03
9001/01-280-280-101	24	111	124	< 100	< 1.4	28.5	267.8	1960	- -	- -	2.1	0.43

CSA Information - Connections to Class I, Zone 0

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-158-270-101	12	64	73	< 100	< 1.4	15.8	270	1067	0.23	0.478	2.2	2.88
9001/01-158-390-101	12	46	53	< 100	< 1.4	15.8	390	1541	0.16	0.478	0.89	2.88
9001/01-199-390-101	16	57	66	< 100	< 1.4	19.9	390	1940	- -	- -	0.89	1.42
9001/01-280-280-101	24	111	124	< 100	< 1.4	28	280	1960	- -	- -	0.6	0.65

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-158-270-101	12	64	73	< 100	< 1.4	15.8	270	1067	0.23	0.478	2.2	2.88
9001/01-158-390-101	12	46	53	< 100	< 1.4	15.8	390	1541	0.16	0.478	0.89	2.88
9001/01-199-390-101	16	57	66	< 100	< 1.4	19.9	390	1940	– –	– –	0.89	1.42
9001/01-280-280-101	24	111	124	< 100	< 1.4	28	280	1960	– –	– –	0.6	0.65



- Application specific for the connection of volt free contacts
- Operational current limited to < 40 mA
- Grounded circuit
- Allows the connection of unregulated power supplies, V_{nom} between + 20 to 35 V DC
- Approved for installation in Division 2 and Zone 2

Technical Tips

- As terminal 4 is connected to ground, this barrier should not be used for fail safe applications. Use the 9002/13-252-121-041 instead.
- Maximum leakage current (terminal 1 to ground (0 V)) ≤ 100 µA

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-252-057-141	20 ... 35	454	505	40	25.2	57	359.1	6.3	0.107	25	0.82

CSA Information - Connections to Class I, II, III, Division 1

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-252-057-141	20 ... 35	454	505	40	25.2	56.4	359.1	10.8	0.18	41.1	0.55

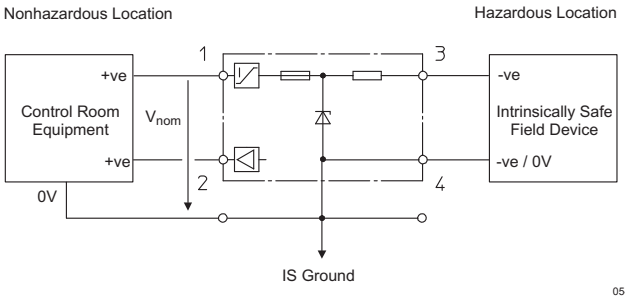
CSA Information - Connections to Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-252-057-141	20 ... 35	454	505	40	25.2	57	359.1	6.3	0.107	25	0.82

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-252-057-141	20 ... 35	454	505	40	25.2	57	359	6.3	0.107	25	0.82

9001 Series, Single Channel - Positive Polarity



- Application specific for the connection of volt free contacts
- Operational current limited to < 40 mA
- Grounded field device
- Input to control system elevated above 0 V
- Allows the connection of unregulated power supplies, V_{nom} between + 20 to 35 V DC
- Approved for installation in Division 2 and Zone 2

Technical Tips

- As terminal 4 is connected to ground, this barrier should not be used for fail safe applications. Use the 9002/13-252-121-041 instead.
- Maximum leakage current (terminal 1 to ground (0 V)) ≤ 100 µA

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
								A, B, E or IIC		C, D, F, G or IIB, IIA	
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	mA	V	mA	mW				
9001/01-252-060-141	20 ... 35	454	505	40	25.2	60	378	6.2	0.107	25	0.82

CSA Information - Connections to Class I, II, III, Division 1

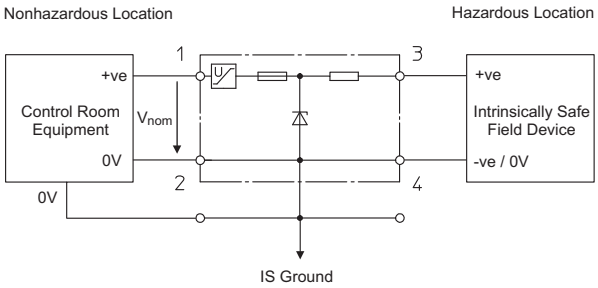
Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
								A, B, E		C, D, F, G	
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	mA	V	mA	mW				
9001/01-252-060-141	20 ... 35	454	505	40	25.2	56.4	378	10.8	0.18	41.1	0.55

CSA Information - Connections to Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
								IIC		IIA, IIB	
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	mA	V	mA	mW				
9001/01-252-060-141	20 ... 35	454	505	40	25.2	60	378	6.2	0.107	25	0.82

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
								IIC		IIB	
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	mA	V	mA	mW				
9001/01-252-060-141	20 ... 35	454	505	40	25.2	60	378	6.2	0.107	25	0.82



- Application specific for the connection of solenoid valves, LEDs or audible alarms
- Grounded circuit
- Allows the connection of unregulated power supplies, V_{nom} between + 20 to 35 V DC
- Approved for installation in Division 2 and Zone 2

Technical Tips

- Maximum leakage current at 24 V (terminal 1 to ground (0 V)) = 1 mA
- Maximum leakage current at 35 V (terminal 1 to ground (0 V)) = 10 mA

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-252-100-141	20 ... 35	259	268	130	25.2	100	630	2	0.107	11	0.82

CSA Information - Connections to Class I, II, III, Division 1

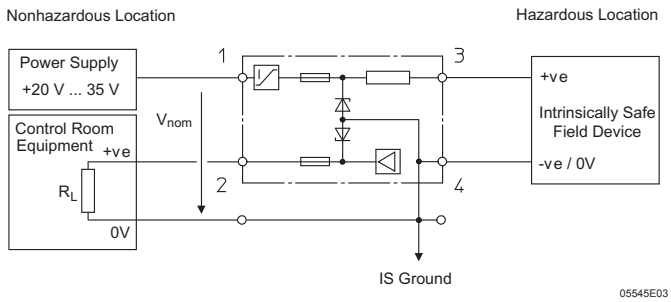
Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-252-100-141	20 ... 35	259	268	130	25.2	100	630	3.5	0.18	13.9	0.55

CSA Information - Connections to Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-252-100-141	20 ... 35	259	268	130	25.2	100	630	2	0.107	11	0.82

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/01-252-100-141	20 ... 35	259	268	130	25.2	100	630	2	0.107	11	0.82



- Application specific for HART / SMART transmitters
- Grounded field device
- Input to control system elevated above 0 V
- Allows the connection of unregulated power supplies, V_{nom} between + 20 to 35 V DC
- Approved for installation in Division 2 and Zone 2

Technical Tips

- $R_L \leq 350\ \Omega$
- Transmitter supply voltage = 14 V when $V_{nom} > 23.5$ V
- Transmitter supply voltage = V_{nom} - 9.5 V when $V_{nom} \leq 23.5$ V

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
							A, B, E or IIC		C, D, F, G or IIB, IIA	
	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	V	mA	mW				
9001/51-280-091-141	20 ... 35	– –	– –	28	91	637	2.2	0.083	14	0.065

CSA Information - Connections to Class I, II, III, Division 1

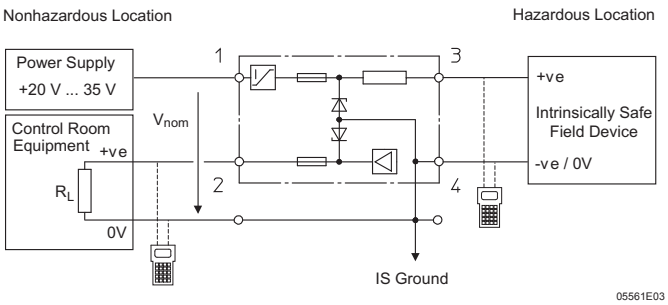
Order Code	Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
							A, B, E		C, D, F, G	
	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	V	mA	mW				
9001/51-280-091-141	20 ... 35	– –	– –	28.1	88	637	4.5	0.14	17.6	0.43

CSA Information - Connections to Class I, Zone 0

Order Code	Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
							IIC		IIA, IIB	
	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	V	mA	mW				
9001/51-280-091-141	20 ... 35	– –	– –	28	91	637	2.2	0.083	14	0.065

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
							IIC		IIB	
	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	V	mA	mW				
9001/51-280-091-141	20 ... 35	– –	– –	28	91	637	2.2	0.083	14	0.65



- Application specific for HART transmitters
- Grounded field device
- Input to control system elevated above 0 V
- Allows the connection of unregulated power supplies, V_{nom} between + 20 to 35 V DC
- Approved for installation in Division 2 and Zone 2

Technical Tips

- $R_L \leq 500\ \Omega$ when $V_{nom} \leq 23.5$ V
- $R_L \leq 750\ \Omega$ when $V_{nom} > 23.5$ V
- Transmitter supply voltage = 15 V when $V_{nom} > 23.5$ V
- Transmitter supply voltage = V_{nom} - 8.5 V when $V_{nom} \leq 23.5$ V
- T_a = 104 °F (40 °C) for FM / UL installations

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/51-280-110-141	20 ... 35	– –	– –	28	110	770	1.2	0.083	9	0.65

CSA Information - Connections to Class I, II, III, Division 1

Order Code	Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
	V	Ω	Ω	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/51-280-110-141	20 ... 35	– –	– –	28.1	106	770	3.2	0.14	12.4	0.43

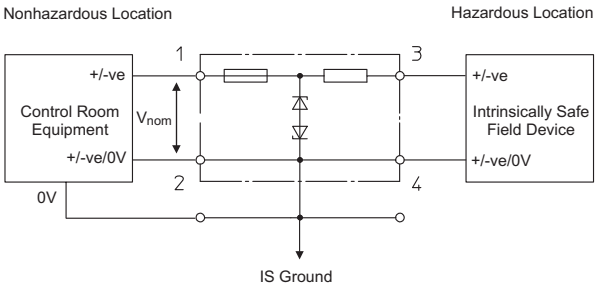
CSA Information - Connections to Class I, Zone 0

Order Code	Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/51-280-110-141	20 ... 35	– –	– –	28	110	770	1.2	0.083	9	0.065

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
	V	Ω	Ω	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/51-280-110-141	20 ... 35	– –	– –	28	110	770	1.2	0.083	9	0.65

9001 Series, Single Channel - Alternating Polarity



- Grounded circuit
- Suitable for AC and DC circuits.
- Various safety and operational characteristics as listed in the table below
- Approved for installation in Division 2 and Zone 2

Technical Tips

- 9001/02-412-095-101 not allowed for interfacing to field devices in gas groups A, B, E and IIC
- 9001/02-016-...-1.1 - Maximum leakage current (terminal 1 to ground (0V)) ≤ 10 µA
- 9001/02-016-...-111 - Tolerance = ± 0.5 %

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	mA	V	mA	mW	L_amH	C_aµF	L_amH	C_aµF
9001/02-016-015-101	0.7	119	134	5	1.6	15	6	160	100	560	1000
9001/02-016-050-101	0.7	38	43	16	1.6	50	20	15	100	56	1000
9001/02-016-050-111	0.7	39	40	17	1.6	50	20	15	100	56	1000
9001/02-016-150-101	0.7	– –	20	35	1.6	150	60	1.3	100	7	1000
9001/02-016-150-111	0.7	19	20	35	1.6	150	60	1.3	100	7	1000
9001/02-016-320-101	0.7	11	14	50	1.6	320	128	0.19	100	1.6	1000
9001/02-093-003-101	6	3141	3472	1,7	9.3	3	6.975	1000	4.1	1000	31
9001/02-093-030-101	6	319	354	16	9.3	30	69.75	40	4.1	150	31
9001/02-093-050-101	6	195	218	27	9.3	50	116.3	15	4.1	56	31
9001/02-093-075-101	6	148	165	36	9.3	75	174.4	6.7	4.1	25	31
9001/02-093-150-101	6	70	79	75	9.3	150	348.8	1.3	4.1	7	31
9001/02-093-390-101	6	– –	36	166	9.3	390	906.8	0.16	4.1	0.89	31
9001/02-133-150-101	10	102	115	86	13.3	150	498.8	1.3	0.91	7	5.6
9001/02-175-050-101	12	378	421	28	17.5	50	218.8	15	0.339	56	1.97
9001/02-175-100-101	12	197	222	54	17.5	100	437.5	4	0.339	15	1.97
9001/02-175-200-101	12	101	114	105	17.5	200	875	0.5	0.339	4	1.97
9001/02-196-150-101	16	148	167	95	19.6	150	735	1.3	0.235	7	1.47
9001/02-280-090-101	24	320	357	67	28	90	630	2.2	0.083	14	0.65
9001/02-412-095-101	36	456	509	70	41.2	95	978.5	- -	- -	9	0.287

CSA Information - Connections to Class I, II, III, Division 1

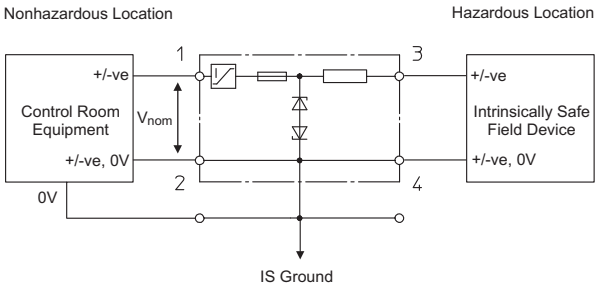
Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/02-016-015-101	0.7	119	134	5	1.6	17	6	172	1000	608	3000
9001/02-016-050-101	0.7	38	43	16	1.6	61	20	13.8	1000	52	3000
9001/02-016-050-111	0.7	39	40	17	1.64	49.9	20	13.8	1000	52	3000
9001/02-016-150-101	0.7	– –	20	35	1.6	167	60	1.9	1000	7.6	3000
9001/02-016-150-111	0.7	19	20	35	1.6	155	60	2.2	1000	8.7	3000
9001/02-016-320-101	0.7	11	14	50	1.6	376	128	0.19	1000	1.6	3000
9001/02-093-003-101	6	3141	3472	1,7	9.4	3	6.975	1000	3.7	1000	11.2
9001/02-093-030-101	6	319	354	16	9.4	29	69.75	39.1	3.7	143	11.2
9001/02-093-050-101	6	195	218	27	9.4	51	116.3	13.4	3.7	50.7	11.2
9001/02-093-075-101	6	148	165	36	9.4	67	174.4	7.6	3.7	29.3	11.2
9001/02-093-150-101	6	70	79	75	9.4	149	348.8	1.3	3.7	6.5	11.2
9001/02-093-390-101	6	– –	36	166	9.4	374	906.8	0.16	3.7	1	11.2
9001/02-133-150-101	10	102	115	86	13.4	143	498.8	1.3	1.1	7	3.2
9001/02-175-050-101	12	378	421	28	17.6	48	218.8	14.8	0.47	55.9	1.4
9001/02-175-100-101	12	197	222	54	17.6	94	437.5	4	0.47	15.7	1.4
9001/02-175-200-101	12	101	114	105	17.6	187	875	0.5	0.47	4.2	1.4
9001/02-196-150-101	16	148	167	95	19.8	142	735	1.3	0.33	7.2	0.99
9001/02-280-090-101	24	320	357	67	27.9	90	630	4.3	0.14	16.9	0.42
9001/02-412-095-101	36	456	509	70	41.4	93.6	978.5	- -	- -	15.7	0.18

CSA Information - Connections to Class 1, Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/02-016-015-101	0.7	119	134	5	1.6	15	6	160	100	560	1000
9001/02-016-050-101	0.7	38	43	16	1.6	50	20	15	100	56	1000
9001/02-016-050-111	0.7	39	40	17	1.6	50	20	15	100	56	1000
9001/02-016-150-101	0.7	– –	20	35	1.6	150	60	1.3	100	7	1000
9001/02-016-150-111	0.7	19	20	35	1.6	150	60	1.3	100	7	1000
9001/02-016-320-101	0.7	11	14	50	1.6	320	128	0.19	100	1.6	1000
9001/02-093-003-101	6	3141	3472	1,7	9.3	3	6.975	1000	4.1	1000	31
9001/02-093-030-101	6	319	354	16	9.3	30	69.75	40	4.1	150	31
9001/02-093-050-101	6	195	218	27	9.3	50	116.3	15	4.1	56	31
9001/02-093-075-101	6	148	165	36	9.3	75	174.4	6.7	4.1	25	31
9001/02-093-150-101	6	70	79	75	9.3	150	348.8	1.3	4.1	7	31
9001/02-093-390-101	6	– –	36	166	9.3	390	906.8	0.16	4.1	0.89	31
9001/02-133-150-101	10	102	115	86	13.3	150	498.8	1.3	0.91	7	5.6
9001/02-175-050-101	12	378	421	28	17.5	50	218.8	15	0.339	56	1.97
9001/02-175-100-101	12	197	222	54	17.5	100	437.5	4	0.339	15	1.97
9001/02-175-200-101	12	101	114	105	17.5	200	875	0.5	0.339	4	1.97
9001/02-196-150-101	16	148	167	95	19.6	150	735	1.3	0.235	7	1.47
9001/02-280-090-101	24	320	357	67	28	90	630	2.2	0.083	14	0.65
9001/02-412-095-101	36	456	509	70	41.2	95	978.5	- -	- -	9	0.287

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
								IIC		IIB	
	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	L_a mH	C_a µF	L_a mH	C_a µF
	V	Ω	Ω	mA	V	mA	mW				
9001/02-016-015-101	0.7	119	134	5	1.6	15	6	160	100	560	1000
9001/02-016-050-101	0.7	38	43	16	1.6	50	20	15	100	56	1000
9001/02-016-050-111	0.7	39	40	17	1.6	50	20	15	100	56	1000
9001/02-016-150-101	0.7	– –	20	35	1.6	150	60	1.3	100	7	1000
9001/02-016-150-111	0.7	19	20	35	1.6	150	60	1.3	100	7	1000
9001/02-016-320-101	0.7	11	14	50	1.6	320	128	0.19	100	1.6	1000
9001/02-093-003-101	6	3141	3472	1,7	9.3	3	6.975	1000	4.1	1000	31
9001/02-093-030-101	6	319	354	16	9.3	30	69.8	40	4.1	150	31
9001/02-093-050-101	6	195	218	27	9.3	50	116.3	15	4.1	56	31
9001/02-093-075-101	6	148	165	36	9.3	75	174.4	6.7	4.1	25	31
9001/02-093-150-101	6	70	79	75	9.3	150	348.8	1.3	4.1	7	31
9001/02-093-390-101	6	– –	36	166	9.3	390	906.8	0.16	4.1	0.89	31
9001/02-133-150-101	10	102	115	86	13.3	150	498.8	1.3	0.91	7	5.6
9001/02-175-050-101	12	378	421	28	17.5	50	219	15	0.339	56	1.97
9001/02-175-100-101	12	197	222	54	17.5	100	437.5	4	0.339	15	1.97
9001/02-175-200-101	12	101	114	105	17.5	200	875	0.5	0.339	4	1.97
9001/02-196-150-101	16	148	167	95	19.6	150	735	1.3	0.235	7	1.47
9001/02-280-090-101	24	320	357	67	28	90	630	2.2	0.083	14	0.65
9001/02-412-095-101	36	456	509	70	41.2	95	979	– –	– –	9	0.287



- Grounded circuit
- Suitable for AC and DC circuits
- Current limitation to < I_{max}
- Approved for installation in Division 2 and Zone 2

Technical Tips

- Not allowed for interfacing to field devices in gas groups A, B, E and IIC

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/02-217-390-101	16	63	72	< 80	< 1.4	21.7	390	2116	- -	- -	0.89	1.17
9001/02-308-230-101	24	143	162	< 65	< 1.4	30.8	230	1771	- -	- -	0.7	0.524

CSA Information - Connections to Class I, II, III, Division 1

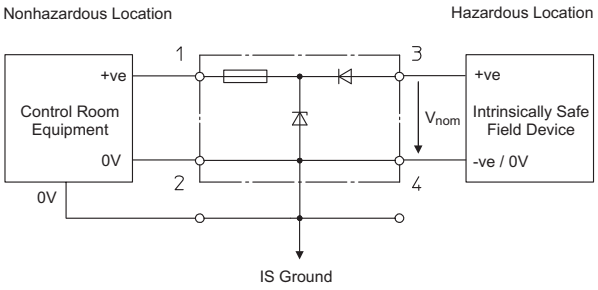
Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/02-217-390-101	16	63	72	< 80	< 1.4	21.4	383	2116	- -	- -	1	0.8
9001/02-308-230-101	24	143	162	< 65	< 1.4	31	232.6	1771	- -	- -	2.8	0.33

CSA Information - Connections to Class I, Zone 0

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/02-217-390-101	16	63	72	< 80	< 1.4	21.7	390	2116	- -	- -	0.89	1.17
9001/02-308-230-101	24	143	162	< 65	< 1.4	30.8	230	1771	- -	- -	0.7	0.524

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/02-217-390-101	16	63	72	< 80	< 1.4	21.7	390	2116	– –	– –	0.89	1.17
9001/02-308-230-101	24	143	162	< 65	< 1.4	30.8	230	1771	– –	– –	0.7	0.524



- Grounded circuit
- For DC current signal returns
- Current limitation to < I_{max}
- Various safety and operational characteristics as listed in the table below
- Approved for installation in Division 2 and Zone 2

Technical Tips

- Not short circuit proof
- T_a = 140 °F (60 °C) except for 9001/03-280-000-101 in FM / UL / ATEX installations where T_a = 122 °F (50 °C)

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/03-086-000-101	6	– –	– –	< 150	3.5	8.6	0	0	1000	6.2	1000	55
9001/03-168-000-101	12	– –	– –	< 100	3.5	16.8	0	0	1000	0.39	1000	2.29
9001/03-199-000-101	16	– –	– –	< 100	3.5	19.9	0	0	1000	0.223	1000	1.42
9001/03-280-000-101	24	– –	– –	< 100	3.5	28	0	0	50	0.083	50	0.65

CSA Information - Connections to Class I, II, III, Division 1

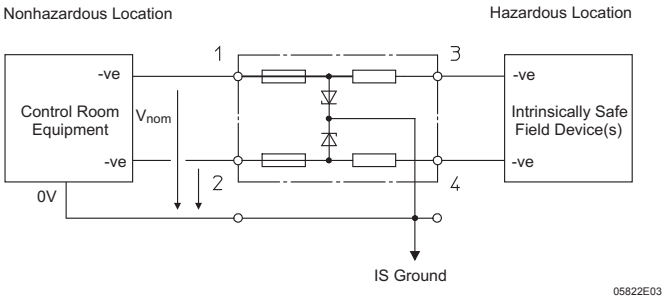
Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/03-086-000-101	6	– –	– –	< 150	3.5	8.6	0	0	1000	5.9	1000	17.6
9001/03-168-000-101	12	– –	– –	< 100	3.5	16.8	0	0	1000	0.59	1000	1.76
9001/03-199-000-101	16	– –	– –	< 100	3.5	19.8	0	0	1000	0.34	1000	1.02
9001/03-280-000-101	24	– –	– –	< 100	3.5	28	0	0	1000	0.14	1000	0.43

CSA Information - Connections to Class I, Zone 0

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/03-086-000-101	6	– –	– –	< 150	3.5	8.6	0	0	1000	6.2	1000	55
9001/03-168-000-101	12	– –	– –	< 100	3.5	16.8	0	0	1000	0.39	1000	2.29
9001/03-199-000-101	16	– –	– –	< 100	3.5	19.9	0	0	1000	0.223	1000	1.42
9001/03-280-000-101	24	– –	– –	< 100	3.5	28	0	0	50	0.083	50	0.65

ATEX Information - Connections to Zone 0

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9001/03-086-000-101	6	– –	– –	< 150	3.5	8.6	0	0	1000	6.2	1000	55
9001/03-168-000-101	12	– –	– –	< 100	3.5	16.8	0	0	1000	0.39	1000	2.29
9001/03-199-000-101	16	– –	– –	< 100	3.5	19.9	0	0	1000	0.223	1000	1.42
9001/03-280-000-101	24	– –	– –	< 100	3.5	28	0	0	50	0.083	50	0.65



- Allows the connection of regulated power supplies, V_{nom}, as listed in the table below.
- Various safety and operational characteristics as listed in the table below
- Approved for installation in Division 2 and Zone 2

Technical Tips When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/00-120-024-001	1	9	1043	1156	7.7	12	12	0.04	240	1.41	850	9
	2	9	1043	1156	7.7	12	12	0.04	2.4	1.41	850	9
	(a)	- -				12.7	24	0.07	63	1.1	230	7.1
9002/00-260-138-001	1	22.5	321	358	62	26	87	0.57	2.7	0.099	15.5	0.77
	2	17.5	416	463	37	20	51	0.26	14	0.22	54	1.41
	(a)	- -				27.4	138	0.85	0.81	0.087	5.1	0.67
9002/00-280-186-001	1	25	321	358	69	28	93	0.65	2	0.083	13	0.65
	2	25	321	358	69	28	93	0.65	2	0.083	13	0.65
	(a)	- -				30.1	186	1.3	- -	- -	2.8	0.551

CSA Information - Connections to Class I, II, III, Division 1

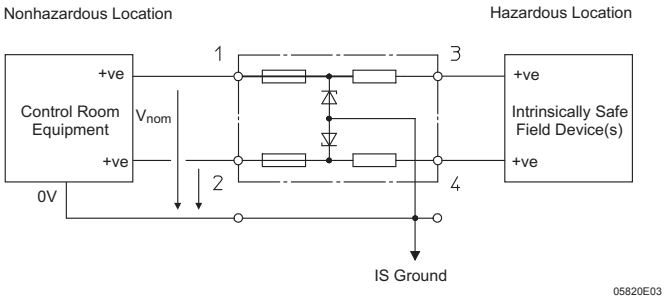
Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/00-120-024-001	1	9	1043	1156	7.7	11.6	11.4	0.04	247	1.8	862	5.5
	2	9	1043	1156	7.7	11.6	11.4	0.04	247	1.8	862	5.5
	(a)	- -				12.4	23	0.07	64	1.4	226	4.3
9002/00-260-138-001	1	22.5	321	358	62	25.8	82	0.57	5.3	0.17	21.0	0.5
	2	17.5	416	463	37	20.1	49	0.26	14.7	0.31	54.0	0.96
	(a)	- -				27.4	132	0.85	8.9	0.14	1.9	0.43
9002/00-280-186-001	1	25	321	358	69	28	91	0.65	4.5	0.14	18.1	0.43
	2	25	321	358	69	28	91	0.65	4.5	0.14	18.1	0.43
	(a)	- -				30.4	183	1.3	- -	- -	5.0	0.34

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/00-120-024-001	1	9	1043	1156	7.7	12	12	0.04	240	1.41	850	9
	2	9	1043	1156	7.7	12	12	0.04	2.40	1.41	850	9
	(a)	- -				12.7	24	0.07	63	1.1	230	7.1
9002/00-260-138-001	1	22.5	321	358	62	26	87	0.57	2.7	0.099	15.5	0.77
	2	17.5	416	463	37	20	51	0.26	14	0.22	54	1.41
	(a)	- -				27.4	138	0.85	0.81	0.087	5.1	0.67
9002/00-280-186-001	1	25	321	358	69	28	93	0.65	2	0.083	13	0.65
	2	25	321	358	69	28	93	0.65	2	0.083	13	0.65
	(a)	- -				30.1	186	1.3	- -	- -	2.8	0.551

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/00-120-024-001	1	9	1043	1156	7.7	12	12	40	240	1.41	850	9
	2	9	1043	1156	7.7	12	12	40	240	1.41	850	9
	(a)	- -				12	24	70	63	1.1	230	7.1
9002/00-260-138-001	1	22.5	321	358	62	26	87	570	2.7	0.099	15.4	0.77
	2	17.5	416	463	37	20	51	260	14	0.22	54	1.41
	(a)	- -				26	138	850	0.81	0.087	5.1	0.67
9002/00-280-186-001	1	25	321	358	69	28	93	650	2	0.083	13	0.65
	2	25	321	358	69	28	93	650	2	0.083	13	0.65
	(a)	- -				28	186	1300	- -	- -	2.8	0.551



- Allows the connection of regulated power supplies, V_{nom}, as listed in the table below.
- Various safety and operational characteristics as listed in the table below
- Approved for installation in Division 2 and Zone 2

Technical Tips When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-120-024-001	1	9	1043	1156	7.7	12	12	0.04	240	1.41	850	9
	2	9	1043	1156	7.7	12	12	0.04	2.4	1.41	850	9
	(a)	- -				12.7	24	0.07	63	1.1	230	7.1
9002/11-130-360-001	1	10	45	52	192	13	321	1.04	0.19	1	1.6	6.2
	2	1	45	52	19	1.6	39	0.016	24	100	91	1000
	(a)	- -				13.7	360	1.17	0.17	0.79	1.3	5
9002/11-137-029-001	1	10	953	978	10	13.7	14.5	0.05	160	0.79	560	5
	2	10	953	978	10	13.7	14.5	0.05	160	0.79	560	5
	(a)	- -				14.4	29	0.1	43	0.67	160	4.18
9002/11-199-030-001	1	16	1423	1576	10	19.9	15	0.075	160	0.223	560	1.42
	2	16	1423	1576	10	19.9	15	0.075	160	0.223	560	1.42
	(a)	- -				19.9	30	0.15	40	0.223	150	1.42
9002/11-260-138-001	1	22.5	321	358	62	26	87	0.57	2.7	0.099	15.5	0.77
	2	17.5	416	463	37	20	51	0.26	14	0.22	54	1.41
	(a)	- -				27.4	138	0.85	0.81	0.087	5.1	0.67
9002/11-280-186-001	1	25	321	358	69	28	93	0.65	2	0.083	13	0.65
	2	25	321	358	69	28	93	0.65	2	0.083	13	0.65
	(a)	- -				30.1	186	1.3	- -	- -	2.8	0.551
9002/11-280-293-001	1	25	321	358	69	28	89	0.63	2.2	0.083	14	0.65
	2	6	59	68	88	9.56	180	0.43	0.6	3.6	5	26
	(a)	- -				28.7	269	2.05	- -	- -	0.56	0.62

CSA Information - Connections to Class I, II, III, Division 1

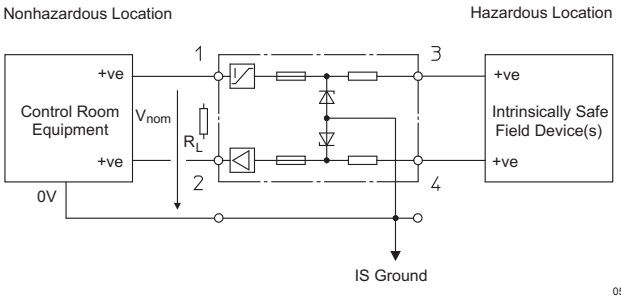
Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-120-024-001	1	9	1043	1156	7.7	11.6	11.4	0.04	247	1.8	862	5.5
	2	9	1043	1156	7.7	11.6	11.4	0.04	247	1.8	862	5.5
	(a)	- -				12.4	23	0.07	64	1.4	226	4.3
9002/11-130-360-001	1	10	45	52	192	13	321	1.04	0.19	1	1.6	6.2
	2	1	45	52	19	1.6	39	0.016	24	100	91	1000
	(a)	- -				13.7	360	1.17	0.17	0.79	1.3	5.0
9002/11-137-029-001	1	10	953	978	10	13.7	14.5	0.05	160	0.79	560	5.0
	2	10	953	978	10	13.7	14.5	0.05	160	0.79	560	5.0
	(a)	- -				14.4	29	0.1	43	0.67	160	4.18
9002/11-199-030-001	1	16	1423	1576	10	19.9	14.4	0.075	157	0.34	511	1.0
	2	16	1423	1576	10	19.9	14.4	0.075	157	0.34	511	1.0
	(a)	- -				20.7	29	0.15	40.5	0.30	149	0.9
9002/11-260-138-001	1	22.5	321	358	62	25.8	82	0.57	5.3	0.17	21.0	0.5
	2	17.5	416	463	37	20.1	49	0.26	14.7	0.32	54.0	0.96
	(a)	- -				27.4	132	0.85	1.9	0.14	8.9	0.43
9002/11-280-186-001	1	25	321	358	69	28	91	0.65	4.5	0.14	18.1	0.43
	2	25	321	358	69	28	91	0.65	4.5	0.14	18.1	0.43
	(a)	- -				30.4	183	1.3	- -	- -	5.0	0.34
9002/11-280-293-001	1	25	321	358	69	28	91	0.63	4.5	0.14	18.1	0.43
	2	6	59	68	88	9.6	181	0.43	0.7	4.2	5.2	12.7
	(a)	- -				28.8	272	2.05	0.23	0.13	2.2	0.4

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-120-024-001	1	9	1043	1156	7.7	12	12	0.04	240	1.41	850	9
	2	9	1043	1156	7.7	12	12	0.04	2.40	1.41	850	9
	(a)	- -				12.7	24	0.07	63	1.1	230	7.1
9002/11-130-360-001	1	10	45	52	192	13	321	1.04	0.19	1	1.6	6.2
	2	1	45	52	19	1.6	39	0.016	24	100	91	1000
	(a)	- -				13.7	360	1.17	0.17	0.79	1.3	5
9002/11-137-029-001	1	10	953	978	10	13.7	14.5	0.05	160	0.79	560	5
	2	10	953	978	10	13.7	14.5	0.05	160	0.79	560	5
	(a)	- -				14.4	29	0.1	43	0.67	160	4.18
9002/11-199-030-001	1	16	1423	1576	10	19.9	15	0.075	160	0.223	560	1.42
	2	16	1423	1576	10	19.9	15	0.075	160	0.223	560	1.42
	(a)	- -				19.9	30	0.15	40	0.223	150	1.42
9002/11-260-138-001	1	22.5	321	358	62	26	87	0.57	2.7	0.099	15.5	0.77
	2	17.5	416	463	37	20	51	0.26	14	0.22	54	1.41
	(a)	- -				27.4	138	0.85	0.81	0.087	5.1	0.67
9002/11-280-186-001	1	25	321	358	69	28	93	0.65	2	0.083	13	0.65
	2	25	321	358	69	28	93	0.65	2	0.083	13	0.65
	(a)	- -				30.1	186	1.3	- -	- -	2.8	0.551
9002/11-280-293-001	1	25	321	358	69	28	89	0.63	2.2	0.083	14	0.65
	2	6	59	68	88	9.56	180	0.43	0.6	3.6	5	26
	(a)	- -				28.7	269	2.05	- -	- -	0.56	0.62

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-120-024-001	1	9	1043	1156	7.7	12	12	40	240	1.41	850	9
	2	9	1043	1156	7.7	12	12	40	240	1.41	850	9
	(a)	- -				12	24	70	63	1.1	230	7.1
9002/11-130-360-001	1	10	45	52	192	13	321	1040	0.19	1	1.6	6
	2	1	45	52	19	1.6	39	16	24	100	91	100
	(a)	- -				13	360	1170	0.17	0.79	1.3	5
9002/11-137-029-001	1	10	953	978	10	13.7	14.5	50	160	0.79	560	5
	2	10	953	978	10	13.7	14.5	50	160	0.79	560	5
	(a)	- -				13.7	29	100	43	0.67	160	4.18
9002/11-199-030-001	1	16	1423	1576	10	19.9	15	75	160	0.223	560	1.42
	2	16	1423	1576	10	19.9	15	75	160	0.223	560	1.42
	(a)	- -				19.9	30	150	40	0.223	150	1.42
9002/11-260-138-001	1	22.5	321	358	62	26	87	570	2.7	0.099	15.4	0.77
	2	17.5	416	463	37	20	51	260	14	0.22	54	1.41
	(a)	- -				26	138	850	0.81	0.087	5.1	0.67
9002/11-280-186-001	1	25	321	358	69	28	93	650	2	0.083	13	0.65
	2	25	321	358	69	28	93	650	2	0.083	13	0.65
	(a)	- -				28	186	1300	- -	- -	2.8	0.551
9002/11-280-293-001	1	25	321	358	69	28	89	630	2.2	0.083	14	0.65
	2	6	59	68	88	9.6	180	430	0.6	3.6	5	26
	(a)	- -				28	269	1050	- -	- -	0.56	0.62



- Application specific for the connection of 3-wire NPN, voltage output sensors
- Low operational current
- Approved for installation in Division 2 and Zone 2

Technical Tips When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-280-112-001	1	24	264	296	8	28	109	0.76	1.3	0.083	9	0.65
	2	24	11979	12221	23	28	3	0.02	50	0.083	150	0.65
	(a)	- -				30.1	112	0.78	0.76	0.065	8.4	0.551

CSA Information - Connections to Class I, II, III, Division 1

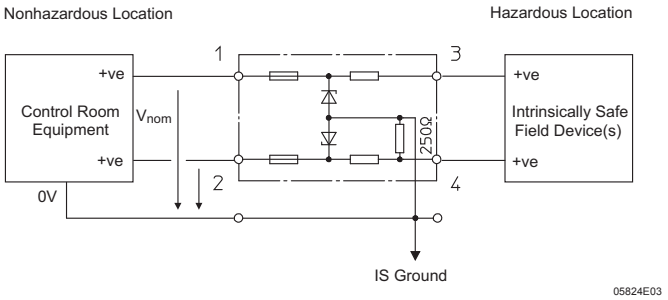
Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-280-112-001	1	24	264	296	8	28	109	0.76	1.3	0.083	9	0.65
	2	24	11979	12221	23	28	3	0.02	50	0.083	150	0.65
	(a)	- -				V30.1	112	0.78	0.76	0.065	8.4	0.551

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-280-112-001	1	24	264	296	8	28	109	0.76	1.3	0.083	9	0.65
	2	24	11979	12221	23	28	3	0.02	50	0.083	150	0.65
	(a)	- -				30.1	112	0.78	0.76	0.065	8.4	0.551

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-280-112-001	1	24	264	296	8	28	109	760	1.3	0,083	9	0.65
	2	24	11979	12221	23	28	3	20	1.3	0,083	150	0.65
	(a)	- -				28	112	780	0.76	0,065	84	0.551



- Application specific for 4/20 mA transmitters with a 1-5 V input in the control room.
- Design includes high tolerance 250 Ω resistor
- Approved for installation in Division 2 and Zone 2

Technical Tips

When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.
Only CSA has approved this device to interface to field devices in gas groups A, B or E.

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-280-293-021	1	25	321	358	69	28	89	0.63	2.2	0.083	14	0.65
	2	6	59	68	88	9.56	180	0.43	0.6	3.6	5	26
	(a)	- -				28.7	269	2.05	- -	- -	0.56	0.62

CSA Information - Connections to Class I, II, III, Division 1

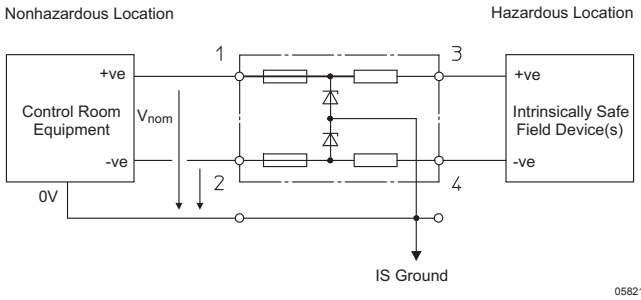
Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-280-293-021	1	25	321	358	69	28	91	0.63	4.5	0.14	18.1	0.43
	2	6	59	68	88	9.6	181	0.43	0.7	4.2	5.2	12.7
	(a)	- -				28.8	272	1.05	0.23	0.13	2.2	0.4

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-280-293-021	1	25	321	358	69	28	89	0.63	2.2	0.083	14	0.65
	2	6	59	68	88	9.56	180	0.43	0.6	3.6	5	26
	(a)	- -				28.7	269	1.05	- -	- -	0.56	0.62

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/11-280-293-021	1	25	321	358	69	28	89	630	2.2	0.083	14	0.65
	2	6	59	68	88	9.6	180	430	0.6	3.6	5	26
	(a)	- -				28	269	1050	- -	- -	0.56	0.62



- Application specific for use with strain gauge load cells
- One positive polarity channel and one negative polarity channel in one unit
- Approved for installation in Division 2 and Zone 2

Technical Tips When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/10-187-020-001	1	+ 6	490	543	11	9.33	20	0.005	90	3.9	330	29
	2	- 6	490	543	11	9.33	20	0.005	90	3.9	330	29
	(a)	- -				18.7	20	0.009	90	0.27	330	1.64
9002/10-187-270-001	1	+ 6	42	49	122	9.33	270	0.063	0.23	3.9	2.2	29
	2	- 6	42	49	122	9.33	270	0.063	0.23	3.9	2.2	29
	(a)	- -				18.7	270	1.26	0.23	0.27	2.2	1.64

CSA Information - Connections to Class I, II, III, Division 1

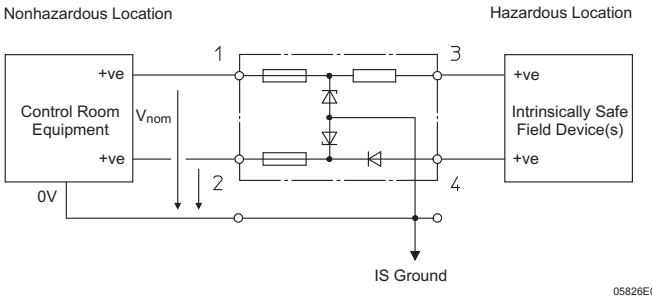
Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/10-187-020-001	1	+ 6	490	543	11	9.3	19.8	0.005	83.4	4.3	301	12.9
	2	- 6	490	543	11	9.3	19.8	0.005	83.4	4.3	301	12.9
	(a)	- -				18.7	22	0.009	68.3	0.39	248	1.17
9002/10-187-270-001	1	+ 6	42	49	122	9.3	251.8	0.63	0.27	4.3	2.4	12.9
	2	- 6	42	49	122	9.3	251.8	0.63	0.27	4.3	2.4	12.9
	(a)	- -				18.7	278.8	1.26	0.21	0.39	2.0	1.17

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/10-187-020-001	1	+ 6	490	543	11	9.33	20	0.005	90	3.9	330	29
	2	- 6	490	543	11	9.33	20	0.005	90	3.9	330	29
	(a)	- -				18.7	20	0.009	90	0.27	330	1.64
9002/10-187-270-001	1	+ 6	42	49	122	9.33	270	0.63	0.23	3.9	2.2	29
	2	- 6	42	49	122	9.33	270	0.63	0.23	3.9	2.2	29
	(a)	- -				18.7	270	1.26	0.23	0.27	2.2	1.64

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/10-187-020-001	1	+ 6	490	543	11	9.3	20	500	90	3.9	330	29
	2	- 6	490	543	11	9.3	20	500	90	3.9	330	29
	(a)	- -				18.7	20	900	90	0.27	330	1.64
9002/10-187-270-001	1	+ 6	42	49	122	9.3	270	630	0.23	3.9	2.2	29
	2	- 6	42	49	122	9.3	270	630	0.23	3.9	2.2	29
	(a)	- -				18.7	270	1260	0.23	0.27	2.2	1.64



- Diode return barrier for supply and return signals in one unit with very small entity current (I_{SC}) addition from the second channel
- Allows the connection of regulated power supplies, V_{nom}, as listed in the table below
- Various safety and operational characteristics as listed in the table below
- Approved for installation in Division 2 and Zone 2

Technical Tips

When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.
Not suitable for voltage signals or resistive sensors
Maximum leakage current through channel 2 ≤ 10 µA

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-199-225-001	1	16	95	108	148	- -	19.9	222	1.1	0.39	0.223	3.18	1.42
	2	16				2	19.9	3	0.015	1000	0.223	1000	1.42
	(a)	- -					20.2	225	1.12	0.37	0.213	3.15	1.38
9002/13-280-093-001	1	24	321	358	67	- -	28	90	0.63	2.2	0.083	14	0.65
	2	24				2	28	3	0.021	50	0.083	150	0.65
	(a)	- -					28.3	93	0.651	2	0.08	13	0.636
9002/13-280-110-001	1	24	269	290	82	- -	28	107	0.749	1.35	0.083	9.6	0.65
	2	24		- -		2	28	3	0.021	50	0.083	150	0.65
	(a)	- -					28.3	110	0.77	1.25	0.08	9	0.635

CSA Information - Connections to Class I, II, III, Division 1

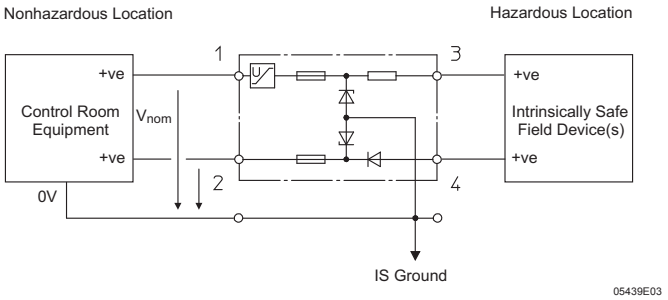
Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-199-225-001	1	16	95	108	148	- -	19.8	220.3	1.1	0.35	0.33	3.1	1.0
	2	16				2	8.6	0	0.015	1000	5.5	1000	16.5
	(a)	- -					20.7	221	1.12	0.35	0.30	2.8	0.9
9002/13-280-093-001	1	24	321	358	67	- -	28	91	0.63	4.4	0.14	17.2	0.43
	2	24				2	28	0	0.021	1000	0.14	1000	0.43
	(a)	- -					30.4	91	0.651	4.4	0.1	17.2	0.3
9002/13-280-110-001	1	24	269	290	82	- -	28	110	0.749	2.9	0.13	11.6	0.39
	2	24		- -		2	28	0	0.021	1000	0.13	1000	0.39
	(a)	- -					28.8	110	0.77	2.9	0.11	11.6	0.33

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-199-225-001	1	16	95	108	148	- -	19.9	222	1.1	0.39	0.223	3.18	1.42
	2	16				2	19.9	3	0.015	1000	0.223	1000	1.42
	(a)	- -					20.2	225	1.12	0.37	0.213	3.15	1.38
9002/13-280-093-001	1	24	321	358	67	- -	28	90	0.63	2.2	0.083	14	0.065
	2	24				2	28	3	0.021	50	0.083	150	0.65
	(a)	- -					28.3	93	0.651	2	0.08	13	0.636
9002/13-280-110-001	1	24	269	290	82	- -	28	107	0.749	1.35	0.083	9.6	0.65
	2	24		- -		2	28	3	0.021	50	0.083	150	0.65
	(a)	- -					28.3	110	0.77	1.25	0.08	9	0.635

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-199-225-001	1	16	95	108	148	- -	19.9	222	1100	0.39	0.223	3.18	1.42
	2	16				2	19.9	3	15	1000	0.223	1000	1.42
	(a)	- -					19.9	225	1120	0.37	0.213	3.15	1.38
9002/13-280-093-001	1	24	321	358	67	- -	28	90	630	2.2	0.083	14	0.65
	2	24				2	28	3	21	50	0.083	150	0.65
	(a)	- -					28	93	651	2	0.08	13	0.636
9002/13-280-110-001	1	24	269	290	82	- -	28	107	749	1.35	0.083	9.6	0.65
	2	24		- -		2	28	3	21	50	0.083	150	0.65
	(a)	- -					28	110	770	1.25	0.08	9	0.635



- Diode return barrier for supply and return signals in one unit with very small entity current (I_{SC}) addition from the second channel
- Operational current limited to 40 mA at 250 Ω load
- Allows the connection of unregulated power supplies, V_{nom}, to channel 1
- Approved for installation in Division 2 and Zone 2

Technical Tips

When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.
Not suitable for voltage signals or resistive sensors
Maximum leakage current at 24 V ≤ 1 mA
Maximum leakage current at 35 V ≤ 10 mA

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-252-121-041	1	20 - 35	216	243	144	- -	25.2	118	0.74	1.3	0.107	7.4	0.82
	2	22				3.5	25.2	0	0.02	50	0.107	150	0.82
	(a)	- -					25.5	121	0.76	1.25	0.104	7.35	0.8

CSA Information - Connections to Class I, II, III, Division 1

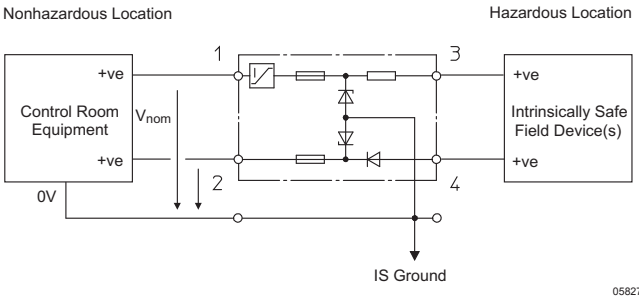
Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-252-121-041	1	20 - 35	216	243	144	- -	25.1	120.1	0.74	2.5	0.17	9.8	0.51
	2	22				3.5	25.1	0	0.02	1000	0.17	1000	0.51
	(a)	- -					25.9	120	0.76	2.5	0.14	9.8	0.42

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-252-121-041	1	20 - 35	216	243	144	- -	25.2	118	0.74	1.3	0.107	7.4	0.82
	2	22				3.5	25.2	0	0.02	50	0.107	150	0.82
	(a)	- -					25.5	121	0.76	1.25	0.104	7.35	0.8

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-252-121-041	1	20 - 35	216	243	144	- -	25.2	118	740	1.3	0.107	7.4	0.82
	2	22				3.5	25.2	0	20	50	0.107	150	0.82
	(a)	- -					25.2	121	760	1.25	0.104	7.35	0.8



- Diode return barrier for supply and return signals in one unit with very small entity current (I_{SC}) addition from the second channel
- Allows the connection of unregulated power supplies, V_{nom}, to channel 1
- Operational current limited to 35 mA
- Approved for installation in Division 2 and Zone 2

Technical Tips

When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.
Not suitable for voltage signals or resistive sensors
Maximum leakage current at < 26 V ≤ 1 mA
Maximum leakage current at > 26 V ≤ 35 mA

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-280-100-041	1	20 - 35	292	327	107	- -	28	97	0.68	1.8	0.083	12	0.65
	2	26				3.5	28	0	0.02	50	0.083	150	0.65
	(a)	- -					28.3	100	1	1.55	0.08	11	0.635
									0.7				

CSA Information - Connections to Class I, II, III, Division 1

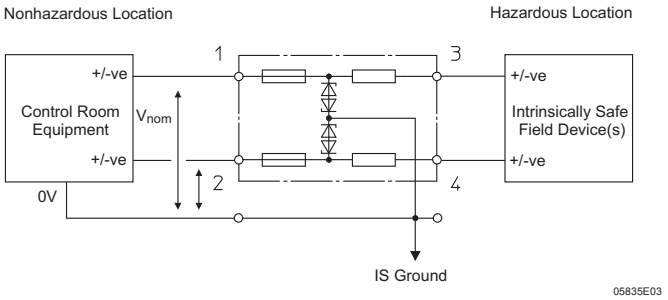
Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-280-100-041	1	20 - 35	292	327	107	- -	28	99	0.68	3.7	0.13	14.4	0.39
	2	26				3.5	28	0	0.02	1000	0.13	1000	0.39
	(a)	- -					28.8	99	1	3.7	0.11	14.4	0.33
									0.7				

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-280-100-041	1	20 - 35	292	327	107	- -	28	97	0.68	1.8	0.083	12	0.65
	2	26				3.5	28	0	0.02	50	0.083	150	0.65
	(a)	- -					28.3	100	1	1.55	0.08	11	0.635
									0.7				

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/13-280-100-041	1	20 - 35	292	327	107	- -	28	97	679	1.8	0.083	12	0.65
	2	26				3.5	28	0	21	50	0.083	150	0.65
	(a)	- -					28	100	700	1.55	0.08	11	0.635



- Application specific for the connection of RTDs
- High resistance tolerance in each channel, 20 Ω ± 0.1
- Low temperature coefficient < 50 ppm/K
- Allows the connection of regulated power supplies, V_{nom}
- Approved for installation in Division 2 and Zone 2

Technical Tips

When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.
Maximum leakage ≤ 10 µA
One channel required for each RTD leg.

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 1

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/22-032-300-111	1	0.7	19	20.1	33	1.6	150	0.06	1.3	100	7	1000
	2	0.7	19	20.1	33	1.6	150	0.06	1.3	100	7	1000
	(a)	1.4				3.2	300	0.12	0.2	100	1.8	1000

CSA Information - Connections to Class I, II, III, Division 1

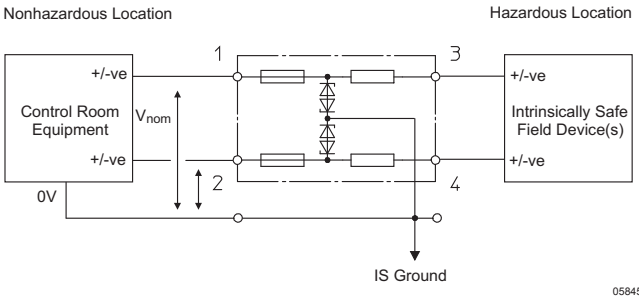
Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/22-032-300-111	1	0.7	19	20.1	33	1.6	155	0.06	2.2	1800	8.7	1800
	2	0.7	19	20.1	33	1.6	155	0.06	2.2	1800	8.7	1800
	(a)	1.4				3.2	311	0.12	0.26	1800	2.3	1800

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/22-032-300-111	1	0.7	19	20.1	33	1.6	150	0.06	1.3	100	7	1000
	2	0.7	19	20.1	33	1.6	150	0.06	1.3	100	7	1000
	(a)	1.4				3.2	300	0.12	0.2	100	1.8	1000

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/22-032-300-111	1	0.7	19	20.1	33	1.6	150	60	1.3	100	7	1000
	2	0.7	19	20.1	33	1.6	150	60	1.3	100	7	1000
	(a)	1.4				3.2	300	120	0.2	100	1.8	1000



- Allows the connection of regulated power supplies, V_{nom}, as listed in the table below.
- Various safety and operational characteristcs as listed in the table below
- Approved for installation in Division 2 and Zone 2

Technical Tips When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/22-158-200-001	1	5.5	84	95	57	7.9	100	0.198	4	8.8	15	115
	2	5.5	84	95	57	7.9	100	0.198	4	8.8	15	115
	(a)	11				15.8	200	0.395	0.5	0.478	4	2.88
9002/22-240-024-001	1	9	1043	1156	7.7	12	12	0.04	240	1.41	850	9
	2	9	1043	1156	7.7	12	12	0.04	240	1.41	850	9
	(a)	18				24	24	0.08	41	0.125	145	0.93
9002/22-240-160-001	1	9	158	177	50	12	80	0.24	6	1.41	22	9
	2	9	158	177	50	12	80	0.24	6	1.41	22	9
	(a)	18				24	160	0.48	0.7	0.125	4	0.93

CSA Information - Connections to Class I, II, III, Division 1

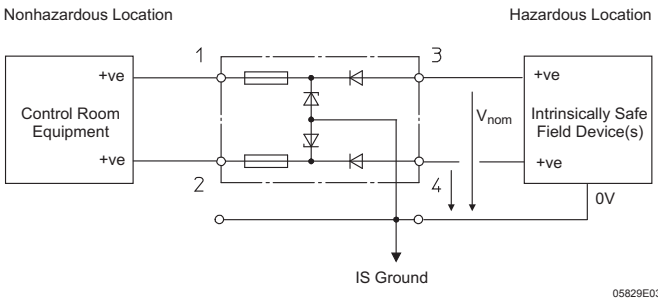
Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/22-158-200-001	1	5.5	84	95	57	7.9	100	0.198	4.0	8.8	15	115
	2	5.5	84	95	57	7.9	100	0.198	4.0	8.8	15	115
	(a)	11				15.8	200	0.395	0.5	0.478	4	2.88
9002/22-240-024-001	1	9	1043	1156	7.7	11.3	11.4	0.04	258	2.0	899	6.0
	2	9	1043	1156	7.7	11.3	1.9	0.04	258	2.0	899	6.0
	(a)	18				22.6	23	0.08	67	0.23	236	0.7
9002/22-240-160-001	1	9	158	177	50	11.3	76	0.24	6.5	2.0	25	6.0
	2	9	158	177	50	11.3	1.9	0.24	6.5	2.0	25	6.0
	(a)	18				22.6	152	0.48	1.2	0.23	7.1	0.7

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/22-158-200-001	1	5.5	84	95	57	7.9	100	0.198	4.0	8.8	15	115
	2	5.5	84	95	57	7.9	100	0.198	4.0	8.8	15	115
	(a)	11				15.8	200	0.395	0.5	0.478	4	2.88
9002/22-240-024-001	1	9	1043	1156	7.7	12	12	0.04	240	1.41	850	9
	2	9	1043	1156	7.7	12	12	0.04	240	1.41	850	9
	(a)	18				24	24	0.08	41	0.125	145	0.93
9002/22-240-160-001	1	9	158	177	50	12	80	0.24	6	1.41	22	9
	2	9	158	177	50	12	80	0.24	6	1.41	22	9
	(a)	18				24	160	0.48	0.7	0.125	4	0.93

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics				Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/22-158-200-001	1	5.5	84	95	57	7.9	100	198	4	8.8	15	115
	2	5.5	84	95	57	7.9	100	198	4	8.8	15	115
	(a)	11				15.8	200	395	0.5	0.478	4	2.88
9002/22-240-024-001	1	9	1043	1156	7.7	12	12	40	240	1.41	850	9
	2	9	1043	1156	7.7	12	12	40	240	1.41	850	9
	(a)	18				24	24	80	41	0.125	145	0.93
9002/22-240-160-001	1	9	158	177	50	12	80	240	6	1.41	22	9
	2	9	158	177	50	12	80	240	6	1.41	22	9
	(a)	18				24	160	480	0.7	0.125	4	0.93



- Diode return barrier for DC current return signals with very small entity current (I_{SC}) addition
- Suitable for dry contact and floating 4/20 mA signal returns
- Both channels are positive polarity.
- Approved for installation in Division 2 and Zone 2

Technical Tips

When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.
Not suitable for voltage sognals or resistive sensors
$\triangle V$ = 2.5 up to 20 mA

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/33-280-000-001	1	25.5	Diode	Diode	60	3.5	28	0	0	1000	0.083	1000	0.65
	2	25.5	Diode	Diode	60	3.5	28	0	0	1000	0.083	1000	0.65
	(a)	- -					28	0	0	1000	0.083	1000	0.65

CSA Information - Connections to Class I, II, III, Division 1

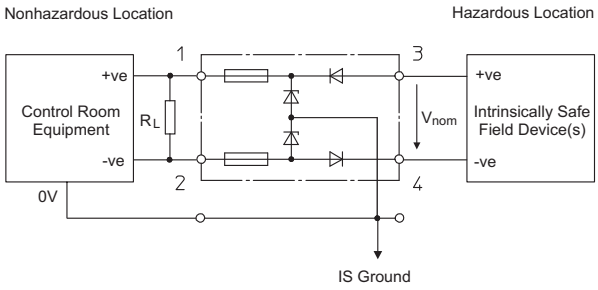
Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/33-280-000-001	1	25.5	Diode	Diode	60	3.5	28	0	0	1000	0.14	1000	0.43
	2	25.5	Diode	Diode	60	3.5	28	0	0	1000	0.14	1000	0.43
	(a)	- -					28.5	0	0	1000	0.14	1000	0.4

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/33-280-000-001	1	25.5	Diode	Diode	60	3.5	28	0	0	1000	0.083	1000	0.65
	2	25.5	Diode	Diode	60	3.5	28	0	0	1000	0.083	1000	0.65
	(a)	- -					28	0	0	1000	0.083	1000	0.65

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/33-280-000-001	1	25.5	Diode	Diode	60	3.5	28	0	0	1000	0.083	1000	0.65
	2	25.5	Diode	Diode	60	3.5	28	0	0	1000	0.083	1000	0.65
	(a)	- -					28	0	0	1000	0.083	1000	0.65



- Diode return barrier for DC current return signals with very small entity current (I_{SC}) addition
- Application specific for passive 4/20 mA signals (from 4-wire transmitters) with isolated analog input at the control system
- One positive polarity channel and one negative polarity channel
- Approved for installation in Divison 2 and Zone 2

Technical Tips

When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.
Not suitable for voltage signals or resistive sensors
ΔV = 2.5 V up to 20 mA

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/34-280-000-001	1	+ 16	Diode	Diode	100	3.5	20	0	0	1000	0.22	1000	1.41
	2	- 5	Diode	Diode	100	3.5	8	0	0	1000	8.4	1000	100
	(a)	21					28	0	0	1000	0.083	1000	0.65

CSA Information - Connections to Class I, II, III, Division 1

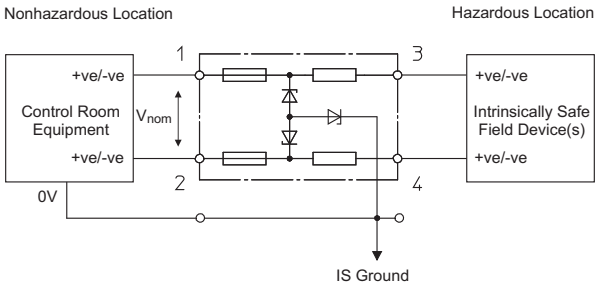
Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/34-280-000-001	1	+ 16	Diode	Diode	100	3.5	19.8	0	0	1000	0.33	1000	1.0
	2	- 5	Diode	Diode	100	3.5	7.9	0	0.06	1000	9.1	1000	27.4
	(a)	21					27.7	0	0	1000	0.14	1000	0.42

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	mA	V	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/34-280-000-001	1	+ 16	Diode	Diode	100	3.5	20	0	0	1000	0.22	1000	1.41
	2	- 5	Diode	Diode	100	3.5	8	0	0	1000	8.4	1000	100
	(a)	21					28	0	0	1000	0.083	160	0.65

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/34-280-000-001	1	+ 16	Diode	Diode	100	3.5	28	0	0	1000	0.22	1000	1.14
	2	- 5	Diode	Diode	100	3.5	8	0	0	1000	8.4	1000	100
	(a)	21					28	0	0	1000	0.083	1000	0.65



- Allows the connection of a voltage, V_{nom}, between the two channels as listed in the table below
- Suitable for voltage signals
- Various safety and operational characteristics as listed in the table below
- Approved for installation in Division 2 and Zone 2

Technical Tips

When two channels of one barrier are connected together to one field device with no isolation between the channels, the resultant entity parameters, V_T, I_T, P_O, and cable parameters, must be used and are as listed in row (a) for each barrier.
High cable capacitance or inductance figures are available due to the two channels in a star connected barrier being interlocked.
The polarity of the voltage must be equal on each channel, i.e. both +DC, both -DC or both AC.
Mixing polarity is not allowed.
9002/77-220-296-001 has not been approved by CSA to interface to field devices in gas groups A, B or E.

FM / UL Information - Connections to Class I, II, III, Division 1 or Class I, Zone 0

Order Code		Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
		V	Ω	Ω	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/77-093-040-001	1	- -	492	545	9.3	20	0.05	90	4.1	330	31
	2	- -	492	545	9.3	20	0.05	90	4.1	330	31
	(a)	6			9.3	40	0.09	23	4.1	87	31
9002/77-093-300-001	1	- -	71	82.1	9.3	150	0.35	1.3	4.1	7	31
	2	- -	71	82.1	9.3	150	0.35	1.3	4.1	7	31
	(a)	6			9.3	300	0.7	0.2	4.1	1.8	31
9002/77-100-400-001	1	- -	60	69.2	10	200	0.5	0.5	3	4	20.2
	2	- -	60	69.2	10	200	0.5	0.5	3	4	20.2
	(a)	6			10	400	1	0.15	3	0.8	20.2
9002/77-150-300-001	1	- -	111	126	15	150	0.56	1.3	0.58	7	3.55
	2	- -	111	126	15	150	0.56	1.3	0.58	7	3.55
	(a)	12			15	300	1.13	0.2	0.58	1.8	3.55
9002/77-220-146-001	1	- -	321	358	22	73	0.4	7	0.165	26	1.14
	2	- -	321	358	22	73	0.4	7	0.165	26	1.14
	(a)	18			22	146	0.8	1.4	0.165	7.4	1.14
9002/77-220-296-001	1	- -	159	180	22	148	0.81	1.35	0.165	7.2	1.14
	2	- -	159	180	22	148	0.81	1.35	0.165	7.2	1.14
	(a)	18			22	296	1.63	0.24	0.165	1.84	1.14
9002/77-280-094-001	1	- -	657	730	28	47	0.33	10.1	0.083	30	0.65
	2	- -	657	730	28	47	0.33	10.1	0.083	30	0.65
	(a)	24			28	94	0.66	1.96	0.083	12.5	0.65

CSA Information - Connections to Class I, II, III, Division 1

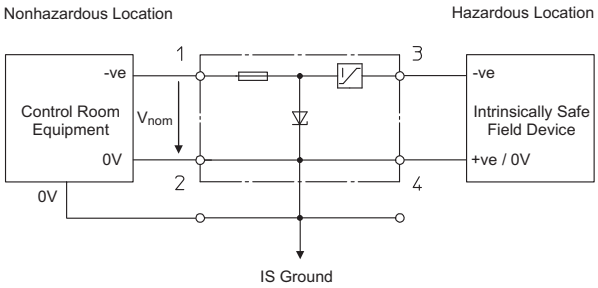
Order Code		Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	A, B, E		C, D, F, G	
		V	Ω	Ω	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/77-093-040-001	1	- -	492	545	9.3	20	0.05	90	4.1	330	31
	2	- -	492	545	9.3	20	0.05	90	4.1	330	31
	(a)	6			9.3	40	0.09	23	4.1	87	31
9002/77-093-300-001	1	- -	71	82.1	9.3	150	0.35	1.3	4.1	7	31
	2	- -	71	82.1	9.3	150	0.35	1.3	4.1	7	31
	(a)	6			9.3	300	0.7	0.2	4.1	1.8	31
9002/77-100-400-001	1	- -	60	69.2	9.9	190	0.5	0.59	3.3	4.6	9.9
	2	- -	60	69.2	9.9	190	0.5	0.59	3.3	4.6	9.9
	(a)	6			9.9	380	1	0.16	3.3	0.9	9.9
9002/77-150-300-001	1	- -	111	126	14.5	140	0.56	1.6	0.85	8.1	2.5
	2	- -	111	126	14.5	140	0.56	1.6	0.85	8.1	2.5
	(a)	12			14.5	280	1.13	0.21	0.85	2.0	2.5
9002/77-220-146-001	1	- -	321	358	21.8	70	0.4	7.4	0.25	28.5	0.76
	2	- -	321	358	21.8	70	0.4	7.4	0.25	28.5	0.76
	(a)	18			21.8	140	0.8	1.6	0.25	8.1	0.76
9002/77-220-296-001	1	- -	159	180	21.8	145	0.81	1.4	0.25	7.6	0.76
	2	- -	159	180	21.8	145	0.81	1.4	0.25	7.6	0.76
	(a)	18			21.8	290	1.63	- -	- -	1.8	0.76
9002/77-280-094-001	1	- -	657	730	28.1	44	0.33	18.5	0.14	67	0.41
	2	- -	657	730	28.1	44	0.33	18.5	0.14	67	0.41
	(a)	24			28.1	88	0.66	4.8	0.14	19.0	0.4

CSA Information - Connections to Class I, Zone 0

Order Code		Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
		V	Ω	Ω	V	mA	W	L_a mH	C_a µF	L_a mH	C_a µF
9002/77-093-040-001	1	- -	492	545	9.3	20	0.05	90	4.1	330	31
	2	- -	492	545	9.3	20	0.05	90	4.1	330	31
	(a)	6			9.3	40	0.09	23	4.1	87	31
9002/77-093-300-001	1	- -	71	82.1	9.3	150	0.35	1.3	4.1	7	31
	2	- -	71	82.1	9.3	150	0.35	1.3	4.1	7	31
	(a)	6			9.3	300	0.7	0.2	4.1	1.8	31
9002/77-100-400-001	1	- -	60	69.2	10	200	0.5	0.5	3	4	20.2
	2	- -	60	69.2	10	200	0.5	0.5	3	4	20.2
	(a)	6			10	400	1	0.15	3	0.8	20.2
9002/77-150-300-001	1	- -	111	126	15	150	0.56	1.3	0.58	7	3.55
	2	- -	111	126	15	150	0.56	1.3	0.58	7	3.55
	(a)	12			15	300	1.13	0.2	0.58	1.8	3.55
9002/77-220-146-001	1	- -	321	358	15	73	0.4	7	0.165	26	1.14
	2	- -	321	358	15	73	0.4	7	0.165	26	1.14
	(a)	18			15	146	0.8	1.4	0.165	7.4	1.14
9002/77-220-296-001	1	- -	159	180	22	148	0.81	1.35	0.165	7.2	1.14
	2	- -	159	180	22	148	0.81	1.35	0.165	7.2	1.14
	(a)	18			22	296	1.63	0.24	0.165	1.84	1.14
9002/77-280-094-001	1	- -	657	730	28	47	0.33	10.1	0.083	30	0.65
	2	- -	657	730	28	47	0.33	10.1	0.083	30	0.65
	(a)	24			28	94	0.66	1.96	0.083	12.5	0.65

ATEX Information - Connections to Zone 0

Order Code		Operational Characteristics			Entity Parameters			Gas Group Cable Parameters			
	ch	V_{nom}	R_{min}	R_{max}	V_{OC}	I_{SC}	P_O	IIC		IIB	
		V	Ω	Ω	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9002/77-093-040-001	1	- -	492	545	9.3	20	50	90	4.1	330	31
	2	- -	492	545	9.3	20	50	90	4.1	330	31
	(a)	6			9.3	40	90	23	4.1	87	31
9002/77-093-300-001	1	- -	71	82.1	9.3	150	350	1.3	4.1	7	31
	2	- -	71	82.1	9.3	150	350	1.3	4.1	7	31
	(a)	6			9.3	300	700	0.2	4.1	1.8	31
9002/77-100-400-001	1	- -	60	69.2	10	200	500	0.5	3	4	20.2
	2	- -	60	69.2	10	200	500	0.5	3	4	20.2
	(a)	6			10	400	1000	0.15	3	0.8	20.2
9002/77-150-300-001	1	- -	111	126	15	150	560	1.3	0.58	7	3.55
	2	- -	111	126	15	150	560	1.3	0.58	7	3.55
	(a)	12			15	300	1130	0.2	0.58	1.8	3.55
9002/77-220-146-001	1	- -	321	358	22	73	400	7	0.165	26	1.14
	2	- -	321	358	22	73	400	7	0.165	26	1.14
	(a)	18			22	146	800	1.4	0.165	7.4	1.14
9002/77-220-296-001	1	- -	159	180	22	148	810	1.35	0.165	7.2	1.14
	2	- -	159	180	22	148	810	1.35	0.165	7.2	1.14
	(a)	18			22	296	1630	0.24	0.165	1.84	1.14
9002/77-280-094-001	1	- -	657	730	28	47	330	10.1	0.083	30	0.65
	2	- -	657	730	28	47	330	10.1	0.083	30	0.65
	(a)	24			28	94	660	1.96	0.083	12.5	0.65



- Electronic current limitation
- Grounded circuit
- Approved for installation in Division 2 and Zone 2

Technical Tips

These devices are not approved by UL.
CSA has not approved these devices for installation in or interfacing to field devices in hazardous locations classed as Divisions.
Approval for interfacing to field devices in gas groups A, B, E or IIC differs between the approval agencies, please check carefully.
These barriers are not approved for interfacing to field devices in Zone 0.
For FM installations, please pay attention to note 10 on the control drawing 90 046 11 31 1.

FM Information - Connections to Class I, II, III, Division 1 or Class I, Zone 1

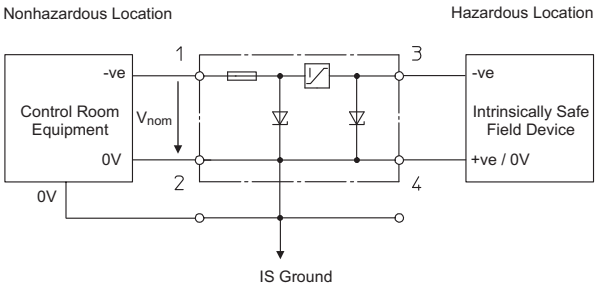
Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/00-168-050-001	12	26	30	40	0.9	16.8	50	840	2	0.09	5	0.3
9004/00-168-100-001	12	20	24	80	0.9	16.8	100	1680	- -	- -	2.5	0.3
9004/00-200-050-001	16	34	44	40	0.9	20	50	1000	0.41	0.07	2.5	0.36
9004/00-263-050-001	20	48	53	40	0.9	26.3	50	1315	- -	- -	2.5	0.16
9004/00-280-025-001	24	60	68	20	0.9	28	25	700	0.9	0.019	2.5	0.17
9004/00-280-045-001	24	50	56	35	0.9	28	45	1260	- -	- -	2.5	0.133
9004/00-315-025-001	26	67	73	20	0.9	31.5	25	787.5	- -	- -	5	0.1

CSA Information - Connections to Class I, Zone 1

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/00-168-050-001	12	26	30	40	0.9	16.8	840	50	0.86	0.16	2.5	1.2
9004/00-168-100-001	12	20	24	80	0.9	16.8	1680	100	- -	- -	1.6	1.1
9004/00-200-050-001	16	34	44	40	0.9	20	1000	50	- -	- -	2.5	0.68
9004/00-263-050-001	20	48	53	40	0.9	26.3	1315	50	- -	- -	1.3	0.33
9004/00-280-025-001	24	60	68	20	0.9	28	700	25	- -	- -	2.5	0.28
9004/00-280-045-001	24	50	56	35	0.9	28	1260	45	- -	- -	1.5	0.28
9004/00-315-025-001	26	67	73	20	0.9	31.5	787.5	25	- -	- -	2.5	0.23

ATEX Information - Connections to Zone 1

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/00-168-050-001	12	26	30	40	0.9	16.8	50	840	0.86	0.16	2.5	1.2
9004/00-168-100-001	12	20	24	80	0.9	16.8	100	1680	- -	- -	1.6	1.1
9004/00-200-050-001	16	34	44	40	0.9	20	50	1000	- -	- -	2.5	0.68
9004/00-263-050-001	20	48	53	40	0.9	26.3	50	1315	- -	- -	1.3	0.33
9004/00-280-025-001	24	60	68	20	0.9	28	25	700	- -	- -	2.5	0.28
9004/00-280-045-001	24	50	56	35	0.9	28	45	1260	- -	- -	1.5	0.28
9004/00-315-025-001	26	67	73	20	0.9	31.5	25	787.5	- -	- -	2.5	0.23



- Electronic current limitation
- Voltage limitation
- Grounded circuit
- Approved for installation in Division 2 and Zone 2

Technical Tips

These devices are not approved by UL.
CSA has not approved these devices for installation in or interfacing to field devices in hazardous locations classed as Divisions.
Approval for interfacing to field devices in gas groups A, B, E or IIC differs between the approval agencies, please check carefully.
These barriers are not approved for interfacing to field devices in Zone 0.
For FM installations, please pay attention to note 10 on the control drawing 90 046 11 31 1.

FM Information - Connections to Class I, II, III, Division 1 or Class I, Zone 1

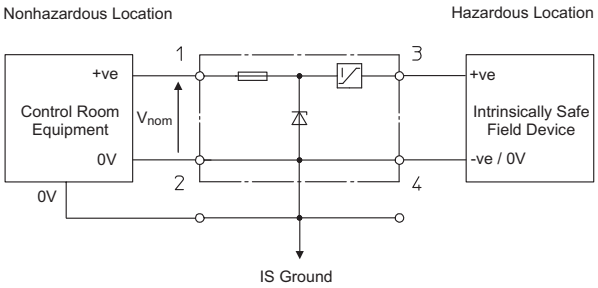
Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/50-206-050-001	23 ... 27	- -	- -	40	- -	20.6	50	1030	0.3	0.060	2.5	0.33
9004/50-206-085-001	23 ... 27	- -	- -	70	- -	20.6	85	1751	- -	- -	0.5	0.25
9004/50-220-030-001	24 ... 26	- -	- -	25	- -	22	30	660	2	0.05	2.5	0.32

CSA Information - Connections to Class I, Zone 1

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/50-206-050-001	23 ... 27	- -	- -	40	- -	20.6	1030	50	- -	- -	2.5	0.58
9004/50-206-085-001	23 ... 27	- -	- -	70	- -	20.6	1751	85	- -	- -	0.37	0.68
9004/50-220-030-001	24 ... 26	- -	- -	25	- -	22	660	30	1.3	0.073	2.5	0.55

ATEX Information - Connections to Zone 1

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/50-206-050-001	23 ... 27	- -	- -	40	- -	20.6	50	1030	- -	- -	2.5	0.58
9004/50-206-085-001	23 ... 27	- -	- -	70	- -	20.6	85	1751	- -	- -	0.37	0.68
9004/50-220-030-001	24 ... 26	- -	- -	25	- -	22	30	660	1.3	0.073	2.5	0.55



- Electronic current limitation
- Grounded circuit
- Approved for installation in Division 2 and Zone 2

Technical Tips

These devices are not approved by UL.
CSA has not approved these devices for installation in or interfacing to field devices in hazardous locations classed as Divisions.
Approval for interfacing to field devices in gas groups A, B, E or IIC differs between the approval agencies, please check carefully.
These barriers are not approved for interfacing to field devices in Zone 0.
For FM installations, please pay attention to note 10 on the control drawing 90 046 11 31 1.

FM Information - Connections to Class I, II, III, Division 1 or Class I, Zone 1

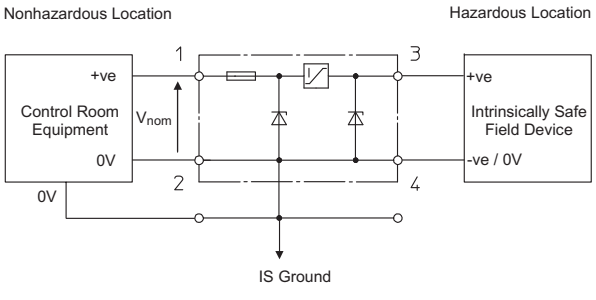
Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/01-168-050-001	12	26	30	40	0.9	16.8	50	840	2	0.09	5	0.3
9004/01-168-100-001	12	20	24	80	0.9	16.8	100	1680	- -	- -	2.5	0.3
9004/01-200-050-001	16	34	44	40	0.9	20	50	1000	0.41	0.07	2.5	0.36
9004/01-263-050-001	20	48	53	40	0.9	26.3	50	1315	- -	- -	2.5	0.16
9004/01-280-025-001	24	60	68	20	0.9	28	25	700	0.9	0.019	2.5	0.17
9004/01-280-045-001	24	50	56	35	0.9	28	45	1260	- -	- -	2.5	0.133
9004/01-315-025-001	26	67	73	20	0.9	31.5	25	787.5	- -	- -	5	0.1

CSA Information - Connections to Class I, Zone 1

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/01-168-050-001	12	26	30	40	0.9	16.8	840	50	0.86	0.16	2.5	1.2
9004/01-168-100-001	12	20	24	80	0.9	16.8	1680	100	- -	- -	1.6	1.1
9004/01-200-050-001	16	34	44	40	0.9	20	1000	50	- -	- -	2.5	0.68
9004/01-263-050-001	20	48	53	40	0.9	26.3	1315	50	- -	- -	1.3	0.33
9004/01-280-025-001	24	60	68	20	0.9	28	700	25	- -	- -	2.5	0.28
9004/01-280-045-001	24	50	56	35	0.9	28	1260	45	- -	- -	1.5	0.28
9004/01-315-025-001	26	67	73	20	0.9	31.5	787.5	25	- -	- -	2.5	0.23

ATEX Information - Connections to Zone 1

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/01-168-050-001	12	26	30	40	0.9	16.8	50	840	0.86	0.16	2.5	1.2
9004/01-168-100-001	12	20	24	80	0.9	16.8	100	1680	- -	- -	1.6	1.1
9004/01-200-050-001	16	34	44	40	0.9	20	50	1000	- -	- -	2.5	0.68
9004/01-263-050-001	20	48	53	40	0.9	26.3	50	1315	- -	- -	1.3	0.33
9004/01-280-025-001	24	60	68	20	0.9	28	25	700	- -	- -	2.5	0.28
9004/01-280-045-001	24	50	56	35	0.9	28	45	1260	- -	- -	1.5	0.28
9004/01-315-025-001	26	67	73	20	0.9	31.5	25	787.5	- -	- -	2.5	0.23



- Electronic current limitation
- Voltage limitation
- Grounded circuit
- Approved for installation in Division 2 and Zone 2

Technical Tips

These devices are not approved by UL.
CSA has not approved these devices for installation in or interfacing to field devices in hazardous locations classed as Divisions.
Approval for interfacing to field devices in gas groups A, B, E or IIC differs between the approval agencies, please check carefully.
These barriers are not approved for interfacing to field devices in Zone 0.
For FM installations, please pay attention to note 10 on control drawing 90 046 11 31 1.

FM Information - Connections to Class I, II, III, Division 1 or Class I, Zone 1

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	A, B, E or IIC		C, D, F, G or IIB, IIA	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/51-206-050-001	23 ... 27	- -	- -	40	- -	20.6	50	1030	0.3	0.060	2.5	0.33
9004/51-206-085-001	23 ... 27	- -	- -	70	- -	20.6	85	1751	- -	- -	0.5	0.25
9004/51-220-030-001	24 ... 26	- -	- -	25	- -	22	30	660	2	0.05	2.5	0.32

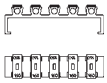
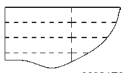
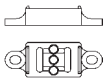
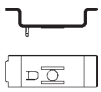
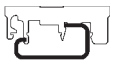
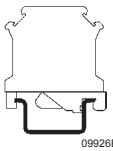
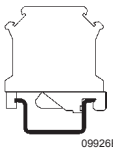
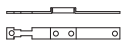
CSA Information - Connections to Class I, Zone 1

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIA, IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/51-206-050-001	23 ... 27	- -	- -	40	- -	20.6	1030	50	- -	- -	2.5	0.58
9004/51-206-085-001	23 ... 27	- -	- -	70	- -	20.6	1751	85	- -	- -	0.37	0.68
9004/51-220-030-001	24 ... 26	- -	- -	25	- -	22	660	30	1.3	0.073	2.5	0.55

ATEX Information - Connections to Zone 1

Order Code	Operational Characteristics					Entity Parameters			Gas Group Cable Parameters			
	V_{nom}	R_{min}	R_{max}	I_{max}	ΔV	V_{OC}	I_{SC}	P_O	IIC		IIB	
	V	Ω	Ω	mA	V	V	mA	mW	L_a mH	C_a µF	L_a mH	C_a µF
9004/51-206-050-001	23 ... 27	- -	- -	40	- -	20.6	50	1030	- -	- -	2.5	0.58
9004/51-206-085-001	23 ... 27	- -	- -	70	- -	20.6	85	1751	- -	- -	0.37	0.68
9004/51-220-030-001	24 ... 26	- -	- -	25	- -	22	30	660	1.3	0.073	2.5	0.55

Accessories and Spare Parts

Order Code	Designation	Illustration	Description	Weight
				lb (kg)
9002801930	Replaceable fuse	 09919E00	for all 9000 Series safety barriers unit: 5 pcs.	0.018 (0.008)
9002002660	Fuse holder	 09927E00	holds 5 fuses and clips to the side of a barrier	0.044 (0.020)
9002901980	Holder for tag labels	 09920E00	clear plastic holder clips onto top of barrier	0.004 (0.002)
9002901850	Labelling paper	 09921E00	perforated, for typing Format: DIN A4	0.011 (0.005)
9002001980	Insulating stand off	 09928E00	to isolate DIN rail & I.S. gnd from back panel	0.051 (0.023)
9002001750	Adaptor	 09922E00	to mount current barriers to old style barrier rail	0.013 (0.006)
9900003980	Mounting attachment moulded plastic	 09924E00	to mount current barriers to G type rail	0.009 (0.004)
0616129	DIN rail	 09925E00	NS 35 / 15 (meter length)	3.109 (1.410)
S-NS35/15-xx-RA	DIN rail assemblies		pre cut lengths of DIN rail complete with stand offs and gnd terminals	– –
S-A1-0006	Flat DIN rail (Busbar)	 06909E00	(meter length)	2.205 (1.000)
S-A1-0006-xx-RA	Flat DIN rail assemblies		pre cut lengths of DIN rail complete with stand offs and gnd terminals	– –
5189580	Ground terminal	 09926E00	USLKG 5 (wire range ≤ 10 AWG, (4 mm^2))	0.026 (0.012)
5187720	Ground terminal	 09926E00	USLKG 6 N (wire range ≤ 8 AWG, (6 mm^2))	0.066 (0.030)
S-MBA-001	Surface mounting bracket	 06908E00		0.020 (0.009)
S-ISL-001	I.S. Caution label		5“ diameter	– –
S-ISL-002			3.5“ diameter	– –

Explosion Protection

Product		NEC and CEC	PTB
9001/9002 Series See individual data sheets for exceptions	Installation in	Class I, Division 2, Class I, Zone 2 and Nonhazardous Location	Zone 2 and Safe Area
		NI/1/2/ABCD/T4, NI/I/2/IIC/T4	II 3 G EEx nA II T4
	Interface to	Class I, II, III, Division 1, Class I, Zone 0	Zone 0
		AIS/I, II, III/1/ABCDEFG, [1/0] AEx [ia] IIC	II (2) G [EEx ia] IIC
9004 Series See individual data sheets for exceptions	Installation in	Class I, Division 2, Class I, Zone 2 and Nonhazardous Location	Zone 2 and Safe Area
		NI/1/2/ABCD/T4, NI/I/2/IIC/T4	II 3 G EEx nA II T4
	Interface to	Class I, II, III, Division 1, Class I, Zone 1	Zone 1
		AIS/I, II, III/1/ABCDEFG, [1/0] AEx [ib] IIC	II (2) G [EEx ib] IIC

Certificate Numbers

Product	FM	UL	CSA	PTB	
				Interface to	Installation in
9001	3011002	E81680	1284547	PTB 01 ATEX 2088	PTB 01 ATEX 2135
9002	3010778	E81680	1284580	PTB 01 ATEX 2053	PTB 01 ATEX 2054
9004	3017163	- -	1497596	PTB 02 ATEX 2008	PTB 02 ATEX 2009

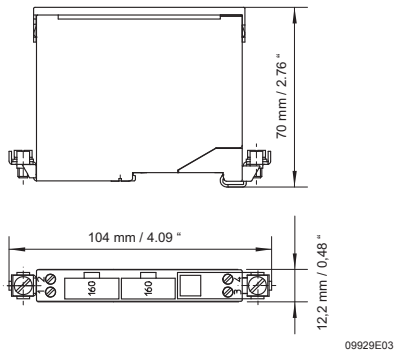
Control Drawings

Product	FM	CSA	UL	ATEX
9001	90 016 11 31 1	90 016 11 31 2	90 016 11 31 3	- -
9002	90 026 11 31 0	90 026 11 31 2	90 026 11 31 3	- -
9004	90 046 11 31 1	90 046 11 31 2	- -	- -

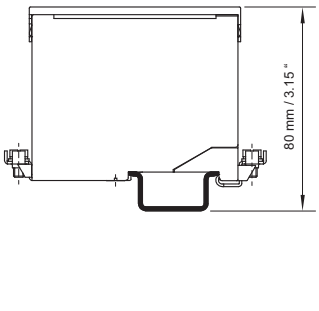
Technical Specifications

Enclosure material	polyamide 6 GF
Degree of Protection	NEMA 1 according to IEC 60529
	terminal enclosure: IP 20 housing: IP 40
Connection	4 screw terminals, each maximum 16 AWG (1.5 mm^2) stranded / solid 2 ground terminals, each maximum 12 AWG (4 mm^2) stranded / solid
Torque specifications	screw terminals 1 through 4 min: 4.43 lb / inch (0.5 Nm) max: 5.31 lb / inch (0.6 Nm)
Ambient temperature	- 4 ˚F ... + 140 ˚F (- 20 ˚C ... + 60 ˚C)
Storage	- 4 ˚F ... + 167 ˚F (- 20 ˚C ... + 75 ˚C)
Maximum relative humidity	95 % mean, no condensation
Leakage current at V_{nom}	≤ 2 µA (except where stated on the data sheet)
Temperature effect	≤ 0.25 % / 10 K
Frequency	for barriers with resistive current limitation:
	at I_m ≤ 50 mA ≤ 50 kHz at I_m > 50 mA ≤ 100 kHz
	for barriers with electronic current limitation:
	≤ 10 kHz
Weight	approx. 0.25 lbs (0.115 kg)

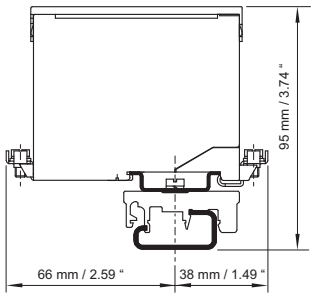
Dimension Drawings - subject to alterations



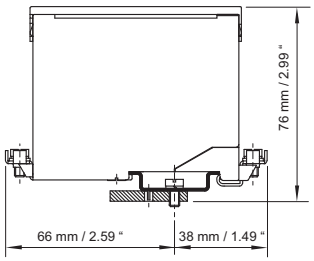
9000 Series



9000 Series on DIN rail NS 35/15 (acc. to EN 50 022)

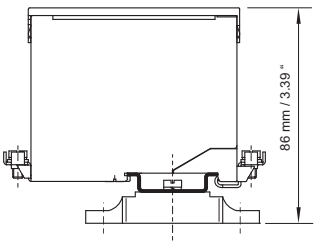


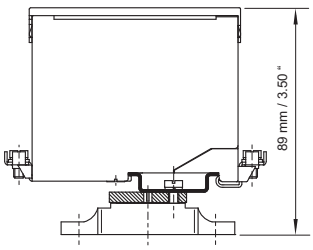
9000 Series on DIN rail NS 32 (acc. to EN 50 035) by means of adaptor and mounting attachment, moulded plastic



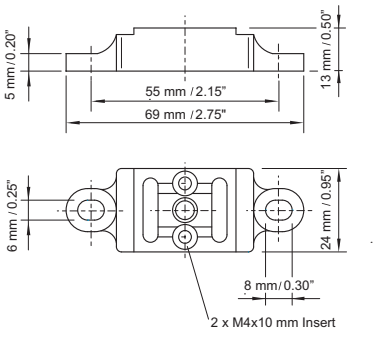
9000 Series on a mounting plate with an adaptor

Dimension Drawings - subject to alterations



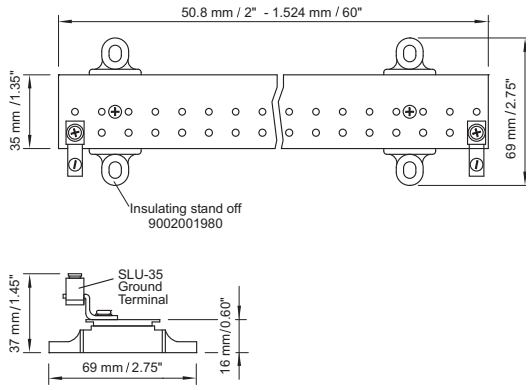


9000 Series installation with insulated stand off



insulating stand off

Dimension Drawings - subject to alterations



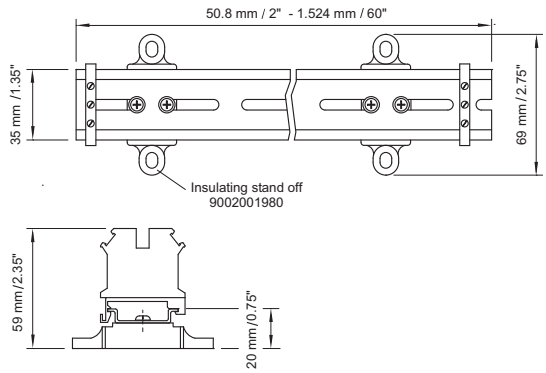
06213E03

Notes:

(1) A1-0006 drilled and tapped Universal Busbar cut to a specified length from 2“ to 60“

(2) SSO-002-2 insulated Standoffs typical spacing of 12“ apart

(3) SLU-35 Ground Terminal screwed onto A1-0006 Busbar



06214E03

Notes:

(1) NS35 / 7.5 Rail cut to a specified length from 2“ to 60“

(2) SSO-002-2 insulated Standoffs typical spacing of 12“ apart

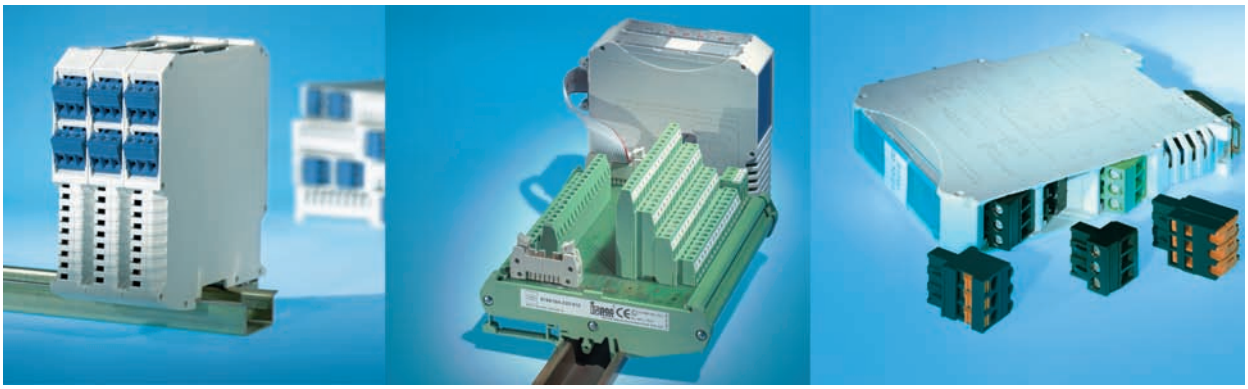
(3) UK-4 Ex Ground Terminal mounted to DIN Rail

Note:

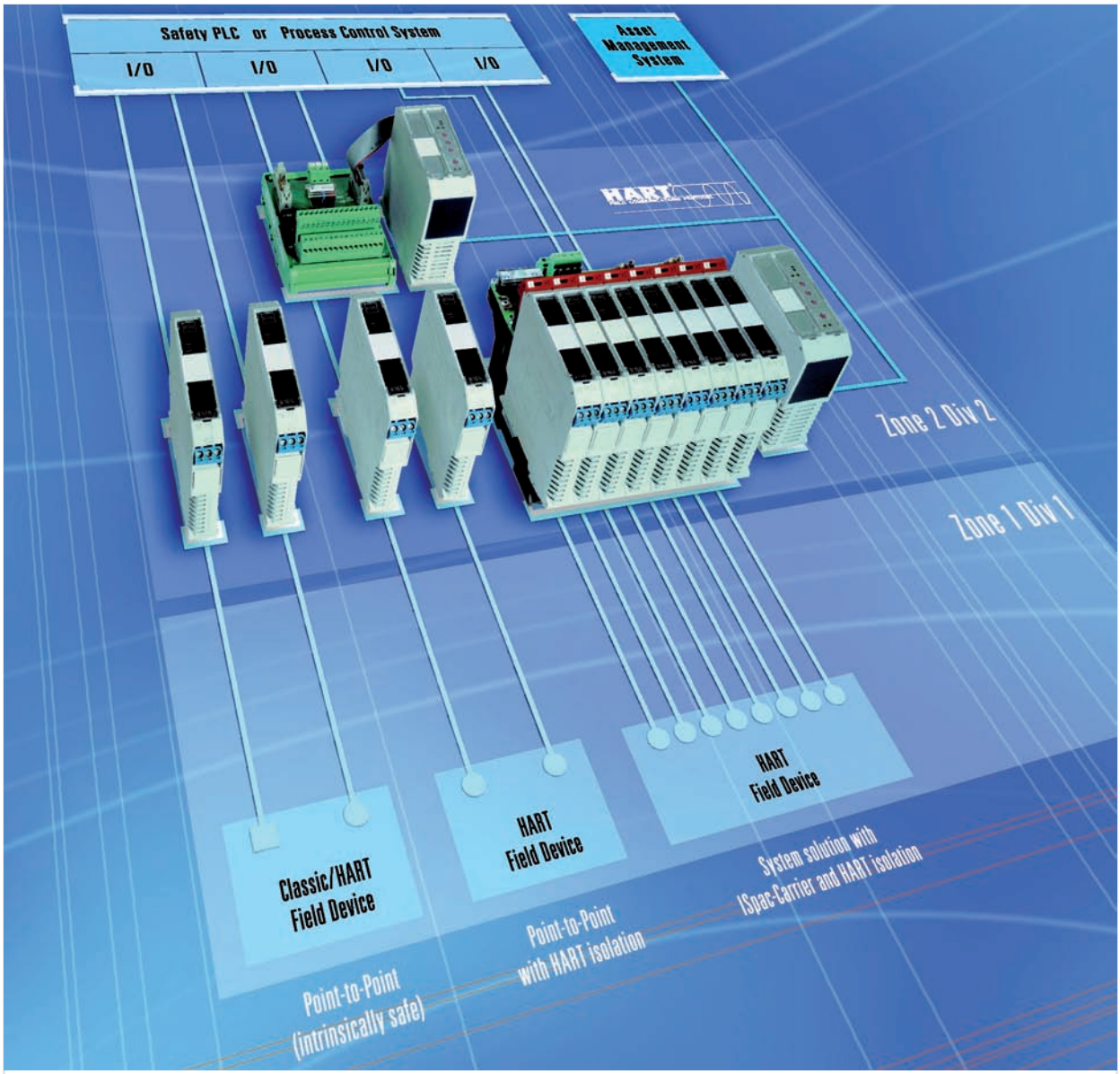
Dimension shown includes TS35 / 7.5 Rail.
T35 / 15 Rail would change the overall dimension to 1.10“ (28 mm).

Galvanic Isolators

Contents



Galvanic Isolators



06793E03

- All standard process applications with 2 independent channels per module
- Simple, multi-module, power supply connection via pac-Bus
- Removable terminals available in three versions
- SIL classified (IEC 61508) (version dependant)
- Modules for DIN rail installation or simple system integration via pac-Carrier
- Broad temperature range - 4 °F ... + 158 °F (- 20 °C ... + 70 °C)
- Approved for installation in Division 2 and Zone 2

General Description

The ISpac isolator range is intended for use in applications which require both intrinsically safe connections and electrical isolation between the hazardous and nonhazardous locations. This requirement may simply be user preference or to reduce the risk of ground loop problems which may arise with the use of safety barriers.

The ISpac range is available with two independent channels in a compact 0.7“ (17.6 mm) package and has removable terminals in three versions. The units can be installed either directly onto standard DIN rail, with pac-Bus onto DIN rail for convenient power supply connection and collective error messaging or via pac-Carrier for simple integration into automation systems with their own system specific cables and plugs.

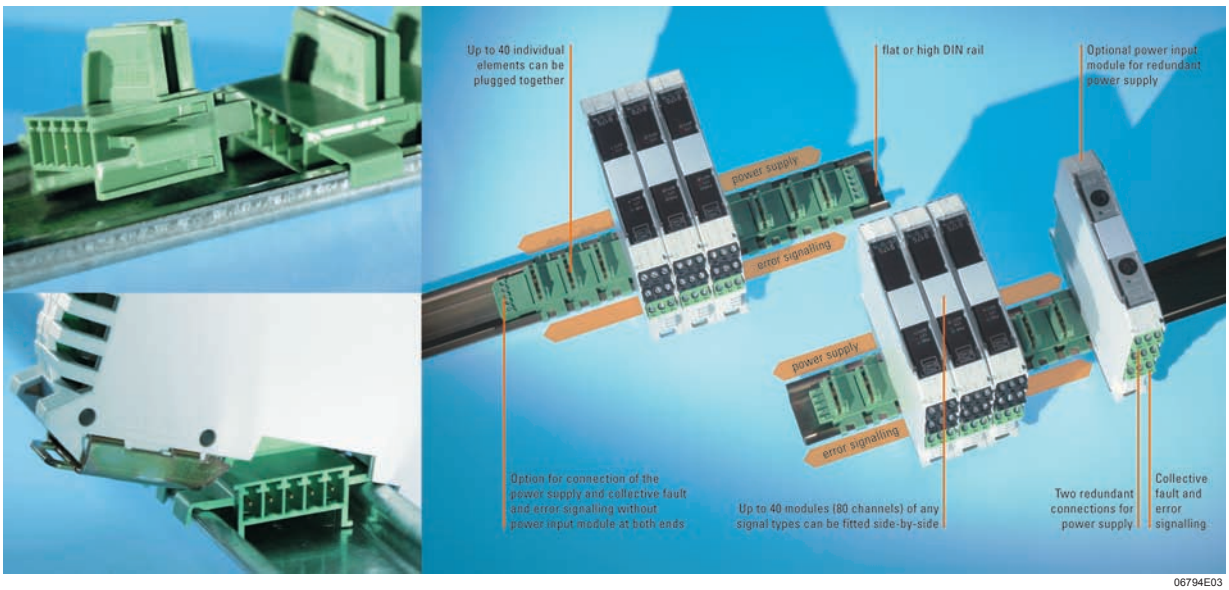
The isolators are equipped with LEDs and DIP switches, where applicable, providing simple module and field circuit status and user configuration for line fault detection and phase reversal. For multifunction units either DIP switches or a serial port can be used for signal programming and diagnostic functions. The available software package, IS Wizard, has been designed to simplify configuration of those units.

Overview of System Components

06797E00

- Compact size, only 0.7“ (17.6 mm) - including the two channel versions
- Terminals are color coded and electrically coded to prevent problems due to wiring errors
- Central wiring of power supply and common error messaging via pac-Bus
- Clear LED indication on the top of the module
- Simple tagging / labeling system on the top of the module
- Removable terminals available as screw, cage clamp and insulation cutting types
- Terminals are optimally angled for ease of wiring to enable space saving cable entry into panduit
- Line fault detection available on all modules with the signaling through a relay contact
- DIP switch settings can be easily accessed on the top of the module

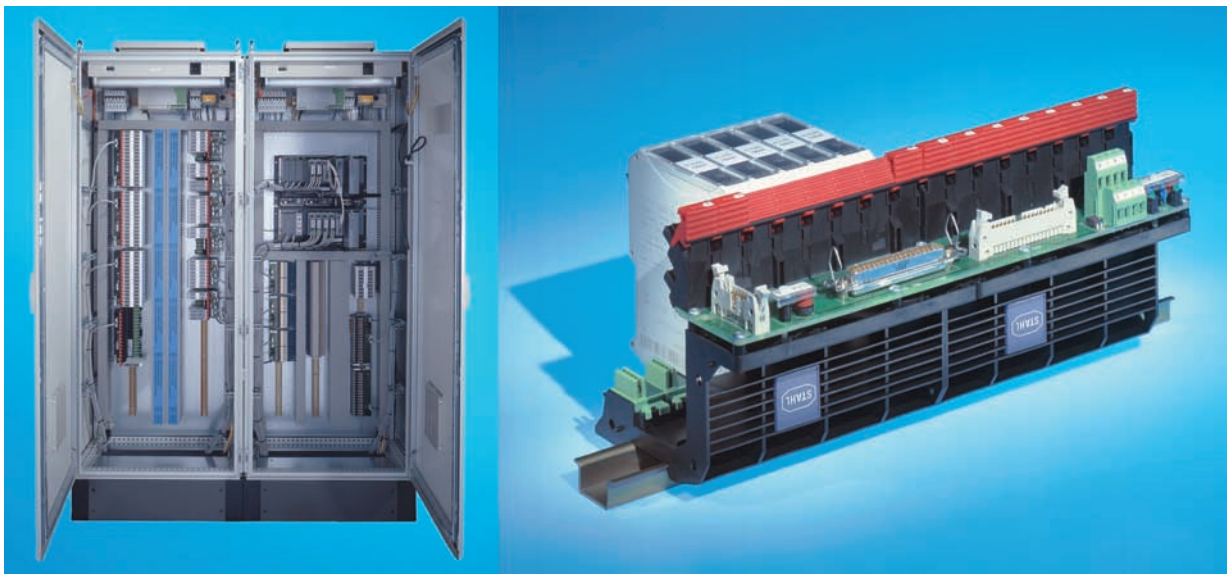
pac-Bus



06794E03

- Fast and simple mounting without tools onto, high or low profile, DIN rail
- Individual pieces can be connected together up to 40 modules
- Integrated pole reversal protection
- Individual pieces allow easy expansion at any time
- Self closing contact for unused slots
- Power supply connection via power feed modules with replaceable fuses and redundancy option
- Potential free error messaging contact for common error signal
- Low cost power supply connection option via end terminals
- Gold plated contacts for maximum contact safety

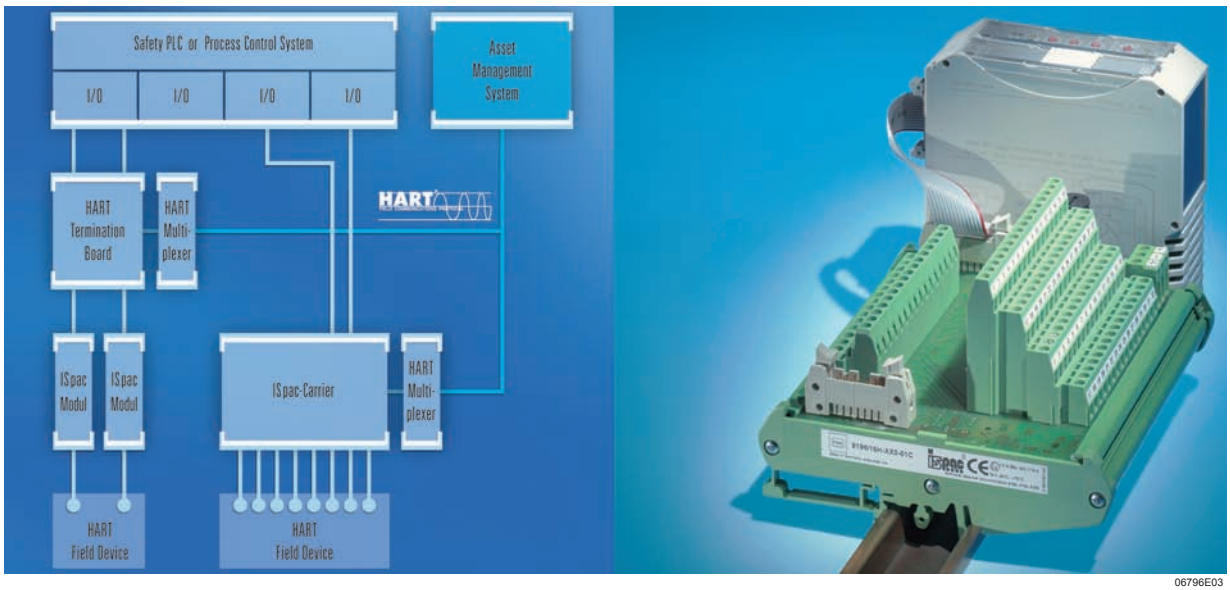
pac-Carrier



06798E00

- For 8 or 16, single or dual channel modules, any mix of signals
- Redundant power supply with message contact and replaceable fuses
- High, user friendly viewing level for system connection
- Mechanical snap on pac-Carrier system with protection against vibration due to secure mounting at the top and bottom
- Rugged, industry standard design with integrated label carrier
- Horizontal or vertical installation on DIN rail or mounting plate
- System specific connectors and PC board designs
- Connection option for HART multiplexer

Asset Management



06796E03

The R. STAHL ISpac isolators are designed to transmit the HART signal in both directions. In conjunction with the HART multiplexer type 9192, HART field devices can be linked to a HART management system. The HART multiplexer can be used in conjunction with the isolators in any mounting arrangement, DIN rail, pac-Bus or pac-Carrier, and with the connection board type 9196 can also be used with non I.S. HART field devices.

Selection Criteria

The selection of galvanic isolators is carried out in two steps:

1. Operational characteristics

2. Safety characteristics

1. Operational Characteristics

Galvanic isolators are selected according to their specific application. Within each particular application series there are options depending on the electrical requirements of the system.
It is therefore necessary to know the electrical data of all the connected apparatus.

For example:

- Specific application
- Voltage or current requirements at the field device
- Contact loading
- Passive or active connection at the automation system
- Load resistances in the circuit.

2. Safety Characteristics

If a device is to be used in an intrinsically safe system it must have an approval certificate (certificate of compliance) from a national recognized test laboratory (NRTL) - FM, CSA, PTB..... (unless classed as simple apparatus).

The approval certificate lists the Entry Parameters (safety data) for the device.

Simple apparatus is included on the approval certificate for the associated apparatus. Simple apparatus are components that do not store or generate more than 1.5 V, 100 mA, 25 mW.

All installations must be in accordance with the control drawing.

- When interfacing to an isolator with an active input or output -

The approval certificate and control drawings will give the following details:

➢ Intrinsically Safe Field Device:

Maximum Voltage (V_{max}), Current (I_{max}) and Power (P_i) that can be supplied to it under fault conditions to maintain safety. Also listed is the Internal Capacitance (C_i) and Inductance (L_i) of the field device.

➢ Intrinsically Safe Associated Apparatus:

Maximum Voltage (V_{OC}), Current (I_{SC}) and Power (P_O) that will be supplied to the field device under fault conditions to maintain safety. Also listed is the total Capacitance (C_a) and Inductance (L_a) that can be used in the system.

- When interfacing to an isolator with a passive input -

The approval certificate and control drawings will give the following details:

➢ Intrinsically Safe Associated Apparatus:

Maximum Voltage (V_{max}), Current (I_{max}) and Power (P_i) that can be supplied to it under fault conditions to maintain safety. Also listed is the Internal Capacitance (C_i) and Inductance (L_i) of the associated apparatus.

➢ Intrinsically Safe Field Device:

Maximum Voltage (V_{OC}), Current (I_{SC}) and Power (P_O) that will be supplied to the associated apparatus under fault conditions. Also listed is the total Capacitance and Inductance that can be used in the system.

In both instances to ensure a safe interconnection:

IS Field Device	Cable		Associated Apparatus	Combinations
V_{max} (U_i)		≥	V_{OC} (U_o)	V_t
I_{max} (I_i)		≥	I_{SC} (I_o)	I_t
P_i		≥	P_O	P_O
C_i	+ C_{cable}	≤	C_a (C_o)	C_a (C_o)
L_i	+ L_{cable}	≤	L_a (L_o)	L_a (L_o)
If cable parameters are unknown, then the following values can be used: C = 60 pF / ft L = 0.2 µH / ft				

06797E00

Any device to be used in a hazardous location must be approved for use in that hazardous location. If intrinsic safety is the installation protection method to be used then the device must be approved to meet the requirements for intrinsic safety. Any connections between the field device and the nonhazardous location must be connected through an associated interface device. Two types of associated apparatus are zener barriers and galvanic isolators.

In all cases, including the standard applications that follow, an evaluation of the safety and operational characteristics should be carried out to ensure compatibility between the field device, the galvanic isolator and the control system. Use the worksheet on the following page for your own system verification or send to R. STAHL via fax or e-mail and the Automation Department will assist you.

For instrumentation systems, there are key isolators that will accomplish 80% of the applications required. These units are listed below, however all aspects of the control system loop must be checked, safety and operational characteristics, to ensure that these are the most suitable for the application at hand.

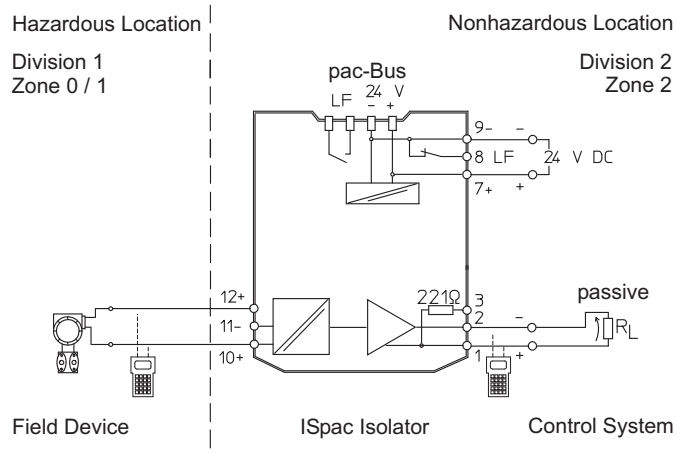
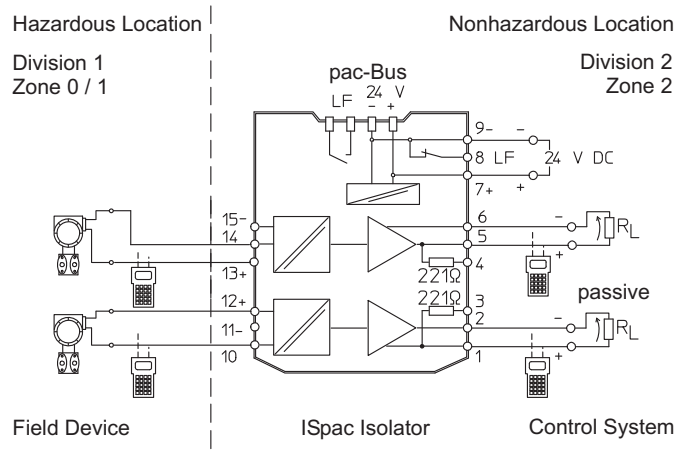
Key Isolators	
Analog Input:	9160/13-11-11.
	9160/23-11-11.
Analog Output:	9165/16-11-11.
	9165/26-11-11.
Digital Input:	9170/10-..-...
	9170/20-..-...
Digital Output:	9175/10-..-11.
	9175/20-..-11.
T/C Input:	9182/10-51-11.
	9182/20-51-11.
RTD Input:	9182/10-51-11.
	9182/20-51-11.
	9180/10-77-11.
	9180/20-77-11.

Application Worksheet

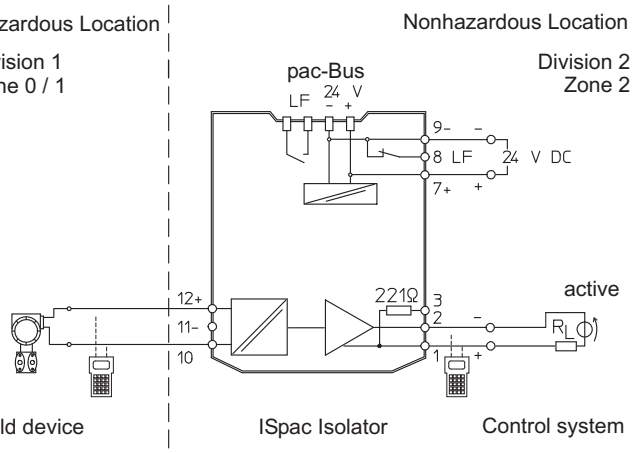
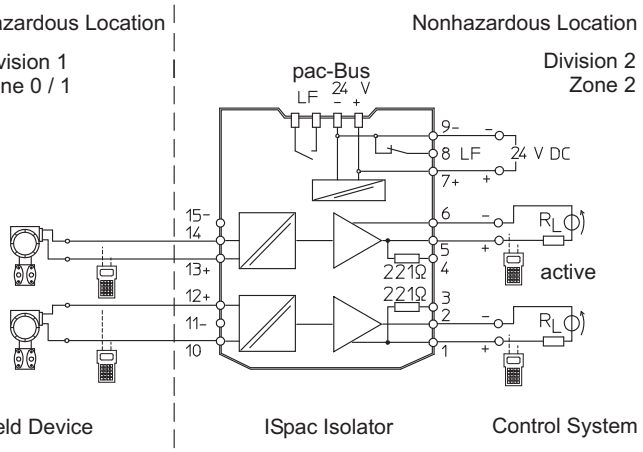
Contact Details:					
Company:		Contact name:			
Address:					
Phone:		Fax:			
Cell:		E-mail:			
Field Device:					
Approved intrinsically safe:	or	Simple apparatus:			
Manufacturer:					
Model no.:					
Description:					
Certificate no.:					
NRTL:					
Safety Data:					
Field device:		Associated apparatus:			
			Barrier	or	Isolator
V_{max} (U_i) =	≥	V_{OC} (U_o) =			
I_{max} (I_i) =	≥	I_{SC} (I_o) =			
P_i =	≥	P_O =			
Cable Parameters:					
C_i =	$+C_{cable}$ =		≤	C_a (C_o) =	
L_i =	$+L_{cable}$ =		≤	L_a (L_o) =	
Operational Data:					
Input or Output:		Analog or Discrete:			
Total no. of field devices of the same type:		Return (signal): grounded or floating:			
Supply voltage:		Maximum current:			
Min. voltage required @ field device:		Min. current required @ field device:			
Output: driving capability of the control system		Input: is the control system input isolated from other inputs			
Load impedance in the nonhazardous location:		Load impedance of field device:			
Transmitter: 2-, 3- or 4-wire		Discrete input: proximity detector or dry contact			
T/C: grounded or ungrounded		RTD: 2-, 3- or 4-wire			

Please provide a diagram showing the field device, control system and interconnecting wiring on a separate sheet.
Please provide as much relevant documentation as possible to support the application.
Fax: 832-476-1840
E-mail: automation@rstahl.com

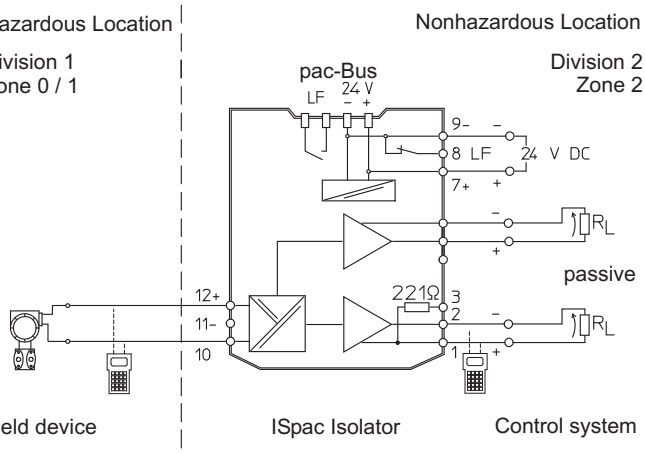
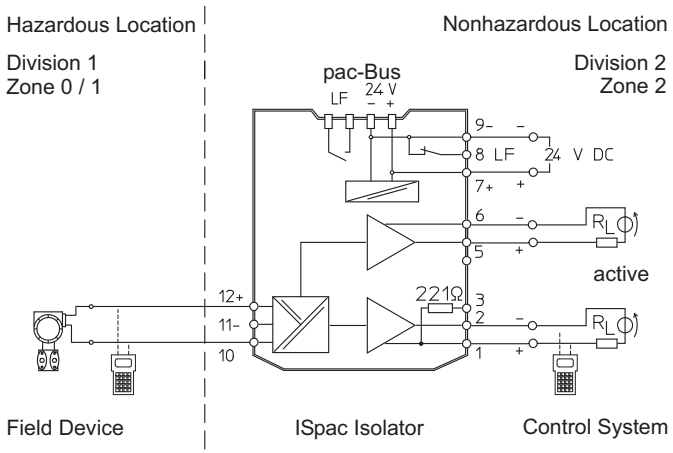
2-wire, 4/20 mA Transmitters - Standard and HART

Order Code	Schematic
9160/13-11-11.	
9160/23-11-11.	
Application Note	This isolator is for use when the control system is a passive input. The isolator provides the power for the messaging circuit within the control system.

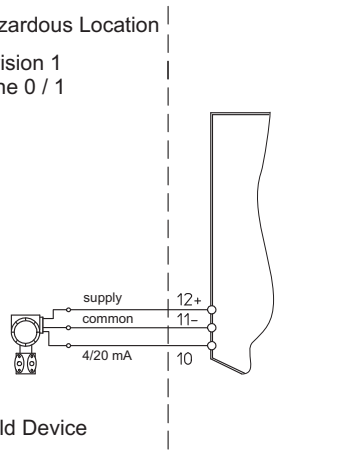
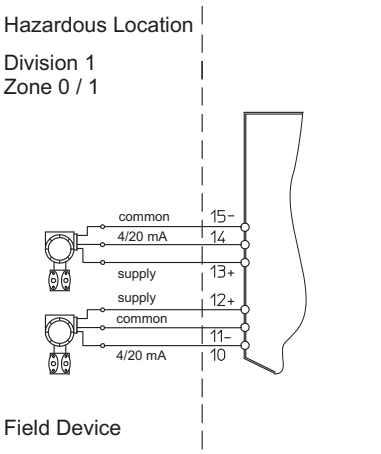
2-wire, 4/20 mA Transmitters - Standard and HART

Order Code	Schematic
9160/13-10-11.	
9160/23-10-11.	
Application Note	This isolator is for use when the control system is an active input. The control system provides the power for the messaging circuit and isolator input.

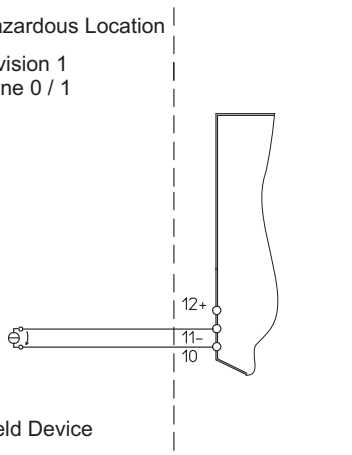
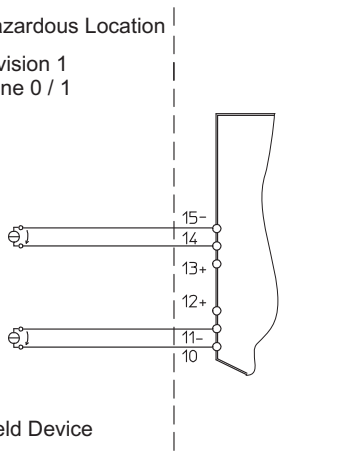
2-wire, 4/20 mA Transmitters - Standard and HART

Order Code	Schematic
9160/19-11-11.	
Application Note	This isolator is for use when two isolated outputs are required for one input from a field device. Channel one is HART compatible, channel 2 is without HART. The control system must be a passive input. The isolator provides the power for the messaging circuit within the control system.
9160/19-10-11.	
Application Note	This isolator is for use when two isolated outputs are required for one input from a field device. Channel one is HART compatible, channel 2 is without HART. The control system must be an active input. The control system provides the power for the messaging circuit and isolator input.

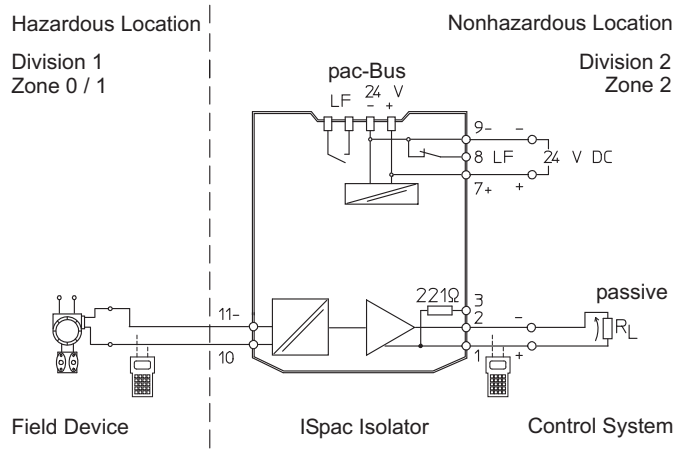
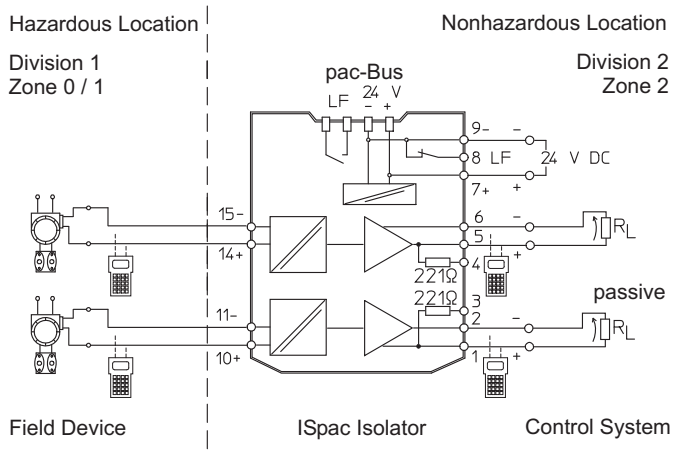
Standard 3-wire, 4/20 mA Transmitters

Order Code	Schematic	Order Code	Schematic
9160/1.-1.-11.		**9160/23-1.-11.**	
Application Note	Connections for the hazardous side are as shown above. Rules for the nonhazardous side are as shown under the 2-wire application section. Pin 12 provides 25 mA for the transmitter.		

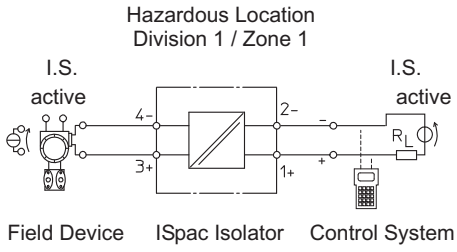
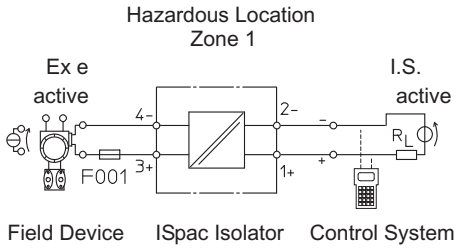
Standard 4-wire, 4/20 mA Transmitters and mA Sources

Order Code	Schematic	Order Code	Schematic
9160/1.-1.-11.		**9160/23-1.-11.**	
Application Note	Connections for the hazardous side are as shown above. Rules for the nonhazardous side are as shown under the 2-wire application section. This application is for non HART current sources and 4-wire transmitters. If HART is required, then the 9163 unit should be used.		

HART 4-wire, 4/20mA Transmitters and mA Sources

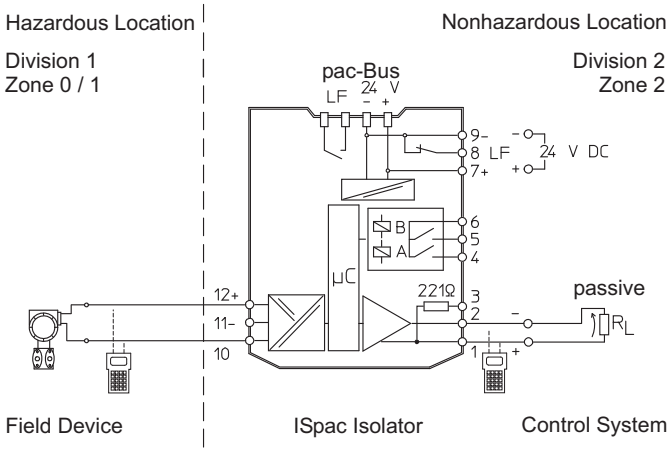
Order Code	Schematic
9163/13-11-11.	
9163/23-11-11.	
Application Note	This isolator is for use with 4-wire transmitters when the HART signal is present.

HART 4-wire, 4/20mA Transmitters and mA Sources

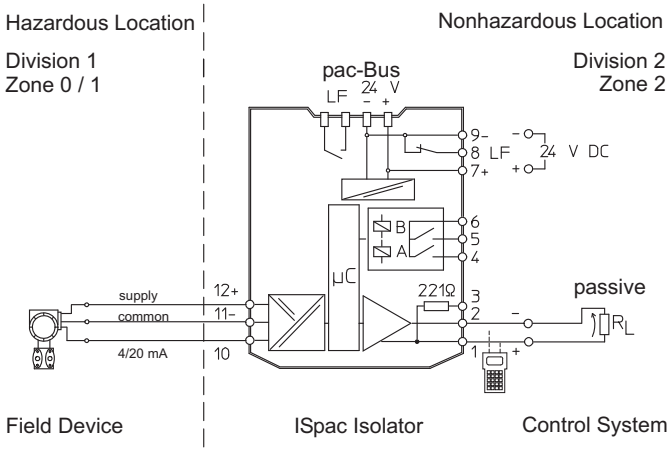
Order Code	Schematic
9164/13-22-08	
9164/13-22-09	
Application Note	This isolator allows 4-wire transmitters and mA sources to be connected to active 2-wire mA inputs. Both versions of this unit have an intrinsically safe output. The difference is the input. The 9164/13-22-08 has an intrinsically safe input and is FM and ATEX approved. The 9164/13-22-09 has an increased safety input and is only ATEX approved. The increased safety version requires a back-up fuse for safe operation. We recommend the R. STAHL series 8560, value 63 mA.

4/20 mA Transmitters and mA Sources with Trip Points

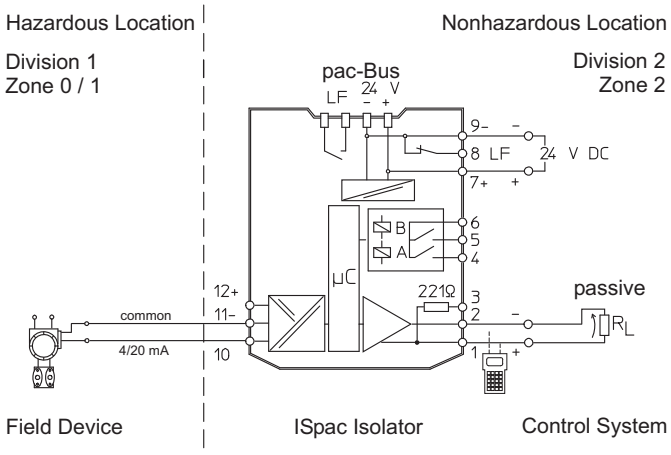
Order Code	Schematic
9162/13-11-12.	



HART 2-wire Tx



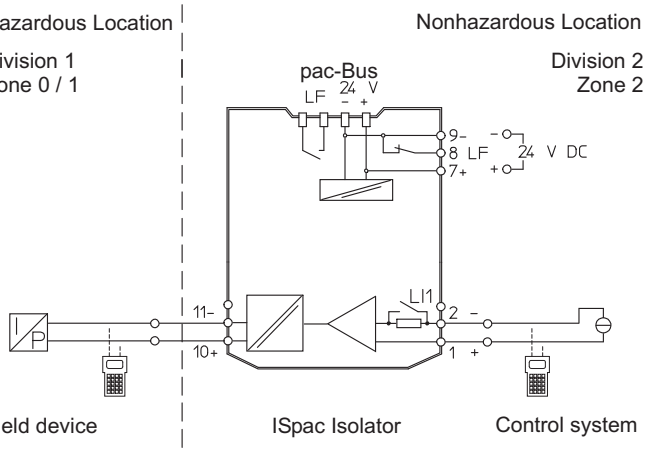
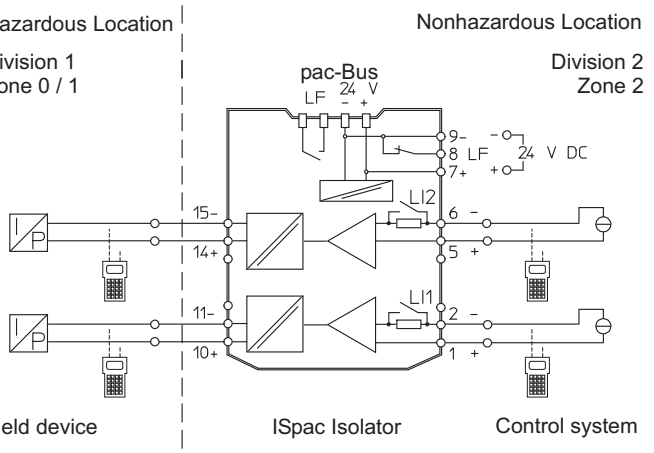
Standard 3-wire Tx



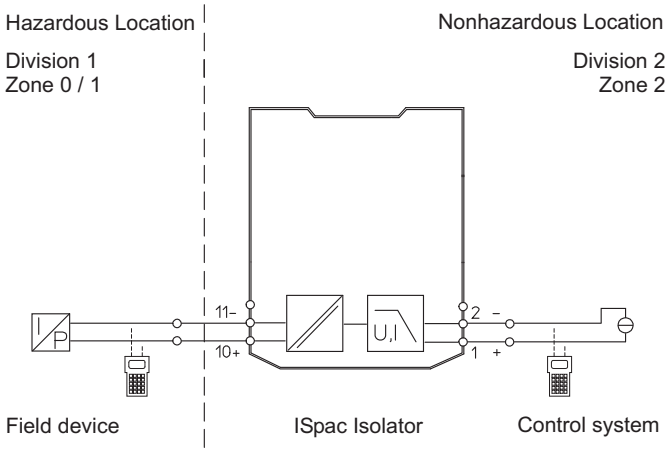
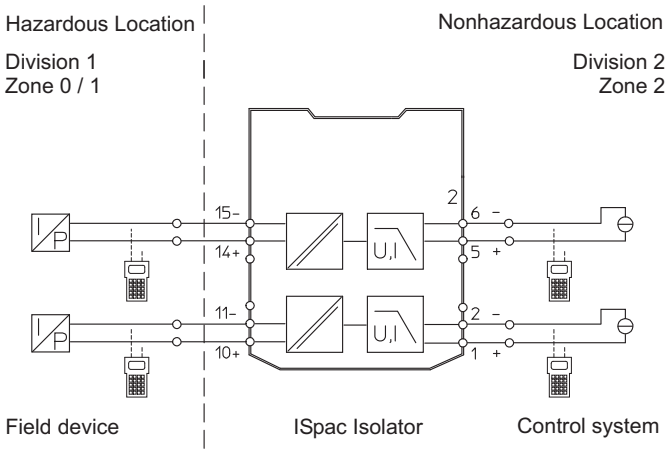
Standard 4-wire Tx and mA Sources

Application Note	For HART 2-wire transmitters and standard 3-wire, 4-wire and mA sources. This single channel isolator provides a 4/20 mA output with two configurable trip points.

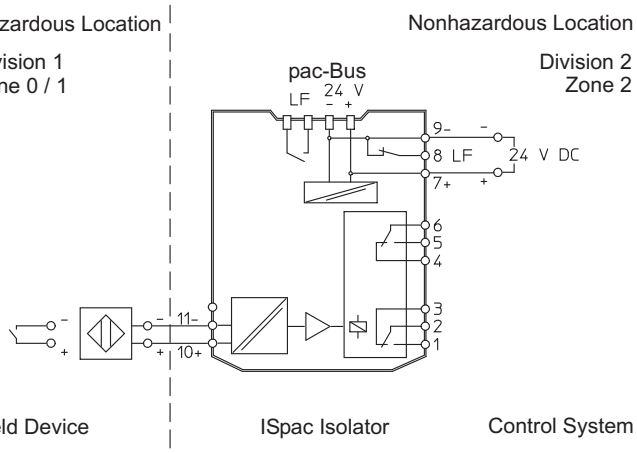
2-wire, 4/20 mA I/P Converters and Control Valves - Standard and HART, 4/20 mA Digital Indicators

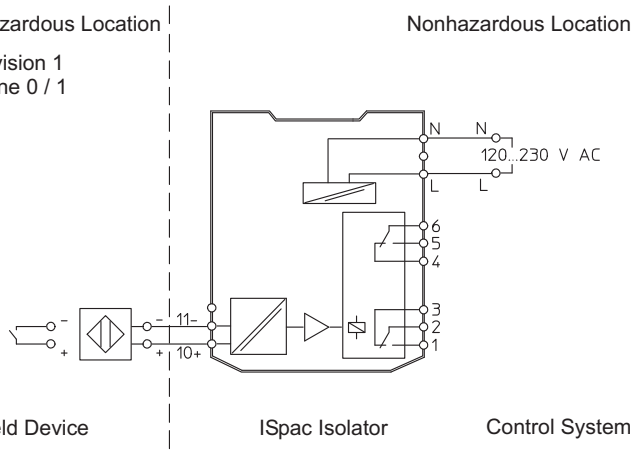
Order Code	Schematic
9165/16-11-11. **9165/16-11-13.**	 06689E03
9165/26-11-11. **9165/26-11-13.**	 06690E03
Application Note	These are separately powered units. The difference between the 9165/.6-11-11. and 9165/.6-11-13. is in the behavior of the units in the way they respond to open and short circuits. Please see the data sheets for more information.

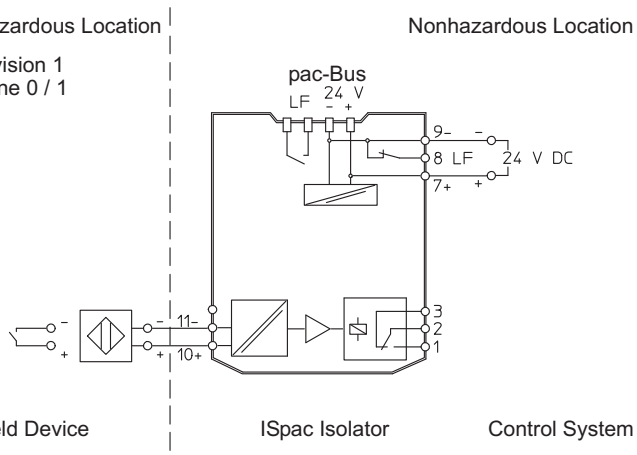
2-wire, 4/20 mA I/P Converters and Control Valves - Standard and HART, 4/20 mA Digital Indicators

Order Code	Schematic
9167/11-11-00. **9167/13-11-00.** **9167/14-11-00.**	
9167/21-11-00. **9167/23-11-00.** **9167/24-11-00.**	
Application Note	These are loop powered units. The difference between the 9167/.1-11-00., 9167/.3-11-00. and 9167/.4-11-00. is in the output entity parameters and the connectable load resistance on the hazardous side. Please see the data sheets for more information.

2-wire Discrete Input from Dry Contacts and NAMUR Proximity Detectors

Order Code	Schematic
9170/10-11-11.	

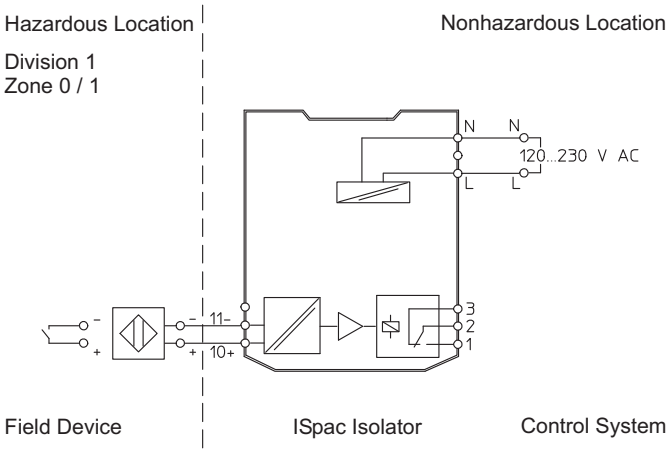
9170/10-11-21.	

9170/10-12-11.	

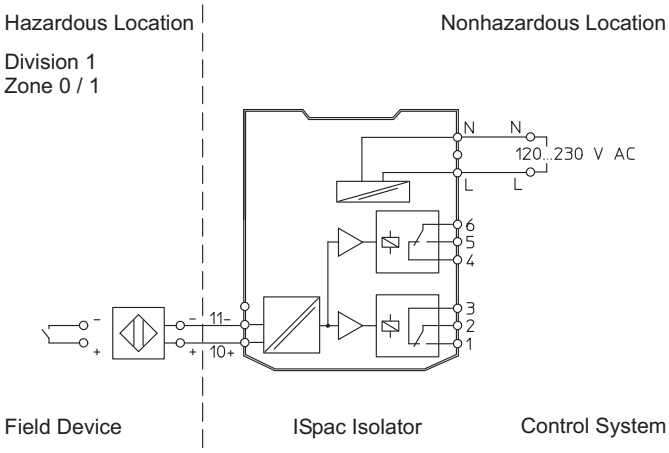
2-wire Discrete Input from Dry Contacts and NAMUR Proximity Detectors

Order Code	Schematic

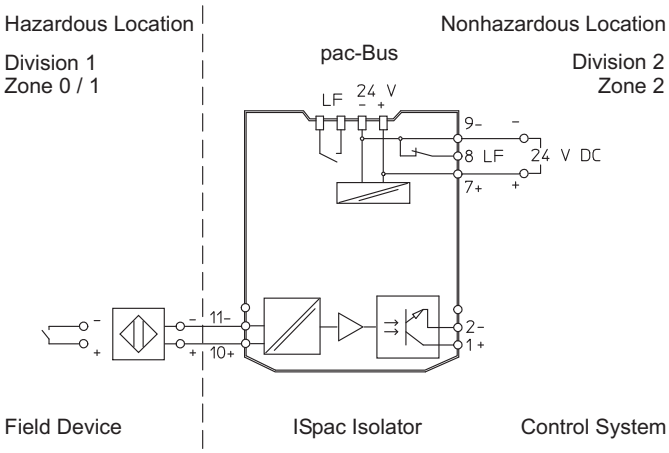
9170/10-12-21.



9170/10-13-21.



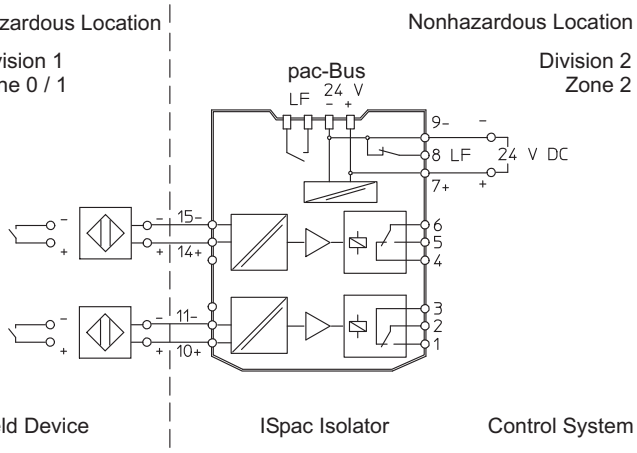
9170/10-14-11.



2-wire Discrete Input from Dry Contacts and NAMUR Proximity Detectors

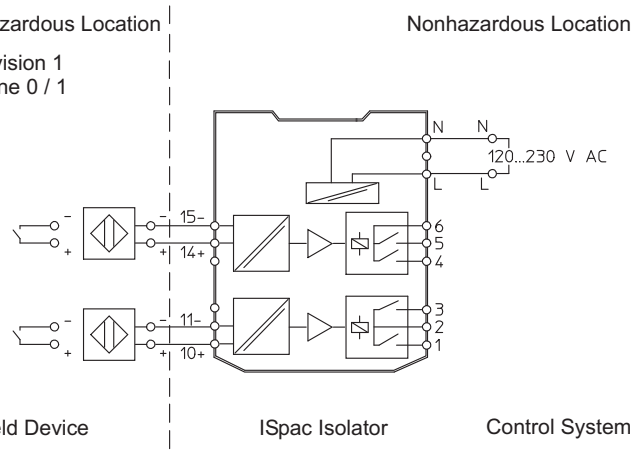
Order Code	Schematic

9170/20-10-11.



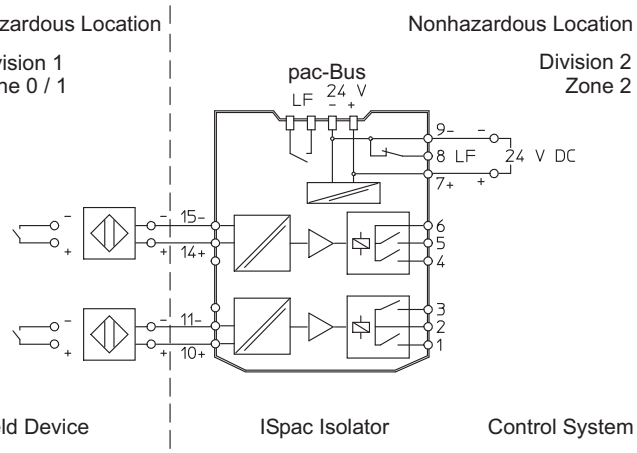
03539E03

9170/20-10-21.



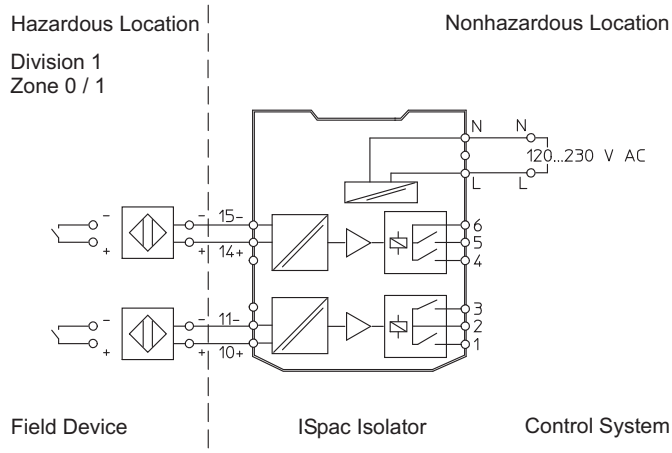
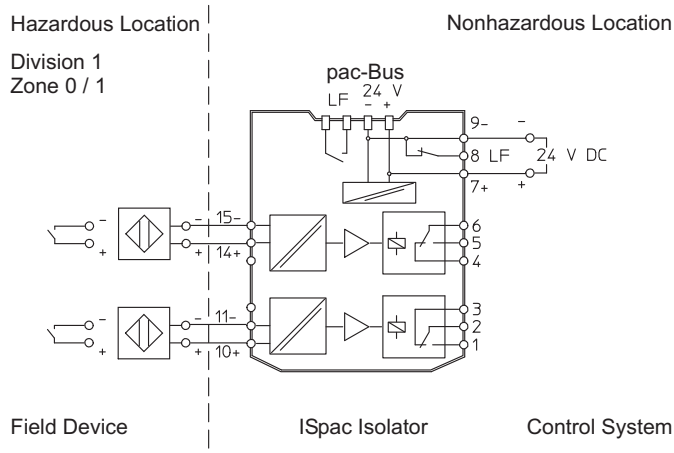
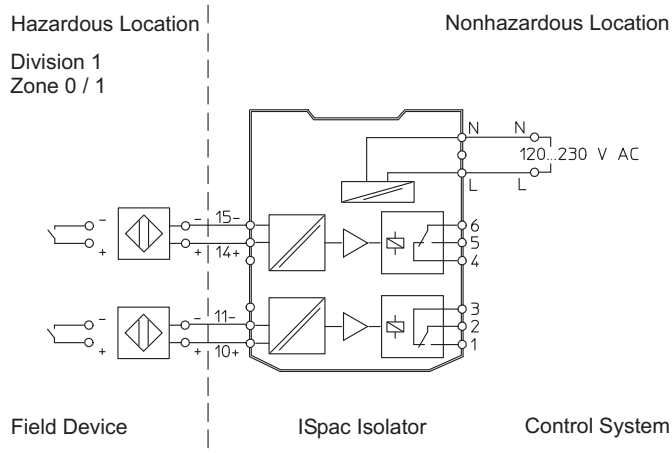
06870E03

9170/20-11-11.

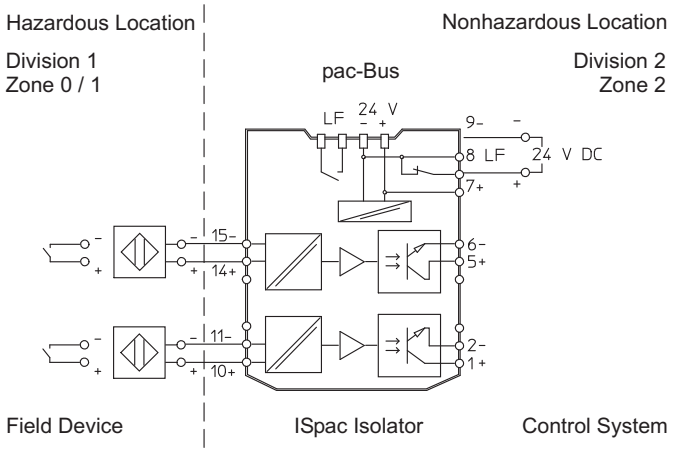


06699E03

2-wire Discrete Input from Dry Contacts and NAMUR Proximity Detectors

Order Code	Schematic
9170/20-11-21.	
9170/20-12-11.	
9170/20-12-21.	

2-wire Discrete Input from Dry Contacts and NAMUR Proximity Detectors

Order Code	Schematic
9170/20-14-11.	

Application Note	The choice of galvanic isolator for this application depends on the power supply rating and type of contacts on the nonhazardous side that are required. See the table below: The drawings show the field device as a normally open contact.

Power Supply:		24 V DC		120 - 230 V AC	
No. of Channels:		Single Channel	Dual Channel	Single Channel	Dual Channel
Electronic Output:	35 V, 50 mA	9170/10-14-11.	9170/20-14-11.		
Type C:	1 x 125 V, 1 A		9170/20-10-11.		9170/20-10-21.
	2 x 125 V, 1 A	9170/10-11-11.		9170/10-11-21.	
	1 x 250 V, 4 A	9170/10-12-11.	9170/20-12-11.	9170/10-12-21.	9170/2012-21.
	2 x 250 V, 4 A			9170/10-13-21.	
Normally Open:	2 x 125 V, 1 A		9170/20-11-11.		9170/20-11-21.

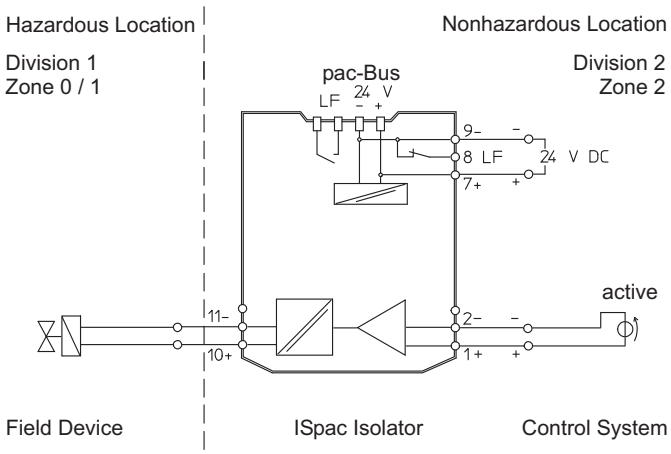
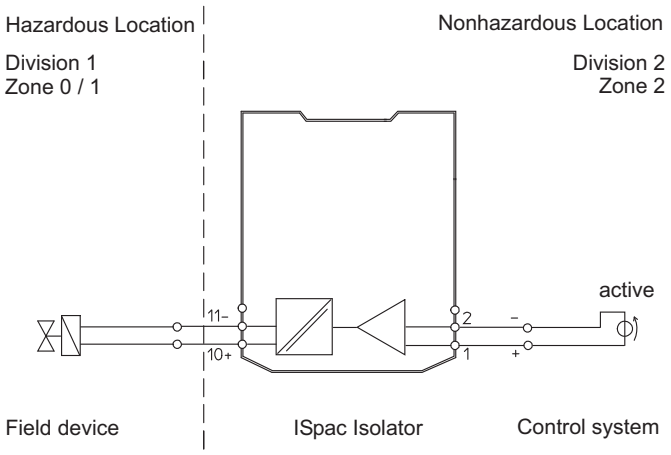
For all 9170 units except 9170/.0-14-11. and 9170/20-11-.1.

Contact	Description
1	NO
2	Common
3	NC
4	NC
5	NO
6	Common

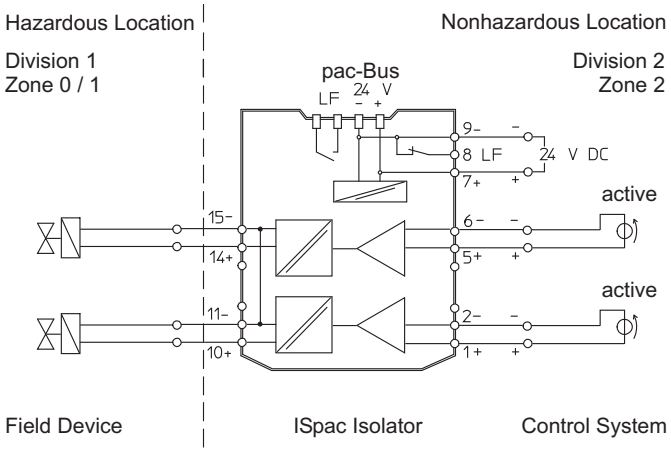
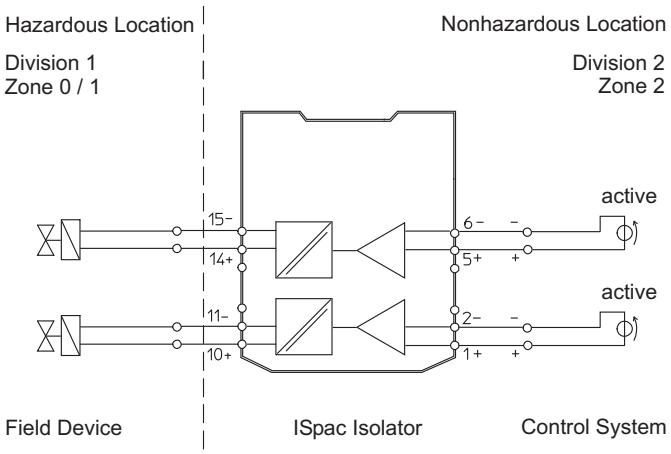
9170/20-11-.1.

Contact	Description
1	NO
2	Common
3	NO
4	NO
5	NO
6	Common

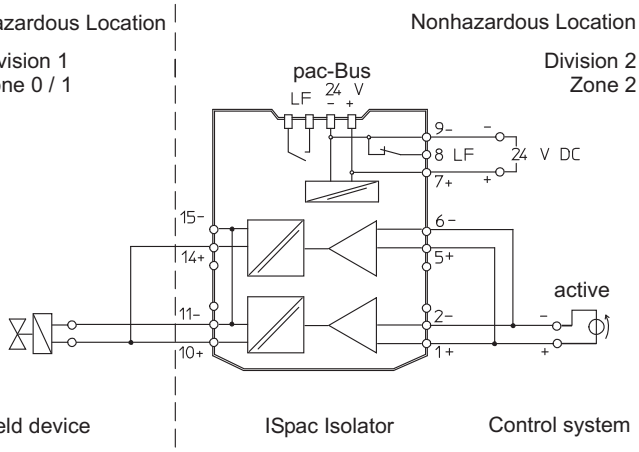
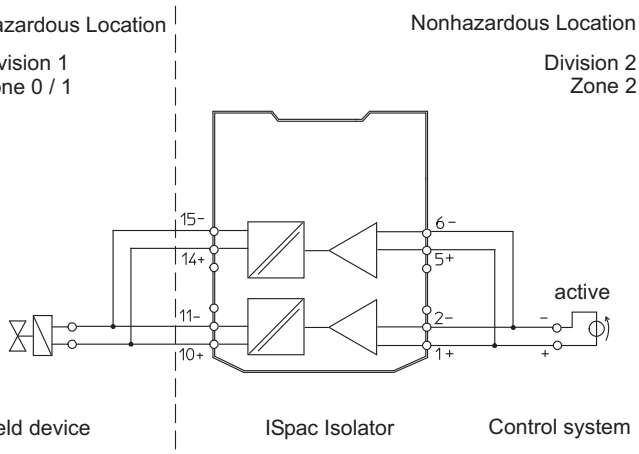
2-wire Discrete Output for Solenoids, LEDs and Audible Alarms

Order Code	Schematic
9175/10-1.-11.	
9176/10-1.-00.	

2-wire Discrete Output for Solenoids, LEDs and Audible Alarms

Order Code	Schematic
9175/20-1.-11.	
9176/20-1.-00.	

2-wire Discrete Output for Solenoids, LEDs and Audible Alarms

Order Code	Schematic
9175/20-1.-11. parallel operation	
9176/20-1.-00. parallel operation	
Application Note	The choice of galvanic isolator for this application depends on entity parameters of the field device and the operational voltage and current required. The 9175 is separately powered whereas the 9176 is loop powered. With both types the outputs from the dual channel version can be paralleled to give double the output current.

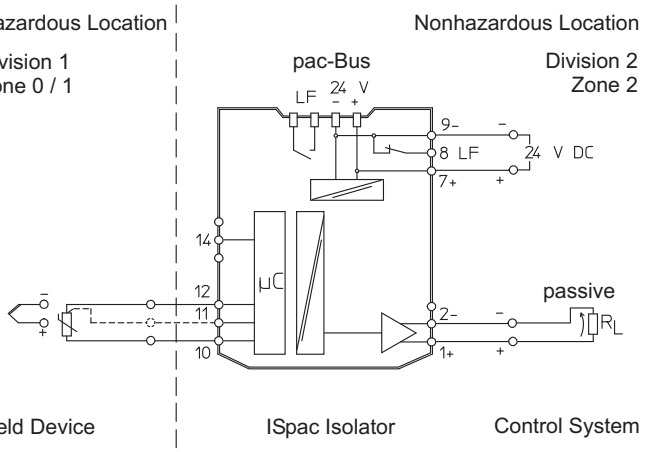
Temperature (T/C or RTD) Converters and Trip Amps

Application Note	The choice of galvanic isolator for this application depends on the requirements on the nonhazardous side.

Thermocouple / RTD Input to Active 4/20 mA Output

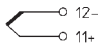
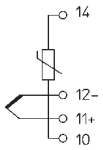
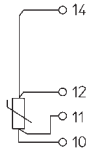
Order Code Schematic

9182/10-51-11.



06714E03

Input Circuitry

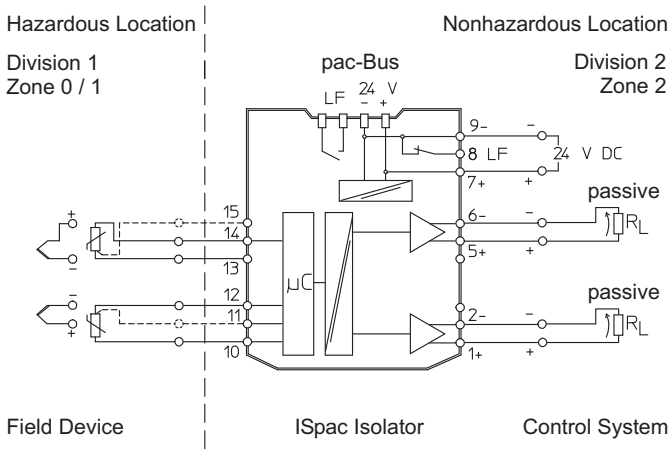
	Thermocouple		Resistance thermometer / potentiometer		
	Cold junction compensation		2-wire	3-wire	4-wire
	const. temp.	ext. Pt. 100			
Channel 1	 09759E00	 07109E00	 09760E00	 09761E00	 07110E00

Temperature (T/C or RTD) Converters and Trip Amps

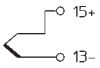
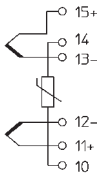
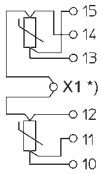
Thermocouple / RTD Input to Active 4/20 mA Output

Order Code Schematic

9182/20-51-11.



Input Circuitry

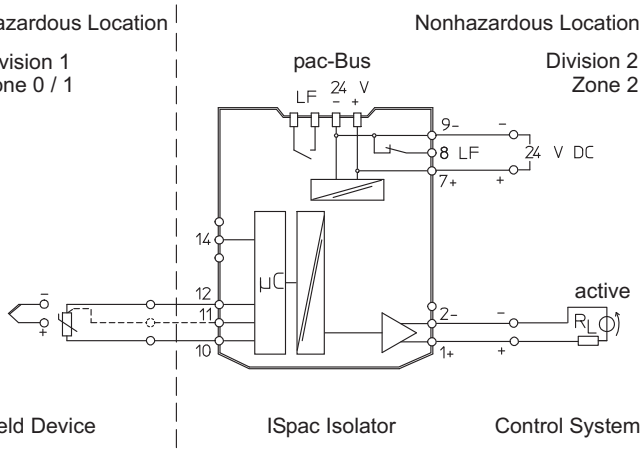
	Thermocouple		Resistance thermometer / potentiometer		
	Cold junction compensation		2-wire	3-wire	4-wire
	const. temp.	ext. Pt. 100			
Channel 2	 09754E00	 09755E00	 09756E00	 09757E00	 06525E00
Channel 1	 09759E00		 09760E00	 09761E00	
					X1 is an external terminal

Temperature (T/C or RTD) Converters and Trip Amps

All connections on the hazardous side of the units are as in the tables on the previous pages.

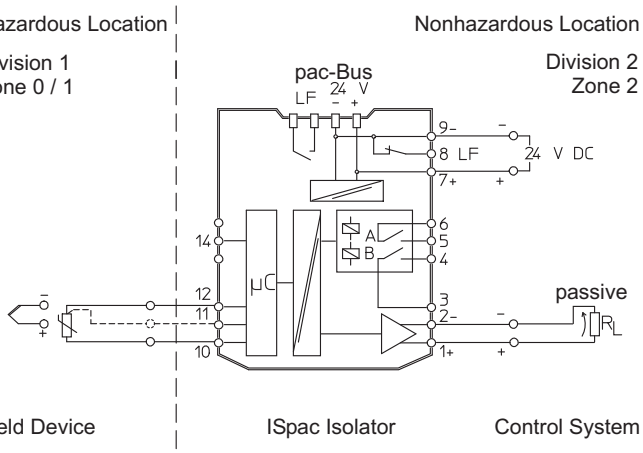
Thermocouple / RTD Input to Passive 4/20 mA Output

Order Code	Schematic
9182/10-59-11.	



Thermocouple / RTD Input to Active 4/20 mA Output with Trip Points

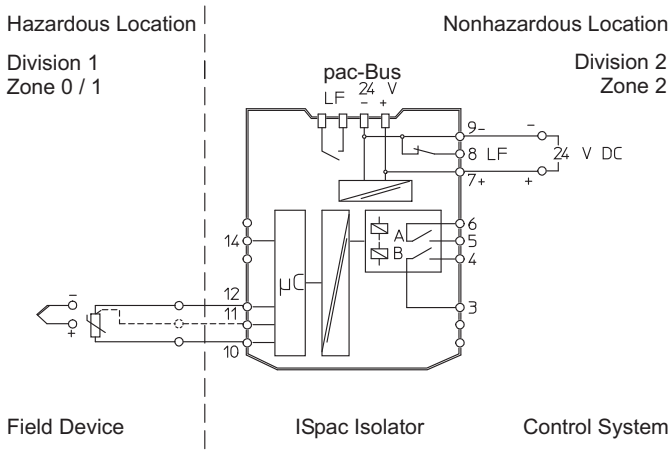
Order Code	Schematic
9182/10-51-12.	



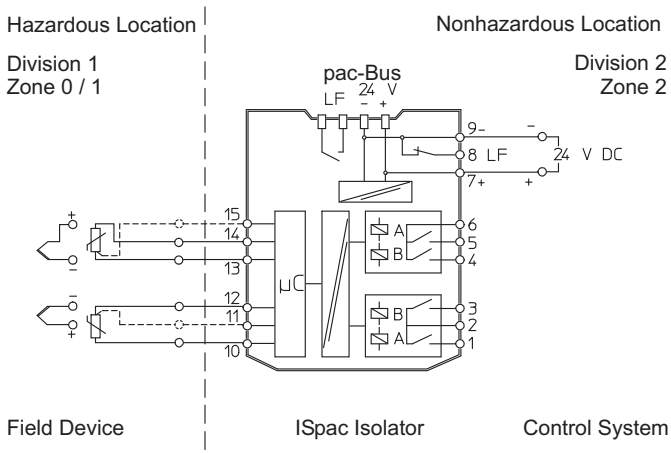
Temperature (T/C or RTD) Converters and Trip Amps

Thermocouple / RTD Input Trip Amplifier

Order Code	Schematic
9182/10-50-12.	



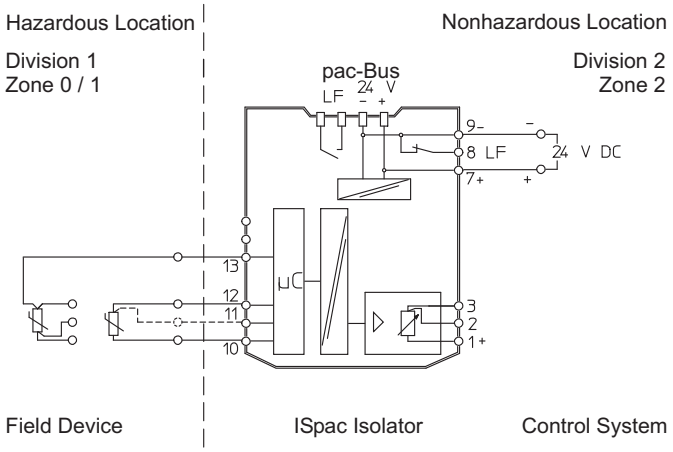
9182/20-50-12.



9182/20-50-12.

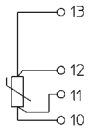
Terminal	Description
1	NO
2	Common
3	NO
4	NO
5	NO
6	Common

RTDs

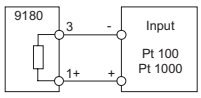
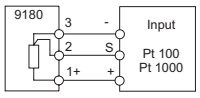
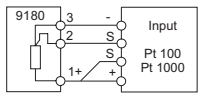
Order Code	Schematic
9180/10-77-11.	

06729E03

Input Connections

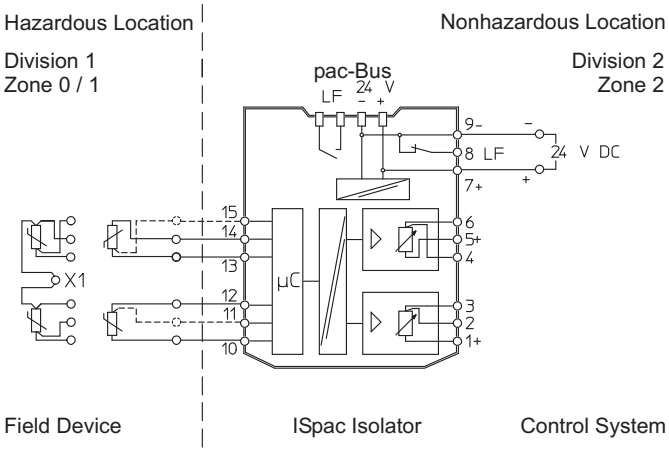
	Resistance thermometer / potentiometer		
	2-wire	3-wire	4-wire
Channel 1	 09760E00	 09761E00	 06522E00

Output Connections

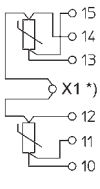
	2-wire	3-wire	4-wire
Channel 1	 06531E02	 06532E02	 06533E02

RTDs

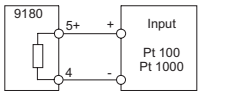
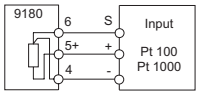
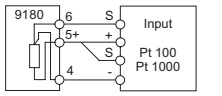
Order Code	Schematic
9180/20-77-11.	



Input Connections

	Resistance thermometer / potentiometer		
	2-wire	3-wire	4-wire
Channel 2			
Channel 1			

Output Connections

	2-wire	3-wire	4-wire
Channel 2			

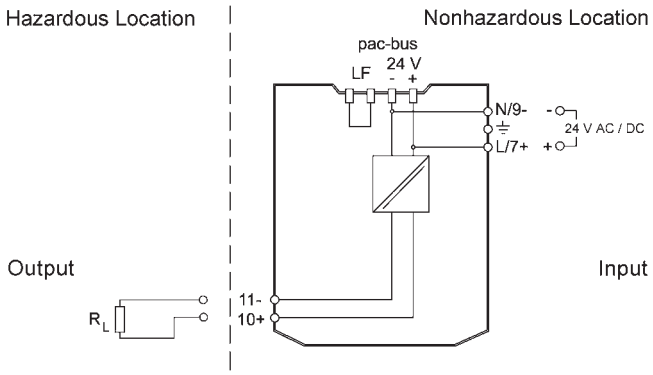
Application Note	For 2-, 3-, and 4-wire RTDs and other resistance sources where a resistance input is required into the measuring device in the nonhazardous location. X1 is an external terminal.

Additional Applications

Isolator Type	Application	Comments	Data Sheet Page #
9143	I.S. power supply	19 versions, various voltages and currents	3-32
9146	Frequency transmitter	NAMUR type pulse input to 4/20 mA output	3-34
9172	I.S. relay		3-68
9185	Data Communication	Copper RS 232, RS 422, RS 485	3-89
9186	Data Communication	Fiber Optic RS 232, RS 422, RS 485	3-93
9192	HART mutiplexer	Separation of HART signals into a HART management system	3-97

10595E00

Connection Drawing



10598E03

For providing intrinsically safe power to I.S. field devices

- Constant output voltage
- Approved for installation in Division 2 and Zone 2
- Compact design

Technical Tips Additional attention should be paid to the power output of these units when matching the entity parameters to the I.S. field device.

Order Code	Intrinsically Safe Output		Note
	Nominal voltage V_{nom}	Max. nominal current I_{nom}	
9143/10-065-150-10s	4.0 ... 5.6 V	130 mA	For all units, if the max. nominal current is reached the output voltage is set to 0 V.
9143/10-065-200-10s	4.0 ... 5.6 V	160 mA	
9143/10-104-220-10s	8.7 ... 9.5 V	200 mA	
9143/10-114-200-10s	9.4 ... 10.4 V	180 mA	
9143/10-124-150-10s	9.5 ... 11.8 V	130 mA	
9143/10-156-065-10s	12.5 ... 14.7 V	45 mA	
9143/10-156-160-10s	12.5 ... 14.7 V	140 mA	
9143/10-187-050-10s	14.6 ... 17.6 V	35 mA	
9143/10-244-035-10s	18.9 ... 23.0 V	15 mA	
9143/10-244-060-10s	18.9 ... 23.0 V	40 mA	
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals		

Technical Specifications

Hazardous Location

Entity Parameters

FM / ATEX	9143/10-065-150-10. V_{OC} = 6.5 V, I_{SC} = 150 mA, P_O = 0.975 W 9143/10-065-200-10. V_{OC} = 6.5 V, I_{SC} = 200 mA, P_O = 1.3 W 9143/10-104-220-10. V_{OC} = 10.4 V, I_{SC} = 220 mA, P_O = 2.288 W 9143/10-114-200-10. V_{OC} = 11.4 V, I_{SC} = 200 mA, P_O = 2.28 W 9143/10-124-150-10. V_{OC} = 12.4 V, I_{SC} = 150 mA, P_O = 1.86 W 9143/10-156-065-10. V_{OC} = 15.6 V, I_{SC} = 65 mA, P_O = 1.014 W 9143/10-156-160-10. V_{OC} = 15.6 V, I_{SC} = 160 mA, P_O = 2.496 W 9143/10-187-050-10. V_{OC} = 18.7 V, I_{SC} = 50 mA, P_O = 0.935 W 9143/10-244-035-10. V_{OC} = 24.4 V, I_{SC} = 35 mA, P_O = 0.854 W 9143/10-244-060-10. V_{OC} = 24.4 V, I_{SC} = 60 mA, P_O = 1.464 W
Isolation voltage	V_m = 250 V AC

Galvanic Isolation

Test voltage under regulations EN 50020

Output to power supply	1.5 kV AC

Technical Specifications

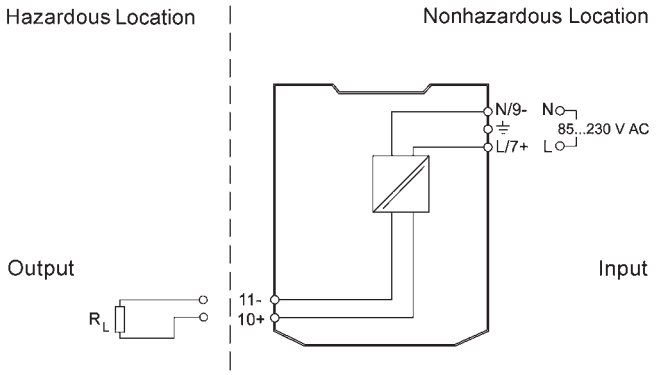
Nonhazardous Location

Power Supply

Indication	green LED "PWR"	
Nominal voltage V_{nom}	24 V AC / 24 V DC	
Voltage range	20 V ... 28 V AC / 18 V ... 35 V DC	
Frequency range	48 Hz ... 62 Hz with AC version	
Polarity reversal protection	yes with DC version	
Power consumption (at I_{nom})	9143/10-065-150-10.	1.1 W
	9143/10-065-200-10.	2.6 W
	9143/10-104-220-10.	5 W
	9143/10-114-200-10.	4.6 W
	9143/10-124-150-10.	3.3 W
	9143/10-156-065-10.	1.5 W
	9143/10-156-160-10.	4 W
	9143/10-187-050-10.	2 W
	9143/10-244-035-10.	1.8 W
	9143/10-244-060-10.	2.8 W


10595E00

Connection Drawing



10597E03

For providing intrinsically safe power to I.S. field devices

- Constant output voltage
- Compact design

Technical Tips Additional attention should be paid to the power output of these units when matching the entity parameters to the I.S. field device.

Order Code	Intrinsically Safe Output		Note
	Nominal voltage V_{nom}	Max. nominal current I_{nom}	
9143/10-065-200-20s	4.0 ... 5.6 V	160 mA	For all units, if the max. nominal current is reached the output voltage is set to 0 V.
9143/10-104-220-20s	8.7 ... 9.5 V	200 mA	
9143/10-114-200-20s	9.4 ... 10.4 V	180 mA	
9143/10-124-150-20s	9.5 ... 11.8 V	130 mA	
9143/10-156-065-20s	12.5 ... 14.7 V	45 mA	
9143/10-156-160-20s	12.5 ... 14.7 V	140 mA	
9143/10-187-050-20s	14.6 ... 17.6 V	35 mA	
9143/10-244-035-20s	18.9 ... 23.0 V	15 mA	
9143/10-244-060-20s	18.9 ... 23.0 V	40 mA	
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals		

Technical Specifications

Hazardous Location

Entity Parameters

FM / ATEX	9143/10-065-200-20. V_{OC} = 6.5 V, I_{SC} = 200 mA, P_O = 1.3 W 9143/10-104-220-20. V_{OC} = 10.4 V, I_{SC} = 220 mA, P_O = 2.288 W 9143/10-114-200-20. V_{OC} = 11.4 V, I_{SC} = 200 mA, P_O = 2.28 W 9143/10-124-150-20. V_{OC} = 12.4 V, I_{SC} = 150 mA, P_O = 1.86 W 9143/10-156-065-20. V_{OC} = 15.6 V, I_{SC} = 65 mA, P_O = 1.014 W 9143/10-156-160-20. V_{OC} = 15.6 V, I_{SC} = 160 mA, P_O = 2.496 W 9143/10-187-050-20. V_{OC} = 18.7 V, I_{SC} = 50 mA, P_O = 0.935 W 9143/10-244-035-20. V_{OC} = 24.4 V, I_{SC} = 35 mA, P_O = 0.854 W 9143/10-244-060-20. V_{OC} = 24.4 V, I_{SC} = 60 mA, P_O = 1.464 W
Isolation voltage	V_m = 250 V AC

Galvanic Isolation

Test voltage under regulations EN 50020

Output to power supply	1.5 kV AC

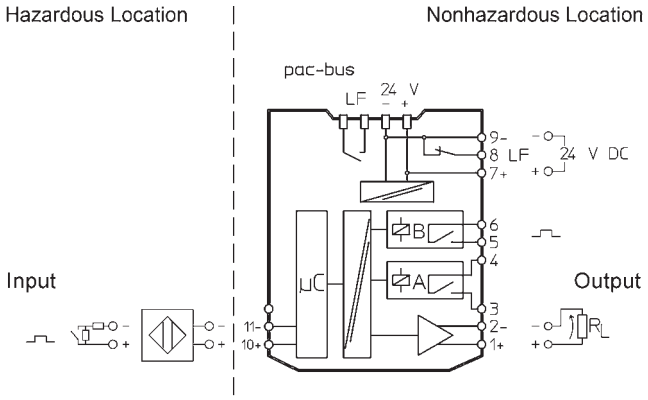
Technical Specifications

Nonhazardous Location

Power Supply

Indication	green LED "PWR"		
Nominal voltage V_{nom}	115 V AC / 230 V AC		
Voltage range	85 V ... 230 V AC		
Frequency range	48 Hz ... 62 Hz		
Power consumption (at I_{nom})		115 V	230 V
	9143/10-065-200-20.	2.3 VA	3.3 VA
	9143/10-104-220-20.	4 VA	4.6 VA
	9143/10-114-200-20.	3.7 VA	4.5 VA
	9143/10-124-150-20.	2.8 VA	3.5 VA
	9143/10-156-065-20.	1.8 VA	2.8 VA
	9143/10-156-160-20.	4 VA	4.9 VA
	9143/10-187-050-20.	2 VA	3.2 VA
	9143/10-187-050-20.	2 VA	3.2 VA
	9143/10-244-035-20.	1.9 VA	3 VA
	9143/10-244-060-20.	2.6 VA	3.8 VA

Connection Diagram



For interfacing with frequency signals from rotating devices

- Most compact device in its class
- Frequency divider function
- Two limit value relays
- Broad input frequency range 0.001 Hz ... 20 kHz
- Approved for installation in Division 2 and Zone 2
- Optional start up delay to prevent nuisance alarms
- Configurable via software
- Line fault detection
- Lockout function to force alarm acknowledgement

Technical Tips ISpac Wizard is required to configure this unit.
In order to use the LFD feature, with dry contacts, resistors must be installed at the field device.
In series: 2.7 kΩ, in parallel: 22 kΩ

Order Code	Output to Nonhazardous Location	Note
9146/10-11-12s	0/4 mA ... 20 mA	2 NO (SPST) contacts. Contact B can be configured as a pulse output
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / $_C$FM / ATEX	V_{OC} = 10.5 V, I_{SC} = 23.4 mA, P_O = 61.4 mW
UL	pending
Isolation voltage	V_m = 253 V AC

Intrinsically Safe Input

Signal	acc. to EN 60947-5-6 (NAMUR)
Current for ON	≥ 2.1 mA
Current for OFF	≤ 1.2 mA
No load voltage	8.5 V
Short circuit current	8.5 mA
Input frequency	0.001 Hz ... 20000 Hz

Technical Specifications

Nonhazardous Location

Output

Signal	0/4 mA ... 20 mA
Load resistance R_L	0 Ω ... 600 Ω
Operating modes	counter, period and event

Trip Point Contacts A and B

Switching voltage	≤ ± 30 V
Switching current	≤ 50 mA
On resistance	≤ 12.5 Ω (typical < 9.5 Ω)
Lockout function	output contact remains in alarm position, reset through DIP switches or "Power Off"
Start up delay	off / 1 ... 999 seconds

Technical Specifications

Hazardous Location

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	I_{in} < 0.05 mA ... 0.35 mA
Short circuit	R_{in} < 100 Ω ... 360 Ω
When line fault detected	configurable

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to configuration interface	1.5 kV AC
I.S. input to error contact	1.5 kV AC

Technical Specifications

Nonhazardous Location

Pulse Output

Frequency range	0 kHz ... 5 kHz
Frequency divider ratio input : output	1:1 ... 1:20000

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom})	55 mA
Power consumption (at V_{nom})	1.32 W
Polarity reversal protection	yes

Error Messaging

Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

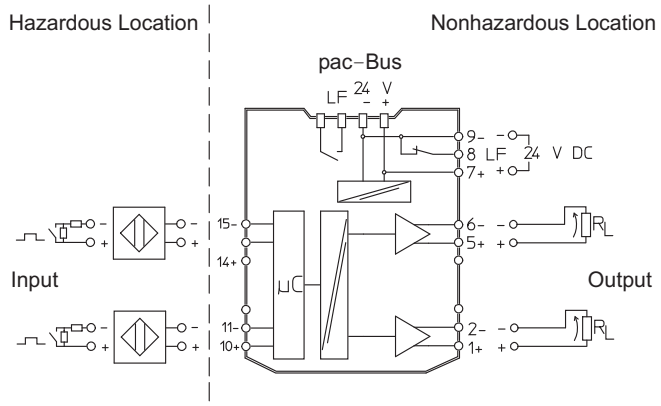
Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Output to configuration interface	350 V AC
Error contact to power supply and output	350 V AC

11027E00

Connection Diagram



11020E03

For interfacing with frequency signals from rotating devices

- Most compact device in its class
- Line fault detection
- Broad input frequency range 0.001 Hz ... 20 kHz
- Optional start up delay to prevent nuisance alarms
- Configurable via software
- Approved for installation in Division 2 and Zone 2

Technical Tips ISpac Wizard is required to configure this unit.
In order to use the LFD feature, with dry contacts, resistors must be installed at the field device.
In series: 2.7 kΩ, in parallel: 22 kΩ

Order Code	Output to Nonhazardous Location	Note
9146/20-11-11s	0/4 mA ... 20 mA	– –
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / $_C$FM / ATEX	V_{OC} = 10.5 V, I_{SC} = 23.4 mA, P_O = 61.4 mW
UL	pending
Isolation voltage	V_m = 253 V AC

Intrinsically Safe Input

Signal	acc. to EN 60947-5-6 (NAMUR)
Current for ON	≥ 2.1 mA
Current for OFF	≤ 1.2 mA
No load voltage	8.5 V
Short circuit current	8.5 mA
Input frequency	0.001 Hz ... 20000 Hz

Technical Specifications

Nonhazardous Location

Output

Signal	0/4 mA ... 20 mA
Load resistance R_L	0 Ω ... 600 Ω
Operating modes	counter, period and event

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom})	75 mA
Power consumption (at V_{nom})	1.8 W
Polarity reversal protection	yes

Technical Specifications

Hazardous Location

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	I_{in} < 0.05 mA ... 0.35 mA
Short circuit	R_{in} < 100 Ω ... 360 Ω
When line fault detected	configurable

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to configuration interface	1.5 kV AC
I.S. input to error contact	1.5 kV AC
I.S. inputs to each other	– –

Technical Specifications

Nonhazardous Location

Error Messaging

Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Output to configuration interface	350 V AC
Outputs to each other	350 V AC
Error contact to power supply and output	350 V AC

Customer Specific Set-up Sheet

Order-No.:_ _ _ _ _ _ _ _ _ _ _ _ -Pos.:_ _ _ Pieces:_____

	Type	Channels	Output	Trip point contact
☐	9146/10-11-12.	1	0/4...20 mA	2 NO
☐	9146/20-11-11.	2	0/4...20 mA	without

with:

☐ Screw terminal s ☐ Spring clamp terminal k

	Standard	Channel 1	Channel 2
Signal Tag	Signal 1/2	_____	_____
I.S. input			
Operating mode	Frequency via period	☐ Counter ☐ Frequency via period ☐ Frequency via event (50ms) ☐ Frequency via event (200ms) ☐ Frequency via event (1000ms)	☐ Counter ☐ Frequency via period ☐ Frequency via event (50ms) ☐ Frequency via event (200ms) ☐ Frequency via event (1000ms)
Impulse type	Positive slope	☐ Positive slope ☐ Negative slope	☐ Positive slope ☐ Negative slope
Frequency range	0...1000 Hz	from _____ to_____ (max. 20 000 Hz)	from _____ to_____ (max. 20 000 Hz)
Output			
Signal	4...20mA	☐ 0...20mA ☐ 4...20mA	☐ 0...20mA ☐ 4...20mA
Fault behavior	Fixed value (2.4 mA)	☐ hold last value ☐ off ☐ fixed value:_____	☐ hold last value ☐ off ☐ fixed value:_____
Trip point settings for contact A (only 9146/10-11-12)			
Signaling	deactivated	☐ activated ☐ deactivated	---
Value	25%	_____% (0 ... 100%)	---
Contact behavior		☐ closes if signal > value ☐ closes if signal < value ☐ opens if signal > value ☐ opens if signal < value	---
Hysteresis	1%	_____% (0.1 ... 10%)	---
Start up delay	deactivated	_____s (0 ... 999s) valid for both channels	---
Lockout function	deactivated	☐ activated ☐ deactivated	---
Trip point settings for contact B (only 9146/10-11-12)			
Signaling	deactivated	☐ activated ☐ deactivated	---
Value		_____% (0 ... 100%)	---
Contact behavior		☐ closes if signal > value ☐ closes if signal < value ☐ opens if signal > value ☐ opens if signal < value	---
Hysteresis		_____% (0.1 ... 10%)	---
Start up delay	deactivated	_____s (0 ... 999s) valid for both channels	---
Lockout function	deactivated	☐ activated ☐ deactivated	---
Pulse output	deactivated	☐ activated ☐ deactivated	---
Pulse divider	1	_____ (1 ... 20 000)	---

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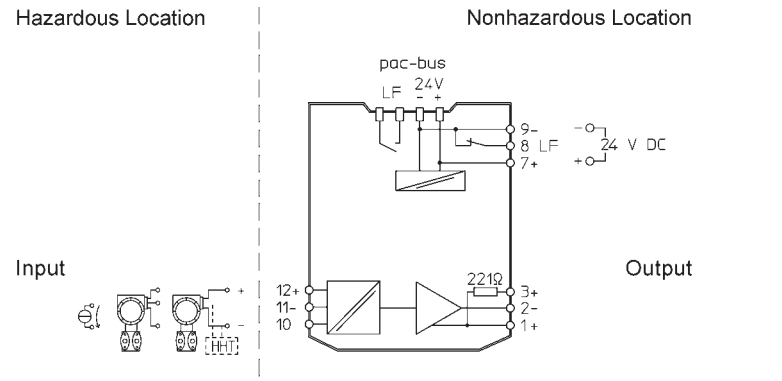
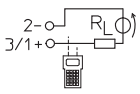
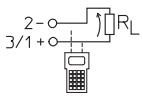
Connection Diagram



For interfacing to 2-wire HART 4/20 mA transmitters, 3- and 4-wire standard 4/20 mA transmitters and mA sources

- Line fault detection
- SIL 2
- Approved for installation in Division 2 and Zone 2

Technical Tips For correct HART communication a minimum load resistance, R_L, of 250 Ω is required. If this is not available at the input card an internal resistance of 221 Ω can be included by using terminals 3+ / 2-.

Order Code	Output to Nonhazardous Location	Output Configuration
9160/13-10-11s	Passive 0/4 mA ... 20 mA with HART	 09743E00
9160/13-11-11s	Active 0/4 mA ... 20 mA with HART	 09744E00
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / ATEX	2-, 3-wire transmitters V_{OC} = 27 V, I_{SC} = 88 mA, P_O = 576 mW when connecting mA sources V_{OC} = 4.1 V, V_{max} = 30 V, I_{max} = 100 mA
CSA	2-, 3-wire transmitters V_{OC} = 27.2 V, I_{SC} = 89 mA, P_O = 605 mW when connecting mA sources V_{OC} = 4.1 V, V_{max} = 30 V, I_{max} = 100 mA

Intrinsically Safe Input

Signal	0/4 mA ... 20 mA
Communication signal	2-wire transmitters only, bidirectional HART transmission, 0.5 kHz ... 10 kHz
Transmitter supply voltage	≥ 16 V at 20 mA

Technical Specifications

Nonhazardous Location

Output

No load voltage	≤ 15.5 V
Communication signal	2-wire transmitters only, bidirectional HART transmission, 0.5 kHz ... 10 kHz
Signal	9160/13-10-11. passive 0/4 mA ... 20 mA
Maximum input voltage	30 V
Minimum load resistance R_L	0 Ω for 5 V ... 15 V 500 Ω for 24 V 800 Ω for 30 V
Signal	9160/13-11-11. active 0/4 mA ... 20 mA
Load resistance R_L	0 Ω ... 600 Ω (terminal 1+ / 2-) 0 Ω ... 379 Ω (terminal 3+ / 2-) (with internal 221 Ω resistor for HART)

Technical Specifications

Hazardous Location

Intrinsically Safe Input

Max. input current for mA sources	50 mA
No load voltage	≤ 26 V
Input resistance (with HART)	500 Ω
Input resistance for mA sources	30 Ω

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	< 2 mA
Short circuit	> 22 mA
When line fault detected	output = input

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to error contact	1.5 kV AC

Technical Specifications

Nonhazardous Location

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	< 2 mA

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom}, 20 mA)	70 mA
Power consumption (at V_{nom}, 20 mA)	1.7 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Error Messaging

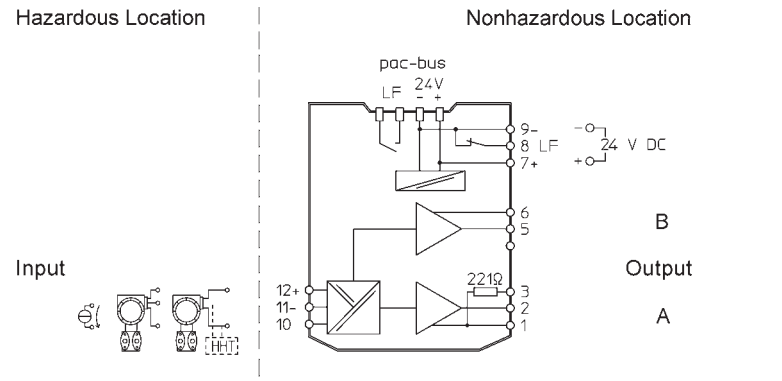
Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Error contact to power supply and output	350 V AC

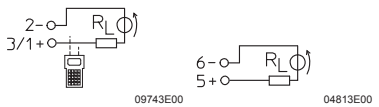
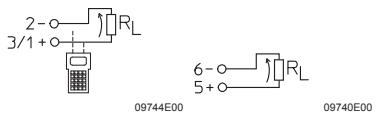
Connection Diagram



For interfacing to 2-wire HART 4/20 mA transmitters, 3- and 4-wire standard 4/20 mA transmitters and mA sources

- Line fault detection
- SIL 2
- Approved for installation in Division 2 and Zone 2

Technical Tips For correct HART communication a minimum load resistance, R_L, of 250 Ω is required. If this is not available at the input card an internal resistance of 221 Ω can be included by using terminals 3+ / 2-. Output B does not carry the HART signal.

Order Code	Output A	Output B	Output Configuration
9160/19-10-11s	Passive 0/4 mA ... 20 mA with HART	Passive 0/4 mA ... 20 mA	
9160/19-11-11s	Active 0/4 mA ... 20 mA with HART	Active 0/4 mA ... 20 mA	
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals		

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / ATEX	2-, 3-wire transmitters V_{OC} = 27 V, I_{SC} = 88 mA, P_O = 576 mW when connecting mA sources V_{OC} = 4.1 V, V_{max} = 30 V, I_{max} = 100 mA
CSA	2-, 3-wire transmitters V_{OC} = 27.2 V, I_{SC} = 89 mA, P_O = 605 mW when connecting mA sources V_{OC} = 4.1 V, V_{max} = 30 V, I_{max} = 100 mA

Intrinsically Safe Input

Signal	0/4 mA ... 20 mA
Communication signal	2-wire transmitters only, bidirectional HART transmission, 0.5 kHz ... 10 kHz

Technical Specifications

Nonhazardous Location

Output

No load voltage	≤ 15.5 V
Communication signal	2-wire transmitters only, bidirectional HART transmission, 0.5 kHz ... 10 kHz
Signal	9160/19-10-11. output A: passive 0/4 mA ... 20 mA with HART output B: passive 0/4 mA ... 20 mA
Maximum input voltage	30 V
Minimum load resistance R_L	0 Ω for 5 V ... 15 V 500 Ω for 24 V 800 Ω for 30 V

Technical Specifications

Hazardous Location

Intrinsically Safe Input

Transmitter supply voltage	≥ 16 V at 20 mA
Max. input current for mA sources	50 mA
No load voltage	≤ 26 V
Input resistance (with HART)	500 Ω
Input resistance for mA sources	30 Ω

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	< 2 mA
Short circuit	> 22 mA
When line fault detected	output = input

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to error contact	1.5 kV AC

Technical Specifications

Nonhazardous Location

Output

Signal	9160/19-11-11. output A: active 0/4 mA ... 20 mA with HART output B: active 0/4 mA ... 20 mA
Load resistance R_L	0 Ω ... 600 Ω (terminal 1+ / 2-) 0 Ω ... 379 Ω (terminal 3+ / 2-) (with internal 221 Ω resistor for HART)

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	< 2 mA

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom}, 20 mA)	70 mA
Power consumption (at V_{nom}, 20 mA)	1.7 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Error Messaging

Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Outputs to each other	350 V AC
Error contact to power supply and output	350 V AC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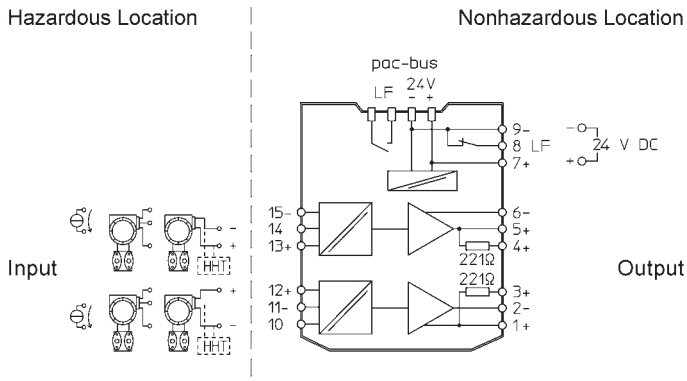
Connection Diagram

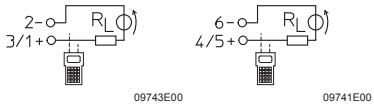
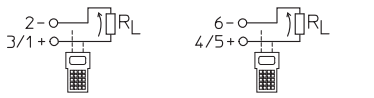


09739E03

For interfacing to 2-wire HART 4/20 mA transmitters, 3- and 4-wire standard 4/20 mA transmitters and mA sources

- Line fault detection
- SIL 2
- Approved for installation in Division 2 and Zone 2

Technical Tips For correct HART communication a minimum load resistance, R_L, of 250 Ω is required. If this is not available at the input card an internal resistance of 221 Ω can be included by using terminals 3+ / 2-, 4+ / 6-.

Order Code	Output to Nonhazardous Location	Output Configuration
9160/23-10-11s	Passive 0/4 mA ... 20 mA with HART	 09743E00 09741E00
9160/23-11-11s	Active 0/4 mA ... 20 mA with HART	 09744E00 09742E00
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / ATEX	2-, 3-wire transmitters V_{OC} = 27 V, I_{SC} = 88 mA, P_O = 576 mW when connecting mA sources V_{OC} = 4.1 V, V_{max} = 30 V, I_{max} = 100 mA
CSA	2-, 3-wire transmitters V_{OC} = 27.2 V, I_{SC} = 89 mA, P_O = 605 mW when connecting mA sources V_{OC} = 4.1 V, V_{max} = 30 V, I_{max} = 100 mA

Intrinsically Safe Input

Signal	0/4 mA ... 20 mA
Communication signal	2-wire transmitters only, bidirectional HART transmission, 0.5 kHz ... 10 kHz

Technical Specifications

Nonhazardous Location

Output

No load voltage	≤ 15.5 V
Communication signal	2-wire transmitters only, bidirectional HART transmission, 0.5 kHz ... 10 kHz
Signal	9160/23-10-11. passive 0/4 mA ... 20 mA
Maximum input voltage	30 V
Minimum load resistance R_L	0 Ω for 5 V ... 15 V 500 Ω for 24 V 800 Ω for 30 V
Signal	9160/23-11-11. active 0/4 mA ... 20 mA
Load resistance R_L	0 Ω ... 600 Ω (terminal 1+ / 2-, 5+ / 6-) 0 Ω ... 379 Ω (terminal 3+ / 2-, 4+ / 6-) (with internal 221 Ω resistor for HART)

Technical Specifications

Hazardous Location

Intrinsically Safe Input

Transmitter supply voltage	≥ 16 V at 20 mA
Max. input current for mA sources	50 mA
No load voltage	≤ 26 V
Input resistance (with HART)	= 500 Ω
Input resistance for mA sources	30 Ω

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	< 2 mA
Short circuit	> 22 mA
When line fault detected	output = input

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to error contact	1.5 kV AC
I.S. inputs to each other	500 V AC

Technical Specifications

Nonhazardous Location

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	< 2 mA

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom}, 20 mA)	125 mA
Power consumption (at V_{nom}, 20 mA)	3 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Error Messaging

Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

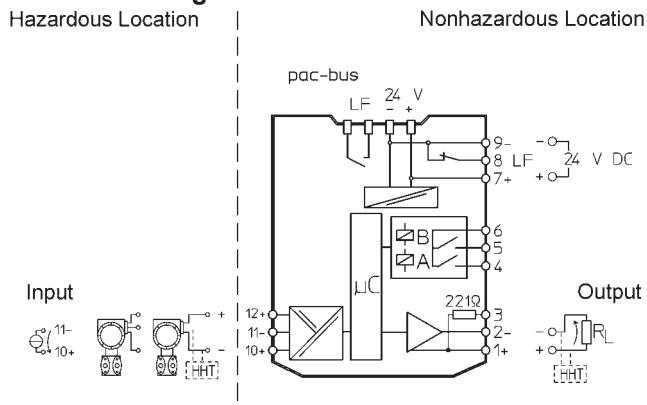
Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Outputs to each other	350 V AC
Error contact to power supply and output	350 V AC


11028E00

Connection Diagram



05517E03

For interfacing to 2-wire HART 4/20 mA transmitters, 3- and 4-wire standard 4/20 mA transmitters and mA sources

- Line fault detection
- Lockout function to force alarm acknowledgement
- Approved for installation in Division 2 and Zone 2
- Configurable via software
- Compact unit with 2 configurable trip points plus a 0/4 mA ... 20 mA output

Technical Tips The ISpac Wizard is required to configure this unit. For correct HART communication a minimum load resistance, R_L, of 250 Ω is required. If this is not available at the input card an internal resistance of 221 Ω can be included by using terminals 3+ / 2-.

Order Code	Output to Nonhazardous Location	Note
9162/13-11-12s	0/4 mA ... 20 mA with HART	2 NO (SPST) contacts
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CFM / ATEX	V_{OC} = 27 V_{OC}, I_{SC} = 87.9 mA, P_O = 574 mW when connecting mA sources: V_{OC} = 4.1 V, V_{max} = 30 V, I_{max} = 100 mA
Isolation voltage	V_m = 250V AC

Intrinsically Safe Input

Signal	0/4 mA ... 20 mA with HART
Communication signal	2-wire transmitters only, bidirectional HART transmission, 0.5 kHz ... 30 kHz
Transmitter supply voltage	≥ 16 V at 20 mA
No load voltage	≤ 26
Input resistance (with HART)	500 Ω
Max. input current for mA sources	50 mA
Input resistance for mA sources	30 Ω

Technical Specifications

Nonhazardous Location

Output

Signal	0/4 mA ... 20 mA with HART
Load resistance R_L	0 Ω ... 600 Ω terminal 1+ / 2- 0 Ω ... 379 Ω terminal 3+ / 2- (with internal 221 Ω resistor for HART)
No load voltage	≤ 15.5 V
Communication signal	2-wire transmitters only, bidirectional HART transmission, 0.5 kHz ... 30 kHz

Trip Point Contacts A and B

Configuration	via ISpac Wizard
Switching voltage	≤ ± 30 V
Switching current	≤ 100 mA
On resistance	≤ 2.5 Ω (typical < 1 Ω)
Lockout function	output contact remains in alarm position, reset through DIP switches or "Power Off"

Technical Specifications

Hazardous Location

Error Detection (LFD)

Open circuit	< 2 mA
Short circuit	> 22 mA
When line fault detected	output = input configurable 0 mA ... 23 mA or hold last value

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to error contact	1.5 kV AC
I.S. input to trip point contact	1.5 V AC

Technical Specifications

Nonhazardous Location

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom}, 20 mA)	83 mA
Power consumption (at V_{nom}, 20 mA)	2 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Error Messaging

Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Output to trip point contact	350 V AC
Error contact to power supply and output	350 V AC

Customer Specific Set-up Sheet

Order-No.:_ _ _ _ _ _ _ _ _ _ _ _ -Pos.:_ _ _ Pieces:_____

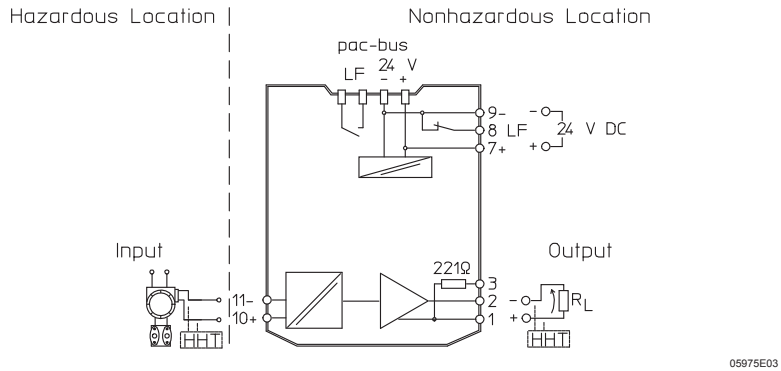
Type	Channel	Output	Trip point contact
9162/13-11-12.	1	0/4...20 mA	2 NO

with:
☐ Screw terminal s ☐ Spring clamp terminal k

	Standard	Customer Specific
Signal Tag	Signal 1	_____
Output		
Signal	4...20mA	☐ 0...20mA ☐ 4...20mA
Fault behavior	Fixed value (2.4 mA)	☐ hold last value ☐ off ☐ fixed value:_____
Trip point settings for contact A		
Signaling	deactivated	☐ activated ☐ deactivated
Value	2.4 mA	_____mA (0.29 ... 24 mA)
Contact behavior		☐ closes if signal > value ☐ closes if signal < value ☐ opens if signal > value ☐ opens if signal < value
Hysteresis	0.24 mA	_____mA (0.24 ... 2.4 mA)
Lockout function	deactivated	☐ activated ☐ deactivated
Trip point settings for contact B		
Signaling	deactivated	☐ activated ☐ deactivated
Value	2.4 mA	_____mA (0.29 ... 24 mA)
Contact behavior		☐ closes if signal > value ☐ closes if signal < value ☐ opens if signal > value ☐ opens if signal < value
Hysteresis	0.24 mA	_____mA (0.24 ... 2.4 mA)
Lockout function	deactivated	☐ activated ☐ deactivated

05206E03

Connection Diagram



For interfacing with 4-wire HART transmitters and (HART) mA sources

- Passive input
- Bidirectional transmission of HART signals
- Line fault detection
- Approved for installation in Division 2 and Zone 2

Technical Tips For correct HART communication a minimum load resistance, R_L, of 250 Ω is required. If this is not available at the input card an internal resistance of 221 Ω can be included by using terminals 3+ / 2-.

Order Code	Input from Hazardous Location	Note
9163/13-11-11s	0/4 mA ... 20 mA with HART	– –
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{max} = 30 V, I_{max} = 150 mA, P_i = 1 mW, V_{OC} = 0 V, I_{SC} = 0 mA, P_O = 0 W
Isolation voltage	V_m = 253 V AC

Intrinsically Safe Input

Signal	0/4 mA ... 20 mA with HART
Max. input current	50 mA
Input resistance (with HART)	≈ 300 Ω
Input resistance (without HART)	≤ 150 Ω
Communication signal	bidirectional HART transmission, 0.5 kHz ... 10 kHz

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	< 2 mA
Short circuit	< 2 mA
When line fault detected	output = input

Technical Specifications

Nonhazardous Location

Output

Signal	0/4 mA ... 20 mA with HART
Load resistance R_L	0 Ω ... 600 Ω (terminal 1+/2-) 0 Ω ... 479 Ω (terminal 3+/2-) (with internal 221 Ω resistor for HART)
No load voltage	≤ 15.5 V
Communication signal	bidirectional HART transmission, 0.5 kHz ... 10 kHz

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom}, 20 mA)	80 mA
Power consumption (at V_{nom}, 20 mA)	1.9 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Technical Specifications

Hazardous Location

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
Error contact to I.S. input	1.5 kV AC

Technical Specifications

Nonhazardous Location

Error Messaging

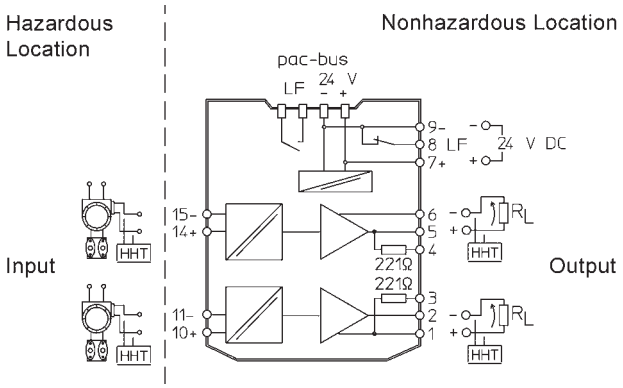
Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Error contact to power supply and output	350 V AC

Connection Diagram



For interfacing with 4-wire HART transmitters and (HART) mA sources

- Passive input
- Bidirectional transmission of HART signals
- Line fault detection
- Approved for installation in Division 2 and Zone 2

Technical Tips For correct HART communication a minimum load resistance, R_L, of 250 Ω is required. If this is not available at the input card an internal resistance of 221 Ω can be included by using terminals 3+ / 2- or 4+ / 6-.

Order Code	Input from Hazardous Location	Note
9163/23-11-11s	0/4 mA ... 20 mA with HART	– –
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{max} = 30 V, I_{max} = 150 mA, P_i = 1 mW, V_{OC} = 0 V, I_{SC} = 0 mA, P_O = 0 W
Isolation voltage	V_m = 253 V AC

Intrinsically Safe Input

Signal	0/4 mA ... 20 mA with HART
Max. input current	50 mA
Input resistance (with HART)	≈ 300 Ω
Input resistance (without HART)	≤ 150 Ω
Communication signal	bidirectional HART transmission, 0.5 kHz ... 10 kHz

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	< 2 mA
Short circuit	< 2 mA
When line fault detected	output = input

Technical Specifications

Nonhazardous Location

Output

Signal	0/4 mA ... 20 mA with HART
Load resistance R_L	0 Ω ... 600 Ω (terminal 1+ / 2-, 5+ / 6-) 0 Ω ... 479 Ω (terminal 3+ / 2-, 4+ / 6-) (with internal 221 Ω resistor for HART)
No load voltage	≤ 15.5 V
Communication signal	bidirectional HART transmission, 0.5 kHz ... 10 kHz

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom}, 20 mA)	135 mA
Power consumption (at V_{nom}, 20 mA)	3.2 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Technical Specifications

Hazardous Location

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
Error contact to I.S. input	1.5 kV AC
I.S. inputs to each other	500 V AC

Technical Specifications

Nonhazardous Location

Error Messaging

Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

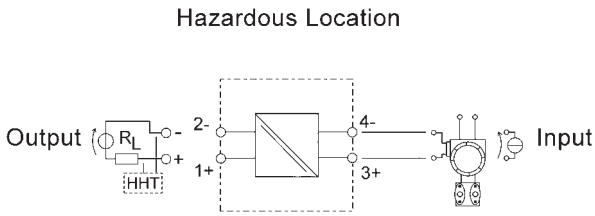
Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Outputs to each other	350 V AC
Error contact to power supply and output	350 V AC

10512E00

Connection Diagram



10471E03

For the interconnection of passive mA sources with active 2-wire mA inputs

- FM and ATEX approved
- Bidirectional transmission of HART signals
- Approved for installation in Division 1 and Zone 1
- Intrinsically safe input and output
- Perfect solution to integrate 4-wire I.S. transmitter with 2-wire I.S. I/O cards or galvanic isolators

Technical Tips For Class 1, Division 1 installations the modules shall be installed in compliance with the enclosure, mounting, spacing and segregation requirements of the ultimate application including access only by the use of a tool.

Order Code	Output	Input
9164/13-22-08	passive 4 mA ... 20 mA HART	passive 4 mA ... 20 mA HART

Technical Specifications

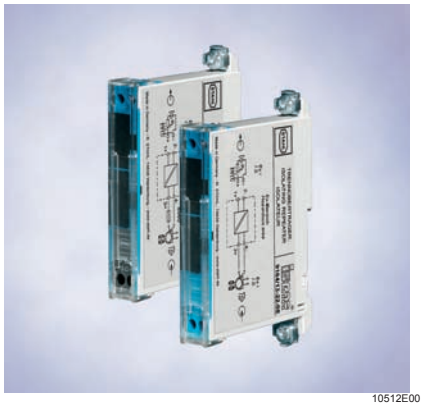
Hazardous Location - Output

Entity Parameters	
FM / ATEX	V_{max} = 30 V, I_{max} = 150 mA, P_i = 800 mW , V_{OC} = 0 V, I_{SC} = 0 mA, P_O = 0 mW
Intrinsically Safe Output	
Signal	passive 3.6 mA ... 21 mA with HART
Active 2-wire input supply voltage	12 V ... 30 V
Input resistance	> 10 kΩ
Communication signal	bidirectional HART transmission, 0.5 kHz ... 5 kHz
Polarity reversal protection	yes
Power Supply	
Power supply	loop powered
Error Detection	
Open circuit	output current < 2.4 mA
Short circuit	output current < 2.4 mA
Galvanic Isolation	
Test voltage under regulations EN 50020	
I.S. input to I.S. output	60 V AC

Technical Specifications

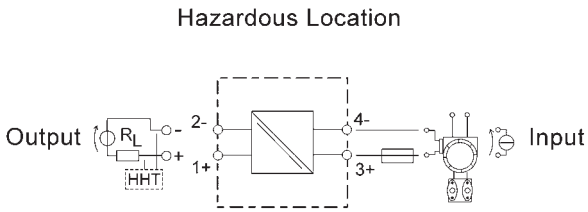
Hazardous Location - Input

Entity Parameters	
FM / ATEX	V_{max} = 30 V, I_{max} = 150 mA, P_i = 1000 mW, V_{OC} = 0 V, I_{SC} = 0 mA, P_O = 0 mW
Intrinsically Safe Input	
Signal	passive 3.6 mA ... 21 mA with HART
Constant voltage drop	≤ 3.5 V
Input resistance	at 0.5 kHz ... 5 kHz; 240 Ω ... 260 Ω (with HART)
Communication signal	bidirectional HART transmission, 0.5 kHz ... 5 kHz
Polarity reversal protection	yes
Power Supply	
Power supply	loop powered
Error Detection	
Open circuit	output current < 2.4 mA
Short circuit	output current < 2.4 mA
Galvanic Isolation	
Test voltage under regulations EN 50020	
I.S. input to I.S. output	60 V AC



10512E00

Connection Diagram



10472E03

For the interconnection of passive mA sources with active 2-wire mA inputs

- ATEX only approved
- Bidirectional transmission of HART signals
- Approved for installation in Division 1 and Zone 1
- Increased safety input, intrinsically safe output
- Perfect solution to integrate 4-wire Ex e transmitters with 2-wire I.S. I/O cards or galvanic isolators

Technical Tips

For Zone 1 installations the modules must be installed into enclosures which meet the needs of EN 50020.

For Zone 2 installations the modules must be installed into enclosures which meet the needs of EN 50021.

Order Code	Output	Input
9164/13-22-09	passive 4 mA ... 20 mA HART	passive 4 mA ... 20 mA HART

Technical Specifications

Hazardous Location - Output

Entity Parameters

ATEX	V_{max} = 30 V, I_{max} = 150 mA, P_i = 800 mW , V_{OC} = 0 V, I_{SC} = 0 mA, P_O = 0 mW

Intrinsically Safe Output

Signal	passive 3.6 mA ... 21 mA with HART
Active 2-wire input supply voltage	12 V ... 30 V
Input resistance	> 10 kΩ
Communication signal	bidirectional HART transmission, 0.5 kHz ... 5 kHz
Polarity reversal protection	yes

Power Supply

Power supply	loop powered

Error Detection

Open circuit	output current < 2.4 mA
Short circuit	output current < 2.4 mA

Galvanic Isolation

Test voltage under regulations EN 50020

Increased safety input to I.S. output	1500 V AC

Technical Specifications

Hazardous Location - Input

Entity Parameters

ATEX	V_{nom} = 30 V, I_{nom} = 30 mA, P_{nom} = 1000 mW

Increased Safety Input

Signal	passive 3.6 mA ... 21 mA with HART
Constant voltage drop	≤ 3.5 V
Input resistance	at 0.5 kHz ... 5 kHz; 240 Ω ... 260 Ω (with HART)
Communication signal	bidirectional HART transmission, 0.5 kHz ... 5 kHz
Back-up fuse	63 mA external
Polarity reversal protection	yes

Power Supply

Power supply	loop powered

Error Detection

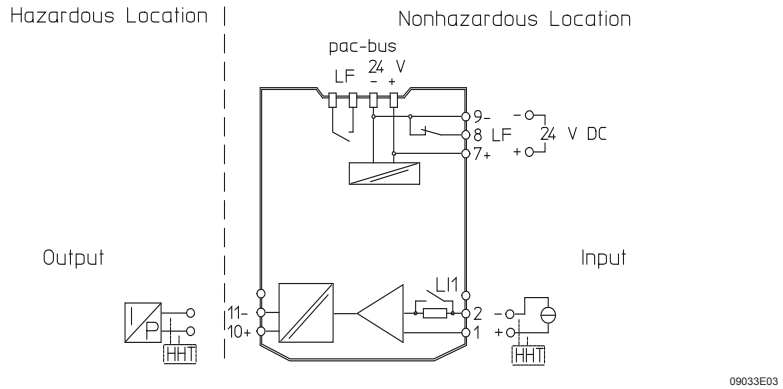
Open circuit	output current < 2.4 mA
Short circuit	output current < 2.4 mA

Galvanic Isolation

Test voltage under regulations EN 50020

Increased safety input to I.S. output	1500 V AC

Connection Diagram



For interfacing to control valves, I/P converters, loop powered indicators and HART control valves

- Bidirectional transmission of HART signals
- Approved for installation in Division 2 and Zone 2
- Line fault detection
- SIL 2

Technical Tips Switch LI1 can be deactivated to raise the input resistance to 550 Ω. This ensures interference free HART communication when the automation system has a low output resistance.

Order Code	Input / Output	Note
9165/16-11-11s	0/4 mA ... 20 mA with HART	– –
9165/16-11-13s	0/4 mA ... 20 mA with HART	If the output is open circuit, the input goes to high impedance - > 100 kΩ. No short circuit detection available.
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / CSA / ATEX	V_{OC} = 25.6 V, I_{SC} = 96 mA, P_O = 605 mW
UL	V_{OC} = 25.6 V, I_{SC} = 100 mA, P_O = 639 mW
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Output

Signal	0/4 mA ... 20 mA with HART
Load resistance R_L	0 Ω ... 800 Ω
Min. load resistance for short circuit monitoring	150 Ω
No load voltage	≤ 25.6 V

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	9165/16-11-11. > 10 kΩ 9165/16-11-13. > 100 kΩ

Technical Specifications

Nonhazardous Location

Input

Signal	0/4 mA ... 20 mA with HART
Max. input current	50 mA
Input resistance (switch LI1, on / off)	225 Ω / 550 Ω
Communication signal	bidirectional HART transmission, 0.5 kHz ... 30 kHz

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom}, 20 mA)	80 mA
Power consumption (at V_{nom}, 20 mA)	1.3 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Technical Specifications

Hazardous Location

Error Detection (LFD)

Short circuit	9165/16-11-11.	15 Ω
	9165/16-11-13.	no short circuit detection
When line fault detected	9165/16-11-11.	input ≥ 6 kΩ
	9165/16-11-13.	input ≥ 100 kΩ
Open circuit detection only with input current	9165/16-11-11.	input ≥ 3.6 mA
	9165/16-11-13.	input ≥ 3.6 mA

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC
I.S. output to power supply	1.5 kV AC
Error contact to I.S. output	1.5 kV AC

Technical Specifications

Nonhazardous Location

Error Messaging

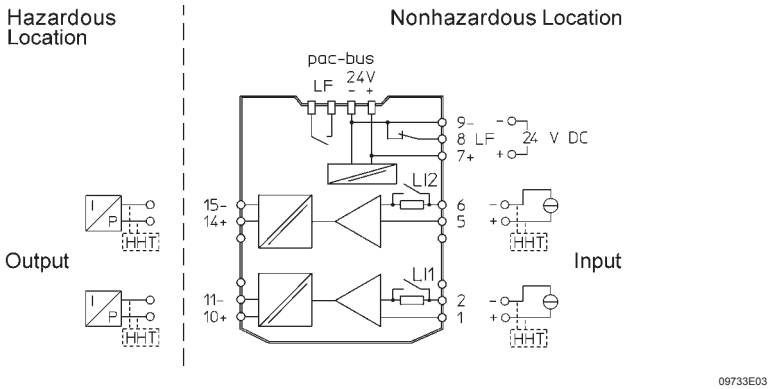
Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Input to power supply	350 V AC
Error contact to power supply and input	350 V AC

Connection Diagram



For interfacing to control valves, I/P converters, loop powered indicators and HART control valves

- Bidirectional transmission of HART signals
- Approved for installation in Division 2 and Zone 2
- Line fault detection
- SIL 2

Technical Tips Switches LI1 and LI2 can be deactivated to raise the input resistance to 550 Ω. This ensures interference free HART communication when the automation system has a low output resistance.

Order Code	Input / Output	Note
9165/26-11-11s	0/4 mA ... 20 mA with HART	– –
9165/26-11-13s	0/4 mA ... 20 mA with HART	If the output is open circuit, the input goes to high impedance - > 100 kΩ. No short circuit detection available.
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / CSA / ATEX	V_{OC} = 25.6 V, I_{SC} = 96 mA, P_O = 605 mW
UL	V_{OC} = 25.6 V, I_{SC} = 100 mA, P_O = 639 mW
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Output

Signal	0/4 mA ... 20 mA with HART
Load resistance R_L	0 Ω ... 800 Ω
Min. load resistance for short circuit monitoring	150 Ω
No load voltage	≤ 25.6 V

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	9165/26-11-11. > 10 kΩ 9165/26-11-13. > 100 kΩ

Technical Specifications

Nonhazardous Location

Input

Signal	0/4 mA ... 20 mA with HART
Max. input current	50 mA
Input resistance (switch LI1 and LI2, on / off)	225 Ω / 550 Ω
Communication signal	bidirectional HART transmission, 0.5 kHz ... 30 kHz

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom}, 20 mA)	135 mA
Power consumption (at V_{nom}, 20 mA)	2.3 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Technical Specifications

Hazardous Location

Error Detection (LFD)

Short circuit	9165/26-11-11.	15 Ω
	9165/26-11-13.	no short circuit detection
When line fault detected	9165/26-11-11.	input ≥ 6 kΩ
	9165/26-11-13.	input ≥ 100 kΩ
Open circuit detection only with input current	9165/26-11-11.	input ≥ 3.6 mA
	9165/26-11-13.	input ≥ 3.6 mA

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC
I.S. output to power supply	1.5 kV AC
Error contact to I.S. output	1.5 kV AC
I.S. outputs to each other	500 V AC

Technical Specifications

Nonhazardous Location

Error Messaging

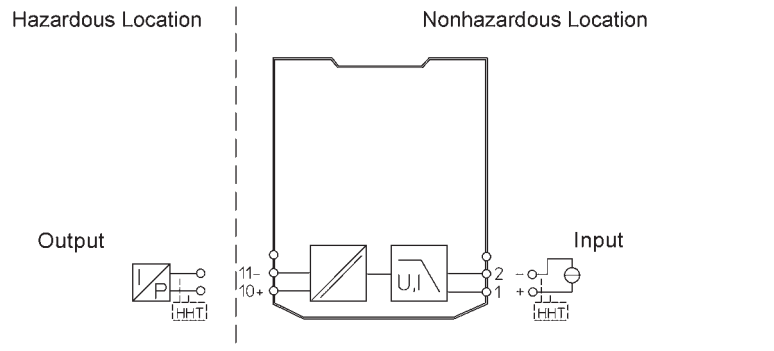
Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Input to power supply	350 V AC
Inputs to each other	350 V AC
Error contact to power supply and input	350 V AC

Connection Diagram



For interfacing to control valves, I/P converters, loop powered indicators, fire and gas detectors and HART control valves

- Bidirectional transmission of HART signals
- Approved for installation in Division 2 and Zone 2
- Very low internal resistance
- SIL 3

Technical Tips The entity parameters and the operational characteristics must be checked to ensure selection of the correct version for the application.

Order Code	No Load Voltage	Max. Load Resistance R_L
9167/11-11-00s	15.7 V	360 Ω
9167/13-11-00s	25 V	800 Ω
9167/14-11-00s	18.8 V	590 Ω
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	9167/11-11.00. V_{OC} = 15.7 V, I_{SC} = 60 mA, P_O = 233 mW 9167/13-11-00. V_{OC} = 25 V, I_{SC} = 99 mA, P_O = 613 mW 9167/14-11-00. V_{OC} = 18.8 V, I_{SC} = 107 mA, P_O = 503 mW
Isolation voltage	V_m = 253V AC

Intrinsically Safe Output

Signal	0/4 mA ... 20 mA with HART
Max. load resistance R_L (at I_A = 20 mA)	9167/11-11-00.: 360 Ω 9167/13-11-00.: 800 Ω 9167/14-11-00.: 590 Ω
No load voltage	9167/11-11-00.: 15.7 V 9167/13-11-00.: 25 V 9167/14-11-00.: 18.8 V
Short circuit current	≤ 60 mA

Error Detection (LFD)

Open circuit	< 0 mA
When line fault detected	output ≤ 1 mA

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC

Technical Specifications

Nonhazardous Location

Input

Signal	0/4 mA ... 20 mA with HART
Internal resistance R_i (at 20 mA)	9167/11-11-00.: 410 Ω 9167/13-11-00.: 380 Ω 9167/14-11-00.: 320 Ω
Internal resistance R_i (at 40 mA)	9167/11-11-00.: 360 Ω 9167/13-11-00.: 330 Ω 9167/14-11-00.: 270 Ω
Additional constant voltage drop ΔV	1 V
Max. effective voltage	9167/11-11-00.: 15.4 V 9167/13-11-00.: 23.6 V 9167/14-11-00.: 18.2 V
Polarity reversal protection	yes

Power Supply

	loop powered

Error Detection (LFD)

Open circuit	< 0 mA
When line fault detected	output ≤ 1 mA

Galvanic Isolation

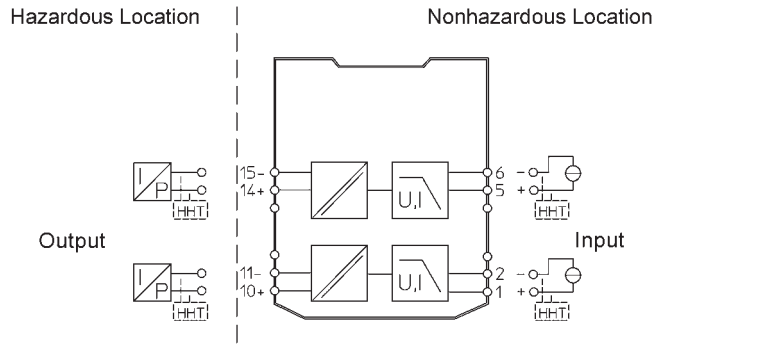
Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC

9167 Series, Analog Output with HART - Dual Channel, Loop Powered


10511E00

Connection Diagram



10509E03

For interfacing to control valves, I/P converters, loop powered indicators, fire and gas detectors and HART control valves

- Bidirectional transmission of HART signals
- Approved for installation in Division 2 and Zone 2
- Very low internal resistance
- SIL 3

Technical Tips The entity parameters and the operational characteristics must be checked to ensure selection of the correct version for the application.

Order Code	No Load Voltage	Max. Load Resistance R_L
9167/21-11-00s	15.7 V	360 Ω
9167/23-11-00s	25 V	800 Ω
9167/24-11-00s	18.8 V	590 Ω
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	9167/21-11.00. V_{OC} = 15.7 V, I_{SC} = 60 mA, P_O = 233 mW 9167/23-11-00. V_{OC} = 25 V, I_{SC} = 99 mA, P_O = 613 mW 9167/24-11-00. V_{OC} = 18.8 V, I_{SC} = 107 mA, P_O = 503 mW
Isolation voltage	V_m = 253 V AC

Intrinsically Safe Output

Signal	0/4 mA ... 20 mA with HART
Max. load resistance R_L (at I_A = 20 mA)	9167/21-11-00.: 360 Ω 9167/23-11-00.: 800 Ω 9167/24-11-00.: 590 Ω
No load voltage	9167/21-11-00.: 15.7 V 9167/23-11-00.: 25 V 9167/24-11-00.: 18.8 V
Short circuit current	≤ 60 mA

Error Detection (LFD)

Open circuit	< 0 mA
When line fault detected	output ≤ 1 mA

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC
I.S. outputs to each other	350 V AC

Nonhazardous Location

Input

Signal	0/4 mA ... 20 mA with HART
Internal resistance R_i (at 20 mA)	9167/21-11-00.: 410 Ω 9167/23-11-00.: 380 Ω 9167/24-11-00.: 320 Ω
Internal resistance R_i (at 40 mA)	9167/21-11-00.: 360 Ω 9167/23-11-00.: 330 Ω 9167/24-11-00.: 270 Ω
Additional constant voltage drop ΔV	1 V
Max. effective voltage	9167/21-11-00.: 15.4 V 9167/23-11-00.: 23.6 V 9167/24-11-00.: 18.2 V
Polarity reversal protection	yes

Power Supply

loop powered

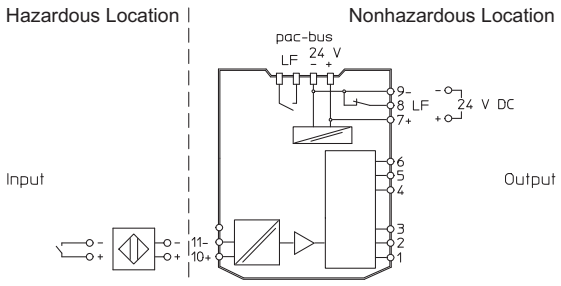
Galvanic Isolation

Test voltage under regulations EN 50178

Inputs to each other	500 V AC


10543E00

Connection Diagram



04947E03

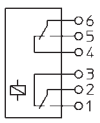
For interfacing with dry contacts, optocouplers and NAMUR type proximity detectors

- Phase reversal
- Transmission frequency up to 10 kHz
- SIL 2 (relay output)
- Line fault detection
- Approved for installation in Division 2 and Zone 2
- SIL 3 (electronic output)

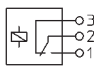
Technical Tips

For inductive loads we recommend the use of a free wheel diode. Do not use a varistor.
The 9170/10-12-11 with power relay contacts is not approved for installation in Division 2 and Zone 2.
In order to use the LFD feature, with dry contacts, resistors must be installed at the field device.
In series: 2.7 kΩ, in parallel: 22 kΩ

Order Code	Output to Nonhazardous Location	Output Configuration
9170/10-11-11s	2 Type C (DPDT), relay contacts, 125 V, 1 A (signal relay)	Type C (DPDT)
9170/10-12-11s	1 Type C (SPDT), relay contacts, 250 V, 4 A (power relay)	Type C (SPDT)
9170/10-14-11s	1 Electronic output, 35 V, 50 mA	Electronic



04297E00



04300E00

04299E00

Note: The order code above is with screw type removable terminals.
For alternative types of terminals, please substitute the **s** as follows:
k: for spring clamp terminals

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{OC} = 10.6 V, I_{SC} = 24 mA, P_O = 64 mW
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Input

Signal	acc. to EN 60947-5-6 (NAMUR)
Current for ON	≥ 2.1 mA
Current for OFF	≤ 1.2 mA
No load voltage	8.2 V
Short circuit current	8.2 mA
Internal resistance	1000 Ω

Technical Specifications

Nonhazardous Location

Output

		amber LED “out“ indicates the output to the nonhazardous location has changed state
Phase reversal		user selectable via DIP switches on top of unit
Minimum load	signal relay	1 V / 100 µA
	power relay	12 V / 100 µA
Maximum load DC	signal relay	125 V / 1 A
	power relay	250 V / 2 A
	electronic	35 V / 50 mA
Maximum load AC	signal relay	125 V / 1 A
	power relay	250 V / 4 A

Technical Specifications

Hazardous Location

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	I_{in} < 0.05 mA ... 0.35 mA
Short circuit	R_{in} < 100 Ω ... 360 Ω
When line fault detected	the output relay is de-energized

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to error contact	1.5 kV AC

Technical Specifications

Nonhazardous Location

Output

Maximum switching power	signal relay	25 W / 50 VA
	power relay	50 W / 1000 VA
	electronic	1.75 W
Overload protected	electronic	yes
Voltage drop	electronic	< 2
Recommended back-up fuses	signal relay	≤ 1 A AC / DC
	power relay	≤ 4 A AC / 2 A DC
Maximum switching frequency	signal relay	15 Hz
	power relay	6 Hz
	electronic	10 kHz

Power Supply

Indication	green LED "PWR"	
Nominal voltage V_{nom}	24 V DC	
Voltage range	18 V ... 31.2 V	
Nominal current (at V_{nom})	relay output	33 mA
	electronic output	26 mA
Power consumption (at V_{nom})	relay output	0.8 W
	electronic output	0.6 W

Error Messaging

Power supply	contact (30 V / 100 mA), close to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

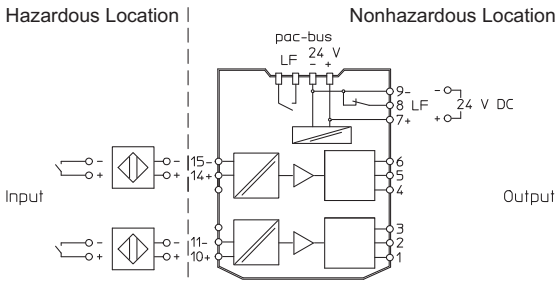
Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	1.1 kV AC
Error contact to power supply	350 V AC
Error contact to output	1.1 kV AC

10543E00

Connection Diagram



04948E03

For interfacing with dry contacts, optocouplers and NAMUR type proximity detectors

- Phase reversal
- Transmission frequency up to 10 kHz
- SIL 2 (relay output)
- Line fault detection
- Approved for installation in Division 2 and Zone 2
- SIL 3 (electronic output)

Technical Tips

For inductive loads we recommend the use of a free wheel diode. Do not use a varistor.
The 9170/20-12-11 with power relay contracts is not approved for installation in Division 2 and Zone 2.
In order to use the LFD feature, with dry contacts, resistors must be installed at the field device.
In series: 2.7 kΩ, in parallel: 22 kΩ

Order Code	Output to Nonhazardous Location	Output Configuration
9170/20-10-11s	1 Type C (SPDT), relay contacts, 125 V, 1 A (signal relay)	Type C (SPDT) / Normally Open (SPDT) / Electronic
9170/20-11-11s	2 NO (SPDT), relay contacts, 125 V, 1A (signal relay)	
9170/20-12-11s	1 Type C (SPDT), relay contacts, 250 V, 4 A (power relay)	
9170/20-14-11s	1 Electronic output, 35 V, 50 mA	
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

04300E00

04297E00

04299E00

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{OC} = 10.6 V, I_{SC} = 24 mA, P_O = 64 mW
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Input

Signal	acc. to EN 60947-5-6 (NAMUR)
Current for ON	≥ 2.1 mA
Current for OFF	≤ 1.2 mA
No load voltage	8.2 V
Short circuit current	8.2 mA
Internal resistance	1000 Ω

Technical Specifications

Nonhazardous Location

Output

	amber LED “out“ indicates the output to the nonhazardous location has changed state	
Phase reversal	user selectable via DIP switches on top of unit	
Minimum load	signal relay	1 V / 100 µA
	power relay	12 V / 100 µA
Maximum load DC	signal relay	125 V / 1 A
	power relay	250 V / 2 A
	electronic	35 V / 50 mA

Technical Specifications

Hazardous Location

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	I_{in} < 0.05 mA ... 0.35 mA
Short circuit	R_{in} < 100 Ω ... 360 Ω
When line fault detected	the output relay is de-energized

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. inputs to each other	500 V AC
I.S. input to error contact	1.5 kV AC

Technical Specifications

Nonhazardous Location

Output

Maximum load AC	signal relay	125 V / 1 A
	power relay	250 V / 4 A
Maximum switching power	signal relay	25 W / 50 VA
	power relay	50 W / 1000 VA
	electronic	1.75 W
Overload protected	electronic	yes
Voltage drop	electronic	< 2
Recommended back-up fuses	signal relay	≤ 1 A AC / DC
	power relay	≤ 4 A AC / 2 A DC
Maximum switching frequency	signal relay	15 Hz
	power relay	6 Hz
	electronic	10 kHz

Power Supply

Indication	green LED "PWR"	
Nominal voltage V_{nom}	24 V DC	
Voltage range	18 V ... 31.2 V	
Nominal current (at V_{nom})	relay output	55 mA
	electronic output	36 mA
Power consumption (at V_{nom})	relay output	1.3 W
	electronic output	1.9 W

Error Messaging

Power supply	contact (30 V / 100 mA), close to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

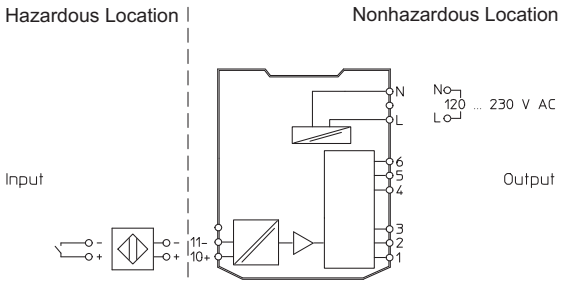
Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	1.1 kV AC
Outputs to each other	1.1 kV AC
Error contact to power supply	350 V AC
Error contact to output	1.1 kV AC

10543E00

Connection Diagram



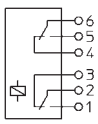
04946E03

For interfacing with dry contacts, optocouplers and NAMUR type proximity detectors

- Phase reversal
- Transmission frequency up to 10 kHz
- Line fault detection
- SIL 2

Technical Tips For inductive loads we recommend the use of a free wheel diode. Do not use a varistor.
In order to use the LFD feature, with dry contacts, resistors must be installed at the field device.
In series: 2.7 kΩ, in parallel: 22 kΩ

Order Code	Output to Nonhazardous Location	Output Configuration
9170/10-11-21s	2 Type C (DPDT), relay contacts, 125 V, 1 A (signal relay)	Type C (DPDT)
9170/10-12-21s	1 Type C (SPDT), relay contacts, 250 V, 4 A (power relay)	Type C (SPDT)
9170/10-13-21s	2 Type C (DPDT), relay contacts, 250 V, 4 A (signal relay)	



04298E00

04300E00

Note: The order code above is with screw type removable terminals.
For alternative types of terminals, please substitute the **s** as follows:
k: for spring clamp terminals

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{OC} = 10.6 V, I_{SC} = 24 mA, P_O = 64 mW
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Input

Signal	acc. to EN 60947-5-6 (NAMUR)
Current for ON	≥ 2.1 mA
Current for OFF	≤ 1.2 mA
No load voltage	8.2 V
Short circuit current	8.2 mA
Internal resistance	1000 Ω

Technical Specifications

Nonhazardous Location

Output

	amber LED “out“ indicates the output to the nonhazardous location has changed state	
Phase reversal	user selectable via DIP switches on top of unit	
Minimum load	signal relay	1 V / 100 µA
	power relay	12 V / 100 µA
Maximum load DC	signal relay	125 V / 1 A
	power relay	250 V / 2 A
Maximum load AC	signal relay	125 V / 1 A
	power relay	250 V / 4 A

Technical Specifications

Hazardous Location

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	I_{in} < 0.05 mA ... 0.35 mA
Short circuit	R_{in} < 100 Ω ... 360 Ω
When line fault detected	the output relay is de-energized

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to error contact	1.5 kV AC

Technical Specifications

Nonhazardous Location

Output

Maximum switching power	signal relay	25 W / 50 VA
	power relay	50 W / 1000 VA
Recommended back-up fuses	signal relay	≤ 1 A AC / DC
	power relay	≤ 4 A AC / 2 A DC
Maximum switching frequency	signal relay	15 Hz
	power relay	6 Hz

Power Supply

Indication	green LED "PWR"	
Nominal voltage V_{nom}	120 V ... 230 V AC	
Voltage range	96 V ... 253 V	
Frequency range	48 Hz ... 62 Hz	
Nominal current (at V_{nom})	120 V AC	12 mA
	230 V AC	12 mA
Power consumption (at V_{nom})	120 V AC	1.4 VA
	230 V AC	1.8 VA

Error Messaging

Power supply	contact (30 V / 100 mA), close to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

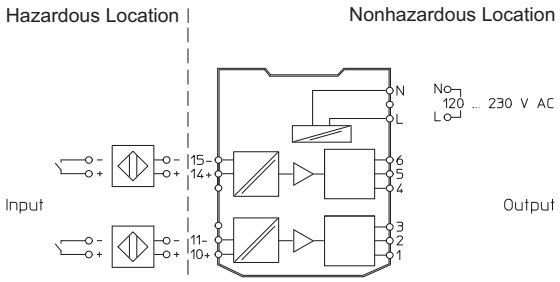
Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	1.1 kV AC
Error contact to power supply	350 V AC
Error contact to output	1.1 kV AC

10543E00

Connection Diagram



04949E03

For interfacing with dry contacts, optocouplers and NAMUR type proximity detectors

- Phase reversal
- Transmission frequency up to 10 kHz
- Line fault detection
- SIL 2

Technical Tips For inductive loads we recommend the use of a free wheel diode. Do not use a varistor.
In order to use the LFD feature, with dry contacts, resistors must be installed at the field device.
In series: 2.7 kΩ, in parallel: 22 kΩ

Order Code	Output to Nonhazardous Location	Output Configuration	
9170/20-10-21s	1 Type C (SPDT), relay contacts, 125 V, 1 A (signal relay)	Type C (SPDT)	Normally open (DPST)
9170/20-11-21s	2 NO (DPST), relay contacts, 125 V, 1A (signal relay)		
9170/20-12-21s	1 Type C (SPDT), relay contacts, 250 V, 4 A (power relay)		
		04300E00	04297E00
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals		

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{OC} = 10.6 V, I_{SC} = 24 mA, P_O = 64 mW
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Input

Signal	acc. to EN 60947-5-6 (NAMUR)
Current for ON	≥ 2.1 mA
Current for OFF	≤ 1.2 mA
No load voltage	8.2 V
Short circuit current	8.2 mA
Internal resistance	1000 Ω

Technical Specifications

Nonhazardous Location

Output

	amber LED “out“ indicates the output to the nonhazardous location has changed state	
Phase reversal	user selectable via DIP switches on top of unit	
Minimum load	signal relay	1 V / 100 µA
	power relay	12 V / 100 µA
Maximum load DC	signal relay	125 V / 1 A
	power relay	250 V / 2 A
Maximum load AC	signal relay	125 V / 1 A
	power relay	250 V / 4 A

Technical Specifications

Hazardous Location

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	I_{in} < 0.05 mA ... 0.35 mA
Short circuit	R_{in} < 100 Ω ... 360 Ω
When line fault detected	the output relay is de-energized

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. inputs to each other	500 V AC
I.S. input to error contact	1.5 kV AC

Technical Specifications

Nonhazardous Location

Output

Maximum switching power	signal relay	25 W / 50 VA
	power relay	50 W / 1000 VA
Recommended back-up fuses	signal relay	≤ 1 A AC / DC
	power relay	≤ 4 A AC / 2 A DC
Maximum switching frequency	Signal relay	15 Hz
	Power relay	6 Hz

Power Supply

Indication	green LED "PWR"	
Nominal voltage V_{nom}	120 V ... 230 V AC	
Voltage range	96 V ... 253 V	
Frequency range	48 Hz ... 62 Hz	
Nominal current (at V_{nom})	120 V AC	18 mA
	230 V AC	18 mA
Power consumption (at V_{nom})	120 V AC	2.2 VA
	230 V AC	2.8 VA

Error Messaging

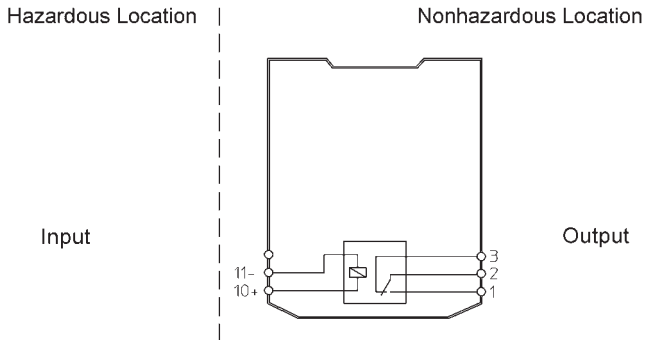
Power supply	contact (30 V / 100 mA), close to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	1.1 kV AC
Outputs to each other	1.1 kV AC
Error contact to power supply	350 V AC
Error contact to output	1.1 kV AC

Connection Diagram



For interfacing between digital signals and control circuits

- I.S. control circuit
- SIL 2
- Approved for installation in Division 2 and Zone 2

Technical Tips Installation in Division 2 and Zone 2 is permitted, provided the max contact load is 125 V AC / DC.

Order Code	Input	Output
9172/10-11-00s	I.S. signal	Type C (SPDT) contacts
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{max} = 30 V, I_{max} = 150 mA, P_i = 1.3 W
Isolation voltage	V_m = 253 V AC

Intrinsically Safe Input

Signal	12 V ... 30 V
Current consumption	20 mA at 12 V 12 mA at 24 V ... 30 V

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC

Technical Specifications

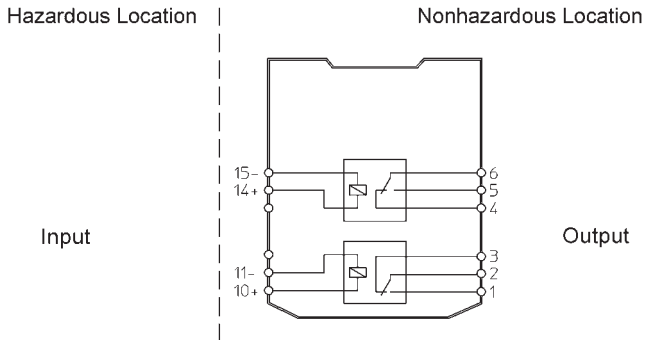
Nonhazardous Location

Output

Minimum load	5 V / 5 mA
Maximum load DC	220 V / 0.1 A 125 V / 1 A 60 V / 0.8 A 30 V / 4 A
Maximum load AC	250 V / 4 A / cos φ > 0.7
Maximum switching frequency	≤ 15 Hz
Switching delay ON / OFF	≤ 10 ms
Switching delay OFF / ON	≤ 10 ms
Power Supply	loop powered


10513E00

Connection Diagram



10514E03

For interfacing between digital signals and control circuits

- I.S. control circuit
- SIL 2
- Approved for installation in Division 2 and Zone 2

Technical Tips Installation in Division 2 and Zone 2 is permitted, provided the max contact load is 125 V AC / DC.

Order Code	Input	Output
9172/20-11-00s	I.S. signal	Type C (SPDT) contacts
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{max} = 30 V, I_{max} = 150 mA, P_i = 1.3 W
Isolation voltage	V_m = 253 V AC

Intrinsically Safe Input

Signal	12 V ... 30 V
Current consumption	20 mA at 12 V 12 mA at 24 V ... 30 V

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. inputs to each other	500 V AC

Technical Specifications

Nonhazardous Location

Output

Minimum load	5 V / 5 mA
Maximum load DC	220V / 0.1 A 125 V / 1 A 60 V / 0.8 A 30 V / 4 A
Maximum load AC	250 V / 4 A / cos φ > 0.7
Maximum switching frequency	≤ 15 Hz
Switching delay ON / OFF	≤ 10 ms
Switching delay OFF / ON	≤ 10 ms

Power Supply

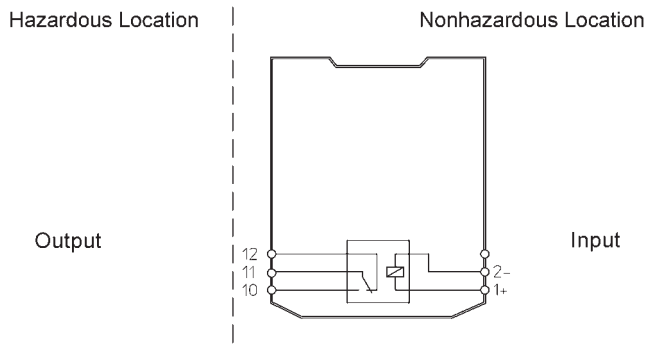
loop powered

Galvanic Isolation

Test voltage under regulations EN 50020

Outputs to each other	1.1 kV AC

Connection Diagram



For interfacing between digital signals and control circuits

- I.S. digital output
- SIL 2
- Approved for installation in Division 2 and Zone 2

Technical Tips Installation in Division 2 and Zone 2 is permitted, provided the max contact load is 125 V AC / DC.

Order Code	Input	Output
9172/11-11-00s	non I.S. signal	I.S., Type C (SPDT) contacts
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{max} = 125 V AC, I_{max} = 4 A
	V_{max} = 125 V DC, I_{max} = 0.25 A
	V_{max} = 60 V DC, I_{max} = 0.8 A
	V_{max} = 30 V DC, I_{max} = 4 A
Isolation voltage	V_m = 253 V AC

Intrinsically Safe Output

Minimum load	5 V / 5 mA
Maximum load DC	125 V / 0.25 A 60 V / 0.8 A 30 V / 4 A
Maximum load AC	125 V / 4 A / cos φ > 0.7
Maximum switching frequency	≤ 15 Hz
Switching delay ON / OFF	≤ 10 ms
Switching delay OFF / ON	≤ 10 ms

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC

Technical Specifications

Nonhazardous Location

Input

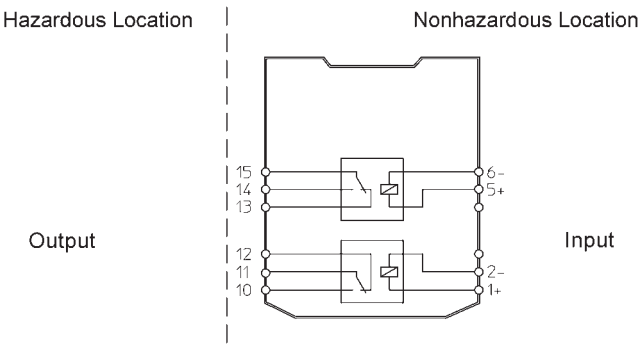
Signal	12 V ... 31.2 V
Current consumption	20 mA at 12 V 12 mA at 24 V ... 31.2 V

Power Supply

loop powered


10513E00

Connection Diagram



10515E03

For interfacing between digital signals and control circuits

- I.S. digital output
- SIL 2
- Approved for installation in Division 2 and Zone 2

Technical Tips Installation in Division 2 and Zone 2 is permitted, provided the max contact load is 125 V AC / DC.

Order Code	Input	Output
9172/21-11-00s	non I.S. signal	I.S., Type C (SPDT) contacts
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{max} = 125 V AC, I_{max} = 4 A
	V_{max} = 125 V DC, I_{max} = 0.25 A
	V_{max} = 60 V DC, I_{max} = 0.8 A
	V_{max} = 30 V DC, I_{max} = 4 A
Isolation voltage	V_m = 253 V AC

Intrinsically Safe Output

Minimum load	5 V / 5 mA
Maximum load DC	125 V / 0.25 A 60 V / 0.8 A 30 V / 4 A
Maximum load AC	125 V / 4 A / cos φ > 0.7
Maximum switching frequency	≤ 15 Hz
Switching delay ON / OFF	≤ 10 ms
Switching delay OFF / ON	≤ 10 ms

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC
I.S. outputs to each other	500 V AC

Technical Specifications

Nonhazardous Location

Input

Signal	12 V ... 31.2 V
Current consumption	20 mA at 12 V 12 mA at 24 V ... 31.2 V

Power Supply

loop powered

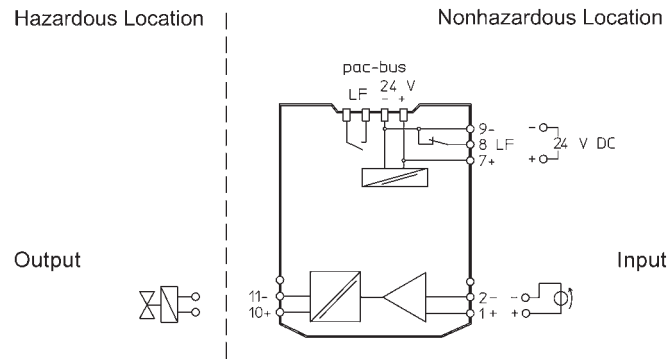
Galvanic Isolation

Test voltage under regulations EN 50020

Inputs to each other	350 V AC


09823E00

Connection Diagram



06574E03

For interfacing to solenoid valves and LEDs

- Line fault detection
- SIL 3
- Approved for installation in Division 2 and Zone 2

Technical Tips The 9175 digital output units can be used for operation with devices marked AEx ib ... , Ex ib ... and EEx ib ... . In these instances the I_{SC} [ib] values can be used. For FM and UL installations, the I_{SC} [ia] values must always be used. For CSA installations either value may be used.

Order Code	Max. Output to Hazardous Location	Note
9175/10-12-11s	60 mA	See output characteristic curves for more information
9175/10-14-11s	45 mA	
9175/10-16-11s	35 mA	
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	9175/10-12-11. V_{OC} = 11.3 V, I_{SC} [ia] = 75 mA, P_O = 210 mW 9175/10-14-11. V_{OC} = 19.6 V, I_{SC} [ia] = 150 mA, I_{SC} [ib] = 60 mA, P_O = 732 mW 9175/10-16-11. V_{OC} = 27.6 V, I_{SC} [ia] = 110 mA, I_{SC} [ib] = 50 mA, P_O = 760 mW
Isolation voltage	V_m = 250V AC

Intrinsically Safe Output

Indication	amber LED "OUT"
Switching delay ON / OFF	≤ 1 ms
Switching delay OFF / ON	≤ 1 ms
Operating frequency	≤ 200 Hz
No load voltage V_{OC}	9175/10-12-11.: 10 V 9175/10-14-11.: 17.5 V 9175/10-16-11.: 25 V
Max. output current I_o	9175/10-12-11.: 60 mA 9175/10-14-11.: 45 mA 9175/10-16-11.: 35 mA
Internal resistance R_i	9175/10-12-11.: 150 Ω 9175/10-14-11.: 130 Ω 9175/10-16-11.: 250 Ω

Technical Specifications

Nonhazardous Location

Input

Voltage for ON	15 V ... 31.2 V
Voltage for OFF	0 V... 5 V
Control current	< 5 mA

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom}, $I_{o\,max}$)	100 mA
Power consumption (at V_{nom}, $I_{o\,max}$)	2.4 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Error Messaging

Power supply	contact (30 V / 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V / 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Input to power supply	350 V AC
Error contact to power supply and input	350 V AC

Technical Specifications

Hazardous Location

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	9175/10-12-11.: > 7 kΩ 9175/10-14-11.: > 10 kΩ 9175/10-16-11.: > 15 kΩ
Short circuit, at 73.4 °F (23 °C)	9175/10-12-11.: 40 Ω ... 60 Ω ± 3 Ω / 10 K 9175/10-14-11.: 40 Ω ... 80 Ω ± 6 Ω / 10 K 9175/10-16-11.: 50 Ω ... 90 Ω ± 8 Ω / 10 K

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC
I.S. output to power supply	1.5 kV AC
I.S. output to error contact	1.5 kV AC

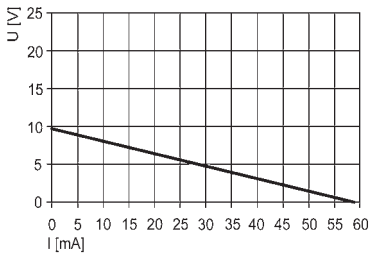
Technical Specifications

Hazardous Location

Output Characteristic Curves

at V_{nom}: - 4 °F ... + 140 °F (- 20 °C ... + 60 °C)

9175/10-12-11.



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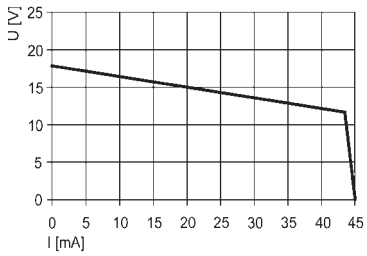
9175/10-14-11.



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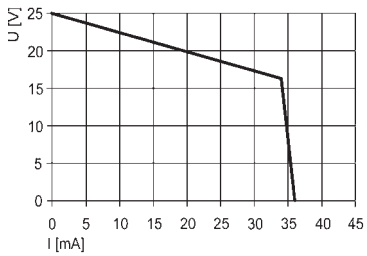
9175/10-16-11.

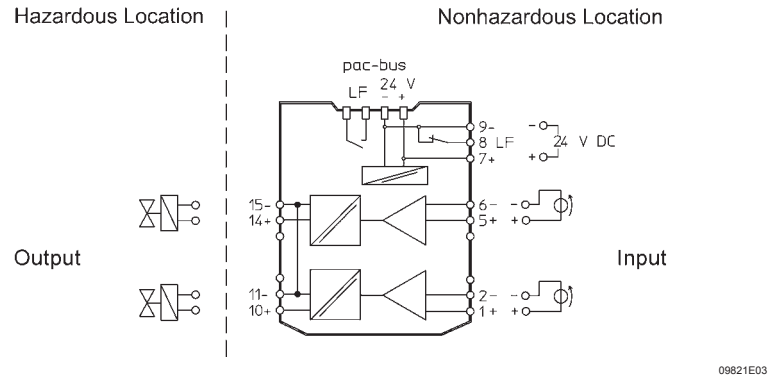


06592E00

Note — A list of compatible I.S. solenoid valves can be found on our homepage www.ispac.info.

09823E00

Connection Diagram



09821E03

For interfacing to solenoid valves and LEDs

- Line fault detection
- Approved for installation in Division 2 and Zone 2
- Two outputs can be connected in parallel for higher current output
- SIL 3

Technical Tips The 9175 digital output units can be used for operation with devices marked AEX ib ... , Ex ib ... and EEx ib ... . In these instances the I_{SC} [ib] values can be used. For FM and UL installations, the I_{SC} [ia] values must always be used. For CSA installations either value may be used.

Order Code	Max. Output to Hazardous Location	Note
9175/20-12-11s	60 mA / 120 mA	See output characteristic curves for more information
9175/20-14-11s	45 mA / 90 mA	
9175/20-16-11s	35 mA / 70 mA	
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	9175/20-12-11. V_{OC} = 11.3 V, I_{SC} [ia] = 75 mA, P_O = 210 mW
	9175/20-14-11. V_{OC} = 19.6 V, I_{SC} [ia] = 150 mA, I_{SC} [ib] = 60 mA, P_O = 732 mW
	9175/20-16-11. V_{OC} = 27.6 V, I_{SC} [ia] = 110 mA, I_{SC} [ib] = 50 mA, P_O = 760 mW
If two outputs connected in parallel:	
FM / UL / CSA / ATEX	9175/20-12-11. V_{OC} = 11.3 V, I_{SC} [ia] = 150 mA, I_{SC} [ib] = mA, P_O = 420 mW
	9175/20-14-11. V_{OC} = 19.6 V, I_{SC} [ia] = 300 mA, I_{SC} [ib] = 120 mA, P_O = 1464 mW
	9175/20-16-11. V_{OC} = 27.6 V, I_{SC} [ia] = 220 mA, I_{SC} [ib] = 100 mA, P_O = 1520 mW
Isolation voltage	V_m = 250V AC

Intrinsically Safe Output

Indication	amber LED "OUT" per channel
Switching delay ON / OFF	≤ 1 ms
Switching delay OFF / ON	≤ 1 ms
Operating frequency	≤ 200 Hz

Technical Specifications

Nonhazardous Location

Input

Voltage for ON	15 V ... 31.2 V
Voltage for OFF	0 V... 5 V
Control current	< 5 mA

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom}, $I_{o\,max}$)	170 mA
Power consumption (at V_{nom}, $I_{o\,max}$)	4.1 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Error Messaging

Power supply	contact (30 V / 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V / 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Input to power supply	350 V AC
Inputs to each other	350 V AC
Error contact to power supply and input	350 V AC

Technical Specifications

Hazardous Location

Intrinsically Safe Output

One output

No load voltage V_{OC}	9175/20-12-11.: 10 V 9175/20-14-11.: 17.5 V 9175/20-16-11.: 25 V
Max. output current I_o	9175/20-12-11.: 60 mA 9175/20-14-11.: 45 mA 9175/20-16-11.: 35 mA
Internal resistance R_i	9175/20-12-11.: 150 Ω 9175/20-14-11.: 130 Ω 9175/20-16-11.: 250 Ω

Two outputs in parallel

No load voltage V_{OC}	9175/20-12-11.: 10 V 9175/20-14-11.: 17.5 V 9175/20-16-11.: 25 V
Max. output current I_o	9175/20-12-11.: 120 mA 9175/20-14-11.: 90 mA 9175/20-16-11.: 70 mA
Internal resistance R_i	9175/20-12-11.: 75 Ω 9175/20-14-11.: 65 Ω 9175/20-16-11.: 125 Ω

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit (per channel)	9175/20-12-11.: > 7 kΩ 9175/20-14-11.: > 10 kΩ 9175/20-16-11.: > 15 kΩ
Open circuit (channels in parallel)	9175/20-12-11.: > 3.5 kΩ 9175/20-14-11.: > 5 kΩ 9175/20-16-11.: > 7.5 kΩ
Short circuit (per channel), at 73.4 °F (23 °C)	9175/20-12-11.: 40 Ω ... 60 Ω ± 3 Ω / 10 K 9175/20-14-11.: 40 Ω ... 80 Ω ± 6 Ω / 10 K 9175/20-16-11.: 50 Ω ... 90 Ω ± 8 Ω / 10 K
Short circuit (channels in parallel), at 73.4 °F (23 °C)	9175/20-12-11.: 20 Ω ... 30 Ω ± 3 Ω / 10 K 9175/20-14-11.: 20 Ω ... 40 Ω ± 6 Ω / 10 K 9175/20-16-11.: 25 Ω ... 45 Ω ± 8 Ω / 10 K

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC
I.S. output to power supply	1.5 kV AC
I.S. outputs to each other	– –
I.S. output to error contact	1.5 kV AC

Technical Specifications

Hazardous Location

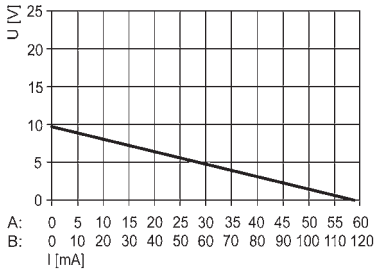
Output Characteristic Curves

at V_{nom}: - 4 °F ... + 140 °F (- 20 °C ... + 60 °C)

X-axis (I [mA])

A: current output per channel
B: current output if channels connected in parallel

9175/20-12-11.



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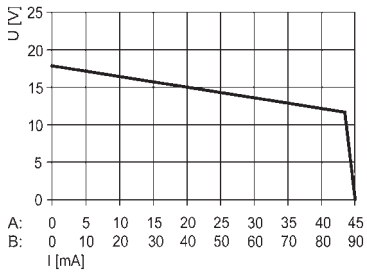
9175/20-14-11.



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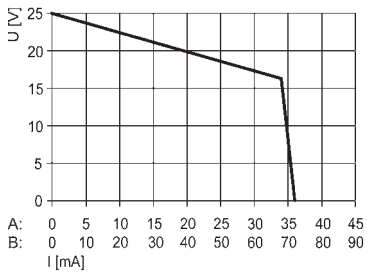
9175/20-16-11.

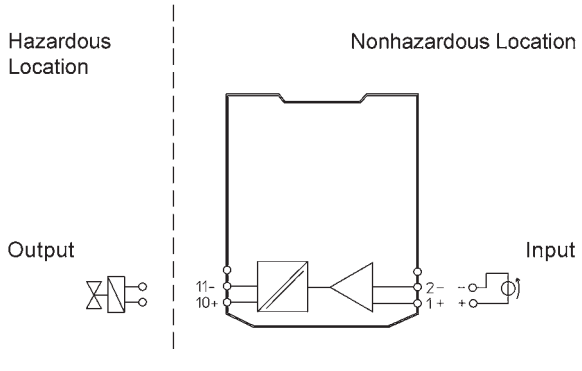


09884E00

Note

A list of compatible I.S. solenoid valves can be found on our homepage www.ispac.info.

Connection Diagram



For interfacing to solenoid valves and LEDs

- Loop powered
- SIL 3
- Approved for installation in Division 2 and Zone 2

Technical Tips The 9176 digital output units can be used for operation with devices marked AEx ib ... , Ex ib ... and EEx ib ... . In these instances the I_{SC} [ib] values can be used. For FM and UL installations, the I_{SC} [ia] values must always be used. For CSA installations either value may be used.

Order Code	Max. Output to Hazardous Location	Note
9176/10-12-00s	60 mA	See output characteristic curves for more information
9176/10-14-00s	45 mA	
9176/10-16-00s	35 mA	
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	9176/10-12-00. V_{OC} = 11.3 V, I_{SC} [ia] = 75 mA, P_O = 210 mW 9176/10-14-00. V_{OC} = 19.6 V, I_{SC} [ia] = 150 mA, I_{SC} [ib] = 60 mA, P_O = 732 mW 9176/10-16-00. V_{OC} = 27.6 V, I_{SC} [ia] = 110 mA, I_{SC} [ib] = 50 mA, P_O = 760 mW
Isolation voltage	V_m = 253 V AC

Intrinsically Safe Output

Indication	amber LED "OUT"
Switching delay OFF / ON	9176/10-12-00.: ≤ 12 ms 9176/10-14-00.: ≤ 20 ms 9176/10-16-00.: ≤ 18 ms
Switching delay ON / OFF	9176/10-12-00.: ≤ 25 ms 9176/10-14-00.: ≤ 40 ms 9176/10-16-00.: ≤ 50 ms

Technical Specifications

Nonhazardous Location

Input

Voltage for ON	18 V ... 31.2 V
Voltage for OFF	0 V ... 5 V
Control Power P_i (with I_o = max. required output current)	9176/10-12-00.: 0.3 W + (I_o x 15 mW / mA) 9176/10-14-00.: 0.38 W + (I_o x 26 mW / mA) 9176/10-16-00.: 0.5 W + (I_o x 37 mW / mA)

Power Supply

loop powered

Technical Specifications

Hazardous Location

Intrinsically Safe Output

Operating frequency	≤ 10 Hz
No load voltage V_{OC}	9176/10-12-00.: 10 V 9176/10-14-00.: 17.5 V 9176/10-16-00.: 25 V
Max. output current I_o	9176/10-12-00.: 60 mA 9176/10-14-00.: 45 mA 9176/10-16-00.: 35 mA
Internal resistance R_i	9176/10-12-00.: 150 Ω 9176/10-14-00.: 130 Ω 9176/10-16-00.: 250 Ω

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC

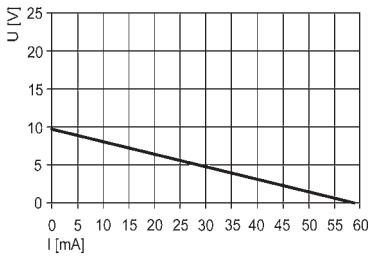
Technical Specifications

Hazardous Location

Output Characteristic Curves

at V_{nom}: - 4 °F ... + 140 °F (- 20 °C ... + 60 °C)

9176/10-12-00.



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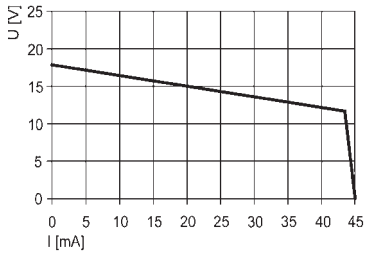
9176/10-14-00.



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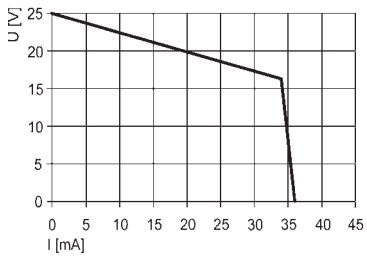
9176/10-16-00.



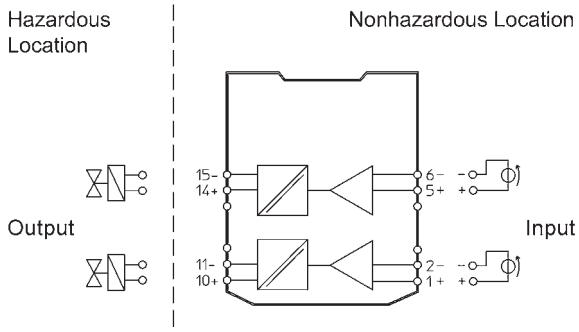
06592E00

Note

A list of compatible I.S. solenoid valves can be found on our homepage www.ispac.info.

10496E00

Connection Diagram



10493E03

For interfacing to solenoid valves and LEDs

- Loop powered
- Approved for installation in Division 2 and Zone 2
- Two outputs can be connected in parallel for higher current output
- SIL 3

Technical Tips The 9176 digital output units can be used for operation with devices marked AEx ib ... , Ex ib ... and EEx ib ... . In these instances the I_{SC} [ib] values can be used. For FM and UL installations, the I_{SC} [ia] values must always be used. For CSA installations either value may be used.

Order Code	Max. Output to Hazardous Location	Note
9176/20-12-00s	60 mA / 120 mA	See output characteristic curves for more information
9176/20-14-00s	45 mA / 90 mA	
9176/20-16-00s	35 mA / 70 mA	
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	9176/20-12-00. V_{OC} = 11.3 V, I_{SC} [ia] = 75 mA, P_O = 210 mW
	9176/20-14-00. V_{OC} = 19.6 V, I_{SC} [ia] = 150 mA, I_{SC} [ib] = 60 mA, P_O = 732 mW
	9176/20-16-00. V_{OC} = 27.6 V, I_{SC} [ia] = 110 mA, I_{SC} [ib] = 50 mA, P_O = 760 mW
If two outputs connected in parallel:	
FM / UL / CSA / ATEX	9176/20-12-00. V_{OC} = 11.3 V, I_{SC} [ia] = 150 mA, P_O = 420 mW
	9176/20-14-00. V_{OC} = 19.6 V, I_{SC} [ia] = 300 mA, I_{SC} [ib] = 120 mA, P_O = 1464 mW
	9176/20-16-00. V_{OC} = 27.6 V, I_{SC} [ia] = 220 mA, I_{SC} [ib] = 100 mA, P_O = 1520 mW
Isolation voltage	V_m = 253V AC

Technical Specifications

Nonhazardous Location

Input

Voltage for ON	18 V ... 31.2 V
Voltage for OFF	0 V ... 5 V
Control Power P_i (with I_o = max. required output current)	9176/20-12-00.: 0.3 W + (I_o x 15 mW / mA) 9176/20-14-00.: 0.38 W + (I_o x 26 mW / mA) 9176/20-16-00.: 0.5 W + (I_o x 37 mW / mA)

Power Supply

loop powered

Galvanic Isolation

Test voltage under regulations EN 50178

Inputs to each other	350 V AC

Technical Specifications

Hazardous Location

Intrinsically Safe Output

Indication	amber LED "OUT" per channel
Switching delay OFF / ON	9176/20-12-00.: ≤ 12 ms 9176/20-14-00.: ≤ 20 ms 9176/20-16-00.: ≤ 18 ms
Switching delay ON / OFF	9176/20-12-00.: ≤ 25 ms 9176/20-14-00:: ≤ 40 ms 9176/20-16-00.: ≤ 50 ms
Operating frequency	≤ 10 Hz
One output	
No load voltage V_{OC}	9176/20-12-00.: 10 V 9176/20-14-00.: 17.5 V 9176/20-16-00.: 25 V
Max. output current I_o	9176/20-12-00.: 60 mA 9176/20-14-00.: 45 mA 9176/20-16-00.: 35 mA
Internal resistance R_i	9176/20-12-00.: 150 Ω 9176/20-14-00.: 130 Ω 9176/20-16-00.: 250 Ω
Two outputs in parallel	
No load voltage V_{OC}	9176/20-12-00.: 10 V 9176/20-14-00.: 17.5 V 9176/20-16-00.: 25 V
Max. output current I_o	9176/20-12-00.: 120 mA 9176/20-14-00.: 90 mA 9176/20-16-00.: 70 mA
Internal resistance R_i	9176/20-12-00.: 75 Ω 9176/20-14-00.: 65 Ω 9176/20-16-00.: 125 Ω

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. output to input	1.5 kV AC
I.S. outputs to each other	500 V AC

Technical Specifications

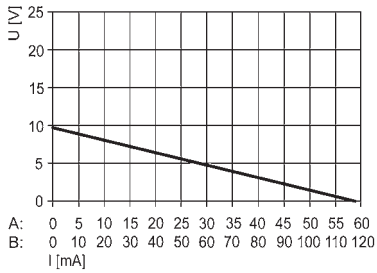
Hazardous Location

Output Characteristic Curves
at V_{nom}: - 4 °F ... + 140°F (- 20 °C ... + 60 °C)

X-axis (I [mA])

A: current output per channel
B: current output if channels connected in parallel

9176/20-12-00.



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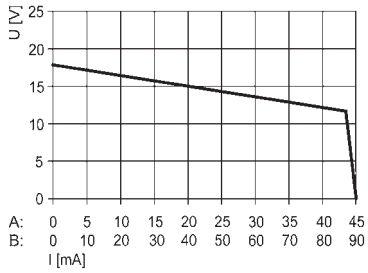
9176/20-14-00.



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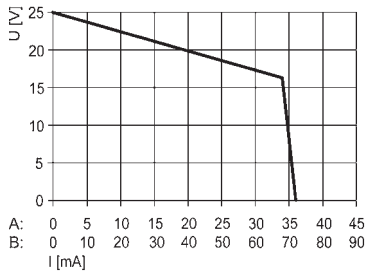
9176/20-16-00.



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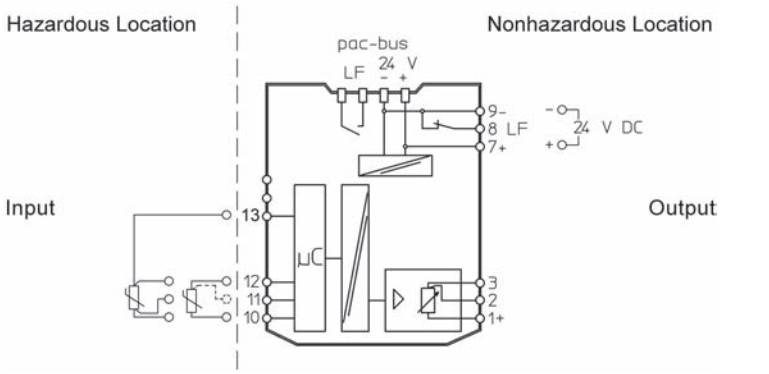
Note

A list of compatible I.S. solenoid valves can be found on our homepage www.ispac.info.

Connection Diagram



For interfacing to RTDs and potentiometers

- Two versions available with resistance ranges from either 18 Ω up to 391 Ω or 180 Ω up to 3910 Ω
- For 2-, 3- and 4-wire circuits
- Short rise time enables connection to a multiplexer in the nonhazardous location
- Approved for installation in Division 2 and Zone 2

Technical Tips When connecting 2-wire sensors, the line impedance must be balanced before operation.

Order Code	Input from Hazardous Location
9180/10-77-11s	18 Ω ... 391 Ω
9180/11-77-11s	180 Ω ... 3910 Ω
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals

Technical Specifications

Hazardous Location

Entity Parameters

FM / $_C$FM / ATEX	V_{OC} = 6.5 V, I_{SC} = 16.4 mA, P_O = 27 mW (linear characteristic)
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Input

Signal	user selectable via DIP switches
Connection type	2-, 3-, 4-wire circuits
Sensor current	≤ 0.25 mA
Max. conductor resistance	≤ 50 Ω for 2-wire circuits ≤ 100 Ω for 3- and 4-wire circuits
Measurement range	9180/10-77-11.: 18 Ω ... 319 Ω 9180/11-77-11.: 180 Ω ... 3190 Ω

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	9180/10-77-11.: > 394 Ω 9180/11-77-11.: > 3940 Ω
Short circuit	9180/10-77-11.: < 16 Ω 9180/11-77-11.: < 160 Ω

Technical Specifications

Nonhazardous Location

Output

Signal	= input signal	
Connection type	2-, 3-, 4-wire circuits	
Settling time (10 % ... 90 %) multiplexer operation	< 10 ms	
Response time (input = output)	< 1 sec	
Sensor current	9180/10-77-11.	200 µA ... 5 mA
	9180/11-77-11.	200 µA ... 0.5 mA or 200 µA ... 2.5 mA until max. 2 V output I_{smax} = 2 V / R_{Ptmax}

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom})	27 mA
Power consumption (at V_{nom})	≤ 0.65 W

Technical Specifications

Hazardous Location

Error Detection (LFD)

When line fault detected	output > 10 kΩ

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to configuration interface	1.5 kV AC
I.S. input to error contact	1.5 kV AC

Technical Specifications

Nonhazardous Location

Power Supply

Polarity reversal protection	yes
Undervoltage monitoring	yes

Error Messaging

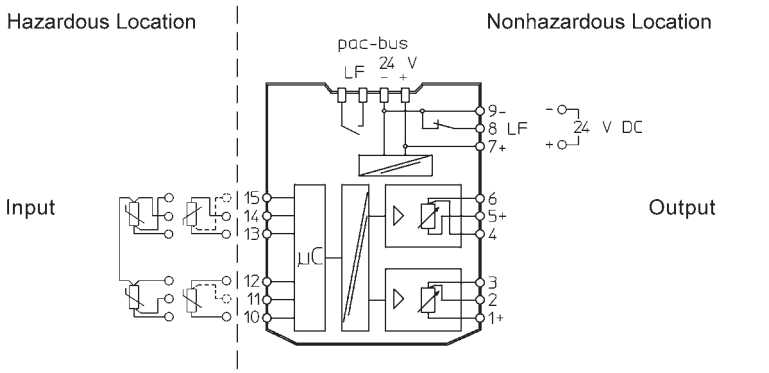
Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Output to configuration interface	350 V AC
Error contact to power supply and output	350 V AC

Connection Diagram



For interfacing to RTDs and potentiometers

- Two versions available with resistance ranges from either 18 Ω up to 391 Ω or 180 Ω up to 3910 Ω
- For 2-, 3- and 4-wire circuits
- Approved for installation in Division 2 and Zone 2
- Short rise time enables connection to a multiplexer in the nonhazardous location
- Unique dual channel solution

Technical Tips The connection of two, 4-wire sensors requires an additional external terminal.

Order Code	Input from Hazardous Location
9180/20-77-11s	18 Ω ... 391 Ω
9180/21-77-11s	180 Ω ... 3910 Ω
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals

Technical Specifications

Hazardous Location

Entity Parameters

FM / $_C$FM / ATEX	V_{OC} = 6.5 V, I_{SC} = 16.4 mA, P_O = 27 mW (linear characteristic)
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Input

Signal	user selectable via DIP switches
Connection type	2-, 3-, 4-wire circuits
Sensor current	≤ 0.25 mA
Max. conductor resistance	≤ 50 Ω for 2-wire circuits ≤ 100 Ω for 3- and 4-wire circuits
Measurement range	9180/20-77-11.: 18 Ω ... 319 Ω 9180/21-77-11.: 180 Ω ... 3190 Ω

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	9180/20-77-11.: > 394 Ω 9180/21-77-11.: > 3940 Ω

Technical Specifications

Nonhazardous Location

Output

Signal	= input signal	
Connection type	2-, 3-, 4-wire circuits	
Settling time (10 % ... 90 %) multiplexer operation	< 10 ms	
Response time (input = output)	< 1 sec	
Sensor current	9180/20-77-11.	200 µA ... 5 mA
	9180/21-77-11.	200 µA ... 0.5 mA or 200 µA ... 2.5 mA until max. 2 V output I_{smax} = 2 V / R_{Ptmax}

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom})	37 mA

Technical Specifications

Hazardous Location

Error Detection (LFD)

Short circuit	9180/20-77-11.: < 16 Ω 9180/21-77-11.: < 160 Ω
When line fault detected	output > 10 kΩ

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to configuration interface	1.5 kV AC
I.S. input to error contact	1.5 kV AC

There is no galvanic isolation between the I.S. input channels

Technical Specifications

Nonhazardous Location

Power Supply

Power consumption (at V_{nom})	≤ 0.89 W
Polarity reversal protection	yes
Undervoltage monitoring	yes

Error Messaging

Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

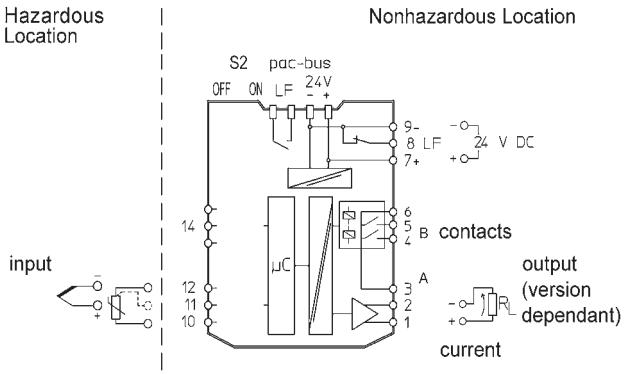
Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Output to configuration interface	350 V AC
Outputs to each other	350 V AC
Error contact to power supply and output	350 V AC

09747E00

Connection Drawing



06658E03

For interfacing to thermocouples RTDs and potentiometers

- One unit for nearly all temperature sensors
- Versions available with limit value relay contacts
- Lockout function to force alarm acknowledgement
- Approved for installation in Division 2 and Zone 2
- Line fault detection
- Simple configuration using a PC or via DIP switches
- Version available with passive output

Technical Tips

When interfacing with a 3-wire potentiometer between 10 kΩ and 100 kΩ, a 10 kΩ shunt resistor is required. No open circuit detection available in this application. External CJC is required when using T/Cs. Three terminal versions with integrated Pt100 are available from R. Stahl. See the accessories section for more information. The units with relay contacts for limit values must be configured using the PC software "ISpac Wizard".

Order Code	Current Output	Relay Output
9182/10-50-12s	– –	2 NO (DPST)
9182/10-51-11s	active 0/4 mA ... 20 mA	– –
9182/10-51-12s	active 0/4 mA ... 20 mA	2 NO (DPST)
9182/10-59-11s	passive 0/4 mA ... 20 mA	– –
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{OC} = 6.5 V, I_{SC} = 19.7 mA, P_O = 32 mW
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Input

Configuration	via PC software: all units, via DIP switches: 9182/10-51-11 and 9182/10-59-11

RTD Input

Input	2-, 3- or 4-wire sensors
Types	**Pt 100, Pt 500, Pt 1000 (IEC 60751)** - 328 °F ... 1562 °F (- 200 °C ... + 850 °C) **Ni 100, Ni 500, Ni 1000 (DIN 43760)** - 76 °F ... + 356 °F (- 60 °C ... + 180 °C)
Linearity	temperature / resistance
Max. line resistance each core	< 50 Ω (2-wire sensor) < 100 Ω (3- or 4-wire sensor)

Technical Specifications

Nonhazardous Location

Output

Active output	0/4 mA ... 20 mA
Load resistance R_L	0 Ω ... 750 Ω
Delay from input to output	≤ 500 ms
Passive output	0/4 mA ... 20 mA
Supply voltage	≤ 31.2 V DC
Minimum load resistance R_L	0 Ω at 3 V ... 20 V, 200 Ω at 24 V, 500 Ω at 30 V

Trip Point Contacts A and B

Contacts	2 NO (DPST)
Switching voltage	≤ ± 30 V
Switching current (resistive load)	≤100 mA
On resistance	≤ 2.5 Ω
Lockout function	output contact remains in alarm position, reset through DIP switches or "power off" in configuration

Technical Specifications

Hazardous Location

Thermocouple Input

Types	Not all the ranges can be set with the DIP switches **B (IEC 60751)** + 482 °F ... + 3272 °F (+ 250 °C ... + 1800 °C) **E (IEC 60751)** - 328 °F ... + 1832 °F (- 200 °C ... + 1000 °C) **J (IEC 60751)** - 328 °F ... + 2192 °F (- 200 °C ... + 1200 °C) **K (IEC 60751)** - 328 °F ... + 2498 °F (- 200 °C ... + 1370 °C) **N (IEC 60751)** - 328 °F ... + 2372 °F (- 200 °C ... + 1300 °C) **R (IEC 60751)** - 58 °F ... + 3213 °F (- 50 °C ... + 1767 °C) **S (IEC 60751), PC configurable only** - 58 °F ... + 3213 °F (- 50 °C ... + 1767 °C) **T (IEC 60751)** - 328 °F ... 752 °F (- 200 °C ... + 400 °C) **L (DIN 43710), PC configurable only** - 328°F ... 1652 °F (- 200 °C ... + 900 °C) **U (DIN 43710), PC configurable only** - 328 °F ... 1112 °F (- 200 °C ... + 600 °C) **XK (GOST), PC configurable only** - 328 °F ... 1472 °F (- 200 °C ... + 800 °C)
Linearity	temperature / voltage
Max. line resistance (sum)	≤ 1000 Ω
Compensation	external CJC must be used, set in PC or via DIP switches “ADJ“ on top of unit,

Potentiometer Input

Input	3-wire sensor 50 Ω ... 100 KΩ

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	for thermocouples and RTDs > 1 kΩ
Short circuit	for potentiometers and RTDs with temperature linearization
When line fault detected	default: output = 2.4 mA, configurable: 0 mA ... 23 mA or hold last value

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to configuration interface	1.5 kV AC
I.S. input to error contact	1.5 kV AC

Technical Specifications

Nonhazardous Location

Configuration

PC Configuration	via “ISpac Wizard“ software, RS 232C via special R. STAHL cable which connects to top of unit, all functions and diagnostics available
DIP Switches	12 switches on the side of the unit, 4 switches on the top of the unit, limited functions and diagnostics available

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom})	70 mA
Power consumption (at V_{nom})	≤ 1.9 W
Polarity reversal protection	yes

Error Messaging

Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Output to configuration interface	350 V AC
Error contact to power supply and output	350 V AC

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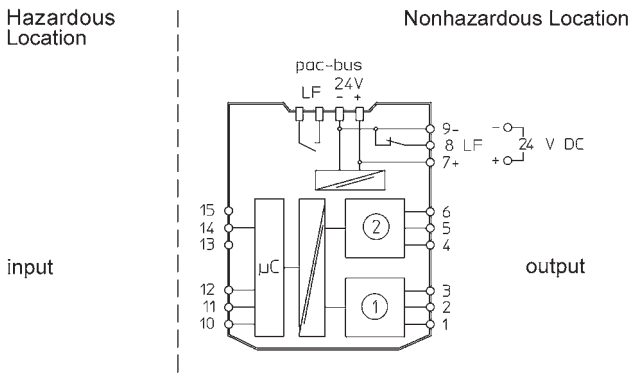
Connection Drawing



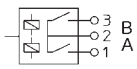
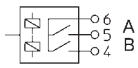
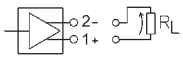
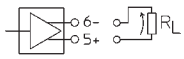
09748E03

For interfacing to thermocouples, RTDs and potentiometers

- One unit for nearly all temperature sensors
- Version available with limit value relay contacts
- Lockout function to force alarm acknowledgement
- Line fault detection
- Simple configuration using a PC or via DIP switches
- Approved for installation in Division 2 and Zone 2

Technical Tips

When interfacing with a 3-wire potentiometer between 10 kΩ and 100 kΩ, a 10 kΩ shunt resistor is required.
No open circuit detection available in this application. External CJC is required when using T/Cs.
Three terminal versions with integrated Pt100 are available from R. Stahl. See the accessories section for more information. The unit with relay contacts for limit values must be configured using the PC software “ISpac Wizard“.

Order Code	Output	Output Configuration	
		Channel 1	Channel 2
9182/20-50-12s	2 NO (DPST)	 09750E00	 09751E00
9182/20-51-11s	active 0/4 mA ... 20 mA	 09749E00	 09753E00
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals		

Technical Specifications

Hazardous Location

Entity Parameters

FM / UL / CSA / ATEX	V_{OC} = 6.5 V, I_{SC} = 19.7 mA, P_O = 32 mW
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Input

Configuration	via PC software: all units, via DIP switches: 9182/20-51-11

RTD Input

Input	2-, 3- or 4-wire sensors
Types	**Pt 100, Pt 500, Pt 1000 (IEC 60751)** - 328 °F ... 1562 °F (- 200 °C ... + 850 °C) **Ni 100, Ni 500, Ni 1000 (DIN 43760)** - 76 °F ... + 356 °F (- 60 °C ... + 180 °C)
Linearity	temperature / resistance
Max. line resistance each core	< 50 Ω (2-wire sensor) < 100 Ω (3- or 4-wire sensor)

Technical Specifications

Nonhazardous Location

Output

Active output	0/4 mA ... 20 mA
Load resistance R_L	0 Ω ... 600 Ω
Delay from input to output	≤ 500 ms

Trip Point Contacts A and B

Contacts	2 NO (DPST)
Switching voltage	≤ ± 30 V
Switching current (resistive load)	≤100 mA
On resistance	≤ 2.5 Ω
Lockout function	output contact remains in alarm position, reset through DIP switches or "power off" in configuration

Technical Specifications

Hazardous Location

Thermocouple Input

Types	Not all the ranges can be set with the DIP switches **B (IEC 60751)** + 482 °F ... + 3272 °F (+ 250 °C ... + 1800 °C) **E (IEC 60751)** - 328 °F ... + 1832 °F (- 200 °C ... + 1000 °C) **J (IEC 60751)** - 328 °F ... + 2192 °F (- 200 °C ... + 1200 °C) **K (IEC 60751)** - 328 °F ... + 2498 °F (- 200 °C ... + 1370 °C) **N (IEC 60751)** - 328 °F ... + 2372 °F (- 200 °C ... + 1300 °C) **R (IEC 60751)** - 58 °F ... + 3213 °F (- 50 °C ... + 1767 °C) **S (IEC 60751), PC configurable only** - 58 °F ... + 3213 °F (- 50 °C ... + 1767 °C) **T (IEC 60751)** - 328 °F ... + 752 °F (- 200 °C ... + 400 °C) **L (DIN 43710), PC configurable only** - 328 °F ... + 1652 °F (- 200 °C ... + 900 °C) **U (DIN 43710), PC configurable only** - 328 °F ... + 1112 °F (- 200 °C ... + 600 °C) **XK (GOST), PC configurable only** - 328 °F ... + 1472 °F (- 200 °C ... + 800 °C)
Linearity	temperature / voltage
Max. line resistance (sum)	≤ 1000 Ω
Compensation	external CJC must be used, set in PC or via DIP switches “ADJ“ on top of unit,

Potentiometer Input

Input	3-wire sensor 50 Ω ... 100 KΩ

Error Detection (LFD)

Error detection	user selectable via DIP switches on top of unit, red LED indication "LF"
Open circuit	for thermocouples and RTDs > 1 kΩ
Short circuit	for potentiometers and RTDs with temperature linearization
When line fault detected	default: output = 2.4 mA, configurable: 0 mA ... 23 mA or hold last value

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. input to output	1.5 kV AC
I.S. input to power supply	1.5 kV AC
I.S. input to configuration interface	1.5 kV AC
I.S. input to error contact	1.5 kV AC

Galvanic isolation of I.S. inputs

with thermocouples	20 V
with resistance sensors	– –

Technical Specifications

Nonhazardous Location

Configuration

PC Configuration	via “ISpac Wizard“ software, RS 232C via special R. STAHL cable which connects to top of unit, all functions and diagnostics available
DIP Switches	12 switches on the side of the unit, 4 switches on the top of the unit, limited functions and diagnostics available

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom})	80 mA
Power consumption (at V_{nom})	≤ 1.9 W
Polarity reversal protection	yes

Error Messaging

Power supply	contact (30 V, 100 mA), closed to ground in case of error
pac-Bus	floating contact (30 V, 100 mA)

Galvanic Isolation

Test voltage under regulations EN 50178

Output to power supply	350 V AC
Output to configuration interface	350 V AC
Outputs to each other	350 V AC
Error contact to power supply and output	350 V AC

Customer Specific Set-up Sheet

Order-No.: _ _ _ _ _ _ _ _ _ _ - Pos.: _ _ _ Pieces: _____

	Type	Channels	Output	Trip point contact
☐	9182 / 10 - 51 - 11.	1	0/4...20 mA	none
☐	9182 / 10 - 59 - 11.	1	passive	none
☐	9182 / 20 - 51 - 11.	2	0/4...20 mA	none
☐	9182 / 10 - 51 - 12.	1	0/4...20 mA	2 NO
☐	9182 / 10 - 50 - 12.	1	None	2 NO
☐	9182 / 20 - 50 - 12.	2	None	2 NO per channel

with:
☐ Screw terminal s (standard) ☐ Spring clamp terminal k

	Standard	Channel 1	Channel 2
Signal Tag	Signal 1/2	_____	_____
I.S. input			
RTD	☐	☐	☐
Sensor type	Pt 100	☐ Pt 100 ☐ Pt 500 ☐ Pt 1000 ☐ Ni 100 ☐ Ni 500 ☐ Ni 1000	☐ Pt 100 ☐ Pt 500 ☐ Pt 1000 ☐ Ni 100 ☐ Ni 500 ☐ Ni 1000
Circuit type	3-wire	☐ 2-wire ☐ 3-wire ☐ 4-wire	☐ 2-wire ☐ 3-wire ☐ 4-wire
Measurement range	0...400 °C	from _____ to _____ ☐ °C ☐ °F ☐ K ☐ Ω	from _____ to _____ ☐ °C ☐ °F ☐ K ☐ Ω
Thermocouple		☐	☐
Type		☐ B ☐ E ☐ J ☐ K ☐ N ☐ R ☐ S ☐ T ☐ L ☐ U ☐ XK	☐ B ☐ E ☐ J ☐ K ☐ N ☐ R ☐ S ☐ T ☐ L ☐ U ☐ XK
CJC type		☐ ext. Pt 100 ☐ const. temp._____	☐ ext. Pt 100 ☐ const. temp._____
Measurement range		from _____ to _____ ☐ °C ☐ °F ☐ K ☐ mV	from _____ to _____ ☐ °C ☐ °F ☐ K ☐ mV
Potentiometer		☐	☐
Range		☐ up to 500 Ω ☐ up to 2.5 kΩ ☐ up to 10 kΩ ☐ up to 100 kΩ (+Shunt)	☐ up to 500 Ω ☐ up to 2.5 kΩ ☐ up to 10 kΩ ☐ up to 100 kΩ (+Shunt)
Measurement range		from _____ % to _____ %	from _____ % to _____ %
Output (only 9182/*0-51-1*)			
Signal	4...20 mA	☐ 0...20 mA ☐ 4...20 mA	☐ 0...20 mA ☐ 4...20 mA
Fault behavior	off	☐ hold last value ☐ off ☐ fixed value: _____ (standard 2.4 mA)	☐ hold last value ☐ off ☐ fixed value: _____ (standard 2.4 mA)
Trip point settings for contact A (only 9182/*0-5*-12)			
Signaling	deactivated	☐ activated ☐ deactivated	☐ activated ☐ deactivated
Value	25 %	_____ % or absolute: _____	_____ % or absolute: _____
Contact behavior	☐	☐ closes if signal > value ☐ closes if signal < value ☐ opens if signal > value ☐ opens if signal < value	☐ closes if signal > value ☐ closes if signal < value ☐ opens if signal > value ☐ opens if signal < value
Hysteresis	1 %	_____ % (0.1...10 %)	_____ % (0.1...10 %)
Lockout function	deactivated	☐ activated ☐ deactivated	☐ activated ☐ deactivated
Trip point settings for contact B (only 9182/*0-5*-12)			
Signaling	deactivated	☐ activated ☐ deactivated	☐ activated ☐ deactivated
Value	75 %	_____ % or absolute: _____	_____ % or absolute: _____
Contact behavior	☐	☐ closes if signal > value ☐ closes if signal < value ☐ opens if signal > value ☐ opens if signal < value	☐ closes if signal > value ☐ closes if signal < value ☐ opens if signal > value ☐ opens if signal < value
Hysteresis	1 %	_____ % (0.1...10 %)	_____ % (0.1...10 %)
Lockout Function	deactivated	☐ activated ☐ deactivated	☐ activated ☐ deactivated

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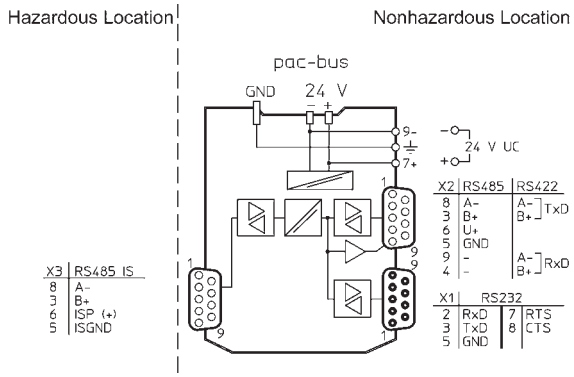
Connection Diagram



09816E03

For interfacing with intrinsically safe RS 485 field devices or protecting RS 485 cables crossing a Division 1 / Zone 1 hazardous location

- Suitable for UART protocols: Profibus DP, Modbus, RS 485 HART
- Automatic transmission speed setting for Profibus DP
- Approved for installation in Division 2 and Zone 2
- Transmission speed adjustable between 1.2 kBit/s and 1.5 MBit/s
- Signal regeneration

Technical Tips When using RS 485 and RS 422 interfaces, the correct 9-pin Sub-D connectors must be used. Connectors with internal end of line resistors that can be switched on or off are recommended. On the nonhazardous interface side, standard connectors can be used. On the hazardous interface side, special I.S. connectors from R.STAHL must be used. See the accessories section for the order code information.

Order Code	Hazardous Location Interface	Nonhazardous Location Interface
9185/11-35-10s	RS 485	RS 232, RS 422, RS 485
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Entity Parameters

FM / CSA / ATEX	V_{OC} = 3.73 V, I_{SC} = 149 mA, P_O = 139 mW,
	V_{max} = ± 4.2 V
Isolation voltage	V_m = 250 V AC

Intrinsically Safe Interface

Signal	user selectable via DIP switches on top of the unit, RS 485 IS PTO specification RS 485 Ex i R. STAHL specification
Connector	9-pin Sub-D, female, X3
Baud rate	user selectable via rotary switch on top of the unit, automatic detection with Profibus DP protocol 1.2 kBit/s ... 1.5 MBit/s
Line length	dependant on transmission speed and cable used
Terminating resistor	user set in external plug
Indication of data received	green LED "RxD3"

Technical Specifications

Nonhazardous Location

Interface

Signal	RS 232 EIA
Connector	9-pin Sub-D, male, X1
Baud rate	user selectable via rotary switch on top of the unit, automatic detection with Profibus DP protocol 1.2 kBit/s ... 93.75 kBit/s
Line length	≤ 20 m
Terminating resistor	not required
Indication of data received	green LED "RxD1"
Signal	user selectable via DIP switches on top of unit, RS 485 / RS 422 EIA
Connector	9-pin Sub-D, female X2
Baud rate	user selectable via rotary switch on top of the unit, automatic detection with Profibus DP protocol 1.2 kBit/s ... 1.5 MBit/s

Technical Specifications

Hazardous Location

Fault monitoring

Indication	red LED "ERR"
Data lines short circuit	if T ≥ 13 x bit time

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. interface to non I.S. interface	1.5 kV
I.S. interface to power supply	1.5 kV

Technical Specifications

Nonhazardous Location

Interface

Line length	dependant on transmission speed and cable used
Terminating resistor	user set in external plug
Indication of data received	green LED "RxD2"

Fault monitoring

Indication	red LED "ERR"
Data lines short circuit	if T ≥ 13 x bit time

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V AC / DC
Voltage range DC	18 V ... 31.2 V
Voltage range AC	24 V ± 15 %
Nominal current (at V_{nom})	66 mA
Power consumption (at V_{nom})	1.6 W
Undervoltage monitoring	yes

Galvanic Isolation

Test voltage under regulations EN 50178

Power supply to non I.S. interface	500 V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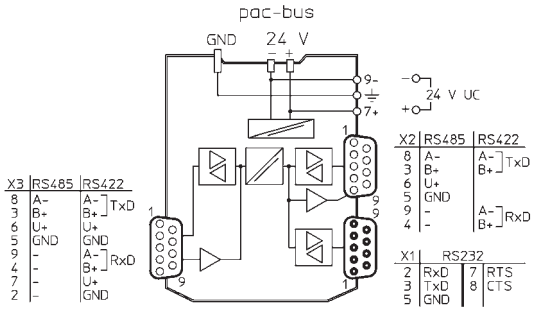
Connection Diagram

Nonhazardous Location / Division 2 / Zone 2



09817E03

For interfacing with nonincendive RS 485 / RS 422 field devices or protecting RS 485 / RS 422 cables crossing a Division 2 / Zone 2 hazardous location

- Suitable for UART protocols: Profibus DP, Modbus, RS 485 HART
- Automatic transmission speed setting for Profibus DP
- Approved for installation in Division 2 and Zone 2
- Transmission speed adjustable between 1.2 kBit/s and 1.5 MBit/s
- Signal regeneration

Technical Tips When using RS 485 and RS 422 interfaces, the correct 9-pin Sub-D connectors must be used. Connectors with internal end of line resistors that can be switched on or off are recommended. See the accessories section for the order code information.

Order Code	Hazardous Location Interface	Nonhazardous Location Interface
9185/12-45-10s	RS 422, RS 485	RS 232, RS 422, RS 485
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals	

Technical Specifications

Hazardous Location

Nonincendive Interface

Signal	user selectable via DIP switches on top of the unit, RS 485 / RS 422 EIA
Connector	9-pin Sub-D, female, X3
Baud rate	user selectable via rotary switch on top of the unit, automatic detection with Profibus DP protocol 1.2 kBit/s ... 1.5 MBit/s
Line length	dependant on transmission speed and cable used
Terminating resistor	user set in external plug
Indication of data received	green LED "RxD3"

Fault monitoring

Indication	red LED "ERR"
Data lines short circuit	if T ≥ 13 x bit time

Technical Specifications

Nonhazardous Location

Interface

Signal	RS 232 EIA
Connector	9-pin Sub-D, male, X1
Baud rate	user selectable via rotary switch on top of the unit, automatic detection with Profibus DP protocol 1.2 kBit/s ... 93.75 kBit/s
Line length	≤ 20 m
Terminating resistor	not required
Indication of data received	green LED "RxD1"
Signal	user selectable via DIP switches on top of unit, RS 485 / RS 422 EIA
Connector	9-pin Sub-D, female X2
Baud rate	user selectable via rotary switch on top of the unit, automatic detection with Profibus DP protocol 1.2 kBit/s ... 1.5 MBit/s

Technical Specifications

Hazardous Location

Galvanic Isolation

Test voltage under regulations EN 50020

I.S. interface to non I.S. interface	1.5 kV
I.S. interface to power supply	1.5 kV

Technical Specifications

Nonhazardous Location

Interface

Line length	dependant on transmission speed and cable used
Terminating resistor	user set in external plug
Indication of data received	green LED "RxD2"

Fault monitoring

Indication	red LED "ERR"
Data lines short circuit	if T ≥ 13 x bit time

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V AC / DC
Voltage range DC	18 V ... 31.2 V
Voltage range AC	24 V ± 15 %
Nominal current (at V_{nom})	66 mA
Power consumption (at V_{nom})	1.6 W
Undervoltage monitoring	yes

Galvanic Isolation

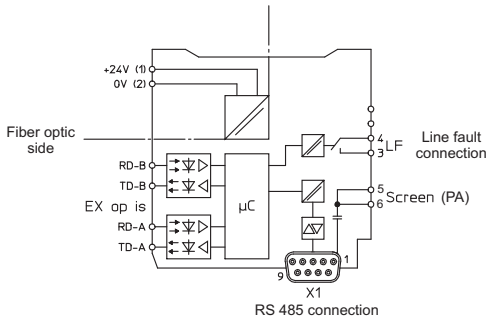
Test voltage under regulations EN 50178

Power supply to non I.S. interface	500 V

9186 Series, Fiber Optic Fieldbus Isolation Repeater - I.S. Version

06973E00

Connection Diagram



05352E03

For building an intrinsically safe fiber optic network in a hazardous location

- Intrinsically safe optical interface
- Point-to-Point network topology available, with or without redundancy
- Transmission of Profibus DP, Modbus, HART and R. STAHL Servicebus
- Integrated analysis of the optical input signal
- Intrinsically safe bus connection via RS 485 I.S. (PTO)
- Ring and line network topologies available
- Error message contact and LED indication of signal level status
- Approved for installation in Division 2 and Zone 2

Technical Tips Industry standardized connectors can be used for the fiber optic cable due to the protection technique, Ex op is, that is used.
The fiber optic connection can also be removed live.

Order Code	Network Structure
9186/12-11-11	ring, point-to-point redundant, line

Technical Specifications

Fiber Optic Side

Entity Parameters	
FM / CFM / ATEX	
Fiber optic interface	Ex op is EN 60079-28 / NEC article 504 / 505
Max. radiated power P_o	≤ 15 mW
Interface	
Signal	optical
Protocols	protocol transparent
Network topologies	ring structure, line structure, point-to-point connection
Redundancy	automatic switchover triggered by line fault Integrated diagnostic function with alarms and automatic switchover to the redundant path, improves availablity
Wave length	850 nm
Transmission line length	≤ 6561 ft (2000 m)
Connection	ST®, BFOC/2.5 socket
Recommended fiber optic cables	G 50 / 125 G 62.5 / 125 multimode only
Power Supply	
Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Nominal current (at V_{nom})	67 mA
Power consumption	≤ 2 W
Polarity reversal protection	yes

Technical Specifications

RS 485 Cable Side

Entity Parameters	
RS 485 I.S. interface	
FM / CFM / ATEX	V_{OC} = ± 3.7 V, I_{SC} = 148 mA, P_O = 137 mW, V_{max} = ± 4.2 V
Error message contact	
FM / CFM / ATEX	V_{max} = 24 V, I_{max} = 600 mA
Interface	
Signal	RS 485 I.S. (PTO specification) 2-wire, half duplex
Protocols	Profibus DP, Modbus, HART, ServiceBus R.STAHL (IS1)
Connector	Sub-D female X3, 9-pin
Baud rate	user selectable via DIP switches under the top cover of the unit, automatic detection with Profibus DP, transmission speed 1.2 kBit/s ... 1.5 MBit/s
Bit refresh	received bit is restored
Cable length	dependant on transmission speed and cable used
Terminating resistor	user set in external plug
Indication of data received	green LED "RD"
Indication of data transmitted	amber LED "TD"
Fault monitoring	
Power supply failure	red LED "PWR", error messaging contact = open
Input signal level good	green and amber LED "FO Signal", error messaging contact = closed

Technical Specifications
Fiber Optic Side

Technical Specifications
RS 485 Cable Side

Fault monitoring

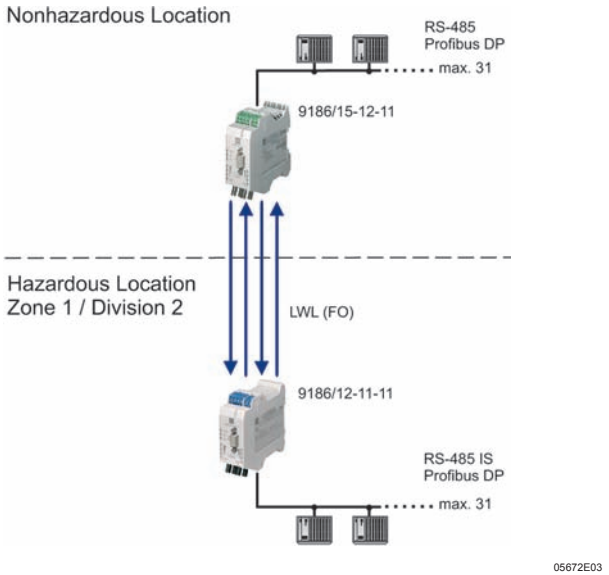
Input signal level reduced (- 1.5 dBm)	amber LED "FO Signal", error messaging contact = open
Fiber optic cable break or input signal level too low (- 3 dBm)	red LED "FO ERR", error messaging contact = open

Galvanic Isolation

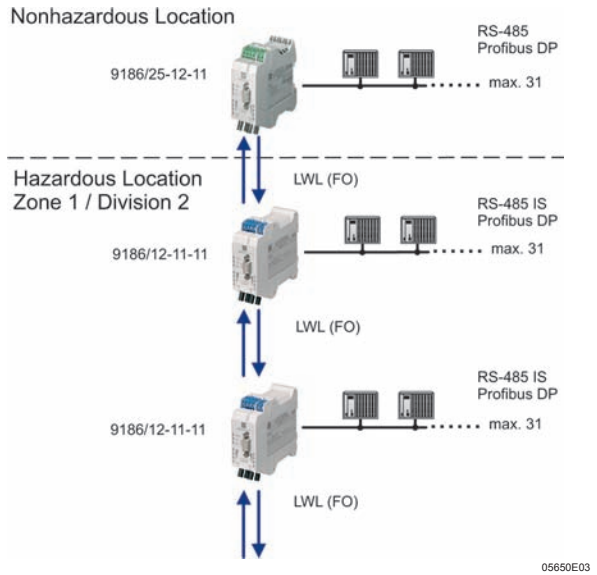
Test voltage under regulations EN 50020

I.S. RS 485 to power supply	1.5 kV
Error message contact to power supply	1.5 kV
Screen connection (PA) to power supply	1.5 kV
I.S. RS 485 to error message contact	500 V
I.S. RS 485 to screen connection (PA)	500 V
Error message contact to screen connection (PA)	500 V

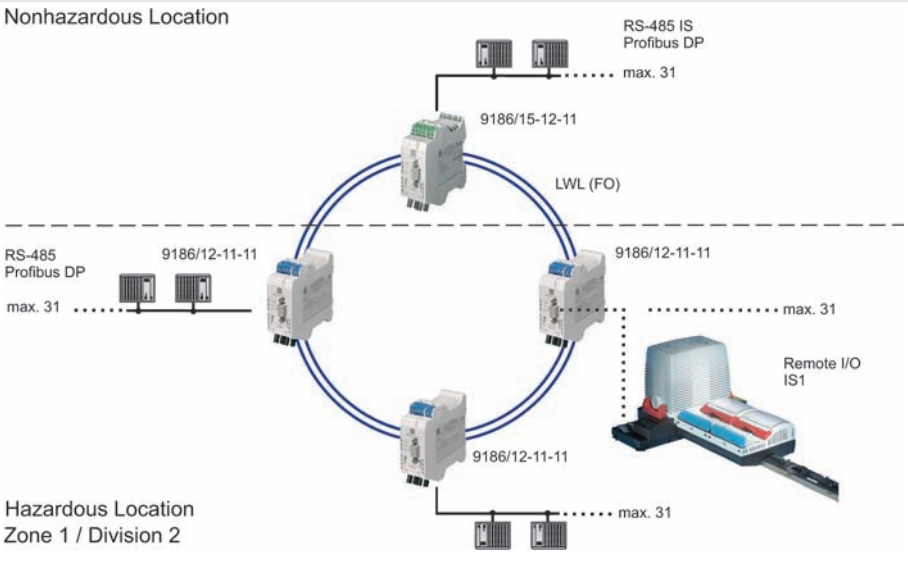
Network Topology



Point-to-Point structure



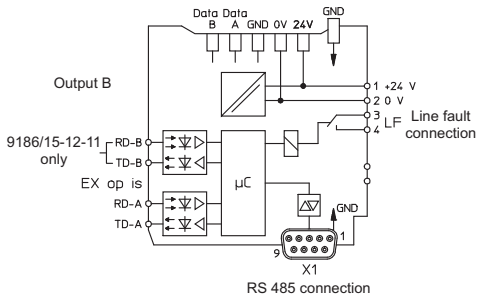
Line structure



Ring structure

9186 Series, Fiber Optic Fieldbus Isolation Repeater - Zone 2 Version

Connection Diagram



For building an intrinsically safe fiber optic network in a zone 2 or nonhazardous location

- Intrinsically safe optical interface
- Point-to-Point network topology available, with or without redundancy
- Transmission of Profibus DP, Modbus, HART and R. STAHL Servicebus
- Integrated analysis of the optical input signal
- RS 485 bus connection
- Ring and line network topologies available
- Error message contact and LED indication of signal level status
- Approved for installation in Zone 2

Technical Tips Industry standardized connectors can be used for the fiber optic cable due to the protection technique, Ex op is, that is used.
The fiber optic connection can also be removed live.

Order Code	Network Structure	Note
9186/15-12-11	ring, point-to-point redundant, line	– –
9186/25-12-11	point-to-point, end of line	without redundancy or ring network options

Technical Specifications

Fiber Optic Side

Entity Parameters	
UL / cUL	nonincendive
ATEX	
Fiber optic interface	Ex op is EN 60079-28
Max. radiated power P_o	≤ 15 mW
Interface	
Signal	optical
Protocols	protocol transparent
Network topologies	ring structure, line structure, point-to-point connection
Redundancy	9186/15-12-11 only, automatic switchover triggered by line fault Integrated diagnostic function with alarming and automatic switch-over to the protection path, improves the availablity
Wave length	850 nm
Transmission line length	≤ 6561 ft (2000 m)
Connection	ST®, BFOC/2.5 socket
Recommended fiber optic cables	G 50 / 125 G 62.5 / 125 multimode only
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V

Technical Specifications

RS 485 Cable Side

Interface	
Signal	RS 485 2-wire, half duplex
Protocols	Profibus DP, Modbus, HART, ServiceBus R.STAHL (IS1)
Connector	Sub-D female X3, 9-pin
Baud rate	user selectable via DIP switches under the top cover of the unit, automatic detection with Profibus DP, transmission speed 9.6 kBit/s ... 1.5 Mbit/s
Bit refresh	received bit is restored
Cable length	dependant on transmission speed and cable used
Terminating resistor	user set in external plug
Indication of data received	green LED "RD"
Indication of data transmitted	amber LED "TD"
Fault monitoring	
Power supply failure	red LED "PWR", error messaging contact = open
Input signal level good	green and amber LED "FO Signal", error messaging contact = closed
Input signal level reduced (- 1.5 dBm)	amber LED "FO Signal", error messaging contact = open
Fiber optic cable break or input signal level too low (- 3 dBm)	red LED "FO ERR", error messaging contact = open

Technical Specifications

Fiber Optic Side

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom})	130 mA
Power consumption	3 W
Polarity reversal protection	yes

Technical Specifications

RS 485 Cable Side

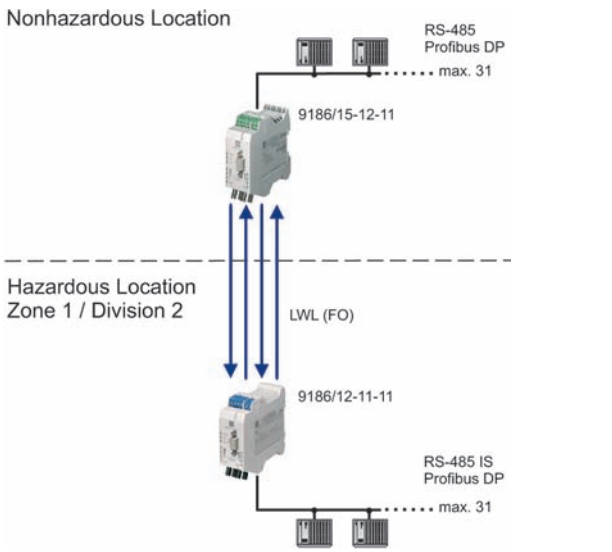
Fault monitoring

Max. load of the contact	max. 60 V DC, 42 V, 1 A

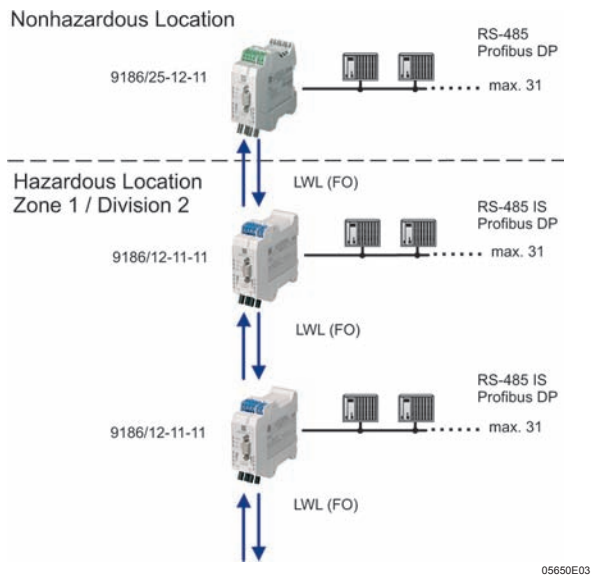
Galvanic Isolation

between RS 485 and power supply	≥ 1.5 kV

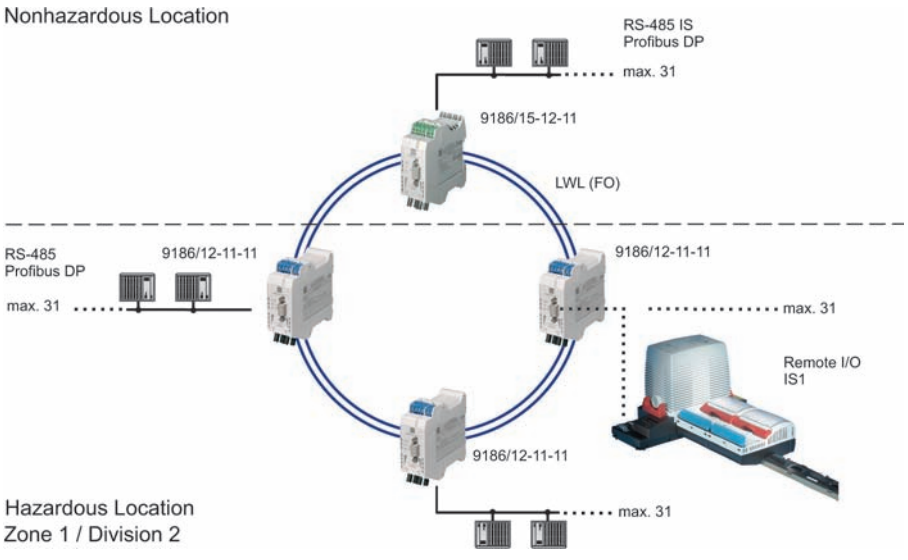
Network Topology



Point-to-Point structure



Line structure

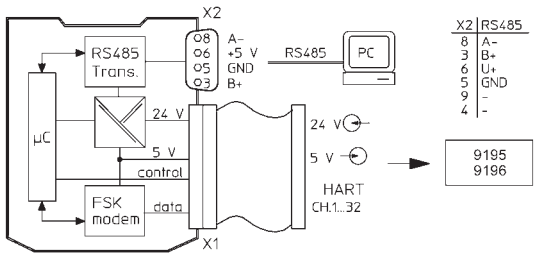


Ring structure


09731E00

Connection Diagram

Nonhazardous Location / Division 2 / Zone 2



09732E03

For interfacing between HART compatible field devices and HART Management systems on a PC

- Compatible with Cornerstone, AMS, PDM, PRM etc.
- Up to 128 HART Multiplexers on one PC interface
- RS 485 bus communication to a PC
- SIL 3
- 32 HART channels per multiplexer
- Up to 4096 HART field devices
- Approved for installation in Division 2 and Zone 2

Technical Tips

The 9192 modules come with a 14-core cable for connection to either the pac-Carrier type 9195 or the HART connection board type 9196.
The power supply is via the pac-Carrier type 9195 or the HART connection board type 9196.
UL have not approved this unit for installation in Division 2.

Order Code	Connection to PC	Connection to field devices
9192/32-10-10	RS 485	via 9195 or 9196

Technical Specifications

Field Device Side

HART Field Device Interface

Indication of data transmisssion	2 yellow LEDs "Tx" and "Rx"
Channels	16 or 32, user selectable via rotary switch on top of unit
Connection	14-core ribbon cable
HART Specification	HART Field Communication Protocol Rev. 6.0 (downwards compatible to Rev. 4.0); FSK Physical Layer Specification (Rev. 8.1)

Error Detection

Error detection on HART bus	flashing red LED indication "ERR"

Power Supply

Indication	green LED "PWR"
Nominal voltage V_{nom}	24 V DC
Voltage range	18 V ... 31.2 V
Nominal current (at V_{nom})	55 mA
Power consumption (at V_{nom})	1.35 W
Undervoltage monitoring	yes

Galvanic Isolation

Test voltage under regulations EN 50178

HART signal to RS 485	350 V AC

Technical Specifications

HART signals to each other	100 V DC capacitive

PC Side

RS 485 Interface

Connection	Sub-D socket, 9-pin
Signal	RS 485
Protocol	compatible to Cornerstone, AMS, PDM and PRM
HART Multiplexers per bus segment	31
Address setting	0 ... 127; user selectable via rotary switch on top of unit
Transmission speed	9,600; 19,200; 38,400; 57,600 [bit/s] user selectable via rotary switch on top of unit
Line length	3937 ft (1200 m)
Indication	2 yellow LEDs "Tx" and "Rx"

Fault monitoring

Processor error	"PWR" LED flashes

Galvanic Isolation

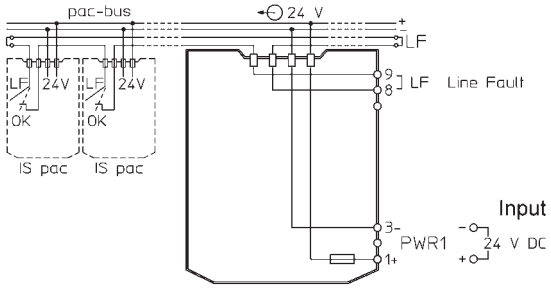
Test voltage under regulations EN 50178

Power supply to HART signal	350 V AC
Power supply to RS 485	350 V AC


09815E00

Connection Diagram

Nonhazardous Location / Zone 2



09819E03

For feeding power, single or redundant 24 V DC, onto the pac-Bus

- Supply current up to 4 A (for approx. 30 - 50 modules)
- Line fault messaging
- Approved for installation in Division 2 and Zone 2
- Replaceable fuse for the supply circuit
- Installation in any slot on the pac-Bus

Technical Tips UL have not approved these units for installation in Division 2.

Order Code	Power Feed
9193/10-11-10s	24 V, 4 A; primary
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals; **q**: for insulation displacement terminals

Technical Specifications

Nonhazardous Location

Input

Power feed-in	24 V DC
Supply range	18 V ... 31.2 V
Max. current	4 A
Indication	green LED "PWR1"
Replaceable fuse	5 x 20 mm; T 4.0 A
Polarity reversal protection	yes

Technical Specifications

Nonhazardous Location

Output

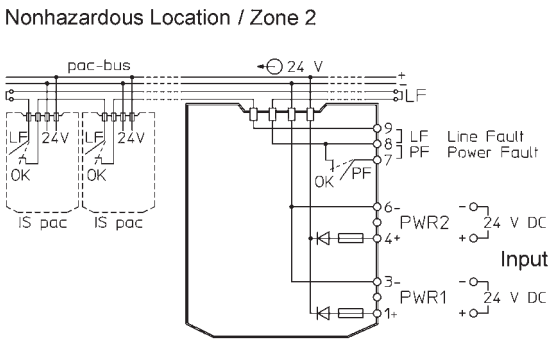
Supply into the pac-Bus	24 V / max. 4 A

Error Messaging

Line fault LF	contact (35 V / 100 mA), closed in good conditions


09815E00

Connection Diagram



09818E03

For feeding power, single or redundant 24 V DC, onto the pac-Bus

- Supply current up to 4 A (for approx. 30 - 50 modules)
- Line fault messaging
- Redundant supply feed available
- Approved for installation in Division 2 and Zone 2
- Replaceable fuse for the supply circuit
- Installation in any slot on the pac-Bus
- Power supply failure via relay contacts

Technical Tips UL have not approved these units for installation in Division 2.

Order Code	Power Feed
9193/20-11-11s	24 V, 4 A; primary + redundant
Note	The order code above is with screw type removable terminals. For alternative types of terminals, please substitute the **s** as follows: **k**: for spring clamp terminals; **q**: for insulation displacement terminals

Technical Specifications

Nonhazardous Location

Input

Power feed-in	24 V DC
Supply range	18 V ... 31.2 V
Max. current	4 A
Redundant supply	decoupled with diodes
Indication	2 green LEDs "PWR1", "PWR2"
Replaceable fuse	5 x 20 mm; 2 x T 4.0 A
Polarity reversal protection	yes

Technical Specifications

Nonhazardous Location

Output

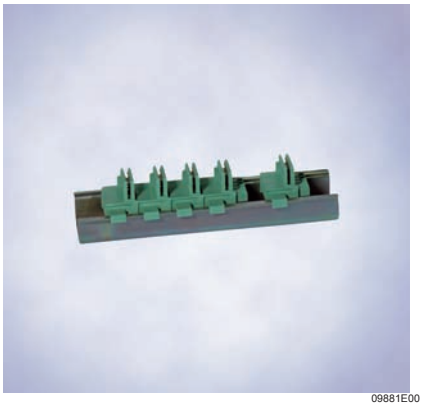
Supply into the pac-Bus	24 V / max. 4 A

Error Messaging

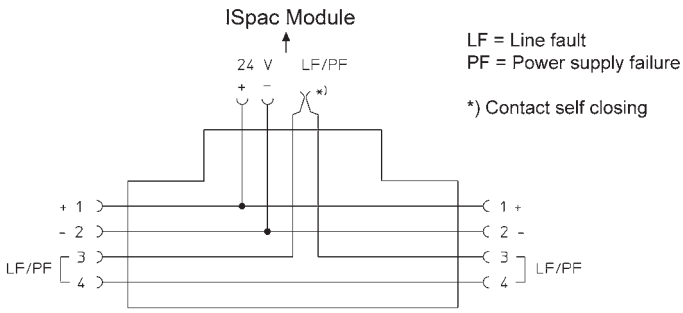
Power supply failure PF	contact (35 V / 100 mA)
Line fault LF	contact (35 V / 100 mA), closed in good conditions
DIP switch settings	user configured on top of unit

Error Detection

Switch "SP"	power failure message off for redundant supply
Switch "LFS"	line fault message on / off


09881E00

Connection Diagram

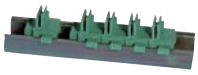
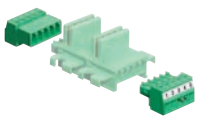


09857E03

For simple and time saving connection of power supply to ISpac isolators with common error messaging

- Fast and simple mounting without tools onto, high or low profile, DIN rail
- Individual pieces allow easy expansion at any time
- Integrated pole reversal protection
- Power supply connection via power feed modules with replaceable fuses and redundancy option
- Self closing contact for unused slots
- Individual pieces can be connected together, up to 40 modules
- Gold plated contacts for maximum contact safety
- Low cost power supply connection option via end terminals
- Potential free error messaging contact for common error signal
- Approved for installation in Division 2 and Zone 2

Technical Tips When monitoring line faults of the ISpac modules via pac-Bus and the power feed module 9193, the terminal end set must be used to terminate the error message chain.

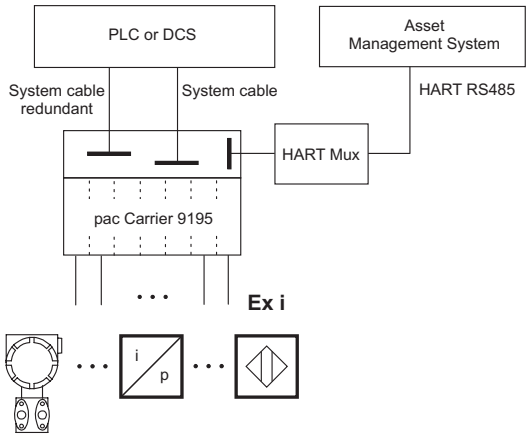
Order Code	Picture	Description
9194/31-17	 09885E00	pac-Bus individual piece 0.7" (17.6 mm)
9194/50-01	 10374E00	5-pole terminal set, begin + end, with bridge for error message chain

Technical Specifications	
Power Supply Connection	
Number of contacts	2
Nominal voltage V_{nom}	24 V DC
Max. voltage	31.2 V
Max. current	4 A
Max. through resistance	< 5 mΩ

Technical Specifications	
Common Error Messaging Connection	
Number of contacts	1 + 1 (self closing)
Nominal voltage V_{nom}	24 V DC
Max. voltage	31.2 V
Max. current	100 mA
Max. through resistance	< 5 mΩ


09824E00

Connection Drawing



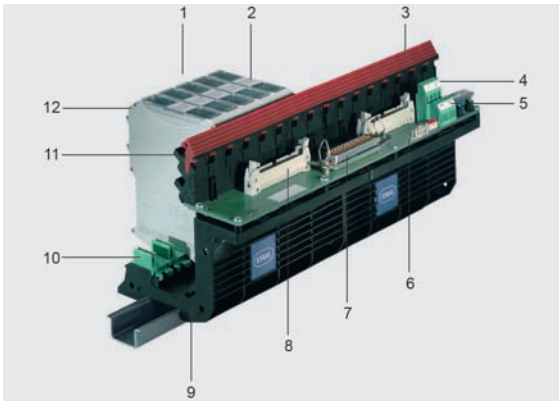
10154E02

For the connection of ISpac isolators to an automation system via system specific cables

- For 8 or 16, single or dual channel modules, any mix of signals
- High, user friendly viewing level for system connection
- Connection option for HART multiplexer to a HART management system
- Redundant power supply with error message contact and replaceable fuses
- Approved for installation in Division 2 and Zone 2
- Rugged, industry standard design with integrated label carrier - approved by DNV for shipbuilding
- System specific connectors and PC board designs
- Horizontal or vertical installation on DIN Rail or mounting plate
- Mechanical snap on pac-Carrier system with protection against vibration due to secure mounting at the top and bottom

Technical Tips Versions available for connection to Yokogawa ProSafe-RS, CS Centum 3000 R3 and Emerson Delta V. Engineering Guides are available online at www.ispac.info.
For customer specific versions, please contact R. STAHL.

Construction Drawing



09828E00

1. Carrier for 8 or 16 modules (32 channels)
2. Labeling for module, slot and carrier
3. Ejector mechanism (with screw driver)
4. Redundant and fused supply
5. Power supply failure and line fault signalling via relay
6. System specific PCB
7. System specific plugs
8. Signal duplication and / or connection HART-Multiplexer
9. For hat-rail or mounting plate
10. Integrated pac-Bus for power supply and line-fault signalling
11. Secure snap-in mechanism, without tool
12. Single slot, any signal mixture

Order Code	Version	I/O-card type	Signal type	Number of slots	HART-Multiplexer	Redundancy
9195/16H-XX0-01C	Screw terminals	all	DI, DO, AI, AO	16	9192/32	no
9195/16A-XX0-01C		all	DI, DO, AI, AO	16	no	no
9195/16H-YO3-01V1	Yokogawa ProSafe-RS	SAI 143	16 x AI	16	9192/32	yes
9195/08H-YO3-06V1		SAI 533	8 x AO	8	9192/32	yes
9195/08H-YO3-02V1		SAV 144	16 x AI	8	9192/32	yes
9195/16H-YO3-02V1		SAV 144	16 x AI	16	9192/32	yes
9195/08A-YO3-03A2		SDV 144 / 541	16 x DI / 16 x DO	8	no	yes
9195/16A-YO3-03A2		SDV 144 / 541	16 x DI / 16 x DO	16	no	yes
9195/08A-YO3-04A2		SDV 531	8 x DO	8	no	yes
9195/08H-YO1-05V1	Yokogawa CS Centum 3000 R3	AAB 841	8 x AI + 8 x AO	8	9192/32	yes
9195/16H-YO1-08V1		AAI 135	8 x AI	8	9192/32	yes
9195/16A-YO1-01D		AAI 141	16 x AI	16	no	no
9195/16A-YO1-01E		AAI 141	16 x AI + each AI 2nd output	16	no	no
9195/08H-YO1-01V1		AAI 141 / 144	16 x AI	8	9192/32	yes
9195/08H-YO3-01V1		SAI 143	16 x AI	8	9192/32	yes
9195/08H-YO1-09V1		AAI 835	4 x AI / 4 x AO	8	9192/32	yes
9195/08H-YO1-04V1		AAI 841	8 x AI + 8 x AO	8	9192/32	yes
9195/16A-YO1-04D		AAI 841	8 x AI + 8 x AO	16	no	no
9195/08A-YO1-10V1		AAP 135	8 x DI (< 800 Hz)	8	no	no
9195/08A-YO1-11V1		AAP 135	8 x DI (> 800 Hz)	8	no	yes
9195/08H-YO1-02V1		AAV 141	16 x AI	8	9192/32	yes
9195/16A-YO1-02D		AAV 141	16 x AI	16	no	no
9195/16A-YO1-06A2		ADV 151 / 161	32 x DI	16	no	yes
9195/16A-YO1-07A2		ADV 551 / 561	32 x DO	16	no	yes
9195/08A-EP1-01A	Emerson	VE4001S2T1B3 VE4002S1T1B3	2 x (8 x DI) or 2 x (8 x DO)	8	no	no
9195/08A-EP1-02A		VE4001S2T1B3 VE4002S1T1B3 VE4003S2B4 VE4005S2B3	2 x (8 x DI) or 2 x (8 x DO) or 2 x (8 x AI) or 2 x (8 x AO)	8	no	no
9195/08A-EP1-03A		VE4003S3B4	2 x (8 x AI)	8	no	no

Technical Specifications

Connections

Field Devices

Connection	at the terminals of the I.S. isolators
Number of channels	8, 16, 32

Automation Systems

Connection	system specific plug (Sub-D, Elco, etc.)
Number of channels	up to 32

HART Interface

Connection	• via the automation system • via HART-Multiplexer 9192 (only at 9195/...H-...-...)

Technical Specifications

Connections

Power Supply

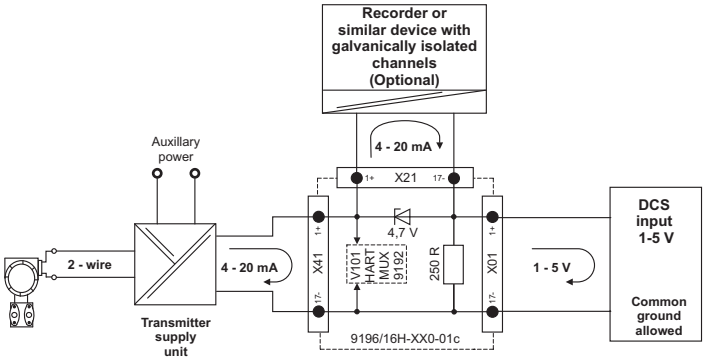
Indication	2 green LEDs "PWR1"; "PWR2"
Nominal voltage V_{nom}	24 V DC
Voltage range	19 V ... 31.2 V
Redundant supply	yes, decoupled with diodes
Fuse	2 x TR5; T 2.0 A; replaceable, for primary and redundant supply
Polarity reversal protection	yes

Error Messaging

Error messaging	selectable via switch settings “SP“ and “LFS“
Power supply failure PF	contact (35 V / 100 mA), open under fault condition - not available with redundant power supply connection
Line fault LF	contact (35 V / 100 mA), open under fault condition


11200E00

Connection Drawing



11340E03

For interfacing between the HART multiplexer type 9192 and HART field devices

- Cost and space saving system for HART
- Simple installation on DIN rail
- Processing of 4 ... 20 mA non I.S. signals
- Approved for installation in Division 2 and Zone 2

Technical Tips For 32 channels, connect two termination boards together. For I.S. signals, connect to the HART field devices via zener barriers or galvanic isolators. Type 9196/16H-XX0-01c contains an additional set of terminals for connection to a printer or similar device.

Order Code	Channels	Application	Signal to the automation system
9196/16H-XX0-01c	16	2-, 3- or 4-wire transmitter	1 ... 5 V

Technical Specifications

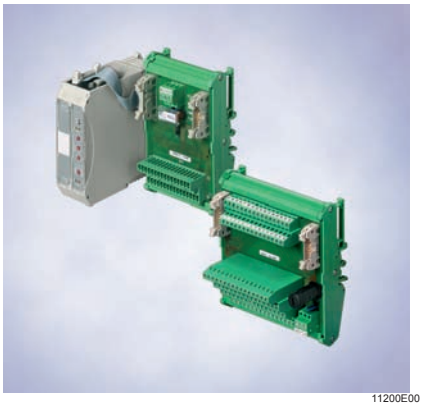
Field Device Side

Connection	to isolators / barriers or non I.S. field devices via integrated screw terminal

Technical Specifications

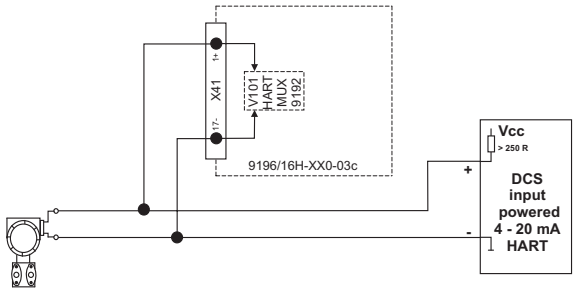
Automation System Side

Connection	to the automation system via integrated screw terminal
Power Supply	
Nominal voltage V_{nom}	24 V DC
Voltage range	19 V ... 31.2 V
Polarity reversal protection	yes

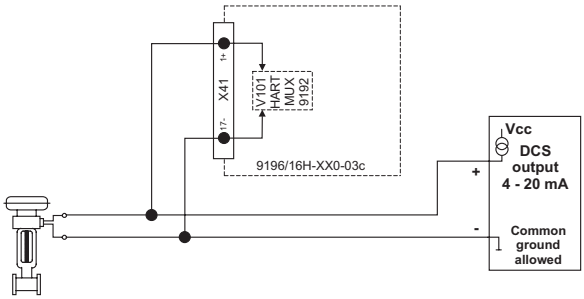


11200E00

Connection Drawings



11338E03



11339E03

For interfacing between the HART multiplexer type 9192 and HART field devices

- Cost and space saving system for HART
- Simple installation on DIN rail
- Processing of 4 ... 20 mA non I.S. signals
- Approved for installation in Division 2 and Zone 2

Technical Tips For 32 channels, connect two termination boards together. For I.S. signals, connect to the HART field devices via zener barriers or galvanic isolators.

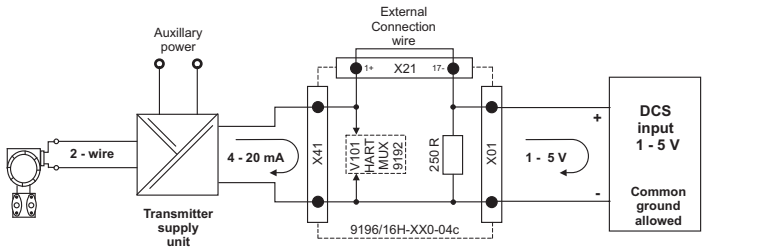
Order Code	Channels	Application	Signal to the automation system
9196/16H-XX0-03c	16	2-, 3- or 4-wire transmitter; positioner	4 ... 20 mA

Technical Specifications	
Field Device Side	
Connection	to isolators / barriers or non I.S. field devices via removable terminal, connected in parallel to the field device / PLC, input or output. See accessories section for order code.

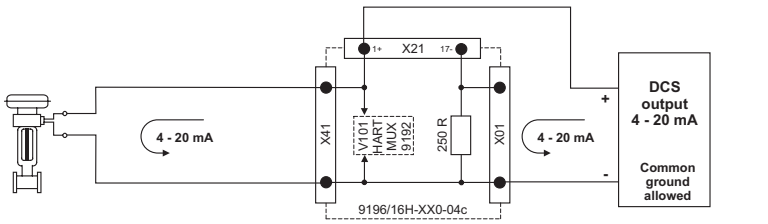
Technical Specifications	
Automation System Side	
Power Supply	
Nominal voltage V_{nom}	24 V DC
Voltage range	19 V ... 31.2 V
Polarity reversal protection	yes


11200E00

Connection Drawings



05674E03



05675E03

For interfacing between the HART multiplexer type 9192 and HART field devices

- Cost and space saving system for HART
- Simple installation on DIN rail
- Processing of 4 ... 20 mA non I.S. signals
- Approved for installation in Division 2 and Zone 2

Technical Tips For 32 channels, connect two termination boards together. For I.S. signals, connect to the HART field devices via zener barriers or galvanic isolators.

Order Code	Channels	Application	Signal to the automation system
9196/16H-XX0-04c	16	2-, 3- or 4-wire transmitter; positioner	1 ... 5 V

Technical Specifications

Field Device Side

Connection	to isolators / barriers or non I.S. field devices via integrated screw terminal

Technical Specifications

Automation System Side

Connection	to the automation system via integrated screw terminal
Power Supply	
Nominal voltage V_{nom}	24 V DC
Voltage range	19 V ... 31.2 V
Polarity reversal protection	yes

Accessories and Spare Parts

Order Code	Designation	Description	Weight lb (kg)
9190901850	Labeling sheet DIN A4	180 labels	0.002 (0.001)
5196040	Screw terminal	green	0.002 (0.001)
5196030		black	0.002 (0.001)
5196050		blue	0.011 (0.005)
5197940	Screw terminal with test plug socket	black	0.002 (0.001)
5197930		blue	0.002 (0.001)
5196120	Spring clamp terminal	green	0.011 (0.005)
5196110		black	0.011 (0.005)
5196130		blue	0.011 (0.005)
9191/20-00-00	Dummy module	for connection of unused cables	0.132 (0.060)
9199/20-01	ISpac Wizard Software with cable	commissioning, configuration and diagnosis of the ISpac Isolators 9146, 9162 and 9182 Series, system requirements: • IBM compatible PC with MS Windows 98, NT, 2000, XP • CD-ROM drive • RS 232 C interface	0.448 (0.203)
3296050	Resistor coupling element	two resistors in parallel and series in one piece to enable open and short circuit detection when using a simple dry contact with the 9146 and 9170 Series	0.022 (0.010)
8560/51-4041	Fuse	63 mA back-up fuse for use with 9164/13-22-09 and non I.S. transmitters	0.463 (0.210)
8560/51-4153			0.463 (0.210)
	Cold Junction Compensation (with 2-wire PT100)	for high accuracy temperature measurement when using thermocouples with the 9182 Series	
9191/VS-03		DIN rail mounting terminal for single channel 9182	0.002 (0.001)
9191/VS-04		DIN rail mounting terminal for dual channel 9182	0.002 (0.001)
9191/VS-05		integral within screw terminal for either single or dual channel 9182	0.002 (0.001)
	Sub-D connector	RS 485 connection onto 9185 Series Termination resistors are built in and can be switched on or off.	
9490002220		for Division 1 / Zone 1 location connection	0.002 (0.001)
3157710		for Division 2 / Zone 2 or nonhazardous location connection	0.002 (0.001)
	16-pin screw terminal	removable terminals for use with the HART Termination Board type 9196/...-...-03c, two terminals per board required	
5197810		horizontal wire connection	0.002 (0.001)
5197820		vertical wire connection	0.002 (0.001)

Explosion Protection

Product		NEC and CEC (check datasheet where approved)	ATEX
All ISpac isolators except where noted below	Installation in	Class I, Division 2, Class I, Zone 2 and Nonhazardous Location	Zone 2 and Safe Area
	Interface to	Class I, II, III, Division 1, Class I, II, III, Zone 0	Zone 0
		NI/1/2/ABCD/T4, AIS/I, II, III/1/ABCDEFG I/2[0]/AEx nAnC [ia] /IIC	II 3 G EEx nAC II T4, II (1) GD [EEx ia] IIC / IIB
9143/10-065-150-.0. 9143/10-065-200-.0. 9143/10-104-220-.0. 9143/10-114-200-.0. 9143/10-124-150-.0. 9143/10-156-065-.0. 9143/10-187-050-.0.	Installation in	Class I, Division 2, Class I, Zone 2 and Nonhazardous Location	Zone 2 and Safe Area
	Interface to	Class I, II, III, Division 1, Class I, II, III, Zone 1	Zone 1
		NI/1/2/ABCD/T4, AIS/I, II, III/1/ABCDEFG NI/2/IIC/T4, I/1/[AEx ib] /IIC	II 3 G EEx nA II T4, II (2) GD [EEx ib] IIC /IIB
9143/10-156-160-.0. 9143/10-244-035-.0. 9143/10-244-060-.0.	Installation in	Class I, Division 2, Class I, Zone 2 and Nonhazardous Location	Zone 2 and Safe Area
	Interface to	Class I, II, III, Division 1, Class I, II, III, Zone 1	Zone 1
		NI/1/2/ABCD/T4, AIS/I, II, III/1/CDEFG NI/2IIC/T4, I/1/[AEx ib] /IIB	II 3 G EEx nA II T4, II (2) GD [EEx ib] IIB
9164/13-22-08	Installation in	Class I, Division 1, Class I, Zone 1	Zone 1 and Safe Area
	Interface to	Class I, II, III, Division 1, Class I, II, III, Zone 0	Zone 0
		IS/I, II, III/1/ABCDEFG/T4 I/1/AEx ia/IIC	II 2 G (1) GD EEx ia IIC T4
9164/13-22-09	Installation in	--	Zone 1 and Safe Area
	Interface to	--	Zone 0
			II 2G (1) GD EEx e mb [ia] IIC T4
9170/..-12-11. 9170/..-..-21.	Installation in	Nonhazardous Location	Safe Area
	Interface to	Class I, II, III, Division 1, Class I, II, III, Zone 0	Zone 0
		AIS/I, II, III/1/ABCDEFG I/0/[AEx ia]/IIC	II (1) GD [EEx ia] IIC / IIB
9172/.1-11-00. Contact loads > 125 V AC, 4 A 125 V DC, 0.25 A 60 V DC, 0.8 A 30 V DC, 4 A	Installation in	Nonhazardous Location	Safe Area
	Interface to	Class I, II, III, Division 1, Class I, II, III, Zone 0	Zone 0
		AIS/I, II, III/1/ABCDEFG I/0/[AEx ia]/IIC	II (1) GD [EEx ia] IIC / IIB
9175/20-16-11. 9176/20-16-00. (outputs connected in parallel)	Installation in	Class I, Division 2, Class I, Zone 2 and Nonhazardous Location	Zone 2 and Safe Area
	Interface to	Class I, II, III, Division 1, Class I, II, III, Zone 0	Zone 0
		NI/1/2/ABCD/T4, AIS/I, II, III/1/CDEFG I/2[0]/AEx nAnC [ia] /IIB	II 3 G EEx nAC II T4, II (1) GD [EEx ia] IIB
9185/11-35-10.	Installation in	Class I, Division 2, Class I, Zone 2 and Nonhazardous Location	Zone 2 and Safe Area
	Interface to	Class I, II, III, Division 1, Class I, II, III, Zone 1	Zone 1
		NI/1/2/ABCD/T4, AIS/I, II, III/1/ABCDEFG NI/2/IIC/T4, I71/[AEx ib] /IIC	II 3 G EEx nA II T4, II (2) GD [EEx ib] IIC/IIB
9185/12-45-10 9192 9193 9194 9195 9196	Installation in	Class I, Division 2, Class I, Zone 2 and Nonhazardous Location	Zone 2 and Safe Area
	Interface to	Class I, Division 2, Class I, Zone 2 and Nonhazardous Location	Zone 2 and Safe Area
		NI/1/2/ABCD/T4 NI/2/IIC/T4	II 3 G EEx nA II T4, II (2) GD [EEx ib] IIC / IIB
9186/12-11-11	Installation in	Class I, Division 2, Class I, Zone 1 and Nonhazardous Location	Zone 1
	Interface to	Class I, II, III, Division 1, Class 1, Zone 0	Zone 0
		NI/1/2/ABCD/T4, AIS/I, II, III/1/ABCDEFG I/1[0]/Ex e m ib [ia op is] IIC T4	II 2 G (1) GD Ex e m b ib [ia, op is] IIC T4
9186/.5-12-11	Installation in	Class I, Zone 2 and Nonhazardous Location	Zone 2 and Safe Area
	Interface to	Class I, Zone 2	Zone 0
		AEx nC IIC	II (1) GD [Ex op is] IIC II 3 G Ex nAC IIT4X

Certificate Numbers

Product	FM	FM for Canada (cFM)	CSA	UL	ATEX
9143	3024718	--	--	--	BVS 05 ATEX E 152 X
9146	3017145	3027620C	--	--	BVS 05 ATEX E 0171 X
9160	3017145	---	1570027	E81680	DMT 03 ATEX E 0171 X
9162	3017145	3027620C	--	--	FM 06 ATEX 0008 X
9163	3017145	--	1570027	E81680	BVS 04 ATEX E 127 X
9164/13-22-08	3022545	--	--	--	KEMA 04 ATEX 1298
9164/13-22-09	--				KEMA 04 ATEX 1236 X
9165	3017145	---	1570027	E81680	DMT 03 ATEX E 012 X
9167	3017145	---	1570027	E81680	BVS 04 ATEX E 082 X
9170	3017145	---	1570027	E81680	DMT 02 ATEX E 195 X
9172	3017145	---	1570027	E81680	BVS 04 ATEX E 097 X
9175	3017145	---	1570027	E81680	DMT 03 ATEX E 043 X
9176	3017145	---	1570027	E81680	BVS 04 ATEX E 075 X
9180	3017145	3027620C	---	---	BVS 05 ATEX E 176 X
9182	3017145	---	1570027	E81680	DMT 02 ATEX E 243 X
9185	3017145	---	1570027	---	DMT 02 ATEX E 246 X
9186/12-11-11	3017145	3027620C	---	---	BVS 06 ATEX E 145 X
9186/.5-12-11	---	---	---	E81680	BVS 07 ATEX E 068 X
9192	3017145	---	1570027	---	BVS 03 ATEX E 213 X
9193	3017145	---	1570027	---	BVS 03 ATEX E 213 X
9194	3017145	---	1570027	---	BVS 03 ATEX E 213 X
9195	3017145	---	1570027	---	BVS 03 ATEX E 213 X
9196	3017145	---	1570027	---	BVS 03 ATEX E 213 X

Control Drawings

Product	FM	FM for Canada (cFM)	CSA	UL	ATEX
9143	91 436 01 31 1	---	---	---	---
9146	9146 6 031 001 1	9146 6 031 001 1	---	---	---
9160	91 906 01 31 1	---	91 606 01 31 2	91 906 01 31 3	---
9162	9162 6 031 001 1	9162 6 031 001 1	---	---	---
9163	91 906 01 31 1	---	91 636 01 31 2	91 906 01 31 3	---
9164/13-22-08	91 906 01 31 1	---	---	---	---
9165	91 906 01 31 1	---	91 656 01 31 2	91 906 01 31 3	---
9167	91 906 01 31 1	---	91 676 01 31 2	91 906 01 31 3	---
9170	91 906 01 31 1	---	91 706 01 31 2	91 906 01 31 3	---
9172	91 906 01 31 1	---	91 726 01 31 2	91 906 01 31 3	---
9175	91 906 01 31 1	---	91 756 01 31 2	91 906 01 31 3	---
9176	91 906 01 31 1	---	91 766 01 31 2	91 906 01 31 3	---
9180	91 906 01 31 1	9180 6 031 001 1	---	---	---
9182	91 906 01 31 1	---	91 826 01 31 2	91 906 01 31 3	---
9185	91 906 01 31 1	---	91 856 01 31 2	---	---
9186/12-11-11	9186 6 031 001 1	9186 6 031 001 1	---	---	---
9186/.5-12-11	---	---	---	---	---
9192	91 906 01 31 1	---	91 926 01 31 2	91 906 01 31 3	---
9193	91 906 01 31 1	---	91 936 01 31 2	91 906 01 31 3	---
9194	91 906 01 31 1	---	91 956 01 31 2	91 906 01 31 3	---
9195	91 906 01 31 1	---	91 956 01 31 2	91 906 01 31 3	---
9196	91 906 01 31 1	---	91 926 01 31 2	91 906 01 31 3	---

Cable Parameters

Product	NEC / ATEX		CEC	
	C_a µF	L_a mH	C_a µF	L_a mH
9143/10-065-150-.0.	25	1.43	Not Approved	Not Approved
9143/10-065-200-.0.	25	0.82	Not Approved	Not Approved
9143/10-104-220-.0.	2.4	0.24	Not Approved	Not Approved
9143/10-114-200-.0.	1.64	0.16	Not Approved	Not Approved
9143/10-124-150-.0.	1.24	0.17	Not Approved	Not Approved
9143/10-156-065-.0.	0.497	0.445	Not Approved	Not Approved
9143/10-156-160-.0.	3.03	0.351	Not Approved	Not Approved
9143/10-187-050-.0.	0.27	0.06	Not Approved	Not Approved
9143/10-244-035-.0.	0.88	26.3	Not Approved	Not Approved
9143/10-244-060-.0.	0.88	0.543	Not Approved	Not Approved
9146	2.41	63	2.41	63
9160	0.09	2.3	0.089	2.25
9162	0.09	2.3	0.09	2.3
9163	Negligible	Negligible	Negligible	Negligible
9164/13-22-08	Negligible	Negligible	Negligible	Negligible
9164/13-22-09	Negligible	Negligible	Negligible	Negligible
9165	0.0103	1.9	0.0103	1.92
9167/.1-11-00.	0.487	10	0.487	10
9167/.1-13-00.	0.11	2.5	0.11	2.5
9167/.1-14-00.	0.266	3	0.266	3
9170	2.32	63	2.32	30.8
9172	Negligible	Negligible	Negligible	Negligible
9175/.0-12-11.	1.79	6.3	1.79	3.1
9175/.0-14-11.	0.235	1.5	0.235	0.79
9175/.0-16-11.	0.085	1.2	0.085	1.4
9176/.0-12-00.	1.79	6.3	1.79	3.1
9176/.0-14-00..	0.235	1.5	0.235	0.79
9176/.0-16-00.	0.085	1.2	0.085	1.4
9180	25	120	25	120
9182	25	90	25	45
9185/11-35-10.	100	1.3	100	0.8
9186/12-11-11	100	1.3	100	1.3
9186/.5-12-11	Negligible	Negligible	Negligible	Negligible

Technical Specifications

Electromagnetic compatibility	tested under the following standards and regulations: EN 61326 (IEC/EN 61000-4-1 ... 6 and 11; EN 55022 Class B) and where applicable NAMUR NE 21 (IEC/EN 61000-4-1 ... 6, 8 and 11; EN 55022 Class B)	
Ambient conditions	please check instruction manual for more details with respect to specific mounting arrangements.	
	ambient temperature	- 4 °F ... + 158 °F (- 20 °C ... + 70 °C)
	storage temperature	- 40 °F ... + 176°F (- 40 °C ... + 80 °C)
	relative humidity (no condensation)	≤ 95 %
Weight		approx. lb (kg)
	All isolators except where listed below	0.353 (0.160)
	9143	0.375 (0.170)
	9164	0.254 (0.115)
	9185	0.452 (0.205)
	9186	0.200 (0.441)
	9192	0.375 (0.170)
	9193	0.243 (0.110)
	9194	0.009 (0.004)
	9195/08.-...-...	0.705 (0.320)
	9195/16.-...-...	1.344 (0.610)
	9196/...-...-01c	0.793 (0.360)
	9196/...-...-03c	0.309 (0.140)
	9196/...-...-04c	0.793 (0.360)

Mechanical Data

Removable Connection Terminals

All the ISpac isolators have three types of removable terminals available for connection of the system wiring.

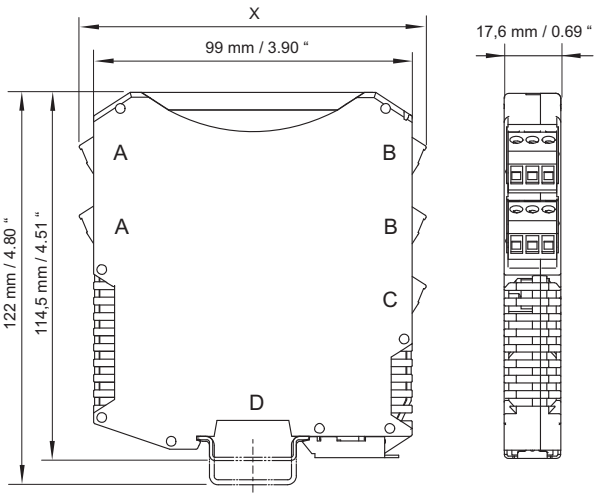
	Add to the isolator ordering code	
Screw terminals	s	i.e. 91../..-..-..**s**
Spring clamp terminals	k	i.e. 91../..-..-..**k**

Cable Connection Size

Single wire:	**Solid**	**Stranded**	**Stranded with ferrule**
Screw terminals	24 ... 14 AWG (0.2 ... 2.5 mm^2)	24 ... 14 AWG (0.2 ... 2.5 mm^2)	22 ... 14 AWG (0.25 ... 2.5 mm^2)
Spring clamp terminals	24 ... 14 AWG (0.2 ... 2.5 mm^2)	24 ... 14 AWG (0.2 ... 2.5 mm^2)	22 ... 14 AWG (0.25 ... 2.5 mm^2)
Two wires:			
Screw terminals	24 ... 16 AWG (0.2 ... 1 mm^2)	24 ... 16 AWG (0.2 ... 1.5 mm^2)	22 ... 16 AWG (0.25 ... 1 mm^2)
Spring clamp terminals	- -	- -	20 ... 16 AWG (0.5 ... 1 mm^2)

Torque specification	screw terminals min: 4.43 lb / inch (0.5 Nm) max: 5.31 lb / inch (0.6 Nm)
Mounting type	on DIN rail acc. to EN 50022 (NS35/15; NS35/7.5) or in pac-Carrier
Mounting position	horizontal or vertical
Casing protection class	IP 30
Terminal protection class	IP 20
Casing material	PA 6.6
Fire protecting class (UL-94)	V0
9164	
Enclosure material	Polyamide 6 GF
Degree of Protection	according to IEC 60529

Dimension Drawings - subject to alterations



For all drawings	x
Screw terminals	4.25" (108 mm)
Spring clamp terminals	5.04" (118 mm)

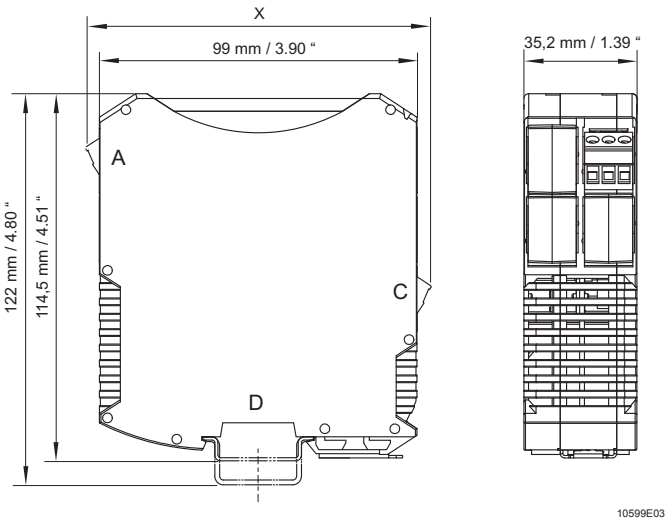
A Blue terminals - connection to hazardous location

B Black terminals - connection to nonhazardous location

C Green terminals - connection to power supply (unless loop powered)

D pac-Bus - power supply connection (24 V DC versions)

All IS Pac units except where shown below

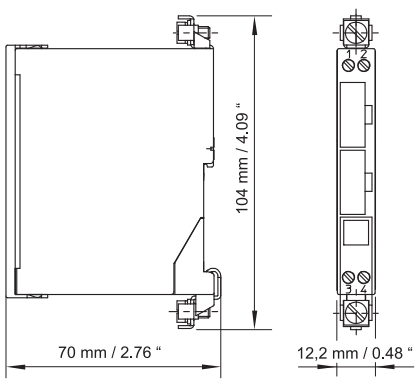


A Blue terminals - connection to hazardous location

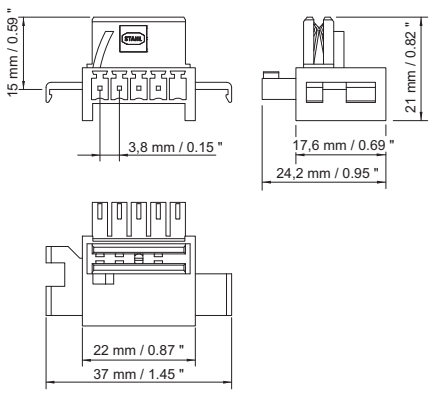
C Green terminals - connection to nonhazardous location

D pac-Bus - power supply connection (DC power supply versions only)

9143 Power Supply

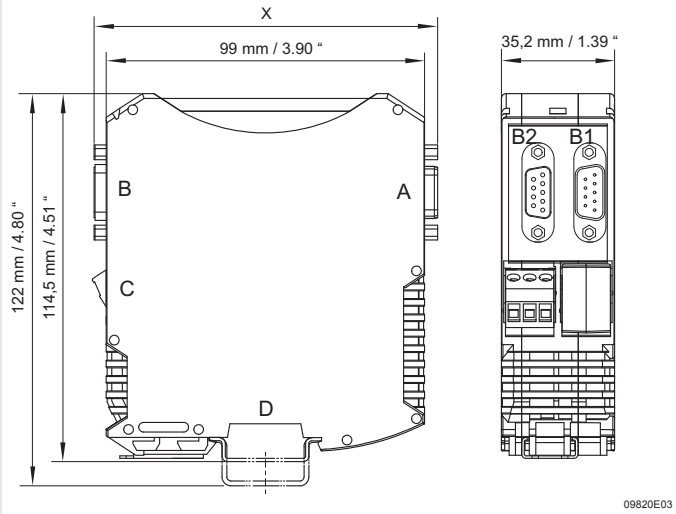


9164 mA Isolating Repeater



9194/31-17 pac-Bus

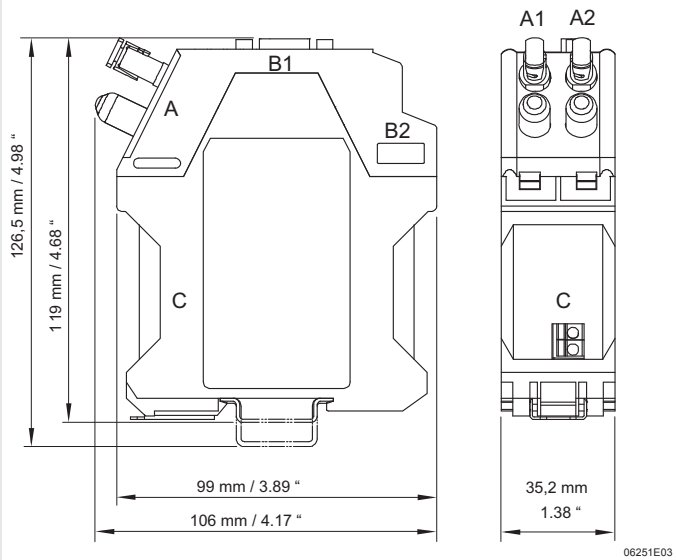
Dimension Drawings - subject to alterations



For all drawings	x
Screw terminals	4.25“ (108 mm)
Spring clamp terminals	5.04“ (118 mm)

A	RS 485 connection to field device
B1	RS 232 connection
B2	RS 485 / RS 422 connection
C	Green terminals - connection to power supply
D	pac-Bus power supply connection

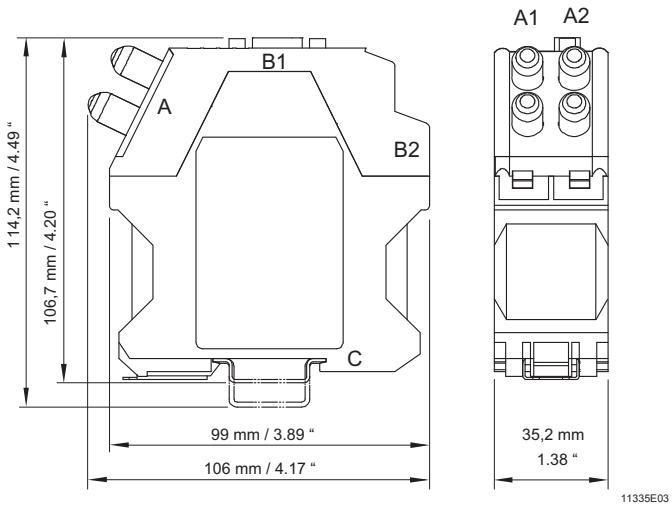
9185 Fieldbus



A1	Fiber optic connection A
A2	Fiber optic connection B
B1	RS 485 connection
B2	Blue terminals - line fault and screen connection
C	Black terminals - power supply connection

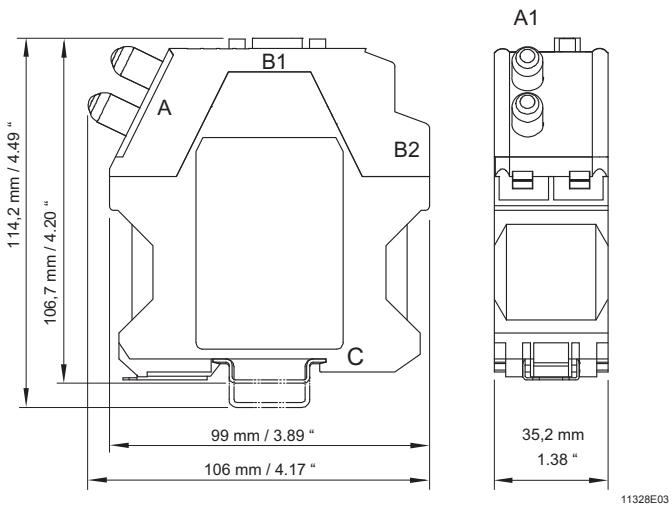
9186/12-11-11 Fiber Optic Fieldbus Isolation Repeater - I.S. Version

Dimension Drawings - subject to alterations



A1	Fiber optic connection A
A2	Fiber optic connection B
B1	RS 485 connection
B2	Green terminals - line fault and power supply connection
C	Screen (PA) connection via DIN rail

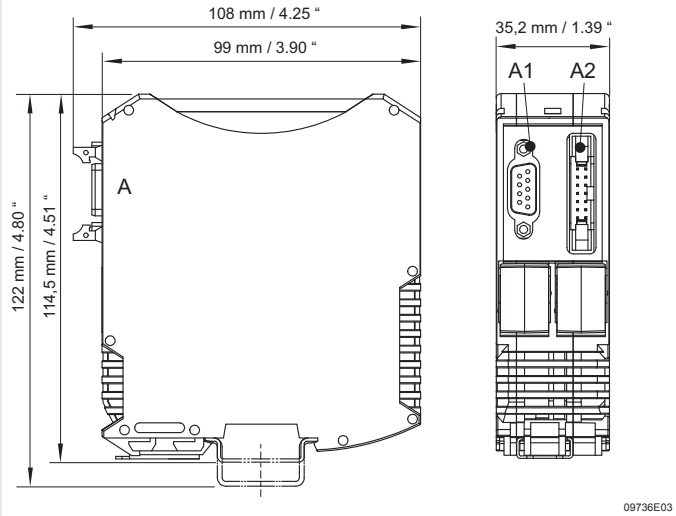
9186/15-12-11 Fiber Optic Fieldbus Isolation Repeater - Zone 2 Version



A1	Fiber optic connection A
B1	RS 485 connection
B2	Green terminals - line fault and power supply connection
C	Screen (PA) connection via DIN rail

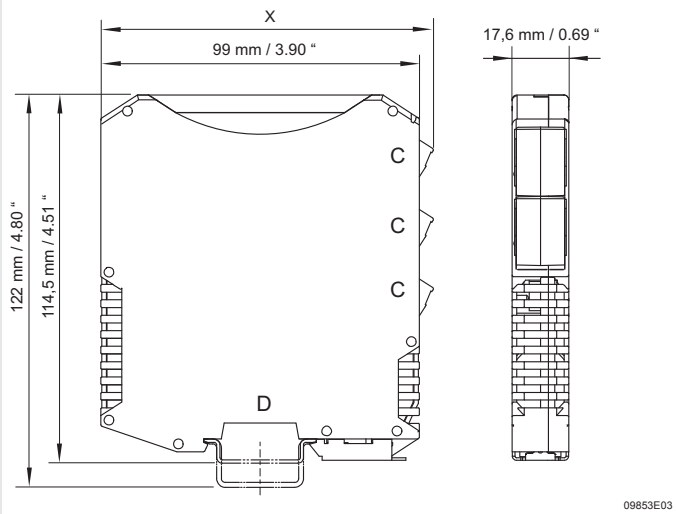
9186/25-12-11 Fiber Optic Fieldbus Isolation Repeater - Zone 2 Version

Dimension Drawings - subject to alterations



A1	RS 485 connection
A2	Ribbon cable connection to 9196

9192 HART Multiplexer



For 9193	x
Screw terminals	4.09" (104 mm)
Spring clamp terminals	4.49" (114 mm)

C	Green terminals - connection to nonhazardous location
D	pac-Bus power supply connection

9193 Power Feed Module

Contents

References

Source	Document	Title
American National Standards Institute (ANSI) 11 West 42nd Street New York, NY 10036 Tel: (212) 642-4900 www.ansi.org	C34.1	Voltage Ratings for Electrical Power Systems and Equipment (60 Hz)
American Petroleum Institute (API) 1220 L Street, NW Washington, DC 20005 Tel.: (202) 682-8000	RP 500	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2.
	RP505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2.
Canadian Standards Association (CSA) 178 Rexdale Boulevard Etobicoke, Ontario M9W 1R3 Tel.: (416) 747-4000 www.csa.ca	C22.1, Part 1	Canadian Electrical Code
	C22.2, No. 157	Intrinsically Safe and Nonincendive Equipment for use in Hazardous Locations
	C22.2, No. 174	Cables and Cable Glands for use in Hazardous Locations
	C22.2, No. 213	Nonincendive Electrical Equipment for use in Class I, Division 2 Hazardous Locations
Factory Mutual Research Corporation (FM) 1151 Boston-Providence Turnpike Norwood, MA 02062 Tel.: (781) 762-4300 www.factorymutual.com	Approval Standard Class No. 3600	Electircal Equipment for use in Hazardous (Classified) Locations, General Requirements
	Approval Standard Class No. 3610	Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, II, and III, Division 1 Hazardous Locations
	Approval Standard Class No. 3611	Electrical Equipment for use in Class I, Division 2, Class II, Division 2 and Class III, Divisions 1 and 2 Hazardous Locations
Instrument Society of America (ISA) 67 Alexander Drive P.O. Box 12277 Research Triangle Park, NC 27709 Tel.: (919) 549-8411 www.isa.org	ISA-S5.1	Instrumentation Symbols and Identification
	ISA-S12.0.01 (IEC 79-0 Mod)	Electrical Apparatus for use in Class I, Zones 0 and 1, Hazardous (Classified) Locations: General Requirements
	ISA-S12.01.01	Definitions and Information Pertaining to Electrical Apparatus in Hazardous (Classified) Locations
	ISA-dS12.2.01 (IEC 79-11 Mod)	Electrical Apparatus for use in Class I, Zones 0, 1, and 2 Hazardous (Classified) Locations: Type of Protection - Intrinsic Safety “i“
	ISA-RP12.2.02	Recommendations for the Preparation, Content, and Organization of Intrinsic Safety Control Drawings
	ISA-RP12.6	Wiring Practices for Hazardous (Classified) Locations Instrumentation Part I: Intrinsic Safety
	ISA-S12.12	Electrical Equipment for use in Class I, Division 2 Hazardous (Classified) Locations
	ISA-dS12.12.01 (IEC 79-15 Mod)	Electrical Apparatus for use in Class I, Zone 2 Hazardous (Classified) Locations: Type of Protection - “n“
	ISA-RP12.24.01 (IEC 79-10 Mod)	Recommended Practice for Classification of Locations for Electrical Installations Classified as Class I, Zone 0, Zone 1, or Zone 2
	ISA-S51.1	Process Instrumentation Terminology

References

Source	Document	Title
International Electrotechnical Commission (IEC) available from ANSI	60079-0	Electrical Apparatus for Explosive Gas Atmospheres: General Requirements
	60079-10	Classification of Hazardous Areas
	60079-11	Intrinsic Safety, Type of Protection 'i'
	60079-15	Electrical Apparatus, Type of Protection 'n'
	60079-17	Inspection and Maintenance of Electrical Installations in Hazardous Areas (other than Mines)
National Electrical Manufacturers Association (NEMA) 1300 North 17th Street Suite 1847 Rosslyn, VA 22209 Tel.: (703) 841-3200 www.nema.org	ICS 6	Enclosures for Industrial Controls and Systems
	No. 250	Enclosures for Electrical Equipment
National Fire Protection Association (NFPA) P.O. Box 9146 Quincy, MA 02269	No. 70	National Electrical Code
Underwriters Laboratories Inc. (UL) 333 Pfingston Road Northbrook, IL 60062 Tel.: (847) 272-8800 www.ul.com	UL 913	Standard for Intrinsically Safe Apparatus for use in Class I, II, and III, Division 1, Hazardous (Classified) Locations
	UL1604	Electrical Equipment for use in Hazardous (Classified) Locations, Class I and II, Division 2, and Class III, Divisions 1 and 2 Hazarous (Classified) Locations

Glossary

Definitions

ATEX	A product that has been evaluated by a European approved notified body in accordance with the ATEX directive.
Approved	Acceptable to the authority having jurisdiction.
Arcing Device	A device, such as make / break component, that under normal conditions produces an arc with energy sufficient to cause ignition of an ignitable mixture. See also “nonincendive circuit.“
Associated Apparatus	Apparatus in which the circuits are not intrinsically safe themselves but affect the energy in the intrinsically safe circuits and are relied upon to maintain intrinsic safety. An example being an intrinsic safety barrier.
Associated Nonincendive Field Wiring Apparatus	Apparatus in which the circuits are not necessarily nonincendive themselves but that affect the energy in nonincendive field wiring circuits and are relied upon to maintain nonincendive energy levels.
Authority Having Jurisdiction	The organization, office, or individual that has the responsibility and authority for approving equipment, installations, or procedures.
Automation System	The system which provides overall control and monitoring functions of a specific process or application. Generally consists of a network of computers, controllers, and I/O modules.
Barrier Specification	The typical way of describing a barrier, for example 28 V 300 Ω 93 mA. This is a reference to the maximum voltage of the terminating zener diode during the period of time it takes for the fuse to break, the minimum value of the terminating resistor and the resulting maximum short circuit current. The description does not refer to the working voltage or the end-to-end resistance, but is purely an indication of the potential fault energy that could be generated in the hazardous area.
CSA	A product that has been evaluated by CSA International in accordance with Canadian codes and standards.
Capacitance	The property of a system of conductors and dielectrics that permits the storage of electrically separated charges when potential differences exist between the conductors. The greater the capacitance, the greater the charge that can be stored. The practical difference between capacitance and inductance in an intrinsically safe circuit is minimal. Both store energy but a capacitor will release energy when a circuit is made and an inductor will release energy when the circuit is broken.
Certified Equipment	Equipment that has been evaluated by a recognized testing agency and confirmed to be in compliance with the applicable standard(s).
Channel	An ungrounded conductor in a grounded intrinsically safe circuit, or a conductor and its reference in galvanically isolated intrinsically safe circuit.
Class I, Division 1 Location	A location (1) in which ignitable concentrations of flammable gases or vapors can exist under normal operating conditions; (2) in which ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or (3) in which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors and might also cause simultaneous failure of electrical equipment that could act as a source of ignition.
Class I, Division 2 Location	A location (1) in which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; (2) in which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation and might become hazardous through failure or abnormal operation of the ventilating equipment; or (3) that is adjacent to a Class I, Division 1 location and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure provided. Electrical conduits and their associated enclosures separated from process fluids by a single seal or barrier are classified as a Class I, Division 2 location if the outside of the conduit and enclosure is a nonhazardous (unclassified) location.
Class II Location	A location that is hazardous because of the presence of combustible dust.

Glossary	
Class II, Division 1 Location	A location (1) in which combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures; (2) in which mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced and might also provide a source of ignition through simultaneous (the word “simultaneous“ is not included in the Canadian definition) failure of electric equipment, operation of protection devices, or from other causes; or (3) in which combustible dusts of an electrically conductive nature may be present in hazardous quantities.
Class II, Division 2 Location (United States)	A location in which combustible dust is not normally in the air in quantities sufficient to produce explosive or ignitable mixtures and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but combustible dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment and where combustible dust accumulations on, in, or in the vicinity of the electrical or may be ignitable by abnormal operation or failure of electrical equipment.
Class II, Division 2 Location (Canada)	A location in which combustible dusts are normally in suspension in air likely to be thrown into suspension by the normal or abnormal operation or the failure of equipment or apparatus in quantities sufficient to produce explosive or ignitable mixtures, but in which: a) deposits or accumulations of dust may be sufficient to interfere with the safe dissipation of heat from electrical equipment or apparatus; or b) deposits or accumulations of dust on, in, or near electrical equipment may be ignited by arcs, sparks, or burning material from the electrical equipment.
Class III Location	A location that is hazardous because of the presence of easily ignitable fibers or flyings but in which such fibers or flyings are not likely to be in suspension in the air in quanities sufficient to produce ignitable mixtures.
Class III, Division 1 Location	A location in which easily ignitable fibers or materials producing flyings are handled, manufactured or used.
Class III, Division 2 Location	A location in which easily ignitable fibers are stored or handled (except in the process of manufacture).
Clearance Distance	The shortest distance measured in air between conductive parts.
Code of Practice	An international term referring to a document that describes basic safety features and methods of protection and recommends the selection, installation, and maintenance procedures that should be followed to ensure the safe use of electrical apparatus.
Control Drawing	A drawing or other document provided by the manufacturer of the intrinsically safe or associated apparatus, or of the nonincendive field wiring apparatus or associated nonincendive field wiring apparatus, that details the allowed interconnections between the intrinsically safe and associated apparatus or between the nonincendive field wiring apparatus or associated nonincendive field wiring apparatus.
Corrective Maintenance	Any maintenance activity that is not normal in the operation of equipment and requires access to the equipment’s interior. Such activities are expected to be performed by qualified personnel who are aware of the hazards involved. Such activities typically include locating causes of faulty performance, replacement of defective components, adjustment of internal controls, and the like.
Dust, Combustible	Dust that (when mixed with air in certain proportions) can be ignited and will propagate a flame. The combustible properties of dust are dependent upon test conditions and dust particle size, chemical structure, and other particle characteristics.
Dust-ignitionproof	A term used in the United States to describe an enclosure that will exclude ignitable amounts of dusts that might affect performance or rating and that, when installed and protected in accordance with the original design intent, will not permit arcs, sparks, or heat otherwise generated or liberated inside the enclosure to cause ignition of exterior accumulations or atmospheric suspensions of a specified dust.
Dust layer, Combustible	Any surface accumulation of combustible dust that is thick enough to propagate flame or will degrade and ignite.
Dust-protected Enclosure	An international term describing an enclosure in which the ingress of dust is not totally prevented, but dust does not enter in sufficient quantity to interfere with the safe operation of the equipment or accumulate in a position within the enclosure where it is possible to cause an ignition hazard.
Dust-tight	An enclosure so constructed that dust will not enter the enclosing case under specified test conditions.

Glossary

Encapsulation	An international term describing a type of protection in which the parts that could ignite an explosive atmosphere by either sparking or heating are enclosed in an encapsulant in such a way that this explosive atmosphere cannot be ignited. This type of protection is referred to by CENELEC as “Ex m“ in draft Standard EN50028.
End-to-End Resistance	The resistance between both ends of a barrier channel. It is the sum of the resistor itself and the resistance of the fuse at an ambient temperature of 20 °C (68 °F).
Entity Concept	The entity concept provides more flexibility in selecting equipment to form an intrinsically safe system. The entity concept allows the user to identify acceptable combinations of intrinsically safe apparatus and associated apparatus that have not been examined as a system.
Entity Evaluation	A method used to determine acceptable combinations of intrinsically safe apparatus and connected associated apparatus that have not been investigated in such combination.
Entity Parameters	The four categories that are set by the certification agency in order to properly match the intrinsic safety barrier to the hazardous area instrument. These four parameters are voltage, current, capacitance and inductance.
Explosionproof Enclosure	An enclosure that is capable of withstanding an explosion of a gas or vapor within it and of preventing the ignition of an explosive gas or vapor that may surround it and that operates at such an external temperature that a surrounding explosive gas or vapor will not be ignited thereby. This type of enclosure is similar to a flameproof enclosure.
Explosionproof Equipment (apparatus)	Equipment or apparatus enclosed in an explosionproof enclosure.
FM	A product that has been evaluated by FM approvals in accordance with U.S. codes and standards.
$_{c}$FM	A product that has been evaluated by FM approvals in accordance with Canadian codes and standards.
$_{c}$FM$_{US}$	A product that has been evaluated by FM approvals in accordance with U.S. and Canadian codes and standards.
Fault (as applicable to intrinsically safe systems)	A defect or electrical breakdown of any component, spacing, or insulation that alone or in combination with other defects or breakdowns may adversely affect the electrical or thermal characteristics of the intrinsically safe system. If a defect or breakdown leads to defects or breakdowns in other components, the primary and subsequent defects and breakdowns are considered to be a single fault. Certain components may be considered not subject to fault when analyses or tests for intrinsic safety are made.
Fibers and Flyings, easily ignitable	Fibers and flyings that are easily ignitable including rayon, cotton (including cotton linters and cotton waste), sisal or henequen, jute, hemp, tow, cocoa fiber, oakum, baled waste kapok, Spanish moss, excelsior, and other materials of similar nature.
Flameproof Enclosure	An international term describing an enclosure that can withstand the pressure developed during an internal explosion of an explosive mixture and that prevents the transmission of the explosion to the explosive atmosphere surrounding the enclosure and that operates at such an external temperature that a surrounding explosive gas or vapor will not be ignited thereby. This enclosure is similar to an explosionproof enclosure. This type of protection is referred to by IEC as “Ex d.“
Galvanic Isolation	A form of isolation which meets stringent standards for intrinsically safe circuits.
Ground	A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth or to some conducting body that serves in place of the earth.
Grounding Device	An impedance device used to connect conductors of an electric system to ground for the purpose of controlling the ground current or voltages to ground, or a nonimpedance device used to temporarily ground conductors for the purpose of the safety of workmen. The grounding device may consist of a grounding transformer or a neutral grounding device, or a combination of these. Protective devices, such as surge arresters, may also be included as an integral part of the device.
Group	A classification of flammable materials of similar hazard. Consists of Groups A, B, C, D, E, F and G to NEC and CEC standards and Groups I, IIA, IIB, and IIC to IEC standards.
Group A	Acetylene Atmospheres
Group B	Atmospheres containing Butadiene, ethylene oxide, propylene oxide, acrolein, or hydrogen (or gases or vapors of equivalent hazard to hydrogen, such as manufactured gas.)

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Group C	Atmospheres containing Cyclopropane, ethyl ether, ethylene, hydrogen sulfide, or gases or vapors of equivalent hazard.
Group D	Atmospheres such as acetone, alcohol, ammonia, benzine, benzol, butane, gasoline, hexane, lacquer solvent vapors, methane, naphtha, natural gas, propane, or gases or vapors of equivalent hazards.
Group E	Atmospheres containing combustible metal dusts regardless of resistivity or other combustible dusts of similarly hazardous characteristics having resistivity of less than 10^2 ohm-centimeter (magnesium, aluminum, bronze powder, etc.)
Group F	Atmospheres containing carbon black, charcoal, coal, coke dusts that have more than 8% total volatile material (coal and coke dusts per ASTM 3175-82) or atmospheres containing these dusts sensitized by other materials so that they present an explosion hazard and having resistivity greater than 10^2 ohm-centimeter but equal to or less thn 10^8 ohm-centimeter.
Group G	Atmospheres containing combustible dusts (flour, starch, pulverized sugar and cocoa, dairy powders, dried hay, etc.) having resistivity of less than 10^8 ohm-centimeter or greater.
Group I	Below ground installations in which methane may be present.
Group IIA	Above ground installations with propane or equal atmospheres. This group most closely matches Group D in the United States and Canadian classifications.
Group IIB	Above ground installations with ethylene or equal atmospheres. This group most closely matches Group C in the United States and Canadian classifications.
Group IIC	Above ground installations with acetylene, hydrogen or equal atmospheres. This group most closely matches Group A in the United States and Canadian classifications.
Hazardous (Classified) Location	A location in which fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, combustible dust, or easily ignitable fibers or flyings.
Hermetically Sealed Device	A device that is sealed against the entrance of an external atmosphere and in which the seal is made by fusion. Continuous soldering, brazing, welding and the fusion of glass to metal are examples of recognized methods.
I/O Module	A module which provides basic input and output functions between the automation system and the field devices. Disregarding specialty modules, there are four basic types available from various vendors - analog input, analog output, discrete input, and discrete output.
Ignitable Gas Mixture	A gas-air mixture that is capable of being ignited by an open flame, arc or spark or high temperature.
Ignition (autoignition) Temperature	The minimum uniform temperature required to initiate or cause self-sustained combustion of a solid, liquid, or gaseous substance (independent of any other ignition source).
Increased Safety	An international term that describes a type of protection in which various measures are applied so as to reduce the probability of excessive temperatures and the occurrence of arcs or sparks in the interior and on the external parts of electrical apparatus that do not produce them in normal service.
Inductance	The property of an electric circuit by virtue of which a varying current induces an electromotive force in that circuit or in a neighboring circuit. The practical difference between capacitance and inductance in an intrinsically safe circuit is minimal. Both store energy, but an inductor will release engery when a circuit is broken, and a capacitor will release energy when the circuit is made.
Insulator	A material that conducts electrons slowly. The importance to intrinsic safety is that air (a spatial distance) is often an insulator.
Intrinsic Safety	A type of protection in which a portion of the electrical system contains only intrinsically safe equipment (apparatus, circuits, and wiring) that is incapable of causing ignition in the surrounding atmosphere. No single device or wiring is intrinsically safe by itself (except for battery-operated self-contained apparatus such as portable pagers, transceivers, gas detectors, etc., which are specifically designed as intrinsically safe self-contained devices) but is intrinsically safe only when employed in a properly designed intrinsically safe system. This type of protection is referred to by IEC as “Ex i.“
Intrinsic Safety Barrier	A component containg a network designed to limit the energy (voltage and current) available to the protected circuit in the hazardous (classified) location under specified fault conditions.
Intrinsically Safe Circuit	A circuit in which any spark or thermal effect, produced either normally or in specified fault conditions, is incapable of releasing sufficient electrical or thermal energy to cause ignition of a specific hazardous atmospheric mixture in its most easily ignitable concentration.

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Intrinsically Safe Equipment (apparatus, circuits, and wiring)	Equipment and wiring that, under normal or abnormal conditions, are incapable of releasing sufficient electrical or thermal energy to cause ignition of a specific hazardous atmospheric mixture in its most easily ignitable concentration.
Intrinsic Safety Ground Bus	A grounding system that has a dedicated conductor separate from the power system so that ground currents will not normally flow and that is reliably connected to a ground electrode (e.g., in accordance with Article 250 NEC, ANSI/NFPA 70, or Section 10 of CEC Part I, CSA C22.1)
Intrinsically Safe Apparatus	Apparatus in which all the circuits are intrinsically safe.
Intrinsically Safe Circuit	A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under prescribed test conditions.
Intrinsically Safe System	An assembly of interconnected intrinsically safe apparatus, associated apparatus, and interconnecting cables in which those parts of the system that may be used in hazardous (classified) locations are intrinsically safe circuits.
Labeled Equipment	Equipment or materials, to which has been attached a label, symbol, or other identifying mark of an organization concerned with product evaluation, that may maintain periodic inspection of the production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
Listed	Equipment or materials, included in a list published by an organization concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or materials meets appropriate standards or has been tested and found suitable for use in the specified manner.
Maintenance, Operational	Any maintenance activity, excluding corrective maintenance, intended to be performed by the operator and required in order for the equipment to serve its intended purpose. Such activities typically include the correcting of “zero“ on a panel instrument, changing charts, record keeping, adding ink and the like.
Maximum Surface Temperature	The highest temperature attained by a surface accessible to flammable gases, vapors, or combustible dusts under conditions of operation within the ratings of the apparatus (including recognized overloads and defined fault conditions.
NTRL	Acronym for Nationally Recognized Testing Laboratory. This recognition indicates that the Occupational Safety & Health Administration has accredited certain organizations to evaluate products according to consensus based safety standards.
Nonhazardous (unclassified) Location	A location in which fire or explosion hazards are not expected to exist specifically due to the presence of flammable gases or vapors, flammable liquids, combustible dusts, or ignitable fibers or flyings. Internationally, such a location is referred to as a safe area.
Nonincendive Circuit	A circuit in which any arc or thermal effect produced in normal operating conditions of the equipment is not capable, under prescribed conditions, of igniting the specified flammable gas, vapor-in-air mixture, combustible dusts, or ignitable fibers or flyings.
Nonincendive Component	A component having contacts for making or breaking a specified incendive circuit in which the contacting mechanism is constructed so that the component is not capable of ignition of the specified flammable gas or vapor-in-air mixture when tested as specified by appropriate test procedure. The housing of a nonincendive component is not intended to (1) exclude the flammable atmosphere or (2) contain an explosion.
Nonincendive Equipment	Equipment having electrical / electronic circuitry and components that are incapable under normal conditions, of causing ignition of a specified flammable gas or vapor-in-air mixture due to arcing or thermal effect. This type of protection is referred to by IEC as “Ex n.“ Ex n protection is limited to gas and vapor hazards.
Nonincendive Field Wiring	Wiring that enters or leaves an equipment enclosure and, under normal operating conditions of the equipment, is not capable, due to arcing or thermal effects, of igniting a specified flammable gas or vapor-in-air mixture. Normal operation includes opening, shorting, or grounding the field wiring.

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Normal Conditions	As related to intrinsically safe and nonincendive systems, equipment is under normal conditions when it conforms electrically and mechanically with its design specifications and is used within the limits specified and is used within the limits specified by the manufacturer. Normal conditions for intrinsically safe systems include the following: 1 Supply volatge at maximum rated value. 2 Environmental conditions within the ratings given for the apparatus or associated apparatus. 3 Tolerances of all components at their most unfavorable conditions. 4 Adjustments at their most unfavorable conditions. 5 Opening of any one, shorting of any two, and grounding of any one of the field wires of the intrinsically safe circuit(s). Normal conditions for nonincendive equipment include the following: 1 Supply voltage, current, and frequency at rated values. 2 Environmental conditions within the ratings given for the apparatus. 3 All tool-removable parts (i.e. covers) in place. 4 Adjustments at their most unfavorable settings. 5 All operator accessible adjustments at their most unfavorable settings. 6 Opening, shorting, and grounding of the nonincendive field wiring.
Polarity	Zener barriers are available in polarized (DC) and nonpolarized (AC) versions. Positive polarity types have the negative side of the circuit grounded, while negative polarity types have the positive side of the circuit grounded. Nonpolarized barriers have zener diodes connected in inverse series pairs and can be used in both AC and DC circuits.
Purging	The process of suppling an enclosure with clean air or inert gas at a specified flow rate and a positive pressure to reduce the concentration of any flammable gas or vapor initially present to an acceptably safe level and to maintain this safe level by positive pressure with or without continuous flow. Refer to the definitions of Type X, Y, and Z purging.
Purging, Type X	In the United States and Canada, a method of reducing the classification within an enclosure from Division 1 to Nonhazardous (unclassified).
Purging, Type Y	In the United States and Canada, a method of reducing the classification within an enclosure from Division 1 to Division 2.
Purging, Type Z	In the United States and Canada, a method of reducing the classification within an enclosure from Division 2 to Nonhazardous (unclassified).
Qualified person	One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has safety training on the hazards involved.
RS 232	An EIA standard which specifies the electrical, mechanical, and functional characteristics for serial communications. Used in point-to-point applications.
RS 485	An EIA standard which specifies the electrical characteristics of a balanced voltage digital interface. Used in multi-point applications.
Safe Area	A nonhazardous location.
Seal, Cable, Explosionproof	A cable terminator filled with compound and designed to contain an explosion in the enclosure to which it is attached or to minimize passage of flammable gases or vapors from one location to another. A conduit seal may also be used as a cable seal. This method differs from the international practice, which requires cable glands.
Seal, Conduit, Explosionproof	A sealed fitting, poured with a cement-like potting compound, designed to contain an explosion in the enclosure to which it is attached or to minimize passage of flammable gases or vapors from one location to another.
Serial Interface	A method of digitally transmitting data between devices over a pair of conductors. See RS 232 and RS 485.
Short-Circuit Proof	The ability of an intrinsic safety barrier or isolator to withstand the shorting of its intrinsically safe connections to ground. Determined by dividing the rated voltage by its internal resistance. If the resulting value is less than the fuse rating, the barrier is said to be short-circuit proof.
Simple Apparatus	An electrical component or combination of components of simple construction with well-defined electrical parameters which does not generate more than 1.5 volt, 100 milliamps and 25 milliwatts, or a passive component which does not dissipate more that 1.3 watts and which is compatible with the intrinsic safety of the circuit in which it is used. Examples are: 1 Passive components, for example switches, junction boxes, resistance temperature devices and simple semiconductor devices such as LEDs; 2 Sources of generated energy, for example thermocouples and photocells, which do not generate more than 1.5 V, 100 mA and 25 mW.

Glossary

Temperature Identification Number (Temperature Class)	A system of classification by which one of 14 temperature identification numbers (internationally, six temperature classes) is allocated to an electrical apparatus. The temperature identification number represents the maximum surface temperature of any component that may come in contact with the flammable gas or vapor mixture.
Termination Panel	A mechanical assembly which resides in front of the I/O system and performs signal conditioning, electrical isolation, and other functions.
UL	A product that has been evaluated by UL approvals in accordance with U.S. codes and standards.
Wiring drawing	A drawing or other document created by the user based upon the relevant control drawings. The wiring drawing is used by the installer to determine the type, color, and size of the wire used to connect each terminal of the equipment used in the intrinsically safe circuit.
Zone	The international method of specifying the probability that a location is made hazardous by the presence, or potential presence, of flammable concentrations of gases and vapors. The term Division is used in the United States and Canada.
Zone 0	An area in which an explosive gas-air mixture is continuously present or present for long periods. Equal to a Division 1 hazardous location in the United States and Canadian classifications.
Zone 1	An area in which an explosive gas-air mixture is likely to occur in normal operation. Equal to a Division 1 hazardous location in the United States and Canadian classifications.
Zone 2	An area in which an explosive gas-air mixture is not likely to occur and if it does occur, will only exist for a short time. Equal to a Division 2 hazardous location in the United States and Canadian classifications.
Entity parameters for intrinsically safe apparatus:	
C_i	Total equivalent internal capacitance of the apparatus that is considered as appearing across the connection facilities of the apparatus.
I_i or I_{max}	Maximum current (peak AC or DC) that can be applied to the connection facilities of the intrinsically safe apparatus circuits without invalidating intrinsic safety. The maximum input current may be different for different terminals.
L_i	Total equivalent internal inductance of the apparatus that is considered as appearing across the connection facilities of the apparatus.
L_i / R_i	The maximum value of ratio of inductance to resistance that is considered as appearing across the terminals of the intrinsically safe apparatus.
P_i	Maximum power in an external intrinsically safe circuit that can be applied to the connection facilities of the apparatus. The maximum input power may be different for different terminals.
U_i or V_{max}	Maximum voltage (peak AC or DC) that can be applied to the connection facilities of the apparatus without invalidating the type of protection. The maximum input voltage may be different for different terminals.
Entity parameters for associated apparatus:	
C_o or C_a	Maximum capacitance in an intrinsically safe circuit that can be connected to the connection facilities of the apparatus.
I_o or I_{SC}	Maximum current (peak AC or DC) in an intrinsically safe circuit that can be taken from the connection facilities of the apparatus.
$L_o$or L_a	Maximum inductance in an intrinsically safe circuit that can be connected to the connection facilities of the apparatus.
L_o/ $R_o$or L_a / R_a	The maximum value of ratio of inductance to resistance that may be connected to the intrinsically safe circuit of the associated apparatus.
P_O	Maximum electrical power in an intrinsically safe circuit that can be taken from the apparatus.
U_o or V_{OC}	Maximum output voltage (peak AC or DC) in an intrinsically safe circuit that can appear under open-circuit conditions at the connection facilities of the apparatus.
Additional entity parameters for associated apparatus with multiple channels may include the following:	
I_t	The maximum DC or peak AC current that can be drawn from any combination of terminals of a multiple-channel associated apparatus configuration.
V_t	The maximum DC or peak AC open circuit voltage that can appear across any combination of terminals of a multiple-channel associated apparatus configuration.

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9001/00-086-100-101	Single channel barrier, negative polarity, resistive limitation	2-29
9001/00-086-150-101	Single channel barrier, negative polarity, resistive limitation	2-29
9001/00-086-390-101	Single channel barrier, negative polarity, resistive limitation	2-29
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