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# Fieldbus Intrinsically Safe Barrier and Repeater SB302-S Datasheet



## Features

- H1 Isolated Barrier and I.S. Power Supply
- Built-in H1 Fieldbus Signal Repeater
- Bus termination on Hazardous side
- Provides up to 60mA @ 11V to the Hazardous Network for field devices
- Can be installed in safe area (Div. 2/Zone 2 or Div. 1/Zone 1)
- Conforms to IEC 1158-2, 31.25 Kbit/s standard for Foundation Fieldbus and PROFIBUS
- FM & CENELEC Intrinsic Safety standards certified

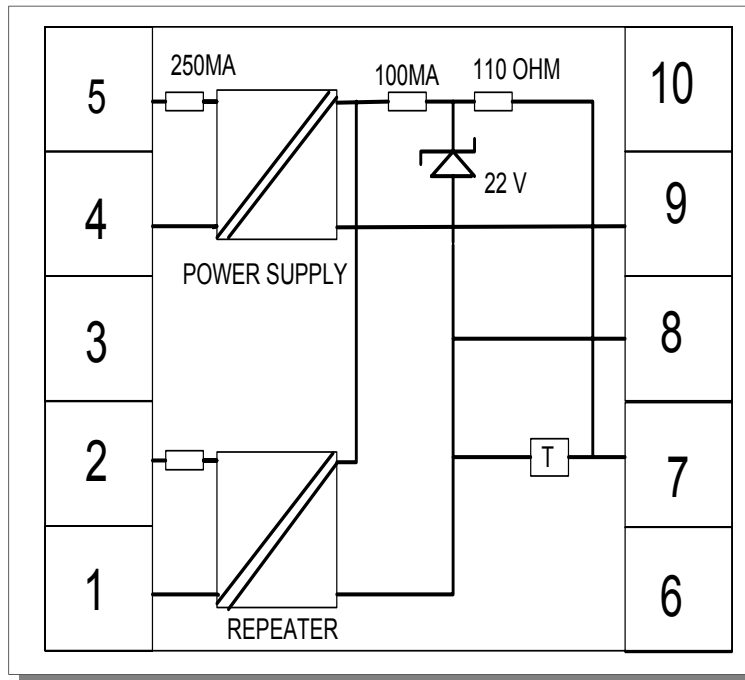
The SB302-S uses Intrinsically Safe (I.S.) technology to completely isolate the control network on the hazardous side of the barrier. It supplies up to 60mA to field devices located in the hazardous area.

The incorporated repeater (operating in compliance with IEC 1158-2 specifications at 31.25 Kbits/s) cleans and boosts the incoming communication signal, transmitting it to instruments inside the hazardous environment without

compromising the safety requirements of explosion proof wiring. The networks on the hazardous and safe sides of the SB 302-S are completely independent of each other.

The SB302-S also incorporates bus termination for the hazardous network in its design so that only one far terminator is required and up to a 2.5 mm<sup>2</sup> (12 AWG) conductor can be used.

**Design Techniques**



**SB302-S - Functional Diagram**

**Mechanical Isolation**

Mechanical Isolation is the most important technique to preventing intrinsically safe circuits and non-intrinsically safe circuits from contacting each other. The SB302-S uses spacing and partitions to achieve mechanical isolation.

**Electrical Isolation**

Electrical Isolation of the SB302-S uses protective transformers to create

electrical isolation between the hazard and non-hazard circuits. One transformer is placed at the power supply and two are placed between the safe and hazardous area for communication signal isolation.

**Current and Voltage Limiting**

Voltage limiting is accomplished in the SB302-S by using redundant zener diodes. Current limiting is accomplished through the use of metal film or wire wound resistors of high reliability.

## Technical Characteristics

<b>Power</b>	
<b>Power Supply Input</b>	Voltage: 24 VDC $\pm$ 5 % Current (max.): 120mA @ 24VDC
<b>Hazardous Area</b>	
<b>Power Supply</b>	Maximum Voltage available at the barrier terminals at maximum current: 11 VDC Maximum current: 60 mA @ 14V DC Resistance (typical): 134 Ohms
<b>Safety Parameters (Hazardous Area)</b>	Open Circuit Voltage (Voc): 20.8 VDC Short Circuit Current (Isc): 189.4 mA Matched Power: 984.8mW Max. Allowed Capacitance: 154nF Max. Allowed Inductance: 0.3mH
<b>Internal Dissipation</b>	2.8W maximum at 24V input
<b>Cable Length</b>	A factor of IS requirements, number of devices, and maximum acceptable voltage drop along cable run.
<b>Digital Signal Transmission</b>	Compatible with 31.25kbit/sec Fieldbus systems
<b>Fuse</b>	Safe area : 250mA Hazardous area: 100mA
<b>Terminals</b>	Accommodate conductors up to 2.5 mm <sup>2</sup> (12AWG)
<b>Isolation</b>	250VAC between input, output, and power supply terminals. Tested at 1500Vrms minimum between hazardous and safe area terminals.
<b>Physical</b>	
<b>Ambient Temperature</b>	-20° to + 60°C (Continuous operation) -40° to + 80°C (storage - off line)
<b>Humidity</b>	-5% to 95% relative humidity
<b>Marking</b>	Ex II (1)G [Eex ia] IIB/IIC Ex I M2 [Eex ia] I SB302 – I.S. Barrier: It should be physically located in a safe area

## Installation

Installation should always be performed by competent, trained personnel. Contact SmarResearch or your local representative for further information.

The installer of an intrinsically safe system must install the system in compliance with all local codes and intrinsic safety requirements. In the United States reference should be made to Article 504 of the National Electrical Code, the ISA RP 12.6 and to SmarResearch's control drawing.

## Location

The barrier is normally installed in a dust-free and moisture-free NEMA 4 or 12 enclosure located in the non-hazardous area. The enclosure should be located as close as possible to the hazardous area to reduce cable runs and increased capacitance. If the barrier is installed in a hazardous area, it must be in a proper enclosure suited for the intended area. The only intrinsically safe terminals are at the barrier output.

## Wiring

Intrinsically safe circuits may be wired in the same manner as conventional circuits installed for unclassified locations

**IMPORTANT**  
**BEFORE PROCEEDING TO INSTALL**  
**AND WIRE THE SB302-S, READ AND**  
**THOROUGHLY UNDERSTAND THESE**  
**INSTRUCTIONS.**

with two exceptions:

- The intrinsically safe conductors must be separated from all other wiring by placing them in separate conduits or by a separation of 2 inches of air space.
- The raceways, cable trays, open wiring, and terminal boxes must be labeled "Intrinsically Safe Wiring" to prevent interference with the other circuits.

## Mounting

The SB302-S enclosure mounts easily by snapping out the standard 35mm DIN rails. It can also be panel mounted using corner mounting holes which accept two M4 or M5 (#6 or #10) screws. These mounting holes are molded into two corners of the housing shell base and do not increase the height or width of the enclosure.

### ***Installation Principles defined by the ISA***

- 1 Ensure that there is positive separation of intrinsically safe and non-intrinsically safe circuits so that ignition capable energy from non-intrinsically safe circuit does not intrude into the intrinsically safe circuit.
- 2 Ensure that the limiting parameters of system design, total inductance and capacitance for example, upon which approval of the system is based are not exceeded.
- 3 Ensure that power system faults and ground potential differences do not make the system ignition capable.

## Intrinsic Safety

In industrial processes where flammable or explosive materials are handled any leak or spill can cause an explosive, dangerous atmosphere. These conditions occur in many industrial environments, most typically those involving petroleum and other chemicals, process gases, metal and carbon dust, alcohol, grain, starch, flour, and fibers. To protect both personnel and plant, precautions must be taken inside these hazardous areas to protect both personnel and plant. In the past pneumatic controls were used in these environments to avoid the risk of electrical spark. Today, while pneumatic equipment is still used, new technologies and engineering advances have created a wide range of electrical controls which allow far greater functionality, and still maintain a safe operating environment.

Many of these new technologies and advances as they apply to process measurement and control fall into a category of engineering know as Intrinsic Safety.

Intrinsic Safety methodology inserts an energy-limiting interface in the wiring between safe and hazardous areas. This restricts the electrical energy in the hazardous-area circuits so that potential electrical sparks or hot spots are too weak to cause ignition. The interface passes signals in both directions but limits the voltage and current that can reach the hazardous area under fault conditions. Intrinsic Safety became popular for many applications in the early 1960s with the introduction of the 'shunt-diode safety barrier' based on the Zener diode, and is now the preferred solution

in most applications for several reasons:

- Advances in semiconductors allow increasingly complex electrical operations to be carried out in hazardous areas at very low ( typically 1 watt) power levels.
- Hazardous-area equipment can be calibrated and serviced 'live'.
- Ordinary instrument wiring can be used in hazardous areas.
- It is Inherently safe for personnel due to the low voltages employed.
- International standards governing the design of Intrinsically Safe equipment allow the same product to be sold and used in many countries.
- With a certified IS interface, safe-area equipment needs no certification and the user can choose or change the hazardous-area equipment within wide limits.

Regulations governing the installation of electrical equipment in a hazardous area are issued on national, regional, and local levels. In the United States specific regulations from Federal, State, and local agencies must be observed; In Canada regulations from the national, provincial, and city governments must be followed.,In Europe European Union regulations define the general specifications and r methods of protection against explosion, while national requirements primarily cover installation criteria. IT IS ESSENTIAL TO DETERMINE ALL OF THE APPROPRIATE REGULATORY REQUIREMENTS PRIOR TO ELECTRICAL DEVICES IN HAZARDOUS AREAS.

## **Instrument Classifications**

DIN EN 50014.

Electrical instruments for explosion groups I and II and temperature classifications T1 - T6

DIN EN 50020.

Design and test specifications and model identifications for intrinsically safe instruments.

Approvals for electrical instruments that are used in explosive environments are regulated by EG-Ex-Framework Guidelines 76/117/EEG and Guideline 94/9/EEG.

### ***Intrinsic Safety Circuit***

An Intrinsically Safe Circuit is one that does not create electrical or heat effects which might compromise the safety of the area or materials being handled. The regulation defining Intrinsic Safety, EN 50020 [2] defines Intrinsic Safety as follows:

*“A circuit in which any spark and any thermal effect produced in the conditions specified in this standard, which include normal operation and specified fault conditions, is not capable of causing ignition of a given explosive gas atmosphere.*”

Intrinsically safe circuits or equipment are classified in two categories, “ia” or

“ib”, with “ia” providing the greater safety level. The primary difference between the two levels involves fault analysis. Devices in category “ia” can have two faults as defined by the standard without impairing the Intrinsic Safety of the circuit. Devices in category “ib” will only protect the circuit after suffering from one fault..

### ***Intrinsic Safety Barrier (Associated Apparatus)***

An Intrinsic Safety Barrier (Associated Apparatus) is a device typically placed in a non-hazardous or safe location that permits the electrical connection of devices located in a hazardous area. The barrier limits the power that can be introduced into the hazardous location to energy levels which are safe for the material being handled or process being performed in that area by protecting against the following faults:

- 1 - Shorting of the wires connected to the hazardous area side of the barrier.
- 2 - Grounding of the wires connected to the hazardous area side of the barrier.
- 3 - Misconnection or failure of the power supply allowing an unsafe voltage to be applied to the safe area side of the barrier.

**SB302-S BARRIER LINEAR MODEL**

**Safety Parameters:**

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FM  
APPROVED

Um = 250V, Ta max = 60C  
 Intrinsically Safe Connections for  
 CL I, DIV 1, GP A, B, C, D  
 CL II, DIV 1, GP E, F, G  
 CL III, DIV 1

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Ex

II(1)G [EEx ia] IIB / IIC  
 I M2 [EEx ia] I

Uo = 20,8V    Ri = 108,9 Ohm  
 Io = 189,4mA    Po = 984,8mW  
 Co = 154nF    Lo = 0,30mH

Input Supply: 24Vdc ± 5% 125mA

DMT 02 ATEX E 083 X

**SmarResearch**

**Barrier Safety Parameters**

A Barrier is evaluated for the maximum energy levels capable of being discharged through its circuit under the defined fault conditions, including the opening, shorting and grounding of the intrinsically safe leads. Voltage and current determine the maximum capacitance and inductance that can be “seen” by the barrier on the hazardous side, and are represented in the form of Safety Parameters consisting of some combination of the following values:

- Voc or Vt** - Maximum open-circuit voltage
- Isc or It** - Short circuit current if the terminals on the hazardous area side are shorted:  $I_{sc} = V_{oc}/R$
- Pt** - Power transfer
- Rmin** - Minimum resistance value for the shunt resistor

**Intrinsically Safe Devices**  
(*Intrinsically Safe Apparatus*)

Intrinsically Safe Devices are products such as transmitters and positioners designed to be connected to an intrinsically safe circuit. Intrinsically Safe Devices 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 material (usually a fuel-air mixture). They are also evaluated for the amount of stored capacitance and inductance that may be discharged under predefined fault conditions. Circuit modifications may be required to either limit or prevent such a condition.

Devices that have energy storing or generation characteristics of > 1.2 V, 0.1 A, 25 mW or 20 mJ require evaluation for use in Intrinsically Safe circuits.

Approved devices will receive one of the following approval ratings:

**Loop Approval**

The device has been evaluated in combination with Associated Apparatus (barrier, isolator, etc. ) and is approved for installation in the approved combination only. Any changes to the device, Associated Apparatus, or wiring require re-approval.

**Entity Approval**

The intrinsically safe apparatus and associated devices are independently evaluated, according to a consistent standard. The devices are combined in a loop on Entity and tested to meet the safety parameters (also called Entity Parameters) shown in the “Comparison of Entity Parameters” table.

Loop and Entity approvals are issued by agencies such as Underwriters Laboratories, Inc. and Factory Mutual Insurance in the United States, CSA in

Canada, several European laboratories following CENELEC standards, and in other countries by national laboratories or testing agencies following the specific requirements of those countries.

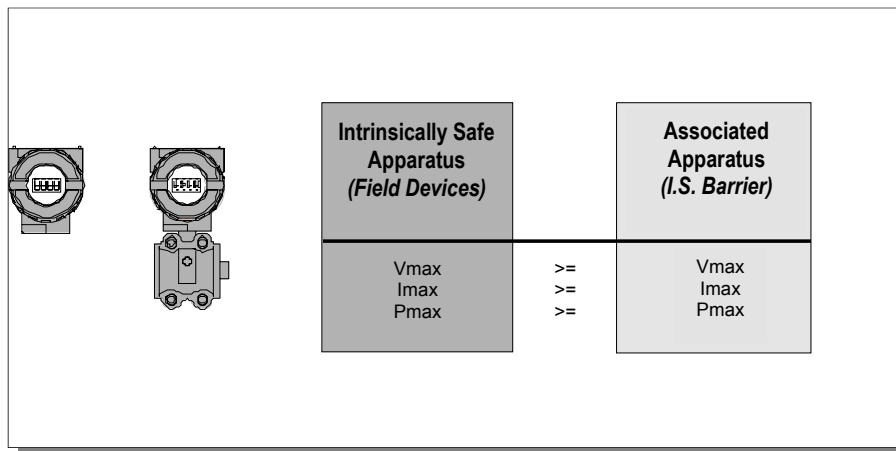
**Intrinsically Safe Devices**  
(*Intrinsically Safe Apparatus*)

Under the Fieldbus Intrinsic Safe Concept (FISCO), intrinsically safe apparatus will be assigned Entity Parameters which, when properly matched to those of associated apparatus, will constitute an intrinsically safe system. Overall cable capacitance and inductance are added to the intrinsically safe apparatus capacitance and inductance, respectively.

These values include:

- V<sub>max</sub>** - Maximum voltage
- I<sub>max</sub>** - Maximum current
- P<sub>max</sub>** - Maximum power

**Comparison of Entity Parameters**



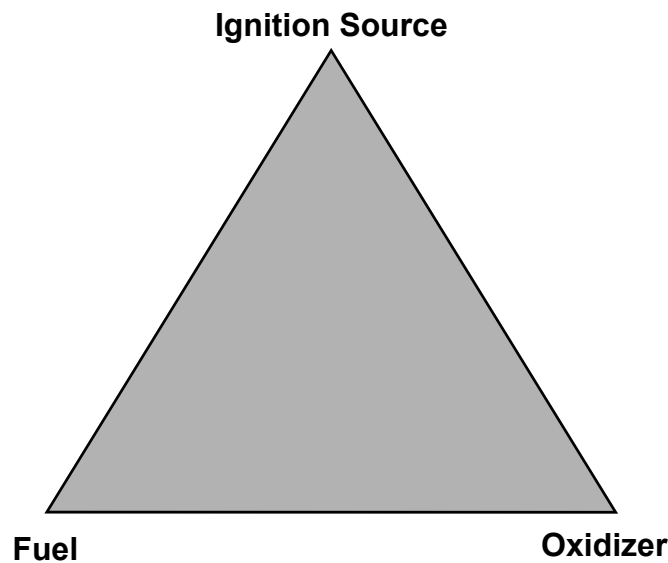
## Hazardous Area Classification

The United States National Electrical Code defines Hazardous atmospheres and designates them by degree of hazard. Class, Division and Group are used to categorize the general form of hazardous material (vapor, dust, fibers), the degree of hazard, and the specific material in the atmosphere. A barrier must be selected that is suitable for use as defined by these classifications. (Detailed information is available in the United States National Electrical Code, Chapter 5, Article 500.)

A certified Barrier is able to safely deliver limited electrical energy to a device located in specifically classified areas and can safely accept signals from

associated elements of the same device, eliminating the risk of an explosion and/or excessive temperature of these devices.

Area classification methods provide a precise description of the hazardous material that may be present and the probability that it is present, so that appropriate equipment is selected and installed properly. Every area classification specifies in some way what kind of flammable material may be present and the probability that it will be present.



# Hazardous Area Classification

## CLASS 1 Flammable Gases or Vapors

### DIVISIONS

#### DIVISION 1

- \* Exists under normal conditions
- \* May exist because of:
  - repair operations
  - maintenance operations
  - leakage
- \* Released concentration because of:
  - breakdown of equipment
  - breakdown of process
  - faulty operation of equipment
  - faulty operation of process which causes simultaneous failure of electrical equipment

#### DIVISION 2

- \* Liquids and gases are in closed containers or the systems are:
  - handled
  - processed
  - used
- \* Concentrations are normally prevented by positive mechanical ventilation.

\* Adjacent to a Class 1, Division 1 location.

### GROUPS

- Group A:** Atmospheres containing Acetylene
- Group B:** Atmospheres such as Butadiene, Ethylene Oxide, Propylene Oxide, Arcolein, or Hydrogen (or gases or vapors equivalent in hazard to hydrogen such as manufactured gas.)
- Group C:** Atmospheres such as Cyclopropane, Ethyl Ether, Ethylene, or gases or vapors equivalent in hazard.
- Group D:** Atmospheres such as Acetone, Alcohol, Ammonia, Benzene, Benzol, Butane, Gasoline, Hexane, Laquer Solvent vapors, Naphtha, Natural Gas, Propane or gases or vapors equivalent in hazard.

## CLASS II Combustible Dusts

### DIVISIONS

#### DIVISION 1

- \* Exists under normal conditions
- \* Combustible mixture produced by:
  - mechanical failure of equipment or machinery

- abnormal operation of equipment and provide source of ignition from:
  - simultaneous failure of electrical equipment
  - simultaneous failure of operation of protection devices
  - other causes

\* Electrically conductive dusts may be present

#### DIVISION 2

- \* Not normally in the air.
- \* Accumulations normally sufficient to interfere with normal operation of electrical equipment or other apparatus.
- \* In the air as a result of infrequent malfunctioning of:
  - handling equipment
  - process equipment
- \* Accumulations are sufficient to interfere with the safe dissipation of heat from electrical equipment.
- \* Accumulations may be ignitable by abnormal failure of electrical equipment.

### GROUPS

GROUP E: Atmospheres containing combustible metal dusts (regardless of resistivity), dusts of similarly

hazardous characteristics ( $< 100 \text{ k}\Omega/\text{cm}$ ) or electrically conductive dusts.

GROUP F: Atmospheres containing combustible Carbon Black, Charcoal or Coke. Dusts which have  $> 8\%$  total volatile material or if these dusts are sensitized so that they present an explosion hazard and having a resistivity  $> 100 \text{ K}\Omega/\text{cm}$  but  $\leq 100 \text{ M}\Omega/\text{cm}$ .

GROUP G: Atmospheres containing combustible dusts having a resistivity  $> 100 \text{ K}\Omega/\text{cm}$  or electrically nonconductive dusts.

## CLASS III Ignitable Fibers or Flyings

### DIVISIONS

#### DIVISION 1

\* Fibers or materials producing combustible flyings are manufactured, stored and handled.

#### DIVISION 2

\* Fibers are handled or stored, except during the process of manufacture.

### NOT GROUPED

\* Manufacturers such as textile mills, cotton related mills or clothing plants.

\* Fibers and flyings include Rayon, Cotton, Sisal, Hemp, Jute and Spanish Moss

## ***Selected Safety Terminology***

***The ignition capability of an electrical circuit*** is determined by the electrical energy available and the manner in which such energy is released. Energy may be released in the form of a spark, by resistive heating effects or a combination of the two.

There are three basic mechanisms by which electrical energy may be released in the form of spark discharge:

- Discharge of a capacitive circuit
- Interruption of current in an inductive circuit
- Make-break of a resistive circuit

The minimum ignition energy for any flammable mixture is the smallest amount of energy released as a spark and sufficient to ignite the mixture at 0 psi.

***The most easily ignited air mixture*** is that mixture of a flammable material in air that requires the minimum amount of energy for ignition. The flammables are usually designated in % by volume in air.

***Normal operating conditions*** include maximum supply voltage and the extreme environmental conditions that fall within the rating given for the specific equipment under investigation.

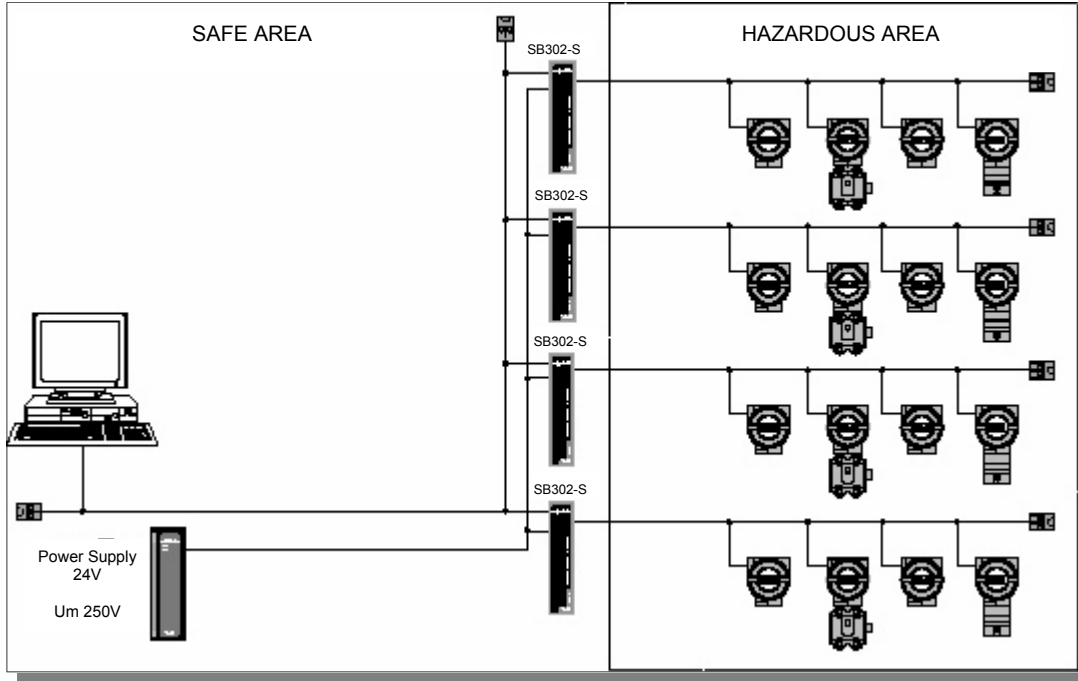
***Abnormal operating conditions*** usually refer to any two mechanical or electrical faults occurring in combination. The faults are independent and include accidental damage to, and failure of, components or wiring.

***Intrinsically Safe electrical equipment*** and associated wiring are incapable of releasing sufficient electrical or thermal energy under normal or abnormal operating conditions to cause ignition of a specific hazardous mixture in its most easily ignited concentration in air. The flammable material may be a gas or vapor.

***Independent testing laboratory approval*** is based on examination and tests of samples of production quality equipment, and inspection of manufacturing and quality control facilities. Of particular consideration are the adequacy of design and workmanship, uniformity and dependability of production, effectiveness of quality control, functional suitability, assurance of availability of service and replacement of parts.

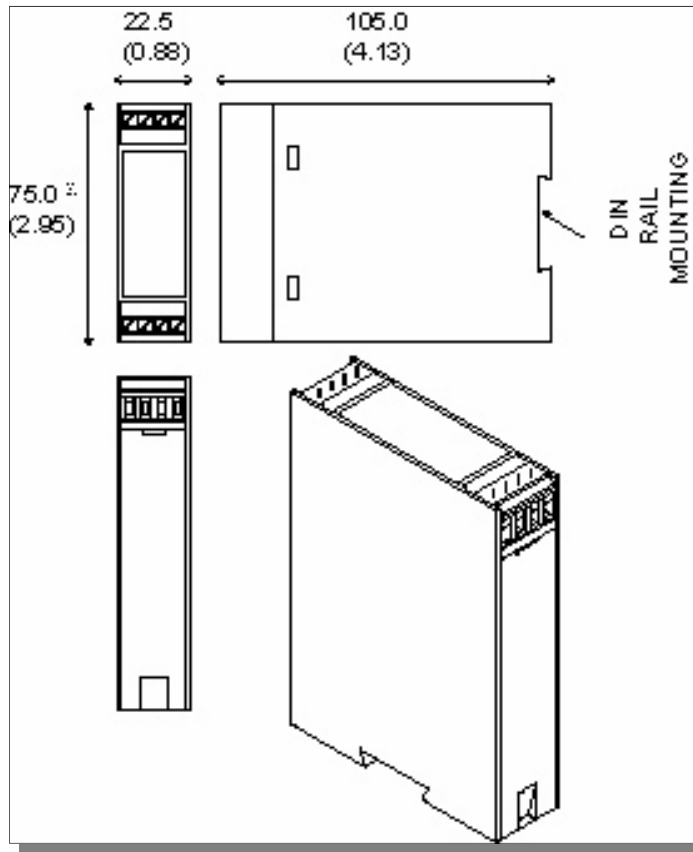
To be completely assured of an Intrinsically Safe installation, all equipment used must be approved; and the installation, including the wiring plus all of the inputs, must meet the requirements of isolation to avoid any failures that may occur in its system.

# Typical Topology



SB302-S Topology

## Mechanical Dimensions



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