MANUAL

SR-EX-IM-EN-2504

Installation of Intrinsically Safe Sensors

Type-SR Rheonics Sensors
Ex Certified Viscometers and
Density Meters
IECEx – ATEX -JPEx - KCs

rheonics

Rev: 4.2 Published: 04-2025

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Ex Certified Viscometers and Density Meters
IECEx – ATEX – JPEx – KCs
DOC. ID: SR-EX-IM-EN-2504

For customer use:
Write sensor identification information here and store for future reference
Sensor Probe S/N:
Electronics S/N:

The device with which this manual was supplied may only be installed as specified in this manual.

Rev: 4.2 Published: 04-2025

GLOBAL SUPPORT

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The English version of this manual is the only approved version from Rheonics. Installers should refer to it to confirm the correctness of information. In case of any questions contact your local partner or Rheonics support.

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Introduction

The operational conditions cited in this manual are essential to and pertain only to the maintenance of the intrinsic safety of the device. Operational conditions required for achieving the specified measurement accuracy and operational factors not relevant to operation in explosive atmospheres are given in the configuration data sheet supplied with the sensor. Please refer to the sensor configuration data sheet before installing and operating the sensor.

This is a certified ATEX document. Changes must be approved by the Rheonics EX Authorized Personnel.

Types of Messages

ATTENTION

This word indicates useful information for the operator but without risk for the operation of Rheonics product.

CAUTION

This word indicates a medium or highly recommended action to ensure the proper function of Rheonics product.

WARNING

This word indicates a hazard or mandatory action to ensure the proper function and safety of Rheonics product.

ATTENTION

Installation in hazardous environment locations shall be made in accordance with IECEx 60079-14 and other applicable codes and standards.

1 Purpose of this manual

This manual contains information to enable the safe installation and operation of Rheonics SR (SRV and SRD) sensors in areas that potentially contain explosive atmospheres. The manual is an adjunct to the operation and configuration manual provided with the particular sensor to be installed. It applies only to Rheonics SR sensors labelled with Ex marking, for example with the hexagonal ATEX mark:

All other versions of Rheonics SR (Type: SR) sensors should NOT be considered safe to use in areas with the potential presence of explosive atmospheres.

2 Description of the sensors and general installation considerations

Rheonics SRV sensors are used to measure and control the viscosity of fluids, mainly under process conditions. Rheonics SRD sensors measure, in addition, fluid density as well as true dynamic and kinematic viscosity. Each sensor has a symmetric torsional resonator as its sensitive element. The effect of the fluid in which it is immersed on its resonant response – its resonant frequency and damping – is measured and interpreted by the electronics unit with which it is supplied.

Both of these devices, hereafter referred to collectively as “SR” or “Type SR” sensors, are delivered in a version that is intrinsically safe. That means that as long as the sensors are installed and operated as specified in this manual, they are incapable of igniting explosive atmospheres in which they operate, provided they are operated within the envelope of parameters described in this manual.

Each Rheonics SR sensor is delivered paired with an electronics unit that both operates the sensor and transmits its measurement values over one of a variety of interfaces. The electronics unit is not itself intrinsically safe. When operating Rheonics SR sensors in a hazardous area, one or more Zener diode barriers must be installed between the Rheonics SR sensor and its electronics unit. This barrier serves to limit the amount of current and voltage available to the sensor in case of a fault in its electronics unit and/or within the sensor itself. The specifications for the required barriers are given in section 5.2 below.

Rheonics SR sensors are manufactured to maintain ingress protection under all operating conditions. They are hermetically sealed in fully welded AISI 316L housings. Electrical connections are made through an M12 connector whose contacts are hermetically sealed into a glass insulating disk.

The Zener diode barriers themselves must be situated either outside of any hazardous zone, or in the zone specified by the manufacturers as safe for the barriers. The Rheonics SR sensor's electronics unit must be situated outside the hazardous zone.

Suitable cabling to safely connect the Rheonics SR sensor to its associated Zener barrier(s) is to be provided by the installer. The minimum specification for the cabling to ensure intrinsic safety is given in section 5.1.

Installation of Rheonics SR sensors must be performed by a qualified installer who is familiar with safe installation practices for intrinsically safe equipment. In addition, the installer must be familiar with the contents of this installation manual, to ensure that all conditions relevant to maintaining intrinsic safety of the Rheonics SR sensors are met.

The following topics are covered in the next sections:

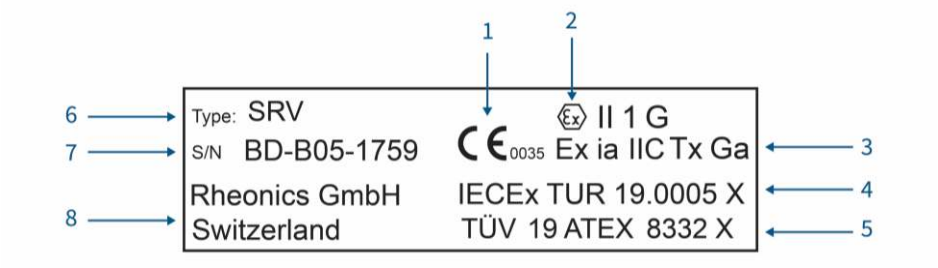
- Description of the Ex label as it defines the safe operating parameters of the sensor
- Discussion of limits on specific operating parameters of the Rheonics SR sensors not explicitly listed on the label, but as indicated by the symbol "X" following the Ex certificate numbers.
- Specification of the Zener diode barrier(s) to ensure safe operation of the Rheonics SR sensors, as well as specific recommendations for commercially available barriers for use with the Rheonics SR sensors.

3 Ex label description

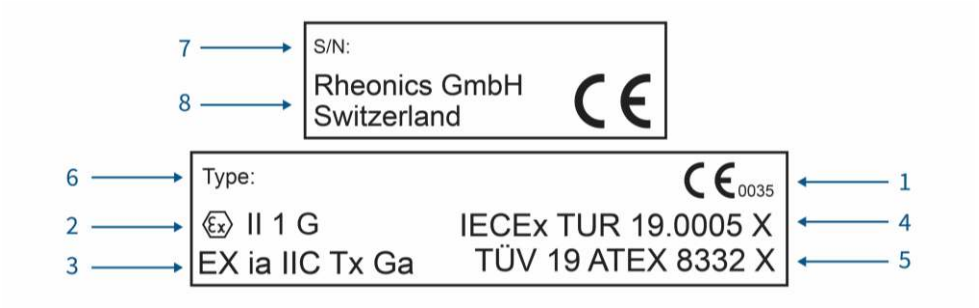
The following graphics show the labels associated with earlier issues of the Ex certificates, as well as the current label. The issue numbers correspond to the issue numbers of the certificates.

Figure 1: Example of sensor labels identifying the markings

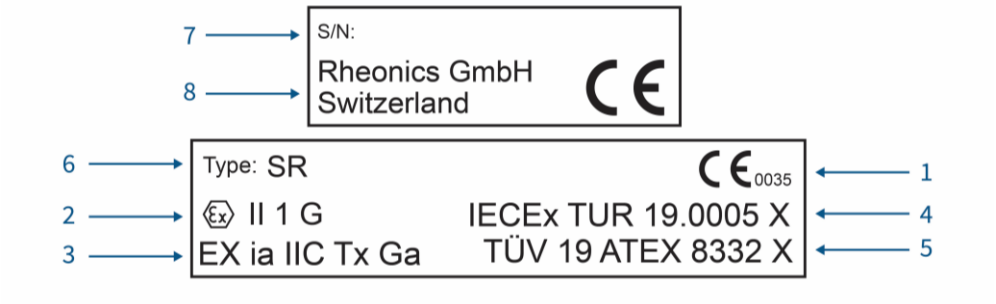
Older label: Certificate Issue No. 0&1



Older label: Certificate Issue No. 2



Current label: Certificate issue No. 3



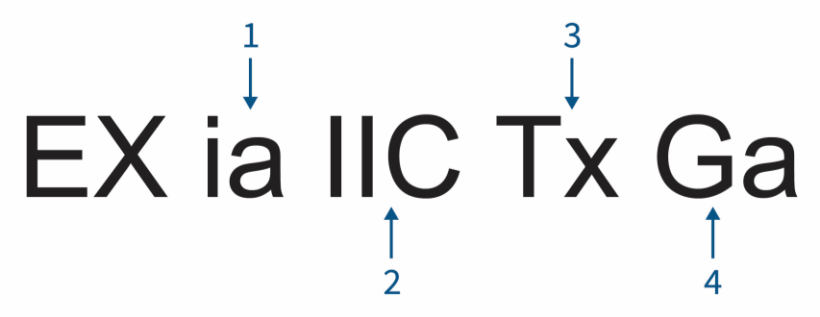
National Ex certificate label

1	CE mark Notified body: TÜV Rheinland

2	ATEX Marking
3	Explosion classification: T class with appended “x”
4	IECEx certificate number with appended “X”
5	ATEX certificate number with appended “X”
6	Sensor type **SR**
7	Identification Number
8	Sensor Manufacturer
National Certificate Number	
9	National EX certificate label, check section 8 for the label marking.

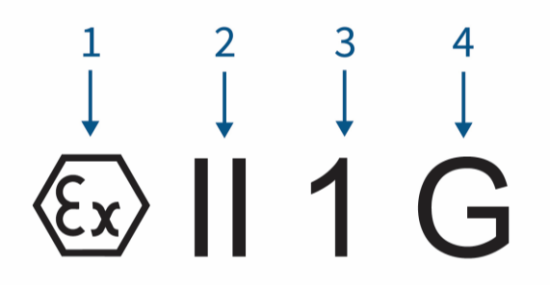
*** See below for “Tx” and “X” conditions for explosion classification and certificates**

Figure 2: IECEx Explosion classification description (and IECEx based Ex certificates like for JPEx)



1	Intrinsically safe
2	Safe for gas groups IIA, IIB and IIC
3	Ignition temperature classes that define ambient/fluid temperature range, as given in table below
4	Equipment protection level = very high

Figure 3: ATEX marking description



1	ATEX Mark
2	Non-mining equipment

3	Category 1 (Zone 0)
4	For gases

3.1 General note on Category of protection and operating zone

Although the sensors are specified for Category 1 (hazardous Zone 0), they may also be used for Categories 2 and 3 (Zones 1 and 2). However, if the sensor has been used in a Category 3 (Zone 2) installation, it is no longer safe to use in categories 1 and 2 (Zones 0 and 1), because of the risk that the sensor has been damaged. It is the responsibility of the installer and the end user to ensure that any Rheonics SRV or SRD sensor that has been used in a Category 3 installation is not re-used for Category 1 or 2 installations.

3.2 Description of “X” conditions

Operating conditions not described on the label, but that are necessary in order to maintain intrinsic safety. Certain operating conditions must be met in order to ensure that the sensors and their associated Zener diode barriers meet intrinsic safety criteria. These include:

- Electrical parameters
- Operating temperature ranges

3.2.1 Area classification & Gas Grouping

Zone 1	Area in which an explosive gas atmosphere is likely to occur in normal operation occasionally
Zone 2	Area in which an explosive gas atmosphere is not likely to occur in normal operation and if it does occur, is likely to do so only infrequently and will exist for a short period only
Zone 21	Place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally
Zone 22	Place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does, will persist for a short period only

Group IIA	e.g. Propane, methane
Group IIB	e.g. Ethylene
Group IIC	Hydrogen and Acetylene

3.2.2 Electrical parameters relevant to intrinsic safety

IS Parameter	Coil + Pt1000 circuit	
	Gas group IIC:	**Gas group IIB:**
Ui	10V	10V
Ii	30mA	80mA
Pi	75mW	130mW
Ci	negligible	negligible
Li	20mH	20mH

Table 1: EX-relevant electrical specification for SRV/SRD sensors

The sum of the output currents I_o of the supplying circuits shall not exceed the given I_i and the input circuits shall refer to the same ground. Note that the same sensor can be used for gas groups IIC or IIB, provided that the lower limiting value of I_i is enforced by a suitable Zener diode barrier. For group IIC, the sum of currents of all channels of the barriers must be less than 30mA; for group IIB, the sum of all barrier currents must be less than 80mA. See section 5.2 below for recommended Zener diode barriers for both gas groups.

3.2.3 Temperature rating of the sensors according to T class

The following temperature class table shows the range of ignition temperature classes for which the sensors are specified, together with the ambient operational temperature for each class, where Ta is the lesser of the process fluid temperature and the ambient temperature surrounding the portion of the sensor outside of the process fluid. In typical applications, the fluid temperature will be equal to or greater than the ambient temperature, so it will determine the temperature class. The symbol “Tx” refers to the corresponding symbol on the sensor Ex label. It refers to the temperature classes listed on the following Table 2. However, the user must be aware that these temperatures only show the limits for safe operation of the sensor in different explosive atmospheres. The actual temperature range over which the sensor will function accurately and without functional damage is shown on the individual configuration data sheet provided with each sensor.

	Ambient temperature range T_a
T class	**Gas group IIC/IIB:**
T6	-200°C….+70°C
T5	-200°C ….+85°C
T4	-200°C….+120°C
T3	-200°C ….+185°C
T2	-200°C ….+285°C
T1	-200°C ….+435°C

Table 2: Temperatures for gas ignition classes

WARNING
These parameters and conditions must be adhered to. If not, injury may be caused to a person or property.

4 Safe use of Ex approved equipment

4.1 Notes on Safe Use of the Ex Approved Equipment

Approved usage of the sensor is restricted to fluids compatible with the wetted materials of the sensor and within the restrictions on temperature and pressure as defined in the product manual.

4.2 Mounting, Commissioning, and Operation

The device has been designed to operate safely in accordance with the current technical and safety regulations of the EU. If installed incorrectly or used for applications for which it is not intended, it is possible that application related changes may arise. For this reason, the instrument must be installed, connected, operated, and maintained according to the instructions in this and the specific product operating manual.

Persons handling/installing or commissioning this equipment must be authorized and suitably qualified. The manual must be read, understood, and the instructions must be followed.

Modifications and repairs to the device are only permissible when they are expressly approved in this manual.

5 Electrical Installation

ATTENTION
Substitution of components may impair intrinsic safety.

CAUTION
Sensor cable must not be removed from probe while sensor cable is attached to Zener diode barriers. Always detach sensor cable from barriers before disconnecting sensor from cable!
In case separate equipotential bonding connection is used, this condition may be disregarded.

Installation of the sensors must be carried out according to the instructions and diagrams in this section. Sensors installed in this manner will become part of an intrinsically safe system that will be incapable of igniting explosive gas atmospheres as specified on the sensor label and additional specifications in the preceding section 3 above.

There are five basic considerations that govern the electrical installation of the sensor. They are:

- Cabling
  - Selection of a suitable cable
  - Wiring of the cable to a suitable sensor-side connector with appropriate temperature rating
  - Wiring of the cable to the Zener diode barrier(s) associated with the system.
- Identification and selection of Zener diode barriers depending on desired gas group operation (section 5.2 below)
  - IIB only
  - IIB and IIC
- Selection / identification of wiring scheme depending on intended Pt1000 temperature sensor connection
  - Sensor with 4-wire Pt1000 connection (Default configuration for SME electronics)
    - 3 Zener diode barriers required
    - Highest accuracy
    - Uses standard sensor
  - Sensor with 3-wire Pt1000 connection (only supported by certain sensor electronics, contact Rheonics product team for details)
    - 2 Zener diode barriers required
    - Lower accuracy than 4-wire Pt1000 connection
    - Uses standard sensor
    - May require temperature calibration for best accuracy
  - Sensor with no Pt1000 sensor
    - 1 Zener diode barrier required
    - Uses special sensor with no Pt1000 installed
    - Temperature may be measured with external temperature sensor

        - Possibility of temperature estimation without external sensor. Please consult Rheonics for more information regarding accuracy.
- Zener diode barrier selection
    - Using Zener diode barriers recommended in this manual
    - Using alternative Zener diode barriers that meet the specifications given in this manual.
- Equipotential bonding method selection
    - Using cable shield for equipotential bonding with Rheonics provided I.S. cable
    - Using separate bonding conductor
        - Different schemes possible depending on requirements of system layout

5.1 Cabling

The SRV/SRD sensor is connected to its associated Zener diode barriers by means of a cable that has an 8 pin M12 connector on the sensor probe. The cable end that connects to the Zener diode barrier must be provided with crimped conductor-end sleeves, which are held by screw clamps on the Zener diode barriers.

The selected cable must conform to the guidelines in IEC 60079-14, described in Edition 5.0 2013-11 of this norm:

5.1.1 Marking of cables

Cables containing intrinsically safe circuits shall be marked (except as below) to identify them as being a part of an intrinsically safe circuit. If sheaths or coverings are marked by a color, the color used for cables containing intrinsically safe circuits shall be light blue. Where intrinsically safe circuits have been identified by the use of light blue covered cable, then light blue covered cable shall not be used for other purposes in a manner or location which could lead to confusion or detract from the effectiveness of the identification of intrinsically safe circuits.

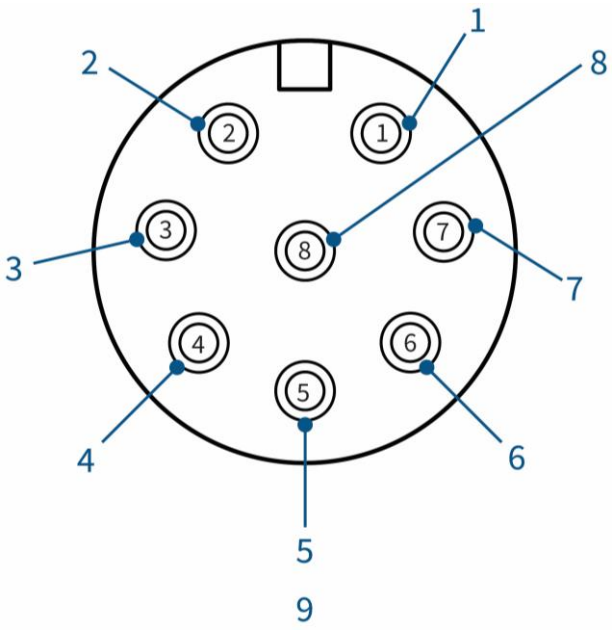
If all intrinsically safe circuit cables or all cables of circuits which are not intrinsically safe are armored, metal sheathed or screened, then marking of intrinsically safe circuit cables is not required.

Alternative marking measures shall be taken inside measuring and control cabinets, switchgear, distribution equipment, etc. where there is a risk of confusion between cables of intrinsically safe and non-intrinsically safe circuits, in the presence of a blue neutral conductor. Such measures include:

- combining the cores in a common light blue harness;
- labelling;
- clear arrangement and spatial separation.

Electrical connections to the M12 connector depend on the presence or absence of the Pt1000, and in its presence, whether a 3-wire or a 4-wire connection has been selected. For a connection with no Pt1000, the pins are assigned as in Fig. 4:

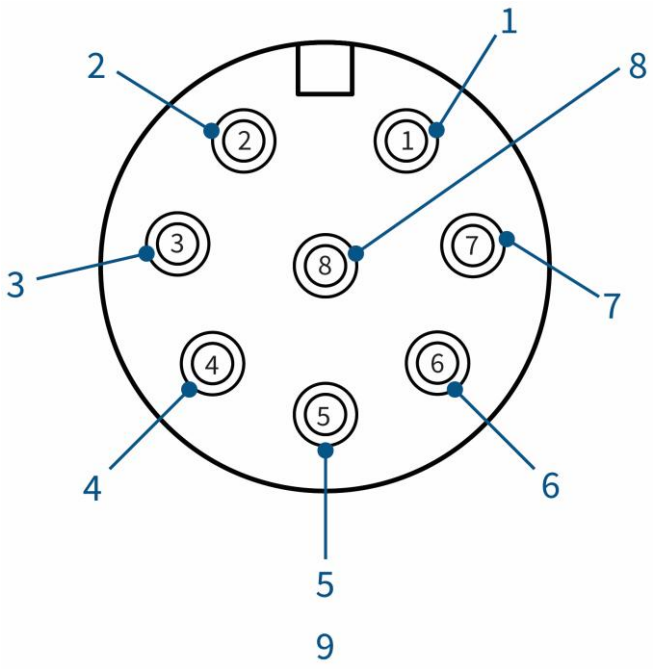
Figure 4: Pinout of M12 connector with no Pt1000 installed



1	1: Transducer coil +
2	2: Transducer coil -
3	3: Not connected
4	4: Not connected
5	5: Not connected
6	6: Not connected
7	7: Not connected
8	8: Not connected
9	Signal assignment version without Pt1000 M12 connector front view

For a connection with 4 wires, the pinout is shown in Fig. 5 below:

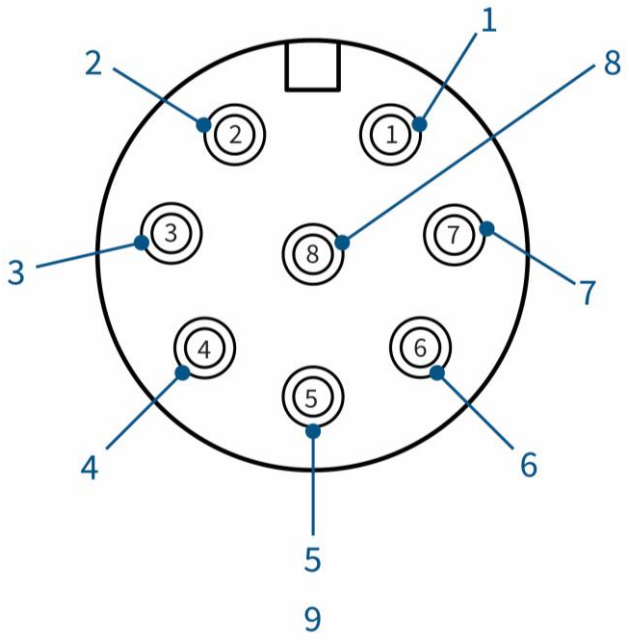
Figure 5: Pinout of M12 connector with 4-wire Pt1000 connection



1	1: Transducer coil +
2	2: Transducer coil -
3	3: Not connected
4	4: Not connected
5	5: Pt1000 Sens +
6	6: Pt1000 Sens -
7	7: Pt1000 I +
8	8: Pt1000 I -
9	Signal assignment Pt1000 4-wire version M12 connector front view

For a connection with 3 wires, the pinout in Fig. 6 is used:

Figure 6: Pinout of M12 connector with 3-wire Pt1000 connection



1	1: Transducer coil +
2	2: Transducer coil -
3	3: Not connected
4	4: Not connected
5	5: Pt1000 Sens +
6	6: Pt1000 Gnd
7	7: Pt1000 I +
8	8: Not connected
9	Signal assignment Pt1000 3-wire version M12 connector front view

In addition, the M12 connector must be rated at IP20 or higher.

Detailed pinout and connection diagrams are given in section 5.3 below.

The cable and connector selected must be rated for at least the highest ambient temperature at which the sensor will be used. They must meet the following specifications:

Parameter	Value
Minimum ingress protection (cable + connector)	IP20
Connector	M12 8 pole, A-coded, female, minimum IP20
Twisted pair cable with a shield	4x2, shielded cable with 4 twisted pairs
Maximum length	500 m.
Minimum required conductor cross section	0.25 mm^2
Maximum inductance	1.5 mH/km, per conductor
Maximum capacitance, conductor-to-conductor	220nF/km
Maximum capacitance, wire to shield	300nF/km

Table 3: Sensor cable specifications

A commercial cable that satisfies the preceding specification is available from Rheonics.

5.2 Zener diode barriers

Each SRV/SRD must be connected to its electronics unit through Zener diode barriers as appropriate to the installation. There are several different connection options, depending on whether or not the SRV/SRD has a built-in Pt1000, and if so, how the Pt1000 is connected (4 or 3 wire connection). The diagrams in section below show these options.

A system that is configured with Zener diode barriers suitable for operation in gas group IIC may also be used in gas group IIB; a system with barriers suitable for group IIB may only be used for IIB

In addition to the proper connection, the Zener diode barriers need to fulfill the electrical specifications shown in the following tables.

The Zener diode barrier connected to the transducer coil circuit must meet the following specifications, depending on whether the sensor will be applied in atmospheres containing gas groups IIC or IIB. A two-channel barrier must be used for the coil circuit. The parameters for the barriers for operation in gas groups IIC and IIB are given in tables 4 and 5 below; table 6 gives the parameters for the Pt1000 circuit:

Max. output voltage	U_o	<10	V
Min. series resistance	R_o	>= 198	Ohm
Max. output current	I_o	<40	mA
Max. output power	P_o	<= 44	mW
Fuse rating		<= 100	mA

Table 4: Coil circuit Zener diode barrier specifications for gas groups IIB

Max. output voltage	U_o	<= 8.61	V
Min. series resistance	R_o	>= 1980	Ohm
Max. output current	I_o	<= 4.4	mA
Max. output power	P_o	<= 9.4	mW
Fuse rating		<= 80	mA

Table 5: Coil circuit Zener diode barrier specifications for gas groups IIC and IIB

Max. output voltage	U_o	<= 10	V
Min. series resistance	R_o	>= 1980	Ohm
Max. output current	I_o	<= 4.4	mA
Max. output power	P_o	<= 9.4	mW
Fuse rating		<= 80	mA

Table 6: Pt1000 (RTD) circuit Zener diode barrier specifications

This Zener diode barrier must have two channels, one for each conductor of the transducer coil circuit.

If the Pt1000 is present in the sensor, it must be connected to one or two Zener diode barriers with the following specification, each with two channels, as specified in Table 7 below.

For a 3-wire connection, a single barrier may be used, with the third (grounding) lead of the Pt1000 circuit connected to ground through the cable shield.

For a 4-wire connection, two Zener diode barriers must be used, with two wires connected to each of the two channels of the Zener diode barriers. This is supported by SME electronics.

The Zener diode barriers must be located outside of the hazardous zone, or in a zone allowed by the manufacturer’s specification. They must be properly grounded.

5.2.1 Commercial Zener diode barriers that fulfill these specifications

For Pt1000 (RTD) circuits (1 or 2 units depending on whether 3 or 4 wire connections are used); applies to both IIC/IIB and IIB gas groups: Pepperl+Fuchs Z041

Series resistance	1957 ohms, min.
Fuse rating	80 mA
Maximum safe voltage	250 V
Output voltage, Uo	8.61 V
Output current, Io	4 mA
Output power, Po	9.4 mW

Table 7: Specification of P+F Z041, each channel

For transducer coil circuit for use with gas group IIB: Pepperl+Fuchs Z042

Series resistance	198 ohms, min.
Fuse rating	100 mA
Maximum safe voltage	250 V
Output voltage, U_o	5.88 V
Output current, I_o	30 mA
Output power, P_o	44 mW

Table 8: Ex parameters for P+F Z042, each channel

For transducer coil circuit for use with gas group IIC and IIB: Pepperl+Fuchs Z041

Series resistance	1957 ohms, min.
Fuse rating	80 mA
Maximum safe voltage	250 V
Output voltage, U_o	8.61 V
Output current, I_o	4 mA
Output power, P_o	9.4 mW

Table 9: Ex parameters for P+F Z041, each channel

5.3 Installation diagrams

The following diagrams show how the sensors, their cables and the associated Zener diode barriers must be connected in order to ensure intrinsic safety of the entire system. In all cases, the Zener diode barriers shall be selected to conform with the requirements of paragraph 5.2 above.

The selected connection method depends on the configuration of the sensor, as well as the choice of temperature measurement connection.

For all variants, the following rules must be followed:

The cable shield must be connected to one of the sensor-side grounding terminals of the Zener diode barrier associated with the transducer coil circuit.

The Zener diode barrier(s) must be grounded to a known-reliable earth ground. It is the responsibility of the installer to ensure the quality and reliability of the selected ground point. Zener diode barriers are delivered with installation instructions that include information about grounding methods. Zener diode barriers that are mounted on DIN rails generally have grounding mechanisms that engage with the rails, which themselves must then be tied to a known-reliable grounding point. It is the responsibility of the installer to ensure that the Zener diode barriers are properly and reliably grounded according to the manufacturer's specifications.

In the event that more than one sensor is used in a system, the decision of how to bond the sensors to a grounding point depends on the layout of the system. One of the configurations shown in section 5.4.3 below may be used, depending on which is the most convenient. In the given examples, a system with three sensors is shown, although larger printing applications may have 10 or more sensors installed on a single machine.

First, we consider different wiring configurations for alternative Pt1000 temperature sensor connections.

Variant 1: Standard sensor with Pt1000 temperature element installed in the sensor tip. 4-wire connection of the Pt1000 circuit to the electronics unit. 2 Zener diode barriers with 2 channels each are required for the Pt1000 circuit. A single 2-channel Zener diode barrier is required for the sensor coil circuit. This configuration provides the highest temperature accuracy, but requires two Zener diode barriers for connection.

Variant 2: Special sensor with no Pt1000 temperature element installed. No Zener diode barriers are required for the Pt1000 circuit. A single 2-channel Zener diode barrier is required for the coil circuit.

Variant 3: Standard sensor with Pt1000 installed, with 3-wire connection to the electronics unit. A single 2-channel Zener diode barrier is required for the Pt1000 circuit. A single 2-channel Zener diode barrier is required for the coil circuit. The advantage of this circuit is that one less Zener diode barrier is required for the installation. Although the electronics unit will function with this circuit, the accuracy of the temperature measurement must be verified and possibly re-calibrated by the end user.

In all cases, the sensor-side diagram shows a ground connection to the sensor labeled “Ground tab (optional)”. This refers to the installation of an equipotential bonding connection to the sensor. The options for bonding to the sensor body are given in section 5.4.2, following the installation diagrams.

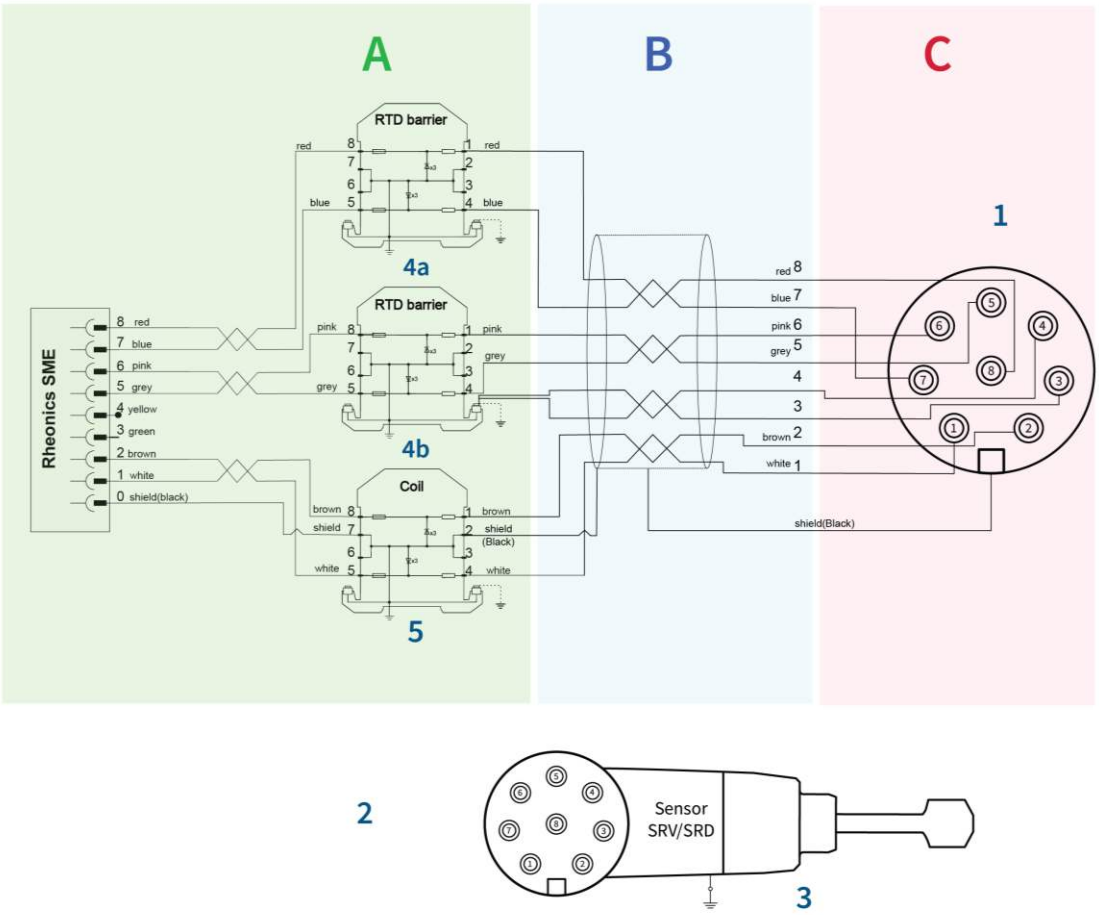
Cable conductor colors are given for convenience only. They reflect cables whose conductors are color coded according to the DIN 47100 norm. It is the installer’s responsibility to verify that the correct M12 cable connector pins are routed to the proper Zener diode barrier terminals, regardless of the actual conductor colors.

In the following wiring diagrams (Figs. 9-11), there are three types of ground connections, labeled “G1”, “G2” and “G3”. For the Zener diode barriers, G2 is the default grounding connection, usually provided by the manufacturer as a grounding clamp that grips the DIN rail on which the Zener diode barrier is mounted. It is the installer’s responsibility to make sure that the DIN rails are securely grounded to a known reliable grounding point.

In the case that secure grounding of the DIN rails cannot be assured, most Zener diode barriers are provided with a screw-clamp grounding terminal labeled G1. In that case, the installer must ground each Zener diode barrier to a known reliable grounding point with a suitable conductor.

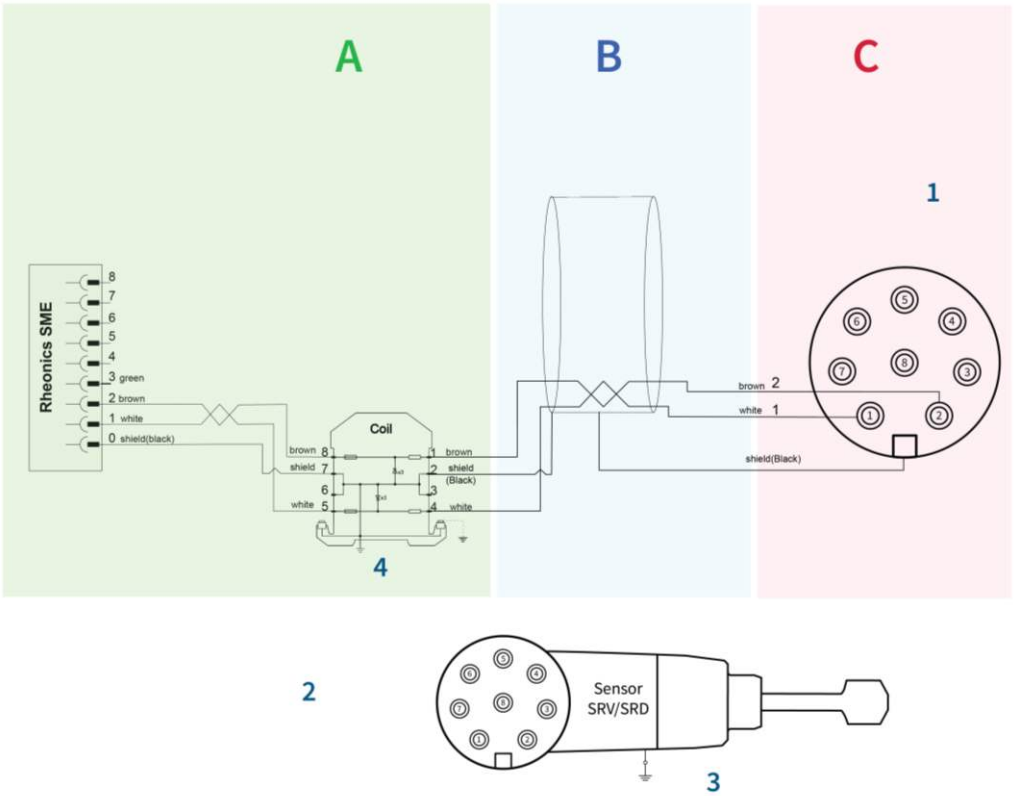
The sensor grounding tab ground connections are labeled “G3” and refer to the sensor’s connection to an equipotential bonding conductor. As described in section 5.4.3 below, there are several options available for equipotential bonding of the sensor. The appropriate method for bonding the sensor should be selected from among these options.

Figure 7: Variant 1 - Wiring diagram with Pt1000 installed, 4-wire Pt1000 connection



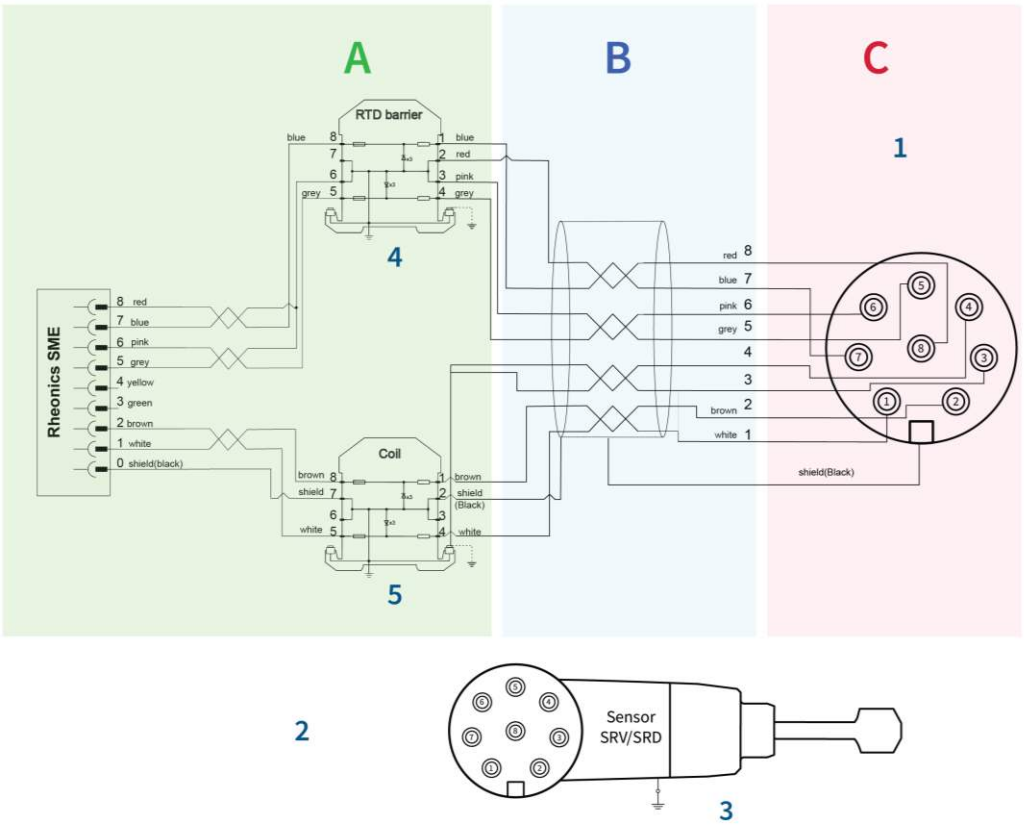
1	M12 cable connector female, rear view
2	Sensor:M12 connector male, front view
3	Ground tab (optional)
4a,4b	RTD (Pt1000) barriers
5	Coil barrier
A	Safe Zone
B	Intrinsically safe cable
C	Hazardous Zone

Figure 8: Variant 2 - Wiring diagram with no Pt1000 installed



1	M12 cable connector female, rear view
2	Sensor:M12 connector male, front view
3	Ground tab (optional)
4	Coil barrier
A	Safe Zone
B	Intrinsically safe cable
C	Hazardous Zone

Figure 9: Variant 3 - Wiring diagram with Pt1000 installed, 3-wire Pt1000 connection



1	M12 cable connector female, rear view
2	Sensor:M12 connector male, front view
3	Ground tab (optional)
4	RTD (Pt1000) barrier
5	Coil barrier
A	Safe Zone
B	Intrinsically safe cable
C	Hazardous Zone

5.4 Equipotential bonding

5.4.1 Bonding/grounding conductor

In order to eliminate the risk of gas ignition by sparks and/or local heating caused by ground loops, the sensors and their associated Zener barriers must be connected by suitable conductors, as specified in the following sections.

There are four different options for equipotential bonding. The first makes use of the cable shield braid to perform the potential equalization function, providing the shield meets certain basic requirements. The other three depend on independent bonding conductors that connect each sensor to the common ground potential.

CAUTION

Sensor cable must not be removed from probe while sensor cable is attached to Zener diode barriers. Always detach sensor cable from barriers before disconnecting sensor from cable!
In case separate equipotential bonding connection is used, this condition may be disregarded.

There are several options available for the equipotential bonding wiring:

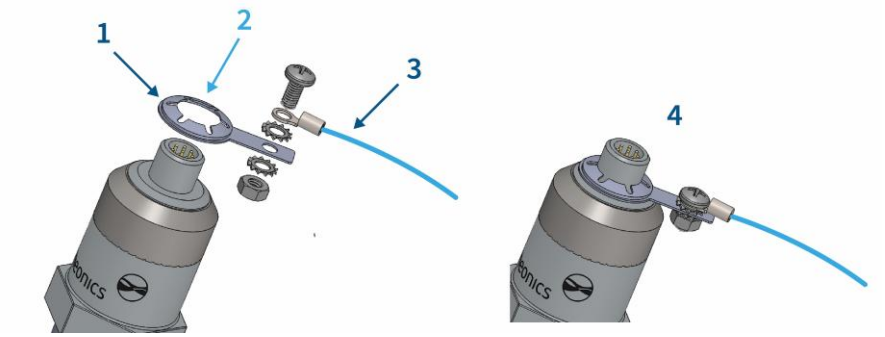
1. Sensor cable shields for equipotential bonding
   1.1. The cable must have a braided shield with a total cross-sectional copper area of at least 2.5mm^2.
   1.2. If it is desired to use the cable shield for equipotential bonding, it is recommended to use Rheonics provided I.S. certified cable for the sensor connection
   1.3. The cable shield must be firmly bonded to the shell of the M12 connector used for the sensor connection. Follow connector manufacturer's installation instructions.
   1.4. The cable shield must be securely connected to the grounding terminal of its associated Zener diode barrier.
2. If a cable other than the recommended type is used, the installer must ensure that its shield cross sectional area is at least 2.5mm^2. If this cannot be verified, then one of the following equipotential bonding methods must be used. *Each of the following methods requires using a sensor with an installed bonding tab. The optional bonding tab is included with each sensor delivered.* Proper installation of the bonding tab is shown in Fig. 12 below.
   2.1. In the case of multiple sensors installed in a specific location that are then connected to Zener barriers in a remote electrical system, a "star" topology can be used (Fig. 13 below)
   2.2. If it is more convenient because of the layout of an array of sensors in the system, a hybrid or "multi-drop" configuration can be used (Fig.14 below).
   2.3. Individual bonding wires between sensors and Zener diode barriers. This requires installing the bonding tab delivered with the sensor. Each

sensor is connected to its respective barrier by means of a wire of at least 4mm^2 cross section. On the sensor side, the wire is connected to the bonding tab on the back of the sensor; on the Zener diode barrier side it is connected to the grounding terminal of the barrier (Fig. 15 below)

5.4.2 Bonding to the sensor

Two options are available for equipotential bonding to the sensor itself. The first makes use of a ground bonding tab that is affixed to the M12 connector shell on the back of the sensor:

Figure 10: Installation of grounding tab on SRV/SRD sensor



1	Crown lock washer with bonding tab
2	Crown lock washer is forced down upon M-12 connector shell. Deformation of hardened teeth guarantees solid contact with threads of connector
3	Equipotential bonding wire
4	Fully assembled grounding tab is permanently installed; cannot be inadvertently dis-lodged

The crown lock washer has an internal diameter that is slightly smaller than the outside diameter of the connector. When forced over the connector shell, the hardened spring fingers of the lock washer dig into the shell slightly, providing both a electrical bond and a solid mechanical connection. The bonding wire, which must have a minimum cross-sectional area of 4mm2, is then connected to the bonding tab by means of a screw, a nut and two toothed lock washers. The crown lock washer leaves sufficient space for normal installation of the M12 sensor connector.

A second option uses the cable shield for equipotential bonding. This can be done provided that the cross-sectional area of the shield conductor is 2.5 mm2Rheonics provided I.S. cable has a shield cross section sufficient to fulfill this requirement. It is then essential to use a suitable M12 cable connector that has a defined ground connection to which the cable shield can be attached. The other end of the cable, whose conductors are attached to the terminals of the Zener diode barriers, must also have a firm attachment of its shield to the grounding terminal of the Zener diode barrier. A recommended method is

to free the conductors from the shield over a length of about 12 cm, and to cover the shield with a length of heat-shrink tubing. The free end of the shield is then crimped into a ferrule, which can then be clamped under the appropriate ground terminal of the Zener diode barrier.

Even if a cable is used whose shield cross sectional area is less than the specified minimum, proper connection of the shield is essential to ensure proper functioning of the sensor. The shield must be connected both to the shell of the connector, as well as to the Zener diode barrier(s), although in that case, the function of preserving intrinsic safety will be performed by one of the following bonding configurations.

5.4.3 Bonding configurations

In the event that a cable with sufficient shield cross sectional area is used, then no additional configuration of the equipotential bonding must be performed.

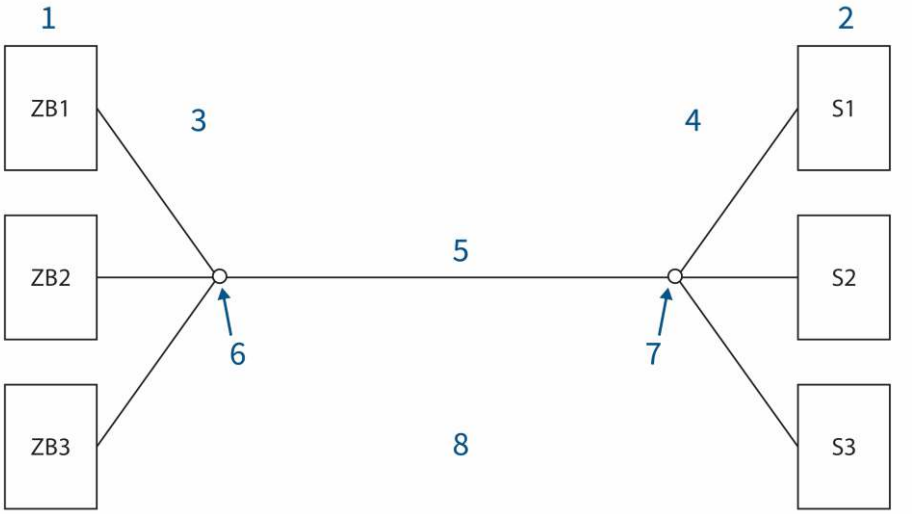
If the shield cross sectional area is insufficient, or cannot be verified, then one of the following methods may be selected.

Three different scenarios are possible, each of which ensures adequate electrical bonding. The particular scheme that is used depends on the overall sensor setup as well as the preference of the installer.

5.4.3.1 Star topology

This is particularly useful where several sensors are installed in one area, and must be connected to their associated Zener diode barriers in an electrical cabinet somewhat remote from the installed sensors. In that case, all the sensors in a given area may be tied to a local grounding point, each with a wire of at least 4mm^2 cross section (ca. 11AWG), and that local grounding point connected to a second grounding point in the remote electrical cabinet by a wire of at least 6mm^2 cross section. Each Zener diode barrier in the electrical cabinet is then connected to the common grounding point by means of a wire of at least 4mm^2 cross section. This is shown schematically in the following figure:

Figure 11: Several sensors grounded to common grounding point ("Star" topology)



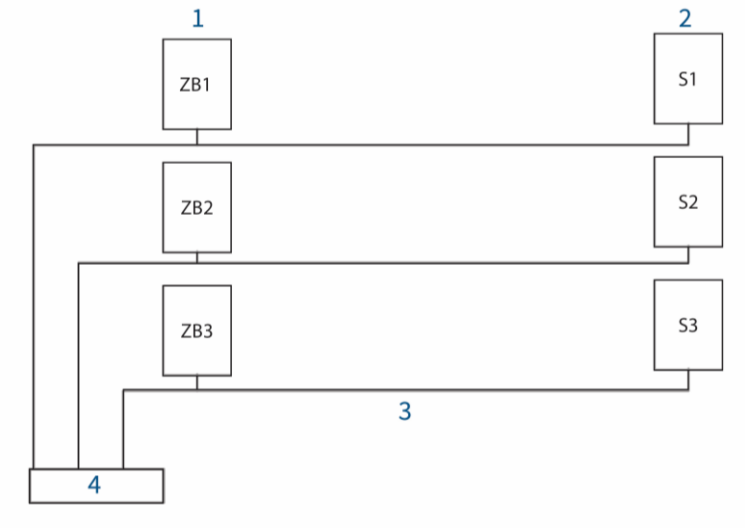
1	Zener Barriers, safe area
2	Sensors, Zone 0
3	4 mm^2 bonding wires (1 per sensor)
4	4 mm^2 bonding wires (1 per sensor)
5	6 mm^2 wire connecting equipment ground point to barrier ground points
6	Common grounding points at equipment
7	Common grounding points at equipment
8	Star connected bonding

5.4.3.2 Individual bonding conductors

A second method, which may be more convenient in situations when the safe zone is close to the sensor installation area, is to use an individual bonding wire of at least 4mm2 cross section connecting each sensor to its associated Zener diode barriers. This is analogous to the use of cable shields for bonding, except that the bonding conductors are now run parallel to the cables.

This arrangement is shown schematically in the following figure:

Figure 12: Individual bonding of sensors to their Zener diode barriers

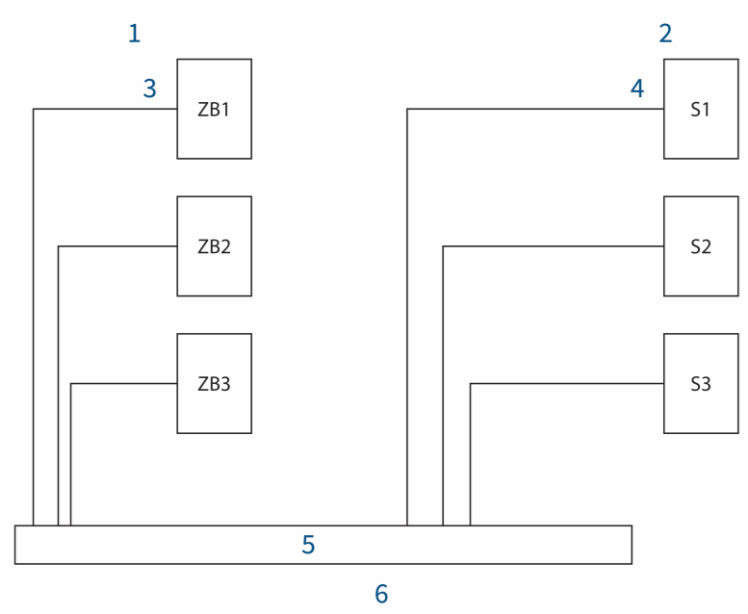


1	Zener Barriers, safe area
2	Sensors, Zone 0
3	4 mm^2 individual bonding wires
4	Individual bonding

5.4.3.3 Multi-drop bonding configuration

A third option, which is a hybrid of the preceding two variants, makes use of a mixture of local grounding rails for both the Zener diode barriers and the sensors, that connect sensor and electronics locales in large distributed apparatus, such as multi-station rotogravure presses. Each sensor and/or Zener diode barrier is connected to a common grounding rail that runs from the sensors to the Zener diode barriers. In this case, each sensor and/or Zener diode barrier must be bonded to the common rail with a conductor of at least 4mm2 cross sectional area, while the common ground rail must have a cross sectional area of at least 6mm2. This arrangement is shown schematically in the following diagram:

Figure 13: Hybrid, or multi-drop bonding



1	Zener Barriers, safe area
2	Sensors, Zone 0
3	4 mm^2 individual bonding wires
4	4 mm^2 individual bonding wires
5	Grounding rail (minimum 6mm^2 cross section)
6	Multi-drop bonding

In any event, it is the sole responsibility of the installer to ensure proper equipotential bonding of all elements of the system, to avoid creation of a potentially unsafe system due to improper bonding.

6 Maintenance

6.1 Sensor Maintenance

No user maintainable parts or components are in the Sensor probe or electronics.

CAUTION

Sensor cable must not be removed from probe while sensor cable is attached to Zener diode barriers. Always detach sensor cable from barriers before disconnecting sensor from cable!
In case separate equipotential bonding connection is used, this condition may be disregarded.

The sensor probe can be cleaned by switching off the power, removing the probe from the process and cleaning the probe with a solvent compatible with 316SS. After cleaning the probe, clean and dry the sensor with compressed air before inserting it back it the process. It is not recommended to use an ultrasonic bath for cleaning. Sensor should only be powered after all connections are in place including equipotential bonding.

6.2 Internal Maintenance

Please make sure that the internals of the unit always stay dry and clean. There are no user maintainable components inside the electronic compartment.

7 Returning Equipment to the factory

Instructions for Returning Your Instrument for Service

The following information will help you return your instrument to Rheonics and will ensure that your order is processed promptly. To request details, contact your local Rheonics distributor or contact one of our offices directly.

Please follow these easy steps to return your instrument for factory service:

1) To obtain a Return Materials Authorization (RMA) number from Rheonics, submit a support ticket with subject “RMA Request for Ex sensor” – https://support.rheonics.com/support/tickets/new
2) Rheonics Support Team will provide you with an RMA Number/Reference number to be used with the shipment.
3) Pack your instrument carefully. Use the original packaging and foam or bubble wrap and include the Reference Number/RMA number with the unit(s).

   Ship the unit(s) to the address on the RMA. Include RMA/Reference Number ***(Your RMA Number – supplied by Rheonics)*** *on the shipment.*

8 Intrinsic safety certificates – National EX labels

Web link: ATEX Certificate
(Scan to access the document)

Web link: IECEx Certificate

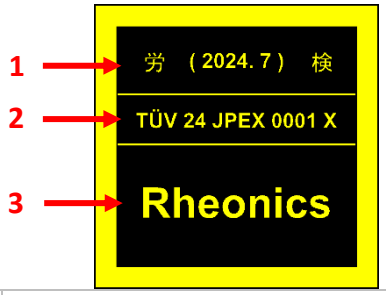
(Scan to access the document)

For latest certificates of Rheonics products, solutions & electronics, visit:
https://rheonics.com/resources/certificates/

8.1 National markings

8.1.1 JPEx: Japan EX certification label

Web link: JPEx Certificate
(Scan to access the web link)



1	Certification date
2	Certification label and number
3	Certified manufacturer company

8.1.2 KCs: Korean EX certification label

Web link: KCs Certificate
(Scan to access the web link)

1	KCs Logo
2	Certificate label e.g. -0051X for gas and -0052X for dust

8.1.3 Additional National Certificates

Other national certificates for other countries are available online.
Web link: National / Regional Certificates
(Scan to access the web link)

9 Revisions and approvals

Version	Nature of changes	Approvals	Date
1.0	Original version	S. Kumar, J. Goodbread	22.06.2020
2.0	1. Minor edits in the existing sections. 2. Update of address and addition of revisions table. 3. Inclusion of the following sections: • Safe Use of ATEX approved equipment • Maintenance and procedures of return of equipment	S. Kumar, J. Goodbread	29.10.2020
3.0	1. Update of coil and PT1000 Ex relevant parameters (table 1). 2. Update of barrier specification (table 4, table 5, table 6).	S. Kumar, J. Goodbread	30.09.2022
3.1	1. Update of coil and PT1000 Ex relevant parameters (table 1).	S. Kumar	23.02.2023
4.0	1. Update of the overall coil parameters for Type-SR sensor probes 2. Update of the EX barrier used for coil	J. Goodbread D. Brunner S. Kumar	22.12.2023
4.1	1. Update of coil and PT1000 Ex relevant parameters (table 1). 2. Inclusion of Zener barrier variants specifications (table 5, table 6, table 7). 3. Detailed barrier labels for installation diagrams (figure 7, figure 8, figure 9).	J. Goodbread D. Brunner S. Kumar	22.01.2024
4.2	1. National Ex Certificates added.	S. Kumar	14.04.2025

10 Notes/Erratas

(Scan to access the
Rheonics Support Portal)

For more information:
https://support.rheonics.com/en/support/home