

# Intrinsically Safe Interface Solutions

## Intrinsically Safe Solutions

This is a guide to using the [E2S Intrinsically safe sounders and beacons](#), it is based on the Atex certification but in general the guidelines apply to other intrinsic safety certifications including North American FM and IECEx. It is not intended as a definitive guide to intrinsic safety and or a complete review of the subject.

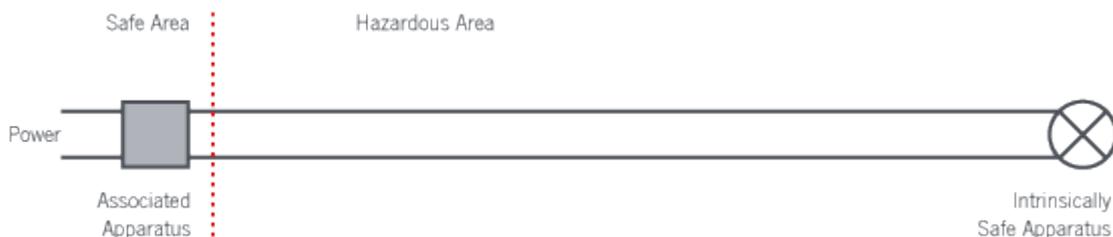
Please refer to the Intrinsic Safety Certificate and installation instructions for individual equipment with reference to the relevant local and national standards.

**Intrinsic Safety** is a protection technique based upon the restriction of electrical energy to a level below that which can cause ignition by either sparking or heating effects. It is a system concept; unlike most other hazardous area protection methods, such as flameproof Ex d, all items in an intrinsically safe circuit must be taken into consideration.

An Intrinsically safe circuit is typically defined as:

**A circuit in which any spark or thermal effect produced in normal operation and specified fault conditions is not capable of causing ignition**

So the preservation of intrinsic safety depends on the strict control of energy in the circuit and therefore the whole circuit needs to be considered, not just the field apparatus in isolation.



**Associated apparatus** is the name given to the piece of equipment which is responsible for controlling the level of voltage and current which will be permitted to enter the intrinsically safe circuit within the hazardous area.

It **preserves** the integrity of the intrinsically safe field device (it does not make it safe) and takes the form of an interface between the safe area and the hazardous area and is usually a zener barrier or isolation interface colloquially both types are generally referred to in context as barriers or isolators. The associated apparatus is located in the safe area near to where the intrinsically safe connections can be passed to the hazardous area. This of course may be inside another piece certified equipment such as an Ex d enclosure, which in effect creates a local safe area inside.

**Additional certification (Ex N)** for the associated apparatus may be utilised e.g. many zener barriers are approved to Ex N which allows the interface to be installed in a Zone 2 hazardous areas with appropriate enclosure. In this case in the context of the intrinsically safe circuit it is assumed the interface is in the safe area.

**Cables** have also to be taken in to consideration. Interconnecting cables include reactance which will have an effect on the storage of energy in the circuit. The calculation of cable requirements is out with the scope of this document. However, as intrinsic safety is low power, and is usually installed with small diameter cabling cable runs are rarely an issue. For more information on this please contact us.

Unlike other protection techniques cable requirements for intrinsic safety are not onerous. Armoured cable is not necessary and the minimum requirements are for double insulated cable only. However local site standards may over-ride the minimum requirements.

**IP Rating** for an intrinsically safe installation is on IP20. However in practice a higher IP rating is usually required to meet environmental conditions or site standards.

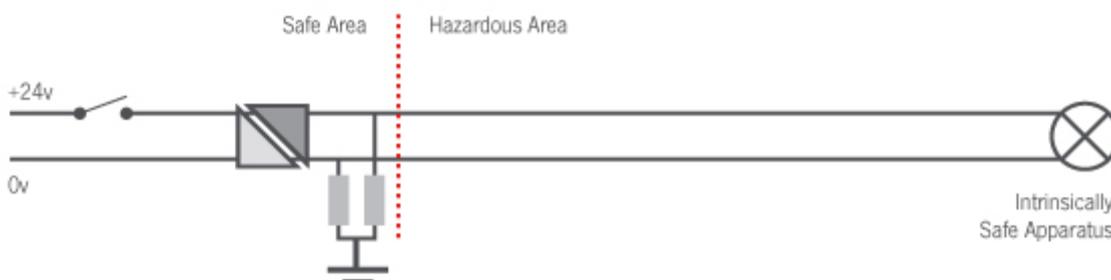
### Interface selection: Zener barriers or isolation interfaces

The decision between these two types of interface will normally be down to site preferences and both have advantages and disadvantages.

**Zener barriers** are much simpler than isolation interfaces and tend to be more flexible in application. Generally zener barriers can be used in different circuits. Isolation interface's tend to be designed for a specific application and are limited in the way they are used.

**Earthing** with Zener barriers is perceived to be difficult as they have a strict Earthing requirement although in practice this rarely a problem. Maintaining an intrinsic safety earth is not as difficult as some believe but, particularly when only a few zener barriers are used, it can introduce extra complication and cost.

**Isolation interfaces** (also known as Galvanic Isolators) do not require the same degree of integrity on the Earth as zener barrier interfaces. However to avoid the risk of cables charging to uncontrolled potentials and so acquiring stored capacitive energy which may be incendive, a discharge path to Earth should be provided. This would typically be between  $200k\Omega$  and  $1M\Omega$  and is not deemed to be earthing in terms of the instrumentation loop.



## Selecting an intrinsic safety interface

The associated apparatus (intrinsic safety interface) preserves the integrity of the field device such as E2S sounder or beacon. It can only do this if it limits the energy by way of voltage and current to a level below the maximum permitted by field device.

These values are the **entity parameters** (often referred to as safety parameters) and consist of voltage current power capacitance and inductance. All of these may not always be specified if they are irrelevant or can be derived directly from the other parameters.

**The E2S sounders and beacons main terminals all have the same entity parameters** (The suffix “i” denotes input characteristics)

$$U_i = 28v \quad | \quad I_i = 93mA \quad | \quad P_i = 660mW$$

This means that the integrity of the apparatus is maintained, i.e. is it is safe, providing these figures are not exceeded. Therefore the associated apparatus (barrier) must have parameters of less than or equal to these figures.

Note that the power figure is not the direct calculation based on Voltage and Current; these are entity or safety parameters not actual working values.

## The capacitance and inductance figures

$$C_i = 0\mu F \quad | \quad L_i = 0mH$$

Refer to the capacitance or inductance that the apparatus contributes to the circuit. In the case of E2S sounders and beacons this is zero which simplifies the safety assessment of the circuit.

**A suitable barrier would have entity parameters of**

$$U_o \leq 28v \quad | \quad I_o \leq 93mA \quad | \quad P_o \leq 660mW$$

## Zener barriers: intrinsic safety solutions

These are typical system diagrams using Isolation interfaces for E2S Intrinsically safe sounders and beacons.

The following circuits are for are for illustration only, installation and details may be omitted for clarity.

Please refer to the relevant certification prior to use. As all E2S sounder and beacons have the same entity parameters in most circuits different E2S intrinsically safe field apparatus may be used providing it has the relevant input feature. Where examples show the IS-mini range a direct replacement can be made using the IS-A105N and IS-L101L or combination.

[Please contact E2S for further information.](#)

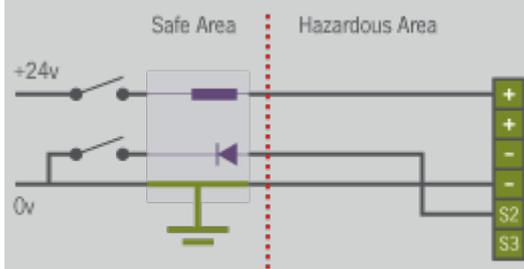
The basic installation is straightforward on/off control using a zener barrier with entity parameters 28v 93mA (often referred to as 28v 300Ω) which is an industry standard barrier (Power driver).

This is suitable for all E2S Intrinsically safe sounders and beacons.

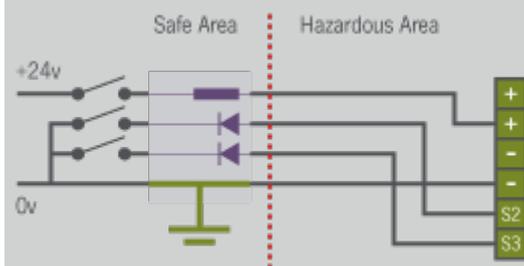


To simplify drawings the rest of the illustration do not show the representative voltage clamping diode.

The 2nd tone on a sounder is switched down to zero volts. This can be achieved in the safe area by using a Diode return barrier.



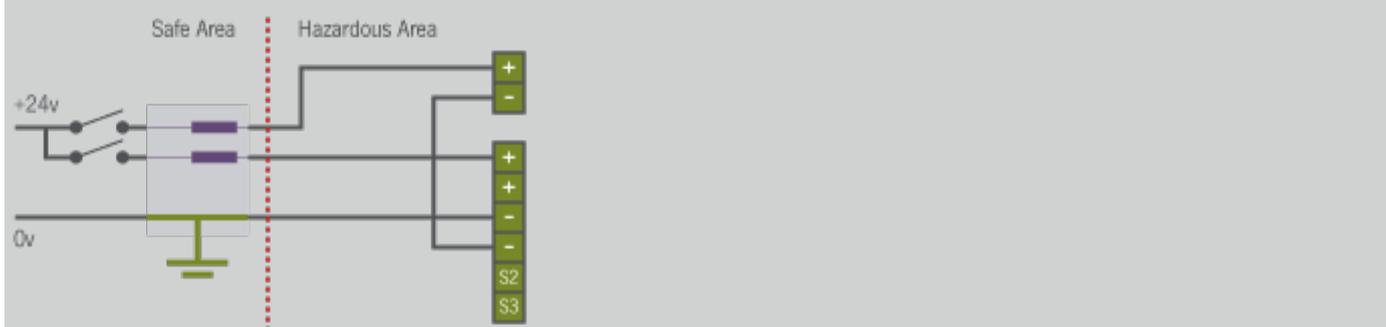
Similarly another diode return can be added for the 3rd stage audible alarm. This can be achieved with a single 3 channel barrier.



The sounder and beacon IS-mC1 or the combination of IS-105N and IS-L101 can be powered from a single zener barrier. Similarly an IS-mA1 plus IS-mb1 could be run from a single zener barrier.



For independent control use a double channel Zener barrier.



Again with the option of 2nd tone switch. This can be extended further using 2 power and diode returns zener barriers to switch the 3rd alarm tone (not shown).



The combined IS-A105N / IS-L101L has a mute option, adding a switch will mute the alarm.

Depending on the DIP switch settings on the IS-L101 reset occurs:

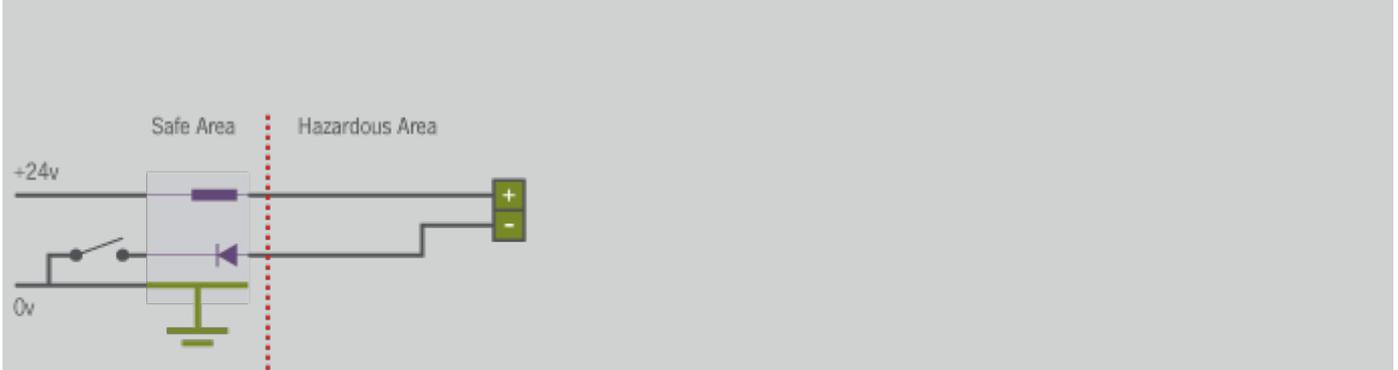
On alarm condition being removed i.e. power down of IS-L101L or after a dip switch selectable interval - from 5 seconds to 2 hours.

Note the reset switch does not need to be certified as it is considered to be simple apparatus.

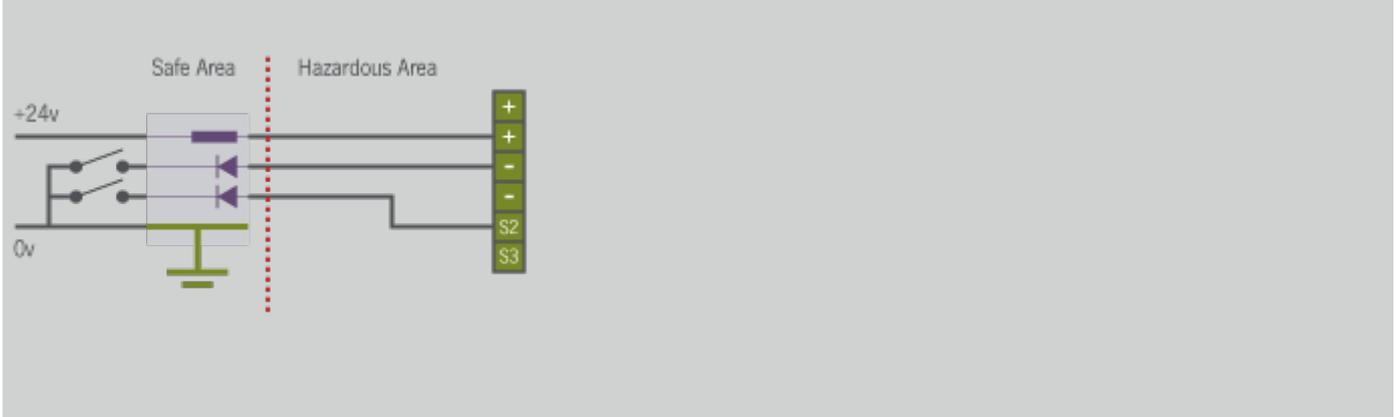


However many DCS cards use pull down signals such as open collector, common emitter outputs. Then a common power feed would be used with all switching being done via a diode return barrier.

Here is a simple on off control.



Adding another diode return gives a second stage alarm.



Should you manufacture a suitable intrinsically safe interface or wish to comment on these applications please email [sales@e2s.com](mailto:sales@e2s.com)

EN1127-1 Explosive atmospheres: Explosion prevention and protection  
 Part 1: Basic concepts and methodology

EN 60079 ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES  
 Part 0 General requirements  
 Part 14 Installation (and selection) of equipment in hazardous areas  
 Part 25 Intrinsically safe systems

Suggested reference book on intrinsic safety and hazardous areas Electrical Apparatus and Hazardous Areas by Robin Garside.  
 5th Edition 2007 ISBN 978-0-9516848-4-9

**Zener Barriers**

Any interface with parameters

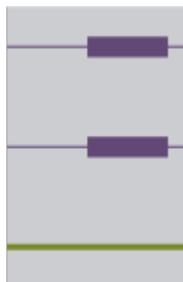
.....  
 $U_o \leq 28v \quad I_o \leq 93mA \quad P_o \leq 660mW$   
 .....

or for the Diode return channel

.....  
 $U_o \leq 28v \quad I_o \leq 0mA$   
 .....

**Double Power**

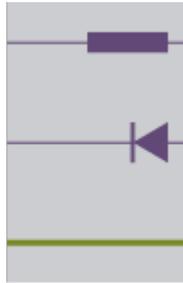
Pepperi & Fuchs  
**Z779**  
 Stahl  
**9002/11-280-186-001**



.....

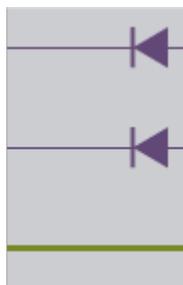
**Power Plus  
Diode Return**

Pepperi & Fuchs  
*Z787 or Z787F*  
MTL  
*7787+ or 7707+*  
Stahl  
*9002/13-280-093-001*



**Double Diode Return**

Stahl  
*9002/33-280-000-001*



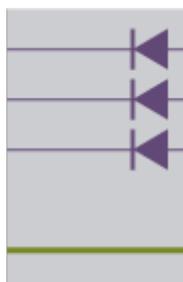
**Power +  
2x Diode Return**

Pepperi & Fuchs  
*Z789*  
MTL  
*7789+*



**Triple Diode Return**

Pepperi & Fuchs  
*Z786*

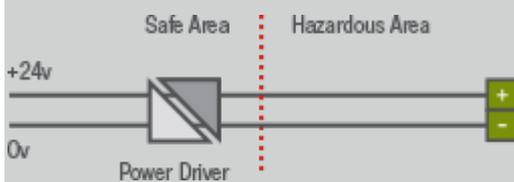


## Isolation interfaces: Intrinsic safety solutions

These are typical system diagrams using isolation interfaces for [E2S intrinsically safe sounders and beacons](#). The following circuits are for illustration only, installation and details may be omitted for clarity.

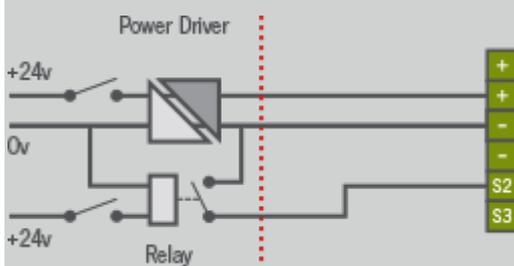
Please refer to the relevant certification prior to use. As all E2S sounder and beacons have the same entity parameters in most circuits different E2S intrinsically safe field apparatus may be used providing it has the relevant input feature. Where examples show the IS-mini range a direct replacement can be made using the [IS-A105N](#) and [IS-L101L](#) or combination. Please contact E2S for further information.

The simplest installation is with a Single stage alarm with a single channel isolation interface (Power driver). This is suitable for all E2S Intrinsically safe sounders and beacons.

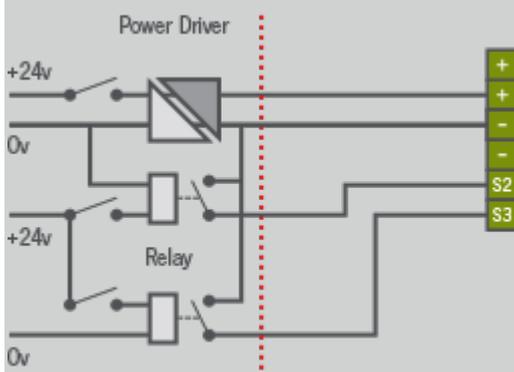


When using isolation interfaces the integrity of the isolation must be maintained so an intrinsically safe relay is used to switch the second stage alarm.

Although the relay contacts can be treated as simple apparatus, the relay must be certified. (see list of suggested relays)



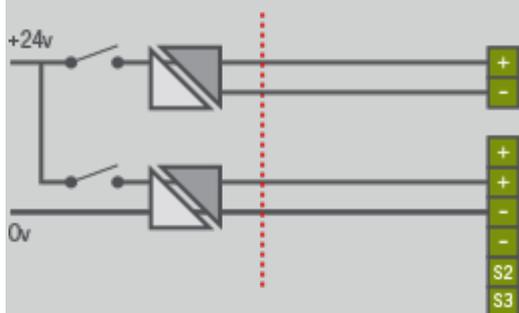
Similarly add another relay (or a double relay module) for the 3rd stage audible alarm.



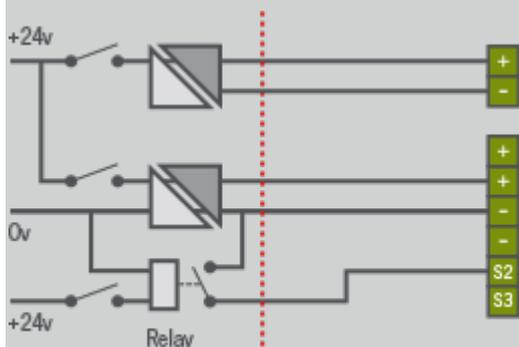
The sounder and beacon IS-MC1 or the combination of IS-105N and IS-L101 can be powered with a single channel interface.



For independent control use a double channel, or 2 separate isolation interfaces.



Again adding a relay gives 2nd level alarm option.



The combined IS-A105N / IS-L101L has a mute option, adding a switch will mute the alarm.

Depending on the DIP switch settings on the IS-L101 reset occurs:

On alarm condition being removed i.e. power down of IS-L101L or after a dip switch selectable interval - from 5 seconds to 2 hours.

Note the reset switch does not need to be certified as it is considered to be simple apparatus.



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## Relays

Any interface with parameters

$U_o \leq 28v$     $I_o \leq 93mA$     $P_o \leq 660mW$

Relays have volt free contacts which can be treated as Simple Apparatus. However, the relay must still be certified... e.g.

## Single Power



Pepperi & Fuchs  
**KFD0-SD2-Ex1.1045**  
 MTL / RTK Eng  
**5025**

**Dual channel power**



Pepperi & Fuchs  
**KFD0-SD2-Ex2.1045**



**Relay**



MTL / RTK Eng  
**DAA149**

**Dual channel relay**



Pepperi & Fuchs  
**KFD0-RO-Ex2**



E2S offers a range of [intrinsically safe sounders, beacons and manual call points](#) which can be viewed [here](#), or by visiting [www.e2s.com](http://www.e2s.com) when online.