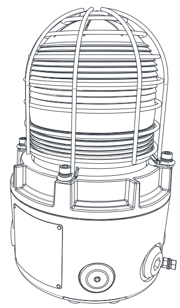


1) Warnings

- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT
- DO NOT OPEN WHEN ENERGISED
- POTENTIAL ELECTROSTATIC CHARGING HAZARD - CLEAN ONLY WITH A DAMP CLOTH
- HIGH VOLTAGE SHOCK HAZARD. WAIT 5 MINUTES AFTER REMOVING POWER BEFORE OPENING THE ENCLOSURE
- DO NOT PAINT
- TO REDUCE THE RISK OF IGNITION OF HAZARDOUS ATMOSPHERES, THE FIRST CONDUIT RUN MUST HAVE A SEALING FITTING CONNECTED WITHIN 18 INCHES OF ENCLOSE. SUBSEQUENT CONDUIT RUNS MUST HAVE A SEALING FITTING CONNECTED AS CLOSE AS PRACTICAL TO THE WALL OF THE ENCLOSURE, BUT IN NO CASE MORE THAN THE SIZE OF THE CONDUIT OR 50MM, WHICHEVER IS THE LESSER.
- TO PREVENT IGNITION OF GROUP A, B, C AND D ATMOSPHERES - SEE INSTRUCTION FOR CHEMICAL COMPATIBILITY

Avertissement:

- NE PAS OUVRIR UN PRESENCE D'ATMOSPHERE EXPLOSIVE
- NE PAS OUVRIR ENERGIE
- DANGER POTENTIEL CHARGE ÉLECTROSTATIQUE - NETTOYER UNIQUEMENT AVEC UN CHIFFON HUMIDE
- HAUT TENSION, RISK DE CHOC. ATTENDEZ 5 MINUTES APRES AVOIR DEBRANCHE L'ALIMENTATION AVANT D'OUVRIR LA BOITIER
- NE PAS PEINTURER
- POUR RÉDUIRE LE RISQUE D'INFLAMMATION DES ATMOSPHÈRES DANGEREUSES, LE PREMIER CONDUIT DE CONDUIT DOIVENT AVOIR UN RACCORD D'ÉTANCHÉITÉ RACCORDÉ À MOINS DE 18 POUCES DE L'ENFERMEMENT. POUR SUBSÉQUENT LES CONDUITES DE CONDUIT LA DISTANCE ENTRE LA SURFACE DE LA MASSE DE REMPLISSAGE AU PLUS PRÈS DE L'ENVELOPPE DOIT ÊTRE AUSSI PETITE QUE CE QUI EST RÉALISABLE MAIS EN AUCUN CAS SUPÉRIEURE À LA PLUS PETITE DES DIMENSIONS CORRESPONDANT À LA TAILLE DU CONDUIT OU À 50 MM.
- POUR PRÉVENIR L'INFLAMMATION DES ATMOSPHÈRES DES GROUPES A, B, C ET D-VOIR L'INSTRUCTION POUR LA COMPATIBILITÉ CHIMIQUE

2) Rating & Marking Information

2.6 ATEX / IECEx certification

The D1xB2X Xenon beacons comply with the following standards:

EN IEC60079-0:2018 / IEC60079-0:2017 (Ed 7)
EN60079-1:2014 / IEC60079-1 (Ed. 7) (2014)
EN60079-31:2014 / IEC60079-31 (Ed. 2) (2013)

The D1xB2X05DC024 Xenon Beacons are rated as follows:

Ex db IIC T4 Gb Ta -55°C to +80°C
Ex db IIC T5 Gb Ta -55°C to +75°C
Ex db IIC T6 Gb Ta -55°C to +60°C
Ex tb IIIC T104°C Db Ta -55°C to +80°C

The D1xB2X10DC024 Xenon Beacons are rated as follows:

Ex db IIC T4 Gb Ta -55°C to +80°C
Ex db IIC T5 Gb Ta -55°C to +45°C
Ex tb IIIC T135°C Db Ta -55°C to +80°C

The D1xB2X15DC024 Xenon Beacons are rated as follows:

Ex db IIC T3 Gb Ta -55°C to +80°C
Ex db IIC T4 Gb Ta -55°C to +65°C
Ex tb IIIC T146°C Db Ta -55°C to +80°C

Certificate No. DEMKO 19 ATEX 2009X
IECEx ULD 19.0006X

ATEX Mark, Equipment Group and Category: **II 2G** **II 2D**

CE Marking Notified Body No.: **2813**

The units can be installed in locations with the following conditions:

Area Classification:

Zone 1	Explosive gas air mixture likely to occur in normal operation.
Zone 2	Explosive gas air mixture not likely to occur in normal operation, and if it does, it will only exist for a short time.

Zone 21	Explosive dust air mixture likely to occur in normal operation.
Zone 22	Explosive dust air mixture not likely to occur in normal operation, and if it does, it will only exist for a short time.

Gas Groupings:

Group IIA	Propane
Group IIB	Ethylene
Group IIC	Hydrogen and Acetylene

Temperature Classification:

T1	450ºC	
T2	300ºC	
T3	200ºC	D1xB2X15DC up to 80°C ambient
T4	135ºC	D1xB2X05DC & D1xB2X10DC up to 80°C ambient, D1xB2X15DC up to 65°C ambient
T5	100ºC	D1xB2X05DC up to 75°C ambient, D1xB2X10DC up to 45°C ambient
T6	85ºC	D1xB2X05DC up to 60°C ambient

Dust Groupings:

Group IIIA	Combustible Flyings
Group IIIB	Non-conductive Dust
Group IIIC	Conductive Dust

Maximum Surface Temperature for Dust Applications:

104°C (D1xB2X05DC)
135ºc (D1xB2X10DC)
146°C (D1xB2X15DC)

Equipment Category: 2G / 2D

Equipment Protection Level: Gb, Gc, Db, Dc

Ambient Temperature Range:
-55°C to +80°C
(D1xB2X05DC, D1xB2X10DC, D1xB2X15DC)

The certification approval has validated continuous use up to 38°C ambient and are for transient use up to 80°C ambient.

2.7 Ingress Protection Ratings

The product is rated for ingress Protection as follows:
IP rating per EN60529: IP66

Suitable for exposure to Acetone , Ammonium Hydroxide , Diethyl Ether , Ethyl Acetate , Ethylene Dichloride , Furfural, n-hexane , Methyl Ethyl Ketone , Methanol , 2-NitroPropane and Toluene.

To maintain the ingress protection rating, the cable entries must be fitted with suitably rated, certified cable entry and/or blanking devices during installation.

2.8 Electrical Ratings

It is important that a suitable power supply is used to run the equipment. The power supply selected must have the necessary capacity to provide the input current to all the units.

Model	Nom. Voltage	Voltage Range	Nom. operating current	Max Current
D1xB2X05DC024	24Vdc	20-28Vdc	295	350
D1xB2X10DC024	24Vdc	20-28Vdc	605	710
D1xB2X15DC024	24Vdc	20-28Vdc	835	920

#Rated at 1Hz

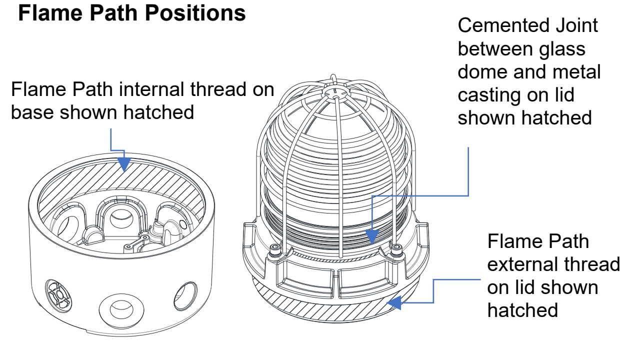
Table 1: Electrical Ratings

The input current will vary according to the voltage input level.

3) Special Conditions of Use

The enclosure coating is non-conductive and may generate an ignition-capable level of electrostatic charges under certain extreme conditions. The user should ensure that the equipment is not installed in a location where it may be subjected to external conditions (such as high pressure steam) which might cause a build-up of electrostatic charges on non-conducting surfaces. Additionally, cleaning of the equipment should be done only with a damp cloth.

Flame Path Positions



4) Installation

There are no restrictions on unit orientation.

The junction box must only be installed by suitably qualified personnel in accordance with the latest issues of the relevant standards:

EN60079-14 / IEC60079-14: Explosive atmospheres - Electrical installations design, selection and erection
EN60079-10-1 / IEC60079-10-1: Explosive atmospheres - Classification of areas. Explosive gas atmospheres
EN60079-10-2 / IEC60079-10-2: Explosive atmospheres - Classification of areas. Explosive dust atmospheres

The installation of the units must also be in accordance with any local codes that may apply and should only be carried out by a competent electrical engineer who has the necessary training.

4.1 Safe Installation Requirements

To maintain the ingress protection rating and mode of protection, the cable entries must be fitted with suitably certified cable entry and/or blanking devices during installation. If conduit is used for installation, seal conduit within 18 inches from the enclosure.

If entries are fitted with adaptors they must be suitably certified for the application. Fitting of blanking elements into adaptors is not permitted.
Check that the 'O' ring seal is in place before replacing the explosionproof cover.

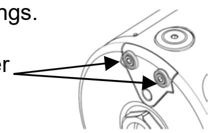
5) Location and Mounting

The location of the beacon should be made with due regard to the area over which the warning signal must be visible. It should only be fixed to services that can carry the weight of the unit.

The D1xB2X beacon can be mounted using one of three methods.

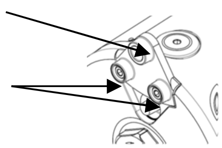
1. The beacon can be surface mounted by removing, rotating and reinstalling the stowed mounting lugs. These are suitable for 6mm diameter fixings.

   a. Remove 2 x M5 fasteners per mounting lug



   b. Reverse and rotate lug and reseat onto enclosure

   c. Secure lug using the 2 x M5 Fasteners



2. Alternatively the beacon can be conduit mounted using the ¾"NPT entry on the base of the unit.

3. Additionally, the beacon can be mounted using the ratchet adjustable stainless-steel wall bracket assembly. This is available as an accessory – part code: SP77-0001.

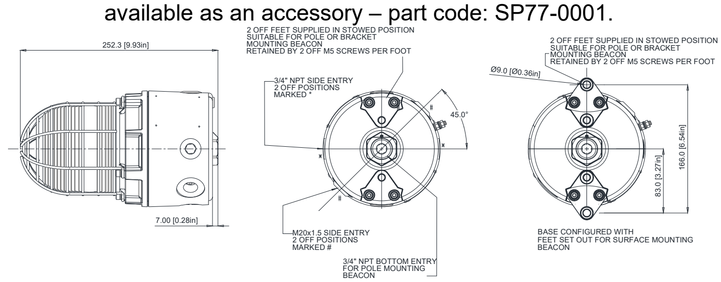


Fig. 1 Fixing Location for Beacon

6) Access to the Enclosure

Warning – High voltage may be present, risk of electric shock. DO NOT open when energised, disconnect power before opening.

Warning – Hot surfaces. External surfaces and internal components may be hot after operation, take care when handling the equipment.

In order to connect the electrical supply cables to the beacon, it is necessary to open the explosion proof enclosure. Loosen the locking grub screw in the cover and then remove the glass dome cover assembly to gain access to the chamber. This can be achieved by unscrewing the glass dome cover, taking extreme care not to damage the threads when doing so.

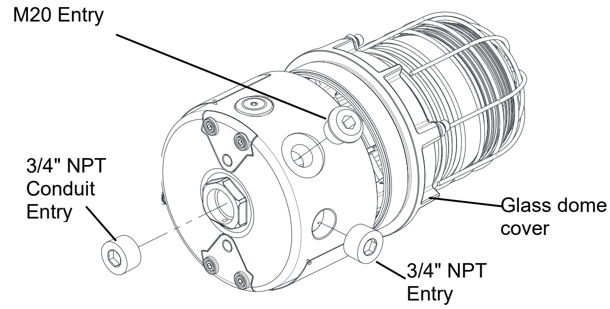


Fig. 2 Accessing the Enclosure.

On completion of the installation the flameproof threads should be inspected to ensure that they are clean and that they have not been damaged during installation. Ensure the O-ring seal is in place and undamaged.

When fitting the flameproof cover ensure the thread is engaged correctly. Fully tighten the cover all the way, ensure no gap is visible between the cover and base of the beacon enclosure.

7) Selection of Cable, Cable Glands, Blanking Elements & Adapters

When selecting the cable size, consideration must be given to the input current that each unit draws (see section 11), the number of beacons on the line and the length of the cable runs. The cable size selected must have the necessary capacity to provide the input current to all of the beacons connected to the line.
The entries are 2-off M20 x 1.5 thread & 3-off ¾" NPT thread

If a high IP (Ingress Protection) rating is required then a suitable sealing washer must be fitted under the cable glands or blanking plugs.

For use in explosive dust atmospheres, a minimum ingress protection rating of IP6X must be maintained.

For use in explosive gas atmospheres, a minimum ingress protection rating of IP54 must be maintained.
NPT plugs should be greased before insertion.

For high ambient temperatures the cable entry temperature or the cable branching point temperature may exceed 60ºC and therefore suitable heat resisting cables and cable glands must be used, with a rated service temperature of at least the values stated below:

	Max Ambient Temp °C	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
Req. cable /	D1xB2X05											61	66	71	76	81	86	91	96
cable gland	D1xB2X10							63	68	73	78	83	88	93	98	103	108	113	118
rating °C	D1xB2X15						64	69	74	79	84	89	94	99	104	109	114	119	124

8) Cable Connections

The units have 2-off M20 x 1.5 threaded entries and 3-off ¾” NPT x 14 threaded entries.

Electrical Connections are to be made into the terminal blocks using solid or stranded wire, sizes 0.5-2.5mm2 / AWG 20-14. Wire insulation needs to be stripped 6-7mm. Wires may be fitted securely with crimped ferrules. Terminal screws need to be tightened down with a tightening torque of 0.4 Nm / 3.5 Lb-in.

See section 5 of this manual for access to the enclosure.

9) Wiring

A 4-way terminal block is provided on the DC beacons for power. There are 2-off +ve, 2-off –ve terminal and an internal Earth boss.

9.1 Wiring Diagrams

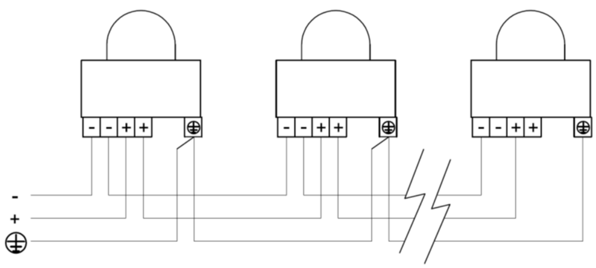


Fig. 3 D1xB2X Simplified Block Diagram

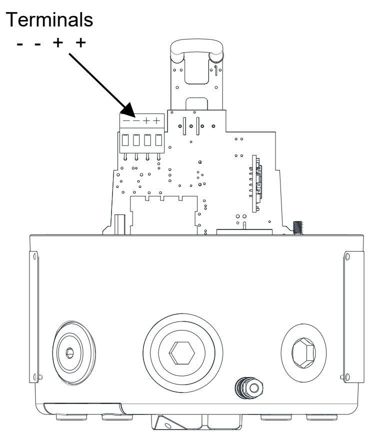


Fig. 4 D1xB2XDC Terminals

9.2 Line Monitoring

On the D1xB2X unit, DC reverse line monitoring can be used if required.
All DC beacons have a blocking diode fitted in their supply input lines. An end of line monitoring resistor can be connected across the +ve and –ve terminals in the explosion proof enclosure. If an end of line resistor is used it must have the following values:

Minimum resistance 3K3 Ohms Minimum Power 0.5W
Minimum resistance 500 Ohms Minimum Power 2.0W

The resistor must be connected directly across the +ve and -ve terminals as shown in the following drawing. Form the resistor legs as shown in Fig. 7a, fit the resistor across the two terminals, as shown in Fig. 7b.

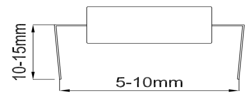


Fig. 7a End of Line Resistor Forming

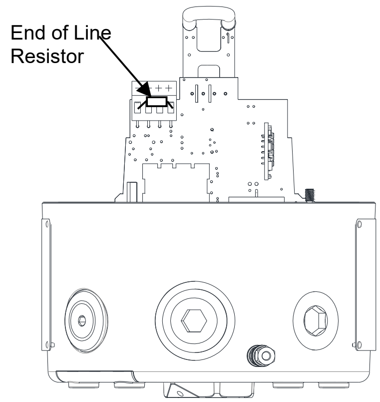


Fig. 7b End of Line Resistor Placement

10) Earthing

The unit has an external and an internal earth terminal, (please see fig 8).

Internal earthing connections should be made to the internal Earth terminal in the base of the housing using a ring crimped terminal to secure the earth conductor under the earth clamp. The earth conductor should be at least equal in size and rating to the incoming power conductors.

External earthing connections should be made to the M5 earth stud, using a ring crimp terminal to secure the earth conductor to the earth stud. The external earth conductor should be at least 4mm" in size.

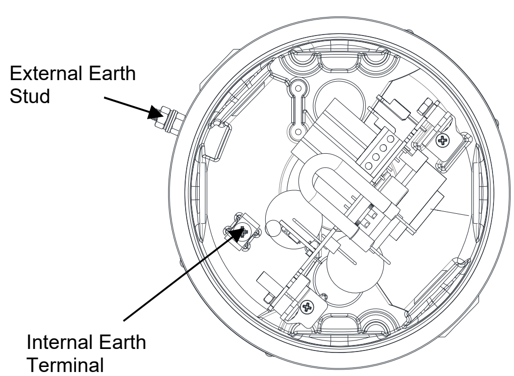


Fig. 8: Internal and External Earth Locations

11) Settings

11.1 Flash Rate Setting

Warning – high-intensity light source.
Avoid looking directly at the light source for extended periods of time.

The D1xB2X beacon can produce different flash patterns as shown in Table 1. The flash patterns are selected by operation of the flash setting DIP switch on the PCB, Fig 9.

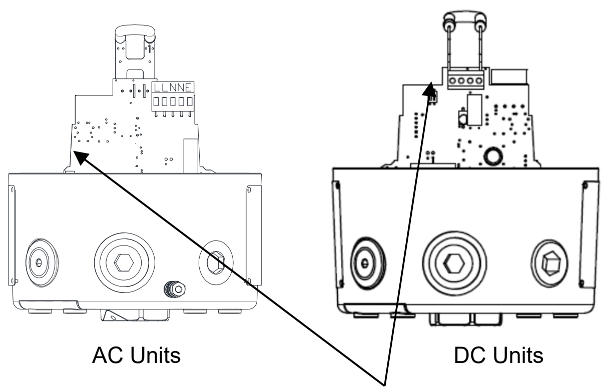
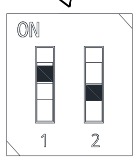


Fig. 9: DIP Switch Location



1=ON; 0=OFF
Example shown: 10 = Flashing 1.5Hz
(Default setting is 00 1Hz)

(*****Setting permitted for use as private mode fire alarm device)

Table 2: Switch Positions for Flash Patterns

Switch Setting	S1 Mode
00	1Hz (60FPM)
01	1.33Hz (80FPM)
10	1.5Hz (90FPM)
11	Double Flash

12) Interchangeable & Spare Parts

Warning – Hot surfaces. External surfaces and internal components may be hot after operation, take care when handling the equipment.

The Beacon lens cover is interchangeable, contact E2S Ltd for a replacement lens cover available in various colours.

To change the lens cover, unscrew the 4-off M5 socket head screws, spring and flat washers using a 4mm Hex key. Remove the wire guard and replace the old lens cover with the new lens cover.

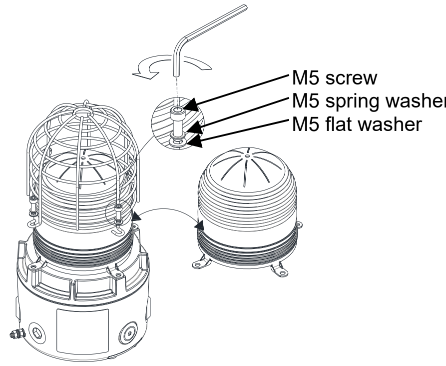


Fig. 10 Replacement of beacon lens cover

Fit the wire guard back onto the housing, over the new lens cover aligning the fixing holes of the guard, lens cover and housing. Refit the fixings to hold into place, the fixings MUST be fitted in the order shown above.

13) Maintenance, Overhaul & Repair

Maintenance, repair and overhaul of the equipment should only be carried out by suitably qualified personnel in accordance with the current relevant standards:

EN60079-19 / IEC60079-19 Explosive atmospheres - Equipment repair, overhaul and reclamation
EN 60079-17 / IEC60079-17 Explosive atmospheres - Electrical installations inspection and maintenance

To avoid a possible ELECTROSTACTIC CHARGE the unit must only be cleaned with a damp cloth.

Units must not be opened while an explosive atmosphere is present.

If opening the unit during maintenance operations a clean environment must be maintained and any dust layer removed.

Flameproof joints are not intended to be repaired.

14) SIL 2 Instruction/Safety Manual

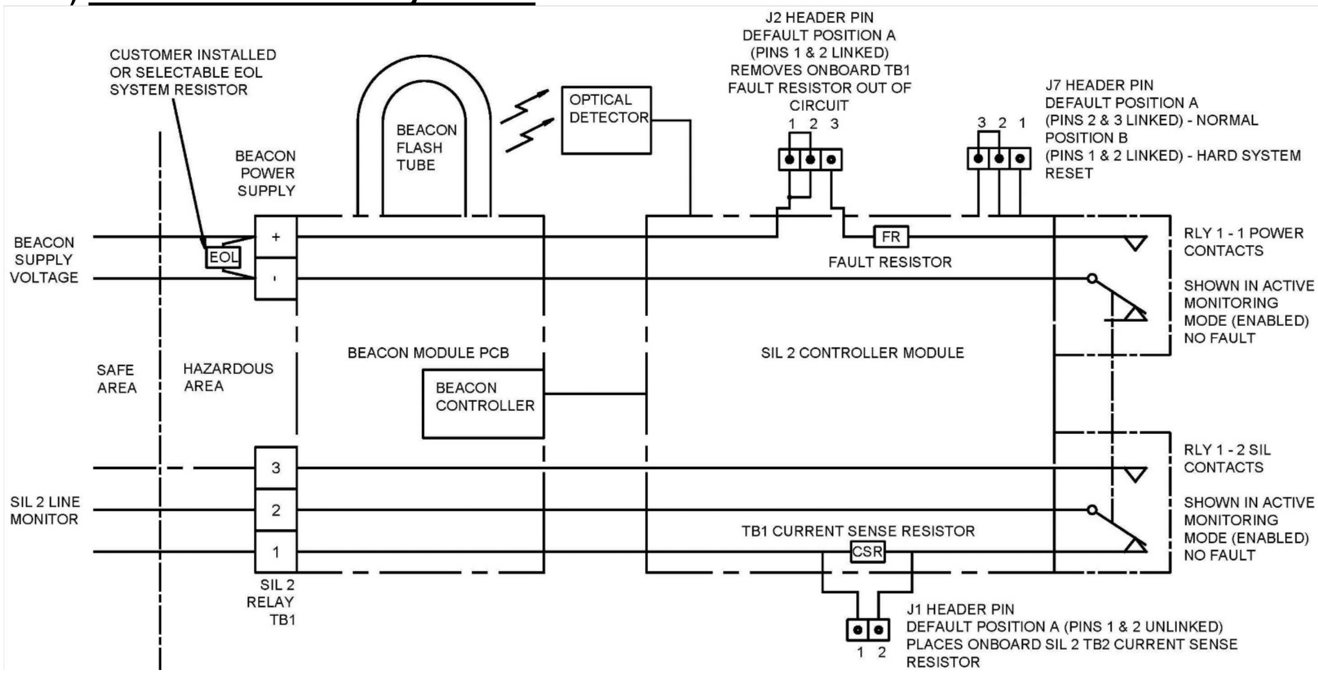


Fig 4 - The SIL 2 Module monitors the Beacon and interfaces to the customer plant.

Warning – To maintain the integrity of the SIL 2 units the system must be installed in accordance with this manual. Any deviation could result in failure of the SIL 2 system and an unintended unit operation or function.

Warning – Unit must be installed, commissioned and used within the parameters outlined in this manual. Failure to comply with this will result in potential unit failure within the system.

Warning – The unit must be powered in either Standby or Active modes to comply with the SIL 2 approval requirement.

Warning – If the power is disrupted the unit must be allowed to go through the commissioning cycle to reset, if this does not happen and the power continues to be disrupted the unit will latch the fault and require a hard system reset.

SIL 2 System Description

The E2S D1x range of IECEx & ATEX compliant signalling devices with integrated SIL 2 fault monitoring modules.

The SIL 2 module monitors the function of the device and provides feedback to the control panel. A fault condition can be communicated via independent fault contacts or by the introduction to the monitoring circuit of an end of line resistor. A SIL 2 system wiring for fault detection in standby and active mode – 4 wire installation can be seen as per section 14.1. A SIL 2 system wiring for fault detection in standby and active mode – 2 wire installation can be seen as per section 14.2.

The new SIL 2 version of the E2S D1XB2X05, D1XB2X10 & D1XB2X15 Xenon strobe beacon are designed, tested and certified, bringing plant safety to new levels.

Key benefits:

- Signalling device function is checked and automatically reported to the control panel.
- Eliminates the need for time consuming physical inspections.
- Increased plant safety, confidence that all devices are fully functioning.
- Designed to integrate seamlessly into your SIL 2 environment.

15) SIL 2 System Terms and Function

The SIL 2 Beacon Unit Monitors

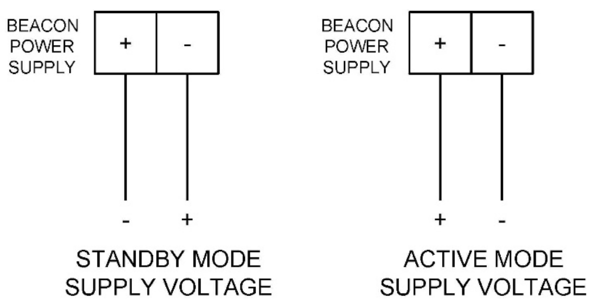
- Standby mode and Active mode
- Health status of power supply
- Beacons correct function and flash pattern

The SIL 2 beacon operates as part of a SIL 2 system.
The beacon will after commissioning remain powered in **Standby mode** (reverse polarity) until the beacon is required to operate. When the signalling device is required to operate beacon the polarity is changed back to normal supply and the beacon will go into **Active mode** where it will start to function/flash. When testing the system and beacons operation, the system is put into **Active mode**.

The customer PLC will control whether the system is in either of the main two operational modes.

Standby Mode – This is where the power supply polarity is reversed so negative (–ve) is fed to the positive (+) beacon terminal and positive (+) is fed to the negative (–ve) beacon terminal.
In this mode the beacon will not flash but the SIL 2 unit is monitoring power supply and is set-up ready to go to Active (alarm) mode.
Power relay RLY1-1 will be open whilst SIL 2 relay RLY1-2 will be closed contact between terminals 1 & 2.
If power is disrupted the SIL 2 unit will go into **Fault mode**, in fault mode the Power relay RLY1-1 will close whilst SIL 2 relay RLY1-2 will become an open circuit between terminals 1 & 2.

Active Mode – This is where the power is in normal polarity, positive (+) supplied to the positive (+) beacon terminal and negative (–ve) is supplied to the negative (–ve) beacon terminal.
In this mode the beacon will flash giving the warning signal, the SIL 2 unit is actively checking the beacons function for flash output and beacon controller signal generation to the right flash frequency.
Power relay RLY1-1 will be open whilst SIL 2 relay RLY1-2 will be closed contact between terminals 1 & 2.
The SIL 2 unit will also check for signal polarity.
If a fault is found the SIL 2 unit will go into **Fault mode**.
If power is disrupted the SIL 2 unit will go into **Fault mode**, in fault mode the Power relay RLY1-1 will close whilst SIL 2 relay RLY1-2 will become an open circuit between terminals 1 & 2.



Fault modes - The fault modes listed 13-1 & 13-2 below will make the SIL 2 unit change the state of the fault relays
In fault mode the Power relay RLY1-1 will close whilst SIL 2 relay RLY1-2 will become open be circuit between terminals 1 & 2.

13-1 Beacon Failure

- Flash Failure – No Flash detected
- Beacon Controller failure – No flash trigger pulse detected
- Flash Rate Failure – Regular 1 Hz flash cycle erratic

Resetting Failure - It is possible that the SIL 2 unit can be reset by powering the unit off for a period greater than 20 seconds.
On restarting the unit and running through the commissioning cycle, the fault may clear. It is necessary to run the test function cycle again to see if the fault is still evident. If the relays activate again the unit must be checked as it is showing a failure and may not be functioning correctly.

13-2 Power Failure / SIL 2 Failure

- SIL 2 Controller failure – Internal function and system checking flags fault
- Rapid Power cycling – System indicates power instability
- Total Power Failure

Resetting Failure - It is possible that the SIL 2 unit can be reset by hard resetting the unit using the reset jumper within the unit (see section 20) on hard resetting.
On restarting the unit and running through the commissioning cycle, the fault may clear. It is necessary to run the test function cycle again to see if the fault is still evident. If the relays activate again the unit must be checked as it is currently showing a failure and may not be functioning correctly.

Commissioning System - Functional start-up of System (Normally in reverse polarity mode)
When Commissioning system the power must not be disrupted to the SIL 2 Unit within the unit's initialization cycle which is **5 seconds**.

Once past this period the SIL 2 system is fully operational and will be in monitoring the beacon and power in Standby mode.

The relay RLY1-2 on the SIL 2 unit will only remain open for a maximum of 1 second on commissioning start-up.
Then they will close contact 1 & 2 showing healthy operation and only open in the event of a fault or power down.

System Testing (Active Mode normal polarity)
The SIL 2 system will remain monitoring the power in standby mode until the polarity is changed to normal mode to enable an active system for beacon functional testing.

Important: - The polarity must be held in active mode for a period in excess of **15 seconds** to ensure a full system check is performed.
Whilst the system is being checked the beacon controller and flash pulses are monitored and checked for correct pattern timing.
Once the test period has been completed the unit can be switched back to standby mode by reversing the polarity.
If no faults have been found during the test the relays will remain in there steady state.
The SIL 2 unit will continue to monitor the power and mode.
Important: - The automated test cycle ***must*** be undertaken on at least a weekly basis to maintain the SIL 2 units reliability.

System Activation (Active Mode normal polarity)
The SIL 2 system will remain monitoring the power in standby mode until the polarity is changed to Active mode to enable an active system for beacon to function as a warning signaling device.

Important :- The polarity must be held in active mode for a period in excess of 15 seconds to ensure a full system check is performed whilst in alarm mode, although it is expected that during a system activation this period will be significantly greater.
Note :- The fault indication signal on TB1 can take up to 1.5 seconds to indicate system fault.

16) SIL 2 Wiring configuration and Beacon set-up

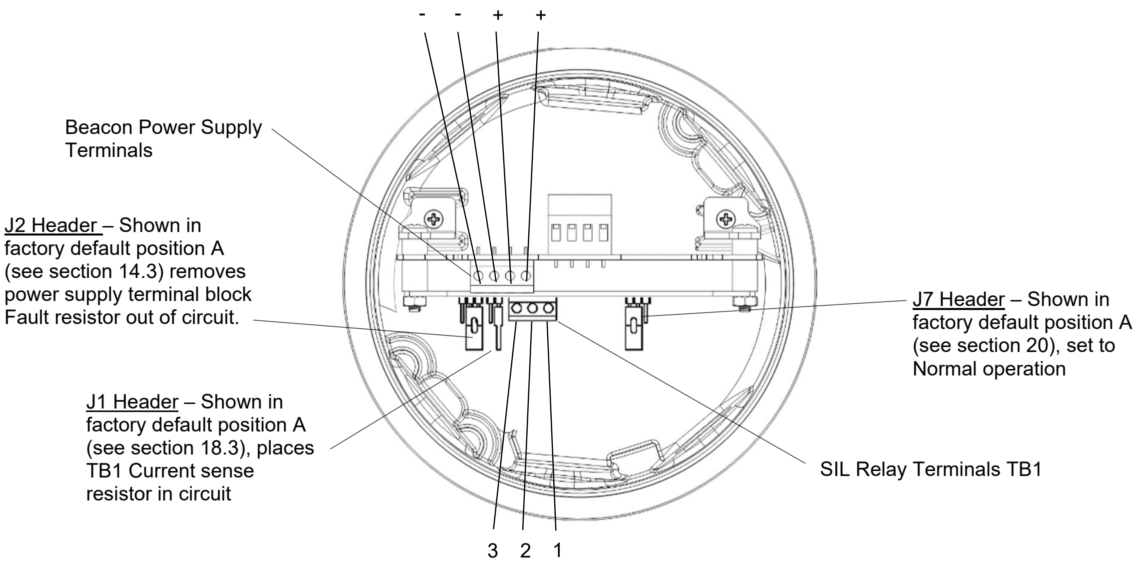


Figure 5 – Terminals and header pins for beacon

Power & Communication with the system control panel can be configured in two ways: - Although it is ***highly*** recommended that the unit is wired as stated in this section 16-1

- ### 16-1 SIL 2 system wiring for fault detection in standby and active mode – 4 wire installation (Recommended)

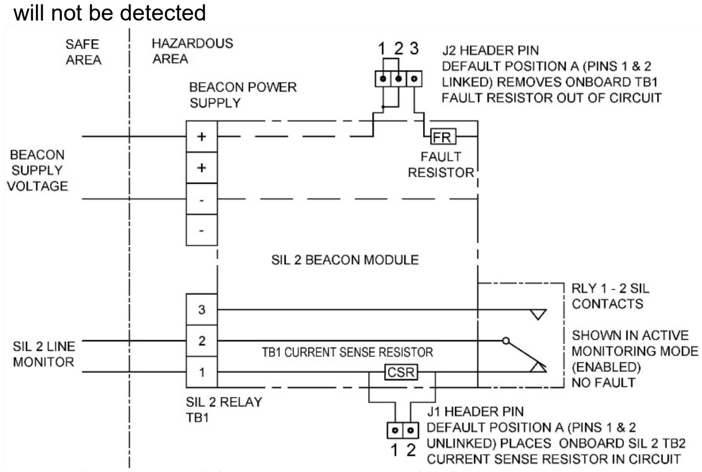
The customer is required to wire into both the beacon power supply terminals and also the SIL 2 Relay terminals TB1

The power supply terminals only need to have the supply power connected. This will be reverse polarity for monitoring mode and normal polarity for active mode. There is no need to fit an EOL resistor on the power supply terminal as the TB1 is configured to raise a fault alarm in any situation.

TB1 the SIL 2 monitoring relay, RLY 1-2 on the SIL 2 board which whilst powered is closed between TB1 terminals 1 & 2, however on any fault will become an open circuit between TB1 terminals 1 & 2.
The fault will be seen via the SIL 2 TB1 terminals as soon as the fault occurs in either Active or Standby modes.

As factory default when there is no fault, the TB1 terminals 1 & 2 will be closed putting a 3.3kΩ current sense resistor in line.
If the circuit is driven with 24V dc the detection current seen is ~7.3mA @ 24V.
System faults will make RLY 1-2 contacts go open circuit between terminals 1 & 2 for any fault mode.
The only other fault mode is if the cable goes short circuit where a short will be seen by the panel.

There is an option (although not recommended) to alter the enable J1 header pin to link pins 1 & 2 (see figure 8) which shorts out the 3.3KΩ current sense resistor making TB1 terminal 1 & 2 into a switch. The disadvantage is that a short circuit on this cable will not be detected



For one unit only:

Beacon power supply terminal block	Current drawn (mA)
Active Mode	190mA
Standby Mode	25mA

TB1 Current Sense Resistor value	Current drawn (mA)
3.3kΩ	7.2mA

On fault mode, current drops to 0 as circuit goes open.

Figure 6 – Schematic of SIL 2 system wiring for fault detection in standby and active mode – 4 wire installation

Multiple Unit Configuration

When multiple units are used in the system, the following considerations are to be made by the customer:

1. Customer panel capabilities -
   The customer is required to identify the minimum change in current the panel can detect (Panel resolution). This will therefore determine what resistors values to pick in section 3 below.

2. Topology -
   The customer has a number of options on how to set up the system.
   - A single unit topology is where only one unit is connected to the customer interface line, as shown in figure 6.
   - A series topology is where each unit is connected to one another as shown in figure 11.
   - A star topology is where each unit is connected to a central source as shown in figure 12.

3. Resistor – TB1 Current Sense Resistor (default 3.3kΩ)
   The customer is required to calculate the total resistance of the system, to determine the change in current when a fault occurs. The default customer sense resistor value is 3.3kΩ. Examples of calculations of resistance for steady mode and fault mode are shown in table 1.

Panel Resolution	Topology	Resistor: TB1 CSR	No. of Units	Steady Mode: Active/Monitoring	Fault Mode	
					1 unit fault	All units fault
2mA	Series	3.3kΩ	3	$3 \text{ x } 3.3\text{k}\Omega = 9.9\text{k}\Omega$ $\frac{24}{9.9\text{k}\Omega} = 2.4\text{mA}$	0mA If one unit fails the whole system fails	
7mA	Star	3.3kΩ	3	$(3.3\text{k}\Omega \sim 7.3\text{mA})$ $3 \text{ x } 7.3\text{mA} = 21.9\text{mA}$	(Fault unit): $1 \text{ x } 0\text{mA} = 0\text{mA}$ (Normal): $2 \text{ x } 7.3\text{mA} = 14.6\text{mA}$	(Fault unit): $3 \text{ x } 0\text{mA} = 0\text{mA}$
1.5mA	Series	3.3kΩ	4	$4 \text{ x } 3.3\text{k}\Omega = 13.2\text{k}\Omega$ $\frac{24}{13.2\text{k}\Omega} = 1.8\text{mA}$	0mA If one unit fails the whole system fails	
7mA	Star	3.3kΩ	4	$(3.3\text{k}\Omega \sim 7.3\text{mA})$ $4 \text{ x } 7.3\text{mA} = 29.2\text{mA}$	(Fault unit): $1 \text{ x } 0\text{mA} = 0\text{mA}$ (Normal): $3 \text{ x } 7.3\text{mA} = 21.9\text{mA}$	(Fault unit): $4 \text{ x } 0\text{mA} = 0\text{mA}$

Table 1

Note: - Cable fault

- Between the panel and the first unit, a cable short, increases the current (presenting a short circuit to the panel), and a cable cut/open reduces current (presenting an open circuit to the panel).
- In series topology a cable short between units will short out one of the current sense resistors which results in an increase in the current used by the unit, and a cable cut/open reduces current (presenting an open circuit to the panel).
- In star topology a cable short between units will short circuit the SIL 2 monitoring line hence presenting a short circuit to the panel, an open circuit fault on one of the units will effectively remove one of the current sense resistors reducing total effective resistance hence decreasing the total current seen by the panel.

- ## 16-2 SIL 2 system wiring for fault detection in standby mode only – 2 wire installation

The customer is required to wire into power supply terminal only. The unit will be monitored in standby mode only, via an customer installed system EOL resistor (2.2kΩ suggested customer EOL and default 2.2kΩ fault resistor will draw a total current of 35.9mA @ 24Vdc as shown in table 2).

In the event of a fault, The SIL 2 unit will automatically place the power supply terminal fault resistor across the power terminals which already has customer EOL resistor (2.2kΩ) in place. This will result in a total fault detection current of 41.8mA @ 24V but can only be detected when unit is in Standby Mode.

If the customer chooses to use this configuration within their system, it must be noted that the factory default settings for the unit does not have an EOL resistor installed. The customer can request E2S to install an EOL resistor and this will be depicted in the product code. See section19 for further information on EOL and fault resistor value choice.

<u>Important</u>: - This configuration will not warn of a fault whilst in Active mode as the PLC will be supplying the unit with power. The PLC will only be able to see the fault when in standby mode, by measuring the fault detection current.

<u>Important</u>: - This configuration requires the customer to set J2 header pin to be set to position B (see figure 9), as the units default position is A.

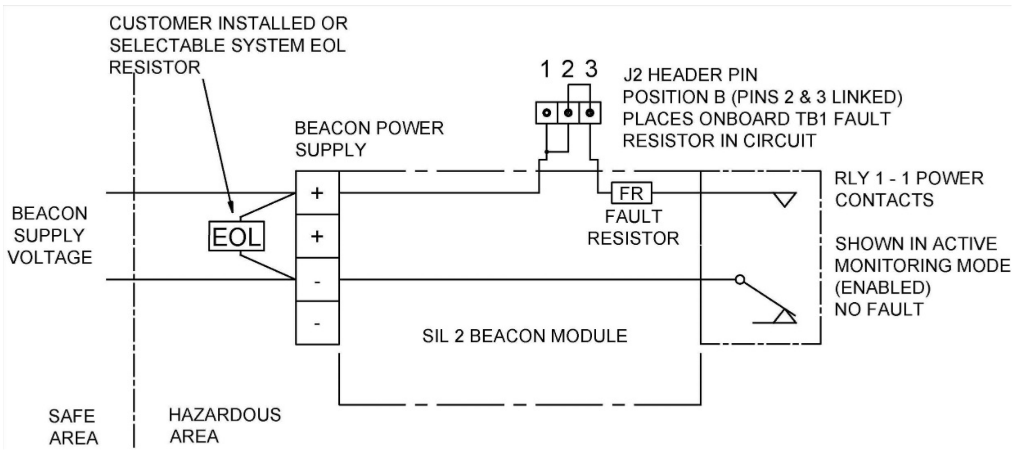


Figure 7 - Schematic of SIL 2 system wiring for fault detection in standby mode only – 2 wire installation

To evaluate the total current drawn from the SIL 2 unit, use the equation below.

I (Total Current drawn) = I_{FR} (Current drawn from Fault Resistor) + I_{EOL} (Current drawn from Customer EOL resistor) + I_{SIL} (Current drawn from SIL board)

In standby mode, where there is no fault, RLY 1-1 is open. This means the voltage only passes through the customer EOL resistor and the current drawn from the SIL 2 board is 25mA. Therefore, the equation for a No Fault scenario is then:

I_{NF} (Standby Mode, Total Current drawn - No Fault) = I_{FR} (0mA) + I_{EOL} (See table 2) + I_{SIL} (25mA)

In standby mode, where there is a fault, the circuit is closed. This means the voltage passes through both the customer EOL resistor and current sense resistor and the current drawn from the SIL 2 board is 20mA. The customer must first calculate the resistance of the two resistors in parallel before applying the currents to the equation. The equation for a Fault scenario is then:

I_F (Standby Mode, Total Current drawn - Fault) = I_{TR} (Total Resistance when EOL & FR in parallel) + I_{SIL} (20mA)

Standby Mode	Power Supply Fault Resistor		Customer EOL Resistor		(Fault Mode Only)		Current drawn from SIL Board	Total current drawn
	Resistor Value	Current drawn (I_{FR})	Resistor Value	Current drawn (I_{EOL})	Total resistance	Current drawn (I_{TR})		
No Fault	2.2 kΩ	0 mA	2.2 kΩ	10.9 mA	-	-	25 mA	35.9 mA
Fault		-		-	1.1 kΩ	21.8 mA	20 mA	41.8 mA
No Fault	1.0 kΩ	0 mA	1.0 kΩ	24.0 mA	-	-	25 mA	49.0 mA
Fault		-		-	500 Ω	48.0 mA	20 mA	68.0 mA
No Fault	2.2 kΩ	0 mA	3.3 kΩ	7.3 mA	-	-	25 mA	32.3 mA
Fault		-		-	1.3 kΩ	18.2 mA	20 mA	38.2 mA
No Fault	1.8 kΩ	0 mA	3.9 kΩ	6.2 mA			25 mA	31.2 mA

Fault		-		-	1.2 kΩ	19.5 mA	20 mA	39.5 mA
No Fault	1.8 kΩ	0 mA	4.7 kΩ	5.1 mA	-	-	25 mA	30.1 mA
Fault		-		-	1.3 kΩ	18.4 mA	20 mA	38.4 mA
No Fault	2.2 kΩ	0 mA	4.7 kΩ	5.1 mA	-	-	25 mA	30.1 mA
Fault		-		-	1.5 kΩ	16.0 mA	20 mA	36.0 mA

Table 2: Resistor combinations and the currents drawn when no faults and faults occur

Multiple Unit Configuration

When multiple units are used in the system, the following considerations are to be made by the customer:

1. Customer panel capabilities -
   The customer is required to identify the minimum change in current the panel can detect (Panel resolution). This will therefore determine what resistors values to pick in section 3 below.

2. Topology -
   The customer has a number of options on how to set up the system.
   - A single unit topology is where only one unit is connected to the customer interface line, as shown in figure 7.
   - A series topology is when each unit is connected to one another as shown in figure 13.
   - A star topology is when each unit is connected to a central source as shown in figure 14.

3. Resistor -
   The customer is required to calculate the total resistance a system, to determine the change in current when a fault occurs. As mentioned above, the customer can select a system EOL resistor. The default fault resistor value is 2.2kΩ which is recommended and is fitted according to the configuration topology chosen.

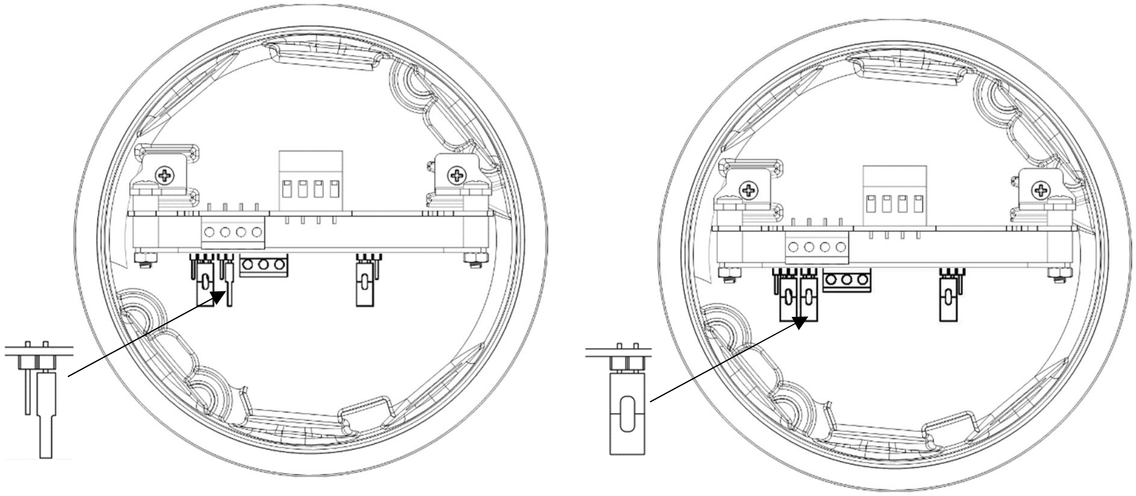
Panel Resolution	Topology	Resistor: Power Supply FR & EOL	No. of Units	Steady Mode Active/ Monitoring	Fault Mode		
					1 unit fault	2 units fault	All units fault
5.5mA	Series	FR = 2.2kΩ & EOL = 2.2kΩ	3	EOL Only	EOL + FR	EOL + (2 x FR)	EOL + (3 x FR)
				$\frac{24}{2.2k\Omega} = 10.9mA$ $3 \times 25mA = 75mA$ $I = 85.9mA$	$R_T = 1.1k\Omega$ $\frac{24}{1.1k\Omega} = 21.8mA$ $2 \times 25mA = 50mA$ $1 \times 20mA = 20mA$ $I = 91.8mA$	$R_T = 0.7k\Omega$ $\frac{24}{0.7k\Omega} = 32.7mA$ $1 \times 25mA = 25mA$ $2 \times 20mA = 40mA$ $I = 97.7mA$	$R_T = 0.55k\Omega$ $\frac{24}{0.55k\Omega} = 43.6mA$ $3 \times 20mA = 60mA$ $I = 103.6mA$
5.5mA	Star	FR = 2.2kΩ & EOL = 2.2kΩ	3	3 x EOL	(3 x EOL) + (1 x FR)	(3 x EOL) + (2 x FR)	(3 x EOL) + (3 x FR)
				$R_T = 0.7k\Omega$ $\frac{24}{0.7k\Omega} = 32.7mA$ $3 \times 25mA = 75mA$ $I = 107.7mA$	$R_T = 0.55k\Omega$ $\frac{24}{0.55k\Omega} = 43.6mA$ $2 \times 25mA = 50mA$ $1 \times 20mA = 20mA$ $I = 113.6mA$	$R_T = 0.44k\Omega$ $\frac{24}{0.44k\Omega} = 54.5mA$ $1 \times 25mA = 25mA$ $2 \times 20mA = 40mA$ $I = 119.5mA$	$R_T = 0.36k\Omega$ $\frac{24}{0.36k\Omega} = 66.6mA$ $3 \times 20mA = 60mA$ $I = 126.6mA$
5.5mA	Series	FR = 2.2kΩ & EOL = 3.3kΩ	3	EOL Only	EOL + FR	EOL + (2 x FR)	EOL + (3 x FR)
				$\frac{24}{3.3k\Omega} = 7.3mA$ $3 \times 25mA = 75mA$ $I = 82.3mA$	$R_T = 1.3k\Omega$ $\frac{24}{1.3k\Omega} = 18.2mA$ $2 \times 25mA = 50mA$ $1 \times 20mA = 20mA$ $I = 88.2mA$	$R_T = 0.8k\Omega$ $\frac{24}{0.8k\Omega} = 30mA$ $1 \times 25mA = 25mA$ $2 \times 20mA = 40mA$ $I = 95mA$	$R_T = 0.6k\Omega$ $\frac{24}{0.6k\Omega} = 40mA$ $3 \times 20mA = 60mA$ $I = 100mA$
5.5mA	Star	FR = 2.2kΩ & EOL = 3.3kΩ	3	3 x EOL	(3 x EOL) + (1 x FR)	(3 x EOL) + (2 x FR)	(3 x EOL) + (3 x FR)
				$\frac{24}{1.1k\Omega} = 21.8mA$ $3 \times 25mA = 75mA$ $I = 96.8mA$	$R_T = 0.7k\Omega$ $\frac{24}{0.7k\Omega} = 32.7mA$ $2 \times 25mA = 50mA$ $1 \times 20mA = 20mA$ $I = 102.7mA$	$R_T = 0.55k\Omega$ $\frac{24}{0.55k\Omega} = 43.6mA$ $1 \times 25mA = 25mA$ $2 \times 20mA = 40mA$ $I = 108.6mA$	$R_T = 0.44k\Omega$ $\frac{24}{0.44k\Omega} = 54.5mA$ $3 \times 20mA = 60mA$ $I = 114.5mA$

Table 3

Note: - Cable fault

- Between the panel and the first unit, a cable short, increases the current (presenting a short circuit to the panel), and a cable cut/open reduces current (presenting an open circuit to the panel).
- In series topology a cable short between units will short out one of the current sense resistors which results in an increase in the current used by the unit, and a cable cut/open reduces current (presenting an open circuit to the panel).
- In star topology a cable short between units will short circuit the SIL 2 monitoring line hence presenting a short circuit to the panel, an open circuit fault on one of the units will effectively remove one of the current sense resistors reducing total effective resistance hence decreasing the total current seen by the panel.

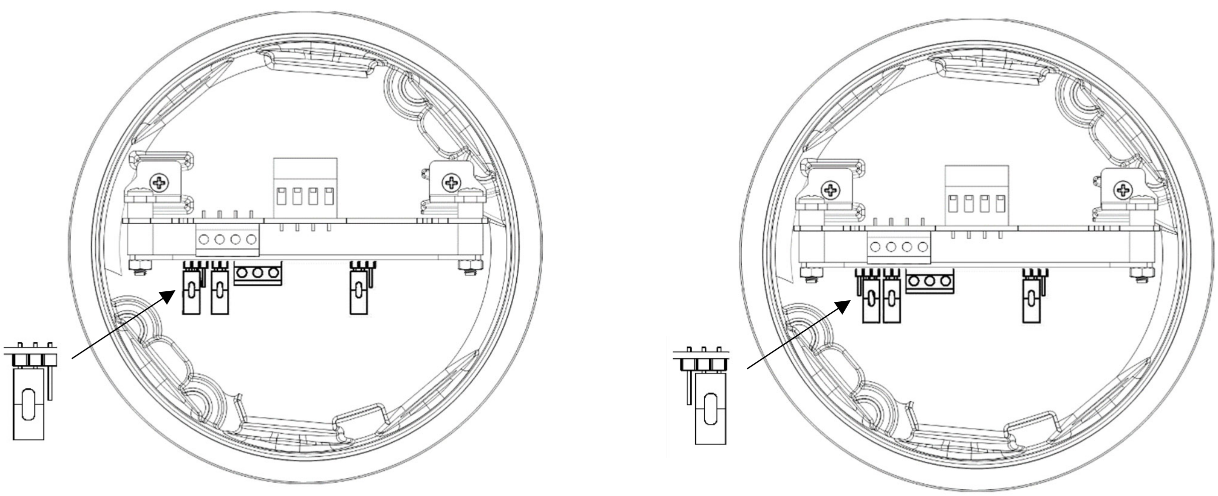
16-3 Header Pins Settings



J1 Header Pin - Postion A, Factory default position (pins 1 & 2 not linked) places TB1 Current sense resistor in circuit.

J1 Header Pin - Postion B (pins 1 & 2 linked) removes TB1 Current sense resistor out of circuit.

Figure 8: J1 Header settings



J2 Header Pin - Postion A, Factory default position (pins 1 & 2 linked) removes power supply TB Fault resistor & RLY 1-2 out of circuit.

J2 Header Pin - Postion B (pins 2 & 3 linked) places power supply TB Fault resistor & RLY 1-2 in

Figure 9: J2 Header settings

SIL Specific Unit Mounting Requirements

The beacon should be mounted no closer that 2m from a beacon or light source of similar candela output. This is to ensure false light activation does not occur when the unit is monitoring the light pulse duration and flash failure.

17) SIL 2 Reliability Data

Reliability and Functional safety IEC/EN61508 which has been assessed and is considered suitable for use in low demand safety function:

- Random Hardware Failures and Architectural constraints (route 1_H)
- As an unvoted item (i.e. hardware fault tolerance of 0) at SIL 2

The product was assessed against failure modes:

- Failure respond to an input by lighting a beacon
- Spurious light output despite no input

Integrity in respect of failure to release	SIL 2
Total Failure rate	0.37 pmh
“hazardous” failure rate (revealed)	0.297 pmh
“hazardous” failure rate (unrevealed)	0.003 pmh
“safe” failure rate (revealed)	0.006 pmh
“safe” failure rate (unrevealed)	0
Diagnostic Coverage	99%
System type	B
Hardware Fault Tolerance	0
Safe Failure Fraction	>99%
PFD (hazardous failure)	3.8×10^{-5}
Proof Test Interval	Up to 1 year

The SIL 2 units life is dependent on the cumulative running hour of the unit. The maximum running duration is 2,500 hours.

18) Synchronised Operation

All D1xB2 SIL2 beacons that are connected to the same supply line will have a synchronised flash rate at one flash every second.

19) End of Line Monitoring

On the D1xB2 SIL2 beacons, DC reverse line monitoring can be used if required. All DC beacons have a blocking diode fitted in their supply input lines. An end of line monitoring diode or an end of line monitoring resistor can be connected across the +ve and –ve terminals.
We suggest that with the SIL system the customer selected EOL resistor is kept to a value of 2.2kΩ however variation is allowed as required by the SIL systems PLC parameters. See section 16.2 and 21.
Values of current draw are given for the 2.2kΩ resistor if used as set up in section 14.

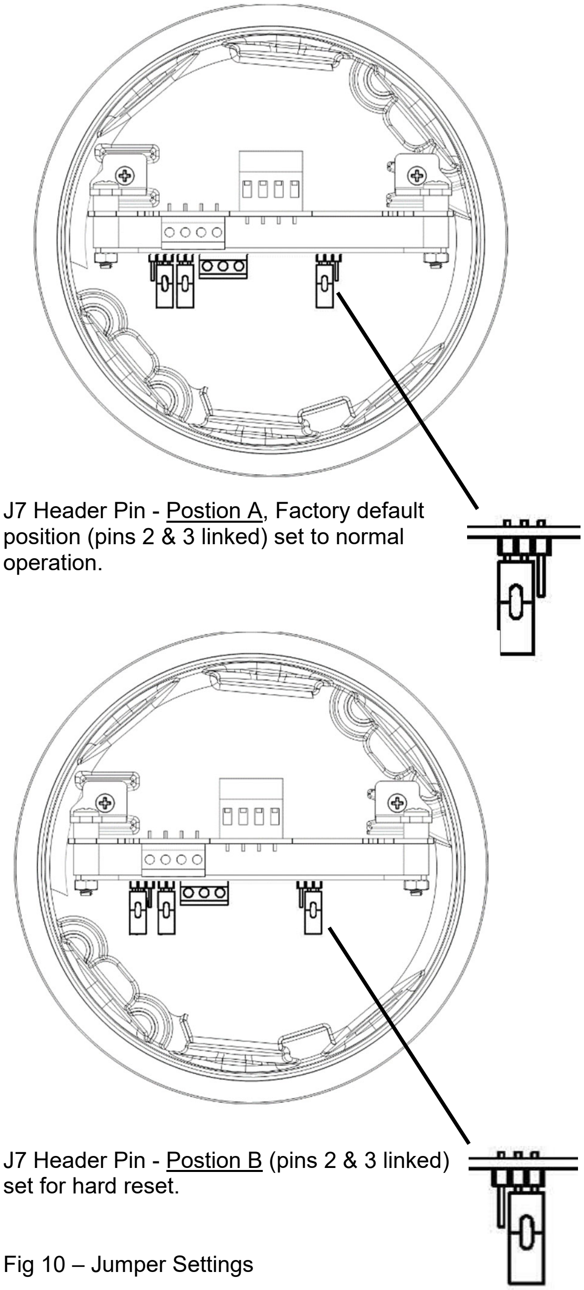
If an alternative value end of line resistor is used it must have a minimum resistance value of 3.3kΩ and a minimum wattage of 0.5 watts or a minimum resistance value of 500Ω and a minimum wattage of 2 watts.

20) SIL 2 Hard Reset

If required to hard system reset the unit, firstly, the unit will need to be opened, to carry out this operation see section 7.

Warning: - Ensure that an explosive atmosphere is not present during reset operation.

Power down the unit completely for a minimum of 30 seconds. Move the hard reset header pin (Jumper J7) to reset position shown. Then power the unit for a minimum of 5 seconds. Power down the unit for 30 seconds and then move the header pin back to the Normal Position.
The unit has been reset. Close the unit as noted in section 7.
If the hard reset does not correct the fault the unit or power supply integrity will need further investigation.



J7 Header Pin - Postion A, Factory default position (pins 2 & 3 linked) set to normal operation.

J7 Header Pin - Postion B (pins 2 & 3 linked) set for hard reset.

Fig 10 – Jumper Settings

21) Product Coding for Fault Resistor and Customer EOL Resistor

The customer is able to identify the resistor values chosen on purchase from the product code. This is represented by the last two characters:

D1XB2X05DC024AB1S1R/A-**XX**

The first character denotes the value of the Fault resistor and the second character denotes the value of the EOL resistor. The values of resistors available are shown in table 4.

Code	Resistor Value
A	2.2 kΩ
B	1.0 kΩ
C	1.5 kΩ
D	1.8 kΩ
E	2.7 kΩ
F	3.3 kΩ
G	3.9 kΩ
H	4.7 kΩ
J	5.6 kΩ
K	6.8 kΩ
L	8.2 kΩ
M	11 kΩ
Z	None Fitted

Table 4: Resistor values

For Example:
D1XB2X05DC024AB1S1R/A-AZ

This shows a standard 5J 24V dc amber beacon with the suggested 2.2kΩ fault resistor and no customer installed or selectable EOL resistor.

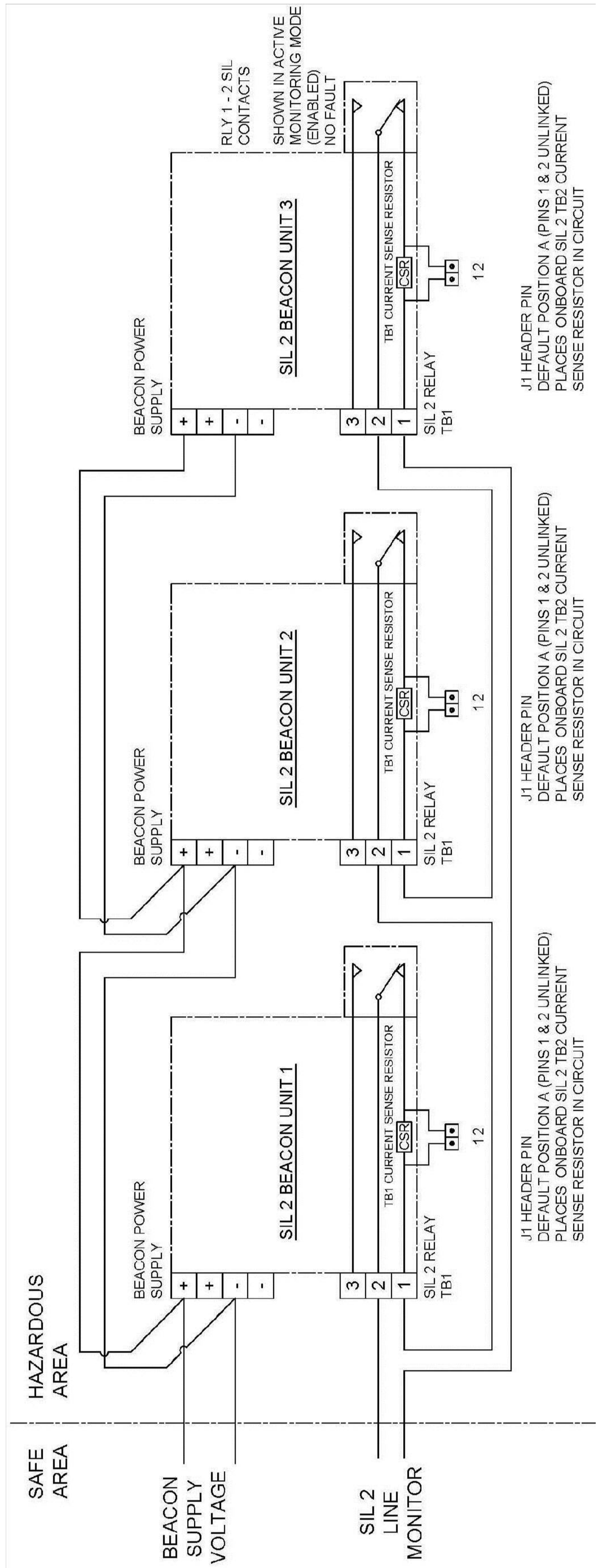


Figure 11: Schematic of SIL 2 system wiring for fault detection in standby mode only – 4 wire installation configuration wired in series

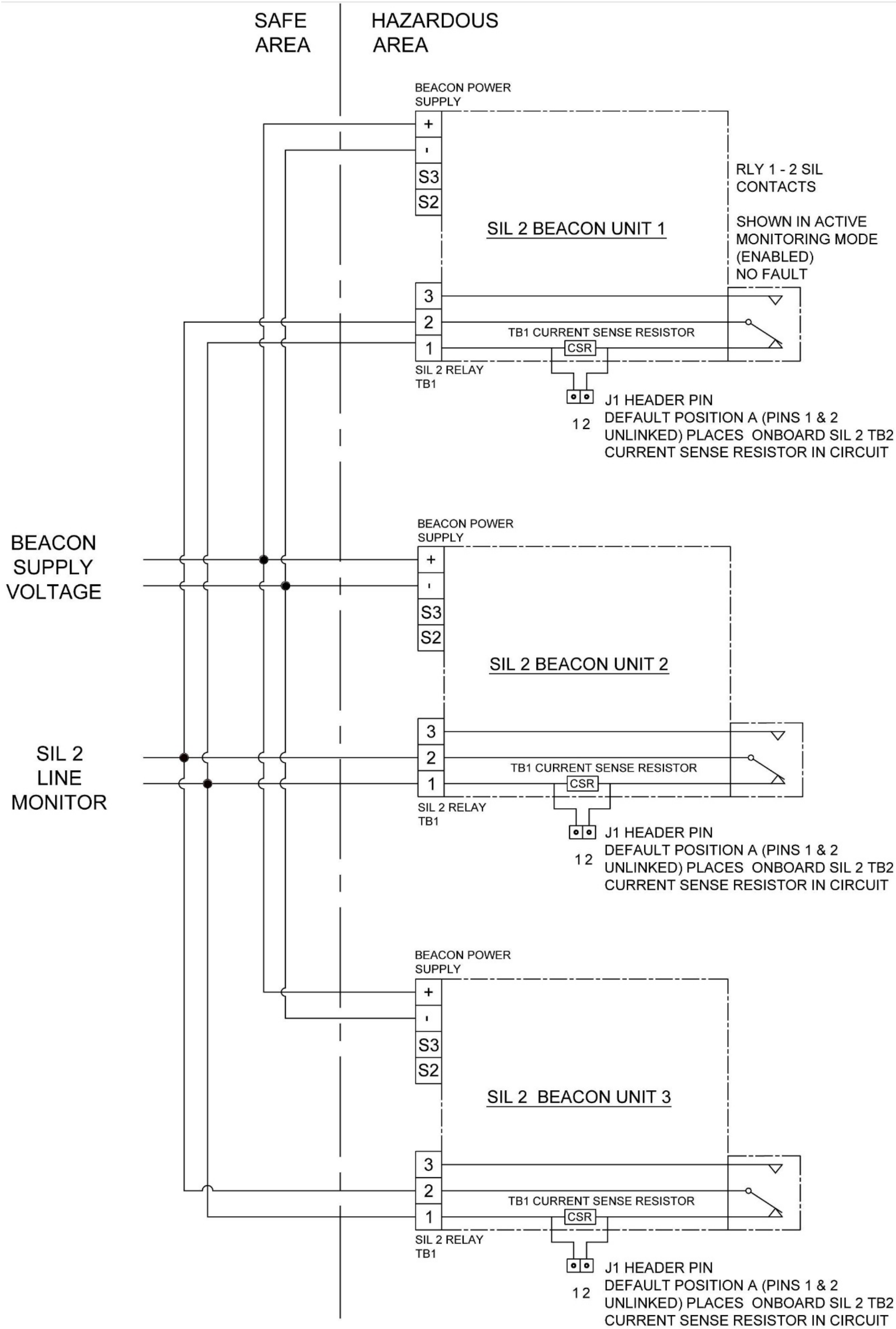


Figure 12: Schematic of SIL 2 system wiring for fault detection in standby mode only – 4 wire installation configuration in Star formation

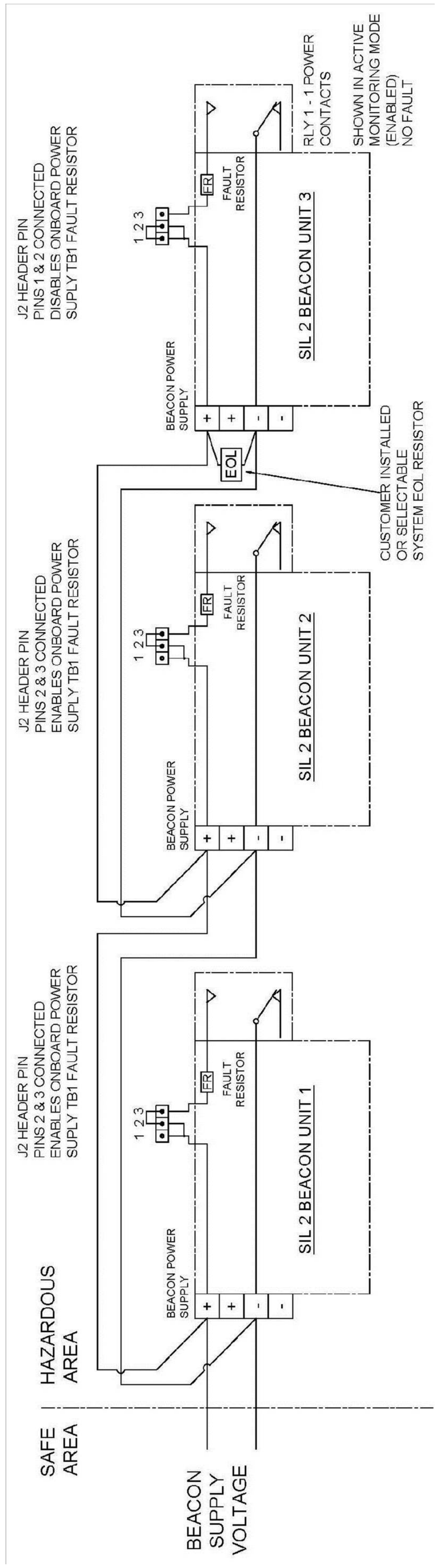


Figure 13: Schematic of SIL 2 system wiring for fault detection in standby mode only – 2 wire installation configuration wired in series

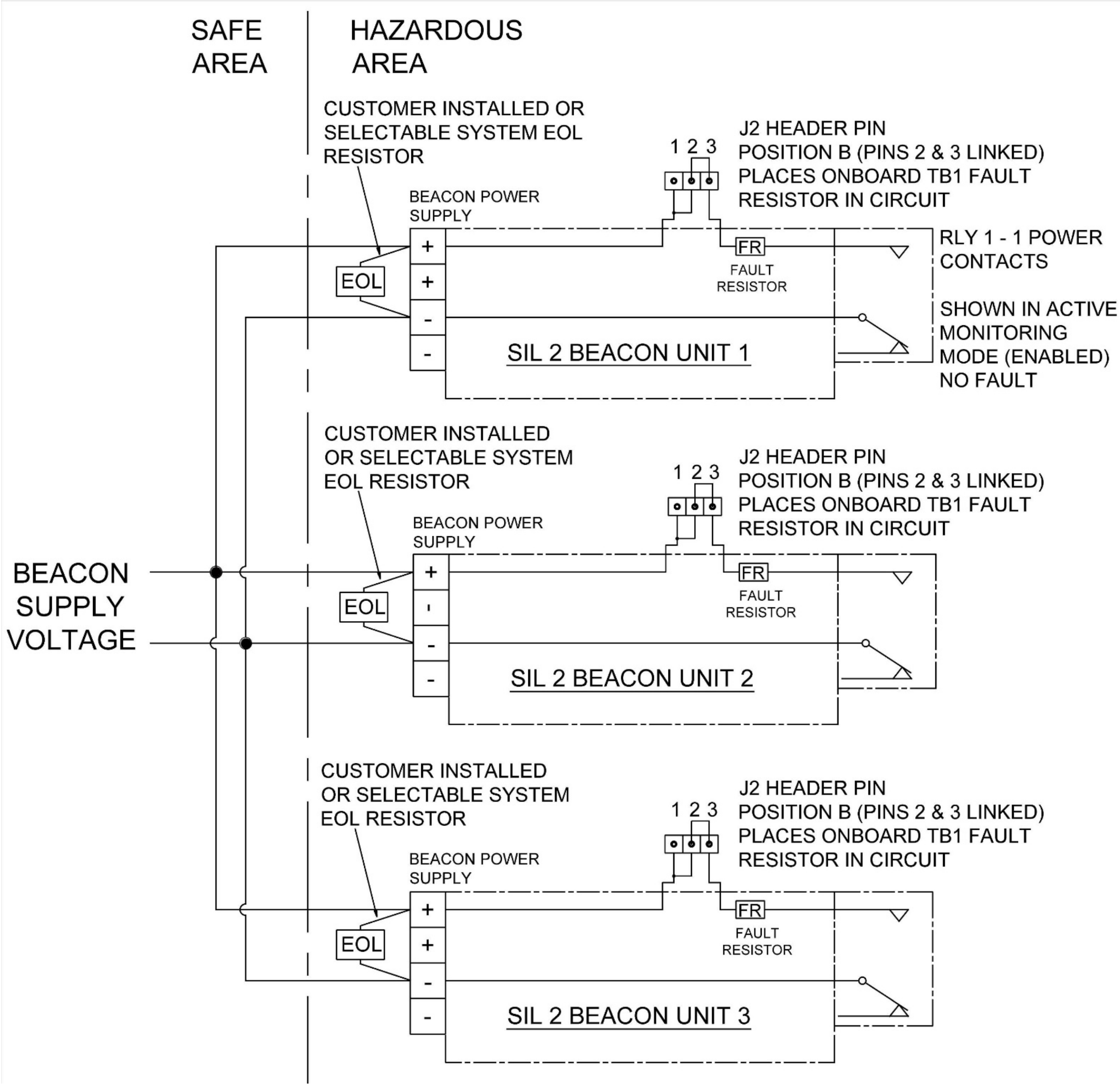


Figure 14: Schematic of SIL 2 system wiring for fault detection in standby mode only – 2 wire installation configuration in star formation