INSTALLATION OF NETWORK DEVICES: REFERENCE MANUAL

Document Control Information

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Safety

Warnings:

- **This equipment contains hazardous voltages.**
- **This equipment should only be installed by qualified personnel.**
- **This equipment must be earthed.**
- Live and Neutral must not be reversed (the neutral line is not fused).
- The Low Voltage Directive EN 60950-1:2002 states in clause 3.2.5.1 that the power supply cord shall be "not lighter than light PVC sheathed flexible cord according to IEC 60227 (designation H03 VV-F or H03 VVH2-F)". The conductor area shall be not less than 0.75mm^2.
- The earth wire in the mains cable shall be longest so if the cable is pulled, the earth wire is the last to take the strain.
- This equipment must be powered off before opening the case. This equipment does not contain a power disconnect device, so must be fitted with a readily accessible external disconnect device and fuse in the power wiring. The disconnect device shall disconnect both poles of the supply, shall have a contact separation not less than 3mm and shall be mounted as closely as practicable to the incoming supply.
- Hazardous voltages are still present when the mains fuse has failed.
- The 4-20mA outputs and the Host / PC communications outputs are isolated and safe to touch (they are SELV circuits in accordance with EN 60950-1:2001). They must only be connected to other SELV circuits.

PCME	**AMC controller**
100-240V ~	**1A**
50/60Hz	
CE	

The Controller operates within the following power supply range:

90V – 260VAC, 50/60Hz

Danger from process:

It is possible that the sensors are installed in ducting containing process particulate that is a hazard to health. This may take one or more of the following forms:

Particulate which is inflammable or explosive.
Particulate which is toxic or in some other way a hazard to health.
Particulate contained within high temperature gas.

Unless the process conditions are known to be entirely safe, suitable precautions such as the use of breathing apparatus or duct purging/detoxifying must be employed before any entry is made into the duct for installation or maintenance purposes. If in doubt, consult the local Safety Officer and/or local Safety procedures.

1 MECHANICAL INSTALLATION

NOTE: For use in hazardous dust or gas zones (e.g. DT990-X, DX800/810 systems), additional care needs to be taken with installation. See the associated manual for details.

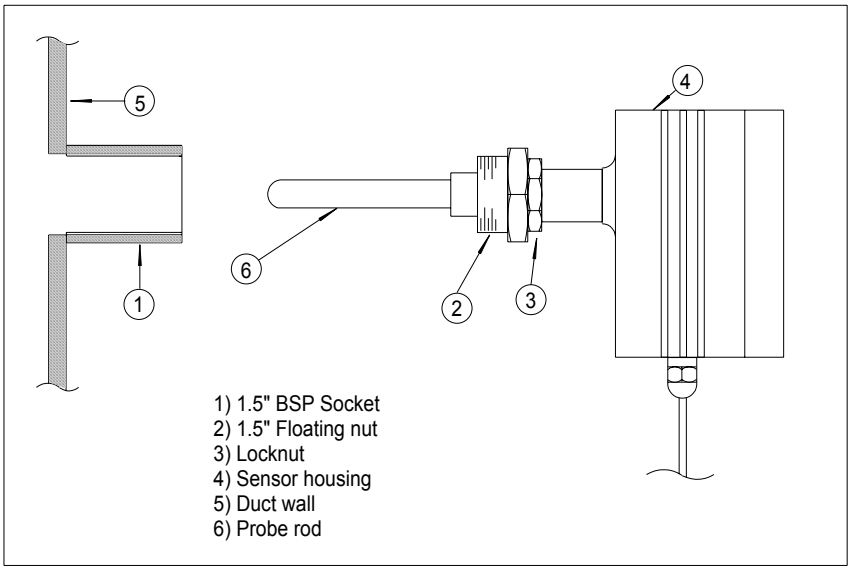
1.1 Choosing the best position for a sensor

The best position for a sensor unit is in a section of ductwork where the particulate has an even distribution and the flow is linear. This would ideally be in a vertical or horizontal section of duct, having no bends or obstructions for at least two duct diameters downstream or upstream. In many applications, a compromise must be made, and the sensor would be fitted in a position that satisfies the majority of the above requirements. The sensor must be fitted to **metal ductwork** in order to be electrically screened from interference signals. The sensor unit should not be mounted in direct sunlight or in areas where the ambient temperature is above 50°C. If you require further advice on any installation aspects, i.e. position, installation into a non-metallic duct, etc., please consult PCME. To summarise, the sensor should be mounted:

- In the longest, straightest, most vertical or horizontal unrestricted section of ductwork available.
- In metallic ductwork, (for non-metallic ductwork consult PCME).
- Away from ambient or radiated temperatures exceeding 50°C.
- Away from excessive vibration

See the Installation Note : **Stack Sampling Port and Instrument Sensor Location** located in the appendix for more details.

1.2 1.5” BSP or NPT Socket



Referring to the diagram above, the sensor is mounted to the stack in the following way:

When the optimum position has been decided for the sensor unit, a **1½" BSP or NPT SOCKET** (1) should be fitted to the ductwork (this is not provided by PCME). The sensor unit is then simply inserted into the socket on the duct. Slide the floating nut (2) on the sensor body to mate with the thread in the socket (1) and tighten. Be careful to ensure that the probe rod (6) does not touch the opposite side of the duct (the probe rod should usually span about half the width of the duct). The locknut (3) must then be tightened against the floating nut using an adjustable spanner to lock the sensor firmly in position. For optimum heat dissipation, the sensor unit should be mounted such that the heat sinking fins on each side of the enclosure are vertical. Do not try to rotate the sensor unit by grasping the enclosure after the locknut has been tightened because damage to the environmental seal may occur. If the sensor must be rotated, first loosen the locknut, then rotate the sensor unit to the required position and finally re-tighten the locknut.

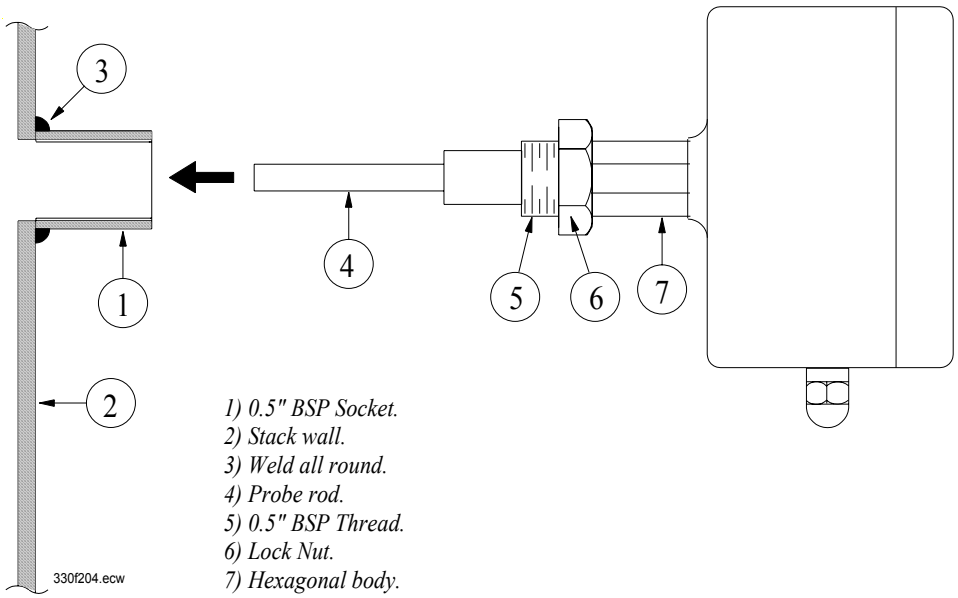
To summarise, to install the sensor unit you must:

- Cut a hole in the ductwork and weld a **1½" BSP or NPT SOCKET** in position.
- Position the sensor unit with the heat sink fins vertical.
- Ensure that the probe rod does not reach the opposite duct wall.
- Tighten the floating nut into the **1½" BSP or NPT SOCKET.**
- Securely tighten the locknut against the floating nut to lock the sensor in position ***(This must also provide a good electrical connection to earth the sensor hence PTFE tape should NOT be used)***.

NOTE: Ensure adequate access is provided by ladder or staging to both the sensor unit(s) and the sampling ports.

NOTE: Do not try to rotate the sensor by grasping the enclosure as damage may occur

1.3 0.5” BSP or NPT Socket



1) 0.5" BSP Socket.
2) Stack wall.
3) Weld all round.
4) Probe rod.
5) 0.5" BSP Thread.
6) Lock Nut.
7) Hexagonal body.

Referring to the diagram above, the sensor is mounted to the stack in the following way;

- Drill or cut a 19mm (¾") diameter hole into the stack wall (2).
- Take a ½" BSP or NPT socket (1), position over the hole and weld all round (3) to provide a secure mounting.
- Pass the probe rod (4) through the socket to mate with the ½" BSP or NPT thread (5).
- Use a spanner on the hexagonal body (7) to rotate the entire sensor while screwing into the socket (1).
- Position the sensor such that the cable gland points downwards.
- Finally, securely tighten the lock nut (6) against the socket (1) to lock the sensor into position.

NOTE: Ensure adequate access is provided by ladder or staging to both the sensor unit(s) and the sampling ports.

NOTE: Do not try to rotate the sensor by grasping the enclosure as damage may occur

2 PLANNING THE NETWORK

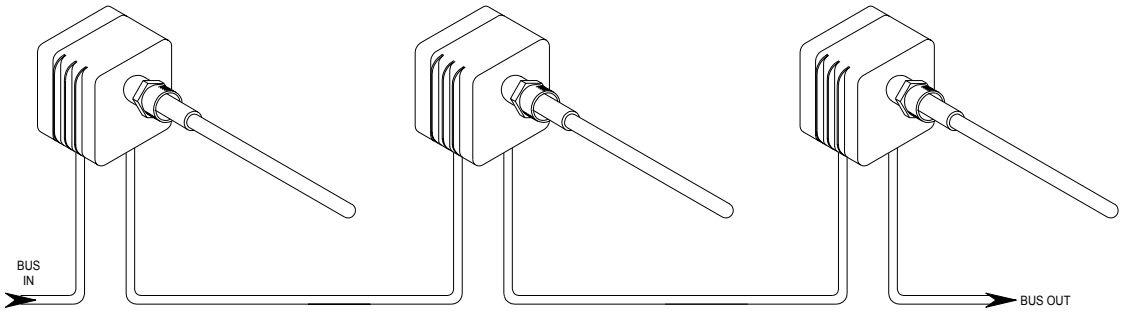
2.1 Overview

The network of sensors and other devices may span over a large area with cable runs of several hundred meters. It is therefore important to ensure that the network configuration is carefully considered *before* installing any of the sensor or devices. This section provides some general advice and guidance on how to best plan and implement the entire network.

2.2 Sensor & Device Connection Options

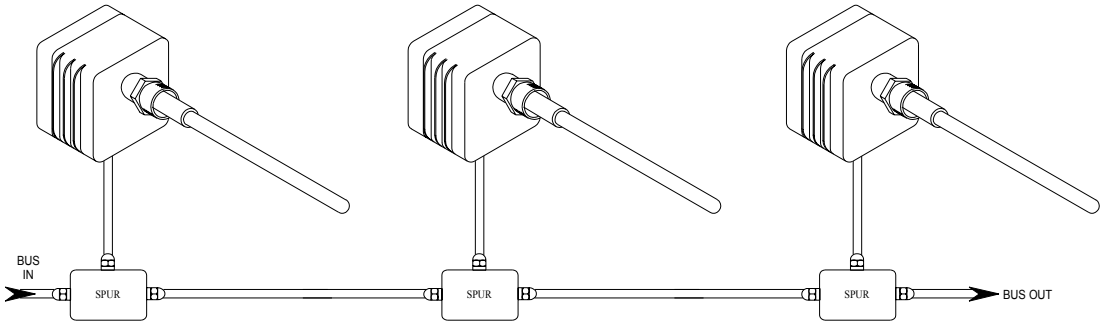
The sensors and other devices may be connected onto the RS485 data network in two ways. The simplest and most economical method is by 'daisy chaining' the sensors or devices, i.e. looping the bus through each sensor or device. The disadvantage of this scheme is that if one sensor or device needs to be removed from the bus, then the entire bus operation is affected. This scheme also requires longer cable runs that may limit the maximum number of sensors that may be fitted before a further Repeater is required.

Daisy Chained System
(not using spur modules)



The alternative to daisy chaining is the 'spur linked' system that uses the PCME spur modules at each sensor or device node. With this scheme, if any sensor or device is removed or fails, the operation of the bus is not affected.

Spur Linked System
(using spur modules)



A combination of the above two methods may be employed if required.

2.3 Running the network data cable

The cable should be fixed such that it is free from excessive vibration and such that it is not under strain. The cable should be secured in accordance with good engineering practice (using cable trays where possible), and careful consideration should be given to positioning of the cable such that it is not easily damaged. The cable should be routed to avoid sources of large electromagnetic fields such as heavy switching gear etc. Care taken during the installation of the cable will give a long and maintenance-free life and will avoid possible future damage to the controller, sensors and other devices.

To summarise, the cable should be installed such that:

- Heavy vibration is minimised to prevent fatigue and failure.
- It is not vulnerable to accidental damage.
- It is away from sources of large electromagnetic fields (where possible).

2.4 Recommended Cable Specification

4 Conductor overall screened cable , diameter < 0.8mm (Each conductor <0.5mm^2), suitable for RS485.

BS Specification : BS5308 Part 2 (PVC) Type 1 , 0.5sqmm x 2 pr, Unarmoured , collectively screened

eg. Batt Cables 85364

Colour coding: Blue, Orange , Green , White.

Note : the colour coding differs from the previous PCME standard. Please use the table below to convert between the two schemes.

Old PCME Colour scheme	**New PCME Colour scheme**	**Your Colour scheme**
Black	Blue	
White	Orange	
Green	Green	
Red	Brown	

2.5 Good Practise Cabling Guidelines

- To minimize water entry to the instrument, any Instrument or Accessory must be mounted with the cable entry glands facing downwards.
- After insertion of cable, the cable entry glands must be tightly fastened onto the cable.
- Cable sheathing must always penetrate the cable entry gland, and the gland be tightly fastened to it.
- Where a cable-run approaches the instrument from above, it must be run down below the instrument and then curved up to the cable entry gland.
- Where a cable enters a cable entry gland, sufficient spare cable should be left so that a new connection can be made if needed.
- Cables should not be run over roofs, and should be supported at appropriate intervals.
- The cable screen must be terminated correctly (see instrument manual).
- Any un-used cable entry glands must be blanked using the appropriate device provided by PCME.
- The case lid securing screws should be lightly coated with copper grease before securing the lid.
- The case lid securing screws should not be over-tightened.
- Where possible, instruments should be mounted out of direct precipitation and away from running water.

2.6 Cable lengths and voltage drops

For small networks, the power supply in your control unit will be able to power all your sensors. For larger networks you may need to add additional power supply repeaters. You can calculate your requirements using the notes below or send information of your cable lengths to PCME.

Note : it is best to place your Control unit in the centre of your network to minimise voltage drop.

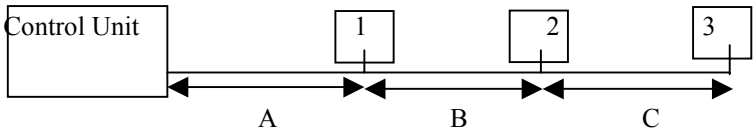
All cables have some electrical resistance. This resistance causes a reduction in voltage proportional to cable length and loading. The notes below give an approximate guide to calculating voltage drops around a network and may be used to determine where additional repeater units are needed. To simplify the calculations, the length of spur branches has been considered negligible

Step 1
Ensure that the total current drawn by all sensors added together does not exceed 1.2 Amps.

A Control Unit (Multicontroller or Interface Module) or PSU Repeater can supply a maximum of 1.2 Amps
A DT990 sensor requires 27mA
A DT990 sensor with 4-20mA card requires 50mA
A BB2220 /DA550/DA660 sensor requires 17.5 mA
A StackFlowII sensor requires 80mA
An AIM unit requires 15mA
A DT990 sensor with isloated spur (990X) requires 70mA

Step 2
Calculate total cable length for each sensor type. Remember to add the total distance from Control Unit to sensor for each sensor used.

Eg



Length for sensor 1 is A
Length for sensor 2 is A + B
Length for sensor 3 is A + B + C
Total length is 3A + 2B + C

Step 3

DT990 : total cable length must be less than 2750m
BBS220/DA660: total cable length must be less than 4280m
DT990X (with isolated spurs) : total cable length must be less than 1070m

If the calbe length exceeds these values you will need to break up your network using a Power Supply Repeater.

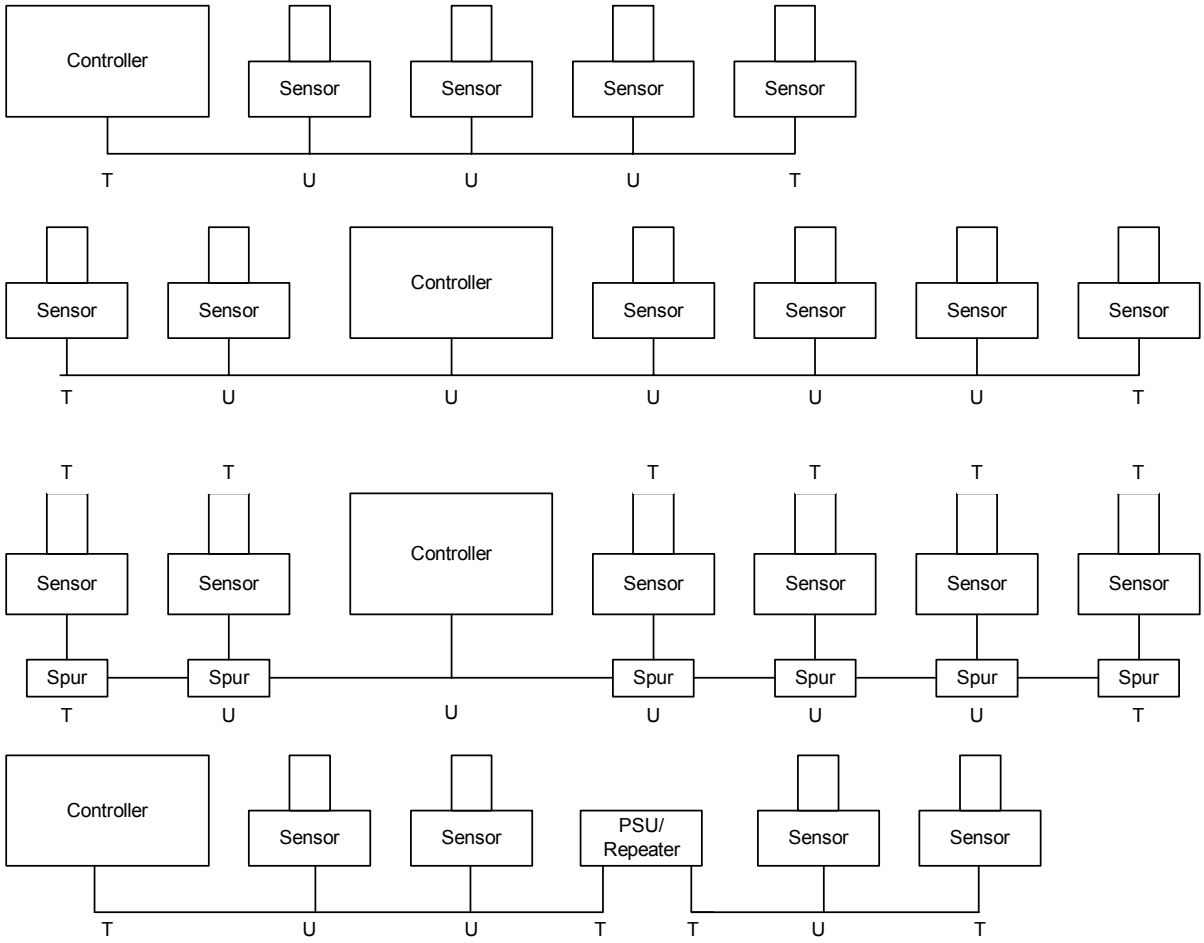
Note - For a Control Unit in the centre of the network use this equation for each side separately.

Assumption in calculation
- allow a maximum of 6V drop (24V down to 18V)
- the actual cable length is double because current travels to the sensor then back to the control unit
- the cable resistance is 40 Ohms/km (same for standard and ATEX cable)

2.7 Why use bus termination?

The various devices of the system provide means of terminating the bus cables. bus termination is required to prevent signal reflections when high-speed data reaches the end of a cable section. Reflections cause data corruption and communication problems. Devices located at the end of any branch should be set to terminated to prevent reflections.
As a rule of thumb, if a device is at the end of a cable, it must be terminated. If the device is in the middle of a cable (i.e. the cable loops through) then it should be un-terminated.
Details of how to set bus termination for each device are provided in the following section.

Examples of bus termination



2.8 Planning Sensor Addresses

Each sensor or device in the network has a unique modbus address which are set using DIP switches inside each sensor.

PCME will supply a new system with modbus addresses preset with consecutive values e.g 1,2,3,4,5,6. The modbus address is also labelled on the outside of the enclosure.

When you run Autodetect from the Control Unit the sensors are added to the display in modbus address order. **Therefore it is recommended to install the sensors in a logical order** e.g. Stack A has address 1 , Stack B has address 2 , Stack C has address 3.

Note : this order does not have to be the same order as the physical cabling order.

Note : the sensor order can also be manually set up in the controller or changed later using the PC Configuration Wizard program.

It is important to keep a record of the required Device Name associated with each modbus address, so this information can be entered into the control unit during commissioning. If the required Device Name and their order are provided with the Site Survey Form then PCME is able to label the devices appropriately and also provide a configuration file which can be loaded directly into controller during commissioning.

The information should be provided as in the following example:

Display Order = Modbus Address	Group Name	Device Name	Sensor Type
1	Stack 1	Dust	990S
2	Stack 2	Dust	990S
3	Stack 3	Dust	990S
4	Stack 4	Dust	990S
5	Stack 5	Dust	990S
6	Stack 6	Dust	990S

3 MULTI-CONTROLLER

3.1 Overview

The controller provides power for a number of sensors and devices and in many cases no additional power supply will be required. If large numbers of sensors and/or long cable lengths are involved, an additional 'repeater' unit may be required. See section 3 for details of maximum cable lengths vs. number of sensors.
The controller is a mains powered instrument and should not be operated with the front cover removed unless suitably qualified to do so. The controller has *two* communication ports; one provides an isolated connection to the network of sensors and devices (RS485/Modbus), the second provides an isolated RS232 or RS485 connection to a host PC or PLC. Four isolated 4-20mA outputs are provided in addition to four volt-free relay contact outputs. External events may be monitored by the controller via the four digital (contact) inputs.
The controller may be wall or panel mounted and the enclosure is sealed to IP65 (Nema 4). The following sections provide details of the connections to the controller.

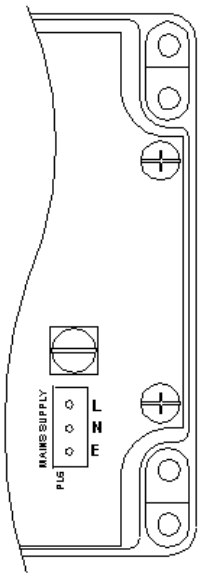
Note : The 4-20mA outpus are not available for use with the BBS220 system or 220 sensor.

3.2 Connecting the Mains Supply

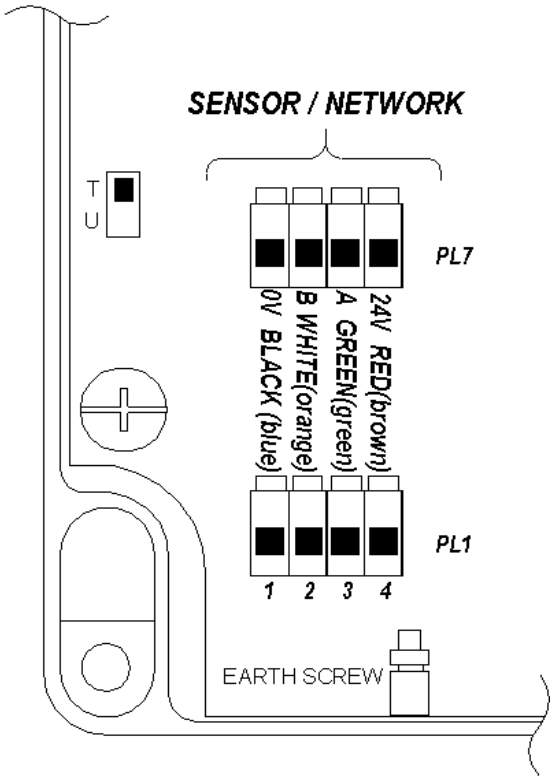
Referring to the diagram to the right of this text, the mains supply cable should be passed through the rightmost of the cable entry glands and should be connected to PL6 as shown.

The controller has a universal voltage input and hence no voltage selection is required.

WARNING: Always take adequate precautions when working with mains voltages and <u>ALWAYS</u> isolate the supply before making any connections.



3.3 Connecting the Sensor / Network Cable



Installing the Controller at the end of the network

Referring to the diagram to the left of this text, the network cable should be passed through the cable gland and connected to PL1 as shown.
Set the termination switch SW200 to the T position (terminated).

Installing the Controller in the middle of the network

For larger networks it is preferable to place the controller in the middle of your network (to minimise voltage drop along the cables). To do this connect one half of the network to PL1 and the other half to PL7.
Set the termination switch SW200 to the U position (unterminated).

Take care to ensure that the colour coding is correct otherwise the controller or network components may be damaged (the alternative PCME colour scheme is shown in brackets)

NOTE: The ends of the network cable should be prepared by first removing approximately 50mm of the outer sheath (taking care not to damage the inner cores). This will reveal 4 coloured wires and an un-insulated screen wire. Each of the coloured wires should then have approximately 5mm of insulation removed to expose the conductor cores.

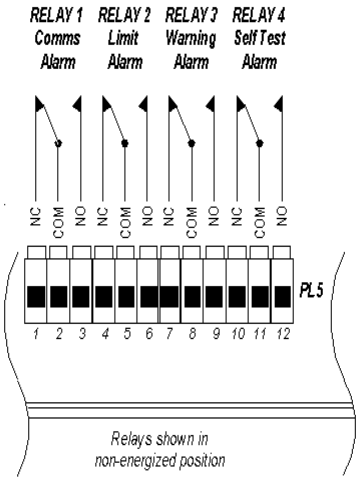
Screen Cable (Earth Strap) : The screen cable should be attached directly to the enclosure using an eyelet tag to one of screws provided (see diagram above). Attach to the closest screw so the cable is as short as possible. The screen cable should also be connected at the sensor end : see individual sensor sections for details.

3.4 Connecting to the Relay Output Contacts

The controller has four alarm contact. Referring to the diagram to the right of this text, the contacts are shown in the normal operating position (i.e. power is applied and no emission alarm exists). Each relay is a voltage-free SPCO contact with a current rating of 3A. The Relays may be used to switch mains voltages.

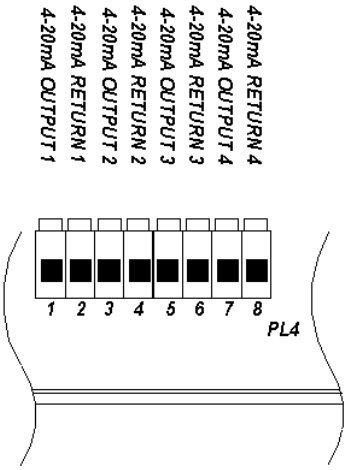
The diagram shows the function of each relay. See the System Wide Settings section in the Using Your Control Unit section for more details.
The relays can be put in Fail Safe Mode (see System Wide Settings section).

NOTE: The PCME Audible/Visible alarm unit is a normally open trigger input device.



CAUTION: The maximum current through the alarm contacts should not exceed 3 Amps.

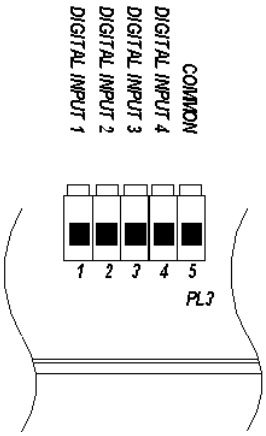
3.5 Connecting to the 4-20mA Outputs



The controller has four isolated 4-20mA outputs each capable of driving a 250 Ohm load. The outputs operate independently and the user may decide which parameters are assigned to each output.
It should be noted that the four outputs share a common return path that is isolated from chassis ground. The outputs should not be floated more than 30V above chassis ground.
Referring to the figure to the left, pass a suitable cable through an entry gland and connect to the required output as shown (Output +, Return -).

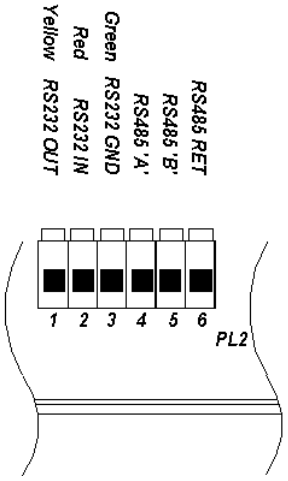
Each output can be set up to output the reading from any sensor or device attached to the controller. See System Wide Settings for more details.

3.6 Connecting to the Digital Inputs



The controller has four digital (contact) inputs that the user may assign as required [see **Configuring Digital Inputs** section]. The inputs are not isolated and may be configured by the user as normally open or normally closed.
To connect to the digital inputs, pass a suitable cable through an entry gland and connect to PL3 as shown.
Note that these inputs are voltage-free and should not be connected to 'logic' outputs from PLC's.
The connection should be made between the required input and common ground.

3.7 Connecting to the Host/PC port



The controller is fitted with an isolated RS232/RS485 port for connection to a PC/PLC.
To connect to this port, pass a suitable cable through a convenient cable entry gland and connect to PL2 as shown.

RS232 Cable Limit : 25m

RS485 : Cable Limit :1km. Also allows several Control Units to be daisy chained together with separate modbus addresses.

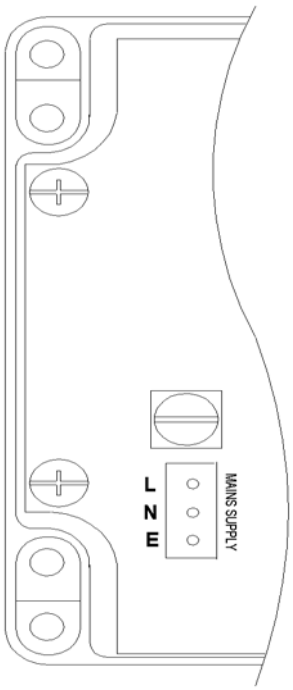
4 INTERFACE MODULE

4.1 Overview

The interface module provides a stand alone user interface to a **single** PCME sensor.

The interface module is a mains powered instrument and should not be operated with the front cover removed unless suitably qualified to do so. The interface module has *two* communication ports; one provides an isolated connection to the sensor (RS485/Modbus), the second provides an isolated RS232 or RS485 connection to a host PC or PLC. A single isolated 4-20mA output is provided in addition to two volt-free relay contact outputs. External events may be monitored by the interface module via the two digital (contact) inputs.
The interface module may be wall or panel mounted and the enclosure is sealed to IP65 (Nema 4). The following sections provide details of the connections to the interface module.

4.2 Connecting the Mains Supply

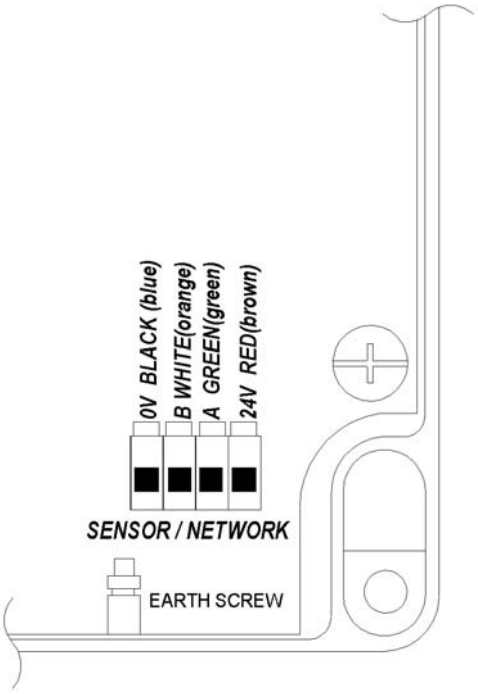


Referring to the diagram to the right of this text, the mains supply cable should be passed through the left most of the cable entry glands and should be connected to connector marker MAINS SUPPLY as shown.

The interface module has a universal voltage input and hence no voltage selection is required.

WARNING: Always take adequate precautions when working with mains voltages and ALWAYS isolate the supply before making any connections.

4.3 Connecting the Sensor / Network Cable



Referring to the diagram to the left of this text, the network cable should be passed through the cable gland and connected to connector marked SENSOR/NETWORK as shown.
The interface module is terminated.

Take care to ensure that the colour coding is correct otherwise the interface module or sensor may be damaged (the alternative PCME colour scheme is shown in brackets)

NOTE: The ends of the network cable should be prepared by first removing approximately 50mm of the outer sheath (taking care not to damage the inner cores). This will reveal 4 coloured wires and an un-insulated screen wire. Each of the coloured wires should then have approximately 5mm of insulation removed to expose the conductor cores.

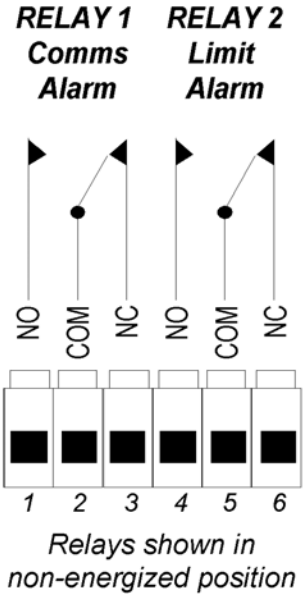
Screen Cable (Earth Strap) : The screen cable should be attached directly to the enclosure using an eyelet tag to one of screws provided (see diagram above). Attach to the closest screw so the cable is as short as possible. The screen cable should also be connected at the sensor end : see the sensor section for details.

4.4 Connecting to the Relay Output Contacts

The interface module has two alarm contacts. Referring to the diagram to the right of this text, the contacts are shown in the normal operating position (i.e. power is applied and no emission alarm exists). Each relay is a voltage-free SPCO contact with a current rating of 3A. The Relays may be used to switch mains voltages.

The diagram shows the function of each relay. See the System Wide Settings section in the Using Your Control Unit section for more details.
The relays can be put in Fail Safe Mode (see System Wide Settings section).

NOTE: The PCME Audible/Visible alarm unit is a normally open trigger input device.



Relays shown in non-energized position

CAUTION: The maximum current through the alarm contacts should not exceed 3 Amps.

4.5 Connecting to the 4-20mA Output

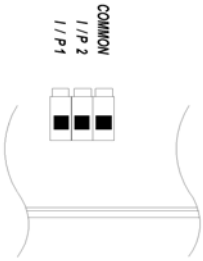
The interface module has a single isolated 4-20mA outputs capable of driving a 250 Ohm load to be used for outputting the sensors emission level.

Pass a suitable cable through an entry gland and connect to the required output as shown (Output +, Return -).

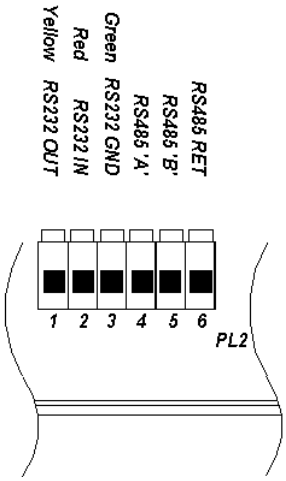
See the System Wide Settings of the Controller Use manual for details of setting the span and filtering of the output.

4.6 Connecting to the Digital Inputs

The interface module has two digital (contact) inputs that the user may assign as required [see **Configuring Digital Inputs** section]. The inputs are not isolated and may be configured by the user as normally open or normally closed.
To connect to the digital inputs, pass a suitable cable through an entry gland and connect as shown.
Note that these inputs are voltage-free and should not be connected to 'logic' outputs from PLC's.
The connection should be made between the required input and common ground.



4.7 Connecting to the Host/PC port



The interface module is fitted with an isolated RS232/RS485 port for connection to a PC/PLC.
To connect to this port, pass a suitable cable through a convenient cable entry gland and connect as shown.

RS232 Cable Limit : 25m

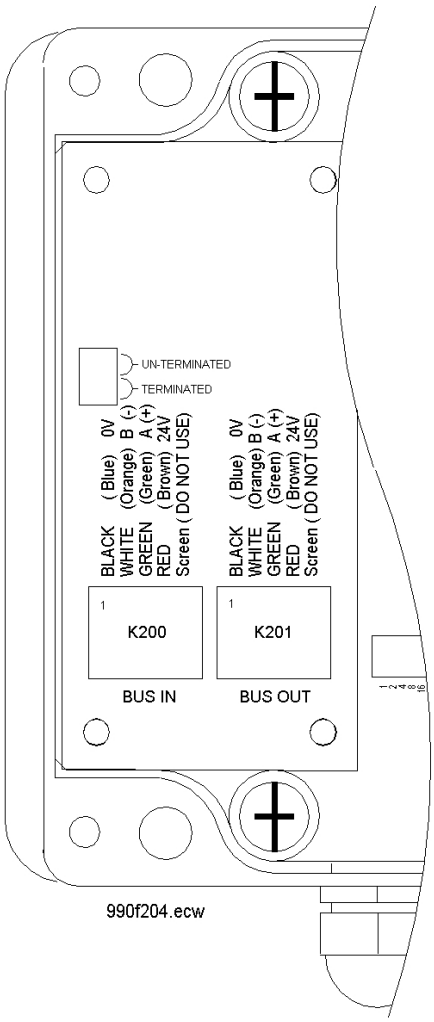
RS485 : Cable Limit :1km. Also allows several Interface Modules to be daisy chained together with separate modbus addresses.

5 DT990 SENSOR

5.1 Connecting the Data/Power bus cable

Referring to the figure to the right, pass the data cable through a convenient cable entry gland and connect to K200 and/or K201 following the colour coding shown. For 'daisy chained' systems, the data cable will connect into K200 (BUS IN) and out from K201 (BUS OUT) to the next sensor. For 'spur linked' systems, there will be a single data/power cable and this should be connected to either K200 (BUS IN) or K201 (BUS OUT). The connection procedure is as follows:

- Remove the sensor lid by unscrewing the four securing screws.
- Remove approximately 40mm of the outer sheath from the 4-core sensor cable and pass the cable through an entry gland.
- Strip approximately 5mm of insulation from each of the 4 cores and connect as shown.
- Pull the cable back through the gland, leaving a little slack in the cores, then fully tighten the cable gland.
- Ensure the Screen Cable is attached to the Earthing Board (see below).
- Ensure that the termination switch is correctly set (see below).
- Ensure comms and address settings are correct (see below).
- Finally, if work is complete within the sensor, securely re-fit the sensor lid.

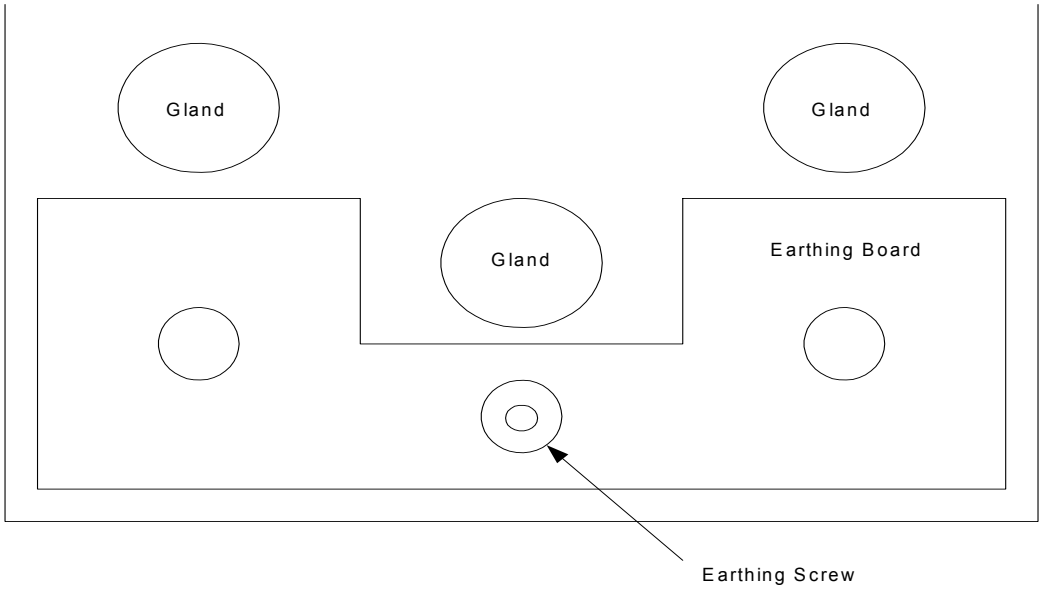


CAUTION! The sensor lid and cable glands must be securely tightened to provide an effective environmental seal.

Note : colours for the alternative wire colour scheme are shown in brackets.

5.2 Connecting the Earthing Screen Cable

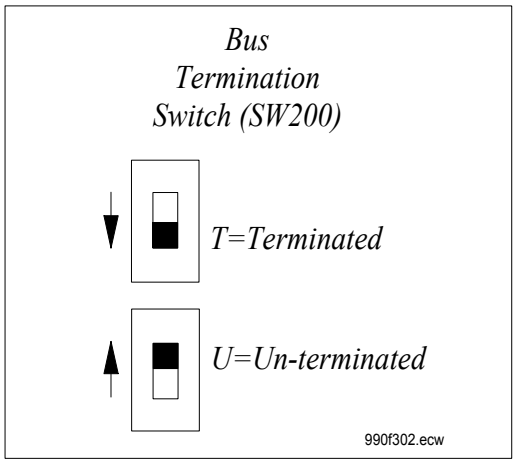
The cable should enter the enclosure via the cable gland. The screen should have an eyelet tag crimped onto it, and the tag should be bolted to the screw provided on the screen termination board attached to the inner wall of the enclosure, close to the gland entry point (see diagram below). Use the short possible length of wire.



Note: Older issues of the 990 sensor do not have the earthing board fitted. Leave the screen cable unconnected. Do not connect to the screen terminal of the Bus-In or Bus-out connectors. This may cause communication problems.

5.3 Setting the 990 bus termination Switch

The 990 sensor has a switch (SW200) near to the bus connectors that allows the bus termination to be changed. When using a spur-linked system, the switch should always be set to TERMINATED. When using a 'daisy chained' system, the sensor at the end of the bus should have the switch set to TERMINATED, those sensors having the bus cable looping through should have the switch set to UN-TERMINATED. (see figure)



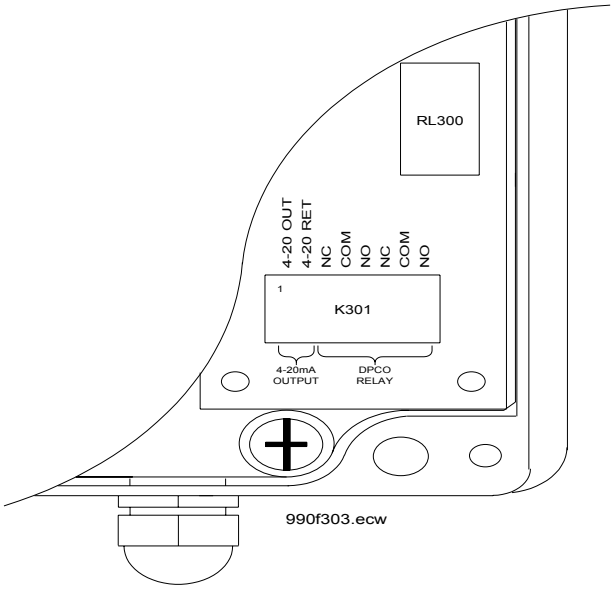
5.4 Connecting to the optional sensor relay and 4-20mA output

The optional 990 Sensor 4-20mA/relay board provides a single 4-20mA output and a single DPCO relay contact. Referring to the figure to the right of this text, pass a suitable cable through a convenient entry gland and connect to K301 as shown.

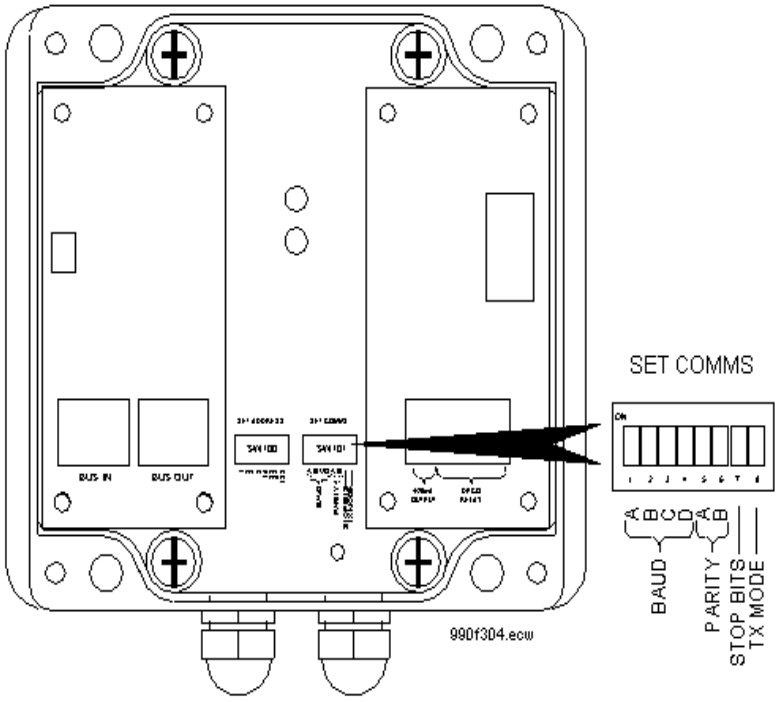
The 4-20mA output will drive a maximum load of 500 Ohms and is isolated (1kV isolation) from the bus supplies and sensor circuitry.

The DPCO relay is volt-free and non fail-safe. The maximum current through the relay is limited to 1 Amp per contact.

DO NOT switch mains voltage with the 990 internal relay! The PCB tracks and connector are NOT mains rated.



5.5 The sensor communications settings



The 990 Communications settings are adjusted by means of an 8 way DIP switch (SW101).

Referring to the figure above: the Baud rate, Parity, Stop bits and Transmit (Tx) mode may be adjusted by setting SW101. The following tables provide details of the switch positions and the corresponding comms settings.

Baud Rate Settings				
BAUD	**SWITCHES 1 TO 4**			
	A	**B**	**C**	**D**
300 Baud	OFF	OFF	OFF	X
600 Baud	ON	OFF	OFF	X
1200 Baud	OFF	ON	OFF	X
2400 Baud	ON	ON	OFF	X
4800 Baud	OFF	OFF	ON	X
9600 Baud	ON	OFF	ON	X
19200 Baud	OFF	ON	ON	X
38400 Baud	ON	ON	ON	X

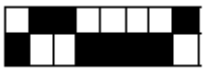
Parity Settings		
PARITY	**SWITCHES 5 & 6**	
	A	**B**
Odd Parity	OFF	OFF
Even Parity	ON	OFF
No Parity	X	ON

NOTE: X = Don't care (may be either ON or OFF)

Stop Bits & Transmit mode settings		
Setting	**SWITCHES 7 & 8**	
	7	**8**
1 Stop Bit	OFF	X
2 stop Bits	ON	X
8 bit data & Modbus RTU Mode.	X	OFF
7 Bit data & Modbus ASCII Mode.	X	ON

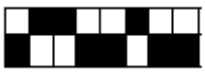
The default settings for the comms for use with the your control unit are:

19200 Baud.
Odd Parity.
1 Stop bit.
ASCII mode



The default settings are compatible with other network devices (e.g. 220 Sensor and AIM unit).
However if you are only planning to install 990 sensors then it is recommended to use RTU mode for improved performance. You will then need the following settings:

19200 Baud.
No Parity.
1 Stop bit.
RTU mode



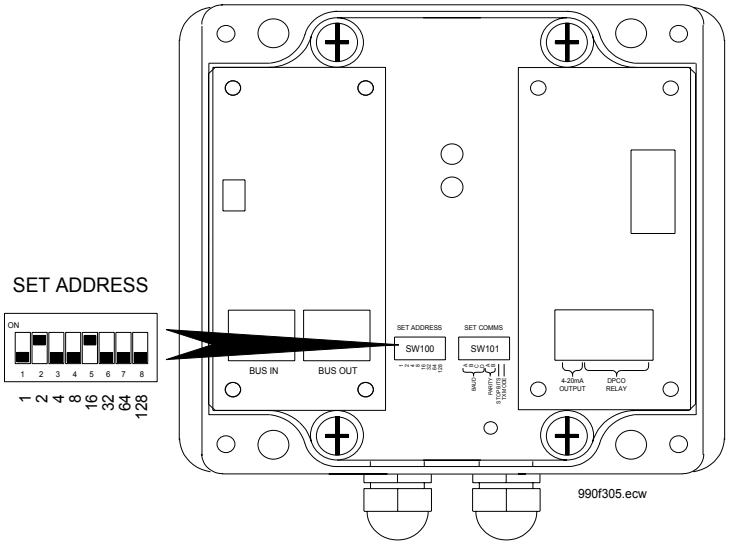
[Note: to adjust from using ASCII to RTU in your Controller go to the 'System Wide Settings' configuration page and adjust the Sensor Comms mode entry:

Default settings:	ASCII	19200	Odd
Adjust to:	RTU	19200	0Pty

See the 'Using your Controller' manual for more details].

5.6 Setting the 990 network address

Each Sensor must have a unique address on the network. The address is set by means of an 8 way DIP switch (SW100). Valid address settings are 1 to 64.

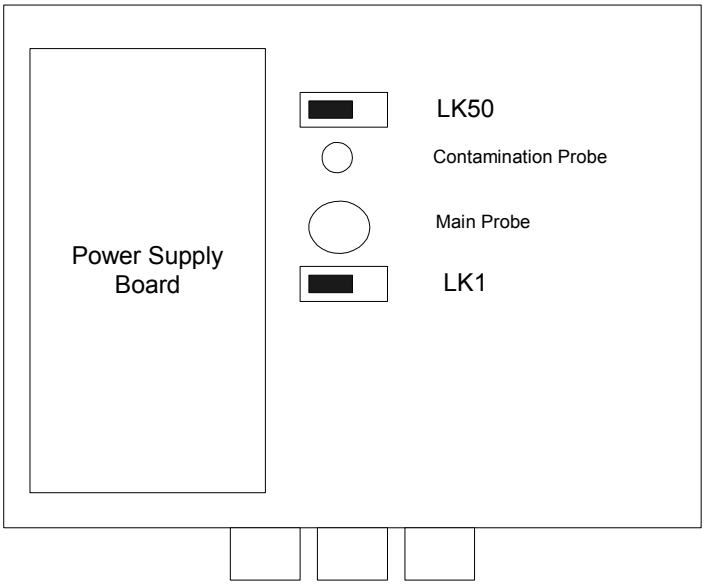


The address switch is marked using a **binary** coding to allow the required address to be easily calculated. For example, to set address number 18, set switch 5 (16) ON and switch 2 (2) ON; 16+2 =18.

5.7 Link Settings

There are two factory set links which connect the probe to the cirucit board. If these are not set correctly the probe sensor will read zero. They should be set as in the diagram below.

LK1	Main sensor probe
LK50	Contamination probe

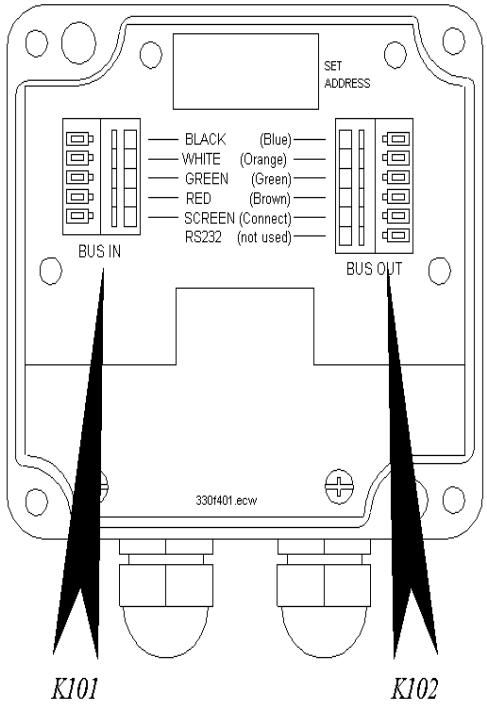


6 BBS220/DA550/DA660 SENSORS

6.1 Connecting the Data/Power bus cable

Referring to the figure to the right, pass the data cable through a convenient cable entry gland and connect to K101 and/or K102 following the colour coding shown. For 'daisy chained' systems, the data cable will connect into K101 (BUS IN) and out from K102 (BUS OUT) to the next sensor. For 'spur linked' systems, there will be a single data/power cable and this should be connected to either K101 (BUS IN) or K102 (BUS OUT). The connection procedure is as follows:

- Remove the sensor lid by unscrewing the four securing screws.
- Remove approx. 40mm of the outer sheath from the 4-core sensor cable and pass the cable through an entry gland.
- Strip approximately 5mm of insulation from each of the 4 cores and connect as shown.
- Pull the cable back through the gland, leaving a little slack in the cores, then fully tighten the cable gland.
- Ensure that the termination switch is correctly set (see below).
- Set the sensitivity and network address (see below).
- Finally, if work is complete within the sensor, securely re-fit the sensor lid.



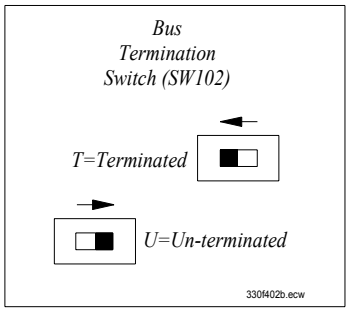
Note: The screen cable should always be connected to the screen terminal of the Bus In and Bus Out connectors. Use the shortest possible length of wire.

Note: colours for the alternative colour scheme are shown in brackets.

CAUTION! The sensor lid and cable gland must be securely tightened to provide an effective environmental seal.

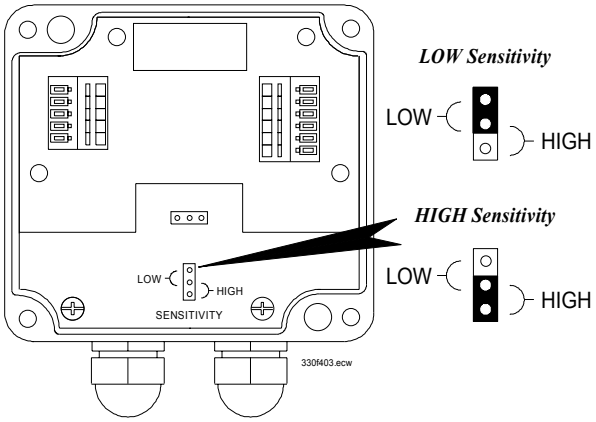
6.2 Setting the bus termination switch

The sensor has a jumper switch (SW102) just below the BUS OUT connector that allows the bus termination to be changed. When using a spur-linked system, the switch should always be set to TERMINATED. When using a 'daisy chained' system, the sensor at the end of the bus should have the switch set to TERMINATED, those sensors having the bus cable looping through should have the switch set to UN-TERMINATED.



6.3 Changing the Sensitivity

Depending upon process conditions and typical dust loading, it may become necessary to adjust the sensitivity of the sensor.



The sensitivity is adjusted by moving the sensitivity 'jumper' to either the HIGH or LOW position on the lower board within the sensor unit (see diagram to the left).

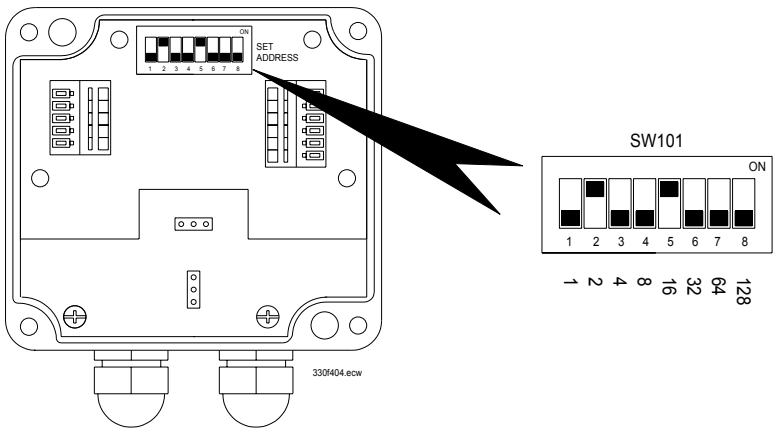
For dust concentrations of above approximately 2mg/m³, **LOW** sensitivity should be used.

For dust concentrations below approximately 2mg/m³, **HIGH** sensitivity should be used.

NOTE 1: The sensor is shipped with a factory setting of LOW sensitivity.

6.4 Setting the network address

Each sensor must have a unique address on the network. The address is set by means of an 8-way DIP switch on the upper board within the sensor (SW101). Valid address settings are 1 to 64.
The address switch uses a binary coding to allow the required address to be easily calculated. For example, to set address number 18, set switch 5 (16) ON and switch 2 (2) ON; 16+2 =18.



6.5 The comms settings

The sensor has fixed comms settings with the following parameters:

19200 Baud.
Odd Parity.
1 Stop bit.
ASCII mode (7-bit).

These settings cannot be changed by the user. These are the default settings used by your controller.

[Note: to adjust the comms settings in the your controller go to the 'System Wide Settings' configuration page and adjust the Sensor Comms mode entry to:

ASCII 19200 Odd

See the 'Using your Controller' manual for more details].

7 SPUR

The Spur module can provide 2 main functions on the bus as follows:

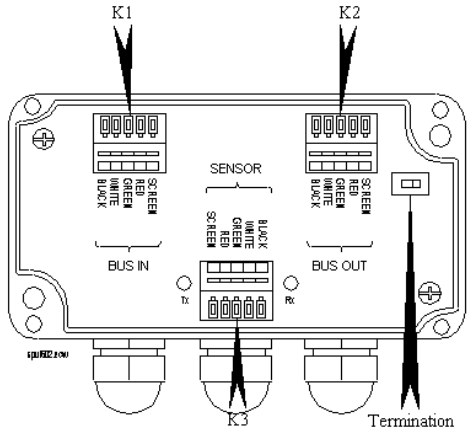
1. Allow sensors/devices to be removed from the bus without interruption of normal operation.
2. Allow the bus to branch off in applications where a 'chain' is awkward to install.

Typically each sensor or device will have its own spur module such that if the sensor or device is removed from the bus for maintenance, the rest of the bus is not affected.

7.1 Connecting the bus cables to the Spur module

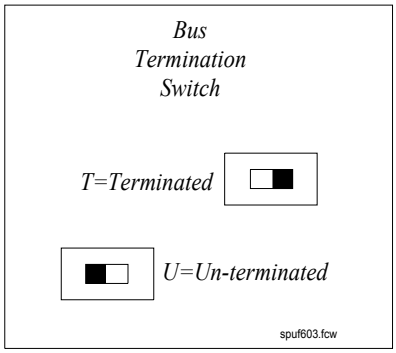
The data bus should be connected 'through' the spur module by connecting to BUS IN (K1) and BUS OUT (K2). The bus cable should be passed through the cable gland below the relevant connector and the connections made following the colour coding shown.

The sensor or device cable should be connected to the SENSOR connector (K3) following the colour coding shown. The distance between each spur and sensor may be up to 500m. If a sensor is to be removed from the bus, the sensor cable should be disconnected within the spur module.



Note : The Screen Connection should always be connected.

7.2 Setting the bus termination



The spur module has a switch at the right hand end of the circuit board that allows the bus termination to be changed. When only one branch of the bus is connected to BUS IN (i.e. no connections to BUS OUT), the switch should be set to the TERMINATED position. If the bus continues through the spur via BUS OUT, the switch should be set to the UN-TERMINATED position.
In general, if nothing is connected to the BUS OUT connector (K2), then the bus should be terminated, otherwise it should be un-terminated.

8 ISOLATED SPUR

Note: for ATEX use the Isolating spur must be installed in the safe zone.

Electrical connections for the isolating spur are as follows (K2 and K3 are in parallel i.e. all connector pins of K2 are connected to the corresponding pins of K3). K2 and K3 are used to connect the non-isolated side of the spur unit to the network. K4 connects the isolated side of the spur to the sensor. This information relates to iss.2 of the ATEX spur. The tables below are in pin-number order.

Network connections (at Isolated Spur iss. 2):

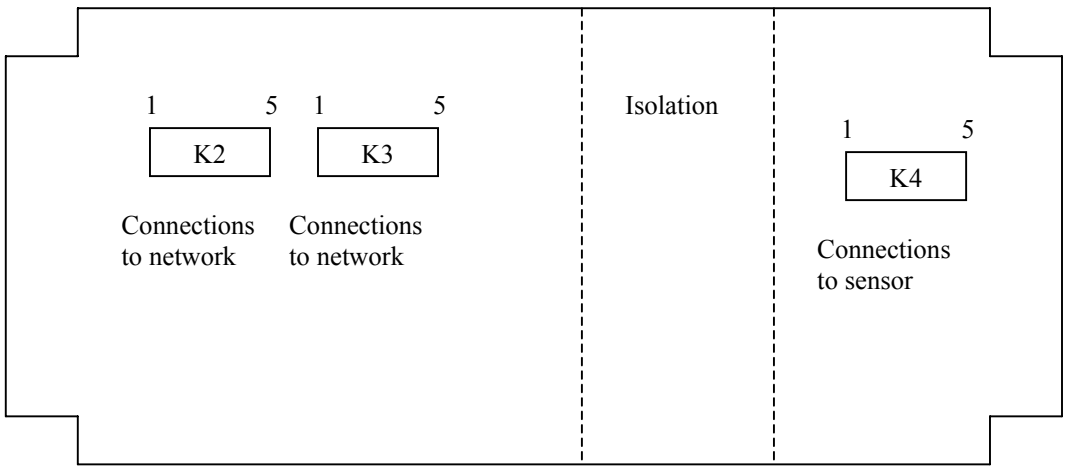
Connection name	Isolated Spur K2, K3 pin number	Network cable wire
0V	1	Blue
/B	2*	Orange
A	3*	Green
+24V	4	Brown
Screen	5	Cable Screen

*Earlier issue C isolated spur had pins 2 and 3 reversed.

Connections -- Sensor to Isolated Spur:

Connection name	Isolated Spur K9 pin number	Sensor cable colour	Sensor PSU connection label
0V	1	Blue	Blue
/B	2	Orange	Orange
A	3	Green	Green
+24V	4	Brown	Brown
Screen	5	Cable Screen	Screen Ground

Schematic view of the isolated spur PCB showing the connector positions and pin numbering:



Electrical connections for the isolating spur are as follows (K2 and K3 are in parallel i.e. all connector pins of K2 are connected to the corresponding pins of K3). K2 and K3 are used to connect the non-isolated side of the

spur unit to the network. K4 connects the isolated side of the spur to the sensor. The tables below are in pin-number order.

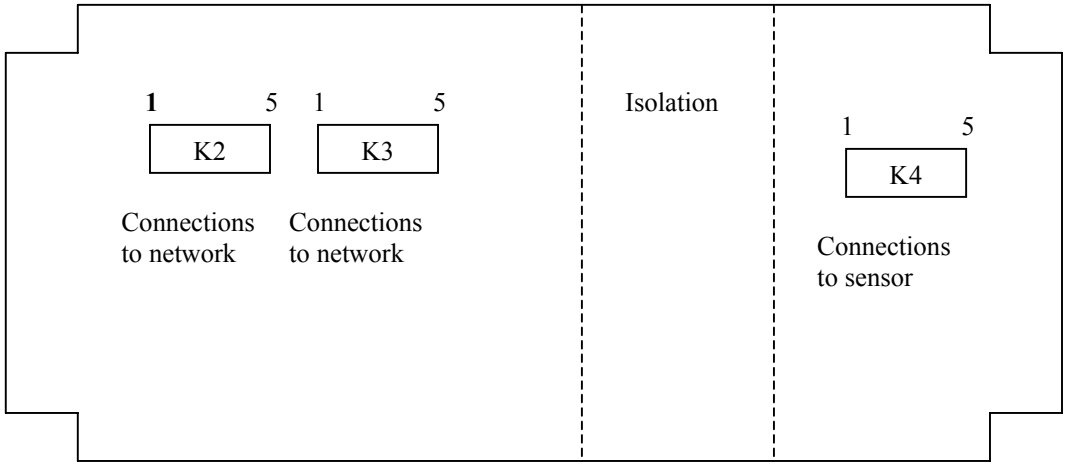
Network connections (Modbus In, Modbus Out)

Connection name	Isolated Spur K2, K3 pin number	Network cable wire
0V	1	Blue
/B	2	Orange
A	3	Green
+24V	4	Brown
Screen	5	Cable Screen

Connections -- Sensor to Isolated Spur

Connection name	Isolated Spur K4 pin number	Sensor cable colour	Sensor PSU connection label
0V	1	Blue	Blue
/B	2	Orange	Orange
A	3	Green	Green
+24V	4	Brown	Brown
Screen	5	Cable Screen	Screen Ground

Schematic view of the isolated spur PCB showing the connector positions and pin numbering:



9 PSU REPEATER

The PSU repeater module provides two main functions in the your network system:

1. Provides additional 24VDC power where cable length/load dictates a requirement.
2. Provides an RS485 ‘repeat’ function to allow the bus to be conveniently extended.

The same rules apply to power supplied by the repeater as from the controller. Use the calculations provided in section 3 to ensure that the repeater will provide the necessary bus power.

9.1 Choosing the best position for the Repeater module

If the bus voltage is expected to be close to or below 12VDC at any point in the network (using the calculations from section 3) then a Repeater should be fitted at that point. The network will continue from the Repeater and the calculations of voltage drops may begin at the Repeater for the next section of the network.

Important! The data bus is not a continuous loop, under no circumstances should the BUS OUT be connected back to BUS IN or damage will occur to the system.

Generally the unit should be mounted in an easily accessible position, away from direct sunlight and in an area where the ambient temperature does not exceed -25°C to +50°C. The enclosure of the unit is sealed to IP65 and thus should be mounted in a sheltered position away from the elements.

To summarise, the repeater should ideally be mounted:

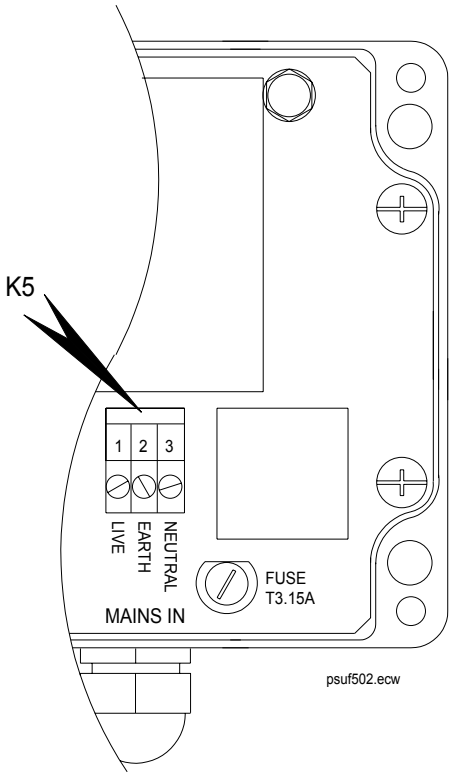
- Where network voltage is close to or below 12VDC.
- In a convenient and accessible position.
- In an area within the temperature range (-25°C to +50°C).
- Away from direct sunlight and sheltered from the elements.
- Do not connect the bus as a loop or 'ring', each branch of the bus must end with a termination.

9.2 Connecting the mains supply to the Repeater module

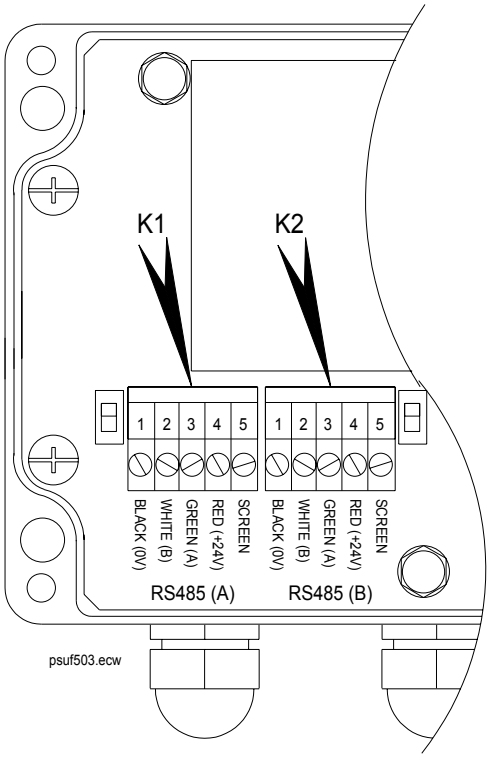
The Repeater requires a mains power supply of 90 to 260Vac 50/60Hz (automatic voltage detect). There is a safety shield covering the high voltage areas of the PSU/Repeater circuitry; this must be removed to allow access to the supply connections. Referring to the figure to the right of this text, the supply cable should be passed through a convenient cable gland and should be connected to K5 as shown.

The safety cover should be replaced when the main connections are complete and the PSU/Repeater should **NEVER** be operated with the safety cover removed.

WARNING ! Before making changes to the mains wiring, or replacing the fuse, the unit must be externally isolated from the supply.



9.3 Connecting the bus cable(s) to the Repeater module



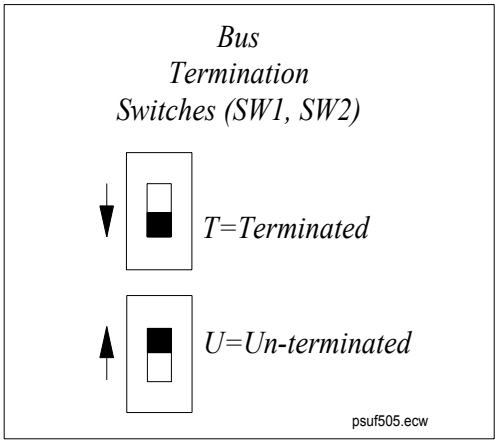
Typically the incoming bus will be connected to RS485(A) (K1) and the outgoing 'boosted' bus will be connected to RS485(B) (K2). Where only one branch of the bus is to be connected (i.e. at one end of the bus), the cable should be connected to the RS485(B) connector (K2)).
Referring to the diagram to the left of this text, the bus cable(s) should be passed through the cable gland(s) and connected as shown. **Take care to ensure that the colour coding is correct otherwise the sensor or repeater unit may be damaged.**

Note1: The ends of the bus cable should be prepared by first removing approximately 50mm of the outer sheath (taking care not to damage the inner cores). This will reveal 4 coloured wires and an un-insulated screen wire. Each of the coloured wires should then have approximately 5mm of insulation removed to expose the conductor cores.

***Note2*: The Screen connection should always be connected.**

9.4 Setting the Repeater bus termination

The Repeater module has two switches located on the circuit board that allow the bus termination to be changed. **In virtually all instances, the switches should be set to Terminated**. It is possible to connect the bus cables in parallel to one port and the termination should be changed in this case.



10 AOM (ANALOGUE OUTPUT MODULE)

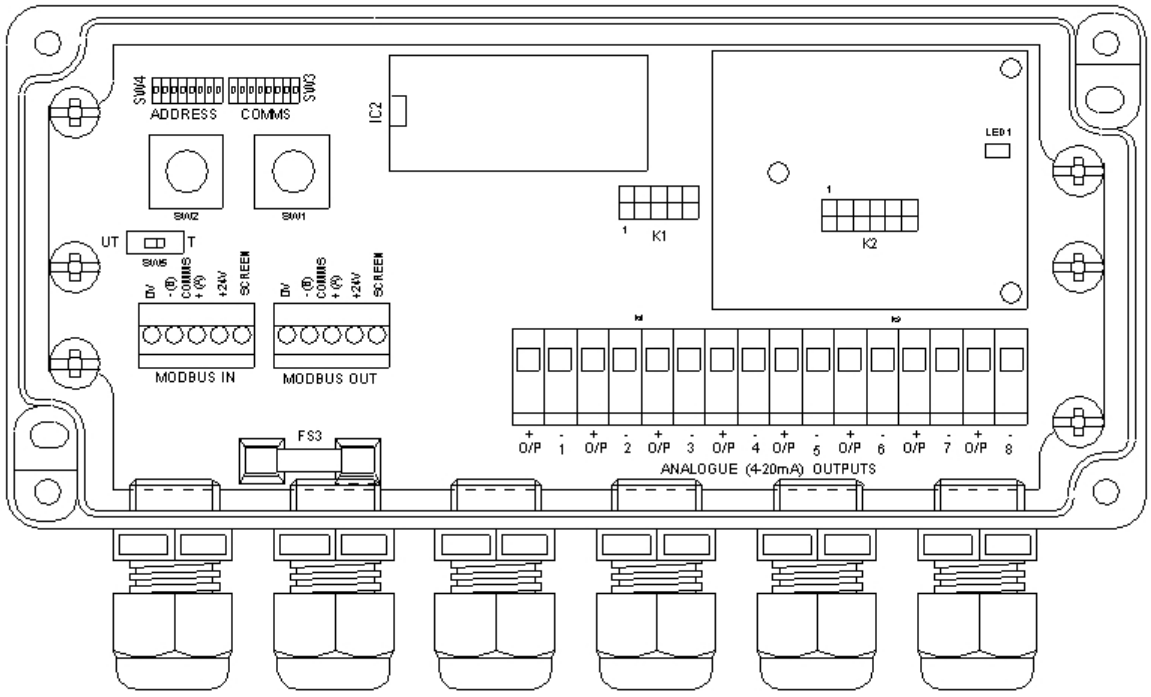
10.1 Principle of operation

Each Analogue Output Module (AOM) provides up to 8 separately configurable 4-20mA outputs. Each individual output can be associated with any sensor input to your control unit. The control unit is responsible for reading data from the sensors and updating the outputs in the AOM. The update typically occurs every second. The Analogue Output Module is connected to your Modbus RS485 network in the same way as your sensor devices.
There is no restriction on how many AOM devices you can add to your network : the outputs can be use in conjunction with the 4 analogue outputs in the control unit , e.g. you can use 2 AOM units to provide up to 4+8+8=20 outputs.

To install your Analogue Output Module:

- Wire the module at a suitable location in your sensor network (see section 2 : electric installation)
- Adjust the configuration within your control unit to add the AOM device then set up the required associations between sensor inputs and analogue outputs.

10.2 Electrical Installation



- Follow the general procedure as for other PCME network devices (see your main sensor manual) to connect the device to your control unit.

- install with cable glands pointing downwards
- connect device into the network using Modbus In and Modbus Out connectors following the colour scheme as in the control unit.
- standard PCME scheme: blue (0V), orange (B), green (A) , brown (24V)
- connect the screen cable to the connector marked SCREEN.
- if the device is installed at the end of the network set the terminator switch to the T (terminated) position.

- Check the **comms settings** (SW3).

- These should be preset to the standard ASCII settings :
OFF ON ON OFF OFF OFF OFF ON
(note : different settings are required if you have 990 sensors set to RTU mode)

- Set the **modbus address** (SW4) to a unique value

e.g. settings of ON OFF ON ON OFF OFF OFF OFF gives address 1+0+4+8 = 13.

11 ROM (RELAY OUTPUT MODULE)

11.1 Principle of operation

Each Relay Output Module (ROM) provides up to 8 separately configurable relay outputs. Each individual output can be associated with any sensor input to your control unit and any particular alarm type (warning alarm, limit alarm, comms error, self test fail). The control unit is responsible for monitoring the alarm states of the sensors and updating the relay state in the ROM. The update typically occurs every second. The Relay Output Module is connected to your Modbus RS485 network in the same way as your sensor devices.
There is no restriction on how many ROM devices you can add to your network : the outputs can be use in conjunction with the 4 relay outputs in the control unit , e.g. you can use 2 AOM units to provide up to 4+8+8=20 outputs.
Optional settings existing to latch the alarm relays and to operate the relays in a fail safe mode.

To install your Relay Output Module:

- Wire the module at a suitable location in your sensor network (see section 2 : electric installation)
- Adjust the configuration within your control unit to add the ROM device then set up the required associations between sensor inputs and relay outputs.

11.2 Electrical Installation

- Follow the general procedure as for other PCME network devices to connect the device to your control unit.

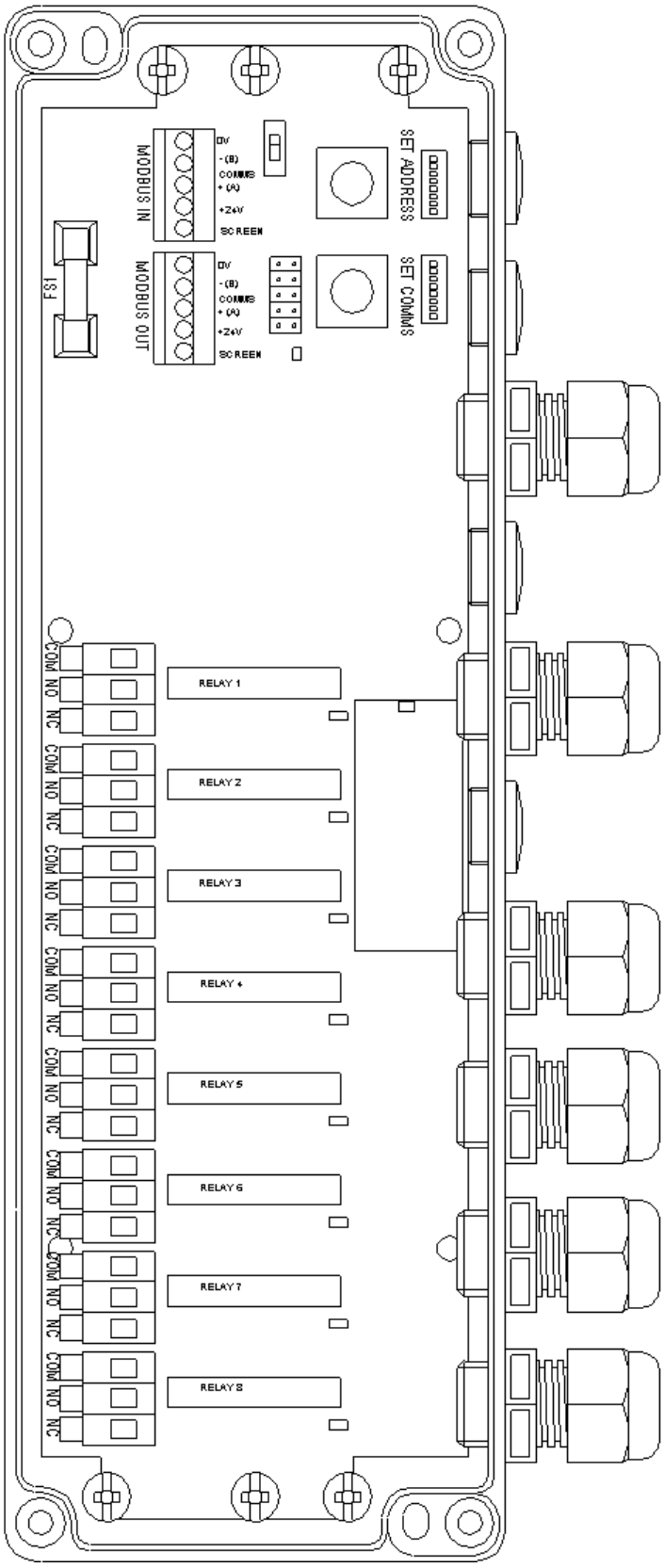
- install with cable glands pointing downwards
- connect device into the network using Modbus In and Modbus Out connectors following the colour scheme as in the control unit.
- standard PCME scheme: blue (0V), orange (B), green (A) , brown (24V)
- connect the screen cable to the connector marked SCREEN.
- if the device is installed at the end of the network set the terminator switch to the T (terminated) position.

- Check the **comms settings** (SW5).

- These should be preset to the standard ASCII settings :
  OFF ON ON OFF OFF OFF OFF ON
(note : different settings are required if you have 990 sensors set to RTU mode)

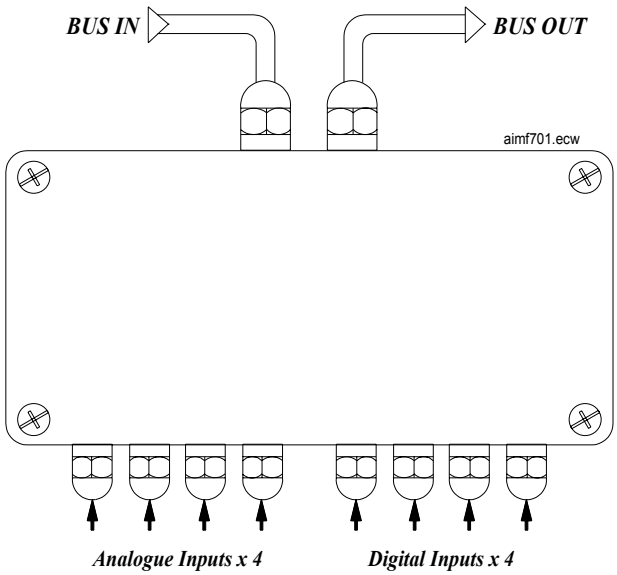
- Set the **modbus address** (SW4) to a unique value

- e.g. settings of ON OFF ON ON OFF OFF OFF OFF gives address 1+0+4+8 = 13.


MODBUS IN
0V
- (B)
COMMS
+ (A)
+24V
SCREEN
MODBUS OUT
0V
- (B)
COMMS
+ (A)
+24V
SCREEN
FS1
SET ADDRESS
SET COMMS
COM
NO
NC
RELAY 1
RELAY 2
RELAY 3
RELAY 4
RELAY 5
RELAY 6
RELAY 7
RELAY 8

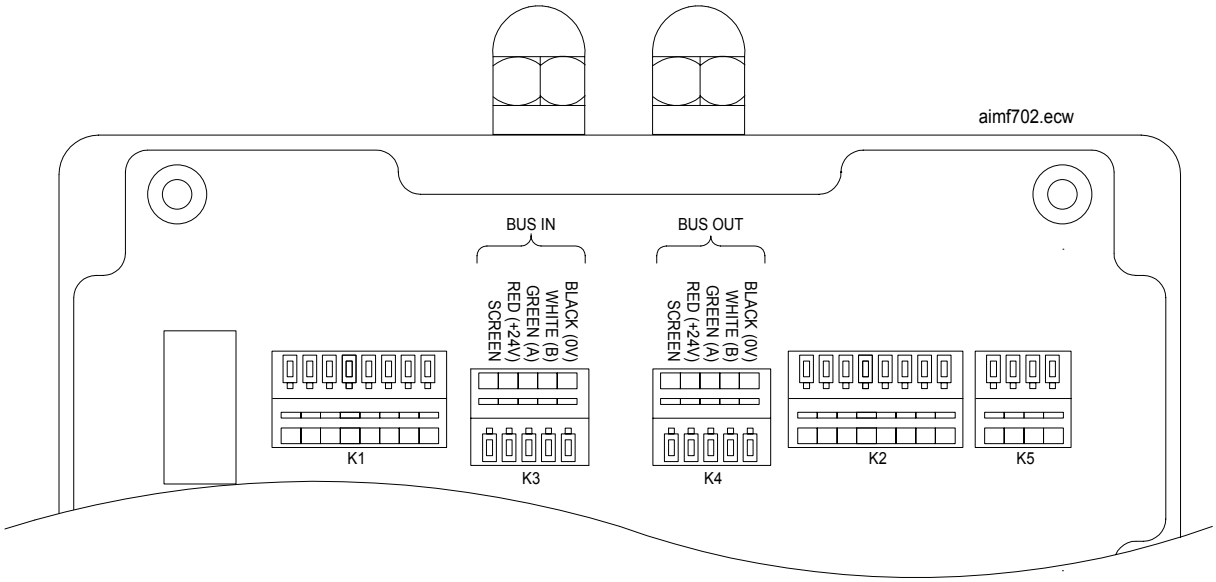
12 AIM (AUXILIARY INPUT UNIT)

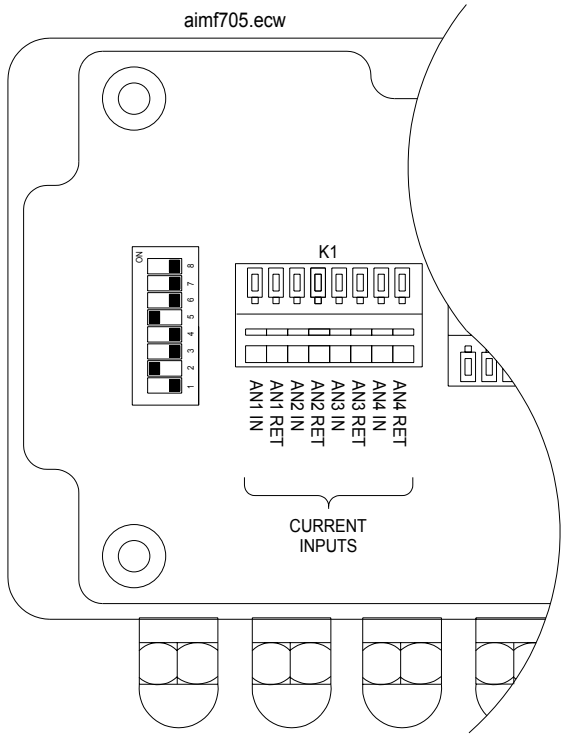
The PCME AIM (Auxiliary Input Module) can provide four 4-20mA inputs and four digital (contact) inputs to allow non-modbus equipment to be interfaced into the network.



12.1 Connecting the bus cables to the AIM

Referring to the figure below, pass the data cable through one of the larger (PG9) cable entry gland and connect to K3 and/or K4 following the colour coding shown. For 'daisy chained' systems, the data cable will connect into K3 (BUS IN) and out from K4 (BUS OUT) to the next device. For 'spur linked' systems, there will be a single data/power cable and this should be connected to either K3 (BUS IN) or K4 (BUS OUT). *Note* : the Screen connection is not used with the the controller.**Note : the Screen Connection should always be connected.**





12.2 Connecting to the AIM Analogue Inputs

Referring to the figure to the left, pass the signal cable through a convenient cable entry gland and connect as shown.
The inputs are marked as follows:

- AN1 IN = CH1 analogue input (+)
- AN1 RET = CH1 analogue input (-)
- AN2 IN = CH2 analogue input (+)
- AN2 RET = CH2 analogue input (-)
- AN3 IN = CH3 analogue input (+)
- AN3 RET = CH3 analogue input (-)
- AN4 IN = CH4 analogue input (+)
- AN4 RET = CH4 analogue input (-)

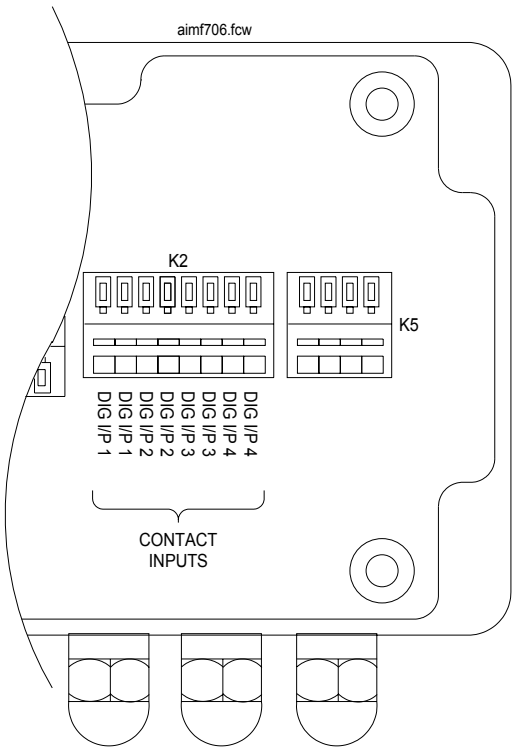
The inputs are NOT isolated and each input has an impedance of 100Ohms.

Note: The Analogue inputs may be factory configured for alternative signal types. The input type will be identified by a sticker inside the AIM unit lid.

The analogue inputs are passive and hence passive transducers will require an external supply.

12.3 Connecting to the AIM Contact Inputs

The AIM has four volt-free contact inputs labelled DIG I/P1 to DIG I/P4 (pins 1 to 8 of K2).
Pass the signal cable through a convenient cable entry gland and connect to the required contact input.
The AIM inputs are configured for normally open operation.
Note that the contact inputs are not isolated and must not be connected to any voltage or current source.



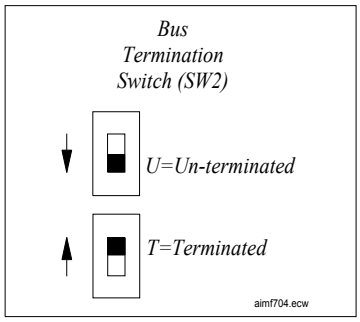
12.4 AIM Contact input level/edge detection

The AIM has a jumper link (LK1) labelled 'Digital triggering' (see the diagram in the appendix). This jumper has two positions: 'Level' and 'Edge'. The purpose of these two positions is as follows:

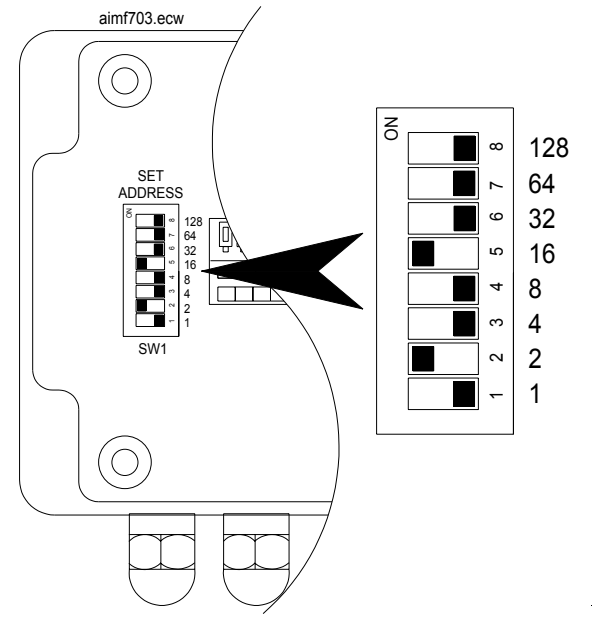
- Level triggering: The contact inputs are sampled several times within one second. When 'Level triggering' is used, the input status at the time of the Modbus read is passed back to the PC. This means that any short duration changes of state between Modbus reads are ignored. This setting is useful for rejecting erroneous input changes in noisy environments.
- Edge triggering: Any change of state of the contact input from the previous reading is held until the next reading. This allows short duration pulses to be 'captured' or 'latched' with relatively slow Modbus polling rates. A typical application for this setting would for broken bag row marker detection.

12.5 Setting the AIM bus termination

The AIM has a switch (SW2) just below the BUS IN and BUS OUT connectors that allows the bus termination to be changed. When using a spur-linked system, the switch should always be set to TERMINATED. When using a 'daisy chained' system, the AIM at the end of the bus should have the switch set to TERMINATED, those AIM's having the bus cable looping through should have the switch set to UN-TERMINATED.



12.6 Setting the AIM network address



Each AIM must have a unique address on the network. The address is set by means of an 8-way DIP switch at the left hand end of the PCB (SW1). Valid address settings are 1 to 64.
The address switch uses a binary coding to allow the required address to be easily calculated. For example, to set address number 18, set switch 5 (16) ON and switch 2 (2) ON: 16+2 =18.

12.7 The AIM communications settings

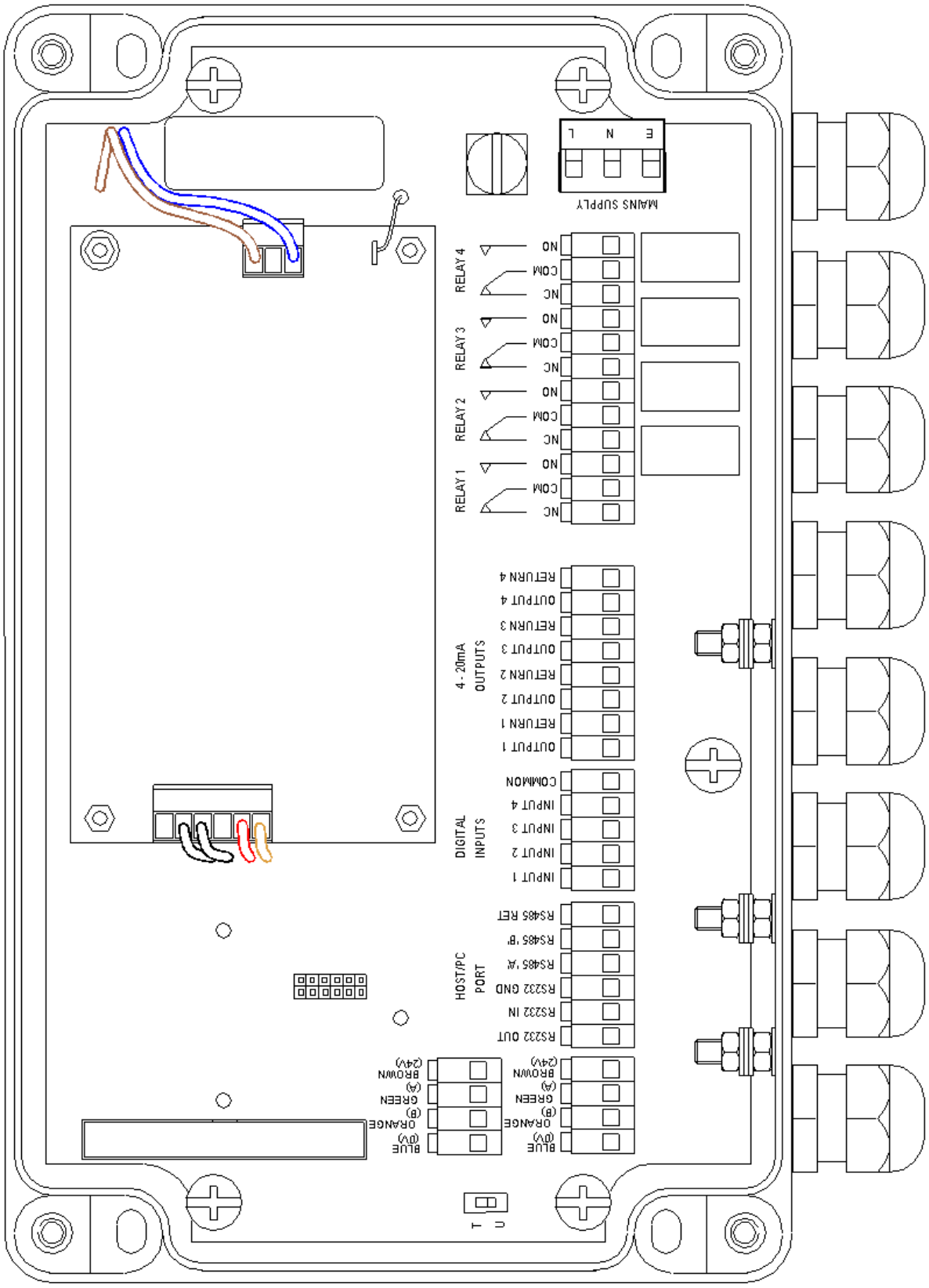
The AIM has fixed communications settings with the following parameters:

19200 Baud.
No Parity.
1 Stop bit.
ASCII mode (7-bit).

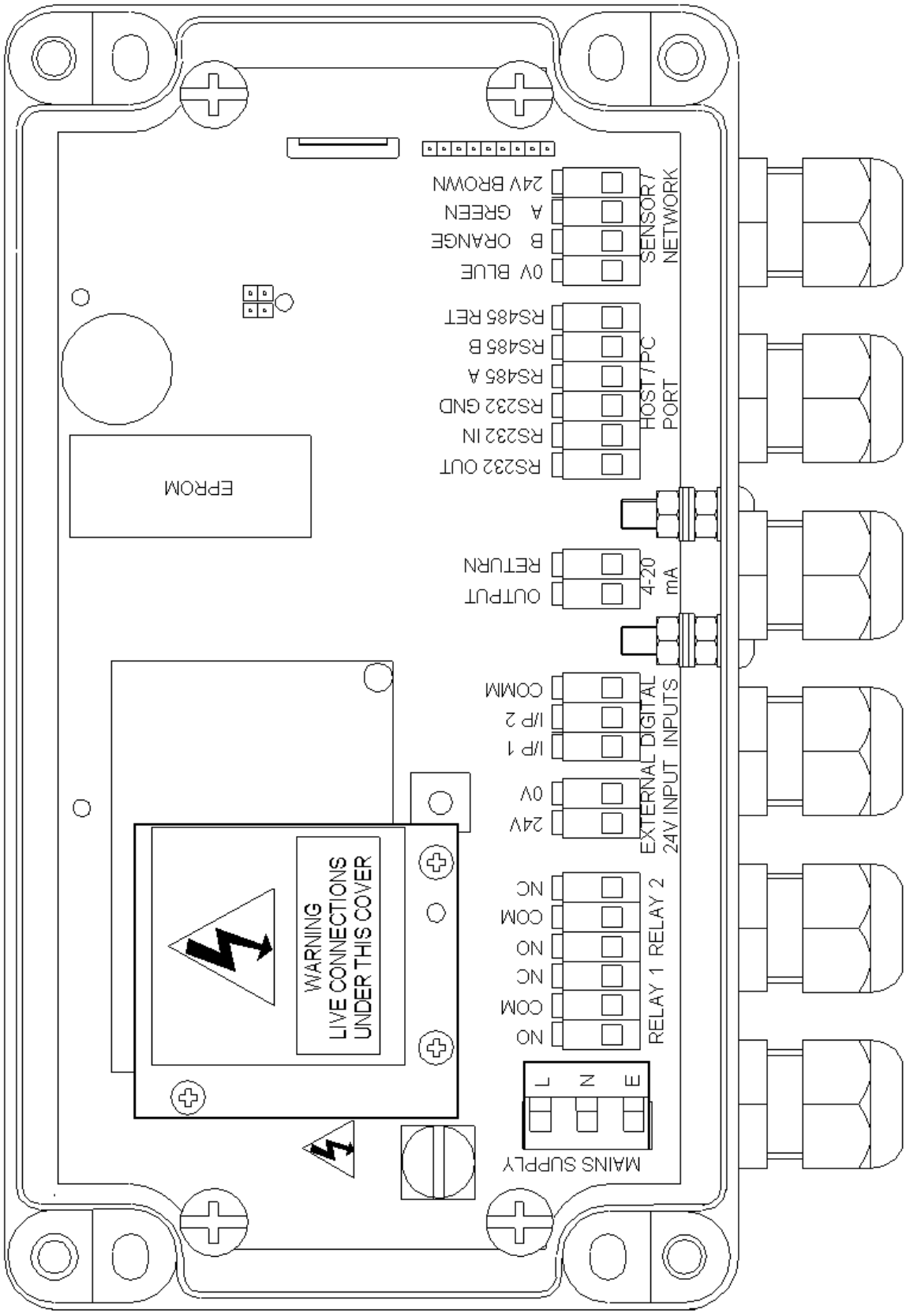
These settings cannot be changed by the user. These are the default settings used by the controller.

13 CONNECTION DIAGRAMS

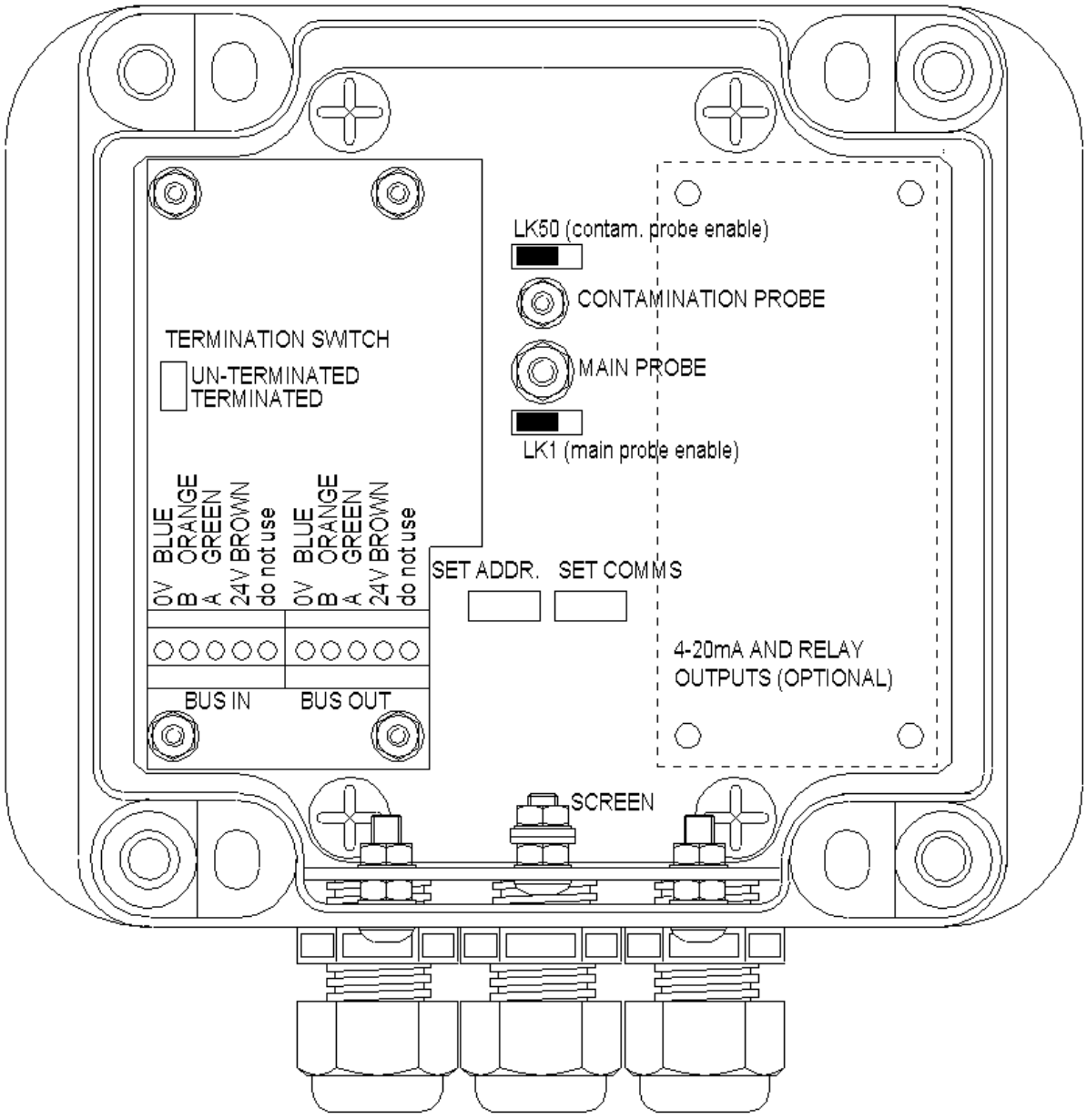
13.1 Multi-Controller



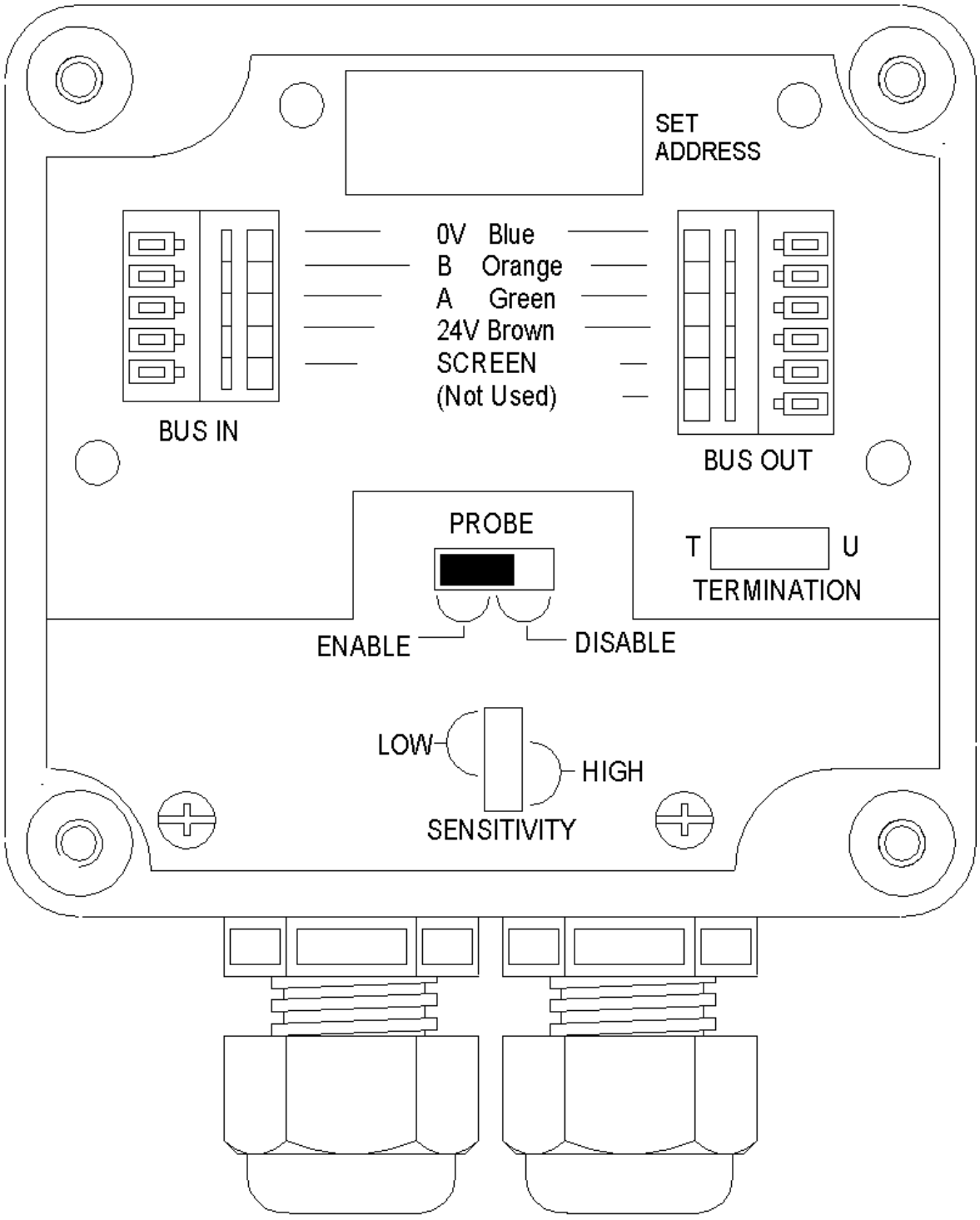
13.2 Interface Module



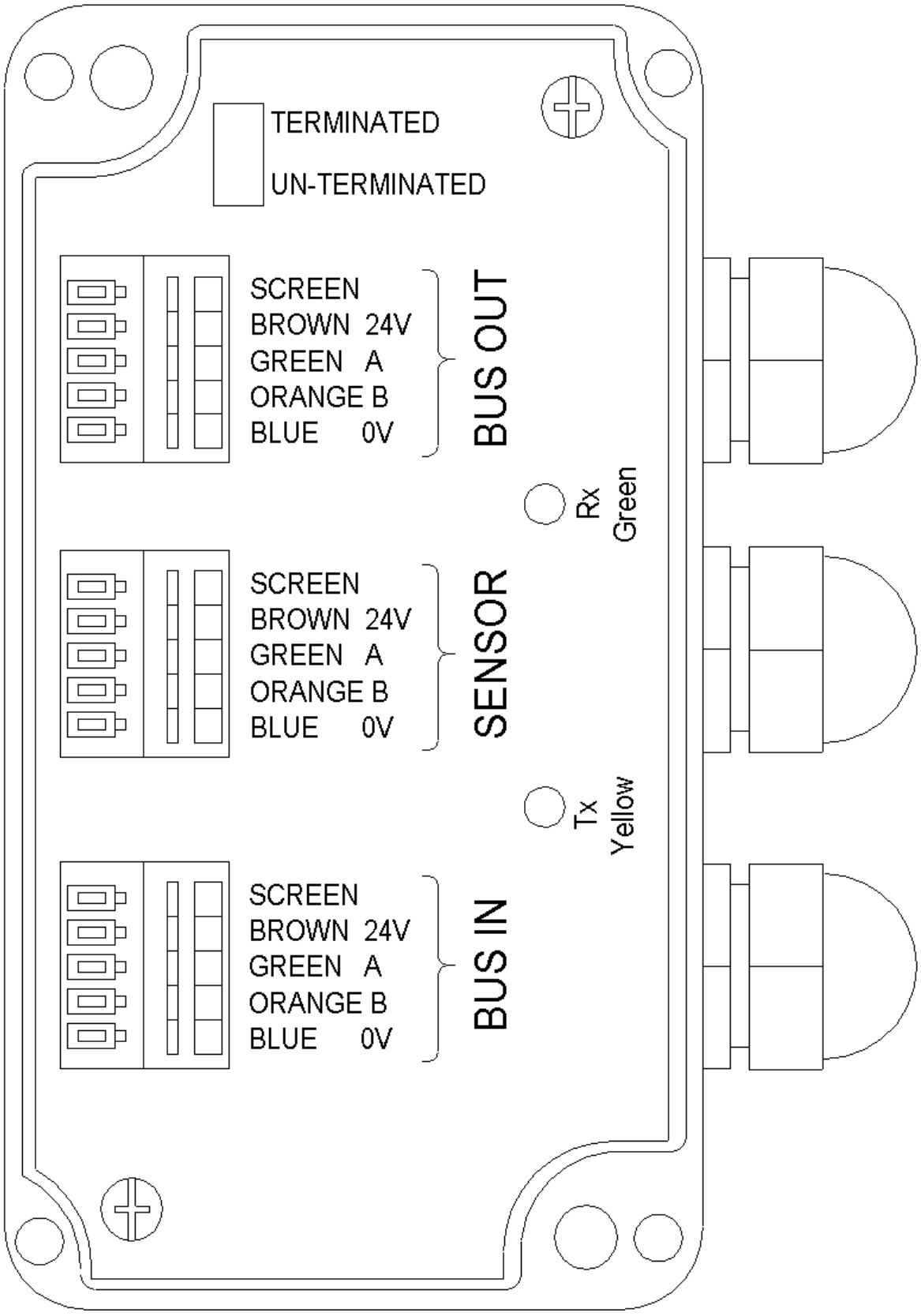
13.3 DT990 Sensor



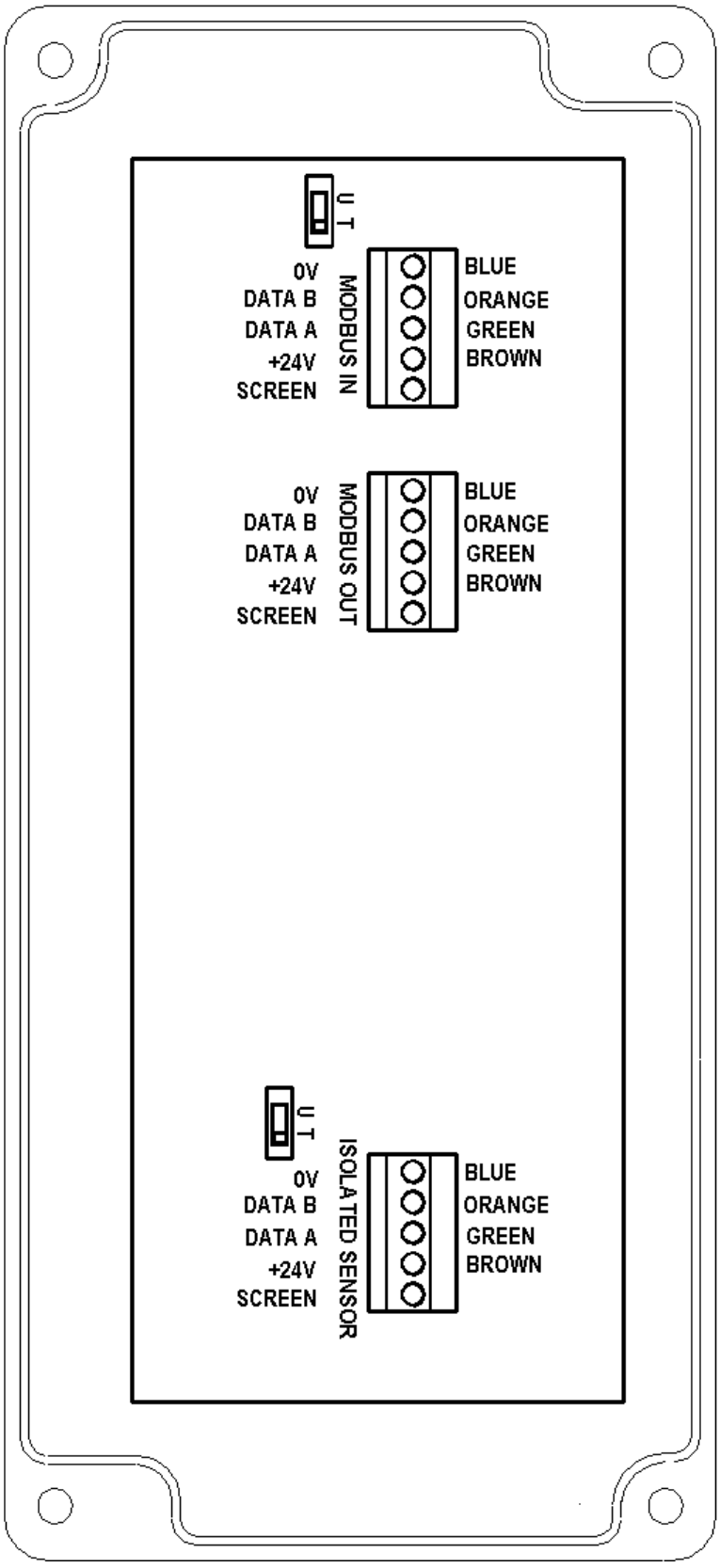
13.4 BBS220/DA550/DA660 Sensor



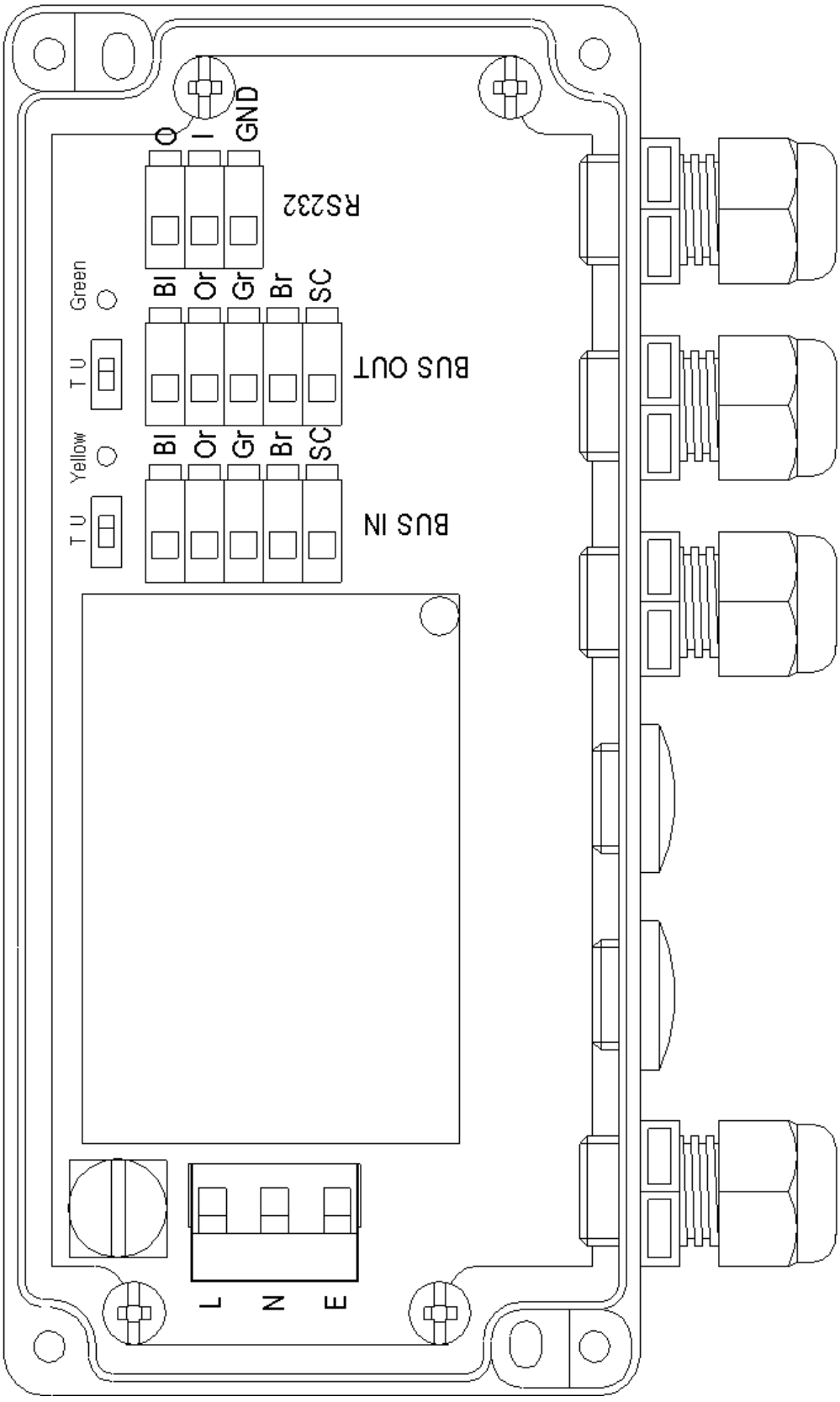
13.5 Spur


TERMINATED
UN-TERMINATED
SCREEN
BROWN 24V
GREEN A
ORANGE B
BLUE 0V
BUS OUT
Rx
Green
SCREEN
BROWN 24V
GREEN A
ORANGE B
BLUE 0V
SENSOR
Tx
Yellow
SCREEN
BROWN 24V
GREEN A
ORANGE B
BLUE 0V
BUS IN

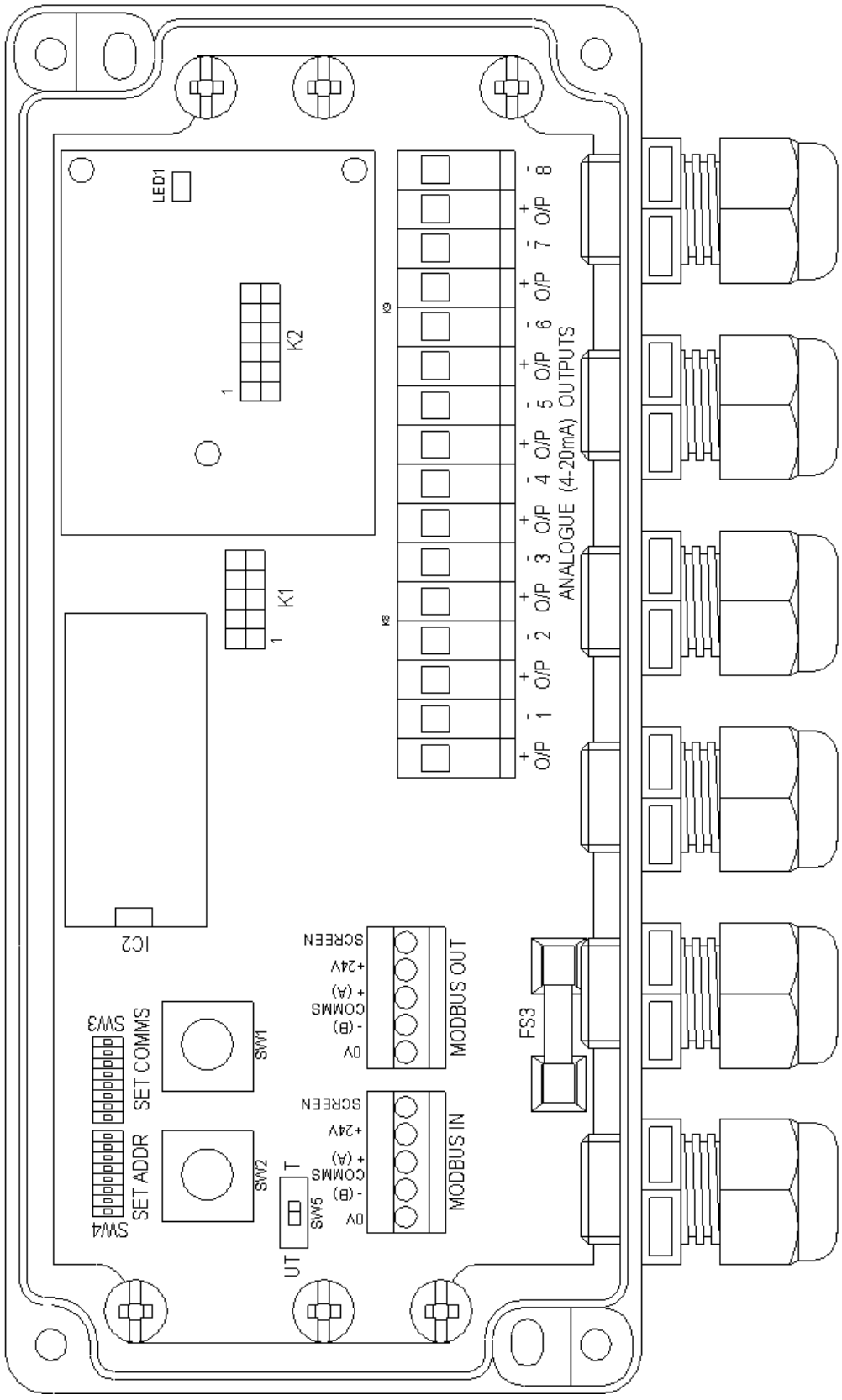
13.6 Isolated Spur



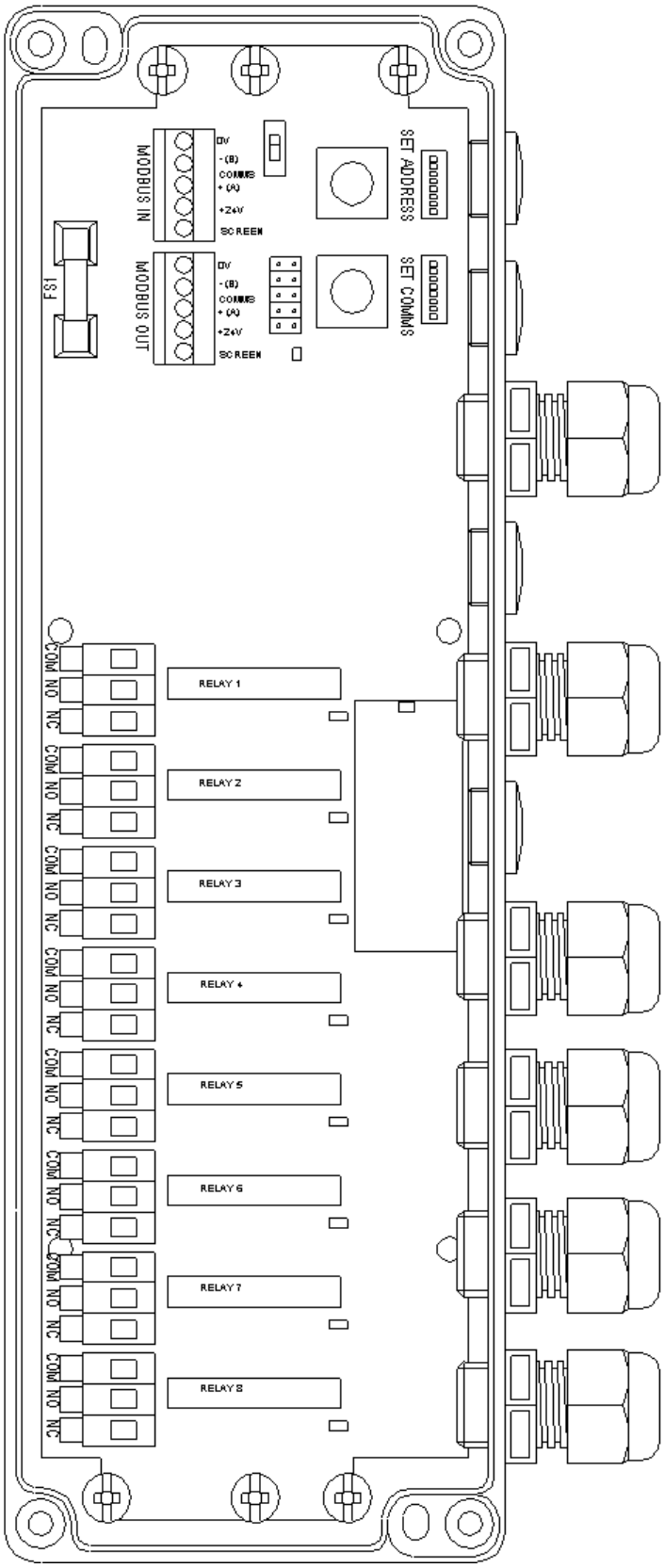
13.7 PSU Repeater



13.8 Analogue Output Module



13.9 Relay Output Module



13.10 AIM (Auxiliary Input Module)