DiFOAM CONTROLLERS AND SENSORS

FDCW2BN
FDCW2CN

INSTALLATION AND OPERATION MANUAL

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SPECIFICATIONS

Power Supply :	FDCW2BN - 110 V ac / 24Vdc (0.3A) FDCW2CN - 230 V ac / 24 Vdc (0.3 A)
Outputs :	Relay 1 – Dosing Control (volt-free change-over contacts) Relay 2 – The material Detect (Volt-free change over contacts) Rating:- 240 V a.c. 30 V d.c. 2 A max. 4-20 mA continuous o/p
Indicators :	Power indicator - Green Sense indicator – Red On when material is initially detected. Activate indicator - Yellow Flashes during response time, then on when controller triggers.
Adjustments :	Delay Time 0 - 30 seconds Dose Time 0 - 30 seconds Relay Trigger adjustment 20, 40, 60, 80% of range Normal mode – relays off when no foam Fail Safe Mode - relays on when no foam Sensitivity adjust 16 selectable options
Enclosure:	IP65 Polystyrene with polycarbonate lid 240 wide x 220 height x 115 depth mm Colour Grey (Ral 7035) Connections: screw terminals.
Sensor Cable:	CAT 5e to Belden 1633E - low attenuation
Error Codes:	All leds flashing in sequence – sensor not synchronising.
Zero Reference:	Must be set with sensor in operating position.

1. INTRODUCTION

The Hycontrol FDCW2BN & FDCW2CN DiFoam Controllers are advanced purpose designed Level Controllers intended for the measurement and control of non-conducting foams and liquids such as oils, resins and solvents. The controller will only function with a Hycontrol DiFoam Sensor to achieve the operation described. The principle parts of a system are as follows:

- Sensor – DiFoam Type
- Interconnecting Cable
- Controller Unit – DiFoam type

There are a variety of sizes and styles of sensor available. They are all designed for hygienic applications and will operate in the presence of high levels of fouling (i.e. surface coating).

The Controller Unit can be used as a transmitter to signal to a process controller or alarm via volt free contacts or 4-20ma signal. They can also be used to control a local dosing pump or valve directly using a separate relay output.

Relay 1 is used to control a dosing function via an algorithm called shot and delay. It switches on and off to control a valve or pump etc. Relay 2 is activated when a material is sensed and stays on when the signal is above the trigger level, and can be used to switch an alarm to connect to a process controller or plc.

An analogue output can be used to indicate level via a 4-20 mA signal.

This is one of a series of products designed and manufactured by Hycontrol Limited for sensing and control of foams and liquids.

2. PRINCIPLE OF OPERATION

The Dielectric Sensor operates by measuring the dielectric constant of the material being tested. The dielectric constant of air is 1 by definition and all other materials are higher than 1. The dielectric constant is measured by means of a high frequency signal from the sensor that is generated by an oscillator circuit in the sensor head. The sensor is extremely sensitive and can be used for materials that are normally very difficult to sense.

The controller energizes the sensor and measures the frequency of the signal. The signal from the sensor is used to determine how much foam or other material is present. The data is used to discriminate between foam and spurious events such as splashing. It also determines when foam is present and signals to a process controller or alarm that foam has been detected. Various output interfaces are available including volt-free contacts (relays x2) and 4-20 mA.

Note the system must be set-up to work correctly. See section 4.

3. INSTALLATION

3.1 Installing the Sensor

The Hycontrol Sensor should be installed in such a way that the sensing electrode is positioned at the point where foam is required to be detected Ensure that the Sensor is mounted securely and is not close to any permanent structure such that a "bridge" of foam can get caught. Ideally the sensing electrode should be more than 50 mm from any other metal parts but certainly more than 25 mm.

The orientation of the sensor can be vertical or horizontal. The advantage of a vertical orientation is that any build-up of foam or material is more likely to drop off. The disadvantage is that the foam or material under test has to cover the sensor enough to trigger it. The advantage of a horizontal orientation is that the sensor will respond as soon as the foam reaches the sensor.

If the Sensor is in an area where air or gas is extracted, then the best location is near to the gas exit where foam could exit the vessel. However this is not essential.

Ensure that the Sensor cannot be flooded by any liquid contents. For example, if varying liquid heights are likely, ensure that the Sensor is high enough to be always above the liquid surface, unless it is especially in use to detect the liquid level as well as foam.

If the Sensor is installed in a pressurised vessel check that the Sensor fitting is tightened and sealed as appropriate before the pressure is raised.

It is essential that the sensor be connected properly: see 3.4 below.

3.2 Installing the Controller

The FDCW2BN/CN are designed to be fastened to a wall or other permanent structure. The controller can be attached in one of two ways. There are two mounting brackets at the top corners and two mounting holes at the bottom on each side under the terminal cover. If the mounting brackets are inconvenient for any reason they can be removed and the top of the unit can be fixed to the wall at the top by means of a small fixing in the back of the unit in the centre. Refer to Figure I.

To connect cabling, remove the blanking plugs in the glands at the bottom of the enclosure and insert the cables. *Blanking plugs should be left in unused cable glands to maintain the IP65 rating and to prevent the ingress of moisture and dust.* Access to the terminals is via the small terminal compartment at the bottom of the unit. Ensure that suitable cable is used to provide the power connection that meets local regulations.

The FDCW2BN can be operated at 110 Vac and the FDCW2CN at 230Vac. Alternatively both can be powered at 24Vdc. *Ensure that the unit is powered with the correct supply*. If another supply is required than the one set please contact the supplier. For connections, refer to figures E and F. Ensure that appropriate cable is used for the connections.

3.3 Sensor Cabling

Due to the sensitivity required it is essential that an appropriate high frequency cable with 75 ohms characteristic impedance and low signal attenuation is required to connect the signal from the sensor. The same cable is required to connect the power supply, which is only required to be suitable for 12v operation.
The connections are shown for the sensor head in figure J and the controller in figure F.

It is important that an earth return be provided for the Sensor. This is normally supplied via an earth bond to the vessel or structure in which foam is being sensed. If the vessel is not connected to earth, a separate earth wire may be required between the sensor body and the vessel. If a non-conducting vessel is used, an earth connection may be needed to connect the material to earth. This may be done via pipework or an earth electrode in the tank.

When connecting the sensor cable to the sensor keep the connections as short as possible to avoid mismatches and interference.

If the sensor is not connected correctly, the three lights on the controller flash in sequence, indicating that the sensor signal is not being received by the controller. It can also do this when the sensor is first used and not zeroed correctly. If the green light is on continuously then the sensor is sending the correct information back to the controller. If the green light is flashing, the controller is in zero-setting mode (see section 4.2 for details).

Now it is necessary to set up the DiFoam system especially the zero level, see section 4 for details.

4. COMMISSIONING

4.1 Self Test

When power is first applied, a self-test in performed and as this happens all the front panels lights should momentarily switch on and then go out. After this the green power light should be on and the other indicators should be off. This indicates that power is applied and that the internal processor is operating correctly and the sensor is connected correctly. If the self-test fails all the front panel lights will flash on and off together indicating that there is a major failure. If the sensor is not communicating correctly with the controller, then the three leds will flash in sequence. If this happens check the sensor cabling or the zero level.

4.2 Setting Up Zero Level (Essential)

The zero level of the instrument should be set up first but only after the sensor is installed in its normal working position. This must be done in the following way:

1. Allow the conditions of the vessel to settle. If it normally operates at a high temperature, then this should be reached before attempting to set the zero level.
2. Switch off the controller and set the DIP switch SW4-8 to ON. See figures G and H for details of the position of the switch.
3. Switch on the controller. The green light will start to flash; relay 2 will be active (energised or not according to the failsafe setting) and the 4-20mA output will be set at 4mA.
4. After 2 minutes, a reading will be taken to establish the zero level. The green light will go off and the red and yellow light will start flashing alternately. Also, relay 2 will be de-energised (or energised if in failsafe mode) and the 4-20mA output will go to 20mA.
5. Switch off the controller and set the DIP switch SW4-8 back to OFF.
6. Switch on the controller. It will now operate as normal using the new zero level.

4.3 Setting Up Other Parameters

It will be necessary to adjust the unit for the particular application. To make a simple initial test that the unit is operating correctly make touch the end of the Sensor with your hand or a metal rod. The red "sense" light on the panel should switch on, and the yellow light will flash. After the delay time the yellow light should switch on and stay on. Ensure that the information has passed correctly to the process controller or other device and that the correct channel has been used. When the connection is removed the red and yellow lights should switch off. It is important that the complete measuring chain is tested back to the process controller if appropriate together with any control feedback.

The Sensor should have been mounted in such a position that it will readily come into contact with the foam that is to be sensed. Ideally, if foam can be generated for a test then the unit should be tested with foam before use. If the Controller does not trigger when foam is present, then increase the sensitivity slightly and try again. (See section 5.4). The sensitivity settings are shown in Figure B. The adjustment switches' location is shown in figures G and H. To increase the sensitivity set a

larger value of the range setting.

In many cases it is impossible or undesirable to create foam for a test. In these situations the operation of the equipment should be monitored to ensure that it is operating as required by visual inspection.

The delay time (or response time) gives discrimination against splashing. This acts as a response time before any action is taken. In most applications a few seconds is adequate to differentiate between occasional splashing and the presence of foam. (See section 5.3). The delay may not be apparent when testing initially but should be borne in mind to allow enough time for the unit to trigger.

4.4 Testing Offline (ie in a bucket)

It is not an easy task to test the sensor with foam in a bucket and this is not recommended. However if you really need to do this then then mount the sensor in a fixed position. If you are using a plastic container then fix an earth rod which extends into the liquid. Once both the sensor and the earth rod are fixed and stable carry out the zeroing process described in section 4.2. Then generate foam to test the sensor. Once this is completed and the sensor is moved back into its final position the zeroing process must be repeated to set it up for the position.

4.5 Failsafe/Default Modes of Operation

The relays can be set to be powered up or down in the normal state. This provides the option to set the relay for the required condition in the event of a power failure or other serious fault. In the default mode when the power is off the condition indicated is the same as when no material is detected. However in the failsafe mode when the power is off the relay state is the same as when material is detected. This allows a power failure to indicate an alarm.

a) Default Mode: The instrument assumes a normal condition in which material is not detected.
i.e. Relay 1 normal, Relay 2 normal.
The relays are powered *down* when material is *not* present.

b) Failsafe Mode: The instrument assumes an alarm condition in which material is detected.
i.e. Relay 1 alarm, Relay 2 dose.
The relays are powered *down* when material *is present*.

(Please note that all the diagrams are drawn to show the default mode with no material present.)

This function is set by SW2 : 8 as follows:

SW2 : 8	Off :	Default mode
	On :	Failsafe mode

See Figures G and H for location of switch.

4.6 Analogue Output

The analogue output can be used to indicate the level of foam or liquid or other material under test. The output is in the range 4-20 mA. If a voltage output is required, this can be achieved by connecting a suitable resistor across the output terminals. The instrument is an active device and does not need an external power supply for the current output. In fact this output must only be connected to a passive input. Do not under any circumstances connect the 4-20mA output into an active input or any input connected to 24Vdc.

The 4-20mA output is generally proportional to the height of material with a fixed density covering the sensor. However foam is not a homogeneous material and the density will vary with height. This means the response will not always respond linearly to the height of the foam.

To set the output scaling, see section 5.4 Range Setting below.

5. OPERATION OF THE DIELECTRIC CONTROLLER

5.1 Making Adjustments

The following adjustments are provided for the operator:

Delay time	- 3 internal DIL switches
Shot time	- 3 internal DIL switches
4-20mA Range	- 2 internal DIL switches
Sensitivity	- 4 internal DIL switches
Zero setting Switch	- 1 internal DIL switch
Failsafe mode	- 1 internal DIL switch

These are described below; please refer to the relevant figures for settings. *Ensure that the power is switched off before adjustments are made, as there are high voltages present on this board.*

To make adjustments to the FDCWBN or FDCW2CN open the front cover by pushing in the latch on the left side, then remove the four screws securing the front panel. Then carefully remove the front panel from the enclosure and put to one side in a safe place. This gives access to the control board. The location of adjustment switches is shown in figure H. After adjustment replace the front panel being careful to ease the LEDs into the window recesses behind the panel. *Take care not to put pressure onto the LEDs if the panel is not located properly as this may cause damage.* Replace the four retaining screws and then ensure that the front cover is closed securely.

The switches are only read by the system when power is applied. When making changes to the switch settings ensure that the unit is turned off and then on again.

5.2 Sensitivity

The sensitivity of the unit to the material can be adjusted if necessary. The default value, which is set in the factory, is suitable for most applications but there are times when this may need to be adjusted. The sensitivity is set by means of 4 small switches on the controller board. The settings are shown in figure B. The location of the switches is shown in figure H. Set the combination of the four switches to give the desired sensitivity as shown in figure B. The switches are marked “on” at one side and the combination of on/off sets the sensitivity. The range setting changes the level at which the unit triggers the dosing and the alarm state. It also affects the 4-20 mA output.

To increase the sensitivity the value should be set to a higher number. To detect very low-density foam, a higher sensitivity will be needed. Low-density foam is characterized by a low liquid content, large bubble size or low dielectric constant.

5.3 Delay Time (Response Time)

The delay time switch is used to set the response time. This is the time for which the material is continuously sensed before the output is activated. It is used to discriminate between the presence of the material and the intermittent splashing of liquid. It is set by means of a dual in-line switch on the controller board. The default time of 4 seconds is suitable for many applications but this can be adjusted if required. To change the setting, adjust the switches with a small screwdriver or similar tool. The settings are shown in Figure A. The switch is located near the top edge of the board and is shown in Figures G and H. In some cases no response time is required at all and in this case the time may be set to zero. However in most applications some short delay time is beneficial. This does not affect the 4-20 mA output.

5.4 Shot Time (Dose Time).

The shot time is part of the dosing function, which is used as part of a feedback loop to control a process. This can be used for example to control level or to add a chemical such as an antifoam or defoamer. The shot time is the time for which relay 1 is activated. The settings for this are shown in Figure A.

5.5 4-20mA Range

The level at which the unit is triggered to indicate the material can be set in relation to the output range. The options are as follows:

Trigger Levels: 20%, 40% (default), 60%, 80% of range.

The default value at which the unit switches to indicate the material is 40%. Most applications use the continuous 4-20 mA output or the relay output so usually the trigger level can be left at 40% and the range adjusted to suit the application. The trigger level control adjusts the 4-20ma range around the trigger points. See figure C for adjustments.

FIGURE A - CONTROLLER DELAY AND SHOT TIME SETTINGS

	DELAY (Secs)	SWITCH 1	SWITCH 2	SWITCH 3
Max >	30	ON	ON	ON
	20	OFF	ON	ON
	12	ON	OFF	ON
	8	OFF	OFF	ON
DEFAULT >	4	ON	ON	OFF
	2	OFF	ON	OFF
	1	ON	OFF	OFF
MIN >	0	OFF	OFF	OFF

	SHOT (Secs)	SWITCH 5	SWITCH 6	SWITCH 7
Max >	30	ON	ON	ON
	20	OFF	ON	ON
	12	ON	OFF	ON
	8	OFF	OFF	ON
DEFAULT >	4	ON	ON	OFF
	2	OFF	ON	OFF
	1	ON	OFF	OFF
MIN >	0	OFF	OFF	OFF

ADJUST BY MEANS OF SW4 DIL SWITCH ON THE BOARD.
FOR LOCATION OF SWITCH SEE FIGURE H.
SWITCHES ARE ONLY READ AT POWER UP – CYCLE POWER AFTER CHANGING.

FIGURE B –SENSITIVITY RANGE SETTINGS

	RANGE	SWITCH SW2: 1	SWITCH SW2: 2	SWITCH SW2: 3	SWITCH SW2: 4
Most Sensitive >	16	ON	ON	ON	ON
	15	OFF	ON	ON	ON
	14	ON	OFF	ON	ON
	13	OFF	OFF	ON	ON
	12	ON	ON	OFF	ON
	11	OFF	ON	OFF	ON
	10	ON	OFF	OFF	ON
	9	OFF	OFF	OFF	ON
	8	ON	ON	ON	OFF
	7	OFF	ON	ON	OFF
	6	ON	OFF	ON	OFF
	5	OFF	OFF	ON	OFF
	4	ON	ON	OFF	OFF
	3	OFF	ON	OFF	OFF
	2	ON	OFF	OFF	OFF
Least Sensitive >	1	OFF	OFF	OFF	OFF

Adjust by means of SW2: 1-4 for location see Figure H

To make the controller more sensitive to material set the range to a smaller number.

To reduce the risk of false triggers do not set the sensitivity higher than required for the application. Power up after adjusting switches.

FIGURE C – 4-20mA RANGE

Trigger Level %	SWITCH SW2: 5	SWITCH SW2: 6
20	OFF	OFF
40 Default	ON	OFF
60	OFF	ON
80	ON	ON

The trigger is the percentage of the output range at which the relays trigger to the alarm state. For example at the default 40% setting the relays trigger to the material at 40% of the analogue output range i.e. at 10.4 mA on the 4-20 mA range. This does not affect the sensitivity and the level at which the relays trigger: it actually moves the 4-20mA range around the switch point. If the 4-20 ma output is not changing enough, in most cases it is better to increase the sensitivity.

Adjust by means of SW2: 5 & 6. See figures G and H for location of switches.

FIGURE E- CONNECTIONS TO WALL MOUNTING UNITS

FDCW2BN and FDCW2CN CONTROLLERS

TERMINAL	DESCRIPTION	
1	Line Supply – LIVE (115/230 V a.c.)	
2	Line Return – NEUTRAL	
3	Supply Ground / EARTH	
4	D.C. Supply 24 V +ve (optional)	
5	D.C. Supply 0 V	
6	Return	
7	No connection	
8	No connection	
9	No connection	
10	Relay 1/A Common.	
11	Relay 1/A Normally Open	
12	Relay 1/A Normally Closed	
13	Relay 1/B Common	
14	Relay 1/B Normally Open	
15	Relay 1/B Normally Closed	
16	Relay 2 Common. (optional)	
17	Relay 2 Normally Open (optional)	
18	Relay 2 Normally Closed (optional)	
19	4-20 mA +ve	
20	4-20 mA –ve (0 V d.c.)	
21	Manual Switch	
22	Manual Switch.	
23	Spare	
24	Screen	}
25	Sensor supply return (0v)	}
26	Sensor supply	}
27	Sensor signal	} Dielectric Sensor
28	Sensor return	}

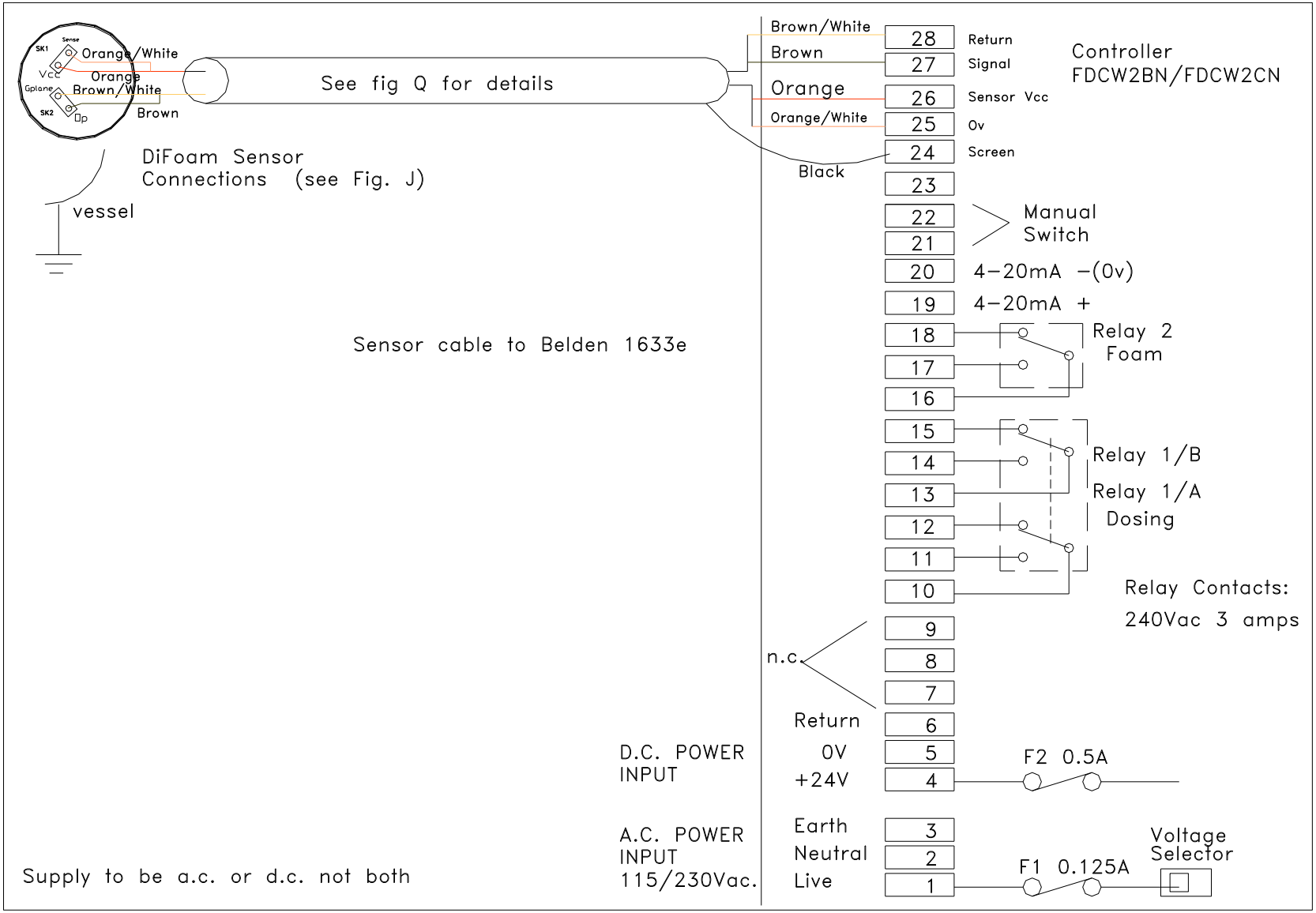


Figure F Cabling DiFoam Controller

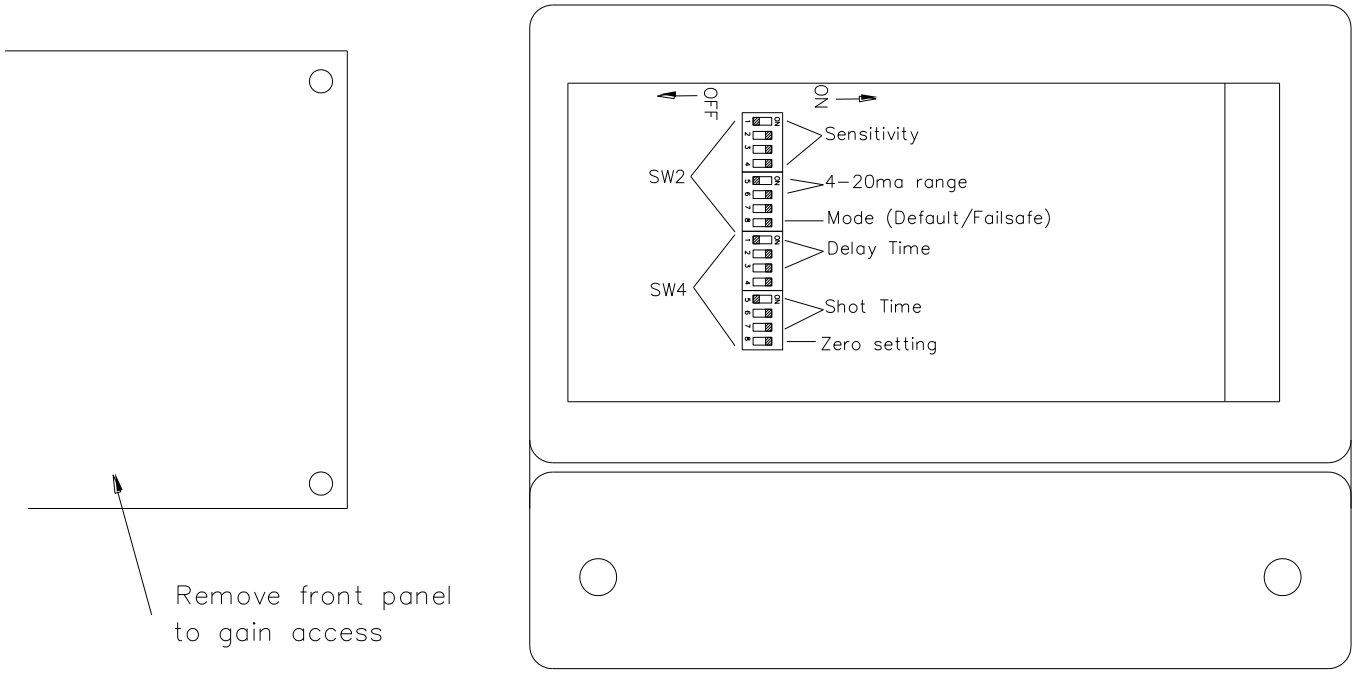


FIGURE H FDiCW ADJUSTMENTS

WARNING: ISOLATE POWER BEFORE MAKING ADJUSTMENTS

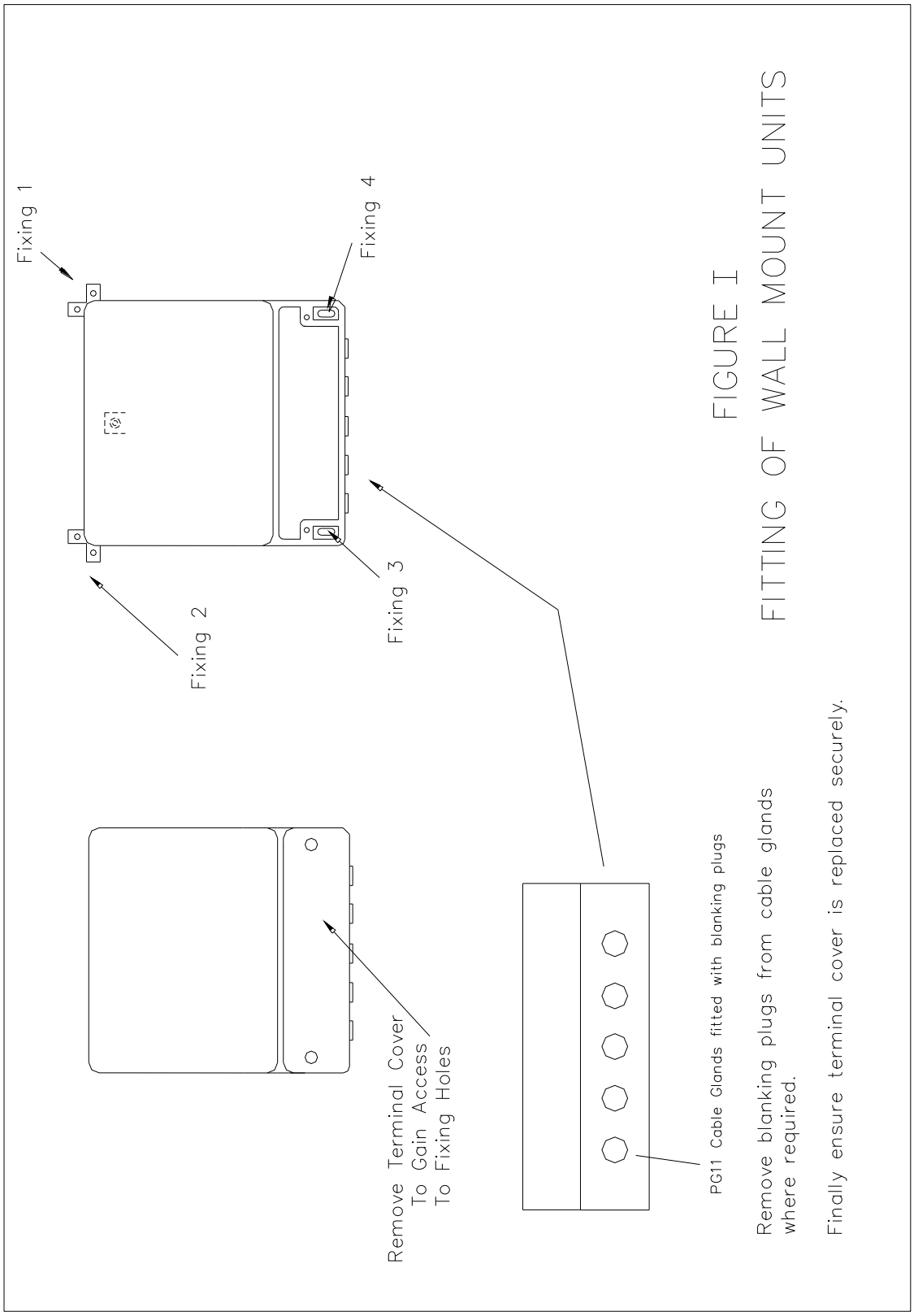


FIGURE I

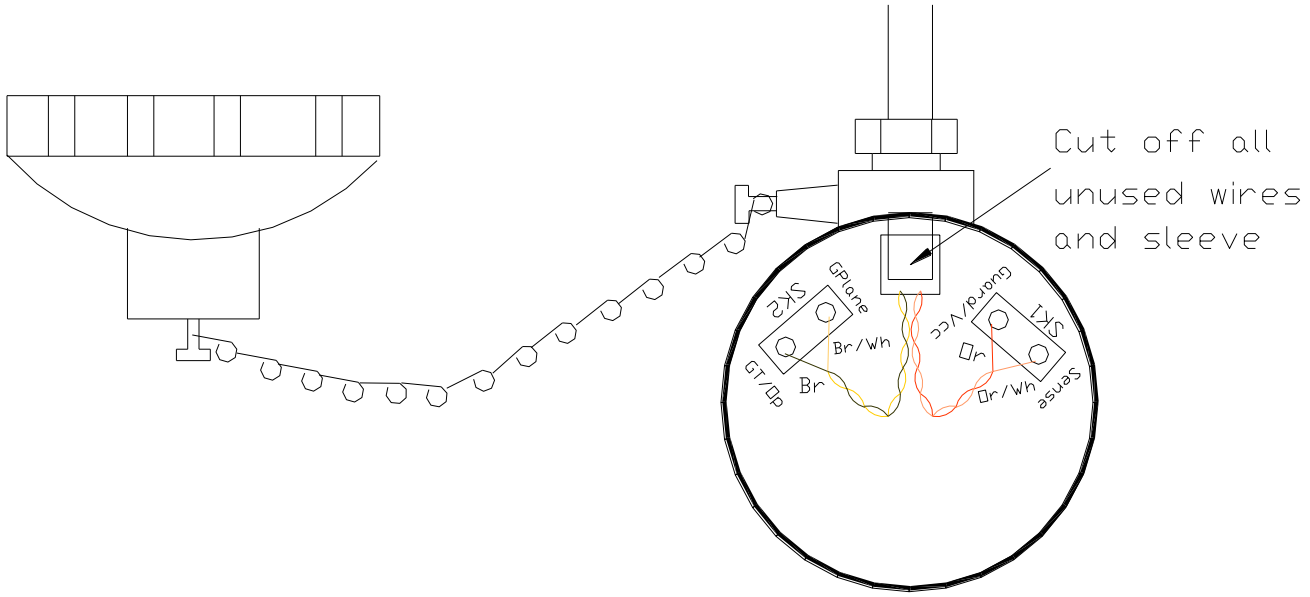
FITTING OF WALL MOUNT UNITS

Remove blanking plugs from cable glands where required.

Finally ensure terminal cover is replaced securely.

Terminal	Function	Wire Colour
Op	Signal o/p	Brown
GPlane	Signal gnd	Brown/White
Vcc	Supply	Orange
Sense	Return	Orange/White

Ensure Cover is correctly replaced
Do not cross thread



Use only low attenuation CAT5 cable e.g. Belden 1633e

FIGURE J DIELECTRIC SENSOR CONNECTIONS

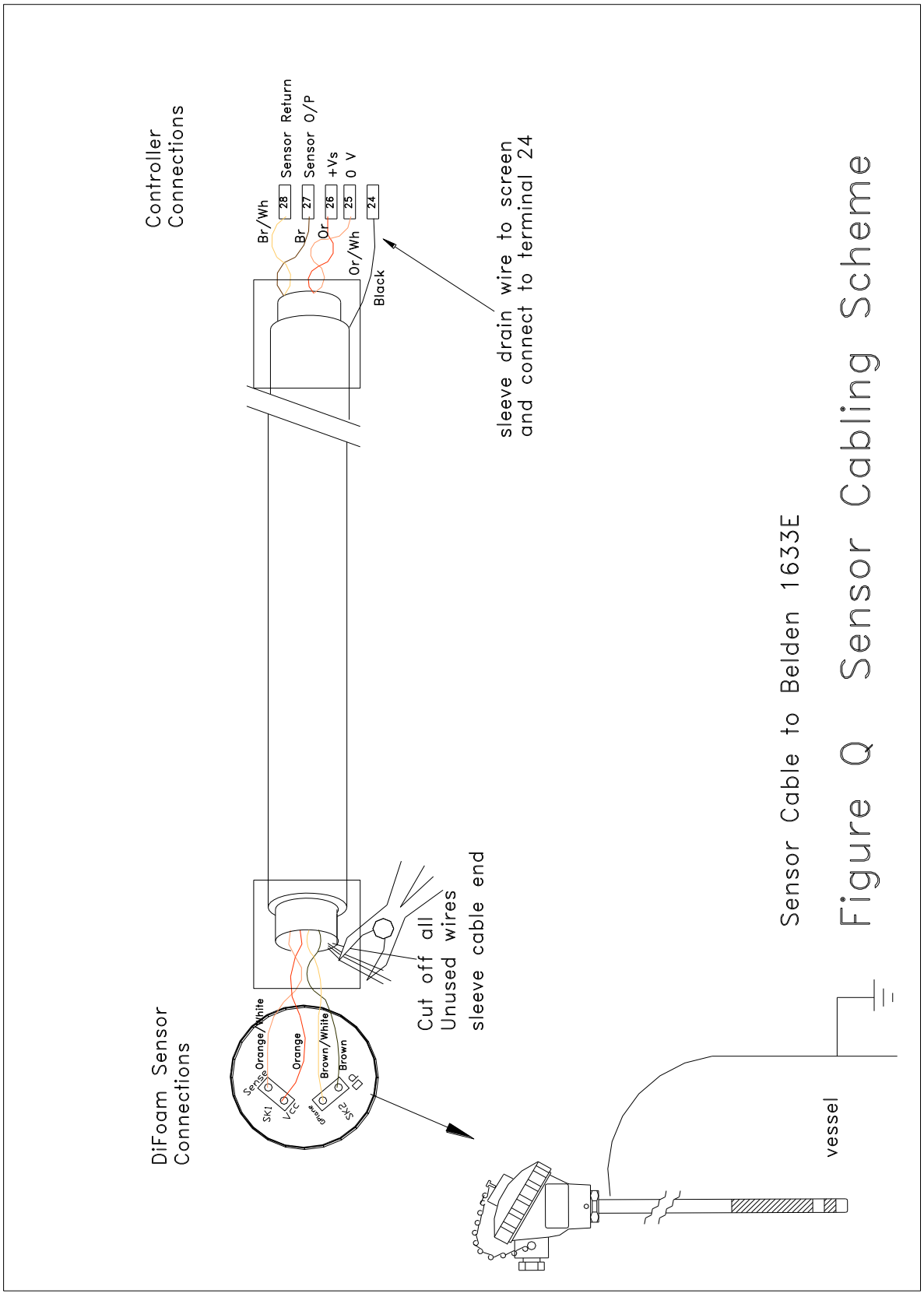


Figure Q Sensor Cabling Scheme
Sensor Cable to Belden 1633E
vessel
DiFoam Sensor Connections
Sense
Orange/White
Orange
Vcc
SK1
Brown/White
Brown
SK2
Cut off all Unused wires sleeve cable end
sleeve drain wire to screen and connect to terminal 24
Controller Connections
Br/Wh
Br
Or
Or/Wh
Black
28
27
26
25
24
Sensor Return
Sensor O/P
+Vs
0 V