FPCCSW40 INDUSTRIAL

FOAM CONTROL SYSTEM

INSTALLATION AND OPERATION MANUAL

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1. QUICK START GUIDE

Install the controller by fitting it to a wall or suitable vertical surface.

Install the sensor in a suitable location to detect foam where required.
Connect the sensor to the controller using screened twisted pair cable according to figure F & Fig Q.

Connect a power supply cable to the controller using a suitable rated cable. See figure F

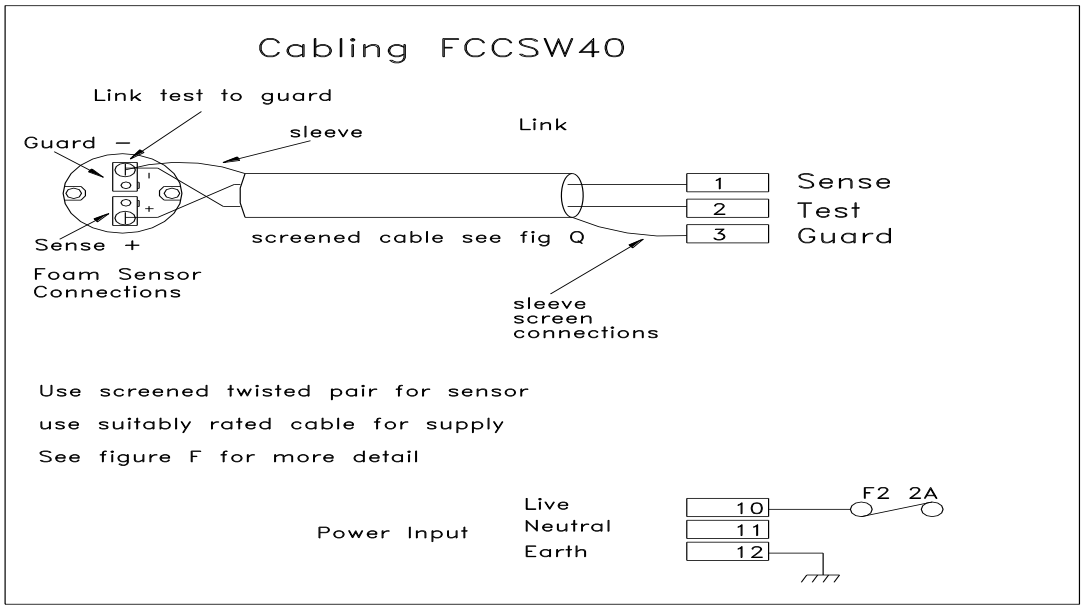
Fit a hose between the inlet of the pump and a supply of antifoam.
Fit a hose between the outlet of the pump and a suitable antifoam injection point in the process.

Apply power to the controller and switch the front panel auto/manual switch to Manual. This will allow the pump to prime and the hoses to fill. Once antifoam reaches the end of the hose switch the controller to Auto.

Test the operation by touching the very end of the sensor against an earth connection e.g. the top or wall of the tank or metal structure. The red indicator shows that foam is detected after a short delay the yellow indictor shows that the pump is running.. Check that the dosing rate (on/off cycle) of the pump is suitable for the required flow rate. If the effective flow rate is too low or too high it can be adjusted by means internal switch to make the pump run for a longer on time. See section 7.3 & 7.4.
(It is not easy to test the sensor in a bucket of foam. However if this is required make sure to use a metal bucket and to connect the bucket to earth or ground potential.)

If the sensor operates correctly when connected to earth but does not sense foam correctly it may be necessary to adjust the sensitivity. See section 7.5 below.

See Figure F for detailed cabling.



2. FPCCSW40 SPECIFICATIONS

Power Supply :	100 - 250 V a.c. , 1A
Outputs :	Dosing o/p : Volt-free change over contacts Foam o/p : Volt-free change over contacts Analogue o/p: 4-20 (0-20) mA
Contact rating:	240 V a.c. 30 V d.c. 3 A max.
Indicators :	Power indicator – Green : always on Foam indicator – Red : On when foam is initially detected. Pump indicator – Yellow : On when foam is detected after delay time.
Adjustments :	Delay Time 0 - 30 seconds (3 pole d.i.l. switch) Shot Time 0-30 seconds (3 pole d.i. switch) Sensitivity 0.3K - 100K ohms impedance. (4 pole d.i.l switch)
Fouling Immunity :	0.2% of sensitivity to Foam
Dimensions:	300 wide x 400 height x 200 depth mm
Weight:	9 Kg
Connections :	Screw terminals
IP Rating:	IP65
Pump Flowrate:	20L/Hr max if continuous
Back Pressure:	4 bar max (anti-clockwise for max pressure)
Pump Connections:	Hose connectors / Quick release connectors
Replacement element:	Part No A492
Hose for Pump:	10mm ID reinforced PVC recommended.

3. INTRODUCTION

The Hycontrol / Charis FPCCSW40 Foam Controller is designed for the control of foam in industrial processes. The controller requires a Hycontrol foam sensor to form an automatic control system which can control foam with a minimal amount of antifoam. The controller includes a peristatic pump to pump antifoam into the process automatically when required. It can also be connected to external devices such as process controllers, Scada systems and alarms.

A sensor can be placed in a process to sense the build up of foam. The system can be optimized to add the minimum amount of antifoam required. This enables the volume of antifoam to be reduced dramatically. Generally the reduction of antifoam compared to a manual dosing system is at least 25%, frequently 50% and sometimes more.

4. PRINCIPLE OF OPERATION

The Hycontrol / Charis Foam Sensor operates by passing a small alternating current through the foam under test, and uses this to measure impedance. The impedance of the material being sensed is used to determine when foam is present.

The Sensor is designed with two electrodes. One is used to sense foam while the other is designed to supply any leakage currents which pass along the body of the Sensor. If the Sensor is covered with a fouling layer deposited on it, then a leakage current must pass through that layer and down to earth. This leakage may be measured as part of the sensing current and consequently cause false readings. In the case of serious fouling this could cause a false alarm and an unnecessary intervention to the process. In the Hycontrol design the guard electrode supplies all the leakage current leaving the sense electrode to sense only foam. The guard electrode effectively isolates the sensor from the interference caused by fouling. This gives the Sensor the ability to continue working reliably even in conditions of extreme fouling.

The controller energizes the sensor and processes the measured data. It discriminates between foam spurious events such as splashing. It also determines when foam is present and runs the antifoam pump and can signal to a process controller or alarm that foam has been detected. Output interfaces are volt-free contacts (relay).

5. INSTALLATION

5.1 Installing the Sensor

The Hycontrol / Charis Sensor should be installed in such a way that the sensing electrode is positioned at the point where foam is required to be detected. The sensing electrode is the lower of the two electrodes at the end of the sensor. 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. If there is a choice of location select the place where foam develops first.

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.

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.

5.2 Sensor Cabling

It is essential that the sensor is connected with a suitable cable to the controller. Use screened twisted pair cable with the screen connected to the guard as shown in fig. Q. It is essential that the cable is connected correctly. If the sensor wiring is reversed the sensor may appear to function but the results will be unpredictable.

The screen should never be connected to ground/earth as this increases the capacitance of the cable and can case false readings. Neither should other cores in the same cable be connected to earth for the same reason.

If an industrial Sensor is being used the cable must be wired into the terminal block in the head. Connect the sense wire to the terminal marked "+" and the guard wire to the terminal marked
"-". Use an IP66 cable gland to seal the cable into the head and to prevent any moisture ingress. (An appropriate cable gland is normally supplied with the Sensor). See Fig J

If a laboratory type sensor is used the cable is connected by means of a Lemo connector. A lead can be supplied by Hycontrol if required. Ensure that the sense and guard are connected to the correct terminals.

It is essential that an earth return is available 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 should be connected between the controller and the vessel. An earth terminal (no 4 return) is provided for this required. Do not use the sensor cable for an earth return but use a separate wire completely. If a non-conducting vessel is used, it is essential that an earth connection is made to the contents. This can be done by using a metal pipe or another electrode immersed in the liquid and connected to the instrument earth.

5.3 Installing the FPCCSW40 Controller

The FPCCSW40 is designed to be fastened to a wall or other permanent structure. It should be mounted in an upright position so that the pump operates vertically upwards. This will enable the pump to prime easily.
There are four mounting brackets supplied which fit at the corners. If these are packed separately they should be fitted to the enclosure.

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.* To access the terminals open the front door of the unit. Ensure that suitable cable is used to provide the power connection which meets local regulations.

The controller is supplied for operation at either 230V or 110Vac, but not both. Ensure that the correct power supply is used for the version supplied. A suitable cable, rated for the power required, must be used.

5.4 Interface Cabling

There are various interfaces available to connect the controller to control devices or to a process control computer. These are listed below:

Relay 1 : Volt-free contacts - change-over type.
Operates as the controller output with delay & shot function.
The relay can be connected to a low voltage to switch to a computer or may be connected to a high voltage to operate an external pump etc.

Relay 2 : Optional relay used as a “detector” function. Relay operates when foam is detected but only after the delay time. This is not affected by the shot time. The relay resets when foam is dispersed.
The relay can be connected to a low voltage to switch to a process controller or may be connected to a high voltage to operate an alarm if required.

NB: Please note that it is essential that the cabling used is suitable for the voltage connected in all cases. If in doubt please consult Hycontrol, or your supplier.

5.5 Connecting the Pump

The pump must be operated in a vertical orientation to enable good priming. The direction of flow is determined by the direction pump head. (This is usually clockwise). The inlet side of the pump faces vertically downwards. Connect a hose from the inlet side of the pump to a container of antifoam. Ensure that the hose is well connected, without any leaks, to enable the pump to prime adequately. Also connect a hose from the outlet side of the pump to a suitable injection point in the process. This should not be too close to the sensor. The relationship between the sensor position and the antifoam injection point should be carefully considered to avoid creating a small area of foam suppression. Contact Hycontrol if you need advice on this.

Antifoam can siphon through the pump if the inlet side has more hydrostatic pressure than the outlet side. In this case a non-return valve may be required in the hose on the outlet side of the pump.

The pump should be primed before putting into service to avoid a long delay while the pump and hoses prime. This can be done using the manual switch on the front panel. See section 6 for details. If the pump does not prime or bubbles appear in the discharge side after priming check that the inlet side of the pump is completely sealed. The pump will suck in air rather than liquid if there are any leaks in the fittings or pipework on the inlet side of the pump.

The pump normally rotates clockwise which gives optimum element wear. However to pump into the maximum back pressure the pump direction can be reversed by reversing the leads to the pump motor. The element will wear more quickly but will generate a higher pressure.

Please note that the pump element will need replacing from time to time as a result of wear. See section 8.2 for details.

The recommended hose is 8mm ID reinforced PVC flexible tube. This will fit on the pump hose tails but may need a hose clip or jubilee clip to secure it depending on the back pressure.

6. COMMISSIONING

6.1 Self Test at Power Up

When power is first applied a self test is performed and as this happens all the front panel lights will 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. If the self test fails all the front panel lights will flash on and off together indicating that there is a major failure. In this case contact your supplier for advice.

6.2 Functional Test

To make a simple initial test that the unit is operating correctly make a temporary connection between the end of the Sensor and the vessel wall with a piece of cable. If this is impractical, make a temporary connection between the sense (+) terminal at the sensor head and earth. The red "sense" light on the panel should switch on, and after a short delay time the yellow light should switch on and stay on for a few seconds, depending on the settings. If the auto/manual switch is set to 'Auto' the pump will run as the yellow light operates. This will be repeated continually. Ensure that the temporary connection is removed and that the red and yellow lights then switch off and the pump should stop after the set time.

The Sensor should have been mounted in such a position that it will readily come into contact with the foam which is to be sensed. Ideally, if foam can be generated for a test then the unit should be tested with foam before putting into service. (*Beware of trying to test a sample of foam in a bucket – see comments below*). If the Controller does not trigger when foam is present, then increase the sensitivity slightly and try again. (See section 7.4). *Do not set the sensitivity higher than necessary as this could decrease the immunity to fouling.* In most applications the sensitivity required is below 20K. The sensitivity settings are shown in Figure B. The adjustment switch location is shown in figure G. To increase the sensitivity set a larger value as shown in the sensitivity column.

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.

Ensure that the sensor is above the liquid level at all times. If the sensor becomes flooded with water or other liquid it will not be able to detect foam. In cases where the liquid level rises and hits the sensor, this will be detected as dense foam.

6.3 Foam Sample Test

If a sample of foam in a container is required to be tested, ensure that it is a fresh sample and test in a metal container with a connection to earth. Some types of foam can drain quickly therefore substantially changing its characteristics. This will make any test difficult to do well and it is therefore not recommended. *Do not use a plastic container for testing.*

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 7.3). The default setting is 4 seconds but this can be adjusted as necessary. The delay is a useful feature to reduce unnecessary antifoam useage, but can be turned off if necessary (see 7.1).

6.4 Pump Set Up

The pump can be tested by setting the auto/manual switch on the front panel to manual. This will enable the pump to be primed and tested. Run the pump for a short time to check that it is pumping correctly and that the flow rate is suitable. The pump can be run dry, if necessary, for a short time for testing. Once it is clear the pump is working with no leaks and the hoses are all filled, switch the auto/manual switch back to Auto.

When in Auto mode the pump operates on a delay and shot principle. This generates "shots" of antifoam dosed by the pump followed by a delay to allow it to take action. In our experience this is the best method of foam control. Generally antifoam is more effective if added in small amounts. This will optimize the antifoam use and reduce the cost to a minimum.

To change the pump flow rate adjust the shot and delay times. To reduce the pumping rate reduce the shot time. To increase the pumping rate increase the shot time. See section 7.4 on how to do this.

Please note that the pump element will need to be replaced at some time as it will wear. See section 8.2 for more information.

7. OPERATION OF THE FCS200 CONTROLLER

7.1 Making Adjustments

The following adjustments are provided for the operator:

Auto/Manual	- front panel rotary switch
Delay time	- internal d.i.l switch - 3 pole
Shot Time	- internal d.i.l switch - 3 pole
Sensitivity	- internal d.i.l switch – 4 pole

The internal 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 afterwards.
The switches are marked "off" at the left side or "on" at the right. The switch is "on" if pushed to the right.
The combination of on/off selects the required setting for each function.

The location of each set of internal switches is shown in figure G. To access the internal switches open the front door.

Ensure that the power is switched off before the controller door is opened, as there are high voltages present inside.

Switch	No	Function
SW2	1	Sensitivity settings – see figure B
	2	
	3	
	4	
	5	Delay Time settings – see figure A
	6	
	7	
	8	Reserved for future use
SW4	1	Shot time settings – see figure A
	2	
	3	
	4	Overun function – on to enable, off to disable
	5	Not used
	6	
	7	Not used
	8	Set to off only.

7.2 Auto / Manual/ Off Switch

This switch mounted on the front door changes the operation of the dosing pump. In normal operation this should be set to Auto, so that the dosing pump operates automatically when foam is sensed. However it can be set to Manual to run the pump continuously for priming and filling the dosing lines or adding an extra volume of antifoam. It can also be set to Off to disable the pump completely if required.

7.3 Delay Time (Response Time)

The delay time switches are used to set the delay time. This is the time for which foam is continuously sensed before the output is activated. It is used to discriminate between the presence of foam 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. (Sw2:5-7) The switches are located near the top edge of the control board and are shown in Figure G. 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.

7.4 Shot Time

The shot time is the time for which the pump runs. The shot and delay system is designed primarily to dose antifoam or defoamer into a process. Antifoam often requires a finite time to take effect so it can be added as a dose or ‘shot’ and then time allowed for the chemical to be effective. This minimizes the amount of antifoam added. The delay time between shots is the same as the initial delay time. The shot time is set by internal dil switches as shown in figure A.(sw4:1-3) The position of the switches are shown in figure G.

If the shot and delay algorithm is not required it can be disabled by setting the shot time to zero. In this case the pump will run continuously after the delay time until the foam subsides.

7.5 Sensitivity

The sensitivity of the unit to foam 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. *Please note that the value should not be set at a higher value than is required for the application, in order to optimize the fouling immunity.* The sensitivity of the sensor to fouling is a small percentage of its sensitivity to foam. This means that if the gain is too high for the application, the fouling rejection is reduced.

The sensitivity is set by means of 4 small switches on the controller board.(SW2:1-4) The settings are shown in figure B. The location of the switches is shown in figure G. Set the combination of the four switches to give the desired sensitivity as shown in figure B.
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 conductivity.

7.6 Hysteresis

Hysteresis is a means of improving the switching point and also to avoid rapid cycling when the foam is only slowly changing in height. The hysteresis is a small difference between the sensitivity at which the unit triggers and the sensitivity at which it resets. This is set to 5% hysteresis to provide very clean and noise free switching. Once the unit has detected foam the switching level is changed by 5% so the foam has to fall further down to reset the unit.

7.7 Overun Function

This function is designed to allow more action to be taken once the foam has subsided. It can be enabled or disabled using the internal switches (sw4:4). The effect of the overrun is to give one extra shot after the foam has subsided. This is sometimes useful to ensure the foam is sufficiently controlled. However it is probably best to disable the overrun if the intention is to use the absolute minimum of chemical additives.

If the shot time is set to zero and the controller is operated as a detector/transmitter then the effect is to increase the ‘on’ time of the relay by one delay time. This can be useful in vacuum cooling applications where a vacuum valve is being controlled to prevent ‘hunting’ of the valve. In other words, it adds an extra delay to prevent rapid switching of an actuator.

8. MAINTENANCE

8.1 Sensor

The sensor should be removed from the process periodically and cleaned. The frequency depends on the nature of the process but it should be at least once per year. The sensor is designed to operate reliably even if it is coated with foam or product but even so it is a good principle to clean it from time to time.

Also check when refitting that it is not too close to metal structures and that it cannot slip into the process liquid. If the sensor is flooded with water it will interpret this as very dense foam and respond accordingly.

If the sensor is unwired make sure it is rewired again to drawing

8.2 Pump

The pump element will eventually wear out and may crack and become ineffective. The element can be replaced with a new one available from Hycontrol (Part No. A492). To replace the element switch off the controller and remove the pipe work from the ends of the pump. Then open the pump cover using a large screwdriver or a coin. This can be done by turning the screw on the cover in the direction of the arrow.

Remove the old element by pulling one fitting out of the pump housing. The rotor can be turned by hand after depressing the yellow button. Turn the rotor to remove the element. Then fit the new element by putting one end fitting into the pump housing the turning the rotor while feeding the new element around the housing in front of the rotor. Then fit the other end fitting into the pump housing. Finally replace the hoses to the pump and ensure that they are leak- tight. The element should be smoothly fitted into the housing avoiding twisting it so that the rotor can pass smoothly along the element when turning.

FIGURE A – TIME SETTINGS

CONTROLLER DELAY TIME SETTINGS

	TIME (Secs)	SW2 SWITCH 5	SW2 SWITCH 6	SW2 SWITCH 7
Max >	30	ON	ON	ON
Default>	20	OFF	ON	ON
	12	ON	OFF	ON
	8	OFF	OFF	ON
	4	ON	ON	OFF
	2	OFF	ON	OFF
	1	ON	OFF	OFF
Min >	0 *	OFF	OFF	OFF

ADJUST BY MEANS OF SW2: 5-7 DIL SWITCH ON THE BOARD.
(* If set to 0 relay response immediately with the red led.)

CONTROLLER SHOT TIME SETTINGS

	TIME (Secs)	SW4 SWITCH 1	SW4 SWITCH 2	SW4 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
Min>	1	ON	OFF	OFF
Shot/delay disabled	OFF **	OFF	OFF	OFF

Adjust SW4: 1-7 internal switch on control board. See fig G.
Switches only read when power is applied. Power up after adjusting.

FIGURE B – SENSITIVITY SETTINGS

	SENSITIVITY	SWITCH 1	SWITCH 2	SWITCH 3	SWITCH 4
MIN >	0.35K	ON	ON	ON	ON
Reducing Sensitivity ↑	0.5K	OFF	ON	ON	ON
	0.7K	ON	OFF	ON	ON
	1K	OFF	OFF	ON	ON
	2K	ON	ON	OFF	ON
	5K	OFF	ON	OFF	ON
	7.5K	ON	OFF	OFF	ON
DEFAULT >	10K	OFF	OFF	OFF	ON
Increasing Sensitivity ↓	12K	ON	ON	ON	OFF
	15K	OFF	ON	ON	OFF
	20K	ON	OFF	ON	OFF
	25K	OFF	OFF	ON	OFF
	35K	ON	ON	OFF	OFF
	50K	OFF	ON	OFF	OFF
	75K	ON	OFF	OFF	OFF
MAX >	100K	OFF	OFF	OFF	OFF

Adjust by means of SW2: 1-4 for location see Fig.G
Sensitivity required is in the range 5K –20K for most applications.
For less dense or lighter foam increase the sensitivity to a higher value.

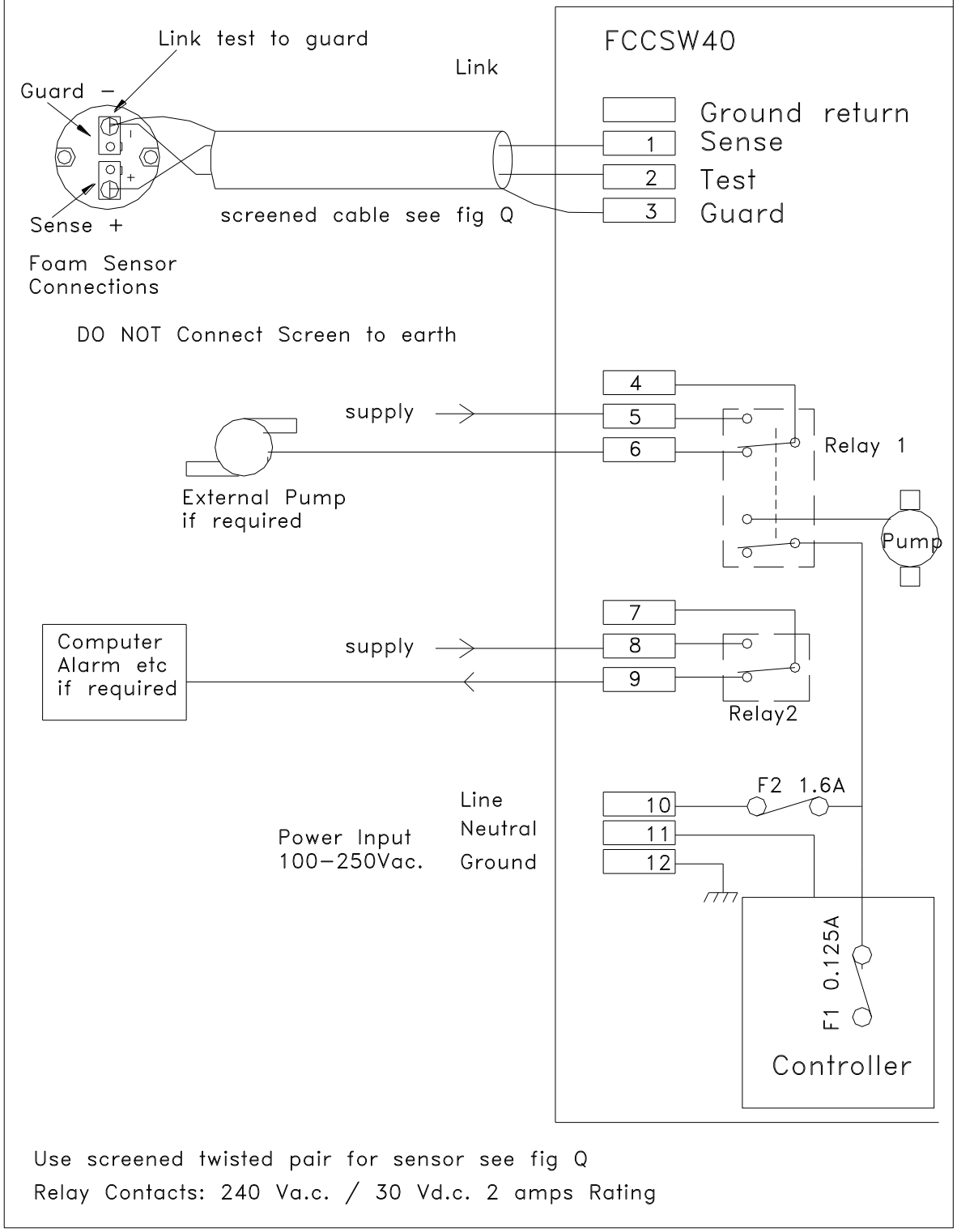
DO NOT SET SENSITIVITY HIGHER THEN REQUIRED FOR THE APPLICATION

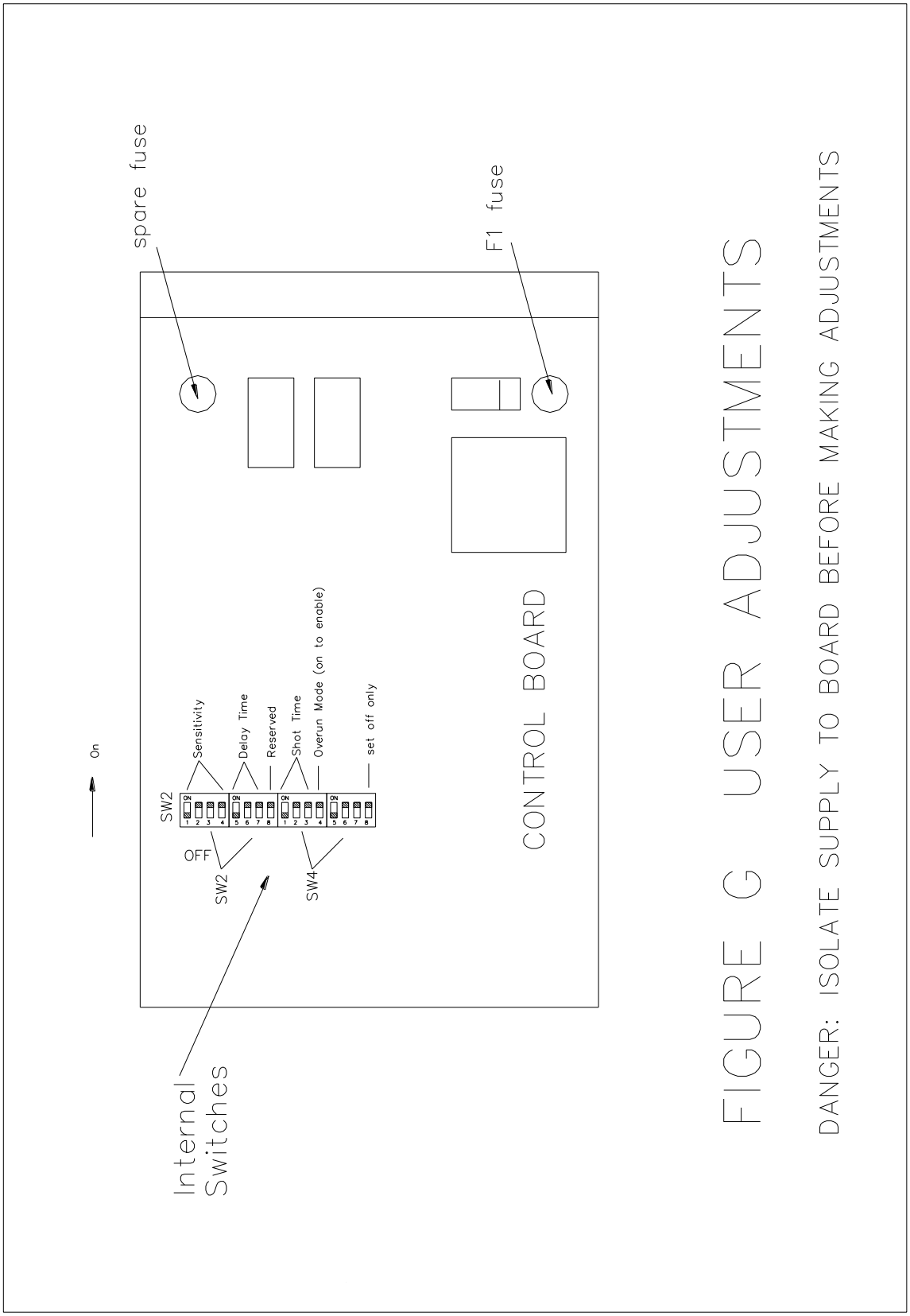
Power up after adjusting switches.

FIGURE C - CONNECTIONS TO FPCCSW40 FOAM CONTROL SYSTEM

TERMINAL	DESCRIPTION
E	Ground return (if required)
1	Sensor: SENSE Connection
2	Sensor: TEST Connection (link to guard)
3	Sensor: GUARD Connection
4	Relay 1 Common
5	Relay 1 Normally Open
6	Relay 1 Normally Closed
7	Relay 2 Common
8	Relay 2 Normally Open
9	Relay 2 Normally Closed
10	Line Supply – LIVE (100-250 V a.c.)
11	Line Return – NEUTRAL
12	Supply Ground / EARTH

Figure F Cabling FCCSW40




spare fuse
F1 fuse
CONTROL BOARD
On
SW2
Sensitivity
Delay Time
Reserved
Shot Time
Overun Mode (on to enable)
set off only
OFF
SW2
SW4
Internal Switches
FIGURE G USER ADJUSTMENTS
DANGER: ISOLATE SUPPLY TO BOARD BEFORE MAKING ADJUSTMENTS

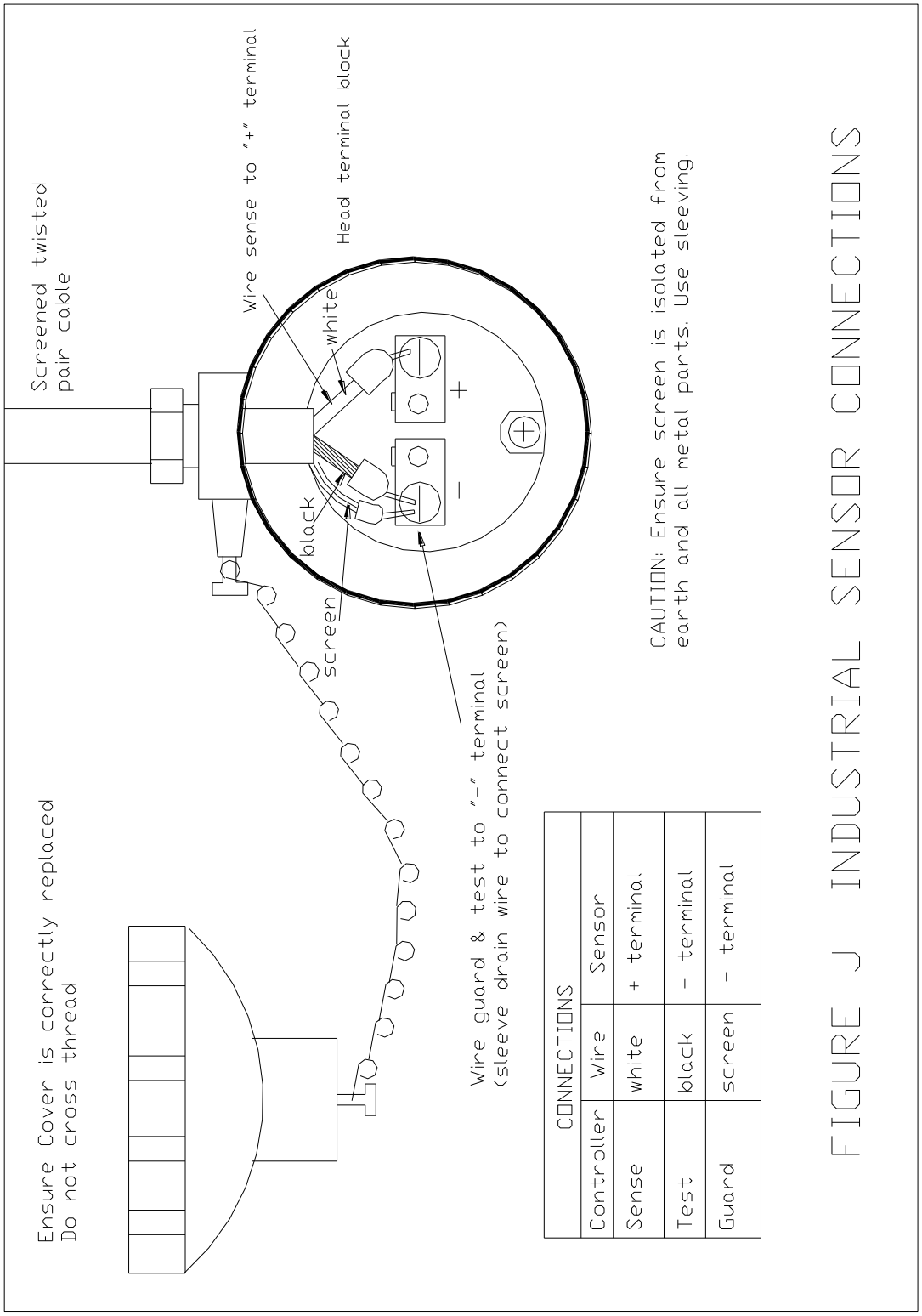
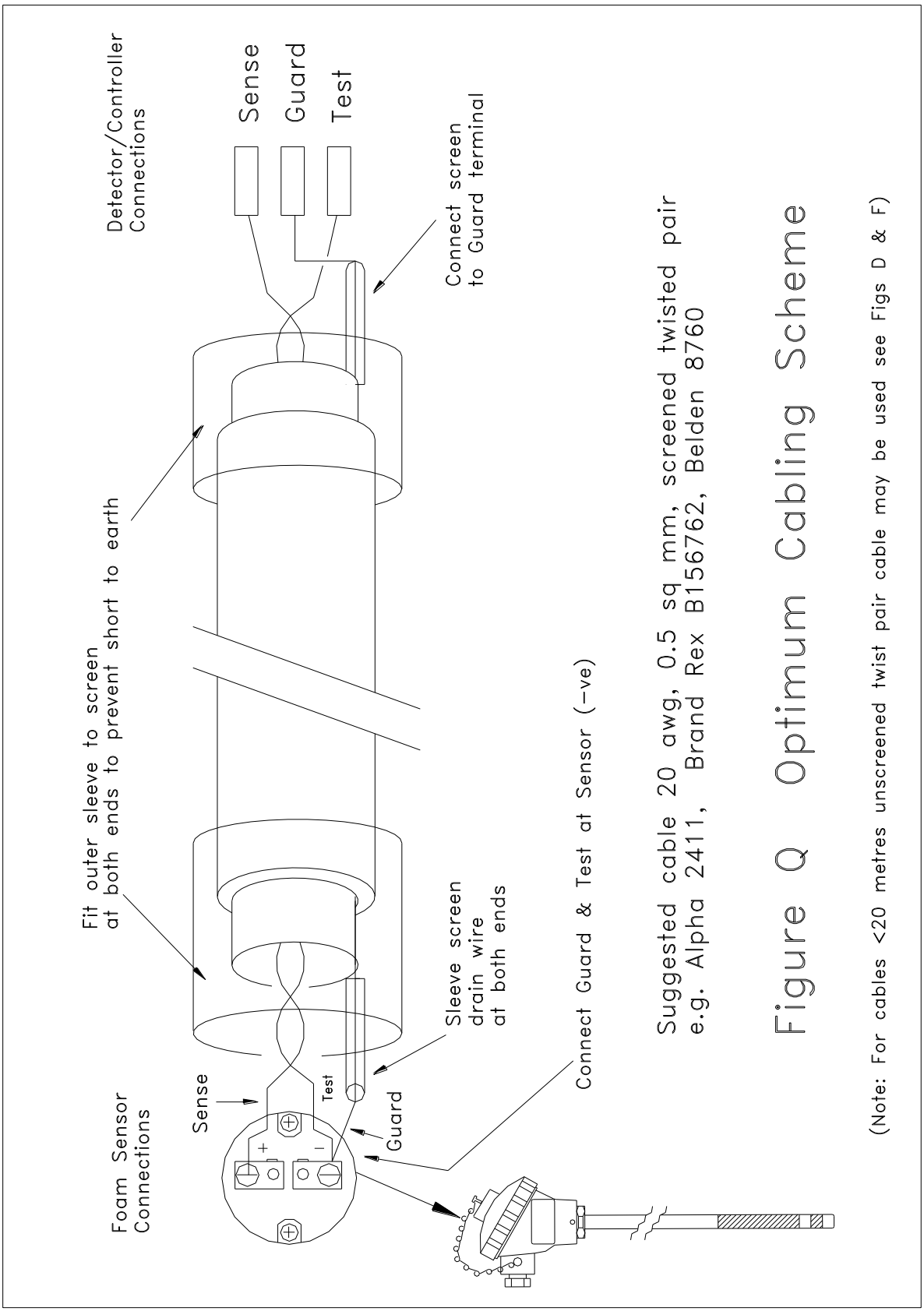


FIGURE J INDUSTRIAL SENSOR CONNECTIONS


Detector/Controller
Connections
Sense
Guard
Test
Connect screen
to Guard terminal
Fit outer sleeve to screen
at both ends to prevent short to earth
Foam Sensor
Connections
Sense
Test
Guard
Sleeve screen
drain wire
at both ends
Connect Guard & Test at Sensor (-ve)
Suggested cable 20 awg, 0.5 sq mm, screened twisted pair
e.g. Alpha 2411, Brand Rex B156762, Belden 8760
Figure Q Optimum Cabling Scheme
(Note: For cables <20 metres unscreened twist pair cable may be used see Figs D & F)