DustSense 10c

Filter Failure Detection Module

USER MANUAL

NOTE: This manual refers to the PCME DUSTSENSE 10c Filter Failure Detection Module with software modifications up to Rev C.

The products described in this manual are subject to continuous development and improvement and it is therefore acknowledged that this manual may contain errors or omissions. PCME encourage customer feedback and welcome any comments or suggestions relating to the product or documentation. These should be forwarded to the Technical Department at the address given below.

This manual is intended as a guide to the use and installation of the product. PCME Ltd. shall not be liable for any loss or damage whatsoever arising from the use of any information or details therein, or omission or error in, this manual, or any mis-use of the product.

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CONTENTS

Section 1.00 provides an introduction to the DS10C and provides an overview of how it works and its component parts. 1

Section 2.00 provides details of how and where to mount the DS10C module. 2

Section 3.00 provides details of how to connect the power supply and relay outputs. 3

Section 4.00 provides details of how to set-up the DS10C to monitor your plant and details of how to set the alarm limits. 4

Section 5.00 provides an overview of normal operation and a summary of alarm operation in relation to the STATUS LED. 5

Section 6.00 covers some aspects of routine maintenance. 6

Appendix A covers setting-up the DS10C against an isokinetic sample test and covers the calculation of alarm settings in mg/m³. A

Appendix B provides details of the optional low voltage Power Supply Unit. B

Appendix C provides overall connection diagrams. C

SAFETY

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;

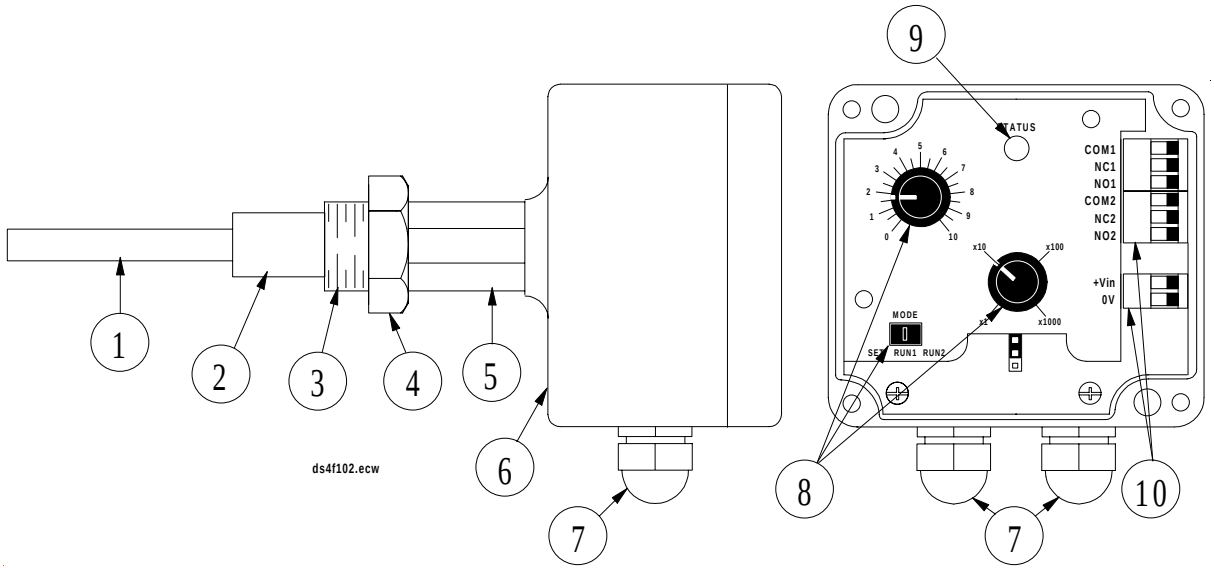
- Particulate which is inflammable or explosive.
- Particulate which is toxic or in some other way a hazard to health.
- Particulate contained within high temperature gas.

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.

1.00 - INTRODUCTION

1

1.01: The DS10C combined Sensor/Control Module;



1)	*Probe Rod.*	*6)*	*Module Enclosure.*
2)	*Insulator.*	*7)*	*PG9 Cable entry glands.*
3)	*½" BSP thread.*	*8)*	*User controls.*
4)	*Lock nut.*	*9)*	*Status LED.*
5)	*Hexagonal body.*	*10)*	*Power & Relay connectors.*

The combined sensor/control module comprises of a probe rod that protrudes at least half way across the stack and connects through the stack via the hexagonal body to the enclosure containing the electronics. The connection of the sensor to the stack is via an ½" BSP thread secured with a lock nut.

The module enclosure contains the alarm relays, the power supply and the controls that allow the DS10C to be quickly set-up.

2.00 - SENSOR INSTALLATION

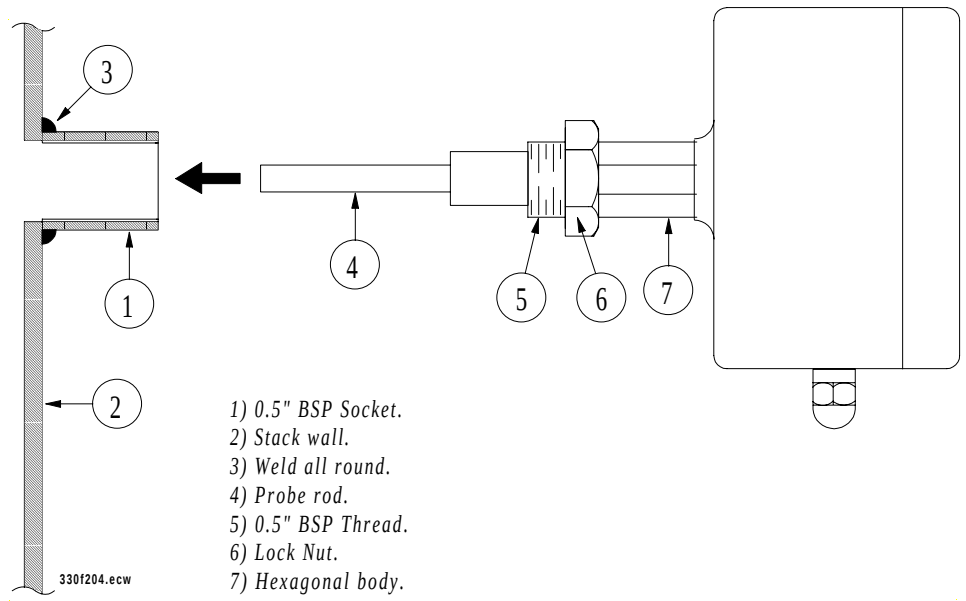
2.01: Choosing the best position for the sensor/control module;

The best position for the 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 three 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.

To summarise, the module should be mounted;

- In the longest, straightest, unrestricted section of ductwork available.
- In metallic ductwork, (for non-metallic ductwork consult PCME).
- Away from ambient or radiated temperatures exceeding 50°C.
- ***See Appendix A for details of Isokinetic sampling port locations.***

2.02: Fitting the sensor/control module to the stack;



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.

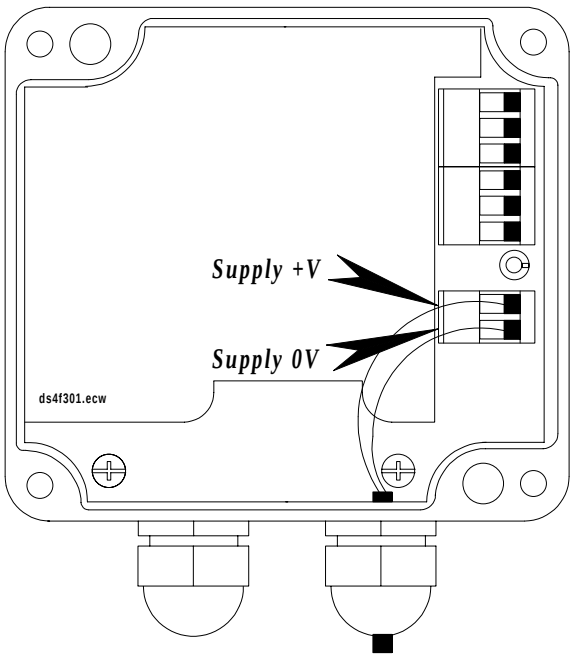
Referring to the diagram above, the sensor is mounted to the stack in the following way;

- Drill or cut a 19mm (¾") diameter hole into the stack wall (2).
- Take a ½" BSP 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 thread (5).
- Use a spanner on the hexagonal body (7) to rotate the entire module while screwing into the socket (1).
- Position the module such that the cable glands point downwards.
- Finally, securely tighten the lock nut (6) against the socket (1) to lock the module into position.

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

3.00 - THE ELECTRICAL CONNECTIONS

3.01: Connecting the power supply;



The DS10CC requires a DC power supply of between 12V and 24V 80mA. Referring to the figure to the left of this text, the supply cable should be passed through a convenient cable gland and should be connected as shown. The supply connections are identified on the Printed Circuit Board.

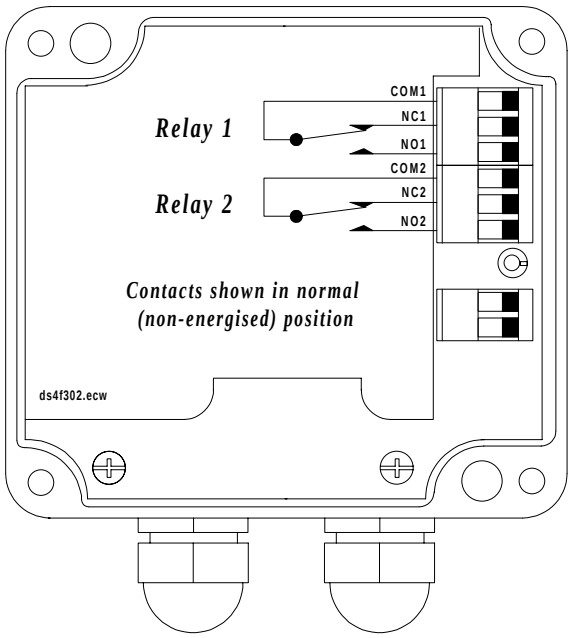
3.02: Connecting to the relay outputs;

Referring to the figure to the right, the contacts are shown in their normal (non-energised) state. Connection may be made by passing a suitable cable through the cable entry gland, and connecting to the required contact.

Both relays are of the SPCO (Single Pole Change Over) type, are volt free, and are not fail safe in operation (i.e. they are not normally energised).

WARNING: The relays and PCB tracks are not mains rated. Any attempt to switch mains could result in damage to the equipment and pose a threat to the operator!

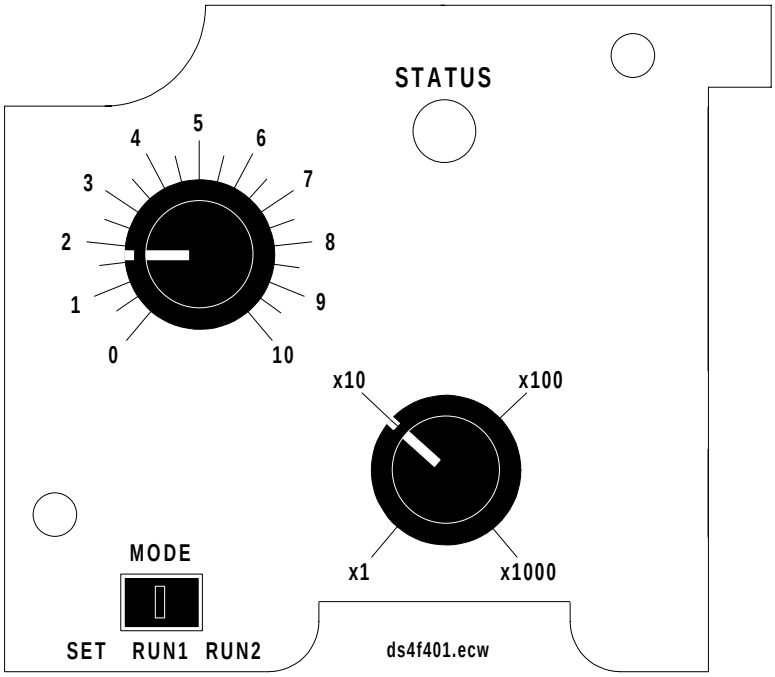
DANGER: Do not exceed 1A DC current through relays!



4.00 - SETTING UP THE DS10CC

4.01: The DS10CC control panel;

The DS10CC may be set-up and operated via a few simple controls located on the internally mounted control panel within the combined module. There are two rotary controls, a 3-position slide switch and a multi-coloured STATUS LED. When the DS10CC set-up is complete, the module lid is replaced thus preventing accidental adjustment and unauthorised tampering with the controls.



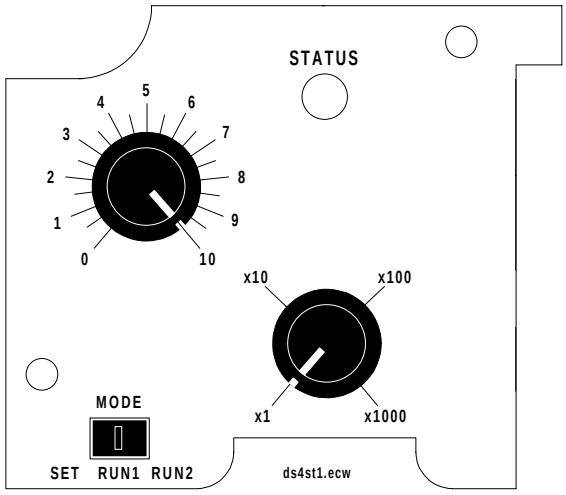
4.02: Set-up Procedure;

There are 5 main steps involved in setting-up the DS10CC, as follows;

NOTE: If you do not wish to trigger an external alarm unit whilst setting-up the DS10C, you should unplug the connectors from the ALARM 1 and ALARM 2 relay contacts.

▪ *STEP 1*

Before applying power, set the controls to the following positions:



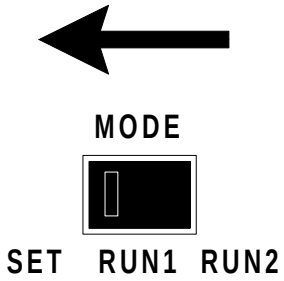
- **Rotate the lower control fully anticlockwise,**
- **Rotate the upper control fully clockwise,**
- **Set the 'MODE' switch to 'RUN 1',**
- **Now apply the power to the DS10C.**

After an initial delay of approximately 1 second, the STATUS LED will illuminate. The colour of the LED is not important at this point.

▪ *STEP 2*

The aim of this step is to 'capture' some information from the plant. It is essential that the plant is running normally during this time (i.e. not during the start-up phase and with bag cleaning operating where appropriate).

- **To begin collecting information, set the 'MODE' switch to 'SET'.**
- **The 'STATUS' LED will flash to indicate that data is being collected.**
- **The data collection process will last as long as you wish (up to a maximum of two hours). In general, a longer collection period will provide a closer representation of plant activity. Typically, 15 minutes will be sufficient to provide a good representation.**

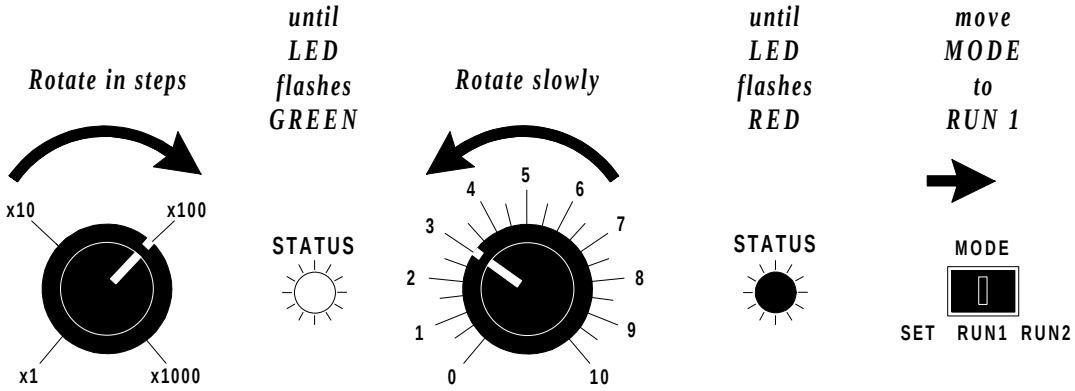


NOTE: If the DS10C is to be referenced against an iso-kinetic sample, the collection period will be the length of the sample run. See appendix A for further details.

▪ *STEP 3*

The aim of this step is to use the DS10C 'SETTINGS' controls to determine the ***Dust level*** from the information stored during the collection period of step 2.

- **If the 'STATUS' LED is flashing GREEN, do not adjust the lower control at this stage.**
- **If the 'STATUS' LED is flashing RED, rotate the lower control clockwise in steps to each marker (x1, x10, x100, x1000) until the 'STATUS' LED changes to flashing GREEN**.**
- **Now slowly rotate the upper control anticlockwise until the 'STATUS' LED changes from flashing green to flashing red.**
- **Move the 'MODE' switch back to the 'RUN 1' position.**



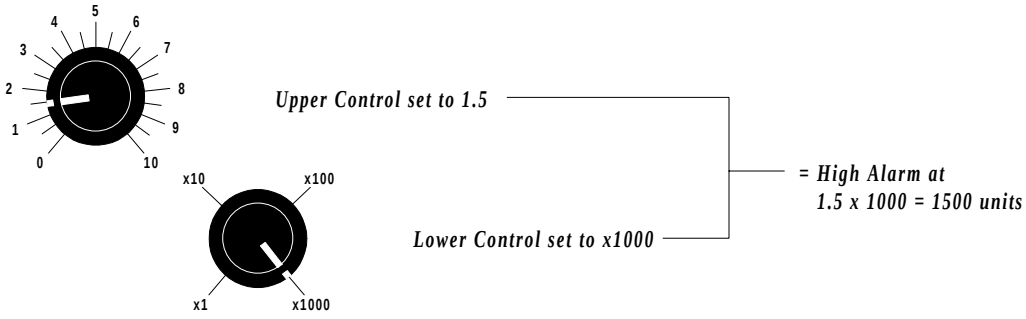
- **It is now possible to read the *Dust level* from the control settings. The *dust level* is found by reading the position of the upper control and multiplying it by the position of the lower control.**
- **In the above diagrams, the upper control was found to be '3' and the lower control was found to be '100'. This gives a *dust level* of 3 x 100 = 300 units.**
- **The *Dust level* corresponds to the normal operation of the plant and may be referenced to an iso-kinetic test if required. See appendix A for details.**

***Note: if it is not possible to make the STATUS LED change to flashing green, the sensitivity will need to be reduced in the sensor unit. See 4.03 at the end of this section for further details.*

▪ *STEP 4*

The aim of this step is to set the alarm levels based upon the ***Dust level*** found in step 3.

- **Decide the level at which the 'high alarm' (Relay 2) is to be triggered. This will depend upon the type of plant and the local authority recommendations.**
- **The DS10C 'status' LED will typically be illuminated in an orange colour at this point.**
- **When the high alarm level has been decided, the DS10C may be 'programmed' with this value by rotating the controls.**
- **Divide the required alarm level value by 1, 10, 100 or 1000 to give a number between 1 and 10.**
- **Rotate the upper control to this new value.**
- **Rotate the lower control to the divisor (i.e. 1, 10, 100 or 1000) that you used.**
- **For example, if the required alarm level is 1500 units, we would divide this value by 1000 to give 1.5. The upper control would then be set to 1.5 and the lower control would be set to x1000.**

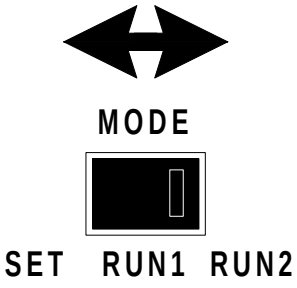


- **The 'early warning' alarm (relay 1) will be triggered at HALF of the value set for relay 2. In the above example this equates to 1500 / 2 = 750 units.**
- **Care must be taken to ensure that the alarm level is set to more than TWICE the *Dust Level* otherwise relay 1 could be permanently triggered.**

▪ *STEP 5*

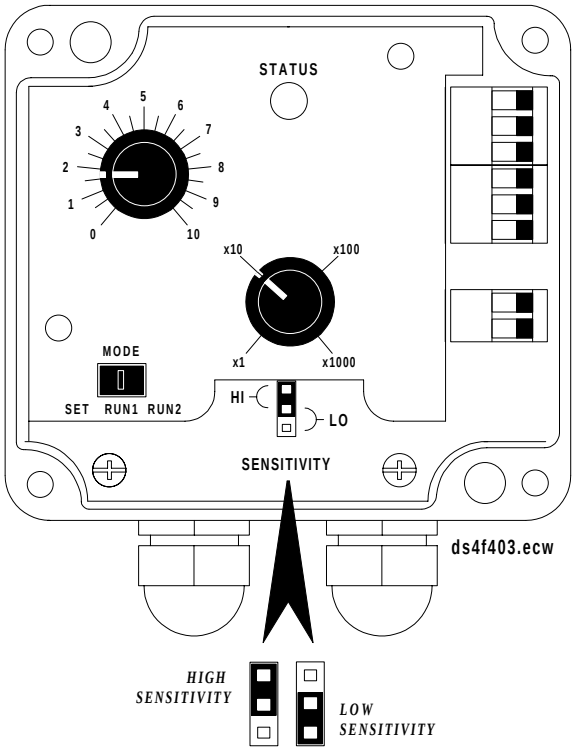
The aim of this step is to set the 'alarm delay' to an appropriate value. The DS10C will activate an alarm if the average plant emission over a period of time exceeds the alarm setting. This period may be selected as either 1 minute or 2 minutes as required by adjusting the ‘MODE' switch.

- **For stable continuous processes, set the alarm delay to 'RUN 1' (1-minute delay).**
- **For dynamic unstable processes, set the alarm delay to 'RUN 2' (2-minute delay).**
- **If you are unsure of the dynamics of your process, select 'RUN 1' and if relay 1 is intermittently triggered, change to 'RUN 2'**



- **Re-fit any connectors that were removed (i.e. alarm relays)**
- **Finally, securely replace the lid of the module.**
- **Check that the cable entry glands are tight.**

4.03: Changing the sensitivity of the sensor;



If during STEP 2 of the set-up procedure it is not possible to make the 'status' LED change colour from red to green, then it is recommended that the sensitivity be reduced in the sensor unit.
The sensitivity is adjusted by moving the 'jumper' JP2 within the sensor unit to either HIGH or LOW (see diagram to the left).

For dust concentrations of above approximately 100mg/M³, **LOW** sensitivity should be used.

For dust concentrations below approximately 100mg/M³, **HIGH** sensitivity should be used.

NOTE 1: The DS10C is shipped with a factory setting of HIGH sensitivity. The link is fitted to the lower pair of pins on JP2

NOTE 2: If the sensitivity is changed while in setup mode, data collection will need to be re-started from the beginning of STEP 2.

5.00 - OPERATION

5.01: Description of normal operation;

when the set-up has been completed, the operation of the DS10C may be monitored by the 'status' LED. During normal operation, the DS10C has the following features;

- The 'Status' LED is illuminated green to show that power is applied and no alarms exist.
- The 'status' LED will 'blink' at one-minute (or two-minute depending upon setting of MODE switch) intervals to indicate the completion of the averaging period.
- Both alarm relays will be non-energised.

5.02: Description of alarm operation;

The DS10C has two independent alarm relay outputs which have their levels set during STEP 4 of the set-up procedure. These relays are summarised as follows;

- Relay 1 - 'High alarm', this level adjusted by the user to suit the application.
- Relay 2 - 'Early warning alarm', this level is fixed at HALF the level of the 'high alarm'.

The 'status' LED is used to indicate the alarm status at any time, this operation is summarised in the table below;

Status LED Green	Emissions **below** HALF of the 'high alarm' setting. (i.e. less than 'early warning').	**Both Relays OFF**
Status LED Orange	Emissions **above** HALF of the 'high alarm' setting. (i.e. 'early warning' triggered).	**Relay 2 ON Relay 1 OFF**
Status LED Red	Emissions **above** the 'high alarm' setting. (i.e. 'high alarm' triggered).	**Relay 2 ON Relay 1 ON**

The alarms are non-latching such that when the plant returns to normal operation, the alarms are automatically cleared (after the alarm delay period of either 1 or 2 minutes).
The alarm relay outputs will typically be connected to an external latching alarm module such as the PCME 4-channel alarm unit.

5.03: Abnormal operation;

The DS10C is able to indicate if an internal error has occurred. If this should occur, the following state will be assumed;

- The 'Status' LED will rapidly pulse between green and red.

Remove power from the DS10C then re-apply after a 5 second delay, this will often clear the condition.

On new installations, ensure that the correct sequence has been followed for the connections at the DS10C module.

If the fault persists, the control unit may be faulty and this should be returned to PCME for evaluation and repair.

6.00 - MAINTENANCE

6.01: General maintenance;

The DS10C is designed to require minimal maintenance, however the nature of many processes is such that a large build up of particulate may develop on the sensor rod. This build up will often have no effect whatsoever on the performance of the instrument but it is recommended that the build up be periodically removed. If the probe rod should require cleaning, this may be performed by removing the module from the duct and thoroughly cleaning the entire rod, paying particular attention to the cleanliness of the insulator. The cleaning may be performed using wire wool , or for sticky or stubborn deposits, a cleaning agent such as isopropyl alcohol has been found to be extremely effective. Always ensure that the probe rod is thoroughly dried before re-fitting to the ductwork.

The following maintenance programme will ensure that the DS10C remains reliable throughout its life. The frequency of the maintenance programme is dependent upon the type of environment in which the instrument is to be used. It is recommended that the programme be followed 1 month after installation, then after 3, 6 or 12 monthly intervals as deemed necessary.

6.02: Routine maintenance program;

- Remove the module from the ductwork.
- Thoroughly clean the probe rod and insulator as described above.
- Clean off any excessive build up from the module enclosure using a stiff brush or damp cloth.
- Check that the lock nut moves freely.
- Apply a small amount of copper slip or grease to the threads to prevent binding.
- Re-fit the sensor unit to the ductwork.
- Inspect the connecting cables (where possible), ensure that they are not damaged or stressed.
- If necessary, follow the set-up procedure to re-set the *Dust Level*.

This completes the routine maintenance programme.

APPENDIX A - ISOKINETIC TESTING

A1: Overview;

The DS10C may be 'referenced' to a dust concentration in mg/m³ in certain applications by correlating the response of the instrument to the results of a gravimetric analysis for a single stack test. This will allow alarms to be set in mg/m³ values as required in many indicative monitoring applications. This process is usually performed in three stages because the isokinetic test results are not usually available immediately. The three typical stages are;

1. Perform isokinetic sample test and record DS10C average value during test.
2. Analyse (weigh) the sample(s) obtained, calculate required alarm settings for DS10C.
3. Enter alarm settings into DS10C.

A2: Location of sampling ports;

Ideally, the sensor unit should be mounted at least 2 duct diameters upstream and not less than 300mm upstream of the sampling ports.

- **NOTE: It is not necessary to fit the sensor in the same length of straight as the sampling ports.**

In general, the sampling ports should be mounted in a section of the ductwork where the flow is fully developed (i.e. reasonably constant and repeatable across the duct). For further details consult the installation note at the rear of this manual.

A3: Pre-calibration checklist;

- Ensure that the DS10C is running correctly. Follow the set-up procedure as outlined in section 4 and set arbitrary alarm values to get a 'feel' for operation of the DS10C, and to highlight any possible problems *before* the Isokinetic testing begins.
- Ensure that the plant is running normally;
  - Calibration is most accurate around the dust levels close to where the calibration is carried out. Interpolation errors arise if the DS10C is operated at levels widely different from those pertaining at the time of calibration.
  - The instrument is sensitive to different types of dust and particle size. It is important, therefore, that the calibration be made with a representative type of particulate.
  - Consult with the plant operator to establish that the conditions pertaining are representative. If it is a batch or cyclical process, ensure that the sampling is carried out at an appropriate point in the batch or cycle.

A4: The Isokinetic test;

Isokinetic sampling must be carried out according to a recognised national standard. It is essential that the position at which sampling is to be taken is downstream of the DS10C module (i.e. towards the flue exit) so that the measurement being made by the module is not interfered with by movement of the sampling equipment.

It is essential to start the DS10C collecting data when each sampling run starts and terminate the DS10C data collection when each sampling run stops. A discrete run is the period of continued use of a sampling filter or pot (i.e. a new filter pot constitutes a new run). As a new sampling run begins, start the DS10C collecting data by following STEP 2 of the set-up procedure (i.e. set the 'mode' switch to the 'setup' position.

Just prior to the end of a sampling run, follow STEP 3 of the set-up procedure to determine the ***dust level*** recorded by the DS10C during the test run. If more than one sampling run is used, it is advisable to calculate the alarm setting based upon a time-weighed average instrument response **Y**, and sampling result **X** using the following formula;

$$Y = \frac{(A1 \times T1) + (A2 \times T2) + (A3 \times T3)}{T1 + T2 + T3}$$

$$X = \frac{(S1 \times T1) + (S2 \times T2) + (S3 \times T3)}{T1 + T2 + T3}$$

Where;

A1, A2 and **A3** are the instrument averages for each sample run.
S1, S2 and **S3** are the average samples obtained during each sample run.
T1, T2 and **T3** are the lengths of each of the sample runs.

Notes:

- The isokinetic results should be normalised to 0ºC and corrected for oxygen if required.
- The DS10C averages are obtained by reading the 'settings' control positions as detailed in STEP 3.

A5: Calculating the alarm setting;

To set the alarms within the DS10C to a specific mg/m³ level, an alarm scaling factor calculated and the required mg/m³ value is then multiplied by this factor to provide the DS10C control settings. The calculation to be performed is as follows;

DS10C alarm setting = Required mg/m³ alarm level X (Y / X)

Where Y=DS10C average during sample run (or time weighted average) obtained by reading 'settings' positions. X=Isokinetic sample results (or time weighted result).

A6: Worked example;

A

A particular isokinetic sample run provided a dust concentration of 15mg/m³ and the DS10C settings were found to be 200 (i.e. upper control = 2, lower control = *100).

The alarm limit for the process type is set at 66mg/m³.

The alarm control settings are calculated as follows;

DS10C Alarm setting = 66mg/m³ X (200 / 15)
DS10C Alarm setting = 880

Follow STEP 4 to enter the alarm setting as calculated.

APPENDIX B – LOW VOLTAGE POWER SUPPLY

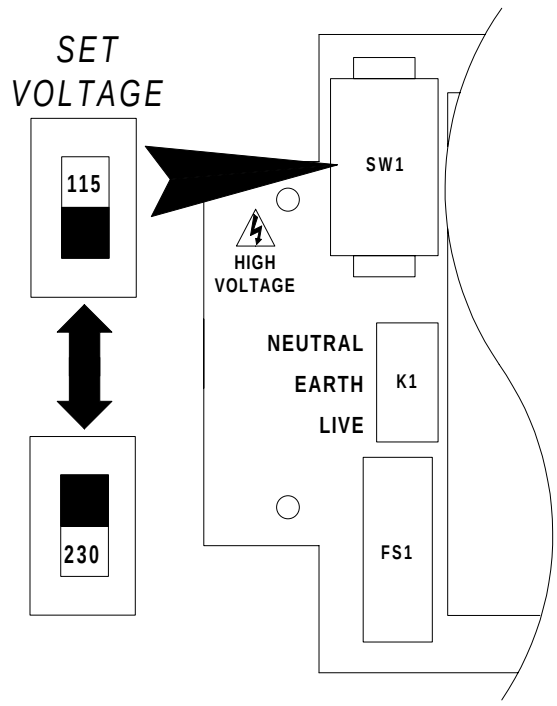
B1: Overview;

The Optional remote power supply for the Dustsense family of products is available as two models:

- **1 Channel Model – Will supply one DS5c, DS10c or DS30c module.**
- **8 Channel Model – Will supply up to 8 DS5c, DS10c or DS30c modules.**

The power supply has an unregulated DC output and hence the terminal voltage will depend upon the load connected. Connection and operation of both models is identical. Due to the heat generated, the PSU has ventilation slots that should not be covered. The PSU is not rated for outdoor installation.

B2: Connecting the mains supply to the PSU;



The Dustsense PSU requires a mains power supply of either 115V or 230V @ 50/60Hz. Remove the PSU cover by unscrewing the four pozi-head screws in the deeply recessed holes on the underside of the unit. Referring to the figure to the left of this text, the supply cable should be passed through the cable entry grommet supplied and should be connected to K1 as shown. Mains cable with a 3A rating will be adequate. This

CAUTION ! The voltage selector switch MUST be set to the appropriate position to suit the supply. Set the switch *before* connecting the supply.

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

The Mains fuse (FS1) rating depends upon the model as follows;

- 1 Channel Model: FS1 = 50mA type T 20mm.
- 8 Channel Model: FS1 = 250mA type T 20mm

Always isolate the supply before checking or changing the fuse.

B3: Connecting to the Output of the PSU;

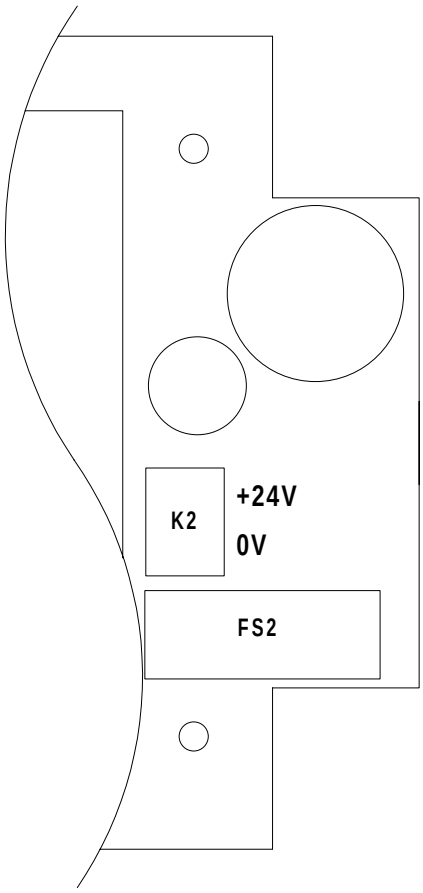
Referring to the figure to the right of this text, pass the cable through the entry grommet and connect to K2 as shown. The cable should be a two core 24/0.2 type or larger. Cable lengths should be minimised where possible up to a maximum of 250m for any network.

The power cable may be 'daisy chained' from sensor to sensor starting from the PSU. This will typically be the most efficient means of connection in terms of cable cost.

Alternatively, each power cable may be individually connected from the PSU to each sensor to form a 'star' topology. This method provides more efficient power distribution.

Junction boxes may be used as necessary to allow cabling to be routed to suit a particular plant layout.

Replace the cover when all wiring is complete.



APPENDIX C - CONNECTION DIAGRAMS