DynOptic Systems Ltd
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DSL-460 MkII Double Pass Opacity/Particulate Monitor

Operators Manual V1.2

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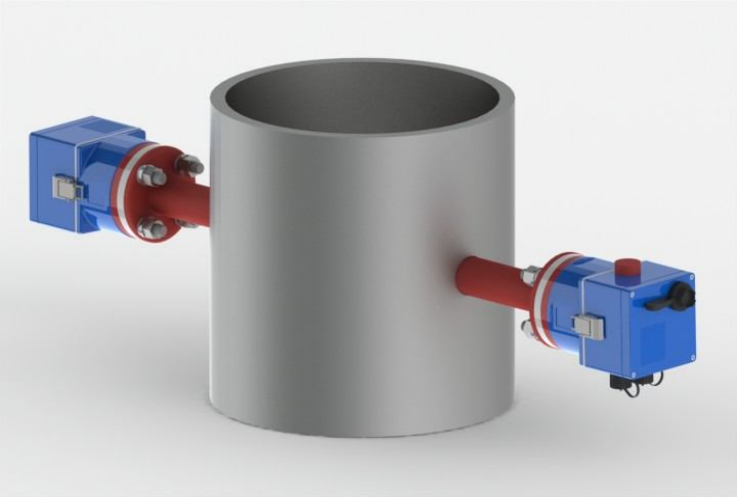
Contents

Product Overview

The DSL-460 MkII Double Pass Opacity Monitor measures open path light transmission using a transceiver (TRX) and reflector system. It is typically installed on a duct, stack, chimney or flue for the purpose of monitoring increases in Opacity (0-100%) or Particle Density (mg/m^3) caused by suspended particles (dust and smoke) passing through the light path. Other available units include transmission (T), extinction and optical density.



The TRX and Reflector are mounted opposite each other across the stack so that the light beam generated in the TRX passes across the centre of the duct, stack or flue (through the gas stream) and falls directly onto the Reflector on the other side. The Reflector then returns the light beam to the TRX. Any dust or smoke particles present will attenuate the light beam and cause the intensity of the light received by the TRX to fall. The amount of light lost in crossing the duct, stack or flue is the opacity and this correlates to the amount of dust or smoke present in the gas flow. These measurements may be used directly or in conjunction with calibrated scale factors to generate a reading in a choice of units.

A number of checks and measures are employed to maintain continued accuracy of the instrument, including direct monitoring and compensation for the light source intensity as well as monitoring and compensation of the internal instrument temperature.

The DSL-460 MkII contains an integrated visual alignment aid, which makes installation easier. The TRX contains a viewing port which allows the user to see an image of the light returned by the Reflector head against a reticle target. Positioning the image within the centre of the target is used to align the TRX head.

The DSL-460 MkII can be supplied for “stand alone” configuration, (i.e. TRX/Reflector heads only; no control unit), in which case command and control of the instrument is performed using either the Utility software provided (for use on a laptop PC) or by ModBus serial comms connected to the TRX. In the stand alone configuration, the TRX head has a range of interface outputs including analogue output, level/service alarm contacts, ModBus and USB, allowing it to fit into standard industrial monitoring systems.

Alternatively the DSL-460 MkII can be supplied with a DSCU (DynOptic Systems Control Unit) which is an OI (Operator Interface) that consists of a numeric / directional keypad, a two line LCD display and a terminal compartment. The DSCU is a multi-headed OI and, if required, can be connected to up to eight separate instruments.

The keypad and display on the DSCU combine to form an interface which can be used to setup and control any connected instrument with similar functionality to the PC based Utility software supplied with each instrument.

Both TRX and Reflector heads are supplied with cast aluminium air-purge bodies. These not only provide the physical mounting point for the instrument but also allow users to connect a high volume, low pressure air supply to help keep the optics clean and prolong service intervals. By default, the instrument is a 24Vdc powered device but it can be optionally supplied with universal input 90-265Vac PSU for AC operation.

Calibration varies depending on the measurement units selected; Opacity, Transmission, Extinction and Optical Density require zero calibrating. Particle Density will require an upscale calibration based on comparison between instrument readings and independent gravimetric sample measurements.

An optional Calibration Head and filters can be purchased to allow for manual zero and span drift checking. The Calibration Head is inserted between the TRX and the air purge head, when a calibration check is required. The reference mirror and filter inserts are then introduced in accordance with the calibration check routine and any performance drift can be measured and corrected, where appropriate. The calibration check routine must be run using the DSL-460 MkII Utility Software on a PC.

This manual assumes that the DSL-460 MkII has been properly installed in accordance with the separate installation manual.

This manual covers the set-up, maintenance, and general operation of a DSL-460 MkII monitor using either the DSL-460 MkII Utility Software supplied, and/or the optional DSCU.

Installing the Utility Software and Configuring USB

Warning: The Utility Software and the USB Driver MUST BE INSTALLED ON THE PC FIRST i.e. before connecting the DSL-460 MkII to a PC. Connecting the PC to a DSL-460 MkII before installing the Utility Software and the USB Driver will cause problems with installation and may even cause the installation to fail.

Minimum hardware/software specification for host PC

The DSL-460 MkII Utility Software is not a large or particularly complex program and therefore, has no requirement for a high performance host PC. Any reasonably modern PC/laptop will be suitable. The only “must have” requirements are:

- Windows XP, or better, operating system
- All recent operating system Service Packs and upgrades (visit the Microsoft website) must have been installed
- At least one free USB slot (assigned to a COM Port between COM1 and COM6 – see later section on Assigning a Valid COM Port).

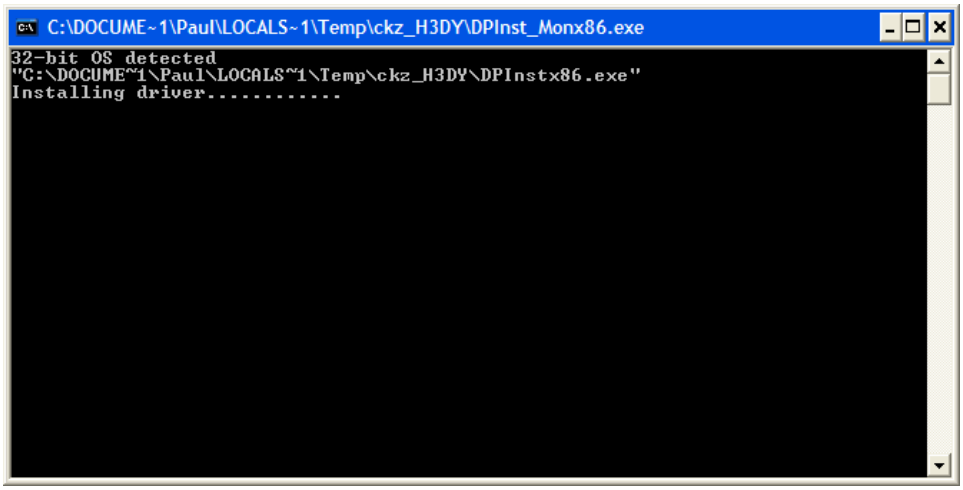
Installing the USB Driver

The DSL-460 MkII USB Driver software is supplied on a CD that is shipped with the instrument.

1. Ensure that you are logged onto the PC with Administrative rights so that you have the necessary permission to install software.

2. Copy the “DSL USB DRIVER (CDMxxxxx).exe” file from the CD to any suitable location on the host PC, (“My Documents” is a good location), then double click it.

3. Having double clicked the .exe file a DOS Prompt window will open and the USB driver will be automatically installed. See the following screenshot. It may take up to 1 minute to install the driver so please be patient and wait for the DOS Prompt window to disappear before performing any other actions on your PC.



Installing the Utility Software

The DSL-460 MkII Utility Software is supplied on a CD that is shipped with the instrument.

1. Ensure that you are logged onto the PC with Administrative rights so that you have the necessary permission to install software.

2. Copy the “DSL 460 MkII Utility Install V*.*.*.zip” file from the CD to any suitable location on the host PC, (“My Documents” is a good location).

3. Extract the contents of the zip file (right click on the zip file and click “Extract All”) to a local directory, (“My Documents” is a good location again).

4. Navigate to the extracted files and double click “setup.exe”.

5. Follow the onscreen installation prompts.

Note; *If you encounter any warning messages about replacing existing .dll files, always choose NOT to replace the existing files.*

The software should now be installed and should appear in the “All Programs” list as “DSL-460 UTILITY”.

Updating the Utility Software

From time to time DynOptic Systems may release updated versions of the DSL-460 MkII Utility Software. If you receive an updated version, it is essential that you remove any existing version from your PC before installing the new one.

To remove your existing Utility Software use the Windows “Add or Remove Hardware” option from the Windows “Control Panel”.

Assigning a valid COM Port

When you first connect the PC to the DSL-460 MkII, it is very likely that the PC will assign the USB connection to a COM Port number outside the acceptable range of COM1 to COM8. In this situation, the DSL-460 MkII Utility Software will be unable to communicate with the instrument.

You can check which COM Port your PC has assigned to the DSL-460 MkII by opening Windows “Device Manager” before connecting your DSL-460 MkII. To open “Device Manager”:

1. Right click on “My Computer”
2. Click on “Manage”
3. Click on “Device Manager”
4. Scroll down to “Ports (COM & LPT)”, then click the “+” symbol to look at the list of COM Ports

Once you can see the list of current COM Ports, connect your PC to a DSL-460 MkII by plugging the USB cable from your PC into the USB connection on the back of the TRX head, (unscrew the weather-proof cap to gain access).

As you connect, your PC should indicate that it has “Found New Hardware” and a new COM Port number should pop up in the “Ports (COM & LPT)” list.

If the new COM Port is between COM1 and COM8 then your PC has allocated a valid COM Port and no further action is required.

However, if the COM Port number that was assigned to the connection is outside the acceptable range, then you must change the assigned COM Port to a number between COM1 and COM8. Follow the procedure below to assign a valid COM Port:

1. Right click on the COM Port (in the “Ports (COM & LPT)” list) that appeared when you connected to the DSL-460 MkII
2. Click “Properties”
3. Select the “Port Settings” tab
4. Click on the “Advanced” button
5. Click the “COM Port” and select a new “COM Port Number” between COM1 and COM8 (avoiding any COM Ports which are marked as in use) from the drop down list

Once you have assigned a valid COM Port number to the DSL-460 MkII USB connection, your PC will remember this COM Port assignment and you should not need to repeat the process again when connecting your PC to the instrument, provided that you always use the same PC and you always connect via the same USB slot in your computer.

Note; *If you connect to the DSL-460 MkII from a different computer, you will need to repeat the process above and assign a valid COM Port.*

Note; *You should always connect to the DSL-460 MkII using the same USB slot on your PC. If you use a different USB slot you will need to repeat the process above and assign a valid COM Port again, because the PC sees each USB slot as a separate entity.*

Using the Utility Software

Warning: The Utility Software and the USB Driver MUST BE INSTALLED ON THE PC FIRST i.e. before connecting the PC to a DSL-460 MkII. Connecting the PC to a DSL-460 MkII before installing the Utility Software and the USB Driver will cause problems with installation and may even cause the installation to fail.

Connecting a PC to the DSL-460 MkII

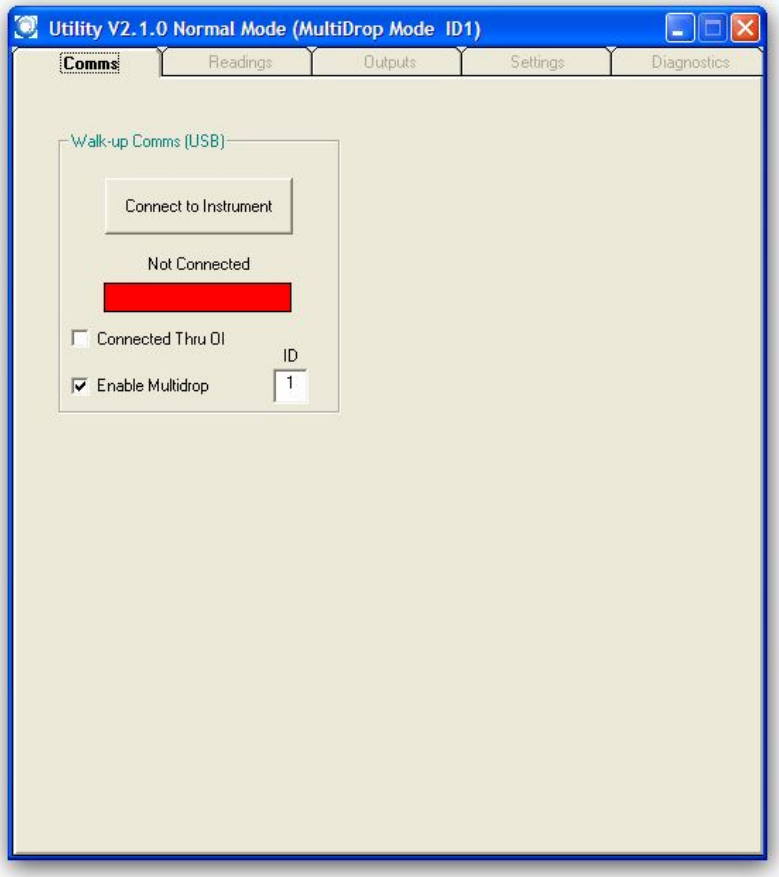
Before connecting the PC to the DSL-460 MkII you MUST have installed the USB Driver and assigned a valid COM Port – see the previous section on installing software.

With the driver installed and com port assigned, connect your PC to the DSL-460 MkII using a standard USB cable (type A to Type B).

On the TRX, the USB connection can be found on the back of the TRX head (under a weather-proof cap). On the DSCU the USB connection can be found on the circuit board inside the terminal compartment.

The Comms tab

On first running the Utility software you will always arrive at the Comms tab. See the following screenshot.

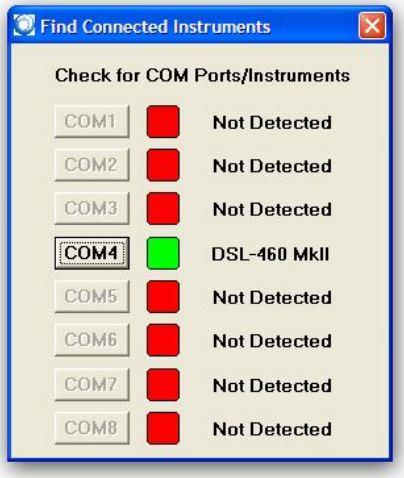


The Comms tab allows you to establish a connection with the DSL-460 MkII. When you first run the program there will be no connection so the status bar will be red (indicating no connection). You will not be able to select any other tab until a comms connection has been established.

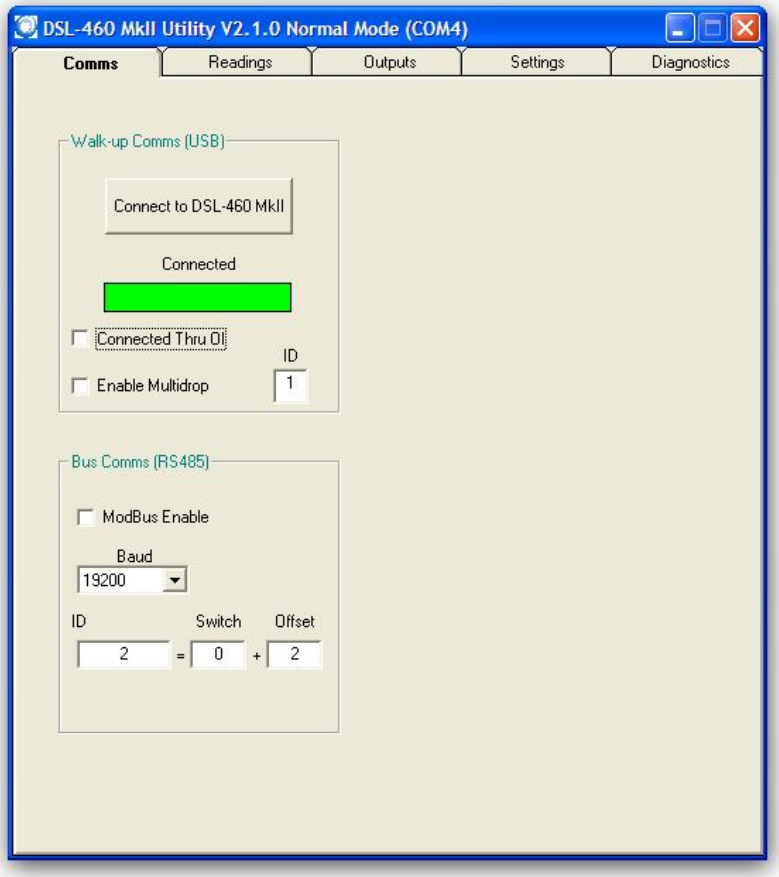
Connect to DSL-460 MkII

To establish a connection with the DSL-460 MkII click the “Connect to DSL-460” button. The software will scan Com Ports 1 to 8 looking for any DSL-460 MkII monitors that may be connected. More than one Com Port may exist so more than one DSL-460 MkII may be connected.

When the scan is complete the software will report the status of any Com Ports found and any DSL-460 MkII's connected on a separate pop-up window. See the following screenshot.



Select a Com Port with "DSL-460 FOUND" alongside it (it will have a green status indicator). You will then be returned to the Comms tab where the status indicator bar will now be green (indicating a positive connection). See the following screen shot.



Once a comms connection is established you will be able to select any of the five tabs.

Connected Thru OI

If you are connected directly to the TRX Head the “Connected Thru OI” checkbox will be un-checked. If you are connected through a DSCU the “Connected Thru OI” checkbox will be checked. This is an automatic checkbox which you do not need to select or alter.

Enable Multidrop

When connecting to the instrument the Utility will automatically check whether the instrument is in normal or multidrop mode. For advanced use only.

Bus Comms (RS485)

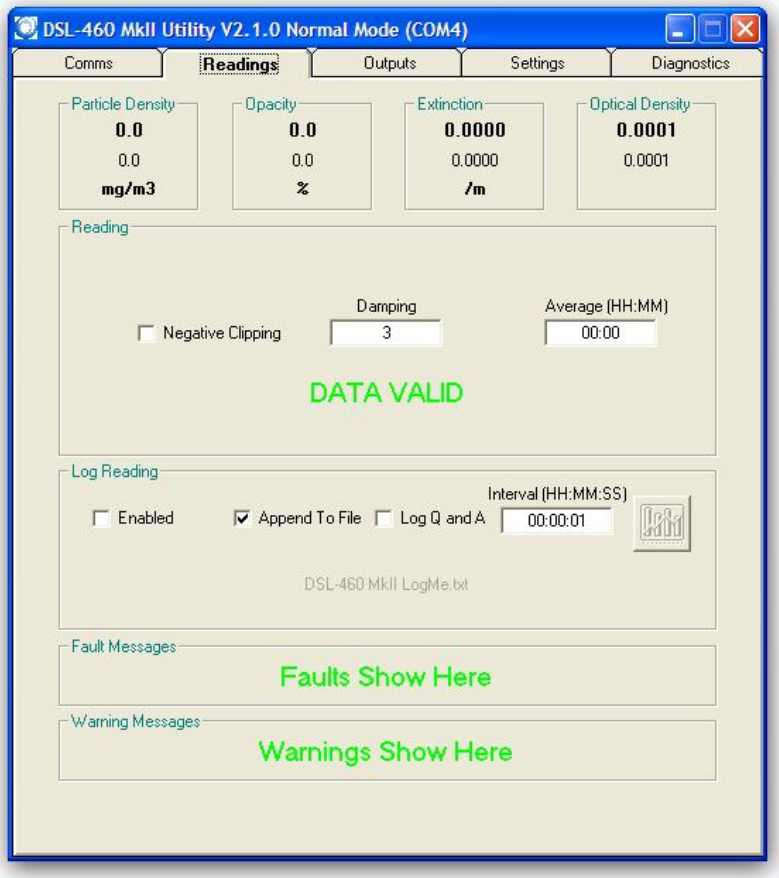
Checking the ‘ModBus Enable’ tick box allows communication with the instrument via ModBus. For further information please contact DynOptic Systems.

ID, Switch & Offset

For use when multi-heading with a DSCU. The default ID is always “1”. Please refer to the DSCU Installation & Operator Manual for more information.

The Readings tab

The Readings tab shows the current measurement readings (complete with units). It allows you to view and alter the damping applied to the measurement reading, select negative clipping, select checkboxes for activating and controlling automatic data logging (which saves log files directly to the PC hard drive) and view any current error messages. See the following screen shot.



Readings

The boxes on this row show the instrument readings in all of the available units. The top row displays the current measurement reading after damping. The bottom row displays the average of the damped reading.

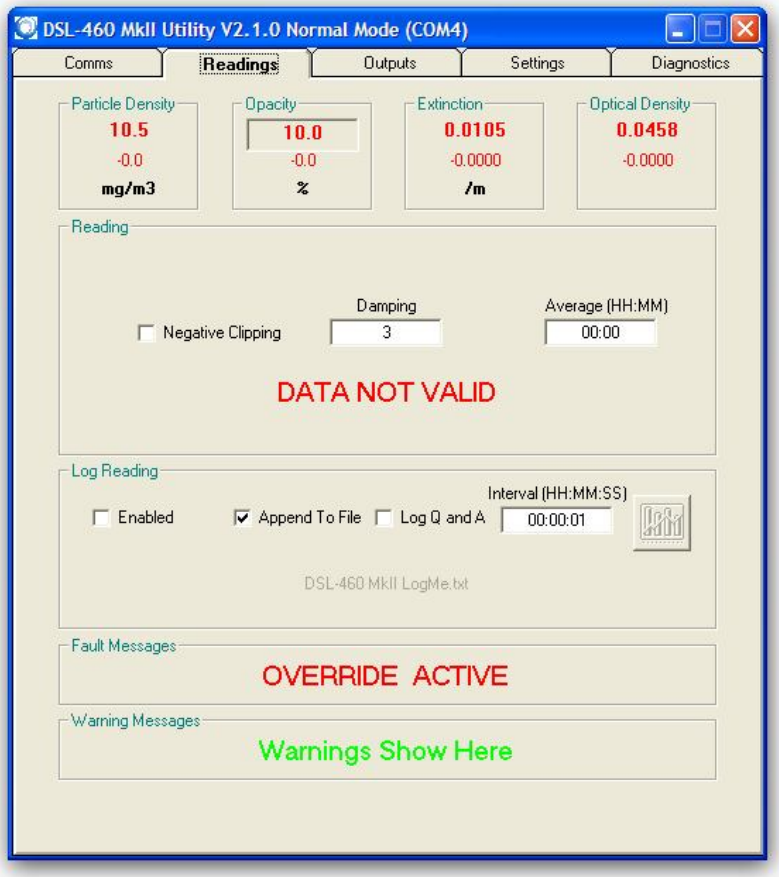
Reading Override Mode

Double clicking on the opacity (non-averaged) measurement reading sets the instrument into the Reading Override Mode.

***Note**: Entering the Reading Override Mode activates the Service Alarm.*

When in this mode the opacity reading text box is highlighted and the text is red (see below), the user can now manually edit the opacity value.

Type a value into the measurement reading box and press enter, this forces the reading to the value entered. This function enables you to check if the outputs are setup and are responding correctly at the SCADA or data logging system.



To exit the Reading Override Mode double click in the opacity reading box. Alternatively the instrument will automatically return to normal readings after 5 minutes of inactivity.

Negative Clipping

If this box is UN-CHECKED the instrument will display and output the true reading, even if that reading is negative. Negative readings are possible when the instrument is not set-up and calibrated properly and from noise fluctuations during operation.

If this box is CHECKED the instrument will clip the current measurement reading and the output at zero so positive readings will show as normal but when the instrument calculates a negative reading, it will hold the display and the outputs at zero (e.g. 0.0%).

Damping

This value (in seconds) displays the level of damping applied to the measurement reading. Entering a new value in this box will change the damping applied. The default damping for this instrument is 3 seconds. The response time of the instrument to a step change in the reading is approximately three times the damping.

Average

This box allows you to set the time required for the average of the measurement reading. This is selectable from 0 to 24 hours (HH:MM). The average measurement reading averages the damped readings for the time period selected and updates it at the end of that period.

Data Valid

When the instrument is fully setup and working 'DATA VALID' will be displayed in green. Prior to the instrument being setup or if there is a fault, 'DATA NOT VALID' will be displayed in red. The reason for the data not being valid will be displayed in the 'Last Error Message' box.

Log Reading - Enabled

When checked, the following parameters will be logged in a CSV file stored in the location C:\DSL READINGS LOGS on the PC; the measurement reading; the calculated mA output for the analogue outputs and the relay status (as a hex number). The logs will be created at intervals defined by the Interval setting.

Log Reading – Append to File

This box is checked by default. The log file created will be a single file using the electronic serial number of the instrument as a reference in the filename and each new log is appended within that file. A new file is created each day with the date forming part of the filename.

When the Append to file box is unchecked, the logging will generate a new file at each logging interval, using the time, date and electronic serial number of the DSL-460 MkII as the file name.

The log file(s) can be opened in a text editor or spreadsheet and can be used for data logging, trend graphing or for diagnostics.

Log Reading – Log Q and A

The logging function uses a "question and answer" system to retrieve data for the log. In this system the DSL Utility Software sends a question (being an ASCII text string) to the DSL-460 MkII, which responds with an answer (usually being a number).

By default the question that is asked relates to the measurement reading and general status of the instrument only. However, with advice from DynOptic Systems, advanced users may modify the question so that the log file records additional or alternative data; for example relay thresholds or analogue output scaling values.

In these circumstances it is beneficial to log both the question and the answer so that the log file is more easily interpreted.

The file that is edited to modify the question is 'DSL-460 LogMe.txt', which is visible below the checkboxes. Left clicking on the file allows users to specify a different file and right clicking on the file opens the current file in a text editor. Please seek advice from DynOptic Systems before making any changes to this file.

When this checkbox is un-checked, the log file (in whichever format) only includes the answer but when this box is checked the log file includes both the question and answer.

Log Reading - Interval

The time interval between the creation/update of log files is determined here.

Graph Button

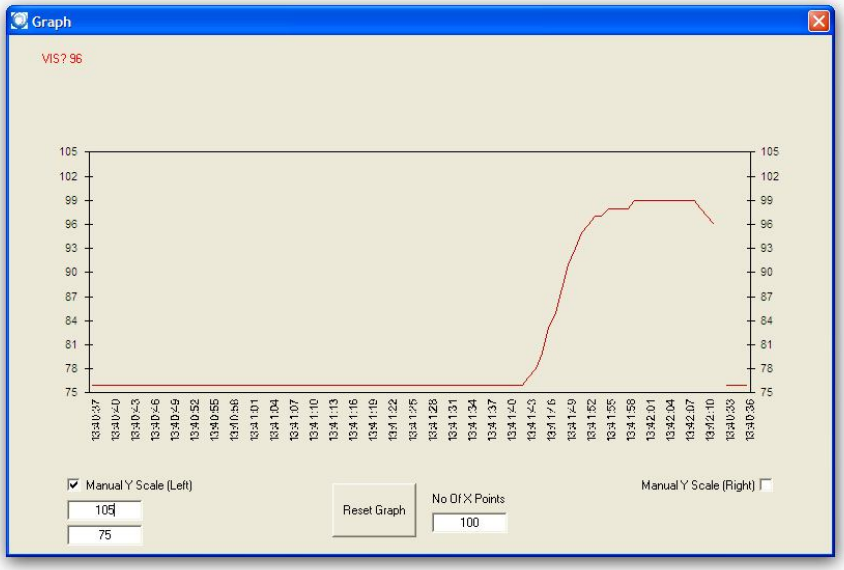
As well as a log file being created, the data can be viewed using the graphing feature. While logging click on the 'Graph Icon' (see screenshot below).

Only the first four lines of the "LogMe.txt" file are viewable on the graph. There are two 'Y' axis, and by clicking on the coloured text at the top "VIS?", the axis

that this data is plotted against can be changed; Left-Left Y-Axis, Centre-Not displayed and Right-Right Y-Axis.

The Y-Axis scales are automatic but can be manually changed by checking the “Manual Y Scale” and then entering the minimum and maximum values.

The number of X coordinates can be changed (between 100 and 3600) by entering the value in the ‘No of X Points’ box and pressing enter.



The ‘Reset Graph’ button clears the currently displayed data.

To exit the graphing feature, close the window using the cross at the top right hand corner of the window to return to the main Portal.

Fault Messages

If the instrument self-detects a fault, it will display a brief message, describing the fault, on this tab. Most fault messages will continue to be displayed on this tab until an operator clicks on the message to acknowledge it. If the fault is no longer active the message will disappear, but if the fault status is still active the message will re-appear immediately.

See the section on “Fault Messages and Troubleshooting” later in this manual for more information.

Warning Messages

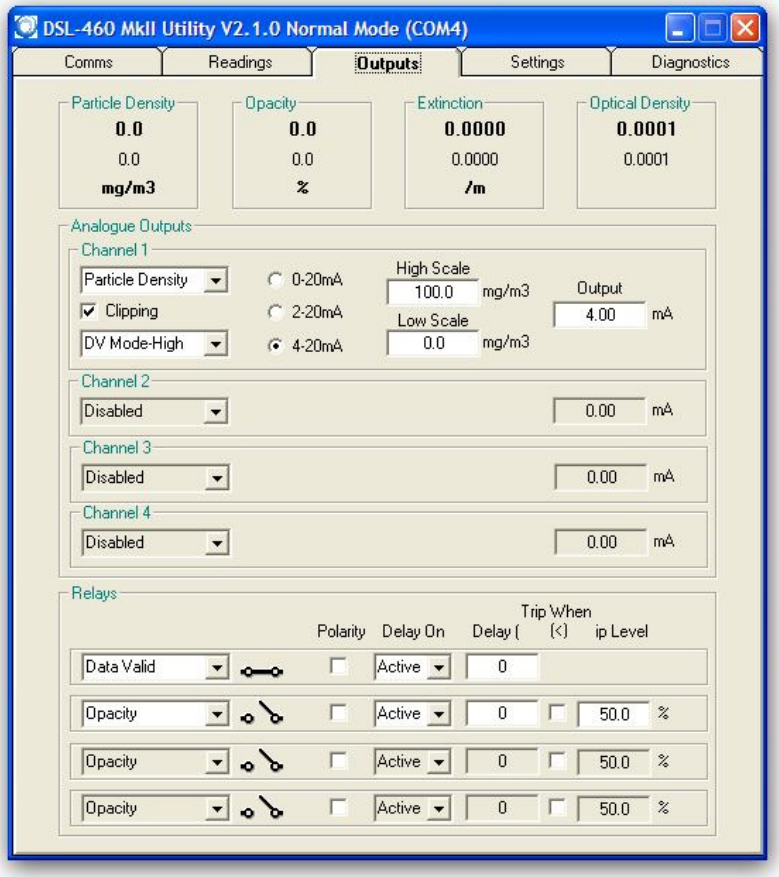
If the instrument self-detects a parameter that is close to or out of range that needs investigating, a brief warning message will be displayed describing the problem. The warning message will continue to be displayed on this tab until an operator clicks on the message to acknowledge it. If the warning is no

longer active the message will disappear, but if the problem causing the warning is still active the message will re-appear immediately.

See the section on “Fault Messages and Troubleshooting” later in this manual for more information.

The Outputs tab

The Outputs tab allows you to configure electrical interface outputs (such as the analogue output and alarm relay contacts) and also allows you to see the effects of those settings. See the following screen shot.



Analogue Outputs

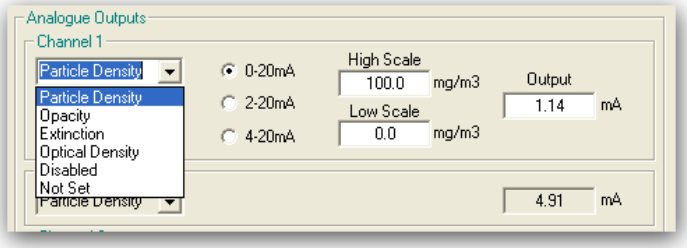
The Utility allows the DSL-460 MkII to set-up conditions for four (4) analogue outputs. Channel 1 is a real analogue output in the TRX head, the remaining three are virtual analogue outputs.

Real Analogue Output

Channel 1 reflects the setup for the single analogue output available from the DSL-460 MkII TRX head.

Select the Measurement

Select from the drop down menu the measurement you would like the analogue output to act on. The options available are; Particle Density, Opacity, Extinction, Optical Density and Disabled (switches the output off).



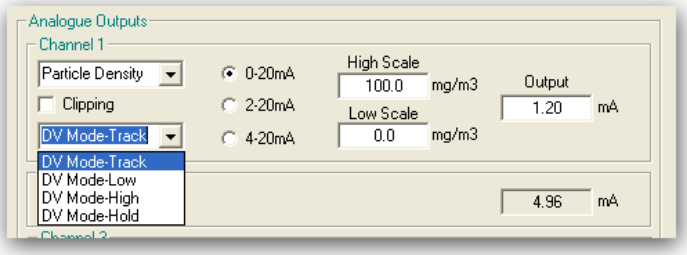
Clipping

By default this box is CHECKED. In this mode the analogue output will not respond to readings below the value set as “Low Scale”, but will send an analogue output equivalent to the lowest current for the scale selected.

If the box is unchecked then the analogue output will track the measured signal even if it is below the value set as “Low Scale”, but only as low as 0mA. Note that if the reading already has negative clipping applied to it (see the Readings tab) then since the analogue output tracks this reading it will also be clipped to zero.

DV Mode

This drop down menu allows you to select what happens to the analogue output in the event of the data being invalid. Both the actual and calculated analogue outputs are acted on.



The available options are:-

Track (default) – In the event of data invalid, the analogue output will continue to track the reading. This is the default setting.

Low – In the event of data invalid, the analogue output will be forced to the low scale value.

The analogue output will continue to be held at this value for the duration of the data invalid period.

When the data valid status is returned the output will return to tracking the current measurement reading.

High – In the event of data invalid, the analogue output will be forced to the high scale value.

The analogue output will continue to be held at this value for the duration of the data invalid period.

When the data valid status is returned the output will return to tracking the current measurement reading.

Hold – In the event of data invalid, the analogue output will be held at the last known output current.

The analogue output will continue to be held at this value for the duration of the data invalid period.

When the data valid status is returned the output will return to tracking the current measurement reading.

0-20mA / 2-20mA / 4-20mA

The current loop analogue output can be configured to operate across any one of three scales: 0-20mA, 2-20mA or 4-20mA. Select the required scale using these radio buttons.

High Scale and Low Scale

These two parameters define the upper and lower scaling points of the 0/2/4-20mA output.

Set the low scale value to the reading at which the analogue output should generate 0mA, 2mA or 4mA (depending on selected scale point).

Set the high scale value to the reading at which the analogue output should generate 20mA.

Note: *If you change the measurement units, (on the Settings tab), you will need to change the low scale and high scale settings here, as there is no automatic adjustment of scaling values when you change between units.*

Output

The output value is a calculated indication of the expected current output in mA; taking into account the low scale and high scale settings and also the 0/2/4mA scale selection.

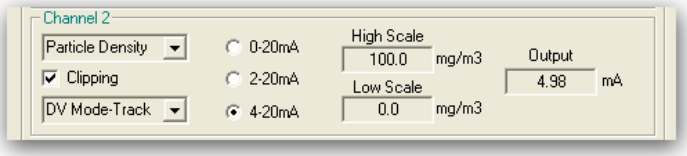
The value shown here is a calculated value only. It is not an electronically measured value from the actual analogue output circuit. There is no direct connection between the calculated value shown and the actual output. However, unless there is a fault with the instrument, the correlation between the calculated value and the electrical output should be very good.

Virtual Analogue Outputs

The DSL-460 MkII has three (3) virtual outputs. These virtual outputs can be setup to be used when the instrument is connecting to a DSCU, which is capable of having up to 8 analogue outputs.

Alternatively the outputs could be integrated into a ModBUS setup, allowing an output for each measurement unit.

Click on an area of the virtual output to activate it. The settings can then be modified in the same way as the real analogue output (Channel 1).



Relays

The Utility allows the DSL-460 MkII to set-up conditions for four (4) relays. The first two are the real relays in the TRX head, the remaining two are virtual relays.

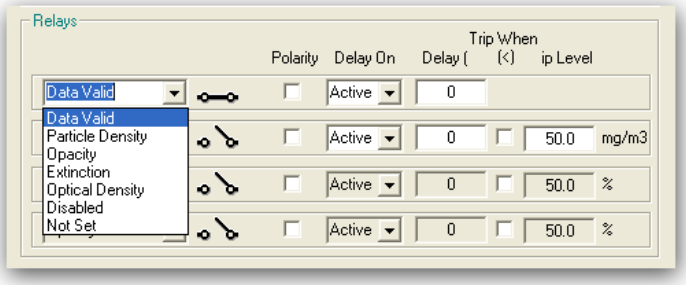
Real Relays

The first relay (by default) is a Data Valid indicator that will go into an alarm condition in the event that the instrument's self-checking identifies a fault. Contacts are open in a de-energised state (i.e. N/O), so contacts fall open naturally in the event of a power loss.

The second relay (by default) is the measurement reading alarm. It operates when the measurement reading exceeds a set Threshold value. The operation of this alarm can be delayed using the Delay setting.

Select the Measurement

Select from the drop down menu the measurement parameter you would like the relay to act on. The options are; Data Valid, Particle Density, Opacity, Extinction, Optical Density and Disabled (switches the relay off).



Relay Polarity checkbox

The relay polarity boxes are UNCHECKED by default.

The Data Valid relay(s) will be energised when data is valid, and the relay status indicator will show a closed contact in the data valid condition. In this polarity the relay will de-energise when the data becomes invalid (i.e. a fault). This condition represents the recommended failsafe operation.

The Level alarm relays are de-energised in a below threshold condition and the relay status indicator will show an open contact in the same below threshold condition. In this polarity the relay will be energised when the reading exceeds the threshold.

With the checkbox CHECKED, the associated relay polarity will be reversed.

Delay On

The activation of the relay can be delayed before triggering. The following options are available:-

Active (default) – The triggering of the alarm condition is delayed by the time set in the 'Delay' box. At the end of the alarm condition, the relay returns immediately to its previous state.

Neither – The triggering of the alarm condition is not delayed at the start or end of the alarm condition.

Clear – The triggering of the alarm condition is not delayed at the start of the alarm condition, but is delayed at the end i.e. when the alarm condition is clear.

Both – The triggering of the alarm condition is delayed at the start and end of the alarm condition.

Delay

This value is the continuous length of time (in seconds) that the relay is delayed by. The exact function is determined by the 'Delay On' condition.

Delaying the activation of the relay can be used to prevent borderline level changes from “dithering” the relay state. Only genuine, sustained readings in excess of the threshold will actually trigger the alarm.

Trip When (<)

Ticking the ‘trip when less than’ checkbox will cause the alarm condition to be activated when the measurement reading is less than the ‘Trip Level’.

For example this could be used to activate an alarm when the temperature drops below a certain value.

Trip Level

This parameter defines the measurement reading at which the alarm relay will trip.

Virtual Relays

The DSL-460 MkII has two (2) virtual relays. These virtual relays can be setup and used when connecting to a DSCU, which is capable of having up to 8 relays.

Alternatively the relays could be integrated into a ModBUS setup, allowing an alarm for each measurement unit.

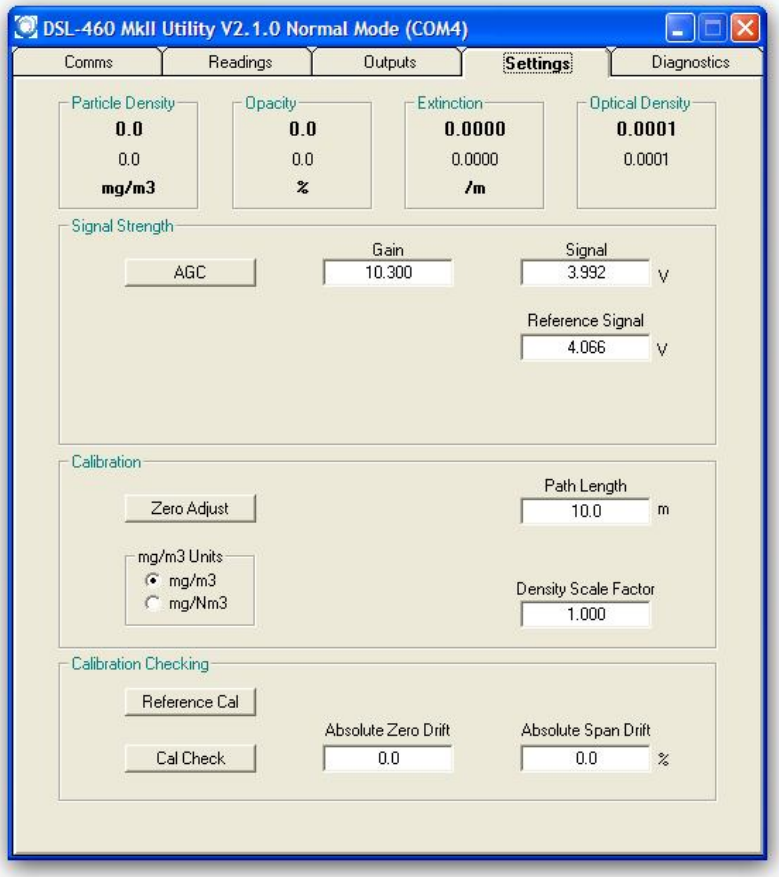
Click on an area of the virtual output to activate it. It can then be modified in the same way as the real relays.

The Settings tab

Caution; care must be taken

Warning: The Settings tab should only be used by a trained instrument engineer who has read and understood the later section on "Setup, Commissioning and Calibration", as the settings and controls on this tab determine the calibration of the instrument and the measurement reading that it generates.

The Settings tab has a range of settings and controls for initial setup and calibration of the instrument.



AGC button

Clicking this button will perform an Automatic Gain Correction (AGC), which will adjust the instruments Gain value to achieve optimum signal strengths.

See the later section on Setup, Calibration and Commissioning for further details on using this feature.

Gain

This box displays the Gain value as determined by the AGC routine (above).

This value can be manually overridden, but such action should only be undertaken in certain unusual circumstances, and should only be performed by a DynOptic trained engineer, who fully understands the consequences of such action.

See the later section on Set-up, Calibration and Commissioning for further details on using this feature.

Signal

This box displays the signal strength from the measurement detector in volts, and is used as a diagnostic tool to confirm Gain settings, or diagnose application problems.

Reference signal

This box displays the signal strength from the reference detector in volts. The reference detector is used to determine changes in the main LED source light output, so that such changes can be compensated for. This value is presented as a diagnostic tool.

Calibration

Zero Adjust button

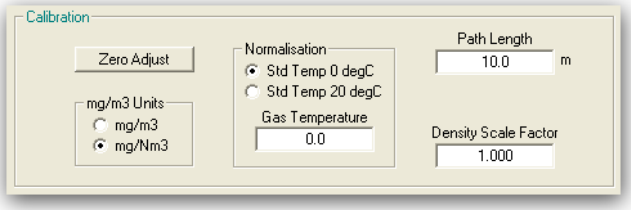
The Zero Adjust button will cause the instrument to adjust its internal zero/span values to achieve a measurement reading equal to 0 (a clear path reading).

Pease note: using the Zero Adjust feature is a central part of the commissioning process, and should only be undertaken after reading the later section on Set-up, Calibration and Commissioning.

mg/m^3 or mg/Nm^3 Selector

Select the particle density reading to be displayed as milligrams per meter cubed (mg/m^3) or milligrams per normalised meter cubed (mg/Nm^3).

If mg/Nm^3 is selected some new options appear in the window, as shown below. These allow the user to select the reference or standard gas temperature to be used for the normalisation (either 0ºC or 20ºC) and input a typical value for the actual gas temperature.



Path Length

The Path Length box is used to define the distance between the TRX and the Reflector heads (the Path length) in metres. The Path length should always be measured “flange-to-flange” i.e. from the face of the flange on the Air-Purge body of the TRX, to the face of the flange on the Air-Purge body of the Reflector. It is recommended to enter this value to accuracy of ±0.1m (10cm).

See the later section on Setup, Calibration and Commissioning for further details on defining this value.

Density Scale Factor

The Density Scale Factor allows you to enter a multiplying factor which will be applied to the measurement of particle density. This value can be used to calibrate the reading to an independent reference measurement so that the DSL-460 MkII can be used to indicate Dust in mg/m³.

See the later section on Setup, Calibration and Commissioning for further details on defining this value.

Calibration Checking

Reference Cal button

Note:-*This routine is only possible with the optional Calibration Head and filters (available separately) and with manual user intervention at the TRX head. Please see the later section on Calibration Checking for further details.*

Clicking this button will start a Reference Calibration routine which will define the reference against which all future Calibration Checks will be compared.

Cal Check button

Note:-*This routine is only possible with the optional Calibration Head and filters (available separately) and with manual user intervention at the TRX head. Please see the later section on Calibration Checking for further details.*

Clicking this button will start a Calibration Check routine which will determine both relative and absolute drift in the measurement performance compared to the original reference calibration.

Absolute Zero Drift

This box reports the absolute zero drift as calculated by use of the Reference Cal and Cal Check routines.

Absolute Zero Drift is defined as the difference between the zero level Opacity reading measured during the last Reference Calibration routine, and the uncorrected zero level Opacity reading measured during the last Calibration Check routine. The instrument parameters may have been automatically adjusted to correct for any zero drift, but this parameter displays the zero drift as if there had been no correction applied. This parameter enables slow continuous drifts in the instrument zero to be monitored.

Note: *although the DSL-460 MkII displays its readings in many different units, the reference calibration and calibration check routines are always performed in units of opacity (0-100%).*

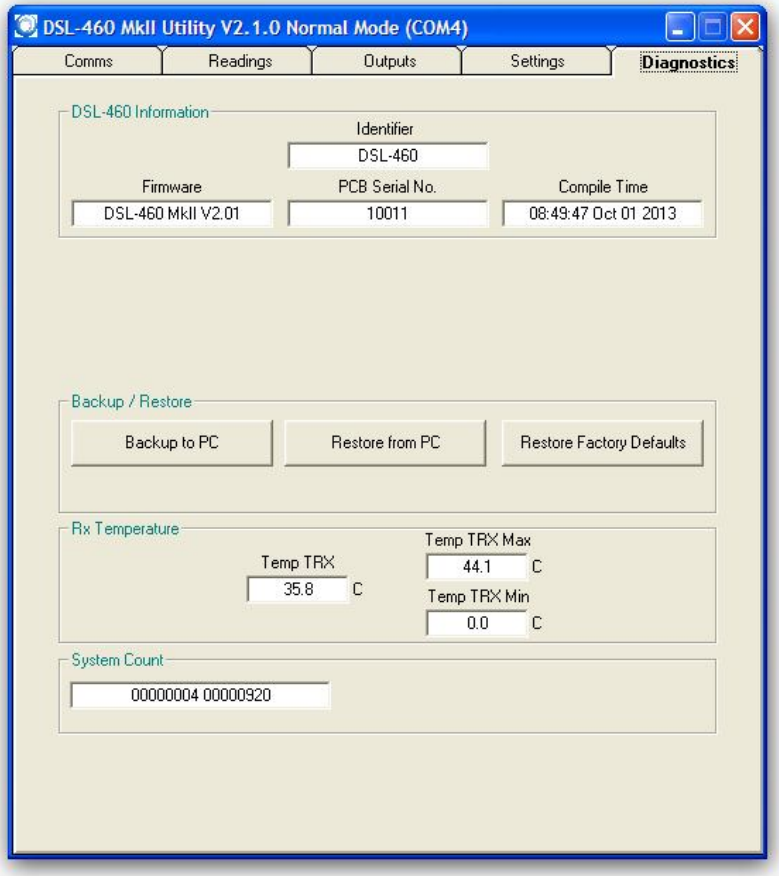
Absolute Span Drift

This box reports the absolute span drift as calculated by use of the Reference Cal and Cal Check routines.

Absolute Span Drift is defined as the difference between the span Opacity reading measured during the last Reference Calibration routine, and the uncorrected span Opacity reading measured during the last Calibration Check routine, using the same span filter. The instrument parameters may have been automatically adjusted to correct for any span drift, but this parameter displays the span drift as if there had been no correction applied. This parameter enables slow continuous drifts in the instrument span to be monitored.

The Diagnostics tab

The Diagnostics tab has a number of information only boxes and some features for backup and restore. See the following screen shot. If the Utility software is communicating through a DSCU then the instrument information is displayed as shown in the following screenshot. However, if the communication is direct to the DSL-460 MkII TRX head then the 'Display Information' field will not be shown.



Instrument Information

Identifier

The identifier, by default, is the instrument name. This can be changed by clicking in the box and editing the text. This is useful when a number of instruments are being used and a descriptive name or code can be used e.g. 'DSL-460 MkII Stack 1'.

Firmware / PCB Serial Number / Compile Time

This section shows the serial number information for the DSL-460 MkII and for the DSCU (if connected).

Backup / Restore

Backup to PC

Clicking this button will cause the current instrument settings to be saved in a backup file in the location: C:\DSL 460 BACKUPS on the PC. The filename of the backup file will incorporate the date, time and electronic serial number of the instrument at the time of the backup. The location where the backup files are stored can be changed if necessary, please contact DynOptic Systems for instructions.

It is highly recommended that you use this button to take a backup of your instrument settings after successfully completing your installation, calibration and commissioning. It is also recommended that a backup file is taken just prior to running the Calibration Check routine. The backup file can be used to restore the instruments settings, should the live settings ever be lost or become corrupted.

Restore from PC

Clicking this button will allow you to choose a log file from which to restore your instrument settings.

Alarm points and scaling factors will all be overwritten, so it is essential that you have confidence in the log file from which you restore.

Caution; care must be taken

Warning: It is highly recommended that you take a backup prior to restoring, so that in the event that you restore from a bad file or unusable settings, you can always restore back to a known good point.

Caution; care must be taken

Warning: Restoring from a log file will overwrite ALL settings, parameters and variables, including those that define the zero point and calibration. Restoring from a log file could change the calibration of your instrument.

Restore Factory Defaults

Clicking this button will restore all settings and parameters to default values as determined at our factory.

Caution; care must be taken

Warning: This action will overwrite all existing settings and parameters with default values, so your set-up and calibration will be lost, as will any alarm points, scaling factors, and drift values.

TRX Temperature

This section shows the temperature as measured inside the TRX head along with the maximum and minimum recorded values.

If the temperature measured inside the head goes outside of the recommended maximum or minimum temperature (-15 to +70 degrees C) a warning will be triggered.

System Count

System count shows the power up count i.e. the seconds since last power up.

Using the DSCU

Familiarisation

The DSCU (DynOptic Systems Control Unit) is an OI (Operator Interface) that consists of a numeric/directional keypad, a two line LCD display, and a terminal compartment.

The terminal compartment is used for electrical connections, the details of which are covered in the separate “DSCU Installation & Operator Manual”.

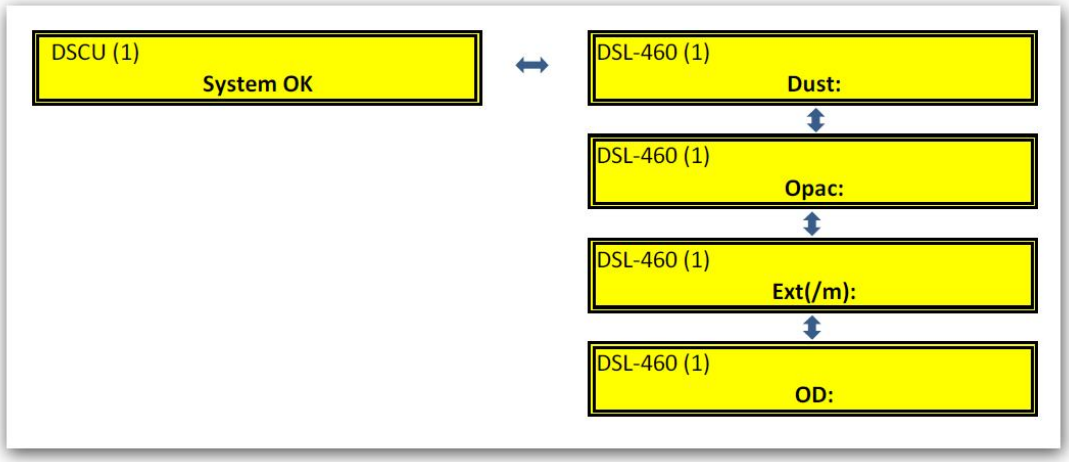
The keypad and display combine to form a human interface which can be used to setup and control the DSL-460 MkII with all the same functionality as the PC based Utility software discussed earlier in this manual. The parameters and values that are available in the DSCU are the same as those available in the Utility Software, so altering a parameter in the DSCU will change the equivalent parameter in the Utility Software and vice versa.

The general operation of the DSCU is described in the ‘DSCU Installation & Operator Manual’.

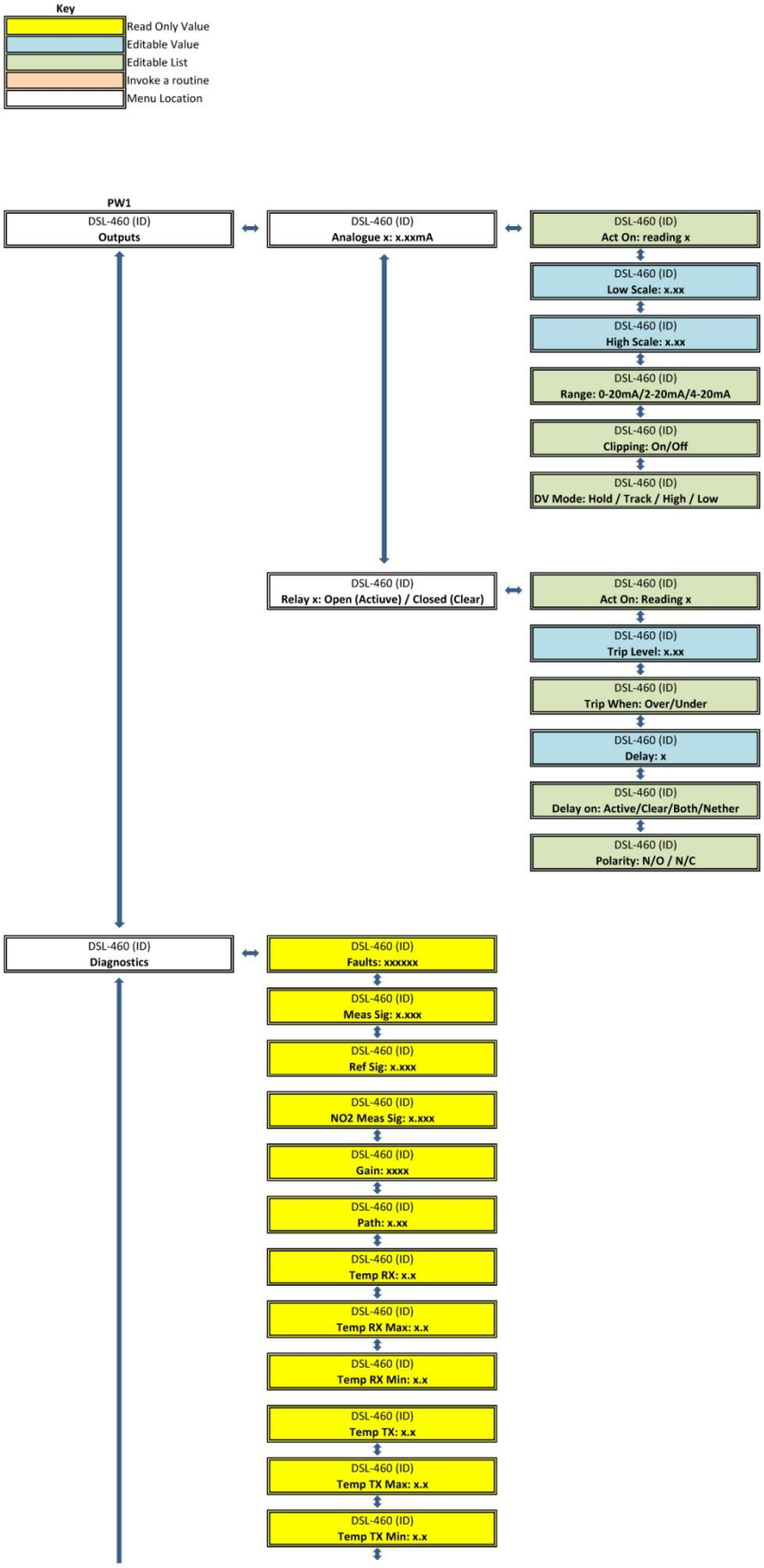
The Menu Structure

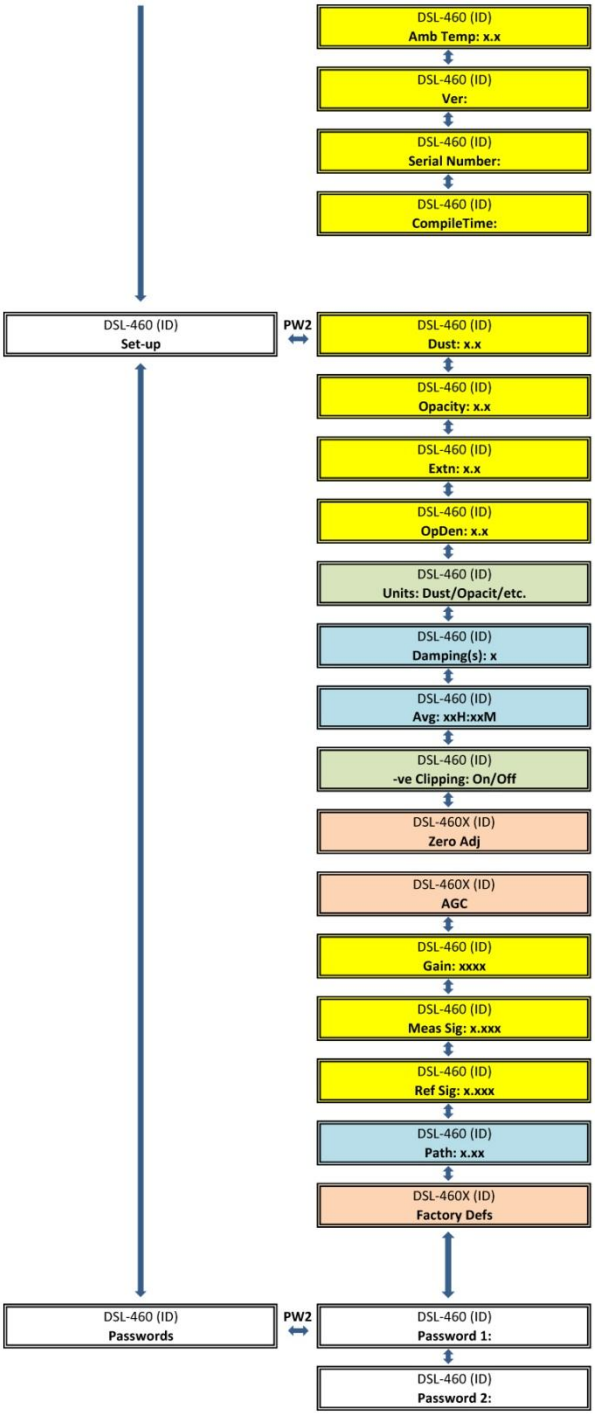
The DSCU menu structure comprises the Readings Screens and the Menus.

The DSL-460 MkII Reading Screens shows the following data:-



Use the up and down buttons to view the Visibility, Ambient Temperature and Relative Humidity readings. Left and right scrolls between the DSCU and any connected instruments. The DSL-460 MkII Menus are shown below:-


Key
Read Only Value
Editable Value
Editable List
Invoke a routine
Menu Location
PW1
DSL-460 (ID)
Outputs
DSL-460 (ID)
Analogue x: x.xxmA
DSL-460 (ID)
Act On: reading x
DSL-460 (ID)
Low Scale: x.xx
DSL-460 (ID)
High Scale: x.xx
DSL-460 (ID)
Range: 0-20mA/2-20mA/4-20mA
DSL-460 (ID)
Clipping: On/Off
DSL-460 (ID)
DV Mode: Hold / Track / High / Low
DSL-460 (ID)
Relay x: Open (Actiuve) / Closed (Clear)
DSL-460 (ID)
Act On: Reading x
DSL-460 (ID)
Trip Level: x.xx
DSL-460 (ID)
Trip When: Over/Under
DSL-460 (ID)
Delay: x
DSL-460 (ID)
Delay on: Active/Clear/Both/Nether
DSL-460 (ID)
Polarity: N/O / N/C
DSL-460 (ID)
Diagnostics
DSL-460 (ID)
Faults: xxxxxx
DSL-460 (ID)
Meas Sig: x.xxx
DSL-460 (ID)
Ref Sig: x.xxx
DSL-460 (ID)
NO2 Meas Sig: x.xxx
DSL-460 (ID)
Gain: xxxx
DSL-460 (ID)
Path: x.xx
DSL-460 (ID)
Temp RX: x.x
DSL-460 (ID)
Temp RX Max: x.x
DSL-460 (ID)
Temp RX Min: x.x
DSL-460 (ID)
Temp TX: x.x
DSL-460 (ID)
Temp TX Max: x.x
DSL-460 (ID)
Temp TX Min: x.x



Where the diagram shows ‘Analogue x’ and ‘Relay x’ pressing the up and down buttons will navigate between the available analogue outputs and relays.

The **Home** button returns you to the Readings screen from anywhere in the menu structure. If pressed twice it exits the password entry.

The **Exit** button cancels data entry.

The **Menu** button takes you to the Menus – you will need to enter a password to continue. The default passwords are:-

Password 1 (PW1) = **0000** (access to diagnostics information only)

Password 2 (PW2) = **1111** (access to all menus)

All the items in the DSCU menus represent the same functions that are described above for the Utility program, and below in the Setup, Commissioning and Calibration section.

Set-up, Calibration and Commissioning

Caution; care must be taken

Warning: It is essential that all components of the instrument have been properly installed, both physically and electrically, before proceeding with set-up, calibration and commissioning. See the separate DSL-460 MkII Installation Manual for full details of installation requirements.

Caution; care must be taken

Warning: This manual assumes a basic knowledge of industrial instrumentation and its associated terminology. It is therefore highly recommended that only engineers with instrumentation experiences perform any of the set-up, calibration, and commissioning routines.

Caution; care must be taken

Warning: when fitting or removing the heads, even for routine maintenance, there is a risk that stack gas may escape from the mounting flange, or air-purge body. Stack gas, can be hot, corrosive or otherwise damaging to health. All necessary precautions must be taken to prevent injury being caused by escaping stack gas.

Overview

The DSL-460 MkII Opacity Monitor is an in-situ analyser that relies on the local plant structure to determine both the length and angular alignment of its light path (the path along which the light beam travels and along which measurements are made).

The natural variation that can be found between installations, in both path length and alignment of the light path, requires the DSL-460 MkII to be capable of working with a wide range of signal strengths.

This necessity to work with a wide range of signal strengths means that it is impossible for the DSL-460 MkII to be supplied pre-calibrated or in any way readied for a specific installation.

It is therefore necessary to perform a number of basic set-up, commissioning and calibration routines (after the instrument has been properly installed) to make allowance for the actual signal strengths achieved in any specific

installation. These routines must be performed properly before the instrument can be considered operational or accurate.

Please note: subtle differences between apparently identical installations can produce very different signal strengths, so it is essential that the set-up, calibration and commissioning process is performed independently for each installed instrument.

Set-up, calibration and commissioning involves performing the following procedures, which must be completed in order. The list below is only an overview of the steps required and their order. See later on in this section for a detailed description of how to perform each step:

1. **Perform a Head Alignment** – This optimises the mounting angle of the TRX and Reflector heads to achieve the largest possible measured signal.

2. **Perform an Automatic Gain Correction** – This adjusts the gain applied to the measurement signal to achieve an amplified signal that is within the required voltage range.

3. **Perform a Zero Adjust –** Perform a zero adjust under clear path conditions; this adjusts the instrument's span setting to define 0.0 (or 1.0) the bottom of the scale.

4. **Define the Path length (if applicable)** – For readings in units of Particle Density and Extinction the instrument requires knowledge of the distance (flange-to-flange) between the TRX and the Reflector heads.

5. **Upscale calibration of Particle Density (if applicable)** – The DSL-460 MkII can be used to indicate the Particle Density in the gas stream (in mg/m^3 or mg/Nm^3), but to do so the instrument must be calibrated to an independent reference measurement (such as isokinetic sampling). This calibration is done by way of a scaling factor. The scaling factor is adjusted to make the instrument readings match the independent reference measurements.

6. **Configure the outputs** – Once the instrument is calibrated in the preferred units, the analogue output and Level Alarm outputs can be configured as required for integration with the wider plant systems.

It is absolutely essential that steps 1 to 5 are performed (in order) before considering the instrument operational.

Note: *if at any stage during the operational life of the instrument there is a significant change to the DSL-460 MkII or its installation, it is essential that you repeat the steps above i.e. you must repeat the setup, calibration and commissioning procedures. Note: the upscale calibration of Particle Density does not need to be repeated.*

Significant changes include: moving the position or alignment of the heads, changing the path length between TRX and Reflector, changing out any functional part of the instrument (especially the circuit boards), changing the Gain value, or performing a Zero Adjust.

Head Alignment

The DSL-460 MkII TRX produces a narrow optical beam that is approximately 3 degrees wide. To achieve a measurable signal this beam must overlap with the aperture of the Reflector head. This requires the angular alignment between the mounting flanges attached to the duct to be less than ±2 degrees, as defined in the installation manual.

For optimum performance of the DSL-460 MkII the final alignment between the heads is achieved by adjusting the mounting angle of the TRX head whilst viewing the image in the visual alignment aid.

To enable this adjustment, the DSL-460 MkII Air-Purge Bodies must be fixed to the mounting flanges with the rubber flange gaskets (supplied) in between, as shown in Figure 1. The angle of the head can then be adjusted by tightening the fixing nuts and compressing the flange gasket in an uneven manner.

Please note that the nuts used to compress the flange gasket should not be over tightened or too loose. The recommended torque range is 10 to 50Nm. The flange gasket provides only a small level of adjustment and cannot correct for angular errors between the flanges of more than the specified ±2 degrees.

The process of adjustment is to set all four nuts to the minimum torque (10Nm) then individually tighten each one to compress the gasket and hence change the angle of the mounting. When the final alignment has been reached always check that all four nuts are sufficiently tight (at least 10Nm), since strongly adjusting one nut can result in others becoming loose.

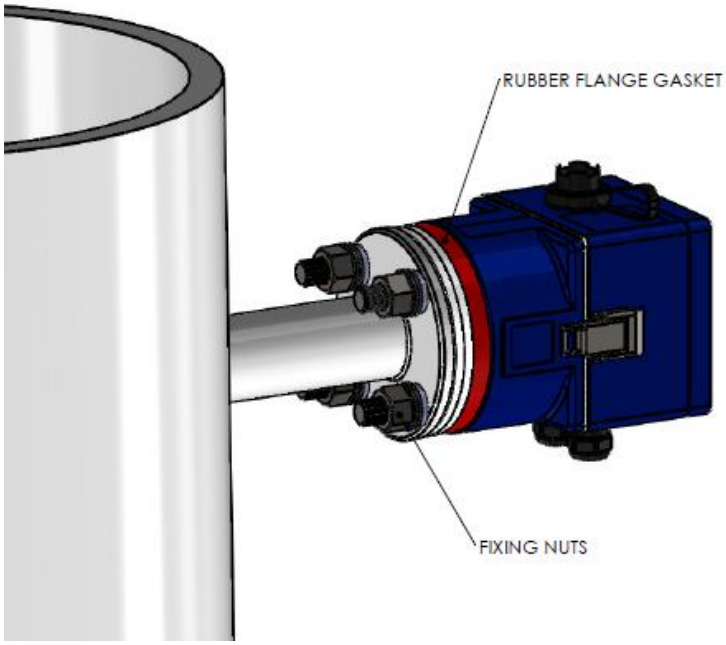


Figure 1: Air-Purge Body mounted to flange with the rubber flange gasket

The following steps outline the recommended procedure for completing the alignment of the heads. This process assumes the use of a Laser Alignment Tool that is available as an optional extra from DynOptic Systems.

1. Attach the Laser Alignment Tool to the Reflector air-purge body and turn it on. Remove the back of the tool and view through the window of the instrument to see the red laser spot on the far side of the stack. The angle of the Reflector purge head can now be adjusted, using the mounting nuts, to approximately align the laser spot to the centre of the TRX flange aperture on the far side of the stack.

   Remove the laser alignment tool and re-attach the Reflector head to its air-purge body.

2. Power the TRX head and view the image through the Visual Alignment Port. This will show the image of the far side of the stack plus a reticle target consisting of two concentric rings. Provided the TRX is illuminating the reflector head a bright image of the illuminated reflector will be seen. There may also be other fainter images visible in the alignment port, but these can be ignored.

   The angle of the TRX head can now be adjusted, using the mounting nuts, to bring the image of the illuminated reflector into the centre of the inner target ring. Ensure that all four mounting nuts are tight (at least 10Nm).

It is recommended that the instrument is left powered for at least a further 20minutes to stabilise and warm-up before proceeding with the next stage.

Automatic Gain Correction (AGC)

An AGC alters the instruments gain value to achieve the optimum signal strength of 4V. It is essential that the ~4.0V is achieved under clear path conditions. Clear path conditions are defined as follows:

1. The instrument must be properly and permanently installed as per the separate Installation Manual and the heads must be fully aligned.

2. The instrument must have been powered up and left to settle for a minimum of 20 min since the head alignment (or a total of 1hr since last turned on).

3. The optical surfaces of the instrument must be perfectly clean and free from dirt, dust, moisture, or oil.

4. The optical path between the TRX and the Reflector must be clear and free from any obstruction.

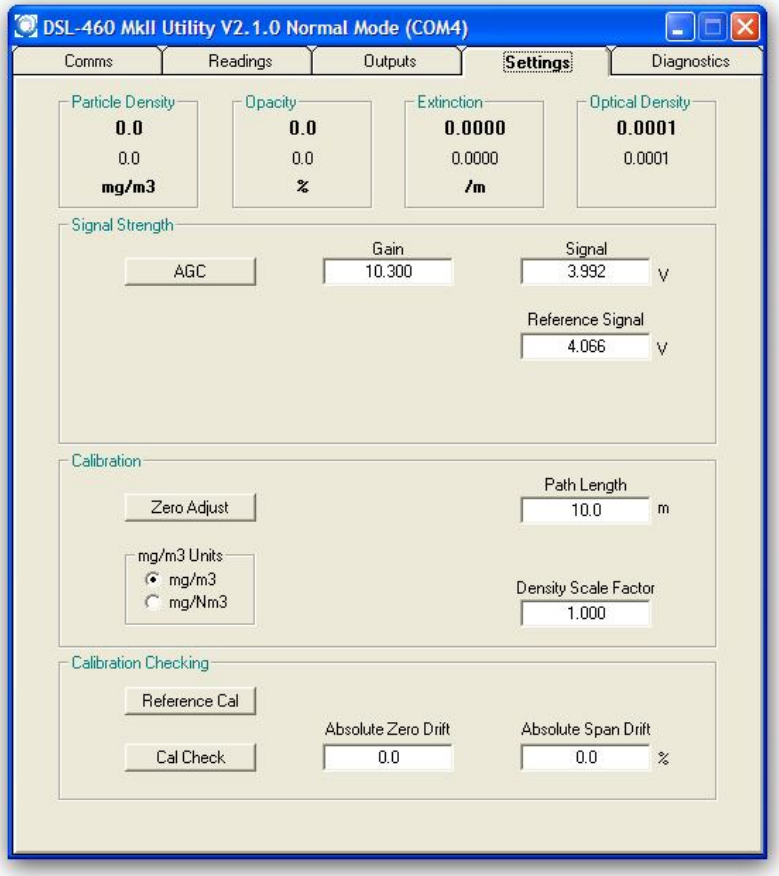
5. The duct or stack must be free from any dust, smoke, soot, steam, or particulate (i.e. the process behind the stack should have been shut down).

Once clear path conditions have been achieved the gain correction should be performed, either by clicking the AGC button on the Settings tab in the Utility Software, or by selecting AGC using the DSCU.

This will cause the instrument to automatically calculate and store a new gain value to achieve the optimum signal strength ~4.0V.

Note that the DSL-460 MkII should not be operated with a gain of more than 2000. The instrument is capable of setting higher gains, but these are for use in alignment and setup only. If the AGC produces a gain higher than 2000 then either the path length being used is too long for the particular instrument or the head optics are dirty or they have not been aligned correctly. If any of these conditions are not correct then there may be an instrument fault which must be reported to a DynOptic trained engineer or your local distributor.

The achieved signal strength can be seen in the Measure Signal box, alongside the Gain box, in the Utility software. See the following screen shot.



The level of gain can also be set manually (by overwriting the value in the gain box) but this is NOT recommended.

Sometimes manual Gain corrections are used where the plant cannot be shut down and proper clear path conditions cannot be established. In this instance it is essential that you have an independent knowledge of the actual opacity in the duct, so that a Gain value can be calculated to give a Measure Signal of ~4.0V when the plant is eventually stopped and a clear path is established.

Warning! Setting a Measure Signal of ~4.0V (using either automatic or manual Gain correction) without clear path conditions can cause the Measure Signal to become saturated when the plant stops and a clear path is established. This is because as the light path clears, the Measure Signal will increase. The maximum possible Measure Signal is 5.0V, but any voltage above 4.7V is considered unsuitable for normal operation.

Manual Gain corrections are usually very imprecise (little better than a guess) and should only ever be considered as a temporary solution in non-critical situations. They should be replaced by a proper AGC at the earliest possible opportunity. Please remember that manual Gain corrections are NOT recommended, and should only be performed by engineers with a full understanding of the consequences.

Warning! Changing the Gain value (either automatically or manually) will invalidate any existing calibration. After a Gain correction of any kind, you must always go on to perform a Zero Adjust and then perform a new Reference Calibration (if required).

Performing a Zero Adjust

The Zero Adjust button will cause the instrument to adjust its internal zero/span values to achieve a measurement reading equal to 0 (clear path reading).

It is not necessary to set the span values for Transmission, Opacity, Extinction or Optical Density as they are defined as absolutes. The upscale calibration for Particle Density is set using the Density Scale Factor; see the next section for more information.

It is essential that an AGC has been performed (under clear path conditions) to achieve a Measure Signal ~4.0V, and that clear path conditions (as defined in the previous section on AGC) still exist when the Zero Adjust is performed.

Defining the Path length

Measurements in units of Particle Density or Extinction require knowledge of the Path length for use in the calculation.

Path length is defined as the distance in metres between the face of the flange on the Air-Purge body of the TRX, and the same point on the Air-Purge body of the Reflector. It is recommended to enter this value with accuracy of ±0.1m (10cm).

If the instrument is to be used to indicate Particle Density (mg/m^3) or Extinction, measure the Path length and enter it in the Path box on the Settings tab in the Utility software.

Density Scale Factor Calibration

The following outlines the basic calibration process for setting the correct Density Scale Factor when measuring in units of Particle Density (mg/m^3).

The DSL-460 MkII measures the optical transmission across the stack or duct and this can be used to indicate the density of particulates carried in the gas stream. This Particle Density is measured in units of mg/m^3, or when normalised to a standard gas temperature and pressure, in units of mg/Nm^3.

The relationship between measured optical transmission and Particle Density is defined by the Density Scale Factor parameter. The Density Scale Factor for any given installation will vary based on the type, shape, size and colour of the particles in the gas stream.

The Density Scale Factor cannot be pre-determined with factory settings, and must instead be determined on site, through comparison of the instrument readings with an independent reference measurement. Making this comparison and adjusting the Density Scale Factor accordingly will complete the calibration for Particle Density measurements.

The nationally recommended standard reference measurement method should be used. This is likely to be a gravimetric analysis based on isokinetic sampling of the gas stream.

The reference measurement must be taken at the same time as the readings from the DSL-460 MkII, so that the two measurements are coincident.

When taking the coincident measurements the plant must be operational, so that there is a meaningful concentration of particulates in the gas stream during the sampling period, ideally close to the maximum expected value.

It is preferable to make coincident measurements when the particle concentration in the stack is at its highest possible since this improves the accuracy of the calibration. Calibrations performed with reference measurements close to 0.0mg/m³ are not valid. Note that the DSL-460 MkII is only suitable for measuring particulates in a dry stack, if there is significant quantity of condensed water in the gas flow the relationship between the optical transmission and reference measurement is no longer valid.

It is essential that the instrument has been properly setup prior to making this calibration. This involves performing an AGC (under clear path conditions), and performing a Zero Adjust (under clear path conditions also). See the previous sections in this manual for details of both these actions.

In order to perform a Particle Density calibration the following conditions for the DSL-460 MkII must be met:

1. The instrument must have been properly and permanently installed, as described in the separate Installation Manual, and the heads aligned for optimum signal.

2. The instrument must have been properly and recently setup (as described earlier in this section of the manual).

3. The correct flange-to-flange Path length has been entered in the Path box on the Settings tab in the Utility software.

4. The instrument has been powered up and left to settle for a minimum of 1 hour.

5. The plant is running and the particulate concentration in the stack is at a high level.

The DSL-460 MkII will display a Particle Density measurement in units mg/m^3 (or mg/Nm^3 if selected) based on the Density Scale Factor displayed in the box on the Settings tab of the Utility software (the default value of DSF is 1.0).

The sampling probe for the reference measurement must be inserted into the duct close to, but not actually in, the optical path of the DSL-460 MkII, in this way it will be sampling a very similar gas stream.

During the time period over which the reference sample is taken (typically 30mins) the average Particle Density displayed by the DSL-460 MkII instrument should be recorded (PD_I).

The Particle Density measured by the standard reference method (PD_{REF}) is then compared to the average reading displayed by the DSL-460 MkII (PD_I). A new Density Scale Factor is calculated to correct for any differences, using the expression below. This new value should then be entered into the Density Scale Factor box in the Utility software.

$$DSF = DSF_0\left(\frac{PD_{REF}}{PD_I}\right)$$

Where:
DSF = the new Density Scale Factor
DSF_0 = the original Density Scale Factor
PD_{REF} = the Particle Density (mg/m^3) from the standard reference method
PD_I = the average Particle Density (mg/m^3) from the DSL-460 MkII instrument

Configuring the outputs

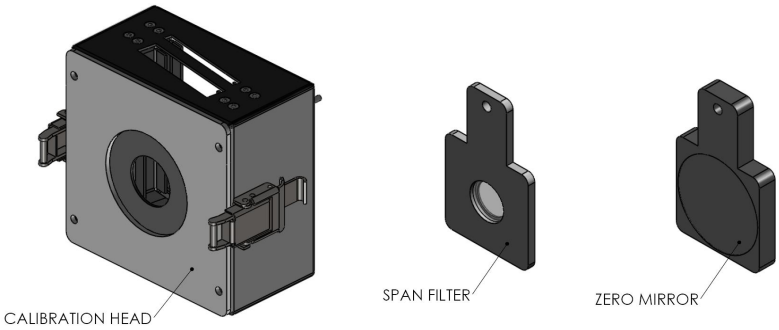
For information on setting up the analogue and relay outputs, refer to the ‘Outputs Tab’ section.

Calibration Checking

Warning: When fitting or removing the heads, even for routine maintenance, there is a risk that stack gas may escape from the mounting flange, or air-purge body. Stack gas, can be hot, corrosive or otherwise damaging to health. All necessary precautions must be taken to prevent injury being caused by escaping stack gas.

The continued accuracy of the zero and span calibration of the instrument can be verified, when required, by performing an initial reference calibration immediately after commissioning, and then regular calibration check routines at the desired intervals.

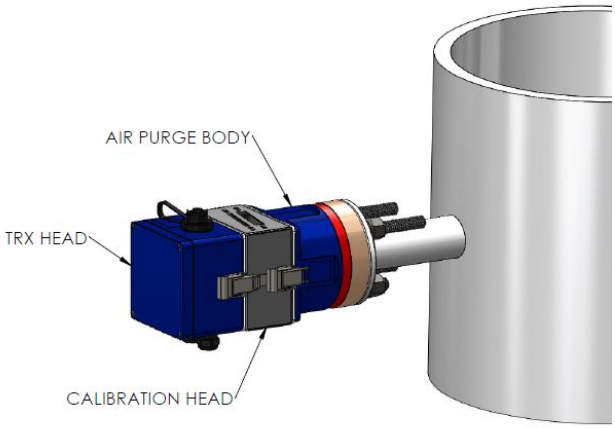
In order to perform a reference calibration or a calibration check routine it is necessary to use the optional Calibration Head (Cal Head) and calibration inserts shown below.



The Zero Mirror is used to simulate a clear path condition and the Span Filter is used to simulate an upscale opacity reading. A range of zero mirrors are available and the one used must be correct for the path length used in the actual installation.

The two inserts have a different thickness and are designed to fit into two separate slots in the Cal Head.

When performing a reference calibration, or a calibration check, the Cal Head must be inserted between the TRX head and the Air-Purge body, as illustrated below.



When fitting the Calibration Head, check that the lens on the TRX is clean. After the applicable routine has been completed the Cal Head must be removed for normal operation of the instrument.

The Zero Mirror and Span Filter are to be used to periodically check the calibration of the instrument. It is therefore essential that they are kept clean and undamaged. When not in use they should always be stored in the bags provided. The optical surfaces of the inserts should not be touched. Before use the optical surfaces should be inspected for scratches, dust and contamination.

Any dust should be removed with a blast of clean dry air from a clean air canister. Remove any stubborn particles or grit with a camera lens brush. Once all the particles and grit have been removed the optical surface can be wiped over with a spectacle cleaning solution and dried with a lint free cloth.

Reference Calibration

Before regular calibration checks can be made on the DSL-460 MkII a reference calibration must first be performed. This reference calibration provides the initial zero and span readings which will be used as the reference during future calibration check routines.

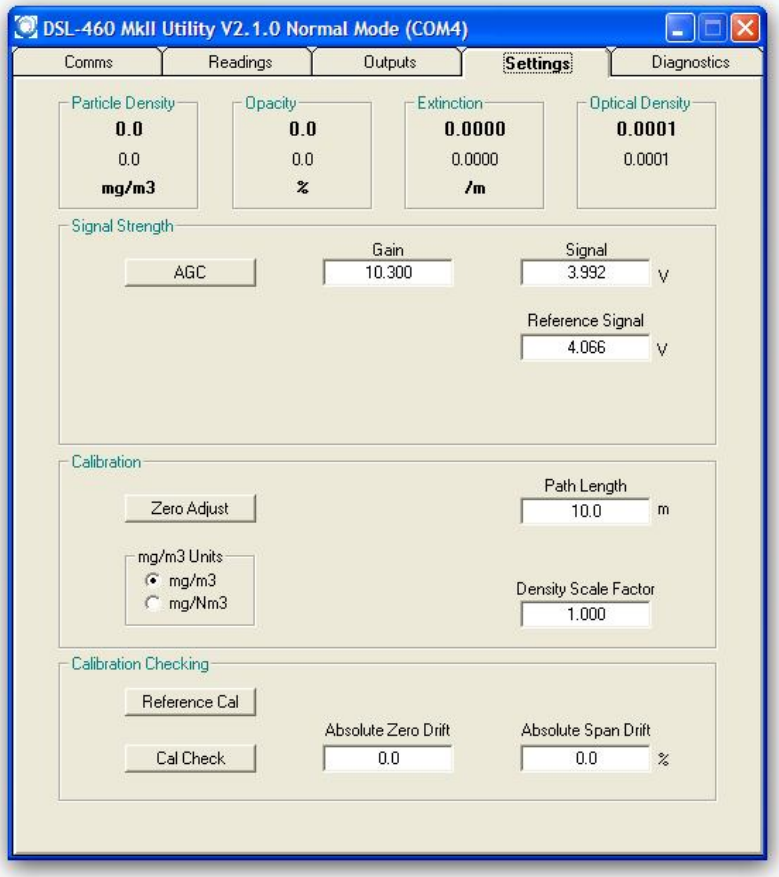
Both the reference calibration and the calibration checking procedures are pre-defined routines which must be initiated and followed via the Utility Software.

The reference calibration must be performed after the DSL-460 MkII has been correctly set-up, calibrated, and commissioned, as described earlier in this manual. A reference calibration will need to be repeated if major changes are made to the instrument that require the gain or zero adjust to be changed, or if a new Zero Mirror or Span Filter is used.

Before starting the reference calibration ensure that the instrument has been powered up for at least 1 hour.

Reference Calibration

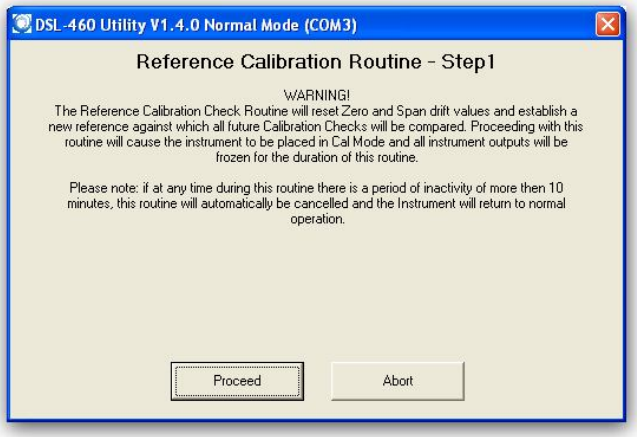
To start the reference calibration, go to the Settings tab of the DSL-460 MkII Utility software and select the Reference Cal button in the Calibration Checking box.



A new window will appear which guides you through the reference calibration procedure in a step-by-step format. Note that when in the calibration mode the normal mode window is locked and all outputs are frozen.

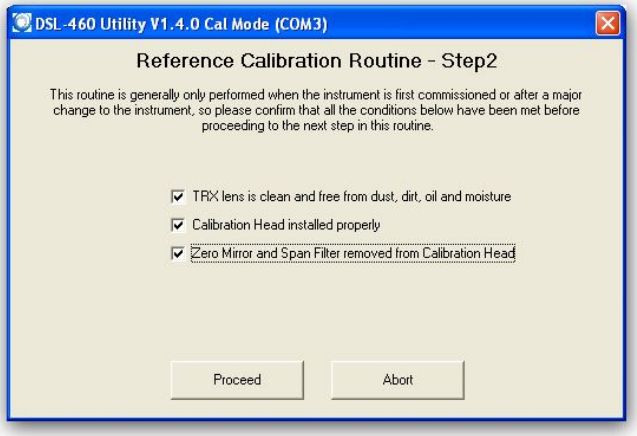
At any stage during the reference calibration process you can stop the procedure by selecting the Abort button. This will take you to the Exiting window which guides you to safely return the instrument to the normal window with no changes having been made to the settings stored in the instrument. The Exiting window is described in more detail later.

Step1:



The first window to appear, after selecting reference calibration, is a warning window. This explains what will happen if you proceed, and allows you to abort if you do not want to perform a reference calibration. Selecting the Abort button will take you to the Exiting window. To continue to Step 2 select the Proceed button.

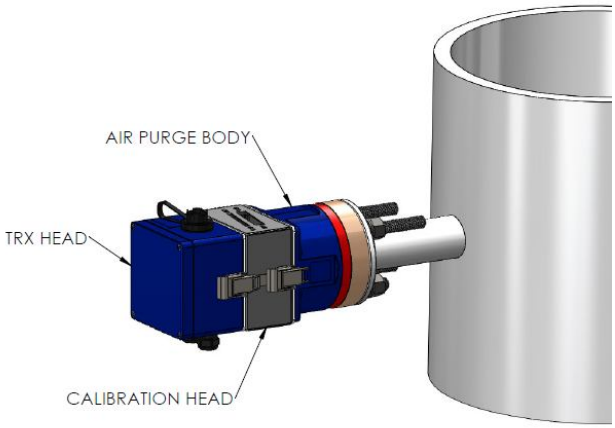
Step 2:



This window has three check boxes that must be completed before you can proceed.

1. Check the first box to confirm that the TRX lens is clean. This should be the case since the reference calibration should only take place under clean, set-up conditions.

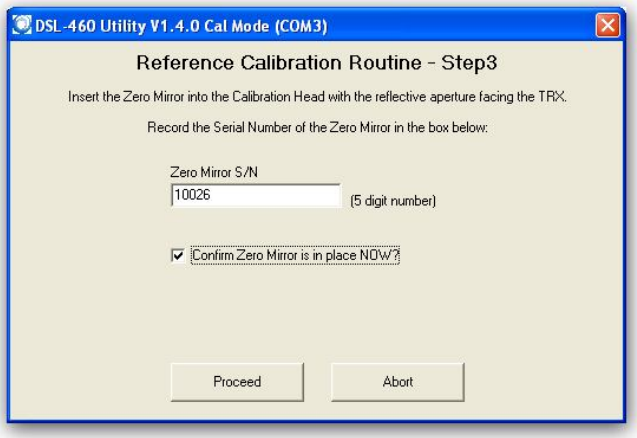
2. Check the second box to confirm that the Calibration Head has been installed correctly, as illustrated below.



3. Check the third box to confirm that there is no Zero Mirror or Span Filter inserted in the Calibration Head at this stage.

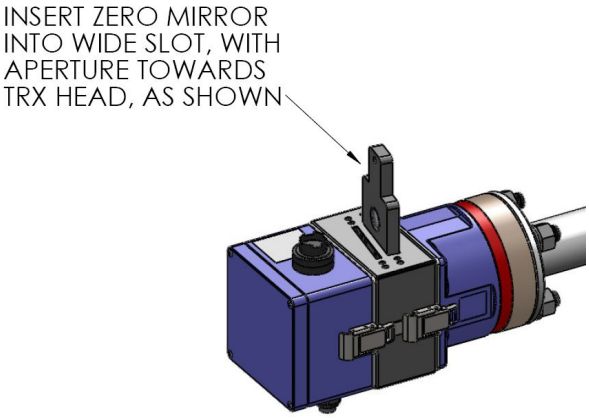
When all three check boxes have been checked the Proceed button becomes available, click on this to proceed to step 3.

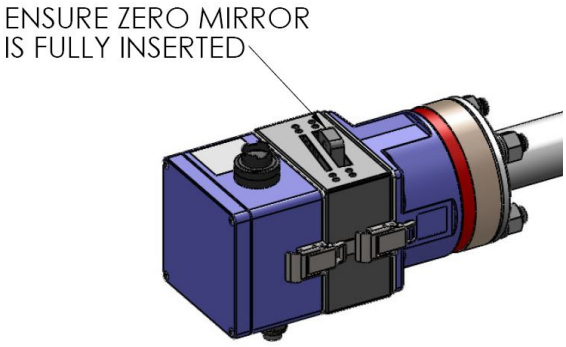
Step 3:



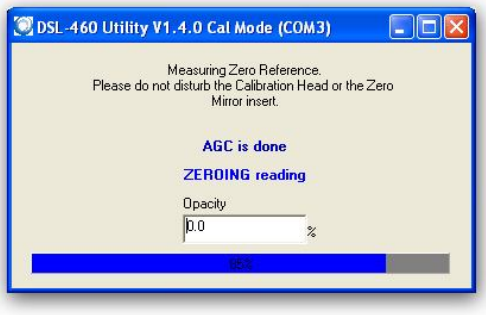
This step performs the reference Zero Mirror calibration. Each Zero Mirror has its own serial number and the same Zero Mirror must be used for all future calibration checking. The 5 digit serial number is marked on the Zero Mirror and should be typed into the Zero Mirror S/N box.

The Zero Mirror should now be placed in the large slot in the top of the Cal Head with the mirror side facing the TRX head see illustration below. It should be pushed down firmly into the Cal Head as far as it will go.



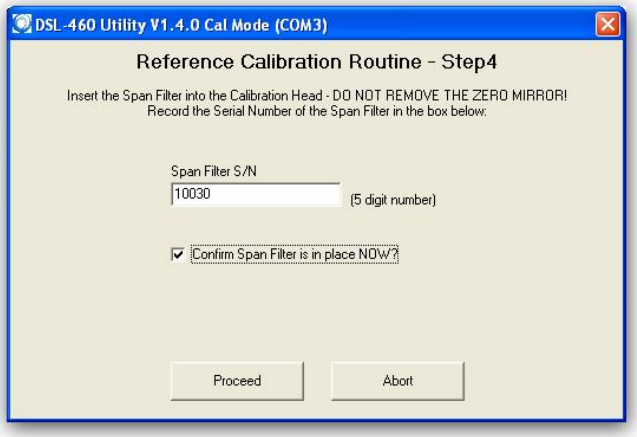


When this is complete select the check box. This makes the Proceed button available, click to proceed. When proceed has been selected the instrument goes through an automatic measurement routine which takes about 20 seconds. A window is displayed showing the progress and also the measured opacity. Do not close this window, if you want to abort wait for this measurement to finish and use the abort button in the step 4 window.



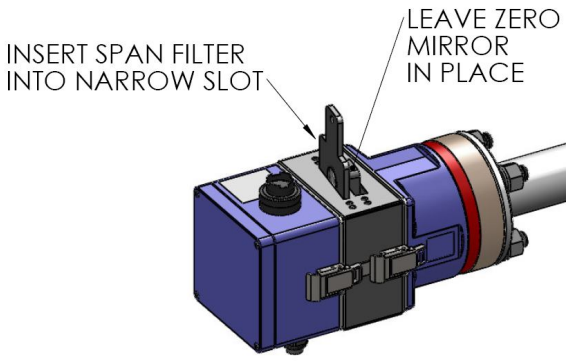
Do not disturb the head or the program until this measurement is complete. On completion the step 4 window automatically appears.

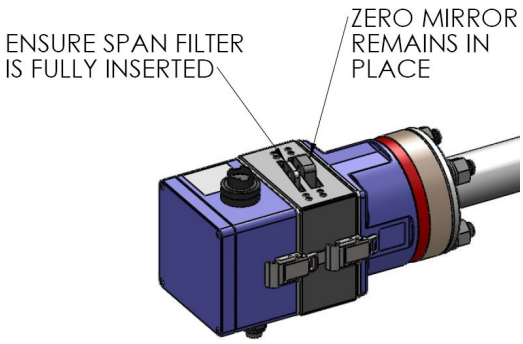
Step 4:



This step performs the reference Span Filter calibration. Each Span Filter has its own serial number and the same Span Filter must be used for all calibration checking. The 5 digit serial number is marked on the Span Filter and should be typed into the Span Filter S/N box.

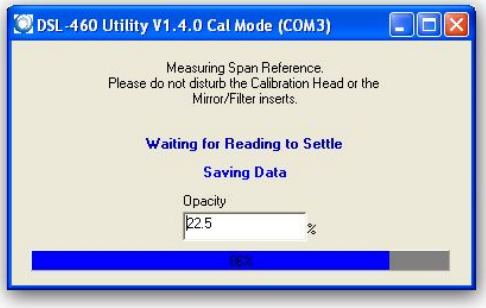
With the Zero Mirror still in place and undisturbed the Span Filter should be pushed into the smaller slot in the top of the Cal Head. It should be pushed down firmly into the Cal Head as far as it will go.





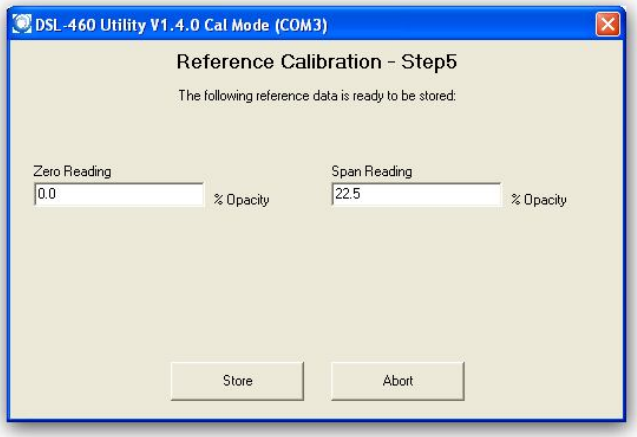
When this is complete select the check box. This makes the Proceed button available, click to proceed. When Proceed has been selected the instrument goes through an automatic measurement routine which takes about 20

seconds. A window is displayed showing the progress and also the measured opacity. Do not close this window, if you want to abort wait for this measurement to finish and use the abort button in the step 5 window.



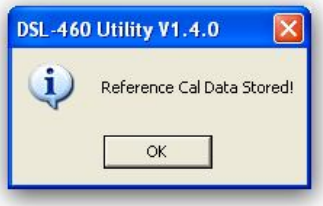
Do not disturb the head or the program until this measurement is complete. On completion the step 5 window automatically appears.

Step 5:

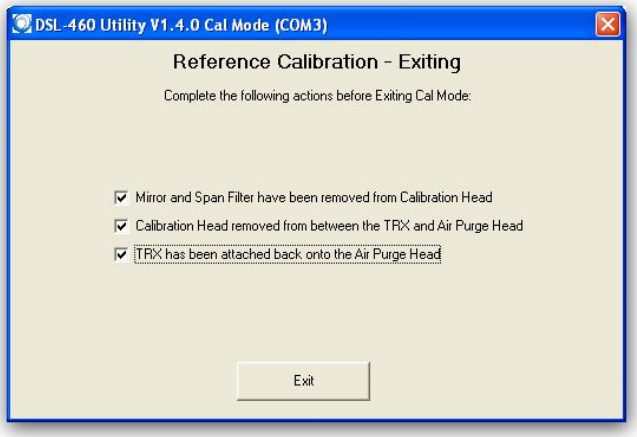


This window displays a summary of the measured reference calibration zero and span opacity values. Selecting the Store button will save these values in the instrument, along with the settings used to perform the reference calibration. All subsequent calibration checks will be performed using the stored settings and any drift will be measured relative to the stored values.

On selecting Store another window will appear when the data has been stored. Click OK to proceed to the final stage which is used to exit from the reference calibration routine.



Exiting:



This window has three check boxes that must be completed before you can proceed. These steps must have been completed before it is safe to return to the normal measurement mode. Note that this Exiting window is also accessed if you abort from the reference calibration at any time.

1. Check the first box to confirm that the Span Filter and Zero Mirror have been removed from the Cal Head. These calibration check inserts must be stored safely and kept clean for future use.

2. Check the second box to confirm that the TRX head has been removed from the Calibration Head and that the Calibration Head has been removed from the purge body.

3. Check the third box when the TRX has been re-attached to the purge body and locked in place with the side latches.

When all three boxes have been ticked the Exit button becomes available, click on this to exit the calibration mode and return to normal operating mode. The reference calibration is now complete and after a few seconds the instrument will be back operating as normal.

Calibration Check

Once an instrument has been subjected to a reference calibration, it is ready to have its calibration checked routinely. The ideal period between calibration checks will vary between installations, depending on many factors such as the process being monitored by the instrument and the air purge system used. For a continuously operating process, with a good air purge applied to the heads, a calibration check interval of 2 weeks is recommended. If over time the results are showing very slow drifts then the calibration check interval could be increased.

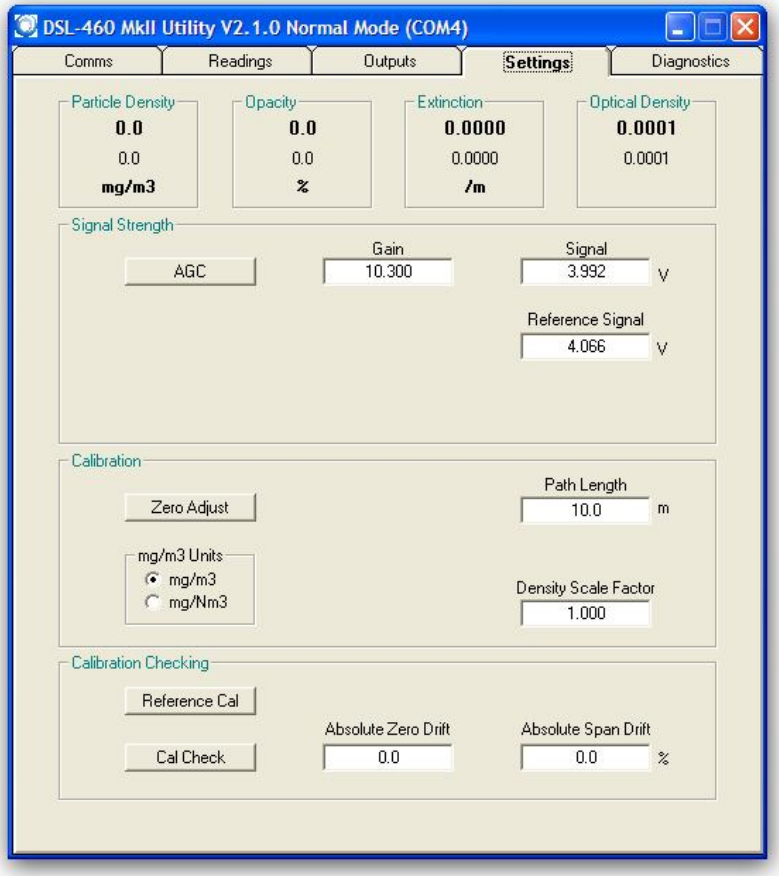
Before starting the calibration check ensure that the instrument has had a previous reference calibration, that the same calibration inserts are available and that the instrument has been powered for at least 1 hour.

It is recommended that before a calibration check routine is run the current settings of the instrument are stored on the PC. This is achieved by clicking the “Backup to PC” button on the Diagnostics Tab. This enables the original instrument setting to be restored if the current calibration settings are changed by mistake at the end of the calibration check routine.

Calibration Check using the Utility Software

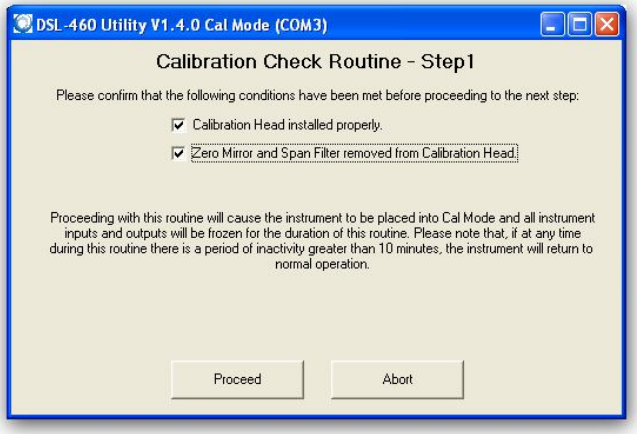
A PC or Laptop containing the DSL-460 MkII Utility software must be connected to the TRX head via its external USB port.

To start the calibration check, go to the Settings tab of the DSL-460 MkII Utility software and select the Cal Check button in the Calibration Checking box. A new window will appear which guides you through the calibration check procedure. Note that when in the calibration mode the normal mode window is locked and any output signals are frozen.



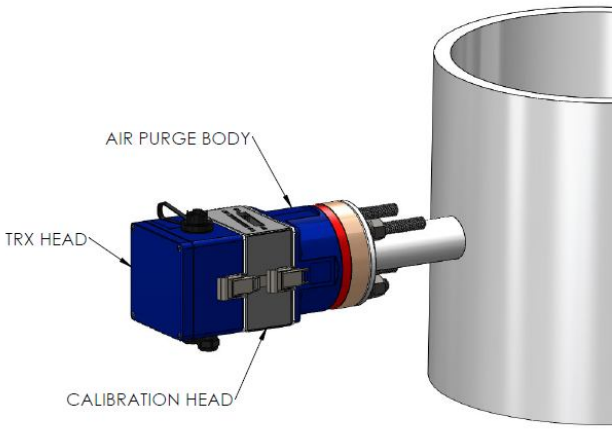
At any stage during the calibration check process the procedure can be stopped by selecting the Abort button. This will take you to the Exiting window which guides you to safely return the instrument to the normal window with no changes having been made to the settings stored in the instrument. The Exiting window is described in more detail later.

Step 1:



The first window to appear, after selecting calibration check, has two check boxes that must be checked before you can proceed. It also contains a warning summarising what will happen if you choose to proceed.

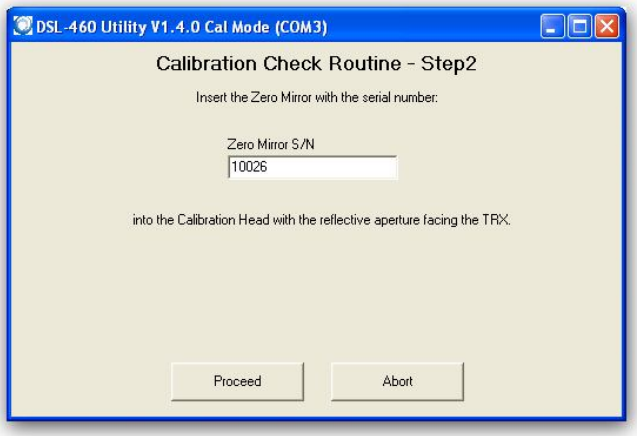
1. Check the first box to confirm that the Cal Head has been installed correctly, as shown below.



2. Check the second box to confirm that there is no Zero Mirror or Span Filter inserted in the Calibration Head at this stage.

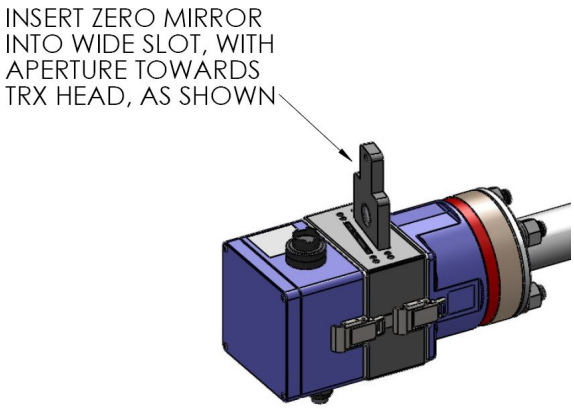
When both check boxes have been checked the Proceed button becomes available, click on this to proceed to step 2.

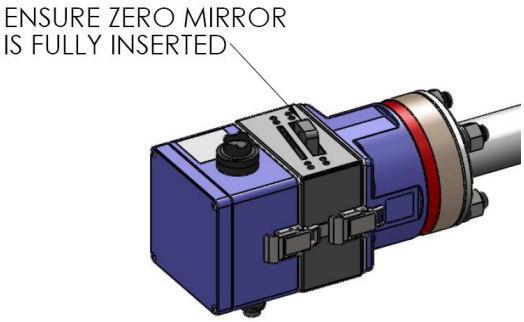
Step 2:



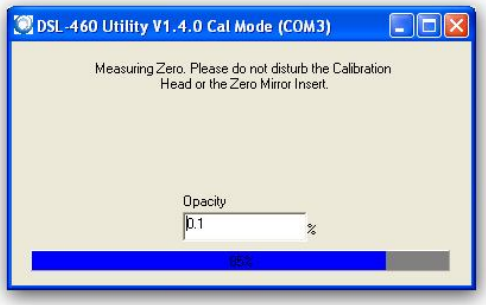
This step performs the Zero Mirror calibration check. The window displays the serial number of the Zero Mirror that was used to perform the reference calibration and the same mirror must be used for the calibration check. If a different Zero Mirror is used the calibration check becomes invalid.

The Zero Mirror should now be placed in the large slot in the top of the Cal Head with the mirror side facing the TRX head see illustration below. It should be pushed down firmly into the Cal Head slot as far as it will go.



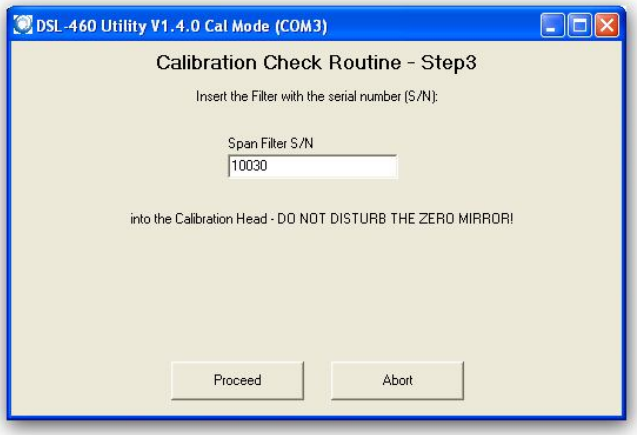


When this is complete select the check box. This makes the Proceed button available, click to proceed. When Proceed has been selected the instrument goes through an automatic measurement routine which takes about 20 seconds. A window is displayed showing the progress and also the measured opacity. Do not close this window, if you want to abort wait for this measurement to finish and use the abort button in the step 3 window.



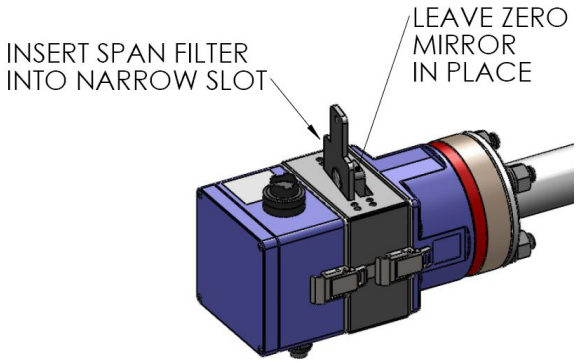
Do not disturb the head or the program until this measurement is complete. On completion the step 3 window automatically appears.

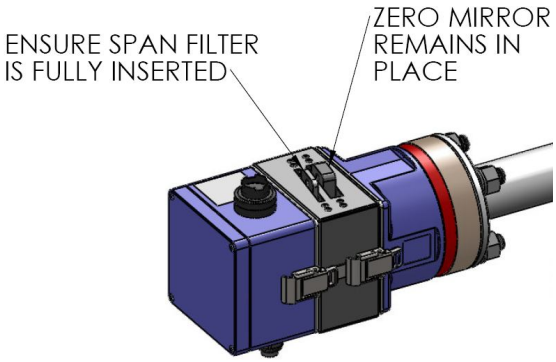
Step 3:



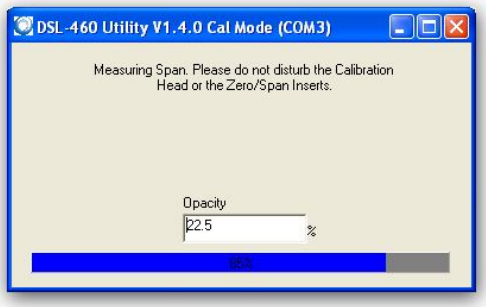
This step performs the Span Filter calibration check. The window displays the serial number of the Span Filter that was used to perform the reference calibration. The same insert must be used for the calibration check. If a different Span Filter is used the calibration check becomes invalid.

With the Zero Mirror still in place and undisturbed the Span Filter should be pushed into the smaller slot in the top of the Cal Head It should be pushed down firmly into the Cal Head slot as far as it will go.



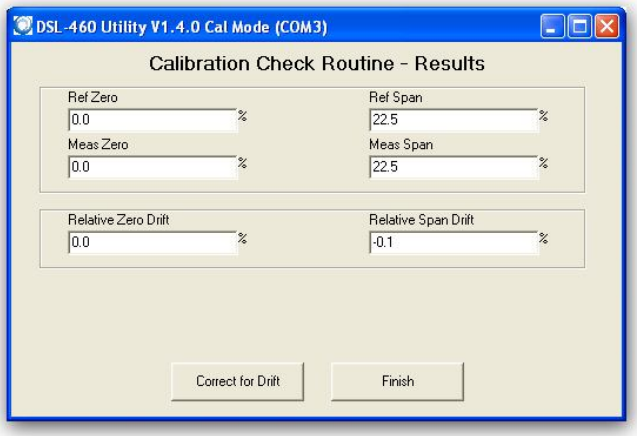


When this is complete select the check box. This makes the Proceed button available, click to proceed. When Proceed has been selected the instrument goes through an automatic measurement routine which takes about 20 seconds. A window is displayed showing the progress and also the measured opacity. Do not close this window, if you want to abort wait for this measurement to finish and use the Finish button in the results window.



Do not disturb the head or the program until this measurement is complete. On completion the results window automatically appears.

Results:



The results window displays a summary of the measured results.

The first two boxes contain the zero and span opacities recorded during the last reference calibration.

The second two boxes contain the zero and span opacities measured at this calibration check.

The third two boxes contain the relative zero and span drift, which is the difference between the previous two values. You now have the choice of adjusting the internal zero and span settings in the instrument to compensate for the measured drift (Correct for Drift) or to finish the calibration check without changing any settings (Finish).

Small changes in measured opacity can arise through measurement repeatability, temperature variations etc. Therefore it is recommended that if the relative drifts are smaller than ±1% then there is no need to perform a drift correction.

Drifts of more than ±1% are likely to represent real changes in the instrument performance, due to factors such as dirt on the lenses. Therefore it is recommended that drift compensation should be applied to drifts greater than ±1%.

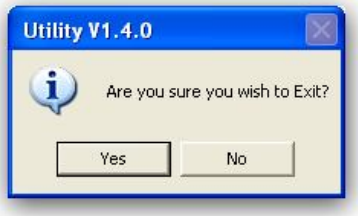
Relative drifts greater than ±10% may be caused by a significant build-up of dirt on the lenses or a misalignment of the TRX head. Under these conditions the calibration check should be finished, without performing a drift compensation. The alignment of the TRX should be checked (using the visual alignment aid) and re-aligned if required, and the optical surfaces of the TRX and Reflector heads should then be cleaned. The calibration check can then be repeated.

If after re-aligning and/or lens cleaning the relative drift is still large (more than ±10%) this may indicate either an instrument fault or a problem with the calibration checking (e.g. wrong inserts, damaged inserts, inserts not inserted correctly). It is recommend that under these conditions the drift is not corrected but reported as a potential instrument fault either to a DynOptic trained engineer or the local distributor.

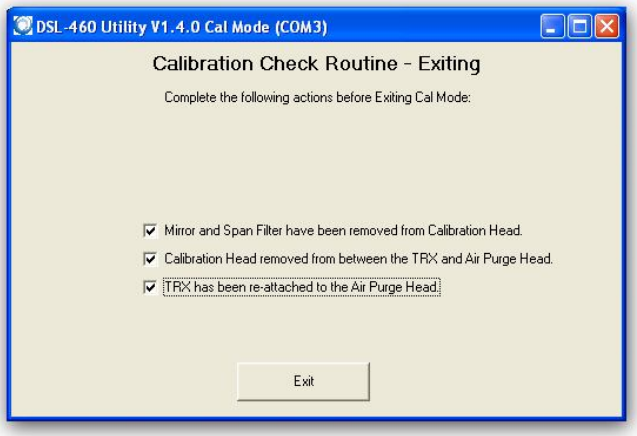
Selecting the Correct for Drift button produces a warning message stating that proceeding will permanently change some instrument settings. Selecting Yes will save the updated calibration settings to the TRX head and will send you to the calibration mode Exiting window.

Selecting No will return you to the Results window.

In the Results window selecting Finish will produce a small window asking if you are sure you want to exit. On selecting “Yes” you will be taken to the calibration mode Exiting window without having changed any of the instrument settings.



Exiting:



This window has three check boxes that must be completed before you can proceed. These steps must have been completed before it is safe to return to the normal measurement mode. Note that this Exiting window is also accessed if you abort from the calibration check at any time.

1. Check the first box to confirm that the Span Filter and Zero Mirror have been removed from the Cal Head. These calibration check inserts must be stored safely and kept clean for future use.

2. Check the second box to confirm that the TRX head has been removed from the Cal Head and that the Cal Head has been removed from the purge body.

3. Check the third box when the TRX has been re-attached to the Air-Purge body and locked in pace with the side latches.

When all three boxes have been checked the “Exit” button becomes available, click on this to exit the calibration mode and return to normal operating mode. The calibration check is now complete and after a few seconds the instrument will be back operating as normal.

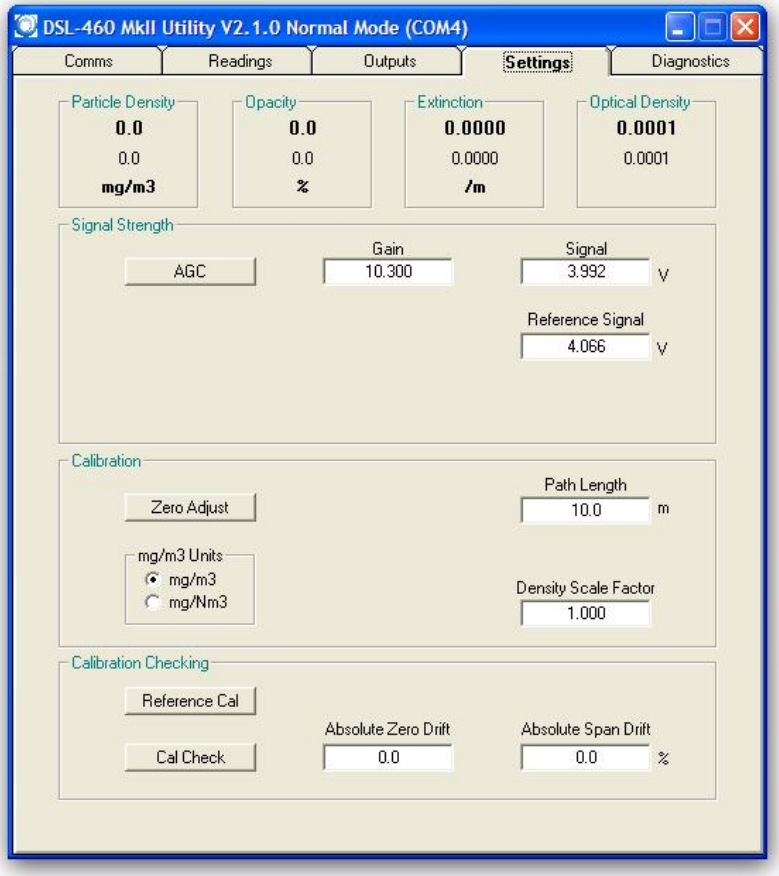
Relative and Absolute Drift

The DSL-460 MkII monitors relative drift (i.e. the change in zero and span measurements since the last drift correction) and absolute drift (i.e. change in zero and span measurements since the last reference calibration).

The calibration check process in the previous section measures and (if required) corrects for the *relative* drift in the zero or span calibration of the instrument.

It's important to remember that performing a drift correction will reset the reference values for relative drift, and that future calibration checks will determine relative drift from these new reference values.

Absolute drift calculations reference the values stored during the last known reference calibration routine, and therefore charts the underlying long term change in the instruments calibration. The absolute drift is re-calculated each time a calibration check routine is performed and is displayed on the Settings tab in the Utility Software.



One use of the absolute drift is that it can indicate gradual build-up of dirt on the lenses by giving an increasing positive absolute drift. The recommendation is that if the absolute drift becomes greater than 10.0% then the lenses should be cleaned.

Maintenance


Caution; care must be taken

Warning: When fitting or removing the heads, even for routine maintenance, there is a risk that stack gas may escape from the mounting flange, or air-purge body. Stack gas, can be hot, corrosive or otherwise damaging to health. All necessary precautions must be taken to prevent injury being caused by escaping stack gas.

The DSL-460 MkII requires very little maintenance because it has no moving parts and no perishable components.

Cleaning the optical surfaces

The main maintenance consideration is the cleanliness of the optical surfaces in both the TRX head and the Reflector head. Dirty optics will introduce an opacity which will be measured by the instrument in the same way that suspended particulates in the stack gas will, causing the opacity reading to drift upwards.

It is therefore recommended that the external optical surface of the TRX and Reflector are cleaned at regular intervals to ensure that they remain completely clear and do not cause drift.

The required interval between cleaning will vary greatly between installations, depending on the nature of the process, the stack and the air purge system. A properly installed and effective air-purge system will significantly lengthen the time between maintenance.

Initially it is recommend that the optical surfaces are checked, and if necessary cleaned, once a week. If at weekly intervals they are found to be clean and free from particle deposition, then the cleaning interval should be increased to two weeks, then 1 month, 2 months etc. until the ideal cleaning frequency is established.

In order to clean the optical surface, first remove the TRX Head from the Air-Purge body by releasing the two latches. Inspect the optical surface and remove any heavy deposition with a blast of clean dry air from a clean air canister. Remove any stubborn particles or grit with a camera lens brush. Repeat the process for the Reflector Head.

Once the heavy particles and grit have been removed the lenses can be wiped over with a spectacle cleaning solution and dried with a clean lint free cloth. It is essential that all grit has been removed from the lens before wiping

over with any cloth. If the lenses are wiped over whilst grit is still present the lenses will be scratched and a permanent opacity drift will be introduced.

Checking the Reference Signal

The LED light source in the TRX head is a long life component that should maintain normal operation for at least 5 years, however eventually its light output is likely to diminish to a level where it should be replaced.

The light output of the LED is continuously monitored by an independent reference photocell. This photocell generates a signal that is displayed in volts in the reference signal parameter on the Settings tab of the Utility Software. As the light output falls, so does the reference signal.

The DSL-460 MkII monitors the Reference Signal and will activate the Service Alarm when this signal falls below a critical level, but ideally operators would also monitor the Reference Signal and consider replacing the TRX circuit board if the signal consistently fell below 2.5V.

It is therefore recommended that the Reference Signal is checked on a 6 month interval.

Fault Messages and Trouble Shooting

Fault and Warning messages can appear either on the Readings tab of the Utility software, or on the display of the optional DSCU.

Where messages appear in the Utility Software they will remain permanently displayed on the Readings tab until the fault has been cleared and the operator has clicked on the text to acknowledge the fault. This means that even if a fault occurs only temporarily and has been resolved before the operator views the Utility Software, the fault message will remain visible until the operator has clicked on the text to acknowledge it. Fault message text can only be cleared if the fault has been resolved.

Where messages appear on the DSCU they will flash intermittently over the LCD display. This means that the operator can still navigate and use the DSCU, but will be constantly reminded of the fault by the flashing message. Flashing messages will automatically disappear when the fault is resolved.

Fault messages indicate there is a fault with the instrument and that the readings are not valid. Warning messages indicate that there may be a problem, and the warning should be investigated.

The DSL-460 MkII TRX Head is the intelligent centre of the instrument, and all measurements, calculations, and data storage is done in the TRX Head. The DSCU is a terminal which presents data from the TRX and provides an interface through which the operator can alter settings and parameters in the TRX Head.

The Utility software runs on a PC or laptop which can be connected via USB to either the DSL-460 MkII TRX Head, or to the DSCU. If a PC is connected to the DSCU, instead of the TRX, the DSCU simply becomes a conduit through which data is passed between the PC and the TRX. In this scenario, if there is a fault with the DSCU, or if the DSCU loses communications with the TRX, or if the DSCU loses power, the Utility software will be unable to retrieve the required data from the TRX, and the Utility Software will disconnect.

The following section describes each fault and warning message, outlines potential causes and highlights actions that can be taken to try and resolve the issue. If the actions described do not solve the problem then further advice should be sought from your DynOptic Systems representative.

Fault Messages

LOREF_FAULT

LOREF_FAULT status indicates that the Reference Signal has fallen below 1.5V. The Reference Signal is a measure of the LED brightness, made by a photocell sat alongside the LED source. This error is usually caused by a dim (or failed) LED in the TRX head.

However, it can also be triggered by a failure of the LED drive circuit, or a low power supply voltage to the DSL-460 MkII (should be 24Vdc), or failure of the Reference Signal measurement circuit.

Check the Reference Signal value on the Settings tab in the Utility Software, it should be ~4.0V. The voltage shown here is the voltage being returned from the photocell mounted directly alongside the LED in the TRX head.

If there is a low voltage (<1.5v) shown in the LED parameter then it is possible that the power supply to your DSL-460 MkII is low, so the first action should be to verify that the DSL-460 MkII has a 24Vdc power supply, by measuring the voltage across the terminals in the TRX Head with a DVM.

If the supply voltage is ok, then it is likely that the LED has been diminished with time and needs replacing. In this instance the TRX head should be swapped out and the original returned to DynOptic Systems for a replacement LED to be fitted.

If the Reference Signal shows 0.0V then it is likely that the LED has failed completely, but it may also be that the Reference Signal circuit that has failed. In either case the TRX head should be swapped out and returned to DynOptic Systems for repair.

In the event that the TRX is swapped out it will be necessary to complete the full setup, calibration and commissioning process as described in the earlier section in this manual.

It is almost totally impossible for this fault condition to be caused by the DSCU.

HIREF_FAULT

HIREF_FAULT status indicates that the Reference Signal has risen above 4.9V. The Reference Signal is a measure of the LED brightness, made by a photocell sat alongside the LED source. The DSL-460 MkII electronics can only measure a maximum signal of 5.0V, so any voltages above this level will saturate the measurement circuit.

Although LEDs can increase in brightness slightly with decreasing temperature, it is unusual for LEDs to increase in brightness with time. So it is unlikely that ageing is the cause of the HIREF_FAULT message.

The Reference Signal is adjusted for a target voltage of ~4.0V during test at our factory, allowing for up to 1.0V increase in brightness due to reductions in temperature. This “headroom” makes it unlikely that a change in temperature is the cause of the HIREF_FAULT condition. However, it is possible in some very cold climates for the LED brightness to rises above a Reference Signal of 4.9V.

If cold temperatures are the cause of the problem then the only way to resolve this error is to warm up the LED. The LED will naturally warm up with operation, so you may find that leaving the instrument running for an hour solves the problem.

However, the most likely cause of this error message is manual interference with the potentiometer marked VR1 on the TRX circuit board. This pot is used to adjust the Reference Signal voltage, but should only be adjusted during test at our factory. After adjustment it is sealed with a red varnish. If the varnish is either missing, or looks broken, it is likely that the pot has been tampered with.

In this case you should contact DynOptic Systems for further advice, which will vary depending on the age of the instrument.

HIMEAS_FAULT

HIMEAS_FAULT status indicates that the Measure Signal has risen above 4.9V. The Measure Signal is the main signal used to generate the instruments measurement reading. The Measure Signal is a voltage generated by light returned from the Reflector head falling on the main photocell in the TRX Head. The DSL-460 MkII electronics can only measure a maximum Measure Signal of 5.0V, so any voltages above this level will saturate the measurement circuit.

This is usually seen when the necessary clear path conditions were not met prior to an AGC being performed.

If an AGC is performed when the plant is running then the gain will be set to achieve a Measure Signal of ~4.0v, but when the plant stops and the stack clears the measured signal will rise and may exceed the 4.9V trigger point, causing a HIMEAS_FAULT STATUS.

The same is true if an AGC is performed with dirty windows, then they are cleaned; or if an AGC is performed with poor alignment, and then it is corrected.

In all these cases the solution is to perform an AGC under the proper clear path conditions. If you perform an AGC, then you must also complete the full setup, calibration and commissioning process as described in the earlier section in this manual.

MEMORY FAULT

The DSL-460 MkII employs CRC checking on the EEPROM memory. Each time the instrument is powered up the CRC checking compares the state of EEPROM that it last knew, against the state of the EEPROM memory on power up.

If the instrument finds a discrepancy between the two EEPROM memory states, a MEM fault is registered.

On registering the MEM fault the instrument performs a self checking routine which analyses each byte of memory and ensures that the values stored there are within an acceptable range. Values outside the acceptable range are considered to be corrupted values and the memory byte is replaced with a default value form FLASH memory. Essentially the instrument heals itself.

Memory corruption is rare, but can occur in certain circumstances, for example if the instrument suffers a power loss whilst writing to its EEPROM memory.

Discrepancies can also be caused by a software upgrade (in the TRX head or the DSCU, not the Utility software), so they can be an expected result of such actions.

On encountering a MEM fault operators should always power cycle the instrument, i.e. switch it off, then on again. This action should clear the fault because self-healing process will have installed a new value in the corrupted memory byte, and the compared states of the power off memory and the power on memory should now match.

If a power cycle does not clear the fault it is likely that there is a more serious problem and you should contact DynOptic Systems or your distributor for further assistance.

Please note that when the instrument self-heals by replacing corrupted data with default data from FLASH memory, operational settings and values may have been overwritten. It is therefore essential that all parameters, settings, and values are checked for validity by the operator immediately after resolving a MEM fault.

OVERRIDE ACTIVE (self clearing error message)

During set-up and commissioning of the instrument it is possible to set the DSL-460 MkII into reading override mode. This can be used to confirm the correct operation of the SCADA or data logging system. When in this mode the fault relay is triggered and this fault message is displayed. The message disappears when the unit returns to normal reading mode.

If this message appears during normal operation then the instrument has been accidentally switched into reading override mode. It should turn itself off after 5 minutes.

CALIBRATION MODE (self clearing error message)

In order to perform detailed calibration of the instrument it is sometimes necessary to switch the instrument into Calibration Mode, which will trigger this error message. This operating mode can only be set by trained DynOptic Systems engineers and so should never appear during normal operation.

If this error message does appear then the Visibility readings are still valid but may not be to the specified accuracy.

If this message appears during normal operation then the instrument has been accidentally switched into calibration mode. The calibration mode can be turned off by power cycling the instrument (i.e. turn it off and on).

STABILISING (self clearing error message)

This error message appears only briefly whenever the TRX head is performing a task such as setting the AGC or performing a zero adjust.

Warning Messages

TEMPERATURE FAULT

The DSL-460 MkII contains a temperature sensor in the TRX. This fault will be triggered if the temperature sensor reading is out of range (the operating range is -15 to +70 degrees C).

This fault message can be an indication that the head has been subjected to excessive heat outside of the recommended operating range.

The fault could also be caused by a failure of the temperature sensor or the surrounding circuitry. Contact DynOptic Systems for further advice.

ALARM ACTIVE (self-clearing warning message)

This warning indicates that an alarm threshold has been passed.

Revision Control

Version	Revision Date	Revision Details	Author
V1.0	21/06/2013	Original.	Dominic Sheedy
V1.1	07/10/2013	Updated screenshots for Utility V2.1.0 (Text updated to MkII).	Dominic Sheedy
V1.2	29/01/2014	Fault code limits updated.	Dominic Sheedy

All technical details and specifications are subject to change without notice

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