DynOptic Systems Ltd
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DSL-460 Double Pass Opacity/Dust Monitor

Operators Manual V1.4

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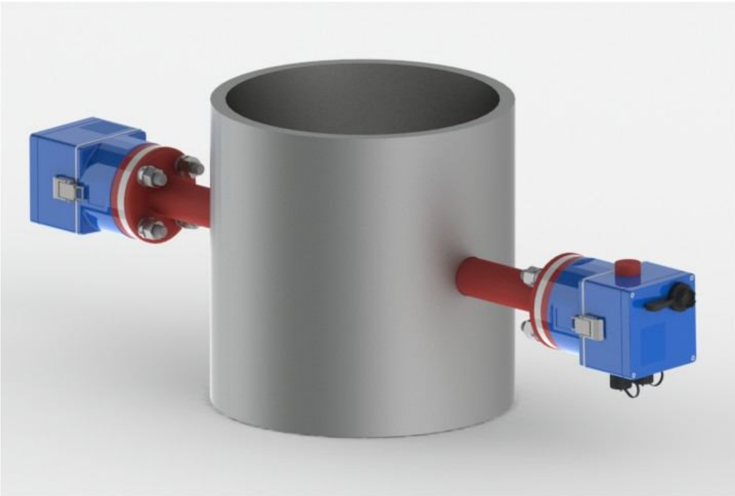
All technical details and specifications are subject to change without notice

Contents

Product Overview

The DSL-460 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 dust (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 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 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 can be supplied with an Operator Interface (OI), which is a remote control unit, with 4-digit LED display, 4-button keypad and full range of interface abilities. The OI is available in a number of different enclosure formats including an IP65 rated wall mounting enclosure for external use, a standard 19” 3U rack enclosure and a small panel mounting enclosure for installation in a master control panel. The OI has a full range of interface outputs to match those listed for the TRX head above.

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. Dust 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 Utility Software on a PC or through the OI.

The DSL-460 offers a variety of industry standard interface options. A scalable (isolated) analogue output and digital alarm (service and level alarm) outputs are available in the form of relay contacts. Serial communications are also available in the form of RS232 USB connection and RS485 protocol bus comms. In stand-alone configuration, all interface options are made available in the TRX, whereas when supplied with an OI all interface connections are made at the OI.

As a stand-alone instrument the DSL-460 requires a +24Vdc power supply (boxed and IP rated PSU’s are available separately if required). Instruments supplied with an OI can be ordered for 24Vdc, or 90-260Vac power.

This manual assumes that the DSL-460 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 monitor using either the DSL-460 Utility Software supplied, and/or the optional OI.

Installing the Utility Software and Configuring USB

Warnings

Warning: The Utility Software and the USB Driver MUST BE INSTALLED ON THE PC FIRST i.e. before connecting the DSL-460 to a PC. Connecting the PC to a DSL-460 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 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).

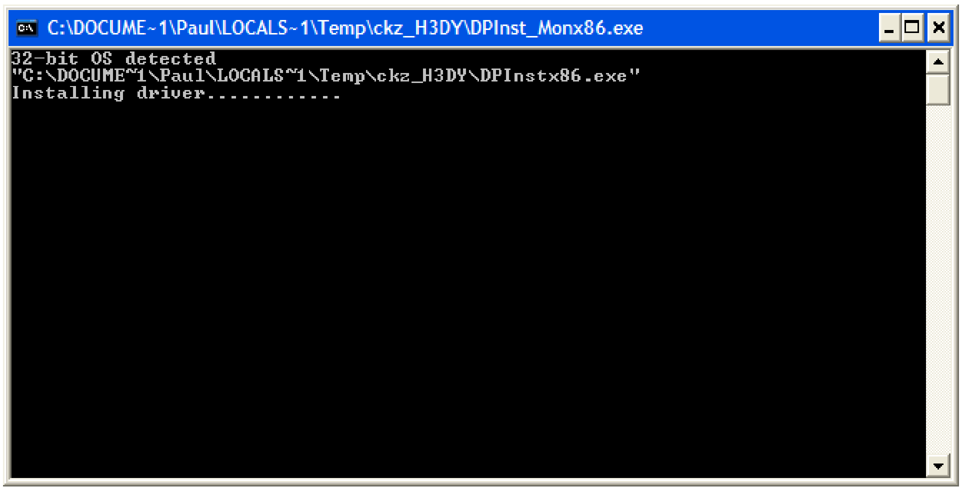
Installing the USB Driver

The DSL-460 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 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 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.

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 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, it is very likely that the PC will assign the USB connection to a COM Port number outside the acceptable range of COM1 to COM6. In this situation, the DSL-460 Utility Software will be unable to communicate with the instrument.

You can check which COM Port your PC has assigned to the DSL-460 by opening Windows “Device Manager” before connecting your DSL-460. 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 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 COM6 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 COM6. 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
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 COM6 (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 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 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 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

Warnings

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. Connecting the PC to a DSL-460 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

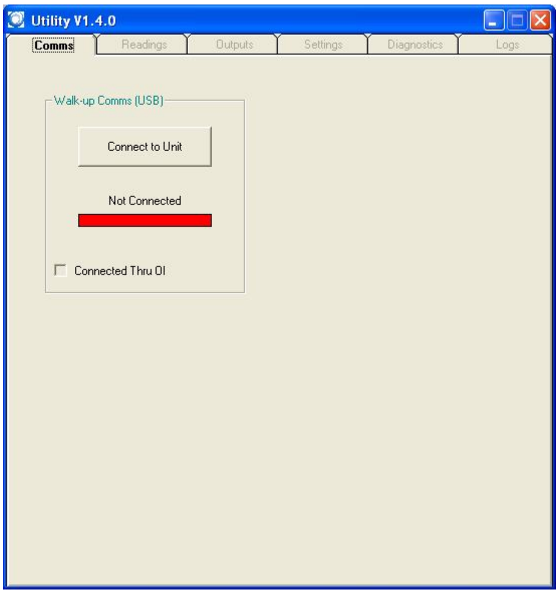
Before connecting the PC to the DSL-460 you MUST have installed the USB Driver and assigned a valid COM Port – see the previous section on installing software.

With the driver installed and com port assigned, connect your PC to the DSL-460 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 OI the USB connection can be found on the circuit board on the back of the front panel, or on the terminal board inside the terminal compartment (dependant on model purchased).

The Comms tab

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

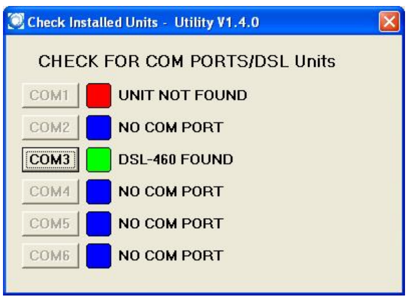


The Comms tab allows you to establish a connection with the DSL-460. When you first run the program there will be no connection so the status bar will be red (indicating no connection). You will not be able to select any other tab until a comms connection has been established.

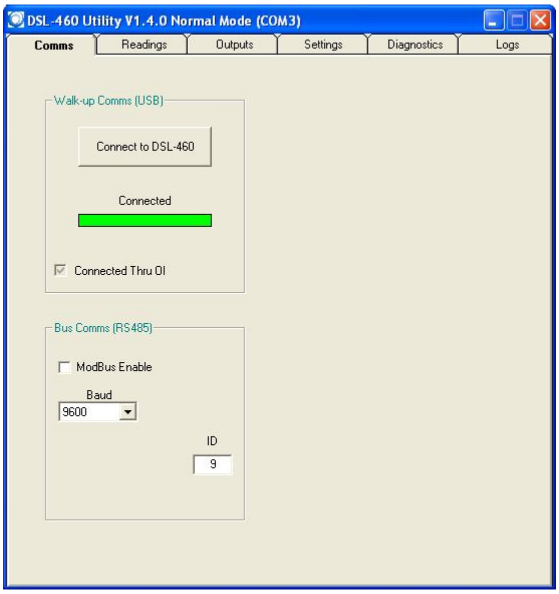
Connect to DSL-460

To establish a connection with the DSL-460 click the “Connect to DSL-460” button. The software will scan Com Ports 1 to 6 looking for any DSL-460 monitors that may be connected. More than one Com Port may exist so more than one DSL-460 may be connected.

When the scan is complete the software will report the status of any Com Ports found and any DSL-460s 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.

Connect thru OI

If you are connected directly to the TRX Head the “Connect thru OI” checkbox will be un-checked. If you are connected to an OI the “Connect thru OI” checkbox will be checked. This is an automatic checkbox which you cannot select or alter.

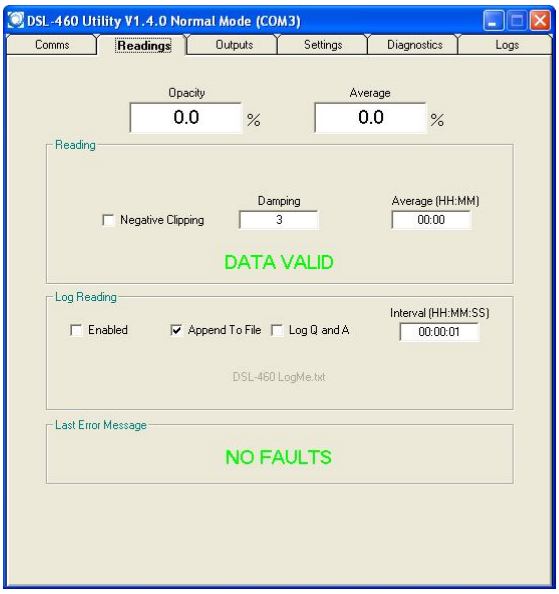
Note: The DSL-460 is an intelligent instrument that makes all measurements and stores all settings in the TRX head so when connecting your USB to an OI, the OI simply passes the comms through to the TRX Head.

Bus Comms (RS485)

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

The Readings tab

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



Reading

The box on the left displays the current measurement reading after damping; the box on the right displays the average measurement reading.

The boxes are read only (cannot be altered here) and the units are determined by options chosen on the Settings tab.

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 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 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, 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.

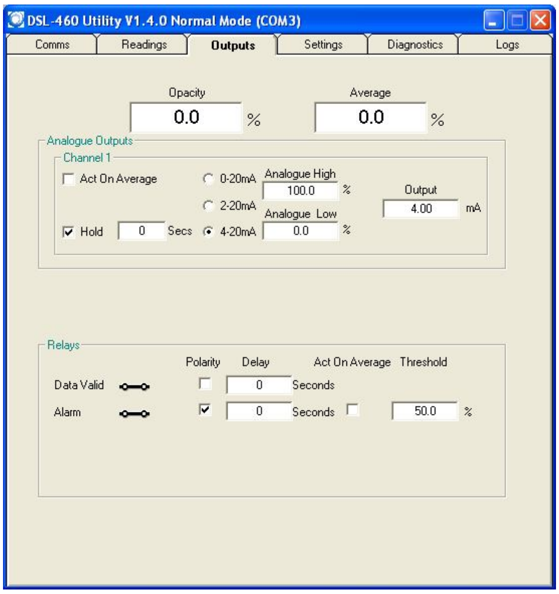
Last Error Message

The last known error message is displayed in a boxed area below. Clicking on the message will make it disappear, unless the error is still present in which case the error message will re-appear instantly. If there are more than one error messages active at one time then they will flash up here alternately.

See the section on Error Messages and Troubleshooting later in this manual.

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.



Act on Average

When unchecked, (default), the analogue output acts on the measurement reading.

When checked the analogue output acts on the averaged measurement reading.

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

The current loop analogue output used on the DSL-460 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.

Analogue Low and Analogue High

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

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

Set the analogue high 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 analogue low and high 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 analogue low/high 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 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.

Hold

When checked, (default), a data invalid status will cause the analogue output (both the calculated reading shown here in the software and also the actual electrical output) to be frozen 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 continue to be held for the delay period defined by the time setting alongside. The time setting box is only visible when the 'Hold' checkbox is ticked.

Once the analogue output is released from hold, the output will return instantaneously to tracking the current measurement reading.

Relays

This section shows the current status of the two (2) relays. The graphical image associated with each relay indicates whether the relay contact is currently open or closed. 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 first relay is a Data Valid indicator that will go into an alarm condition in the event that the instruments' self-checking identifies a fault.

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

Relay Polarity checkbox

The Data Valid relay polarity is UNCHECKED by default. The relay will be energised in a below threshold condition, and the relay status indicator will show a closed contact in the same below threshold condition. In this polarity the relay will de-energise when the reading exceeds the threshold. This condition represents the recommended failsafe operation.

With the checkbox CHECKED, the associated relay will be 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. The operation of the Data Valid relay can be delayed using the Delay setting.

The Alarm relay polarity is CHECKED by default. The relay will be energised in a below threshold condition, and the relay status indicator will show a closed contact in the same below threshold condition. In this polarity the relay will de-energise when the reading exceeds the threshold. This condition represents the recommended failsafe operation.

With the checkbox UNCHECKED, the associated relay will be 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. The operation of the Alarm relay can be delayed using the Delay setting.

The Alarm relay can act on the measurement reading or averaged measurement reading.

Delay

This value determines the continuous length of time (in seconds) for which the measurement reading must have exceeded the associated threshold value, before the alarm will activate and the relay will change state.

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

Act on Average (Alarm Relay)

When unchecked the alarm relay acts on the measurement reading. When checked the relay acts on the averaged measurement reading.

Threshold

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

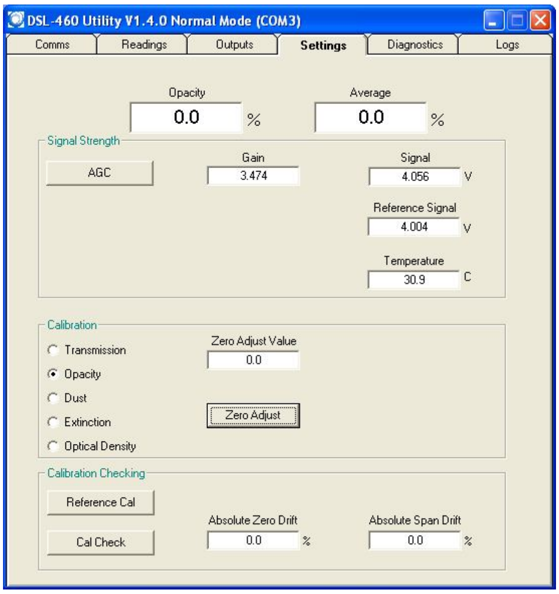
The Settings tab

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.

The Calibration section of the Settings tab changes depending on which units are selected.

The following screenshot shows the appearance of the Settings tab with Opacity selected.



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.

Measure signal

This box displays the signal strength on 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 on 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.

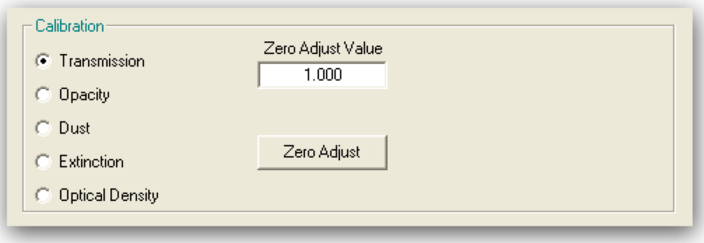
Temperature

This box displays the current circuit board temperature inside the TRX Head and is a diagnostic tool to determine operating conditions.

Radio buttons for selecting Measurement Units

The 5 radio buttons on the left-hand side of the Calibration box allow you to change the unit of measurement that the reading is displayed in. All of the displayed units are related to the fundamental measurement unit of Transmission.

Units Selected – Transmission



Zero Adjust Value

The Zero Adjust Value allows you to define the measurement reading to which the instrument will be forced when using the Zero Adjust button.

The default value for Transmission is 1.0. The purpose of the Zero Adjust button is to adjust the instrument to a measurement reading of 1.0 under clear path conditions.

Whilst the Utility software does allow the Zero Adjust Value to be overwritten with another value, this is not a recommended action, and is something that should only be done in certain specific situations by a DynOptic trained engineer who fully understands the consequences.

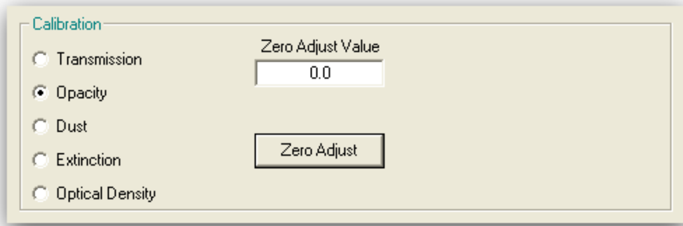
Please note: using the Zero Adjust feature is a central part of the commissioning process, and should only be undertaken after reading the later section on Set-up, Calibration and Commissioning.

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 the value defined in the Zero Adjust Value box.

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.

Units Selected – Opacity



$$OP = 100\left(1 - \sqrt{T}\right)$$

Zero Adjust Value

The Zero Adjust Value allows you to define the measurement reading to which the instrument will be forced when using the Zero Adjust button.

The default value for Opacity is 0.0. The purpose of the Zero Adjust button is to adjust the instrument to a measurement reading zero under clear path conditions.

Whilst the Utility software does allow the Zero Adjust Value to be overwritten with another value, this is not a recommended action, and is something that should only be done in certain specific situations by a DynOptic trained engineer who fully understands the consequences.

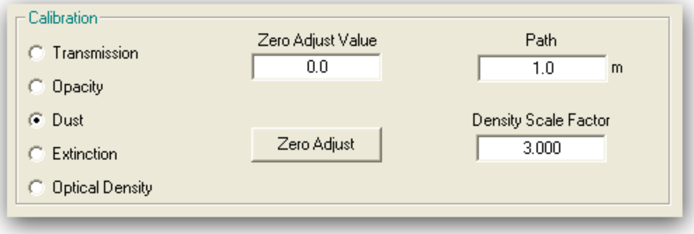
Please note: using the Zero Adjust feature is a central part of the commissioning process, and should only be undertaken after reading the later section on Set-up, Calibration and Commissioning.

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 the value defined in the Zero Adjust Value box.

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.

Units Selected - Dust



$$PD = DSF\left(\frac{-\ln(T)}{2L}\right)1000$$

Zero Adjust Value

The Zero Adjust Value allows you to define the measurement reading to which the instrument will be forced when using the Zero Adjust button.

The default value for Dust is 0.0. The purpose of the Zero Adjust button is to adjust the instrument to a measurement reading zero under clear path conditions.

Whilst the Utility software does allow the Zero Adjust Value to be overwritten with another value, this is not a recommended action, and is something that should only be done in certain specific situations by a DynOptic trained engineer who fully understands the consequences.

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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 the value defined in the Zero Adjust Value box.

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.

Path (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).

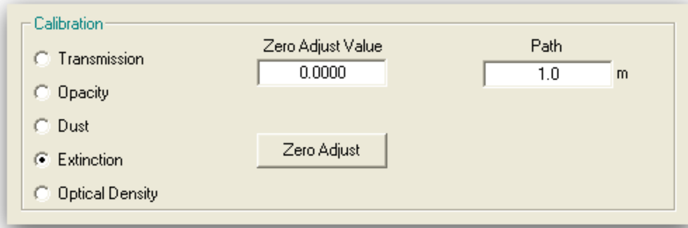
See the later section on Setup, Calibration and Commissioning for further details on defining this value.

Density Scale Factor

The Density Scale Factor allows you to enter a multiplying factor which will be applied to the reading. This value can be used to calibrate the instruments reading to independent reference measurements so that the DSL-460 can be used to indicate Dust in mg/m^3.

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

Units Selected – Extinction



$$k = \frac{-\ln(T)}{2L}$$

Zero Adjust Value

The Zero Adjust Value allows you to define the measurement reading to which the instrument will be forced when using the Zero Adjust button.

The default value for Extinction is 0.0. The purpose of the Zero Adjust button is to adjust the instrument to a measurement reading zero under clear path conditions.

Whilst the Utility software does allow the Zero Adjust Value to be overwritten with another value, this is not a recommended action, and is something that should only be done in certain specific situations by a DynOptic trained engineer who fully understands the consequences.

Please 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.

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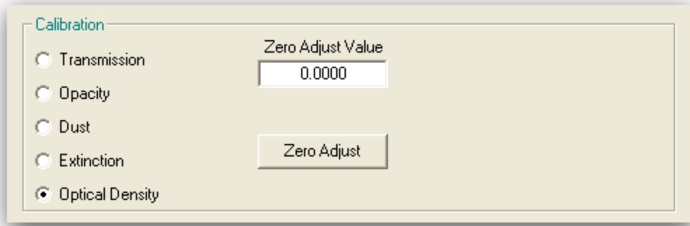
Pease note: using the Zero Adjust feature is a central part of the commissioning process, and should only be undertaken after reading the later section on Set-up, Calibration and Commissioning.

Path (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 ±0.15m (10cm).

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

Units Selected – Optical Density



$$OD = \frac{-\log(T)}{2}$$

Zero Adjust Value

The Zero Adjust Value allows you to define the measurement reading to which the instrument will be forced when using the Zero Adjust button.

The default value for Optical Density is 0.0. The purpose of the Zero Adjust button is to adjust the instrument to a measurement reading zero under clear path conditions.

Whilst the Utility software does allow the Zero Adjust Value to be overwritten with another value, this is not a recommended action, and is something that should only be done in certain specific situations by a DynOptic trained engineer who fully understands the consequences.

Please 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.

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 the value defined in the Zero Adjust Value box.

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.

Please note: when changing between units of measurement, the value associated with some parameters (for example Analogue High or Alarm Delay) will change also, because the measurement units selected may have a different range to those previously selected. It's important to note that the replacement values will not be scaled to the previous values, so when moving between units you should always check that output settings etc. are as required before relying on them.

Reference Cal button

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

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 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.

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 clear path Opacity reading measured during the last Reference Calibration routine, and the uncorrected clear path 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 can display its readings in mg/m^3, the reference calibration and calibration check routines are performed in units of opacity (0-100%).

Absolute Span Drift

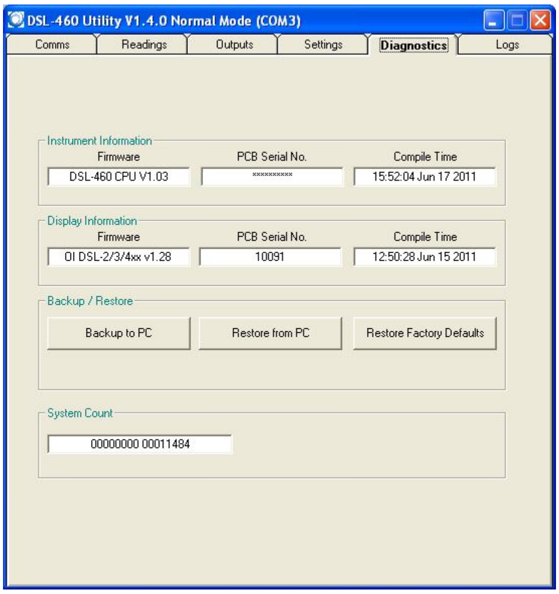
This routine is only possible with the optional Calibration Head and filters (available separately) and with manual user intervention at the TRX Head. Please see the later section on Calibration Checking for further details.

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 an OI then the instrument information is displayed as shown in the following screenshot. However, if the communication is direct to the DSL-460 TRX head then the 'Display Information' field will not be shown.



Firmware

There can be two boxes indicating Firmware, the first relates to the DSL-460 instrument itself (the firmware in the TRX circuit board), and the second relates to the OI (the firmware in the main OI circuit board).

PCB Serial No.

There can be two boxes indicating PCB Serial No., the first relates to the DSL-460 instrument itself (the serial no. of the TRX circuit board), and the second relates to the OI (the serial no. of the main OI circuit board).

Compile Time

There can be two boxes indicating Compile Time, the first relates to the DSL-460 instrument itself (the date/time on which firmware in the TRX circuit board was compiled), and the second relates to the OI (date/time on which the firmware in the main OI circuit board was compiled).

Backup to PC

Clicking this button will cause the current instrument settings to be saved in a backup file in the location: C:\DSL BACKUPS on the PC. The filename of the backup file will incorporate the date, time and electronic serial number of the instrument at time of 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.

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.

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.

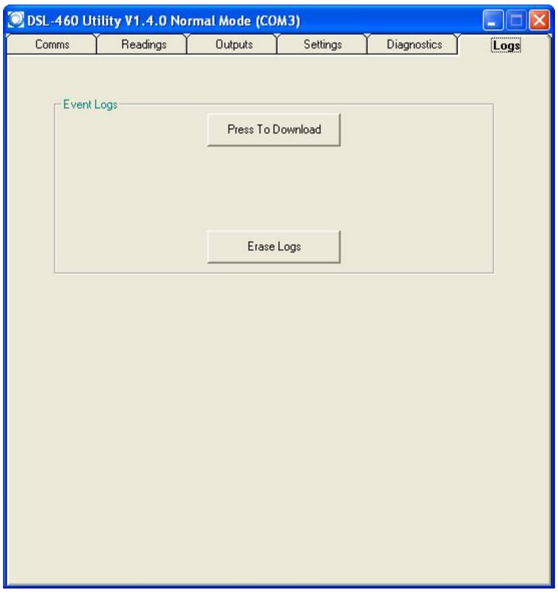
WARNING! This action will overwrite all existing settings and parameters with default values, so your set-up and calibration will be lost, as will any alarm points, scaling factors, and drift values.

System Count

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

The Logs Tab

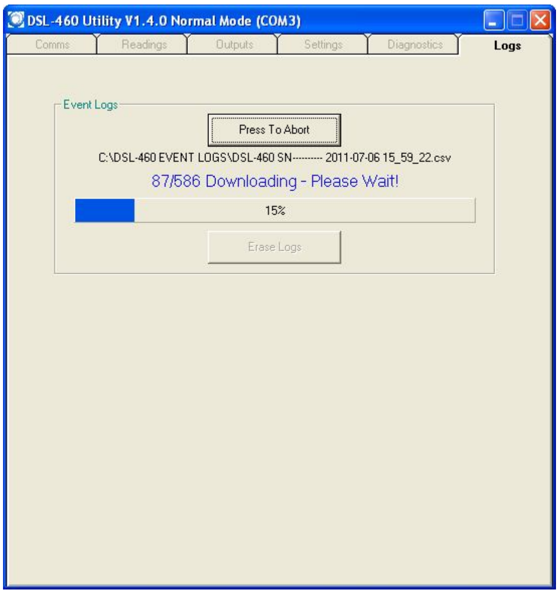
The logs tab allows the download of Event Logs, see the following screen shot.



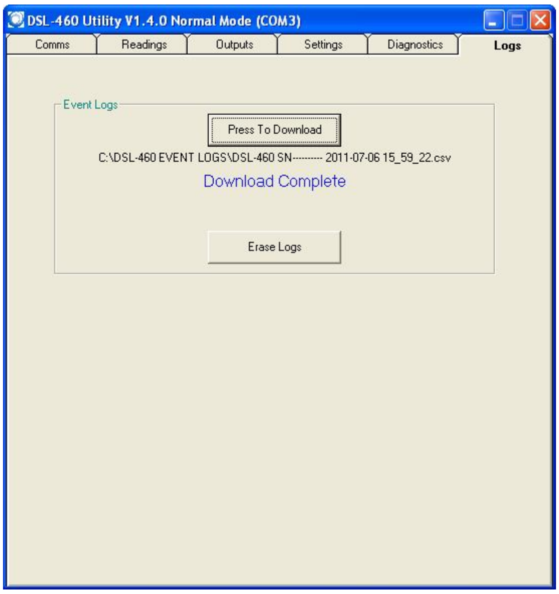
Event Logs

Certain information is logged by the DSL-460 such as changes of settings, faults and when relay threshold levels have been crossed.

To access this data - click the “Press to Download” button to download the Event Logs. This will take several minutes to complete.



The path where the file has been stored is shown beneath the ‘Press to Download’ button. Clicking this link will automatically open the file.



Data is added to the event log until the memory buffer is full. Old data is then overwritten in order of importance (less critical data is overwritten first).

The event log contains the following data:-

Power Up Count – This number is incremented each time the instrument is powered up.

Seconds Since Power Up – This is a counter that is reset with each power up.

Log Type – A code relating to the event.

Event Description – This may be descriptive or coded and is used to identify the event or fault.

Erase Logs

To erase the logs click on the ‘Erase Logs’ button, a pop up box will ask for confirmation, click OK to proceed.

Using the OI

Keypad / Display Fundamentals

The OI has a 4 digit LED display, four laminated push-buttons, and two LED alarm indicators.

The **Cycle** button cycles you through the available parameters on the Page. It can also be used to cancel data entry.

The **Next** button initiates data entry and moves between digits during data entry.

The **Increase** button is used to increment a digit or move the decimal point during data entry.

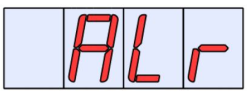
The **Enter** button is used to end data entry and store the altered value. It can also be used to re-display a parameters “name”.

The level alarm LED will illuminate when the threshold of the level alarm is exceeded.

The service alarm LED will illuminate when the instrument detects a fault condition that requires attention.

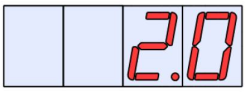
The display will display just one parameter at a time, but the Cycle button can be used to cycle the display through all the available parameters in turn.

When cycling through parameters the display will initially show the “name” of the parameter.



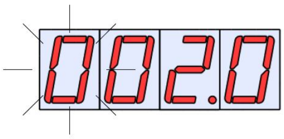
= parameter name

Once cycling is ended, and the display has settled on one parameter for more than one second, the display will switch to show the “value” of that parameter.

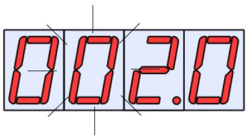


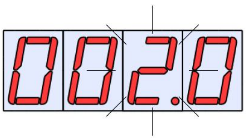
= parameter value

The value of a parameter can be altered by initiating data entry mode, which is achieved by pressing the Next button. On initiating data entry mode the first digit of the value will begin to repeatedly flash indicating that the value of that digit can now be incremented.

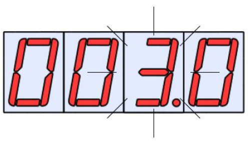


Only one digit can be increased in value at any one time, so select a digit by moving between them with the Next button.

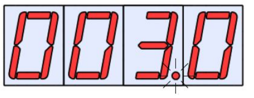




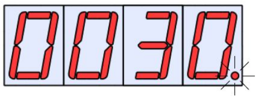
Increase the value of a selected digit using the increase button.



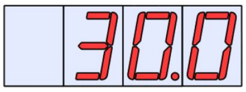
The decimal point can also be selected (if present) by using the Next button also.



The position of the decimal point can be changed using the increase button.



Once the desired value has been achieved in data entry mode, the Enter button can be used to accept that new value and store it in memory. At this point the digits will stop flashing.



It is possible to exit data entry mode without saving an altered value (i.e. to abandon data entry) by pressing the Cycle button before pressing Enter during data entry.

Moving between Pages

The parameters available in the display are arranged on two “pages”.

Page 0 is made up of parameters which are more commonly used, such as output settings, damping, and alarm delays.

Page 1 comprises parameters which are less commonly used or that can be used to alter the calibration or fundamental setup of the instrument.

Switching between Pages is achieved by selecting the Page parameter and toggling between 0 and 1. Because Page 1 contains parameters which can alter the calibration and fundamental setup of the instrument, it is password protected, so upon choosing Page 1 the message PAS? will show briefly, and the user will then be prompted to enter a 4 digit number (the password) using the usual data entry method.

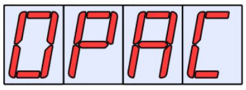
The default password is 0000.

If the correct number is entered, the message yES will appear and the display will move to Page 1. If the wrong password is entered, the message no will appear and the display will default back to Page 0.

Page 0 parameters

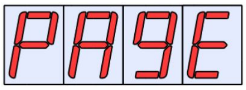
Page 0 contains parameters which are more commonly adjusted and which can only be used to alter the instruments outputs. This page does not contain any parameters which can be used to alter the instruments calibration or fundamental setup, therefore this page is NOT password protected.

The parameters available on Page 0 are listed below by parameter “name” and in the order they appear in the display. In the list below the corresponding Utility Software reference is shown in brackets after the parameter name.



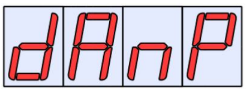
OPAC / trAn / En / OPdE / duSt (Reading)

The name of this parameter changes dependant on which measurement units are selected, but essentially this parameter is the measurement reading, in real time after damping.



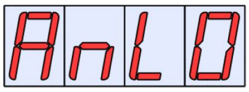
PAgE

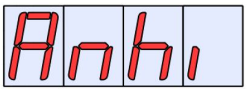
This parameter allows you to change between “pages”. Choose between 0 and 1 (Page 0 and Page 1). Please note: on choosing Page 1 you will be prompted to enter a password (PAS?) and should enter the password using the normal data entry method. The default password is 0000.



dAnP (Damping)

The value entered here (in seconds) determines the level of damping applied to the particulate reading. 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.



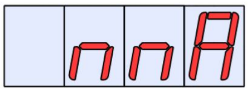


AnLo & AnHi (Analogue Low & Analogue High)

These two parameters set the upper and lower scaling points of the analogue output.

Set the analogue Low value to the measurement reading at which the analogue output should generate 0/2/4mA depending on which scale is selected.

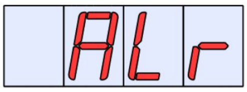
Set the analogue high value to the measurement reading at which the analogue output should generate 20mA.



nnA (Analogue Output)

nnA is the best possible representation of “mA” within the limitations of the LED display. This value is a calculated indication of the expected analogue output - taking into account the analogue low/high settings.

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

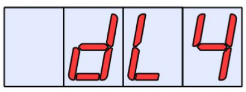


ALr (Level Alarm)

This value defines the reading at which the level alarm is activated.

When the level alarm is activated it changes the state of the associated alarm relay, and it also lights the level alarm LED on the OI front panel.

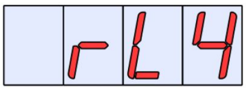
The default state of the alarm relay (i.e. energised or de-energised) can be determined with the relay polarity parameter.



DLy (Level Alarm Delay)

This value determines the time (in seconds) for which the reading must have exceeded the level alarm value, before the level alarm will activate.

Delaying the activation of the level alarm can prevent borderline alarm readings from “dithering” in and out of active alarm status. Only genuine, sustained alarm readings will actually trigger the level alarm.



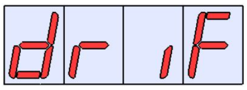
rLy (Relay Polarity)

Changing this value alters the default state of the relays in their non-alarm condition.

With the value set to 0, the relays will be de-energised in a non-alarm condition. In this polarity relays will energise when an alarm is activated.

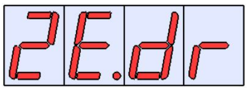
With the value set to 1, the relays will all be energised in a non-alarm condition. In this polarity relays will de-energise when an alarm is activated.

We strongly recommend that users have this value set to 1 so that the relays are used in a “failsafe” configuration.



driF (Drift)

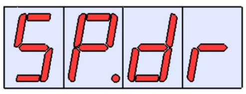
This parameter alternates between displaying the absolute zero drift and absolute span drift values detailed below.



ZE.dr (Absolute Zero Drift)

This box reports the absolute zero drift as calculated by use of the reference calibration and calibration check routines. These routines require the optional calibration head and filters (available separately) and manual user intervention at the TRX head.

Absolute zero drift is defined as the difference between the clear path Opacity reading measured during the last reference calibration routine, and the clear path opacity reading measured during the last calibration check routine.



SP.dr (Absolute Span Drift)

This box reports the absolute span drift as calculated by use of the reference calibration and calibration check routines These routines require the optional calibration head and filters (available separately) and manual user intervention at the TRX head.

Absolute span drift is defined as the difference between the upscale opacity reading measured during the last reference calibration routine, and the upscale opacity reading measured during the last calibration check routine.

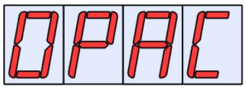
Page 1 parameters

Warning: Page 1 should only be used by a trained instrument engineer who has read and understood the later section on "Setup, Commissioning and Calibration", as the parameters and functions on this page determine the calibration of the instrument and the measurement reading that it generates.

Page 1 has a range of parameters and functions for initial setup and calibration of the instrument, and it is therefore password protected. The default password is 0000.

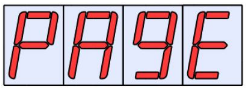
Some parameters and functions on Page 1 are only available when certain measurement units are selected.

The parameters available on Page 1 are listed below by parameter "name" and in the order they appear in the display. In the list below the corresponding Utility Software reference is shown in brackets after the parameter name.



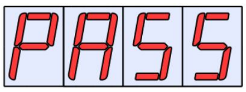
OPAC / trAn / En / OPdE / duSt (Reading)

The name of this parameter changes dependant on which measurement units are selected, but essentially this parameter is the measurement reading, in real time after damping.



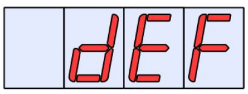
PAgE

This parameter allows you to change between "pages". Choose between 0 and 1 (Page 0 and Page 1). Please note: on choosing Page 1 you will be prompted to enter a password (PAS?) and should enter the password using the normal data entry method. The default password is 0000.



PASS

This parameter shows the current password. The password can be altered using the normal data entry process.

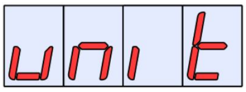


dEF (Restore Factory Defaults)

This function can be used to restore factory defaults. To use this function the operator must initiate data entry by pressing the Next button, then use the Increase button to select "yES", and finally press Enter.

Performing a restore Factory Defaults will restore all settings and parameters to default values as determined at our factory.

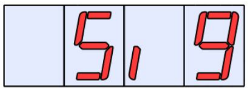
WARNING! This action will overwrite all existing settings and parameters with default values, so your complete setup and calibration will be lost, as will any alarm points, scaling factors, damping values etc.



Unit (Measurement Units)

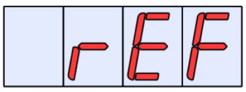
This parameter allows the operator to select the required measurement units.

Please note: when changing between units of measurement, the value associated with some parameters (for example Analogue High or Alarm Delay) will change also, because the measurement units selected may have a different range to those previously selected. It’s important to note that the replacement values will not be scaled to the previous values, so when moving between units you should always check that output settings etc. are as required before relying on them.



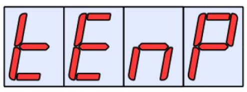
Sig (Measure signal)

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



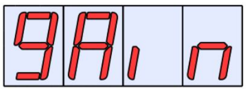
rEF (Reference signal)

This parameter displays the signal strength on 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 in the opacity measurement. This value is presented as a diagnostic tool.



tEnP (Temperature)

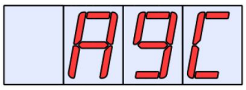
This parameter displays the current circuit board temperature inside the TRX Head in degrees C. This value is presented as a diagnostic tool.



gAIn (Gain)

This parameter displays the current Gain value as determined by the AGC function (below).

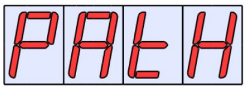
This value can be manually overridden, but such action should only be undertaken in certain unusual circumstances, and should only be performed by a DynOptic trained engineer, who fully understands the consequences of such action.



AgC (AGC)

This function enables the operator to perform an Automatic Gain Correction (AGC), which will adjust the instruments Gain value to achieve optimum signal strengths.

To perform an AGC, first initiate data entry using the Next button, then select “yES” use the Increase button, then select Enter.

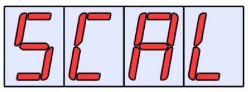


PAtH (Path Length)

(Only available in when units are set to Dust)

This parameter is only visible when units of Dust are selected.

The Path parameter is used to define the distance between the TRX and Reflector (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 TRX Air-Purge body, to the face of the flange on the Reflector Air-Purge body.

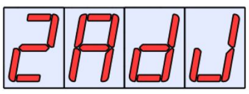


SCAL (Density Scale Factor)

(Only available in when units are set to Dust)

This parameter is only visible when units of Dust are selected.

The Density Scale Factor is a multiplying factor which will be applied to the reading in Dust mode. This value can be altered to calibrate the instruments reading with reference to independent reference measurements so that the DSL-460 can be used to indicate Dust in mg/m^3.

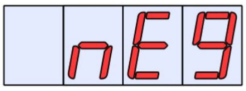


Adj (Zero Adjust)

The Zero Adjust function can be used to force the instruments reading to match the value entered here. The purpose of this feature is to allow the instrument to be zeroed.

The value entered here should normally be zero (0.0) for Opacity, Dust, Extinction and Optical Density, but would normally be one (1.0) for Transmission, because Transmission is inverse to the other measurement units.

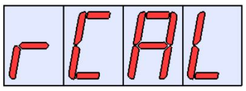
Whilst this function does allow the instrument to be adjusted to values other than 0.0 (or 1.0 for Transmission), this is not a recommended action, and is something that should only be done in certain specific situations by a DynOptic trained engineer who fully understands the consequences.



Negative Clipping

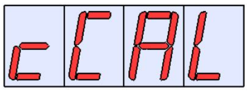
If this parameter is set to “YES” the instrument will clip all the reading and the output at zero (0.0), so positive readings will show as normal, but when the instrument calculates a negative reading it will hold the display and the outputs at zero.

If this parameter is set to “no” 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.



rCAL (Reference Calibration)

Selecting this function will start a reference calibration routine which will define the reference against which all future calibration checks will be compared. This routine is only possible with the optional calibration head and filters (available separately) and with manual user intervention at the TRX head.



cCAL (Calibration Check)

Selecting this function will start a calibration check routine which will determine both relative and absolute drift in the measurement performance. This routine is only possible with the optional calibration head and filters (available separately) and with manual user intervention at the TRX head.

Dual Units Mode

When units of Opacity or Dust are selected, it is possible to switch between the measurement readings.

When viewing the measurement reading in Opacity on Page 0, it is possible to view the measurement value of Dust by pressing and holding the Enter button for 1 second. Press and hold the Enter button for 1 second to switch back.
Likewise when viewing the measurement reading in Dust, it is possible to view the measurement reading in Opacity using the same method.

Note: Switching between viewing the measurement reading of Opacity and Dust does not change the units, only the displayed measurement value. The displayed measurement value will return to the units selected after 5 minutes or when the Cycle button is pressed.

Set-up, Calibration and Commissioning

Warnings

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 Installation Manual for full details of installation requirements.

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.

Overview

The DSL-460 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 length and alignment of the light path, requires the DSL-460 to be capable of working with a wide range of signal strengths.

This necessity to work with a wide range of signal strengths mean that it is impossible for the DSL-460 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 instruments span setting to define 0.0 (or 1.0) the bottom of the scale.

4. **Choose the unit of measurement** – The default measurement unit of the DSL-460 is Opacity (%), however the instrument can be configured to report readings in Transmission, Extinction, Optical Density and Dust (mg/m^3).

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

6. **Upscale calibration of Dust (if applicable)** – The DSL-460 can be used to indicate Dust (mg/m^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.

7. **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 7 are performed (in order) before considering the instrument operational.

Please note: if at any stage during the operational life of the instrument there is a significant change to the DSL-460 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 dust does not need to be repeated.

Significant changes include: moving the position or alignment of the heads, reducing 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 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 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 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.

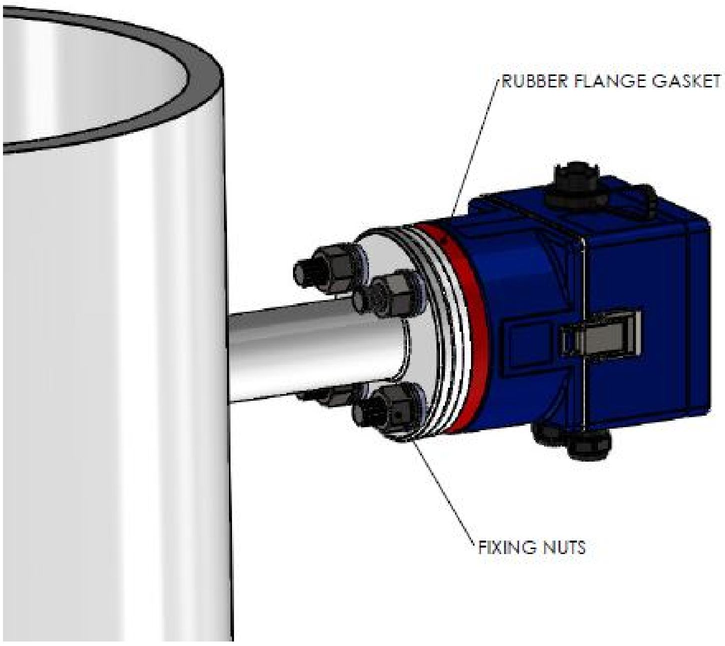


Figure 1: Air-Purge Body mounted to flange with the rubber flange gasket

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 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 aligned for optimum signal.

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.

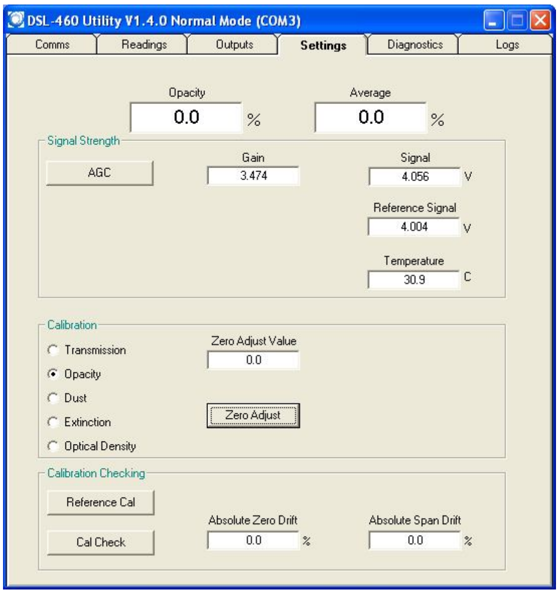
5. The duct or stack must be free from any dust, smoke, soot, steam, or particulate (i.e. the process behind the stack should have been shut down).

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 the AGC parameter in the OI and toggling to yEs.

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 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 determined 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 (in any units). After a Gain correction of any kind, you must always go on to perform a Zero Adjust, and then calibrate the Dust (where applicable) and 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 the value defined in the Zero Adjust Value box.

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 Dust 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.

To perform a Zero Adjust, first check that the Zero Adjust Value is set to 0.0 for Opacity, Dust, Extinction and Optical Density, or 1.0 for Transmission, then click the Zero Adjust button. The measurement reading (which can be seen at the top of the Settings tab) will be adjusted to read 0.0 (or 1.0 for Transmission).

The Zero Adjust feature can be used to set measurement values other than 0.0 (or 1.0), but this is NOT recommended.

Adjusting to a measurement reading other than 0.0 (or 1.0) is sometimes 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 the instruments reading can be adjusted to the correct value.

Adjusting to a measurement reading other 0.0 (or 1.0) is considered to be an imprecise method of calibration since the uncertainty in knowing the actual measurement reading of the stack has been added to the instrument reading.

Choosing the unit of measurement

The fundamental unit of measurement of the DSL-460 is transmission (T) measured as the detected signal level relative to the previously defined clear path condition (T=1.0). The standard display units of the DSL-460 is Opacity, but the instrument can also be configured to display readings in other units. The list below details each of the available measurement units and their mathematical relationship to the measured transmission (T).

1. Transmission T
2. Opacity (%) $OP = 100\left(1 - \sqrt{T}\right)$
3. Dust (mg/m^3) $PD = DSF\left(\frac{-\ln(T)}{2L}\right)1000$
4. Extinction (/m) $k = \frac{-\ln(T)}{2L}$
5. Optical Density $OD = \frac{-\log(T)}{2}$

L (in meters) is the flange-to-flange Path length and DSF (in g/m^2) is the Density Scale Factor for the dust or particles being measured. To use Dust (mg/m^3) as the units of measurement requires an upscale calibration to be performed to determine the correct Density Scale Factor for the installation being monitored. This is described in the next section.

Defining the Path length

Measurements in units of Dust 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 Dust (mg/m^3) or Extinction, measure the Path length and enter it in the Path box on the Settings tab in the Utility software.

Calibration of Dust

The following describes the calibration process for setting the correct Density Scale Factor when measuring in units of Dust.

The measured transmission in a stack or duct can be used to indicate the Dust carried in the gas stream. Sometimes called the particulate concentration, or the dust measurement, Dust is measured in units of mg/m^3.

The relationship between transmission and dust 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.

Therefore 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 Dust measurements.

It is recommended that standard reference measurement is made using gravimetric analysis based on isokinetic sampling of the gas stream.

The reference measurements must be taken at the same time as the Dust readings from the DSL-460, 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 at that instant, 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 $0.0mg/m^3$ are not valid. Note that the DSL-460 is only suitable for measuring dust on a dry stack, if there is significant quantity of condensed water in the gas flow the relationship between the measured optical transmission and reference dust 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 Dust calibration the following conditions for the DSL-460 must be met:

1. The instrument must have been properly and permanently installed as per 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. Dust has been selected as the measurement units (on the Settings tab in the Utility software).

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

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

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

The DSL-460 will show a measurement in units of Dust (mg/m^3) based on the Density Scale Factor displayed in the box on the Settings tab of the Utility software (the default value of DSF is 3.0).

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, 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 Dust displayed by the DSL-460 instrument should be recorded (PD_I).

The dust measured by the standard reference method (PD_{REF}) is then compared to that displayed by the DSL-460 (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 Dust (mg/m^3) from the standard reference method
PD_I = the Dust (mg/m^3) from the DSL-460 instrument

For improved accuracy this process should be repeated a number of times (at least 5) using the original Density Scale Factor (DSF_0) for all measurements. The average of all of the derived new Density Scale Factors should then be used as the final Density Scale Factor for the instrument.

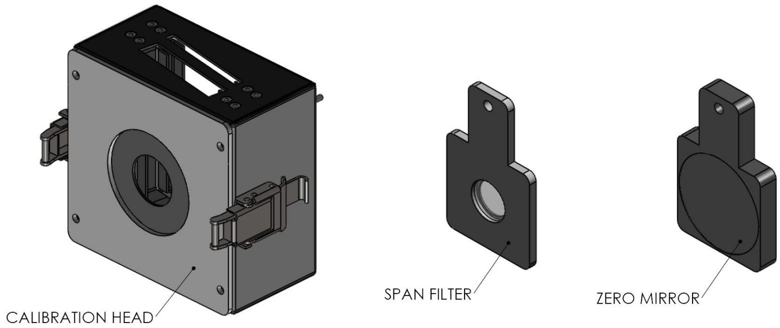
Configuring the outputs

For information on setting up the outputs, refer to the 'Outputs Tab' section.

Calibration Checking

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.

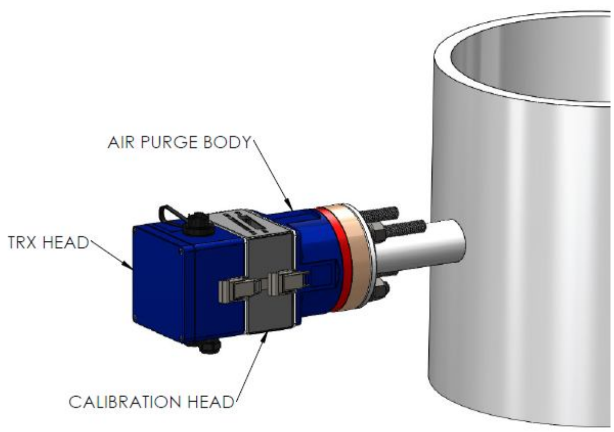
In order to perform a reference calibration or a calibration check routine it is necessary to use the optional Calibration Head (Cal Head) and calibration inserts shown below.



The Zero Mirror is used to simulate a clear path condition and the Span Filter is used to simulate an upscale opacity reading.

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.



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 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.

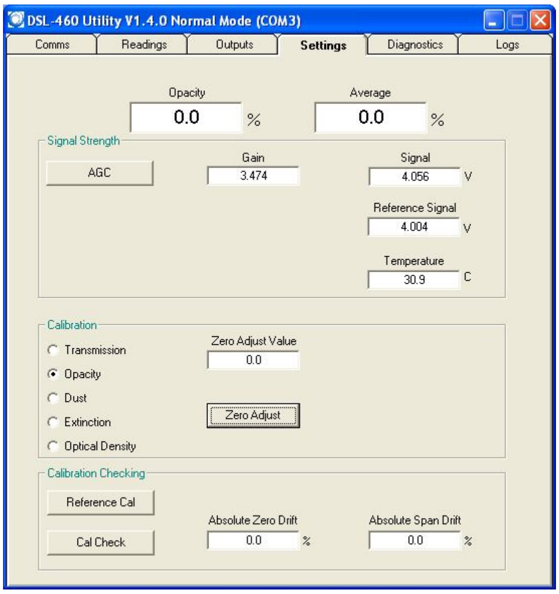
Both the reference calibration and the calibration checking procedures are pre-defined routines which must be initiated and followed via the Utility Software or the OI. The preferred method is to use the Utility Software, as the PC screen interface allows more detailed instruction to be offered at each stage of the procedure.

The reference calibration must be performed after the DSL-460 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 using the Utility Software

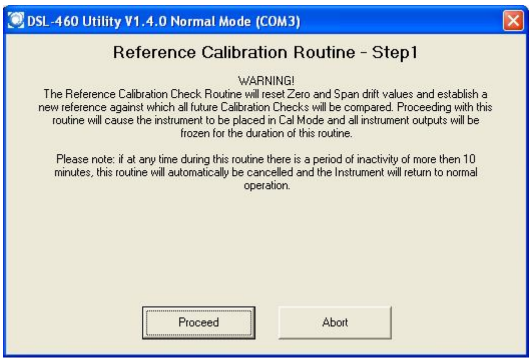
To start the reference calibration, go to the Settings tab of the DSL-460 Utility software and select the Reference Cal button in the Calibration Checking box.



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.

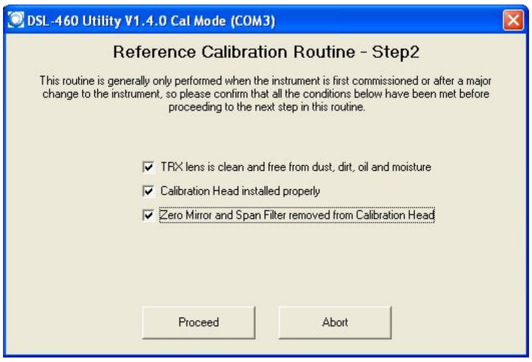
At any stage during the reference calibration process you can stop the procedure by selecting the Abort button. This will take you to the Exiting window which guides you to safely return the instrument to the normal window with no changes having been made to the settings stored in the instrument. The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

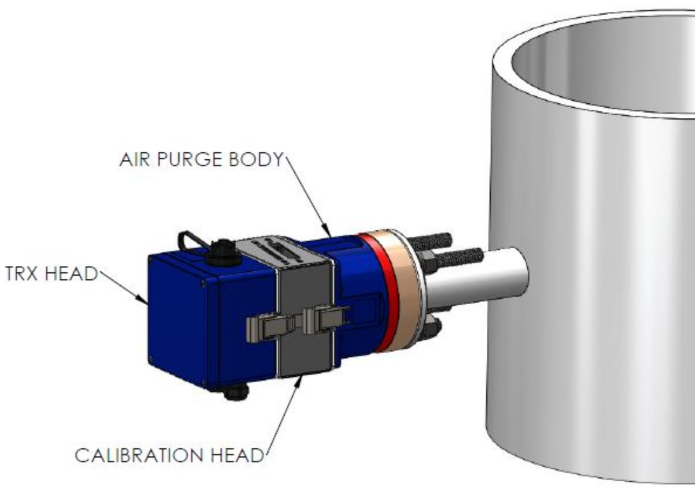
Step 2:



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.

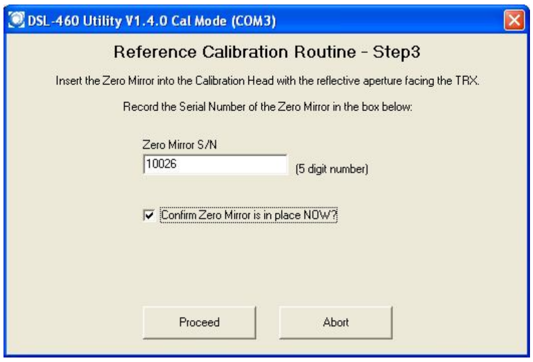
2. Check the second box to confirm that the Calibration Head has been installed correctly, as illustrated below.



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

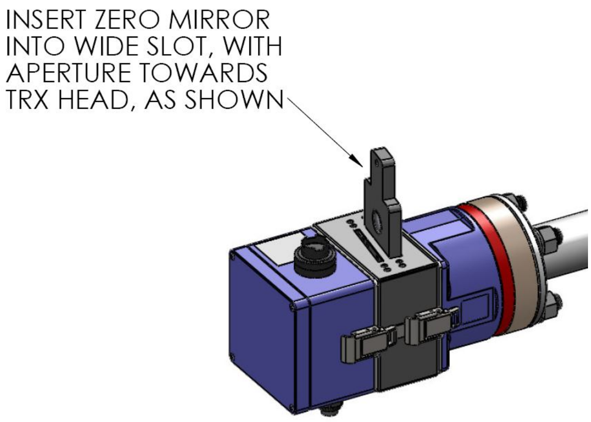
When all three check boxes have been checked the Proceed button becomes available, click on this to proceed to step 3.

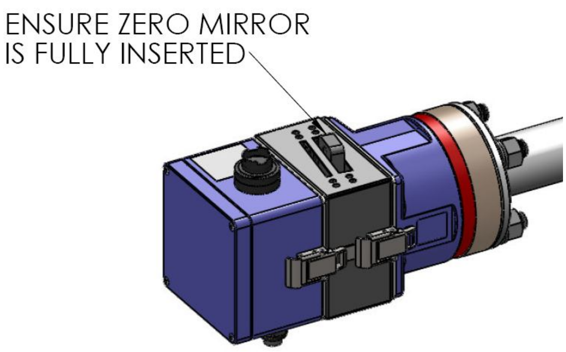
Step 3:



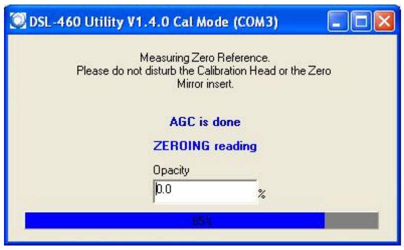
This step performs the reference Zero Mirror calibration. Each Zero Mirror has its own serial number and the same Zero Mirror must be used for all future calibration checking. The 5 digit serial number is marked on the Zero Mirror and should be typed into the Zero Mirror S/N box.

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.



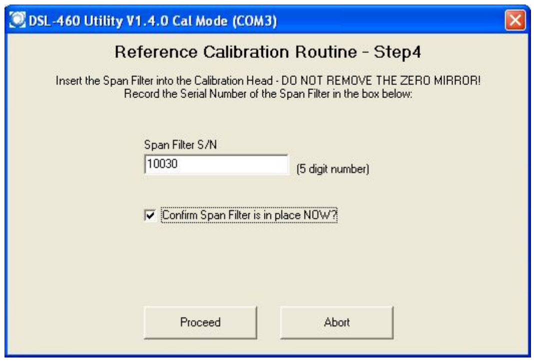


When this is complete select the check box. This makes the Proceed button available, click to proceed. When proceed has been selected the instrument goes through an automatic measurement routine which takes about 20 seconds. A window is displayed showing the progress and also the measured opacity. Do 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.



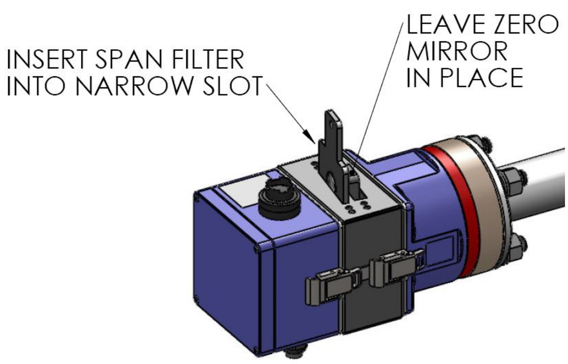
Do not disturb the head or the program until this measurement is complete. On completion the step 4 window automatically appears.

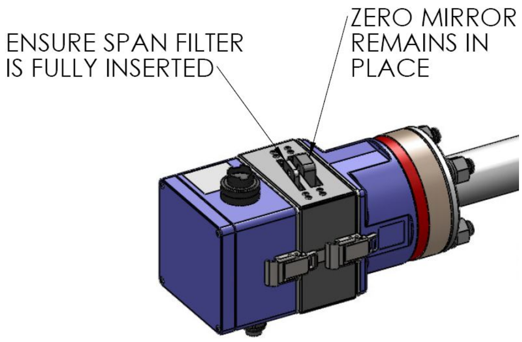
Step 4:



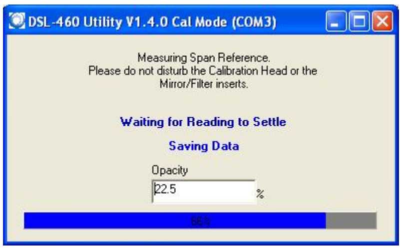
This step performs the reference Span Filter calibration. Each Span Filter has its own serial number and the same Span Filter must be used for all calibration checking. The 5 digit serial number is marked on the Span Filter and should be typed into the Span Filter S/N box.

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.



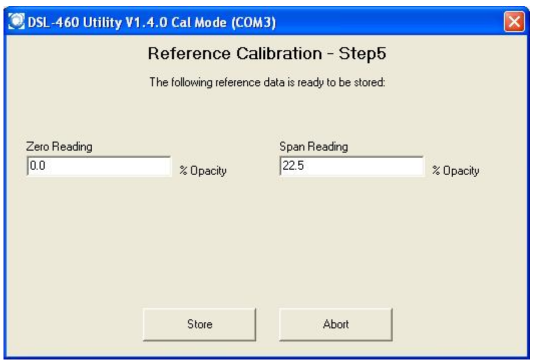


When this is complete select the check box. This makes the Proceed button available, click to proceed. When Proceed has been selected the instrument goes through an automatic measurement routine which takes about 20 seconds. A window is displayed showing the progress and also the measured opacity. Do 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.



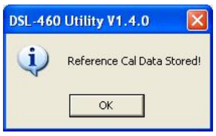
Do not disturb the head or the program until this measurement is complete. On completion the step 5 window automatically appears.

Step 5:

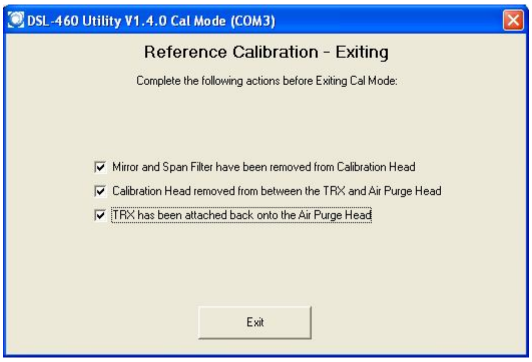


This window displays a summary of the measured reference calibration zero and span opacity values. Selecting the Store button will save these values in the instrument, along with the settings used to perform the reference calibration. All subsequent calibration checks will be performed using the stored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

Reference Calibration using the OI

The underlying procedure for performing a reference calibration is identical, whether it's performed using the OI, or the Utility Software. This is discussed in detail in the previous section, and therefore not repeated in this section.

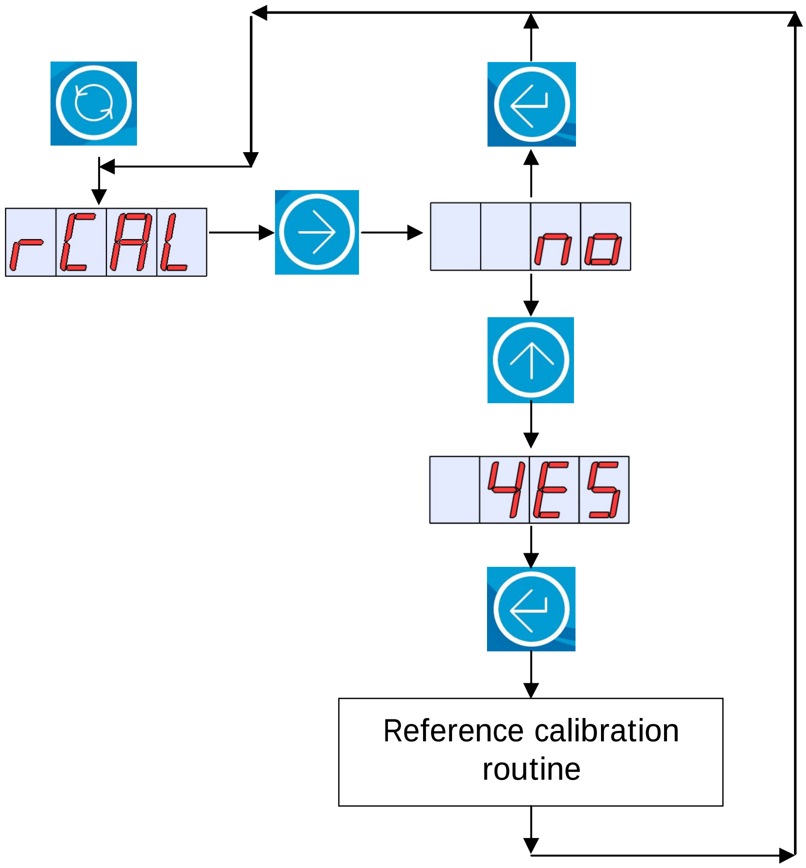
Instead this section will only outline the flow of the procedure for performing a reference calibration using the different interface (the OI).

In order to perform a reference calibration using the OI it is necessary to initiate the rCAL mode and then follow a series of prompts in the OI display.

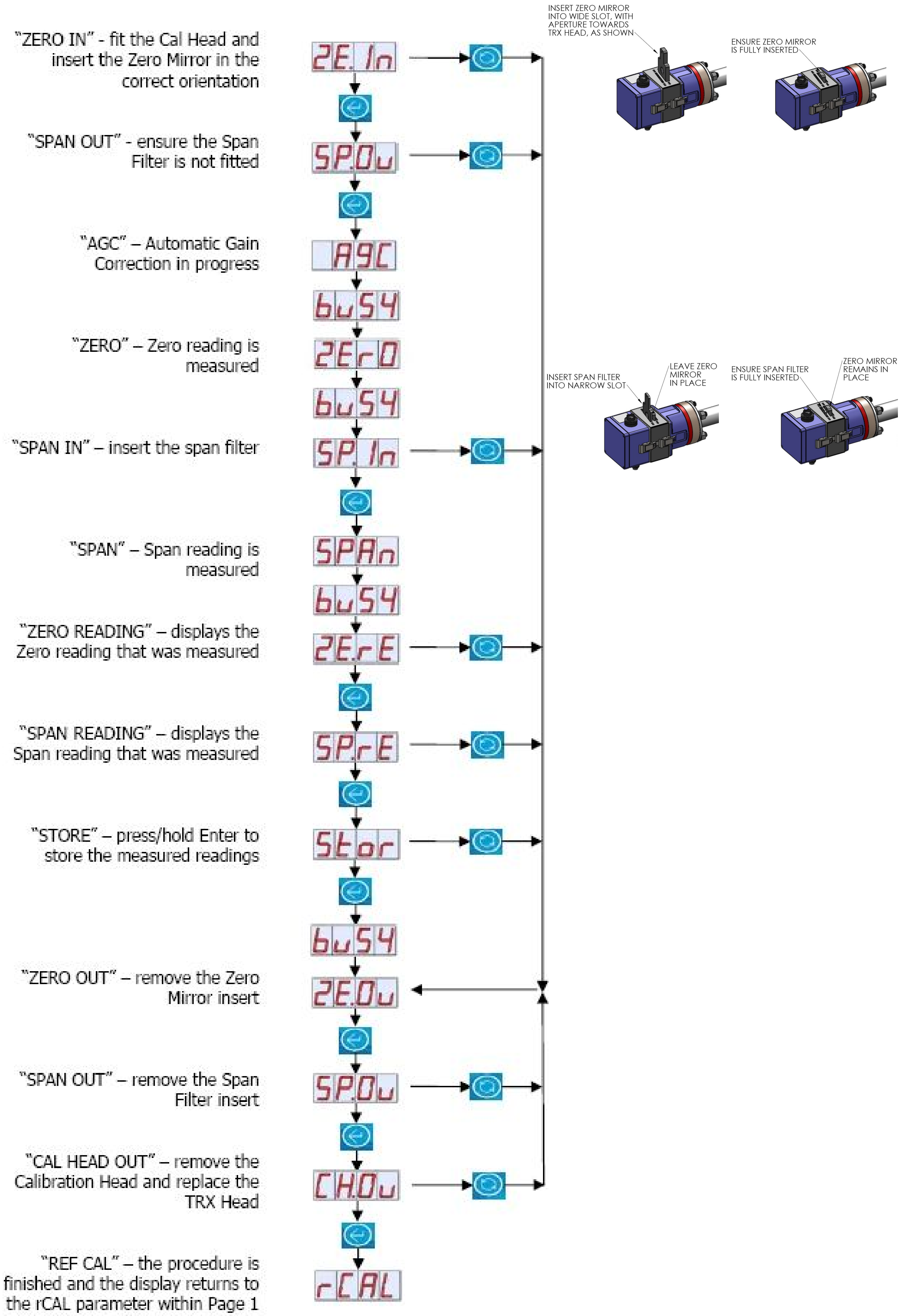
Each prompt in the OI display will require the operator to perform a manual task (such as removing an insert or removing the cal head). Once that manual task has been completed you should press and hold the Enter button (for approximately 1 second) until the next prompt appears.

At any stage during the reference calibration process the procedure can be stopped by pressing/holding the Cycle button. This action will cause the calibration routine to be abandoned, and will initiate the exiting procedure to safely return the instrument to normal operation.

To initiate the reference calibration, go to the rCAL parameter in the OI, press the Next button, then select yES with the Increase button and press Enter, as shown below.



The following page details the flow of the reference calibration routine from start to finish.


"ZERO IN" - fit the Cal Head and insert the Zero Mirror in the correct orientation
INSERT ZERO MIRROR INTO WIDE SLOT, WITH APERTURE TOWARDS TRX HEAD, AS SHOWN
ENSURE ZERO MIRROR IS FULLY INSERTED
"SPAN OUT" - ensure the Span Filter is not fitted
"AGC" – Automatic Gain Correction in progress
"ZERO" – Zero reading is measured
"SPAN IN" – insert the span filter
INSERT SPAN FILTER INTO NARROW SLOT
LEAVE ZERO MIRROR IN PLACE
ENSURE SPAN FILTER IS FULLY INSERTED
ZERO MIRROR REMAINS IN PLACE
"SPAN" – Span reading is measured
"ZERO READING" – displays the Zero reading that was measured
"SPAN READING" – displays the Span reading that was measured
"STORE" – press/hold Enter to store the measured readings
"ZERO OUT" – remove the Zero Mirror insert
"SPAN OUT" – remove the Span Filter insert
"CAL HEAD OUT" – remove the Calibration Head and replace the TRX Head
"REF CAL" – the procedure is finished and the display returns to the rCAL parameter within Page 1

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.

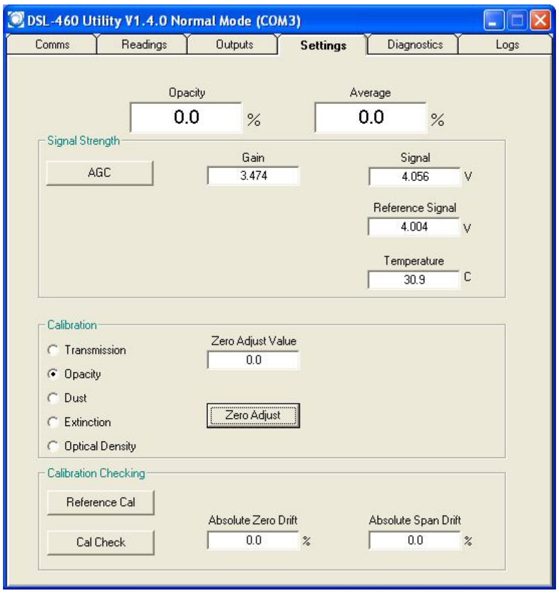
Before starting the calibration check ensure that the instrument has had a previous reference calibration, the same calibration inserts are available and that instrument has been powered for at least 1 hour.

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

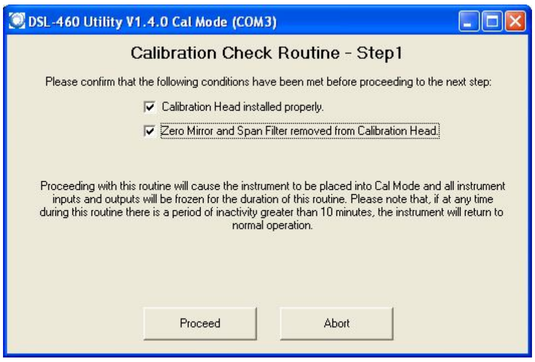
A PC or Laptop containing the DSL-460 Utility software must be connected to the TRX head via its external USB port.

To start the calibration check, go to the Settings tab of the DSL-460 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.



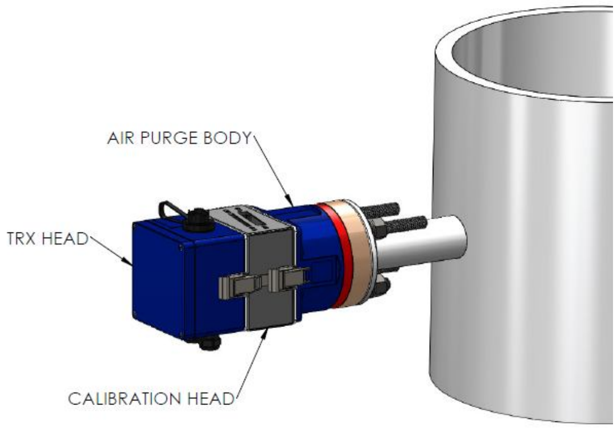
At any stage during the calibration check process the procedure can be stopped by selecting the Abort button. This will take you to the Exiting window which guides you to safely return the instrument to the normal window with no changes having been made to the settings stored in the instrument. The Exiting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

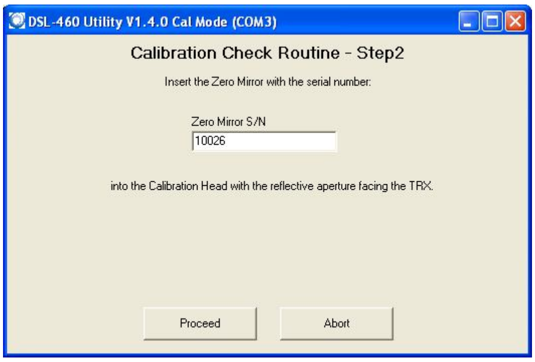
1. Check the first box to confirm that the Cal Head has been installed correctly, as shown below.



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

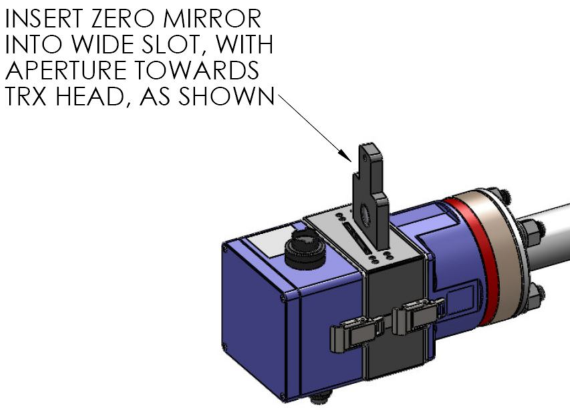
When both check boxes have been checked the Proceed button becomes available, click on this to proceed to step 2.

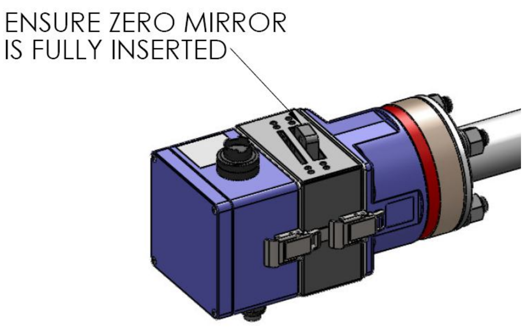
Step 2:



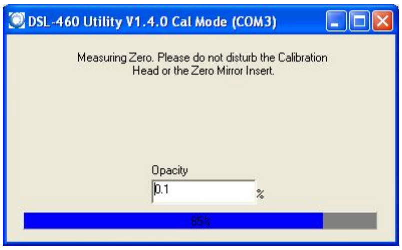
This step performs the Zero Mirror calibration check. The window displays the serial number of the Zero Mirror that was used to perform the reference calibration and the same mirror must be used for the calibration check. If a different Zero Mirror is used the calibration check becomes invalid.

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.



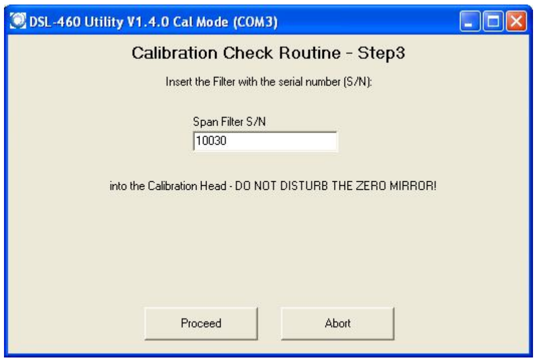


When this is complete select the check box. This makes the Proceed button available, click to proceed. When Proceed has been selected the instrument goes through an automatic measurement routine which takes about 20 seconds. A window is displayed showing the progress and also the measured opacity. Do 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.



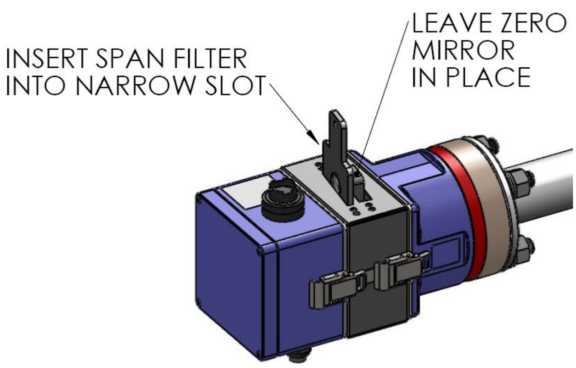
Do not disturb the head or the program until this measurement is complete. On completion the step 3 window automatically appears.

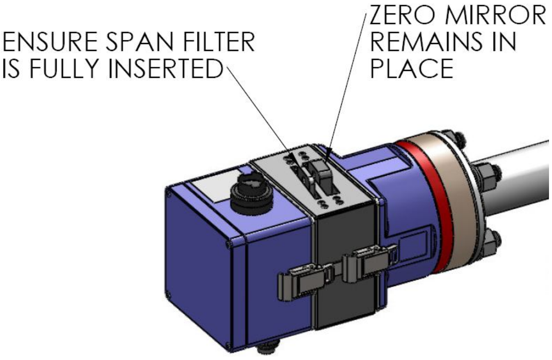
Step 3:



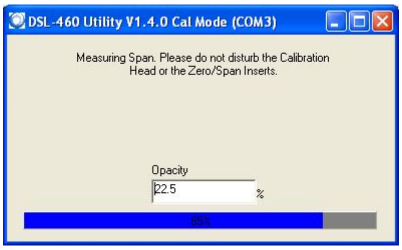
This step performs the Span Filter calibration check. The window displays the serial number of the Span Filter that was used to perform the reference calibration. The same insert must be used for the calibration check. If a different Span Filter is used the calibration check becomes invalid.

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.



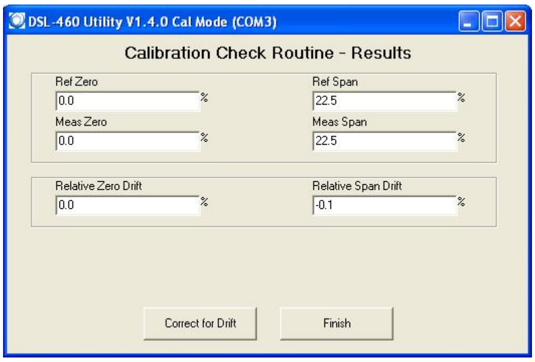


When this is complete select the check box. This makes the Proceed button available, click to proceed. When Proceed has been selected the instrument goes through an automatic measurement routine which takes about 20 seconds. A window is displayed showing the progress and also the measured opacity. Do 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).

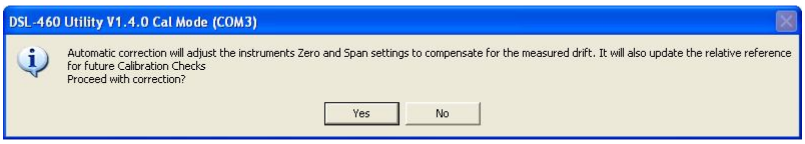
Small changes in measured opacity can arise through measurement repeatability, temperature variations etc. Therefore it is recommended that if the relative drifts are smaller than ±1.0% then there is no need to perform a drift correction.

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 ±1.0%.

Relative drifts greater than ±10% may be caused by a significant build-up of dirt on the lenses. Under these conditions the calibration check should be finished, without performing a drift compensation. The lenses of the TRX and Reflector heads should then be cleaned, and the calibration check repeated.

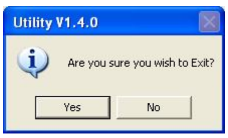
If after lens cleaning the relative drift is still large (more than ±10%) this may indicate either an instrument fault or a problem with the calibration checking (e.g. wrong inserts, damaged inserts, inserts not inserted correctly). It is recommend that under these conditions the drift is not corrected 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.

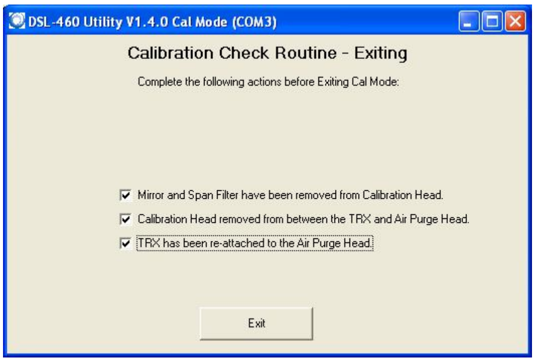


Selecting No will return you to the Results window.

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.

Calibration Check using the OI

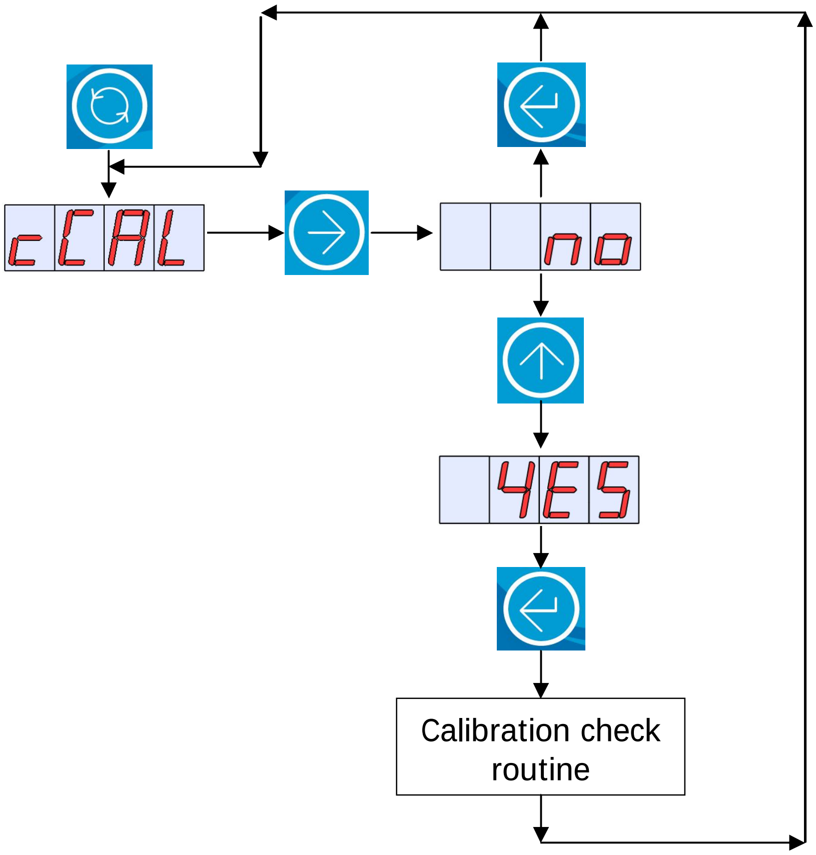
The underlying procedure for performing a calibration check is identical, whether it’s performed using the OI, or the Utility Software. This is discussed in detail in the previous section, and therefore not repeated in this section. Instead this section will only outline the flow of the procedure for performing a calibration check using the different interface (the OI).

In order to perform a calibration check using the OI it is necessary to initiate the cCAL mode and then follow a series of prompts in the OI display.

Each prompt in the OI display will require the operator to perform a manual task (such as removing an insert or removing the cal head). Once that manual task has been completed you should press and hold the Enter button (for approximately 1 second) until the next prompt appears.

At any stage during the calibration check process the procedure can be stopped by pressing/holding the Cycle button. This action will cause the calibration checking routine to be abandoned, and will initiate the exiting procedure to safely return the instrument to normal operation.

To initiate the calibration check, go to the cCAL parameter in the OI, press the Next button, then select yES with the Increase button and press Enter, as shown below.



The following page details the flow of the reference calibration routine from start to finish.

"ZERO IN" - fit the Cal Head and insert the Zero Mirror in the correct orientation

"SPAN OUT" - ensure the Span Filter is not fitted

"ZERO" – Zero reading is measured

"SPAN IN" – insert the span filter

"SPAN" – Span reading is measured

"ZERO DRIFT" – displays the Zero drift that was measured

"SPAN DRIFT" – displays the Span drift that was measured

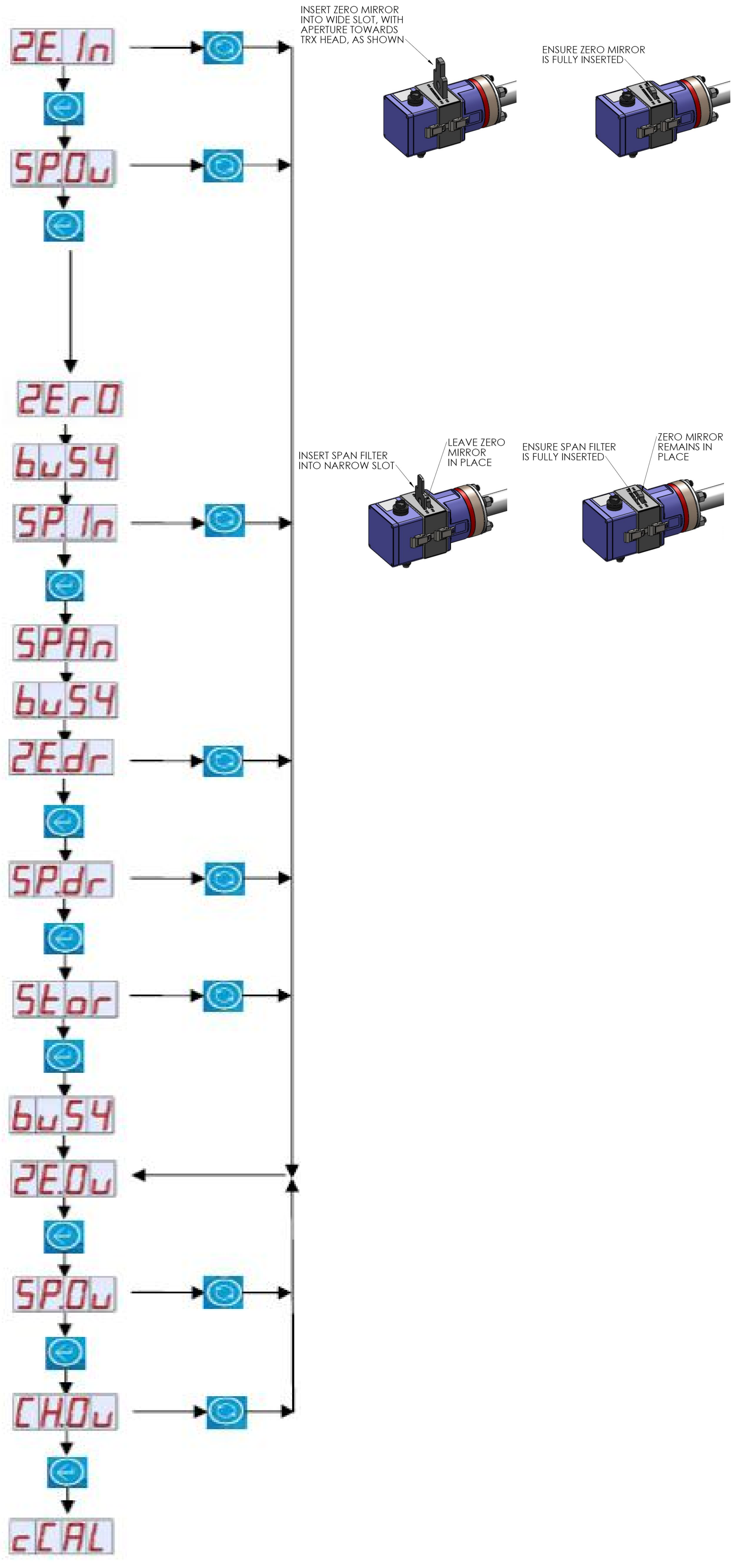
"STORE" – press/hold Enter to correct for drift or press/hold cycle to exit without saving any changes

"ZERO OUT" – remove the Zero Mirror insert

"SPAN OUT" – remove the Span Filter insert

"CAL HEAD OUT" – remove the Calibration Head and replace the TRX Head

"REF CAL" – the procedure is finished and the display returns to the rCAL parameter within Page 1



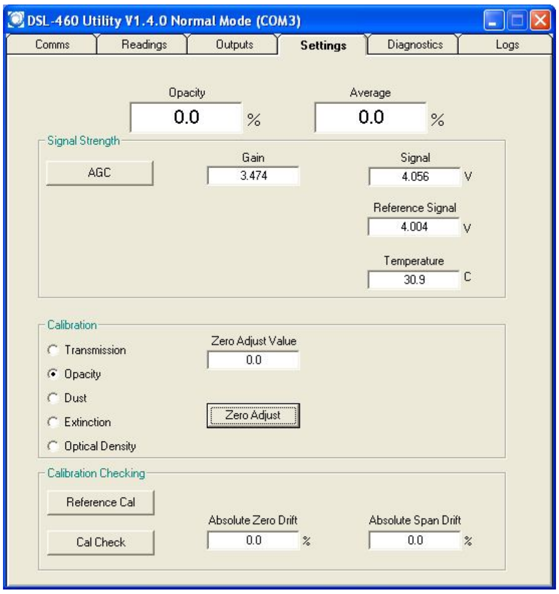
Relative and Absolute Drift

The DSL-460 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 and in the driF parameter in the OI.



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

The DSL-460 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 instruments 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 or in the rEF parameter in the OI. As the light output falls, so does the reference signal.

The DSL-460 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.

Error Messages and Trouble Shooting

Error messages can appear either in on the Readings tab of the Utility software, or on the display of the optional OI.

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

The DSL-460 TRX Head is the intelligent centre of the instrument, and all measurements, calculations, and data storage is done in the TRX Head. The OI is just a terminal which simply presents data from the TRX and provides an interface through which the operator can alter settings and parameters in the TRX Head. If the OI loses communications with the TRX it will be unable to access the data and settings in the TRX and it will therefore freeze all readings settings and values at their last known values, whilst activating a “HEAd” fault (see below for details).

The Utility software runs on a PC or laptop which can be connected via USB to either the DSL-460 TRX Head, or to the OI. If a PC is connected to the OI, instead of the TRX, the OI 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 OI, or if the OI loses communications with the TRX, or if he OI loses power, the Utility software will be unable to retrieve the required data from the TRX, and the Utility Software will disconnect.

LOREF_FAULT (Displayed as “Lo r” on the OI)
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 (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 is low, so the first action should be to verify that the DSL-460 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 OI or the circuit board inside the OI.

HIREF_FAULT (Displayed as "Hi r" on the OI)

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 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 (Displayed as “Hi S” on the OI)
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 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.

TEMPERATURE FAULT (Displayed as “TEnP” on the OI)
The DSL-460 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 -10 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.

MEMORY FAULT (Displayed as “EECh” on the OI)
The DSL-460 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 OI, 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.

Head Fault - “HEAd” (only displayed on the OI)
This message is specific to the OI. This message indicates that the OI has lost communications with the DSL-460 TRX Head.

This fault is usually caused by a problem with the cable between the OI and the TRX Head. Check that the wiring connections have been made in the correct order (consult the Installation Manual), and that all the connections are sound. Ensure that all two part terminals have been pushed in properly and in the correct orientation. Check that the cable is intact and has not been severed or damaged.

This problem can also be caused by having an incorrect combination of negative and positive bias applied to the RS485 signals in the interconnecting cable, or by missing termination links. Check that the RS485 bias links and termination link (marked as POS BIAS, NEG BIAS, and TERMINATION) are properly fitted on the main OI circuit board (up underneath the front panel). Also check that the termination link (marked as LAST HEAD) is fitted on the circuit board in the TRX Head.

This message will also appear if the TRX Head loses power. Check that the TRX has power (use a DVM or open the TRX Head and look for flashing LEDs on the TRX circuit board).

Warning! When a HEAD fault is activated the OI freezes all readings, values, and settings at the last known levels. This includes the measurement reading, analogue output levels, and Level Alarm status, with the exception of the Service Alarm which will activate to indicate the fault.

CRC Check Fault - “CrC” (only displayed on the OI)

This message is specific to the OI. This message indicates that the OI has regular data corruption occurring in the communications between the OI and the TRX Head.

The DSL-460 employs real time CRC checking on the communications between the OI and the TRX Head to maintain data integrity. This checking can determine if any packets of information sent between the OI and the TRX, or vice versa, have been corrupted.

If the instrument finds an error in a data packet, it will reject that data and request that the data be resent. If the CRC checking identifies a repeatedly high proportion of CRC failures the instrument will flag a CRCFAULT.

CRC failures are caused by corruption of the data passed along the interconnecting cable between the OI and the TRX. Corruption is rare and is usually caused by RF interference, electromagnetic radiation, or a poor connection in the wiring.

Check that the interconnecting cable is screened and that the screen is connected to Earth as described in the separate installation manual. Also check all wiring connections for loose wires, poor connections, or loose terminal screws.

This problem can also be caused by having an incorrect combination of negative and positive bias applied to the RS485 signals in the interconnecting cable, or by missing termination links. Check that the RS485 bias links and termination link (marked as POS BIAS, NEG BIAS, and TERMINATION) are properly fitted on the main OI circuit board (up underneath the front panel). Also check that the termination link (marked as LAST HEAD) is fitted on the circuit board in the TRX Head.

Warning! When a CRC fault is activated the OI freezes all readings, values, and settings at the last known levels. This includes the measurement reading, analogue output levels, and Level Alarm status, with the exception of the Service Alarm which will activate to indicate the fault.

Revision Control

Version	Revision Date	Revision Details	Author
V1.0	26/08/2011	Original	Dominic Sheedy
V1.1	28/08/2011	Added Dual Units text, updated Dust Units screenshot.	Dominic Sheedy
V1.2	18/01/2012	Minor wording changes, erase log description added.	Dominic Sheedy
V1.3	17/04/2012	Cal Check using OI – clarification made to flow diagram	Dominic Sheedy
V1.4	29/01/2014	Fault code limits updated.	Dominic Sheedy

All technical details and specifications are subject to change without notice