# CEMForm Manual
## Ver. 2.9

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# 1 CONTENTS

## 2   INTRODUCTION

### 2.1   CEMFORM

**CEMForm** is a PC based program, designed to operate under practically all Windows operating systems. Operation is performed by using simple mouse instructions.

CEMForm forms part of an Envirosoft suite of environmental programs.
The main Envirosoft environmental programs are:

**CEMForm**
Typical data analysis (normalization and averaging) to provide real time and historical data analysis. Also acts as the interface to other data export programs to provide outputs from processed data.

**CEMPort**
Specialist program to summerise emissions data into a format for submission to the authorities or for internal housekeeping or analysis.

**CEMQual**
Specialist program to analyse and report drift and validity of analyser calibration, based entirely upon the European standard EN14181.

**WIDReport**
Specialist Waste Incineration Directive reporting program that provides the data in a dedicated format suitable for submission to the authortites.

**LCPD**
Specialist power Generation reporting program that provides the data in a dedicated format suitable for submission to the authorities. Covers reports required under the Large Combustion Plant Directive.

**Figure 1 Envirosoft Ltd - Environmental Programs**

## 2.2   THE CEMFORM PROGRAM

CEMForm is a PC based program, designed to operate under all Windows operating systems. Selections and information are available from several pages each accessed as a Windows style 'tabbed notebook'. Operation is performed by using simple mouse instructions.

Measurement data may be displayed either as a spreadsheet style grid or as multi-measurand, coloured trends. Other screens allow the retrieval of diagnostics information and calibration data where this is available.

CEMForm converts emission measurements to the units required for most legislation – mg/m3 at reference conditions; these units are labelled as mg/Nm3. The 'raw' data before this conversion may be expressed in terms of ppm or simply mg/m3.

There are also special units required under the Large Combustion Plant Directive where the data must be corrected for uncertainty, mg/Nm3C. CEMForm provides four rolling averages, from 60 seconds to 24 hours; these may be configured as required. The program refreshes these averages when new data becomes available.

Two alarms are provided for each measurement, for each rolling average and measurement unit in order to help plant operators meet the requirements of local legislation. All data is available to display as a grid of real-time measurements and averages, or in graphical format.

## 2.3   THE CEMFORM MANUAL

This manual describes the operation and function of the CEMForm program and explains how to use the program to display the information as required.

For information concerning any of the other CEMSuite programs please refer to the relevant documentation.

# 3  SOFTWARE OPERATION

## 3.1  COMPUTER REQUIREMENTS

**PC Requirements (minimum)**

Processor: Intel i5
Memory: 4GB Ram
Graphics: Intel HD 3000
Display: 1920x1080 pixel resolution. 21" monitor or greater.
Hard disk: 250 GB
Modem/3G Dongle: Required for support
Operating system: Windows 7 Pro

The software will operate on PCs with lesser specifications. However, some operations involve lengthy calculations and the time taken to perform them may become tiresome.

## 3.2  INSTALLATION

The software is provided on CD-ROM. From Windows explorer, or 'My Computer', select the relevant drive and run the setup program.

**Note:** If the CD drive has been set for 'Auto insert notification', the installation should start automatically.

Once started follow the instructions on the screen. The installation program creates files and folders and provides a shortcut to start the program from the Windows Start button.
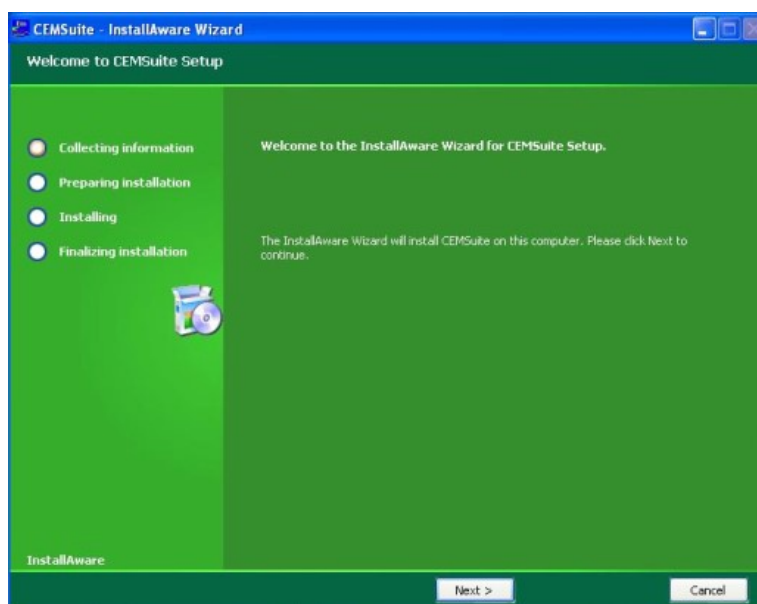


**Figure 2 CEMSuite Setup**

*Installation continued...*

**Note:** Once the installation has completed, the PC's Borland Database Engine will also need to be installed/updated. CEMSuite will start this process automatically.



**Figure 3 Borland Database Engine**

## 3.2.1    USB INSTALLATION

The software may be supplied with a USB 'dongle' and will not function without it being present in a USB socket. To install the dongle drivers, use Windows Explorer to locate a subdirectory on the CD-ROM called 'Dongle driver' and open up this sub-directory. Double-click on the file called setupdrv.exe and this will install the dongle drivers. The CEMForm program will now operate normally.

## 3.3 ASSOCIATED PROGRAMS

### 3.3.1 CEMSYNC

Envirosoft's program CEMSync should be in operation to copy the historic and live data sets from the DSU(s). This may be seen in the taskbar as the following icon:

**Figure 4 CEMSync Icon**

The timing of the CEMSync program operations is:
- Between 5 and 10 seconds past each minute: copy the short term live data set from the DSU(s).
- Between 10 and 25 seconds past each minute: process the above data.
- At 20 past midnight, download the historic data for the previous day and completely refresh the rolling 24-hour data set.

### 3.3.2 CEMSOCKET

Should there be more than one DSU on the CEMSuite system, Envirosoft's program CEMSocket should be in operation on the taskbar; it has the following icon:

**Figure 5 CEMSocket Icon**

# 4   QUICK START GUIDE

## 4.1   STARTING THE PROGRAM

Start the program by double-clicking the left-hand mouse button on the CEMForm icon; which should now reside on the PC desktop. Alternatively, it can also be started by pressing the Windows Start Button > Programs > Envirosoft > CEMForm.

**Figure 6 CEMForm Desktop Icon**

## 4.2   INITIAL SCREEN

After starting the program, the 'Live data' screen is displayed. From here 'measurement groups' with associated measurands are available for display along with measurement units and rolling averages. Up to 8 trends are available on the right-hand side of the screen and Alarm, ELV and QAL2/3 details are displayed below the measurand group information.
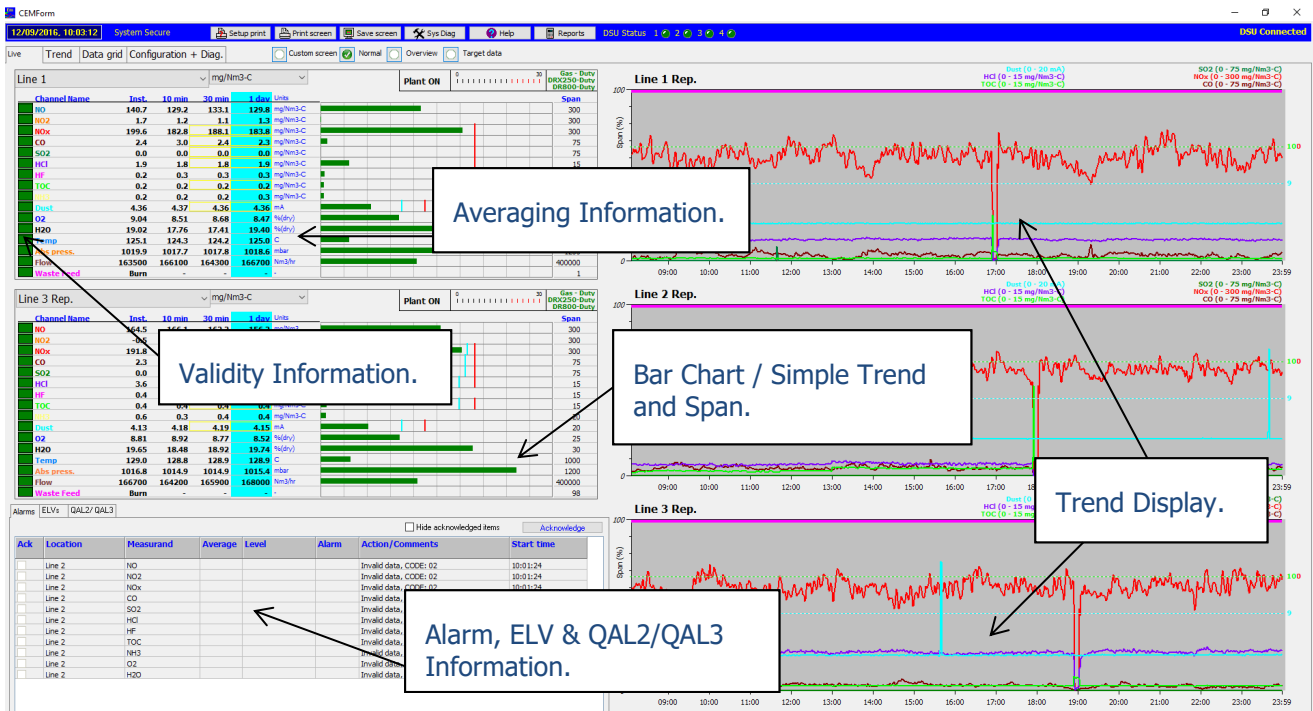


**Figure 7 Initial Screen**

Each area of the screen is examined individually within this manual.

## 4.3 TOP BAR INFORMATION

This area allows access to the following information and features:

Select and setup the required printer for use.

Save the screen as a JPEG image – Filename and save location are requested.

Start the Report program – More information can be found in the CEMPort Manual.



**Figure 8 Top Bar**

Displays the connection status of the Data Storage Units (DSUs).

Print the current screen.

Displays various system status information such as other Envirosoft CEMSuite programs running and the last date and time data was received.

Displays version information, Envirosoft contact details and a link to open this manual in PDF format.

## 4.4 TAB SELECTION

The Tab selection is used to move between different information pages:

Live Data Tab – Live Information for all measurements.

Data Grid Tab – Allows operators to view recent detailed averages.



**Figure 9 Tab Selection**

Trend Tab – Allows operators to view and configure trend information.

Configuration + Diag. Tab – CEMForm configuration and information.

Each page can be selected by left clicking the required page.

# 5   PROGRAM OPERATION

## 5.1   LIVE DATA PAGE

The Live Data screen is displayed by selecting the Live tab on the pages tab bar.
From here all measurands are available for display, for all available measurement units and for four rolling averages. All averages are displayed for a selected measurement unit.

Up to 8 trends are available on the right-hand side of the screen showing a minimum of 3 measurands to a maximum of 9 depending on the number of trends displayed. Holding the shift key will allow the operator to move the cursor along the trend, detailing time and channel readings. Alarm, ELV and QAL2/3 details are displayed below the measurand group information.



**Figure 10 Live Data Screen**

Each area of the screen is now examined individually.

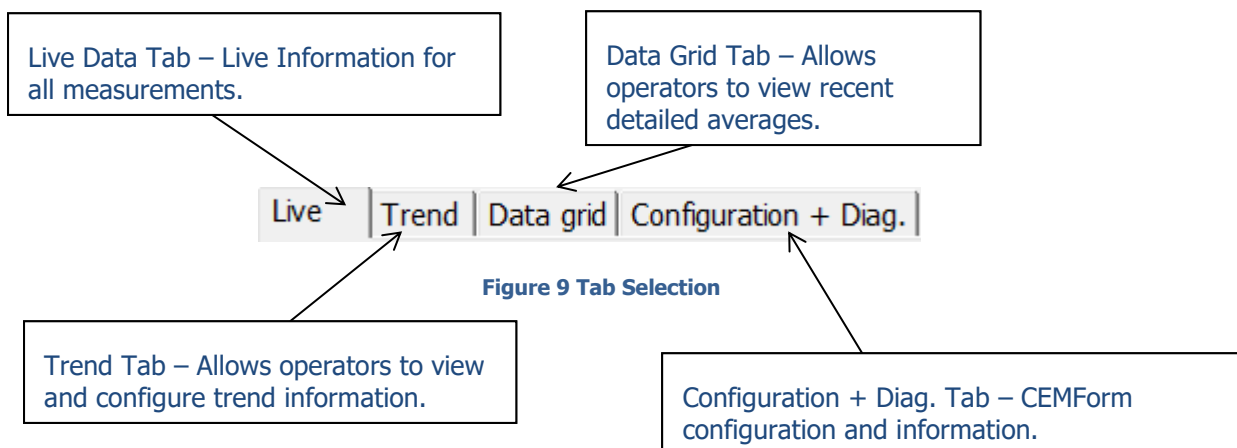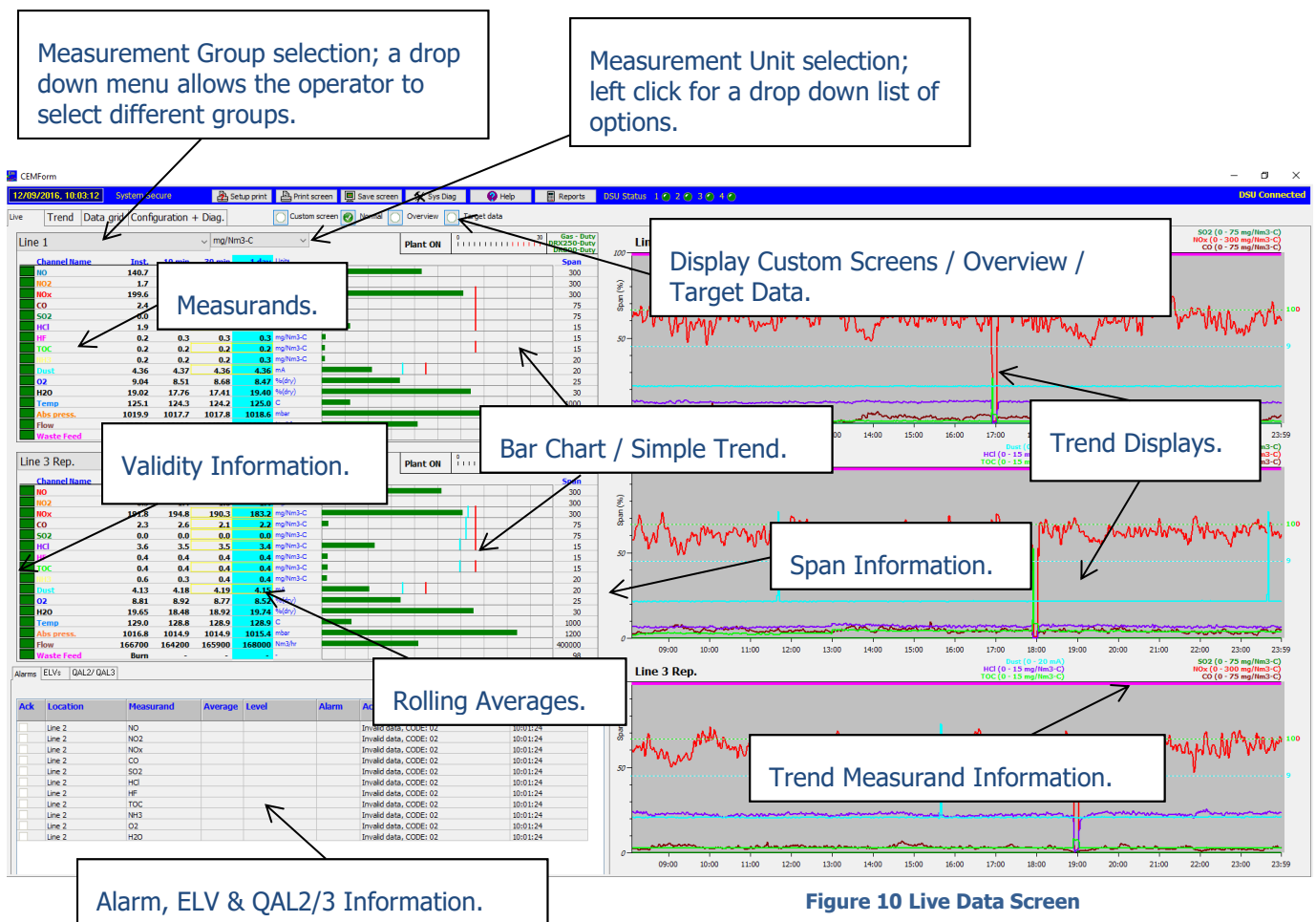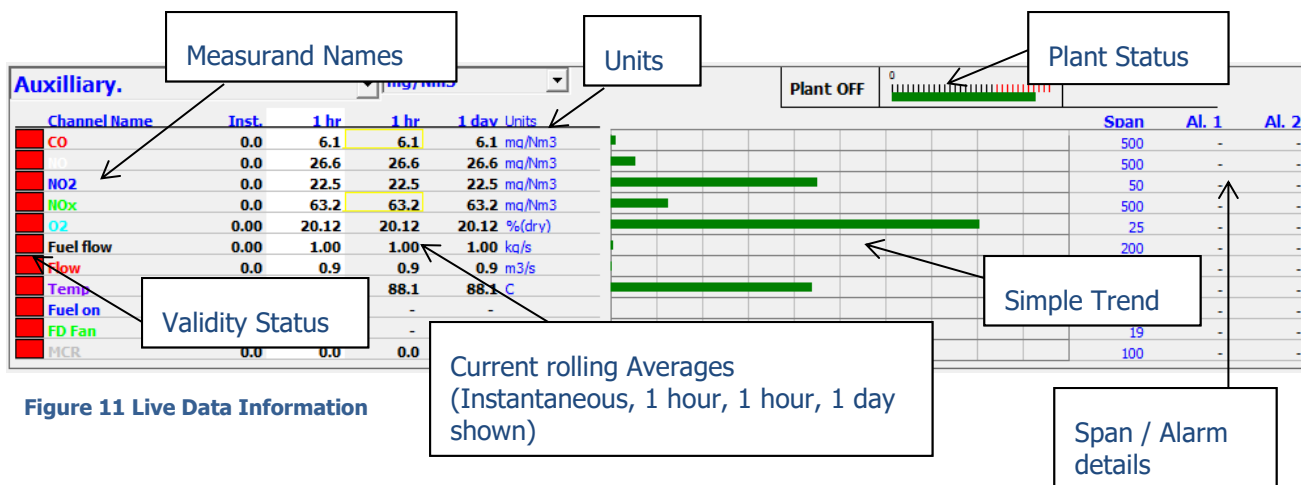## 5.2 LIVE DATA INFORMATION



**Figure 11 Live Data Information**

### 5.2.1 VALIDITY

Each measurement measurand on the system may have the validity information available – this depends on the source of the data, and whether the instrumentation allows for an assessment of validity. The coloured box to the left of each measurand name shows the validity and may be one of four colours:

Red              No data available – usually associated with a communication problem.
Yellow          Data available, but the data is not considered valid.
Green           Data valid.
White           The plant is shut down.

Hold the mouse pointer over a validity box and an information box appears to provide more information.

**Note:** In order for the validity information to be up-to-date, be sure to select the 60 seconds average. For longer-term averages, data is usually considered valid should 66% of the data or more be available, i.e. for a 1-hour average, 40 minutes of valid data must be present. If this threshold is not reached, the message 'Not enough data for the selected average' is displayed.

### 5.2.2 MEASURAND NAMES

Each measurand is identified by its name in a selectable colour (selected from the Trends page.) Should the measurand be used to normalise the measurements within the group to reference conditions, the standard level is given in brackets following the name. For the examples on the preceding page, each group of measurements is being normalised to standard values of Temperature (273K), Oxygen (15%), Water (Dry) and Pressure (101kPa).

## 5.2.3    AVERAGES – SHORT TERM

Values for the four rolling averages are displayed to the right of each measurement name. The user may select which of these averages are used to drive the bar charts/simple trends for the group by clicking the mouse over the relevant average column; to indicate which average is selected; the column is shaded in blue.

These may be configured from instant up to 1 day.

## 5.2.4    AVERAGES – LONG TERM

Long term averages can be selected in the configuration page. These include Year-to-Date, Month-to-Date, mg and kg.

## 5.2.5    UNITS

Up to four different measurement units are available for display; this depends on the type of measurement. Some examples are given below:

For a <u>Gas</u> measurement:

| | | |
|---|---|---|
| 1. | ppm: | Usually the 'raw' data from the analyser. |
| 2. | mg/m3: | Density of the gas as it exists in the duct – used as an interim measurement for the calculation of mass emission – kg/hr. |
| 3. | mg/Nm3: | Density of the gas at the reference conditions. |
| 4. | mg/Nm3-C | Normalised concentration. In such cases, the mg/Nm3 units have been corrected according to the recognised 'uncertainty' of the measurement. |
| 5. | kg/hr: | Mass emission calculated from mg/m3 and the flow as it exists in the duct. |

For a <u>Dust</u> measurement:

| | | |
|---|---|---|
| 1. | Opacity: | Usually the 'raw' data from the analyser, other alternatives Include; % output – triboelectric devices, extinction and mA. |
| 2. | Mg/m3, mg/Nm3 and kg/hr as gas measurement above. | |

For a <u>Flow</u> measurement:

| | | |
|---|---|---|
| 1. | m/s: | Gas velocity, the raw measurement information. |
| 2. | $m^3$/s: | Gas flow as it exists within the duct – (1) x the cross sectional area. |
| 3. | $Nm^{3/}$s: | Gas flow at the reference conditions. |

Some systems have been configured to replace the kg/hr unit with a normalised density; this is referred to as $mg/Nm^3C$. In such cases, the $mg/Nm^3$ units have been corrected according to the recognised 'uncertainty' of the measurement. Other measurements and calculations are available, but this covers the majority of emission monitoring units.

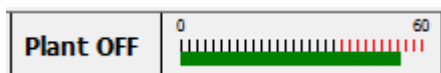## 5.2.6    PLANT STATUS & AVERAGE TIMER



**Figure 12 Plant Status**

CEMForm will display real-time status information, detailing the plant and CEMForm's reporting status.

The status information box will show one of four reports:

**Plant OFF**:    Plant Shut Down
**Plant ON**:    In operation or reporting
**No Report**:    In operation but not for reporting
**Mass Only**:    In operation but only for mass operation

The Averaging information is displayed to the right of the Plant Status. This bar will indicate the start and end of the average. The ticks change colour when there is enough data in the average to report.

The bar will increase in minutes as the current averaging period matures, this will be from 1 to 30 minutes for WID applications, and from 1 to 60 minutes for LCPD applications.

## 5.2.7    SPAN & ALARMS

The Span for each individual measurand is displayed by default. The Alarm levels are displayed if an engineer is currently logged into CEMForm. Both the Span and the alarms can be configured at any time by an engineer; to do this switch to the Configuration + Diag. page and log in by entering your Engineer's username and password.

**Note:** No changes may be made if the security code has not been entered correctly.



**Figure 13 Span & Alarms**

Once logged in the user can then return to the 'Live' page and edit the values by double-clicking the value currently displayed.

A pop-up selection box to change the span/alarm level will then appear. Once a new value has been entered, press OK to save the new level.
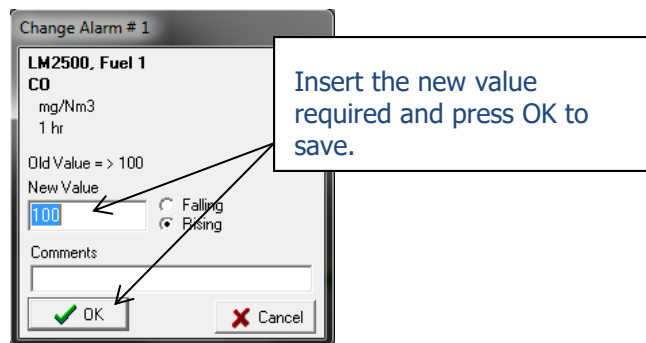


**Figure 14 Changing Alarms**

A comment may also be added that will display when the alarm is triggered.

**Notes:**
1. Three span values are available: ppm, $mg/m^3$ & $mg/Nm^3$, and for kg/hr; whichever unit is selected for display is available for modification.
2. There are two alarms for each average and each of the measurement units for every measurand, take care not to apply too many alarms – they should be meaningful.
3. A message may also be stored with each alarm; this is displayed in the 'Show Alarms' list.
4. An alarm value of 0 (or null input) will remove the alarm setting.
5. Should an alarm 1 occur, the bar will turn from green to yellow; an alarm 2 will turn the bar red and sound an alarm.

## 5.2.8    TARGET DATA

Should an alarm have been defined, the target data will indicate the emission level that can be operated at for the rest of the average in order for the level to finish below the alarm level. Should the current average be below the alarm level, the target value will indicate a level higher than the alarm value.
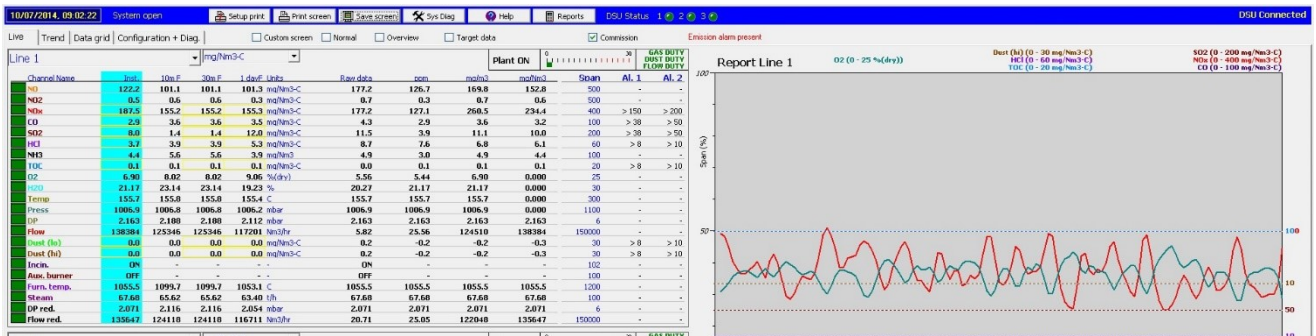
## 5.2.9    COMMISSIONING VIEW



**Figure 15 Commissioning View**

To view the Commissioning page the user must be logged into CEMForm with an Engineers username and password. Once enabled this gives the operator access to instantaneous data in the form of raw data (with no QAL2 factors applied), ppm, mg/m3 and mg/Nm3. This is useful during commissioning to check the calculations used, and also to remove the effect of QAL2 when comparing the CEMForm data with that at the analysers directly.

## 5.2.10    SWITCHING INFO

Should redundant analyser data be available for the same release point, the area to the right of the plant status information will reveal the source of the data for the reports. For such systems, three data pages are usually defined: duty analyser data, standby analyser data and the report data. The report data will normally consist of duty analyser data, but when switched either due to invalid duty data or a manual input, the standby data is used. Note that although this information is displayed for the duty analyser page, this is only for information, only the report data page will reflect the actual data source displayed.

Three DUTY/ STANDBY switches are available and they are usually defined as GAS, DUST and FLOW for the three main types of measurement used.
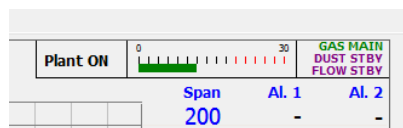


**Figure 16 Switching Panel**

In the example shown here, the gas analyser data is from the DUTY analyser, whereas the Dust and flow data are from the STANDBY analysers. This information is also available for viewing on the top bar of the trend display.

## 5.2.11    OVERVIEW

The overview checkbox allows users to view a configurable selection of measurands from any of the measurement groups.

## 5.2.12    CUSTOMISATION

The size of the live data information section can be adjusted to span the majority of the display in order to cater for screens with a high resolution. This can be achieved by altering the following parameters on the 'live page config' sub-tab of the 'Configuration + Diag' tab:

- Live Page Row Height          (adjusts the height of each channel row)
- Live Page Font Size           (adjusts the font size of all live data information text)
- Live Page Width Offset        (adjusts the width of the channel name & numerical section)
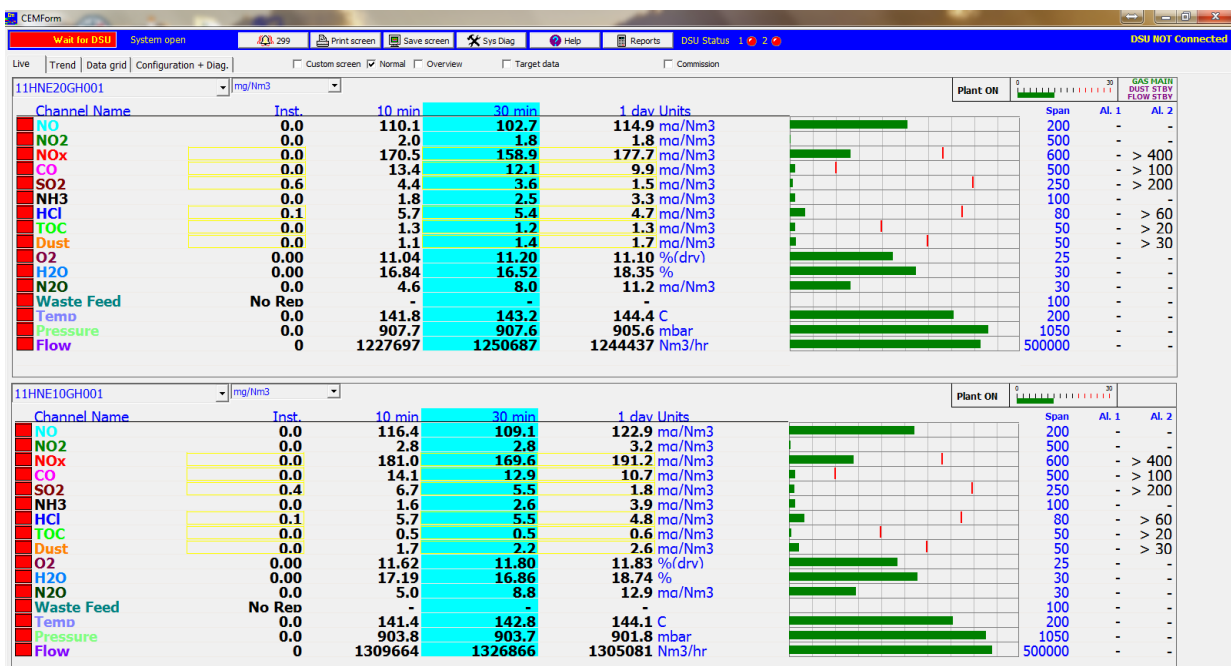- Live Page Bar Offset          (adjusts the width of the data bar section)
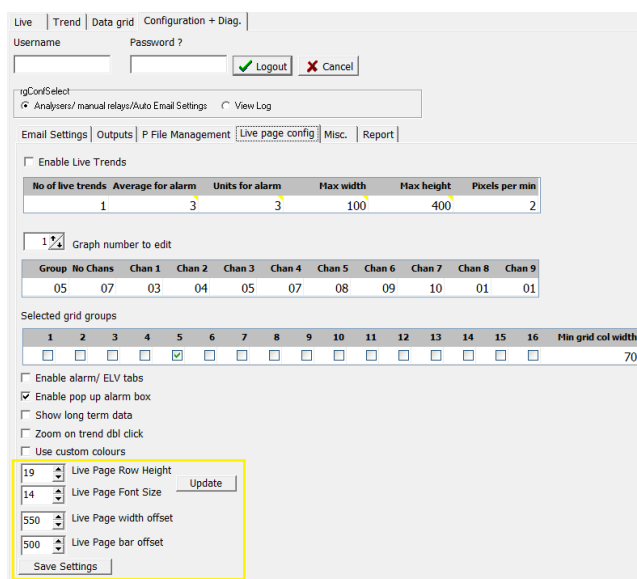


**Figure 17 Expanded Live Screen**



**Figure 18 Live Screen Customisation Settings**

## 5.2.13   CUSTOM LIVE SCREENS

If required, Envirosoft can produce some custom screens that can highlight specific plant and emission information (An example is shown below). These are highly application specific and may contain any information from the CEMSuite system in formats and colours defined to assist operators.
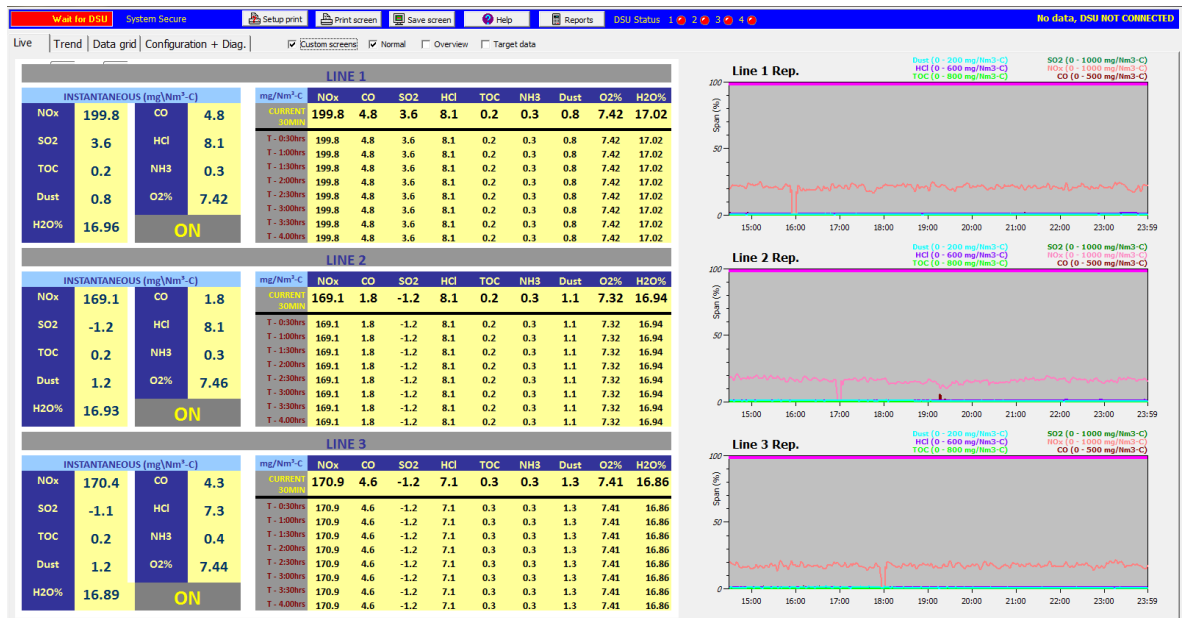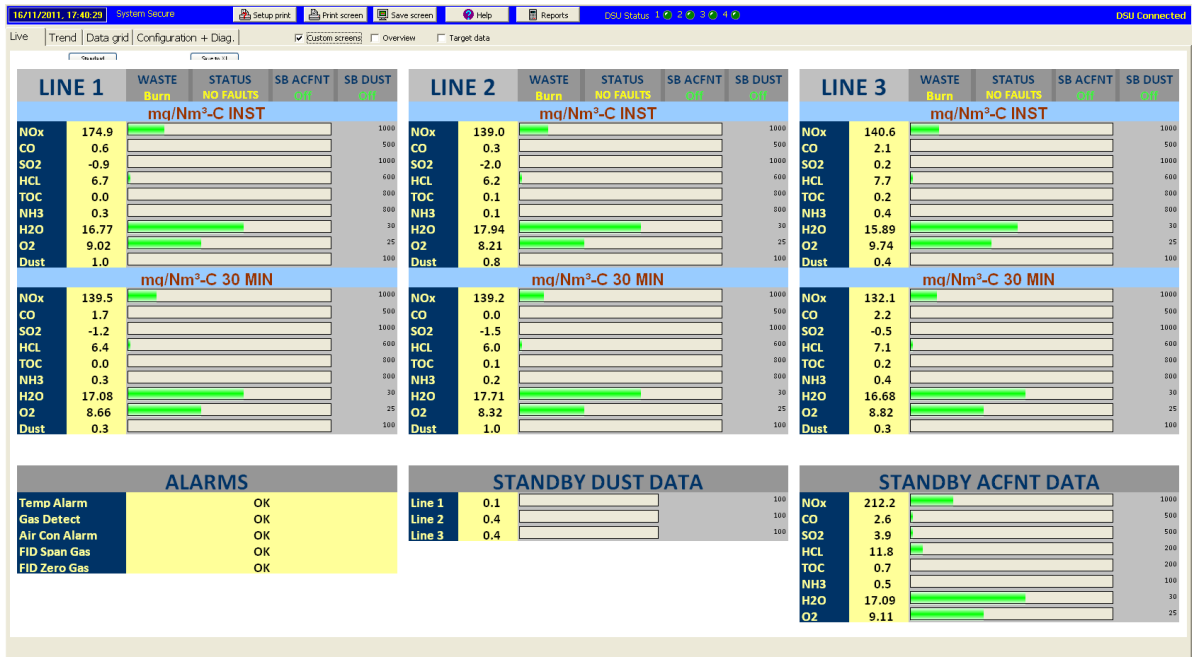


**Figure 19 Custom Screen Examples**

## 5.2.14   NON-STANDARD LIVE DATA DISPLAYS

Some system configurations may have displays different from those described above.

If a weather station is available, a wind rose and typical meteorological units are displayed as illustrated below. Typically, the weather station will output data in imperial units; the CEMForm program converts these to metric units. This conversion is also conducted for the trends display.
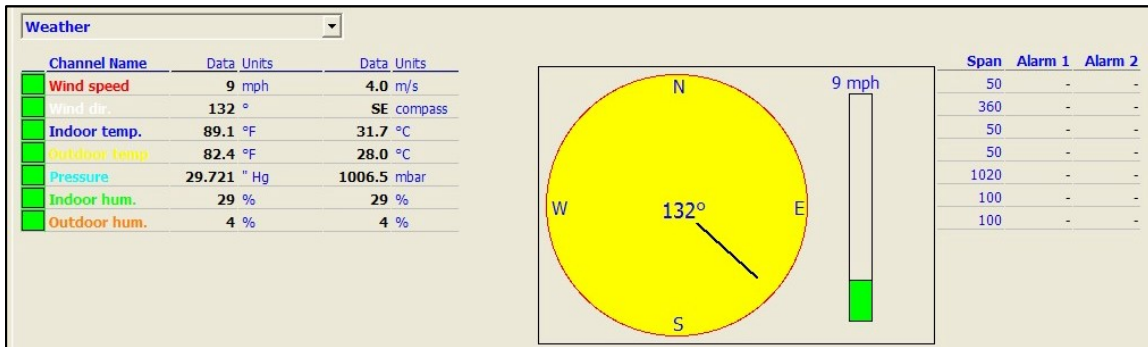


**Figure 20 Weather Display**
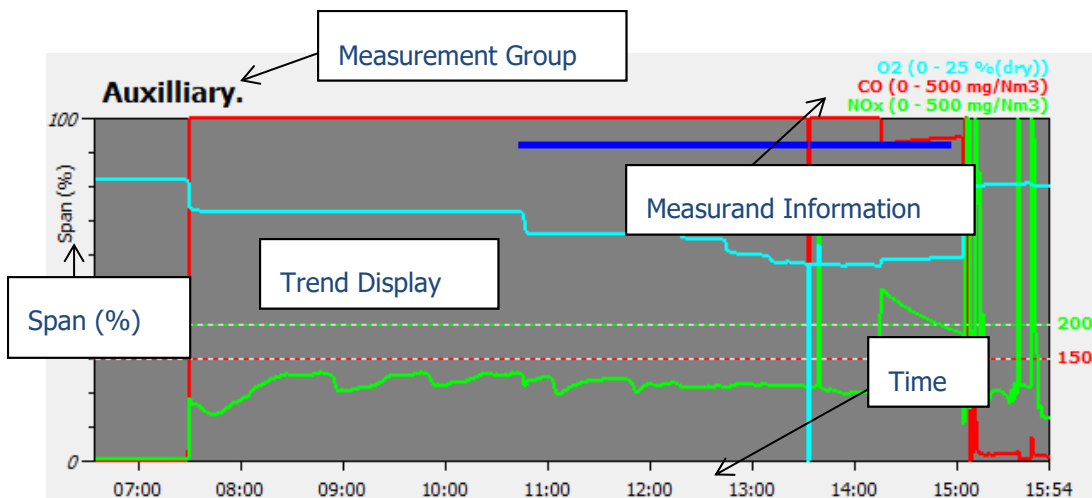
## 5.2.15    TRENDS



**Figure 21 Trends**

Up to 8 trends can be displayed on the right-hand side of the Live data page. These individually show a minimum of 1 measurand up to a maximum of 9. These will occupy the right-hand side of the screen; if 1 to 3 has been selected, they will be displayed on top of each other, 4, 6 and 8 will be seen as a grid, two columns wide.
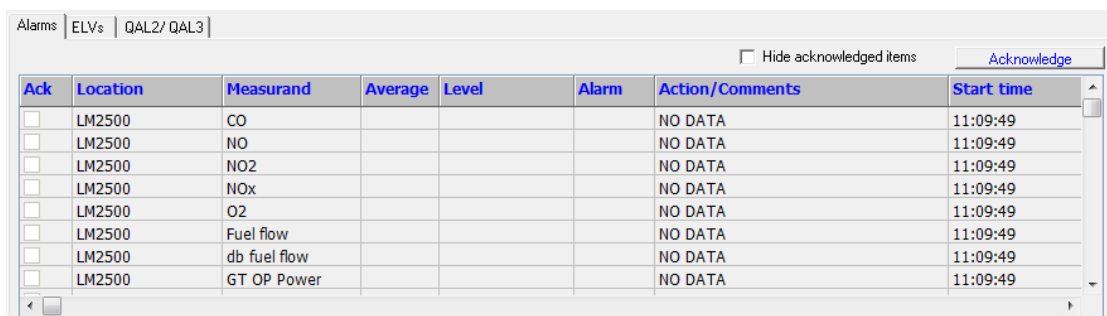
Left clicking the trend will bring up a specific time and measurand information (top left of the trend) relating to the cursor position on the trend. Right clicking will remove this information.

By holding down the Shift key the cursor can dynamically move along the trend, displaying time and measurand information relating to its position.

## 5.2.16    ALARMS / ELVS / QAL2/3

The Alarm information box details any excursions above the set alarm values. The information displayed includes; Location and Measurand identifiers, any comments that were added when setting the alarm value and the time when the alarm was triggered.

A simple checkbox system allows each alarm to be individually acknowledged, with the option to hide acknowledged items.



**Figure 22 Alarms / ELVs / QAL**

The ELV tab allows the operator to view the location, measurand, 1 hour and daily ELV limits and the units for any set ELVs.

The QAL2/3 tab allows operators to view QAL2 settings and the latest QAL3 results for both span and zero. These will have been determined and stored by the CEMQual program.

## 5.3   TREND PAGE

The Trend screen is displayed by selecting the Trend tab on the pages tab bar.

Group / Average / Units / Date Selection

Trend Display / Settings

Measurement Information and Display key

Trend Display Information and Cursor Tools

Long Term Trend Selections

Data validity display

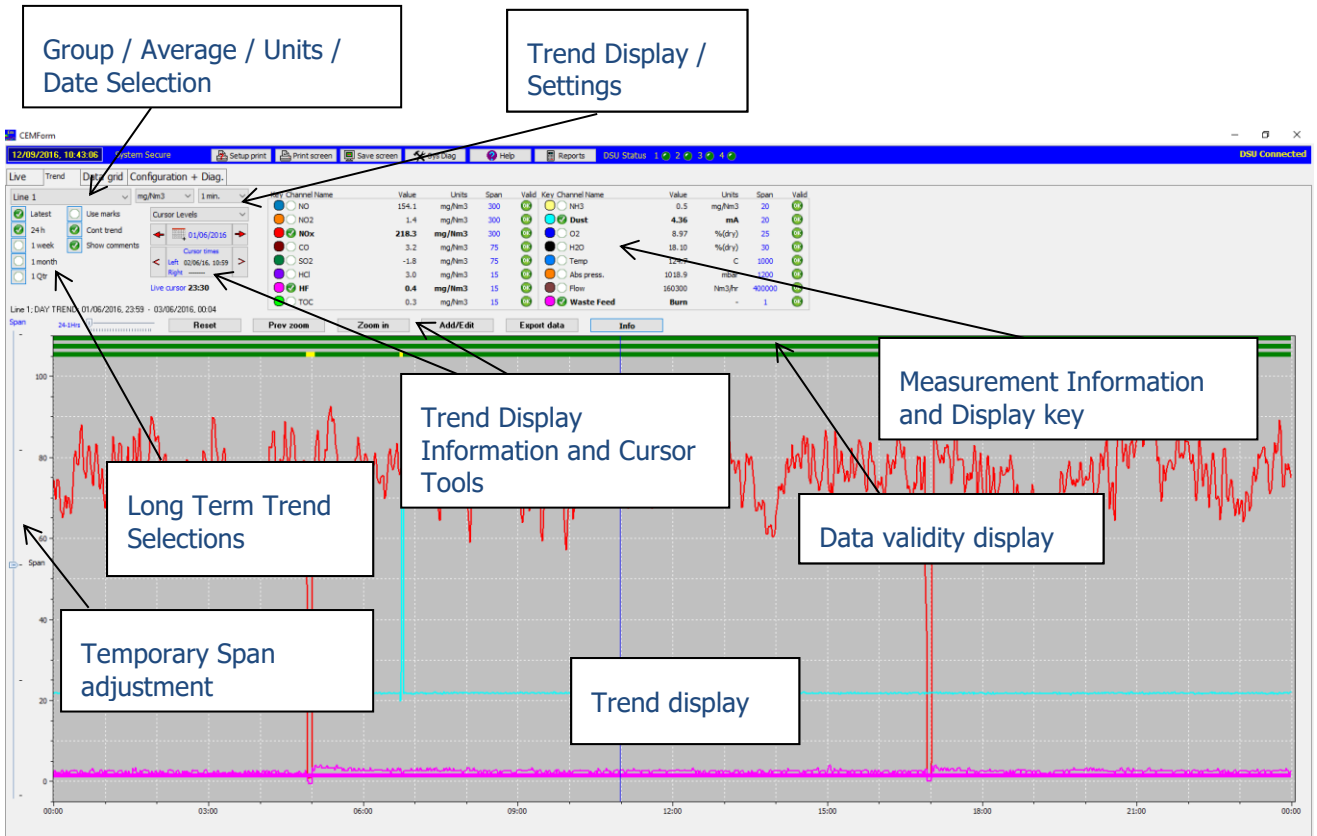Temporary Span adjustment

Trend display



**Figure 23 Trend Page**

## 5.4   TREND INFORMATION

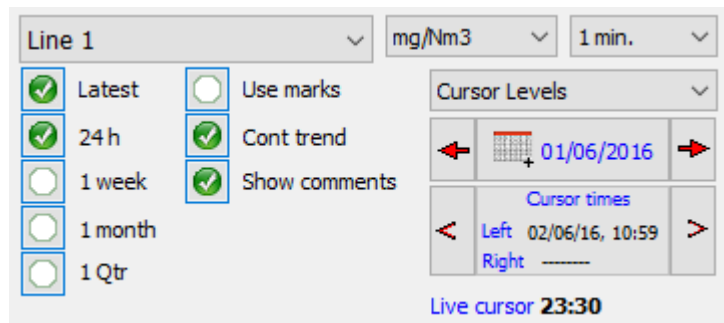### 5.4.1   GROUP, UNITS, AVERAGES AND SHORT TERM SELECTION

**Figure 24 Group Selection**

In this panel, the operator can select the group, measurement units, averaging, date and period they wish to display on the trend. Either the latest date available or a specific historical date can be selected.

The group, units and rolling average for the trend are selected via a drop down menu. The last item within the average selection is 'Custom'; if this is selected, another input is required – a time in minutes that is desired for averaging.

The clock symbol and date, below the unit selection, brings up a calendar from where the user may select any date from which to retrieve the data. Dates with available data are coloured green. The period of time to display can be selected using the checkbox to the left-hand side. The two red directional arrows either side allow the operator to move the trend forwards or backwards in time. (The amount of time depends on the which period checkbox is currently selected, between 24 hours and 1 quarter)

The latest checkbox allows the operator to lock the trend to the latest data, i.e. the trends will always reflect the latest data available when the page is selected.

### 5.4.2   TREND DISPLAY OPTIONS (KEYBOARD SHORTCUTS)

A number of keyboard shortcuts have been added to CEMForm to allow operators more control when viewing and navigating the trend.

The 'Zoom in' (shortcut: **Z** key) and 'Prev zoom' (shortcut: **X** key) buttons allow the operator to zoom in and out of the trend between two cursors, up to a maximum of 10 levels deep. The reset button (shortcut: **R** key) removes any current zoom from the trend display.

Other shortcuts include:

D = Pan around the trend (in combination with the mouse).
, = Move the cursor left.
. = Move the cursor right.
Q = Move back a group.
A = Move forward a group.

W = Move back a unit.
S = Move forward a Unit.
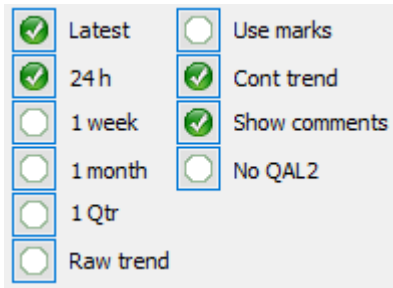\ = Move back a day.
/ = Move forward a day.

## 5.4.3    TREND INFORMATION

Comments may be placed and stored on the trend display; to display all current comments check the 'Show Comments' checkbox. To store a note; place the left-click cursor at the time the annotation is required then press the 'Add/Edit' button. A dialogue box is opened and a comment may be entered. If the user is logged into CEMForm, previous comments may be edited or deleted. To delete a comment, select it from the comments list then press the CTRL key and the DELETE keys together.

**Figure 25 Trend Information**

QAL2 coefficients can also be toggled on and off from this panel as long as the operator has entered their username and password into the Configuration + Diag box. The channel labels will annotate each trend line with the measurement name and span value. Once logged in operators can also select to the view raw data on the trend.

'Use Marks' adds point markers to each data point.

## 5.4.4    CURSOR & TREND INFORMATION
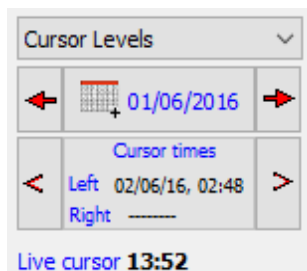
At the top of the trend, the Left and Right Cursor time are displayed. Here the operator can see the time and date of either the left or right cursor. The small red arrows either side allow the operator to move the cursor along the trend minute by minute.

**Figure 26 Cursor Information**

## 5.4.5 TREND DATA READINGS

| Key Channel Name | Value | Units | Span | Valid | Key Channel Name | Value | Units | Span | Valid |
|---|---|---|---|---|---|---|---|---|---|
| NO | 154.2 | mg/Nm3 | 300 | OK | NH3 | 0.2 | mg/Nm3 | 20 | OK |
| NO2 | 2.4 | mg/Nm3 | 300 | OK | Dust | 4.37 | mA | 20 | OK |
| NOx | 219.2 | mg/Nm3 | 300 | OK | O2 | 8.32 | %(dry) | 25 | OK |
| CO | 2.1 | mg/Nm3 | 75 | OK | H2O | 20.18 | %(dry) | 30 | OK |
| SO2 | -1.4 | mg/Nm3 | 75 | OK | Temp | 125.3 | C | 1000 | OK |
| HCl | 3.1 | mg/Nm3 | 15 | OK | Abs press. | 1019.4 | mbar | 1200 | OK |
| HF | 0.3 | mg/Nm3 | 15 | OK | Flow | 169400 | Nm3/hr | 400000 | OK |
| TOC | 0.3 | mg/Nm3 | 15 | OK | Waste Feed | Burn | - | 1 | OK |

**Figure 27 Trend Readings**

The readings to the right of the trend selection display the current levels at the position of the left cursor along with unit and validity information. The order of readings matches with the group order shown in the Live Tab.

The display of each individual measurement on the trend can be selected or deselected here by clicking the tick next to each measurement.

Right-clicking this area brings up a pop up box allowing a channel to be renamed.

## 5.4.6    THE TREND DISPLAY
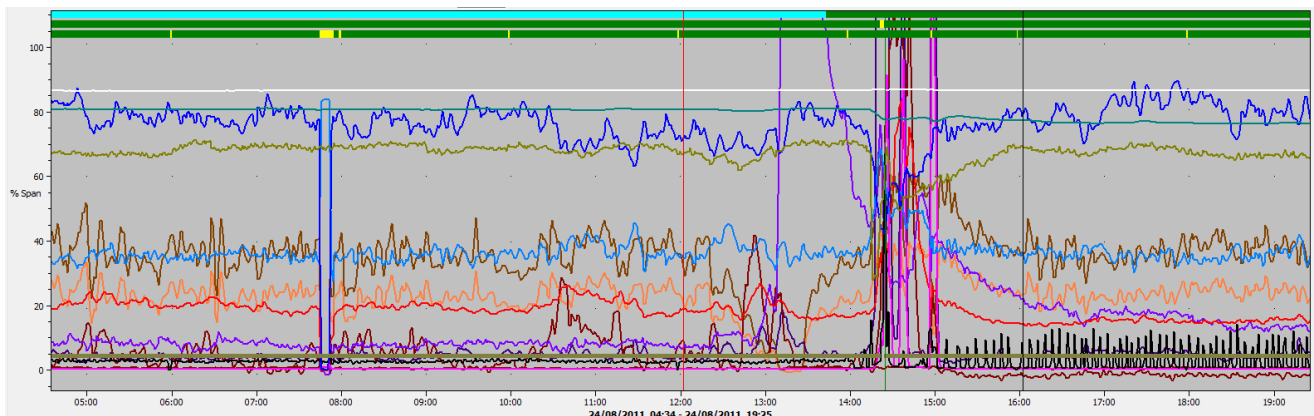


**Figure 28 Trend Display**

Three bars are present above the trend and these represent Plant Status, Data Security and Validity.

- The top bar represents data security and signifies if the data is secure to use and whether the data is being received from a backup analyser. Options are:
  - o   Green (Data Secure)
  - o   Red (No Data)
  - o   Yellow (Data not secure)
  - o   Aqua (Backup Data)
- The second bar represents plant status and is either:
  - o   Green (Plant on)
  - o   Yellow (Plant on but not meeting reporting parameters)
  - o   Red (No data)
  - o   White (Plant off)
- The lower bar reflects the validity of all displayed measurands within the group
  - o   Red = No Data
  - o   Yellow = Invalid Data
  - o   Green = Data Valid

**Note:** Red takes priority over yellow and yellow over green.

Holding the mouse button over each area will provide more information.

## 5.4.7    CURSOR INFORMATION AREA
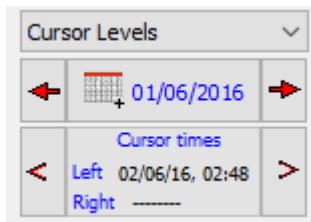


The cursor information area can be reached by selecting 'Cursor Levels' in the trend menu on the left-hand side of the screen.

**Figure 29 Cursor Information**

The levels shown in the cursor grid here are usually the levels at the left cursor time; other selections may be made using the drop selection shown above.
The available options are:
1. Current Levels – The latest levels as shown in the live display.
2. Average within the whole display window.
3. Cursor Levels
4. Average between the two cursors.

Each measurement may be removed or added to the trend by pressing on the check box associated with each name. Pressing the 'All Channels button' will return all measurands to the screen and the 'Invert Selection' button will reverse the display settings for every measurand.

Double-clicking on the span value here changes the span. This is conducted in a similar fashion to the live data display and the password must have been entered via the Configuration + Diag tab.

A very useful feature is the ability to store data isolated between two cursor lines. Firstly, click the left mouse button on the screen at the beginning of a period and then use the arrow buttons to inch the cursor to the correct time. Next, repeat the process with the right cursor; you have now isolated a period of time; click on the save button and a file save screen will appear, give the file a name and click on save. This process saves the averaged value of each measurand (between cursor lines) in a file.
It can be used to calibrate the analyser by comparing the average output over a period against the results of an SRM (Standard Reference Method). It is used extensively in CEMSuite Plus for this purpose and more information can be found in the CEMQual Manual.

## 5.4.8 TREND COLOURS

To change the colour of each individual trend the user must first log in, via the Configuration + Diag. tab using their username and password.

Once logged in, double-clicking on the measurand name within the cursor information box will bring up a colour selection dialogue; select the required colour associated with the selected measurand. If a measurand has been removed from the display, it will be reinstated should the colour be changed.
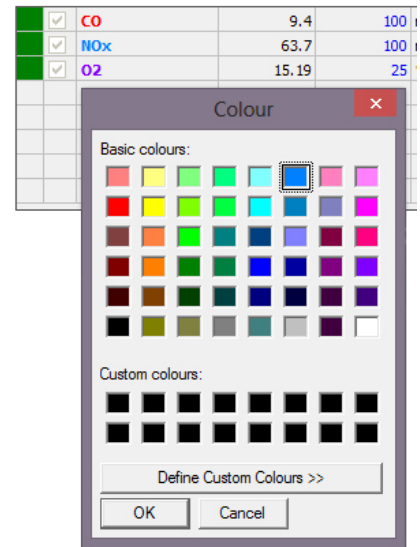


**Figure 30 Colour Chart**
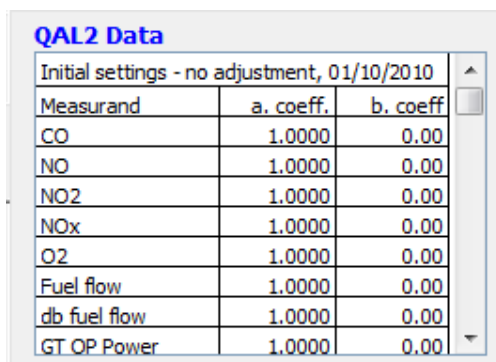
## 5.4.9 TREND SETTINGS



**Figure 31 Trend Settings Information**

Selecting Info on the Trend page will bring up Calculation and QAL2 information.
This information is now examined.

## 5.4.10 QAL2 DATA

The QAL2 information shows the calibration factors in use to create the data shown in mg/m3. The factors are entered via the CEMQual module from an independent analysis of the QAL2 information. They cannot be edited in CEMForm.



**QAL2 Data**

| Initial settings - no adjustment, 01/10/2010 | | |
|---|---|---|
| Measurand | a. coeff. | b. coeff |
| CO | 1.0000 | 0.00 |
| NO | 1.0000 | 0.00 |
| NO2 | 1.0000 | 0.00 |
| NOx | 1.0000 | 0.00 |
| O2 | 1.0000 | 0.00 |
| Fuel flow | 1.0000 | 0.00 |
| db fuel flow | 1.0000 | 0.00 |
| GT OP Power | 1.0000 | 0.00 |

**Figure 32 QAL2 Data**

The settings shown here (1.0000 & 0.00) indicate that no QAL2 factors are in operation (The value is multiplied by 1.0000 and there is 0 offset)

## 5.4.11 CALCULATION PARAMETERS



**Calculation parameters**

Default, Fuel Number 1, Default

Normalisation Reference Levels
        Temp 0 C
        O2 11 %
    Abs. press. 1013 mbar
        H2O 0 %

Plant Status

Molecular Weights & Miscellaneous Factors
    NO    2.05 x ppm = mg
    NO2   2.05 x ppm = mg
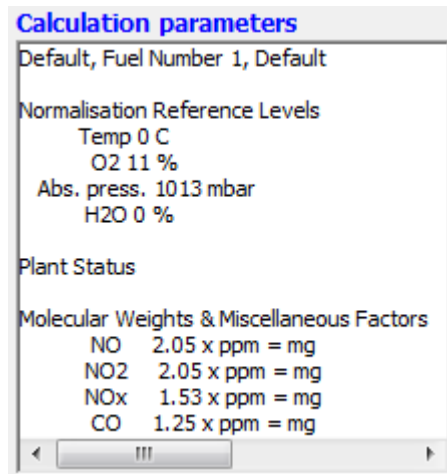    NOx   1.53 x ppm = mg
    CO    1.25 x ppm = mg

**Figure 33 Calculation Parameters**

As a check that the program is performing the correct calculations required users can view certain information via the Calculation Parameters box.

This area indicates the measurements used for normalising the data and the reference conditions. Also indicated are the parameters used to access the plant status.
Should a dust monitor be present within the group, the factor used to convert from opacity, extinction or raw dust units would also be displayed here.
Finally, the molecular weights used to convert the outputs of the gas analysers within the group are shown.

## 5.5   DATA GRID

The Data Grid screen is displayed by selecting the Data Grid tab on the pages tab bar.

The Data Grid allows the operator to view recent averages for all measurands or a single specific location. The Data Grid will automatically highlight all instances of non-reportable data and any excursions over the ELVs. The option to only display readings above the ELV is also available.
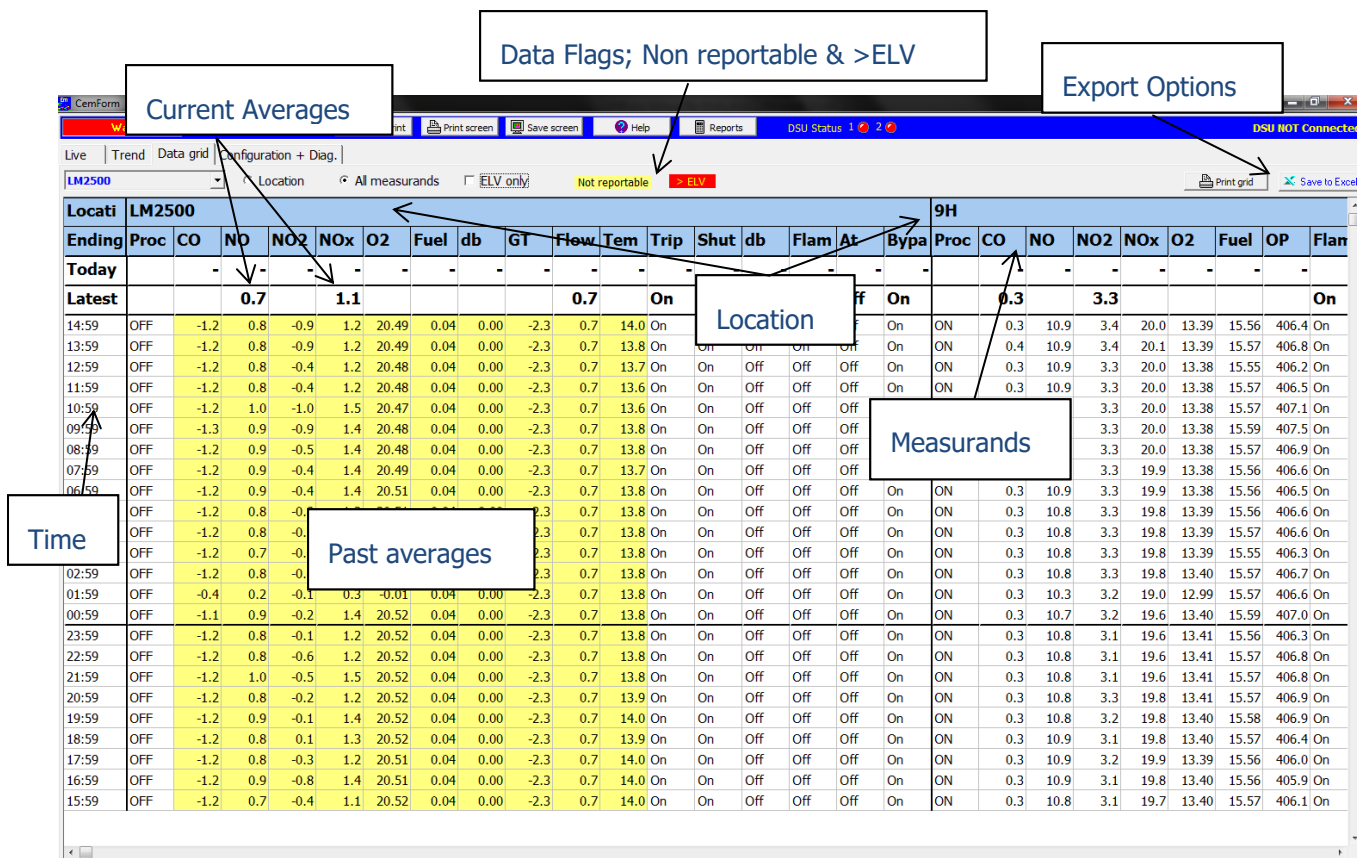


**Figure 34 The Data Grid**

Each area of the screen is now examined individually.

## 5.6   DATA GRID INFORMATION
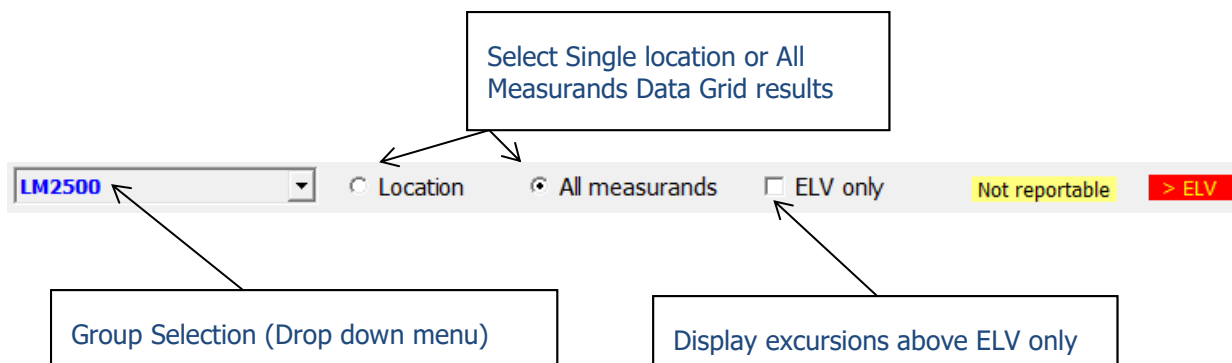
### 5.6.1    DATA GRID OPTIONS



**Figure 35 Data Grid Selection**

The operator has the option to select single location results on the Data Grid via the group selection drop down menu and by checking the 'Location' radio button. If the operator wishes to display recent averages for all measurands then the 'All measurands' radio button should be selected.

The operator also has the option to only display any averages above the set ELVs, to do this the 'ELV only' checkbox should be ticked.
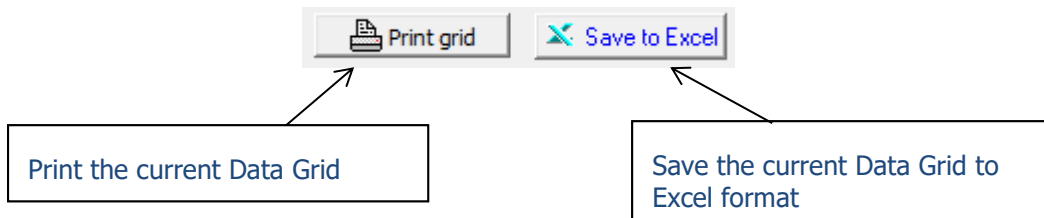


**Figure 36 Data Grid Export**

Two Data grid export options are available; the first allows the operator to print the data grid currently displayed (via the default printer). The second allows the operator to save the data grid as a .xls (Excel) format. A name and save location must be selected before pressing 'Save'.

## 5.7   SYSTEM DIAGNOSTICS

By selecting System Diagnostics, located on the top bar of CEMForm (See section 4.3), operators have access to a system status box. From here, users can see other CEMSuite programs, whether they are currently running and an option to start the program. By default, CEMSync and CEMSocket are displayed. CEMBus can also be added, along with a maximum of two other programs.
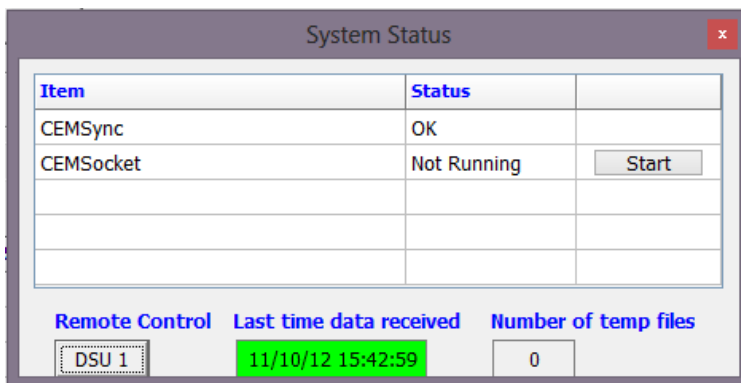
**Figure 37 System Status**

By logging into CEMForm the operator will also be able to access the DSU remote control. This allows direct VNC access into any of the DSUs on the system (A pop-up box will request the DSU VNC password).

The Systems Diagnostics will also display the last time data was received from each of the DSUs. The background will change depending on the current status of the DSU:

Green = DSU Ok.
Yellow = Warning! Possible DSU communication error.
Red = Error! DSU Connection problem.

The number of temporary files on the CEMs PC is also displayed in order to ensure no erroneous files are being created. These are temporary database files and in order to ensure smooth operation, this number should always be <100.

## 5.8   CONFIGURATION + DIAG. PAGE

The Configuration + Diag. screen is displayed by selecting the tab on the pages tab bar.
From here users can view and configure various elements of CEMForm including Alarms and outputs, language options, system information, diagnostic information, maintenance and relay control and email/SMS settings.
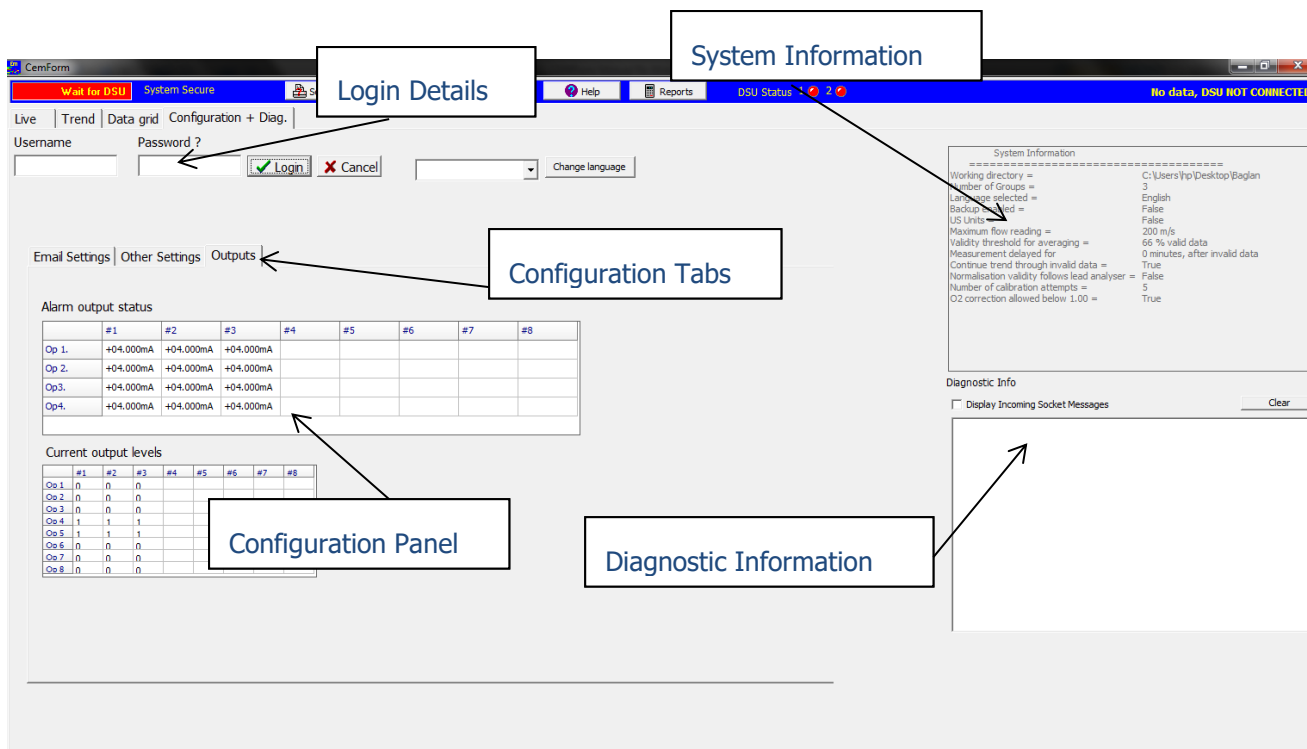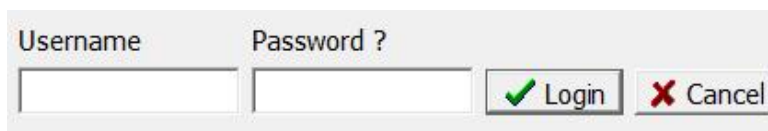


**Figure 38 Configuration + Diag.**

Each area of the screen and the configuration options are now examined individually.

## 5.9 CONFIGURATION + DIAG. INFORMATION

### 5.9.1 PASSWORD ENTRY

For the security of the operator and to ensure complete integrity of the process, the 'Configuration' section is password protected. The Username and password will be provided to you by Envirosoft, you should keep a copy in a safe and secure place. We will supply as many usernames/passwords as you request.

Enter your username and password and click on the "Log in" button.



**Figure 39 Password Entry**

If this is the first time the system is run or somebody has deleted the previous password data then the following box will appear after a successful login.
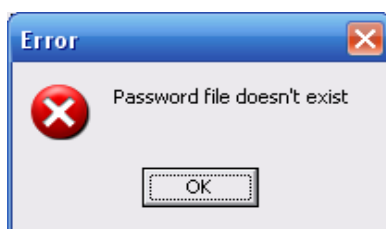


**Figure 40 Password Error**

After a successful login, if there were unauthorised or incorrect logins since the last successful login, then the following box will appear detailing all the previous failed login attempts.
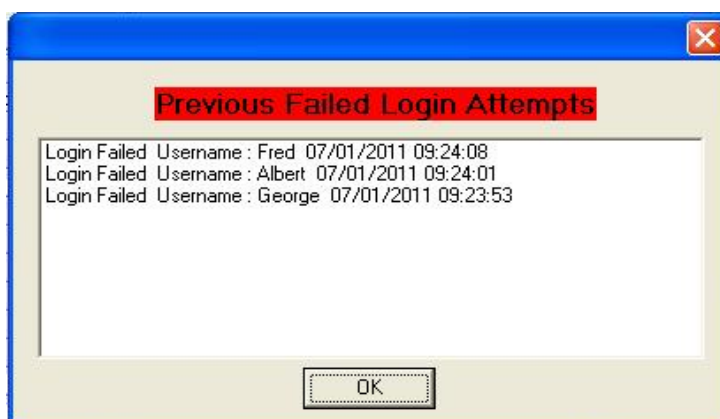


**Figure 41 Previous Login Attempts**

## 5.9.2    CHANGE LANGUAGE

The CEMSuite programs have been translated into several languages, and if this translation has been supplied by Envirosoft, the language may be changed here via a simple drop down menu.

## 5.9.3    SYSTEM INFORMATION



**Figure 42 System Information**

The System Information box includes a variety of information, such as the location of the CEMSuite folder CEMform is running from, the number of groups etc.

## 5.9.4 DIAGNOSTIC INFO



Checkbox to display diagnostic information.

'Clear' button to clear all information currently displayed within the Diagnostic Information display box.
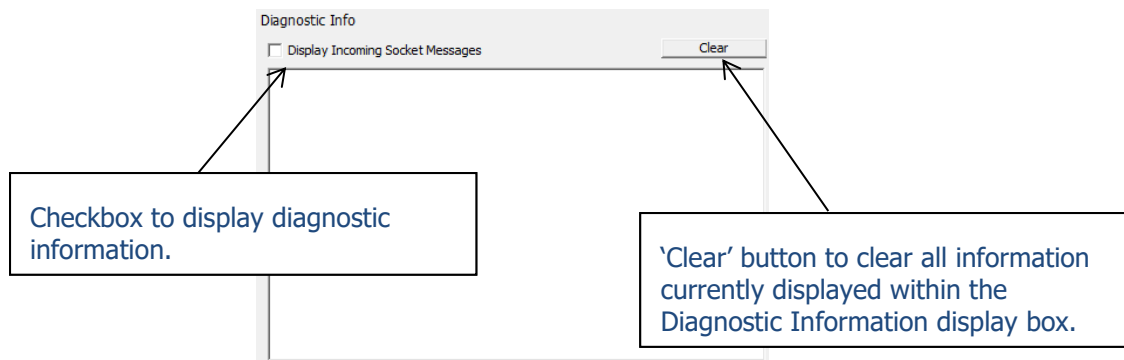
**Figure 43 Diagnostic Information**

If the 'Display Incoming Socket Messages' is checked, the data for each DSU will be seen in the Diagnostic Information area. The data is displayed in hexadecimal format.

Should 4-20mA outputs be generated by CEMSuite, these levels will also be visible here as they are transmitted back to D/A units.

## 5.9.5    OUTPUTS – ALARM OUTPUT STATUS

**Alarm output status**

| | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 |
|---|---|---|---|---|---|---|---|---|
| Op 1. | +04.000mA | +04.000mA | +04.000mA | | | | | |
| Op 2. | +04.000mA | +04.000mA | +04.000mA | | | | | |
| Op3. | +04.000mA | +04.000mA | +04.000mA | | | | | |
| Op4. | +04.000mA | +04.000mA | +04.000mA | | | | | |

**Figure 44 Alarm Output Status**

All defined outputs on the system may be examined from this grid, hold the mouse over the mA signal to reveal how each has been set up. These are configured from the CEMCfg program, not from CEMForm. Each block holds 4 outputs, these are normally set to 4-20mA as shown in this example, other options may be:

- 0 – 20mA
- 2-20mA
- 1-5V
- -10 - + 10V
- 0 – 10V.

Again, this is configured from the CEMCfg program

## 5.9.6    OUTPUTS – CURRENT OUTPUT LEVELS

**Current output levels**

| | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 |
|---|---|---|---|---|---|---|---|---|
| Op 1 | 0 | 0 | 0 | | | | | |
| Op 2 | 0 | 0 | 0 | | | | | |
| Op 3 | 0 | 0 | 0 | | | | | |
| Op 4 | 1 | 1 | 1 | | | | | |
| Op 5 | 1 | 1 | 1 | | | | | |
| Op 6 | 0 | 0 | 0 | | | | | |
| Op 7 | 0 | 0 | 0 | | | | | |
| Op 8 | 0 | 0 | 0 | | | | | |

**Figure 45 Current Output Levels**

Relays may be used to indicate alarm breaches or analyser failure information. They are set up from the CEMCfg program and may represent: an alarm excursion, analyser failure, a watchdog (changes state every minute) or 95 / 97% of an alarm level as an early warning. Hold the mouse over each relay to reveal how each has been set up.

A value of 0 here will indicate that the relay is un-energised, and this normally represents the usual condition. It is possible to reverse the logic, however, so that the relays are normally closed, and will open on an alarm; this is conducted by the CEMCfg program.

### 5.9.7    OTHER SETTINGS – MAINTENANCE

The maintenance panel allows operators to set a maintenance flag to invalidate data while the maintenance takes place. Select the unit in the left-hand box and then click on the check box for the required measurands.

### 5.9.8    OTHER SETTINGS – MANUAL RELAY CONTROL

This facility enables an operator to manually initiate a relay normally controlled by the software. Simply click on the required check box and click 'Send'.

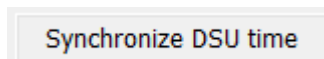### 5.9.9    DSU TIME

Synchronize DSU time

**Figure 46 Synchronize DSU Time**

The Synchronize DSU time function allows operators to synchronise the time between the CEMS PC and the DSU, should a discrepancy occur. Press the 'Synchronize DSU time' button to synchronise the time between the two devices.

### 5.9.10    ALARMS – PROGRAM STARTUP/SHUTDOWNS

An alarm grid here illustrates excursions above alarm limits and any program 'start/stops'.

The columns in the grid may be sorted by clicking the mouse pointer whilst over the heading row. A small triangle will appear and the rows of data will be sorted according to the data in that column, i.e. the Events column will be sorted automatically. Clicking the mouse button again will reverse the order; it will toggle between ascending and descending order.
It is possible to sort the grid by more than one column by holding the shift key while clicking on the second column to sort by.

## 5.9.11   EMAIL SETTINGS

CEMForm has an optional facility that allows it to send email & SMS alarms to key personnel in the event that the process exceeds an Emission Limit Value or a Validity alarm is tripped.
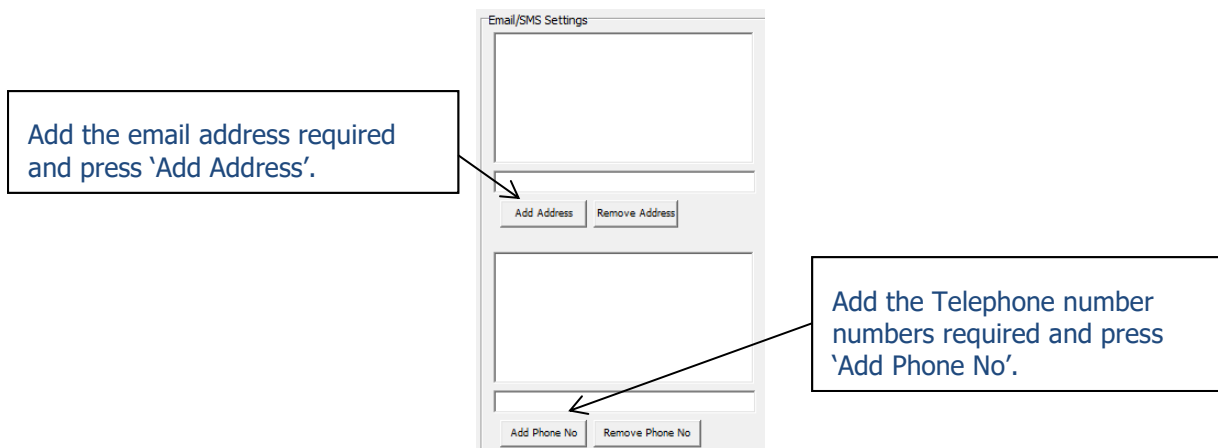


Add the email address required and press 'Add Address'.

Add the Telephone number numbers required and press 'Add Phone No'.

**Figure 47 Add Email/SMS**

To use this facility, enter the relevant email addresses and telephone numbers in the 'Email/SMS settings' section. To remove a current address/phone number, highlight the entry you wish to remove and press 'Remove'.

Next, go to the 'Select Alarms to Email' section to the right, and select either the 'High' (ELV) or 'Validity' radio button. Then click on the checkboxes that require email/SMS alarms.
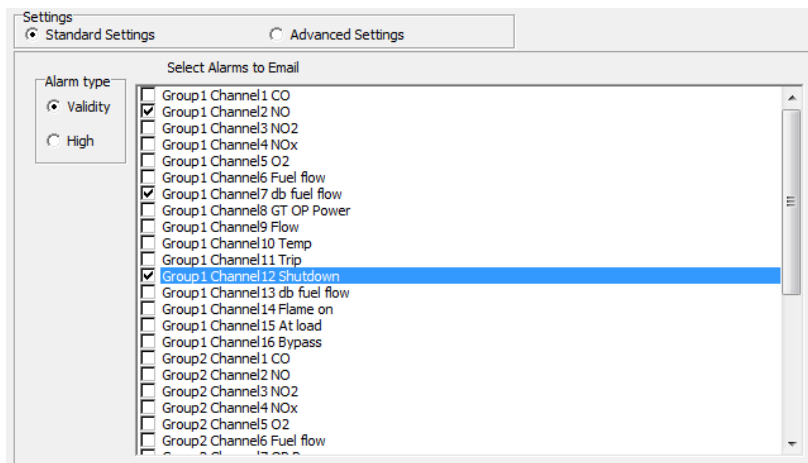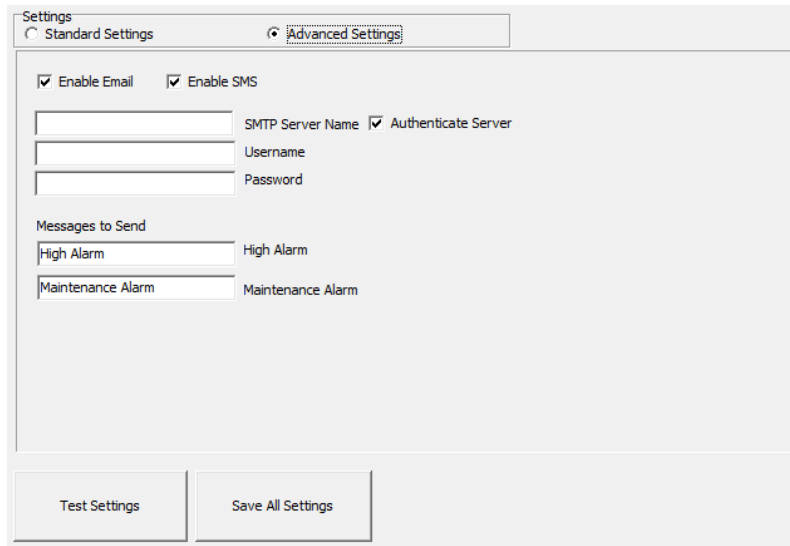


**Figure 48 Email/SMS Standard Settings**

After the alarms have been selected click on 'Advanced settings'. This will enable the Email/SMS set up screen below; complete the details and then click on the 'Standard settings' radio button. Now click on the 'Test email' button to check that it all works. Finally, click on the 'Save all settings' Button.



**Figure 49 Email/SMS Advanced Settings**
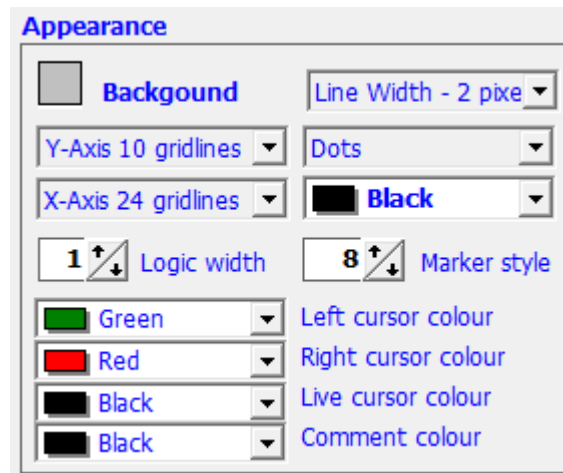
## 5.9.12 TREND APPEARANCE



**Figure 50 Trend Appearance**

The visual appearance of the trend can be modified using this panel. The trend background, line thickness, grid lines, logic width, marker style and cursor colours can all be changed.

**Note:** Any changes made here will also be reflected in the mini-trend displays on the live data page.

# 6   APPENDIX A – CEMFORM SPECIFICATIONS

| | |
|---|---|
| Analysis Points: | 12 (Max) |
| Measurands: | 24 (Max) at each point, 128 maximum for the system |
| Resolution: | 16 bits of data (+/- 32767), 8 bits for validity |
| Rolling Averages: | 1 minute to 1 day |
| Normalisation: | Temperature, Oxygen, Carbon Dioxide, Pressure and Water Vapour as defined units |
| Typical Emission Units: | PPM, mg/Nm3 and kg/hr where flow data available. Others on request |
| Alarms: | 2 alarms for each measurand, for up to 4 averages and 4 units of measurement. Visual and audible alarm warnings. |
| Outputs: | Print directly to a printer, export to an image file or excel file. |

# 7 APPENDIX B – CALCULATION PRINCIPLES

## 7.1 UNITS

Throughout the program, four measurement units are available and may be selected for reporting as required. Different measurements will have slightly different units for each of the four positions. The most common are detailed below, for particular applications different measurements will use other calculations:

### 7.1.1 NORMALISATION AND AVERAGING WITHIN CEMSUITE

Practically all legislation considers emission levels in terms of $mg/m^3$ at reference conditions ($mg/Nm^3$ for the CEMSuite programs). This is to enable the measurements from similar processes to be compared and assessed under the same conditions and removes the diluting effects of 'tramp' air and water vapour.

### 7.1.2 GAS MEASUREMENTS (PPM)

- ppm: as measured by the analyser
- $mg/m^3$: corrected for molecular weight, but uncorrected for STP, Standard Temperature and Pressure i.e. as the gas exists at duct conditions. This measurement is used for the calculation of mass emission using the measured gas velocity in the duct.
- $mg/Nm^3$: as above but now corrected for all relevant normalisation parameters.
- $mg/NM^3$ C: As above but corrected for uncertainty
- kg/hr: calculated from $mg/m^3$ and the gas flow:
    - kg/hr    =b ($mg/m^3$)  x  m3/s (flow)  x  3600 (seconds in an hour)  / 1,000,000 ( mg in a kg)

### 7.1.3 DUST MEASUREMENTS (OPACITY)

- Opacity (%): as measured by the analyser.
- $mg/m^3$: opacity converted to extinction, and then multiplied by a dust conversion factor. This measurement is used for the calculation of mass emission using the gas velocity in the duct.
- $mg/Nm^3$: as above but now corrected for all relevant normalisation parameters
- kg/hr: calculated from $mg/m^3$ and the gas flow – see calculations above.

### 7.1.4 DUST MEASUREMENTS (TRIBOELECTRIC OR OTHER DIRECT MEASURING ANALYSER)

- Tribo-electric output (%): as measured by the analyser.
- mg/m$^3$: output multiplied by a dust conversion factor.
- mg/Nm$^3$:  as above but now corrected for all relevant normalisation.
- kg/hr: calculated from mg/m$^3$ and the gas flow – see calculations above.

### 7.1.5 OXYGEN

Normally the biggest effect from normalisation is from the oxygen level, and this reference level varies between processes:

Gas and oil:          3%
Coal:                 6%
Waste:                11%
Gas turbines:         15%

This is not an exhaustive list, but the reference levels required for most plants can normally be found on their process guidance notes.

CEMSuite uses the following formula to correct for air dilution:

Correction        =        (21 – O$_2$ reference level %) / (21 – actual dry O$_2$ level %)

### 7.1.6 WATER VAPOUR

Where measurements are made on a wet basis (i.e., they have not been dried by a chiller or filter before analysis) they should be corrected down to a dry measurement. It is preferable that a dynamic water vapour measurement is required, but should this not be practical, a fixed value may be used. The formula below is used by the software:

Correction        =        (100 %) / (100 – actual H2O level %)

### 7.1.7 TEMPERATURE

The reference temperature is usually 0$^0$C (273K) for Europe but may be 25$^0$C for the Americas.  Most gas measurements are already corrected to standard temperature and pressure (STP) and so no correction applies. For dust and other measurements, however, the following formula applies:

Correction                = (Actual temperature C + 273) / (reference temperature C + 273)

## 7.1.8    PRESSURE

Again, most gas levels are reported at STP and no further corrections apply. For dust and other in-situ measurements, however, correction may be required. In such cases, the following formula applies:

Correction                =        (101.3 kPa) / (actual Pressure kPa)

## 7.2   DATA STORAGE

Data is stored every minute on the minute; the CEMComm program is responsible for this storage. A Paradox database file is created for each day, in a month sub-folder, from a year folder. These reside in the 'HistData' folder from the original installation folder. The format is not particularly easy to read; to speed up data access, each group of measurements is compressed into a 'hexadecimal string'. Should further information be required on how to access the data, please contact Envirosoft.

## 7.3   AVERAGING

The CEMSuite programs consider the data down to each minute, each minute data point being the average of all data within that minute; most systems are set to gather data every 5 – 10 seconds.

For longer term averages, two averaging bases are provided; a rolling average and a block average. Data during plant off periods (see below) or invalid data are not used when calculating the average values. Furthermore, there must be 2/3 of valid data for any given averaging time, i.e., for a one-hour average, there must be 40 minutes of valid data while the plant was in operation for the averaged data to be considered as valid.

The 2/3 requirement is configurable but usually set at this level.

## 7.3.1    ROLLING AVERAGE

A rolling average considers the data on a minute-by-minute basis; for each and every minute, the average is calculated from the preceding data for the selected average time.

## 7.3.2   BLOCK AVERAGE

Each block average is considered individually for the period; should a 1-hour average be selected, then the day will consist of 24 block averages. Each average will end at 59 minutes past the hour.

| | | | |
|---|---|---|---|
| Average 1 | 00:00 | to | 00:59 |
| Average 2 | 01:00 | to | 01:59 |
| Average 3 | 02:00 | to | 02:59 |
| ... | | | |
| Average 24 | 23:00 | to | 23:59 |

Should a 30-minute average be used, then each will end at 29 and 59 minutes past the hour. As the average builds up during its period, it will be considered valid should 66% of the expected data points be available. So, for a 1 hour average at 00:29, there should be 30 points, so it will be considered valid if 20 minutes or more of valid data points exist.

## 7.4   PLANT STATUS

To prevent periods where the plant is shut down diluting the reported emission levels, CEMForm does not use measurements during these periods – they are ignored and will not generate any alarms or form part of any averages. The plant status off condition may be determined from various sources; the most common being oxygen – should the oxygen level rise above a particular threshold (say 18%) the program assumes that the plant is shut down. Other sources may be temperature (falling below a threshold) or a contact signal from a fan or pump.

**Note**: Plant status assessment is made from the data before it is averaged.

# 8 APPENDIX C – FAQ (FREQUENTLY ASKED QUESTIONS)

This section is provided as a quick reference for performing the most common operations required.

## 8.1 HOW CAN THE COLOUR FOR EACH MEASURAND BE CHANGED?

Select the trends display and double click on the measurand name – a colour dialogue box is opened. Select the required colour and press the OK button.

## 8.2 HOW CAN A DATE IN THE PAST BE SELECTED TO TREND?

Select the trends display and click on the button within the 'Date Selection' area. A calendar is now shown; select the year, month and day as required. Note: only the days where data has been acquired are available for selection. After a date has been selected, the left and right buttons at the top of the trend display move the graph backwards and forwards in time. The time moved is equal to the time span for the trend.

## 8.3 HOW CAN THE SPAN ALARM LEVELS BE CHANGED?

Before the spans and/or alarm levels may be changed the password must be entered from the configuration screen. To change levels, simply double-click on the values from the 'Live Data' or 'Trends' displays.

## 8.4 HOW CAN THE CALCULATED MG/NM3 VALUES BE CHECKED?

CEMForm converts the 'raw' analyser signal to units of mg/m$^3$ and normalises these to standard reference conditions. To check that the relevant weights and conditions are being used, select the 'Trends' page, and then select the 'Calculation between Units' checkbox. The levels and weights used will now be revealed in the top left-hand corner of the trend display.

# 9   APPENDIX D – GLOSSARY OF TERMS

**AMS**: Automated Measuring System (see CEM)

**AST**: Annual Surveillance Test refer CEN standard EN14181

**CEM/S**: Continuous emission monitoring system – the equipment for the sampling, analysis and data reduction of gaseous emissions measurements on a continuous basis.

**Drift**: Monotonic change of the calibration function over a period of unattended operation, which results in a change of the measured value.

**EA**: Environmental Agency responsible for England and Wales.

**ELV**: Emission Limit Value.

**HWI**: Hazardous Waste Incinerator, refer WID.

**ISO**: International Standards Organisation – Multinational organisation that develops and publishes measurement criteria and performance standard.

**LAU**: Environmental Agency Local Authority Unit.

**Measurand**: Particular quantity subject to measurement.

**MID**: Method Implementation Document – developed by EA and STA on how to apply standards in the UK.

**Precision**: Closeness of agreement of results obtained from the AMS.

**QA**: Quality Assurance.

**QAL**: Quality Assurance Level.

**QAL1**: Quality assurance level 1 – AMS as tested to the requirements CEN standard EN15267 or MCERTS CEM system.

**QAL2**: Quality assurance level 2 – Calibration of an AMS in accordance with CEN standard EN14181.

**QAL3**: Quality assurance level 3 – Ongoing performance of an AMS in accordance with CEN standard EN14181.

**Reference Material**: Material simulating a measurand of known concentration of the input parameter and traceable to national standards.

**SRM**: Standard Reference Method.

**SSP**: Site Specific Protocol

**SD**: Standard Deviation.

**Sams**: Standard deviation for the for the automated measurement system.

**Variability**: Standard deviation of the differences of parallel measurements between the SRM and AMS.

**TC**: Technical committee as referred to in standards organisations e.g. CEN.

**TE**: Technical Endorsement as referred to in MCERTS performance standard for personnel.

**WID**: Waste Incineration Directive.

## 10 INDEX

## 10.1 MAIN INDEX

## 10.2 LIST OF FIGURES / PICTURES

## 10.3 MANUAL REVISION HISTORY

| Revision Number | Date | Summary of Changes | Author |
|---|---|---|---|
| v1.01 | 15/12/2002 | Addition of 'All Measurands' Check Box | R Grant |
| v1.02 | 06/05/2004 | Addition of alarm page | R Grant |
| v1.03 | 18/11/2005 | Addition of control page | S Wright |
| v1.04 | 08/03/2006 | Addition of trends screen save function | S Wright |
| v1.05 | 08/12/2008 | Addition of email alarms | S Wright |
| v1.06 | 15/09/2009 | Addition of custom screens and format change | R Grant |
| v1.07 | 19/04/2010 | Format change | D Volgin |
| v2.00 | 05/10/2011 | Content update (CEMForm 4.0) and format change | P Swindell |
| v2.01 | 03/05/2012 | Content update – Trend Information | P Swindell |
| v2.02 | 18/10/2012 | Trend screen update & System Diag information added | P Swindell |
| v2.03 | 10/01/2013 | Content Update | P Swindell |
| v2.04 | 19/09/13 | General Update | R Vincent |
| v2.05 | 04/07/2014 | Minor Revisions | P Swindell |
| v2.06 | 15/10/14 | Minor Revisions | P Swindell |
| v2.07 | 05/10/16 | Minor Format changes | P Swindell |
| v2.08 | 25/07/18 | Screenshots changed (new GUI) & Updates | P Swindell |
| V2.09 | 23/04/19 | Minor Updates & Text Changes | P Swindell |

## 10.4 APPROVALS

This document requires the following approvals:

| Name | Title |
|---|---|
| R. Grant | Managing Director |
| P.Swindell | QA Coordinator |
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