Series 4 Gas Analysers

S4i
User Guide

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DOCUMENT HISTORY

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1 Introduction

The S4Interface application is a PC-based user interface for Signal's Series 4 gas analysers. The requirements for installing this on a PC are that it is running MS Windows operating system Win98, XP, Vista, Win7 & Win8. Connection to the analyser can be through a serial (RS232) connection running at up to 115200 baud, or through an Ethernet connection.

The S4Interface sends AK protocol commands as ASCII text strings to the analyser and receives and interprets AK commands which come back from the analyser. Timer-driven events in the interface constantly interrogate the analyser in order to keep the displayed data up-to-date. There is also a feature built-in to the analyser to send data without request at up to 20Hz at the interface for items which require high update rates.

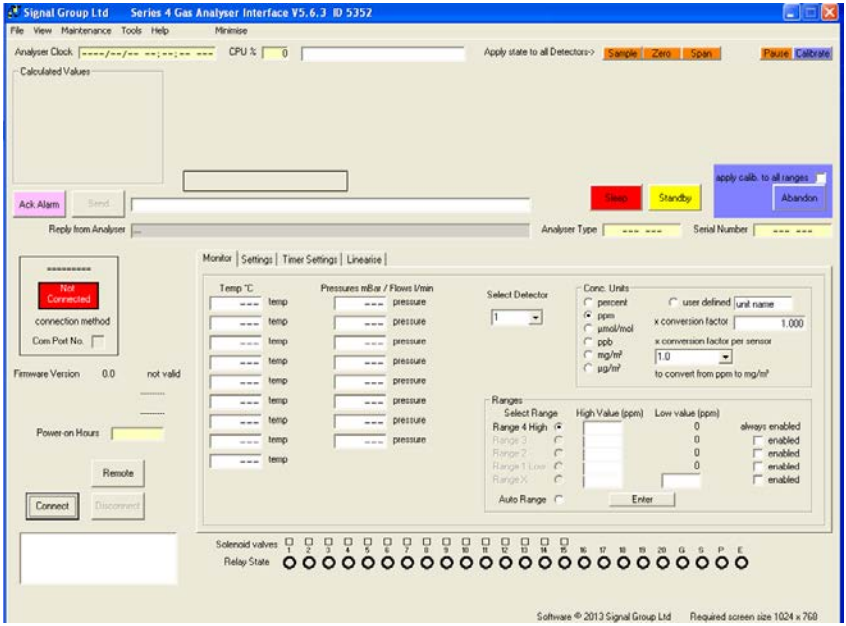


Figure 1

A view of the interface main screen is shown in Figure 1. This view is as it appears upon initial opening of the application.

The S4i can be invoked more than once in order to connect to multiple analysers. To reduce screen 'clutter' the interface can be 'minimised' to a smaller display area, as shown in Figure 2.

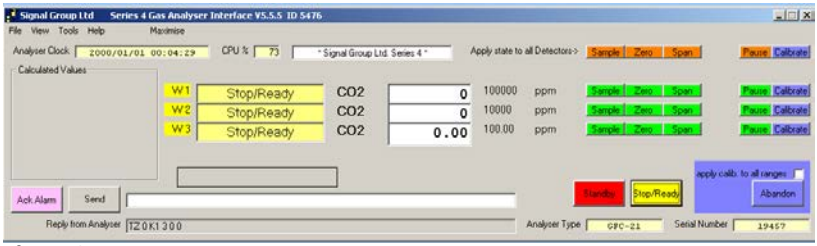


Figure 2

2 Quick Start Guide

Ensure Serial and/or Ethernet cables are connected between the rear panel of the analyser and your chosen PC or network before switching the analyser power on. (If it has been used before it will attempt to return to its previous operating mode.)

Figure 3

Double-click on the S4Interface icon (Figure 3) to start the application. The screen shown in Figure 1 will appear. Depending on your choice of connection method you now need to set-up one of the following options. Choose ‘Settings’ on the ‘File’ menu as shown in Figure 4.

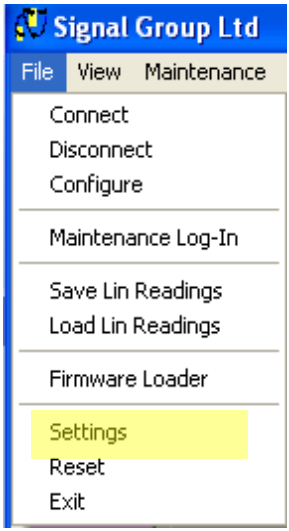


Figure 4

2.1 Serial RS232 connection

For a Serial RS232 connection the default settings for baud rate, bits, parity, flow control, parity and com port are as shown in

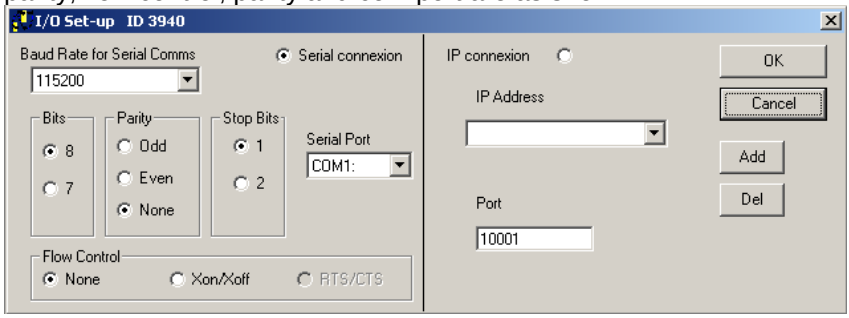


Figure 5. Change these as required to connect to your PC.

NOTE: RTS/CTS handshake is not possible with the current hardware. Flow control is generally not needed, but can be enabled by using Xon/Xoff..
Note also that for high rate data logging the baud rate should not drop too low. 19k baud might be sufficient but this has not been tested.

Remember to select the Option button marked ‘Serial Connection’. Once your desired setting shave been chosen, click OK. You will be returned to the Main Screen where you should now click CONNECT (see figure 1). The S4i will take a few seconds to populate with the analyser information. You may begin to use all functions once connected.

2.2 Ethernet connection

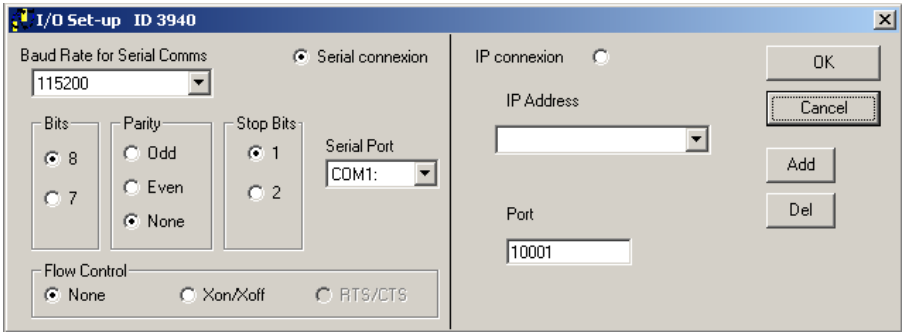


Figure 5

Since the interface can be used to connect to multiple analysers, by running separate instances of the interface, it is useful to list the IP addresses of the available analysers. If you know the IP address and connection port of your analyser (see its Test Report or the "Maintenance Section User Guide" for further details), enter it in the combo box and then press 'ADD' the address will be added to the drop-down list. (To remove an address, select it from the drop-down list and then press 'DEL'.) IP addresses listed here are also shown in the listbox on the Main Screen, where you should select the IP address that relates to the instrument with which you wish to connect. Once your desired settings shave been chosen, click OK. You will be returned to the Main Screen where you should now click CONNECT (see figure 1). The S4i will take a few seconds to populate with the analyser information. You may begin to use all functions once connected.

2.3 Analyser Modes

Once you have established a connection to the analyser the screen will self-adjust to suit the analyser. Figure 6 shows a section of the screen with details relating to an analyser with 3 measurement channels (NO, NO_2 and NO_x). (All channels on this analyser always have to be in the same state, so only one button for gas path selection is shown for all channels (Sample, Span, Zero).)

2.3.1 SLEEP

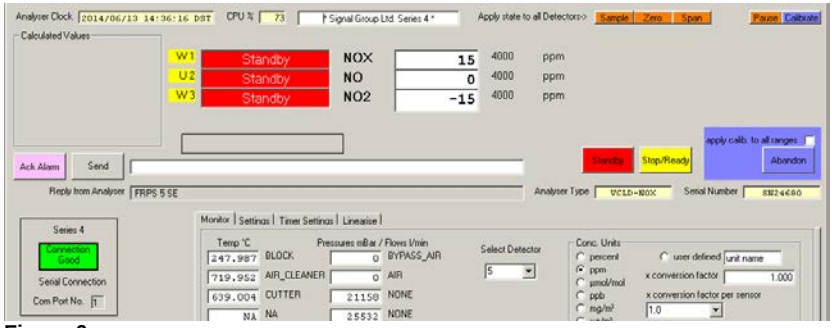


Figure 6

At power-on there is very little activity and very low power consumption in SLEEP mode. The power supply unit fan will be operating, but heaters, pumps, other fans and valves will all be idle. The screen (if fitted) will be dark (backlight off). Temperature measurement, pressure measurement, voltage monitoring, chart recorder outputs and concentration readings will all still be active. Figure 7 shows SLEEP state for an analyser with 5 detectors. (The measurement channels in this example are independent, so have corresponding gas-path selection buttons.)

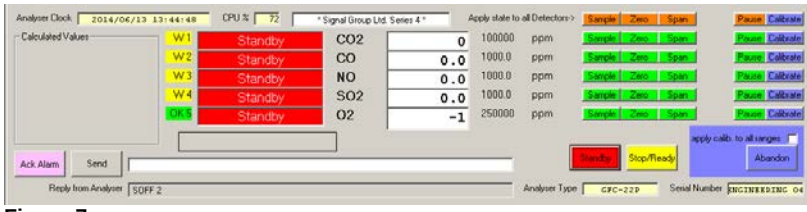


Figure 7

2.3.2 STANDBY

To prepare for measurement the analyser has to be switched to STANDBY mode, or one of the measurement modes (Sample, Span, or Zero).

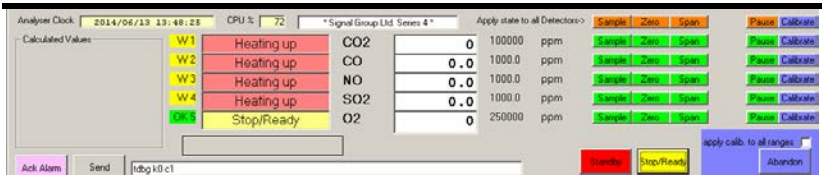


Figure 8

While the analyser is heating up the display shows the state as in Figure 8. Note that the oxygen channel is already shown in STANDBY mode. When the analyser is ready to measure, the indication will show STANDBY for that detector.
The STANDBY indication (as in Figure 9; dual FID SOLAR) is only shown when the choice is made to go to STANDBY mode. Going directly to a measurement mode, the 'Heating' indication is shown and then the final mode, such as 'Sample'. On a FID there is also an indication of when the analyser is attempting to ignite the Hydrogen flame (or flames, in the case of a dual FID SOLAR).

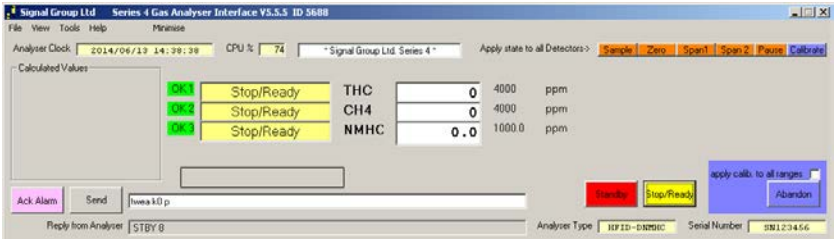


Figure 9

2.3.3 Measure (Sample, Zero, Span, Pause)

Once the analyser has attained the required temperatures and pressures and any fans and pumps have started and flames are lit, the mode can be changed to a measurement mode such as that shown in Figure 10, 'Sample'.

Zero mode will switch the gas inlet path to Zero. Span mode will switch the gas inlet path to Span. These modes are used to check the calibration of the instrument and to allow particular calibrations (see 2.3.4 for further information).

Pause mode allows isolation of the analyser from any measurement gas path (i.e. closes Sample, Span and Zero inlet valves), without halting measurement, therefore maintaining measurement stability.
WARNING: Instruments with internal pumps should not be left in Pause mode for extended periods.

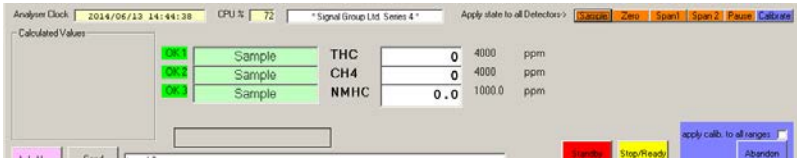


Figure 10

2.3.4 Calibration

Detectors must be in a Measurement mode (i.e. Sample, Span or Zero) to allow calibration.
Ensure that the Span Gas Table is completed correctly before attempting a Span or Sample calibration (see 3.2.2.3).

To perform a calibration, first select your desired gas path (Sample, Span or Zero), then select Calibrate. Each gas path performs a different calibration:

Calibration from Sample mode will first switch the gas path to Zero before adjusting the Zero offset, then will automatically switch to Span and adjust the Span coefficient.
Calibration from Zero mode adjusts only the Zero offset.
Calibration in Span mode adjusts only the Span coefficient.

2.3.4.1 Apply Calib to All Ranges

The analyser is designed to allow a different span gas and calibration coefficient to be applied to each range on each detector channel. However, the calibration results may be applied to all ranges if this is not required. Simply check the 'apply calib. to all ranges' box before starting a calibration.

2.3.4.2 Abandon

If you wish to stop calibration once it has begun, without applying any new coefficients, you may do so by selecting Abandon.

2.4 Calculated Values & Command Line

Under the Detector mode indications is a blank text box with a button marked 'Send' to its left. This is the command line for manually sending commands to the analyser. Type the command in the text box (it is not case-sensitive so upper-case or lower-case or mixed-case may be used), and then select 'Send'. Replies will be shown in the box below the command line.

The command line can be used to set-up some calculated values which are shown in the 'Calculated Values' box which is below the command line.
The syntax for setting a calculated value is as follows.

CALC A = Kn {+,-,*,/} Km

Where the list in braces indicates one of these symbols may be used and 'n' is a number representing a detector and so is 'm'
Example:- CALC A = K1 / K2

Alternatively the second 'K' value can be replaced by a constant value.
Example:- CALC A = K3 / 1.618

This can be extended so that an additional operator can be added.
Example:- CALC A = K1 / K3 * 2.7

Five calculations can be accommodated and these are labelled A, B, C, D , and E

For example:- CALC B = K2 + K4
CALC C = K3 – K5 /3.33

If these calculations are to be a permanent feature then you should create a text file with the commands in it. Then after starting the S4Interface apply the file using the menu option Configure. Select the file and it will be read and applied.

2.5 Push Monitoring

The Settings tab on the main screen (as shown in Figure 11) allows selection of fast data rates (20Hz for concentration, etc).
Concentration values are by default requested by the S4Interface at a rate of approximately 2Hz.
To “push” data at a higher rate (20Hz for concentration) check the boxes that correspond to the desired output channel, followed by Set:

S = Serial (RS232)
E = Ethernet
C = CANBus (Only available with CANBus Option)
D=Display (Not necessary with currently available Front-Panel Display option)

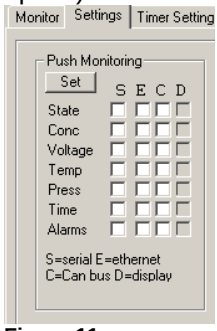


Figure 11

3 Detailed Operation

3.1 Main Screen Tabs

3.1.1 Monitor

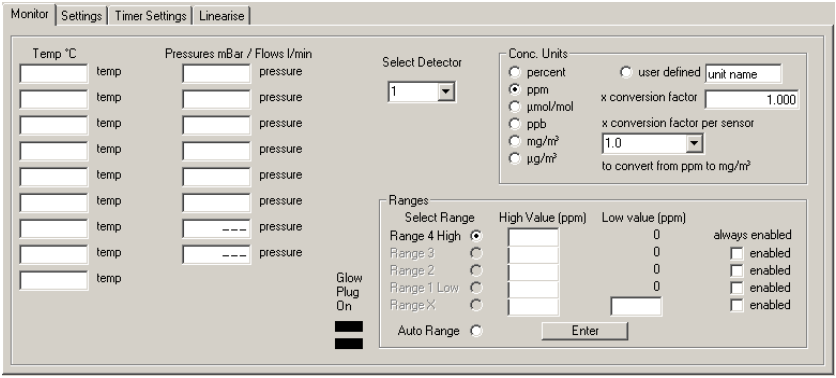


Figure 12

3.1.1.1 Diagnostics

The Monitor tab shows diagnostic details relating to the analyser sensors (temperature and pressure/flow) and the Detector ranges. When connected to an analyser, the details of all its temperature and pressure sensors are populated here. These details will only be updated if Press and Temp “Push Monitoring” is set on the Settings tab.

A handy feature for FID SOLAR analysers are the two Glow Plug tell-tales. These show when the analyser is energising the glow-plugs to light the flames for the FID detectors.

3.1.1.2 Ranges and Units

There is a drop-down box which lists possible detectors. When a valid detector is chosen, the range data for that sensor is populated below. There are 4 “Zero Minimum” ranges and one “Offset Minimum” range marked ‘Range X’.

"Zero Minimum" ranges all have 0ppm as their minimum. Each has a maximum value within the full scale of the measurement channel.
The "Offset Minimum" range has a minimum not equal to 0ppm. This allows the analogue outputs to be scaled to show greater resolution in the desired region. E.g. the range could be set to 95-100%, giving a 5% minimum to maximum scale on the analogue output.
The ranges are set as default by the configuration file for that analyser, but they can be reconfigured at any time (Note: not during calibration) by the user. Once the ranges have been changed on the display they are saved by clicking on the 'Enter' button within the 'Ranges' area.
A useful feature of the S4Interface is the ability to show the measured concentration in a variety of units. By choosing the detector and range, then the units from the option buttons the displayed value is changed. By entering a conversion factor and unit name and then selecting the 'user defined' unit button, the concentration can be displayed in any desired units.

3.1.2 Settings

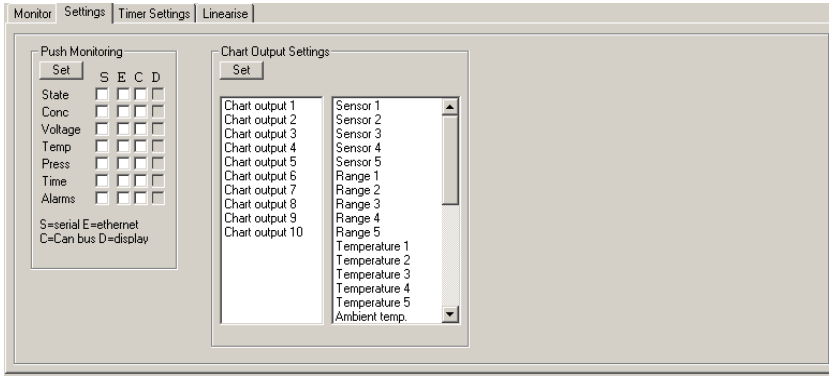


Figure 13

The Settings tab has two functions: Push Monitoring and Chart Output Settings.

3.1.2.1 Push Monitoring

This section allows the setting of the analyser to send out data on any of up to 4 channels, without having to send an interrogation command first. This presents much faster data rates (20Hz for concentration).

Pushed data may be sent to the following outputs:
S = Serial (RS232)
E = Ethernet
C = CANBus (Only available with CANBus Option)
D=Display (Not necessary with currently available Front-Panel Display option)

Click on the check boxes to enable the pushing of the selected data. Then click on the 'Set' button to send the settings to the analyser.

3.1.2.2 Chart Output Settings

This section is dedicated to the configuration of the analogue (0-10V) outputs.
There are 10 available analogue outputs on analysers with an I/O Option fitted. Each is configurable to show measurement channel concentration or diagnostic information (e.g. temperatures or pressures). To configure these outputs, first select the desired output number in the left list box (this corresponds to output pins. See

Appendix B – Analogue Output Wiring for details), then the data item in the right list box (e.g. Sensor 1 for measurement channel 1 concentration) then click on the 'Set' button to apply these settings to the analyser.

3.1.3 Timer Settings

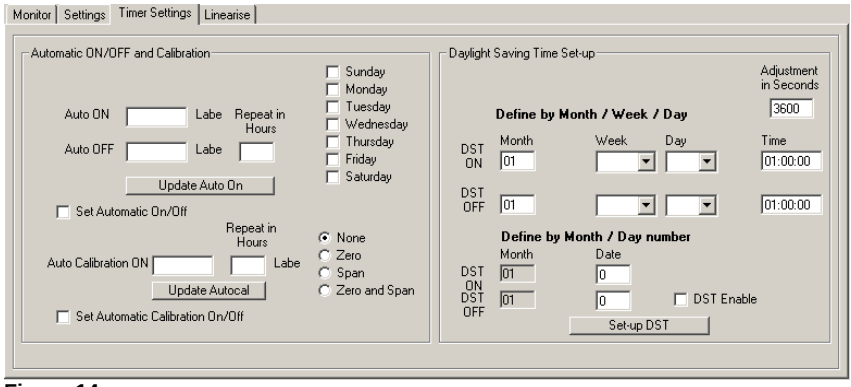


Figure 14

The timer settings tab is used to set-up Daylight Saving Time (DST) changes, and clock-controlled automatic ON and OFF and Automatic calibration.

The DST set-up can be a Month, Week and Day setting, for example Last Sunday in October at 2am, or it can be a Month and Date, for example 31st September at 2am. The DST ON setting will move the clock forward by the amount specified in the 'Adjustment in Seconds' box, and the DST OFF will move the clock back by the same amount.

To set the DST by the first method enter the start month (01 – 12) in the 'Month' box adjacent to the DST ON label. Then choose the week from the drop-down box (1,2,3,4,Last) and the day from the day drop-down (Sun,Mon,Tue,Wed,Thu,Fri,Sat). Finally set the time-of-day when the change should take place, and click on the Set-up DST button. This saves the DST settings but does not enable DST until the DST Enable check box is ticked.

The second setting method only requires the month to be set and then the date in the lower ‘Date’ box (01 – 31) This value is checked to confirm it is a valid date (preventing errors such as 31 June from being entered).

Both the DST ON and DST OFF details can be set at the same time and then clicking on the ‘Set-up DST’ button.

The clock is factory set, however after a battery reset or similar you may need to manually set it. To do this you will need to enter the details via the command line.
Type the command ‘ESYS K0 YYYY/MM/DD HH:MM:SS’, (e.g. ESYS K0 2013/10/24 16:50:00) and click ‘Send’ to set the date and time. If daylight saving is enabled, you need to allow for this.
Alternatively, to automatically account for daylight saving use the following command: - ‘GSTC K0 HH:MM:SS DD/MM/YYY’ (e.g. GSTC K0 16:50:00 24/10/2013). Note that the parameters are in a different order.

3.1.4 Linearise

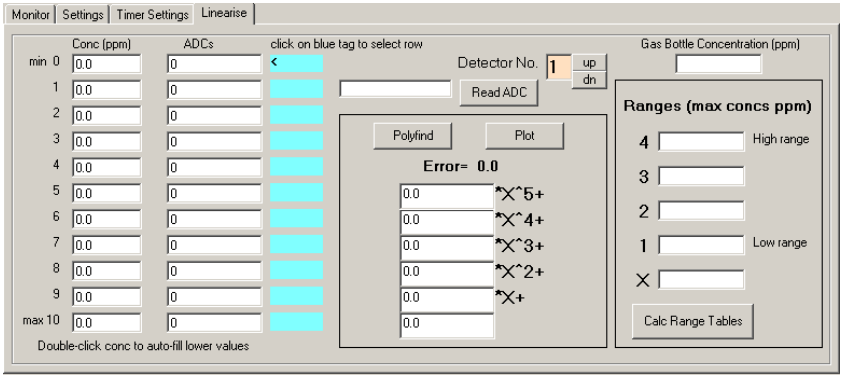


Figure 15

The Linearise tab may be used with a Signal Model 821S Gas Divider to set-up a linearisation table for non-linear analysers. This may be required for example if the analyser has not met the requirements of a linearity audit.
The Span Gas Table (see section 3.2.2.3), and the Gas Divider Table (see section 3.2.2.4) must be setup before using this feature.
A suitable span gas concentration for the range to be linearised must be chosen (i.e. 95 to 105% of FSD).
To Linearise:

1. Connect a Gas Divider to the Sample inlet of the channel you wish to linearise, as described in the Gas Divider user manual.
2. Select the channel (Detector No.) to be linearised using the up and down buttons. The ranges will be automatically filled at this point. All ranges are filled by default – to linearise one particular range or ranges, delete the unwanted range information.
3. Ensure that the concentration values (Conc [ppm]) are filled in. This can be done manually or by using the Gas Divider Table (see section 3.2.2.4). Use of the Gas Divider Table is recommended to take into account variations in gas flow viscosities and Gas Divider calibration.
4. Click in the blue box next to the concentration being measured, an arrow will point towards the ADCs box.
5. Choose the corresponding setting on the Gas Divider and wait for the reading to stabilise.

6. Click the 'Read ADC' button. After a short period of time the averaged ADC count will be filled automatically into the box.
   Note: During averaging the blue box will turn yellow, and upon successful population of the ADC counts it will turn green.
7. Repeat 4 to 6 for the rest of the concentrations until the table is completed.

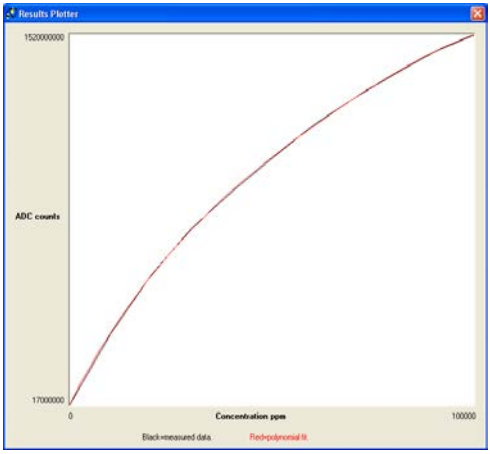


Figure 16

8. After all concentration levels have been completed, click 'Polyfind' which will try to find a polynomial which will fit the data and create the coefficients. Clicking on 'Plot' will display a graph of the actual results (black line, straight segments) against the polynomial fit (red line, curve).
   Note:If the polynomial fit is successful, the two lines should lie almost over the top of each other. If the polynomial fit is unsuccessful then check your settings. If still unsuccessful then it is likely that the analyser has developed a fault – please contact your local Signal representative for assistance.
9. If you have not already done so, choose the ranges to which you wish to apply this linearisation simply deleting the undesirable range information from the range box on the right of the page.
10. Click 'Calc Range Tables'. A window will display the tables for the specified ranges.
11. Click 'Save to Config file' and enter a description. This will be used as part of the file name S4_Ranges_*****.S4C (where ***** is the description entered into the box). The file will be saved into the folder in which the user S4i executable is stored.

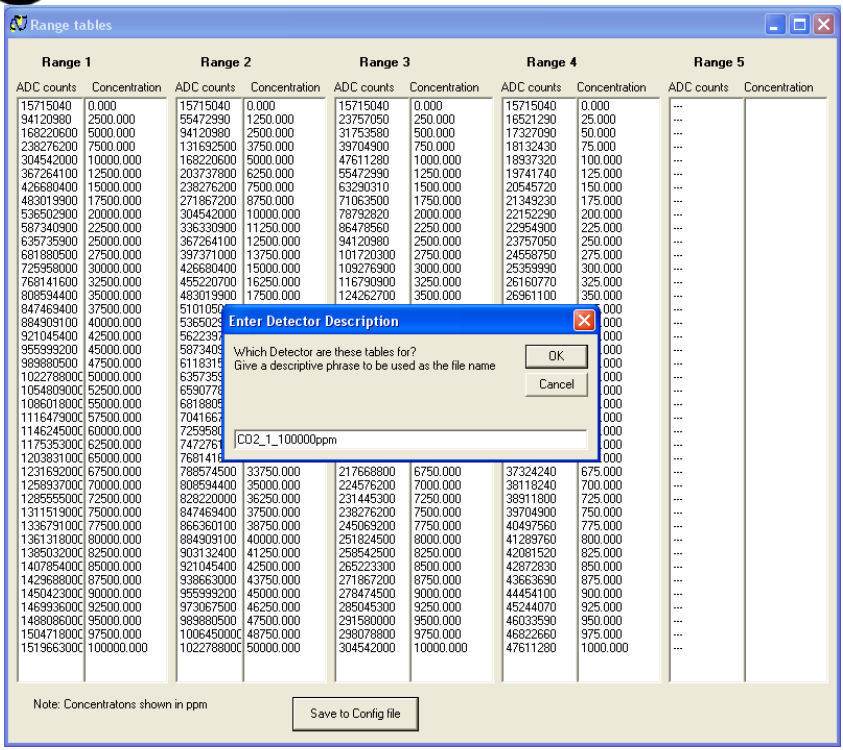


Figure 17

12. After saving the linearisation tables, close the Range Tables window and the Results Plotter and click File>>Save Lin Readings, enter a description into the dialog box and click open. The concentration values and the recorded ADC counts will be saved so that they may be re-loaded if required at a later date. The file will be saved with the extension .S4LIN and will be in the folder in which the user interface executable is stored.
13. To load the linearisation tables onto the analyser first make sure that the analyser is in SLEEP mode then click File>>Configure. Select the linearisation file and wait for a couple of minutes for the file to load. Linearisation has finished when the syntax in the command box starts with "ELPN Kn M5", where n is the detector number. Repeat for the other detectors.

3.2 Menu Options

3.2.1 File

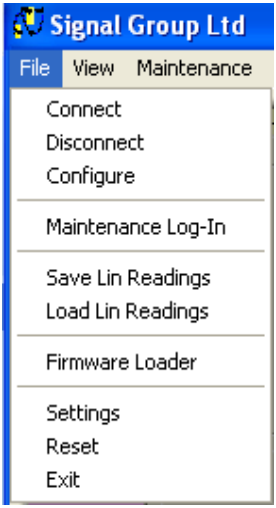


Figure 18

3.2.1.1 Settings (Comms Setup)

The menu item 'Settings' brings up the screen shown in Figure 19. These are the connection settings for both the RS232 serial connection and the Ethernet connection. The radio buttons are used to choose between serial and Ethernet (IP connexion). See sections 2.1 and 2.2 for further details.

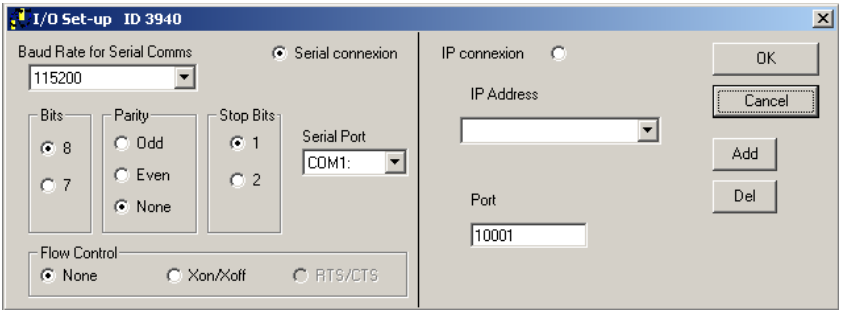


Figure 19

3.2.1.2 Connect/Disconnect

Use this to connect and disconnect to the analyser once the comms have been setup (equivalent to Connect and Disconnect on the Main Screen).

3.2.1.3 Configure

This option is used to apply a full analyser configuration file (**advanced users only**), linearisation table files (see section 3.1.4) and “calculated value” files (see section 2.4).
The analyser should be in SLEEP mode whenever any configuration file is applied. Contact your local Signal representative for further information.

3.2.1.4 Maintenance Log-In

For Signal Service Personnel use only. Contact your local Signal representative for further information.

3.2.1.5 Save Lin Readings / Load Lin Readings

After having performed a linearisation (see section 3.1.4), the results can be saved to file using this option. Saved results can then be re-loaded and examined if desired.

3.2.1.6 Firmware Loader

Use this to update the analyser firmware to the latest version (**advanced users only**. Contact your local Signal representative for further information.)

3.2.1.7 Reset

This option causes the analyser to re-initialise (**advanced users only**. Contact your local Signal representative for further information.)

3.2.2 View

3.2.2.1 Repeater

This displays the concentrations in a larger format for greater visibility from distance.

3.2.2.2 Errors list

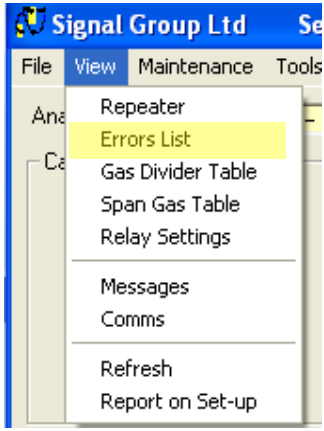


Figure 20

Selecting the 'Errors List' option on the 'View' menu (Figure 20) brings up the errors list screen as shown in Figure 21. This gives a list of all current fault and warning messages generated by the analyser. Some faults will cause the analyser to shut down while others give a warning message and intermittent buzzer activation.
NOTE: Errors are shown here until manually cleared, so a shown error may not be current.
Click Clear List to clear the displayed error list.
Click List Errors to then list the errors which currently apply.

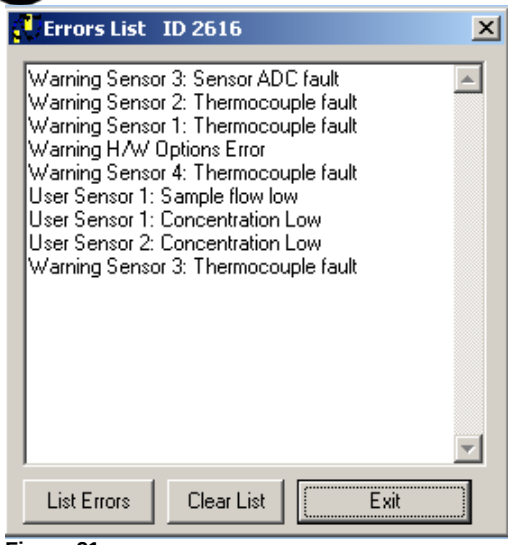


Figure 21

3.2.2.3 Span Gas Table

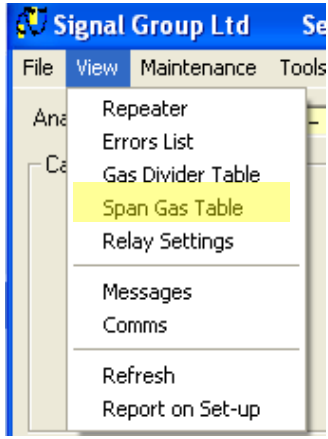


Figure 22

An analyser can have up to 5 measurement channels, each with a set of ranges. Each of these ranges can have a dedicated calibration (zero offset, span coefficient and linearity table).

Some regulatory bodies require span calibration gases to be within certain regions of used ranges, therefore a facility is provided to allow for a different span gas for each available range – the Span Gas Table. This table should be completed before any Span calibration or Linearisation is attempted.

The measurement channels are labelled as Detector 1 to Detector 5. Detector 1 has a secondary table for Span Gas 2, which is used for SOLAR Dual FIDs and QUASAR CLD based analysers.

The ranges are labelled Range 1 to Range 4, and Range X, where Range 1 is the lowest range, Range 4 is the highest, and Range X is the "Offset Minimum" Range.

For SOLAR FID based analysers, carbon number is also shown. For SOLAR Dual FIDs, the carbon number for Span Gas 2 may be set to 2 (for Ethane span gas), or 3 (for Propane span gas). This allows the analyser to calibrate accordingly to give ppmC equivalent measurements.

To complete the table (as shown in Figure 23), simply enter the values of the span gas bottle into the relevant box.

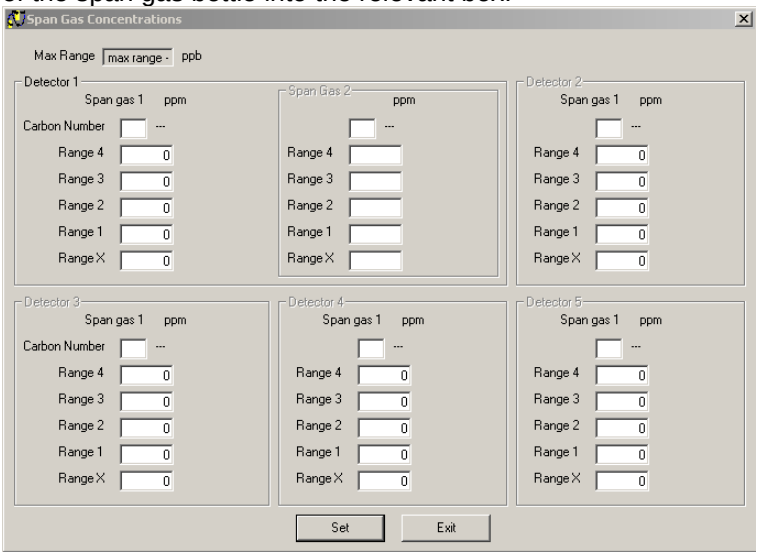


Figure 23

3.2.2.4 Gas Divider Table

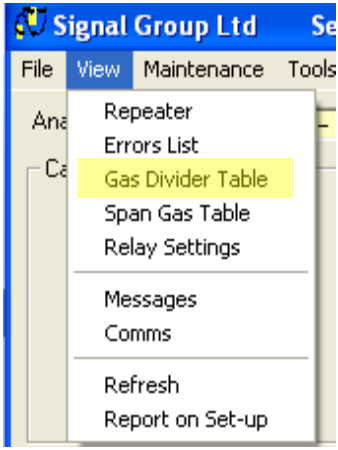


Figure 24

The Linearisation function of the S4i (see section 3.1.4) may be used to correct the linearity curve of an analyser measurement channel/range at any time.
It is recommended that a Signal Model 821S Gas Divider is used to provide accurate gases for linearisation and linearity checking.
Signal Model 821S Gas Dividers are provided with an accurate calibration certificate specific to each instrument. The values on these are specific to the gas divider and so are identified by the gas divider serial number.
Figure 25 shows the screen for setting and loading such tables.
To complete the Gas Divider Table:

1. Input the serial number (or other unique identification) for the Gas Divider to be used.
2. Load the Gas Divider calibration details by clicking Load Table, or type the calibration points manually into the Gas Divider Corrected % column.
   NOTE: To save the Gas Divider calibration details, manually fill the Gas Divider Corrected % column with the Gas Divider calibration points and click Save Table. Make a note of the unique identification used as this will be required to load the details in future.

3. Input the Span Gas bottle concentration taken from the bottle certificate.
4. Input the span and balance gas types (choose from the list shown).
   NOTE: It is assumed that the span gas bottle balance gas is the same as the balance gas applied to the Gas Divider, e.g. air or N2).
5. Click Calc Actuals. This will automatically populate the tableand allow for automatic population of the Conc [ppm] column on Linearise tab of the Main Screen.
6. Click Exit.

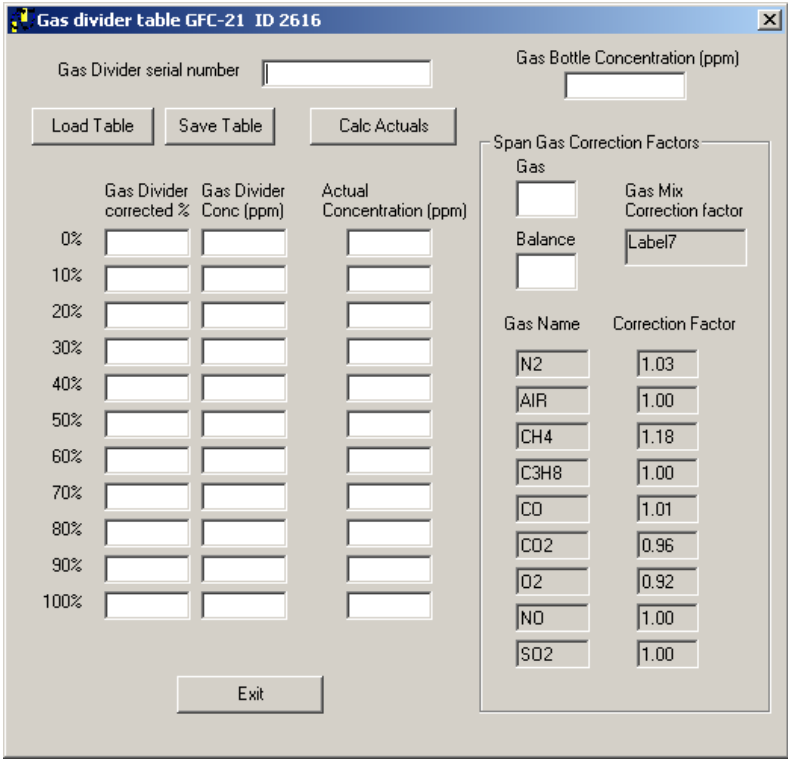


Figure 25

3.2.2.5 Relay Settings

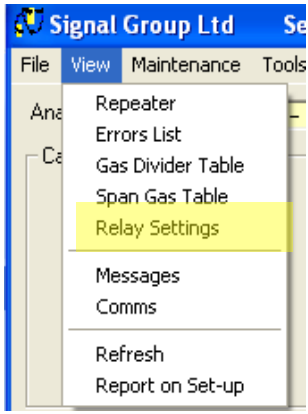


Figure 26

The Analyser can be fitted with up to 35 contact closure output relays which can be configured to operate when in alarm states or to actuate valves for a particular detector, range and gas path.
The following output relays are available depending on your selected option:

1. Standard IO – 3 (non-configurable)
2. Extended IO – 23 (20 configurable)
3. Special Extended IO – 35 (32 configurable)

NOTE: See Appendix C – Relay Specifications for contact closure electrical characteristics.

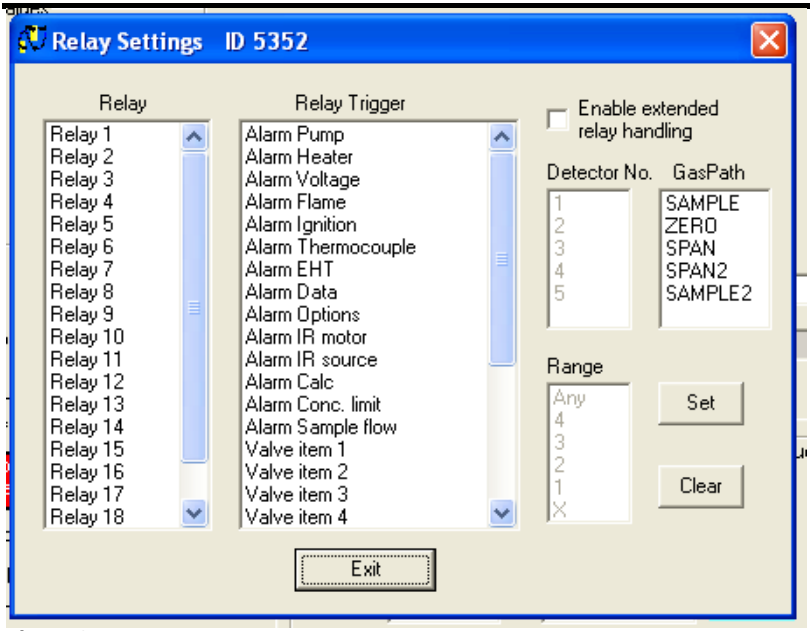


Figure 27

Figure 27 shows the Relay Settings page. To configure the contact closure output relays, choose your relay (see **Error! Reference source not found.** for wiring details), then select your trigger for this contact.
For alarm triggers, simply choose the alarm type(s) and click Set.
For exterior valve switching, choose a valve item number and select the Channel (Detector) number, the range for which the valve should switch (choose any for all ranges), and the desired gas path. This is useful when multiple span gases are required (one for each range), or for passing calibration gas down a heated sample line, for example (these valves are also switched during the corresponding calibration type). Click Set to apply these settings.

3.2.2.6 Messages

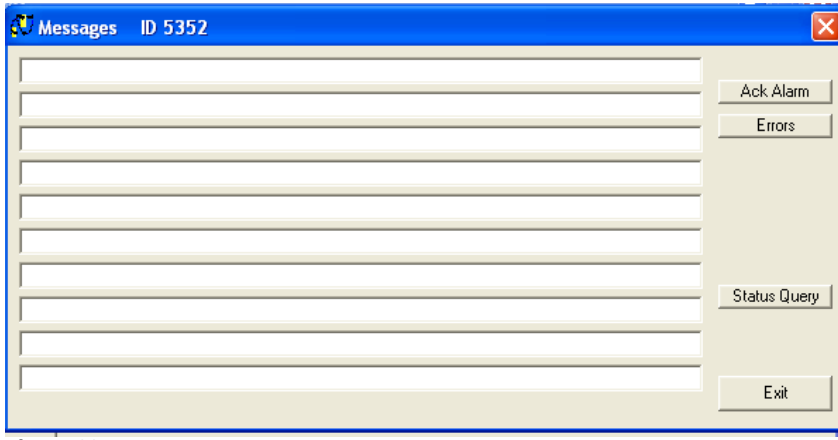


Figure 28

The messages screen shows some outgoing commands from the command line and replies from the analyser. The S4Interface will intercept command replies which it normally expects to receive from the analyser, so this feature is of most use when using test and debug commands, or command which are not commonly used. For convenience some buttons are provided which send useful commands to the analyser.

- 'Status Query' button sends 'TDBG K0 Q' which returns the current status of each detector.
- 'Ack Alarm' sends 'ERAL K0' to clear any alarm condition
- 'Errors' sends 'TDBG K0 X' which responds with a list of errors, and clears the errors list.

3.2.2.7 Comms

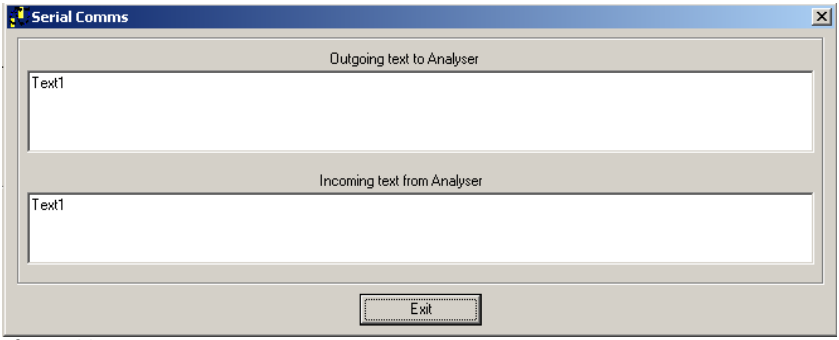


Figure 29

This screen shows real-time data transmissions between the analyser and the S4i.

3.2.2.8 Refresh

This is used to refresh the S4i information, for example if some data was missed during initial analyser connection, or if a subsequent connection issue has occurred.

3.2.2.9 Report On Setup

Advanced users only. This interrogates the analyser to provide a file which contains its complete configuration.

Tools

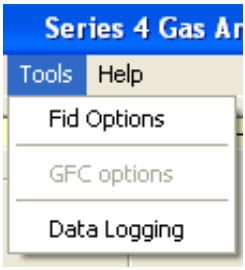


Figure 30

3.2.2.10 Data Logging

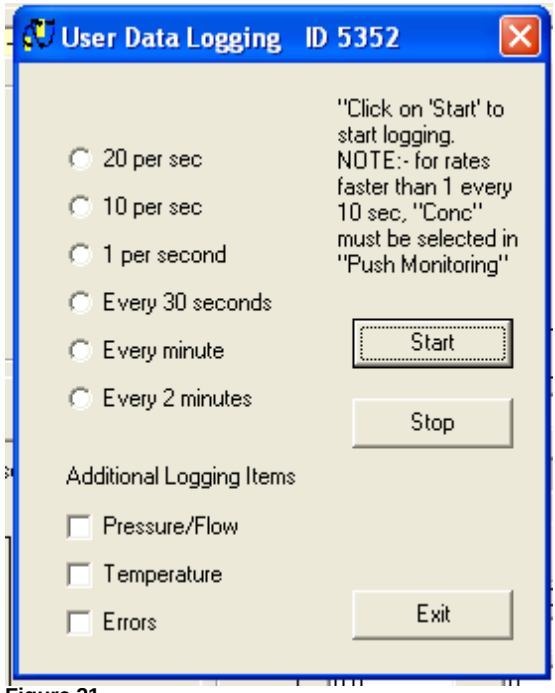
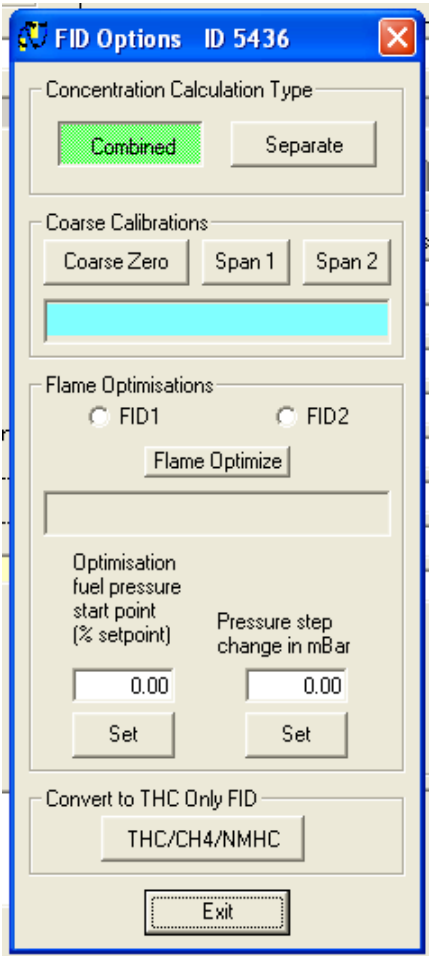


Figure 31

Digital data logging of the measured gas concentration can be performed by selecting a rate on the screen shown in Figure 31, and then clicking on 'Start'. You will be requested at this point to supply a name for the logfile. Diagnostics (Pressure/Flow, Temperature, and any errors) can also be logged by checking the appropriate check box before clicking 'Start'. The data logging will continue until 'Stop' is clicked, or until connection to the analyser is lost.
NOTE: For 20 or 10 Hz (per second) logging, Push Monitoring must be set on. See section 2.5 for further information).

3.2.2.11 FID Options (SOLAR)



FID based analysers (SOLAR) have some options specific to them:

3.2.2.11.1 Concentration Calculation Type

This applies to dual FIDs only. Select Combined for readings that use Signal's proprietary calibration logarithms to determine the THC, CH4 and NMHC concentrations including response factors, or Separate for readings directly from each detector, with no response factors taken into account.

3.2.2.11.2 Coarse Calibration

Advanced users only.
Select Coarse Zero to initiate a coarse zero calibration.
Select Span1 or Span 2 to initiate coarse span calibrations on detector 1 or detector 2.
Coarse calibrations can take several minutes.

3.2.2.11.3 Flame Optimisation

Advanced users only.
Each detector flame can be automatically adjusted to give optimum readings after ignition.

1. Select the detector you wish to optimise (FID1 for THC, FID2 for CH4).
2. Choose the starting fuel pressure by entering the level as a percentage of the current set level and clicking Set below the input box.
3. Enter the desired pressure step change and click Set below the input box (this will determine the graduation of the pressure increase of the fuel – 10mBar is recommended).
4. Click Flame Optimise. The analyser will then attempt to optimise the flame following a procedure as outlined in SAE 770141. The analyser must be recalibrated after flame optimisation. This may take several minutes.

3.2.2.11.4 THC Only

Dual FIDs are able to be used as THC-only FIDs when desired. This is recommended in order to reduce fuel consumption when CH4 and NMHC measurements are not necessary. To do this you must set the analyser to SLEEP mode, then go to Tools>>FID Options and click THC/CH4/NMHC. This will toggle the analyser between THC and NMHC modes.

Appendix A – AK Commands

The following listing describes the commands which can be used from the command line.
Note: For further details refer to the Signal document 'Series4 AK Commands Descriptions'

AKFG – Returns analyser configuration as model number, serial number, Series identifier, Number of sensors, sensor type, and gas id for the sensor.

EKEN – Sets an identification string. Once set it cannot be changed. It can be removed by setting to 'C' which clears the current value and allows a new value to be sent. To clarify: the command EKEN K0 C will clear the identification string, and this will allow a new string to be sent.

AKEN – Returns the 'ident' string which was set by the customer.

Analyser Mode setting:-
SEGA – Sets SPAN. This starts the analyser on a process to get to 'span' mode, which requires the oven to be at temperature, and also the cutter and air cleaner if fitted. For a FID (SOLAR), the flame (or flames) has to be lit, and if this is all true, then the pump is started and the span port is switched open. The front panel LED shows green when the analyser is measuring.

SMGA – Sets SAMPLE. As for span, but the sample port is opened.

SNGA – Sets ZERO, As for span but the zero port is opened.

SPAU – Sets PAUSE mode. As for span but no inlet ports are open. The analyser should not be left in this state for more than 1 minute.

STBY – Analyser SLEEP. In this state the Oven and other items are brought up to temperature and then remain there. No flames are lit. The front panel LED shows amber.

SOFF – Sets OFF mode. All heaters, flames, pumps and motors are turned off and all valves and pressure controllers are shut. Front panel LED shows red.

SRES – Analyser Reset. This puts the analyser into a temporary state with none of the analyser's main functions operational. All analyser functions will be started from their default states.

SATK – Start calibration. The analyser will save the current operating mode, then switch to a calibration mode:- if the analyser was in SAMPLE mode then a zero calibration followed by a span calibration will be performed. If the analyser was in ZERO mode then just a zero calibration will be performed. If the analyser was in SPAN mode then a span calibration will be performed. For a dual FID (SOLAR) there will be two span calibrations, SPAN1 and SPAN2 using methane and propane span gases.
The calibration sequence proceeds and returns to the saved mode when it completes. When the analyser is calibrating the front panel led shows alternating green and amber.

GSAC – Abandon Calibration. Only has effect when analyser is calibrating. Returns the analyser to the state it was in prior to calibration.

GRLG – Gets gas alarm low and high limits in ppm.
GSLG – Sets gas alarm limits in ppm.

GRPS – Gets pump status, either off or on.

GRMW – Gets current measurement path number; one of:- off, span, zero, sample or span2 if that is appropriate for the analyser type.

ASTZ – Gets Analyser Modes such as Off, SLEEP, Zero, Span, Sample, Pause, or purging. (Purging opens the zero gas port, runs the pump and continues for 30 seconds. Front panel LED flashes amber while this is happening.)

ATCS – Gets Time to Consumable Replacement in hours for consumable items.

ETCS – Resets Consumable Time

AKON – Gets gas concentration for one or more sensors (some may be calculated values) in ppm.

ADUF – Gets the sample flow rate in litres per minute.

AATK – Gets the autocalibration range number for one sensor
EATK – Sets the autocalibration range number for one sensor

AKAK – Gets calibration gas concentration in ppm.
EKAK – Set calibration gas concentration in ppm.

AANG – Gets the zero calibration error .
AAEG – Gets the full-scale calibration error.
GRCL – Gets calibration state number, zero status, span1 and span2 statuses and date and time of last calibration.

GRCT – Gets auto-cal start time, autocal period and whether enabled or not.
GSCT – Sets auto-cal start time, and period .
AKOW – Gets Calibration values, zero adc counts, date and time of last zero cal., span adc counts and date and time of last span cal.

GSCL – Set calibration settling limits. Sets upper and lower limits for sensor.

SEMB – Sets current analyser operating range in ppm.
AEMB – Gets current range.

AMBE – Gets range full scale concentration in ppm.
EMBE – Sets range FSD Concentration in ppm. This allows the user of the analyser to set their own ranges. The upper limit is set for each range, and the values are checked for consistency, showing a syntax error if there is a problem.

AMBU – Gets auto-range lower and upper concentration thresholds, in ppm.
EMBU – Recalculates auto-range thresholds. Needed when user re-defines range settings, so as to get new auto-range change-over points.

AT90 – Gets T90 filtering parameters for use with the ‘adaptable filter’.
ET90 – Sets T90 filtering parameters.

SARA – Sets auto-range off
SARE – Sets auto-range on.

AUKA – Gets ADC Count from chosen sensor.

ALIN – Gets User Linearisation Table entry, of concentration and ADC counts.
ELIN – Sets User Linearisation Table entry, of concentration and ADC counts.

ALPN – Gets all 9 User Linearisation Polynomial Coefficients
ELPN – Sets all 9 User Linearisation Polynomial Coefficients

ASTA – Gets error status

ASTF – Gets list of all active error codes. Gives list of error descriptions if L parameter is used.

ATEM – Gets Heater set point temperature in deg C. (there are 5 temperature sensing channels)
ETEM – Sets a Heater set point temperature in deg C.
GTEM – Gets a measured temperature from a thermocouple or thermistor.

GRTC – Gets time and date inclusive of any daylight savings setting.
GSTC – Sets time and date date inclusive of any daylight savings setting.

ASYS – Gets date and time without daylight saving adjustment. (actual clock value. Daylight saving does not affect the clock, only the displayed time)
ESYS – Sets date and time without daylight saving adjustment.

GRDD – Reads daylight saving settings.
GSDD – Sets daylight savings settings.

GRDS – Reads Analyser automatic switch-on and switch-off times, and repetition interval in hours. This uses daylight saving time if appropriate.
GSDS – Sets Analyser automatic switch-on and switch-off times.

GRAL – Gets alarm status showing whether the alarm is on (present) off (absent) or not used.
ARAL – GetsAlarm and Relay Allocation. Relays can be allocated to Alarms or Valves. In the latter case a sensor, gas path and range is indicated.
ERAL – Sets Relay and Alarm allocation. Relays can be allocated to Alarms or Valves. In the latter case a sensor, gas path and range is required.

SRAL – Set/Reset a Relay state. Relays can be defined to be normally open or normally closed. When a relay is set ON its normal state changes. This means normally closed relays use negative logic.
AKRL – Read all the Relay states. This reports the relays as ON or OFF with a binary string, or shows the mask for n/o and n/c relays (n/o = 0 n/c = 1)

ACHT – Gets Chart corrections for zero and FSD.
ECHT – Sets Chart corrections. While setting, the chart state is maintained as a 'set-up mode'.
When setting is complete, another ECHT is sent to restore normal operation.

SMAN – Sets manual operation, that is, the analyser is controlled from the front panel.
SREM – Sets remote operation, where the analyser is controlled over Serial or Ethernet.

ASPC – Gets RS232 Configuration
ESPC – Sets RS232 Configuration; baud rate, 7 or 8 bit ascii, stop bits, parity.

ADRU – Gets a Pressure or Flow for one or all pressure/flow sensors. If additional 'L1' parameter then list sensor type as absolute, gauge,

differential or true differential. If ‘L’ parameter then list sensor descriptions.

GSAN – Sets analyser model, gases, serial number, analyser series number, and many other customisation values.
GRAN – Reads back the analyser model, and other values.

GSBS – Sets Build Standard. This is an alternative way of setting some of the configuration values which are set in GSAN. It sets the type of the sensor boards, whether or not the i/o card, or daughter card is fitted, and the display type. The boards have a set of links which give rise to a binary value which identifies the board. The cpu can read this data and compare it against the rerquired configuration, and issue a warning if they do not match.
GRBS – Gets Build Standard details as set in GSBS or GSAN.

GRFV – Gets Firmware Version.

GSCC – Clear Configuration. This resets the analyser to its pre-configured state.

GRSI – Gets Sensor Input source ID, such as 1=THC FID 3=CH4 FID 8=NMHC. (List is not complete yet)
GSSI – Sets Sensor Input source ID.

GRGL – Gets Gas Flow Limits.
GSGL – Sets Gas Flow Limits. Gas flow outside of limits will set off alarm.
GREL – Gets Electrometer Configuration
GSEL – Sets Electrometer Configuration

GRVD – Gets List of Solenoid Functions as descriptive text
GSVD – Sets Solenoid Functions.
GRVM – Gets Solenoid Mapping or State. The state is a number showing which gas path the solenoid controls for that sensor.
GSVM – Sets Solenoid Mapping.

GRRD – Gets range configuration data. This shows whether the range chosen is in use, what its displayed units are, and the number of significant digits.
GSRD – Sets range configuration

GRRT – Gets Default Time Constants
GSRT – Sets Default Time Constants

FRPN – Gets Number of Pressure Sensors
FRPS – Gets Pressure Sensor Configuration
FSPS – Sets Pressure Sensor Configuration

GRPW – Gets PWM Assignment
GSPW – Sets PWM Assignment

GRTM – Gets Temperature Sensor Configuration
GSTM – Sets Temperature Sensor Configuration
GRTD – Gets Heater Configuration
GSTD – Sets Heater Configuration
GRDE – Gets heater channel and default efficiencies for a converter
GSDE – Sets heater channel and default efficiencies for a converter

GRFD – Gets Factory Linearisation Table
GSFD – Sets Factory Linearisation Table

GSRE – Copies FLASH into RAM
GSWE – Copies RAM to FLASH

GRCO – Gets Chart Offset
GSCO – Sets Chart Offset

GRAR – Gets re-ignition status
GRFS – Gets flame out status

TRAD – Gets raw ADC count.

TRPR – Gets Pressure Sensor ADC Count
TSPC – Sets Pressure Sensor Calibration Parameters
TRPC – Gets Pressure Sensor Calibration Parameters

TSPL – Sets Pressure PID Control Parameters

TRPL – Gets Pressure PID Control Parameters
TSFC – Sets Flow Calibration Parameters
TRFC - Gets Flow Calibration Parameters

TSPS – Sets a Controlled Pressure Point
TRPS – Gets a Controlled Pressure Set Point

TSPW – Sets the On Width of a PWM Channel
TRPW – Gets the On Width of a PWM Channel
TSGP – Sets the Glow Plug PWM default value
TRGP – Gets the Glow Plug PWM default value

TRSV – Gets system supply voltages.
TSIG – Glow Plug ON for Given Time
TSSS – sets solenoid valve state

Appendix B – Analogue Output Wiring

Chart Output No	Pin	Colour	Polarity
1	1	Pink	+
	26	Black	-
2	2	Pink	+
	27	Brown	-
3	3	White	+
	28	Black	-
4	4	White	+
	29	Brown	-
5	5	White	+
	30	Red	-
6	6	White	+
	31	Orange	-
7	7	White	+
	32	Yellow	-
8	8	White	+
	33	Green	-
9	9	White	+
	34	Blue	-
10	10	White	+
	35	Purple	-

Appendix C – Relay Specifications

Load Resistive load (cosφ = 1)

Rated Load 0.5 A at 125 VAC; 1 A at 24 VDC

Contact Material Ag (Au alloy)

Rated Carry Current 2 A

Max. switching voltage 125 VAC, 60 VDC

Max. switching current 1 A

Max. switching power 62.5 VA, 30 W

Failure rate (reference value) 1 mA at 5 VDC

Note: P level: λ60 = 0.1 x 10-6/operation. This value was measured at a switching frequency of 120 operations/min and the criterion of contact resistance is 100. This value may vary depending on the operating environment. Always double-check relay suitability under actual operating conditions.

Appendix D – Relay Wiring

Relay No/Digital IO	Pin	Colour
1	1	PINK
	35	BLACK
2	2	PINK
	36	BROWN
3	3	PINK
	37	RED
4	4	PINK
	38	ORANGE
5	5	PINK
	39	YELLOW
6	6	PINK
	40	GREEN
7	7	WHITE
	41	BLACK
8	8	WHITE
	42	BROWN
9	9	WHITE
	43	RED
10	10	WHITE
	44	ORANGE
11	11	WHITE
	45	YELLOW
12	12	WHITE
	46	GREEN

Relay No/Digital IO	Pin	Colour
13	13	WHITE
	47	BLUE
14	14	WHITE
	48	PURPLE
15	15	WHITE
	49	GREY
16	16	WHITE
	50	PINK
17	17	GREY
	51	BLACK
18	18	GREY
	52	BROWN
19	19	GREY
	53	RED
20	20	GREY
	54	ORANGE
21	21	GREY
	55	YELLOW
22	22	GREY
	56	GREEN
23	23	GREY
GND Power	57	BLUE
+24V Fused output	24	GREY
TTL SLEEP	58	PURPLE

Relay No/Digital IO	Pin	Colour
NC	25	GREY
TTL CAL	59	PINK
GND Power	26	PURPLE
GND Power	60	BLACK
DIO1	27	PURPLE
DIO9	61	BROWN
DIO2	28	PURPLE
DIO10	62	RED
DIO3	29	PURPLE
DIO11	63	ORANGE
DIO4	30	PURPLE
DIO12	64	YELLOW
DIO5	31	PURPLE
DIO13	65	GREEN
DIO6	32	PURPLE
DIO14	66	BLUE
DIO7	33	PURPLE
DIO15	67	PINK
DIO8	34	BLUE
DIO16	68	BLACK