MODEL 1100M SO_2 ANALYSER

OPERATING MANUAL

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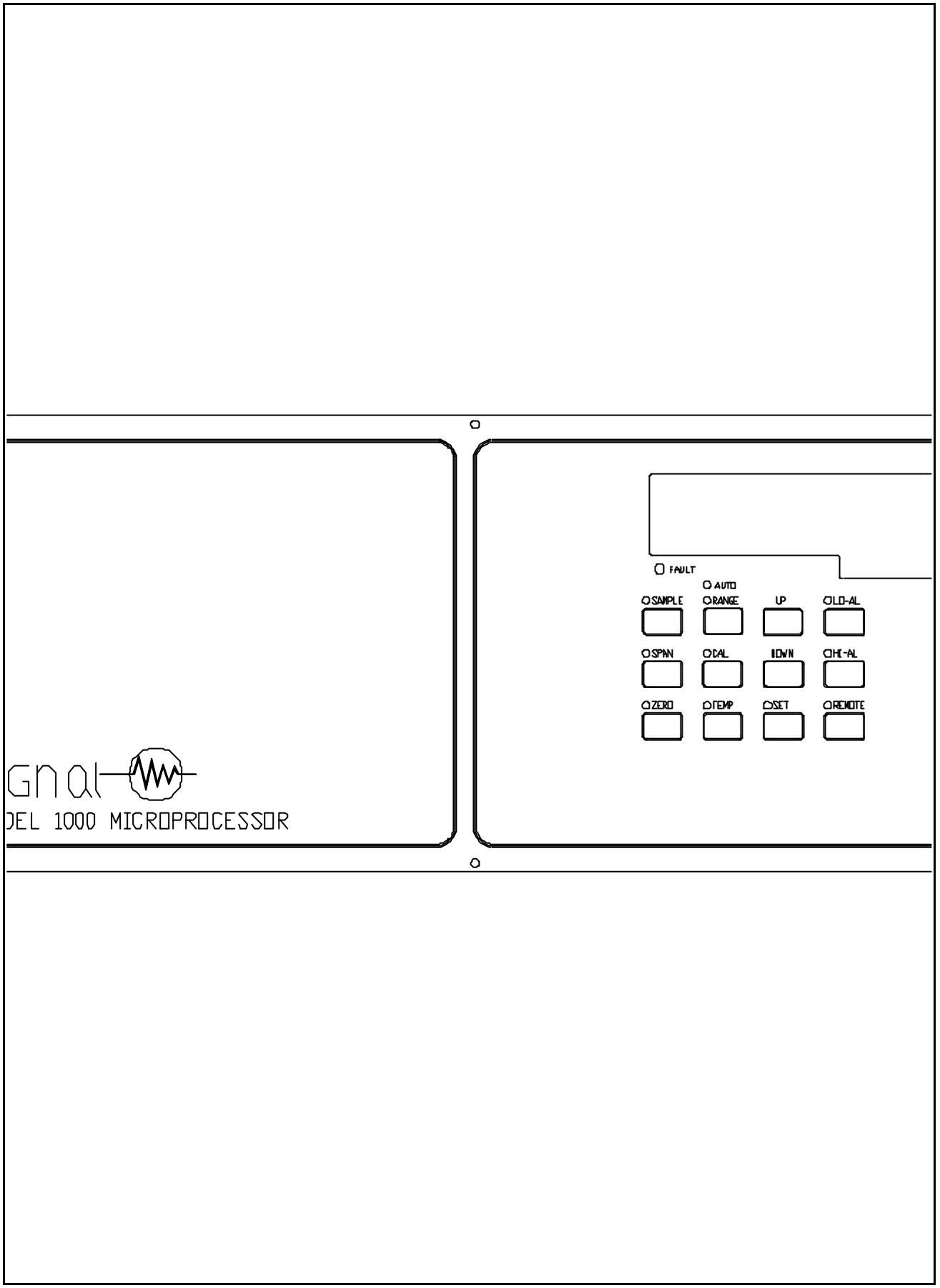

Figure 1 Model 1000 Series Analyser

1 INTRODUCTION

1.1 1100M SO_2 Analyser

1.1.1 The Signal Model 1100M is a heated Sulphur Dioxide analyser designed for continuous monitoring in pollution control and automotive research applications.

1.1.2 Using the non-dispersive ultra-violet (NDUV) technique the instrument offers extremely good sensitivity and selectivity. The high temperature sample system maintains the sample gas above the acid dew-point, allowing direct measurement of hot flue gases even when saturated with water.

1.1.3 The microprocessor based electronics are simple to operate with all analyser functions located on the front panel key-pad. Many features that were previously optional have now been included as standard. These include automatic calibration and range-changing, high/low alarms, and 0-10V and 4-20mA isolated analogue outputs. New features include extensive diagnostic functions and RS232 communications.

1.2 Manual

1.2.1 This Operating Manual contains operating and routine maintenance instructions. It does not contain sufficient information for fault finding if the analyser stops working. Full Maintenance Manuals are normal issued to distributors and service agents only, but can be purchased by customers if they wish to carry out their own servicing. All warranty will cease however, if a customer carries out his own servicing during the warranty period unless special arrangements have been made in writing. Servicing should be carried out every 2700 hours of use.

2 UNPACKING

2.1 Package Contents

2.1.1 The carton contains the analyser, and an accessory kit.

2.1.2 The accessory kit contains a nut spanner, filter extraction tool, spare ¼" nuts and ferrules, 25 way "D" connector with hood, a mains lead, and this manual.

2.1.3 The analyser is packaged for general freight purposes. It should withstand the occasional bumps and knocks which occur during transit. Please inspect the analyser and report any damage immediately to the shipping company and to Signal or your local representative. Please retain all packing for inspection.

2.2 Internal Inspection

CAUTION

This inspection procedure must be performed BEFORE the mains and gas connections are made.

2.2.1 Unscrew the 4 cross head screws on the instrument cover lid.

2.2.2 Slide lid back to reveal the internal assemblies of the instrument.

2.2.3 Check that all PCBs are firmly in their mating connectors.

2.2.4 Check and report any obviously loose or broken parts which may have occurred during transit.

2.2.5 Slide lid back and secure with the screws.

2.2.6 Read through the rest of this manual thoroughly and then carry out the installation.

3 SPECIFICATION

3.1 Mains Supply

3.1.1 115Vac or 230Vac ±15%, 50Hz or 60Hz, 360VA maximum.

3.1.2 Fuse rating 6.3AT for 115Vac or 3.15AT for 230Vac.

3.2 Environment

3.2.1 Ambient temperature 0 to 35°C.

3.2.2 Relative humidity 0 to 60% non-condensing.

3.2.3 Must be placed in a free venting location and protected from vibration, draughts, and direct sunlight.

3.2.4 Materials in contact with the sample gas are 316 stainless steel, quartz, PTFE, and VESPEL.

3.3 Mechanical

3.3.1 19" rack mounting 4U high, 435mm behind panel, 45mm in front of panel.

3.3.2 Bench mounting 483mm wide, 178mm high, 480mm overall depth.

3.3.3 Weight 18kg.

3.4 Performance

3.4.1 Ranges

3.4.1.1 Optional choice at time of order.

3.4.1.2 0 to 1000ppm with 100ppm and 500ppm additional chart recorder ranges, or 0 to 5000ppm with 500ppm and 2000ppm additional chart recorder ranges.

3.4.2 Sample flow

3.4.2.1 0.5 to 4l/min.

3.4.3 Sample flow sensitivity

3.4.3.1 Less than 0.3% of FSD per l/min.

3.4.4 Resolution

3.4.4.1 Better than 0.1% of FSD.

3.4.5 Noise

3.4.5.1 Less than 0.05% of FSD.

3.4.6 Repeatability

3.4.6.1 Better than 1% of FSD.

3.4.7 Transient Response

3.4.7.1 0 to 90% in less than 30secs.

3.4.8 Zero Drift

3.4.8.1 2% per week subject to a stable ambient temperature.

3.4.9 Span Drift

3.4.9.1 1% per day subject to a constant atmospheric pressure.

3.4.10 Ambient Temperature Drift

3.4.10.1 2% of FSD for a 10°C change in ambient.

3.4.11 Warm-up Time

3.4.11.1 Full specification within 2hrs. Useable within 15mins.

3.5 Sample Filter

3.5.1 0.1 micron.

3.6 RS232 Interface

3.6.1 Conforms to the RS232E standard.

3.7 Analogue Outputs

3.7.1 0-10V

3.7.1.1 Lowest load resistor 2KΩ.

3.7.1.2 Continuous short circuit allowed. Recovery < 15mins.

3.7.2 4-20mA

3.7.2.1 Highest loop resistance 400Ω including sense resistor.

3.7.3 Voltage and current outputs cannot be used at the same time.

3.8 Relay

3.8.1 Contact ratings are 1A at 24Vdc.

3.8.2 Isolation to chassis >10MΩ at 50Vdc.

3.9 Digital Outputs

3.9.1 Voltages must not be applied to these outputs. Continuous short circuit to 0V allowed.

3.9.2 Logic 0 (FALSE) level < 1Vdc at 5mA sink.

3.9.3 Logic 1 (TRUE) level nominally 5Vdc via 1KΩ resistor.

4 INSTALLATION

4.1 Mechanical

4.1.1 General

4.1.1.1 The analyser contains a heated sample oven and requires ventilation. Ventilation can be impaired if the analyser is mounted above a source of heat, or under a shelf or other obstruction where ventilation may be impaired.

4.1.1.2 Refer to Section 3 for the environmental specification.

4.1.1.3 Install the analyser in a clean, dry area which is free from vibration and in an ambient temperature which does not fluctuate or exceed 35°C.

4.1.1.4 **UNDER NO CIRCUMSTANCES SHOULD THE VENTILATION SLOTS IN THE TOP OR BOTTOM PANELS BE COVERED.**

4.1.2 Bench Mounting

4.1.2.1 The analyser should be mounted on a firm, flat surface, in an area free from vibration, draughts, and direct sunlight.

4.1.2.2 The front feet under the analyser can be pulled down to angle the front panel for better visibility and to improve the ventilation.

4.1.3 Rack Mounting

4.1.3.1 The analyser is suitable for mounting in a 19" rack enclosure or cabinet located on a firm base, and in an area free from direct sunlight unless internal cooling is provided.

4.1.3.2 The analyser contains a heated oven and sample cells, and requires ventilation. When mounted in a rack or enclosure, internally generated heat must be extracted and heat from other instruments mounted below the analyser prevented from affecting the analyser performance. It is recommended that 1U high louvred panels be fitted above and below the analyser.

4.1.3.3 The analyser must be supported over it's length by the use of chassis support brackets and not held by the front panel alone.

4.1.4 Rear Panel

4.1.4.1 All gas and electrical connections are made at the rear panel. The rear panel layout is shown in 2. The SPAN and ZERO adjustment controls at the right of the panel (viewed from the rear) should only be adjusted during routine service.

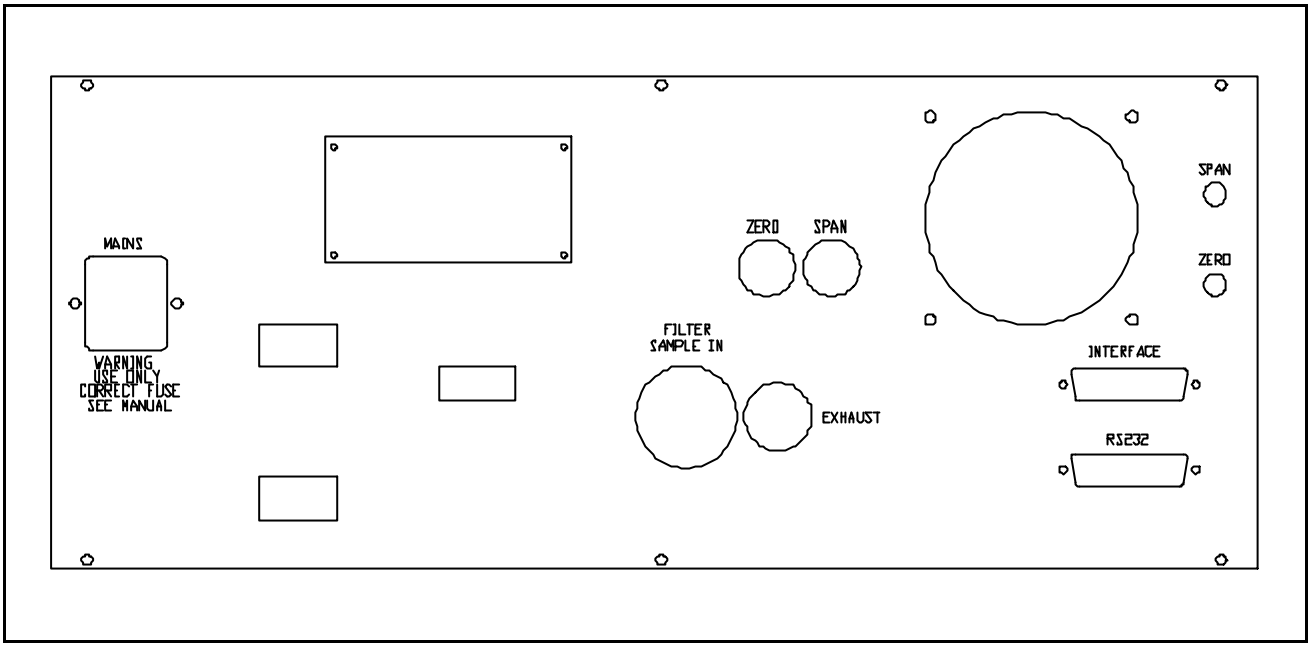

Figure 2 Rear Panel

4.2 Electrical Power

4.2.1 The analyser mains supply requirements are detailed on the serial number plate mounted on the rear panel. Check that the correct fuse is fitted before applying power.

4.2.2 A mains lead is supplied in the accessory kit. Connect the BROWN wire to Live, the BLUE wire to Neutral, and the GREEN/YELLOW wire to Earth.

4.3 Output Connections

4.3.1 Pin Allocation on the 25 way 'D' socket.

Standard Pin Allocation	
1 Channel 1 0-10V output	14 Channel 1 common return
2 Channel 1 4-20mA output	15 Do Not Use
3 Do Not Use	16 Do Not Use
4 Do Not Use	17 Do Not Use
5 Do Not Use	18 Range Identification 2^0
6 0V return for pins 18, 19, & 20	19 Range Identification 2^1
7 Do Not Use	20 Range Identification 2^2
8 Do Not Use	21 High limit relay COM contact
9 High limit relay NC contact	22 High limit relay NO contact
10 Low limit relay COM contact	23 Low limit relay NC contact
11 Low limit relay NO contact	24 Fault relay NO contact
12 Fault relay NC contact	25 Fault relay COM contact
13 No connection	

1.1.1 A typical circuit arrangement for the range identification outputs is shown in 3

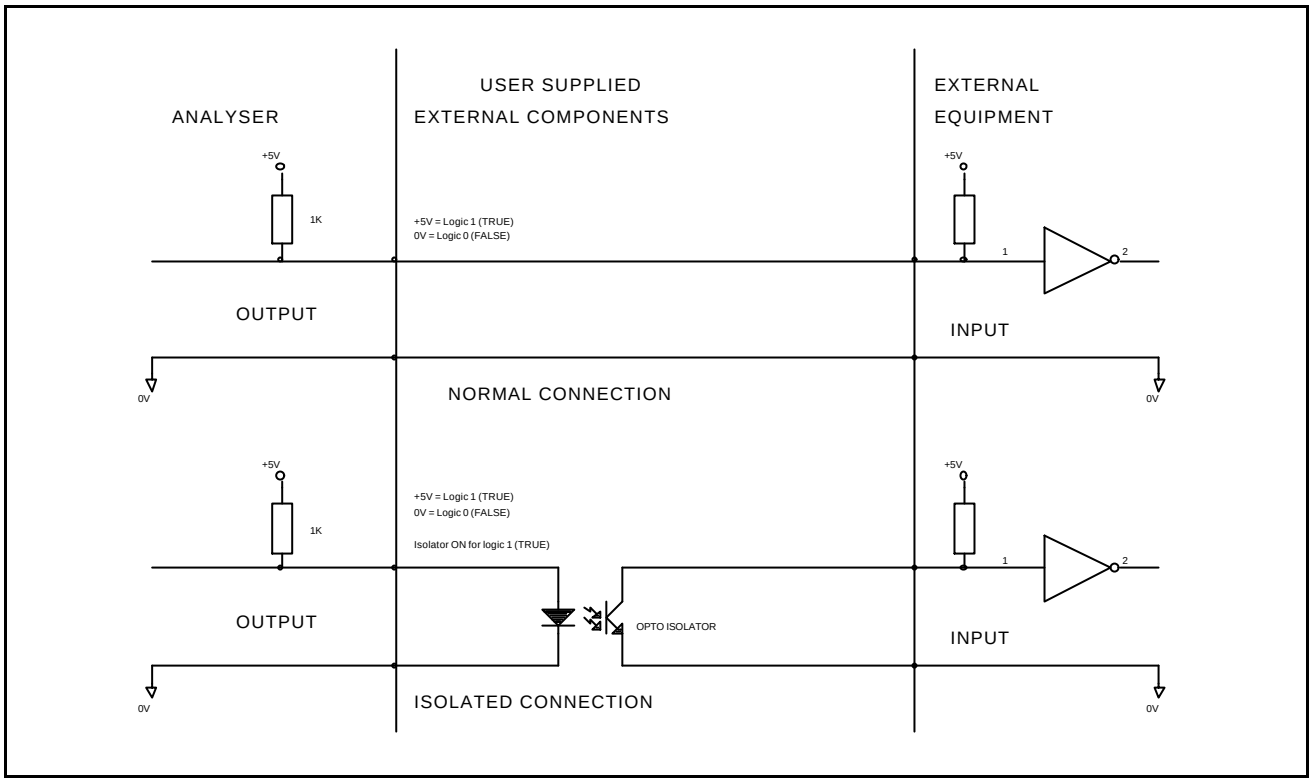

Figure 3 Standard Interface

1.1.2 The 0-10V and 4-20mA outputs are not available at the same time. Choose one or the other for connection to a chart recorder or data acquisition system.

1.2 RS232 Connections

1.2.1 RS232 Pin Allocation

RS232 Pin Allocation	
1 No connection	14 No connection
2 **TDX**	15 No connection
3 **RTX**	16 No connection
4 No connection	17 No connection
5 No connection	18 No connection
6 No connection	19 No connection
7 **0V**	20 No connection
8 No connection	21 No connection
9 No connection	22 No connection
10 No connection	23 No connection
11 No connection	24 No connection
12 No connection	25 No connection
13 No connection	

1.1 RS232 Defaults

1.1.1 The RS232 port uses the following factory set defaults.

Baud Rate	9600
Parity	None
Data Bits	8
Stop Bits	1
XON/XOFF	Enabled

1.2 RS232 Configuration

1.2.1 The analyser can be configured to suit the host. An 8 position DIL switch, located internally on the CPU card, controls the RS232 configuration.

CAUTION

Configuring the RS232 port requires access to the inside of the analyser.

SWITCH OFF AND DISCONNECT FROM THE MAINS SUPPLY BEFORE ATTEMPTING RE-CONFIGURATION

1.2.1.1 Remove the four screws securing the cover to the case and slide it to the rear. Identify the CPU card as the one mounted on, but furthest away from, the front panel. Identify the 8 way DIL switch close to the microprocessor; a large, square IC. Set the individual switches as required using the information in section 1.2.2.

1.2.1.2 Replace the cover and secure using the four screws.

1.2.2 Switch Functions

1.2.2.1 Switches 1, 2 and 3 control Baud rate. Use the following codes.

Baud Rate Selection			
Switch 1	**Switch 2**	**Switch 3**	**Baud Rate**
OFF	OFF	OFF	19200
ON	OFF	OFF	9600
OFF	ON	OFF	4800
ON	ON	OFF	2400
*	*	ON	1200
Where * represents any state.			

1.1.1.1 Switches 4 and 5 control parity. Use the following codes.

Parity Selection		
Switch 4	**Switch 5**	**Parity**
OFF	OFF	None
OFF	ON	Even
ON	OFF	Odd
ON	ON	None

1.1.1.1 Switch 6 controls the number of data bits. Set it ON for 7 bits or OFF for 8 bits.

1.1.1.2 Switch 7 controls the number of stop bits. Set it ON for 1 bit or OFF for 2 bits.

1.1.1.3 Switch 8 controls XON/XOFF. Set it ON to disable or OFF to enable XON/XOFF.

1.2 Pneumatic

1.2.1 Sampling System

1.2.1.1 When using the analyser on stack gases or hot wet gases, it will be necessary to keep the sample hot during transfer from the sampling point to the analyser. Signal manufacture a range of trace heated lines for this application. The internal filter and pump are usually adequate for most sampling applications, but if severe particulate is present in the sample, then the addition of Model 333 Signal Heavy Duty Prefilter is necessary.

1.2.1.2 If the analyser is used in conjunction with the Signal Series 4000 Chemi-luminescent NOx analysers, then the vent can be connected directly to the inlet of the NOx analyser via a short length of heated line.

1.2.1.3 Literature on heated lines, prefilters, and other equipment can be supplied on request.

1.2.2 Sample Gas

1.2.2.1 A hot sample gas should be kept hot by the use of a heated line. It is always advisable to keep gases hot if the sample may condense at ambient temperatures and affect the measurement accuracy. The analyser is fitted with a heated sample path to prevent internal condensation. A corrosive mist may form if water is allowed to condense. This is particularly important when measuring Sulphur Dioxide.

1.2.2.2 Special steps should be taken to remove exceptionally corrosive substances from the sample such as Sulphur Trioxide, Sulphur Acid mist, or Sulphur compounds which may penetrate conventional particulate filters.

1.2.2.3 The internal sample pump can be used to draw in sample gas from a low pressure source.

1.2.2.4 The pressure of the sample gas need not be controlled provided the maximum pressure is not likely to be exceeded. Too high a pressure will cause too high a flow and will result in a cell pressure higher than atmospheric pressure. This will cause measurement errors which can be calibrated out if the pressure is constant. Pressures above 5psig may cause cell window damage.

1.2.2.5 Connect the sample to the rear panel ¼" compression fitting labelled FILTER/SAMPLE IN. The use of PTFE tube for piping is recommended.

1.2.3 Exhaust

1.2.3.1 The gas leaving the analyser will be the sample, span, or zero gas. If it is toxic or corrosive, it must be connected up to an exhaust tube and vented to a safe area It is essential that large bore tubing be used if the pipe run is more than 2 or 3 metres, otherwise pressure will build up in the tube back to the sample cell and this will cause errors in the reading and also possibly damage the sample cell optical components. If in doubt, connect a pressure gauge in the tube line next to the analyser rear connection; pressure should not be allowed to rise more than 1psig. The analyser is sensitive to outlet pressure but the effect can be calibrated out if the pressure is constant.

1.2.3.2 If the exhaust is not heated, always pipe "downhill" to allow water condensate to drain away. Condensate must not be allowed to build up and block the exhaust path.

1.2.3.3 Connect the exhaust pipe to the rear panel ¼" compression fitting labelled EXHAUST.

1.2.4 Zero Gas

1.2.4.1 Zero grade nitrogen is recommended as the Zero reference gas. An internal orifice disc limits the flow and cell pressure for input pressures up to 20psig. Not more than 20psig will be required in this gas line and care should be taken to ensure that pressures do not exceed 20psig otherwise damage could occur to the sample cell optical components.

1.2.4.2 Connect the zero gas the rear panel ¼" compression fitting labelled ZERO. The use of PTFE tube for piping is recommended.

1.2.5 Span Gas

1.2.5.1 The analyser must be calibrated against a known standard. Bottles of calibration gas in a nitrogen diluent can be purchased at various levels of accuracy from many suppliers. Calibrate at, or near the measuring point. If the sample gas is an unusual mixture of gases, it is advisable, but not mandatory, to obtain a calibration gas having the same diluent mixture. An internal orifice disc limits the flow and cell pressure for input pressures up to 20psig. Not more than 20psig will be required in this gas line and care should be taken to ensure that pressures do not exceed 20psig otherwise damage could occur to the sample cell optical components.

1.2.5.2 Connect the span gas to the rear panel ¼" compression fitting labelled SPAN. The use of PTFE tube for piping is recommended.

1.2.5.3 Although all Signal analysers are checked and adjusted for linearity at the factory, the user may wish to check the analyser again from time to time in order to be sure that accuracy is optimised throughout the measuring range. For this purpose Signal produce the industry standard tool, a Model 821S Gas Divider. Literature on this and other gas blending equipment can be supplied upon request. Instructions for linearising the analyser can be found in the maintenance manual 1100M/SERV.

2 OPERATION

2.1 Introduction

2.1.1 This section describes actions required for control and set-up of the analyser. It makes use of the square brackets "[]" to indicate where a key press is required. As an example, the key to select Sample measurement would be shown as [SAMPLE]. It also makes use of the brace (or curly) brackets to indicate a warning number. As an example, a sample flow error would be shown by {E23}.

2.1.2 It is necessary to set internal parameters so that the analyser can perform certain tasks. This is done by a series of key presses, normally starting with the [SET] key. There is only a finite time in which to confirm the new settings before the analyser will exit the SET mode. If the [SET] key is not pressed within about two seconds after the [UP] or [DOWN] keys have been released, the display will return to CONCENTRATION, and the parameter will remain at it's previous value.

2.1.3 The [UP] and [DOWN] keys will cause a unit or step change when pressed and released. If pressed and held, they will cycle through the available settings. For some parameters, a fast cycle mode becomes active after a few seconds.

2.1.4 The front panel controls are shown in 4.

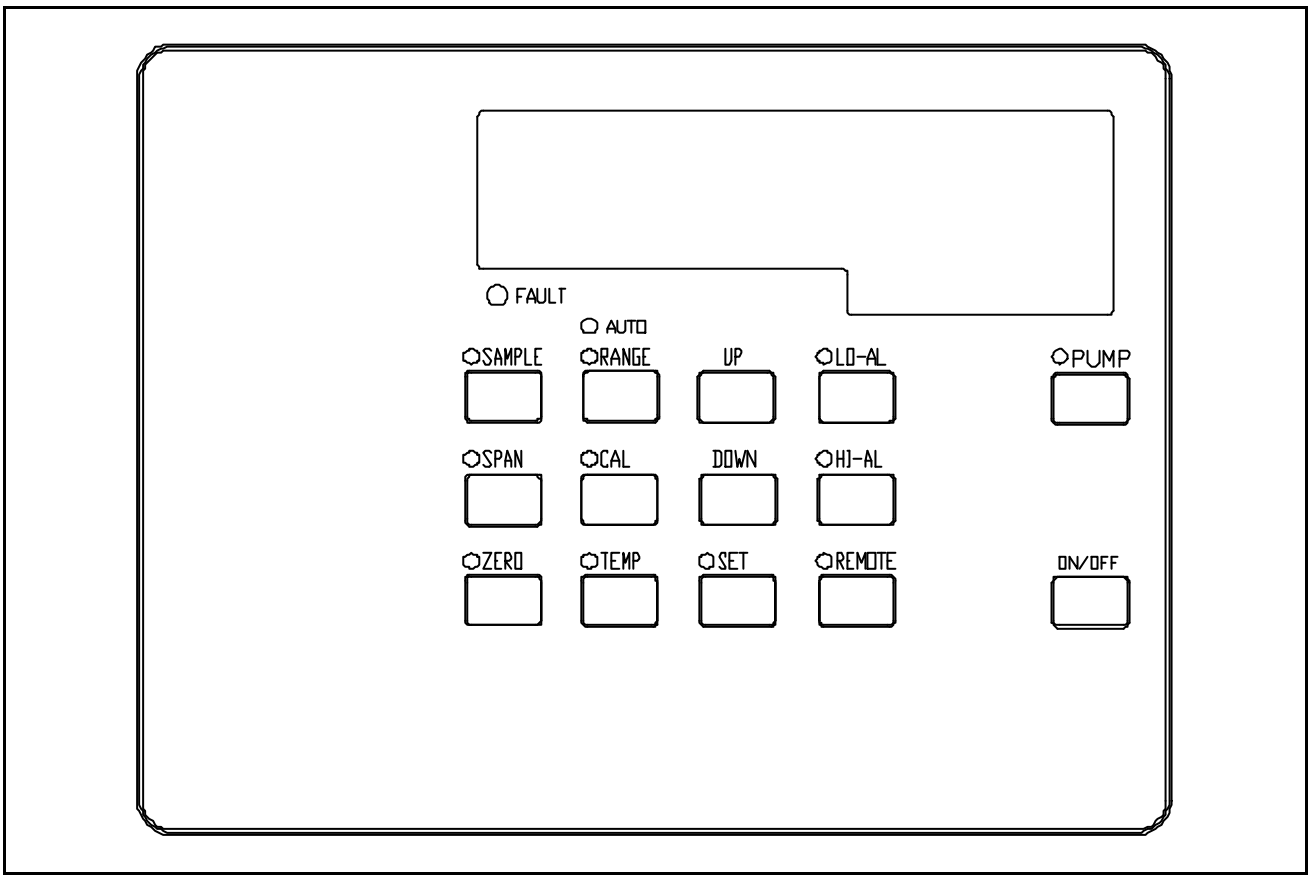

Figure 4 Front Panel Controls

2.2 Power Switch

2.2.1 The mains power switch is located at the lower right hand corner of the front panel. Press [ON/OFF] to switch the analyser on or off. Check that the local mains supply conforms to the power requirements for the analyser as detailed on the rear panel serial number plate.

2.2.2 When switched on, the 'beeper' will sound for a few seconds, and the microprocessor will go through an automatic self test routine which includes software, hardware, and display checks. This test takes a few seconds and during this time the display will have all segments turned on, followed by a visual count-down from 10 to 0. Software versions greater than 3.91 will place the version number on the display for the first six seconds followed by a visual count-down from 4 to 0. The version is displayed in the form Pn.nn where n.nn is the version number.

2.2.3 If a condition is detected that the user should be made aware of, a warning will be displayed in the form of an "E" number. Some warnings are not due to an analyser failure, but indicate that the analyser is not ready yet. A list of warning codes is given in section 4. A typical start-up warning would be {E23} indicating that the sample flow is not sufficient.

2.3 Start-Up

2.3.1 It is important that the sample cell reaches it's working temperature before hot gases are allowed to enter the analyser. It will take about 15mins to reach a usable temperature from cold. Full stability will not be achieved until 2hrs have elapsed.

2.3.2 Press [SAMPLE] (indicator glowing) to display concentration and press [PUMP] (indicator glowing) if the flow rate is not sufficient or if an {E23} warning is present. Press [ZERO] to select the gas connected to the ZERO port and check the zero point of the analyser, or [SPAN] to select the gas connected to the SPAN port and check the calibration point.

2.3.3 A flashing display that includes the decimal points indicates that too sensitive a range has been selected. Change to a higher range.

2.4 Range Selection

2.4.1 Manual

2.4.1.1 Press [RANGE] (indicator glowing), then press [UP] or [DOWN] until the required full scale range is shown on the display.

2.4.1.2 [UP] or [DOWN] can be pressed at any time while the RANGE indicator is glowing. Once the indicator is off, [RANGE] must be pressed again before further changes can be made.

2.4.2 Automatic

2.4.2.1 Range changing can be programmed to occur automatically such that the most appropriate range for the present concentration is used. The next range up will be selected when the concentration rises above 85% of the current range, and the next down when the concentration falls below 15% of the current range.

2.4.2.2 Press [RANGE] (indicator glowing), followed by [UP] or [DOWN] until "AUTO" appears on the display.

2.4.3 Remote Range Indication

2.4.3.1 The range in use is coded onto three pins of the Output and Control connector on the rear panel. These can be used to inform a digital or process controller about the scale of the chart recorder outputs. The codes are given in the following table.

Remote Range Indication			
2^2	2^1	2^0	Range
LOW	LOW	LOW	1 (Most Sensitive)
LOW	LOW	HIGH	2
LOW	HIGH	LOW	3 (Least Sensitive)

Where LOW is a logic low, and HIGH is a logic high.

1.1 Calibration

1.1.1 Before an analyser can be used it must be calibrated, and before it can be calibrated it must be informed of the **calibration details**. Once entered, they will remain valid until the span gas calibration bottle is replaced. Ensure that the correct zero and gas bottles are connected and are at the correct pressures. More accurate results will be obtained if the span gas concentration is close to the expected sample concentration.

1.1.2 Always allow the full warm up time for the analyser before performing calibration.

1.1.3 Enter Calibration Details

1.1.3.1 Manually select the most appropriate range for the concentration of calibration gas to be used. A calibration value can be selected if it falls between 12% above the selected range FSD, and the upper limit (12% above the normal FSD) of the next lower range. Other values can be only be selected by changing to a different range.

1.1.3.2 Set the span concentration to that on the bottle certificate by pressing [SET] (indicator glowing), [SPAN] (indicator glowing), followed by [UP] or [DOWN] as necessary until the display shows the correct concentration, followed finally by [SET].

1.1.4 Set Zero

1.1.4.1 Press [ZERO] (indicator glowing) and, if not previously set, slowly increase the input pressure until the {E23} warning ceases. Wait for the reading to become stable. A low flow-rate uses less gas but will take longer to stabilise.

1.1.4.2 Press [CAL] (indicator glowing). Each analyser range is zeroed and this may take some time if the reading is not stable. Zero calibration can be cancelled before [CAL] is pressed by selecting [SAMPLE] but those ranges that have been zeroed will have been updated. If it is not possible to zero a range, a warning condition is set. In normal operation, this will be seen as a flashing ZERO indicator when the un-zeroable range is used. The analyser is still useable but the concentration values must be considered suspect.

1.1.5 Set Span

1.1.5.1 Press [SPAN] (indicator glowing) and, if not previously set, slowly increase the input pressure until the {E23} warning ceases. Wait for the reading to become stable. A low flow-rate uses less gas but takes longer to stabilise.

1.1.5.2 Press [CAL] (indicator glowing) and after a short period the display will be updated with the calibration gas value. This sequence can be cancelled before [CAL] is pressed by selecting [SAMPLE].

1.1.6 Set Zero and Span Together

1.1.6.1 Press [SAMPLE] (indicator glowing) followed by [CAL]. The analyser will first switch to zero gas and perform a zero calibration and then switch to span gas and perform a span calibration. The sequence can be cancelled at any time by pressing [SAMPLE] and with the same limitations as for individual calibrations. If the SAMPLE indicator is already glowing, it is only necessary to press [CAL].

1.1.7 Calibration Limits

1.1.7.1 The SPAN and ZERO potentiometers on the rear panel are set at the factory so that a reasonable amount of drift can be corrected using the calibrate functions. If the analyser calibration points need to change by more than a preset amount from their factory setting, it is possible that the dynamic range of the detector, the amplifiers, and the analogue to digital convertor may not be adequate to cover the specified analyser measurement range. The SPAN or ZERO indicators will flash if this situation exists. A flashing ZERO or SPAN indicator should be regarded as an indication that routine servicing should be carried out. This involves cleaning the detector, checking gas flows, re-calibrating via the rear panel controls and, if necessary, re-linearising the analyser.

1.1.7.2 It is possible that a SPAN error condition could result from an incorrect setting for the calibration concentration. Before starting routine servicing, check that the set point agrees with the bottle calibration certificate by selecting the applicable range and pressing [SPAN], then [CAL], and comparing the figures. Press [SAMPLE] to cancel the setting process. If another calibration gas bottle is available, it is worth comparing the results from both.

1.1.8 Automatic Calibration

1.1.8.1 A facility is provided to carry out a regular calibration at programmable intervals. It uses the following sequence to ensure correct and reliable calibration.

1.1.8.1.1 Zero gas is selected and monitored until a steady reading is obtained. The display and output is set to Zero. This is done for each range.

1.1.8.1.2 Span gas is selected and the range changed to that selected when entering the calibration details in section 1.1.3. The value is monitored until a steady reading is obtained. The display and output are set to the value of Span gas entered as part of the calibration details entered.

1.1.8.2 Setting the Automatic Calibration Interval

1.1.8.2.1 The interval can be set up to 99.9 hours. A suitable interval for general purpose use would be 24 hours.

1.1.8.2.2 Press [SET] (indicator glowing), [CAL] (indicator glowing), then [UP] or [DOWN] until the display shows the required interval in HRS, followed finally by [SET]. Setting an interval of zero disables automatic calibration.

1.1.8.2.3 Calibration will automatically occur after the set interval from the time the final [SET] was pressed, and will repeat at the same interval thereafter.

1.1.9 Cancel Automatic Calibration

1.1.9.1 An automatic calibration sequence can be cancelled by pressing [SAMPLE]. The analyser will resume operation with those settings acquired before cancellation. Automatic calibration will occur again after the set interval.

1.1.10 Restore Factory Defaults

1.1.10.1 The original factory settings can be restored by pressing [SET], [SAMPLE] in sequence followed by [UP] and [DOWN] together, followed by [SET]. The display will show "DONE" in acknowledgement.

1.2 High and Low alarms

1.2.1 The analyser is fitted with two adjustable level alarms with SPDT relays wired up to the rear panel connector. When enabled, the HI-AL or LO-AL indicators will glow to show that a trip point has been set, and will flash when the reading is above the HI-AL or below the LO-AL. These level alarms are inhibited during automatic calibration but will be effective when [SAMPLE], [SPAN], or [ZERO] is selected.

1.2.2 Each alarm can be set using the following procedure.

1.2.2.1 The level adjustment will change by the smallest step of the current range. Use this effect to avoid prolonged waiting while the level goes from it's present value to the required one. Select a suitable range by pressing [RANGE] (indicator glowing), followed by [UP] or [DOWN] until the display shows the required full scale range.

1.2.2.2 Press [SET] (indicator glowing), [HI-AL] OR [LO-AL] (indicator glowing) as required, followed by [UP] or [DOWN] until the display shows the required trip point, followed finally by [SET]. The key sequence can be cancelled at any time by pressing [SAMPLE].

1.2.3 Restore Factory Defaults

1.2.3.1 The original factory settings can be restored by pressing [SET], [SAMPLE] in sequence followed by [UP] and [DOWN] together, followed by [SET].

1.3 Remote Control

1.3.1 Normal control is via the keys on the front panel. Remote control is accessed via the RS232 interface.

1.3.2 RS232 Control

1.3.2.1 RS232 control can be gained by pressing [REMOTE]. The current status is shown by the REMOTE indicator. Once the RS232 interface has taken control, it should formally relinquish control before local control can be regained. Return to local (front panel) control by pressing and holding [REMOTE] for about five seconds until the indicator turns off and the "beeper" stops. Refer to section 3 for a description of the command structure.

1.4 Pump

1.4.1 Use the [PUMP] key to turn the pump on or off. The current state is shown by the PUMP indicator. This key is normally disabled if no pump is fitted.

1.5 Shut-Down

1.5.1 Check that the analyser is not in the middle of a calibration cycle. Unless the analyser will be re-calibrated when next switched on, it is best to let the calibration cycle finish before switching the analyser off.

1.5.2 It is important that the analyser is not switched off until the sample cell has been purged. Press [ZERO] to allow a clean gas into the sample cell and allow it to flush the cell for about 5 minutes. If the analyser is fitted into a system with a purge gas available to all analysers via the sample port, this is a satisfactory alternative. If no other means is available, disconnect the sample inlet and allow the pump to pass ambient air through the sample cell.

1.5.3 Check that any equipment connected via the RS232 serial port has finished communication.

1.5.4 Switch off using the [ON/OFF] key. In the OFF state, the Fault relay NC and COM contacts will be shorted together.

2 CONTROLS

2.1 Philosophy

2.1.1 The front panel controls are based on function. There are therefore no menu structures to complicate the display or set procedures. Most functions allow a parameter to be read and, in conjunction with a second key, allow the parameter value to be changed or to perform a task.

2.1.2 A typical function is the [SPAN] key. If [SPAN] is pressed, the span gas is selected and the display will show the concentration. To perform a span calibration press [SPAN] followed by [CAL]. To enter the actual calibration gas concentration (from the bottle calibration certificate) press [SET], [SPAN], and the [UP] or [DOWN] keys until the display shows the required value, then complete the operation by pressing [SET]. This intuitive data selection and entry method is easy to learn and leads to fewer mistakes.

2.1.3 For most functions, the display will return to showing the sample concentration if no key has been pressed for some time.

2.1.4 This section of the manual describes the basic function of each key and indicator. A full description of key sequences required to perform particular operations is given in section 2.

2.2 Keys

2.2.1 [ON/OFF]

2.2.1.1 This is the mains power switch and is used to turn the analyser on and off.

2.2.2 [SAMPLE]

2.2.2.1 Selects the sample gas for measurement.

2.2.3 [SPAN]

2.2.3.1 Selects the span gas for measurement. Used in conjunction with the [SET] and [CAL] keys to calibrate the analyser.

2.2.4 [ZERO]

2.2.4.1 Selects the zero gas for measurement. Used in conjunction with the [SET] and [CAL] keys to set the zero point of the analyser.

2.2.5 [RANGE]

2.2.5.1 Used to display the full scale range of the chart recorder output. Used in conjunction with [UP] and [DOWN] to select a chart recorder range. The displayed units will be PPM.

2.2.6 [CAL]

2.2.6.1 Used in conjunction with the [SPAN] and [ZERO] keys to perform analyser calibration, and with the [SET], [UP] and [DOWN] keys to set an automatic calibration interval.

2.2.7 [TEMP]

2.2.7.1 This key is non-functional. It is present to maintain compatibility with other analysers and is reserved for future control and monitoring facilities.

2.2.8 [UP]

2.2.8.1 Used to increase a parameter value or to select a higher (less sensitive) range when used in conjunction with [RANGE], [CAL], [SET], [HI-AL], or [LO-AL] keys.

2.2.9 [DOWN]

2.2.9.1 Used to decrease a parameter value or to select a lower (more sensitive) range when used in conjunction with [RANGE], [CAL], [SET], [HI-AL], or [LO-AL] keys.

2.2.10 [SET]

2.2.10.1 Selects the mode that allows parameter values to be changed. Used as a prefix in conjunction with [CAL], [TEMP], [SET], [HI-AL], or [LO-AL] keys. The [RANGE] key, needed more frequently than parameter adjustment, does not need the [SET] prefix. A final press on this key returns to the previous measurement mode. It is important that this confirmatory second press happens with a couple of seconds from the release of the last key otherwise the setting is ignored and the display returns the previous measurement mode.

2.2.11 [LO-AL]

2.2.11.1 Displays the low alarm limit. Used in conjunction with the [SET], [UP] and [DOWN] keys to set the low alarm level.

2.2.12 [HI-AL]

2.2.12.1 Displays the high alarm limit. Used in conjunction with the [SET], [UP] and [DOWN] keys to set the high alarm level.

2.2.13 [REMOTE]

2.2.13.1 Used to allow remote control operation by a host computer. Press this key to place the analyser in the control of a host computer. Pressing this key continuously for more than five seconds will restore front panel control.

2.2.14 [PUMP]

2.2.14.1 Controls the operation of the internal pump. This key is disabled if there is no pump fitted.

2.3 Indicators

2.3.1 General Numeric Display

2.3.1.1 This is located in the top area of the window and is used for all displays requiring a numeric value and units. The units are abbreviated to PPM (parts per million), and DG C (°C).

2.3.2 Chart Recorder Output

2.3.2.1 This is a horizontal bar graph immediately underneath the General Numeric Display and within the same window. It represents the fraction of the chart recorder range being used.

2.3.3 Gas

2.3.3.1 This shows the gas or measurement mode in current use. It is located in the bottom right of the window.

2.3.4 FAULT

2.3.4.1 This indicator glows when a warning or fault condition has been detected.

2.3.5 AUTO

2.3.5.1 This indicator glows when automatic range changing has been selected.

2.3.6 SAMPLE

2.3.6.1 This indicator glows when the Sample gas is being analysed and the resulting value is displayed.

2.3.7 SPAN

2.3.7.1 This indicator glows when the Span gas is being analysed and the resulting value is displayed or when a span calibration is in progress, and flashes if the last span calibration failed.

2.3.8 ZERO

2.3.8.1 This indicator glows when the Zero gas is being analysed and the resulting value is displayed or when a zero calibration is in progress, and flashes if the last zero calibration failed for the current range.

2.3.9 RANGE

2.3.9.1 This indicator glows when the display is showing range information.

2.3.10 CAL

2.3.10.1 This indicator glows when either manual or automatic calibration is in progress.

2.3.11 TEMP

2.3.11.1 This indicator is non-functional. It is present to maintain compatibility with other analysers and is reserved for future control and monitoring facilities.

2.3.12 SET

2.3.12.1 This indicator glows while in the change parameter mode.

2.3.13 LO-AL

2.3.13.1 This indicator glows if a low limit has been set and flashes if the measured value of the Sample gas is below the set value. Flashing is inhibited during automatic calibration.

2.3.14 HI-AL

2.3.14.1 This indicator glows if a high limit has been set and flashes if the measured value of the Sample gas is above the set value. Flashing is inhibited during automatic calibration.

2.3.15 REMOTE

2.3.15.1 This indicator glows when the analyser is allowed to be controlled by a host computer.

2.3.16 PUMP

2.3.16.1 This indicator glows when the sample pump is switched on.

3 REMOTE CONTROL

3.1 Control Via the RS232 Port

3.1.1 The remote control protocol follows the standard known as `AK' and which has been specified by the German automobile industry.

3.1.2 The Signal Host/Analyser communications protocol is based on the master/slave principle. The host is the master and the analysers are the slaves. Each analyser is connected to the host via an individual RS232 link. The host (master) issues a command `packet' to an analyser (slave), the analyser processes the data and responds with an acknowledgement packet. The analyser cannot transmit any data to the host other than as an acknowledgement packet.

3.2 RS232 General Packet Format

3.2.1 The general form of every packet is as follows:

<STX><x><CODE>[.. data field ..] <ETX>

Where:
<STX> Ascii STX
<ETX> Ascii ETX
<CODE> 4 Ascii Character Command code
x is a don't care byte that is read from DIP switches in the equipment.

3.2.2 All characters transmitted are standard ASCII printable characters except for the following:

<STX> Ascii STX (Decimal 2, or Hex 02)
<ETX> Ascii ETX (Decimal 3, or Hex 03)
<CR> Ascii carriage return (Decimal 13, or Hex 0D)
<LF> Ascii line feed (Decimal 10, or Hex 0A)

3.3 RS232 Command Packet

3.3.1 `Commands' and `data' packets are transmitted from the MASTER to a SLAVE.

3.3.2 <STX><x><CODE><space><K><n><space>[...data...]<ETX>

Where: K = Ascii character `K'
n = A single digit, 0-9, indicating channel number.

From the Signal Host to the Analysers, n is always 0.

3.4 RS232 Acknowledgement Packet

3.4.1 Acknowledgement messages are transmitted from a SLAVE to the MASTER as an acknowledgement to a command packet from the master.

3.4.2 The general form of an acknowledgement is

<STX><x><CODE><space><error>[.. data field ..]<ETX>

Where ...

3.4.2.1 space = Ascii space character.

3.4.2.2 error = A one byte indication of the state of the equipment.

Ascii `0' = No errors.
Ascii `1' - `9' = cyclic count of errors increasing with each error and decreasing when each error is cleared. Eg: `1' can mean 1 or 10 or 19 errors.

3.4.2.3 CODE = The code of the command that was sent if it was understood. If received code was not understood, CODE in the acknowledgement will contain four question marks, i.e. ????.

3.4.2.4 Data field = Dependent upon the command issued.

3.4.3 There are various different acknowledgement packets.

3.4.3.1 OK Acknowledgement

3.4.3.1.1 If the received command was understood and processed by the slave the format of the acknowledgement is :-

<STX><x><CODE><space><error>[data]<ETX>

Where the data area contains the response to the command.

3.4.3.2 Offline Acknowledgement

3.4.3.2.1 If the Analyser is `offline' i.e. not in `remote' mode, the acknowledgement is :-

<STX><x><CODE><space><error><space><K><0><space><0><F><ETX>

The command will be ignored.

3.4.3.3 Busy Acknowledgement

3.4.3.3.1 If the Analyser is `busy' i.e. not ready to accept and process a new command, the acknowledgement is :-

<STX><x><CODE><space><error><space><K><0><space><B><S><ETX>

The command will be ignored.

3.4.4 The Data Field

3.4.4.1 The data field may be from 0 to 99 characters long. Every data value will be preceded by a space. <CR> and <LF> characters may also be used as separators.

3.5 RS232 Protocol

3.5.1 SRES Reset
data = NA
results = NA
Used by: Analyser/host/gas divider

3.5.2 STBY Standby
data = NA
results = NA

Used by: Analyser/host/gas divider

3.5.3 SPAU Pause
data = NA
results = NA
Used by: Analyser/host/gas divider

3.5.4 SARE Autorange On
data = NA
results = NA
Used by: Analyser

3.5.5 SARA Autorange Off
data = NA
results = NA
Used by: Analyser

3.5.6 SEMB Set Range
data = Mx x=range number
results = NA
Used by: Analyser

3.5.7 SMGA Sample gas
data = NA
results = NA
Used by: Analyser/host

3.5.8 SNGA Zero gas
data = NA
results = NA
Used by: Analyser/host

3.5.9 SEGA Span gas
data = NA
results = NA
Used by: Analyser/host

3.5.10 SATK Calibrate (equivalent to front panel [CAL])
data = NA
results = NA
Used by: Analyser/host

3.5.11 SREM Remote
data = NA
results = NA
Used by: Analyser/host/gas divider

3.5.12 SMAN Manual
data = NA
results = NA
Used by: Analyser/host/gas divider

3.5.13 AKON Measured value
data = NA
results = ffff.fffff
Used by: Analyser

3.5.14 AANG Zero point error "Range, Value, PPM Error, %Error"
data = NA
results = Mx xxx.xxx xxxx.xxx xx for each range
Used by: Analyser

3.5.15 AAEG Full scale error "Range, Value, PPM Error, %Error"
data = NA
results = Mx xxx.xxx xxxx.xxx xx for each range
Used by: Analyser

3.5.16 ASTF Error Status: Equipment error code (s)
data = NA
results = x x x ... list of all current error codes
Used by: Analyser

3.5.17 AEMB Selected Range: Current analyser range
data = NA
results = Mx x=1 to 8
Used by: Analyser

3.5.18 AMBE Range Full Scale "Range, FSD"
data = NA
results = Mx xxxx.xx xxxx.xx ... in ppm for each range
Used by: Analyser

3.5.19 AMBU Autorange Threshold "Range, Lower, Upper"
data = NA
results = Mx xxxx.xx xxxx.xx ... in ppm for each range
Used by: Analyser

3.5.20 AKAK Cal. gas concentration "Range, Cal Gas"
data = NA
results = Mx xxxx.xxx
Used by: Analyser

3.5.21 AUKA Uncorrected values "Range, uncorrected analogue value"
data = NA
results = Mx adc=xxxx
Used by: Analyser

3.5.22 EKAK Set cal. gas conc. "Range, Concentration".
data = Mx Span=xxxx.xx concentration in ppm
results = NA
Used by: Analyser

3.5.23 GRAV Read average reading and max and min
data = NA
results = AV=fffff.fff MX=gggg.gggg MN=hhhhh.hhhh
ffff.fff average reading.
gggg.ggg Minimum reading.
hhhh.hhh Maximum reading.
Used by: Analyser

3.5.24 GRAD Read average and alignment delay
data = NA
results = Av=X D0=X D1=X
X= time in 0.1 seconds

Used by: Analyser

3.5.25 GSAD Set average and alignment delay
data = Av=X D0=X D1=X
results = NA
X= time in 0.1 seconds
Used by: Analyser

3.5.26 GSPS Set pump state
data = io=(0/1)
results = NA
1=ON, 0=OFF
Used by: Analyser

3.5.27 GSAC Abandon the calibration
data = NA
results = NA
Used by: Analyser

3.5.28 GRPS Read the pump state
data = NA
results = io=(0/1)
1=ON, 0=OFF
Used by: Analyser

3.5.29 GSCT Set the auto cal time
data = ATnnn
results = NA
nnn= in 6 minute units
Used by: Analyser

3.5.30 GRCT Read the auto cal time
data = NA
results = ATnnn
Used by: Analyser

3.5.31 GRLG Read the gas limits
data = Gx
results = Gx Low=xxx High=xxxx
x= 0,1,2 for the gas, xxx= limit in ppm
Used by: Analyser

3.5.32 GRAL Read alarms (high low span zero temperature)
data = NA
results = LA=a HA=b ZA=c SA=d TA=e
a=low concentration alarm status
b=high concentration alarm status
c= zero cal alarm status
d=span cal alarm status
e= temperature alarm status
Used by: Analyser

3.5.33 GRCL Read calibration state
data = NA
results = CS=a ZS=b SS=c
a= calibration status
0=Not calibrating

1=Zero calibrating only
2=Span calibrating only
3=Zero calibrating before span
4=Not calibrating Basic data installed

b= zero calibration status
0=No zero calibration
1=Last Zero calibration Successful
2=Last Zero calibration Unsteady
3=Last Zero calibration Outside limits

c= Span calibration status
0=No Span calibration
1=Last Span calibration Successful
2=Last Span calibration Unsteady
3=Last Span calibration Outside limits

Used by: Analyser

3.5.34 GRRR Read the remote range setting

data = NA
results = io=x Mxxxx
x=remote range status 0/1 on/off
xxxx=range number

Used by: Analyser

3.5.35 GRSO Read span over-range percent

data = NA
results = SO=xxx
xxx= over-range value in percent

Used by: Analyser

3.5.36 GRTI Read grace time, cal limits time, warm-up, range change

data = NA
results = GT=a WT=b CST=c CSL=d CVL=e IRT=f IMT=g RCT=h
a=fault grace time after switch on.
b=warm-up time after switch on.
c=calibration steady reading time for a good reading.
d=calibration steady reading variation.
e=calibration successive reading required.
f=automatic Re-ignition time.
g=Ignition range time.

Used by: Analyser

3.5.37 GRWG Read which gas NO, NO2 etc

data = NA
results = Gx
x=Gas number 0, 1, 2 type depends on the model.

Used by: Analyser

3.5.38 GRMW Read which route ie span, sample, etc

data = NA
results = me=x
x=0, 1, 2 for SAMPLE, ZERO, SPAN

Used by: Analyser

3.5.39 GRSS Read system state

data = NA

results = Gx me=a Mb Conc=b AvC=c CS=d ZS=e SS=f LA=g HA=h ZA=i SA=j TA=k NF=1

x = which gas number 0, 1, 2. See GRWG
a = which gas route 0, 1, 2. See GRMW
b = the instantaneous reading in ppm.
c = The average reading in ppm.
d = The calibration status. See GRCL
e = The zero calibration status. See GRCL
f = The span calibration status. See GRCL
g = The low alarm status. See GRAL
h = The high alarm status. See GRAL
i = The zero alarm status. See GRAL
j = The span alarm status. See GRAL
k = The temperature alarm status. See GRAL
l = The number of faults.

Used by: Analyser

3.5.40 GSBC Tell analyser to use the basic linearity data in EPROM as the current linearity data, Clear zero span calibration effects and appropriate statuses.

data = NA

results = NA

Used by: Analyser

4 FAULT CODES

4.1 Health Check

4.1.1 The microprocessor continuously monitors the state, or health, of the analyser.

4.1.2 If a condition is detected that the user should be made aware of, a warning will be displayed in the form of an "E" number. Some warnings are not due to an analyser failure, but indicate that the analyser is not ready yet. All possible warnings are listed but not all will apply to this analyser.

4.1.3 Related to digital health monitors ...

E 1 Flame out (3000 only)
E 2 Watchdog timer reset
E 3 Invalid Linearisation Data
E 4 Error writing to EEPROM
E 5 ADC Calibration fault
E 6 Invalid Configuration Data
E 7 -
E 8 -

4.1.4 Related to analogue health monitors ...

E 9 Battery failure
E10 -
E11 -
E12 -
E13 -
E14 -
E15 -
E16 -
E17 DC Power fault

4.1.5 Related to internal control ...

E18 -
E19 -
E20 -
E21 -
E22 Instrument too hot
E23 No gas flow (1000 and 2000 series)
E24 -
E25 -
E26 Oven (3000) or Converter (4000) Temperature out of limits
E27 -

4.1.6 Related to hardware faults ...

E28 -
E29 -
E30 - E63 Reserved
E64 - E79 Fault in PIO
E80 - E143 Reserved
E144 - E159 Fault in ADC
E160 - E175 Fault in EEPROM
E176 - E900 Reserved
E901 Fault in RAM
E902 Fault in EPROM
E903 Checksum error in EEPROM

5 GENERAL NOTES

5.1 Performance

5.1.1 The analyser measures the concentration of the input gas selectively and continuously. In order to obtain the most satisfactory performance, observe the following procedures.

5.1.2 After switch-on always allow the instrument at least two hours warm-up time to attain accurate readings.

5.1.3 Switching off for any significant length of time will disturb the operating temperature and cause a delay before measurements can be resumed. The instrument should be left switched ON where possible. Where fitted, the Pump switch should be in the "OFF" position, except when sampling.

5.1.4 Protect the instrument from draughts, direct sunlight, rain and vibration. If the instrument is rack mounted, ensure that it is securely bolted in the rack.

5.1.5 Ensure that the flow of Sample gas is between 0.5 and 1.5l/min. Insufficient flow will result in a slow response. Excessive flow will cause inaccuracy of measurement because of an increase in pressure inside the sample cell.

5.1.6 The analyser is fitted with an internal heated particulate filter. If heavy particulate levels are present in the sample gas then a Signal Model 333 Heated Prefilter can be used upstream in order to increase the filter change intervals.

5.1.7 Carry out regular checks of the instrument zero and span settings using Test gases. Remember that the accuracy of the instrument can never be greater than the accuracy of the Test gases used. Do not use too large a cylinder of Span gas as the quality may deteriorate with long storage. Discard a cylinder when its contents pressure falls below approximately 100psig ($7kg/cm^2$) as the quality of the contents becomes increasingly unreliable at low pressure. Obtain a replacement Test gas cylinder before its predecessor becomes depleted so that one can be compared with the other.

5.2 Atmospheric Pressure

5.2.1 The used sample gas from the Series 1000 UV is normally vented to atmosphere, thus the pressure inside the sample cell will follow atmospheric pressure changes, leading to a corresponding variation in sensitivity. For example, in the United Kingdom, atmospheric pressure is normally within the range 960 to 1040mbar, giving a variation in sensitivity of ±4%.

5.2.2 This effect can be corrected by :-

5.2.2.1 Carrying out calibration checks using Test gases at appropriate regular intervals.

5.2.2.2 Measuring the barometric pressure and either applying corrections in proportion to the observed changes, or re-calibrating with Test gases when a significant change in barometric pressure is observed.

6 ROUTINE MAINTENANCE

6.1 Filter Replacement

CAUTION

If the analyser has been switched on, the filter housing will be too hot to touch. The filter replacement tool provides a method for changing hot filter elements.

Dirty filters may contain corrosive compounds. Use gloves.

6.1.1 Disconnect the sample gas line. The filter is immediately underneath the pipe fitting. The pipe fitting and filter cap are removed as a single item using a special tool.

6.1.2 Identify the filter extraction tool in the accessory kit. It has a "T" bar at one end.

6.1.3 Using the filter extraction tool, release the filter cap by rotating ¼ turn anti-clockwise. Reverse the tool and screw it onto the pipe fitting. Withdraw the housing taking care not to touch any hot surfaces.

6.1.4 The filter element will be found protruding from the cap. It will quickly cool and may be removed by hand.

6.1.5 Fit a new filter element. Filter elements are available from Signal in packs of ten under the part number FILT/010. If you purchased a 1 year spares kit with the analyser, a pack of filters was included.

6.1.6 Re-assemble the filter cap to the analyser using the reverse procedure and reconnect the sample line.

6.2 Calibration

6.2.1 Regularly perform a span and zero calibration. Allow the instrument to warm up fully before the calibration is checked. If the analyser is in continuous use, consider using the automatic calibration facility.

6.2.2 The frequency of calibration checks depends on the degree of accuracy expected from the instrument, the conditions under which it is being used and its mode of operation. Calibration every four days (96 hours) is recommended for normal operation under good conditions, if the analyser is left running for 24 hours per day. Once per day is recommended if the analyser is switched off overnight, or if barometric pressure compensation is desired.

7 ROUTINE SERVICING

7.1 Schedule

7.1.1 Servicing should be carried out every 2700 hours of use and involves cleaning the gas paths and optical filters, lamp replacement, calibration and linearity test. We recommend that all servicing is carried out by our Service Department or approved distributors and agents.

7.2 Service Manual

7.2.1 Full Maintenance Manuals are normal issued to distributors and service agents only, but can be purchased by customers if they wish to carry out their own servicing. All warranty will cease however, if a customer carries out his own servicing during the warranty period unless special arrangements have been made in writing. If you wish to carry out your own servicing, contact Signal, your local distributer or agent to discuss the implications and ask for Part Number 1000/SERV.