



SERIES 4

NEBULA

HEATED TDLS NH₃
ANALYSER

OPERATING MANUAL





DOCUMENT HISTORY

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Table 1 : Document history table

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1 What's in the box

- Signal Series 4 Nebula analyser
- Signal Series 4 Wireless Tablet (Optional)
- Signal USB Drive containing:
 - Operating Manual
 - S4i installation (Optional)
 - Datasheet
 - Test Reports
- Shipping kit containing – Signal Part No. 9000/396010:
 - 2m Mains lead cable
 - Sample filter key (MC/318011)
 - 9/16" Wrench
 - 7/16" Wrench
 - USB drive with related documents
- Analogue output connection cable – Signal Part No. MI/995 (Optional)
- Relay output connection cable – Signal Part No. MI/1020 (Optional)



 **Read This First** 

Signal Group Ltd designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you **MUST** properly install, use, and maintain them to ensure they continue to operate within their normal specifications. The following instructions **MUST** be adhered to and integrated into your safety program when installing, using and maintaining Signal Group Ltd products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- Read all instructions prior to installing, operating, and servicing the product.
- If you do not understand any of the instructions, contact your Signal Group Ltd representative for clarification.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Signal Group Ltd. Unauthorised parts and procedures can affect the product's performance, place the safe operation of your process at risk, and **VOID YOUR WARRANTY**. Substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed, and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.



2 Important safety instructions

2.1 *Wiring and Installation*

The following safety instructions apply to all EU member states and should be followed according to Low Voltage Directive. It is recommended that non-EU areas should also comply with these instructions unless superseded by other local or national standards.

- It is essential that suitable grounding connections be made at all connectors provided for this purpose.
- All safety covers and grounding connections must be properly reinstated after maintenance or troubleshooting. The integrity of all earth terminals must always be maintained.
- To ensure safe operation of this equipment, connection to the mains supply should be made through a circuit breaker which will disconnect all circuits carrying conductors in the case of a fault. These circuit breakers should comply with a recognised standard such as IEC947. All wiring must conform to any local or national standards.

2.2 *Handling and Storing Pressurised Gases*

This instrument requires pressurised gases for use. Some general safety precautions are outlined below; however, it is advisable that operators are properly trained in the handling and storage of pressurised gas containers:

- Never drop cylinders or permit them to strike each other violently.
- Cylinders may be stored in the open, but in such cases should be protected against extremes of weather and, to prevent rusting, from the dampness of the ground. Cylinders should be stored in the shade when located in areas where extreme temperatures are likely.
- The valve protection cap should be left on each cylinder until it has been safely secured against a wall or other solid structure or placed in dedicated cylinder stand.
- Avoid dragging, rolling or sliding cylinders, even for a short distance – they should be moved using a suitable transportation device (e.g. bottle trolley).
- Never tamper with the safety devices in valves or cylinders.
- Avoid storage of full and empty cylinders together. Serious suck-back can occur when empty cylinders are attached to pressurised systems.
- No part of a cylinder should be exposed to a temperature higher than 52°C (125°F), or a naked flame or incandescent material.
- Do not place cylinders where they could become part of an electric circuit.



2.3 Operation and Maintenance

On leaving the Signal Group Ltd factory, this product conformed to all applicable safety directives. The operator must take care to follow the instructions given in this manual to preserve this condition.

Before switching on the instrument, ensure that the local supply voltage is within the limits indicated in this manual.

Any interruption of the protective earth connections, whether inside or outside of the unit, or removal or interruption of its ground line connection, may result in reduced instrument performance and exposure to the risk of electrocution. It is therefore strictly forbidden to deliberately disconnect the protective earth.

The removal of covers and panels may expose electrical components. Connectors may also be energised even if no mating connector is present. The unit should therefore be disconnected from all electrical supplies before any kind of maintenance or repair is carried out. Only trained personnel who are aware of the risk are permitted to energise an open unit.

Fuses may only be replaced with identical items. It is forbidden to use repaired fuses or to bypass fuses.

Substances hazardous to health may escape from the unit's gas outlets. It is advisable to exhaust the gas outlets to a safely ventilated area.

The safety of the personnel operating this equipment is paramount. All efforts should be taken to ensure their protection.

Our analysers are checked and tested using state of the art equipment and techniques. Despite this, an element of risk remains to the user when using any gas analyser. Even when operated as intended and observing all applicable safety instructions and standards, some risks remain, including but not limited to the following:

- An accidental interruption of the protective earth line, e.g. In an extension cable, may result in a risk to the user;
- Electrically live components may be exposed if operating the instrument with covers removed;
- The emission of hazardous gases may be possible even if all connections have been made correctly and according to the manufacturers' instructions.

Avoid exposure to the dangers of these residual risks by taking care when installing, operating, maintaining and servicing the analyser.

If unsure about anything in this manual, please contact your local Signal Group Ltd representative for further guidance.



2.4 *Competent Personnel*

Specialist knowledge of this instrumentation is a necessity for working with and on the unit.

Authorised personnel for installing, operating, servicing, and maintaining the analyser are instructed and trained personnel of the operating company, Signal Group Ltd or their local representatives.

- It is the responsibility of the operating company to:
 - Ensure their staff have adequate training.
 - Observe safety regulations.
 - Follow this instruction manual.
- Operators must:
 - Have been properly trained.
 - Have read and understood all relevant sections of the instruction manual before commencing use of the instrument.
 - Know all the applicable safety mechanisms and regulations.

To avoid personal injury and loss of property, do not install, operate, maintain or service this instrument before reading and understanding this manual and receiving appropriate training.

Do not dispose of this instruction manual.



3 Quick-start



Please read all safety instructions before operating the analyser



This section is intended as a quick guide for trained personnel. See the Operation section for detailed instructions.

- Connect your power supply to the mains IEC connector on the rear panel (for standard AC operation);
- Connect your gases to the rear panel at the following pressures, using tubing as indicated below:

| Gas | Tube | Pressure |
|-------------------------------------|----------------------|-----------------|
| SAMPLE | 1/4" PTFE or similar | 0.75 ± 0.15 Bar |
| SPAN (NH ₃) | 1/8" PTFE or similar | 1.0 ± 0.2 Bar |
| ZERO (Clean Air or N ₂) | 1/8" PTFE or similar | 1.0 ± 0.2 Bar |

Table 2 : Quick-start setup

- Switch on the power using the switch on the rear panel (AC operation only). At this stage you should see a solid blue LED on the front panel, indicating that the unit is in Sleep mode. An internal fan may also be audible;
- Your instrument is now powered up and ready for general use. The various internal heated components require time to warm up. For the NEBULA it is **imperative** you wait at least 30 minutes for all components' temperature to stabilize after every power off. Use your chosen operating interface (front panel display or S4i. See the appropriate user guide for detailed information) to proceed and initiate the warmup procedure;
- The following options will initiate warmup:

Standby – the unit will go to a state ready for measurement. No gas valves will be open.

Zero – the unit will automatically open the zero valve to begin measuring zero gas.

Span – the unit will automatically open the span valve to begin measuring span gas.

Sample – as Zero & Span but the unit will begin measuring Sample gas.

Pause – Span, Zero and Sample Solenoids will all be closed.



- For optimal performance you need to calibrate your instrument. (It is recommended to do this daily) You can calibrate from the following modes:

Zero – calibration in this mode will adjust the zero offset only.

Span – calibration in this mode will adjust the span coefficient only.

Sample – calibration in this mode will adjust the zero offset, followed by the span coefficient.

NOTE – it is advisable to leave your instrument on for at least an hour before first calibration to allow the detector to stabilise.

Further details regarding calibration can be found in Section 6 (Including calibration through the sample port).

- Once calibrated and stable, your instrument is ready for accurate measurement. Use the relevant user interface guide for further information regarding instrument features such as analogue outputs and data logging, and how to configure and use them.

Front Panel Light codes

| Light | Status |
|--------------|---------------------|
| Red Blink | Heating |
| Purple | Loading Config File |
| Yellow | Standby |
| Yellow Blink | Purge |
| Green | Measurement Mode |
| White | No Config |
| Red/Blue | Alarm |
| Blue | Sleep |



4 Introduction

The Signal NEBULA range of gas analysers uses reference-method Tunable Diode Laser Spectrometry (TDLS) technology to determine the Ammonia (NH_3) content of gas samples.

Specifically designed to be versatile and reliable, the Nebula can be used in a multitude of applications. These include Process control (incineration & combustion), emission monitoring and environmental safety (leak detection, toxicity etc.). Proprietary digital flow and temperature control, together with Signal's world-class Series 4 electronics package, provides superior performance across the board.

- Standard NEBULA analysers allow optional:
- Measurement ranges as low as 1ppm NH_3 equivalent up to as high as 1% NH_3 equivalent;
- Full internal heating (to 191°C);
- Fully automated calibration;
- Continuous measurement of Ammonia (NH_3);
- 10 user-programmable analogue outputs for monitoring concentrations, ranges, pressures and/or temperatures;
- Up to 35 user-programmable relay outputs for alarm or external valve operation;
- Remote control and data logging over Ethernet or RS232;
- On-board data logging;
- 24VDC power supply.

Signal is renowned for its ability to create instruments for special applications, so if the options above do not cover your specific requirements, then contact Signal or one of their local representatives to discuss your application further.



5 The Principle of Tunable Diode Laser Spectrometry

Tunable Diode Laser Spectrometry is an infrared absorption measurement which utilizes the interaction of infrared light with gas molecules to determine the concentration of a target gas. The absorption of infrared light by the gas molecules causes a decrease in IR radiation intensity on the detector/photo diode.

A standard TDLS setup consists of a laser diode, optical lens, gas sample cell and a photo detector. The optical lens in the system collimates the laser light to ensure the light is perpendicular as it hits the photo diode. The laser diode in the detector is tuned to the characteristic absorption lines of a material in a sample gas. Therefore, one laser/detector will be used to measure one gas with little to no chance of any cross-sensitivity with other species in the sample.

5.1 Sample System

The compact 3U 19" rack unit includes a 191 °C heated sample handling module which houses a sample particulate filter, a sample selection solenoid, and connections to the zero and span selection valves.

The sample handling module allows the connection of a heated sample line directly to the rear panel preventing cold spots where sample condensation may occur. This is particularly dangerous for this application as Ammonia is such a toxic gas. The NEBULA uses an internal heated inlet line to maintain the temperature from the sample handling module to the detector to prevent condensation forming on the inlet pipe. It also has a heated exhaust pipe so that moisture build up does not occur and form aqueous ammonia in the outlet line.



6 Operation

6.1 Services

Signal Group Ltd assumes that the user has a certain level of understanding of gas analysers. Some aspects of gas analysis can be dangerous without proper training and understanding. Signal and its representatives are able to provide full analyser training on request. Contact your local representative for further information.

To use your NEBULA analyser, you will need the following services:

- **Power:** NEBULA's standard universal power supply allows operation from 100Vac to 250Vac at 50 to 60Hz. 600W maximum.

24DC operation is available on request. Please ask for details.

- **Zero:** Depending on your chosen options, you may need zero-grade compressed air. For applications where accuracy under 1ppm CH₄-equivalent are required, you should use zero-grade air or an external air purifier such as Signal's model AS80 air purifier.
- **Calibration Gases:** Only NH₃ may be used. Signal recommends a gas concentration close to the expected measurement level. The NEBULA's TDLS detector is manufactured to measure a specific level of concentration. Do not attempt to measure over your analyser's measurement range as you will not get reliable results and may over saturate.
- **Humidity:** In most cases, the analyser will only read a sample which has more than 5% H₂O in the sample gas. If you intend to analyse gases under this level of humidity you will need to contact Signal Group LTD to configure the analyser for this, as it will not read accurately.

CAUTION: If you suspect your gas may have dust load, it is imperative you use the filtered SAMPLE line to avoid cell contamination. Always use clean, particulate-free gases for calibration as there is no filter on the Zero/Span inlets.



6.2 Start

- Ensure that the analyser is resting on a stable surface or fixed into a rack, or on a wall if the wall-mount option has been chosen;
- Connect the included (or equivalent) power cable to the rear panel IEC power socket, ensuring the supply voltage is within the operational limits of the instrument;



Figure 1: NEBULA rear panel

- Ensure that the correct fuses are in place within the integrated IEC socket on the rear panel.
- Figure 2 below shows the rear panel layout of the NEBULA;

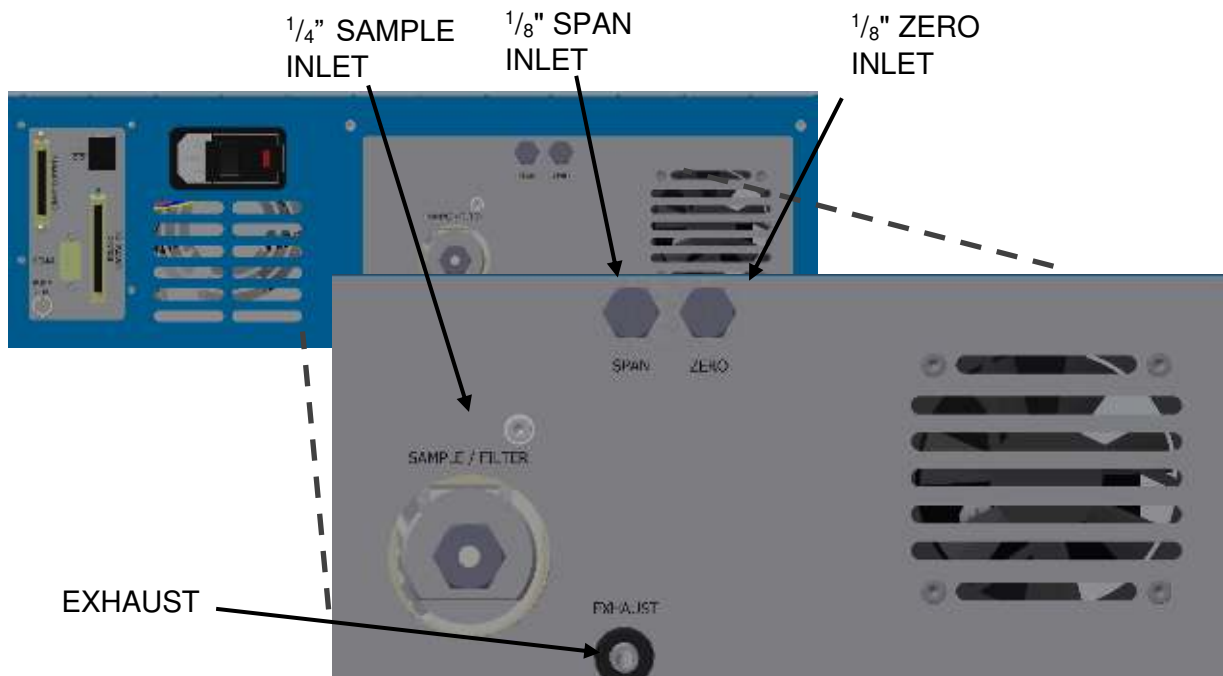


Figure 2: NEBULA pneumatic connections



- **ZERO:** Ensure that the correct air supply is available for your chosen option: -
 - For flushing out the system, pressurised air or N₂ is required, at 1.0±0.2bar (100±20kPa, 14.5±3psi).
 - Zero-grade air is recommended for accurate readings and sufficient cleansing. Some applications may require an external air purifier to achieve best performance. Consult your local Signal Group Ltd representative for further advice.
 - Connect your chosen air supply to the ZERO port on the rear panel.

- **SPAN**
 - Connect your chosen concentration of span calibration gas to the SPAN port on the rear of the analyser at 1.0 Bar ± 0.2 Bar. It is recommended that the concentration value of your span gas should be between 40% and 80% of your chosen measurement range.

- **SAMPLE**
 - Connect your sample supply to the SAMPLE/FILTER port on the rear panel at 0.75 Bar ± 0.15 Bar.
 - It is recommended that the sample gas temperature be maintained at a level above the dew point of the measurand(s), e.g. 191°C, using a heated sample line obtainable from Signal Group Ltd.

- **EXHAUST**
 - Connect the exhaust to a well-ventilated area, ensuring that the connection is free from obstruction that could cause restrictions. Ensure that the connection tubing remains at a downward angle to avoid moisture build up in the tubing.

CAUTION: The gases emitted from the EXHAUST will be hot and contain sample gas. Care must be taken to avoid risk of burning or local build-up of sample gases.

- If desired, attach your chosen output cables (analogue/relays/etc) now. Preassembled cables can be purchased separately from Signal Group Ltd. Contact your local representative for details. Alternatively, see the Output Wiring section of this manual for connection information.
- When all the fittings and cables are secure, you may apply power to the unit by using the switch on the rear panel (this applies to units powered by mains AC only. 24VDC units should use an external switch capable of carrying up to 25Amps if switching 24VDC, 3.15 Amps (for 230VAC) or 6.5Amps (for 115VAC), if switching the primary side of an AC-DC transformer.
- The front panel Status LED should now be illuminated solid blue. This indicates that the unit is in Sleep mode.



6.3 Control

Once the analyser is powered on it may be controlled using either the wireless tables or optional S4i for computer use. (See the appropriate User Guides provided for further information).

6.3-1 Calibration

Calibration Requirements

The TDLS detector within the analyser will reliably measure a sample gas with 5% or more H₂O present. Therefore, for accurate calibration, anhydrous NH₃ of a known PPM value is required to be mixed with humidified air/zero gas. The diagram below is the recommended experimental setup for doing this:

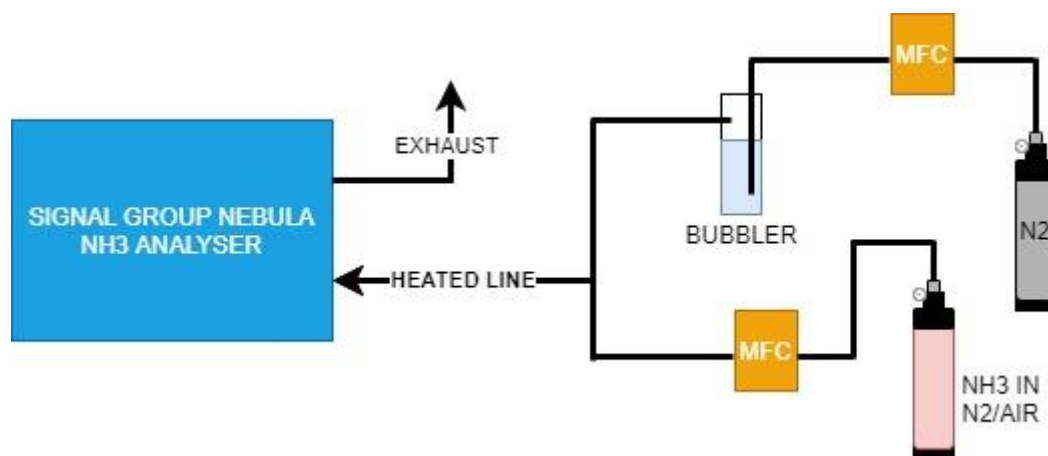


Figure 3: Nebula Calibration Schematic

Signal Group LTD provide an external calibration unit with humidifying capabilities that will aid this process. Please contact the Sales team if this is something you require.

Zero/Span Calibration

- The procedures for calibration of the zero offset and span coefficient are fully automated. The process is as follows:
 - Enter the span gas bottle concentration values as described in your chosen interface guide
 - Select Calibrate while the unit is lit and stable to initiate the process. The analyser will start by choosing the correct gas path (if not already selected), to allow the calibration gas to flow.
 - It will then monitor the measurements to determine the point at which they have become stable enough to use as a reference for calibration.



- Once stability is achieved, the unit will monitor the measurements for a short period before setting the correct values.
- Before attempting any calibration, ensure that the correct gases are connected.
- Before attempting a Span calibration, ensure that the span gas table is complete with the correct gas values, as described on the gas cylinder certificate. Failure to do this may result in large errors in measurement and/or unexpected readings.
- Each measurement range has its own individual zero offset and span coefficient. Select Apply Calib. to All Ranges before any calibration if you wish to use the same offset and coefficient for all ranges.
- You may begin a Calibration from any of the following modes:
 - **ZERO**: only the zero offset is adjusted.
 - **SPAN**: only the span coefficient is adjusted.
 - **SAMPLE**: First the zero-gas path is automatically selected and the zero-offset adjusted, then the adjustment of the span coefficient is performed with the span gas path selected.

Calibration Through Sample Port

- If required, the analyser may be configured so that calibration is performed through the SAMPLE port instead of the separate SPAN and ZERO ports.
- In this case the procedure is the same, ZERO and SPAN modes can still be selected but when calibration starts, the sample solenoid will open.
- If calibration is selected in SAMPLE mode a zero and span calibration will still be performed consecutively but the gases must be switched over manually.

Calibration Failure

- The calibration routine automatically waits for a stable reading before applying the results. If a stable reading cannot be found within the built-in time limit, then the calibration will fail, and an alarm will be activated.
- There are many reasons that a stable reading would not be found. It is advisable to contact your local Signal Service representative for advice if this occurs.

Measurement

- Once the unit is stable and fully calibrated, accurate measurements can be taken.
- Select Sample mode to energise the heated internal sample valve and allow sample gas to flow.
- You may check the calibration at any time by switching to Zero or Span gas paths and monitoring the measurements.



Ranges

- The instrument has a single hardware range, allowing accurate measurement from zero to full scale of the instrument at all times, regardless of selected user range. However, it is standard practice (and often dictated by regulations) to choose a suitable range for measurement. For this reason, consult your local regulations for further guidance on the use of ranges.
- To enable compliance with various regulations, 5 ranges are provided, together with an auto range facility. Each of these ranges is programmable by the user, apart from the maximum range which is fixed.
- Four of the five ranges are standard 0-n type, with a fixed lower end, but the fifth is m-n, which means that it has a programmable lower end allowing the expansion of the specific range of measurement. For example, if the expected range of measurement is 11 to 18ppm, an instrument range of 5 to 25ppm may be chosen. The main benefit of this facility is that it allows for greater resolution on the analogue outputs.
 - NOTE: Each range uses separate calibration curves and coefficients. Ensure that all the ranges that will be in use are properly calibrated before taking measurements.
 - NOTE: Due to the capability of separate calibrations for each range, it may appear that one range measures differently to another. In this case it is necessary to recalibrate in order to realign the measurements. Always apply the calibration to all ranges to avoid inter-range differences.

6.4 Remote Control

Consult the S4i User Guide or Tablet Software User Guide (if applicable) for detailed remote-control operational guidance.

6.5 Connectivity

Relays

- 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:
 - Standard IO – 3 (non-configurable)
 - Extended IO – 23 (20 configurable)
 - Special Extended IO – 35 (32 configurable)



- I/O cables, MI/1020 can be ordered separately to connect to the Relay outputs. (Previously, MI/996)

Relay specification

- Load: Resistive load ($\cos\phi = 1$)
 - 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
- P level: $\lambda_{60} = 0.1 \times 10^{-6}/\text{operation}$. 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



MI/1020

| Relay No/Digital IO | Pin | Colour | Relay No/Digital IO | Pin | Colour |
|---------------------|-----|------------------|---------------------|-----|------------------|
| 1 | 1 | Brown | 18 | 18 | LightGreen |
| | 68 | White/Red | | 51 | Pink/Black |
| 2 | 2 | Brown/Green | 19 | 19 | LightGreen/Brown |
| | 67 | Purple/Green | | 50 | White/Black |
| 3 | 3 | Red | 20 | 20 | LightBlue |
| | 66 | LightBlue/Gray | | 49 | Gray/Green |
| 4 | 4 | Orange | 22 | 21 | Green/White |
| | 65 | Pink/Gray | | 48 | Gray/Black |
| 5 | 5 | Orange/Brown | GLB ALB23 (NO) | 22 | Yellow/Red |
| | 64 | Purple/Yellow | GLB ALA23 (Com) | 47 | Purple/White |
| 6 | 6 | Yellow | GLB ALC23 (NC) | 23 | Blue/Red |
| | 63 | Yellow/Gray | GND Power | 46 | Purple/Black |
| 7 | 7 | Green | +24V Fused Output | 24 | LightBlue/Red |
| | 62 | Green/Brown | TTL Sleep | 45 | Blue/Black |
| 8 | 8 | Pink/Green | NC | 25 | Green/Red |
| | 61 | Yellow/White | TTL CAL | 44 | LightBlue/Yellow |
| 9 | 9 | Blue/Green | GND POWER | 26 | Green/Orange |
| | 60 | Orange/White | GND POWER | 43 | Pink/Blue |
| 10 | 10 | Green/Yellow | DIO1 | 27 | yellow/Gray |
| | 59 | Red/White | DIO9 | 42 | Pink/Red |
| 11 | 11 | Blue | DIO2 | 28 | LightGreen/Green |
| | 58 | LightBlue/Green | DIO10 | 41 | Green/Black |
| 12 | 12 | Purple | DIO3 | 29 | Yellow/Brown |
| | 57 | Blue/Orange | DIO11 | 40 | Yellow/Black |
| 13 | 13 | Purple/Red | DIO4 | 30 | Brown/Yellow |
| | 56 | Yellow/Blue | DIO12 | 39 | Orange/Gray |
| 14 | 14 | Gray | DIO5 | 31 | Brown/Pink |
| | 55 | Blue/White | DIO13 | 38 | Orange/Black |
| 15 | 15 | Gray/Red | DIO6 | 32 | LighBlue/Brown |
| | 54 | LightBlue/Black | DIO14 | 37 | Red/Black |
| 16 | 16 | White | DIO7 | 33 | Gray/Brown |
| | 53 | LightGreen/Gray | DIO15 | 36 | Brown/White |
| 17 | 17 | Pink | DIO8 | 34 | Black |
| | 52 | LightGreen/Black | DIO16 | 35 | Brown/Black |

Table 3 : Relay wiring table - Colours refer to Signal output cable MI/1020

**MI/996 (Previous data cable)**

| Relay No/Digital IO | Pin | Colour | Relay No/Digital IO | Pin | Colour |
|---------------------|-----|--------|---------------------|-----|--------|
| 1 | 1 | Pink | 18 | 18 | Grey |
| | 68 | Black | | 51 | Black |
| 2 | 2 | Pink | 19 | 19 | Grey |
| | 67 | Pink | | 50 | Pink |
| 3 | 3 | Pink | 20 | 20 | Grey |
| | 66 | Blue | | 49 | Grey |
| 4 | 4 | Pink | 22 | 21 | Grey |
| | 65 | Green | | 48 | Purple |
| 5 | 5 | Pink | GLB ALB23 (NO) | 22 | Grey |
| | 64 | Yellow | GLB ALA23 (Com) | 47 | Blue |
| 6 | 6 | Pink | GLB ALC23 (NC) | 23 | Grey |
| | 63 | Orange | GND Power | 46 | Green |
| 7 | 7 | White | +24V Fused Output | 24 | Yellow |
| | 62 | Red | TTL Sleep | 45 | Orange |
| 8 | 8 | White | NC | 25 | Grey |
| | 61 | Brown | TTL CAL | 44 | Red |
| 9 | 9 | White | GND POWER | 26 | Purple |
| | 60 | Black | GND POWER | 43 | Brown |
| 10 | 10 | White | DIO1 | 27 | Purple |
| | 59 | Pink | DIO9 | 42 | Black |
| 11 | 11 | White | DIO2 | 28 | Purple |
| | 58 | Purple | DIO10 | 41 | Green |
| 12 | 12 | White | DIO3 | 29 | Purple |
| | 57 | Blue | DIO11 | 40 | Green |
| 13 | 13 | White | | 30 | Purple |
| | 56 | Green | DIO12 | 39 | Yellow |
| 14 | 14 | White | DIO5 | 31 | Purple |
| | 55 | Yellow | DIO13 | 38 | Orange |
| 15 | 15 | White | DIO6 | 32 | Purple |
| | 54 | Orange | DIO14 | 37 | Red |
| 16 | 16 | White | DIO7 | 33 | Purple |
| | 53 | Red | DIO15 | 36 | Brown |
| 17 | 17 | Grey | DIO8 | 34 | Blue |
| | 52 | Brown | DIO16 | 35 | Black |

Table 4 : Relay wiring table - Colours refer to Signal output cable MI/996



Analogue Outputs

- Five 0-10Vdc analogue outputs are included as standard. These may be used for chart recordings, to connect to an external datalogger, or to operate external alarms. Ten analogue outputs are available with extended and special extended IO options. Up to ten isolated 4-20mA outputs are also optionally available. (MI/995)
- These outputs are typically configured to provide measurements from each gas detector channel (scaled to the range in use), and to indicate the range in use. For range indication, 1V = range 1 (lowest range), 2V = range 2, etc.
- The outputs may also be configured by users to provide outputs of internally measured temperatures and pressures. This can be useful for fault finding as well as tracking sample flows

MI/995

| Ch number | Pin Number | Old Pin Colour | New Pin Colour |
|-----------|------------|----------------|----------------|
| 1 | 1 | Pink | Brown |
| | 26 | Black | White |
| 2 | 2 | Pink | Yellow |
| | 27 | Brown | Green |
| 3 | 3 | White | Pink |
| | 28 | Black | Grey |
| 4 | 4 | White | Red |
| | 29 | Brown | Blue |
| 5 | 5 | White | Violet |
| | 30 | Red | Black |
| 6 | 6 | White | Red/Blue |
| | 31 | Orange | Grey/Pink |
| 7 | 7 | White | White/Pink |
| | 32 | Yellow | Brown/Green |
| 8 | 8 | White | White/Green |
| | 33 | Green | Grey/Brown |
| 9 | 9 | White | White/Yellow |
| | 34 | Blue | White/Grey |
| 10 | 10 | White | Yellow/Brown |
| | 35 | Purple | Pink/Brown |

Table 5 : Chart Output Pinout Colour



7 Routine Maintenance

7.1 Introduction

The analyser requires little routine maintenance to keep it in good working order.

If the analyser is used infrequently, check the filter and Zero/Span calibration every time it is used.

If the analyser is used continuously, check the filter and Zero/Span calibration once per week or as experience dictates.

The filter may need to be checked at different intervals depending on the particulate content of the sample gas.

Zero/span calibration may need to be checked at different intervals depending on the local variations in ambient temperature and/or atmospheric pressure.

7.2 Sample Filter

CAUTION

If the analyser has been switched on, the filter housing may 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. Obey local safety measures.

Signal recommends and supplies PTFE filters (Part number FILT/023) for use as internal Sample filter in all measurement instruments. These PTFE filters may be cleaned and re-used.

Glass fibre filters are not recommended for use in our heated analysers. They can be damaged during installation into the heated manifold and fibres can become detached and block critical sample paths.

Removal/Replacement

Before filter removal, ensure that the Sample gas line has been shut off using an external valve, or that the process has been paused to allow for safe servicing of the analyser.

- Disconnect the sample gas line from the back of the instrument.
- The filter is immediately behind the pipe fitting. The pipe fitting and filter cap are removed as a single item using a special tool. Identify the filter extraction tool (MC/318011), supplied in the accessory kit. Using the filter extraction tool, release the filter cap by rotating $\frac{1}{4}$ turn anti-clockwise.
- Reverse the filter extraction tool and screw it onto the pipe fitting.
- Withdraw the housing, taking care not to touch the hot surfaces.
- The filter element will be found protruding from the cap. It will quickly cool and may be removed by hand. Dirty filters can contain corrosive compounds. Use gloves.



- Lightly soiled filters may be cleaned following the guidelines below. Clean the filter or fit a replacement filter element if heavily soiled.
- Re-assemble the filter cap to the analyser using the reverse procedure and reconnect the sample line.

New filter elements are available from Signal with part number FILT/023.

NOTE: If you did not purchase a spares kit with the analyser, consider purchasing one now. Several kits are available which contain items that you will find useful in your servicing and maintenance schedules.

Cleaning

The preferred cleaning method is to immerse the filter in an ultrasonic bath containing a solution of 1 part 'Ardrox® 6333' to 4 parts water at a temperature of 70°C for a period of 10 minutes or until all surface particles are removed.

Ardrox® is a registered trademark of Chemetall GmbH and is available from them or their distributors. It is an aqueous based liquid concentrate comprising a blend of alkali builders, sequestrants, corrosion inhibitors and biodegradable surfactants.

| ARDROX | |
|----------------------|----------------------------------|
| Appearance | Pale, yellow liquid |
| Density | 1.07 g/ml at 20°C |
| Flash Point | Non-flammable |
| pH | 12.3 |
| Storage requirements | Protect from freezing conditions |

Table 6 : Ardrex Information



8 Routine Servicing

8.1 Schedule

The analyser requires regular servicing to maintain its accuracy and operational status.

Servicing should be carried out by a qualified service engineer with electrical and pneumatic experience. If you do not have these in-house skills, contact your local Signal representative who will be pleased to assist you.

8.2 Service Manual

Full service manuals are normally only issued to distributors and agents. However, they can be purchased by those who wish to carry out their own servicing. Signal recommend attendance of a complete service training course prior to attempting a service.

Note: All warranty will cease if a customer carries out their own servicing during the warranty period unless special arrangements have been made in writing.



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