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Manufacturer’s Statement

Thank you for selecting the Ecotech Serinus 30 Carbon Monoxide Analyser.

The Serinus series is the next generation of Ecotech designed and manufactured gas analysers. The Serinus 30 will perform CO measurements over a range of 0-200 ppm with a lower detectable limit of 40 ppb.

This User Manual provides a complete product description including operating instructions, calibration and maintenance requirements for the Serinus 30 Carbon Monoxide Analyser. This manual is valid for the most recent version of the Serinus 30 which includes the new Autoranging Power Supply, Main Controller PCA and Rear Panel PCA.

Reference should also be made to the relevant local standards which should be used in conjunction with this manual. Some of these standards are listed in this manual.

If, after reading this manual you have any questions or you are still unsure or unclear on any part of the Serinus 30, please do not hesitate to contact Ecotech or your local Ecotech distributor.

Notice

The information contained in this manual is subject to change without notice. Ecotech reserves the right to make changes to equipment construction, design, specifications and/or procedures without notification.

Copyright © 2018. All rights reserved. Reproduction of this manual, in any form, is prohibited without the written consent of Ecotech Pty Ltd.
Safety Information

Read all the safety information in this section prior to using the equipment. To reduce the risk of personal injury caused by potential hazards, follow all safety notices and warnings in this documentation.

The following internationally recognised symbols are used on Ecotech equipment:

Table 1 – Internationally Recognised Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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<td>![Symbol]</td>
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<td>![Symbol]</td>
<td>Alternating current</td>
<td>IEC 60417-5032</td>
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<td>![Symbol]</td>
<td>Caution, hot surface</td>
<td>IEC 60417-5041</td>
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<tr>
<td>![Symbol]</td>
<td>Caution, risk of danger to user and/or equipment</td>
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<tr>
<td>![Symbol]</td>
<td>Caution, risk of electric shock</td>
<td>ISO 3864-5036</td>
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These symbols will also be found throughout this manual to indicate relevant safety messages.

**Note:** Notes are used throughout this manual to indicate additional information regarding a particular part or process.

If the equipment is used for purposes not specified by Ecotech, the protection provided by this equipment may be impaired.
Important Safety Messages

Disconnect Power Prior to Service
Hazardous voltages exist within the instrument. Do not remove or modify any of the internal components or electrical connections whilst the mains power is on.
Always unplug the equipment prior to removing or replacing any components.

Replacing Parts
Replacement of any part should only be carried out by qualified personnel, using only parts specified by Ecotech, as these parts meet stringent Ecotech quality.

Mains Supply Cord
Do not replace the detachable mains supply cord with an inadequately rated cord. Any mains supply cord that is used with the instrument must comply with the safety requirements (250V/10A minimum requirement). A mains power cord with a protective earth conductor must be used.
Ensure that the mains supply cord is maintained in a safe working condition.

Do Not Expose Equipment to Flammable Gases
This equipment is not intended for use in explosive environments, or conditions where flammable gases are present. The user should not expose the equipment to these conditions. Do not introduce any flammable gases into the instrument, otherwise serious accidents such as explosion or fire may result.

Electromagnetic Compliance
The instrument lid should be closed when in normal operation, to comply with EMC regulations.

Means of Lifting/Carrying Instrument
This instrument is a heavy and bulky object. Two persons should lift/carry the object, otherwise use proper lifting equipment. Proper lifting techniques should be used when moving the instrument.

Internal Components
Do not insert a rod or finger into the cooling fans, otherwise injury may result.
Do not energise the instrument until all conductive cleaning liquids, used on internal components, are dried up.
Warranty

This product has been manufactured in an ISO 9001/ISO 14001 facility with care and attention to quality.

The product is subject to a 24-month warranty on parts and labour from date of shipment. The warranty period commences when the product is shipped from the factory. Lamps, filters and other consumable items are not covered by this warranty.

Each instrument is subjected to a vigorous testing procedure prior to despatch and will be accompanied with a parameter list and a multipoint precision check, thereby enabling the instrument to be installed and ready for use without any further testing.
Service & Repairs

Our qualified and experienced technicians are available to provide fast and friendly service between the hours of 8:30am – 5:00pm AEST Monday to Friday. Please contact either your local distributor or Ecotech regarding any questions you have about your instrument.

Service Guidelines

This manual is designed to provide the necessary information for the setup, operation, testing, maintenance and troubleshooting of your instrument.

Should you still require support after consulting the documentation, we encourage you to contact your local distributor for support.

To contact Ecotech directly, please e-mail our Technical Support Services group at support@ecotech.com or to speak with someone directly:

Please dial 1300 364 946 if calling from within Australia.

Please dial +61 3 9730 7800 if calling from outside of Australia.

Please contact Ecotech and obtain a Return Material Authorisation (RMA) number before sending any equipment back to the factory. This allows us to track and schedule service work and to expedite customer service. Please include this RMA number when you return equipment, preferably both inside and outside the shipping packaging. This will ensure you receive prompt service.

When shipping instrumentation, please also include the following information:

• Name and phone number
• Company name
• Shipping address
• Quantity of items being returned
• Model number/s or a description of each item
• Serial number/s of each item (if applicable)
• A description of the problem and any fault-finding completed
• Original sales order or invoice number related to the equipment

Shipping Address:

Attention Service Department
Ecotech Pty Ltd
1492 Ferntree Gully Road,
Knoxfield, VIC, Australia 3180.
Product Compliance and Approvals

The Serinus 30 Carbon Monoxide Analyser, as manufactured by Ecotech Pty Ltd, complies with the essential requirements of the directives listed below (including CE compliance). The respective standards have been applied:


EN 61010-1:2010 Safety requirements for electrical equipment, for measurement, control and laboratory use – General requirements

Electromagnetic Compatibility (EMC) Directive 2014/30/EU

EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use – EMC requirements – General requirements

Radio Equipment Directive (RED) 2014/53/EU

EN 300 328 V2.1.1 Wideband transmission systems – Data transmission equipment operating in the 2.4 GHz ISM band and using wide band modulation techniques

Regulatory Compliance Mark (RCM) - Australia

AS/NZS 4268:2017 Radio equipment and systems – Short range devices – Limits and methods of measurement

ARPANSA Radiation Protection Standard

Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz – Radiation Protection Series Publicaiton No. 3: 2002

This analyser is also certified to a number of measurement standards – refer to section 1.2.8.
Claims for Damaged Shipments and Shipping Discrepancies

Damaged Shipments

Inspect all instruments thoroughly on receipt. Check materials in the container/s against the enclosed packing list. If the contents are damaged and/or the instrument fails to operate properly, notify the carrier and Ecotech immediately.

The following documents are necessary to support claims:

- Original freight bill and bill of lading
- Original invoice or photocopy of original invoice
- Copy of packing list
- Photographs of damaged equipment and container

You may want to keep a copy of these documents for your records.

Please refer to the instrument name, model number, serial number, sales order number and your purchase order number on all claims.

You should also:

- Contact your freight forwarder for an insurance claim
- Retain packing material for insurance inspection

Shipping Discrepancies

Check all packages against the packing list immediately on receipt. If a shortage or other discrepancy is found, notify the carrier and Ecotech immediately. Ecotech will not be responsible for shortages against the packing list unless they are reported within seven days.

Contact Details

Head Office
1492 Ferntree Gully Road, Knoxfield, VIC Australia 3180
Phone: +61 (0)3 9730 7800 Fax: +61 (0)3 9730 7899
Email: info@ecotech.com
Service: service@ecotech.com
Support: support@ecotech.com
www.ecotech.com
Manual Revision History

Manual PN: M010027
Current revision: 3.2
Date released: 14 June 2018
Description: User Manual for the Serinus 30 Carbon Monoxide Analyser

This manual is the full user manual for the Serinus 30 Carbon Monoxide Analyser. This manual contains all relevant information on theory, specifications, installation, operation, maintenance and calibration. Any information that cannot be found within this manual can be obtained by contacting Ecotech.

This manual uses cross reference links extensively throughout this manual. The hot keys below will greatly reduce the amount of time scrolling between references:

- You can access the links by pressing the following:
  >  CTRL + LEFT MOUSE CLICK: Move to the link location

- You can switch between links by pressing the following:
  >  ALT + LEFT ARROW KEY: Returns you to previous Link
  >  ALT + RIGHT ARROW KEY: Swaps back

Table 2 – Manual Revision History

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1. Introduction

1.1 Description

The Ecotech Serinus 30 Carbon Monoxide Analyser uses Non-Dispersive Infrared Spectrophotometry (NDIR) technology to measure CO in ambient air, in the range of 0-200 ppm.

The U.S. EPA has designated the Serinus 30 Carbon Monoxide Analyser as a reference method and TUV has designated it as an EN approved instrument.

This section will describe the specifications of the instrument as well as the main components and techniques used to obtain stable gas concentration readings.

1.2 Specifications

1.2.1 Measurement

Range

0-200 ppm autoranging

USEPA designated range: Any full scale range between 0-50 ppm

TUV EN certification range: 0-100 ppm

Lower detectable limit: 0.04 ppm (40 ppb), with Kalman filter active

1.2.2 Precision/Accuracy

Precision

20 ppb or 0.1 % of reading, whichever is greater

Linearity

Better than ±1 % of full scale (0-50 ppm); ±2 % of full scale (0-200 ppm), from best straight-line fit

Noise at Zero

0.02 ppm

Response Time

60 seconds to 95 %

Sample Flow Rate

1.0 slpm
1.2.3 Calibration

Zero Drift
Temperature dependant: 0.01 ppm per °C
24 hours: < 0.1 ppm
30 days: < 0.1 ppm

Span Drift
Temperature dependant: 0.05 % per °C
24 hours: 0.5 % of reading
30 days: 0.5 % of reading

1.2.4 Power

Operating voltage
100-240V AC (± 10%)
50 to 60 Hz
Overvoltage Category II

Power Consumption
190 W max (typical at start up)
150 VA after warm-up

1.2.5 Operating Conditions

Ambient Temperature 0 °C to 40 °C (32 °F to 104 °F)
Relative Humidity 10% to 80% (non-condensing)
Pollution Degree 2

Sample Pressure Dependence
5 % change in pressure produces less than a 1 % change in reading
Maximum altitude: 2000m\(^1\) above sea level

\(^1\) Contact Ecotech for options at higher altitudes
1.2.6 Communications

Analog Output
- Menu selectable current output of 0-20 mA, 2-20 mA or 4-20 mA.
- Voltage output of 0 to 5 V, with menu selectable zero offset of 0 V, 0.25 V or 0.5 V.
- Voltage output of 0 to 10 V (configured using jumpers (JP3) on rear panel PCA).
- Range: 0 to full scale from 0-0.05 ppm to 0-20 ppm.

Analog Input
- Three analog voltage inputs (0-5 VDC) CAT I rated.

Digital Output
- RS232 port #1: Normal digital communication.
- RS232 port #2: Multidrop port used for multiple instrument connections on a single RS232.
- USB port connection on rear panel.
- TCP/IP port (optional)
- USB memory stick (front panel) for data logging, event logging, parameter and configuration storage.
- 25 pin connector with discrete status and user control.
  - Eight Digital Outputs, open collector max 400 mA each @ 12 VDC (max total output 2 A).
  - Eight Digital Inputs, 0-5 VDC, CAT I rated

1.2.7 Physical Dimensions

Case Dimensions
- Rack length (front to rear): 597 mm (23.5”)
- Total length (with latch release): 638 mm (25.1”)
- Chassis width: 418 mm (16.5”)
- Front panel width: 429 mm (16.9”)
- Chassis height: 163 mm/Uses 4 RU (6.4”)
- Front panel height: 175 mm (6.9”)
- Weight: 17.8 kg

1.2.8 Certifications
- U.S. EPA approved (RFCA-0509-174)
- EN approval (TUV 936/21221977/D)
- Non Dispersive I.R. Spectrometry method EN1426
- Determination of carbon monoxide AS 3580.7.1.2011 Australian/New Zealand standards
## 1.3 Nomenclature

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO:</td>
<td>Carbon monoxide.</td>
</tr>
<tr>
<td>Span:</td>
<td>A gas sample of known composition and concentration used to calibrate/check the upper range of the instrument (carbon monoxide).</td>
</tr>
<tr>
<td>Zero:</td>
<td>Zero calibration uses zero air (CO scrubbed ambient air) to calibrate/check the lower range of the instrument.</td>
</tr>
<tr>
<td>Background:</td>
<td>Draws air from the background port to compensate for changes in the IR source and background interferences.</td>
</tr>
<tr>
<td>Multipoint Precision Check:</td>
<td>A procedure to verify the linearity of the instrument.</td>
</tr>
<tr>
<td>Calibration:</td>
<td>The process of adjusting the instrument to ensure that it is measuring the correct concentration.</td>
</tr>
<tr>
<td>Zero Drift:</td>
<td>The change in the instruments response to zero air over a period of continuous unadjusted operation.</td>
</tr>
<tr>
<td>Automatic Zero:</td>
<td>The automatic zero performs a zero check at a specified time through a 24 hour cycle which adjusts the lower limit of the instrument.</td>
</tr>
<tr>
<td>Zero Air:</td>
<td>Is purified air in which the concentration of CO is &lt;50 ppb with water vapour of less than 10 % RH. The internal CO-CO$_2$ catalytic converter uses platinum impregnated alumina beads heated to 90 °C as a conversion agent to achieve this under ambient conditions.</td>
</tr>
<tr>
<td>External Span Source:</td>
<td>Span gas that is delivered via an external accredited cylinder (e.g. NATA/NIST).</td>
</tr>
<tr>
<td>Sample Air:</td>
<td>Sample air is defined as the sample before it has entered the Measurement cell, as distinguished from the exhaust air.</td>
</tr>
<tr>
<td>Exhaust Air:</td>
<td>Exhaust air is the sample air after it has passed through the reaction/measurement/detection cell and is moving towards being expelled from the instrument.</td>
</tr>
<tr>
<td>ID and OD:</td>
<td>These are measurements of tubing. ID is the internal diameter of tubing, OD is the outer diameter.</td>
</tr>
<tr>
<td>Multidrop:</td>
<td>A configuration of multiple instruments connected via the same RS232 cable.</td>
</tr>
<tr>
<td>Bootloader:</td>
<td>A program that checks whether the current firmware is valid and executes the instrument start-up. The Bootloader can be entered by pressing the ‘+’ key on the front keypad during the first ½ second after power on and following the prompts. The Bootloader enables various low level recovery tools, including updating the firmware from a USB stick.</td>
</tr>
</tbody>
</table>

IR: Infrared. The region of the optical spectrum with a wavelength of around 4.7 microns.

slpm: Standard litres per minute. This is the flow referenced to standard temperature and pressure conditions. For the purposes of this manual, all flows are referenced to 0 °C and 101.3 kpa (1 atm).

1.4 Background/Theory

Carbon monoxide poisoning is the most common type of fatal poisoning in many industrialised countries\(^2\). Carbon monoxide is a colourless, odourless and tasteless gas caused by the incomplete combustion of hydrocarbon fuels.

Carbon monoxide is a toxic gas to the human body, when inhaled it binds to haemoglobin, myoglobin and mitochondrial cytochrome oxidase reducing oxygen storage, transport and respiration in these organelles.

This can affect humans by causing low level symptoms such as headaches, nausea and dizziness leading up to vomiting and loss of mental/muscular control at high exposure and death in extreme cases.

1.4.1 Measurement Theory

The measurement of carbon monoxide is completed via the following principles and measurement techniques:

CO absorbs infrared radiation (IR) at a wavelength near 4.7 microns. IR radiation (at 4.7 microns) is passed through a five metre folded path length through sample air. The strength of the signal received is proportional to the amount of CO in the sample. A band pass filter is fitted to the signal detector to ensure only light near 4.7 microns wavelength is detected.

\(^2\) Toxicology. 2002 Nov 15;180(2):139-50
Figure 1 – Measurement Cell Theory

A gas filter correlation wheel is combined with this system. This wheel contains three parts to increase measurement accuracy: CO, N₂ and the mask.

- The CO window contains saturation (40 %) of CO which acts as a reference beam – absorbing a known amount of light.
- The N₂ window, containing 100 % N₂, does not absorb IR at 4.7 microns at all and is used during normal CO measurement.
- The mask totally blocks the light source and is used to determine background signals, the strength of other signals relative to each other and the background.

Figure 2 – Correlation Wheel

1.4.2 Kalman Filter Theory

The digital Kalman filter provides an ideal compromise between response time and noise reduction for the type of signal and noise present in ambient air analysers.

The Kalman filter enhances measurements by modifying the filter time base variable, depending on the change rate of the measured value. If the signal is changing rapidly, the instrument is allowed to respond quickly. When the signal is steady, a long integration time is used to reduce noise. The system continuously analyses the signal and uses the appropriate filtering time.
1.5 Instrument Description

The major components of the Serinus 30 are described below:

1.5.1 Calibration Valve Manifold

The calibration valve manifold switches between sample, calibration and background gas.

1.5.2 Sample Filter Holder

Within the sample filter holder is a particulate filter. The particulate filter is a Teflon 5 micron (µm) filter with a diameter of 47 mm. This filter prevents all particles larger than 5 µm from entering the measurement system that could interfere with sample measurement.

1.5.3 CO-CO₂ Converter

The CO-CO₂ catalytic converter uses platinum impregnated alumina beads heated to 90 °C as a conversion agent. The catalyst achieves conversion of 0-200 ppm CO to less than 0.1 ppm CO, even in the presence of up to 2% water.

Within the body of the CO-CO₂ converter assembly, there is a heat exchanger used to precondition the sample gas up to temperature. The sample gas is then drawn into the measurement cell.
1.5.4 Measurement Cell

The measurement cell consists of the following components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Refer to Section 1.5.4.1.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell</td>
<td>Source Timing Assembly</td>
</tr>
<tr>
<td>Cell</td>
<td>Source Timing Assembly</td>
</tr>
<tr>
<td>Cell</td>
<td>Detector Assembly</td>
</tr>
</tbody>
</table>

1.5.4.1 Cell

Cell

The measurement cell contains five mirrors that form a five meter folded path length through the cell. The sample gas fills this chamber and the IR light travels through the sample. The cell pressure is monitored to compensate for pressure changes.

1.5.4.2 Source Timing Assembly

The source timing assembly consists of the following:

**IR Source**

The IR source emits broadband infrared radiation that irradiates the filter in the correlation wheel.

**Gas Filter Correlation Wheel**

The gas filter correlation wheel contains three segments: a N\(_2\) filled sapphire chamber, a CO filled sapphire chamber and a mask.

- The N\(_2\) chamber allows all the IR radiation to pass through, which allows the radiation to be absorbed by CO in the measurement cell and readings to be recorded.
- The CO filled chamber absorbs wavelengths sensitive to CO. The sample gas (containing CO) in the measurement cell does not receive CO specific IR radiation and the only detected signals registered by the IR detector are from background sources and interference.
- The mask blocks all IR light entering the cell. This allows the intensity of the other two signals to be corrected for the detector response to no IR.

**Opto-Detector**

The correlation wheel has four tabs that act as an opto electronic switch ensuring that the main controller PCA can determine accurate timing of the wheel and the segment currently exposed to the IR radiation.

**Motor**

The motor that drives the correlation wheel is a 12 V precious metal brushed motor.

1.5.4.3 Detector Assembly

The detector assembly consists of the following:
Narrow-Bandpass Filter

The narrow bandpass filter allows only the CO sensitive portion of the IR radiation to pass through to the IR detector (4.7 microns) reducing noise and interference.

IR Detector

The IR detector is a cooled lead selenide (PbSe) photoconductive IR detector. It creates an electrical signal when wavelengths centred at 4.7 microns reach it.

1.5.5 Pressure Sensor PCA

An absolute-pressure transducer is mounted on the measurement cell and used to measure the sample pressure in the cell. This pressure is used to check for flow and correct readings for pressure variations.

1.5.6 Pneumatic Tubing

The pneumatic tubing inside this instrument is specially designed for use in Ecotech Serinus instruments. It has the flexibility of Tygon tubing with the added inner sheath of Teflon to prevent contamination of the sample. Care should be taken when removing and inserting the tubing into the barbed fittings.

Figure 4 – Ecotech Tygon Tubing

1.5.7 Main Controller PCA

The main controller PCA controls all the processes within the instrument. As well as the on-board microprocessor, it contains a battery backed clock, calendar analog to digital converters and many other circuits for signal processing and control. The ambient pressure and chassis temperature sensors are also located on this board. The main controller PCA is located above all other components within the instrument. It pivots on hinges to allow access to the components underneath. The current revision of the main controller PCA for which this manual applies, has many differences to previous revisions, highlighted by the many vacant component locations on the PCA.

CAUTION

Never place objects on top of the main controller PCA as it may result in damage.
1.5.8 Power Supply

The power supply is a self-contained unit housed in a steel case designed to meet all the relevant safety and EMC requirements. The new revision of power supply is different to the previous revision as there is no need to set the operating voltage switch because it is autoranging.

The output of the power supply provides +12 V, +5 V, -12 V and +3.3 V to the instrument.

1.5.9 On/Off Switch

The on/off switch is located on the back panel (bottom right facing the rear of the instrument). It is part of the power supply.

1.5.10 Communications

Communication between the instrument and either a data logger, laptop or network can be performed with the following communication connections located on the back panel (refer to Figure 6). These connections can be used for downloading data, onsite diagnostics, maintenance and firmware upgrades.

RS232 #1

This port is designed to be used for simple RS232 communication.

RS232 #2

This port is designed to be used for simple RS232 communication or in multidrop configuration.

USB

This port can be used for instrument communications with equipment through a standard USB port.

TCP/IP Network (optional)

This port is best used for remote access and real-time access to instruments when a network is available to connect with.

Analog and Digital I/O

The analog/digital port sends and receives analog/digital signals to other devices. These signals are commonly used to activate gas calibrators or for warning alarms.

Analog Outputs

The instrument is equipped with a maximum of three analog outputs for each measured gas. The outputs are menu selectable as voltage output 0-5 VDC, or current output 0-20, 2-20 or 4-20 mA. The current output can also be configured as a voltage output of 0 to 10 V, by configuring the jumpers (JP3) on the rear panel PCA.

Refer to Section 4.4 for more detail.
Analog Inputs

The instrument is also equipped with three analog voltage inputs (0-5 VDC CAT 1) with resolution of 15 bits plus polarity.

**CAUTION**

Exceeding these voltages can permanently damage the instrument and void the warranty.

Digital Status Inputs

The instrument is equipped with eight logic level inputs (0–5 VDC CAT 1) for the external control of zero/span calibration sequences.

**CAUTION**

Exceeding these voltages can permanently damage the instrument and void the warranty.

Digital Status Outputs

The instrument is equipped with eight open collector outputs, which will convey instrument status conditions and warning alarms such as no flow, sample mode, etc.

**CAUTION**

Exceeding 12VDC or drawing greater than 400mA on a single output or a total greater than 2A across the eight outputs can permanently damage the instrument and void the warranty.

Bluetooth

This allows for remote access of the instrument to any Android device with the Serinus Remote Application installed on it. It uses Bluetooth to control the instrument, view parameters, download data and construct real-time graphs.
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2. Installation

2.1 Initial Check

Packaging

The Serinus 30 is transported in packaging specifically designed to minimise the effects of shock and vibration during transportation. Ecotech recommends that the packaging be kept if there is a likelihood that the instrument is going to be relocated.

Note: The red plastic caps that seal the pneumatic connections during transport must be removed prior to operation.

Opening the Instrument

Check the interior of the instrument with the following steps:

1. Undo the screws located on the rear panel.
2. Open the chassis lid by releasing the latch (pressing the button) located on the front panel in the top left-hand corner, slide the lid backwards.
3. To completely remove; slide the lid backwards until the rollers line up with the gaps in the track and pull the lid upwards to remove from the instrument (refer to Figure 5).
4. Check that all pneumatic and electrical connectors are connected. If not, reconnect.
5. Check for any visible and obvious damage. If damage exists contact your supplier and follow the instructions in Claims for Damaged Shipments and Shipping Discrepancies at the front of this manual.

Figure 5 – Opening the Instrument
Items Received

With the delivery of the Serinus 30, the user should have received the following:

- Ecotech Serinus 30 Analyser  PN: E020030
- Green Ecotech Resources USB Stick  PN: H030137-01
- End Caps  PN: B010002
- Manual  PN: M010027 (hardcopy optional)
- USB Memory Stick  PN: H030021
- USB Cable  PN: COM-1440
- Power Lead (120 V)*  USA  PN: C040007
- Power Lead (240 V)*  Australia  PN: C040009
  Europe  PN: C040008
  UK  PN: C040010

*The power lead received depends on the mains supply of the country (120 V or 240 V).

Note: Check that all these items have been delivered undamaged. If any item appears damaged, please contact your supplier before turning the instrument on.

2.2 Installation Notes

When installing the instrument the following points must be taken into account:

- The instrument should be placed in an environment with minimal dust, moisture and variation in temperature (20-30 °C for U.S. EPA designated range).
- For best results the instrument should be located in a temperature and humidity controlled environment (air conditioned shelter). An enclosure temperature of 25-27 °C is optimum.
- Whether in a rack or placed on a bench, the instrument should not have anything placed on top of it or touching the case.
- Instruments should be sited with easy access to the front panel (instrument screen/USB memory stick) and to the back panel (communication ports/pneumatic connections).
- It is recommended that the sample line be as short as possible and/or a heated manifold be used for sampling (minimising moisture condensation in the sample).
- Do not pressurise the sample line under any circumstances. Sample should be drawn through the instrument under atmospheric pressure. This should be achieved by either using the internal pump option (if installed) or an external vacuum pump connected to the exhaust port of the instrument.
- When supplying span gas, ensure the flow is approximately 1.5 slpm and excess is sufficiently vented.
- Undo the travel screws from the measurement cell as shown in the drawing supplied (refer to Section 2.3.4).
2.3 Instrument Set-Up

After installing the instrument the following procedures should be followed to ready the instrument for monitoring:

![Image of Instrument Back Panel]

2.3.1 Pneumatic Connections

The Serinus 30 has four pneumatic ports on the back panel of the instrument: the Sample Port, the Calibration Port, the Exhaust Port and the Background Air Port. All tubing and fittings used should follow the instructions below:

- Must be made of Teflon® FEP material, Kynar®, stainless steel, glass or any other suitably inert material.
- Sample line should be no more than two meters in length with ⅛ inch ID and ⅛ inch OD.
- Sample inlet pressure should not exceed 5 kPa above ambient pressure.
- Tubing must be cut squarely and any burrs removed.
- Remove the inlet port nut and insert the tubing through the back of the nut with the tube extending one inch through the front.
- Place the tubing into the port until it hits the tube stop located inside the fitting.
- Place the nut back onto the fitting and tighten clockwise until finger tight.
- Nuts should be re-tightened when instrument reaches operating temperature.

Sample Port

The sample port must be connected to an ambient source of sample air. When using a sample manifold the Serinus requires at least 1.5 slpm delivered to the sample manifold (1 slpm for measurement plus approximately 50 % excess).
Calibration Port

The calibration port can be connected to the span/zero sources. It is recommended that a gas dilution calibrator (Ecotech’s Serinus Cal 1000) be used with a cylinder of carbon monoxide (CO) to deliver precise concentrations of CO.

**Note:** All connections to this port should not exceed ambient pressure. A vent is required for excess gas.

Exhaust Port

The exhaust port is where the measured sample, calibration gases and background air are exhausted from the instrument. The exhaust port should be connected to the vacuum pump using ¼” OD tubing. The P030004 240 V vacuum pump (P030005 110 V) available from Ecotech, can be used to provide the required vacuum and flow for one Serinus 30 analyser as well as two other instruments such as a Serinus 10 or Serinus 50.

**CAUTION**

Carbon monoxide (CO) is a toxic gas. It is recommended that exhaust air is expelled into an unoccupied area, as it contains trace levels of carbon monoxide. Furthermore, the exhaust must be a suitable distance from the sample inlet to avoid influencing the ambient measurements.

Background Air Port

The background port is used to supply air to the CO to CO₂ converter (CO scrubber) within the instrument. This is used for backgrounds and internal zero calibration.

2.3.2 Power Connections

**CAUTION**

- Hazardous voltages exist within the instrument. Do not remove or modify any of the internal components or electrical connections whilst the mains power is on.
- Always unplug the equipment prior to removing or replacing any components.
- Do not replace the detachable mains supply cord with an inadequately rated cord. Any mains supply cord that is used with the instrument must comply with the safety requirements (250V/10A minimum requirement).
- Ensure that the mains supply cord is maintained in a safe working condition.

When connecting the mains power to the instrument, the following must be adhered to otherwise the safety and the reliability of the instrument may be compromised.

- A three pin mains power cord with a protective earth conductor **MUST** be used.
• The mains power outlet (wall socket) must be in the range of 100-240VAC, 50 to 60Hz
• The mains power outlet must be protected by an earth leakage protection circuit
• Connect the instrument’s power cord into the mains power outlet and turn the power switch on.

2.3.3 Communications Connections

There are a number of ways to communicate with the instrument. Use the supplied Airodis software to access the instrument and download data. The Airodis software is supplied on the green Ecotech resources USB stick provided with this instrument.

RS232 #1

Connect this port to a data logger (such as WinAQMS) with an RS232 cable.

RS232 #2

Connect the RS232 cable from the instrument to a computer or data logger in a multidrop formation.

**Note:** When using multidrop ensure each instrument is given a unique Serial ID.

USB

Connect a standard type B USB cable (supplied with the instrument) to this port.

TCP/IP Network (optional)

Plug in an ethernet cable (this cable should be attached to a network).

Analog and Digital I/O

This port is used to send and receive analog and digital signals. It is normally used to connect with a gas calibrator or to activate alarm signals.

Each instrument contains eight digital inputs, eight digital outputs, three analog inputs and three analog outputs.

Bluetooth

Connection is enabled using Ecotech’s Serinus Remote Android Application.

Use the Serinus Remote Android Application to access instrument and download data. It is available for download directly from the Google Play Store. Search for “Ecotech Serinus Remote”.

2.3.4 Instrument Set-Up

1. Open the lid and ensure that the USB memory stick is installed (refer to Figure 8).
2. Remove the travel screws from the measurement cell.
3. Check that the battery is turned on at the main controller PCA (refer to Figure 9).
4. Turn on the instrument and allow the warm-up procedure to complete (refer to Section 3.1).
5. Set time and date (refer to Section 3.4.8).
6. Set the digital filter to desired setting (refer to Section 3.4.9).
7. Set the internal data logging options (refer to Section 3.4.23).
8. Set the analog and digital inputs and outputs settings (refer to Section 3.4.25, 3.4.26, 3.4.27 and 3.4.28).
9. Perform a pressure sensor check (refer to Section 6.4.9).
10. Perform a leak check (refer to Section 6.4.4).
11. Leave the instrument to warm-up for at least three hours. Wait for a stable concentration measurement for at least one hour.
12. Perform a manual background (refer to Section 5.4).
13. Perform a span calibration (refer to Section 5.6)
14. Follow the procedure for a multipoint precision check (refer to Section 5.8).
15. The instrument is now ready for operation.

2.4 U.S. EPA Reference Set-Up

The Serinus 30 is designated as reference method RFCA–0509–174 by the U.S. EPA (40 CFR Part 53). The Serinus 30 must be used under the following conditions to satisfy this approval:

**Range**

0-50 ppm

**Ambient Temperature**

20-30 °C
**Line Voltage**

105-125 VAC, 60 Hz

**Pump**

Ecotech optional internal or external pump

**Filter**

Factory setup to meet requirement:

**Instrument Settings**

If the units in the measurement menu are changed from volumetric to gravimetric (or gravimetric to volumetric) the instrument must be re-calibrated.

The following menu selections must be used:

**Measurement Settings Menu**

Background Interval: 24 hrs

**Calibration Menu**

Span Comp: Disabled

**Diagnostics Menu**

Press/Temp/Flow Comp: On
Diagnostic Mode: Operate
Control loop: Enabled

The instrument must be operated and maintained in accordance with this User Manual.

The Serinus 30 analyser is designated U.S. EPA reference method with or without the following options/items:

- Internal pump
- Rack mount assembly
- Optional Ethernet Port

### 2.5 EN Type Approval Set-Up

The Serinus 30 has been certified to TUV performance standards for Continuous Ambient Air Quality Monitoring Systems. The certificate number is TUV 936/21221977/D. The Serinus 30 must be used under the following conditions to meet EN requirements:

**Range**

0-100 ppm
Ambient Temperature
0-30 °C

Instrument Settings
The instrument must be operated and maintained in accordance with this user manual.

The following menu selections must be used:

Measurement Settings
Background interval: 24 hrs

Calibration Menu
Span Comp: Disabled

Diagnostics Menu
Press/Temp/Flow Comp: On
Diagnostic mode: Operate
Control Loop: Enabled

2.6 Transporting/Storage

Transporting the instrument should be done with great care. It is recommended that the packaging the instrument was delivered in should be used when transporting or storing.

When transporting or storing the instrument the following points should be followed:

1. Turn off the instrument and allow it to cool down.
2. Remove all pneumatic, power and communication connections.
3. If storing over a long period (six months) turn the battery off by moving the switch (S1) on the main controller PCA (refer to Figure 9).
4. Remove the instrument from the rack.
5. Replace the red plugs into the pneumatic ports.
6. If transporting the instrument, replace the travel screws (refer to Figure 7).
7. Remove the USB memory stick and pack with instrument. (for location refer to Figure 8)
8. Place the instrument back into a plastic bag with desiccant packs and seal the bag (ideally the bag supplied upon delivery).
9. Place the instrument back into the original foam and box it was delivered in. If this is no longer available find some equivalent packaging that provides protection from damage.
10. The instrument is now ready for long term storage or transportation.

Note: After transport or storage the instrument must be set-up and calibrated (refer to Section 2.3.4).
Figure 8 – Installation of USB Memory Stick

Figure 9 – Switching the Battery On/Off
3. Operation

3.1 Warm-Up

When the instrument is first turned on it must go through a period of adjustment and calibration. No measurements are taken during this warm-up period.

The following activities occur during warm-up:

**Auto Ref. Adjust**

Adjusts the reference voltage and internal trim pot setting

**Auto Zero Adjust**

Adjusts the zero offset

**Heat CO Scrubber**

The instrument progressively increases the temperature of the CO scrubber until it reaches the desired temperature of 90 °C. When heating from cold, the scrubber will take approximately 20-30 minutes to reach desired temperature.

**Cell Temperature**

Wait until the cell temperature reaches at least 90 % of set point.

After this warm-up has completed the instrument will immediately begin making measurements (refer to Section 3.2).

3.2 Measurement

The Serinus 30 primarily operates in the sample cycle continuously. A background is performed after warm-up, once a day (at 23:45 as default) or when the chassis temperature changes by 4 °C. It is used to measure background absorption in the cell and is subtracted from sample measurements.

**Table 3 – Measurements: Background and Sample Cycles**

<table>
<thead>
<tr>
<th>Instrument State</th>
<th>Duration (minutes)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background Fill</td>
<td>3</td>
<td>Measurement cell fills with background air</td>
</tr>
<tr>
<td>Background Meas</td>
<td>1</td>
<td>Measurement of background air</td>
</tr>
<tr>
<td>CO Sample Fill</td>
<td>3</td>
<td>Measurement cell fills with sample air</td>
</tr>
<tr>
<td>CO Sample Meas</td>
<td>Continuous</td>
<td>Measurement of sample air</td>
</tr>
</tbody>
</table>
3.3 General Operation Information

3.3.1 Keypad & Display

The instrument is operated with the use of four sets of buttons:

![Front Panel Image]

**Figure 10 – Front Panel**

**Selection Buttons (1)**

The selection buttons will perform the function specified directly above it on the screen. Generally this involves opening a menu, editing a value, accepting or cancelling an edit or starting an operation.

**Scrolling Buttons (2)**

The scrolling buttons allow users to scroll up and down through menus or selection boxes. The scrolling buttons are also used to scroll side to side through editable fields such as: Dates, Times, Numbers etc.

On the home screen these buttons are used for adjusting the screen contrast. Press and hold the up button to increase contrast; press and hold the down button to decrease.

**Keypad (3)**

The keypad contains the numbers 0-9, a decimal point/minus key ( ), and a space/plus key ( ).

In the few cases where letters can be entered, the number keys act like a telephone keypad. Every time a number key is pressed, it cycles through its choices. The up/down arrow keys scroll through all the numbers and the entire alphabet.

1 = 1, space, underline
2 = 2, A, B, C, a, b, c
3 = 3, D, E, F, d, e, f
4 = 4, G, H, I, g, h, i
5 = 5, J, K, L, j, k, l
6 = 6, M, N, O, m, n, o
7 = 7, P, Q, R, S, p, q, r, s
8 = 8, T, U, V, t, u, v
9 = 9, W, X, Y, Z, w, x, y, z
0 = 0, space, underline

The \( \text{+SPACE} \) and \( \text{-} \) keys function is context dependent. When editing a floating point number, the \( \text{-} \) key inserts a negative sign if the editing cursor is at the start of the number and negative signs are allowed. Otherwise it moves the decimal place to the current cursor location. The \( \text{+SPACE} \) key inserts a positive sign if the cursor is at the start of the number; otherwise it enters a space.

For non-floating point numbers, these keys usually increment or decrement the current value by 1.

When editing the month field of a date, the \( \text{+SPACE} \) and \( \text{-} \) key change the month.

Instrument Status Light Buttons (4)

Located in the top left corner, these lights indicate the status of the instrument as a whole.

- A red light indicates that the instrument has a major failure and is not functioning.
- An orange light indicates there is a minor problem with the instrument, but the instrument may still take measurements reliably.
- A green light indicates that the instrument is working and there are no problems.

In the case of an orange or red light, the user can enter the Status Menu to find which components are failing (refer to Section 3.4.4) or press the orange or red status light button when illuminated to bring up a pop up box with a full list of current faults.

Pressing the green status light button at any time will cancel any open edit box or menu and return the user to the home screen.

If no instrument status lights are on and the keypad is backlit, this indicates that the instrument is running the bootloader. The screen will also indicate that it is in the bootloader menu.
3.3.2 Home Screen

The home screen is composed of seven parts: readings (1), error/status line (2), instrument activity line (3), selection buttons (4), time/date (5), concentration units (6) and USB status (7).

![Home Screen Diagram](image)

Figure 11 – Home Screen

Readings (1)

Displays the concentration being measured in real-time. The display can be configured to show just the instantaneous data or the instantaneous and average data (refer to Section 3.4.8 Home Screen).

Error/Status Line (2)

The error/status line provides users with information on any problems the instrument may have. It displays the highest priority error or status condition contained in the Status Menu (refer to Section 3.4.4).

Instrument Activity (3)

This line shows what function the instrument is currently performing. Generally, it will show three groups of actions: Warm-up, Measurement or Calibration.

Selection Buttons (4)

These buttons are used on the home screen to enter one of two menus. The Quick Menu (refer to Section 3.4.1) contains all information and features necessary for scheduled maintenance. The Main Menu (refer to Section 3.4.2) contains all information and fields available to users and is generally only used during initial set-up and diagnostics.

Time and Date (5)

The time and date are displayed in between the menu buttons at the bottom of the screen.
Concentration Units (6)

The instrument units are displayed in the bottom right hand corner of the display.

USB Detection (7)

A USB symbol will be displayed in the bottom right corner when the USB memory stick is plugged in (the USB socket is behind the front panel). If the USB symbol is not shown the USB memory stick should be inserted. Underneath, the USB symbol arrows may be displayed which indicates data transfer. The USB memory stick must not be removed whilst the arrows are visible.

**Note:** To safely remove the USB memory stick, navigate to the Quick Menu and use the Safely Remove USB Stick function (refer to Section 3.4.1).

### 3.4 Menus & Screens

The menu system is divided into two sections, the Quick Menu and the Main Menu selectable from the Home Screen. The Quick Menu contains all information and operations necessary during scheduled maintenance visits. The Main Menu contains all fields that are accessible to users. It provides information on component failures and measurement parameters as well as editable fields and test procedures.

In general, editable parameters are displayed in bold font. Non-editable information is displayed in a thin font. Some parameters may become editable based on the state of the instrument.

For example, the manual calibration type and mode can only be changed when the instrument has finished the warm-up process.

#### 3.4.1 Quick Menu

The Quick Menu contains all the maintenance tools in one easy to use screen. It allows operators to perform calibrations, check important parameters and review the service history.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span Calibrate CO</td>
<td>This field is used to perform a span calibration adjustment and should only be used when a known concentration of span gas is being drawn through the measurement cell and the reading is stable. Activating the span calibrate field for a named gas will open a dialog box. Enter the concentration of the span gas that the instrument is sampling and press Accept.</td>
</tr>
<tr>
<td>Event Log</td>
<td>This field enters a screen with a log of all the events that the instrument has performed. These events include errors and warnings. This log is stored on the removable USB memory stick. The log is organised by month. When you enter this screen you will be prompted to enter the month for which you wish to view events.</td>
</tr>
<tr>
<td>Instrument</td>
<td>This field allows the instrument to be set to either Online (normal instrument operation) or In Maintenance (data is flagged as invalid).</td>
</tr>
</tbody>
</table>
3.2

3.4.2 Main Menu

There are six menus on the Main Menu screen.

- **Analyser State Menu**
  Refer to Section 3.4.3.
- **General Settings Menu**
  Refer to Section 3.4.8.
- **Measurement Settings Menu**
  Refer to Section 3.4.9.
- **Calibration Menu**
  Refer to Section 3.4.10.
- **Service Menu**
  Refer to Section 3.4.13.
- **Communications Menu**
  Refer to Section 3.4.22.

3.4.3 Analyser State Menu

Main Menu → Analyser State Menu

This displays the status of various parameters that affect instrument measurements.

- **Status Menu**
  Refer to Section 3.4.4.
- **Temperature Menu**
  Refer to Section 3.4.5.
- **Pressure & Flow Menu**
  Refer to Section 3.4.6.
- **Voltage Menu**
  Refer to Section 3.4.7.
- **Model**
  This field will always display Serinus.
- **Variant**
  The variant of the Serinus model (e.g. S30).
- **Range**
  The range of the Serinus model (Standard, High or Trace).
- **Ecotech ID**
  The Ecotech ID number.
- **Serial No.**
  The main controller PCA serial number.
- **Board Revision**
  The main controller PCA version.
- **Firmware Ver.**
  This field displays the firmware version currently in use on this instrument. This can be important when performing diagnostics and reporting back to the manufacturer.
Power Failure
This field displays the time and date of the last power failure or when power was disconnected from the instrument.

3.4.4 Status Menu

Main Menu → Analyser State Menu → Status Menu

The Status Menu presents a list of the current Pass/Fail statuses of the main components. During warm-up, the status of some parameters will be a dashed line.

**Event Log**
This field enters a screen with a log of all the events that the instrument has performed. These events include errors and warnings. This log is stored on the USB memory stick. The log is organised by month. When you enter this screen you will be prompted to enter the month for which you wish to view events.

**Show Error List**
This field allows the user to display the list of current errors and warnings on the screen.

**Next Service Due**
This field is visible with the next service due date if the service is due within the next two weeks.

**+5V Supply**
Pass if the +5 V power supply is within the acceptable range.

**+12V Supply**
Pass if the +12 V power supply is within the acceptable range.

**+Analog Supply**
Pass if the analog power supply is within the acceptable range (+12 V).

**-Analog Supply**
Pass if the analog power supply is within the acceptable range (-12 V).

**A2D**
Fail only if a problem is detected with the analog to digital conversion.

**Cell Temp.**
Pass if the cell heater temperature is within ± 10% of the heater set point.

**CO Scrubber Temperature**
Pass if the CO scrubber heater temperature is within ±10% of 90 °C.

**Mirror Temp.**
Pass if the mirror heater temperature is within ±10% of set point.

**Lamp/Source**
Fail if the reference voltage is less than 0.5 V and the input pot is over 250, which can be caused by the IR source failing.

**Correlation Wheel**
Fail if the correlation wheel is not functioning.

**Ref Voltage**
Checks that the reference voltage is within acceptable limits 3.6 V to 4.4 V.

**IR Source**
Checks that the IR source voltage is 5 V ±0.5 V.

**System Power**
Pass if the system has an adequate electrical supply.

**Maintenance Mode**
Error if the system is “In Maintenance” (refer to Section 3.4.13).

**Diagnostic Mode**
Error if the electronics are in Diagnostic Mode (refer to Section 3.4.15).

**Diagnostic PTF Comp**
Error if the Pres/Temp/Flow Comp. is disabled (refer to Section 3.4.14).
### Diagnostic Control
Error if the control loop is disabled (refer to Section 3.4.14).

### Valve Manual Control
Error if the valve sequencing is disabled (refer to Section 3.4.17).

### CO Conc V Saturated
Indicates if the voltage of the concentration during measurement is within the limits of the analog to digital converter (-0.26 V to 3.29 V).

### Background Conc V Saturated
Indicates if the voltage of the concentration during background measurement is within the limits of the analog to digital converter (-0.26 V to 3.29 V).

### Pressure Calibration
Error if the user is performing a pressure calibration.

### Flow Calibration
[Internal Pump Option]
Error if the user is performing a flow calibration.

### Flow Fault
Ok when the instrument has acceptable sample flow based on the difference between cell and ambient pressures.
With the internal pump option this fault is monitored by a flow sensor.

### Flow Block Temp.
[Internal Pump Option]
Pass if the flow block temperature is within 10% of the heater set point (to keep a constant accurate flow).

### Chassis Temperature
Pass if the chassis temperature is within the acceptable limits (0-50 °C).

### USB Stick Disconnected
Detects whether a USB memory stick is plugged into the front USB port.

### Instrument Warmup
Ok once the instrument is out of warm-up status.

### Backgrounds Disabled
Ok if backgrounds is enabled.

## 3.4.5 Temperature Menu

### Main Menu -> Analyser State Menu -> Temperature Menu

**Temperature Units**
The current temperature units of the instrument (Celsius, Fahrenheit or Kelvin).

**Set Point (CELL)**
The temperature set point of the measurement cell. The factory default is 50 °C.

**Set Point (FLOW)**
[Internal Pump Option]
The temperature set point of the flow block heater. The factory default is 50 °C.

**Cell**
Displays current temperature of the measurement cell.

**CO Scrubber**
Displays current temperature of the CO Scrubber.

**Flow Block**
[Internal Pump Option]
Displays the current temperature of the flow block.

**Chassis**
Displays the temperature of air inside the chassis, measured on the main controller PCA.

**Mirror**
Displays the temperature of the end-cap mirror plate on the measurement cell.
3.4.6  Pressure & Flow Menu

Main Menu → Analyser State Menu → Pressure & Flow Menu

| Pressure Units | Select the units that the pressure will be displayed in (torr, PSI, mBar, ATM or kPa). |
|---------------------------------------------|
| Ambient | Current ambient pressure. |
| Cell | Current pressure within the measurement cell. |
| Flow Units | Select the units that the sample flow will be displayed in (slpm or L/min). |
| Flow Set Point | The desired sample flow. |
| [Internal Pump Option] | |
| Sample Flow | Indicates the gas flow through the sample port of the instrument. The value should be around 1.0 slpm. If there is an error with the sample flow, it will read 0.00 slpm. |

3.4.7  Voltage Menu

Main Menu → Analyser State Menu → Voltage Menu

| IR Source | The drive voltage of the IR source 5 V ±0.5 V. |
| Conc Voltage (RAW) | Voltage from the sensor proportional to the detected signal from the measurement cell. This voltage represents the actual measurement of gas. |
| Conc Voltage | Displays the detector voltage after PGA scaling. |
| Ref. Voltage | The reference voltage is a measure of the IR source intensity. |
| Flow Voltage | The current voltage measured from the flow block PCA. |
| [Internal Pump Option] | |
| Cooler Voltage | Voltage of the peltier cooler within the IR detector (~1.17 V). |
| +5V Supply | +5 V power supply. |
| +12V Supply | +12 V power supply. |
| +Analog Supply | +12 V (primary) power supply. The value should be within ±2 V. |
| -Analog Supply | -12 V (primary) power supply. The value should be within ±2 V. |

3.4.8  General Settings Menu

Main Menu → General Settings Menu

| Decimal Places | Select the number of decimal places (0-5) used for the concentration displayed on the home screen. |
| Conc. Units | Sets the concentration units (ppm, ppb, ppt, mg/m³, μg/m³ or ng/m³). |
| Conversion Factor [Gravimetric Units] | This option only appears if concentration units are set to gravimetric (mg/m³, μg/m³ or ng/m³). Select either 0°C, 20°C or 25°C. This sets the standard temperature used from conversion for measured volumetric values. |
### Temperature Units
Select the units that temperature will be displayed in (Celsius, Fahrenheit or Kelvin).

### Pressure Units
Select the units that the pressure will be displayed in (torr, PSI, mBar, ATM or kPa).

### Flow Units
Select the units that the sample flow will be displayed in (slpm or L/min).

### Date
Displays the current date and allows users to edit if required.

### Time
Displays the current time and allows users to edit if required.

### Backlight
Select the length of time the screen and keypad backlight remain on after a button press. The setting Always Off means the backlight never turns on; the setting Always On means the backlight never turns off.

### Home Screen
This field allows the user to display concentrations on the Home Screen in two formats. The first is Inst. only which displays only the instantaneous concentration reading, the second is Inst & Avg which displays both instantaneous and average concentration on the Home Screen. The average is measured over the time period set in Measurement Settings Menu (refer to Section 3.4.9).

### Char 0 has Slash
When enabled, the instrument will display the zero character with a slash (\(0\)) to differentiate it from a capital ‘O’.

---

#### 3.4.9 Measurement Settings Menu

**Main Menu ➔ Measurement Settings Menu**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Period</strong></td>
<td>Set the time period over which the average will be calculated: Minutes (1, 3, 5, 10, 15 or 30) or hours (1, 4, 8, 12 or 24).</td>
</tr>
<tr>
<td><strong>Filter Type</strong></td>
<td>Sets the type of digital filter used (None, Kalman, 10 sec, 30 sec, 60 sec, 90 sec, 300 sec or Rolling). The Kalman filter is the factory default setting and must be used when using the instrument as a U.S. EPA equivalent method or to comply with EN certification. The Kalman filter gives the best overall performance for this instrument.</td>
</tr>
<tr>
<td><strong>Rolling Size</strong></td>
<td>Sets the number of measurements included in the rolling average. Only available if the Filter Type is set to Rolling.</td>
</tr>
<tr>
<td><strong>Backgrounds</strong></td>
<td>The default setting is enabled. When enabled it allows the user to edit the background interval via the following fields Time, Repeat and Units. When any of the backgrounds fields are edited the instrument will automatically calculate the date and time the next background is due to run and display under each relevant field.</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>Displays the date that the next background is due to run.</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>Edit and display the time that the next background will run. The time is set using a 24 hour clock.</td>
</tr>
</tbody>
</table>
**Operation**

### 3.4.10 Calibration Menu

**Main Menu → Calibration Menu**

Calibrating the instrument should be done with care (refer to Section 5 before using these menus).

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeat [Backgrounds]</td>
<td>Defines an interval value for the repeat of the background based on the <strong>Units</strong> selected. Once the specified amount of time has lapsed, the background will automatically run again. The user can edit this field but some restriction apply depending on the <strong>Units</strong> selected. Default is “1”.</td>
</tr>
<tr>
<td>Units [Backgrounds]</td>
<td>This is where the user can define the type of units for the <strong>Repeat</strong> delay period. For example: A <strong>Repeat</strong> of “1” and <strong>Units</strong> of “Days” means that a calibration will automatically run every day at the defined time. Default is “Days”</td>
</tr>
</tbody>
</table>

**3.4.10.1 Calibrate CO**

This field is used to perform a span calibration and should be only used when a known concentration of span gas is running through the measurement cell and the reading is stable.

- Activating the span calibrate field for a named gas will open a dialog box. Enter the concentration of the span gas that the instrument is sampling and press **Accept**.

**3.4.10.2 Zero Calibrate CO**

This command is used to correct the zero calibration setting. This option should be used only when zero gas is running through the measurement cell (refer to Section 5.5 before using this command).
### 3.4.10.1 Manual Mode

These items appear in the **Calibration Menu** when **Cal. Type** is set to **Manual**.

<table>
<thead>
<tr>
<th>Cal. Mode</th>
<th>When calibration type is set to <strong>Manual</strong> the instruments operational mode can be chosen from the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measure</strong>:</td>
<td>Is the normal measurement through the sample port.</td>
</tr>
<tr>
<td><strong>Zero</strong>:</td>
<td>This mode will take air through the calibration port so that a zero calibration can be performed. Data is flagged as zero data.</td>
</tr>
<tr>
<td><strong>Span</strong>:</td>
<td>This mode will take air through the calibration port so that a span calibration can be performed. Data is flagged as span data.</td>
</tr>
<tr>
<td><strong>Cycle</strong>:</td>
<td>Performs a zero and a span calibration mode and returns to measure mode. The length of time spent measuring each calibration mode is set in <strong>Cycle Time</strong> (refer to Section 3.4.10). While the instrument is still in the warm-up period (refer to Section 3.1) the <strong>Cal. Mode</strong> cannot be changed from <strong>Measure</strong> mode.</td>
</tr>
</tbody>
</table>

### 3.4.10.2 Timed Mode

These items appear in the **Calibration Menu** when **Cal. Type** is set to **Timed**.

<table>
<thead>
<tr>
<th>Date</th>
<th>Enter the date for the next calibration to start.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Enter the time that calibration will be performed. The time is set using a 24 hour clock.</td>
</tr>
<tr>
<td>Repeat</td>
<td>The calibration will automatically run again after the specified amount of time. This field specifies the delay period (from 1 to 20,000 units, as specified below).</td>
</tr>
<tr>
<td>Units</td>
<td>This is where the user can define the type of units for the <strong>Repeat</strong> delay period. For example: A <strong>Repeat</strong> of “3” and units of “Days” means that a calibration will automatically be performed every three days.</td>
</tr>
<tr>
<td>Span Compensation</td>
<td>When <strong>Enabled</strong> the instrument will automatically perform a <strong>Span Calibrate CO</strong> at the end of the <strong>Cycle Time</strong> and adjust the gain based on the <strong>Span Level</strong>. When <strong>Disabled</strong> it will do a precision check only, no adjustment is made.</td>
</tr>
</tbody>
</table>

Timed calibration with span compensation enabled does not fulfil U.S. EPA approval or EN certification.
Span Level

Enter the concentration of span gas expected. Used when the Span Compensation is Enabled.

### 3.4.11 Pressure Calibration Menu

**Main Menu → Calibration Menu → Pressure Calibration Menu**

Entering this menu will set the valves to the pressure calibration configuration; leaving the menu will restore the valves to normal operation (refer to Section 5.2).

<table>
<thead>
<tr>
<th><strong>Vacuum Set Pt.</strong></th>
<th>The zero point for the calibration. Activating this item will open a dialog box of instructions.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ambient Set Pt.</strong></td>
<td>The high point for the calibration. Activating this item will open a dialog box of instructions.</td>
</tr>
<tr>
<td><strong>Pressure Units</strong></td>
<td>Select the units that the pressure will be displayed in (torr, PSI, mBar, ATM or kPa).</td>
</tr>
<tr>
<td><strong>Ambient</strong></td>
<td>The current ambient pressure.</td>
</tr>
<tr>
<td><strong>Cell</strong></td>
<td>The current pressure in the measurement cell.</td>
</tr>
</tbody>
</table>

### 3.4.12 Flow Calibration Menu (Option)

**Main Menu → Calibration Menu → Flow Calibration Menu**

This menu only appears when the internal pump option is installed. Please refer to Section 5.9 for the calibration procedure. Setting the Flow Control to MANUAL will automatically disable the valve sequencing ready for flow calibration.

<table>
<thead>
<tr>
<th><strong>Flow Control</strong></th>
<th>Set to MANUAL to disable the automatic flow control. AUTO allows the flow PID to modify the pump coarse and fine settings. START will transition to AUTO after one second.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Internal Pump</strong></td>
<td>This field allows the internal pump to be turned on or off. This field is only editable when the Flow Control field is set to MANUAL.</td>
</tr>
<tr>
<td><strong>Coarse</strong></td>
<td>Internal pump speed control (Coarse). This field is only editable when the Flow Control field is set to MANUAL.</td>
</tr>
<tr>
<td><strong>Fine</strong></td>
<td>Internal Pump speed control (Fine). This field is only editable when the Flow Control field is set to MANUAL.</td>
</tr>
<tr>
<td><strong>Sample Flow</strong></td>
<td>Current sample flow through the instrument. This is only accurate when reading close to the flow calibration point.</td>
</tr>
<tr>
<td><strong>Flow Set Point</strong></td>
<td>The desired sample flow target.</td>
</tr>
</tbody>
</table>
### Cal. Point

The flow at which the last flow calibration was performed. If **Flow Control** is set to **MANUAL** and **Internal Pump** is ON, this field can be edited to calibrate the current flow against a reference. Calibration must be done at or near the flow set point for best results (refer to Section 5.9).

### Cal. Zero

If Flow Control is set to **MANUAL** and **Internal Pump** is OFF, activating this command will calibrate the flow sensor zero point (refer to Section 5.9).

### Valve Menu

Refer to Section 3.4.17.

#### 3.4.13 Service Menu

**Main Menu → Service Menu**

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostics Menu</td>
<td>Refer to Section 3.4.14.</td>
</tr>
<tr>
<td>Calculation Factors Menu</td>
<td>Refer to Section 3.4.21.</td>
</tr>
<tr>
<td>Load Auto-Backup Config.</td>
<td>Loads the auto-backup configuration file. The configuration is automatically backed up every night at midnight.</td>
</tr>
<tr>
<td>Load Configuration</td>
<td>Loads a user selectable configuration file from the USB memory stick.</td>
</tr>
<tr>
<td>Save Configuration</td>
<td>Saves all of the EEPROM-stored user-selectable instrument configurations to the USB memory stick (calibration and communication settings, units, instrument gain, etc.). If there are problems with the instrument use this function to save settings to the USB memory stick and send this file (together with the parameter list save) to your supplier with your service enquiry.</td>
</tr>
<tr>
<td>Save Parameter List</td>
<td>Saves a text file of various parameters and calculation factors. If you have problems with the instrument use this function to save settings to the USB memory stick and send this file (together with the configuration save) to your supplier with your service enquiry.</td>
</tr>
<tr>
<td>Instrument</td>
<td>This field allows the instrument to be set to either <strong>Online</strong> (normal instrument operation) or <strong>In Maintenance</strong> (data is flagged as invalid).</td>
</tr>
<tr>
<td>Next Service Due</td>
<td>Displays when the next scheduled service is due.</td>
</tr>
<tr>
<td>Safely Remove USB Stick</td>
<td>This command must be activated to safely remove the USB memory stick.</td>
</tr>
<tr>
<td>System Restart</td>
<td>Activating this will restart the instrument.</td>
</tr>
</tbody>
</table>

#### 3.4.14 Diagnostics Menu

**Main Menu → Service Menu → Diagnostics Menu**

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Pots Menu</td>
<td>Refer to Section 3.4.15.</td>
</tr>
<tr>
<td>Internal Pump Menu</td>
<td>Refer to Section 3.4.16.</td>
</tr>
<tr>
<td>[Internal Pump Option]</td>
<td>Refer to Section 3.4.16.</td>
</tr>
<tr>
<td>Valve Menu</td>
<td>Refer to Section 3.4.17.</td>
</tr>
</tbody>
</table>
Operation

Tests Menu
Refer to Section 3.4.18.

Pres/Temp/Flow Comp.
On (default): Is used to compensate instrument measurements for environmental fluctuations that might affect readings (pressure, temperature and flow).
Off: Is used only when running diagnostics.

Control Loop
Enabled (default): Allows the instrument to automatically adjust digital pots and other outputs.
Disabled: Prevents the instrument from changing most outputs so the service technician can manually control them.

3.4.15 Digital Pots Menu

Main Menu ➔ Service Menu ➔ Diagnostics Menu ➔ Digital Pots Menu

Digital pots are electronically controlled digital potentiometers used for adjustments to operations of the instrument. Each of the digital pots can go from 0-255. This menu should be accessed only during diagnostics.

Unless the Control Loop is Disabled (refer to Section 3.4.14), changes to the pots may be modified by the instrument. This is intentional; some diagnostics are best done with instrument feedback and some are best done without.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGA Gain</td>
<td>1-128</td>
<td>Displays the gain of the PGA.</td>
</tr>
<tr>
<td>Input Pot</td>
<td>180-230</td>
<td>Reduces the raw signal to measurable level.</td>
</tr>
<tr>
<td>Conc. Voltage (RAW)</td>
<td>0-3.1</td>
<td>The concentration voltage measured by the analog to digital converter.</td>
</tr>
<tr>
<td>Conc. Voltage</td>
<td>0-3.1</td>
<td>The concentration voltage after adjustment for the PGA gain factor.</td>
</tr>
<tr>
<td>Meas. Zero Pot (COARSE)</td>
<td>125-225</td>
<td>Electronic zero for the measure channel.</td>
</tr>
<tr>
<td>Meas. Zero Pot (FINE)</td>
<td>0-255</td>
<td>Electronic zero for the measure channel.</td>
</tr>
<tr>
<td>Ref. Test Pot</td>
<td>0</td>
<td>For diagnostics only.</td>
</tr>
<tr>
<td>Ref. Voltage</td>
<td>3.5-4.5</td>
<td>The reference voltage of the detector.</td>
</tr>
<tr>
<td>Source Pot</td>
<td>227</td>
<td>Adjusts the drive current for the IR source.</td>
</tr>
<tr>
<td>Cooler Pot</td>
<td>45</td>
<td>Adjusts the drive current for the cooler.</td>
</tr>
<tr>
<td>Cooler Voltage</td>
<td>1.15-1.20</td>
<td>The voltage being applied to the cooler.</td>
</tr>
<tr>
<td>Test Meas Pot</td>
<td>0</td>
<td>This Digital Pot is used for diagnostics only. When in the Electrical or Preamp Diagnostic Mode, this Digital pot should be adjusted from 0 to 255. This will produce a change in the concentration voltage as well as the indicated gas concentration.</td>
</tr>
<tr>
<td>Test Ref Pot</td>
<td>0</td>
<td>This Digital Pot is used for diagnostics only. When in the Electrical or Preamp Diagnostic Mode, this Digital Pot should be adjusted from 0 to 255. This will produce a change in the reference voltage.</td>
</tr>
<tr>
<td>Diagnostic Mode</td>
<td>Operate</td>
<td>• Operate (default): Puts the instrument in normal operation mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Electrical: Injects an artificial test signal into the electronic processing circuitry on the main controller PCA to verify that the circuitry is operating correctly. When in this Diagnostic Mode, adjust the Test Meas Pot from 0 to 255. This will produce a change</td>
</tr>
</tbody>
</table>
in the concentration voltage as well as the indicated gas concentration. Adjust the Test Ref Pot from 0 to 255 to produce a change in the reference voltage.

- **Preamp**: Injects an artificial test signal into the Preamplifier mounted on the Measurement Cell to verify that the Preamplifier, cabling and electronic circuitry on the main controller PCA is operating correctly. When in this Diagnostic Mode, adjust the Test Meas Pot from 0 to 255. This will produce a change in the concentration voltage as well as the indicated gas concentration. Adjust the Test Ref Pot from 0 to 255 to produce a change in the reference voltage.

### 3.4.16 Internal Pump Menu (Option)

**Main Menu → Service Menu → Diagnostics Menu → Internal Pump Menu**

This menu only appears when the internal pump option is installed. Setting the Flow Control to MANUAL will automatically disable the valve sequencing.

<table>
<thead>
<tr>
<th>Flow Control</th>
<th>Set to MANUAL to disable the automatic flow control. AUTO allows the flow PID to modify the pump coarse and fine settings. START will transition to AUTO after one second.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Pump</td>
<td>This field allows the internal pump to be turned on or off. This field is only editable when the Flow Control field is set to MANUAL.</td>
</tr>
<tr>
<td>Coarse</td>
<td>Internal pump speed control (Coarse). This field is only editable when the Flow Control field is set to MANUAL.</td>
</tr>
<tr>
<td>Fine</td>
<td>Internal Pump speed control (Fine). This field is only editable when the Flow Control field is set to MANUAL.</td>
</tr>
<tr>
<td>Sample Flow</td>
<td>Current gas flow. This is only accurate when reading close to the flow calibration point.</td>
</tr>
</tbody>
</table>

### 3.4.17 Valve Menu

**Main Menu → Service Menu → Diagnostics Menu → Valve Menu**

The Valve Menu allows the user to observe the instrument controlled switching of the valves. If the valve is On it means the valve is energised. When a three way valve is in the On state it will now be in the NC (normally closed) position as shown in the plumbing schematic. When the valve sequencing is disabled the user has the ability to turn the valve Off and On manually. It is recommended that the valve menu be used by a trained technician following the plumbing schematic (refer to Section 9.5).

**Note:** When interpreting the information below regarding the flow path through the valve note that (NC = Normally Closed), (NO = Normally Open) and (C = Common).

| Valve Sequencing | When Enabled the valves will turn On and Off under the instruments control (even if you have manually turned Off or On a valve). When Disabled the valves will change only in response to a user’s action. |
| Sample/Cal | Indicates if the Sample/Cal valve on the Calibration Valve Manifold is Off or On. This will determine the port the instrument draws its sample from. 
  
  Off = Flow from NO to C (drawing sample from the Sample Port). 
  
  On = Flow from NC to C (drawing sample from the Calibration Port). |
|---|---|
| Internal Zero/Cal | Indicates if the Internal Zero/Cal valve on the Calibration Valve Manifold is Off or On. This will determine the port the instrument draws its sample from when selecting Cal. Mode → Zero. 
  
  Off = Flow from NO to C (drawing sample from the B Gund Air Port). 
  
  On = Flow from NC to C (drawing sample from the Calibration Port). |
| Pressurised Zero [optional] | Indicates if the optional pressurised zero port valve is Off or On (refer to Section 8.6). |
| Pressurised Span [optional] | Indicates if the optional pressurised span port valve is Off or On (refer to Section 8.6). |

### 3.4.18 Tests Menu

**Main Menu → Service Menu → Diagnostics Menu → Tests Menu**

**Screen Test**

Performs a screen test by drawing lines and images on the screen so that the operator can determine if there are any faults in the screen. Press a keypad key to step through the test. The up and down arrow keys will adjust the contrast.

**Digital Input Test Menu**

Refer to Section 3.4.19.

**Digital Output Test Menu**

Refer to Section 3.4.20.

### 3.4.19 Digital Input Test Menu

**Main Menu → Service Menu → Diagnostics Menu → Tests Menu → Digital Input Test Menu**

**Input 0..7**

Displays the status of the 0-7 digital input pins. Value will be 0 or 1.

**Note:** Entering the Digital Inputs Menu will temporarily disable all digital and analog input/outputs. This will affect logging via these outputs. Exiting the menu restores automatic control.

### 3.4.20 Digital Output Test Menu

**Main Menu → Service Menu → Diagnostics Menu → Tests Menu → Digital Output Test Menu**

**Automated Test**

When started will automatically step through each output, turning it On and Off.

**Output 0..7**

Displays the state of the output pin (On or Off), and allows the user to manually set the state.
**Note:** Entering the Digital Outputs Menu will temporarily disable all digital and analog input/outputs. This will affect logging via these outputs. Exiting the menu restores automatic control.

### 3.4.21 Calculation Factors Menu

**Main Menu → Service Menu → Calculation Factors Menu**

The Calculation Factors Menu provides the user with the values used to calculate different aspects of measurement and calibration.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dilution Ratio</td>
<td>Entering a value here will multiply the displayed and recorded measurements by the dilution amount. For example, if the instrument is measuring a source where the average concentration is above the upper limit of the measurement range, a dilution probe with a fixed ratio dilution ratio can be used to reduce the level measured by the instrument, so for a 4:1 dilution ratio, enter a value of 4. Enter the ratio here so the instrument can display the correct value on the instrument. The default value is 1.00 (this indicates no dilution is applied).</td>
</tr>
<tr>
<td>Instrument Gain</td>
<td>A multiplication factor used to adjust the concentration measurement to the appropriate level (set at calibration).</td>
</tr>
<tr>
<td>Zero Offset CO</td>
<td>This field displays the offset created from a zero calibration. This is the concentration measured from zero air and is subtracted from all readings.</td>
</tr>
<tr>
<td>Background</td>
<td>The correction factor calculated from the background cycle (used to eliminate background interferences).</td>
</tr>
<tr>
<td>PTF Correction CO</td>
<td>Displays the correction factor applied to the concentration measurement. This correction is for changes in pressure, temperature and flows since the last calibration.</td>
</tr>
</tbody>
</table>
| Noise                | The standard deviation of the concentration. The calculation is as follows:  
  - Take a concentration value once every two minutes.  
  - Store 25 of these samples in a first in, last out buffer.  
  - Every two minutes, calculate the standard deviation of the current 25 samples. This is a microprocessor-generated field and cannot be set by the user.  
This reading is only valid if zero air or a steady concentration of span gas has been supplied to the instrument for at least one hour. |

### 3.4.22 Communications Menu

**Main Menu → Communications Menu**

Configures how the instrument communicates with external instrumentation and data loggers.

<table>
<thead>
<tr>
<th>Menu</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Logging Menu</td>
<td>Refer to Section 3.4.23.</td>
</tr>
<tr>
<td>Serial Communication Menu</td>
<td>Refer to Section 3.4.24.</td>
</tr>
<tr>
<td>Analog Input Menu</td>
<td>Refer to Section 3.4.25.</td>
</tr>
</tbody>
</table>
Analog Output Menu  Refer to Section 3.4.26.
Digital Input Menu  Refer to Section 3.4.27.
Digital Output Menu  Refer to Section 3.4.28.
Network Menu  Refer to Section 3.4.29.
Bluetooth Menu  Refer to Section 3.4.30.

3.4.23  Data Logging Menu

Main Menu  Communications Menu  Data Logging Menu

When editing the numeric or text menus, the “-” key will delete the current parameter and move the others up to take its place; the “+” key will insert a parameter at the current location and move the ones below it down. The internal logger can log a maximum of 12 parameters.

<table>
<thead>
<tr>
<th>Data Log Interval</th>
<th>Displays the interval at which the data is saved to the USB memory stick. Selecting a 1 sec interval may result in occasional measurements not being logged or slow response to serial commands.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Log Setup – Numeric</td>
<td>Numeric list of the parameters logged. This is a quicker way to enter parameters (for a list of parameters refer to Table 26).</td>
</tr>
<tr>
<td>Data Log Setup – Text</td>
<td>Select the list of logged parameters by name.</td>
</tr>
</tbody>
</table>

3.4.24  Serial Communication Menu

Main Menu  Communications Menu  Serial Communication Menu

<table>
<thead>
<tr>
<th>Serial ID</th>
<th>This is the ID of the instrument when using multidrop RS232 communications. This ID can be changed to support multiple instruments on the same RS232 cable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bayern-Hessen ID  [Bayern-Hessen Protocol]</td>
<td>This is the Bayern-Hessen ID used by the Bayern-Hessen Protocol.</td>
</tr>
<tr>
<td>CO ID  [Bayern-Hessen Protocol]</td>
<td>This is the ID of the CO gas used by the Bayern-Hessen Protocol.</td>
</tr>
<tr>
<td>CO2 ID  [Bayern-Hessen Protocol]  [Input 1 is CO2 Option]</td>
<td>This is the ID of the CO2 gas used by the Bayern-Hessen Protocol. This option is only available if you have installed the Input 1 is CO2 option in the Hardware Menu (refer to Section 3.4.32).</td>
</tr>
<tr>
<td>Service port (RS232 #1)  Multidrop port (RS232 #2)</td>
<td>The port parameters below are repeated for each serial port.</td>
</tr>
<tr>
<td>Serial Delay</td>
<td>Some older communication systems require a delay before the instrument responds to a serial command. The number of milliseconds of delay required (0-1000). The default is 0, meaning the instrument responds as quickly as possible to any serial request.</td>
</tr>
<tr>
<td>Baudrate</td>
<td>Sets the baud rate for this serial port (1200, 2400, 4800, 9600, 14400, 19200, 38400 or 115200).</td>
</tr>
</tbody>
</table>
3.2 Protocol
Sets the protocol used for this serial port (Advanced, ModBus, EC9800 or Bayern-Hessen). This must be set to Advanced for Ecotech supplied software.

Endian [Modbus Protocol]
Select Little or Big endian mode for ModBus protocol.

3.4.25 Analog Input Menu
Main Menu → Communications Menu → Analog Input Menu

The Serinus supports three analog inputs from the 25 pin I/O connector. Each input is a 0 to 5 volt CAT 1 input that can be scaled and logged to the USB memory stick or accessed remotely as parameters 199 to 201.

CAUTION
Exceeding these voltages can permanently damage the instrument and void the warranty.

<table>
<thead>
<tr>
<th>Input 1 is CO2</th>
<th>When enabled several new menu items appear in other menus and the home screen now displays the CO and CO2 gas concentrations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input 1/2/3</td>
<td>The sections below are repeated for each analog input.</td>
</tr>
<tr>
<td>Multiplier</td>
<td>The input voltage will be multiplied by this number. For example, if a sensor has a 0-5 V output for a temperature of -40 °C to 60 °C, the multiplier would be (60-(-40))/5 = 20.</td>
</tr>
<tr>
<td>Offset</td>
<td>This value will be added to the above calculation. Continuing the example in the multiplier description, the offset should be set to -40, so that a voltage of 0 V will be recorded as -40 °C.</td>
</tr>
<tr>
<td>Reading</td>
<td>The current reading from the analog input, after the multiplier and offset are applied. This is the value that is logged or reported as parameter 199 to 201.</td>
</tr>
</tbody>
</table>

3.4.26 Analog Output Menu
Main Menu → Communications Menu → Analog Output Menu

Output Mode
The analog output can be set to be either Current or Voltage. Different fields will be displayed depending on which analog output type is selected.

CO
The first analog output is always CO. If you have enabled the Input 1 is CO2 option in the Hardware Menu (refer to Section 3.4.32), the second analog output will be CO2 and all of these fields will be repeated for both analog output.

CO2 [optional]
Sets the lower range limit (in concentration units). This is the value at which the analog output should be at its minimum. For example, 4 mA for a 4 to 20 mA current output.
Max Range | Sets the upper range limit (in concentration units). This value can be edited but cannot exceed the Over Range value. This is the value at which the analog output should be at its maximum. For example, 20 mA for a current output.

Over-Ranging | Set to Enabled or Disabled to turn the over-ranging feature on or off.

Over-Range [Over-Ranging Enabled] | This field is only visible when Over-Ranging is set to Enabled. Set to the desired over range value. This value cannot be set below the Range value. This is the alternate scale that is used for the analog output when over-ranging is active and enabled. When 90% of the standard range is reached, this over range is automatically entered. When 80% of the original range is reached, it returns to the original range.

### 3.4.26.1 Analog Output Menu - Voltage

**Main Menu ➔ Communications Menu ➔ Analog Output Menu**

These items appear when Output Mode is set to Voltage.

**Voltage Offset** | Choices are 0 V, 0.25 V or 0.5 V. This sets the voltage for a reading of 0. Since the output cannot go negative, this offset can be used to record negative readings.

**0.5V Calibration** | Enables the user to calibrate the analog voltage output at a low point. Edit the value against a reference volt meter until the connected equipment reads 0.5 V (refer to Section 4.4.1.1).

**5.0V Calibration** | Enables the user to calibrate the voltage output at a full scale point (5 V). Edit the value against a reference volt meter until the connected equipment reads 5 V (refer to Section 4.4.1.1).

### 3.4.26.2 Analog Output Menu - Current

**Main Menu ➔ Communications Menu ➔ Analog Output Menu**

These items appear when Output Mode is set to Current.

**Current Range** | Enables the user to set desired current ranges. The user's choices are 0-20 mA, 2-20 mA or 4-20 mA.

**4mA Calibration** | Enables the user to calibrate the current output at a low point. Edit the value against a reference amp meter until the connected equipment reads 4 mA (refer to Section 4.4.1.2).

**20mA Calibration** | Enables the user to calibrate the current output at a full scale point (20 mA). Edit the value against a reference amp meter until the connected equipment reads 20 mA (refer to Section 4.4.1.2).
3.4.27  Digital Input Menu

Main Menu → Communications Menu → Digital Input Menu

This menu is used to remotely trigger zero and span calibrations. This is done by assigning the eight digital inputs with one of the following commands.

<table>
<thead>
<tr>
<th>DI N (Pin X)</th>
<th>Associates an action with a digital input. There are eight digital inputs (the pin numbers are for the 25 pin connector). Each one can have one of the following associated actions, triggered when the corresponding digital input goes to the <strong>Active</strong> state:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disabled</strong></td>
<td>No action (this digital input does nothing).</td>
</tr>
<tr>
<td><strong>Do Span</strong></td>
<td>Used to perform a span precision check. When activated the instrument sets the <strong>Cal. Mode</strong> to <strong>Span</strong> (refer to Section 3.4.10.1).</td>
</tr>
<tr>
<td><strong>Do Zero</strong></td>
<td>Used to perform a zero precision check. When activated the instrument sets the <strong>Cal. Mode</strong> to <strong>Zero</strong> (refer to Section 3.4.10.1).</td>
</tr>
</tbody>
</table>

**Active**

Each pin can be set to be active **High** or **Low**. Active High means that the event will be triggered when the line is pulled to 5 V. Active Low means that the event will be triggered when the line is pulled to 0 V.

**Example**

Here is a typical configuration between an instrument and either a data logger or calibrator (master device):

1. Set the jumper JP1 to 5 V position (refer to Section 4.4.3).
2. Connect one of the master devices digital output signals to pin 18 and the ground signal to pin 5 of the instrument’s analog/digital 25 pin female connector (refer to Figure 20).
3. Program master device to output 0 volts to pin 18 when a span is desired.
4. In the instrument’s **Digital Input Menu** assign **DI 0 → Do Span** - Accept.
5. The same procedure can be followed to also activate zero calibrations. Pin 6 of the instrument’s analog/digital 25 pin female connector can be connected to one of the other master devices digital outputs and the instrument can be set so **DI 1** is assigned to **Do Zero**.
3.4.28 Digital Output Menu

Main Menu → Communications Menu → Digital Output Menu

This allows the instrument to trigger external alarms in response to certain events. There are eight different pins available, which will be set high during an associated event:

<table>
<thead>
<tr>
<th>DO N (Pin X)</th>
<th>Associates a state with a digital output. There are eight digital outputs (the pin numbers are for the 25 pin connector). Each one can have one of the associated states listed in Table 4. The pin will be driven to the active state while the instrument state is true.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>Each pin can be set to be active High or Low. Active High means that the pin will be pulled to 5 V when the associated event occurs. Active Low means the pin will be pulled to 0 V when the associated event occurs.</td>
</tr>
</tbody>
</table>

**Table 4 – Digital Output States**

<table>
<thead>
<tr>
<th>Digital Output State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disabled</td>
<td>No state (this state is never Active).</td>
</tr>
<tr>
<td>Pwr Supply Fail</td>
<td>Power supply fault.</td>
</tr>
<tr>
<td>A2D Fail</td>
<td>Analog to digital fault.</td>
</tr>
<tr>
<td>Corr. Wheel Fail</td>
<td>Correlation wheel fault.</td>
</tr>
<tr>
<td>Flow Fail</td>
<td>Sample flow fault.</td>
</tr>
<tr>
<td>Cell Heat Fail</td>
<td>Cell heater fault.</td>
</tr>
<tr>
<td>Conv. Heat Fail</td>
<td>CO Scrubber heater fault.</td>
</tr>
<tr>
<td>Flow Heat Fail</td>
<td>Flow block heater fault.</td>
</tr>
<tr>
<td>Mirror Heat Fail</td>
<td>Mirror heater fault.</td>
</tr>
<tr>
<td>Lamp Heat Fail</td>
<td>Lamp heater fault.</td>
</tr>
<tr>
<td>Chassis Tmp Fail</td>
<td>Chassis temperature fault.</td>
</tr>
<tr>
<td>USB Disconnected</td>
<td>The USB memory stick is disconnected.</td>
</tr>
<tr>
<td>Background</td>
<td>Performing a background.</td>
</tr>
<tr>
<td>Span</td>
<td>Performing a span check.</td>
</tr>
<tr>
<td>Zero</td>
<td>Performing a zero check.</td>
</tr>
<tr>
<td>System Fault</td>
<td>Any system fault (the red light is on).</td>
</tr>
<tr>
<td>Maintenance Mode</td>
<td>User has activated maintenance mode.</td>
</tr>
<tr>
<td>Over Range AO 1</td>
<td>Over range for the CO analog output is active.</td>
</tr>
<tr>
<td>Over Range AO 2</td>
<td>Over range for the CO2 analog output is active.</td>
</tr>
</tbody>
</table>
3.4.29  Network Menu (Option)

Main Menu ➔ Communications Menu ➔ Network Menu

The Network Menu only appears when the Network Port is enabled in the Hardware Menu (refer to Section 3.4.32). The Network Menu allows the user to view or set the IP Address, Netmask and Gateway if the optional network port is installed.

<table>
<thead>
<tr>
<th>Start-up Mode</th>
<th>The following modes are available:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• <strong>Normal</strong>: In this mode nothing is done with the network port during boot-up. It is assumed to be configured correctly or unused.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Read IP</strong>: This mode interrogates the network port for its IP address. The menu will display the network address after boot-up.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Set IP</strong>: The user may enter an IP address, Netmask and Gateway address (following the usual rules for formatting these addresses). At this time the instrument does not validate the correctness of these entries. When you cycle power, the instrument will first instruct the network port on its new address. It will switch to <strong>Read IP</strong> mode and read back the address it just set so the user may verify it in the menu.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Set DHCP</strong>: This sets the network port into DHCP mode, allowing the network to assign the instrument an IP address.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IP Address</th>
<th>This is the current IP address of the instrument.</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Read IP or Set IP Start-up Mode]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Netmask</th>
<th>This is the subnet mask of the network the instrument is connected to.</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Read IP or Set IP Start-up Mode]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gateway</th>
<th>This is the IP address of the router to access addresses not on the same subnet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Read IP or Set IP Start-up Mode]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adaptor is in DHCP mode</th>
<th>In this mode the instrument will ask for its network parameters from a DHCP server on your network.</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Set DHCP Start-up Mode]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Sets the protocol used for the network port (Advanced, ModBus, EC9800 or Bayern-Hessen). This must be set to Advanced for Ecotech supplied software.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Select <strong>Little</strong> or <strong>Big</strong> endian mode for ModBus protocol.</td>
</tr>
<tr>
<td>[Modbus Protocol]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bayern-Hessen ID</th>
<th>This is the Bayern-Hessen ID used by the Bayern-Hessen Protocol.</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Bayern-Hessen Protocol]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CO ID</th>
<th>This is the ID of the CO gas used by the Bayern-Hessen Protocol.</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Bayern-Hessen Protocol]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CO2 ID</th>
<th>This is the ID of the CO2 gas used by the Bayern-Hessen Protocol. This option is only available if you have enabled the Input 1 is CO2 option in the Hardware Menu (refer to Section 3.4.32).</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Bayern-Hessen Protocol]</td>
<td></td>
</tr>
<tr>
<td>[Input 1 is CO2 Option]</td>
<td></td>
</tr>
</tbody>
</table>
3.4.30  Bluetooth Menu

Main Menu → Communications Menu → Bluetooth Menu

This instrument supports Bluetooth communication through the Serinus Remote Android Application (refer to Section 4.7).

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluetooth</td>
<td>This field indicates whether the instrument is remotely connected to an Android device.</td>
</tr>
<tr>
<td>Reset</td>
<td>After changing the ID or PIN, it is necessary to reboot the Bluetooth module. This is done by resetting the instrument or by using this menu item to reboot only the Bluetooth.</td>
</tr>
<tr>
<td>ID</td>
<td>This is the Bluetooth ID of the instrument. Use the keypad to edit this field. The default ID setting is <strong>Serinus(Ecotech ID)</strong>. The word <strong>Serinus</strong> is always the first part of the name and cannot be edited. The second part is the <strong>Ecotech ID</strong>.</td>
</tr>
<tr>
<td>PIN</td>
<td>This is a passcode/pin required for the Serinus Remote Application to connect to the instrument. The default pin is 1234.</td>
</tr>
</tbody>
</table>

3.4.31  Advanced Menu

This menu is accessed via a different method than the other menus. From the **Home Screen** press the following keys: \( (\text{.)}99\text{(+SPACE)} \)

This menu contains technical settings, diagnostics and factory hardware installations. No items in this menu should be accessed without authorisation and supervision of qualified service personnel.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>Select a language.</td>
</tr>
<tr>
<td>Hardware Menu</td>
<td>Refer to Section 3.4.32</td>
</tr>
<tr>
<td>Service Displays</td>
<td>When set to <strong>On</strong>, new items appear on many different menus. These fields are for diagnostic and service personnel only. Default is <strong>Off</strong>.</td>
</tr>
<tr>
<td>Next Service Due</td>
<td>Enables the user to edit the next service due date.</td>
</tr>
<tr>
<td>Jump to Next State</td>
<td>Moves the sequence to the next state (e.g. from Fill to Measure). This command is most commonly used to force an instrument out of the warm-up sequence early.</td>
</tr>
<tr>
<td>Parameter Display Menu</td>
<td>Refer to Section 3.4.33.</td>
</tr>
<tr>
<td>Reset to Factory Defaults</td>
<td>Reset the configuration to factory defaults. This will erase all calibrations and user configuration information.</td>
</tr>
<tr>
<td>Rebuild Index</td>
<td>If a data log becomes corrupted it may be possible to restore it by rebuilding its index file. This command will ask you to specify a month and will rebuild the index for that month. This operation can take many minutes and it should not be interrupted. While the file is rebuilding any data logging will be suspended.</td>
</tr>
</tbody>
</table>
CAUTION
No items in this menu should be accessed without authorization and supervision of qualified service personnel.

3.4.32 Hardware Menu

Advanced Menu → Hardware Menu

This menu contains factory hardware installations. If you reset to factory defaults you may need to revisit this menu to enable your installed optional features.

<table>
<thead>
<tr>
<th>Variant</th>
<th>Select the instrument model. Normally this only needs to be reset when the configuration is corrupted. The selections available will depend on licensing. It is not recommended to run an instrument with firmware set to an incorrect model.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Select the range of the instrument. Not all instruments support all ranges. Default is Standard.</td>
</tr>
<tr>
<td>Front Panel Style</td>
<td>Choosing the incorrect front panel will result in the traffic lights behaving inconsistently. Default is Aluminium.</td>
</tr>
<tr>
<td>Network Port</td>
<td>When Enabled indicates the instrument has a network port installed. Default is Disabled.</td>
</tr>
<tr>
<td>Internal Pump</td>
<td>When Enabled indicates the instrument has an Internal pump installed. Default is Disabled.</td>
</tr>
<tr>
<td>Orifice Size [Internal Pump Option Disabled]</td>
<td>Specify the input orifice for instruments without an internal pump. Default is 1.08 for Standard range instruments and 1.50 for High range instruments.</td>
</tr>
<tr>
<td>Input 1 is CO2</td>
<td>When Enabled, analog input 1 is treated as a measurement of CO₂. This gas will appear on the Home screen and can be logged as the second gas. Default is Disabled.</td>
</tr>
<tr>
<td>AO Max Limit</td>
<td>Edit this menu item to set the lower limit of the analog output Max Range.</td>
</tr>
</tbody>
</table>

CAUTION
No items in this menu should be accessed without authorization and supervision of qualified service personnel.

3.4.33 Parameter Display Menu

Advanced Menu → Parameter Display Menu

Used to display a parameter in real-time on the screen (refer to Table 26 for a full list of parameters).

<table>
<thead>
<tr>
<th>Data Parameter</th>
<th>This is an editable field. Enter the parameter number you wish to view (refer to Table 26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Displays the name of the selected parameter.</td>
</tr>
<tr>
<td>Value</td>
<td>Displays the current value of the selected parameter.</td>
</tr>
</tbody>
</table>
4. Communications

The Serinus has a number of different interfaces for communication with other equipment (RS232, USB, 25 pin digital/analog input/output, TCP/IP network (optional) and Bluetooth). A demonstration version of Ecotech’s Airodis software is included with the instrument, enabling basic data downloads and remote operation from a PC running MS Windows (7 or 8). The full version of Airodis is available separately and includes automated data collection, data validation and complex reporting by multiple users. Please refer to the Airodis Manual and Section 4.6 for details on setting up and communicating with the instrument.

![Communication ports]

**Figure 12 – Communication Ports**

### 4.1 RS232 Communication

RS232 communication is a very reliable way to access data from the instrument and is recommended for use in connection to a data logger for 24/7 communication. Both RS232 ports are configured as DCE and can be connected to DTE (Data Terminal Equipment such as a data logger or computer).

Port #2 also supports a multidrop arrangement (a configuration of multiple instruments connected via the same RS232 cable where the transmit signal is only asserted by the instrument that is spoken to).

For reliable multidrop RS232 communications please follow these guidelines:

- Verify that the Serial ID is set to a unique value which is different to the other instruments in the chain (refer to Section 3.4.24).
- All of the instruments in the multidrop chain must have the same baud rate and communication protocol settings. A maximum of 9600 baud rate is recommended.
- The multidrop RS232 cable should be kept to less than three meters in length.
- A 12K ohm terminating resistor should be placed on the last connector of the cable (connect from pin 2 to pin 5 and from pin 3 to pin 5 – refer to Figure 13).
- The shielding of the multidrop cable must be continuous throughout the cable.
- The shielding of the multidrop cable must only be terminated at one end. It should be connected to the metal shell of the DB 9 way connector.
This is ideal for irregular connection to a laptop running Ecotech’s Airodis software to download logged data and remotely control the instrument. Due to the nature of USB, this is a less reliable permanent connection as external electrical noise can cause USB disconnection errors on a data logger.

For more information on making connections refer to Section 4.6.1.1.

**Note:** Only the Advanced protocol is supported for USB communication.
4.3 TCP/IP Network Communication (optional)

Instruments with the optional network port installed can be accessed using a TCP/IP connection. Figure 14 shows examples of some possible configurations for remote access.

**Direct Connection**

Serinus

IP: 192.168.0.2

Computer

IP: 192.168.0.3

Cross-over LAN Cable

**LAN**

Serinus

IP: 192.168.0.2

Modem/Router

IP: 192.168.0.1

Computer

IP: 192.168.0.3

LAN Cable

LAN Cable /Wireless

**WAN**

Serinus

LAN IP: 192.168.0.2

WANIP: 192.125.125.1

Modem/Router

LAN IP: 192.168.0.1

LANIP: 192.125.120.1

Computer

LAN IP: 192.168.1.3

ISP/Internet

LAN Cable /Wireless

1 ISP: Internet Service Provider

*Figure 14 – Example of Typical Network Setups*
Note: In Figure 14 all the IP addresses are taken as an example. The WAN IP addresses are normally provided by your ISP. Whereas, the LAN IP addresses can be set manually to any range which is within the subnet of the Modem/Router/switch.

Use a cross-over LAN cable to connect the instrument directly to a computer, or a standard LAN cable for connection to a Modem/Router/Switch as shown in Figure 14. The computer could be connected to the Modem/Router using either CAT5 cable or a wireless connection, but the instrument must be connected using CAT5/6 cable.

4.3.1 Reading Network Port Setup

To read the current network port settings perform the following steps:

Procedure
1. Open - Main Menu → Communications Menu → Network Menu.
2. Select - Start-up Mode → Read IP - Accept.
3. Manually use the power switch on the rear of the instrument to turn the power Off. Please leave the instrument off for 10 seconds before turning the power back On.
4. Open - Main Menu → Communications Menu → Network Menu.
5. The current network port settings will now be displayed on the screen.
6. When viewing is complete select - Start-up Mode → Normal - Accept.

4.3.2 Setting Network Port Setup

Below is an example of how to setup the network port.

Procedure
1. Open - Main Menu → Communications Menu → Network Menu.
2. Select - Protocol → Advanced - Accept.
4. Edit - IP Address - (Change the IP address to the address you wish to use within the Modem/Router/switch subnet).
5. Edit - Netmask - (Change the Netmask to the setup specified by the Modem/Router).
6. Edit - Gateway - (Change the Gateway to the setup specified by the Modem/Router).
7. Once completed, use the power switch on the rear of the instrument to turn the power Off. Please leave the instrument off for 10 seconds before turning the power back On.

**Note:** Manually perform a hardware power cycle every time the IP address is changed for it to take effect.

8. Open - **Main Menu** → **Communications Menu** → **Network Menu**.

9. The **Start-up Mode** automatically changes to **Read IP** and the current network port settings will be displayed on the screen.

10. When viewing is complete select - **Start-up Mode** → **Normal** - Accept.

### 4.3.3 Port Forwarding on Remote Modem/Router Setup

When using the network port to connect to the router / modem with NAT enabled, you will need to add IP mapping to ensure that data is forwarded through to the desired port. This is known as port forwarding. To set-up the port for the instrument, you will need to go into the modem/router configuration. Normally, you will see the port forwarding setup under Port Forwarding, NAT or Port Mapping menu. Below is an example port forwarding setup.

The default port for the Serinus range of instruments is **32783**. The destination address is the instrument IP address setup in the **Network Menu**.

<table>
<thead>
<tr>
<th>Item</th>
<th>Protocol</th>
<th>Incoming Address</th>
<th>Incoming Port</th>
<th>Destination Address</th>
<th>Destination Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>tcp</td>
<td>0.0.0.0</td>
<td>32783-32783</td>
<td>192.168.0.2</td>
<td>32783 - 32783</td>
</tr>
</tbody>
</table>

**Figure 16 – Port Forwarding Example**
4.3.4 Airodis Setup to Communicate with Serinus

Below is an example of Airodis setup for a LAN network. Ensure the IP address is set to the same as on the instrument Network Menu.

![Figure 17 – LAN Network Set-Up (Airodis)](image)

Below is an example of Airodis setup for a WAN network. Ensure the IP address is set the same as on the remote modem/router.

![Figure 18 – WAN Network Set-Up (Airodis)](image)
4.4 Analog and Digital Communication

The 25 Pin analog and digital I/O port on the rear of the instrument sends and receives analog and digital signals to other devices. These signals are commonly used to activate gas calibrators or for warning alarms.

4.4.1 Analog Outputs

The instrument is equipped with one to three analog outputs that can be set to provide either voltage (0-5 V) or current (0-20, 2-20 or 4-20 mA) output. The analog outputs are tied to specific instrument measurements, depending on the instrument type.

For 0-10 V analog output operation, set the output mode to current and move the jumpers (JP3) on the rear panel PCA to 0-10 V (refer to Figure 19). Ensure the Current Range is set to 0-20 mA to obtain the 0-10 V range. When calibrating the (current) analog output with the jumper set to 0-10 V, the 4 mA calibration target is now a 2 V target and 20 mA calibration target is now a 10 V target.

Table 5 – Analog Outputs

<table>
<thead>
<tr>
<th>Analysers/Calibrator</th>
<th>Output 1</th>
<th>Output 2</th>
<th>Output 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serinus 10</td>
<td>O₃</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Serinus 30</td>
<td>CO</td>
<td>CO₂ [optional]</td>
<td>N/A</td>
</tr>
<tr>
<td>Serinus 40</td>
<td>NO</td>
<td>NOₓ</td>
<td>NO₂</td>
</tr>
<tr>
<td>Serinus 44</td>
<td>NO</td>
<td>NH₃</td>
<td>NO₂</td>
</tr>
<tr>
<td>Serinus 50</td>
<td>SO₂</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Serinus 51</td>
<td>SO₂</td>
<td>H₂S</td>
<td>N/A</td>
</tr>
<tr>
<td>Serinus 55</td>
<td>H₂S</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Serinus 56</td>
<td>TS</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Serinus 57</td>
<td>TRS</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Serinus 60</td>
<td>NO₂</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Serinus Cal 3000</td>
<td>N/A</td>
<td>O₃</td>
<td>N/A</td>
</tr>
</tbody>
</table>

4.4.1.1 Analog Outputs Voltage Calibration

**Equipment Required**

- Multimeter (set to volts)
- Male 25 pin connector with cable

**Procedure**

1. Open - **Main Menu** → **Communications Menu** → **Analog Output Menu** (refer to Section 3.4.26).
2. Select - **Output Mode** → **Voltage**.
3. Connect a multimeter (using an appropriate adaptor or probes on the multimeter) to the ground (pin 24) and the relevant output pin (pin 10).
4. Edit - **0.5V Calibration** - (until the multimeter reads 0.500 V ±0.002) - Accept.

5. Edit - **5.0V Calibration** - (until the multimeter reads 5.00 V ±0.002) - Accept.

### 4.4.1.2 Analog Outputs Current Calibration

#### Equipment Required

- Multimeter (set to mA)
- Male 25 pin connector with cable

#### Procedure

1. Open - **Main Menu ➔ Communications Menu ➔ Analog Output Menu** (refer to Section 3.4.26).
2. Select - **Output Mode ➔ Current**.
3. Connect a multimeter (using an appropriate adaptor or probes on the multimeter) to the ground (pin 24) and the relevant output pin (pin 10).

4. Edit - **4mA Calibration** - (until the multimeter reads 4 mA ±0.01) - Accept.

5. Edit - **20mA Calibration** - (until the multimeter reads 20 mA ±0.01) - Accept.

### 4.4.2 Analog Inputs

The instrument is also equipped with three analog inputs with resolution of 15 bits plus polarity, accepting a voltage between 0-5 V. These go directly to the microprocessor and should be protected to ensure static/high voltage does damage the main controller PCA (instrument warranty does not cover damage from external inputs).

### 4.4.3 Digital Status Inputs

The instrument is equipped with eight logic level inputs for the external control of the instrument such as Zero or Span sequences. Each input has a terminating resistor which can be either PULL UP or PULL DOWN. This is set using the jumper JP1 on the back panel PCA (refer to Figure 19).

### 4.4.4 Digital Status Outputs

The instrument is equipped with eight open collector outputs which will convey instrument status condition warning alarms such as no flow, sample mode, etc. Two of the digital outputs can be set so that there is +5 V and +12 V available on the 25 pin connector for control purposes, instead of digital outputs 0 and 1.

In the default jumper locations (refer to Figure 19) these two outputs will function normally as open collector outputs. If moved to the position closer to the 25 pin connector then the DO 0 will supply +12 V and DO 1 will supply +5V.

The +12 V and +5 V supplies are limited to about 100 mA each.

Each digital output is limited to a maximum of 400 mA. The total combined currents should not exceed 2 A.
Figure 19 – 25 Pin Rear Panel PCA (Default Jumpers Highlighted)

Figure 20 – External 25 Pin I/O Individual Pin Descriptions

CAUTION
The analog and digital inputs and outputs are rated to CAT I. Exceeding 12 VDC or drawing greater than 400 mA on a single output or a total greater than 2 A across the eight outputs can permanently damage the instrument and void the warranty.
4.5 Logging Data

When the user receives the instrument from the factory it will have a default set of parameters already setup in the internal data logger. These select few parameters have been chosen for their relevance in assisting in troubleshooting the instrument.

4.5.1 Configure Instrument Internal Logging

In order to log data you must first specify a data logging interval. This is how often data will be logged to the USB memory stick. You can log a maximum of 12 parameters. These parameters can be selected by name or by parameter number using the parameter list as a reference (refer to Table 26).

4.5.1.1 Data Log Setup – Numeric

Procedure
1. Open - Main Menu → Communications Menu → Data Logging Menu (refer to Section 3.4.23).
2. Select - Data Log Interval - (adjust to the desired value) - Accept.
3. Open - Data Log Setup – Numeric - (select the parameter numbers you wish to log).
4. Edit - (Change one of the storage locations “Parameter 1-12” to the parameter number you wish to log) - Accept

4.5.1.2 Data Log – Text

Procedure
1. Open - Main Menu → Communications Menu → Data Logging Menu (refer to Section 3.4.23).
2. Select - Data Log Interval - (adjust to the desired value) - Accept.
3. Open - Data Log Setup – Text - (select the names of the parameters you wish to log).
4. Select - (Change one of the storage locations “P1-P12” to the parameter text you wish to log) - Accept.

4.6 Using Airodis Software to Download Data

4.6.1 Connecting the Instrument to Your PC

The instrument can communicate with a PC using RS-232 (Serial), TCP/IP (Network), Bluetooth or USB. Serial, Bluetooth and network communications do not require additional drivers. If you wish to connect using a USB cable, the driver must first be installed.

4.6.1.1 Connecting Over USB

If you wish to connect using USB, you will need to first install the Serinus USB driver.
Power on the instrument and connect it to your PC with a USB cable. You should receive a prompt if the driver needs to be installed. If not, open Device Manager (Under “System” in Control Panel), find the device and select “Update Driver Software”.

![Figure 21 – Installing Driver Software (Device Manager)](image1)

When prompted where to search for the driver, select “Browse my computer for driver software”.

![Figure 22 – Update Driver Popup](image2)

The Serinus USB driver is located on the green Ecotech resources USB stick under “\Drivers\Ecotech Analyser”. Select this directory and click Next.
Figure 23 – Update Driver Popup (Directory Location)
If you receive a confirmation prompt to install the driver, select Install.

Figure 24 – Installing Driver Confirmation Prompt
If everything went smoothly, Windows will inform you that the driver was successfully installed.
4.6.1.2 Connecting Over Serial (RS-232)

The following steps outline how to setup the instrument for connection to a PC or datalogger (refer to Section 3.4.24).

Procedure

2. Determine which RS232 Port you are physically making the connection with. Remember, multidrop is only supported on RS232 #2.
3. Select - Baudrate → 38400 - Accept (Set an appropriate baud rate, default is 38400).

If you are running Airodis in a multidrop configuration, ensure that the Serial ID is unique for each instrument on the chain.

4.6.1.3 Connecting Over Network (TCP/IP)

The following steps outline how to setup the instrument for connection to a PC or datalogger (refer to Section 3.4.29).

Procedure

1. Open - Main Menu → Communication Menu → Network Menu.
2. Select - Protocol → Advanced - Accept.
4. Assign a unique static IP address to the instrument.
5. Reboot the instrument by cycling the power.
4.6.2 Installing Airodis

The user can download data from the instrument using either a full retail (paid) version of Airodis or with the demo version which is included on the green Ecotech resources USB stick. The demo version has limited functionality, but will allow you to download and export data from up to three instruments. If you do not already have Airodis, this can be obtained from Ecotech:

http://www.airodis.com.au

The installer is straightforward: Ensure you install the correct version for your operating system. If you are running 64-bit windows, install the 64-bit (x64) version. Otherwise, install the 32-bit (x86) version.

4.6.3 Configuring Airodis

1. Once installed, double click on the Airodis shortcut on the desktop to start Airodis Workspace Manager. You will be presented with the default workspace options. These will suffice for downloading data from the instrument.

![Figure 26 – Airodis Workspace Manager](image)

2. Start the Client, Server and Download Server by single-clicking the toggle button for each. The client may prompt to register with Ecotech or install an update. Follow the prompts if it does.

3. Once the Client application has loaded, click **Home** → **Add Station** → **New Physical Station**.
4. This automatically brings you to the **Station** tab on the ribbon. Enter the communication details to connect to the instrument.

**Figure 28 – New Station Connection**

**Table 6 – New Station Setup**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station Name</td>
<td>The name of the station. If you have other loggers, the name is used to distinguish them.</td>
</tr>
<tr>
<td>Logger</td>
<td>Set this to “Ecotech Serinus” when downloading from any Serinus series instrument. This will communicate with the instrument via the <strong>Advanced</strong> protocol. If using a network or serial connection, ensure that the Advanced protocol has also been selected on the instrument itself.</td>
</tr>
<tr>
<td>Time Zone</td>
<td>Set this to the time zone that the instrument is located in.</td>
</tr>
<tr>
<td>DST</td>
<td>Enable this option if you plan on changing the clock on the instrument with daylight savings. Leave this disabled if the clock does not shift during DST. The instrument will need to be adjusted manually for DST – it will not happen automatically.</td>
</tr>
<tr>
<td>Database Name</td>
<td>This is the name to be used for the table in the SQL database containing this station’s data. It must be unique for each station.</td>
</tr>
<tr>
<td>Device ID</td>
<td>Enter the Serial ID of the instrument. If you are not using multidrop; this can be set to “0” or left blank.</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Link Type</td>
<td>Select the type of connection used to connect to the instrument. Different properties will appear depending on the link type selected. Align these settings with those of the instrument.</td>
</tr>
<tr>
<td>Log Interval</td>
<td>This needs to be the same as the <strong>Data Log Interval</strong> setting on the instrument.</td>
</tr>
</tbody>
</table>

**Note:** The available fields for communication parameters will change when you change the link type. You will need to set the communication parameters that have been defined on the instrument.

5. Once the station has been created, save the station by clicking the Save shortcut icon or **File ➔ Save.**

6. Click Acquire Configuration. This will probe the instrument for a channel list. After a few seconds, the channel list should be visible in the **Channels** tab.

![Figure 29 – Station Configuration (Channel List)](image)

**Note:** If there was an error connecting to the instrument, a red dot will appear next to the station name in the station list (on the far left hand side). Hovering over the red dot will present you with an error message (refer to Figure 30).

![Figure 30 – Error Status Notification](image)
7. Select the Data Manager tab, click download. The Download Data window will appear. Select the appropriate time period that you wish to download and click Download.

![Figure 31 – Downloading Data](image)

8. The status of the download will appear in the bottom-left corner of the window. You can also monitor the status of the download from the Home tab.

![Figure 32 – Download Data Status](image)

9. Data will become available in the data manager as it is downloaded. You can load data for a date range by entering the start and end dates and clicking Display. The selected data will be loaded into the data manager.
10. Data can be exported by clicking the Export function. This will allow you to save your data in CSV format, which can be loaded into another program such as Microsoft Excel. It is also possible to copy/paste (Ctrl + C / Ctrl + V) data directly from the Airodis data manager.

11. That’s it! The data has been downloaded from the instrument and exported to a standard CSV file.
The Serinus Remote Application allows for any Android device (Tablet or Smartphone) to connect to an instrument.

The Serinus Remote Application allows the user to:

- Completely control the instrument using a remote screen displayed on the device.
- Download logged data and take snapshots of all the instrument parameters.
- Construct graphs from logged data or real time measurements.

The following sections cover installation, connection and use of the application.

### 4.7.1 Installation

The Serinus Remote Application can be found in the Google Play Store by searching for Ecotech or Serinus. Once found, choose to **Install** the application and **Open** to start the application.
4.7.2 Connecting to the Instrument

Procedure

1. Open - Main Menu ➔ Communications Menu ➔ Bluetooth Menu (to find the Bluetooth ID and PIN) (refer to Section 3.4.30).

2. Touch the Scan Serinus Analysers button at the bottom of the screen.

3. Select the Analyser ID from either the Paired Devices or the Other Available.

4. Input the PIN (if prompted) and press OK (refer to Section 3.4.30).

5. A screen shot of the instrument’s current screen should appear on your Smartphone or tablet. To disconnect press the back key/button on the device.
Note: Once the instrument has been paired with the device it will appear under “Paired Devices” and the PIN will not need to be entered again. Only one Bluetooth connection can be made to an instrument at any one time.

4.7.3 Instrument Control

Once connected the user has full control of the instrument. The range for remote control depends on the device’s Bluetooth capabilities and any intervening obstructions, but is usually up to 30 meters.

Remote Screen Operation

With the exception of the number pad, all button functions/actions can be performed by touching the screen. This includes the selection buttons and the scroll buttons. Touching any part of the screen where there is not already a button also enacts the functions of the scroll buttons.

Home Screen

Touching the upper half of the screen increases the contrast and touching the lower half of the screen decreases contrast on the real instrument.

Menus

Touching the upper or lower half of the screen allows the user to scroll up and down respectively.

Right-hand Section of the Screen

Swiping from right to left brings up the number pad for entering numbers (swipe from left to right to hide the number pad).

![Figure 38 – Showing or Hiding the NumPad](image)

Left-hand Section of the Screen

Swiping from left to right brings up a list of available analysers (swipe from right to left to hide the instrument list).
Back Button

This button will enable the user to return to the selection screen, allowing connection to a different instrument.

Options Menu

The Options Menu is accessed by the grey button in the top right corner of the screen or pressing the Menu Button, depending on your Android device.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refresh</td>
<td>Refresh the display.</td>
</tr>
<tr>
<td>Show/Hide NumPad</td>
<td>Show or hide the number pad.</td>
</tr>
<tr>
<td>Real Time Plot</td>
<td>Refer to Section 4.7.4.</td>
</tr>
<tr>
<td>Download</td>
<td>Refer to Section 4.7.5.</td>
</tr>
<tr>
<td>Get Parameters</td>
<td>Refer to Section 4.7.6.</td>
</tr>
<tr>
<td>Preferences</td>
<td>Refer to Section 4.7.7.</td>
</tr>
</tbody>
</table>

4.7.4 Real-Time Plot

Allows the user to view real-time plotting of up to four parameters at the same time. The user can also scroll from left to right, top to bottom or zoom in and out on the plot by swiping/pinching.

Once the plot is zoomed or scrolled, it enters into Observer Mode, meaning that auto-scaling is suspended. Press at the top of the screen (where it says Observer Mode) to return to Normal Mode.
Figure 40 – Real-Time Plot

Options Menu

The Options Menu is accessed by the grey button in the top right corner of the screen or pressing the menu button, depending on the Android device.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>Restarts graphing if it has been stopped and returns the graph to <strong>Normal Mode</strong>.</td>
</tr>
<tr>
<td>Stop</td>
<td>Stops collecting data. In this mode you can scroll the display without going into <strong>Observer Mode</strong>, because the system has no data collection to suspend. It is necessary to “Stop” data collection to set the interval.</td>
</tr>
<tr>
<td>Clear</td>
<td>Clears the window and restarts the graphing.</td>
</tr>
<tr>
<td>Save</td>
<td>Saves an image of the graph and accompanying data in the location specified in preferences (refer to Section 4.7.7). The user will also be asked whether they want to send the file and data via email. When saving the data, you can choose to <strong>Save All Data</strong> or <strong>Customise</strong> the length of the data by entering a time between five minutes and six hours. Only the data from the start of collection to that limit will be saved (although the plot will still appear exactly as it does on the screen).</td>
</tr>
<tr>
<td>Set Interval</td>
<td>While data collection is stopped, the user can specify the time intervals between collections.</td>
</tr>
</tbody>
</table>

**4.7.5 Download**

Download logged data from the USB memory stick inside the instrument. All data logged by the instrument to the USB memory stick over the period of time specified will be collected. Due to the slow connection speed of Bluetooth, this should only be used for relatively short sections of data. Downloading one days’ worth of one minute data is likely to take a couple of minutes.

**Options Menu**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Save</td>
<td>Generates a filename based on the start and end date/time specified. It saves the downloaded data in the location specified in preferences and asks to send the saved comma separated text file (.csv) as an attachment to an email. This file format does not include the parameter headings, just the values.</td>
</tr>
</tbody>
</table>
### Send E-Mail
Sends an email with the parameter data in the body of the email, formatted as displayed (this includes the parameter name and the values).

### Plot
Graphs the data that has been downloaded. The user is prompted to select which parameters to plot based on the parameters that were being logged (refer to Figure 41).

### Preferences
Refer to Section 4.7.7.

---

**Figure 41 – Plot of Downloaded Data**

#### 4.7.6 Get Parameters

Download a list of parameters and corresponding values directly from the instrument. This list of parameters is a snap shot of the current instrument state and is very helpful in diagnosing any problems with the instrument.

### Options Menu

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get Parameters</td>
<td>Refreshes the parameter list display.</td>
</tr>
<tr>
<td>Save</td>
<td>Generates a filename from the current date and time, saves the parameter data in the location specified in preferences and asks to send the saved text file as an attachment to an email.</td>
</tr>
<tr>
<td>Send E-Mail</td>
<td>Sends an email with the parameter data in the body of the email, formatted as displayed.</td>
</tr>
<tr>
<td>Preferences</td>
<td>Refer to Section 4.7.7.</td>
</tr>
</tbody>
</table>
4.7.7 Preferences

The Preferences Menu allows the user to adjust the directory settings, logged data format and the colour scheme settings. It can be accessed through the Options Menu in most windows.

Directory Settings

The operator can specify/select where to save the parameter lists, logged data and real time plots.

Figure 42 – Directory Settings

Logs Format

When downloading logged data, the parameters can be displayed on one line or each parameter on a separate line.

Figure 43 – Logs Format
Colour Theme Settings

Allows the user to choose a colour scheme for the remote screen: Matrix, Classic, Emacs or Custom.

Figure 44 – Colour Theme Settings
5. Calibration

The following sections describe how to calibrate the span and zero points of the instrument as well as giving a brief overview of the calibration system.

Main Menu → Calibration Menu (refer to Section 3.4.10 for information on menu items).

5.1 Overview

Figure 45 – Example of a Calibration System

CAUTION

All calibration gases must be supplied at ambient pressure to avoid damaging the instrument. If direct gas cylinder connection is required, high pressure Span/Zero options can be installed at time of ordering.

The calibration chapter consists of:

- General discussion of calibration.
- Description of the pressure calibration procedure.
- Description of the Zero/Span precision check and calibration procedures.
- Description of the multipoint precision check procedure.
The Serinus 30 analyser is a precision measuring device which must be calibrated against a known source of CO (e.g. a certified gas cylinder).

There are several different types of checks/calibrations performed:

- **Level 1 Calibration** – A simplified two-point instrument calibration used when instrument linearity does not need to be checked or verified. This check is typically performed on a monthly basis. Adjustments to the instrument response can only be made when performing level 1 calibration.
- **Level 2 Calibration** – A simple check of the instrument’s response. Level 2 checks may be performed using non-certified reference sources and are most often used as a performance monitoring tool. The instrument may not be adjusted.
- **Multipoint precision check** – A series of calibration points, typically covering zero and 5 up-scale points, measured using a certified reference atmosphere and covering the instruments FS measurement range. These precision checks are used to determine the linearity of the instrument response across its measurement range.

In general terms, the calibration process includes the following steps:

1. Establish a reliable and stable calibration source.
2. Provide a satisfactory connection between the calibration source and the instrument.
3. Calibrate the instrument against the calibration source.

Multipoint precision check is used to establish the relationship between instrument response and pollutant concentration over the instrument's full scale range. Zero and span calibrations are frequently used to provide a two-point calibration or an indication of instrument stability and function.

**Note:** Zero calibrations are not recommended by Ecotech, but may be performed when specifically required by a user. Zero calibrations tend to mask issues that should be addressed during maintenance/service.

Regulations generally require that the instrument be span calibrated any time:

- The instrument is moved.
- The instrument is serviced.
- When changing the instruments units between volumetric and gravimetric.
- Whenever the instrument characteristics may have changed.

Regulatory agencies establish the time intervals at which the instrument must be calibrated to ensure satisfactory data for their purposes.

**Note:** Use of the Serinus 30 analyser as a U.S. EPA or EN-designated equivalent method requires periodic multipoint precision checks in accordance with the procedure described below. In addition, the instrument must be set to the parameters indicated in U.S. EPA (refer to Section 2.4) or EN Equivalent Set-up (refer to Section 2.5).
5.2 Pressure Calibration

The pressure sensors are a vital component of the instrument operation. The pressure calibration should be checked on installation or whenever maintenance is performed.

A thorough leak check must be performed prior to performing a pressure calibration (refer to Section 6.4.4).

The pressure calibration can either be a two point calibration (one point under vacuum and the other at ambient pressure) or a single ambient point calibration (when very minor adjustments are required).

Note: Ensure that the instrument has been running for at least one hour before any calibration is performed to ensure the instrument’s stability. When performing a two point pressure calibration, it is advisable to perform the vacuum pressure calibration first.

5.2.1 Full Pressure Calibration

This section outlines how to perform a full pressure calibration. Using the required equipment follow the steps below to complete a full pressure calibration.

Note: Ensure that the instrument has been running for at least one hour before the calibration is performed.

Note: Ensure units of measure are the same on both the barometer and instrument.

Equipment Required

- Barometer
- Vacuum source

Procedure

1. Turn off the vacuum source and allow the instrument to return to ambient pressure.
2. Disconnect any external tubing connected to the rear of the instrument.
3. Open - Main Menu → Calibration Menu → Pressure Calibration Menu - (read note) - OK.

Note: This action will place the valve sequencing on hold; normal sampling will be interrupted.

4. Edit - Vacuum Set Pt. - (Read displayed instructions) - OK.
5. Connect a barometer to the Sample Port (refer to Figure 6).
6. Connect a vacuum source to Exhaust Port (refer to Figure 6) of instrument.
7. Wait 2-5 minutes and ensure the pressure reading on the barometer has dropped and is stable.
8. Enter the barometer reading into the instrument - Accept.
9. Read displayed instructions - OK.
10. Turn off the vacuum source and wait 1 min or until the barometer reads ambient. Disconnect the vacuum source and barometer from Exhaust Port and Sample Port.

11. Wait 2-5 min, enter the ambient barometer reading into the instrument - Accept.

**Note:** Both cell and ambient pressure sensors should now be displaying the current ambient pressure and they should be the same value within 3 torr of each other.

12. Back - Pressure Calibration Menu - (read note) - OK.

### 5.2.2 Ambient Point Pressure Calibration

Full pressure calibrations are generally recommended, however it is possible to calibrate only the ambient point in cases where only a minor ambient pressure adjustment is required.

**Note:** Ensure that the instrument has been running for at least one hour before any calibration is performed to ensure the instrument’s stability.

**Note:** Ensure units of measure are the same on both the barometer and instrument.

### Equipment Required

- Barometer

### Procedure

1. Turn off the vacuum source and allow the instrument to return to ambient pressure.
2. Disconnect any external tubing connected to the rear of the instrument.
3. Open - Main Menu ➔ Calibration Menu ➔ Pressure Calibration Menu - (read note) - OK.

**Note:** This action will place the valve sequence on hold; normal sampling will be interrupted.

4. Edit - Ambient Set Pt. - (Read displayed instructions) - OK.
5. Disconnect any external tubing connected to the rear ports of the instrument (Sample Port, Exhaust Port, etc).
6. Wait 2-5 minutes and enter the ambient barometer reading into the instrument - Accept.

**Note:** Both cell and ambient pressure sensors should now be displaying the current ambient pressure and they should be the same value within 3 torr of each other.

7. Back - Pressure Calibration Menu - (read note) - OK.
5.3 Pressure Calibration (Internal Pump Option Only)

The internal pump requires a separate pressure calibration procedure that replaces the one used in Section 5.2.

**Note:** Ensure that the instrument has been running for at least one hour before any calibration is performed to ensure sufficient stability.

**Note:** Ensure units of measure are the same on both the barometer and instrument.

**Equipment Required**

- Barometer

**Procedure**

1. Disconnect any external tubing connected to the rear of the instrument.
2. Open **Main Menu ➔ Calibration Menu ➔ Pressure Calibration** - (read displayed note) - OK.

**Note:** Entering this menu will switch off the internal pump and place the valve sequencing on hold; normal sampling will be interrupted.

3. Connect a barometer to the **Sample Port** (refer to Figure 6).
4. Edit **Vacuum Set Point** - (read note) - OK.
5. Wait 2-5 minutes and ensure the pressure reading on the barometer is stable.
6. Enter the barometer reading into the instrument - Accept.
7. Read displayed instructions - OK.
8. The pump should now stop automatically. Disconnect the barometer from the **Sample Port**.
9. Wait 2-5 minutes and enter the ambient barometer reading into the instrument - Accept.

**Note:** Both cell and ambient pressure sensors should now be displaying the current ambient pressure and they should be the same value within 3 torr of each other.

10. Back **Pressure Calibration Menu** - (read note) - OK.

5.4 Manual Background

A background is a measurement that is made when CO free air is drawn through the reaction cell. The resulting measurement signal (background) will include signals unrelated to CO. The background is an electronic baseline, it is normally run every 24 hours automatically. There is sometimes a need for the user to run a manual background.

**Note:** A manual background is recommended before commencing a multipoint precision check.
Equipment Required

- N/A

Procedure

1. Open - Main Menu → Calibration Menu.
3. Manual background will now display running and will proceed to draw air from the CO-CO2 converter for 4 minutes (3 minutes of fill time and 1 minute of measure). The user can press stop at any time to cancel the background. At the end of the 4 minute period a new background voltage will be recorded in the event log as well as in the Calculation Factors Menu.

5.5 Zero Calibration

Zero calibrations are used to determine the zero response of the instrument and apply an offset to the reading.

Performing a zero calibration will adjust the Zero Offset CO. This offset can be checked in the Main Menu → Service Menu → Calculation Factors Menu and should be very close to zero. A large offset may indicate a problem with the instrument (refer to Section 7).

Note: Ecotech encourages regular zero precision checks; however Ecotech recommends that the zero calibration only be performed when specifically required as it may mask issues that should be addressed during maintenance/service.

A zero calibration can be performed either through the Calibration Port, Background Air Port or the Sample Port. Refer to the instructions outlined in the next three sections:

Note: Ensure the instrument has been running for at least one hour before any calibration is performed to ensure sufficient stability.

5.5.1 Calibration Port

Equipment Required

- Zero source

Procedure

1. Ensure a suitable zero source is connected to the Calibration port.
2. Open - Main Menu → Calibration Menu.
6. Allow the instrument time to achieve a stable response.
7. Enter - **Zero Calibrate CO** - OK.
8. Select - **Cal. Mode → Measure** - Accept (To return to sample measure).

### 5.5.2 Sample Port

**Equipment Required**
- Zero source

**Procedure**
1. Ensure a suitable zero source is connected to the **Sample Port**.
2. Open - **Main Menu → Calibration Menu**.
5. Select - **Cal. Mode → Measure** - Accept.
6. Allow the instrument time to achieve a stable response.
7. Enter - **Zero Calibrate CO** - OK.
8. Disconnect the zero source and reconnect the sample line to the **Sample Port**.

### 5.5.3 Background Air Port

**Equipment Required**
- N/A

**Procedure**
1. Open - **Main Menu → Calibration Menu**.
2. Select - **Cal. Type → Manual** - Accept.
5. Allow the instrument time to achieve a stable response.
6. Enter - **Zero Calibrate CO** - OK.
7. Select - **Cal. Mode → Measure** - Accept (To return to sample measure).

### 5.6 Span Calibration

A span calibration is a calibration performed at the upper end of the instrument’s measurement range. Ecotech recommends calibration at 80% of the full scale measurement or operating range of the instrument.

While the instrument range is commonly set as a default 0-50 ppm, this is widely recognised as no longer being valid with modern digital communication and most regulators will now recommend a range more suited to local conditions.
A span gas can be supplied through either the **Calibration Port** or **Sample Port**. Refer to the instructions outlined in the next two sections.

**Note:** Ensure that the instrument has been running for at least one hour before any calibration is performed to ensure sufficient stability.

### 5.6.1 Calibration Port

**Equipment Required**
- Span source

**Procedure**
1. Ensure a suitable span source is connected to the **Calibration Port**.
2. If diluting the gas with a dilution calibrator, set the output concentration to 80 % of the instrument measurement range.
3. Open - **Main Menu → Calibration Menu**.
5. Select - **Cal. Mode → Span** - Accept.
6. Let the instrument stabilise, typically 15 minutes.
7. Enter - **Span Calibrate CO** - (Enter the span output concentration) - Accept.
8. Select - **Cal. Mode → Measure** - Accept (To return to sample measure).

### 5.6.2 Sample Port

**Equipment Required**
- Span source

**Procedure**
1. Ensure suitable span source is connected to the **Sample Port**.
2. If diluting the gas with a dilution calibrator, set the output concentration to 80 % of the instrument measurement range.
3. Open - **Main Menu → Calibration Menu**.
5. Select - **Cal. Mode → Measure** - Accept.
6. Let the instrument stabilise, typically 15 minutes.
7. Enter - **Span Calibrate CO** - (Enter the span output concentration) - Accept.
8. Disconnect the span source and reconnect the sample line to the **Sample Port**.
5.6.3 Manual Instrument Gain and Offset Adjustments

**CAUTION**

Manual adjustment of the Instrument Gain does not take into account the PTF correction and can lead to an incorrect calibration.

At times it may be desirable to manually adjust the instrument’s gain and offset. Typically this option is only used when an instrument calibration has been corrupted and the user wishes to reset the instrument response factors prior to performing a new calibration.

To manually adjust the instrument follow the below procedure:

1. Open Main Menu → Service Menu → Calculation Factors Menu.
2. Edit Instrument Gain - (Adjust as required. 1 is the default) - Accept.
3. Edit Zero Offset CO - (Adjust as required. 0 is the default) - Accept.

5.7 Precision Check

Similar to a normal zero or span calibration, a precision check is a Level 2 calibration that may be performed using a non-certified reference. The instrument is supplied with a known concentration of span gas (or zero air) and the instrument’s response observed. However, no adjustment to the instrument response is made during a precision check.

**Note:** Ensure that the instrument has been running for at least one hour before any calibration is performed to ensure sufficient stability.

**Equipment Required**

- Span source
- Zero source

**Procedure**

1. Supply the instrument with a zero source (refer to Section 5.5 for the procedure of setting up a zero, but do not do a Zero Calibrate CO).
2. Observe and record the measurement from the instrument.
3. Supply the instrument with a span source (refer to Section 5.6 for the procedure of setting up a span but do not do a Span Calibrate CO).
4. Observe and record the measurement from the instrument.
5. Check both readings against your local applicable standards.

If an instrument fails a span precision check (based on the users local applicable standards), perform a span calibration (refer to Section 5.6).

If an instrument fails a zero precision check (based on the users local applicable standards), resolve the issue by referring to Section 6 (Service).
5.8 Multipoint Precision Check

A multipoint precision check is used to determine the linear response of the instrument across its operating range. The instrument is supplied with span gas at multiple known concentrations, typically a zero point and at least five up-scale points, spread across the operating range of the instrument. The observed concentrations are compared to expected values and the linearity of the instrument assessed against local applicable standards.

Note: The instrument is inherently linear and the instrument gain should not be adjusted at each individual point. Non-linearity indicates a problem with the instrument (refer to Section 7). Ensure that the instrument has been running for at least one hour before any calibration is performed to ensure sufficient stability.

Several methods for producing multiple known concentrations are available to use, such as connecting multiple certified gas cylinders at different concentrations. However, Ecotech strongly recommends the use of a dilution calibrator and a certified cylinder of CO at an appropriate concentration.

1. Connect your calibration system to the Calibration Port of the instrument (Ecotech recommends the Serinus Cal 1000 as a minimum, refer to Figure 45).

2. Generate and record the displayed span concentrations for (at least) six stepped points (of known concentrations) evenly spaced across the instruments measurement range (refer to the example below).

3. Then using a program such as MS Excel, create an X Y scatter plot of expected concentration versus the recorded instrument response and use linear regression to calculate the line of best fit and the correlation factor ($R^2$) – refer to the users local applicable standards.

Example for an instrument measurement range of 75 ppm:

a. For the 1st concentration, set the gas dilution calibrator to supply 60 ppm CO gas to the instrument.

b. Allow the instrument to sample the calibration gas until a prolonged stable response is achieved (the amount of time this takes is impacted by the calibration setup). Record the instrument response.

c. Repeat the above steps using concentrations of 50 ppm, 30 ppm, 20 ppm, 10 ppm and a Zero point.

Note: To highlight hysteresis errors, it is advisable to run the multipoint check in both descending and ascending order - refer to your applicable local standards.

d. Graph the results and use linear regression to determine a pass or fail as per your applicable local standards.

4. The linear regression equation will be displayed.

$$ y = mx + c $$
5. The following is a guide to approximate expected good results.
   a. The gradient (m) falls between 0.98 and 1.02.
   b. The intercept (b) lies between -2 and +2.
   c. The correlation ($R^2$) is greater than 0.99.

6. If unsatisfactory results are observed refer to Section 7.

5.9 Flow Calibration (Internal Pump Option Only)

This procedure calibrates the rate of the flow generated by the internal pump. The following procedure must be performed if the instrument:

- After a service or repair.
- When the external flow check has found the flow to be outside normal range.
- When a new pump has been installed.
- When the instrument is reset to factory defaults.

**Equipment Required**

- Calibrated Flow Meter

**Procedure**

1. Disconnect any external tubing connected to the rear ports of the instrument (Sample Port, Exhaust Port, etc.).
3. Off - **Internal Pump** → Off.
4. Wait for the **Sample Flow** to become stable around 0 (±0.01 slpm).
5. Set - **Cal. Zero** - Yes (Calibration of your zero point).
6. Connect a calibrated flow meter to the Sample Port.
7. On - **Internal Pump** → On.
8. Edit the **Coarse** and **Fine** pots until the flow meter reads the desired instrument **Sample Flow** rate (Set Point).

**Note:** Adjust the **Fine** pot to 253, adjust the **Coarse** to be as close as possible to desired reading and use **Fine** pot to make it exact.

9. Edit - **Cal. Point** - (Enter the reading from the flow meter) - Accept.
10. Select - **Flow Control** → **START** - Accept.
11. Leave for up to five minutes to return to normal operation. If instrument doesn’t return to normal there may be a blockage (refer to Section 7).
12. Remove flow meter and reconnect external tubing.
13. Back - **Flow Calibration Menu** - (Read note) - OK

### 5.10 High Pressure Zero/Span Valve (Option)

If the instrument was ordered with this option, the internal pressurised calibration valves will already be installed within the instrument as either a zero or span calibration source, thus no other internal connections need to be made.

**Note:** Before using a high pressure span or zero as a source for calibrating the instrument, please check the local regulatory requirements. This is generally only be used as an operational check of the instrument’s zero point and single span point (recommended as 80 % of full scale).
5.10.1 Single Pressurised Calibration Option

Set-Up of Single Calibration Option

![Diagram of Serinus High Pressure Calibration Option - 1 Valve]

*Figure 47 – Single High Pressure Calibration Option*

When using the pressurised calibration option, either a high pressure zero or span cylinder (depending on the option you have ordered) should be connected to the **Aux In Port**.

**Equipment Required**

- Calibrated Flow Meter
- Gas Cylinder

**Procedure**

1. Ensure the gas cylinder is fitted with an appropriate gas regulator with a shut off valve.
2. Connect a \(\frac{3}{4}\)“ line of stainless steel tubing between the gas cylinder and the instrument’s **Aux In Port**.

| Note: This connection may need to be retightened during this operation. |

3. Open the cylinder main valve and adjust the regulator to 15 psig.
4. Open the regulator’s shutoff valve and test for leaks:
   a. Pressurise the line.
   b. Close the cylinder main valve.
   c. If pressure drops by more than 2 PSI over five minutes, check the connections and retest.
d. Open cylinder main valve.

5. Temporarily place a flow meter on the Calibration Port (This port is now used as the high pressure calibration vent).


8. Select - Cal. Mode → Span or Zero - Accept (Depending on the option installed).

**Note:** When using the high pressure zero option, ensure Zero Source is set to External.

9. Adjust the regulator pressure until the flow meter on the vent line (Calibration Port) is between 0.5 and 1 slpm. This flow rate is your excess calibration gas.

**Note:** Do not exceed a pressure of 2 bars, this can damage the instrument and cause gas leakage.

**Return to Normal Operation**

1. Select - Cal. Mode → Measure - Accept. (To return to sample measure).

2. Remove the flow meter on the Calibration Port and connect a vent line.

3. Reconnect the instrument fittings and return to the original set-up.

The instrument is now in normal operation mode. When either zero or span calibration is initiated (depending on which option has been installed) the instrument will automatically open the valves to run a pressurised calibration.
5.10.2 Dual Pressurised Calibration Option

Set-Up of Dual Calibration Option

![Diagram of Dual High Pressure Calibration Option - 2 Valves](image)

**Figure 48 – Dual High Pressure Calibration Option**

When using the dual pressurised calibration option, a high pressure zero cylinder should be connected to the **Aux In** port and a high pressure span cylinder connected to the **Calibration** port.

**Equipment Required**

- Calibrated Flow Meter
- Gas Cylinder of Zero air
- Gas Cylinder of CO

**Procedure**

1. Ensure the gas cylinder is fitted with an appropriate gas regulator with a shut off valve.
2. Connect a ¼” line of stainless steel tubing between the appropriate gas cylinders and the instrument’s **Aux In Port** and **Calibration Port**.

**Note:** This connection may need to be retightened during this operation.

3. Open the cylinder main valve and adjust the regulator to 15 psig.
4. Open the regulator’s shutoff valve and test for leaks:
   a. Pressurise the line.
   b. Close the cylinder main valve.
   c. If pressure drops by more than 2 PSI over five minutes, check the connections and retest.
   d. Open cylinder main valve.
5. Temporarily place a flow meter on the **Aux Out Port** (This port is now used as the high pressure calibration vent for both span and zero).

6. Open - **Main Menu → Calibration Menu**.

7. Select - **Cal. Type → Manual** - Accept.


   **Note:** When using the high pressure zero option, ensure **Zero Source** is set to **External**.

9. Adjust the regulator pressure until the flow meter on the vent line (**Aux Out**) is between 0.5 and 1 slpm. This flow rate is your excess calibration gas.

   **Note:** Do not exceed a pressure of two bars, this can damage the instrument and cause gas leakage.

10. Select - **Cal. Mode → Span** - Accept.

11. Adjust the regulator pressure until the flow meter on the vent line (**Aux Out**) is between 0.5 and 1 slpm. This flow rate is your excess calibration gas.

   **Note:** Do not exceed a pressure of two bars, this can damage the instrument and cause gas leakage.

**Return to Normal Operation**

1. Select - **Cal. Mode → Measure** - Accept. (To return to sample measure).

2. Remove the flow meter on the **Aux Out Port** and connect a vent line.

3. Reconnect the instrument fittings and return to the original set-up.

The instrument is now in normal operation mode. When either zero or span calibration is initiated the instrument will automatically open the valves to run a pressurised calibration.
6. Service

6.1 Additional Safety Requirements for Service Personnel

In addition to Safety Information stated previously, service personnel are also advised of the following:

- Documentation must be consulted in all cases where caution symbol is marked, in order to find out the nature of the potential hazards and any actions which have to be taken to avoid them. Refer to Table 1 – Internationally Recognised Symbols.
- Do not energise the instrument until all conductive cleaning liquids, used on internal components, are dried up.
- Do not replace the detachable mains supply cord with an inadequately rated cord. Any mains supply cord that is used with the instrument must comply with the safety requirements (250V/10A minimum requirement).

6.2 Maintenance Tools

To perform general maintenance on the Serinus 30 the user may require the following equipment:

- Customizable Test Equipment Case PN: H070301
- Digital Multimeter & Leads (DMM) PN: E031081 & E031082
- Barometer PN: E031080
- Thermometer & Probe PN: E031078 & E031079
- Flow Meter (Select Range)
  - Range: 50 sccm to 5000 sccm PN: ZBI-200-220M
  - Range: 300 sccm to 30000 sccm PN: ZBI-200-220H
- Minifit Extraction Tool PN: T030001
- Orifice/Sintered Filter Extraction Tool PN: H010046
- Leak Test Jig PN: H050069
- Computer/Laptop and Connection Cable for Diagnostic Tests
- 1.5 mm Hex Key
- Assortment of 1/4” and 1/8” Tubing and Fittings
- Zero Air Source
- Span Gas Source

Figure 49 – Minifit Extraction Tool – (PN: T030001)
6.3 Maintenance Schedule

The maintenance intervals are determined by compliance standards that differ in various regions. The following is recommended by Ecotech as a guide. Compliance with local regulatory or international standards is the responsibility of the user.
Table 7 – Maintenance schedule

<table>
<thead>
<tr>
<th>Interval *</th>
<th>Task performed</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly</td>
<td>Check inlet particulate filter, replace if full/dirty</td>
<td>6.4.1</td>
</tr>
<tr>
<td></td>
<td>Check sample inlet system for moisture or foreign materials. Clean if necessary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perform precision check</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>Check instrument status light is ok (green)</td>
<td></td>
</tr>
<tr>
<td>Monthly</td>
<td>Perform leak check</td>
<td>6.4.4</td>
</tr>
<tr>
<td></td>
<td>Check fan filter, clean if necessary</td>
<td>6.4.2</td>
</tr>
<tr>
<td></td>
<td>Perform span calibration</td>
<td>5.6</td>
</tr>
<tr>
<td>6 Monthly</td>
<td>Check date and time is correct</td>
<td>3.4.8</td>
</tr>
<tr>
<td></td>
<td>Check the CO-CO₂ converter</td>
<td>6.4.5</td>
</tr>
<tr>
<td></td>
<td>Perform multipoint precision check</td>
<td>5.8</td>
</tr>
<tr>
<td>Yearly</td>
<td>Replace DFU filter</td>
<td>6.4.3</td>
</tr>
<tr>
<td></td>
<td>Replace sintered filter and orifice (only if necessary)</td>
<td>6.4.6</td>
</tr>
<tr>
<td></td>
<td>Trim pot tuning procedure</td>
<td>6.4.7</td>
</tr>
<tr>
<td></td>
<td>Perform pressure check</td>
<td>6.4.9</td>
</tr>
</tbody>
</table>

* Suggested intervals for maintenance procedure are a guide only and may vary with sampling intensity and/or environmental conditions.

6.4 Maintenance Procedures

6.4.1 Particulate Filter Replacement

Contamination of the filter can result in degraded performance of the instrument, including slow response time, erroneous readings, temperature drift and various other problems.

1. Turn off the vacuum source and allow the instrument to return to ambient pressure.
2. Slide open the lid of the instrument to access the particulate filter (located in front right hand corner). Unscrew the filter cap (bright blue) by turning it counter-clockwise.
3. Remove the filter plunger from the casing, place finger on tubing connector and pull to the side (refer to Figure 53).
4. Remove the old filter paper, wipe down the plunger with a damp cloth and insert a new filter.
5. Replace the plunger, screw the cap on and reconnect the pump.
6. Close the instrument and perform a leak check.

6.4.2 Clean Fan Filter

The fan filter is located on the rear of the instrument. If this filter becomes contaminated with dust and dirt it may affect the cooling capacity of the instrument.

1. Remove outer filter casing and filter.
2. Clean filter with water and wring dry or shake vigorously.
3. Reinstall filter and filter casing.

6.4.3 DFU Replacement

1. Turn the instrument off and unplug from the power.
2. Remove the Kynar nut from the end of the DFU by turning it anti-clockwise (looking from the DFU side).
3. Replace the DFU and ensure that the flow is in the correct direction (arrow should point towards the Kynar nut).
4. Tighten the Kynar nut clockwise.
6.4.4 Leak Check

**Equipment Required**

- Vacuum Source (Pump)
- Leak Test Jig (PN: H050069)
- Kynar 1/4” Blocker Nuts
- 5/8” Spanner
- 9/16” Spanner

**Note:** Ensure that the instrument has been running for at least one hour before this procedure is performed.

**Procedure**

1. Turn off the vacuum source and allow the instrument to return to ambient pressure.
2. Disconnect any external tubing connected to the rear of the instrument.
3. Connect the leak check jig to the Exhaust Port of the instrument.
4. Connect a vacuum source to the shut off valve ensuring the shut off valve is in the open position.
5. Block the instrument’s Sample, Calibration and Background Air Ports with Kynar 1/4” blocker plugs.
6. Open - **Main Menu → Service Menu → Diagnostics Menu → Valve Menu.**
7. Disable - **Valve Sequencing → Disabled.**
8. Close - **Sample/Cal → Closed.**
9. Close - **Internal Zero/Cal → Closed.**
10. Close - **Pressurized Zero (OPT) → Closed.**
11. Close - **Pressurized Span (OPT) → Closed.**
12. Close the shut off valve and record the vacuum indicated on the leak test jig. Wait for three minutes and observe the gauge on the leak test jig. It should not drop more than 5 kpa. If it has, a leak is present within the sample cycle of the instrument.
13. Open - **Sample/Cal → Open.**
14. Open the shut off valve and allow the vacuum source to evacuate the pneumatics.
15. Close the shut off valve and record the vacuum indicated on the leak test jig. Wait for three minutes and observe the gauge on the leak test jig. It should not drop more than 5 kpa. If it has, a leak is present within the zero cycle of the instrument.
16. Open - **Internal Zero/Cal → Open.**
17. Open the shut off valve and allow the vacuum source to evacuate the pneumatics.
18. Close the shut off valve and record the vacuum indicated on the leak test jig. Wait for three minutes and observe the gauge on the leak test jig. It should not drop more than 5 kpa. If it has, a leak is present within the span calibration cycle of the instrument.
19. If the instrument did not leak, skip to step 22.
20. Inspect the instrument’s plumbing looking for obvious damage. Check the condition of fittings, particulate filter housing plus the O-rings.
21. When the location of the leak has been determined, repair and re-run the leak check procedure.
22. Inspect the tubing again ensuring the tubing is cleanly connected to the fittings and that the internal Teflon lining has not been kinked or crumpled.
23. Remove the leak check jig and Kynar blocking nuts.
24. Open - **Main Menu → Service Menu → Diagnostics Menu → Valve Menu.**
25. Enable - **Valve Sequencing → Enabled.**
6.4.4.1 Leak Check (Internal pump option)

**Equipment Required**

- Barometer
- Kynar ¼” Blocker Nuts
- 5/8” Spanner
- 9/16” Spanner
- 7/16” Spanner

**Procedure**

**Note:** Ensure that the instrument has been running for at least one hour before this procedure is performed.

1. Disconnect all external tubing connected to the rear ports of the instrument.
2. Open - Main Menu → Service Menu → Diagnostics Menu → Internal Pump Menu.
4. Edit - Coarse - (set to 255) - Accept.
5. Edit - Fine - (set to 255) - Accept.
6. Open - Main Menu → Service Menu → Diagnostics Menu → Valve Menu.
7. Disable - Valve Sequencing → Disabled.
8. Turn Off all the valves.
9. Block the Sample Port with a barometer.
10. Allow the internal pump to time to evacuate the pneumatic system (the time required will depend on the condition of the pump 1 to 2 minutes).
13. Note the value on the barometer. Wait for three minutes, the value should not drop more than 5 kpa (37.5 torr). If the leak check passed skip to step 16.
14. Inspect the instrument’s plumbing looking for obvious damage. Check the condition of fittings, particulate filter housing plus the O-rings.
15. If the leak is still present divide up the pneumatic system into discrete sections to locate the leak (refer to Section 9.5). When the location of the leak has been determined repair and then rerun the leak check procedure.
16. Remove the barometer from the Sample Port, slowly allow the instrument to return to ambient.
17. Open - Main Menu → Service Menu → Diagnostics Menu → Valve Menu.
18. Enable - Valve Sequencing → Enabled.
6.4.5  CO-CO$_2$ Converter Check

The internal CO-CO$_2$ converter provides a source of continuous CO free air for auto-zero and background functions. Failure of the converter can result in drift, poor sensitivity near zero and continuous electronic zero adjusts.

**Note:** Ensure that the instrument has been running for at least one hour before this procedure is performed.

**Equipment Required**

- Span gas source 40ppm CO
- 5/8” Spanner

**Procedure**

1. Open - Main Menu ➔ Calibration Menu.
5. Allow the instrument to sample Zero air from the CO-CO$_2$ for approximately five minutes.
6. Record the instrument response as the “Initial” value.

**Note:** This value should be 0.00 ±0.1 ppm. If it is not, a background should be initiated by initiating the background field within the calibration menu. The background will take approximately five minutes to complete.

7. Connect 40 ppm CO span source to the Background Air Port ensuring the inlet pressure is maintained at ambient (vented).
8. Allow the instrument to sample the span source for five minutes.
9. Record the instrument response as the “Challenge” value.
10. Disconnect the span source.
15. Compare the initial value and the challenge value. They should agree within ±2 ppm. If not the CO-CO$_2$ converter should be replaced.

6.4.6  Sintered Filter/Orifice Replacement

**Equipment Required**

- Orifice/filter removal tool (PN: H010046)
- 9/16” Spanner
Procedure

1. Remove the Vacuum source from the Exhaust Port.

2. Unscrew the Kynar nut from the fitting (anti-clockwise) on the Measurement Cell (refer to Figure 57).

![Kynar fitting](image)

**Figure 57 – Kynar Fitting Containing Orifice and Sintered Filter**

3. Use the orifice/sintered filter extraction tool to screw into the orifice (clockwise) and gently pull the orifice out of the fitting.

4. Repeat the process again for the sintered filter using the other end of the orifice/sintered filter extraction tool.

5. The orifice can now be cleaned or exchanged as required. The sintered filter is normally replaced.

6. Replace the sintered filter then the orifice back into the fitting with the orifice/filter extraction tool.

7. Replace the Kynar nut back into the Measurement Cell.

8. Perform a leak check (refer to Section 6.4.4).

9. Reconnect the vacuum source to the Exhaust Port.

**6.4.7 Trim Pot Tuning Procedure**

The following must be performed to ensure the Serinus 30 receives an optimal signal after the cell has been aligned. If this procedure is not performed, the Serinus 30 is likely to produce unstable results. If the Input Pot reads less than 180 (refer to Section 3.4.15), this is an indication that this procedure needs to be performed.

**Equipment Required**

- Pot Adjustment tool

**Procedure**

1. Open - Main Menu → Service Menu → Diagnostics Menu.

2. Disable - Control Loop → Disabled.


4. Edit - Input Pot - (Adjust to 200) - Accept.
5. Adjust the trim pot on the detector assembly (refer to Figure 3) such that the **Ref. Voltage** reads 3.80 V ±0.05 V.

6. Back - **Diagnostics Menu**.

7. Enable - **Control Loop → Enabled**.

8. Reset the instrument.

9. Ensure that the Input pot reads 200 ±10 after the instrument is out of warm-up. If not, perform this procedure again.

**6.4.8 Clean Pneumatics**

The **Calibration Valve Manifold** (refer to Figure 3) will require disassembling and cleaning. Ideally the valves and the manifold should be cleaned in a sonic bath with lab detergent and distilled water. Once clean rinse with distilled water and dry with clean dry oil free air before reassembling. A leak test should be performed once the instrument is ready for operation (refer to Section 6.4.4).

**Note:** If the tubing shows signs of significant contamination, it should be replaced with new tubing. Do not clean the **CO-CO2 converter** or the mirrors found within the **Measurement Cell**.

**6.4.9 Pressure Sensor Check**

Pressure checks are needed to ensure that the pressure sensor is accurately measuring pressure inside the instrument.

During normal operation ensure that the pressure and flow menu indicate the following parameters. Ambient should display the current ambient pressure at site. Cell should indicate current cell pressure depending on the pump condition and location. The cell pressure is normally about 20 torr below ambient.

**Equipment Required**

- Barometer
- Digital Multimeter (DMM)

**Procedure**

1. Open - **Main Menu → Analyser State Menu → Pressure & Flow Menu**.

2. Disconnect the exhaust and sample port connections.

3. After two-five minutes observe the pressure readings: ambient and cell. Ensure that they are reading the same ±3 torr (±0.4 kPa).

4. If the readings are outside this level, perform a pressure calibration (refer to Section 5.2).

If the pressure calibration fails, the instrument may have a hardware fault. The cell pressure PCA has test points. To determine the condition of the sensor measure and the voltage on the test points, refer to Figure 58. The voltage measured across the test points is proportional to the pressure measured by the sensor. If the sensor is exposed to ambient pressure at sea level, the voltage will be around 4 volts but if the sensor is under vacuum, the voltage will be low (e.g. 0.5 volts). If the test point measures zero or negative voltage, the assembly is most likely faulty and will need to be replaced.
6.5 Bootloader

The Serinus Bootloader is the initial set of operations that the instruments’ microprocessor performs when first powered up (similar to the BIOS found in a personal computer). This occurs every time the instrument is powered up or during instrument resets. Once the instrument boots up, it will automatically load the instruments’ firmware. A service technician may need to enter the Bootloader to perform advanced microprocessor functions as described below.

To enter the Bootloader turn off the power to the instrument. Press and hold the plus key while turning the power on. Hold the Plus key until the following screen appears.

<table>
<thead>
<tr>
<th>Ecotech Analyser / Calibrator</th>
</tr>
</thead>
<tbody>
<tr>
<td>V3.0 Bootloader</td>
</tr>
<tr>
<td>Press ‘1’ to enter Bootloader</td>
</tr>
</tbody>
</table>

If the instrument displays the normal start up screen, the power will need to be toggled and another attempt will need to be made to enter the Bootloader. Once successful, press 1 to enter the Bootloader Menu.

6.5.1 Display Help Screen

Once in the Bootloader screen it is possible to redisplay the help screen by pressing 1 on the keypad.

6.5.2 Communications Port Test

This test is very useful for fault finding communication issues. It allows a communication test to be carried out independent to any user settings or firmware revisions.
This command forces the following communication ports to output a string of characters: Serial Port RS232 #1, USB rear and Ethernet Port. The default baud rate is 38400 for the RS232 Serial Port. To initiate the test press the number 2 key from the Bootloader screen.

6.5.3 Updating Firmware

It is important for optimal performance of the instrument that the latest firmware is loaded. The latest firmware can be obtained by visiting Ecotech’s website:

http://www.ecotech.com/downloads/firmware

Or by emailing Ecotech at service@ecotech.com or support@ecotech.com

To update the firmware from a USB memory stick, use the following procedure:

USB Memory Stick Update

1. Turn the instrument off.
2. Place the USB memory stick with the new firmware (ensure that firmware is placed in a folder called FIRMWARE) in the front panel USB Port.
3. Enter the Bootloader (refer to Section 6.5).
4. Select option 3 (upgrade from USB memory stick), press 3 on the keypad.
5. Wait until the upgrade has completed.
6. Press 9 on the keypad to start the instrument with the new firmware.

6.5.4 Erase All Settings

This command is only required if the instruments firmware has become unstable due to corrupted settings. To execute this command enter the Bootloader Menu (refer to Section 6.5) and press 4 on the keypad.

6.5.5 Start Analyser

The start analyser command will simply initiate a firmware load by pressing 9 on the keypad from the Bootloader Menu. It is generally used after a firmware upgrade.
7. Troubleshooting

Before troubleshooting any specific issues, Ecotech recommends ensuring the instrument has successfully completed its warm-up routine and resolving all issues listed in the instrument status menu (refer to Section 3.4.4).

Table 8 – Troubleshoot List

<table>
<thead>
<tr>
<th>Error Message/Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow fault</td>
<td>Multiple possibilities</td>
<td>Refer to Section 7.1.</td>
</tr>
<tr>
<td>Pump failed</td>
<td></td>
<td>Replace the internal or external pump.</td>
</tr>
<tr>
<td>Blocked filter or orifice -</td>
<td></td>
<td>Replace sintered filter and orifice.</td>
</tr>
<tr>
<td>only installed in external</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pump optioned instrument.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressurised measurement cell</td>
<td></td>
<td>Ensure sample and zero inlets are maintained at ambient pressure (vented to atmosphere)</td>
</tr>
<tr>
<td>Pressure sensors</td>
<td></td>
<td>Recalibrate or replace the pressure sensors.</td>
</tr>
<tr>
<td>Noisy/unstable readings</td>
<td>Multiple possibilities</td>
<td>Refer to Section 7.2.</td>
</tr>
<tr>
<td>Calibration system error</td>
<td></td>
<td>Ensure calibration system is functioning correctly and is leak free.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ensure sufficient gas is available for instrument and an adequate vent is available for excess gas.</td>
</tr>
<tr>
<td>Leaks</td>
<td></td>
<td>A leak in the instrument or calibration system dilutes the sample stream and causes low span readings and noise.</td>
</tr>
<tr>
<td>Temperature unstable</td>
<td>A failed temperature control allows the instrument to drift with ambient temperature. Verify that both the cell and mirror temperatures are 50 °C ± 3 °C.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chassis lid not in place causing instrument to drift with ambient temperature.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chassis temperature drifting with ambient temperature fluctuations. Stabilise ambient temperature and remove instrument from direct ambient heating or cooling.</td>
<td></td>
</tr>
<tr>
<td>Hardware fault</td>
<td>Measurement cell internal hardware loose. Mirrors have detached or degraded.</td>
<td></td>
</tr>
<tr>
<td>Commissioning error</td>
<td>Measurement cell travel screws are still fastened (refer to Section 2.3.4).</td>
<td></td>
</tr>
<tr>
<td>Error Message/Problem</td>
<td>Cause</td>
<td>Solution</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------</td>
<td>----------</td>
</tr>
</tbody>
</table>
| Gain too high         |       | - Leak check, repair any leaks. (refer to Section 6.4.4)  
|                       |       | - Measurement cell internal hardware loose – return to nearest service centre.  
|                       |       | - Mirrors have detached or degraded – return to nearest service centre.  
|                       |       | - Correlation wheel has leaked replace correlation wheel.  |
| Cell temperature failure | Faulty heater or temperature sensor | Refer to Section 7.3. |
| Mirror temperature failure | Faulty heater or temperature sensor | Refer to Section 7.4. |
| Instrument resetting  | Multiple possibilities | - Check that the instrument is not overheating.  
|                       |       | - Possibly a faulty power supply.  
|                       |       | - Corrupted firmware. Perform an ‘erase all settings’ in the **Bootloader Menu** and reload or upgrade firmware (refer to Section 6.5.4).  |
| 12 Voltage supply failure | Power supply has failed | Replace power supply. |
| No display            | Contrast adjustment required | Adjust the display contrast by pressing either of the two scrolling buttons on the front panel:  
|                       |       | - Press Up scrolling button (↑) for darker contrast.  
|                       |       | - Press Down scrolling button (↓) for lighter contrast.  |
| DC power              | Verify that the power supply is providing ±12 V, +5 V DC. TP40, TP23 and TP41. |
| Display               | Check the interface cable between the display and the microprocessor board. |
| Bad display or main controller PCA | Replace the front panel display.  
|                       | Replace the main controller PCA.  
|                       | Bad cables are unlikely, but if suspect it; perform a pin-for-pin continuity test using an ohmmeter. |
| AC power              | Verify that the mains power cable is connected and the rear fan is operating. |
| Sample pressure too high or low | Loss of pressure calibration | - Perform a pressure calibration (refer to section 5.2).  
|                       |       | - Ensure particulate filter has been recently changed.  
|                       |       | - Ensure tubing is not kinked or blocked.  
<p>|                       |       | - Ensure vacuum pump is correctly installed and operating. |</p>
<table>
<thead>
<tr>
<th>Error Message/Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample flow not at 1 slpm</td>
<td>Multiple possibilities</td>
<td>• Check/replace sample filter.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check pump.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check valves.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check/replace sintered filter.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Re-calibrate pressure sensors.</td>
</tr>
<tr>
<td>Unstable flow or pressure</td>
<td>Faulty pressure sensors</td>
<td>• Check pressure calibration.</td>
</tr>
<tr>
<td>readings</td>
<td></td>
<td>• Check calibration valve block is functioning and not blocked. If unable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>to diagnose problem, check the voltage across TP1 and TP2 of pressure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sensor PCA. Ensure it is about 4 volts ±0.3 volts. If unable to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>diagnose problem, it may be a noisy A/D converter, replace main</td>
</tr>
<tr>
<td></td>
<td></td>
<td>controller PCA.</td>
</tr>
<tr>
<td>Low span</td>
<td>Leaks</td>
<td>• A leak in the instrument or calibration system dilutes the sample</td>
</tr>
<tr>
<td></td>
<td></td>
<td>stream and causes low span readings and noise.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Correlation wheel has leaked replace correlation wheel.</td>
</tr>
<tr>
<td></td>
<td>Span calibration out</td>
<td>Adjust the span using the calibration procedure (refer to Section 5.6).</td>
</tr>
<tr>
<td>No response to span gas</td>
<td>Leaks/blockages</td>
<td>Leak or blockages in tubes or valves. Perform leak check and flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>check and repair any leaks/blockages.</td>
</tr>
<tr>
<td></td>
<td>Faulty calibration source</td>
<td>Ensure calibration gas is plumbed correctly and is not contaminated or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>has no leaks and is a certified reference gas.</td>
</tr>
<tr>
<td></td>
<td>Hardware fault</td>
<td>Faulty Measurement cell.</td>
</tr>
<tr>
<td></td>
<td>Correlation wheel leaking</td>
<td>Replace correlation wheel.</td>
</tr>
<tr>
<td>Zero drift</td>
<td>Poor temperature control</td>
<td>Ensure instrument is operated in a temperature controlled environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>with the lid on.</td>
</tr>
<tr>
<td></td>
<td>Faulty zero air</td>
<td>Ensure zero air source is not overly polluted.</td>
</tr>
<tr>
<td></td>
<td>Leak</td>
<td>Perform a leak test (refer to Section 6.4.4).</td>
</tr>
<tr>
<td></td>
<td>CO-CO₂ converter faulty</td>
<td>Replace CO-CO₂ converter.</td>
</tr>
<tr>
<td>Negative zero</td>
<td>Indicates that the internal</td>
<td>Perform a leak test (refer to Section 6.4.4). Check the internal zero</td>
</tr>
<tr>
<td></td>
<td>zero air converter is less</td>
<td>zero air converter is less efficient than the external zero air supplied</td>
</tr>
<tr>
<td></td>
<td>efficient than the external</td>
<td>Perform a leak test (refer to Section 6.4.4). Check the internal zero</td>
</tr>
<tr>
<td></td>
<td>external zero air supplied</td>
<td>air supply is equipped with a functioning CO removing device.</td>
</tr>
</tbody>
</table>
7.1 Flow Fault

** Figure 59 – Flow Fault Diagnostic Procedure **

** Section 2.3.1 **

*** Section 5.2 ***
7.2 Noisy/Unstable Readings

**Figure 60 – Noisy Zero or Unstable Span Diagnostic Procedure**

** Section 6.4.4  
*** Section 6.4.7  
**** Section 5.2
7.3 Cell Temperature Failure

Figure 61 – Cell Temperature Failure Diagnostic Procedure
7.4 Mirror Temperature Failure

Figure 62 – Mirror Temperature Failure Diagnostic Procedure
7.5 USB Memory Stick Failure

Figure 63 – USB Memory Stick Failure
7.6 Ecotech Service Support Files

Regular backup of the settings, parameters and data on the instruments USB memory stick is recommended.

In the event of a fault that requires Ecotech technical support, please make copies of the following files and email to support@ecotech.com.

Equipment Required

- PC/Laptop

Procedure

State the ID number, variant, board revision and firmware version of the instrument with a brief description of the problem. Take a copy of the current configuration if possible and a save of the parameters.

1. Open - Main Menu ➔ Analyser State Menu.
2. Variant - (take note).
3. Ecotech ID - (take note).
4. Board Revision - (take note).
5. Firmware Ver. - (take note).
7. Save - Save Configuration - (CONFIG**.CFG) - Accept.

Note: CONFIG99.CFG is the “Factory Backup” file, this is the configuration of the instrument as it left the factory. It is recommended that this file is kept unchanged but can be used as a reference backup point.

** Can be any number from 0 – 98.

8. Save - Save Parameter List - (PARAM**.TXT) - Accept.
9. Eject - Safely Remove USB Stick - (Follow instructions).

Note: PARAM99.TXT is the “Factory Backup” file, This is a snap shot of the parameters while it was under test in the factory just prior to release. It is recommended that this file is kept unchanged but can be viewed for reference.

** Can be any number from 0 – 98.
10. Insert the USB memory stick into your PC/Laptop computer and access the files.
11. Best practice is to email all the on the USB memory stick but if it’s too large just send:
12. The CONFIG**.CFG and PARAM**.TXT files that are saved in the CONFIG folder.
13. The LOG files (Event Log text files) and data files (14=Year, Sub folder=month).
14. Safely Eject the USB from the PC/Laptop and return to the instrument.
8. Optional Extras

This section contains information on optional kits and installed options.

<table>
<thead>
<tr>
<th>Optional Extra</th>
<th>Refer to Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Sample Filter</td>
<td>8.1.</td>
</tr>
<tr>
<td>Network Port</td>
<td>8.2.</td>
</tr>
<tr>
<td>Rack Mount Kit</td>
<td>8.3.</td>
</tr>
<tr>
<td>Internal Pump</td>
<td>8.4.</td>
</tr>
<tr>
<td>Metric Fittings Kit</td>
<td>8.5.</td>
</tr>
<tr>
<td>High Pressure Zero/Span Valves</td>
<td>8.6.</td>
</tr>
<tr>
<td>Trace Level Instrument</td>
<td>8.7.</td>
</tr>
</tbody>
</table>

---

8.1 Dual Sample Filter (PN: E020100)

The dual filter is designed with two sample filters plumbed in parallel with a split line. This formation allows sample flow not to be affected, yet reduces the loading on each filter and therefore, the frequency with which they will need to be changed.

The dual filter option is shown in the pneumatic diagram (dashed line) and requires no operational changes to the instrument (refer to section 9.5).

![Dual Filter Option Installed](image)

---

8.2 Network Port (PN: E020101)

The network port option allows the user to setup and connect to a range of TCP/IP network options. If you have this option installed you need to make sure it is enabled in the Hardware Menu before the feature can be used.
Refer to Section 3.4.29, for details on the network menu.

Refer to Section 4.3, for details on network setup.

### 8.2.1 Hardware Setup

This procedure will need to be followed after a factory reset.

**Procedure**

1. Press - (the green instrument status light button), this will take you to the home screen.
2. Press - (-99+) on the keypad. This will open the Advanced Menu.
3. Open - Advanced Menu → Hardware Menu.
4. Enable - Network Port → Enabled.

### 8.3 Rack Mount Kit (PN: E020116)

The rack mount kit is necessary for installing the Serinus into a 19" rack (the Serinus is 4RU in height).

**Table 9 – Included Parts (Rack Mount Kit)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rack Slide Set</td>
<td>1</td>
<td>H010112</td>
</tr>
<tr>
<td>Rack Mount Adaptors</td>
<td>4</td>
<td>H010133</td>
</tr>
<tr>
<td>Rack Mount Ears</td>
<td>2</td>
<td>H010134</td>
</tr>
<tr>
<td>Spacers</td>
<td>4</td>
<td>HAR-8700</td>
</tr>
<tr>
<td>M6 x 20 Button Head Screws</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>M6 Washers</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>M6 Nyloc Nuts</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>M4 x 10 Button Head Screws</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>M4 Washers</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>M4 Nyloc Nuts</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>M6 Cage Nuts</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

**Installing the Instrument**

1. Remove the rubber feet from the instrument (if attached).
2. Separate the slide rail assembly by pressing the black plastic clips in the slide rails to remove the inner section of the rail.
3. Attach the inner slide rails to each side of the instrument using M4 x 10 button screws; three on each side (refer to Figure 67).

4. Install rack mount ears on the front of the instrument using two M4 x 10 screws on each side (refer to Figure 68).
5. Attach the rack mount adaptors to the ends of the outer slide rails using M4 x 10 button screws, washers and locknuts. Do not fully tighten at this stage as minor adjustments will be required to suit the length of the rack (refer to Figure 69).

6. Test fit the rack slide into the rack to determine the spacing of the rack mount adaptors.
7. Install the two assembled outer slide rails onto the left and right side of the rack securely with M6 bolts; washer and locknuts/cage nuts (refer to Figure 71).

**Figure 70 – Test Fit the Rack Slide Assembly into the Rack**

8. Now carefully insert the instrument into the rack by fitting the instrument slides into the mounted rails. Ensuring that the rack slide locks engage on each side.

**Figure 71 – Attach Slides to Front of Rack**

**CAUTION**
When installing this instrument ensure that appropriate lifting equipment and procedures are followed. It is recommended that two people lift the instrument into the rack due to the weight, unless proper lifting equipment is available.
Note: Ensure both sides of the inner slide are attached to the outer slides before pushing into the rack fully.

9. Push the instrument into the rack. Adjust and tighten the screws as required to achieve a smooth and secure slide.

To Remove the Instrument

1. To remove the instrument first pull instrument forward of rack giving access to the slides.
2. Find the rack slide lock labelled Push and push it in whilst sliding the instrument out of the rack, complete this for both sides while carefully removing instrument.

Figure 72 – Slide Clips

8.4 Internal Pump (PN: E020107)

8.4.1 Hardware Setup

This procedure should be followed after a factory reset.

Equipment Required

- NA

Procedure

1. Press - (the green instrument status light), this will take you to the home screen.
2. Press -(-99+) on the keypad. This will open the Advanced Menu.
3. Open - Advanced Menu → Hardware Menu.
4. Enable - Internal Pump → Enabled.

8.4.2 Internal Pump Additional Components

The Serinus 30 internal pump option includes the following additional components:
### Table 10 – Internal Pump Additional Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal pump</td>
<td>Draw sample through the instrument</td>
<td>H010027</td>
</tr>
<tr>
<td>Flow block</td>
<td>Includes sintered filter and differential pressure sensor to measure flow.</td>
<td>H010120</td>
</tr>
<tr>
<td>Heater and Thermistor</td>
<td>Mounted in flow block to measure and control temperature for accurate flow measurement.</td>
<td>Installed in flow block</td>
</tr>
</tbody>
</table>

#### 8.4.3 Internal Pump Removed Components

The Serinus 30 has a number of components missing from the standard instrument due to the presence of the internal pump and flow block controlling flow within the instrument. The parts that have been removed when this option is installed are listed in the table below.

### Table 11 – Internal Pump Removed Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sintered filter</td>
<td>F010004</td>
</tr>
<tr>
<td>O-ring</td>
<td>O010012</td>
</tr>
<tr>
<td>Spring</td>
<td>H010040</td>
</tr>
<tr>
<td>O-ring</td>
<td>O010013</td>
</tr>
<tr>
<td>Orifice</td>
<td>H010043-13</td>
</tr>
</tbody>
</table>

#### 8.4.4 Pressure Calibration Internal Pump Option

The internal pump requires a separate modified procedure to allow the internal pump to generate the necessary vacuum (refer to Section 5.3).

#### 8.4.5 Flow Calibration

The flow calibration menu is only available when the internal pump option is installed (refer to Section 3.4.12).

The internal pump requires a separate flow calibration procedure. The flow calibration detailed in Section 5.9 must be performed after any pump service or pressure calibration.

#### 8.4.6 Internal Pump Leak Check

The internal pump requires a separate modified procedure to leak check the system (refer to Section 6.4.4.1).

#### 8.4.7 Pump Control

This section describes how to turn off and on the internal pump for servicing and maintenance purposes.
Procedure
1. Open - Main Menu → Service Menu → Diagnostics Menu → Internal Pump Menu.
3. Toggle Off - Internal Pump → Off.

8.5 Metric Fittings Kit (PN: E020122)

The metric fittings kit allows the user to connect 6 mm tubing to the rear ports of the analyser. This can be very handy if it is hard to source ¼” tubing from a local supplier.

8.6 High Pressure Zero/Span Valves

High pressure span calibration valve (factory installed (PN: E020108))
High pressure zero calibration valve (factory installed (PN: E020109))

For more information on how to setup and use the high pressure valves refer to section 5.10.

Please refer to Section 9.12 for the exploded assembly drawing.

**Note:** Before using a high pressure span or zero as a source for calibrating the instrument, please check your local regulatory requirements.

8.7 Trace Level Instrument (PN: E020127)

The trace option enables the instrument to detect levels carbon monoxide (CO) from 0-20,000 ppb with a lower detectable limit of 20 ppb. This allows the Serinus 30 Trace to sample in the most useful range for CO background measurement (25-500 ppb CO in air, levels that represent the range of global CO mixing ratios in the unpolluted atmosphere).

The Serinus 30 Trace has a number of extra passes in the measurement cell to increase the resolution, along with a thermally stabilised detector housing with a more sensitive IR detector operating at a lower temperature (-50 °C) to reduce thermal noise.

This option is also available without a dryer (PN: E020120).

8.7.1 Trace Specifications

The following tables list the changes to a standard instrument with the trace option installed.

**Table 12 – Trace Parts Removed**

<table>
<thead>
<tr>
<th>Parts Removed</th>
<th>Quantity</th>
<th>Part Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Cell</td>
<td>1</td>
<td>H014100</td>
</tr>
</tbody>
</table>
**Table 13 – Trace Parts Added**

<table>
<thead>
<tr>
<th>Parts Added</th>
<th>Quantity</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace Measurement Cell</td>
<td>1</td>
<td>H014100-02</td>
</tr>
<tr>
<td>Dryer</td>
<td>1</td>
<td>H014180</td>
</tr>
</tbody>
</table>

**8.7.2 Measurement**

**Range**

0-20 ppm autoranging

Lower detectable limit: 20 ppb, with Kalman filter active

**8.7.3 Precision/Accuracy**

**Noise at Zero**

<10 ppb

**8.7.4 Calibration**

**Zero Drift**

24 hours: < 50 ppb

**Span Drift**

24 hours: 1 % of reading or 50 ppb whichever is greater

**8.7.5 Trace setup**

**Sighting and System Setup**

The sensitivity of the Serinus 30 trace requires special materials to be used for all measurement path lines. These materials must be inert to the pollutant being measured as shown below.

- **Sample Column**: The Sample Column should be made of glass to prevent reactions with air drawn into column.
- **Sample Hood**: The Sample Hood should be made of Teflon, ensuring that there is no sample retention.
- **Lines**: All sample transport tubing, including zero and calibration lines, must be made of virgin Teflon, PTFE or FEP.
- **Regulator**: A High purity, stainless steel dual stage regulator should be used.
- **Stainless steel chromatography grade 1/8 gas lines should be used to connect span gas cylinder to gas dilution device.**
- **Calibration** should be carried out by flooding the sample manifold with 10-20 l/m of calibration gas. This method ensures that all sample gas contact areas are exposed to the calibration gas.
Serinus 30 User Manual 3.2

- Zero calibrations should also involve flooding with zero gas at 10-20 l/m
- Sample gas residence time in the manifold should be less than 3.5 seconds.

**Instrument**

A standard Serinus 30 draws ambient air from within its localised area when performing a background while when sampling it draws the sample form a sample manifold. The difference between air sources (sample and background) may alter readings on a trace level instrument. Trace instruments can detect these slight differences so background and sample air must be drawn from an identical source. The trace instruments obtain background air from the same source as the sample air, helping standardise air samples and eliminating potential differences such as humidity.

- Connect ¼ inch virgin PTFE FEP tubing between the sample manifold and the sample inlet on the instrument.
- Connect ¼ inch virgin PTFE FEP tubing from the BGnd Air Port to the sample manifold. Or if no ports are available on the sample manifold add a tee connection with the tubing going to the sample inlet on the instrument.

8.7.6 Trace Operation

Please refer to Section 9.5 for a detailed pneumatic diagram.

**Pneumatics**

A standard Serinus 30 instrument uses calibration valves to supply sample, span and zero air to the inlet. The small error created from delivering gas through different lines is not measurable in standard instruments but can offset results in a trace level instrument. To eliminate this difference the zero and span gas is flooded directly into the sample manifold (the manifold pump or fan is disabled and isolated with a valve) to a point where it fills the entire manifold and overflows preventing any ambient external air from entering. Thus the manifold inlet now becomes the calibration vent. The air within the manifold is then drawn through the instrument where measurements can be taken and compared to the concentration being delivered by the calibration system.

8.7.7 Trace Default Values

The Serinus 30 Trace default parameters vary from the Serinus 30 standard setup. The following is a list of differing parameters and their new default/expected values.

**Table 14 – Trace Parameter Value Changes**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooler Pot</td>
<td>255</td>
</tr>
<tr>
<td>Cooler Voltage</td>
<td>2.0 V</td>
</tr>
</tbody>
</table>
8.7.8 Trace Calibration Guidelines

To perform a multipoint calibration follow the procedure outlined in Section 5.8 for general setup, some aspects of calibration need more attention to detail. These following steps detail some of the changes in the calibration procedure that must be understood before performing any calibration.

**Note:** Before commencing a multipoint calibration, perform a manual background with diluted zero air flowing at 10-20 Lpm in the sample manifold.

- Span/Zero gas should be injected directly into the sample manifold with a volume that will flood the manifold preventing any external air from entering and influencing the Span/Zero gas.
- Losses may occur in sample manifold and tubing due to contaminants entering during normal measurement cycle. Flooding the sample manifold and tubing with zero air can help clean these contaminants out.
- The instrument must be powered up and in normal measurement calibration mode (ie all gas lines are attached and ready for use) for up to 48 hours before a calibration can be performed.

**Note:** A 48 hour preconditioning is necessary to warm-up materials and ensures that the instrument is working at its optimum when the calibration is performed. This preconditioning is particularly important for trace instrument calibrations due to the sensitive nature of the measurements.

- The instrument must be powered up and in normal measurement calibration mode (ie all gas lines are attached and ready for use) for up to 48 hours before a calibration can be performed.

- The Serinus 30 Trace must be used in a laboratory environment which includes air conditioning to stabilise the temperature.
- A zero test should be performed over a 24 hour period to get an accurate reading of the Lowest Detectable Limit (LDL) of the entire system installation. Throughout this time period ten minute intervals should be used to collect readings of the CO from the zero air. From the data acquired the smallest detectable signal that can be accurately measured is found as well as the noise which determines the stability and precision of readings.
- A shut off valve should be designed into the sample manifold system, whereby the fan or pump used to draw in the sample air is turned off and the valve isolates the fan or pump from the sample manifold, when a calibration is in process (as ambient air is not required for calibration and will make calibration void). This valve can be controlled manually or via the data logger providing the data logger is designed with this function.

8.7.9 Trace Service and Maintenance

The maintenance intervals are determined by compliance standards that differ in various regions. The following is recommended by Ecotech as a guide. Compliance with local regulatory or international standards is the responsibility of the user. The below list only includes items that are different to a standard range instrument.

**Table 15 – Maintenance Schedule**

<table>
<thead>
<tr>
<th>Interval *</th>
<th>Task performed</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly</td>
<td>Replace particulate filter</td>
<td>6.4.1</td>
</tr>
<tr>
<td></td>
<td>Check sample inlet system for moisture or foreign materials and clean</td>
<td></td>
</tr>
<tr>
<td>6 Monthly</td>
<td>Perform multipoint precision check</td>
<td>8.7.8</td>
</tr>
</tbody>
</table>

* Suggested intervals for maintenance procedure are a guide only and may vary with sampling intensity and/or environmental conditions. Please refer to your local regulatory standard for your personalised maintenance schedule.
9. Parts List and Schematics

9.1 Serinus Accessories Kit

This kit contains assorted fittings, tubing and an orifice removal tool which are useful when working on the instruments internal pneumatics. This is usually purchased with the instrument.

Table 16 – Serinus Accessories Kit – (PN: H010136)

<table>
<thead>
<tr>
<th>Part Description</th>
<th>Quantity</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kynar Union Tee Fitting</td>
<td>4</td>
<td>F030007</td>
</tr>
<tr>
<td>Kynar Union Fitting</td>
<td>2</td>
<td>F030008</td>
</tr>
<tr>
<td>Adapter, 1/4&quot; Fitting to 1/8&quot; Barb</td>
<td>4</td>
<td>H010007</td>
</tr>
<tr>
<td>Adapter, 1/4&quot; Tube to 1/8&quot; Barb</td>
<td>2</td>
<td>H010008</td>
</tr>
<tr>
<td>Orifice Extraction Tool</td>
<td>1</td>
<td>H010046</td>
</tr>
<tr>
<td>Ecotech Tygon Tubing (1/4&quot; OD, 1/8&quot; ID (Clear))</td>
<td>3 Feet</td>
<td>T010011</td>
</tr>
<tr>
<td>Neoprene Tubing (1/4&quot; OD, 1/8&quot; ID (Black))</td>
<td>3 Feet</td>
<td>T010021</td>
</tr>
</tbody>
</table>

9.2 Maintenance Kit

This maintenance kit is required when performing annual maintenance on the instrument. Depending on the environment the instrument is operating, this maintenance may need to be carried out more often than yearly.

Table 17 – Serinus 30 Maintenance Kit – (PN: E020202)

<table>
<thead>
<tr>
<th>Part Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel Sintered Filter</td>
<td>F010004</td>
</tr>
<tr>
<td>23 Micron DFU</td>
<td>F010005</td>
</tr>
<tr>
<td>Viton O-Ring</td>
<td>O010008</td>
</tr>
<tr>
<td>O-Ring (0.364 ID X 0.070 W)</td>
<td>O010010</td>
</tr>
<tr>
<td>Viton O-Ring (0.114 ID X 0.07 W)</td>
<td>O010012</td>
</tr>
<tr>
<td>O-Ring (5/32 ID X 1/16 W (BS007))</td>
<td>O010013</td>
</tr>
<tr>
<td>Viton O-Ring (1 11/16 ID X 3/32 W)</td>
<td>O010014</td>
</tr>
<tr>
<td>Viton O-Ring (1/4 ID X 1/16 W)</td>
<td>O010015</td>
</tr>
<tr>
<td>Viton O-Ring (13/16 ID X 1/16 W)</td>
<td>O010016</td>
</tr>
<tr>
<td>Viton O-Ring (BS015)</td>
<td>O010023</td>
</tr>
<tr>
<td>O-Ring (BS110)</td>
<td>ORI-1009</td>
</tr>
<tr>
<td>Ecotech Tygon Tubing (1/4&quot; OD, 1/8&quot; ID (Clear))</td>
<td>T010011</td>
</tr>
</tbody>
</table>
9.3 Consumables

Parts shown as consumables below will require replacement over the course of the instrument’s lifespan.

Table 18 – Serinus 30 Consumables

<table>
<thead>
<tr>
<th>Part Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>47 mm, 5 micron, Teflon Filter Paper, Pack of 50</td>
<td>F010006-01</td>
</tr>
<tr>
<td>47 mm, 5 micron, Teflon Filter Paper, Pack of 100</td>
<td>F010006</td>
</tr>
<tr>
<td>CO-CO2 Converter</td>
<td>H014130</td>
</tr>
<tr>
<td>#14 Orifice – Used In The Measurement Cell</td>
<td>H010043-13</td>
</tr>
<tr>
<td>Stainless Steel Sintered Filter</td>
<td>F010004</td>
</tr>
<tr>
<td>23 Micron DFU</td>
<td>F010005</td>
</tr>
<tr>
<td>External Pump Repair Kit (To Suit a 607 Pump)</td>
<td>P031001</td>
</tr>
<tr>
<td>Internal Pump Repair Kit (to suit KNF Pump)</td>
<td>P031005</td>
</tr>
<tr>
<td>Ecotech Tygon Tubing, 25 ft Length</td>
<td>T010011-01</td>
</tr>
</tbody>
</table>

*Warranty Disclaimer: The product is subject to a warranty on parts and labour from date of shipment (the warranty period). The warranty period commences when the product is shipped from the factory. Lamps, fuses, batteries and consumable items are not covered by this warranty. Subject to variable ambient conditions, toxic gases, dirt, extremes of temperature and moisture ingress may shorten the lifespan of components.

9.4 Instrument Parts List

List of Serinus 30 components and part numbers for reference:

Table 19 – Spare Parts List Serinus 30

<table>
<thead>
<tr>
<th>Part Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Controller PCA</td>
<td>E020230-01</td>
</tr>
<tr>
<td>Serinus Power Supply, Auto-ranging</td>
<td>P010013</td>
</tr>
<tr>
<td>Measurement Cell Assembly</td>
<td>H014100</td>
</tr>
<tr>
<td>Infrared Source</td>
<td>H014201</td>
</tr>
<tr>
<td>Narrow-Bandpass Filter</td>
<td>H014205</td>
</tr>
<tr>
<td>Detector PCA</td>
<td>C010009</td>
</tr>
<tr>
<td>Detector</td>
<td>S030005</td>
</tr>
<tr>
<td>Pressure Sensor PCA</td>
<td>C010004</td>
</tr>
<tr>
<td>Pressure Sensor Gasket</td>
<td>H010037</td>
</tr>
<tr>
<td>Source Timing Assembly</td>
<td>H014125</td>
</tr>
<tr>
<td>Motor Assembly</td>
<td>M020006</td>
</tr>
<tr>
<td>Part Description</td>
<td>Part Number</td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Correlation Wheel Assembly</td>
<td>H014114</td>
</tr>
<tr>
<td>Optical Interrupter</td>
<td>S030002</td>
</tr>
<tr>
<td>Measurement Cell Heater, Thermister Assembly</td>
<td>C020073</td>
</tr>
<tr>
<td>Sapphire Window</td>
<td>H014206</td>
</tr>
<tr>
<td>Spring Compression Used in The Measurement Cell</td>
<td>H010040</td>
</tr>
<tr>
<td>#14 Orifice Used in The Measurement Cell</td>
<td>H010043-13</td>
</tr>
<tr>
<td>Sintered filter</td>
<td>F010004</td>
</tr>
<tr>
<td>Gasket For Measurement Cell</td>
<td>H014212</td>
</tr>
<tr>
<td>Front Panel Assembly</td>
<td>H010130</td>
</tr>
<tr>
<td>Serinus 30 Label For Front Panel Assembly</td>
<td>H010132-03</td>
</tr>
<tr>
<td>Rear Panel PCA</td>
<td>C010002</td>
</tr>
<tr>
<td>Calibration Valve Manifold Assembly</td>
<td>H010013-01</td>
</tr>
<tr>
<td>CO-CO2 Converter Assembly</td>
<td>H014130</td>
</tr>
<tr>
<td>Thermal Fuse and Heater Thermister Assembly – CO to CO₂ converter</td>
<td>C020082</td>
</tr>
<tr>
<td>Silicone Heat Sink Compound</td>
<td>C050013</td>
</tr>
<tr>
<td>Sample Filter Holder Assembly</td>
<td>H010020</td>
</tr>
<tr>
<td>Fan For Rear Panel</td>
<td>C020058</td>
</tr>
<tr>
<td>Fan Filter Kit for Rear Panel Fan</td>
<td>H010044</td>
</tr>
<tr>
<td>Barb Adaptor</td>
<td>H010007</td>
</tr>
<tr>
<td>Fitting Kynar Bulkhead</td>
<td>F030023</td>
</tr>
<tr>
<td>O-Ring, Flat and Spherical Mirrors</td>
<td>O010011</td>
</tr>
<tr>
<td>O-Ring, Mounting Plate</td>
<td>O010009</td>
</tr>
<tr>
<td>Internal Pump Assembly Spare Part (KNF Pump)</td>
<td>H010027</td>
</tr>
<tr>
<td>Internal Pump Repair Kit (to suit KNF Pump)</td>
<td>P031005</td>
</tr>
<tr>
<td>External Pump (607 Pump) 240 VAC</td>
<td>P030004</td>
</tr>
<tr>
<td>External Pump (607 Pump) 110 VAC</td>
<td>P030005</td>
</tr>
<tr>
<td>External Pump Repair Kit (To Suit a 607 Pump)</td>
<td>P031001</td>
</tr>
<tr>
<td>Extraction Tool, Sintered Filter and Orifice</td>
<td>H010046</td>
</tr>
<tr>
<td>Minifit Extraction Tool</td>
<td>T030001</td>
</tr>
<tr>
<td>Serinus 30 User Manual</td>
<td>M010027</td>
</tr>
<tr>
<td>USB Memory Stick</td>
<td>H030021</td>
</tr>
</tbody>
</table>
9.5 Plumbing Schematic – (PN: D020005)

NOTE: some parts of the optional internal plumbing diagram are not shown.

- BGrid Air
- Calibration
- Sample
- 500 mm – NO PUMP
- 250 mm
- 5 mm
- 5 mm
- 250 mm
- 5 mm
- 250 mm
- 5 mm
- 5 mm
- 250 mm
9.7 Block Wiring Schematic – (PN: D020102)
9.8 CO Cell Assembly – (PN: H014100)
9.9 Source Timing Assembly – (PN: H014125)
9.11 Valve Assembly – (PN: H010042)

Steps to Replace O-rings:

1. Mark the solenoid coil with a permanent marker to identify.
2. Secure the 3-way valve body with a large wrench to prevent damage to the valve.
3. Remove nut from the top of the 3-way valve using a suitable wrench.
4. Remove small O-ring from around 3-way valve using.
5. Lift off the solenoid coil from the 3-way valve then unplug.
6. Remove the 3-way valve from the manifold block.
7. Ensure the solenoid valve is in the off position on manifold block.
8. Assemble the solenoid with the specified valve.
9. Assemble the nut on top of the valve.
10. Assemble the nut on top of the valve.
11. Assemble the nut on top of the valve.
12. Assemble the nut on top of the valve.

PN: H010042
9.12 High Pressure Valve Exploded View – (PN: H050043)
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Appendix A. Advanced Protocol

The Advanced protocol allows access to the full list of instrument parameters.

A.1 Command Format

All commands and responses sent to and from the Instrument will be in the following packet format to ensure data is reliable.

Table 20 – Packet Format

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6 ... 5+n</th>
<th>6+n</th>
<th>7+n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STX (2)</td>
<td>Serial ID</td>
<td>Command</td>
<td>ETX (3)</td>
<td>Message Length (n)</td>
<td>Message</td>
<td>Checksum</td>
</tr>
</tbody>
</table>

Where:

<STX> ASCII Start of Text = 0x02 hex.

Serial ID The Serial ID assigned in the Main Menu → Communications Menu → Serial Communication Menu.

<ETX> ASCII End of Text = 0x03 hex.

Checksum The XOR of the individual bytes except for STX, ETX, EOT and Checksum.

Message length Must be in the range 0 to 32. Responses from the instrument can have a message Length of 0 to 255.

<EOT> ASCII End of Transmission = 0x04 hex.

Examples

A basic request for Primary gas data would be as follows:

Table 21 – Example: Primary Gas Request

<table>
<thead>
<tr>
<th>Byte Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>STX</td>
<td>ID</td>
<td>Command</td>
<td>ETX</td>
<td>Message Length</td>
<td>Primary Gas Conc</td>
<td>Checksum</td>
<td>EOT</td>
</tr>
<tr>
<td>Value</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>50</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>Checksum Calculation</td>
<td>0</td>
<td>0⊕1=1</td>
<td>1⊕1=0</td>
<td>0⊕50=50</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

And a sample response:
### Table 22 – Example: Primary Gas Response

<table>
<thead>
<tr>
<th>Byte Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Continued in next table.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>STX</td>
<td>ID</td>
<td>Command</td>
<td>ETX</td>
<td>Message Length</td>
<td>Primary Gas Conc</td>
<td></td>
</tr>
<tr>
<td>Value</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Checksum Calculation</td>
<td>0</td>
<td>0②1=1</td>
<td>1②5=4</td>
<td>4②50=54</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 23 – Example: Primary Gas Response (continued)

<table>
<thead>
<tr>
<th>Byte Number</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>IEEE representation of 1.00</td>
<td>Checksum</td>
<td>EOT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value</td>
<td>63</td>
<td>128</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>Checksum Calculation</td>
<td>54②63=9</td>
<td>9②128=137</td>
<td>137②0=137</td>
<td>137②0=137</td>
<td>137</td>
<td></td>
</tr>
</tbody>
</table>

### A.2 Commands

#### A.2.1 Communication Error

Where:

- Command byte: 0
- Message byte 1: 0
- Message byte 2: 0..7

If the command byte of a response is 0, this indicates an error has occurred. The message field will be 2 bytes long, where the 2\textsuperscript{nd} byte indicates the error according to the following table.

### Table 24 – List of Errors

<table>
<thead>
<tr>
<th>Error #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Bad Checksum received</td>
</tr>
<tr>
<td>1</td>
<td>Invalid Parameter Length</td>
</tr>
<tr>
<td>2</td>
<td>Invalid Parameter</td>
</tr>
<tr>
<td>3</td>
<td>Internal Data Flash Erase in Progress unable to return data for a few seconds</td>
</tr>
<tr>
<td>4</td>
<td>Unsupported Command.</td>
</tr>
<tr>
<td>5</td>
<td>Another process is collecting data – unable to service request.</td>
</tr>
<tr>
<td>6</td>
<td>MemStick No Connected</td>
</tr>
<tr>
<td>7</td>
<td>MemStick Busy</td>
</tr>
</tbody>
</table>
A.2.2  Get IEEE Value

Where:

Command byte 1
Message byte 1 Index from List of Parameters
Message byte 2..32 Additional indexes (optional)

This command requests the value of an instrument parameter. The message field byte contains the index of the parameter requested, as described in the List of Parameters.

Up to 32 indexes can be supplied in a single request. The response has 5 bytes for each parameter requested – the first byte is the parameter index and the next four are the IEEE representation of the current value.

Example

A request with a message field of 50,51,52 to a Serinus S40 would return a 15 byte message as shown below:

Table 25 – Example: Get IEEE Response data

<p>| | | | | | | | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>51</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>52</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO reading</td>
<td>NOx reading</td>
<td>NO2 reading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A.2.3  Set Calibration Mode

Where:

Command byte 4
Message byte 1 85
Message byte 2-5 The IEEE representation of 0, 1, 2, or 3
0 puts the instrument into Measure mode (0,0,0,0)
1 puts the instrument into Cycle mode (63,128,0,0)
2 puts the instrument into Zero mode (64,0,0,0)
3 puts the instrument into Span mode (64,64,0,0)

This command puts the instrument into a calibration mode (the same as going to the Calibration menu and choosing a Cal. Mode).

Example

A request with a command of 4 and a message field of 85,64,64,0,0 would place the instrument into Span mode.
A.2.4 Set Calibration

Enters a new calibration value: the same as entering Span Calibrate or Zero Calibrate on the calibration menu.

Where:

Command byte 18
Message byte 1 0, 1, 2, or 3 where
0 = Span
1 = Zero (first zero gas)
2 = Zero (second zero gas)
3 = Zero (Third zero gas)
Message byte 2-5 The IEEE representation of the calibration value.

A.3 List of Parameters

Note: Parameters are for all Serinus series analysers and may not be applicable to an individual instrument.

Table 26 – Advanced Protocol Parameter List

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cal/Zero Valve</td>
<td>0 = Zero, 1 = Cal</td>
</tr>
<tr>
<td>2</td>
<td>Internal Span Valve</td>
<td>0 = Off, 1 = On</td>
</tr>
<tr>
<td>3</td>
<td>Positive Supply</td>
<td>Positive analog supply voltage</td>
</tr>
<tr>
<td>4</td>
<td>Gas 5 Avg.</td>
<td>Average of the readings (for Gas 5) of the last n minutes where n is the averaging period E.g. Nx</td>
</tr>
<tr>
<td>5</td>
<td>Pregain</td>
<td>S30H linearization coefficient gain</td>
</tr>
<tr>
<td>6</td>
<td>Sample/Cal Valve</td>
<td>0 = Sample, 1 = Cal/Zero</td>
</tr>
<tr>
<td>7</td>
<td>NOx Measure Valve</td>
<td>0 = NO, 1 = NOx</td>
</tr>
<tr>
<td>8</td>
<td>NOx Bypass Valve</td>
<td>0 = NO, 1 = NOx</td>
</tr>
<tr>
<td>9</td>
<td>NOx Backgnd Valve</td>
<td>0 = Off, 1 = On</td>
</tr>
<tr>
<td>10</td>
<td>Valve Sequencing</td>
<td>0 = Off, 1 = On</td>
</tr>
<tr>
<td>11</td>
<td>LCD Contrast Pot</td>
<td>0 = Lightest, 255 = Darkest</td>
</tr>
<tr>
<td>12</td>
<td>SO2 Ref Zero Pot</td>
<td>S50 Reference zero pot</td>
</tr>
<tr>
<td>13</td>
<td>CO Input Pot</td>
<td>S30 Input pot</td>
</tr>
<tr>
<td>14</td>
<td>CO Reference Test Pot</td>
<td>Not Used</td>
</tr>
<tr>
<td>15</td>
<td>CO Measure Pot</td>
<td>Not Used</td>
</tr>
<tr>
<td>16</td>
<td>High Volt Adjust Pot</td>
<td>PMT High Voltage Adjust Pot for S50 &amp; S40</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>SO2 Lamp Adjust Pot</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>O3 Lamp Adjust Pot</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>O3 Meas. Zero Pot (C)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>O3 Meas. Zero Pot (F)</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>PMT Fan Pot</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Rear Fan Pot</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Pump Fine Pot</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Pump Coarse Pot</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Analog input 0</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Analog input 1</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Analog input 2</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Analog input 3</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Analog input 4</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Analog input 5</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Analog input 6</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Analog input 7</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Analog input 8</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Analog input 9</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Analog input 10</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Analog input 11</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Analog input 12</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Analog input 13</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Analog input 14</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Analog input 15</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>CO Meas. Zero Pot (coarse)</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>CO Meas. Zero Pot (fine)</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>SO2 Input Pot</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>SO2 Ref. Gain Pot</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>SO2 Meas. Zero Pot</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>O3 Input Pot</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>Diagnostic Test Pot</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>NOx Input Pot</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>PGA Gain</td>
<td></td>
</tr>
</tbody>
</table>

S50 Lamp adjustment Pot
S10 Lamp adjustment Pot
S10 Signal zero measure (coarse)
S10 Signal zero measure (fine)
Optical Bench fan speed control pot
Chassis Fan speed control pot
Internal Pump speed fine pot
Internal Pump speed coarse pot
SO2 Reference signal
CO Reference signal
O3 Reference signal
SO2 & O3 Lamp current
Flow block pressure
Cell pressure
Ambient pressure
Raw ADC calibration input
Reserved
Concentration data
Reserved
Reserved
Raw analog to digital count for external analog input 0. 0-5V= 0-32766 A/D counts
Raw analog to digital count for external analog input 1. 0-5V= 0-32766 A/D counts
Raw analog to digital count for external analog input 2. 0-5V= 0-32766 A/D counts
Reserved
S30 Measure ZERO coarse adjustment Pot
S30 Measure ZERO fine adjustment Pot
SO2 Measure Signal Gain Pot
SO2 Reference Signal Gain Pot
SO2 Measure zero pot
O3 Input signal gain pot
The Diagnostic mode adjustment pot for all the analysers except for S30
PMT signal input gain control FOR NOx
1, 2, 4, 8, 16, 32, 64, 128
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Gas 1 Inst.</td>
</tr>
<tr>
<td>51</td>
<td>Gas 2 Inst.</td>
</tr>
<tr>
<td>52</td>
<td>Gas 3 Inst.</td>
</tr>
<tr>
<td>53</td>
<td>Gas 1 Avg.</td>
</tr>
<tr>
<td>54</td>
<td>Gas 2 Avg.</td>
</tr>
<tr>
<td>55</td>
<td>Gas 3 Avg.</td>
</tr>
<tr>
<td>56</td>
<td>Instrument Gain</td>
</tr>
<tr>
<td>57</td>
<td>Serial ID</td>
</tr>
<tr>
<td>58</td>
<td>Bayern-Hessen ID</td>
</tr>
<tr>
<td>59</td>
<td>Decimal Places</td>
</tr>
<tr>
<td>60</td>
<td>Noise</td>
</tr>
<tr>
<td>61</td>
<td>Gas 1 Offset</td>
</tr>
<tr>
<td>62</td>
<td>Gas 3 Offset</td>
</tr>
<tr>
<td>63</td>
<td>Flow Temperature</td>
</tr>
<tr>
<td>64</td>
<td>Lamp Current</td>
</tr>
<tr>
<td>65</td>
<td>Digital Supply</td>
</tr>
<tr>
<td>66</td>
<td>Conc. Voltage</td>
</tr>
<tr>
<td>67</td>
<td>High Voltage</td>
</tr>
<tr>
<td>68</td>
<td>Ozonator</td>
</tr>
<tr>
<td>69</td>
<td>Control Loop</td>
</tr>
<tr>
<td>70</td>
<td>Diagnostic Mode</td>
</tr>
<tr>
<td>71</td>
<td>Gas Flow</td>
</tr>
<tr>
<td>72</td>
<td>Gas Pressure</td>
</tr>
<tr>
<td>73</td>
<td>Ambient Pressure</td>
</tr>
<tr>
<td>74</td>
<td>12V Supply</td>
</tr>
<tr>
<td>75</td>
<td>Cell Temperature</td>
</tr>
<tr>
<td>76</td>
<td>Conv. Temperature</td>
</tr>
<tr>
<td>77</td>
<td>Chassis Temperature</td>
</tr>
</tbody>
</table>

Primary gas concentration currently displayed on the front screen e.g. NO
Secondary gas concentration currently displayed on front screen e.g. NOx
Calculated gas concentration currently displayed on front screen e.g. NO2
Average of the readings (for Gas1) of the last n minutes where n is the averaging period
Average of the readings (for Gas2) of the last n minutes where n is the averaging period
Average of the readings (for Gas3) of the last n minutes where n is the averaging period
Current calibration value (default is 1.0)
Multidrop or Bayern-Hessen gas id
For multigas instruments only
2-5
Instrument noise
An offset applied to Gas 1
An offset applied to Gas 3
Temperature of the flow block
Lamp current in mA e.g. 35mA
Digital Supply voltage (should always read close to 5 volts)
Concentration Voltage
High Voltage reading for PMT
0 = Off, 1 = On (default is On)
0 = Operate, 1 = Preamp, 2 = Electrical, 3 = Optical (default is Operate)
Units in slpm
Units in torr
The 12 volt Power supply voltage
Cell Temperature
Converter Temperature
Chassis Temperature
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td>Manifold Temp.</td>
<td>Manifold Temperature</td>
</tr>
<tr>
<td>79</td>
<td>Cooler Temperature</td>
<td>Cooler Temperature</td>
</tr>
<tr>
<td>80</td>
<td>Mirror Temperature</td>
<td>Mirror Temperature</td>
</tr>
<tr>
<td>81</td>
<td>Lamp Temperature</td>
<td>Lamp Temperature</td>
</tr>
<tr>
<td>82</td>
<td>IZS Lamp Temperature</td>
<td>O3 Lamp Temperature</td>
</tr>
<tr>
<td>83</td>
<td>Instrument Status</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>Reference Voltage</td>
<td>Units in Volts</td>
</tr>
<tr>
<td>85</td>
<td>Calibration State</td>
<td>This variable has two different sets of values:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Set Calibration State</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = MEASURE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = CYCLE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = ZERO</td>
</tr>
<tr>
<td>86</td>
<td>Primary Raw Conc.</td>
<td>(For S40, before NOx background and gain)</td>
</tr>
<tr>
<td>87</td>
<td>Secondary Raw Conc.</td>
<td>Only for multigas instruments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(For S40, before NOx background and gain)</td>
</tr>
<tr>
<td>88</td>
<td>S40 Backgnd Conc.</td>
<td>NOx Background Concentration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(For S40, before gain)</td>
</tr>
<tr>
<td>89</td>
<td>Cal. Pressure</td>
<td>Calibration Pressure</td>
</tr>
<tr>
<td>90</td>
<td>Conv. Efficiency</td>
<td>Converter Efficiency</td>
</tr>
<tr>
<td>91</td>
<td>Multidrop Baud Rate</td>
<td>0 = 1200 bps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = 2400 bps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = 4800 bps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 = 9600 bps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 = 14400 bps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 = 19200 bps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 = 38400 bps</td>
</tr>
<tr>
<td>92</td>
<td>Analog Range AO 1</td>
<td>Maximum range value for analog output</td>
</tr>
<tr>
<td>93</td>
<td>Analog Range AO 2</td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>Analog Range AO 3</td>
<td></td>
</tr>
<tr>
<td>95</td>
<td>Output Type AO 1</td>
<td>Output Type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Voltage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Current</td>
</tr>
<tr>
<td>96</td>
<td>Output Type AO 2</td>
<td></td>
</tr>
<tr>
<td>97</td>
<td>Output Type AO 3</td>
<td></td>
</tr>
<tr>
<td>98</td>
<td>Anlg Ofst/Rng AO1</td>
<td>Voltage Offset /Current Range</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = 0 % or 0-20mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = 5 % or 2-20mA</td>
</tr>
<tr>
<td>99</td>
<td>Anlg Ofst/Rng AO2</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Anlg Ofst/Rng AO3</td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>F/Scale Volt AO 1</td>
<td>5.0 Volt Calibration value</td>
</tr>
<tr>
<td>102</td>
<td>F/Scale Volt AO 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>103</td>
<td>F/Scale Volt AO 3</td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>Z Adj Volt AO 1</td>
<td>0.5 Volt Calibration value</td>
</tr>
<tr>
<td>105</td>
<td>Z Adj Volt AO 2</td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>Z Adj Volt AO 3</td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>Negative Supply</td>
<td>Negative analog supply</td>
</tr>
<tr>
<td>108</td>
<td>Digital Outputs</td>
<td>A single byte expressing the most recent state of the digital outputs</td>
</tr>
<tr>
<td>109</td>
<td>Digital Inputs</td>
<td>A single byte expressing the most recent state of the digital inputs</td>
</tr>
</tbody>
</table>
| 110 | Instrument State | 0 = SAMPLE FILL  
1 = SAMPLE MEASURE  
2 = SAMPLE FILL AUX  
3 = SAMPLE MEASURE AUX  
4 = SAMPLE FILL AUX2  
5 = SAMPLE MEASURE AUX2  
6 = BACKGROUND FILL  
7 = BACKGROUND MEASURE  
8 = BACKGROUND PURGE  
9 = BACKGROUND FILL AUX  
10 = BACKGROUND MEASURE AUX  
11 = ZERO FILL  
12 = ZERO MEASURE  
13 = ZERO FILL AUX  
14 = ZERO MEASURE AUX  
15 = ZERO FILL AUX2  
16 = MEASURE AUX2  
17 = BACKGROUND FILL ZERO  
18 = BACKGROUND MEASURE ZERO  
19 = SPAN FILL  
20 = SPAN MEASURE  
21 = SPAN FILL AUX  
22 = SPAN MEASURE AUX  
23 = SPAN FILL AUX2  
24 = SPAN MEASURE AUX2  
25 = BACKGROUND FILL SPAN  
26 = BACKGROUND MEASURE SPAN  
27 = BACKGROUND PURGE SPAN  
28 = ELECTRONIC ZERO ADJUST  
29 = INSTRUMENT WARM UP  
30 = BACKGROUND ADJUST FILL  
31 = BACKGROUND ADJUST MEASURE |
<p>| 111 | CO Lin. Factor A | CO Linearisation Factor A |
| 112 | CO Lin. Factor B | CO Linearisation Factor B |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>113</td>
<td>CO Lin. Factor C</td>
<td>CO Linearisation Factor C</td>
</tr>
<tr>
<td>114</td>
<td>CO Lin. Factor D</td>
<td>CO Linearisation Factor D</td>
</tr>
<tr>
<td>115</td>
<td>CO Lin. Factor E</td>
<td>CO Linearisation Factor E</td>
</tr>
</tbody>
</table>
| 116 | Instrument Units | 0 = ppm  
1 = ppb  
2 = ppt  
3 = mg/m³  
4 = µg/m³  
5 = ng/m³  
6 = % |
<p>| 117 | Backgnd Meas. Time | In seconds. |
| 118 | Sample Fill Time | These parameters can be changed, but only temporarily; restarting the instrument will restore them to their default values. |
| 119 | Sample Measure Time |   |
| 120 | Aux Measure Time |   |
| 121 | Aux Smpl. Fill Time |   |
| 122 | Backgnd Fill Time |   |
| 123 | Zero Fill Time |   |
| 124 | Zero Measure Time |   |
| 125 | Span Fill Time |   |
| 126 | Span Measure Time |   |
| 127 | O3 Gen Coeff D | O3 Generator Coefficient D |
| 128 | Backgnd Pause Time | In seconds |
| 129 | Bkngd Intrleav Fact |   |
| 130 | Cal. Pressure 2 | Calibration Pressure for 2nd gas |
| 131 | 2nd Instrument Gain | Unused (always reports 1.0) |
| 132 | Background voltage | Units in Volts |
| 133 | Perm Rate | Permeation rate of the gas in ng/min |
| 134 | Perm Flow | Total flow past the permeation chamber during an activated internal span mode. In ml/min |
| 135 | Perm Oven Setpoint | Set target temperature for the permeation oven. Default is 50 °C |
| 136 | Perm Oven Temp | Temperature readout of the Permeation oven. Units in °C |
| 137 | Ozone Target | Ozone Target for S10 IZS ozone generation |
| 138 | Conc Adjusted 1 | Concentration value in PPM before filtering |
| 139 | Conc Adjusted 2 |   |
| 140 | Conc Adjusted 3 |   |
| 141 | Reserved |   |</p>
<table>
<thead>
<tr>
<th>Page 142</th>
<th>Reserved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page 143</td>
<td>IR Source</td>
</tr>
<tr>
<td>Page 144</td>
<td>Background (hrs)</td>
</tr>
<tr>
<td>Page 145</td>
<td>Cycle Time</td>
</tr>
<tr>
<td>Page 146</td>
<td>CO Cooler Pot</td>
</tr>
<tr>
<td>Page 147</td>
<td>CO Source Pot</td>
</tr>
<tr>
<td>Page 148</td>
<td>CO Test Meas. Pot</td>
</tr>
<tr>
<td>Page 149</td>
<td>CO Test Ref. Pot</td>
</tr>
<tr>
<td>Page 150</td>
<td>O3 Ref Average</td>
</tr>
<tr>
<td>Page 151</td>
<td>PTF Correction (gas 1)</td>
</tr>
<tr>
<td>Page 152</td>
<td>PTF Correction (gas 2)</td>
</tr>
<tr>
<td>Page 153</td>
<td>Inst. Cell Pressure</td>
</tr>
<tr>
<td>Page 154</td>
<td>Manifold</td>
</tr>
<tr>
<td>Page 155</td>
<td>Cell Press. (gas1)</td>
</tr>
<tr>
<td>Page 156</td>
<td>Cell Press. (gas2)</td>
</tr>
<tr>
<td>Page 157</td>
<td>Cell Press. (Bgnd)</td>
</tr>
<tr>
<td>Page 158</td>
<td>Background</td>
</tr>
<tr>
<td>Page 159</td>
<td>Gas To Measure</td>
</tr>
<tr>
<td>Page 160</td>
<td>Valve States</td>
</tr>
<tr>
<td>Page 161</td>
<td>Temperature Units</td>
</tr>
<tr>
<td>Page 162</td>
<td>Pressure Units</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| 163 | **Averaging Period** | 0 = "1 Min"
1 = "3 Mins"
2 = "5 Mins"
3 = "10 Mins"
4 = "15 Mins"
5 = "30 Mins"
6 = "1 Hr"
7 = "4 Hrs"
8 = "8 Hrs"
9 = "12 Hrs"
10 = "24 Hrs"
| 164 | **Filter Type** | 0 = NO FILTER
1 = KALMAN FILTER
2 = 10 SEC FILTER
3 = 30 SEC FILTER
4 = 60 SEC FILTER
5 = 90 SEC FILTER
6 = 300 SEC FILTER
7 = ADPTIVE FILTER
| 165 | **NO2 Filter enabled** | 0 = Disabled, 1 = Enabled
| 166 | **Background Interval** | 0 = 24 Hrs
1 = 12 Hrs
2 = 8 Hrs
3 = 6 Hrs
4 = 4 Hrs
5 = 2 Hrs
6 = Disable
| 167 | **Service (COM1) Baud** | Serial baud rate
| 168 | **Multidrop (COM2) Baud** | 0 = 1200 bps
1 = 2400 bps
2 = 4800 bps
3 = 9600 bps
4 = 14400 bps
5 = 19200 bps
6 = 38400 bps
| 169 | **Service Protocol** | 0 = EC9800
| 170 | **Multidrop Protocol** | 1 = Bayern-Hessen
2 = Advanced
3 = Modbus
| 171 | **AO1 Over Range** | The Upper Concentration Range when Over-Ranging is enabled
| 172 | **AO2 Over Range** |   
| 173 | **AO3 Over Range** |   

*Note: The content above is a table with information about averaging periods, filter types, NO2 filter enabled status, background intervals, service baud rates, service protocols, and multidrop protocols for AO1, AO2, and AO3.*
<table>
<thead>
<tr>
<th>Page</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>174</td>
<td>AO1 Over-Ranging</td>
</tr>
<tr>
<td>175</td>
<td>AO2 Over-Ranging</td>
</tr>
<tr>
<td>176</td>
<td>AO3 Over-Ranging</td>
</tr>
<tr>
<td>177</td>
<td>Heater Set Point</td>
</tr>
<tr>
<td>178</td>
<td>PMT High Volt. Pot</td>
</tr>
<tr>
<td>179</td>
<td>PMT Test LED Pot</td>
</tr>
<tr>
<td>180</td>
<td>Last Power Failure</td>
</tr>
<tr>
<td>181</td>
<td>Inst Manifld Pres.</td>
</tr>
<tr>
<td>182</td>
<td>Cell Press. (gas5)</td>
</tr>
<tr>
<td>183</td>
<td>Gas 4 Inst.</td>
</tr>
<tr>
<td>184</td>
<td>Gas 4 Avg.</td>
</tr>
<tr>
<td>185</td>
<td>Gas 5 Inst.</td>
</tr>
<tr>
<td>186</td>
<td>NH3 Conv. Efficiency</td>
</tr>
<tr>
<td>187</td>
<td>Cell/Lamp Duty Cycle</td>
</tr>
<tr>
<td>188</td>
<td>Mirror T. Duty Cycle</td>
</tr>
<tr>
<td>189</td>
<td>Flow Temp Duty Cycle</td>
</tr>
<tr>
<td>190</td>
<td>Cooler T. Duty Cycle</td>
</tr>
<tr>
<td>191</td>
<td>Conv Temp Duty Cycle</td>
</tr>
<tr>
<td>192</td>
<td>CO Conv T Duty Cycle</td>
</tr>
<tr>
<td>193</td>
<td>F/Scale Curr AO 1</td>
</tr>
<tr>
<td>194</td>
<td>F/Scale Curr AO 2</td>
</tr>
<tr>
<td>195</td>
<td>F/Scale Curr AO 3</td>
</tr>
<tr>
<td>196</td>
<td>Z Adj Curr AO 1</td>
</tr>
<tr>
<td>197</td>
<td>Z Adj Curr AO 2</td>
</tr>
<tr>
<td>198</td>
<td>Z Adj Curr AO 3</td>
</tr>
<tr>
<td>199</td>
<td>Ext Analog Input 1</td>
</tr>
<tr>
<td>200</td>
<td>Ext Analog Input 2</td>
</tr>
<tr>
<td>201</td>
<td>Ext Analog Input 3</td>
</tr>
<tr>
<td>Page</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>202</td>
<td>Conv Set Point</td>
</tr>
<tr>
<td>203</td>
<td>Cal. Pressure 3</td>
</tr>
<tr>
<td>204</td>
<td>PTF Correction (gas 3)</td>
</tr>
<tr>
<td>205</td>
<td>Dilution Ratio</td>
</tr>
<tr>
<td>206</td>
<td>Traffic Light</td>
</tr>
<tr>
<td>207</td>
<td>Network Protocol</td>
</tr>
<tr>
<td>208</td>
<td>Gas 4 Offset</td>
</tr>
<tr>
<td>209</td>
<td>O3 GEN Fine Pot</td>
</tr>
<tr>
<td>210</td>
<td>O3 Gen Lamp Current</td>
</tr>
<tr>
<td>211</td>
<td>O3 GEN Coarse Pot</td>
</tr>
<tr>
<td>212</td>
<td>Logging Period</td>
</tr>
<tr>
<td>213</td>
<td>O3 Gen Coeff A</td>
</tr>
<tr>
<td>214</td>
<td>O3 Gen Coeff B</td>
</tr>
<tr>
<td>215</td>
<td>O3 Gen Coeff C</td>
</tr>
<tr>
<td>216</td>
<td>Meas. Count</td>
</tr>
<tr>
<td>217</td>
<td>Sig. Count 1</td>
</tr>
<tr>
<td>218</td>
<td>Sig. Count 2</td>
</tr>
<tr>
<td>219</td>
<td>Sig. Count 3</td>
</tr>
<tr>
<td>220</td>
<td>Sig. Count 4</td>
</tr>
<tr>
<td>221</td>
<td>Signal Voltage</td>
</tr>
<tr>
<td>222</td>
<td>LED Drive</td>
</tr>
</tbody>
</table>
This page is intentionally blank.
Appendix B.  EC9800 Protocol

The Serinus implements a subset of the 9800 instrument protocol. Only the basic commands of reading the concentration value and setting the instrument calibration state (measure, span or zero) are supported.

B.1 Command Format

All commands are sent as ASCII strings. Fields are delimited by commas and the command ends with the normal return key (i.e. the TERMINATOR is either a <CR> or a <LF>). The DEVICE I.D. is the Serial ID assigned in the Main Menu → Communications Menu → Serial Communication Menu. If the instrument is not being used in a multi-drop connection, the DEVICE I.D> can be replaced with the string “???”.

B.2 Commands

B.2.1 DCONC

Function: Sends the current instantaneous concentration data to the serial port.
Format: DCONC, {<DEVICE I.D.>} {TERMINATOR}
Device response: {GAS} <SPACE> {STATUS WORD} <CR><LF>

The GAS value is the concentration value in the current instrument units, expressed as a floating point number (i.e. 12.345). The STATUS WORD indicates the instrument status in hex (i.e. A01F) using the following format:

Bit 15 = SYSFAIL (MSB)
Bit 14 = FLOWFAIL
Bit 13 = LAMPFAIL
Bit 12 = CHOPFAIL
Bit 11 = CVFAIL
Bit 10 = COOLERFAIL
Bit 9  = HEATERFAIL
Bit 8  = REFFAIL
Bit 7  = PS-FAIL
Bit 6  = HV-FAIL
Bit 5  = OUT OF SERVICE
Bit 4  = Instrument is in zero mode
Bit 3  = Instrument is in span mode
Bit 2  = Unused
Bit 1  = SET→PPM selected, CLEAR→MG/M3
Bit 0  = reserved (LSB)

B.2.2 DSPAN

Function: Commands the instrument to enter span mode.
Format: DSPAN, {<DEVICE I.D.>} {TERMINATOR}
Device response: <ACK> if the instrument is able to perform the command, <NAK> if not.
B.2.3 DZERO
Function: Commands the instrument to enter the zero mode.
Format: DZERO, {<DEVICE I.D.>} {TERMINATOR}
Device response: <ACK> if the instrument is able to perform the command, <NAK> if not.

B.2.4 ABORT
Function: Commands the instrument to abort the current span/zero mode and return to measure mode.
Format: ABORT, {<DEVICE I.D.>} {TERMINATOR}
Device response: <ACK> if the instrument is able to perform the command, <NAK> if not.

B.2.5 RESET
Function: Reboots the instrument (software reset).
Format: RESET, {<DEVICE I.D.>} {TERMINATOR}
Device response: <ACK>.
Appendix C. Bayern-Hessen Protocol

The Serinus implements a limited subset of the Bayern-Hessen Network protocol. Only the ability to set the instrument calibration state (measure, span or zero) and read the gas concentrations are supported.

C.1 Command Format

<STX><text><ETX><bcc1><bcc2>

Where:

<STX> ASCII Start of Text = 0x02 hex.
<Text> ASCII text maximum length of 160 characters.
<ETX> ASCII End of Text = 0x03 hex.
<bcc1> ASCII representation of block check value MSB. (That is, the character “3” for 3, the character “F” for 15, etc.)
<bcc2> ASCII representation of block check value LSB.

The block check algorithm begins with 0 and exclusive-OR’s each ASCII character from <STX> to <ETX> inclusive. This block check value is converted to ASCII format and sent after the <ETX> character.

Examples

This is an example of a valid Bayern-Hessen data request for an instrument that has a Serial ID of 97 (Serial ID assigned in the Main Menu → Communications Menu → Serial Communication Menu):

<STX>DA097<ETX>3A

The block check calculation is best shown by the following example:

Table 27 – Bayern-Hessen Data

<table>
<thead>
<tr>
<th>Character</th>
<th>Hex Value</th>
<th>Binary</th>
<th>Block Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;STX&gt;</td>
<td>02</td>
<td>0000 0010</td>
<td>0000 0010</td>
</tr>
<tr>
<td>D</td>
<td>44</td>
<td>0100 0100</td>
<td>0100 0110</td>
</tr>
<tr>
<td>A</td>
<td>41</td>
<td>0100 0001</td>
<td>0000 0111</td>
</tr>
<tr>
<td>0</td>
<td>30</td>
<td>0011 0000</td>
<td>0011 0111</td>
</tr>
<tr>
<td>9</td>
<td>39</td>
<td>0011 1001</td>
<td>0000 1110</td>
</tr>
<tr>
<td>7</td>
<td>37</td>
<td>0011 0111</td>
<td>0011 1001</td>
</tr>
<tr>
<td>&lt;ETX&gt;</td>
<td>03</td>
<td>0000 0011</td>
<td>0011 1010</td>
</tr>
</tbody>
</table>

The binary value 0011 1010 corresponds to the hex value 3A. This value in ASCII forms the last two characters of the data request message.
Note: The I.D. of 97 is sent as the sequence 097. All I.D. strings must have three digits and must always be padded with ASCII zero characters.

This is an example of a valid command to put the unit in the manual span mode if the instrument has an ID of 843:

<STX>ST843 K<ETX>52

The block check operation is best shown with the following table:

**Table 28 – Block Check Operation**

<table>
<thead>
<tr>
<th>Character</th>
<th>Hex Value</th>
<th>Binary</th>
<th>Block Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;STX&gt;</td>
<td>02</td>
<td>0000 0010</td>
<td>0000 0010</td>
</tr>
<tr>
<td>S</td>
<td>53</td>
<td>0101 0011</td>
<td>0101 0001</td>
</tr>
<tr>
<td>T</td>
<td>54</td>
<td>0101 0100</td>
<td>0000 0101</td>
</tr>
<tr>
<td>8</td>
<td>38</td>
<td>0011 1000</td>
<td>0011 1101</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
<td>0011 0100</td>
<td>0000 1001</td>
</tr>
<tr>
<td>3</td>
<td>33</td>
<td>0011 0011</td>
<td>0011 1010</td>
</tr>
<tr>
<td>&lt;SPACE&gt;</td>
<td>20</td>
<td>0010 0000</td>
<td>0001 1010</td>
</tr>
<tr>
<td>K</td>
<td>48</td>
<td>0100 1011</td>
<td>0101 0001</td>
</tr>
<tr>
<td>&lt;ETX&gt;</td>
<td>03</td>
<td>0000 0011</td>
<td>0101 0010</td>
</tr>
</tbody>
</table>

The binary block check value is 0101 0010 which is the hex value 52 as shown at the end of the command string.

**C.2 Commands**

**C.2.1 DA**

Return the current instantaneous concentration.

**Command Format**

<STX>[DA]{<kkk>}{<ETX>}{<bcc1>}{<bcc2>}

Where:

<table>
<thead>
<tr>
<th>kkk</th>
<th>Device’s ID. This field is optional, but if provided it must be padded with zeros to be 3 characters long. The value must match one of the following: the instrument’s Bayern-Hessen ID, 000, or ??? (three question marks).</th>
</tr>
</thead>
<tbody>
<tr>
<td>bcc1</td>
<td>First byte of the block check calculation.</td>
</tr>
<tr>
<td>bcc2</td>
<td>Second byte of the block check calculation.</td>
</tr>
</tbody>
</table>
Device response

The instrument responds with a variable length string, depending on how many measured gasses have been assigned an ID above 0. The text between the [] will be repeated once for each reported gas.

<STX>{MD}{cc}<SP><kkk><SP><+nnnn+ee><SP><ss><SP><ff><SP><mmm><SP>eeeeee<SP>]<ETC><bcc1><bcc2>

Where:

<SP> Space (0x20 hex).
cc The number of gasses reported (0..5). The text in between the [ ] will be repeated once for each gas reported.
kkk The Bayern-Hessen instrument ID.
+nnnn+ee Gas concentration.
ss Status byte (see table below for individual bits).
ff Failure byte (see table below for individual bits).
mmm Gas ID.
eeeeee Ecotech instrument ID.
bcc1 First byte of the block check calculation.
bcc2 Second byte of the block check calculation.

Table 29 – Status Bit Map

<table>
<thead>
<tr>
<th>Status Bit</th>
<th>Meaning if set to 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Instrument off (this value is always set to 0).</td>
</tr>
<tr>
<td>1</td>
<td>Out of service.</td>
</tr>
<tr>
<td>2</td>
<td>Zero mode.</td>
</tr>
<tr>
<td>3</td>
<td>Span mode.</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Units: 1 = Volumetric, 0 = Gravimetric.</td>
</tr>
<tr>
<td>7</td>
<td>Background mode (S30 and S50 family only).</td>
</tr>
</tbody>
</table>

Table 30 – Failure Bit Map (Positive Logic)

<table>
<thead>
<tr>
<th>Failure Bit</th>
<th>Meaning if set to 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Flow sensor failure.</td>
</tr>
</tbody>
</table>
### Failure Bit

<table>
<thead>
<tr>
<th>Failure Bit</th>
<th>Meaning if set to 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Instrument failure. Note that while the In Maintenance mode reports as an instrument failure with a red light on the front panel, for Bayern-Hessen this particular error is merely a status instead of a failure.</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Lamp failure (S40 family only).</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Cell heater failure (S30, S40 and S50 family only).</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
</tr>
</tbody>
</table>

### C.2.2 ST

Set the instrument mode.

**Command Format**

```
<STX>{ST}{< kkk>}{SP}{command}<ETC><bcc1><bcc2>
```

Where:

- **kkk**: Device’s Serial ID. This field is optional, but if provided it must be padded with zeros to be 3 characters long. The value must match one of the following: the instrument’s Bayern-Hessen ID, 000, or ??? (three question marks).

- **Command**: M, N or K for Measure, Zero or Span mode.

- **bcc1**: First byte of the block check calculation.

- **bcc2**: Second byte of the block check calculation.

**Device response**

The device does not issue a response to this command.
Appendix D.  ModBus Protocol

The Serinus supports a limited Modbus implementation. The only function codes supported are 3 (read holding register) and 16 (write multiple registers). The Serial ID is assigned in the Main Menu → Communications Menu → Serial Communication Menu.

D.1 Command Format

<Slave address><Function code><Start register (MSB)><Start register <LSB><Register count (MSB)><Register count (LSB)><Write byte count><Write data><CRC (MSB)><CRC (LSB)>

Where:

Slave address  
The instrument Serial ID. If the request is being made via TCP, this field is omitted.

Function code  
3 (read) or 16 (write).

Start register  
Specifies an Advanced Protocol IEEE index (refer to Table 26 to see what values are available and what index to specify for them). The ModBus index is calculated from the Advanced Protocol index via the following formula:

$$\text{Modbus Index} = \text{Advanced Protocol Parameter List number} \times 2 + 256$$

Register count  
A single read command may request from 2 to 124 registers, which is to say from 1 to 62 values. The first index is specified by Start register; all following indexes are in sequential order. To read values that are not sequential requires using another read command. Note that the number of registers must be even, as each value is returned as a floating point value (4 bytes) and each register is a word (2 bytes).

A write command can only write a single IEEE value at a time. Thus for write commands this value must be 2.

Write byte count  
This field is only supplied for a write request; it indicates the amount of bytes of data that will follow, and must be set to 4 (since only one value can be written at a time).

Write data  
This field is only supplied for a write request. It is the value to be written, expressed in IEEE format. The “Endian” structure can be selected on the Modbus Serial Communications menu. Big Endian means that the MSB byte of the IEEE value is at the right end of the four bytes; Little Endian means it is at the left.

CRC  
Calculated by the standard Modbus CRC method. If the request is being made via TCP, this field is omitted.
D.2 Commands

D.2.1 Read Holding Registers

The response to a read request is in the following format:

<Slave address>3<Register count (MSB)><Register count (LSB)><Data><CRC (MSB)><CRC (LSB)>

Where:

Slave address As general command format.
Register count As general command format.
Data 4 to 248 bytes of data, representing 1 to 62 floating point numbers in IEEE format. The “Endian” structure can be selected on the Modbus Serial Communications menu. Big Endian means that the MSB byte of the IEEE value is at the right end of the four bytes; Little Endian means it is at the left.
CRC As general command format.

D.2.2 Write Holding Register

The only supported use for this command is to set the instrument into a calibration state.

Where:

Start register MSB 1
Start register LSB 170
Register count 2
Write Data bytes The IEEE representation of 0, 1, 2, or 3
0 puts the instrument into Measure mode (0,0,0,0)
1 puts the instrument into Cycle mode (63,128,0,0)
2 puts the instrument into Zero mode (64,0,0,0)
3 puts the instrument into Span mode (64,64,0,0)

The response to a write request is to return the first six bytes of the initiating write request.

D.2.3 Error

An error will be returned in the following format:

<Slave address><Function code><Exception code><CRC (MSB)><CRC (LSB)>

Slave address As general command format.
Function code The initiating command’s function code + 128; so either 131 (read) or 144 (write).
Exception code The error code (see table below).
CRC As general command format.

**Table 31 – Modbus Error Codes**

<table>
<thead>
<tr>
<th>Value</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Illegal Function</td>
</tr>
<tr>
<td>2</td>
<td>Illegal Data Address</td>
</tr>
<tr>
<td>3</td>
<td>Illegal Data Value</td>
</tr>
<tr>
<td>4</td>
<td>Slave Device Failure</td>
</tr>
</tbody>
</table>

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