ecotech
environmental monitoring solutions

Serinus 30

Carbon Monoxide Analyser

User Manual

Version: 2.2

www.ecotech.com

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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 carbon monoxide measurements over a range of 0-200ppm 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.

Reference should also be made to the relevant local standards which should be used in conjunction with 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 then please do not hesitate to contact Ecotech or your local Ecotech distributor.

Please help the environment and recycle the pages of this manual when you have finished using it.

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 notice.

CAUTION

Hazardous voltages exist within the analyser. The analyser lid should be closed when the analyser is left unattended or turned on. Ensure the power cable, plugs and sockets are maintained in a safe working condition.

Safety Requirements

To reduce the risk of personal injury caused by electrical shock, follow all safety notices and warnings in this documentation.

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

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 assurance standards. Always disconnect the power source before removing or replacing any components.

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, fuses, filters, batteries and other consumable items are not covered by this warranty.

Each analyser is subjected to a vigorous testing procedure prior to despatch and will be accompanied with a parameter list and a multipoint calibration check thereby enabling the analyser 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. You are welcome to speak to a service technician regarding any questions you have about your analyser.

Service Guidelines

In the first instance, please call or email us if you are experiencing any problems or issues with your analyser.

If you are within Australia or New Zealand please contact our service response centre via email on service@ecotech.com.au or call +61 (0)3 9730 7800

If outside of Australia and New Zealand please email our international support department at intsupport@ecotech.com or call +61 3 9730 7800

If we cannot resolve the problem through technical support, please email 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
- Original sales order or invoice number related to the equipment

When you email us we will assign a Return Material Authorisation (RMA) number to your shipment and initiate the necessary paperwork to process your equipment within 48 hours.

Please include this RMA number when you return equipment, preferably both inside and outside the shipping packaging. This will ensure you receive prompt service.

CE Mark Declaration of Conformity

This declaration applies to the Serinus 30 Carbon Monoxide Analyser as manufactured by Ecotech Pty. Ltd. of 1492 Ferntree Gully Rd, Knoxfield, VIC, 3180, Australia. The instrument to which this declaration relates is in conformity with the following European Union Directives:

Council Directive of 15 December 2004 on the approximation of the laws of Member States relating to electromagnetic compatibility (2004/108/EC)

The following standard was applied:

EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements.

Immunity Requirements EN 61326-1

IEC-61000-4-2	Electrostatic discharge immunity
IEC-61000-4-3	Radiated RF immunity
IEC-61000-4-4	Electrical fast transient burst immunity
IEC-61000-4-5	Surge immunity
IEC-61000-4-6	Conducted RF Immunity
IEC-61000-4-11	Voltage dips and interruption immunity

Electromagnetic Compatibility EN 61326-1

CISPR-11	Radiated RF emission measurements
CISPR-11	Mains terminal RF emission measurements
IEC-61000-3-3	Mains terminal voltage fluctuation measurements
IEC-61000-3-2	Power frequency harmonic measurements

Council Directive of 12 December 2006 on the harmonisation of the laws of member states relating to electrical equipment designed for use within certain voltage limits (2006/95/EC)

The following standard was applied:

EN 61010-1:2001	Safety requirements for electrical equipment, for measurement control and laboratory use – Part 1: General requirements.

For protection against:

- Electric shock or burn
- Mechanical HAZARDS
- Excessive temperature
- Spread of fire from the equipment
- Effects of radiation, including laser sources and sonic and ultrasonic pressure

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 you 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. We will not be responsible for shortages against the packing list unless they are reported promptly (within 7 days).

Contact Details

Head Office
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Email: info@ecotech.com
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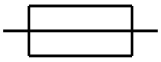
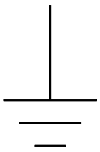
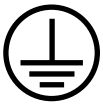
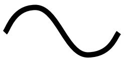
Internationally Recognised Symbols on Ecotech Equipment

	Electrical fuse	IEC 60417-5016
	Earth (ground) terminal	IEC 60417-5017
	Protective conductor terminal	IEC 60417-5017
	Equipotentiality	IEC 60417-5021
	Alternating current	IEC 60417-5032
	Caution, hot surface	IEC 60417-5041
	Caution, risk of danger. Refer to accompanying documents	ISO 7000-0434
	Caution, risk of electric shock	ISO 3864-5036

Manual Revision History

Manual PN: M010027

Current revision: 2.2

Date released: 10 December 2013

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.

Table 1 – Manual revision history

Edition	Date	Summary	Pages
1.0	October 2008	Initial release	All
1.1	February 2009	Updated communications	37
1.2	February 2009	New maintenance procedures Updated analyser set-up Small corrections	35, 44 13 Various
1.3	November 2009	Updates to menu system Serinus downloader software Internal pump option Advanced parameter list	20-31 63 123 125
1.4	September 2010	CE conformity added Updated parts list Pressurised zero/span valve added Updates to rack mount option Updates to Serinus downloader Update to 25 pin I/O Update to network communication	12 106 93 119 63 60 60
		Analog inputs Network adapter menu	32-34 55
2.0	July 2012	New chassis Update menu system Add Bluetooth menu Serinus Remote Android App Rack mount procedure update Analog output calibration	Various

Edition	Date	Summary	Pages
2.1	March 2013	General overhaul of manual drawings, pictures and content. Format updated.	Various
2.2	November 2013	Formatting updates Addition of Airodis installation steps	All 63-73

1. Introduction

1.1 Description

The Ecotech Serinus 30 Carbon Monoxide Analyser is used to measure CO in ambient air, in the range of 0-200ppm. The Serinus 30 measures CO using the following components:

- Microprocessor control
- Proven Gas Filter Correlation (GFC)
- Combined with Non-Dispersive Infrared Spectrophotometry (NDIR) technology

A microprocessor programmed with Serinus firmware monitors the detector response and many other parameters. The CO concentrations are automatically corrected for gas temperature and pressure changes and when using gravimetric units (e.g. µg/m^3) is referenced to 0°C, 20°C or 25°C at 1 atmosphere. This allows the Serinus 30 to provide readings in the relevant units for your requirements.

The U.S. EPA has designated the Serinus 30 Carbon Monoxide Analyser as a Reference Method and SIRA has designated it as an EN approved instrument

1.2 Specifications

1.2.1 Measurement

Range

0-200 ppm auto ranging.

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

MCERTS 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

99 to 132 VAC (57-63 Hz) or via switch 198 to 264 VAC (47-53 Hz).

U.S. EPA designated range: 105-125 VAC, 60 Hz.

Power Consumption

265 VA maximum (typical at start-up).

190 VA after warm-up.

Fuse Rating

20x5 mm, T 250 V, 5 A (slow blow).

1.2.5 Operating Conditions

Ambient Temperature Range

0 °C to 40 °C (32 °F-104 °F).

U.S. EPA designated range: 20 °C-30 °C.

Sample Pressure Dependence

5% change in pressure produces less than a 1% change in reading.

Maximum altitude: 3000 m above sea level.

1.2.6 Communications

- USB port connection on rear panel

- Bluetooth (digital communication via Android App)
- TCP/IP Ethernet network connection (optional)
- RS232 port #1: Normal digital communication
- RS232 port #2: Multi-drop port used for multiple analyser connections on a single RS232 cable
- USB memory stick (front panel) for data logging, event logging and parameter/configuration storage

Protocols

Modbus RTU/TCP, Bavarian, EC9800, Advanced.

25 Pin I/O Port

- Analog output (menu selectable current or voltage output):
  - Current output of 0-20 mA, 2-20 mA or 4-20 mA
  - Voltage output of 0-5 V, with menu selectable zero offset of 0 V, 0.25 V or 0.5 V
  - Range: 0 to full scale from 0-0.05 ppm to 0-20 ppm
- 8 digital outputs, open collector max 400 mA/12 VDC (max total output 2 A)
- 8 digital inputs, 0-5 VDC, CAT I rated
- Three analog voltage 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 (w/ 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 (Sira MC 100166/02)
- Non Dispersive I.R. Spectrometry method EN1426
- Determination of carbon monoxide AS 3580.7.1.2011 Australian/New Zealand standards

1.3 Nomenclature

CO:	Carbon monoxide.
Span:	A gas sample of known composition and concentration used to calibrate/check the upper range of the instrument (carbon monoxide).
Zero:	Zero calibration uses zero air (CO scrubbed ambient air) to calibrate/check the lower range of the instrument.
Background:	Is the reading of the sample without carbon monoxide present in the measurement cell
Zero Drift:	The change in instrument response to zero air over a period of continuous unadjusted operation.
Automatic Zero:	The automatic zero performs a zero check at a specified time through a 24 hour cycle which adjusts the lower limit of the analysers.
Zero Air:	Is purified air in which the concentration of CO is <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.
External Span Source:	Span gas that is delivered via an external accredited cylinder (e.g. NATA/NIST).
Sample Air:	Sample air is defined as the sample before it has entered the reaction cell, as distinguished from the exhaust air.
Exhaust Air:	Exhaust air is the sample air after it has passed through the reaction/measurement/detection cell and is moving towards being expelled from the analyser.
ID and OD:	These are measurements of tubing. ID is the internal diameter of tubing, OD is the outer diameter.
Multi-drop:	A configuration of multiple analysers connected via the same RS232 cable.
Photomultiplier Tube:	A highly sensitive device which can detect extremely low levels of light (photons) and multiply the electrical signal to a point where it can be accurately measured. These are often called PMTs for short.
Bootloader:	A program that checks whether the current firmware is valid, then 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 then enables various low level recovery tools, including updating the main firmware from a USB key.

1.4 Background/Theory

Carbon monoxide poisoning is the most common type of fatal poisoning in many industrialised countries[1]. 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 5 metre folded path length through sample air. The strength of the signal received is proportional to the amount of CO in the sample as shown in the Beer Lambert Law. A band pass filter is fitted to the signal detector to ensure only light near 4.7 microns wavelength is detected.

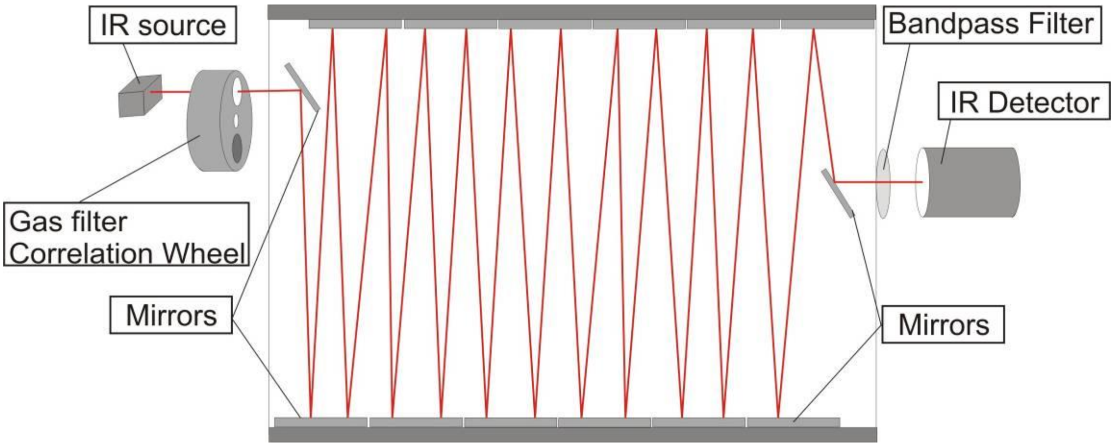


Figure 1 – Measurement cell theory

A gas filter correlation wheel is combined with this system. This wheel contains 3 parts to increase measurement accuracy; CO, N_2 and the mask.

[1] Toxicology. 2002 Nov 15;180(2):139-50

- The CO window contains a saturation (40%) of CO which acts as a reference beam – absorbing a known amount of light.
- The N_2 window, containing 100% N_2, 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 and the strength of other signals relative to each other and the background.

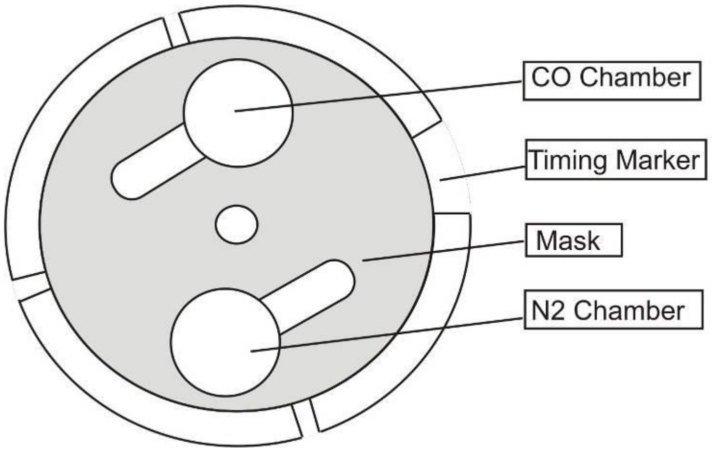


Figure 2 – Correlation wheel

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:

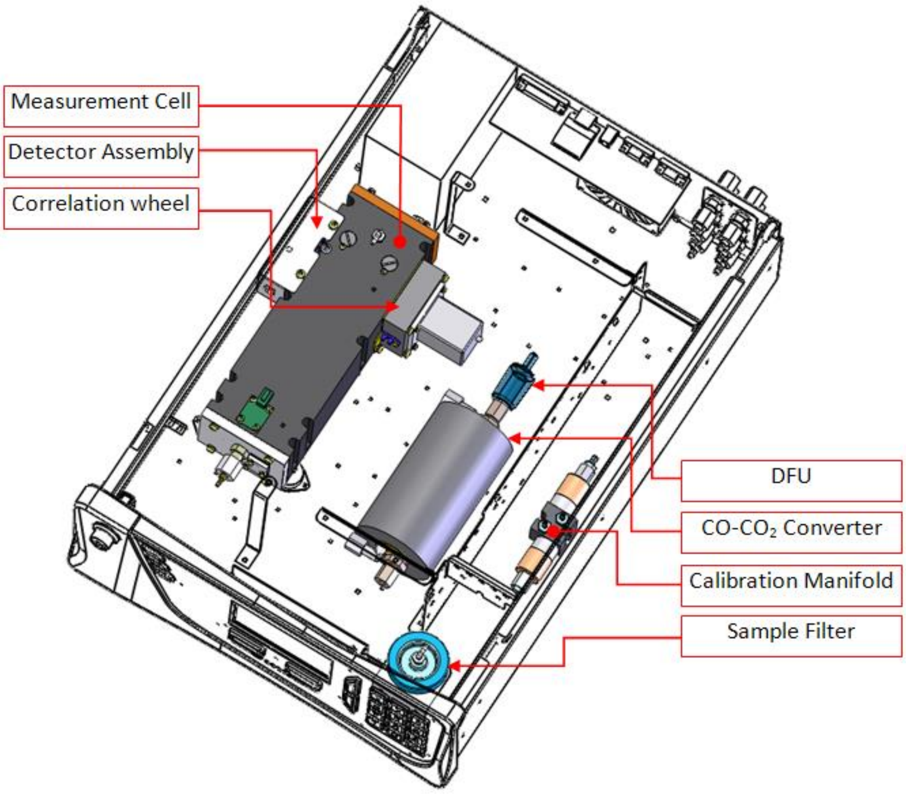


Figure 3 – Major components

1.5.1 Calibration Valve Manifold

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

1.5.2 Particulate Filter

The particulate filter is a Teflon 5 micron (µm) filter with a diameter of 47mm. This filter eliminates all particles larger than 5 µm that could interfere with sample measurement.

1.5.3 CO-CO_2 Converter

The CO-CO_2 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.

1.5.4 Optical Cell

The optical cell consists of the following components:

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 3 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 PCB can determine accurate timing of the wheel and which segment is currently exposed to the IR radiation.

Measurement Cell

The measurement cell contains 5 mirrors that form a five meter path length through the cell. The sample gas fills this chamber and the IR light travels through the sample.

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/PCB

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 Main Controller PCB

The main controller PCB controls all the processes within the instrument. It contains a battery backed clock, calendar and an on-board microprocessor. The main controller PCB is located on top of the other components with the analyser. The PCB pivots on hinges allowing access to the components underneath.

CAUTION

Never place objects on top of the main controller PCB as it may result in damage.

1.5.7 Power Supply

The power supply is a self-contained unit housed in a steel case.

It has a selectable input voltage of 115 or 230 VAC, 50/60 Hz and an output voltage of 12 VDC power for distribution within the analyser.

CAUTION

Input voltage can be manually changed by sliding the red switch left (230) for 220-240 V or right (110) for the 100-120 V. Ensure the switch is set to the correct voltage (from supply) before switching on.

1.5.8 On/Off Switch

Located on the back panel (bottom right facing the rear of the instrument).

1.5.9 Communications

Communication between the analyser and either a data logger, laptop or network can be performed with the following communication connections located on the back panel (refer to Figure 5).

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 multi-drop configuration.

USB

This port can be used for instrument communication and is also good for quickly downloading data, onsite diagnostics, maintenance and firmware upgrades.

TCP/IP (optional)

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

External I/O Port

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 analyser is equipped with three analog outputs. Menu selectable as either voltage output 0-5 VDC, or current output 0-20, 2-20, 4-20 mA.

Analog Inputs

The analyser 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 analyser is equipped with 8 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 analyser is equipped with 8 open collector outputs which will convey instrument status conditions and warning alarms such as no flow, sample mode, etc.

CAUTION

Exceeding 12 VDC or drawing greater than 400 mA on a single output or a total greater than 2 A across the 8 outputs can permanently damage the instrument and void the warranty.

Bluetooth

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

2. Installation

2.1 Initial Check

Packaging

The Serinus 30 is transported in packaging which is 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 in 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, then 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 4).
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).

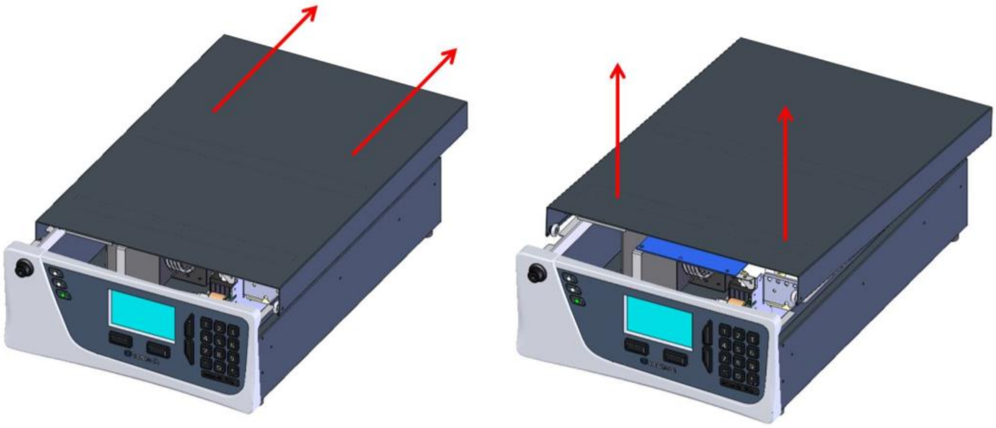


Figure 4 - Opening the instrument

Items Received

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

• Ecotech Serinus 30 instrument		PN: E020030
• Software CD		PN: S040001
• End caps		PN: B010002
• Manual		PN: M010027 (hardcopy optional)
• USB stick		PN: H030021
• Power cord (120 V)*		PN: C040007
• Power cord (240 V)*	Australia	PN: C040009
	Europe	PN: C040008
	UK	PN: C040010

*Power cord received depends on the power supply of the country (120 V or 240 V).

Note: Please 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 Mounting/Installing

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

- The analyser 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 analyser 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 flash) 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 analyser.
- When supplying span gas, ensure the flow is approximately 1.5 lpm and excess is sufficiently vented.
- Undo the travel screws from the cell as shown in the drawing supplied (refer to Section 2.3.4).

Note: The power on/off switch is accessible from the rear of the instrument only. Site the analyser so that the on/off power switch is accessible.

2.3 Instrument Set-up

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

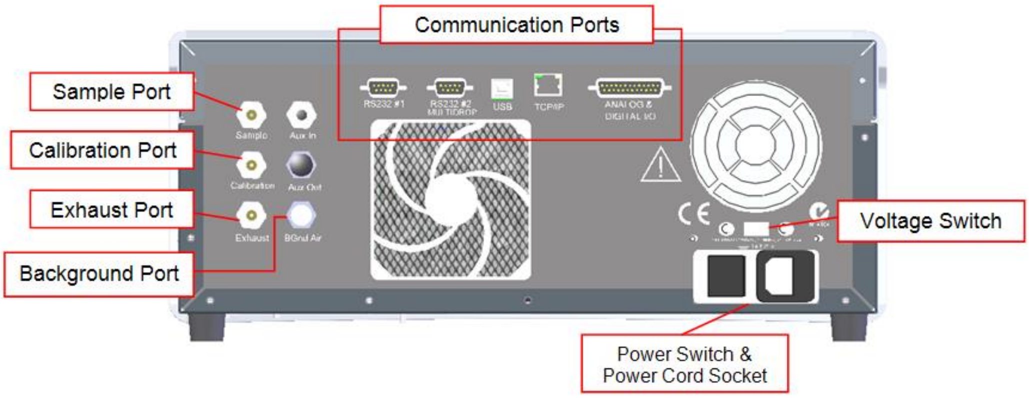


Figure 5 – Instrument back panel

2.3.1 Pneumatic Connections

The Serinus 30 has 4 pneumatic ports on the back panel of the analyser; 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 2 meters in length with ⅛ inch ID, ¼ 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, then insert the tubing through the back of the nut with the tube extending 1 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 sample manifold (1 slpm for measurement plus approximately 50% overflow).

Calibration Port

The Calibration Port should be connected to the span/zero source. It is recommended that a dilution gas calibrator be used with carbon monoxide to deliver precise concentrations of CO.

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

Exhaust Port

The Exhaust Port is where the measured sample is exhausted from the analyser. The exhaust tubing should be fitted to a vacuum pump (minimum: 1.5 SLPM at 50 kPa) if the internal pump option is not installed in your analyser.

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.

The Background Port is used to supply air to the CO to CO_2 converter (i.e. CO scrubber) within the instrument. This is used for backgrounds and internal zero calibration.

2.3.2 Power Connections

CAUTION

The following points MUST be followed. Incorrect setup and activation of instrument may cause damage and will void warranty.

When connecting the power source the following must be adhered to:

- Verify that the red switch (above power switch) is switched to the correct setting (230 V or 110 V)
- A three pin power plug (with ground) MUST be used with an earthed power socket (3 pin)
- Connect the power plug into the mains power point and turn the power switch on.

2.3.3 Communications Connections

There are a number of ways to communicate with the analyser:

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, data logger or in a multi-drop formation.

Note: When using multi-drop ensure each analyser is given a unique instrument ID.

USB

Connect a USB cable to a computer and run either the Serinus downloader program or the Ecotech WinAQMS data logger.

TCP/IP (optional)

Plug in a network cable (this cable should be attached to a network), then use the supplied Airodis software to access the instrument and download data. The Airodis software is supplied on the green USB resources key provided with the instrument.

Analog/Digital

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 8 digital inputs, 8 digital outputs, 3 analog inputs and 3 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 Analyser Set-up

1. Ensure that the USB key is installed.
2. Remove the travel screws from the measurement cell.

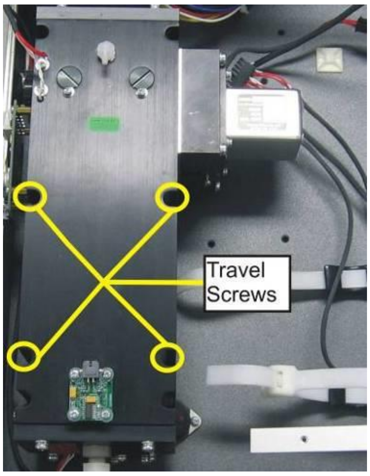


Figure 6 – Travel screw locations

3. Check that the battery is turned on at the main controller PCB (refer to Figure 7).
4. Turn on the instrument and allow the warm-up procedure to complete (refer to Section 3.1).
5. Check/set time and date (refer to Section 3.5.8).

6. Set the digital filter to desired setting (refer to Section 3.5.9).
7. Set the data logging options (refer to Section 3.5.21).
8. Set the analog/digital inputs and outputs settings (refer to Section 3.5.20).
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 over 3 hours. Wait for a stable concentration measurement for at least 1 hour.
12. Perform a multipoint calibration (refer to Section 5.3).
13. 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

5 micron PTFE filter must be installed in front of the sample inlet (zero and span gas must pass through this filter).

- If the units in the measurement menu are changed from volumetric to gravimetric (or gravimetric to volumetric) the analyser must be re-calibrated
- The analyser must be operated and maintained in accordance with this user manual

The following menu selections must be used:

Measurement Settings

Background interval: Enabled

Calibration Menu

Span comp: Disabled

Diagnostics Menu

Press/Temp/Flow comp: On

Diagnostic mode: Operate

Control loop: Enabled

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

- Internal pump
- Rack mount assembly
- Internal zero/span assembly (IZS)
- Optional Ethernet Port

2.5 EN Type Approval Set-up

The Serinus 40 has been certified to MCERTS performance standards for Continuous Ambient Air Quality Monitoring Systems. The certificate number is Sira MC 100167/02. The Serinus 40 must be used under the following conditions to meet EN requirements:

Range

0-50 ppb

Ambient Temperature

0-30 °C

The analyser must be operated and maintained in accordance with this user manual.

The following menu selections must be used:

Measurement Settings

Background interval: Enabled

Calibration Menu

Span comp: Disabled

Service→Diagnostics Menu

Press/Temp/Flow comp: On

Diagnostic mode: Operate

Control loop: Enabled

2.6 Transporting/Storage

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

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 (6 months) turn the battery off by moving the switch on the main processor board (shown in Figure 7) to the left.
4. Remove the instrument from the rack.
5. Replace the red plugs into the pneumatic connections.
6. Place the instrument back into a plastic bag with desiccant packs and then seal the bag (ideally the bag it was delivered in).
7. Place the instrument back into the original foam and box it was delivered in. If this is no longer available find some equivalent packaging which provides protection from damage.
8. 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).

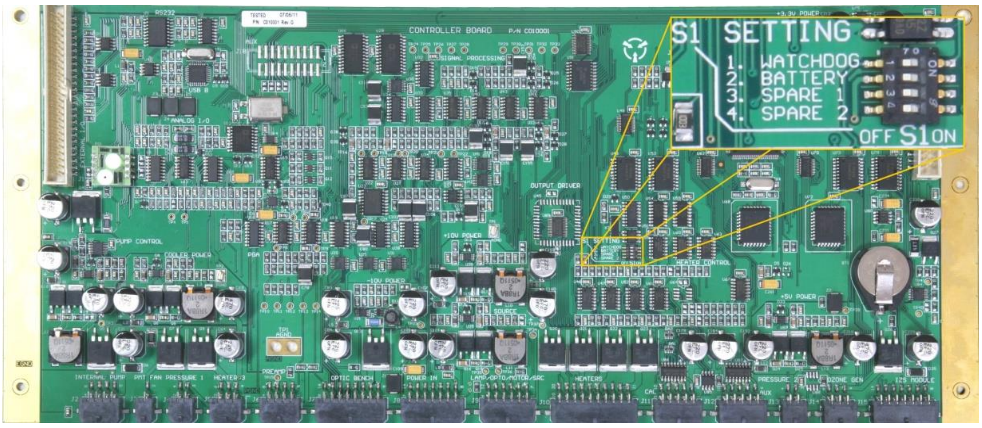


Figure 7 – Switching the battery on/off

3. Operation

3.1 Warm-up

Once the instrument is turned on it will adjust itself to prepare for monitoring. No measurements are taken during the warm-up.

The following activities occur during warm-up:

Auto Ref. Adjust

Adjusts the reference voltage and internal trim pot setting. Includes the sub actions; ref self-test/ zero self-test/auto ref adjust.

Converter is Cold

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

After this warm-up has completed the instrument will immediately begin taking measurements.

3.2 Measurement

The Serinus 30 primarily operates in one continuous cycle, the sample cycle. A background is performed after warm-up, once a day (at 23:50) or when the chassis temperature changes by 4°. It is used to measure background absorption in the cell and is subtracted from sample measurements.

Sample Cycle

- Sample fill: Measurement cell fills with sample air
- Sample measure: Measurement of sample air

Background Cycle

- Background fill: Measurement cell fills with background air
- Background measure: Measurement of background air

3.3 General Operational Information

The Serinus is operated with the use of 4 sets of buttons: (1) selection buttons (2) scrolling buttons (3) keypad and (4) instrument status light buttons.

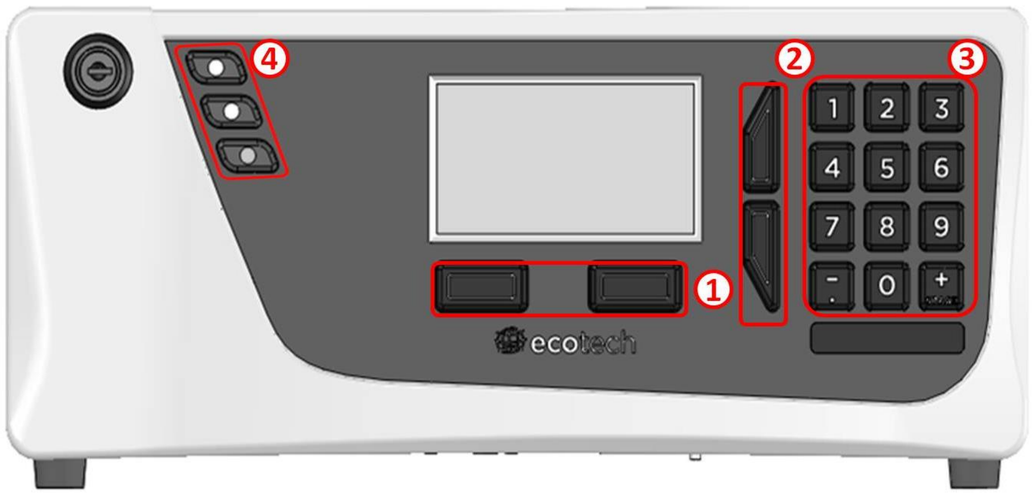


Figure 8 – Serinus front panel

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 main 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 contrast.

Keypad (3)

The keypad contains numbers 0-9, decimal point/minus key ($\overset{-}{.}$) and a space/plus key ($\overset{+}{\text{SPACE}}$). The number keys are used to input numbers; in those cases where letters can be entered, the number keys act like a telephone keypad.

The ($\overset{+}{\text{SPACE}}$) and key ($\overset{-}{.}$) key functions depend on context. When editing a floating point number, the key ($\overset{-}{.}$) 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 ($\overset{+}{\text{SPACE}}$) 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 ($\overset{+}{\text{SPACE}}$) and the ($\overset{-}{.}$) 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 flashing 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 a yellow or red light enter the **Main Menu → Analyser State → Status Menu** to find which components are failing (refer to Section 3.5.4).

The green status button will cancel any open edit box or menu and return to the main display.

If no instrument status lights are on and the keypad is backlit, then this indicates that the instrument is running the bootloader.

3.4 Main Display

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

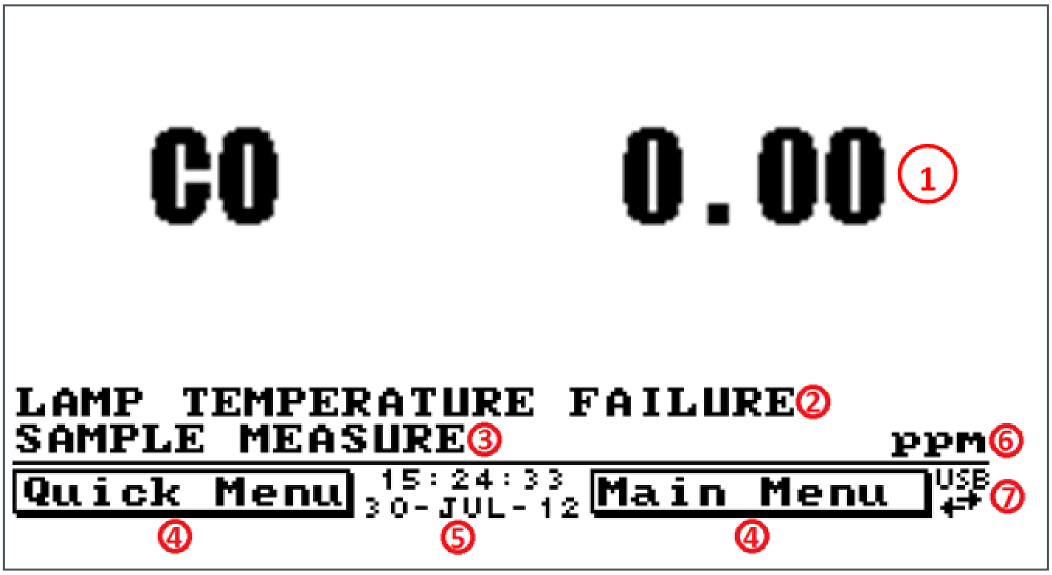


Figure 9 – Main screen

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 3.5.8).

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 3.5.4).

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 main screen to enter one of two menus. The **Quick Menu** (refer to Section 3.5.1) contains all information and features necessary for scheduled maintenance. The **Main Menu** (refer to Section 3.5.2) contains all information and fields available to users and is generally only used during initial setup 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 current 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 (behind 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 3.5.1)

3.5 Menus & Screens

The menu system is divided into two sections, the **Quick Menu** and the **Main Menu**. The **Quick Menu** contains all information and operations necessary during scheduled maintenance visits. The **Main Menu** contains all fields that are accessible to users; they provide information on component failures, 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 machine (for example, the manual Cal. Mode and Port can only be changed when the instrument is out of warm-up).

3.5.1 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.

Span Calibrate

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.

After activating the span calibrate field, a window will open with editable numbers. Change the numbers to match the concentration of the span gas that the instrument is sampling and select **Accept**. The instrument span calibration has now been performed.

Event Log

This field enters a screen with a log of all the events that the instrument has performed. These events include calibrations, errors, backgrounds and warnings. This log is stored on the removable USB flash memory.

Instrument

This field allows the instrument to be set to either **Online** (normal instrument operation) or **In Maintenance**. This field is used to change the instrument to **In Maintenance** when service work is being performed.

Safely Remove USB

Before removing the USB memory stick, always select this menu item (also present in the **Service Menu** Section 6). Failure to do this may cause corruption of the memory stick.

Gain

This is a multiplication factor which is used to adjust the concentration measurement to the appropriate level (set by performing a **Span Calibrate**). This should be recorded after each calibration in the station log book.

Service Due

A field that notifies the user when the next instrument service is due. This value is editable in the **Next Service Due** field of the **Service Menu** (refer to Section 3.5.14). This field is only displayed in the 2 weeks prior to the date displayed in this field, or after the date has occurred.

3.5.2 Main Menu

There are six menus found on the main menu screen.

Figure 10 – Main menu

Note: Only fields that are bold are editable/selectable.

Analyser State	Refer to Section 3.5.3
General Settings	Refer to Section 3.5.8
Measurement Settings	Refer to Section 3.5.9
Calibration Menu	Refer to Section 3.5.10
Service Menu	Refer to Section 6
Communications Menu	Refer to Section 3.5.20

3.5.3 Analyser State

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

Status	Refer to Section 3.5.4
Temperatures	Refer to Section 3.5.5
Pressures & Flow	Refer to Section 3.5.6
Voltages	Refer to Section 3.5.7
Event Log	This field enters a screen with a log of all the events that the instrument has performed. These events include calibrations, errors, background measurements and warnings. This log is stored on the removable USB flash memory.
Firmware Version	This field displays the firmware version currently in use on this analyser. This can be important when performing diagnostics and reporting back to the manufacturer.
Instrument	This field displays the instrument model number.
Board Revision	This field displays the PCB board version.
Power Failure	This field displays the time and date of the last power failure (or when power was disconnected from the analyser).

3.5.4 Status

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.

Service Due	This field is visible with the next service due date if the service is due within the next two weeks.
Cell Temp.	Pass if the cell temperature is within ± 10% of the heater set point (refer to Section 3.5.8).
Mirror Temp.	Pass if the mirror temperature is within ± 10% of the heater set point (refer to Section 3.5.8).
Converter Temp.	The converter temperature should be 90°C ±10% to pass.
Sample Flow	Indicates whether the instrument has acceptable sample flow (based on the difference between cell and ambient pressures).
Flow Block Temp.	Pass if the flow block temperature is within 10% of the heater set point (to keep a constant accurate flow). This field is only present when the internal pump option is installed.
A/D Input	A reference voltage is monitored by the analog to digital converter IC; this field will display a pass if the voltage has acceptable limits.
Chassis Temperature	Displays whether the chassis temperature is within the acceptable limits (0-50 °C).
Ref Voltage	Checks that the reference voltage is within acceptable limits 3.6 V to 4.4 V.

Correlation Wheel	Detects whether the correlation wheel is functioning or not.
Lamp/Source	Checks if the reference voltage is close to 0, and the input pot close to 255, which can be caused by the IR source failing.
USB Memory Stick	Detects whether a USB memory stick is plugged into the front USB port.
Bkgnd 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).
CO Conc V Saturated	Indicates if the voltage of the concentration during CO measurement is within the limits of the analog to digital converter (-0.26 V to 3.29 V).

3.5.5 Temperatures

Temp. Units	Editable field to allow the user to change the current temperature units of the analyser (Celsius, Fahrenheit, or Kelvin).
Set Point (cell)	Editable field that sets the target temperature that some heated components are regulated to including the cell.
Cell	Displays current temperature of the reaction cell.
Converter	Temperature of the catalytic converter that converts CO to CO_2 at a temperature of 90 °C.
Flow block	If an internal pump is installed, if this field displays the current temperature of the flow block.
Chassis	Displays the temperature of air inside the chassis, measured on the main controller board.
Mirror	Temperature of the end-cap mirror plate on the reaction cell.

3.5.6 Pressures and Flow

Note: If your instrument contains an internal pump, refer to Section 8.3 for additions to the menu.

Press. Units	Select the units that the pressure will be displayed in (torr, PSI, mBar, ATM, kPa).
Ambient	Current ambient pressure.
Cell	Current pressure within the reaction cell.
Flow Set Point	The desired flow if the optional internal pump is installed.
Sample Flow	Indicates the gas flow through the Sample Port of the instrument (should be around 1.0).

Note: The sample flow will read 0.00 if there is a sample flow error.

3.5.7 Voltages

Conc Volt (raw)	Voltage from the sensor proportional to the detected signal from the reaction cell. This voltage represents the actual measurement of gas.
Ref. Voltage	The reference voltage is a measure of the IR source intensity.
Cooler Voltage	Voltage of the peltier cooler within the IR detector (~1.17 V). This voltage should be stable.
Analog Supply	+12 V (primary) power supply.
Digital Supply	+5 V microprocessor power supply.
-10V Supply	-10 V reading from the main controller board.

3.5.8 General Settings

Decimal Places	Select the number of decimal places (0-5) used for the concentration displayed on the front screen.
Concentration Units	Sets the concentration units. (ppm, ppb, ppt, mg/m^3,µg/m^3, ng/m^3).
Conversion Factor	This option only appears if concentration units are set to gravimetric. (mg/m^3, µg/m^3, ng/m^3). You can 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, kPa).
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 how long the instrument backlight will stay on for either seconds (30), minutes (1, 2, 5, 10, 30), hours (1), or always on/always off.
Front Screen	This field allows the user to display concentrations on the front 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 front screen. The average is measured over the time period set in **Measurement Settings** (refer to Section 3.5.9).
Char 0 has Slash	When enabled, the instrument will display the zero character with a slash (ø) to differentiate it from a capital 'O'.

3.5.9 Measurement Settings

Average Period	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).
Filter Type	Sets the type of digital filter used (None, Kalman, 10 sec, 30 sec, 60 sec, 90 sec, 300 sec or Rolling). Note: The Kalman filter is the factory default setting and must be used when using the instrument as a U.S. EPA reference method or to comply with EN certification. The Kalman filter gives the best overall performance for this instrument.
Rolling Size	Sets the period for the rolling average if the **Filter Type** is set to **Rolling**.
Bkgnd Interval	Sets the background interval time in hours (2, 4, 6, 8, 12, 24 or disabled). The background will begin 10 minutes before the end of the allocated period (e.g. to 12 hours a background occurs at 11:50 and 23:50). The results of the background are stored in the event log. Note: The default setting for this field is 24 hours.
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, calculates the standard deviation of the current 25 samples. This is a microprocessor-generated field and cannot be set by the operator. **Note:** This reading is only valid if zero air or a steady concentration of span gas has been fed to the analyser for at least one hour.

3.5.10 Calibration Menu

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

Calibration Type	Depending on the selection in this field, a number of extra menu items will be displayed. These are separately documented in Sections 0 and 3.5.12. Select the **Calibration Type** field and select either **Timed** or **Manual**. Timed calibration is an automatic calibration controlled by the: ▪ Interval between cycles ▪ Length of each calibration cycle ▪ When the calibration will begin ▪ Whether the calibration will perform automatic compensation **Note:** Timed calibration with span compensation enabled **does not** fulfil U.S. EPA approval. Manual calibration will perform a manual calibration depending on the calibration mode selected below.
Zero Source	Select whether the instrument will sample from the external Calibration Port or from the internal zero source when zero gas is requested.
Span Calibrate	This field is used to correct the span calibration setting and should be used only when a known concentration of span gas is running through the measurement cell. When the readings are stable, activate the **Span Calibrate** field, a window will open with editable numbers, change the numbers to the concentration that the instrument is receiving and select accept. The instrument span calibration has now been set.
Zero Calibrate	This field is used to correct the zero calibration setting on the CO channel. This option should be used only when zero gas is running through the measurement cell. When this is stable activate the **Zero Calibrate** field, a window will open with editable numbers. Leave the numbers at 0000.000 and select **Accept**.
Pressure Calibration	This menu allows the user to calibrate the pressure sensors as explained in section 5.5.
Flow Calibration	This menu only appears if the optional internal pump is installed, allowing the instrument flow sensors to be calibrated.
Calibration Pressure	This field displays the measured manifold pressure during the last calibration.
Calibration Temperature	Cell temperature when the last span calibration was performed.

3.5.11 Manual Mode

These items appear in the calibration menu when **Calibration Type** is set to **Manual.**

Calibration Mode **(Only accessible once instrument has completed warm-up)**	When calibration type is set to **Manual** the instruments operational mode can be chosen from the following: Measure: is the normal measurement through the Sample Port. Zero: this mode will take air through the Calibration Port so that a zero calibration can be performed. Data is flagged as zero data. Span: this mode will take air through the Calibration Port so that a span calibration can be performed. Data is flagged as span data. Cycle: performs a zero, then a span then returns to measure mode. The length of time spent measuring calibration gases is set in cycle time (below).
Cycle Time	The time period that the zero and then span ports will be selected when **Calibration Mode** is set to **Cycle**. Users can set the time from (5 to 59 minutes).

3.5.12 Timed Mode

These items appear in the calibration menu when **Calibration Type** is set to **Timed.**

Date	Enter the date for the next calibration to start.
Time	Enter the time that calibration will be performed. The time is set using a 24 hour clock.
Repeat	The calibration will be automatically run again after the specified amount of time. This field specifies the delay period (from 1 to 20,000 units, as specified below).
Units	This is the units of the repeat delay period. Thus, a repeat of 3 and units of days means that a calibration will automatically be performed every 3 days
Span Compensation	When **Enabled** the instrument will adjust the gain based on the span level, when set to **Disabled** no correction is made. **Note:** 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 during the timed span calibrations.
Cycle Time	The time period that the zero and then span ports will be selected when the calibration runs. Users can set the time from (5 to 59 minutes).

3.5.13 Flow Calibration

When the internal pump is installed in the analyser this menu is added, unique only to instruments with an internal pump.

Manual Flow Control	Enable or disable the automatic flow control.
Internal Pump	This field allows the internal pump to be turned on or Off. This field is only editable when the **Manual Flow Control** field is set to **On.**
Coarse	Internal pump speed control (coarse).
Fine	Internal pump speed control (Fine). **Note:** Coarse and fine are not selectable when the flow control is enabled.
Sample Flow	Current gas flow (This is only accurate when reading close to the flow calibration point).
Flow Set Point	The flow that the internal pump is set to control to.
Cal. Point	When **Manual Flow Control** is set to **Enabled**, then this is the flow at which the flow calibration was last performed. When set to **Disabled**, editing this field sets the current flow calibrated point to the value entered (must be calibrated at **Flow Set Point** for accurate flow control). Refer to Section 5.5.2 for details on the flow calibration procedure.
Zero Flow	When there is no flow through instrument (“Sample Flow” = 0) select this field to calibrate the zero flow point.
Valves Menu	Opens the **Valves Menu** where individual valves can be opened and closed (refer to Section 3.5.17 for the **Valves Menu**).

3.5.14 Service

Diagnostics	Refer to Section 3.5.15
Calculation Factors	Refer to Section 3.5.19
Save Configuration	Saves all of the EEPROM-stored user-selectable instrument configurations to the USB memory stick (calibration and communication settings, units, instrument gain etc). If you have problems with your instrument use this function to save settings to the removable USB stick and send this file (and the parameter list) to your supplier with your service enquiry.
Save Parameter List	Saves a text file of various parameters and calculation factors. If you have problems with your instrument use this function to save settings to the removable USB stick and send this file (and the configuration) to your supplier with your service enquiry.
Load Configuration	Loads a configuration file from the USB memory stick. Thus, you can save a configuration and restore it later.

Auto-Backup	Select whether the parameter and configuration files are automatically saved once a day (at midnight).
Load Auto-Backup Configuration	Loads the auto-backup configuration file. This is useful when the configuration has been changed in error.
Instrument	This field allows the instrument to be set to either **Online** (Normal instrument operation) or **In Maintenance** (data is not valid, as service work etc is being performed).
Next Service Due	User editable field to set the date when the next instrument service is required. Section 6.3 has a recommended maintenance schedule that may be used as a basis for the interval entered above. This value is also displayed as a non-editable field in the **Quick Menu** section.
Safely Remove USB Stick	This feature must be activated to safely remove the USB stick (also found in the **Quick Menu**).
System Restart	Activating this will reboot the microprocessor.

3.5.15 Diagnostics

Digital Pots	Refer to Section 3.5.16
Valves Menu	Refer to Section 3.5.17
Tests	Refer to Section 3.5.18
Pressure/Temperature /Flow Comp	Set to either **On** or **Off**. ▪ **On** is used to compensate analyser measurements for environmental fluctuations that might affect readings (pressure, temperature and flow). ▪ **Off** is used only when running diagnostics to see fluctuations in readings.
Diagnostics Mode	▪ **Operate** which leaves the instrument in normal operation mode. ▪ **Optic** which configures the instrument for tests on the optical measurement source. ▪ **Electrical** which configures the instrument for testing of the electrical circuits. ▪ **Preamp** which configures the instrument for testing of the pre-amplification circuitry. **Note:** Selecting any mode other than **Operate** will disrupt normal measurement.
Control Loop	When **Enabled** the instrument will control all processes within the instrument. Selecting **Disabled** pauses the instrument control over certain processes and parameters (e.g. digital pots). The user can now manually alter and adjust digital pots without the microprocessor overwriting the changes. **Note:** Turning off the control loop will disrupt normal measurement.

3.5.16 Digital Pots

Pots are electronically controlled digital potentiometers used for adjustments to operations of the analyser. This menu should be accessed only during diagnostics.

Unless the control loop is turned off (refer to Section 3.5.15), changes to the pots may be modified by the microprocessor. This is intentional; some diagnostics are best done with instrument feedback, and some are best done with the instrument inactive.

Table 2 – Digital pots

Digital Pot	Normal Range	Description
PGA Gain	(1-128)	Displays gain of the Programmable Gain Amplifier (used to boost the concentration voltage before the analog to digital converter).
Input Pot		Input gain – only part of the raw signal is fed into the analog to digital converter.
Conc Voltage (RAW)	(0-3.1)	The concentration voltage measured by the analog to digital converter.
Conc Voltage	(0-3.1)	The concentration voltage after adjustment for the PGA gain factor.
Meas. Zero (coarse)	(125-225)	This pot maintains the electronic zero adjustment.
Meas. Zero (fine)	(0-255)	This pot maintains the electronic zero adjustment.
Ref. Test		This pot has no role in measurements; for diagnostics only.
Ref. Voltage	(3.5 V-4.5 V)	The reference voltage of the detector.
Source	(277)	Adjusts the drive current for the IR source.
Cooler	(0)	Adjusts the drive current for the cooler.
Cooler Voltage	(1.15 V-1.20V)	The voltage being applied to the cooler.
Measure Test	(0)	This pot has no role in measurements; for diagnostics only.

3.5.17 Valve Menu

The **Valve Menu** allows the user to observe the opening and closing of valves as well as providing the ability to open and close them manually.

Valve Sequencing	When **Enabled** the instruments valves will open and close under microprocessor control. When **Disabled** the valves will change only in response to manual controls. Manually changing a valve while sequencing is enabled does not prevent the microprocessor from changing it again. Valve sequencing will remain off unless the instrument has returned to main screen for longer than 2 minutes.
Sample/Cal	Shows the action of the valve that determines whether sample gas or calibration gas/internal zero air is being sampled (**Open** = Span/Zero, **Closed** = Sample gas).
Internal Zero/Cal	Shows the action of the valve that determines whether the sample calibration gas is taken from the Calibration Port or the internal zero (**Closed** = Internal Zero, **Open** = Calibration Port).
Pressurised Span (optional)	Shows the action of the valve that determines whether the instrument calibration gas is taken from the optional pressurised Span Port (refer to Section 5.6).
Pressurised Zero (optional)	Shows the action of the valve that determines whether the instrument calibration gas is taken from the optional pressurised Zero Port (refer to Section 5.6).

3.5.18 Tests

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 Inputs	Displays the status of the 0-7 digital input pins. Value will be a 0 or a 1.
Digital Outputs	This menu item allows the user to view the pins that digital outputs are located on. The output can be switched on and off to test the connection. **Note:** Entering either the **Digital Inputs** or **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.

3.5.19 Calculation Factors

The calculation factors provide the values used to calculate different aspects of measurement and calibration.

Instrument Gain	A multiplication factor used to adjust the concentration measurement to the appropriate level (set at calibration).
Zero Offset	This field displays the offset created from a zero calibration, this is the concentration measured from zero air and is subtracted from all readings.
Background	The background voltage calculated from the background cycle (used to eliminate background interferences).
PTF Correction	Displays the correction factor applied to the concentration measurement. This correction is for changes in pressure, temperature and flows since the last calibration.

3.5.20 Communications Menu

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

Data Logging Menu	Section 3.5.21
Serial Communications	Section 3.5.22
Analog Input Menu	Section 3.5.23
Analog Output Menu	Section 3.5.24
Digital Input Menu	Section 3.5.25
Digital Output Menu	Section 3.5.26
Network Adaptor Menu	Section 3.5.27
Bluetooth Menu	Section 3.5.28

3.5.21 Data Logging Menu

Data Log Setup – Numeric	This allows up to 12 parameters to be logged. After each parameter (labelled **Logging Param. 1 – Logging Param. 12)** place the number of the parameter that is to be logged. A 255 indicates the end of the list of parameters to be logged (refer to Appendix A for a list of parameters).
Data Log Setup – Text	This is an alternate and easier way to select logged parameters. Instead of entering a number, select the item by name from a list. Select the blank line to indicate the end of the list of parameters to be logged.
Data Log Interval	Set the frequency that measurement data will be logged (1 second to 24 hours) or **Disabled** which means that no data is logged to the USB memory stick. **Note:** It takes about 1/3 of a second to log a measurement, selecting the 1 second interval may slow down communications when collecting logged data.

Note: The '–' key will delete the currently highlighted parameter; the '+' key will insert a new parameter at that location, moving the others down. The list of parameters must be contiguous. Thus, when you delete a logging parameter, any parameters below it will be moved up.

3.5.22 Serial Communications

Multi-drop ID	This is the ID of the analyser when multi-drop RS232 communications is used. This defaults to 40 but can be changed if multiple Serinus instruments are on the same RS232 cable.
Delay (RS232 #2)	When set to "**Enabled**" it will delay the serial communication responses through the RS232 #2 port by approximately 0.25 seconds. This is used in systems that cannot cope with the rapid response of the Serinus instruments. When set to **Disabled** communication will proceed without delay.
Baud (RS232 #1)	Sets the baud rate for this Serial Port (1200, 2400, 4800, 9600, 14400, 19200, or 38400).
Protocol (RS232 #1)	Sets the protocol used for this Serial Port (EC9800, Bavarian, Advanced, or Modbus). This must be set to **Advanced** for Ecotech supplied software.
Baud (RS232 #2)	Sets the baud rate for this Serial Port (1200, 2400, 4800, 9600, 14400, 19200, or 38400).
Protocol (RS232 #2)	Sets the protocol used for this Serial Port (EC9800, Bavarian, Advanced, or Modbus). This must be set to **Advanced** for Ecotech supplied software.

3.5.23 Analog Input Menu

The Serinus supports 3 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 then logged to the internal memory, or accessed remotely as parameters 199-201.

CAUTION

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

Input 1/2/3 Multiplier	The input voltage will be multiplied by this number. E.g. if a sensor has a 0-5 V output for a temperature of -40 °C to 60 °C, then the multiplier would be (60-(-40))/5 = 20.
Input 1/2/3 Offset	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.
Input 1/2/3 Reading	The current reading from the input voltage after the multiplier and offset have been applied. This is the value that would currently be logged, or reported as parameter 199-201 via USB or serial requests.

3.5.24 Analog Output Menu

Output Type	The analog output can be set to be either current or voltage. Only some of the fields below will be displayed depending on which analog output type is selected.
Range	Set the upper range limit (in concentration units) to the desired concentration. This value cannot exceed the Over Range value. This is the value at which the analog output should be at its maximum (e.g. 20mA for a current output).
Over-Ranging	Set to **Enabled** or **Disabled** to turn the over-ranging feature on or off.
Over-Range	This field is only visible when **Over-Range** 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 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).
Voltage Offset	Choices are 0 V, 0.25 V, and 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.
5.0 V Calibration	Enables the user to calibrate the analog output to be exactly 5 V. Increase/decrease the value until the connected equipment reads 5 V.

0.5 V Calibration	Enables the user to calibrate the analog output at a low point. Increase/decrease the value until the connected equipment reads 0.5 V.
Current Range	Enables the user to set desired current ranges. Choices are 0-20 mA, 2-20 mA or 4-20 mA.
20mA Calibration	Enables the user to calibrate the current output at a full scale point of 20mA. Increase/decrease the value until the connected equipment reads 20 mA.
4mA Calibration	Enables the user to calibrate the current output at a low point. Increase/decrease the value until the connected equipment reads 4 mA.

3.5.25 Digital Inputs Menu

This menu is used to remotely trigger zero and span calibrations. This is done by assigning the 8 digital inputs with one of the following commands.

Disabled

No action taken

Do Span

Perform a span check

Do Zero

Perform a zero check

The input is triggered with an active low. The actual digital input pin-outs are listed in the menu.

Example

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

1. Set the jumper JP1 to 5V position (refer Section 4.4.4).
2. Connect one of the master devices digital output signal to pin 18 and the ground signal to pin 5 of the analyser’s analog /digital 25 pin female connector (refer to Figure 13).
3. Program master device to output 0 volts to pin 18 when a span is desired.
4. In the analyser’s **Digital Input Menu** assign DI to **Do Span**.
5. The same procedure can be followed to also activate zero calibrations; pin 6 of the analyser’s analog/digital 25 pin female connector can be connected to one of the other master devices digital outputs and the analyser can be set so DI 1 is assigned to **Do Zero**.

3.5.26 Digital Outputs Menu

This allows the analyser to trigger external alarms in response to certain events.

There are 8 different pins available, which will be set high during an associated event:

- Disabled (never triggered)
- Power Supply Failure
- Ref Voltage Failure
- A2D Failure
- Lamp Failure
- Flow Heater Failure
- Lamp Heater Failure
- Chassis Temp Failure
- USB Disconnected
- Background
- Span
- Zero
- System

Assign the digital outputs 0-7 (refer to Figure 13 for pinouts).

3.5.27 Network Adaptor Menu

The **Network Adaptor Menu** allows the user to view or set the I.P. address, Netmask and Gateway if the optional Network Port is installed.

To read the IP address, perform the following steps:

1. Set the instrument to Read IP.
2. Manually cycle power off.
3. Wait 3 seconds.
4. Turn power on.
5. Read or set the IP address.

Protocol (Network)	Sets the protocol used for the Network Port (EC9800, Bavarian, Advanced, or Modbus). This must be set to Advanced for Ecotech supplied software.
Start-up Mode	The following modes are available: **Normal**: In this mode nothing is done with the Network Port during boot-up. It is assumed to be configured correctly or unused. **Read IP:** This mode interrogates the Network Port for its IP address. The menu will display the network address after boot-up. **Set IP**: You may enter an IP address, Netmask, and Gateway address (following the usual rules for formatting these addresses). Please note that at this time the Serinus does not validate the correctness of these entries. When you cycle power, the Serinus will first instruct the Network Port on its new address. It will then switch to Read IP mode and read back the address it just set so that you may verify it in the menu. **Set DHCP**: This sets the Network Port into DHCP mode, allowing the network to assign the Serinus an IP address.
IP Address	This is the current IP address of the analyser e.g. 192.168.1.2
Netmask	This is the subnet mask of the network the analyser is connected to e.g. 255.255.255.0
Gateway	This is the IP address of the router to access addresses not on the same subnet e.g. 192.168.1.1
Adaptor is in DHCP mode	In this mode the analyser will ask for its network parameters from a DHCP server on your network.

3.5.28 Bluetooth Menu

Serinus instruments manufactured after 2012 support Bluetooth communication through the Serinus Remote Android Application (refer to Section 4.6).

Bluetooth	This field indicates whether the analyser is remotely connected to an Android device.
Reset Bluetooth	After changing the ID or PIN reboot the Bluetooth module. This is done by resetting the instrument or by using this menu item to reboot only the Bluetooth.

ID	This is the Bluetooth ID of the analyser. In edit mode 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 or space 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 or space The default setting is the **Serinus ID/Serial Number. Note:** The word “Serinus” is always the first part of the name and cannot be edited.
PIN	This is a passcode/pin required for the Serinus Remote Application to connect to the analyser. The default pin is 1234.

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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 collection, data validation and complex reporting by multiple users. Refer to the Airodis Manual for details on setting up and communicating with the Serinus.

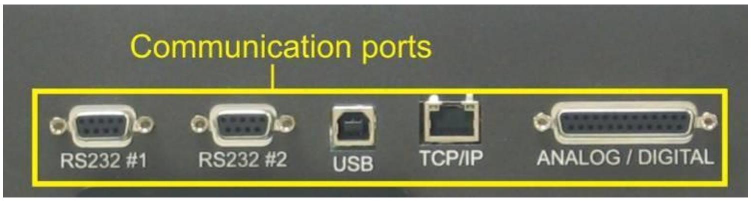

Figure 11 – Communication ports

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 multi-drop arrangement (a configuration of multiple analysers connected via the same RS232 cable where the transmit signal is only asserted by the instrument that is spoken to). Verify that the **Multi-drop ID** is set to either 0 (for direct connection) or a unique value which is different to the other analysers in the chain for a multi-drop configuration (refer to Section 1.5.9).

The Serinus supports the following protocols:

- Advanced protocol (Appendix A)
- EC9800 protocol (Appendix B)
- Bavarian protocol (Appendix C)
- Modbus protocol (Appendix D)

4.2 USB Communication

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.

4.3 TCP/IP Network Communication (optional)

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

It supports any one the following protocols:

- Advanced protocol (Appendix A)
- EC9800 protocol (Appendix B)
- Bavarian protocol (Appendix C)
- Modbus protocol (Appendix D)
- Configuring the Network Port requires setting the IP address, Netmask, gateway and protocol in the **Network Adaptor Menu** (refer to Section 3.5.27).

4.4 Digital/Analog Communication

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

4.4.1 Analog Outputs

The analyser is equipped with three analog outputs that can be set to provide either Voltage (0-5 V) or Current (0-20, 2-20, 4-20 mA). The analog outputs are tied to the instrument measurements:

Table 3 – Analog outputs

Analyser	Output 1	Output 2	Output 3
S10	O_3	N/A	N/A
S30	CO	N/A	N/A
S40	NO	NO_2	NO_X
S44	NO	NH_3	NO_X
S50	SO_2	N/A	N/A
S51	SO_2	H_2S	N/A
S55	H_2S	N/A	N/A
S56	TS	N/A	N/A
S57	TRS	N/A	N/A

4.4.2 Analog Output Calibration Procedure

Voltage Calibration

1. Navigate to the **Communications→Analogue Output Menu.**
2. Ensure that **Output Type** is set to **Voltage.**
3. Connect a volt meter (using an appropriate adaptor or probes on the volt meter) to the ground (pin 24) and the relevant output pin (pin 10).
4. Adjust the **0.5V Calibration** value until the volt meter reads 0.500 +/ .002.
5. Adjust the **5.0V Calibration** value until the volt meter reads 5.00 +/ .002.

Current Calibration

1. Navigate to the **Communications→Analogue Output Menu.**
2. Ensure that **Output Type** is set to **Current.**
3. Connect a current meter (using an appropriate adaptor or probes on the current meter) to the ground (pin 24) and the relevant output pin (pin 10).
4. Adjust the **4mA Calibration** value until the volt meter reads 4mA +/ .01.
5. Adjust the **20mA Calibration** value until the volt meter reads 4mA +/ .01.

4.4.3 Analog Inputs

The analyser 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 not damage the main board (instrument warranty does not cover damage from external inputs).

4.4.4 Digital Status Inputs

The analyser is equipped with 8 logic level inputs for the external control of the analyser such as Zero/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 printed circuit board (refer to Figure 12).

4.4.5 Digital Status Outputs

The analyser is equipped with 8 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 or +12 V available on the 25 pin connector for control purposes, instead of digital outputs 0 and 1.

In the default jumper locations (Figure 12) these two outputs will function normally as open collector outputs. If moved to the position closer to the 25 pin connector then DO 0 will supply +12 V and DO 1 will supply +5 V. These supplies are limited to about 100 mA.

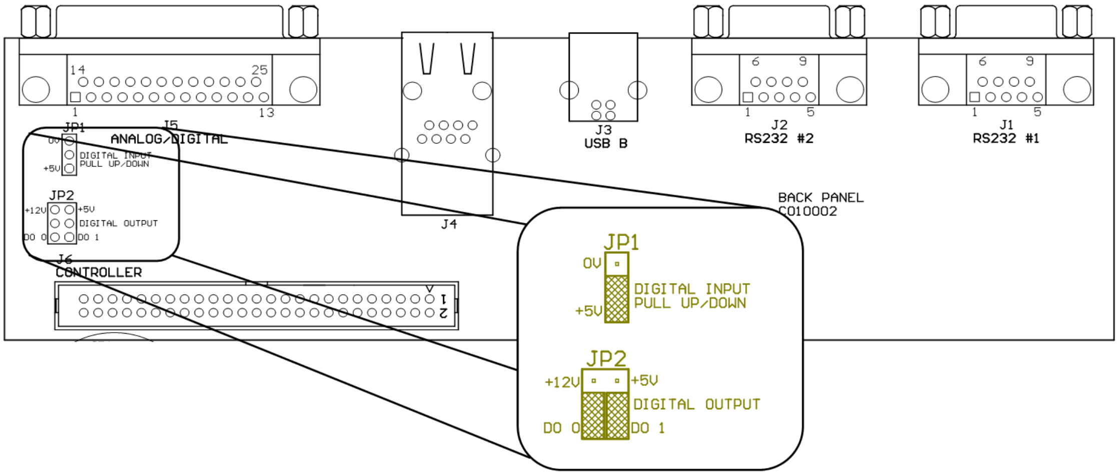

Figure 12 – Serinus 25-pin microprocessor board (with default jumpers highlighted)

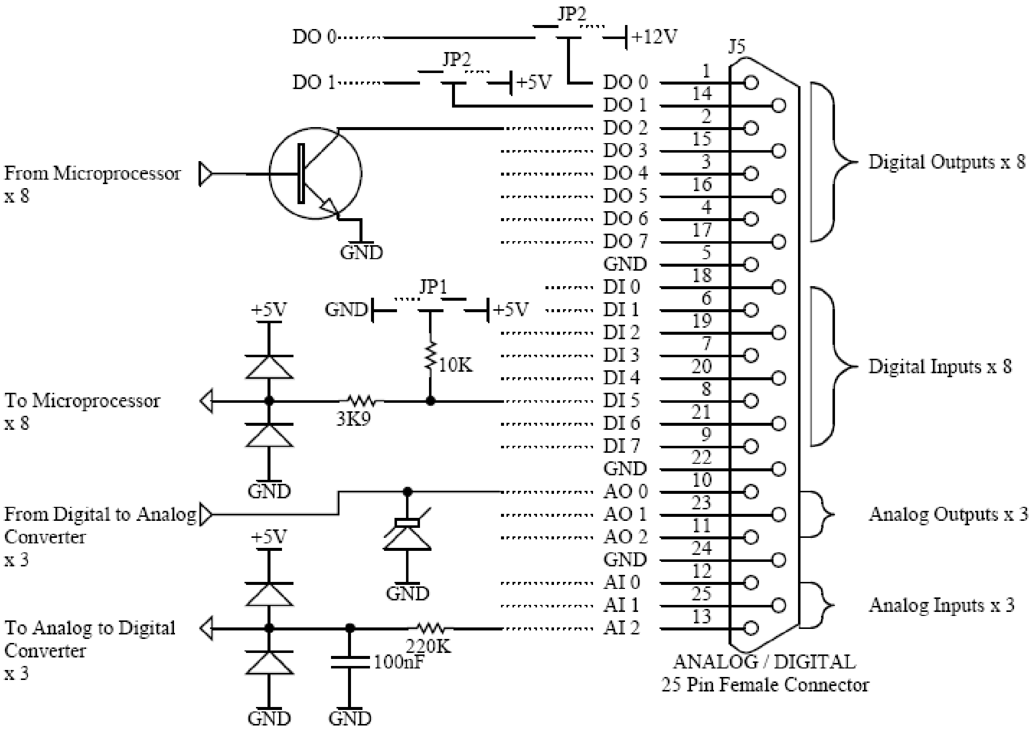

Figure 13 – External 25pin I/O individual pin descriptions

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 8 outputs can permanently damage the instrument and void the warranty.

4.5 Using Airodis Software to Download Data from a Serinus Gas Analyser

4.5.1 Installation

Configure the Serinus Logging Interval

In order to download logged data from the Serinus, you will need to define the data logging interval.

Navigate to **Main Menu →Communications Menu → Data Logging Menu**

Figure 14 – Configure Serinus logging interval

Set the *Data Log Interval* to the desired value.

4.5.2 Connecting the Serinus to your PC

The Serinus Gas Analyser can communicate with a PC using RS-232 (Serial), TCP (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 be installed.

4.5.2.1 Connecting over USB

If you wish to connect using USB, you will need to first install the Serinus USB driver.

Power on the Serinus 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”.

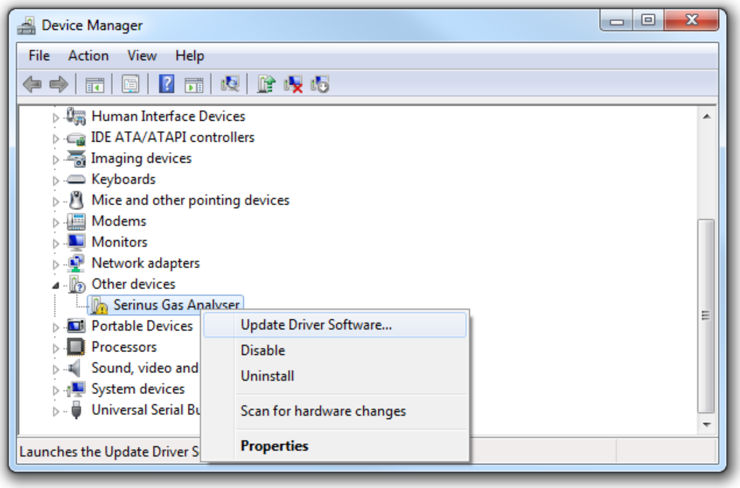

Figure 15 – Installing driver software

When prompted where to search for the driver, select "Browse my computer".

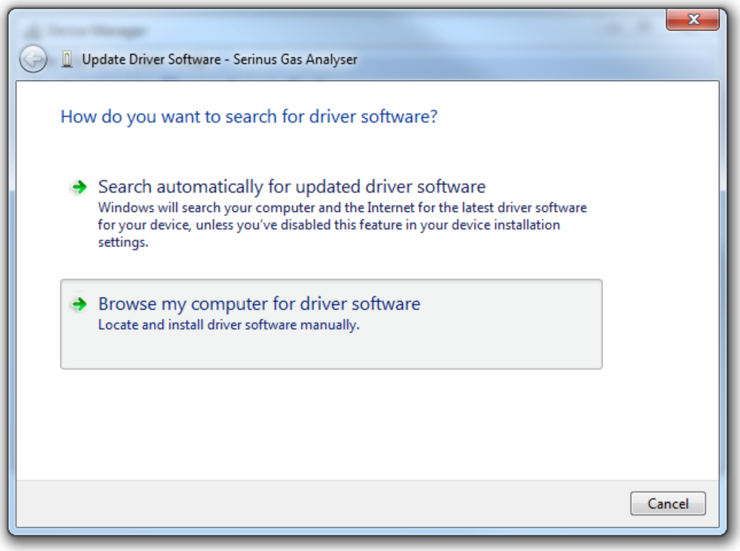

Figure 16 – Installing driver software

The Serinus USB driver is located on the green Ecotech Resources USB stick under "\Drivers\Ecotech Analyser". Select this directory and click "Next".

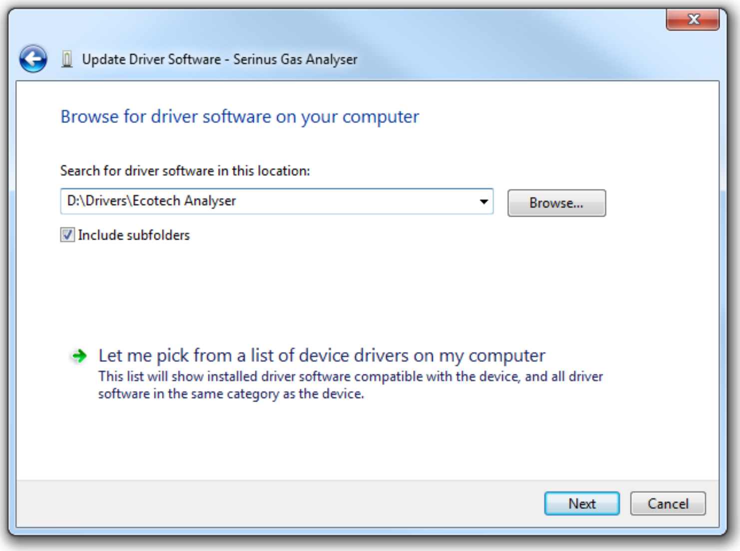

Figure 17 – Installing driver software

If you receive a confirmation prompt to install the driver, select "Install".

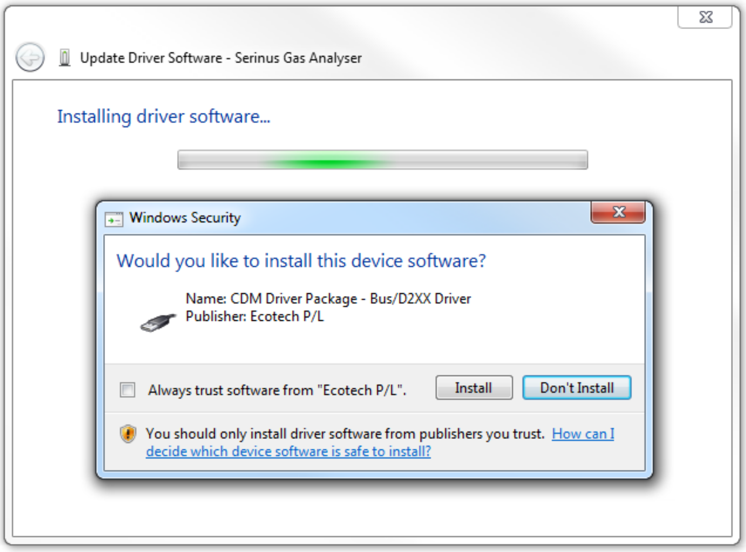

Figure 18 – Installing driver

If everything went smoothly, Windows will inform you that the driver was successfully installed.

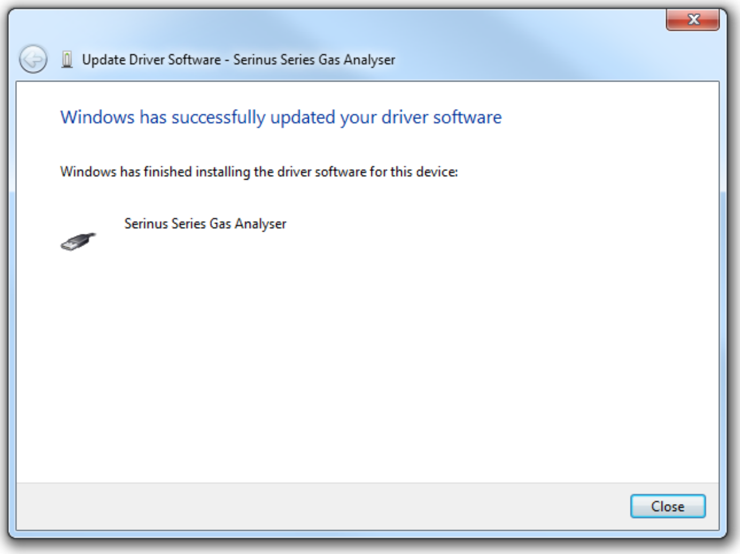

Figure 19 – Successful driver installation

4.5.2.2 Connecting over Serial (RS-232)

From the Serinus menu, navigate to **Main Menu →Communications Menu → Serial Communications.**

Figure 20 – Serial communications menu

1. Determine which RS232 Port you are physically connecting with. You can use either; however, multidrop is only supported on RS232 #2.
2. Set the appropriate baud rate (in most situations, fastest is best).
3. Ensure that the protocol is set to **Advanced.**
4. If you are running Airodis in a multidrop configuration (multiple instruments on a single COM port), ensure that the multidrop ID is unique for each instrument on the chain.

4.5.2.3 Connecting over Network (TCP / IP)

From the Serinus menu, navigate to **Main Menu →Communications Menu → Network Adaptor Menu.**

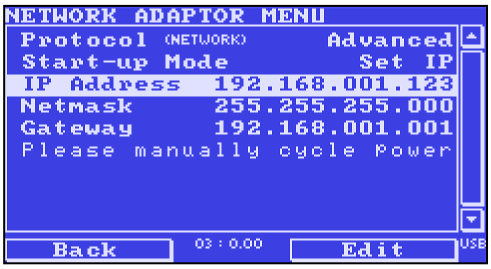

Figure 21 – Network adaptor menu

1. Ensure that the protocol is set to **Advanced.**
2. Assign a unique static IP address to the instrument.
3. Reboot the Serinus by cycling the power.

4.5.3 Installing Airodis

You can download data from the Serinus 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 a Serinus (up to 3 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 (x32) version.

4.5.4 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 a Serinus.

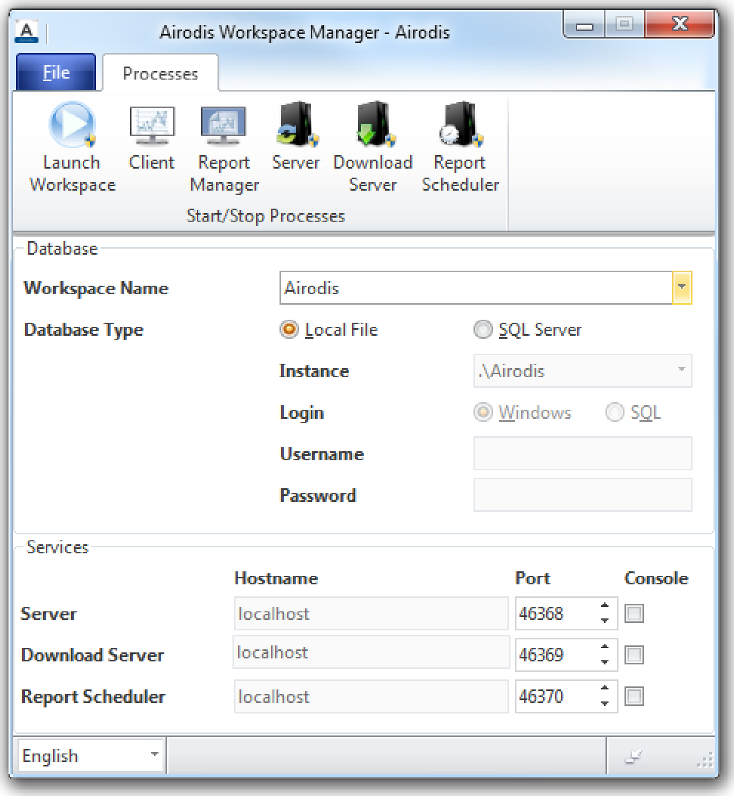

Figure 22 – Airodis workspace manager

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.**

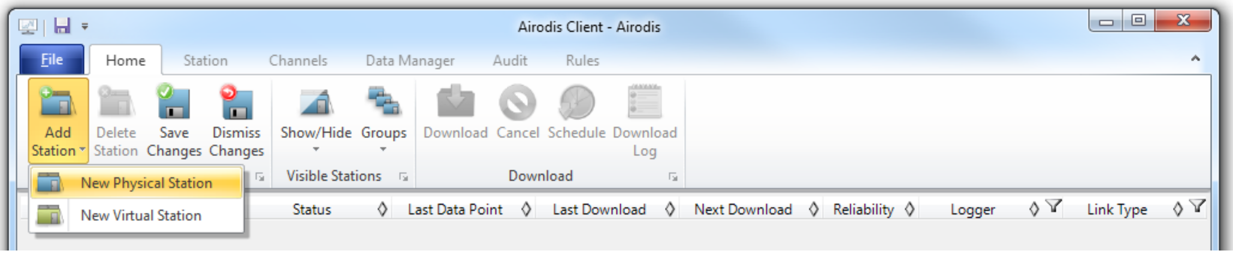

Figure 23 – Adding a new station

4. Select the new station and move to the **Station** tab on the ribbon. Enter the details to connect to the Serinus.

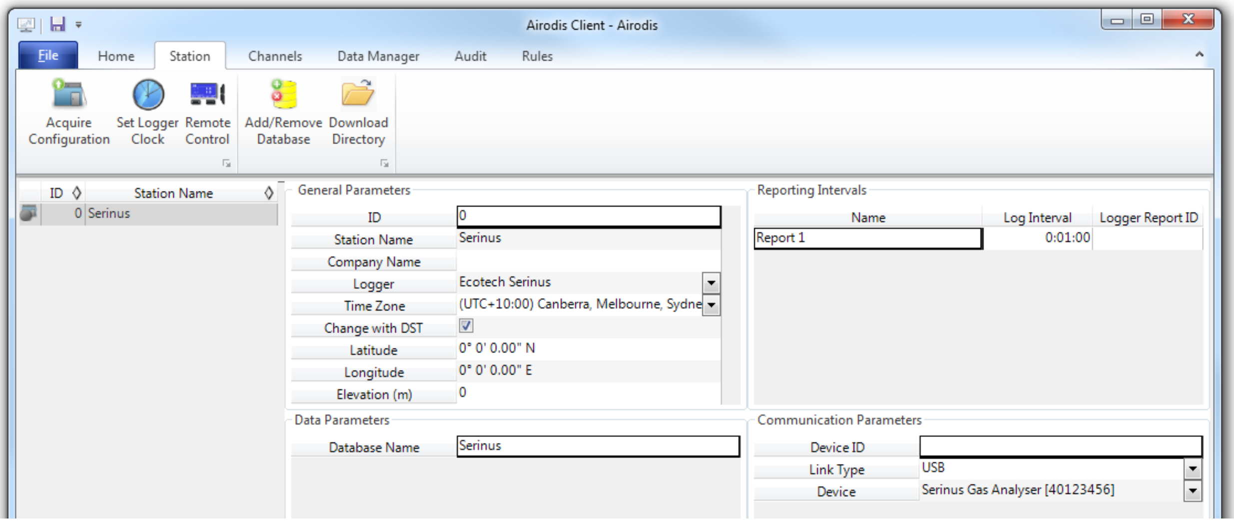

Figure 24 – New station connection

Table 4 – Setting up a new station via Airodis

Property	Description
Station Name	The name of the station. If you have other loggers, the name is used to distinguish them.
Logger	Set this to "Ecotech Serinus" when downloading from any Serinus series instrument. This will communicate with the Serinus on the *Advanced* protocol. If using a network or serial connection, ensure that the **Advanced protocol** has also been selected on the Serinus itself (Refer to Appendix A).
Time Zone	Set this to the time zone that the Serinus is configured to log in.
DST	Enable this option if you plan on changing the clock on the Serinus with daylight savings. Leave this disabled if the clock does not shift during DST. **Note**: the Serinus will need to be adjusted manually for DST – it will not happen automatically.
Database Name	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.
Device ID	Enter the multidrop ID of the Serinus (Refer to Section 4.1). If you are not using multidrop, this can be set to "0" or left blank.

Property	Description
Link Type	Select the type of connection used to connect to the Serinus. Additional properties will appear to connect to the Serinus. Make these align with the configured communications settings on the Serinus.
Log Interval	This needs to be the same as the **Data Log Interval** setting on the Serinus.

The available fields for communications parameters will change when you change the link type. You will need to set the communication parameters that have been defined on the Serinus.

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 Serinus for a channel list. After a few seconds, the channel list should be visible in the **Channels** tab.

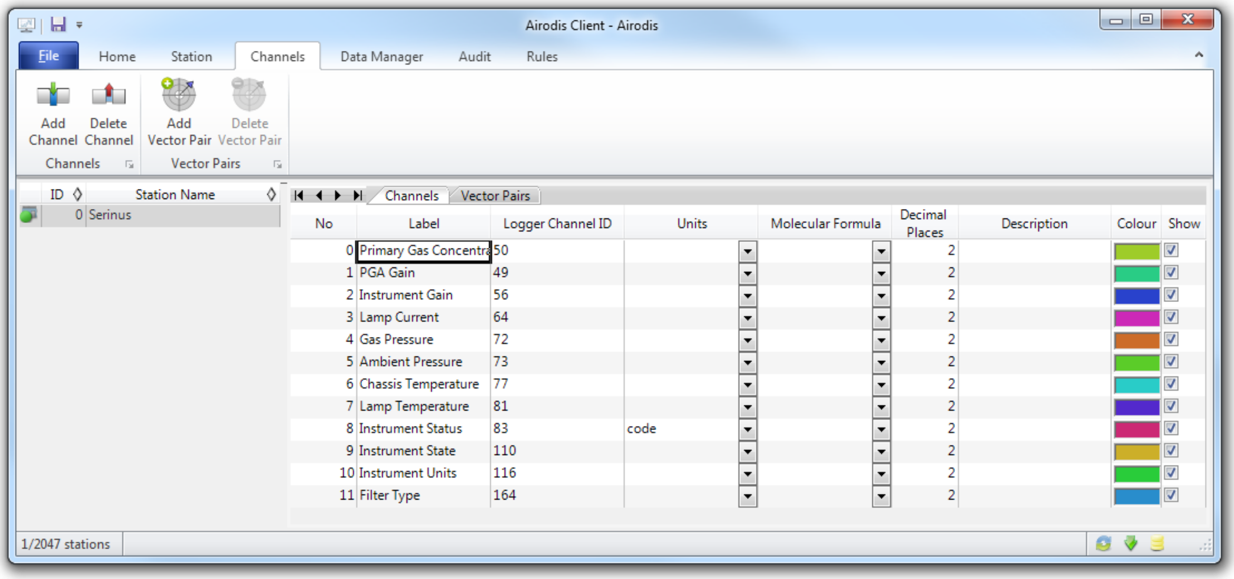

Figure 25 – Station configuration

Note: If there was an error connecting to the Serinus, a red dot will appear next to its name in the station list. Hovering over the red dot will present you with an error message.

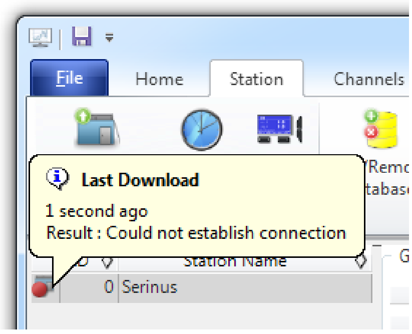

Figure 26 – Error status notification

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.

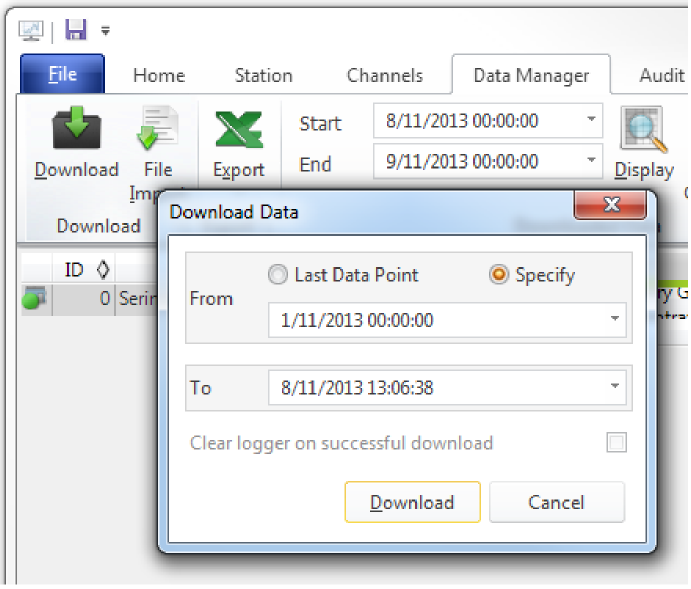

Figure 27 – Downloading data

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.

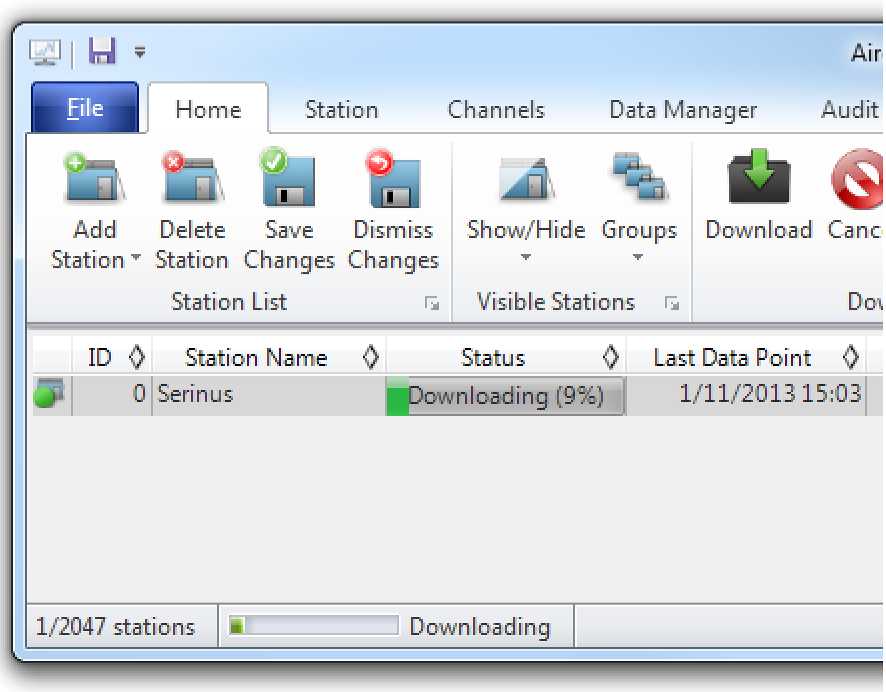

Figure 28 – Download data status

8. 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 then be loaded into the data manager.

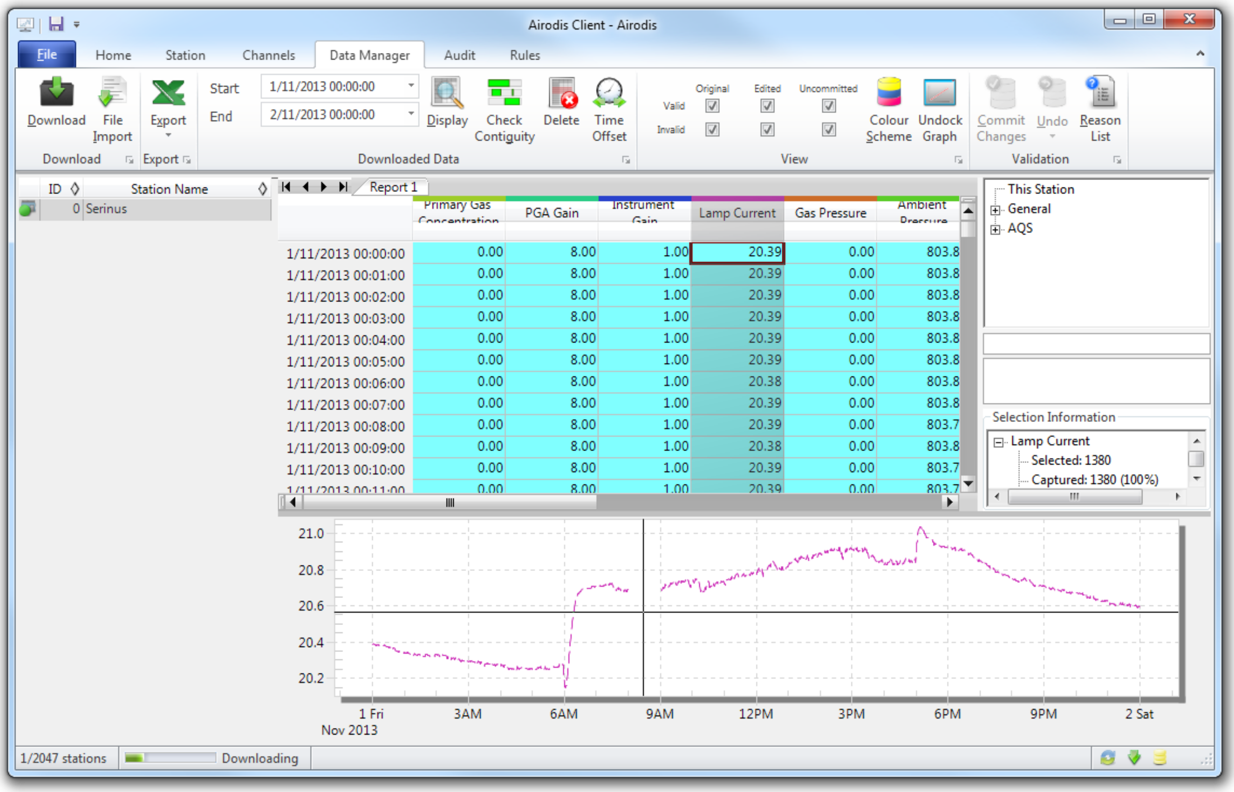

Figure 29 – Data visibility

9. Data can be exported by clicking the **export** function. This will allow you to save your data in CSV format, which can then 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.

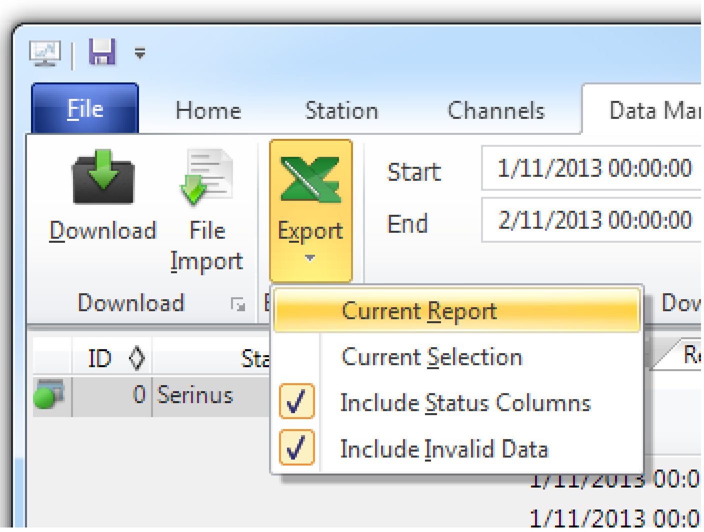

Figure 30 – Exporting data

10. That's it! The data has been downloaded from the instrument and exported to a standard CSV file.

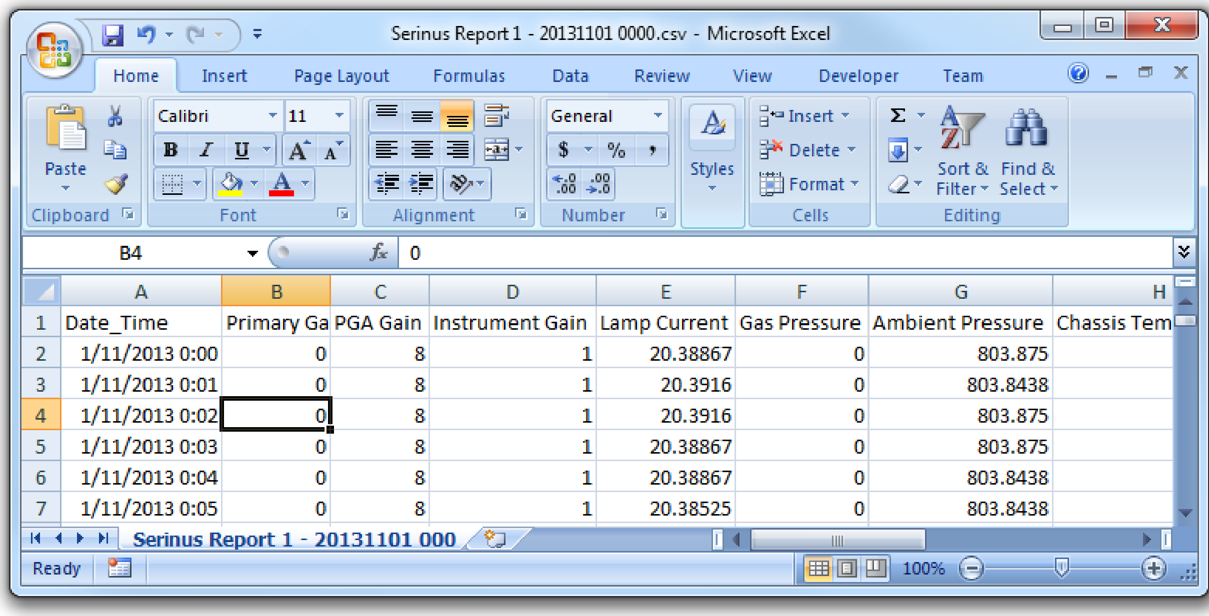

Figure 31 – Data download complete

4.6 Serinus Remote App/Bluetooth

Ecotech's Serinus Remote Application allows for any Android device (Tablet or Smartphone) to connect to an analyser.

Using the Serinus Remote Application the user can:

- Completely control the analyser 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

4.6.1 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 then **Open** to start the application.

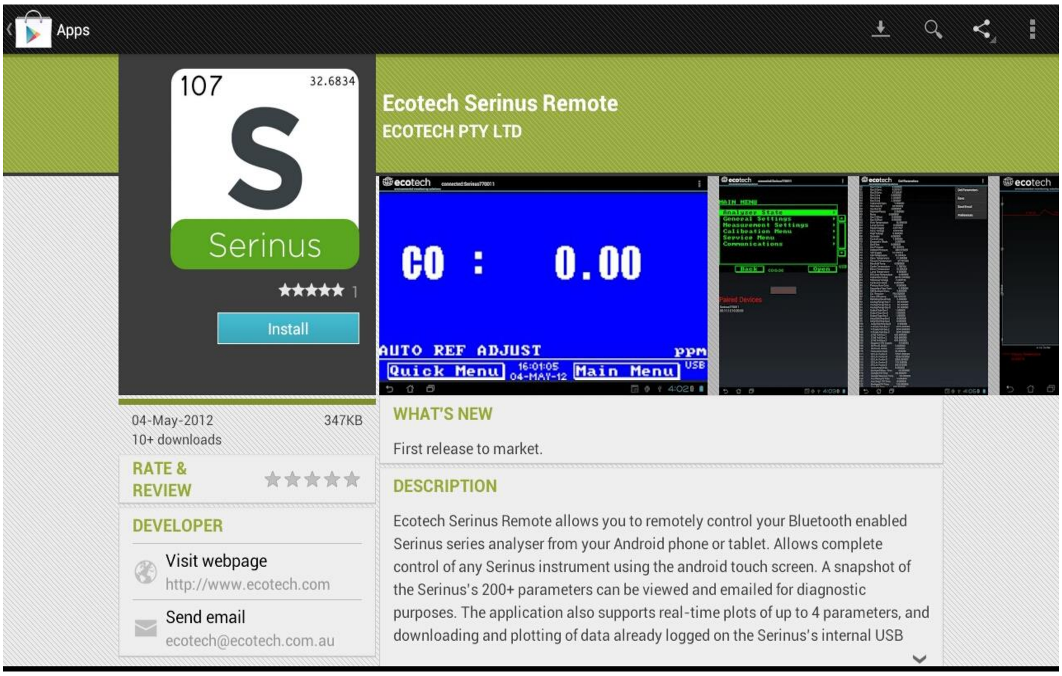

Figure 32 – Downloading the app from Google Play store

> **Note**: A menu containing additional features and functions can be accessed by entering the **Options menu** (or similar) on your device. The location and format of this menu may vary.

4.6.2 Connecting to the Analyser

Refer to the **Bluetooth Menu** to find the Serinus Analyser Bluetooth ID and PIN (refer to Section 3.5.28).

To connect to an analyser:

4. Touch the **Scan Serinus Analysers** button at the bottom of the screen.
5. Select the **Analyser ID** from either the **Paired Devices** or the **Other Available Devices** (see ID in the **Bluetooth Menu**).
6. Input the PIN (if prompted to do so) then press **OK** (see PIN in the **Bluetooth Menu**).

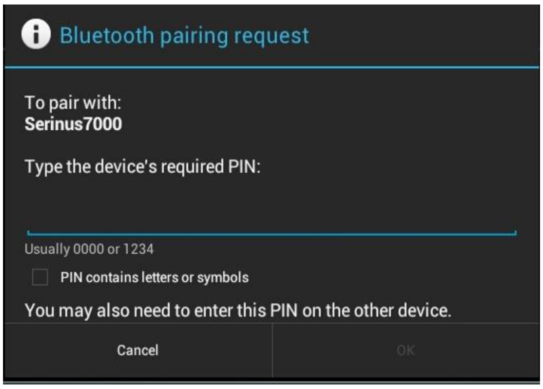

Figure 33 – Bluetooth pairing request

A screen shot of the analyser's current screen should appear on your Smartphone or Tablet. To disconnect press the Back key/button on the device.

> **Note:** Once the analyser has been paired with the device it will appear under "Paired Devices" and the PIN will not need to be entered again.

4.6.3 Control Serinus Analyser

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

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.

Main 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).

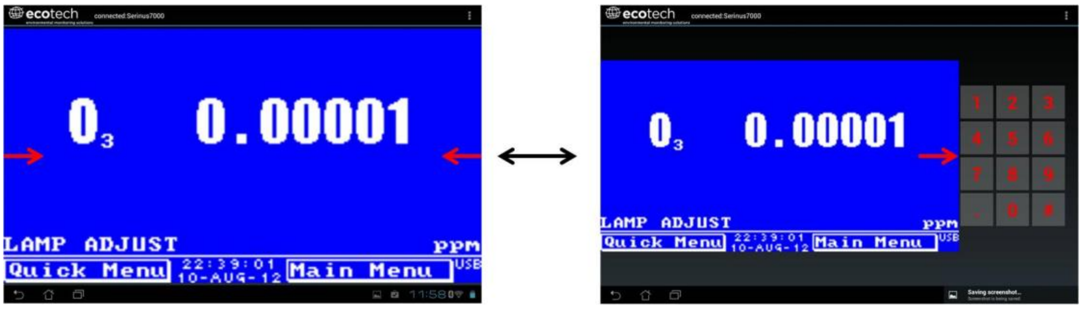

Figure 34 – Entering numbers into the Serinus Application

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 analyser list).

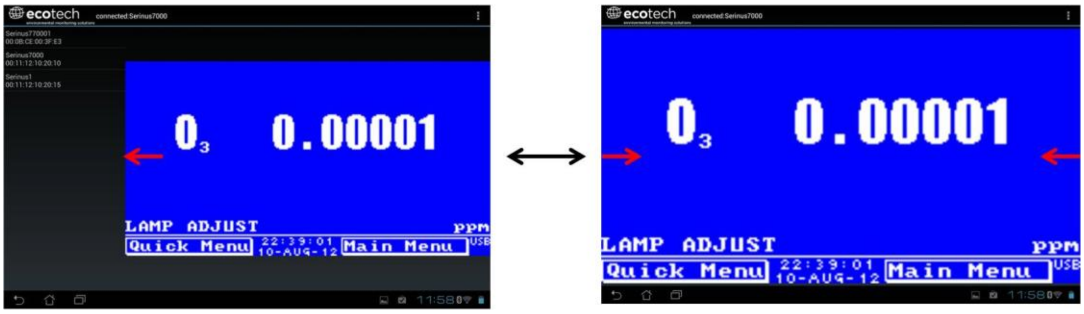

Figure 35 – Switching analysers in Serinus Application

Back Button

This button will return to the selection screen, allowing you to connect to a different analyser.

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.

Refresh	Refresh the display
Show/Hide NumPad	Show or hide the number pad
Real Time Plot	Refer to Section 4.6.4
Download	Refer to Section 4.6.5
Get Parameters	Refer to Section 4.6.6
Preferences	Refer to Section 4.6.7

4.6.4 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.**

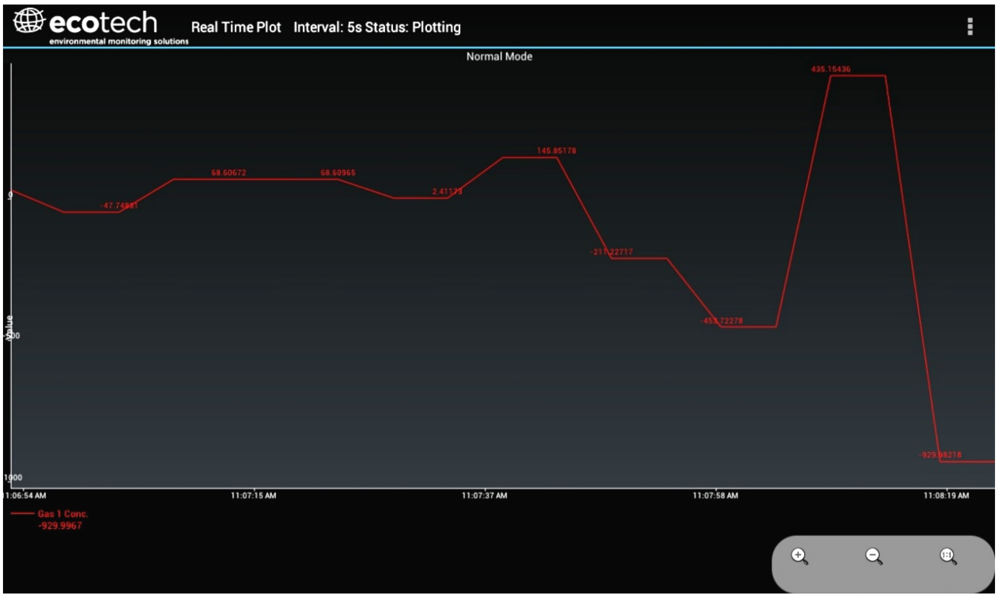

Figure 36 – Real-time plot

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 your Android device.

Start	Restarts graphing if it has been stopped and returns the graph to **Normal Mode.**
Stop	Stops collecting data. In this mode you can scroll the display without going into **Observer Mode,** because the system has no data collection to suspend. It is necessary to "Stop" data collection to set the interval.
Clear	Clears the window and restarts the graphing.
Save	Saves an image of the graph and accompanying data in the location specified in preferences (refer to Section 4.6.7). 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 **Save All Data** or **Customise** the length of the data by entering a time between 5 minutes and 6 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).
Set Interval	While data collection is stopped, the user can specify the time intervals between collections.

4.6.5 Download

Downloads logged data from the USB stick inside the analyser. All data logged by the analyser to the USB 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 1 day's worth of 1 minute data is likely to take a couple of minutes.

Options Menu

Save	Generates a filename based on the start and end date/time specified, saves the downloaded data in the location specified in preferences, and then asks to send the saved comma separated text file (.csv) as an attachment to an email. Note that this file format does not include the parameter headings, just the values.
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 37 for an example.
Preferences	Refer to Section 4.6.7

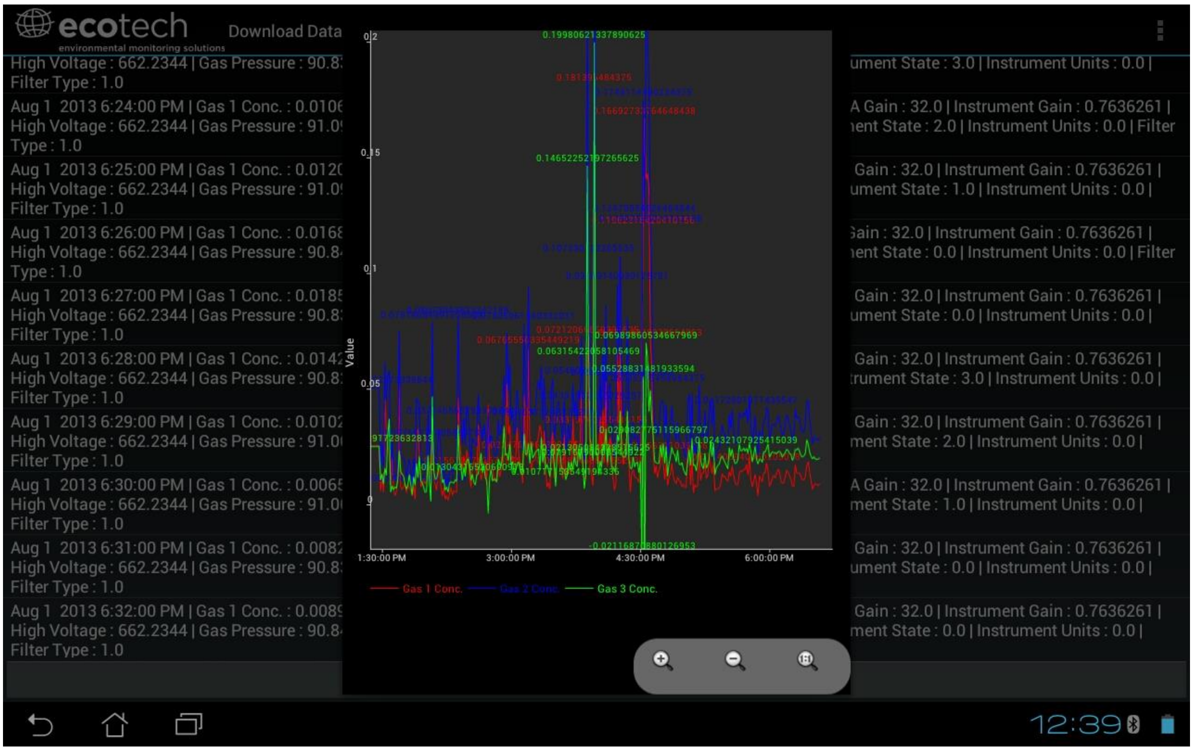

Figure 37 – Plot of downloaded data

4.6.6 Get Parameters

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

Options Menu

Get Parameters	Refreshes the parameter list display.
Save	Generates a filename from the current date and time, saves the parameter data in the location specified in preferences, and then asks to send the saved text file as an attachment to an email.
Send E-Mail	Sends an email with the parameter data in the body of the email, formatted as displayed.
Preferences	Refer to Section 4.6.7

4.6.7 Preferences

The **Preferences Menu** allows the operator 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.

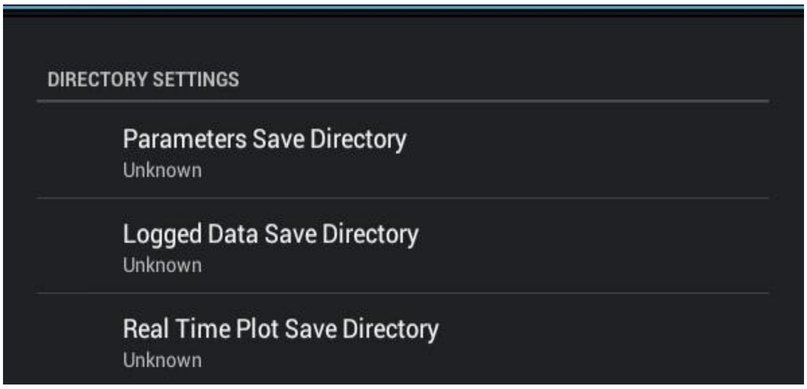

Figure 38 – Directory settings

Logs Format

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

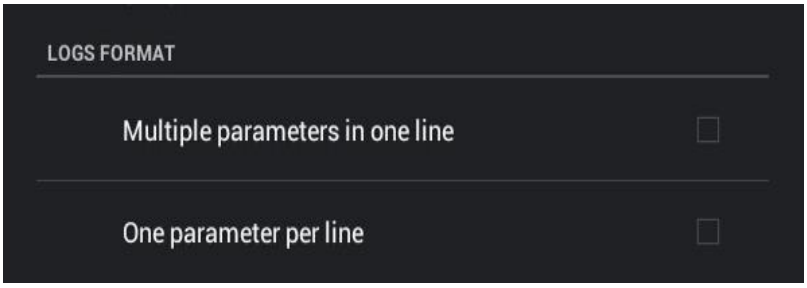

Figure 39 – Logs format

Colour Theme Settings

Allows the operator to choose a colour scheme for the remote screen (“Matrix”, “Classic”, “Emacs” or “Custom”).

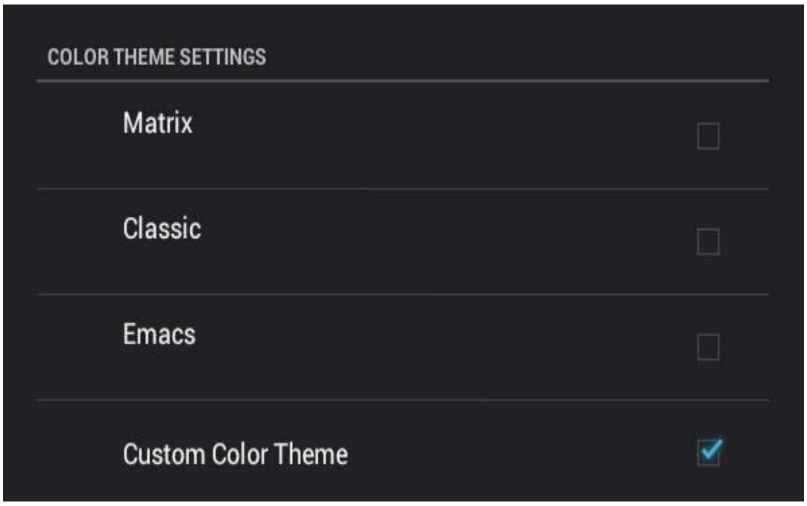

Figure 40 – Colour theme settings

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5. Calibration

These procedures describe how to calibrate the Span and Zero point for the analyser.

The following sections assume the instrument is in the **Calibration Menu** (refer to Section 3.5.10).

5.1 Zero Calibration

Zero calibrations are used to set the zero point of the analyser.

Note: This calibration is unnecessary and Ecotech recommends that the zero calibration only be used when specifically required as it tends to mask issues that should be addressed during maintenance/service.

A zero calibration can be performed through either the Calibration Port, Background Air Port or the Sample Port. Follow the instructions below:

Calibration Port/Background Air Port

1. Ensure a suitable zero source is connected to the correct port on the back panel of analyser.
2. Set **Cal. Type** to **Manual**.
3. Set **Cal. Mode** to **Zero** (to indicate that the measurement sample should be drawn from the Calibration Port).
4. Set **Zero Source** to **External** for the Calibration Port or to **Internal** for the Background Air Port.
5. Allow the instrument to stabilise for 15 minutes.
6. Select the **Zero Calibration** field and enter 0.0 (the gas concentration).

Sample Port

1. Ensure a suitable zero source is connected to the **Sample Port** on the back panel of analyser.
2. Set **Cal. Type** to **Manual**.
3. Set **Cal. Mode** to **Measure** (to indicate that the measurement sample should be drawn from the Sample Port).
4. Let the instrument stabilise for 15 minutes.
5. Select the **Zero Calibration** field and enter 0.0 (the gas concentration).

5.2 Span Calibration

Span calibrations calibrate the instrument to the upper limits of normal monitoring. Ecotech recommends that 80% of the required measurement range should be sufficient for calibrations in ambient monitoring situations (~ 40 ppm). A span calibration can be performed through either the Calibration Port or Sample Port. Follow the relevant instructions below:

Calibration Port

1. Ensure a suitable span gas source is connected to the Calibration Port on the back panel of the analyser (refer to Section 2.3.1).
2. Set the span source to a known concentration (80% of the required measurement range recommended).
3. Enter the **Main Menu → Calibration Menu**.
4. Set **Cal. Mode** to **Span**.
5. Let the instrument stabilise (15 minutes).
6. Enter the **Quick Menu** and select **Span Calibrate**.
   (Also accessible through: **Main Menu→Calibration Menu→Span Calibrate**).
7. A box will appear with editable numbers. Enter the concentration being delivered to the instrument.
8. The instrument will perform a span calibration.
9. Enter **Main Menu → Calibration Menu** and set **Cal. Mode** back to **Measure**
10. The instrument will return to normal activities.

Sample Port

1. Ensure suitable span gas source is connected to the Sample Port on the back panel of analyser (refer to Section 2.3.1).
2. Set the span source to a known concentration (80% of the required measurement range recommended).
3. Let the instrument stabilise (15 minutes).
4. Enter the **Quick Menu** and select **Span Calibrate**.
   (Also accessible through: **Main Menu→Calibration Menu→Span Calibrate**).
5. A box will appear with editable numbers. Enter the concentration being delivered to the instrument.
6. Instrument will perform a span calibration, when finished the instrument will return to normal activities.

5.3 Multipoint Precision Check

The multipoint check involves supplying the instrument with span gas at multiple known concentrations and recording the output of the instrument. Multipoint calibrations are used to determine the linearity of the concentration readings over the range of the multipoint calibration. The instrument gain should not be adjusted to each individual point.

1. Ensure a suitable span source is connected to the instrument from a gas calibrator (Ecotech recommends the GasCal-1100) through the Calibration Port.
2. Record the analyser's instrument gain before performing a calibration (refer to Section 3.5.10).
3. Perform a precision check using zero air as described in Section 5.4.
4. Perform a span calibration as described in Section 5.25.2.
5. Set up a program for measuring the span concentration through 5 steps down from 80% of required measurement range.
6. Example for measurement range of 50ppm:
    a. Set the 1st concentration on the gas calibrator to 40 ppm, allow the instrument to sample for 15 minutes, record the measurement.
    b. Set the 2nd concentration on the gas calibrator to 30 ppm, allow the instrument to sample for 15 minutes, record the measurement.
    c. Set the 3rd point at a concentration of 0 ppm (zero air); allow the instrument to sample for 15 minutes and record the measurement.
    d. Set the 4th concentration on the gas calibrator to 10 ppm, allow the instrument to sample for 15 minutes, record the measurement.
    e. Set the 5th concentration on the gas calibrator to 20 ppm, allow the instrument to sample for 15 minutes, record the measurement.
7. The linearity and correlation can be calculated for each point manually or all points calculated within an excel spread sheet. Both options are detailed below.

Manual Calculations

Record the concentration measurement at each point and determine the percentage difference between instrument response and the supplied concentration using the following equation:

$$\boxed{\frac{\text{Instrument Response} - \text{Supplied Concentration}}{\text{Supplied Concentration}} \times 100 = \text{Percent Difference}}$$

Equation 1 – Instrument accuracy

If the difference between values is less than 1% of full scale then the instrument is within specifications. If not, a leak check and/or service are required (refer to Section 6).

Microsoft Excel

Alternatively all the data can be placed in an excel spread sheet in columns next to the supplied concentration.

1. Create an X Y scatter plot of expected calibration against instrument response. Right click on either point and select **Add Trend line.** Tick the **Display Equation on Chart** and **Display R-squared Value on Chart.**
2. The linear regression equation y = mx + b will be displayed.

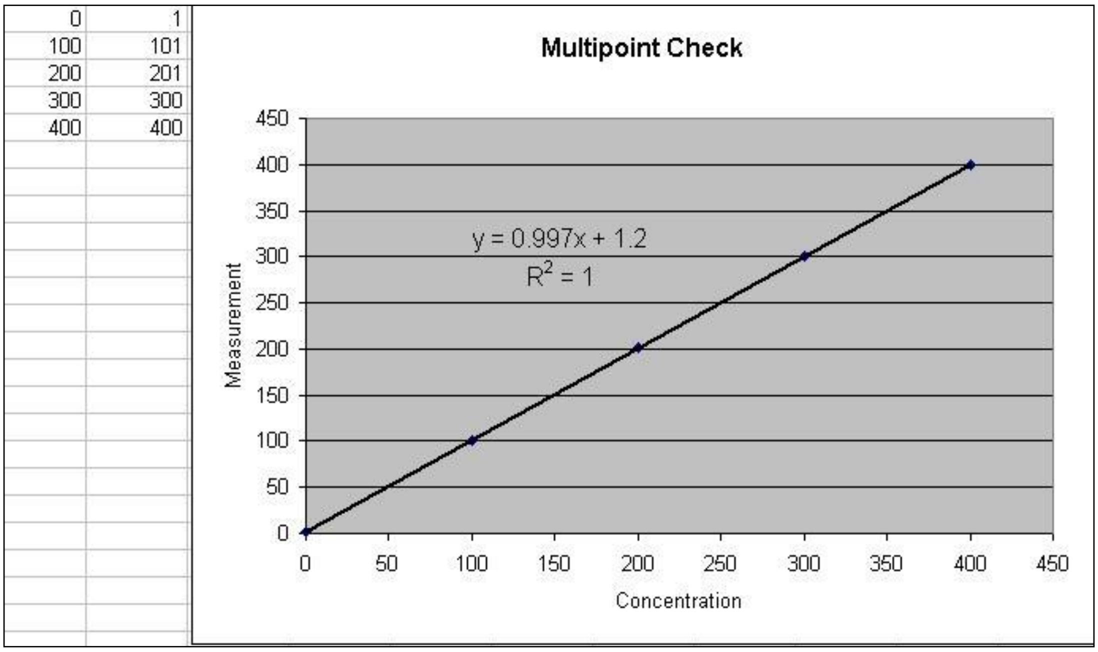

Figure 41 – Excel graph of multipoint calibration

3. 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.
4. If unsatisfactory results are observed, perform a leak check (refer to Section 6.4.4) check zero air scrubbers or check troubleshoot guide for possible errors.

5.4 Precision Check

A precision check is a Level 2 calibration. This means that the instrument has a known concentration of span gas (or zero air) run through it and an observation of the instrument's concentration is made with no adjustment. A precision check can be performed either manually or automatically. If an instrument fails a precision check (based on your local applicable standards), perform a span calibration (refer to Section 5.2) or zero calibration (refer to Section 5.1) where appropriate.

5.5 Pressure Calibration

The pressure calibration involves a two point calibration, one point under vacuum and the other point at ambient pressure. To perform a pressure calibration the following steps must be completed.

Note: The vacuum calibration must be performed first when performing a full pressure calibration.

Vacuum Point Calibration

1. Open instrument.
2. Unplug tubing from top of measurement cell (refer to Figure 42).
3. Connect pressure meter to fitting.

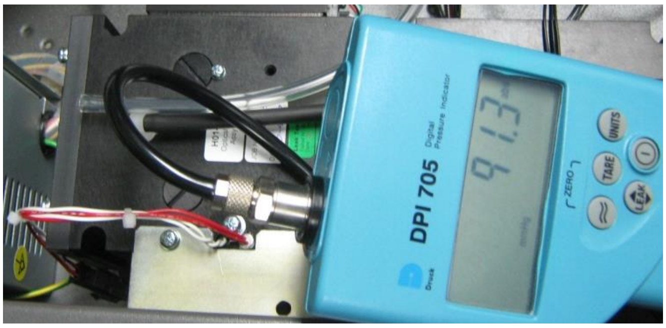

Figure 42 – Pressure calibration

4. Connect vacuum source to Exhaust Port of analyser, switch vacuum source on.
5. Enter **Calibration Menu → Pressure Calibration** and select **Vacuum Set pt.**

Figure 43 – Vacuum set pt.

6. Ensure that the pressure reading on the external meter is stable. Now edit the **Vacuum Set pt.** value to equal the pressure measured by the external meter.

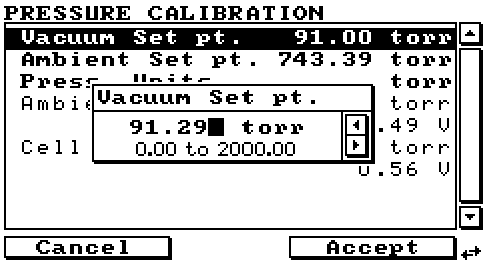

Figure 44 – Edit vacuum set pt.

7. Press the **Accept** button to calibrate pressure sensor.
8. The instrument menu will now take you to the **Ambient Set pt.**

Figure 45 – Ambient set pt.

9. Disconnect the vacuum line from Exhaust Port and remove the external meter.
10. Reconnect the original tube to the top of measuring cell.

Ambient Point Calibration

Note: It is important to wait 3 to 5 minutes to allow the analyser to stabilise before performing the ambient calibration.

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

1. Ensure that any vacuum source connected to the Exhaust Port of the analyser has been switched off and disconnected. Also disconnect any tubing connected to the Sample Port.
2. Obtain the current ambient pressure with a pressure meter.
3. Enter the **Main Menu → Calibration Menu → Pressure Calibration→Ambient Set pt.** (If continuing from the vacuum pressure calibration this step is not necessary).
4. Edit the **Ambient Set pt.** value using the keypad to input the current ambient pressure (ensure you are using the same pressure units that are shown on screen).

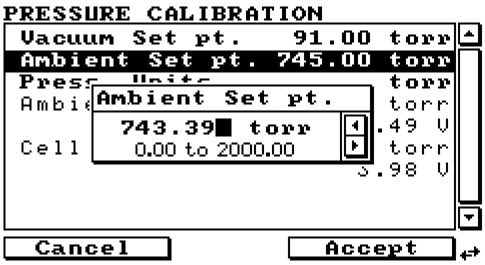

Figure 46 – Setting the ambient set point

5. Press the **Accept** button to calibrate pressure sensors.
6. Exit the **Pressure Calibration Menu**.

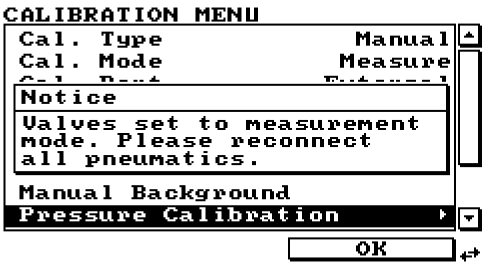

Figure 47 – Exit calibration menu

7. Reconnect external tubing to the rear of the analyser.

5.5.1 Pressure Calibration (with internal pump option only)

The internal pump requires a separate pressure calibration procedure that replaces the one used in Section 5.5.

1. Disconnect any external tubing connected to the rear of the analyser. Also ensure the analyser has been powered up for at least two hours prior to this calibration.
2. Go to **Main Menu → Calibration → Pressure Calibration.**

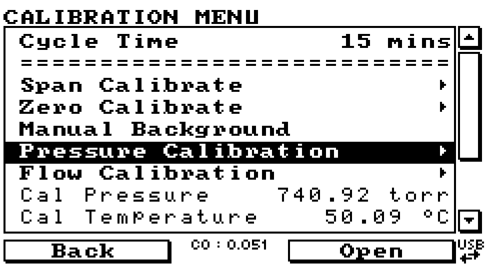

Figure 48 – Pressure calibration menu

3. Once the **Pressure Calibration Menu** is open, the valves will be set automatically to enable this pressure calibration procedure.

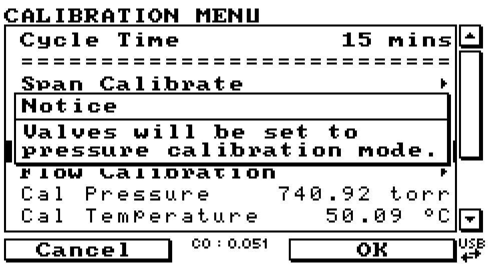

Figure 49 – Valves automatically set

4. Select **Vacuum Set Pt.** and **OK** the instructions.

Figure 50 – Vacuum set pt.

5. Connect a pressure meter (barometer) to top fitting of the optical bench (detector end). Ensure you set or convert the pressure units as per the units set on the analyser.

Figure 51 – Connect a pressure meter

6. The internal pump should automatically start running at full speed. Wait until the pressure stabilises (about 5 minutes). Edit **Vacuum Set Pt.** by entering the pressure shown on the external meter. Select **Accept.**
7. The pump should now stop automatically. Remove the external pressure sensor and wait a few minutes. Adjust the ambient set point to the current ambient pressure and select **Accept**.

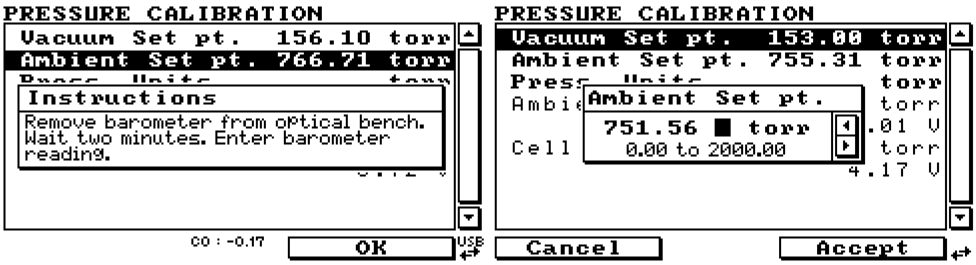

Figure 52 – Adjust ambient set pt.

8. Reconnect the original tube to the cell assembly. Also reconnect the ports on the rear of the analyser (Sample, Calibration and Exhaust).

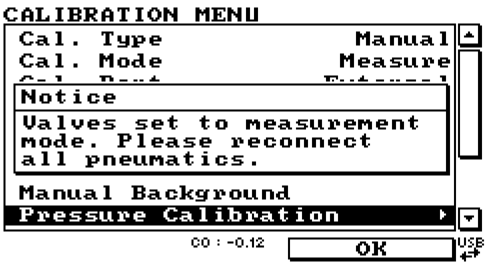

Figure 53 – Exit pressure calibration menu

9. Exit the **Pressure Calibration Menu** and return to the **Flow Calibration Menu.**
10. Set the internal pump to **Off**.
11. Remove barometer from Sample Port.
12. Return to the **Calibration Menu**.
    Instrument will prompt user **Do you want to resume the flow control** select **NO**.
13. Under the **Pressure Calibration Menu** select **Ambient**.
14. Allow 3 to 5 minutes for the pressure reading to stabilise to ambient (both barometer and analyser).
15. Press **EDIT** and enter the measured reading from the barometer and press **Accept**.
16. Go to the **Pressure & Flow Menu** (**Main Menu → Analyser State**) and compare the **Ambient** and **Cell** pressures to each other. If they are within 5 TORR of each other pressure calibration was fine, if they are >± 5 TORR repeat pressure calibration procedure.
17. When completed return to the **Flow Control** field and set to **Enabled**.
18. Go to the **Valve Menu** and set **Valve Sequencing** to **ON**.
19. The procedure is now completed.

5.5.2 Flow Calibration (with internal pump option only)

The following procedure must be performed if the instrument has been set back to factory defaults, the external flow check has found the flow to be outside normal range, or if the flow rate set points need to be changed.

1. Disconnect all external tubing.
2. Go to **Main Menu → Calibration → Flow Calibration.**

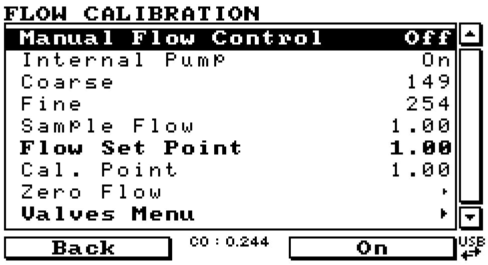

Figure 54 – Manual flow calibration

3. Go to the **Valve Menu** and set **Valve Sequencing** to **OFF**.
4. Set **Span/Zero** and **Cal Port** valves to **Closed**.
5. Return to the **Flow Calibration Menu**.
6. Set the **Flow Control** field to **Disabled**.
7. Set the internal pump to **OFF**.
8. Wait for the sample flow to become stable around 0 (± 0.01).

> **Note:** Make sure that the **Flow Set point** and the **Cal. Point** are both preset to 1.00.

9. Press **Zero Flow → Set** (sample flow should not change).
10. Pop up will display **Zero flow/set current flow as zero flow?** Select **YES**.
11. Connect a calibrated flow meter to the Sample Port on the back of the analyser.
12. Set internal pump to **ON**.
13. Manually adjust the coarse and fine pots until the flow meter reads the desired analyser sample flow rate (set point).

> **Note:** Set fine pot to 253, then adjust coarse to be as close as possible to desired reading, then use fine pot to make it exact.

14. Enter the reading from the flow meter into the **Cal. Point** field.
15. Set the **Flow Control** field to **Enabled**.
16. Go to the **Valve Menu** and set **Valve Sequencing** to **ON**.
17. (**Main Menu → Service Menu → Diagnostics → Valve Menu**)
18. Leave for up to 5 minutes to return to normal operation. If instrument doesn't return to normal there may be a blockage (Refer to Section 7.1).
19. Remove external meter and reconnect external tubbing to the rear of analyser.

5.6 High Pressure Zero/Span Valve

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

Note: This is NOT intended as a source for calibrating the instrument. This should only be used as an operational check of the instrument's zero point and single upscale point (recommended as 80% of full scale).

5.6.1 Single Pressurised Calibration Option

Operation of Single Calibration Option

When using the pressurised calibration option, either a high pressure zero or span bottle should be connected to the **Auxiliary In** Port on the back of the analyser.

1. Ensure the gas cylinder is fitted with an appropriate gas regulator with a shut off valve.
2. Connect a line of stainless steel tubing between the gas cylinder and the analyser's **Auxiliary Port** inlet.

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

3. Open the cylinder main valve and adjust the regulator to 15 psig or 1 bar.
4. Open the regulator's shutoff valve and test for leakage.
5. Temporarily place a flow meter on the Calibration Port inlet (used as a span/zero gas vent during this check).
6. Enter the **Calibration Menu (Main Menu → Calibration Menu).**
7. Change **Set Cal Port** to **External**.
8. Select either **Span** or **Zero** under the **Cal Mode** option depending on which calibration check is being performed. This will initiate the pressurised calibration.
9. Open the shutoff valve on the cylinder, and adjust the regulator pressure until the flow on the vent line (Calibration Port) is between 0.5 and 1 lpm.

Note: Do not exceed a pressure of 2 bar, this can damage the analyser and cause gas leakage.

Return to Normal Operation

1. Set **Cal. Mode** → **Measure**.
2. Remove the flow meter on the Calibration Port and connect the vent line to the port.
3. Reconnect the instrument fittings and return to the original set-up.
4. The instrument is now in normal operation mode.

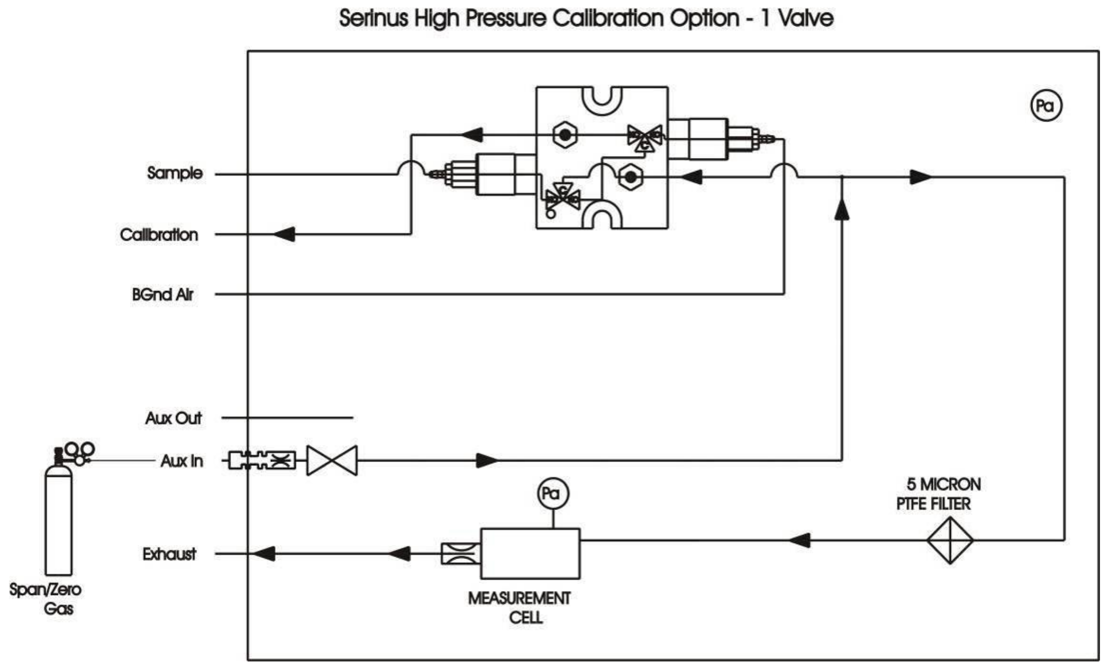

Figure 55 – Single high pressure calibration option

5.6.2 Dual Pressurised Calibration Option

Operation of Dual Calibration Option

When using the pressurised calibration option a high pressure zero bottle should be connected to the **Auxiliary In Port** and a high pressure span bottle connected to the Calibration Port on the back of the analyser.

1. Ensure the gas cylinder is fitted with an appropriate gas regulator with shut off valve.
2. Connect a line of stainless steel tubing between the appropriate gas cylinder and the analyser's Inlet Port.

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

3. Open the **Main Valve** and adjust the regulator to 15 psig or 1 bar.
4. Open the regulator shutoff valve and test for leaks.
5. Temporarily place a flow meter on the **Auxiliary Out** Port (used as a span/zero gas vent during this check).
6. Change **Set Cal Port** to **External** (**Main Menu** → **Calibration Menu**) then select zero under the **Cal Mode** option this will initiate the pressurised zero calibration.
7. Open the shutoff valve on the zero-air cylinder; adjust the regulator pressure until the flow on the vent line (**Auxiliary Out** Port) is between 0.5 and 1 lpm.
8. Change **Set Cal Port** to **External** **(Main Menu → Calibration Menu)** then select span under the **Cal Mode** option this will initiate the pressurised span calibration.
9. Open the shutoff valve on the span-gas cylinder; adjust the regulator pressure until the flow on the vent line (**Auxiliary Out** Port) is between 0.5 and 1 lpm.

Note: Do not exceed a pressure of 2 bar, this can damage the analyser and cause gas leakage.

Return to Normal Operation

1. Set **Cal. Mode** → **Measure**.
2. Remove the flow meter from the Auxiliary Out Port and connect a vent line to the port.
3. Reconnect instrument fittings and place in original set-up.
4. The instrument is now in normal operation mode.

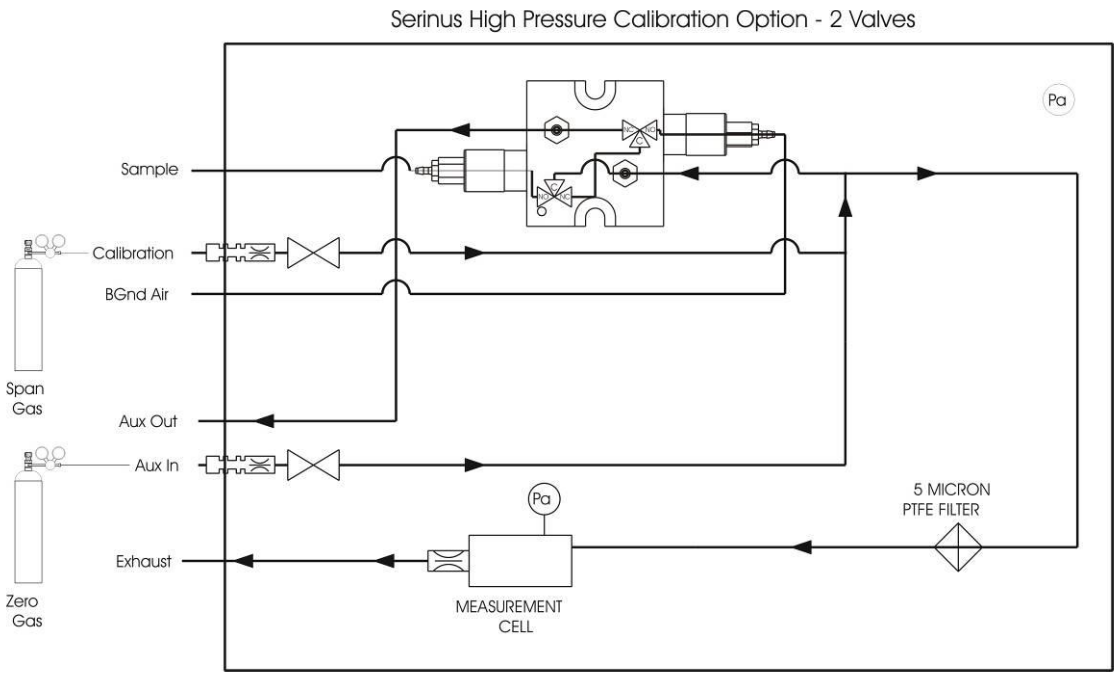

Figure 56 – Dual high pressure calibration option

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6. Service

6.1 Pneumatic Diagram

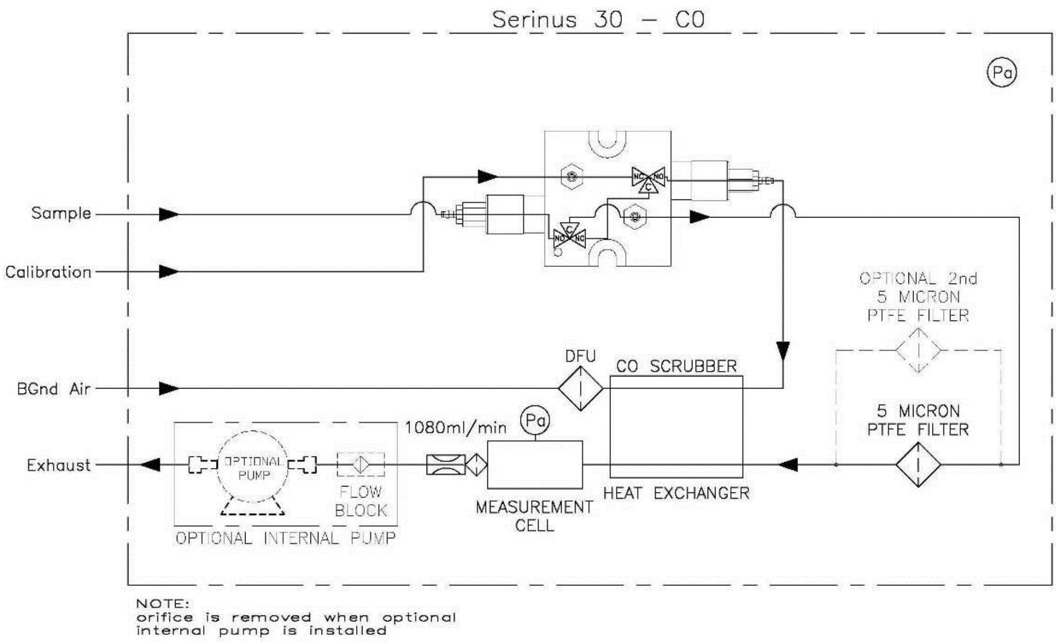

Figure 57 – Serinus 30 pneumatic diagram

6.2 Maintenance Tools

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

- Digital multimeter (DMM)
- Computer or remote data terminal and connection cable for RS232 or USB communication
- Pressure transducer (absolute) and connection tubing
- Flow meter (1 slpm nominal)
- Minifit extraction tool PN: T030001
- Orifice removal tool PN: H010046
- Assortment of 1/4” and 1/8” tubing and fittings
- Zero air source
- Span gas source
- Leak tester jig PN: H050069

6.3 Maintenance Schedule

Table 5 – Maintenance schedule

Interval *	Task performed	Page
Weekly	Check inlet particulate filter, replace if full/dirty	98
	Check sample inlet system for moisture or foreign materials. Clean if necessary	
	Perform precision check	86
Monthly	Perform leak check	100
	Check fan filter, clean if necessary	99
	Perform span calibration	84
6 Monthly	Check date and time is correct	46
	Check the CO-CO_2 converter	101
	Perform multi-point calibration	85
Yearly	Replace DFU filter	99
	Replace sintered filter and orifice (only if necessary)	102
	Trim pot tuning procedure	103
	Perform pressure check	103

* 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 analyser, including slow response time, erroneous readings, temperature drift and various other problems.

1. Disconnect the external pump.
2. Slide open the lid of the analyser to access the particulate filter (located in front right hand corner).
3. Unscrew the filter cap (bright blue) by turning it counter-clockwise.
4. Remove the filter plunger from the casing, place finger on tubing connector and pull to the side (refer to Figure 58).

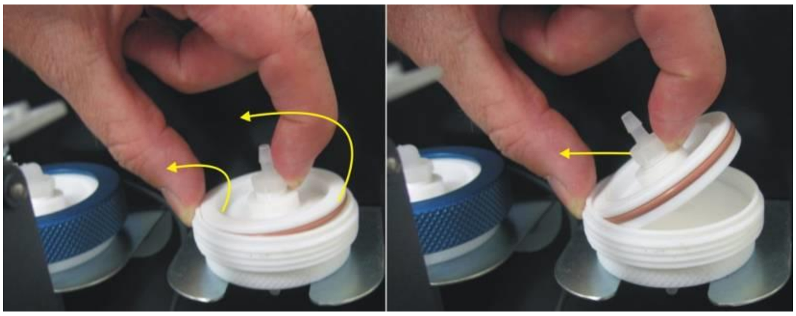

Figure 58 – Removing plunger

5. Remove the old filter, wipe down the plunger with a damp cloth and insert new filter.
6. Replace the plunger, screw the cap on and reconnect the pump.
7. Close the instrument and perform a leak check (refer to Section 6.4.4).

6.4.2 Clean Fan Filter

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

1. Disconnect the fan power cable.
2. Remove outer filter casing and filter (refer to Figure 59).
3. Clean filter by blowing with compressed air (if available) or shaking vigorously.
4. Reinstall filter and filter casing.
5. Reconnect fan power cable.

Figure 59 – Removing fan filter

6.4.3 DFU Replacement

1. Turn the analyser 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.

Figure 60 – DFU filter

6.4.4 Leak Check

Equipment Required

- Source of vacuum (pump)
- Leak check device
- Swagelok ¼" blocker nut

Leak Check Procedure

1. Connect the leak check device to the Exhaust Port of the analyser.

Figure 61 – Pressure gauge on exhaust

2. Connect a pump to the shut off valve ensuring the shut off valve is in the open position, turn on the pump.
3. Block the analyser's Sample Calibration and BGnd Air Ports with a Swagelok ¼" blocker nut.
4. Switch on the analyser; navigate from the **Main Menu → Service Menu → Diagnostics → Valve menu**. Switch off the valve sequencing and close all valves.
5. Close the shut off valve and record the vacuum. Wait for 3 minutes and then observe the gauge on the leak check jig. It should not drop more than 5 kpa. If it has then a leak is present within the sample cycle of the instrument.

6. Enter **Main Menu → Service Menu → Diagnostics → Valve menu.** Then set **Sample/Cal Open**.
7. Turn on the pump, switch the shut off valve to the **Open** position and allow the pump to evacuate the pneumatics.

   Switch the shut off valve to the **Closed** position and turn off pump. Record the vacuum indicated on the leak checking device. Wait 3 minutes then observe the gauge on the leak check device. It should not drop more than 5 kpa. If it does then a leak is present within the zero cycle of the instrument.
8. Enter **Main Menu → Service Menu → Diagnostics → Valve Menu.** Then set **Sample/Cal Open** and **Internal Zero/Cal Open.**
9. Turn on the pump, switch the shut off valve to the **Open** position and allow the pump to evacuate the pneumatics.
10. Switch the shut off valve to the **Closed** position and turn off pump. Record the vacuum indicated on the leak checking device. Wait 3 minutes then observe the gauge on the leak check device it should not drop more than 5 kpa. If it has then a leak is present within the span calibration cycle of the instrument.
11. If the instrument did not leak then skip to step number 15.
12. Inspect the instrument's plumbing looking for obvious damage. Check the condition of fittings, sample filter housing, O rings both in the filter assembly and in the cell assembly.
13. When the location of the leak has been determined, repair and then rerun the leak check procedure.
14. 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.
15. Remove the leak check jig and Swagelok blocking nuts.
16. Re-enable valve sequencing from the **Valve Menu**.

6.4.5 CO-CO_2 Converter Check

The internal CO-CO_2 converter provides a source of continuous zero air for auto-zero and background functions. Failure of the converter can result in drift, poor sensitivity near zero and continuous electronic zero adjusts.

To check the CO-CO_2 converter:

1. Enter **Main Menu → Calibration Menu** and change the **Cal. Mode** field to **Zero** and the **Cal. Port** to **Internal**.
2. Allow the analyser to sample zero air from the zero air scrubber for approximately 5 minutes.
3. Record the front panel CO reading 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 5 minutes to complete.

4. Connect 40 ppm of span gas to the Background Air Port ensuring the inlet pressure is maintained at ambient pressure.
5. Enter **Main Menu → Calibration Menu** and change **Cal. Mode** field to **Zero** and the **Cal. Port** to **Internal**.
6. Allow the analyser to sample the span gas for 10 minutes.
7. Record the indicated CO reading as the "Challenge" value.
8. Compare the CO initial value and the challenge value. They should agree within ±2 ppm. If the initial value is less positive than the challenge value, the CO-CO_2 converter should be replaced.
9. Disconnect the span gas and set the "Cal. Port" to your normal setting. Verify that the analyser is in the measure mode.

6.4.6 Sintered Filter/Orifice Replacement

Required Equipment

- Orifice/filter removal tool PN: H010046

1. Turn off the pump.
2. Disconnect the tubing from the measurement cell (refer to Figure 62).

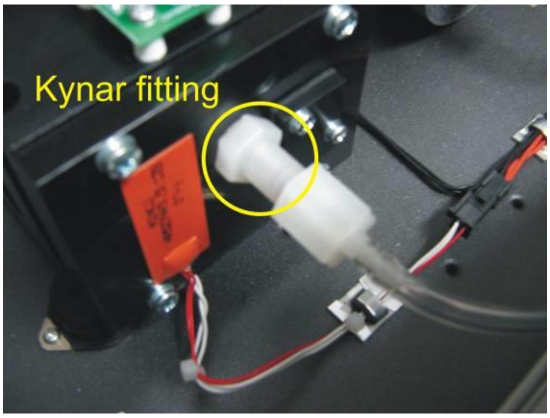

Figure 62 – Kynar fitting containing orifice and sintered filter

3. Unscrew the fitting from the cell (anti-clockwise).
4. Use the orifice/filter removal tool to screw into the orifice (clockwise) and then gently pull the orifice out of the fitting.
5. The orifice can now be cleaned or exchanged as required and replaced with the orifice/filter removal tool.
6. Repeat the procedure for the sintered filter using the other end of the orifice/filter removal tool.
7. Replace the fitting into the measurement block and replace tubing if necessary.
8. Turn on the pump.

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, then the Serinus 30 is likely to produce unstable results. If the Input pot reads less than 180 (refer to Section 3.5.16), this is an indication that this procedure needs to be performed.

1. Ensure the laser and detector has been aligned to provide an optimum shaped response.
2. Disable the control loop.
3. Adjust the input pot to 190 in the diagnostic menu.
4. Adjust the trim pot on the detector board (on the side of the reaction cell) such that the reference voltage reads 4.00 V ±0.03 V.
5. Re-enable the control loop, reset the instrument.
6. Ensure that the Input pot reads 190±10 after the analyser is out of start-up. If not, perform this procedure again.
7. Perform a leak check (refer to Section 6.4.4).

6.4.8 Clean Pneumatics

The valve manifold will require disassembling and cleaning. Ideally the vales and manifold should be cleaned in a sonic bath with soppy water. Once clean, rinse with distilled water and dry before reassembling. A leak test should be performed once the analyser is ready for operation (refer to Section 6.4.4).

Note: If the tubing shows signs of significant contamination, then it should be replaced with new tubing. Do not clean the converter or the mirrors found within the 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.

To navigate to the pressure and flow menu: Enter **Main Menu** → **Analyser State** → **Pressures and Flow**.

1. A simple way of checking the pressure sensors response is to disconnect the exhaust and sample tubing from the back of the analyser. After 2-5 minutes observe the pressure readings: ambient and cell. Ensure that they are reading the same ± 3 torr (± 0.4 kPa).
2. If the readings are outside this level then perform a pressure calibration (refer to Section 5.5).

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

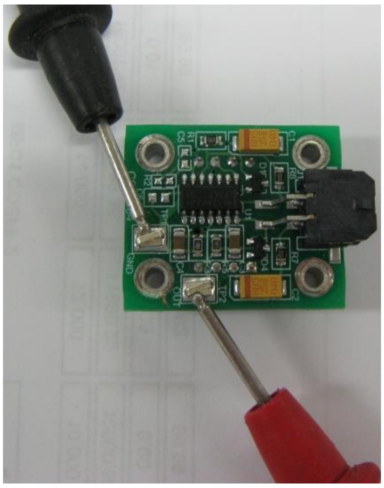

Figure 63 – Test point location

Figure 64 – Typical test point reading of cell pressure sensor

6.4.10 Battery Replacement

The replaceable battery (BT1) on the main controller board may need to be replaced. If the clock resets or does not increment when the power is off, then the battery is going flat. The battery should be replaced with the correct type of battery, a 3V Lithium CR2025 type should be used and installed correctly as follows:

1. Turn off the instrument, open the lid and remove the 2 screws holding down the main controller PCB.
2. Lift the PCB up to its open position. The battery (BT1) is located toward the front of the PCB.

3. Using a small flat screwdriver, lift the metallic clip holding the battery whilst sliding the old battery out.
4. Now place the new battery in with the positive (+) side facing up.
5. Close the main PCB and return the screws. Close the lid again.
6. Turn on the instrument and set the clock time and date in the **General Settings Menu** (refer to Section 3.5.8).

6.5 Parts List

Below is a list of the replaceable parts of the Serinus 30. Some of these parts will not need replacing and other consumables will need constant replacing. See below for information on yearly consumable kits available from Ecotech.

Table 6 – Spare parts list

Part Description	Part Number
Infrared source	H014201
Filter optical	H014205
Detector	S030005
Window, Sapphire	H014206
PCA CO detector	C010009
PCA for LCD and Keypad (Original front panel design)	C010010
PCA for LCD and Keypad (Newer Backlit keypad design)	C010010-01
PCA pressure sensor	C010004
PCA back panel	C010002
Motor, opto, lamp, correlation wheel assembly	H014125
Barb adaptor	H010007
Fitting Kynar bulkhead	F030023
PCA, controller	E020220
Motor, correlation wheel	M020006
Reflector, optical interrupter	S030002
Valve manifold assembly	H010013-01
Single heater and thermistor assembly	C020082
Surface heater and thermistor assembly (stick on)	C020075
Correlation wheel assembly	H014114
Serinus 30 user manual	M010027
O-ring, flat and spherical mirrors	O010011
O-ring, mounting plate	O010009
Gasket	H014212
Gasket pressure sensor	H010037
Extraction tool, filter and orifice	H010046

Table 7 – Serinus 30 Maintenance Kit

Part Description	Part Number
Serinus 30 maintenance kit	E020202
Filter, sintered qty 1	F010004
O-ring, optical filter qty 1	O010010
23 micron DFU filter qty 1	F010005
O-ring, orifice and filter qty 2	O010012
O-ring 5/32ID X 1/16W, viton qty 2	O010013
O-ring 1/4ID X 1/16W, viton qty 2	O010015
O-ring 13/16ID X 1/16W, viton qty 2	O010016
O-ring 1 11/16ID X 3/32W viton qty 2	O010014
O-ring BS015, viton qty 4	O010023
O-ring, sapphire window qty 1	O010008
O-ring, bulkhead qty 1	ORI-1009
Tygon tubing ¼ x 1/8 (3ft)	T010011

Table 8 – Other Consumables – Not included in Maintenance Kit

Other Consumables (not included in the maintenance kit)	
Filter paper Teflon 47MM pack of 50	F010006-01
Filter paper Teflon 47MM pack of 100	F010006
Orifice – sample (14mil)	H010043-13
Converter assembly, CO, Serinus	H014130
Silicone heat sink compound	C050013
External pump repair kit (suite 607 pump)	P031001
Tygon tubing, 25ft length	T010011-01

6.6 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 do this, power up the instrument and immediately press the plus key multiple times until the following screen appears.

** Ecotech Serinus Analyser **
V2.1 Bootloader
Press '1' to enter Bootloader

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

6.6.1 Display Help Screen

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

6.6.2 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.

6.6.3 Updating Firmware

It is important for optimal performance of the Serinus analyser that the latest firmware is loaded onto the analyser. 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.au** or **intsupport@ecotech.com**

To update the firmware from a USB memory stick, use this procedure.

Upgrade from USB Memory Stick.

USB Memory Stick Update

1. Turn instrument off.
2. Place USB memory stick with new firmware (ensure that firmware is placed in a folder called FIRMWARE) in the front panel USB Port.
3. Enter the instrument Bootloader (refer to Section 6.6)

4. Select option 3, (Upgrade from USB memory stick) press 3 on keypad.
5. Wait till upgrade has completed.
6. Press 9 to start the analyser with new firmware.

6.6.4 Erase All Settings

This command is only required if the instruments firmware has become unstable due to corrupted settings. To execute this command enter into **Bootloader Menu** and select key 4.

6.6.5 Start Analyser

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

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7. Troubleshooting

Before troubleshooting any specific issues, Ecotech recommends ensuring the analyser has successfully completed its start-up routine, and then resolving all issues listed in the instrument status menu (refer to Section 3.3).

Table 9 – Troubleshoot list

Error Message/Problem	Cause	Solution
Flow fault	Multiple possibilities	Refer to Section 7.1
	Pump failed	Replace the internal or external pump.
	Blocked filter or orifice	Replace sintered filter and orifice.
	Pressurised Rx cell	Ensure sample and zero inlets are maintained at ambient pressure.
	Pressure sensors	Recalibrate or replace the pressure sensors.
Noisy/unstable readings	Multiple possibilities	Refer to Section 7.2
	Calibration system error	Ensure calibration system is functioning correctly and is leak free. Ensure sufficient gas is available for instrument and an adequate vent is available for excess gas.
	Leaks	A leak in the analyser or calibration system dilutes the sample stream and causes low span readings and noise.
	Temperature unstable	1. A failed temperature control allows the instrument to drift with ambient temperature. Verify that both the cell and mirror temperatures are 50 °C $\pm$ 3 °C. 2. Chassis lid not in place causing analyser to drift with ambient temperature. 3. Chassis temperature drifting with ambient temperature fluctuations. Stabilise ambient temperature and remove analyser from direct ambient heating or cooling.
	Hardware fault	Measurement cell internal hardware loose. Mirrors have detached or degraded.
	Commissioning error	Measurement cell travel screws are still fastened (refer to Section 2.3.4).
	Gain too high	1. Leak check (repair any leaks). 2. Measurement cell internal hardware loose – return to nearest service centre. 3. Mirrors have detached or degraded – return to nearest service centre.
Cell temperature failure	Faulty heater or temperature sensor	Refer to Section 7.3

Error Message/Problem	Cause	Solution
Mirror temperature failure	Faulty heater or temperature sensor	Refer to Section 7.4
Analyser resetting	Multiple possibilities	1. Check that the instrument is not overheating. 2. Possibly a faulty power supply. 3. Corrupted firmware. Perform an 'erase all settings' in the **Bootloader Menu** and reload or upgrade firmware.
12 Voltage supply failure	Power supply has failed	Replace power supply.
No display	AC power	1. Verify that the line cord is connected. 2. Check that the power supply fuse is not open. The fuse should be 5 A (115 V) or 3 A (230 V). 3. Verify that the voltage switch is in the proper position.
No display Sample pressure too high or too low	Contrast misadjusted	Adjust the display contrast by pressing two keys on the front panel: - Press Up arrow (⋀) for darker contrast - Press Down arrow (⋁) for lighter contrast
	DC power	Verify that the power supply is providing ± 12 V + 5V DC.
	Display	Check the interface cable between the display and the microprocessor board.
	Bad display or microprocessor PCA	1. Replace the front panel display. 2. Replace the microprocessor board. 3. A bad cable is unlikely, but if you suspect it; perform a pin-for-pin continuity test using an ohmmeter.
	Loss of pressure calibration	Too high - re-calibrate pressure sensors. Too low – check calibration and sample flow.
Sample flow not at 1 SLPM	Multiple possibilities	Check/replace sintered filter Check/replace sample filter Check pump Check valves Re-calibrate pressure sensors
Unstable flow or pressure readings	Faulty pressure sensors	Check pressure transducer calibration. If unable to diagnose problem then it may be a noisy A/D converter, replace main PCB.
Low span	Leaks	A leak in the analyser or calibration system dilutes the sample stream and causes low span readings and noise.
	Span calibration out	Adjust the span using the calibration procedure.

Error Message/Problem	Cause	Solution
No response to span gas	Leaks/blockages	Leak or blockages in tubes or valves. Perform leak check and flow check and repair any leaks/blockages.
	Faulty calibration source	Ensure calibration gas is plumbed correctly, is not contaminated, has no leaks and is a NATA/NIST reference gas.
	Hardware fault	Faulty measurement cell.
	Correlation wheel leaking	Replace correlation wheel.
Zero drift	No flow	Check sample flow.
	Faulty zero air	Ensure zero air source is not overly polluted.
	Leak	Perform leak test.
	CO-CO_2 converter faulty	Replace CO-CO_2 converter.
A/D conversion error	Temperature/pressure error	Replace main PCB.
Negative zero	Indicates that the internal zero air is less efficient than the external zero	Check the internal zero air supply is equipped with a functioning CO removing device.

7.1 Flow Fault

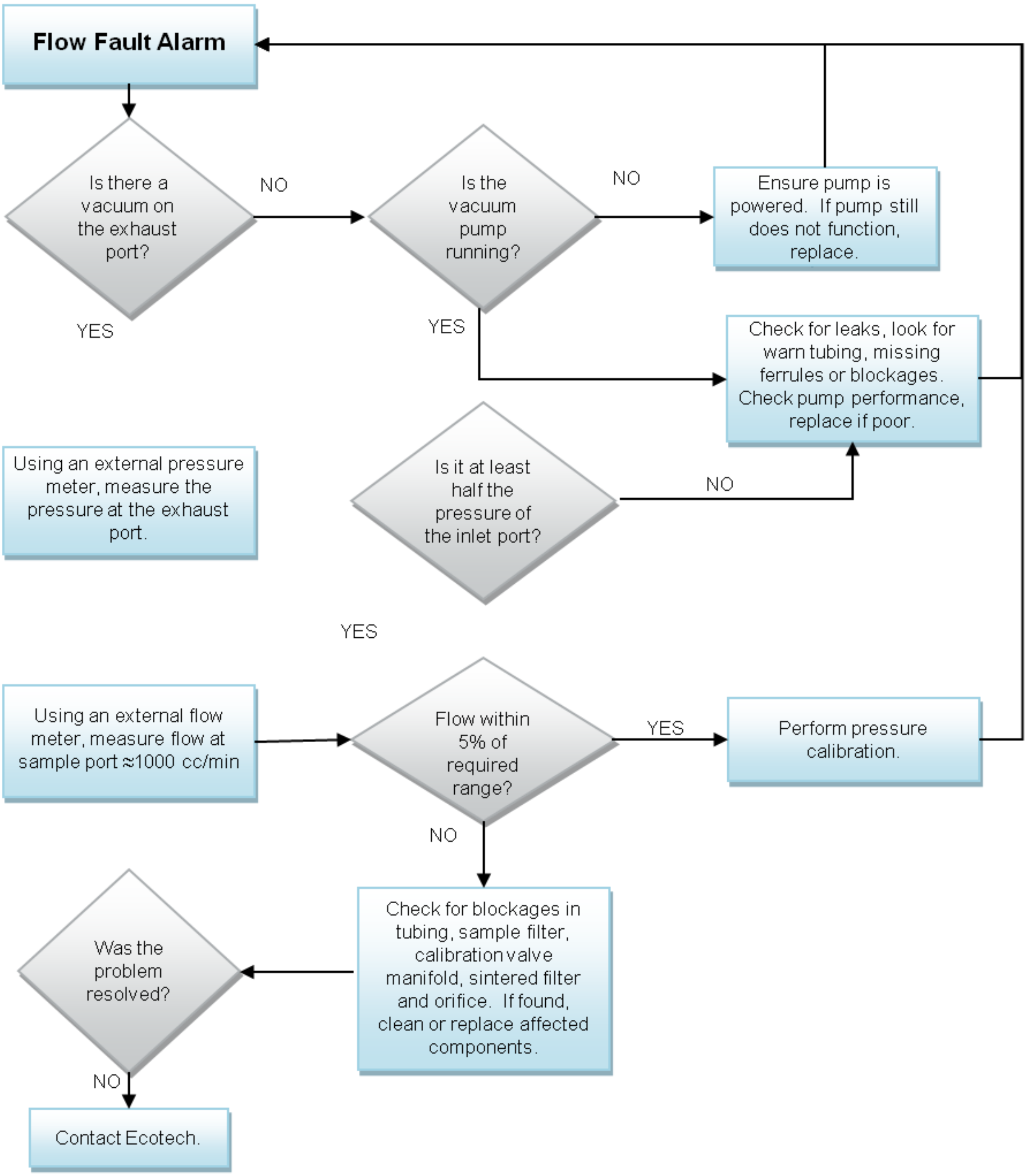

Figure 65 – Flow fault diagnostic procedure

7.2 Noisy/Unstable Readings

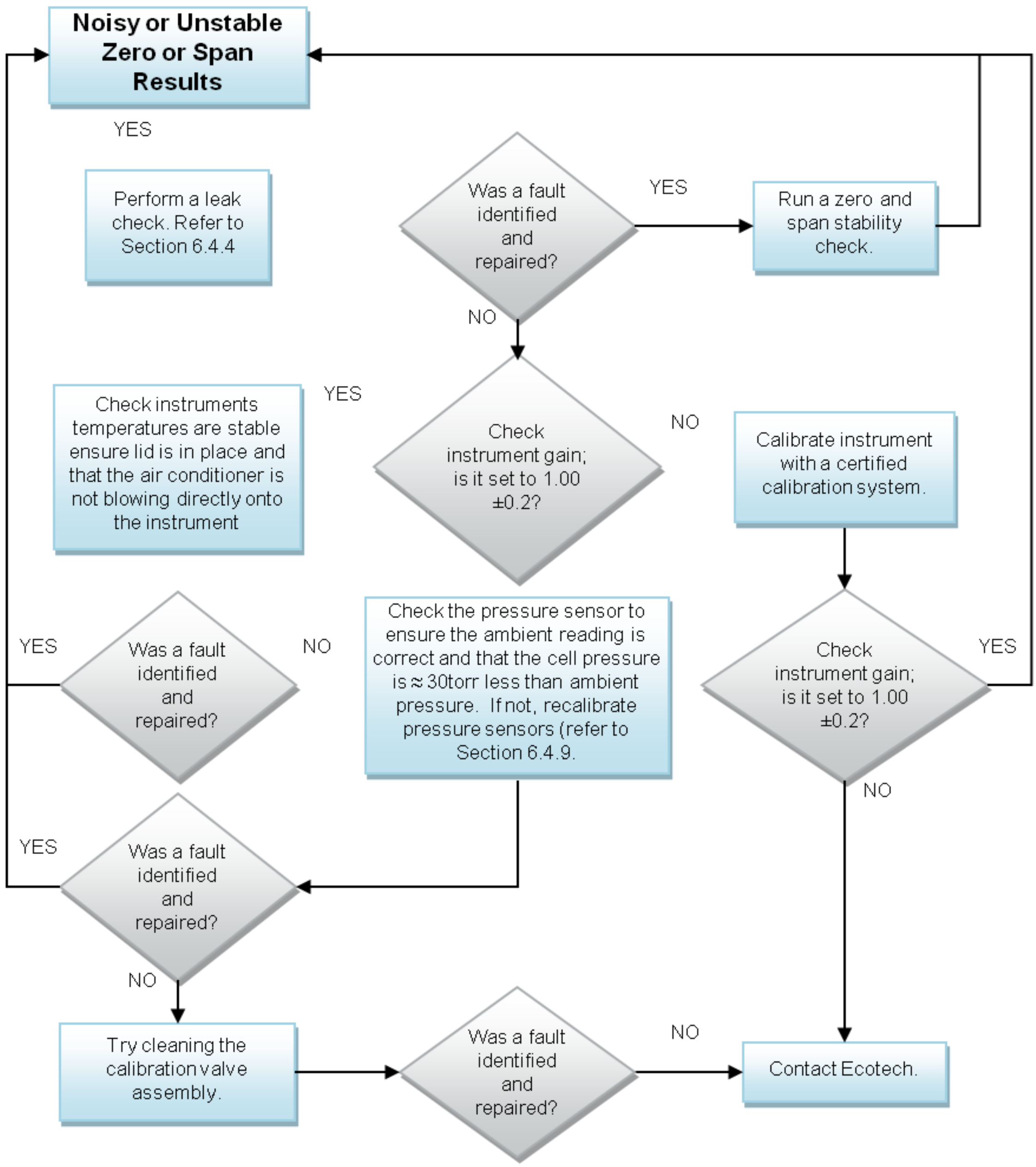

Figure 66 – Noisy zero or unstable span diagnostic procedure

7.3 Cell Temperature Failure

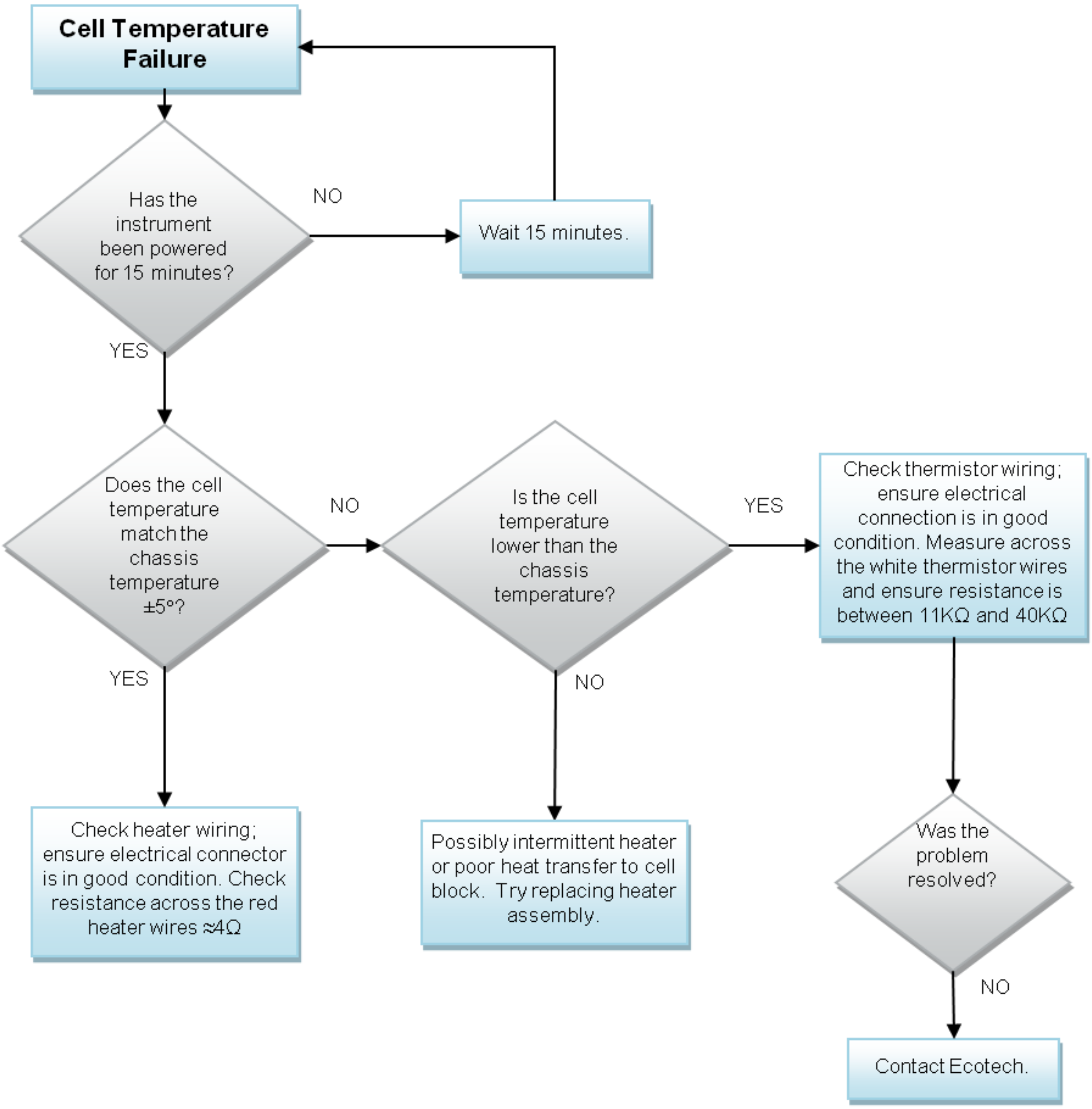

Figure 67 – Cell temperature failure diagnostic procedure

7.4 Mirror Temperature Failure

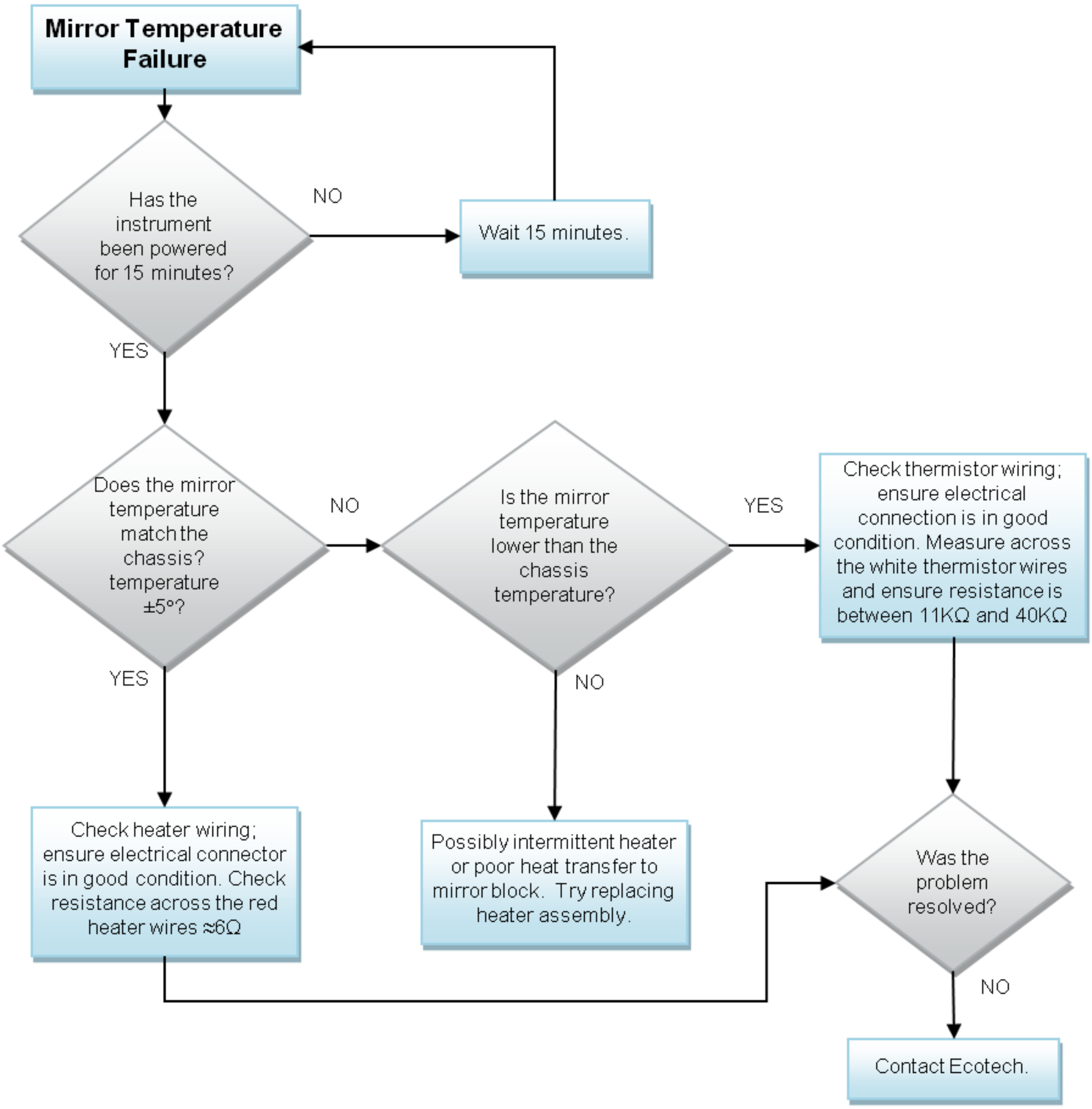

Figure 68 – Mirror temperature failure diagnostic procedure

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8. Optional Extras

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.

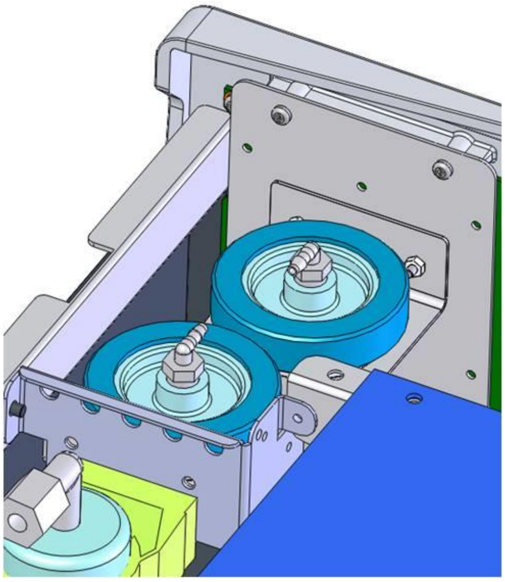

Figure 69 – Dual filter option installed

8.2 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).

Included Items

1	Rack Slide Set	H010112
4	Rack Mount Adaptors	H010133
2	Rack Mount Ears	H010134
4	Spacers HAR-8700	
8	M6 x 20 Button Head Screws	
16	M6 Washers	
8	M6 Nyloc Nuts	
14	M4 x 10 Button Head Screws	
8	M4 Washers	
8	M4 Nyloc Nuts	
4	M4 x 10 Phillips Pan Head Screws	
8	M6 Cage Nuts	

Installing the Instrument

1. Remove the rubber feet from the analyser (if attached).
2. Separate the slide rail assembly, pressing the black plastic clips on the slide rails to remove the inner section of the rail. (Refer to Figure 70).

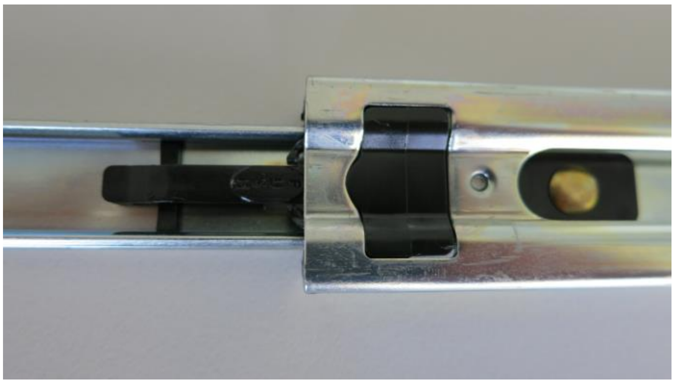

Figure 70 – Separate rack slides

3. Attach the inner slide rails to each side of the analyser using M4 x 10 button screws - three each side. Make sure you use the vertical slotted holes and push the slide firmly downwards so that the screws sit at the top of the slot. This ensures that any protrusions under the base of the analyser do not hit any blanking panels which may be fitted (refer to Figure 71).

Figure 71 – Assemble inner slide on chassis

4. 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 may be required to suit the length of the rack (refer to Figure 72).

Figure 72 – Attach rack mount adaptors to outer slides

5. Install the two assembled outer slide rails onto the left and right side of the rack securely with M6 bolts, washer and locknuts (refer to Figure 74).

Figure 73 – Attach slides to front of rack

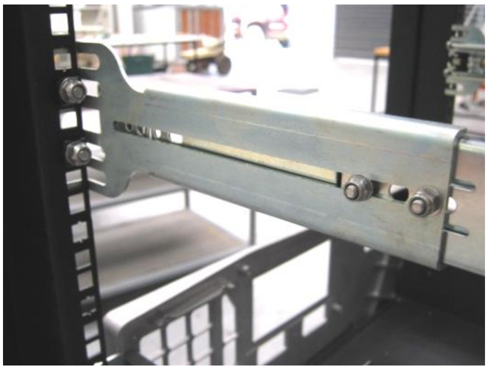

Figure 74 – Attach rack mount adaptors to outer slides

6. Use a spacer (or cage nut) to space the rear claw from the side of the rack and a washer and locknut to secure it (refer to Figure 75).

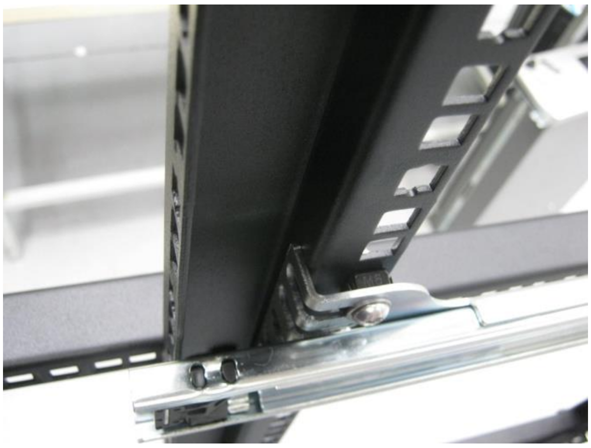

Figure 75 – Attach rear mount adapters to slide

7. Install rack mount ears on the front of the instrument using two M4 x 10 screws on each side (refer to Figure 76).

Figure 76 – Rack mount ears fitted to analyser

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 (you will hear a click from both sides).

Note: Ensure both sides of the inner slide are attached to the outer slides before pushing into the rack fully.

9. Push the analyser fully in. At this point, make sure that the analyser slides reach and locate in to the plastic catches at the rear end of the outer slides. Adjust the outer slides as required until this is achieved. Remove analyser and now tighten the M4 screws and nuts that secure the front and rear claws on both sides of the rack.

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.

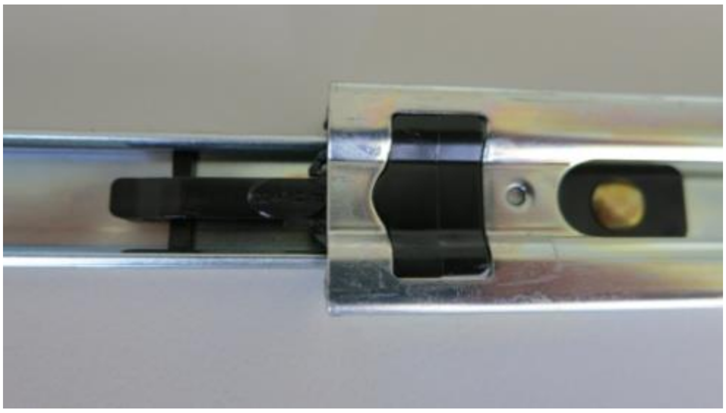

Figure 77 – Slide clips

8.3 Internal Pump PN E020107

8.3.1 Additional Components

The Serinus 30 internal pump option includes the following additional components:

Table 10 – Internal pump additional components

Component	Description	Part number
Internal pump	Pull sample through instrument, strength of pulling is dependent on temperature and pressure readings.	H010027
Flow block	Includes sintered filter and differential pressure sensor to measure flow.	H010120
Heater and Thermistor	Mounted in flow block to measure and control temperature for accurate flow.	Installed in flow block

8.3.2 Removed Components

The Serinus 30 has a number of components missing from the standard analyser due to the presence of the internal pump and flow block controlling flow within the instrument. The parts that have been removed when internal pump is included are:

Table 11 – Internal pump removed components

Component	Part number
Sintered filter	F010004
O-ring	O010012
Spring	H010040
O-ring	O010013
Orifice	H010043-13

8.3.3 Flow Calibration

The flow calibration menu is only available when the internal pump option is installed. Refer to section 3.5.13 for details.

The internal pump requires a separate flow calibration procedure. The flow calibration detailed in section 5.5.1 must be performed after any exchanges/changes to fittings or filters.

8.3.4 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 the procedure shown in Section 5.5.1.

8.4 High Pressure Zero/Span Valves

High pressure span calibration valve (factory installed) PN E020108

High pressure zero calibration valve (factory installed) PN E020109

Note: This is NOT intended as a source for calibrating the instrument. This should only be used as an operational check of the instrument's zero point and single upscale point (recommended as 80% of full scale).

Appendix A. Advanced Protocol Parameter List

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

Table 12 – Advanced protocol parameter list

#	Description	Notes
0	Sample / Cal Valve	0=Sample, 1=Cal/Zero
1	Cal / Zero Valve	0=Zero, 1=Cal
2	Internal Span Valve	0=Closed, 1=Open
3	Spare Valve 1	0=Closed, 1=Open
4	Spare Valve 2	0=Closed, 1=Open
5	Spare Valve 3	0=Closed, 1=Open
6	Spare Valve 4	0=Closed, 1=Open
7	NO_X Measure Valve	0=NO, 1=NO_X
8	NO_X Bypass Valve	0=NO, 1=NO_X
9	NO_X Background Valve	0=Closed, 1=Open
10	Valve Sequencing	0=Off, 1=On
11	LCD Contrast Pot	0=Lightest, 255=Darkest
12	SO_2 Reference Zero Gain Pot	S50 reference zero pot
13	CO Measure Gain Pot	S30 measure gain adjust
14	CO Reference Gain Pot	
15	CO Test Measure Pot	See 149. Exists
16	PMT High Voltage Pot	High voltage controller pot for PMT S50 & S40
17	SO_2 Lamp Adj Pot	S50 lamp adjust pot
18	O_3 Lamp Adj Pot	S10 lamp adjust pot
19	O_3 Zero Measure Pot: Coarse	S10 signal zero (coarse)
20	O_3 Zero Measure Pot: Fine	S10 signal zero (fine)
21	PMT Fan Pot	PMT fan speed controller pot
22	Rear Fan Pot	Chassis fan speed control pot
23	Pump Speed Motor Driver Pot: Fine	Internal pump speed fine pot
24	Pump Speed Motor Driver Pot: Coarse	Internal pump speed coarse pot
25	Analogue Input 0	SO_2 reference signal
26	Analogue Input 1	CO reference signal
27	Analogue Input 2	O_3 reference signal
28	Analogue Input 3	SO_2 & O_3 lamp current

#	Description	Notes
29	Analogue Input 4	Flow block pressure
30	Analogue Input 5	Cell pressure
31	Analogue Input 6	Ambient pressure
32	Analogue Input 7	Raw ADC calibration input
33	Analogue Input 8	MFC1 not used
34	Analogue Input 9	Concentration data
35	Analogue Input 10	MFC2 not used
36	Analogue Input 11	MFC3 not used
37	Analogue Input 12	External analog input 0
38	Analogue Input 13	External analog input 1
39	Analogue Input 14	External analog input 1
40	Analogue Input 15	MFC0 not used
41	CO Measure Pot : Coarse	S30 measure zero coarse adjustment pot
42	CO Measure Pot: Fine	S30 measure zero fine adjustment pot
43	SO_2 Measure Signal Gain Pot	SO_2 measure signal gain pot
44	SO_2 Reference Gain Pot	SO_2 reference signal gain pot
45	SO_2 Signal Zero	SO_2 measure zero pot
46	O_3 Signal Gain Pot	O_3 input signal gain pot
47	Test Pot	Test pot for all the analysers
48	NO_X signal gain pot	PMT signal input gain control for NOX
49	PGA Gain	1, 2, 4, 8, 16, 32, 64, 128
50	Primary Gas Concentration	Current value on front screen
51	Secondary Gas Concentration	Current value on front screen (if applicable e.g. NO_x)
52	Calculated Gas Concentration	Gas 3 (e.g. NO_2)
53	Primary Gas Average	Average of the readings(for Gas1) of the last n minutes where n is the averaging period
54	Secondary Gas Average	
55	Calculated Gas Average	
56	Instrument Gain	
57	Main Gas ID	
58	Aux Gas ID	
59	Decimal Places	2-5
60	Noise	
61	Gas 1 Offset	
62	Gas 3 Offset	

#	Description	Notes
63	Flow Temperature	
64	Lamp Current	
65	Digital Supply Voltage	Digital supply voltage (should always read close to 5 volts)
66	Concentration Voltage	
67	PMT High Voltage	High voltage reading for PMT
68	Ozonator Status	0=Off, 1=On
69	Control Loop	
70	Diagnostic Mode	
71	Gas Flow	
72	Gas Pressure	
73	Ambient Pressure	
74	12V Supply Voltage	The 12 volt power supply voltage
75	Cell Temperature	
76	Converter Temperature	
77	Chassis Temperature	
78	Manifold Temperature	
79	Cooler Temperature	
80	Mirror Temperature	
81	Lamp Temperature	
82	$O_{)}$ Lamp Temperature	
83	Instrument Status	
84	Reference Voltage	
85	Calibration State	0 = MEASURE 1 = CYCLE 2 = ZERO 3 = SPAN
86	Primary Raw Concentration	(Before NO_x background and gain)
87	Secondary Raw Concentration	(Before NO_x background and gain)
88	NO_x Background Concentration	(Before gain)
89	Calibration Pressure	
90	Converter Efficiency	
91	Multidrop Baud Rate	
92	Analog Range Gas 1	
93	Analog Range Gas 2	
94	Analog Range Gas 3	

#	Description	Notes
95	Output Type Gas 1	1=Voltage 0=Current
96	Output Type Gas 2	1=Voltage 0=Current
97	Output Type Gas 3	1=Voltage 0=Current
98	Voltage Offset /Current Range Gas1	0=0% or 0-20mA 1=5% or 2-20mA 2=10% or 4-20mA
99	Voltage Offset /Current Range Gas2	0=0% or 0-20mA 1=5% or 2-20mA 2=10% or 4-20mA
100	Voltage Offset /Current Range Gas3	0=0% or 0-20mA 1=5% or 2-20mA 2=10% or 4-20mA
101	Full Scale Gas 1	5.0 Volt calibration value for analog output 1
102	Full Scale Gas 2	5.0 Volt calibration value for analog output 2
103	Full Scale Gas 3	5.0 Volt calibration value for Analog output 3
104	Zero Adjust Gas 1	0.5 Volt calibration value for analog output 1
105	Zero Adjust Gas 2	0.5 Volt calibration value for analog output 2
106	Zero Adjust Gas 3	0.5 Volt calibration value for analog output 3
107	Negative 10V Supply	
108	N/A	Unsupported
109	N/A	Unsupported
110	Instrument State	
111	CO Linearisation Factor A	
112	CO Linearisation Factor B	
113	CO Linearisation Factor C	
114	CO Linearisation Factor D	
115	CO Linearisation Factor E	
116	Instrument Units	0= PPM 1=PPB 2=PPT 3=mG/M^3 4=µG/M^3 5=nG/M^3
117	Background Measure Time	In seconds

#	Description	Notes
118	Sample Fill Time	In seconds
119	Sample Measure Time	In seconds
120	Aux Measure Time	In seconds
121	Aux Sample Fill Time	In seconds
122	Background Fill Time	In seconds
123	Zero Fill Time	In seconds
124	Zero Measure Time	In seconds
125	Span Fill Time	In seconds
126	Span Measure Time	In seconds
127	Span Purge Time	In seconds
128	Background Pause Time	In seconds
129	Background Interleave Factor	In seconds
130	Calibration Pressure 2	
131	Aux Instrument Gain	
132	Background Voltage	
133	Aux Background Voltage	
134	O_3 Generator Output	PPM
135	O_3 Generator On/Off	
136	Calibration Point 1	PPM
137	Calibration Point 2	PPM
138	Calibration Point 3	PPM
139	Calibration Point 4	PPM
140	Calibration Point 5	PPM
141	Desired Pump Flow	SLPM
142	Actual Pump Flow	SLPM
143	Set Lamp Current	%
144	Lamp Current	mA
145	Cycle Time	Minutes
146	CO Cooler Pot	CO cooler voltage adjustment pot
147	CO Source Pot	CO source voltage adjustment pot
148	CO Measure Test Pot 0	CO measure test pot
149	CO Reference Test Pot 1	CO reference test pot
150	O_3 Ref Average	S10 background average
151	PTF Gain 0	Pressure temperature flow compensation factor for first gas

#	Description	Notes
152	PTF Gain 1	Pressure temperature flow compensation factor for second gas in dual gas analysers
153	Inst. Cell Pressure	Instantaneous cell pressure
154	Manifold Pressure	Valve manifold pressure
155	Cell Gas 1 Pressure	Cell pressure for gas 1
156	Cell Gas 2 Pressure	Cell pressure for gas 2
157	Cell Bgnd Pressure	Cell pressure when in background
158	Reserved	
159	Reserved	
160	Reserved	
161	Temperature Units	0 = "^{o}C" 1 = "^{o}F" 2 = "^{o}K"
162	Pressure Units	0 = "torr" 1 = "psi" 2 = "mbar" 3 = "atm" 4 = "kPa"
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	No filter = 0, Kalman filter = 1 10 sec filter = 2 30 sec filter = 3 60 sec filter = 4 90 sec filter = 5 300 sec filter = 6 Adaptive filter =7
165	NO_2 Filter	0 = Disabled, 1 = Enabled

#	Description	Notes
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 Baud	0 = "1200 bps" 1 = "2400 bps" 2 = "4800 bps " 3 = "9600 bps" 4 = "14400 bps" 5 = "19200 bps" 6 = "38400 bps"
168	Multidrop Baud	0 = "1200 bps" 1 = "2400 bps" 2 = "4800 bps" 3 = "9600 bps" 4 = "14400 bps" 5 = "19200 bps" 6 = "38400 bps"
169	Service Port (COM 1) Protocol	0 = "EC9800" 1 = "Bavarian" 2 = "Advanced"
170	Multidrop Port (COM 2) Protocol	0 = "EC9800" 1 = "Bavarian" 2 = "Advanced"
171	Gas1 Over Range	The upper concentration range when over-ranging is enabled for analog output 1
172	Gas2 Over Range	The upper concentration range when over-ranging is enabled for analog output 2
173	Gas3 Over Range	The upper concentration range when over-ranging is enabled for analog output 3
174	Gas1 Over Ranging	0 = over ranging disabled 1 = over ranging enabled (gas1)
175	Gas2 Over Ranging	0 = over ranging disabled 1 = over ranging enabled (gas2)
176	Gas3 Over Ranging	0 = over ranging disabled 1 = over ranging enabled (gas3)
177	Heater Set Point	Cell heater set point

#	Description	Notes
178	PMT HV Ctrl Pot	PMT high voltage controller pot
179	PMT Test Led Pot	PMT test LED intensity controller pot
180	Last Power Failure Time	Time stamp of the Last power fail (4 byte time stamp) Bit 31:26 ---- Year (0 – 99) Bit 25:22 ---- Month (1 – 12) Bit 21:17 ---- Date (1 – 31) Bit 16:12 ---- Hour (00 – 23) Bit 11:06 ---- Min (00 – 59) Bit 05:00 ---- Sec (00 – 59)
181	Instantaneous Manifold Pressure	Instantaneous manifold pressure in S40 analysers (no filter)
182	Calibration Pressure 2	
183	Gas 4 (NH_3) Concentration	
184	Gas 4 (NH_3) Average Concentration	
185	Gas 5 (NO_x) Concentration	
186	NH_3 Conv. Efficiency	
187	Cell/Lamp M/S Ratio	
188	Mirror T. M/S Ratio	
189	Flow Temp M/S Ratio	
190	Cooler T. M/S Ratio	
191	NO Conv T. M/S Ratio	
192	CO Conv T M/S Ratio	
193	F/Scale Curr Gas 1	
194	F/Scale Curr Gas 2	
195	F/Scale Curr Gas 3	
196	Z Adj Curr Gas 1	
197	Z Adj Curr Gas 2	
198	Z Adj Curr Gas 3	
199	Ext Analog Input 1	
200	Ext Analog Input 2	
201	Ext Analog Input 3	
202	Converter Set Point	
202	H2S Converter Set Point	
203	Cal. Pressure 3	
204	Dilution Ratio	

#	Description	Notes
205	Traffic Light	0=illegal value 1=Green 2=Amber 3=Flashing Red
206	Network Protocol	
207	Gas 4 Offset	
208	IZS Pot	
209	IZS Pot Setting	
210	IZS Lamp Current	

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Appendix B. EC9800 Protocol

The following commands are supported.

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>

All numbers are in floating point format. The STATUS WORD indicates the instrument status in hex 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).

DSPAN

Function:	Commands the unit under test to enter the span mode and stay there.
Format:	DSPAN,{<DEVICE I.D.>}{TERMINATOR}
Device response:	<ACK> if the unit under test is able to perform the command, <NAK> if not.

DZERO

Function:	Commands the unit under test to enter the zero mode and stay there.
Format:	DZERO,{<DEVICE I.D.>}{TERMINATOR}
Device response:	<ACK> if the unit under test is able to perform the command, <NAK> if not.

ABORT

Function: Commands the addressed device to abort the current mode and return to the measure mode.

Format: ABORT,{<DEVICE I.D.>}{TERMINATOR}

Device response: <ACK> if the unit under test is able to perform the command, <NAK> if not.

RESET

Function: Reboots the instrument (software reset).

Format: RESET, {<DEVICE I.D.>}{TERMINATOR}

Device response: <ACK>

Appendix C. Bavarian Protocol

All Bavarian Network commands follow the command format as specified in this section.

Bavarian Network Command Format

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

Where:

<STX> = ASCII start of transmission = 0x02 hex

<text> = ASCII text maximum length of 120 characters

<ETX> = ASCII end of transmission = 0x03 hex

<bcc1> = ASCII representation of block check value MSB

<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 then converted to ASCII format and sent after the <ETX> character.

Examples

The following is an example of a valid Bavarian data request for an instrument that has an ID of 97:

<STX>DA097<EXT>3A

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

Table 13 – Bavarian data

Character	Hex Value	Binary	Block Check
<STX>	02	0000 0010	0000 0010
D	44	0100 0100	0100 0110
A	41	0100 0001	0000 0111
0	30	0011 0000	0011 0111
9	39	0011 1001	0000 1110
7	37	0011 0111	0011 1001
<ETX>	03	0000 0011	0011 1010

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. Please note that the I.D. of 97 is sent as the sequence 097. All I.D. strings must have 3 digits and the user should always pad 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 14 – Block check operation

Character	Hex Value	Binary	Block Check
<STX>	02	0000 0010	0000 0010
S	53	0101 0011	0101 0001
T	54	0101 0100	0000 0101
8	38	0011 1000	0011 1101
4	34	0011 0100	0000 1001
3	33	0011 0011	0011 1010
<SPACE>	20	0010 0000	0001 1010
K	4B	0100 1011	0101 0001
<ETX>	03	0000 0011	0101 0010

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

Supported Commands

The command set supported by the Bavarian protocol is:

Table 15 – Bavarian Protocol Commands

Command	Effect
DA<id>	Returns gas concentration
DA	Returns gas concentration w/o ID
ST<id> M	Enter Measure mode
ST<id> N	Enter Zero mode
ST<id> K	Enter Span mode
ST<id> S	Force a background check

DA

Return the current instantaneous concentration.

Format:

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

Or:

<STX>{DA}<ETX>< bcc1><bcc2>

Where:

kkk = device’s multi-drop ID

bcc1 = first byte of the block check calculation

bcc2 = second byte of the block check calculation

Device response (S10, S30, and S50 family)

<STX>{MD}{01}<SP><kkk><SP><+nnnn+ee><SP><ss><SP><ff><{000}><SP>{00000000}

<SP><ETC>< bcc1><bcc2>

Device response (S40 family)

<STX>{MD}{02}<SP><kkk><SP><+nnnn+ee><SP><ss><SP><ff><SP>{00000000}

<SP><mmm><SP><+pppp+ee><SP><ss><SP><ff><SP>{00000000}

<SP><ETC><bcc1><bcc2>

Where:

<SP> = space (0x20 hex)

kkk = Device’s multi-drop ID. If the DA command is issued without an ID, then the response omits this field. Exception: the S40 family always includes both ID fields, even when a DA command without an ID is issued.

+nnnn+ee = Main instantaneous gas concentration (for S40 family, this is NO)
ss = status byte with the following bit map:

Table 16 – Bit map

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

ff = failure byte for both channels with the following bit map (positive logic):

Table 17 – Bit map (positive logic)

Failure Bit	Meaning if set to 1
0	Flow sensor failure
1	Instrument failure
2	-
3	Lamp failure (S40 family only)
4	-
5	Cell heater failure (S30, S40 and S50 family only)
6	-
7	-

mmm = NO instrument ID
+pppp+ee = NOx gas concentration (unless the NO_2 option was selected in the **Serial Communications Menu**, in which case it is NO_2)

bcc1 = first byte of the block check calculation

bcc2 = second byte of the block check calculation

ST

Set the instrument mode.

Format:

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

Where:

kkk = device’s multi-drop ID

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

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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).

Read Holding Register

You must specify a slave address for Serial requests (but not for TCP requests). This value is the Serinus' Multi-drop ID.

Read requests specify which Advanced Protocol IEEE value they want to read as the starting reference. Refer the appendix on the Advanced Protocol 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:

Modbus Index =Advanced Protocol Parameter List # x 2 + 256

You may read from 2 to 124 registers.

Note: You must read an even number of registers because the return data is always 4 bytes (a float).

The Serinus expects 8 data bits, 1 stop bit, and no parity. The baud rate is specified by the **Serial Communications Menu**.

The value will be returned as a big-endian 32-bit IEEE floating point value.

Write Multiple Registers

You must specify a slave address for Serial requests (but not for TCP requests). This value is the Serinus' Multi-drop ID.

The start reference is the same as for reading.

Only 2 registers may be written at a time; that is, a single IEEE value. Currently the only supported value is 85, to put the instrument into span (3), zero (2), cycle (1), or measure (0) mode.

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