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USER MANUAL

CAL-301

Ozone Transfer Standard

Version 1.2

Met One Instruments
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Met One Instruments

POWERED BY ACOEM

Met One Instruments is now part of the Acoem Group. The Met One range of gas analyzers was originally developed by Acoem under the brand name Serinus® Cal 300.

For the purposes of expediting the availability of Met One gas analyzers to Met One customers around the world; Met One Instruments have chosen to use the original Serinus® Cal 300 operating manual.

Although the name of the Met One instrument is different, the analyzer itself has remained unchanged and meets the strictest quality and performance requirements expected of Met One equipment. All the information presented in this manual is current, including analyzer specifications and operating principles.

Met One will update this manual to reflect the new branding convention in due course.

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Manufacturer's Statement

The Serinus Cal 300 is designed primarily as a standalone ozone transfer standard used to supply precise concentrations of ozone span gas to gas analysers.

This User Manual provides a complete product description including operating instructions, calibration, and maintenance requirements for the Serinus Cal 300.

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

If, after reading this manual you have any questions or you are still unsure or unclear on any part of the Serinus Cal 300, 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.

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Safety Information

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

The following internationally recognised symbols are used on Ecotech equipment:

Table 1 – Internationally Recognised Symbols

	Protective conductor terminal	IEC 60417-5017
	Alternating current	IEC 60417-5032
	Caution, hot surface	IEC 60417-5041
	Caution, risk of danger to user and/or equipment Refer to any accompanying documents	ISO 7000-0434
	Caution, risk of electric shock	ISO 3864-5036

These symbols will also be found throughout this manual to indicate relevant safety messages.

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

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

Important Safety Messages



Disconnect Power Prior to Service

Hazardous voltages exist within the instrument. Do not remove or modify any of the internal components or electrical connections whilst the mains power is on.

Always unplug the equipment prior to removing or replacing any components.



Replacing Parts

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



Mains Supply Cord

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

Ensure that the mains supply cord is maintained in a safe working condition.



Do Not Expose Equipment to Flammable Gases

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



Electromagnetic Compliance

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



Means of Lifting/Carrying Instrument

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



Internal Components

Do not insert a rod or finger into the cooling fans, otherwise injury may result.

Do not energise the instrument until all conductive cleaning liquids, used on internal components, are dried up.

Warranty

This product has been manufactured in an ISO 9001/ISO 4801 facility with care and attention to quality.

The product is subject to a two year warranty period on parts and labour from date of shipment (the warranty period). The warranty period commences when the product is shipped from the factory. Lamps and consumable items are not covered by this warranty.

Each calibrator 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 calibrator to be installed and ready for use without any further testing.

Service and 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 calibrator.

Service Guidelines

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

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

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

Please dial 1300 364 946 if calling from within Australia

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

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

When shipping instrumentation, please also include the following information:

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

Shipping Address:

Attention Service Department

Ecotech Pty Ltd

1492 Ferntree Gully Road,

Knoxfield, VIC, Australia 3180

Product Compliance and Approvals

The Serinus Cal 300 Ozone Transfer Standard, as manufactured by Ecotech Pty Ltd, complies with the essential requirements of the directives listed below (including CE compliance). The respective standards have been applied:

Low Voltage Directive (LVD) Directive 2014/35/EU

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

Electromagnetic Compatibility (EMC) Directive 2014/30/EU

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

Radio Equipment Directive (RED) 2014/53/EU

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

Regulatory Compliance Mark (RCM) - Australia

AS/NZS 4268:2017	Radio equipment and systems – Short range devices – Limits and methods of measurement
ARPANSA Radiation Protection Standard	Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz – Radiation Protection Series Publication No. 3: 2002

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

Manual Revision History

Manual PN: M010059

Current revision: 1.2

Date released: 14 May 2020

Description: User Manual for the Serinus Cal 300 Ozone Transfer Standard

This manual is the full user manual for the Serinus Cal 300 Ozone Transfer Standard. This manual contains all relevant information on theory, specifications, installation, operation, maintenance and calibration. Any information that cannot be found within this manual can be obtained by contacting Ecotech.

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

- You can access the links by pressing the following:
  - > CTRL + LEFT MOUSE CLICK: Move to the link location
- You can switch between links by pressing the following:
  - > ALT + LEFT ARROW KEY: Returns you to previous Link
  - > ALT + RIGHT ARROW KEY: Swaps back

Table 2 – Manual Revision History

Edition	Date	Summary	Pages
1.0	06/09/2017	Initial release	-
1.1	14/05/2020	Based on Firmware v3.90.0002. Firmware menus and valve types updated. O_3 Flow calibration routine updated. Safety Instructions updated. Relief valve added. Diagrams updated.	All
1.2	17/12/2020	Ambient operating temp updated	

1. Introduction

1.1 Description

The Serinus Cal 300 has been designed as a stand-alone Ozone Transfer Standard specifically for environmental applications and should give many years of trouble free service provided that it is used and maintained correctly.

It can be used in conjunction with ozone analysers such as the Serinus 10 to provide precise and constant volumes of zero air or various concentrations of ozone for calibration.

The Serinus Cal 300 includes its own internal zero air generator, ozone generator as well as an ozone photometer for the accurate creation and delivery of ozone concentrations for use when calibrating O_3 analysers.

This section will describe the specifications of the calibrator as well as the main components and techniques used to provide stable gas concentrations.

1.2 Specifications

1.2.1 Photometer

Range

0 – 3000 ppb

Precision

0.5 ppb or 0.2 % of reading, whichever is greater

Linearity

1 ppb or <1 % of full scale, whichever is greater

Noise at Zero

<0.25 ppb

Noise at Span

<0.1 % or 0.25ppb of reading, whichever is greater

Lag Time

Less than 20 sec

Rise/Fall Time

Less than 60 sec

1.2.2 Calibration

Zero Drift

Temperature dependant:	0.1 ppb per °C
24 hours:	< 0.3 ppb
7 days:	< 0.3 ppb

Span Drift

Temperature dependant:	0.1 % per °C
24 days:	0.5 % of reading
30 days:	0.5 % of reading

1.2.3 Output Flow

Repeatability

Within 0.15 % of full scale

Linearity

Within 0.15 % of full scale

Assumes operating diluent pressure of 120-180 kPa.

1.2.4 Internal Diluent

Range

3 to 5 slpm

Accuracy

±1 % of full scale

1.2.5 External Diluent

Range

0.05 to 5 slpm

Accuracy

±1 % of full scale

1.2.6 Ozone Generator

Output

50 ppb to 1000 ppb at 5 slpm

Repeatability

< 1 % short term (24 hours)

5 % long term at constant temperature and humidity

1.2.7 Power

Operating Voltage

100-240V AC (± 10%)

50 to 60 Hz

Overvoltage Category II

Power Consumption

177 VA max (typical at startup)

87 VA after warm up

1.2.8 Operating Conditions

Ambient Temperature Range

0 °C to 35 °C (32 °F to 104 °F), 20 °C to 35 °C for optimum performance.

Relative Humidity

10 % to 80 % (non-condensing)

Pollution Degree

2

Maximum Altitude

2000 m above sea level

1.2.9 Communications

User Interface

- Via front panel keypad, computer or Android Bluetooth device

Programmable Calibrations

- 16 separate programmable sequences
- 32 separate programmable points

Analog Output

- Menu selectable current output of 0-20 mA, 2-20 mA or 4-20 mA.
- Voltage output of 0 to 5 V, with menu selectable zero offset of 0 V, 0.25 V or 0.5 V.
- Voltage output of 0 to 10 V (configured using jumpers (JP3) on rear panel PCA).
- User definable Range.

Analog Input

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

Digital Output

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

1.2.10 Physical Dimension

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 4RU (6.4”)
Front panel height:	175 mm (6.9”)
Weight:	25.7 kg

1.3 Nomenclature

O_3:	Ozone is an inorganic molecule with the chemical formula O_3. It is a pale blue gas with a distinctively pungent smell.
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 enables various low-level recovery tools, including updating the main firmware from a USB memory stick.
Diluent:	Diluent gas is a clean, unreactive gas used to dilute reactive samples via the Diluent Port.
Exhaust Air**:**	The exhaust port is where excess calibration gases and ozone are exhausted from the instrument.
ID and OD:	These are measurements of tubing. ID is the internal diameter of tubing. OD is the outer diameter.
Multidrop:	A configuration of multiple calibrators and/or analysers connected via the same RS232 cable.

Span:	A gas sample of known composition and concentration used to calibrate/check the upper range of an instrument.
Zero:	Zero air to calibrate/check the lower range of an instrument.
Point:	A single operation such as a dilution.
Sequence:	A group of points and operations.
Background:	Is the reading of the instrument without ozone present in the measurement cell. The background measurement is performed using reference air supplied from the diluent port.
Calibration:	The process of adjusting an instrument to ensure that it is measuring the correct concentration.
Zero Drift:	The change in instrument response to zero air over a period of continuous unadjusted operation.
Zero Air**:**	Is purified air in which contaminants are removed to a level below what is detectable by the instruments used within the calibration system. In a typical ambient air monitoring station this normally includes water vapour, hydrocarbons, O_3, NO, NO_2, SO_2, H_2S and CO.
PCA:	Printed Circuit Assembly. An electronic circuit mounted on a printed circuit board to perform a specific electronic function.
Slpm:	Standard litres per minute. This is the flow referenced to standard temperature and pressure conditions. For the purposes of this manual, all flows are referenced to 0 °C and 101.3 kPa (1 atm).

1.4 Background/Theory

1.4.1 Ozone Photometer Theory

This section outlines the relevant theory for Serinus Cal 300 which contains an ozone (O_3) photometer and ozone generator.

The photometer accurately measures and controls the ozone concentration generated by an internal generator, allowing its use as a transfer standard to calibrate ozone analysers.

The Serinus Cal 300 follows these principles and measurement techniques:

- Ozone shows strong absorption of UV light at 254 nm.
- Diluent air is passed into the glass absorption tube (Optical Cell).
- Within the photometer, a single beam of UV radiation (from a mercury vapour lamp) passes through the sample and is absorbed by the ozone.
- The solar blind vacuum photodiode detects any UV light that is not absorbed.
- The strength of the UV light signal being detected is proportional to the amount of UV light being absorbed by ozone.

- The Serinus Cal 300 uses the Beer-Lambert relationship (Appendix F) to calculate the ozone concentration.
- O_3 is not the only gas that absorbs UV (254 nm), SO_2 and aromatic compounds also absorb radiation at this wavelength. To eliminate these interferences a second cycle (referred to as the reference cycle) is performed with zero air from the internal zero air generator (ZAG). This reference signal is removed from the sample measurement signal. This enables the accurate measurement of ozone without the influence of interferent.
- The main controller PCA contains electronics to measure, and correct for all the major external variables to ensure stable and reliable operation.

Note: In order to obtain the desired stability levels necessary for ozone analyser calibrations, the user should run the Serinus Cal 300 at the same ozone concentration for at least 30 minutes to obtain a sufficiently stable output.

1.4.2 Explanation Photometer Transfer Standards

In ambient air monitoring applications, precise ozone concentrations called *standards* are required for the calibration of ozone analysers. Due to the instability of ozone, concentrations must be generated and "verified" on site with another instrument referred to as a *transfer standard*.

A transfer standard is defined as a transportable device or apparatus which is capable of accurately reproducing ozone.

The transfer standard's purpose is to transfer the authority of a Level 1 pollutant standard to a remote point where it is used to verify or calibrate an air monitoring analyser.

The U.S. EPA identifies the family of standard reference photometers (SRPs) as Level 1 standards.

Beyond the SRPs, all standards are considered transfer standards and are numbered (starting with 2) based on their 'distance in the traceability chain' from a verification against a Level 1 standard. With each additional level, the number of standards available is multiplied. Each standard is traceable through a chain of "higher" standards to the Level 1 standard.

The majority of transfer standards include both ozone generators and photometers. Therefore, it is strongly suggested that:

- **Level-2 standards** used in the verification of other transfer standards include both a generation device and a photometer. (Serinus Cal 3000 or Serinus Cal 300)
- **Level-3 standards** at a minimum, a photometer (Serinus 10). The level 3 standard can be a photometer and generator (Serinus 10, Serinus Cal 3000 or Serinus Cal 300) but should not be just a generator.
- **Level-4 standards** can be an ozone generation device (Serinus Cal 2000)

Ozone Transfer Standards also require routine calibration against a higher transfer standard. Please refer to your local standard.

Ecotech is able to offer a Level 2 and lower calibration service.

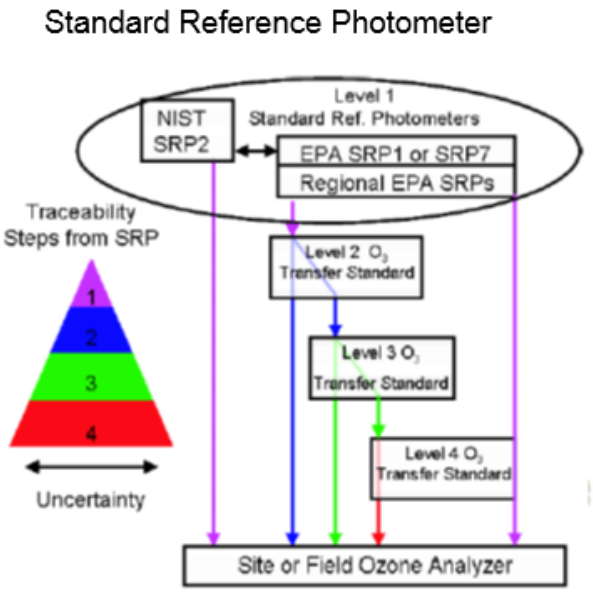

Figure 1 – Ozone Transfer Standard Hierarchy

1.5 Instrument Description

The major components of the Serinus Cal 300 are described below in Figure 2.

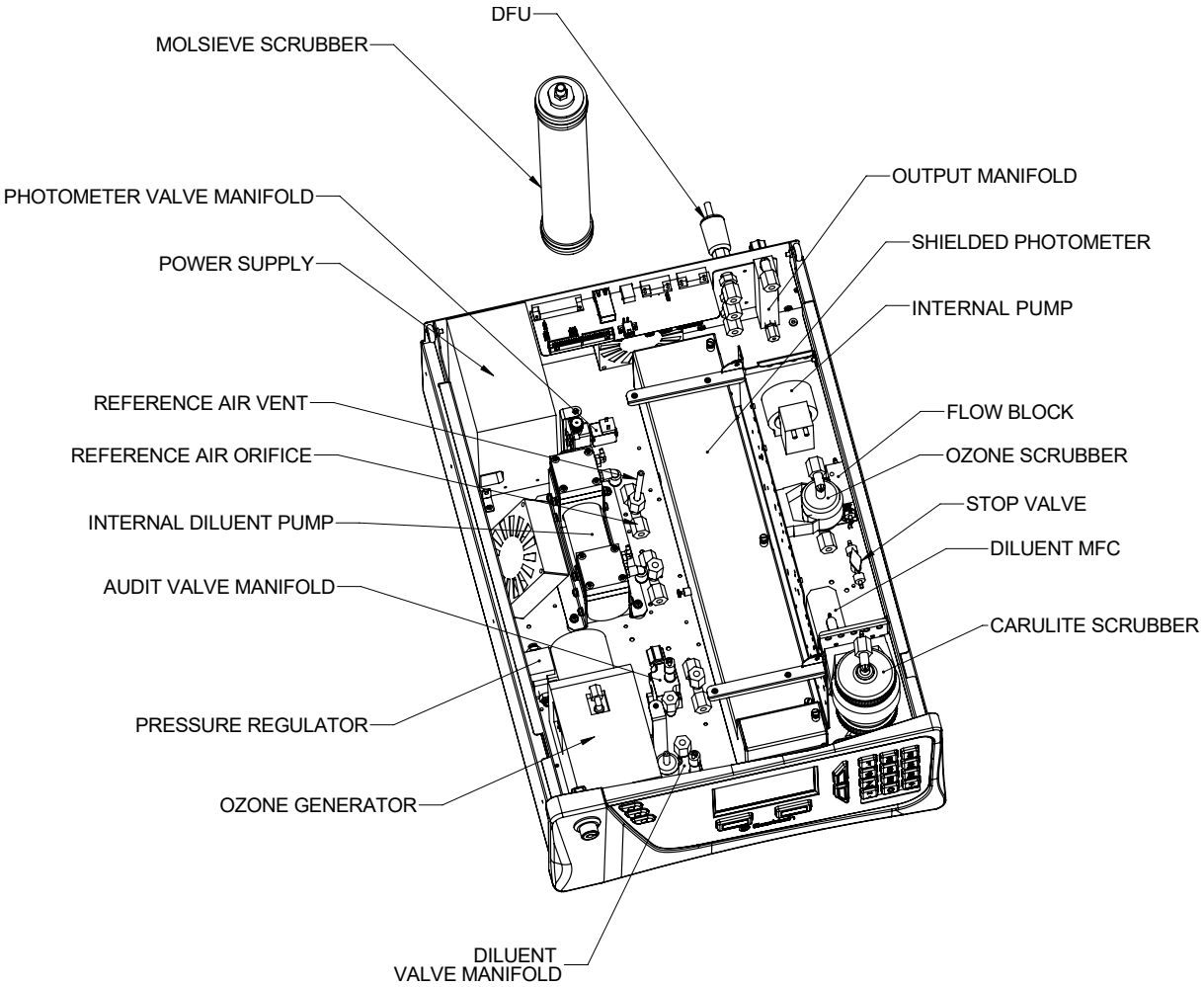

Figure 2 – Internal Components Diagram

The Serinus Cal 300 provides both an ozone generator and an ozone photometer to measure the concentrations created. A feedback control algorithm allows the main controller PCA to adjust the output from the ozone generator so that a precise concentration of ozone is produced. This allows the Serinus Cal 300 to be used as a transfer standard for calibration of ozone analysers.

1.5.1.1 Main Controller PCA

The main controller PCA controls all the processes within the instrument. As well as the on-board microprocessor, it contains a battery backed clock-calendar, analog to digital converters and many other circuits for signal processing and control. The ambient pressure and chassis temperature sensors are also located on this board. The main controller PCA is located above all other components within the instrument. It pivots on hinges to allow access to the components underneath.

CAUTION

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

1.5.1.2 Rear Panel PCA

The rear panel PCA contains all the communications connections for the user through the rear panel. This PCA also controls all the internal solenoid bullet valves as well as the diluent control. This PCA has its own power connection directly from main controller PCA.

1.5.1.3 Solenoid Valves

The solenoid valves control the flow path of the instrument. V4 is the Audit valve, V8 is the photometer valve and V13 is the diluent valve. They are designated the same in the instrument firmware. In their energised state or "ON" state a red led lights up on the tip of the valve and this makes troubleshooting faulty valve states very easy. V4 and V13 are bullet valves, shown in Figure 4. V8 is made from material better compatible with the photometer. Refer to Figure 5.

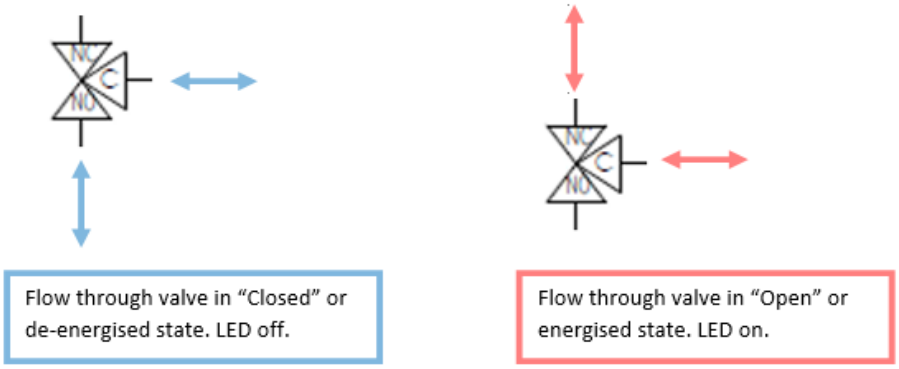

Figure 3 – Solenoid Valve Operation

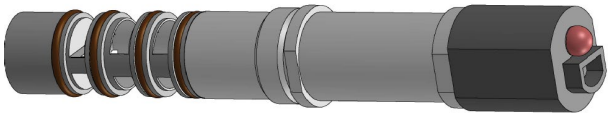

Figure 4 – Solenoid Bullet Valve

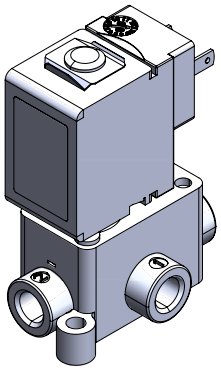

Figure 5 – Photometer Diaphragm Valve

1.5.1.4 Pressure PCA

The Serinus Cal 300 has a pressure sensor installed on the main controller PCA to monitor the ambient pressure. An additional differential pressure sensor is installed on the ozone generator assembly to monitor the output flow. Lastly there are two more ambient pressure sensors installed on the photometer assembly and on the flow block to monitor the flow through the photometer.

1.5.1.5 Power Supply

The power supply is a self-contained unit housed in a steel case designed to meet all the relevant safety and EMC requirements. This power supply is auto ranging.

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

1.5.1.6 On/Off Switch

Located on the back panel, bottom right facing the rear of the instrument, (refer to Figure 16), it is part of the power supply.

1.5.1.7 Diluent MFC

Diluent mass flow controller (MFC) is a device that is used to measure and control the flow of gases at a particular flow rate. It is controlled by the main controller PCA and is used to give the user the desired output concentration as defined in the point setup.

1.5.1.8 DFU

A disposable filter unit (DFU) is used to protect the MFC's and other pneumatic system components from a build-up of particulate matter.

1.5.1.9 Output Manifold

The output manifold is a common set of ports used as the conduit for delivering the final user defined diluted gas concentration to its final destination. When the gas leaves the calibrator it will be at ambient pressure. This is achieved by always allocating one of the 4 common ports as a vent leading to atmosphere.

1.5.1.10 Photometer Valve Manifold

The photometer valve manifold is used to switch between sampling reference air and sample air from the output manifold. In the plumbing schematics it is referred to as V8.

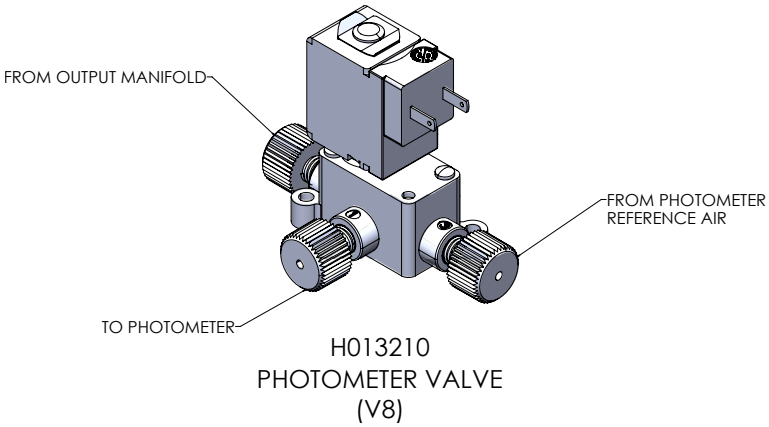

Figure 6 – Photometer Valve Manifold

1.5.1.11 Diluent Valve Manifold

The diluent valve manifold is used to switch between internal and external diluent air. In the plumbing schematics it is referred to as V13.

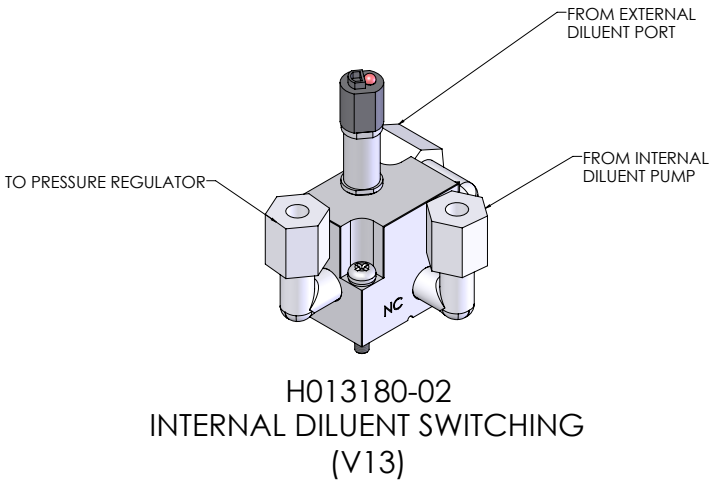

Figure 7 – Diluent Valve Manifold

1.5.1.12 Audit Valve Manifold

The audit valve manifold is used to switch between sampling ozone produced by the ozone generator and an external ozone source for auditing purposes. In the plumbing schematics it is referred to as V4.

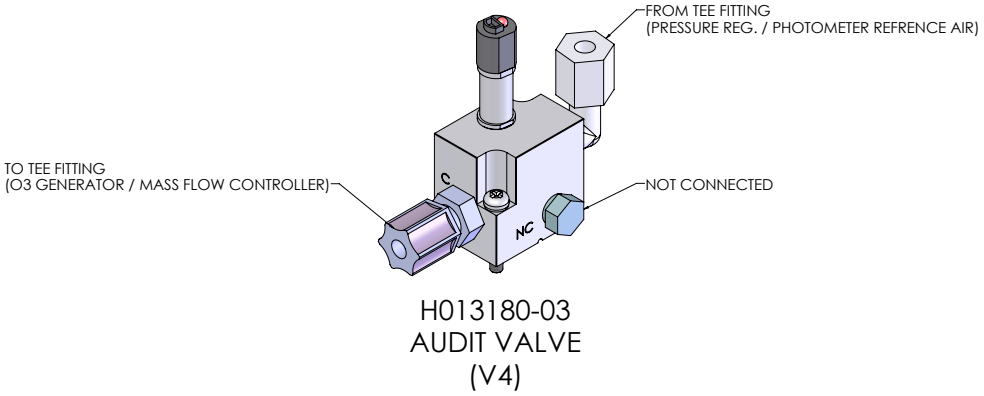

Figure 8 – Audit Valve Manifold

1.5.1.13 Ozone Generator

The ozone generator consists of a pressurized chamber, ozone producing ultraviolet lamp, heater thermistor assembly, pressure sensor, gas inlet and outlet, fittings and ozone generator controller PCA. Together these components produce ozone which is fed into the ozone mixing manifold. The entire assembly is insulated for temperature stability.

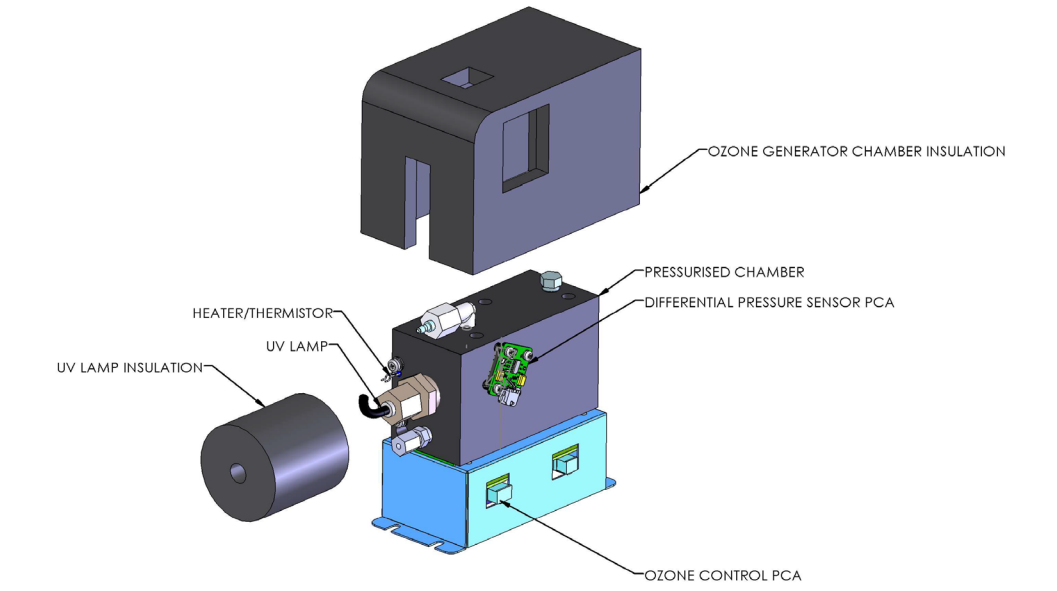

Figure 9 – Ozone Generator Assembly

1.5.1.14 Pressure Regulator – Ozone Generator

The pressure regulator is factory set to approximately 120-180 kPa. The pressure regulator maintains a constant pressure for the critical orifice and MFC within the instrument. Enabling the instrument to provide stable ozone flow, diluent flow and reference air flow.

1.5.1.15 Internal Pump

The internal pump draws a sample of generated ozone from the output manifold, through the shielded photometer assembly to be measured before scrubbing the ozone and passing it through the pump and out the exhaust port.

1.5.1.16 Ozone Scrubber

The ozone scrubber is used to protect the internal pump.



Figure 10 – Ozone Scrubber

1.5.1.17 Stop Valve

The stop valve is used to isolate the internal pump from the rest of the system during a leak check. The internal pump is known to leak through the pump.

1.5.1.18 Flow Block

The flow block measures the downstream pressure created by the pressure drop caused by the internal pump and the critical orifice. The pump speed is controlled by the main controller PCA in order to maintain sufficient pressure drop across the critical orifice within the shielded photometer assembly. This ensures that a stable photometer flow is maintained.

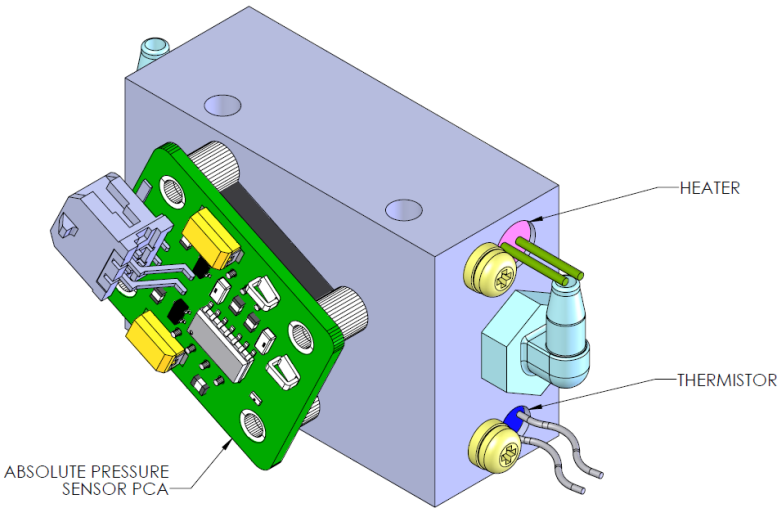

Figure 11 – Flow Block Assembly

1.5.1.19 Internal Diluent Pump

The internal diluent pump is used in conjunction with the Molsieve scrubber, Carulite scrubber and DFU to provide clean dry pressurised air for the system. Once it passes through the Carulite scrubber it becomes diluent air. The internal diluent pump is protected by a pressure relief valve on the pump outlet.

1.5.1.20 Carulite Scrubber

The Carulite scrubber is used to create diluent air from the clean dry air supplied from the Molsieve scrubber, which gets drawn in by the internal diluent pump. The output of the Carulite scrubber is filtered by a DFU to prevent stray particulate from blocking the pump and diluent valve manifold.

1.5.1.21 Molsieve Scrubber

The Molsieve scrubber is used to dry the air before being drawn in by the internal diluent pump. The DFU is used to protect the internal diluent pump from any stray particulate matter from the Molsieve scrubber. The Molsieve scrubber holds two types of media, one is the main drying material (cream coloured balls) and the other is an indicating gel (orange coloured balls). Both media types dry the air. Once the scrubber is saturated the orange indicating gel changes colour to clear. This lets you know when to change the scrubber.

1.5.1.22 Reference Tee

The reference tee has the reference air vent at the top of the tee and holds the reference air orifice used for flow control on the front panel side of the tee.

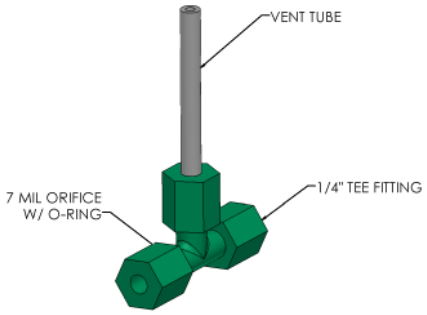

Figure 12 – Reference Tee

1.5.1.23 Shielded Photometer Assembly

The shielded photometer assembly consists of an Optical Cell, Ozone Detector PCA, Pressure PCA, UV Lamp, Lamp Driver PCA, Heater, Thermistor, Orifice and Measurement Cell Shield Cover. It is a non-dispersive ultraviolet (UV) photometer which switches between measuring ozone from the output manifold and reference air. It calculates the ratio of transmitted light between the two signals providing an accurate and reliable measure of ozone concentration.

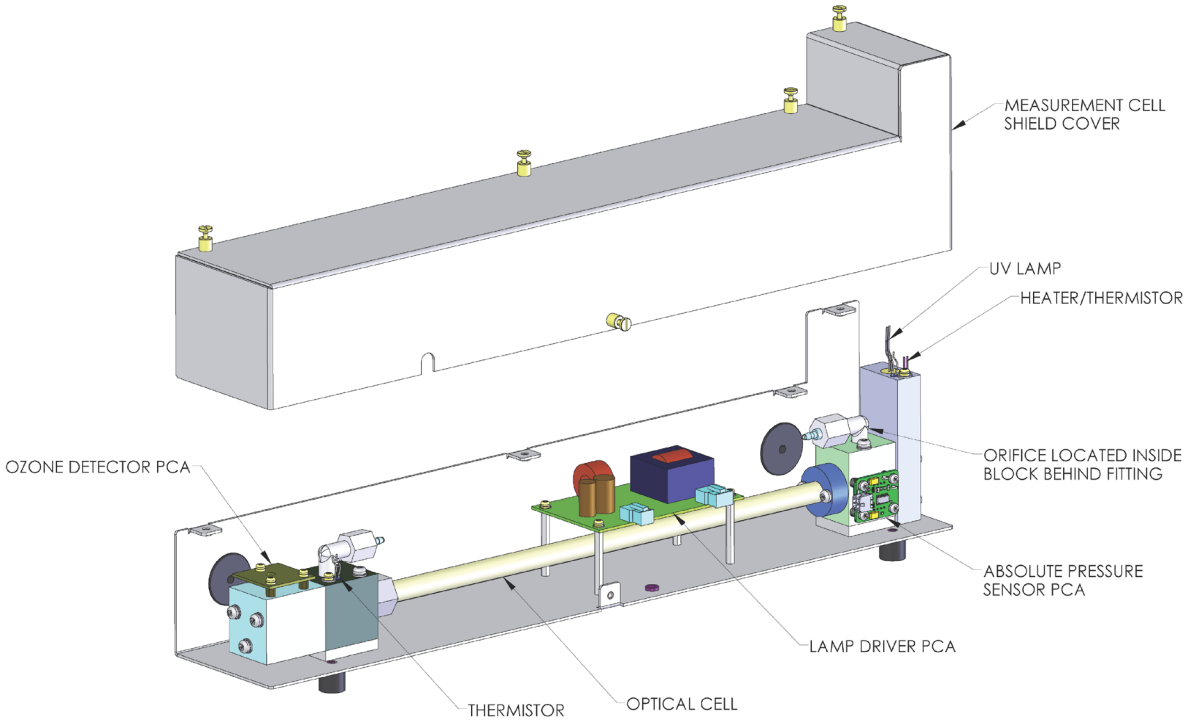

Figure 13 – Shielded Photometer Assembly

1.5.1.24 Optical Cell

The optical cell is a glass tube with a UV source at one end and a detector at the other. UV radiation is sequentially absorbed by ozone gas and background air over the length of the absorption cell. The remaining light reaching the detector is measured and used to calculate the O_3 concentration. The optical cell is protected by a metal sheath.

1.5.1.25 Ozone Detector PCA

The detector is a solar blind vacuum diode sensitive only in the spectral region where O_3 absorbs UV light at 254 nm. This detector is used to monitor the intensity of the residual light after absorption in the optical cell. The detector PCA converts this intensity into a voltage level which is processed by the main controller PCA to calculate the O_3 concentration.

1.5.1.26 UV Lamp

The UV source is a mercury vapour lamp that emits radiation around 254 nm. It is powered by the lamp driver PCA.

1.5.1.27 Lamp Driver PCA

The lamp driver PCA generates a high voltage (800-1100 V), high frequency voltage to start and maintain the UV lamp at a constant intensity. The lamp current is fixed at 10 mA. The lamp driver PCA is located under the UV absorption cell.



CAUTION

The lamp driver PCA contains high voltages. Ensure instrument is turned off before accessing this component.

Note: The lamp driver PCA is the same type as used on the Serinus 50 SO_2 Analyser. For the Serinus Cal 300 (which measures Ozone), with a REV D lamp diver PCA, set all the jumpers marked in red (JP1 – JP5) to the right (refer to Figure 14). The correct setting must be used or damage to the electronics may occur.

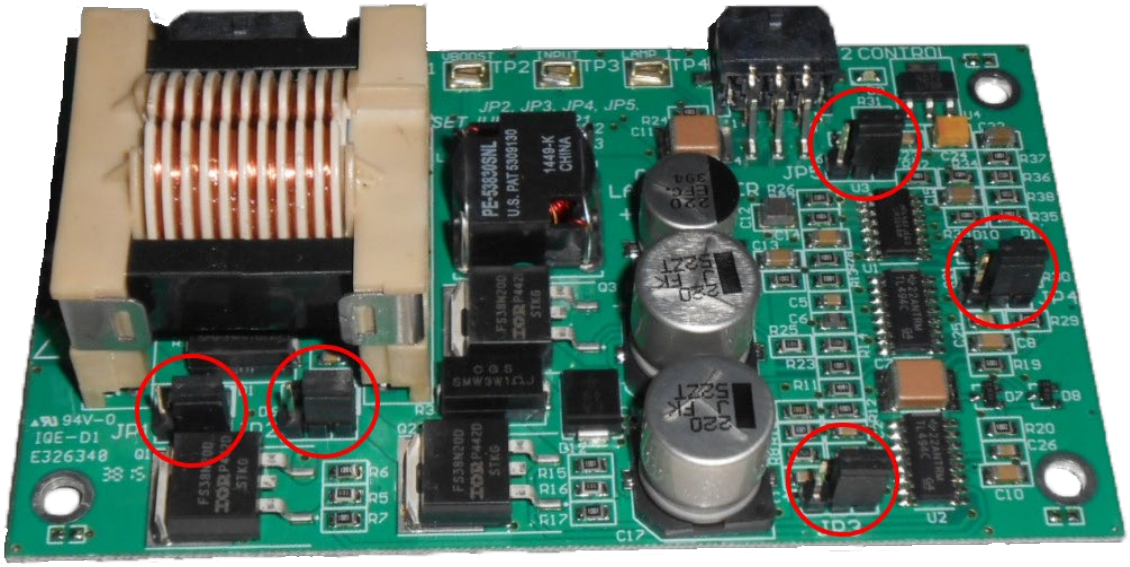

Figure 14 – Lamp Driver PCA Type Jumper Settings (REV D)

1.5.1.28 Heater and Thermistor

The heater and thermistor are located on the lamp housing end of the photometer assembly and is used to keep the block temperature to a stable and constant 50 °C.

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2. Installation

2.1 Initial Check

2.1.1 Packaging

The Serinus Cal 300 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.

2.1.2 Opening the Instrument

Check the interior of the instrument with the following steps:

1. Undo the screws located on the rear panel.
2. Open the chassis lid by releasing the latch (pressing the button) located on the front panel in the top left-hand corner, then slide the lid backwards.
3. To completely remove the lid, 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 15).
4. Check that all pneumatic and electrical connectors are connected.
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.

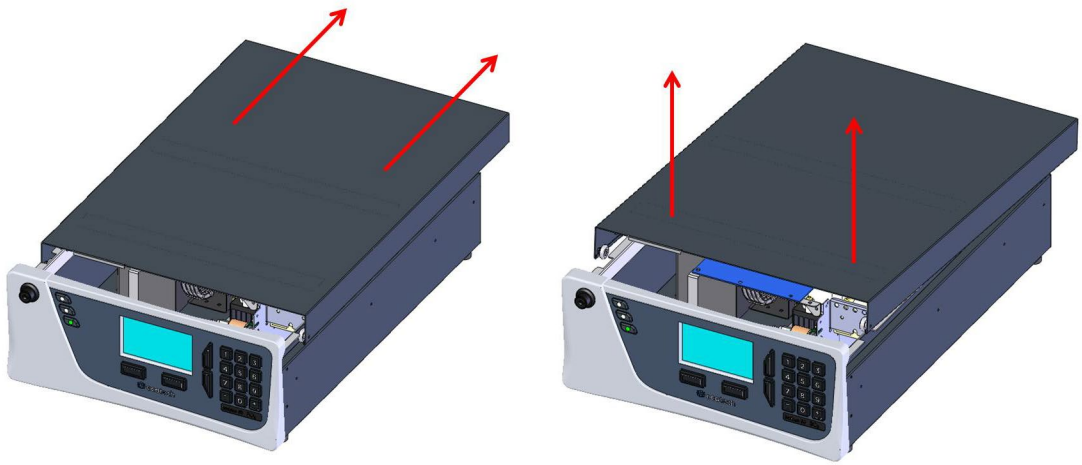

Figure 15 – Opening the Instrument

2.1.3 Items Received

With the delivery of the Serinus Cal 300, you should have received the following:

- Ecotech Serinus Cal 300 PN: E020300
- Green Ecotech Resources USB Stick PN: H030137-01

• Manual		PN: M010059 (hardcopy optional)
• USB memory stick		PN: H030021
• FQA Kit, Serinus Cal		PN: H050080
• Power Lead (120 V)*	US	PN: C040007
• Power Lead (240 V)*	Australia	PN: C040009
	Europe	PN: C040008
	UK	PN: C040010

*The power lead 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 Installation Notes

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

- The Serinus Cal 300 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 Serinus Cal 300 should be located in a temperature and humidity controlled environment (air conditioned shelter). An enclosure temperature of 25-27 °C is optimum.
- Whether in a rack or placed on a bench, the instrument should not have anything placed on top of it or touching the case.
- Instruments should be sited with easy access to the front panel (instrument screen/USB memory stick and to the back panel (communication ports/pneumatic connections).
- It is recommended that the pneumatic lines be as short as possible.
- When supplying calibration gas to other instruments through the output ports, ensure the flow is not pressurised and is sufficiently vented to ambient pressure.
- The Fan on the rear panel should be kept free of any obstructions.

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

2.3 Instrument Set-up

After unpacking the instrument, the following procedures should be followed to ready the calibrator for operation.

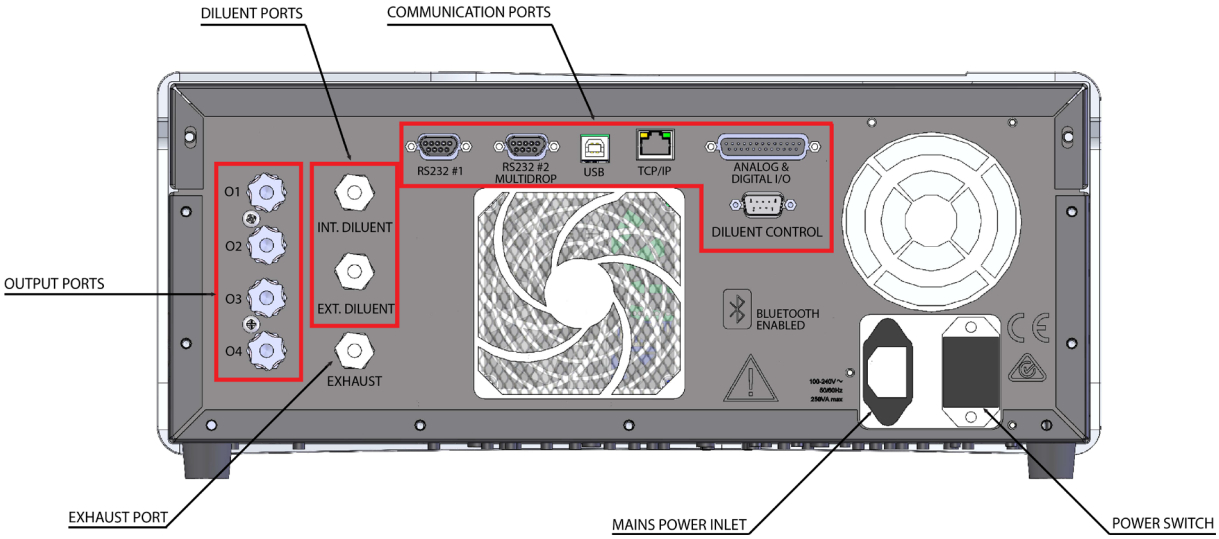

Figure 16 – Serinus Cal 300 Rear Panel

2.3.1 Setting-up a Serinus Cal 300

1. Open the lid and install the USB memory stick (refer to Figure 17).
2. Check the battery switch is turned to on. It is located under the main controller PCA (refer to Figure 18).
3. Close the lid.
4. Connect the output ports **O1 – O3** to your test analysers. **Plug any unused output ports.**
5. Connect tubing to the output **O4** and vent end of line away to atmosphere.
6. Turn on the instrument and allow it to warm-up.
7. Connect a source of Diluent air to the **Ext. Diluent** port if running in a lab type installation (running over a long period) and open the **Quick Menu** and change the **Internal diluent** to **Disabled** or connect a Molsieve scrubber (chemical dryer with indicator) to the **Int. Diluent** port if using as a portable transfer standard (run for a short period) and open the **Quick Menu** and change the **Internal diluent** to **Enabled**.
8. Set the internal data logging options (refer to Section 3.5.35).
9. Check/set time and date (refer to Section 3.5.17).
10. Configure the analog input and output settings and digital outputs settings if used (refer to Section 3.5.36).
11. Set the communication parameters to your chosen communication method (refer to Section 3.5.34).
12. Let the instrument warm-up and stabilise for 2-3 hours before operation.
13. The instrument is now ready to be operated.

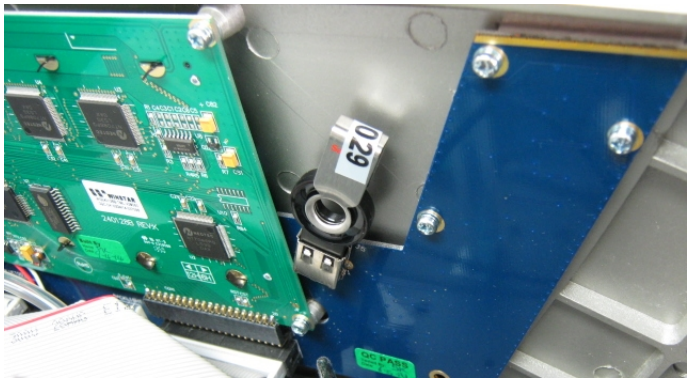

Figure 17 – Installation of USB Memory Stick

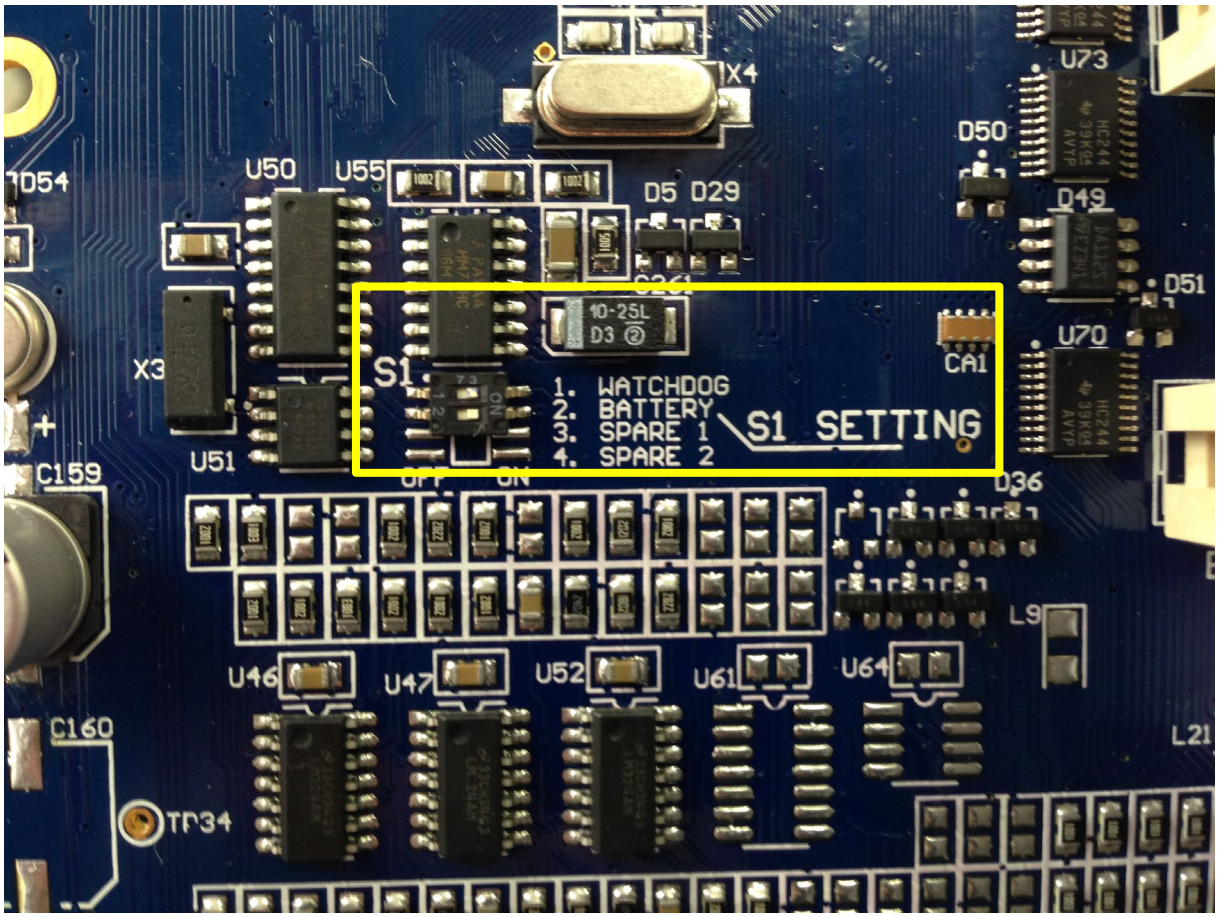

Figure 18 – Switching the Battery On/Off

2.3.2 Pneumatic Connections

The Serinus Cal 300 features several pneumatic ports on the back panel; the output port(s), the internal diluent port, the external diluent port and the exhaust port. All tubing and fittings used should follow the instructions below:

1. Must be made of Teflon® FEP material, Kynar®, stainless steel, glass or any other suitably inert material.
2. Calibration lines should be kept to a minimum length.

3. Exhaust line for the Serinus Cal 300 should be no more than 2 meters in length with ID, ¼ inch. If longer is required, use ID 3/8 inch.
4. Tubing must be cut squarely and any burrs removed.
5. Remove the inlet/outlet port nut, insert the tubing through the back of the nut with the tube extending 1 inch through the front.
6. Place the tubing into the port until it hits the tube stop located inside the fitting.
7. Place the nut back onto the fitting and tighten clockwise until finger tight.
8. Nuts should be re-tightened when instrument reaches operating temperature.

2.3.3 Power Connection



CAUTION

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



CAUTION

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

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

2.3.4 Internal Diluent

The Serinus Cal 300 features an internal diluent port (Int. Diluent) which is typically used to provide clean, unreactive gas used by the ozone generator to generate ozone and as reference air for the photometer. The Diluent air is achieved by connecting a chemical dryer to the port with an inline disposable filtration unit (DFU). Once connected, an internal pump draws air through the chemical dryer (external), Carulite scrubber (to remove ozone and other interferent gases) and then a DFU. It is then pressurised to supply the MFC. The internal diluent pump is protected by a pressure relief valve.

2.3.5 External Diluent

The Serinus Cal 300 features an external diluent port (Ext. Diluent) which is typically used to provide clean, unreactive gas used by the ozone generator to generate ozone and as reference air for the photometer.



CAUTION

Dry, clean and filtered diluent gas should be supplied to the Serinus Cal at a regulated pressure of between 17 and 26 psig (120 kPa – 180 kPa). Damage will occur if the pressure exceeds 40 psig (275 kPa).

2.3.6 Output Ports

There are four output gas ports available on the Serinus Cal 300, labelled O1 to O4. Diluted Ozone gas is sent to each of the four output ports. Chemically inert Kynar fittings have been used and should be finger tight only. If any of the output ports are not used, they should be sealed with the supplied Kynar blanking nut. One of the output ports must be connected to vent in order to avoid pressurising the unit. Damage to the equipment may occur if the output pneumatic system is pressurised.



CAUTION

One of the output ports must be connected to the vent in order to avoid pressuring the unit.

2.3.7 Exhaust Port

The exhaust of the internal photometer pump is vented out of this port. The exhaust port must be connected to an exhaust manifold venting to a suitable location outside the room and away from the sample inlets of gas analysers in the system.



CAUTION

It is recommended that exhaust air is not expelled into a shelter/room inhabited by people. It should be expelled into the external air with sufficient distance away from the sample inlet of gas analysers.

2.3.8 Communications Connections

There are a number of ways to communicate with the instrument. The user can use the supplied Airodis software to access the instrument and download data. The Airodis software is supplied on the green resources USB stick provided with this instrument. Other data logging software such as Ecotech's Congrego can also be used to control and setup the instrument.

RS232 #1

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

RS232 #2

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

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

USB

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

TCP/IP (optional)

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

Analog/Digital

This port is used to send and receive analog and digital signals between instruments. It is normally used to connect with a gas analyser or data logger to activate calibration points and sequences.

Each instrument contains 8 digital inputs, 8 digital outputs, 3 analog inputs and 1 analog output.

Diluent Control

This port is used to control an external Zero Air Generator (such as the Ecotech 8301LC) by providing a 12 V signal when the Diluent is required.

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'.

2.4 Transporting/Storage

Transporting the Serinus Cal 300 should be done with great care. It is recommended that the packaging the Serinus Cal 300 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 switching the switch (S1) on the main controller PCA to off (refer to Figure 18).
4. Remove the instrument from the rack.
5. Replace the red plugs into the pneumatic connections.
6. Remove the USB memory stick and pack with instrument (refer to Figure 17).
7. Place the instrument back into a plastic bag with desiccant packs and seal the bag (ideally the bag it was delivered in).
8. 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.
9. The instrument is now ready for long term storage or transportation.

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3. Operation

3.1 Warm-Up

The Serinus Cal 300 requires a warm up period before it can execute a photometer point. During this period, the instrument will adjust itself to prepare for monitoring. Other functions are available immediately at start up.

The following activities occur during Serinus Cal 300 warm-up:

Lamp Adjust

The instrument automatically adjusts the lamp's current (10 mA) for a stable (reference voltage) signal/output (2 minutes).

Ref Stabilise

The instrument sets the reference voltage to 2.8 - 3.2 V output and waits for a stable output signal.

Zero Adjust

The instrument sets the course and fines zero pots for a zero detector output.

Zero Stabilise

The instrument waits until the zero voltage signals are stable.

After this warm-up has completed the Serinus Cal 300 can execute photometer points.

3.2 Theory of Operation

The Serinus Cal 300 operates by using definitions of points and sequences.

From the **Points and Sequencing Menu** points can be defined. A point is a user-defined configuration of gas flows. Up to 32 points can be defined and named. Each point can perform one of three types of operation (Zero Point, O3 Generator or O3 Gen/Photometer), utilizing different flows, and concentrations.

A sequence is a series of points. Up to 16 sequences can be defined. Each sequence can run up to 16 points for a user-specified amount of time. Sequences can also run other sequences as one of their actions, allowing for very complex series of points to be executed. The nesting of sequences can only go three levels deep before you will get a nesting error. To signify the end of a sequence you can select the repeat or idle action, which will repeat the sequence or place the Serinus Cal 300 into Idle.

Points or sequences can be initiated from the **Quick Menu → Mode**, or they can be initiated remotely via digital inputs or serial commands.

For convenience there is a "Manual" point. This is exactly like a point definition except it does not occupy one of the 32 named point definitions. It is useful for operating the machine in an immediate mode where flow and concentration changes can be done on the fly. Points created in manual mode can be copied to a point number and given a name when the user wants to keep it long term and is satisfied.

3.2.1 Running a Point or Sequence

Initially the Serinus Cal 300 requires several steps to be followed in order to run an automatic point or sequence.

- Program points in the **Points & Sequencing Menu**
- Program sequences (if applicable) in the **Points & Sequencing Menu**
- Start the desired point or sequence by accessing the **Quick Menu → Mode** and selecting point or sequence

3.2.2 Operation

When defining a point, you first need to select an operation. The Serinus Cal 300 has three operations, Zero Point, O3 Generator and O3 Gen/Photometer. The following sections give examples of each type of operation and how set them up.

3.2.2.1 Zero Point

Step by Step Example:

1. Return to the **Home Screen** (the user can press the bottom status light (green)).

Note: There are some menu items that will not be used in the steps, an explanation is given at the end of the example. **Define Point Menu** has 32 available programmable points.

2. Open - **Main Menu → Points & Sequences Menu → Define Points Menu**.
3. Edit - **Point 10**.
4. Edit - **Name** - (give the point a name that will help distinguish it from the others, for this example we will be using “EXE 00”) - Accept.
5. Select - **Operation** - **Zero Point** - Accept.
6. Edit - **Flow** - (set to the flow to the value required for the instruments connected to the output manifold, for this example we will set it to 3.0 slpm) - Accept.
7. Return to the **Home Screen** (the user can press the bottom status light (green)).
8. This Point is now configured correctly and can be started automatically (via serial commands or digital bits) or manually (via the **Quick Menu**).
9. Open - **Quick Menu**.
10. Select - **Mode** - Point - Accept - EXE 00 - Accept.

Note: Some of the menu items in the **Define Point Menu** that were not discussed were the ‘Copy From…’, ‘Input Mask’ and ‘Output Mask’. The ‘Copy From…’ feature can be used make quick copies of existing points that are similar or that were developed in **Manual Point Menu**. The ‘Input Mask’ and ‘Output Mask’ relate to the two lots of eight digital bits that can be used to automatically start points (digital input) and give a digital output to give an indication or control other instruments or relays (digital output).

3.2.2.2 O3 Generator

Step by Step Example:

1. Return to the **Home Screen** (the user can press the bottom status light (green)).

Note: There are some menu items that will not be used in the steps, an explanation is given at the end of the example. **Define Point Menu** has 32 available programmable points.

2. Open - **Main Menu → Points & Sequences Menu → Define Points Menu**.
3. Edit - **Point 1**.
4. Edit - **Name** - (give the point a name that will help distinguish it from the others, for this example we will be using "EXE 01") - Accept.
5. Select - **Operation** - **O3 Generator** - Accept.
6. Edit - **Flow** - (set to the flow to the value required for the instruments connected to the output manifold, for this example we will set it to 3.0 slpm) - Accept.
7. Off - **Zero Point** - Off (this will allow the Ozone generator to produce ozone).
8. Select - **Units** - (this will be the units that are displayed on the home screen, for this example we will select "ppb") - Accept.
9. Edit - **Set Point** - (this is where the user can set the concentration required from the Ozone Generator. For this example we will select "350 ppb") - Accept.

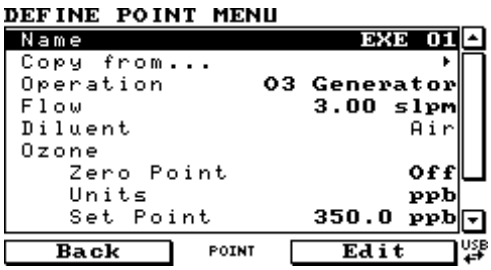

Figure 19 – O3 Generator Setup

10. Return to the **Home Screen** (the user can press the bottom status light (green)).
11. This Point is now configured correctly and can be started automatically (via serial commands or digital bits) or manually (via the **Quick Menu**).
12. Open - **Quick Menu**.
13. Select - **Mode** - Point - Accept - EXE 01 - Accept.

Note: Figure 20 shows the Home Screen with the Serinus Cal 300 automatically controlling the dilution and ozone flow to give you your total flow requested in the point definition.

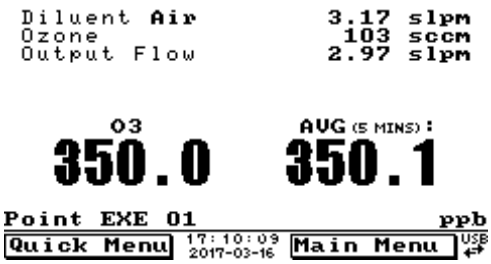

Figure 20 – Home Screen Running EXE 01 Point

Note: Some of the menu items in the **Define Point Menu** that were not discussed were the 'Copy From…', 'Input Mask' and 'Output Mask'. The 'Copy From…' feature can be used make quick copies of existing points that are similar or that were developed in **Manual Point Menu**. The 'Input Mask'

and 'Output Mask' relate to the two lots of eight digital bits that can be used to automatically start points (digital input) and give a digital output to give an indication or control other instruments or relays (digital output).

3.2.2.3 O3 Gen/Photometer

Step by Step Example:

1. Return to the **Home Screen** (the user can press the bottom status light (green)).

Note: There are some menu items that will not be used in the steps, an explanation is given at the end of the example. **Define Point Menu** has 32 available programmable points.

2. Open - **Main Menu → Points & Sequences Menu → Define Points Menu**.
3. Edit - **Point 2**.
4. Edit - **Name** - (give the point a name that will help distinguish it from the others, for this example we will be using "EXE 02") - Accept.
5. Select - **Operation** - **O3 Gen/Photometer** - Accept.
6. Edit - **Flow** - (set to the flow to the value required for the instruments connected to the output manifold, for this example we will set it to 3.0 slpm) - Accept.
7. Off - **Zero Point** - Off (this will allow the Ozone generator to produce ozone).
8. Select - **Units** - (this will be the units that are displayed on the home screen, for this example we will select "ppb") - Accept.
9. Edit - **Set Point** - (this is where the user can set the concentration required from the Ozone Generator. For this example we will select "350 ppb") - Accept.

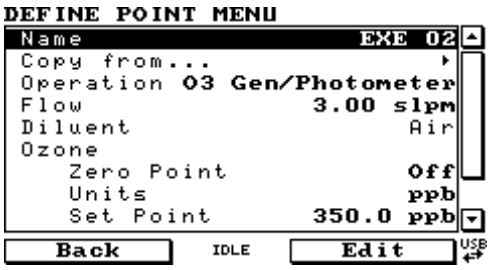

Figure 21 – O3 Gen/Photometer Setup

10. Return to the **Home Screen** (the user can press the bottom status light (green)).
11. This Point is now configured correctly and can be started automatically (via serial commands or digital bits) or manually (via the **Quick Menu**).
12. Open - **Quick Menu**.
13. Select - **Mode** - Point - Accept - EXE 02 - Accept.

Note: Figure 22 shows the Home Screen with the Serinus Cal 300 automatically controlling the dilution and ozone flow to give you your total flow requested in the point definition.

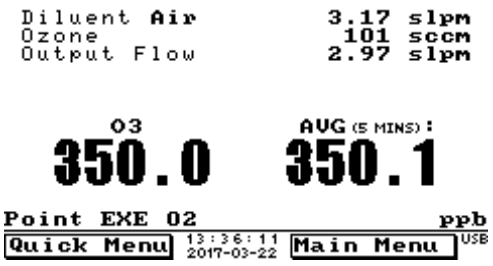

Figure 22 – Home Screen Running EXE 02 Point

Note: Some of the menu items in the **Define Point Menu** that were not discussed were the "Copy From…", "Input Mask" and "Output Mask". The "Copy From…" feature can be used make quick copies of existing points that are similar or that were developed in **Manual Point Menu**. The "Input Mask" and "Output Mask" relate to the two lots of eight digital bits that can be used to automatically start points (digital input) and give a digital output to give an indication or control other instruments or relays (digital output).

3.2.2.4 Sequence

Once you have defined some points you can define a sequence. A sequence is a collection of defined points connected by steps. Each step has duration and uses the point definition. The end of the sequence is defined by either Idle, repeat or using up all 16 steps. The steps don't always need to be points they can be linked to other sequences, allowing nested sequences. This method can only go three sequences deep before you get a nesting error. The following example demonstrates an ozone multipoint linearization check with a zero before and after.

Step by Step Example:

Point Setup

1. Open - **Main Menu → Points & Sequences Menu → Define Points Menu**.
2. Edit - **Point 3**.
3. Edit - **Name** - (give the point a name that will help distinguish it from the others, for this example we will be using "50..MP") - Accept.
4. Select - **Operation** - **O3 Generator** - Accept.
5. Edit - **Flow** - (set to the flow to the value required for the instruments connected to the output manifold, for this example we will set it to 3.0 slpm) - Accept.
6. Off - **Zero Point** - Off (this will allow the Ozone generator to produce ozone).
7. Select - **Units** - (this will be the units that are displayed on the home screen, for this example we will select "ppb") - Accept.
8. Edit - **Set Point** - (this is where the user can set the concentration required from the Ozone Generator. For this example we will select "50 ppb") - Accept.
9. Back - **Main Menu → Points & Sequences Menu → Define Points Menu**.
10. Edit - **Point 4**.
11. Copy - **Copy from…** - (select "50..MP") - Accept.
12. Edit - **Name** - (give the copied point a name that will help distinguish it from the others, for this example we will be using "100.MP") - Accept.

13. Edit - **Set Point** - (this is where the user can set the concentration required from the Ozone Generator. For this example we will select “100 ppb”) - Accept.
14. Back - **Main Menu → Points & Sequences Menu → Define Points Menu**.
15. Edit - **Point 5**.
16. Copy - **Copy from…** - (select “100.MP”) - Accept.
17. Edit - **Name** - (give the copied point a name that will help distinguish it from the others, for this example we will be using “150.MP”) - Accept.
18. Edit - **Set Point** - (this is where the user can set the concentration required from the Ozone Generator. For this example we will select “150 ppb”) - Accept.
19. Back - **Main Menu → Points & Sequences Menu → Define Points Menu**.
20. Edit - **Point 6**.
21. Copy - **Copy from…** - (select “150.MP”) - Accept.
22. Edit - **Name** - (give the copied point a name that will help distinguish it from the others, for this example we will be using “200.MP”) - Accept.
23. Edit - **Set Point** - (this is where the user can set the concentration required from the Ozone Generator. For this example we will select “200 ppb”) - Accept.
24. Back - **Main Menu → Points & Sequences Menu → Define Points Menu**.
25. Edit - **Point 7**.
26. Copy - **Copy from…** - (select “200.MP”) - Accept.
27. Edit - **Name** - (give the copied point a name that will help distinguish it from the others, for this example we will be using “250.MP”) - Accept.
28. Edit - **Set Point** - (this is where the user can set the concentration required from the Ozone Generator. For this example we will select “250 ppb”) - Accept.
29. Back - **Main Menu → Points & Sequences Menu → Define Points Menu**.
30. Edit - **Point 8**.
31. Copy - **Copy from…** - (select “250.MP”) - Accept.
32. Edit - **Name** - (give the copied point a name that will help distinguish it from the others, for this example we will be using “Zero..”) - Accept.
33. On - **Zero Point** - On (this will disable the Ozone generator an only produce zero air).
34. Return to the **Home Screen** (the user can press the bottom status light (green)).

Sequence Setup

1. Open - **Main Menu → Points & Sequences Menu → Define Points Menu**.
2. Edit - **Sequence 1**.
3. Edit - **Name** - (give the point a name that will help distinguish it from the others, for this example we will be using “MultiP”) - Accept.
4. Edit - **Step 1** - (change from **Idle** to **Point**) - (select “Zero..”) - Accept.
5. Edit - **Time** - (For this example we will use 10 mins) - Accept.

6. Edit - **Step 2** - (change from **Idle** to **Point**) - Accept - (select “250.MP”) - Accept.
7. Edit - **Time** - (for this example we will use 20 mins) - Accept.
8. Edit - **Step 3** - (change from **Idle** to **Point**) - Accept - (select “200.MP”) - Accept.
9. Edit - Time - (for this example we will use 20 mins) - Accept.
10. Edit - **Step 4** - (change from **Idle** to **Point**) - Accept - (select “150.MP”) - Accept.
11. Edit - **Time** - (for this example we will use 20 mins) - Accept.
12. Edit - **Step 5** - (change from **Idle** to **Point**) - Accept - (select “100.MP”) - Accept.
13. Edit - **Time** - (for this example we will use 20 mins) - Accept.
14. Edit - **Step 6** - (change from **Idle** to **Point**) - Accept - (select “50..MP”) - Accept.
15. Edit - **Time** - (for this example we will use 20 mins) - Accept.
16. Edit - **Step 7** - (change from **Idle** to **Point**) - Accept - (select “Zero..”) - Accept.
17. Edit - **Time** - (for this example we will use 20 mins) - Accept.

Note: the next step (step 8) will default to Idle. This will indicate the end of the sequence, no adjustment is required by the user.

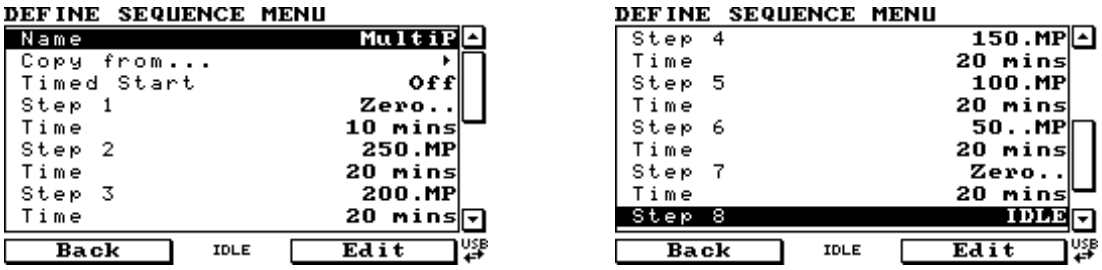

Figure 23 – Multipoint Sequence Setup

18. Return to the **Home Screen** (the user can press the bottom status light (green)).
19. This Sequence is now configured correctly and can be started automatically (via serial commands or digital bits) or manually (via the **Quick Menu**).
20. Open - **Quick Menu**.
21. Select - **Mode** - Sequence - Accept - MultiP - Accept.
22. Once a sequence is running you can use the **Mode** feature in the **Quick Menu** to Pause, Skip, Rewind or Stop.

3.3 General Operation Information

3.3.1 Keypad & Display

The Serinus Cal 300 is operated with the use of 4 sets of buttons:

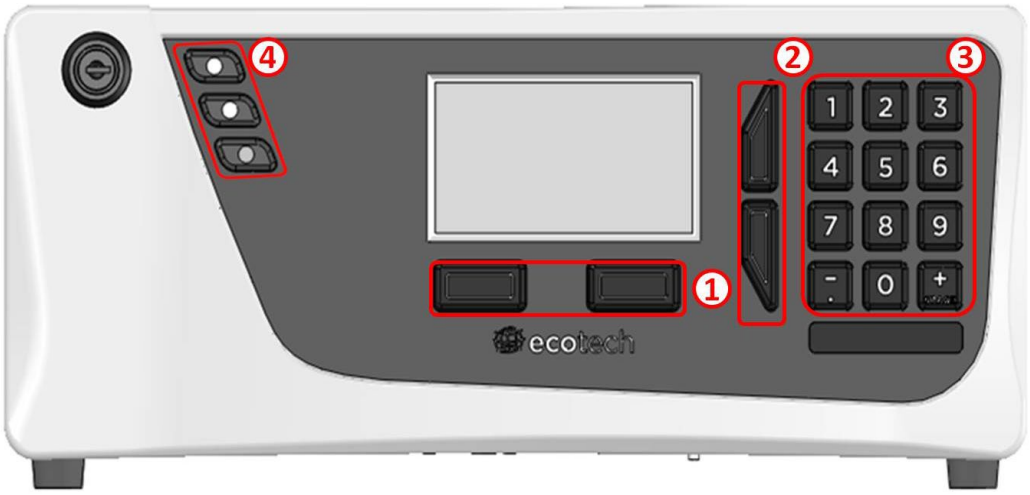

Figure 24 – Front Panel

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.

Keypad (3)

The keypad contains the numbers 0-9, a decimal point/minus key ($\overset{-}{.}$) and a space/plus key ($\underset{\text{SPACE}}{+}$).

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

1 = 1 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 ($_{\text{SPACE}}^{+}$) and key ($\overline{.}$) button functions depend on context. When editing a floating point number, the key ($\overline{.}$) inserts a negative sign if the editing cursor is at the start of the number and negative signs are allowed. Otherwise it moves the decimal place to the current cursor location. The ($_{\text{SPACE}}^{+}$) key inserts a positive sign if the cursor is at the start of the number; otherwise it enters a space.
For non-floating point numbers, these keys usually increment or decrement the current value by 1. When editing the month field of a date, the ($_{\text{SPACE}}^{+}$) and ($\overline{.}$) key change the month.

Instrument Status Light Buttons (4)

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

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

In the case of an orange or red light enter the Status Menu to find which components are failing (refer to Section 3.5.13) or pressing the orange or red light when illuminated will bring up a pop up box with a full list of current faults.

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

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

3.4 Home Screen

The Home Screen is composed of six parts: Readings (1), Concentrations (2), Error Line (3), Status Line (4), Selection Buttons (5), Time and Date (6), USB Detection (7), Concentration Units (8).

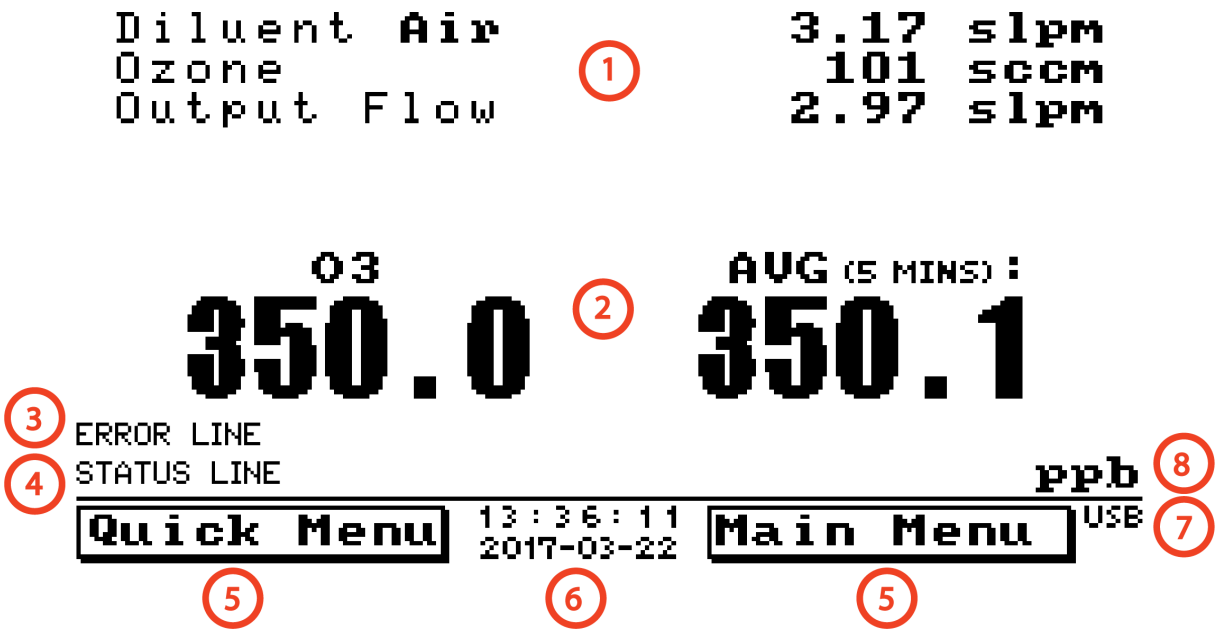

Figure 25 – Home Screen

Readings (1)

Displays the flow of each flow control device currently available in the system. The total flow distributed to the output port is also displayed.

Concentrations (2)

Displays concentration of each gas defined in the gas standard, which is currently being delivered to the output port.

Error Line (3)

The error line provides users with information on any problems the instrument may have. It displays the highest priority error condition contained in the Status menu.

Status Line (4)

The status line provides users with information on the current status of the instrument.

If a defined point or sequence is running, the name will appear on this line, along with the remaining time (in minutes) for the current point when running a sequence manual point.

Selection Buttons (5)

These buttons are used on the home 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 3.5.3) contains all information and fields available to users and is generally only used during initial set-up and diagnostics.

The right button opens the **Main Menu** (refer to Section 3.5.3) contains all information and fields available to users and is generally only used during initial set-up and diagnostics.

Time and Date (6)

The time and date are displayed in between the menu buttons at the bottom of the screen.

USB Detection (7)

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

Note: To safely remove the USB memory stick, navigate to the **Service Menu** and use the **Safely Remove USB Stick** function (refer to Section 3.5.24).

Concentration Units (8)

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

3.5 Menus & Screens

To begin using the Serinus Cal 300, a number of parameters must be programmed into the unit through the menu system. This section of the manual gives an overview of the menu system to the user. To access these items, press the Menu button while on the home screen.

In general, editable parameters are displayed in bold font. Non-editable information is displayed in a thin font.

Some parameters may become editable based on the state of the instrument.

Sub-menus will be indicated with a small arrow; pressing the right-hand button on these items will open a new menu or a dialog box.

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.

Mode	Allows the user to select a mode of operation. Refer to Section 3.5.2
Event Log	This field enters a screen with a log of all the events that the instrument has performed. These events include errors and warnings. This log is stored on the removable USB memory stick. The log is organised by month. When you enter this screen you will be prompted to enter the month for which you wish to view events.

Point/Seq Log	This field enters a screen with a log of all the actions the calibrator has performed. Every time a point or sequence starts and stops, is edited, when a sequence repeats, when the mode is changed (e.g. idle, manual…) and when the pause skip or rewind function is used. This log is stored on the removable USB memory stick. The log is organised by month. When you enter this screen you will be prompted to enter the month for which you wish to view actions.
Instrument	This field allows the instrument to be set to either **Online** (normal instrument operation) or **In Maintenance** (data is flagged as invalid).
Safely Remove USB Stick	Always select this menu item before removing the USB memory stick or select the same menu item from the **Service Menu** (refer to Section 3.5.24). Failure to do this may cause corruption of the memory stick.
Instrument Gain	Shows the user the instrument gain of the photometer.
Next 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 **Advanced Menu** (refer to Section 3.5.44). This field is only displayed in the 2 weeks prior to the date displayed in this field or after the date has occurred.
Internal Pump	Allows the user to turn the internal pump on and off.
Internal Diluent	When **Disabled** valve thirteen is switched to change the source of diluent air to an external source (Ext Diluent Port). When **Enabled** the diluent air is sourced Internally.

3.5.2 Mode

Quick Menu → Mode

Stop	The instrument stops all flows, closes all valves, and does not respond to any other input (manual, serial or digital).
Idle	The default state. The instrument is not running any points or sequences but will respond to any request to do so. Selecting this option from the **Mode** button will terminate any point or sequence currently active.
Point	The instrument is currently running a point. Selecting this option from the **Mode** button will allow the user to initiate a new point.
Sequence	The instrument is currently running a sequence. Selecting this option from the **Mode** button will allow the user to initiate a new sequence.
Pause **[Running a Sequence]**	The instrument is attempting to run a sequence but the user has asked it to pause. This means the instrument remains in the current point indefinitely (until resumed) instead of moving on to the next point once the count-down has expired.

Resume [Running a Sequence]	When a sequence is paused, opening the **Mode** button will allow the choice to resume. This continues the point's countdown from where it was paused.
Skip [Running a Sequence]	While running a sequence the **Mode** button can be used to skip ahead to the next point.
Rewind [Running a Sequence]	While running a sequence the **Mode** button can be used to rewind back to the previous point.

3.5.3 Main Menu

There are nine menus on the **Main Menu** screen.

Points & Sequencing Menu	Refer to Section 3.5.4.
Manual Operation Menu	Refer to Section 3.5.9.
Analyser State Menu	Refer to Section 3.5.12.
General Settings Menu	Refer to Section 3.5.17.
Measurement Settings Menu	Refer to Section 3.5.18.
Calibration Menu	Refer to Section 3.5.19.
Service Menu	Refer to Section 3.5.24.
Communications Menu	Refer to Section 3.5.34.
Trend Display Menu	Refer to Section 3.5.42.

3.5.4 Points & Sequencing Menu

Main Menu → Points & Sequencing Menu

Define Points Menu	Refer to Section 3.5.5.
Define Sequences Menu	Refer to section 3.5.7.
Points/Seq Log	Records all the events relating to points and sequences.

3.5.5 Define Points Menu

Main Menu → Points & Sequencing Menu → Define Points Menu

Edit Point	This is a quick method for the user to access the point definition they wish to edit.
Reset All Points	This will erase all the current point definitions stored in the USB memory stick.
Point 1..32	Select a point to edit (from 1-32), this leads the user to the **Define Point Menu** submenu. Note that the point definitions are not stored in the instrument's EEPROM. Instead, they are stored on the USB flash drive in a file named "POINT.TXT".

3.5.6 Define Point Menu

Main Menu → Points & Sequencing Menu → Define Points Menu → Define Point Menu

Name	Enter a name for the point (limited to 6 letters or numbers).
Copy from…	Copy the definition of another point into this one. Useful for making a series of points that only differ in one or two small ways.
Operation	The type of operation for this point. Please refer Section 3.5.6.1 through to Section 3.5.6.3 for details of each operation.
[Various]	Various fields will be displayed based on the type of operation selected.
Input Mask	When the digital input lines match this pattern, the point will automatically trigger. An X means the pattern will trigger regardless of the state of that line. If the pattern is set to all XXXXXXXX, it will never be triggered by the digital input lines. Conversely, if it is set to XXXXXXX1, the point will automatically be triggered as soon as the instrument turns on, as the default state of the digital input lines is 11111111. Remember that selecting manual operation, or manually starting a point or sequence, will temporarily disable the digital input controls. Digital inputs will be ignored while the system is in warmup
Output Mask	The digital output lines will be a combination (OR operation) of this pattern, the sequence DIO output mask (if running a sequence) and the DIO Output Mask (refer to the **Digital Output Menu**, Section 3.5.39). An X will have no impact on the combination (i.e. any bits marked X here will either be set by the sequence or the DIO Output Mask).

3.5.6.1 Zero Point

Run a zero point.

Flow	Desired flow delivered to the output port. If the Set Point you selected is incompatible with this flow, you will be asked if you want to change the Set Point.
Diluent	The diluent to be used; selected from the diluents attached to the instrument if you have the dual diluent option.

3.5.6.2 O3 Generator

Generate and dilute ozone.

Flow	Desired flow delivered to the output port. If the Set Point you selected is incompatible with this flow, you will be asked if you want to change the Set Point.
Diluent	The diluent to be used; selected from the diluents attached to the instrument if you have the dual diluent option.
Ozone	Gas name
Zero Point	When this option is ON, the set point is fixed to 0.0 and the ozone lamp is turned off. This is necessary when calibrating the photometer.

Units	Units for the desired concentration. These are the units that all the gasses will be displayed in, on the **Home Screen**.
Set Point	The desired concentration of ozone. Note that the amount of ozone that can be delivered depends on the flow.

3.5.6.3 O3 Gen/Photometer

Generate and dilute ozone under photometer control. The amount of ozone delivered will be constantly monitored and adjusted by a feedback loop, to remain at the desired concentration.

Flow	Desired flow delivered to the output port. If the Set Point you selected is incompatible with this flow, you will be asked if you want to change the Set Point.
Diluent	The diluent to be used; selected from the diluents attached to the instrument if you have the dual diluent option.
Ozone	Gas name
Zero Point	When this option is ON, the set point is fixed to 0.0 and the ozone lamp is turned off. This is necessary when calibrating the photometer.
Units	Units for the desired concentration. These are the units that all the gasses will be displayed in, on the **Home Screen**.
Set Point	The desired concentration of ozone. Note that the amount of ozone that can be delivered depends on the flow.

3.5.7 Define Sequences Menu

Main Menu → Points & Sequencing Menu → Define Sequences Menu

Edit Sequence	This is a quick method for the user to access the sequence definition they wish to edit.
Reset all Sequences	This will erase all the current sequence definitions stored in the USB memory stick.
Sequence 1-16	Select a sequence to edit (from 1-16). Note that the sequence definitions are not stored in the instrument's EEPROM. Instead, they are stored on the USB flash drive in a file named "SEQUENCE.TXT".

3.5.8 Define Sequence Menu

Main Menu → Points & Sequencing Menu → Define Sequences Menu → Define Sequence Menu

Name	Enter a name for the sequence (limited to 6 letters or numbers).
Copy from…	Copy the definition of another sequence into this one.
Timed Start	When **Timed Start** is turned on it allows the user to define a time and date for the sequence to start running. The only other condition is that the instrument must be in "Idle" mode, while in any other mode the **Timed Start** will be ignored.
Date **[Timed Start On]**	Displays the date that the sequence is due to run.

Time **[Timed Start On]**	Edit and display the time that the sequence will run. The time is set using a 24 hour clock.
Repeat **[Timed Start On]**	Defines an interval value for the repeat of the sequence based on the **Units** selected. This field indicates the delay period; once the specified amount of time has lapsed the sequence will automatically run again. The user can edit this field but some restrictions apply depending on the **Units** selected. Default is "1".
Units **[Timed Start On]**	This is where the user can define the type of units for the **Repeat** delay period. For example: A **Repeat** of "**1**" and **Units** of "**Days"** means that the sequence will automatically run every day at the defined time. Default is "Days"
Step 1-16	Define the task to perform at this point in the sequence. **IDLE**: The sequence is terminated and the instrument goes to the IDLE state. **REPEAT**: Go back to the beginning of the sequence and start over. **POINT**: Load a point for a specified amount of time. **SEQUENCE**: Load a sequence and repeat it a specified number of times. Note that you may only nest sequences three deep; that is, Seq A can call Seq B, which can call Seq C. If you attempt to have Seq C call another sequence, the entire sequence will terminate with an error. You may call sequences in order as many times as you like: so Seq A can call Seq B, C, D, and E one after the other.
Time **[Point]**	Run the named point for this many minutes. At the end of that time the sequence advances to the next task.
Repeats **[Sequence]**	Repeat the named sequence this many times. At the end of that loop the sequence advances to the next step.
Input Mask	When the digital input lines match this pattern, the sequence will automatically trigger. An X means the pattern will trigger regardless of the state of that line. If the pattern is set to all XXXXXXXX, it will never be triggered by the digital input lines. Conversely, if it is set to XXXXXXX1, the sequence will automatically be triggered as soon as the instrument turns on, as the default state of the digital input lines is 11111111. Remember that selecting manual operation, or manually starting a point or sequence, will temporarily disable the digital input controls.
Output Mask	The digital output lines will be a combination (OR operation) of this pattern, the point DIO output mask (if running a sequence) and the DIO Output Mask (refer to **Digital Output Menu**, Section 3.5.39). An X will have no impact on the combination (i.e. any bits marked X here will either be set by the point or the DIO Output Mask).

3.5.9 Manual Operation Menu

Main Menu → Manual Operation Menu

Manual Timeout	When using the manual point menu to operate the instrument, the instrument will automatically return to the “Idle” state after this timeout has expired. If the Manual Timeout is set to 0, then no timeout is used. The instrument will remain in the manually selected state indefinitely.
Manual Point Menu	Refer to Section 3.5.10.
Manual Flow Menu	Refer to Section 3.5.11.

3.5.10 Manual Point Menu

Main Menu → Manual Operation Menu → Manual Point Menu

This menu allows the user to operate the instrument directly (without defining a point). This may be used when experimenting with points it can then later be copied into a permanent point definition with the “Copy from…” feature.

Mode	This is the same as the Mode in the Quick Menu.
Operation	The type of operation. Refer to Sections 3.5.6.1 and 3.5.6.3 for operation descriptions.
[Various]	Various fields will be displayed based on the type of operation selected.
Output Mask	The digital output lines will be a combination (OR operation) of this pattern, the sequence DIO output mask (if running a sequence) and the DIO Output Mask (refer to the Digital Output Menu, Section 3.5.39). An X will have no impact on the combination (i.e. any bits marked X here will either be set by the sequence or the DIO Output Mask).
Audit Mode **[Operation O3 Gen/Photometer]**	Provides a method for external audits of the photometer. When turned on, a warning dialog box appears, stating “Connect external ozone generator". The point is then forced into a Zero point (if it isn't already). While running this point, the MFCs are locked closed and their flow alarms are supressed. The new status condition "Audit Mode" will be triggered, forcing a yellow warning light. Otherwise the point runs as normal. Refer to Section 5.6.

3.5.11 Manual Flow Menu

Main Menu → Manual Operation Menu → Manual Flow Menu

For calibration and test it is often necessary to directly control the MFC flows.

Gas	Indicate which gas is being provided. This is used to calculate the MFC correction factor.
MFC Diluent	Enter the desired flow for the diluent MFC (in sccm).
Flow	Displays the measured flow for the above MFC.

3.5.12 Analyser State Menu

Main Menu → Analyser State Menu

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

Status Menu	Refer to Section 3.5.13.
Temperature Menu	Refer to Section 3.5.14.
Pressure & Flow Menu	Refer to Section 3.5.15.
Voltage Menu	Refer to Section 3.5.16.
Model	This field displays the model type selected.
Nominal Range	This is the nominal range of the photometer.
Ecotech ID	The Ecotech ID number.
Serial No.	The main controller PCA serial number.
Board Revision	The main controller PCA version.
Firmware Ver.	This field displays the firmware version currently in use on this instrument. This can be important when performing diagnostics and reporting back to the manufacturer.
Power Failure	This field displays the time and date of the last power failure or when power was disconnected from the instrument.

3.5.13 Status Menu

Main Menu → Analyser State Menu → Status Menu

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

Event Log	This field enters a screen with a log of all the events that the instrument has performed. These events include errors and warnings. This log is stored on the USB memory stick. The log is organised by month. When you enter this screen you will be prompted to enter the month for which you wish to view events.
Show Error List	This field allows the user to display the list of current errors and warnings on the screen.
Next Service Due	This field is visible with the next service due date if the service is due within the next two weeks.
Maintenance Mode	Ok if the instrument is online and Error if the instrument is in maintenance mode. Refer to **Service Menu** (refer to Section 3.5.24) or **Quick Menu** (refer to Section 3.5.1).
+5V Supply	Pass if the +5 V power supply to the main board is within the acceptable range.
+12V Supply	Pass if the +12 V power supply is within the acceptable range.
+ Analog Supply	Pass if the analogue power supply is within the acceptable range (+12 V).
- Analog Supply	Pass if the analogue power supply is within the acceptable range (-12 V).
A2D	Fail only if a problem is detected with the analog to digital conversion.
Ozone Lamp Temp.	Pass if the ozone generator lamp is the correct temperature.

Lamp Temp.	Pass if the photometer lamp is the correct temperature.
Lamp/Source	Checks if the photometer lamp current is within acceptable limits 8-12 mA.
Ref Voltage	Checks that the reference voltage is within acceptable limits 1.5 to 4.5 V.
System Power	Pass if the system has an adequate electrical supply.
Diagnostic Mode	Error if the electronics are in diagnostic mode. Refer to Digital Pots Menu, Section 3.5.26.
Diagnostic PTF Comp	Error if the pressure /temperature compensation is disabled. Refer to Diagnostics Menu, Section 3.5.25).
Diagnostic Control	Error if the control loop is disabled. Refer to Diagnostics Menu, Section 3.5.25).
Valve Manual Control	Error if the valves have been placed in manual control mode. Refer to Valve Menu, Section 3.5.29).
O3 Gen. Manual Control	Error if the ozone generator is under manual control. Refer to Digital Pots Menu, Section 3.5.26.
O3 Conc V Saturated	Indicates if the voltage of the concentration during photometer measurement is within the limits of the analog to digital converter (-0.26 to 3.29 V).
Bkgnd Conc V Saturated	Indicates if the voltage of the concentration during photometer background measurement is within the limits of the analog to digital converter (-0.26 to 3.29 V).
Ozone Gen. Cal	Fail if the instrument is performing an O_3 generator calibration. Refer to Ozone Calibration Menu, Section 3.5.21).
Pressure Calibration	Error if the user is performing a pressure calibration.
Flow Calibration	Error if the user is performing a flow calibration.
Photometer Flow Fault	Pass when the photometer has sufficient flow.
Full Stop	Error if the instrument is in STOP mode.
Manual Flow	Error if the instrument is under manual flow control (Refer to Manual Flow Menu, Section 3.5.11.
Diluent Flow Fault	Pass when the diluent flow is within 5 % of specified flow.
Ozone Flow Fault	Pass when the ozone generator flow is within 10 % of 100 sccm.
Flow Block Temp.	Pass if the flow block temperature is within 10 % of the heater set point (to keep a constant accurate flow).
Chassis Temp.	Pass if the chassis temperature is within the acceptable limits (0-50 °C).
USB Stick Disconnect	Detects whether a USB memory stick is plugged into the front USB port.
Instrument Warmup	Ok once the photometer is out of warm-up status.
O3 Gen. Flow Fault	Fail if the O3 Gen. Warm feature is enabled but there is insufficient flow through the ozone generating chamber (< 70 sccm).
Audit Mode	Error if a manual O3 Gen/Photometer point is in audit mode.

3.5.14 Temperature Menu

Main Menu → Analyser State Menu → Temperature Menu

Temperature Units	The current temperature units of the analyser (**Celsius**, **Fahrenheit**, or **Kelvin**).
Set Point (LAMP)	The temperature set point of the photometer UV lamp. The factory default is 50 °C.
Set Point (FLOW)	The temperature set point of the flow block heater. The factory default is 50 °C.
Set Point (O3 GEN.)	The temperature set point of the ozone generating lamp. The factory default is 50 °C.
Lamp	The current temperature of the photometer lamp.
Sample	The current sample temperature of the shielded photometer.
Flow Block	The current temperature of the flow block.
Chassis	The current temperature of air inside the chassis, measured on the main controller PCA.
O3 Gen.	The current temperature of the ozone generator.

3.5.15 Pressure & Flow Menu

Main Menu → Analyser State Menu → Pressure & Flow Menu

Pressure Units	Select the units that the pressure will be displayed in (**torr**, **PSI**, **mBar**, **ATM**, **kPa**).
Ambient	Current ambient pressure.
Cell	Current photometer cell pressure.
Internal Pump	Current photometer pumps pressure.
Flow Units	Select the units that the flow will be displayed in (**slpm** or **L/min**).
Photometer	The current photometer flow.
Diluent	The gas flow through the diluent MFC.
Ozone	The current ozone flow.

3.5.16 Voltage Menu

Main Menu → Analyser State Menu → Voltage Menu

Lamp Current	The photometer UV lamp current.
Conc Voltage (RAW)	Voltage from the sensor proportional to the detected signal from the cell. This voltage represents the actual measurement of gas.
Conc Voltage	Displays the detector voltage after PGA scaling.
Ref. Voltage	A voltage offset from the detector that is removed to measure the concentration voltage. This is set to 3 V (using the input pot) at start-up, and automatically adjusts if the reference voltage drops below 2 V or above 4 V.

O3 Gen. Current	Ozone generator current.
+5V Supply	+5 V power supply.
+12V Supply	+12 V power supply.
+Analog Supply	+12 V (primary) power supply. The value should be within ±2 V.
-Analog Supply	-12 V (primary) power supply. The value should be within ±2 V.

3.5.17 General Settings Menu

Main Menu → General Settings Menu

Internal Diluent	When **Disabled** valve five is switched to change the source of zero air (diluent) to an external source (Ext Zero Port). When **Enabled** the zero air (diluent) is sourced Internally.
Decimal Places	Select the number of decimal places (0-5) used for the concentration displayed on the home screen.
Reference Temperature	The standard temperature used when calculating **slpm** flow from the MFC.
Temperature Units	Select the units that temperature will be displayed in **°C (Celsius), °F (Fahrenheit), or K (Kelvin)**.
Pressure Units	Select the units that the pressure will be displayed in (**torr**, **PSI**, **mBar**, **ATM** and **kPa**).
Flow Units	Select the units that the sample flow will be displayed in (**slpm** or **L/min**).
Date	The current instrument date.
Time	The current instrument time.
Backlight	Select the length of time the screen and keypad backlight remain on after a button press. The setting **Always Off** means the backlight never turns on; the setting **Always On** means the backlight never turns off. The setting **Daytime** means the backlight will turn on at 7am and off at 7pm.
Home Screen	This field allows the user to display concentrations on the **Home Screen** in three formats. **Inst. only** which displays only the instantaneous concentration reading. **Inst & Avg** which displays both instantaneous and average concentration on the **Home Screen**. **Avg. Only** which only displays the average concentration reading. The average is measured over the time period set in Measurement Settings Menu (refer to Section 3.5.18).
Char 0 has Slash	When enabled, the instrument will display the zero character with a slash (0) to differentiate it from a capital “O”.

3.5.18 Measurement Settings Menu

Main Menu → Measurement Setting Menu

Average Period	Allows the user to set the averaging period from 1 min to 24 hours

Min. Data Capture	Controls how much of the previous time period needs to be included before the average yields a number. The default is 0 %, which reflects past behaviour of the instrument: turning on a machine with 15 minute averaging and a setting of 0 % at 1:01 or 1:14 would produce #### until 1:15 (because at 1:15, there was at least 1 valid measurement to construct the average from). Setting 100 % would mean the value stayed #### until 1:30 (because there needs to be a complete 15 minutes worth of measurements to construct the average from).

3.5.19 Calibration Menu

Main Menu → Calibration Menu

Photometer	Displays the current photometer reading.
Average	Displays the average photometer reading based off the average set up in the Measurement Settings Menu (refer to Section 3.5.18).
Audit Mode	Sets the instrument to sample from an external Ozone source. Used for calibration of the photometer. Refer to section 5.6.
Span Calibrate O3	Calibrate the photometer span point to the current reading. Note the instrument must be running a photometer point before it will enable this function.
Zero Calibrate O3	Calibrate the zero point to the current reading. Note the instrument must be running a zero point before it will enable this function.
Pressure Calibration Menu	Refer to section 3.5.20.
Ozone Calibration Menu	Refer to Section 3.5.21.
Flow Calibration Menu	Refer to Section 3.5.22.
MFC Calibration Menu	Refer to Section 3.5.23.
Pressure O3	The instrument cell pressure in the photometer during the last calibration.
Temperature	The instrument temperature during the last calibration.

3.5.20 Pressure Calibration Menu

Main Menu → Calibration Menu → Pressure Calibration Menu

Vacuum Set Pt.	The zero point for the calibration. Activating this item will open a dialog box of instructions. Refer to Section 5.3 for the calibration procedure.
Ambient Set Pt.	The high point for the calibration. Activating this item will open a dialog box of instructions. Refer to Section 5.3 for the calibration procedure.

Pressure Units	Select the units that the pressure will be displayed in (**torr**, **PSI**, **mBar**, **ATM** or **kPa**).
Ambient	The current ambient pressure (displayed in pressure units and as a raw voltage).
Cell	The current photometer reaction cell pressure (displayed in pressure units and as a raw voltage).
Internal Pump	The current internal pump pressure (displayed in pressure units and as a raw voltage).
O3 Flow	Calibrates the ozone flow. Refer to Section 5.2 for the calibration procedure.
Vacuum Cal Mode	Defaults to OFF. When turned ON, the valves will be set to the same state as during a Vacuum Set Pt. adjustment, but there is no adjustment. Used for checking the accuracy of the vacuum pressure calibration. There are no dialog boxes or prompts, so the user needs to follow similar steps and precautions as during Vacuum Set Pt.
Ambient Cal Mode	Defaults to OFF. Similar to Vacuum Cal Mode, except the valves are set to check the ambient cal.

3.5.21 Ozone Calibration Menu

Main Menu → Calibration Menu → Ozone Calibration Menu

Diluent	Diluent gas for the ozone calibration.
Flow	Specify the flow desired for the ozone generator calibration process.
Min Range	This is the minimum value for the ozone generator calibration. The calibration is performed between the Min and Max values.
Max Range	This is the maximum value for the ozone generator calibration. The calibration is performed between the Min and Max values.
Ozone Calibration	Refer to Section 5.4 for the calibration procedure.
Reset Ozone Cal	Resets the ozone generator calibration to factory default. Photometer calibrator remains unaffected.

3.5.22 Flow Calibration Menu

Main Menu → Calibration Menu → Flow Calibration Menu

Cell	The current pressure in the photometer measurement cell.
Photometer	Current photometer gas flow.
Internal Pump	This is the pressure reading from the internal photometer pump flow block PCA.

Internal Pump	This field allows the internal photometer pump to be turned on or off. This field is only editable when the **Flow Control** field is set to **MANUAL**.
Pump Control	Set to **MANUAL** to disable the automatic flow control. **AUTO** allows the flow PID to modify the pump coarse and fine settings. **START** will transition to **AUTO** after one second.
Coarse	Internal photometer pump speed control (Coarse). This field is only editable when the **Flow Control** field is set to **MANUAL**.
Fine	Internal photometer pump speed control (Fine). This field is only editable when the **Flow Control** field is set to **MANUAL**.
Valve Menu	Refer to section 3.5.29.

3.5.23 MFC Calibration Menu

Main Menu → Calibration Menu → MFC Calibration Menu

This menu allows a manual calibration of each MFC.

Standard Temperature	User selected reference temperature of reference flow during subsequent MFC calibrations.
Gas	Indicate which gas is being provided. This is used to calculate the MFC correction factor.
Points	Select the number of points to include in the calibration (5-10).
MFC Calibration	Refer to Section 5.1 for the calibration procedures.
Coeff. A0	The polynomial terms for the MFC calibration. Default is 0.
Coeff. A1	The polynomial terms for the MFC calibration. Default is the maximum flow of the MFC in sccm divided by 5.
Coeff. A2	The polynomial terms for the calibration. Default is 0.
Readout Calibration	Refer to Section 5.1.3 for the calibration procedures.
Coeff. A0	The polynomial terms for the readout calibration. Default is 0.
Coeff. A1	The polynomial terms for the readout calibration. Default is 1.
Coeff. A2	The polynomial terms for the readout calibration. Default is 0.

3.5.24 Service Menu

Main Menu → Service Menu

Diagnostics Menu	Refer to Section 3.5.25.
Calculation Factors Menu	Refer to Section 3.5.33.
Load Auto-Backup Config.	Loads the auto-backup configuration file. The configuration is automatically backed up every night at midnight.
Load Configuration	Loads a configuration file from the USB memory stick.

Save Configuration	Saves all of the EEPROM-stored user-selectable analyser configurations to the USB memory stick (calibration and communication settings, units, instrument gain, etc.). If there are problems with the analyser use this function to save settings to the removable USB memory 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 the analyser use this function to save settings to the removable USB memory stick and send this file (and the configuration) to your supplier with your service enquiry.
Instrument	This field allows the analyser to be set to either **Online** (normal instrument operation) or **In Maintenance** (data is flagged as invalid).
Next Service Due	Displays when the next scheduled service is due.
Safely Remove USB Stick	This command must be activated to safely remove the USB memory stick.
System Restart	Activating this will restart the calibrator.

3.5.25 Diagnostics Menu

Main Menu → Service Menu → Diagnostics Menu

Digitals Pots Menu	Refer to Section 3.5.26.
Internal Pump Menu	Refer to Section 3.5.27.
Internal Diluent Menu	Refer to Section 3.5.28.
Valve Menu	Refer to Section 3.5.29.
Tests Menu	Refer to Section 3.5.30.
Pres/Temp/Flow Comp.	Set either ON or OFF. OFF is used when running diagnostics to see fluctuations in readings. The default state is ON, to compensate for environmental fluctuations.
Control Loop	When ENABLED is selected, the microprocessor maintains control of the digital pots; when DISABLED is selected, the microprocessor does not control the digital pots and the user can manually adjust the digital pots. The red traffic light will be on while the control loop is disabled.

3.5.26 Digital Pots Menu

Main Menu → Service Menu → Diagnostics Menu → Digital Pots Menu

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

Unless the **Control Loop** is **Disabled** (refer to Diagnostics Menu, Section 3.5.25), changes to the pots may be modified by the instrument. This is intentional; some diagnostics are best done with instrument feedback and some are best done without.

Lamp Current	**9.5-10.5**	Displays the UV lamp current in mA.

PGA Gain	**1-128**	Displays the gain of the PGA.
Input Pot	**50-200**	Reduces the raw signal to measurable level.
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 Pot (COARSE)	**50-200**	Electronic zero for the measure channel.
Meas. Zero Pot (FINE)	**0-255**	Electronic zero for the measure channel.
Ref. Voltage	**1.5-4**	The reference voltage of the detector.
O3 Gen. Override	**On-Off**	When On, enables the user to manually control of the O_3 generator.
O3 Gen. Enable	**On-Off**	When On allows the user to turn on or off the O_3 generator. Only editable if the **Override** is **On**.
O3 Gen. DAC	**0-65535**	O_3 generator lamp. Only editable if the **Override** is **On**. The O_3 generator is controlled either by a coarse and fine pot or a DAC.
O3 Gen. Current	**0-4.9**	The O_3 generator lamp current, as determined by the pot or DAC setting.
Diagnostic Mode	**Operate**	▪ **Operate** (default): Puts the instrument in normal operation mode. ▪ **Electrical**: Injects an artificial test signal into the electronic processing circuitry on the main controller PCA to verify that the circuitry is operating correctly. When in this **Diagnostic Mode**, adjust the **Diagnostic Test Pot** from 0 to 255. This will produce a change in the concentration voltage as well as the indicated gas concentration. ▪ **Preamp**: Injects an artificial test signal into the Preamplifier mounted on the **Optical Cell** to verify that the Preamplifier, cabling and electronic circuitry on the main controller PCA is operating correctly. When in this **Diagnostic Mode**, adjust the **Diagnostic Test Pot** from 0 to 255. This will produce a change in the concentration voltage as well as the indicated gas concentration.
Diagnostic Test Pot	**0**	This Digital Pot is used for diagnostics only. When in the **Electrical** or **Preamp Diagnostic Mode**, this Digital pot should be adjusted from 0 to 255. This will produce a change in the concentration voltage as well as the indicated gas concentration.
Valve Drive V Pot	**0**	Additional valve drive voltage pot that is used by technicians when troubleshooting.

3.5.27 Internal Pump Menu

Main Menu → Calibration Menu → Flow Calibration Menu

Cell	The current pressure in the photometer measurement cell.
Photometer	Current photometer gas flow.

Internal Pump	This is the pressure reading from the internal photometer pump flow block PCA.
Internal Pump	This field allows the internal photometer pump to be turned on or off. This field is only editable when the **Flow Control** field is set to **MANUAL**.
Pump Control	Set to **MANUAL** to disable the automatic flow control. **AUTO** allows the flow PID to modify the pump coarse and fine settings. **START** will transition to **AUTO** after one second.
Coarse	Internal photometer pump speed control (Coarse). This field is only editable when the **Flow Control** field is set to **MANUAL**.

3.5.28 Internal Diluent Menu

Main Menu → Service Menu → Diagnostics Menu → Internal Diluent Menu

Internal Diluent	When **Disabled** valve thirteen is switched to change the source of diluent air to an external source (Ext Diluent Port). When **Enabled** the diluent air is sourced Internally.
Pump	Internal diluent pump speed control pot.
Flow	The current diluent gas flow.
Pump Adjust	When you get a flow fault the user can select pump adjust and the instrument automatically increases the diluent pump pot until the flow fault is resolved. Prior to running Pump Adjust, the user must ensure the following: With the user's standard setup connected to the outlets, including vents and other instruments, choose 'a' or 'b' from below. If external diluent air is available, it is preferable to use the external diluent air option. a) Connect to External DIL air, pressure 150-180 kPa. • Ensure the O3 Gen flow has been calibrated. (80 sccm and 100 sccm) and all plumbing is returned to normal. • Run a Photometer Zero point at 4 slpm. • Adjust the pressure regulator inside the Serinus Cal 300 until the O3 gen flow displays 100 sccm +/- 1 sccm on the home screen. b) Change the Internal Diluent pump speed control pot to 255 • Ensure the O3 Gen flow has been calibrated. (80 sccm and 100 sccm) and all plumbing is returned to normal. • Run a Photometer Zero point at 4 slpm. • Adjust the pressure regulator inside the Serinus Cal 300 until the O3 gen flow displays 100 sccm +/- 1 sccm on the home screen. After adjusting the O3 gen flow, run the Pump Adjust routine. This routine will automatically enable the internal pump if it was disabled, then return the enabled/disabled setting to its prior state when done. The routine sets the pump pot to 30, then moves up until the desired Diluent and O3 Generator flow is achieved when

	set to 5 slpm. This typically takes about 2 minutes. As new, the Pump control speed pot will be around 80.

3.5.29 Valve Menu

Main Menu → Service Menu → Diagnostics Menu → Valve Menu

The Valve Menu allows the user to observe the instrument-controlled switching of the valves. If the valve is On it means the valve is energised. When a three way valve is in the On state the NC (normally close) port will be open and the NO (normally open) port will be closed. When the valve sequencing is disabled the user has the ability to turn the valve Off and On manually. It is recommended that the valve menu be used by a trained technician following the plumbing schematic (refer to Section 9.5).

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

Valve Sequencing	When **Enabled** the valves will open and close under instrument control (even if you have manually opened or closed a valve). When **Disabled** the valves will change only in response to manual controls.
V4: Audit	Shows the status of the audit valve. When the valve is on, the calibrator is in audit mode ready for an external O_3 source. When the valve is off it utilises the internal O_3 generator supply.
V8: Photometer	Shows the status of the photometer valve. When the valve is off the photometer is sampling reference air and when the valve is on the photometer is sampling ozone.
V13: Internal Diluent	Shows the status of the dilution selection valve. When the valve is on the diluent is sourced internally. When the valve of off the diluent is sourced from an external source.
Diluent Supply	This output can be used to automatically turn on the diluent supply when it is required.
Internal Diluent Pump	Shows the status of the internal diluent pump allowing the user to turn the pump on and off when required.

3.5.30 Tests Menu

Main Menu → Service Menu → Diagnostics Menu → Tests Menu

Screen Test	Performs a screen test by drawing lines and images on the screen so that the operator can determine if there are any faults in the screen. Press a keypad key to step through the test. The up and down scrolling buttons will adjust the contrast.
Digital Input Test Menu	Refer to Section 3.5.31.
Digital Output Test Menu	Refer to Section 3.5.32.

3.5.31 Digital Input Test Menu

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

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

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

3.5.32 Digital Output Test Menu

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

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

Automated Test	Steps through each output, turning it on and off.
Output 0..7	Displays the state of the output pin (**ON** or **OFF**), and allows the user to manually set the state.

3.5.33 Calculation Factors Menu

Main Menu → Service Menu → Calculation Factors Menu

Instrument Gain	A multiplication factor used to adjust the concentration measurement to the appropriate level (set at calibration).
Zero Offset O3	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 correction factor calculated from the background cycle (used to eliminate background interferences).
PTF Correction O3	Displays the correction factor applied to the concentration measurement. This correction is for changes in pressure, temperature and flows since the last calibration.
Noise	The standard deviation of the concentration. The calculation is as follows: ▪ Take a concentration value once every two minutes. ▪ Store 25 of these samples in a first in, last out buffer. ▪ Every two minutes, calculate the standard deviation of the current 25 samples. This is a microprocessor-generated field and cannot be set by the user. **Note**: This reading is only valid if zero air or a steady concentration of span gas has been supplied to the instrument for at least one hour.

3.5.34 Communications Menu

Main Menu → Communications Menu

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

Data logging Menu	Refer to Section 3.5.35.
Serial Communication Menu	Refer to Section 3.5.36.
Analog Input Menu	Refer to Section 3.5.37.
Analog Output Menu	Refer to Section 3.5.38.
Digital Output Menu	Refer to Section 3.5.39.
Network Menu	Refer to Section 3.5.40.
Bluetooth Menu	Refer to Section 3.5.41.

3.5.35 Data Logging Menu

Main Menu → Communications Menu → Data Logging Menu

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

Data Log Interval	Displays the interval at which the data is saved to the USB memory stick. Selecting **1 sec** interval may result in occasional measurements not being logged or slow response to serial commands.
Data Log Setup –Numeric	Numeric list of the parameters logged. This is a quicker way to enter parameters (for lists of parameters refer to Table 37).
Data Log Setup –Text	Select the list of logged parameters by name.

3.5.36 Serial Communication Menu

Main Menu → Communications Menu → Serial Communications Menu

Serial ID	This is the ID of the analyser when using Multidrop RS232 communications. This ID can be changed to support multiple instruments on the same RS232 cable. The default is 0 for the Serinus Cal 300.
Bayern-Hessen Serial ID [Bayern-Hessen Protocol]	This is the Bayern-Hessen ID used by the Bayern-Hessen Protocol.
O3 ID [Bayern-Hessen Protocol]	This is the ID of the O_3 gas used by the Bayern-Hessen Protocol.
Service port (RS232 #1) Multidrop port (RS232 #2)	The port parameters below are repeated for each serial port.

Serial Delay	Some older communications systems require a delay before the analyser responds to a serial command. Enter the number of milliseconds of delay required here (0-1000). The default is 0, meaning the analyser responds as quickly as possible to any serial request.
Baudrate	Sets the baud rate for this serial port (**1200**, **2400**, **4800**, **9600**, **14400**, **19200**, **38400**, or **115200**).
Protocol	Sets the protocol used for this serial port (**Advanced**, **ModBus**, **EC9800**, **Bayern-Hessen** or **GasCal**). This must be set to **Advanced** for Ecotech supplied software.
Endian [Modbus Protocol]	Select **Little** or **Big** endian mode for ModBus protocol.

3.5.37 Analog Input Menu

Main Menu → Communications Menu → Analog Input Menu

The Serinus Cal 300 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 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	The sections below are repeated for each analog input.
Multiplier	The input voltage will be multiplied by this number. For example, if a sensor has a 0-5 V output for a temperature of –40 °C to 60 °C, the multiplier would be (60-(-40))/5 = 20.
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.
Reading	The current reading from the input voltage, after the multiplier and offset has been applied. This is the value that is logged or reported as parameter 199-201 via USB or serial requests.

3.5.38 Analog Output Menu

The Serinus Cal 300 has one available analog output, called Channel 1 (or sometimes AO1) on screen and is linked to AO1 on the rear panel 25 pin connector. Refer also to Figure 35.

Main Menu → Communications Menu → Analog Output Menu

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

Channel 1	Channel 1 as default will be setup to be Parameter 50, which is O3 instantaneous reading. This Channel can be user defined to any of the available parameters (for a list of parameters refer to Table 22.
Name	Text list of user selectable parameters defined to output through the analog output (for a list of parameters refer to Table 22). Channel 1 on screen = AO1 on the 24 pin connector.
Parameter	Numeric list of user selectable parameters defined to output through the analog output. This is a quicker way to enter parameters (for a list of parameters refer to Table 22). Channel 1 on screen = AO1 on the 24 pin connector.
Min Range	Sets the lower range limit (in concentration units). This is the value at which the analog output should be at its minimum. For example, 4 mA for a 4 to 20 mA current output.
Max Range	Sets the upper range limit (in concentration units). This value can be edited but cannot exceed the **Over Range** value. This is the value at which the analog output should be at its maximum. For example, 20 mA for a current output.
Over-Ranging	Set to **Enabled** or **Disabled** to turn the over-ranging feature on or off.
Over-Range **[Over-Ranging Enabled]**	This field is only visible when **Over-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 the used for the analog output when over-ranging is active and enabled. When 90 % of the standard range is reached, this over range is automatically entered. When 80 % of the original range is reached, it returns to the original range.

3.5.38.1 Analog Output Menu - Voltage

Main Menu → Communications Menu → Analog Output Menu

These items appear when **Output Mode** is set to **Voltage**.

Voltage Offset	Choices are **0 V**, **0.25 V**, 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.
0.5V 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.
5.0V Calibration	Enables the user to calibrate the analog output at maximum output (5 V). Increase/decrease the value until the connected equipment reads 5 V.

3.5.38.2 Analog Output Menu - Current

Main Menu → Communications Menu → Analog Output Menu

These items appear when **Output Mode** is set to **Current**.

Current Range	Enables the user to set desired current ranges. Choices are **0-20 mA**, **2-20 mA** or **4-20 mA**.

4mA Calibration	Enables the user to calibrate the current output at a low point. Increase/decrease the value until the connected equipment reads 4 mA.
20mA Calibration	Enables the user to calibrate the current output at a full scale point (20 mA). Increase/decrease the value until the connected equipment reads 20 mA.

3.5.39 Digital Output Menu

Main Menu → Communications Menu → Digital Output Menu

The digital outputs are shared among digital alarms and point and sequence definitions. A digital output that is designated as a digital alarm will display an **R** instead of a **0**, **1**, or **X** in the digital mask.

Idle Mask	This is the state of the digital outputs when the instrument is **IDLE**. When the instrument is running a point or sequence, the digital output masks for the point, sequence, and digital alarms will be combined (OR operation) with this pattern (any bit that is a 1 in either this mask, the point mask, the sequence mask, or the a digital alarm will be set to 1).
DO N (Pin X)	Associates a state with a digital output. There are 8 digital outputs (the pin numbers are for the 25-pin connector). Each one can have one of the associated states listed in Table 3 – Digital Output States. The pin will be driven high while the analyser is in that state. If a pin is set to anything other than **Disabled**, that pin will not be available for point or sequence masks.
Active	Each pin can be set to be active **High** or **Low**. Active High means that the pin will be pulled to 5 V when the associated event occurs. Active Low means the pin will be pulled to 0 V when the associated event occurs.

Table 3 – Digital Output States

Digital Output State	Description
Disabled	No state (this output is never set high).
Pwr Supply Fail	Power supply fault.
Ref Volt. Fail	Reference voltage fault.
A2D Fail	Analog to digital fault.
Lamp Fail	Lamp fault.
Flow Fail	Photometer flow fault.
Flow Heat Fail	Flow block heater fault.
Lamp Heat Fail	Lamp heater fault.
Chassis Tmp Fail	Chassis temperature fault.
USB Disconnected	The USB memory stick is disconnected.
Background	Performing a background.
Span	Performing a span check.

Digital Output State	Description
Zero	Performing a zero check.
System Fault	Any system fault (the red light is on).
Diluent Flow Fault	A diluent flow fault.
Maintenance Mode	User has activated maintenance mode.
Over Range AO 1	Over range for analog output channel 1 (AO1 on 25 pin connector) is active.

3.5.40 Network Menu

Main Menu → Communications Menu → Network Menu

The **Network Menu** only appears when the **Network Port** is enabled (refer to **Hardware Menu**, Section 3.5.45). The Network Menu allows the user to view or set the I.P. address, Netmask and Gateway if the optional network port is installed.

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). Note that at this time the instrument does not validate the correctness of these entries. When you cycle power, the instrument will first instruct the network port on its new address. It will switch to **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 instrument an IP address.
IP Address **[Read or Set mode]**	This is the current IP address of the instrument.
Netmask **[Read or Set mode]**	This is the subnet mask of the network the instrument is connected to.
Gateway **[Read or Set mode]**	This is the IP address of the router to access addresses not on the same subnet.
Adaptor is in DHCP mode **[DHCP mode]**	In this mode the instrument will ask for its network parameters from a DHCP server on your network.
Protocol	Sets the protocol used for the network port (**Advanced**, **ModBus**, **EC9800**, **Bayern-Hessen** or **GasCal**). This must be set to **Advanced** for Ecotech supplied software.
Endian **[Modbus Protocol]**	Select **Little** or **Big** endian mode for ModBus protocol.

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.

3.5.41 Bluetooth Menu

Main Menu → Communications Menu → Bluetooth Menu

Serinus Cal instruments support Bluetooth communication through the Serinus Remote Android Application (refer to Section 4.7).

Note: If the user has security concerns about the Bluetooth, it can be disabled by disconnecting the ribbon cable connecting the Bluetooth module to the main controller PCA. This will disable the Bluetooth and remove the Bluetooth menu item from the communications menu after a power cycle.

Bluetooth	This field indicates whether the instrument is remotely connected to an Android device.
Reset	After changing the ID or PIN, it is necessary to reboot the Bluetooth module. This is done by resetting the instrument or by using this menu item to reboot only the Bluetooth.
ID	This is the Bluetooth ID of the instrument. Use the keyboard to edit this field (refer to Section 3.3.1 for instructions on entering text with the numeric keypad). 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.

3.5.42 Trend Display Menu

Main Menu → Communications Menu → Trend Display Menu

Parameter	Allows the user to select a parameter from 0 – 254 to graph on the trend display.
Name	Displays the name of the **Parameter** the user has selected.
Autoscale	Autoscale can be on or off. When it is “On” the parameter will be scaled automatically for user convenience based on the current values logged.
Min	This is the minimum scale of the chart as defined by the **Autoscale** or the user.
Max	This is the maximum scale of the chart as defined by the **Autoscale** or the user.
Clear	Clears the current data points in the **Chart**.

Data Log Interval	The data log interval can be user set from 1 sec interval up to 24 hours.
Chart	This field enters a screen with a graph of the user selected **Parameter** (Refer to Section 3.5.43).

3.5.43 Chart

Main Menu → Communications Menu → Trend Display Menu → Chart

The chart allows the user to select a parameter and view it in a real time chart. The user can select from the 254 parameters available (refer to Table 37). Changing the logged parameter will reset the chart. However, up to the first four Instantons gas and Ozone values are always memorized. Changing the Data Log Interval resets all charts.

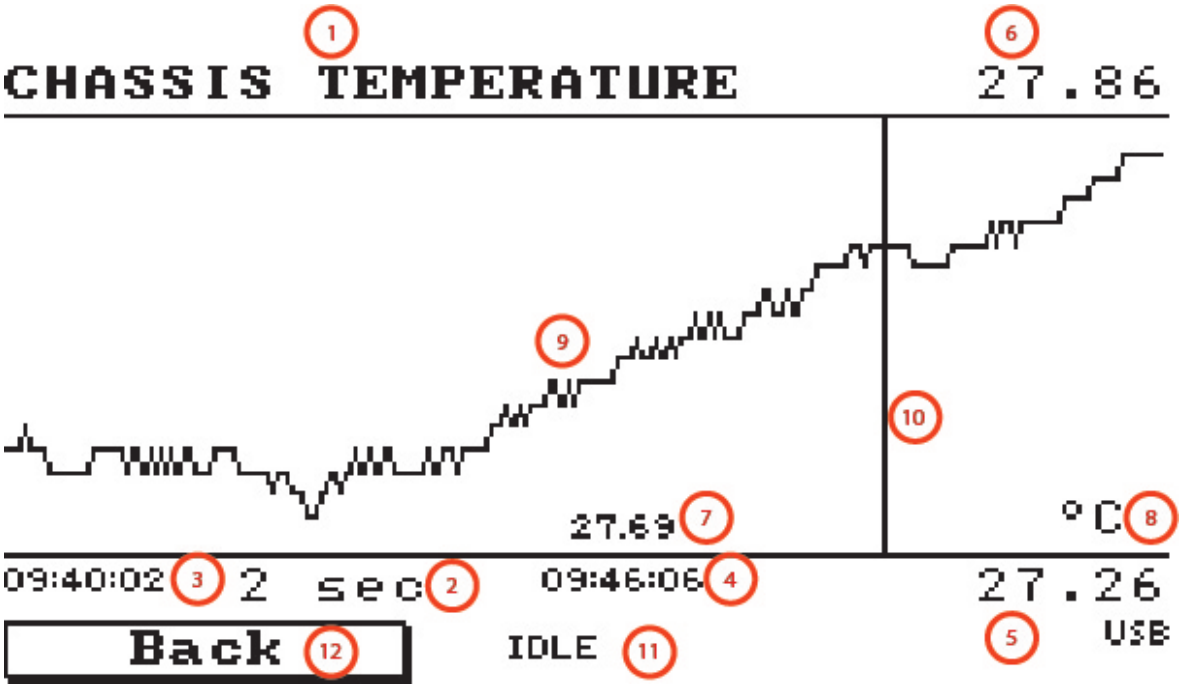

Figure 26 – Chart Screen

Chart Title (1)

Displays the name of the parameter as it would be displayed on the advanced protocol parameter list.

Data Log Interval (2)

Displays the value of the data logging interval as determined by the user in the Trend Display Menu (refer to Section 3.5.42).

Chart X-Axis (3 & 4)

(3) Displays the time stamp for the oldest data point (left hand side).

(4) Displays the time stamp for the newest data point (right hand side) or if the cursor is active it displays the current cursor data point time stamp.

Chart Y-Axis (5 & 6)

(5) This is the minimum scale as defined by the autoscale or the user (refer to section 3.5.42).

(6) This is the maximum scale as defined by the autoscale or the user (refer to section 3.5.42).

Current Data Point Value (7)

Displays the current value of the newest data point unless the **cursor** is active then is displays the current cursor data point value.

Units (8)

Displays the units of measure for the parameter that the user has selected.

Data Points (9)

Displays the last 240 data points recorded for the selected parameter.

Chart Cursor (10)

If the user wishes to know the value at any at a particular data point on the chart, the cursor can be used. The cursor is activated by pressing the (-) key on the keypad and is represented by a vertical line on the chart. The cursor can be moved left or right by the (-) or (+) key respectively. This cursor location now represents the current data point value of interest. The cursor will stay with the chosen data point and move with the updating chart. When the cursor finally hits the end of the chart it deactivates and the current data point value will now be the latest data point entering the chart.

Mode (11)

This Field indicates the mode the instrument is currently running.

Back (12)

Pressing back allows the user to access other menu items while the chart is still logging in the background.

Digital Output State	Description
Left Selection Button	Returns the user back to the trend display menu.
Scrolling Buttons	Using the scrolling buttons will cycle through the user selected parameter as well as any default gas(es) currently logging.
- Button	Pressing the (-) button will bring up the cursor and move it to the left.
+ Button	Pressing the (+) button will move the cursor to the right. When the cursor moves all the way to the right due to the chart moving it will deactivate.

3.5.44 Advanced Menu

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

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

Language	Select a language.
Hardware Menu	Refer to Section 3.5.45.
Service Displays	When set to **On**, new items appear on many different menus. These fields are for diagnostic and service personnel only. Default is **Off**.
Next Service Due	Enter the next service due date.
Jump to Next State	Move to the next mode (for example, from fill to measure). This command is most commonly used to force an instrument out of warm-up early.
Parameter Display Menu	Refer to Section 3.5.47.
Reset to Factory Defaults	Reset the configuration to factory defaults. This will erase all calibrations and user configuration information.
Rebuild Index	If a data log becomes corrupted it may be possible to restore It by rebuilding its index file. This command will ask you to specify a month and will rebuild the index for that month. This operation can take many minutes and it should not be interrupted. While the file is rebuilding any data logging will be suspended.

3.5.45 Hardware Menu

Advanced Menu → Hardware Menu

This menu contains factory hardware installations. If you reset to factory defaults you may need to revisit this menu to re-install optional features.

Model	Select the instrument model. Normally this only needs to be reset when the configuration is corrupted. The selections available will depend on licensing. It is not recommended to run an instrument with firmware set to an incorrect model.
Front Panel Style	Choosing the incorrect front panel will result in the traffic lights behaving inconsistently. Default is **Aluminium**.
Network Port	The instrument has a network port. Default is **Disabled**.
Orifice Size	Specify the input orifice for the calibrator. Note that unlike the Serinus line of analysers, the Serinus Cal 300 uses both an orifice and an internal pump. Default is **0.3**.
Analog Dew Point	The instrument has a diluent Dew Point option installed. Default is **Disabled**.
Ozone Lamp	Specifies the type of lamp used in the ozone generator. Default is **Standard**.
MFC Installation Menu	Refer to Section 3.5.46.
Shielded Bench	The instrument has a shielded bench. Default is **Enabled**.

3.5.46 MFC Installation Menu

Advanced Menu → Hardware Menu → MFC Installation Menu

Select an MFC by capacity (i.e. **5000 SCCM**) from the list of supported capacities. When an MFC is selected, the polynomials for its calibration will be displayed along with its corresponding readout calibration.

MFC Diluent	The primary diluent MFC.
Coeff. A0	Co-efficient for MFC.
Coeff. A1	Co-efficient for MFC.
Coeff. A2	Co-efficient for MFC.
Readout Calibration	Each available MFC will have its own Correction Co-efficient for the MCF readout.
Coeff. A0	Co-efficient for Readout calibration.
Coeff. A1	Co-efficient for readout calibration.
Coeff. A2	Co-efficient for readout calibration.

3.5.47 Parameter Display Menu

Advanced Menu → Parameter Display Menu

Used to display a parameter in real-time on the screen (refer to Table 37 for a full list of parameters).

Data Parameter	Enter the advanced protocol parameter number.
Name	Displays the name of the selected parameter.
Value	Displays the current value of the selected parameter.

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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 a supported MS Windows operating system. 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 and Section 4.6 of this manual for details on setting up and communicating with the Serinus.

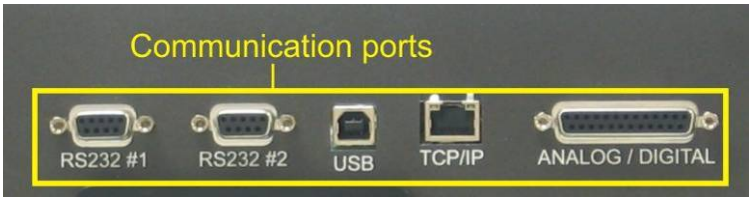

Figure 27 – Communication Ports

4.1 RS232 Communication

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

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

For reliable Multidrop RS232 communications please follow these guidelines:

- Verify that the Multidrop ID is set to a unique value which is different to the other analysers in the chain (refer to Serial Communication Menu, Section 3.5.36).
- All of the analysers in the multidrop chain must have the same baud rate and communication protocol settings. A maximum of 9600 baud is recommended.
- The Multidrop RS232 cable should be kept to less than 3 meters in length.
- A 12K ohm terminating resistor should be placed on the last connector of the cable. (Connect from pin 2 to pin 5 and from pin 3 to pin 5) (Refer to Figure 28).
- The shielding of the Multidrop cable must be continuous throughout the cable.
- The shielding of the Multidrop cable must only be terminated at one end. It should be connected to the metal shell of the DB 9 way connector.

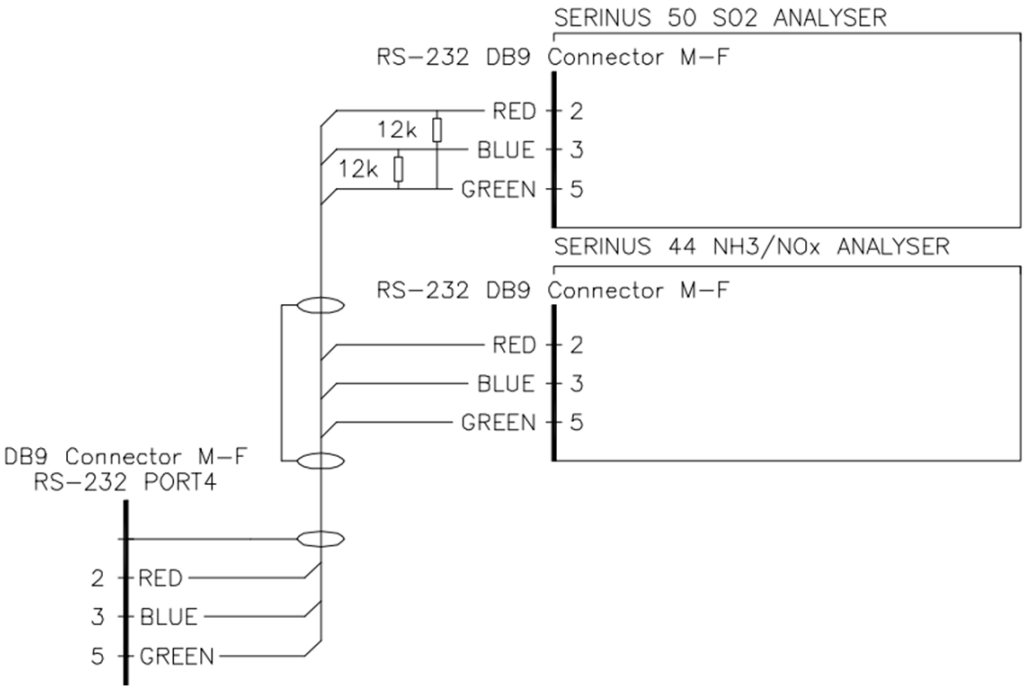

Figure 28 – Multidrop RS232 Cable Example

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.

Please note that only the Advanced protocol (refer to Table 37) is supported for USB communication.

4.3 TCP/IP Network Communication (optional)

Instruments with the optional network port installed can be accessed using a TCP/IP connection. Figure 29 shows examples of some possible configurations for remote access.

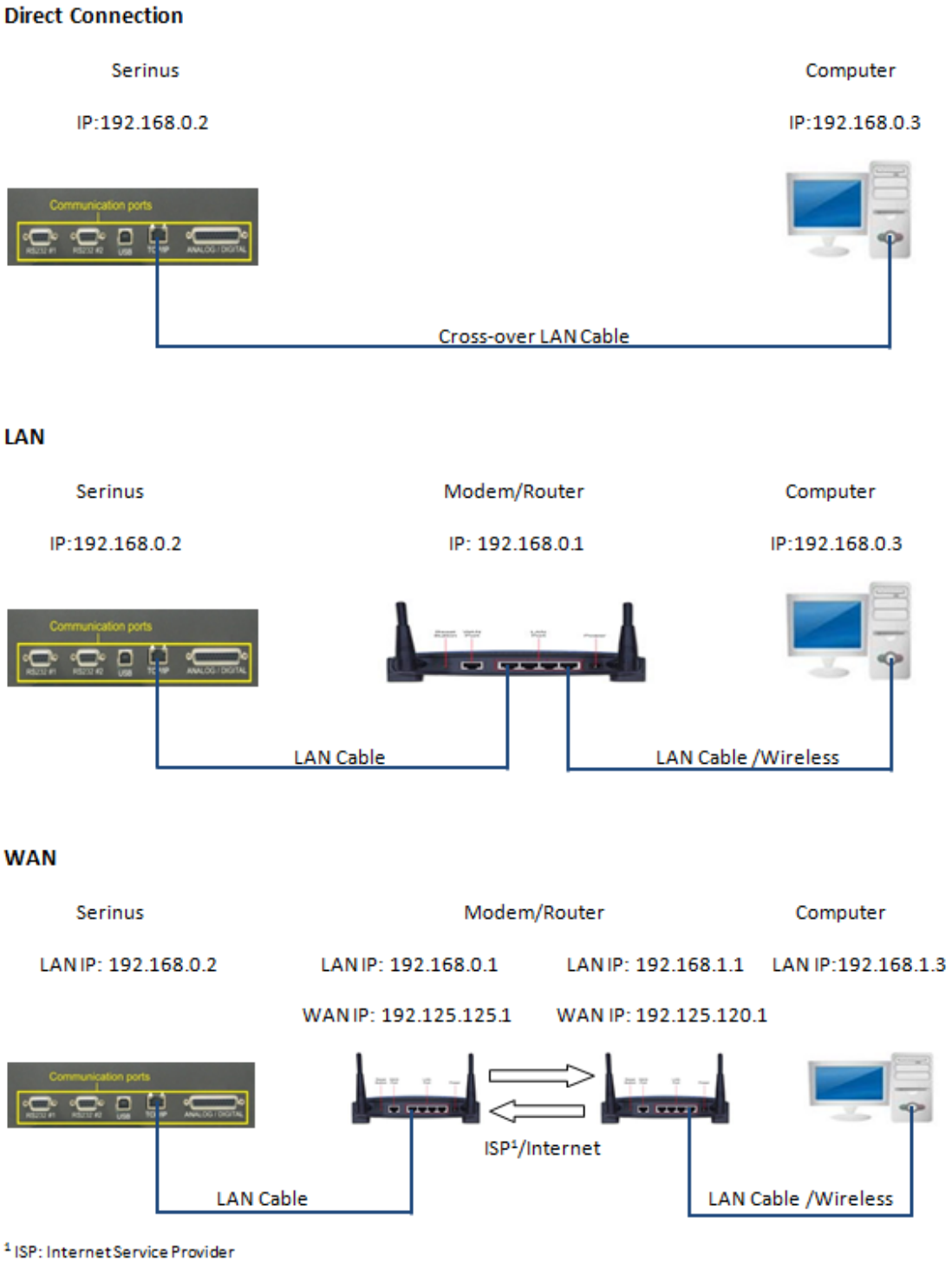

Figure 29 – Example of Typical Network Setups

Note: In Figure 29 all the IP addresses are taken as an example. The WAN IP addresses are normally provided by your ISP. Whereas, the LAN IP addresses can be set manually to any range which is within the subnet of the Modem/Router/switch.

Use a cross-over LAN cable to connect the instrument directly to a computer, or a standard LAN cable for connection to a Modem/Router/Switch as shown in Figure 29. The computer could be connected to the Modem/Router using either CAT5 cable or a wireless connection, but the instrument must be connected using CAT5/6 cable.

4.3.1 Network Setup

Below is an example of how to setup the network.

1. Open - **Main Menu → Communications Menu → Network Menu**.
2. Select - **Protocol → Advanced** - Accept.
3. Select - **Start-up Mode → Set IP -** Accept.
4. Edit - **IP Address** - (Change the IP address to the address you wish to use within the Modem/Router/switch subnet) **-** Accept.
5. Edit - **Netmask** - (Change the Netmask to the setup specified by the Modem/Router) **-** Accept.
6. Edit - **Gateway** - (Change the Gateway to the setup specified by the Modem/Router) **-** Accept.

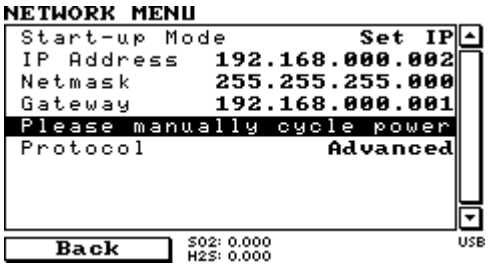

Figure 30 – Example of Network Menu Setup

Once completed, use the power switch on the rear of the instrument to turn the power off. Please leave the instrument off for 10 seconds before turning the power back on.

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

4.3.2 Port Forwarding on Remote Modem/Router Setup

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

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

Item	Protocol	Incoming Address	Incoming Port	Destination Address	Destination Port
1	tcp	0.0.0.0	32783 - 32783	192.168.0.2	32783 - 32783

Figure 31 – Port Forwarding Example

4.3.3 Airodis Setup to Communicate with Serinus

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

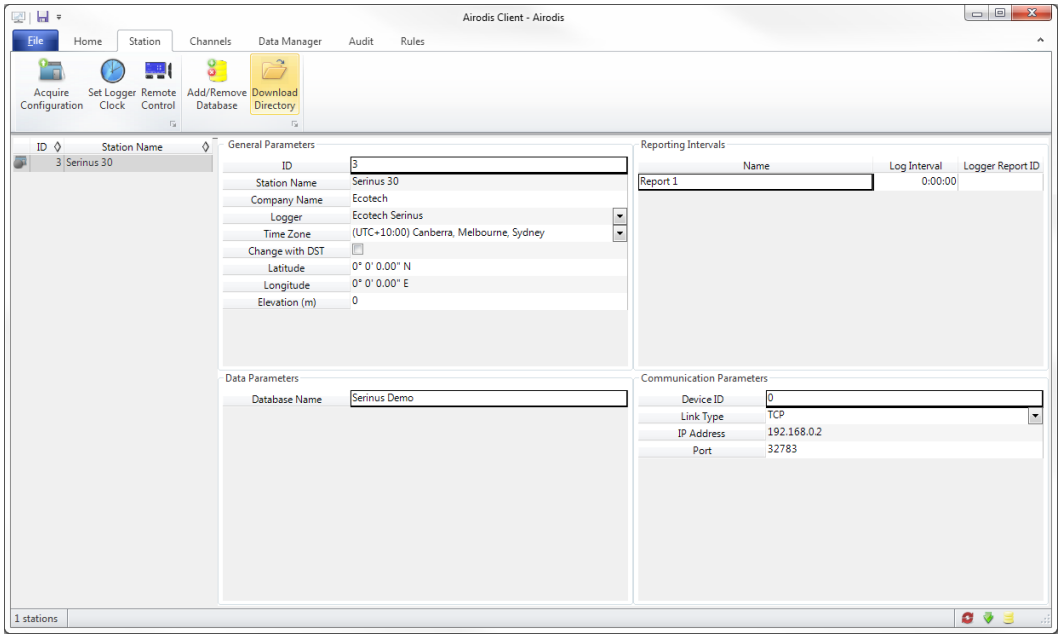

Figure 32 – LAN Network Set-Up (Airodis)

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

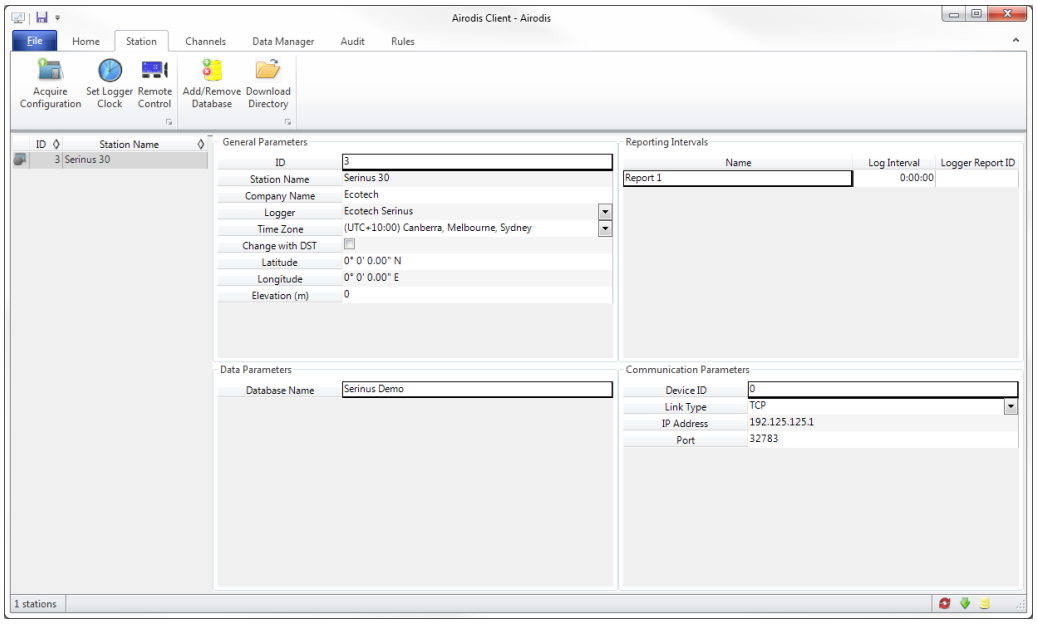

Figure 33 – WAN Network Set-Up (Airodis)

4.4 Digital/Analog Communication

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

4.4.1 Analog Outputs

The instrument is equipped with one analog output that can be set to provide either voltage (0-5 V, 0.25-5 V, 0.5-5 V, 0-10 V) or current (0-20, 2-20, 4-20 mA). The parameter that is sent to the analog output is user-selectable (refer to Section 3.5.38).

For 0-10 V analog output operation, set the output type to current and move the jumpers (JP3) on the rear panel PCA to 0-10 V (refer to Figure 34).

Table 4 – Analog Outputs

Analyser	Channel 0 (AO0)	Channel 1 (AO1)	Channel 2 (AO2)
Serinus Cal 300	N/A	User-Selectable	N/A

4.4.1.1 Analog Outputs Voltage Calibration

Equipment Required

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

Procedure

1. Open - **Main Menu → Communications Menu → Analog Output Menu** (refer to Section 3.5.38).
2. Select - **Output Mode → Voltage**.
3. Connect a multimeter (using an appropriate adaptor or probes on the multimeter) to the ground (pin 24) and the relevant output pin (pin 23).
4. Edit - **0.5V Calibration** - (until the multimeter reads 0.500 V ±0.002) - Accept.
5. Edit - **5.0V Calibration** - (until the multimeter reads 5.00 V ±0.002) - Accept.

4.4.1.2 Analog Outputs Current Calibration

Equipment Required

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

Procedure

1. Open - **Main Menu → Communications Menu → Analog Output Menu** (refer to Section 3.5.38).
2. Select - **Output Mode → Current**.
3. Connect a multimeter (using an appropriate adaptor or probes on the multimeter) to the ground (pin 24) and the relevant output pin (pin 23).

4. Edit - **4mA Calibration** - (until the multimeter reads 4 mA ±0.01) - Accept.
5. Edit - **20mA Calibration** - (until the multimeter reads 20 mA ±0.01) - Accept.

4.4.2 Analog Inputs

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



CAUTION

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

4.4.3 Digital Status Inputs

The instrument is equipped with eight logic level inputs (0 - 5 VDC CAT 1) for the external control of the instrument such as Zero or Span sequences. Each input has a terminating resistor which can be either PULL UP or PULL DOWN. This is set using the jumper JP1 on the back panel PCA (refer to Figure 34).



CAUTION

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

4.4.4 Digital Status Outputs

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

In the default jumper locations (refer to Figure 34) these two outputs will function normally as open collector outputs. If moved to the position closer to the 25 pin connector then the DO 0 will supply +12 V and DO 1 will supply +5 V.

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

Each digital output is limited to a maximum of 400 mA. The total combined currents should not exceed 2 A.

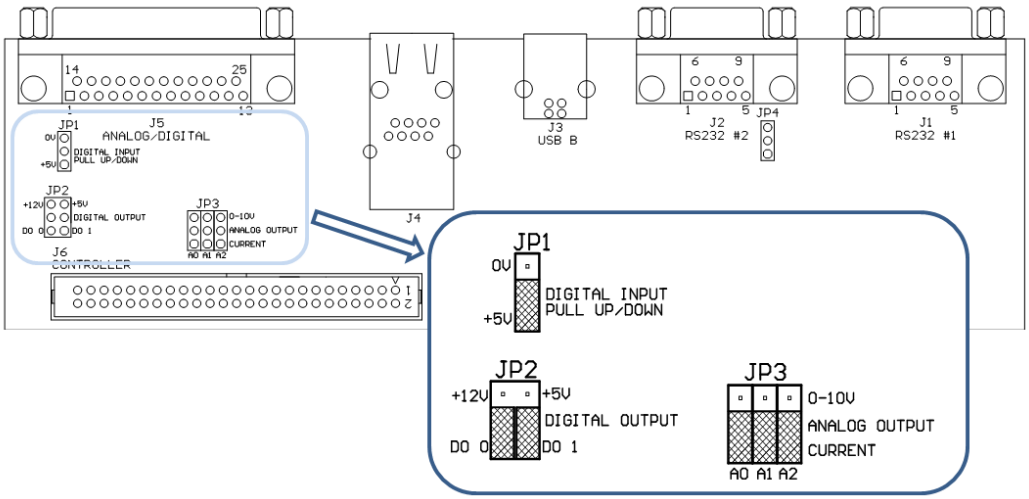

Figure 34 – 25 Pin Rear Panel PCA (Default Jumpers Highlighted)

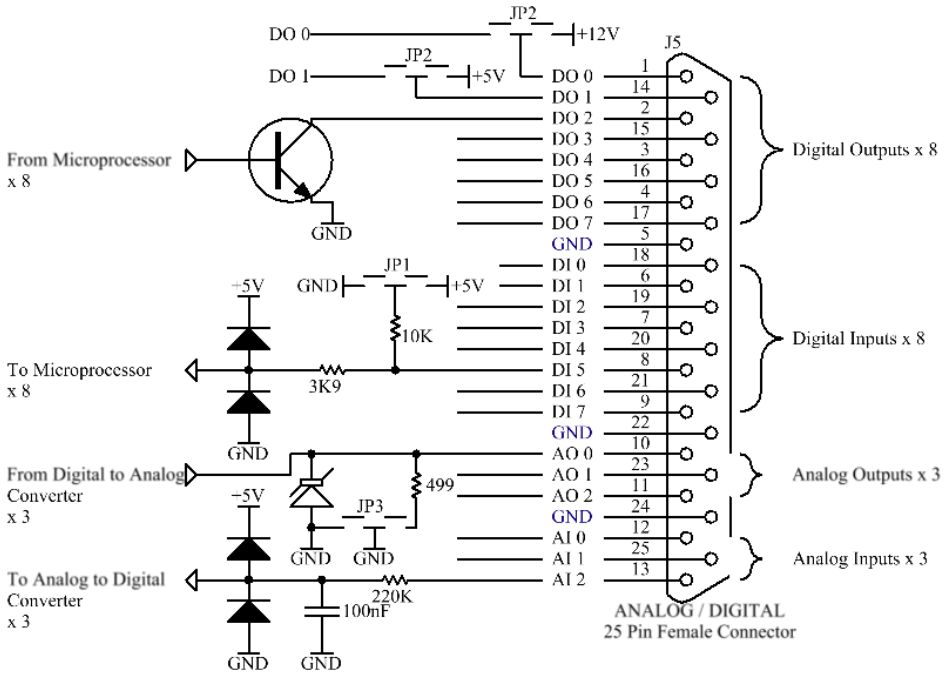

Figure 35 – External 25 Pin I/O Individual Pin Descriptions

CAUTION

The analog and digital inputs and outputs are rated to CAT I. Exceeding 12 VDC or drawing greater than 400 mA on a single output or a total greater than 2 A across the 8 outputs can permanently damage the instrument and void the warranty.

4.5 Logging Data

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

4.5.1 Configure Instrument Internal Logging

In order to log data, you must first specify a data logging interval. This is how often data will be logged to the USB memory stick. You can log a maximum of 12 parameters. These parameters can be selected by name or by parameter number using the parameter list (refer to Table 37).

Procedure

1. Open - **Main Menu → Communications Menu → Data Logging Menu** (refer to Section 3.5.35).
2. Select - **Data Log Interval** - (adjust to the desired value) - Accept.
3. Select - **Data Log Setup –Numeric** (select the parameter numbers you wish to log) **or** Select - **Data Log Setup –Text** (select the names of the parameters you wish to log).

4.6 Using Airodis Software to Download Data

4.6.1 Connecting the Serinus to your PC

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

4.6.1.1 Connecting over USB

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

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

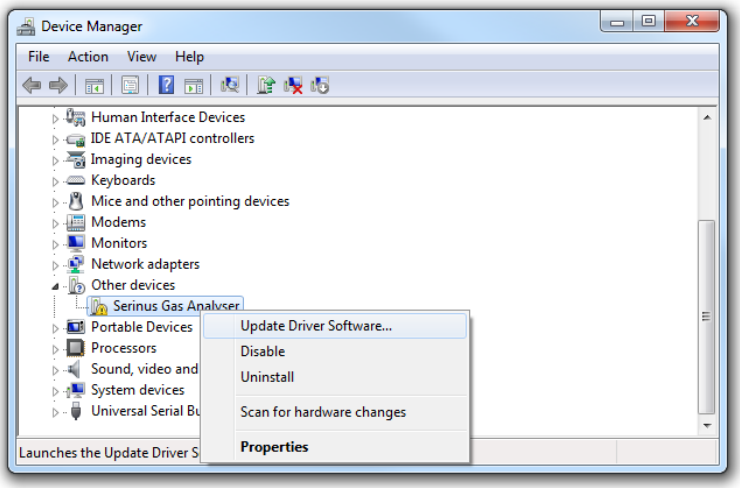

Figure 36 – Installing Driver Software (Device Manager)

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

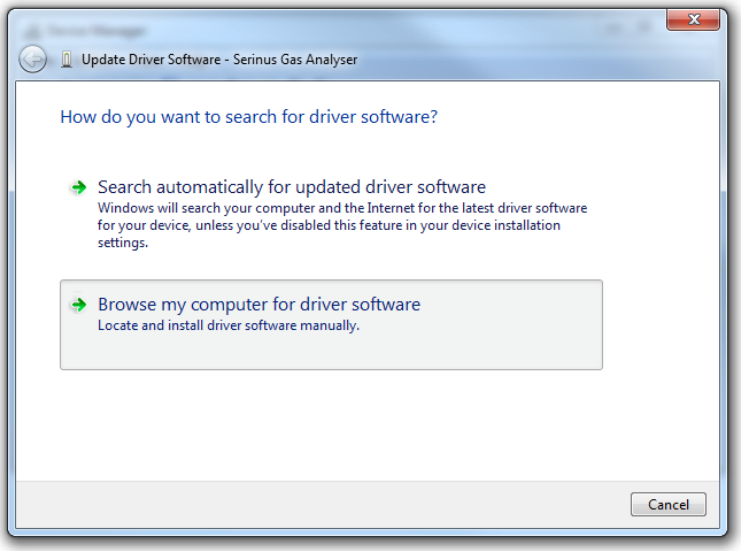

Figure 37 – Update Driver Popup

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

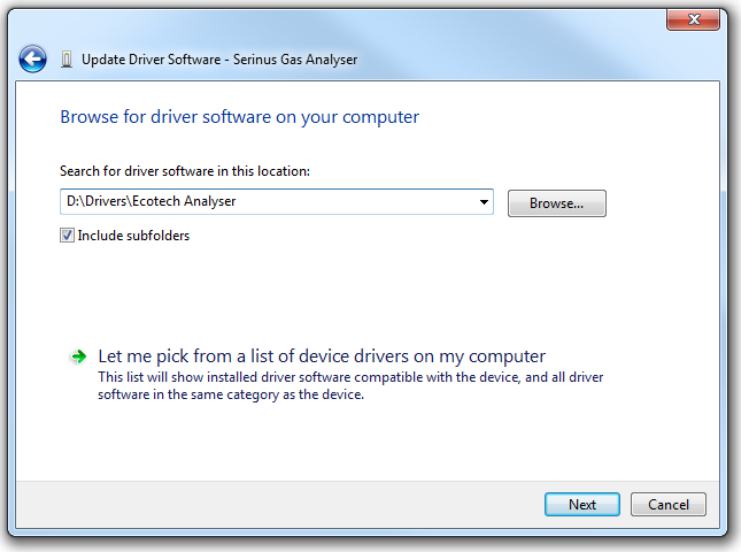

Figure 38 – Update Driver Popup (Directory Location)

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

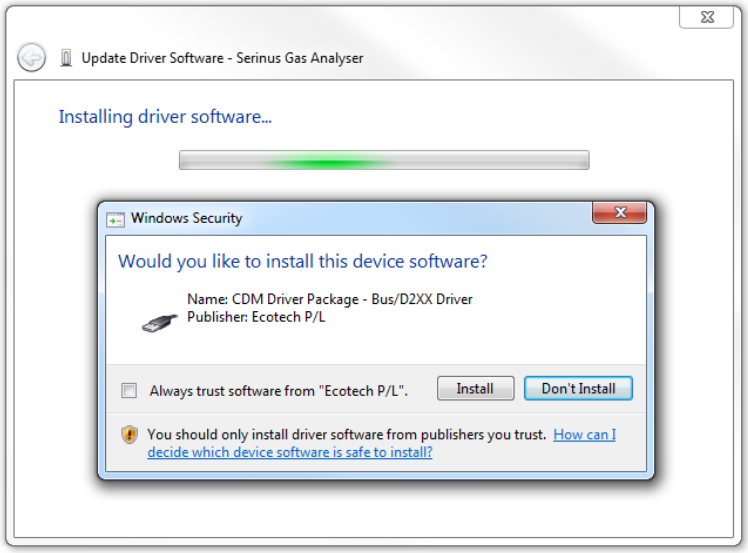

Figure 39 – Installing Driver Confirmation Prompt

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

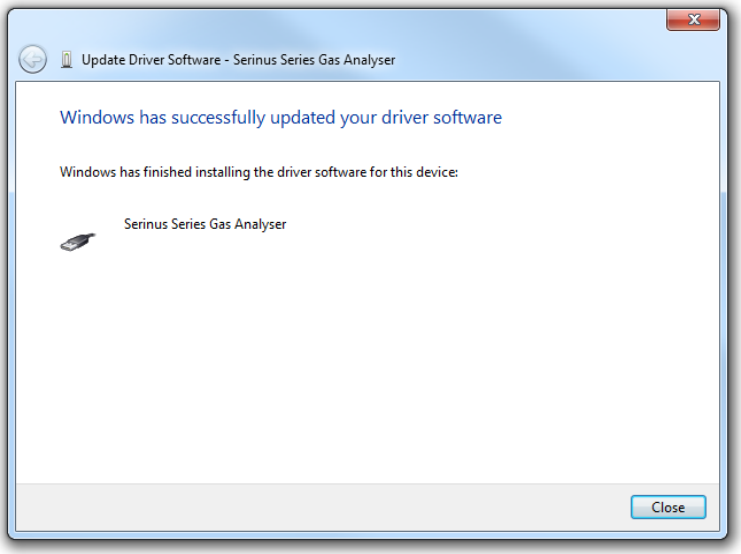

Figure 40 – Successful Driver Installation

4.6.1.2 Connecting over Serial (RS-232)

The following steps outline how to setup the instrument for connection to a PC or datalogger (refer to Section 3.5.36).

Procedure

1. Open - **Main Menu → Communication Menu → Serial Communication Menu**.
2. Determine which RS232 Port you are physically making the connection with. Remember, multidrop is only supported on RS232 #2.
3. Select - **Baudrate** → 38400 - Accept (Set an appropriate baud rate, default is 38400).
4. Select - **Protocol → Advanced** - Accept.

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

4.6.1.3 Connecting over Network (TCP/IP)

The following steps outline how to setup the instrument for connection to a PC or datalogger (refer to Section 3.5.40).

Procedure

1. Open - **Main Menu → Communication Menu → Network Menu**.
2. Select - **Protocol → Advanced** - Accept.
3. Select - **Start-up Mode → Set IP** - Accept.
4. Assign a unique static IP address to the instrument.
5. Reboot the instrument by cycling the power.

4.6.2 Installing Airodis

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

http://www.airodis.com.au

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

4.6.3 Configuring Airodis

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

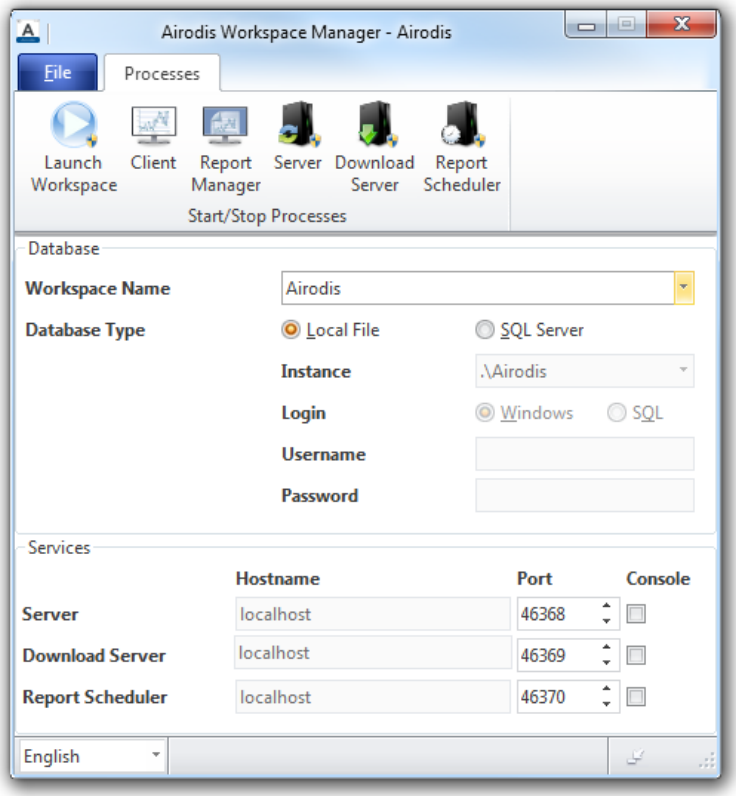

Figure 41 – Airodis Workspace Manager

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**.

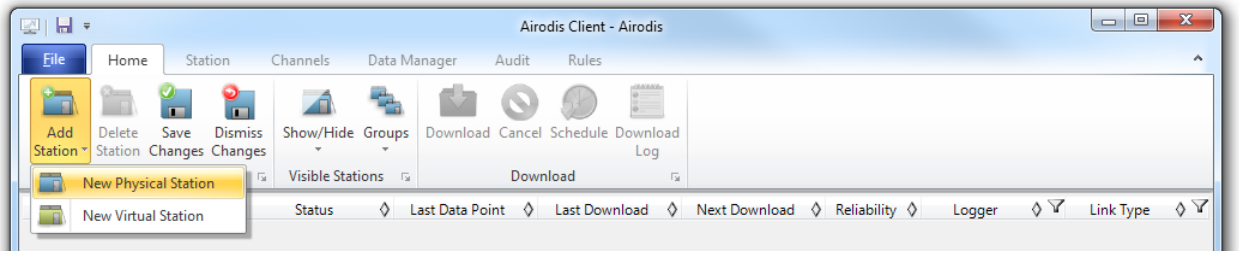

Figure 42 – Adding a New Station

4. This automatically brings you to the **Station** tab on the ribbon. Enter the communication details to connect to the instrument.

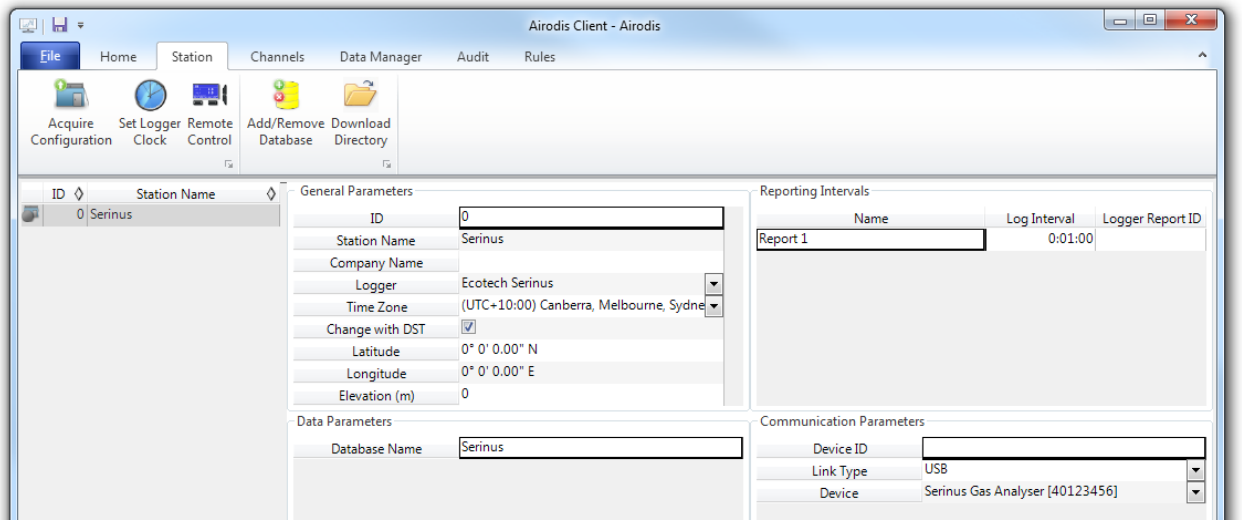

Figure 43 – Adding a New Station

Table 5 – 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 instrument via the Advanced protocol. If using a network or serial connection, ensure that the Advanced protocol has also been selected on the instrument itself.
Time Zone	Set this to the time zone that the instrument is located in.
DST	Enable this option if you plan on changing the clock on the instrument with daylight savings. Leave this disabled if the clock does not shift during DST. The instrument will need to be adjusted manually for DST – it will not happen automatically.
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 Serial ID of the instrument. If you are not using multidrop; this can be set to “0” or left blank.
Link Type	Select the type of connection used to connect to the instrument. Different properties will appear depending on the link type selected. Align these settings with those of the instrument.
Log Interval	This needs to be the same as the Data Log Interval setting on the instrument.

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

5. Once the station has been created, save the station by clicking the Save shortcut icon or **File→Save**.
6. Click Acquire Configuration. This will probe the Serinus for a channel list. After a few seconds, the channel list should be visible in the Channels tab.

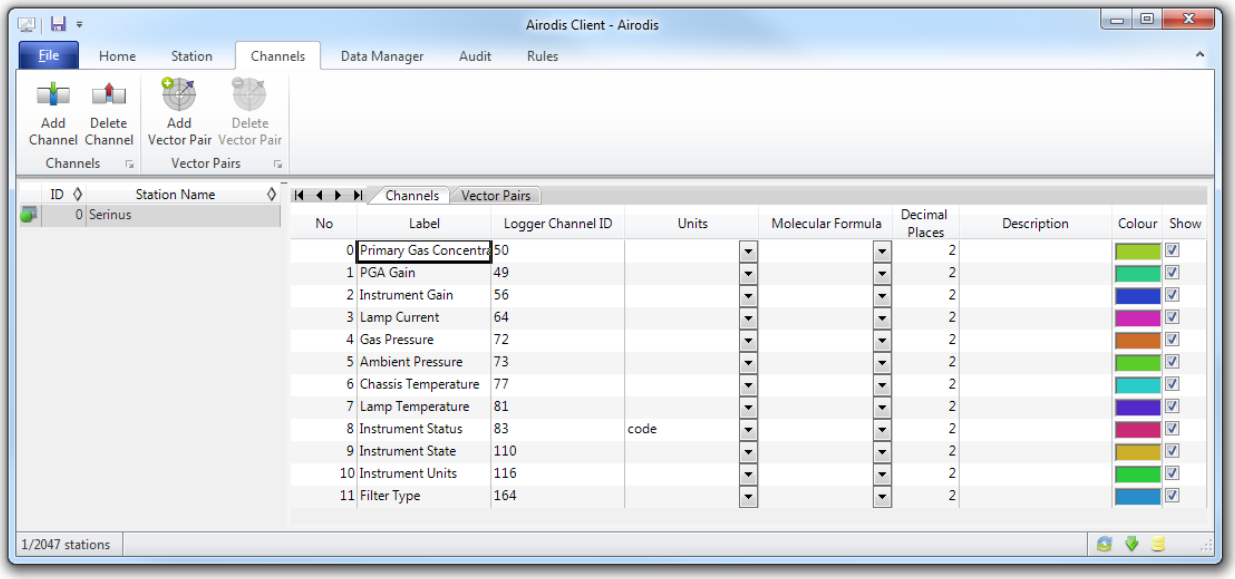

Figure 44 – Station Configuration (Channel List)

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.

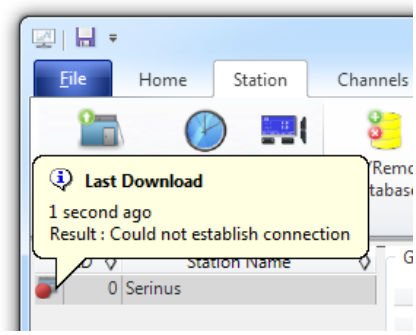

Figure 45 – Error Status Notification

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.

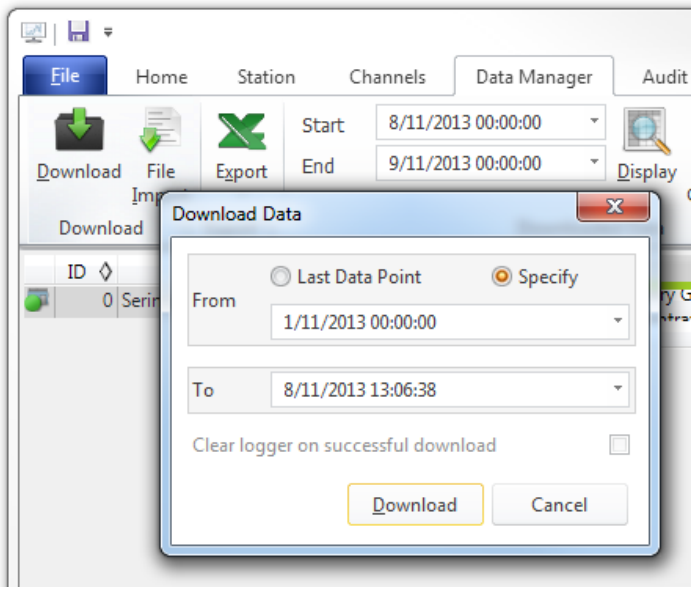

Figure 46 – Downloading Data

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.

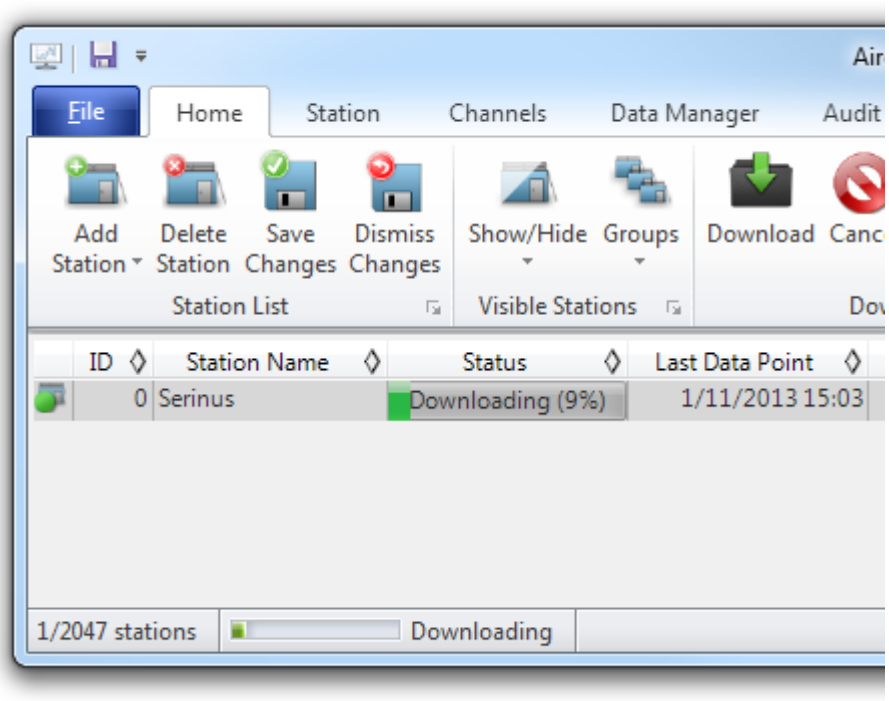

Figure 47 – Download Data Status

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 be loaded into the data manager.

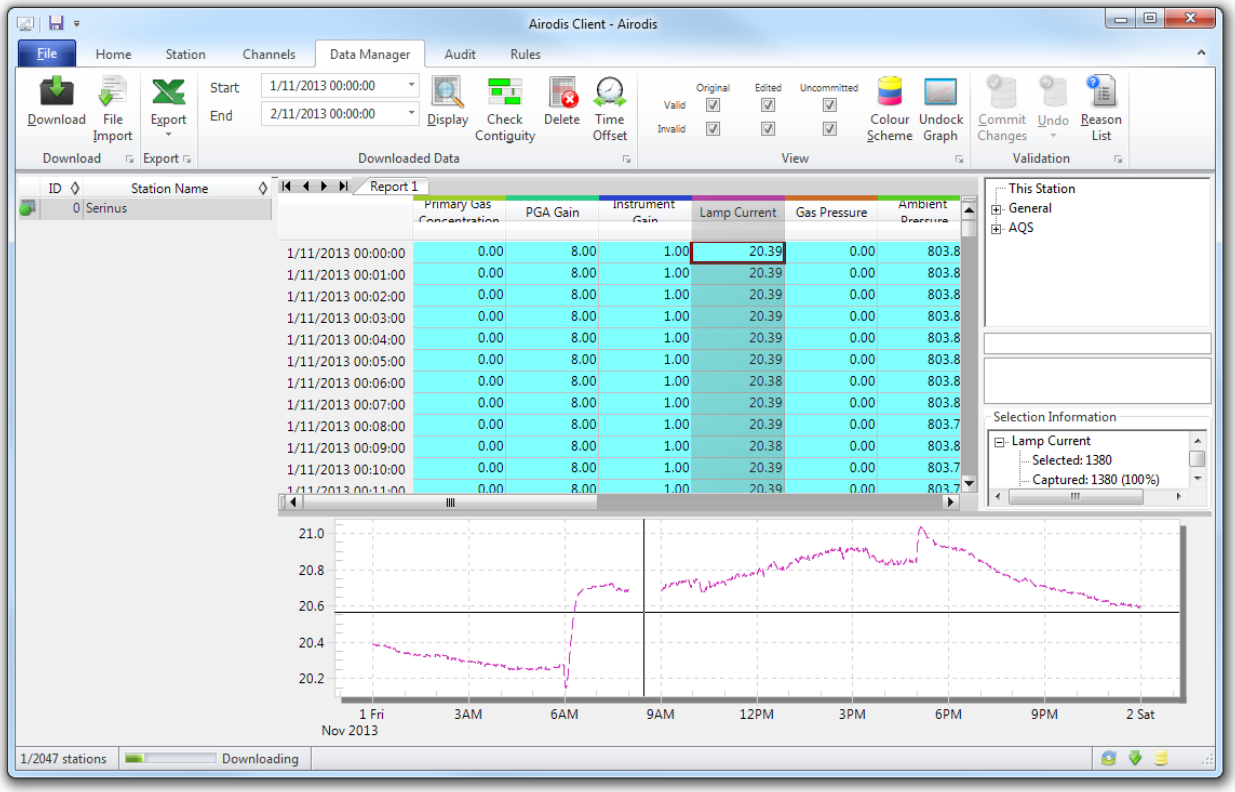

Figure 48 – Data Visibility

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

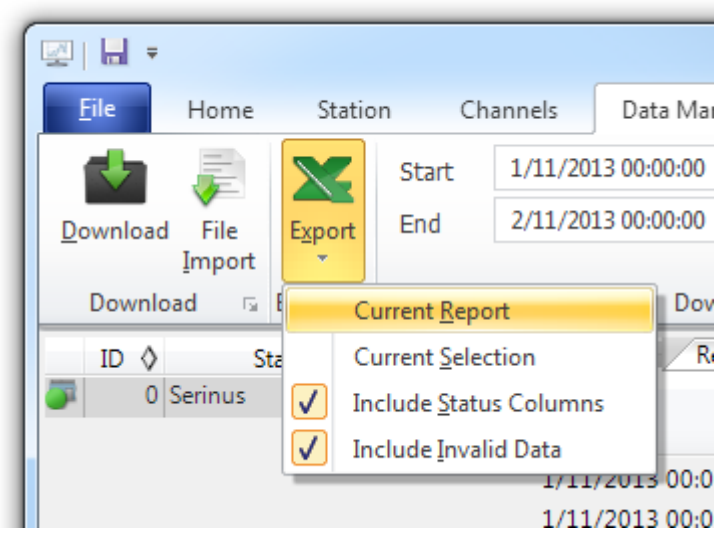

Figure 49 – Exporting Data

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

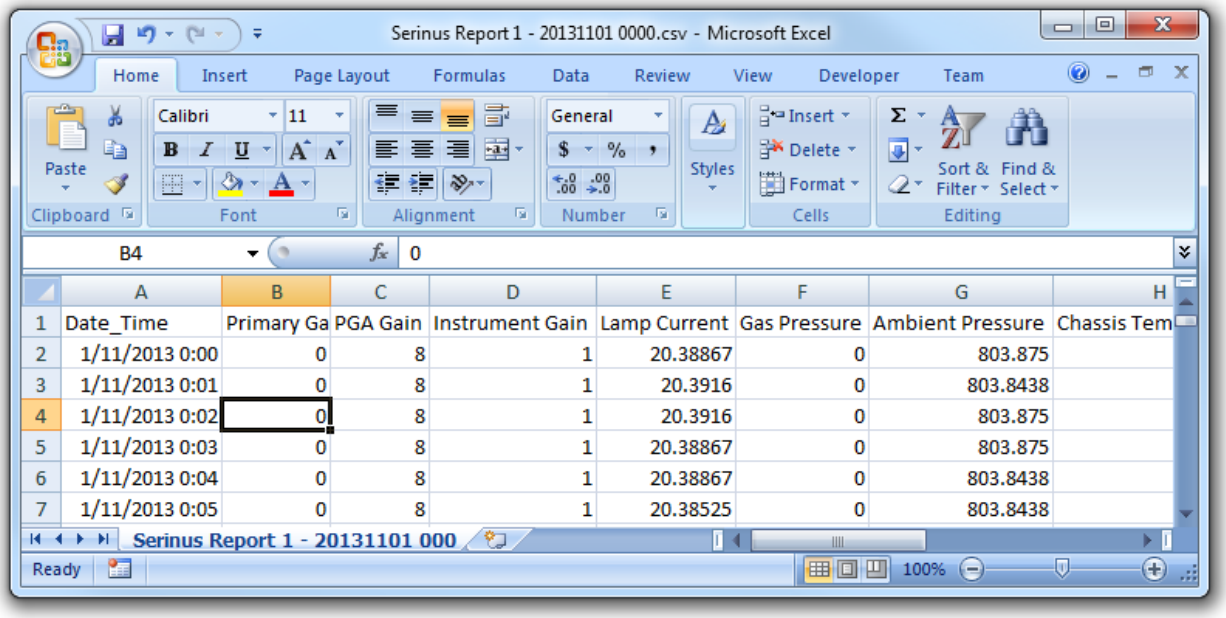

Figure 50 – Data Download Complete

4.7 Serinus Remote App/Bluetooth

The Serinus Remote Application allows for any Android device (Tablet or Smartphone) to connect to an instrument.

The Serinus Remote Application allows the user to:

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

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

4.7.1 Installation

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

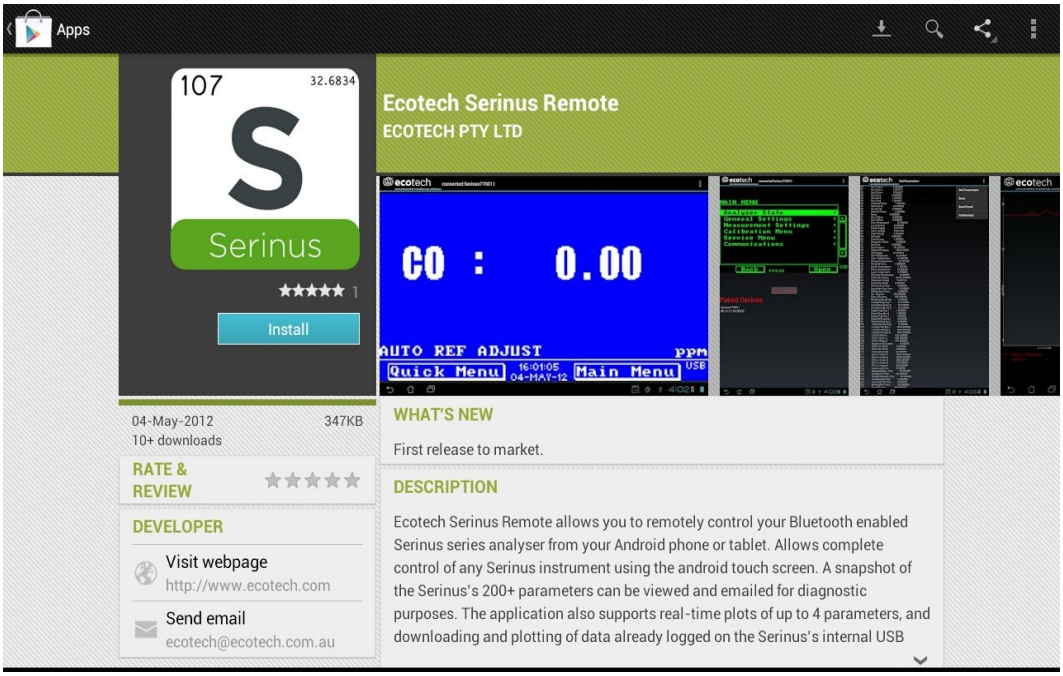

Figure 51 – Downloading the App from Google Play Store

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.

4.7.2 Connecting to the Instrument

Procedure

1. Open - **Main Menu → Communications Menu → Bluetooth Menu** (to find the Bluetooth ID and PIN) (refer to Section 3.5.41).
2. Touch the Scan Serinus Analysers button at the bottom of the screen.
3. Select the Analyser ID from either the Paired Devices or the Other Available.
4. Input the PIN (if prompted) and press OK (refer to Section 3.5.41).

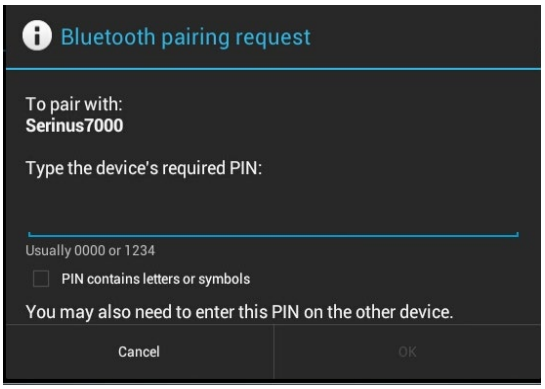

Figure 52 – Bluetooth Pairing Request

5. A screen shot of the instrument's current screen should appear on your Smartphone or tablet. To disconnect press the back key/button on the device.

Note: Once the instrument has been paired with the device it will appear under "Paired Devices" and the PIN will not need to be entered again. Only one Bluetooth connection can be made to an instrument at any one time.

4.7.3 Control Serinus Instrument

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

Remote Screen Operation

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

Home Screen

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

Menus

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

Right-hand Section of the Screen

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

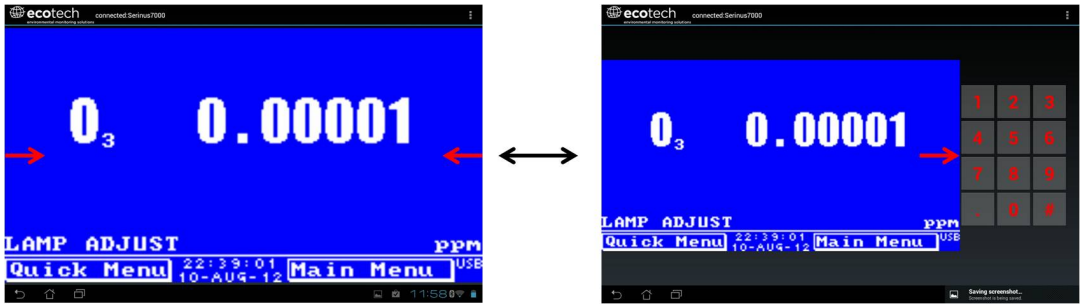

Figure 53 – Showing or Hiding the NumPad

Left-hand Section of the Screen

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

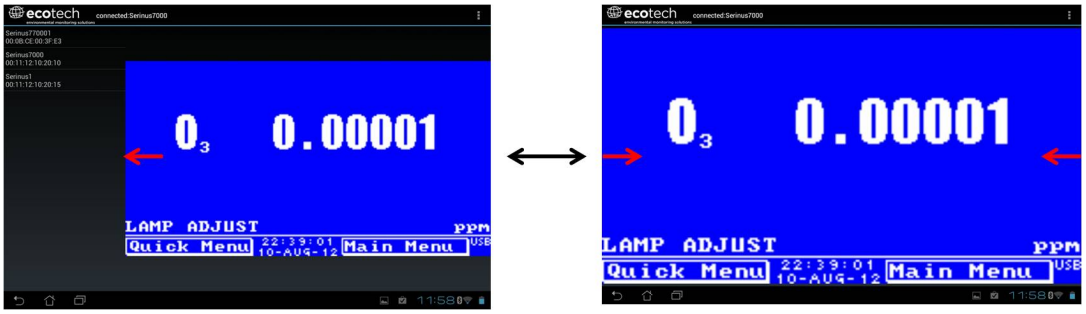

Figure 54 – Switching Analysis

Back Button

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

Options Menu

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

Table 6 – Options Menu

Refresh	Refresh the display.
Show/Hide NumPad	Show or hide the number pad.
Real Time Plot	Refer to Section 4.7.4.
Download	Refer to Section 4.7.5.
Get Parameters	Refer to Section 4.7.6.
Preferences	Refer to Section 4.7.7.

4.7.4 Real-Time Plot

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

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

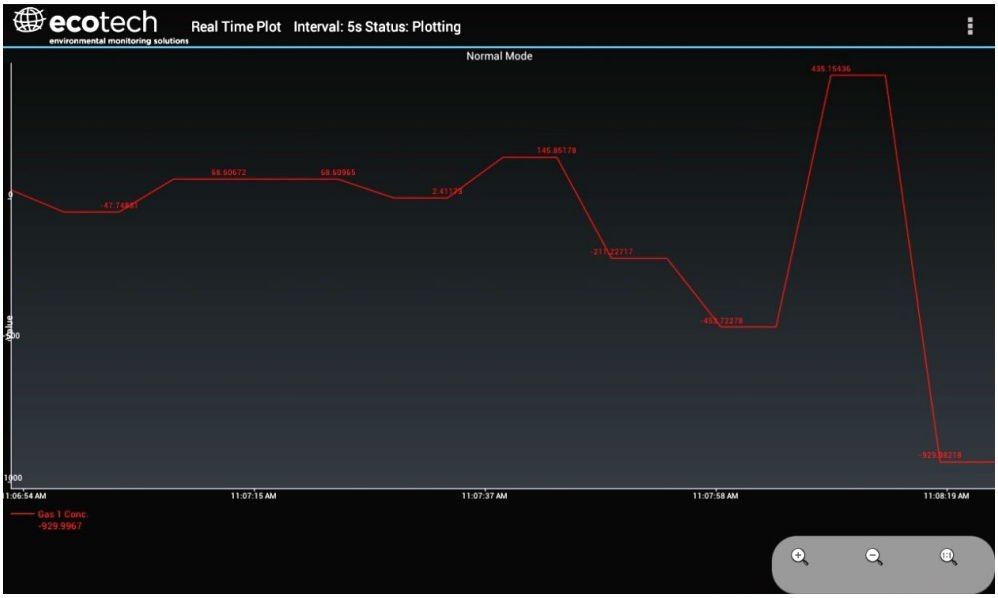

Figure 55 – Real-Time Plot

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 4.7.7). The user will also be asked whether they want to send the file and data via email. When saving the data, you can choose to **Save All Data** or **Customise** the length of the data by entering a time between five minutes and six hours. Only the data from the start of collection to that limit will be saved (although the plot will still appear exactly as it does on the screen).
Set Interval	While data collection is stopped, the user can specify the time intervals between collections.

4.7.5 Download

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

Options Menu

Save	Generates a filename based on the start and end date/time specified. It saves the downloaded data in the location specified in preferences and asks to send the saved comma separated text file (.csv) as an attachment to an email. This file format does not include the parameter headings, just the values.
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 56).
Preferences	Refer to Section 4.7.7.

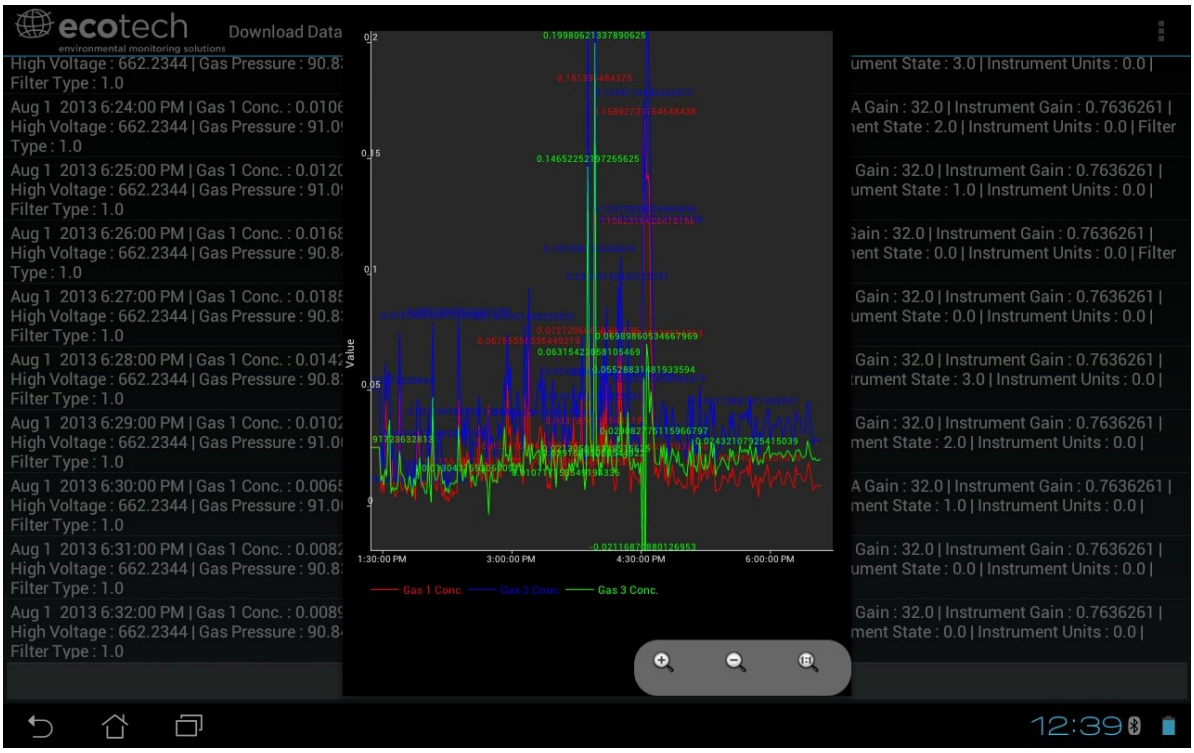

Figure 56 – Plot of Downloaded Data

4.7.6 Get Parameters

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

Options Menu

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 4.7.7.

4.7.7 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.

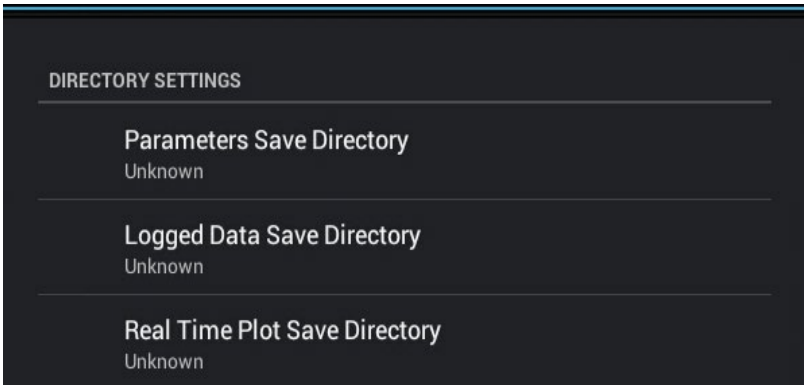

Figure 57 – Directory Settings

Logs Format

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

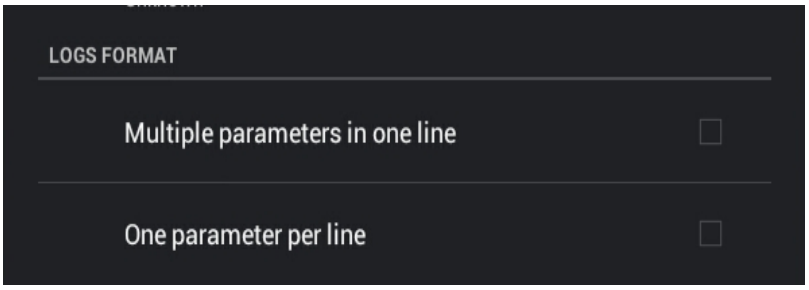

Figure 58 – Logs Format

Colour Theme Settings

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

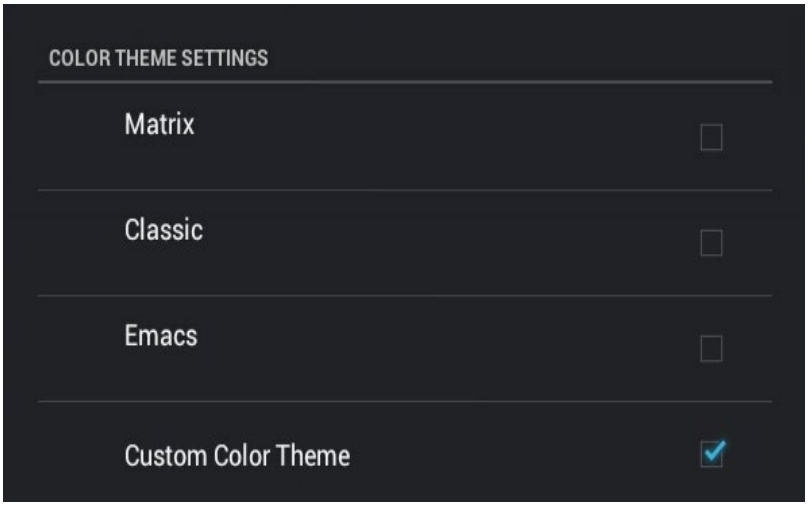

Figure 59 – Colour Theme Settings

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5. Calibration

The following sections will cover how to calibrate the MFC's, ozone flow, pressure, ozone generator and photometer.

5.1 MFC Calibration

It is generally not necessary to recalibrate the MFC within the Serinus Cal 300. The MFC function is to control the zero air flow keeping it constant. The actual accuracy of the flow set point is not critical to operation of this instrument. Flow stability & repeatability is most important.

If an application determines that it is necessary to re-calibrate the mass flow controllers within the Serinus Cal 300, please follow the below procedure.

In order to perform this task, you will require a flow device/s having an accuracy of equal to or better than 1% of the device under test and must be currently certified.

Equipment Required

- A certified mass flow measurement device **OR**
- A certified volumetric flow measurement device/s in conjunction with a certified temperature probe and barometer

Note: The measurement devices range must match the range of the Serinus Cal MFC you are calibrating. Typical setup is a Diluent MFC Range 0 – 5 slpm.

Procedure

Note: You can either, connect another MFM (Mass Flow Meter) device to the Serinus Cal 300 set to 0 Deg C and 1013.25 mbar, **OR** if the measurement device is volumetric, measure the temperature and pressure of the gas stream to calculate the volumetric flow into mass flow. It is important to have stable ambient conditions when performing this calibration to ensure accurate and consistent results.



CAUTION

It is recommended that exhaust air is not expelled into a shelter/room inhabited by people. It should be expelled into the external air and away from the sample inlet.

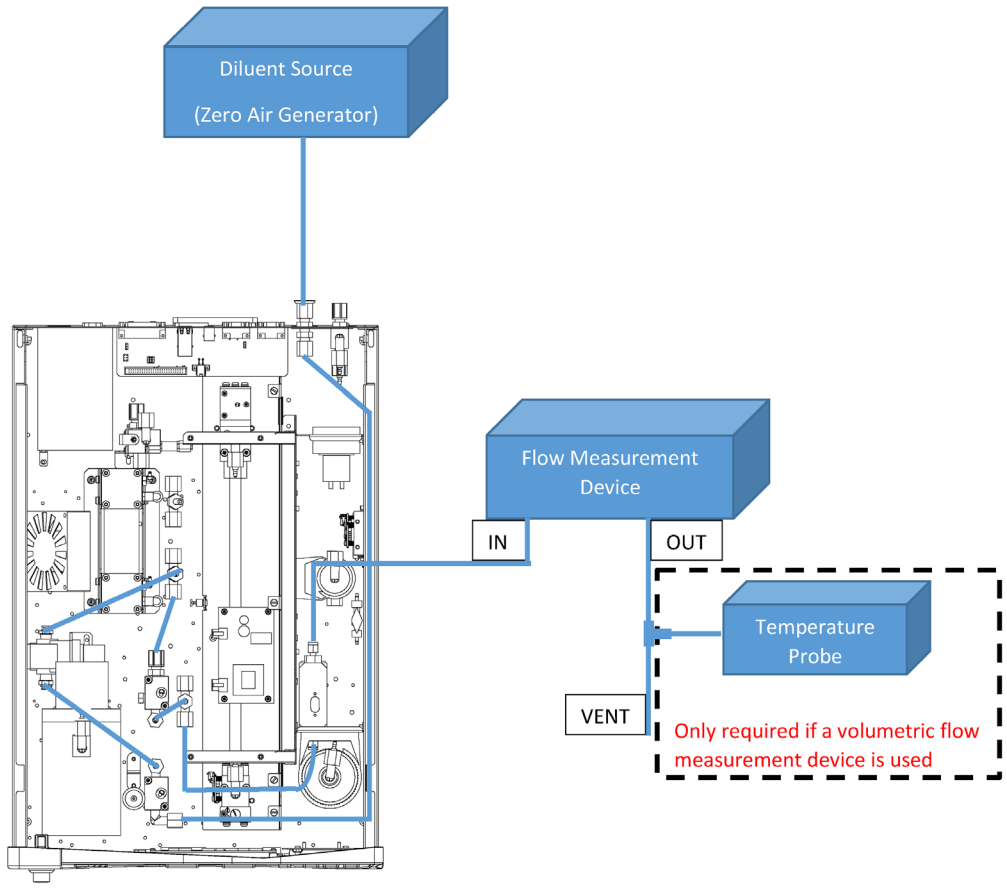

Figure 60 – MFC Calibration Setup

5.1.1 MFC Pre Calibration Setup

1. Backup settings and parameters to the internal USB memory stick (refer to Section 7.2).
2. Supply between 120 kPa - 180 kPa of pressurised diluent air to the Ext. Diluent Port.
3. Open - **Quick Menu**.
4. Disable - **Internal Diluent** - Disabled.

5.1.2 MFC Calibration

Before starting this procedure complete the MFC pre calibration setup (refer to Section 5.1.1). If at any point during the calibration you make a mistake or wish to abort, press cancel to prevent any changes.

1. Open - **Main Menu → Calibration Menu → MFC Calibration Menu**.
2. Select - **Standard Temperature** - (select the standard temperature required for your region) - Accept.
3. Confirm your flow measurement device is within the correct range for a 5 slpm MFC calibration.
4. Remove the top cover of the Serinus Cal 300.
5. Connect the flow measurement device directly to the output port of the MFC (refer to Figure 60).

6. Lightly place the top cover of the Serinus Cal 300 (over the tubing connection to MFC ensuring not to crush or restrict the tubing) to ensure a stable temperature. Allow 15 minutes for the Chassis Temperature to re-stabilize.
7. Edit - **Points** - (default is 10, but you can select from 5 to 10 calibration points) - Accept.
8. Start - **MFC Calibration** - (follow the instructions, editing the displayed value to match your flow measurement device before accepting to start the next calibration point. Be sure to allow suitable stabilisation time, between points).

Note: If you are using a volumetric flow measuring device, you need to correct the reading for temperature and pressure before entering the final value into the Serinus Cal 300.

9. MFC Calibration is now complete. Remove the tubing connected to the MFC and replace the cover.

5.1.3 Readout Calibration

Before starting this procedure complete the MFC pre calibration setup (refer to Section 5.1.1).

1. Open - **Main Menu → Calibration Menu → MFC Calibration Menu**.
2. Select - **Standard Temperature** - (select the valid standard temperature for your region) - Accept.
3. Edit - **Points** - (default is 10, but you can have from 5 to 10 calibration points) - Accept.
4. Start - **Readout Calibration** - (allow the instrument to run the automated calibration, 10 seconds each step).



CAUTION

The Serinus Cal 300 MFC Readout Calibration will not work without a suitable diluent source connected to the instrument's diluent port.

5.2 Ozone Flow Calibration

It may be necessary occasionally to adjust the pressure regulator supplying diluent air to the Ozone Generator.

Equipment required

- A certified mass flow measurement device or a certified volumetric flow measurement device (corrected for temperature and pressure) able to measure from 0 – 200 sccm range.

  If the volumetric flow device is programmable set flow settings to 0 Deg and 1013.25 mbar to standardise and match the Serinus Cal 300.

  If it is not programmable you will also need a certified temperature probe and a pressure sensor to correct measurement readings to 0 Deg STP and 1013.25 mbar.



CAUTION

It is recommended that exhaust air is not expelled into a shelter/room inhabited by people. It should be expelled into the external air and away from the sample inlet.

Procedure

1. Supply between 120 kPa - 180 kPa of pressurised diluent air to the Ext. Diluent Port.
2. Open - **Quick Menu**.
3. Disable - **Internal Diluent** - Disabled.
4. Remove the top cover of the Serinus Cal 300.
5. Disconnect the tubing connected to the top of the Ozone Generator and connect your flow measurement device.

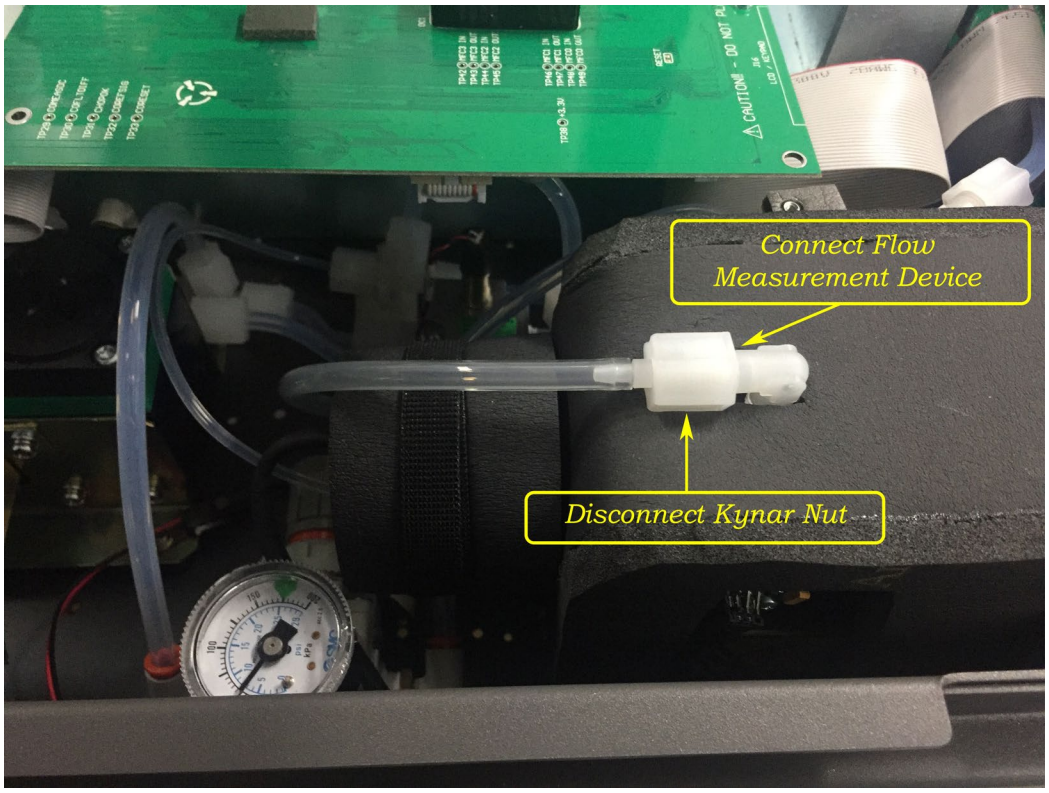

Figure 61 – Ozone Generator Flow Test Point

6. The calibration procedure consists of two flow points one at 80 sccm and one at 100 sccm.
7. Open - **Main Menu → Calibration Menu → Pressure Calibration Menu** - (read note) - OK.

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

8. Unlock the regulator adjustment knob by pulling up towards the shielded bench.
9. In the menu, select **O3 Flow**, then press Start.

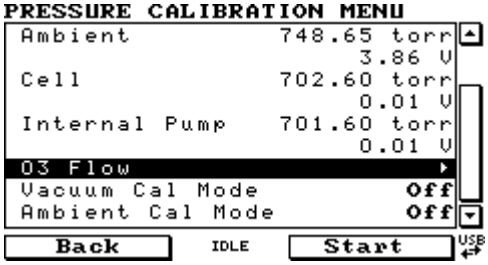

Figure 62 – Ozone Flow Calibration Start

10. Follow the instructions. Adjust the pressure regulator (turning the knob left or right to adjust flow) inside the Serinus Cal 300 until 80 ± 2 sccm is measured on your flow device). Once the flow is set, press OK.

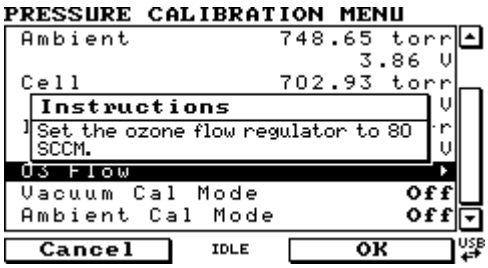

Figure 63 **– Ozone Flow Calibration 80 sccm**

11. Enter the actual mass flow as measured by your reference flow meter, then press Accept

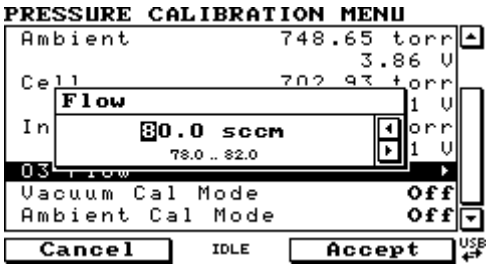

Figure 64 – Enter Ozone Flow 80 ± 2 sccm

12. The following screen will appear. Adjust the pressure regulator until 100 ± 2 sccm is measured on your flow device, then press OK.

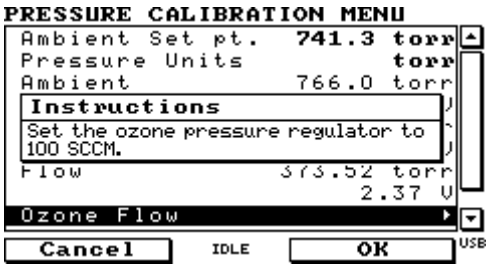

Figure 65 – Ozone Flow Calibration 100 sccm

13. The following screen will appear. Enter the actual mass flow as measured by your reference flow meter, then press Accept.

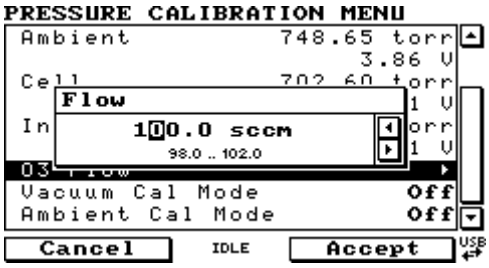

Figure 66 – Enter Ozone Flow 100 ± 2 sccm

14. Lock the pressure regulator by pushing the knob until it snaps back into place.

15. Disconnect the flow meter and reconnect the tubing to the top of the Ozone Generator.

Note: Running a point with higher total flow will result in a slightly lower O_3 flow and vice-versa. Given the way the O_3 output is calibrated, this is not a problem, but if it is desired to display 100sccm, the below final adjustment can be done.

16. Run a Zero point with the Output flow you typically use, with external plumbing connected as you usually use.
17. Check that the O3 flow displays 100 ± 2 sccm.
18. If necessary, adjust the regulator until the O3 flow displays 100 ± 2 sccm.
19. Replace the top cover of the Serinus Cal 300.
20. Ozone flow calibration complete.

5.3 Pressure Calibration

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

A thorough leak check must be performed prior to performing a pressure calibration (refer to Section 6.3.1).

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

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

Equipment Required

- Barometer

Procedure

1. Open - **Main Menu → Calibration Menu → Pressure Calibration Menu** - (read note) - OK.

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

2. Edit - **Vacuum Set Pt.** - (read instructions) - OK.
3. Disconnect all connections to the output ports and block ports 1, 2 and 3. Then connect a barometer to output port 4 (as seen in Figure 67).



Figure 67 – Connecting the Barometer to O4 (Output 4)

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

4. Wait 2-5 minutes and ensure the pressure reading on the barometer has dropped and is stable.
5. Enter the barometer reading into the instrument - Accept.
6. Read displayed instructions - OK.
7. Disconnect the barometer from output port 4.
8. Wait 2-5 min, enter the ambient barometer reading into the instrument - Accept.
9. Read displayed instructions - OK.
10. Pressure calibration is now complete, reconnect the connections to the output ports.

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

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

5.4 Ozone Generator Characterisation

It may be necessary occasionally to adjust the ozone output characterisation on the Serinus Cal 300. This is typically performed after the ozone generator UV lamp has been replaced or if the ozone output has significantly drifted away from requested set point. This procedure is best carried out using the external diluent due to the duration of the procedure.

Note: This process will take at least 25 min and may take up to 5 hours.

Equipment Required

- (AIR) Diluent

Procedure

1. Supply between 120 kPa - 180 kPa of pressurised diluent air to the Ext. Diluent Port.
2. Open - **Quick Menu**.
3. Disable - **Internal Diluent** - Disabled.
4. Open - **Main Menu → Calibration Menu → Ozone Calibration Menu**.
5. Edit - **Flow** - (Enter the flow you want the calibration to be performed at) - Accept.
6. Edit - **Min Range** - (Enter the value for the lowest calibration point to be used when running the automated ozone calibration (run over 10 points spread between max and min)) - Accept.
7. Edit - **Max Range** - (Enter the value for the highest calibration point to be used when running the automated ozone calibration (run over 10 points spread between max and min)) - Accept.
8. Start - **Ozone Calibration** - (The firmware will now automatically step up through 10 points and adjust itself based on the internal photometer results).
9. The process is complete when no steps are displayed and the "Start" button option returns.

Note: Pressing Stop or terminating the O3 Gen/Photometer point will terminate the calibration without saving any changes.

5.5 Photometer Calibration

5.5.1 Photometer Pre-Check

Note: Both your Serinus Cal 300 and the external transfer standard should be powered up and active for a minimum of 2 hours.

Equipment required

- External ozone transfer standard
- (Zero Air) Diluent

Procedure

1. Supply between 120 kPa - 180 kPa of pressurised diluent air to the Ext. Diluent Port.
2. Open - **Quick Menu**.
3. Disable - **Internal Diluent** - Disabled.
4. Connect an external ozone transfer standard to one of the ports on the output manifold (if the external ozone transfer standard requires external reference air ensure it is connected to the same diluent air source used by the Serinus Cal 300).
5. Create and run an **O3 Gen/Photometer** point at 100 % of range (normally 500 or 1000 ppb). Refer Section 3.2.2.3.
6. If the ozone measured on the Serinus Cal 300 is outside ±2 % of the transfer standard then an adjustment will need to be made.

5.5.2 Photometer Calibration

Note: Both your Serinus Cal 300 and the external transfer standard should be powered up and active for a minimum of 2 hours.

Equipment required

- External ozone transfer standard
- (AIR) Diluent

Procedure

1. Supply between 120 kPa - 180 kPa of pressurised diluent air to the Ext. Diluent Port.
2. Open - **Quick Menu**.
3. Disable - **Internal Diluent** - Disabled.
4. Connect an external ozone transfer standard to one of the ports on the output manifold (if the external ozone transfer standard requires external reference air ensure it is connected to the same diluent air source used by the Serinus Cal 300).
5. Create and run **O3 Gen/Photometer** point at 100 % of range (normally 500 or 1000 ppb) refer to Section 3.2.2.3.
6. Open - **Main Menu → Calibration Menu**.
7. Let the instrument stabilise, minimum 60 minutes.
8. Enter - **Span Calibrate O3** - (Enter the reading from the transfer standard) - Accept.

5.6 Photometer Audit With External Ozone Source

Note: Both the Serinus Cal 300 and the external O_3 transfer standard should be powered up and active for a minimum of 2 hours.

Audit mode provides a method for external audits of the photometer. The point is then forced into a Zero point (if it isn't already), even if the unit was previously in Idle. While running this point, the MFCs are locked closed and their flow alarms are supressed. The new status condition "Audit Mode" will be triggered, forcing a yellow warning light. Otherwise the point runs as normal.

Equipment required

- External ozone generator transfer standard
- (Zero Air) Diluent
- ¼" Kynar plugs

Procedure

1. Ensure the Serinus Cal 300 is warmed up and out of startup.
2. Supply between 120 kPa - 180 kPa of pressurised diluent air to the Ext. Diluent Port. Pressurised dilution air must be sourced from the same stream as used by the external ozone generator.

3. Open - **Quick Menu**.
4. Disable - **Internal Diluent** - Disabled.
5. Return to the **Home Screen** (the user can press the bottom status light (green).
6. Open - **Main Menu → Calibration Menu**.
7. On - **Audit Mode** - On - (the warning message “Connect external ozone generator.” will appear) - OK.
8. Return to the **Home Screen** (the user can press the bottom status light (green).
9. Connect an external ozone generator transfer standard to port “O4” on the output manifold (ensure the external ozone generator transfer standard external reference air is sourced from the same stream as used by the Serinus Cal 300 diluent air source).
10. Block output ports “O3” and “O2” on the output manifold. The last output “O1” becomes the vent for the excess ozone generated from the external ozone generator transfer standard.
11. Using the external ozone generator, generate a point of ozone, 500 or 1000 ppb @ one litre output. Allow the instrument time to stabilise, minimum 60 minutes.
12. Compare the external ozone generator transfer standard against the ozone concentration displayed on the home screen.
13. If desired, change Ozone concentration on the external ozone generator, reallow stabilization period and then compare / record the results.

6. Service

6.1 Maintenance Tools

To perform general maintenance on the Serinus Cal 300 the user may require the following equipment.

- Customizable Test Equipment Case — PN: H070301
- Digital Multimeter & Leads (DMM) — PN: E031081 & E031082
- Barometer — PN: E031080
- Thermometer & Probe — PN: E031078 & E031079
- Flow Meter (Select Range) Range: 50 sccm to 5000 sccm — PN: ZBI-200-220M
- Minifit Extraction Tool — PN: T030001
- Orifice Removal Tool — PN: H010046
- Valve Driver Tool — PN: T030014
- Leak Test Jig — PN: H050069
- Computer and Connection Cable for Diagnostic Tests
- Assortment of 1/4” and 1/8” Tubing and Fittings



Figure 68 – Minifit Extraction Tool – (PN: T030001)

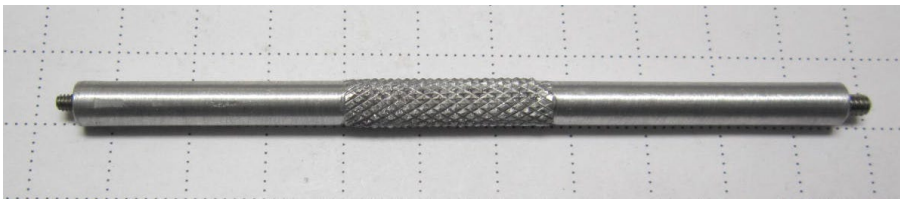

Figure 69 – Orifice Removal Tool – (PN: H010046)

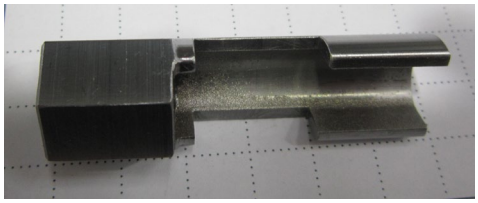

Figure 70 – Valve Driver Tool – (PN: T030014)

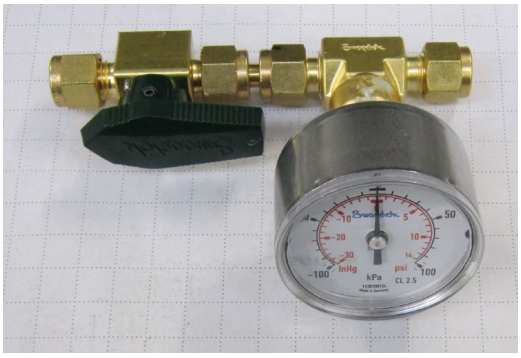

Figure 71 – Leak Check Jig – (PN: H050069)



Figure 72 – Air Monitoring Test Equipment Kit (AMTEK) – Customisable

6.2 Maintenance Schedule

The Serinus Cal 300 requires minimal ongoing maintenance. The intervals for calibration are determined by compliance standards that vary in different countries. The following is recommended by Ecotech as a guide and compliance with local regulatory or international standards is the responsibility of the user.

Table 7 – Maintenance Schedule

Frequency	Maintenance Tasks
Monthly	Check Status Menu and all parameters PASS/Ok. Backup configuration files to USB.
	UV Lamp check. Input Pot nominal value less than 255 otherwise replace lamp.
6 Monthly	MFC Multipoint Calibration
	Photometer Calibration – Transfer Standard (Portable)
Yearly	Ozone Flow Calibration

6.3 Maintenance Procedures

6.3.1 Leak Check

A Leak check is recommended when any service or repair of the internal valves or pneumatics has been performed or a leak is suspected.

Equipment required

- Vacuum leak test device (Ecotech Leak Jig PN: H050069)
- Assorted plugs and tubing supplied with instrument (Serinus Accessories Kit PN: H010136)

6.3.1.1 Leak Check - Full

Procedure

1. With the instrument powered on set the operation Mode to IDLE and remove lid.
2. Plug all the output ports (O1 – O4) and the Ext. Diluent port with the provided Kynar plugs.
3. Locate the reference air vent tube and block as seen in Figure 73.

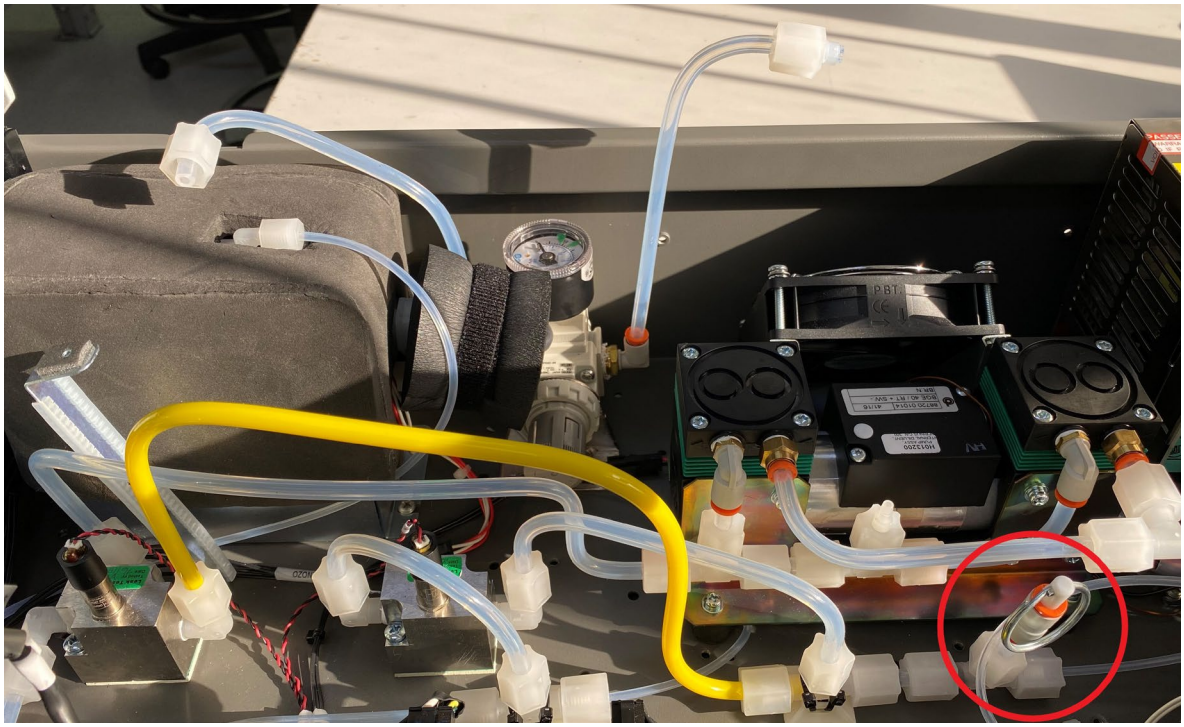

Figure 73 – Blocking Reference Air Vent

4. Disconnect the tubing as marked by the red circles in Figure 74. Connect a piece of bypass tubing between the tee and the diluent valve manifold as shown in Figure 74. The pressure regulator has an internal bleed valve and your leak test **will not work** if the pressure regulator is not isolated.

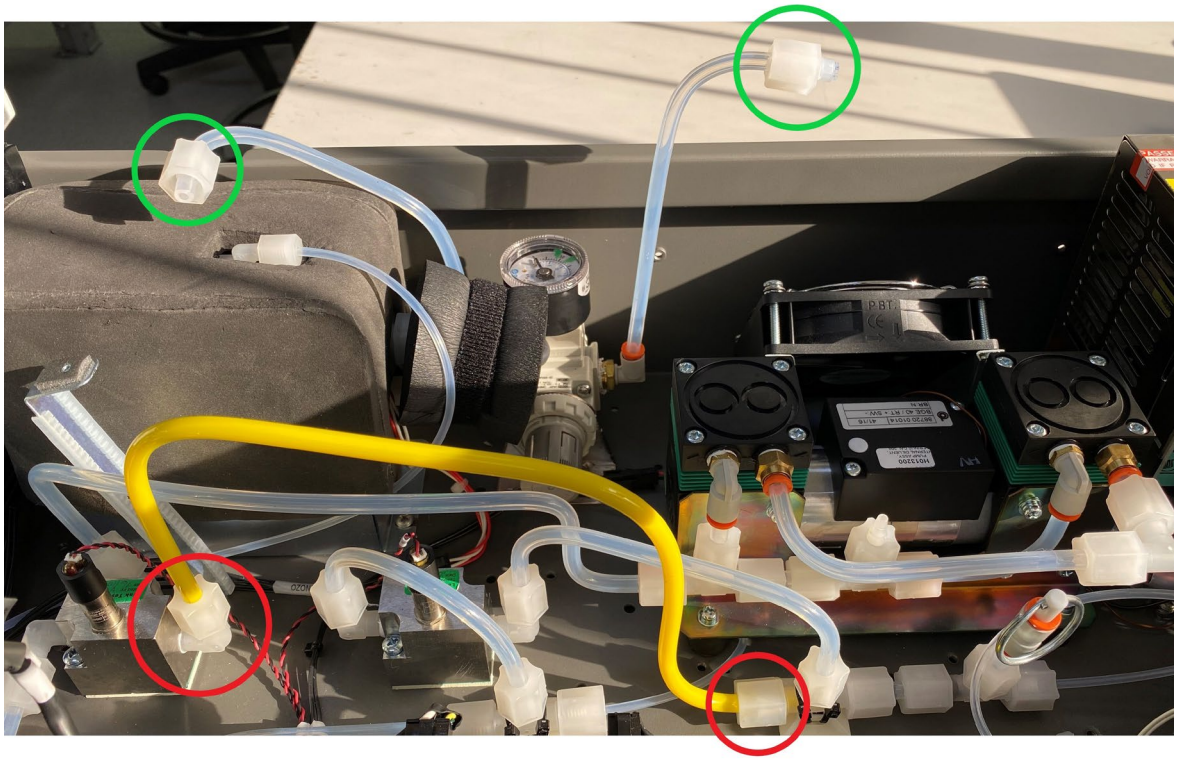

Figure 74 – Isolating Pressure Regulator

5. Open - **Main Menu → Service Menu → Diagnostics Menu → Valve Menu.**
6. Disable - **Valve Sequencing** - Disabled.
7. Turn off all valves.

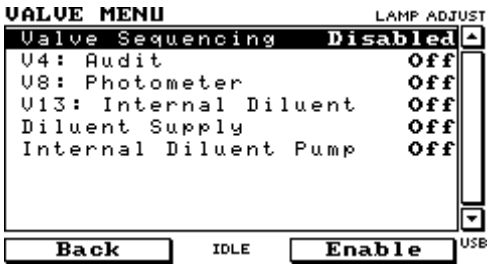

Figure 75 – Leak Check: Full Test

8. Open - **Main Menu → Analyser State Menu → Pressure & Flow Menu**.
9. Check that all three pressures match and are at ambient. If they do not match within 3 torr then a pressure calibration is required.

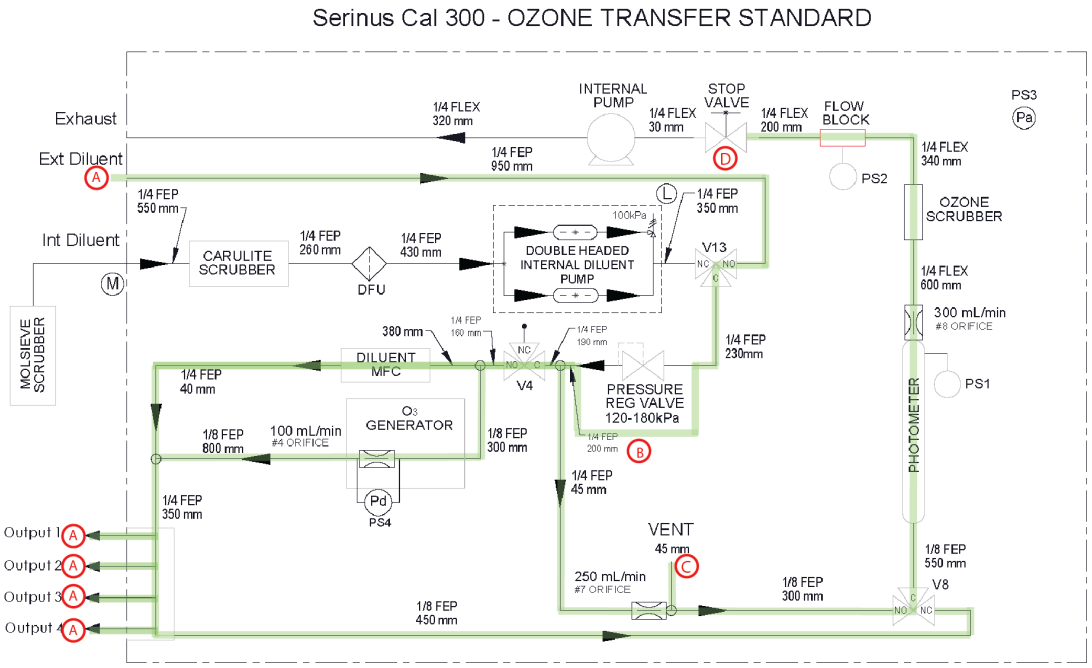

Figure 76 – Leak Check: 1A (Photometer + Gas Delivery + Ext. Diluent + Ref. Air)

10. Open - **Main Menu → Service Menu → Diagnostics Menu → Internal Pump Menu**
    a. Select - **Pump Control** - Manual - Accept
    b. On - **Internal Pump** - On
    c. Edit - **Coarse** - 240
11. Wait 3 min with the internal pump running then turn the stop valve (90 degrees) marked as "D" on Figure 76.
12. Off - **Internal Pump** - Off.
13. Open - **Main Menu → Analyser State Menu → Pressure & Flow Menu**.

14. Record the Cell pressure, wait 5 minutes, then record the Cell pressure again. It should not drop more than 2 kPa.

- If the leak test passes the leak test is complete for section 1A (photometer + gas delivery + ext. diluent + ref. air).
- If the leak check fails continue to 6.3.1.2.

15. Slowly remove the blocker on the Ext. Diluent port allowing the instrument to return to ambient pressure.
16. Disconnect the tubing as marked by the red circles in Figure 77. Connect a piece of bypass tubing with some unions to join the two pieces of tubing together, bypassing the internal diluent pump. The internal diluent pump has a pressure relief valve and your leak test **will not work** if the internal diluent pump is not isolated.

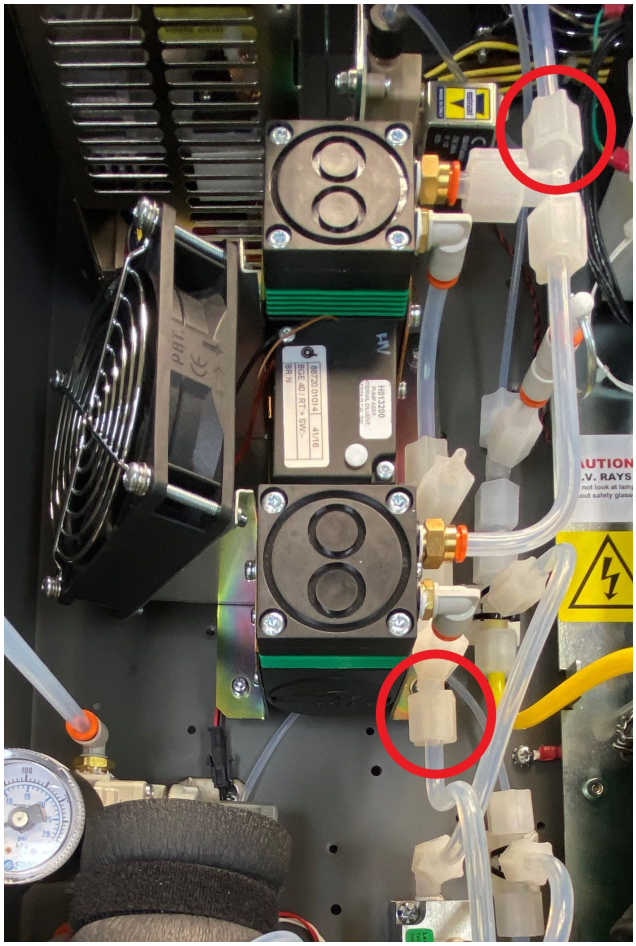

Figure 77 – Bypass Internal Diluent Pump

17. Open - **Main Menu → Service Menu → Diagnostics Menu → Valve Menu.**
18. Turn on valve 13 internal diluent (V13).
19. Place a blocker on the Int. Diluent port or the end of the Molsieve scrubber if connected.

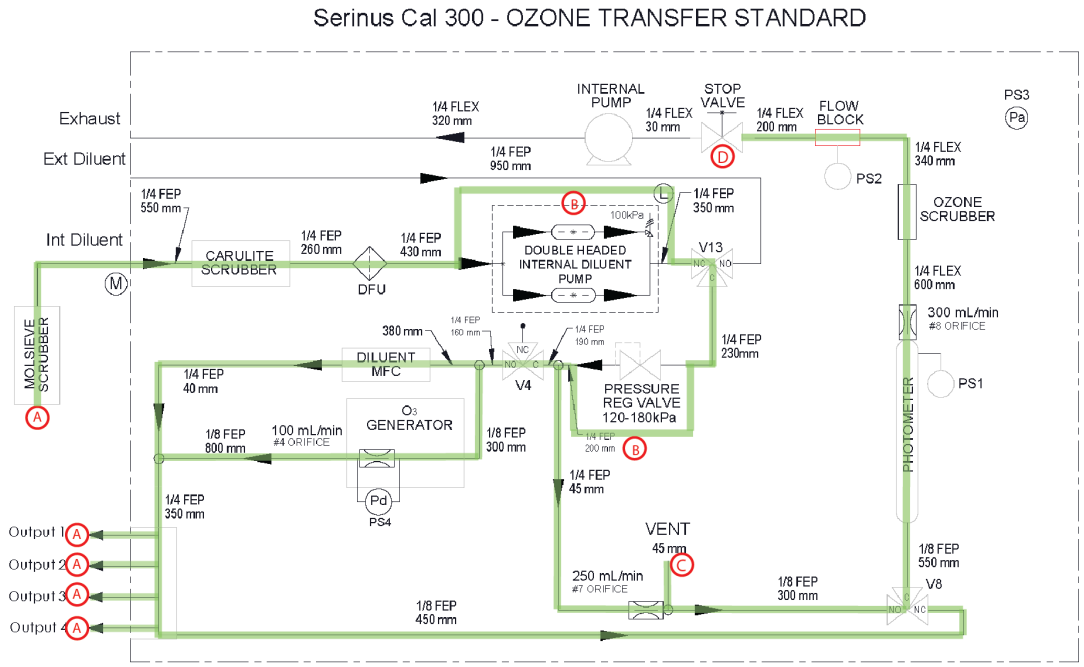

Figure 78 – Leak Check: 1B (Photometer + Gas Delivery + Int. Diluent + Ref. Air)

20. Open - **Main Menu → Service Menu → Diagnostics Menu → Internal Pump Menu**
    a. Select - **Pump Control** - Manual - Accept
    b. On - **Internal Pump** - On
    c. Edit - **Coarse** - 240
21. Wait 3 min with the internal pump running then turn the stop valve (90 degrees).
22. Off - Internal Pump - Off.
23. Open - **Main Menu → Analyser State Menu → Pressure & Flow Menu**.
24. Record the Cell pressure, wait 5 minutes, then record the Cell pressure again. It should not drop more than 2 kPa.

- If the leak test passes the leak test is complete for section 1B (photometer + gas delivery + int. diluent + ref. air).

25. Slowly remove the blocker on the Int. Diluent port allowing the instrument to return to ambient pressure.

- The full leak check is complete. Remove the blocker on the reference air vent (Figure 73) and remove the pressure regulator bypass and reconnect the tubes marked with green circles as seen in Figure 74. Enable **Valve Sequencing** and return operation mode to original state.
- If the leak check fails continue to 6.3.1.2.

6.3.1.2 Leak Check - Isolate Diluent

The following procedure assumes the user is continuing from the full leak check procedure.

Procedure

1. Ensure all the section marked with an “A” are blocked with a blind nut and the reference vent marked with a “C” is blocked.

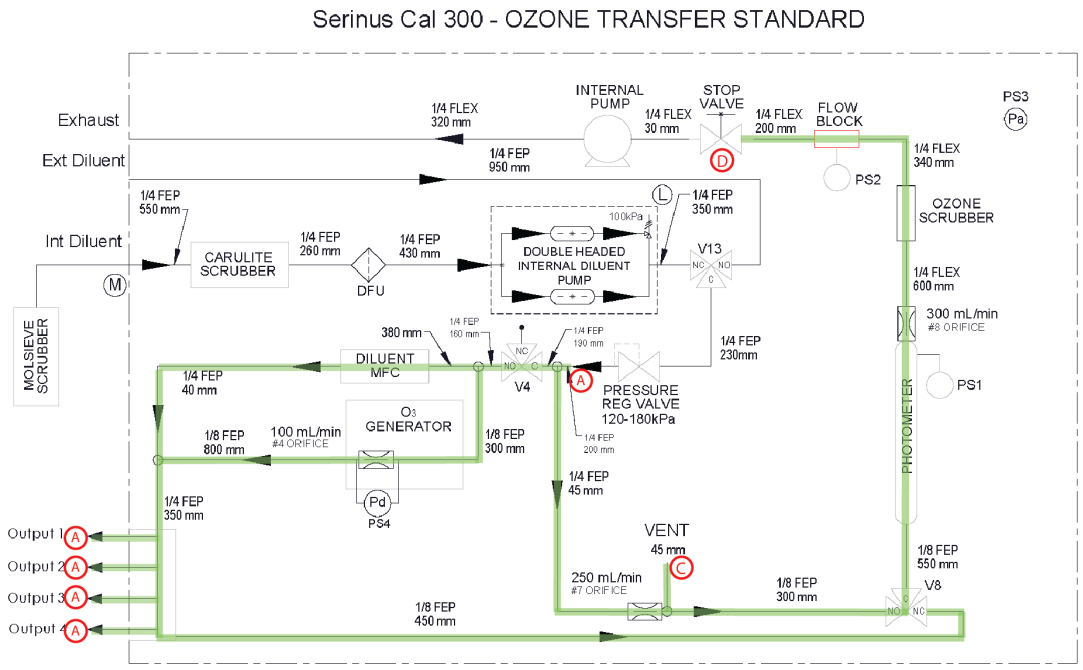

Figure 79 – Leak Check: 2 (Photometer + Gas Delivery + Ref. Air)

2. Open - **Main Menu → Service Menu → Diagnostics Menu → Internal Pump Menu**
   a. Select - **Pump Control** - Manual - Accept
   b. On - **Internal Pump** - On
   c. Edit - **Coarse** - 240
3. Wait 3 min with the internal pump running then turn the stop valve (90 degrees) marked as “D” on Figure 78.
4. Off - Internal Pump - Off.
5. Open - **Main Menu → Analyser State Menu → Pressure & Flow Menu**.
6. Record the Cell pressure, wait 5 minutes, then record the Cell pressure again. It should not drop more than 2 kPa.

- If the leak check passes the leak test is complete for section 2 (photometer + gas delivery + ref. air). The leak is somewhere in the ext. diluent or int. diluent sections. Find and repair the leak then complete the full leak check again.
- If the leak check fails continue to 6.3.1.3.

6.3.1.3 Leak Check – Isolate Gas Delivery

The following procedure assumes the user is continuing from 6.3.1.2 Leak Check - Isolate Diluent procedure.

Procedure

1. Ensure all the section marked with an “A” are blocked with a blind nut and the reference vent marked with a “C” is blocked.
2. Open - **Main Menu → Service Menu → Diagnostics Menu → Valve Menu.**
3. Turn on valve 4 audit valve (V4).

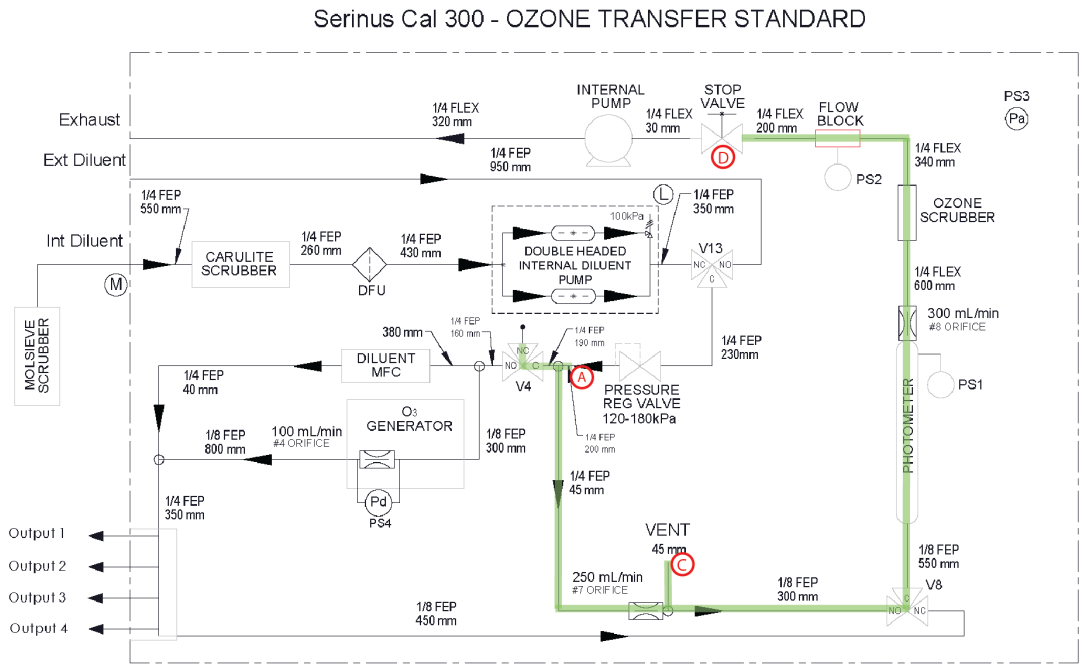

Figure 80 – Leak Check: 3 (Photometer + Ref. Air)

4. Open - **Main Menu → Service Menu → Diagnostics Menu → Internal Pump Menu**
   a. Select - **Pump Control** - Manual - Accept
   b. On - **Internal Pump** - On
   c. Edit - **Coarse** - 240
5. Wait 3 min with the internal pump running then turn the stop valve (90 degrees) marked as "D" on Figure 79.
6. Off - **Internal Pump** - Off.
7. Open - **Main Menu → Analyser State Menu → Pressure & Flow Menu**.
8. Record the Cell pressure, wait 5 minutes, then record the Cell pressure again. It should not drop more than 2 kPa.

- If the leak check passes the leak test is complete for section 3 (photometer + ref. air). The leak is somewhere in the gas delivery section. Find and repair the leak then complete the full leak check again.
- If the leak check fails continue to 6.3.1.3.

6.3.1.4 Leak Check – Isolate Ref. Air

The following procedure assumes the user is continuing from 6.3.1.3 Leak Check – Isolate Gas Delivery procedure.

Procedure

1. Ensure all the section marked with an "A" are blocked with a blind nut.
2. Open - **Main Menu → Service Menu → Diagnostics Menu → Valve Menu**.

3. Turn on valve 8 photometer valve (V4) and ensure Valve 4 audit valve is still on.

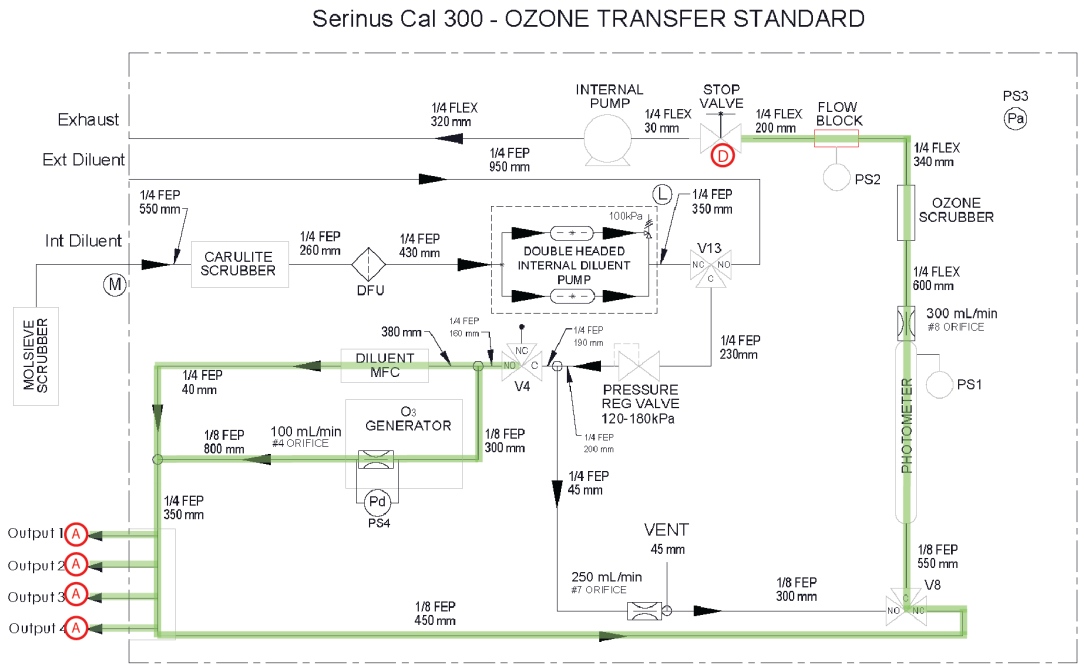

Figure 81 – Leak Check: 4 (Photometer + Gas Delivery)

4. Open - **Main Menu → Service Menu → Diagnostics Menu → Internal Pump Menu**
   a. Select - **Pump Control** - Manual - Accept
   b. On - **Internal Pump** - On
   c. Edit - **Coarse** - 240
5. Wait 3 min with the internal pump running then turn the stop valve (90 degrees) marked as “D” on Figure 80.
6. Off - Internal Pump - Off.
7. Open - **Main Menu → Analyser State Menu → Pressure & Flow Menu**.
8. Wait 5 minutes, observe the Cell pressure on the leak check jig, it should not drop more than 2 kPa.

- If the leak check passes the leak test is complete for section 4 (photometer + gas delivery). The leak is somewhere in the ref. air section. Find and repair the leak then complete the full leak check again.
- If the leak check fails review the remaining section (photometer) find and repair the leak then complete the full leak check again.

6.3.2 Measurement UV Lamp

6.3.2.1 Measurement UV Lamp Check

The UV lamp intensity decreases over time, to compensate for this the instrument will increase the digital Input Pot. As the digital pot (Input Pot) approaches 255 the lamps intensity is decreasingly suitable for accurate measurement and the lamp should be replaced. A weak or noisy lamp may

cause noisy or erratic readings. However, it is recommended to check the pneumatics system i.e. leak check, flow checks and valve operation before changing the lamp.

6.3.2.2 Measurement UV Lamp Removal

Equipment required

- 1.5 mm Hex Key

Procedure



CAUTION

The UV Lamp operates from Hazardous Live Voltages. Be sure to turn the instrument power off during UV lamp replacement.

CAUTION

The UV Lamp emits harmful UV radiation. Be sure to turn the instrument power off during UV lamp replacement. Use UV protective eye were if it is necessary to observe if the lamp is operating correctly.

1. Turn the Serinus Cal 300 off.
2. Remove the lid of the Serinus Cal 300 (refer to Section 2.1.2).
3. Remove the thumb screws that secure the main controller PCA and raise the PCA until it's at a 90˚ angle. This will allow us to gain access to the shielded photometer.
4. Disconnect the two large ribbon cables on either side of the main controller PCA as well as all the connections to the rear panel PCA. Remove the top cover of the shielded photometer by loosening the five captive screws as seen in Figure 81.

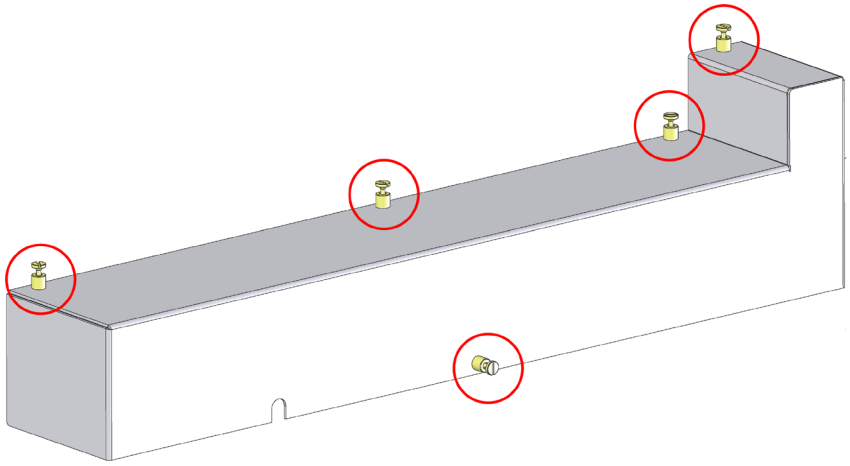

Figure 82 – Removing Shielded Photometer Top Cover

5. Lift out the top cover evenly.
6. Locate the UV lamp (refer to Figure 13) and disconnect the lamp from the lamp driver PCA (J1).
7. Remove the grub screw (1.5 mm hex key) from the hole in the left side of the block (refer to Figure 82) securing the UV lamp and slide the lamp out of the block.

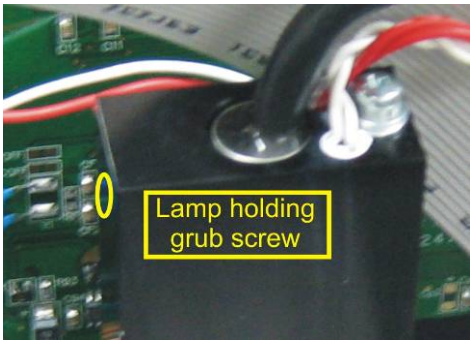

Figure 83 – Location of UV Lamp Fastening Grub Screw

6.3.2.3 Measurement UV Lamp Installation

The following procedure assumes you have followed the procedure to remove the top cover and expose the internal components 6.3.2.2 preparing the shielded photometer for UV lamp replacement.

Equipment required

- 1.5 mm Hex Key

Procedure



CAUTION

The UV Lamp operates from Hazardous Live Voltages. Be sure to turn the instrument power off during UV lamp replacement.



CAUTION

The UV Lamp emits harmful UV radiation. Be sure to turn the instrument power off during UV lamp replacement. Use UV protective eye were if it is necessary to observe if the lamp is operating correctly.

1. Install a new lamp into the block taking care not to touch the lamp. Be sure to insert the lamp completely in the block to achieve maximum signal strength.
2. Gradually tighten the grub screw with the 1.5 mm hex key, until the lamp cannot move.



CAUTION

Be careful when securing lamp with grub screw not to tighten too much and damage the lamp.

3. Connect the UV lamp to the lamp driver PCA (J1).
4. Reconnect the two large ribbon cables on either side of the main controller PCA as well as all the connections to the rear panel PCA.
5. Turn on the Serinus Cal 300 and allow one hour to stabilise.
6. Open - **Main Menu → Service Menu → Diagnostics Menu → Digital Pots Menu**.
7. Check that the **Lamp Current** is reading 10 mA.
8. Check that the **Input Pot** has reached its ideal target of between 50 to 120.

Note: If the Input Pot is below 50 than the UV lamp is too bright and will need to be detuned, If the Input Pot is greater than 120 than the UV lamp is too dull and will need to be tuned.

9. Perform a Photometer Calibration.

6.3.2.4 Measurement UV Lamp Tuning

The following procedure assumes you have followed the procedure to remove the top cover and expose the internal components as described in Section 6.3.2.2 Measurement UV Lamp Removal.

Equipment required

- 1.5 mm Hex Key

Procedure





CAUTION

The UV Lamp operates from Hazardous Live Voltages **DON'T** touch the **Lamp Driver PCA** while the power is **ON**.

CAUTION

The UV Lamp emits harmful UV radiation. Be sure to turn the instrument power off during UV lamp replacement. Use UV protective eye were if it is necessary to observe if the lamp is operating correctly.

1. Open - **Main Menu → Service Menu → Diagnostics Menu**.
2. Disable - **Control Loop** - Disabled.
3. Open - **Digital Pots Menu**.
4. Edit - **Input Pot** - (set the value to 50).
5. Loosen the grub screw that holds the UV lamp with the 1.5 mm Hex key.
6. Slowly turn the lamp from side to side until the **Ref. Voltage** reaches 3.0 V. If 3.0 volts can not be reached, increase the input pot (digital pot), keeping in mind upper limits previously mentioned.
7. Gradually tighten the grub screw with the 1.5 mm hex key, until the lamp cannot move.



CAUTION

Be careful when securing lamp with grub screw not to tighten too much and damage lamp.

8. Restart the instrument.
9. Wait for 1 hour for the calibrator to stabilise and confirm the **Ref. Voltage** is still 3.0 V.
10. Perform a Photometer Calibration.

6.3.2.5 Shielded Photometer Top Cover Replacement

The following procedure assumes you have followed the procedure to remove the top cover and expose the internal components as described in Section 6.3.2.2 Measurement UV Lamp Removal. We will now step through replacement of the shielded photometer top cover.

Equipment required

- 1.5 mm Hex Key

Procedure





CAUTION

The UV Lamp operates from Hazardous Live Voltages. Be sure to turn the instrument power off during UV lamp replacement.

CAUTION

The UV Lamp emits harmful UV radiation. Be sure to turn the instrument power off during UV lamp replacement. Use UV protective eye were if it is necessary to observe if the lamp is operating correctly.

1. Turn the Serinus Cal 300 off.
2. Disconnect the two large ribbon cables on either side of the Main controller PCA as well as all the connections to the Rear panel PCA.
3. Place down the shielded photometer top cover taking care to ensure all tubing and cables are clear.
4. Tighten the five captive screws as seen in Figure 81.
5. Connect the two large ribbon cables on either side of the Main controller PCA as well as all the connections to the Rear panel PCA.
6. Lower the main controller PCA and tighten the thumb screws that secure it to the PCB mount.
7. Replace the Serinus Cal 300 lid (refer to Section 2.1.2).

6.3.3 Cleaning

The instrument enclosure is made from aluminium and steel which are resistant to most forms of contamination. In order to keep the enclosure looking clean, use a microfiber cleaning cloth or a lightly dampened cloth. Be sure to turn the power off when doing so. The calibrator is not water proof so large volumes of water may damage the instrument.

6.4 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 in the following sections.

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

```
** Ecotech Serinus Cal **
V2.1 Bootloader
Press '1' to enter Bootloader
```

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

6.4.1 Display Help Screen

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

6.4.2 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. Initiate the test by pressing 2 on the keypad from the Bootloader screen.

6.4.3 Updating Firmware from USB Memory Stick

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

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

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

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

USB Memory Stick Update

1. Turn the instrument off.
2. Place the USB memory stick with the new firmware (ensure that firmware is placed in a folder called FIRMWARE) in the front panel USB Port.
3. Enter the Bootloader (refer to Section 6.4).
4. Select option 3 (upgrade from USB memory stick), press 3 on the keypad.
5. Wait until the upgrade has completed.
6. Depending on bootloader version, the firmware may run automatically, or the user may need to Press 9 on the keypad to start the instrument with new firmware.

6.4.4 Erase All Settings

This command is only required if the instrument's firmware has become unstable due to corrupted settings. To execute this command, enter the Bootloader Menu (refer to Section 6.4) and press 4 on the keypad.

6.4.5 Start Calibrator

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

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7. Troubleshooting

7.1 Main Screen Error Messages

In the event of an instrument fault an error message will be displayed on the lower left corner of the home screen. It will also be logged on the internal USB memory stick as an event in the “Event Log”.

In addition, the green status led will change to orange or red.

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

To determine which component/s of the instrument is causing a fault you can press the orange or red button to display a complete list of all current errors and warnings.

You can also find the complete list of self-diagnostic checks at;

Main Menu → Analyser State Menu → Status Menu

Refer to Section 3.5.13 of this manual has a complete table and explanation of all fault conditions. If you need further assistance please backup your instrument files to a USB memory stick and contact Ecotech Service Support.

7.2 Ecotech Service Support Files

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

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

Equipment Required

- PC/Laptop

Procedure

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

1. Open - **Main Menu → Analyser State Menu**.
2. **Model** - (take note).
3. **Ecotech ID** - (take note).
4. **Board Revision** - (take note).
5. **Firmware Ver.** - (take note).
6. Open - **Main Menu → Service Menu**.
7. Save - **Save Configuration** - (CONFIG**.TXT) - Accept.

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

** Can be any number from 0 – 98.

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

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

** Can be any number from 0 – 98.

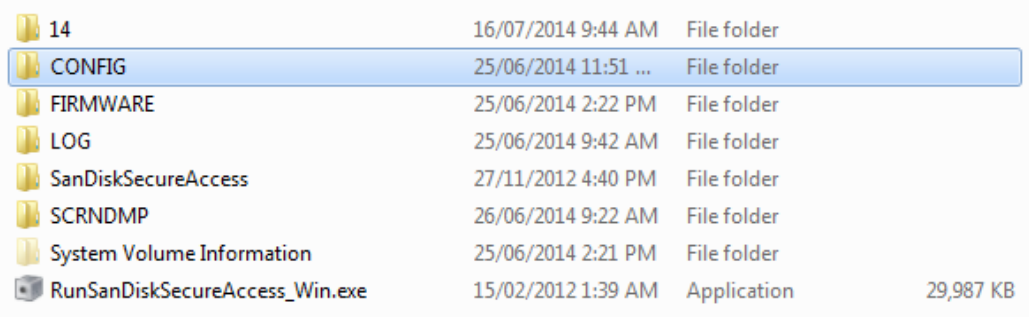

Figure 84 – USB Memory Stick File Structure

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

8. Optional Extras

This section contains information on optional kits and installed options.

Rack Mount Kit	Refer to Section 8.1.
Network Port	Refer to Section 8.2.
Metric Fittings Kit	Refer to Section 8.3.

8.1 Rack Mount Kit (PN: E020116)

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

Table 8 – Included Parts (Rack Mount Kit)

Description	Quantity	Part Number
Rack Slide Set	1	H010112
Rack Mount Adaptors	4	H010133
Rack Mount Ears	2	H010134
Spacers	4	HAR-8700
M6 x 20 Button Head Screws	8	
M6 Washers	16	
M6 Nyloc Nuts	8	
M4 x 10 Button Head Screws	18	
M4 Washers	8	
M4 Nyloc Nuts	8	
M6 Cage Nuts	8	

Installing the Instrument

1. Remove the rubber feet from the instrument (if attached).
2. Separate the slide rail assembly by pressing the black plastic clips in the slide rails to remove the inner section of the rail (refer to Figure 84).

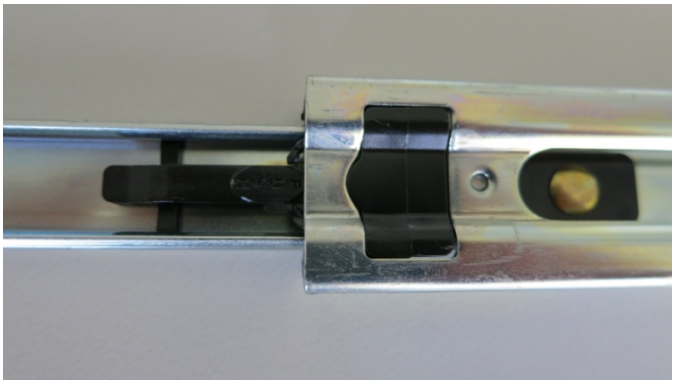

Figure 85 – Separate Rack Slides

3. Attach the inner slide rails to each side of the instrument using M4 x 10 button screws; three on each side (refer to Figure 85).



Figure 86 – Assemble Inner Slide on Chassis

4. Install rack mount ears on the front of the instrument using two M4 x 10 screws on each side (refer to Figure 86).



Figure 87 – Rack Mount Ears Fitted to Instrument

5. Attach the rack mount adaptors to the ends of the outer slide rails using M4 x 10 button screws, washers and locknuts. Do not fully tighten at this stage as minor adjustments will be required to suit the length of the rack (refer to Figure 87).



Figure 88 – Attach Rack Mount Adaptors to Outer Slides

6. Test fit the rack slide into your rack to determine the spacing of the rack mount adaptors.

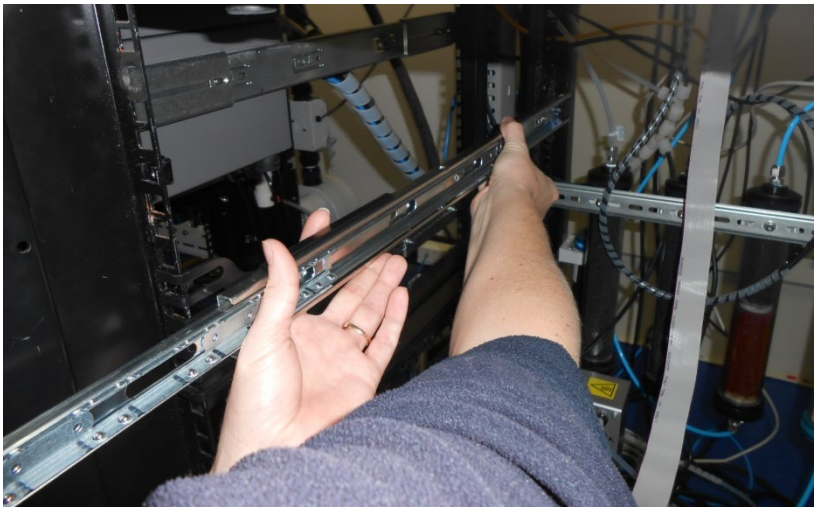

Figure 89 – Test Fit the Rack Slide Assembly into Your Rack

7. Install the two assembled outer slide rails onto the left and right side of the rack securely with M6 bolts; washer and locknuts/cage nuts (refer to Figure 89).

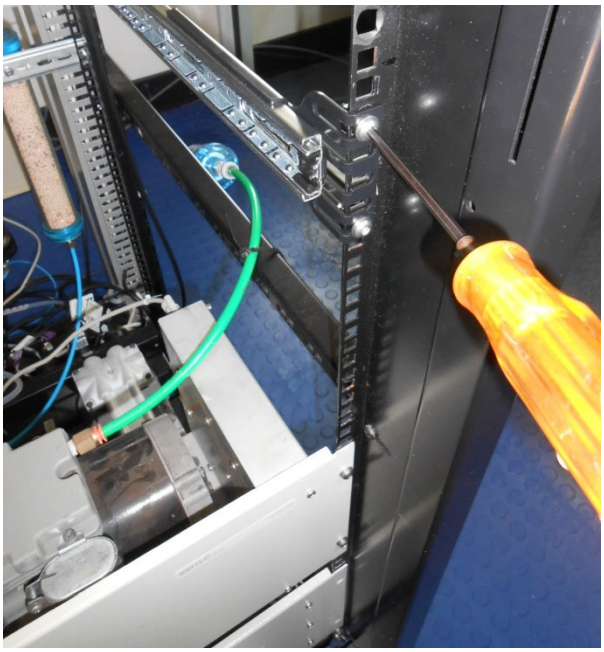

Figure 90 – Attach Slides to Front of Rack

8. Now carefully insert the instrument into the rack by fitting the instrument slides into the mounted rails. Ensuring that the rack slide locks engage on each side (you will hear a click from both sides).



CAUTION

When installing this instrument ensure that appropriate lifting equipment and procedures are followed. It is recommended that two people lift the instrument into the rack due to the weight, unless proper lifting equipment is available.

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

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

To Remove the Instrument

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

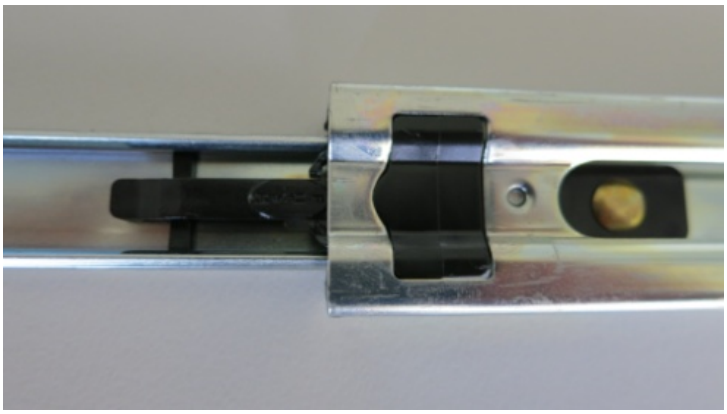

Figure 91 – Slide Clips

8.2 Network Port (PN: E020101)

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

- Refer to Section 3.5.40, for details on the network menu.
- Refer to Section 4.3, for details on network setup.

8.2.1 Hardware Setup

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

Procedure

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

8.3 Metric Fittings Kit (PN: E020122)

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

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9. Spare Parts and Schematics

9.1 Maintenance Kit (PN: E020325)

Routine maintenance parts that may be required.

Table 9 – Serinus Cal 300 Maintenance Kit (PN: E020325)

Description	Part Number
FILTER SINTERED SS	F010004
FILTER DFU 23 MICRON	F010005
SPRING, COMPRESSION, SS	H010062
O-RING, 1/2ID X 3/32W,	O010005
O-RING, 1/2ID X 1/16W,	O010008
O-RING, 0.114ID X 1/16W,	O010012
O-RING, 5/32ID X 1/16W,	O010013
O-RING .364ID X .07W SILICONE	O010024
O-RING .359ID X .139W SILICONE	O010025
O-RING 1.862ID X 0.103W,	O010030
O-RING, 7.5 X 1.0, VITON,	O010046
TUBING, 1/4 x 1/8,	T010026

9.2 Serinus Cal Service Kit (PN: E020320)

Assorted fittings, tubing and orifice removal tool useful when working on the instrument's internal pneumatics.

Table 10 – Serinus Accessories Kit

Part Description	Part Number
FITTING, KYNAR, UNION TEE, 1/8 BARB	F030007
FITTING, KYNAR, UNION ELBOW, 1/8 BARB	F030008
FITTING NUT 1/4T KYNAR DOUBLE PLASTIC FERRULE	F030024
FITTING, NUT 1/4T S/S	28800400-3
FITTING SWAGELOK FERRULE 1/4T S/S	28820400-3
FITTING NUT 1/4T KYNAR PLUG BLIND NUT	036-130440-2
FITTING, PLUG, 1/4T S/S	28840400-3
FITTING, CAP, 1/4T S/S	28860400-3
FITTING, PLUG, 1/8T S/S	28840200-3
FITTING, CAP, 1/8T S/S	28860200-3

Part Description	Part Number
ADAPTOR, 1/4" FITTING TO 1/8" BARB	H010007
ADAPTOR,1/4" TUBE TO 1/8" BARB	H010008
ORIFICE AND FILTER EXTRACTION TOOL	H010046
TYGON TUBING, 1/4 X 1/8 (3 FT)	T010011
TEFLON, TUBING, CLEAR 1/8 X 1/16 (1 MTR)	TUB-1000
BLACK RUBBER CAP, 1/8	H030003
FITTING KYNAR UNION TEE 1/8T	F030034-01

9.3 Consumables

Instrument components that will require replacement over the course of the instrument's lifespan.

Table 11 – Serinus Cal 300 Consumables

Part Description	Part Number	Replacement Lifespan Estimate*
ECOTECH TUBING, 25 FT LENGTH	T010026-01	Subject to use
UV LAMP ASSY, PHOTOMETER	C020077	2 Years+
UV LAMP ASSY, OZONE GENERATOR	C020124-50	2 Years+
SILICONE HEATSINK COMPOUND 50g	C050013	Subject to use
ORIFICE W/ O-RING GROOVE, 4Ml	H010043-02	Subject to use
ORIFICE W/ O-RING GROOVE, 7Ml	H010043-05	Subject to use
ORIFICE W/ O-RING GROOVE, 8Ml	H010043-06	Subject to use
PUMP ASSY, SERINUS CAL	H010030	6 months+
REBUILD KIT, DIAPHRAGM PUMP, SUIT H010030	P031005	Replacement part
PUMP ASSY, INTERNAL DILUENT	H013200	1 year +
PUMP REBUILD KIT, TO SUIT H013200, VITON DIAPHRAGM	P031006	Replacement part
FILTER DFU 23 MICRON DIF-BN70	F010005	12 months+
OZONE SCRUBBER	H013120	2 Years+
CARULITE SCRUBBER - (scrubbing for internal diluent air)	H013145	Subject to use
CATALYST CARULITE, 1KG BOTTLE	C050008	Replacement media
SCRUBBER ASSY, MOLECULAR SIEVE W/ INDICATOR, COBALT FREE	H030510	Subject to use
MOLECULAR SIEVE 4A, 1KG BOTTLE	ECO-1036	Replacement media
SILICA GEL, SELF INDICATING, COBALT FREE, 500 GRAM BOTTLE	C050030-05	Replacement media

***Warranty Disclaimer:** The product is subject to a warranty period on parts and labour from the date of shipment (the warranty period). The warranty period commences when the product is shipped from the factory. **Lamps, fuses, batteries and consumable items are not covered by this warranty.**

Subject to use refers to variable ambient conditions, toxic gases, dirt, extremes of temperature and moisture ingress may shorten the lifespan of components.

9.4 Instrument Parts List

List of Serinus Cal 300 components and part numbers for user reference.

Table 12 – Spare Parts List

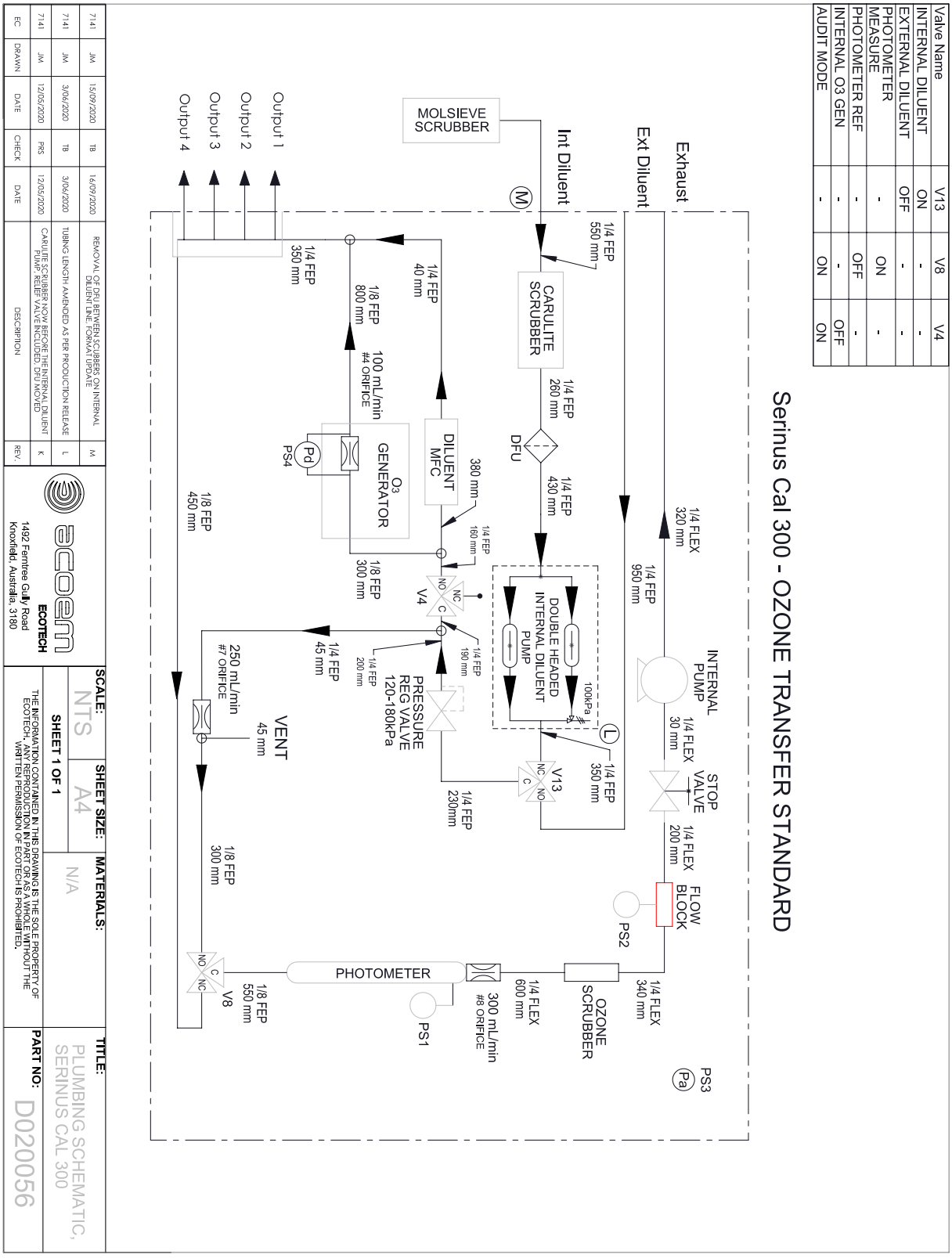
Part Description	Part Number
PCA, PRESSURE GAUGE - (used in H013165 and H013190)	C010004
PCA, PRESSURE DIFFERENTIAL - (used in H013140 ozone generator)	C010005-01
PCA, LAMP DRIVER GAS ANALYZER	C010006
PCA, OZONE DETECTOR	C010007
PCA, OZONE GENERATOR	C010012
PCA, MAIN CONTROLLER, CALIBRATOR	E020220-02
PCA, REAR PANEL, CALIBRATOR, STANDARD	C010002-02
PCA, REAR PANEL, CALIBRATOR, with NETWORK PORT	C010002-20
POWER SUPPLY	P010013
FRONT PANEL ASSEMBLY	H010130
OZONE SELECTIVE SCRUBBER - (to protect the internal photometer pump)	H013120
CARULITE SCRUBBER - (scrubbing ozone for internal diluent air)	H013145
O-RING 1.862ID X 0.103W - (used in H013145 Carulite scrubber)	O010030
OZONE GENERATOR ASSEMBLY	H013140
UV LAMP ASSEMBLY - (used in H013140 ozone generator)	C020124-50
GASKET, OZONE GENERATOR	H013152
REGULATOR, PRESSURE ASSEMBLY	R010002-50
SHIELDED PHOTOMETER ASSEMBLY,	H013190
UV LAMP ASSEMBLY - (used in H013190 shielded photometer)	C020077
SENSOR, PHTOTUBE, UV, R765-01 - (used in H013190 shielded photometer)	H013111-01
QUARTZ WINDOW 1/2 - (used in H013190 shielded photometer)	H013112
REACTION CELL TUBE - (used in H013190 shielded photometer)	H013113
FLOW BLOCK ASSEMBLY	H013165
THERMAL ISOLATOR, FLOW BLOCK	H010119
PUMP ASSEMBLY, VACUUM - (sample pump for the shielded photometer)	H010030
REBUILD KIT, DIAPHRAGM PUMP, SUIT H010030	P031005
MASS FLOW CONTROLLER - 5 SLPM	ZUN-UFC180-005L

Part Description	Part Number
GASKET, MASS FLOW CONTROLLER	HAR-6100
PUMP ASSEMBLY, INTERNAL DILUENT	H013200
RELIEF VALVE ASSY, 100kPa, IN BARB ADAPTOR (H010007) FITTING	H030174
PUMP REBUILD KIT, TO SUIT INTERNAL DILUENT PUMP	P031006
VALVE, 90 DEG TAP, POLY-CARB, WITH LUER CONNECTIONS	H030170
FAN,COOLING - (used on the rear panel)	C020058
HEATER AND THERMISTOR ASSEMBLY - (used in H013190, H013165 and H013140)	C020073
THERMISTOR ASSEMBLY - (used in H013190 shielded photometer)	C020142
MANIFOLD ASSEMBLY, OUTPUT - (rear panel output ports)	H013170-02
VALVE ASSY, OZONE SUITABLE, 1/8T FITTINGS, PHOTOMETER - (V8)	H013210
MANIFOLD ASSEMBLY, DILUENT - (V13)	H013180-02
FITTING, 1/8T - 1/4-28 UNF, INVERTED CONE TYPE (for V8 assy)	F030102
FERRULE, INVERTED CONE, SUIT 1/8 TUBING (for V8 assy)	F030103
MANIFOLD ASSEMBLY, AUDIT - (V4)	H013180-03
GASKET, MANIFOLD, INTERNAL	H013186
CABLE, PRESSURE	C020062-02
CABLE, DISPLAY	C020065
CABLE, EXTERNAL I/O	C020066
CABLE, PREAMP	C020080
CABLE, HEATER/THERMISTOR	C020083
CABLE, BLUETOOTH	C020119
CABLE, HEATER	C020125
CABLE, OZONE GEN CONTROL	C020132-01
CABLE, VALVE POWER/ LAMP DRIVER	C020141
CABLE, FAN POWER	C020146
CABLE, INTERNAL PUMP CONTROL	C020147
CABLE, MFC CONTROL	C020148
CABLE, VALVE POWER	C020149
CABLE, DILUENT VALVE	C020152
CABLE, OZONE FLOW/ PHOTOMETER	C020153
USB MEMORY STICK, ATLEAST 8 Gb	H030021
GASKET, PRESSURE SENSOR	H010037
VALVE, BULLET, 3 WAY	H010058
FITTING, MALE CONNECTOR, 1/8 BARB - 1/8NPT, 400 SERIES PVDF	F030006-01
FITTING, KYNAR, UNION TEE	F030007-01
FITTING KYNAR MALE CONNECTOR	F030020

Part Description	Part Number
FITTING KYNAR BULKHEAD UNION	F030023
FERRULE PTFE STRAIGHT 1/4	F030028
FITTING NUT 1/4T STEEL GRIPPER	F030029
FITTING KYNAR UNION ELBOW	F030030
FERRULE, PTFE, REDUCING, 1/4-1/8	F030031
FITTING KYNAR MALE ELBOW	F030032-02
FITTING KYNAR UNION TEE	F030034-02
FITTING SMC MALE ELBOW	FIT-KQ2L07-01S
FITTING SMC MALE CONNECTOR 1/4T - 1/8BSPT	FIT-KQ2H07-01S
FITTING KYNAR MALE CONNECTOR	28001143-1
FITTING KYNAR MALE CONNECTOR	28001143-6
ADAPTOR, 1/4" FITTING TO 1/8" BARB	H010007
ADAPTOR, 1/4" TUBE TO 1/8" BARB	H010008
FERRULE PTFE STRAIGHT 3/8	F030002
PLUG KYNAR 1/8 NPT - (used in H013140 ozone generator)	HAR-3660
O-RING, 1/2ID X 3/32W - (used in H013190 shielded photometer)	O010005
O-RING, 1/2ID X 1/16W - (used in H013190 shielded photometer)	O010008
O-RING, 0.114ID X 1/16W - (used in H013190 and H013140)	O010012
O-RING, 5/32ID X 1/16W - (used in H013190 and H013140)	O010013
O-RING .364ID X .07W SILICONE - (used in H013190 shielded photometer)	O010024
O-RING .359ID X .139W SILICONE - (used in H013190 shielded photometer)	O010025
O-RING, 7.5 X 1.0, VITON - (used in H013180 and H013180-02)	O010046
TUBING, 1/4 x 1/8, FLEXIBLE SILICONE WITH PVDF LINING, PER FOOT	T010026
TUBING TEFLON 1/8 CLEAR	TUB-1000
TUBING TEFLON 1/4 THICK WALL	TUB-1003
SPRING, COMPRESSION, STAINLESS STEEL - (used in H013190 and H013140)	H010062
FILTER SINTERED, STAINLESS STEEL - (used in H013190 shielded photometer)	F010004
FILTER DFU 23 MICRON	F010005
ORIFICE W/O-RING GROOVE, 8ML - (used in H013190 shielded photometer)	H010043-06
ORIFICE W/O-RING GROOVE, 4ML - (used in H013140 ozone generator)	H010043-02
ORIFICE W/O-RING GROOVE, 7ML - (used in reference air tee)	H010043-05

9.5 Plumbing Schematic – (PN: D020056)

Valve Name	V13	V8	V4
INTERNAL DILUENT	ON	-	-
EXTERNAL DILUENT	OFF	-	-
PHOTOMETER MEASURE	-	ON	-
PHOTOMETER REF	-	OFF	-
INTERNAL O3 GEN	-	-	OFF
AUDIT MODE	-	ON	ON



REV.	DESCRIPTION	DATE	CHECK	DRAWN	DATE	EC
M	REMOVAL OF DFU BETWEEN SCUBBERS ON INTERNAL DILUENT LINE FORMAT UPDATE	16/09/2020	TB	JM	15/09/2020	7141
L	TUBING LENGTH AMENDED AS PER PRODUCTION RELEASE	3/04/2020	TB	JM	3/06/2020	7141
K	CARULITE SCRUBBER NOW BEFORE THE INTERNAL DILUENT PUMP, RELIEF VALVE INCLUDED, DFU MOVED	12/04/2020	PRS	JM	12/05/2020	7141

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1492 Ferntree Gully Road
Knoxfield, Australia, 3160

SCALE: NTS
SHEET SIZE: A4
SHEET 1 OF 1
MATERIALS: N/A

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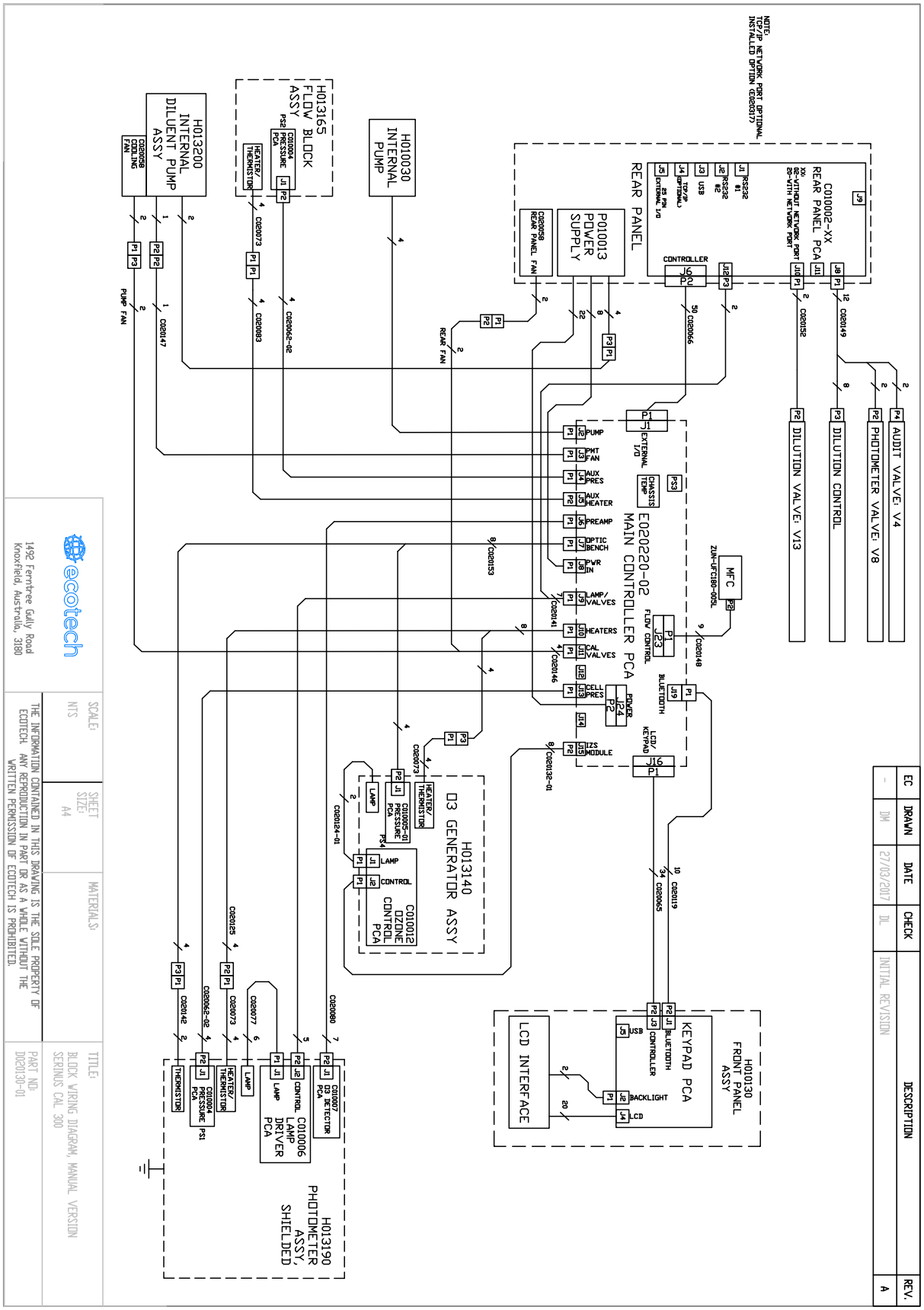
TITLE: PLUMBING SCHEMATIC, SERINUS CAL 300
PART NO: D020056

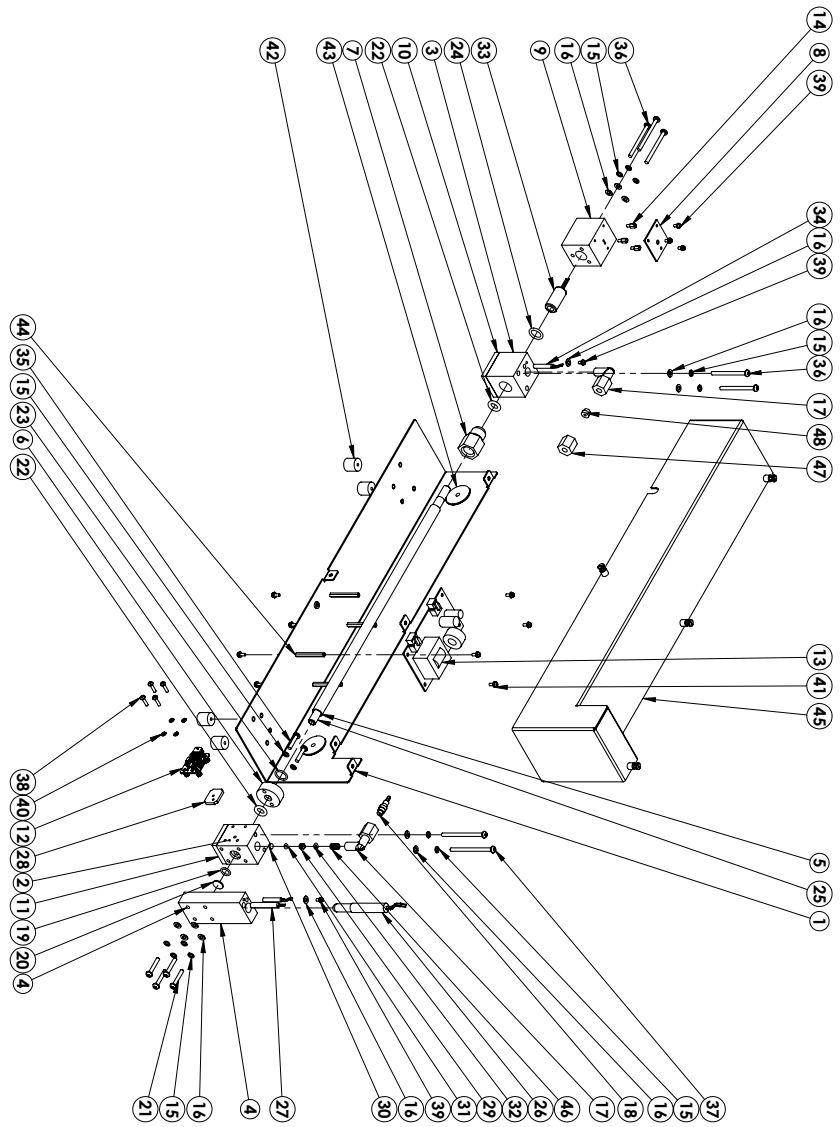
9.6 Block Wiring Schematic – (PN: D020130-01)



9.7 Shielded Photometer Assembly Exploded View – (PN: H013190)

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H013191	BASE, MEASUREMENT CELL, SHIELDED	1
2	H013104	MOUNTING BLOCK, LAMP AND OZONE CELL	1
3	H013105-01	MOUNTING BLOCK, SENSOR AND OZONE CELL	1
4	H013106	MOUNTING BLOCK, LAMP, OZONE	1
5	H013102	COVER, TUBE, OZONE CELL	1
6	H013108	COLLET, COVER, OZONE CELL	1
7	H013107	COLLET, TUBE, OZONE CELL	1
8	C010007	PCA OZONE DETECTOR GAS ANALYZER	1
9	H013103	HOUSING, SENSOR, OZONE	1
10	H013193	ISOLATOR, MEASUREMENT CELL, DETECTOR END, O3	1
11	H013194	ISOLATOR, MEASUREMENT CELL, LAMP END, O3	1
12	C010004	PCA, PRESSURE GAUGE, GAS ANALYZER	1
13	C010006	PCA LAMP DRIVER GAS ANALYZER	1
14	F030016	HEX SPACER, M3x6, MALE-FEMALE	3
15	FAS-M4ZP-21	M4 SPRING WASHER	13
16	FAS-M4ZP-22	M4 FLAT WASHER	13
17	F030032-02	FITTING KYNAR MALE ELBOW 1/4T - 1/8NPT	2
18	H010007	ADAPTOR, 1/4" FITTING TO 1/8" BARB	1
19	O010024	O-RING .364ID X .07W SILICONE	1
20	H013112	QUARTZ WINDOW 1/2	1
21	FAS-M4ZP-7	M4X25 PAN PHILLIPS	4
22	O010025	O-RING .359ID X .139W SILICONE	2
23	O010008	O-RING, VITON	1
24	O010005	O-RING BS112, SILICONE	1
25	H013113	REACTION CELL TUBE FIRE POLISH & ANNEAL ENDS	1
26	C020077	LAMP, UV, OZONE GAS ANALYZER	1
27	C020073	HEATER AND THERMISTOR, SINGLE HEATER, GAS ANALYZER	1
28	H010037	GASKET,PRESSURE SENSOR	1
29	H010043-06	ORIFICE 8 MIL	1
30	R010004	FILTER SINTERED SS	1
31	O010012	O-RING 5/32ID X 1/16W, VITON	1
32	O010013	O-RING 5/32ID X 1/16W, VITON	1
33	H013111	TUBE UV, R765-01 9810 9850	1
34	C020142	THERMISTOR ASSY ENCASEMENT	1
35	FAS-M4ZP-6	M4 x 20, PAN PH, ZP	2
36	FAS-M4SS-28	M4X50 PAN HEAD PHILLIPS SCREW SS	5
37	R050028	M4X40 PAN HEAD PHILLIPS SCREW	2
38	FAS-M3ZP-4	M3X12 PAN HEAD PHILLIPS SCREW	4
39	R050011	M3X6 SEMS PAN HEAD PHILLIPS SCREW	5
40	FAS-M3ZP-20	M3 SPRING WASHER	4
41	R050018	M3X10 SEMS PAN HEAD PHILLIPS SCREW	8
42	H030164	ISOLATOR MOUNT, RUBBER, FEMALE TO FEMALE, M4, 15MM	4
43	H030193	GROMMET, 1/8"IDx 1-1/4"OD, NEOPRENE	2
44	R050115	HEX SPACER, M3x40, BRASS NICKEL PLATED, FEMALE/FEMALE	4
45	H013192	COVER, OPTICAL BENCH, SHILDED	1
46	H010062	SPRING COMPRESSION, 0.24 DIA 0.630 mm wire	1
47	R030029	FITTING NUT 1/4T KYNAR STEEL, GRIPPER FERRULE	1
48	F030031	FERRULE PTFE REDUCING 1/4-1/8	1

EC	DRAWN	DATE	CHECK	DATE	DESCRIPTION	REV.
7141	JM	15/07/2016	ND		INITIAL DRAWING	A
7141	JM	18/01/2019	VC		FITTING NOW 28001.46- 1 WAS F030032-02. REMOVED 2X GROMMETS	B
7141	JM	12/05/2020	TB	14/05/2020	DETECTOR BLOCK H013105-01 ADDED, WAS H013105, ADDED MISSING PARTS	C



THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETRES. REMOVE BURRS AND SHARP EDGES.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED: TOLERANCES ARE: LINEAR: .X ±0.5 .XX ±0.25 .XXX ±0.127 ANGULAR: ±1° MACH. FILLET R.10, 0.5MAX CONCENTRICITY: 0.10TIR PERPENDICULARITY: 0.10 SURFACE TEXTURE: N7 TO N8

Ecotech

1/472 Tremtree Gully Road Knoxfield, Australia, 3180

SCALE: 1:5 | SHEET SIZE: A3 | SHEET 1 OF 1

MATERIALS: SEE BOM

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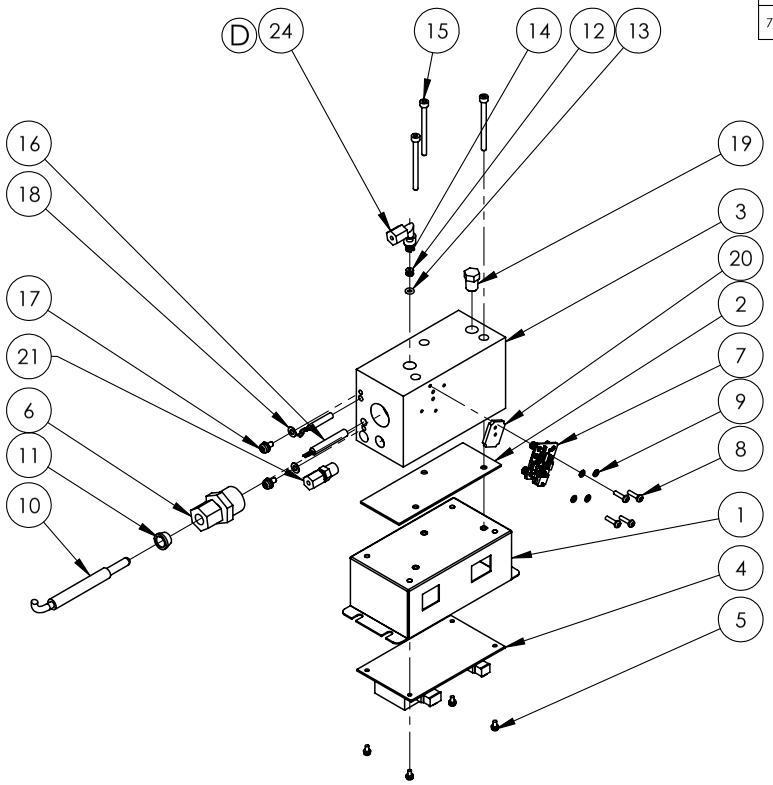
TITLE: SHIELDED PHOTOMETER ASSY, OZONE, SERINUS CAL

PART NO: H013190

NOTE:
1. ITEM 22 & 23 NOT SHOWN

EC	DRAWN	DATE	CHECK	DATE	DESCRIPTION	REV.
7141	JM	19/07/2016	ND		INITIAL ISSUE	A
7141	JM	23/08/2016	ND		ADDED H010037, REMOVED 1x F010004 & O010012, H010043-02 WAS H010043-06	B
7141	JM	4/04/2017	CJ		ADDED 1x 28001143-1, REMOVED 1x F030006-01. ADDED INSULATION PARTS TO BOM	C
7141	JM	14/05/2020	TB	14/05/2020	1x 28001146-1 ADDED WAS F030032-02, LOGO UPDATED	D



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H012108	COVER, LAMP DRIVER PCB	1
2	H013152	GASKET, OZONE GEN	1
3	H013141	BLOCK, OZONE GEN, W/ PRESSURE SENSOR MOUNT	1
4	C010012	PCA, IZS CONTROLLER, OZONE GAS ANALYZER	1
5	F050011	M3X6 SEMS PAN HEAD PHILLIPS SCREW	4
6	28001143-6	FITTING KYNAR MALE CONNECTOR 3/8T - 1/2NPT	1
7	C010005-01	PCA, PRESSURE GAUGE, GAS ANALYZER	1
8	FAS-M3ZP-4	M3X12 PAN HEAD PHILLIPS SCREW	4
9	FAS-M3ZP-20	M3 SPRING WASHER	4
10	C020124-01	CABLE, IZS OZONE LAMP, SERICAL	1
11	F030002	FERRULE PTFE STRAIGHT 3/8	1
12	H010043-02	ORIFICE 4MIL	1
13	O010013	O-RING 5/32ID X 1/16W, VITON	1
14	H010062	SPRING COMPRESSION, 0.24 DIA 0.630 mm wire	1
15	FAS-M4SS-26	M4x50 SHCS, SS	3
16	C020073	HEATER AND THERMISTOR, SINGLE HEATER, GAS ANALYZER	1
17	F050022	M4 X 8 SEMS	2
18	FAS-M4ZP-22	M4 FLAT WASHER	2
19	HAR-3660	PLUG, 1/8 NPT, KYNAR	1
20	H010037	GASKET,PRESSURE SENSOR	1
21	28001143-1	FITTING, KYNAR, MALE CONNECTOR 1/8T - 1/8NPT	1
22	H013142	INSULATOR, OZONE GENERATOR, FOAM	1
23	LAMP INSULATOR	INSULATION, 1/2" ID x 7/8 WT	1
24	28001146-1	FITTING KYNAR MALE ELBOW 1/8T - 1/8NPT	1

D

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SCALE: 1:5 | SHEET SIZE: A4 | SHEET 1 OF 1

MATERIALS: SEE BOM

TITLE: OZONE GENERATOR ASSY, SERINUS CAL 300

PART NO: H013140

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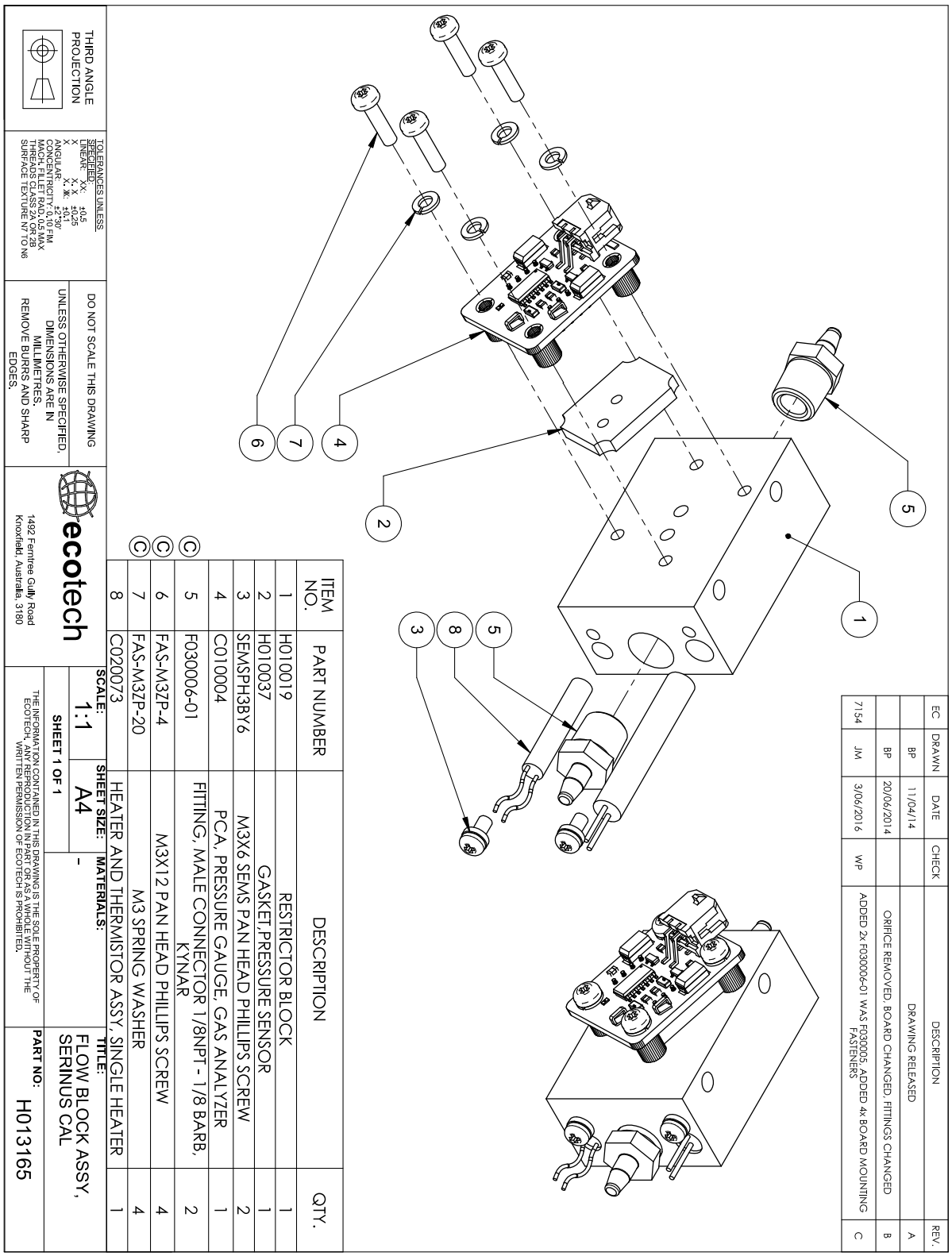
9.9 Flow Block Assembly Exploded View – (PN: H013165)



REV.	DESCRIPTION	CHECK	DATE	DRAWN	EC
A	DRAWING RELEASED		11/04/14	BP	
B	ORIFICE REMOVED, BOARD CHANGED, FITINGS CHANGED		20/06/2014	BP	
C	ADDED 2x F030006-01 WAS F030005, ADDED 4x BOARD MOUNTING FASTENERS	WP	3/06/2016	JM	7154

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H010019	RESTRICTOR BLOCK	1
2	H010037	GASKET,PRESSURE SENSOR	1
3	SEMSPH3BY6	M3X6 SEMS PAN HEAD PHILLIPS SCREW	2
4	C010004	PCA, PRESSURE GAUGE, GAS ANALYZER	1
Ⓒ 5	F030006-01	FITTING, MALE CONNECTOR 1/8NPT - 1/8 BARB, KYNAR	2
Ⓒ 6	FAS-M3ZP-4	M3X12 PAN HEAD PHILLIPS SCREW	4
Ⓒ 7	FAS-M3ZP-20	M3 SPRING WASHER	4
8	C020073	HEATER AND THERMISTOR ASSY, SINGLE HEATER	1

THIRD ANGLE PROJECTION

TOLERANCES UNLESS SPECIFIED:
LINEAR: X ±0.5, .XX ±0.25
ANGULAR: X° ±1°, .X° ±0.5°
CONCENTRICITY Ø 0.10 FIM
MACH. FILLET RAD.0.5 MAX
THREADS CLASS 2A OR 2B
SURFACE TEXTURE N7 TO N6

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETRES. REMOVE BURRS AND SHARP EDGES.

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SCALE: 1:1 | SHEET SIZE: A4 | SHEET 1 OF 1

MATERIALS: -

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TITLE: FLOW BLOCK ASSY, SERINUS CAL

PART NO: H013165

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9.10 Photometer Valve Manifold (V8) – (PN: H013180)

NOTES

1. NOTE THE ORIENTATION OF FERRULES, FLAT SIDE MUST FACE TOWARD VALVE BODY

REV.	DESCRIPTION	DATE	CHECK	DATE	DRAWN
A	INITIAL DRAWING	14/05/2020	TB	14/05/2020	JM
					EC

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H013216	VALVE, ISOLATION, SOLENOID, 12VDC, OZONE SUITABLE	1
2	F030102	FITTING, 1/8T - 1/4-28 UNF, INVERTED CONE	3
3	F030103	FERRULE, INVERTED CONE, SUIT F030102, EFTE	3

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETRES.

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SCALE: 1:1
SHEET SIZE: A4
SHEET 1 OF 1
MATERIALS: SEE BOM

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TITLE: VALVE ASSY, OZONE SUITABLE, 1/8T FITTINGS

PART NO: H013210

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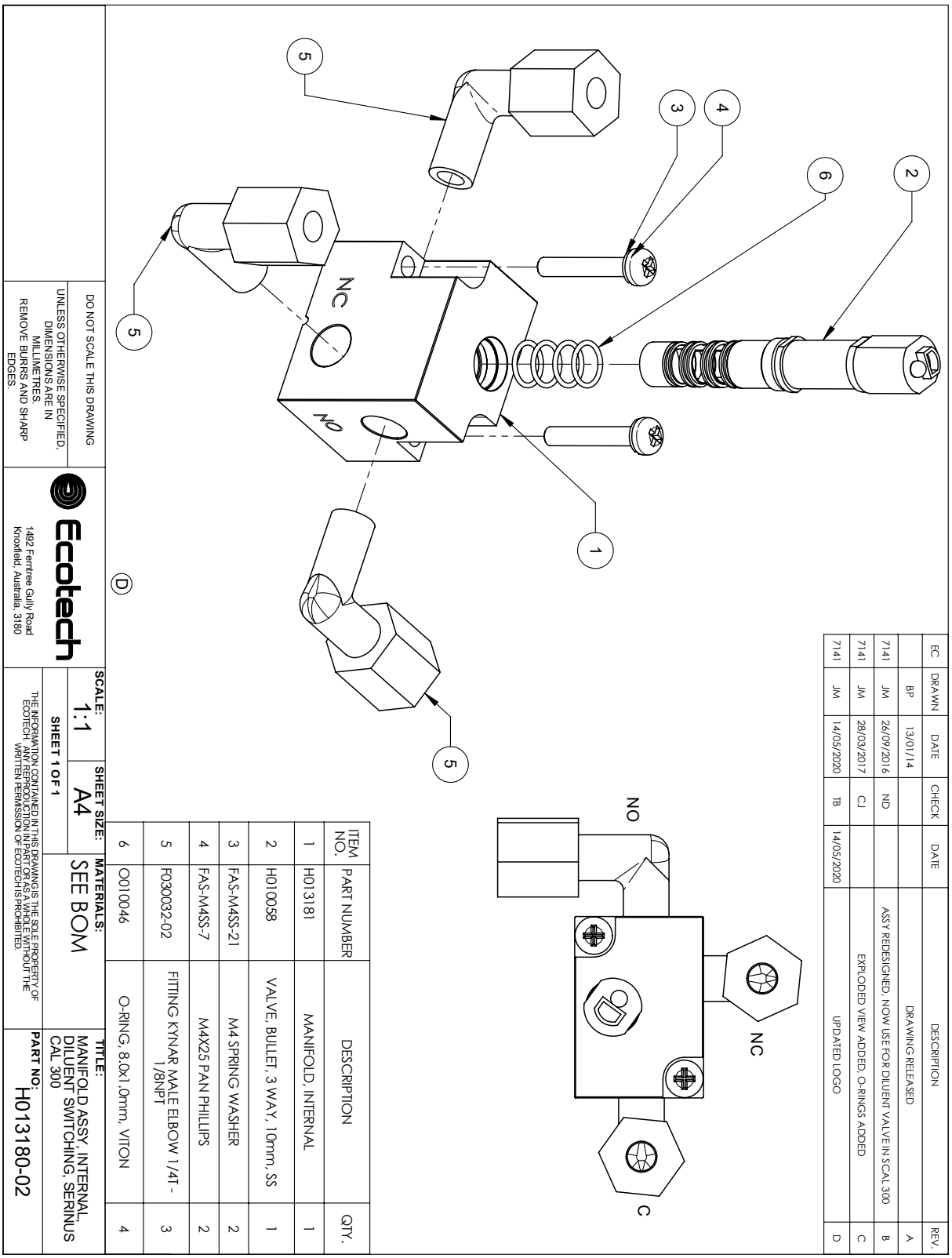
9.11 Dilution Valve Manifold (V13) – (PN: H013180-02)



REV.	DESCRIPTION	DATE	CHECK	DATE	DRAWN	EC
A	DRAWING RELEASED			13/01/14	BP	
B	ASSY REDESIGNED, NOW USE FOR DILUENT VALVE IN SCAL 300		ND	26/09/2016	JM	7141
C	EXPLODED VIEW ADDED, O-RINGS ADDED		CJ	28/03/2017	JM	7141
D	UPDATED LOGO	14/05/2020	TB	14/05/2020	JM	7141

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H013181	MANIFOLD, INTERNAL	1
2	H010058	VALVE, BULLET, 3 WAY, 10mm, SS	1
3	FAS-M4SS-21	M4 SPRING WASHER	2
4	FAS-M4SS-7	M4X25 PAN PHILLIPS	2
5	F030032-02	FITTING KYNAR MALE ELBOW 1/4T - 1/8NPT	3
6	O010046	O-RING, 8.0x1.0mm, VITON	4

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETRES. REMOVE BURRS AND SHARP EDGES.

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SCALE: 1:1 | SHEET SIZE: A4 | SHEET 1 OF 1

MATERIALS: SEE BOM

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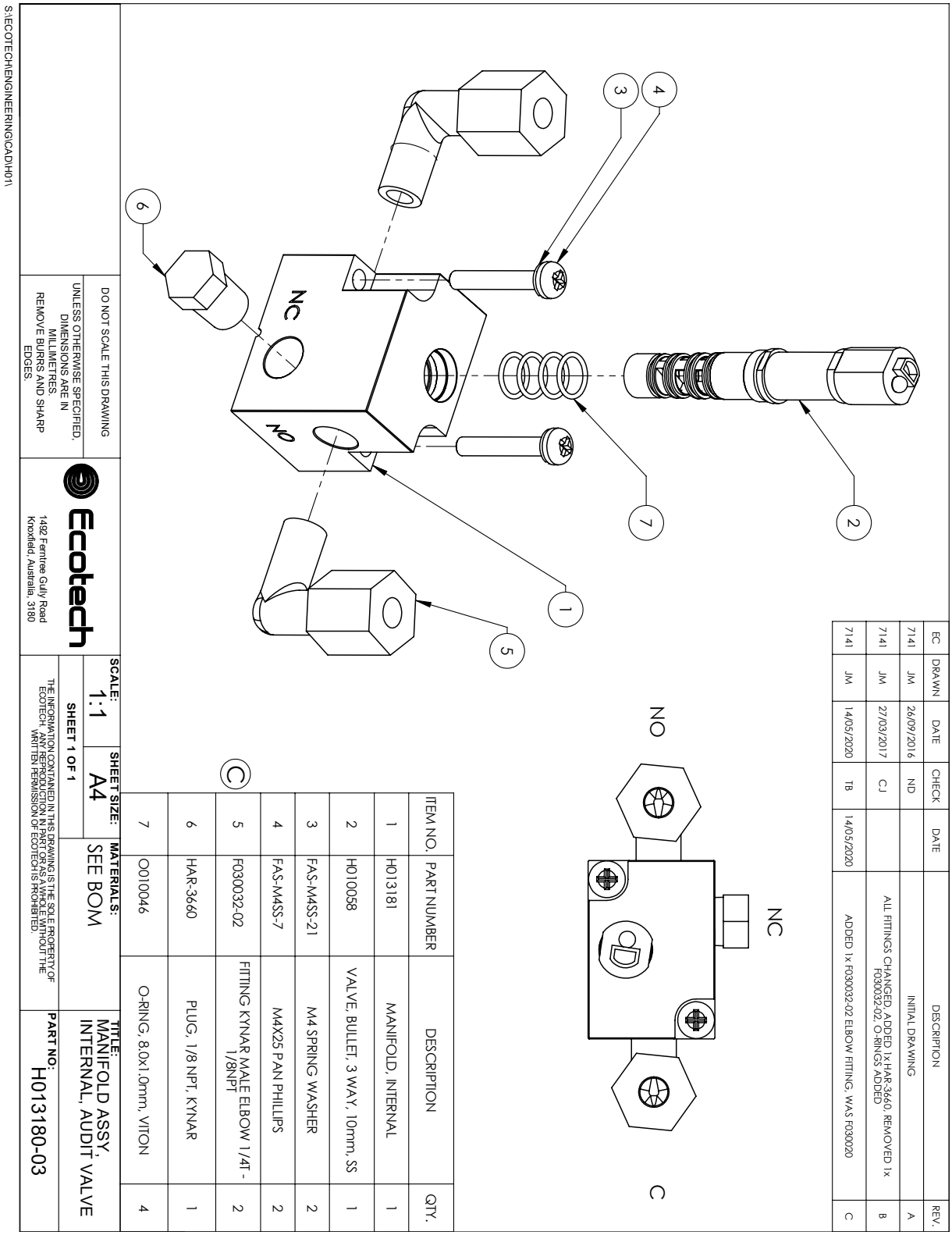
TITLE: MANIFOLD ASSY, INTERNAL, DILUENT SWITCHING, SERINUS CAL 300

PART NO: H013180-02

9.12 Audit Valve Manifold (V4) – (PN: H013180-03)



REV.	DESCRIPTION	DATE	CHECK	DATE	DRAWN	EC
A	INITIAL DRAWING		ND	26/09/2016	JM	7141
B	ALL FITTINGS CHANGED, ADDED 1x HAR-3660, REMOVED 1x F030032-02, O-RINGS ADDED	14/05/2020	CJ	27/03/2017	JM	7141
C	ADDED 1x F030032-02 ELBOW FITTING, WAS F030020	14/05/2020	TB	14/05/2020	JM	7141

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H013181	MANIFOLD, INTERNAL	1
2	H010058	VALVE, BULLET, 3 WAY, 10mm, SS	1
3	FAS-M4SS-21	M4 SPRING WASHER	2
4	FAS-M4SS-7	M4X25 PAN PHILLIPS	2
5	F030032-02	FITTING KYNAR MALE ELBOW 1/4T - 1/8NPT	2
6	HAR-3660	PLUG, 1/8 NPT, KYNAR	1
7	O010046	O-RING, 8.0x1.0mm, VITON	4

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETRES.
REMOVE BURRS AND SHARP EDGES.

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SCALE: 1:1 | SHEET SIZE: A4 | SHEET 1 OF 1

MATERIALS: SEE BOM

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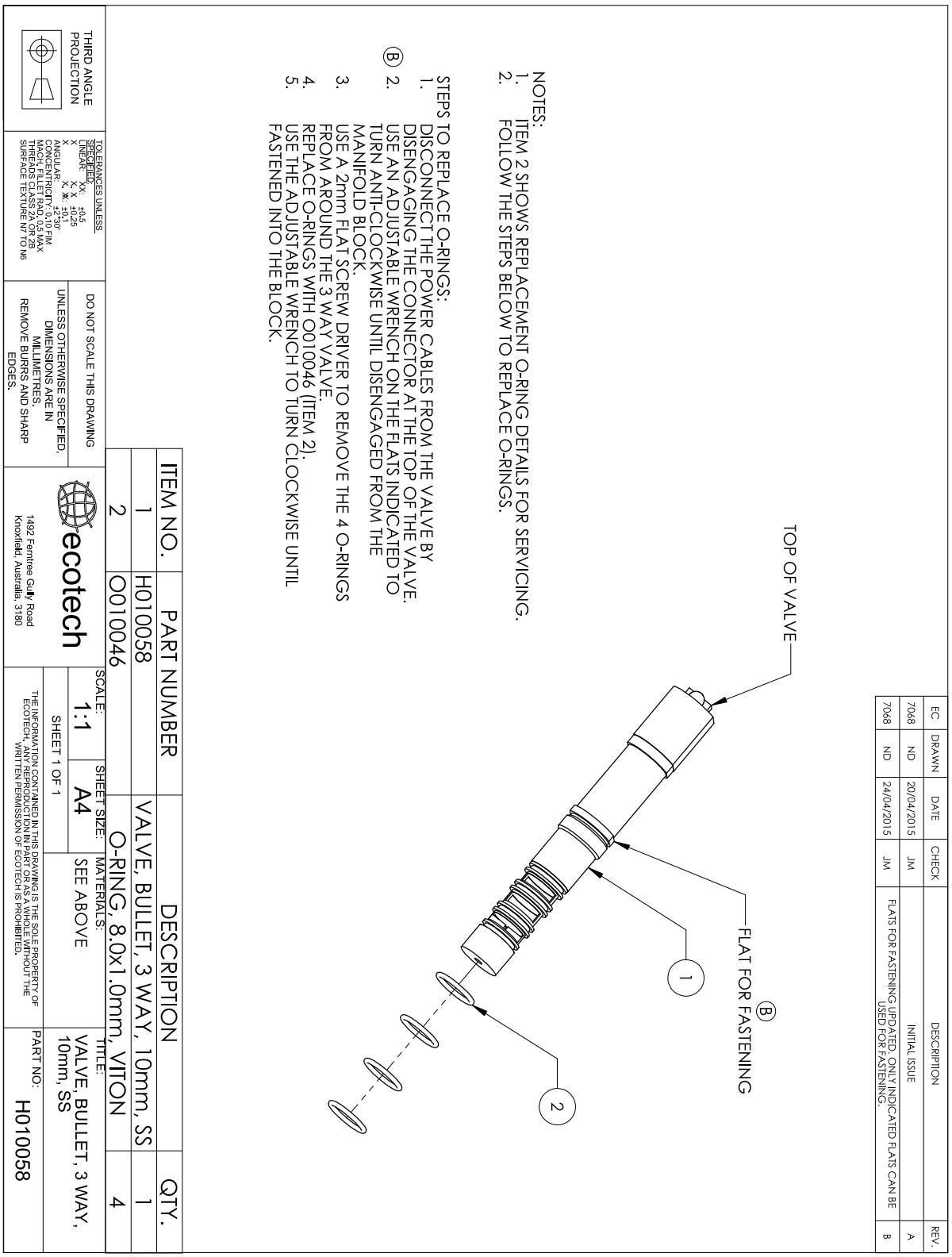
TITLE: MANIFOLD ASSY, INTERNAL, AUDIT VALVE

PART NO: H013180-03

9.13 Bullet Valve – (PN: H010058)



9.14 Internal Diluent Pump Assembly – (PN: H013200)

REV.	DESCRIPTION	DATE	CHECK	DRAWN	DATE
A	INITIAL DRAWING		ND	JM	25/07/2016
B	ADDED BRACKETS, FEET AND FASTENERS		TB	JM	4/04/2017
C	INLET FITTINGS NOW PUSH-IN STRAIGHT FITTINGS, ADDED TUBING TO MODEL. ADDED RELIEF VALVE	14/05/2020	TB	JM	14/05/2020

DESCRIPTION	ITEM NO	CONNECTOR DESC.	PIN	CRIMP	CABLE
+12V	4	P1	3	6	RED
0V	4	P1	1	6	BLACK
SIGNAL	5	P2	2	7	BROWN

NOTES
1. ITEMS 11 & 12 NOT SHOWN

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	P030014	DIAPHRAGM PUMP, TWIN HEAD, 12VDC	1
2	FIT-KQ2L07-01S	FITTING, SMC, MALE ELBOW, 1/4T - 1/8 BSP	2
3	H011141	BRACKET, INTERNAL PUMP, NOX	2
4	F050022	M4 X 8 SEMS	16
5	H030164	ISOLATOR MOUNT, RUBBER, FEMALE TO FEMALE, M4, 15MM	4
6	H010005	FAN BRACKET OPTICAL BENCH	1
7	C020038	FAN, BACK PANEL, SERINUS	1
8	FIT-KQ2H07-01S	FITTING, PUSH-IN, MALE CONNECTOR, 1/4T - 1/8 BSPT	2
9	F030034-02	FITTING, TEE UNION, 1/4T, KYNAR	3
10	H030174	RELIEF VALVE ASSY, 100kPa, ADAPTOR HOUSING	1
11	C030135-01	CONNECTOR, MINIFIT, 4 PIN, MALE	1
12	C030217	CONNECTOR, MICROFIT, 2 PIN, RECEPTACLE	1

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETRES.
REMOVE BURRS AND SHARP EDGES.

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1492 Ferntree Gully Road
Knoxfield, Australia, 3180

SCALE: 1:3 | SHEET SIZE: A4 | SHEET 1 OF 1

MATERIALS: SEE BOM

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TITLE: PUMP ASSY, INTERNAL, SERINUS CAL 300

PART NO: H013200

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Appendix A. Advanced Protocol

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

A.1 Command Format

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

Table 13 – Packet Format

1	2	3	4	5	6 … 5+n	6+n	7+n
STX (2)	Serial ID	Command	ETX (3)	Message Length (n)	Message	Checksum	EOT (4)

Where:

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

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

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

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

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

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

Examples

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

Table 14 – Example: Primary Gas Request

Byte Number	1	2	3	4	5	6	7	8
Description	STX	ID	Command	ETX	Message Length	Primary Gas Conc	Checksum	EOT
Value	2	0	1	3	1	50	50	4
Checksum Calculation		0	0⊕1=1		1⊕1=0	0⊕50=50	50	

And a sample response:

Table 15 – Example: Primary Gas Response

Byte Number	1	2	3	4	5	6	Continued in next table.
Description	STX	ID	Command	ETX	Message Length	Primary Gas Conc	
Value	2	0	1	3	5	50	
Checksum Calculation		0	0⊕1=1		1⊕5=4	4⊕50=54	

Table 16 – Example: Primary Gas Response (continued)

Byte Number	7	8	9	10	11	12
Description	IEEE representation of 1.00				Checksum	EOT
Value	63	128	0	0	50	4
Checksum Calculation	54⊕63=9	9⊕128=137	137⊕0=137	137⊕0=137	137	

A.2 Commands

A.2.1 Communication Error

Where:

Command byte 0

Message byte 1 0

Message byte 2 0..7

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

Table 17 – List of Errors

Error #	Description
0	Bad Checksum received
1	Invalid Parameter Length
2	Invalid Parameter
3	Internal Data Flash Erase in Progress unable to return data for a few seconds
4	Unsupported Command.
5	Another process is collecting data – unable to service request.
6	MemStick Not Connected
7	MemStick Busy

A.2.2 Get IEEE Value

Where:

Command byte 1

Message byte 1 Index from List of Parameters

Message byte 2..32 Additional indexes (optional)

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

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

Example

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

Table 18 – Example: Get IEEE Response data

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50	NO reading				51	NOx reading				52	NO2 reading			

A.2.3 Set Calibration Mode

Where:

Command byte 4

Message byte 1 85

Message byte 2-5 The IEEE representation of 0, 1, 2, or 3

0 puts the instrument into Measure mode (0,0,0,0)

1 puts the instrument into Cycle mode (63,128,0,0)

2 puts the instrument into Zero mode (64,0,0,0)

3 puts the instrument into Span mode (64,64,0,0)

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

Example

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

A.2.4 Set Calibration

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

Where:

Command byte 18

Message byte 1 0, 1, 2, or 3 where

0 = Span

1 = Zero (first zero gas)

2 = Zero (second zero gas)

3 = Zero (Third zero gas)

Message byte 2-5 The IEEE representation of the calibration value.

A.2.5 Serinus Calibrator

The Serinus Cal command byte is 19. Each individual Serinus Cal operation is controlled by the first message byte (the sub-command). The corresponding byte value is indicated in parenthesis next to each sub-command name and listed as the first parameter byte value.

A.2.5.1 General Comments

All Serinus Calibrator commands use the following constants and formats.

A.2.5.1.1 Gas Index

Gasses are referred to by index. Whenever a command asks for a gas index, use the following values:

Table 19 – Gas Indexes

Gas		Index
Air	AIR	1
Ammonia	NH3	2
Butane	C4H10	3
Carbon Dioxide	CO2	4
Carbon Monoxide	CO	5
Ethane	C2H6	6
Helium	HE	7
Hydrogen Sufilde	H2S	8
Methane	CH4	9
Nitric Oxide	NO	10
Nitrogen	N2	11

Gas		Index
Nitrogen Dioxide	NO2	12
Oxygen	O2	13
Ozone	O3	14
Propane	C3H8	15
Sulfur Dioxide	SO2	16
Custom	User defined	17-26
Internal	Internal Air Source (if that option is installed)	27
External	External Air Source (only applies to a 3011)	28

A.2.5.1.2 Unit Index

Whenever a command asks for a unit index, use the following values:

Table 20 – Unit Indexes

Unit	Index
%	0
ppm	1
ppb	2
ppt	3

A.2.5.1.3 Port Index

Whenever a command asks for a port index, use the following values:

Table 21 – Port Indexes

Port	Index
None	0
Diluent 1	1
Diluent 2	2
Source 1	3
Source 2	4
Source 3	5
Source 4	6
Source 5	7
Source 6	8
Source 7	9
Source 8	10

A.2.5.1.4 IEEE

Any value marked IEEE is a standard IEEE 4-byte representation of a floating point value.

A.2.5.1.5 Reading and Writing Values

Refer to the – Advanced Protocol Parameter List, Table 37, for details on which values can be read and set via GetIEEEValue and SetIEEEValue.

A.2.5.2Sub Commands

Each sub-command is detailed below.

A.2.5.2.1 Mode (1)

Sets the operational mode of the instrument. Used to start or stop points and sequences.

Table 22 – Mode Control

Parameter	Value	Byte
Sub-Command	1	1
Mode	0..3	2
Function	Varies	3*

* Conditional

The Mode is one of the following values.

0 = Stop

1 = Idle

2 = Point

3 = Sequence

Stop shuts down all operation and ignores both manual and DI input signals.

Idle stops the current point or sequence but allows manual and DI input signals.

Point runs a point. A point number between 0 and 32 must be supplied as the Function parameter; 0 is the manual point (normally a copy of the last point run).

Sequence runs a sequence. A sequence number between 1 and 16 must be supplied as the Function parameter.

A.2.5.2.2 Purge (2)

Controls the purge operation of the instrument.

Table 23 – Purge Control

Parameter	Value	Byte
Sub-Command	2	1
Operation	0..5	2
Purge Time	0..15	3*

* Conditional

The Operation is one of the following values.

0 = Stop

1 = Immediate

2 = Time

3 = Disable

4 = On Change

5 = On Start

Stop terminates a purge if one is occurring.

Immediate begins a purge immediately (the same as a manual purge).

Time is the number of seconds to do a purge. Setting this to 0 is the same as disabling the purge. The purge time value is in the Purge Time parameter (in seconds). Other modes do not accept a Purge Time parameter.

Disable stops the system from doing purges.

On Change means the system will purge when a point calls for a different gas standard.

On Start means the system will purge every time the system starts a point.

A.2.5.2.3 Port (3)

Define what standards and diluents are attached to the ports.

Table 24 – Port Definition

Parameter	Value	Byte
Sub-Command	3	1
Port Index	Port Index	2
Attachment	Gas Index or 1..10	3

The Port Index is the port to define the supply for.

Attachment is either the gas (for diluents) or the gas standard (for sources). Gas is specified by a Gas Index; the standard is numbered 1..10.

A.2.5.2.4 Standard (4)

Define a gas standard.

Table 25 – Gas Standard Definition

Parameter	Value	Byte
Command	4	1
Standard	1..10	2
Name	Text	3-8
Serial	Text	9-14
Expiry Day	1..31	15
Expiry Month	1..12	16
Expiry Year	0..63	17
Balance Gas	Gas Index	18
Gas 1	Gas Index	19
Units	Unit Index	20
Conc	IEEE	21-24
Gas 2*	Gas Index	25
Units*	Unit Index	26
Conc*	IEEE	27-30
Gas 3*	Gas Index	31
Units*	Unit Index	32
Conc*	IEEE	33-36
Gas 4*	Gas Index	37
Units*	Unit Index	38
Conc*	IEEE	39-42
Gas 5*	Gas Index	43
Units*	Unit Index	44
Conc*	IEEE	45-48
Gas 6*	Gas Index	49
Units*	Unit Index	50
Conc*	IEEE	51-54

* Optional

Standard is the index of the gas standard. Up to 10 can be defined.

Name is six ascii characters. If less than six are required, set the remaining characters to NULL (0).

Serial number is six ascii characters.

Expiry day, month, and year specify the expiry date. This has no effect on the firmware but is included for user records.

Balance Gas is the dominant gas in the standard.

Gas 1..6 are the gas names and concentrations (in ppm). Only the first gas must be defined; the rest are optional.

Units are the units the concentration value is expressed in. Thus, a standard that was 50% CO2 could be described as 4,0,50 or 4,1,500000.

Concentrations are in standard IEEE floating point format and limited to 0.0 to 100% (or 1,000,000 for ppm, etc.). Values below 0 will be clipped to 0 and above 100% will be clipped to 100%.

A.2.5.2.5 Point (5)

Define a point. Different types of points require different parameters; unused parameters should be set to zero in this command. For example, an O3 Generator point does not need a gas standard; thus, the six bytes of the Standard field should be set to 0. Refer to Define Point Menu, Section 3.5.6 to determine which fields are necessary for a given type of point.

A note on error conditions: when you define points from the instrument menu it does not allow you to select impossible levels of gas, ozone, or flow, or to select gasses that are not defined in the named standard. However, during remote operation none of these checks are applied. It is up to the user to define only valid points; any invalid points will generate an error condition when they are run.

Table 26 – Point Definition

Parameter	Range	Byte
Sub-Command	5	1
Point	0..32	2
Name	Text	3-8
Input Mask	0xFF	9
Input Pattern	0xFF	10
Output Mask	0xFF	11
Output Pattern	0xFF	12
Operation	0..5	13
Diluent	Gas Index	14
Standard	Text	15-20
Gas	Gas Index	21
Units	Unit Index	22
Gas Target	IEEE	23-26
Units	Unit Index	27
Ozone Target	IEEE	28-31
Flow	IEEE	32-35

Point is the index of the point. 0 is the “Manual” point and 1..32 are the named points. Note that the Manual point is overwritten whenever a named point is run.

Name is six ascii characters. If less than six are required, set the remaining characters to NULL (0).

Input Mask and Pattern are bytes that set the Digital Input control signals. Each bit in Mask indicates that the following bit in Pattern is part of the signal that runs the point. If you are not using Digital Input, set Mask and Pattern to 0.

Out Mask and Pattern are the same as the input, but control how the Digital Output lines are set. Some of these lines may be reserved by the instrument for alarms, in which case the state of the alarm will control that bit.

Operation is the type of point.

0 = Gas dilution

1 = Zero point

2 = Source Control

3 = Titration

4 = O3 Generator

5 = O3 Gen/Photometer

Diluent is a gas index.

Standard is six ascii characters. The gas standard is specified by name rather than index; at the time the point is run the instrument will search for the named standard and use it if it is attached to any port.

Gas is a gas index as defined by Table 32.

Units are the units the gas target value is expressed in.

Gas Target is the target concentration of gas in ppm.

Units are the units the ozone target value is expressed in.

Ozone Target is the target concentration of ozone in the above units.

Flow is the target flow in sccm.

A.2.5.2.6 Sequence (6)

Define a sequence. A sequence must contain at least one set of State/Function/Period parameters, and may contain up to sixteen. Thus, the command can be as little as 16 bytes or as many as 76 bytes.

Table 27 – Sequence Definition

Parameter	Range	Byte
Sub-Command	6	1
Sequence	1..16	2

Parameter	Range	Byte
Name	Text	3-8
Input Mask	0xFF	9
Input Pattern	0xFF	10
Output Mask	0xFF	11
Output Pattern	0xFF	12
State*	0..3	13
Function*	1..32 or 1..16	14
Period*	0..65535	15-16

* May be repeated up to 15 additional times.

Sequence is the index of the sequence.

Name is six ascii characters. If less than six are required, set the remaining characters to NULL (0).

Input Mask and Pattern are bytes that set the Digital Input control signals. Each bit in Mask indicates that the following bit in Pattern is part of the signal that runs the sequence. If you are not using Digital Input, set Mask and Pattern to 0.

Out Mask and Pattern are the same as the input, but control how the Digital Output lines are set. Some of these lines may be reserved by the instrument for alarms, in which case the state of the alarm will control that bit.

State is the action to be taken at that point in the sequence. Idle terminates the sequence; point and sequence run the sequence indicated in Function for the duration indicated in Period; and Repeat starts the sequence over at the first state.

0 = Idle

1 = Point

2 = Sequence

3 = Repeat

Function is a point or sequence index. Points range from 1..32 and sequences range from 1..16. If the State is IDLE or REPEAT then this field should be 0.

Period is the duration in minutes to run a point, or the number of times to repeat a sequence. If the State is IDLE or REPEAT then this field should be 0.

A.2.5.2.7 Ozone Cal (7)

Perform an ozone calibration on a Serinus 2000, 3000 or 300.

Table 28 – Ozone Calibration

Parameter	Range	Byte
Sub-Command	7	1
Calibration	0..5	2

Parameter	Range	Byte
Value*	IEEE	3-6

* Conditional

Calibration is one of the following operations:

Table 29 – Calibration Mode Indexes

Calibration	Value	Description
Status	0	Returns a single byte that indicates the status of the current calibration. 0 = No calibration in progress 1..10 = Current step of Automatic calibration 11 = Manual calibration is waiting to start 12 = In a manual calibration
Last	1	Returns a single byte that indicates success (1) or failure (0) of the last calibration.
Stop	2	Stop any ozone calibration currently in progress.
Automatic	3	Begin an automatic calibration (3000 only).
Manual	4	Begin a manual calibration (2000 or 3000). The remote must follow with 5 more Ozone_Cal Value commands, supplying the ozone concentrations at each point.
Value	5	Supplies the value measured at the current step of the manual calibration. For this command the next 4 bytes must be an IEEE float

Value is the ozone concentration (in ppm) measured by an external instrument.

A.2.5.2.8 Manual Flow (8)

This command allows the MFCs to be directly controlled. Typically, an external program controls the MFCs, measures the flows, calculates the MFC coefficients, and then writes those results using SetIEEEValue. All of the MFCs can be controlled separately, thus allowing several MFCs to be calibrated at once.

The Manual Flow command supports four different operations: Mode, Port, Flow, and Gas.

Table 30 – Mode Selection

Parameter	Range	Byte
Sub-Command	8	1
Operation	0	2
Value	0..1	3

Mode enters or exits manual mode. While in manual flow mode all points and sequences are interrupted. While not in manual mode, all other manual flow commands are ignored.

Value is one of the following:

0 = Exit manual mode.

1 = Enter manual mode.

Table 31 – Diluent Port Selection

Parameter	Range	Byte
Sub-Command	8	1
Operation	1	2
Index	Port Index (0…3)	3

Port opens or closes a port.

Index is a port index value (see the Port Index table). Only one diluent port can be opened at a time. Setting the diluent ports to zero disables the respective MFCs. On instruments without the optional second diluent port, selecting it has no effect.

Table 32 – Source Port Selection

Parameter	Range	Byte
Sub-Command	8	1
Operation	2	2
Index	Port Index (0, 3…10)	3

Port opens or closes a port.

Index is a port index value (see the Port Index). Only one source port can be opened at a time. Setting the source ports to zero closes all ports and disables the respective MFCs.

Table 33 – Flow

Parameter	Range	Byte
Sub-Command	8	1
Operation	3	2
MFC	1..4	3
Value	IEEE	4-7

Flow sets a flow for a given MFC.

NOTE: This command does not set any valves! Thus, to run flow through the optional Source MFC, you must bypass the optional source select valve (V5) with plumbing.

MFC indicates which mass flow controller is to be set.

1 = Diluent

2 = Optional diluent

3 = Source

4 = Optional source

Value is the flow in sccm. A value of 0.0 will shut off the MFC.

Table 34 – Gas Selection

Parameter	Range	Byte
Sub-Command	8	1
Operation	4	2
Value	Gas Index	3

Gas indicates the gas being supplied for the calibration. This is only used to scale the flow values displayed on the Manual Flow Menu, so for remote calibrations it is not necessary.

Value is a Gas Index, normally AIR.

A.2.5.2.9 Gas (9)

Define a custom gas.

Table 35 – Custom Gas Definition Sub Command

Parameter	Value	Byte
Sub-Command	9	1
Index	1..10	2
Name	Text	3-8
Structure	1..4	9
Temperature	FLOAT	10-13
Density	FLOAT	14-17
Pure MFC	FLOAT	18-21

Index is the index of the custom gas. Up to 10 can be defined.

Name is six ascii characters. If less than six are required, set the remaining characters to NULL (0).

Structure is number indicating the size of the molecule.

Table 36 – Molecular Structure Index

Structure	Value
Monoatomic	1
Diatomic	2
Triatomic	3
Polyatomic	4

Temperature is the temperature constant.

Density is the density constant.

Pure MFC is the MFC fact for the gas if the bottle contained nothing but that gas.

A.3 List of Parameters

Note: Parameters in this list are for Serinus Cal series instruments and may not be applicable to other models.

All of these parameters may be logged to the USB Flash drive or requested via the GetIEEEValue command or set via the SetIEEEValue command.

Table 37 – Advanced Protocol Parameter List

#	Description	Notes
1	Cal/Zero Valve	0 = Zero, 1 = Cal
2	Internal Span Valve	0 = Off, 1 = On
3	+Analog Supply	Positive analog supply voltage
4	Gas 5 Avg.	Average of the readings (for Gas5) of the last n minutes where n is the averaging period E.g. Nx
5	Pregain	S30H linearization coefficient gain
6	Sample/Cal Valve	0 = Sample, 1 = Cal/Zero
7	NOx Measure Valve	0 = NO, 1 = NOx
8	NOx Bypass Valve	0 = NO, 1 = NOx
9	NOx Backgnd Valve	0 = Off, 1 = On
10	Valve Sequencing	0 = Off, 1 = On
11	LCD Contrast Pot	0 = Lightest, 255 = Darkest
12	SO2 Ref Zero Pot	S50 Reference zero pot
13	CO Input Pot	S30 Input pot
14	CO Reference Test Pot	Not Used
15	CO Measure Pot	Not Used
16	High Volt Adjust Pot	PMT High Voltage Adjust Pot for S50 & S40
17	SO2 Lamp Adjust Pot	S50 Lamp adjustment Pot
18	O3 Lamp Adjust Pot	S10 Lamp adjustment Pot
19	O3 Meas. Zero Pot (C)	S10 Signal zero measure (coarse)
20	O3 Meas. Zero Pot (F)	S10 Signal zero measure (fine)
21	PMT Fan Pot	Optical Bench fan speed control pot
22	Rear Fan Pot	Chassis Fan speed control pot
23	Pump Fine Pot	Internal Pump speed fine pot
24	Pump Coarse Pot	Internal Pump speed coarse pot
25	Analog input 0	SO2 Reference signal
26	Analog input 1	CO Reference signal

27	Analog input 2	O3 Reference signal
28	Analog input 3	SO2 & O3 Lamp current
29	Analog input 4	Flow block pressure
30	Analog input 5	Cell pressure
31	Analog input 6	Ambient pressure
32	Analog input 7	Raw ADC calibration input
33	Analog input 8	Reserved
34	Analog input 9	Concentration data
35	Analog input 10	Reserved
36	Analog input 11	Reserved
37	Analog input 12	Raw analog to digital count for external analog input 0. 0-5V= 0-32766 A/D counts
38	Analog input 13	Raw analog to digital count for external analog input 1. 0-5V= 0-32766 A/D counts
39	Analog input 14	Raw analog to digital count for external analog input 2. 0-5V= 0-32766 A/D counts
40	Analog input 15	Reserved
41	CO Meas. Zero Pot (coarse)	S30 Measure ZERO coarse adjustment Pot
42	CO Meas. Zero Pot (fine)	S30 Measure ZERO fine adjustment Pot
43	SO2 Input Pot	SO2 Measure Signal Gain Pot
44	SO2 Ref. Gain Pot	SO2 Reference Signal Gain Pot
45	SO2 Meas. Zero Pot	SO2 Measure zero pot
46	O3 Input Pot	O3 Input signal gain pot
47	Diagnostic Test Pot	The Diagnostic mode adjustment pot for all the analysers except for S30
48	NOx Input Pot	PMT signal input gain control FOR NOx
49	PGA Gain	1, 2, 4, 8, 16, 32, 64, 128
50	Gas 1 Inst.	Primary gas concentration currently displayed on the front screen E.g. NO
51	Gas 2 Inst.	Secondary gas concentration currently displayed on front screen E.g. NOx
52	Gas 3 Inst.	Calculated gas concentration currently displayed on front screen E.g. NO2
53	Gas 1 Avg.	Average of the readings (for Gas1) of the last n minutes where n is the averaging period
54	Gas 2 Avg.	Average of the readings (for Gas2) of the last n minutes where n is the averaging period
55	Gas 3 Avg.	Average of the readings (for Gas3) of the last n minutes where n is the averaging period
56	Instrument Gain	Current calibration value (default is 1.0)

57	Serial ID	Multidrop or Bayern-Hessen gas id
58	Bayern-Hessen ID	For multigas instruments only
59	Decimal Places	2-5
60	Noise	Instrument noise
61	Gas 1 Offset	An offset applied to Gas 1
62	Gas 3 Offset	An offset applied to Gas 3
63	Flow Temperature	Temperature of the flow block
64	Lamp Current	Lamp current in mA E.g. 35 mA
65	+5V Supply	Digital Supply voltage (should always read close to 5 volts)
66	Conc. Voltage	Concentration Voltage
67	High Voltage	High Voltage reading for PMT
68	Ozonator	0 = Off, 1 = On
69	Control Loop	0 = Off, 1 = On (default is On)
70	Diagnostic Mode	0 = Operate 1 = Preamp 2 = Electrical 3 = Optical (default is Operate)
71	Gas Flow	Units in slpm
72	Gas Pressure	Units in torr
73	Ambient Pressure	Units in torr
74	+12V Supply	The 12 volt Power supply voltage
75	Cell Temperature	Cell Temperature
76	Conv. Temperature	Converter Temperature
77	Chassis Temperature	Chassis Temperature
78	Manifold Temp.	Temperature of the mixing manifold (all models except 1000)
79	Cooler Temperature	Cooler Temperature
80	Mirror Temperature	Mirror Temperature
81	Lamp Temperature	Lamp Temperature
82	IZS Lamp Temperature	O3 Lamp Temperature

<table>
<tr><td>83</td><td>Instrument Status</td><td>Each bit in this 4-byte word represents a different condition (not all conditions apply to every instrument model):
<table>
<tr><th>BIT</th><th>Condition if set</th></tr>
<tr><td>0</td><td>Currently in warmup process</td></tr>
<tr><td>1</td><td>Volumetric units (otherwise gravimetric units)</td></tr>
<tr><td>2</td><td>Performing a background</td></tr>
<tr><td>3</td><td>Currently in Span mode</td></tr>
<tr><td>4</td><td>Currently in Zero mode</td></tr>
<tr><td>5</td><td>Instrument Out of Service (or in Diagnostic mode, PTF compensation or control loop disabled, or Comms debugging enabled)</td></tr>
<tr><td>6</td><td>High Voltage failure</td></tr>
<tr><td>7</td><td>System power failure (not actually possible to report)</td></tr>
<tr><td>8</td><td>Reference voltage failure</td></tr>
<tr><td>9</td><td>Cell temperature failure</td></tr>
<tr><td>10</td><td>Cooler failure</td></tr>
<tr><td>11</td><td>Converter failure</td></tr>
<tr><td>12</td><td>Correlation wheel failure</td></tr>
<tr><td>13</td><td>Lamp source failure</td></tr>
<tr><td>14</td><td>Flow fault</td></tr>
<tr><td>15</td><td>Any system error (the red instrument panel light is on)</td></tr>
</table></td></tr>
<tr><td>84</td><td>Reference Voltage</td><td>Units in Volts</td></tr>
<tr><td>85</td><td>Calibration State</td><td>This variable has two different sets of values:
<table>
<tr><td>Set Calibration State
0 = MEASURE
1 = CYCLE
2 = ZERO
3 = SPAN</td><td>Get IEEE Value
0 = MEASURE
1 = ZERO
2 = SPAN</td></tr>
</table></td></tr>
<tr><td>86</td><td>Primary Raw Conc.</td><td>(For S40, before NOx background and gain)</td></tr>
<tr><td>87</td><td>Secondary Raw Conc.</td><td>Only for multigas instruments
(For S40, before NOx background and gain)</td></tr>
<tr><td>88</td><td>S40 Backgnd Conc.</td><td>NOx Background Concentration
(For S40, before gain)</td></tr>
<tr><td>89</td><td>Cal. Pressure</td><td>Calibration Pressure</td></tr>
<tr><td>90</td><td>Conv. Efficiency</td><td>Converter Efficiency</td></tr>
</table>

91	Multidrop Baud Rate	0 = 1200 bps 1 = 2400 bps 2 = 4800 bps 3 = 9600 bps 4 = 14400 bps 5 = 19200 bps 6 = 38400 bps
92	Analog Range AO 1	Maximum range value for analog output
93	Analog Range AO 2	
94	Analog Range AO 3	
95	Output Type AO 1	Output Type 1 = Voltage 0 = Current
96	Output Type AO 2	
97	Output Type AO 3	
98	Anlg Ofst/Rng AO1	Voltage Offset /Current Range 0 = 0% or 0-20mA 1 = 5% or 2-20mA 2 = 10% or 4-20mA
99	Anlg Ofst/Rng AO2	
100	Anlg Ofst/Rng AO3	
101	F/Scale Volt AO 1	5.0 Volt Calibration value
102	F/Scale Volt AO 2	
103	F/Scale Volt AO 3	
104	Z Adj Volt AO 1	0.5 Volt Calibration value
105	Z Adj Volt AO 2	
106	Z Adj Volt AO 3	
107	-Analog Supply	Negative analog supply
108	Digital Outputs	A single byte expressing the most recent state of the digital outputs
109	Digital Inputs	A single byte expressing the most recent state of the digital inputs

110	Instrument State	0 = SAMPLE FILL 1 = SAMPLE MEASURE 2 = SAMPLE FILL AUX 3 = SAMPLE MEASURE AUX 4 = SAMPLE FILL AUX2 5 = SAMPLE MEASURE AUX2 6 = BACKGROUND FILL 7 = BACKGROUND MEASURE 8 = BACKGROUND PURGE 9 = BACKGROUND FILL AUX 10 = BACKGROUND MEASURE AUX 11 = ZERO FILL 12 = ZERO MEASURE 13 = ZERO FILL AUX 14 = ZERO MEASURE AUX 15 = ZERO FILL AUX2 16 = MEASURE AUX2 17 = BACKGROUND FILL ZERO 18 = BACKGROUND MEASURE ZERO 19 = SPAN FILL 20 = SPAN MEASURE 21 = SPAN FILL AUX 22 = SPAN MEASURE AUX 23 = SPAN FILL AUX2 24 = SPAN MEASURE AUX2 25 = BACKGROUND FILL SPAN 26 = BACKGROUND MEASURE SPAN 27 = BACKGROUND PURGE SPAN 28 = ELECTRONIC ZERO ADJUST 29 = INSTRUMENT WARM UP 30 = BACKGROUND ADJUST FILL 31 = BACKGROUND ADJUST MEASURE
111	CO Lin. Factor A	CO Linearisation Factor A
112	CO Lin. Factor B	CO Linearisation Factor B
113	CO Lin. Factor C	CO Linearisation Factor C
114	CO Lin. Factor D	CO Linearisation Factor D
115	CO Lin. Factor E	CO Linearisation Factor E
116	Instrument Units	0 = ppm 1 = ppb 2 = ppt 3 = mg/m^3 4 = $\mu g/m^3$ 5 = ng/m^3 6 = %

117	Backgnd Meas. Time	In seconds. These parameters can be changed, but only temporarily; restarting the instrument will restore them to their default values.
118	Sample Fill Time	
119	Sample Measure Time	
120	Aux Measure Time	
121	Aux Smpl. Fill Time	
122	Backgnd Fill Time	
123	Zero Fill Time	
124	Zero Measure Time	
125	Span Fill Time	
126	Span Measure Time	
127	O3 Gen Coeff D	O3 Generator Coefficient D
128	Backgnd Pause Time	In seconds
129	Bkgnd Intrleav Fact	
130	Cal. Pressure 2	Calibration Pressure for 2nd gas
131	2nd Instrument Gain	Unused (always reports 1.0)
132	Background voltage	Units in Volts
133	MFC 1 Coeff A0	Serial MFC coefficients MFC 1 = Diluent MFC 2 = Optional Diluent MFC 3 = Source MFC 4 = Optional Source
134	MFC 2 Coeff A0	
135	MFC 3 Coeff A0	
136	MFC 4 Coeff A0	
137	MFC 1 Coeff A1	
138	MFC 2 Coeff A1	
139	MFC 3 Coeff A1	
140	MFC 4 Coeff A1	
141	MFC 1 Coeff A2	
142	MFC 2 Coeff A2	
143	MFC 3 Coeff A2	
144	MFC 4 Coeff A2	
145	Cycle Time	In minutes
146	CO Cooler Pot	CO Cooler voltage adjustment POT
147	CO Source Pot	CO Source voltage adjustment POT
148	CO Test Meas. Pot	Diagnostics use only
149	CO Test Ref. Pot	Diagnostics use only
150	O3 Ref Average	S10 Background Average
151	PTF Correction (gas 1)	Pressure Temperature Flow Compensation Factor for first gas
152	PTF Correction (gas 2)	Pressure Temperature Flow Compensation Factor for second gas in dual gas analysers.

153	Inst. Cell Pressure	Instantaneous cell pressure
154	Manifold Pressure	Manifold Pressure in S40 instruments
155	Cell Press. (gas1)	Cell Pressure for Gas 1
156	Cell Press. (gas2)	Cell Pressure for Gas 2
157	Cell Press. (Bgnd)	Cell Pressure when in Background
158	Background	0 = the instrument is measuring a gas sample 1 = the instrument is measuring background air
159	Gas To Measure	S51 only; see Measurement Settings Menu 0 = Measure both gasses 1 = Measure SO2 only 2 = Measure H2S only
160	Valve States	Diagnostic use only
161	Temperature Units	0 = "°C" 1 = "°F" 2 = "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	0 = NO FILTER 1 = KALMAN FILTER 2 = 10 SEC FILTER 3 = 30 SEC FILTER 4 = 60 SEC FILTER 5 = 90 SEC FILTER 6 = 300 SEC FILTER 7 = ADPTIVE FILTER
165	NO2 Filter enabled	0 = Disabled, 1 = Enabled

166	Background Interval	0 = 24 Hrs 1 = 12 Hrs 2 = 8 Hrs 3 = 6 Hrs 4 = 4 Hrs 5 = 2 Hrs 6 = Disable
167	Service (COM1) Baud	Serial baud rate 0 = 1200 bps 1 = 2400 bps 2 = 4800 bps 3 = 9600 bps 4 = 14400 bps 5 = 19200 bps 6 = 38400 bps
168	Multidrop (COM2) Baud	
169	Service Protocol	0 = EC9800 1 = Bayern-Hessen 2 = Advanced 3 = Modbus
170	Multidrop Protocol	
171	AO1 Over Range	The Upper Concentration Range when Over-Ranging is enabled
172	AO2 Over Range	
173	AO3 Over Range	
174	AO1 Over-Ranging	0 = Over Ranging Disabled 1 = Over Ranging Enabled 2 = Over Ranging enabled and currently active
175	AO2 Over-Ranging	
176	AO3 Over-Ranging	
177	Heater Set Point	Cell Heater Set Point units in °C
178	PMT High Volt. Pot	High voltage pot setting
179	PMT Test LED Pot	PMT Test LED intensity controller POT
180	Last Power Failure	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	Inst Manifold Pres.	Manifold Pressure in S40 instruments (instantaneous)
182	Cell Press. (gas5)	Cell Pressure for Gas 5 (Nx)
183	Gas 4 *Inst*.	Calculated gas concentration currently displayed on front screen E.g. NH3
184	Gas 4 Avg.	Average of the readings (for Gas 4) of the last n minutes where n is the averaging period E.g. NH3

185	Gas 5 Inst.	Calculated gas concentration currently displayed on front screen E.g. Nx
186	NH3 Conv. Efficiency	
187	Cell/Lamp Duty Cycle	
188	Mirror T. Duty Cycle	
189	Flow Temp Duty Cycle	
190	Cooler T. Duty Cycle	
191	Conv Temp Duty Cycle	
192	CO Conv T Duty Cycle	
193	F/Scale Curr AO 1	20 mA Calibration value
194	F/Scale Curr AO 2	
195	F/Scale Curr AO 3	
196	Z Adj Curr AO 1	4 mA Calibration value
197	Z Adj Curr AO 2	
198	Z Adj Curr AO 3	
199	Ext Analog Input 1	The value of the external analog input after the multiplier and offset have been applied
200	Ext Analog Input 2	
201	Ext Analog Input 3	
202	Conv Set Point	Converter Set Point
203	Cal. Pressure 3	Calibration Pressure 3
204	PTF Correction (gas 3)	Pressure Temperature Flow Compensation Factor for third gas in multi-gas instruments.
205	Dilution Ratio	The current dilution ratio (default is 1.0)
206	Traffic Light	State of the status light: 0 = Green 1 = Amber 2 = Off (normally impossible) 3 = Red
207	Network Protocol	0 = EC9800 1 = Bayern-Hessen 2 = Advanced 3 = Modbus
208	Gas 4 Offset	An offset applied to Gas 4
209	O3 GEN Fine Pot	Ozone generator control, DAC controlled. DAC: 0..64535
210	O3 Gen Lamp Current	Units in mA
211	O3 GEN Coarse Pot	Repeat of parameter 209
212	Logging Period	The data logging period, in seconds (1.. 86400)
213	O3 Gen Coeff A	Ozone generator coefficients

214	O3 Gen Coeff B	Note that Coeff D is parameter 127
215	O3 Gen Coeff C	
216	MFC 1 Voltage	Flow voltages Uses the same mapping as the MFC coefficients
217	MFC 2 Voltage	
218	MFC 3 Voltage	
219	MFC 4 Voltage	
220	Diluent Flow	SCCM
221	Source Flow	SCCM
222	Ozone Flow	SCCM
223	Output Flow	SCCM
224	Gas 1 Conc.	Delivered gas concentrations
225	Gas 2 Conc.	
226	Gas 3 Conc.	
227	Gas 4 Conc.	
228	Gas 5 Conc.	
229	Gas 6 Conc.	
230	Ozone Conc.	
231	Gas 1 Id	Gas ID number 0 = AIR 1 = NH3 2 = C4H10 3 = CO2 4 = CO 5 = C2H6 6 = HE 7 = H2S 8 = CH4 9 = NO 10 = N2 11 = NO2 12 = O2 13 = O3 14 = C3H8 15 = SO2
232	Gas 2 Id	
233	Gas 3 Id	
234	Gas 4 Id	
235	Gas 5 Id	
236	Gas 6 Id	
237	Diluent Id	
238	Diluent Port	0..1
239	Source Port	0..8
240	Mode	0 = Idle 1 = Manual 2 = Point 3 = Sequence

241	Point	Current or last point (0..32), where 0 is the manual point
242	Sequence	Current or last sequence (1..16)
243	Operation	0 = Gas Dilution 1 = Zero Point 2 = Source Control 3 = Titration 4 = O3 Generator 5 = O3 Gen/Photometer
244	Time Remaining	Current point time remaining in minutes
245	MFC Factor Diluent	MFC factor for current diluent
246	MFC Factor Source	MFC factor for current gas standard
247	MFC 1 Size	MFC capacity in SCCM Uses the same mapping as the MFC coefficients 0 means the MFC is not installed
248	MFC 2 Size	
249	MFC 3 Size	
250	MFC 4 Size	
251	Manual Timeout	Sets the manual timeout for points and flows not controlled by a sequence (0..24 hours)
252	Ozone Adjusted	Ozone value before filtering (same as 138 on a Serinus)
253	PCT Active	True if the Photometer Correction Titration is enabled. This occurs after a photometer ozone point has been running long enough to reach stability, and expires five minutes after the point stops running, Writing a 1 to this value will enable the PCT, so that if a titration point is launched within five minutes it will use the PCT value for the ozone generator. To force a PCT this value must be written within five minutes before the point is started.
254	PCT Value	The DAC value for the current or last photometer corrected titration point. To use this value in a titration it must be written before the point is started.

Appendix B. EC9800 Protocol

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

B.1 Command Format

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

B.2 Commands

B.2.1 DCONC

Function: Sends the current instantaneous concentration data to the serial port.

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

Device response: {GAS} <SPACE> {STATUS WORD} <CR><LF>

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

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

B.2.2 DSPAN

Function: Commands the instrument to enter span mode.

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

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

B.2.3 DZERO

Function: Commands the instrument to enter the zero mode.

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

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

B.2.4 ABORT

Function: Commands the instrument to abort the current span/zero mode and return to measure mode.

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

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

B.2.5 RESET

Function: Reboots the instrument (software reset).

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

Device response: <ACK>.

Appendix C. Bayern-Hessen Protocol

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

C.1 Command Format

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

Where:

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

<Text> ASCII text maximum length of 160 characters.

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

<bcc1> ASCII representation of block check value MSB. (That is, the character “3” for 3, the character “F” for 15, etc.)

<bcc2> ASCII representation of block check value LSB.

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

Examples

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

<STX>DA097<EXT>3A

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

Table 38 – Bayern-Hessen 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.

Note: The I.D. of 97 is sent as the sequence 097. All I.D. strings must have three digits and must always be padded with ASCII zero characters.

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

<STX>ST843 K<ETX>52

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

Table 39 – 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.

C.2 Commands

C.2.1 DA

Return the current instantaneous concentration.

Command Format

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

Where:

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

Device response

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

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

Where:

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

Table 40 – Status 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).

Table 41 – Failure Bit Map (Positive Logic)

Failure Bit	Meaning if set to 1
0	Flow sensor failure.

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

C.2.2 ST

Set the instrument mode.

Command Format

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

Where:

kkk	Device's Serial ID. This field is optional, but if provided it must be padded with zeros to be 3 characters long. The value must match one of the following: the instrument's Bayern-Hessen ID, 000, or ??? (three question marks).
Command	M, N or K for Measure, Zero or Span mode.
bcc1	First byte of the block check calculation.
bcc2	Second byte of the block check calculation.

Device response

The device does not issue a response to this command.

Appendix D. ModBus Protocol

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

D.1 Command Format

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

Where:

Slave address	The instrument Serial ID. If the request is being made via TCP, this field is omitted.
Function code	3 (read) or 16 (write).
Start register	Specifies an Advanced Protocol IEEE index (refer to Table 37 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 number x 2 + 256
Register count	A single read command may request from 2 to 124 registers, which is to say from 1 to 62 values. The first index is specified by Start register; all following indexes are in sequential order. To read values that are not sequential requires using another read command. Note that the number of registers must be even, as each value is returned as a floating point value (4 bytes) and each register is a word (2 bytes). A write command can only write a single IEEE value at a time. Thus, for write commands this value must be 2.
Write byte count	This field is only supplied for a write request; it indicates the amount of bytes of data that will follow, and must be set to 4 (since only one value can be written at a time).
Write data	This field is only supplied for a write request. It is the value to be written, expressed in IEEE format. The “Endian” structure can be selected on the Modbus Serial Communications menu. Big Endian means that the MSB byte of the IEEE value is at the right end of the four bytes; Little Endian means it is at the left.
CRC	Calculated by the standard Modbus CRC method. If the request is being made via TCP, this field is omitted.

D.2 Commands

D.2.1 Read Holding Registers

The response to a read request is in the following format:

<Slave address>3<Register count (MSB)><Register count (LSB)><Data><CRC (MSB)><CRC (LSB)>

Where:

Slave address	As general command format.
Register count	As general command format.
Data	4 to 248 bytes of data, representing 1 to 62 floating point numbers in IEEE format. The “Endian” structure can be selected on the Modbus Serial Communications menu. Big Endian means that the MSB byte of the IEEE value is at the right end of the four bytes; Little Endian means it is at the left.
CRC	As general command format.

D.2.2 Write Holding Register

The only supported use for this command is to set the instrument into a calibration state.

Where:

Start register MSB	1
Start register LSB	170
Register count	2
Write Data bytes	The IEEE representation of 0, 1, 2, or 3 0 puts the instrument into Measure mode (0,0,0,0) 1 puts the instrument into Cycle mode (63,128,0,0) 2 puts the instrument into Zero mode (64,0,0,0) 3 puts the instrument into Span mode (64,64,0,0)

The response to a write request is to return the first six bytes of the initiating write request.

D.2.3 Error

An error will be returned in the following format:

<Slave address><Function code><Exception code><CRC (MSB)><CRC (LSB)>

Slave address	As general command format.

Function code	The initiating command's function code + 128; so either 131 (read) or 144 (write).
Exception code	The error code (see table below).
CRC	As general command format.

Table 42 – Modbus Error Codes

Value	Error
1	Illegal Function
2	Illegal Data Address
3	Illegal Data Value
4	Slave Device Failure

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Appendix E. Gascal Protocol

The Serinus Cal has a number of in built serial functions that will respond when interrogated. All commands are prefixed by a digit 0…7 corresponding to the Serial ID (see **Serial Communications Menu**, Section 3.5.36). This system allows multiple Serinus Cals to be connected to and controlled by the same DTE controller.

Note: All commands are in upper case. In this list, lower-case letters are placeholders, e.g., “n” refers to a single digit number, “nn” refers to a two-digit number (preceded by 0 if necessary), “nnn” refers to an integer of any length, and “n.n” and “c0,c1,c2” refer to floating point numbers of any length.

All commands sent to the Serinus Cal must terminate with a carriage return (CR). Unless otherwise stated, all responses sent from the Serinus Cal conclude with a carriage return and line feed (CR LF).

Table 43 – Native Serial Commands

Command	Description	Response
iMFCn?	Outputs polynomial coefficients for MFC n=1..4, where result = c2*v^2 + c1*v + c0 1 = Diluent 2 = Optional Diluent 3 = Source 4 = Optional Source	c0,c1,c2
iMFCn=c0,c1,c2	Inputs polynomial coefficients for MFC n=1..4 1 = Diluent 2 = Optional Diluent 3 = Source 4 = Optional Source	OK
iSETFLOWn=	Sets flow for MFC n=1..4 1 = Diluent 2 = Optional Diluent (Note: on the Gas Cal this set the flow for ozone production; on the Serinus Cal that is the same as setting the Diluent) 3 = Source 4 = Optional Source	OK
PURGE TIME?	Returns purge time in seconds	nnn
PURGE TIME=time	Sets purge time in seconds	OK
iMANUAL=ON	Turns on Manual mode. This will begin running the last point loaded with iSETPOINT.	OK
iMANUAL=OFF	Turns off Manual mode (selects Idle mode)	OK
iT?	Outputs manual timeout (minutes)	nnn
iT=nnn	Inputs manual timeout (minutes)	OK
iSETPOINTnn	Makes point nn the current point (i.e., loads its parameters into the Manual operation screen).	OK

Command	Description	Response
iOZONE=c0,c1,c2	Sets ozone generator coefficients	OK
iOZONE?	Returns ozone generator coefficients	c0,c1,c2
iOZONES=n.n	Sets the current manual point's ozone target (in ppm). For this to have any effect, iSETPOINT must have previously loaded an ozone point.	OK
iVInn?	Outputs a/d voltage for a specific source. 0 = source MFC 1 = optional source MFC 2 = diluent MFC 3 = optional diluent MFC 4 = ozone lamp current 5 = ozone lamp temperature 7 = positive 12V supply 8 = positive 5V supply 10 = positive analog supply 11 = negative analog supply 13 = chassis temperature	n.n
iSTATUS?	Outputs status and any alarms	IDLE or POINTnn n, where nn is the current point and n is a bit field with the following meanings: Bit 3 = ozone temp fail Bit 6 = source or diluent flow fail Bit 7 = bit 3 or bit 6
iVER?	Outputs software version	n.nn.nnnn
iREADn	Outputs a value based on n 0 = gas concentration of first gas in the gas standard for the current point (ppm) 1 = ozone concentration (ppm) 2 = diluent flow (sccm) 3 = source flow (sccm)	n.n
iC?	Reports primary gas concentration (the same as iREAD0)	n.n

Appendix F. Beer-Lambert Law

The Beer-Lambert equation, shown below, is used to calculate the concentration of ozone from the ratio of the two light intensities measured:

$$\frac{I}{I_0} = e^{-acd}$$

Equation 1 – Beer-Lambert Law

Where:

- I is the light intensity measured with ozone in the gas sample
- I_0 is the light intensity measured with no ozone in the gas sample
- a is the ozone absorption coefficient at 253.7 nm (1.44 x 10-5 m2/mg)
- c is the mass concentration of ozone in mg/m^3
- d is the optical path length in m

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