USER MANUAL

Serinus 55

Hydrogen Sulfide Analyser

Version 1.0

acoem

acoem.com

Ecotech Pty Ltd is now part of the Acoem Group and as such, the branding of our instruments & software has also changed to ‘Acoem’.

Over time we will be updating the content of all documents to reflect the Acoem branding convention.

In the interim, please note that while the cover of this document features Acoem branding, information contained within its pages still utilises the original ‘Ecotech’ name.

Manufacturers statement

Thank you for selecting the Acoem Serinus 55 Hydrogen Sulfide Analyzer.

The Serinus series is the next generation of Acoem designed and manufactured gas analyzer, the Serinus 55 will perform Hydrogen Sulfide measurements over a range of 0-20ppm with an LDL of 0.4 ppb.

This User Manual provides a complete product description including operating instructions, calibration, and maintenance requirements for the Serinus 55.

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

If, after reading this manual you have any questions or you are still unsure or unclear on any part of the Serinus 55 then please do not hesitate to contact Acoem or your local Acoem distributor.

Acoem also welcomes any improvements that you feel would make this a more useable and helpful product then please send your suggestions to us here at Acoem.

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

Notice

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

WARNING

Hazardous voltages exist within the analyzer. The analyzer lid should be closed and quarter turn lid fasteners locked when the analyzer is left unattended or turned on. Ensure the power cord, plugs and sockets are maintained in a safe working condition and lid is closed and screw is fastened in place.

Safety requirements

- To reduce the risk of personal injury caused by electrical shock, follow all safety notices and warnings in this documentation.
- If the equipment is used for purposes not specified by Acoem, the protection provided by this equipment may be impaired.
- Replacement of any part should only be carried out by qualified personnel, using only parts specified by Acoem as these parts meet stringent Acoem quality assurance standards. Always disconnect power source before removing or replacing any components.

Factory service/warranty

This product has been manufactured in an ISO 9001/ISO 14000 facility with care and attention to quality.

The product is subject to a 12-month warranty on parts and labour from date of shipment (the warranty period). The warranty period commences when the product is shipped from the factory. Lamps, fuses, batteries and consumable items are not covered by this warranty.
Each analyzer 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 analyzer to be installed and ready for use without any further testing.

To ensure that we process your factory repairs and returned goods efficiently and expeditiously, we need your help. Before you ship any equipment to our factory, please call your local Acoem service response centre (or distributor) to obtain a return authorisation number.

When you contact Acoem please provide the following information:

1. your name, telephone number and Facsimile number
2. Your company name
3. The model number or a description of each item
4. The serial number of each item, if applicable
5. A description of the problem or the reason you are returning the equipment (e.g. sales return, warranty return, calibration, etc)

If you are required to return the equipment an accompanying document with:

1. Your name, number and Facsimile number
2. Your company name with return shipment
3. The model number or a description of each item
4. The serial number of each item, if applicable

A description of the problem/reason you are returning the equipment

Claims for Damaged Shipments and Shipping Discrepancies

Damaged shipments

1. 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 Acoem immediately.

2. The following documents are necessary to support claims:

   a. Original freight bill and bill lading
   b. Original invoice or photocopy of original invoice
   c. Copy of packing list
   d. Photographs of damaged equipment and container
   e. Contact you freight forwarder for insurance claims

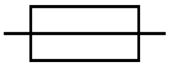
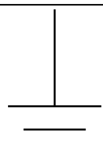
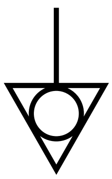
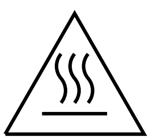
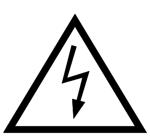
   You may want to keep a copy of these documents for your records also.

   Refer to the instrument name, model number, serial number, sales order number, and your purchase order number on all claims. Upon receipt of a claim, we will advice you of the disposition of your equipment for repair or replacement.

Shipping Discrepancies

Check all containers against the packing list immediately on receipt. If a shortage or other discrepancy is found, notify the carrier and Acoem immediately. We will not be responsible for shortages against the packing list unless they are reported promptly (within 7 days).

Internationally recognised symbols used on Acoem Equipment

	Electrical fuse	IEC 60417, No. 5016
	Earth (ground) terminal	IEC 417, No. 5017
	Equipotentiality	IEC 417, No. 5021
	Alternating current	IEC 417, No. 5032
	Caution, hot surface	IEC 417, No. 5041
	Caution, refer to accompanying documents	ISO 3864, No. B.3.1
	Caution, risk of electric shock	ISO 3864, No. B.3.6

Manual Revision History

Acoem Manual ID: **MAN 0071**
Manual PN: **M010032**
Current Revision: **1.0**
Date released: **January 2010**
Description: **User Manual for the Serinus 55 Hydrogen Sulfide Analyzer**

This manual is the full user manual for the Serinus 55 Hydrogen Sulfide Analyzer. This manual contains all relevant information on theory, specifications, installation, operation, maintenance, calibration, communication and troubleshooting. Any information that cannot be found within this manual can be found by contacting Acoem at:

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1 Introduction

1.1 Description

The Serinus 55 Hydrogen Sulfide analyzer uses UV fluorescent radiation technology combined with an external thermal converter to detect Hydrogen Sulfide to a sensitivity of 0.4 ppb in the range of 0-20 ppm (Convertor dependant). The Serinus 55 measures H_2S with the following instruments/techniques:

- Thermal converter
- Hydrocarbon kicker
- UV lamp
- Fluorescence cell
- Optical bandpass filters
- Photomultiplier tube (PMT)

The H_2S concentration is automatically corrected for gas temperature and pressure changes and referenced to 0°C, 20°C or 25°C at 1 atmosphere. This manual will detail the operation, calibration, preventive maintenance, cautions and health warnings.

1.2 Specifications

1.2.1 Measurement

Range:

- 0-20 ppm auto ranging

Lower detectable limit:

- < 0.5 ppb or 0.2% of concentration reading, whichever is greater; with Kalman filter active.

1.2.2 Precision/Accuracy

Precision:

- 0.5 ppb

Linearity:

- ±1% of full scale (from best straight-line fit).

Sample flow rate:

- 0.675 slpm

1.2.3 Calibration

Zero drift

- Temperature dependant: 0.1 ppb per °C
- 24 hours: < 1.0 ppb
- 30 days: < 1.0ppb

Span drift

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

1.2.4 Power

Operating voltage:

- 99 to 132 VAC, 198 to 264 VAC, 47 to 63 Hz

1.2.5 Operating conditions

Ambient Temperature Range:

- 5ºC to 40 ºC (41 ºF to 104 ºF)

Sample pressure dependance:

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

1.2.6 Communications

Analog Output

- Menu selectable current output of 0-20 mA, 2-20mA or 4-20 mA
  or
- Voltage output of 0 to 5 V, with menu selectable zero offset of 0%, 5%, or 10%.
- Range: 0 full scale from 0-0.05 ppm to 0-20 ppm with 0%, 5%, and 10% offset.
- Resolution: 0.5 ppb or 0.2% of analog output full scale, whichever is greater.

Digital Output

- RS232 port #1: Normal digital communication or termination panel connection
- RS232 port #2: Multidrop port used for multiple analyzer connections on a single RS232
- USB port connection on rear panel
- 25 pin connector with discrete status and user control
- USB stick memory (front panel) for data logging, event logging and parameter storage

1.2.7 Physical dimensions

Case dimensions:

- Length: 620mm with no handle (24.4" inches)
- Width: 440mm (17.3" inches)
- Height: 178mm/4RU (7" inches)

Weight: 18.1kg

1.3 Nomenclature

Span: A gas sample of known composition and concentration used to calibrate/check the upper range of the instrument (Hydrogen Sulfide).

Zero: Zero calibration uses zero air (H_2S scrubbed ambient air) to calibrate/check the lower range of the instrument.

Background: External signals that can be confused with that of the signal being measured.

Zero drift: the change in instrument response to zero pollutant concentration over 12hr and 24hr periods of continuous unadjusted operation.

Automatic zero: The automatic zero performs a zero check at a specified time through a 24 hour cycle which adjusts the lower limit of the analyzers.

Zero air: Purified air in which the combined effect of the concentration of impurities is less than 1% of the relevant midrange of the analyzer instrument. Sufficient purified air can be obtained by passing dry ambient air through an activated charcoal filter and a particulate filter.

External span source: Span gas that is delivered via an external accredited cylinder (e.g. NATA/NIST).

Sample Air: Sample air is defined as the sample before it has entered the reaction cell, as distinguished from the exhaust air.

Exhaust air: Exhaust air is the sample air after it has passed through the reaction/measurement/detection cell and is moving towards being expelled from the analyzer.

ID and OD: Measurements of tubing, ID is the internal diameter of tubing, OD is the outer diameter.

1.4 Background/ Theory

Hydrogen sulfide is created through industrial processes and released into the atmosphere. The main sources of anthropogenic Hydrogen sulfide (H_2S) emissions are from petroleum refineries, paper mills, coke ovens (aluminum, steel, graphite, electrical, and construction industries) and to a smaller extent tannaries.

Hydrogen sulfide is toxic to many different parts of the human body, it effects the nervous system most acutely and also inhibits respiration. General harmful levels of Hydrogen sulfide (H_2S) exposure are 5-10 ppm, levels above this begin with eye irritation and lead up to death.

1.4.1 Measurement Theory

The measurement of Hydrogen Sulfide is based on classical fluorescence spectroscopy principles and the conversion of H_2S into SO_2. The Serinus 55 uses an SO_2 scrubber to scrub all SO_2 out of the sampler before it reaches the H_2S converter. When the SO_2 free air reaches the converter all H_2S is then converted into SO_2. Sulfur Dioxide (SO_2) exhibits a strong ultraviolet (UV) absorption spectrum between 200 and 240nm, when SO_2 absorbs UV from this, emission of photons occurs (300-400nm). The amount of fluorescence emitted is directly proportional to the H_2S concentration. The Serinus 55 follows these principles and measurement techniques:

- Sample air is passed through a hydrocarbon kicker which removes hydrocarbons in high concentration in sample air to low hydrocarbon concentration exhaust air)

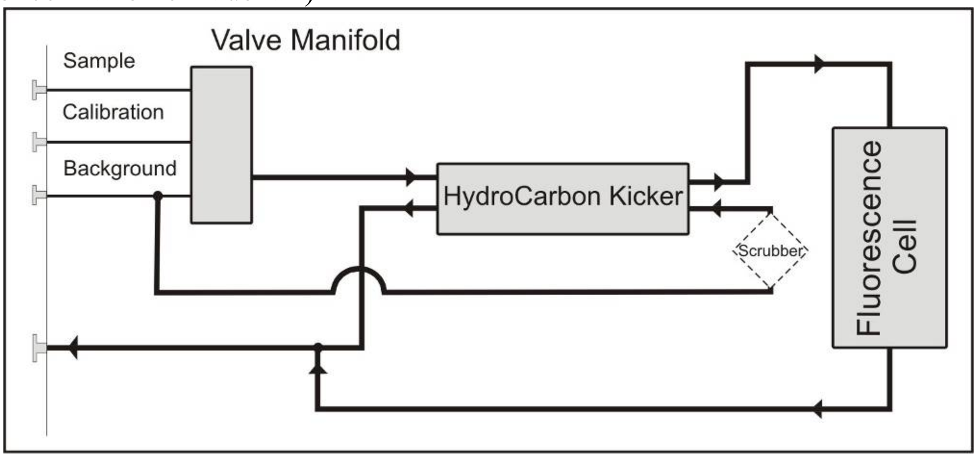


Figure 1 Simple pneumatic diagram

- A zinc discharge lamp and a UV bandpass filter are used to produce radiation at 214nm.
- The radiation (214nm) is focused into the fluorescence cell where it interacts with SO_2 molecules and emits photons uniformly in all directions.
- A portion of the fluorescence is collected and filtered.
- Wavelengths at 310-350nm pass through the filter where they reach the photomultiplier and record a signal.
- A reference detector monitors the emission from the zinc lamp and is used to correct for fluctuations in lamp intensity.

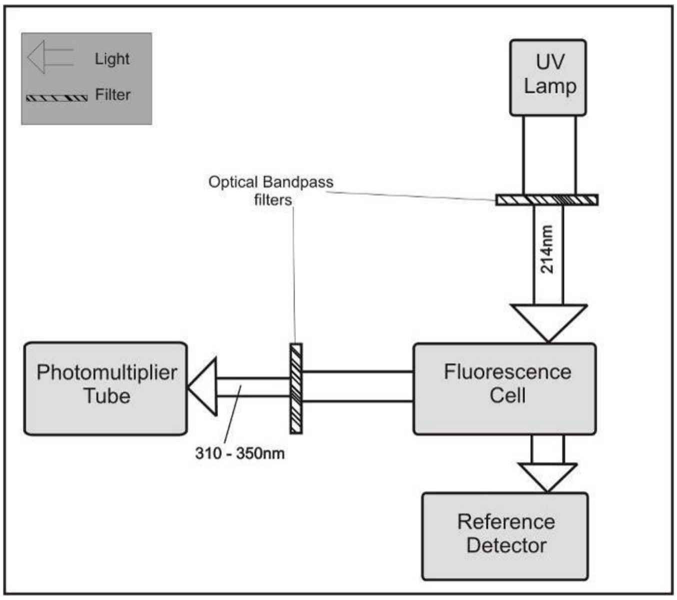


Figure 2 Optical measurement theory

- Exhaust air is scrubbed with a charcoal scrubber to eliminate Hydrocarbons and SO_2. This air is then ideal for use in the hydrocarbon kicker to remove hydrocarbons from sample air.

1.4.2 Kalman filter theory

The Serinus analyzer series use the advanced digital Kalman filter. This filter provides the best possible compromise between response time and noise reduction for the type of signal and noise present in ambient air analyzers.

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

1.5 Instrument description

The Hydrogen Sulfide analyzer consists of six main assemblies:

- The external thermal converter
- The pneumatics to transfer sample and exhaust gas
- The sensors for the measurement of H_2S (optical cell) and other relevant parameters
- The control system which encompasses all circuit boards, is used to control all sensors and pneumatic components
- The power supply which supplies power for all the instrument processors
- The Communication module to access data

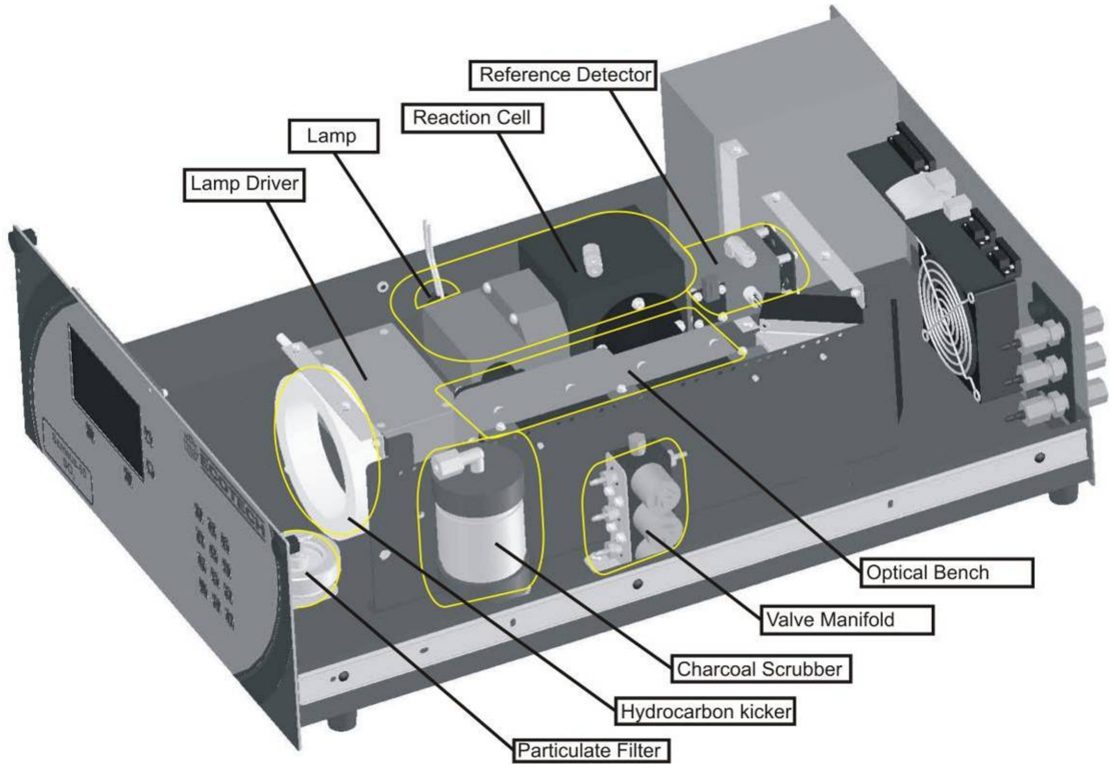


Figure 3 Major Components of analyzer

1.5.1 Particulate filter

The Particulate filter is a Teflon 5 micron (µm) filter with a diameter of 47mm. This filter eliminates all particles larger than 5µm and condensed water vapour that interfere with sample measurement.

1.5.2 Hydrocarbon Kicker

The Hydrocarbon kicker removes interfering hydrocarbons from sample air. This is achieved by using counter current exchange, where an air with a lower concentration moves in an opposite direction to air with a higher concentration. The high concentration of hydrocarbons diffuse through a selective permeation membrane to the low concentration air and are removed with exhaust air. Increasing the flow of the low concentration air also increase the rate of diffusion.

1.5.3 Zero Air Scrubber

A charcoal scrubber is used to produce H2S free air which is used in the hydrocarbon kicker to remove hydrocarbons from sample air.

1.5.4 Reaction Cell

UV lamp

The UV lamp is a discharge zinc UV lamp which emits UV radiation over a broad range

UV Bandpass Filter
The bandpass filter only allows UV at 214nm through into the cell.

Photomultiplier tube
The PMT detects the amount of light reaching its sensors. The filtering of light reaching the PMT allows direct measurement of H2S in the cell.

Optical Bandpass Filter
The optical bandpass filter is a colored glass that only allows light of a specific wavelength through (310-350nm)

UV Grade Lenses
Two UV grade silica lenses are used in the optical path, the first (plano-convex) to focus UV radiation inside the measurement cell and the second (bi-convex) focuses the fluorescent light onto the PMT cathode from the H2S reactions.

UV Reference Detector
The UV reference detector monitors the intensity of UV radiation entering the measurement cell. This measurement is used to compensate for variations in UV lamp output.

1.5.5 Main Controller PCB
The Main Controller PCB controls all the processes within the instrument, it contains a battery backed clock/calendar and an onboard microprocessor. The Main Controller PCB is located at the top of the instrument, above the rest of the components when lid is removed. The PCB is hinged and can be lifted up to stand up vertically allowing easy access to instrument components underneath.

1.5.6 Reference detector Preamplifier
This circuit board converts current signal from reference detector to a voltage signal and provide amplification.

1.5.7 PMT High Voltage Supply and Preamplification
This is a single component within the PMT housing. Its function is to supply high voltage to the PMT and to amplify the photocurrent signal from the PMT.

1.5.8 Lamp Driver PCB
This driver uses a high voltage and high frequency switching supply to start and maintain the UV lamp at a constant intensity. The lamp current is set by the microprocessor and is maintained at 30 mA.

1.5.9 Pressure PCB

The absolute pressure transducer is mounted to the measurement cell, and used to measure the sample pressure in the cell. This pressure is also used for the instrument to calculate flow.

1.5.10 Power supply

The power supply is a self-contained unit housed in a steel case designed to meet CE requirements.

It has an input voltage of 115/230VAC 50/60 Hz and an output voltage of 12 VDC power for distribution within the analyzer.

Note: Input voltage can be manually changed by flicking the red switch left (230) for 220-240V or right (110) for the 100-120V.

On/off switch

Located on the back panel (bottom right facing from behind the instrument)

1.5.11 Communications

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

RS232 #1

This port is designed to be used for simple RS232 communication or with a Termination Panel allowing the Serinus instrument to work as a datalogger. This function is an optional extra and must be purchased from acoem.

RS232 #2

This port is designed to be used for simple RS232 communication, or in a daisy chain (multidrop) configuration (multiple analyzers connected via the same RS232 cable).

USB

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

TCP/IP (optional)

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

External I/O port

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

Analog Outputs

The analyzer is equipped with three analog outputs. Settable as either voltage ouput 0-5VDC, or current output 0-20,2-20,4-20 mA

Analog Inputs

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

Warning: Exceeding these voltages can permanently damage the instruments and void warranty

Digital Status Inputs

The analyzer is equipped with 8 logic level inputs for the external control of Zero/Span calibration sequences.

Digital Status Outputs

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

1.5.12 H_2S 1100 external thermal converter (optional)

The H_2S-1100 Hydrogen Sulfide Converter employs both catalytic and thermal principles in the conversion of H_2S to SO_2. Converter efficiency is better than 96% over a temperature range of 200°C to 400°C. A factory set temperature of 350°C is used.

The H_2S 1100 is connected to the Serinus 55 analyzer through the rear ports. See section 8.4 for more details

2 Installation

2.1 Initial check

Packaging

The packaging which the Serinus 55 is transported in is specifically designed to minimise the effects of shock and vibration during transportation. Acoem recommends that the packaging be kept if there is a likelihood that the instrument is going to be relocated. For this purpose, it is also good to keep the red plastic caps installed in the pneumatic connections.
In the event that the packaging is to be disposed of, all the materials used are recyclable and should be disposed of accordingly.

Check the analyzer with the following steps:

- Open instrument lid by using a screwdriver to undo the front quarter turn fasteners, also undo any further screws that may be installed in either the front or rear panel, then either slide the lid backwards (bench top)
- Check that all pneumatic and electrical connectors are connected, if not reconnect
- Check for any visible and obvious damage
  (if damage exists contact you supplier and follow the instructions in Claims for Damaged Shipments and Shipping Discrepancies page iv)

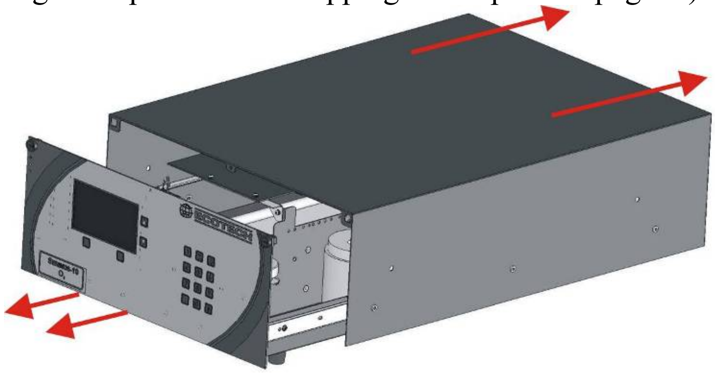


Figure 4 Opening the lid

Items Received

With the delivery of the Serinus 55, you should have received the following:

- Acoem Serinus 55 instrument PN: E020055
- Acoem H_2S 1100 converter (optional) PN: ECO-H2S1100
- Software CD PN: S040001
- End Caps PN: B010002-02
- Manual PN: M010032
- Power Cord (120V)* PN: 060-070110
- Power Cord (240V)* Australia PN: 060-070140
  Europe PN: 060-070120
  UK PN: 060-070160

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

Please check that all these items have been delivered undamaged. If there is any item damaged or if you are unsure, please contact your supplier BEFORE turning on the instrument.

2.2 Mounting/Siting

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

- Instruments should be placed in an environment with minimal dust, moisture and variation in temperature
- For best results instruments should be located in a controlled environment with temperature and humidity controlled (air conditioned shelter) set to 25-27°C
- Whether in rack or placed on bench instruments should not have objects placed on top of or immediately next to (touching) casing
- Analyzer should be placed with easy access to front panel (instrument screen/USB flash) and to the back panel (Communications suite/pneumatic connections)
- It is recommended that sample line be as short as possible and/or a heated manifold be used for sampling (minimizing moisture condensation in sample)
- Do not pressurize sample line under any circumstances. Sample should be drawn through instrument from the atmosphere. This should be done either by and internal pump if installed or by an external pump connected to the exhaust port of the analyzer

2.3 Instrument setup

When the Serinus has been mounted in a suitable site, the following sections must be followed to ready the analyzer for monitoring.

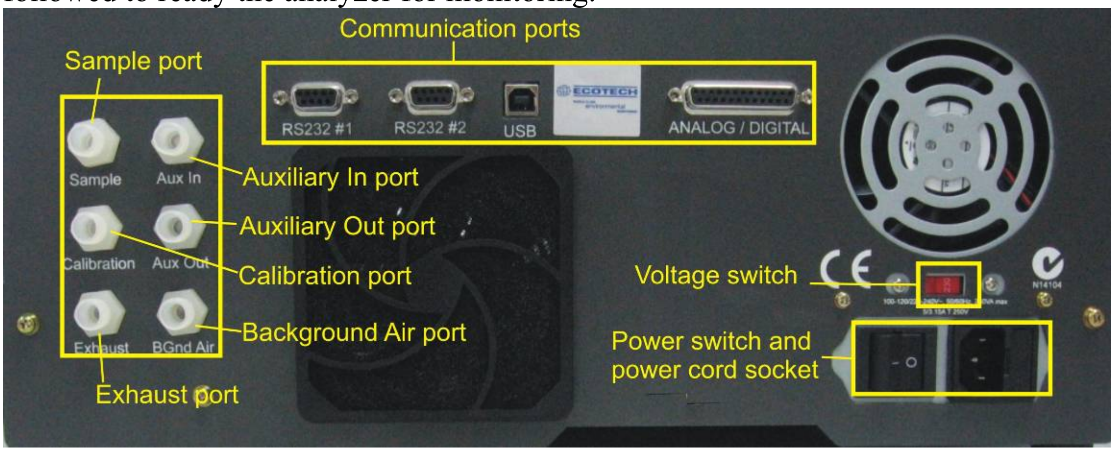


Figure 5 Instrument Back panel

2.3.1 Pneumatic connections

The Serinus 55 contains 6 pneumatic ports on the back panel of the analyzer; the sample port, calibration port, exhaust port background air port, Auxiliary In port and Auxiliary Out port. All tubing and fittings used should follow the instructions below:

- Must be made of Teflon® FEP material, Kynar®, stainless steel, glass or any other suitably inert material

- Sample line should be no more than 2 meters in length with ⅛ inch ID, ¼ inch OD
- Sample inlet pressure should not exceed 5 kPa above ambient pressure
- Tubing must be cut squarely and any burrs removed
- Remove nut, insert tubing through back of nut with tube extending 1 inch through front
- Place tubing into port until it hits the tube stop inside fitting
- Move nut onto fitting and tighten nut (clockwise) finger tight
- Nuts should be re-tightened when instrument reaches operating temperature

Sample port

The sample port must be connected to an ambient source of sample air. When using a sample manifold the Serinus requires at least 1.05 slpm delivered to sample manifold (0.675 slpm for measurement plus approx 50% overflow).

Calibration port

The calibration port should be connected to the span/zero source. It is recommended that a gas calibrator be used with H_2S source to deliver precise concentrations of H2S.

Exhaust port

The exhaust port is where the measured sample is expelled from the analyzer. The exhaust tubing should be fitted to a vacuum pump (minimum: 1 SLPM at 50 kPa), if the internal pump is not installed in your analyzer.
It is recommended that exhaust air is not expelled into a shelter/room inhabited by people, it should be expelled into the external air, away from the sample inlet.

Auxiliary In port

The Auxiliary In port (AUX In) brings air in from the converter and is connected to the "Outlet" of the H_2S 1100.

Auxiliary Out port

The Auxiliary Out port (AUX Out) takes air from the analyzer and delivers it to the converter. Tubing is connected to the "Inlet" of the H_2S 1100.

2.3.2 Power connections

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

Warning

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

- Verify that the red switch (above power switch) is switched to the correct setting (240V or 110V)
- The three pin power plug (with ground) **MUST** be used with an earthed power socket (3 pin)
- Connect the power plug into the a mains power point and turn the power switch on

2.3.3 Communications connections

There are a number of different ways to communicate with the analyzer, select one of the following options

RS232 #1

- Connect this port to a Termination Panel with an RS232 cable.
- This port is also designed to be used with a Termination Panel allowing the Serinus instrument to work as a datalogger. This function is an optional extra and should be purchased from Acoem.

RS232 #2

- Connect RS232 cable from instrument to computer, datalogger or in a daisy chain formation.

> **Note:** When using daisy chain formations ensure each analyzer is given a unique instrument ID

- Configure computer/datalogger software for data export/remote control

USB

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

TCP/IP (optional)

- Plug in network cord (this cord should be attached to network)
- Use Remote data download program to access instrument and download data (supplied on utilities CD)

Analog/Digital

- This port is used to send/receive analog and digital signals. This port is normally used to connect with a gas calibrator, or to activate alarm signals.
- Contains 8 digital inputs, 8 digital outputs and 3 analog inputs and 3 analog outputs

2.3.4 Analyzer set up

- Ensure USB key is installed
- Check battery is turned on at main controller PCB (Figure 6)
- Ensure all pneumatics are connected as described above
- Ensure Converter is plugged in and turned on
- Turn on analyzer and allow warm-up procedure to complete (section 3.1)
- Check/Set time and date (section 3.5.3)
- Set filter to desired monitoring option
- Set internal data logging options
- Set analog/digital inputs and outputs settings
- Leave instrument to warm up for 2-3 hours and converter 4 hours, wait for a stable concentration measurement for at least 1 hour
- Perform span calibrations (see section 4.2) and a zero check (see section 4.5)
- Instrument will now be ready

2.4 Transporting/Storage

Transporting the Serinus should be done with great care. It is recommended that the packaging the Serinus was delivered in should be used for any transport as it ensures minimal damage to the instrument. When transporting or storing the instrument the following points should be followed:

- Turn off instrument and allow to cool down
- Remove all pneumatic, power and communication connections*
- Remove instrument from rack
- Replace red plugs into pneumatic connections
- Place instrument back in plastic bag with desiccant packs and seal bag (Ideally the bag it was delivered in)
- Place back in foam and box instrument was delivered in if possible, if not find some equivalent packaging which provides protection from damage
- Instrument is now ready for long term storage or transportation

Note: After transport or storage, instrument must be set up and calibrated see section 2.3.4

*if storing over long period (6 months) turn the battery off by switching the following switch on the main processor board (Figure 6) to the left

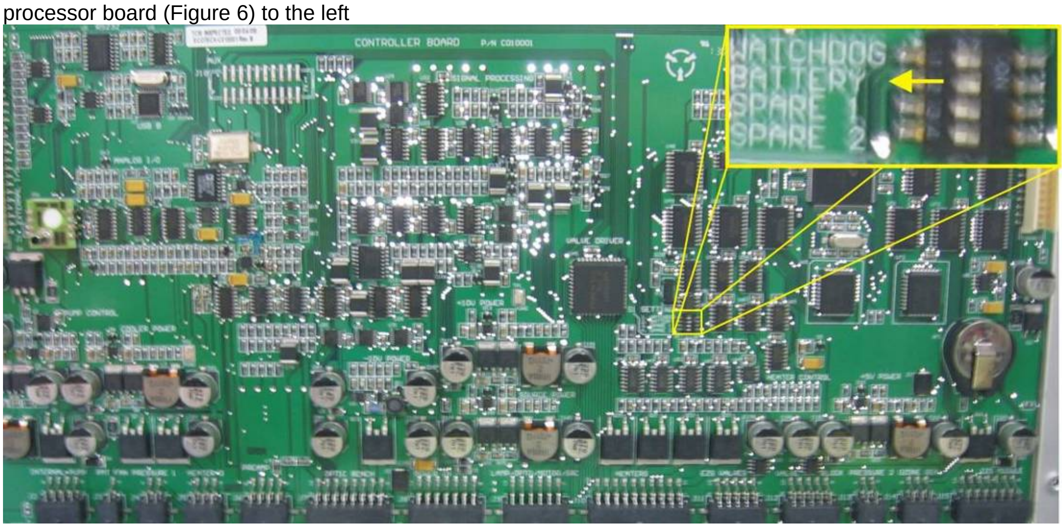


Figure 6. Switching battery off

3 Operation

3.1 Warmup

As the instrument is turned on it will adjust and calibrate itself ready for monitoring. No measurements are taken during the warm-up.
When the main screen appears, the instrument will display the following actions being taken (bottom of the screen):

High voltage check:
Instrument setting upper voltage limit for measurement

Lamp Stabilize
Adjusts the lamps current (35mA) for a stable (reference voltage) signal/output (10-15 minutes).

Ref stabilize
Adjusts the detector to set its maximum voltage output and create a stable output signal.

After this warm-up has completed the instrument will immediately begin taking measurements as seen in section 3.4.

3.2 General operational information

The Serinus is operated with the use of 3 sets of buttons. There are the selection buttons, scrolling buttons and keypad.

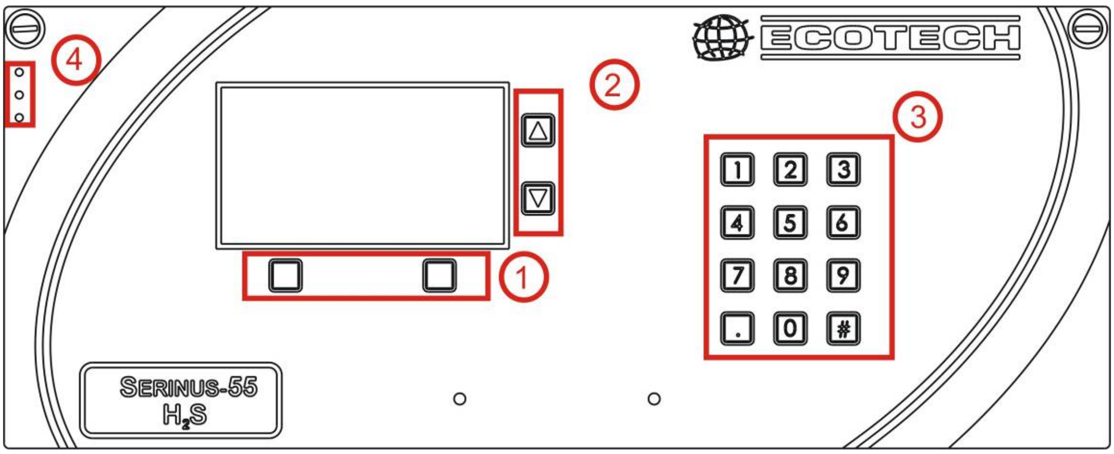


Figure 7 Serinus front panel

(1) Selection buttons

The selection buttons will perform the function specified directly above it on the screen i.e. quick menu, main menu, open, back, select, start etc

(2) Scrolling buttons

The scrolling buttons allow users to scroll up and down through menus. The scrolling buttons are also used to scroll side to side through editable fields (Date, time, concentration etc). On the main screen these buttons are used for adjusting contrast.

(3) Keypad

The keypad contains numbers 0-9, decimal point (.) and hash (#). The keypad is used to input numbers and concentrations when numbers on the screen are highlighted. In some circumstances the decimal point and hash are used for different functions (as explained on that specific screen).

(4) Instrument status lights

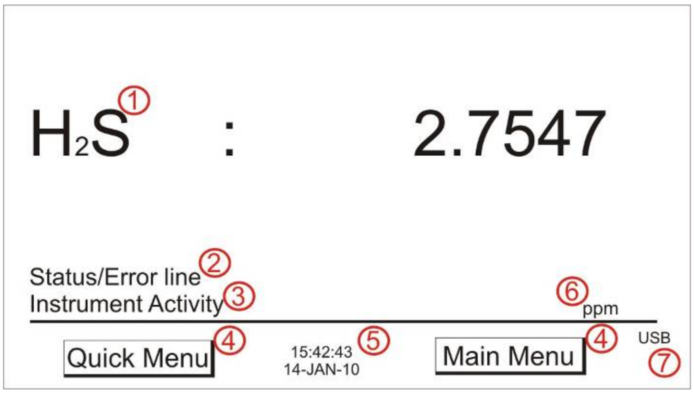
Located in the top left corner these lights indicate the status of the instrument as a whole.

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

In the case of a yellow or red light enter the Main menu → Analyzer State → Status menu to find which components are failing (see section 3.5.2.1).

3.3 Main screen

The main screen is composed of 7 parts, the Readings, the Status/Error line, the time, the Instrument Activity line, menu buttons, the concentration units and USB detection. The contrast is adjustable only on the main screen, pressing the up scroll arrow will darken the screen; pressing the down scroll arrow will lighten it.



Reading (1)

The Reading section takes up most of the screen, it displays the concentration being measured in real time including during calibrations. When the instrument is changed in the Front screen field (General settings section 3.5.3) from “inst only” to “inst & avg” the reading will display both the average concentration (above) and the instantaneous concentration.

Status/Error line (2)

The Status/Error line provides users with information on any problems the instrument may have. It includes all the status/errors contained in the Status Menu section 3.5.2.1.

Instrument Activity (3)

The Instrument activity line shows what function the instrument is currently performing. This will generally be showing three groups of actions; Warm-up (section 3.1), Measurement (section 3.4) or Calibration (section 4).

Menu buttons (4)

The Menu buttons are used on the main screen to enter one of two menus. The Quick Menu (section 3.5.1) contains all information and features necessary in scheduled maintenance; the Main Menu (section 0) contains all information and fields available to users and is generally only used during initial setup.

Time and Date (5)

The Time and Date are displayed in between the menu buttons at the bottom of the screen. Time and Date are displayed as selected in section 3.5.3.

Concentration Units (6)

The current instrument units are displayed at the bottom right hand corner of the main screen.

USB detection (7)

A USB symbol will be displayed in the bottom right corner when the USB key is plugged in (behind front panel). If the USB symbol is not shown the USB key should be reattached. Underneath the USB symbols arrows may be displayed which indicates data transfer. The USB key should not be removed whilst this is happening.

3.4 Sampling

The Sampling performed by the Hydrogen Sulfide analyzer consists mainly of one continuing cycle, the sample cycle. The sample cycle measures sample air with Hydrogen Sulfide present. A background is performed once a day (normally leading up to midnight) and is used to measure background fluorescence in the cell and subtract it from sample measurements.

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

3.5 Menus and screens

The Menu system is divided into 2 sections, the Quick Menu and the Main Menu. The quick menu contains all information and operations necessary during scheduled maintenance visits. The main menu contains all fields that are accessible to users; they provide information on component failures, measurement parameters as well as editable fields and test procedures.

Main Menu

ANALYZER STATE
GENERAL SETTINGS
MEASUREMENT SETTINGS
CALIBRATION MENU
SERVICE
COMMUNICATIONS

3.5.1 Quick Menu

The quick menu is designed to contain all the tools for maintenance performed by operators in one easy to use screen. The quick menu allows operators to perform calibrations/checks, check important parameters and review service history in one menu.

Instrument Gain
A multiplication factor used to adjust the concentration measurement to the appropriate level (set at calibration)

Span Calibrate
This field is used to perform a span calibration. This option should be used only when a known concentration of span gas is running through the measurement cell. When this is happening activate the span calibrate field, a window will open with editable numbers, change the numbers to match the concentration that the instrument is reading and select accept. The instrument span calibration has now been set.

Zero calibrate
This field is used to correct the zero calibration setting. This option should be used only when zero gas is measured by the instrument. When this is happening activate the zero calibrate field, a window will open with editable numbers, leave the numbers at 0000.000 and select accept. The instrument zero calibration has now been set.

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

3.5.2 Analyzer State

Displays the status of various parameters that effect instrument measurement and various functions.

3.5.2.1 Status

The Component status menu contains a list of the main components within the instrument and their status.

Cell temperature
The cell temperature must be within ± 10% of the heater set point (section 3.5.3)

Cooler Status
Status of the PMT cooler,

Sample Gas Flow
Indicates whether the instrument has flow or not.

A/D Input
A reference voltage is sent to analog to digital input chip, this field will display a pass or fail indicating if the board is working or not.

Reference Voltage
Checks that the background is performing within acceptable limits Pass/Fail.

Lamp/Source
Checks if the Lamp current is between 20-50 mA. Pass if within these limits, Fail if outside.

USB Key
Detects whether a USB key is plugged into the USB port and instrument is logging

3.5.2.2 Temperatures

Temperature Units
Editable field to allow the user to change the current temperature units of the analyzer.

Heater set point
Sets the temperature that the heated components will be regulated at including the cell.

Cell
Temperature of the reaction cell.

Chassis
Displys the temperature of air inside the chassis, measured on the microprocessor board.

Cooler
Temperature of the cooled PMT block

3.5.2.3 Pressures

Sample Flow
Indicates the gas flow through the sample port of the instrument, should be around 0.70

> **Note:** Will indicate 0.00 if the flow transducer senses flow has gone to zero.

Pressure Units
Select the units that pressire will be measured and displayed in (torr, psi, mbar, atm, kPa)

Ambient
Current ambient pressure (outside the analyzer).

Cell
Current pressure within the measurement cell

3.5.2.4 Voltages

Concentration Voltage
Voltage from the preprocessor proportional to the detected gas signal from the reaction cell. This voltage represents the actual measurement of gas.

Reference Voltage
Reference voltage as measured by the preamplifier board. This voltage is indicative of the UV lamp signal intensity.

Analog Supply
+12 volt (primary) power supply.

Digital Supply
+5 volt microprocessor power supply.

High Voltage
High voltage supplied to the PMT

3.5.2.5 Version

Indicates the current firmware version installed in the Microprocessor.

3.5.3 General Settings

Decimal Places

Select "Edit" to change the amount of decimal places (0-5) used for concentration on the front screen

Concentration units
Select the units that concentration will be displayed in (ppm, ppb, ppt, mg/m^3, $\mu g/m^3$, ng/m^3).

Temperature units
Select the units that temperature will be displayed in (ºC, ºF, K)

Pressure units
Select the units that pressure will be displayed in (Torr, Psi, Bar, atm, KPa)

Date
The date can be entered in this screen by selecting "change" and using the keypad and scroll buttons to change date.

Time
The time can be entered in this screen by selecting "change" and using the keypad and scroll buttons to change time (24 hour clock).

Backlight Timeout
Choose how long the screen will take for the backlight to turn off

Front Screen
Choose what type of concentration readings will be displayed on the front screen: only instantaneous readings (inst. only) or instantaneous and average readings (inst & avg)

3.5.4 Measurement settings

Average period
Set the time period over which the average will be calculated: Minutes (1, 3, 5, 10, 15, or 30) or Hours (1, 4, 8, 12, or 24).

Filter type
Sets the type of digital filter used. Choices are:
No filter, Kalman, 10 sec, 30 sec, 60 sec, 90 sec, 300 sec or Adaptive.

Backgnd Interval
Choose the length of time (interval) between each background adjustment

Noise
The standard deviation of the concentration. The manner in which this is calculated is as follows:

1. Take a concentration value once every two minutes
2. Store 25 of these samples in a first in, last out buffer

3. Every two minutes, calculate the standard deviation of the current 25 samples. This is a microprocessor-generated field and cannot be set by the operator.

> **Note:** This reading is only valid if zero air or a steady concentration of span gas has been fed to the analyzer for at least one hour.

3.5.5 Calibration menu

Span Calibrate

This field is used to correct the span calibration setting. This option should be used only when a known concentration of span gas is running through the measurement cell. When this is happening activate the span calibrate field, a window will open with editable numbers, change the numbers to the concentration that the instrument is receiving and select accept. The instrument span calibration has now been set.

Zero calibrate

This field is used to correct the zero calibration setting. This option should be used only when zero gas is running through the measurement cell. When this is happening activate the zero calibrate field, a window will open with editable numbers, leave the numbers at 0000.000 and select accept. The instrument zero calibration has now been set.

Pressure calibration

This field allows the user to calibrate the pressure sensors as explained in section 4.4

Cal. type

Select the “Calibration type” field and select either Timed or Manual. Timed calibration is an automatic calibration controlled by the

- Interval between cycles,
- Length of each calibration cycle,
- When the calibrations will begin from
- Whether the calibration will perform automatic compensation.

Manual calibration will perform a manual calibration depending on the calibration mode selected below.

Cal. mode

When in Manual mode the instruments operational mode can be chosen from the following:

- Measure: is the normal measurement through the sample port
- Cycle: performs a zero, then a span then returns to measure mode. The length of time spent measuring calibration gases is set in cycle time (below)

- Span: this mode will take air through the calibration port so that a span calibration can be performed
- Zero: this mode will take air through the calibration port so that a zero calibration can be performed

Cycle time
Set the time period that the zero and span calibrations will last for during Timed Calibration (1 to 59 minutes).

Cal Pressure
This field displays the measured pressure during the last calibration (for reference).

Manual Background
Will display when the instrument is performing a background (running), when this is not the case pres the start button to perform a manual background.

Pressure calibration
This field allows the user to calibrate the pressure sensors as explained in section 4.4

3.5.6 Service

The Diagnostic Menu is information used to diagnose problems or suspected problems. The settings return to the previously set conditions when the operator leaves this menu.

3.5.6.1 Diagnostics

3.5.6.1.1 Preprocessor pots menu

Preprocessor pots are electronically controlled digital potentiometers used for adjustments to operations of the analyzer. Each pot is set with digits 0 to 255 in a non-wraparound scrolling field.

Input pot

Test measure

Measure coarse zero

Measure fine zero

Ref Gain

Conc Voltage

Conc Volt / PGA

Lamp Current

Stable Threshold

3.5.6.1.2 Valve menu

The valve menu allows the user to observe the opening and closing of valves as well as opening and closing them manually.

Sample
Shows the action of the sample valve, when open air is being sampled through sample port, when closed this does not occur. Selecting switch will change to the alternative state (open or closed).

Internal zero
Shows the action of the internal zero valve, when open air is being sampled through the internal zero, when closed this does not occur. Selecting switch will change to the alternative state (open or closed).

Valve sequencing
When set to "on" the instruments valves will switch as normal, when set to "off" the instrument will hold the valves in their current formation and valves can be opened and closed via the above fields.

> **Note:** valve sequencing will remain off unless the instrument has returned to main screen for over 2 minutes.

3.5.6.1.3 Pres/temp/flow Comp

Set to either On or Off.
On is used to compensate analyzer measurements for environmental fluctuations that might affect readings (pressure, temperature and flow). Off is used only when running diagnostics to see fluctuations in readings.

3.5.6.1.4 Diagnostics mode

The instrument can be placed in 4 diagnostic modes:

- Operate which leaves the instrument in normal operation mode
- Optic which configures the instrument for tests on the optical measurement source
- Electrical which configures the instrument for testing of the electrical circuits
- Preamp which configures the instrument for testing of the preamplification circuitry

3.5.6.1.5 Control loop

When "enabled" the instrument will control all processes within the instrument.

- Selecting Disabled will pause the instruments control over certain processes and parameters (digital pots, internal pump etc). The user can now manually alter and adjust digital pots.
- When instrument is put back in "Enabled" mode or taken back to main screen the new pots will be set and instrument will resume control over pots.

3.5.6.1.6 Run screen test

Run test screen
Will perform a screen test by activating lines on the screen so that the operator can determine if there are any faults in the screen

3.5.6.2 Calculation factors

The Calculation factors screen is a non editable screen which provides the values used to calculate different aspects of measurement and calibration.

Instrument gain
A multiplication factor used to adjust the concentration measurement to the appropriate level (set at calibration)

P/T/F Correction
Displays the correction factor applied to the concentration measurement. This factor corrects for changes in pressure, temperature and flow.

Background
The correction factor calculated from the background cycle (used to eliminate background interferences).

Zero Offset
This field displays the offset created from a zero calibration, this is the concentration measured from zero air and is subtracted from all readings.

3.5.6.3 Save Configuration

Saves instrument EEPROM settings to USB key including (calibration and communication settings, units, instrument gain etc). If you have problems with your instrument use this function to save setting to the removable USB stick and send them to your supplier with your service enquiry.

3.5.6.4 Load Configuration

Loads instrument EEPROM setting from USB key (including calibration and communication settings, units, instrument gain etc).

3.5.6.5 Next service due

An editable field that the user can set the date the instruments next service is required

3.5.7 Communications

3.5.7.1 Analog Output Menu

Range
Set upper range limit (in concentration units) to desired H2S concentration. This value cannot exceed the “Over Range” value.

Output type
Setting the output to be either current or voltage

Offset
Choices are 0%, 5%, and 10%. Recorder or DAS output will reflect this.

Current range
Choices are 0-20 MA, 2-20 MA, and 4-20 MA.

5.0V Calibration
Enables the user to calibrate the analog output at a full scale point.

0.5V Calibration
Enables the user to calibrate the analog output at a low point.

Full scale
X.XX%, a correction factor for full scale setting. Used when calibrating the analog outputs.

Zero adjust
X.XX%, a correction factor for the zero setting. Used when calibrating the analog outputs.

Over range
Set to desired over range value. This value cannot be set below the RANGE value. This is the alternate scale the recorder or DAS indicates when over-ranging is active and enabled. (When 90% of the set range is reached, this auto range is effective. When 80% of the original range is reached, it returns to the original range.)

Over-ranging
Set to “Enabled” or “Disabled” to turn the over-ranging feature on or off.

3.5.7.2 Data Logging Menu

Data Log Setup –Quick
Allows up to 15 parameters to be logged. After each parameter (labelled “Logging Param. 1” – “Logging Param. 15”) place the number of the parameter that is to be logged found in:

- Appendix A Advanced Protocol Parameter List for parameter number list
- Data Log setup –GUI below

Data Log setup –GUI

This field works in tandem with the “Data Log setup –Quick” field and is used when the parameter number is not known. The user can enter each logging parameter field (P1-P15) and scroll through all the parameters that can be logged. Once the parameters to be logged has been filled out, the parameter numbers can be copied from within the “Data Log Setup –Quick” field for future use.

3.5.7.3 Serial Communications

Main Gas ID

The ID address of the analyzer when Multidrop RS232 communications is used.

RS232 #1

Baud

Set the Baud rate that the instrument will communicate over (1200, 2400, 4800, 9600, 14400, 19200, 38400)

Protocol

Set the protocol used for communication either EC9800, Bavarian or Advanced

RS232 #2

Baud

Set the Baud rate that the instrument will communicate over (1200, 2400, 4800, 9600, 14400, 19200, 38400)

Protocol

Set the protocol used for communication either EC9800, Bavarian or Advanced

3.5.7.4 Network Adaptor Menu

The Network Adaptor Menu allows the user to enter or change the I.P. address, Netmask and Gateway.

```
             NETWORK ADAPTER MENU


I.P. ADDRESS      0.      0.     0.     0.
NETMASK           0.      0.     0.     0.
GATEWAY           0.      0.     0.     0.
```

4 Calibration

Calibrations with the Serinus 55 H_2S analyzer incorporates the H_2S converter and should be performed as outlined below with no changes to the analyzer-converter configuration. Span gas used throughout all procedures is H_2S gas.

4.1 Zero Calibration

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

> **Note:** This calibration is unnecessary in most situations and should only be performed if required. Acoem recommends that zero calibration not be used unless specifically required.

Performing a zero calibration can be performed through either the Calibration port or Sample port. Follow the relevant instructions below:

Calibration port

1. Ensure suitable zero air source is connected to the "Calibration port" on the back panel of analyzer (see section 2.3.1)
2. Enter the Main Menu → Calibration Menu → Calibration Mode
3. Select the Calibration mode to be zero
4. Allow the instrument to stabilize (15 minutes)
5. Enter the Quick Menu and select "Zero Calibration"
6. A box will appear with editable numbers, select 0.00
7. Instrument will perform Zero calibration, when finished the instrument will return to normal activities

Sample port

1. Ensure suitable zero air source is connected to the "sample port" on the back panel of analyzer (see section 2.3.1)
2. Let the instrument stabilize
3. Enter the quick menu and select "Zero Calibration"
4. A box will appear with editable numbers, select 0.00
5. Instrument will perform Zero calibration, when finished the instrument will return to normal activities

4.2 Span Calibration

Performing a span calibration can be performed through either the Calibration port or Sample port. Span calibrations calibrate the instrument to the upper limits of normal monitoring. Acoem recommends that 80% of full scale should be sufficient for calibrations in ambient monitoring situations 400 ppb. Follow the relevant instructions below:

Calibration port

1. Ensure suitable span gas source is connected to the "Calibration Port" on the back panel of analyzer (see section 2.3.1)
2. Set the span source to a known concentration (80% full scale recommended)
3. Enter the Main menu → Calibration menu → Calibration mode
4. Select the Calibration mode to be span

5. Let the instrument stabilize (15 minutes)
6. Enter the quick menu and select “Span Calibration”
7. A box will appear with editable numbers, select the concentration being delivered to the instrument
8. Instrument will perform Span calibration, when finished the instrument will return to normal activities

Sample port

1. Ensure suitable span gas source is connected to the “Sample Port” on the back panel of analyzer (see section 2.3.1)
2. Set the span source to a known concentration
3. Let the instrument stabilize (15 minutes)
4. Enter the quick menu and select “Span Calibration”
5. A box will appear with editable numbers, select the concentration being delivered to the instrument.
6. Instrument will perform Span calibration, when finished the instrument will return to normal activities

4.3 Multipoint Calibration

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

1. Ensure a suitable span source is connected to instrument from a gas calibrator (Acoem recommends the GasCal-1100) through the sample port
2. Record analyzer instrument gains before performing calibration (section 3.5.1)
3. Perform a zero calibration as described in section 4.1
4. Perform a span calibration as described in section 4.2
5. Set up a program for measuring the span concentration through 5 steps down from 80% of full scale

   Example for full scale of 500ppb

   a. Set the 1st concentration on the gas calibrator to 400ppb, allow instrument to sample for 15 minutes, record measurement.
   b. Set the 2nd concentration on the gas calibrator to 300ppb, allow instrument to sample for 15 minutes, record measurement.
   c. Set the 3rd concentration on the gas calibrator to 200ppb, allow instrument to sample for 15 minutes, record measurement.
   d. Set the 4th concentration on the gas calibrator to 100ppb, allow instrument to sample for 15 minutes, record measurement.
   e. Set the 5th point at a concentration of 0ppm (zero air); allow the instrument to sample for 15 minutes and record measurement.
6. The linearity and correlation can be calculated for each point manually or all points calculated within excel
7. **Manual Calculations**

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

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

Equation 1 Instrument accuracy

8. If the difference between values is less than 1% then the instrument is within specifications. Otherwise a Leak Check and or service are required
9. **Microsoft Excel**
   Alternatively all the data can be placed in an excel spreadsheet in columns next to the supplied concentration.
10. Create an X Y scatter plot of expected calibration against instrument response, right click on either point and select "Add Trendline". Tick the "Display equation on chart" and "Display R-squared value on chart" in the options tab
11. The linear regression equation y = mx + b will be displayed

0	1
100	101
200	201
300	300
400	400

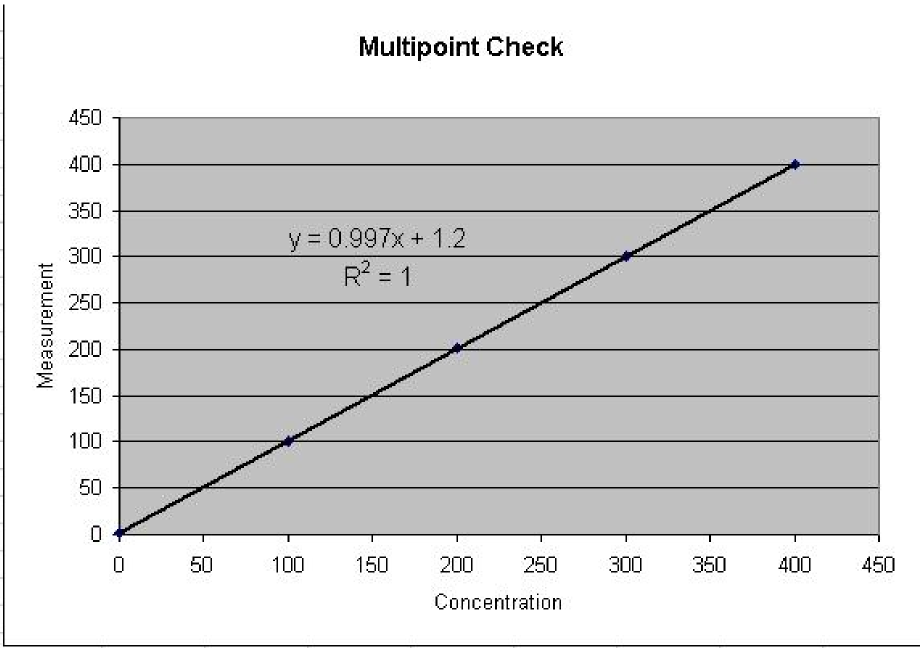


Figure 8 Excel graph of Multipoint Calibration

12. Accept the calibration if the following are found:
    - The gradient (m) falls between 0.98 and 1.02
    - The intercept (b) lies between ±0.3.
    - The correlation (R^2) is greater than 0.9995
13. Reject the calibration if the above criteria are not met. If the calibration fails perform a leak check (section 6.4.4), check zero air scrubbers or check troubleshoot guide for possible errors (section 7).

4.4 Pressure calibration

The pressure calibration involves a two point calibration, one point under vacuum and another point at ambient pressure. This procedure is necessary when all settings have been wiped, when pressure readings are faulty or for diagnostic purposes. To perform a pressure calibration the following steps must be completed

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

Vacuum

1. Open instruments (section 2.1)
2. Unscrew fitting from top of cell, anticlockwise, remove 1/8 black tubing and screw stainless steel blocker onto fitting (1 in Figure 9)
3. Remove tubing (connecting to hydrocarbon kicker) from cell T-piece (2 in Figure 9)
4. Connect pressure meter onto cell T-piece and measure pressure

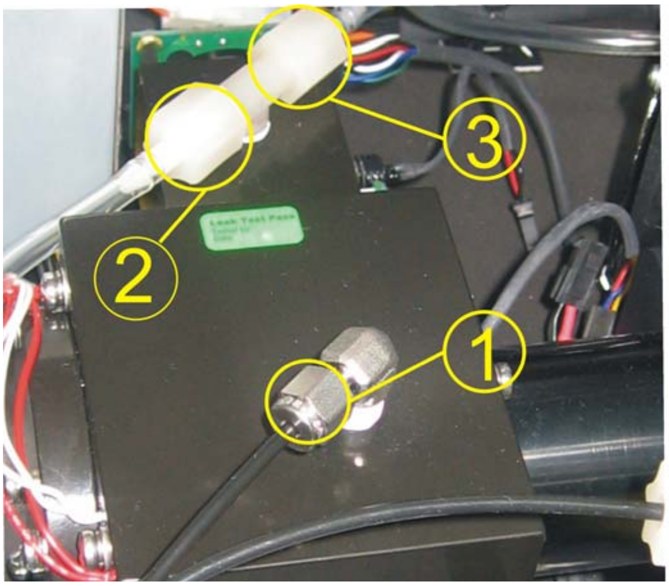


Figure 9 Pressure Calibration

5. Connect vacuum source to exhaust port of analyzer,.
6. Enter Calibration menu → Pressure Calibration and select pressure (vacuum pressure) then select the unit of pressure being used (torr etc)
7. The screen will display two horizontal bar (Figure 10) the first (Amb) is for the ambient pressure sensor, the second (Pres2) is for the cell pressure sensor
8. Ensure that the pressure is stable (arrows are not moving up and down the bar.

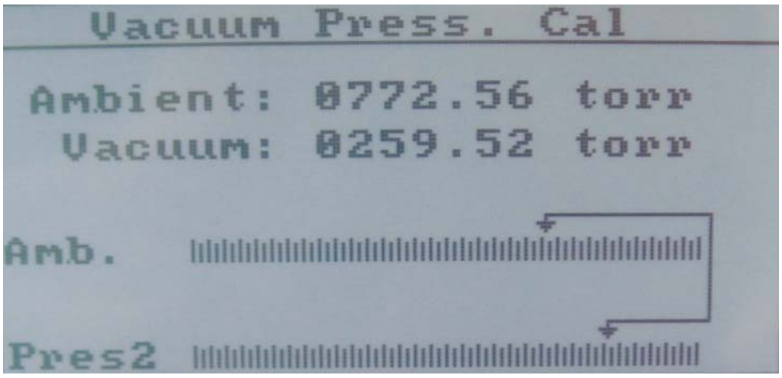


Figure 10 Pressure menu

9. Select the set option (activate buttons) the Current Pressure window will open
10. Using the keypad, input the current pressure reading on the meter.
11. Press the "Accept" button to calibrate pressure sensors

Ambient

1. Continuing from the Vacuum calibration, remove the pressure meter from the cell fitting
2. Remove the stainless steel blocker from the cell T-piece fitting (3 in Figure 9)
3. Switch off and disconnect any vacuum sources from the Exhaust port.
4. Measure the ambient pressure from the meter
5. Enter the main menu → Calibration menu → Pressure calibration
6. Select ambient (ambient pressure) then select the unit of pressure being used (torr etc)
7. The screen will display two horizontal bars (Figure 10) the first (Amb) is for the ambient pressure sensor, the second (Pres2) is for the cell pressure sensor
8. Ensure that the pressure is stabile (arrows are not moving up and down the bar.
9. Select the set option (activate buttons) the Current Pressure window will open
10. Using the keypad, input the current pressure reading on the pressure meter in ambient air.
11. Press the "Accept" button to calibrate pressure sensors
12. Reconnect tubing to cell as shown in 1 +2 Figure 9

4.5 Precision check

A precision check is a Level 2 calibration. This means that the instrument has a known concentration, or zero air, run through it and an observation of the instruments concentration is made with no adjustment. A precision check can be performed either manually or automatically.

5 Communications

The Serinus analyzer has four methods of communication. Each communication method is used in specific situations for data download, instrument control or both. The Serinus can perform communication through 4 different paths (RS232, USB, 25 pin Digital/Analog input/output or TCP/IP network (optional). The Serinus also includes a windows application, the Serinus Communicator, that allows data download and remote activation from a PC.

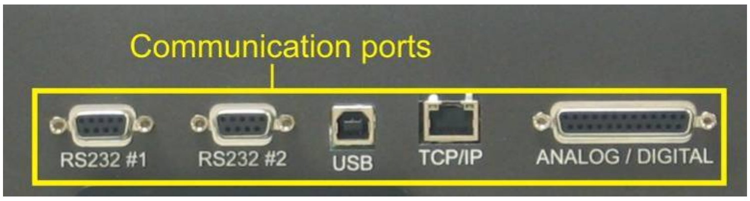


Figure 11 Communication ports

5.1 RS232 Communication

RS232 #1

This port is designed to be used with a Termination Panel allowing the Serinus instrument to work as a datalogger. This function is an optional extra and must be purchased from Acoem.

RS232 #2

RS232 communication is the most reliable way to access data from instrument. RS232 port #2 should be connected to a computer, datalogger or in a daisy chain configuration (multiple analyzers connected via the same RS232 cable).

Uses the following protocols

EC9800 protocol (Appendix B)
Bavarian protocol (Appenidx C)
Advanced (Appendix D)

5.2 USB Communication

USB

This port is ideal for downloading data quickly via a laptop and for onsite diagnostics and maintenance.

5.3 TCP/IP Network Communication

TCP/IP (optional)

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

5.4 Digital/Analog communication

External I/O port

The Analog/Digital ports sends and receive analog/digital signals to other devices. These signals are commonly used to activate gas calibrators or for warning alarms.

Analog Outputs

The analyzer is equipped with three analog outputs Voltage 0-5V or Current settable 0-20,2-20,4-20 mA

Analog Inputs

The analyzer is also equipped with three analog inputs with resolution of 15 bits plus polarity. Input voltage 0-5 V

> **Warning:** Exceeding these voltages can permanently damage the instruments and void warranty

Digital Status Inputs

The analyzer is equipped with 8 logic level inputs for the external control of Zero/Span calibration sequences.

Digital Status Outputs

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

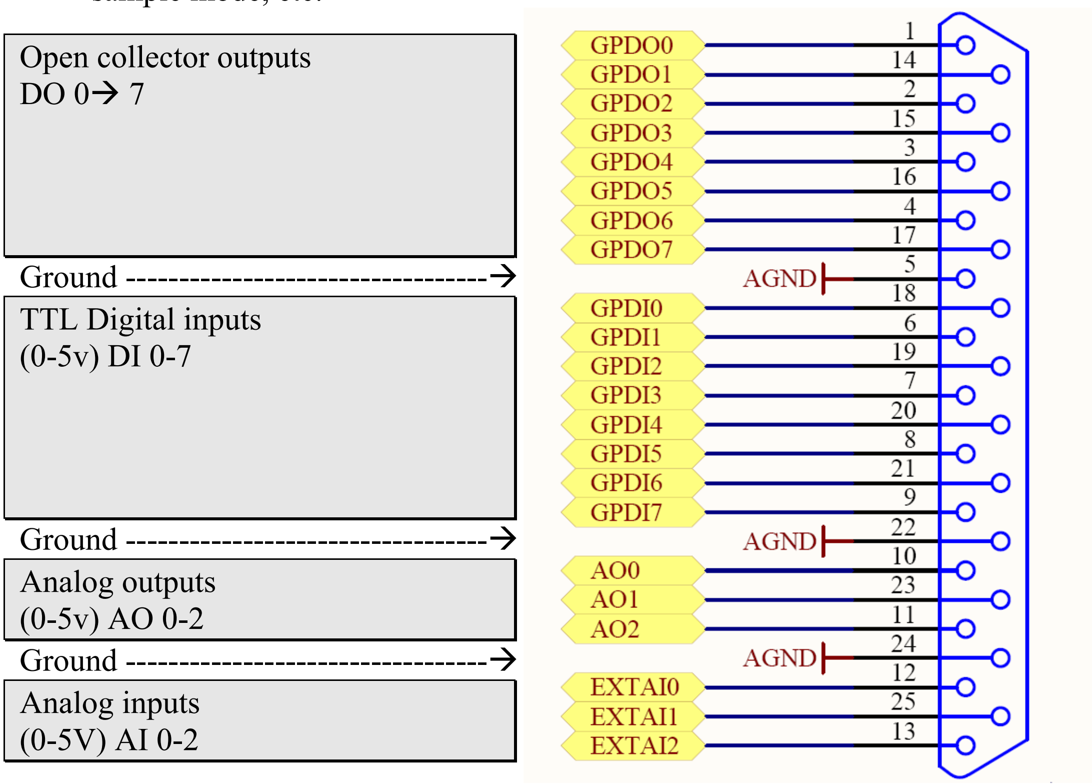


Figure 12 External 25pin I/O individual pin descriptions

5.5 Serinus downloader program

The Serinus Downloader program is designed to allow the user to acquire data directly from the analyzer and control it remotely. The Serinus downloader program has four main windows; **“Settings”** where configurations are made to communicate with the analyzer, **“Data”** where data is downloaded into a spreadsheet and **“Remote Screen”** where the analyzer can be controlled directly and “Remote Terminal” which is a diagnostic tool used to check instrument operation and parameter values.

5.5.1 Settings

Within this window both the data format setting and analyzer communications settings are defined. There are two icons in the main header, they are **Save Settings** (which saves the current settings as default) and Cancel changes

Output

Ouput file: Enter in the destination (folder) including file name (extension must be .txt) for the data to be downloaded into

Date Format: Enter in the date format that data will be written as (within the text file).
Date must be separated by forward slashes, commas and time by colon. and must contain:

Year	yyyy
Month	MM
Day	dd
Hour	HH
Minute	mm
Second	ss

The date can be used for one of three activities

Append Data	Add data onto the end of the current entries within the text file
Overwrite Data	Always create new text file rather than adding to existing file
Prompt User	Displays a window that prompts user to overwrite data, if no is selected data will be appended to current .txt file

Connection

The user must select the type of connection that the computer is connect to the analyzer with. This is chosen in the **“Connection Type”** field and consists of:

Direct Serial connection:
Used when the analyzer is connected directly to PC via serial port

Port → Choose which port on the PC the Serinus is attached to
Baud Rate → Select the baud rate with which communication will take place (must match the baud rate set on the analyzer see the Serial Communications section)

Network Connection:
Used when the analyzer is being connected via a network.

IP Address → Enter the IP address of the analyzer as described in Acoem technote: TEC 0045
Port → Enter the port number of the analyzer as described in Acoem technote: TEC 0045

USB Connection:
Used when the analyzer is connected directly to PC via the USB connection

Analyzer → A drop down list will display all analyzers that the downloader program can connect to, the user must select the appropriate analyzer number matching that of the analyzer connected to.

Analyzer

Analayser ID:
Enter the analyzer ID found in the “Main Gas ID” field (Main Menu → Communications → Serial Communications)

Note: Only relevant for a direct serial connection

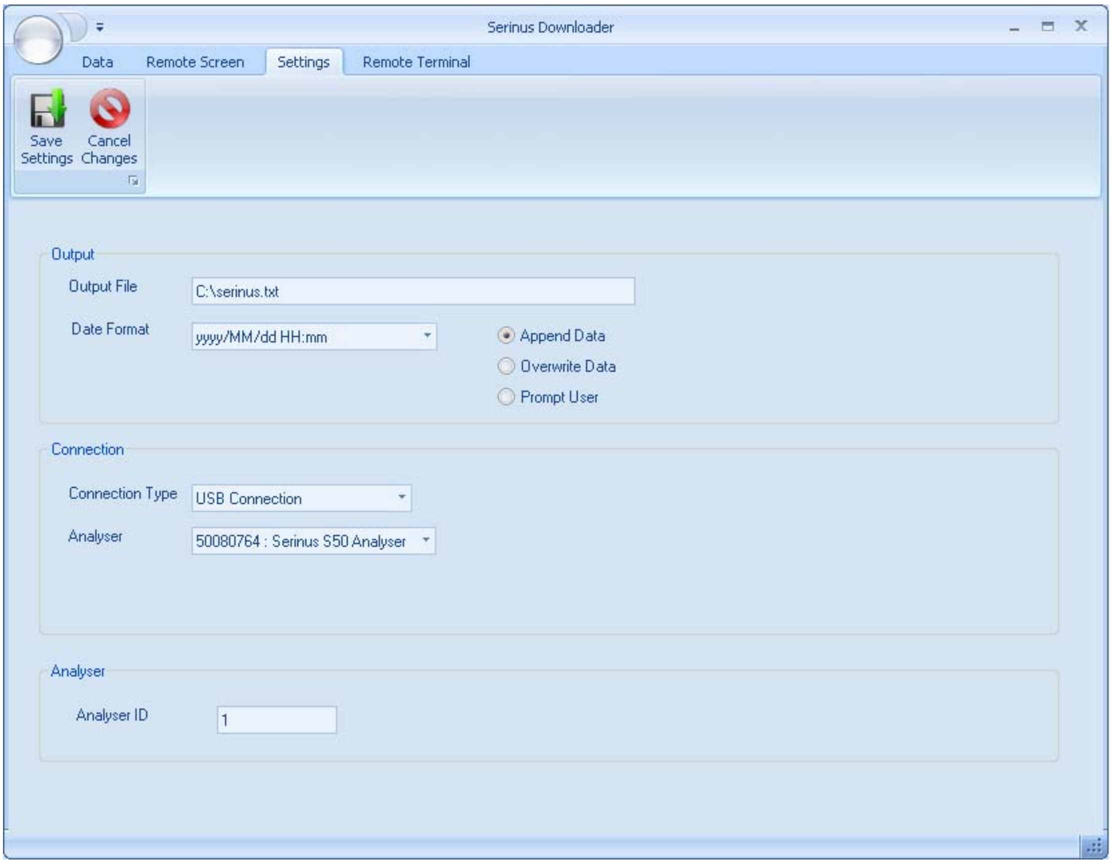


Figure 13 Serinus downloader - settings tab

5.5.2 Data

The Data window consists mainly of a spreadsheet with rows (numeric) and columns (labeled as per parameter). The amount of data to be uploaded into the spreadsheet is determined by the start and end date range on the left side of the main menu bar. The other features in the menu bar are:

- **Acquire data** This button acquires data from the analyzer (within the date ranges) and displays on screen along with saving as a text file
- **Save data** Saves the data into excel file format
- **Clear Data** Deletes data from the screen
- **Rebuild index** This function is used when the downloader is unable to access data. A common reason for this is a corruption or deletion of the index.dat file (on removable USB stick) or data in the text file has been deleted. Rebuilding the index will create new index files and allow all current data to be accessed.
- **Reset Memory stick** Resets the memory stick, this is used if the instrument is having problems detecting the stick.

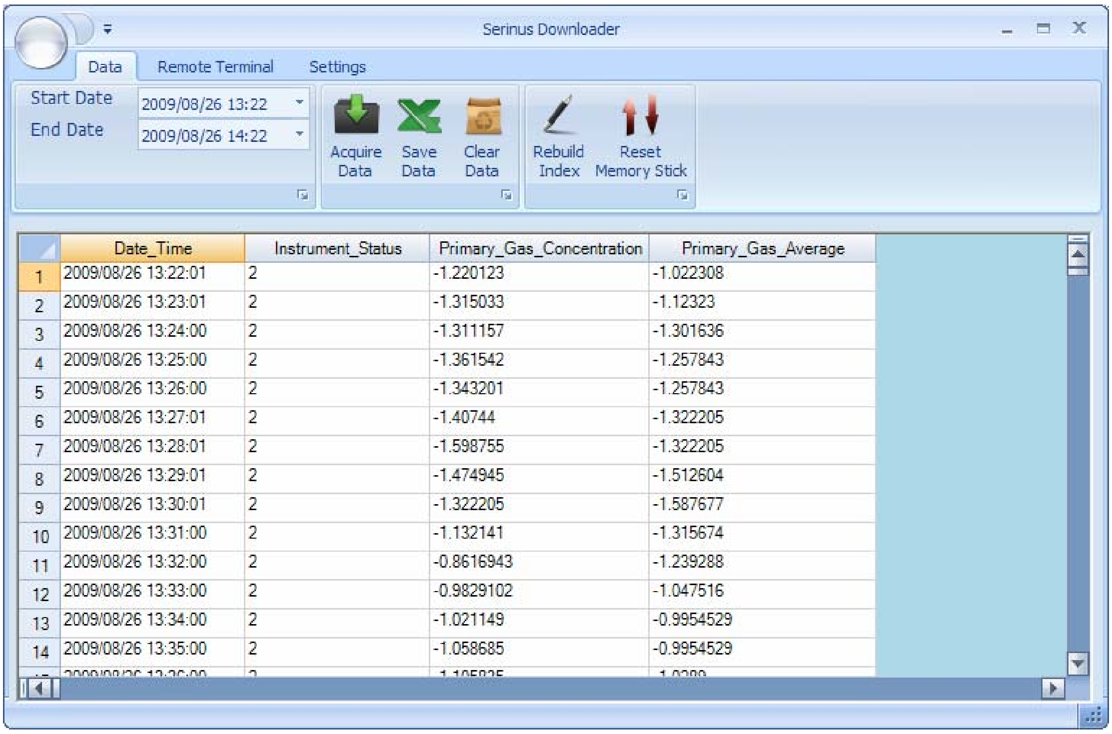


Figure 14 Serinus Downloader – Data tab

5.5.3 Remote screen

The remote screen tab allows the user to connect to the Serinus instrument and control it remotely. The screen has all the same buttons as the Serinus gas analyzer and is used as virtual interface with the instrument. The screen is a screenshot and not an automatically updated feed; the refresh button will need to be used when tracking changes in parameters.

- By clicking the green "Connect" button in the top left hand corner, the remote terminal session will begin.
- The session can be terminated at anytime by pressing the red "Disconnect" button
- The screen can be updated by clicking the "refresh screen" button. This must be used

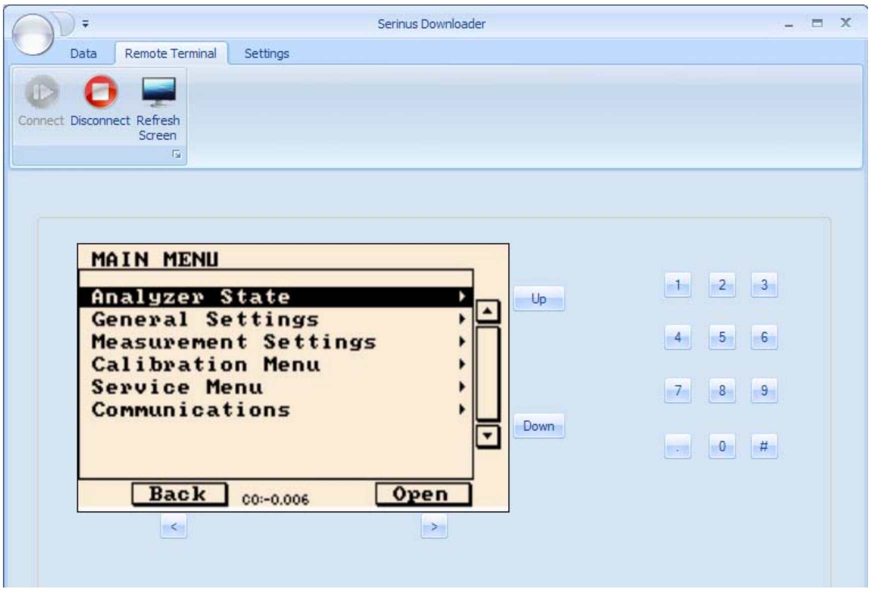


Figure 15 Serinus Downloader – Remote Screen tab

5.5.4 Remote terminal

The remote terminal tab is a diagnostic tool used to check instrument operation and parameters. The remote terminal is used in a similar way to "ping" a computer; it is used to ensure communications are working properly. Firstly the Downloader program must be connected to the instrument and the green connect button in the top left hand corner must be clicked. The remote terminal tab consists of 3 different sections:

- Advanced Protocol
  Within this section the user selects the parameter number (from within the advanced protocol) then clicks the get button to receive that parameters value
- EC9800 Protocol
  Within this section a command can be sent to the instrument using the EC9800 protocol. Simply type in the text command in the field and click the send button.
- Received Data
  This field contains the value or the parameter that has been requested. Values can be cleared by pressing the clear button

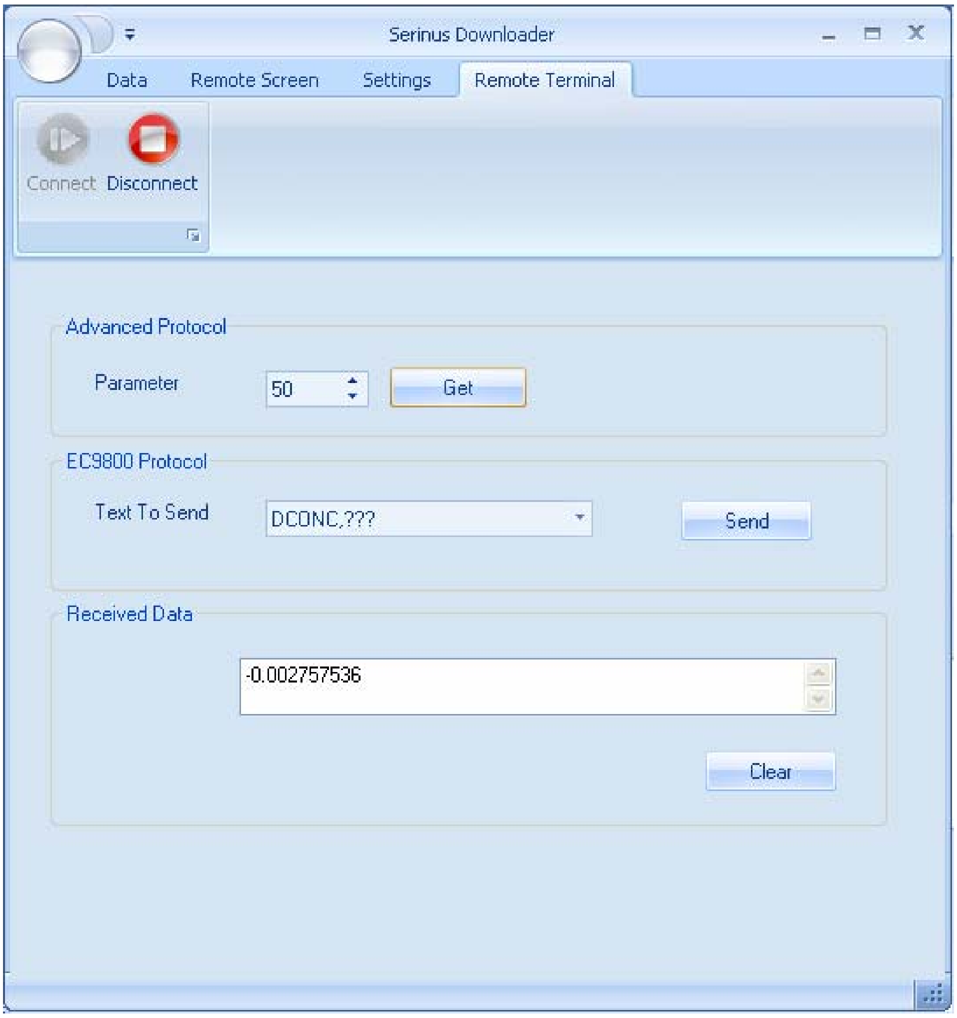


Figure 16 Serinus downloader - Remote Terminal tab

6 Service

6.1 Pneumatic diagram

See section 8.3.1 for pneumatic diagram with internal pump

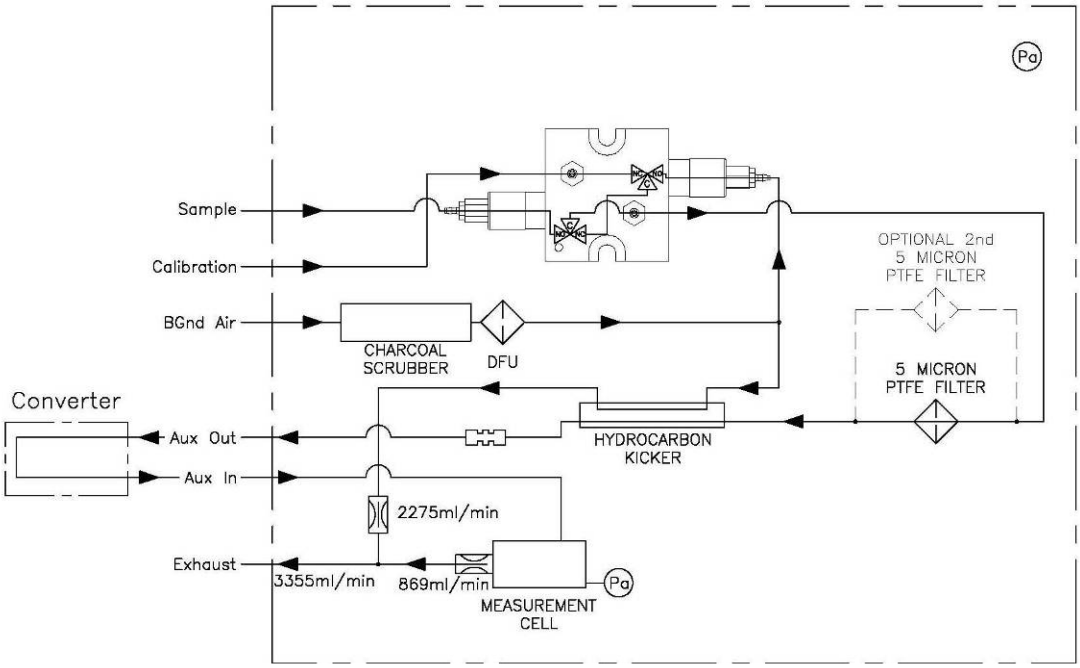


Figure 17 Pneumatic diagram

6.2 Maintenance tools

To perform general maintenance on the Serinus 55 the user will be require the following equipment:

- Toolbox
- Digital multimeter (DMM)
- Computer or remote data terminal and connection cable for RS232 communication
- Pressure transducer (absolute) and connection tubing, calibrated in torr
- Flow meter (1 slpm nominal)
- Minifit extraction tool
- Orifice removal tool
- 1.5mm hex key
- Assortment of 1/4” and 1/8” tubing and fittings
- Test zero air source
- Test span gas source
- Leak tester

6.3 Maintenance schedule

Table 1 Maintenance Schedule

Interval *	Task performed	Page
Weekly	Check inlet particulate filter, replace if full/dirty	44
	Check sample inlet system for moisture or foreign materials. Clean if necessary	
	Perform precision check	33
Monthly	Check fan filter, clean if necessary	44
	Perform span calibration	29
	Check date and time is correct	20
6 Monthly	Check the zero air scrubber	46
	PMT Desiccant packs	47
	Perform multi-point calibration check	30
Yearly	Replace DFU filter	45
	Replace sintered filter and orifice (only if necessary)	
	Check UV lamp alignment (or as required)	48
	Perform pressure check	49

* Suggested intervals for maintenance procedure may vary with sampling intensity and environmental conditions.

6.4 Maintenance procedures

6.4.1 Particulate filter replacement

1. Disconnect the external pump
2. Slide open (Figure 18) to access the particulate filter (located in front right hand corner
3. Unscrew the filter cap (bright blue) by turning it counterclockwise
4. Remove the filter plunger from the casing, place finger on tubing connector and pull to the side

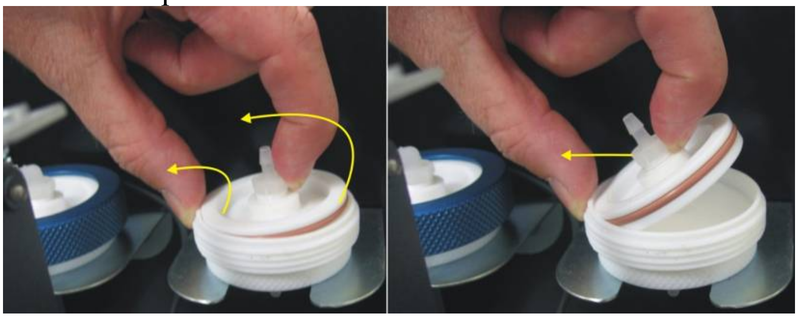


Figure 18 Removing plunger

5. Remove old filter, wipe down plunger with damp cloth and insert new filter
6. Replace plunger, screw cap on and reconnect the pump
7. Close instrument and perform a quick leak check (section **Error! Reference source not found.**)
8. Resume monitoring

6.4.2 Clean fan Filter

1. Turn off fan
2. Remove outer filter casing and filter (Figure 19)
3. Clean filter by blowing with compressed air (if available) or shaking vigorously
4. Replace filter and filter casing

Figure 19 Removing fan filter

6.4.3 DFU Replacement

1. Turn off analyzer and remove power
2. Remove Kynar nut from the end of the DFU by turning anti-clockwise (looking from DFU side)
3. Replace DFU and ensure that the flow is in the correct direction (arrows points toward Kynar nut)
4. Tighten kynar nut clockwise

6.4.4 Quick Leak test

This procedure is designed to determine if the instrument pneumatics has a leak, this initial check. If the instrument passes the check then no further leak checks are needed, if it fails a full leak check will be required.

1. Enter main menu → Diagnositcs → Valve menu and set valve sequencing to off. Then open all the valves in that menu
2. Plug both the “Sample port” and the “Calibration port” (see Figure 20 below)

Figure 20 Plugged sample and calibration ports

3. Enter the main menu → status menu → pressure menu and compare the ambient pressure to the inst gas pressure
4. Allow 1-2 minutes for the pressures to stabilize, check that the gas flow = 0, if this is not the case then there is a leak
5. If the two pressures are within 10% of each other then the leak check has passed.
6. If the pressures fluctuate with channel switching or are more than 10% different, perform pressure calibration (section 4.4), after this is completed repeat quick leak check, if this again fails perform advanced leak check (section 6.4.5).

6.4.5 Advanced leak check

If a leak is suspected a more intensive leak check can be performed.

1. Continue from the setup in the quick leak check.
2. Connect a pump to the exhaust port with a shut off valve (pump side) and a vacuum gauge (exhaust port side) between the two
3. Ensure that the shut off valve is open then turn on the pump (1-2 minutes) and create a vacuum.
4. Close the shut off valve and measure the vacuum. If the vacuum slowly drops (pressure rises) then a leak is present
5. Open each valve individually, leaving the other two closed, and using the plumbing diagram determine the location of the leak
6. When the location of the leak has been determined check all tubing and fittings to make sure that they are attached appropriately and have no splits or cracks

6.4.6 Replace Zero air scrubber

1. Open the lid of the analyzer
2. Remove the tubing from the barb fitting on top of the scrubber (1 in Figure 21)
3. Remove the DFU from the fitting below the scrubber by pulling it out (2 in Figure 21)
4. Now the scrubber holder can be opened with a screwdriver (3 in Figure 21)

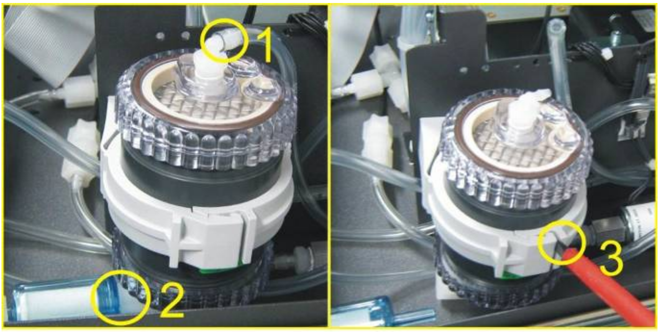


Figure 21 Zero scrubber removal

5. The zero scrubber can now be replaced with a new scrubber and all fittings and tubing replaced
6. Perform a leak check (section 6.4.4)
7. Perform a zero and span calibration (section 4.1 and 4.2)

Average H_2S Concentration	Charcoal Replacement
0 to 30 ppb	12 Months
30 to 100 ppb	6 Months
> 100 ppb	1 Month

6.4.7 Replace PMT desiccant pack

The PMT housing contains two desiccant packs to prevent condensation on the cooled PMT housing. If the desiccant expires it will result in corrosion of the PMT housing and premature cooler failure. It is recommended that the desiccant bags be changed at least annually. If moisture is detected inside the housing or the desiccant packs are saturated the interval should be reduced. To change the desiccant packs perform the following:

Caution
Because the PMT is extremely sensitive to light, it is essential that before opening the PMT assembly to make sure that the analyzer is switched off.
In addition, even when the analyzer is switched off it is very important to cover the PMT at all times so that no direct light reaches its window.

1. Turn the analyzer off and disconnect power.
2. Using an offset Phillips head screwdriver, remove the desiccant pack access cap from the PMT housing.

Note
Removal of the desiccant access cap may be easier if the Rx cell/PMT housing is removed from the analyzer. Refer to section 3.3.8.

3. Remove the old desiccant packs and replace with new (see Figure 22). Do not attempt to dry and reuse the old packs.

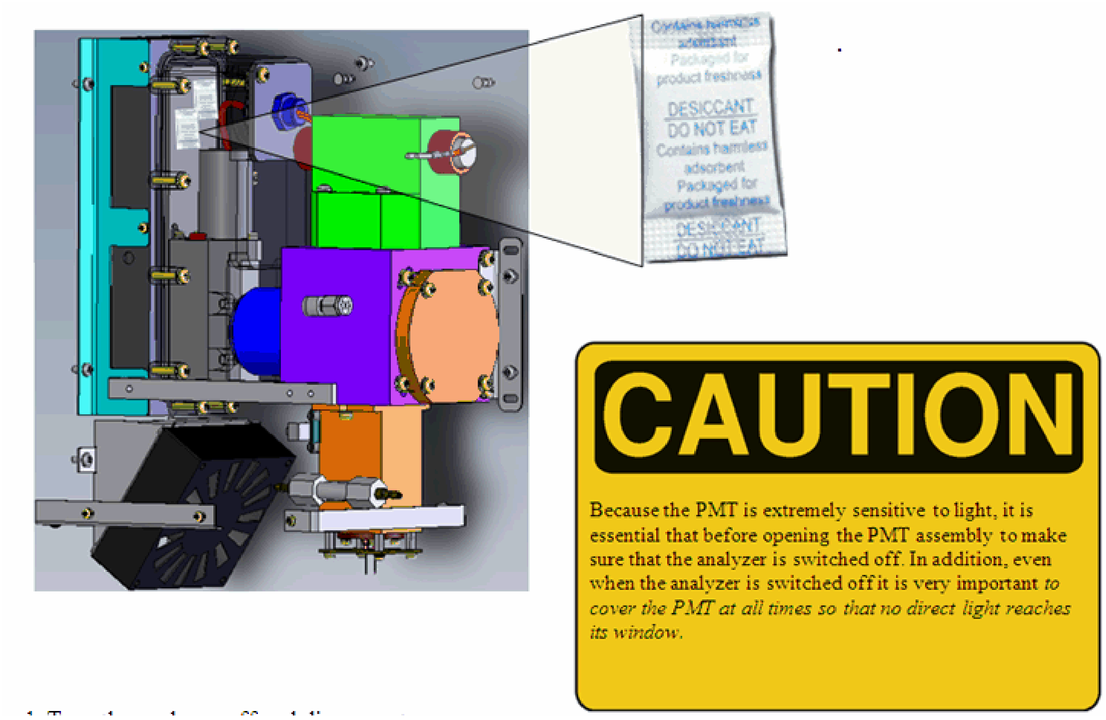


Figure 22 Position of desiccant packs

4. Inspect the inside of the PMT housing (by touch or with an inspection mirror) to check for moisture inside the housing. If moisture is detected inside the housing, the desiccant pack replacement frequency should be increased.
5. Reinstall the desiccant cap by gently twisting and pressing the cap back into the PMT housing. It may help to apply a small amount of lubricant to the O ring on the desiccant cap. Secure with two screws.

> **Caution**
> Do not attempt to insert the desiccant cap into the PMT housing by using the screws to pull the cap into place. This will damage the PMT housing.

6. Reconnect power and restart the analyzer.

6.4.8 Replace DFU filter

1. Turn off analyzer and remove power
2. Remove DFU from kynar nut by pulling and twisting slightly if any resistance.
3. Remove tubing connected to the DFU on the other side
4. Replace DFU and ensure that the flow is in the correct direction (arrows points toward tubing)

6.4.9 Check UV lamp alignment

Required equipment:
Oscilloscope

Proper operation of the UV lamp is essential to the Serinus 55. The UV lamp should be checked yearly to ensure it is operating within acceptable parameters and may require realignment to maintain sufficient UV light for analyzer operation. The UV lamp will need to be adjusted only when the “Reference gain pot” goes above 200 or below 5. Following are procedures to check, align, and replace the UV lamp assembly.

> **Warning**
> The Lamp Driver PCA can generate in excess of 1000 volts. Exercise extreme care when working in the vicinity of the Lamp Driver.

> **Caution**
> If the UV lamp is adjusted, the analyzer will require recalibration.

1. Turn the analyzer on and allow the UV lamp to warm up and stabilize (about 30 minutes).
2. Connect an oscilloscope to TP13 (PREOUT) on the Main controller board and TP1 (AGND). Adjust the scope for 0.5 V/division and 20 msec/division.
3. Loosen the collets (do not remove) at each end of the lamp (Figure 23).

Figure 23 Collets of the UV lamp

4. Physically adjust the UV lamp (rotate and move left and right) until the maximum peak voltage on the oscilloscope is obtained, not to exceed 2 volts peak. The minimum usable output from the lamp is approximately 0.25 volts amplitude (peak to peak). If the UV lamp output is below 0.5 volts, then replacement should be considered.
5. Tighten the UV lamp collets and verify the UV lamp has remained at its previously adjusted position.
6. Reset the analyzer and allow it to run a startup sequence.
7. Instrument must now be recalibrated

6.4.10 Pressure sensor check

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

1. Remove the exhaust and sample tubing from the back of the analyzer
2. After 5-10 minutes observe the pressure reading in the “cell” (section 3.5.2.3)
3. Compare the Serinus pressure sensor measurement to the current ambient pressure from an external calibrated sensor. Ensure that they are reading the same ± 3 TORR (± 0.4 kPa)
4. If no external pressure sensor is available, compare the Serinus “cell” pressure to the “ambient” pressure (section 3.5.2.3). Ensure that they are reading the same ± 3 TORR (± 0.4 kPa)
5. If the readings are outside this level then perform a Pressure calibration (section 4.4)

6.5 Parts list

Below is a list of the replaceable parts of the Serinus 55. Some of these parts will not need replacing and other consumables will need constant replacing.

Table 2 Parts List

Part Description	Part Number
Scrubber assembly charcoal for Zero/Air, Serinus	H010038
Lamp Assembly, UV	C020076
Filter Glass, U330	002-035300
Filter, Ultraviolet	002-035400
Photomultiplier tube	57000011
LCD and interface assembly	D010001
PCA, Controller	C010001
Power Supply, Serinus	P010003
PCA, lamp driver	C010006
PCA, reference detector	C010008
Sample valve manifold assy Serinus	H010013-01
Coooler thermoelectric	53000162
Thermistor assembly	885-071600
Charcoal activated, 1kg bottle	ECO-1035
Lense plano convex	002-039700
Kicker assembly (hydrocarbon scrubber)	H012140
Heater and thermistor assembly	C020074
Power supply optical bench	98412028-2-SP
Cooler, thermoelectric kit	98412028-3-SP
Thermistor assembly kit	98412028-4-SP
Serinus 55 User Manual	M010029
Lense Biconvex	002-039800
Diode photo-detector	37000077
Filter element, 5 micron, consumable (50 each)	98000098-1
Orifice, 14 mil	98000180-13
Orifice, 20 mil	98000180-19
Scrubber assembly charcoal for zero/air, Serinus	H010038
Charcoal activated, 1KG bottle	ECO-1035
Gasket Pressure Sensor	H010037
Serinus 50 Maintenance Kit – used for Serinus 55 (includes consumables marked with *)	E020204
O-ring, orifice and filter	*25000419-3
Filter unit disposable	*036-040180
Dessicant, 5 gram pack (2 required)	*26000260
Silicone Heatsink Compound	*028-090120
O-ring, plano convex lense	*025-030610
O-ring, reaction cell cover plate	*ORI-1019
Oring, U330	*025-030830
O-ring, Dessicant cap	*25000419-1
O-ring Reaction cell to optical bench	*25000423

O-ring, Ultraviolet filter	*25000429
Fitting kynar male branch tee	*28001148-1
O-ring	*O010004
Tygon tubing (3ft)	*T010011
O-ring, Dump-Cell Assembly	*025-030770
O-ring, Opt Bench	*25000447-162
O-ring, Collet (2 required)	*O010004
O-ring, Test Plug, Test lamp	*28001126-2
O-ring, Photo detector	*25000447-109

6.6 Updating firmware

USB memory stick update

1. Turn instrument off
2. Place USB memory stick with new firmware on the Front panel USB port
3. Turn instrument on and immediately press the hash key multiple times until the following screen appears

Vx.x Bootloader Press ‘1’ to enter Bootloader

4. Press 1 to enter the Bootloader menu
5. Select option 3, (Upgrade from USB memory stick) press 3 on keypad
6. Press 9 to start the analyzer with new firmware

7 Troubleshooting

Table 3 Troubleshoot list

Error Message/ Problem	Cause	Solution
A/D conversion error	Temp/press error	Replace main PCB
Input pot limited to 0 or 255	Damaged Lamp	Check that lamp current is 35mA. If not 35mA replace Lamp driver board. If pot still 255, replace UV lamp
Zero Flow	Multiple	Troubleshoot 7.1
Reset Detection		Upgrade firmware
Electronic zero adjust	Faulty zero air or pneumatics	Troubleshoot 7.2
12 Voltage supply failure	Power supply has failed	Replace power supply
Cell temperature failure		Troubleshoot 7.3
No display	AC power	1. Verify that the line cord is connected. 2. Check that the power supply fuse is not open. The fuse should be 5A (115 V) or 3A (230 V). 3. Verify that the voltage switch is in the proper position.
	Contrast misadjusted	Set or adjust the display contrast by simultaneously pressing two keys on the front panel as follows: - Contrast: Press Up arrow (↑) for darker contrast, Down arrow (↓) and <Select> for lighter contrast.
	DC power	Verify that the power supply is providing ± 12V + 5V DC
	Display	Check the interface cable between the display and the microprocessor board.
	Bad display or Microprocessor PCA	1. Replace the front panel display. 2. Replace the microprocessor board. 3. A bad cable is unlikely, but if you suspect it, perform a pin-for-pin continuity test using an ohmmeter.
Noisy or unstable readings	Leaks	A leak dilutes the sample stream and causes low span readings and noise.
	Lamp not correctly positioned	Adjust the UV lamp. If you are unable to obtain an acceptable reading, replace the lamp.
	TE cooler or Reaction cell heater	A failed temperature control allows the instrument zero to drift with ambient

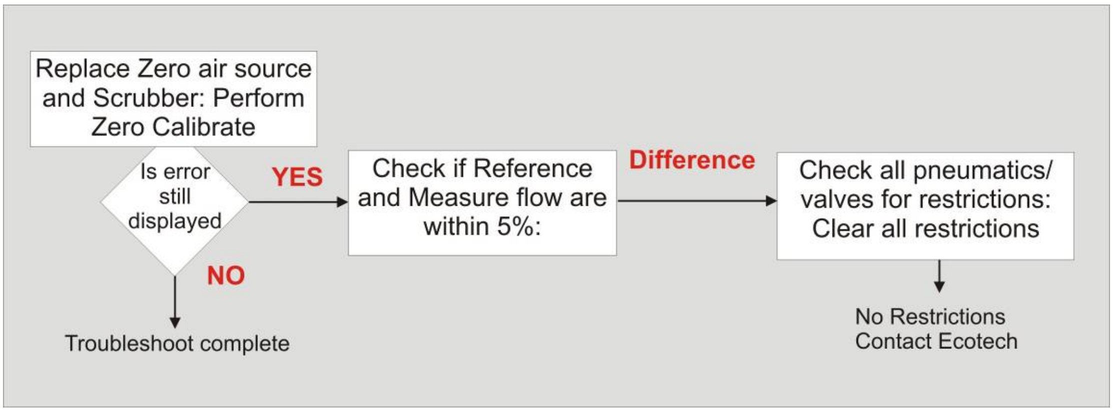
		temperature. Verify that the cell temperature is 50° ±3° C and that the TE cooler is 10° ±2° C.
Low span	Leaks	A leak dilutes the sample stream and causes low span readings and noise.
	Span calibration out	Adjust the span using the calibration procedure
	Faulty lamp	Replace UV Lamp
No response to span gas	Leaks/blockages	Leak or blockages in tubes or valves. Perform leak check and flow check and repair any leaks/blockages.
	Faulty calibration source	Ensure calibration gas is plumbed correctly, is not contaminated and is a NATA/NIST reference gas.
Zero drift	No flow	Check sampler flow
	Charcoal saturated	Replace the charcoal.
	Faulty zero air	Ensure zero air source is not overly polluted
Unstable flow or pressure readings	Faulty pressure sensors	Replace main PCB

7.1 Zero Flow

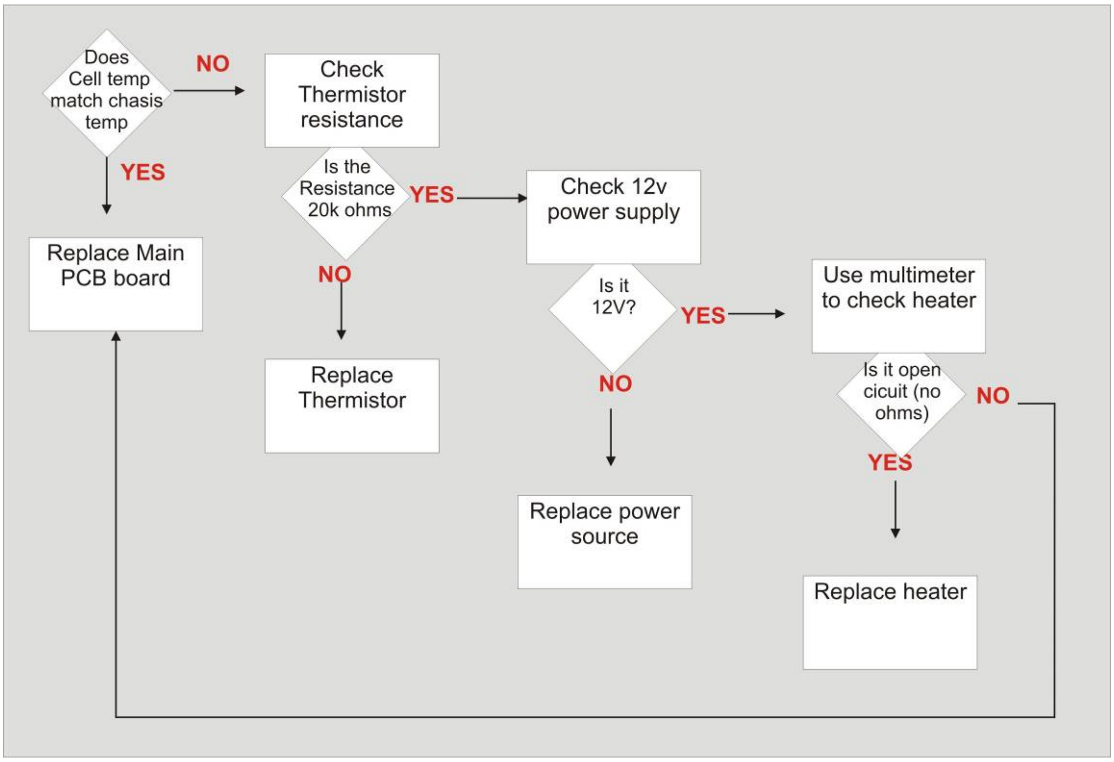
Table 4 Zero flow Troubleshoot

Cause	Solution
Pump failed	Replace the internal or external pump.
Blocked filter or orifice	Replace sintered filter and orifice
Pressurized Rx cell	Ensure Sample and Zero inlets are maintained at ambient pressure.
Flow control assembly	Recalibrate the flow control assembly.

7.2 Electronic Zero adjust



7.3 H2S reaction cell temperature failure



8 Optional Extras

8.1 Dual sample filter

The dual filter is designed with two sample filters plumbed in parallel with a split line. This formation allows sample flow not to be affected, yet reduces the loading on each filter, and therefore the frequency with which they will need to be changed.
The dual filter option is shown in the pneumatic diagram (red dashed line) and requires no operational changes to the instrument.

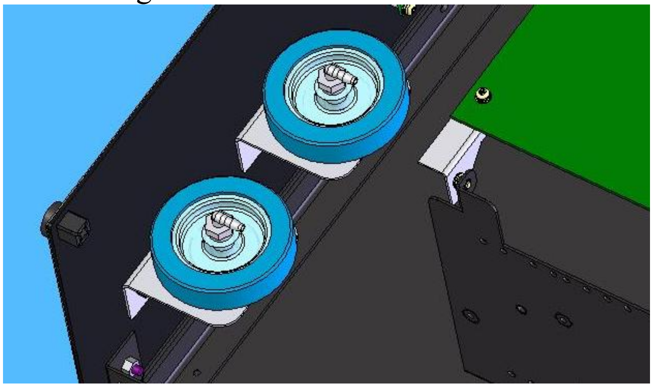


Figure 24 Dual filter option installed

8.2 Rack mount kit

The rack mount kit is necessary for installing the Serinus 55 into a 19" rack. The Serinus 55 is 4RU in height to install in the rack follow these steps.

Installing the instrument

1. Remove rubber feet from analyzer (if attached)
2. Install instrument brackets into rack securely with M6 bolts as shown in Figure 25.

Figure 25 Installation of rack mount brackets

3. Attach instrument lid (only) onto instrument brackets with M6 bolts (supplied) as shown in Figure 26.

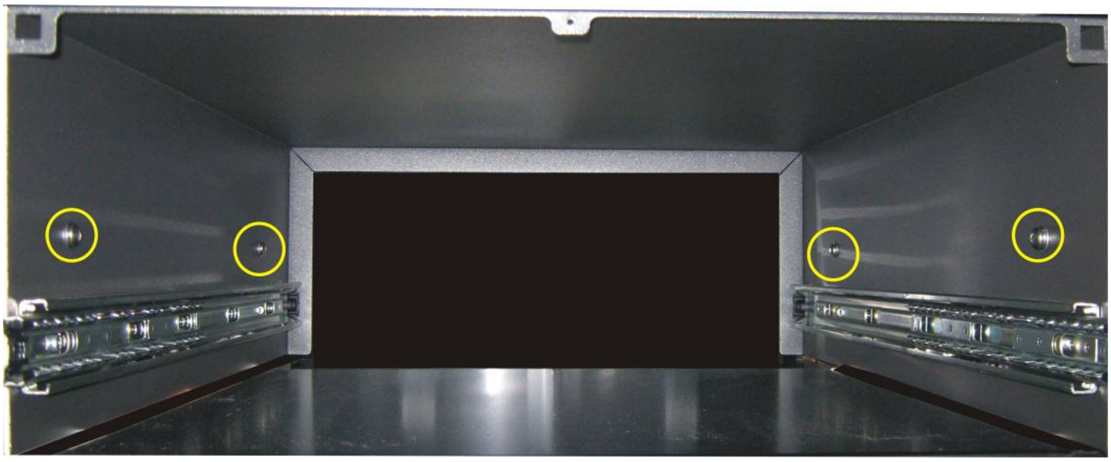


Figure 26 Installation of lid to rack mount brackets

4. Check that the instrument lid is not bowed (bent), if there is a bow adjust bracket and lid bolts until the lid is square, and bolts are tight.
5. Now carefully insert the instrument into the rack by placing the instrument slides into the lid slides, ensure that the rack slide locks engage (Figure 27) on each side (you will hear a click) and gently slide the instrument into the rack.

> **Note:** Ensure both sides of the slide are attached to the lid slides before pushing into rack

Removing the instrument

1. To remove the instrument first pull instrument out of rack giving access to the slides
2. Find the rack slide lock labelled "push" (Figure 27) and push it in whilst sliding the instrument out of the rack, complete this for both sides before carefully removing instrument

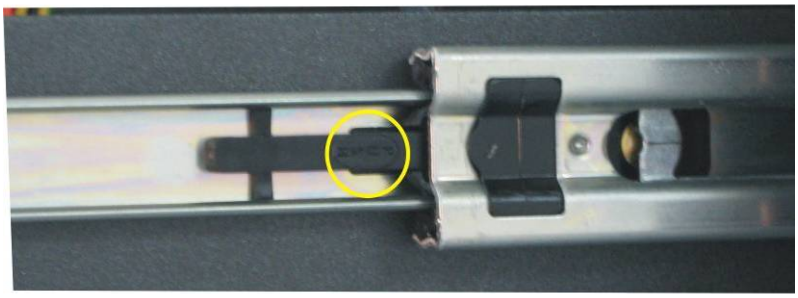


Figure 27 Rack slide lock

3. Unscrew lid by removing M6 bolts shown in Figure 26
4. Slide lid back on to instrument ready for transport or storage

8.3 Internal pump

8.3.1 Pneumatic diagram (internal pump)

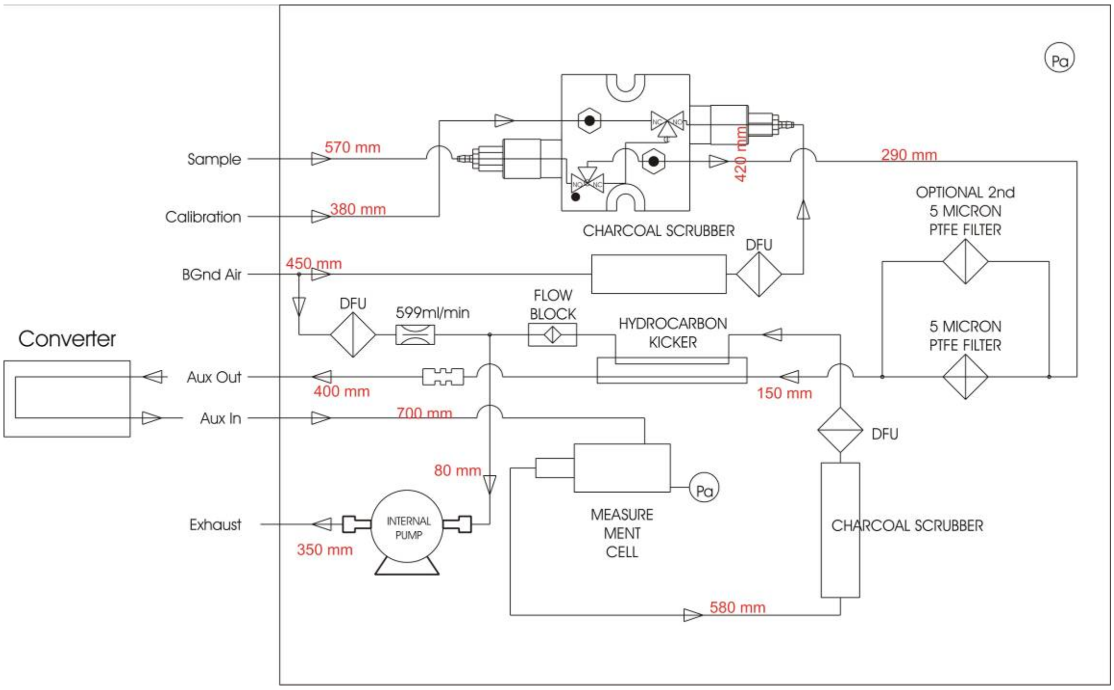


Figure 28 Pneumatic diagram with internal pump

8.3.2 Additional components

The Serinus 55 internal pump option includes the following additional components

Table 5 Internal pump additional components

Component	Description	Part number
Internal pump	Pull sample through instrument, strength of pulling is dependant on temperature and pressure readings	H010027
Flow block	Includes sintered filter and differential pressure sensor to measure flow	H010120
Heater and Thermistor	Mounted in flow block to measure and control temperature for accurate flow	Installed in flow block
Scrubber	Charcoal scrubber	H010038

8.3.3 Removed components

The Serinus 55 has a number of components missing from the standard analyzer due to the presence of the internal pump and flow block controlling flow within the instrument. The parts that have been removed when internal pump is included are:

Table 6 Internal pump removed components

Component	Part number
Orifice	98000180-19
Orifice	98000180-13
Fitting	28001148-1
O-ring (X 2)	25000447-007
Barb adaptor (X 2)	H010007

8.3.4 Menus

When the internal pump is installed in the Serinus 55 the following menus are added, unique only to instruments with an internal pump.

Pressure & Flow menu

Flow SetPoint
The flow that the internal pump is set to pull

Calibration menu

Flow Calibration
This menu contains all the controls for calibrations with an internal pump

Sample Flow
Current Gas flow

Flow SetPoint
The flow that the internal pump is set to pull

Cal. Point
Point to which the flow calibration is performed to (normally calibrated at "Flow set point")

Zero Flow
When there is no flow through instrument ("Sample flow" = 0) select this field to calibrate the zero flow point

Internal Pump
This field allows the internal pump to be turned **ON** or **OFF**. This field is only editable when "Flow Control" field is set to disabled (below).

Flow control
Enable or disable the automatic flow control and internal pump

Coarse
Internal Pump speed control (Coarse)

Fine

Internal Pump speed control (Fine)

> **Note:** Coarse and Fine are not selectable when the Flow control is enabled

Valves Menu:

Opens valve menu where individual valves can be open and shut (see section 3.5.6.1.2 for valves menu)

8.3.5 Flow Calibration

The following procedure must be performed after any exchanges/changes to fittings or filters.

1. Go to Main menu → Calibration → Flow calibration
2. Go to the "Valve menu" and set "Valve sequencing" to **OFF**
3. Set Span/Zero and Cal port valves to **"Closed"**
4. Return to the Flow Calibration menu
5. Set the "Flow Control" field to "Disabled"
6. Set the internal pump to **OFF**
7. Wait for the sample flow to become stable around 0 (Stability of ± 0.01)

> **Note:** Make sure that the "Flow setpoint" and the "Cal point" are both preset to 0.70

8. Press "Zero Flow" → press "Set" (sample flow should not change)
9. Pop up will display "Zero flow/set current flow as zero flow?" select **"YES"**
10. Connect a calibrated flow meter to the Sample port on the back of the analyzer
11. Set internal pump **ON**
12. Manually Adjust the course and fine pots until the flow meter reads the desired (set point) flow = 0.7

> **Note:** Set fine pot to 128, then adjust course to be as close as possible to desired reading, then use fine pot to make it exact

13. Enter the reading from the flow meter into the "Cal point" field
14. Set the "Flow Control" field to "Enabled"
15. Go to the "Valve menu" and set "Valve sequencing" to **ON** (Main menu → Service menu → Diagnostics → Valve menu)
16. Leave for up to 5 minutes to return to normal operation. If instrument doesn't return to normal there may be a blockage, see section 7.1

8.3.6 Pressure Calibration

The internal pump requires a separate flow calibration procedure that replaces the one used in section 4.4

1. Go to Main menu → Calibration → Flow calibration
2. Go to the "Valve menu" and set "Valve sequencing" to **OFF**
3. Set Span/Zero and Cal port valves to **"Closed"**
4. Return to the Flow Calibration menu
5. Set the "Flow Control" field to "Disabled" this will turn the pump off
6. Set the "Course" pot to 254
7. Set the "Fine" pot to 230
8. Connect a calibrated Barometer to the sampler port on the back of the analyzer (remove sample tubing)
9. Return to the "Calibration menu"
   Instrument will prompt user "Do you want to resume the flow control" select **"NO"**
10. Under the "Pressure Calibration" menu select "Vacuum" and select units as **"TORR"**
11. Allow 1 to 2 minutes for the pressure reading to stabilize to vacuum (both barometer and analyzer)
12. Press **"EDIT"** and enter the measure reading from the barometer and press accept
13. Return to the "Flow calibration: menu
14. Set the internal pump off
15. Remove barometer from sample port
16. Return to the "Calibration menu"
    Instrument will prompt user "Do you want to resume the flow control" select **"NO"**
17. Under the "Pressure Calibration" menu select "Ambient", and select units as **"TORR"**
18. Allow 1 to 2 minutes for the pressure reading to stabilize to ambient (both barometer and analyzer)
19. Press **"EDIT"** and enter the measured reading from the barometer and press accept
20. Go to the "Pressure & Flow" menu (Main menu → Analyzer state) and compare the "Ambient" and "Cell" pressures to each other. If they are within 5 TORR of each other pressure calibration was fine, if they are >± 5 TORR repeat pressure calibration procedure
21. When completed return to the "Flow Control" field and set to "Enabled"
22. Go to the "Valve menu" and set "Valve sequencing" to **ON**
23. Procedure completed

8.4 H2S 1100 converter

8.4.1 Specifications

Power:	Input power 115/230 VAC 50/60 Hz. (selectable)
Fuse:	5A (type 3AG) for internal 12V supply (on rear panel) Internal Power supply fuse: 6A slow-blow (115 V) Internal Power supply fuse: 4A slow-blow (230V)
Flow Rate:	450 – 750 cc/min
Ambient temperature:	0°C – 50°C, RH non condensing
Converter temperature:	350 °C for 96% conversion
SO_2 Scrubber temperature:	20°C – 40°C, RH non condensing (ambient)
Ambient air **H_2S** Converter:	H_2S less than 2 ppm, 96% efficiency (new converter)
Converter life:	6000 ppm/hours of **$H_2S \rightarrow SO_2$** conversion.

Converter life will also depend on condition of the sample gas.
High level water vapour will reduce the life of converter!

8.4.2 H2S 1100 components

8.4.2.1 Flow path

- Sample gas passes through the analyzers 47mm diameter 5 micron Teflon filter before entering the H_2S-1100 converter.
- The gas passes through an internally mounted proprietary SO_2 removing scrubber.
- Sample gas containing H_2S then goes through the converter that converts H_2S to SO_2 this gas is then analyzed by the Serinus 55 analyzer. Conversion of H_2S to SO_2 has a 1:1 relationship therefore the measured concentration of SO_2 is directly proportional to the H_2S concentration.
- Gas line connections should be made using clean ¼” Teflon tubes.

8.4.2.2 Front panel

The front panel contains the temperature controller for setting and monitoring the converter temperature. The front panel also provides rack-mounting holes suitable for a 19” rack. The converter temperature should be set at 350°C, shown as SV. PV indicates the actual temperature of the converter. The controller does not require any adjustments.

8.4.2.3 Rear panel

The rear panel has power inlet connection and ON/OFF switch, a fuse for the 12V internal supply, process gas connections (INLET and OUTLET) and an earth screw for grounding to a suitable earth point. A grille provides ventillation to the heated internal components. Ensure that the grille is not blocked or over-heating of the cabinet will occur.

Inlet
This port should be connected to the “Auxiliary Out” port located on the Serinus 55 analyzer with ¼ inch teflon tubing.

Outlet
This port should be connected to the “Auxiliary In” port located on the Serinus 55 backpanel with ¼ inch Teflon tubing.

8.4.3 Maintenance

8.4.3.1 Converter Temperature Adjustment

If the set point temperature (SV) needs to be adjusted to 350□C, use Up/Down key to change the setting.

> **Note:** The converter temperature has been factory set at 350°C and should not be changed. Increasing the temperature may cause premature heater failure and conversion of other sulfur compounds, while decreasing the temperature will reduce the efficiency of conversion.

8.4.3.2 Converter Efficiency Check

The converter is a heated catalytic converter mounted in an insulated box inside the H_2S 1100. Check the performance of the converter at 12 monthly intervals (at least.)

> **Note:** Allow 40 minutes for absorption and desorption of H_2S in the sampling system.

Efficiency of the converter can be determined as follows:

1. First zero the analyzer with a reliable zero air supply.
2. Bypass the H_2S-1100 temporarily with teflon tubing and appropriate ¼” fittings. Calibrate the Serinus 55 using a diluted SO_2 NATA accredited calibration gas (typically at 200ppb concentration).
3. Reconnect the H_2S 1100 into the sample train. Open the H_2S-1100 case and temporarily bypass the SO_2 scrubber with teflon tubing and

appropriate ¼” fittings. Check the analyzer calibration using the same concentration of SO_2 as in step 1. Check that the analyzer reads close to the expected value (190-200ppb). Adjust the calibration of the SO_2 analyzer again to read 200ppb.

4. Now pass a diluted H_2S NATA accredited calibration gas (at the same concentration) through the converter (with the SO_2 scrubber still bypassed) and record the analyzer reading. The efficiency is calculated as follows:

%Efficiency = (Analyzer reading/ H_2S Input concentration) x 100

> **Note:** The percent efficiency will be dependent on the accuracy of the calibration gases used. Take note of the ±value of each calibration gas used for determining the efficiency of the converter and also the % error of the dilution system. These errors are additive and the efficiency can vary considerably just because of the errors associated with the uncertainties of the calibration gases.

The converter is normally between 92 – 96% efficient. The converter should be replaced or reconditioned when the efficiency is less than 92%.

8.4.3.3 SO_2 Scrubber Performance Check

Check the performance of the scrubber at 12 monthly intervals (at least.) Pass 200ppb SO_2 NATA accredited calibration gas through the scrubber, bypassing the converter, then to the SO_2 analyzer. The analyzer should indicate less than 10ppb SO_2.

Finally, reconnect all items of the sample train and recalibrate the analyzer

Appendix A Advanced Protocol Parameter List

Note: Parameters are for all Serinus analyzers and may not be applicable to an individual analyzer.

Table 7 Advanced Protocol Parameter list

#	Description	Notes
0	Sample / Cal Valve	0=Sample, 1=Cal/Zero
1	Cal / Zero Valve	0=Zero, 1=Cal
2	Internal Span Valve	0=Closed, 1=Open
3	Spare Valve 1	0=Closed, 1=Open
4	Spare Valve 2	0=Closed, 1=Open
5	Spare Valve 3	0=Closed, 1=Open
6	Spare Valve 4	0=Closed, 1=Open
7	NOx Measure Valve	0=NO, 1=NOx
8	NOx Bypass Valve	0=NO, 1=NOx
9	NOx Background Valve	0=Closed, 1=Open
10	Valve Sequencing	0=Off, 1=On
11	LCD Contrast Pot	0=Lightest, 255=Darkest
12	SO_2/H_2S REFERENCE ZERO Gain Pot	S50 Reference ZERO POT
13	CO Measure Gain Pot	S30 Measure Gain Adjust
14	CO Reference Gain Pot	
15	CO Test Measure Pot	SEE 149. EXISTS
16	& PMT HIGH VOLTAGE Pot	High Voltage Controller Pot for PMT S50 & S40
17	SO_2/H_2S Lamp ADJ Pot	S50 Lamp Adjust Pot
18	O3 Lamp ADJ Pot	S10 Lamp Adjust Pot
19	O3 ZERO Measure Pot: Coarse	S10 Signal Zero (coarse)
20	O3 ZERO Measure Pot: Fine	S10 Signal Zero (fine)
21	PMT Fan Pot	PMT fan speed controller Pot
22	Rear Fan Pot	CHASSIS Fan speed control POT
23	PUMP SPEED Motor Driver Pot: Fine	INTERNAL Pump speed fine POT
24	PUMP SPEED Motor Driver Pot: Coarse	INTERNAL Pump speed coarse POT
25	Analogue input 0	SO_2/H_2S REFERENCE SIGNAL
26	Analogue input 1	CO REFERENCE SIGNAL
27	Analogue input 2	O3 REFERENCE SIGNAL
28	Analogue input 3	SO_2, H_2S & O3 LAMP CURRENT
29	Analogue input 4	FLOW BLOCK PRESSURE
30	Analogue input 5	CELL PRESSURE
31	Analogue input 6	AMBIENT PRESSURE
32	Analogue input 7	RAW ADC CALIBRATION INPUT
33	Analogue input 8	MFC1 NOT USED
34	Analogue input 9	CONCENTRATION DATA
35	Analogue input 10	MFC2 NOT USED
36	Analogue input 11	MFC3 NOT USED
37	Analogue input 12	EXTERNAL ANALOG INPUT 0

38	Analogue input 13	EXTERNAL ANALOG INPUT 1
39	Analogue input 14	EXTERNAL ANALOG INPUT 1
40	Analogue input 15	MFC0 NOT USED
41	CO Measure Pot : Coarse	S30 Measure ZERO Coarse adjustment Pot
42	CO Measure Pot: Fine	S30 Measure ZERO Fine adjustment Pot
43	SO_2/H_2S Measure SIGNAL Gain Pot	SO_2/H_2S Measure Signal Gain Pot
44	SO_2/H_2S REFERENCE Gain Pot	SO_2/H_2S Reference Signal Gain Pot
45	SO_2/H_2S SIGNAL ZERO	SO_2/H_2S Measure Zero Pot
46	O3 SIGNAL GAIN POT	O3 INPUT SIGNAL GAIN POT
47	Test Pot	Test Pot for all the analyzers
48	NOX Signal GAIN Pot	PMT signal input gain control FOR NOX
49	PGA Gain	1, 2, 4, 8, 16, 32, 64, 128
50	Primary Gas Concentration	Current value on front screen
51	Secondary Gas Concentration	Current value on front screen(if applicable eg NOx
52	Calculated Gas Concentration	Gas 3 (eg:NO2)
53	Primary Gas Average	Average of the readings(for Gas1) of the last n minutes where n is the averaging period
54	Secondary Gas Average	
55	Calculated Gas Average	
56	Instrument Gain	
57	Main Gas ID	
58	Aux Gas ID	
59	Decimal Places	
60	Noise	
61	Gas 1 Offset	
62	Gas 3 Offset	
63	Flow Temperature	
64	Lamp Current	
65	Digital Supply Voltage	Digital Supply voltage (should always read close to 5 volts)
66	Concentration Voltage	
67	PMT High Voltage	High Voltage reading for PMT
68	Ozonator Status	0=Off, 1=On
69	Control Loop	
70	Diagnostic Mode	
71	Gas Flow	
72	Gas Pressure	
73	Ambient Pressure	
74	12V Supply Voltage	The 12 volt Power supply voltage
75	Cell Temperature	
76	Converter Temperature	
77	Chassis Temperature	
78	Manifold Temperature	
79	Cooler Temperature	
80	Mirror Temperature	
81	Lamp Temperature	

82	O3 Lamp Temperature	
83	Instrument Status	
84	Reference Voltage	
85	Calibration State	0 = MEASURE 1 = CYCLE 2 = ZERO 3 = SPAN
86	Primary Raw Concentration	(before NOx background and gain)
87	Secondary Raw Concentration	(before NOx background and gain)
88	NOx Background Concentration	(before gain)
89	Calibration Pressure	
90	Converter Efficiency	
91	Multidrop Baud Rate	
92	Analog Range Gas 1	
93	Analog Range Gas 2	
94	Analog Range Gas 3	
95	Output Type Gas 1	1=Voltage 0=Current
96	Output Type Gas 2	1=Voltage 0=Current
97	Output Type Gas 3	1=Voltage 0=Current
98	Voltage Offset /Current Range Gas1	0=0% or 0-20mA 1=5% or 2-20mA 2=10% or 4-20mA
99	Voltage Offset /Current Range Gas2	0=0% or 0-20mA 1=5% or 2-20mA 2=10% or 4-20mA
100	Voltage Offset /Current Range Gas3	0=0% or 0-20mA 1=5% or 2-20mA 2=10% or 4-20mA
101	Full Scale Gas 1	5.0 Volt Calibration value for Analog Output 1
102	Full Scale Gas 2	5.0 Volt Calibration value for Analog Output 2
103	Full Scale Gas 3	5.0 Volt Calibration value for Analog Output 3
104	Zero Adjust Gas 1	0.5 Volt Calibration value for Analog Output 1
105	Zero Adjust Gas 2	0.5 Volt Calibration value for Analog Output 2
106	Zero Adjust Gas 3	0.5 Volt Calibration value for Analog Output 3
107	Negative 10V Supply	
108	NA	
109	NA	
110	Instrument State	
111	CO Linearisation Factor A	
112	CO Linearisation Factor B	
113	CO Linearisation Factor C	
114	CO Linearisation Factor D	
115	CO Linearisation Factor E	
116	Instrument Units	0= PPM 1=PPB 2=PPT

		3=mG/M³ 4=µG/M³ 5=nG/M³
117	Background Measure Time	In seconds
118	Sample Fill Time	In seconds
119	Sample Measure Time	In seconds
120	Aux Measure Time	In seconds
121	Aux Sample Fill Time	In seconds
122	Background Fill Time	In seconds
123	Zero Fill Time	In seconds
124	Zero Measure Time	In seconds
125	Span Fill Time	In seconds
126	Span Measure Time	In seconds
127	Span Purge Time	In seconds
128	Background Pause Time	In seconds
129	Background Interleave Factor	In seconds
130	Calibration Pressure 2	
131	AUX Instrument Gain	
132	Background voltage	
133	AUX Background Voltage	
134	O3 Generator Output	PPM
135	O3 Generator On/Off	
136	Calibration Point 1	PPM
137	Calibration Point 2	PPM
138	Calibration Point 3	PPM
139	Calibration Point 4	PPM
140	Calibration Point 5	PPM
141	Desired Pump Flow	SLPM
142	Actual Pump Flow	SLPM
143	Set Lamp Current	%
144	Lamp Current	mA
145	Cycle Time	Minutes
146	CO Cooler Pot	CO Cooler voltage adjustment POT
147	CO Source Pot	CO Source voltage adjustment POT
148	CO MEASURE Test Pot 0	CO MEASURE TEST POT
149	CO REFERENCE Test Pot 1	CO REFERENCE TEST POT
150	O3 REF Average	S10 Background Average
151	PTF Gain 0	Pressure Temperature Flow Compensation Factor for first gas
152	PTF Gain 1	Pressure Temperature Flow Compensation Factor for second gas in dual gas analyzers.
153	Inst. Cell Pressure	Instantaneous cell pressure
154	Manifold Pressure	Valve Manifold Pressure
155	Cell Gas 1 Pressure	Cell Pressure for Gas 1
156	Cell Gas 2 Pressure	Cell Pressure for Gas 2
157	Cell Bgnd Pressure	Cell Pressure when in Background
158	Reserved	
159	Reserved	

160	Reserved	
161	Temperature Units	0 = "ºC", 1 = "ºF", 2 = "ºK",
162	Pressure Units	0 = "torr", 1 = "psi", 2 = "mbar", 3 = "atm", 4 = "kPa"
163	Averaging Period	0 = " 1 Min", 1 = " 3 Mins", 2 = " 5 Mins", 3 = "10 Mins", 4 = "15 Mins", 5 = "30 Mins", 6 = " 1 Hr", 7 = " 4 Hrs", 8 = " 8 Hrs", 9 = " 12 Hrs", 10 = " 24 Hrs"
164	Filter Type	NO FILTER = 0, KALMAN FILTER = 1, 10 SEC FILTER = 2, 30 SEC FILTER = 3, 60 SEC FILTER = 4, 90 SEC FILTER = 5, 300 SEC FILTER = 6, ADPTIVE FILTER =7
165	NO2 Filter	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 Baud	0 = " 1200 bps", 1 = " 2400 bps ", 2 = " 4800 bps ", 3 = " 9600 bps ", 4 = "14400 bps ", 5 = "19200 bps ", 6 = "38400 bps "
168	Multidrop Baud	0 = " 1200 bps", 1 = " 2400 bps ", 2 = " 4800 bps ", 3 = " 9600 bps ", 4 = "14400 bps ", 5 = "19200 bps ", 6 = "38400 bps "

169	Service Port (COM 1) Protocol	0 = " EC9800", 1 = "Bavarian", 2 = "Advanced"
170	Multidrop Port (COM 2) Protocol	0 = " EC9800", 1 = "Bavarian", 2 = "Advanced"
171	Gas1 Over Range	The Upper Concentration Range when Over-Ranging is enabled for Analog Output 1
172	Gas2 Over Range	The Upper Concentration Range when Over-Ranging is enabled for Analog Output 2
173	Gas3 Over Range	The Upper Concentration Range when Over-Ranging is enabled for Analog Output 3
174	Gas1 Over Ranging	0 = Over Ranging Disabled 1 = Over Ranging Enabled (Gas1)
175	Gas2 Over Ranging	0 = Over Ranging Disabled 1 = Over Ranging Enabled (Gas2)
176	Gas3 Over Ranging	0 = Over Ranging Disabled 1 = Over Ranging Enabled (Gas3)
177	Heater Set Point	Cell Heater Set Point
178	PMT HV Ctrl POT	PMT High Voltage Controller POT
179	PMT Test LED POT	PMT Test LED intensity controller POT
180	Last Power Failure Time	Time Stamp of the Last power fail (4 byte time stamp) Bit 31:26 ---- Year (0 – 99) Bit 25:22 ---- Month (1 – 12) Bit 21:17 ---- Date (1 – 31) Bit 16:12 ---- Hour (00 – 23) Bit 11:06 ---- Min (00 – 59) Bit 05:00 ---- Sec (00 – 59)
181	Instantaneous Manifold Pressure	Instantaneous Manifold Pressure in S40 analyzers (no filter)

Appendix B – EC9800 Protocol

DCONC

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

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

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

DSPAN

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

DZERO

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

ABORT

Function	Commands the addressed device to abort the current mode and return to the measure mode.
Format	ABORT,{<DEVICE I.D.>}{TERMINATOR}

Device response	<ACK> if the unit under test is able to perform the command, <NAK> if not.
RESET	
Function	Reboots the instrument (software reset).
Format	RESET, {<DEVICE I.D.>}{TERMINATOR}
Device response	<ACK>

Appendix C – Bavarian Protocol

Bavarian Network Command Set Format
All Bavarian Network commands follow the command format as specified in this section. The specific Bavarian commands and their function are described in section

Bavarian Network Command Format: <STX><TEXT><ETX><BCC1><BCC2>
Where:

<STX> = ASCII Start Of Transmission = 02 hex
<TEXT> = ASCII text maximum length of 120 characters
<ETX> = ASCII end of transmission = 03 hex
<BCC1> = ASCII representation of block check value MSB
<BCC2> = ASCII representation of block check value LSB.

The block check algorithm begins with 00 Hex and exclusive-OR each ASCII character from <STX> to <ETX> inclusive. This block check value is then converted to ASCII format and sent after the <ETX> character.

Examples
The following is an example of a valid Bavarian data request for an instrument that has an I.D. of 97:
<STX>DA097<EXT>3A
The block check calculation is best shown by the following table:

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

The binary value 0011 1010 corresponds to the hex value 3A. This value in ASCII forms the last two characters of the data request message. Please note that the I.D. of 97 is sent as the sequence 097. All I.D. strings must have 3 digits and the user should always pad with ASCII zero characters.
This is an example of a valid command to put the unit in the manual span mode if the instrument has an I.D. of 843:
<STX>ST843 K<ETX>52
The block check operation is best shown with the following table:

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
	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.