ecotech
environmental monitoring solutions

EC9850

A & B Series

Sulfur Dioxide Analyser

Service Manual

Revision: D

www.ecotech.com

Table of Contents

Manual History

This manual is the combination of two previous versions which have now been merged into one document to cater for the continuing development of the EC9800 series analyzers. The original manuals were:

- ML9850 Service Manual , PN: 98500022, Rev. V, December 1998.
- ML9850B Service Manual , PN: 98507005, Rev. P, July 1999.

The scope of this new manual covers the following analyzers:

- EC9850 Sulfur Dioxide Analyzer, (A-Series), PN: 98501000-100.
- EC9850B Sulfur Dioxide Analyzer, (B-Series), PN: 98507000-1.

Both of the instruments are manufactured by Ecotech P/L in Australia and support the new (SMD) Microprocessor Board (Part number 98000063-4). This manual is current for firmware version 1.11 and above.

This manual should only be used in conjunction with *EC9850 Sulfur Dioxide Analyzer, Operation Manual PN: 98507600 Rev D, April 2007.*

Ecotech Manual ID: MAN 0023
Manual PN: 98507601.
Current Revision: D
Date Released: April 2007.
Description: EC9850 Sulfur Dioxide Analyzer, Service Manual, A & B Series.

Revision History

Rev	Date	Summary	Affected Pages
A	Jan 2004	New Release for new Microprocessor Board. A & B series Combined. Based on original manuals.	All
B	Feb 2004	Changes to menu options and structure.	All
C	Jun. 2005	Changed to updated EC manual	All
D	April 2007	Updated specifications, language and links within pdf manual created.	All

Safety Requirements

- To reduce risk of personal injury caused by electrical shock, follow all safety notices and warnings in this documentation.
- This equipment should *always* be used with a protective earth installed.
- The EC9850 is compliant with the requirements of EN61010-1 A2:1995, Safety Requirements for Equipment for Measurement, Control, and Laboratory Use.
- If the equipment is used for purposes not specified by the manufacturer, the protection provided by this equipment may be impaired.
- Replacement of any part should only be carried out by qualified personnel, only using parts specified by the manufacturer. Always disconnect power source before removing or replacing any components.

Equipment Rating

- 100-120/220-240V~ ±10%
- 50/60 Hz
- 250 VA max
- FUSE: 5/3.15A T 250V
- All wiring must be in accordance with local norms and be carried out by experienced personnel.

Service and Spare Parts

For world wide customer service & spare parts contact ECOTECH:

Address:	**Ecotech Pty Ltd** **1492 Ferntree Gully Rd** **Knoxfield** **Australia. VIC 3180**
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Email - Spare Parts:	**parts@ecotech.com.au**
Web:	**www.ecotech.com.au**

1.0 Installation

1.1 Initial Check

Verify that the serial number label on the documentation and the serial number(s) on the analyzer match.

Check to make certain your instrument arrived undamaged. If you find damage, report it as described in the preface, on the page titled Claims for Damaged Shipments and Shipping Discrepancies in the Operation manual.

Analyzers are shipped ready to power up. Occasionally, however, rough handling during shipment causes dislodged PC boards, disconnected cables, or incorrectly positioned switches. Verify that your instrument is in operating condition by performing the following procedure.

1.1.1 Remove the Top Cover

Grasp the front top corners of the front panel and pull forward. The panel will pop loose and pivot forward. See Figure 1. The top cover retaining hardware is then visible as shown in Figure 2. Use a screwdriver to unscrew the two captive screws. When the two captive screws are loosened, slide the cover backward about 4 inches and lift the top cover straight up.

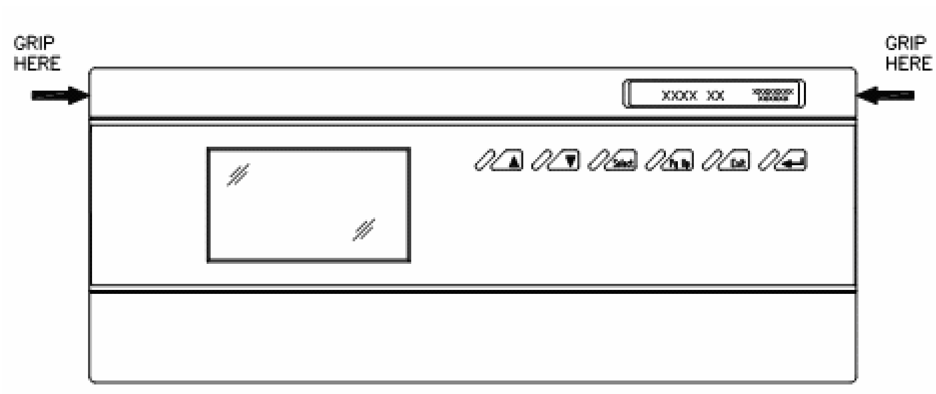

Figure 1. Opening the Front Panel

1.1.2 Service Switch

Opening the front panel allows a view of the secondary panel where four switches are visible. The position of the toggle switches for operating mode is:

DC PowerON
Pump ON
Service IN

The Reset switch is not a toggle switch and is only activated when pressed. It resets the microprocessor. The pump switch is not applicable to the B-line instrumentation because the flow is generated through the use of an external pump.

When in the OUT position, the Service switch sets the `OUT OF SERVICE` bit in the 50-pin I/O interface and in the status word from the serial port. The OUT position has no other effect on the operation or validity of the data obtained from the analyzer. When the Service switch is set from OUT to IN, the instrument returns to the normal operating conditions.

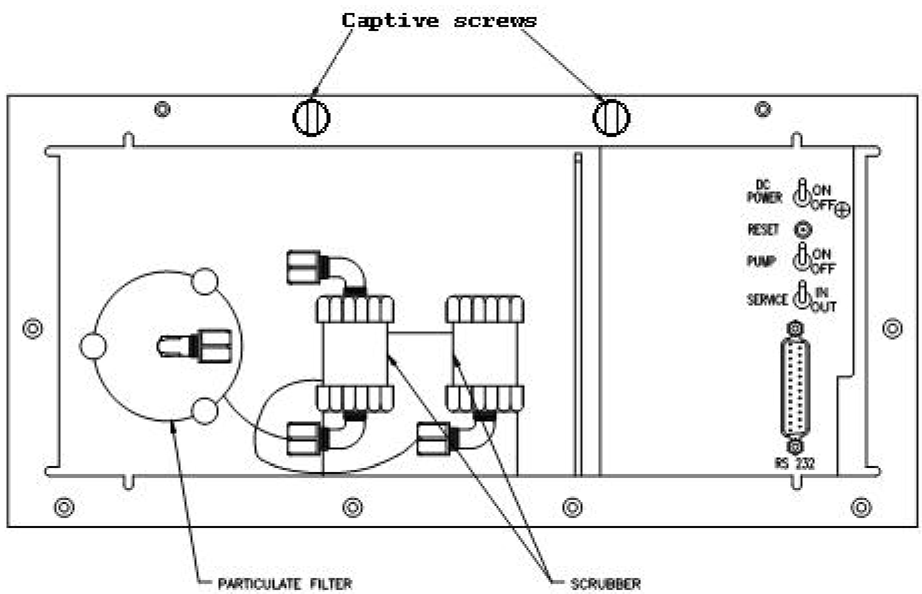

Figure 2. The Secondary Panel (A SERIES)

1.1.3 Inspect the Components

Verify that the components were not damaged in shipping. If any PC boards are dislodged or cables disconnected, follow the instructions below.

1.1.4 Reinsert Dislodged Boards

The bottom edge of the boards must be held in place by the guides. The top of the boards must be attached to the metal bulkheads by the plastic or metal studs with spring tips.

1.1.5 Cable Connections

The cable connectors and the board connectors must be matched securely in place for correct connection. The red indicator on each cable must be positioned at the arrowhead mark on the board connector. Make the connection by pressing the cable connector into the mating connector until a click is heard. Then, fold the retainers inward to secure the connection (see Figure 3).

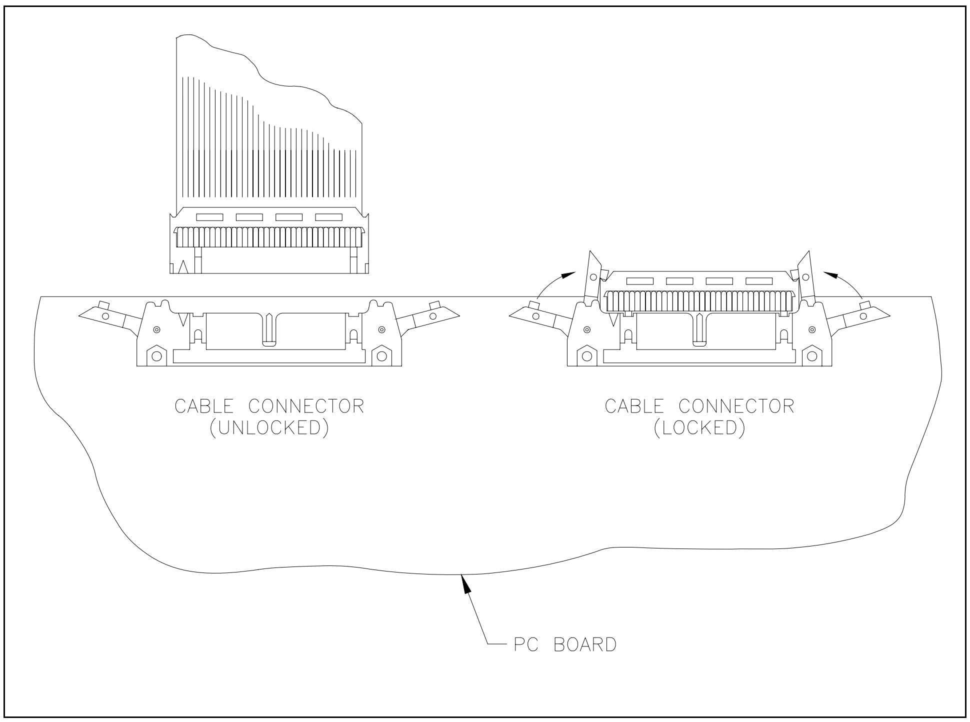

Figure 3. Cable Connections

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2.0 Theory of Operation

The EC9850 sulfur dioxide analyzer is based on classical fluorescence spectroscopy principles. Sulfur dioxide exhibits a strong ultraviolet absorption spectrum between 200 and 240 nm. Absorption of photons at these wavelengths results in the emission of fluorescence photons at wavelengths between approximately 300 and 400 nm. The amount of fluorescence emitted is directly proportional to the SO_2 concentration. These characteristics are exploited by the 9850 SO_2 analyzer.

UV radiation at 214 nm from a zinc discharge lamp is separated from the other wavelengths in the zinc spectrum by a UV bandpass filter. The 214 nm radiation is focused into the fluorescence cell where it interacts with SO_2 molecules in the beam path. The resulting fluorescence is emitted uniformly in all directions. A portion of the fluorescence; i.e., that emitted perpendicularly to the excitation beam, is collected and focused onto a photomultiplier tube. A reference detector monitors the emission from the zinc lamp and is used to correct for fluctuations in lamp intensity.

The 9850 analyzer uses 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 and their application.

Ecotech’s’ implementation of this filter enhances the analyzer’s measurement method 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. Ecotech’s’ analyzers have passed USEPA equivalency testing using this advanced signal filtering method.

2.1 Instrument Description

The instrument consists of a power/microprocessor module and a sensor module. The power/microprocessor module contains the power supply, voltage regulators, and the system microprocessor. The sensor module contains all components necessary to measure the pollutant gas. The slight variations between the A and B series analyzers are illustrated using system block diagrams (Figure 4 & Figure 5) and major component layout diagrams (Figure 6 & Figure 7).

2.1.1 Power/Microprocessor Module

The power/microprocessor module can be described in three sections: the power supply, the voltage regulator, and the microprocessor.

2.1.1.1 Power Supply

The power supply is a self-contained unit housed in a steel case. It is designed to meet UL, VDE, CSA and other regulatory requirements. It converts 99 to 264 VAC 50/60 Hz to 12 VDC power for distribution within the analyzer. The power supply also furnishes a 250 msec power extension in the event of power failure to allow the computer to store data before the power failure can affect it.

2.1.1.2 Voltage Regulator

The voltage regulator board regulates and distributes the different voltages needed throughout the system: 12 VDC to +5 VDC for the digital circuitry and 12 VDC to ±10 V for analog circuitry. An additional +15 VDC supply is present to power the microprocessor display supplies and analog output circuits. The voltage regulator also furnishes a 300 msec power extension in the event of power failure to allow the computer to store data before the power failure can affect it.

2.1.1.3 Microprocessor

The microprocessor board contains a battery backed clock/calendar and an onboard 16-bit microprocessor (MC68HC12) operating at 16 MHz. The microprocessor board is the control center for input and output apparatus such as the 2 inch by 4 inch liquid crystal display (LCD), keyboard switches, the serial ports, and the 50-pin I/O connector on the rear panel. The 50-pin I/O connector input accepts control lines from the rear panel and sends status and failure signals to solid state relay drivers. Support circuitry for the liquid crystal display includes a -20 V power supply and digitally adjusted potentiometers for contrast level.

All analog voltages from the sensor assembly are digitized by the analog-to-digital (A/D) converter for microprocessor use. Digital-to-analog (D/A) conversion of three channels is used to send 0 to 20 mA analog signals to the 50-pin I/O connector.

The microprocessor has electrically erasable ROMs which store the operating program and internally logged data. Program upgrades can be easily made through the serial port. The Service and Reset switches are located on the front of the board and are accessible when the top is removed or when the front panel is opened. The microprocessor also has provisions for USB and optional TCIP connections through the rare panel

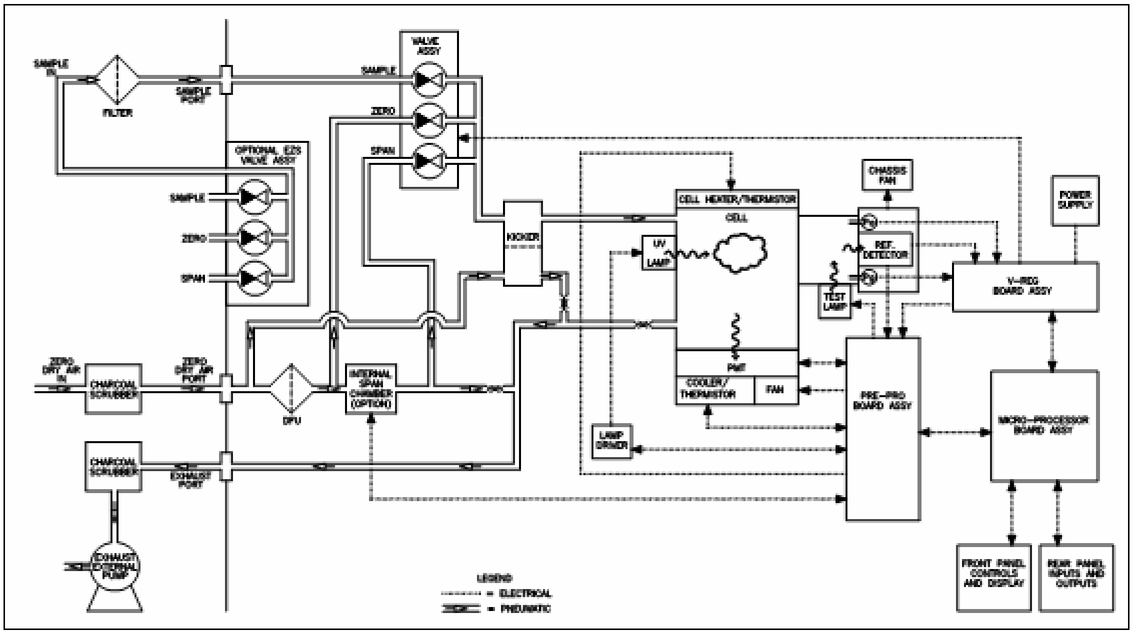


Figure 4. System Block Diagram (A Series)

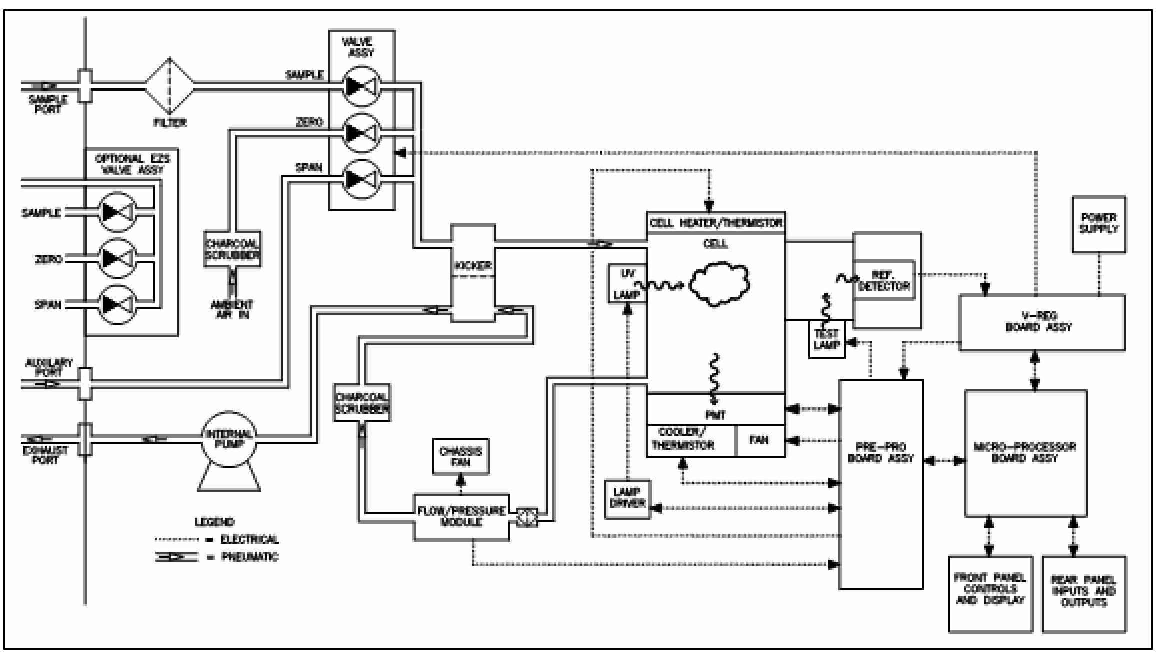


Figure 5. System Block Diagram (B Series)

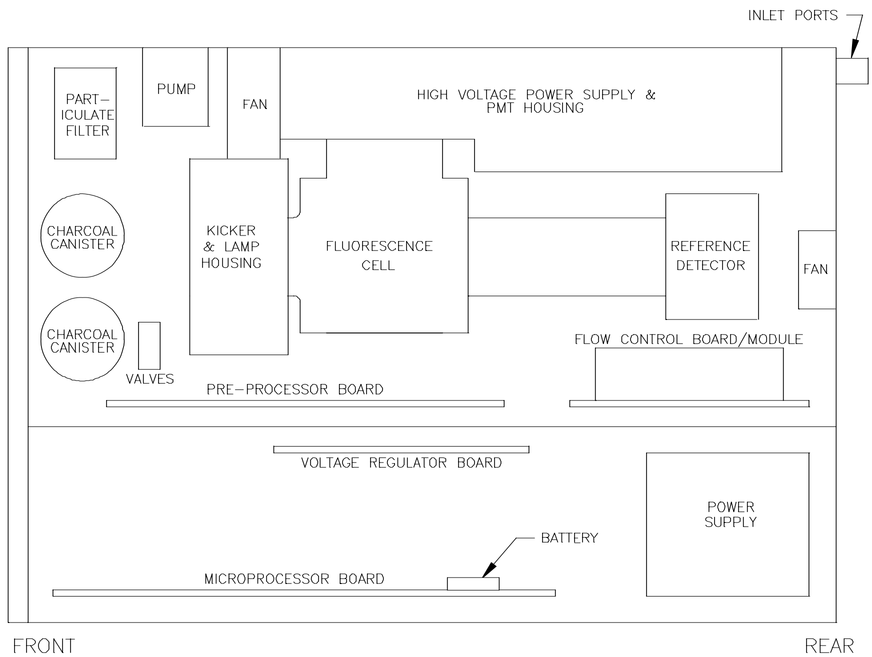


Figure 6. Major Components (A Series)

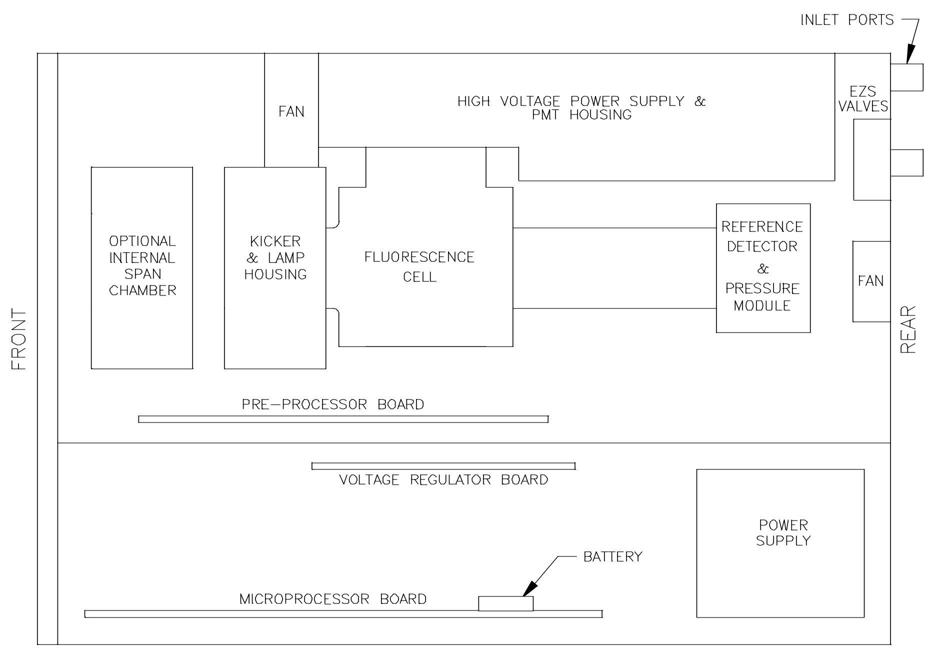


Figure 7. Major Components (B Series)

2.1.2 Sensor Module

The sensor module can be divided into three areas of description: pneumatics, optics, and electronics.

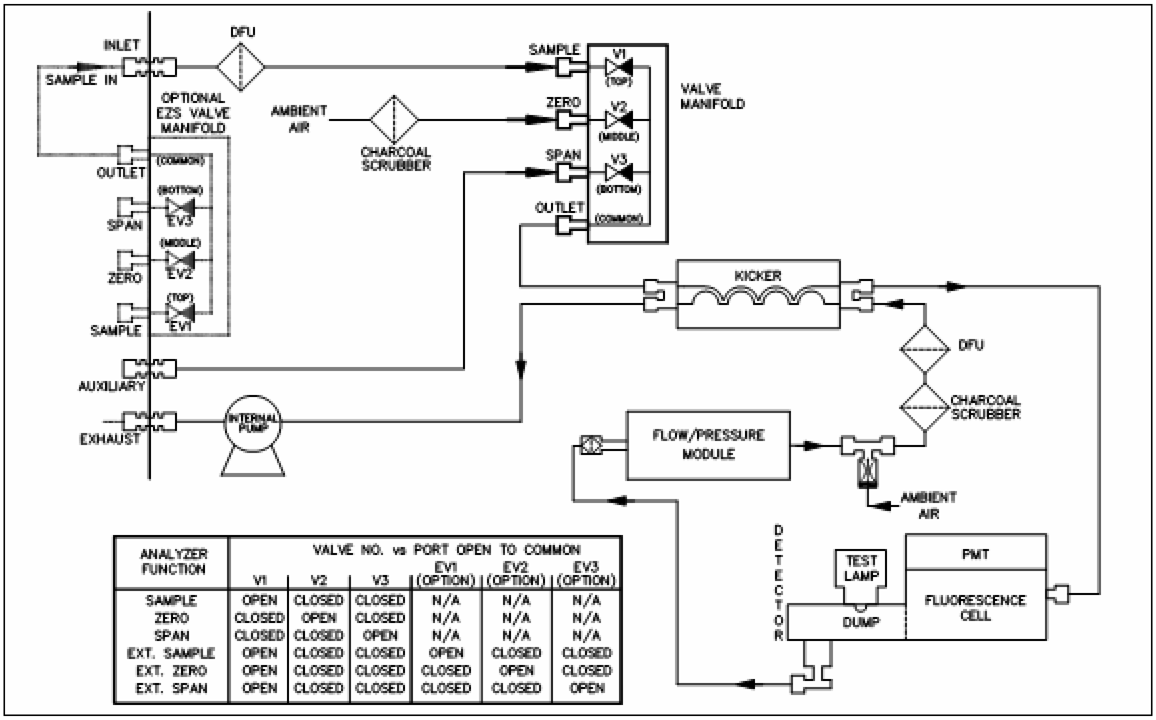
2.1.2.1 Pneumatics

The pneumatics system continuously supplies sample air to the measurement cell at a rate that allows the sample to be measured before exiting the analyzer. The pneumatic system flow is illustrated in Figure 8 & Figure 9. The pump causes sample air to be drawn into the sample inlet and through the 5 micron particulate filter. The inherent difference between the A and B series analyzers is the method of flow control and the pump used. These differences will be discussed in the following sections.

From the valve manifold the sample stream enters the hydrocarbon kicker (described in more detail in the following paragraphs), where possible hydrocarbon interferents are removed. After being scrubbed of hydrocarbons, the sample enters the fluorescence cell where the SO_2 measurement is accomplished.

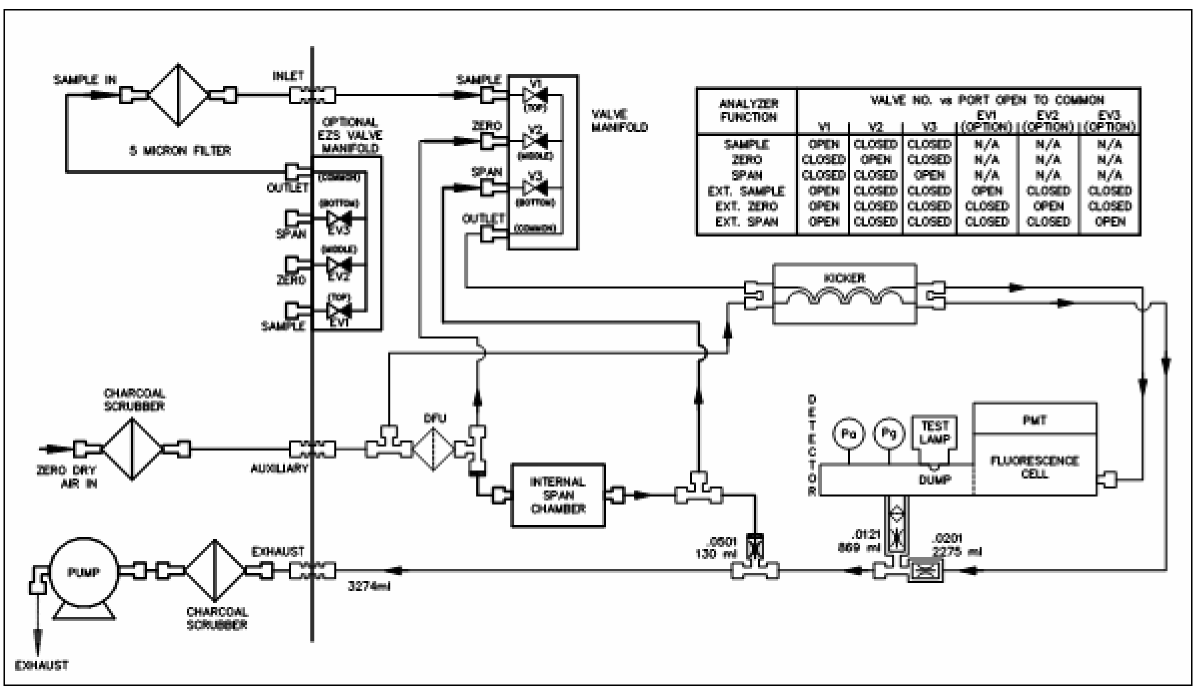
During the startup and auto-zero cycles sample is switched by the valve manifold to zero air from the zero air scrubber and into the measurement cell. This provides the analyzer with a stable reference of zero air to automatically correct for zero baseline changes.

- *Particulate Filter*. The particulate filter is designed to remove particles larger than 5 micrometers and to expose the sample to only nonreactive materials of Kynar, Teflon, and Viton. The filtering agent is a 47 mm diameter 5 micron filter. The filter body is made from Teflon. The filter is held in the body by a Viton O-ring and backed by a Teflon screen. This filter is not supplied with the B series analyzer and must be purchased as an option.



ANALYZER FUNCTION	V1	V2	V3	EV1 (OPTION)	EV2 (OPTION)	EV3 (OPTION)
	VALVE NO. vs PORT OPEN TO COMMON					
SAMPLE	OPEN	CLOSED	CLOSED	N/A	N/A	N/A
ZERO	CLOSED	OPEN	CLOSED	N/A	N/A	N/A
SPAN	CLOSED	CLOSED	OPEN	N/A	N/A	N/A
EXT. SAMPLE	OPEN	CLOSED	CLOSED	OPEN	CLOSED	CLOSED
EXT. ZERO	OPEN	CLOSED	CLOSED	CLOSED	OPEN	CLOSED
EXT. SPAN	OPEN	CLOSED	CLOSED	CLOSED	CLOSED	OPEN

Figure 8. Pneumatic Diagram (A Series)



ANALYZER FUNCTION	V1	V2	V3	EV1 (OPTION)	EV2 (OPTION)	EV3 (OPTION)
	VALVE NO. vs PORT OPEN TO COMMON					
SAMPLE	OPEN	CLOSED	CLOSED	N/A	N/A	N/A
ZERO	CLOSED	OPEN	CLOSED	N/A	N/A	N/A
SPAN	CLOSED	CLOSED	OPEN	N/A	N/A	N/A
EXT. SAMPLE	OPEN	CLOSED	CLOSED	OPEN	CLOSED	CLOSED
EXT. ZERO	OPEN	CLOSED	CLOSED	CLOSED	OPEN	CLOSED
EXT. SPAN	OPEN	CLOSED	CLOSED	CLOSED	CLOSED	OPEN

Figure 9. Pneumatic Diagram (B series)

- *Hydrocarbon Kicker.* A kicker is placed in the pneumatic system of the 9850 analyzer before the fluorescence cell to remove hydrocarbons that might interfere with the measurement of SO_2. The kicker is composed of a Silastic® membrane within a Teflon tubing jacket. Sample is pulled through the internal membrane at 0.500 slpm, while zero air is pulled through the outer jacket at 2.3 slpm in the opposite direction. Because of the counter-propagating flows and differential partial pressures between the two flow channels, hydrocarbon interferents diffuse through the membrane and are carried away in the exhaust flow. Consequently, the interference by hydrocarbons in the SO_2 measurement process is minimized.
- *Zero Air Scrubber.* The charcoal scrubber is used to provide a clean SO_2-free zero air supply for the automatic zero function of the instrument and for the kicker jacket flow. This scrubber is not supplied with the B series analyzer and must be purchased as an option.

2.1.2.1.1 A series Flow Control

- *Flow Control Module***.** The sample flow rate is monitored by measuring the pressure drop across a calibrated flow restrictor. The upstream pressure of this restrictor is the sample cell pressure. Mass flow through the restrictor is computed from the upstream and downstream pressures. Since the pressure transducers used are temperature sensitive, they are mounted in a temperature controlled block. The sample air is then mixed with approximately 2.3 slpm of externally supplied zero air from the bypass jacket of the kicker. This flow is then exhausted through the exhaust port of the instrument.
- *Sample Pump.* The rotary vane-type pump is powered by a brushless DC motor. Since the pump is working with a very light load, it rotates very slowly, resulting in very little bearing or vane wear. The estimated pump life is in excess of 5 years. The Pump speed is controlled by a DC input voltage derived from two digital potentiometers under microprocessor control on the flow control board. The pump speed is varied to achieve desired sample flow rate.
- *Rear Fan.* The fan speed is controlled by a variable input voltage derived from a digital potentiometer under microprocessor control on the flow control board. The fan speed is controlled to begin operating at about 30° C chassis temperature and increase its speed in a linear fashion until it is at full operating speed about 50° C chassis temperature.

2.1.2.1.2 B series Flow Control

- *Flow Control***.** The Sample flow is controlled by critical orifices in the pneumatic outlet of the measurement cell. The Detector/Pressure PCA monitors sample pressure and flow. Sample flow rate is calculated based upon critical flow through an orifice at a given upstream pressure. This upstream pressure is monitored by a calibrated pressure transducer, with the assumption made that the downstream side of the orifice is sufficient to hold the orifice critical (<1/2 the pressure of the upstream side). Flow through the analyzer is verified by measuring the differential (gauge) pressure between the upstream side of the orifice and ambient pressure. This differential pressure is due to the minor flow restriction through the kicker.
- *Sample Pump.* The sample pump is supplied as an option by Ecotech and is connected to the exhaust of the analyzer. This vacuum pump must be capable of maintaining at least 1/2 atmosphere (approximately 15” Hg or 50 kPa at sea level) in order to keep the orifice flow critical.
- *Rear Fan.* The fan speed is connected directly to the flow block and is operated continuously to keep the chassis temperature low.

2.1.2.2 Optics

The optics in the 9850 analyzer consist of a discharge zinc UV lamp, a Fabry-Perot 214 nm UV bandpass filter, UV grade fused silica lenses, a colored glass 350 nm optical bandpass filter, a UV-sensitive photomultiplier tube, and a solid state UV reference detector.

- *UV Lamp.* The UV lamp generates broad-band UV light which is used to irradiate the measurement cell.
- *UV Bandpass Filter.* The 214 nm UV bandpass filter limits the UV light within the cell to 214 nm, which is the frequency of interest for SO_2 fluorescent spectroscopy.
- *UV Grade Lenses.* Two UV grade fused silica lenses are present in the optical path. The first is a plano-convex lens which is used to focus the UV light inside the measurement cell. The second is a bi-convex lens which focuses the fluorescent light from the SO_2 reaction onto the cathode of the PMT.
- *Optical Bandpass Filter.* The colored glass optical filter limits the light reaching the PMT to the frequency of interest for the photon emitted during the SO_2 reaction.

- *Photomultiplier Tube (PMT).* The cooled PMT detects the amount of 350 nm light proportional to the concentration of SO_2 present in the measurement cell. The PMT is connected to an integrated High Voltage Power Supply (HVPS)/Preamp.
- *UV Reference Detector.* The UV detector is a solid state photo diode that monitors the intensity of the UV light entering the measurement cell. This signal is used to compensate for variations in the UV lamp signal.

2.1.2.3 Electronics

- *Reference Detector Preamplifier***.** This circuit board is housed within the box labeled Reference Detector in Figure 6. The circuit board's function is to convert the current signal from the reference detector to a voltage signal and provide amplification. (A series only).
- *Preamp/Pressure PCA.* This assembly is located at the end of the fluorescence cell as noted in Figure 7. The reference preamplifier (detector) portion of the board converts the current from the UV detector to voltage and amplifies it to a waveform proportional to the reference signal. The pressure/flow portion of the board contains an absolute and a gauge pressure transducer to measure cell pressure and detect sample flow. This board also powers the chassis fan. (B series only).
- *Flow Control PCA.* The pressure/flow portion of the board contains an absolute and a gauge pressure transducer to measure cell pressure and control sample flow. This board also controls the pump speed, powers the chassis fan and has a heater control circuit to heat the flow block. (A series only).
- *PMT High Voltage Supply and Preamplifier.* 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.
- *Preprocessor PCA.* This circuit board contains the analog electronics that condition the reference detector and PMT signals, generate the lamp control and modulation signals and all the signals required for preamp, optic, and electronic test diagnostic functions. It also contains a heater control circuit to heat the measurement cell to 50° C. The board also contains an EAROM which contains device identification and stored setup parameters. All circuitry adjustments are made via microprocessor-controlled digital potentiometers.
- *Lamp Driver PCA.* The lamp driver contains a high voltage switching supply to start and maintain the UV lamp at a constant intensity. This board is under the control of signals from the preprocessor PCA.

2.2 Operation Modes

The analyzer operates in a number of different measurement modes. These modes include startup, measurement and auto-zero modes. Following is a description of each of the operating modes.

2.2.1 <u>Startup Mode</u>

When the instrument is initially powered up, several components in the instrument are automatically configured by the microprocessor and an automatic zero is run. This process requires about 30 minutes. Following is a description of the various adjustments made during the startup routine. All adjustments are automatically performed by the microprocessor; no manual intervention is required. During all the startup routines the cell is filled with zero air.

2.2.1.1 Reference Adjust

Reference adjust allows the gain of the preprocessor reference channel to be adjusted for the proper reference voltage level (the reference voltage is proportional to the intensity of the UV lamp). Prior to any adjustments being made, the UV lamp is first allowed to stabilize for approximately 10 minutes. After 10 minutes the preprocessor reference gain potentiometer is adjusted until a reference voltage of 2.5 ±0.2 volts is obtained. After the reference voltage is set it is not adjusted again until another auto startup routine is performed or the reference voltage goes below 1 volt or above 4 volts.

2.2.1.2 Electronic Zero Adjust

Electronic zero adjust sets the preprocessor measurement channel to minimize any electronic or optical offset present at zero. First the cell is allowed to fill completely with zero air. The preprocessor measure coarse zero potentiometer is then adjusted until a concentration voltage of just above 0.00 volts is obtained. This is the analyzers coarse zero adjustment. Once this is set it is not readjusted until another auto startup routine is performed or the concentration voltage is sensed to be below -0.1 volts.

2.2.1.3 Background

Background allows the analyzer to sample zero air and measure the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyzer’s fine zero measurement. The background is re-run nightly at midnight (unless background is disabled), when manually selected through the `CALIBRATION MENU`, or when another auto startup routine is performed.

2.2.1.4 Sample Fill/Measure

After the background the analyzer is switched into the Sample Fill mode where the reaction cell is filled with sample gas, and finally to Sample Measure mode when actual gas measurement begins.

2.2.1.5 Quick-Start Routine

If the analyzer power is removed for less than two minutes, the full auto startup routine is replaced by a quick start routine. The analyzer is returned to its last known operating parameters and normal operation is immediately restored. This allows the analyzer to rapidly return to measurement mode and keeps data loss to a minimum. If power is lost for greater than two minutes, a full auto restart is performed.

2.2.2 Measure Modes

2.2.2.1 Sample Measure

Sample measure is the standard operating mode of the 9850. The cell is continuously filled with sample gas via the main valve manifold. The PMT senses the fluorescent signal in the Rx cell and this signal is amplified, conditioned by the preprocessor to become what is called *concentration voltage*. This concentration voltage is then used to determine gas concentrations. The UV lamp is also monitored so the measurement reading can be compensated for fluctuations in lamp output.

2.2.2.2 Zero Measure

Zero measure allows the cell to be filled with zero air either from the standard zero air source with internal valves selected or from an external zero air source with external valves selected. Processing of the signal is identical to measurement processing, the only difference is the source of the sample stream.

2.2.2.3 Span Measure

Span measure allows the cell to be filled with a span source either from an internal source such as the IZS oven, or from an external source with the external valve manifold. Processing of the signal is identical to measurement processing, the only difference is the source of the sample stream.

2.2.2.4 AZS Cycle

The analyzer can be placed in an AZS cycle mode where the sample stream is automatically switched to zero, then span, then back to sample. For further information on the AZS cycles, refer to the EC*9850 Operation Manual*.

2.2.3 Auto Zero Routines

The 9850 is an auto zero instrument. The analyzer is allowed to periodically sample zero air and correct for the readings obtained.

2.2.3.1 Background

The auto zero function (background) is performed nightly at midnight unless background is disabled. This compensates for drift in the measurement baseline of the analyzer. The nightly background routine is identical to the background described in the startup routine.

2.2.3.2 Electronic Zero Adjust

Long-term negative drift may occasionally cause the measurement voltage near zero to drift outside the range of the preprocessor measurement channel. If this occurs the analyzer will initiate an electronic zero adjust to reset the preprocessor measurement zero adjustment. This routine is identical to the electronic zero adjust described in the startup routine. After an electronic zero adjust the analyzer will always perform a background to fine adjust for the new baseline value.

3.0 Maintenance

3.1 Maintenance Schedule

The following outlines a periodic maintenance schedule for the EC9850 analyzer. This schedule is based on experience under normal operating conditions, and may need to be modified to suit specific operating conditions and regulations. It is recommended that this schedule be followed in order to maintain reliable, long-term operation of the analyzer.

Interval[1]	Item	Procedure	Section
Weekly	Inlet Particulate Filter	Check/Replace	Service Manual:- 3.3.1
	Event Log / System Faults	Check	Service Manual:- 4.2.4 & 4.2.7
	Precision Check	Check	Operation Manual:- 2.4
Monthly	Fan Filter	Check/Clean	Service Manual:- 3.3.3
	Zero / Span Calibration	Perform	Operation Manual:- 2.4
	Clock	Check	Operation Manual:-2.3.3
6 Monthly	Zero Air Scrubber	Check/Replace[2]	Service Manual:- 3.3.4
	PMT Desiccant Packs	Replace[3]	Service Manual:-3.3.8
	Multi-point Calibration	Perform	Operation Manual:- 3.2
1 Year	DFU Filter (B series)	Replace	Service Manual:- 3.3.5
	UV Lamp alignment	Check / Replace	Service Manual:- 3.3.7
	Leak Check	Perform	Service Manual:- 3.3.13
	Flow Calibration	Check / Calibrate	Service Manual:- 3.5

[1] Suggested intervals for normal operation and actual intervals will vary depending upon application. The user can refer to this table as a guideline, but should develop a maintenance schedule to suit their specific requirements.
[2] Replacement interval determined by ambient SO_2 levels.
[3] Humid conditions nay necessitate more frequent replacement.

3.2 Replaceable Parts

EC9850 Analyzer Spare Parts Requirements			
Description	**Series**	**Part Number**	**Level**
O-ring, orific and filter	B	25000447-007	1
Filter unit, disposable	B	036-040180	1
Desiccant, 5 gram pack (4 required)	A & B	26000260	1
Charcoal, activated, 2 pound bulk container	A & B	850-056500	1
Filter element, 5 micron, consumable (50 each)	A & B	98000098-1	1
Lamp assembly, ultraviolet	A & B	98500018	2
Filter, glass, U330	A & B	002-035300	3
Filter, ultraviolet	A & B	002-035400	3
O-ring, plano convex lens	A & B	025-030610	3
O-ring, reaction cell cover plate	A & B	025-030810	3
O-ring, U330	A & B	025-030830	3
Heat sink compound	A & B	028-090120	3
O-ring, desiccant cap	A & B	25000422	3
O-ring, adapter, reaction cell collar	A & B	25000420-2	3
O-ring, reaction cell to optical bench	A & B	25000423	3
O-ring, ultraviolet filter	A & B	25000429	3
Extraction tool, minifit connectors	A & B	29000141-2	3
Photomultiplier tube	A & B	57000011	3
Pump	A	58500037	3
PCA, Voltage Regulator	A & B	98000056	3
Display/switch assembly	A & B	98000057SP	3
PCA, 50-Pin I/O	A	98000066-2	3
PCA, Microprocessor (SMD)	A & B	98000063-4	3
PCA USB Board Assembly	A & B	98007502	3
Power supply, 115/230 VAC to 12 VDC	A & B	98000142	3
Orifice, 10 mil	B	98000180-09	3
Orifice, 20 mil	B	98000180-19	3
Extraction tool, filter and orifice	B	98000190	3
Service kit, pump	B	98000242	3
Lamp driver assembly	A & B	98100031	3
PCA, Preprocessor	A & B	98500005	3
PCA, Reference Detector	A	98100039	3
Valve manifold assembly	A & B	98300037	3
Flow control assembly	A	98300046SP1	3
Cooler, thermoelectric	A & B	98412028-3-SP	3

EC9850 Analyzer Spare Parts Requirements			
Description	**Series**	**Part Number**	**Level**
Thermistor assembly	A & B	98412028-4-SP	3
Kicker assembly (hydrocarbon scrubber)	A & B	98500036-2	3
Heater and thermistor assembly	A & B	98500039	3
HVPS and preamplifier assembly, photomultiplier	A & B	98500067-2-SP	3
Pressure/preamplifier assembly (B Series Only)	B	98507008SP	3

Level 1: General maintenance supplies and expendables such as filters, O-rings, lamps, etc.

Level 2: Critical items that are known from experience to have a higher failure rate, such as pumps, heaters, converters, valves, and circuit boards.

Level 3: Other miscellaneous items not included in Level 1 or 2. This level includes other spare parts that are not expected to fail over a given time frame.

Components marked with shading are essential components which need to be kept on hand at all times.

EC9850 Analyzer Spare Parts Requirements Options and Accessories		
Description	**Series**	**Part Number**
Pump, external, 115V/60 Hz, 4 slpm at 20 inches Hg	B	884-017300
Pump, external, 100V/50 Hz, 4 slpm at 20 inches Hg	B	884-017301
Pump, external, 230V/50 Hz, 4 slpm at 20 inches Hg	B	884-017302
Pump, external, 110V/50 Hz, 4 slpm at 20 inches Hg	B	884-017303
Rack mount kit with slides	A & B	98000036-2
PCA, 50-Pin I/O	B	98000066-2
Battery power option, 12 VDC	A & B	98000115
Filter, particulate, sample inlet, 5 micron	B	98000210-1
Filter kit, particulate, sample inlet, 5 micron	A	98000211-1
Calibration check kit, internal zero/span (without permeation tube)	B	98000230
50-pin connector and shell kit	A & B	98000235-1
Charcoal scrubber (for zero air generation)	B	98415105-1
Charcoal scrubber (for exhaust)	B	98415105-1
EC9850 Operation Manual	A & B	98507600
EC9850 Service Manual	A & B	98507601
Reaction cell maintenance kit	A & B	98500061-KIT2

EC9850 Analyzer Spare Parts Requirements Options and Accessories		
Description	**Series**	**Part Number**
Valve manifold kit, external zero/span (EZS)	A & B	98300087

3.2.1 Expected Life Span of Consumables

Component	Minimum	Typical
UV Lamp	6 months	1 to 2 years

3.3 Maintenance Procedures

Following is a list of routine maintenance procedures which may be required through the life of the analyzer.

Recommended equipment to perform maintenance:

- Toolbox
- Oscilloscope
- Digital multimeter (DMM)
- Computer or remote data terminal and connection cable for RS232 communication
- Pressure transducer (absolute) and connection tubing, calibrated in torr
- Flowmeter (2 slpm nominal)
- Wire strippers
- Soldering iron
- Minifit extraction tool
- Orifice removal tool
- Assortment of 1/4” and 1/8” tubing and fittings
- Test zero air source
- Test span gas source
- Leak tester

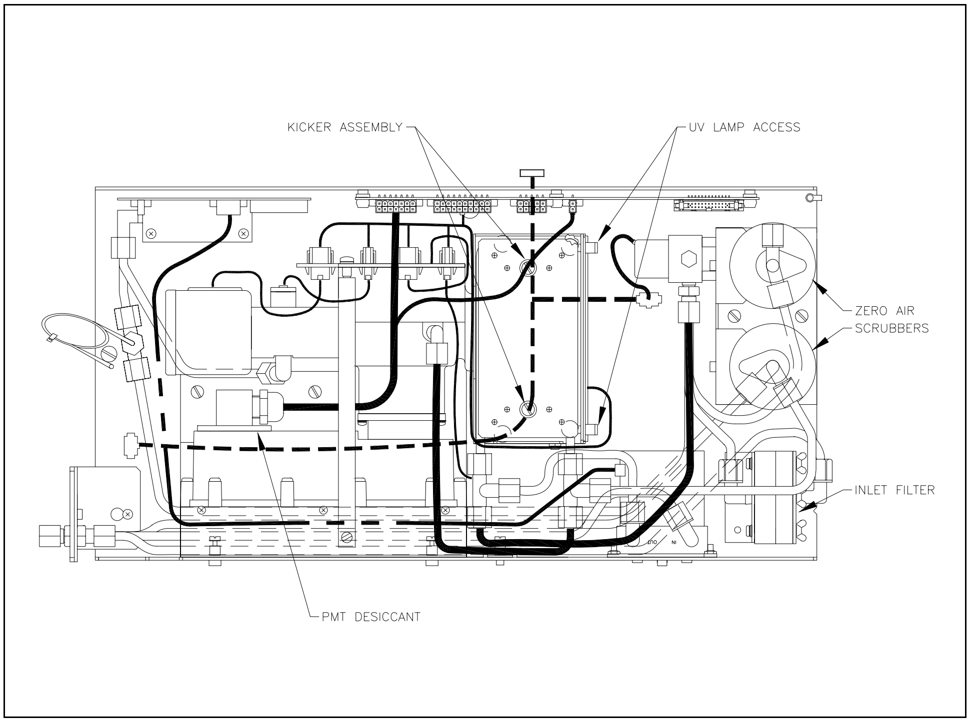


Figure 10. Routine Maintenance Components (A Series)

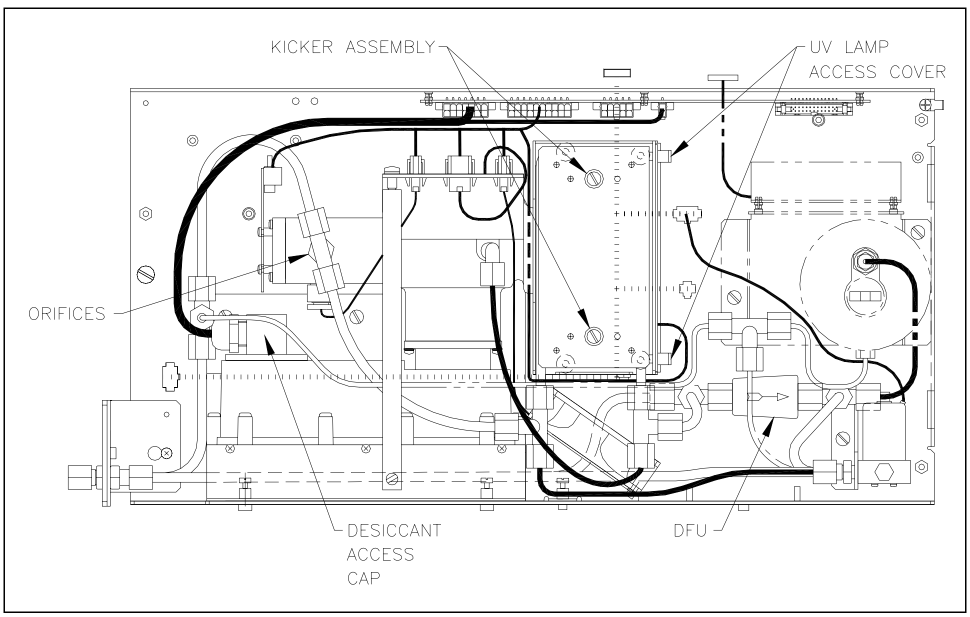


Figure 11. Routine Maintenance Components (B Series)

3.3.1 Check Particulate Filter

The inlet filter prevents particulates from entering the pneumatic components of the EC9850. Contamination of the filter can result in degraded performance of the EC9850 including slow response time, erroneous readings, temperature drift and various other problems.

Several factors affect the filter replacement schedule. In the springtime, for example, the filter might accumulate pollens and dust. Man-made environmental changes such as construction dust might indicate more frequent change, or a climate where dry, dusty conditions are normal might dictate more frequent filter replacement than climates with few natural pollutants.

Determining the schedule for changing the filter is best developed by monitoring the filter at weekly intervals for the first few months, then adapting the schedule to fit the specific site.

3.3.2 Particulate Filter Replacement Procedure

Use Figure 12 as reference when performing the filter replacement procedure.

1. Open the Front Panel to access the service switches and particulate filter. Position the Pump Switch in the secondary front panel to OFF. For the B series Analyzer, you will need to disconnect the external pump.
2. Remove the tubing from the front of the particulate filter.
3. Unscrew and remove the 3 thumb screws. Remove the filter cover and attached plate.
4. Remove the O-ring and the filter. Discard the filter and save the O-ring.
5. Place a new filter over the Teflon® screen and replace the O-ring.
6. Position the filter cover over the filter, aligning the holes, and install the three thumb screws. Snug all three screws, then tighten firmly with finger pressure.
7. Reattach the tubing to the filter housing.
8. Return the Pump to ON.
9. Close the Front Panel.

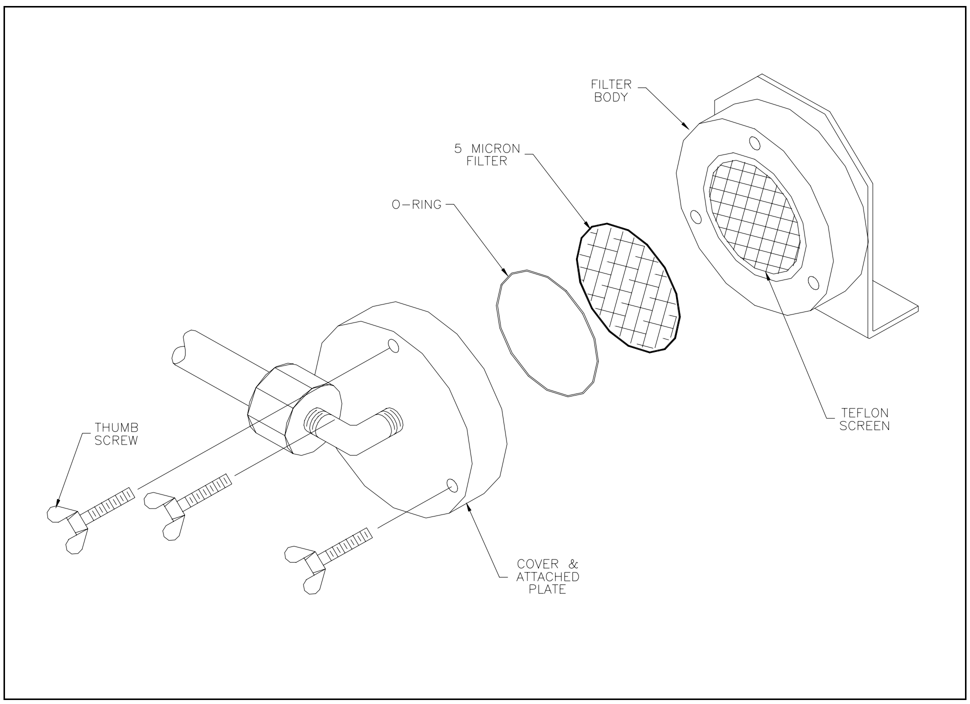


Figure 12. Particulate Filter Replacement

3.3.3 Clean Fan Filter

The fan filter is located on the rear of the analyzer. If this filter becomes contaminated with dust and dirt it may affect the cooling capacity of the analyzer. The fan screen should be cleaned by removing it from the analyzer and blowing it out with compressed air, or by cleaning it with mild soapy water and air drying.

3.3.4 Zero Air Scrubber

The zero air supply is critical to the operation of the EC9850. Poor zero air can result in numerous problems such as inaccurate measurements near zero and span drift. The quality of the zero air system should be checked by challenging the analyzer with a known good zero air source (such as commercially available Ultra Zero Air or a known good charcoal scrubber). To check the zero air system, perform the following:

Required equipment:
Test zero air supply

1. From the `CALIBRATION MENU` place the analyzer in `CAL. MODE: ZERO`. This will allow the analyzer to sample zero air from the zero air scrubber. Allow to sample for approximately 15 minutes.

2. Record the front panel SO_2 reading as the initial value.

Note

This value should be 0.000 ± 0.001 ppm. If it is not, a background should be initiated by choosing `CALIBRATION MENU` and `BACKGROUND: START`, then press <Enter> to re-establish the zero baseline. The background will require approximately 15 minutes to complete.

3. Connect the challenge zero air to the Sample inlet of the analyzer. Be sure the inlet pressure is maintained at ambient pressure.

4. From the `CALIBRATION MENU` select `CAL. MODE: MEASURE` and press <Enter>. This will allow the analyzer to sample the challenge zero air. Allow to sample for 5 minutes.

5. Record the front panel SO_2 reading as the challenge value.

6. Compare the initial SO_2 value and the challenge value. They should agree within ±0.002 ppm. If the initial value is more positive than the challenge value, the zero air scrubber should be recharged or replaced.

7. Disconnect the challenge zero air and reconnect the sample line to the Sample inlet of the analyzer. Verify the analyzer is in the Sample Measure mode.

The life span of a zero air scrubber system is typically dependent upon the amount of SO_2 the system is required to scrub. The user should closely monitor the performance of the zero air system after initial installation and note when the zero air begins to degrade. This interval can then be used as the baseline for establishing a zero air maintenance schedule. If the instrument uses the Ecotech Zero Air Scrubber (part number 98415105-1), the following replacement schedule can be used as a starting point for development of this schedule.

Average Ambient SO_2 Concentration	Charcoal Replacement Interval
0 to 30 ppb	12 Months
30 to 100 ppb	6 Months
> 100 ppb	1 Month

3.3.4.1 Charcoal Scrubber Replacement Procedure (A Series)

Use Figure 13 as a reference when replacing the charcoal. This procedure applies to both charcoal scrubbers. The same type of scrubber can be used for the B series and mounted externally. Hence the same procedure would apply.

1. Open the Front Panel to access the service switches and the scrubber canisters. Position the Pump Switch on the secondary panel to OFF.
2. Remove the Kynar nuts and Teflon tubing from the canister. Disengage the nylon restraining strap on the scrubber canister.
3. Unscrew the canister cap and remove the plastic insert, metal screen, and felt pad. Pour the charcoal out of the canister.
4. Refill the canister with charcoal (see the Replaceable Parts list for the part number).
5. Replace the felt pad, metal screen, plastic insert and canister lid.
6. Reconnect the Teflon tube to the canister and secure the canister with the strap.

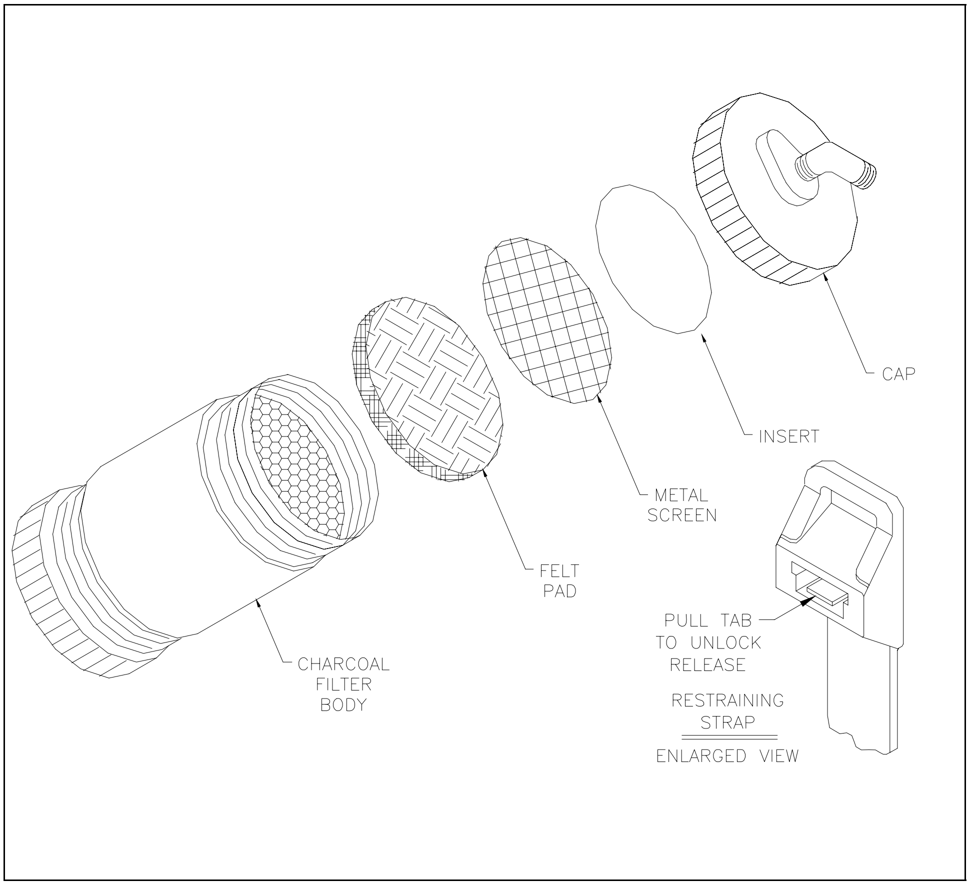


Figure 13. Charcoal Replacement Procedure

3.3.5 DFU Replacement (B Series)

The zero air entering the analyzer is filtered by a disposable filtration unit (DFU) to prevent contamination of the pneumatics and Rx cell. Failure of the DFU could result in poor zero readings or loss of purge/supply air to the IZS module (if installed). This filter is located inside the analyzer just aft of the valve manifold. It should be replaced annually or whenever it begins to discolor. To replace the filter:

1. Turn off the pump.
2. Remove and retain the Kynar nuts from each end of the DFU.
3. Remove and replace the DFU, ensuring that direction of flow is correct (from rear to front of analyzer).
4. Reinstall the Kynar nuts, ensuring that the ferrules are properly installed in the nuts.
5. Turn on the pump.

3.3.6 Orifice Removal for Replacement or Cleaning (B Series)

Recommended equipment:
Orifice/Filter Removal Tool (part number 98000190)

1. Remove the 1/4” Teflon lines from the tee in the exhaust arm of the Rx cell and unthread the tee from the fitting. Refer to Figure 11.
2. The sample orifice is located in the base of the tee. Using the orifice filter removal tool, remove the sample orifice. The orifice may be replaced, cleaned with alcohol, or cleaned in an ultrasonic bath. When reinstalling the new orifice, be sure to use a new O-ring, and orient the orifice with the threaded port facing outward.
3. The kicker orifice is located in one branch of the tee. The orifice may be replaced, cleaned with alcohol or cleaned in an ultrasonic bath. When reinstalling the orifice, be sure to use a new O-ring, and orient with the threaded port of the orifice facing outward.
4. Reinstall the tee into the Rx cell. Be sure to use Teflon tape around the NPT threads and connect the side of the tee with the kicker orifice to the 1/4” line from the kicker, and the side of the tee without the orifice to the 1/4” line from the pump.

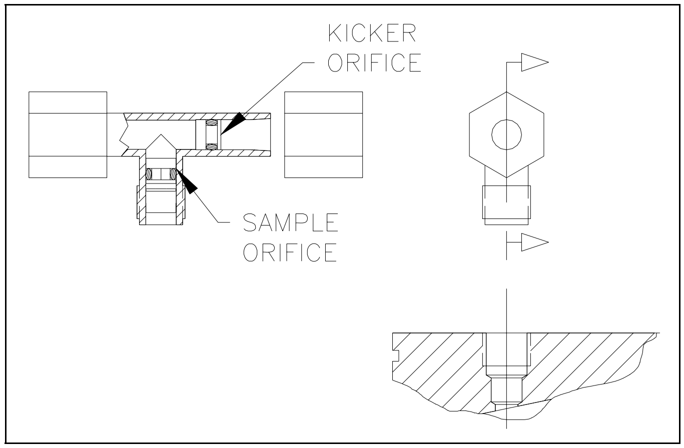


Figure 14. Orifice Removal

3.3.7 UV Lamp

Proper operation of the UV lamp is essential to the EC9850. The UV lamp should be periodically checked to see if it is operating within acceptable parameters and may require periodic realignment to maintain sufficient UV light for analyzer operation. 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.

3.3.7.1 UV Lamp Alignment

Required equipment:
Oscilloscope

1. Turn the analyzer on and allow the UV lamp to warm up and stabilize (about 15 minutes).

2. Connect an oscilloscope to Preprocessor J5/3 (REFX2) and TP1 (AGND). Adjust the scope for 0.5 V/division and 20 msec/division.

3. Remove the UV lamp access cover and remove the two captive screws that secure the kicker to the UV lamp housing. Refer to Figure 11. Gently move the kicker backward away from the UV lamp.

4. Loosen (do not remove) the captive screws securing the UV lamp holder to the housing. Refer to Figure 15.

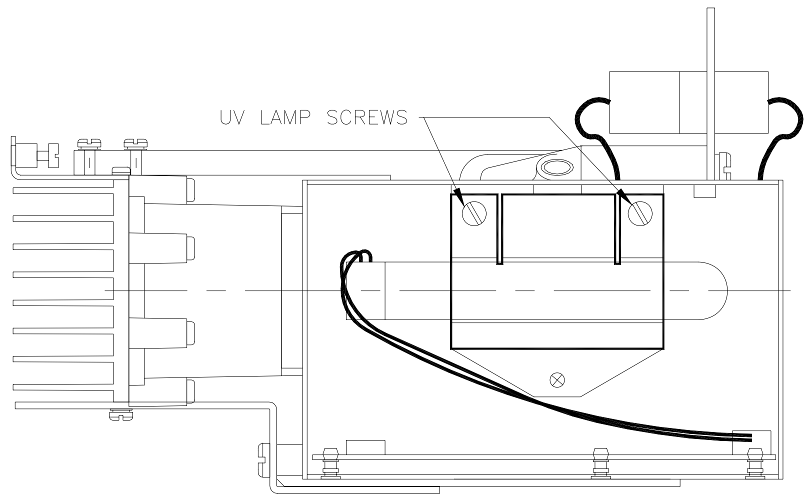


Figure 15. UV Lamp Replacement

5. 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 about 0.25 volts peak. If the UV lamp output is below 0.5 volts, then replacement should be considered.

6. Tighten the UV lamp holder screws and verify the UV lamp has remained at its previously adjusted position.

7. Reinstall the kicker assembly and the UV lamp access cover.

8. Reset the analyzer and allow it to run a startup sequence.

3.3.7.2 UV Lamp Removal and Replacement

1. Turn the analyzer off.

2. Remove the UV lamp access cover and remove the two captive screws that secure the kicker to the UV lamp housing. Refer to Figure 11. Gently move the kicker backward away from the UV lamp.

3. Disconnect the UV lamp from J1 of the Lamp Driver PCA.

4. Loosen the two captive screws which secure the UV lamp in the holder. Swing down the UV lamp holder and remove the UV lamp from the housing. Refer to Figure 15.

5. Position the new UV lamp into the housing, ensuring the Max. Output side is toward the Rx cell (the leads from the UV lamp should be pointed toward the top of the housing). Loosely secure the UV lamp holder with the captive screws.

Note

UV lamp bodies may vary in diameter. It may be necessary to add or remove a layer of heat shrink plastic from the UV lamp body to obtain a proper fit.

6. Connect the UV lamp to J1 of the Lamp Driver PCA.

7. Turn the analyzer on and adjust the UV lamp (refer to 3.3.7.1).

8. Tighten the UV lamp cover screws and reinstall the kicker and cover plate.

3.3.8 PMT Desiccant Pack Replacement

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 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. Refer to Figure 11.

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. Do not attempt to dry and reuse the old 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 interval should be decreased

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.

3.3.9 Rx Cell/PMT Housing Removal (SERIES B)

1. Turn the analyzer off and disconnect power.

2. Remove the UV lamp access cover and remove the two captive screws that secure the kicker to the UV lamp housing. Refer to Figure 11. Gently move the kicker forward away from the Rx cell.

3. Disconnect the 1/8” tubing from the Rx cell inlet and both 1/4" tubing lines from the tee on the Rx cell outlet. Be sure to note which 1/4” line connects to which side of the tee. Refer to Figure 16.

4. Disconnect J1, J2, and J4 from the Preprocessor PCA and disconnect the PMT housing fan power cable (the front connector) from the Rx cell bulkhead. Refer to Figure 16.

5. Loosen the captive screws that secure the PMT housing to the chassis (two screws secure to the side of the chassis, and two screws secure to the bottom of the chassis). Refer to Figure 16.

6. Gently swing the kicker housing forward and out of the way of the UV lamp housing. Grasp the Rx cell and PMT assembly by the top cross brace and gently lift it straight up out of the analyzer.

7. To separate the Rx cell from the PMT housing, remove the three screws that secure the Rx cell to the PMT housing. Refer to Figure 17.

8. Gently pull the Rx cell straight away from the PMT housing assembly.

9. To reconnect the Rx cell to the PMT housing, align the base of the Rx cell with the groove in the PMT housing mounting bracket and slide it gently into place against the PMT housing.

10. Reinstall the three screws to secure the PMT housing to the Rx cell assembly and alternately tighten these screws to pull the Rx cell squarely into the PMT housing.

11. Reassemble the Rx cell/PMT housing assembly and reinstall into the analyzer.

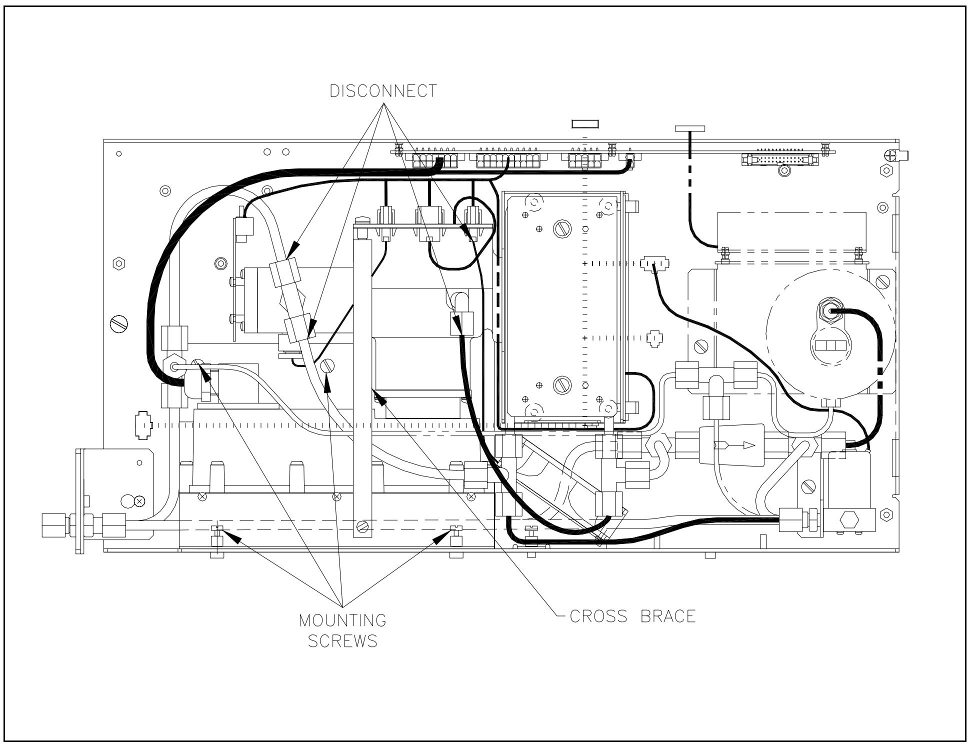


Figure 16. Rx Cell/PMT Housing Removal (SERIES B)

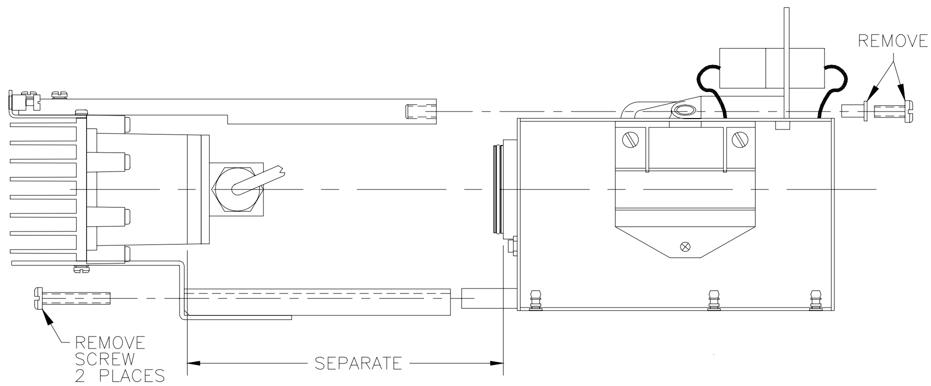


Figure 17. Rx Cell PMT/Housing Separation

3.3.10 Rx Cell/PMT Housing Removal

1. Turn the analyzer off and disconnect power.

2. Remove the UV lamp access cover and remove the two captive screws that secure the kicker to the UV lamp housing. Refer to Figure 10. Gently move the kicker forward away from the Rx cell.

3. Disconnect the 1/8” tubing from the Rx cell inlet and the 1/4" tubing line from the Flow Control inlet (top fitting). Refer to Figure 18.

4. Disconnect J1, J2, and J4 from the Preprocessor PCA and disconnect the PMT housing fan power cable (the front connector) from the Rx cell bulkhead.

5. Loosen the captive screws that secure the PMT housing to the chassis (two screws secure to the side of the chassis, and two screws secure to the bottom of the chassis). Refer to Figure 18.

6. Gently swing the kicker housing forward and out of the way of the UV lamp housing. Grasp the Rx cell and PMT assembly by the top cross brace and gently lift it straight up out of the analyzer.

7. To separate the Rx cell from the PMT housing remove the three screws that secure the Rx cell to the PMT housing. Refer to Figure 19

8. Gently pull the Rx cell straight away from and PMT housing assembly.

9. To reconnect the Rx cell to the PMT housing align the base of the Rx cell with the groove in the PMT housing mounting bracket and slide it gently into place against the PMT housing.

10. Reinstall the three screws to secure the PMT housing to the Rx cell assembly and alternately tighten these screws to pull the Rx cell squarely into the PMT housing.

11. Reassemble the Rx cell/PMT housing assembly and reinstall into the analyzer.

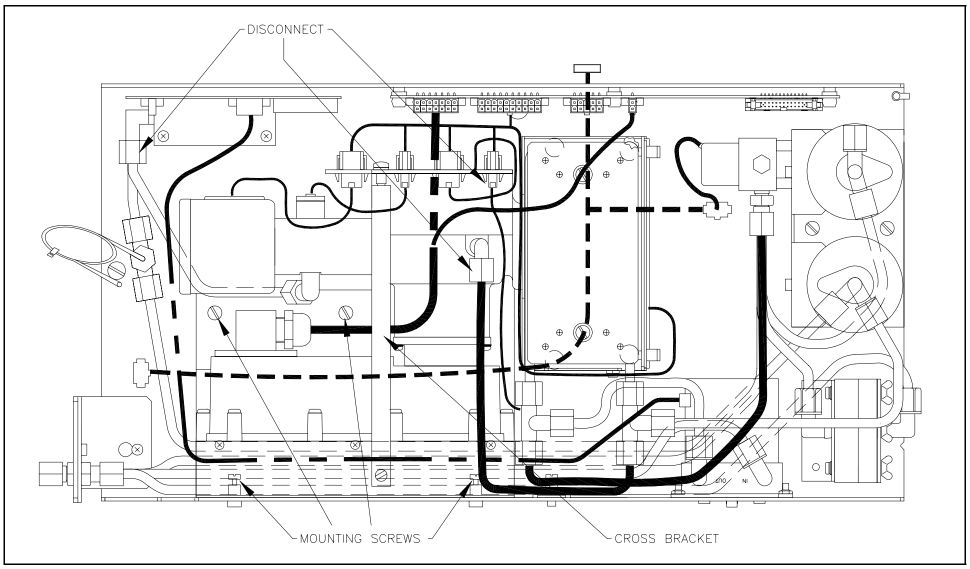


Figure 18. Rx Cell/PMT Housing Removal (A Series)

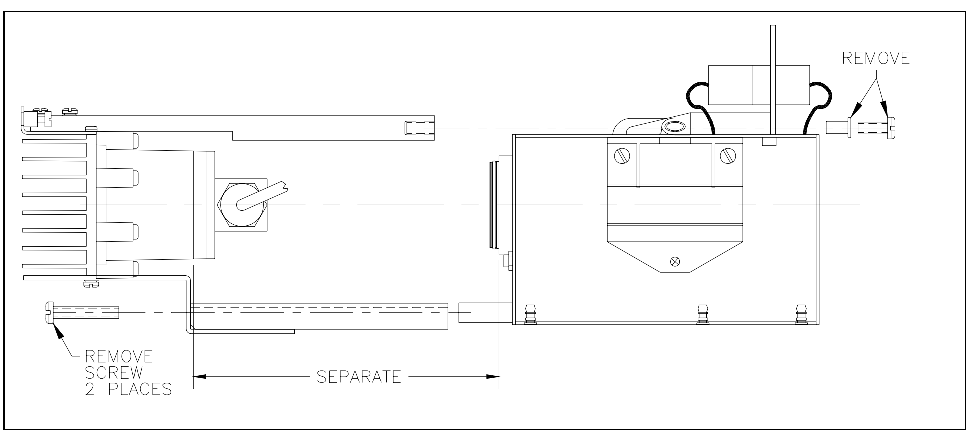


Figure 19. Rx Cell PMT Housing Separation

3.3.11 Rx Cell Cleaning

The Rx cell cleaning procedure should be performed when zero values begin to drift, when the analyzer can no longer accomplish an electronic zero adjust, or can be performed as an annual periodic maintenance item.

1. Remove the Rx cell/PMT housing assembly from the analyzer (refer to section 3.3.8 above).

2. Remove the bulkhead/end cap from the Rx cell. Refer to Figure 20.

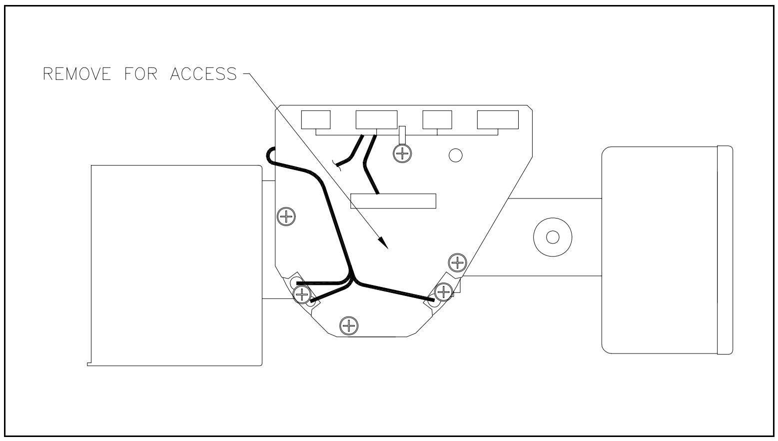


Figure 20. Rx Cell Cleaning

3. Using a lint-free cloth such as a Kimwipe, thoroughly wipe and clean the inside of the Rx cell and bulkhead/end cap using a *high-purity* isopropyl alcohol and allow to air dry.

Caution

Ensure hands and fingers do not make contact with the inside of the Rx cell or end cap during cleaning. Finger oils will fluoresce and result in an artificially high zero signal. After cleaning there should be no lint, oils, or residue present in the Rx cell.

4. Reinstall the end cap using a new O-ring (part number 025-030810).

5. Reinstall the Rx cell/PMT assembly in the analyzer.

3.3.12 PMT Cooler Replacement

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 is very important to cover the PMT at all times so that no direct light reaches its window.

1. Remove the Rx cell/PMT housing assembly from the analyzer and separate the Rx cell from the PMT housing (refer to section 3.3.11 above).

2. Remove the desiccant access cap and disconnect the electrical connector.

3. Remove the 12 screws that secure the PMT housing cover to the heatsink and lift the cover off the heatsink. It may be necessary to loosen the crossbar or mounting bracket to remove the PMT housing cover.

4. Disconnect the HVPS/Preamp from the PMT and remove the PMT from its housing. Refer to Figure 21.

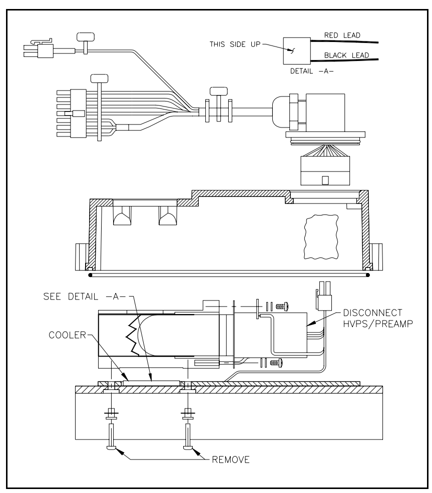


Figure 21. Cooler Replacement

Important

Note the orientation of the red and black cooler wires as they relate to the PMT housing/heatsink. The new cooler must be installed in the same way.

5. From the underside of the heatsink, remove the two screws that secure the PMT cold block to the heatsink and remove the cold block. Refer to Figure 21.

6. Remove the cooler from the heatsink and disconnect the cooler from the electrical connector.

Note

If corrosion or moisture is detected inside the PMT housing assembly, then the desiccant replacement interval should be reduced (replace the desiccant more often).

7. Clean the cooler facings of the heatsink and PMT cold block and recoat with a thin layer of heatsink compound (Dow Corning 340 or equivalent).

8. Install the new cooler in place on the PMT housing, being careful to align it in the notch on the PMT cold block. Ensure the orientation of the red/black wires on the cooler are red on the right and black on the left (when viewed from the wire side of the cooler).

9. Place the PMT cold block and cooler on the heatsink and secure with the screws from the underside of the heatsink. Ensure the shoulder washers and neoprene washers are properly in place around the screws.

Caution

Alternately tighten each of the screws securing the PMT cold block to the heatsink approximately 1/4 turn until the PMT housing and heatsink are secured flush with the cooler face and the screws are snug. *Do not* overtighten.

10. Connect the cooler wires to the electrical connector, red wire to pin 13 and black wire to pin 12.

11. Reinstall the PMT housing cover, ensuring that the O-ring on the base of the cover remains in place.

12. Install two *new* desiccant packs in the PMT housing.

13. Reconnect the desiccant access cap electrical connector and reinstall the access cap.

Caution

Do not attempt to install the desiccant cap into the PMT housing by using the screws to pull the cap into place. This will damage the PMT housing. A small amount of lubricant on the desiccant cap O-ring will facilitate its installation.

14. Reassemble the Rx cell/PMT housing and reinstall in the analyzer

3.3.13 Leak Test Procedure

3.3.13.1 A Series

This is a test for the pneumatic system of the instrument. The display readings will indicate whether the system is leaking.

Note

This procedure applies ***only to the instrument***. It does not include the EZS valve option. The EZS valve option, if included in the instrument, must be disabled to perform this test.

1. Enter the `TEST MENU` and select `OUTPUT TEST MENU`, then `VALVE TEST MENU`; from these items pick `VALVE SEQUENCING` and set to `OFF`.

2. Set all valves to `CLOSED`.

3. Press <Pg Up> to return to the `OUTPUT TEST MENU` and choose `FLOW CONTROL POTS.`

4. Turn the Pump Switch on the secondary panel to OFF and verify `FLOW: 0.00 SLPM`. If it does not read 0.00 the Flow Control PCA requires re-calibration. Return the Pump Switch to on.

5. Plug the INLET and AUXILIARY ports on the rear panel. Also plug the inlet of the zero air canister, located behind the Front Panel.

6. Verify `GAS FLOW` in the `FLOW CONTROL POTS` screen reads 0.00. If the reading is not 0.00, the leak is somewhere between the valves and the flow block.

7. Press <Pg Up> and select the `VALVE TEST MENU`. Set `INT. VALVE #1` to `OPEN`; return to the `FLOW CONTROL POTS` screen and verify `GAS FLOW: 0.00 SLPM`. If the reading is not zero, the leak is in the measure/sample line.

8. Return to the VALVE TEST MENU. Close the INT. VALVE #1 and open the INT. VALVE #2. Return to the FLOW CONTROL POTS screen and observe the flow reading. If the reading is not zero, the leak is in the zero air line.

9. Return to the VALVE TEST MENU. Close the INT. VALVE #2 and open the INT. VALVE #3. Return to the FLOW CONTROL POTS screen and observe the GAS FLOW. If the reading is not zero, the leak is in the span gas line.

10. Return to the VALVE TEST MENU. Close INT. VALVE #3 and open INT. VALVE #1 for normal operation.

11. Set VALVE SEQUENCING: ON and then press EXIT. Remove the plugs from the INLET and AUXILIARY ports and from the zero air scrubber port.

12. Verify that the flow returns to the original setting by observing the INSTRUMENT STATUS menu.

The actual flow through the analyzer should be checked by turning on the pump and connecting a flow meter to the measure inlet (ensure that the analyzer is in SAMPLE MEASURE). Actual flow through the analyzer should be approximately 0.5 slpm. If flow is too low, perform the flow calibration in section 3.5 below.

3.3.13.2 B Series

The leak check ensures the integrity of the pneumatic system, and should be performed annually or after any maintenance on the pneumatic system. To leak check the EC9850B, perform the following:

Note

This leak check procedure requires that the vacuum capacity of the pump be known and converted to an equivalent atmospheric pressure. This can be obtained by connecting a vacuum gauge through a tee to the pump inlet.

1. Disconnect the Sample inlet and zero air from the Auxiliary inlet. Leave the Exhaust port connected to the pump.

2. Turn off the pump and allow to settle for 2 minutes. Select the INSTRUMENT STATUS menu and record the GAS PRESSURE reading as the current ambient pressure.

3. Plug the Sample inlet and Auxiliary inlet ports.

4. Turn on the pump and allow it to operate for 5 minutes to evacuate the pneumatics.

5. Select the `INSTRUMENT STATUS` menu and monitor the `GAS FLOW` and `GAS PRESSURE` readings. After 2 minutes the `GAS FLOW` should indicate `0.00 SLPM` and the `GAS PRESSURE` should be equal the vacuum capacity of the pump (see following conversion) ±15 Torr (2 kPa).

Note

To convert vacuum capacity to equivalent atmospheric pressure, perform the following calculation:

Current ambient pressure (Torr) - (Vacuum (“Hg) * 25.32)

Or

Current ambient pressure (kPa) - Vacuum (kPa)

6. Unplug the Sample and Auxiliary inlets and reconnect the sample and zero air lines.

If a leak is detected, the user can attempt to isolate the leak by using the `VALVE TEST MENU` and the pneumatic diagram (Figure 9) to select and close off different sections of the analyzer.

Caution

Do *not* use pressure to isolate leaks. Pressure in excess of 5 psi (35 kPa) will damage the pressure transducers.

3.4 Hidden Menu

The new software features of the Ecotech Microprocessor board (SMD version) provides provisions for a hidden menu. This enables the experienced user to access menus for maintenance purposes. These menus eliminate the need for a portable computer to perform flow & pressure calibrations.

To access the hidden menu, simultaneously press three keys on the front panel from the primary screen as follows:

Up arrow (⮝) , <Pg Up> and *Enter*> (↵)
The following menu will be displayed:

```
                    HIDDEN MENU

     SERIES                      A
     ANALYZER TYPE            9850
     SUB TYPE             STANDARD
     FLOW BLOCK TYPE      STANDARD
     GAS NAME                  ___
     PRESSURE CALIBRATION MENU
     FLOW CALIBRATION MENU
```

Figure 22. Hidden Menu

SERIES

Allows the user to choose the correct series of analyzer. The options are `A, B & S.` The selection must reflect the Hardware to which it is being installed. i.e. for a EC9850 analyzer, it must be set to `A,` and for a EC9850B analyzer set to `B,` in order to operate correctly. The `S` option is reserved for special system software.

ANALYZER TYPE

Allows the user to choose the correct analyzer type. The options are `9810, 9811, 9812, 9820, 9830, 9841, 9842 & 9850.` The selection must reflect the Hardware to which it is being installed. i.e. for a EC9850 analyzer, it must be set to `9850` in order to operate correctly. The analyzer type will default to `????` if the device type has not been set or cannot be read from the preprocessor board.

SUB TYPE

Allows the user to set the correct Hardware options for this analyzer. The options for the EC9850 A & B series are: `STANDARD, TRACE & HIGH LVL.`

GAS NAME

Allows the user to set a 3 character name for the primary gas name. The name entered here will be used to replace the primary gas name in all screens. If the first character is a space then O3 will be used as a gas name.

FLOW BLOCK TYPE

Displays the type of flow block installed. If the flow block is not connected or calibrated, then no type will be displayed. For **A** series analyzers the **STANDARD** type is selected. For **B** series analyzers the **ISO-B** type is selected. The `PRESSURE and FLOW CALIBRATION MENU's` will change depending on which `FLOW BLOCK TYPE` is selected.

3.4.1 Pressure & Flow Calibration sub-menus

The pressure and flow calibration menus allow the user to manually calibrate the pressure transducers and calibrate the flow of the flow controllers. The contents of the pressure and flow calibration menus are described below. Note that these parameters will vary depending on which flow block type is selected. Refer to section 3.4 for further details.

CRITICAL ORIFICE

Designated flow rate of the critical orifice installed in the ISO-B flow block. For the EC9850B, this should be set to 0.650 unless otherwise specified.

DESIRED FLOW

Desired flow rate that the standard flow block will maintain a constant flow at.

Note

If the flow rate is changed within an A series analyzer the instrument must be reset in order for the change to take effect.

FLOW SPAN POINT

During the flow calibration of the standard flow block, this is where the externally measured flow rate is entered.

FLOW ZERO POINT

During the zero flow calibration of the standard flow block, this option must be set to `set` and enter pressed for the zero calibration to take effect. Select `cancel` to abort this operation.

FLOW TRANSDUCER DF

Selecting set, loads the factory default calibration curve into the earom on the standard flow control board.

PRESSURE 1 HIGH

Pressure entered during ambient calibration.

PRESSURE 1 LOW

Pressure entered during low pressure calibration.

VALVE SEQUENCING

Turn the valve sequencing on or off. Same as in the Valve Test Menu. When turned off, the appropriate valve sequence will set ready for pressure calibration.

CONTROL LOOP

When `ENABLED`, the microprocessor controls the pump speed (via the flow control pots) to give the desired flow rate. When `DISSABLED`, the user can manually adjust the pump speed using the flow control pots. For the standard flow block only.

FLOW CONTROL ZERO

This flow control pot is used to manually adjust the zero flow offset voltage during the zero calibration of the standard flow block.

PUMP SPEED COARSE/ FINE

The two flow control pots (PUMP SPEED COARSE & PUMP SPEED FINE) are software-controlled pots which control the pumps speed on the standard flow block.

AMBIENT PRESSURE

Current ambient pressure measured from the ISO flow controller.

GAS PRESSURE

Current gas pressure measured from the flow controller.

GAS FLOW

Current gas flow measured from the flow controller.

3.5 Pressure & Flow Calibration

The pressure and flow calibrations should be performed whenever a flow or pressure reading becomes suspect, when a transducer is replaced, or can be performed as an annual maintenance item. The pressure and flow transducer calibration may be performed separately or together. The following procedures cover both the STANDARD and ISO-B flow block types. For both procedures the following equipment is required:

- Digital Volt Meter.
- Pressure transducer (absolute); calibrated in torr.
- Flowmeter, 1 slpm nominal
- ¼” fitting with hose to suit pressure transducer.

3.5.1 Pressure/Flow Calibration (A Series)

3.5.1.1 Setup

Note

The EC9850 analyzer should be left running for at least one hour with the pump switched on before this procedure is attempted. This will allow the flow block temperature to stabilize to 50^{o}C.

From the HIDDEN MENU, set the **FLOW BLOCK TYPE** TO **STANDARD**, and press Enter> (↵). Press Reset on the analyzer secondary panel.

3.5.1.2 Pressure Calibration

1. From the HIDDEN MENU, select the **PRESSURE CALIBRATION MENU**. The menu of Figure 23 should be displayed.

```
            PRESSURE CALIBRATION MENU

PRESSURE 1 HIGH      743.0 TORR
PRESSURE 1 LOW       530.0 TORR

VALVE SEQUENCING     ON
CONTROL LOOP         ENABLED
PUMP SPEED COARSE    28


GAS PRESSURE         710.0 TORR
GAS FLOW             0.500 SLPM
```

Figure 23. Pressure Calibration Menu for Standard flow block

2. Verify the pump is turned off by setting the pump switch to **OFF** on the secondary panel.

3. Allow 30 seconds for the pressure reading to stabilize to ambient pressure on both the calibrated pressure transducer and the analyzer. This reading (in TORR) should be the ambient pressure. Set this value as **PRESSURE 1 HIGH** in the PRESSURE CALIBRATION MENU and then press Enter> (↵).

Note

To convert from millibar to TORR, multiply the pressure by 0.75.

4. Set the **CONTROL LOOP** TO **DISABLED**, and press Enter> (↵).This will disable the flow control loop.

5. Connect the calibrated pressure transducer to the sample inlet on the rear panel of the analyzer.

6. Turn the pump **ON** from the secondary panel.

7. Set the **PUMP SPEED COARSE** to **99** and press Enter> (↵).

8. Allow approximately 1 minute for the pressure to drop to a stable reading. This reading should be typically 100 to 200 torr lower than the ambient pressure (depending upon the capacity of the pump).

9. Set this reading (in TORR) as **PRESSURE 1 LOW** in the PRESSURE CALIBRATION MENU and press Enter> (↵).

10. Disconnect the pressure transducer from the inlet and turn the pump **OFF**.

11. To verify that the pressure transducers on the standard flow control board are calibrated, view the **GAS PRESSURE** reading in the PRESSURE CALIBRATION MENU . it should be at ambient pressure +/- 2 TORR.

This completes the pressure transducer calibration procedure.

3.5.1.3 Flow Calibration

1. From the HIDDEN MENU, select the **FLOW CALIBRATION MENU**. The menu of Figure 24 should be displayed.

```
                FLOW CALIBRATION MENU

      DESIRED FLOW          1.00 SLPM
      FLOW CONTROL ZERO     81
      FLOW TRANSDUCER DF    CANCEL
      CONTROL LOOP          ENABLED
      VALVE SEQUENCING      ON
      FLOW ZERO POINT       CANCEL
      FLOW SPAN POINT       1.000 SLPM
      PUMP SPEED COARSE     28
      PUMP SPEED FINE       7
      GAS PRESSURE          710.0 TORR
      GAS FLOW              1.000 SLPM
```

Figure 24. Flow Calibration Menu for Standard flow block

2. Verify the pump is turned **OFF** .and the **CONTROL LOOP** is **DISABLED** in the FLOW CALIBRATION MENU.

3. Load the linearization table into the flow control board EAROM by setting **FLOW TRANSDUCER DF** to **SET** and pressing Enter> (↵). The linearization table contains the following parameters:

   Flow points: 0, 0.5, 1.75, 2.5, 3.25, 3.75.

   Voltage points: 0,0.13, 0.91, 1.783, 2.5, 3.478.

4. Connect the calibrated flow meter to the sample inlet on the rear panel of the analyzer. With the pump turned off, verify that there is no flow.

5. Connect a Digital Volt Meter (DVM) to the FLOW test point on the Flow Control PCA. TP1 is the 0V connection, and pin 5 of the J2 connector is the FLOW test point. The Digital Volt Meter should be set to the 2V DC range.

6. Adjust the **FLOW CONTROL ZERO** pot until the DVM reads slightly positive (0 to 0.5 VDC), then press <Enter>.

7. Set the **FLOW ZERO POINT** to **SET** and press Enter> (↵). The **GAS FLOW** should now read 0.000 SLPM.

8. Disconnect the DVM.

9. Turn the analyzer pump **ON** and verify the **CONTROL LOOP** is still **DISABLED.**

10. From FLOW CALIBRATION MENU use the **PUMP SPEED COARSE** and **PUMP SPEED FINE** pots to adjust the measured flow (external flowmeter) to as close as possible to 0.50 SLPM.

Note

If the analyzer attempts to automatically change the pot position during adjustment then repeat step 9.

11. Record the average measured flow from the flowmeter and enter it into the **FLOW SPAN POINT** and press Enter> (↵).

12. Set the **DESIRED FLOW** to 0.50 SLPM and press Enter> (↵).

13. Press Reset on the analyzer and allow the flow to stabilize. Verify the flowmeter reading is now 0.50 ±0.05 SLPM.

Note

After the instrument startup is complete, verify the gas pressure is slightly below actual ambient pressure (approximately 10 - 20 torr). The gas pressure and gas flow readings may not bet updated during the startup routine.

This completes the flow transducer calibration procedure.

3.5.2 Pressure/Flow Calibration (B Series)

3.5.2.1 Setup

Note

The EC9850B analyzer should be left running for at least one hour with the pump running before this procedure is attempted. This will allow the flow block temperature to stabilize to 50°C.

From the HIDDEN MENU, set the **FLOW BLOCK TYPE** TO **ISO-B**, and press Enter> (↵). Press Reset on the analyzer secondary panel.

3.5.2.2 Pressure Calibration

1. From the HIDDEN MENU, select the **PRESSURE CALIBRATION MENU**. The menu of Figure 25 should be displayed.

```
              PRESSURE CALIBRATION MENU


       PRESSURE 1 HIGH      743.0 TORR
       PRESSURE 1 LOW       70.0 TORR

       VALVE SEQUENCING     ON



       AMBIENT PRESSURE     750.0 TORR
       GAS PRESSURE         710.0 TORR
       GAS FLOW             0.500 SLPM
```

Figure 25. Pressure Calibration Menu for ISO-B Flow Block

2. Turn off the pump.

3. Disconnect the inlet tubing from the flow block and connect a calibrated pressure transducer to this inlet.

4. Allow 30 seconds for the pressure reading to stabilize to ambient pressure on both the calibrated pressure transducer and the analyzer. This reading (in TORR) should be the ambient pressure. Set this value as **PRESSURE 1 HIGH** in the PRESSURE CALIBRATION MENU and press Enter> (↵).

Note

To convert from millibar to TORR, multiply the pressure by 0.75.

5. Connect the pump to the exhaust port and turn it on.

6. Allow the pump to evacuate the cell and the pressure reading to stabilize. This reading should be low (typically 100 to 200 torr), and is dependent upon the capacity of the pump. Set this value as **PRESSURE 1 LOW** in the PRESSURE CALIBRATION MENU and press Enter> (↵).

7. Disconnect the pressure transducer from the flow control inlet and reconnect the inlet tubing.

The flow calibration must now be completed.

3.5.2.3 Flow Calibration

1. From the HIDDEN MENU, select the **FLOW CALIBRATION MENU**. The menu of Figure 26 should be displayed.

```
FLOW CALIBRATION MENU

CRITICAL ORIFICE     0.650

VALVE SEQUENCING     ON


AMBIENT PRESSURE     750.0 TORR
GAS PRESSURE         710.0 TORR
GAS FLOW             0.650 SLPM
```

Figure 26. Flow Calibration Menu for ISO-B flow block

2. Set the **CRITICAL ORIFICE** to **0.650** and press Enter> (↵).

3. Press Reset on the analyzer secondary panel.

4. The actual flow should now be checked by turning on the pump and connecting a flow meter to the sample inlet of the analyzer. The flow should read approximately 0.65 slpm. If the flow is too low, perform the sintered filter/orifice replacement procedure. If flow is too high, there is probably a leak.

Note

The gas pressure and gas flow readings on the INSTRUMENT STATUS menu will not update until the startup routine is complete.

This completes the pressure & flow transducer calibration procedure.

3.6 Preprocessor Device ID Entry

This procedure is only required if the microprocessor is not reading the device ID from the preprocessor board, or if the preprocessor board has been replaced.

1. From the `HIDDN MENU` set the **`SERIES`** `to` **`A`** `or` **`B`** depending on which analyzer it is. Then press Enter> (↵).

2. Set the **`ANALYZER TYPE`** `to` **`9850`** and press Enter> (↵).

3. Press Reset on the analyzer secondary panel. The display should now display `9850 SO2 ANALYZER`.

4. You may need to erase memory after this procedure to avoid any problems.

This completes the analyzer device type programming.

3.7 Firmware Update

As improvements are made to the EC9800 series analyzers, these can be easily passed on to the user by updating the firmware (software operating within the Microprocessor board).

To update your EC9800 Analyzer, download the Firmware Updater Software. Install this software on a Windows based computer with a COM port. To do this, run the downloaded file 'setup.exe' by double clicking on it, then follow the installation screens to install.

Next, download the required software version for your 9800 analyzer from those listed at the bottom of this page (eg V1.00.0002), by right clicking on the link, and choosing 'Save Target As', and saving the .sx file on your computer. You will need to select save as type 'All Files' in the download window.

To update the firmware on the analyzer:

1. Run 'Firmware Updater' from the 'Start - Programs - Ecotech - Firmware Updater' menu.

2. Connect the 9800 analyzer to the computer using a standard serial cable (you can connect to either the Multidrop port on the back of the analyzer, or the service port on the front of the analyzer).

3. Select 'Serial Port' and the COM Port on the computer from those listed on the Firmware Update screen.

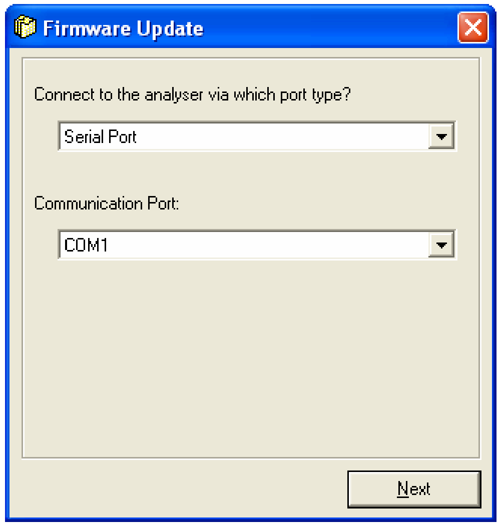


Figure 27 Firmware Update communication settings screenshot

4. Click Next

5. Enter the full path and file name of the firmware (.sx) file you downloaded. eg - C:\TEMP\V1.03.0001.SX assuming the file was saved to C:\TEMP.

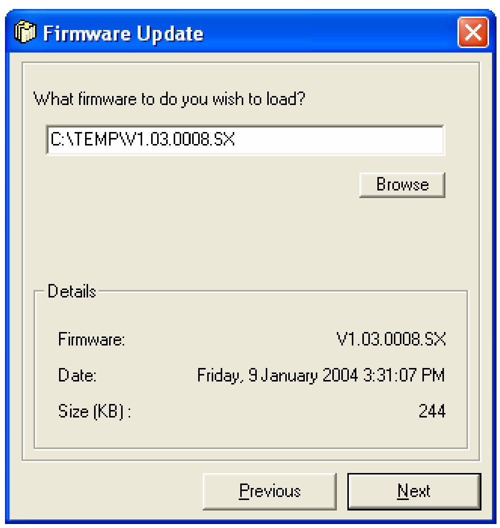


Figure 28. Firmware Update firmware selection screenshot

6. Click Next

7. Tick the boxes as shown in the figure below.

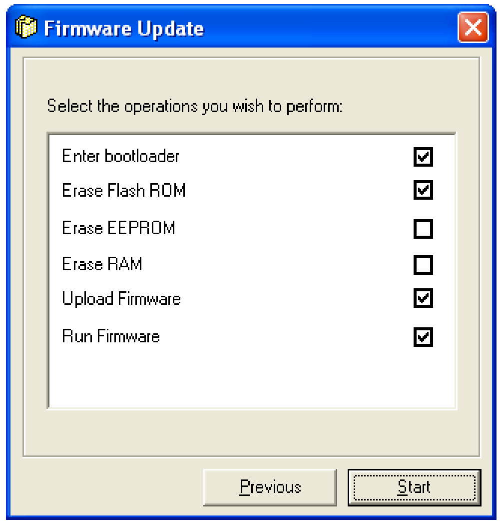


Figure 29. Firmware Update operations screenshot

8. Ensure the analyzer is switched off using the switch under the front panel.

9. Click 'Start'.

10. Switch the analyzer on.

11. The Firmware Updater window will show each step as the firmware is uploaded. DO NOT turn the analyzer off until the 'Close' button is enabled as shown below, and the Analyzer is operating as usual again.

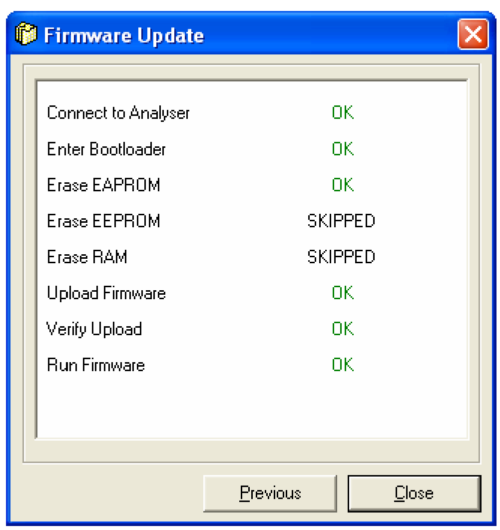


Figure 30. Firmware Update completion screenshot

4.0 Troubleshooting

4.1 DC Power Supply Voltages

Before consulting the troubleshooting section, verify that the DC power supply voltages are present and within the specifications given for each printed circuit board listed in the following table. Circuit board illustrations indicating the test points and other component locations immediately follow the Troubleshooting Guide.

Troubleshooting Voltage Table				
PCB	**Supply**	**DVM(-)**	**DVM(+)**	**Response**
Microprocessor	+12V GOOD* -10V -20V	TP1	TP2 TP3 TP4	+5V ±0.5V -10V ±0.5V -20V ±0.5V
Voltage Regulator	+12V +10V -10V +5V	TP7 (AGND)	TP9 TP8 TP6 TP4	+12V ±0.5V +10V ±0.5V -10V ±0.5V +5V ±0.25V
Preamp/Pressure	+10V -10V	TP2 (AGND)	J1-4 J1-5	+10V ±0.5V -10V ±0.5V
Preprocessor	+12V +5V +10V -10V	TP1 (AGND)	J3-1, J3-6 J3-3 J3-4 J3-5	+12V ±0.5V +5V ±0.25V 10V ±0.5V -10V ±0.5V
Lamp Driver	+12V	TP1 (AGND)	TP5	+12v ±0.5V

* The +12V GOOD test point is a 5 volt status output from the power supply to indicate that the Mains supply is within the correct operating range.

4.2 Troubleshooting the EC9850 Analyzer

Because of the sophisticated design of the EC9850 analyzer, a significant amount of information about the condition of the system is available on the front panel display. You can therefore troubleshoot an operating instrument without opening the front cover.

The most useful menus in terms of troubleshooting are:

- ❐ `PREPROCESSOR POTS`
- ❐ `VALVE TEST MENU`
- ❐ `EVENT LOG`

- INSTRUMENT STATUS
- SYSTEM TEMPERATURES
- SYSTEM FAULTS.

These menus provide information that may indicate a failure or an operational problem. If instrument performance appears to have changed dramatically, the component that is causing the problem can possibly be determined, thereby speeding up the corrective process. It may assist the operator to periodically check and record these parameters to establish an operational history of the analyzer. In addition, information from this section may be requested by the Ecotech Service support personnel when assistance is required.

4.2.1 Preprocessor Pots Menu

```
                 PREPROCESSOR POTS

MEASURE COARSE ZERO  :  25 - 70
REFERENCE ZERO       :  50
MEASURE GAIN         :  50
REFERENCE GAIN       :  5 - 95
TEST MEASURE         :  0
HIGH VOLTAGE ADJUST  :  60 - 70
LAMP ADJUST          :  80 - 90

REF. VOLTAGE    1.0 - 4.0   VOLTS
SO2             0 - 20      PPM
CONC. VOLTAGE   0.0 - 4.2   VOLTS
HIGH VOLTAGE    690 - 710   VOLTS
```

Figure 31. Preprocessor Pots and Ranges

The TEST MENU/OUTPUT TEST MENU/PREPROCESSOR POTS screen displays the potentiometer settings associated with several components, variables, or signals on the preprocessor board. Figure 31 illustrates a typical screen for an instrument that is operating normally. The value of the potentiometer settings is somewhat arbitrary, and differences in the examples shown here and the values displayed on an operating instrument should not be construed as a definite indicator of a problem. Potentiometer settings of 99 and 0, however, represent the extreme limits of the potentiometer range and may be reason to suspect a problem, except for TEST MEASURE, which is zero unless changed by the operator.

4.2.2 Flow Control Pots Menu (A Series only)

The FLOW CONTROL POTS screen displays the potentiometer settings associated with several components, variables, or signals on the A series Flow Control board. Figure 32 illustrates a typical test screen for an instrument that is operating normally. Like PREPROCESSOR POTS, the value of the potentiometer settings is somewhat arbitrary. Potentiometer settings 99 and 0, however, represent the extreme limits of the potentiometer range and may be reason to suspect a problem.

```
                     FLOW CONTROL POTS

         FLOW CONTROL ZERO  : 81 (50 –90)
         FAN SPEED CONTROL  : 16 (0 - 99)
         PUMP SPEED FINE    : 85 (0 - 99)
         PUMP SPEED COARSE  : 36 (20 - 60)


         GAS FLOW            0.505  SLPM
         GAS PRESSURE        585.6  TORR
```

Figure 32. Flow Control Pots Range

4.2.3 Valve Test Menu

```
                     VALVE TEST MENU


       INT. VALVE #1          :  CLOSED
       INT. VALVE #2          :  OPEN
       INT. VALVE #3          :  CLOSED

       AUX. VALVE #2          :  CLOSED
       EXT. MEASURE           :  CLOSED
       EXT. ZERO GAS          :  CLOSED
       EXT. SPAN GAS          :  CLOSED
       VALVE SEQUENCING       :  ON
```

Figure 33. Valve Test Menu

The VALVE TEST MENU (see Figure 33) displays the current status of each valve in the instrument. This menu can be particularly useful in correcting flow problems in the machine. The valves can be opened and closed from this menu, thus allowing the operator to determine whether valves are operating correctly. Valve sequencing must be ON in order for correct gas measurement to be accomplished.

See the *EC9850 Operation Manual* for a key to the valve names used in the menu.

4.2.4 Event Log

Upon noting a possible operational problem, examine the EVENT LOG menu to determine whether the microprocessor is reporting a system failure or problem. Should the EVENT LOG indicate an error, it will also provide information as to the portion or component of the instrument which is at fault.

Event Log Messages		
Message	**Description**	**Action**
RAM CHECKSUM FAILURE	Checksum of memory at power down differs from checksum at restart.	Battery failure or system software error. If error persists, call Ecotech Customer Service for instructions.
EAROM X DATA ERROR Y	EROM designated X detected error at location Y.	Check Pressure PCA cable connections and Pressure PCA.
SERVICE SWITCH ACTIVATED	Unit taken out of service from front panel.	Return analyzer to service using the front panel switch.
LCD DISPLAY BUSY	LCD constantly busy indicates hardware failure in display.	Check display cable connection, Display PCA, and Microprocessor PCA.
SYSTEM POWER FAILURE	Power removed from system.	No action required.
SYSTEM POWER RESTORED	Power applied to system.	No action required.
HIGH VOLTAGE POT LIMITED TO 99	High voltage adjustment exceeds range.	Check Preprocessor PCA, PMT, or high voltage module.
LAMP ADJUST ERROR	Lamp Adjust Pot reached limit before 35 mA lamp current was achieved.	Check UV lamp, Lamp Driver PCA, or Preprocessor PCA
ZERO POT LIMITED TO 0 OR 99	Zero voltage controller reached limits before voltage reached set point.	Reset analyzer, check zero air source.
REF POT LIMITED TO 0 OR 99	Reference voltage controller reached limits before reference voltage reached set point.	Check UV lamp.
ZERO FLOW	Instrument flow has gone to zero.	The pump has failed or a flow obstruction has occurred. Replace pump, or clear obstruction.
SPAN RATIO <0.75	After AZS cycle, ratio of requested span to measured span is <0.75.	Instrument span has drifted beyond acceptable limits. Recalibrate.
SPAN RATIO >1.25	After AZS cycle, ratio of requested span to measured span is >1.25.	Instrument span has drifted beyond acceptable limits. Recalibrate.
ELECTRONIC ZERO ADJUST	An analyzer electronic zero cycle was initiated.	Normal after reset or power failure. If not associated with these, check zero air supply

Event Log Messages		
Message	**Description**	**Action**
BACKGROUND CYCLE	Background cycle started. The value of the result of the previous background is stored here.	No action required.
RESET DETECTION	Reset button pressed or watchdog timer caused reset.	Unless the reset was not initiated by the user, no action is required.
AZS CYCLE	AZS cycle started.	No action required.
DATA LOGGING MEM FAIL	Occurs if unable to write to datalogging memory.	Battery failure or system software error. If error persists, call Ecotech Customer Service for instructions.
CONTROL LOOP RESTARTED	Occurs when Control Loop has been disabled, and then automatically enabled after the main screen has been visible for the last 1 minute.	No action required.
VALVE SEQUENCING RESTARTED	Occurs when valve sequencing has been disabled, and then automatically enabled after the main screen has been visible for the last 1 minute.	No action required.

4.2.5 Instrument Status

```
                 INSTRUMENT STATUS

GAS FLOW         :  0.375 - 0.625      SLPM
GAS PRESSURE     :  690 – 760      TORR
REF. VOLTAGE     :  2.3 – 2.7      VOLTS
CONC. VOLTAGE    :  0.0 - 4.2      VOLTS
ANALOG SUPPLY    :  11.6 - 12.2    VOLTS
DIGITAL SUPPLY   :  4.8 - 5.2      VOLTS

HIGH VOLTAGE     :  700 - 720      VOLTS
LAMP CURRENT     :  34 - 36        MA

VERSION 1.11.0002                      EXIT
```

Figure 34. Instrument Status Ranges

If any of the parameters displayed on the INSTRUMENT STATUS screen vary significantly from the values shown in Figure 34, the fault or operational problem is probably related. This is also true if one of the parameters is demonstrating a rapid change or is oscillating strongly around the desired setpoint. For more information on the operational limits and fault messages, refer to the table in section 4.2.7 System Faults..

Several of the parameters displayed on the INSTRUMENT STATUS screen are affected by the potentiometer settings on the PREPROCESSOR POTS screen. If a parameter is out of the normal operating range, make note of the parameter value, proceed to the respective menu, and examine the pertinent potentiometer settings.

4.2.6 System Temperatures

```
                SYSTEM TEMPERATURES

CELL TEMP.     :  47 - 53     DEG C

CHASSIS TEMP.  :  25 - 35     DEG C
FLOW TEMP.     :  45 – 55     DEG C
COOLER TEMP.   :  10 - 14      DEG C
```

Figure 35. System Temperatures and Tolerances

The SYSTEM TEMPERATURES screen provides the temperatures of the fluorescence cell, the chassis, and the thermoelectric cooler used to cool the PMT. Figure 35 contains the nominal values that should be displayed on this screen. If any of the parameters are outside the acceptable ranges, a significant problem among these components is strongly indicated. For more information on the operational limits and fault messages, refer to the table in section 4.2.7 System Faults..

Note

Flow Temp does not appear in the B series.

4.2.7 System Faults

The SYSTEM FAULTS display is a pass/fail indication of various parameters that are continually monitored. These parameters must be within acceptable operating ranges in order to display PASS. If FAIL is indicated, this indicates a major failure in the affected area. If the instrument is in startup mode, START will be displayed.

Note

The SYSTEM FAULTS screen only indicates PASS or FAIL of the various analyzer parameters, and is meant to indicate major failures. Desired operating ranges are indicated in the INSTRUMENT STATUS and SYSTEM TEMPERATUREs ranges section. If analyzer readings are not within these ranges, it could indicate deterioration of certain assemblies within the analyzer, or minor failures.

The following table lists the possible system fault messages that are displayed on the primary screen if a major failure occurs. If a fault message is displayed, use the Troubleshooting Guide to find the possible cause of the fault.

System Fault Messages	
Message	**Description/Failure Limits**
OUT OF SERVICE	Indicates the Service switch is in the OUT position. Unless the analyzer is being serviced, this switch should be in the IN position.
ZERO FLOW (A series)	Indicates that measured flow has gone below 0.05 SLPM.
ZERO FLOW (B series)	Indicates that the gauge pressure from the Pressure PCA is less than 20 torr (bad pump or plugged orifice) or greater than 200 torr (plugged inlet). Can also occur if the Sample inlet is pressurized.
LAMP FAILURE	Indicates that the lamp current is not within the acceptable limits. In the EC9850, a fault is indicated if the lamp current is ***below*** 20 mA or ***above*** 50 mA.
COOLER FAILURE	Indicates that the cooler temperature or voltage is not within the acceptable limits. In the EC9850, a fault is indicated if the cooler temperature is ***above*** 15° C or ***below*** 0° C.
REFERENCE VOLTAGE OUT OF RANGE	Indicates that the reference voltage is not within the acceptable limits. In the EC9850, a fault is indicated if the reference voltage is ***below*** 1 volts or ***above*** 4 volts.
12 VOLT SUPPLY FAILURE	Indicates that the 12 volt supply voltage is not within the acceptable limits. A fault is indicated if the 12 volt supply voltage is ***below*** 11.1 volts or ***above*** 14.3 volts.

System Fault Messages	
Message	**Description/Failure Limits**
HIGH VOLTAGE FAILURE	Indicates that the high voltage is not within the acceptable limits. A fault is indicated if the high voltage reading differs by ***greater than*** 25% of the expected value as determined from the high voltage pot setting.
CELL TEMPERATURE FAILURE	Indicates that the cell temperature is not within the acceptable limits. A fault is indicated if the cell temperature is ***below*** 35° C or ***above*** 60° C.
FLOW BLOCK TEMP	Indicates the flow block temperature is not within acceptable limits. A fault is indicated if the flow temperature is ***below*** 35° C or ***above*** 60° C.
START UP SEQUENCE ACTIVE	Indicates that the analyzer is in start-up mode. Usually after power-up or reset.

4.3 Test Functions

The following lists the available diagnostic modes in the EC9850 under the TEST MENU:

4.3.1 Optic

The optic test function turns on a small incandescent light bulb in the exhaust arm of the reaction cell. The glow from this light simulates the glow of the normal fluorescent reaction of SO_2 in the cell, which is then detected by the PMT as if it were an actual signal. This test is used to verify the operation of the PMT.

4.3.2 Preamp

The preamp test function generates an electronic test signal which is applied to the input of the PMT Preamp. This simulates an input from the PMT and is then processed as if it were an actual signal. This test is used to verify the operation of the PMT Preamp.

4.3.3 Electric

The electric test function generates an electronic test signal which is applied to the input of the preprocessor. This simulates an input to the preprocessor and is then processed as if it were an actual signal. This test is used to verify the operation of the Preprocessor PCA reference and measure channels.

4.3.4 Use of Diagnostic Modes

The diagnostic modes are actuated by selecting DIAGNOSTIC MODE: OPTIC or PREAMP or ELECTRIC and adjusting the TEST MEASURE potentiometer until a response (simulated concentration) is noted. Response to tests will vary depending upon individual analyzer parameters. These tests are typically pass/fail. Functional problems can be isolated to a single component by logical use of the diagnostic modes.

4.4 Troubleshooting Guide

Use this troubleshooting guide to find the symptom, then follow in order the possible causes and fault isolation/solutions until the problem is discovered. Then take the action described.

If you cannot identify the problem, contact Ecotech at the locations given in the front of this manual.

System Troubleshooting Table

Symptom	Possible Cause	Fault Isolation/Solution
1. No display/ instrument dead	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.
2. No display	Contrast misadjusted	Set or adjust the display contrast by simultaneously pressing two keys on the front panel as follows: - Contrast: Press Up arrow (↑) and <Select> for darker contrast, Down arrow (↓) and <Select> for lighter contrast.
	DC power	1. Verify the cable connection from the power supply to the Vreg board. 2. Check the Vreg board for correct voltages as listed in the Troubleshooting Voltages table in section 4. If incorrect voltages are found, replace the power supply or Vreg. 3. Check Microprocessor test points listed in the Troubleshooting Voltages table table in section 4.
	Display	Check the interface cable between the display and J6 on 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.
3. Zero flow	Pump failed	Replace the pump.
	Filter	Check the particulate filter. Replace if dirty or plugged.

System Troubleshooting Table		
Symptom	**Possible Cause**	**Fault Isolation/Solution**
	Pressurized Rx cell (B series)	Ensure Sample and Zero inlets are maintained at ambient pressure.
	Plugged orifice (B series)	Clean or replace the orifice. Remove sintered filter if installed, and discard.
	Flow control assembly (A Series)	Recalibrate the flow control assembly.
	External Valves installed but not selected (A Series)	Select `CALIBRATION: EXTERNAL` from the `CALIBRATION MENU`.
4. Noisy or unstable readings	Leaks	A leak dilutes the sample stream and causes low span readings and noise. See section 3.3.13.
	Lamp not correctly positioned	Adjust the UV lamp. If you are unable to obtain an acceptable reading, replace the lamp.
	TE cooler or Rx 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.
5. Low span	Span setting	Adjust the span using the calibration procedure in the EC9850 Operation Manual.
	No flow	See the Zero flow symptom in this table.
	Leaks	A leak dilutes the sample stream and causes low span readings and noise. See section 3.3.13
6. No response to span gas	Leaks	A leak dilutes the sample stream and causes low span readings and noise. See section 3.3.13
	No flow	Check the `INSTRUMENT STATUS MENU` and verify flow.
	Software lockup	1. Observe whether `ECOTECH GLOBE` on the display is turning. 2. Verify that other menus can be selected. 3. Press the Reset button on the secondary panel. 4. Check that D5 HEART BEAT LED is flashing on the Microprocessor Board
7. Zero drift	Leak	A leak dilutes the sample stream and causes low span readings and noise. See section 3.3.13
	Charcoal saturated	Replace the charcoal.
8. Unstable flow or pressure readings	Failed cell control heater	The cell temperature (`SYSTEM TEMPERATURES` screen) should be 50° ±5° C.

<table>
<tr><th colspan="3">System Troubleshooting Table</th></tr>
<tr><th>Symptom</th><th>Possible Cause</th><th>Fault Isolation/Solution</th></tr>
<tr><td rowspan="2">9. Instrument stuck in reference adjust</td><td>Reference voltage (INSTRUMENT STATUS screen) not at 2.5 V</td><td>Perform UV lamp check and adjustment.</td></tr>
<tr><td>High voltage won't reach 700 V (±10 V)</td><td>Check to see if the high voltage adjust potentiometer is at 99. If it is, the high voltage power supply may be bad. If the pot is not at 99, try restarting the instrument. If the problem continues, call the Service Response Center.</td></tr>
<tr><td rowspan="2">10. Response time not at specified value</td><td>Low flow</td><td>Check sample flow with flowmeter. It should be 0.6 to 0.7 slpm @ STP. Bypass kicker or replace orifice if it is not.</td></tr>
<tr><td>Kicker damaged</td><td>Perform leak test. If there are no leaks, bypass the kicker and re test the response time. If the rise time corrects itself, replace the kicker. If not, check the gas delivery system, flow, and particulate filter.</td></tr>
<tr><td rowspan="2">11. PMT voltage does not reach 700 V (±10 V)</td><td>High voltage</td><td>Replace the HVPS/Preamp module.</td></tr>
<tr><td>Bad Microprocessor or Preprocessor PCA</td><td>Check that D5 HEART BEAT LED is flashing on the Microprocessor Board. Check Display connection.
Replace the Microprocessor or Preprocessor PCA.</td></tr>
<tr><td>12. Analyzer displays BAD I.D. ANALYZER</td><td>Preprocessor ID set wrong</td><td>1. Check J5 connector on Microprocessor.
2. Check J6 connector on Preprocessor.
3. Reprogram device ID.
4. Replace Preprocessor</td></tr>
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