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VS Series Component Leak Detector

OPERATIONS MANUAL

Contents

Figures

Tables

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121 Hartwell Avenue
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VS Series Component Leak Detectors

to which this declaration relates is in conformity with the following standards:

Safety:

- EN 61010-1, Second Edition, 2001 - *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use-Part 1: General Requirements*

per the provisions of the **Low Voltage Directive** - 2006/95/EC of 21 December 2006.

- CAN/CSA-C22.2 No. 61010-1-04 - *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use-Part 1: General Requirements* (Adopted IEC 61010-1:2001, MOD)

- UL 61010-1, Second Edition, 2004 - *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use-Part 1: General Requirements*

EMC Emission and Immunity:

- EN 55011:1998/A1: 1999/A2: 2002 Group 1 Class A: *ISM radio-frequency equipment - Radio disturbance characteristics - Limits and methods of measurement (EU)*

- EN 61326:1997/A1: *1998 /A2:2001 Electrical equipment for measurement, control and laboratory use - EMC requirements (EU)*

per the provisions of the **Electromagnetic Compatibility Directive** 2004/108/EEC of 31 December 2004.

EMC Emission:

- FCC: Code of Federal Regulations, 47CFR: 2004, Part 15, *Class A* (USA)

Test Specification for Profinet IO Device, Version 2.2.2, Jan. 2008

The authorized representative located within Community is:

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Preface

Documentation Standards

This manual uses the following documentation standards:

NOTE

Notes contain important information.

CAUTION

Cautions appear before instructions, which if not followed, could cause damage to the equipment or data loss.

WARNING

Warnings appear for a particular procedure or practice which, if not followed correctly, could lead to serious injury or death.

Text

Hard buttons are depicted in text in **bold** text.

Soft key screen buttons are depicted in **bold** text when part of an action.

Italics is used for emphasis or to indicate screen text.

Hazard and Safety Information

The common international symbols used in this manual and on the equipment are defined below.

○	OFF Supply (Power)		Earth (Ground) Terminal
|	ON Supply (Power)		Caution, Hot Surface
~	AC – Alternating Current		Caution, Risk of Electrical Shock
⚠	Warning, Risk of danger		Protective Conductor Terminal
	Frame or chassis Terminal		Do Not Place in Trash
	Indoor, Dry Location Use Only	CE	Caution, Radio Restriction

Operators and service personnel must be aware of all hazards associated with this equipment. They must know how to recognize hazardous and potentially hazardous conditions, and know how to avoid them. The consequences of unskilled, improper, or careless operation of the equipment can be serious. Every operator or service person must read and thoroughly understand operation/maintenance manuals and any additional information provided by Agilent. All warning and cautions must be read carefully and strictly observed. Consult local, state, and national agencies regarding specific requirements and regulations. Address any safety, operation, and/or maintenance questions to your nearest Agilent office.

Solvents

WARNING

The mechanical components of leak detectors are typically cleaned with alcohol, methanol, or other solvents.

When heated, sprayed, or exposed to high-temperature equipment, these solvents become flammable and explosive, causing serious injury or death. Do not use these solvents near a high-temperature source. Ventilate the working area with a blower and work in a large, well-ventilated room.

Alcohol, methanol, or other solvents are irritants, narcotics, depressants and/or carcinogens. Their inhalation and/or ingestion may produce serious side effects. Prolonged or continued contact with the skin results in absorption through the skin and moderate toxicity. Always ensure that cleaning operations are carried out in large, well-ventilated rooms, and wear eye shields, gloves, and protective clothing.

To clean the leak detector enclosure and the LCD display, use only a soft cloth slightly dampened with water or a mild soap.

Do NOT use excess water or cleaning solvents of any kind.

Avoid splashing any cleaning solvents into the unit through the ventilation openings. Wipe the surface with a dry lint-free cloth.

CAUTION

Do not clean any aluminum parts with Alconox®. Alconox is not compatible with aluminum and will cause damage.

Vacuum Equipment and Cleanliness

Cleanliness is vital when servicing the leak detector or any vacuum equipment. There are some techniques that are more important in leak detector servicing than in general vacuum work:

CAUTION

Do not use silicone oil or silicone grease.

Use powder-free butyl or polycarbonate gloves to prevent skin oils from getting on vacuum surfaces.

NOTE

Agilent does not recommend the use of vacuum grease. Vacuum grease absorbs helium tracer gas and releases this slowly resulting in helium background during leak test operations. If it must be used, use it sparingly and avoid silicone types. Apiezon® L grease is recommended (Agilent Part No. 695400004).

O-ring Care

When removing, checking or replacing O-rings, keep in mind the following:

NOTE

Agilent recommends replacing all O-rings during routine maintenance or during any maintenance procedure requiring that O-rings be removed.

NOTE

Due to the effective cleaning nature of VacuSolv solvent and its residue-free properties, Agilent' Component and Spectrometer Cleaning Kit (Part Number 670029096), used in accordance with the kit instructions, is recommended for cleaning spectrometer components. The kit can also be used for fine cleaning of other parts in the leak detector's vacuum system such as valves and fittings. No rinsing steps or high-temperature drying are required following cleaning with VacuSolv. Although appropriate precautions are advised, VacuSolv is compatible with most materials and does not contain toxic chemicals or CFCs (chlorofluorocarbons). Other acceptable solvents are isopropyl alcohol (IPA) or Dow Corning® OS-20.

CAUTION

Remove O-rings carefully with your fingers. Do not use metal tools for this task; this prevents scratching of any sealing surfaces.

❑ *Wipe all O-rings clean with a lint-free cloth before installation to ensure that no foreign matter is present to impair the seal.*

❑ *Do not use grease or any other substance on O-rings that will come in contact with the spectrometer.*

❑ *Do not use alcohol, methanol or other solvents on O-rings. Doing so causes deterioration and reduces their ability to hold a vacuum.*

❑ *Agilent does not recommend the use of vacuum grease. If applicable, apply a small amount of Apiezon® L grease and wipe the O-rings shiny dry.*

Equipment, General

Environment of intended use:

❑ *Indoors use in an industrial and laboratory installation only.*

❑ *Altitude up to 2000m*

❑ *POLLUTION DEGREE 2, Overvoltage Category: I, Class III (DC powered)*

❑ *Operating Temperature: +5 °C to +48 °C, Relative Humidity (RH) up to 80% max. Operating in the top working range of [-3, -4, -5, -6], avoid operating with a constant foreline pressure > 500 mTorr at +48° C.*

❑ *Storage ambient conditions: RH from 0% to 95%, non-condensing, temperature: -20°C to +60°C*

WARNING

❑ *Do not use in presence of flammable or explosive gas.*

❑ *Do not attempt to disassemble or modify the equipment. Such action could lead to electric shock or injury. Agilent's authorized technician will do any repair work.*

❑ *If there is smoke or unusual smell or noise, stop the using the equipment immediately, and contact the Agilent Service Center.*

WARNING

The leak detector is not designed for use with hazardous gases. Verify that the system to be tested has been purged of all hazardous gases prior to using the leak detector. When testing a system that contained hazardous gases, connect the exhaust of the leak detector to a scrubbed or toxic containment exhaust. Exposure to hazardous gases could result in serious injury or death.

WARNING

Equipment tightness is guaranteed for normal operating conditions when the equipment leaves the factory. It your responsibility to maintain the level of tightness, particularly when pumping dangerous products.

CAUTION

The performance and operating safety of this equipment can only be guaranteed if it is operated according to normal conditions of use.

Allow at least 4" of clearance adjacent to the ventilation slots at the front, sides and back of the equipment enclosure.

Allow sufficient room for the operator to safely maneuver to perform testing.

LCD Display

WARNING

If the LCD display breaks, avoid getting any liquid crystal in mouth or eyes. If it gets on the operator hands, feet or clothing, wash it immediately with soap and water.

CAUTION

Do not apply excessive pressure to the LCD display as this may cause smears.

In general, the lower the temperature, the longer it takes the LCD display to turn on. Performance of the LCD display may deteriorate in low temperature.

Power and Static Sensitivity

The power supply requirements for VS C15 Component leak detector: 24 VDC, 5 A min.

The VS Component leak detector can be ordered with or without an external 24 VDC AC-DC power supply.

❏ When ordered with the universal external AC-DC power supply (VSC15PS), you must provide a mains supply:

❏ 100-230 VAC ± 10%, 50/60 Hz ± 2%, with a 10 A local power switch/circuit breaker.

❏ When ordered without the external power supply, you must supply a 24 VDC +/- 5%, 5 A min. power supply with a local power switch.

Provide the 24 VDC power to the VS Component leak detector via a detachable cable: 18 AWG triple-twisted wires terminated by Molex's HCS-125 Receptacle (P/N 03-12-1036), with 3-socket female terminals (Molex P/N 18-12-1222) that are compatible with a DC inlet connector of an EMI filter on the rear panel of the VS C15 Base Unit. Wire as follows:

❏ +24 VDC: position 1 (D-shape terminal) of the receptacle.

❏ PE wire: position 2 (middle terminal) of the receptacle; to provide grounding between the VS C15 units and the external power supply system.

❏ 24VRTN wire: position 3 of the receptacle.
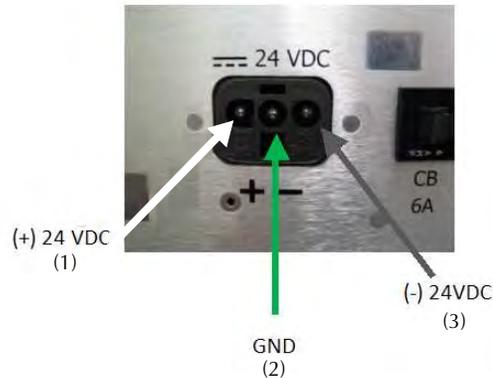
Figure 1   24VDC Input Power Connection

Provide the 24 VDC power to an optional VS C15 Display Unit via a High Density 15-pin D-Sub M/F cable connected to the DISPLAY connector on the rear panel of the Base Unit as shown below.

CAUTION

Use surge protection to improve the immunity of the leak detector against unidirectional transients caused by the following phenomena:

❑ *Switching phenomena in the power network (e.g., switching of capacitor banks, inductive loads, electrical motors, etc.)*

❑ *Faults in the power network*

❑ *Indirect lightning strokes*

CAUTION

Many components of the leak detector are static sensitive. Wear a grounding device when performing any maintenance on the leak detector, especially when performing maintenance of static sensitive parts, such as circuit boards and the spectrometer.

CAUTION

This equipment has been tested and found to comply with the limits for Class A digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference when it is operated in a commercial environment.

This equipment generates, uses, and can radiate RF energy, which if not installed and used in accordance with the instructional manual, can cause harmful interference to radio communications.

When this equipment is operated in a commercial environment, operation is subject to the following two conditions:

❑ *This equipment must not cause harmful interference.*

❑ *This equipment must accept any interference received, including interference (RF and ESD) that may cause undesired operation.*

The equipment may need to be reset after RF and/or ESD events by disconnecting/reconnecting the 24 VDC power supply power cable on the back panel of the unit.

Operation of this equipment in a residential area is also likely to cause harmful radio communications interference, in which case, you are required to correct the interference at their expense.

If needed to improve EMC performance, place a Snap-It-ferrite, Fair-Rite's p/n 0443164151 or equivalent, onto the cables and wires at the distance of 2.0" to 3.0" from a plug connected to the following I/O connectors of the VSC15BU unit:

❑ *24 VDC input*

❑ *Analog Output*

❑ *Profinet IO*

❑ *Pressure Gauge*

and create a cable double loop around ferrite as shown below:
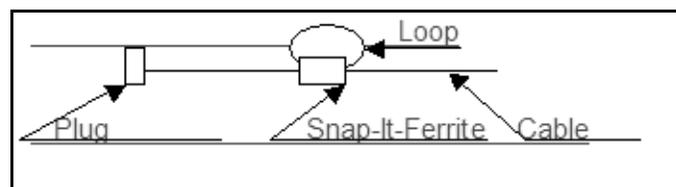
WARNING

⚠️

This equipment is designed to meet current EEC regulations: LVD (Low Voltage Directive, 2006/95/EC of 21 December 2006) and EMC (Electromagnetic Compatibility Directive, 2004/108/EEC of 31 December 2004) for Pollution Degree 2, Overvoltage Category I, Class III (DC powered) environment for Industrial, Scientific, Measuring and Process Control Electrical Equipment.

❏ *Any modifications on your part are liable to cause non-compliance with regulations or affect the EMC performance and the safety of the product. Agilent cannot be held responsible for consequences resulting from such intervention.*

❏ The equipment can be damaged by:

  ❏ *Incorrect mains AC supply voltages*

  ❏ *Radio Frequency (RF) and Electrostatic Discharge (ESD) energy inputs that exceed the maximum ratings*

  ❏ *Operating in very high temperatures or without adequate ventilation*

  ❏ *Immersion in liquids*

  ❏ *Physical abuse*

❏ *All electrical connections must be performed by a qualified electrician and must comply with national and local codes.*

❏ *Opening the enclosure may expose hazardous voltages. Always disconnect the power cord and interface cables before opening the enclosure. Do not touch the power inlet's contacts for at least 10 seconds after disconnecting the power cord.*

❏ *Electrical installation must include the appropriate branch circuit (10 A maximum), with a long time delay and a reliable earth ground.*

❏ *Use only the power cable that was provided with or recommended for your leak detector. The use of extension cords is not recommended and could result in damage to the equipment and loss of warranty.*

❏ *To avoid electric shock, connect the product power cable PE conductor to a grounded terminal of the external AC-DC power supply. A power cable with a grounding conductor is required.*

Spectrometer

WARNING

Store the Ion Source/Preamplifier sub-assembly in a cool, dry area in a tightly sealed, ESD protected container. Wear lint-free gloves when handling the spectrometer. Wash hands thoroughly after handling the spectrometer filaments and especially before smoking or eating.

CAUTION

The spectrometer operates at a very high vacuum produced by the high vacuum pump. Service of the spectrometer requires that this vacuum be vented to the atmosphere.

CAUTION

Do not use grease or any other substance on O-rings that will come in contact with the spectrometer.

CAUTION

If the spectrometer magnet comes in contact with a magnetic surface, the magnet can become degraded causing the spectrometer to lose sensitivity.

Pumps

WARNING

To avoid injury, use proper lifting techniques when moving pumps. Two people may be required to move pumps safely.

WARNING

The vacuum pumps are also compressors; incorrect operation may be dangerous. Study the Mechanical Pump Operation Manual enclosed with your pump before starting pumps.

The pumps are designed to prevent any thermal risk for user safety. However, specific operating conditions may generate temperatures >70 °C.

Hot oil and surfaces burn the skin. Service of the pumps in this OEM leak detection system area, must be performed by authorized personnel only. Stand back from a mechanical pump before starting it.

WARNING

To avoid injury, wait until the turbo pump is completely stopped before disconnecting it from the vacuum system.

To vent the turbo, open the knurled vent screw located on the side of the turbo. If the turbo is spinning, you will hear it wind down. Close the vent screw after the turbo has stopped.

If the internal calibrated leak option is installed, break the vacuum by disconnecting the calibrated leak valve block from the NW16 vent port.

Agilent Services

Agilent offers:

❑   Rebuilt spectrometers on an exchange basis.

❑   NIST-traceable calibrated leak testing and verification services.

❑   Preventive maintenance services.

❑   Overhaul services.

❑   System recertification.

❑   Support agreements.

❑   On-site support.

Please see our catalog or contact us to learn about available services.

Section 1. Introduction to the VS Series Component Leak Detector

1.1 The VS Series Component Leak Detector

The VS Component Leak Detector is a version of the VS Series wide-range Helium Mass Spectrometer Leak Detectors with a new concept to integrate the whole leak detector into portable compact units for easy installation into an OEM leak detection system:

❑ VSC15BU, Base Unit, with all high vacuum components such as a helium mass spectrometer/turbo molecular pump sub-assembly, electronics PCBs, internal cables and I/O connectors

Optional Accessories:

❑ VSC15DU, Display Unit, with Color LCD Display/Touch Panel, Front Panel control PCB and a speaker

❑ VSC15PS, 24 VDC Power Supply with universal (100-230) VAC input

❑ VSCFLDCL, Calibrated Leak, Field Installed

❑ VSCFACCL, Calibrated Leak, Factory Installed

❑ VSCFLDPN, ProfiNet Module, Field Installed

❑ VSCFACPN, ProfiNet Module, Factory Installed

❑ ConvecTorr Gauge

❑ VSCBUPC8, 24 VDC Power Cable, 8'

❑ VSCDUC10, Display Power/Signal Cable, 10'

❑ VSCCTC10, ConvecTorr Cable, 10'

❑ VSCCTC25, ConvecTorr Cable, 25'

You provide:

❑ A vacuum connection of a VSC15BU unit to the OEM leak detection system via a single NW25 flange on the front panel of the Base unit, CovecTorr Gauge for the Test Port/Foreline pressure measurement

❑ a 24 VDC input power to the VSC15BU unit,

❑ a VSC15DU Display (via display cable) and VSC15BU unit,

❑ and utilize one of several communications control interfaces via computer, PLC or industrial ProfiNet network.

To provide instant Profinet Real Time connectivity, install the Profinet IO module (VSCFACPN or VSCFLDPN) into the VSC15BU unit and use a shielded Category 5E min Ethernet cable with RJ45 plug (ISO/IEC 11801, Edition 2) between the VSC15BU unit and a Profinet host controller.

Agilent's patent-pending electronic calibration system provides precise full and fast calibration across the entire leak range with one standard leak. Specialized software permits you to calibrate to internal or external leaks and provides a range of set point functionality. You must provide a suitable *test valve* to control vacuum pressure upstream of the VS C15BU unit. The VS C15BU unit can be mounted in a variety of orientations within a system.

CAUTION	*The use of a longer cable (> 3.0m) for the connection with an external PLC, computer or industrial network is fully the user's responsibility. Some EMC prevention measure may be required.*

1.1.1 VS Series Component Leak Detector Configurations

This section contains outline drawings of the Base, VSC15BU, and Display, VSC15DU, units. Dimensions are given in inches, in brackets, and in mm, below the brackets.
Figure 1-1 shows the outline drawing and physical dimensions of the VS C15 System unit
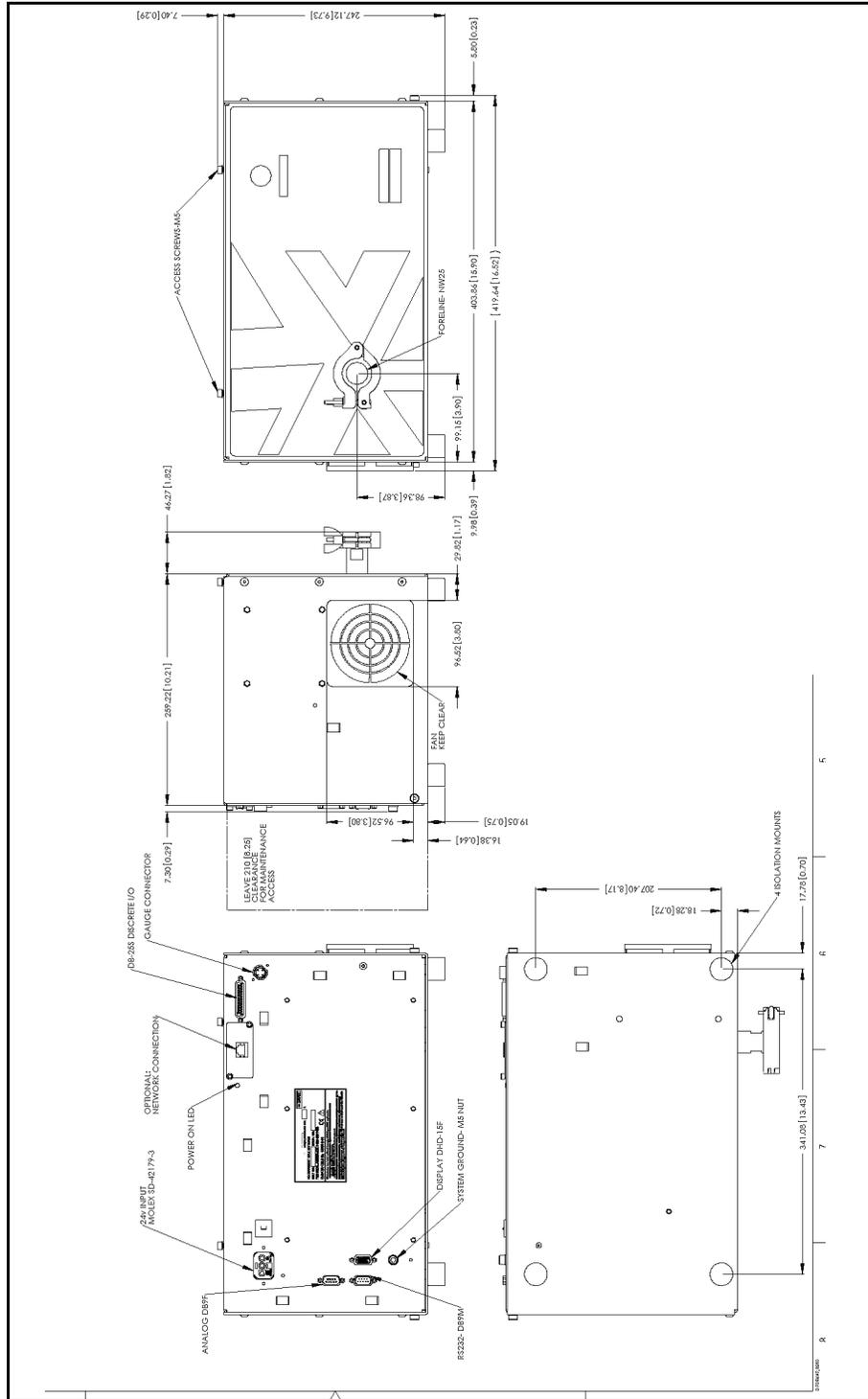
Figure 1-1   VS C15 Base Unit, Outline Drawing

Figure 1-2 shows the outline drawing and physical dimensions of a VS C-15 Display Unit.
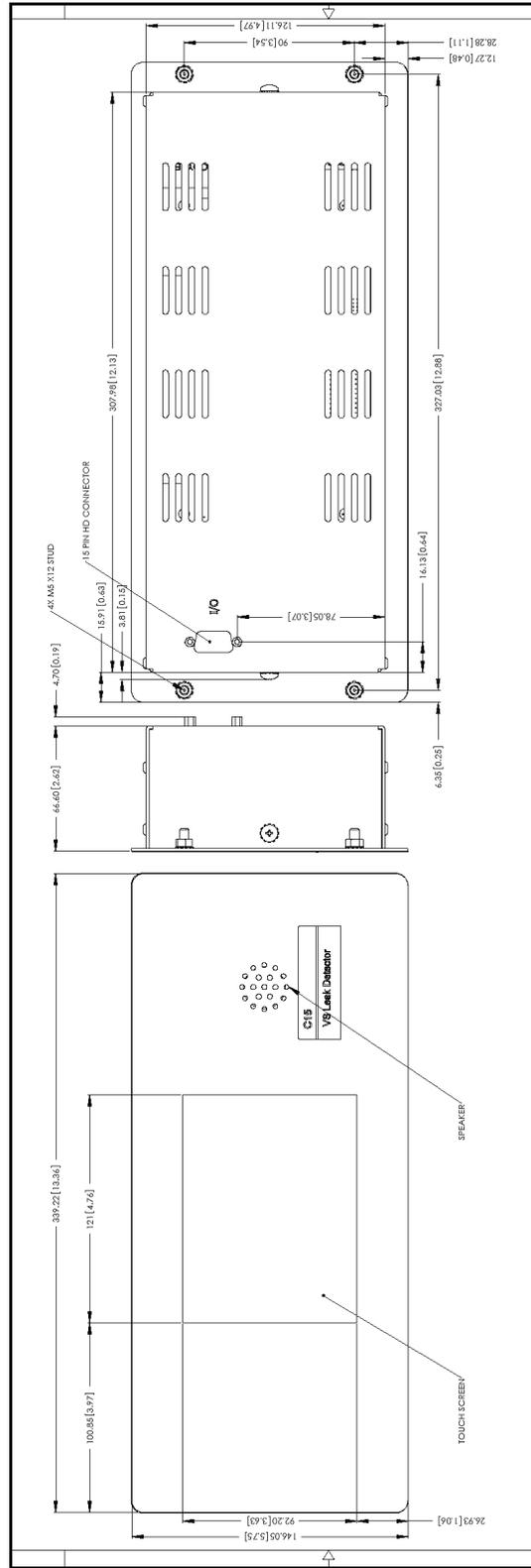
Figure 1-2   VS C-15 Display Unit Physical Dimensions: Front and Side

1.2 Unpacking the Leak Detector

The following items are included in the shipment:

❑ VS Series Component Leak Detector Operations Manual

❑ VS Series Component Leak Detector configured and completely assembled as ordered

❑ All necessary cables, as ordered

❑ Turbo Pump manual (CD)

❑ Any optional equipment ordered

❑ Any manuals for optional equipment purchased

1.2.1 Unpacking Instructions

1. Inspect the container for evidence of damage in shipment.

    a. Retain any evidence of rough handling.

    b. Report the damage to the carrier and to Agilent Customer Service without delay. See the back cover of this manual for a listing of our sales and service offices.

2. Carefully remove the shipping container.

3. Inspect the leak detector and related items immediately for any indication of shipping damage.

4. Remove any loose boxes or packages and put them aside. Keep the original packing for re-use in the event that it is necessary to return the leak detector to Agilent.

5. Carefully remove the plastic bag covering the leak detector.

1.3 Installation

CAUTION *Read the Preface for all operational warnings and cautions.*

The VS Series Component Leak Detector is delivered completely assembled as ordered. Installation requirements are described in Table 1-2.

Table 1-1 Installation Requirements

Item	Requirement
VS C15 Base unit Location	❑ Place the Base unit in OEM leak detection system in an orientation close to a 24 VDC power source. ❑ Connect the C15 vacuum flange on a tee junction between the backing pump and the test chamber. To achieve fast test cycle time, the diameter of the interconnecting pipe should be as large as possible. The length of the interconnecting pipe should be a short as possible. This ensures the system is not limited by gas conduction in the interconnecting vacuum pipes. ❑ Place the VS C15as close as possible to the test chamber. ❑ Maintain a 4" clearance for proper ventilation and sufficient room for the operator to safely maneuver and for Interface cables connections. *Additional ventilation requirements for your specific application are discussed in Section 1.3.3 "Recommended Additional Services " on page 1-8.*
Power	Either (depends on configuration ordered): ❑ With a 24 VDC external universal AC-DC power supply. Provide: ❑ Mains supply: (100 to 230) VAC ±10% 50/60 Hz, 10 A min ❑ Local branch Power Switch/Circuit breaker – 10 A ❑ Without a 24 VDC power supply. Provide: ❑ 24 VDC ± 5%, 5 A min ❑ Local Power Switch 10 A min
Mains Supply Voltage Fluctuations	Must not exceed ±10% of the nominal voltage.
Pollution	Pollution Degree 2 per EN61010-1 Standard.

Table 1-1   Installation Requirements

Foreline Pump	❑ A primary vacuum pump with a minimal pumping 285-300 l/m (10 cfm) for use as a Foreline/(Roughing) Test Pump for a single pump configuration system. Recommended: Agilent's DS302 Rotary Vane Mechanical pump. ❑ A primary vacuum pump with a minimal pumping speed of 100 l/m (4 cfm) for use as a **Dedicated Foreline Pump only** in a two pump configuration system. Recommended: Agilent's DS102 Rotary Vane Mechanical pump.
Fixed Mains Socket Outlet	Connect to a building protective earthing system.

1.3.1 Typical VS- C-15 Leak Detection System Interconnection Diagram
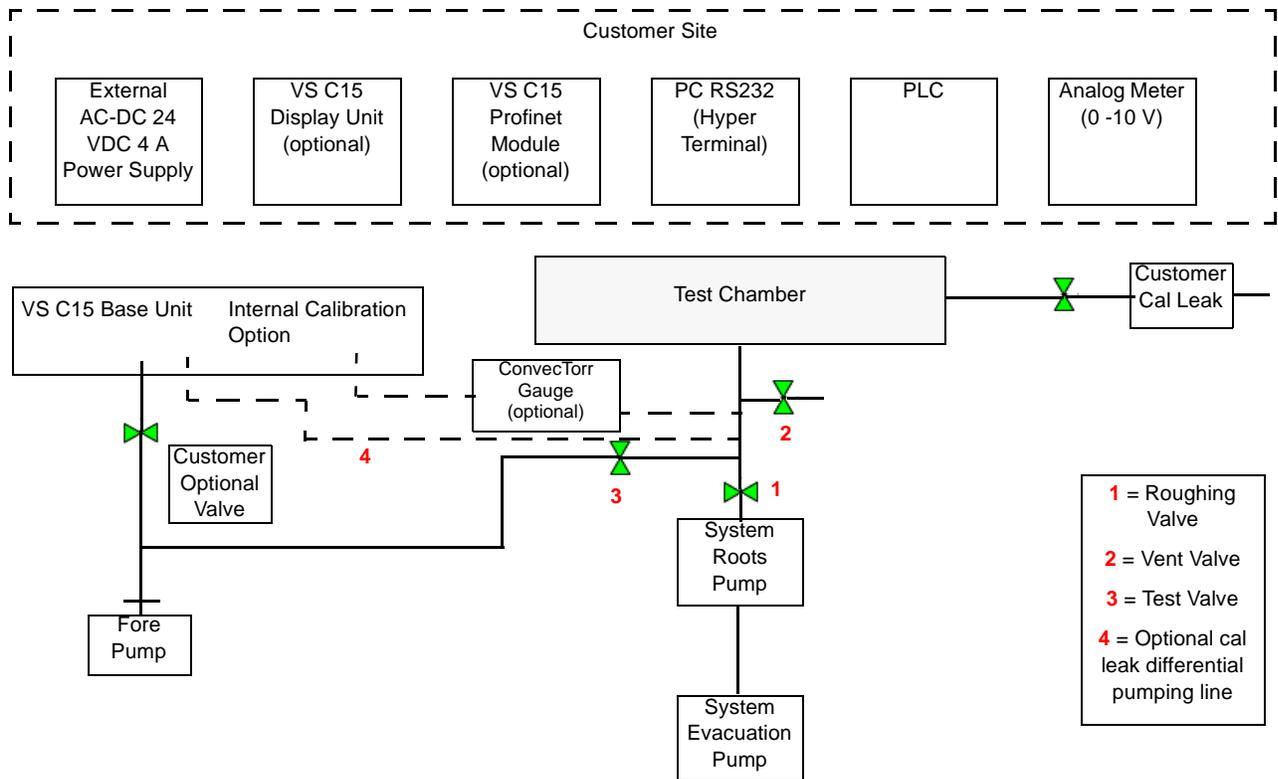
Figure 1-3   C-15 Interconnection Diagram

1.3.2 Helium

Welding grade helium in a standard cylinder with pressure regulating valve and hose is required for testing products and leak checking.

1.3.3 Recommended Additional Services

The following additional services are recommended, as good vacuum practice, based on the application:

❑ Connect an exhaust hose to the foreline pump and vent it outside of the room, or to the facility's exhaust, to reduce the particulate count and the helium background signal.

❑ When using oil lubricated mechanical pumps, use an oil mist eliminator on the exhaust port of the mechanical pump to reduce the oil mist from the exhaust. Oil mist eliminators can, however, become saturated with oil causing slower pumping speeds and higher helium backgrounds in the leak detector. The replacement time interval of the oil mist eliminator is determined by whether you frequently operate at elevated roughing pressures, pumps on large volumes, or frequently cycles the system. Refer to Table 4-4 on page 4-6 and Table 4-5 on page 4-7 for the mist eliminator and replacement cartridge part number.

❑ Use a dry nitrogen purge for venting or elevating the foreline pressure to keep the test system dry. Refer to Section 4.2 on page 4-5 for more information.

❑ Adequate circulation to prevent an increased helium background level.

1.3.4 Storage

If the VS Series Component leak detector Base and Display units are not used immediately, it can be stored as received without special precautions. A dry, relatively dust-free area is preferred. The required environmental conditions for storage are:

❑ 0% to 95% relative humidity, non-condensing

❑ -20 °C (-4 °F) to + 60 °C (+ 140 °F) ambient temperature

1.4 Front Panels

1.4.1 VS C-15 Base Unit

The VS C15 Base unit front panel (Figure 1-4) has an opening for a single NW25 flange that provides vacuum connection to a user leak detection system.

Figure 1-4   VS C-15 Base Unit Front Panel

1.4.2 VS C-15 Display Unit

The VS C15 Display Front Panel (Figure 1-5) consists of a LCD display with a Touch Panel to access the software control screens. All operator control and monitoring of results are achieved via the resident software accessed using the HOME screen. Table 2-2 on page 2-7 lists the main sub-screens and their purpose. Operational discussions are in Section 2 Section 2 "Operating the VS C-15 Leak Detector via Front Panel Display".
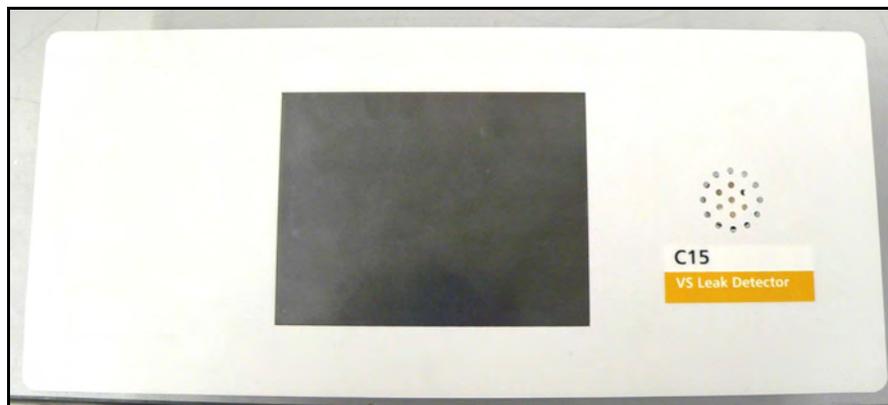
Figure 1-5   VS C-15 Display Front Panel

The VS C-15 Displays touch panel is calibrated at the factory and should not require recalibration. If the touch panel buttons do not respond to pushes, recalibrate as follows:

1. Turn off the leak detector power.

2. Press and hold the center of the touch panel and restart power. A blue screen appears.

3. Press the four cross hairs on the screen and accept the calibration.

1.4.2.1 LCD Display

Represents:

❏ Leak Rate - in a Bar Graph format with a numeric range indicator

❏ Leak Rate, System Status and Parameters - in alphanumeric format

❏ Series of **screens** with the soft key buttons for operator interface.

Leak Rate Bar Graph   The large bar graph displays the leak rate in one of three forms:

❏ A linear bar graph

❏ A logarithmic bar graph

❏ Both linear and logarithmic bar graphs

Use the Output Control Set-Up screen (Section 6.3.5 "Output Control" on page 6-10) to change the type of bar graph that appears.

Over-range and under-range conditions are indicated using two up and down arrows on the right and left side of the bar graph, respectively.

Leak Rate, Pressure, System Status and Parameters in alphanumeric format:

❏ Leak Rate/Pressure is presented in a scientific notation: XXE-YY with appropriate units. Where:

❏ X .X mantissa is a leak rate/pressure value

❏ E- Y = 10-YY exponent is a leak rate/pressure range

❏ X and Y are any numbers from 0 to 9

❏ System Status and/or Mode are represented in alpha format on the screen and an *italic* font in this manual.

❏ Parameters are represented on the screen in alphanumeric format and a **bold** font in this manual.

Pressures Bar Graph   The small bar graph displays the Test Port Pressure in the logarithmic format.

Series of screens with the soft key buttons for operator interface. An operator interfaces the leak detector functions through a series of screens, which are navigated as shown in Section 2.2.1 "Screens Flow" on page 2-6.

Speaker   Provides an audio indication of the leak rate.

1.5 Rear Panel

1.5.1 VS C-15 Base Unit

The rear panel of VS C-15 Base Unit with an optional ProfiNet-I/O Module is shown in Figure 1-6.
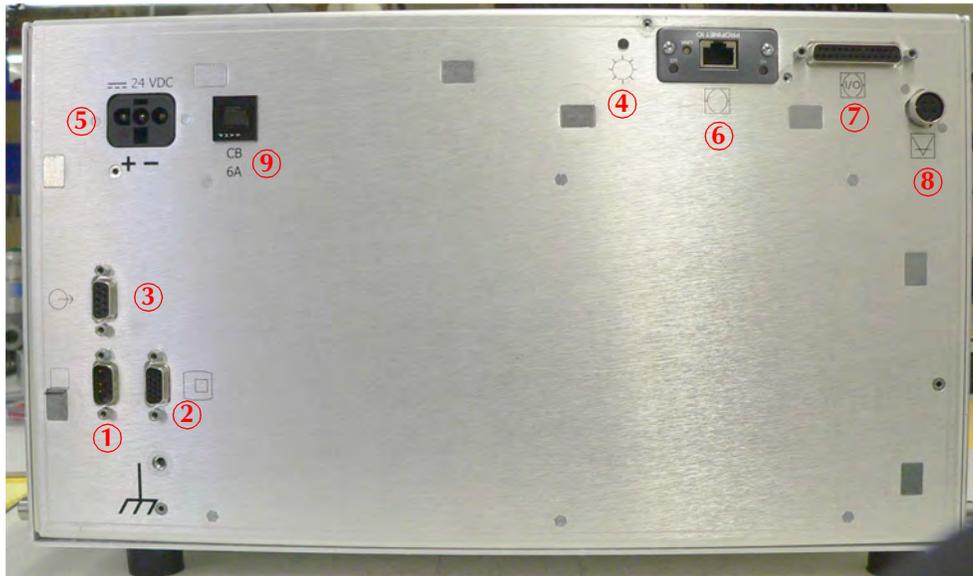
Figure 1-6   VS C-15 Base Unit Rear Panel

Table 1-2 gives the rear panel pin assignments and descriptions.

Table 1-2   Base Unit Rear Panel Components

Name	Description
DIAGNOSTIC ①	A 9-pin male D-type connector to interface with an external PC via RS-232 type communications protocol for system diagnostic or control. A detailed summary of information related to serial communication is provided in Section 4 "RS-232 Interface and Operation" on page 4-1.
REMOTE DISPLAY ②	A 15-pin female High Density HDP-22 connector to interface with an optional VS C-15 Component Display unit via a standard 15 –pin High Density, Male/Female cable.
Analog Output ③	A 9-pin female D-type connector for an Isolated Leak Rate Analog reading. Signal range: From 0 to +10 VDC.

Table 1-2   Base Unit Rear Panel Components (Continued)

Name	Description
POWER ④	Green LED light indicates 24 VDC ON
Power Entry Module ⑤	Provides 24 VDC supply power connection and EMI protection for the VS C-15 Base unit. The Power Entry Module consists of: DC Power Input Connector - three-prong grounded Inlet connector that is compatible with the Molex's HCS-125 Receptacle, P/N 03-12-1036 10 A EMC line filter
INDUSTRIAL NETWORK ⑥	A slot for an optional ProfiNet –IO module. If the module is not installed, the slot is closed by a *blind* slot-cover. ProfiNet-IO module's RJ45 8 X 8 (Ethernet) connector to interface with a ProfiNet industrial network via a standard industrial Ethernet cable. A detailed summary of information related to ProfiNet-IO communication is provided in Section 5 "Profinet Interface and Operation" on page 5-1.
DISCRETE I/O ⑦	A 25-pin female D-sub connector to interface with an external PLC via a parallel cable.
CONVECTORR GAUGE ⑧	A 4-pin female RM12 –type connector to interface with a ConvecTorr vacuum gauge.
CB 6 A ⑨	Thermal circuit breaker for the VS C-15 Base unit electronics.
Product Label	A product label with part number, serial number and rating information.
Chassis (Earth) Terminal	Provided for additional connection of the leak detector to the building grounding system to improve ESD protection.
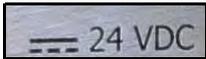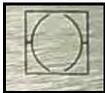
1.5.2 VS C15 Display Unit

The rear panel of VS C15 Display Unit is shown in Figure 1-7.

Figure 1-7   VS C-15 Component Display Unit Rear Panel

Table 1-3 gives the rear panel pin assignments and descriptions.

Table 1-3   Display Unit Rear Panel Components

I/O Connector	A 15-pin male High Density HDP-22 connector to interface with an VS C-15 System unit (RS-232 PX/TX signals and 24 VDC power). 10' cable comes with display.
Product Label	A product label with part number, serial number and rating information.

1.6 Features

The VS C-15 leak detector has the following options that can be added to the VS C-15 Base unit:

❑ Remote Display Option: a VSC15DU, Display Unit, and 10-foot long standard High Density 15-pin D-Sub M/F Cable

❑ External Power Supply unit, VSC15PS: an DIN-rail type universal AC-DC power supply:

    ❑ Input: (100-230) VAC ±10%

    ❑ Output: 24 VDC, 5 A

❑ External 24 VDC power cable for the power supply connection to the VS C-15 System unit

❑ Internally mounted, temperature compensated standard calibrated leak module for internal calibration of the leak detector in all ranges from E-03 to E-09 std-cc/sec He

❑ 10' cable for connecting a ConvecTorr vacuum gauge with the VS C-15 Base unit (25-foot also available)

❑ ProfiNet -IO module to interface with the ProfiNet industrial network via an Ethernet connection.

The features for the VS Series VS C15 leak detector are provided in Table 1-4. Ordering information is given in Table 6-4 on page 6-5.

Table 1-4   VS Series VS-C-15 Features

Feature	Description
Calibration	Fully automated tuning and calibration using the internal or external calibrated leak.
	Agilent's patent-pending electronic calibration system provides precise and fast calibration across the entire leak range with one standard leak.
	Specialized software permits you to calibrate to internal or external leaks and provides a range of set point functionality.
	You must provide a suitable *test valve* to control vacuum pressure upstream of the VS C15 Base unit.
	Customers have the option for connecting an external helium leak or air-tuning leak on the vacuum lines of their system for external calibration. In this case, the customer controls activation of all the valves required for correct spectrometer tuning, zeroing, and calibration**.**
Dynamic Range Specification	You can select leak rate ranges from E-03 to E-09 std-cc/sec He via ProfiNet, RS-232 or touch screen.
	See Table 1-5 for the ranges displayed by the VS C-15 Display unit.
	The internal calibration will always be done using an E-07 range leak with the VS C-15 electronics compensated to achieve precise sensitivity for a given working range. The orange shaded column indicates the recommended helium calibration decade for each working range when customers are performing external calibration via system PC or PLC.
Zero Control	Selectable mode background elimination with a Zero Enable feature (Control Panel).
Leak Indication	A bar graph (linear or log) displays leak rates automatically; alphanumeric indication on LCD display. A leak can also trigger an audible alarm that varies in proportion to the size of the leak, dedicated volume control and programmable audio threshold. Analog voltage is proportional to the leak rate.

Table 1-4   VS Series VS-C-15 Features (Continued)

Feature	Description
Pressure Indication	An optional ConvecTorr gauge can be installed on the customer system and connected to VS C15 Base unit via a dedicated rear panel CONVECTORR GAUGE connector.
	The gauge can be installed in the turbo pump fore line to indicate fore line pressure on the optional VS C-15 Display unit, or may be installed in the customer system and used to activate a pressure set point, either via VS C15 software or via I/O interface for external process control in customer software.
	If a gauge is installed, the VS C-15 will display the vacuum pressure reading on the optional display screen.
	If a gauge is not installed, that area of the displays screen is blank.
	If a gauge is installed, the pressure can be displayed in either analog or digital mode. In digital mode, the numeric value appears. In analog mode, the bar graph appears.
	Two standard gauge cables are available in lengths of 10 and 25'. Special lengths can be ordered up to 100' in length.
Multilanguage Support	The VS C-15 Display supports English, German, Spanish, French, Korean, Mandarin (Chinese), Kanji (Japanese). Words are displayed with appropriate characters while numerical values are displayed using 1, 2, 3… for all languages. Go to the LANGUAGES screen to select the language you wish to display
Spectrometer	Sensitivity optimized design, header mounted ion source with dual thoria-coated iridium filament, a high sensitivity, wide dynamic range preamplifier, and total pressure gauge.
Discrete I/O Control	This provides 12 outputs and 8 inputs lines, optically isolated, to control the VS leak detector using an external PLC via a 25-pin DB25 female connector

Table 1-5 gives the Dynamic Range Specification by range.

Table 1-5   Dynamic Range Specification

Displayed Ranges	-3	-4	-5	-6
Maximum Test Pressure / Crossover Pressure = 5 Torr				
Turbo Speed = 80K RPM				
Displayed Ranges	-4	-5	-6	-7
Maximum Test Pressure / Crossover Pressure = 5 Torr				
Turbo Speed = 60K RPM				
Displayed Ranges	-5	-6	-7	-8
Maximum Test Pressure / Crossover Pressure = 1 Torr				
Turbo Speed = 41500 RPM				
Displayed Ranges	-6	-7	-8	-9
Maximum Test Pressure / Crossover Pressure = 1 Torr				
Turbo Speed = 33K RPM				
	Recommended External Calibration Range			

Section 2. Operating the VS C-15 Leak Detector via Front Panel Display

This section defines how to navigate and operate the VS C15 component leak detector via the optional front panel display.

Before an initial startup verify that:

❑ VS C-15 Base unit is connected to the user leak detection vacuum system via a single NW25 flange

❑ Optional VS C-15 Display unit connected via a standard High Density 15-pin D-Sub M/F Cable

❑ VS C-15 24 VDC Power Cable (P/N# VSCBUPC8) with a Molex, HCS-125, Socket Receptacle, P/N 03-12-1036 is connected to the user-provided 24 VDC, 5 A min, power supply with a local branch 10 A Power Switch/Circuit breaker

❑ A suitable *Test Valve* and the optional ConvecTorr gauge to control vacuum pressure upstream of the VS C-15 System unit is provided

❑ The optional ConvecTorr gauge is connected to VS C-15 via the *CONVECTORR GAUGE* connector

> **NOTE**
>
> *If a gauge is installed, it must be activated via the display (Section 6.3.1 "Advanced Parameters" on page 6-4) or via RS-232 (Section 4 "RS-232 Interface and Operation"). Gauge status can verified using the Advanced Parameters screen or via RS-232 (SERVICE2 command or ?TCGAUGE command).*
>
> *If a gauge is not installed, it must be deactivated via the display or RS-232 to avoid a System Not Ready condition.*

❑ One of several communications control interfaces is utilized via a computer (RS-232), PLC (Parallel Discrete I/O) or Industrial Network (an optional ProfiNet-IO module).

> **NOTE**
>
> *For troubleshooting information see Section C "Troubleshooting" on page C-1.*

2.6.1 Power Up Sequence

The power up sequence is:

1. 24 VDC is applied to the VS-C15 and the turbo pump ramps up to the programmed RPM value for the selected working range. During this time the system is not ready.

2. The turbo RPM is satisfied when the *Turbo Ready* signal is transmitted.

3. The filaments are checked for emission:

   ❑ If no emission is detected for either one of the filaments, the appropriate status flag is generated.

   ❑ If emission is present the stabilization process begins:

      ❑ Cold Start - Stabilization starts upon successful filament emission and at that time the system background is monitored. The stabilization timer is set for 15 minutes and at that time if the system background is not at a satisfactory level, the turbo pump ramps up to full speed (80K RPM) for 5 min to expedite the cleanup process. During the remainder of stabilization time, if the background cleans up to an acceptable level, the timer is disabled and the *System Ready* indication appears.

      ❑ Normal power on/off cycles – In normal power interruptions, the system background is typically within acceptable limits and the stabilization cycle times out almost immediately or after a short time delay, except when the system has been exposed to large Helium gross leaks.

2.1 Initial Startup and Shutdown

2.1.1 Startup

To start the VS C-15 leak detector:

1. Plug the 24 VDC power cable into the 24 VDC inlet on the VS C-15 Base unit rear panel.

   Move the local branch power switch/circuit breaker in the **ON** position.

2. Verify that the POWER indicator, a green LED, on the VS C-15 Base rear panel is ON and VS C-15 Display LCD goes ON after about 10 seconds.

NOTE   *Table 2-1 describes the startup scenario for the display screen.*

Table 2-1   VS C15 Startup Scenario

System Startup Function	Front Panel Display
Power up unit: 24 VDC	
Turbo ramps to programmed RPM	*System Pressure Wait* *System Not Ready*
Turbo reaches programmed RPM Filaments 1 & 2 are checked and selected filament activates	*Filament Wait* *Stabilization Wait* *Offset Wait* (countdown timer is displayed and is active)
System background and turbo bearing temperature are measured. If these parameters meet the startup limits the 15 minute stabilization timer stops or times out.	*Test*

Refer to Section 2.2.5.1 "Calibration Set-Up Screen" on page 2-23 to properly set-up the leak detector for auto-calibration.

NOTE   *If the system was recently calibrated before shut down, it can be used for qualitative testing. Read the standard leak to verify accuracy. For more accurate quantitative leak values, perform a calibration 30 minutes after start-up.*

To accurately read in the most sensitive decades of each working range, perform a full internal or external calibration after a 20-30 minute warm up.

The VS C15 Base unit is always in Test/Measurement mode.

2.1.2 Calibrated Leak

2.1.2.1 Internal calibration via the Front Panel Display

Perform an internal calibration (if installed) to verify that the leak detector is functional and is ready for testing

> **NOTE**
>
> !
>
> *Verify that the correct information for the internal calibrated leak has been entered in the Maintenance screen, which is found in the Set Up Menu.*

Action: Isolate the leak detector from the test system.

1. From HOME screen press **MENUS > CALIBRATION SET-UP** calibrate with **> Internal Leak.**

2. Press **Control Panel** on the HOME screen and the Control Panel appears.

3. Press **Calibrate** and the following messages appears on the display:

    Calibration Prep
    Offsetting
    Std Leak Prep
    Calibrating
    Zeroing
    Test

4. Press **CONTROL PANEL > STD LEAK > HOME** and verify that the VS C15 Base unit reads the Calibrated Leak correctly. The VS C15 Base Unit performs an automated FULL internal calibration to the optional installed Calibrated Leak.

2.1.2.2 Full External Calibration via the Front Panel Display

Manual full external calibration *(Tune, Offset, & Ext. Calibration)*

Select and program the desired working range and external calibrated leak value prior to calibration. Perform a full external calibration to verify that the leak detector is functional if an internal calibrated leak is not installed.

1. Vent the leak detection test system and then install a calibrated leak into the system test port.
2. From HOME screen press **MENUS > CALIBRATION SET-UP** calibrate with > external leak **<VALUE>** buttons. External leak value key pad screen appears. Enter the external Calibrated Leak value and press **OK** to return to CALIBRATION SET UP screen.
3. Press **EXTERNAL LEAK.**
4. Press **Done > HOME**.
5. Place the leak detection test system in the Test/Measurement mode with the external calibrated leak open.
6. Press **Control Panel** on the HOME screen and the Control Panel appears.
7. Press **TUNE** to perform an automated tuning calibration.
8. When tuning is complete, cal leak is off (isolated); press **OFFSET**.
9. When the offsetting is complete, turn the cal leak on; press **CALIBRATE**.

The VS C15 Base unit performs the Fast automated calibration of the leak detection system to the external Calibrated Leak.

NOTE *The order of Tune and Offset is optional.*

The following messages appears on the display:

Tuning
Offsetting
Calibration Prep
Calibrating
Test

2.1.3 Shutdown

The VS C-15 Leak Detector can be in any mode when shut down.

To shut down the VS C-15 leak detector:

❑ Disconnect VS C-15 24 VDC power cable from the inlet on the VS C-15 System unit, or
❑ Move the local branch Power switch/Circuit breaker to the **OFF** position.

2.2 VS C-15 Display

The optional VS C-15 Display unit with Touch Panel is used for the initial set-up and configuration of the VS C-15 leak detector. Once the leak detector is set up and configured for a specific application, basic operation is controlled by primarily utilizing one of several communications control interfaces: PC, PLC or Industrial ProfiNet network.

2.2.1 Screens Flow

The operator interfaces the VS C-15 leak detector functions through a series of screens and soft key buttons, which are navigated as shown in Figure 2-1.
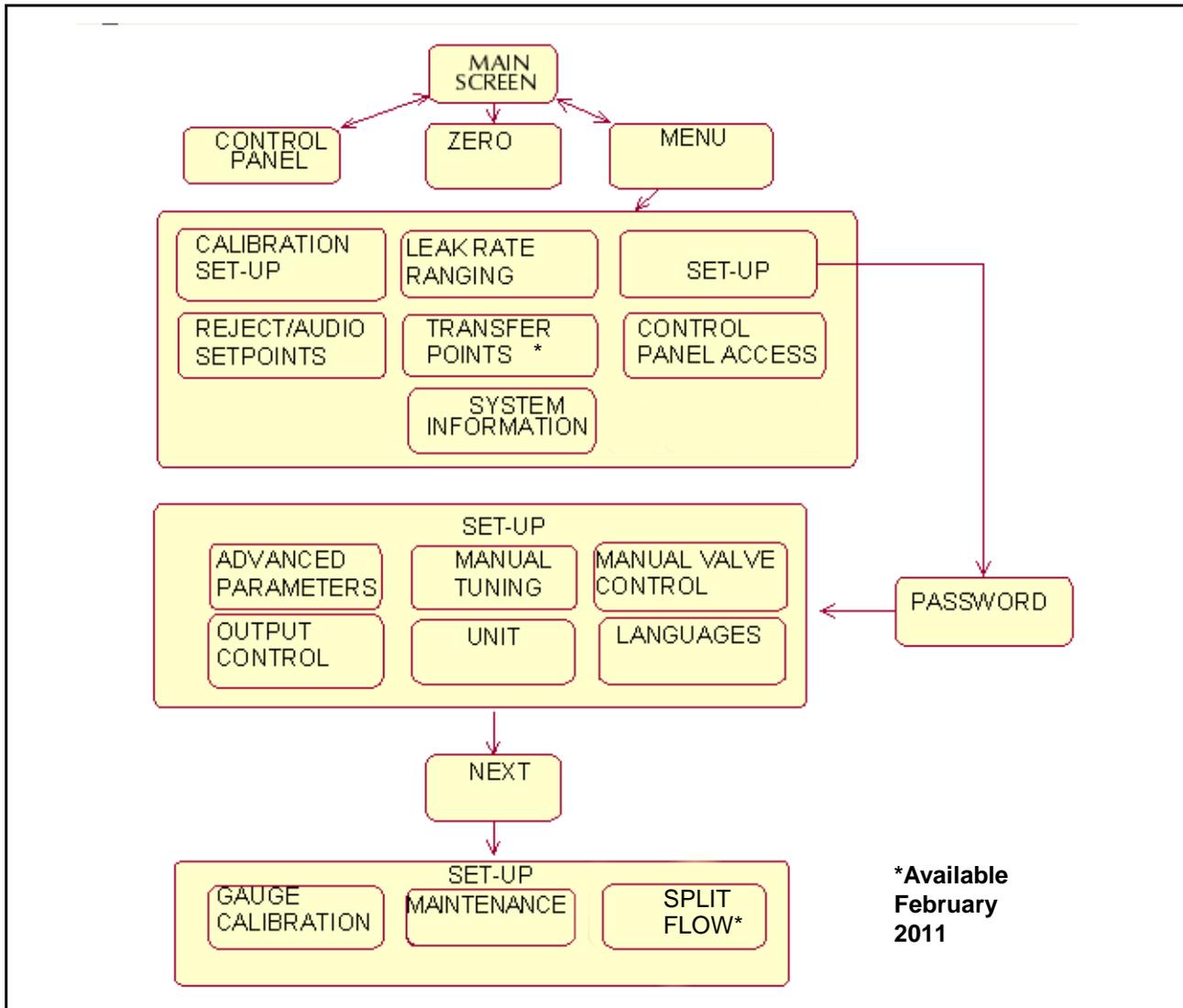
Figure 2-1   Screen Flow

Table 2-2   General Description

Screen	Purpose
HOME	Accesses the Control Panel and Menu screens. Activates the Zero function. The LED illuminates while zeroing occurs.
Control Panel	Activates/deactivates: ❑ Std Leak ❑ Offset ❑ Tune ❑ Calibrate ❑ Zero Enable Displays the type of leak: Internal or external, associated with Calibrate. Enables the leak rate vs. time graphic display Adjusts the speaker volume.
Menus	Accesses the following screens for tailoring leak detector operation: ❑ Calibration Set-Up – Configures leak type, mode and parameters (Section 2.2.5.1 "Calibration Set-Up Screen" on page 2-23). ❑ Reject & Audio Set Points – Configures parameters and toggles operations on/off for each reject set point for both pressure and leak rate and for the audio threshold (Section 2.2.5.2 "Reject and Audio Set Points Screen" on page 2-25). ❑ Transfer Points with Stabilization Wait Timer - Configures the transfer points wait timer (Section 2.2.5.3 "Transfer Points with Stabilization Wait Timer" on page 2-28). ❑ Leak Ranging – Configures the Range Stop, Manual Range values, and range of operation (Section 2.2.5.4 "Leak Rate Ranging Screen" on page 2-29). ❑ System Information – Displays the status of configured and active items (Section 2.2.5.5 "System Information" on page 2-32). ❑ Control Panel Access – Panel Lockout. ❑ Set-Up - Accesses all the screens shown in Section 2-6 "First Menu Screen" on page 2-22.

Table 2-2   General Description (Continued)

Screen	Purpose

Set-Up	Accesses the following screens:
	
	❑ Advanced Parameters
	   ❑ Activates Autozero<0, Activates Optional Internal Calibrated Leak, and Activates Optional Vacuum Gauge with Analog or Digital display mode.
	❑ Output Control – Configures the Analog Output and Bar Graph default units (Section 6.3.5 "Output Control" on page 6-10).
	❑ Manual Tuning:
	   ❑ Toggles between Filament 1 and 2.
	   ❑ Sets Emission, Ion and Gain settings (Section 6.3.3 "Manual Tuning Procedure (Internal or External Standard Leak)" on page 6-8).
	   ❑ Units – Configures Leak Rate and Pressure units (Section 6.3.6 "Units" on page 6-11).
	❑ Manual Valve Control – Displays Vacuum System schematic and allows access to control Internal Calibrated Leak valve (if installed). Displays:
	   ❑ Calibrated leak temperature.
	   ❑ Turbo pump bearing temperature, RPM and operational hours. (Section 6.3.4 "Manual Valve Control" on page 6-9).
	❑ Languages – Configures language (Section 6.3.7 "Languages" on page 6-12).
	❑ Gauge Calibration – Calibrates the Test Port Vacuum and Test Port ATM reference points and displays Test Port Pressure and Spectrometer Pressure (Section 6.3.8 "Gauge Calibration" on page 6-13).
	❑ Maintenance – Configures
	   ❑ Date and Time (Section 6.3.9.1 "Date & Time Set-Up" on page 6-17)
	   ❑ Cal Leak Expiration and Internal Calibrated Leak values (Section 6.3.9.3 "Cal Leak Expiration Set-Up" on page 6-20 and Section 6.3.9.2 "Internal Calibrated Leak" on page 6-18)
	❑ System Defaults:
	   ❑ Displays Turbo and filament hours of operation.
	   ❑ Restore Factory Defaults - resets all calibrated leak values and information, and reject setpoints and other programmed items.
	❑ Split Flow:
	   ❑ One time setup to properly characterize the test system to an external calibrated leak.

2.2.2 Basic Soft Button Functions

Table 2-3 explains the basic on-screen functions used to enter or manipulate values.

Table 2-3   Basic Soft Button Functional Items

Item	Function
● CALIBRATE	Using the **Calibrate** button as an example, LEDs light when the button is selected and activated.
DONE	Press **Done** to exit a screen.
8.6E-07	Using a leak value as an example, press the value button and a keypad appears for entering values.
EXTERNAL LEAK VALUE: ATM-CC/SEC 5.0E-9 [1] [2] [3] [4] [CLEAR] [5] [6] [7] [8] [CANCEL] [*] [9] [0] [-/+] [OK]	Using External Leak Value as an example, these keypads appear wherever values are entered. Enter the values with the keypad and press **OK**. The keypad values are dictated by the data required on the parent screen. For example, if entering a leak rate value, the system places an *E* or - sign in for the exponent. Press: ❑ **Clear** to clear the display. ❑ **Cancel** to close the keypad screen without saving. ❑ **OK** to close the keypad and save.
	Appears on screens more than one level from the HOME screen. Press this button to return directly to the HOME screen.
▲ ▼	Used to increment/decrement values.
OK	Saves all values on the screen and exits to the next higher screen.
◀ ▶	Moves you between menu selection screens when there is more than one screen of choices.
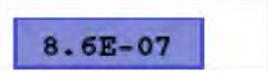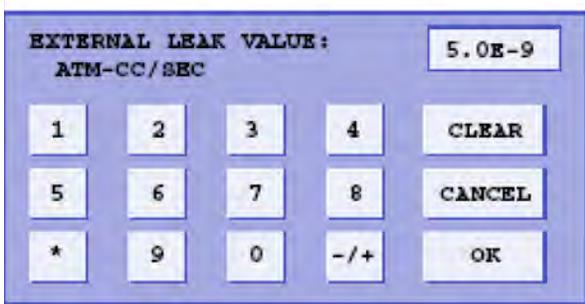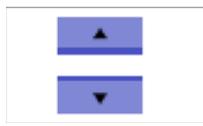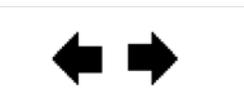
Table 2-4 explains the icons that appear on various screens and their meaning.

Table 2-4   On-Screen Icons

Icon	Meaning
	Indicates that the system is controlled by the I/O.
	Indicates a feature is locked.
	❏ Indicates the status of the internal calibrated leak: ❏ A FLASHING calibrated leak symbol appears. ❏ Lets you know that the calibrated leak is going to expire, this message begins to appear 10 days prior to the expiration date. ❏ A steady calibrated leak symbol appears, BLUE in color. ❏ Lets you know that the calibrated leak has expired per the date put into the system at the *Internal Calibrated Leak* set-up screen. ❏ A steady calibrated leak symbol appears, RED in color. ❏ Lets you know that the calibrated leak temperature sensor has failed or is disconnected
	Indicates a turbo pump fault. Turbo pump (Manual Valve screen). If flashing red on Home screen this indicates a turbo failure.
	Indicates that a valve is open. A red filled circle indicates the valve is failing.
	Indicates there is a valve fault.
	Indicates that a valve is closed.
	Selects a graphical representation (xy graph) of leak rate versus time.
	ConvecTorr gauge
	Numerical representation of the ConvecTorr gauge pressure.
	Bar graph representation of the ConvecTorr gauge pressure.

2.2.3 HOME Screen

The HOME Screen is displayed on Power-Up with delay about 10 seconds.

The HOME Screen displays the leak rate in the linear and log bar graph and digital format, a summary of the leak detector status and configuration settings:

Linear Bar Graph   **Log Bar Graph**
Digital Leak Rate Display   Test Port Pressure

Leak Detector Status (Table 2-Condition Indication (Table 2-
5 on page 2-13)   6 on page 2-14)
Reject Status Indicator

Control Panel button   **Menus** button   **Zero** button

Two soft key buttons, **Control Panel** and **Menus**, give access for changing the leak detector configuration (Figure 2-2).
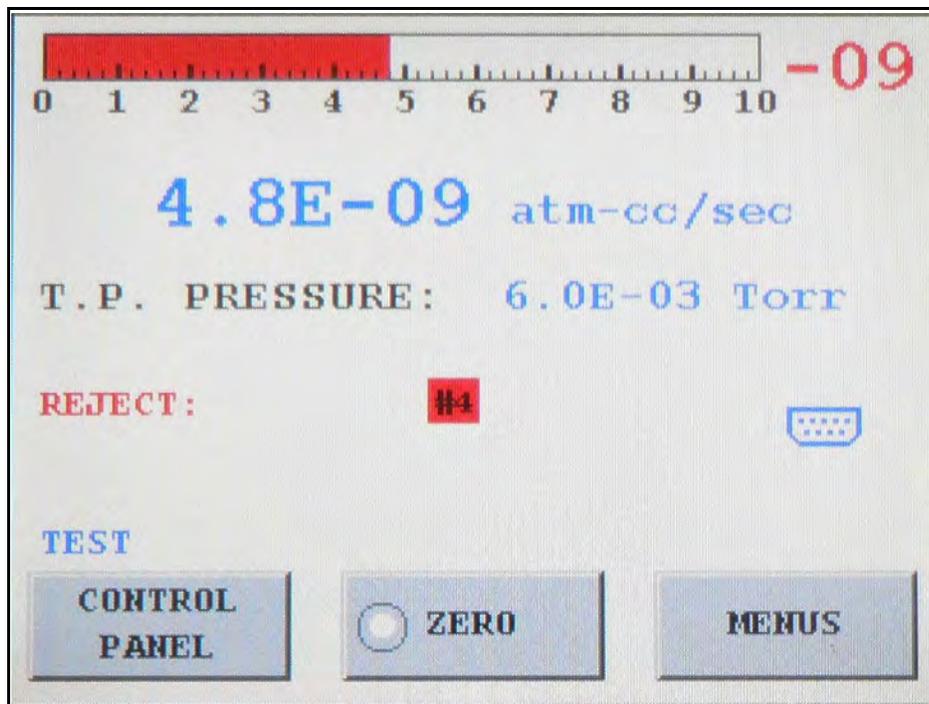
Figure 2-2   HOME Screen

Linear Bar Graph   Displays one decade of the leak rate reading in linear mode and
Display   range exponent in digital format

Log Bar Graph Display   Displays full range of the leak rate reading in logarithmic mode

Digital Leak Rate	Correlates (Figure 2-2) directly with the log bar graph leak rate display. The units for the measurements are selected on the Units Set-Up screen (see Section 6.3.6 "Units" on page 6-11).
Test Port Pressure	Appears on the HOME screen and represents the test port pressure as measured by a ConvecTorr gauge mounted in the customer leak detection test system. The pressure transducer and associated electronics ensure that the VS C-15 transfers into Test at or less than the recommended transfer pressure. The test port pressure can be displayed in numerical value (digital mode) or in a bar graph (analog mode)
Leak Detector Status	Appears above **Control Panel** soft key button and indicates the current leak detector operating state. The normal operating states are detailed in Table 2-5 on page 2-13
Leak Detector Condition	Appears above the Leak Detector Status and indicates the current leak detector condition during abnormal conditions. See Table 2-6 on page 2-14 for a list of leak detector conditions.
Reject Status Indicator	Reject Set Points appear above the Leak Detector Condition on the left-hand center of the HOME screen when any of the four independent set points are enabled and activated. ❑ Rejects are highlighted in red boxes and displayed in the proper order and location as shown above. ❑ The red boxes will flash ON and OFF while active to make them stand out and be more obvious to the operator.
Control Panel	**Control Panel** soft key button, when pressed, opens the Control Panel screen (Section 2.2.4 "Control Panel Screen" on page 2-16).
Zero	**Zero** soft key button zeroes out the helium leak indicated on the display. When **Zero** is pressed or requested by a PLC, it sets the indicated leak rate to *0* while displaying the previous background for 2 seconds. The **Zero** LED lights while zeroing is taking place. The **Zero** button is only active while the leak detector is in the test state and causes the leak detector to reset the leak rate display. The leak detector automatically subtracts the recorded background signal to display only the real leak rate.

*Pressing **Zero** while introducing helium tracer gas to the test object or while the helium background is varying significantly could result in the suppression of a real leak. Only use the **Zero** button after the helium tracer gas source has been removed or Helium background is stable.*

The Zero capability allows the testing of sensitivity levels that are below the system background. This feature also reduces test cycle times by reducing the amount of time required for background levels to naturally clean up or by allowing testing to begin at relatively high test pressures. It is recommended that only two decades of signal be zeroed out.

Menus   Menus soft key button, when pressed, opens the Menus screen (Section 2.2.5 "Menus Screen" on page 2-22).
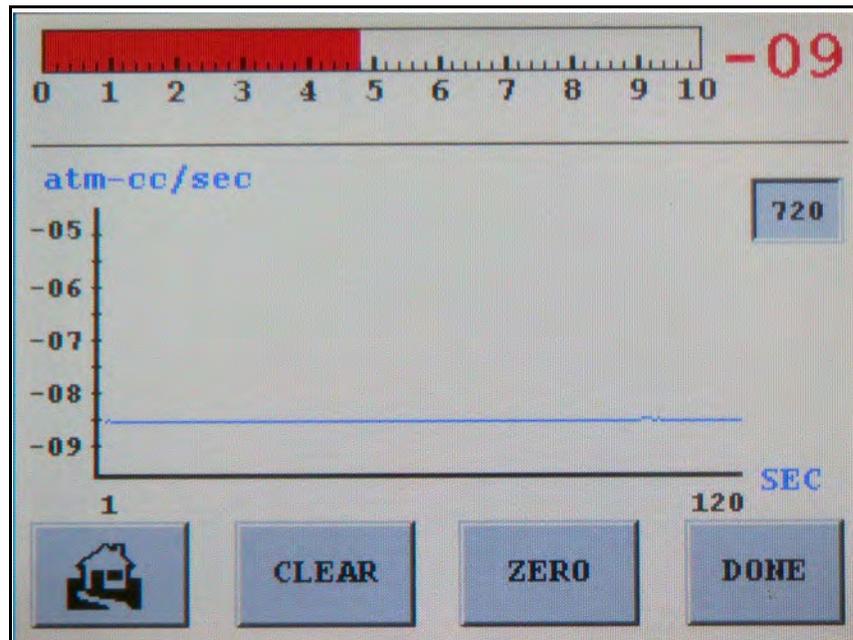
Figure 2-3   Leak Rate vs. Time Screen

Table 2-5   VS C-15 Leak Detector Operating States

Display	Description
CALIBRATING	Indicates that the leak detector is currently performing a Internal or External Calibration Sequence.
TUNING	Indicates that the leak detector is adjusting the ion voltage to find (move) the peak He signal.

Table 2-5   VS C-15 Leak Detector Operating States (Continued)

TEST	Indicates that the leak detector is in Test mode. When in Test mode the leak detector is ready for leak testing.
Reject	Reject followed by a flashing red number indicates that a reject setpoint has been activated.
STD LEAK	Indicates that the optional internal calibrated leak standard valve is open and that the leak detector is reading the Standard Calibrated leak value.

Table 2-6   Leak Detector Condition States

	Indicates that both filament 1 and filament 2 of the ion source burnt out
Calibration Prep	Indicates that the leak detector is preparing for a Full Internal Calibration sequence.
Filament 1 NO EMISSION	Indicates that filament 1 of the ion source has no emission due to the Filament 1 is not lit or no ion source voltages. Filament 2 automatically lights if it is still good and the voltages are OK, and a flashing C appears in the leak rate exponent, indicating that a calibration sequence is required.
Filament 2 NO EMISSION	Indicates that filament 2 of the ion source has no emission due to the Filament 2 is not lit or no ion source voltages Filament 1 automatically lights if it is still good and the voltages are OK, and a flashing C appears in the leak rate exponent, indicating that a calibration sequence is required.
FILAMENTS NO EMISSION	Indicates that both filaments, No. 1 and No.2, of the Ion Source not lit or burnt out and/or no ion source voltages
Filament Wait	Indicates that the leak detector is lightning the filament
Flashing C On Exponent Display	Indicates that the leak detector requires calibration.
Gain Too High	Indicates that the gain value required to calibrate the leak detector during the Calibration/Tuning sequences is greater than the maximum allowable value: ❑ Internal Calibration: Gain > 9.0 ❑ External Calibration: Gain > 150 This is generally the result of system sensitivity being too low.
Gain Too Low	Indicates that the gain value required to calibrate the leak detector during the Calibration sequence is less than the minimum allowable value (Gain < 0.1). This is generally the result of a system leak.
No Ion Peak	Indicates a tuning failure due to the leak detector is not detecting an ion peak during the tuning sequence due to a weak He source or signal.

Table 2-6   Leak Detector Condition States (Continued)

Offset Wait/ Offsetting	Indicates that the leak detector is setting the Offset value.
Spec-Tube	Flashes red when the spectrometer pressure > 1.0E-4 Torr.
Stabilization Wait	Indicates that the leak detector is waiting for the electronics to stabilize before completing the startup sequence; up to two and a half minutes. A count down display indicates time left.
Std Leak Prep	Indicates that the system is preparing to turn on the standard leak. The process consists of turning off the filament and opening the standard leak, followed by a time delay and the filament is turned on.
Switching Filaments	Indicates that the leak detector is momentarily in the process of switching from one filament to another as a result of manual selection or a NO Emission failure. NO Emission filament to the next available filament.
System Pressure Wait	During Start up indicates that the turbo is not yet up to speed and that the (spectrometer) pressure is too high to light the ion source filament.
System Not Ready	Indicates that the leak detector is NOT READY: Turbo is not ready (< programmed rpm) and the filament is not active.
Zeroing	Indicates that the leak detector is in the process of Zeroing out a background signal. The Zero routine is initiated automatically during the startup and calibration routines, or manually when the operator presses the Zero button on the HOME screen.

2.2.4 Control Panel Screen

1. Press **Control Panel** on the HOME screen.

   The Control Panel screen appears (Figure 2-4).
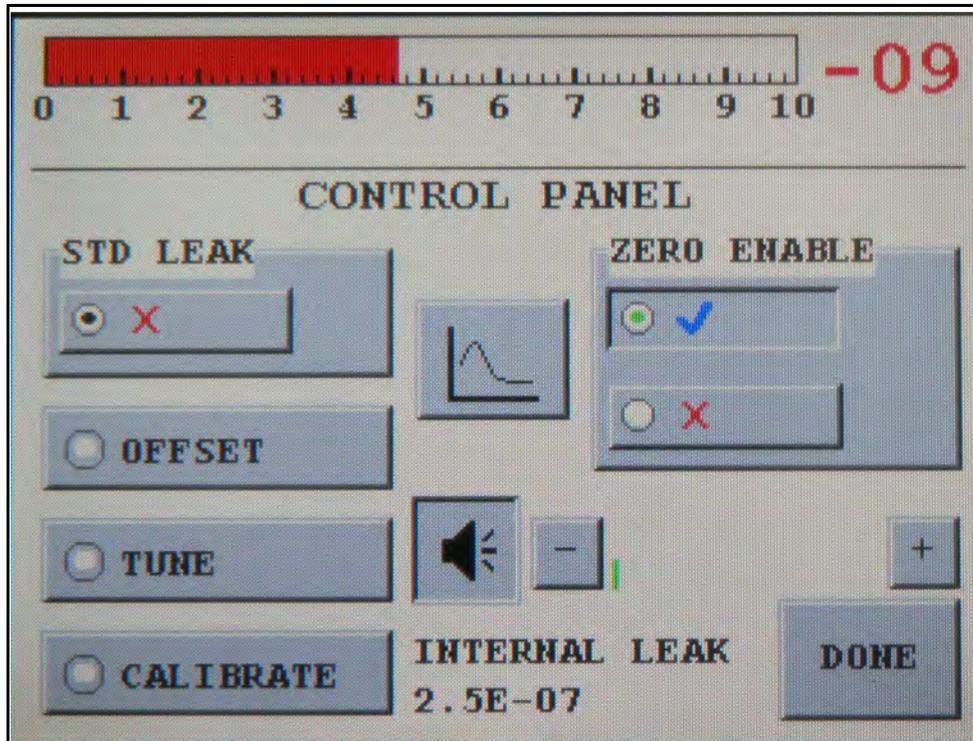
Figure 2-4   Control Panel

Std Leak

The **Std Leak** soft key button opens the standard leak valve so the leak detector can see an optional internal calibrated Leak if it is installed. The leak detector must be isolated from test system. The Std Leak button is blanked out if the option is not installed.

The **Std Leak** button is only functional while the leak detector is TEST mode and activates the internal calibrated leak, allowing verification of the system calibration. When the leak detector is in Std Leak mode, Std Leak message appears on the HOME screen.

The **Std Leak** button exposes the internal calibrated leak to the spectrometer. This compares the displayed leak rate value to the calibrated leak value on the System Information screen to verify proper leak detector operation.

Because the test port is isolated from the fore pump in this mode, a slight increase in test port pressure may be indicated on the test port pressure display.

Offset

The **Offset** soft key button establishes the baseline zero reference point in the absence of Helium. The leak detector must be isolated from test system.

Tune

The **Tune** soft key button initiates the Tuning sequence to peak ion voltages for maximum Helium signal

This feature tunes to helium utilizing a user-provided air leak or calibrated helium leak located on the user system. The sequence is similar to that used in the full internal calibration: scan the ion voltage for maximum sensitivity, but the system is not zeroed and the gain is not calculated.

Calibrate

If the calibration is set to run with internal calibrated leak, The Calibrate soft key button initiates the Full Internal Calibration sequence.

The leak detector must be isolated from test system.

This feature calibrates the leak detector to the preset internal calibrated leak found in the calibration set up menu.

The Calibrate LED lights while calibration is taking place.

Automated calibration is performed based on the parameters set on the Calibration Set-Up screen (Section 2.2.5.1 "Calibration Set-Up Screen" on page 2-23).

The sequence of events is:

❑ The leak detector exposes the internal calibrated leak to the spectrometer

❑ The ion voltage is scanned to find the peak helium signal.

❑ The leak detector notes the leak rate reading, turns the internal calibrated leak off and zeroes the system.

❑ A gain is calculated from the leak rate reading to make the signal match the value of the calibrated leak and returns the leak detector to Test mode.

If the calibration is set to run with the external calibrated leak, the Calibrate button initiates the External Calibration, which calculates the gain (system sensitivity factor) only. The following sequence must be run before initiating the External Calibration if no internal calibration was performed or if the internal calibrated leak option is not installed:

Pre-External Calibration Sequence:

❑ Expose the leak detector to an external calibrated leak (test and external calibrated valves open)

❑ Select **Tune**

❑ Isolate the leak detector from test system (test and external calibrated valves closed)

❑ Select **Offset**

❑ Select **Zero**

If an internal calibration was performed, it is not necessary to perform a tune.

Zero Enable	The **Zero Enables** soft key buttons turn on or off the zeroed out background. This feature excludes the background leak from the leak rate signal.
	Helium background represents helium that is in the system but does not come from the part under test. If the background is zeroed out, a more accurate measurement of the leak rate of the part is determined. If **Zero Enable** is turned ON, the background is excluded; if it is turned OFF, the system displays the full helium signal, including total background.
	If **Zero Enable** is turned ON in the display screen, discrete I/O pin 16 is inactive.
Audio Volume Control	❑ Pressing the **Speaker** button turns ON/OFF audio. On power down, the volume level and the audio (ON/OFF) is saved so that when the leak detector is turned on again the volume level and the audio (ON or OFF) state is the same as prior to power down
	❑ Pressing on the +/- buttons adjusts the volume up and down.
	If the +/- b[uttons are pressed and held for 2/3 seconds auto repeat will trigger, this feature will continue to increase or decrease the volume level.
	When the leak rate bar graph display is set to Linear mode:
	❑ The audio signal increases from a low to high frequency as the leak rate increases within each decade.
	❑ The pitch cycles low to high as it passes through each decade. The audio response corresponds directly to the size of the leak.
Internal/External Leak <Value>	Indicates the current calibration type which is set in the Calibration Set-Up screen (Section 2.2.5.1 "Calibration Set-Up Screen" on page 2-23).
Graphical Display	The **Graphical Display** soft key button opens the Leak Rate Graph screen.

2.2.4.3 Graphical Display Screen

The graphical display screen (Figure 2-5) represents the leak rate over time. The graphing line appears in blue and changes to red when a reject set point is triggered.
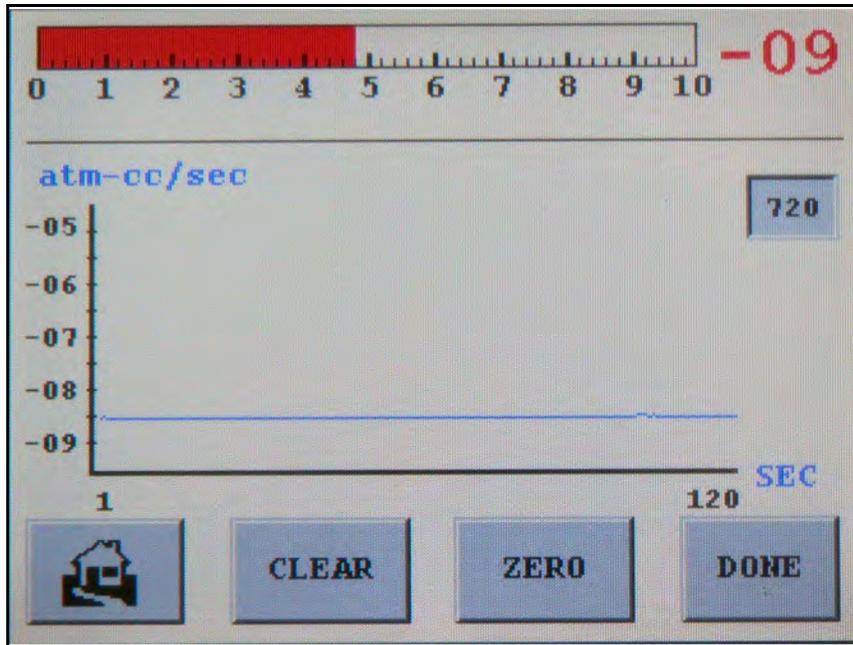
Figure 2-5   Graphical Display

Timer	The **Timer** soft key button toggles the graphing time between 120 and 720 seconds.
	The timer automatically defaults to 120 seconds on the leak detector power -up.
	Press the **Timer** button while graphing to toggle the timing scale and clear the current graph.
	The data rate for the timers are:
	❑ 120 seconds - two measurements per second
	❑ 720 seconds - one measurement per three seconds.
Clear	The **Clear** soft key button clears the plotted graph. The graph automatically clears when the leak detector start of a new test.

Zero

The **Zero** soft key button zeroes out the displayed helium leak.

This button causes the leak detector to reset the leak rate display, while the graph tracks the effect of the Zero command.

Pressing Zero while introducing helium tracer gas to the test object, or while the helium background is varying significantly, could result in the suppression of a real leak. Only use the Zero button after the helium tracer gas source has been removed or IO is stable.

The Zero capability allows the testing of sensitivity levels that are below the system background. This feature also reduces test cycle times by reducing the amount of time required for background levels to naturally clean up or by allowing testing to begin at relatively high test pressures. It is recommended to zero out only two decades of signal.

2.2.5 Menus Screen

Press **Menus** on the HOME screen. The Menus screen appears (Figure 2-6). Use the arrow to navigate to the previous screen.

The Menus screen consists of buttons to access the lower level screens used for application-specific configuration.
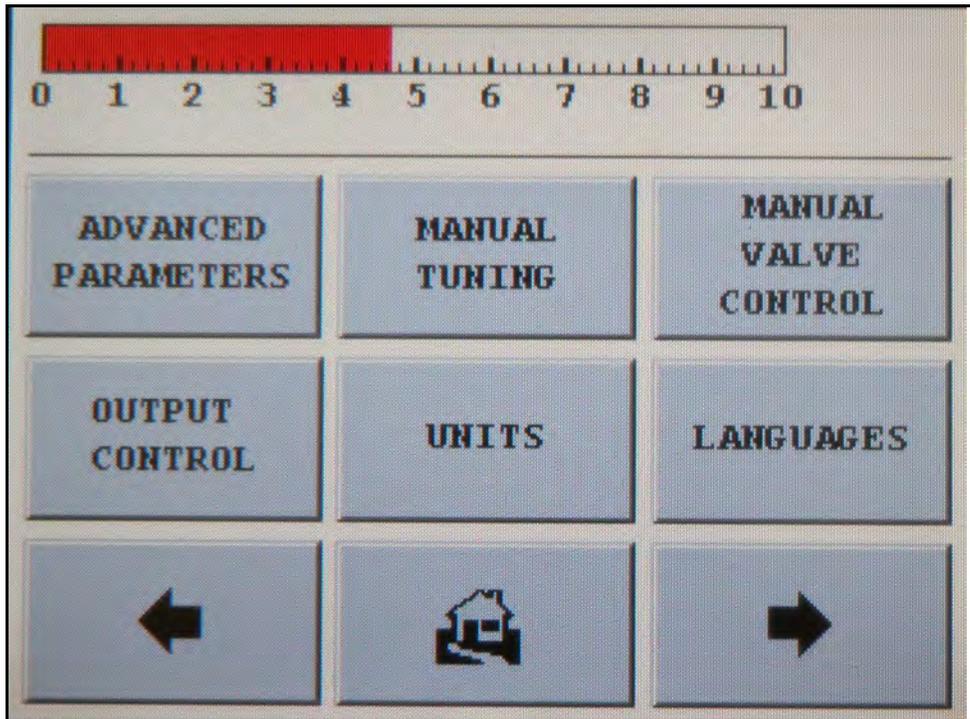
Figure 2-6   First Menu Screen

2.2.5.1 Calibration Set-Up Screen

❑ Press **Calibration Leak Set-Up** on the Menus screen.

The Calibration Set-Up screen appears (Figure 2-7). Use this screen to:

❑ View the value and expiration date of the Internal Calibrated Leak

❑ Enter the External Calibrated leak value

❑ Select whether to use an Internal or external calibrated leak
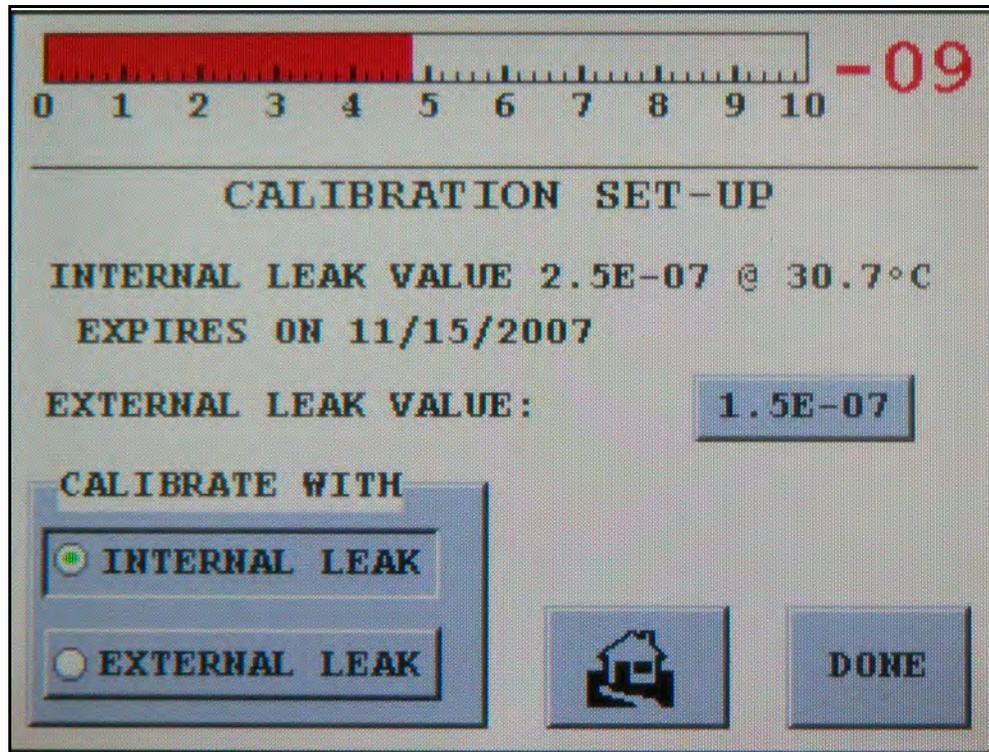
Figure 2-7   Calibration Set-up Screen

NOTE *If the internal calibrated leak option is not installed, the internal leak value and expiration date is grayed out and the internal leak selection is inactive.*

Internal Leak Value   An optional calibrated helium leak can be installed inside the leak detector unit and used to perform a FULL INTERNAL CALIBRATION of the leak detector. The temperature-compensated internal leak value and expiration date appear to the right of the Internal Leak Value text if this option is selected. The actual Internal Leak Value and Expiration Date can be modified using the Internal Calibration Leak screen, which is located in the *Maintenance* screen.

External Leak Value | The <**Value**> soft key button allows you to configure and display an external leak value:
- Press **EXTERNAL LEAK**
- Press the **VALUE** to the right of the External Leak Value text. The Data Entry Pad screen appears.
- Enter the leak value and press **OK.**

Calibrate With | The *Calibrate With*: *INTERNAL LEAK* or *EXTERNAL LEAK* soft key buttons allow you to select which leak, internal or external, the system uses when running a calibration.

Internal Calibration: Is a full calibration routine, consisting of tuning, zeroing and calculating and applying the gain.

External Calibration: A fast calibration routine consisting of calculating and applying the gain.

Two types of the external leaks can be used for the calibration of the leak detection system:

- *Tuning Leak*
The tuning leak is a customer-supplied air leak that permits ambient helium to the spectrometer for tuning. Adjust the tuning leak for a foreline pressure from 5E-1 to 1 T. Once activated with the TUNE command the ion voltage is scanned for peak helium sensitivity. The absolute value of the leak rate is not indicated on the display.

- *External Calibrated Leak*
The external leak is a customer-provided calibrated helium leak located on the customer system used to perform an EXTERNAL FAST CALIBRATION to adjust system gain (equivalent to adjusting PLC machine factor). To set up an external leak, press the Value button to the right of the EXTERNAL LEAK VALUE text. Using the Data Entry Pad enter the value of the leak and press **OK.**

Data Entry Pad Operation | The data entry pad is a pop up screen, which appears when any value box is pressed. The data entry pad function corresponds to the data being entered. For example, in the case of entering the value 123, that value appears on the screen and accepted when OK is pressed. In the case of entering a leak rate value, the system knows when to place an *E* or - sign for the exponent.

- When **CLEAR** is pressed, the display is cleared out

- When **CANCEL** is pressed, the data entry pad screen will disappear and the value to be changed will remain unchanged.

The data entry pad is also used for the Password Screen.

2.2.5.2 Reject and Audio Set Points Screen

Reject and Audio Set Points makes the acceptance and rejection of parts more obvious. By creating a set point, you let the leak detection system indicate if the part meets specification or not. Example: Selecting and activating Reject Set point #1 for LEAK RATE and setting the reject activation to be greater than (>), which implies that the reject set point activates when the leak rate is above that set point value. When the system is put into TEST, the leak detector indicates that the part has not meet the set point requirement until the leak rate settles below the set point value and then the set point failure indication disappears.

Multiple set points are used when you want to indicate several levels of acceptance. There are times when you may want to assure the leak detector is working properly by bounding the failure limit. For example, if LEAK RATE #1 were set as per above, then any leak rate below 1.0E-8 would pass the part. Also assume that the leak detector was not seeing helium, it would always pass parts. One way of preventing this from happening is to periodically read the external or optional internal calibrated leak if installed. Another way is to place a calibrated leak within the working decade of the given range into the test port and program a second reject set point to fail if the leak detector were to go below that value. In that case, you would program a leak rate set point (typically a decade less than the reject setpoint) matching the value of the calibrated leak and set the reject activation < and turn the set point ON. In this case, when the system is put into TEST, the system indicates a failure if the leak rate goes below the reference calibrated leak setpoint value.

❏ Press **Reject & Audio Set Points** on the Menus screen.

The Reject and Audio Set Points screen appears (Figure 2-8 on page 2-26). Use this screen to:

❏ Set the parameters to enable or disable.

❏ Display or change the value of the four reject set points and the audio set point.
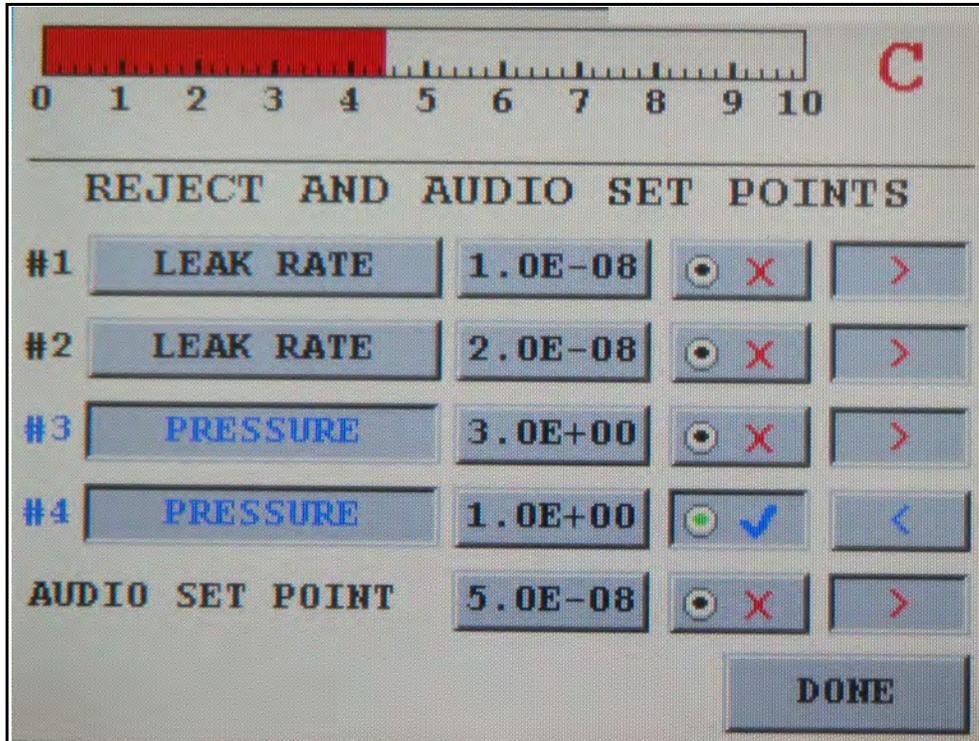
Figure 2-8   Reject and Audio Setpoints

Reject Set Points

❑ There are four possible reject set points in Figure 2-8 on page 2-26:

❑ Each set point can be programmed to operate around leak rate or test port pressure (if an optional ConvecTorr gauge is installed) by pressing the button, which will toggle between LEAK RATE and PRESSURE.

❑ Change the values of the four Reject Set Points by following the Data Entry Pad Operation above. Data is in units specified by the *Units* screen.

❑ Set points may be turned ON or OFF (enabled or disabled) for each set point

❑ Each reject set point is set to activate above or below the programmed value. To activate the reject set point

❑ Above the programmed value, select >.

❑ Below the programmed value, select <.

Active reject set points cause Reject to appear on the HOME screen along with the number of the reject set point that has been activated, which blinks to highlight the reject. The status of the reject set points is also available through the RS-232 line (see Section 4 "RS-232 Interface and Operation" and Section 5 "Profinet Interface and Operation" on page 5-1).

NOTE

❏ *Pressure setpoints are always monitored, regardless of system status.*

❏ *Leak rate setpoints are always monitored while the leak detector is in Test mode.*

Audio Set Point

Settings:

❏ **On**: The audio tone rate increases proportionally with each decade that the measured leak increases above the set point (leak rate pass/fail specification). The audio volume control is located on the Control Panel (see Section 2.2.4 "Control Panel Screen" on page 2-16).

❏ **Off**: The audio sounds for all leak rates above zero (see Section 2.2.5.4 "Leak Rate Ranging Screen" on page 2-29).

Set points may be turned ON or OFF (enabled or disabled)

When the Audio Set Point is OFF, audio sounds for all leak rates above zero (see Section 2.2.5.4 "Leak Rate Ranging Screen" on page 2-29).

When the audio set point is ON, audio sounds only for leak rates above the audio set point.

To configure reject set points and the audio set point:

1. Press the blue check for the Reject Set Point.

2. Press the value button associated with the set point.

    The data entry pad appears.

3. Enter the set point and press **OK**.

4. Press the < or > soft key to select whether the reject   setpoint activates above or below the programmed value.

5. Press the blue check for the Audio Set Point

6. Press the value button associated with the audio set point. The data entry pad appears.

7. Enter the set point and press **OK**.

2.2.5.3 Transfer Points with Stabilization Wait Timer

❑ Press **Transfer Points** on the Menus screen. The Transfer Points screen appears (Figure 2-9). Use this screen to set the Stabilization Wait.

NOTE *This feature is available February 2011.*
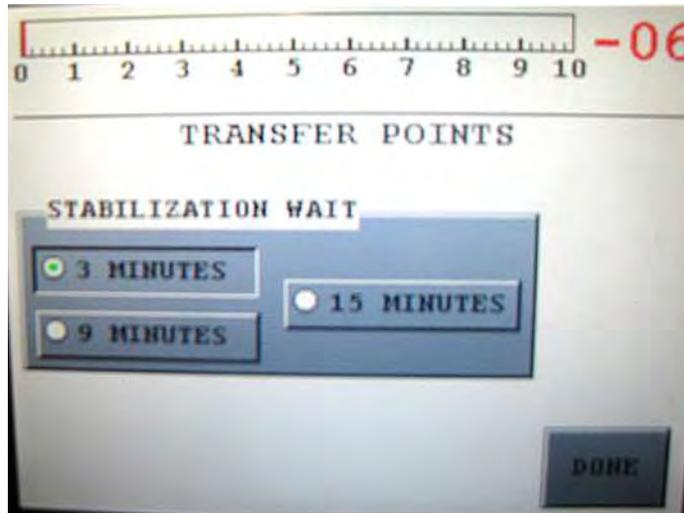
Figure 2-9   Transfer Points with Stabilization Wait Timer

Stabilization Wait
This appears on the Home screen after a successful startup. This timer is necessary for the spectrometer stabilization and degassing.

The factory default is three (3) minutes. It is highly recommended, if you power off the leak detector overnight, over a weekend, or expose the leak detector to aggressive applications, to select the 9 or 15 minute selection.

2.2.5.4 Leak Rate Ranging Screen

1. Press **Leak Rate Ranging** on the Menus screen.

    The Leak Rate Ranging screen appears (Figure 2-10). Use it to setup and enable the Range Stop and Manual Range functions and *Range* of operation (working decades of operation).
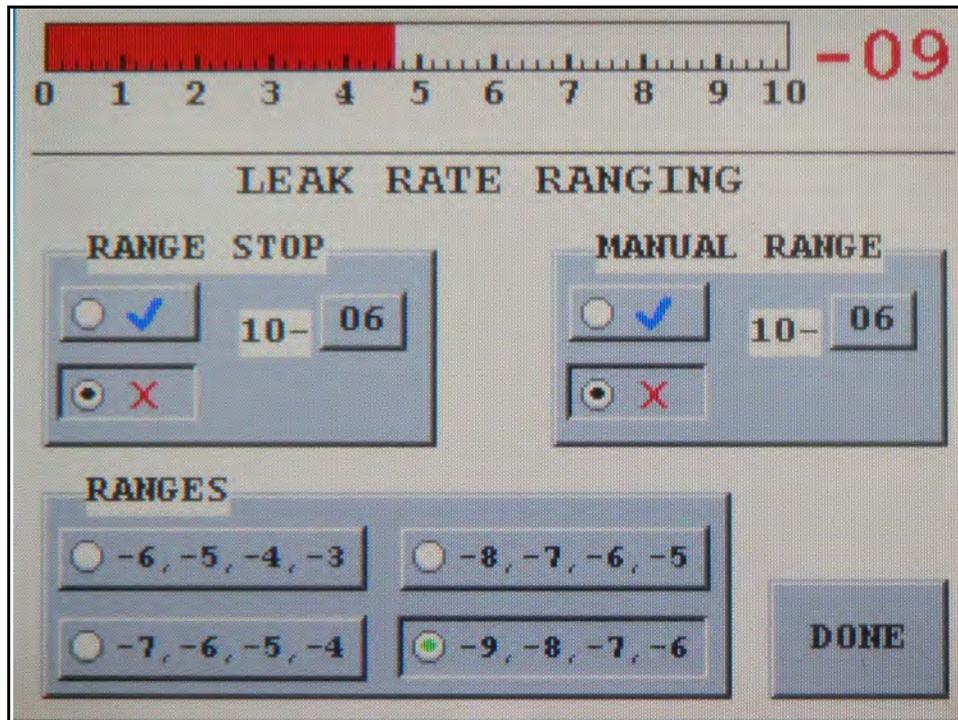
Figure 2-10   Leak Rate Ranging

NOTE

Select desired working range and VS C-15 sets required internal operating parameters.

Range Stop

When in Auto-Ranging (Manual Range is turned OFF), the system ranges down to the decade selected in the RANGE STOP box. To activate, select Range Stop ON and select the decade in which you want the system to stop when it pumps down. Select the range by following the Data Entry Pad Operation above. Range Stop will calculate and activate automatically upon completion of an external calibration with a system gain >10.

Configures the leak detector so that it only auto-ranges down to the pre-selected decade entered in the Range Stop variable field. For example, if range stop was enabled and the range stop setting was 1E-7, the most sensitive range that the leak detector would displays is full scale 1E-7 atm cc/sec. To allow auto-ranging to the maximum sensitivity of the system, turn Range Stop Off.

This feature is useful when a product specification is more than one decade less stringent than the actual sensitivity of the leak detector. If the leak detector is capable of displaying full scale < 1E-9 atm cc/sec, but the test specification is only in the 1E-7 atm cc/sec range, then setting the range stop to 1E-8 atm cc/sec would reduce the test cycle time by eliminating the need for the leak detector to reach its most sensitive scale during each test cycle.

Manual/AutoRange	To read out one fixed decade, select Manual Range ON (Range Stop is turned OFF) and select the decade in the Manual Range box by following the Data Entry Pad Operation above.
	Range Stop and Manual Range are not allowed to both be **ON** at the same time!
	Configures the leak detector so that it only displays the pre-selected decade entered in the manual range variable field. For example, if the manual range feature was enabled and the manual range variable was set to 1E-6, then the leak rate decade displayed on the LED bar graph during testing would be the 1E-6 atm cc/sec range only. This feature is useful when the concern is only with monitoring the leak rate measurement within a single decade.
Range Selection	Customer selects a desired top range. There are four available top ranges and each range covers four decades.
	The correct turbo speed and A/D gain is adjusted accordingly.
	-6, -5, -4, -3
	-7, -6, -5, -4
	-8, -7, -6, -5
	-9, -8, -7, -6

To configure the leak rate range stop:

1. Press the Range Stop blue check button.

2. Press the associated Range Stop Value button. The data entry pad appears.

3. Enter the value and press **OK** to save the value.

To configure manual leak rate ranging:

1. Press the Manual Range blue check button.

2. Press the value/exponent button associated with the Manual Range. The data entry pad appears.

3. Enter the value and press **OK** to save the value.

2.2.5.5 System Information

❑ Press **System Information** on the Menus screen.

The System Information screen appears (Figure 2-11 on page 2-32).

The system information screen shows the current status of various settings within the system as well as the software version information. Table 2-7 on page 2-32 describes the displayed system information in detail.
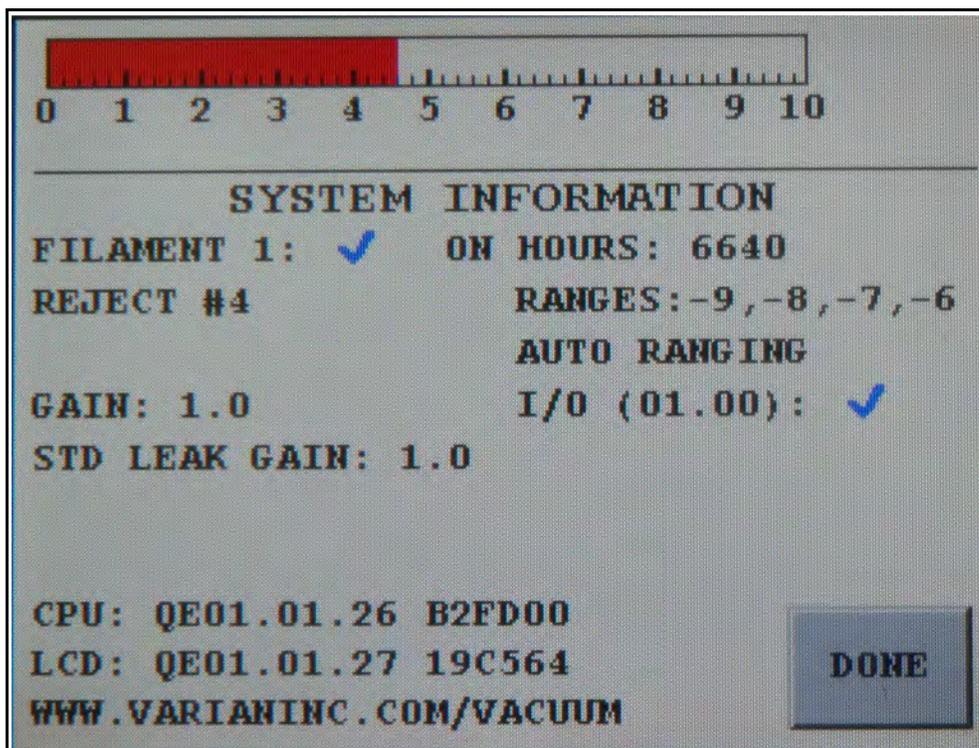
Figure 2-11   System Information

Table 2-7   System Information Display Detail

Display	Description	Action
Active Filament	Shows which filament (**1** or **2**) is **Active**	To change the filaments, go the MENUS SET_UP MANUAL TUNING screens
Active Reject Set points	Shows the enabled reject set points and those that are turned on in the system	To change which set points are active, go to the MENUS REJECT AND AUDIO SET screens
Audio Set Point Status	Shows the status of the audio set point if **ACTIVE**.	To change the status of the audio set point, go to the MENUS REJECT AND AUDIO SET screens

Table 2-7 System Information Display Detail (Continued)

Display	Description	Action
Gain:	Shows the external calibration gain value.	The actual helium signal is multiplied by the gain value to read the correct calibrated leak rate value
Standard Leak Gain	Shows the internal calibration gain value.	Displayed, if the optional Internal Standard Calibrated Leak is installed.
ON HOURS	Shows the current used filament ON elapsed time	
RANGES: [-W, -X, -Y, -Z]	Shows the currently selected sensitivity range	To change the sensitivity range, go to MENUS LEAK RATE RANGING screens
Ranging Selection: Rate Ranging screen.	Shows either the **AUTO** or **MANUAL** ranging	To change the selection, go to the Leak MENUS LEAK RATE RANGING screens
I/O (0x.xx)	Shows the SW version of the Discrete I/O-ProfiNet PCB An *X* or check mark appears if the I/O or parallel enable is active.	Displayed if the optional Discrete I/O-ProfiNet PCB is installed
Software Version and Agilent Web site	Shows the software version of: CPU PCB (L version) of the VS C-15 System unit Display (D version) of the Optional VS Component Display unit. Agilent web address for customer use.	See the back cover of this manual for a listing of our sales and service offices

2.2.5.6 Control Panel Access

❑ Press **Control Panel Access** on the MENUS screen.

The Control Panel Access screen appears (Figure 2-12. Use it to enable the VS Component Display lockouts.
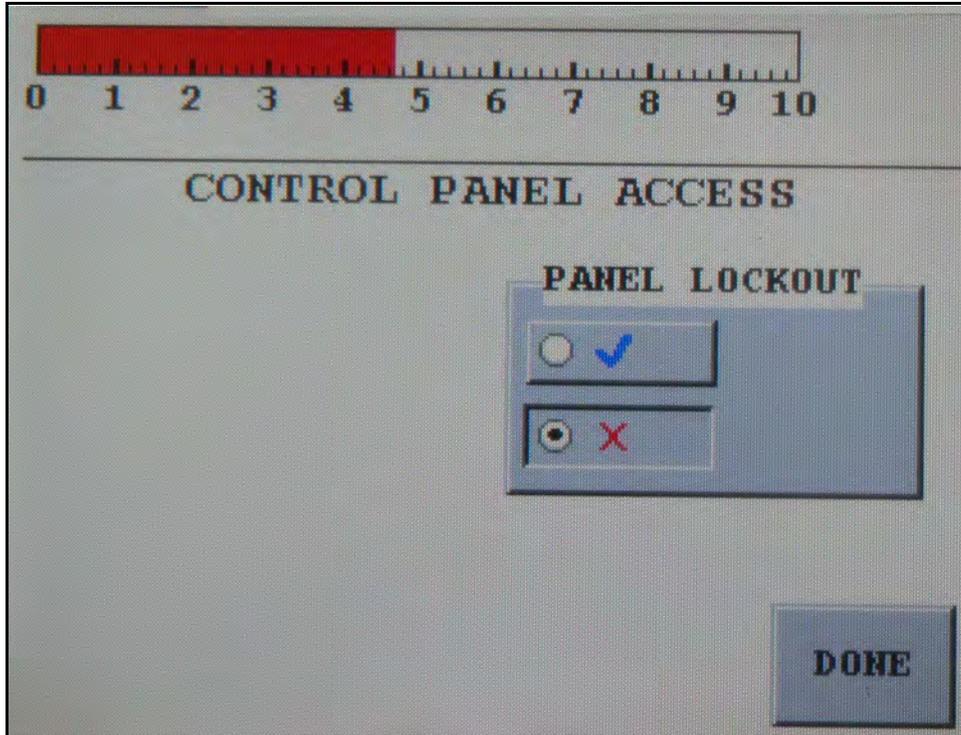
Figure 2-12   Control Panel Access

Panel Lockout   Disables the access to the Control Panel screen. This is primarily used while the system is under PC or PLC control.

2.3 Set-Up Menu

The Set-Up menu screen contains the soft key buttons for functions that deal with VS C-15 leak detector performance, tuning, and maintenance issues. All sub-screens below this level have a **HOME** button that returns the program directly to the HOME screen.

> **CAUTION**
>
> *The items configured using the Set-Up sub-screens significantly affect the performance of the leak detector and must only be accessed by trained service personnel.*
>
> *Many of the values for the parameters included on the Set-Up sub-screens are calculated when the leak detector performs functions such as Calibrate and tuning. Changing these values can cause unreliable test results.*

1. Press **Set-Up** on the **Menus** screen to open the Initial Set-Up screen.
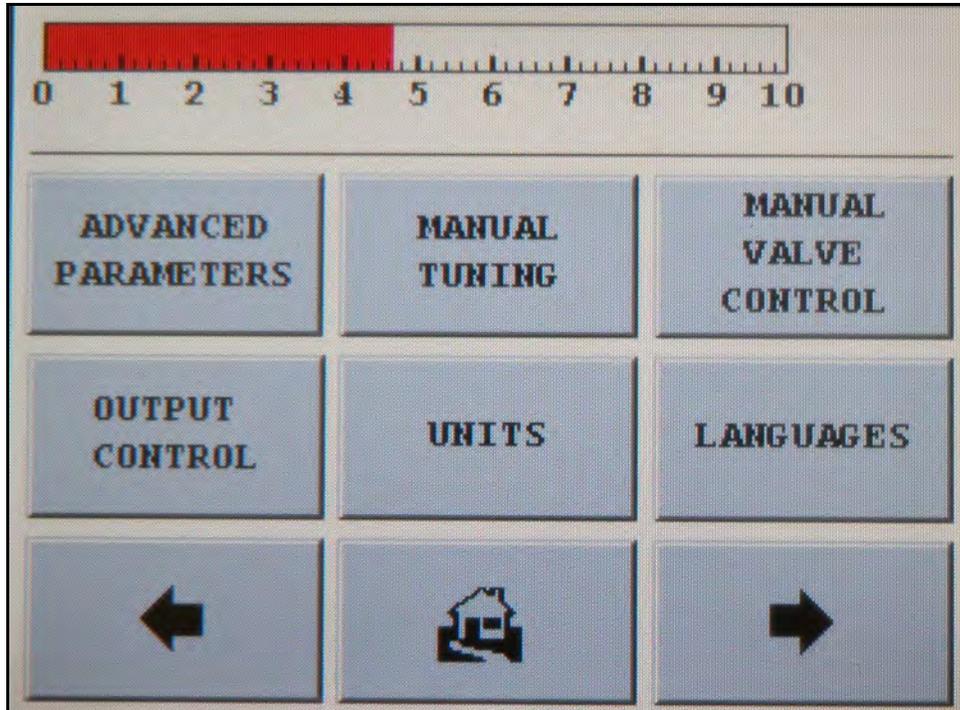
Figure 2-13   Set-Up Screen Initial

❑ When the **Set-Up** is pressed, a Password screen appears if the password function is ON.

Figure 2-14 Password Protection Screen

❑ If the password function is OFF, no Password request appears.

To access the Password change mechanism or to turn the feature ON or OFF, access the **Maintenance** screen

2. Press the right arrow soft key button and the second Set-Up screen appears:
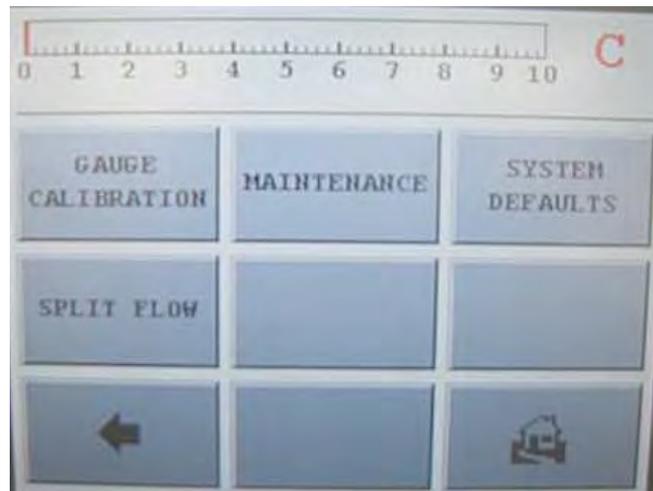
Figure 2-15 Set-Up Screen – Second

3. Press **Maintenance** on the second Set-Up screen to access the password change mechanism and enable or disable the password feature (see Section 6.1 "Daily Maintenance" on page 6-4).

The password can also be read off the RS-232 connector.

See the following sections for these screens (all accessed from the Set-Up screen):

2.3.6 Advanced Parameters

1. Press **Advanced Parameters** on the Set-Up screen and the Advanced Parameters screen appears (Figure 2-16).

   Use this screen to configure the Auto-Zero < 0, Std Leak and TC action.
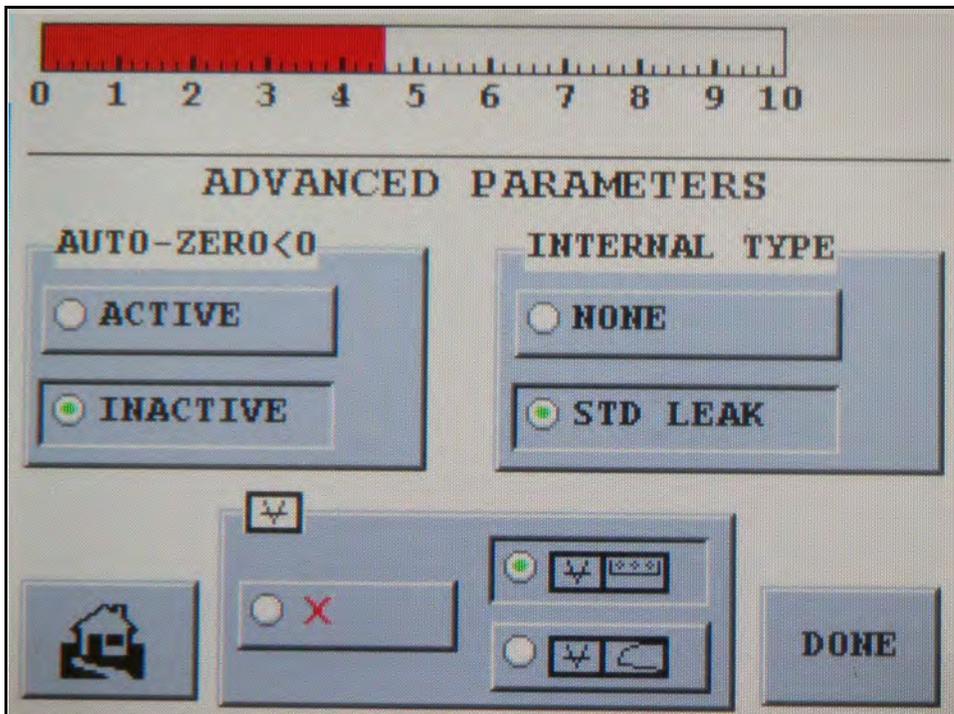
Figure 2-16   Advanced Parameters Screen

Activating **Auto-Zero<0**

The AUTO ZERO<0 feature is enabled or disabled by checking the appropriate **Active** or **Inactiv**e soft key button.

When ACTIVE, in the event that the leak rate becomes less than that which the bar graph can display, the *zero point* is lowered such that the current leak rate is zero.

The default is inactive. In order to properly utilize this feature, the system integrator must activate the function via the RS232 while in test and de-activate via the RS232 prior to venting for the next test piece.

When INACTIVE, the leak detector does not automatically adjust the zero reference point when the helium background level drops below the previously set zero reference point. In this condition, a leak less than the previously set zero value is not indicated by the system. Instead, the arrows remain lit, indicating that the background level is below the previously set zero reference point. Press **Zero** on the on the HOME screen to readjust the zero reference point manually. This clears the lights.

Vacuum Gauge This window enables activation/deactivation of the optional ConvecTorr vacuum gauge. Use the gauge to program C15 pressure points for test system process control. The gauge status is factory preset if a gauge and cable are purchased with the C15. The button with the red x turns the gauge on/ off. The buttons to the right select an alpha-numeric display (upper button) or logarithmic bar graph display (lower button) of the vacuum pressure. If no gauge is installed, the button must be turned off.

Internal Type This feature activates an Internal Standard Calibrated Leak, if the optional internal helium leak is installed in the VS C-15 System unit

2.3.7 Manual Tuning

1. Press **Manual Tuning** on the Set-Up screen and the Manual Spectrometer Tuning screen appears (Figure 2-17).

   Use this screen to manually adjust the parameters of the ion source in the spectrometer for a maximum helium signal.

   NOTE

   To view the calibration gain for the last successful internal standard leak calibration, the internal calibrated leak must be activated. Values are illustrated in blue, or otherwise black for external calibration gain.
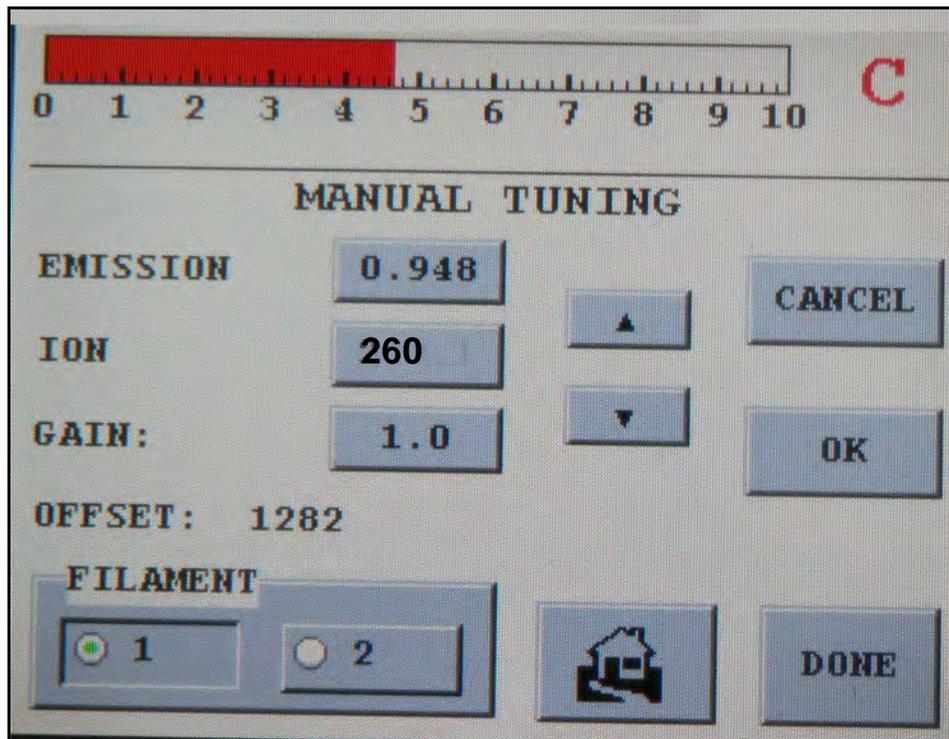
Figure 2-17   Manual Tuning Screen

Emission Current   Displays the value of the existing Emission current of the spectrometer Ion Source and allows for emission current adjustment. The emission current parameter tunes the leak detector, maximizing the leak detector output for a peak helium signal.

Typical Emission current values range from 0.6 mA to 1.2 mA.

Ion Voltage   Displays the current ion voltage value of the spectrometer Ion Source. The ion voltage parameter tunes the leak detector, maximizing the leak detector output for a peak helium signal.

Typical ion voltage values range from 250 VDC to 270 VDC.

The ion voltage value is automatically adjusted and set during the full calibration routine.

Filament   Switches between Filament 1 and 2.

The filament selection can be performed manually, but occurs automatically if the current operating filament burns out or has no emission.

If a filament burns out or has no emission the output signals of the Discrete I/O connector:

❑ READY/TEST_OUT, CAL_ INT_OUT_OK or CAL_ EXT_OUT_OK go LOW
❑ FIL_1 status or FIL_2 status_go HIGH
❑ In the event that either or both filaments have no emissions, the leak detector will report the condition on the HOME screen.

A calibration routine is recommended every time the operating filament is changed.

The filament change appears on the HOME System Information screen and *C* flashes on the HOME screen to indicate that calibration is required.

Replace the filament inside the spectrometer as soon as it is convenient after the spare filament has been put into use.

Gain   If the system is in TEST mode, the gain is the external calibration gain. The displayed value is in Black.

If the system is reading the internal calibrated leak, the gain is the internal calibration gain. The displayed value is in Blue.

Gain is used to scale the indicated value of a known leak to agree with a known correct value. The gain parameter is adjusted after the leak detector has been tuned to helium. Calibrate Procedure automatically sets GAIN (see Section 2.2.5.1 "Calibration Set-Up Screen" on page 2-23).

The. GAIN can also be changed manually by selecting the **Value** and adjusting the value by pressing the or arrows (auto repeat

❏ Changing Gain changes Zero by the same percentage.
❏ External gain and internal gain have different ranging limits. The higher the gain, the more noise shows up in the least sensitive range.

2.3.8 Manual Tuning Procedure (Internal or External Standard Leak)

Run the Calibrate Procedure before manual tuning. The Emission is set during the Calibrate Procedure.

The Emission and Ion settings can be changed for optimal leak detection by selecting the Emission or Ion buttons and adjusting the values by pressing the UP or DOWN arrows (auto repeat).

To change a manual tuning parameter:

1. Press **Value** of the desired parameter. When you press the box containing the desired variable, a highlighted indicator appears to the right of the numbers.

> **NOTE**
>
> *Once a change of value is initiated, you can press Cancel to exit the screen and revert to the original value.*

2. Press the arrows to maximize the helium signal.

> **NOTE**
>
> *Do not press the Cancel before pressing the OK . This causes the selected parameter to revert to its previously stored value.*

3. Press **OK** to accept the changes and to store the new parameter value in the leak detector memory.

4. Press **Done** to exit the screen and return to the previous menu screen.

To manually tune the leak detector system using the VS C-15 Display unit:

1. Place the system in TEST mode.

2. Navigate to the Control Panel and turn the STD LEAK ON.

3. Navigate to the Calibration Set-Up screen and write down the INTERNAL CALIBRATED LEAK value. This value is temperature compensated.

4. Navigate to the Manual Tuning screen and:

❏ Set the GAIN to 1.0.

❏ Set the EMISSION to between 0.600 and 0.6500.

❏ Adjust the ION value up or down to attain the maximum value. Ideally, the ION value should be between 250 and 270.

❏ Adjust the EMISSION to attain the maximum value. Ideally, the EMISSION value should be between 0.600 and 1.200.

❏ Set the GAIN so that the leak rate on the screen matches the value of the internal leak you wrote down.

5. Navigate to the CONTROL PANEL and turn the STD LEAK OFF.

2.3.9 Manual Valve Control

1. Press **Valve Control** on the Set-Up screen and the Manual Valve Control screen appears (Figure 2-18).

   Use this screen to manually control the calibrated leak valve in the leak detector vacuum system for troubleshooting purposes.

   See Figure 1-3 on page 1-7 for an illustration of the leak detector vacuum system.
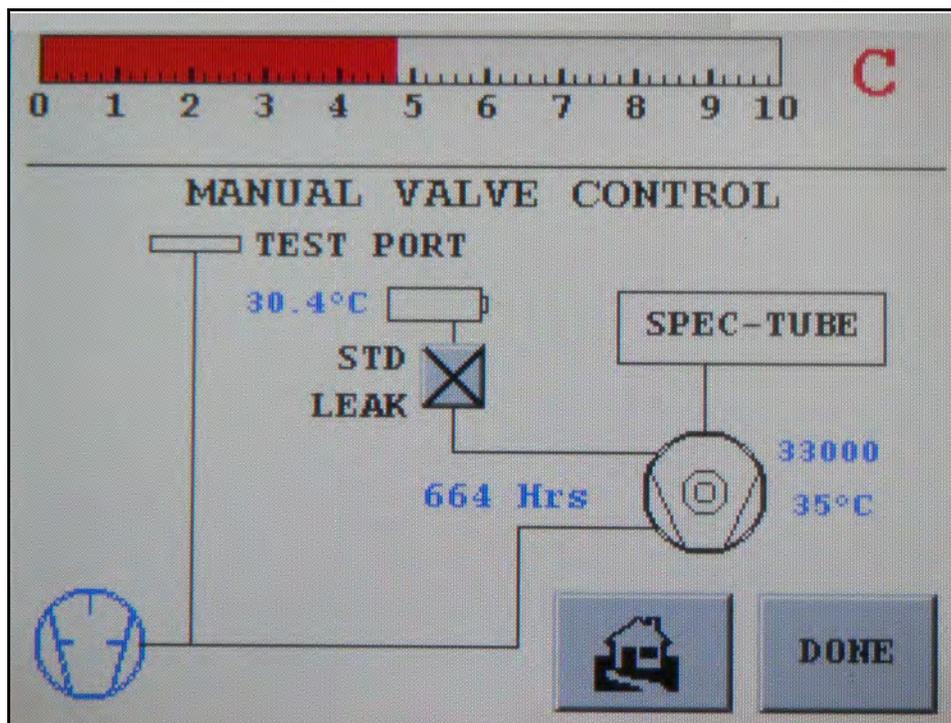
Figure 2-18   Manual Valve Control screen

2. Press the box corresponding to the valve to change it state

   The valve changes state and the box toggles from an X indication (CLOSED) to a Green Circle (OPENED).

2.3.10 Output Control

❑ Press **Output Control** and the Output Control screen appears (Figure 2-19).

Use this screen to select the desired leak rate output, and Bar Graph display mode.
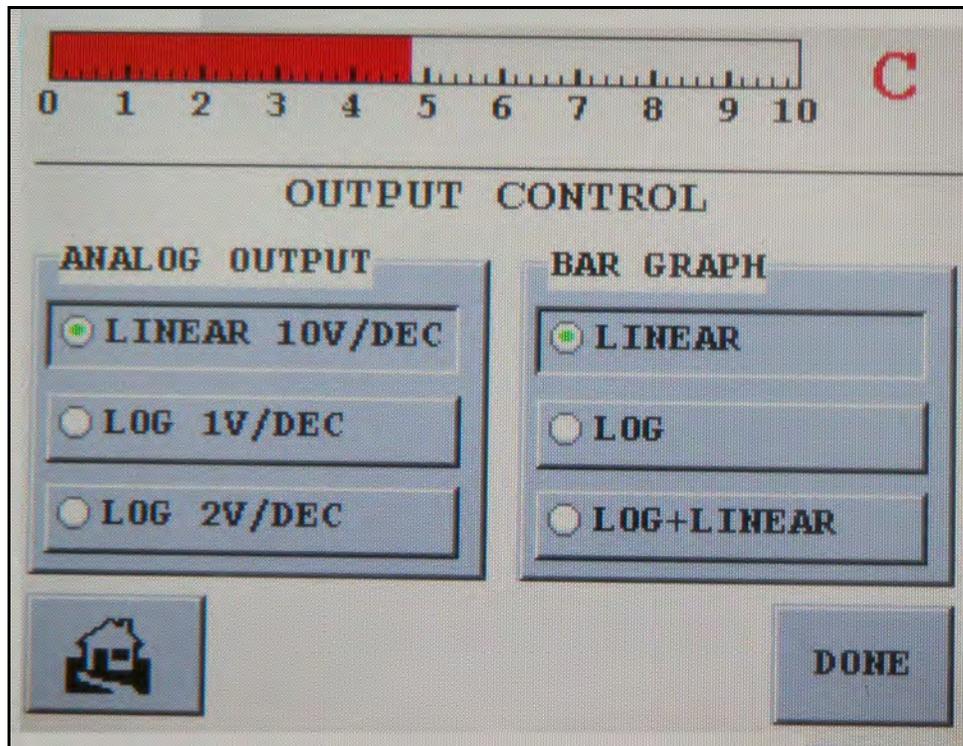
Figure 2-19 Output Control Screen

To select from alternate analog outputs, touch the appropriate soft key button.

Linear   Matches the mantissa of the measured leak rate signal.

Log 1V/Dec   Measure over the complete leak detector sensitivity levels, regardless of the selected working range.

Log 2V/Dec   Measure over the selected working range. This option has more resolution.

2.3.11 Units

❑ Press **Units** on the Set-Up screen and the Units screen appears (Figure 2-20).

Use this screen to configure the Leak Rate and Pressure Units used on the leak rate bar graph.
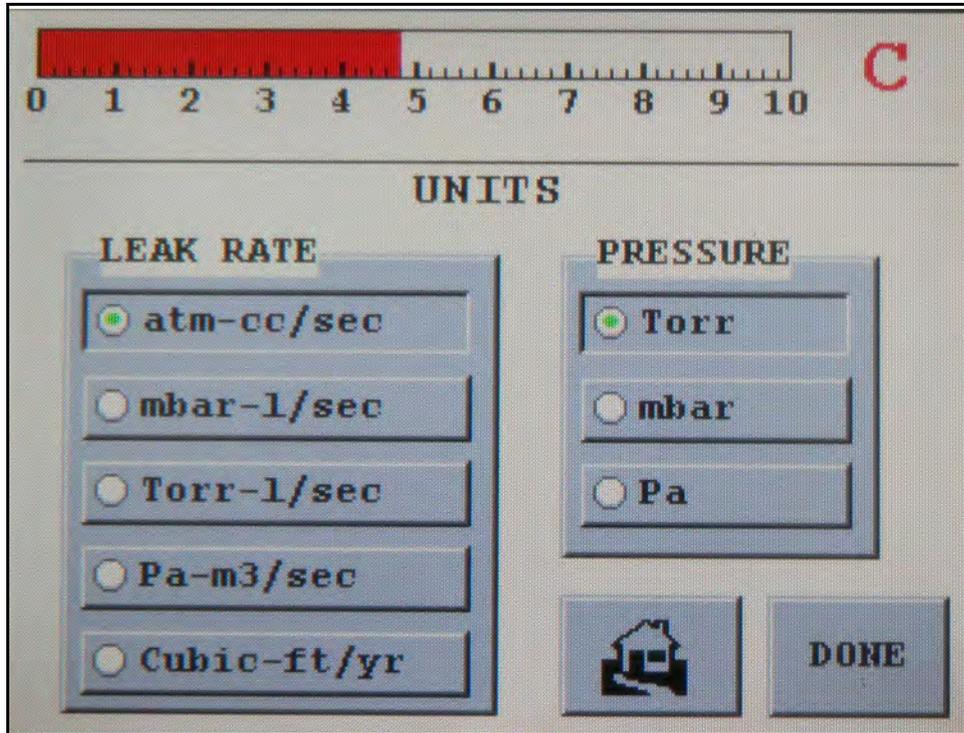
Figure 2-20   Units

Leak Rate Units   Switches the leak rate units between atm-cc/sec, mbar-l/sec, Torr-l/sec, Pa-m3/sec., and Cubic-ft/yr.

Pressure Units   Switches the pressure units between Torr, mbar, and Pa.

2.3.12 Languages

❑ Press **Language Set-Up** on the Set-Up screen and the Languages screen appears (Figure 2-21).

Use this screen to select a language.

Figure 2-21   Languages

The Languages screen allows you to select from the different types of languages offered.

No matter which language is selected, all numbers are 1,2,3 and are not represented in any other language format (Kanji characters for example).

2.3.13 Gauge Calibration

If the vacuum gauge option is activated, press **Gauge Calibration** on the Set-Up screen and the Gauge Calibration screen appears (Figure 2-22).

Use this screen to perform a calibration on the test port vacuum gauge. Calibrate the vacuum gauge for the most accurate operation.

To calibrate the gauge:

1. Set a calibration point at atmosphere.

2. Set a calibration point at a low vacuum level (<= 1E-4 Torr).
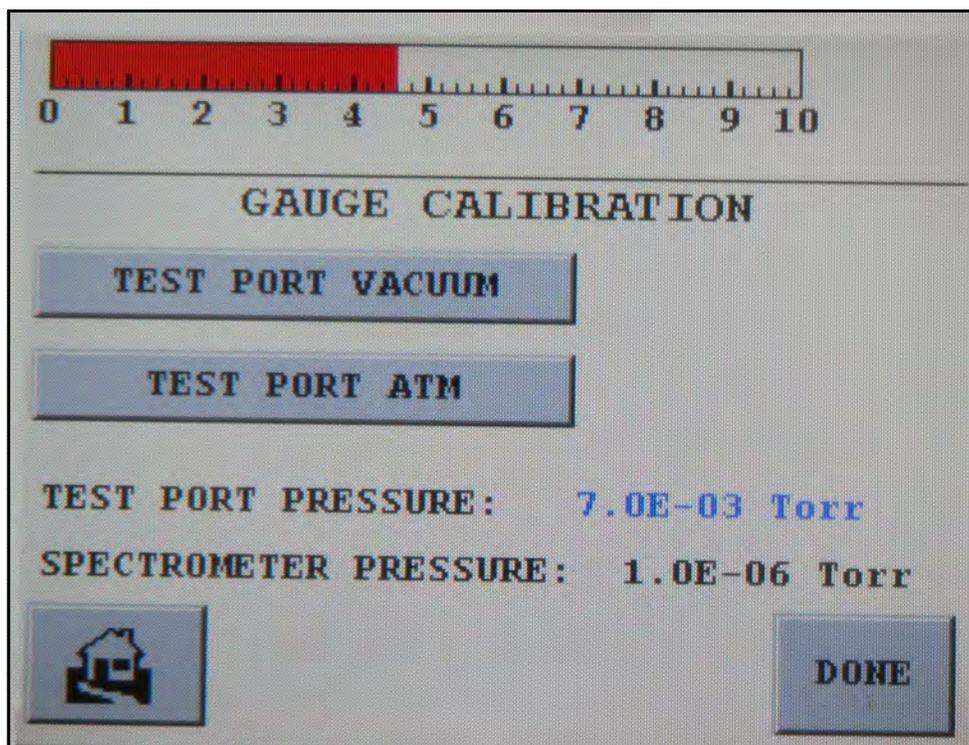
Figure 2-22   Gauge Calibration

Test Port Vacuum   Calibrates the Convectorr gauge zero value. Do this at or below 1E-4 Torr

> !
>
> *Note: In order to maximize the accuracy of the Convectorr gauge due to the lack of exposure to a high vacuum environment for a vacuum calibration, you can perform a reasonable vacuum calibration with a standard rotary vane mechanical pump or dry scroll pump with a base pressure <10 mTorr. Mount the Convectorr gauge directly to the inlet of the primary pump in the orientation, which it will be installed on the leak test system. Perform a vacuum calibration after a three-minute stabilization time. The Convectorr inaccuracy, worst case would range from 5 to 10 mTorr*

Test Port ATM — Sets the Convectorr atmospheric value. Perform this operation only when the test port is at atmosphere.

Test Port Pressure and Spectrometer Pressure — The Test Port Pressure and the Spectrometer Pressure values appear on this screen for reference

Test Port Pressure Gauge Calibration Procedure — Calibrates the test port pressure Convectorr gauge. Perform both the Vacuum and Atmospheric Calibration procedures in the order written, TEST PORT VACUUM and the TEST PORT ATM.

> !
>
> *There are reasonableness tests applied to the Convectorr calibration:*
>
> ❑ *If the test fails the words CAL FAILED appear briefly to the right of the box of the requested calibration.*
>
> ❑ *If the calibration is successful, the words CAL OK appear.*

> !
>
> *Display of <1.0E-03 indicates the pressure is less than the lowest displayable pressure of the vacuum gauge which is 1.0E-03.*

2.3.13.7 Vacuum (Low Pressure) Calibration

To perform Vacuum Calibration:

❑ Expose ConvcTorr gauge to a high vacuum environment.

2.3.13.8 Atmospheric Calibration

To perform Atmospheric Calibration:

1. .If the system is not already in Vent mode, press **VENT.**

2. Wait approximately ten seconds for the test port pressure to stabilize then move to the Gauge Calibration screen (Figure 2-22 on page 2-47).

3. Press **Test Port Atm**. You will receive one of the following messages:

    A Cal OK indication, to the right of the Test Port TC Atm box confirms that the calibration was successful.

    A Failed message indicates that the calibration was not successful. This is the result of a defective or contaminated thermocouple gauge, or that the actual pressure was not at or near atmosphere. Verify the latter case using an appropriate vacuum gauge installed on the test port.

4. Press **Done** to leave the screen and return to the previous menu.

2.3.14 Maintenance

1. Press **Maintenance** on the Set-Up screen and the Maintenance screen appears (Figure 2-23).

   Use this screen to configure:

   ❑ The PASSWORD and to turn that feature ON or OFF

      Section 2.3.14.1 "Date & Time Set-Up" on page 2-51

      Section 2.3.14.2 "Internal Calibrated Leak" on page 2-52
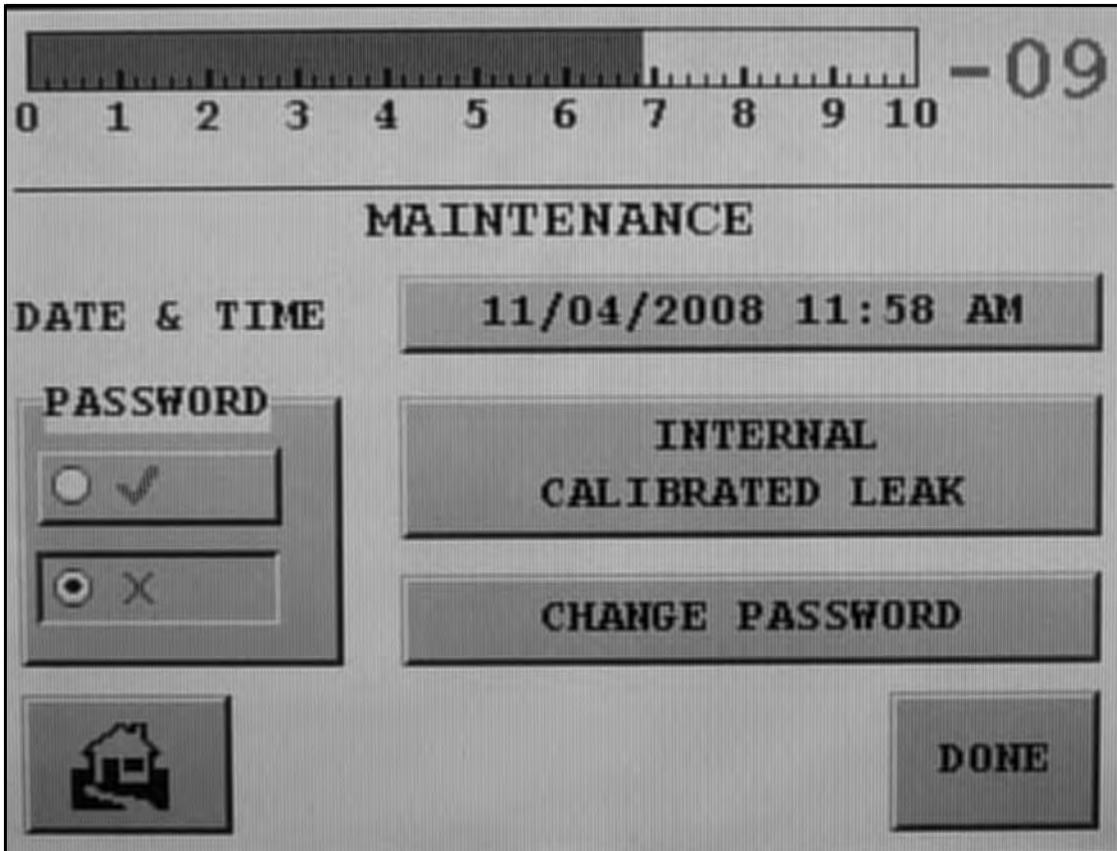
Figure 2-23   Maintenance

Password   Activates/deactivates the password function: ON/OFF. When ON, pressing **Maintenance** from the Menus screen opens the password prompt screen.

When OFF, no password is required to access the SET-UP screens.

The default condition for this parameter is *OFF*.

Change Password   Changes the password used to access the Set-Up and Maintenance screens. Enter up to 8 numeric values for the password and confirm the password selection. An empty entry is not allowed. If no password is entered, the old password is used. The default password from the factory is *777777*. You will need this when changing to a new password

⚠ *The password can also be read through the RS-232 port in the event of a lost password. See Table 4-1 on page 4-1 and Table 4-6 on page 4-15.*

2.3.14.1 Date & Time Set-Up

This function allows you to input the current date and time so that the system can use that information

1. Press the button next to Date & Time.

    The Current Date & Time Set-Up screen appears (Figure 2-24).

Figure 2-24   Current Date & Time Set-Up

To configure the Date & Time screen:

1. Press a button to activate its field.

2. Use the and arrows or keypad to set the value.

3. Press **Done** for each item configured.

4. Repeat step 1 through 3 for each desired item.

5. Press **OK** to exit the screen.

2.3.14.2 Internal Calibrated Leak

If the internal calibrated leak option is activated, the Internal Calibrated Leak button appears.

1. Press **Internal Calibrated Leak**. The Internal Calibrated Leak screen appears (Figure 2-25).

    The screen allows you to enter information about the optional internal calibrated leak.
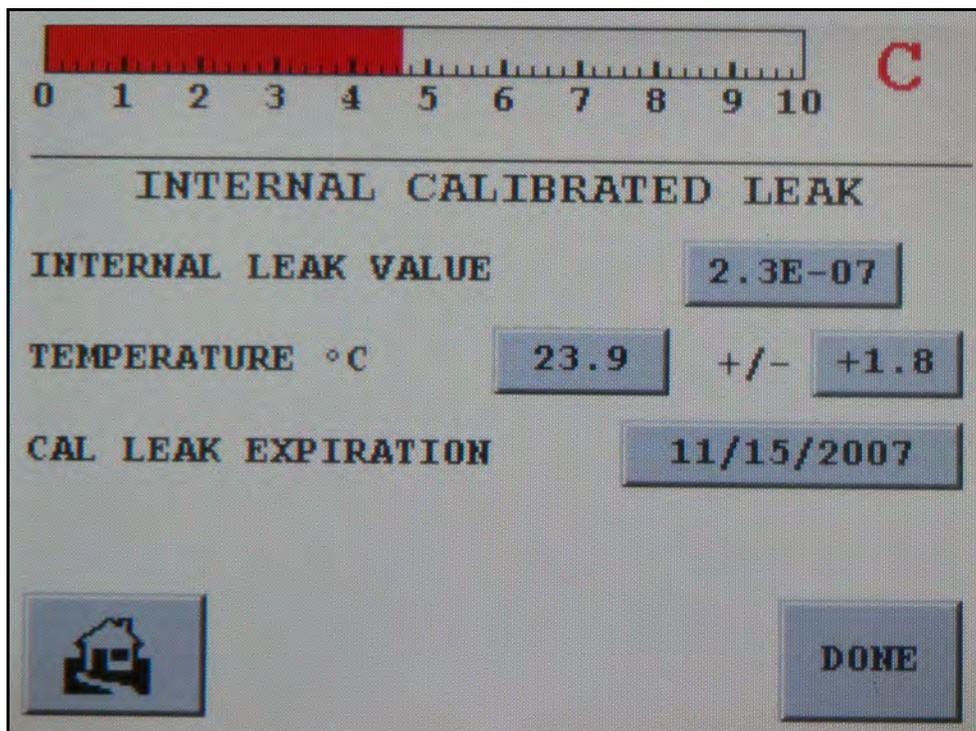
Figure 2-25   Internal Calibrated Leak

To use this screen:

1. Press a Value button to activate its field. A keypad screen appears.

2. Enter the required values as shown on the calibrated leak label.

3. Repeat step 1 and 2 for each desired item.

4. Press **Done** to exit the screen.

   The value of the internal calibrated leak, as shown on the CALIBRATION SET-UP and CONTROL PANEL screens, is compensated for temperature using the calibrated leak temperature sensor.

   The calibrated leak is not compensated for temperature if any of the following conditions exist:

   ❑ The temperature sensor on the calibrated leak fails or there is a cable connection problem.

   ❑ The temperature sensor reading is out of the operating range. The operating temperature range is from 10.0 to 50.0° C (50 to 122° F).

   ❑ The internal calibrated leak is not a E-7 or E-8 range leak.

2.3.14.3 Cal Leak Expiration Set-Up

The Cal Leak Expiration button allows you to put in the calibrated leak expiration date located on the cal leak label.

1. Press the button next to the Cal Leak Expiration text on the Internal Calibrated Leak screen.

   The Cal Leak Expiration Set-Up screen appears (Figure 2-26).
   The Cal Leak Expiration is usually one year from leak installation.

   As the calibrated leak approaches its expiration date (starting within 30 days of expiration), a cal leak symbol will flash on the HOME screen. When the calibrated leak expires, a symbol appears on the HOME screen steady and blue.
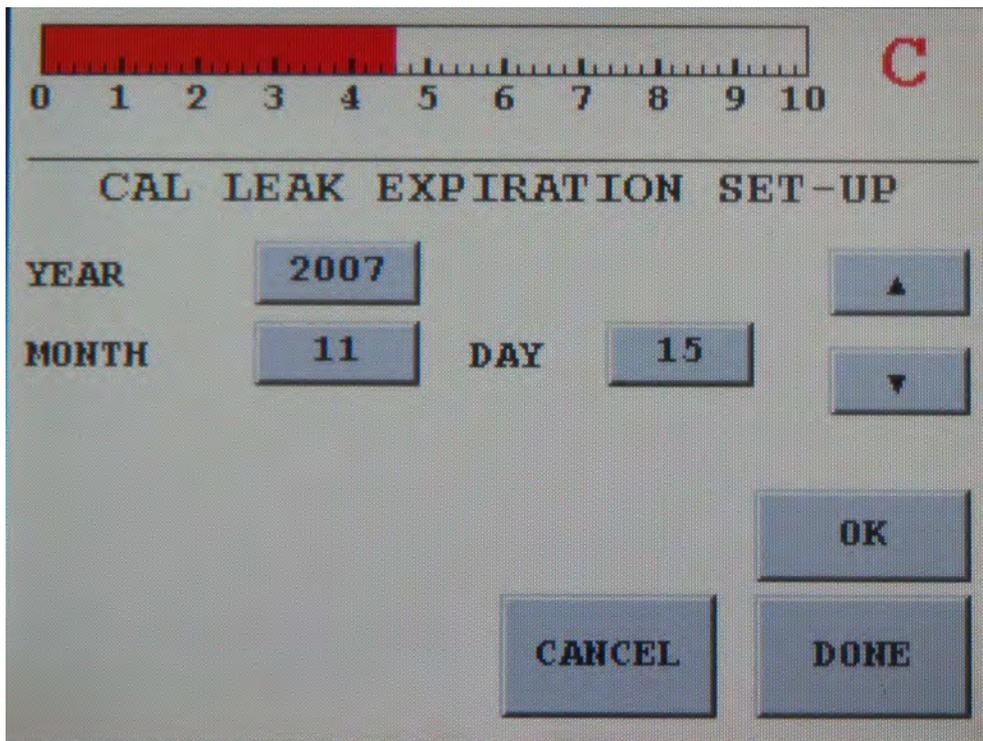
Figure 2-26   Cal Leak Expiration Set-Up

To use this screen:

1. Press the button next to *Year* or Day and a keypad screen appears to set the value.

2. Press **Done** for each item configured.

3. Press the button next to *Month,* use the up and down arrows to change the value and press **OK**.

4. Press **DONE** to set the calibrated leak expiration date and exit the screen.
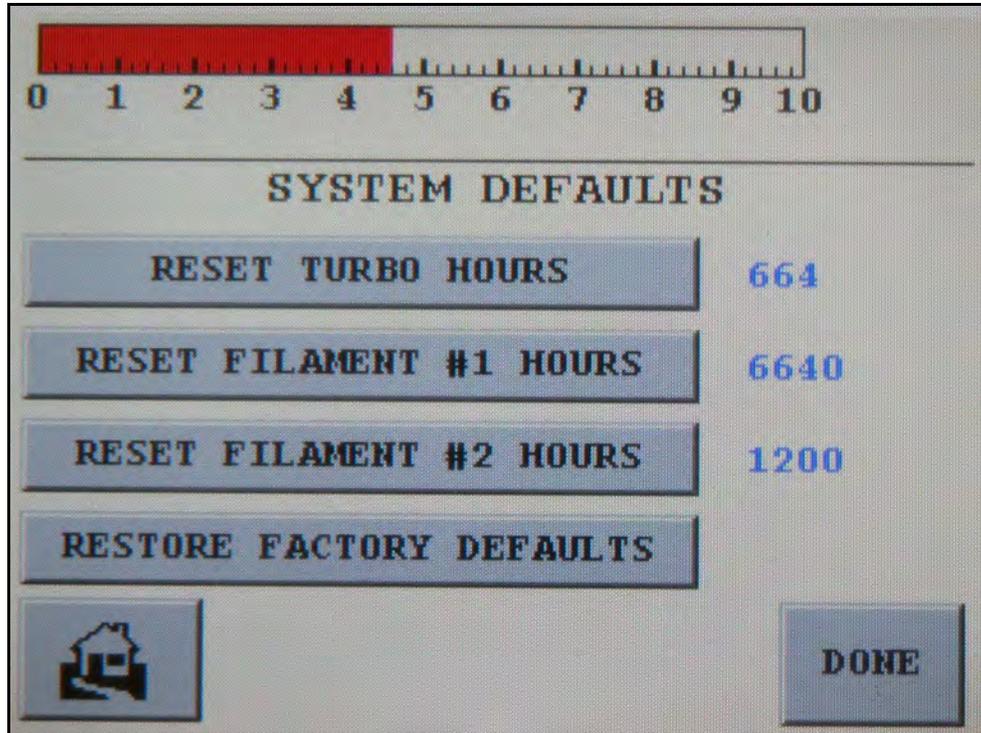
Figure 2-27   System Defaults Screen

5. Reset Turbo, Filament 1 and Filament 2 Hours:

    Upon the installation of a new turbo pump or the activation or replacement of a new filament the hours can be reset to 0 Hours

Restore System Defaults:

This feature allows for resetting the system back to the original factory configurations:

❑ Resets Reject Setpoints

❑ Range Stop

❑ Top Range & original V-gain

❑ English for language for the display

2.3.15 Split Flow Operation or Parallel Pump Operation

The VS-C15 takes into account split flow operation where a considerable amount of helium signal can be diverted away from the mass spectrometer caused by parallel pumping, which is necessary for rapid test cycles. An external calibration to a calibrated leak connected to the test chamber is highly recommended. External gain calculations, up to a split flow factor of 150, can be obtained for proper characterization of the leak test system.

When large split conditions are present, with large external gain factors, a Range Stop is implemented for up to two decades of operation.

Access this screen via the Setup Menu (2nd level):

Figure 2-28   Split Flow

NOTE   *This feature is available February 2011.*

Split Flow Activation   This feature is very helpful for those customers (integrators) who only perform an internal calibration. If an external calibration is not performed the internal calibration gain is applied to the system gain. Typically the internal and external calibrations are the same (within 20%) but this not the case for large roughing/test pumps.

NOTE

[!]

Activating Split Flow is a onetime setup at the integrator's facility using an external calibrated leak. The Split Flow option is self-calculating and would properly characterize the system and scale accordingly with an increase or decrease of internal calibration sensitivity. The only other time this should be performed is when there is a change in Foreline and Roughing/Test vacuum pumps or a scheduled preventive maintenance. The Split Flow factor is heavily influenced by the pumping speed of these pumps.

Once active, this feature is always active until an external calibration is performed or until deactivated by manually turning the feature off.

Ground rules and assumptions:

❏ The software limits split flow to no more than 150. If the split flow is turned ON and the leak rate entered is more than 150 times higher than the system leak rate, the system will not allow the split flow to turn ON and <> appears on the screen.

❏ At the main screen, the split flow symbol ⛁ blinks when split flow is ON. When split flow is turned ON, the corrected leak rate appears but the system knows the real leak rate value.

❏ When ZERO is pressed with split flow ON, the system zeroes out background up to a limit equal to the maximum split flow value.

To activate split flow:

1. Place the system into **TEST** mode and let the leak rate stabilize and perform an internal calibration.

2. Install an external calibrated leak on the system.

3. Press the Split Flow blue check button. The leak detector keypad appears (Figure 2-29 on page 2-58).

4. Enter the leak rate for the customer's calibrated standard leak (what the leak rate should be).
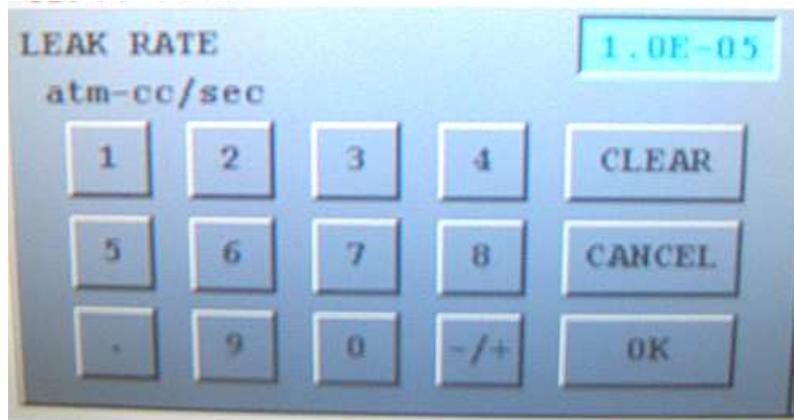
Figure 2-29   Leak Rate Keypad

The leak detector displays the corrected leak rate, essentially calculating a split flow gain value. The leak detector automatically calculates the split flow factor, turns on and calculates the range stop, based on the split flow factor.

When Split Flow is turned OFF, the system reverts back to the uncorrected leak rate. This process must be repeated when reactivating split flow.

NOTE

High Split Flow Factor and High External Gain: A VS-C15 is operating in the [-6,-7,-8,-9] working range and with a 7E-7 std cc/sec He standard leak is installed, on a test station where a large split flow condition is present. The 7E-7 standard leak is measured as a mid E-9 std cc/sec He signal. Normally in the past integrators would re-scale accordingly to match the standard leak value. Agilent's VS-C15 software allows a split flow factor and external gain up to 150 and imposes a Range Stop of E-7 std/cc sec He, as in the above example. The reason for the automatic Range Stop is that the mass spectrometer cannot resolve a Helium signal less than 1E-9 std cc/sec He. The E-7 standard leak is seen to the mass spectrometer as E-9 standard leak, therefore an E-8 std cc/sec standard leak would be seen as an E-10 range signal, which cannot be resolved by the mass spectrometer. In this situation, only two decades in the working range can be used; E-6 and E-7.

Section 3. I/O Interface and Operation

This section describes interfacing and operating the VS C15 component leak detector via the I/O connector, and monitoring the leak rate output using the 9-pin female D-type connector.

3.1 I/O Connector: Customer Accessible Inputs and Outputs

Table 3-1 lists the Discrete I/O signals. This I/O connector provides a means for a controller, usually a PLC, to control or to determine the leak detector status. The I/O is accessible via a type DB25S (female socket) connector

Table 3-1   I/O Connector Pin Signals

PIN No.	Signal Name	I/O	Level	Description	Leak Detector Behavior
15, 19, 23	+ VIN	N/A	+5V to +24VDC	Customer-supplied +5 VDC to + 24 VDC for Output Common pins	
17, 21	VRET	N/A	0 VDC	Customer -supplied GND for the Input Common pins	
1	TUNE_OK	O	LEVEL	Low level= Tune not OK High level= Tune OK	This output indicates tune results.
2	CAL_INT_OUT_OK	O	LEVEL	Active HIGH when internal calibration is successful	Indicates internal calibration has successfully completed. Set low on power-up or if calibration is not successfully completed or if filament has no emission.
3	FILAMENT_IN_USE	O	LEVEL	Low level = filament #1 active High level = filament #2 active	Level indicates which filament is active (operating)

Table 3-1 I/O Connector Pin Signals (Continued)

PIN No.	Signal Name	I/O	Level	Description	Leak Detector Behavior
4	FILAMENT_1 status	O	LEVEL	Low level = good High level = fault	This output becomes active if the filament burns out.
5	FILAMENT_2 status	O	LEVEL	Low level (0 volts) = good High level (5 volts) = fault	This output becomes active if the filament burns out.
6	READY/TEST_OUT	O	LEVEL	Low level=system not ready. High level=system in test mode	Low indicates LD is not ready High indicates LD is ready for leak test; filaments, turbo are OK, calibration is OK. ConvecTorr gauge is OK.
7	BUSY_OUT	O	LEVEL	Low level = not busy High level = offsetting, calibrating or stabilization wait	Indicates LD is not in test due to performing one of the stated activities.
8	REJECT1_OUT	O	LEVEL	Active HIGH when value is over set point #1	Indicates that the value of the leak rate or test port pressure exceeds the value set in 1REJECT variable
9	REJECT2_OUT	O	LEVEL	Active HIGH when value is over set point #2	Indicates that the value of the leak rate or test port pressure exceeds the value set in 2REJECT variable

Table 3-1   I/O Connector Pin Signals (Continued)

PIN No.	Signal Name	I/O	Level	Description	Leak Detector Behavior
10	REJECT3_OUT	O	LEVEL	Active HIGH when value is over set point #3	Indicates that the value of the leak rate or test port pressure exceeds the value set in 3REJECT variable
11	REJECT4_OUT	O	LEVEL	Active HIGH when value is over set point #4	Indicates that the value of the leak rate or test port pressure exceeds the value set in 4REJECT variable
12	CAL_EXT_OUT_OK	O	LEVEL	Active HIGH when external calibration is successful	Indicates external calibration has successfully completed. Set low on power-up or if calibration is not successfully completed or if filament has no emission.
13	AUTO_MANUAL_RANGE_IN	I	LEVEL	Active HIGH when Manual Ranging is selected.	Activation causes the leak detector to change from AUTO to MANUAL ranging. Default is AUTO.
14	FULL_INTERNAL_CAL	I	>200ms Pulse	Active HIGH pulse	Initiate FULL CALIBRATING routine with Internal Calibrated Leak. Zeroing routine is included. Customer TEST valve must be closed.

Table 3-1   I/O Connector Pin Signals (Continued)

PIN No.	Signal Name	I/O	Level	Description	Leak Detector Behavior
16	ZERO_IN	I	>200ms Pulse	Active HIGH pulse	Initiate ZEROING routine. If ZERO ENABLE is turned OFF in the display screen, pin 16 is inactive. To reactivate pin 16, turn ON ZERO ENABLE in the Control Panel display screen.
18	OFFSET_IN (Decide later for a better name function)	I	>200ms Pulse	Active HIGH pulse	Initiates/Establishes a zero reference (offset) calculation prior to a fast external calibration.
20	TUNE_IN	I	>200ms Pulse	Active HIGH pulse	Initiate TUNE routine with customer provided helium source. Customer controls TEST valve.
22	FAST_EXTERNAL_CAL	I	>200ms Pulse	Active HIGH pulse	Customer TEST valve must be open. Customer previously zeroes background. Customer opens their standard cal leak. LD will adjust calibration and compensate for split flow.
24	RDSTDLK_IN	I	LEVEL	Active HIGH when standard leak is ON.	Initiate the INTERNAL STANDARD LEAK reading routine

Table 3-1   I/O Connector Pin Signals (Continued)

PIN No.	Signal Name	I/O	Level	Description	Leak Detector Behavior
25	PARALLEL_ENABLE_IN	I	LEVEL	Active HIGH when ENABLE is active.	Activation causes the leak detector to take inputs only from the rear panel I/O or RS-232 port. No control functions (inputs) from the front panel.

Figure 3-1 shows the output circuit sketch. Level outputs are optically isolated emitter followers with 10 Ohm series resistors, and a 14 mA max drive current (24 VDC max).
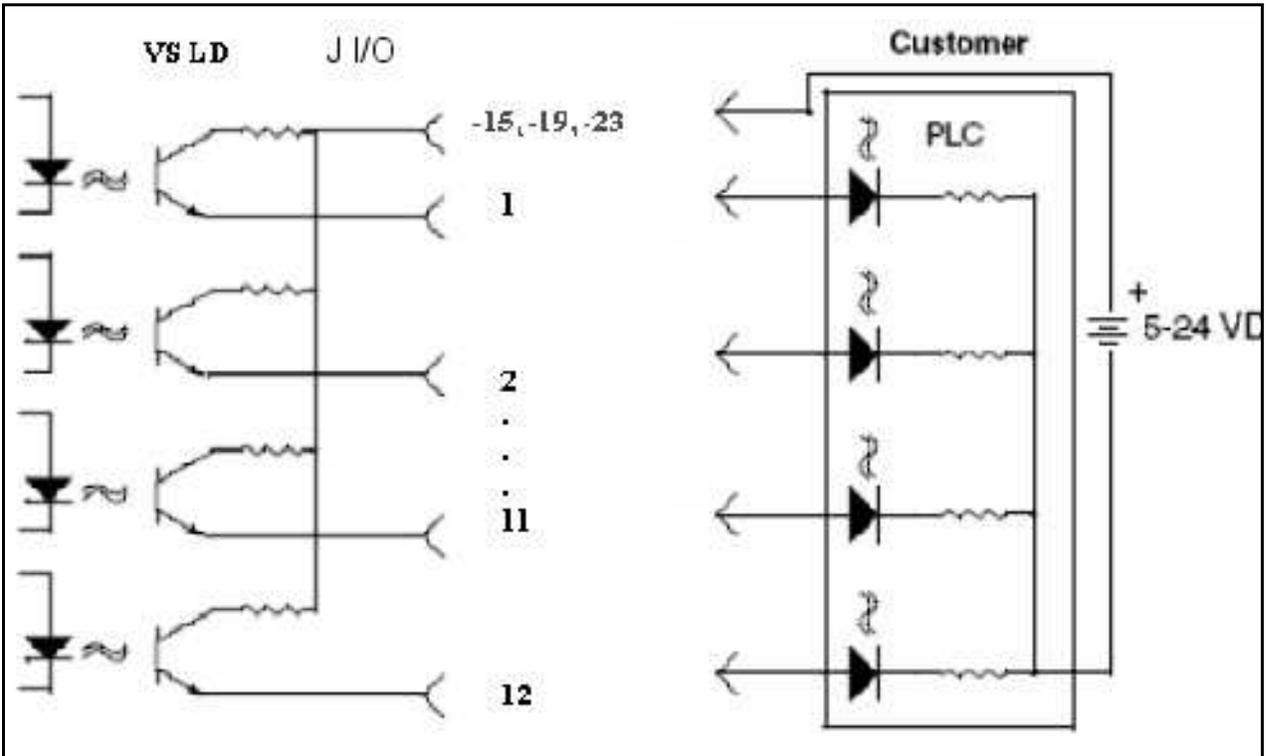
Figure 3-1   Optically Isolated Output Circuit Sketch

Figure 3-2 shows the input circuit sketch. All inputs are optically isolated 3300 Ohm resistive loads in series with the LEDs of the opto-isolators and voltage level from +5 VDC to +24 VDC. The required pulse inputs are 200 ms minimum pulse width.
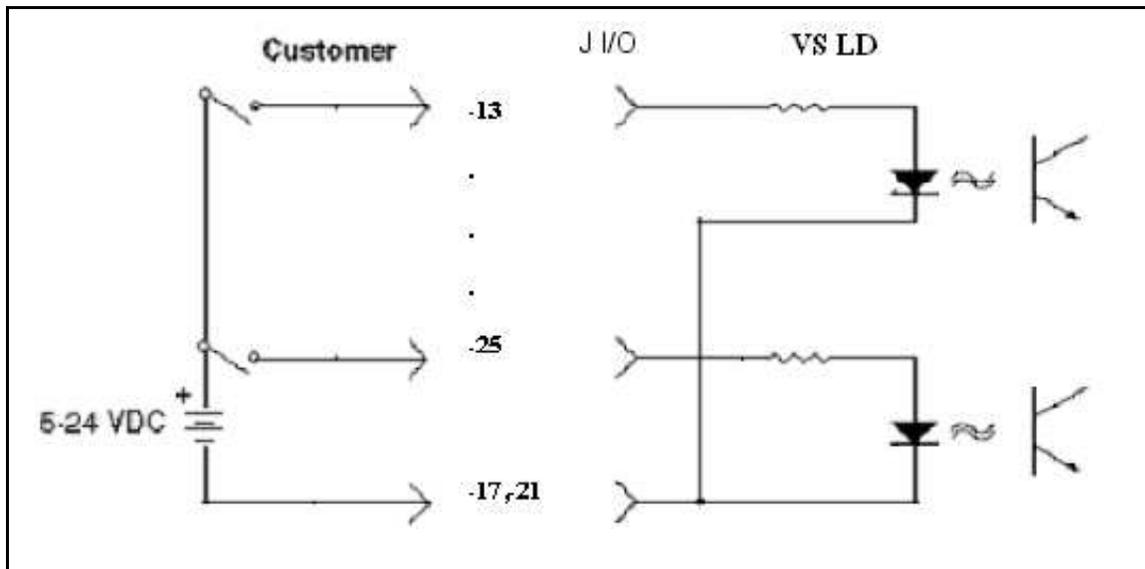
Figure 3-2   Optically Isolated Input Circuit Sketch

3.2 Analog Output Voltage

A 9 pin female D-type connector for an Isolated Leak Rate Analog reading:

Signal range: From 0 to +10 VDC

Pins   2 (+) 3 (-)

Analog output voltage modes:

❑   *Linear* – 0 to 9.9 voltage output within the decade only, the voltage output matches the leak rate mantissa on the front panel display and RS232. This option provides the most resolution within the decade of operation when locked in Manual Ranging.

Ex. 3.4E-6 std cc/sec He   Output voltage = 3.4 VDC

❑   *Log 1V/Decade* – 0 to 10 VDC voltage output spanning over the complete leak rate spectrum of the instrument regardless of the selected working range: E-3 to E-9 std cc/sec He.

Leak Rate Conversion Formula   Leak Rate $= 10^{Vout}/10^{11}$

❑   *Log 2V/Decade* – 0 to 10 VDC voltage output spanning over the selected working range. This option provides better resolution than Log 1V/Decade.

Leak Rate Conversion Formula   Leak Rate $= 10^{(Vout/2)}/10^{(\text{Top Range Variable}+3)}$

NOTE

A constant analog output voltage of 9.99 VDC indicates that the VS-C15 is not ready (System Not Ready error indication) or a successful internal or external calibration has not been performed or has failed.

For added accuracy add 0.06 to V_{out}. Leak Rate = $10^{Vout+0.06}/10^{11}$.

Figure 3-3 and Figure 3-3 give the leak rates versus output.
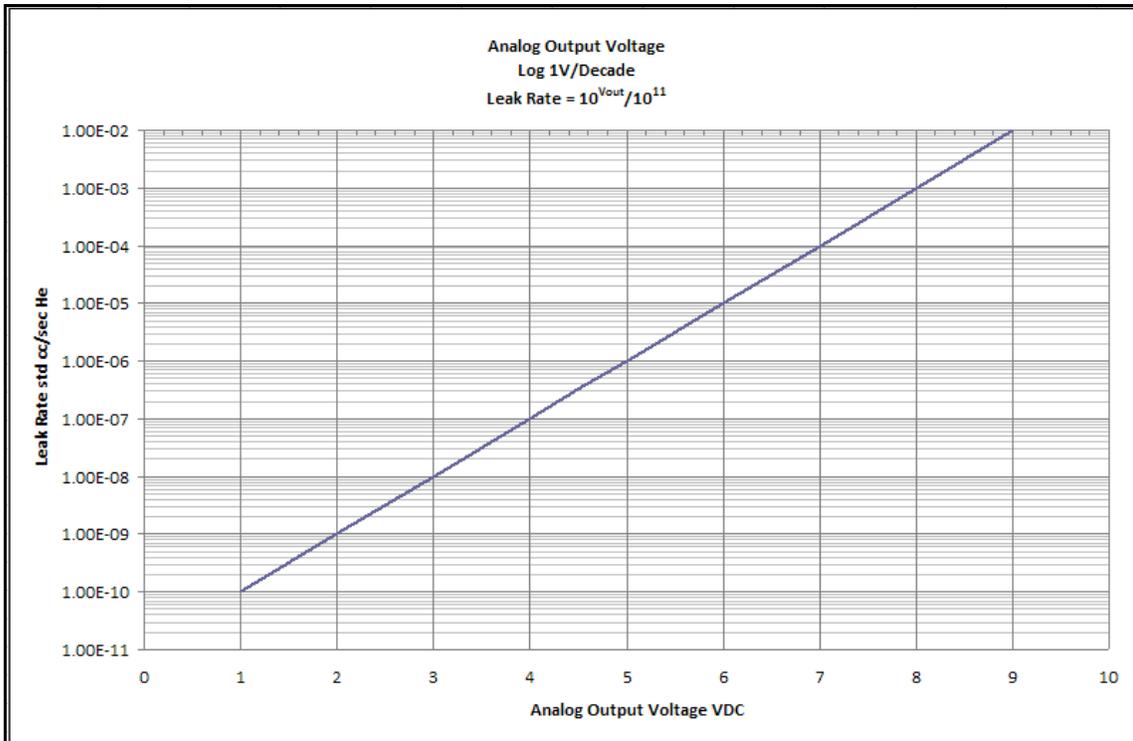
Figure 3-3   Leak Rate vs Analog Output - 1V\Dec

Analog Output Voltage
Log 2V/Decade
Leak Rate = $10^{(Vout/2)}/10^{(\text{Top Range Variable}+3)}$
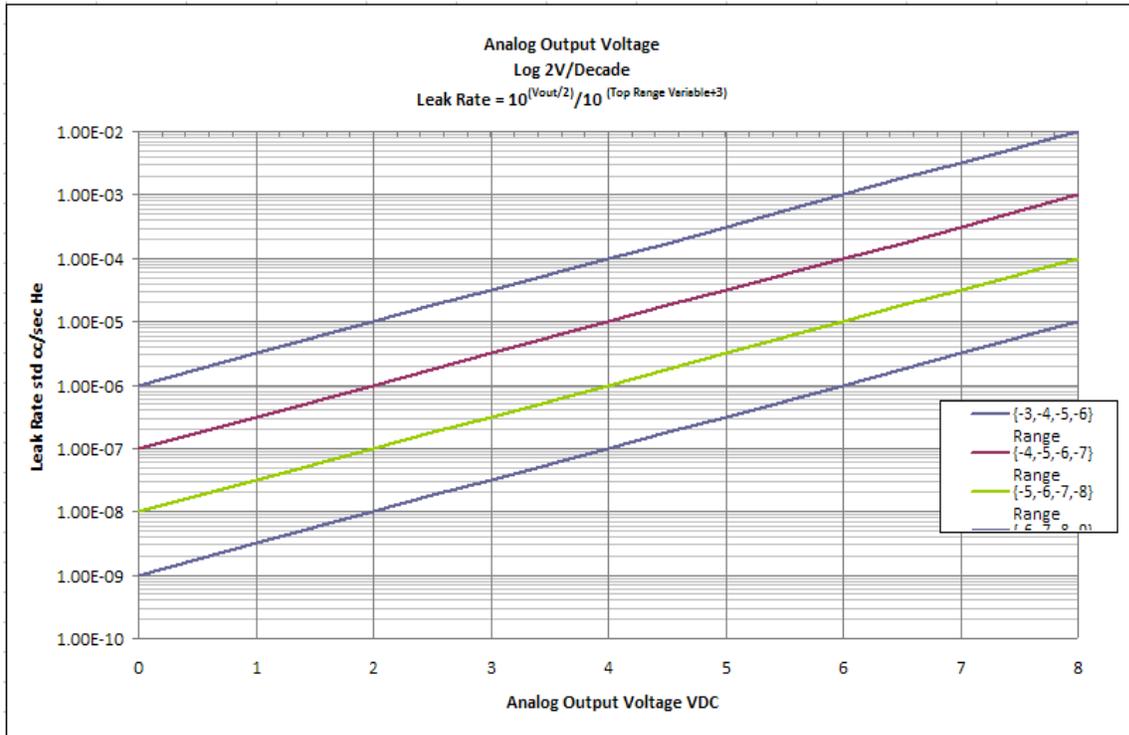
Figure 3-4   Leak Rate vs Analog Output - 2V\Dec

NOTE

⚠️

Table 3-2 describes the startup scenario for the I/O interface option.

Table 3-2   VS C15 Startup Scenario

System Startup Function	I/O
Power up unit: 24 VDC	
Turbo ramps to programmed RPM	System Ready – pin 6 low Busy- pin 7 high
Turbo reaches programmed RPM Filaments 1 & 2 are checked and selected filament activates	System Ready – pin 6 low Busy – pin 7 high
System background and turbo bearing temperature are measured. If these parameters meet the startup limits the 15 minute stabilization timer stops or times out.	System Ready – pin 6 high Busy – pin 7 low

NOTE

If the system was recently calibrated before shut down, it can be used for qualitative testing. Read the standard leak to verify accuracy. For more accurate quantitative leak values, perform a calibration 30 minutes after start-up.

To accurately read in the most sensitive decades of each working range, perform a tune, calibration and offset, and internal or external calibration after a 20-30 minute warm up.

NOTE

The VS C15 Base unit is always in Test/Measurement mode.

3.2.1 Internal Calibration via the I/O

Action: Isolate the leak detector from the test system.

Input: Parallel_Enable - pin 25 high
Output: Ready/Test_Out - pin 6 high
Input: Full_Internal_Cal - pin 14 pulse
Output: Busy_Out - pin 7 high
Output: Tune_Ok - pin 1 High (*if successful*)
Output: Cal_Int_Out_Ok - pin 2 High (*if successful*)

3.2.2 Full External Calibration via the I/O

Manual full external calibration *(Tune, Offset, & Ext. Calibration)*

Output: Ready/Test_Out - pin 6 high
Input: Parallel_Enable - pin 25 high
Action: Place the leak detection test system in the Test/Measurement mode external calibrated leak on.
Input: Tune_In - pin 20 pulse
Output: Busy_Out - pin 7 high
Output: Tune-Ok - pin 1 High *(if successful)*

Action: Isolate the external calibrated leak from the system.

Input: Offset_In - pin 18 pulse
Output: Busy - pin7 high

Action: Place the leak detection test system in the Test/Measurement mode external calibrated leak on.

Input: External Cal - pin 22 pulse
Output: Busy - pin 7 high
Output: Ext_Cal_ ok - pin 12 high *(if successful)*

> **NOTE**
>
> *Quick external calibration - If a successful internal calibration has been performed it is unnecessary to do an external tuning procedure since the tuning was done during the internal calibration. Perform only an Offset and an External Calibration.*

3.3 I/O Integration: Highlighted Points

Parallel Enable Pin 25 (input)	Must be active (level high, in order for the leak detector to execute input commands (calibrate, zero…ECT.). Must in inactive (level low), to execute commands via the front display panel or RS232.
System Ready Pin 6 (output)	Active after power up when the *Turbo Ready* condition is satisfied, *(operating at the programmed RPM)* a successful emission for either filament 1 or 2 an if the optional ConvecTorr gauge is functional. In the event that the turbo is not at the programmed RPM or no emission is present for either filaments 1 & 2 the *System Ready* will not be active. Take no leak rate measurements. The system is no longer in test.
Busy Pin 6 (output)	When the *Busy* output is active, the leak detector is performing one of the following requested routines; waiting for stabilization or stabilizing, internal or external calibration routine, tuning, offsetting, reading the internal standard leak or zeroing. During the *Busy* condition, the leak detector is not in test and no leak rate measurements should be made.
TUNE OK Pin 1 (output)	Active when a successful ion voltage scan obtains an optimal Helium peak signal for both internal and full manual external calibrations. Not locating a peak Helium signal results in a failed tuning scan *No Ion Peak Found (signal < 30% of the most sensitive decade within the working range of operation).* The *Tune ok* is inactive upon power up or a failed tuning attempt. Do not test until this condition is satisfied.
Internal Calibration OK Pin 2 (output)	Active after a successful internal calibration routine, which consists of an offset calculation, tuning routine, zeroing routine and a gain calculation *(Gain:.1 to 9.0).* The *Internal Calibration ok* is inactive upon power up or after a failed calibration attempt. Do not test until this condition is satisfied.

External Calibration ok Pin 12 (output) — Active after a successful external calibration routine, which consists of a gain calculation *(Gain:.1 to 150).* You are responsible for this procedure. If an internal calibrated leak is not installed, perform a tuning and offset routine prior to calibration. The *External Calibration ok* is inactive upon power up or after a failed calibration attempt. Do not test until this condition is satisfied.

An internal calibrated leak option is recommended since the internal calibration routine performs the tune and offset routines. The other advantage of an internal calibrated leak is that it isolates the leak detector from the test system and validates the leak detector integrity.

Once the internal calibration is complete and the leak detector is exposed to the system;

1. Perform an offset.

2. Perform a simple external calibration to the external calibrated leak to calculate the system gain to complete the test system characterization.

NOTE

The External Calibration ok signal is disabled if the internal calibration routine fails after a successful external calibration routine.

Reject Set Points 1 to 4 Pins 8-11 respectively (outputs) — Trigger above or below the programmed set point value. The set points can trigger on leak rate or pressure (optional Convectorr vacuum gauge).

NOTE

Leak Rate set points are not monitored while the system is not ready or in the Busy mode. Pressure set points are always monitored regardless of system status.

3.4 Inputs: Helpful Tips

Internal Calibration
Pin 14 (input)

Use with the internal calibrated leak option only. Routine consists of an offset calculation, tuning routine, zeroing routine and a gain calculation. Verify the system test valve is closed during the calibration process.

NOTE

After power up and a successful internal calibration, the internal calibrated leak gain is applied to the system gain until a successful external calibration is performed.

Full External
Calibration Process
(no internal
calibrated leak
installed)

❑ *Tune Pin 20 (input)* - Scan ion voltage for peak Helium signal.

❑ *External Calibration Pin 22 (input)* - Calculates the system gain (.1 to 150) by exposing a external calibrated leak to the leak detector.

❑ Offset Pin 18 (input) - Establishes the zero reference point. Isolate any external Helium sources from the leak detector for proper system characterization.

NOTE

The input routines, Internal Calibration, Tune and Offset can be aborted while in process. This is done by re-initializing the input commands via the Front Panel display (Control Panel), I/O or RS232.

Section 4. RS-232 Interface and Operation

This section defines the technical specifications for the RS-232 protocol used with the leak detector.

4.1 Serial Connector

Use the *SERIAL* connector on the Rear Panel to interface the VS Series leak detector to a PC via an isolated RS-232 connection. Table A-5 and Figure 4-1 provide details of the connection. A typical connection from a 9-pin PC serial connector requires a female-to-female, 9-pin, null modem cable, where pins 2 and 3 are crossed

Table 4-1   Serial Connector Summary

Pin	EIA Name	Description
2	Received Data	Data into the leak detector
3	Transmit Data	Data out of the leak detector
5	Signal Common	RS-232 Ground
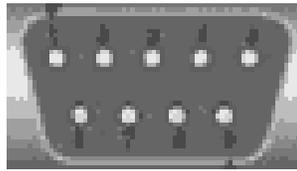
Figure 4-1   Serial Connector Map

4.2 Protocol (RS-232), Diagnostic Port

RS-232 ports operate at 9600 baud, 8 bits, no parity, and one stop bit.

All characters transmitted to the leak detector are echoed by the leak detector. Commands, inquiries, and strings of both commands and inquiries must be terminated by a carriage return <CR>; the carriage return is echoed as a space character.

The maximum length of the input is 80 characters, if no carriage return has been received before the 80th character the execution of the command string begins anyway.

Words that begin with:

- ❏ *?* are inquiries for the controlling device to determine the current state or value of a leak detector parameter.

- ❏ *PUT* - are commands for the controlling device to set the current state or value of a volatile leak detector parameter.

- ❏ *INIT* - are commands for the controlling device to set non-volatile leak detector parameters.

Other commands do not require a parameter and do not begin with any special characters.

Successful inquiries respond with data, followed by a space, then: *ok*<CR><LF>, as specified in the tables of this appendix. Unsuccessful inquiries respond with the offending inquiry followed by a space, then: **#?**<CR><LF> (line feed, <LF>).

Inquiries, parameters, and commands can be concatenated. Each word or numeric parameter is followed by one or more spaces. The string is terminated by a <CR>, which causes execution to begin.

Successful strings respond with the specified data for the input inquiries in the order the inquiries were issued, followed by: **ok**<CR><LF>. Unsuccessful strings respond with the *first* offending command followed by a space, then: **#?**<CR><LF>. All commands and inquiries following the failed word are ignored; all parameters are discarded.

Table 4-2 on page 4-5, Table 4-3 on page 4-9, Table 4-4 on page 4-12, and Table 4-5 on page 4-12 outline the available control and query commands.

4.3 Communicating with RS-232

The RS-232 Protocol is intended for diagnostic purposes and initial set-up inquires. The RS-232 connection is located on the rear D-sub 9-pin connector.

The leak detector RS-232 port is not an interrupt-driven port. It is configured as DTE (Data Terminal Equipment), therefore the leak detector's RS-232 Protocol cannot be sent as strings.

NOTE

When programming with virtual instrumentation programs such as LabView, TestPoint, or Visual Basic, try one the following two methods:

❏ *Transmit the intended command one character at a time with a minimal delay time of 50 milliseconds between each character. Terminate the command with a carriage return (CR).*

❏ *Transmit the intended command one character at a time. Wait for an echoed response from the leak detector before transmitting the next character. Terminate the command with a carriage return (CR) Windows 95, Windows 2000, and Windows XP contain a serial communications program called HyperTerminal, a useful tool in establishing communication between the leak detector and a PC.*

4.3.1 Windows HyperTerminal Set-Up Instructions

To set up Windows HyperTerminal:

1. Click **Start**.

2. Select *Programs > Accessories > Communications > HyperTerminal.*

3. Double-click Hypertrm.exe.

   The *Connection Description* dialog box appears.

4. Enter a name and choose an icon for the connection, for example: leak detector RS-232.

5. Click **OK**.

   The *Connect To* dialog box appears.

6. Select a COM port from the *Connect Using*: the pull-down list.

   The *Com Properties/Port Setting* dialog box appears.

7. Configure the following settings:

   ❏ Bits per second (baud rate) – 9600

   ❏ Data bits: – 8

   ❏ Parity: – None

   ❏ Stop bits: – 1

❑   Flow Control: – None

8. Click **OK**.

9. Select **Properties** from the File menu.

The Properties window appears.

10. Configure the following settings on the Connect To tab:

Connect using – Verify the COM port is correct.

Click **Configure** and verify the port settings are correct.

11. Ensure that the Settings tab is configured as follows:

Terminal keys radio button selected.

Ctrl+H radio button selected.

Auto detect selected from the Emulation pull-down list.

ANSI entered in the Telnet terminal ID.

500 set in the Background buffer lines field.

12. Click **ASCII Set-Up**.

The ASCII Set-Up dialog box appears.

13. Ensure that the settings are as follows:

❑   Line delay – 0 milliseconds

❑   Character delay – 0 milliseconds

❑   ASCII Receiving – Wrap lines that exceed terminal width

The cursor begins blinking.

14. Type some simple commands:

❑   ?LEAK

❑   ?ALL

❑   ?SETUP

Table 4-2   Internal Operating Parameters

Inquiry	Response
?ALL	Responds with four lines. Each begins with a <cr><lf>. The first line reports the ion chamber value. The second line reports the emission value. The third line reports the values of the internal calibration and external calibration offset variables, which are separated by a space. The fourth line reports the external calibration and internal calibration gain variables which are separated by a space.
?AZ<0	Reports the status of the Auto-zero < 0 function, ON or OFF.
?CALOK	Reports the status of the last external calibration.
?CALINTOK	Reports the status of the last internal calibration.
?CPLOCKOUT	Reports the status of the control panel lockout feature, ON or OFF.
?CURRDATE	Reports the current system date and time in the following format: 3 05/25/2005 04:19:03.35 1 Where: **3** is the day of the week (0 = Sunday, 1 = Monday, etc), **05/25/2005** is mm/dd/yyyy (date), **04:19:03.35** is hh/mm/ss/ms (time) and **1** is PM (0=AM, 1=PM, 2=24 hour).
?DISPLAY	Reports what the display bar graph is set to, *log,lin, or both*.
?EMISSION	Reports the emission value.
?EXPONENT	Reports the current manual-mode exponent with a two-character (minus followed by one digit) number. The exponent is within the least sensitive range (as reported by ?RANGE) and the three lower (more negative exponent) ranges. See also INIT-EXPONENT.
?EXTLEAK	Reports the currently stored value of the external standard leak.
?FIL1HOURS	Reports the illuminating hours for Filament 1.
?FIL2HOURS	Reports the illuminating hours for Filament 2.
?GAIN	Reports the current gain value used by the system depending what mode the system is in.
?INTERNAL-TYPE	Reports the internal standard leak option disabled (0) or enabled (1).
?INTEXT	Indicates which leak, Internal or External has been selected for use during calibration.

Table 4-2   Internal Operating Parameters (Continued)

?I/O BOARD	0: Not installed 1: Installed
?IONCHAMBER	Reports the ion chamber value
?I/O_VER	I/O software version
?LANGUAGE	Reports the language that has been selected to display on the front panel (0=English, 1=French, 2=German, 3=Korean, 4=Spanish, 5=Japanese, 6=Chinese).
?LEAK	Reports a six-character number consisting of a two-digit leak rate mantissa with decimal point after the first digit followed by **E** - then a two digit number, which is the leak rate range exponent (e.g., 1.3E-08).
?LKEXPIRE	Reports the internal calibrated leak expiration date mm/dd/yyyy.
?LEAKTEMP	Reports the internal calibrated leak temperature that the factory calibration was performed at (degrees C).
?LP	Reports the current leak rate along with the test port and system pressures.
?LPV	Reports the current Leak Rate, Pressures and Valve state.
?LPVR	?LPV plus Rejects
?LPVRM	?LPVR plus general msg
?LPVRJG	?LPVR plus spectube and general msg
?LPVRJGC	?LPVRJG plus calibration msg
?LPVRJGCTbTpV	?LPVRJGC plus turbo error msg, vacuum gauge error msg, valves' status and temperature sensor error msg.
?NOCAL-VMAXOUT	This command is used to query the feature status. The response of *off* means disabled, *on* means enabled (9.99V).
?OFFSET	Displays the current offset value used by the system depending what mode the system is in.
?PREHEAT	Command to query if the preheat Ion source PCB is installed. A response of 0 = No, 1 = Yes
?PREHEAT-TIME	A numerical response in minutes.
?PRESSURES	Reports two lines. Each begins with a <cr><lf>. The first line consists of the words *test port* followed by a number in mTorr. The second line consists of the words Spectrometer followed by a number in uTorr.

Table 4-2   Internal Operating Parameters (Continued)

?PWDONOFF	Reports status of system password (ON or OFF).
?RANGE	A two character (minus followed by one digit) number indicating the exponent of the least sensitive ranges of detectable leak. The reported leak rates are in this range and three lower (more negative exponent) ranges. See also INIT-RANGE.
?RANGESTOP	Reports the value of the Range Stop variable.
?xREJECT	Reports the reject leak rate setpoint (e.g., 7.0E-05) (where x is a number from 1 to 4 or the letter A).
	A six character number consisting of a two digit reject leak rate mantissa with a decimal point after the first digit followed by **E–** then a single digit which is the reject leak rate range exponent (eg. 7.0E-5). This inquiry is used for reporting the reject leak rate most recently input using INIT-xREJECT
?xREJECTP	Reports the reject test port pressure setpoint (e.g., 1.0E+01)
	(where x is a number from 1 to 4).
	A six character number consisting of a two digit reject test port pressure mantissa with a decimal point after the first digit followed by **E–** then a single digit which is the reject pressure range exponent (eg. 1.0E+01). This inquiry is used for reporting the reject test port pressure most recently input using INIT-xREJECTP.
?>xREJECT	Reports the reject set point is *on* or *off* (where x is a number from 1 to 4 or the letter A).
?RSONOFF	Reports the status of the Range stop function as Enabled or Disabled.
SERVICE1	Displays the current status of the operating parameters.
SERVICE2	Displays the current status of the operating parameters.
?SETUP	Reports seven lines, each begins with a <cr><lf>.
	The first line reports the turbo pump speed with the RPM value or OFF. The second line reports the selected manual leak rate range, and the ranging method as auto or manual.
	The third line reports the least sensitive leak rate range.
	The fourth line reports the reject set point leak rate.
	The fifth line reports the internal calibrated leak rate value.
	The sixth line reports the DAC output method as Linear, Log (2V) The seventh line reports the active filament status as *One* or *Two*, followed by *Lit* or *Out*.
?SOFTSTART	Returns the status of Soft Start (on or off)
?SPLITFLOW	Returns the status of the split flow function, ON or OFF.

Table 4-2   Internal Operating Parameters (Continued)

?STDLEAK	Reports a six-character number consisting of a two-digit calibration standard leak rate mantissa with a decimal point after the first digit followed by *E-*, and then by a two-digit exponent (e.g., 1.3E-07). This inquiry is used for reporting the calibration standard leak rate entered using INIT-STDLEAK.
?STDLK-GAIN	Reports the internal standard leak gain value
?SYS-GAIN	Reports the external /system gain value
?SYSPWD	Reports the value of the system password.
?TC-GAUGE	Reports the vacuum gauge option disabled (0) or enabled (1).
?TUNEOK	Reports the tuning result.
?TURBO	Reports four lines, each begins with a <cr><lf>. The first line consists of the word *turbo* followed by either READY or NOT READY. The second line consists of the word *turbo* followed by *either Fault* or *No Fault*. The third line consists of the words *turbo speed RPM* followed by the RPM value: *xxxxx*. The fourth line consists of the words *Turbo Temp (Celsius):* followed by the bearing temperature value: XX. The fifth line is the *Turbo Life: hours*
?TURBOHR	Reports the Turbo running hours.
?VALVESTATE	Reports the current mode of the system: Tuning, Calibrating, etc.
VER	Reports the CPU software version in the form LC02.05 followed by a six digit hexadecimal checksum.
?VOLUMEONOFF	Reports audio as either ON or OFF.
WHYNOCAL	Reports the external calibration failure
WHYNOCAL-INT	Reports the internal calibration failure.
?0ENABLE	Responds with the status of the *Zero Enable* function, ON or OFF.

The commands listed in Table 4-3 are used to set non-volatile operating parameters. The current value of the operating parameter is changed to the new value. If the leak detector is in back panel control, the response is cant.

Table 4-3   Non-Volatile Operating Parameters

Command	Parameter
INIT-AZ<0	Preceded by 0 or 1, sets the status of Auto-zero < 0. 0 = off, 1 = on.
INIT-CPLOCKOUT	Sets the status of the control panel lockout. Preceded by (0) or (1), 0 = OFF, 1 = ON.
INIT-DATE	Sets the system date and time. Preceded by: dow, mm dd yyyy hh mm ss AmPm 24-12 mode, Where: ❑ **2** is the day of the week (dow) (0 = Sunday, 1 = Monday, etc), ❑ mm/dd/yyyy (date), ❑ hh:mm:ss (time) ❑ AmPm (0=AM, 1=PM) ❑ 24-12 mode (0 for 24 hr, 1 for 12 hr). Examples: ❑ 2 02 12 2005 04 16 33 1 0 INIT-DATE ❑ (Tuesday, February 12, 2005, 4:16:33 on a 24 hr clock) ❑ 2 02 12 2005 04 16 33 1 1 INIT-DATE(Tuesday, February 12, 2005, 4:16:33 PM) ❑ ?CURRDATE reports the stored value
INIT-DISPLAY	Sets the status of the bar graph display to either a log or linear display. Preceded by (1) Log or (0) Linear.
INIT-EMISSION	Sets the emission of the ion source. Preceded by a three-digit number (counts), in the range 0 to 255.
INIT-EXPONENT	Sets the range that the leak detector will operate in when Manual Range is ON. Preceded by -XX. *This command is ignored if the system is in internal calibrated leak mode.*
INIT-EXTLEAK	Sets the value of the external leak. Preceded by a two-digit leak rate mantissa with a decimal point after the first digit followed by *E-*, and then by a two-digit leak range exponent: the helium leak rate number in atm cc/sec of the calibration standard leak. Example: 3.2E-08 INIT-EXTLEAK
INIT-FILAMENT	Sets the operating filament in the ion source. Preceded by a single digit, either 1 or 2.

Table 4-3   Non-Volatile Operating Parameters (Continued)

INIT-GAIN	If the system is in the standard leak mode, it sets the value of the (internal) gain used for adjusting the helium signal to match an internal standard leak.
	If the system is in TEST mode, it sets the value of the (external) gain used for adjusting the helium signal to match an external calibrated leak.
	Preceded by a one or up to three-digit number and one decimal point. In the range 0.2 to 9.0 for the internal calibrated leak gain and 0.2 to 590.0 for the external calibrated leak gain.
	Note: Changing External Calibrated Gain changes the Zeroes by the same ratio. This command is not valid during the system calibration.
INIT-INTERNAL-TYPE	Enables or disables the internal standard leak option. Preceded by a single digit, either 0 (disable) or 1 (enable).
INIT-ION	Sets the ion voltage of the ion source. Preceded by a three-digit number (counts) in the range 0 to 255.
INIT-LANGUAGE	Selects the language to be shown on the display. Preceded by 0-6 where (0=English, 1=French, 2=German, 3=Korean, 4=Spanish, 5=Japanese, 6=Chinese).
INIT-LINEAR	Sets the leak rate analog output voltage to Linear. Not preceded by a value.
INIT-LKEXPIRE	Sets the date on which the internal calibrated leak expires. Preceded by the date.
	Example: mm dd yyyy INIT-LKEXPIRE
INIT-1LOG	Sets the leak rate analog output voltage to logarithmic at 1 volt per decade. Not preceded by a value.
INIT- 2LOG	Sets the leak rate analog output voltage to logarithmic at 2 volt per decade. Not preceded by a value.
INIT-PASSWORD	Sets the system password. Preceded by a 1 to 6 digit password and followed by a digit indicating the number of digits in the password. Example: 123123 6 INIT-PASSWORD.
	Password is read back using the ?SYSPWD command.
XX INIT-PREHEAT-TIME	Command to set the preheat time. Where XX=3, 9, or 15 (in minutes).
INIT-RANGE	Sets the working range (sensitivity level). Preceded by –3, -4, -5, or –6.
	Note: *Turbo speed and the A/D gain will adjust accordingly. This command is ignored if the system is in internal calibrated leak mode.*
INIT-RANGESTOP	Sets the value of the most sensitive range exponent. Preceded by XX. *This command is ignored if the system is in internal calibrated leak mode.*

Table 4-3 Non-Volatile Operating Parameters (Continued)

INIT-REJECT	A two digit leak rate mantissa with a decimal point after the first digit followed by **E–** followed by a single digit which is the leak rate range exponent: the helium leak rate number in std cc/sec. Values outside the working range of the leak detector will not be stored. These reject commands listed in red will change because of the reject set point changes (program set point to either leak rate or pressure)
INIT-1REJECT	Sets the leak rate value for Reject Set Point #1. Preceded by a two-digit leak rate mantissa with a decimal point after the first digit followed by *E-*, and then by a two-digit leak range exponent, the helium leak rate number is in atm cc/sec. Example 3.4E-08 INIT-1REJECT
INIT-2REJECT	Same as INIT-1REJECT, but for Reject Set Point #2.
INIT-3REJECT	Same as INIT-1REJECT, but for Reject Set Point #3.
INIT-4REJECT	Sets the test port pressure value for Reject Set Point #4.
INIT-AREJECT	Same as INIT-1REJECT, but for the Audio Reject Set Point.
INIT-1REJECTP	Sets the test port pressure value for Reject Set Point #1. Preceded by a two-digit pressure mantissa with a decimal point after the first digit followed by *E–*, and then by a two-digit pressure range exponent, the pressure number is in Torr. Example 1.0E+01 INIT-1REJECTP
INIT-2REJECTP	Same as INIT-1REJECTP, but for Reject Set Point #2.
INIT-3REJECTP	Same as INIT-1REJECTP, but for Reject Set Point #3.
INIT-4REJECTP	Same as INIT-1REJECTP, but for Reject Set Point #4.
INIT-STDLEAK	Sets the value of the internal leak. Preceded by a two-digit leak rate mantissa with a decimal point after the first digit followed by *E-*, and then by a two-digit leak range exponent: the helium leak rate number in atm cc/sec. Example: 3.2E-08 INIT-STDLEAK.
INIT-TCTPZERO	Used to calibrate the low-pressure end of the test port thermocouple to a known pressure higher than zero. Preceded by a number (*XX*) of mTorr representing the test port pressure at the time of the command.
0 INIT-TC-GAUGE	Turns vacuum pressure gauge off.
1 INIT-TC-GAUGE	Turns vacuum pressure gauge on.

The commands listed in Table 4-4 are used to cause an immediate change in the spectrometer operating parameters. These commands do not change the non-volatile operating parameters.

Table 4-4   Spectrometer Operating Parameters

Command	Parameter
PUT-EXPONENT	Sets the exponent leak range for Manual mode. Preceded by a two-character numbers. Acceptable values are 0 through -10. Unacceptable values will not be stored. *This command is ignored if the system is in internal calibrated leak mode.*
PUT-ION	A three digit number of volts, in the range 200 to 350, which sets the ion voltage of the ion source.
PUT-EMISSION	A four digit number of microamps, in the range 0300 to 2000, which sets the emission current of the ion source.
PUT-GAIN	If the system is in the standard leak mode, it sets the value of the (internal) gain used for adjusting the helium signal to match an internal standard leak. If the system is in TEST mode, it sets the value of the (external) gain used for adjusting the helium signal to match an external calibrated leak. Preceded by a one or up to three-digit number and one decimal point. In the range 0.2 to 9.0 for the internal calibrated leak gain and 0.2 to 150.0 for the external calibrated leak gain.
PUT-RANGESTOP	Sets the Range Stop exponent. Preceded by two or three characters *-XX* or *–X*. *This command is ignored if the system is in internal calibrated leak mode.*

The commands listed in Table 4-5 are used to cause certain leak detection actions.

Table 4-5   Leak Detection Actions

Command	Action
AUTO	Initiates auto-ranging mode. Success is indicated by the normal *ok* response.
CALIBRATE	Initiates a Full or Fast calibration depending on which leak is chosen do the routine. Internal Calibration: Full calibration only External Calibration: Fast calibration only
DECREMENT	Subtracts 1 from the Manual Ranging leak rate exponent (making it more negative). Success is indicated by the normal *ok* response. Does nothing in auto-ranging mode. Does nothing upon reaching the most sensitive range.

Table 4-5   Leak Detection Actions (Continued)

DISABLE-0ENABLE	Turns the Zero Enable function OFF.
DISABLE-NOCAL-VMAXOUT	This command is used to turn off the 9.99V output when system is not calibrated.
DISABLE-PASSWORD	Turns the password function OFF.
DISABLE-xREJECT	Turns the Reject Set Point OFF. Where x is a number from 1 to 4 or the letter A.
DISABLE-RANGESTOP	Turns the Range Stop function OFF.
DISABLE-SPLIFLOW	Turns the split flow function OFF.
DISABLE-VOLUME	Turns audio OFF.
ENABLE-0ENABLE	Turns the Zero Enable function ON.
ENABLE-NOCAL-VMAXOUT	To turn the feature back on.
ENABLE-PASSWORD	Turns the Password feature ON.
ENABLE-xREJECT	Turns the Reject Set Point ON. Where x is a number from 1 to 4 or the letter A.
ENABLE-RANGESTOP	Turns the Range Stop function ON.
ENABLE-SPLITFLOW	Turns the split flow function ON.
ENABLE-VOLUME	Turns audio ON.
EXTERNAL	Sets the External Calibrated Leak (in test port) as the leak for use during calibration. (Fast Calibration only)
HIGH-xREJECT	Sets the reject test port pressure or leak rate set point triggered above the set point (where x is a number from 1 to 4 or the letter A).
INCREMENT	Adds 1 to the Manual Ranging leak rate exponent (making it less negative). Success is indicated by the normal *ok* response. Does nothing in auto-ranging mode. Does nothing upon reaching the least sensitive range.
INTERNAL	Sets the Internal Calibrated Leak as the leak to be used during calibration (Full Calibration only).
LEAK-xREJECT	Sets the reject set point to leak rate (where x is a number from 1 to 4).
LOW-xREJECT	Sets the reject test port pressure or leak rate set point triggered below the set point (where x is a number from 1 to 4 or the letter A).
!OFFSET	Adjusts the zero-signal baseline.
PSI-xREJECT	Sets the reject set point to test port pressure (where x is a number from 1 to 4). This command is valid only if the ConvecTorr gauge option is installed.

Table 4-5   Leak Detection Actions (Continued)

RESET-FIL1-HRS	Clears Filament1's illuminating hours to 0.
RESET-FIL2-HRS	Clears Filament2's illuminating hours to 0.
RESET-TB-HRS	Clears the Turbo pump's running hours to 0.
SOFTSTARTOFF	Tells turbo to start with soft start off (must power down to activate)
SOFTSTARTON	Tells turbo to start with soft start on (must power down to activate)
STDLEAK	Turns Read Std Leak ON/OFF. Verifies calibration by exposing internal cal leak to the system.
TPTCATM	Sets the current test port ConvecTorr reading to represent atmospheric pressure when the test port is exposed to atmosphere. Success is indicated by the normal *ok* response.
TPTCZERO	Sets the current test port CovecTorr reading to represent a ZREO pressure reading when the test port pressure is less than 1.0E-04 Torr. Success is indicated by the normal *ok* response.
TUNE	Adjusts the ion source voltage to cause a maximum response to helium.
XYZZY	Unlocks the system so that all RS-232 commands are accessible.
ZERO	Sets the current leak rate measurement to be 0.0 atm cc/sec in the most sensitive range.

NOTE

Table 4-6 describes the startup scenario for the RS232 interface option.

Table 4-6   VS C15 Startup Scenario

System Startup Function	RS232 Action + Response
Power up unit: 24 VDC	
Turbo ramps to programmed RPM	?LPV (leak rate – test port pressure – spectrometer pressure – valve state or system condition) Ex. 0.00E-6 000016 000001 NOT READY
Turbo reaches programmed RPM Filaments 1 & 2 are checked and selected filament activates	?LPV 0.00E-6 000016 000001 NOT READY
System background and turbo bearing temperature are measured. If these parameters meet the startup limits the 15 minute stabilization timer stops or times out.	?LPV 0.00E-6 000016 000001 CONTRAFLOW

Refer to Section 2.2.5.1 "Calibration Set-Up Screen" on page 2-23 to properly set-up the leak detector for auto-calibration.

NOTE

If the system was recently calibrated before shut down, it can be used for qualitative testing. Read the standard leak to verify accuracy. For more accurate quantitative leak values, perform a calibration 30 minutes after start-up.

To accurately read in the most sensitive decades of each working range, perform a full internal or external calibration after a 20-30 minute warm up.

NOTE

The VS C15 Base unit is always in Test/Measurement mode.

4.3.2 Internal Calibration via the RS232 Interface

RS232 Action: 1 INIT-INTERNAL-TYPE *(Internal Calibrated Leak Installed)*

RS232 Action: X.XE-0X INIT-STDLEAK
(program the value of the internal cal leak ex. 3.4E-07 INIT-STDLEAK)

RS232 Action: INTERNAL *(Calibrate to the Internal Calibrated leak)*

RS232 Action: CALIBRATE

Inquiry: ?LPV

Response:

0.00E-6 000016 000001 CAL PREP
0.00E-6 000016 000001 OFFSETTING
0.00E-6 000016 000001 STD LEAK PREP
0.00E-6 000016 000001 CALIBRATE
0.00E-6 000016 000001 ZEROING
0.00E-6 000016 000001 CONTRAFLOW

RS232 Action: ?TUNEOK

RS232 Action: ?CALINTOK

Response: Yesok

Section 5. Profinet Interface and Operation

5.1 Protocol (PROFINET-I/O)

5.1.1 PROFINET IO Interface Introduction

The Network I/O PCB implements a PROFINET IO interface using the *Anybus®-CompactCom PROFINET IO* module. The module exchanges cyclic data on the ProfiNet network as PROFINET input data (data from the module to the ProfiNet host - PLC or PC), and PROFINET output data (data from the ProfiNet host to the module). This document describes the structure and meaning of the exchanged data.

5.1.2 PROFINET I/O Interface Setup

The PROFINET I/O interface is installed into the Controller (PLC or PC) using the GSDML file located on the CD with this document. The file has the naming convention *GSD-VX.X-Agilent-PISAIO-PRT-YYYYMMDD.XML*, where *X.X* is the revision and *YYYYMMDD* is the release date. Also on the CD is a bitmap logo file that is sometimes used by the development software to identify the VS C15 leak detector. Typically, the GSDML file (and the bitmap file) are loaded into the development software that is used to write code in the Controller. Additionally, the programmer might be required to configure further interface details. If so, the following information may be useful: The interface data is arranged as 8 16-bit Output words followed by 8 16-bit Input words.

NOTE	*The GSDML File is located on the CD that shipped with the VS-C15.*
[!]	

5.2 VS C15 ProfiNet Data Structure

5.2.1 PROFINET Input Data

The following data is cyclically transferred from the module to the host. The data is arranged in 16-bit words with the described meaning.

Cyclic input Data	Data words 0-2 are updated each cycle with status information. This data is available at all times at the host to indicate the status of the machine.
Word 0 Parallel I/O Input Bits	The bits in this word mirror the output bits on the parallel I/O connector.

(1 = Active):

- ❑ Bit 0:TUNE_OK
- ❑ Bit 1:INTERNAL_CAL_OK
- ❑ Bit 2:FILAMENT_IN_USE
- ❑ Bit 3:FILAMENT_1 status
- ❑ Bit 4:FILAMENT_2 status
- ❑ Bit 5:READY
- ❑ Bit 6:BUSY
- ❑ Bit 7:REJECT1_TRIPPED
- ❑ Bit 8:REJECT2_TRIPPED
- ❑ Bit 9:REJECT3_TRIPPED
- ❑ Bit 10:REJECT4_TRIPPED
- ❑ Bit 11:EXTERNAL_CAL_OK
- ❑ Bits 12-15:Reserved

Word 1: Status Bits - The bits in this word indicate status of leak actions:

- ❏ Bit 0:ZERO IS ENABLED (1 = Enabled)
- ❏ Bit 1:PASSWORD IS ENABLED (1 = Enabled)
- ❏ Bit 2:RANGESTOP (1 = ON, 0 = OFF)
- ❏ Bit 3:AZ<0 (1 = ON, 0 = OFF)
- ❏ Bit 4:Reserved
- ❏ Bit 5:AUDIO_MUTE (0 = ON, 1 = Mute)
- ❏ Bit 6:Reserved
- ❏ Bit 7:Reserved
- ❏ Bit 8:MANUAL RANGING (1 = Manual, 0 = Auto)
- ❏ Bit 9:Reserved
- ❏ Bit 10:EXTERNAL CAL SELECTED (1 = External Calibration , 0 = Internal Calibration)
- ❏ Bit 11:REJECT1 ENABLED (1 = Active)
- ❏ Bit 12:REJECT2 ENABLED (1 = Active)
- ❏ Bit 13:REJECT3 ENABLED (1 = Active)
- ❏ Bit 14:REJECT4 ENABLED (1 = Active)
- ❏ Bit 15:Reserved

Word 2: xxx (Leak Rate mantissa X 1000)

Word 3: yy (Leak Rate exponent)

Read/Write Variable Interface: Data words 4-7 are for the configuration and status variable interface. This interface is described below.

Word 4: Variable Status

- ❏ Byte 0:Variable Index
- ❏ Byte 1:Command status (see command interface description)

Word 5: Variable Input Data 0

Word 6: Variable Input Data 1

Word 7: Variable Input Data 2   Variable data words contain the value of the variable read or written.

5.2.2 PROFINET Output Data

The following data is cyclically transferred from the host to the module. The data is arranged in 16 bit words with the described meaning.

Cyclic output Data   Data words 0-2 can be modified at any time by the host. Changes to these words will create the described action on the next cycle.

Word 0: Parallel I/O Output Bits   The bits in this word mirror the input bits on the parallel I/O connector.

❑ Bit 0:INTERNAL_CAL_IN (Rising Edge)

❑ Bit 1:ZERO_IN (Rising Edge)

❑ Bit 2:OFFSET_IN (Rising Edge)

❑ Bit 3:TUNE_IN (Rising Edge)

❑ Bit 4:EXTERNAL_CAL_IN (Rising Edge)

❑ Bit 5:READ STANDARD LEAK_IN (High Level)

❑ Bit 6:PARALLEL_ENABLE_IN (High Level)

❑ Bit 7:AUTO_MANUAL_RANGE_IN (1= MANUAL) (High Level)

❑ Bits 8-15:Reserved

Word 1: Command Bits   The bits in this word cause leak detection actions:

❑ Bit 0:ZERO ENABLE (1 = Enable)

❑ Bit 1:PASSWORD ENABLE, (1 = Enable)

❑ Bit 2:RANGESTOP ENABLE (1 = Enable)

❑ Bit 3:AZ<0 (1 = ON, 0 = OFF)

❑ Bit 4: Reserved

❑ Bit 5:AUDIO MUTE (1= Muted , 0 = Audio ON)

❑ Bit 6: Reserved

❑ Bit 7: Reserved

❑ Bit 8: Reserved

❑ Bit 9: Reserved

❑ Bit 10:SELECT EXTERNAL OR INTERNAL CAL (1 = External Calibration , 0 = Internal Calibration)

❑ Bit 11:ENABLE REJECT1(1 = Enable)

❑ Bit 12:ENABLE REJECT2 (1 = Enable)

❑ Bit 13:ENABLE REJECT3 (1 = Enable)

❑ Bit 14:ENABLE REJECT4 (1 = Enable)

❑   Bit 15: Reserved

Word 2: Reserved

Word 3: Reserved

Read/Write Variable   Data words 4-7 are for the configuration and status variable inter-
Interface   face. This interface is described below.

Word 4: Variable Command:

❑   Byte 0:Variable Index

❑   Byte 1:Command (see command interface description)

Word 5: Variable Output Data 0

Word 6: Variable Output Data 1

Word 7: Variable   Variable data words contain the value to write to a variable.
   Output Data 2

5.2.3 Configuration and Status Variable Interface

The configuration and status variable interface provides a method to read and write
configuration and status variables. The interface works as follows:

Write Variable Command (0x81):

1.   Put value to write in Variable Data words.

2.   Put variable index, in Byte 0 of Variable Command word, and set Byte 1 to 0x81.

3.   Variable Status word is set to match Variable Command word if command accepted, or
     to 0x7Fxx if error where xx=error code.

4.   Input Variable data words is set to value written.

5.   Clear Variable Command word to reset interface.

     Variable status word is cleared, indicating interface is ready for next command.

Read Variable Command (0x82):

1.   Put variable index, in Byte 0 of Variable Command word, and set Byte 1 to 0x82.

2.   Variable Status word is set to match Variable Command word if command accepted, or
     to 0x7Fxx if error where xx=error code.

     If command is accepted, input Variable data words will contain the variable value.

3.   Clear Variable Command word to reset interface.

     Variable status word is cleared, indicating interface is ready for next command.

5.2.4 Configuration and Status Variables

The following configuration and status variables can be read or written through the variable interface.

Table 5-1   Configuration and Status Variables

Index	Variable	Access	Description	Response
00		R/W	Clear Variable Command Word.	
01	RESERVED			
02	CPLOCKOUT	R/W	The control panel lockout feature, ON or OFF.	Word 5: 0=OFF, 1= ON
03	CURRDATE	R/W	The system date as kept by the I/O PCB and transferred to the CPU on a Write.	Word 5: mm, Word 6: dd, Word 7: yyyy
04	DISPLAY	R/W	The display bar graph mode, *log* or *lin*.	Word 5: 1 = LOG, 0 = LIN
05	EXPONENT	R/W	The manual-mode exponent.	Word 5: xx i.e. 03 or 10
06	EXTLEAK	R/W	The external calibrated leak.value.	Word 5: xxx (mantissa X 1000), Word 6: yy (exponent) Word 7: 0 = neg, 1 = pos exponent
07	GAIN	R/W	The system gain value.	Word 5: xx (gain X 10 i.e. 22 = 2.2)
08	RESERVED			
09	TIME	R/W	The system time as kept by the I/O PCB and transferred to the CPU on a Write.	Word 5: hhmm,Word 6: ssap (ap = 1 for pm)
10	RESERVED			
11	LKEXPIRE	R/W	The internal calibrated leak expiration date mm/dd/yyyy.	Word 5: mm, Word 6: dd, Word 7: yyyy
12	LEAKTEMP	R/W	The internal calibrated leak temperature that the factory calibration was performed at (degrees C).	Word 5: tt (temp X 10)
13	TPPRESSURE	R	The current Test Port pressure in mTorr.	Word 5: xxx (mantissa X 1000), Word 6: yy (exponent) Word 7: 0 = neg exponent
14	SYPRESSURE	R	The current System Pressure in mTorr.	Word 5: xxx (mantissa X 1000), Word 6: yy (exponent) Word 7: 0 = neg exponent
15	RESERVED			
16	RESERVED			
17	RANGE	R/W	The number indicating the exponent of the least sensitive range of detectable leak. The reported leak rates are in this range and three lower (more negative exponent) ranges.	Word 5: yy (exponent), Word 6: 0 = neg, 1 = pos exponent
18	RANGESTOP	R/W	The Rangestop variable.	Word 5: yy (exponent), Word 6: 0 = neg, 1 = pos exponent
19	1REJECT	R/W	The reject 1 leak rate setpoint.	Word 5: xxx (mantissa X 1000), Word 6: yy (exponent), Word 7: 0 = neg, 1 = pos exponent
20	2REJECT	R/W	The reject 2 leak rate setpoint.	Word 5: xxx (mantissa X 1000), Word 6: yy (exponent), Word 7: 0 = neg, 1 = pos exponent
21	3REJECT	R/W	The reject 3 leak rate setpoint.	Word 5: xxx (mantissa X 1000), Word 6: yy (exponent), Word 7: 0 = neg, 1 = pos exponent
22	4REJECT	R/W	The reject 4 leak rate setpoint.	Word 5: xxx (mantissa X 1000), Word 6: yy (exponent), Word 7: 0 = neg, 1 = pos exponent
23	RESERVED		Reports the currently stored Test Sequencer rough time used as part of setting up the Auto Sequencer.	
24	STDLEAK	R/W	The calibration standard leak rate.	Word 5: xxx (mantissa X 1000), Word 6: yy (exponent), Word 7: 0 = neg, 1 = pos exponent
25	STDLEAKt	R	Reports the temperature corrected value of the internal calibrated leak. If the value is out of range or the temp cannot be read, the STDLEAK value is returned.	Word 5: xxx (mantissa X 1000), Word 6: yy (exponent), Word 7: 0 = neg, 1 = pos exponent
26	RESERVED			
27	SYSPWD	R	The value of the system password.	
28	RESERVED			
29	TEMPFACTOR	R/W	Coefficient of temperature change of the cal leak (Determined at the factory when the cal leak was calibrated).	Word 5: tt (temp X 10), Word 6: 1 = neg
30	RESERVED			
31	VER	R	The CPU software version in the form *LC02.05*.	Word 5: xxxx (Revision X 100), Word 6: yy (Chksum MSByte), Word 7: Chksum LSByte ex
32	CHKSUM	R	The checksum of the software in the CPU PCB.	Word 5: Hi Byte, Word 6: Lo Byte
33	WHYNOCAL	R	The calibration failure diagnostics.	Word 5: 0 to 5 0 = Cal Ok, 1 = No Ion Peak, 2 = No E Peak, 3 = GainTooHigh, 4 = GainTooLow, 5 = LostPower

Table 5-1   Configuration and Status Variables (Continued)

Index	Variable	Access	Description	Response
34	OFFSET	R	Reports the offset number.	Word 5: Hi Byte, Word 6: Lo Byte, Word 7: 1 = neg
35	IONCHAMBER	R	Reports the Ion Chamber Voltage.	Word 5: xxxx (Volts x 10)
36	EMISSION	R	Reports the Emission Current.	Word 5: (mA x 1000)
37	FIL1HOURS	R	Reports the running hours of Filament 1.	Word 5: Hi Byte, Word 6: Lo Byte, Word 7: 1 = neg
38	FIL2HOURS	R	Reports the running hours of Filament 2.	Word 5: Hi Byte, Word 6: Lo Byte, Word 7: 1 = neg
39	TURBOHRS	R	Reports the running hours of th Turbo Pump.	Word 5: Hi Byte, Word 6: Lo Byte, Word 7: 1 = neg

NOTE *Table 5-2 describes the startup scenario for the ProfiNet interface option.*

Table 5-2   VS C15 Startup Scenario

System Startup Function	ProfiNet
Power up unit: 24 VDC	
Turbo ramps to programmed RPM	Cyclic Input Data, Word 0, Ready – Bit 5 – *0* Busy - Bit 6 – *1*
Turbo reaches programmed RPM Filaments 1 & 2 are checked and selected filament activates	Cyclic Input Data, Word 0, Ready – Bit 5 – *0* Busy - Bit 6 – *1*
System background and turbo bearing temperature are measured. If these parameters meet the startup limits the 15 minute stabilization timer stops or times out.	Cyclic Input Data, Word 0, Ready – Bit 5 – *1* Busy - Bit 6 – *0*

NOTE *If the system was recently calibrated before shut down, it can be used for qualitative testing. Read the standard leak to verify accuracy. For more accurate quantitative leak values, perform a calibration 30 minutes after start-up.*

To accurately read in the most sensitive decades of each working range, perform a tune, calibration and offset, and internal or external calibration after a 20-30 minute warm up.

NOTE *The VS C15 Base unit is always in Test/Measurement mode.*

5.2.5 Internal Calibration via the Profinet Option

NOTE   *Active = 1*

[!]

Action: Isolate the leak detector from the test system.

Cyclic Input Data: Word 0, Ready -Bit 5 - 1
Cyclic Output Data: Word 1, Parallel_Enable - Bit 6 - 1
Cyclic Input Data (External Cal Selected): Word 1, Bit 10 - 0
Cyclic Output Data (Select External or Internal Calibration):
Word 1, Bit 10 - 0
Cyclic Output Data: Word 0 - Internal Calibration - Bit 0 - pulse
Cyclic Input Data: Word 0 - Busy - Bit 6 - 1
                       Word 0 - Tune_ok - Bit 0 - 1
                        Word 1 - Interna_Cal ok - Bit 1 - 1

5.2.6 Full External Calibration via the Profinet Option

Manual full external calibration *(Tune, Offset, & Ext. Calibration)*

Action: Place the leak detection test system in the Test/Measurement mode external calibrated leak on.

Cyclic Input Data: Word 0, Ready - Bit 5 - 1
Cyclic Output Data: Word 0, Parallel_Enable - Bit 6 - 1

Cyclic Output Data: Word 0, Tune In - Bit 3 - pulse 0,1,0
Cyclic Input Data: Word 0, Busy Bit 6 - 1
Cyclic Input Data: Word 0, Tune OK - Bit 0 - 1

Action: Isolate the external calibrated leak from the system.

Cyclic Output Data: Word 1, Select External or Internal Calibration - Bit 10 - (1 = Ext., 0 = Int.)

Cyclic Output Data: Word 0, Offset - Bit 2 - pulse 0,1,0
Cyclic Input Data: Word 0, Busy Bit 6 - 1
Cyclic Output Data: Word 0, External Cal - Bit 4 - pulse 0,1,0
Cyclic Input Data: Word 0, Busy Bit 6 - 1
Cyclic Input Data: Word 0, Ext Cal OK - Bit 1 - 1

NOTE   *Quick external calibration - If a successful internal calibration has been performed it is unnecessary to do an external tuning procedure since the tuning was done during the internal calibration. Perform only an Offset and an External Calibration.*

[!]

Section 6. Maintenance

NOTE

Only trained personnel must perform all services.

A VS C-15 mass spectrometer leak detector requires periodic maintenance to ensure continued reliable operation. After prolonged use, the leak detector accumulates contaminants from even the cleanest of products tested that eventually impair operation. A thorough disassembly and cleaning of the entire vacuum system, which includes the spectrometer, restores normal operation. For heavy production use, more frequent overhauls may be needed. In most cases, maintenance personnel do this work, but Agilent can also do this work under the terms of a service contract.

This maintenance section covers daily and as-required maintenance. It does not cover overhaul of the entire vacuum system. Refer to the *VS C-15 Helium Mass Spectrometer Leak Detectors Field Service Component Replacement Manual* for annual and preventive maintenance procedures.

If your leak detector requires service that is not covered in this section, contact Agilent Customer Service. See the back cover of this manual for a listing of our sales and service offices.

Important Reminders

In addition to the safety notes at the beginning of this manual, heed the following notes, cautions, and warnings when performing maintenance.

WARNING

Disconnect power from the leak detector before performing any maintenance procedure that requires physically disconnecting any part of the system.

The VS C-15 leak detector has a battery backed clock which uses a primary (non-rechargeable) lithium coin battery from Panasonic, P/N BR2477A/HB (3.0 V, 1 A) that is permanently soldered onto a Motherboard PCB. Never replace this battery with a rechargeable type. Use only the primary type of lithium battery. Only a qualified technician should replace any battery. The battery has a life of 7 to 10 years.

The VS C-15 leak detector uses fuses and circuit breakers that are not operator replaceable. Only a qualified technician should replace any fuse.

Information about the fuses and circuit breakers is given in Table 6-3 on page 6-4.

Cleanliness is vital when servicing the leak detector or any vacuum equipment. There are some techniques more important in leak detector servicing than in general vacuum work:

CAUTION

Do not use silicone oil or silicone grease.

Use powder-free butyl or polycarbonate gloves to prevent skin oils from getting on vacuum surfaces.

Do not clean any aluminum parts with Alconox®. Alconox is not compatible with aluminum and will cause damage.

NOTE

Agilent does not recommend the use of vacuum grease. Vacuum grease absorbs helium tracer gas and releases this slowly resulting in helium background during leak test operations. If it must be used, use it sparingly and avoid silicone types. Apiezon® L grease is recommended (Agilent Part No. 695400004).

When removing, checking or replacing O-rings:

CAUTION

Remove O-rings carefully with your fingers. Do not use metal tools for this task. This prevents scratching of any sealing surfaces.

Wipe all O-rings clean with a lint-free cloth before installation to ensure that no foreign matter is present to impair the seal.

Do not use grease or any other substances on O-rings or metal seals that will come in contact with the spectrometer.

Do not use alcohol, methanol or other solvents on O-rings as this causes deterioration and reduces their ability to hold a vacuum.

NOTE

If applicable, apply a small amount of Apiezon® L grease and wipe the O-rings shiny dry.

NOTE

Due to the effective cleaning nature of VacuSolv solvent and its residue-free properties, Agilent' Component and Spectrometer Cleaning Kit (Part Number 670029096), used in accordance with the kit instructions, is recommended for cleaning spectrometer components. The kit can also be used for fine cleaning of other parts in the leak detector's vacuum system such as valves and fittings. No rinsing steps or high-temperature drying are required following cleaning with VacuSolv. Although appropriate precautions are advised, VacuSolv is compatible with most materials and does not contain toxic chemicals or CFCs (chlorofluorocarbons). Other acceptable solvents are isopropyl alcohol (IPA) or Dow Corning® OS-20.

For simplicity, the maintenance functions in this section are grouped by recommended frequency, as shown in Table 6-1, based on assumed daily use.

Table 6-1   Scheduled Maintenance

Description	Daily	12 Months
Calibration check	X	
Recalibrate the internal calibrated leak		X

Maintenance functions that may be required on a demand basis, such as changing a filament after filament failure, are listed in Table 6-2.

Table 6-2   As-Required Maintenance

Function	Most Common Symptom
Spectrometer cleaning	The spectrometer is designed to operate for years without maintenance, however actual performance depends on the leak detector operational environment. Spectrometer cleaning restores optimum performance if the unit shows significant sensitivity loss or high background signal. Sensitivity loss appears as a high gain value after a calibration or failure to calibrate with a *gain too high* error message.
Filament replacement	Filaments are designed to operate for several years with no maintenance. When a filament burns out, the system automatically switches to the other filament and notifies you to recalibrate. The calibration notice also serves to inform you of a filament failure. Agilent recommends that the burned out filament be replaced at a convenient time so that a spare is always available during leak test operations to prevent unplanned system down time.
Tuning adjustments	If calibration is not successful or if the system is calibrated to an external leak, tuning can maximize the helium signal.
Mechanical pump fluid change	Persistent, high helium background signal. Fluid contamination (dirty brown color indicates burnt or contaminated fluid, milky white consistency indicates high water vapor content in fluid).

Table 6-3 lists the fuses and circuit breakers.

Table 6-3   Fuses and Circuit Breakers

Function	Type, MFG, PIN	Location
Circuit Breaker	DC Power Supply: 6 A, 32 VDC Tyco, P/N W28-XQ1A-6	Rear Panel
Fuses (PCB over current protection)	1.85 A, 33 VDC Tyco/Raychem. SMD185-2	Motherboard (RT400) Discrete I/O _ProfiNet (RT300) Ion Source (Fl) Front Panel Controller (RT400)
	5x20mm, T4A, 4 A, 250V AC, Cooper/Bussmann S505-4 A	Turbo Controller (F2)

NOTE

!

Only a qualified technician should replace circuit breakers and fuses. Use only circuit breakers and fuses of the same type and rating.

6.1 Daily Maintenance

6.1.1 Sensitivity Check

Refer to Section 2.1.1 "Startup " on page 2-3.

6.2 Spare Parts List

Table 6-4   Leak Detector Spare Parts

Assembly	Part Number
VS-C15 Base Unit (w/o internal calibrated leak) Exchange	EXVSC15BU
Motherboard PCB	R2101501
CPU PCB	R2361304
Ion Source PCB	R2120501
24 VDC Turbo Controller PCB	EX9699538
VS C15, Display Unit	VSC15D4
VS C15, Display Power cable 10'	VSCDUC10
VS C15, 24 V Power Supply	VSC15PS
VS C15, 24 V Power cable, 8'	VSCBUPC8
Spectrometer Assembly, Exchange	EXR3340301
Spectrometer Header Assembly - exchange	EXVSCFLDHHA
VS C15, Option, Calibrated Leak (Field Installed)	VSCFLDCL
VS C15, Option, Calibrated Leak (Factory Installed)	VSCFACCL
Replacement Calibrated Leak	VSFLDCL
Fan Assembly	VSCFLDFN
Convectorr Gauge	L9090301 1/8 NPT L9090303 Cajon 4 VCR L9090305 NW16 L9090306 NW25
VS C15, ConvecTorr cable, 10'	VSCCTC10
VS C15, ConvecTorr cable, 25'	VSCCTC25
Filament Replacement*	VSFLDFR, EXVSFLDHFR
O-ring Kit	VSCFLDOR
Discrete I/O PCB	R3220501
VS C15, ProfitNet Module (Factory Installed)	VSCFACPN
VS C15, ProfitNet Module (Field Installed)	VSCFLDPN
Ion Source Replacement Kit	EXVSFLDHIS

Table 6-4   Leak Detector Spare Parts (Continued)

Calibrated Leak 3-way Valve	612229214
Ion Box Replacement Kit	EXVSFLDHIB

* C15 units sold after 8/18/2009 with a serial number LL0909L826 or higher use kit VSFLDHFR.

6.3 Leak Detector Accessory Item List

Table 6-5   Leak Detector Accessories

Assembly	Part Number
Power Probe, 10' (NW25 Flange)	K9565306
Power Probe, 25' (NW25 Flange)	K9565307
Spare Tip Filters for Power Probe (Qty: 10)	K9565303
Throttle Valve (NW25 Flange)	R1947301
Elite-Z Mechanical Pump Fluid	695409005
Calibrated Leak, 10-5, 10-6 (NW25 Flange)	F8473320
Calibrated Leak, 10-7 (NW25 Flange)	F8473321
Calibrated Leak, 10-8 (NW25 Flange)	F8473322

Appendix A. VS Series Leak Detector Hardware Descriptions

The VS Series Helium Mass Spectrometer Leak Detector system hardware locates and measures the partial pressure of helium that is proportional to the desired Helium leakage flow rate in a vacuum system under full software control. The VS Series leak detector hardware provides:

❏ High vacuum creation for a spectrometer

❏ Helium detection and leak rate measurement

❏ Microprocessor-based software control of all leak detector functions, mode and operations such as:

 ❏ Spectrometer tube electrode parameters

 ❏ Leak rate analog-to-digital and digital-to-analog conversion, calculation and presentation via LCD Display, audio speaker, analog voltage and RS-232 outputs

 ❏ Spectrometer and Test Port pressure measurement, calculation and presentation via the LCD display and RS-232 output

 ❏ Valve control (via I/O board)

 ❏ Turbo molecular control

 ❏ Front Panel control and indication

 ❏ Discrete I/O reading and control

VS Series hardware resides in a stand-alone unit with a metal enclosure compromised:

❏ Spectrometer tube sub-assembly with a pre-amplifier PCB

❏ Optional Internal Standard Calibrated Leak with a Temperature Sensor PCB

❏ Turbo molecular pump

❏ Electronics block sub-assembly with the CPU, Motherboard, Ion Source and Turbo Controller PCBs

❏ Front Panel with the color LCD Display

❏ Discrete I/O PCB - with:

 ❏ A control 3-way valve (optional standard leak)

 ❏ Profinet Industrial Network

❏ A fan

All VS Series leak detector hardware PCBs and sub-assemblies are interconnected using the cables shown in Figure E-1 on page E-2.

A.1 Spectrometer Tube Description

The spectrometer tube is a heart of the VS Series Helium Mass Spectrometer Leak Detector and is quantitatively sensitive to the presence of helium.

The VS Series spectrometer tube:

❑ Creates positive ions from gas molecules that penetrate inside the spectrometer, maintained under high vacuum, via any leaks in the unit under test (UUT), which is connected to the test port

❑ Separates helium from all other gas ions, detects helium and total gas pressures as currents

❑ Converts the helium current into voltage with amplification.

The VS Series leak detector spectrometer tube is a stand-alone unit comprised of five sections:

❑ Spectrometer tube body with magnets

❑ Ion source with two filaments section

❑ Electro-magnetic ion lenses

❑ Electrometer section for the partial helium pressure signal

❑ Collector plate for the total pressure signal

A.2 Printed Circuit Boards P/Ns and Descriptions

This section describes the following circuit boards:

A.2.1 CPU PCB

The CPU PCB (Agilent P/N R2361304) is a modified version of a PC104-based single board Computer that functions as an embedded PC in the VS Series leak detector.

The CPU PCB circuitry provides:

- ❑ 32-bit, 16 MHz, integrated MC68332 microcontroller unit (MCU), which combines high-performance data manipulation capabilities with powerful peripheral subsystems

- ❑ Battery backed SRAM for frequently updated process parameters and real time clock/calendar

- ❑ Flash Memory with boot sector

- ❑ EEPROM for setup and configuration parameters

- ❑ Non-isolated UART/RS-232 serial interface for communication with the external VS Series leak detector peripherals such as:

  - ❑ Front Panel PCB

  - ❑ Turbo Pump Controller PCB

  - ❑ Discrete I/O PCB

- ❑ Serial Interface for background debug mode (BDM)

- ❑ EEPLD control signals generation for the Motherboard PCB

- ❑ ESD protected PC104 Parallel Interface (Data, Address and Control) Bus for communication with the Ion Source and Preamp PCBs via the Motherboard PCB

The CPU circuitry resides on a stand-alone PC104 PCB comprised of six sections:

❑ MCU and memory (SRAM, FLASH and EEPROM) section

❑ Real Time Clock/Calendar section with the battery and super capacitor backup with 4-pin battery connector (JXBT) and IRQ1 jumper

❑ RS-232 section with 9-pin connector (J2); pin No. 10 is removed

❑ BDM section with 10-pin connector (J1)

❑ Time processor section with 34-pin connector (J4); not used in VS leak detector.

❑ Parallel interface section with two 64-pin, 0.1x0.1, PC-104 bus type I/O connectors (J3)

A.2.2 Motherboard PCB

The Motherboard PCB (Agilent P/N R2101301) functions as liaison between the CPU PCB and all other hardware section under full software control provided by CPU PCB.

The Motherboard PCB circuitry provides:

❑ Parallel interface (Data, Address and Control) communication between a CPU and an Ion Source PCBs

❑ UART/RS-232 non–isolated parallel-to-serial and serial-to-parallel interface for the leak detector peripherals such as:

  ❑ Front Panel PCB

  ❑ Turbo Pump Controller PCB

  ❑ Discrete I/O PCB

❑ RS-232 isolated serial communication between the CPU PCB and a rear panel serial diagnostic port

❑ Isolated leak rate analog output (0-10 VDC)

❑ Parallel-to-serial and serial-to-parallel communication between the Pre-amp ADC PCB and CPU PCB

❑ Test Port Thermocouple (TP TC) power supply and TP pressure voltage-to-frequency signal conversion

❑ Isolated calibrated leak temperature frequency signal conversion

❑ CLPD control signals generation, data-to-frequency and frequency-to-data conversion

❑ +24 VDC to a +5 VDC DC-DC conversion for the 5V-logic supply and clock/ memory battery power back up.

The Motherboard circuitry resides on a stand-alone PCB comprised of five sections:

❏ Parallel interface section with two 64-pin, 0.1x0.1, PC-104 bus type I/O connectors (J1 and J2)

❏ Non-isolated quad UART/RS-232 section with four I/O, RJ45-8x8 connectors (J100A/B and J101A/B)

❏ TP TC gauge section with 4-pin I/O connector (J200)

❏ Isolated section that consists of analog output and RS-232 circuitry with 10-pin I/O connector (J300) and two I/O, RJ45-8x8 connectors (J302) and a calibrated leak temperature circuitry with 4-pin input connector (J301)

❏ Power Supply section with 3-pin connector (J400) and 4-pin connector (XJBT1)CPLD section with two 14-pin JTAG connectors (J501 and J502) and RJ45-10x10 connector (J500)

A.2.3 Ion Source PCB

The Ion Source PCB (Agilent P/N R2120501) creates the high voltage and filament current supply for all spectrometer tube electrodes under full software control provided by the CPU PCB.

The Ion Source PCB circuitry provides:

❏ Parallel interface (Data, Address and Control) communication between the Ion Source and CPU PCBs via the Motherboard PCB

❏ High voltage flyback power supplies for a spectrometer tube such as:

  ❏ Filament Bias

  ❏ Suppressor

  ❏ Chamber/Repeller

❏ Filament power supply with an emission current regulation loop

❏ CLPD control signals generation

❏ Isolated digital control of the ion voltage (filament bias/repeller voltage) and emission current (filament voltage) tuning; the filament selecting (FIL 1_SEL and FIL2_SEL), high voltage supply (HV_ON/OFF) switching

❏ +24 VDC to a +5 VDC DC-DC conversion for the filament supply and +24 V to +15 V for the digital control circuitry

The Ion Source circuitry resides on a stand-alone PCB comprised of five sections:

❏ Parallel interface/CPLD section with a 64-pin, 0.1x0.1, PC-104 bus type I/O connector (J5) and a 14-pin JTAG connector (J2)

❏ High voltage section with the ion voltage tuning and a 10-pin connector (J4)

❑ Filament power supply section with the emission tuning and good emission (EMI-OK) signals generation

❑ Isolated digital control section

❑ Power supply section with 3-pin connector (J1)

A.2.4 Turbo Controller PCB

Turbo V81 Controller PCB circuitry provides:

❑ RS-232 communication with the CPU PCB via the Motherboard PCB

❑ Local microprocessor-controlled 24 VDC-to- frequency conversion with auto-diagnostic (voltage, current and temperature control) and auto-protection (over current and temperature) functionality for turbo pump

❑ 3-phase variable output voltage, current and frequency control respect to the speed reached by the turbo pump

❑ +24 VDC to +5 VDC, +15 VDC, +12 VDC and +VP (~50 VDC) conversion

A.2.5 Front Panel Controller PCB

The Front Panel PCB (Agilent P/N R2117501) functions as liaison between an operator and VS Series leak detector via an LCD display.

The Front panel PCB circuitry provides:

❑ ± 50 V isolated RS-232 interface with the CPU PCB via the Motherboard PCB

❑ Non-isolated RS-232 interface with a Wireless Base PCB

❑ Microprocessor (CPU) control of the two UART, color TFT- LCD Display, Touch and Front Panels, LCD brightness and audio volume, PWM output for an audio circuitry, USB device functionality and temperature control

❑ Power amplification for the audio control

❑ CPLD control signal generation

❑ 24 VDC to +3.3 VDC, +12 VDC and +1.8 VDC conversion

❑ 24 VDC to 600 VAC conversion for a CCFL backlight of the LCD display

The Front Panel Controller PCB circuitry resides on a stand-alone PCB comprised of nine sections:

❑ CPU and memory (SDRAM and Flash) section

❑ Isolated I/O RS-232 interface section (UART1) with a RJ45-8x8 connector (J303)

❑ Non-isolated I/O RS-232 interface section (UART2) with a DB9 female connector (P300)

❑ USB device section with a USB B-type connector (J302)

❏   CPLD section with a 6-pin overlay connector (J503) and 14-pin CPLD JTAG connector (J500)

❏   Audio amplifier section with a 2-pin speaker connector J501

❏   TFT_LCD and Touch Panel interface section with a 33-pin display connector (J602), 4-pin touch panel connector (J601), and 20-pin debug connector (P602)

❏   Power supply section with 3-pin power connector (J401) and 5-pin backlight connector (J400)

❏   DC-AC daughter PCB with high voltage AC connector CN2

A.2.6 Pre-Amp PCB

The Pre-Amp PCB (Agilent P/N R2107301) functions as an ADC converter for the spectrometer tube helium and total pressure signals under full software control provided by the CPU PCB. The Pre-Amp PCB passes all voltages and currents to the ion source section of the spectrometer tube. The Pre-Amp PCB is soldered directly to a spectrometer tube header.

Pre-Amp PCB circuitry provides:

❏   Digital isolated serial interface with the Motherboard PCB

❏   24-bit sigma-delta analog-to-digital conversion of the signals proportional to:

   ❏   Helium leak rate generated by an electrometer amplifier in a spectrometer tube

   ❏   Total (spectrometer tube) pressure generated by the ions of gasses heavier than helium, collected by an off-target collector plate and amplified by an active low pass filter stage

   ❏   24 VDC conversion to ± 15 VDC, ± 12 VDC (the electrometer supply), ± 5 VDC analog supply for the ADC converter, +5 VDC digital supply and 24 V/5 V DC-DC conversion for the electrometer Peltier cooler element inside of the spectrometer tube

   ❏   Ion source's electrodes voltage supply distribution and filtering

The Pre-Amp PCB circuitry resides on a stand-alone PCB comprised of four sections:

❏   Digital isolated section with a RJ45-10x10 connector (JR1)

❏   ADC section with 8-pin spectrometer connector (J3)

❏   Power supply section

❏   Ion source's high voltage and high current distribution section with 10-pin connector (J1) and 6-pin spectrometer connector (J2)

A.2.7 Temperature Sensor PCB

The Temperature Sensor PCB (Agilent P/N R2114301) provides direct temperature –to-frequency conversion, where a period of the output square-wave 5 V-TTL signal is proportional to temperature. Further conversion to 16-bit digital signal is provided by a CPLD on the Motherboard PCB and sent to the CPU PCB via RS-232 port.

The Temperature circuitry resides on a stand-alone PCB directly placed on the Standard Calibrated Leak and comprised of an TMP03 integrated circuit and a 4-pin connector (J1).

A.2.8 Discrete I/O PCB

The Discrete I/O PCB (Agilent P/N R32205B1) functions as liaison between the VS Series leak detector and the external devices, such as PLC, PC and printer. The Discrete I/O PCB is under full software control provided by the CPU PCB.

1. The Discrete I/O PCB circuitry provides:

❏ Local CPU and memory (SDRAM and Flash) for serial-to parallel (Address, Data and Control signals) conversion for the parallel I/Os

❏ Parallel optically isolated input (8- lines) and Output (12-lines) interface between the VS leak detector and external equipment (e.g. PLC)

❏ RS-232 Isolated Serial communication interface with the CPU PCB via the Motherboard PCB

The Discrete I/O circuitry resides on a stand-alone PCB comprised of six sections:

❏ CPU and memory section

❏ Isolated RS-232 section (system site) with a RJ45-8x8 connector (J100)

❏ Isolated parallel interface section (customer site) with a 25-pin DB25 female type connector (J103)

❏ Power supply section with a 3-pin connector (J101)

2. Single valve channel:

Valve Driver PCB circuitry provides:

❏ Local microprocessor control and valve failure detection signals for two solenoid valves (one used only for the VS C-15)

❏ Delayed pulse-width modulated (PWM) output voltage for the solenoid valves

❏ +24 VDC to a +5 VDC conversion for the 5 V-logic.

The Valve Driver circuitry resides on an I/O PCB comprised of two sections:

❏ Microcontroller and two valve driver cells section with two 12-pin connectors (J3 and J4)

❏ Power supply with 3-pin connector (J2)

3. Orofinet Industrial Network (see Section 5 "Profinet Interface and Operation").

A.2.9 PROFINET I/O Module

The Network I/O PCB functions as liaison between VS Series LD and the external devices such as PLC via an opto-isolated discrete I/O parallel interface or Industrial Network via an Anybus CompactCom ProfiNet –IO, Plug-In Module. The Network I/O PCB is under full SW control provided by the VS LD CPU PCB.

❏ The Network I/O PCB circuitry provides:

❏ Local CPU functions for Serial-to Parallel (Address, Data and Control signals) conversion for the parallel discrete I/Os and embedded Anybus-CompactCom Module interface.

❏ Parallel Optically Isolated Input (7 lines) and Output (12 lines) Interface between a VS C15 Base unit and an external equipment (e.g. PLC).

❏ ± 50V RS-232 Isolated Serial communication interface with the CPU PCB via the Motherboard PCB.

❏ Transformer Isolated Ethernet interface for instant ProfiNet Real Time connectivity via the Anybus-CompactCom Profinet IO module and the uniform Anybus-CompactCom host interface.

❏ Local microprocessor control and valve failure detection signals for 2 solenoid valves and Flapper Box interface.

❏ Isolated +24V/ +3.3V conversion for the 3.3V-logic

❏ The Discrete I/O circuitry resides on a stand-alone PCB comprised of six sections:

❏ CPU sections with ICD Programming Port: 5-pin connector (J102) and Diagnostic port(4-pin connector J104 Isolated RS-232 Interface Section (system site) with a RJ45-8x8 connector (J100)

❏ Isolated Parallel Interface Section (customer site) with a 25-pin DB25 female type connector (J203)

❏ 2-CH Valve Driver section with a 6-pin connector (J302)

❏ Power supply section with a 3-pin connector (J301)

❏ Anybus-CompactCom Module Interface section with a 50-pin CompactFlash type connector (J105).

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Appendix B. Replacement Procedures

B.1 VS-C15 Field Replacements: p/n EXVSC15BU

Field exchange replacements of component leak detectors is often more practical where testing uptime is critical and where troubleshooting time to perform failure and root cause analysis is a constraint.

Once the leak detector has been programmed (setup) and is ready for testing or is needs to be taken offline, record the operational parameters. This can be done manually or through the RS232 port with the DUMP-PARAMS command.

See Section 4 "RS-232 Interface and Operation" on page 4-1.

To perform a dump:

1. Connect to the serial port of the VS-C15.

2. Open HyperTerminal and open the *Transfer Menu* then select **Capture Text** and create a file name in a convenient location.

3. Enter *DUMP-PARAMS <CR>*

    ENABLE-0ENABLE

    15 INIT-AUDVOL DISABLE-VOLUME

    3.0E-06 INIT-EXTLEAK

    1 INIT-INTERNAL-TYPE

    1.4E-07 INIT-STDLEAK

    25.0 INIT-LEAKTEMP

    +0.0 INIT-TEMPFACTOR

    1 1 2005 INIT-LKEXPIRE

    INTERNAL

    LR1REJECT 1.0E-08 INIT-1REJECT DISABLE-1REJECT HIGH-1REJECT

    LR2REJECT 1.0E-08 INIT-2REJECT DISABLE-2REJECT HIGH-2REJECT

    LR3REJECT 1.0E-08 INIT-3REJECT DISABLE-3REJECT HIGH-3REJECT

    LR4REJECT 1.0E-08 INIT-4REJECT DISABLE-4REJECT HIGH-4REJECT

    1.0E-08 INIT-AREJECT DISABLE-AREJECT HIGH-AREJECT

    -06 INIT-RANGE

    -08 INIT-RANGESTOP DISABLE-RANGESTOP

-06 INIT-EXPONENT AUTO

0 INIT-AZ<0

1 INIT-TC-GAUGE

INIT-LINEAR

0 INIT-DISPLAY

777777 6 INIT-PASSWORD DISABLE-PASSWORD

0 INIT-LANGUAGE

4. Open the *Transfer Menu* and select **Capture Text** and **Stop.**

5. Open the created file and delete the first and last line of text file and **Save**.

B.1.1 Configuring a Field Replacement or New VS-C15

To do this:

1. Open HyperTerminal

    a. Select **Properties > Settings > ASCII Setup > ASCII Sending: Character delay**.

    b. Set *Input* to 200 milliseconds and select **Save settings**.

2. From the HyperTerminal – *Transfer Menu*:

    a. Select **Send Text File**.

    b. Select the original DUMP-PARAMS file for that leak detector.

3. Verify the saved *Dump Parameters Settings* against the settings on the front panel display in the various menus (Control Panel, Calibration Set Up, Reject & Audio Set point Setup, Leak Rate Ranging, Advanced Parameters, Output Control & Maintenance).

B.2 Turbo Pump Replacement

Equipment Required:

❑ M4 Allen Wrench

❑   Powder-free Nitrile Gloves

❑ 10 mm Nut Driver

❑ Adjustable Wrench

WARNING

⚠

Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.

1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-1).

Figure B-1   Unit Top Screws

CAUTION *Wear powder-free Nitrile gloves and minimize contact with the O-ring during this procedure.*

4. Remove the:

   ❑ NW16 clamp using the wing nut and place the O-ring to the side and lay the Calibrated Leak gently to the side (Figure B-3).

   ❑ Open the vent thumb screw and close after 30 seconds, if the Calibrated Leak option is not installed.

Figure B-2   NW25 Clamp with Calibrated Leak Not Present
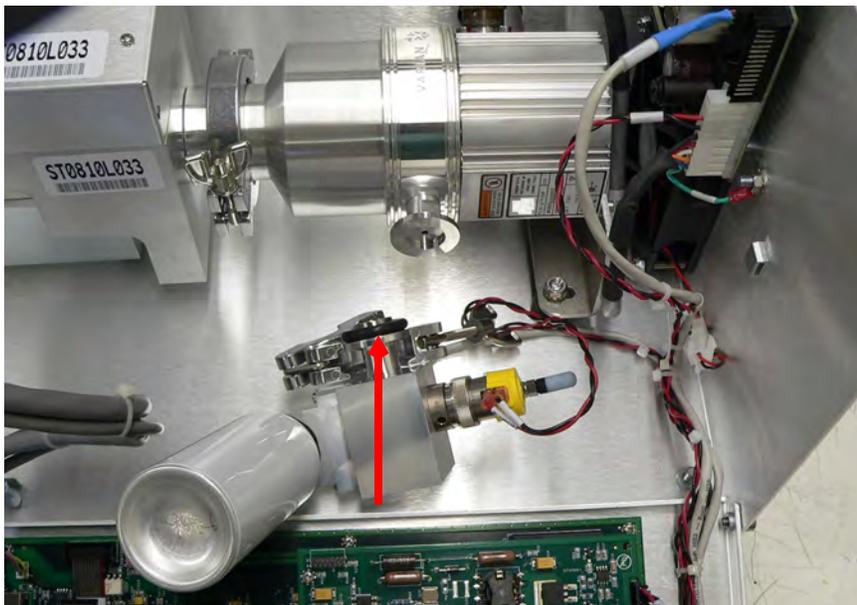
Figure B-3   Calibrated Leak O-ring

5. Remove the NW25 clamp using the wing nut and place the O-ring to the side (Figure B-4).
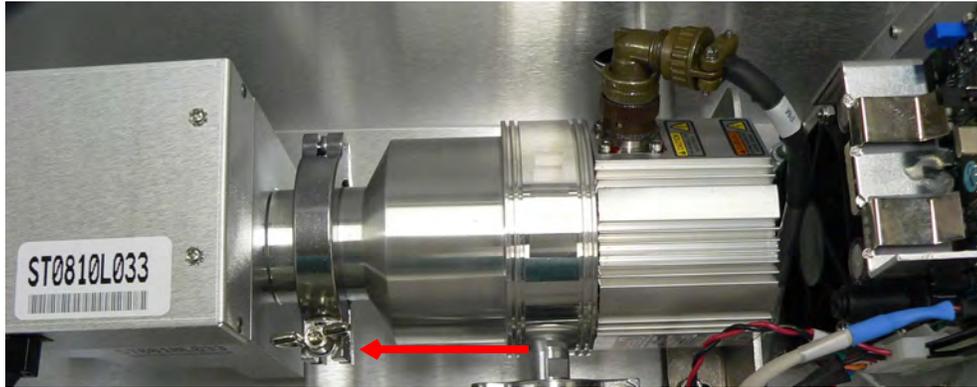
Figure B-4   NW25 Clamp To Spectrometer

6. Unscrew the connector to the pump ad pull the cable away (Figure B-5).
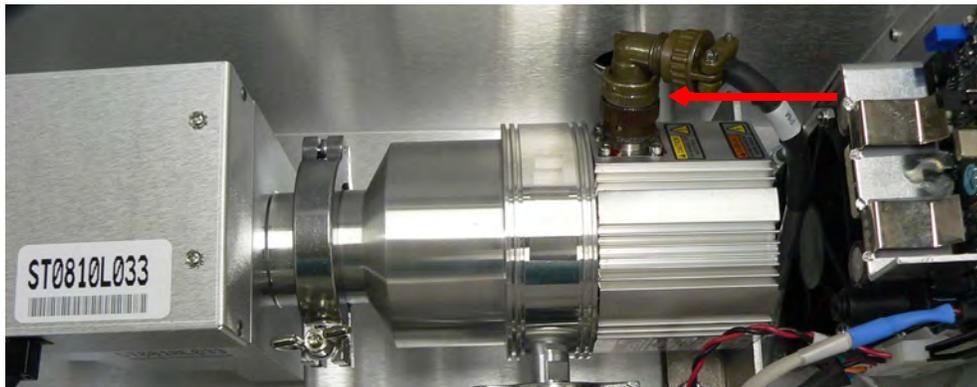
Figure B-5   NW25 Clamp To Spectrometer

7. Use a 10 mm nut driver to remove the two nuts holding the feet (Figure B-6).
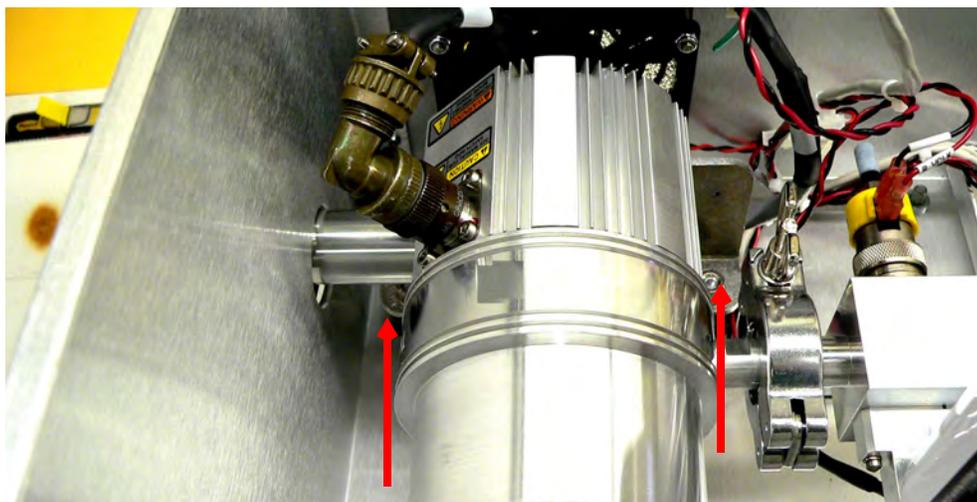
Figure B-6   Pump Feet Nuts

8. Use an adjustable wrench to unscrew the test port connection on the front of the unit (Figure B-7).

Figure B-7   Test Port Connection

9. Use an M2.5 wrench to remove the four (4) nuts holding the pump to the mounting assembly (Figure B-8).
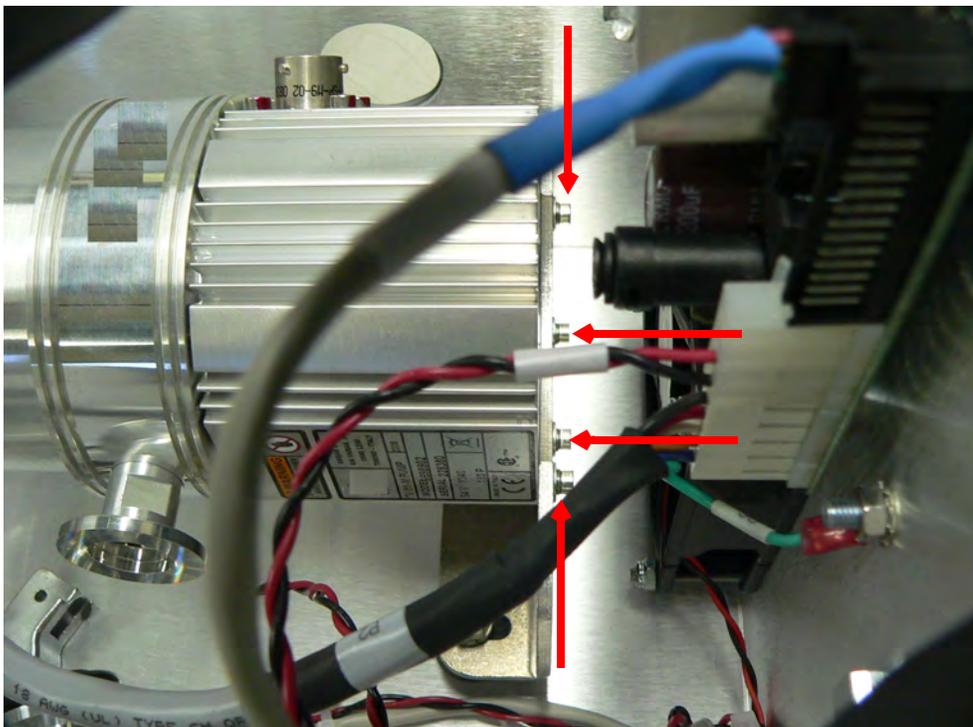
Figure B-8   Pump To Mounting Assembly

10. Remove the old pump and insert new pump.

11. Use an M2.5 wrench to reinstall the four (4) nuts holding the pump to the mounting assembly (Figure B-8 on page B-6).

12. Use an adjustable wrench to reinstall the test port connection on the front of the unit (Figure B-7 on page B-6).

13. Use a 10 mm nut driver to reinstall the two nuts holding the feet (Figure B-6 on page B-5).

14. Reattach the pump connector (Figure B-5).

15. Reattach the NW25 and NW16 clamps being careful to align the O-ring and metal inserts properly.

16. Use an M4 Allen wrench to replace the two screws on the unit's top (Figure B-1 on page B-3).

17. Replace the power cord and power up the unit.

B.3 Fan Replacement

Equipment Required:

❑ M4 Allen Wrench

❑ M2.5 Allen Wrench

WARNING

⚠

Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.

1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-9).


Figure B-9   Unit Top Screws

4. Disconnect the white fan connector (Figure B-10).
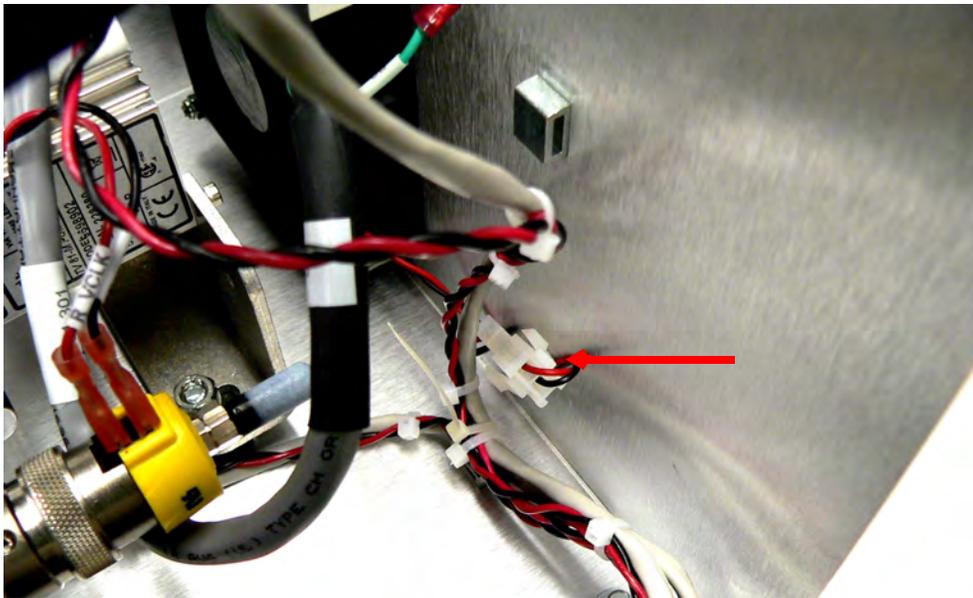
Figure B-10   Fan Connector

5. Remove the fan filter (Figure B-11).
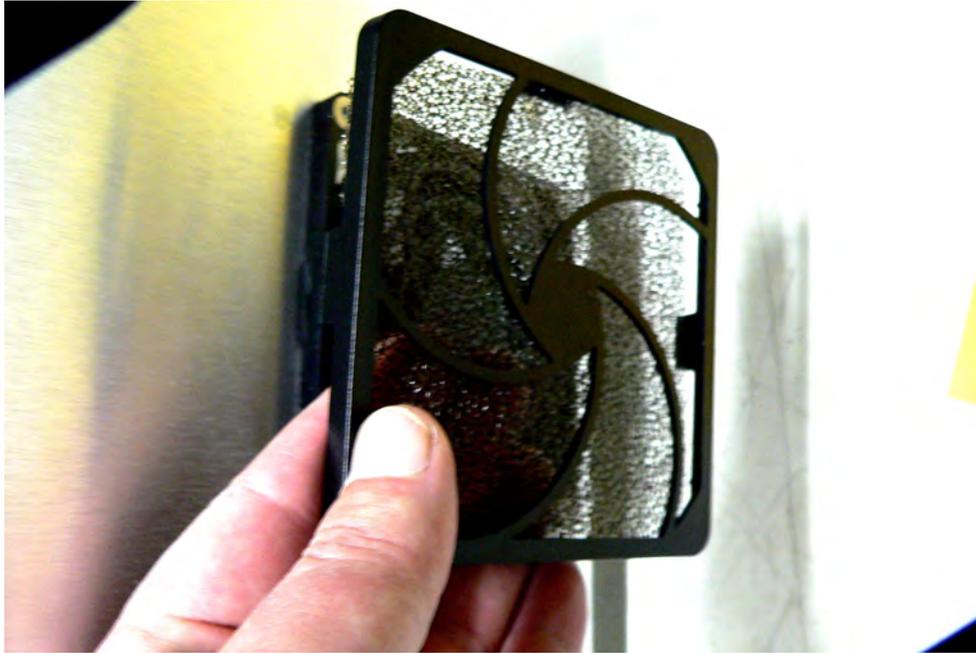
Figure B-11   Fan Filter

6. Remove the four (4) M2.5 screws from the outside of the unit (Figure B-12), securing each associated nut inside the unit. Ensure once loosened that the washer/nut/spacer for each do not roll into the unit (Figure B-13).
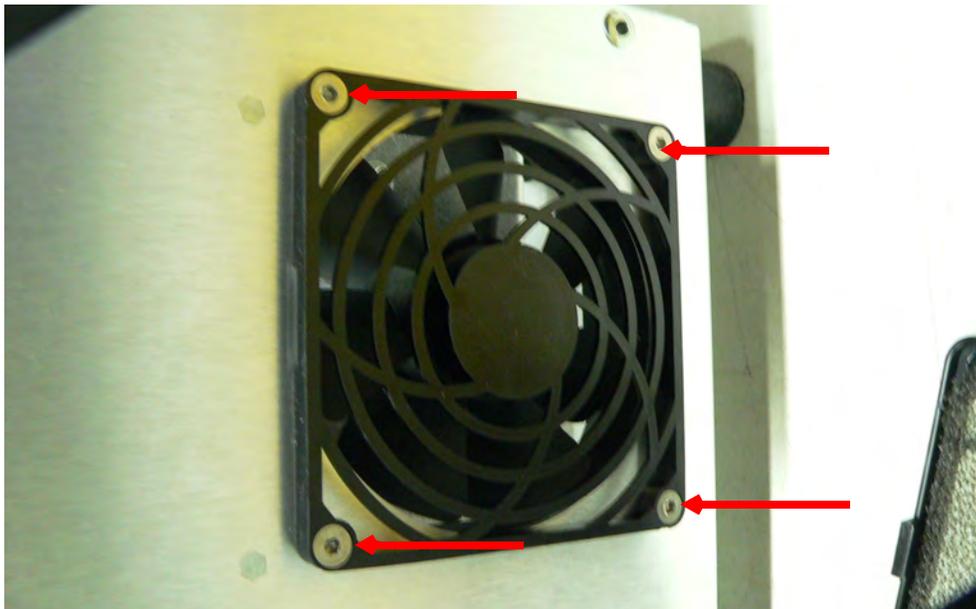
Figure B-12   Fan Exterior Screws
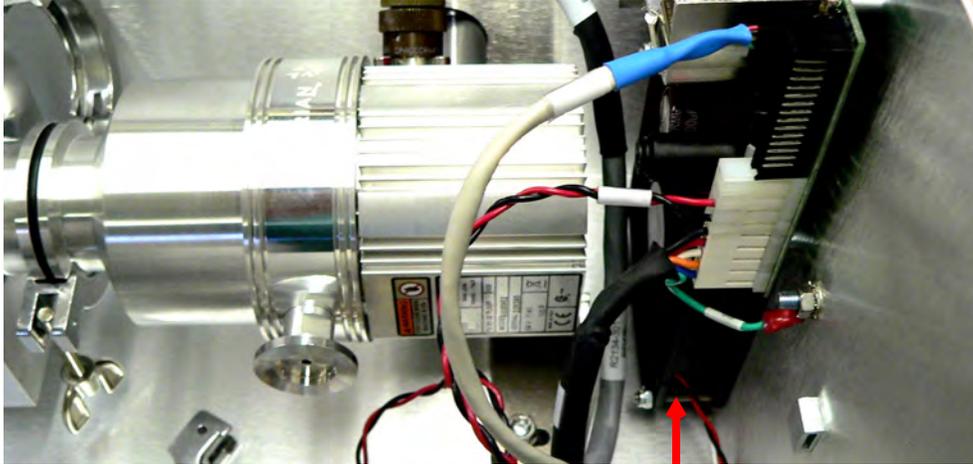
Figure B-13   Fan Washer/Nut/Spacer

7. Remove old fan.

8. Insert new fan and reinstall the four (4) sets of washer/nut and spacers and tighten front mounting screw.

9. Reconnect the white fan connector (Figure B-10 on page B-8).

10. Reinstall filter.

B.4 Calibrated Leak

Equipment Required:

❑   M4 Allen Wrench

❑   12 mm Open End Wrench

> **WARNING**
>
> ⚠️
>
> *Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.*

1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-14).

Figure B-14   Unit Top Screws

4. Remove the vent screw from the turbo pump (Figure B-15).

Figure B-15   Turbo Pump Vent Screw

5. Remove the clamp from the calibrated leak assembly and remove the turbo pump flange (Figure B-16).
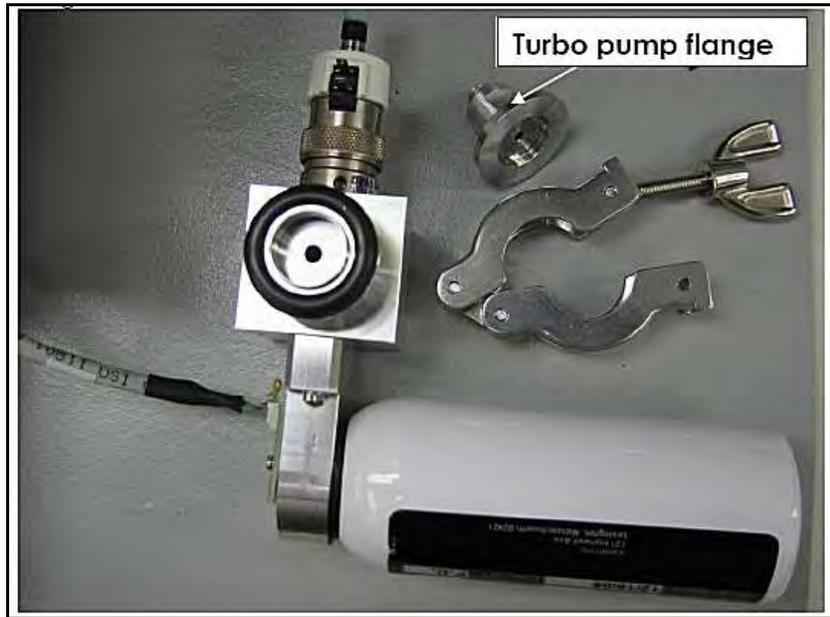
Figure B-16   Turbo Pump Flange

6. Verify the installation of the O-ring into the turbo pump flange. Then screw the turbo pump flange onto the turbo pump and tighten ¼ turn (Figure B-17) using a 12 mm open end wrench. Do not over tighten the flange as the threads in the turbo body can be damaged.
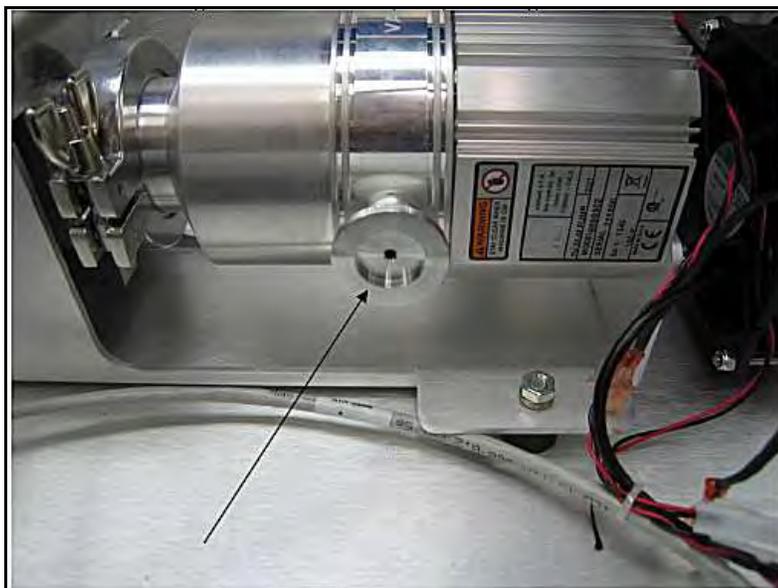
Figure B-17   Turbo Pump Flange in Place

7. Attach the calibrated leak assembly in the orientation shown using the clamp (Figure B-18).
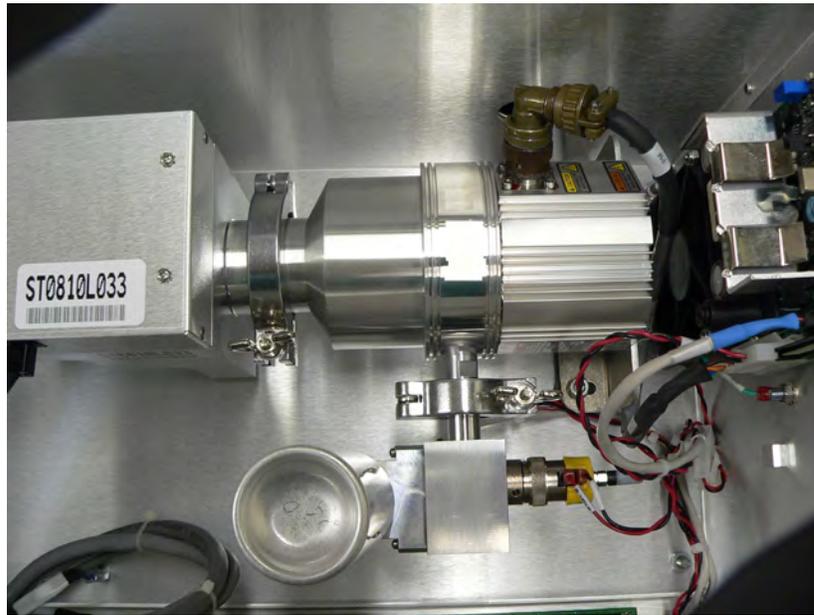
Figure B-18   Calibrated Leak in Place

8. Install the valve control cable to the valve and route it to the discrete I/O board J7 connector (Figure B-19 and Figure B-20).
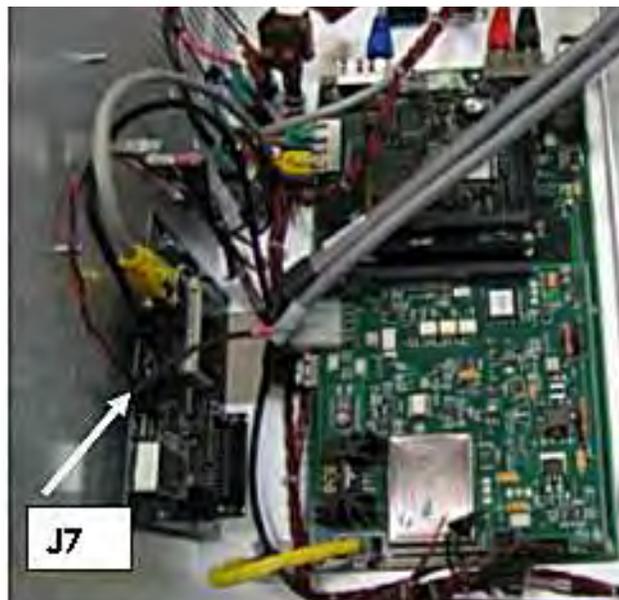
Figure B-19   J7 Connector and Valve
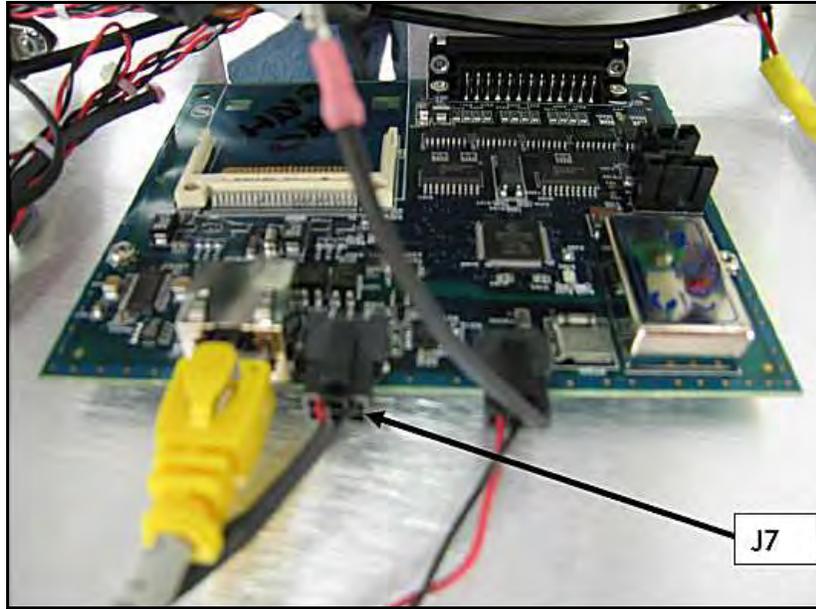
Figure B-20   J7 Connector on Discrete I/O Board

9. Connect the calibrated leak temperature cable end labeled P1A to the leak assembly
    board connector J1A. Then connect the end labeled P301 to the motherboard connector
    labeled J301 (Figure B-21 and Figure B-22).
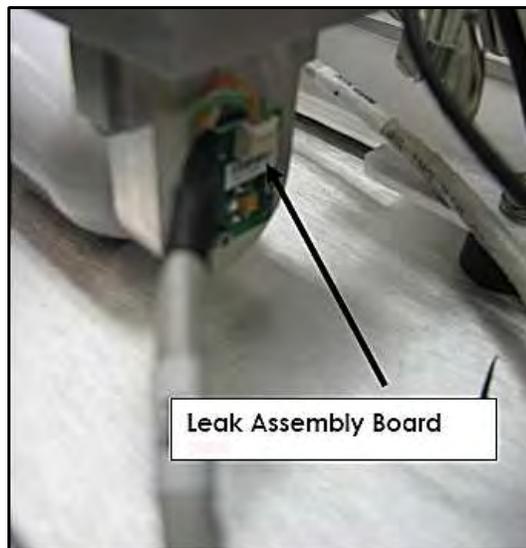
Figure B-21   Leak Assembly Board Connection
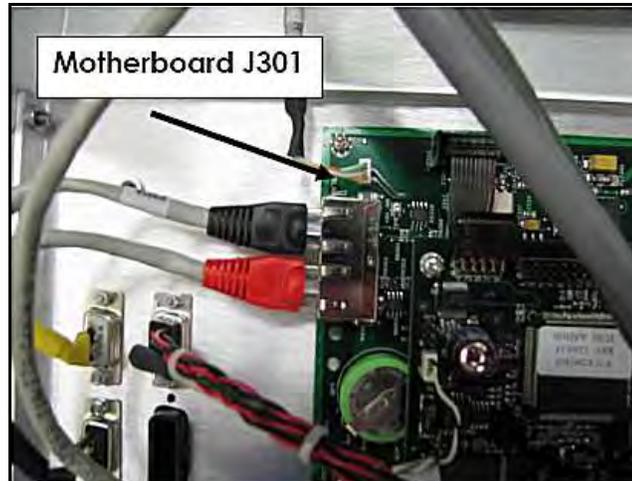
Figure B-22   Motherboard Connection

10. Power up the VS C15 component leak detector.

11. Set up the Internal Calibrated Leak Option via the front panel display by:

   a. Select *Advanced Parameters > Internal Type* and select *STD LEAK*.

   b. Select Maintenance > Internal Calibrated Leak and input the calibration data from the Calibration Certificate for the internal calibrated leak including:

   ❑ *Internal Leak Value*

   ❑ *Temperature*

   ❑ *Temperature coefficient factor*

   ❑ *Cal Leak - Date of Expiration*

   c. Validate the setup using the *Calibration Set Up* menu: the temperature compensated leak value, internal calibrated leak temperature and date of expiration.

12. Set up the *Internal Calibrated Leak Option* via the RS232 serial communications port (see the operation manual for communicating via the RS232 serial port).

13. Enter the following commands:

   ❑ *1 INIT-INTERANL-TYPE*

   ❑ *X.XE-0X INIT-STDLEAK* (Enter the leak rate value from the calibration certificate ex. *1.8E-07 INIT-STDLEAK*).

   ❑ *XX.X INIT-LEAKTEMP* (Enter the temperature from the calibration certificate ex. *23.5 INIT-LEAKTEMP*).

   ❑ *-/+XX INIT-TEMPFACTOR* (Enter the temperature coefficient from the calibration certificate ex. *-7 INIT-TEMPFACTOR*).

   ❑ *mm dd yyyy INIT-LKEXPIRE* (Enter the date of expiration from the calibration certificate ex. *12 22 2008 INIT-LKEXPIRE*).

14. Validate that the correct internal leak data was input (data from the Calibration Certificate):

- ❏ *?STDLEAK* (reports back the value of the internal calibrated leak).

- ❏ *?LEAKTEMP* (reports back the temperature of the calibrated leak from the factory calibration).

- ❏ *?TEMPFACTOR* (reports back the temperature coefficient).

- ❏ *?LKEXPIRE* (reports back the date of expiration).

15. Perform an internal calibration (via the I/O, Front Panel Display or RS232) to validate a successful installation of the internal calibrated leak.

16. Leak check the calibrated leak module to ensure a leak free joint between the atmosphere and vacuum space inside.

17. Attach the cover and secure using existing hardware.

B.5 Turbo Controller Board

Equipment Required:

- ❏ M4 Allen Wrench

- ❏ Small Philipps Screwdriver

WARNING

Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.

CAUTION

Static sensitive device, ensure that personnel are properly grounded before proceeding.

1. Disconnect the power to back of the unit and unplug.

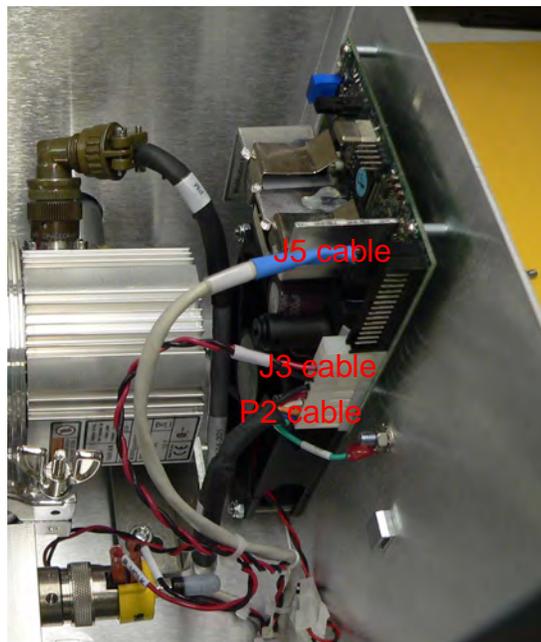2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-14).

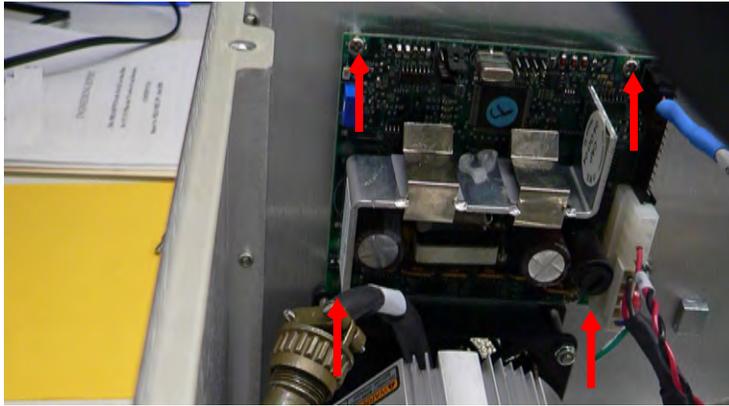**Figure B-23   Unit Top Screws**

4. Disconnect the following cables (Figure B-24):

    ❑   J5 cable from the P5 connector.

    ❑   J3 cable from the P2 connector.

    ❑   P2 cable from the connector.

Figure B-24   Turbo Board Connections

5. Remove the four (4) Philipps screws/washers and spacers (Figure B-25).

Figure B-25   Turbo Controller Board Screws

6. Place in the new board and attach with the four (4) Philipps screws/washers and spacers (Figure B-25).

7. Reconnect the following cables (Figure B-24 on page B-17):

   ❑ J5 cable from the P5 connector.

   ❑ J3 cable from the P2 connector.

   ❑ P2 cable from the connector.

8. Use an M4 Allen wrench to reinstall the two screws on the unit's top and open the unit (Figure B-14 on page B-11).

9. Reconnect the unit and powerup.

B.6 CPU (Brain) Board

Equipment Required:

   ❑ M4 Allen Wrench

   ❑ Small Philipps Screwdriver

WARNING

⚠️

Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.

CAUTION

✋

Static sensitive device, ensure that personnel are properly grounded before proceeding.

1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-26).
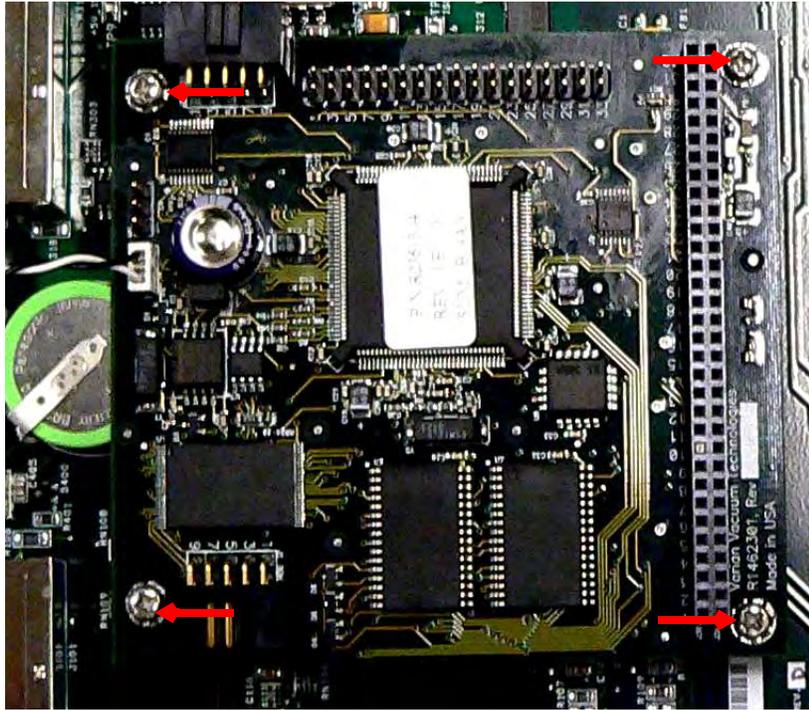

Figure B-26   Unit Top Screws

4. Disconnect R2142-301 (white/black) connector from the J100 connector (Figure B-27).
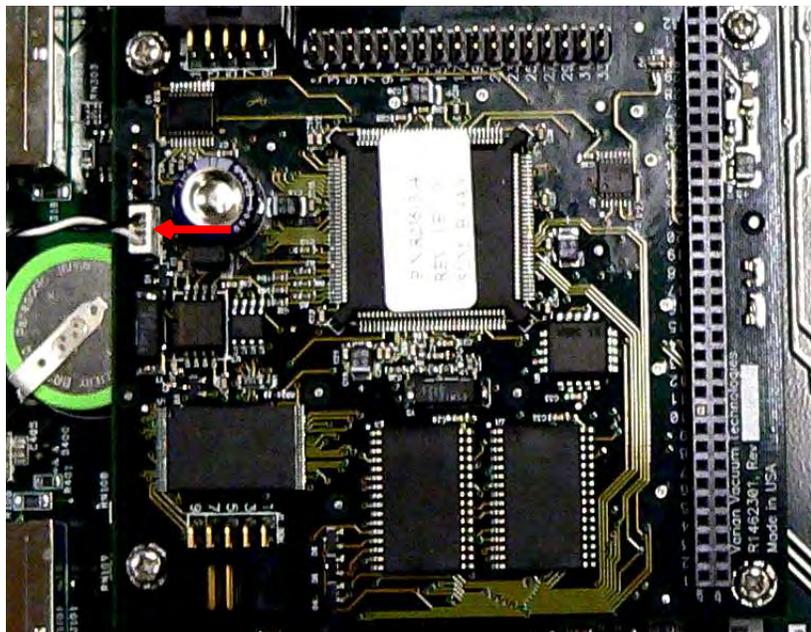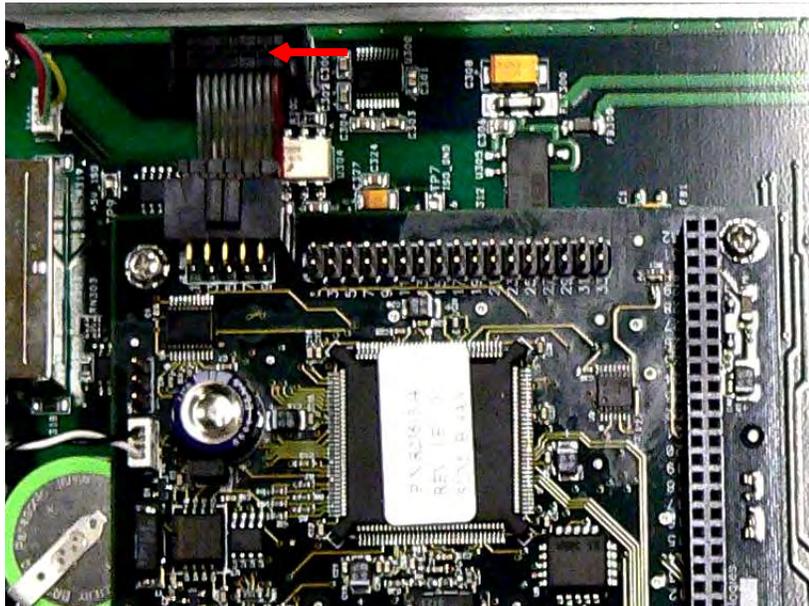

Figure B-27   J100 Connector

5. Remove the four (4) Philipps head screws and washers (Figure B-28).
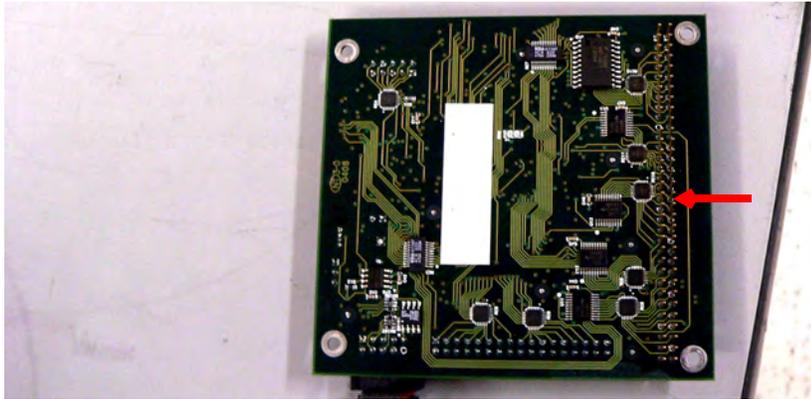

Figure B-28   Mounting Screws

6. Remove the black connector (2140-301) from the Mother board at J306 (
    Figure B-29).

Figure B-29   Mother Board Connection

7. Pull the board gently straight up to avoid damaging the pins underneath (Figure B-30).

Figure B-30   Pins Underneath

8. Lower the new board into position by carefully aligning the pins seen in Figure B-30.

9. Reinstall the black connector (2140-301) to the Mother board at J306 (Figure B-29 on page B-20).

10. Reinstall the four (4) Philipps head screws and washers (Figure B-28 on page B-20).

11. Reconnect R2142-301 (white/black) connector to the J100 connector (Figure B-27 on page B-19).

12. Use an M4 Allen wrench to reinstall the two screws on the unit's top and open the unit (Figure B-14 on page B-11).

13. Reconnect the unit and powerup.

B.7 Ion Source Board

Equipment Required:

❏   M4 Allen Wrench

❏   Small Philipps Screwdriver

WARNING   *Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.*

CAUTION   *Static sensitive device, ensure that personnel are properly grounded before proceeding.*

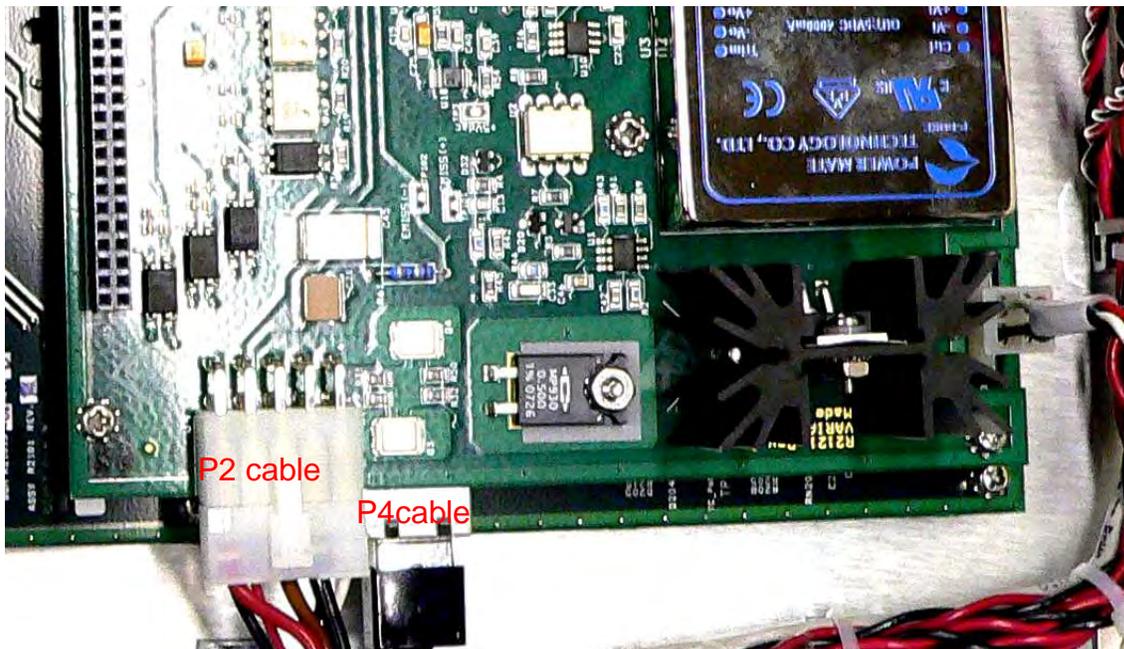1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-31).

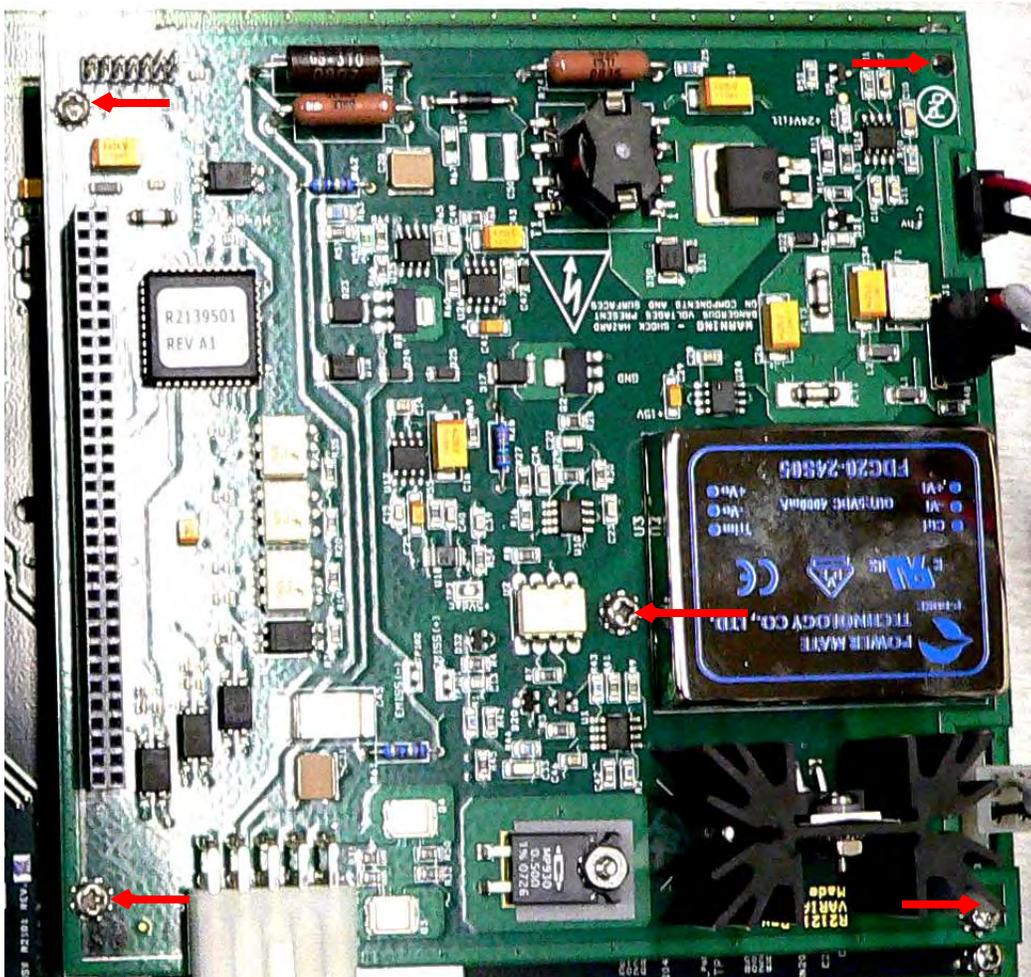**Figure B-31   Unit Top Screws**

4. Remove the following connections (Figure B-32):

❑ P2 at J1

❑ P4 at J4

Figure B-32   Connections

5. Remove the five (5) Philipps head screws and washers (Figure B-33).

Figure B-33   Mounting Screws

6. Pull the board gently straight up to avoid damaging the pins underneath.

7. Lower the new board into position by carefully aligning the pins.

8. Reinstall the following connections (Figure B-32 on page B-22):

   ❏ P2 at J1

   ❏ P4 at J4

9. Reinstall the five (5) Philipps head screws and washers.

10. Use an M4 Allen wrench to reinstall the two screws on the unit's top and open the unit (Figure B-14 on page B-11).

11. Reconnect the unit and powerup.

12. Ensure that the *System Ready Condition* filament fault conditions off.

B.8 Mother Board

Equipment Required:

❑ M4 Allen Wrench

❑ Small Philipps Screwdriver

WARNING *Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.*

CAUTION *Static sensitive device, ensure that personnel are properly grounded before proceeding.*

1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-34).
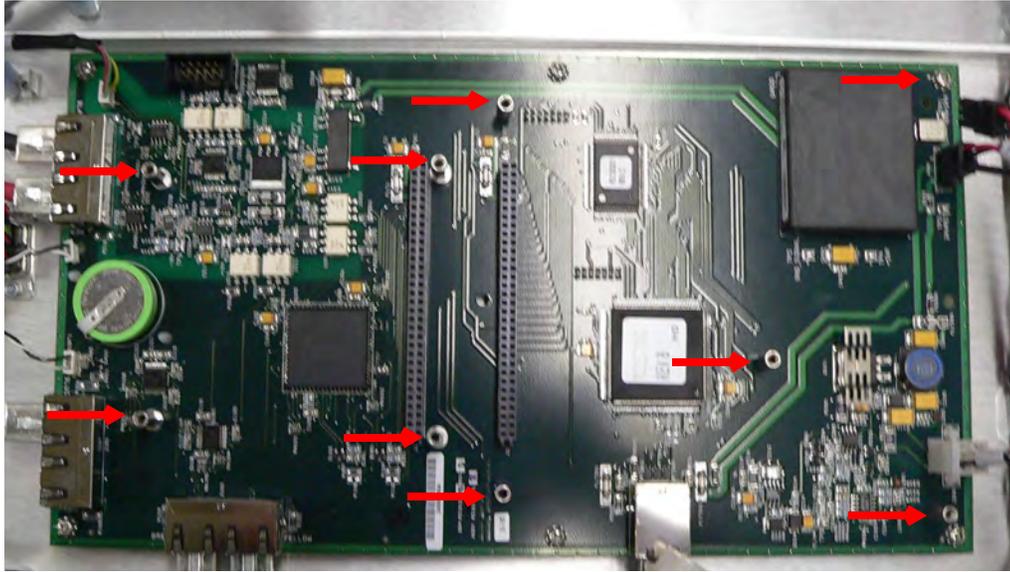

Figure B-34 Unit Top Screws

4. Remove the Ion Source board as per Section B.7 "Ion Source Board" on page B-21.

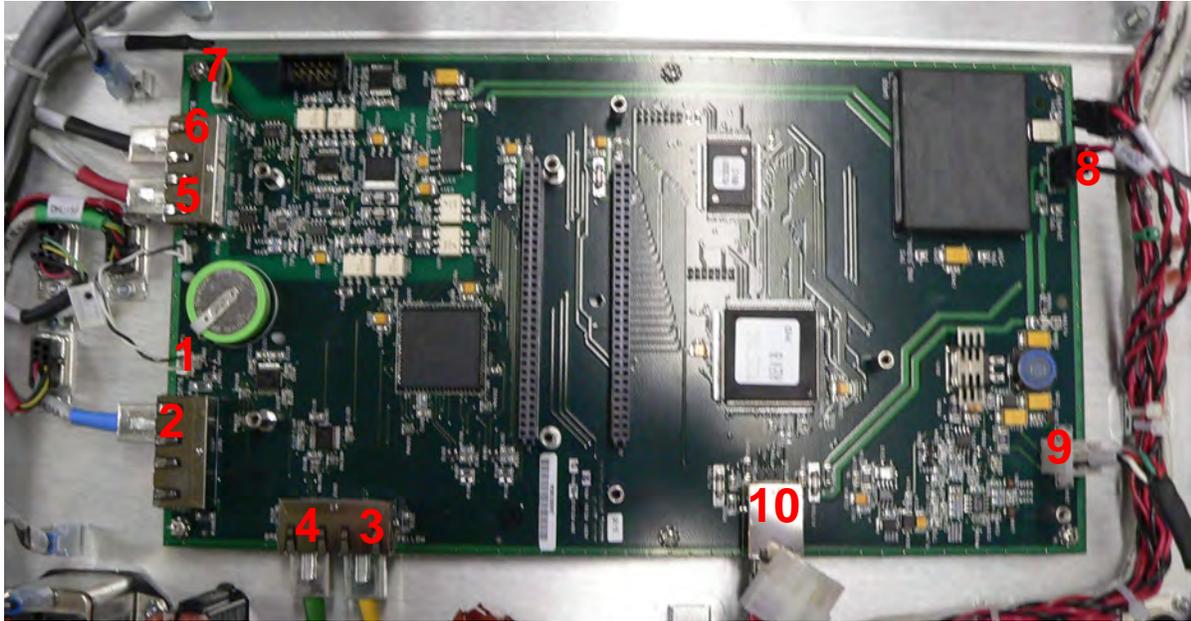5. Remove the board as per Section B.6 "CPU (Brain) Board" on page B-18.

6. Remove the nine (9) sets of spacer hardware that separated the smaller boards from the Mother board (Figure B-35).
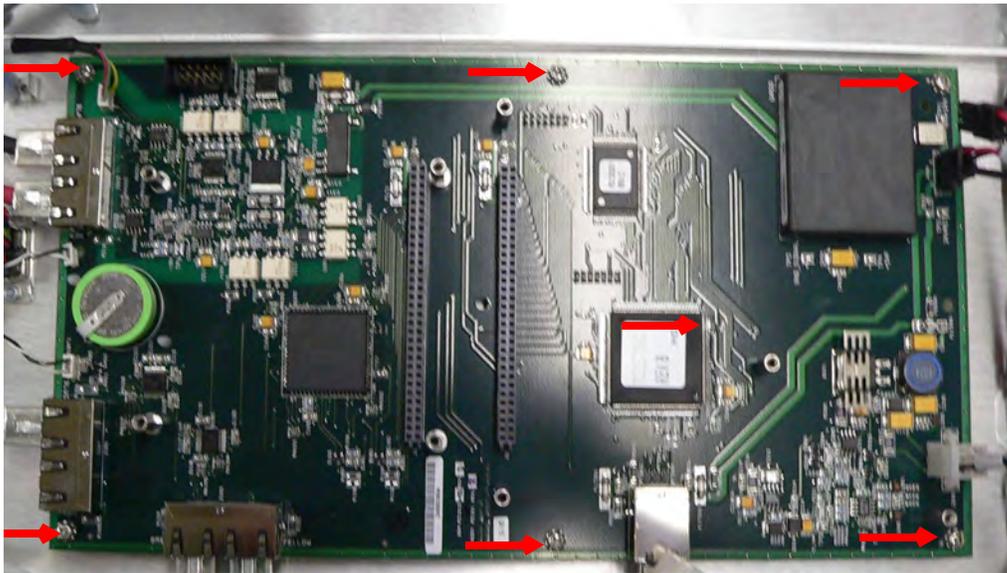

Figure B-35   Mother Board Spacers

7. Disconnect the wiring as follows (Figure B-36):

1. R2142-301 (white/black)

2. P101A (Blue) at J101

3. P100B (Yellow) at J100

4. P100A (Green) at J100

5. P302B (Red) at J302

6. P302A (Black at J302)

7. P301 (Red/Green/Yellow/Black) at J301

8. P400 (Red/Black) at J100

9. R32334-501 (Red/Green/White/Black) at J200

10. P500 connector at J500

Figure B-36 Mother Board Wiring

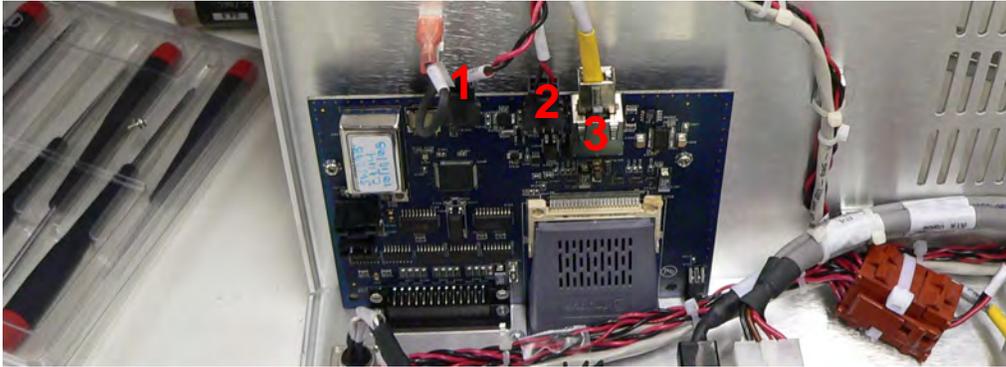8. Remove the six (6) Philipps screws holding the board (Figure B-37).

Figure B-37 Mother Board Mounting Screws

9. Remove the board and mount the new board with the six (6) Philipps screws.

10. Reconnect the wiring as in (Figure B-36 on page B-26).

11. Reinstall the nine (9) sets of spacer hardware that separated the smaller boards from the Mother board (Figure B-35 on page B-25).

12. Reinstall the Ion Source board as per Section B.7 "Ion Source Board" on page B-21.

13. Reinstall the board as per Section B.6 "CPU (Brain) Board" on page B-18.
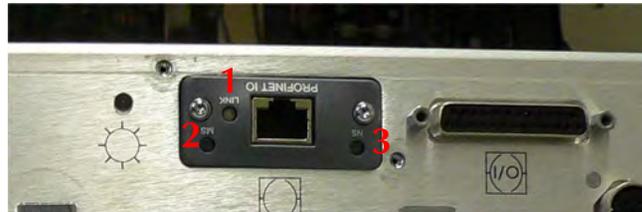
14. Use an M4 Allen wrench to reinstall the two screws on the unit's top and open the unit (Figure B-14 on page B-11).

15. Reconnect the unit and powerup.

B.9 Discrete I/O Board

Equipment Required:

❑ M4 Allen Wrench

❑ Small Philipps Screwdriver

WARNING *Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.*

CAUTION *Static sensitive device, ensure that personnel are properly grounded before proceeding.*

1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-34).

Figure B-38   Unit Top Screws

4. Disconnect (Figure B-39):

   ❑ 1. P301 (Red/Black) J301

   ❑ 2. PG1_2

   ❑ 3. P300

Figure B-39   Discrete I/O Board Wiring

5. Remove the (Figure B-40):

   ❑ Two (2) Philipps screws holding the Profinet connector.

   ❑ Two nuts holding the I/O connector, using a 5 mm nut driver.

Figure B-40   Profinet and I/O Connectors

6. Remove the old card and slip the new card in place.

7. Reconnect (Figure B-39 on page B-28):

   ❑ P301 (Red/Black) J301

   ❑ PG1_2

   ❑ P300

8. Reinstall the (Figure B-40):

   ❑ Two (2) Philipps screws holding the Profinet connector.

   ❑ Two nuts holding the I/O connector, using a 5 mm nut driver.

9. Use an M4 Allen wrench to reinstall the two screws on the unit's top and open the unit (Figure B-14 on page B-11).

10. Reconnect the unit and powerup.

11. Ensure the PROFINET IO connector LEDs perform the following sequence:

❑ Link LED (1) - Goes Green steady

❑ M5 LED (2) - Goes Green, Red, Green and then off

❑ N5 LED (3) -Goes Green and then Red

B.10 Calibrated Leak Replacement

Equipment Required

❑ M4 Allen Wrench

❑ Flat Head Screwdriver

WARNING

⚠

Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.

1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-41).

Figure B-41   Unit Top Screws
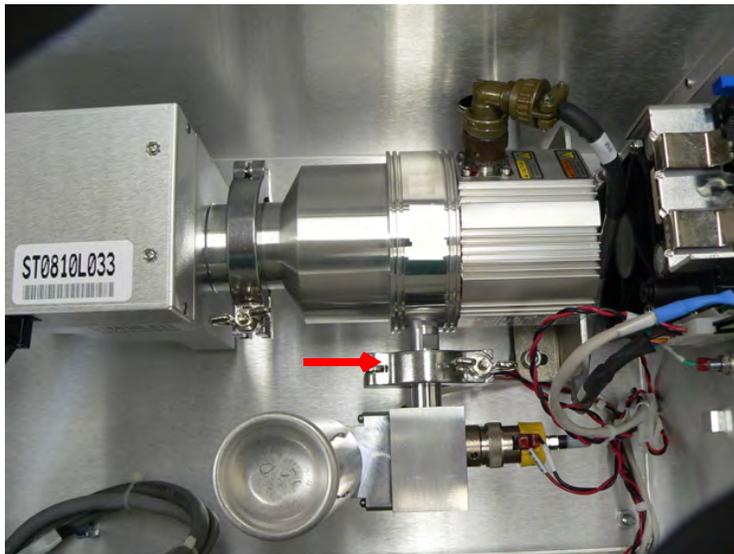
4. Disconnect the cable from the calibrated leak board (Figure B-42).

Figure B-42   Cable to Calibrated Leak Connection

5. Loosen and remove the clamp (Figure B-43).


Figure B-43   Remove Clamp

6. Remove the assembly and use a flat head screw driver to remove the two screws holding the calibrated leak (Figure B-44).

Figure B-44   Calibrated Leak Screws

7. Install the new calibrated leak using the same two screws.

8. Reattach the leak assembly to the flange with the clamp.

9. Connect the calibrated leak temperature cable end labeled P1A to the leak assembly board connector J1A (Figure B-45).
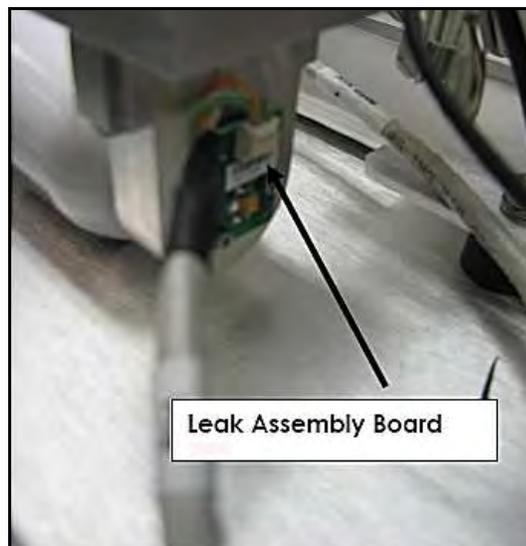
Figure B-45   Leak Assembly Board Connection

10. Close the cover and secure using the existing hardware.

11. Power up the VS C15 component leak detector.

12. Set up the Internal Calibrated Leak by either:

❑ Setting up the Internal Calibrated Leak Option via the front panel display by:

a. Select *Advanced Parameters > Internal Type* and select *STD LEAK*.

b. Select Maintenance > Internal Calibrated Leak and input the calibration data from the Calibration Certificate for the internal calibrated leak including:

❑ *Internal Leak Value*

❑ *Temperature*

❑ *Temperature coefficient factor*

❑ *Cal Leak - Date of Expiration*

c. Validate the setup using the *Calibration Set Up* menu: the temperature compensated leak value, internal calibrated leak temperature and date of expiration.

— **or** —

❑ Setting up the *Internal Calibrated Leak Option* via the RS232 serial communications port (see the operation manual for communicating via the RS232 serial port) by:

a. Enter the following commands:

❑ *1 INIT-INTERNAL-TYPE*

❑ *X.XE-0X INIT-STDLEAK* (Enter the leak rate value from the calibration certificate ex. *1.8E-07 INIT-STDLEAK*).

❑ *XX.X INIT-LEAKTEMP* (Enter the temperature from the calibration certificate ex. *23.5 INIT-LEAKTEMP*).

❑ *-/+XX INIT-TEMPFACTOR* (Enter the temperature coefficient from the calibration certificate ex. *-7 INIT-TEMPFACTOR*).

❑ *mm dd yyyy INIT-LKEXPIRE* (Enter the date of expiration from the calibration certificate ex. *12 22 2008 INIT-LKEXPIRE*).

b. Validating that the correct internal leak data was inputted (data from the Calibration Certificate) by:

❑ *?STDLEAK* (reports back the value of the internal calibrated leak).

❑ *?LEAKTEMP* (reports back the temperature of the calibrated leak from the factory calibration).

❑ *?TEMPFACTOR* (reports back the temperature coefficient).

❑ *?LKEXPIRE* (reports back the date of expiration).

13. Perform an internal calibration (via the I/O, Front Panel Display or RS232) to validate a successful installation of the internal calibrated leak.

B.11 Spectrometer Header M1 Replacement

Equipment Required:

- ❏ Metric Allen Wrench (Range 1.5mm to 10mm)

- ❏ M3 Philips head screwdriver

- ❏ Non-powdered ESD-safe Nitrile or equivalent gloves

- ❏ Isopropyl alcohol

- ❏ Torque wrench, M5 head (must be adjustable to 45 in-lbs (5.0 N-m) and 90 in-lbs (10.2 N-m)

- ❏

WARNING

⚠️

Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.

NOTE

❗

Inspect the new header kit for deformation, damage and filament coating flaking prior to installation. Do not install if damaged. Touching the filament under any condition will cause damage.

1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-46).
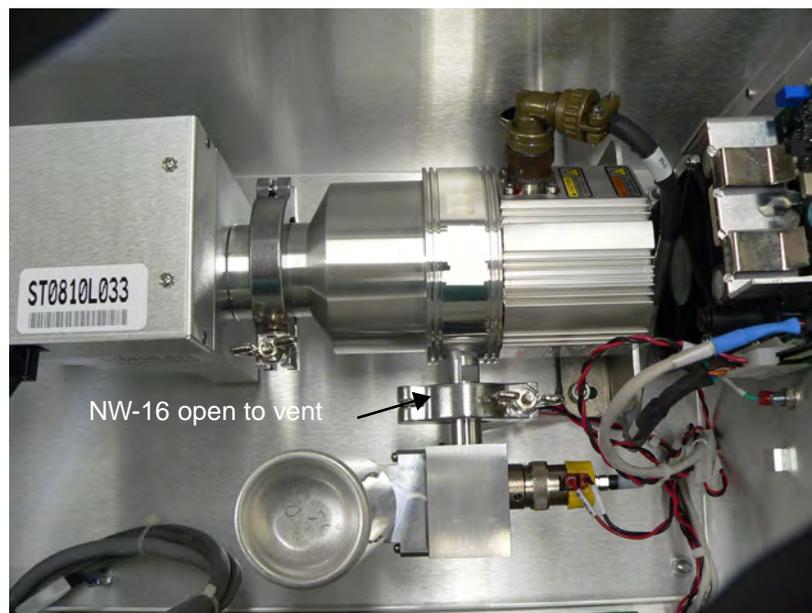

Figure B-46   Unit Top Screws

4. If the unit was just running, either:

   ❑ Open the turbo vent valve, if the internal calibrated leak option was not installed (Figure B-47),

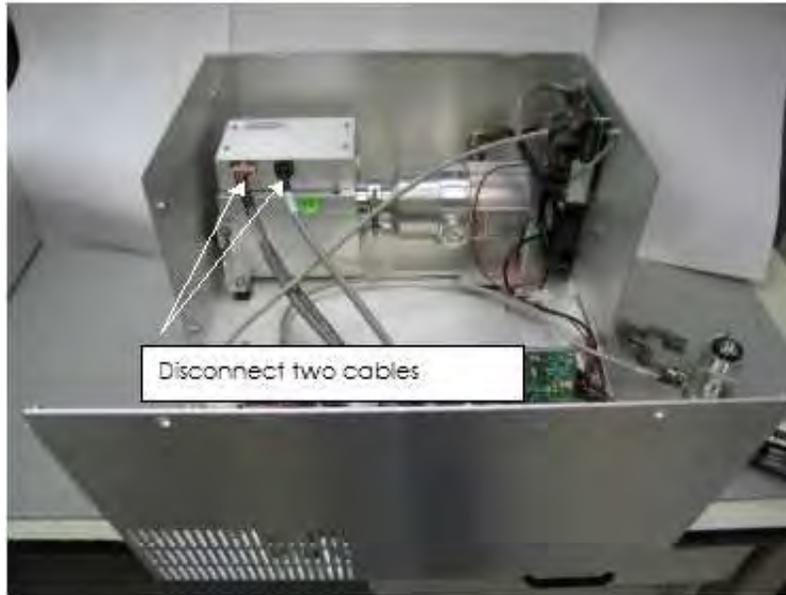   ❑ Or crack the NW16 connection (Figure B-48) on the calibrated leak to bring the turbo to a controlled stop.

Figure B-47   Turbo Vent

Figure B-48   NW-16 Vent

5. Disconnect both cables from the spectrometer (Figure B-49).

Figure B-49   Cables To Spectrometer

CAUTION   *Static sensitive device, ensure that personnel are properly grounded before proceeding.*

6. Using an M3 Philips head screw driver, remove the four screws holding the spectrometer cover and ground strap on (Figure B-50).

Figure B-50   Spectrometer Cover Screws

7. Using an M5 allen wrench, remove the six screws holding on the spectrometer header assembly (Figure B-51).

Figure B-51   Spectrometer Header Assembly Screws

> **NOTE**
>
> ⚠️ *Wear non-powdered, ESD-safe Nitride or equivalent gloves (not included in kit) to prevent skin oils from getting on vacuum surfaces. Ensure that personnel are properly grounded before proceeding.*

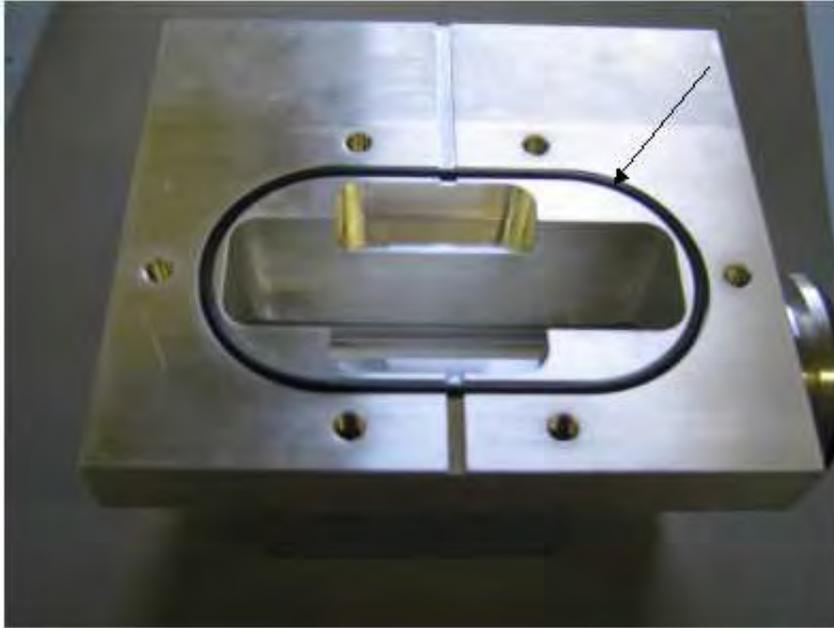8. Remove the spectrometer header assembly (Figure B-52).

Figure B-52   Spectrometer Assembly Removal

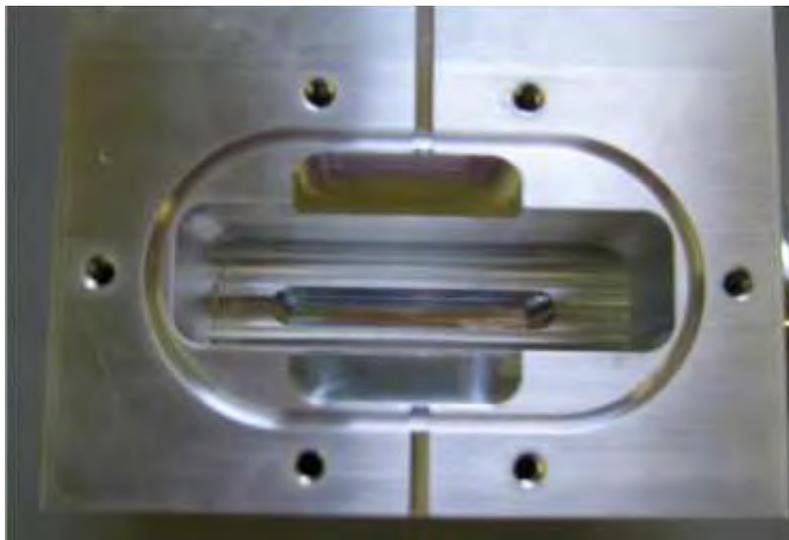9. Remove the O-ring and discard (Figure B-53).

Figure B-53   O-ring

10. If the inside of the spectrometer body appears to be dirty, clean it with a lint free wipe and Isopropyl alcohol (Figure B-54).

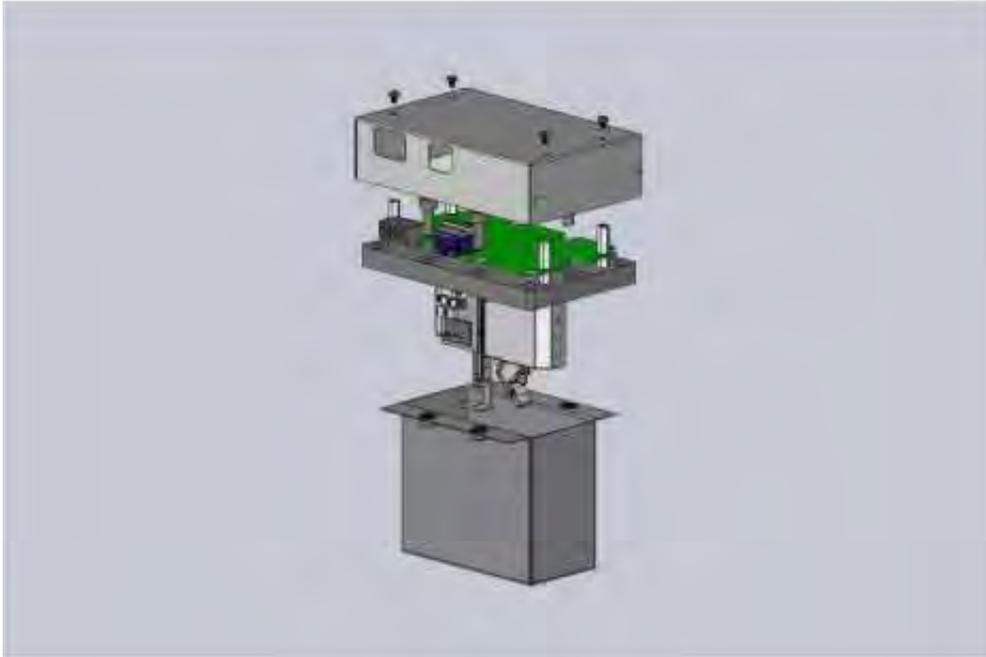**NOTE** — *Agilent recommends that you use the Vac-u-solv spectrometer cleaning kit (PN: 670029096).*

Figure B-54   Inside of Spectrometer Body

11. Install the new O-ring into the groove.

12. Unpack the new header assembly.

13. Remove the top cover from the header assembly by removing the four screws using an M3 Philips screw driver (Figure B-55).

Figure B-55   Header Assembly Screws

14. Remove the protective shipping cover by removing the four screws using an M5 allen head wrench.

> **NOTE**
> ⚠
>
> *Reuse the cover on the old header assembly when it is shipped back to Agilent.*

15. Clean the mating surfaces of the spectrometer body and header with Isopropyl alcohol and a clean lint free wipe.

16. Install the new header with the six existing screws. Torque to 10.2 N-M (90 IN-LB).

> **NOTE**
> ⚠
>
> *The cones of the Belleville washers should all point to the head of the screw.*

17. On the PCB, use the resistance meter to verify an open circuit between any two of the six ion source header pins (except FIL-1 to FIL-1 and FIL-2 to FIL-2 which should be 0.3 Ohms or less). Also verify an open circuit between the body of the spectrometer and any of the ion source header pins (Figure B-56). If there is continuity (short circuit) at any of the points, remove the header and inspect for shorting.
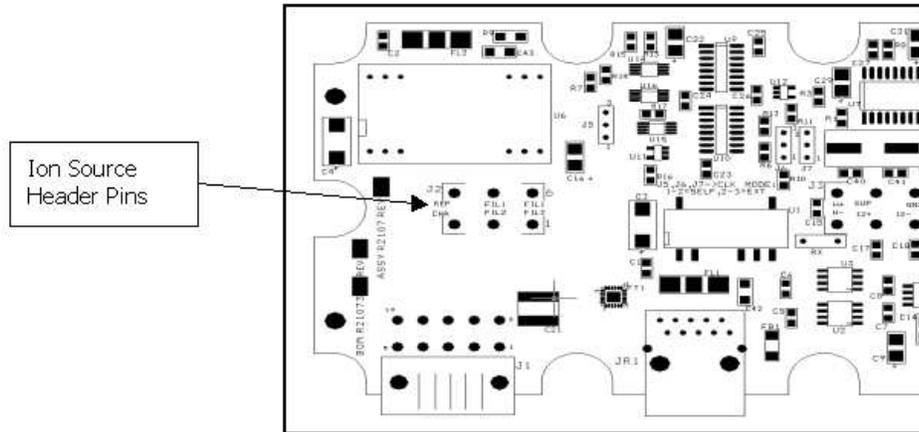
Figure B-56   Ion Source Header Pin Schematic

18. Re-Install the cover with the four screws.

19. Re-plug in both cables and ground strap.

20. Verify that turbo vent valve is closed.

21. Leak check the spectrometer to ensure a leak free joint.

22. Close the cover and secure using existing hardware.

23. Power up the leak detector.

24. Let the unit run for 20 minutes, then perform a calibration (via the I/O, front panel display or RS232), per the user manual, to validate a successful installation.

B.12 Ion Source Replacement

Equipment Required

❑ Metric Allen Wrench (Range 1.5mm to 10mm)

❑ M3 Philips head screwdriver

❑ Non-powdered ESD-safe Nitrile or equivalent gloves

❑ Isopropyl alcohol

❑ Torque wrench, M5 head (must be adjustable to 45 in-lbs (5.0 N-m) and 90 in-lbs (10.2 N-m)

WARNING *Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.*

NOTE *Inspect the kit for deformation, damage and filament coating flaking prior to installation. Do not install if damaged. Touching the filament under any condition will cause damage.*

Use CPU software version LE01.02 or higher with ion sources shipped after August 18, 2009 and with a unit of serial LL0909L826 or higher.

1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-57).

Figure B-57   Unit Top Screws

4. If the unit was just running, either:

   ❑ Open the turbo vent valve, if the internal calibrated leak option was not installed (Figure B-58),

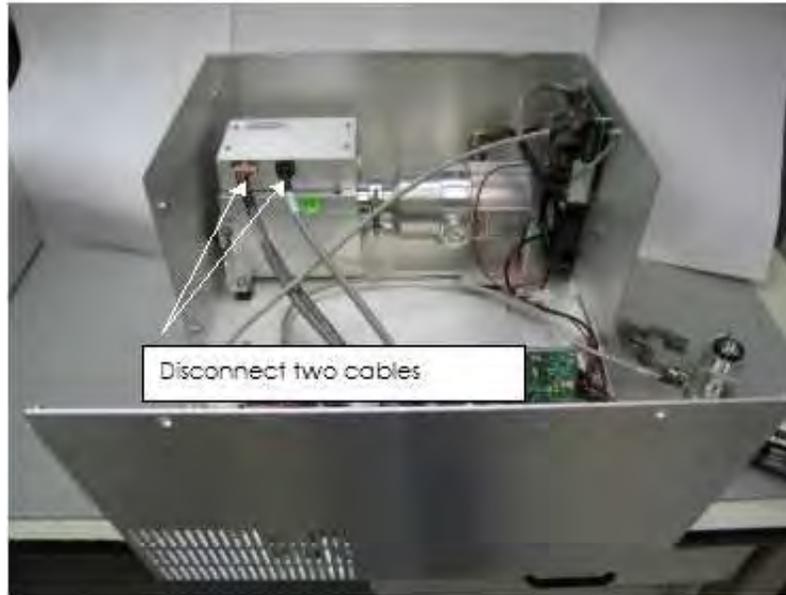   ❑ Or crack the NW16 connection (Figure B-59) on the calibrated leak to bring the turbo to a controlled stop.

Figure B-58   Turbo Vent

Figure B-59   NW-16 Vent

5. Disconnect both cables from the spectrometer (Figure B-60).

Disconnect two cables

Figure B-60   Cables To Spectrometer

CAUTION   *Static sensitive device, ensure that personnel are properly grounded before proceeding.*

6. Using an M3 Philips head screw driver, remove the four screws holding the spectrometer cover and ground strap on (Figure B-61).

Figure B-61   Spectrometer Cover Screws

7. Using an M5 allen wrench, remove the six screws holding on the spectrometer header assembly (Figure B-62).

Figure B-62   Spectrometer Header Assembly Screws

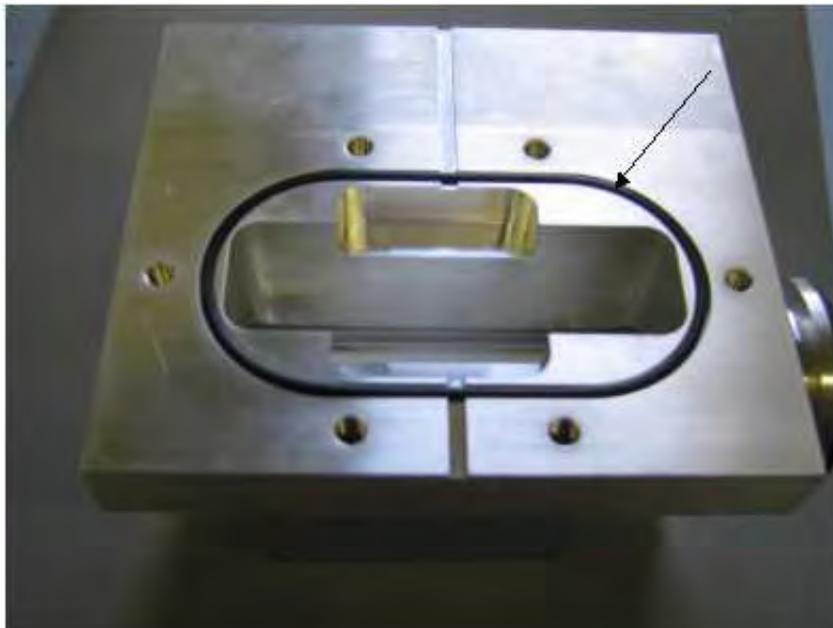| NOTE	*Wear non-powdered, ESD-safe Nitride or equivalent gloves (not included in kit) to prevent skin oils from getting on vacuum surfaces. Ensure that personnel are properly grounded before proceeding.*

8. Remove the spectrometer header assembly (Figure B-63).

Figure B-63   Spectrometer Assembly Removal

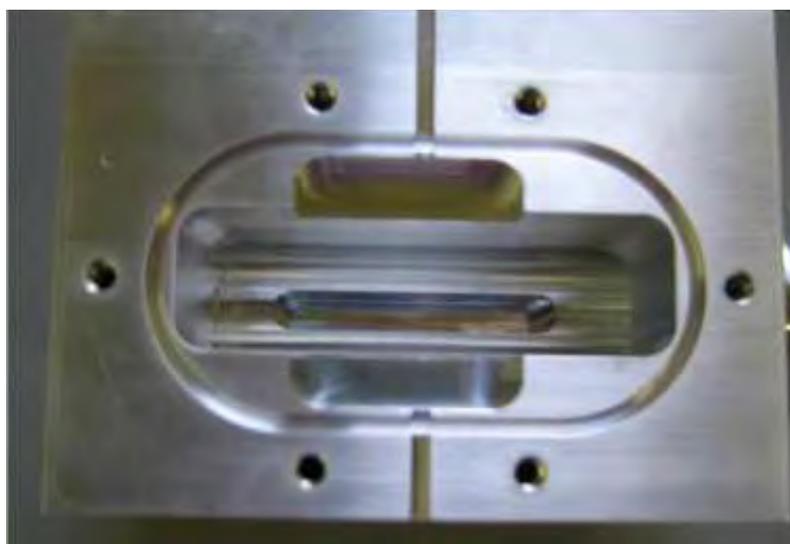9. Remove the O-ring and discard (Figure B-64).

Figure B-64   O-ring

10. If the inside of the spectrometer body appears to be dirty, clean it with a lint free wipe and Isopropyl alcohol (Figure B-65).
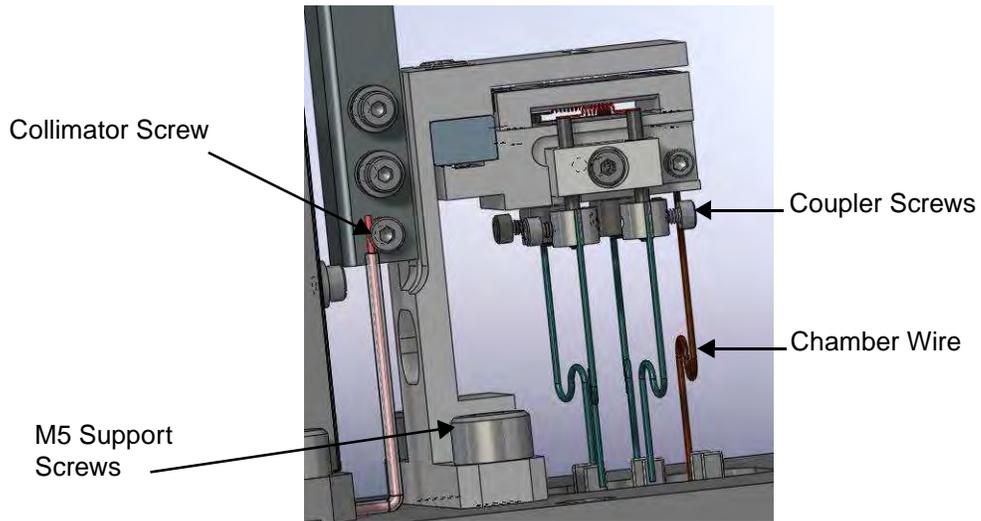
NOTE

⚠

Agilent recommends that you use the Vac-u-solv spectrometer cleaning kit (PN: 670029096).

Figure B-65   Inside of Spectrometer Body

11. Use an M1.5 Allen wrench to unscrew the four coupler screws, the collimator screw and the chamber wire screw (Figure B-66).
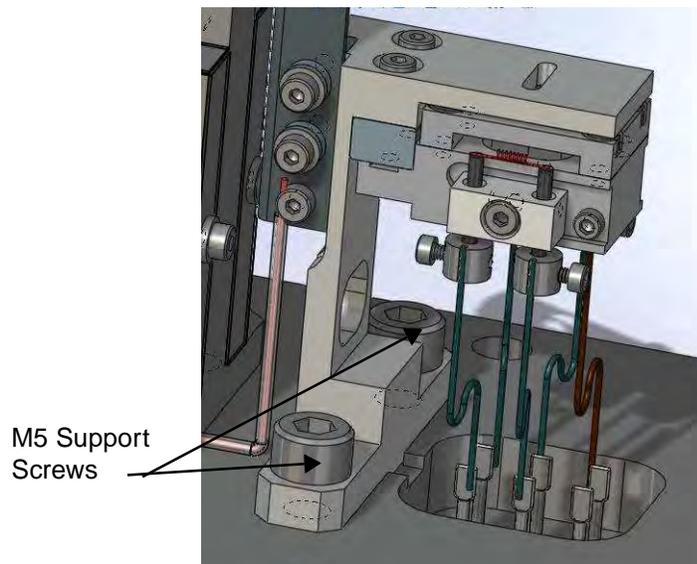

Figure B-66   Ion Support Assembly

CAUTION   *This is a static sensitive device, ensure that personnel are properly grounded before proceeding.*

12. Remove the chamber and collimator wires from the assembly.

13. Remove the two M5 support screws (Figure B-67).


Figure B-67   M4 Support Screws

14. Gently remove the ion support assembly from the spectrometer header.

NOTE *Ensure that no damage is done to the spectrometer wire during disassembly.*

15. Position the new ion support assembly onto the spectrometer header and align.

16. Secure to the spectrometer header using two M5 support screws.

17. Connect the collimator wire to the collimator plate using an M2 screw (Figure B-68).

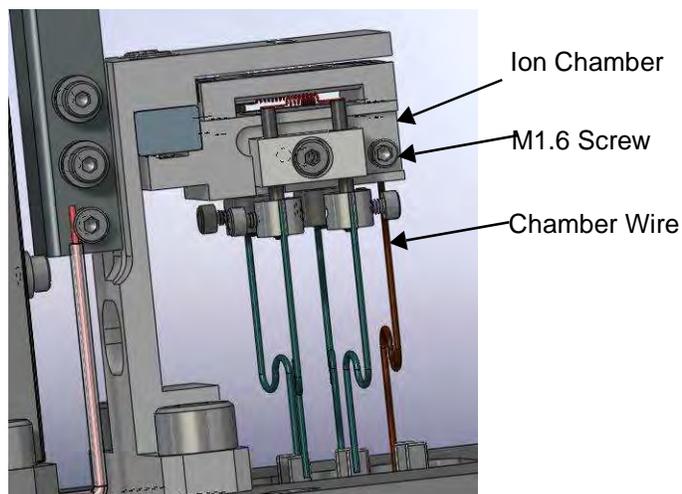Collimator Wire

M2 Screw
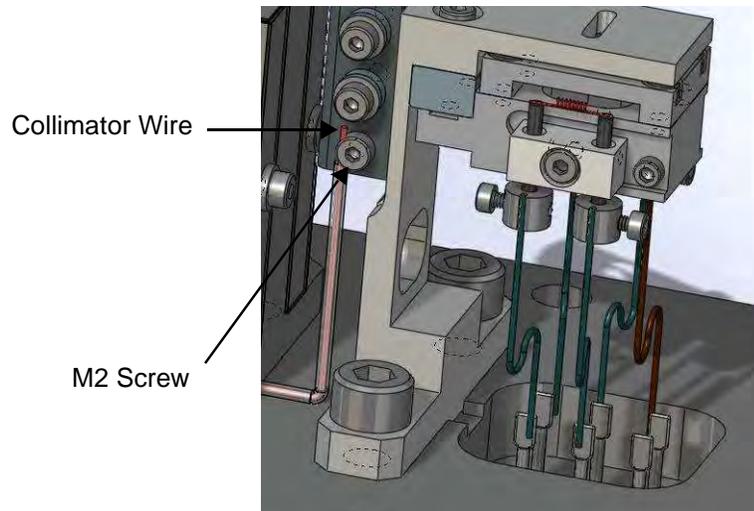
Figure B-68   Partial Pressure Plate

18. Insert the chamber wire into the ion support assembly (Figure B-69).

CAUTION *Do not cut the wire by over tightening. Ensure that wire is contacting the assembly where required and that no short circuit exists.*

Ion Chamber

M1.6 Screw

Chamber Wire

Figure B-69   Extractor Plate

19. Insert each new filament assembly into a pair of couplers.

20. Guide the ceramic against the bottom and side ribs of the ion source support block (Figure B-70 and Figure B-71). Correct positioning of filament is critical for proper spectrometer operation.
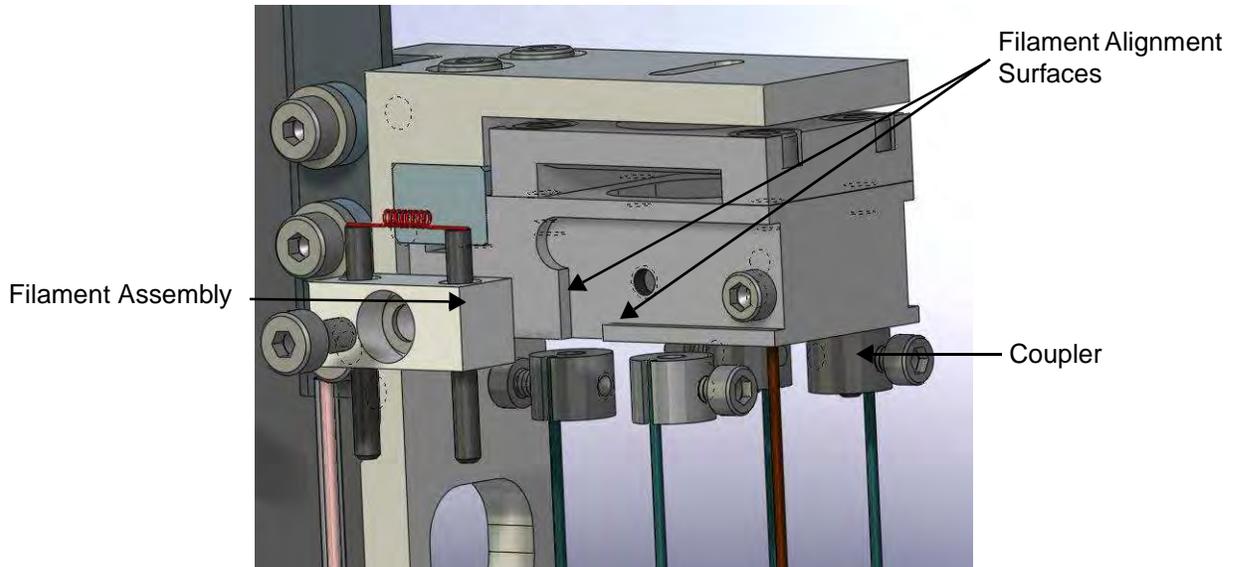
Figure B-70   Coupler and Filament Assembly

21. While holding the filament in position, insert the M2 screw and washer and tighten (Figure B-71).

22. Tighten the coupler screws onto the filament posts (Figure B-71).

23. Verify ceramic is tight against the bottom and right side ribs. Visually ensure that the filament is positioned in the slot of the ion source as shown (Figure B-71 and Figure B-72).
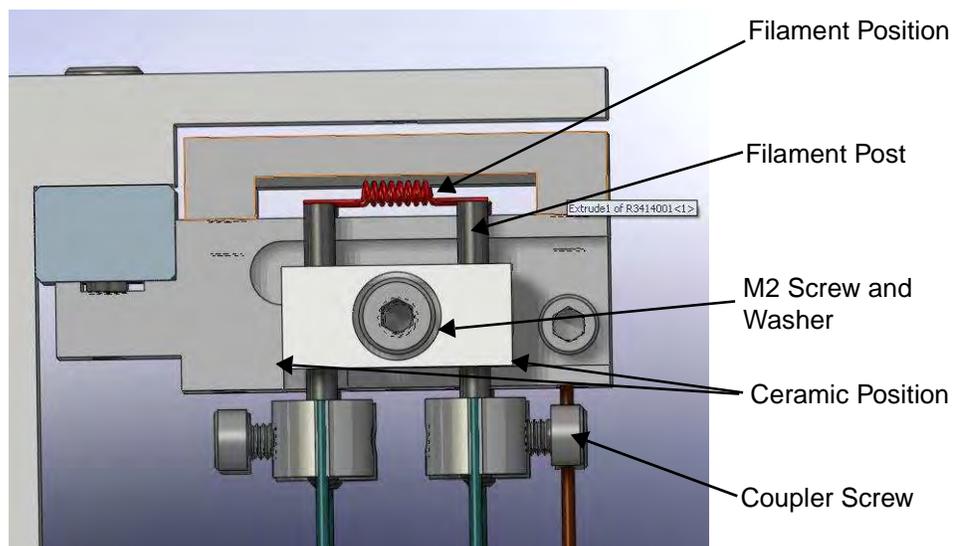
Figure B-71   Filament Position
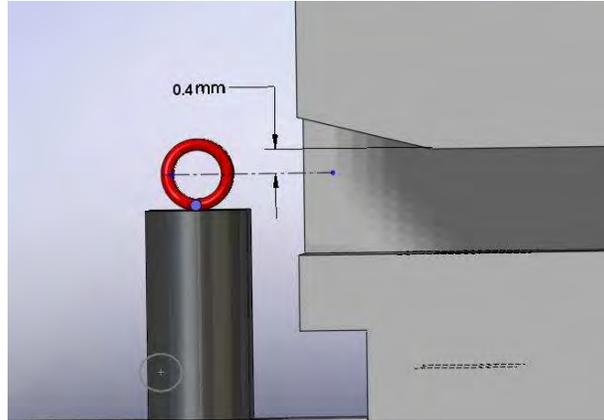
Figure B-72   Filament Alignment

NOTE   *Reuse the cover on the old header assembly when it is shipped back to Agilent.*

24. Clean the mating surfaces of the spectrometer body and header with Isopropyl alcohol and a clean lint free wipe.

25. Install the new header with the six existing screws. Torque to 10.2 N-M (90 IN-LB).

NOTE   *The cones of the Belleville washers should all point to the head of the screw.*

26. On the PCB, use the resistance meter to verify an open circuit between any two of the six ion source header pins (except FIL-1 to FIL-1 and FIL-2 to FIL-2 which should be 0.3 Ohms or less). Also verify an open circuit between the body of the spectrometer and any of the ion source header pins (Figure B-73). If there is continuity (short circuit) at any of the points, remove the header and inspect for shorting.
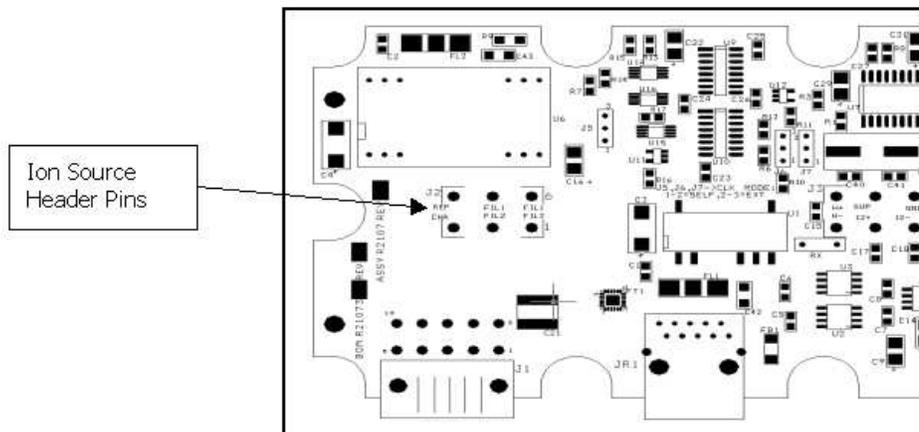
Figure B-73   Ion Source Header Pin Schematic

27. Re-Install the cover with the four screws.

28. Re-plug in both cables and ground strap.

29. Verify that turbo vent valve is closed.

30. Leak check the spectrometer to ensure a leak free joint.

31. Close the cover and secure using existing hardware.

32. Power up the leak detector.

33. Let the unit run for 20 -30 minutes, then perform a calibration (via the I/O, front panel display or RS232), per the user manual, to validate a successful installation.

B.13 Filament Replacement

Equipment Required

❏ Metric Allen Wrench (Range 1.5mm to 10mm)

❏ M3 Philips head screwdriver

❏ Non-powdered ESD-safe Nitrile or equivalent gloves

❏ Isopropyl alcohol

❏ Torque wrench, M5 head (must be adjustable to 45 in-lbs (5.0 N-m) and 90 in-lbs (10.2 N-m)

WARNING ⚠	*Disconnect power from the unit before performing any maintenance procedure that requires physically disconnecting any part of the system.*
NOTE ⚠	*Inspect the kit for deformation, damage and filament coating flaking prior to installation. Do not install if damaged. Touching the filament under any condition will cause damage.*
NOTE ⚠	*C15 units shipped prior to August 18, 2009 use filament replacement Agilent P/N# VSFLDFR. Units shipped after August 18, 2009 use filament replacement Agilent P/N# VSFLDHFR. The replacement procedure for both is identical.*

1. Disconnect the power to back of the unit and unplug.

2. Wait 30 seconds for the high voltage to dissipate.

3. Use an M4 Allen wrench to remove the two screws on the unit's top and open the unit (Figure B-74).

Figure B-74   Unit Top Screws

4. If the unit was just running, either:

❏ Open the turbo vent valve, if the internal calibrated leak option was not installed (Figure B-75),

❏ Or crack the NW16 connection (Figure B-76) on the calibrated leak to bring the turbo to a controlled stop.

Figure B-75   Turbo Vent
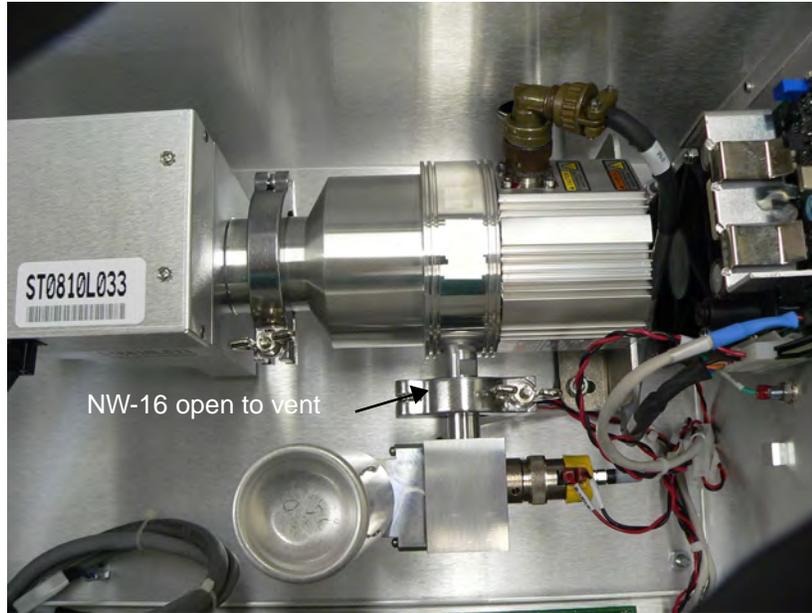
Figure B-76   NW-16 Vent

5. Disconnect both cables from the spectrometer (Figure B-77).
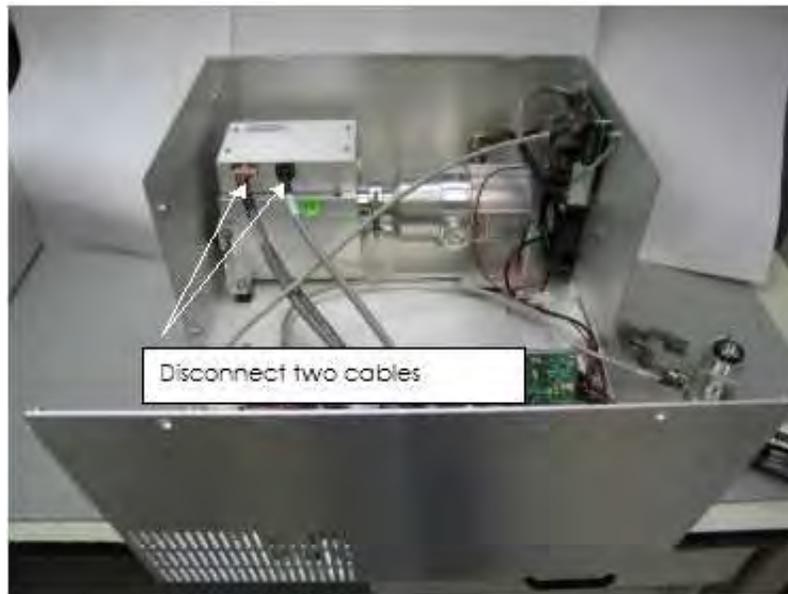
Figure B-77   Cables To Spectrometer

CAUTION   *Static sensitive device, ensure that personnel are properly grounded before proceeding.*

6. Using an M3 Philips head screw driver, remove the four screws holding the spectrometer cover and ground strap on (Figure B-78).

Figure B-78   Spectrometer Cover Screws

7. Using an M5 allen wrench, remove the six screws holding on the spectrometer header assembly (Figure B-79).

Figure B-79   Spectrometer Header Assembly Screws

NOTE	*Wear non-powdered, ESD-safe Nitride or equivalent gloves (not included in kit) to prevent skin oils from getting on vacuum surfaces. Ensure that personnel are properly grounded before proceeding.*

8. Remove the spectrometer header assembly (Figure B-80).

Figure B-80   Spectrometer Assembly Removal

9. Remove the O-ring and discard (Figure B-81).
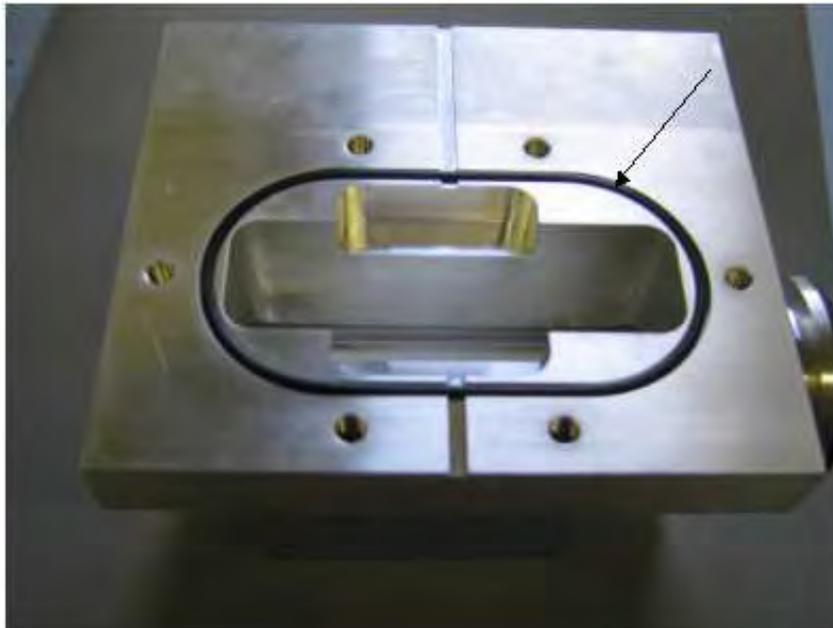
Figure B-81   O-ring

10. If the inside of the spectrometer body appears to be dirty, clean it with a lint free wipe and Isopropyl alcohol (Figure B-82).

NOTE ⚠

Agilent recommends that you use the Vac-u-solv spectrometer cleaning kit (PN: 670029096).

Figure B-82   Inside of Spectrometer Body

11. On a clean work surface, remove the defective filament(s) from the spectrometer by loosening the two coupler screws. Then loosen the M2 screw and washer and remove the defective filament (Figure B-83).
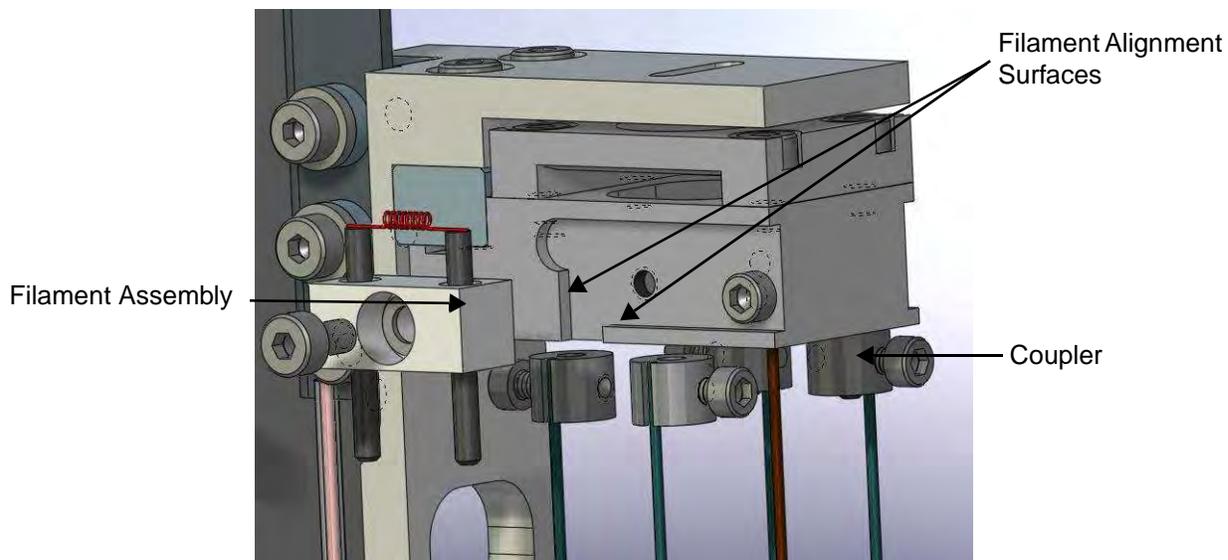
Figure B-83   Coupler Screws

12. Inspect the new filament assembly for deformation, damage and flaking of the coating prior to installation. Do not install if damaged.

13. Insert new filament assembly into the coupler.

14. Guide the ceramic against the bottom and side surfaces of the ion chamber (Figure B-84 and Figure B-85). Correct positioning of filament is critical for proper spectrometer operation.
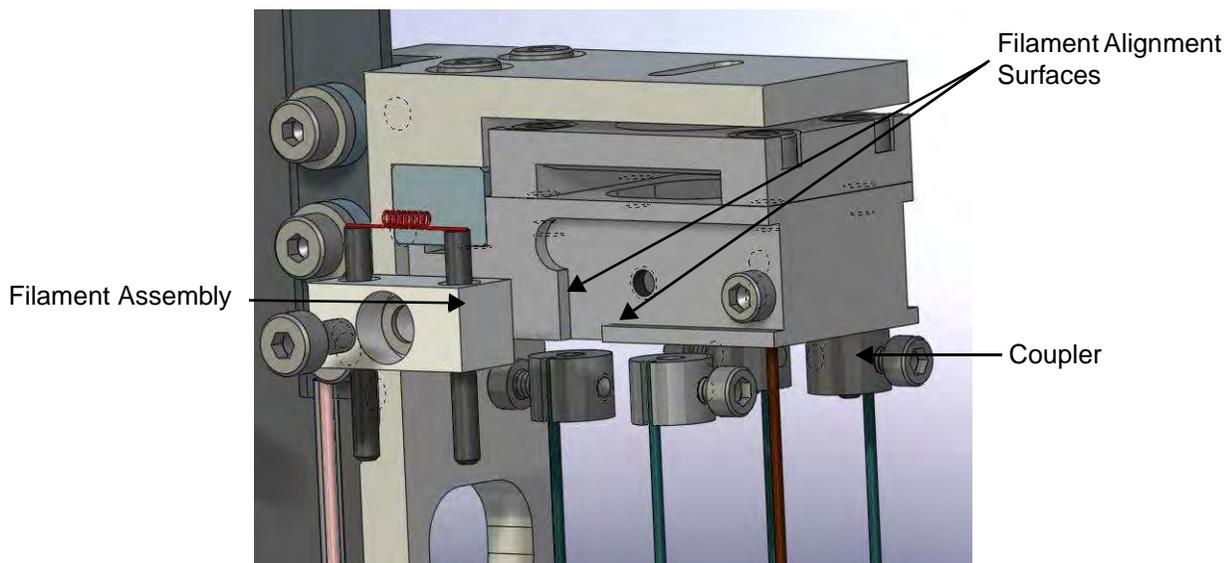
Figure B-84   Coupler and Filament Assembly

15. While holding the filament in position, insert the M2 screw and washer and tighten (Figure B-85).

16. Tighten the coupler screws onto the filament posts (Figure B-85).

17. Visually verify ceramic is tight against the bottom and right side ribs. Ensure that the filament is positioned in the slot of the ion source as shown (Figure B-85 and Figure B-86).
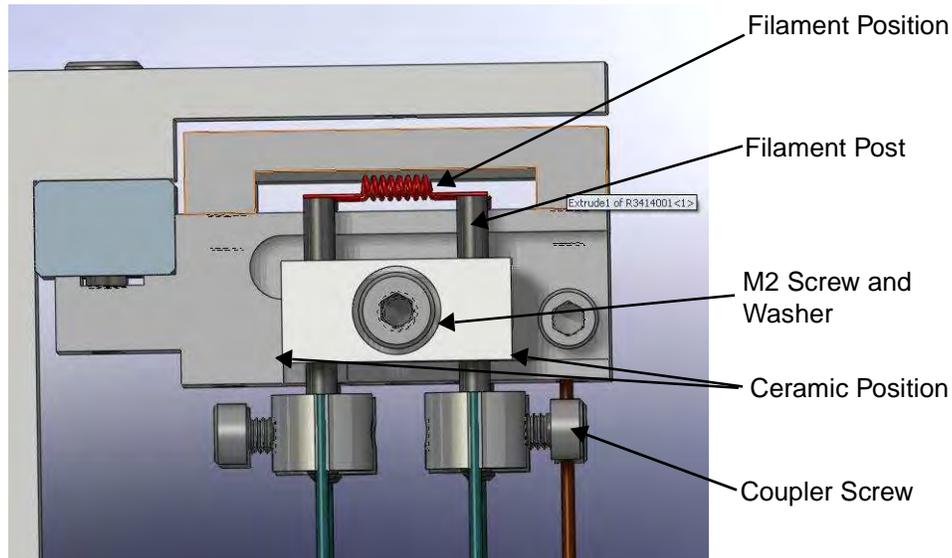
Figure B-85   Filament Position
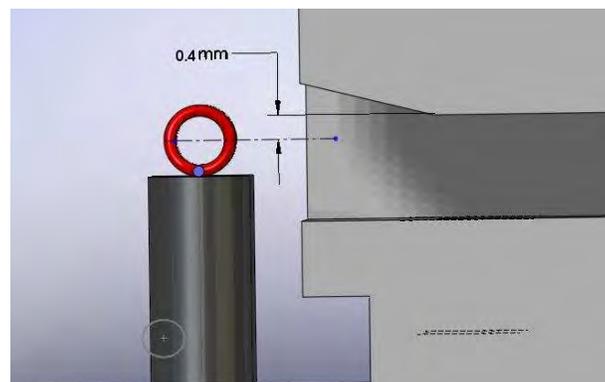
Figure B-86   Filament Alignment

18. Clean the mating surfaces of the spectrometer body and header with Isopropyl alcohol and a clean lint free wipe.

19. Install the new header with the six existing screws. Torque to 10.2 N-M (90 IN-LB).

NOTE   *The cones of the Belleville washers should all point to the head of the screw.*

20. On the PCB, use the resistance meter to verify an open circuit between any two of the six ion source header pins (except FIL-1 to FIL-1 and FIL-2 to FIL-2 which should be 0.3 Ohms or less). Also verify an open circuit between the body of the spectrometer and any of the ion source header pins (Figure B-87). If there is continuity (short circuit) at any of the points, remove the header and inspect for shorting.
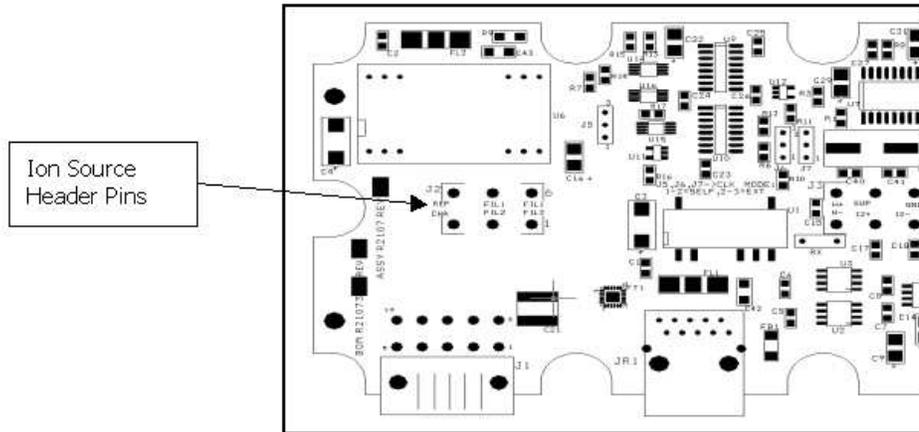
Figure B-87   Ion Source Header Pin Schematic

21. Re-Install the cover with the four screws.

22. Re-plug in both cables and ground strap.

23. Verify that turbo vent valve is closed.

24. Leak check the spectrometer to ensure a leak free joint.

25. Close the cover and secure using existing hardware.

26. Power up the leak detector.

27. Let the unit run for 20-30 minutes, then perform a calibration (via the I/O, front panel display or RS232), per the user manual, to validate a successful installation.

Appendix C. Troubleshooting

C.1 Service 1/Service 2 Commands

The Service1 and Service2 RS232 commands provide a detailed setup and operational status of the VS-C15 component leak detector, especially for customers who do not have optional Front Panel Display. This information is very helpful in diagnosing problems in the field for Agilent's Service and Technical Support Representatives.

C.1.1 SERVICE1

Entering this command elicits a response from the VS-C15 as follows:

Current Date: 1 11/03/2008 12:10:26.951

IONCHAMBER 244.6
EMISSION 0.553
OFFSET (Sys/Std/Curr) -2914 0 -2914
GAIN (Sys/Std/Curr) 1.0 1.0 1.0

LPV: 0.01E-09 008426 000001 CONTRAFLOW

Turbo Speed (RPM): 33000

range   -06 auto
exponent -06
reject 1.0E-08 1.0E-08 1.0E-08 1.0E-08 1.0E-08
stdleak 1.4E-07
output   linear

filament Two Lit internal
Filament 1 Hours: 345
Filament 2 Hours: 0

Turbo Ready
Turbo No Fault
Turbo Speed (RPM): 33000
Turbo Temp (Celsius): 30
Turbo Life (Hrs): 355

STD_LEAK_VALVE Closed
Current Cal Leak Temperature: 24.5
Internal Calibration OK?: No
Internal Calibration Error: Lost-
Power
External Calibration OK?: No

External Calibration Error: LostPower
Tune OK?: LostPower

LR Reject #1: off 1.0E-08 High
LR Reject #2: off 1.0E-08 High
LR Reject #3: off 1.0E-08 High
Pressure Reject #4: on   1.0E-00 Low
Audio Reject: off 1.0E-08 High

C.1.2 SERVICE2

Entering this command elicits a response from the VS-C15 as follows:

Version: QE01.04 B29900
Calibration Type: internal
AZ<0: off
Zero Enabled: on
External Leak: 3.0E-06
Leak Rate: 0.01E-09
Std Leak: 1.4E-07
Calibrated Leak Expiration: 1 1 2009
Leak Calibrated at Temperature: 25.0
Temperature Factor: +0.0

LR Reject #1: off 1.0E-08 High
LR Reject #2: off 1.0E-08 High
LR Reject #3: off 1.0E-08 High
Pressure Reject #4: on   1.0E-00 Low
Audio Reject: off 1.0E-08 High
Ctrl Panel Lock-Out: off
Speaker Volume: off
Range Stop: -08 off
Manual Exponent: -06 auto
Top Range:
Display Mode: lin
Language: ENG
Password Status: off
Password: 777777
GAIN: 20
I/O Board Version: 00.06
Vacuum Gauge: Installed Status: OK

C.2 *System Pressure Wait* error message appears on the front panel display

This error can also occur during normal operation.

Causes/Resolutions

1. Foreline pump is not running:

   ❑ Ensure the foreline pump is operating - check electrical connections and that the power switch is on.

2. Turbo pump failure:

   a. Verify that the red turbo symbol appears on the *Home* screen. This symbol flashes when a turbo failure is present.

   b. Select the *Manual Valve Control* screen and verify that the turbo RPM is at the programmed value for that given range (see chart) and that the bearing temperature is normal (< 50 °C (122 °F). If the bearing temperature is > 60 °C, the turbo shuts down.

   c. If no turbo error symbol is present on the *Home* screen, select the *Manual Valve Control* screen and observe the turbo RPM and bearing temperature. If the turbo RPM is 6000, it is possible that the turbo has crashed:

      ❑ Remove the spectrometer from the turbo and see if the turbo spins freely. If not, replace turbo.

3. Turbo Controller board failure:

   a. Verify that the red turbo symbol appears on the *Home* screen.

   b. Open the *Manual Valve Control* screen and ensure that the turbo RPM = 0 and the bearing temperature = 255 °C (491 °F).

   c. Verify that the power cable is connected to the turbo and that 24 VDC is present at the turbo controller board. If all connections are secure, replace the turbo controller board.

   d. Open the *Manual Valve Control* screen and ensure that the turbo RPM = 0 and the bearing temperature = 0 C (32 F). Ensure that the RS-232 cable is secure at the turbo controller board and motherboard. If the RS-232 cable is secure, replace the turbo controller board.
   If the replacement turbo controller board does not solve the communication problem, there is a chance that the RS-232 cable is defective or that the communication port on the motherboard is not working, replace the motherboard.

4. Gross leak in vacuum system:

    ❏ Ensure that the foreline connection (bellows) between the foreline pump and valve block are properly attached and free of cracks and fractures. If not, replace these.

System Not Ready message error appears on the front panel display

I/O pin 6 - Low
Profinet I/O - Cyclic Input Data: Word 0 - Bit 5 - low
RS232 - Inquiry: ?LPV - Response/ 0.00E-00 760000 000001 NOT READY
Analog Output Voltage = 9.99 VDC

Indicates that the leak detector is NOT READY:

    ❏ Turbo is not ready (< programmed rpm)

    ❏ Filament is not active (no emission)

    ❏ ConvecTorr gauge is activated via software, but not connected or is defective

Offset Fault error message and a flashing *C* appear on the front panel display after a calibration attempt

Causes/Resolutions

1. Defective electrometer (spectrometer assembly):

    a. Go to the *Manual Tuning* screen and observe the first offset value (uV).

    b. Power off and open the VS-C15.

    c. Remove the aluminum cover of the spectrometer and reconnect the ion source and pre-amp cables and verify that the pre-amp going to the Mother board is secure.

    d. Power unit back up.

    e. Place the leak detector in Hold or Vent.

    f. On the Pre-Amp board, measure the voltage with a DMM the pin labeled *OUT* (electrometer output) with reference to ground.

    The voltage should be in the mV DC range. Verify if the voltage reading is in V and matches the large offset reading observed prior in the *Manual Tuning* screen.

    g. Carefully remove the Ion Source (high voltage) cable from the pre amp board and re-measure the electrometer output.

    If the large voltage reading (-500mV to -11 VDC) is still present in the absence of the ion source high voltage and the filament voltage the electrometer is defective: Replace the spectrometer header assembly or the entire spectrometer assembly.

2. Defective Pre-Amp board (A/D converter-corrupted):

    a. Place the leak detector in Hold or Vent.

    b. On the Pre-Amp board measure the voltage with a DMM the pin labeled *OUT* (electrometer output) with reference to ground:

❑ Confirm that the electrometer output is approximately between -20 to +20mV DC.

❑ Place the leak detector in Test and activate the internal standard leak.

❑ Verify that the electrometer output is approximately between -20 to -100mV.

❑ Attempt another full internal calibration. If the calibration aborts to an *Offset Fault* condition go into the *Manual Tuning* screen and observe the first *Offset* reading. The Offset reading should be between -20000 to +20000 uV for a normal operating Pre-Amp board.

c. Replace the Pre-Amp board or Spectrometer Header assembly if the observed *Offset* reading is abnormally higher (ex. -1000000 to -10000000 uV) than what was measured above.

High Background error message and a flashing *C* appear on the front panel display after a calibration attempt

Causes/Resolutions

1. Helium background is >1E-5 std cc/sec He in Test (ContraFlow) or E-7std cc/sec He in Fine Test (Midstage):

a. This is sometimes due to leak checking parts that have gross leaks thus saturating the leak detector with helium:

❑ MR15 - Open the gas ballast on the DS302 for 5 minutes and then shut off the gas ballast and re-calibrate. Repeat the process, if necessary, until the leak detector completes a full internal calibration.

❑ MD30/PD03 - Place a light Nitrogen purge in the test port of the leak detector and throttle the Nitrogen until the leak detector transfers into Test or Fine Test for several minutes. Repeat the process, if necessary, until the leak detector completes a full internal calibration.

❑ PR02 - Remove the test port cap or plug and place the leak detector into Test and run for several minutes at atmospheric pressure. Repeat the process, if necessary, until the leak detector completes a full internal calibration.

b. Possible leaks in the foreline connections or bellows:

❑ Inspect and fix - leak check foreline.

c. Defective foreline pump (MD30, MR15 & PD02 models):

❑ Activate a High Pressure Test in the Leak Rate Ranging Menu with the test port blanked off and observe the test port pressure after two minutes. A typical baseline pressure of 10 mTorr should be achieved; 100 mTorr or higher indicates a poor performing primary pump.

d. MD30/PD03 models only - High ambient helium background due to poor helium management; excessive spraying of helium and poor ventilation:

❑ MD30 - Plumb in a nitrogen purge (15 sccm or 2 psi) at the inlet of the scroll pump. Verify that the test port pressure is <100mTorr while in Test.

❑ PD03 - Verify that the diaphragm pump is functional, electrically (running) and creating a vacuum.

Spec Tube message error appears on the front panel display

This error can also occur during normal operation.

Causes/Resolutions

1. Spectrometer pressure is > 7E-3 due to a gross leak:

    a. Select *Setup menu > Gauge Calibration* menu and ensure that the *Spectrometer Pressure* reading is < 1E-4 Torr.

    b. Check for a gross leak at the turbo inlet, spectrometer centering ring or at the spectrometer header (O-ring misaligned) or entire spectrometer.

2. Spectrometer pressure is >1E-4 due to a misaligned, incorrectly assembled or contaminated total pressure plate:

    a. Disassemble the spectrometer header from the spectrometer body and inspect the total pressure plate (Figure C-1 and Figure C-2).
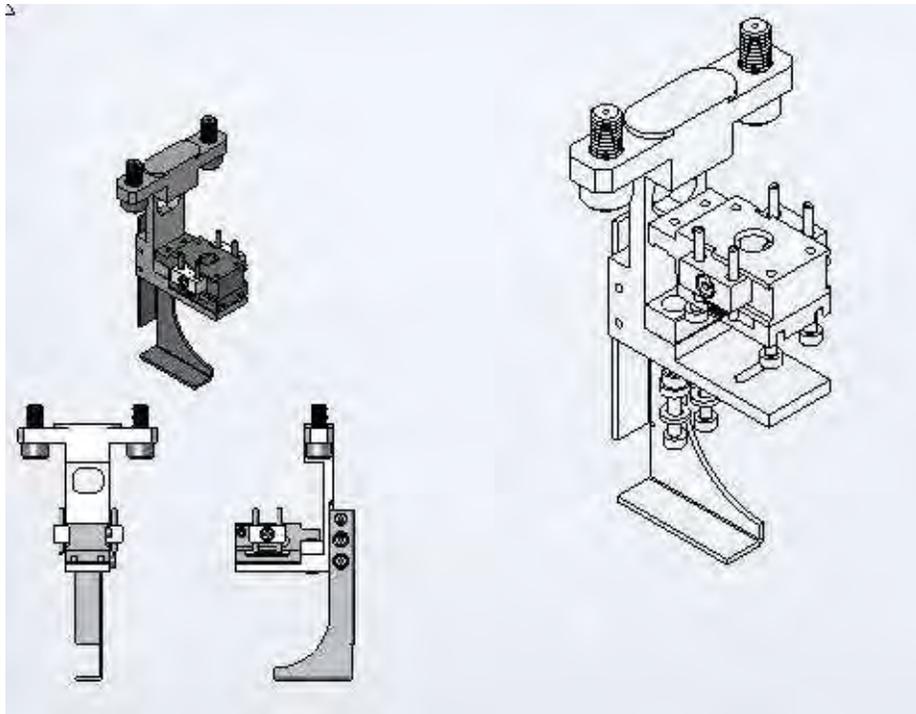
Figure C-1   Spectrometer (Ion Source Assembly)
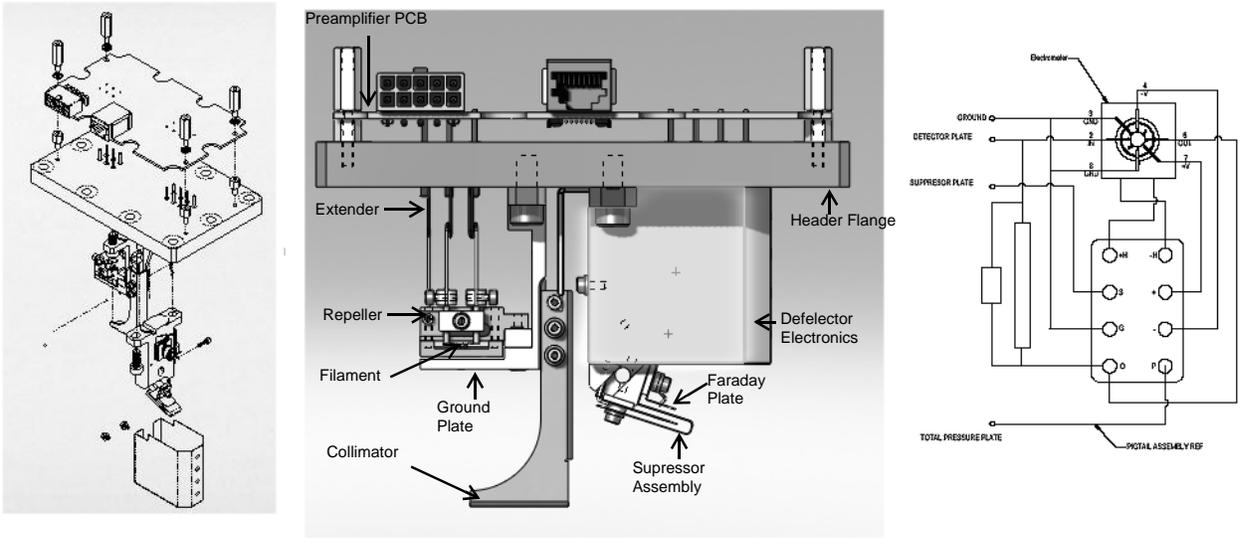
Figure C-2   Spectrometer Header: Decomposition

   b. Ensure the total pressure plate is electrically isolated from ground and other points of contact.

   c. Ensure that the total pressure plate wire is securely fastened to total pressure plate and feed through pin.

3. Pre-amp board failure (Figure C-2 and Figure C-3):
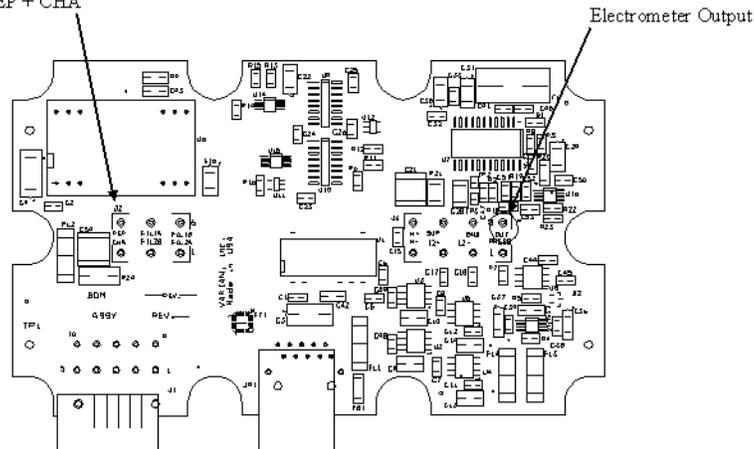
Figure C-3   Pre-Amp Board - Measurement Points

   a. Measure on the pre-amp board the voltage present at the header pin labeled *PRESS* (spectrometer pressure output).

   b. Carefully remove the ion source power cable (warning high voltage present), if the measured voltage is greater than 1.5 VDC.

c. Re-measure the voltage at the *PRESS* pin. The voltage should be 0. If a constant steady state voltage is measured, replace the pre-amp board.

CAUTION *Many components of the leak detector are static sensitive. Wear a grounding device when performing any maintenance on the leak detector, especially when performing maintenance of static sensitive parts, such as circuit boards and the spectrometer.*

Table C-1 gives the spectrometer header, pre-amp board J1 connector pin assignments.

Table C-1   Spectrometer Header, Pre-amp Board J1 Pin Assignments

Chamber	Repeller	Filament #2		Filament #2
Filament #1	Filament #1			

Both Filaments No Emission error message appears on the front panel display

This error can also occur during normal operation.

Causes/Resolutions

1. Both filaments are an open circuit due to age and prolonged normal everyday use:

   ❑ Spectrometer - Pre Amp Board (Figure C-2 and Figure C-3 on page C-7): Measure the J2 connector filament resistance (with power off) (filament resistance < .5 Ohm). If filaments are open circuit, open the spectrometer and replace the filaments. See Section B.13 "Filament Replacement".

2. Ion Source board failure:

   a. Ensure that the ion source board cable is secure at both the spectrometer and ion source board.

   b. If both filaments failed prematurely and both were replaced:

      ❑ Run a full calibration (Figure C-2 on page C-7 and Figure C-3 on page C-7) and after a successful pass, measure the voltage of the filament that is in use on the Pre-Amp board J2 connector (Spectrometer Header). The filament voltage should = 1.4 to 1.9 VDC with < 30 mV of noise (AC). If not, go to the *Manual Tuning* screen and adjust the *Emission Current* until the AC ripple is < 50 mV and the filament voltage is 1.4 to 1.9 VDC.·

      ❑ Select *Setup Menu > Manual Tuning* screen and note the *Emission Current*. Measure the emission current (actually VDC) on the Ion Source board at test points EMISS T.P and TP101 FIL GND. The measured voltage should correspond to the observed reading in the *Manual Tuning* screen (within +/- 10%). If the emission current <.3 mA, the system senses no emission current, indicating that the filament is defective. Replace the filament.

NOTE

Ion Source Bd. Assy. Rev G May 2007 the measured emission current will be a factor of 10 lower than observed emission. For example, Manual Tuning screen - Emission Current = .702, if measured on the Ion Source board = .0702.

c. Adjust the emission in ether direction; the measured value should track the displayed value. If the measured emission current (voltage) is fixed at 1.5 to 3.0 VDC, replace the Ion Source board due to a failed emission regulation circuit:

❏   Remove the spectrometer header and inspect filaments for distortion and loss of thoria coating due to over heating; replace if needed

d. *Select Setup Menu > Manual Tuning* screen and verify that the *Emission* or *Ion* is 0. Measure (with power on) the ion voltage (with respect to ground) on the pre-amp board, J2 connection, pins labeled REP or CHA. The voltage range is from 198 to 287 VDC. If no high voltage is present replace the Ion source board.

e. If the high voltage is present and there is continuity for both filaments, verify if the filament voltage is present at either of the two filaments (Filament Voltage 1.3 to 1.8 VDC). If there is no filament voltage or < 1.0 VDC is measured replace, the ion source board.

3. Contaminated spectrometer - Emission current cannot be established - ion source:

a. Refer to step 2b for steps to measure filament resistance, ion voltage and filament voltage. Verify (Figure C-3 on page C-7 and Figure C-1 on page C-6):

❏   Continuity for both filaments.·

❏   Reverify that the ion and filament voltage are available at the spectrometer. If yes, continue to the step b.

b. Select *Setup Menu > Manual Tuning* and note the *Emission Current* setting. Measure the emission current on the Ion Source board (Figure C-4 on page C-12) at test points EMISS T.P and TP101 FIL GND. The measured voltage should correspond to the noted reading (within +/- 10%). If emission current < .3 mA or zero, inspect the spectrometer for contamination (if necessary, replace the ion source). See Figure C-1 on page C-6 and Figure C-2 on page C-7.

C.3 Operational Failures

NOTE

> *Front Panel Display Option*
>
> *A flashing C indicates that the leak detector has failed a calibration attempt.*

Gain Too High error message and a flashing *C* appear on the front panel display after a calibration attempt.

- ❑ Internal Calibration Not OK
- ❑ External Calibration Not OK

Insufficient helium signal during calibration - Gain > 9.0 internal, Gain > 150 external

Causes/Resolutions

1. Calibrating to the wrong calibrated leak or the leak rate value was incorrectly entered:

   a. Open the *Calibration Set Up* screen and verify that the correct calibrated leak is selected.

   b. Select *Setup Menu > Maintenance Option > Internal Calibrated Leak* and verify that the programmed parameters match the calibration certificate or physically check the information on the label for the internal standard leak.

2. Internal or external calibrated leak is damaged/destroyed. If the:

   - ❑ Internal full calibration failed; try calibrating to an external calibrated leak.

   - ❑ External calibration is successful turn on the internal calibrated to validate the leak rate and vice versa.

3. I/O board is defective:

   - ❑ Front Panel Display - abnormal parameters:

      - ❑ Verify the internal standard leak is active.

      - ❑ Verify on the Manual Valve screen that Std Leak symbol appears and that the temperature is correct.

4. Filament failure - not generating enough electrons for proper ionization to occur:

   - ❑ Switch filaments and re-calibrate and if the second filament fails, inspect the ion source and filaments and replace (Figure C-2 on page C-7). See Section B.13 "Filament Replacement".

   - ❑ Measure the ion voltage with respect to filament (1 or 2). The voltage should = 88 VDC ± 1%; if not, replace Ion Source board.

5. Contaminated ion source:

   - ❑ Measure ion voltage/ read ion voltage (*Manual Tuning* screen). The voltage should be > 27 VDC; if not, the ion source is contaminated.

Emission current
measurement

Figure C-4   Ion Source Board - Measurement Points

    c. Turn down the emission current to .702 and perform a full calibration and verify that it was successful.

No Ion Peak error message and a flashing *C* appear on the front panel display after a calibration attempt

Output from A/D converter on the pre-amp board is constant (no- change in reading).

    Causes/Resolutions

1. Int. Cal Leak option - 3-way valve not activating. There is a defective calibrated leak.

2. External calibrated leak not installed or defective (customer) valve or signal.

3. Cable (w/RJ45 connectors) from Pre-Amp board to motherboard disconnected:

    ❑ Check the cable and re-calibrate.

4. Pre-Amp board failure (Figure C-3 on page C-7):

    a. Measure the voltage, with respect to ground, on the pre-amp board J3 connector OUT pin.

    b. Monitor the output voltage during the calibration routine.

    c. Monitor the A/D output from the Pre-Amp board by connecting a laptop to the leak detector using HyperTerminal.

    d. Enter the command: *'AD_READ @ . CR 1 SECS MANY*
        The following response appears (example):
        8390438...8391004...8390710...8390937 (continues until *ESC* is entered).

    e. Perform a full calibration and note the electrometer output voltage. The voltage should be scaling up and down as the ion voltage is scanning. The same should be happening for the A/D output.

    f. If the:·

        ❑ Response back from the A/D is not changing, the A/D on the Pre-Amp board is defective. Replace the Pre-Amp board.

❑ Electrometer was not responding during the calibration, measure and verify that +/- 12 VDC is available on the Pre-Amp board J3 connection.

5. Electrometer failure (spectrometer):

❑ If +/- 12 VDC is:·

❑ Not measured, replace the Pre-Amp board.

❑ Available on the Pre-Amp board, use the same troubleshooting method in step 2. Both the electrometer and the A/D will not respond, as the electrometer has failed. Install a new spectrometer header.

I/O Board Problem

1. The VS-C15 does not respond to PLC inputs and status outputs are not indicated:

❑ Verify 24 VDC is applied to the I/O board by observing the power on LED on the rear panel next to 25 pin I/O connector.

❑ Optional Front Panel Display – Verify on the *Systems Information* screen that the I/O board option is displaying a software revision number and has a blue check mark. If the I/O board shows a software revision of *99.99* with a red *X*, the I/O board is not communicating with the Mother board:

❑ Check RJ45 cable connections at the Mother board and I/O board.

❑ Connect to the RS232 diagnostic port and query the RS232 command ?IOBOARD:

❑ Response *0* I/O board is not communicating with Mother board.

❑ Response *1* I/O board is communicating with Mother board.

2. The calibrated leak valve does not activate during calibration:

❑ Check the standard leak cable connections at both the standard leak three way valve and I/O board ends.

❑ Optional Front Panel Display – Verify the standard leak option has been selected in the *Advanced Parameters* menu.

C.4 Performance Issues

High helium background - after a full calibration with the test port blanked off

Causes/Resolutions

1. Filament condition:

   ❑ Switch filaments and perform a full calibration.

2. Contaminated ion source/spectrometer: Both filaments 1 and 2 produce a high helium background:

   a. Open the spectrometer and inspect the ion source for contamination (carbon buildup) or noticeable discoloration (Figure C-1 on page C-6).

   b. Clean or replace the ion source and filaments (Figure C-2 on page C-7).

3. Electrometer offset /noise drift:

   a. Measure the voltage, with respect to ground, on the pre-amp board (Figure C-3 on page C-7), J3 connector OUT pin.

   b. Monitor the output voltage (low mV range).

   c. Unplug the P1 (ion source bd. cable) cable and observe if the leak rate is 0.0E-11 and electrometer output voltage <= 5mV DC. If the leak rate and output voltage remain unchanged or very unstable replace spectrometer header or entire spectrometer. *This page intentionally left blank.*

4. Foreline pump oil contamination (enriched with helium):

   ❑ Replace the TriScroll pump.

Unstable leak rate reading - (Test and Fine Test modes of operation)

Causes/Resolutions

1. Leak in system:

   ❑ Perform a full calibration, blank off test port and leak check the system.

2. Filament - unstable/damaged:

   ❑ Switch filaments and verify if instability has been eliminated.

3. Contaminated ion source: If both filaments 1 and 2 produce an unstable background reading (Figure C-2 on page C-7):

   a. Open the spectrometer and inspect ion source for contamination (carbon buildup) or noticeable discoloration (Figure C-1 on page C-6 and Figure C-2 on page C-7).

   b. Clean or replace ion source and filaments.

4. Electrometer - cooler failure (Figure C-2 and Figure C-3 on page C-7):

   a. Verify that 5.0 VDC is present on the pins labeled H+ and H on the Pre-amp board.

b. Power off the unit and measure resistance of pins H(+) and H(-); resistance should be between 15 to 45 Ohms.

c. Replace the spectrometer header or entire spectrometer if the voltage or resistance is not within specification.

5. Foreline pump failure:

❑ Let the system stabilize and verify instability. If the foreline pump is a:

    ❑ Rotary vein mechanical pump, drain and add new oil.

    ❑ Dry scroll pump, replace tip seal or pump module.

If needed replace foreline pump.

6. Ion Source board Emission Current noise regulation > 100 mVAC:

a. Open the *Manual Tuning* menu and adjust and measure the emission current (Figure C-4 on page C-12), to minimize the emission current to < 30 mVAC.

b. If after adjustment, emission current noise is > 100 mV AC:

    ❑ Switch filaments: if no change,

    ❑ replace ion source board, if no change (noise > 100 mVAC),

    ❑ replace the ion source (Figure C-1 on page C-6).

Front Panel Display - Difficulty selecting menus or in activating/deactivating features/options

Causes/Resolutions   Front Panel Display is out of calibration:

❑ Re-calibrate front panel by:

a. Turning off leak detector.

b. Place and hold a finger on front panel and hold; power up unit.

c. A blue screen appears with the message *Touch all Crosshairs*. In every corner of the screen a crosshair appears; touch all four crosshairs.

d. A second message appears *Accept Calibration*; select *Accept*.

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Appendix D. Introduction to Leak Detection

D.1 Leak Testing—Why is it Needed?

Helium is a superior choice of tracer gas used to find leaks for a multitude of reasons. Helium is:

❑   Non-toxic

❑   Inert and non-condensable

❑   Normally not present in the atmosphere at more than trace amounts

❑   Relatively inexpensive

❑   Readily passes through leaks due to its small atomic size

❑   Non-flammable

❑   Available in various size cylinders

❑   Available in purities appropriate for medical usage

The only molecule smaller than Helium (mass 4) is Hydrogen (mass 2), which is not inert. Helium is much lighter than the next heavier inert molecule, Neon (mass 20) which is much more expensive. Helium is present at a concentration of only 5 ppm in normal atmospheric conditions.

D.2 Agilent's Helium Leak Detection Technologies

A Mass Spectrometer Leak Detector *(MSLD)* is a complete system for locating and/or measuring the size of leaks into or out of a device or a container. This method of leak detection is initiated when a tracer gas, helium, is introduced to a test part that is connected to the MSLD system. The helium leaking from the test part diffuses through the system, its partial pressure is measured, and results are displayed on a meter.

The MSLD operating principle consists of ionization of the gases in a vacuum and their acceleration across a voltage drop and a magnetic field (Figure D-1). The helium ions are separated and collected, and the resulting ion current is amplified and indicated on the meter or display.

A mass spectrometer leak detector consists of the following components:

❑   A spectrometer tuned to detect the mass of helium

❑   A vacuum system to maintain adequately low pressure in the spectrometer

❑   A mechanical pump(s) to evacuate the part to be tested

❑ Valves that enable the various stages of the leak detection cycle, from evacuation, to test, to venting

❑ Amplifier and readout instrumentation that monitors spectrometer output signal

❑ Electrical power supplies and controls that sequence valve's, protective circuits, etc.

❑ Fixturing that attaches the part to be leak-tested to the leak testing equipment
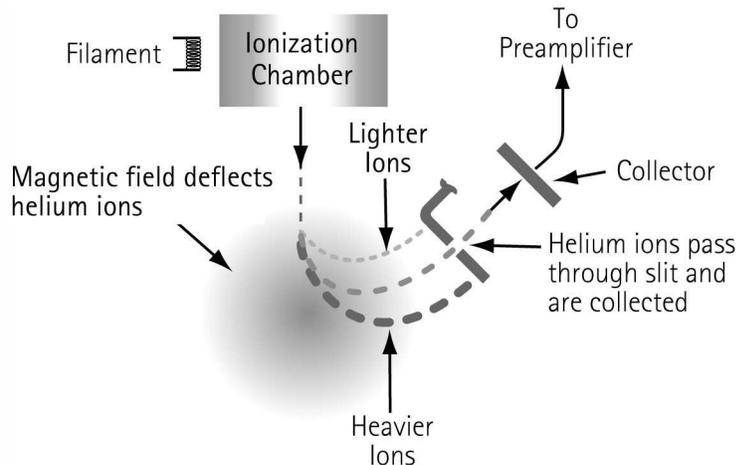
Figure D-1   Magnetic Separation Principle

Our *SIPD* family of products is also sensitive to helium and is based on a patented technology called Selective Ion Pump Detection (Figure D-2). The sensor technology incorporates an ion pump connected to a quartz capillary tube and maintained under high vacuum. This membrane is heated with a coiled platinum filament. Once heated, the membrane becomes permeable to helium. As the partial pressure of helium in the ion pump increases, so does the current draw of the ion pump. This current is proportional to the pressure and is therefore representative of the helium at the test probe of the instrument.

A selective ion pump detector consists of the following:

❑ An ion pump and controller

❑ A permeable quartz capillary

❑ A heater coil that surrounds the quartz capillary

❑ Electronics to process the signal

❑ Display for access to leak rate and other unit functions
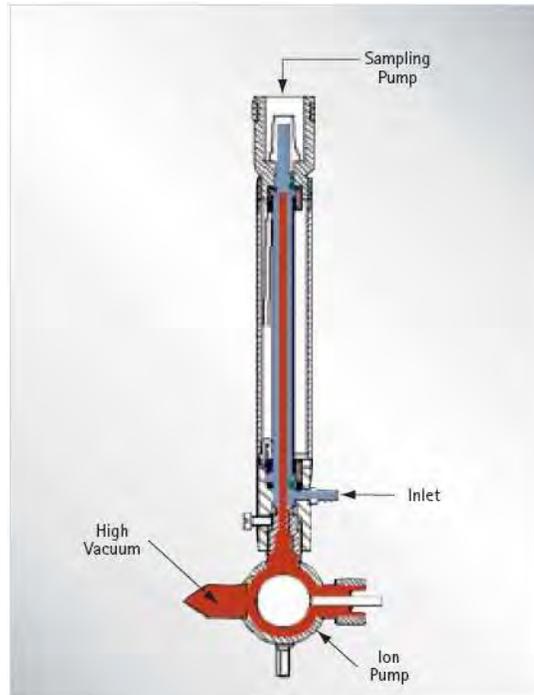
Figure D-2   Selective Ion Pump Detector

D.3 Methods of Leak Testing

There are many different ways to leak test parts using helium as a tracer gas. In general, the leak detection method is selected based on the actual working conditions of the part being tested. It is recommended that during leak testing, the same pressure differential be maintained and in the same *direction* as exists during the actual use of the part. For example, a vacuum system is tested with a vacuum inside the chamber, while a compressed air cylinder should be tested with a high pressure inside the cylinder.

There are two general concerns when leak testing. One is the location of leaks and the other is the measurement of the total leakage rate of the part, as some leakage may be acceptable. In many cases, parts may be first tested to determine if they pass an acceptable level, and if not, the part may be taken off line and subjected to a second test with the intent of locating the leak. Additionally, many parts may be tested in batches. If a batch fails, the individual parts in that batch may then be tested separately to identify the leaking part(s).

D.3.1 Vacuum Testing Method (Outside-in)

The part to be tested is evacuated with a separate pumping system for large volumes, or with just the leak detector itself. When the appropriate cross over pressure has been reached, the leak detector is valved-in or transfers into test and the part is tested using one of the following methods:

D.3.1.1 Locating Leaks

To pinpoint the location of the leak(s) (but not measure the total leakage rate), helium is administered to the suspected leak sites of the part using a spray probe with an adjustable flow (Figure D-3).
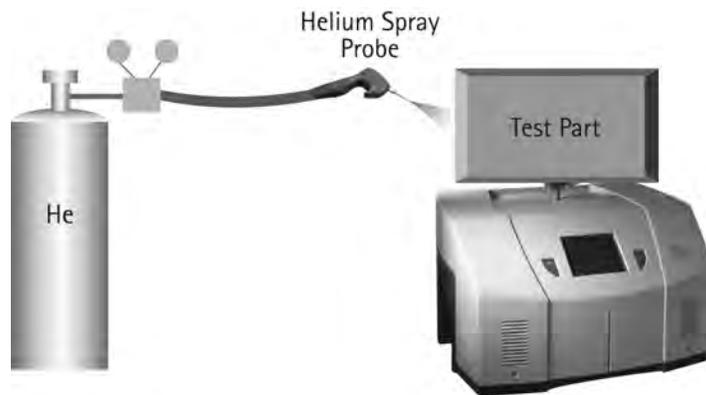
Figure D-3   Locating Leaks: Outside In

D.3.1.2 Measuring Leaks

To determine the total quantity of leakage (but not the number or location of leaks), the part is connected to the leak detector and shrouded by a helium environment. This helium environment can be contained in many methods ranging from a simple plastic bag to more complex bell jar arrangements (Figure D-4).
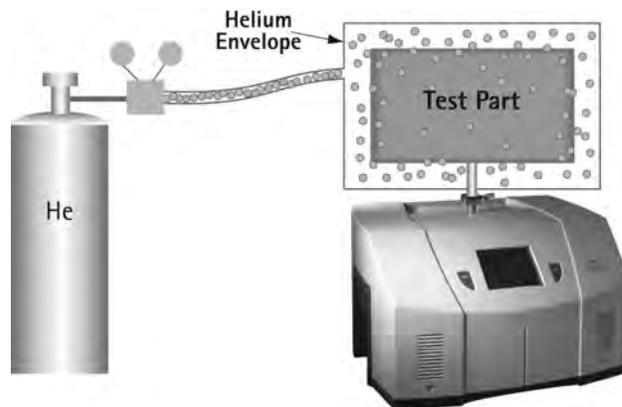
Figure D-4   Measuring Leaks: Outside In

D.3.2 Pressure Testing Method (Inside-out)

In this technique, the part is pressurized with helium or a mixture of helium and air, and tested by one of the following methods.

D.3.2.1 Measuring Leaks

To determine the total quantity of leakage (but not the number or location of leaks), the part is pressurized with helium (or a mixture of helium and air or nitrogen). This can be done by bombing or backfilling small hermetically sealed parts. Larger parts can be actively pressurized using a hose or tubing to deliver the helium. The part is placed in a volume that is then evacuated by the leak detector. All the helium escaping from the part is captured and quantified (Figure D-5).
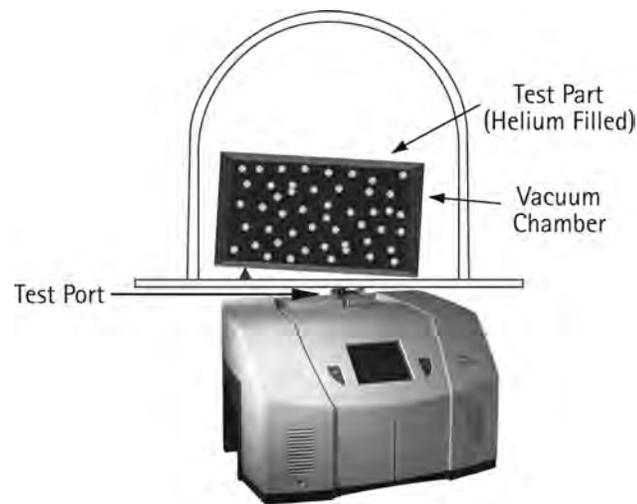
Figure D-5   Measuring Leaks: Inside Out

D.3.2.2 Locating Leaks

To pinpoint the location of the leak(s) (but not measure the total leakage), the likely potential leak sites of the part are scanned using a Sniffer Probe connected to the inlet of the leak detector (Figure D-6).
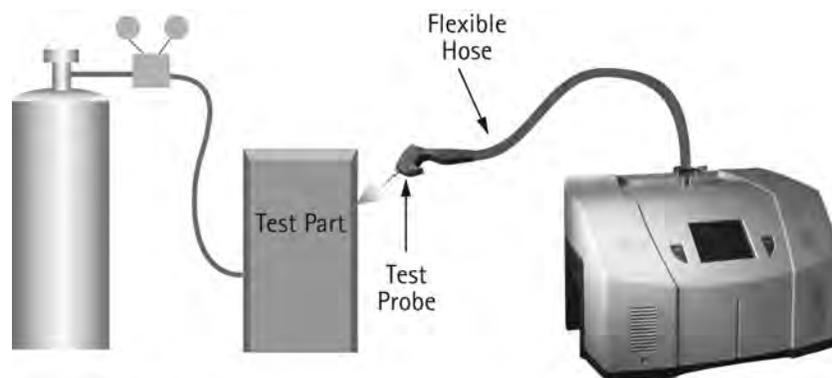
Figure D-6   Locating Leaks: Inside Out

D.3.2.2.1 Accumulation Testing Method

This method can both locate and quantify leaks. Some type of shroud or hood is placed in such a manner as to envelop a potential leak site. A certain amount of time is given to allow leaking helium to accumulate in the shrouded area, increasing the helium concentration. The leak detector is then valved-in to the shrouded volume. If many potential leak sites exist in a manifold or if many parts are to be tested at the same time, they can be sequentially valved-in to determine which site is leaking (Figure D-7).
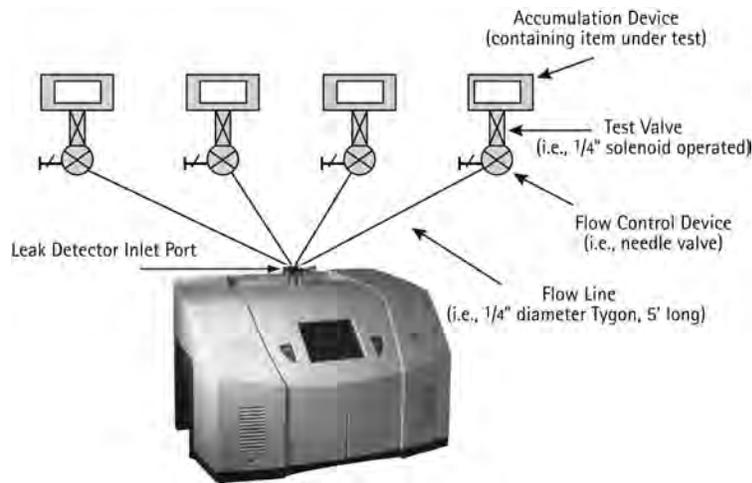
Figure D-7   Accumulation: Inside Out

D.3.3 System Leak Test Methods

Systems, like individual parts, should be tested with the same pressure differential and in the same direction as in actual use. Therefore, systems that are under vacuum while in operation should be leak tested under vacuum, while pressurized systems should be charged with helium to a pressure similar to operational conditions when possible.

D.3.3.1 Vacuum Systems

In general, vacuum systems are tested with a portable leak detector. Typically the leak detector is connected by means of a *tee* connected in between the foreline of the high vacuum pump and the inlet of its backing pump. A system should be capable of maintaining a foreline pressure low enough to operate the leak detector at this location. Helium is supplied to potential leak site using a spray probe or *bagging* suspected areas. If a leak exists, helium enters the system and rapidly diffuses through it. The leak detector should respond within several seconds or less. Leak detector sensitivity is diminished in systems with large backing pumps. If a system is using a cryopump as a high vacuum pump, it must be valved off before helium is introduced as cryopumps have limited helium pumping capacity (Figure D-8).
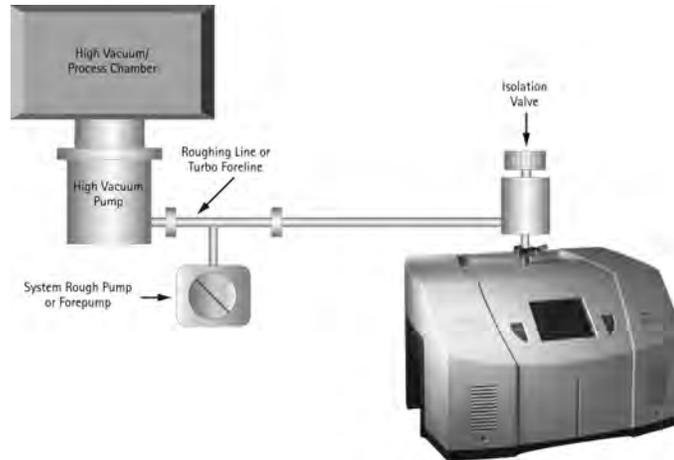
Figure D-8   Vacuum System

D.3.3.2 Pressurized Systems

Many different types of pressurized systems also need to be leak-free. These systems can be charged with helium or some mixture of helium and another gas such as nitrogen. If a diluted helium mixture is used, the helium signal is diminished proportionally. For example, if a mixture of 10% helium and 90% nitrogen is used, the signal reads 10% of the actual value of the leak, or a decade lower. This may be acceptable in many cases as system leak checking is usually to locate rather than quantify leaks. Once the system has been charged with an appropriate amount of helium, leak checking can be performed by means of a sniffer probe, or by *bagging* suspected leak sites so that leaking helium accumulates to a detectable level.

D.4 Typical Leak Detection Applications

D.4.1 Quality Control of Production Parts and Assemblies

The detection and location of leaks is critical in the production of many products from individual components, to subassemblies, to completed systems. In many of these cases, it is as important to know the size or rate of the leak, as it is the location. Whether quantitative or qualitative testing is required, our leak detectors help assure the leak integrity of your parts or assemblies. Some examples include:

Evacuated parts and assemblies

- ❑ Hermetically sealed electronic packages
- ❑ Valves and manifolding
- ❑ Feedthroughs/glass-to-metal seals
- ❑ Vacuum vessels and systems

Pressurized parts and assemblies

- ❑ Air conditioning and refrigeration assemblies
- ❑ Radiators, heat exchangers, and condensers
- ❑ Brake, fuel, and hydraulic lines
- ❑ Gas tanks
- ❑ Food storage tanks and packaging
- ❑ Body implantable medical devices
- ❑ High purity piping

D.4.2 Maintenance of Systems

Many vacuum process tools in fabs of all types require occasional leak checking. This may be part of a preventative maintenance schedule or in the event of an unexpected failure. Downtime in either case must be minimized. A rugged, dependable, fast starting leak detector is essential to maximize up time of production tools. Agilent VS Series portable leak detectors keep industry moving. Examples of some of these applications are:

Vacuum process equipment or tools

- ❑ Vacuum furnaces
- ❑ Vacuum coaters
- ❑ Beam lines
- ❑ Electron beam and ion beam process equipment
- ❑ Analytical Instruments

❑   Semiconductor process tools

❑   Laser process equipment

Pressurized systems

❑   Power Plants

❑   Underground tanks, cables, and pipes

❑   High purity gas handling systems

❑   Bioreactors and fermenters

❑   Liquid gas manufacturing facilities

❑   Fuel tanks and bladders

D.4.3 System Integrated Leak Detection

Manufacturers of large, complex systems may choose to integrate into those systems a component leak detector that can facilitate the on-going maintenance of leak-free integrity, thereby providing additional value to their customers. The Agilent 990CLD and 990dCLDII provide the necessary elements for flexible integration of leak detection capability into a large system. Examples of these systems are:

❑   Semiconductor process equipment

❑   PVD/CVD equipment

❑   E-beam and ion beam processing equipment

D.4.4 Mass Produced Parts

Some manufacturing processes require the integration of a leak-checking device into a multi-step process, usually with very high production rates. Component leak detectors are designed specifically for these applications in which a vacuum system and the control electronics may be mounted separately. The Agilent 990CLD and 990dCLDII offer the ultimate flexibility in a helium mass spectrometer leak detection system. The flexibility, ruggedness and rapid response time of these units allows for accurate, repeatable, high volume leak testing in demanding production environments. Some examples include:

High Volume Manufactured Parts

❑   Automotive fuel systems

❑   Automotive brake components

❑   Cooling and refrigeration system components

❑   Medical devices

❑   Automotive airbag components

❑   Tire and wheel assemblies

Portable Sniffing Applications

Some applications require operators or technicians to look for leaks from a ladder, outdoors, above or below ground, or in a densely constructed industrial facility or power plant. In these cases, a mobile cart-mounted MSLD may not be practical. A truly portable unit such as the PHD-4 is required. Some examples of such applications are:

❑   Aircraft manufacturing and maintenance

❑   Power generating plants

❑   Pressurized pipelines

❑   Bioreactors and fermenters

❑   Petrochemical plants and refineries

❑   Underground tanks

❑   Large condensers or heat exchangers

Appendix E. Specifications

E.1 Specifications

The specifications for the unit are provided in Table E-1.

Table E-1   Leak Detector Series Specifications

Specifications	Description
Minimal Detectable Leak	5E-10 atm std cc/sec He, 5E-10 mbar l/s, 5E-11 Pa m3/sec
Selectable Sensitivity Ranges	Four working ranges covering to E-3 to E-9 atm cc/sec He
Maximum Test Port (foreline pressure	5 Torr, 7 mbar, 667 Pa
Calibration Routine	Automated or manual (internal or external)
Background Suppression	Auto Zero (turn on/off background) and Auto Zero < Zero function
Display Interface (optional)	High clarity TFT color touch screen
Display - Selectable languages	English, French, German, Spanish, Japanese, Korean & Mandarin
Set Points (process control)	Five set points: four leak rate and /or pressure and one audio
Analog Output Voltage	0 - 10 VDC: Log 1V/decade, log 2V/decade and linear within the decade (DB-9F)
Serial Interface	RS232 isolated interface @ 9600 baud (DB-9M)
Discrete I/O	Optically isolated, 5-24 VDC outputs and inputs (DB-25S)
Networking Interface (optional	Profinet® I/O option (RJ45)
Power Input	24 VDC power input; 24 VDC, +/- 5%, max current: 5 A
Operating Temperature	+5 to +48°C
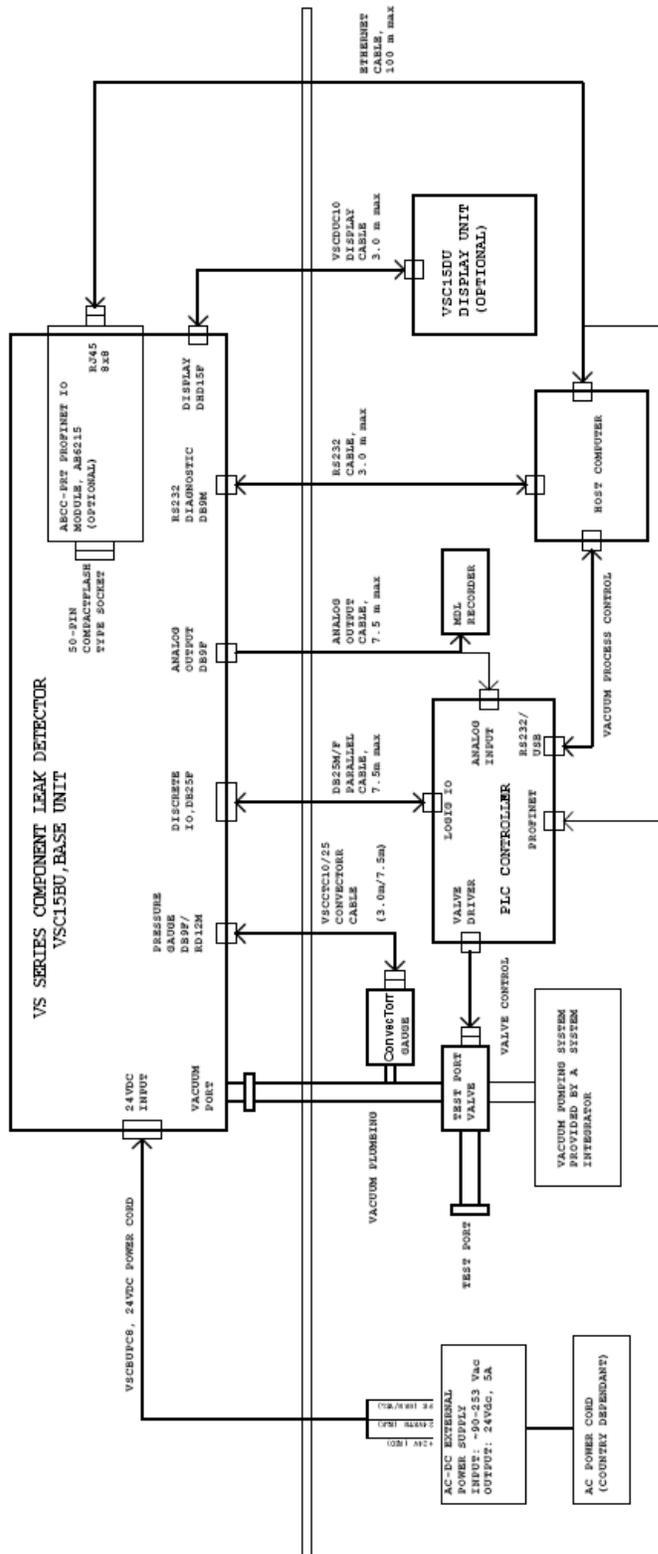
Figure E-1   VS C15 Interconnection Diagram

![Agilent Technologies logo]

**Vacuum Products Division
Instructions for returning products**

Dear Customer:

Please follow these instructions whenever one of our products needs to be returned.

1) Complete the attached Request for Return form and send it to Agilent Technologies (see below), taking particular care to identify all products that have pumped or been exposed to any toxic or hazardous materials.

2) After evaluating the information, Agilent Technologies will provide you with a Return Authorization (RA) number via email or fax, as requested.
    Note: Depending on the type of return, a Purchase Order may be required at the time the Request for Return is submitted.   We will quote any necessary services (evaluation, repair, special cleaning, eg).

3) **Important steps for the shipment of returning product:**
    - Remove all accessories from the core product (e.g. inlet screens, vent valves).
    - Prior to shipment, drain any oils or other liquids, purge or flush all gasses, and wipe off any excess residue.
    - If ordering an Advance Exchange product, **please use the packaging from the Advance Exchange to return the defective product.**
    - Seal the product in a plastic bag, and package product carefully to avoid damage in transit. You are responsible for loss or damage in transit.
    - Agilent Technologies is not responsible for returning customer provided packaging or containers.
    - **Clearly label package with RA number**. Using the shipping label provided will ensure the proper address and RA number are on the package. Packages shipped to Agilent without a RA clearly written on the outside cannot be accepted and will be returned.

4) Return only products for which the RA was issued.

5) **Product being returned under a RA must be received within 15 business days.**

6) **Ship to the location specified on the printable label, which will be sent, along with the RA number, as soon as we have received all of the required information.** Customer is responsible for freight charges on returning product.

7) Return shipments must comply with all applicable **Shipping Regulations** (IATA, DOT, etc.) and carrier requirements.

RETURN THE COMPLETED **REQUEST FOR RETURN** FORM TO YOUR NEAREST LOCATION:

EUROPE:	**NORTH AMERICA:**	**PACIFIC RIM:**
Fax: 00 39 011 9979 330		
Fax Free: 00 800 345 345 00	Fax: 1 781 860 9252	please visit our website for individual
Toll Free: 00 800 234 234 00	Toll Free: 800 882 7426, Option 3	office information
vpt-customercare@agilent.com	vpl-ra@agilent.com	http://www.agilent.com

Agilent Technologies

Vacuum Products Division
Request for Return Form
(Health and Safety Certification)

Please read important policy information on Page 3 that applies to all returns.

1) CUSTOMER INFORMATION

Company Name:	**Contact Name:**
Tel: **Email:**	**Fax:**
Customer Ship To:	**Customer Bill To:**
<u>Europe only</u>: **VAT reg. Number:**	<u>USA/Canada only</u>**:** ☐ **Taxable** ☐ **Non-taxable**

2) PRODUCT IDENTIFICATION

Product Description	Agilent P/N	Agilent S/N	Original Purchasing Reference

3) TYPE OF RETURN (**Choose one from each row** and supply Purchase Order if requesting a billable service)

3A. ☐ Non-Billable   ☐ Billable   ➡   New PO # (hard copy must be submitted with this form):

3B. ☐ Exchange ☐ Repair ☐ Upgrade ☐ Consignment/Demo ☐ Calibration ☐ Evaluation ☐ Return for Credit

4) HEALTH and SAFETY CERTIFICATION

AGILENT TECHNOLOGIES CANNOT ACCEPT ANY PRODUCTS CONTAMINATED WITH BIOLOGICAL OR EXPLOSIVE HAZARDS, RADIOACTIVE MATERIAL, OR MERCURY AT ITS FACILITY.
Call Agilent Technologies to discuss alternatives if this requirement presents a problem.

The equipment listed above (check one):
    ☐   **HAS NOT** pumped or been exposed to any toxic or hazardous materials. OR
    ☐   **HAS** pumped or been exposed to the following toxic or hazardous materials. If this box is checked, the following information must also be filled out. Check boxes for all materials to which product(s) pumped or was exposed:

☐ Toxic   ☐ Corrosive   ☐ Reactive   ☐ Flammable   ☐ Explosive   ☐ Biological   ☐ Radioactive

List all toxic/hazardous materials. Include product name, chemical name, and chemical symbol or formula:
_____

NOTE: If a product is received at Agilent which is contaminated with a toxic or hazardous material that was not disclosed, **the customer will be held responsible** for all costs incurred to ensure the safe handling of the product, and **is liable** for any harm or injury to Agilent employees as well as to any third party occurring as a result of exposure to toxic or hazardous materials present in the product.

Print Name: **Authorized Signature:** ....   **Date:**

5) FAILURE INFORMATION:

Failure Mode (REQUIRED FIELD. See next page for suggestions of failure terms):
Detailed Description of Malfunction: (Please provide the error message)
Application (system and model):

I understand and agree to the terms of Section 6, Page 3/3.
Print Name: **Authorized Signature:** ....   **Date:**

Please use these Failure Mode to describe the concern about the product on Page 2.

TURBO PUMPS and TURBO CONTROLLERS

APPARENT DEFECT/MALFUNCTION		POSITION	PARAMETERS	
- Does not start	- Noise	- Vertical	Power:	Rotational Speed:
- Does not spin freely	- Vibrations	-Horizontal	Current:	Inlet Pressure:
- Does not reach full speed	-Leak	-Upside-down	Temp 1:	Foreline Pressure:
- Mechanical Contact	-Overtemperature	-Other:	Temp 2:	Purge flow:
- Cooling defective	-Clogging	....	OPERATING TIME:	

ION PUMPS/CONTROLLERS

- Bad feedthrough	- Poor vacuum
- Vacuum leak	- High voltage problem
- Error code on display	- Other

VALVES/COMPONENTS

- Main seal leak	- Bellows leak
- Solenoid failure	- Damaged flange
- Damaged sealing area	-Other

LEAK DETECTORS

- Cannot calibrate	-No zero/high backround
- Vacuum system unstable	- Cannot reach test mode
- Failed to start	- Other

INSTRUMENTS

- Gauge tube not working	- Display problem
- Communication failure	- Degas not working
- Error code on display	- Other

SCROLL AND ROTARY VANE PUMPS

- Pump doesn't start	- Noisy pump (describe)
- Doesn't reach vacuum	- Over temperature
- Pump seized	- Other

DIFFUSION PUMPS

- Heater failure	- Electrical problem
- Doesn't reach vacuum	- Cooling coil damage
- Vacuum leak	- Other

Section 6) *ADDITIONAL TERMS*

Please read the terms and conditions below as they apply to all returns and are in addition to the Agilent Technologies Vacuum Product Division – Products and Services Terms of Sale.

- Customer is responsible for the freight charges for the returning product. Return shipments must comply with all applicable **Shipping Regulations** (IATA, DOT, etc.) and carrier requirements.
- Customers receiving an Advance Exchange product agree to return the defective, rebuildable part to Agilent Technologies **within 15 business days**. Failure to do so, or returning a non-rebuildable part (crashed), will result in an invoice for the non-returned/non-rebuildable part.
- Returns for credit toward the purchase of new or refurbished Products are subject to prior Agilent approval and may incur a restocking fee. Please reference the original purchase order number.
- Units returned for evaluation will be evaluated, and a quote for repair will be issued. If you choose to have the unit repaired, the cost of the evaluation will be deducted from the final repair pricing. A Purchase Order for the final repair price should be issued within 3 weeks of quotation date. Units without a Purchase Order for repair will be returned to the customer, and the evaluation fee will be invoiced.
- A Special Cleaning fee will apply to all exposed products per Section 4 of this document.
- If requesting a calibration service, units must be functionally capable of being calibrated.

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QUALITY SYSTEM
ISO 9001
CERTIFIED

ENVIRONMENTAL MANAGEMENT SYSTEM
ISO 14001
CERTIFIED

Agilent Technologies