VARIAN

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CE

senTorr™ Gauge Controller

INSTRUCTION MANUAL

Manual No. 699908165
Revision H
October 2003

senTorr Gauge Controller

Warranty

Products manufactured by Seller are warranted against defects in materials and workmanship for twelve (12) months from date of shipment thereof to Customer, and Seller's liability under valid warranty claims is limited, at the option of Seller, to repair, to replace, or refund of an equitable portion of the purchase price of the Product. Items expendable in normal use are not covered by this warranty. All warranty replacement or repair of parts shall be limited to equipment malfunctions which, in the sole opinion of Seller, are due or traceable to defects in original materials or workmanship. All obligations of Seller under this warranty shall cease in the event of abuse, accident, alteration, misuse, or neglect of the equipment. In-warranty repaired or replaced parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced parts. After expiration of the applicable warranty period, Customer shall be charged at the then current prices for parts, labor, and transportation.

Reasonable care must be used to avoid hazards. Seller expressly disclaims responsibility for loss or damage caused by use of its Products other than in accordance with proper operating procedures.

Except as stated herein, Seller makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except as stated herein, Seller shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise. Statements made by any person, including representatives of Seller, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Seller unless reduced to writing and approved by an officer of Seller.

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All claims under warranty must be made promptly after occurrence of circumstances giving rise thereto, and must be received within the applicable warranty period by Seller or its authorized representative. Such claims should include the Product serial number, the date of shipment, and a full description of the circumstances giving rise to the claim. Before any Products are returned for repair and/or adjustment, written authorization from Seller or its authorized representative for the return and instructions as to how and where these Products should be returned must be obtained. Any Product returned to Seller for examination shall be prepaid via the means of transportation indicated as acceptable by Seller. Seller reserves the right to reject any warranty claim not promptly reported and any warranty claim on any item that has been altered or has been returned by non-acceptable means of transportation. When any Product is returned for examination and inspection, or for any other reason, Customer shall be responsible for all damage resulting from improper packing or handling, and for loss in transit, notwithstanding any defect or non-conformity in the Product. In all cases, Seller has the sole responsibility for determining the cause and nature of failure, and Seller's determination with regard thereto shall be final.

If it is found that Seller's Product has been returned without cause and is still serviceable, Customer will be notified and the Product returned at Customer's expense; in addition, a charge for testing and examination may be made on Products so returned.

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senTorr Gauge Controller

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auf das sich diese Erklärung bezieht, mit der/den flogenden Norm(en) oder Richtlinie(n) übereinstimmt.
auquel se réfère cette déclaration est conforme à la (auz) norme(s) ou au(x) document(s) normatif(s).
al que se refiere esta declaración es conforme a la(s) norma(s) u otro(s) documento(s) normativo(s).
waamaar deze verklaring verwijst, aan de volende norm(en) of richtlijn(en) beantwoodt.
a cui se rifersce questa dichiarazione è conforme alla/e sequente/I norma/o documento/I normativo/i.

EN 55011
1991 . . . . . Group 1 Class A ISM emission requirements
EN 61010-1
1993 . . . . . Safety requirements for electrical equipment for measurement, control, and laboratory use incorporating Amendments Nos 1 and 2.
EN 50082-2
1995 . . . . . EMC heavy industrial generic immunity standard

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Operations Manager
Vacuum Technologies
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Lexington, Massachusetts, USA

October 2003

CE

Preface

Hazard and Safety Information

This manual uses the following standard safety protocols:

WARNING

The warning messages are for attracting the attention of the operator to a particular procedure or practice which, if not followed correctly, could lead to serious injury.

CAUTION

The caution messages are displayed before procedures, which if not followed, could cause damage to the equipment.

NOTE

The notes contain important information.

This product must only be operated and maintained by trained personnel.

Before operating or servicing equipment, read and thoroughly understand all operation/ maintenance manuals provided by Vacuum Technologies. Be aware of the hazards associated with this equipment, know how to recognize potentially hazardous conditions, and how to avoid them. Read carefully and strictly observe all cautions and warnings. The consequences of unskilled, improper, or careless operation of the equipment can be serious.

In addition, consult local, state, and national agencies regarding specific requirements and regulations. Address any safety, operation, and/or maintenance questions to your nearest Vacuum Technologies office.

EMC Warnings

EN 55022 Class A Warning

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

FCC

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesirable operation.

NOTE

The equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generated, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is also likely to cause harmful radio communications interference in which case the user will be required to correct the interference at his own expense.

Contacting Vacuum Technologies

In the United States, you can contact Vacuum Technologies Customer Service at 1-800-8VARIAN.

Internet users:

- Send email to Customer Service & Technical Support at vpl.customer.support@varianinc.com
- Visit our web site at www.varianinc.com/vacuum
- Order on line at www.evarian.com

See the back cover of this manual for a listing of our sales and service offices.

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Introduction and Installation

This chapter introduces the senTorr, including:

This chapter also describes .

Vacuum Technologies senTorr Gauge Controller is a complete, half-rack vacuum gauge controller that offers continuous, reliable pressure measurement from rough to high vacuum. The controller comes completely configured from the factory to operate one of eight gauge tube configurations:

- ❑ UHV2C – Two ConvecTorrs and one UHV type HFIG
- ❑ BA2 – Two Thermocouples and one Bayard-Alpert gauge tube
- ❑ BA2C – Two ConvecTorrs and one Bayard-Alpert gauge tube
- ❑ CC2 – Two Thermocouples and one Cold Cathode gauge tube
- ❑ CC2C – Two ConvecTorrs and one cold cathode gauge tube
- ❑ BA – One Bayard-Alpert gauge tube
- ❑ CC – One Cold Cathode gauge tube
- ❑ UHV – One UHV type HFIG

The senTorr Gauge Controller features one digital display per gauge tube. These LED displays provide clear and sharp pressure readings. The front panel keypad has practical lockout features that protect against unauthorized parameter inputs. Analog outputs and remote capabilities are located on the back panel. The optically-isolated and floating level-sensitive external remote input controls turn on and off the high-vacuum gauge emission.

The available options include:

UHV and Bayard-Alpert Configurations

Up to three optional plug-in printed circuit boards can be installed in the UHV, UHV2C, BA2, BA2C, and BA configurations, with the following restrictions:

- ❑ One Setpoint board
  (four setpoints, one for each gauge tube plus an additional setpoint assignable to any one of the three gauge tubes),
- ❑ One degas board
  (resistive I2R degas)
  (BA2s are resistive degas (UHV E-beam)
- ❑ One communications board
  (either RS232 or RS485)

Cold Cathode Configurations

Up to two optional plug-in printed circuit boards can be installed in the CC2, CC2C, and CC configurations, with the following restrictions:

- ❑ One Setpoint board
  (four setpoints, one for each gauge tube plus an additional setpoint assignable to any one of the three gauge tubes)
- ❑ And one communications board
  (either RS232 or RS485)

Introduction

Front Panel

Figure 1-1 shows the front panel keys and display features. Following each key name are the senTorr models and the option, if any, to which the function applies. Some keys may not work unless a particular option has been installed.

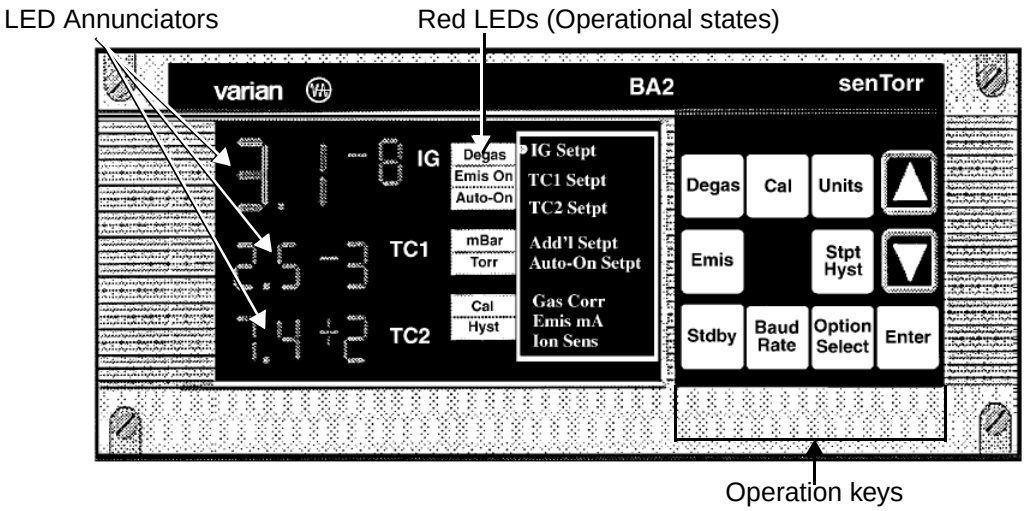


Figure 1-1 senTorr Gauge Controller Front Panel

Refer to Table 1-2 on page 1-6 for descriptions of the keypad items.

The front panel display of the senTorr consists of 7-segment LED digits and LED annunciators. These provide continuous, crisp readings, with no directional bias. The display uses three LED colors to group information:

Green	Pressure data and parameter values
Yellow	Setpoint and parameter annunciators
Red	Operational status legends

A single pressure display has four digits: two for the mantissa and two for the exponent. The following appear, as applicable:

Label	Pressure
IG	UHV or Bayard-Alpert or Cold Cathode (depending on the model)
TC1	Thermocouple one or ConvecTorr one
TC2	Thermocouple two or ConvecTorr two

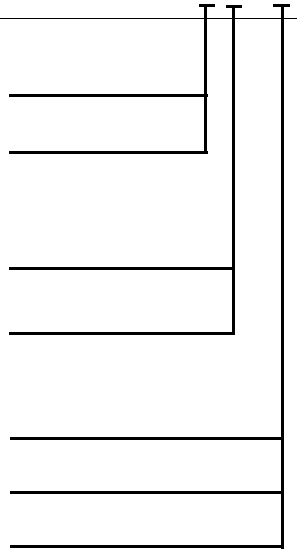
The column of red LEDs indicate the following operational states:

Degas	UHV BA ion gauge is degassing
EMIS On	Ion gauge is on
Auto-On	Auto-on feature is programmed
mBar	Pressure measurements units are in mBar (Pascal if LED not illuminated)
Torr	Pressure measurement units are in Torr (Pascal if LED not illuminated)
Cal	Thermocouples or ConvecTorrs are calibrating
Hyst	Setpoint hysteresis is programmed or not in default

The keypad is a sealed membrane-type, with tactile feedback. There are eleven keys, some of which have dual functions. To determine the order number, select the desired configuration as shown in Table 1-1.

Table 1-1 Gauge Configuration Key Entries

Configuration		Key Entry
One Ion Gauge		
BA – Bayard-Alpert (563, 564, 571, 572)		**L 9 1 2 0 3 0 1 X X 0 X**
CC – Standard Cold Cathode (525)		**L 9 1 2 1 3 0 1 X X 0 X**
UHV – Ultra-High-Vacuum Nude Gauge (UHV-24, MBA100, MBA200)		**L 9 1 1 0 3 0 1 X X 0 X**
One Ion Gauge, Two Thermocouple Gauges		
BA2		**L 9 1 2 0 3 0 2 X X 0 X**
CC2		**L 9 1 2 1 3 0 2 X X 0 X**
One Ion Gauge, Two ConvecTorr Gauges		
BA2C		**L 9 1 2 0 3 0 3 X X 0 X**
CC2C		**L 9 1 2 1 3 0 3 X X 0 X**
UHV2C		**L 9 1 1 0 3 0 3 X X 0 X**
Setpoint Options		
No Setpoints	0	
Setpoints	1	
Degas Options		
No Degas	0	
Degas (BA resistive, UHV E-Beam)	1	
Communications Options		
No Communications	0	
RS-232	1	
RS-485	4	



Keypad

Table 1-2 describes the keypad items shown in Figure 1-1 on page 1-3.

Table 1-2 Keypad Functions

	Key	Function
All Models	Option Select	Puts the senTorr into the Program mode, as indicated by the flashing yellow annunciator. Repeated single presses step the annunciator through the column of setpoints and parameters, returning the senTorr to Run mode after the last key press. ❑ Press **Option Select** and then **Enter** to cancel storing a new digit setting. See "Parameter Programming" on page 2-1. for further information.
	Enter	Advances the flashing cursor through a selected Program mode. Press **Enter** after the last digit to save the setting.
	UP Arrow DOWN Arrow	Increments and decrements, respectively, digit values when entering data.
	Stdby	Powers off the display, the fan, and the ion gauge tube. This is considered a low power shutdown. The unit continues to provide power to the processor.
	Units	Toggles the pressure measurement units between Torr, mBar and Pascal for all pressure readings. The front panel reflects the pressure units, with both the Torr and mbar lamps extinguished for Pascal.
BA2 BA2C UHV2C CC2 CC2C	Cal	Calibrates the vacuum and atmosphere readings for the thermocouple gauges. *Cal* illuminates red when calibrating the thermocouples or ConvecTorrs.
All Models with Setpoint option	Stpt Hyst	Displays or programs the setpoint hysteresis values when used in conjunction with the *Option Select* program mode. *Hyst* illuminates red to indicate that the setpoint pressure shown is the hysteresis level. See "Setpoint Hysteresis" on page 2-5.
All Models	Emis	Turns the high vacuum gauge on or off. The hidden *Emis On* legend illuminates to reflect the on state of the ion emissions. The high vacuum gauge emissions comes on only if the appropriate vacuum has been achieved. For BA/UHV dual filament models: Press **Enter** and then press **Emis** to use the second filament.

Table 1-2 Keypad Functions (Continued)

	Key	Function
All Models	Baud Rate	Displays and sets the serial communications baud rate, parity, and the controller address used in a multi-drop communication link. See Appendix C “RS-232 and RS-485 Options” on page C-1.
BA, UHV Models with degas option	Degas	Illuminates the hidden degas legend to show the state of the degas. ❑ Press **Degas** to turn the degas function off. The degas automatically turns off after engagement. ❑ For I2R degas, turns off after approximately 1 hour. ❑ For E-beam, turns off after 15 minutes.  *The degas option must be installed. Active only if the pressure at the Bayard-Alpert ion gauge is less than 10^{-5} Torr/10^{-3} Pa.*

Serial Communication

The senTorr can be operated remotely via a serial link. The RS232 option consists of a plug-in printed circuit board (Vacuum Technologies part no. L9141301) available with either a 9-pin, D-subminiature connector.

All of the keypad functions, except for the baud rate settings and the display output, are accessible through the RS232 bidirectional computer link.

The RS485/422 PCB option (Vacuum Technologies part no. L91433010) provides serial communications capability as specified in EIA standard 422 and 485. Both employ differential line drivers and receivers, and are capable of communicating to distances of 4000’ (1219.2m) at 19,200 baud in a multidrop scheme, with up to 32 senTorr units. Refer to Vacuum Technologies manual 6999-08-170, provided with the serial communication option, for further information.

Battery Backup

The senTorr uses a lithium battery and CMOS RAM for storage of all system parameters during power outages or when powered down. On power up, the senTorr verifies the RAM content. If the RAM is good, the parameters remains as previously saved; if the RAM is corrupted, all parameters are reset to their default values.

Installation

NOTE

- *Use a braided -shield cable for the analog outputs and setpoint wiring.*
- *Connect metal or metallized plastic backshells directly to the cable shield at the 9-position D-sub connector, if using serial communications.*
- *Connect the shields of all I/O cables to the ground at the users equipment.*

Installation consists of:

- "Unpacking"
- "Setting Line Voltage, Installing Optional PCBs and Installing the Recorder Option"

Unpacking

Each senTorr unit is inspected and carefully packed prior to shipment. If the unit arrives damaged, save the packing material and immediately notify the carrier. Because the packing materials are designed specifically for this instrument, always reuse them when transporting the unit. The shipping container is packed with:

- 1 senTorr Basic Unit
- 1 AC line cord
- 1 Instruction Manual
- 4 rubber adhesive feet for bench top use of the senTorr

Setting Line Voltage, Installing Optional PCBs and Installing the Recorder Option

This section consists of:

- "Setting the Line Voltage" on page 1-9
- "Installing the Setpoint Relays" on page 1-11
- "Installing the Recorder" on page 1-12

Setting the Line Voltage

NOTE *The unit is shipped with switch S1 (internal) set to 230 VAC.*

WARNING *Before servicing the unit, check that the line cord is not plugged into a power source. Observe all warnings and cautions printed on the cover.*

Before operating the unit, it is necessary to set it for the proper line voltage level.

To set the line voltage.

1. Remove the two screws at the top rear of the unit, pivot the cover up and back to disengage the front lip, and lift off the cover.
2. Set the line voltage by moving line voltage selector switch S1 (Figure 1-2) to either:
   - ❑ For 110 VAC or 115 VAC, 50/60 Hz Set to 115 VAC
   - ❑ For 220 VAC or 240 VAC, 50/60 Hz Set to 230 VAC

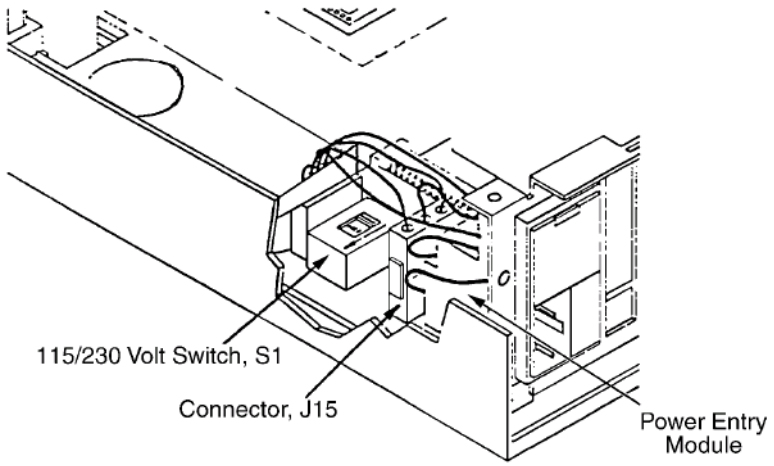


Figure 1-2 Setting Line Voltage

3. Ensure that:
   - ❑ All cables are properly plugged in
   - ❑ All hardware inside the senTorr unit is properly connected
   - ❑ No loose metal parts inside the senTorr unit
4. Replace the cover and secure it with the two screws.

5. Mount the unit using the desired rack-mounting kit (Figure 1-3).

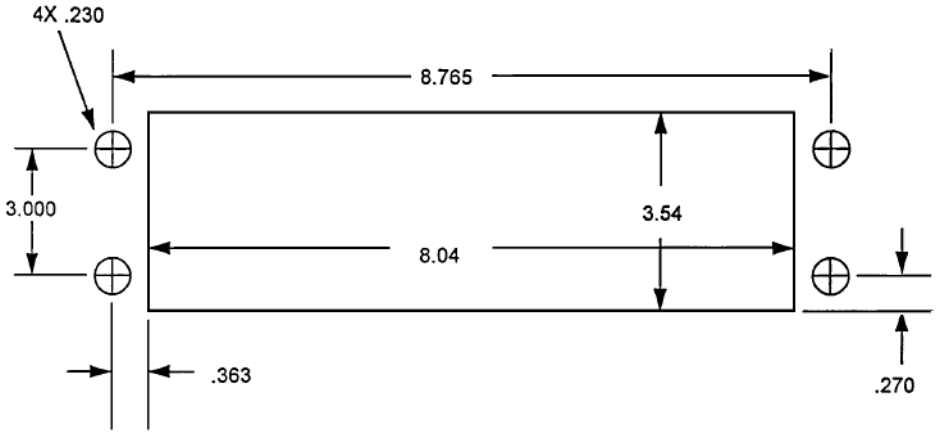


Figure 1-3 Panel Cutout Dimensions

6. Attach the appropriate external gauge and system cables (Figure 1-4).

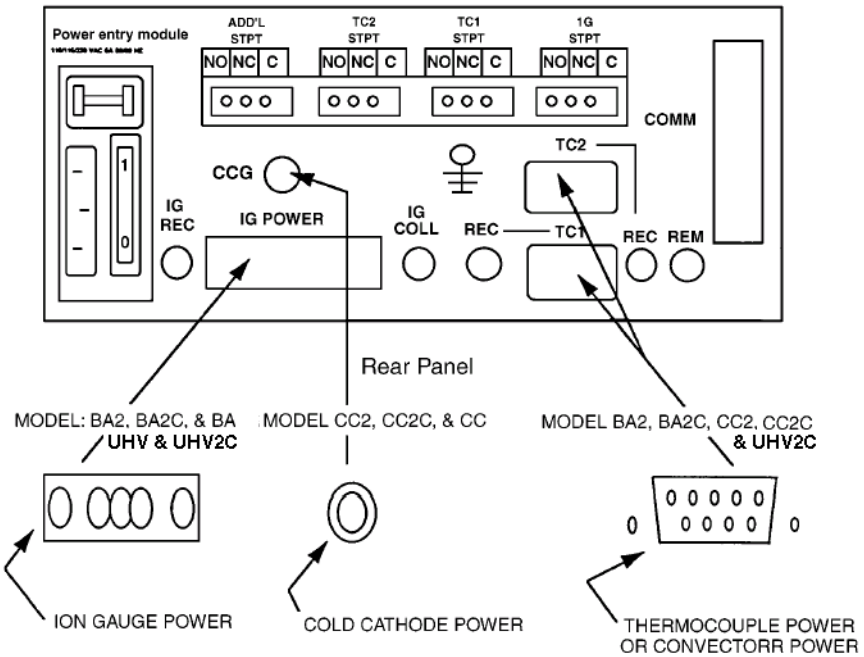


Figure 1-4 Rear Panel Connections

NOTE

Use Bezel Trim Kit (Vacuum Technologies part number R0130301) to hide gaps between senTorr case and panel.

Installing the Setpoint Relays

CAUTION

The relay contacts are gold-flashed, making them suitable for logic-level switching. The application of AC or DC voltages, however, greater than 20 V (3 A @ 24 VDC/250 VAC) or 20 VA causes erosion of the gold in a single switching cycle.

Refer to Table 1-3 and Figure 1-5 to install the setpoint option.

Table 1-3 Setpoint Option PCB Components

Number In Figure	Description
1	Setpoint Assembly (Part number L9132002)
2	Bracket
3	Screw
4	Cable
5	Connector Mate

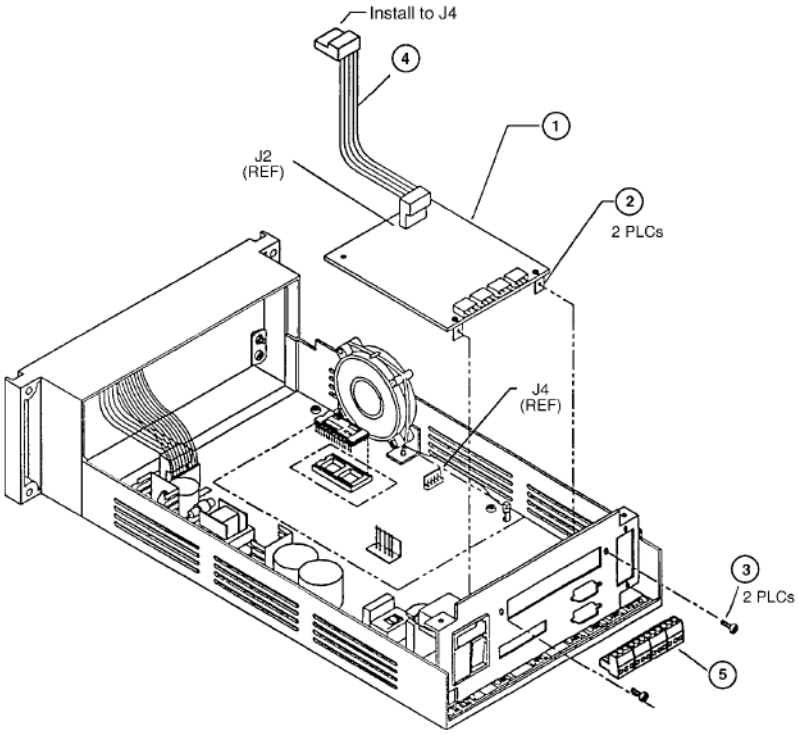


Figure 1-5 Setpoint Option

To install the Setpoint option:

1. Punch out the metal panel on the back of the unit.
2. Lower the Setpoint Assembly PCB into the senTorr and hold.
3. Place and tighten two screw (item 3) through the plate on the right side of the senTorr and the Setpoint Assembly PCB mounting flanges (item 2) and tighten.
4. Connect the ribbon cable to J4 and ensure it is connected to J2 on the Setpoint Assembly PCB.
5. Install the connector mate to the connects on the Setpoint board (item 5).

Installing the Recorder

Recorder output for each gauge is provided at the back of the unit. A two-conductor Micro Jax connector is plugged into each output. Shielded wiring (coaxial cable) is strongly recommended to maintain compliance with FCC regulations for radiated emissions. Any recorder with an input impedance greater than 2,000 Ohms and a full scale input range of +10 V can be used.

Refer to Figure 1-6 for instructions on installing the recorder.

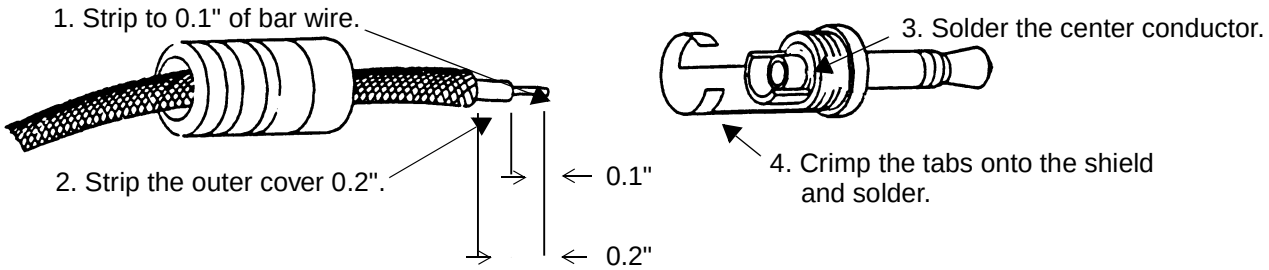


Figure 1-6 Assembling the Cable

Operating Instructions

Operations consist of:

- ❑ “Parameter Programming”
- ❑ “Setpoint Hysteresis” on page 2-5
- ❑ “Recorder Output” on page 2-6
- ❑ “Thermocouple and ConvecTorr Calibration” on page 2-9
- ❑ “Access Codes” on page 2-10
- ❑ “Software Revision” on page 2-12
- ❑ “Display Test” on page 2-12
- ❑ “Accessing Second Filament” on page 2-12

Parameter Programming

The setpoint and ion gauge parameters shown in a column on the front panel are viewed or programmed by putting the senTorr into the Program mode. To the left of each parameter is a single yellow LED.

If the yellow LED is:

❑ Flashing	The selected parameter is in Program mode and its value appears in the corresponding gauge readout.
❑ Illuminated solidly	The selected menu item is active, indicating that the setpoint is energized or the ion gauge parameter has been changed from its default setting.

NOTE

If the ion gauge is on when power is lost, emission is not automatically reestablished unless the TC Auto-On function is programmed to do so.

To enter Program mode:

NOTE

The senTorr exits the Program mode if no keys are pressed for about eight seconds.

1. Press **Option Select**.

   The first available parameter, beginning from the top of the column and depending on the senTorr models and options installed, flashes in the appropriate gauge display.

2. Press **Option Select** to advance to the desired parameter.

NOTE

Option Select returns the unit to the Run mode after the last parameter is selected.

3. Use the up and down arrow keys to set a new value.
4. Press **Enter** to advance to the next digit.
5. Use the up and down arrow keys to set a new value for each digit as required.
6. Press **Enter** until the last digit for the parameter is passed.

NOTE

No individual digit for a parameter is saved until all digits of that parameter have been passed through using Enter. Then the entire parameter value is saved. Use Option Select to escape from saving a changed value prior to entering the last digit.

If the yellow LED remains flashing in the Program mode unattended for more than eight seconds, the annunciator automatically returns to Run mode.

After the value has been saved, the whole setting flashes.

- ❑ To disable a setpoint, Set its mantissa to **0.0**.

Table 2-1 lists the setpoints and their functions.

Table 2-1 Setpoints

	Setpoint	Function
All Models with Setpoint option	IG Setpt	Sets the ion gauge setpoint to energize when the ion gauge pressure drops below the *IG Setpt* threshold setting. It de-energizes when the ion gauge pressure goes above the *IG Setpt* hysteresis setting (See "Setpoint Hysteresis" on page 2-5). The *IG Setpt* pressure flashes in the *IG* display.
All Models with Setpoint option	TC1 Setpt	Sets the *TC1* setpoint to energize when *TC1* reads less than the *TC1 Setpt* threshold setting. It de-energizes when the *TC1* pressure goes above the *TC1 Setpt* hysteresis setting (See "Setpoint Hysteresis" on page 2-5). The *TC1 Setpt* pressure appears in the *TC1* readout.
All models with TC or ConvecTorr with Setpoint option	TC2 Setpt	Sets the *TC2* setpoint to energize when *TC2* reads less than the *TC2 Setpt* threshold setting. It de-energizes when the *TC2* pressure goes above the *TC2 Setpt* hysteresis setting (See "Setpoint Hysteresis" on page 2-5). The *TC2 Setpt* pressure appears in the *TC2* readout.
All Models with Setpoint option	Add'l Setpt	Assigns the additional setpoint to any of the gauges: 1. Select this parameter. All three pressure displays flash. 2. Press **Enter** to assign the **Add'l Setpt** to the ion gauge. 3. Ensure no value is set in the ion gauge display: mantissa = 0.0. 4. Press **Enter** again to assign the **Add'l Setpt** to *TC1*, or likewise to *TC2*.
BA2 BA2C CC2 CC2C UHV2C	Auto–On	Assigns *TC1* as the turn-on source for the ion gauge: 1. Press **Option Select** until the *Auto-On Setpt* annunciator flashes. The *Auto-On* setting then appears in the *TC1* readout. 2. Set the turn-on pressure from 1.0×10^{-3} Torr to 5.0×10^{-3} Torr (1.3×10^{-2} Pa to 6.6×10^{-1} Pa) and additionally between 1.0×10^{-2} Torr to 5.0×10^{-2} Torr (1.3 Pa to 6.6 Pa). The ion gauge turns on when *TC1* reaches the programmed pressure. Press **Emis** to turn the ion gauge off and temporarily override the *Auto-On* feature. The *Auto-On* feature goes back into effect after the *TC1* pressure rises above the programmed Auto-On pressure.

Table 2-1 Setpoints (Continued)

	Setpoint	Function
BA BA2 BA2C UHV UHV2C	Emis mA	Controls the hot filament gauge emission current. The programmed value flashes in the *IG* display: ❑ Select a value from 0.1 mA to 9.9 mA. The default setting is 4 mA for standard gauges and 0.1 mA for broad range Bayard-Alpert gauges (Vacuum Technologies model 564). If the emission current is set to: ❑ Less than or equal to 1.0 mA, it remains constant over all pressures. ❑ Greater than 1.0 mA, it is automatically reduced to one-tenth of the setting at pressures greater than 5×10^{-5} Torr (6.6×10^{-2} Pa). This feature extends filament life.
All Models	Ion Sens	Compensates for the different gauge geometries. The current setting flashes in the *IG* display. Refer to Table B-1 on page B-1 for the default sensitivity settings.
All Models	GasCorr	Adjusts the ion gauge pressure calculation depending on the system gas. The gas correction value appears in the *IG* readout. The default setting is 1.0 for N2 (air). The setting can range from 0.1 to 9.9. Refer to Appendix A “Gas Correction Factor Table”.

Setpoint Hysteresis

A setpoint:

- ❑ Energizes when the pressure of its preassigned gauge drops below the setpoint programmed threshold pressure.
- ❑ De-energizes when the gauge pressure rises above the setpoint hysteresis pressure.

The setpoint hysteresis automatically defaults to 10% above the threshold value. This value can be changed by pressing the *Stpt Hyst* key. The red *Hyst* legend illuminates to indicate that the setpoint pressure shown is the hysteresis level.

NOTE

The Stpt Hyst key does not function if the setpoint has not been programmed.

Recorder Output

The output reflects the displayed pressure of the gauges. Refer to Figure 2-1 and Figure 2-2 on page 2-7 and Table 2-2 on page 2-8 through Table 2-4 on page 2-8 for standard and linear output characteristics of the recorders.

The following algorithms are used:

Ion Gauge Algorithm

To convert recorder output voltage to pressure:

Example recorder output = 4.28 VDC

To get the exponent, take the integer part of voltage output which is 4 and subtract 11:

4 – 11 = –7 (E–7)

To find the mantissa, take the fractional portion and add .1 to it and divide by .11:

(.28 + .1)/.11 = 3.45

Therefore:

4.28 VDC = 3.45E–7 Torr

TC ConvecTorr Algorithm

To convert recorder output voltage to pressure:

Example recorder output = 3.28 VDC

To get the exponent, take the integer part of voltage output which is 3 and subtract 4:

3 – 4 = –1 (E–1)

To find the mantissa, take the fractional portion, add .1 to it, and divide by .11:

(.28 + .1)/.11 = 3.45

Therefore:

3.28 VDC = 3.45E–1 Torr

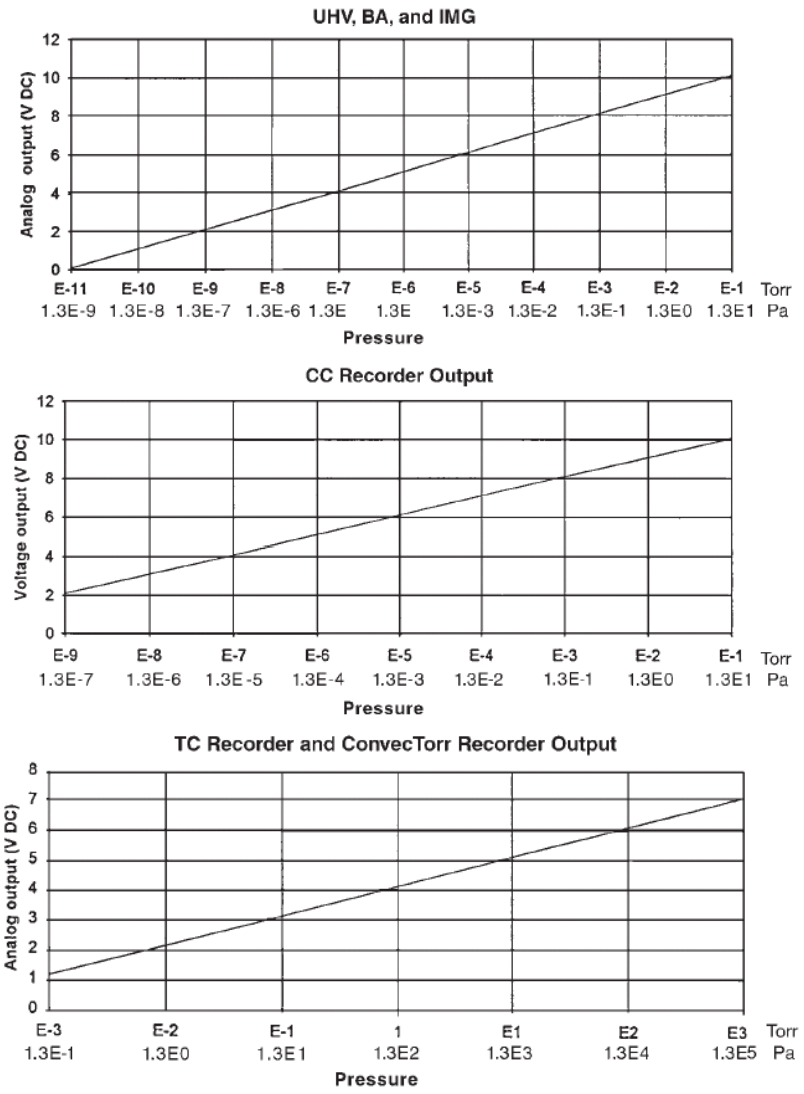


Figure 2-1 Standard Recorder Output Characteristics

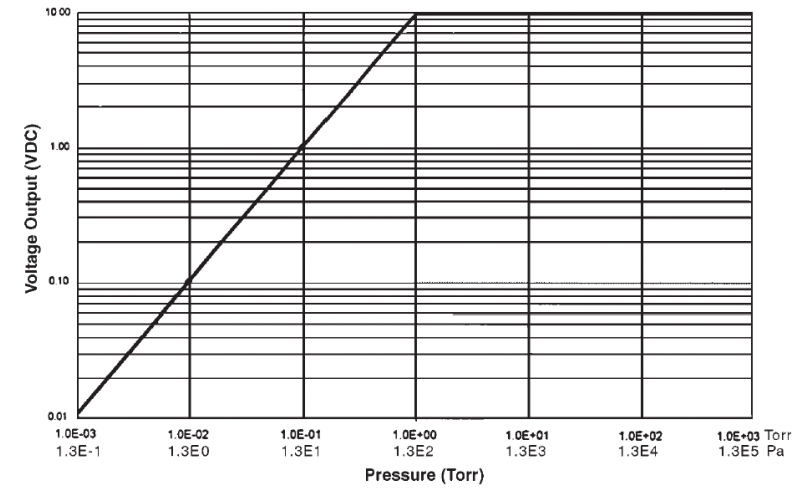


Figure 2-2 Optional Linear Recorder Output Characteristics

Table 2-2 lists the optional linear recorder output for the TC configuration, which requires optionally purchased firmware.

Table 2-2 TC Linear Output

Pressure (Torr)	Pressure (Pa)	Voltage
≥1E +0	≥133	10
1E–1	1.3 E1	1
5E–2	6.6	0.5
1E–2	1.3	0.1
≥E–3	≥.3E–1	0.01
Error E03	Error E03	10.156 (over scale)

Table 2-3 lists the optional linear recorder output option for the UHV, BA and CC configurations.

Table 2-3 UHV, BA and CC Linear Output

Full Scale Setting (Torr)	Full Scale Setting (Pa)	Access Code
1E–3	1.3E–1	93 (Default)
1E–4	1.3E–2	94
1E–5	1.3E–3	95
1E–6	1.3E–4	96

Table 2-4 lists the results using a full scale setting of 1E–3 Torr as an example.

Table 2-4 Full Scale Results

Pressure (Torr)	Pressure (Pa)	Voltage
≥1E –3	≥1.3E–1	10
1E–4	1.3E–2	1
5E–5	6.6E–3	0.5
1E–5	1.3E–3	0.1
≥E–6	≥.3E–4	0.01
Exx/Off	Exx/Off	0

Thermocouple and ConvecTorr Calibration

The calibration is a two-point calibration, with one point at *atmosphere* and the second point at *vacuum*.

Perform calibration:

- ❑ Before using the senTorr for the first time
- ❑ After the unit has been reset
- ❑ After the transducer has been changed
- ❑ If the display drifts
- ❑ If calibration values are off at atmosphere or vacuum

Atmosphere Calibration Procedure

You can calibrate individual transducers or both at once:

1. Ensure your transducer is at atmosphere.
2. To calibrate transducers:
   - ❑ Individually
     a. Press **Cal** and the transducer 1 display flashes *7.6+2.*
     b. Press **Enter** and *7.6+2* appears on the transducers display.
     c. Press **Cal** twice and the transducer 2 display flashes *7.6+2*.
     d. Press **Enter** and *7.6+2* appears on the transducers display.
   - ❑ Simultaneously
     a. Press **Cal** and the transducer 1 display flashes *7.6+2.*
     b. Press **Enter** and *7.6+2* appears on the transducer 2 display.
     c. Press **Enter** and *7.6+2* appears on both displays.

Vacuum Calibration Procedure

1. Ensure your transducer is evacuated down to 1.0 E-4.
2. To calibrate transducers:
   - ❑ Individually
     a. Press **Cal** and the transducer 1 display flashes *1.0-3.*
     b. Press **Enter** and *1.0-3* appears on the transducers display.
     c. Press **Cal** twice and the transducer 2 display flashes *1.0-3*.
     d. Press **Enter** and *1.0-3* appears on the transducers display.
   - ❑ Simultaneously
     a. Press **Cal** and the transducer 1 display flashes *1.0-3.*
     b. Press **Enter** and *1.0-3* appears on the transducer 2 display.
     c. Press **Enter** and *1.0-3* appears on both displays.

Access Codes

The senTorr offers protection for the operator and the system by requiring that the operator know the access code for a desired function.

To enter an access code:

1. Press **Enter** and then **Units**.
2. Use the up and down keys to select the appropriate two-digit code, shown in the *IG* readout. Table 2-5 lists the codes and their respective functions.

Table 2-5 Access Codes

Code	Function
33 A	Unlocks the keypad (default).
27 A	Locks the keypad, except for the *Enter*, *Units*, and arrow keys to allow further access code entry.
17 A	Locks the keypad, except for the *Enter*, *Units*, arrow, *Emis*, and *Degas* keys to prevent parameter changes.
81 A	Resets the total system. All parameters except the baud rate settings revert to defaults. The ion gauge turns off.
71 A	Resets TC calibrations to system defaults.
61 A	Removes all setpoint programming.
39 A	Sets Bayard-Alpert parameters to default Bayard-Alpert values: sensitivity, emission current, and overpressure shutdown.
49 A	Sets Bayard-Alpert parameters to broad range Bayard-Alpert values (Vacuum Technologies Model 564): sensitivity, emission current, and overpressure shutdown.
79 A	Sets thermocouple or ConvecTorr pressure update to slow, allowing more stable readings through data averaging (default).
89 A	Sets thermocouple or ConvecTorr pressure update to fast, allowing a faster response to pressure changes.
56 A	Enables E02 (pressure burst) and E06 (grid error) fault protection.
52 A	Disables E02 (pressure burst) and E06 (grid error) fault protection. The senTorr overrides these faults for systems that are able to handle pressure spikes.

Software Revision

- ❑ To display the software revision, press **Enter**, then the down arrow. The revision appears in the *IG* display for several seconds.

Display Test

- ❑ To verify LED function, press **Enter** and the up arrow and the entire display can be lit for several seconds.

Accessing Second Filament

See Table 1-2 on page 1-6, *EMIS Key* for controlling dual filament tubes.

Troubleshooting

These troubleshooting procedures are provided to aid in identifying failure modes. For further troubleshooting assistance or for the repair or replacement of a board, contact Vacuum Technologies service at 1-800-882-7426 or 781-861-7200 within the U.S.

This section is comprised of:

Error Codes

Table 3-1 lists the senTorr Gauge error codes:

Table 3-1 senTorr Gauge Error Codes

Code	Error Condition
O2 E	Pressure burst caused by a sudden rise in pressure at the ion gauge.
O3 E	No ion current or measurement signal. Examples: bad or missing collector cable connection; bad electrometer; emission current too low; cold cathode pressure less than minimum pressure capability. See Appendix B “senTorr Gauge Specifications”.
O4 E	Filament overcurrent caused by a shorted filament circuit.
O5 E	Filament undercurrent caused by an open filament; cable not properly connected; bad control circuit or control circuit not properly installed.
O6 E	Grid voltage low caused by a grounded grid or a bad grid supply.
O7 E	Overtemperature caused by a temperature inside unit over 65° C.
O8 E	Board logic failure caused by a bad component or electrical noise.
O9 E	Overpressure caused by an indicated pressure above high pressure limit of the ion gauge.
12 E	Underpressure caused by an indicated pressure beyond minimum pressure of ion gauge.
13 E	Insufficient current caused by a dirty cold cathode gauge or an open cable connection.
14 E	Invalid keypress caused by a locked keypad.

Changing Line Fuses

Due to age or overload, It become necessary to change the AC line fuses. There are two fuses located on the top of the power entry module marked with the outline of the fuses.

To change a fuse:

1. Remove the power cable.
2. Pry out the cover of the fuse holder with a small screwdriver.
3. Slide the small fuse board out of the holder by lifting the black plastic retainer (Figure 3-1).

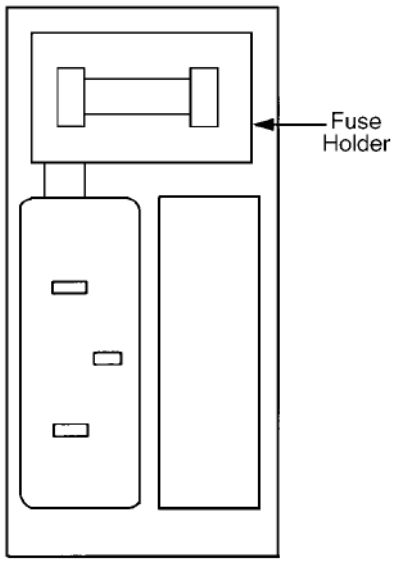


Figure 3-1 Power Entry Module

NOTE

For continued protection against fire, both fuses must be replaced with fuses of the same type and rating as originally supplied: T, 5A, 250 V.

4. Replace the fuses.
5. Replace the cover and plug in the unit.

Application Footnotes

This section contains the following application notes:

- “Emission mA”
- “Sensitivity” on page 3-5

Emission mA

The Emission current is set to 4.00 mA as a default. The emission current remains constant, at 4 mA, as long as the pressure is less than 1×10^{-5} Torr/1.3×10^{-3} Pa. The senTorr automatically reduces the current by a factor of 10 when the pressure is greater than 5×10^{-5} Torr/6.6×10^{-3} Pa. Thus, the emission current drops to 0.4 mA. This promotes an extended pressure range measurement capability and/or prolongs tube life by protecting the filament. Emission current can, however, be adjusted from 10 µA to 9.99 mA via the keypad on the front panel of the senTorr unit.

One reason for lowering the emission current is to prevent a small fluctuation in a pressure reading that can occur when operating:

- just below 1×10^{-5} Torr/1.3×10^{-3} Pa
- just above 5×10^{-5} Torr/6.6×10^{-3} Pa

If emission current is adjusted to <1 mA, the current remains constant throughout the entire pressure range.

Another reason to lower the emission current is for applications that require higher pressure readings from the gauge tube. The lower the emission current, the higher pressure the tube is able to measure. This also applies in the opposite direction; the higher the emission current is raised, the lower the pressure the tube can measure.

Programming Emission mA

Table 3-2 lists the emission defaults by gauge.

Table 3-2 Emission Defaults

Gauge	Default Value
UHV25, 571, 572, 563	4.0 mA
564	.1 mA
MBA100, MBA200	.1 mA

NOTE

Do not exceed 1 mA.

To program the emission mA:

1. Press **Option Select**.

   The first available parameter, beginning from the top of the column (depending on the senTorr models and options installed) flashes in the appropriate gauge display.

2. Select **Emis mA**.

NOTE

Option Select returns the unit to Run mode after the last parameter is selected.

3. Use the up and down arrow keys to set a new value.
4. Press **Enter** to advance to the next digit.
5. Use the up and down arrow keys to set a new value for each digit as required.
6. Press **Enter** until the last digit for the parameter is passed.

Sensitivity

To improve the accuracy of pressure measurements, adjust the sensitivity to match gauge tube calibration.

Table 3-3 lists the sensitivity values at various pressures for different tubes.

Table 3-3 Sensitivity

Tube	Default Sensitivity Tube	
UHV 24	25/Torr	3325/Pa
571, 572, 563	10/Torr	1330/Pa
525, 524	5/Torr	665/Pa
564	8/Torr	1064/Pa
CC	1 Torr	133A/Pa
MBA100, MBA200	15 Torr	

Programming Sensitivity

To program the sensitivity:

1. Press **Option Select**.

   The first available parameter (appears in the column depending on the senTorr models and options installed) flashes in the appropriate gauge display.

2. Select **Ion Sens**.

NOTE

Option Select returns the unit to Run mode after the last parameter is selected.

3. Use the up and down arrow keys to set a new value.
4. Press **Enter** to advance to the next digit.
5. Use the up and down arrow keys to set a new value for each digit as required.
6. Press **Enter** until the last digit for the parameter is passed.

Troubleshooting Tips

Vacuum Technologies offers reference ionization B/A gauges, which are sealed off at approximately 5E–6 Torr/6.6E–4 Pa. These gauges are extremely helpful in troubleshooting a vacuum system problem by isolating the defective component.

NOTE

These reference ion gauge tubes are not NIST traceable calibrated gauges, and act only as a load for the ion gauge controller.

To aid in troubleshooting and to verify the integrity of the ion gauge controller or the cold cathode gauge itself, use a resistive dummy load. Obtain a 5.6 MOhm, 2 W resistor. This value simulates a pressure reading in the mid E–5 Torr/E–3 Pa region. Higher resistor values than this yield a lower pressure reading and lower resistor values yields a higher pressure reading.

WARNING

When connecting the resistive load to the back of the cold cathode gauge controller, –2000 VDC is present. Make sure the power to the unit is off. Keep all conductive material away from the back of the controller when troubleshooting.

Follow all safety precautions to avoid electrical shock when performing this test.

Appendix A. Gas Correction Factor Table

Table A-1 on page A-2 lists relative gauge gas correction factors for various gases. The table is reproduced for convenience only and do not imply that the use of other gases with hot filament gauge controllers is safe.

The values are derived by empirical methods substantiated by measurements reported in literature. This table was compiled and published by Robert L. Summers of Lewis Research Center, NASA Technical Note TND-5285, National Aeronautics and Space Administration, Washington, DC, June 1969.

To automatically convert readings of the senTorr Controller, normally calibrated for nitrogen:

1. Use *OPTION SELECT* to access the *GASS CORR* function.
2. Enter the relative gas correction constant.
3. Enter the gas constant.

   The gauge divides the result by the gas correction constant and displays the correct adjusted value, however, a proper understanding for the transformation of the result is required.

The correction for different gas species is purely mathematical. The sensitivity of the tube is affected by different gases which, in turn, are responsible for the tube output being manipulated by the pressure equation. There is some loss in resolution of the instrument when gas correction constants are used. The loss in resolution becomes more apparent as the correction constants approach 0.5 from either direction.

When the correction constants are 0.1 or 10, the tube output is 1/10 or 10 times normal. This causes the instrument to lose the high vacuum decade or the near atmosphere decade, respectively.

NOTE *The default for Gas Correction is 1.*

Table A-1 Gas Correction Factor Table

Substance	Formula	Relative Ionization Gauge Gas Correction Factor
Acetaldehyde	C_2H_4O	2.6
Acetone	$(CH_3)_2CO$	3.6 4.0 3.6
Acetylene	C_2H_2	1.9 2.0
Air		1.0 0.98
Ammonia	NH_3	1.3 1.2 1.3
Amylene: ISO· cyclo·	 ISO·C_5H_{10} CY·C_5H_{10}	 5.9 5.8
Argon	Ar	1.3 1.1 1.2 0.9
Benzene	C_6H_6	5.9 5.8 5.7 5.9 6.0
Benzoic Acid	C_6H_5COOH	5.5
Bromine	Br	3.8
Bromomethane	CH_3Br	3.7
Butane: n· ISO·	 n·C_4H_{10} ISO·C_4H_{10}	 4.9 4.7 4.6 4.9
Cadmium	Cd	2.3 3.4
Carbon Dioxide	CO_2	1.4 1.4 1.5 1.5 1.4
Carbon Disulfide	CS_2	5.0 4.7 4.8
Carbon Monoxide	CO	1.05 1.05 1.1
Carbon Tetrachloride	CCl_4	6.0 6.3
Cesium	Cs	4.3 2.0 4.8
Chlorine	Cl_2	0.68 2.6 1.6
Chlorobenzene	C_6H_5Cl	7.0
Chloroethane	C_2H_5Cl	4.0
Chloroform	$CHCl_3$	4.7 4.8 4.8
Chloromethane	CH_3Cl	2.6 3.2 3.1
Cyanogen	$(CN)_2$	2.8 3.6 2.7
Cyclohexylene	C_6H_{12}	7.9 6.4
Deuterium	D_2	0.35 0.38
Dichlorodifloromethane	CCl_2F_2	2.7 4.1
Dichloromethane	CH_2Cl_2	3.7
Dinitrobenzene o· m· p·	$C_6H_4(NO_2)_2$	 7.8 7.8 7.6
Ethane	C_2H_6	2.6 2.8 2.5
Ethanol	C_2H_5OH	3.6 2.9
Ethyl Acetate	$CH_3COOC_2H_5$	5.0

Table A-1 Gas Correction Factor Table *(Continued)*

Substance	Formula	Relative Ionization Gauge Gas Correction F5tor
Ethyl ether	$(C_2H_5)_2O$	5.1 5.1
Ethylene	C_2H_4	2.3 2.4 2.2 2.2 to 2.5
Ethylene oxide	$(CH_2)_2O$	2.5
Helium	He	0.18 0.15 0.13 0.12
Heptane	C_7H_{16}	8.6
Hexadiene: 1.5· cyclo·	 1.5·C_5H_{10} CY·C_6H_{10}	 6.4 6.0
Hexane	C_6H_{14}	6.6
Hexene: 1· cyclo	 1·C_6H_{12} CY·C_6H_{10}	 5.9 6.4
Hydrogen	H_2	0.46 0.38 0.41 0.45 0.44
Hydrogen Bromide	HBr	2.0
Hydrogen Chloride	HCl	1.5 1.6 2.0 1.5
Hydrogen Cyanide	HCN	1.5 1.6
Hydrogen Floride	HF	1.4
Hydrogen Iodide	HI	3.1
Hydrogen Sulfide	H_2S	2.2 2.2 2.3 2.1
Iodine	I_2	5.4
Iodomethane	CH_3I	4.2
Isoamyl Alcohol	$C_5H_{11}OH$	2.9
Isobutylene	C_4H_8	3.6
Krypton	Kr	1.9 1.7 1.7
Lithium	Li	1.9
Mercury	Hg	3.6
Methane	CH_4	1.4 1.5 1.6 1.4 to 1.8 1.5 1.5
Methanol	CH_3OH	1.8 1.9
Mehtyl Acetate	CH_3COOCH_3	4.0
Mythyl ether	$(CH_3)_2O$	3.0 3.0

Substance	Formula	Relative Ionization Gauge Gas Correction Factor
Naphthalene	$C_{10}H_8$	9.7
Neon	Ne	0.30 0.31
Nitrobenzene	$C_6H_5NO_2$	7.2
Nitrogen	N_2	1.0
Nitrotoluene (o·, m·, p·)	$C_6H_4CH_3NO_2$	8.5
Nitric Oxide	NO	1.3 1.2 1.0
Nitrous Oxide	N_2O	1.5 1.7 1.7 1.3 to 2.1
Oxygen	O_2	1.0 1.1 0.9 0.9
Pentane n· ISO· neo·	 n·C_5H_{17} ISO·C_5H_{17} $(CH_3)_4C$	 6.2 6.0 5.7 6.0 5.7
Phenol	C_6H_5OH	6.2
Phosphine	PH_3	2.6
Potassium	K	3.6
Propane	C_3H_8	4.2 3.7 3.7 to 3.9 3.6
Propene oxide	C_3H_6O	3.9
Propene: n· cyclo·	 n·C_3H_6 cy·C_3H_6	 3.3 3.2 to 3.7 3.6
Rubidum	Rb	4.3
Silver perchlorate	$AgClO_4$	3.6
Sodium	Na	3.0
Stannic iodide	SnI_4	6.7
Sulphur Dioxide	SO_2	2.1 2.3
Sulphur Hexafloride	SF_6	2.3 2.8
Toluene	$C_6H_5CH_3$	6.8
Trinitrobenzene	$C_6H_3(NO_2)_3$	9.0
Water	H_2O	1.1 1.0 0.8
Xenon	Xe	2.9 2.2 2.4
Xylene: o· p·	 o·$C_6H_4(CH_3)_2$ p·$C_6H_4(CH_3)_2$	 7.8 7.9

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Appendix B. senTorr Gauge Specifications

General Specifications

Table B-1 provides the senTorr Gauge Specifications.

Table B-1 General senTorr Gauge Specifications

Specification	Description
Altitude	2000 m
Cabling	The senTorr basic unit includes a 6’ (1.83 m) power cord and fuse set. Gauge cabling is available separately. Standard gauge cable lengths are 10’ (3 m), 25’ (7.6m), 50’ (15.2m), 75’ (22.9m), and 100’ (30.5m), however, cables up to 500’ (152.4m) are available by special order. All cable connections are made at the rear of the unit. Vacuum Technologies cannot guarantee compliance with FCC regulations for radiated emissions unless all external wiring is shielded.
Data Retention	The senTorr retains its parameter values, upon power down or a power failure, for a period of four years accumulated off time.
Installation	Indoor use, Installation Category II
Maximum Relative Humidity	80% relative humidity, non-condensing
Operating Temperature	0 to 50° C (32 to 122 °F) The senTorr meets all performance specifications (unless otherwise noted) at 25 °C (+5° C) at 90% relative humidity, non–condensing.
Pollution Degree	2
Power Requirements	90 to 127 VAC, 50/60 HZ 208 to 250 VAC, 50/60 HZ The senTorr is fitted with an internal switch to accommodate the desired power input.
Size	Half-rack mount, 3.5" (8.9 cm) high by 8.0" (20.3 cm) wide by 15" (38.1 cm) deep Optional rack mounting kits are available for mounting one or two units in a standard 19" (48.3 cm) rack.

Specifications for the HFIG Gauge, Cold Cathode Gauge, Thermocouple and ConvecTorr Gauge are given in Table B-2 and Table B-3 on page B-2, and Table B-4 on page B-3 respectively.

Table B-2 HFIG Gauge Specifications (Models: BA2, BA2C, BA, UHV, and UHV2C)

Minimum pressure capability	1 x 10^{-9} Torr/1.3 x 10^{-7} Pa (BA) 4 x 10^{-11} Torr/5.3 x 10^{-9} Pa (UHV)
Maximum pressure capability	1 x 10^{-3} Torr/1.3 x 10^{-1} Pa (standard BA and UHV) 1 x 10^{-1} Torr/1.3 x 10^{-1} Pa (broad range BA)
Degas (optional)	Resistive, 1 hour timeout E–beam (UHV), 15 minute timeout
Sensitivity	Adjustable from 1/Torr to 99/Torr (1.33/Pa to 1.31 x 10^{-4}/Pa) 10/Torr (1330/Pa) standard BA default value 8/Torr (1064/Pa) broad range BA default value 25/Torr (3325/Pa) UHV default value
Emission current	Adjustable from 0.1 mA to 9.9 mA 4 mA (standard BA and UHV) 0.1 mA (broad range BA)
Analog output	1 V/decade 0 V for *OFF*, - -, and *xxE* conditions Optional Linear Recorder Out available
Auto–on (standard)	Available on BA2, BA2C, and UHV2C configurations only, set to TC1 only

Cold Cathode Gauge

Table B-3 Cold Cathode Gauge Specifications (Models: CC2 and CC2C)

Minimum pressure capability	1 x 10^{-8} Torr/1.3 x 10^{-6} Pa (CC models)
Maximum pressure capability	1 x 10^{-2} Torr/1.3 Pa
Operating voltage	–2 kV (CC models)
Sensitivity	Adjustable from 1 A/Torr to 99 A/Torr (133A/Pa to 1.31 x 10^{-4} A/Pa) (5 A/Torr) CC default value
Analog output	1 V/decade Optional Linear Recorder Out available
Auto–on (standard)	Available on CC2, CC2C, set to TC1 only

Thermocouple and ConvecTorr Gauge

Table B-4 Thermocouple and ConvecTorr Gauge Specifications (Models: BA2, CC2, BA2C, CC2C, and UHV2C)

Minimum pressure capability	1 x 10^{-3} Torr/1.3 x 10^{-1} Pa
Maximum rated pressure capability	2 Torr/266 Pa (TC models) 1000 Torr/1.3 x 10^{-5} Pa (ConvecTorr models)
Heater current	165 mA ± 10% (TC models)
Calibration (two points)	1 x 10^{-3} Torr/1.3 x 10^{-1} Pa (vacuum) 7.6 x 10^{+2} Torr/1.0 x 10^{+4} Pa (atmosphere)
Auto–on threshold (available on TC1 only)	1 x 10^{-3} Torr to 5 x 10^{-2} Torr (1.3 x 10^{-1} Pa to 6.6 Pa)
Analog output	1 V/decade 1 V at 1 x 10^{-3} Torr/1.3 x 10^{-1} Pa 7 V at 1000 Torr/1.3 x 10^{-5} Pa 10 V for *03E* condition Optional Linear Recorder Out available

Setpoints

Setpoints (all models with Setpoint option)	Floating SPDT relays with NO, NC, and C terminals Contact rating 3 A at 24 VDC/250 VAC, gold–flashed

Remote Input

Input (all models)	3 to 32 VDC, 500 Ohms minimum to activate high vacuum gauge (optically–isolated and floating level–sensitive)

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Appendix C. RS-232 and RS-485 Options

The senTorr serial communication board is available in the following configurations:

- RS–232 standard with a 9-pin D-subminiature connector (Part number L6439-301)
- RS–485 (Part number L8940-301)

The serial communication capability is in accordance with the Electronics Industry Association (EIA) standards 232 and 485.

Board Configurations

This section discusses board configuration and capabilities.

RS–232 standard version

The standard RS–232 board contains a DIP switch that reverses the pin-outs of the RTS/CTS and TXD/RXD pairs. This built-in, null modem capability is used to simplify the cable connection to the host system.

The senTorr outputs +9 V for an asserted (logic 0) level, and –9 V for an unasserted (logic 1) level. The input signals to senTorr must be between +2.4 V and +30 V for an asserted level and +8 V and -30 V for an unasserted level.

Maximum cable length is 50’ (15.24 m).

RS–485

The RS–485 board employs differential line drivers and receivers capable of communicating with up to 32 senTorr units, at distances of up to 4000’ (1219.2 m) at 19,200 baud in a multidrop scheme. The network arrangement allows any unit to go offline without affecting the operation of the other units. A shielded, twisted pair cable provides good resistance to electrical noise. The cable multiplexes transmit and receive signals on one pair, leaving the other pair available for RTS. The factory setting is for RS–485.

Installation

NOTE

Do not use the EPROM supplied when purchasing the RS–485 Board (Part No. L8940-3010) as it is used in the Multi-Gauge Controller only.

Add a 100 Ohm resistor in series from the senTorr serial port ground pin to the system ground to help break ground loops.

To configure and install the board:

1. Ensure that the line cord is unplugged.
2. Open the unit by removing the two screws at the top rear of the unit, pivot the cover up and back to disengage the front lip, and lift off the cover.
3. Remove the blank plastic cover from the rear panel (Figure C-1).

   Save the two small screws for attaching the cover plate with the cable opening.

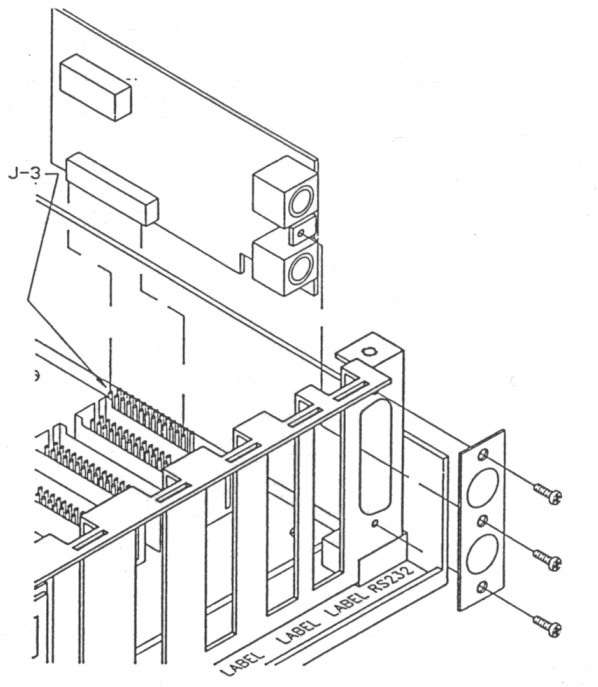

Figure C-1 Installing the Serial Communication Board

4. Set the DIP switches as per board type, as discussed below:

   ❑ RS–485

   Refer to Table C-1. If the senTorr is shipped with this option installed, the board is configured as ordered.

Table C-1 RS–485 Selection

Switch Number	RS–485
SW1-1	closed
SW1-2	open
SW1-7	closed
SW1-8	open

A differential terminating resistance of 220 Ohms can be switched into the two-wire pairs. The factory setting is unterminated (Table C-2).

Table C-2 RS–485 Terminating Resistance Selection

Switch Number	Number Terminating Resistance	220 Ohm Terminating Resistance
SW1-3	open	closed
SW1-4	open	closed

- RS–232 Standard

Table C-3 lists the serial port pin-outs of the standard 9-pin connector for both standard and null modem operation. Table C-4 lists DIP switch SW1 settings to select the signal output mode. The factory setting is for the null modem mode.

Table C-3 RS–232 Signal Communications

Signal	Null Modem Pin	Standard Pin	Description
Gnd	5	5	Signal Ground
TXD	3	2	Transmitted Data
RXD	2	3	Received Data
RTS	8	7	Request To Send
CTS	7	8	Clear To Send
DTR	4	4	Data Terminal Ready

Table C-4 RS–232 Null Modem or Standard Selection

Switch Number	Null Modem Setting	Standard Setting
SW1-1	closed	open
SW1-2	open	closed
SW1-3	closed	open
SW1-4	open	closed
SW1-5	closed	open
SW1-6	open	closed
SW1-7	closed	open
SW1-8	open	closed

5. Plug the serial communication board into its connector J3.

   Ensure that the board connectors are properly aligned and that the cable connection is at the rear of the unit.

6. Attach the cover plate using the two small screws.

7. Replace the cover and secure it with the two screws.

NOTE

Vacuum Technologies cannot guarantee compliance with FCC regulations for radiated emissions unless all external wiring is shielded.

There are two shielded mini–DIN connectors to facilitate connections to the rest of the network. These are in parallel and permit easy daisy–chaining of multiple units. The connections are listed in Table C-5 and are shown in Figure C-2.

Table C-5 RS–485 Signal Connections for Daisy Chaining

Pin Number	RS–485	Wire Color*
1	Gnd	Green
2	Gnd	Black
3	RTS –	Brown
4	XCV +	Red
5	RTS +	White
6	XCV –	Blue

* These colors are pre-made cinch cable type MDC-6Pxx.

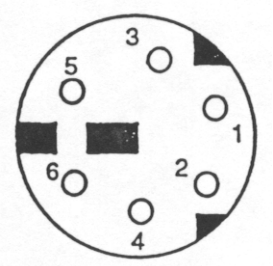

Figure C-2 Pin Connections

Operation

The user application must conform to the software protocol as specified (refer to “Command Syntax and Definitions” on page 7). The senTorr's baud rate and address are programmed through the front panel keypad. For successful operation, all units on the network must be at the same baud rate and, to avoid contention, have different addresses. All units are shipped from the factory with a default address of 00.

Upon receipt of a command, senTorr holds its RTS line to logic 1 (unasserted) while it processes the command and returns any required data. If the host does not monitor its CTS line (as in RS–485), it must limit the frequency of commands as follows.

- ❑ The host must allow 500 mseconds after sending an emission or degas on/off command. Any bytes sent during that time overwrite each other.
- ❑ If a response is expected, the host waits to receive the response before starting the next command.

While senTorr tolerates high speed communications, the application does not tie up senTorr with incessant strings of commands so it can process pressure data from the gauge channels.

Setting Baud Rate and Address

The BAUD RATE key is used to display and set the serial communications baud rate, parity, and the controller address (for use in a multi-drop communication link).

To set the baud rate and address:

1. Press **BAUD RATE**.

   The IG display mantissa flashes the present baud rate.

2. Use the up/down arrows to select the desired baud rate:

   1.2 (1200), 2.4 (2400), 4.8 (4800), 9.6 (9600), or 19.2 (19,200).

3. Press **ENTER** to save the baud rate setting and to advance to the parity setting display in the IG exponent.
4. Use the arrow keys to select *no (n)*, *even (E)*, or *odd (0)* parity.
5. Press **ENTER** to save the parity setting.

   The controller address setting flashes in the IG mantissa.

6. Use the arrow keys to select the desired address for the unit, from *00* to *99*.

   Change the address from the default of *00* if more than one unit is to be installed on the communication link.

NOTE

It is not necessary to change the address from 00 with an RS–232 application.

7. Press **Enter** to save the address and exit baud rate programming.

   The default settings are 9600 baud with no parity and an address of 00. After a senTorr reset or power-up, the serial settings are verified and re-initialized to their default settings only if they are found to be corrupt.

Command Syntax and Definitions

The command format is:

 # {senTorr address} {command} {optional data} {carriage return}

The response format is:

> {optional data} {carriage return}

The senTorr sends *?FF* as a response if the command or data is invalid, or if the command length is incorrect. There is no response to a parity error, wrong address, or lack of termination character.

The senTorr commands are based on the front panel keypad functions. The optional data bytes used in the commands indicate the gauge on which the command is operating and the desired pressure or parameter setting, as necessary.

Table C-6 lists the convention for numbering the set points.

Table C-6 Setpoint Numbering

Set Point Number	Set Point Name
1	IG set point
2	TC 1 set point
3	TC2 set point
4	Additional set point

The senTorr command set is compatible with the Multi-Gauge controller RS–485 serial command set. While the pressure and parameter data mantissas require that four digits be sent, the senTorr uses only the two most significant digits for set point and parameter settings.

Table C-7 lists the senTorr serial commands. All lower case characters must be replaced as follows:

aa	unique 2 digit hexadecimal bus address (""00" ...:99"), as set on the unit
hh	2 character hex data value (00 ...FF")
c	1 character channel type ("1", 'or") where I = BNCC T=TC
n	1 character channel number where IG = 1, TC1 = 1, TC2 = 2 x = 1 character data value ("1" '19")
t	message terminator character (#13, <carriage return>

Table C-7 Serial Command Set

Function	Command	Response
Read senTorr configuration	#aa01t	>hhhhhhhhhht where the card id codes are: ❑ 20 = BA configured for Broad-range gauges ❑ 30 = BA configured for standard Bayard-Alpert gauges ❑ 38 = Cold cathode ❑ 40 = Thermocouple board ❑ 50 = Setpoint ❑ FE = Empty slot
Read gauge pressure	#aa02cnt	>x.xxxE-xxt
Read Setpoint State	#aa03t	>00hht where hh bits 0 – 3represent setpoints 1 – 4 and value is state (0 = off, 1 = on)
Read programmed setpoints	#aa04cnt	>00hht Where bits 0 – 3 represent setpoints 1 – 4 and value is assignment (0 = not assigned, 1 = assigned)
Read software revision	#aa05t	>hhhht where hh = 0 – 9 and the revision is hh.hh r

Table C-7 Serial Command Set (Continued)

Function	Command	Response
Reset senTorr	#aa06t	>t
Read Remote Input State	#aaODt	>OOhht where 00 = inactive (low) 01 = active (high)
Read Pressure Dump	#aaOFt	>x.xxxE-xx[,. ..] t The number of bytes in the response varies with the configuration of the unit. The order of readings is from top to bottom of the front panel display.
Set pressure units to Torr	#aa10t	>t
Set pressure units to mBar	#aa11t	>t
Read pressure units	#aa13t	>hht where: ❑ hh = 00 is Torr ❑ hh = 01 is mBar
Set key pad lock OFF	#aa20t	>t
Set keypad lock ON	#aa21t	>t
Read keypad lock status	#aa22t	>hht where: ❑ hh = 00 is unlocked ❑ hh = 01 is locked ❑ hh = is a partial lock
Set Partial keypad lock	#aa23t	>t
Set Emission OFF	#aa30Int	>t
Set Emission ON	#aa31Int	>t
Read Emission status	#aa32Int	>hht where: ❑ hh = 00 is OFF ❑ hh = 01 is ON
Set degas OFF	#aa40l1t	>t
Set degas ON	#aa41l1t	>t

Table C-7 Serial Command Set (Continued)

Function	Command	Response
Read degas status	#aa42l1tt	>hht where: ❑ hh = 00 is OFF ❑ hh = 01 is ON
Read gas correction	#aa50l1t	>x.xxxt
Set gas correction	#aa51l1x.xxxt	>t
Read Emission current	#aa52l1t	>x.xxxt
Set Emission current	#aa53l1x.xxxt	>t
Read Sensitivity	#aa54l1t	>xx.xxt
Set Sensitivity	#aa55l1xx.xxt	>t
Set Setpoint pressure level	#aa6hcnx.xxxE-xxt where h is the setpoint relay number, 1 – 4	>t
Set Setpoint hysteresis level	#aa7hcnx.xxxE-xxt where h is the setpoint relay number, 1 – 4	>t
Read Setpoint pressure level	#aa8ht where h is the setpoint number, 1 – 4	>x.xxxE-xxt
Read Setpoint hysteresis level	#aa9ht where h is the set point number, 1 – 4	>x.xxxE-xxt
Set Thermocouple Cal	#aaA1Tnt	>t
Set Thermocouple Update Rate to Slow (standard)	#aaA7t	>t
Set Thermocouple Update Rate to Fast	#aaA8t	>t
Read Thermocouple Update Rate	#aaA9t	>hht hh = 00 is Slow hh = 01 is Fast
Set Auto-On	#aaB0l1T1x.xE-xxt	>t
Read Auto-On	#aaB1l1t	>T1x.xExxt

Request for Return
Health and Safety Certification

1. Return authorization numbers (RA#) **will not** be issued for any product until this Certificate is completed and returned to a Varian, Inc. Customer Service Representative.
2. Pack goods appropriately and drain all oil from rotary vane and diffusion pumps (for exchanges please use the packing material from the replacement unit), making sure shipment documentation and package label clearly shows assigned Return Authorization Number (RA#) VVT cannot accept any return without such reference.
3. Return product(s) to the nearest location:

North and South America	**Europe and Middle East**	**Asia and ROW**
Varian, Inc. Vacuum Technologies 121 Hartwell Ave. Lexington, MA 02421 Fax: (781) 860-9252	Varian S.p.A. Via F.lli Varian, 54 10040 Leini (TO) – ITALY Fax: (39) 011 997 9350	Varian Vacuum Technologies Local Office

For a complete list of phone/fax numbers see www.varianinc.com/vacuum

4. If a product is received at Varian, Inc. in a contaminated condition, **the customer is held responsible** for all costs incurred to ensure the safe handling of the product, and **is liable** for any harm or injury to Varian, Inc. employees occurring as a result of exposure to toxic or hazardous materials present in the product.

CUSTOMER INFORMATION

Company name: .....

Contact person: Name: ..... Tel: .....

Fax: ..... E-mail: .....

Ship method: Shipping Collect #: ..... P.O.#: .....

Europe only: VAT Reg Number: ..... *USA only:* ❒ Taxable ❒ Non-taxable

Customer ship to: ..... Customer bill to: .....

....

....

PRODUCT IDENTIFICATION

Product Description	Varian, Inc. Part Number	Varian, Inc. Serial Number

TYPE OF RETURN (check appropriate box)

❒ Paid Exchange	❒ Paid Repair	❒ Warranty Exchange	❒ Warranty Repair	❒ Loaner Return
❒ Credit	❒ Shipping Error	❒ Evaluation Return	❒ Calibration	❒ Other

HEALTH and SAFETY CERTIFICATION

VACUUM TECHNOLOGIES CANNOT ACCEPT ANY BIOLOGICAL HAZARDS, RADIOACTIVE MATERIAL, ORGANIC METALS, OR MERCURY AT ITS FACILITY. CHECK ONE OF THE FOLLOWING:

❒ I confirm that the above product(s) has (have) **NOT** pumped or been exposed to any toxic or dangerous materials in a quantity harmful for human contact.

❒ I declare that the above product(s) has (have) pumped or been exposed to the following toxic or dangerous materials in a quantity harmful for human contact (Must be filled in):

Print Name..... Signature ..... Date .....

PLEASE FILL IN *THE FAILURE REPORT SECTION* ON THE NEXT PAGE

Do not write below this line

Notification (RA) #: ..... Customer ID #: ..... Equipment #: .....

VARIAN

Request for Return
Health and Safety Certification

ISO 9001 REGISTERED

FAILURE REPORT
(Please describe in detail the nature of the malfunction to assist us in performing failure analysis):

TURBO PUMPS AND TURBOCONTROLLERS

Claimed Defect		**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		Operation Time:	
Describe Failure:				
Turbocontroller Error Message:				

ION PUMPS/CONTROLLERS

❒ Bad feedthrough	❒ Poor vacuum
❒ Vacuum leak	❒ High voltage problem
❒ Error code on display	❒ Other .....
Describe failure:	
Customer application:	

VALVES/COMPONENTS

❒ Main seal leak	❒ Bellows leak
❒ Solenoid failure	❒ Damaged flange
❒ Damaged sealing area	❒ Other .....
Describe failure:	
Customer application:	

LEAK DETECTORS

❒ Cannot calibrate	❒ No zero/high background
❒ Vacuum system unstable	❒ Cannot reach test mode
❒ Failed to start	❒ Other .....
Describe failure:	
Customer application:	

INSTRUMENTS

❒ Gauge tube not working	❒ Display problem
❒ Communication failure	❒ Degas not working
❒ Error code on display	❒ Other .....
Describe failure:	
Customer application:	

ALL OTHER VARIAN, INC.

❒ Pump doesn't start	❒ Noisy pump (describe)
❒ Doesn't reach vacuum	❒ Overtemperature
❒ Pump seized	❒ Other .....
Describe failure:	
Customer application:	

DIFFUSION PUMPS

❒ Heater failure	❒ Electrical problem
❒ Doesn't reach vacuum	❒ Cooling coil damage
❒ Vacuum leak	❒ Other .....
Describe failure:	
Customer application:	

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