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Agilent Technologies

CE

RS-232 and RS-485 Options for the senTorr™ Gauge Controller

INSTRUCTION MANUAL

Manual No.699908170
Revision B
May 2004

RS-232 and RS-485 Options for the 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.

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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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Declaration of Conformity
Konformitätserklärung
Déclaration de Conformité
Declaración de Conformidad
Verklaring de Overeenstemming
Dichiarazione di Conformità

VARIAN

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Noi

Varian, Inc.
Vacuum Technologies
121 Hartwell Avenue
Lexington, MA, 02421-3133 USA

declare under our sole responsibility that the product,
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RS-232 and RS-485 Options for the senTorr Gauge Controller

to which this declaration relates is in conformity with the following standard(s) or other normative documents.
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
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Varian, Inc.
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 which the user may be required to take adequate measures to alleviate.

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 generates, 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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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 last digit of the senTorr key entry determines the communication options installed (Table 1-1).

Table 1-1 Gauge Configuration Key Entries

Configuration	Key Entry
No Communications	0
RS-232	1
RS-485	4

Board Configurations

This section discusses board configuration and capabilities.

RS–232 standard version

All of the keypad functions, except for the baud rate settings and the display output, are accessible through the RS–232 bidirectional computer link.

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 1-1).

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

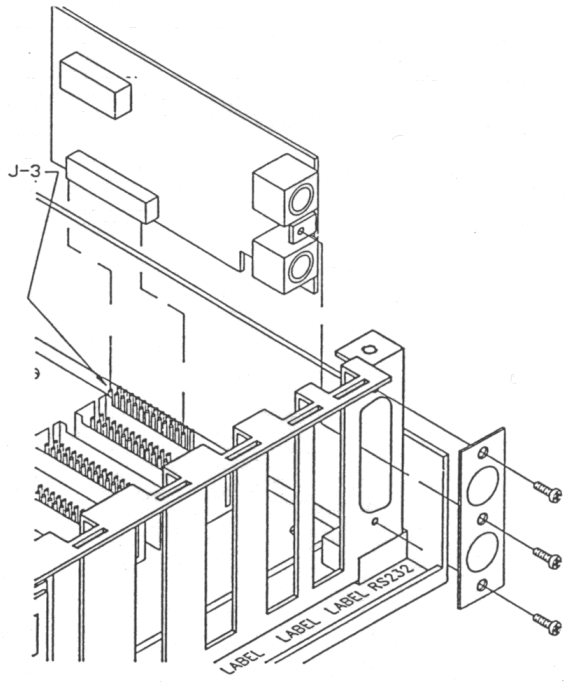

Figure 1-1 Installing the Serial Communication Board

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

   ❑ RS–485

   Refer to Table 1-2. If the senTorr is shipped with this option installed, the board is configured as ordered.

Table 1-2 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 1-3).

Table 1-3 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 1-4 lists the serial port pin-outs of the standard 9-pin connector for both standard and null modem operation. Table 1-5 lists DIP switch SW1 settings to select the signal output mode. The factory setting is for the null modem mode.

Table 1-4 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 1-5 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 1-6 and are shown in Figure 1-2.

Table 1-6 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.

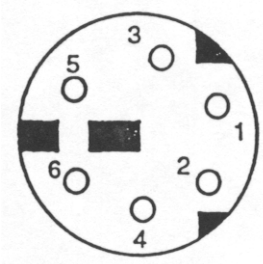

Figure 1-2 Pin Connections

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 1-7 lists the convention for numbering the set points.

Table 1-7 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 1-8 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 1-8 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 1-8 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	#aa30lnt	>t
Set Emission ON	#aa31lnt	>t
Read Emission status	#aa32lnt	>hht where: ❑ hh = 00 is OFF ❑ hh = 01 is ON
Set degas OFF	#aa40l1t	>t
Set degas ON	#aa41l1t	>t

Table 1-8 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

VARIAN

Request for Return
Health and Safety Certification

ISO 9001 REGISTERED

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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