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CT-550

(Formerly Eyesys ConvecTorr)

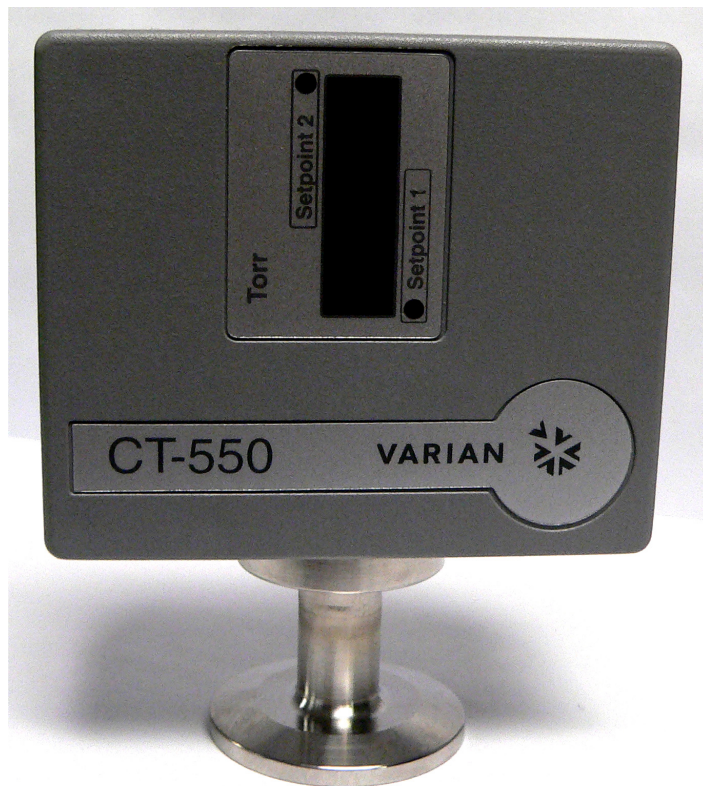
INSTRUCTION MANUAL

Manual No. 699908210

Revision K

October 2009

CT-550



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Declaration of Conformity
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Déclaration de Conformité
Declaración de Conformidad
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CT-550

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- 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

A handwritten signature in black ink that reads "John Ehman".

John Ehman
Operations Manager
Varian, Inc.
Lexington, Massachusetts, USA

October 2003



Preface

Hazard and Safety Information

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

This manual uses the following standard safety protocols:

WARNING

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

CAUTION

Cautions indicate a particular procedure or practice, which if not followed, could cause damage to the equipment.

NOTE

Notes contain important information.

Before operating or servicing equipment, read and thoroughly understand all operation/maintenance manuals provided by Varian. 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 Varian office.

EMC Warning

EN 55022 Class A Warning

This is a Class A product. In a domestic environment this product may cause radio interference. In such cases, the user will be required to correct the interference at his own expense.

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.



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.

Installation Requirements

To maintain compliance with both the FCC Part 15 rules and the European Union's EMI directives, use a shielded cable constructed of a braided shield and metal or metalized plastic backshells directly connected to the cable shield at the 9 position D-sub connector of the unit. The shield must be connected to ground at the user's equipment. Failure to install the equipment in this way may result in the unit no longer meeting the requirements for radiated emissions and susceptibility.

Some installations may require connecting pin 8 to the CT-550 shield to eliminate ground loop effects.

Use with Combustibles and Mixtures

WARNING



As with all ionization gauges, this device is not intrinsically safe. Exercise extreme care when using this vacuum gauge while pumping or backfilling a system or in any other system condition which contains combustible gases or mixtures. The filament, the end of a hot filament ion gauge and the high voltage discharge of a cold cathode gauge can be ignition sources.

When such a gas or mixture is present, do not turn on any such vacuum gauge. Failure to follow this instruction could result in serious injury to personnel and damage to equipment.

Vacuum Equipment and Cleanliness

Cleanliness is vital when servicing any vacuum equipment.

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.

Normally, it is unnecessary to use vacuum grease. However, if it must be used, do not use silicone types, and use it sparingly. Apiezon L grease is recommended (Varian Part Number 695400004).

Contacting Varian

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

Please contact Varian Customer Care for assistance:

In North America:

Toll-Free: 1-800-882-7426

Hours: 8:00 AM to 7:00 PM Eastern
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Language: English

Product Return Authorizations

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In Japan:

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In Taiwan:

Toll-Free: 0 (800) 051 342

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time

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CT-550

Introduction

The CT-550 vacuum pressure gauge is a transducer, integrated into a compact sensing gauge controller, which can read pressure measurements from 1000 Torr (1330 mbar/133 kPa) to .1 mTorr (.1 μ bar/.013 Pa) with accurate repeatability and fast response to pressure change. The CT-550 vacuum pressure gauge has:

- An easy to use manual calibration switch
- Dual set point switches with LEDs for convenient indication when configured with the optional digital display
- A 1V/decade log linear output
- Selectable transducer fittings

The unit is enclosed in a plastic space-saving RF-shielded case that reduces the need for additional expensive rack mounted instrumentation.

Options

Table 1-1 lists the CT-550 options for front panel pressure display, serial communication and transducer fittings. For ordering information, see your Varian catalog or brochure.


Table 1-1 CT-550 Options

Item	Options
Displays	<input type="checkbox"/> Digital Numeric
Serial Communication	<input type="checkbox"/> RS232 <input type="checkbox"/> RS485
Transducer Fittings	<input type="checkbox"/> NW-16 <input type="checkbox"/> NW-25 <input type="checkbox"/> NW-25

Specifications

Table 1-2 lists the CT-550 specifications.

Table 1-2 Specifications

Item	Specification
Altitude	2000 m
Connection	<p>The 9-pin D-subminiature connector provides power, control and outputs.</p> <p>Note</p>  <p><i>Analog pressure signal is not available with models ordered with digital serial communications (RS232/RS485).</i></p>
External Power Requirements	<p>UL recognition for 24 VDC \pm10% @ 500 mA max (18 VDC to 30 VDC @ 125 mA, typical operating).</p> <p>Optional 110 VAC adapter: Varian PN# 670077101</p>
Indoor Use	Installation Category II
Minimum Pressure Capability	760 Torr (1 bar, 100 kPa) to 1 mTorr (1 μ bar, .13 Pa)
Operating Temperature	UL recognized: From 0 to 40° C; maximum relative humidity 80% for temperatures up to 31° C decreasing linearly to 50% relative humidity at 40° C.
Output Signal	1V/decade log linear, optional non-linear available
Overpressure Capability	1500 Torr (2 bar, 200 kPa)
Pollution Category	Category 2
Range	1000 Torr (1330 mbar, 133 kPa) to .1 mTorr (.1 μ bar, 0.13 Pa)
Set Point	<p>Digital potentiometer setting, Normally Open relay, 100 mA/ 40 VDC</p> <p>Range: 5 mTorr (5 μbar, .5 Pa) to 500 Torr (500 mbar, 50 kPa)</p>
Size	3.5" H x 3.4" W x 1.5" D
Units	Pa, mbar or Torr, preset at factory

Connector Pin Assignments

One set of N/O contacts is available for each set point. The connector pinouts are listed in Table 1-3.

Table 1-3 Dual Setpoint Options

Pin #	Dual Set Point CT-550	Dual Set Point CT-550 with RS232/RS485 Option
1	Set Point 1 Contact	Set Point 1 Contact
2	Set Point 2 Contact	Set Point 2 Contact
3	+24V Power	+24V Power
4	Power Ground	Power Ground
5	Pressure Analog Signal	RS232 TxD RS485 T-
6	Set Point 1 Contact	Set Point 1 Contact
7	Remote Calibration Input	Remote Calibration Input
8	Signal Ground	RS232 RxD RS485 T+
9	Set Point 2 Contact	Set Point 2 Contact

Operation

Operations consist of:

- "Pressure Reading"
- "CT-550 Calibration" on page 1-4
- "Setpoint Setting" on page 1-7
- "Reset" on page 1-7
- "Data Storage Fault" on page 1-7
- "Output Voltage" on page 1-8

Pressure Reading

The gauge operates on power-up and indicates pressure on an analog output, front panel display (optional) and the serial communication port (optional). Pressure readings below the CT-550 measuring range are indicated by:

- A voltage output of approximately 1V
- A serial communications port (optional) reading of 1.0 E-4 Torr (1.3 E-4 mbar, 1.3 E-2 Pa).

Lack of any readings, for example, if there is a disconnected or failed tube, results in an Error 3 condition, indicated by:

- ❑ An *E03* (digital display option),
- ❑ A serial communications reading of *E03*,
- ❑ and a voltage output of 10 V or greater.

CT-550 Calibration

For maximum reading accuracy, the CT-550 requires calibration at atmosphere and vacuum. Once calibrated, the calibration information is stored in non-volatile memory. Only a power-up RESET can erase the stored values. The calibration system is *smart* in that it recognizes which end of the scale is being calibrated and performs the appropriate calibration. This eliminates the problem of trying to perform a vacuum calibration when the actual pressure is atmosphere and vice-versa.

CT-550 provides three ways to do the calibration.

- ❑ Manually by pressing **CAL** on the unit.
- ❑ Remotely by a switch closure or logic signal.
- ❑ Remotely by serial communications (RS232 or RS485)



All units have been calibrated at the factory. However, it is strongly recommended that the calibration is repeated in-situ after installation if at all possible for maximum performance. While the CT-550 operates in any position, maximum accuracy in the 10 Torr to 200 Torr range is obtained with the unit oriented vertically with the vacuum port pointing downwards.

To calibrate:

1. Perform an "Atmosphere Calibration".
2. Perform a "Vacuum Calibration" on page 1-5.



The procedure is described for manual calibration, refer to the I/O and serial comm. sections for remote calibration).

If it is not possible to reach a low enough pressure to do the vacuum calibration, use the factory calibration.

Atmosphere Calibration

1. Install the unit and allow it to warm-up for at least 15 minutes.
2. Ensure that the unit is at atmospheric pressure.
3. Press **CAL** for ~ ¼ second.

- If the digital display is present, the reading should be between 7.5E+2 Torr and 7.7E+2Torr.
 - The analog output should be ~7.88 VDC. Some fluctuation of the reading is normal
4. Select alternate atmosphere values (optional setting) to compensate for barometric pressure or high elevations (such as in Denver, CO) where the actual value of atmospheric pressure is not 760 Torr (1330 mbar, 133 kPa):
- With serial communication, use the SET ATMOSPHERE VALUE command.
 - For manual or switch closure remote do the following while monitoring the digital display or analog output:
 - a. Refer to Table 1-4 on page 1-6 for the pressure vs. analog output voltage values.
 - b. Determine the correct atmosphere pressure reading.
 - c. Press **CAL** for ~ 5 seconds. The reading begins to decrease.
 - d. Release **CAL** when the desired reading is reached.
 - Press **CAL** again within 10 seconds and the readings begin to increase until the button is released.
 - After **CAL** is released for over 10 seconds, the CAL button resumes normal function and the new atmosphere reading is stored in memory.



If using remote I/O, use the calibration input (pin 7 of the connector), which works just like the CAL button.

Vacuum Calibration



If an atmosphere calibration has just been performed, additional warm-up is not required. However, if the unit has been just powered up, allow the unit the warm up for at least 15 minutes.

1. Ensure that the applied pressure is no higher than 1×10^{-4} Torr.
2. Once the readings look stable, press **CAL** for ~1/4 second.
 - If the digital display is present, the reading should be 1.0E-4 Torr.
 - The analog output should be ~1.00 VDC. Some fluctuation of the reading is normal.

Table 1-4 Fine Adjustment of Log Output Voltage

Pressure			Volts
Pascal	millibar	Torr	
7.98E+04	798	600	7.778
8.11E+04	811	610	7.785
8.25E+04	825	620	7.792
8.38E+04	838	630	7.799
8.51E+04	851	640	7.806
8.65E+04	865	650	7.813
8.78E+04	878	660	7.820
8.91E+04	891	670	7.826
9.04E+04	904	680	7.833
9.18E+04	918	690	7.839
9.31E+04	931	700	7.845
9.44E+04	944	710	7.851
9.58E+04	958	720	7.857
9.71E+04	971	730	7.863
9.84E+04	984	740	7.869
9.98E+04	998	750	7.875
1.01E+05	1011	760	7.881
1.02E+05	1024	770	7.886
1.04E+05	1037	780	7.892
1.05E+05	1051	790	7.898
1.06E+05	1064	800	7.903

Setpoint Setting

The dual set point feature offers a means of process control. Each set point output consists of a Normally Open Form B relay, allowing integration of contact closures into a PLC. Select the set point level by turning a digital switch to one of sixteen settings.

The set point relay triggers and the setpoint led illuminates when the pressure falls below the set value. To prevent relay chatter, relays clear at 40% above the set value. For example, if a 10×10^{-3} Torr setting is chosen, the relay closes at 10×10^{-3} Torr and opens again at 14×10^{-3} Torr.

Serial Communication Options

Set points can be set at any value by use of a serial command. Set point status (ON or OFF) can also be polled by use of serial commands. Any serial communication set points are stored in non-volatile memory. When power is returned, the set points stay at their last setting.

Reset

Calibration can be reset to default values by following the power-up reset procedure:

1. Turn the power OFF and press and hold **CAL**.
2. Power up unit and keep pressing **CAL** for five seconds or until the LED test is complete (display option).

Atmosphere Value is reset to a default value of 760T (1.0E+3 mbar, 1.0E+5 Pa).

Serial Communications Option

A power-up reset removes the unit from remote control, and the set points default to the set point switch settings. This differs from the serial reset command (see Appendix "Reset" on page A-2).

Data Storage Fault

Settings that uniquely configure each CT-550 are stored in non-volatile memory, and fall into two categories:

- Operator defined data which is defaulted with a Reset: Setpoints (Serial Option), Calibration and Set Atmosphere Value.
- Factory set data which is not changed with a Reset: Units selection and output voltage calibration.

During power-up, if any data is unable to be read from memory it is set to a default value, and a Data Valid error is flagged. (default value for Units is Torr.) This error can be seen by:

- A slowly flashing display (digital display option), or
- The Data Valid status command (serial communication option).

If this error occurs, cycle unit power. If the:

- ❑ Faulty data is of the first category, (setpoints, calibration or Atmosphere Value), and the non-volatile memory is still functioning, the error clears with the next power-up and no further action is required.
- ❑ Error does not clear, the CT-550 remains running at default values until returned to the factory for re-configuration.

Output Voltage

The CT-550 output options are listed in Table 1-5.

Table 1-5 CT-550 Output Options

	Pressure			Volts
	Pascal	mbar	Torr	Log-Linear
Vacuum	1.3E-02	1.3E-04	.1 mT	1.000
	1.3E+00	1.3E-02	10 mT	3.000
	2.7E+00	2.7E-02	20 mT	3.301
	6.7E+00	6.7E-02	50 mT	3.698
	1.3E+01	1.3E-01	100 mT	4.000
	2.7E+01	2.7E-01	200 mT	4.301
	6.7E+01	6.7E-01	500 mT	4.698
	1.3E+02	1.3E+00	1 T	5.000
	2.7E+02	2.7E+00	2 T	5.301
	6.7E+02	6.7E+00	5 T	5.698
	1.3E+03	1.3E+01	10 T	6.000
	2.7E+03	2.7E+01	20 T	6.301
	6.7E+03	6.7E+01	50 T	6.698
	1.3E+04	1.3E+02	100 T	7.000
	2.7E+04	2.7E+02	200 T	7.301
6.7E+04	6.7E+02	500 T	7.698	
Atmosphere	1.0E+05	1.0E+03	760 T	7.880

Table 1-5 CT-550 Output Options

	Pressure			Volts
	Pascal	mbar	Torr	Log-Linear
	1.1E+05	1.1E+03	800 T	7.903
	1.2E+05	1.2E+03	900 T	7.954
	1.3E+05	1.3E+03	1000 T	8.000

The Log Linear CT-550 output is a 1V/decade output which follows the log of the pressure.

To determine a voltage given a pressure:

- Volts = Log (Pressure/1.33) + 3 for Pascal
- Log (Pressure) + 5 for Torr
- Log (Pressure/1.33) + 5 for mbar

For a given voltage, to find pressure:

- Pressure = 10 (V -3) x 1.33 for Pa
- 10 (V -5) for Torr
- 10 (V -5) x 1.33 for mbar

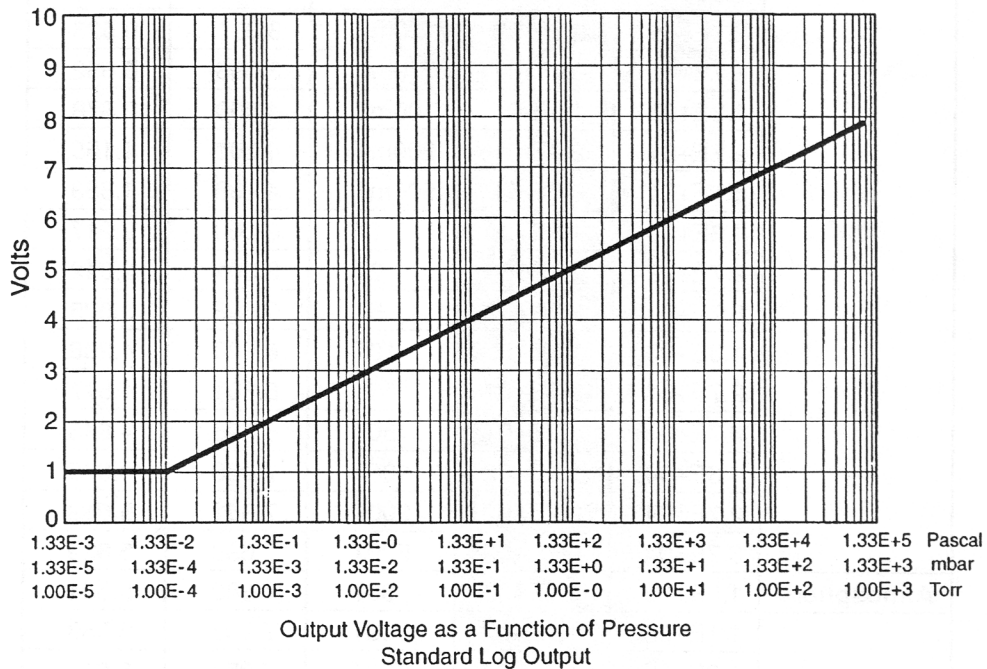


Figure 1-1 Standard Log Output Graph

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Appendix A. Serial Communications Options

The CT-550 serial communications option allows remote status checking and remote control of calibration and setpoint. Using serial communication, all CT-550 parameter status' can be checked, however, CT-550 must be in Remote Control to change setpoint or calibration values.

Table A-1 lists the serial communications parameters.

Table A-1 Hardware Setup

Setting	Value
Baud Rate	9600
Parity	None
Stop Bits	1
Flow control	None

It is suggested that communication be initially established/tested using Microsoft Terminal, Hyperterminal, or equivalent before connecting to an untested device.

The following are configurable serial communications options:

- | | |
|----------------------------|---|
| Changing to Remote Control | <ul style="list-style-type: none"> <input type="checkbox"/> When remote commands put CT-550 in remote control, the local setpoint switch and calibration button are inoperative. <input type="checkbox"/> Setpoint remains at the local switch setting until changed by a remote setpoint command. <input type="checkbox"/> The Calibration command mimics pressing the Calibration button. It can be activated at atmospheric pressure or at high vacuum at any time. |
| Changing to Local Control | <ul style="list-style-type: none"> <input type="checkbox"/> Calibration and Setpoint can be changed by the controls on the CT-550 box. <input type="checkbox"/> Select Local Control and the Setpoint is immediately changed to the local switch setting. <input type="checkbox"/> Any remote calibration remains in effect until updated by local calibration. |
| Local/Remote Status | CT-550 powers up in whatever Local/Remote status the system was in when last powered down. |

Reset Remote Reset can be activated in both Local and Remote Control and is similar to Powerup Reset in function. Both Powerup Reset and Remote Reset reset calibration. Powerup Reset always leaves CT-550 in Local Control, while Remote Reset leaves CT-550 in whatever control mode existed before the reset.

Command Set

The command format is:

"#" {Gauge address} {command} {data} {carriage return}

The response is:

">" {optional data} {carriage return}

All lower-case characters are place holders and must be replaced as follows:

aa = two character listener address (00 for RS232)

x = "0"... "9" data value

{cr} = message terminator character (carriage return). Note: Carriage Return/Linefeed terminator is accepted, but using CR alone is preferable.

Table A-2 lists the command sets.

Table A-2 Command Set

	Command	Response															
Read AG Type	#aa01{cr}	>43FEFEFEFE{cr}															
Read Pressure	#aa02T1{cr}	>x.xxxE-xx{cr}															
Read Setpoint State	#aa03{cr}	>000x{cr} where <table border="0" style="margin-left: 20px;"> <tr> <td>x</td> <td>Relay1</td> <td>Relay2</td> </tr> <tr> <td>0</td> <td>OFF</td> <td>OFF</td> </tr> <tr> <td>1</td> <td>ON</td> <td>OFF</td> </tr> <tr> <td>2</td> <td>OFF</td> <td>ON</td> </tr> <tr> <td>3</td> <td>ON</td> <td>ON</td> </tr> </table>	x	Relay1	Relay2	0	OFF	OFF	1	ON	OFF	2	OFF	ON	3	ON	ON
x	Relay1	Relay2															
0	OFF	OFF															
1	ON	OFF															
2	OFF	ON															
3	ON	ON															
Read S/W Rev	#aa05{cr}	>xxxx{cr} where the revision is xx.xx															
Reset (clears Calibration)	#aa06{cr}	>{cr}															
Set LOCAL Control	#aa20{cr}	>{cr}															
Set REMOTE Control	#aa21{cr}	>{cr}															

Table A-2 Command Set

	Command	Response
Read Local/Remote Status	#aa22{cr}	>xx{cr} where xx=00 is LOCAL xx=01 is REMOTE
Set Setpoint Pressure Level	#aa6hT1x.xxxE-xx{cr} where range is any value from 2.000 E-02 to 1.000 E+05 Pa (2.000 E-04 to 1.000 E +03 mbar 1.500E-04 to 9.000E+02 Torr) and h is Setpoint # and = 1 or = 2 (Dual Set Point Option only)	>{cr}
Read Setpoint Pressure Level	#aa8h{cr} where h is Setpoint No. and = 1 or 2	>x.xxxE-xx{cr}
Calibrate (applies to both Vacuum and Atmosphere)	#aaA1T1{cr}	>{cr}
Set Atmospheric Value	#aaA3T1x.xxxE-xx{cr} where pressure is desired atmospheric value. Default is 100 kPa, 1000 mbar, 760Torr. The Calibrate command is still required to perform calibration.	>{cr}
Data Valid Status	#aaC0 {cr}	>01 if DATA VALID >00 if DATA INVALID (indicates clearing of factory calibration)

Error Messages

CT-550 responds to incorrect commands with the messages in Table A-3.

Table A-3 Error Messages

Error Message	Reasons
?FF	The proper address was received, but: <ul style="list-style-type: none"> <input type="checkbox"/> Command does not follow one of the above formats <input type="checkbox"/> Command or data is invalid <input type="checkbox"/> Command length is incorrect. There is no response to a wrong address, or lack of termination character.
?Local	<ul style="list-style-type: none"> <input type="checkbox"/> A <i>Set Setpoint Pressure Level</i> command was received by CT-550 when in Local Control. <input type="checkbox"/> A <i>Calibrate</i> command was received by CT-550 when in Local Control.

Recommended Serial Communications Cabling

Figure A-1 and Figure A-2 show the cabling configuration by serial communication type.

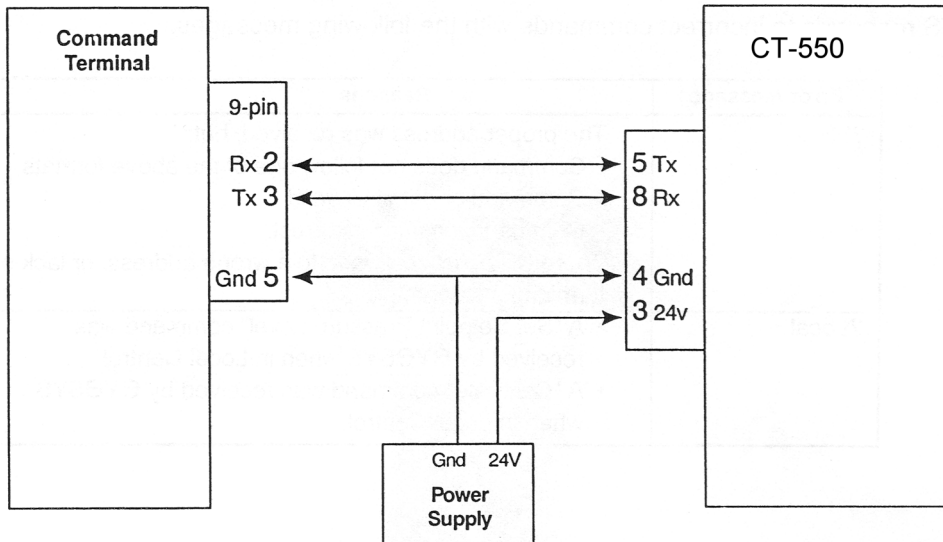


Figure A-1 Recommended Cabling – RS232

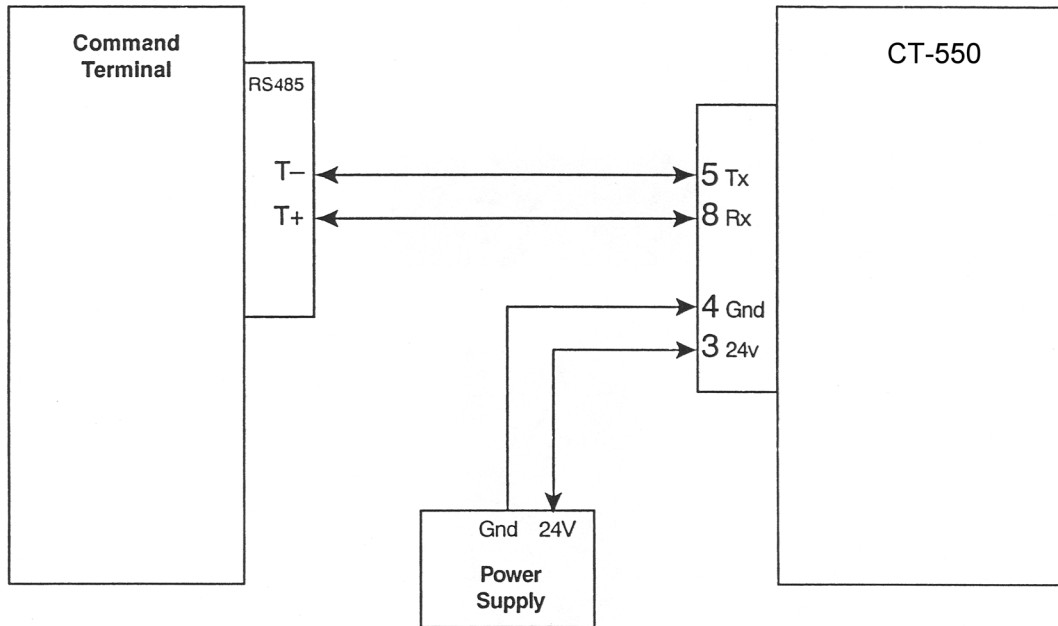


Figure A-2 Recommended Cabling – RS485

485 Address Selection

Each RS485 listener must have a separate address. To select the CT-550 address:

- ❑ Select 0 through 7 on the rotary switch at the side of the CT-550.

Any commands sent to CT-550 must be prefixed with the corresponding address 00 through 07 (See *aa* in Table A-2 on page A-2)

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Appendix B. CT-550 Tube Replacement Procedure

The thermal pressure vacuum sensor is mounted inside the plastic housing and is accessible for changing by opening the housing. Perform this work at an ESD controlled workstation.

Tools required:

- ❑ Phillips head screwdriver, small
- ❑ Allen (hex) wrench, 1/8"

To replace the sensor:

1. Disconnect the D-connector plug from the CT-550.
2. Remove the CT-550 from the vacuum system.
3. Remove three screws holding the cover to the gauge body and lift the cover off.

The screw at the position shown in Figure B-1 is longer than the other two screws and must be returned to the same place when reassembling the cover.

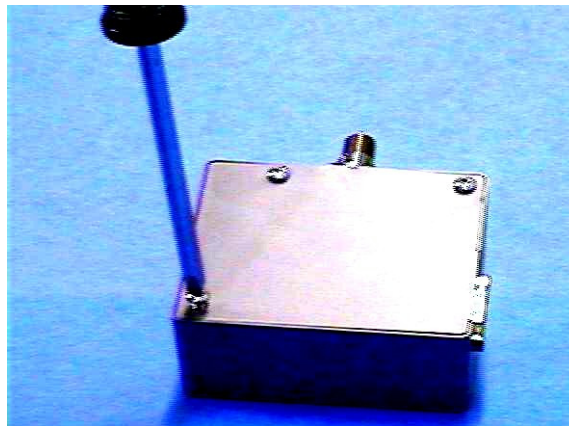


Figure B-1 Location of the Long Screw

4. Locate the Allen (hex) screw at the top, outer end of the sensor body.
Use a 1/8" hex wrench and remove the screw as shown in Figure B-2.

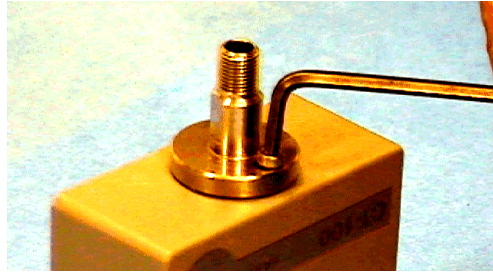


Figure B-2 Location of Allen (hex) Screw

5. Locate and unplug the red plastic connector that attaches the cable from the sensor to the circuit board, as shown in Figure B-3.

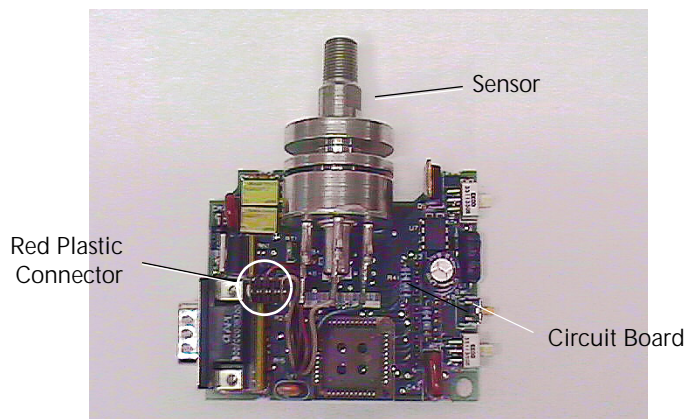


Figure B-3 Red Connector and Sensor

6. Lift the sensor and its attached cable out of the gray plastic cradle.
7. Put the new sensor into the cradle. Be sure to locate the tube and wires as shown in Figure B-4.

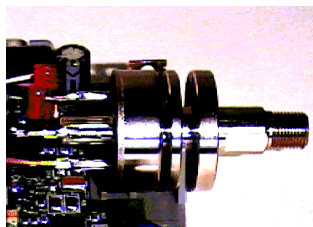


Figure B-4 Sensor in its Cradle

8. Rotate the sensor so the Allen screw anchor hole is at the top of the assembly and is visible through the hole in the cover as shown in Figure B-5.

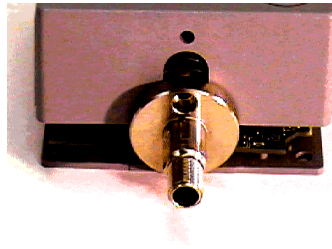


Figure B-5 Positioning the Sensor

9. Insert and finger tighten the Allen screw.
10. Reattach the red connector. The connector is polarized to be inserted in only a specific orientation and with full alignment of plug and socket.

CAUTION



Sensor failure may take place if the connector and plug are not aligned and if any pins are not firmly engaged.

11. Replace the gauge cover and fully tighten the Allen screw.
12. Locate the longer of the cover screws and insert it in the lower left position as shown in Figure B-1 on page B-1 with the vacuum port facing upward.
13. Replace the remaining two screws and replace the gauge in the vacuum system.
14. Calibrate the gauge using the procedure on "CT-550 Calibration" on page 4.

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Please visit our website for individual office information.

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