Agilent Technologies

Vacuum Products Division

CE

RS232C

Serial Interface

CDG-500

Communication Protocol

JEVINSTRUMENTS.COM

Manual No. tqra76e1
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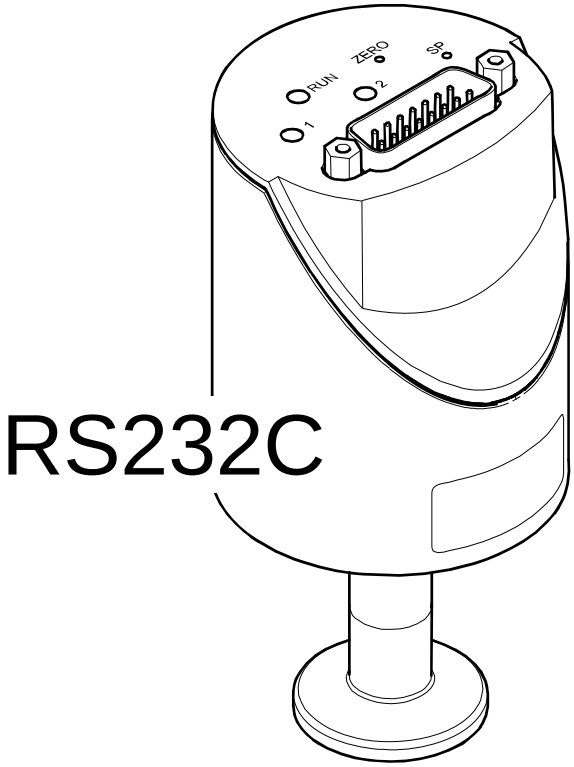
RS232C

Serial Interface

CDG-500

JEVINSTRUMENTS.COM



General Information

The RS232C Serial Interface permits the communication between the digital Agilent Capacitance Diaphragm Gauge and

- an Agilent Vacuum Gauge Controller (AGC-100) or
- another appropriate controller.

The RS232C Serial Interface integrated in the Capacitance Diaphragm Gauge allows to digitally transmit measurement values and information on the gauge status as well as to make parameter settings.

Caution

Caution: data transmission errors

Any attempt to simultaneously operate the gauge via the RS232C Serial Interface and the diagnostic port may result in incorrect data and data transmission errors.

Therefore, it is inadmissible to simultaneously operate the gauge via the RS232C Serial Interface and the diagnostic port.

Functional Principle

The RS232C Serial Interface is used in duplex operation. The gauge continuously (approximately every 20 ms) transmits a nine byte send string without request.

Instructions to the gauge are transmitted via five-byte receipt strings.

Data format

- binary
- 8 data bits
- 1 stop bit
- no parity bit
- no handshake

Transmission rate

- 9600 Baud

Pin assignment

- TxD Pin 13
- RxD Pin 14
- GND Pin 5

  (sensor cable connector)

1 Interface Protocol

1.1 Send String

The complete send string (frame) is nine bytes (byte 0 … 8) long. Bytes 1 … 7 form the data string.

Structure of send string

Byte No.	Function	Value	Comment
0	Data string length	7	Constant value
1	Page No.	2	Constant value for CDG-500
2	Status		→ "Status byte"
3	Error		→ "Error byte"
4	Measured value high byte	<value>	→ "Calculation of pressure value"
5	Measured value low byte	<value>	→ "Calculation of pressure value"
6	Read command	<value>	Read value
7	Sensor type		→ "Sensor type"
8	Checksum		→ "Synchronization"

Status byte
(byte No. 2)

Bit 0		Definition
0		Continuous output of measured value
1		Individual measured value (polling) [1)]

[1)] → 🗎 8, "DataTxMode". Send a read command of any parameter to the gauge for requesting a send string.

Bit 2	Bit 1	Definition
1	0	Manual setpoint setting
1	1	Zero adjust active

Bit 3		Definition
0 ⇔ 1		Toggle bit, changes with every string received correctly

Bit 5	Bit 4	Definition
0	0	Current pressure unit mbar
0	1	Current pressure unit Torr
1	0	Current pressure unit Pa

Bit 6		Definition
0		Standard measurement mode
1		Reserved for internal use

Error byte
(byte No. 3)

Bit No.	Definition
0	RS232 synchronization error
1	Incorrect command, e.g. inadmissible address (syntax error)
2	Inadmissible read command
3	SP1 status
4	SP2 status
5	Not used
6	Not used
7	Extended error set (→ Read command "Extended Error L-Byte and H-Byte")

No bit set → value = 0x00 = no error set

Error handling

Errors are only recorded in the error bytes as long as they persist, except for RS232 interface errors. Errors are not acknowledged.

RS232 errors are signaled by the "toggle bit", i.e. when an RS232 error occurs, the "toggle bit" is not inverted. For checking the status of the "toggle bit", a read operation is required, which also allows to read the error byte for detailed error analysis.

If an "extended error" is set, it has to be read as variable by means of the "read command" (→ table "Variables for bytes No. 2 and 3"). After the read operation, the variable is automatically erased.

Calculation of pressure value

The pressure is calculated from bytes 4 and 5 of the send string (decimal presentation).

Conversion formula (byte No. 4 and 5)

$$p = \frac{<\text{pressure\_value}> \times a}{32000} \times \text{F.S.R.\_Mantissa} \times 10^{(\text{F.S.R.\_Exp})}$$

Parameter	Description
p	Pressure value in selected pressure unit (→ Parameter a)
<pressure_value>	Pressure measurement data, composed of "low and high byte" (16 bit value) and converted into decimal format
F.S.R._Mantissa	F.S.R. factor according to "Sensor type" variable, which has to be read separately (→ "Read command")
F.S.R._Exp	F.S.R. exponent according to "Sensor type" variable, which has to be read separately (→ "Read command")
a	Conversion factor for pressure units other than "Torr". Torr: a = 1.00 mbar: a = 1.3332 Pa: a = 133.32

Read command (byte No. 6)

All variables in a receipt string that are addressed for reading are output on this byte. For variable types >1 byte, each byte (e.g. low, high, or further bytes) has to be addressed and read individually.

Read Command L-Byte → Read Data L-Byte
Read Command H-Byte → Read Data H-Byte

- After a write operation, the value of the addressed variable is output.
- After a reset (Power on) the software version is output on byte 6.

Sensor type (byte No. 7)

Bit No. 0 … 3	Description	Comment
0x0	F.S.R.= 10^{-3}	→ Variable "Sensor_pressure_range"
0x1	F.S.R.= 10^{-2}	F.S.R._Exponent = (<value> -3)
0x2	F.S.R.= 10^{-1}	
0x3	F.S.R.= 10^{0} = 1	
0x4	F.S.R.= 10^{1} = 10	
0x5	F.S.R.= 10^{2} = 100	
0x6	F.S.R.= 10^{3} = 1000	
0x7	F.S.R.= 10^{4} = 10000	

Bit No. 4 … 7	Description	Comment
0x0	F.S.R._Mantissa = 1.0	→ Variable "Sensor_FSR"
0x1	F.S.R._Mantissa = 1.1	
0x2	F.S.R._Mantissa = 2.0	
0x3	F.S.R._Mantissa = 2.5	
0x4	F.S.R._Mantissa = 5.0	

Checksum and synchronization (byte No. 8)

The recipient (master) is synchronized by checking three bytes:

Byte No.	Function	Value	Comment
0	Data string length	7	Constant value
1	Page No.	2	Constant value for CDG-500
8	Checksum of bytes No. 1 … 7	0 … 255	Low byte of checksum [1)]

[1)] Possible high bytes are ignored

Example

The example is based on the following output string:

Byte No.	0	1	2	3	4	5	6	7	8
Value	7	2	16	0	125	0	20	6	69

The instrument or controller (receiver) interprets this string as follows:

Byte No.	Function	Value	Comment
0	Length of datastring	7	(Set value)
1	Page No.	2	CDG-500
2	Status	16	Pressure unit = Torr
3	Error	0	No Error
4 5	Measurement High byte Low byte	 125 0	Calculation of pressure value: Conversion formula → 🗎 5
6	Read command	20	Software version = 20 / 20 = 1.0
7	Sensor type	6	F.S.R.= 10^{+3}
8	Check sum	169	2 + 16 + 0 + 125 + 0 + 20 + 6 = 169_{dec} ≙ 00 $A9_{hex}$ High order byte is ignored ⇒ Check sum = $A9_{hex}$ ≙ 169_{dec}

1.2 Receipt String

Commands to the gauge are transmitted in receipt strings (frames) consisting of five bytes (without <CR>). The data string is formed by bytes 1 … 3.

Structure of receipt string

Byte No.	Designation	Value	
0	Data string length	3	(constant value)
1	Data		→ "Service command"
2	Data		→ "Address byte"
3	Data		→ "Data byte"
4	Checksum of bytes No. 1 … 3	<value>	Low byte of checksum [1)]

[1)] Possible high bytes are ignored.

- The operation selected in byte No. 1 is addressed in byte No. 2.
- Variables are transmitted in byte No. 3. Variables >1 byte have to be transmitted in several receipt strings (splitting).

Service command (byte No. 1)

Description	Data	Comment
Read command	0x00	Read command for variable according to address in byte No. 2
Write command	0x10	Write command for variable according to address in byte No. 2
Special services	0x40	Direct command (write command) without data information, e.g. Reset, Zero adjust

Address byte (byte No. 2)

Enter the address of the variable to be read/written (→ table "Variables for bytes No. 2 and 3").

Data byte (byte No. 3)

When a variable is written (receipt string) the content of byte No. 3 is written to the variable addressed in byte No. 2 (→ table "Variables for bytes No. 2 and 3").

When a variable is read (send string), the value of the variable addressed in byte No. 2 is output in byte No. 6 of the send string. The content of byte No. 3 is not relevant for read operations.

Checksum (byte No. 4)

The checksum is calculated from the sum of byte No. 1 to 3.

Example

Das Beispiel basiert auf dem Empfangsstring:

Byte No.	0	1	2	3	4
Value	3	0	2	0	2

The instrument or controller (receiver) interprets this string as follows:

Byte No.	Designation	Value	Comment
0	Data string length	3	(constant value)
1	Service command	0	Read command
2	Address byte	2	Filter
3	Data byte	0	
4	Checksum	2	$0 + 2 + 0 = 2_{dec} \triangleq 00\ 02_{hex}$ High bytes are ignored ⇒ Checksum = $02_{hex} \triangleq 2_{dec}$

Variables for bytes No. 2 and 3
(read/write command)

Parameter name	Data type	Description	Byte No. 2	Byte No. 3	Comment
DataTxMode	uint8_T / RW		0	0 [1)]	Continued output of measured value
				1	Individual output of measured value (polling)
Unit	uint8_T / RW		1	0	Pressure unit "mbar"
				1 [1)]	Pressure unit "Torr"
Filter	uint8_T / RW		2	0 [1)]	Filter dynamic
				1	Filter time fast
				2	Filter time slow
SP1 Level Low	sint16_T / RW	H-Byte	4	<value>	Lower setpoint threshold SP1 [2)]
		L-Byte	5	<value>	
SP2 Level Low	sint16_T / RW	H-Byte	6	<value>	Lower setpoint threshold SP2 [2)]
		L-Byte	7	<value>	
SP1 Level High	sint16_T / RW	H-Byte	8	<value>	Upper setpoint threshold SP1 (hysteresis) [2)]
		L-Byte	9	<value>	
SP2 Level High	sint16_T / RW	H-Byte	10	<value>	Upper setpoint threshold SP2 (hysteresis) [2)]
		L-Byte	11	<value>	
Software version	uint8_T / Ro		16	<value>	(<value> / 20) = Software Version e.g. 20 = V1.0
Calib date	uint32_T / Ro	MSB	17	<value>	Date: YY,MM,DD,HH,MM
		Byte 2	18	<value>	e.g. 0410291109 =
		Byte 1	19	<value>	2004-10-29 at 11:09
		LSB	20	<value>	
Zero_Adjust_Value	sint16_T / RW	H-Byte	21	<value>	Zero Offset Adjust Level [3)]
		L-Byte	22	<value>	
DC Output Offset	sint16_T / RW	H-Byte	23	<value>	Customer DC Output Offset [3)]
		L-Byte	24	<value>	(Base pressure offset)
Production No.	uint8_T / Ro	Byte 0	25	<value>	Production number as ASCII string (barcode)
	uint8_T / Ro	Byte 1	26	<value>	(Max. 16 byte)
	uint8_T / Ro	…	…	...	
	uint8_T / Ro	Byte 15	40	<value>	(Last digit: null terminator)
Software date Year	uint16_T / Ro	H-Byte	212	<value>	Software version date Year in Hex e.g. 0x2007 = 2007
		L-Byte	213	<value>	
Software date M/D	Uint16_T / Ro	H-Byte	214	<value>	Software version date Month in Hex e.g. 0x03 = March
		L-Byte	215	<value>	Software version date Day in Hex e.g. 0x19 = 19
Part No.	uint8_T / Ro	Byte 0	218	<value>	Part number as ASCII string
	uint8_T / Ro	Byte 1	219	<value>	(Max 20 byte)
	uint8_T / Ro	…	…	<value>	e.g. 378-000
	uint8_T / Ro	Byte 19	237	<value>	(Last digit: null terminator)
Remaining_Zero	sint16_T / Ro	H-Byte	72	<value>	Max. remaining offset value
		L-Byte	73	<value>	

(continued)

(completed)

Parameter name	Data type	Description	Byte No. 2	Byte No. 3	Comment
Extended error H-Byte	uint8_T / Ro	H-Byte	54	Bit 0	PT1000 fault [4]
				Bit 1	Heater block overtemp. [4]
				Bit 2	Electronic overtemp. [4]
				Bit 3	Zero adjust error
				Bit 4	Reserve
				Bit 5	Reserve
				Bit 6	Reserve
				Bit 7	Reserve
Extended error L-Byte	uint8_T / Ro	L-Byte	55	Bit 0	Atm. pressure out of range
				Bit 1	Temperature out of range
				Bit 2	Reserve
				Bit 3	Reserve
				Bit 4	Cal. mode wrong
				Bit 5	Pressure underflow
				Bit 6	Pressure overflow
				Bit 7	Zero adjust warning
Pressure range (Exponent)	uint8_T / Ro		56	0	F.S.R. = E-3
				1	F.S.R. = E-2
				2	F.S.R. = E-1
				3	F.S.R. = E 0
				4	F.S.R. = E+1
				5	F.S.R. = E+2
				6	F.S.R. = E+3
				7	F.S.R. = E+4
Pressure range (Mantissa)	uint8_T / Ro		57	0	Mantissa = 1.0
				1	Mantissa = 1.1
				2	Mantissa = 2.0
				3	Mantissa = 2.5
				4	Mantissa = 5.0
Gauge config	uint8_T / Ro		58	0	= Analog out 0 ... 10.24 V
				1	= Analog out 1 ... 9 V
CDG type	uint8_T / Ro		59	0	= CDG-500

RW = Read / Write Ro = Read only

[1] Factory setting

[2] Conversion → Section 1.1, byte 6 "Read command"

[3] Conversion → Section 1.1, bytes 4 and 5 "Pressure unit"

Variables for bytes No. 2 and 3
(special services)

Parameter name	Data type	Description	Byte No. 2	Byte No. 3	Comment
RESET	uint8_T / W		0	0	Power reset: Starts continuous pressure output
RESET Factory	uint8_T / W		1	0	Factory reset: Sets factory configuration
Zero_adjust	uint8_T / W		2	–	Starts zero offset adjustment

W = Write

Description of variables

Setpoint_level xy

$$\text{Setpoint\_level xy} = \frac{\text{<data\_value>×a}}{32000} \times \text{F.S.R.\_Mantisse} \times 10^{(\text{F.S.R.\_Exp})}$$

Parameter [1]	Description
Setpoint_level xy	Setpoint threshold in the selected pressure unit.

[1] Further parameter → 11, table "Parameter"

- **Minimum value** lower switching threshold = 0 ; negative values are not admissible.
- **Maximum value** lower switching threshold = F.S.R. – 1 % hysteresis.

Zero_Adjust_Value

Zero_Adjust_Value contains the zero pressure offset value required for zeroing (writable and readable).

- Automatic zero_adjust function via key or command (→ table "Variables for bytes No. 2 and 3 (special services)").
- Base-Pressure-Adjust for adjusting a defined zero offset, e.g. if the required final pressure as indicated in the operating manual is not reached.

The Zero_Adjust_Value consists of the high and low byte and has to be converted with the "Pressure value" formula (→ 5).

$$\text{Zero\_Adjust\_Value} = \frac{\text{<data\_value>×a}}{32000} \times \text{F.S.R.\_Mantisse} \times 10^{(\text{F.S.R.\_Exp})}$$

Parameter [1]	Description
Zero_Adjust_Value	Zero pressure offset in the selected pressure unit (→ 11, table "Parameter").

[1] Further parameter → 11, table "Parameter"

Remaining_Zero

Maximal remaining offset value. The Zero_Adjust can only be executed within this value.

DC Output Level

The "DC Output Level" variable is used for assigning a defined offset level to the analog output signal, e.g. for setting a certain zero offset signal level.

A "DC Output Level" >0 reduces the output range of the measurement range 0 … 10 V by the selected offset value (F.S.R. - DC output level).

The "DC Output Level" parameter (16-Bit) consists of the high and low byte.

$$\text{DC Output Level} = \frac{\text{<data\_value>} \times a}{32000} \times \text{F.S.R.\_Mantisse} \times 10^{(\text{F.S.R.\_Exp})}$$

Parameter [1]	Description
DC Output Level	DC-Output-Signal in the selected pressure unit (→ 11, table "Parameter").

[1] Further parameter → 11, table "Parameter"

Software version

$$\text{Software version} = \frac{\text{<data\_value>}}{20}$$ e.g. <data_value> = 20 ≙ V1.0

Parameter	Description
<data_value>	1 byte value (8 bit), data value in decimal format.

Parameter

Parameter	Description
<data_value>	Zero offset measurement data, consisting of "low and high byte" (16 bit value), data value in decimal format.
a	Conversion factor for pressure units other than "Torr" Torr: a = 1.00 mbar: a = 1.3332 Pa: a = 133.32
F.S.R._Mantisse	F.S.R. factor according to the "Sensor type" variable, which has to be read separately (→ "Read command").
F.S.R._Exp	F.S.R. exponent according to "Sensor type" variable, which has to be read separately (→ "Read command").

Notes

Vacuum Products Division
Instructions for returning products

Dear Customer:

Please follow these instructions whenever one of our products needs to be returned.

1) Complete the attached Request for Return form and send it to Agilent Technologies (see below), taking particular care to identify all products that have pumped or been exposed to any toxic or hazardous materials.

2) After evaluating the information, Agilent Technologies will provide you with a Return Authorization (RA) number via email or fax, as requested.
Note: Depending on the type of return, a Purchase Order may be required at the time the Request for Return is submitted. We will quote any necessary services (evaluation, repair, special cleaning, eg).

3) Important steps for the shipment of returning product:
   - Remove all accessories from the core product (e.g. inlet screens, vent valves).
   - Prior to shipment, drain any oils or other liquids, purge or flush all gasses, and wipe off any excess residue.
   - If ordering an Advance Exchange product, please use the packaging from the Advance Exchange to return the defective product.
   - Seal the product in a plastic bag, and package product carefully to avoid damage in transit. You are responsible for loss or damage in transit.
   - Agilent Technologies is not responsible for returning customer provided packaging or containers.
   - Clearly label package with RA number. Using the shipping label provided will ensure the proper address and RA number are on the package. Packages shipped to Agilent without a RA clearly written on the outside cannot be accepted and will be returned.

4) Return only products for which the RA was issued.

5) Product being returned under a RA must be received within 15 business days.

6) Ship to the location specified on the printable label, which will be sent, along with the RA number, as soon as we have received all of the required information. Customer is responsible for freight charges on returning product.

7) Return shipments must comply with all applicable Shipping Regulations (IATA, DOT, etc.) and carrier requirements.

RETURN THE COMPLETED REQUEST FOR RETURN FORM TO YOUR NEAREST LOCATION:

EUROPE:	NORTH AMERICA:	PACIFIC RIM:
Fax: 00 39 011 9979 330		
Fax Free: 00 800 345 345 00	Fax: 1 781 860 9252	please visit our website for individual office information
Toll Free: 00 800 234 234 00	Toll Free: 800 882 7426, Option 3	
vpt-customercare@agilent.com	vpl-ra@agilent.com	http://www.agilent.com

Agilent Technologies

Vacuum Products Division
Request for Return Form
(Health and Safety Certification)

Please read important policy information on Page 3 that applies to all returns.

1) CUSTOMER INFORMATION

Company Name:	**Contact Name:**
Tel: **Email:**	**Fax:**
Customer Ship To:	**Customer Bill To:**
Europe only: **VAT reg. Number:**	USA/Canada only: ☐ **Taxable** ☐ **Non-taxable**

2) PRODUCT IDENTIFICATION

Product Description	Agilent P/N	Agilent S/N	Original Purchasing Reference

3) TYPE OF RETURN (Choose one from each row and supply Purchase Order if requesting a billable service)

3A. ☐ Non-Billable ☐ Billable ➡ New PO # (hard copy must be submitted with this form):

3B. ☐ Exchange ☐ Repair ☐ Upgrade ☐ Consignment/Demo ☐ Calibration ☐ Evaluation ☐ Return for Credit

4) HEALTH and SAFETY CERTIFICATION

AGILENT TECHNOLOGIES CANNOT ACCEPT ANY PRODUCTS CONTAMINATED WITH BIOLOGICAL OR EXPLOSIVE HAZARDS, RADIOACTIVE MATERIAL, OR MERCURY AT ITS FACILITY.
Call Agilent Technologies to discuss alternatives if this requirement presents a problem.

The equipment listed above (check one):

☐ **HAS NOT** pumped or been exposed to any toxic or hazardous materials. OR

☐ HAS pumped or been exposed to the following toxic or hazardous materials. If this box is checked, the following information must also be filled out. Check boxes for all materials to which product(s) pumped or was exposed:

☐ Toxic ☐ Corrosive ☐ Reactive ☐ Flammable ☐ Explosive ☐ Biological ☐ Radioactive

List all toxic/hazardous materials. Include product name, chemical name, and chemical symbol or formula:

_____

NOTE: If a product is received at Agilent which is contaminated with a toxic or hazardous material that was not disclosed, the customer will be held responsible for all costs incurred to ensure the safe handling of the product, and is liable for any harm or injury to Agilent employees as well as to any third party occurring as a result of exposure to toxic or hazardous materials present in the product.

Print Name: **Authorized Signature:** ..... **Date:**

5) FAILURE INFORMATION:

Failure Mode (REQUIRED FIELD. See next page for suggestions of failure terms):
Detailed Description of Malfunction: (Please provide the error message)
Application (system and model):

I understand and agree to the terms of Section 6, Page 3/3.
Print Name: **Authorized Signature:** ..... **Date:**

Agilent Technologies

Vacuum Products Division
Request for Return Form
(Health and Safety Certification)

Please use these Failure Mode to describe the concern about the product on Page 2.

TURBO PUMPS and TURBO CONTROLLERS

APPARENT DEFECT/MALFUNCTION		POSITION	PARAMETERS	
- Does not start	- Noise	- Vertical	Power:	Rotational Speed:
- Does not spin freely	- Vibrations	-Horizontal	Current:	Inlet Pressure:
- Does not reach full speed	-Leak	-Upside-down	Temp 1:	Foreline Pressure:
- Mechanical Contact	-Overtemperature	-Other:	Temp 2:	Purge flow:
- Cooling defective	-Clogging	_____	OPERATING TIME:	

ION PUMPS/CONTROLLERS

- Bad feedthrough	- Poor vacuum
- Vacuum leak	- High voltage problem
- Error code on display	- Other

VALVES/COMPONENTS

- Main seal leak	- Bellows leak
- Solenoid failure	- Damaged flange
- Damaged sealing area	-Other

LEAK DETECTORS

- Cannot calibrate	-No zero/high backround
- Vacuum system unstable	- Cannot reach test mode
- Failed to start	- Other

INSTRUMENTS

- Gauge tube not working	- Display problem
- Communication failure	- Degas not working
- Error code on display	- Other

SCROLL AND ROTARY VANE PUMPS

- Pump doesn't start	- Noisy pump (describe)
- Doesn't reach vacuum	- Over temperature
- Pump seized	- Other

DIFFUSION PUMPS

- Heater failure	- Electrical problem
- Doesn't reach vacuum	- Cooling coil damage
- Vacuum leak	- Other

Section 6) *ADDITIONAL TERMS*

Please read the terms and conditions below as they apply to all returns and are in addition to the Agilent Technologies Vacuum Product Division – Products and Services Terms of Sale.

- Customer is responsible for the freight charges for the returning product. Return shipments must comply with all applicable Shipping Regulations (IATA, DOT, etc.) and carrier requirements.
- Customers receiving an Advance Exchange product agree to return the defective, rebuildable part to Agilent Technologies **within 15 business days.** Failure to do so, or returning a non-rebuildable part (crashed), will result in an invoice for the non-returned/non-rebuildable part.
- Returns for credit toward the purchase of new or refurbished Products are subject to prior Agilent approval and may incur a restocking fee. Please reference the original purchase order number.
- Units returned for evaluation will be evaluated, and a quote for repair will be issued. If you choose to have the unit repaired, the cost of the evaluation will be deducted from the final repair pricing. A Purchase Order for the final repair price should be issued within 3 weeks of quotation date. Units without a Purchase Order for repair will be returned to the customer, and the evaluation fee will be invoiced.
- A Special Cleaning fee will apply to all exposed products per Section 4 of this document.
- If requesting a calibration service, units must be functionally capable of being calibrated.

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