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Model RGC-100 Series Digital Vacuum Gauge

RGC-100 Ranges
.001 to 760 Torr
.001 to 991 millibar

*INSTALLATION AND
OPERATION MANUAL*

Manual No. RGC100M
Revision A
May 2010



Varian Model RGC-100 Series Digital Vacuum Gauge

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.

Warranty Replacement and Adjustment

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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Contents

Description and Principle Of Operation.....	1
Construction.....	1
Unpacking and Inspection.....	2
Installation.....	2
Operation.....	4
Servicing and Maintenance.....	6
Gauge Tube Servicing.....	6
Maintenance.....	6
Factory Repair and Calibration.....	6
Field Calibration.....	6
Notes on Calibration.....	7
Understanding Torr.....	8
Accessories and Modifications.....	9
Special Requirements.....	9
Specifications.....	9

Model RGC-100 Series Digital Vacuum Gauge

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VARIAN

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

We
Wir
Nous
Nosotros
Wij
Noi

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declare under our sole responsibility that the product,
erklären, in alleniniger Verantwortung, daß dieses Produkt,
déclarons sous notre seule responsabilité que le produit,
declaramos, bajo nuestra sola responsabilidad, que el producto,
verklaren onder onze verantwoordelijkheid, dat het product,
dichiariamo sotto nostra unica responsabilità, che il prodotto,

Model RGC-100 Series Digital Vacuum Gauge

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) beantwoordt.
a cui se riferisce questa dichiarazione è conforme alla/e sequente/l norma/o documento/l 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 61000-3-2 (2006) Limits for harmonic current emissions (equipment input current up to and including 16A per phase).
- EN 61000-3-3 (2005) Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current up to and including 16A.
- EN 61326 (1997/A1; 1998/A2; 2001/A3) EMC requirements for Electrical equipment for measurement, control and laboratory use — General Use.
- EN 61326 (1997/A1; 1998/A2; 2001/A3) EMC requirements for Electrical equipment for measurement, control and laboratory use
- EN 61000 - 4-2 (2001) Electrostatic Discharge Immunity
- EN 61000 - 4-4 (2004) Electrical Fast Transient Immunity
- EN 61000 - 4-5 (2005) AC Lightning Surge Immunity

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

May 27, 2010



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. Board installation/replacement requires a properly trained service technician.

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.

Description and Principle Of Operation

The VARIAN RGC-100 series gauge is a compact digital vacuum sensing instrument. It uses a thermocouple gauge tube to sense vacuum and display the reading in either milliTorr or mbar. The Varian Model RGC-100 can be panel mounted using the same cutout and hole mounting pattern of a traditional Varian 801 pointer meter gauge.

Consult the Varian website www.Varianinc.com for information about other Varian vacuum controllers and gauges.

The Varian Model RGC-100 operates by measuring the temperature rise of an electrically heated thermocouple exposed to a vacuum. As vacuum increases, or more correctly, as absolute pressure decreases, fewer and fewer molecules of gas are available to cool the thermocouple. With fewer molecules in the vacuum space, the air temperature rises and the thermocouple gauge thus senses the vacuum. A precision reference inside the Varian in conjunction with an integrated circuit amplifier controls the electrical excitation of the sensor filament. The voltage response of the thermocouple is piped through a CPU and is translated to the current vacuum reading.

Construction

The RGC-100 consists of the indicating and controlling instrument, the gauge tube, the gauge tube cable, AC power supply, and if so equipped also has interfaces for the two control connections, analog out, and RS232.

The gauge tube houses the various thermocouple sensing, heating and compensating elements and terminates in an octal connector. On this model, the connector wiring terminates at the instrument with a 6 position RJ24. Regulating circuitry in the Varian provides proper current for gauge tube excitation, and thus compensates for resistance in the probe leads.

Unpacking and Inspection

After the VARIAN RGC-100 is received, carefully unpack and inspect it for damage during shipment and for completeness. In the event of a loss during shipment, immediately make a claim to the common carrier or the postal service, as applicable. The Varian warranty pertains only to the instrument, and does not cover losses in shipping.

Each RGC-100 comes with:

- Display controller
- AC Power supply with wire leads
- Gauge Tube Cable
- Varian 531 gauge tube
- Mounting Hardware

If ordered with additional options, it also comes with:

- AC power supply with international adapters (instead of above)
- 5V5T analog recorder terminal connector
- RS232 DB9 connector
- Terminal connector for U and L relays

Installation

Locate the instrument in a clean, dry environment for best results. The unit can be panel mounted with the hardware provided:

1. Remove the front panel of the gauge, leaving the aluminum spacers on the gauge printed circuit board.
2. Make a 2.66" circular mounting hole in the panel at the desired location.
3. Make 3 or 4 holes, 5/32" diameter (clearance holes for #4 screws) on a 1.58 radius from the center of the mounting hole. (The front panel that comes with the gauge can be used as a template.)
4. Reassemble the gauge, with the plastic panel outside, and the gauge behind.

Identify the gauge tube cable by wire tags or markings specific to your environment.

Model RGC-100 Series Digital Vacuum Gauge

Thermocouple gauge tubes must be installed in a thread-down orientation in a clean, dry vacuum system. While threading the gauge tube in to the manifold, disconnect the gauge tube cable to avoid damage. In this way, twisting of the cable and the octal socket on the tube is avoided. Exercise care to install the tubes in a dry part of the system. Since the instrument works on the principle of temperature rise, the probes will not work if they become filled with a liquid such as vacuum or diffusion pump oil. Protect the gauge tube against oil and other contaminants by installing it in such a way to protect it. A good practice is to mount the gauge tube in the most vertically distant place from oil and other contaminants as applicable. Mount the gauge tube in the most stable pressure region of the vessel to be measured. For example, it would be better to install the gauge tube on a tank rather than on the pipe that is directly connected to a vacuum pump. In the event of contamination, see section 6.0 for gauge tube cleaning instructions.

If the gauge is used in a Neon sign processing facility, the following is recommended to protect the gauge from bombarding damage:

- ❑ Isolate the gauge tube from the system with a stopcock. Close the stopcock closed when bombarding.
- ❑ There must be at least two (2) feet of tubing between the electrode and the Instrument. For best results, use metal tubing.
- ❑ In extreme cases, the gauge can be absolutely protected by installing a normally open solenoid valve between the gauge tube and the system. Ensure the solenoid valve coil is in parallel with the bombarding transformer. In this way, the solenoid is closed and the gauge tube is positively protected whenever bombarding is done.
- ❑ If a gauge is damaged by bombarding, it can generally be brought back to operating condition by replacing the Op amp which controls the gauge tube current. Consult Varian.

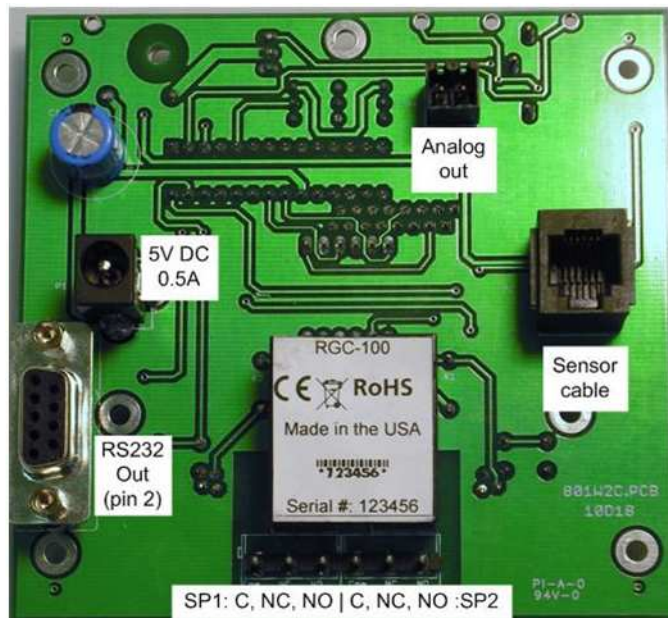


Figure 1 Card Interface Connections

Model RGC-100 Series Digital Vacuum Gauge

The set point connections are in the back of the unit. There is one row of pins with a terminal strip connector for the two (2) set point connections. The set point connections are in the order:

1. Common The common line of a switch.
2. N.C. Normally closed. This means that above the set point value there is a current path between the common and the N.C. terminal. Put another way the switch is *ON* between these 2 terminals. At the set point value and below (higher vacuum, lower pressure) the connection is open. Put another way, the switch is *OFF* between the common and the N.C. connection at higher vacuum (a lower pressure reading).
3. N.O. Normally open. This means that above the set point value there is no current path between the common and N.O. connection. Put another way the switch is *OFF* between these 2 terminals. When the vacuum indication goes below the set point value (higher vacuum, lower pressure) the current path closes. Put another way the switch is *ON* between the common and N.O. connections at absolute pressure readings below the set point value.

Take care to insure that the wire connections are made fast, and the voltage and current does not exceed 250V or 7A. If you need to control a device that draws more power, consider another relay in between the unit output and the device to be controlled

The Analog output is located in the center of the back panel, and must be connected to a high impedance input. The output impedance is 1K.

The RS232 connection can be made to a PLC or computer via a male DB9 cable connection to the female DB9 connection on the unit. The Varian acts as a DCE, so a straight serial connection is appropriate.

Use the supplied 5V AC adapter with your Instrument. This adapter provides clean short protected power to protect and insure proper functioning of the internal circuitry.

Operation

After installation, the Instrument is ready for immediate operation. The unit normally provides accurate readings immediately however, occasionally a gauge tube absorbs material during storage, and may require as much as 24 hours of operation before accurate readings are attained. It is recommended that the VARIAN AGC-100 be energized continuously during vacuum system operation. In this way, the hot filament does not allow contaminants to condense.

In cases where the system has contaminants, as is often the case with metalizing and coating equipment, it is often effective to isolate the gauge tube with a solenoid or manual valve during periods when contamination is most active.

Model RGC-100 Series Digital Vacuum Gauge

The Varian RGC-100 has two set points to actuate external equipment. These two set points can be adjusted from the front of the gauge in your currently selected units:

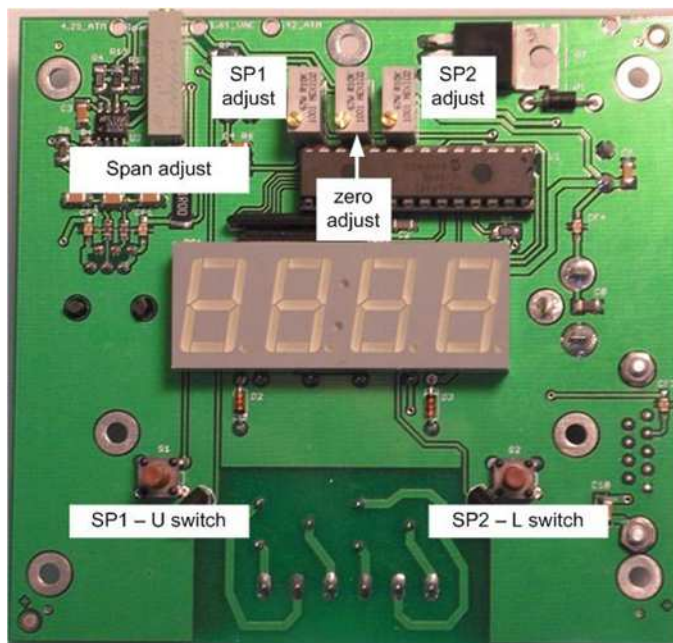


Figure 2 Card Adjustment Buttons

1. Change SP1 by:
 - a. Pressing the **U** button (Figure 2) - set point 1 appears.
 - b. Turning the *SP1* or the left most potentiometer when looking at the front face of the RGC-100 to adjust set point 1 to the desired level.
2. Change SP2 by:
 - a. Pressing the **L** button- set point 2 appears.
 - b. Turning the *SP2* or the right most potentiometer when looking at the front face of the RGC-100 to adjust set point 2 to the desired level.
3. If you don't want the set points to actuate at all, set the set point for *000*.

The instrument has additional outputs:

RS232

The instrument puts out a standard RS232 serial stream with settings 9600, 8, N, and 1. The unit transmits but does not receive, and displays the current vacuum indication in the current units.

Analog out

This output reads from 0 to 5 Volts from a pressure of 1 micron all the way up to 5 Torr. There is a graduation of 1 millivolt per milliTorr. Therefore, 10 millivolts = 10 milliTorr, and 4 Volts = 4 Torr.

Servicing and Maintenance

Gauge Tube Servicing

In many cases, a gauge tube may become fouled with oil or other foreign matter. It is often possible to restore the functionality of contaminated probes with cleaning. If the contaminant is known, fill the tube with a fluid that is known to be a solvent to that contaminant. As an example, ether is often effective in removing residues of some oils. Commercial carburetor cleaners are very powerful solvents and are highly effective against some contaminants.

After cleaning with solvents, completely dry or flush the gauge tube with a volatile solvent to assure that it is dry prior to re-installing it. If this is not done, contamination of the system may result.

Maintenance

Your vacuum instrument should give you many years of trouble free service. There are no regularly scheduled maintenance intervals. If consistent accuracy is required, it is recommended that the gauge, tube, cable and power supply be returned for a yearly calibration check.

Factory Repair and Calibration

The vacuum gauge assembly is designed to provide years of trouble-free service, and the liberal internal use of plug-in components make it easily repairable. No field servicing of the unit is recommended, other than replacement of the gauge tube, but factory servicing and calibration are available at a nominal cost and fast turn-around times.

Field Calibration

Each Varian vacuum gauge controller is calibrated to the particular vacuum gauge sensor that is shipped with the unit. While changing the gauge tube is possible, it results in a slightly different reading as all gauge tubes are not created equal. Although it is preferable that all calibration be performed at Varian, field calibration can be accomplished.

Before re-calibrating the instrument, ascertain if the instrument is in fact incorrect. In many cases, the problem is with a fouled tube, or a system that is operating improperly. It is recommended that a spare tube be kept on hand and stored in a clean, dry place. Then, in cases of suspect readings, change the tube before proceeding further.

If adjustments are to be made, proceed as follows:

1. Remove the instrument from the panel.

The *Zero* potentiometer is at the top center just below the top mounting hole as you look at the LED Display, the *ATM* or span adjust is to the left on the back of the board on the same side as the sensor RJ connector.

Model RGC-100 Series Digital Vacuum Gauge

2. Operate the vacuum system at the lowest attainable pressure, and allow the system and the gauge tube to stabilize for several minutes. Factory zero setting is done at a pressure of .1 milli Torr (.1 micron) or less.
3. Adjust the zero setting potentiometer so the unit reads zero. Make sure not to under span. Allow the measurement standard to rise to 1 milli Torr and make sure the gauge reading also reads 1 milli Torr.
4. Check the operation of the gauge at other pressures. Normally, slight adjustments of the zero will not be interactive with the readings of the instrument at higher pressures.

The ATM adjustment is normally not necessary. If necessary, adjust the span with the ATM potentiometer:

1. Set the vacuum level to Atmosphere (approximately 760 Torr) and slowly turn the potentiometer on the right until the Varian gauge reads 760 Torr, being careful not to over span.
2. If you adjust the span, recheck the zero, then the span, and the zero one last time.

Notes on Calibration

The instrument is calibrated in nitrogen, which has thermal properties virtually identical to air. Other gasses affect the readings by an amount proportional to the thermal conductivity of the gases. In most cases, the gases present in a vacuum system are air, nitrogen, or oxygen, and no appreciable errors occur.

Certain other gases, however, have thermal conductivity significantly greater than air and cause the instrument to read higher than the actual amount of pressure. Examples of such gasses are water vapor, fluorocarbon refrigerants, and acetone. Conversely, other gasses have thermal conductivity significantly lower than air and cause the instrument to read lower than actual pressure. Examples of such gasses include helium, oxygen and to a lesser extent, CO₂.

When interpreting readings using gasses other than air, remember that the Varian AGC-100 reads Torr, which is a measure of absolute pressure - that is the opposite of vacuum. Thus, a lower numerical reading actually is a higher level of vacuum. For more information, refer to "Understanding Torr" on page 8. When in doubt, consult Varian.

Understanding Torr

The VARIAN AGC-100 and many similar instruments are calibrated in microns or *milliTorr*. It is appropriate to discuss what microns are and to relate microns to other measures of pressure and vacuum. Microns are not really a measure of vacuum at all, but rather of absolute pressure. The pressure of the atmosphere is 14.696 or approximately 14.7 pounds per square inch at sea level. This pressure is due to the weight of all of the air in the earth's atmosphere above any particular square inch. This 14.696 psi is equivalent to the pressure produced by a mercury column of approximately 29.92 inches high or .76 meters (about 3/4 of a yard) or 760 millimeters of mercury. Atmospheric pressure varies greatly with altitude. It decreases approximately 1 inch of mercury per thousand feet of altitude. It also varies widely with local weather conditions. (Variations of one half inch in a single day are common.) The word vacuum means pressure lower than atmospheric or *suction*, but, in describing negative pressure, the atmosphere is only a satisfactory reference if we are dealing with values of vacuum down to about 27 inches of mercury. Below that, it is much more useful to talk in terms of absolute pressure, starting from absolute zero. The RGC-150 and all similar instruments do just this.

One TORR, a commonly used unit, is an absolute pressure of one millimeter of mercury. A milliTorr is equal to one thousandth of a TORR. A MICRON is the same as a milliTorr.

Accessories and Modifications

Consult the product guide and website for the latest available accessories. We also offer analog output, RS232 and two (2) set point controls as production options to the RGC-100.

Special Requirements

It is the policy of the Varian Company to customize instruments for specialized requirements whenever it is economically feasible to do so. We encourage inquiries about your special needs.

Specifications

Table 2-1 Specifications

Specification	Definition
Input Voltage	0.5 A at 5 VDC
Maximum Relay Voltage and Current	250 VAC at 7 Amps
Recommended wire gauge for analog and set point wiring	14-28 AWG
Maintenance Interval	1-10 years depending on use
Overall Dimensions	4.0 in wide, 3.5 in high, 5.65 in deep
Panel Cutout Dimensions	2.66 inch diameter cutout
Ambient Operating range	0°C to 70°C
Measurement Media	Clean Dry Air or Nitrogen

CAUTION



There may be impairment to the protection of the equipment if it is used in a manner that is not specified.

Table 2-2 Instrument Accuracy

Range	Accuracy
.001 to .010 Torr	+/- .001 Torr
.010 to 2.00 Torr	+/- 15% of reading
2.0 to 160 Torr	+/- 50% of reading
160 to 760 Torr	+/- 25% of reading

Model RGC-100 Series Digital Vacuum Gauge

For repair or recalibration, return gauges to:

Varian Vacuum Technologies
Lexington, MA 02421-3133
Ph:1.800.882.7426
www.varianinc.com

E-mail: Direct from our website **www.Varianinc.com**

Varian manufactures a complete line of vacuum gauges and process computers. Contact us or your distributor if you need further information. See www.Varianinc.com for our latest offerings



IMPORTANT Instructions for returning products

Dear Customer,

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

1. Complete the *Request for Return* form on our website (www.varianinc.com) and send it to Varian (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, Varian 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, e.g.).

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, **use the packaging from the Advance Exchange to return the defective product.**
 - Seal the product in a plastic bag, and package the product carefully to avoid damage in transit. You are responsible for loss or damage in transit.
 - Varian, Inc. is not responsible for returning customer provided packaging or containers.
 - Clearly label package with the RA number.** Using the shipping label provided ensures the proper address and RA number are on the package. Packages shipped to Varian without an 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 an 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:

North America:

FAX: 1-781-860-9252

Toll Free: 800-8VARIAN

(800-882-7426

vtl.ra@varianinc.com

Europe:

FAX: 00 39-011-9979125

Fax Free: 00 800 345 345 00

Toll Free: 00 800 234 234 00

vtt.ra@varianinc.com

Pacific Rim:

Please visit our website for individual office information.

<http://www.varianinc.com/vacuum>

Model RGC-100 Series Digital Vacuum Gauge

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vtl.technical.support@varianinc.com

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vtl.technical.support@varianinc.com

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Worldwide Web Site, Catalog and On-line Orders:

www.varianinc.com

Representatives in most countries



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