



AGC302 Active Vacuum Gauge Controller



User Manual

InstruTech
1475 S. Fordham St.
Longmont, CO 80503
USA

Phone: +1-303-651-0551
Fax: +1-303-678-1754
E-mail info@instrutechinc.com
www.instrutechinc.com

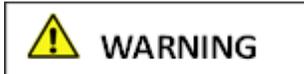
Important User Information There are operational characteristic differences between solid state equipment and electromechanical equipment. Because of these differences, and because there are a variety of uses for solid state equipment, all persons that apply this equipment must take every precaution and satisfy themselves that the intended application of this equipment is safe and used in an acceptable manner.

In no event will InstruTech be responsible or liable for indirect or consequential damages that result from the use or application of this equipment.

Any examples or diagrams included in this manual are provided solely for illustrative purposes. Because of the many variables and requirements imposed on any particular installation, InstruTech cannot assume responsibility or liability for any actual use based on the examples and diagrams.

No patent liability is assumed by InstruTech with respect to use of information circuits, equipment, or software described in this manual.

Throughout this manual we use notes, notices and apply internationally recognized symbols and safety messages to make you aware of safety considerations.



Identifies information about practices or circumstances that can cause electrical or physical hazards which, if precautions are not taken, could result in death or serious injury, property damage, or economic loss.



Identifies information about practices or circumstances that can cause electrical or physical hazards which, if precautions are not taken, could result in minor or moderate injury, property damage, or economic loss.



Identifies information that is critical for successful application and understanding of the product.



Labels may be located on or inside the device to alert people that dangerous voltages may be present.

Copyright © 2017 by InstruTech

All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or by any information storage or retrieval system, except as may be expressly permitted in writing by InstruTech.

Printed in the United States of America

Mini-Convectron® and Granville-Phillips® are registered trademarks of MKS Instruments, Andover, MA

Table of Contents

1	Introduction / General Information	3
1.1	Description	3
1.2	Specifications	3
1.3	Dimensions.....	4
1.4	Part Numbers	4
2	Important Safety Information.....	6
2.1	Safety Precautions - General.....	6
2.2	Safety Precautions - Service and operation	7
2.3	Electrical Conditions.....	7
2.3.1	Proper Equipment Grounding	7
2.3.2	Electrical Interface and Control	8
2.4	Overpressure and use with hazardous gases	8
2.5	Gases other than Nitrogen / air	8
3	Installation	9
3.1	Mechanical Installation - Controller	9
3.2	Electrical Installation.....	10
3.2.1	Grounding.....	10
3.2.2	Electrical Connections.....	10
4	Setup and Operation.....	15
4.1	Initial Setup	15
4.2	User Interface Basics.....	15
4.3	Factory-Set Default Parameters.....	16
4.4	Programming.....	17
4.4.1	SETUP UNIT	18
4.4.2	RELAYS	20
4.4.3	Analog Output.....	21

4.4.4 SERIAL COMM.....22

4.4.5 DISPLAY23

5 Using the gauge with different gases24

6 RS485 / RS232 / USB serial communications.....25

6.1 Device Specific Serial Communication Info.....25

6.2 RS232/USB/RS485 Command Protocol Summary26

6.3 RS485 / RS232 Command Protocol Summary27

7 Service30

7.1 Calibration.....30

7.2 Calibration.....30

7.3 Troubleshooting.....30

8 Factory Service and Support31

9 Warranty31

1 Introduction / General Information

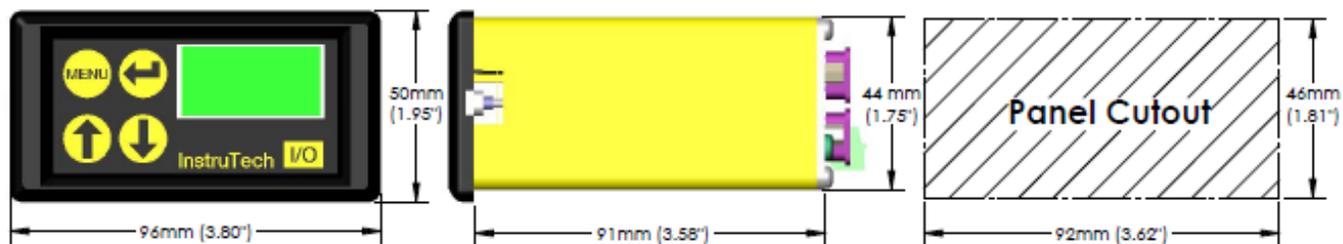
1.1 Description

The AGC302 vacuum gauge controller is a power supply and readout instrument offered specifically for the InstruTech active vacuum gauge series WGM701 pirani-cold cathode combination gauge, CCM502 cold cathode gauge, PCM301 pirani-capacitance combination gauge, CDM900 capacitance diaphragm gauge (CDG) and other brands of CDGs. Note that the vacuum gauges listed above do not necessarily require the AGC302 to operate. These gauges provide analog output signals that can be directly interfaced with user's control system. As such, AGC302 is recommended only when a bench top, panel or rack mount display installation is required. Furthermore, the AGC302 controller can be used to provide two setpoint relays as well as serial communications for these types of devices. If needed, AGC302 can also be used with other InstruTech active gauges such as the CVM201, CVM211 convection or CCM501, IGM401, IGM402 ionization gauges although these gauges are provided with their own integrated displays. The controller is powered by user supplied 20 to 28 Vdc, or by InstruTech PS301 optional power supply. The controller provides power to the InstruTech active gauges operating on 24 Vdc including the CDM900 CDG, however other brands of CDGs operating on ± 15 Vdc power require an external power supply provided by the user.

1.2 Specifications

measurement range	dependent on active vacuum gauge device connected (see vacuum gauge data sheets)
display	bright OLED, 3 digit plus 2 digit exponent, user-selectable Torr, mbar or Pa
display update rate	0.5 sec
weight	9 oz. (250 g)
operating temperature	0 to +40 °C
storage temperature	-40 to +70 °C
humidity	0 to 95% relative humidity, non-condensing
input signal	analog input from one of the following active vacuum gauge devices: full range cold cathode-pirani combination gauge: WGM701 cold cathode gauge: CCM502 pirani-capacitance combination gauge: PCM301 capacitance diaphragm gauge: CDM900 or other brands of CDGs
analog output	retransmits analog input from the active vacuum gauge device connected
serial communications	RS232 and RS485 - ASCII protocol
housing	1/8-DIN panel-mount enclosure (aluminum extrusion)
input power	20-28 Vdc, 2 W plus the wattage required for the active vacuum gauge connected protected against power reversal and transient over-voltages
setpoint relays	two single-pole double-throw relays (SPDT) / 5 A at 30 Vdc, 5 A at 250 Vac, resistive load
connectors	gauge: 9-pin D-sub female (mating connector provided as part of the gauge cable) analog output: 9-pin D-sub male RS232 serial communications: 9-pin D-sub male or USB RS485 serial communications: 9-pin D-sub male relay outputs: 6-pin pluggable terminal block (mating connector included) power: 2-pin pluggable terminal block (mating connector included)
CE compliance	EMC Directive 2014/30/EU, EN55011, EN61000-6-2, EN61000-6-4, EN61326-1, EN61010-1
environmental	RoHS compliant

1.3 Dimensions



1.4 Part Numbers

AGC302 Active Vacuum Gauge Controller

P/N
AGC302A

Optional power supply when used with WGM701, CCM501, CCM502, PCM301, CDM900, CVM201, CVM211 active gauges.

Input: 100 - 240 Vac, 50-60 Hz

Output: + 24 Vdc / 18 W

Cable Length: 6 ft. (2 m)



with North American AC Plug



PS301-A

with Universal European AC Plug



PS301-EU

with UK AC Plug



PS301-UK

with China AC Plug



P301-C

with Australian AC Plug



PS301-SP

Optional power supply for AGC302 when used with the above active gauges as well as IGM401, IGM402 and CDGs requiring power higher than 18 W at 24 Vdc. User supplied AC power cord required.



This variation of the PS301 power supply may be used when an AC plug that is not listed above is required. The conventional IEC60320 AC power entry receptacle allows use with any user supplied AC mains power cord set available worldwide.

PS301-UX

Input: 100 - 240 Vac, 50-60 Hz

Output: + 24 Vdc / 60 W

Cable Length: 6 ft. (2 m)

Part Numbers continued -

Vacuum Gauge Cable	For WGM701, CCM502, CCM501, IGM401, IGM402	For PCM301, CVM201, CVM211	For CDM900
10 ft. (3 m)	WRG741-1-10F	PCG341-1-10F	CDG941-1-10F
25 ft. (8 m)	WRG741-1-25F	PCG341-1-25F	CDG941-1-25F
50 ft. (15 m)	WRG741-1-50F	PCG341-1-50F	CDG941-1-50F
>50 ft. consult factory	consult factory	consult factory	consult factory

Note. If you intend to use the CVM201/CVM211 with the AGC302, consider using the more economical CVG101 convection gauge tube with the VGC301 controller instead.

Vacuum Gauges: For vacuum gauge part numbers and specifications see individual data sheets for these devices you intend to connect to the AGC302 controller.

2 Important Safety Information

InstruTech has designed and tested this product to provide safe and reliable service, provided it is installed and operated within the *strict safety guidelines provided in this manual*. **Please read and follow all warnings and instructions.**



To avoid serious injury or death, follow the safety information in this document. Failure to comply with these safety procedures could result in serious bodily harm, including death, and or property damage.

Failure to comply with these warnings violates the safety standards of installation and intended use of this instrument. InstruTech disclaims all liability for the customer's failure to comply with these instructions.

Although every attempt has been made to consider most possible installations, InstruTech cannot anticipate every contingency that arises from various installations, operation, or maintenance of the controller. If you have any questions about the safe installation and use of this product, please contact InstruTech.

2.1 Safety Precautions - General

Hazardous voltages are present with this product during normal operation. The product should never be operated with the enclosure removed unless equivalent protection of the operator from accidental contact with hazardous internal voltages is provided.

 **WARNING!** There are no operator serviceable parts or adjustments inside the product enclosure. Refer servicing to service trained personnel.

Do not modify this product or substitute any parts without authorization of qualified InstruTech service trained personnel. Return the product to an InstruTech qualified service and repair center to ensure that all safety features are maintained. Do not use this product if unauthorized modifications have been made.

 **WARNING!** Source power must be removed from the product prior to performing any servicing.

After servicing this product, ensure that all safety checks are made by a qualified service person. When replacement parts are required, ensure that the parts are specified by InstruTech. Substitutions of non-qualified parts may result in fire, electric shock or other hazards. Use of unauthorized parts or modifications made to this product will void the warranty.

To reduce the risk of fire or electric shock, do not expose this product to rain or moisture. These products are not waterproof and careful attention must be paid to not spill any type of liquid onto these products. Do not use these products if they have been damaged. Immediately contact InstruTech to arrange return of the product if it is damaged.

Due to the possibility of corrosion when used in certain environmental conditions, it is possible that the product's safety could be compromised over time. It is important that the product be periodically inspected for sound electrical connections and equipment grounding. Do not use if the equipment grounding or electrical insulation has been compromised.

2.2 Safety Precautions - Service and operation

Ensure the enclosure of the AGC302 is connected directly to a good quality earth ground.

Ensure that the vacuum port on which the vacuum gauge sensors are mounted is electrically grounded.

Use an appropriate power source of 20 to 28 Vdc or use InstruTech series PS301 optional power supplies.

Turn off power to the unit before attempting to service the controller.

Turn off power to the unit if a cable or plug is damaged or the product is not operating normally according to this instruction manual. Contact qualified InstruTech service personnel for any service or troubleshooting condition that may not be covered by this instruction manual.

It is important that the product be periodically inspected for sound electrical connections and equipment grounding. Do not use if the equipment grounding or electrical insulation has been compromised.

Do not use if the unit has been dropped or the enclosure has been damaged. Contact InstruTech for return authorization and instructions for returning the product to InstruTech for evaluation.

2.3 Electrical Conditions

 **WARNING!** When high voltage is present in any vacuum system, a life threatening electrical shock hazard may exist unless all exposed electrical conductors are maintained at earth ground potential. This applies to all products that come in contact with the gas contained in vacuum chambers. An electrical discharge within a gaseous environment may couple dangerous high voltage directly to any ungrounded conductor of electricity. A person could be seriously injured or killed by coming in contact with an exposed, ungrounded electrical conductor at high voltage potential. This condition applies to all products that may come in contact with the gas inside the vacuum chamber (vacuum/pressure containment vessel).

2.3.1 Proper Equipment Grounding

 **WARNING!** Hazardous voltages that could seriously injure or cause death are present in many vacuum processes. Verify that the vacuum port on which the vacuum gauge is mounted is electrically grounded. Consult a qualified Electrician if you are in doubt about your equipment grounding. Proper grounding of your equipment is essential for safety as well as intended operation of the equipment. Proper grounding of your equipment is essential for safety as well as intended operation of the equipment. Vacuum gauge and enclosure of any control module must be connected directly to a good quality equipment earthing conductor. Use a ground lug on the vacuum connection flange of the pressure measurement devices if necessary.

⚠ WARNING! In order to protect personnel from electric shock and bodily harm, shield all conductors which are subject to potential high voltage electrical discharges in or around the vacuum system.

2.3.2 Electrical Interface and Control

It is the user's responsibility to ensure that the electrical signals from this product and any connections made to external devices, for example, relays and solenoids, are used in a safe manner. Always double check the system set-up before using any signals to automate your process. Perform a hazardous operation analysis of your system design and ensure safeguards and personnel safety measures are taken to prevent injury and property damage.

2.4 *Overpressure and use with hazardous gases*

⚠ WARNING! Install suitable protective devices that will limit the level of pressure inside your vacuum chamber to less than what the vacuum chamber system components are capable of withstanding. InstruTech gauges should not be used at pressures exceeding the pressure rating listed in the data sheets and User Manuals for these products.

In cases where an equipment failure could cause a hazardous condition, always implement fail-safe system operation. For example, use a pressure relief device in an automatic backfill operation where a malfunction could result in high internal pressures if the pressure relief device was not installed on the chamber.

If your chamber goes to higher pressures than the gauge is rated for, you should install an isolation valve or pressure relief device to protect the gauge tube from overpressure conditions. With some fittings, actual safe overpressure conditions may be lower; for example, a quick-connect, O-ring compression fitting may forcibly release the gauge from the vacuum chamber fitting with only a few psi over local uncorrected barometric (atmospheric) pressure.

⚠ CAUTION! If the internal pressure of a vacuum gauge device is allowed to increase above local uncorrected barometric pressure (atmospheric pressure side), vacuum fittings may release and possible overpressure conditions may cause leaks that would allow the gas inside the gauge tube to release into the atmosphere of the surrounding environment. Toxic, pyrophoric and flammable gases are examples of hazardous gases that if allowed to leak out of the vacuum/pressure containment vessel into the atmospheric environment, could cause bodily injury and possible damage to equipment. Never expose the gauge tube internal volume to pressure above local atmospheric pressure when using hazardous gases.

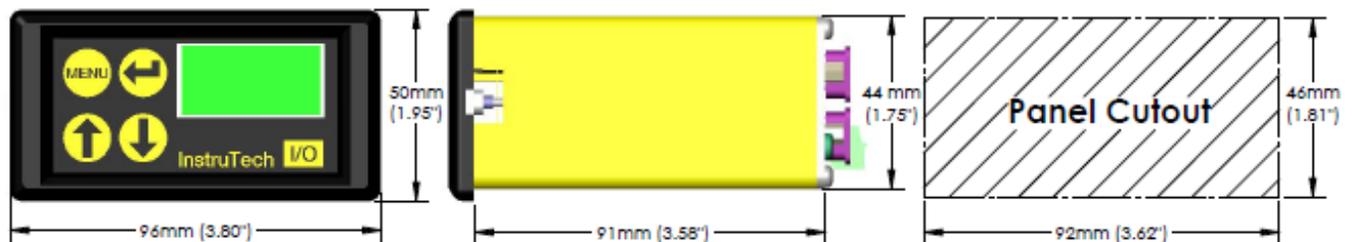
2.5 *Gases other than Nitrogen / air*

⚠ WARNING! When using gas dependent types of vacuum gauges do not attempt to use with gases other than nitrogen (N₂) or air without referring to correction factor data tables or charts in the User Manuals for these products. InstruTech gas dependent types of vacuum gauges such as the WGM701, CCM502, CCM501, IGM401, IGM402, PCM301, CVM201 and CVM211 modules are calibrated for direct readout of nitrogen or air. Do not attempt to use with other gases such as argon (Ar) or carbon dioxide (CO₂) unless accurate conversion data for N₂ to other gas is properly used.

3 Installation

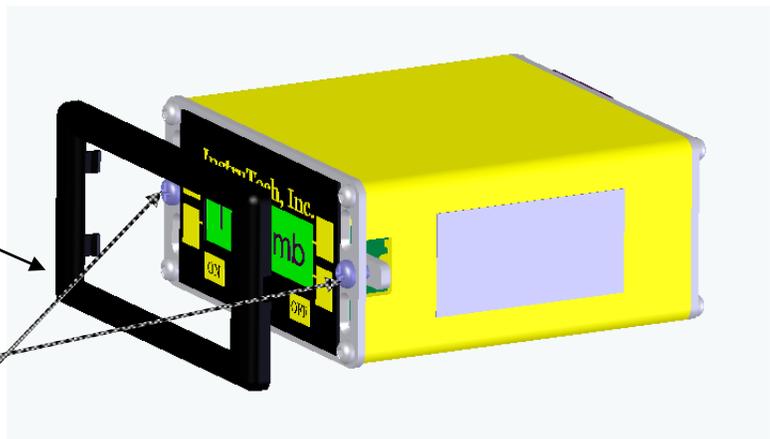
3.1 Mechanical Installation - Controller

The AGC302 is designed for use on a bench top, or it may be mounted in an instrument control panel.



To mount the AGC302 in a panel:

1. Make a cutout in your instrument control panel as shown in the drawing above. Be sure to allow clearance behind the panel for the instrument as well as connectors and cables at the rear of the instrument
2. Gently pry the front panel bezel loose and remove.
3. Slide the AGC302 into the panel hole cutout.
4. On either side of the AGC302 are two screw-mounting brackets. When the screws in the front of the instrument are turned counterclockwise, the hold-down brackets recess out of the way into the AGC302 housing. When these screws are turned clockwise, the brackets rotate out 90° behind the panel. Tighten these screws until the brackets hold the AGC302 in place against the panel.
5. Press the front panel bezel back in place.



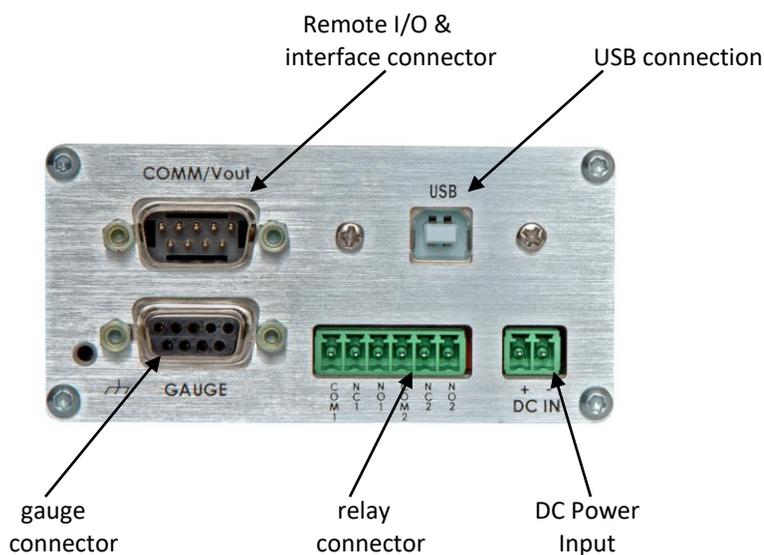
3.2 Electrical Installation

3.2.1 Grounding

⚠ Be sure the vacuum gauge and your vacuum system are properly grounded to protect personnel from shock and injury. Be aware that some vacuum fittings, especially those with O-rings, may not produce a good electrical connection between the gauge and the chamber it is connected to.

3.2.2 Electrical Connections

A good recommended practice is to remove power from any cable prior to connecting or disconnecting it.



DC IN

The AGC302 requires a power source of 20 to 28 Vdc, 2 W plus the wattage required for the active vacuum gauge connected to it. If the user prefers to use AC power, InstruTech offers the series PS301 optional power supplies with various AC Plugs.

2-pin pluggable terminal strip

(Mating connector included and shipped with device (Phoenix p/n 1803578 or InstruTech p/n 000729))

pin number	pin description
1	+20 to +28 Vdc
2	Power ground

COMM/V out (Remote I/O & Interface Connector)

The 9-Pin D-sub connector is used for analog output and serial communications. Please note the following:

When using RS485 serial communications, you must fabricate your own cable according to the 9-pin D-Sub pinout shown below. If using only RS232 serial communications a standard off the shelf serial cable for connection to a standard PC can be used. Both cable ends must have 9-pin D-Sub female connectors.

9-pin D-sub male (Mating connector provided by user or order InstruTech P/N C431-03)

pin number	pin description
1	analog output signal
2	RS232 TX When using RS232 serial comm., this pin is typically connected to pin # 2 of your PC serial port 9-pin D-sub connector
3	RS232 RX When using RS232 serial comm., this pin is typically connected to pin # 3 of your PC serial port 9-pin D-sub connector
4	No Connection
5	analog output ground Also when using serial comm., this pin is typically connected to pin # 5 of your PC RS232 serial port 9-pin D-sub connector, or ground pin of your RS485 converter
6	RS485 DATA A (-) Input/output
7	No Connection
8	Remote IG ON/OFF (For CCM501, CCM502 and IGM401 only). The sensors of these active ion gauges can be remotely activated by applying a continuous ground to this pin. The IG sensor is turned off by removing the ground.
9	RS485 DATA B (+) Input/output

Relay Connector

There are two single-pole double-throw relays (SPDT) rated for 5 A at 30 Vdc, 5 A at 250 Vac, resistive load.

6-pin pluggable terminal strip

(Mating connector included and shipped with device (Phoenix p/n1803617 or InstruTech p/n 000730))

pin number	pin description
1	relay 1 common
2	relay 1 NC
3	relay 1 NO
4	relay 2 common
5	relay 2 NC
6	relay 2 NO

USB

A USB connection is available for serial communications. When using the USB connection the RS232 and RS485 serial communications will no longer be available for use with other devices.

Gauge

Per part numbers listed in section [1.4](#) cable assemblies are provided in different lengths from InstruTech for connecting the AGC302 controller to various InstruTech active gauges.

The cable pin to pin connection is shown below in case user prefers fabricating their own cable.

Pin to pin connection - Gauge cable assembly	
AGC302 connector marked "GAUGE" 9 pin D-Sub pin number	CCM502,WGM701,CCM501,IGM401,IGM402 9 pin D-sub pin number
1	1
2	2
3	3
4	4
5	
6	
7	7
8	
9	9

Note: When using the IGM401, IGM402 and CCM501 connect gauge cable to the connector marker "Analog" on these devices.

The cable pin to pin connections are shown below in case user prefers fabricating their own cable.

Pin to pin connection - Gauge cable assembly	
AGC302 connector marked "GAUGE" 9 pin D-Sub pin number	PCM301,CVM201,CVM211 9 pin D-Sub pin number
1	
2	4
3	5
4	3
5	
6	
7	8
8	
9	

Note: When using the CVM201 connect gauge cable to the 9 pin- D-Sub of CVM201.

Pin to pin connection - Gauge cable assembly	
AGC302 connector marked "GAUGE" 9 pin D-Sub pin number	CDM900 9 pin D-Sub pin number
1	
2	9
3	1
4	4
5	
6	
7	8
8	
9	

Pin to pin connection - Gauge cable assembly for use with other brands of capacitance diaphragm gauges operating on 24 Vdc power	
AGC302 connector marked "GAUGE" 9 pin D-Sub pin number	CDG connection - other brands
1	
2	power ground
3	analog output signal
4	24 Vdc power
5	
6	
7	analog output ground
8	
9	

When connecting a CDG which operates on ± 15 Vdc a user supplied external power supply is required. Fabricate a cable according to the pinout shown below.

Pin to pin connection - Gauge cable assembly for use with other brands of capacitance diaphragm gauges operating on ± 15 Vdc power		
AGC302 connector marked "GAUGE" 9 pin D-Sub pin number	CDG connection - other brands	± 15 Vdc external power supply
1		
2	← → power ground	← → power ground
3	← → analog output signal	
4	+ 15 Vdc	← → + 15 Vdc
5	- 15 Vdc	← → - 15 Vdc
6		
7	← → analog output ground	
8		
9		

4 Setup and Operation

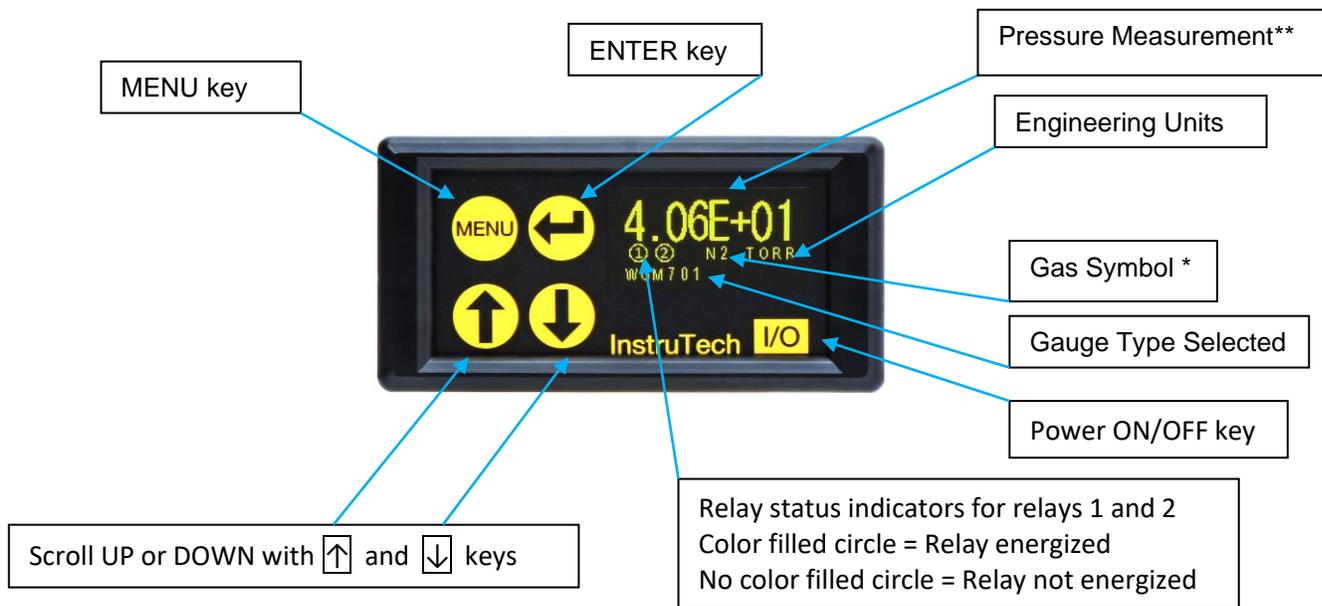
4.1 Initial Setup

Before you turn on power to the AGC302 controller, ensure you have read the entire User Manual for the active gauge connected to the controller. Ensure the cable from the active gauge is connected and secured otherwise you won't be able to access the programming menus. Do not connect any of the output signals to your control system until you have completely programmed the controller. Turn on power by pressing the I/O key.

4.2 User Interface Basics

The setup and programming of the AGC302 controller is done via the four programming keys located to the left side of the display. During programming of the AGC, the display will identify what function each key represents.

To begin programming, press the MENU key. Press the UP and DOWN key to select the desired menu and change the parameters. Press the ENTER key {this is the  key with the arrow pointing to the left as viewed from the front of the AGC} to access the parameters and save the new settings. Press the  Key to return to the previous menu or press repeatedly to return to the main screen. To continue setting additional parameters, scroll with the UP  and DOWN  keys until you reach the desired parameter then press ENTER.



* If you are using gas dependent gauges such as the WGM701, CCM502, etc., on gases other than air/nitrogen you must manually apply correction factors to the pressure readings per instructions given in the user Manuals of these devices.

** Under certain faults or sensor off conditions the PCM301, CVM201, CVM211 output 0 volt and the WGM701, CCM501, CCM502, IGM401, IGM402 output 10 volts. When these level of signals are received by the controller, the pressure reading disappears from the AGC302 screen indicating a fault. Refer to the user Manual of these active gauges to determine issue.

4.3 Factory-Set Default Parameters

The following is a summary of all factory-set default values in the B-RAX setup screen menu.

SETUP UNIT

- UNITS [Factory default = *TORR*]
- INFO [Factory default = *FIRMWARE VERSION* and *Gauge Type WGM701*]
- GAUGE ID [Factory default = *WGM701*]
- GAUGE CAL [Factory default = *Factory Set Number*]
- GAUGE NAME [Factory default = *WGM701*]
- DEFAULTS [Factory default = *PRESS ENTER TO SET OR MENU TO EXIT*]

RELAYS

- REL 1 LO TRIP [Factory default = *1.00E-06*]
- REL 1 HI TRIP [Factory default = *2.00E-06*]
- REL 2 LO TRIP [Factory default = *1.00E-01*]
- REL 2 HI TRIP [Factory default = *2.00E-01*]
- TEST RELAYS [Factory default = *OFF*]

ANALOG OUTPUT

- AOUT CAL [Factory default = *Factory Set Number*]

SERIAL COMM

- COMM TYPE [Factory default = *RS485*]
- BAUDRATE [Factory default = *19200 BAUD*]
- FRAMING [Factory default = *8 BITS NONE 1*]
- ADDRESS [Factory default = *01*]

DISPLAY

- SCREEN SETUP [Factory default = *NORMAL*]
- SCREEN SAVER [Factory default = *ON*]
- BRIGHTNESS [Factory default = *0*]

4.4 Programming

This section provides detailed information on programming and configuration of various menus and submenus of the device.



←This key, on the AGC302 front panel, is referred to as the 'ENTER' key throughout this manual.

From the main menu (press the **MENU** key if the main menu is not shown), scroll Up  or Down  to **SETUP UNIT** then press the ENTER key to access the SETUP UNIT menu for configuring the AGC general parameters such as the units of measure, gauge type, etc. In certain instances, during setup of the programmed functions and settings, you may need to press the ENTER key until you reach the end of a program/setup sequence before pressing the **MENU** key to return to the main menu or previous setup screen.

A) When you first press the **MENU** key the following top level menus will be accessible to the user.

Top-Level Program Menu from the factory:

SETUP UNIT
RELAYS
ANALOG OUTPUT
SERIAL COMM
DISPLAY

B) If you are using active gauges CCM501, CCM502 and IGM401 and program any of these gauges in the SETUP UNIT menu (*GAUGE ID*) two additional top level menus will appear above the SETUP UNIT menu as shown below. This allows the user to turn the sensor on or off when operating these types of ionization gauges.

Top-Level Program Menu when GAUGE ID is CCM501, CCM502 and IGM401

IG ON
IG OFF
SETUP UNIT
RELAYS
ANALOG OUTPUT
SERIAL COMM
DISPLAY

Gauge ID	CDG Full Scale	CDG Type*
10 mTORR CDG	10 mTorr	H
20 mTORR CDG	20 mTorr	I
50 mTORR CDG	50 mTorr	J
100 mTORR CDG	100 mTorr	K
250 mTORR CDG	250 mTorr	L
500 mTORR CDG	500 mTorr	M
1 TORR CDG	1 Torr	N
2 TORR CDG	2 Torr	O
5 TORR CDG	5 Torr	P
10 TORR CDG	10 Torr	A
20 TORR CDG	20 Torr	B
50 TORR CDG	50 Torr	C
100 TORR CDG	100 Torr	D
200 TORR CDG	200 Torr	E
500 TORR CDG	500 Torr	F
1000 TORR CDG	1000 Torr	G

* When the specific CDG has been programmed, the CDG TYPE in the form of an upper case letter will be displayed on the main pressure measurement display screen. For example, if you have selected a 100 mTORR CDG, the gauge type shown will be displayed as CDG TYPE K. This is to prevent confusion that the actual pressure reading is 100 mTorr.

Note that CDG types A thru G is available from InstruTech as the CDM900 capacitance diaphragm gauges. Other brands of CDGs with any of the full scale ranges listed above, with a 0-10 Vdc analog output and operating on 24 Vdc power can be connected to the controller. However those CDG brands operating on ± 15 Vdc power require an external ± 15 Vdc power supply provide by the user.

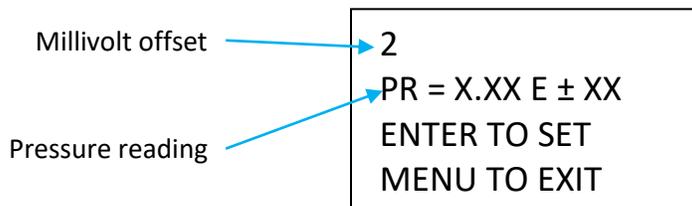
- GAUGE CAL [Factory default = *Factory Set Number*]

The *GAUGE CAL* menu selection is used to optimize the analog input calibration when the controller is connected to those gauges with their own built-in displays such as the PCM301, IGM401/402, CCM501 and CVM201/211. It is recommended that the user **not** make this adjustment unless the displayed pressure on the AGC302 does not closely match the displayed pressure on the gauge. The *GAUGE CAL* menu is not applicable when using InstruTech gauges such as the CCM502, or WGM701, CDM900 or other brands of CDGs with no built-in displays.

Example - To perform *GAUGE CAL* if the gauge connected to the controller is an IGM401. Establish a system pressure so that the displayed gauge reading is preferably at the high end of any decade (for example 9.00E-05 as opposed to 1.00E-05). While in the *GAUGE CAL menu* screen use the UP or DOWN keys to adjust the displayed pressure in the *GAUGE CAL* menu screen to match the pressure reading recorded on the IGM401 display. The pressure in the *GAUGE CAL* menu screen you are adjusting will be displayed as PR = XX.XXE \pm XX. Once the displayed pressure on both the controller and the gauge have been matched use the ENTER key to save the adjustment.

Note - As you make this adjustment the number being displayed in the *GAUGE CAL* screen represents the millivolts offset from zero volts that is being used internally for the analog input gain adjustment.

Example of *GAUGE CAL* menu screen



- **GAUGE NAME** [Factory default = *WGM701*]

The default name is the *GAUGE ID* menu selected above. You can however change this to suit your requirements for naming conventions and documentation purposes. For example you may change the default name of, say, *PCM301* to a descriptor such as 'FORELINE' or 'ROUGHVAC'.

- **DEFAULTS** [Factory default = *PRESS ENTER TO SET OR MENU TO EXIT*]

The system can be returned to the original factory settings by using the ENTER key to set factory defaults.

4.4.2 RELAYS

Press the ENTER key to access the *RELAYS* menu for configuring the setpoint relays.

- **REL 1 LO TRIP** [Factory default = *1.00E-06*]

This setpoint corresponds to the turn on point for Relay #1. Relay #1 will turn on when the pressure drops below this setting.

- **REL 1 HI TRIP** [Factory default = *2.00E-06*]

This setpoint corresponds to the turn off point for Relay #1. Relay #1 will turn off when the pressure rises above this setting.

- **REL 2 LO TRIP** [Factory default = *1.00E-01*] (*RELAY 2 LO TRIP*; same info as *RELAY 1 LO TRIP* above)

- **REL 2 HI TRIP** [Factory default = *2.00E-01*] (*RELAY 2 HI TRIP*; same info as *RELAY 1 HI TRIP* above)

- **TEST RELAYS** [Factory default = *OFF*]

This allows the user to manually toggle the relays on and off to test for correct external circuit wiring and ensure polarity is as desired. Press ENTER to access the *TEST RELAYS* menu. Select a specific relay by pressing the ENTER key so that the relay number is highlighted. Press the UP or DOWN key to energize the specific relay.

4.4.3 Analog Output

The AGC302 controller provides one analog output proportional to the pressure measured by the gauge connected to it. The analog output characteristics and scaling is the same as the analog signal being received from the gauge. Essentially, the controller retransmits the same analog signal received from the gauge as analog output. The analog output is available on the 9-pin D-Sub labeled COMM/Vout in the rear panel of the AGC302 controller. To convert the analog output to pressure measurements refer to the User Manuals for the specific vacuum gauge connected to this controller.

- AOUT CAL [Factory default = *Factory Set Number*]

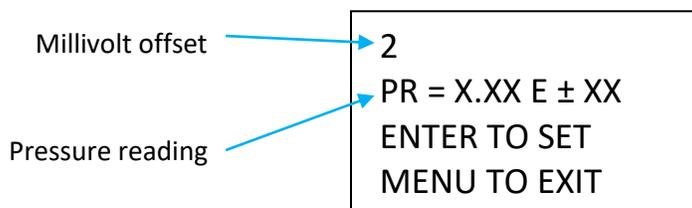
This has been pre-set in the factory and is used to optimize the analog output calibration. It is recommended that the user **not** make this adjustment unless the displayed pressure on the controller and the resulting pressure recorded from the analog output do not match closely.

To perform *AOUT CAL* adjustment connect the gauge to the controller and connect the analog output (9-pin D-Sub labeled COMM/Vout) to your system, PLC, etc. Establish a system pressure so that the displayed gauge reading is preferably at the high end of any decade (for example 9.00E-05 as opposed to 1.00E-05). In the *AOUT CAL* screen use the UP or DOWN keys to adjust the analog output as measured by your volt meter to match the corresponding pressure displayed on the same *AOU CAL* screen. The pressure shown in this *AOUT CAL* menu screen is displayed as PR = XX.XXE ± XX. Alternatively, if the IG analog output is used to display the IG pressure on your PLC or system display console, simply adjust the *AOUT CAL* so that the IG pressure displayed by your PLC (pressure established at the high end of any decade preferred) matches the IG pressure displayed in the *AOU CAL* menu screen.

Example: The gauge type connected to the controller is an InstruTech WGM701. The AGC302 controller is registering a pressure reading of 9.00E-06 Torr. Based on the equation given in the Analog Output section of the WGM701 User Manual the expected analog output at 9.00E-06 Torr is 2.9771 V. While in the *AOUT CAL* screen, use the UP or DOWN keys to set the analog output to 2.9771 V as recorded by your voltmeter. Alternatively, if the analog output is used to display the pressure on your PLC or system display console, simply adjust the *AOUT CAL* so that the pressure displayed by your PLC (pressure established at the high end of any decade preferred) matches the pressure reading of 9.00E-06 displayed in *AOUT CAL* menu screen. The pressure shown in this *AOUT CAL* menu screen is displayed as PR = XX.XXE ± XX.

Note - As you adjust the analog output, the number being displayed in the *AOUT CAL* screen represents the millivolts offset from zero volts that is being used internally for the analog output gain adjustment.

Example of *AOUT CAL* menu screen



4.4.4 SERIAL COMM

The AGC302 provides RS485, RS232 / USB serial communications. Press the ENTER key to access the *SERIAL COMM* menu for configuring the serial communications.

- **COMM TYPE** [Factory default =RS485]

The AGC302 supports four different protocols listed below (See section 6 for details).

- *RS485* *RS485* with start and stop characters and address
- *RS232* *RS232* with start and stop characters, like RS485 above but no address
- *USB* *USB* with start and stop characters, like RS232 above. USB is provided to act as a simulated serial port and emulating RS232. When connecting to a PC, windows should automatically load the driver, Silicon Labs CP210x USB to UART Bridge.

- **BAUDRATE** [Factory default =19,200]

This sets the baud rate for the RS485 and the RS232 / USB serial communications. The baud rate can be set to various values listed below.

- *38400 BAUD*
- *19200 BAUD*
- *9600 BAUD*
- *4800 BAUD*
- *2400 BAUD*
- *1200 BAUD*
- *600 BAUD*
- *300 BAUD*

- **FRAMING** [Factory default = 8 BITS, NONE 1]

This sets the character framing by providing the user various selections to control the number of characters, parity and number of stop bits. Character framing can be set to one of the following:

- *8 BITS NONE 1* (This selection sets the character framing to 8 data bits, no parity, 1 stop bit)
- *7 BITS ODD 2*
- *7 BITS EVEN 2*
- *7 BITS ODD 1*
- *7 BITS EVEN 1*
- *8 BITS ODD 1*
- *8 BITS EVEN 1*

- **ADDRESS** [Factory default = 01]

This sets the two byte RS485 device address. For example, an *ADDRESS* of 05 will make the address 0x05 in hexadecimal. An address of 15 will set the *ADDRESS* to 0x15 in hexadecimal.

4.4.5 DISPLAY

The *DISPLAY* menu allows the user to configure the OLED display screen. The user can configure the set-up screen to normal or research mode, enable or disable screen saver and adjust the display intensity. Press the ENTER key to access the *DISPLAY* menu for configuring the display screen.

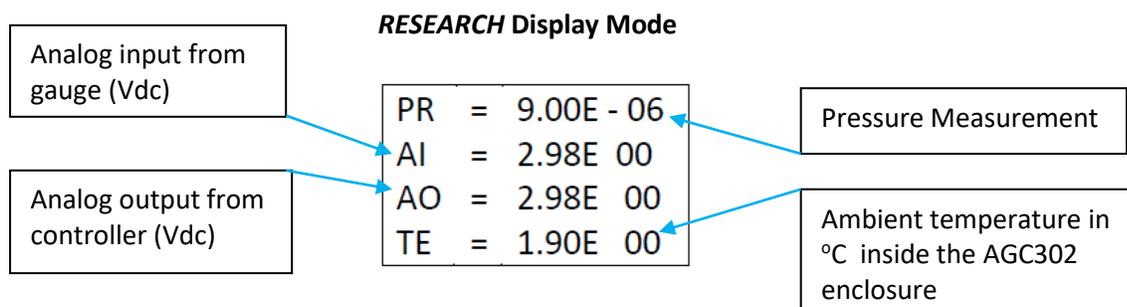
- SCREEN SETUP [Factory default = *NORMAL*]

This menu configures the display mode for the display screen. The display screen can be configured to display certain parameters in *NORMAL* or *RESEARCH* mode. Use the UP and DOWN keys to select the desired setup screen mode from the following menu choices.

- **NORMAL** Normal display mode (shown in section [4.2](#))
- **RESEARCH** Research display mode

Select '**NORMAL**' if you would like to configure the display screen in the normal mode shown in section [4.2](#).

Select '**RESEARCH**' if you would like to configure the display screen in the research (diagnostics) mode shown below. This is particularly helpful when troubleshooting analog input or output issues.



- SCREEN SAVER [Factory default = *ON*]

The AGC302 uses an OLED type display which over an extended period of time can start to show divergence between pixels that are on at all times versus pixels that are not. This could result in pixels exhibiting a burned-in effect. To minimize the burned-in effect, a screen saver function can be activated by programming the *SCREEN SAVER* menu selection to ON. With the screen saver function turned on, the display appearance changes every 12 hours. The display will appear in the normal mode with a dark background color for the first 12 hours and will then switch to a back-lit background color for the next 12 hours. If you like to have the 12 hour period for the normal display mode to start at a specific time of the day, simply access the *SCREEN SAVER* menu and change setting to OFF and then ON again. This initiates the screen saver function immediately.

Note - To increase longevity of the OLED display, InstruTech recommends that the screen saver function remains ON as shipped from the factory.

- **BRIGHTNESS** [Factory default = 0]

The **BRIGHTNESS** menu allows the user to select the brightness of the setup screen display. The brightness setting of 0 provides the lowest brightness (contrast) and 10 the highest.

Note - To increase longevity of the OLED display, InstruTech recommends that the brightness function remains at 0 as shipped from the factory.

5 Using the gauge with different gases

 **WARNING!** When using gas dependent types of vacuum gauges do not attempt to use with gases other than nitrogen (N₂) or air without referring to correction factor data tables or charts in the User Manuals for those gauges. Without using accurate gas conversion data and other proper precautions could result in injury to personnel and/or damage to equipment.

InstruTech gas dependent types of vacuum gauges such as the WGM701, CCM502, CCM501, IGM401, IGM402, PCM301, CVM201 and CVM211 modules are calibrated for direct readout of nitrogen or air. Do not attempt to use with other gases such as argon (Ar) or carbon dioxide (CO₂) unless accurate conversion data for N₂ to other gas is properly used. When using these types of vacuum gauges on gases other than air/nitrogen you must manually apply correction factors to the pressure readings per instructions given in the User Manuals of these devices.

Gas correction factors are not needed when using gas independent types of vacuum gauges such as the InstruTech CDM900 capacitance diaphragm gauges or other brands of CDGs. As such, the gas symbol N₂ disappears from the pressure measurement screen when the type of gauge selected (*GAUGE ID*) is a CDG.

6 RS485 / RS232 / USB serial communications

6.1 Device Specific Serial Communication Info

The AGC302 provides RS232 and RS485 serial communications capability. The following information and the command protocol summaries listed in the following sub-sections of this chapter can be used to establish serial communications with the device. Three distinct protocols (COM type) are defined: RS232, RS485 and USB. USB is provided to act as a simulated serial port and emulating RS232. The user has access from the front panel main menu to change settings for COM Type, Baud Rate, Data Bits, Parity, Stop Bits and device Address (when using RS485).

Baud Rate is selectable at 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400 baud.

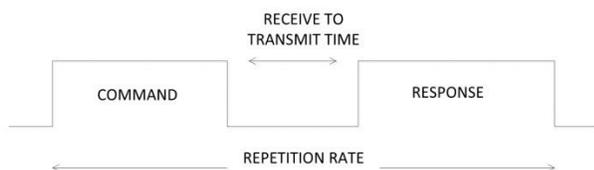
Data bits may be set to either 7 or 8.

Parity selection may be set to None, Even or Odd.

Either 1 or 2 Stop Bits may be selected.

The device address when using RS485 can be within the range 00 to FF hexadecimal (Default = 01).

There is a finite period of time between the time a command is sent from a terminal (PC COM Port, for example) and the point in time in which the AGC302 starts to send a response to that command. This delay is dependent upon the command sent and the baud rate.



The maximum command repetition rate will depend on the length of the command sent and the response received, as well as the baud rate. The maximum repetition rate for the baud rate you are using can be found in the following table:

<i>Selected Baud Rate</i>	<i>Repetition Rate</i>	<i>Receive to Transmit Time</i>
38400	38 ms	26 μ s
19200	46 ms	52 μ s
9600	61 ms	1.0 ms
4800	93 ms	2.0 ms
2400	156 ms	4.1 ms
1200	280 ms	8.3 ms
600	530 ms	16 ms
300	1030 ms	33 ms

6.2 RS232/USB/RS485 Command Protocol Summary

The following notes are intended to be understood by the user when using InstruTech's RS485 / RS232 / USB command protocol with the AGC302.

1. Default settings are **19,200** baud rate, **8** data bits, **No Parity**, **1** stop bit.
2. The baud rate can be set to different values using the front panel soft-keys.
3. All Responses are 13 characters long.
4. 'xx' is the RS485 address of the device (00 thru FF). For RS232, 'xx' is replaced with two space characters.
5. <CR> is a carriage return, a non-printable character. Do not enter <CR> from your keyboard. A carriage return, non-printable character may be entered as the hex value: 0D hexadecimal (13 decimal). From your keyboard, a key entry sequence of CNTL-M may be used to obtain the required character for a carriage return when using certain terminal emulator programs.
6. '_' represents a 'space' character. Press the space bar on your keyboard. Do not enter a '_' (underscore) character.
7. All commands sent to the controller start with a '#' character, and all normal responses from the controller start with a '*' character. Error responses start with a "?".
8. A valid address must be used [Factory default = 01] when using the RS485 protocol. The B-RAX 3200 will not respond to a command with an invalid address while using RS485.
9. The command syntax examples used in the protocol summary table for ASCII are shown in scientific notation. However, floating point notation is acceptable as long as a leading digit is entered as '0.' or '1.', etc. There must be a digit to the left of the decimal point. For example, when constructing the syntax for the command to set the gauge calibration value (e.g., #xxTS_y.yyEzzy<CR> when using scientific notation), use either #xxTS_760<CR>.
10. USB is provided to act as a simulated serial port and emulating RS232. RS232 and USB mods are the same as RS485 but ADDRESS is ignored and can be eliminated from the command string or replaced with space characters. Responses will not return ADDRESS, replaced with space characters.

6.3 RS485 / RS232 Command Protocol Summary

The RS232 and USB modes are the same as RS485, except ADDRESS is ignored in RS232 mode and can be eliminated from the command string or replaced with space characters. Responses will not return ADDRESS; the ADDRESS is replaced with space characters.

COMMAND	BRIEF DESCRIPTION	COMMAND SYNTAX	RESPONSE
READ GAUGE	Read the current gauge pressure	#xxRD<CR> (eg: #01RD<CR>)	*xx_y.yyEzzy<CR> (eg: *01_1.53E-06<CR>) When sensor is off: *01_1.10E+03 When device does not exist: *01_9.90E+09
READ all PC states	Read the current state of process control setpoints	#xxRL<CR> (eg: #01RL<CR>)	*xx_0003_RL_<CR> (eg: right most F represent first 2 relays, 0001=RL1 ON ...)
READ one PC state	Read the current state of one process control setpoint	#xxRLx<CR> (eg: #01RL1<CR>)	*xx_0_RL_OFF<CR> *xx_1_RL_ON_<CR> RL1 = relay 1 RL2 = relay 2
READ PRESSURE UNIT	Read pressure unit	#xxRU<CR> (eg: #01RU<CR>)	*xx_TORR_<CR> *xx_MBAR_<CR> *xx_PASCAL_<CR>
SET PRESSURE UNIT	Pressure unit for display and RD response	#xxSUx<CR> (eg: #01SUT<CR>)	*xx_PROGM_OK<CR> T = Torr, M = mBar, P = Pascal
READ GAUGE on/off STATUS	Find out if IG is reading.	#xxIGS<CR> (eg: #01IG1S<CR>)	*xx_0_IG_OFF<CR> *xx_1_IG_ON_<CR> When sensor is something other than an IG: ?01_INVALID_<CR> When device does not exist: ?01_INVALID_<CR>
TURN ON IG	Turn ON the Ion Gauge	#xxIG_1<CR> (eg: #01IG_1<CR>)	*xx_PROGM_OK<CR> When sensor is something other than an IG: ?01_INVALID_<CR> When device does not exist: ?01_INVALID_<CR>
TURN OFF IG	Turn OFF the Ion Gauge	#xxIG_0<CR> (eg: #01IG_0<CR>)	*xx_PROGM_OK<CR> (clears errors) When sensor is something other than an IG: ?01_INVALID_<CR> When device does not exist: ?01_INVALID_<CR>
READ GAUGE STATUS	Finds out the cause of the inactive reading	#xxRS<CR> (eg: #01RS<CR>)	*xx_00_ST_OK *xx_08_POWER first response after power up *xx_20_LOWINP negative input voltage *xx_40_NOCON gauge not connected *xx_80_OVTMP unit over temperature *xx_01-ERROR gauge error

COMMAND	BRIEF DESCRIPTION	COMMAND SYNTAX	RESPONSE - EXAMPLES
SET GAUGE CAL	Set the GAUGE CAL	#xxTS_y.yyEzzy<CR> (eg: #01TS 7.60E+02)	*xx_PROGM_OK<CR> When input Voltage < 5V: ?01_INVALID_<CR> When requested Voltage < 5V: ?01_INVALID_<CR> When requested Voltage > 10V: ?01_INVALID_<CR> When device does not exist: ?01_INVALID_<CR>
SET GAUGE NAME	Message in bottom line of display	#xxSGN_XXXXXXXXXX<CR> (eg: #01SGN FORELINE<CR>)	*xx_PROGM_OK<CR> Up to 12 characters, upper case alpha, numeric and space () - . : = Invalid characters will be replaced with space.
SET GAUGE TYPE	Select type of sensor to be connected	#xxSGTx<CR> (eg: #01SGT1<CR>)	*xx_PROGM_OK<CR> SGT0 = WGM701 SGT1 = WGM801 SGT2 = PCM301 SGT3 = IGM402 SGT4 = IGM401 SGT5 = CCM502 SGT6 = CCM501 SGT7 = CG NON-LIN SGT8 = CVM201 SGT9 = CVM211 SGT10 = 10 mTORR CDG SGT11 = 20 mTORR CDG SGT12 = 50 mTORR CDG SGT13 = 100 mTORR CD SGT14 = 250 mTORR CD SGT15 = 500 mTORR CD SGT16 = 1 TORR CDG SGT17 = 2 TORR CDG SGT18 = 5 TORR CDG SGT19 = 10 TORR CDG SGT20 = 20 TORR CDG SGT21 = 50 TORR CDG SGT22 = 100 TORR CDG SGT23 = 200 TORR CDG SGT24 = 500 TORR CDG SGT25 = 1000 TORR CD
READ GAUGE TYPE	Read type of sensor to be connected	#xxRGT<CR> (eg: #01RGT<CR>)	*xx_03_RGT_<CR> Range 00 to 25
SET RELAY PRESSURE	Pressure where the relay activates and deactivates	#xxPCxA_y.yyEzzy<CR> (eg: #01PC1A 7.60E+02)	*xx_PROGM_OK<CR> PCxA activation pressure PCxD deactivation pressure x = 1 for relay 1 and 2 for relay 2

COMMAND	BRIEF DESCRIPTION	COMMAND SYNTAX	RESPONSE - EXAMPLES
READ RELAY PRESSURE	Read Pressure where the relay activates and deactivates	#xxPCxA <CR> (eg: #01PC1A)	*xx_7.60E+02<CR> PCxA activation pressure PCxD deactivation pressure x = 1 for relay 1 and 2 for relay 2
READ SW VERSION	Read the revision number of the firmware.	#xxVER<CR> (eg: #01VER<CR>)	*xx_mmmmm-vv eg: *01_02837-00 <CR>
SET FACTORY DEFAULTS	Changes all settings to factory default.	#FAC<CR> (eg: #FAC)	*xx_PROGM_OK<CR>
Syntax Error	Response to an unknown command	#xxXXX<CR>	?01_SYNTAX_ER<CR>

NOTES:

1. <CR> is a carriage return (0x0D); this is the terminator character.
2. The ' _ ' used in certain defined commands represent a space character. Space characters may be omitted from commands.
3. Hardware handshake controls do not exist on the AGC302 (e.g., RTS, CTS, DTR).

7 Service

7.1 Calibration

For calibration of active vacuum gauges connected to the AGC302 please refer to the User Manual for those devices. Calibration for the controller can be considered using the *GAUGE CAL* menu described in section [4.4.1](#) and *AOUT CAL* menu described in section [4.4.3](#).

7.2 Calibration

In general, maintenance is not required for your InstruTech controller. Periodic performance checks may be done by comparing the active gauge connected to the controller to a known reference standard.

7.3 Troubleshooting

Indication	Possible Cause	Possible Solution
Display is off / blank	No power	Check power supply & power cable
Display is on but no pressure reading or error message	Inoperable or faulty active gauge If using an ion gauge IG filament maybe off Wrong active gauge cable	Refer to active gauge User Manual to troubleshoot Refer to active gauge User Manual to troubleshoot Ensure correct gauge cable part number in use
Readings appear very different from expected pressure	The process gas is different from the gas used to calibrate the active gauge	Refer to the active gauge User Manual. Apply gas correction factors to the pressure readings. Gas correction factors not required for CDGs.
Readings are noisy or erratic	Loose cables or connections Contamination of the active gauge Vibration	Check and tighten connections Refer to the active gauge User Manual. Refer to the active gauge User Manual.
Setpoint does not actuate	Incorrect setup	Check setpoint setup

8 Factory Service and Support

If you need help setting up, operating, troubleshooting, or obtaining a return materials authorization number (RMA number) to return the controller for diagnosis, please contact us during normal business hours (8:00am to 5:00pm Mountain time) Monday through Friday, at 303-651-0551. Or e-mail us at support@instrutechinc.com.

If you intend to also return the vacuum gauge sensor used with the controller, for the safety of our employees, you must download, complete and submit a material disclosure form from our website at www.instrutechinc.com. Please use this form to provide a history of the gauge detailing what gases have been used. We cannot accept gauges that have been exposed to hazardous materials.

9 Warranty

SELLER warrants that its products are free of defects in workmanship and material and fit for the uses set forth in SELLER's catalog or product specifications, under the normal use and service for which they are intended.

The entire warranty obligation of SELLER is for the repair or replacement, at SELLER's option, of products or parts (examination of which shall disclose to SELLER's satisfaction that it is defective) returned, to SELLER's plant, properly identified within five years (unless otherwise noted) after the date of shipment from InstruTech Plant. BUYER must obtain the approval of SELLER and a return authorization number prior to shipment.

Alteration or removal of serial numbers or other identification marks renders this warranty void. The warranty does not apply to products or components which have been abused, altered, operated outside of the environmental specifications of the product, improperly handled or installed, or units which have not been operated in accordance with SELLER's instructions. Furthermore the warranty does not apply to products that have been contaminated, or when the product or part is damaged during the warranty period due to causes other than ordinary wear and tear to the product including, but not limited to, accidents, transportation, neglect, misuse, use of the product for any purpose other than that for which it was designed.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY EXTENDS ONLY IN FAVOR OF THE ORIGINAL BUYER. THE BUYER'S SOLE REMEDY SHALL BE THE REPAIR OR REPLACEMENT, AS IS EXPRESSLY PROVIDED HEREIN, OF ANY WARRANTED DEFECTIVE PRODUCT OR PART, AND UNDER NO CIRCUMSTANCE SHALL SELLER BE LIABLE TO BUYER OR ANYONE ELSE FOR ANY CONSEQUENTIAL DAMAGES TO PERSONS OR PROPERTY, FOR INCIDENTAL DAMAGES OR LOSS OF TIME, FOR ANTICIPATED OR LOST PROFITS, OR ANY OTHER LOSS INCURRED BY THE BUYER RELATED TO THE PRODUCT COVERED BY THIS WARRANTY. THIS EXCLUSIVE REMEDY SHALL NOT BE DEEMED TO HAVE FAILED OF ITS ESSENTIAL PURPOSE SO LONG AS SELLER IS WILLING AND ABLE TO REPAIR OR REPLACE DEFECTIVE PARTS IN THE PRESCRIBED MANNER. THIS LIMITED WARRANTY MAY NOT BE MODIFIED BY SELLER UNLESS SUCH MODIFICATION OR WAIVER IS IN WRITING, EXECUTED BY AN AUTHORIZED OFFICER OF SELLER.



InstruTech®

1475 S. Fordham St
Longmont, CO 80503
USA

Phone +1-303-651-0551

Fax +1-303-678-1754

E-mail info@instrutechinc.com

www.instrutechinc.com