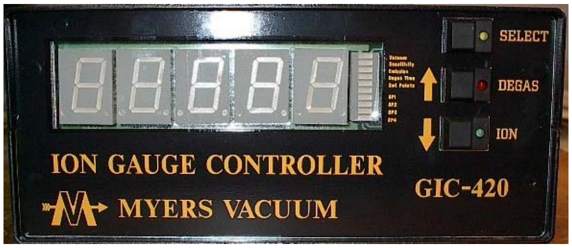
Instruction Manual For

Hot Cathode Ionization Gauge

GIC-420



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GIC-420 Ionization Gauge Controller

Instruction Manual.

Dangerous Voltages are present during the operation of this ion gauge controller. Do not enter the controller cabinet. Do not touch any cable connections when power is being applied to the unit. Follow safe procedures to avoid electrical shock hazards. Safety Pays. Determine what action you are going to take and study this instruction manual before beginning any action. If there is any concern about the best way to proceed, return the controller to Myers Vacuum for repairs or contact Myers Vacuum for repair procedures.

EXPLOSIVE GASES

Do not use this equipment to measure the vacuum pressure of explosive, combustible, corrosive or unknown gases. Ionization gauge filaments operate at high temperatures.

IMPLOSION AND EXPLOSION

Ion gauges in glass enclosures should not be treated roughly or be bumped. If the glass is damaged, it may implode causing glass to fly. If a positive pressure is developed inside the glass enclosure the glass may explode, again causing glass to fly. A shield may be installed around the glass enclosure to help prevent damage.
Install the ion gauge cable on the ion gauge pins before the gauge reaches vacuum pressures. This will prevent bending the gauge pins and possibly causing the glass to crack and the gauge to implode. The gauge cables should be securely fastened to prevent strains or stress on the gauge tube pins. Do not allow the gauge tube temperature to exceed 100^0C. Sustained high temperatures can damage the tube, causing air leakage into the vacuum system. Over pressurization of a gauge tube is as dangerous as implosion. Always remember that ion gauges are calibrated for Nitrogen gas. Other gas pressures should be carefully calculated to be sure that over pressurization and the possible explosion of the gauge tube does not occur.

DANGER, HIGH VOLTAGE

+180 VAC is present in the gauge during operation. Do not touch the ion gauge tube, Ion Gauge Connector or tube connectors while the controller is in operation.

GROUNDING

For safe operation of vacuum equipment the vacuum chamber and all instrumentation, pumps, etc. MUST be grounded. **LETHAL VOLTAGES** may be established in the vacuum system if all chamber surfaces are not grounded. Check with an Ohmmeter to make sure all chamber surfaces are at ground potential, sometimes vacuum chamber gaskets will isolate parts. The ground screw on the back of the GIC-420 must be directly connected to the vacuum chamber.
Confirm that the shipped controller is the same as listed on the packing list and that it includes all the materials and options that were ordered. If materials are damaged, the carrier that delivered the carton or cartons must be notified in accordance with the Interstate Commerce Commission regulations - normally within 15 days. A damage claim must be filed with the carrier, do not call the manufacturer to file a claim as all claims must be made by the recipient through the delivering carrier. Myers Vacuum will be happy to help with shipping identification numbers, routing and/or shipment tracing. Any

damaged materials including all shipping containers, boxes and packing materials should be kept for the carriers inspection.
Contact the manufacturer:
Myers Vacuum
RD# 2 Box 247A
Kittanning, PA 16201
Phone (724) 545 8331 or (888) 780-8331
Fax (724) 545-8332
If the shipment is not identical to the packing list or not what was ordered.

International Shipments

Inspect all materials received for shipping damage. Check to be certain your shipment includes all materials and controller options ordered. Any items damaged must be reported to the carrier making the delivery to the customs broker within 15 days of delivery.

The Myers Vacuum GIC-420 Ionization Gauge Controller is guaranteed for **One Year** against defects in parts, materials and workmanship. Any misuse or attempts to reprogram the controller during the warranty period will void the warranty. No other warranties are expressed or implied. If the unit malfunctions during the warranty period, return it to Myers Vacuum and it will be repaired at no charge. Please include a written statement of the problem with a contact name and phone number.

Power Requirements: 95 - 125 VAC (50/60 Hz), 185 Watts
200-250 VAC (50/60 Hz),185 Watts - OPTIONAL
Size: 3 ½" H (90 mm), 8" W (204 mm), 10.5" D (267 mm)
Weight: 11 Lbs.
Temperature Range: 0 - 40^{0}C
Ion Gauge: Type GIC-048-2
Range: 9.9 x 10 $^{-4}$ to 2.0 x 10 $^{-9}$ Torr
Sensitivity: 1/Torr to 80/Torr (Factory set to 13/Torr)
Emission Current: 1.0 mA o 25.5 mA (Factory set to 10.0 mA)
Collector Potential: 0 VDC
Grid Potential: +180 VDC
Filament Potential: +30 VDC
Degas: I 2 R, 7V, 8A max;
Display Modes:

Vacuum Full range of Ion Gauge Tube
Sensitivity Adjustable from 1/Torr to 80/Torr
Emission Current Adjustable from 1.0 mA to 25.5 mA
Degas Time Timer Adjustable from 1 to 60 Minutes
SP1 Adjustable from 9.9 x 10 $^{-4}$ to 1.0 x 10 $^{-10}$ Torr
SP2 same as SP1
SP3 same as SP1
SP4 same as SP1

Setpoints: 2A @ 100 VAC SPST Relay
RS-232: 9 pin RS-232 Data Port.

IONIZATION GAUGE INSTALLATION

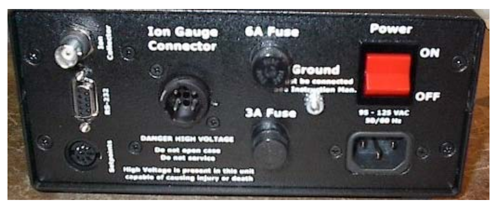
WARNING - Do not Connect the IG Cable to the glass tube while it is under vacuum. Accidental bending of the tube pins could cause the tube to crack and implode.

Mount the Ionization Gauge in a central location in the vacuum system. The ion gauge reading will read a higher vacuum if mounted near the vacuum pumps. The reading will be lower if mounted near a gas inlet or source of contamination. If your vacuum system has an electron beam source the tube should have a shield around it to keep any spurious charged particles out of it.

When connecting the GIC-420 Cable to the tube, don't force the connectors onto the tube. The pins on the tube can bend easily. Connect the collector plug onto the collector pin at the top of the tube. Plug the other end of the cable into the IGT Connector on the back of the GIC-420. Also connect the BNC Plug into the Collector Connector next to the IGT Connector. Route the IG Cable so that it won't get tripped on or pulled.

GROUNDING

Make sure the GIC-420 and the Vacuum chamber are properly grounded to each other and to all vacuum instrumentation being used. See GROUNDING



CONTROLLER INSTALLATION

Place the Controller in a secure place, or mount into an equipment rack with the Optional Rack Mount Kit. The unit comes from the factory, wired for either 115 or 230 VAC, Check the Back panel for input voltage type and connect the power cord to the appropriate voltage.

Operation

READ THE SAFETY PAGE BEFORE PROCEEDING

Follow the instructions in the installation chapter and install the ion gauge tube and cable. The GIC-420 takes a few seconds after power on to run an initializing routine. The unit comes preset for a standard ion gauge tube with the emission current set to 4.1 mA and the sensitivity to 14/Torr. When you are ready to read the chamber pressure, press the Ion pushbutton switch. The green LED in the switch will turn on and in a few seconds you will see the pressure reading on the main display. To turn off the ion gauge, press the switch again.

Vacuum Switch

In the Vacuum mode, the GIC-420 will display "- - - - -" when the ion gauge tube is turned off. To turn on the tube, press the "Ion (-)" switch. The LED in the switch will turn on to indicate that the filament is on. After a few seconds the vacuum at the tube will be displayed. If something is wrong, the switch LED will turns off and a code value will be displayed.

Degas Switch

The GIC-420 uses resistive heating for degassing the ion gauge tube. To degas, the GIC-420 must be indicating a good vacuum (i.e. 1.0×10^{-4} Torr or lower). The degas cycle is started by pressing the “Degas (+)” switch, the red LED in the Degas switch should come on to indicate degassing. The degas timer will determine the length of the degas cycle. Degas will only start if the controller is in the Vacuum mode and the ion gauge tube is turned on. There are 3 ways to shut off the Degas cycle; the degas timer can run out and the controller will turn off the degas, you can press the degas button again, or you can shut off the ion gauge filament and the degas will also shut off.

Adjustment Modes (Select Switch)

The GIC-420 has 8 different modes of adjustment, they are selected by pushing the Select Switch. When in any adjustment mode the yellow LED in the Select Switch will be lit The LED’s next to the main display will inform you of which adjustment mode the controller is in. When in a Setpoint mode, the “Setpoint” & the appropriate SP1 - SP4 LED will come on. All information is displayed on the main display.
When in any mode except for Vacuum, the value displayed can be adjusted by pressing the “DEGAS (+)” switch to increase the value or “ION (-)” to decrease it. All values are stored in an internal EEPROM so they are remembered after the power is turned off. All values can also be adjusted externally using the RS-232 port.
Here is a list of the modes and what they do:

Mode	Select LED	Operation	Display units
1	Vacuum	Display Ion Gauge Vacuum	#.#-## Torr
2	Sensitivity	Display/Adjust Sensitivity	## 1/Torr
3	Emission	Display/Adjust Emission Current	##.# mA
4	Degas Time	Display/Adjust Degas Time	## minutes
5	Setpoint /SP1	Display/Adjust Setpoint 1	#.#-## Torr
6	Setpoint /SP2	Display/Adjust Setpoint 2	#.#-## Torr
7	Setpoint /SP3	Display/Adjust Setpoint 3	#.#-## Torr
8	Setpoint /SP4	Display/Adjust Setpoint 4	#.#-## Torr

Sensitivity Adjustment

Press the Select Switch once to enter the Sensitivity Adjustment mode. The sensitivity value is displayed on the main display. To adjust the value, press the “DEGAS/(+)” switch to increase the value by 1 /Torr, or press the “ION/ (-)” switch to decrease it. The range of adjustment is from 1 to 80 /Torr. There are 2 factors in ion gauges that have a sensitivity. The first is the sensitivity of the gauge tube and the second is the sensitivity of the gas in the vacuum system. These two values should be multiplied together to form the sensitivity value.

Sensitivity = Tube Sensitivity X Gas Sensitivity

Emission Adjustment

Press the Select Switch twice to enter the Emission Adjustment mode. The emission current value is displayed on the main display. To adjust the value, press the “DEGAS/(+)” switch to increase the value by 0.1 mA, or press the “ION/(-)” switch to decrease it. The range of adjustment is from 1.0 to 25.5 milliamps. The controller will automatically switch to a 1/10 emission setting when it is in the lower pressure ranges. This will help increase the life of the ion gauge tube. There is no real reason for changing this adjustment. On older ionization controllers the emission adjustment was used to correct for different sensitivity. The GIC-420 has a sensitivity adjustment and it should be used to change sensitivity.

Degas Timer

Press the Select Switch 3 times to enter the Degas Time Adjustment mode. The degas time value is displayed on the main display. To adjust the value, press the “DEGAS (+)” switch to increase the value by 1 minute, or press the “ION (-)” switch to decrease it. The range of adjustment is from 1 to 60 minutes. If you enter the degas timer mode while Degassing you will see two numbers displayed. The right number is the length of the degas cycle and the left number is the time remaining in the cycle.

Process Control Set Points

The GIC-420 has 4-process control set points, which are activated by the vacuum pressure. The setpoints are activated if the pressure goes below the setpoint value. If the ion gauge tube is turned off, the setpoints will deactivate. When the GIC-420 is reading vacuum, the SP1 - SP4 LED’s will indicate the condition of the setpoints (pressure below setpoint value LED is on) To display or adjust the setpoints, press the Select Switch 4 times to enter SP1 mode. Setpoint 2, 3 & 4 are reached by continuing to pressing the Select Switch. The setpoint value is displayed on the main display. To adjust the value, press the “DEGAS (+)” switch to increase the value by 0.1 , or press the “ION (-)” switch to decrease it. The range of adjustment is from 9.9x10 -4 to 1.0x10 –10. The output of the setpoints are (4) SPST 2A relays that can be configured for either normally open or normally close. The unit comes with SP1 & SP3 as normally open and SP2 & SP4 as normally closed.

The relays are accessed through the 8 pin DIN connector on the back of the unit.

Pin #’s	Connection
1,2	SP1
3,4	SP2
5,6	SP3
7,8	SP4

Configuring Setpoint Relays

The relays of the GIC-420 can be set as either normally open or normally closed. To change the relay you must enter a special calibration mode. The following sequence will enter the Setpoint Relay Configuration Mode:

1. Turn power off to the GIC-420.
2. Press and hold the Select Switch.
3. Turn power on to the GIC-420.
4. Release the Select Switch once the LED check is complete.
5. Press the Select Switch 8 times, the display should read “S1 no” . This indicates that setpoint 1 is normally open, “S1 nc” indicates that setpoint 1 is normally closed.
6. To change the relay press either the + or – button. The display will change from “S1 no” to “S1 nc”. Note: The Actual Relay will not change unless the filament is on, or the controller is turned off then on again.
7. To Adjust/Check Setpoint 2 through 4, continue to press the Select Switch.
8. Press the Select Switch once more to go back to the vacuum mode.
9. To return GIC-420 to normal operation turn power off, then on.

Ion Gauge Shut Down Codes

When the GIC-420 turns off the ion gauge tube, the controller will display a CODE# on the main display. This will stay on the display for about 2 seconds. Here is the list of the CODE#'s.

CODE E1

The Ion Gauge shuts off because it can not get or hold the Emission Current.
Possible Problems: Pressure is to high
Ion Gauge Cable is disconnected
Filament Fuse is blown

CODE E2

The Ion Gauge shuts off because it can not establish Collector Current.
Possible Problems: Pressure is to low
Ion Collector BNC is disconnected

CODE E3

The Ion Gauge shuts off because the vacuum lower than $9.9x10^{-4}$ Torr. This is the normal shut down mode when bringing the pressure up in the vacuum system.

CODE E4

There is a problem with the EEPROM. If this Code is displayed call Myers Vacuum for repair.

CODE E6

There is a problem with the RS-232 receiver routine.
Possible Problems: RS-232 Cable is loose or broken
Baud Rate or Communication Setting are wrong.

Operating Principles

All ionization gauges operate on the basis of ionizing a fraction of the gas molecules present in the gauge and the collecting the gas ions. The gas ions are positively charged and cause an electrical current flow to the ion collector circuit. The magnitude of this current indicates the amount of pressure. A higher pressure (density of gas molecules) will cause a larger rate of ionization, resulting in a greater rate of positive ionic charge on the collector. These positive charges form a current in the collector circuit, from which the pressure is calculated.

Simple hot filament ionization gauges are available in several forms; such as the triode geometry or the more popular inverted triode (Bayard-Alpert) geometry. The GIC-048-2 tubes have glass enclosures. The ion collector is a slender wire down the center of a grid structure. The electron emitting filaments are outside the grid structure. Since the traditional triode gauge arrangement has the electron emitter inside the grid and the ion collector outside the grid, the Bayard-Alpert gauge is often referred to as an inverted triode gauge. The GIC-048-2 has two electron emitting filaments; however only one filament is used during the operation of the gauge. The second one is available for use when the first one burns out. The filaments on a GIC-048-2 are made of iridium coated with yttrium oxide. The coated filaments have a longer life because they can withstand operation in higher partial pressures of oxygen and water vapor.

In the normal operation of the gauge, power is applied to the filament. The filament heats and electrons are emitted. The emission current is usually a few milliamperes when the gauge is operated in the high vacuum pressure range. The emitted electrons are accelerated toward the positively biased grid. Usually this accelerating potential difference is 150 volts. The grid is a relatively open structure therefore, most of the electrons pass through the grid, slow down, turn around and are accelerated back toward the grid again. The electrons pass through the grid and may oscillate back and forth through the grid structure many times before they hit the grid. This long mean free path for the electrons improves the probability that they will hit a gas molecule and ionize it even though the pressure may be in the ultra-high vacuum range. When such an ionizing collision takes place the positively charged gas ion is attracted to the most negative element in the gauge tube; the ion wire. Usually the ion collector wire is held at ground potential or zero volts. The ionized gas molecules are attracted to the ion collector and create a current in the collector circuit which provides the pressure indication.

Pressure Calculation

In hot filament ion gauges, the ionizing electrons are emitted from the hot filament. The rate at which electrons are emitted is measured by the emission current (Ie) of the filament. The gas ions produced in the gauge are attracted to the ion collector and produce an ion current (Ic) in the ion collector circuit. In order to determine the pressure (P) measured by the ion collector current we need to know what relationship exists among the variables; P,Ie and Ic.

There is a direct relationship between the ion current and the emission current. If the user increases the emission current more electrons are emitted from the filament.

Therefore more gas molecules will be contacted and ionized and the ion current will be increased. The ion current is a direct function of the density of the gas molecules present. As the pressure increases, the density of gas molecules increase. Hence there will be more gas molecules hit by the emitting electrons, resulting in an increase of ion current. The ion current is also a function of the geometry of the elements in the tube and to some degree the electrical potentials of the various elements. If the emitted electrons have a very long mean free path from emitter to collector there is an increased probability of hitting a gas molecule, ionizing it and producing an increased ion current. We must remember that the probability of ionization is also a function of the gas species present in the gauge tube. Theeffect of geometry, electrical potentials and gas species are combined to form the gauge's sensitivity (s).

The equation that relates all these quantities is :

P = Ic Ie * S

S = Tube Sensitivity x Gas Sensitivity.

Effects of Various Gases

(Relative Sensitivity)

We want to examine what effects different gases in the gauge tube will have on the indicated pressure. We have to make the distinction between the true pressure in the gauge tube and the pressure that is indicated by the controller. Almost all manufacturers calibrate their gauges so that the indicated pressure is nearly identical with the true pressure when the gas is a normal air mixture.

In any gauge tube that has a fixed volume and operates at a constant temperature, the true pressure is determined solely by the number of gas molecules present. However the indicated pressure in an ionization gauge is determined by the rate at which gas ions are collected. Typically this rate of collection is determined by the rate gas molecules are ionized. This ionization rate varies with gases, other than normal air or nitrogen, causing a discrepancy between the indicated pressure and the true pressure (when nitrogen or normal air is not being used). The relative sensitivity of a gas is the relationship between the ionization rate of the gas and nitrogen. When not using nitrogen, the indicated pressure of the ion gauge controller must be divided by the relative sensitivity number for that gas. Table 2 shows the relative sensitivities for various gases.

Gas Type Relative Gas

Sensitivity S/SN

Adjustment

Helium 0.178
Neon 0.316
Hydrogen 0.410
Oxygen 0.780
Water Vapor 0.90
Nitrogen 1.00
Carbon Monoxide 1.01
Carbon Dioxide 1.39
Argon 1.42
Krypton 1.94
Xenon 2.75

Degas

There is a possibility at some time during ion gauge operation that the pressure in the gauge tube will be higher than the pressure in the vacuum system because of gases and vapors desorbing from the surfaces of the gauge tube. Degassing is the process by which we attempt to speed up desorbtion or outgassing of the surfaces inside the gauge tube. Once these surfaces are outgassed or degassed, the pressure in the gauge tube is more likely to be equal to the pressure in the vacuum system..12

Degassing is usually accomplished by applying an additional amount of electrical power to some of the elements in the tube, thus causing those elements to heat. Heated surfaces outgas more rapidly than cool surfaces. Heat flow, by radiation and conductance, causes all the gauge surfaces to heat, and thus to outgas.

The GIC-420 performs degas by using Resistive heating (I 2 R). An electrical current is passed through the grid structure. This causes these wires and all the gauge elements to get hot. In order to thoroughly outgas a hot filament gauge tube allow 15 to 45 minutes of operation in the degas mode. It may take a longer period of degas time or repeated degas cycles if the gauge is extremely contaminated.

X-ray Limit

The x-ray limit is one of the fundamental factors which limit the minimum pressure that is measurable by the hot filament ionization gauge. In any gauge there is a hot, electron emitting filament on the axis of a cylindrical electrode structure. Surrounding the filament is a positively biased electron collecting grid, and a negatively biased ion collector surface. Electrons emitted from the filament are accelerated to the grid. Some of the electrons hit gas molecules and ionize them. The positively charged ions are attached to the ion collector circuit. The arriving charged ions give rise to a current in the ion collector circuit.

The ion current is supposed to be proportional to the pressure in the gauge tube.

When the emitted electrons hit the grid they impact with enough energy that soft (low energy) x-rays are generated. These x- rays are emitted from the grid structure in all directions, so that many of the x-rays hit the ion collector surface. When an x-ray hits the ion collector it simulates the emission of a negative electron from the ion collector. A negatively charged electron leaving the ion collector, is electrically equivalent to a positively charged ion arriving at the collector. The electronics in the ion collector circuit cannot distinguish the difference. Therefore as long as the arriving ion current is much greater than the x-ray stimulated (leaving electron) current, the gauge can accurately indicate the pressure. But, if the pressure is so low that the ion current becomes comparable to or less than the x-ray stimulated electron current, the gauge electronics will only indicate a lowering pressure down to that "stimulated pressure," analogous to the value of the x-ray stimulated electron current. At this point the gauge is said to be at its x-ray limit.

Electrometer

The electrometer collects and monitors the current in the collector circuit and thus indicates the vacuum level by the amount of current. The electrometer is a high precision integration amplifier that converts the current to a pulse width. The microprocessor computes the vacuum by timing the width of the pulse. The electrometer must be able to monitor a large current flow in the 10^{-4} torr range and a very minute current flow in the 10^{-9} torr range.

The GIC-420 Ion Gauge Controller has a full functioning Remote computer port. All aspects of the GIC-420 can be controlled via the RS-232 interface by sending simple commands to the controller. Any computer or terminal with a serial RS-232 port can be connected to the GIC-420. If the controller is connected when the power is turned on the Software version name will be sent to the computer.

RS-232 Interface

The RS-232 interface uses a standard 9 pin serial port. The port specifications are listed in table 3 below. The Pin out of the controllers RS-232 port is listed in table 4, you can get by with only the TX, RX & Ground wires connected. The DTR is connected internally to the DSR and the RTS to the CTS.

Pin Function	**Pin #**	**Function**
Interface Type RS-232	1	NC
Interface Mode DTE	2	TX (Transmit Data)
Baud Rate 2400	3	RX (Receive Data)
Stop Bits 1	4	DTR
Data Bits 8	5	Ground
Parity Bits None	6	DSR
Flow Control None	7	RTS
Voltage of Logic 0 +12 VDC	8	CTS
Voltage of Logic 1 -12 VDC	9	NC

Software Commands

- All commands must terminate with a <CR>
- The controller will echo back the characters received (unless disabled).
- Standard ASCII is used
- "n, nn, nn.n" refer to a numerical value
- "m.m" refer to a mantissa value
- "ee" refer to an exponent

Command	Response	Example	Description
=RS	S=*nn* (1 to 80)	=RS S=10	Read Sensitivity
=RE	E=*nn.n* (1.0 to 25.5)	=RE E=10.0	Read Degas Time
=RT	T=nn	=RT	Read Degas Time

	(1 to 60)	T=30	
=R1	1=m.m-ee (1.0-03 to 1.0-10)	=R1 1=2.3-04	Read Setpoint 1
=R2	2=m.m-ee (1.0-03 to 1.0-10)	=R2 2=5.0-09	Read Setpoint 2
=RV	V=m.m-ee (2.0-00 to 1.0-10)	=RV V=5.0-07	Read Vacuum
=R*	*= b1b2b3b4	=R* *=1010	Read Status .b1= Ion on .b2=Degas On .b3=SP1 On .b4=SP2 On
=SS:nn (1 to 80)	S:OK	=SS:25 S:OK	Set Sensitivity
=SE:nn.n (1.0 to 25.5)	E:OK	=SE:4.0 e;OK	Set Emission Current
=ST:nn (1 to 60)	T:OK	=ST:20 T;OK	Set Degas Time
=S1:m.m-ee (1.0-4 to 1.0-10)	1:OK	=S1:1.0-4 1:OK	Set Setpoint 1
=S2:m.m-ee (1.0-4 to 1.0-10)	2:OK	=S1:1.0-4 1:OK	Set Setpoint 2
=SF1	F=:On	=SF1 F=On	Turn on Ion Gauge (You should check the status to see if the filament stays on or get shut off)
=SF0	F=Off	=SF0 F=Off	Turn Off ion Gauge
=SD1	D=On	=SF0 F=OFF	Turn On Degas (you will get an error 3 if the ion gauge is not on)
=SD0	D=Off	=SD0 D=Off	Turn Off Degas
	Error 1	Sdkcjbn	Syntax Error
	Error 2	=ST:99 Error 2	Number Out of Range
	Error 3	=ST:99 Error 3	Operation Not Allowed
	Error 4		TX Buffer Overflowed
=R#	IFS400 V?.??.?? SN <serial number>	=R# IGS400 V.00.00	Read Serial number
=X	IGS400 V?.??.??	=X IGS400 V.00.00	Read GIC-420 (Displays Software Version)

Symptom Possible Cause

Unit won't power up, no response to power switch.
- No power to unit
- Power cord not inserted tightly
- Power fuse is blown

3A Power fuse blows repeatedly.
- Wrong line voltage
- Wrong Power fuse rating
- Defective Power Supply

8A fuse blows repeatedly.
- Ion Gauge tube filament is shorted
- Ion Gauge cable is shorted

Ion Gauge tube won't come on, or comes on briefly then shuts off with CodE1 displayed. (The Tube does NOT light up at all)
- Unplugged Ion Gauge Cable
- Burned out filament
- Blown 8A fuse
- Broken Ion Gauge Cable
- Defective Power Supply

Ion Gauge tube won't come on, or comes on briefly then shuts off with CodE1 displayed. (The Tube light's up briefly)
- System pressure is too high
- Badly contaminated Ion Gauge tube
- Defective Ion Gauge Cable
- Defective Ion Gauge tube

Ion Gauge tube won't come on, or comes on briefly then shuts off with CodE2 displayed.
- System pressure is too low
- Ion Collector BNC is unplugged
- Ion Collector wire is off of the tube
- Defective Ion Gauge Cable

Ion Gauge tube won't come on, or comes on briefly then shuts off with CodE3 displayed.
- System Pressure is too high

CodE4 is being displayed on the controller.
- Send Unit back for repair

CodE6 is being displayed on the controller.
- RS-232 Cable is loose or broken
- Baud Rate or Communication Setting are wrong.

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