351 Series Ionization Vacuum Gauge Module



User Manual

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p/n 002159-102

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 Kurt J. Lesker Company (KJLC) 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, KJLC cannot assume responsibility or liability for any actual use based on the examples and diagrams.

No patent liability is assumed by KJLC 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.

WARNING

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.

CAUTION

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.

NOTICE

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

SHOCK HAZARD

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

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1 Introduction / General Information

1.1 Description

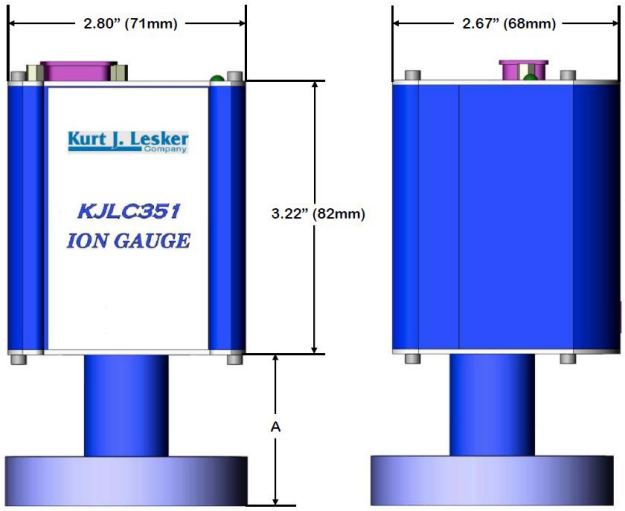
A hot cathode ionization gauge measures vacuum pressure by ionizing gas atoms and molecules inside the vacuum region of the gauge transducer and measuring the quantity of ions produced. The measurement of the resulting ion current is directly proportional to the density of gas inside the gauge transducer therefore proportional to the pressure. As pressure inside the vacuum system drops, there are fewer ions created and therefore ion current measured is lower translating to a lower pressure reading.

The Kurt J. Lesker Company (KJLC) 351 is an ionization gauge module specifically designed for use with the MGC3200 and MGC4000 vacuum gauge controllers (MGC). The measurement range for the 351 hot cathode ionization gauge is 1 x 10^{-9} to 5 x 10^{-2} Torr.

1.2 Specifications

measurement range	1 x 10^{-9} to 5 x 10^{-2} Torr / 1.3 x 10^{-9} to 6.7 x 10^{-2} mbar / 1.3 x 10^{-7} to 6.66 Pa
accuracy - N_2 (typical)	1 x 10^{-8} to 5 x 10^{-2} Torr; ± 15% of reading
repeatability - (typical)	± 5% of reading
materials exposed to gases	dual filaments: yttria coated iridium or optional tungsten Ion collector: tungsten Grid: 304 Stainless Steel Others: 316/304 SS, glass, nickel
sensitivity	Factory pre-set. Also user adjustable from 2 to 99 (set by the MGC3200/4000 (MGC) controllers)
x-ray limit	< 5 x 10^{-10} Torr, < 6.7 x 10^{-10} mbar, < 6.7 x 10^{-8} Pa
emission current	100 µA, 4 mA, or automatic switching between 100 µA and 4 mA
degas	3 W, electron bombardment
overpressure protection	gauge turns off at factory default setting of 5 x 10^{-2} Torr MGC can also be set up to auto filament turn on/off using a convection gauge
filament status	filament on/off status LED located on the 351. The filament on/off status is also displayed by the MGC controller
internal gauge volume	1.0 in^3 (16.4 cm^3)
operating temperature	0 to + 40 °C
storage temperature	-40 to + 70 °C
bakeout temperature	200 °C (sensor only - electronics removed)
humidity	0 to 95% RH non-condensing
weight	0.6 lb. (0.27 kg) with NW25 KF flange
housing (electronics)	aluminum extrusion
mounting orientation	any
altitude	operating; 8,200 ft. (2,500 m) max storage; 41,000 ft. (12,500 m) max
setpoint relay	relays available at the MGC
input signal	all 351 operations controlled from the MGC
filament selection	user selectable between filament 1 and 2 - command signal sent from the MGC
input power	powered by MGC Multi-Gauge Controller
connector/cabling	KJLC custom cable/connector assembly for connection to MGC
CE compliance	EMC Directive 2014/30/EU, EN55011, EN61000-6-2, EN61000-6-4, EN61326-1, EN61010-1
environmental	RoHS

1.3 Dimensions



fitting	dimension A
NW16KF	1.45 in. (37mm)
NW25KF	1.45 in. (37mm)
NW40KF	1.45 in. (37mm)
1 1/3 in. Mini CF	1.85 in. (47 mm)
2 3/4 in. Conflat®	1.70 in. (43 mm)

1.4 Part Numbers

351 Fittings / Flanges	Ion Gauge Module (Yttria filaments)	Replacement Sensor
NW16KF	KJLC351400YB	IG4YB
NW25KF	KJLC 351400YC	IG4YC
NW40KF	KJLC 351400YD	IG4YD
1 1/3 in. Mini-CF/NW16CF Mini-Conflat®	KJLC 351400YE	IG4YE
2 3/4 in. CF / NW35CF Conflat®	KJLC 351400YF	IG4YF

351 / MGC cable	*Part Number*
Cable, 351 to MGC, 10ft. (3m)	BXC400-1-10F
Cable, 351 to MGC, 25ft. (8m)	BXC400-1-25F
Cable, 351 to MGC, 50ft. (15m)	BXC400-1-50F

2 Important Safety Information

KJLC 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.**

⚠ WARNING

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. KJLC disclaims all liability for the customer's failure to comply with these instructions.

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

This device meets FCC part 15 requirements for an unintentional radiator, class A.

2.1 Safety Precautions - General

Hazardous voltages are present with this product during normal operation. The product should never be operated with the covers 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 KJLC service trained personnel. Return the product to a KJLC 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 KJLC. 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 KJLC 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 351 is properly connected to earth ground.

Do not turn on filaments and try to activate the sensor when pressure exceeds 1.00×10^{-3} Torr if the device is operating at the 4 mA emission current setting.

Do not turn on the filaments and try to activate the sensor when pressure exceeds 5.00×10^{-2} Torr if the device is operating at the 100 µA emission current setting.

Ensure vacuum level is at or less than 5.00×10^{-5} Torr before attempting to initiate degas.

⚠ **WARNING!** The power supply used in the 351 hot cathode gauge module is subject to high voltages which could cause severe injury or death. In order to prevent electric shock and bodily harm, the user should wait 5 minutes after power is removed before touching the 351 power supply components.

⚠ **WARNING!** When the 351 is turned on, 180 V is present at the power supply and other components such as the ion gauge and the cable. Furthermore, voltages as high as 350 V are present during degas. DO NOT operate or apply power to the 351 with the 351 enclosure removed. Contact with exposed electrical circuits in the 351 could result in death or serious injury.

NOTICE Do not use another gauge to automatically turn off the Ion gauge when the Ion gauge filament in use is constructed of tungsten (yttria coated filament is ok). The response time of other gauges may not allow for timely turn off of the tungsten filament leading to filament damage. Always turn off the IG filament manually before pressure is to rise above 1.00×10^{-3} Torr.

When using yttria coated filaments, it is highly recommended to periodically alternate operating Filaments 1 and 2. An inactive filament not operating for an extended length of time may result in that filament failing to establish emission current when it is eventually used. This will be more problematic in dirty applications.

The source power to the 351 is supplied from the MGC controller using the custom cable provided by KJLC.

Turn off power to the unit before attempting to service the module. Turn off power to the unit before detaching the electronics from the sensor for sensor replacement or bake-out purposes.

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.

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

Use yttria coated filaments with air and inert gases such as N_2, argon, etc. Optional tungsten filaments are available for use with gases not compatible with yttria filaments.

The most common cause of all vacuum gauge failures is contamination of the sensor. Noisy or erratic readings and total gauge failure are possible indications of gauge contamination. Contamination can generally be characterized as either:

A) A physical or chemical reaction of process gases with the sensor element. A different gauge may be considered if neither Yttria nor Tungsten filament sensor materials are compatible with your application.

B) An accumulation of material on the sensor element. In this case, performing the degas function of the instrument may resolve the issue.

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 connection port on which the ion 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. The vacuum gauge transducer 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 device 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.

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.

The 351 is not intended for use at pressures above 20 psia (1000 Torr); DO NOT exceed 35 psig (< 2 ½ bars) pressure inside the sensor. If your chamber goes to higher pressures, 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 tube 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!** Do not attempt to use with gases other than nitrogen (N_2) or air without referring to correction factor data tables.

KJLC gauges are calibrated for direct readout of nitrogen or air. Do not attempt to use with other gases such as argon (Ar) or carbon dioxide (CO_2) unless accurate conversion data for N_2 to other gas is properly used. Refer to the correction factor data listed in the controller User Manual operating this device. The MGC controller User Manual provides a more complete discussion of using correction factors when using the gauge on gases other than N_2 / air.

⚠ **WARNING!** Do not use this device in an explosive atmosphere or in the presence of flammable gases, vapors or fumes. Do not use this device to measure the pressure of explosive or combustible gases or gas mixtures. The sensor filaments operate at incandescent temperatures and could become an ignition source. This could cause an explosion which could result in serious injury or death.

3 Installation

3.1 Mechanical Installation

Mount the 351 as close as possible to the pressure you want to measure. Long or restricted, small diameter tubing will create a pressure difference between your process chamber and the gauge. This may cause a delay in response to pressure changes. Mounting the 351 too close to a gas source inlet may also cause measurement and control instability.

The 351 can be mounted in any orientation, however, if possible, mount the gauge with port down to help minimize the effect of any particles or condensation collecting in the gauge.

Do not mount the 351 where it will be subjected to excessive vibration. Vibrations may cause unstable readings, measurement errors and possible mechanical stress to components in the 351.

Shield the 351 near ion or electron sources such as an electron beam or in a sputtering system.

For electrical safety purposes the housing of the gauge must be grounded to the vacuum chamber. When using KF flanges, metal clamps must be used to ensure proper grounding. Do not attempt to modify your flange in order to use non-metallic-type flange clamps.

Fittings/Flanges - follow the fitting/flange manufacturer's recommendations for installation and use.

Use all metal vacuum fittings with metal seals when operating pressures are expected to be below 1.00×10^{-7} Torr (1.33×10^{-7} mbar, 1.33×10^{-5} Pa).

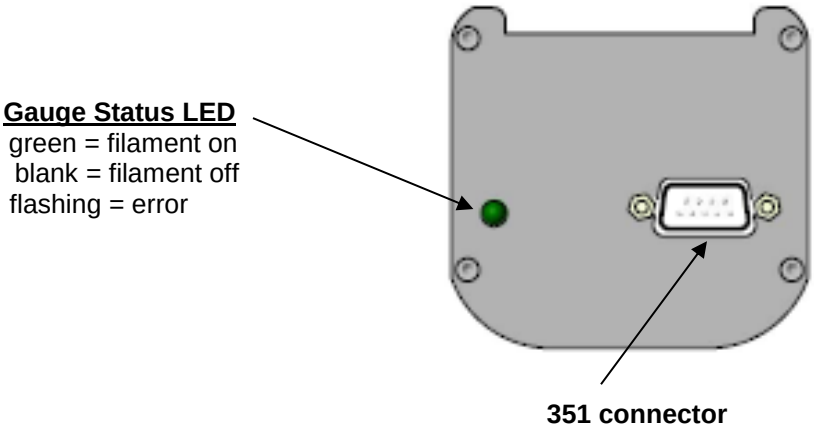
3.2 Electrical Installation

3.2.1 Grounding

⚠ Be sure the vacuum gauge and the rest of your vacuum system are properly grounded to protect personnel from shock and injury. Be aware that some vacuum fittings, especially those with O-rings when not used with metal clamps, may not produce a good electrical connection between the gauge and the chamber it is connected to. Use a ground lug on the vacuum connection flange of the pressure measurement device if necessary.

3.2.2 Electrical connection

Use the KJLC custom cable/connector assembly for connection to the MGC vacuum gauge controller.



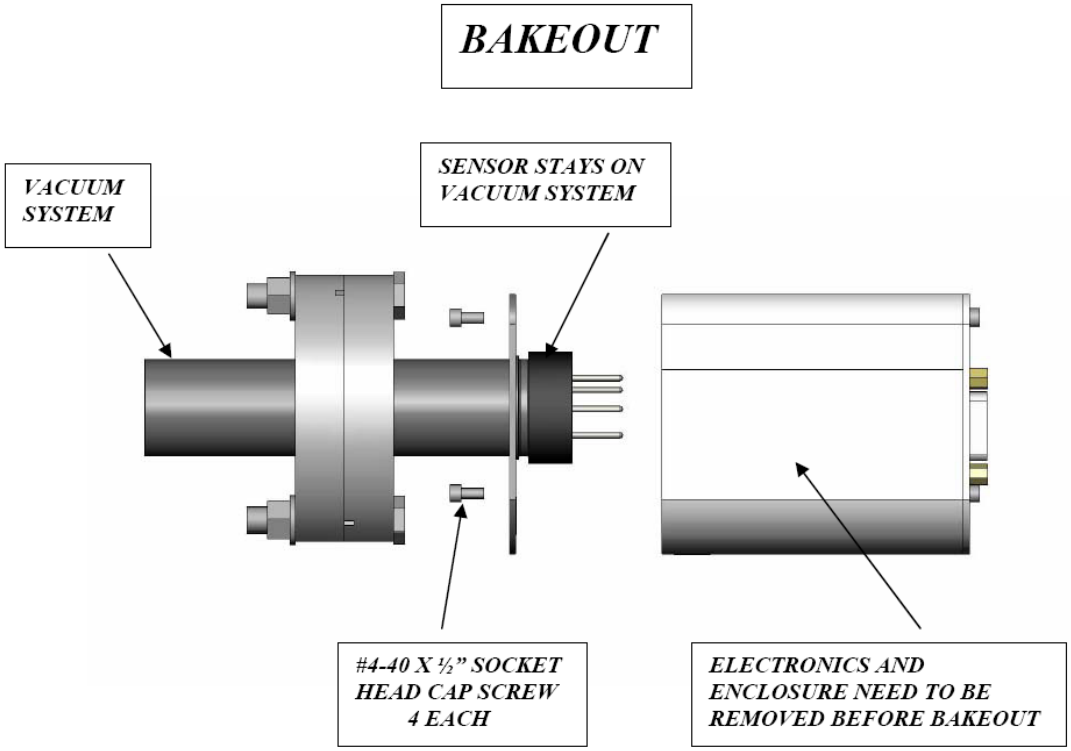
⚠ **CAUTION!** Possible damage to property and injury to personnel may result if connections to the Ion Gauge (**IG**) connector of the 351 are made while power is applied to the controller unit. **DO NOT** connect, disconnect or reconnect the cable from the controller back panel **IG** connector to the 351 module when power is applied to the controller. Switch the AC Mains Power Switch on the back panel of the MGC controller to OFF (0) prior to either disconnecting or reconnecting cables to the C351 module.

The DE-9P D-subminiature end of the KJLC cable assembly for connecting the 351 ion gauge module to the MGC is connected to the 351 module. The mini-DIN connector end of this cable connects to the connector labeled **IG** on one of the available IGM/CG option cards in the MGC.

4 Bakeout

If desired, a chamber bake may be performed for new systems or after routine maintenance. The 351 sensor can be baked out to 200 °C as long as the sensor fitting uses metal seals. For sensor fittings using elastomer O-rings, the maximum bakeout temperature is limited to the maximum temperature rating of the elastomer O-ring. Ensure the temperature of the sensor tube and the vacuum fitting to the sensor is at the same or above the chamber temperature. The electronic module must be removed from the sensor if the bake-out temperature is to exceed 70 °C. To bake out the sensor use the following procedure:

1. Turn off power to the 351.
2. Disconnect the cable from the 351.
3. Use a 3/32 in. size Hex key to remove the #4-40 socket head cap screws (SHCS) as shown below.
4. Detach the metal enclosure and the electronics from the sensor. Gently pull the electronics enclosure away from the sensor using a gentle rocking motion.
5. The black plastic cap attached to the sensor and the end plate does not have to be removed for bakeout.
6. Perform bake out with the electronics removed.
7. Reattach the electronics enclosure. Reinstall the screws (4 ea.)



5 Setup and Operation

The 351 receives power from the MGC controller via custom cables supplied by KJLC. All display and control functions of the 351 are performed remotely by the MGC controller. The 351 receives commands for the emission current selection; degas function commands as described below and all other control functions from the MGC controller.

5.1 Emission Current

4 mA or 100 µA (0.1 mA) emission current are available settings of emission current.

1) In clean applications and operating at higher pressure ranges (5.00×10^{-6} Torr to 5.00×10^{-2} Torr) the 100 µA emission setting is preferred.

2) At lower operating pressures (1.00×10^{-9} Torr to 5.00×10^{-4} Torr) the 4 mA emission setting should be used.

3) The emission current can also be set to automatically switch between 4 mA and 100 µA. This results in optimal and stable pressure readings over the entire measurement range from low to high vacuum. For example if an application requires that pressure measurements be performed by the ion gauge from pressures lower than 5.00×10^{-6} Torr to 5.00×10^{-2} Torr then the user may want to consider using the automatic switching feature of the MGC controller. The switching of the emission current may be programmed to take place at any pressure from 1.00×10^{-6} to 1.00×10^{-4} Torr.

4) When using a diffusion pump or other pumps that use fluids, there is a possibility of the pump oil vapors entering the IG transducer. These vapors may form an insulator on the internal components of the transducer which can lead to instability or failure in controlling the emission. In this case, the 4 mA emission current may provide improved operating lifetime and measurement performance.

5.2 Overpressure shut down

The 351 is provided with factory set default values for overpressure shut down. The gauge will shut off automatically should the pressure reach or rise above the pressure shut down values shown below:

Factory set overpressure shut down values

Emission Current	Overpressure Shut Down (Torr)	Overpressure Shut Down (mbar)	Overpressure Shut Down (Pa)
4 mA	1.00×10^{-3}	1.33×10^{-3}	1.33×10^{-1}
100 µA (0.1 mA)	5.00×10^{-2}	6.66×10^{-2}	6.66

5.3 Degas

Degas is used to rid the gauge sensor of adsorbed gas. Degas is achieved by applying Electron Bombardment (EB) to the grid. The intervals at which degas should be applied vary for each application. The low pressure measurement performance of the transducer will normally improve after each degassing cycle.

- Degas can only be applied while the filament is turned on and operating.
- Ensure vacuum level is at or less than 5.00×10^{-5} Torr before attempting to initiate degas.
- Power during degas is about 3 watts higher than the normal operating power.
- Degas will automatically turn off after 2 minutes when using factory default settings. Degas can be programmed in the MGC controller for duration of 2 to 10 minutes.
- The 351 will continue to measure pressure while degas is in progress.
- Degas will automatically turn off if the pressure exceeds 3.00×10^{-4} Torr during the degas cycle, but the filament will remain turned on.
- Degas can be interrupted by turning the IG filament off from the MGC controller.

5.4 Filament Material Selection / Venting the Chamber

The choice of which filament material type to use in the 351 is primarily dependent upon the process and process gases the ion gauge will be used with. For general vacuum applications, dual yttria coated filaments are offered for use with air and inert gases such as N_2, argon, etc. Optional dual tungsten filaments are available for use with gases not compatible with yttria filaments.

1) Yttria coated iridium filament
In most general vacuum applications, the yttria coated iridium filament is the best choice.

Yttria coated filaments typically operate at a lower temperature than tungsten filaments and thus have a lower outgassing rate at UHV and lower chemical reactivity with active gases.

Yttria coated filaments typically have a longer operating life than tungsten filaments in clean applications.

The yttria coated filament can survive occasional accidental start attempts at atmosphere in air, but the overall life of the filament may be shortened during each occurrence. Good vacuum practice is to use the KJL275 convection gauge to know when to turn on the ion gauge filament. Refer to the vacuum gauge controller operating this device for further details on how to use the convection gauge to turn on the ion gauge filament.

2) Tungsten filament
Typically a bare tungsten filament is a better choice in those applications where an yttria coated filament is quickly damaged due to the gas type in use. For example, processes such as ion implantation may only use tungsten filaments. Be aware that corrosive applications are hard on any filament and filament life will be shortened while operating in such environments. Tungsten filaments are easily damaged by exposure to air/oxygen during accidental system vents or if considerable quantities of water vapor are outgassed during pump-down and bake-out. It is very important to make sure the tungsten filament is turned off before bringing the chamber up to atmosphere, especially if air is being used to vent the chamber. The use of pure N_2 gas is highly recommended to vent or purge your vacuum chamber. Testing has shown that tungsten filaments can withstand limited high pressure excursions when only N_2 is present.

Venting with air or other oxygen containing gases can damage the tungsten filaments. If you try to turn on an ion gauge with tungsten filaments while it is sitting on your desk exposed to room air, you will immediately damage or destroy the filament beyond repair.

NOTICE Do not use another gauge to automatically turn off the ion gauge when the ion gauge filament in use is constructed of tungsten (yttria coated filament is ok). The response time of other gauges may not allow for timely turn off of the tungsten filament leading to filament damage. Always turn off the IG filament manually before pressure is to rise above 1.00×10^{-3} Torr.

Both types of filaments discussed here will suffer eventual damage if operated at high pressures. The type and amount of damage at high pressure is dependent upon the length of operating time, the pressure and the gases present.

5.5 Activating the sensor

Before you turn on the IG filament and activate the sensor, make sure you understand all instructions and information provided in this user manual. You can only activate the sensor from the MGC controller.

Note - It may take up to 8 seconds for the 351 transducer filament to turn on after it has received a turn on command from the controller.

5.6 Gauge Status LED

The 351 is provided with a Gauge Status LED to determine the gauge / filament status as shown in section 3.2.2 and described below:

- When LED is green = filament on
- When LED is blank = filament off
- When LED is flashing = error

5.7 Using the gauge with different gases

KJLC gauges are calibrated for direct readout of nitrogen or air. Do not attempt to use with other gases such as argon (Ar) or carbon dioxide (CO_2) unless accurate conversion data for N_2 to other gas is properly used. Refer to the correction factor data listed in the controller User Manual operating this device. The User Manual for MGC controllers provide a more complete discussion of using correction factors when using the gauge to measure pressure of gases other than nitrogen / air.

6 Service

6.1 Calibration

Every KJLC device is calibrated prior to shipment using nitrogen. Care should be exercised when using gases other than nitrogen (N_2) / air. (See Section 5.7 titled "Using the gauge with different gases")

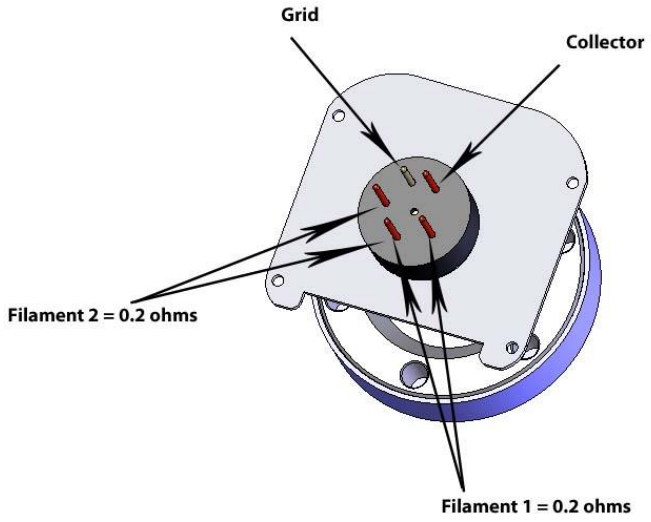
6.2 Troubleshooting - Operation

Indication	***Possible Cause***	***Possible Solution***
Measurements appear different from expected pressure	Sensor not in the proper location to measure system pressure	Ensure the sensor is located in appropriate location
	The process gas is different from the gas (nitrogen) used to calibrate the 351	Apply gas sensitivity correction factor if applicable
	Sensor has been dropped causing mechanical damage	Replace the Ion gauge sensor tube
	The gauge sensor tube is contaminated	Replace sensor
	Leak in the vacuum system	Re-check for leak in the system
Ion gauge cannot be turned on	Pressure exceeds 1.00 x 10^{-3} Torr at 4 mA emission	Decrease pressure below required value
	Pressure exceeds 5.00 x 10^{-2} Torr at 0.10 mA (100 µA) emission	Decrease pressure below required value
	Emission Control not functioning	Switch to the other filament Replace Ion gauge sensor tube due to possible filament failure or contamination
Unable to initiate degas	System pressure above 5.0 x 10^{-5} Torr	Decrease pressure below the required value

6.3 Troubleshooting - Filaments F1 or F2 open

If a filament is open, then trying to start the filament will result in the MGC error messages “F1 or F2 open” or similar displayed error messages. This may be an indication of open filaments but in some cases it could also be an indication of faulty electronics.

To determine whether the problem is caused by either a failed filament or the electronics, refer to section 6.6 and follow instructions to remove the ion gauge transducer from the control module. Measure the resistance (electrical continuity) of filaments 1 and 2 as shown below. A good, intact filament will indicate a resistance of 0.2 ohms on your ohmmeter.



6.4 Maintenance

In general, maintenance is not required for your KJLC module. Periodic performance checks may be done by comparing the gauge to a known reference standard. When using the transducer in gases containing contaminants or materials that react with the filaments of the hot cathode ion gauge, periodic degas and switching to the alternate filament from time-to-time is recommended for longest useable transducer lifetime. When the hot cathode (filament) of the ionization gauge transducer is at or near end-of-life, transducer (sensor) replacement is recommended.

6.5 Contamination

The most common cause of all vacuum gauge failures is contamination of the sensor. Noisy or erratic readings, and total gauge failure are all possible indications of gauge contamination.

Contamination can be generally characterized as either a reaction of process gases with sensor elements, or an accumulation of material on the sensor elements. Sensors that fail due to chemical reaction are generally not repairable. Sensors that fail due to condensation, coatings, or particles may possibly be restored by performing the degas function.

A) Reactive Gases

If process gases react with the materials of construction of the sensor, the result is corrosion and disintegration of the sensor over time. For general vacuum applications, dual yttria coated filaments are offered for use with air and inert gases such as N_2, argon, etc. Optional dual tungsten filaments are available for use with gases not compatible with yttria coated filaments.

B) Oil, Condensation, Coatings, and Particles

If the failure is due to an accumulation of material in the gauge, you may be able to rid the gauge sensor of adsorbed gas using the degas function of the device.

Oils and hydrocarbons: Exposure of the gauge internal surfaces to oils and hydrocarbons can result in sensor contamination. Some of these types of contamination may possibly be removed by degas. Furthermore, if there is the possibility of oil back streaming from wet vacuum pumps, it is recommended that a filter or trap be installed to prevent contamination of components of your vacuum system.

In some vacuum processes, desorbed and sputtered materials from the process may enter vacuum components connected to the process vacuum chamber by line-of-sight transport especially under high vacuum conditions, i.e., in the molecular flow regime. To prevent materials that may be transported via line-of-sight momentum from entering your vacuum gauge or other components, it is advisable to install some form of apparatus that will block the line-of-sight. In some cases a simple 90^{o} elbow may help prevent or reduce the transport of particles from entering your vacuum gauge.

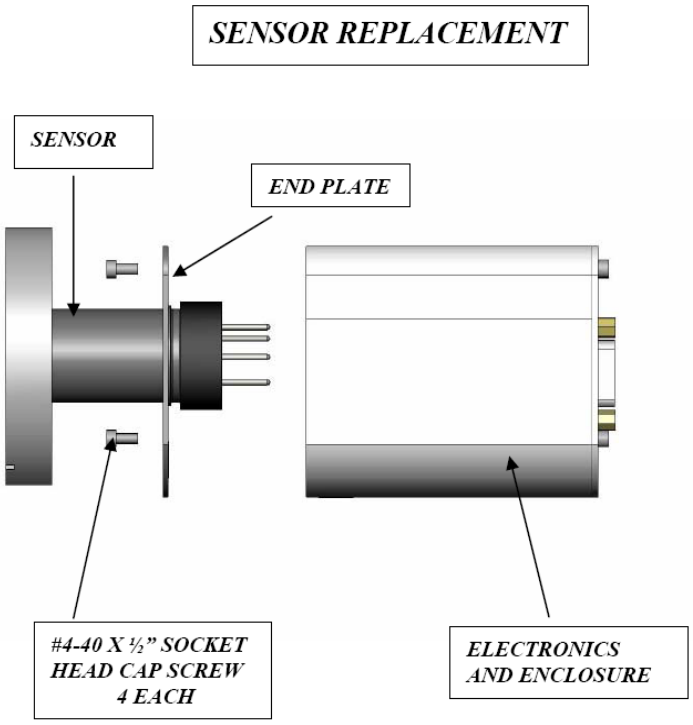
In the event of gauge contamination you can attempt to degas the sensor**.** If degas fails to resolve the issue, switch to second filament or replace the sensor as described in the next section.

6.6 Sensor Replacement

The 351 ion gauge module is factory calibrated for the specific ion gauge transducer (sensor) installed in it. If both filaments fail for any reason, the sensor can be replaced with a new one. The sensitivity of the new sensor must be re-programmed in the external vacuum gauge controller used with the device. Follow all instructions below in order to replace the sensor in the field. If you prefer, you can contact the factory for return authorization and the replacement of the sensor will be done at the factory.

To replace the sensor use the following procedure:

1. Turn off power to the 351.
2. Disconnect the cable from the 351.
3. Remove the 351 from the vacuum system.
4. Use a 3/32 in. size Hex key to remove the #4-40 socket head cap screws (SHCS) as shown below.
5. Detach the metal enclosure and the electronics from the sensor. Gently pull the electronics enclosure away from the sensor using a gentle rocking motion.
6. Replace sensor. Reinstall the screws (4 ea.)
7. Reprogram new sensor sensitivity. The sensitivity is a value designated by the letter "S" and marked on the sensor End Plate.



7 Factory Service and Support

If you need help setting up, operating, troubleshooting, or obtaining a return materials authorization number (RMA number) to return the module for diagnosis, please contact us during normal business hours (8:00am to 5:00pm Eastern Standard time) Monday through Friday, at 1-412-387-9200. Or e-mail us at gauging@lesker.com

For the safety of our employees, you must down load a material disclosure form from our website at www.Lesker.com Please use this form to provide a history of the gauge detailing what gases have been used. We cannot perform services on products that have been exposed to hazardous materials.

8 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 eighteen (18) months after the date of shipment from KJLC 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.



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