OWNERS MANUAL

DELTA GLOW™ MODEL DG-300

HIGH ENERGY RF PLASMA SOURCE

CUSTOMER ____

DATE ____

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Part # 03-000100-00

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WARNING Lethal RF and DC voltages are present in this system.

Only qualified personnel should install and service this equipment.

Prior to installation and operation of this system, this instruction manual should be consulted to ensure that the installation and operation are in accordance with **Manitou Systems**' recommendations.

Failure to properly install or operate this unit will result in voiding the equipment warranty.

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This owner's manual is provided to enable the user to safely install, operate and service the equipment described.

Manitou Systems, Inc. reserves the right to make product changes and enhancements without notification or obligation.

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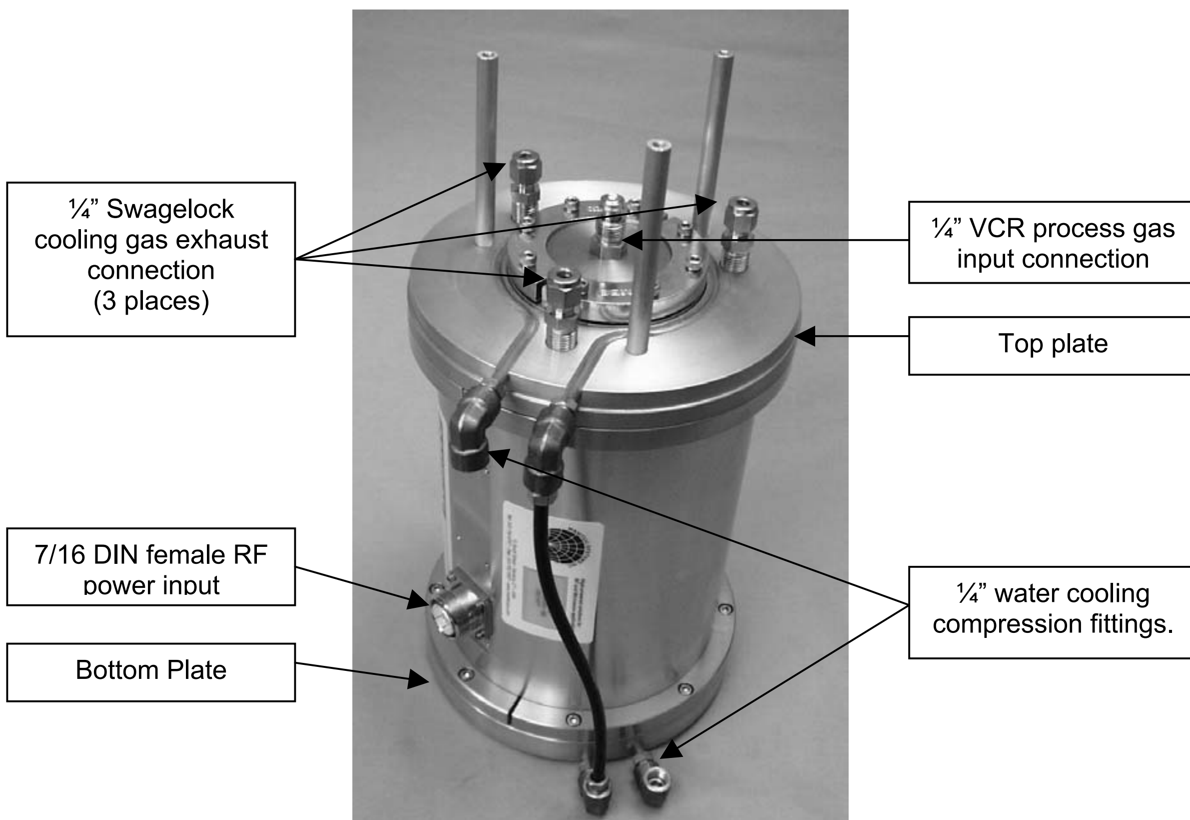
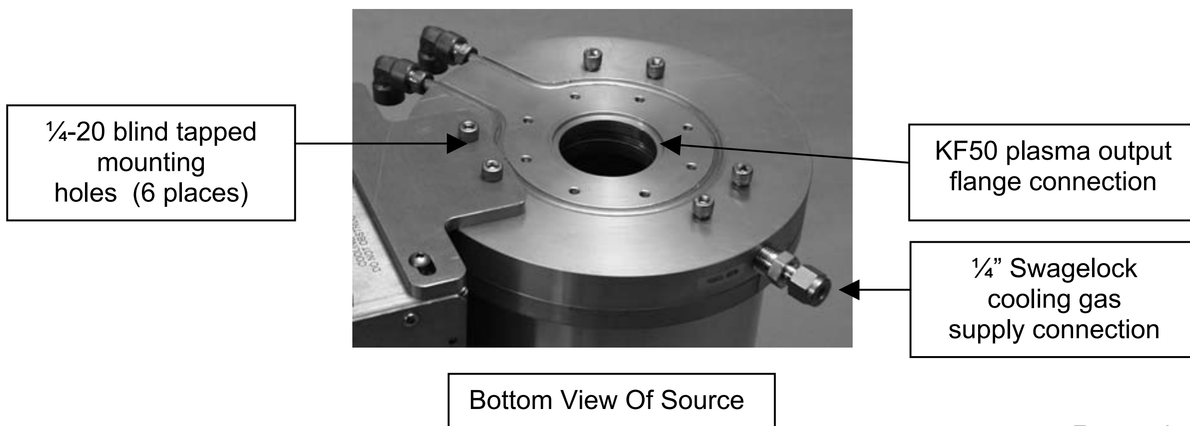
Delta Glow™ Quick Start Guide

The following information is designed to enable the user of Manitou Systems, Inc. plasma source & RF power system products to install and interface the hardware. Additional information on individual components included in this system will be found in the following pages of this manual or in the RF generator & matching network manuals.

Delta Glow™ Model DG-300 High Energy Plasma Source





Bottom View Of Source

Delta Glow™ Assembly Steps

1. Please check all delivered packages and the internal packing material upon receipt of shipment from Manitou Systems Inc. A complete list of included items is located in section 2.2 of this manual.

2. Physically mount the plasma source to the vacuum system port using the supplied KF-50 centering ring & clamp ring. Provide a bracket fastened to the vacuum system frame or vacuum chamber which will support the plasma source from it's bottom plate. There are three pairs of ¼-20 bottom tapped holes for this purpose. Two of the six supplied ¼-20 cap head screws are slightly longer as they are to be used with the standard manual matching network bridging plate. *Do not use the body or top plate for support!*

3. If the optional automatic impedance matching network is used (or the manual matching network is remote mounted), this will require that it be mounted close to the plasma source. An 25" long RF power cable is furnished to connect the plasma source to the matching network. Fasten the matching network enclosure to a metallic, grounded surface by using the PEM type nut fasteners located on the bottom or rear sides. *Do not allow the mounting screws to protrude more than ¼" into the network's bottom or rear surface.*

4. Connect the RF power cable between the plasma source (type 7/16 DIN female) and the output of the matching network (type HN female). Use only the supplied high current RF cable for this purpose. *Do not force fit or twist the coaxial connectors as this action will shear the coax cable outer braid*. To reposition the connector with reference to the cable, please loosen the connector body with two wrenches and gently rotate the connector to the desired position. Tighten the locking nut to the connector body to ensure proper RF conductivity.

5. Connect the compressed gas cooling supply line to the single ¼" Swagelock fitting located on the bottom plate of the plasma source. The compressed gas should be filtered and dry. Set the supply pressure to 40 PSI. The gas supply can be operated during plasma on time by using a solenoid-operated valve. (See options in Section 5.)

6. Connect the water-cooling supply and return lines to the ¼" compression fittings located on the top and bottom plates of the plasma source. These plates each have separate cooling channels, which are connected in series via a plastic tube. Self-sealing quick disconnect type fittings may be used to facilitate disconnection in the event of service. House cooling water with either open or closed return systems is acceptable. The cooling water can be operated during plasma on time by using a solenoid-operated valve. (See options in Section 5.)

Delta Glow™ Assembly Steps cont.

7. Remove the top plate lid (3 button head screws). Locate possible positions for holes to pass the process gas supply (single line) and gas cooling outlet lines (3 lines). Drill, punch or slot the lid to pass the tubes. Use a grommet or grommet strip to protect the tubing. All four lines should be ¼" diameter stainless tubing.

8. Connect the three ¼" diameter gas cooling exhaust lines (Swagelock fittings) to the facility's house exhaust. Typical installations may include the use of bellows flex lines or welded 90 degree fittings. *Do not induce back pressure on these lines*. The best connection method is to run each line individually to the main house exhaust or to run a large diameter exhaust line near to the plasma source. The exhaust gas will contain a large quantity of ozone during operation when an SIO2 (quartz) process tube is used.

9. Connect the process gas line (¼" VCR fitting – KF-50 flange adapter) to a regulated gas supply. Select the proper grade of gas for the application. If necessary, the adapter style may be changed to accommodate the user's application. The process gas can be operated during plasma on time by using a solenoid-operated valve. (See options in Section 5.)

10. Review the included RF generator and impedance matching network owner's manuals for detailed information on the installation, theory and operation of these modules. Basic information as it relates to use with the Delta Glow™ plasma source will be found in various sections in this manual.

1.1 GENERAL DESCRIPTION
1.2 ICON EXPLANATIONS
1.3 MECHANICAL DESCRIPTION
1.4 TECHNICAL SPECIFICATIONS
1.5 SAFETY PRECAUTIONS
1.6 THEORY OF OPERATION
1.7 APPLICATIONS
1.8 WARRANTY DESCRIPTION

1.1 GENERAL DESCRIPTION

The Delta Glow™ family of plasma sources is designed to generate a continuous dense gas plasma for use in thin film deposition, etching and material surface modification applications. A combination of proprietary plasma excitation circuitry and simple construction techniques enable the DG-300 to provide an economical and reliable high-energy, down stream plasma process engine.

The Delta Glow™ system is furnished with it's own RF power delivery system including a choice of matching networks and RF power generators. Continuous wave (CW) or pulse power operation is possible with the use of the Cesar™ RF generator.

This device is housed in a single compact enclosure designed to be mounted to the vacuum process chamber. In some applications, the DG-300 is used as a pass through plasma source and actually becomes the process chamber. Rugged construction enables use in all industrial environments. All mechanical components are constructed from chemically treated aluminum and stainless steel. RF components are 100% silver-plated for enhanced conductivity. Dielectric parts are manufactured from virgin grade PTFE.

Vacuum chamber interfacing is accomplished through industry standard KF-50 vacuum flanges. Process gas enters the reactor tube via a ¼" VCR fitting. Standard reactor tubes are manufactured from quartz material. Aggressive fluorine based processes may require the use of an optional alumina reactor tube. The process tube and sealing o-rings are the only consumables and are field replaceable.

Typical applications include vacuum chamber conditioning/cleaning, plasma enhanced chemical vapor deposition (PECVD), polymer material surface treatments, gas plasma studies, and in-situ enhancements of the thin film deposition process.

1.2 ICON EXPLANATIONS

WARNING is used only where an immediate hazard exists. When this word is used, immediate danger exists and special precautions are necessary to prevent possible injury, death or significant property damages.

CAUTION is used when unsafe operating or service practices could result in damage to the equipment.

This icon means "NOTE" or the information following should be mentally highlighted.

The finger-pointing icon is used to indicate a procedure or step required before powering on the system.

1.3 MECHANICAL DESCRIPTION

The plasma source module measures 14.5" L x 7.5" Dia. The source body end plates and compression rings are constructed from chemically treated (iridite process) aluminum. The top lid is removable to provide access to the process gas supply and gas cooling fittings. The user is required to locate and punch (or drill or slot) access holes to pass the process and gas cooling lines.

The source’s top and bottom plates may be easily and completely dissembled for the purpose of routine maintenance or in the event of service. Both plates include a process tube clamp ring and o-ring for the purpose of providing a vacuum seal. A 50mm diameter quartz (optional alumina) process tube is captured in-between the two end plates and provides containment for the plasma reaction.

Compressed (dry) cooling gas enters through a ¼” Swagelock fitting located on the bottom plate. Cooling gas is injected at the base of the process tube clamp ring and provides a turbulent flow around the tube’s diameter and down the length of the source removing radiated heat from the plasma process and the RF antenna coil. The heated exhaust gas exits through three ¼” Swagelock fittings located on the top plate.

1.3 MECHANICAL DESCRIPTION cont.

Pressure controlled process gas enters the plasma source through a ¼” VCR fitting/transition adapter located on the source’s top plate directly over the process tube. (This adapter is an industry standard ¼” VCR – KF50 adapter and may be substituted by the user for other types of KF50 adapters.) The high-pressure process gas flows toward the outlet of the plasma source via the pressure differential created by the vacuum system pumps. Energized gas radicals are therefore carried out of the source and into the vacuum chamber.

Water cooling is required to remove conducted heat from the source body and end plates. The liquid cooled areas are positioned to directly cool the process tube o-ring seals at each end of the tube. The source’s cooling channels on the end plates are connected in series via a ¼” diameter plastic tube. User connections to the I/O are via industry standard compression fittings. Flow direction is not important.

RF power is delivered to the plasma source through an impedance matching network and then into the source body through a 7/16 DIN female type coaxial connector located on the OD of the body near the bottom plate. A special high current Teflon coaxial cable is used to conduct the RF energy from the matching network to the plasma source.

A silver plated RF antenna coil is located inside the source body and used to transfer the RF energy into the dielectric process tube. The antenna is captured in a cage manufactured from Teflon components. The cage is designed to maintain the spacing of the antenna coil turns while also keeping it properly positioned inside the body. This is required as the source is considered a Helical Resonator” type device. This means that the source is resonant at the 13.56 MHz operating frequency that the RF generator supplies.

The bottom plate is considered the plasma source output or exhaust. The dense plasma exits through a KF50 fitting located on the outside bottom surface. The user may select a variety of fittings and transitions to accommodate an installation on the vacuum chamber.

1.4 TECHNICAL SPECIFICATIONS

Operating Frequency	13.56 MHz
RF Input Power	Up to 500 watts (maximum).

CAUTION The RF power MUST be slow ramped with a minimum time of 500 ms to avoid internal arcing of the plasma source. Consult Section 10 for additional information on RF power ramping!

> Delta Glow™ Model DG-300
>
> ***WARNING !***
>
> **RF power ramping or soft start MUST be used to avoid internal damage. Consult the Delta Glow™ or CESAR™ RF generator operating manual for further information!**
>
> **Improper use will void warranty.**

Plasma Source Weight	19 lbs. Includes weight of plasma source and RF connection cable.
Model MTK Weight	5 lbs. Weight of manual matching network and bridging plate.
Model ATK Weight	9 lbs. Weight of optional automatic matching network.
AC Mains Requirements	The Model ATK matching network will require a 90-240 VAC 50/60 Hz input to operate it's internal power converter. The AC current requirement is 2A maximum.

The Model MTK matching network requires 110 VAC 50/60 Hz input to operate an external wall mount power pack. The MTK's cooling fan however, will operate from any 24 VDC power source. The DC current draw is 200 mA maximum.

1.4 TECHNICAL SPECIFICATIONS cont.

Process Gas Interface	¼" VCR male connector. Use ¼" diameter stainless steel tubing to connect the source to a flow meter/controller. Typical installations may include the use of bellows flex lines and/or welded 90 degree fittings to ease routing. An optional mass flow kit is available to enable process gas flow presetting and control.
Water Cooling	¼" compression fitting. Use ¼" diameter plastic or metallic tubing for connection to the water supply and drain. The source requires 0.3 GPM @ 40 PSI minimum. The temperature should be 39 degrees minimum & 80 degrees maximum. 75 PSI maximum pressure. Flow direction is not important. ***CAUTION*** Minimum temperature must be controlled to ensure that NO condensation occurs inside the source body. The cooling water flow may be operated during plasma on conditions using the optional valve kit.
Gas Cooling	40 PSI dry air or other inert gas through a ¼" Swagelock fitting. Exhaust gas exits through three ¼" Swagelock fittings. The cooling water flow may be operated during plasma on conditions using the optional valve kit.
Source Footprint	14.5" L x 7.5" Dia.
Vacuum Interface	KF50 vacuum fitting. The source's bottom plate is manufactured with a KF50 penetration and split clamp ring hole pattern. The source is delivered with a KF50 centering ring (with Viton o-ring) and a split clamp ring. The user will supply complementary transition fittings.
RF Input Connector	Type 7/16 DIN female coaxial cable connector
Duty Cycle	100%

1.4 TECHNICAL SPECIFICATIONS cont.

Matching Network Circuit Topology	"PI" configuration using a variable shunt capacitors and a fixed series inductor. The actual component values may change based on plasma process parameters.
Process Tube Type	50mm OD Quartz (SiO_2) - For general-purpose applications. An optional alumina tube and high-temperature inert type o-rings can be supplied to accommodate the use of corrosive fluorine based process gasses.
Operating pressure	1 Micron to 5 Torr based on flow rates and process gas types.
Physical mounting	3 pairs of ¼-20 blind tapped holes on bottom plate of source. 1 pair of holes may be in use to mount the MTK manual matching network.

1.5 SAFETY PRECAUTIONS

SAFE OPERATION IS THE RESPONSIBILITY OF THE USING ORGANIZATION AND IT'S PERSONNEL. READ THIS OWNERS MANUAL AND UNDERSTAND HOW TO AVOID HAZARDS PRIOR TO OPERATING THIS UNIT.

Your compliance with the following safety practices is expected:

1. Never work alone on live electrical circuits. You must be within sight or calling distance of another employee who has the following qualifications:

   A. Knows how to remove power from the equipment.
   B. Knows how to apply artificial respiration.
   C. Is acquainted with emergency procedures, first aid locations and the use of fire extinguishers.

2. Do not wear rings, wristwatches or other jewelry on your person while working on live electrical circuits.

1.5 SAFETY PRECAUTIONS cont.

3. Wear eye protection while working on live electrical circuitry where a flash might occur. **DO NOT WEAR CONTACT LENSES**.

   Because currents of 40 ma or greater across the chest can be fatal, read this manual to find out, before working on the equipment, how much current is present in each circuit. **BE EXTRA CAREFUL!**

4. Replace all safety shields after completing system setup, trouble shooting and maintenance procedures.

5. Immediately report to your supervisor any unsafe conditions that exist.

WARNING Proper use and safe operating practices with respect to this system are the responsibility of the user of this system. Manitou Systems, Inc. provides information on its products and associated hazards, but it assumes no responsibility for the after-sale operation and safety practices; take appropriate action to protect personnel and property from hardware failure. All personnel who work with or are exposed to this system must take precautions to protect themselves against possible serious and/or fatal bodily injury. **DO NOT** be careless around this system.

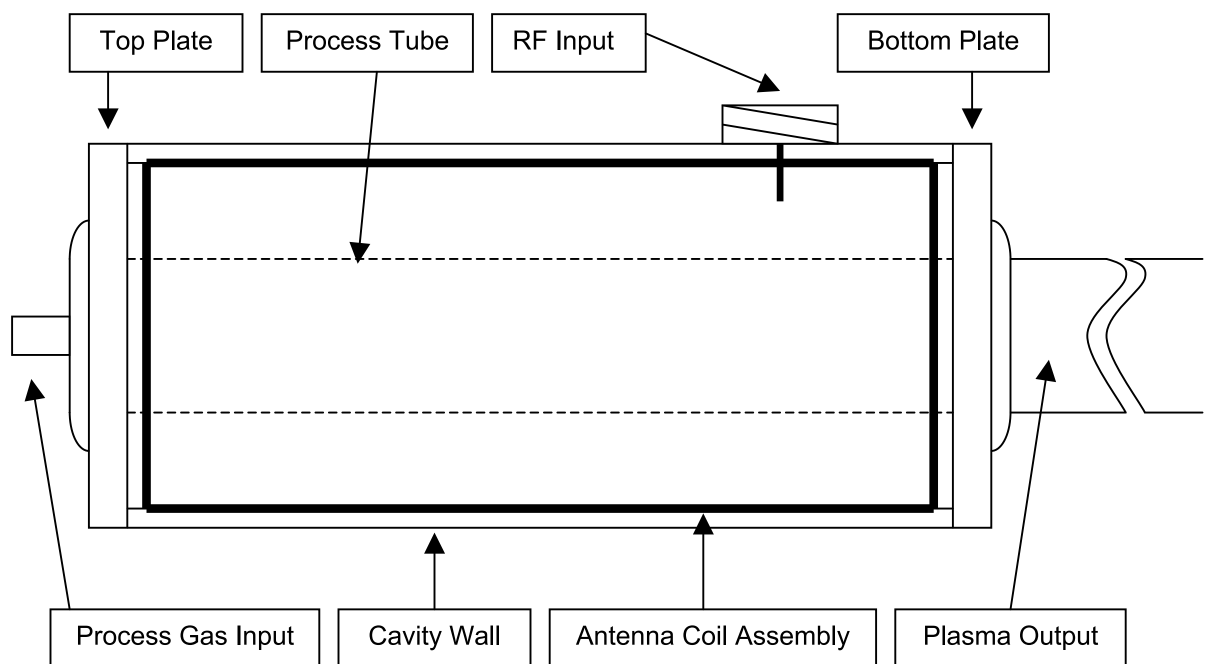
1.6 THEORY OF OPERATION

The Model DG-300 is helical resonator type plasma source designed to operate at a fixed frequency and through its resonant characteristics, efficiently couple RF energy into the plasma process tube. This device has a very hi “Q” (or quality factor) which enables consistent plasma ignition at low power levels. Once the plasma discharge is established, the effective Q of the circuit is greatly reduced. The Delta Glow™ device is also known as a “down stream” reactor as the raw process gas that enters one end of the process tube is pumped through it’s process tube to the main vacuum chamber as it is converted to active gas radicals. The reactive gas species is then used to perform various thin film process functions in the main vacuum chamber.

1.6 THEORY OF OPERATION cont.

The complementary impedance matching network enables the delivered RF energy (from the RF generator @ 50 ohms impedance) to be matched to the highly inductive characteristics of the plasma source. In most cases, the manual matching network is sufficient as the plasma source is very well behaved operating into typically fixed process parameters. An optional fully automatic matching network is also used in the event of dynamic production process conditions or during process development.

These sources may be scaled up or down in physical size to accommodate different types of process applications. The Model DG-80 for example operates at a frequency of 80 MHz and is approximately 1/3rd the physical volume of the Model DG-300. The smaller size is better suited for small vacuum chambers and load lock applications. The Model DG-600 is much larger in volume compared to the DG-300 and is used primarily for development and research applications.



Delta Glow™ DG-300 Cutaway View

1.7 APPLICATIONS

History of the Delta Glow™ product

The Model DG-300 was originally developed for the purpose of enhancing an industrial low temperature CVD process. Delta Glow™ provided O_2 radicals necessary to react an HMDSO pre-cursor liquid and deposit a glass like barrier film (SIO_x) onto plastic substrates This thin film performance coating enhanced the substrate's surface by providing an oxygen barrier. The substrate material is used today in medical devices and food packaging. Since it's introduction in 1993, Delta Glow™ products have been used to enhance many different thin film processes.

Below, please find a list of applications for this product family:

- Deposition - Delta Glow can be used as the main plasma source reacting the process gas. Coupled with the proper diffusion plate, this apparatus comprises the source technology required to perform many CVD processes.
  - CVD – semiconductor
  - CVD – industrial low temperature CVD–deposition of $Si0^2$ films
- Reactive Sputter Deposition – These processes can be enhanced by the use of the Delta Glow to provide a source of energetic reactive process gas molecules onto the substrate's surface. These gas molecules easily combine with the material being sputtered to form dense reactive films.
- Etching - Delta Glow is employed to react a gas mixture for the purpose of etching a thin film structure on a semiconducting substrate.
- Cleaning Source – Using reactive gas chemistries the Delta Glow is typically used to clean vacuum process chambers in between process cycles and during process start up.
  - Industrial laser cavities
  - Semiconductor & Flat panel display CVD chambers – Using process chemistries Such As NF^3 & O^2

1.7 APPLICATIONS cont.

- Cleaning Source
  - ♦ Accessory To Vacuum Systems
    - ❑ Chamber Cleaning & Conditioning - Delta Glow provides an energetic plasma discharge to bombard the internal surfaces of a vacuum chamber with ions and electrons. The plasma stimulates and mobilizes water vapor while the vacuum pumping system provides the method for removal. The source can be used as a production tool to reduce initial pump-down times or installed as an OEM component to be used during every process cycle.
    - ❑ In Between Process Runs – load lock chambers - Faster Pump-down on New Chambers - Chamber Cleansing Between Process Cycles
    - ❑ Substrate Pre-clean & Condition
    - ❑ During pump down – Desorption of Water Vapor on Surfaces - Via Electron & Ion Bombardment
    - ❑ UV Activation

- Enhancement to Processes
  - ♦ O^2 Radical Generator

- Manufacturing tool
  - ♦ Newly Manufactured Chambers
  - ♦ Tool to ignite light bulbs – low sodium – consumer lamp testing

- Polymer Materials surface enhancements or modifications - Chemical Activation
  - ♦ Powder substrate surface treatments – The surfaces of powdered material can be treated to provide hydrophilic or hydrophobic properties by passing it through the plasma source's dense plasma region. The typical apparatus consists of a long, vertically mounted dielectric tube which is vacuum pumped at the bottom and has the substrate material introduced at the top end. Differential pumping techniques may be employed to ensure acceptable vacuum levels.
  - ♦ Polymer based medical devices such as catheter tubes can be treated to provide enhanced properties such as increased lubricity and cell growth adhesion. The material is processed by passing it through the center of the Delta Glow source. Vacuum chambers located on either side of plasma source contain the pay out and take up reels, pumping ports and process gas inlet.

1.7 APPLICATIONS cont.

- Polymer Materials surface enhancements or modifications - Chemical Activation
  - ♦ Plastic substrates such as automotive parts, medical devices, etc. can be plasma processed to provide better paint adhesion, gas barriers, and other properties that enable their use in specialized applications. The Delta Glow is used as the main plasma source (to provide energetic gas radicals) in conjunction with a secondary plasma source (to provide the substrate surface reaction and process uniformity across the substrate).

- Novel applications
  - ♦ Excitation of gaseous lamps – Delta Glow is used to excite electrodeless and conventional lamps during testing and as an industrial light source. These include mercury vapor and other specialized industrial lamps.
  - ♦ Exhaust Gas Abatement – Exhaust gas from many plasma processes can be post processed through the Delta Glow plasma source. The DG-300 is placed in-between the high vacuum pump and the process chamber. The rich plasma discharge is used as a secondary reaction to neutralize and abate the main process effluents.

- Benefits of ownership
  - ♦ Reduced Contamination In Deposited Films -The innovative new plasma sources improve the quality of thin films by reducing contaminants and deposited film inclusions.
  - ♦ Better Film Quality Control

1.8 WARRANTY DESCRIPTION

The Model DG-300 is covered under a limited warranty. Please note that the process tube and o-ring seals are not covered as they are considered a consumable item. Failure to follow proper installation and operational procedures will void this warranty. Additional details can be found in the Manitou Systems Inc. Standard Terms and Conditions form.

Manitou Systems Inc. warrants that all equipment manufactured by it shall be free from defects in materials and workmanship under normal use and service for a period of six (6) months from date of shipment. This warranty is subject to MSI's equipment being installed, maintained, and operated in accordance with this operating and maintenance instruction booklet. Warranty shall be void if MSI's equipment is modified by the CUSTOMER or used in other than recommended manner or applications. Purchased equipment incorporated into any item supplied by MSI will be covered by manufacturer's warranty.

1.8 WARRANTY DESCRIPTION cont.

The liability of MSI for any claims of CUSTOMER arising out of damages alleged to result from the use or failure of equipment provided by MSI shall be limited to the original invoice cost. MSI shall not be liable for latent defects or consequential damages.

This warranty is in lieu of all other warranties, express or implied including any implied warranty of fitness for a particular purpose to the extent that any implied warranty of merchantability is disclaimed.

The CUSTOMER may bring no action regardless of the form, arising out of the actions hereunder more than one (1) year after the cause of the action has occurred.

Repairs to equipment under warranty will be performed at MSI after determination that equipment is under warranty. CUSTOMER is responsible for all applicable shipping charges to and from MSI. CUSTOMER will obtain an RMA # prior to shipment of any equipment back to MSI. MSI has the right to invoice the CUSTOMER for all parts and services not covered under the warranty.

INSTALLATION SECTION 2

2.1 UNPACKING YOUR DG-300
2.2 SYSTEM COMPONENTS LIST
2.3 MECHANICAL INSTALLATION OF THE DG-300
2.4 MECHANICAL INSTALLATION OF THE MATCHING NETWORK
2.5 MECHANICAL INSTALLATION OF THE RF GENERATOR
2.6 ELECTRICAL INSTALLATION
2.7 DG-300 SETUP

2.1 UNPACKING

Remove the unit from its packing and shipping material. Inspect for any damage and contact **Manitou Systems** and the shipping company if any is found.

The system is typically shipped in two cartons: one for the plasma source & tool kit and the 2nd for the matching network & accessories.

The RF generator is shipped in it's own separate (3RD) carton.

These products are shipped with plastic caps and plugs to protect the various RF and tube fittings. Remove these before installation and use.

2.2 SYSTEM COMPONENTS LIST

The following list details the included components in the Delta Glow™ package. Please check all packing material upon receipt of shipment from Manitou Systems Inc. Your Delta Glow package may include items which vary slightly from the list below so always check the deliverable to the packing list.

A. Standard DG-300 package – With Model MTK-600 manual matching network, quartz process tube & Viton o-rings.

- Model DG-300 plasma source with KF50 centering and clamp ring.
- Tool kit including: 9/64" Tee handle wrench, 5/32" ball driver wrench, 5/32" Allen wrench
- 18" RF cable – For connecting the plasma source to the matching network.
- 12' RF cable – For connecting the matching network to the RF generator.
- MTK-600 manual matching network
- Bridging plate – To mount MTK onto plasma source.
- Delta Glow Owners Manual
- Model MTK-600 matching network owner's manual

2.2 SYSTEM COMPONENTS LIST cont.

A. Enhanced DG-300 package – With automatic matching network, quartz process tube & Viton o-rings.

- ♦ Model DG-300 plasma source with KF50 centering and clamp ring.
- ♦ Tool kit including: 9/64” Tee handle wrench, 5/32” ball driver wrench, 5/32” Allen wrench
- ♦ 25” RF cable – For connecting the plasma source to the matching network.
- ♦ 12’ RF cable – For connecting the matching network to the RF generator.
- ♦ ATK-600 manual matching network
- ♦ Delta Glow Owners Manual
- ♦ Model ATK-600 matching network owner’s manual

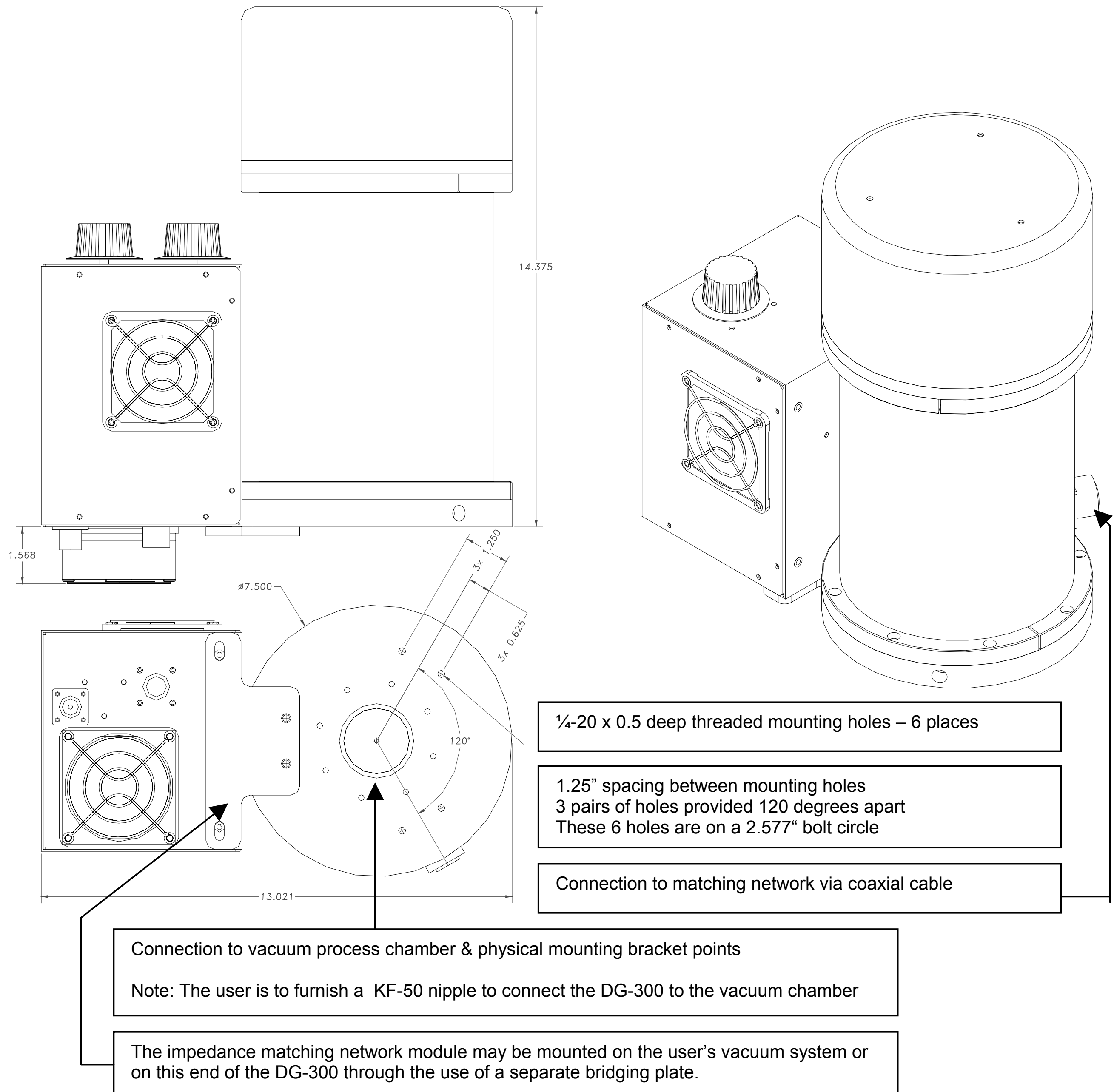
System Shown With Manual Impedance Matching Network

System Shown With Automatic Impedance Matching Network

2.3 MECHANICAL INSTALLATION OF THE DG-300

Model DG-300 Plasma Source Mounting Information

The image below details the standard DG-300 High Energy Plasma Source with a Model MTK-600 manual impedance matching system.



2.3 MECHANICAL INSTALLATION OF THE DG-300

Refer to the Quick Start Guide in the beginning of this manual.

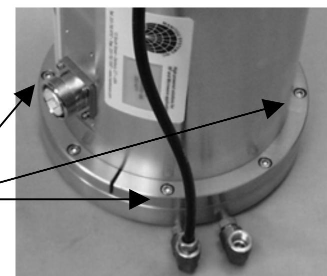
1. Plan the location for the mounting of the DG-300, matching network and RF generator. Typically, the RF generator will mount within a vented electronics control cabinet. If the Model MTK-600 is being used, select the mounting position – on the source body or remotely on the vacuum system frame. The Model ATK-600 automatic impedance matching network can only be mounted remotely.

2. Physically mount the plasma source to the vacuum system port using the supplied KF-50 centering ring & clamp ring. Provide a bracket fastened to the vacuum system frame or vacuum chamber, which will support the plasma source from its bottom plate. There are three pairs of ¼-20 bottom tapped holes for this purpose. Two of the six supplied ¼-20 cap head screws are slightly longer as they are to be used with the standard manual matching network bridging plate. Do not use the body or top plate for support!

3. Mounting to the vacuum chamber is accomplished via a KF-50 nipple or the use of a customer supplied transition plate. This plate should attach to the vacuum chamber (on one side) and have a KF-50 type recess machined into the opposite side. The DG-300 plasma source will then be bolted down to this plate via four clamps located on the outside diameter of the bottom plate or by modifying four of the tapped holes on the bottom plate. (The modification consists of drilling a #8 through hole to pass a 10-32 screw. See the image below.) The vacuum seal will be made via the KF-50 centering ring.

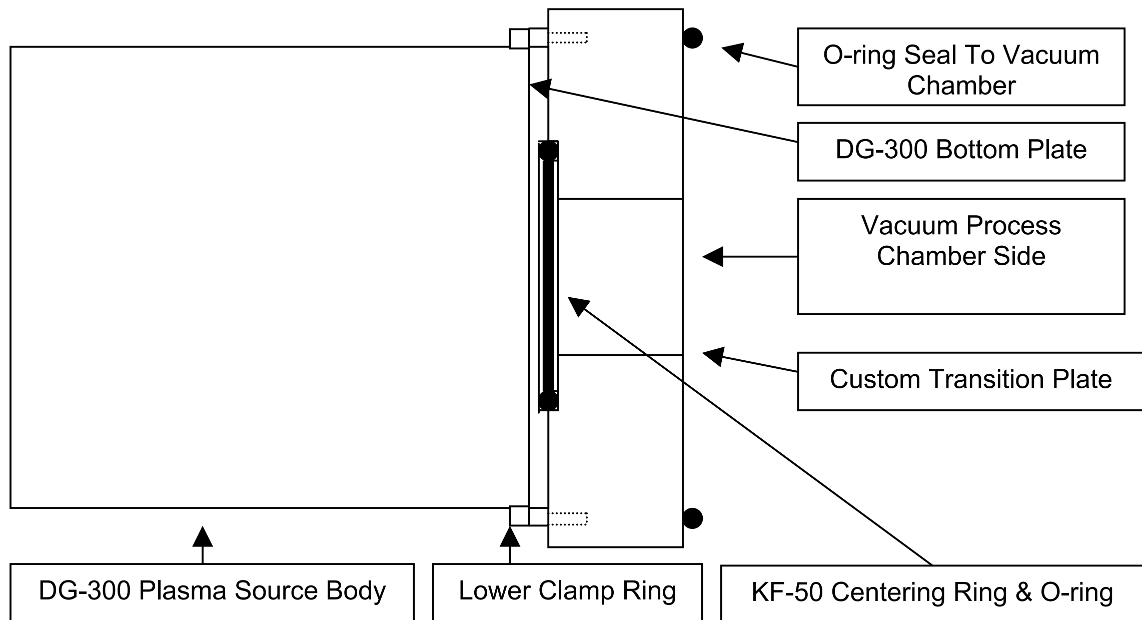
Bottom Plate With KF-50 Nipple Transition To A Vacuum Chamber

Use a #8 drill bit to open up every other threaded hole. This will enable the source to be directly bolted to a custom transition plate.

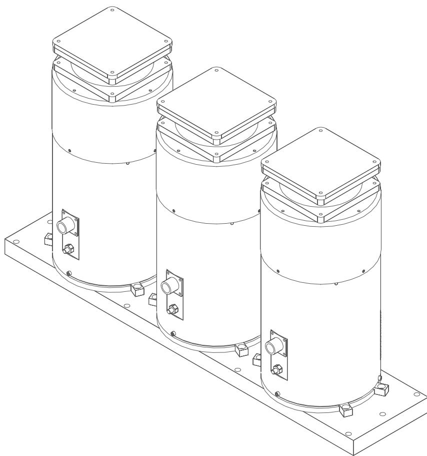


DG-300 Bottom Plate

2.3 MECHANICAL INSTALLATION OF THE DG-300 cont.



Side View – DG-300 Mounted On A Custom Transition Plate

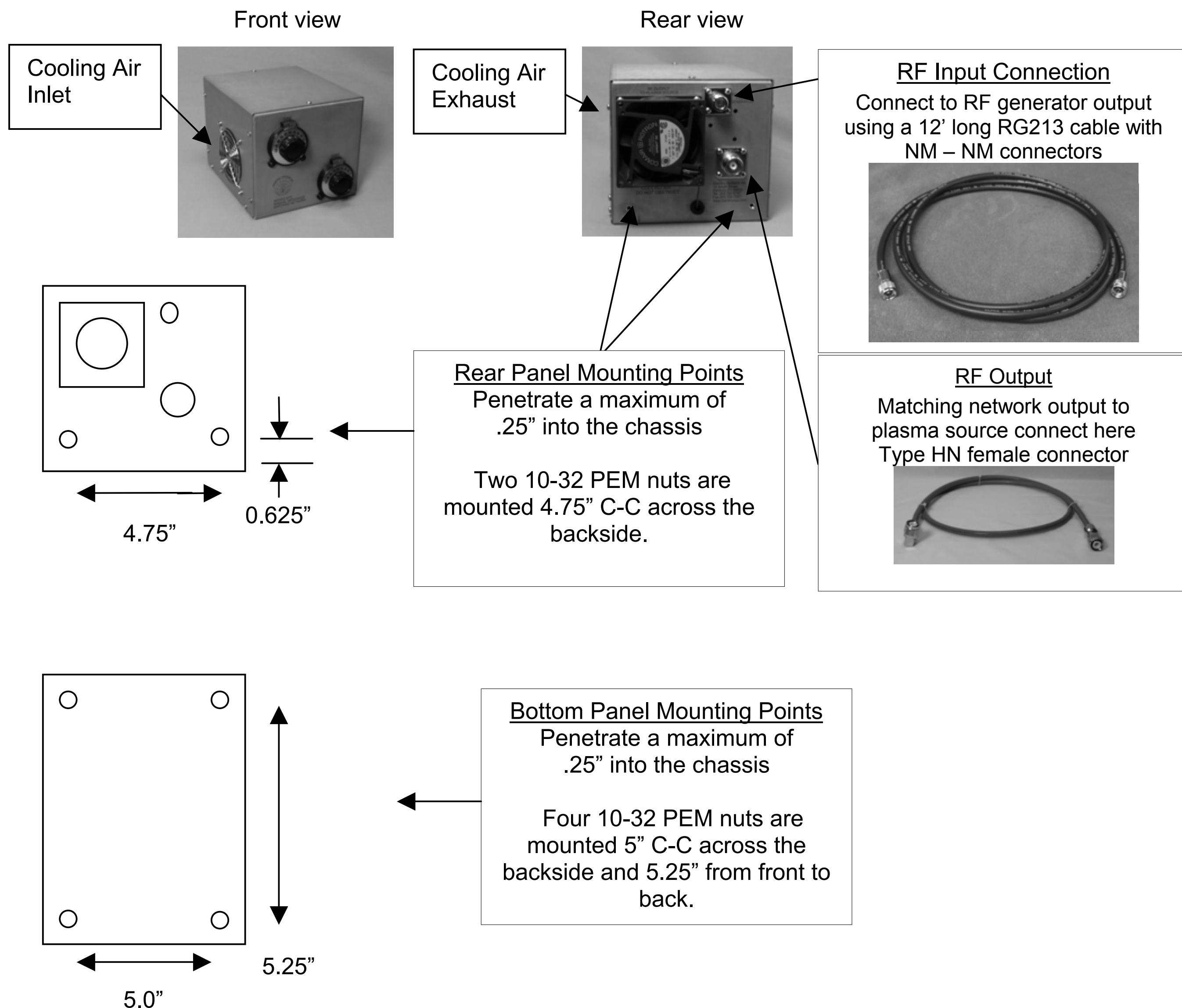


Three DG-300 Sources Mounted On A Custom Linear Transition Plate

Seven DG-300 Sources Mounted On A Round Custom Transition Plate

2.4 MECHANICAL INSTALLATION OF THE MATCHING NETWORK

- Review the following section if the Model MTK-600 manual impedance matching network is used.



Bottom Panel Mounting Points
Penetrate a maximum of .25" into the chassis

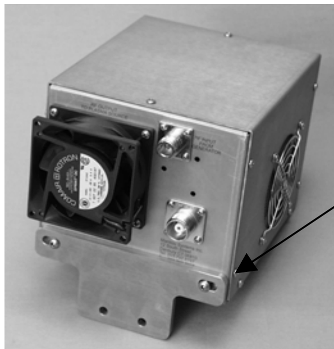
Four 10-32 PEM nuts are mounted 5" C-C across the backside and 5.25" from front to back.

5.25"

5.0"

2.4 MECHANICAL INSTALLATION OF THE MATCHING NETWORK

1. The Model MTK-600 manual matching network can be physically mounted directly onto the plasma source via the supplied bridge bracket. It may also be mounted directly onto a grounded surface of the vacuum process system.



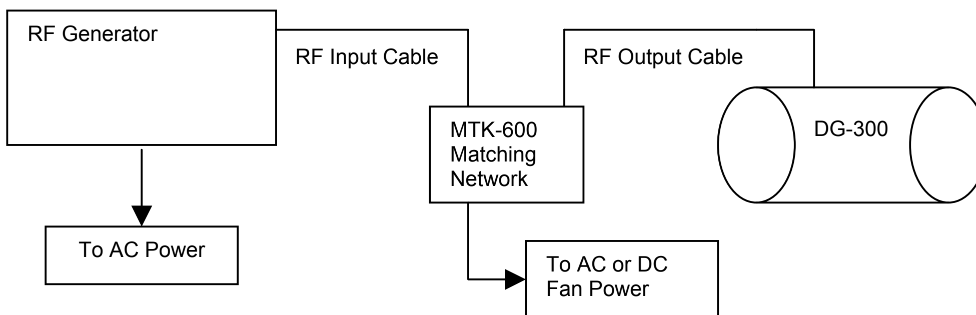
Rear Panel Mounting Points

Shown with the bridge bracket installed.

2. Connect the RF output cable from the matching network output connector (HN female) to the 7-16 DIN female connector located on the plasma source body.

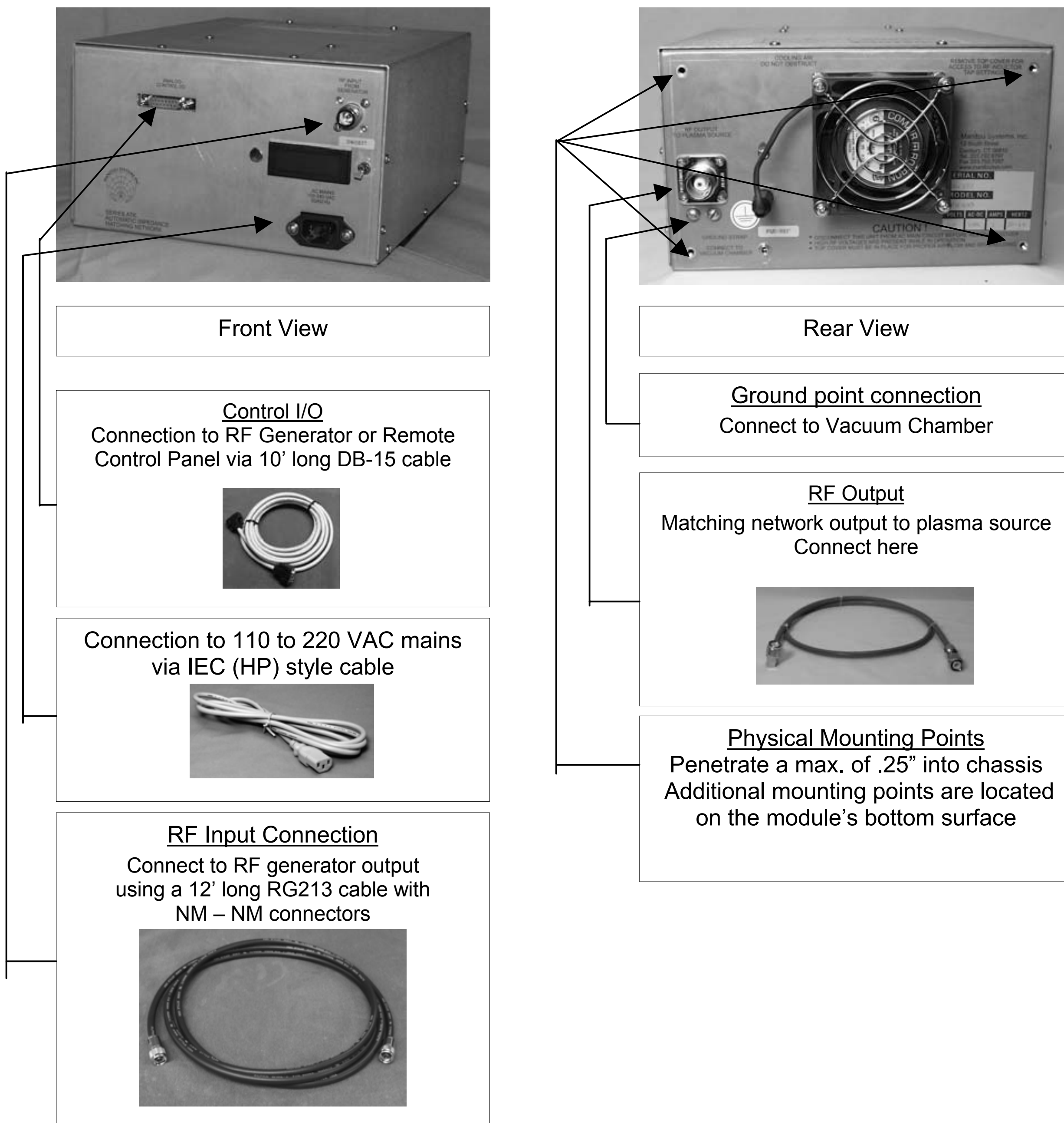
3. Connect the RF input power cable (RF power generator output to matching network input) located on the rear of the matching network.

4. Connect the cooling fan to the appropriate power source. Some models are supplied with a 110 VAC fan and others are supplied with a 12 or 24 VDC fan. The DC powered fans use a wall mount power pack. The user may elect to connect the fan directly to the vacuum system's 24 VDC power source.



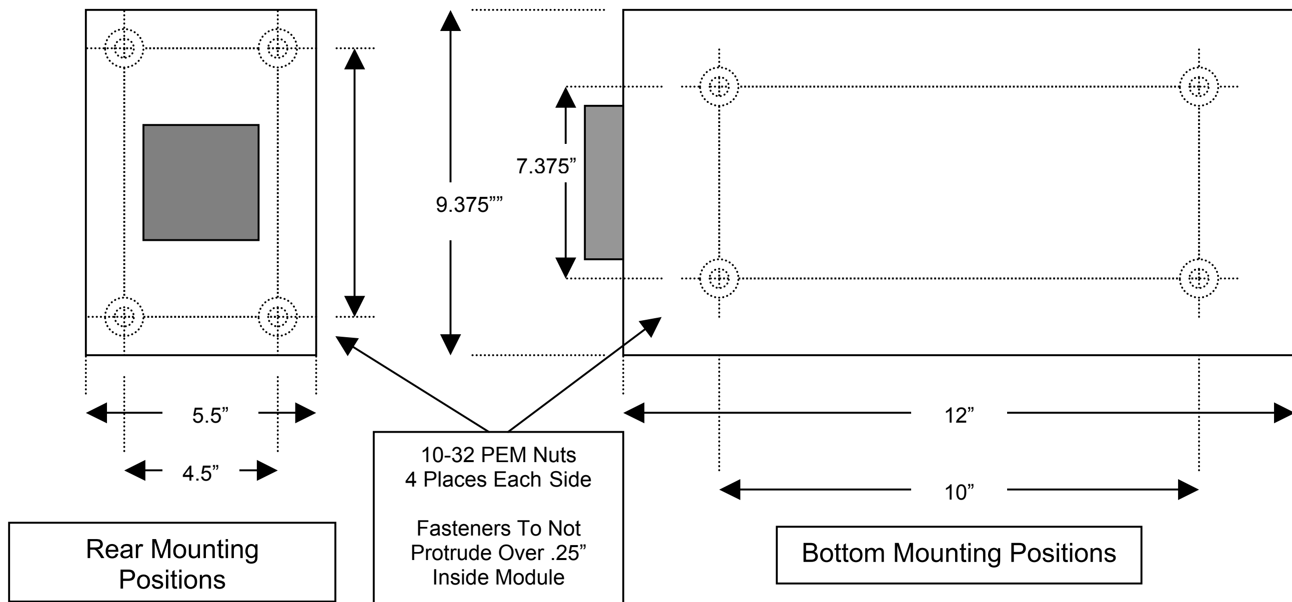
2.4 MECHANICAL INSTALLATION OF THE MATCHING NETWORK

- ♦ Review the following section if the Model ATK-600 Automatic impedance matching network is used.

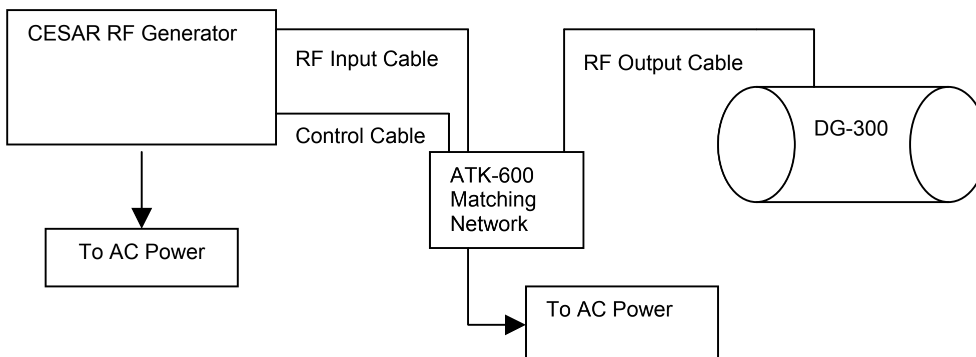


2.4 MECHANICAL INSTALLATION OF THE MATCHING NETWORK

The Model ATK-600 automatic RF impedance matching network is designed to mount at or close to the plasma source RF feed-through. This unit is connected to the source through a 25” length of high current, Teflon coaxial cable and bolted directly to the vacuum process system’s grounded frame. PEM nut fasteners are provided on the rear and bottom surfaces for this purpose.



1. Connect the RF input power cable (RF power generator output to matching network input) located on the front of the matching network (2 X type N connectors).
2. Connect the RF output cable from the matching network output connector (HN female) to the 7-16 DIN female connector located on the plasma source body.
3. Connect the control cable coming from the RF generator (or optional remote control panel) to the control I/O connector on the front of the matching network (2 X DB-15 connectors).
4. Connect the AC mains input to a 100 to 240 VAC 50/60 Hz power source.



2.5 MECHANICAL INSTALLATION OF THE RF GENERATOR

- Review the following section if the Model PB-3 RF Generator is used.

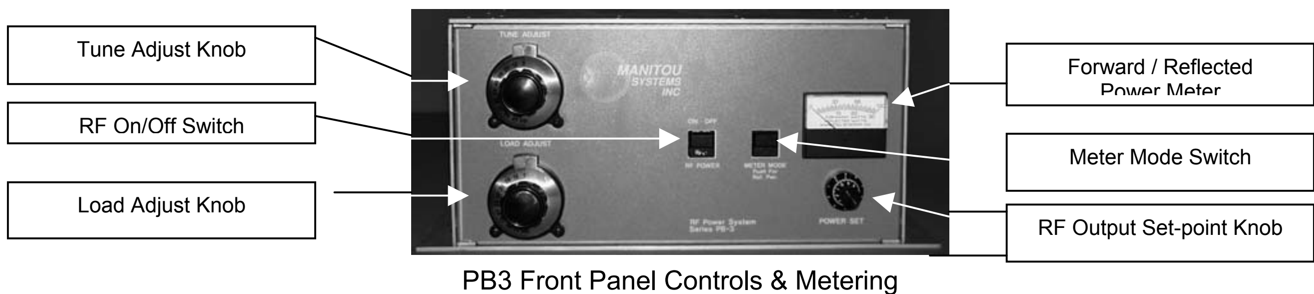
1. Always refer to the PB-3 RF generator owner’s manual for detailed installation and commissioning information.

2. Physically install the RF generator on a grounded surface near to the plasma source, as the connecting RF cable is only 25” long.

3. Connect the AC mains power cord and provide a proper safety ground. Ensure that the AC mains and grounding is compliant with typical electrical and safety codes.

4. Connect the generator to an external user interface (if required). Note: The supplied DB-25 shorting plug must be installed to enable proper interlock operation or hard wire the interlock plug into the vacuum system’s interlock string.

5. Connect the RF output cable to the matching network.



PB3 Front Panel Controls & Metering

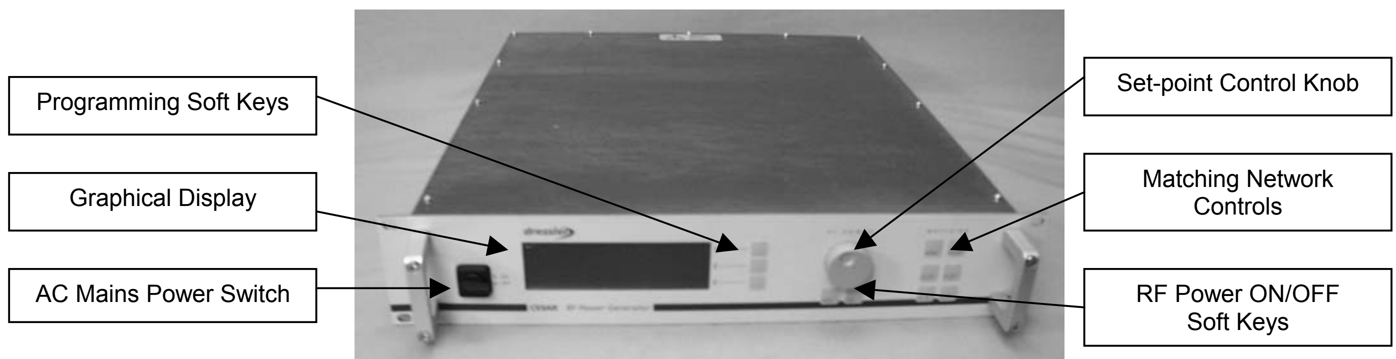
PB3 Rear View of Chassis

2.5 MECHANICAL INSTALLATION OF THE RF GENERATOR

- Review the following section if the Model Cesar RF Generator is used.

1. Always refer to the CESAR RF generator owner's manual for critical installation and commissioning details.

2. Physically install the RF generator into a vented electronics rack cabinet or other suitable enclosure.



CESAR RF Generator

3. Connect the AC mains power cord and provide a proper safety ground. Ensure that the AC mains and grounding is compliant with typical electrical and safety codes.

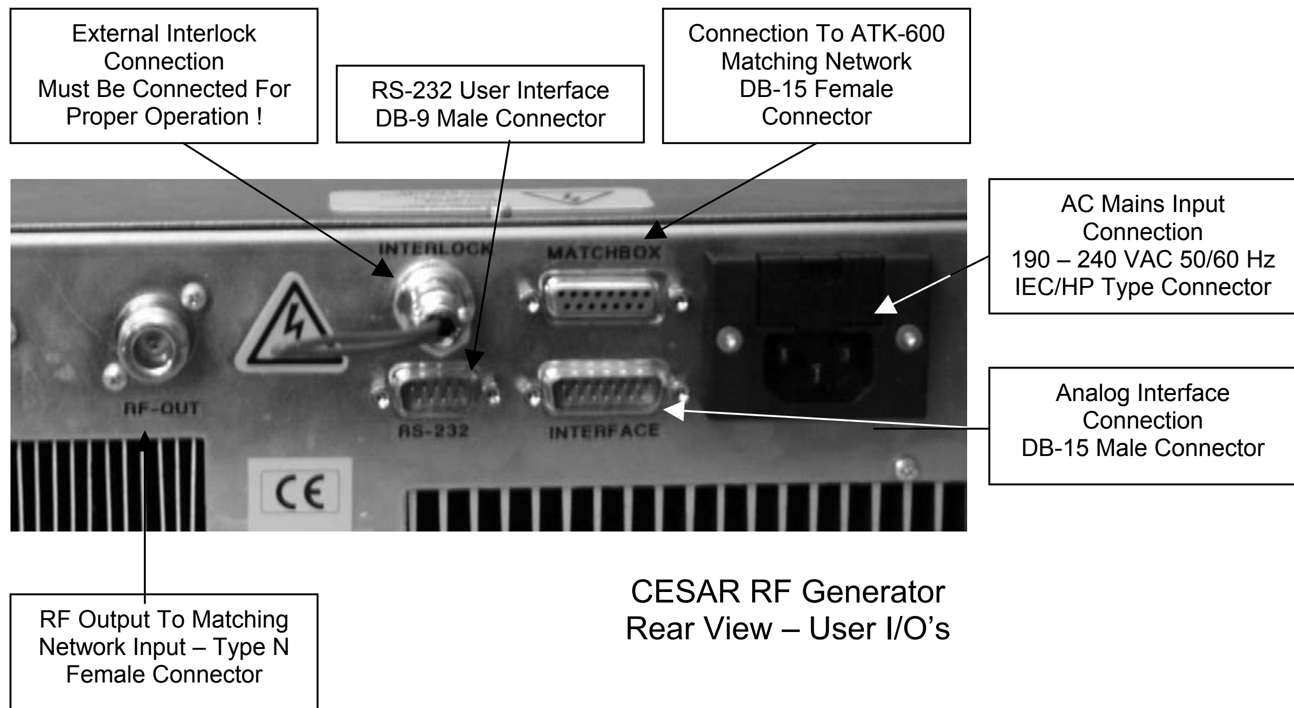
4. Connect the external user interface (if required) via the DB-15 connector.

5. Connect the Interlock shorting plug or wire the interlock plug into the vacuum system's interlock string.

6. Connect the RF output cable to the matching network.

7. Connect the matching network control cable (for Model ATK automatic matching network only).

2.5 MECHANICAL INSTALLATION OF THE RF GENERATOR



CESAR RF Generator
Rear View – User I/O's

2.6 ELECTRICAL INSTALLATION

The following installation steps will help understand how to connect the Model DG-300 to a plasma processing system. Please keep in mind that most RF System problems are directly related to the installation and grounding techniques that are employed.

♦ General information

WARNING Please review the following initial checkout procedure. Follow these steps prior to normal system operation.

1. The high voltage in this process system can cause instant electrocution upon contact or, under some circumstances, even close proximity to contact. Except as specified in this manual, never open the system covers or panels without disconnecting the AC input power at it's wall source and also attaching a grounding rod to the high voltage circuit.

2.6 ELECTRICAL INSTALLATION cont.

2. The system's radio frequency power is transferred to the plasma source through a shielded components & cables. Harmonic RF energy generated in the plasma discharge and will radiate if the vacuum chamber is not well grounded. Install a low impedance ground strap between the chamber and matching network module & chamber and earth ground. This strap should be constructed from silver plated copper sheet. The width should be 1" to 2" wide X .020" thick. Keep these connections as short as possible.

3. Before operating the system for the first time, it is essential to insure that ground connections have been installed as specified that all interlocks are verified to be working properly, that all high voltage and RF carrying conductors are shielded from human contact. Every precaution must be taken to install and operate the system in accordance with this manual.

4. In a faulty circuit, operational voltages can be retained internally even after the source of the power is shut off. Always insure that all filter capacitors are discharged after disconnecting source power and before examination. Don't assume the power is off until it is checked.

5. If you must examine the system or it's AC source with the power on, have another person present, use the schematics, lock out any power that is not needed, and attach test meter leads **before** turning the power on. NEVER, UNDER ANY CIRCUMSTANCES, REACH INSIDE THE UNIT WITH THE POWER ON.

- Model MTK-600 Matching network electrical installation

  1. Mains Power

  The Model MTK-600 matching network module may be supplied with an AC or DC cooling fan. Look closely at the fan’s label to determine proper operating voltage. If it operates on AC, it should be connected to an AC mains circuit of 110 or 220 VAC, 50/60 Hz power source via its two - (2) conductor cord. The power source should be capable of supplying at least 1 amp of AC current. The safety ground is attached to the fan body via a screw and a code compliant wire.

2.6 ELECTRICAL INSTALLATION cont.

2. Module Grounding

There are high RF circulating currents flowing through any given conductor connecting the matching network output to the plasma chamber even at low power operation. Current values of 5 to 30 amps are common as the real component of the plasma impedance is measured at 1 to 10 ohms.

At typical operating frequencies of 13 MHz, skin effects cause the RF current to flow on the conductor surface (~ 10-20 micrometers in depth). Improperly designed conductors will exhibit resistive power losses in addition to unwanted developed voltages across the conductor surface. Therefore, all RF carrying conductors should have a large surface area (i.e. wide strap – not a round dimensioned wire).

3. RF Output Conductors

The output of the matching network is designed to be connected to the plasma load via a high quality Teflon based coaxial cable such as type RG-393. Ensure that connections on both ends are tight. Improperly installed coaxial connectors will cause RF leakage and interference to adjacent wiring.

Use the supplied RF output cable, as it is compliant with this application.

Ensure that the matching module is grounded to the vacuum chamber through the use of a separate ground strap.

4. Cable Positioning

Dress all RF carrying cables away from all other control and sensor cables to eliminate the possibility of conducted electrical interference.

- Model ATK-600 Matching network electrical installation – Please see previous section for information regarding grounding and output connections.

1. Mains Power

The Model ATK-600 matching network module should be connected to an AC mains circuit of 110 to 220 VAC, 50/60 Hz power source via its three - (3) conductor cord. The power source should be capable of supplying at least 2 amps of AC current.

3.1 PRELIMINARY SETTINGS
3.2 PRELIMINARY CHECKS BEFORE TURNING ON THE RF POWER
3.3 TURNING ON THE RF POWER

3.1 PRELIMINARY SETTINGS

Prior to turning on the AC Main Power and RF Output Power we recommend presetting the controls to the following:

A. RF Power output setting on the RF generator to 0.00 watts (Set the control mode to “Forward” power control on the Cesar RF generator).
B. Matching network controls (Load & Tune) pre-set to 50 % or mid range positions. Additionally, set the automatic impedance matching control mode to “AUTO” after manually pre-setting to mid positions.

Ensure that the matching network output and input (and control) cables are properly connected to the plasma source and RF generator.

3.2 PRELIMINARY CHECKS BEFORE TURNING ON THE RF POWER

Prior to turning the RF Power On, preset and stabilize all process parameters such as vacuum chamber pressure and process gas flow.

Turn on all cooling water channels (to DG-300).

Ensure that all RF connections and system grounds are tight. Plug in AC Mains power cord.

3.3 TURNING THE RF ON

Automatic Operation (using the ATK-600)

Turn on the RF Power. Raise the RF Power Output control so that ~50 watts of FORWARD RF power is being delivered to the plasma source.

The matching network will automatically adjust the capacitors until the glow discharge starts. Once the plasma ignites, the matching network will then automatically reduce the indicated reflected power to below 1% of the indicated forward power indicating an acceptable “load match” (and maximum forward power transfer to the plasma).

3.3 TURNING THE RF ON

Automatic Tuning Operation (using the ATK-600)

View the REFLECTED power meter on the RF generator. It should now display a very small value after the servomotors have stop and are “tuned”.

If a problem exists with the tuning – for example, the network continues to hunt for the lowest reflected power, (and the plasma **IS** ignited) the problem is most likely to be an incorrectly sized series inductor. Please refer to the Section 4 for information regarding the replacement of this inductor.

Once proper low power (<50 watts) operation is qualified, the Cesar RF generator can now be turned off and re-programmed to include a soft start ramp. Refer to and review the Cesar Owner’s Manual for detailed programming information located in sections 6 & 7.

The unit should be programmed to include a four (4) time period output ramp. Scroll through the Cesar program mode to “Power Ramping” and set this function to “ON”. Press “OK” and select 4 “Time Frames”. Press “OK” and set the first time value to 0.02 min and press OK – select 50 W for the first “Start Value” – select 100 W for the first Final Value and press OK. Continue to program time periods 2 & 3 with a time ramp of 0.02 (or longer) and a power ramp equal to a segment of the total process power. Setting t1 through t3 in this fashion enables the RF power to be started softly helping to keep initial plasma starting stresses on the DG-300 to a minimum.

Now you can set t4 for the desired process cycle time. In the event that remote RF ON/OFF operation is desired and the user’s computer will control the actual process time, t4 can be set to a time value slightly above the required process time which will enable the computer to automatically shut the power off.

A typical Ramp Mode on the Cesar RF Generator menu may look like this:

```
t1 :   0.02 min  St-Val :  50W
t2 :   0.02 min  St-Val : 100W
t3 :   0.02 min  St-Val : 200W
t4 :  20.00 min  St-Val : 350W
```

3.3 TURNING THE RF ON cont.

Manual Tuning Operation (using the MTK-600)

The system may be operated in the manual tuning mode using the MTK-600 or when the ATK-600 is in the "MAN" mode. The user will be able to manually control the position of the tuning capacitors. Follow the procedure below.

Turn on the RF Power. Raise the RF Power Output control so that ~50 watts of FORWARD RF power is being delivered to the plasma source.

Adjust the matching network controls (Load & Tune) manually until the glow discharge starts. Start by moving the Tune control through it's range until a pronounced dip in the Reflected power is noticed – stop at this point and then adjust the Load control to further decrease the Reflected power value. A number of iterations will be required to reduce the reflected power value to below 1% of the forward power value. Log the Tune and Load positions into a notebook for future reference.

Now, the power can be raised to the desired process power. A small amount of adjustment will be necessary to reduce the reflected power value at the actual (higher) process power set-point. Note these positions.

The DG-300 is a well-behaved plasma load and will not require constant adjustments if the process is well defined and controlled during each cycle. Re-adjustment will be required if the process parameters change either during the cycle of from cycle to cycle.

4.1 IMPEDANCE MATCHING NETWORK
4.2 PLASMA SOURCE

4.1 IMPEDANCE MATCHING NETWORK

- Model ATK-600 Automatic Impedance Matching Network

A) Module does not power up – Fan does not run.

Has the AC power cord been connected to a "live" AC outlet of the correct voltage?

Check the fuse located on the control power supply.

Check to see if the fan is plugged into its power jack.

B) The matching network cannot be manually controlled by the Cesar RF generator control panel.

Ensure that the DB-15 cable connecting the generator to the ATK-600 has been installed properly.

Is the operating mode set to “MAN” (manual)?

C) There is no automatic matching control.

Is the operating mode set to “AUTO” (automatic)?

Remove DB-15 control cable and start the RF power again. The ATK-600 will sense the applied RF power and operate in the AUTO mode. The problem may be located in the control cable or circuits located in the RF generator.

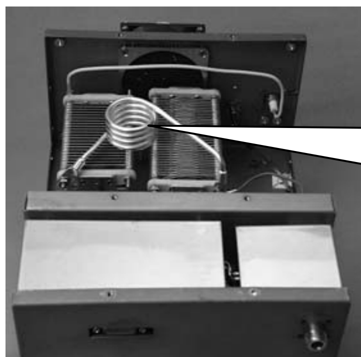
Is the unit powered on? Refer to problem (A).

4.1 IMPEDANCE MATCHING NETWORK

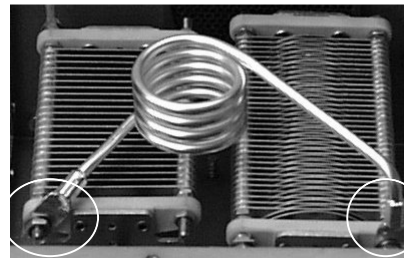
- Model ATK-600 Automatic Impedance Matching Network

D) System will match the plasma load in manual but cannot find match (null) point in automatic mode. The capacitors travel to their end stops and continue to hunt.

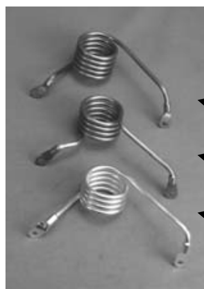
Keep a log of all capacitor positions. Manually adjust the network to a low reflected power and note the capacitor positions. If the load is matched (low reflected power) and the position(s) are below 30% or above 75%, the series inductor may need exchange.



Model ATK-600 Series Inductor Position



Connection Points For The
ATK-600 Series Inductor

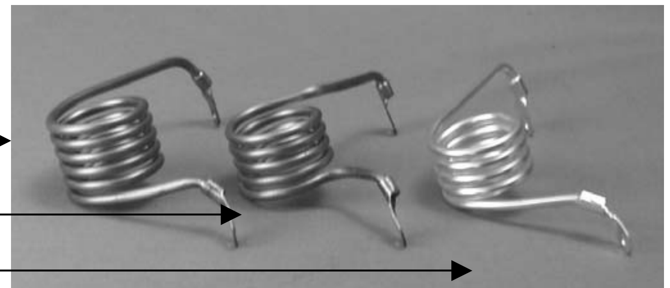


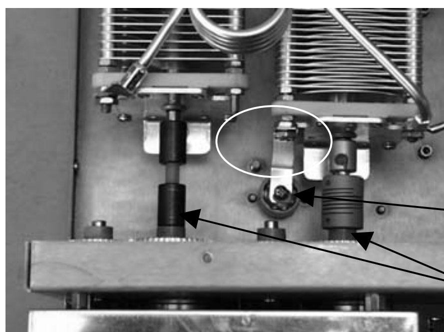
Series Inductor Types
4, 4.5 &, 5 Turns

5 Turns

4.5 Turns

4 Turns





In some cases, an additional fixed shunt capacitor may be required. Look at the Shunt capacitor position – if it is above 90%, the fixed shunt capacitance needs to be increased. Please contact the factory for further information regarding the available capacitor values.

Shunt Capacitor Location

Mechanical Linkage Points

4.1 IMPEDANCE MATCHING NETWORK

E) If the system will still not match the following may be possible:

The mechanical linkage connecting the servomotors to the capacitors has loosened or broken. These couplings will need to be tightened and the capacitor's positions re-calibrated.

♦ Model MTK-600 Manual Impedance Matching Network

A. Cooling fan does not run.

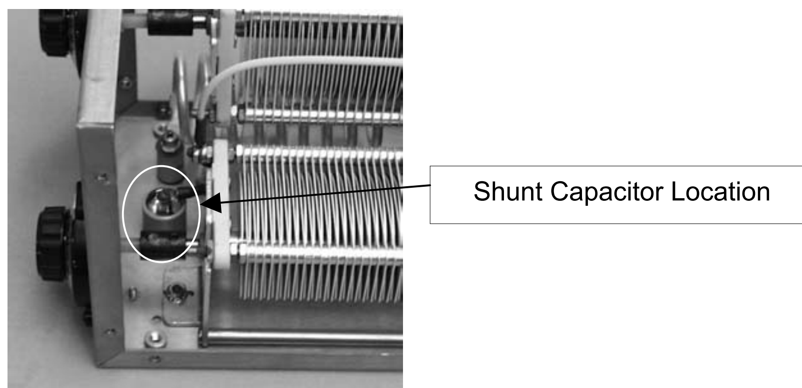
Has the power cord been connected to a "live" AC outlet of the correct voltage?

If a DC fan is used, check to see that the fan is connected to the proper voltage and polarity power source.

B. Reflected power value cannot be completely reduced

The RF system will ignite the plasma discharge and partially match the plasma load in but will not completely match (or null) the Reflected power value. The Load & Tune capacitors have been adjusted between their end stops with no possible match point. Please record the typical process parameters and capacitor positions for use in discussions with the factory if necessary.

If the Load capacitor is at the maximum position, it is likely an additional (or larger value) fixed shunt capacitor may be required. Please contact the factory for further information regarding the available capacitor values.

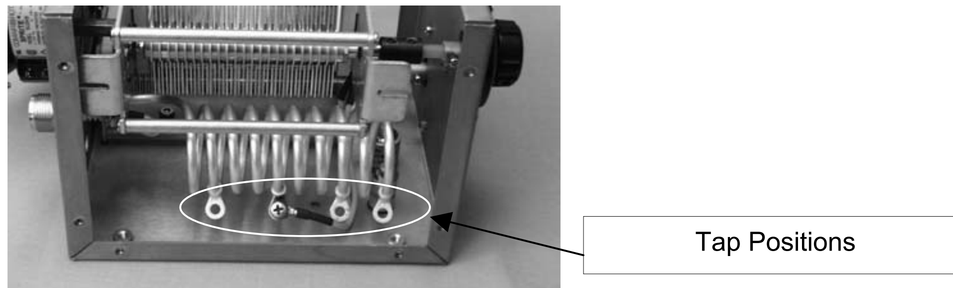


4.1 IMPEDANCE MATCHING NETWORK

♦ Model MTK-600 Manual Impedance Matching Network cont.

B. Reflected power value cannot be completely reduced cont.

If the Tune capacitor is at the maximum or minimum position, it is likely that the tapped series inductor may need to be reset. The series inductor located inside the enclosure is factory set to enable proper tuning for typical process conditions. Remove the enclosure cover to reset the tap for operation with process conditions outside the factory preset window. Typically, the inductor should be set to enable the series or tune capacitor to tune at 40 to 60 % of it's range.



Please note that different plasma operating pressures and gas compositions will cause different tuning positions on the network. Keep a log of these parameters so when they change, corrective action can be taken based on known previous information.

4.2 PLASMA SOURCE

WARNING Most operational problems result from vacuum or process gas system failures. Be sure to inspect the vacuum process system first! Never turn ON the RF power above 50 watts upon commissioning or if a problem is suspected!

A. Plasma discharge will not ignite

Are all RF components properly interconnected?
Is the AC mains power connected and turned ON?
Is the RF generator ON & indicating forward power?
Is the vacuum level correct?
Is the process gas supply turned ON and flowing?

4.2 PLASMA SOURCE cont.

B. Plasma discharge ignites but the reflected power is not reduced to a level of below 1% (of the forward power)

If a manual matching network is used, has it been properly adjusted?
If the automatic matching network is used, is it trying to tune? Are the servo motors moving running?
Is it possible to reduce the reflected power to a level lower than the forward power but not below 1% (and the capacitor positions are at their maximum or minimum)? – The series inductor may need adjustment or replacement with the proper value component.

C. The DG-300 body heats up excessively

Is the cooling water and cooling gas operating properly?
Are the return lines plugged up?

D. The DG-300 may operate normally at a very low power input but operation at higher power results in little or no plasma discharge and high reflected power

The antenna assembly may have become damaged and is arcing internally. This will be evident by removing the top plate from the source body and inspecting the white Teflon antenna coil supports. A telltale black carbon residue will be noticeable between the antenna coil and the I.D. of the body. Factory service is required.

The antenna coil may also arc in the event that debris or excessive moisture has entered the source body. Check the gas cooling supply.

E. The DG-300 looses vacuum integrity

Perform a helium leak check on the source. The problem is usually limited to a cracked process tube or defective o-ring seals. Ensure that the proper tube and seal material is specified for the current process chemistry.

5.1 CLEANING OF DEBRIS
5.2 REPLACEMENT OF PROCESS TUBE AND O-RINGS
5.3 SPARE PARTS AND CONSUMABLES
5.4 OPTIONAL EQUIPMENT LIST

5.1 CLEANING OF DEBRIS

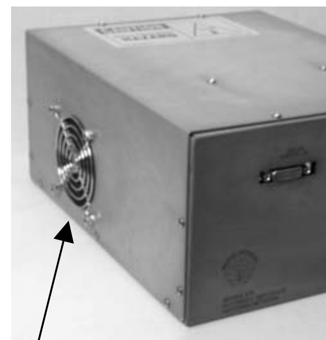
After continued use, the ATK (or MTK) matching network will build up dust and debris around the air intake positions and the exhaust fan.

NOTE: Collected dust and debris on the variable capacitor plates will cause arcing (especially in humid environments).

Use a vacuum cleaner with a soft brush attachment to gently remove the dust build up from these areas.

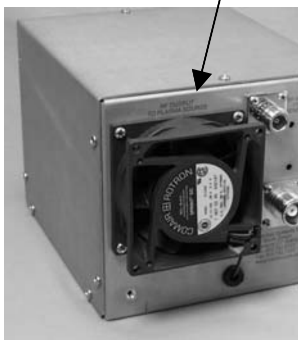
If the system is used in a very dusty location, the top cover may be removed to facilitate the cleaning of the interior components (tuning capacitors). Use compressed air (less than 20 psi) to loosen and blow out the dust.

Model ATK-600



Air Exhaust Location

Air Intake Location



Model MTK-600

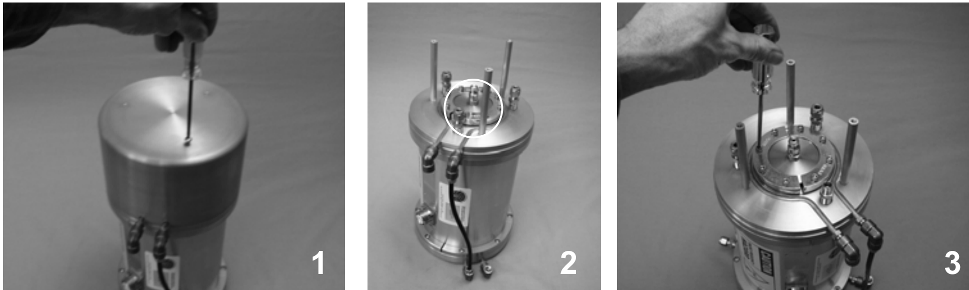
5.2 REPLACEMENT OF PROCESS TUBE AND O-RINGS

- Disassembly of the DG-300 Top Plate

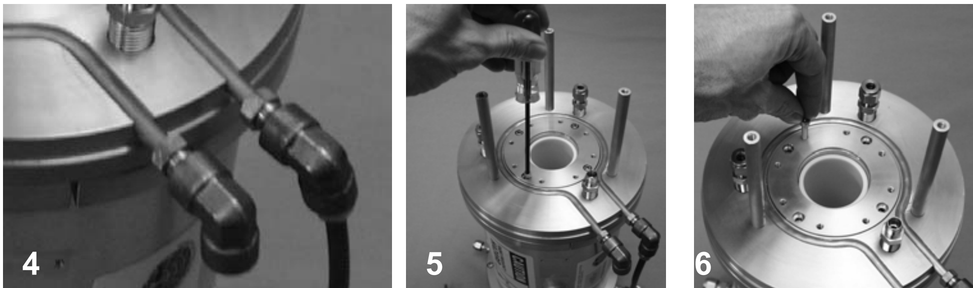
During normal operation of the DG-300, the process tube and sealing o-rings may need replacement. The period between service will vary based on operating parameters including power level, process gas type, pressure level, tube and o-ring types, etc. The following section will explain how to properly dissemble the source, replace the process tube and o-rings and re-assemble to unit.

CAUTION – Exercise extreme caution if the process chemistry and resultant contamination is considered hazardous to human health!

It is assumed that the DG-300 is either removed from the vacuum process chamber or is fully accessible from the top end. Blow out all water in the cooling loop. Use the included tool kit for this process. Follow the steps below.

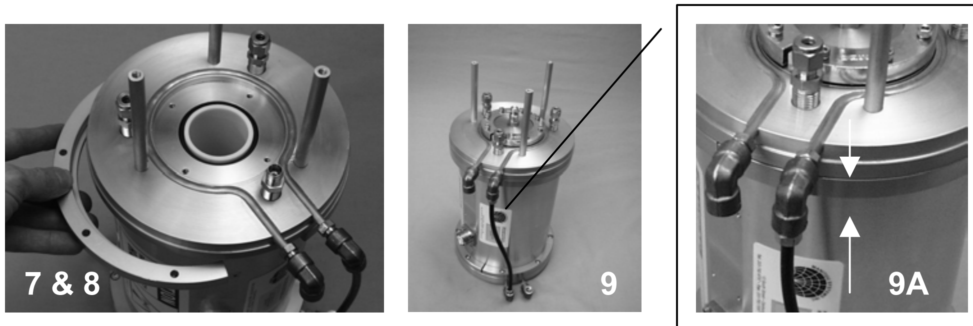


1. Remove the top cover – 3ea 10-32 button head Allen screws
2. Disconnect the three ¼” Swagelock cooling gas exhaust lines
3. Disconnect the KF-50 gas feed adapter – 8ea 10-32 Allen cap screws

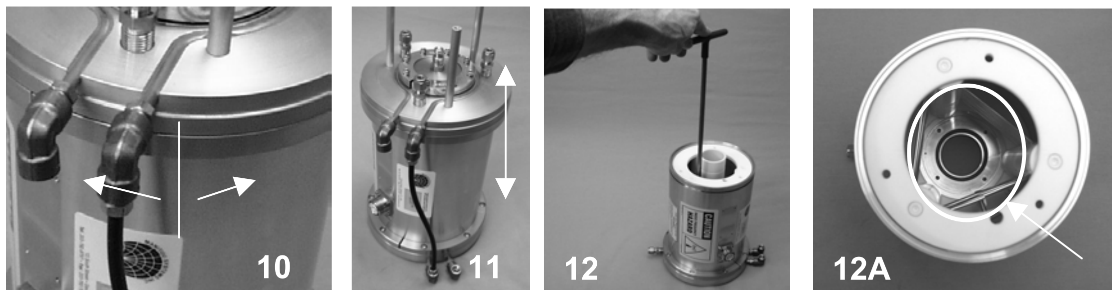


4. Disconnect the upper water cooling lines from the compression fittings
5. Remove the four vented 8-32 cap head Allen screws in a crosswise fashion (to prevent distortion of the sealing ring).
6. When all four screws are removed, gently lift off the sealing ring to expose the o-ring. Do not pry the sealing ring out but simply use a 10-32 screw, threaded into the ring as a handle for removal.

5.2 REPLACEMENT OF PROCESS TUBE AND O-RINGS



7. The o-ring can be removed using a non-metallic o-ring pick available from a local supplier.
8. Remove the two semicircle clamp rings that hold the top plate by removing all eight of the 10-32 cap head Allen screws. Use the ball end driver for this step.
9. Note and document the position of the top plate water cooling lines with reference to the source body and bottom plate. Use an adhesive label or dry marker to identify these positions. Correct re-assembly depends on proper orientation of the bottom, top and body components.



10. Gently rotate the top plate a few degrees in one direction then back past the starting point to break the body to top plate seal.
11. Once the seal is broken, gently pull the top plate away from the body taking care to keep the top plate parallel. Failure to do so will crack the process tube. DO NOT FORCE! The process tube and o-ring seals are considered a consumable item and therefore covered under a limited warranty.
12. At this time you will have access to the DG-300 antenna coil assembly, process tube & lower sealing ring. Use the large tee handle hex wrench to loosen (Do not remove) the four vented 8-32 cap head Allen screws holding the lower sealing ring. Loosen the screws in a cross wise fashion to prevent binding of the screws and distortion of the seal ring. Image 12A shows the lower o-ring seal and screw positions.

5.2 REPLACEMENT OF PROCESS TUBE AND O-RINGS

13. Once the screws are loose, the process tube will be able to be removed by rocking it back and forth gently and then pulling it straight out – parallel to the body. DO NOT TOUCH OR BEND THE ANTENNA COIL. If the lower sealing ring has permanently attached itself to the process tube, do not force the tube out but just completely remove all four sealing ring screws and then the entire assembly. (If the lower o-ring requires replacement, remove the four screws and lower seal ring from the start of this step.) Image 13A shows the process tube mounted into the base plate assembly. Image 13B shows the Antenna assembly – for reference only – DO NOT REMOVE.
14. With the lower sealing ring assembly and tube removed, you should clean the o-ring sealing surfaces using a solvent and lint free wipe. Additionally, blow out any remaining debris with low-pressure compressed air.

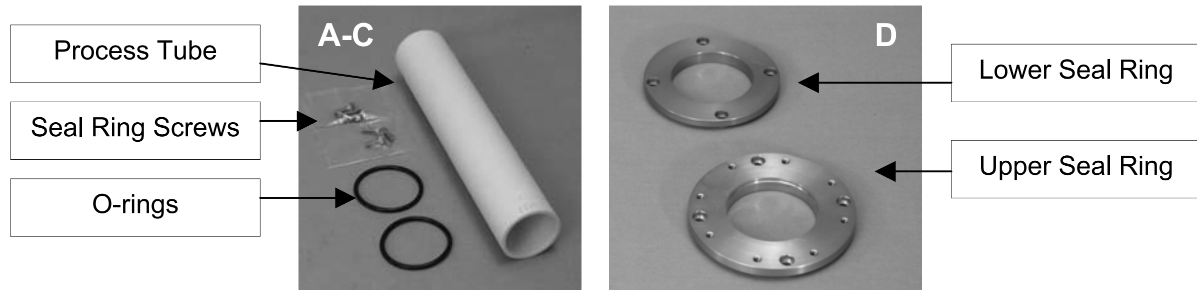
♦ Re-assembly of the DG-300 Top Plate

1. Clear and clean a work surface on which to lay out all of the replacement parts for the DG-300.
2. The following parts should be available for the re-assembly process:

   A. New or cleaned process tube
   B. Process tube o-rings (2ea)
   C. Sealing ring screws (8ea)
   D. Upper & lower sealing rings
   E. Top plate assembly
   F. Top plate o-ring
   G. Split clamp rings and removed screws
   H. KF-50 adapter, clamp assembly and, centering ring assembly

5.2 REPLACEMENT OF PROCESS TUBE AND O-RINGS

- Re-assembly of the DG-300 Top Plate cont.



3. Place the lower o-ring seal into the base plate groove and cover it with the lower sealing ring. (Smaller diameter ring with four screw holes.)
4. Insert (start) the four 8-32 vented screws but do not completely tighten.
5. Once the ring is just snugged down, gently place the process tube into the center of the sealing ring and ensure that it seats on the base plate parallel to the body axis. DO NOT CONTACT OR BANG THE TUBE ON ANY EDGES AS IT WILL CHIP AND CAUSE DAMAGE.
6. With the process tube held down into the seated position, use the large tee handle wrench to completely tighten the four screws in a cross wise fashion.
7. Verify that the tube is firmly held in position by the lower seal ring. Gently try to rock the tube. If it moves, it is too loose.
8. Replace the o-ring (~6" diameter) sealing the top plate to the body. Push the o-ring down towards the sealing edge of the top plate.
9. Recall the position of the top plate (with respect to the source body and bottom plate). This position is important as the cooling gas exhaust flow may be impacted in not correct.
10. Gently place the top plate over the exposed end of the process tube without contacting or banging the edge of the tube. Once the plate is over the end of the tube, seat it firmly onto the body.
11. Ensure that the top plate is positioned properly by inserting the small ball end driver into one of the cooling gas exhaust Swagelock fittings. This technique will enable the top plate's position to be aligned over the antenna assembly's cooling gas exhaust holes located in the upper Teflon support ring. The ball end wrench should easily slide all the way down into the body assembly. If not, rotate the top plate back and forth a few degrees until it does.
12. Replace the two split clamp rings and start the screws into the top plate. Snug all of the screws and then fully tighten in a crosswise pattern.
13. Install the upper process tube o-ring and replace the sealing ring and the 4 vented 8-32 screws.
14. Connect the two water cooling lines.

5.2 REPLACEMENT OF PROCESS TUBE AND O-RINGS

♦ Re-assembly of the DG-300 Top Plate cont.

15. Connect the KF-50 adapter flange and process gas line.
16. The DG-300 can now be helium vacuum leak checked if required. Use a typical industry accepted leak checker or an RGA connected to the vacuum system. Consult the owner's manual for the proper procedures. (The three Swagelock connectors on the top plate may be used to flood the body interior for additional leak checking purposes.
17. Once the DG-300 is verified as leak free – re-connect the three gas cooling exhaust lines.
18. Replace the top lid and operate the DG-300.

5.3 SPARE PARTS AND CONSUMABLES

Consult the factory for all spare parts requirements. Below, you will find typical spares that will be required for periodic process tube maintenance.

- Fastener kit including vented 8-32 screws
- Body O-ring kit
  - Viton o-rings
- O-ring kit
  - Calrez o-rings
- VCR gasket
- Service tool kit
- Top lid grommet strip
- Quartz process tube and Viton o-rings
  - Viton o-rings
  - Process tube
- Alumina process tube replacement kit
  - Calrez o-rings
  - Process tube

6.1 OPTIONAL EQUIPMENT LIST

The DG-300 can be supplied with optional equipment designed to enhance it's performance with your vacuum process. Please consult the factory with your specific needs so we can identify and recommend the proper auxiliary hardware levels. Below, please find a list of typical components and descriptions of their use:

- Cooling gas and water valve assembly kit – includes: solenoid operated valves (24 VDC control voltage) with Swagelock fittings, Polyflow tubing and, air pressure regulator. This kit is installed to control the flow of the water and gas used to cool the DG-300. The user simply connects the valves in series with the supply side of the gas & water. Each valve is also connected to a source of 24 VDC, which is present when the RF power and resultant plasma discharge is ON.
- I/O vacuum fittings – The customer may specify a different type of vacuum fitting for the process gas input side or to include a fitting on the output side of the source (not included in the base package). One side of the fitting will always be a type KF-50 and the opposite end is user specified. Please consult typical industry vendor catalogs for information on stocked components.
- DC bias adapter kit – This kit includes hardware required to inject a DC bias voltage directly into the process gas feed end of the DG-300. It consists of an isolated electrode that is also part of the process gas feed assembly. The electrode is in direct contact to the plasma discharge and is therefore de-coupled to inhibit any conducted RF energy from leaving the process tube. An adjustable DC power supply is used to vary the potential on the electrode. One side of the DC supply is connected to the electrode and the other may be grounded to the vacuum chamber or completely isolated and connected to the substrate (inside the vacuum chamber).
- Bellows flex line kit – Flexible stainless steel tubes can be supplied to facilitate connections to a user's process system. These typically consist of ¼" tubes with smooth ends for connection to the Swagelock gas cooling fittings or smooth on one end and VCR on the opposite end to connect to the process gas input. Custom gas lines are also available upon request.
- Alumina process tube kit – This option is used to replace the standard quartz tube and Viton o-rings when corrosive fluorine based process gasses are used. Included are Calrez™ o-rings and a 99.9% pure alumina process tube. This option can be ordered with the DG-300 or added at a later date.

6.1 OPTIONAL EQUIPMENT LIST cont.

- Process gas mass flow control kit – Two different methods may be used to control the process gas flow into the DG-300. Either a manually adjusted method using a needle valve or a fully automatic method using a mass flow controller (MFC) may be employed. Both kits include a (24 VDC) solenoid operated shutoff valve. Consult the factory for more information.
- Interlock sensor kit – Typical installations include interlock switches for the cooling water flow and the cooling gas supply. This kit includes a rotary flow switch for the water supply and a pressure switch for integration into the supply side of the cooling gas line.