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1.1 MANUAL ORGANIZATION

This Operations and Maintenance Manual was composed to aid you in the installation, operation and maintenance of your Technics 800 Series Micro Reactive Ion Etch System. This system requires specific skills to install, maintain and operate properly. Individuals who do not have the required skills should not attempt to operate or service this system.

WARNING

This system contains lethal voltages. Persons not skilled or properly trained in working with lethal voltages should not service this system.

1.1.1 MANUAL CONTENTIONS

Where information is presented which relates to safety, it will look like this:

WARNING

This format is used to indicate information which relates to a safety issue to the operator, technician or the system itself.

When special or critical information is presented, it will be shown as follows:
1.1.2 SAFETY DISCLAIMER
In order to avoid possible shock or fire hazards, connection of this system should be made in compliance with the National Electrical Code (NEC) and/or any other city, county or state requirements applicable to the user. Installation, operation and maintenance should be performed by qualified personnel only.

1.1.3 PROPRIETARY INFORMATION NOTICE
This document contains proprietary and confidential information of Technics, Inc. Possession of this document does not imply the right to reproduce or disclose the information in this document without the express permission of Technics, Inc.

1.1.4 MANUAL REGISTRATION
The registration page at the end of this Manual should be filled out by the customer at the time of installation. By registering this manual, you will be able to receive manual updates and service bulletins from time to time from the factory. Manual registration will also help us in supporting your system with regard to spare parts and documentation. Make sure to include your system serial number when filling out the registration form.

NOTE: The serial number of the system is located on the rear access panel.

1.2 SYSTEM OVERVIEW
1.2.1 OPERATING PRINCIPLES
The Technics 800 Series Micro Reactive Ion Etch system utilizes various components working in a specific sequence to etch a thin film from a substrate or work piece. Reactive Ion Etching (RIE) combine plasma and ion beam removal of the surface of a substrate. The etching gas (as in plasma etch) enters the reaction chamber and is ionized by the application of an electric field such as RF Individual gas molecules are accelerated to the substrate surface. These charged particles remove the top layer of material by the combined efforts of mechanical and chemical reactions.

This combined action results in an etch process that is very controllable and much faster than either action by itself. Reactive ion etch is the preferred dry etch technique in use today. RIE provides a means of reliable production of sub-micron sized openings.

Uniform etching depends on a number of key parameters; the thickness and type of material being etched, the type and flow rate of the etching gas, chamber pressure and energy level of the plasma. Since all these parameters are under control of the user, precise results can be achieved.
A common gas used for plasma etching is CF$_4$ plus O$_2$. When ionized, CF$_4$ breaks down and produces fluorine and carbon. The fluorine will react with silicon dioxide, resulting in SiF$_4$ and the O$_2$ reacts with carbon creating CO. These newly formed gases are then removed from the chamber by the vacuum system. This results in removing portions of the top surface of the material being etched. Etch gases are typically either Fluorine or Chlorine based.

In the Technics 800 Series Micro Reactive Ion Etch system, two electrodes are used; the platen, (cathode) is connected to the RF power supply. The power supply may operate at 30 KHz or 13.56 MHz. The other is the chamber itself (anode). The device to be etched is placed on the platen. Material removed from the device is pumped out as a gas.

Under proper conditions of chamber pressure, gas, applied voltage and proper distance between the electrodes, the gas will become ionized. This ionized gas is simply referred to as a plasma. Other types of plasmas in physics are the sun and lightning.

The reactive ions created in the plasma impinge the top layer of the device being etched. This material is removed by physical and chemical reactions between the reactive components of the etch gas and the material being etched and is converted to a gas and pumped from the chamber.

**DC SELF-BIAS**

An interesting phenomenon occurs in a plasma; due to the difference in mass between electrons and ions, their respective velocity in the plasma discharge are significantly different. Any electrode exposed to the plasma will see a difference in the rate of arrival of electrons and ions accordingly: if an electrode (in this case the platen) is insulated from ground, a self bias voltage will develop to balance the electron and ion current to a net zero value. In Reactive Ion Etching, this self bias voltage will occur on the platen because the platen is insulated from ground by a blocking capacitor in the RF power supply. This self bias DC voltage acts to attract positive ions. The platen is bombarded with positive ions causing atoms of the substrate being etched to be sputtered and usually react chemically with the etching gas forming a derivative gas that is pumped from the chamber.

**1.3 SYSTEM CONFIGURATION**

**1.3.1 SYSTEM LAYOUT**

The Technics 800 Series Micro Reactive Ion Etch system is comprised of nine basic sub-assemblies which collectively function to provide the capability for Reactive Ion Etching. The eight sub-assemblies are:

1) Main Console
2) Reaction Chamber/Platen Assembly
3) Vacuum System
4) Gas Control System
5) Pressure Sensor/Display
6) RF Power Source
7) Process Control System
8) Water Cooling System
9) System Interlocks

1.3.2 CONSOLE
The integrated system is housed in an attractive cabinet with the reaction chamber mounted on top. Except for the mechanical vacuum pump and some options, all other components are mounted within this cabinet.

1.3.3 PROCESS CHAMBER/SUBSTRATE ASSEMBLY
The process chamber is fabricated of stainless steel, 10 inch inside diameter. The platen is 9 inches in diameter, and capable of etching one 200, 150 or 125 mm wafer, or five 3 inch or twenty 2 inch wafers. The platen is water cooled and placed to create a 3:1 anode to cathode ratio which offers the highest self induced bias voltage at the wafer plane.

1.3.4 VACUUM SYSTEM
An 11 CFM Plasma Corrosive Series dual stage vacuum pump is supplied charged with Fomblin® fluid and a pneumatically operated isolation valve mounted to the chamber base plate. A 40” stainless steel welded bellows tube connects the pump to the vacuum valve. This tube is terminated with KF-25 quick disconnect flanges.

1.3.5 GAS INLET CONTROL SYSTEM
The Technics 800 Series Micro Reactive Ion Etch system in its standard configuration has two gas channels. Each channel consists of a Porter® valve and an isolation solenoid. Porter® valves are a type of variable flow control device which provide a constant gas flow independent of chamber pressure variations. Actual flow is set by adjusting a control knob on the front of the system. The isolation solenoid is used to turn the gas channel on and off. When on, the preset flow rate provides a fixed flow to the chamber. All gas lines and fittings are stainless steel and each gas line includes a sub-micron filter.

As an option, Mass Flow Controllers (MFC) are available with up to four additional channels of gas. With this option, up to five gases can be used; two by Porter® valves, and four more by MFC When MFCs are selected, Gas 1 Porter® valve is not available.

When MFCs are added to the system, they are selected by the process controller as Gas 1. The user must choose between Gas 1 Porter® valve or the added MFCs. You can not
use both at the same time, although you can use the MFCs and Gas 2 Porter® valve at the same time.

1.3.6 PRESSURE SENSOR/DISPLAY
For measuring chamber pressure, a corrosion-resistant capacitance manometer (absolute pressure) gauge is used, mounted to the underside of the baseplate. Chamber pressure is digitally displayed on the process controller digital panel.

1.3.7 RF POWER SOURCE
The system includes a 350 watt 30 KHz power supply for plasma generation. The power supply is located in the main console and is controlled by the process controller. Power level is set by a potentiometer on the control panel and digitally displayed on the process controller display panel. As an option, the system can be configured with a 350 watt 13.56 MHz power supply. When 13.56 MHz is used, an impedance matching network is also included. This network automatically matches the RF output to the chamber. The matching network is housed in a side module, on the right side of the main console.

1.3.8 PROCESS CONTROL MODULE
A solid state process controller is used to control the etch process. It consists of two circuit boards; a digital sequencer and an digital display board. The display board displays RF power, chamber pressure, etch cycle time and individual functions. The sequencer controls cycling and operation of individual functions in the proper order. The process control module is located on the right front of the main console.

1.3.9 WATER COOLING SYSTEM
Cooling water is required to cool the devices to be etched. Cooling water is circulated through the platen. A flow detection switch is used to interlock the RF power supply. If cooling water flow is insufficient, the RF power supply can not operate.

1.4 SYSTEM OPTIONS

1.4.1 13.56 MHZ POWER SUPPLY
The standard 30 KHz RF power supply can be replaced with a 350 watt 13.56 MHz power supply. This option consists of the power supply and an automatic matching network. The network can be operated manually, or in automatic. In automatic mode, the matching network constantly adjusts tuning to provide maximum power transfer between the power supply and the chamber.

1.4.2 MASS FLOW CONTROL
Mass Flow Controllers (MFC) can be added with up to four additional channels of gas. This option consists of the MFC’s and an auxiliary gas control panel. The panel is
located behind the door on the front of the system console. The panel includes a digital display which is used to set desired flow, gas conversion factors (for gases other than nitrogen or oxygen) and actual flow.

With this option, up to five gases can be used; two by Porter® valves, and up to four more by MFC. When MFCs are selected, Gas 1 Porter® valve is not available.

1.4.3 AUTOMATIC DOWN STREAM PRESSURE CONTROL

The automatic pressure controller provides a constant chamber pressure independent of pumping speed fluctuations within the operating range of the system. The pressure controller consists of an electrically driven butterfly valve and an electronic controller as standard equipment. The valve position is adjusted to provide the proper pumping conduction to maintain a specific chamber pressure during etching. The controller is controlled by a precise feedback loop from the capacitance manometer monitoring chamber pressure.

1.4.4 EXTERNAL WATER RECIRCULATOR

The external water recirculator is a 5 liter, closed-loop system capable of sustaining a 5 L.P.M. (Liters Per Minute) flow at zero head pressure. It has a temperature control range of -15°C to 100°C. The unit is self-contained and operates on 110/220 VAC.

1.4.5 EXTERNAL OIL FILTRATION SYSTEM

An external oil filtration system is available charged with Fomblin® fluid for the mechanical pump. The system consists of a filter cartridge, transfer pump and flex hoses to connect to the oil fill and drain ports on the mechanical pump. The purification system is equipped with pressure gauges for monitoring filter condition and quick disconnect fittings.

1.4.6 EXHAUST SCRUBBER

A self contained packed bed type fume scrubber is available which removes hazardous components from the mechanical pump exhaust. The scrubber is compact and is sized to operate in conjunction with the 800 RIE.
2 Installation

2.1 UNPACKING SYSTEM

The 800 Micro RIE system is shipped in a wooden crate for maximum protection in transit. Depending on the configuration and options ordered, additional boxes and crates are also included.

**WARNING**
All containers and crates must be maintained in the upright position at all times to avoid damage.

Check all containers and boxes for visible external damage prior to uncrating. Check tilt and shock indicators if so equipped. If any are tripped or crates or packages are damaged, notify the carrier, insurance company and Technics, Inc. at once. **Do not proceed with unpacking**

If no visible damage is obvious, remove the screws and remove the lid of the crate. Gently LIFT the system out of the crate.

**WARNING**
The system is heavy. One person can not lift the system. Get help.

**NOTE:** Do not dismantle the crate at this time.
There are “tip-and-tell” and “shock-watch” indicators attached to the side panels of the system crate. Check to see if the system has been stressed beyond the normal range of these indicators. If so, do not proceed any further.

If the indicators are normal, proceed with unpacking the system and all additional crates and packages. Once all components have been removed from their shipping material, do a careful visual inspection for any hidden shipping damage.

**2.1.1 SHIPPING DAMAGE**

Although shipping damage is rare, it can occur. If shipping damage is discovered, make the proper notifications at this time.

**NOTE:** The sooner shipping damage is reported to the carrier and/or insurance agent, the quicker the resolution. Do not move the system or throw away any shipping material until the responsible parties have had an opportunity to inspect them.

**2.1.2 SHIPPING MATERIALS**

System shipping materials other than common cardboard boxes should be retained. In the unlikely event that a system component is returned to the factory for service or modification, proper packing is required to guard against shipping damage. If the crate has been thrown away, a new crate will be required for shipping. Some components will not be accepted by the factory unless properly crated.

All packing material should be saved at least until the system is installed and operating. This will guarantee that no components or documents have been inadvertently thrown away with the packing material.

**2.2 PLACING THE SYSTEM**

Although the placement of the system is usually dictated by other factors, some thought should be given to the placement of the system and the system options and sub-systems.

**2.2.1 PHYSICAL CONSIDERATIONS**

**Main Console**

For the main system cabinet, consideration should be given to system access for maintenance. Side access is desirable for maintenance purposes. Rear access is required. Make sure there is adequate room for removal of the rear access panel. Also make sure there is adequate room to swing open the chamber lid.

There should be adequate air flow to the rear of the system console. Many components are air cooled. If there is air flow blockage or high ambient air temperature, the system may not perform accurately or a system failure could occur. Make sure there is adequate
room to route the interconnect lines from the system to the mechanical pump and any options. The interconnect lines should be routed in a way that prevents someone from stepping on them.

**Mechanical Pump**
The mechanical pump should be located in a utility area if possible. The mechanical pump should be placed in a pan to catch any oil that may drip when the mechanical pump is serviced. The mechanical pump should be located within the reach of the supplied bellows roughing line. If necessary, this line can be extended, but pumping performance (especially roughing time) can be degraded.

Make sure the mechanical pump is placed such that the fill and drain ports are easily accessible. Adequate air flow is required for cooling the motor.

### 2.2.2 OPTIONAL EQUIPMENT PLACEMENT

**External Water Recirculator**
This unit should be placed in the utility area if possible. Access should be provided for maintenance and adding or draining fluid. Keep the inlet and outlet lines to the RIE system as short as possible. The longer the lines, the lower the water flow. Adequate air flow is required for cooling.

**External Oil Filtration System**
The external oil filtration system should be located next to the mechanical pump. It should be placed in a pan to catch any oil. Access should be provided for changing the oil filters. Adequate air flow should be provided to eliminate the possibility of the motor/pump from overheating.

**Exhaust Scrubber**
The exhaust scrubber should be located next to the mechanical pump and house exhaust line to keep lines as short as possible. Access to the scrubber tank fill and drain ports is required.

### 2.3 UTILITY CONNECTIONS

#### 2.3.1 COOLING WATER

**WARNING**
There are stringent water flow requirements. The cooling system is designed for specific maximum and minimum pressure and water purity. Supply-return minimum delta pressures must be maintained. If proper water conditions are not met, system performance may be affected.
The water cooling system specifications must be met. Higher pressures than specified may result in a serious water leaks and system damage. Warranty status can be affected by improper water pressure. Water purity is also important. Poor water condition may result in abnormal system performance. Since the platen is water cooled, the water comes in contact with the platen electrical potential. Impure water can result in RF power being bypassed to ground through the water lines.

NOTE: Refer to the Specifications section of this manual for cooling water requirements. These water specifications apply to all systems not equipped with the External Water Recirculator Option.

A suitable facilities water flow meter (0-1 GPM) is recommended to ensure adequate flow on systems not equipped with an external water recirculator. Water connections should be made using the proper fittings (1/4” Swage-loc) and line size to match the RIE system, paying attention to the inlet and outlet port labeling. If water flow is reversed, the safety interlock flow switch will not detect water flow.

Water lines should be as short as possible, and routed in a way to eliminate kinks. If required, a suitable water filter should be installed. If house supply pressure is above the RIE system specification, a pressure regulator must be used. Water pressure should not exceed 40 PSI maximum.

2.3.2 PROCESS GAS
Process gases should be provided from regulators with a range of 0-40 PSI Connect the gas lines to the required ports using the proper fittings to match the RIE system (1/4” VCO) for MFCs and porter valves. Inlet gas pressure should be set to 10 PSI for both Porter valves and MFCs.

2.3.3 VENT GAS
Dry nitrogen is normally used to vent the process chamber. Nitrogen should be provided from a regulator with a range of 0-40 PSI Connect the nitrogen line to the VENT port at the back of the system using the proper fittings (1/4” VCO). Nitrogen pressure should not exceed 10 PSI A lower pressure may be desirable to minimize turbulence when venting, but will increase vent time.

2.3.4 MECHANICAL PUMP
Connect the mechanical pump inlet port to the RIE system pumping port via the bellows line and the supplied KF-25 flanges. Make sure the line termination at the pump is the inlet and not the exhaust. If in doubt, check the mechanical pump manual. Connect the mechanical pump exhaust to the scrubber if applicable or to the house exhaust. Keep in mind that mechanical pumps produce an oil mist when high gas loads are present (like pumping down the chamber from atmosphere. If the mechanical pump exhaust is connected to a house exhaust, avoid pockets where oil vapor can condense and puddle.
Fill the mechanical pump with the supplied Fomblin fluid. Watch the sight gauge as you fill to avoid overfilling. Any excess fluid caused by overfilling will be expelled by the pump out the exhaust line.

**NOTE:** If an external oil filter is being used, the pump will have to be refilled or topped off as the filter absorbs oil.

**Foreline Trap**

In normal operation, there is little likelihood that mechanical pump oil can migrate from the mechanical pump back to the process chamber. However, if the RIE system is operated in the manual mode incorrectly, causing the roughing pump to be left open to the chamber, back streaming of oil can occur. If desired, a foreline trap can be added at the mechanical pump inlet to minimize back streaming. There are numerous types available or you can contact Technics, Inc. for advice.

**2.3.5 Mechanical Pump Exhaust**

The mechanical pump exhaust is normally connected to a facility house vent or to the optional scrubber. All process gases used in the RIE system will pass through this vent. Local, State and Federal O.S.H.A. and E.P.A. regulations may affect how these vent gases are handled.

Condensed oil vapor is present in the exhaust of the mechanical pump. This is normal, but some house venting systems are sensitive to this. Also, the vent line should be configured to eliminate sharp bends and runs which can accumulate oil vapor over time creating a potential fire hazard. A common way of eliminating this problem is to install a drain valve and bend in the exhaust line close to the pump. Periodically this valve can be opened to drain any accumulated oil. Special traps are also available which catch the oil vapor and return it to the pump. Consult Technics for advice.

**2.3.6 Electrical Mains**

The RIE System operates on 110/220 VAC, 50/60 Hz, 15A single phase. All main power requiring components are terminated in standard 110 or 220 VAC plugs. The following is a list of required outlets:

**STANDARD**

1) Main console
2) Mechanical Pump

**OPTIONS**

3) External Oil Filter
4) Exhaust Scrubber
5) External Water Recirculator
6) 13.56 MHz Automatic Matching Network
7) Down Stream Pressure Controller

Connect the power lines as required. The power lines should be connected to a disconnect breaker or switch for safe maintenance. Installation should be in accordance to all local and N.E.C. codes.

2.3.7 COMPRESSED AIR
The system requires clean, dry air to operate the pneumatics. Air requirements are minimum 75 PSI and maximum 85 PSI. The air supply should be filtered to remove any moisture if not passed through a house dryer. Flow is 1.5 CFM intermittent. A separate regulator is advised. Lubricated air is preferred, but not required.

2.3.8 SYSTEM GROUND
A chassis ground line should be run from the RIE system frame to a good earth ground.

The resistivity of the earth ground should be less than 5 ohms, non-polarized with reference to the electrical utility ground reference. Grounding the system will ensure minimum radiated R.F.I. from the 13.56 MHz power supply (if so equipped) and the process controller. Copper strap, 1 inch wide and .012 inches thick should be used. Grounding should be as follows:

A direct copper line from earth ground to the RF power supply. A separate braided line from the RF power supply to the Auto-tuner and another from the chamber top to the RF power supply.

2.4 OPTIONAL EQUIPMENT INSTALLATION
2.4.1 **EXTERNAL OIL PURIFICATION SYSTEM**
Connect the inlet and outlet lines to the mechanical pump as specified in the supplied oil filtration Manual located in the Vendor Manual section of this document.

Open the filter canister and fill with pump fluid slowly to the lip of the canister. Replace the canister top. As the filter pump is run, additional oil will have to be added to the mechanical pump until the filter is saturated.

**NOTE:** If an external oil filter is being used, additional oil will be needed to fill the oil filter.

2.4.2 **WATER CIRCULATOR**
Connect the inlet and outlet lines from the water recirculator to the system. Make sure to observe the correct ports on the back of the system. If the lines are reversed, the water flow switch will not work. Keep these lines as short as possible for maximum flow. Make sure there are no kinks or sharp bends.

2.4.3 **EXHAUST SCRUBBER**
Connect the interlock cable from the scrubber to the back of the system console. An internal flow switch in the scrubber monitors water flow and interlocks the main console.

If water flow is insufficient, the system will not operate and an audible alarm will sound from the scrubber.

Fill the scrubber tank with 3 gallons of water. Chemicals can be added to the water, but they must dissolve completely to prevent plugging of the spray nozzle.

2.5 **SYSTEM TURN ON**
This completes installation of the 800 RIE System. If factory installation is being provided, do not turn on any utilities or AC power. This will be done by the Field Service Engineer. If factory installation is not authorized, proceed as follows:

1. Turn on the house cooling water or External Water Recirculator while watching the water connections for water leaks. If any leaks are seen, immediately turn off the water and repair the leak.

2. Turn on or plug in the mechanical pump. The sound of the pump should quickly change in amplitude as the pump evacuates the roughing line. If it does not, turn the pump off and check the quick disconnect flange connections between the pump and the main console.
3. If equipped, plug in the external oil filter. As it begins to run, watch the oil level in the mechanical pump. It will initially fall as the oil filter system fills with fluid and the filter element saturates. This may take several hours.

4. If so equipped, plug in the exhaust scrubber. You should be able to see the spray pattern at the top of the column.

5. Plug in the system console and automatic matching network/Down Stream Pressure Controller (if so equipped).

Open the control panel door and verify that all switches except TORR SET are in the down position.

Switch on the system console. The console has a power on push button located on the rear top panel. When this switch is pressed, you will hear the main contactor click on. If the console fails to stay on when the button is released, it means that the interlock switch loop is open. This can be due to a loose or removed panel or depressed E.M.O. switch (or scrubber water flow if so equipped). There are interlock switches on the right and left panels (right panel blocked if equipped with 13.56 MHz and/or Down Stream Pressure Controller option) and on the rear panel. Switch on the Down Stream Pressure Controller and the Matching Network (if so equipped) by depressing the front panel power switch. Each switch should light when depressed.

This completes installation of the 800 RIE system. Proceed to the next section, Operation.
3.1 CONTROLS AND FUNCTIONS

The 800 Series RIE system operates from a process controller. It operates in either manual or automatic modes. Process parameters and functions are pre-set directly from the control panel at the bottom of the console front behind a swing down door, the Gas control panel located behind the door just above the control panel (if so equipped) and the front and rear panels for start/stop and system on.

3.1.1 CONTROL PANEL

On the control panel, from left to right, the following switches are provided:

MODE SWITCH

**MAN** - Manual Operation
Allows the system to respond to each control switch or function controlled within the control panel and the optional MFC gas control panel provided all system interlocks are satisfied.

**AUTO** - Automatic Operation
Cycles the system automatically provided that all interlocks are satisfied and the function is enabled.

VACUUM SWITCH
**ON**-Vacuum Valve On  
Opens the vacuum valve when the mode switch is in MAN. Enables the vacuum valve when the mode switch is in AUTO.

**OFF**-Vacuum Valve Off  
Closes the vacuum valve when the mode switch is in MAN. Disables the vacuum valve when the mode switch is in AUTO.

**VENT SWITCH**  
**ON**-Vent Valve On  
Opens the vent valve when the mode switch is in MAN. Enables the vent valve when the mode switch is in AUTO.

**OFF**-Vent Valve Off  
Closes the vent valve when the mode switch is in MAN. Disables the vent valve when the mode switch is in AUTO.

**TORR SET SWITCH**  
**HIGH**-High Set Point Display  
Switches the process controller to display the high vacuum set point. This set point is used by the process controller to interlock certain functions such as the RF interlock.

**LOW**-Low Set Point Display  
Switches the process controller to display the low vacuum set point. This set point is user set by adjusting the potentiometer next to this switch. This set point is used by the process controller as the initial pump down value. The program will not proceed until this set point is reached.

**POWER SWITCH**  
**ON**-RF. On  
With the mode switch in the MAN position, turns on RF power if all interlocks are satisfied (water flow, panel switches and high set point). Applies RF power to the platen as set on the power level potentiometer next to it. With the mode switch in the AUTO position, it enables RF power.

**OFF**-RF. Off  
With the mode switch in the MAN position, turns off RF power. With the mode switch in the AUTO position, it disables RF power.

**POWER LEVEL POTENTIOMETER**  
Sets the RF power level.

**GAS 1 SWITCH**  
**ON**-Gas Channel 1 On
With the mode switch in the MAN position, turns on Gas 1 isolation solenoid if the high set point is reached. With the mode switch in the AUTO position, it enables Gas 1 to be controlled by the process controller.

**OFF** - Gas Channel 1 Off
With the mode switch in the MAN position, turns off Gas 1 isolation solenoid. With the mode switch in the AUTO position, it disables Gas 1.

**GAS LEVEL 1 CONTROL KNOB**
Sets the gas flow rate for Gas 1.

**GAS 2 SWITCH**

**ON** - Gas Channel 2 On
With the mode switch in the MAN position, turns on Gas 2 isolation solenoid if the high set point is reached. With the mode switch in the AUTO position, it enables Gas 2 to be controlled by the process controller.

**OFF** - Gas Channel 2 Off
With the mode switch in the MAN position, turns off Gas 2 isolation solenoid. With the mode switch in the AUTO position, it disables Gas 2.

**GAS LEVEL 2 CONTROL KNOB**
Sets the gas flow rate for Gas 2.

**TIME SWITCH BANK**
These 3 digi-switches select the plasma etch time. Time is user set from .1 to 99.9 minutes. When the process controller runs a process, it reads this switch bank and loads the value into its internal count down timer. Time is displayed on the process controller. This switch bank is only operational in the AUTO mode.

**NOTE:** The value set in this switch bank is read at the beginning of a process cycle. If the value is changed while the system is running in AUTO, the new value will not be read.

**3.1.2 CYCLE CONTROL**
The cycle control switch is located to the right of the control panel.

**START/STOP SWITCH**
This momentary push button switch starts or stops the process cycle each time it is depressed when the mode switch is in the AUTO position. If a process cycle is running, it will abort the process and vent the process chamber. If a process is not running, it will start the process cycle.

**3.1.3 POWER ON**
The following switch is located on the rear console panel.

**POWER SWITCH**

This momentary push button switch enables the main contactor. If all panel interlocks are made, the contactor will latch the system on. If all panel interlocks are not made, the system will shut off when this switch is released. The system is turned off by depressing the red E.M.O. switch located on the top of the console next to the process chamber.

**3.1.4 PROCESS CONTROLLER**

The following displays are located on the Process Controller:

**WATTS DISPLAY**

Indicates RF power level in watts being applied to the platen.

**TORR DISPLAY**

In normal operation this display indicates process chamber pressure in Torr.

When the TORR set switch on the control panel is set to HIGH, it displays the high vacuum set point (point at which program interlock is made (gas on, RF enabled, etc.). When the TORR set switch on the control panel is set to LOW, it displays the user set low vacuum set point (point at which process cycle will pump to before continuing.

**NOTE:** .001 Torr equals 1 mTorr. Display range is .000 to 1.999 Torr.

**MINUTES DISPLAY**

This display indicates the etch time which was set on the Time set digi-switch bank at the time of process cycle start. If this time is changed after starting a process cycle, it will not change the process control time. The time displayed will count down to zero in 1/10 minute (6 second) increments. Time range is 00.0 to 99.9 minutes.

**FUNCTIONS DISPLAY**

The functions display L.E.D.s are located at the bottom of the process controller. They indicate the following when lit:

**MAN**- The process controller is in the manual mode. The mode switch on the control panel is in the MAN position.

**AUTO**- The process controller is in the automatic mode. The mode switch on the control panel is in the AUTO position.

**TIMER**- The process controller timer is running.
**VAC**- The vacuum solenoid is open. Process chamber is pumping down.

**VENT**- The vent solenoid is open. The process chamber is venting.

**GAS 1**- Gas 1 solenoid is open or the optional MFC gas control panel is enabled (if so equipped). If there is no optional MFC gas control panel or if the select switch on the MFC gas control panel is in the Gas 1 position, Gas 1 is flowing into the process chamber at the flow rate set on Gas 1.

If an optional MFC gas control panel is installed, and the select switch on the MFC gas control panel is in the Gas MFC position, Gas is flowing into the process chamber at the flow rate set for each MFC enabled.

**GAS 2**- Gas 2 solenoid is open and gas is flowing into the process chamber at the flow rate set on Gas 2.

**PLAS**- RF is on and is being applied to the platen at the level set on the power level potentiometer on the control panel.

### 3.1.5 OPTIONAL GAS PANEL

The following switches and indicators are located on the MFC Gas Control panel located behind the front console door:

**MODE SWITCH**

**GAS 1**- Gas 1 mode selected. Gas flow is through the Gas 1 Porter® valve on the control panel and flow rate is set on the Gas 1 flow pot.

**A.C**- MFC. Gas Panel is enabled when Gas 1 is on in the manual mode or enabled in the automatic mode. Gas flow into the process chamber is through the selected MFCs not the Gas 1 Porter® valve.

**RIGHT DISPLAY SWITCH**

Selects gas channel being displayed on the digital readout- A through D.

**LEFT DISPLAY MODE SWITCH**

**CAL**- Displays the conversion factor required to calibrate the digital readout to read in standard cubic centimeters per minute (sccm). Since MFCs function by measuring the heat exchange rate of molecules, the size of the molecule (varies with different gases) must be factored into the MFC measurement circuitry. This is done by adjusting the conversion factor.

**SET**- Displays the flow set point of the selected MFC on the digital readout in sccm.

**READ**- Displays the actual flow of the selected MFC on the digital readout in sccm.
sccm.

3.1.6 OPTIONAL 13.56 MHz Power Supply

In order to transfer maximum energy when creating a plasma, it’s necessary to match the impedance of the RF source to the load (plasma). This is achieved by the Automatic Matching Network. It contains a tunable element which is automatically adjusted by its controller to match the impedance of the RF power supply to the plasma.

As process pressures vary, and as different gases are used, the optimum tuning point will change. The automatic matching network measures the forward and reflected power and adjusts itself to the best tuning point. The following controls and indicators are located on the front panel of the Automatic Matching Network:

**DIGITAL DISPLAY SWITCH**

**FWD-** Switches the display to read forward power in watts.

**REF-** Switches the display to read reflected power in watts.

**BIAS-** Switches the display to indicate DC bias in volts present on the platen.

**POWER ON SWITCH**

Controls AC power to the automatic matching network. Press on to turn the unit on, press again to turn it off.

3.1.7 OPTIONAL Down Stream Pressure Controller

The down stream pressure controller adjusts the position of a butterfly valve between the process chamber and the mechanical pump. It receives pressure information from the Baratron® gauge and compares it to a user selected set point. Any differences between these two values results in an error signal which is amplified and applied to an electric motor which drives the butterfly valve. The amplitude of the error signal is adjustable by way of the GAIN potentiometer. As gain is increased, the error signal magnitude is increased which results in a more rapid correction. The other potentiometer is called PHASE. This control acts as follows: The error signal passes through an electronic switch which periodically interrupts the error signal to the butterfly valve motor. When the phase control is set to minimum, there is no interruption of the error signal. All error signals are immediately applied to the motor. When the phase control is set to maximum, the error signal is periodically interrupted for its maximum time. This is done to allow the chamber pressure to stabilize before another correction takes place. Without these two controls, the controller would not be able to operate at different pressures.

**SET POINT POTENSIOMETER**

Sets the chamber operating pressure. 10 turn pot with dial readout. The readout range is 0 to 1000 which represents 0 to 1000 mTorr.
GAIN POTENTIOMETER
Sets the gain of the error amplifier. Full counter-clockwise is minimum gain. Full clockwise is maximum gain.

PHASE POTENTIOMETER
Sets the on-off time of the interruption of the error signal to the motor. Full counter-clockwise is no interruption (off time). Full clockwise is maximum interruption time.

ZERO POTENTIOMETER
This screwdriver adjustable potentiometer adjusts the offset of the error amplifier so that at the set chamber pressure agrees with the actual chamber pressure.

VALVE POSITION SWITCH
OPEN- Drives the butterfly valve to its full open position.
CLOSED- Drives the butterfly valve to its fully closed position.
CENTER (OFF)- Switches the controller to automatic operation

VALVE STATUS DISPLAY LEDS
HIGH- When lit it indicates that the chamber pressure is above the set point.
STABLE- When lit it indicates that the chamber pressure is at the set point.
LOW- When lit it indicates that the chamber pressure is below the set point.
OPEN- When lit it indicates that the butterfly valve is at its full open position.
CLOSED- when lit it indicates that the butterfly valve is at its full closed position.

3.2 MANUAL OPERATION

WARNING
Operating the system in the manual mode bypasses some of the built-in safeguards to protect the system. Manual mode should be used with care and only by qualified individuals familiar with the operation of the system.

3.2.1 CONTROL OVERVIEW
The RIE system can be operated in two different ways; manual or automatic. In the manual mode, individual functions are selected sequentially by the user. When
operating manually, safety interlocks are still in effect, but process interlocks are not. It is possible to operate the system in an improper mode which can degrade system performance. When operating manually, the following interlocks still apply:

**Water Flow Switch**- Water must be flowing in order to turn on RF

**Panel Interlocks**- All panel interlock switches must be made and the E.M.O. switch not made in order to turn on the system power.

**High Set Point**- Chamber pressure must be below high set point to turn on gas or RF

### 3.2.2 INITIAL START-UP

The following procedure is to be used the first time the system is operated. It consists of a start-up and test procedure. When a procedure step does not meet the specified result, possible faults are stated to correct the error.

1. Open the control panel door and verify that all switches except **TORR SET** are in the down position.

2. With all power cords plugged in, press the **POWER ON** switch located on the back panel of the console. The process controller should light up and you should hear the main contactor click on.

   If the process controller does not light up, make sure the system is plugged in and the plug is powered.

   Check the fuse located next to the AC power cord on the back of the console (15A, fast-blow).

   If the process controller lights up when you press the **POWER ON** switch, but goes out when you release the switch, a panel interlock switch is not made or is defective, the E.M.O. switch is made or the scrubber flow switch is not made.

3. If the system is configured with the 13.56 MHz option, press the **POWER ON** switch at the bottom of the Automatic Matching Network. The button should light.

   If it does not, make sure it is plugged in. Check the fuse at the back of the unit. It should be a 2 amp, fast blow.

4. If the system is configured with the Down Stream Pressure Control (D.S.P.C.) option, press the **POWER ON** switch at the bottom of the front panel. The button should light. Move the **VALVE** toggle switch to the **OPEN** position. When the open L.E.D. lights, press the **POWER ON** switch to turn the D.S.P.C. off.
If it does not, make sure it is plugged in. Check the fuse at the back of the unit. It should be a 1 amp, fast blow.

5. On the front control panel, place the MODE switch in the MAN (down) position. Verify that the L.E.D. labeled MAN lights on the process controller.

6. On the control panel, place the VENT switch in the ON (up) position. Verify that the L.E.D. labeled VENT lights on the process controller. The process chamber should now be venting. After a minute or two, you should be able to open the process chamber. When the chamber is open, turn the VENT switch off.

If the process chamber doesn’t fully vent within 2 minutes, but you can hear the vent solenoid click on and off when you operate the vent switch, check the supply of nitrogen to the vent port on the back of the console. It should be between 5 and 10 PSI.

If the process chamber doesn’t fully vent within 2 minutes and you can not hear the vent solenoid click on and off when you operate the vent switch and you know you have pressurized nitrogen at the vent fitting and at least 70 PSI. for pneumatics, you probably have a system failure and will require service.

With the process chamber open, inspect the platen and insulator carefully for damage or breakage. Remove any packing materials which were in the chamber for shipping.

Wipe down the chamber with alcohol and dry by blowing air or nitrogen. Close the process chamber.

NOTE: When closing the process chamber, always make sure the chamber lid is centered on the baseplate and that the sealing o-ring in the chamber lid is clean.

7. On the control panel, make sure the VENT switch is off, then place the VAC switch in the ON (up) position. Verify that the L.E.D. labeled VAC lights on the process controller. The process chamber should now be pumping down. After a minute or so, the pressure display should start to register the chamber pressure. The pressure display has a range of 0 to 1.999 Torr. Chamber pressure above 1.999 Torr result in a blank screen.

If you are within hearing range of the mechanical pump, you should notice an increase in sound when the process chamber starts pumping down, which will decrease in sound as it continues to pump. If the sound level does not decrease, and the pressure display does not display a pressure below 1.999 Torr within 60 seconds, it indicates a significant vacuum leak. Check all quick disconnect fittings on the roughing line. Make sure the chamber is seated correctly on the base plate. If this does not correct the problem, the system will require leak checking.
NOTE: If the platen was stressed during shipment, it may have damaged the feedthru vacuum seals where the platen water lines pass through the base plate.

8. Pump down the process chamber to a pressure of .050 (50 mTorr) as displayed on the process controller, then switch the VAC switch off (down). Watch the pressure indication on the process controller. Allow the system to idle in this condition for 5 minutes, then note the pressure. Again pump down the chamber to .050 with the VAC switch. Allow the system to idle for 5 minutes and again note the pressure.

If the resulting pressure after the second 5 minute term is below 150 mTorr, the system is probably leak tight. If it is above 150 mTorr and the pressure is the same as the first 5 minute term, there may be a leak and the system should be serviced.

9. Pump down the process chamber again by turning VAC switch on (up). Pump down to a pressure of .050 (50 mTorr) as displayed on the process controller, then switch Gas 2 on (up). Adjust the gas flow by turning the flow knob. You should be able to raise and lower chamber pressure as you adjust the flow. Turn Gas 2 off.

If chamber pressure does not vary up and down with the flow knob, check the gas supply for gas 2. The inlet pressure should be 10 PSI

10. If your system is configured with the optional MFC Gas Panel, place the switch marked A.F.C./Gas 1 on the gas control panel to the Gas 1 position. If it is not equipped with the optional panel, skip this step.

Pump down the process chamber by turning VAC switch on (up). Pump down to a pressure of .050 (50 mTorr) as displayed on the process controller, then switch Gas 1 on (up). Adjust the gas flow by turning the flow knob. You should be able to raise and lower chamber pressure as you adjust the flow. Turn Gas 1 off.

If chamber pressure does not vary up and down with the flow knob, check the gas supply for gas 1. The inlet pressure should be 10 PSI

NOTE: Refer to the fold out drawing at the end of this section for the following steps.

Switch the left switch (CAL, SET, READ) to CAL. Switch the right switch (A, B, C, D) to A. Adjust the CAL pot for gas A to the conversion factor for gas A.

NOTE: Refer to the Gas Conversion Sheet in Appendix E for the proper conversion factors.
Switch the left switch (CAL, SET, READ) to READ. If the digital display does not read zero (or close to it) the MFC zero must be reset. Refer to Section 4, maintenance for the procedure.

Switch the left switch (CAL, SET, READ) to SET. Adjust the flow set pot to read 10% of the MFCs total flow range. For example, if the MFC has a maximum flow rate of 50 sccm, set it to 5. This represents 5 sccm.

**NOTE:** MFCs are unpredictable when operating at less than 10% of their flow range.

Enable gas channel A by switching on (up) the enable switch. Pump down the process chamber by turning VAC switch on (up). Pump down to a pressure of .050 (50 mTorr) as displayed on the process controller, then switch Gas 1 on (up). You should see a rise in chamber pressure when Gas 1 is switched on.

Switch the left switch (CAL, SET, READ) to READ. The digital display now indicates the actual flow through the MFC. It should read the same value as the SET position (+/-4%). If it does not, check the inlet pressure to the MFC. It should be 10 to 15 PSI.

Turn Gas 1 off at the control panel. Chamber pressure should drop.

Repeat this step with each additional gas channel (B, C, D). When finished, switch VAC off.

12. If your system is configured with the optional Down Stream Pressure Controller, proceed with this step. If not, skip this step and proceed to Step 13.

**NOTE:** The Down Stream Pressure Controller (D.S.P.C.) has a finite operating range. If you try to run the system out of this range, the operation will become unstable and unpredictable.

When operating the system, it is important to operate the D.S.P.C. within its design operating range. For example, if you were to try to operate the system at a pressure of 10 mTorr with a high gas load, the D.S.P.C. will open the butterfly valve completely to try to achieve the low chamber pressure. With the butterfly valve completely open (as indicated by the OPEN L.E.D. on the D.S.P.C. front panel), pumping speed is at maximum. You can not achieve a lower chamber pressure.

Conversely, if you call for a high chamber pressure with a low gas load, the butterfly valve will completely close (as indicated by the CLOSED L.E.D. on the front panel), in an attempt to achieve the high chamber pressure. Chamber pressure will then rise above
Either of the above situations can be easily be corrected by either adjusting the chamber pressure set point, adjusting the gas load, or both.

**NOTE:** The following steps require using Gas 2. If your system is not equipped to run Gas 2, use Gas 1 instead, but make sure the Gas 1/A.F.C. switch on the optional Gas Panel is set to Gas 1 (if so equipped).

Turn on the D.S.P.C. by pressing the **POWER ON** switch. The switch should light. Adjust the pressure set point to 250. Switch **VAC** on. Switch **Gas 2** on. Place the **(OPEN -CLOSED)** switch on the D.S.P.C. to the **OPEN** position. Adjust Gas 2 flow to achieve a chamber pressure of about 150 mTorr as indicated by the digital pressure display on the process controller. Place the **(OPEN -CLOSED)** switch on the D.S.P.C. to the **CLOSED** position. Chamber pressure should rise considerably. If it does not, check the interface cable between the D.S.P.C. and the main console.

Place the **(OPEN- CLOSED)** switch on the D.S.P.C. to the **CENTER** (unmarked) position. Chamber pressure should stabilize to 150 mTorr within 30 seconds.

Switch **Gas 2** off. The throttle valve should close (as indicated by the CLOSED L.E.D. on the front panel), within 15 seconds, then as chamber pressure exceeds 150 mTorr, it will open partially and the CLOSED L.E.D. will go off.

Switch **Gas 2** back on. Allow the chamber pressure to stabilize. Proceed to Step 15 if your system is configured with a 30 KHz power supply. If you have a 13.56 MHz power supply, proceed to Step 16.

**13.** This step is for systems not configured with a D.S.P.C. Switch **Gas 2** on. Adjust the gas flow to achieve a chamber pressure of 150 mTorr as indicated by the digital pressure display on the process controller. If your system is configured with the optional 13.56 MHz power supply, go to Step 15. If equipped with a 30 KHz power supply, continue to the next step.

**14.** Turn the **POWER** pot on the control panel fully counter-clockwise. Switch the **RF switch to the on (up) position. Slowly rotate the **POWER** pot clockwise while watching the digital power display on the process controller. Adjust the power to 100 watts. You should see a plasma in the process chamber through the view port.

**NOTE:** When plasma is run for the first time, it may be unstable for a short period of time as it cleans up the chamber.

Slowly adjust the power pot to raise and lower the power. You should be able to vary the
power level (and resulting plasma) from about 50 watts to 300 watts (with oxygen as the gas).

**NOTE:** Maximum power and minimum plasma levels are a function of the gas being ionized and chamber pressure. These values will vary with different gases.

15. This step is for systems equipped with the optional 13.56 MHz power supply and matching network. If your system is equipped with a 30 KHz power supply, skip this step.

**Matching Network Operation Overview**
The matching network contains a variable tuning circuit consisting of two variable capacitors and a fixed inductor. By varying the position of the capacitors, the matching network matches the impedance of the power supply with the load (plasma in the process chamber).

**Digital Display Switch**
This switch determines which value is displayed on the digital readout.

**Forward**
Displays the forward RF power in watts.

**Reflected**
Displays the reflected RF power in watts. Reflected power is a result of a mis-match between the plasma and the RF power supply.

**NOTE:** Reflected power is returned to the RF power supply and must be dissipated as heat. Significant reflected power can damage the RF power supply. Always try to keep the reflected power as low as possible.

**Bias**
Displays the self induced DC bias in -volts created by the RF at the platen.

On the control panel, make sure the **POWER** pot is fully counter-clockwise. Chamber pressure should still be at 150 mTorr. Switch the **RF** switch to the on (up) position. Slowly rotate the power pot clockwise until 100 watts is displayed on the process controller **WATTS** display.

As you raise the power level, a plasma should begin. The matching network will begin tuning and lower the reflected power. Reflected power should never exceed 20% of forward power or 60 watts for extended periods of time.

If you can not strike a plasma, turn the power pot counter clockwise to zero and raise chamber pressure by increasing gas flow by adjusting **Gas 2** and/or adjusting the set
point on the D.S.P.C. (if so equipped). Raise chamber pressure to 150-200 mTorr.

Again rotate the **POWER** pot clockwise until a plasma is struck.

### 3.2.3 Operating Methods

There are essentially three ways of running the system. The method you use is a function of the type of processing you do with the system. The following is a brief overview of operating methods:

**MANUAL**- All controls and functions are manually controlled by the operator.

- **Advantages**: Provides maximum flexibility and best control of tuning when using 13.56 MHz power supply. Best method for process development. Usually used in conjunction with pre-tuning.

- **Disadvantages**: Requires constant monitoring of system by operator.

**AUTOMATIC**- All controls and functions are controlled by the process controller.

- **Advantages**: Automatic one button control with no operator intervention once process cycle is started.

- **Disadvantages**: If the system is equipped with a 13.56 MHz power supply, may not result in optimum tuning without pre-tuning.

**PRE-TUNE/AUTOMATIC**- All controls and functions are pre-set by the operator by running a dummy cycle with a short cycle time, then loading work, resetting the cycle timer to the desired time, then running in automatic mode.

- **Advantages**: Combines maximum flexibility and accuracy with the convenience of automatic operation.

- **Disadvantages**: Requires additional steps and time.

The most common mode of operation of the 800 RIE is pre-tune then automatic. In this mode, a short cycle time is set on the time switch bank, then gas flow, RF tuning (13.56) and pressure control (D.S.P.C.) is adjusted manually. Once this is done, the settings are left as they are, workpieces are loaded and the process cycle is started. The process controller will then sequence the controls and functions at their pre-set positions.

### 3.2.4 Operating Flow Chart

The following is a simplified flow chart of the operating sequence of running in the manual/pre-set mode.
4.1 SCHEDULED MAINTENANCE

**WARNING**

System maintenance should only be performed by qualified personnel. This system contains hazardous voltages.

Scheduled maintenance consists of maintenance functions which are predictable or can be determined prior to a failure. An example would be chamber cleaning. As devices are etched, some material will be deposited on the chamber walls and lid. At some point this material must be removed. Another example is the replacement of the filters in the external oil filter (if so equipped).

Unscheduled maintenance is that maintenance which must be performed when an unforeseen failure occurs such as a component failure. There is a gray area between the two types of maintenance. For example, a vacuum valve is a very reliable device, but it will not operate forever without maintenance. This valve can be maintained periodically or you can wait until it fails to operate properly. If the valve is rebuilt on a time table based on cycles or hours of operation, it is a scheduled maintenance function. If you wait until the valve fails, it is unscheduled. For systems such as the 800, scheduled maintenance becomes difficult because the system isn’t usually used in a continuous, regular operating mode.

**OPERATING LOG**

The most valuable tool in any maintenance operation is a functional log. By keeping track of operating parameters and time, it is possible to predict most maintenance functions prior to failure. A log can also serve as a measuring tool to assure that the system is operating correctly and is within the required process tolerances. A sample log sheet is included at the end of this section. This sample can be copied onto lint-free paper and used at the system if desired.
4.1.1 System Calibration
Periodic system calibration is required in order to assure proper operation. Calibration consists of adjustment of the Baratron® and gas flows. Other calibration procedures may be required depending on which options are installed. Calibration procedures are listed in the Maintenance Schedule Sheet at the end of this section. For pressure calibration, an external vacuum measuring device is required, such as a thermocouple or Pirani type gauge. For pressure calibration, a suitable pressure transducer capable of measuring down to 0 mTorr is required. This transducer should be pre-calibrated to 0 mTorr on another vacuum system or leak detector. The transducer must be mated to a KF-25 flange to match the chamber view port.

4.1.2 Mechanical Pump Maintenance
Mechanical pump maintenance consists of only three functions:

♦ Checking fluid level and topping off as required
♦ Periodically draining the fluid and replacing with fresh fluid
♦ Rebuilding the mechanical pump

CHECKING FLUID LEVEL
The fluid level in the mechanical pump should be checked often. In the normal operation of the pump, some fluid is lost out the pump exhaust as fluid vapor. In time, the fluid level in the pump will drop. Additional fluid must be added to replace the fluid lost.

REPLACING FLUID
Mechanical pump fluid looses its ability to lubricate the pump properly in time. Also, the fluid becomes contaminated with gas and compounds and acids resulting from the type of gas being pumped. If an external oil filtration system is used, the useful lifetime of the fluid increases dramatically, but at some point it must be changed. In general, the condition of the fluid will have a direct effect of the pumping ability and ultimate pressure of the pump. As the fluid degrades, the ultimate vacuum level of the pump will decrease.

NOTE: The mechanical pump uses Fomblin® synthetic fluid. This fluid is expensive. It should not be thrown away or wasted. Used fluid can be reclaimed by the manufacturer.

PUMP REBUILDING
Internal seals and valves within the mechanical pump wear over time. At some point the pump performance will degrade to the point that it must be rebuilt to restore pumping ability.

Mechanical pump operation and therefore required maintenance is directly affected by the types and quantities of gases pumped. Because of these variables, it is very difficult to schedule mechanical pump maintenance. Here again a maintenance log can be put to use. If the pump ultimate pressure or time to pump to a specific pressure is periodically measured, pump performance can be roughly determined. If pump performance degrades, it could be due to a leak, pump fluid or need for a pump rebuild.

4.1.3 Oil Filtration System Maintenance
This item is optional. Maintenance consists of periodically replacing the filter elements and replacing or rebuilding the pump. Filter condition can be determined by noting the differential input and output pressures of the filter array. Consult the supplied manual in the Vendor Manual section of
this document for maintenance requirements and procedures. Extra filters should be stocked. Filters are part of the consumable spare parts kit listed in this manual. Additional filters can be ordered from Technics, Inc.

4.1.4 Chamber Cleaning

**WARNING**

Some etched materials can pose a safety hazard due to flammability or being toxic when cleaning the chamber.

The following materials are required to properly clean the chamber:
- Isopropyl alcohol
- Scotch-Brite®
- Q-Tips
- De-ionized water
- Lint free wipes
- Gloves

**NOTE:** Whenever you are working inside the chamber, latex gloves should be worn to avoid contaminating the chamber. Always use a cleaning solution to minimize generating dust particles. Do not scrub dry.

**WARNING**

Never use any acid to clean the chamber. Acid can damage seals and vacuum sensors mounted to the chamber baseplate.

To clean the chamber, vent the system either manually, or in automatic mode. Open the chamber lid and press the E.M.O. button. This removes all power from the system. Make up a mixture of cleaning solution consisting of 25% isopropyl alcohol and 75% de-ionized water. Scrub the chamber by dipping the Scotch-Brite® in the cleaning solution then wringing out the excess solution. Scrub the chamber surface to remove the coated material. Also scrub the platen sides and the insulator sides being careful not to apply excessive lateral force which can break the insulator or cause vacuum leaks at the water feed-through lines.

Carefully remove the chamber lid O-ring. Inspect the ring for cuts and abrasions. If damaged, replace. Otherwise, wipe the O-ring with a wipe soaked with cleaning solution and set aside. Clean the O-ring groove in the chamber lid with a Q-tip.

Inspect the base plate surface at the edge where it seals against the O-ring. Any scratches should be carefully polished out using Scotch-Brite. Do not use any vacuum grease on this O-ring.

Inspect the view port. If it is clouded, replace it by first removing the acrylic UV shield by removing the four retaining screws. Press out the glass from the chamber side. Remove, clean or replace the glass sealing O-ring.
NOTE: If pressure calibration is going to be performed after chamber cleaning, do not install the new view port at this time.

After the chamber is scrubbed, wipe down the scrubbed surfaces with a lint free cloth wetted with de-ionized water. Follow this with a wipe down with a lint free cloth wetted with isopropyl alcohol. If a blow gun is available, blow dry the chamber. Install the chamber O-ring. Close the chamber.

At the control panel, place the MANUAL/AUTO switch in the AUTO position. Place the PUMP, GAS 1, GAS 2, POWER and VENT switches in the OFF (down) position. Turn on system power by pressing the power switch on the rear system panel.

NOTE: If pressure calibration is going to be performed, place and hold the external pressure transducer on the view port while pumping down the system.

Pump down the system by placing the PUMP switch in the ON (up) position. The chamber will now pump down. Chamber pump down will proceed rapidly until it reaches around 300 to 500 mTorr. At this point, pump down will appear to stall. This is due to the residual water and alcohol vapor present in the system from cleaning. Pressure will continue to fall, but at a slow rate. This is normal.

4.1.5 Pressure Calibration

Pressure calibration consists of adjusting the Baratron® gauge to indicate the same pressure as a pre-calibrated external pressure transducer mounted to the chamber view port.

The most accurate method of pressure calibration is to use a thermocouple or similar device as the external standard when this device has been recently calibrated on another vacuum system capable of reaching a high vacuum level.

The external device must also be capable of high resolution at 0 to 25 mTorr. A thermocouple gauge is ideal for this purpose because they have high resolution at this pressure range.

A common method is to place the external gauge on a mass spectrometer helium leak detector and zero the gauge when the leak detector indicates a pressure well below $10^{-3}$ Torr.

NOTE: Because thermocouple gauges work on a thermal transfer method and as such are sensitive to the mass of the gas being measured, they should only be used when the 800 system’s chamber is vented with nitrogen and only within a range of 0 to 25 mTorr.

In order to properly calibrate the chamber pressure, the system must be capable of pumping down to a low base pressure. Excluding vacuum leaks or a heavily coated process chamber, base pressure is a direct function of the condition of the mechanical pump.

A poor performing pump will result in a poor base pressure. As a mechanical pump degrades, it gives indications. Besides being unable to achieve a low base pressure, the time to reach its base pressure will increase. If pump down times and pressures are periodically measured, they can be used as an indicator of pump condition. By also measuring leak back rate (described later in this section) vacuum leaks can be checked.

To calibrate the Baratron®, proceed as follows:

Vent the system either manually, or in automatic mode. Press the E.M.O. switch to remove system power. Remove the acrylic UV shield by removing the four retaining screws. Press out the glass from the chamber side. Remove, clean or replace the glass sealing O-ring. Remove the left access panel by removing the four retaining screws. Bypass the panel interlock switch by pulling the
plunger out. Drop the power distribution panel by removing the retaining screw. Look into the system console, and locate the Baratron gauge. Refer to the Figure on the next page.

If the zero set pot is not accessible from your side, rotate the Baratron® until it is. Cover the power distribution panel with something to protect yourself from shock. This panel contains 110 VAC.

At the control panel on the front of the system, place the MANUAL/AUTO switch in the AUTO position. Place the VAC, GAS 1, GAS 2, POWER and VENT switches in the OFF (down) position. Turn on system power by pressing the power switch on the rear system panel. While holding the external pressure transducer to the view port, pump down the system by placing the VAC switch in the ON position.

The chamber will now pump down. When the chamber pressure reaches its lowest level and is below 20 mTorr as indicated on the external pressure transducer, adjust the zero pot on the Baratron® until the pressure display on the process controller is equal to the pressure indicated on the external transducer.

**NOTE:** If you can not achieve a base pressure below about 25 mTorr, it indicates that there is a pumping problem.

If the chamber pressure does not drop to 25 mTorr or less, possibilities are:

**Poor mechanical pump performance due to mechanical wear or condition of pump fluid**

**Vacuum leak in the system**

**Dirty process chamber**

**NOTE:** If the process chamber has just been cleaned, it may take a considerable amount of time for the vacuum pump to remove the water vapor and alcohol from the chamber.

Pressure calibration can be achieved at higher pressures that 25 mTorr, but accuracy will degrade. Process requirements normally dictate the required accuracy.

**4.1.6 Water Recirculator Maintenance**

This is an optional item. The water level should be checked frequently and topped off as required with a 10% mixture of ethylene glycol and water. Consult the supplied manual in the Vendor Manual section of this document for maintenance requirements and procedures.
4.2 TROUBLESHOOTING

Unscheduled maintenance are failures which occur without warning. The first step in correcting a failure is the proper diagnosis of the fault in question. Most failures on this type of system are straight forward and do not require much effort to determine or correct. Others are not so simple.

In order to properly diagnose a failure, it is necessary to understand exactly how the system works. What follows is a block diagram of how the control system operates:

All system functions are engaged by the process controller. Each function line is in series with a manual switch. When the system is placed in the manual mode (by switching the AUTO/MAN switch to MAN) all function lines are active. That is, each function switch will cause that function to operate. For example, if the vent switch is off (down) the vent function will not operate in either manual or automatic mode. If the system is in manual mode, switching the vent switch on will vent the system. In automatic mode, if this switch is on, the process controller will enable this line at the proper time to vent the system.

The vent solenoid operates on 12 VAC. This voltage is switched on by an optical isolator and a triac within the process controller. Applying 5 VDC to the L.E.D. within the opto isolator will turn on the triac. The L.E.D. can be lit in manual by switching the VENT on when the AUTO/MANUAL switch is in the MANUAL position. In the Auto position, the L.E.D. is lit by the process controller logic at the end of the process cycle.

Some functions are also interlocked to other conditions. Interlock conditions are as follows:

**PANEL INTERLOCK/E.M.O.** - If a panel interlock is not satisfied, or the E.M.O. switch is open circuit, the system power contactor latch is interrupted. If you press the POWER ON push-button at the rear of the system, and this interlock circuit is not correct, system power will remain on only as long as the POWER ON switch is depressed. Releasing the switch will cause system power to be
removed. There are three panel interlock switches; one on each side panel (facing the system) and one on the rear access panel.

**WATER FLOW**- If the internal flow switch is not made, the R.F. power supply is disabled. This interlock is hard wired into the system and is active in both automatic and manual operation.

**LOW TORR SET POINT**- When the system is run in automatic mode, the vacuum chamber is pumped down until this set point is reached. If the set point is not reached, the process controller will not proceed. This set point is user adjustable.

**HIGH TORR SET POINT**- This set point disables gas flow and R.F. If chamber pressure exceeds this set point, gas and R.F. will be turned off. This set point is active in both manual and automatic modes and is factory set to 900 mTorr.

**PROCESS RELATED**
Different materials require different conditions to etch. Also, the type of etch gas and power applied have a significant impact on the etch process. Whenever a new material is etched, operating parameters may have to be experimented with to develop the optimum conditions to meet the process requirements. Before the system becomes suspect, run a process that’s known to work.

**DYNAMIC RELATED**
Common dynamic problems are things like a short between the platen and the chamber. This can be checked by measuring the resistance between the platen and the base plate with the R.F. power input line dis-connected. With your meter on a high resistance range, resistance should be infinity.

**NOTE:** Poor cooling water (resistivity below 50K ohm/cm² can be a cause of poor performance.

If you measure a resistance but not a low resistance, the problem could be due to either poor cooling water or a coated platen insulator. Before faulting the insulator, blow out the cooling water and check it again.

**NOTE:** A defective insulator may measure infinity with the meter, but still arc when R.F. power is applied.

**4.2.1 Vacuum Leaks**

**NOTE:** Vacuum system practices and procedures are beyond the scope of this document. Only qualified personnel knowledgeable in accepted vacuum technology should perform service on this equipment.

Problems due to vacuum leaks are straight forward on this system. Vacuum leaks can be found following standard vacuum system practices. Leaks can be detected by using a helium mass type leak detector, spraying alcohol on a suspected leak, etc. If a vacuum leak is suspected after a chamber clean, check the water feed-thrus to the platen. These may of been loosened by applying lateral pressure during the clean procedure.
4.2.2 Rate of Rise Test

**NOTE:** The normal rate of rise time test should be run regularly and logged in order to be used as an accurate measurement of vacuum integrity.

The total time to reach a particular pressure is a rough indicator of the health of the vacuum system. If used regularly, it can serve as an early warning system for vacuum related problems. A rate of rise test is not useful if the only test data is from a clean, uncoated system with new pumps and fresh oil. As a system is used, pumping performance degrades. This is due to vacuum pump conditions and chamber coating. A true vacuum leak will often appear suddenly, and can usually be traced to some recent mechanical handling.

4.2.3 Water Cooling System Troubleshooting

The internal water lines within the system are various types of plastic, depending on the application. The use of plastics is required due to the high voltage potentials on the platen. As such, these lines can not handle high pressures or sudden bursts.

Periodically inspect the water lines for kinks or discoloration. If the cooling water is not clean, system performance may degrade.

**WARNING**

Never alter or bypass the water flow switch. Serious damage to the system may result.

4.2.4 R.F. System Troubleshooting

Both the 30 Khz and 13.56 Mhz R.F. power supplies are not field serviceable. Special equipment and test procedures are required. Servicing is limited to determining whether the supply is performing to specifications. If it is not, it must be returned to the factory for service. This also applies to the automatic matching network (if so equipped).
5.1 SCHEMATICS

Certain components and sub-assemblies are deemed “not field repairable”. An example of this is the R.F. power supply. In order to service this supply, special equipment and procedures are required which are not usually available in the field. Other items are warranted by the original manufacturer. Servicing these items voids the warranty.

5.1.1 SCHEMATIC LISTING

Schematics are provided only for those items deemed field repairable. The following schematics are provided:

<table>
<thead>
<tr>
<th>Schematic Name</th>
<th>Drawing Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process Control Boards</strong></td>
<td></td>
</tr>
<tr>
<td>Digital Display Board</td>
<td>942-3460</td>
</tr>
<tr>
<td></td>
<td>942-3450</td>
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<tr>
<td></td>
<td>946-3453</td>
</tr>
<tr>
<td></td>
<td>946-3463</td>
</tr>
<tr>
<td>Power Distribution/D.C. Power Supply</td>
<td>826-0159</td>
</tr>
<tr>
<td>30 Khz R.F. Power Supply Interface</td>
<td>826-0151A</td>
</tr>
<tr>
<td>Manual Control Board</td>
<td>826-0521</td>
</tr>
<tr>
<td><strong>Options</strong></td>
<td></td>
</tr>
<tr>
<td>Down Stream Pressure Controller</td>
<td>826-0508</td>
</tr>
<tr>
<td>13.56 Mhz  R.F. Power Supply Interface</td>
<td>826-0548</td>
</tr>
<tr>
<td>Automatic Matching Network Interface</td>
<td>826-0522</td>
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<tr>
<td>Gas Panel</td>
<td>826-0159C</td>
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5.2 MECHANICAL DRAWINGS

5.2.1 DRAWING LIST

<table>
<thead>
<tr>
<th>Drawing Name</th>
<th>Drawing Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilities Drawing</td>
<td>828-0125</td>
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</tbody>
</table>

5.3 FACILITIES

5.3.1 FACILITIES DRAWING

The following drawing is to be used as an aid in installing and facilitating the system.
Spare Parts/Accessories

6.1 RECOMMENDED SPARE PARTS LIST

In order to maintain maximum uptime on your system, spare parts and consumable items should be kept on hand. Spare parts are listed in two categories; Level 1 and Level 2. Level 1 is for those customers that are located close to the factory and/or can tolerate wait times for parts. Level 2 is for those customers that are located a significant distance from the factory or want maximum up time on their system. Spare parts kits can be ordered which results in considerable savings over individual purchases. The following kits are available:

6.1.1 LEVEL 1 SPARES KIT

Part Number 05-0010

O-Rings

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>Chamber Lid</td>
<td>20-2271</td>
</tr>
<tr>
<td>2</td>
<td>Chamber View Port</td>
<td>20-2127</td>
</tr>
<tr>
<td>4</td>
<td>Water Feed-Thru</td>
<td>20-2010</td>
</tr>
<tr>
<td>2</td>
<td>Rough Valve Seal</td>
<td>520005</td>
</tr>
<tr>
<td>8</td>
<td>VCO</td>
<td>20-2010</td>
</tr>
<tr>
<td>2</td>
<td>Baratron Seal</td>
<td>20-2014</td>
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Process Chamber

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<tbody>
<tr>
<td>2</td>
<td>Viewport</td>
<td>910005</td>
</tr>
<tr>
<td>1</td>
<td>Platen Insulator</td>
<td>98-0185</td>
</tr>
<tr>
<td>6</td>
<td>Platen Stand-offs</td>
<td>40-0044</td>
</tr>
<tr>
<td>2</td>
<td>Water Feed-thru</td>
<td>98-0511</td>
</tr>
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</table>

Main Console
<table>
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<tr>
<th>Quantity</th>
<th>Description</th>
<th>Part Number</th>
</tr>
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<tbody>
<tr>
<td>2</td>
<td>Switch, D.P.D.T., Panel</td>
<td>51-0024</td>
</tr>
<tr>
<td>1</td>
<td>Switch, S.P.D.T., Panel</td>
<td>51-0027</td>
</tr>
<tr>
<td>1</td>
<td>Switch Assembly (Time Set)</td>
<td>930066</td>
</tr>
<tr>
<td>1</td>
<td>Potentiometer, R.F. Power</td>
<td>64-0015</td>
</tr>
<tr>
<td>1</td>
<td>Potentiometer, Low Torr Set</td>
<td>64-0032</td>
</tr>
<tr>
<td>1</td>
<td>Solenoid- Vent, Gas</td>
<td>14-0030</td>
</tr>
<tr>
<td>4</td>
<td>Bulb, Start/Stop</td>
<td>420005</td>
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**6.1.2 LEVEL 2 SPARES (INCLUDES ONE LEVEL 1 SPARES KIT)**

**Part Number 05-0020**

<table>
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<th>Quantity</th>
<th>Description</th>
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<tr>
<td>1</td>
<td>Bellows valve</td>
<td>14-0003</td>
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<tr>
<td>1</td>
<td>Pilot valve</td>
<td>14-0010</td>
</tr>
<tr>
<td>1</td>
<td>switch, stop/Start &amp; Power</td>
<td>410013</td>
</tr>
<tr>
<td>1</td>
<td>Transformer</td>
<td>54-0002</td>
</tr>
<tr>
<td>1</td>
<td>Relay</td>
<td>55-0001</td>
</tr>
<tr>
<td>1</td>
<td>Flow Control valve</td>
<td>560004</td>
</tr>
<tr>
<td>1</td>
<td>Low Frequency Power supply) (350 Watt)</td>
<td>60-0002</td>
</tr>
<tr>
<td>1</td>
<td>A/B Board Assy.</td>
<td>930095</td>
</tr>
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**Optional Down Stream Pressure Controller**
Part Number xx-xxxxx

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
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</thead>
</table>

**Optional 13.56 Mhz R.F. Power Supply/Auto Matching Network**
Part Number xx-xxxxx

<table>
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<th>Quantity</th>
<th>Description</th>
<th>Part Number</th>
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</table>

**Optional External Oil Filtration System**
Part Number xx-xxxxx

<table>
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<th>Quantity</th>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
</table>

**Optional Gas Panel**
Part Number xx-xxxxx

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Part Number</th>
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</thead>
</table>

**Optional Water Recirculator**
Part Number xx-xxxxx

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
</table>

**Optional Scrubber**
6.2 SPARE PARTS ORDERING
Spare parts can be ordered by calling or faxing the factory at Voice: (510) 417-1500 or Fax: (510) 417-1300. Ordering hours are 8:30 AM to 5:30 PM Pacific Daylight Time, Monday through Friday. Fax orders may be placed at any time.

6.2.1 TERMS AND CONDITIONS
There is a minimum order amount of $50.00, not including shipping. A valid Purchase Order is required. Spare parts can not be shipped to accounts on credit hold except by C.O.D. Terms are Net 30 to qualified accounts, F.O.B. factory.

6.2.2 MODEL/SERIAL NUMBER
When ordering any part, you must supply the factory with complete information. If the component in question is manufactured by Technics, the system model and serial number is required. If you are ordering a part that is part of a supplied sub-system, then both the system model/serial number and the sub-system model/serial number is required.

6.3 RECOMMENDED SPECIAL TOOLS
No special tools required for this system.
7 Specifications

7.1 STANDARD COMPONENTS
The Technics 800 RIE System offers fully automated reactive ion etching in a compact, free standing system. It is available with up to 5 gas inputs and can etch a wide range of materials on silicon device wafers or other substrates such as gallium arsenate, ceramic, metals, plastic and glass.

7.1.1 PROCESS CHAMBER
10 inch diameter, stainless steel chamber with a 9 inch water cooled substrate holder to provide process uniformity.

7.1.2 VACUUM SYSTEM
The vacuum system consists of an 16 CFM mechanical pump charged with Fomblin oil. A 150 CFM Roots Blower or a Turbo Pump is available as an option. Consult the factory for specific specifications.

Connection between the mechanical pump and the rough port on the system is by way of a 40 inch stainless steel convoluted bellows terminated with KF-25 flanges. All vacuum system components are connected by quick disconnect flanges for easy maintenance. A 25 mm electo-pneumatic bellows sealed valve is provided for chamber pumping.

7.1.3 GAS SYSTEM
The standard gas system consists of two Porter® valves which are preset by the user and an electrically operated solenoid controlled by the process controller.

7.1.4 VACUUM INSTRUMENTATION
Baratron® capacitance manometer gauge with a range of 0 to 10 Torr.

**7.2 OPTIONAL COMPONENTS**

**7.2.1 Etching Power Supplies**
The standard power supply is a 350 watt 30 KHz. The following power supply and accessories are available as an option. Consult the factory for specific specifications.

- 350 watt 13.56 MHz with Automatic Matching Network

**7.2.2 Gas System**
Up to four MFCs can be added raising the total capability to 5 process gases. With this option, one of the Porter® valve channels is used for the mass flow controllers.

**7.2.3 Gas Scrubbing System**
An external gas scrubbing system is available. Consult the factory for specific specifications.

**7.2.4 External Oil Filtration**
An external oil filtration system is available, pre-charged with Fomblin® oil.

**7.2.5 External Water Recirculator**
The external water recirculator is a 5 liter, closed-loop system capable of sustaining a 15 L.P.M. (Liters Per Minute) flow at zero head pressure. It has a temperature control range of -15°C. to 100°C. The unit is self contained and operates on 110/220 VAC.

**7.3 Utility Specifications**

**7.3.1 Cooling Water**
800 SERIES MICRO R.I.E. SYSTEM
Specifications

Temperature: 18 to 35°C.
Inlet Pressure: 40 PSI max.
Delta Pressure: 25 PSI min.
Resistivity: 50K-ohm/cm² or higher

7.3.2 ELECTRICAL
Main Console: 100-240 VAC 50/60 Hz

Note: Current requirements vary with configuration and options. System current requirements are listed on the Model/Serial label on the console frame.

ACCESSORIES/OPTIONS

Mechanical Pump: 200-240 VAC (6.5 amp)- 100-120 VAC (13 amp) 50/60 Hz single phase
Ext.Oil Filtration: 100-240 VAC 50/60 Hz single phase
Ext. Water Recirculator: 100-120 VAC (10 amp) 50/60 Hz single phase

Note: Standard system configuration is 115/240 VAC for the console and 115 VAC for mechanical pump and all accessories external to the main console.

7.3.3 PROCESS GAS/NITROGEN
Inlet Pressure: 12 PSI max.
Purity: (process dependent)
8.1 WARRANTY STATEMENT

Technics, Inc. warrants this 800 Micro R.I.E. System as specified and is limited herein to be free from defective parts or workmanship for a period of one year from the date of shipment, assuming the system is installed properly and operated in accordance with the seller’s instructions. Within this period, any defects determined by the seller to have resulted from defective original parts or workmanship will be remedied by replacement (or repair at seller’s option) free of charge at the seller’s plant. This warranty does not cover the following:

1. Transportation and/or travel costs incurred in performing service on equipment at the buyer’s location.

2. Cathode plates, insulators, o-rings and other items deemed expendables.

3. Normal wear of parts, normal maintenance or the result of misuse, accident or abuse.

4. Maintenance or repair due to modifications not authorized by the seller.

5. Remote or consequential damage or any sums in excess of the original purchase price of the instrument covered hereby. There is no warranty representation or condition of any kind, expressed or implied, including non warranty of merchantability or of fitness, except that specified in the paragraphs above and none shall be implied by law. With the exception only of the warranty contained in this above paragraph, any affirmation of fact or promise made by the seller to the buyer which relates to the goods sold here-under shall not be regarded as part of the basis of the bargain and shall not be deemed to create an express warranty that such goods shall conform the affirmation or promise. Any description of the goods sold here-under shall not be regarded as part of the basis of the bargain and shall not be deemed to create an express warranty that the whole of the goods sold here-under shall conform to the sample or model. The seller’s performance under this warranty as herein limited shall be the buyer’s sole remedy for and all losses arising out of the sale or use of the instrument.
8.1.1 REQUESTING SERVICE
If you require service, follow this procedure:

1. Contact Technics, Inc. or your local representative. Have the system Model and Serial number with you when you call.

2. Be prepared to accurately describe the problem or service desired.

3. Do not return any parts to equipment without an R.M.A. number and authorization from Technics, Inc.

4. If a complete system or sub-system is returned to Technics, it must be packed the same way it was received. If the item in question was originally shipped to you in a wooden crate, it must be returned to Technics in the same crate or equivalent.

5. If the item in question has been exposed to any toxic, corrosive or flammable material, Technics must be notified at the time of requesting service.

6. Shipping costs and appropriate shipping insurance are the responsibility of the customer. Make sure any item sent to Technics is properly packed and insured if applicable.

7. If the item returned is out of warranty, and you request an estimate prior to repair, indicate this when requesting service.

8. If Field Service is requested, a purchase order is required prior to Technics dispatching a Field Service Engineer. If the item to be serviced is still under warranty, the purchase order must be adequate to cover normal expected travel costs. If the item to be serviced is out of warranty, the purchase order will also need to cover travel, labor and parts costs. Technics will advise on average costs.

8.2 VENDOR MANUALS
Some vendor manuals supplied with this document are located in a separate package. Some of the manuals are too large to be included here.

8.2.1 VENDOR MANUAL LISTING
Mechanical Pump-Alcatel
Option-Oil Filtration-Motorguard
Baratron® Pressure Gauge-M.K.S.
Option-A.F.C.-Unit Instruments
Option-External Water Recirculator

8.3 MANUAL REGISTRATION
The form on the next page should be filled out completely and returned to Technics, Inc. Doing so will allow Technics to provide better service and support. Periodically, updated material is sent to end users. By filling out and returning the form, material can be sent to you directly.
8.4 SAMPLE LOG SHEETS
Sample log sheets are included for use in operating the system. These sheets follow the manual registration page.

8.5 GAS CONVERSION TABLE
Enclosed is a gas conversion factor sheet. This sheet is to be used to calibrate gases other than nitrogen when your system is equipped with the optional gas panel. A conversion table is also listed in the Unit M.F.C. vendor manual.
Manual Registration Form

Company______________________________________________________________
Name_______________________Title_________________Department______________
Mailing Address__________________________________________________________
Mail Stop_________________City_________________State______Zip______________
Phone No.______________Ext.______________Fax No.__________________________
System Model No. (On system label on frame)________________________________
System Serial No. (On system label on frame)________________________________
Received Date_____________________Installation Date________________________
Manual No._________________________