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SECTION I

CONTROL SYSTEM OVERVIEW

1. GENERAL

1.1. This document provides an overview of the Computer Control and Operator Interface System for the MK II Series Plasma Desmear/Etchback and Surface Treatment System (program name “PLASMAX”). For a detailed system operating procedure reference the System Manual, Section II, “System Operating Instructions”.

1.2. The goals of this document are:

1) Provide a reference to the different areas of the Operator Interface.
2) Provide a reference to the sequence and part number databases and their functions.
3) Provide an introduction to the Control System.

2. CONTROL OPTIONS

2.1. There are several methods for inputting instructions into the computer control system, which include both standard and optional features. These methods include:

1) Use of the keyboard cursor keys (right, left, up & down) to scroll through the commands and enter the appropriate instructions via the keyboard.

2) Use of the keyboard speed-keys (indicated by a highlighted letter associated with each command) to scroll through the commands and enter the appropriate instructions via the keyboard.

Note: The speed keys are activated by depressing the ”Alt” key and the appropriate highlighted letter key simultaneously.

3) Use of the optional mouse to scroll through the commands and enter the appropriate instructions.

3. OPERATOR INTERFACE

3.1. This section provides an overview of the Operator Interface (menus and graphic displays). Reference paragraph 4 for an overview of the Operating Procedures.

3.2. Boot-Up Screen (reference Figure I, page 21 of 34, for a sample screen).

The Boot-Up Screen graphic is displayed when the Operator Interface is turned on. This screen displays the Plasma Etch Logo and the following system command options:

3.2.1. Main Screen

Selection of the Main Screen command will switch to the graphic display used to execute plasma processing.

3.2.2. Technician

It is necessary to enter a valid password before the Technician Menu will be displayed (reference paragraph 5.3.4 for password programming instructions).

The following functions are accessible through the Technician Menu (reference Figure II, page 22 of 34, for a sample screen):

3.2.2.1. Database

The following functions are accessible through the Database Menu (reference Figure III, page 23 of 34, for a sample screen):

1) Sequences (reference Figure IV, page 24 of 34, for a sample screen).

The Sequence Database contains all the process sequences which can be run on the system.

The process sequences present in the Sequence Database can be viewed by either the <Page Up> (View Previous) or <Page Down> (View Next) commands or by entering the name of the Sequence/Enter and depressing the <F4> (Recall Entry) key. If no sequence with that name exists, all fields will display zeros.

Note: For a listing of all sequences present in the Sequence Database (reference paragraph 4) of this section.

To add a sequence to the database, type in the name of the Sequence/Enter and depress the <F4> (Recall Entry) key. If a sequence already exists with that name, its value will be displayed. If no sequence with that name exists, all fields will display zeros. The new sequence values can then be entered.

The various fields may be edited by moving to the fields and entering the new data.

Each sequence consists of two sub-sequences (dual sequencing). Dual sequencing allows two different plasma processes to run sequentially. If the second sub-sequence is not to be used, set the appropriate sequence parameters to zero.

When all entries have been correctly entered, depress the<F2> key (Save Entry) to store the sequence.

Sequences may be deleted from the database by entering the sequence name and depressing the <F3> (Delete Entry) key.

Note: The program will prevent deletion of a sequence, as long as there are part numbers in the database which still use the sequence. All associated part numbers must be deleted before the sequence can be deleted.

2) Part Numbers (reference Figure V, page 25 of 34, for a sample screen).

The Part Number Database contains all part numbers and related process sequences which can be run on the system.

The part number/sequence relationships present in the Part Number Database can be viewed by either the <Page Up> (View Previous) or <Page Down> (View Next) commands or by entering the Part Number/Enter and depressing the <F4> (Recall Entry) key. If the part number does not exist, all fields will display zeros.

Note: For a listing of all part numbers in the Part Number Database reference paragraph 3 of this section.

To add a part number to the database, type in the name of the Part Number/Enter and depress the <F4> (Recall Entry) key. If a part number with the same name exists, its values will be displayed. If no part number exists with the same name, all fields will display zeros. The new part number/sequence data can be entered.

The two fields may be edited by moving to the fields and entering the new data.

When all entries have been correctly entered, depress the <F2> (Save Entry) key to store the part number.

Part numbers may be deleted from the database by entering the part number and depressing the <F3> (Delete Entry) key.

3) Part Directory

Selection of the Part Directory command will output an alphanumeric listing of all the current part numbers and related sequences, to the system printer.

4) Sequence Directory

Selection of the Sequence Directory command will output an alphanumeric listing of all the current sequences and related part numbers, to the system printer.

3.2.2.2. Data Acquisition

Activation of the Data Acquisition command archives the process variables to a file on the system hard disk and the process variables are also output to the system printer.

Data acquisition may be executed at any pre-selected scan interval (in the range of 5 seconds to 9999 seconds), as defined in the Configuration Editor instructions.

Note: Reference paragraph 5.3.4 for data acquisition scan interval programming instructions.

The following process variables are archived to the data acquisition file:

1) Date

2) Time

3) Temperature

4) Vacuum

5) Gas Flow 1

6) Gas Flow 2

7) Gas Flow 3 (if applicable)

8) R.F. Power

One data acquisition file is generated for each process scan. The name of the file is the date appended by the process number for that day.

Example:

> 051103.ACQ represents the data acquisition file for May 11, Process #3.

The size of the data acquisition files will vary depending on the length of the sequences executed and the data acquisition interval. Excessive data acquisition files will fill the hard disk, slowing system operation and eventually abort the system program.

The data acquisition function is intended as a process evaluation tool and not a full time process monitoring function. Hard disk capacity problems can be minimized by limiting data acquisition usage.

It is the responsibility of the operator to use DOS commands periodically to archive and remove old data acquisition files from the hard disk.

Example:

> To copy the data acquisition file 051103.ACQ to a floppy disk in drive A, at the "C:\Plasvia>" prompt type:
>
> Copy 051103.ACQ A:\051103.ACQ
>
> To delete the same file from the hard disk, at the "C:\Plasvia>" prompt type:
>
> Del 051103.ACQ
>
> An alternate command will delete all archived data acquisition files simultaneously, at the "C:\Plasvia>" prompt type:
>
> Clean
>
> Caution: The use of this command will also delete all log file (process data sheets) archives. Reference paragraph 3.3.3.3 for the procedure for backing up log files.

The data in the data acquisition files is in a database readable format which may be used in programs such as Paradox, Lotus, etc. Each field in the file is separated by a comma and string fields are surrounded by quotation marks.

3.2.2.3. Log Files

The following functions are accessible through the Log Files Menu:

1) Copy Log File

All processing data is archived to a data log file on the system hard disk for later retrieval and reference. Data log files may be downloaded to floppy disk using the Copy Log File command.

Data log files are identified using the months of the year (JAN.LOG, FEB.LOG, etc.). The information stored in a data log file will exist on the system hard disk for one year. At the beginning of each month the data log file for that month will be deleted and new data is written to the file.

The data in the data log files is in a database readable format which may be used in programs such as Paradox, Lotus, etc. Each field in the file is separated by a comma and string fields are surrounded by quotation marks.

The following process data is archived to the log file:

a) Date

b) Time

c) Part Number

d) Quantity

e) Lot Number

f) Operator

g) Shift

h) Comments

i) Process Name

j) Plasma Time

k) Temperature

l) Gas Flow 1

m) Gas Flow 2

n) Gas Flow 3 (if applicable)

o) R.F. Power

2) Print Log File

The Print Log File function is identical to the Copy Log File function, except the data is output to the system printer.

3.2.2.4. Back Up

The following functions are accessible through the Backup Menu:

1) Dbase To Floppy

Part number and sequence data may be downloaded from the system to a floppy disk using the Dbase To Floppy command.

The part number and sequence data is in a database readable format which may be used in programs such as Paradox, Lotus, etc. Each field in the file is separated by a comma and string fields are surrounded by quotation marks.

2) Dbase From Floppy

Part number and sequence data may be uploaded to the system using the Dbase From Floppy command.

The part number and sequence data is in a database readable format which may be used in programs such as Paradox, Lotus, etc. Each field in the file is separated by a comma and string fields are surrounded by quotation marks.

3.2.2.5. Report Enable/Report Disable

The Report Enable and Report Disable functions are used to either enable or disable the printed process data sheet. All other generated reports will remain active.

3.2.3. Exit (exits the “PLASMAX” program)

It is necessary to enter a valid password before the Exit function will activate (reference paragraph 5.3.4 for password programming instructions).

3.3. Main Screen (reference Figure VI, page 26 of 34, for a sample screen).

The Main Screen graphic displays the following process control functions:

3.3.1. Process Sequence

The Process Sequence section of the Main Screen graphic displays the current process sequence and the following programmed process parameters:

1) Part Number

2) Sequence

3) Temperature (°F or °C) (see note 1)

4) Plasma Time (Min.) (See note 2)

5) R.F. Power (Watts)

6) Gas 1 Selection & Flow (CC/Min.) (See note 3)

7) Gas 2 Selection & Flow (CC/Min.) (See note 3)

8) Gas 3 Selection & Flow (CC/Min.) (See note 3) (If applicable)

Note:

1. Reference paragraph 5.3.3 for temperature scale programming instructions.

2. Plasma time is the only process sequence setpoint that can be edited from the Main Screen.

3. Reference paragraph 5.3.1 for gas configuration (up to five independent gas sources are allowable depending on system options).

3.3.2. System Power

The System Power section of the Main Screen graphic displays the On/Off status of the following system power functions:

1) Temperature Control

2) Vacuum Pump

3) R.F. Power

3.3.3. Miscellaneous Messages:

The Miscellaneous Messages section of the Main Screen graphic displays the following system status messages:

1) Last Alarm:

   Displays last alarm condition, if any, in the current process run.

   The following potential system alarm conditions are monitored (allowable limits are noted here for reference, but are not included as part of the displayed alarm message):

   a) Electrode High Temp. (programmable to a maximum of 325°F of 163°C) (±3%)

   b) Low Coolant Flow (>1/4 GPM)

   c) Low Gas Pressure (>10 PSIG)

   d) Gas Flow Out of Range (±5%)

   e) R.F. Power Out of Range (±5%)

   f) Emergency Stop

   g) Printer Error

2) Data Acquisition

   Displays the On/Off status of the data acquisition function. To enable/disable the data acquisition function, reference paragraph 3.2.2.2.

3) Alarm Silence

Displays the On/Off status of the audible alarm. To silence the alarm, reference paragraph 3.3.7.

4) Print Reports

Displays the On/Off status of the system printer. To enable/disable the system printer, reference paragraph 3.2.2.6.

3.3.4. Step & Wait

The Step section of the Main Screen graphic displays the current step the process sequence is in. The Wait section of the Main Screen graphic displays the next step to be executed by the process sequence. These two displays afford the operator a better understanding of the function of the system.

The following is a list of the process steps in order of execution:

1) "Home"

All power off.

2) "Warm"

Temperature control on.

3) "Vacuum"

Vacuum pump on (after five seconds delay the blank-off valve opens).

4) "Standby"

R.F. generator is on.

5) "Plasma : 1st Stage Vacuum"

Fist stage vacuum pump on, system pumps down to vacuum switch setpoint (approx. 15 MM HG).

6) "Plasma : 2nd Stage Vacuum"

Second stage blower vacuum pump on, system pumps down to vacuum meter setpoint (.02 MM HG)

7) "Plasma : Stabilize Gases"

Process One flow on (waits for chamber to stabilize).

8) "Plasma :1"

   R.F. power on, Process One sequence starts.

9) "Close Valves After Process One"

   Process One gas flow off R.F. power off.

10) "Open Valves For Process Two"

    Process Two gas flow on.

11) "Plasma : Stabilize Gases"

    Waits for chamber to stabilize.

12) "Plasma : 2"

    R.F. power on, Process Two sequence starts.

13) "Plasma : Close Blank Off Valve"

    Process Two gas flow off, R.F. power off, blank-off valve closes.

14) "Plasma : Vent Chamber"

    Chamber vents to near atmospheric pressure.

15) "Purge : 1st Stage Vacuum"

    Blank-off valve opens, first stage pump on, sytem pumps down to vacuum switch setpoint (approx. 15.0 MM HG).

16) "Purge : 2nd Stage Vacuum"

    Second stage blower vacuum pump on, system pumps down to vacuum meter setpoint (.02 MM HG)

17) "Plasma : Complete"

    Plasma sequence complete, second stage vacuum turns off, alarm sounds (5 seconds).

18) “Cycle Off : Close Blank Off Valve”

Blank-off valve closes

19) “Cycle Off : Vent Chamber”

Chamber vents to atmosphere, door opens.

20) “Cycle Off : Complete”

Plasma cycle complete.

21) “Standby : More Than 10 Minutes”

Automatic power down of the vacuum pump and R.F. generator.

Note:

Reference paragraph 4.1.2 for a functional description of timed power down in Standby mode.

22) “Shutdown”

Automatic shutdown of temperature control, vacuum pump and R.F. generator.

Note:

Reference paragraph 4.1.2 for a functional description of Shutdown.

3.3.5. Date And Time

The Date and Time section of the Main Screen graphic displays the current date and time. For date and time editing procedure, reference paragraph 4.1.4.

3.3.6. Plasma System Graphic

The Main Screen graphic portrays key elements of the plasma system and indicates the current status of these elements. Shape is used to indicate whether a control device is “On” or “Off”, “Open” or “Closed”. For example, a valve or pump displays a solid connection extending through it when it is on and the absence of line when it is off. This graphic in conjunction with the current Step data provides the operator with a better understanding of the status of the plasma sequence.

System operation status is indicated by two circles (representing status lamps) located to the right of the plasma system vacuum chamber door graphic. The following system status conditions are displayed:

1) Green (continuous) – Plasma sequence in progress.

2) Green (blinking) – Plasma sequence complete.

3) Red (blinking) – Alarm condition exists.

3.3.7. Monitored Sequence Variables

The following process sequence variables are monitored and displayed on the Main Screen graphic display:

1) Gas Flow 1 : (CC/Min.)

2) Gas Flow 2 : (CC/Min.)

3) Gas Flow 3 : (CC/Min.) (if applicable)

4) Plasma Time : (Hrs./Min./Sec.) (elapsed plasma time is displayed)

5) Elapsed Time : (Hrs./Min./Sec.) (elapsed sequence time is displayed)

6) Vacuum : (MM HG)

7) R.F. Power : (Watts) (High or Low frequency)

8) Temperature : (°F or °C)

3.3.8. Vacuum Chamber Door

The Door section of the Main Screen graphic indicates the status of the vacuum chamber door (Open or Closed).

4. OPERATING PROCEDURE

This section defines the basic operating procedure for the system. For detailed operating instructions reference the System Manual, Section II, “System Operating Instructions”.

4.1. The following system control commands are displayed at the top of the Main Screen graphic.

4.1.1. Power

The following system primary power functions are accessed through the Power Menu (reference Figure VII, page 27 of 34, for a sample screen):

1) Temperature

2) Vacuum Pump

3) R.F. Power

Power is applied by activating the Power command, selecting the appropriate function and selecting the On command.

Note:

The Power command must be activated in order (i.e., Temperature, Vacuum and RF)

4.1.2. Commands

The following system control options are accessed through the Command Menu (reference Figure VIII, page 28 of 34, for a sample screen).

1) Plasma

Plasma sequencing is started by activating the Plasma command.

Initially the Report Information graphic will be displayed. The operator may input additional information which will be automatically added to the printed process data sheet. The following optional data may be entered:

a) Operator

b) Shift

c) Quantity

d) Lot Number

e) Comments (four lines maximum)

This information will be maintained from process run to run, unless otherwise modified or deleted.

The plasma sequence will proceed automatically to completion. When the plasma sequence has been completed the system will alarm for five

seconds, notifying the operator that the sequence has been completed. The green system status lamp will blink continuously to indicate completion of the sequence.

2) Plasma Time 1 & Plasma Time 2

Plasma times may be edited as required. The current programmed plasma times are displayed in the Process Sequence section of the Main Screen graphic display. If a different plasma time is required, it may be changed by activating the appropriate Plasma Time command (1 and/or 2) and entering the new plasma time. Plasma time is the only process parameter which can be edited while the plasma sequence is in progress.

3) Cycle Off

The Cycle Off command vents the vacuum chamber to atmospheric pressure, to prepare the system for loading/unloading. Cycle Off is entered by activating the Cycle Off command.

4) Standby

If the system is not currently being used for plasma processing, it should be placed in the Standby mode. In this mode the system is maintained ready for immediate return to plasma processing. The Standby mode is entered by activating the Standby command.

Note:

After ten minutes of uninterrupted standby operation the system will partially power down. This automatic procedure is used to conserve electrical power, eliminate nitrogen purge gas consumption and extend the service life of the vacuum pump and R.F. generator.

5) Shutdown

When the system is turned off it must be done so using the shutdown mode. This mode turns off the system in a prescribed sequence, allowing adequate cool-down of critical system components. The shutdown mode is entered by activating the Shutdown command.

6) Silence Alarm

The system audible alarm may be turned off by activating the Silence Alarm command. This procedure will inhibit the alarm for the period

of the current process sequence. Starting a new process sequence will automatically re-enable the system alarm.

The system alarm has a sound level damping feature, which may be adjusted by manually rotating the front baffle on the alarm.

4.1.3. Part Numbers (reference Figure IX, page 29 of 34, for a sample screen).

Part number information is entered by activating the Part Number command and selecting the desired part number. If a part number is in the database the part number and the corresponding process sequence will be displayed in the Process Sequence section of the Main Screen graphic display. If the part number is not in the database the default process sequence will be displayed.

Part numbers may be selected by one of two methods:

1) Activate the Enter Selection command, enter the desired part number and activate the Accept command.

2) Activate the appropriate part number command button (multiple pages of part number commands may exist) and activate the Accept command.

Reference paragraph 3.2.2.1 for the procedures for adding or editing part number and sequence information.

4.1.4. Screens (reference Figure X, page 30 of 34, for a sample screen).

The following functions are accessed through the Screen Menu:

1) Trends (reference Figure XI, page 31 of 34, for a sample screen).

The trend screen provides a plot of current processing parameters. Each process parameter is color coded for easy identification. Process values are displayed in the vertical axis and process time is displayed in the horizontal axis.

The following process parameters are displayed:

a) Temperature

b) Gas Flow 1

c) Gas Flow 2

d) Gas Flow 3 (if applicable)

e) Vacuum

f) R.F. Power

The interval between scans can be selected by activating the Interval command and inputting the desired scan interval time in seconds.

Note:

Trend data provides a visual display of current processing conditions. This data is for reference only and cannot be recorded or saved. To record processing data, reference the Data Acquisition function in paragraph 3.2.2.2.

2) Events

The Events screen displays current Log File (last 1000 events) information for reference. The following additional features are provided:

a) System date and time may be changed by activating the Change Date & Time command and entering the desired changes.

b) The user may record special messages to the Log File by activating the Add Event command and entering the desired message.

3) I/O (reference Figures XII and XIII, page 32 and 33 of 34, for a sample screen).

The I/O screen displays the current status of all system input and output devices (both digital and analog). This feature is provided primarily for system maintenance.

The status of digital inputs and outputs are indicated by highlighting the entries in red when On. Analog inputs and outputs may displayed in engineering units (CC/Min., Watts or °F/°C) or in digital format, by toggling the Eng/Raw command.

5. CONFIGURATION EDITOR (reference Figure XIV, page 34 of 34 for a sample screen).

5.1. There are a number of parameters which are configured on a per system basis by editing the system configuration function.

5.2. The configuration function may be edited by exiting the program at the Boot Up Screen, entering a valid password and entering “Config” at the “C:\PLASMA>” prompt.

5.3. Do not attempt to edit any system variables other than:

5.3.1. Gas Configuration

These entries should only be changed if the system gas selection is to be changed.

Use the following procedure to change system gas inputs:

1) Enter the chemical symbol for the new gas.

2) Enter the gas correction factor for the new gas. Gas correction factors can be found in the Flow Controller section of the System Manual.

Note:

The proper gas correction factors must be entered to maintain mass flow controller calibration.

5.3.2. Default Sequence

5.3.3. Temperature Configuration

1) Units in DEG F or C:

Editing temperature scales (°F or °C) requires that all existing process sequences be manually converted to the new temperature scale.

2) Maximum Setpoint

The system has a maximum safe operating temperature of 325°F.

5.3.4. Miscellaneous Configuration

1) Company Name

The Company Name will be printed on the header of the process data sheet.

2) Password 1 or Password 2

Each password may be an alphanumeric combination of twenty or less characters.

3) Data Acquisition Frequency

Scan interval may be set in the range of 5 seconds to 9999 seconds.

5.3.5. Editing other parameters will change system operation and calibration.

Note:

Unauthorized changes to the Configuration Editor can cause permanent damage to the system.

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FIGURE I: BOOTUP SCREEN

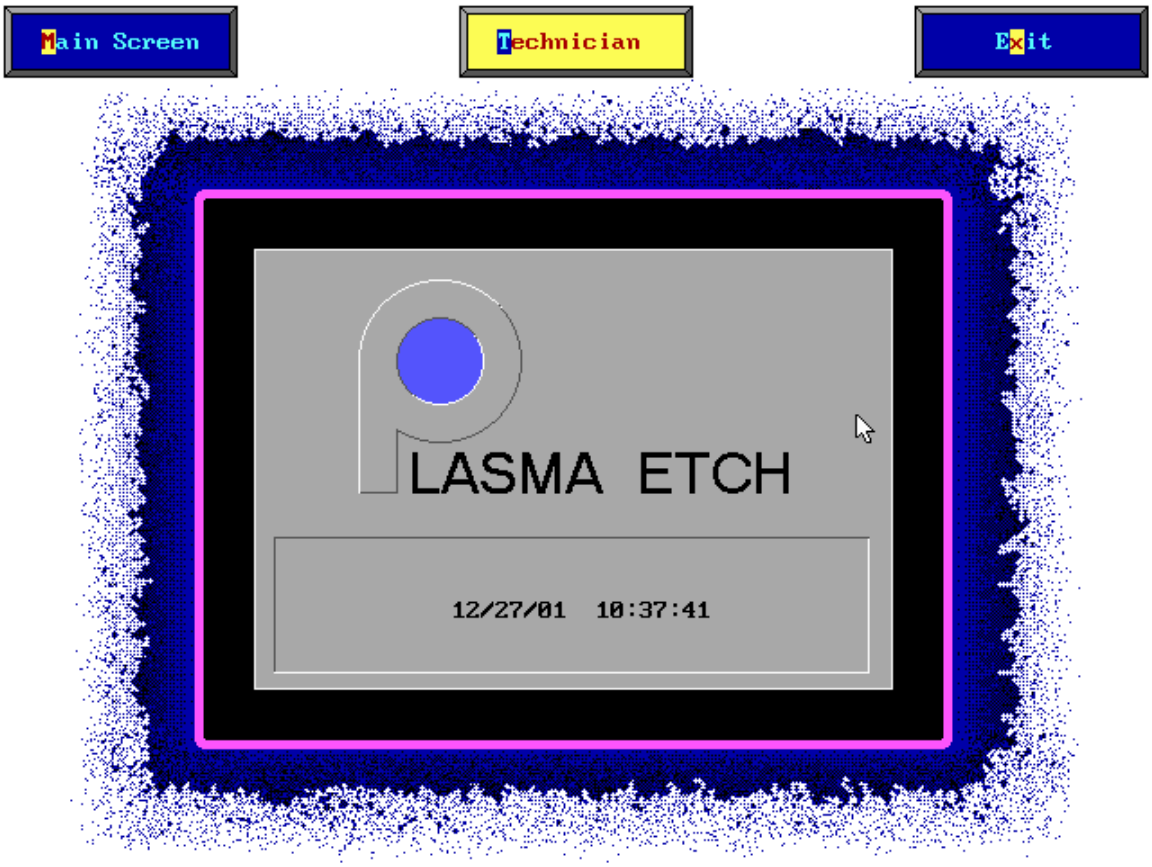


FIGURE II: TECHNICIAN MENU

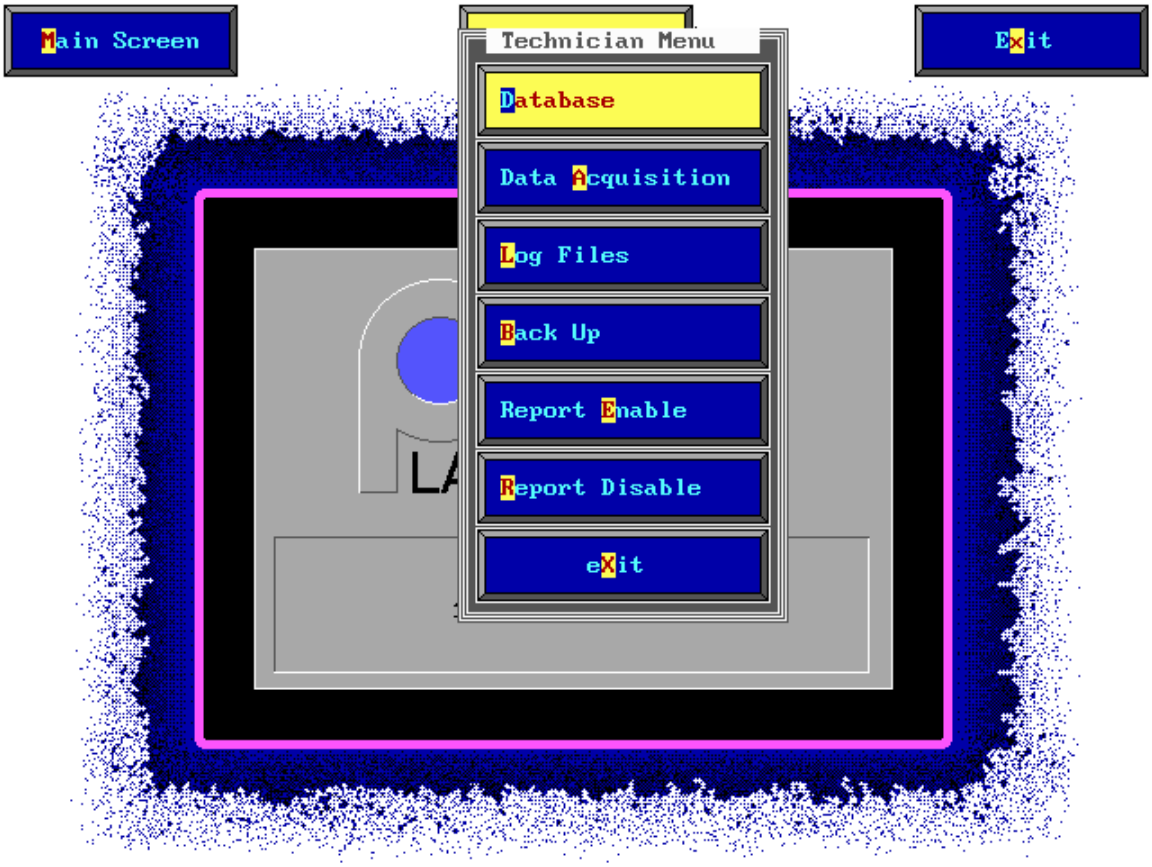


FIGURE III: DATBASE MENU

FIGURE IV: SEQUENCE DATABASE

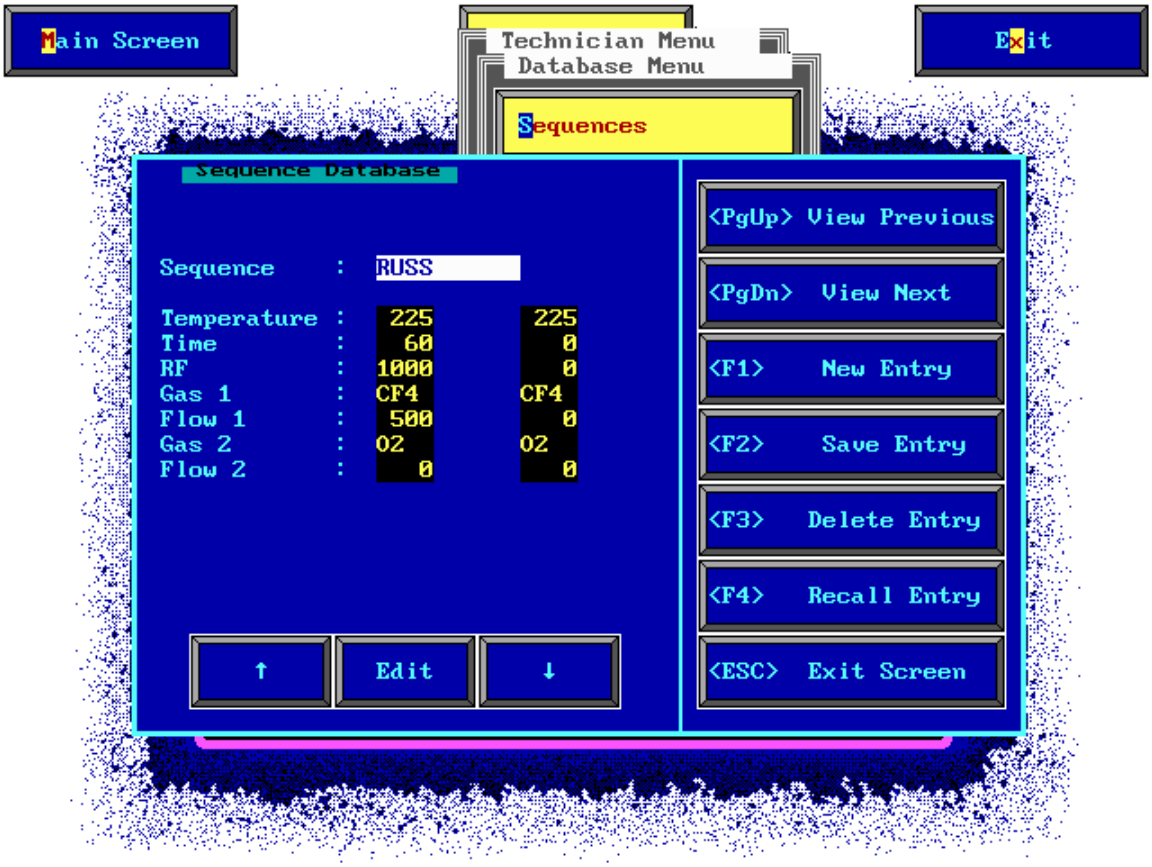


FIGURE V: PART NUMBER DATABASE

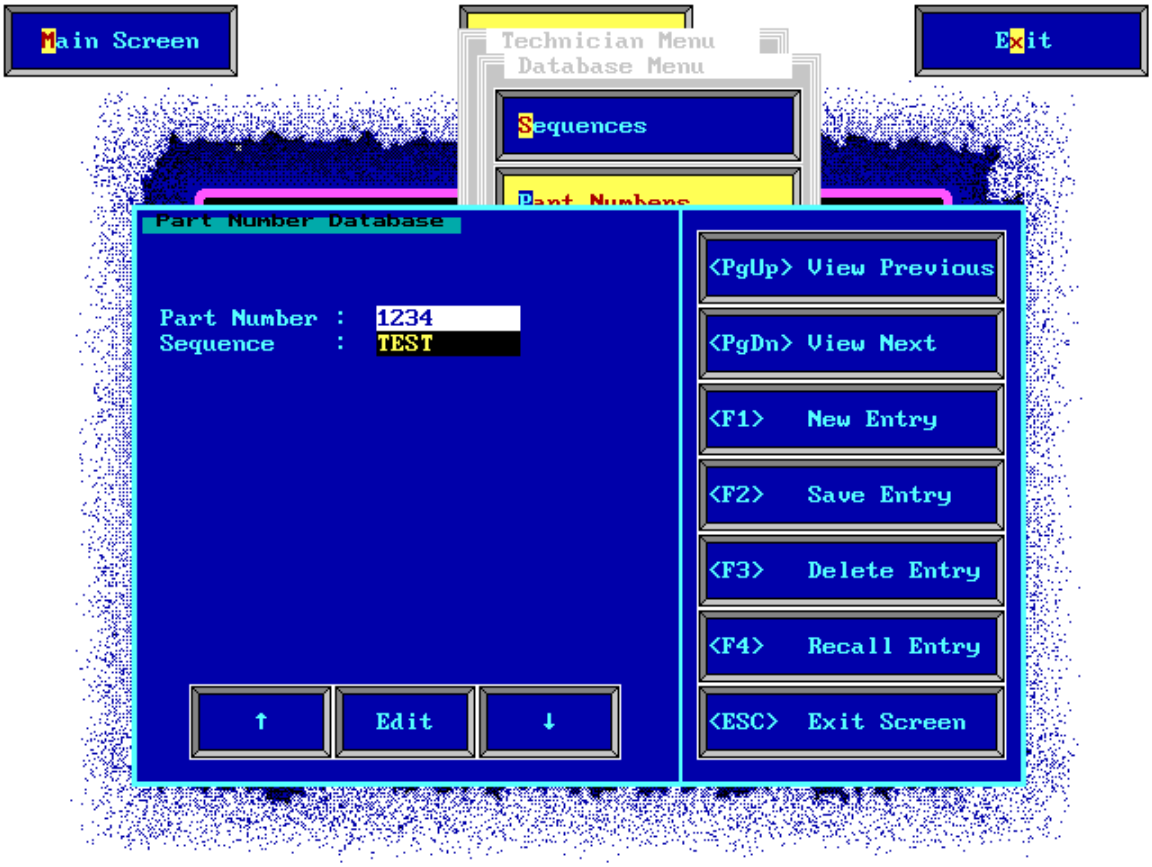


FIGURE VI: MAIN SCREEN

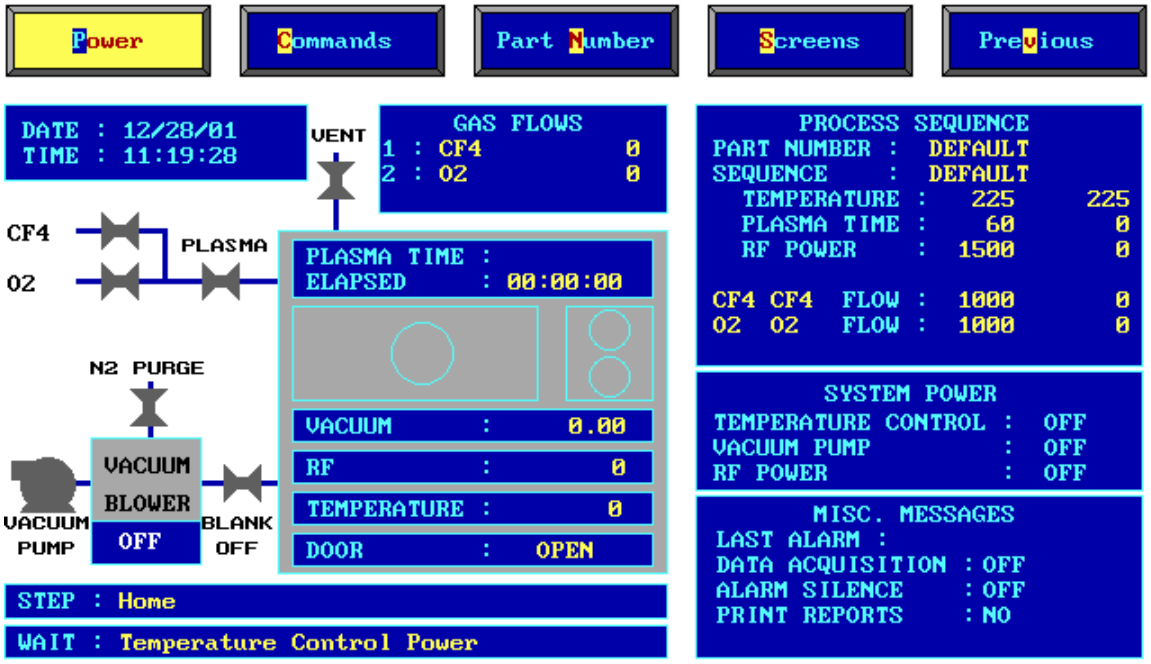


FIGURE VII: POWER MENU

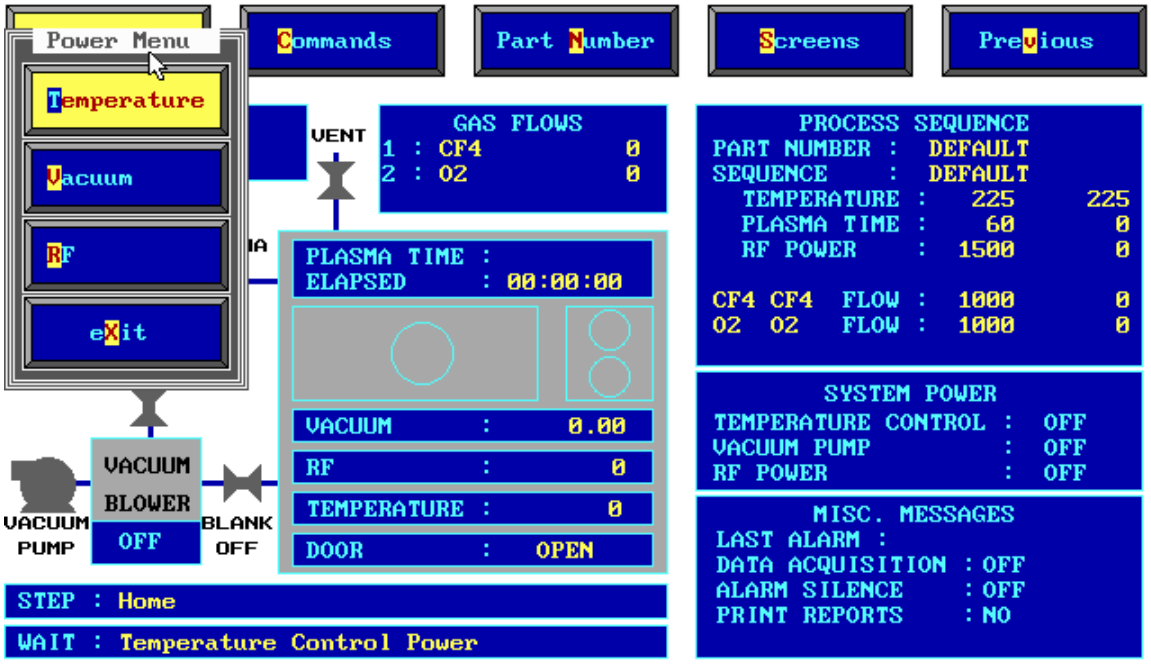


FIGURE VIII: COMMANDS MENU

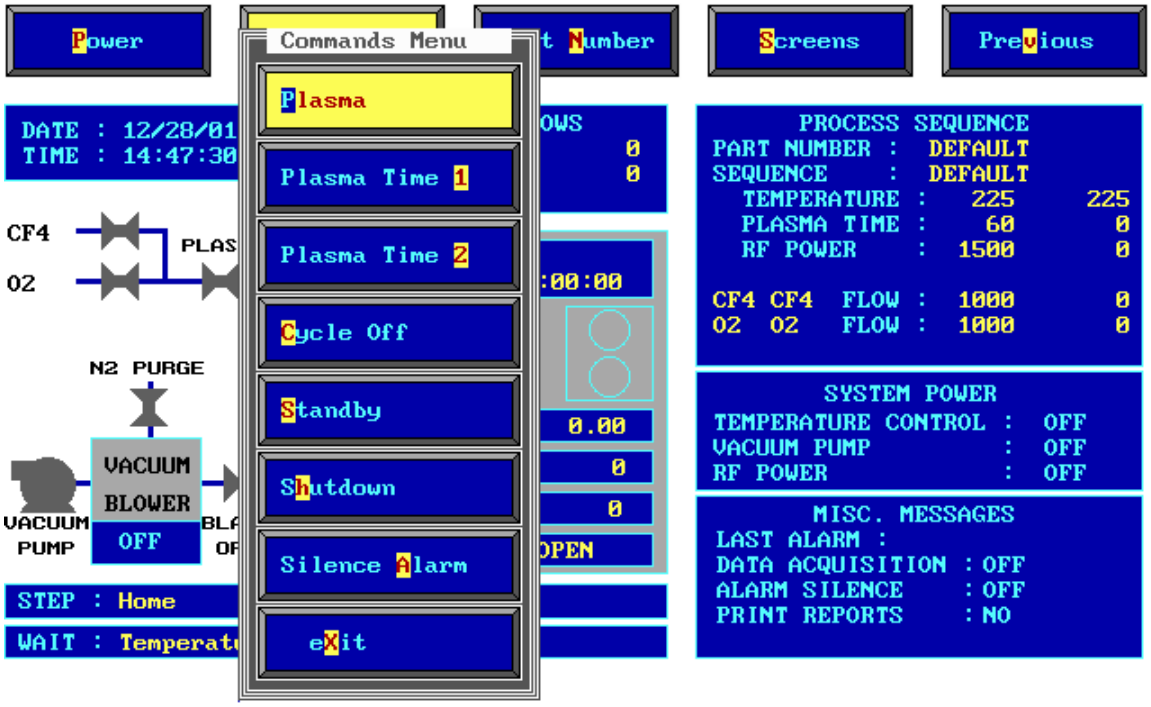


FIGURE IX: PART NUMBER SCREEN

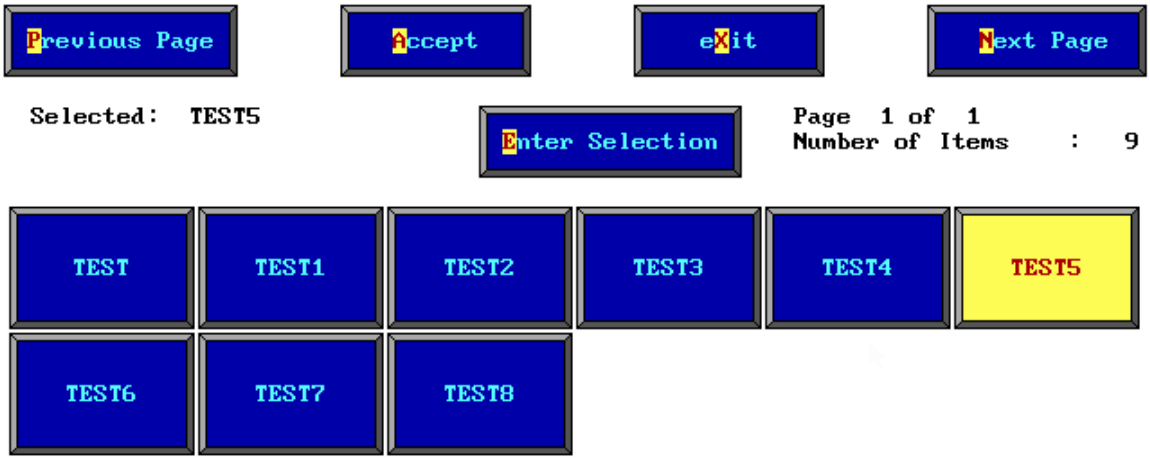
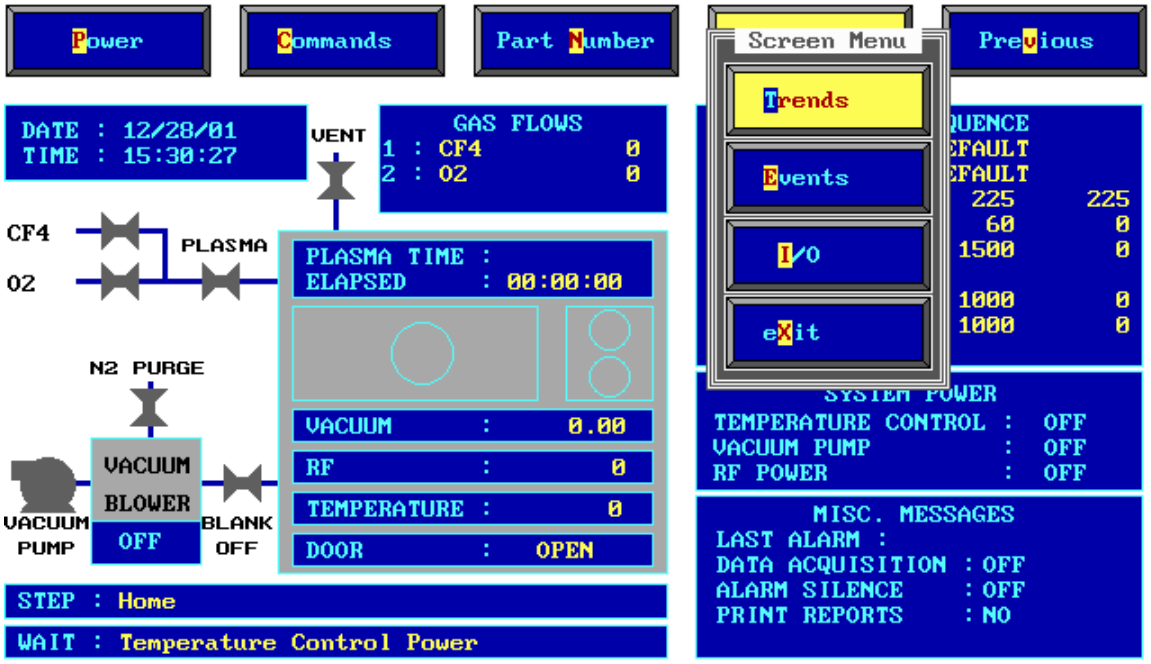


FIGURE X: SCREEN MENU



FIGUE XI: TREND SCREEN

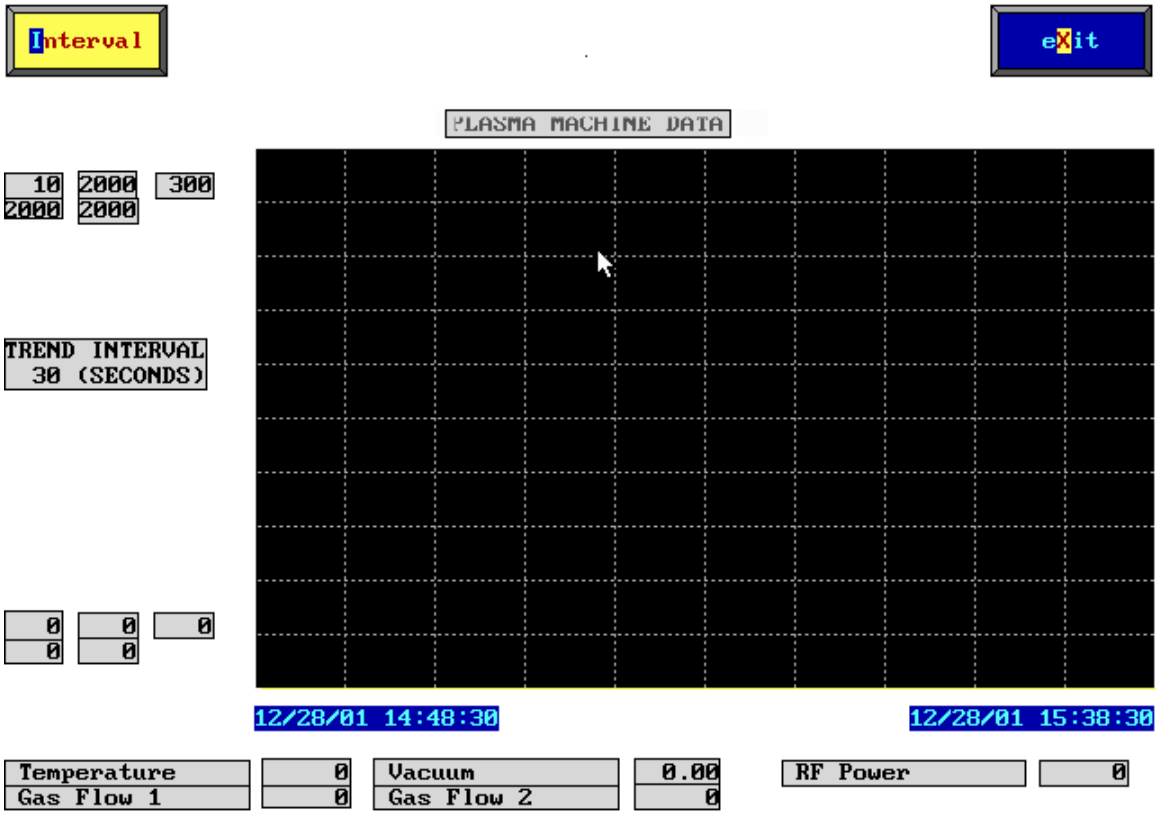


FIGURE XII: I/O SCREEN (SCREEN 1 OF 2)

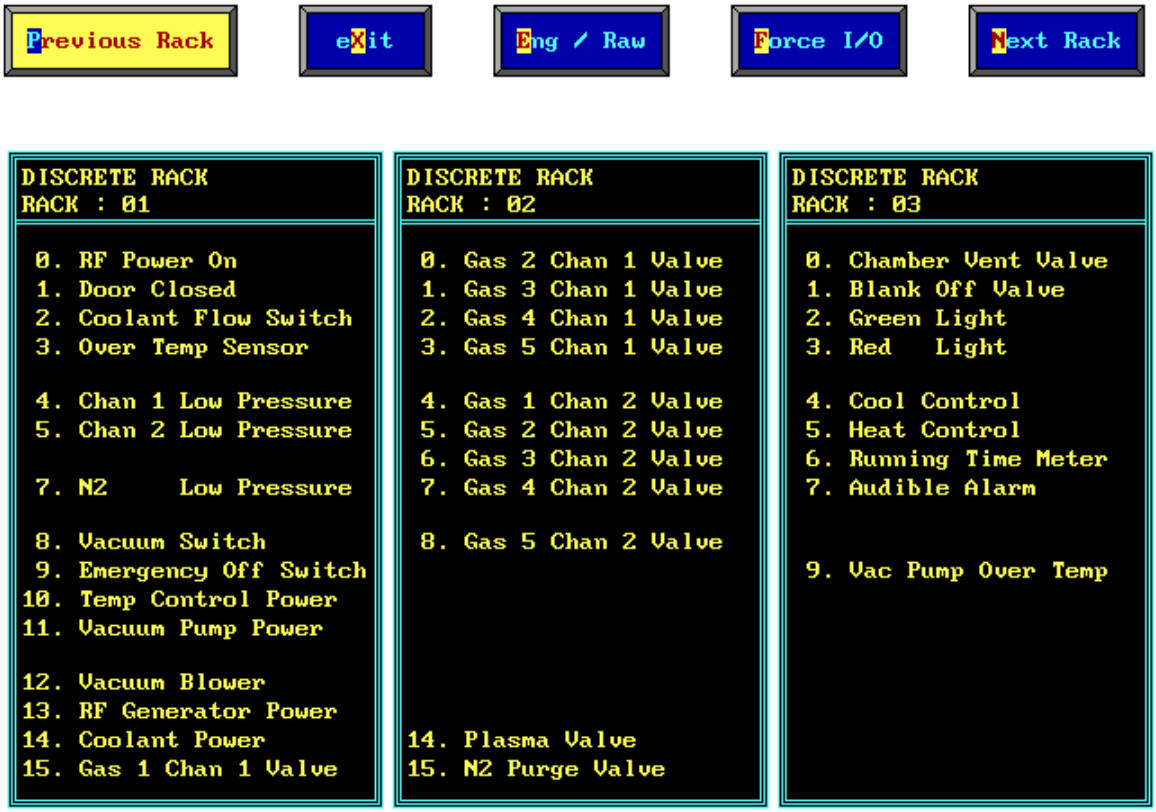


FIGURE XIII: I/O SCREEN (SCREEN 2 OF 2)

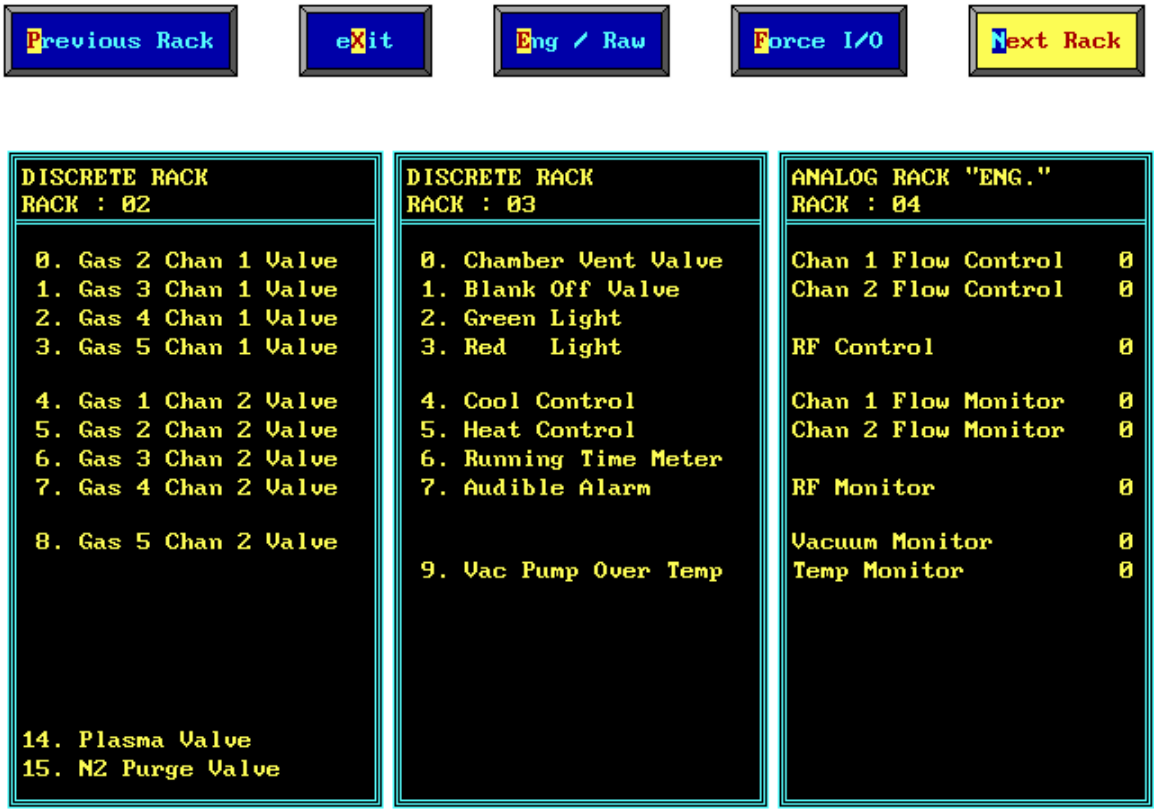
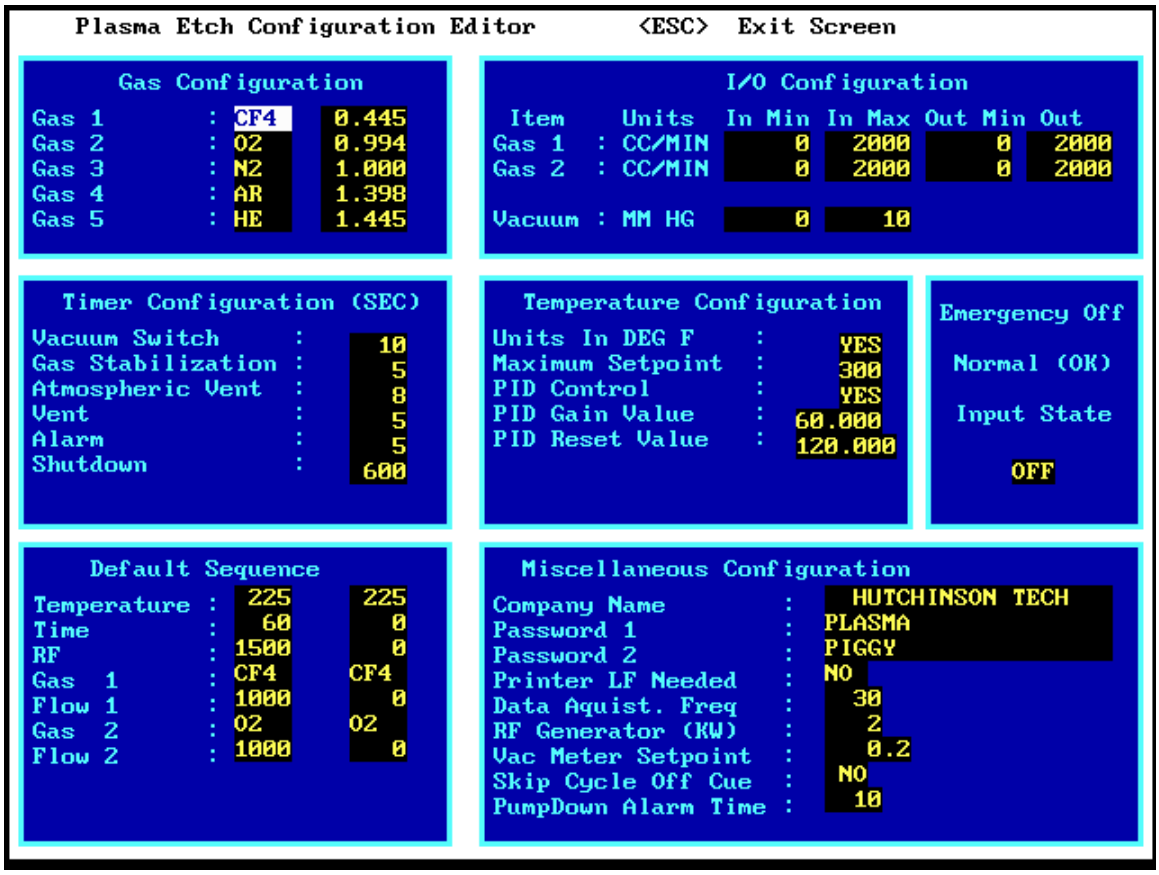


FIGURE XIV: CONFIGURATION EDITOR SCREEN



SECTION II

SYSTEM OPERATING INSTRUCTIONS

1. GENERAL

1.1. This document defines the operating procedures for the MK II Desmear/Etchback and Surface Treatment System (program name "Plasmax"). For an overview of the Computer Control and Operator Interface System, reference the System Manual, Section I, "Control System Overview". It is assumed that the operator has thoroughly familiarized himself with this document, prior to attempting operation of the system.

1.2. A detailed description of plasma processing is provided in the System Manual, Section III, "Plasma Processing Methods & Procedures". It is assumed that the operator has thoroughly familiarized himself with this document, prior to attempting operation of the system.

1.3. System preventive maintenance is defined in the System Manual, Section IV, "Preventive Maintenance Procedures". It is assumed that the operator has thoroughly familiarized himself with this document, prior to attempting operation of the system.

1.4. All computer controls and displays are referenced in "UPPER CASE". Speed-keys are identified by double underlined characters (i.e., PLASMA, CYCLE OFF, etc.). All other control references indicate actual location (i.e., AC Circuit Breaker Panel, R.F. Generator Panel, etc.).

2. SYSTEM STARTUP

2.1. At the gas sources slowly open the gas cylinder valves (fully CCW). Sudden opening of the valves may damage the gas regulators. Maintain all gas pressures at approximately 15 PSIG.

2.2. At the AC Circuit Breaker Panel, set the circuit breaker to the On (Up) position.

2.3. The computer will automatically boot up to the Logo Screen display graphic.

2.4. Access the Main Screen Display graphic.

2.5. Apply temperature control power by activating the POWER, TEMPERATURE and ON commands in the order shown.

2.5.1. The temperature control system will activate and electrode temperature will start to rise toward the preset process temperature referenced in the Process Sequence section of the Main Screen display graphic.

2.5.2. Do not proceed with the system startup procedure until system temperature is within approximately fifteen degrees of the preset valve.

2.6. While holding the vacuum chamber door closed, apply vacuum pump power by activating the POWER, VACUUM and ON commands in the order shown.

2.6.1. The vacuum pump will turn on and after a five second delay the vacuum chamber starts to pump down.

2.7. On the R.F. Generator Circuit Breaker Panel set the circuit breaker to the On (Up) position (this circuit breaker may be left in the On position permanently).

2.8. Apply R.F. generator power by activating the POWER, RF and ON commands in the order shown.

2.9. On the R.F. Circuit Breaker Panel the AC Mains lamp will illuminate

2.10. On the R.F. Generator Panel the Standby switch will illuminate.

2.11. On the R.F. Generator Panel momentarily depress the Power switch (illuminates). The Standby switch will extinguish.

3. PLASMA PROCESSING

Note: On initial system startup it is recommended that a dummy plasma sequence be run with the vacuum chamber empty, to stabilize the system. Skip paragraphs 3.1 through 3.3, and at paragraph 3.4 set the Default Sequence plasma time for 15 minutes minimum (30 minutes preferred).

3.1. Enter the part number of the items to be process by activating the PART NUMBER command and entering the part number.

3.2. While holding the vacuum chamber door closed, enter the plasma mode by activating the COMMANDS and PLASMA commands in the order shown.

3.3. The Report Information graphic will be displayed. The operator may enter optional information which will be added to the printed process data sheet. Depress the "F1" key to record this data or bypass Report Information data entry.

3.4. Plasma time may be edited by activating the COMMANDS and PLASMA TIME commands in the order shown.

3.5. Upon completion of the plasma process the alarm will sound for five seconds and the green system status lamp will blink continuously to signal that the sequence is complete.

3.6. Enter the cycle off mode by activating the COMMANDS and CYCLE OFF commands in the order shown.

3.7. The chamber will vent to atmosphere and the DOOR:OPEN message will be displayed.

3.8. Vacuum chamber unloading and loading may be performed at this time.

3.9. For further plasma processing, repeat paragraphs 3.1 through 3.8.

4. STANDBY MODE

4.1. If the system is not currently being used for plasma process, it should be placed in the standby mode. In this mode the system is maintained ready for immediate return to plasma processing.

4.2. While holding the vacuum chamber door closed, enter the standby mode by activating the COMMANDS and STANDBY commands in the order shown.

Note: After ten minutes of uninterrupted standby operation the system will partially power down. This automatic procedure is used to conserve electrical power, eliminate nitrogen purge gas consumption, extend the service life of the vacuum pump and the R.F. generator.

4.3. To return to active processing repeat paragraphs 2.6 through 2.11, then proceed to paragraph 3.1.

5. SHUTDOWN MODE

CAUTION: When the system is turned off, it must be done so using the shutdown mode. This mode turns off the system in a prescribed sequence, allowing adequate cooling of critical system components. The shutdown mode can only be initiated while in the standby mode.

5.1. Enter the shutdown mode by activating the COMMANDS and SHUTDOWN commands in the order shown.

Note: After ten minutes the system will automatically power down.

5.2. At the AC Circuit Breaker Panel set the circuit breaker to the Off (Down) position.

5.3. At the gas sources turn the gas cylinder valves fully CW.

Note: The gas cylinders must not be shut off until the automatic shutdown sequence is complete.

5.4. System shutdown is complete.

SECTION III

PLASMA PROCESSING METHODS & PROCEDURES

1. GENERAL

1.1. This document defines general plasma processing methods and procedures, including pre plasma, plasma and post plasma processing.

1.2. Included as part of this document are all current "Field Service Bulletins". It is important that these bulletins be reviewed before operating the system. In some cases the instructions in these bulletins can have a major impact on system reliability.

1.3. Detailed system operating instructions are provided in Section I, "Control System Overview" and Section II, "System Operating Instructions".

2. PRE PLASMA PROCESSING

2.1. Board Preheating

2.1.1. Prior to plasma processing it is required that all boards be baked at an elevated temperature for a specified minimum period.

2.1.2. Board preheating provides the following benefits:

1) There is a direct relationship between plasma process temperature and plasma processing efficiency. Within specified temperature limits, the higher the process temperature, the higher the plasma etch rate. The plasma process is inhibited until the boards reach processing temperature. By preheating all boards prior to processing, the plasma process temperature will reach equilibrium faster and in turn maximize load to load process repeatability.

2) Water vapor introduced into the plasma system slows etching. Printed circuit boards are by nature hydroscopic. The board preheating process drives off this moisture, allowing the plasma process to reach equilibrium faster and in turn maximizes load to load process repeatability.

3) Water vapor introduced into the system has the potential to condense in the vacuum pump. This water vapor, in combination with the fluorine gas byproduct of the plasma process, will form hydrofluoric acid (HF). The formation of hydrofluoric acid in the vacuum pump, even in moderate concentrations, will attack the vacuum pump and

severely reduce its service life. Reference Section IV, "Preventive Maintenance Procedure", Section 1.3, for additional measures taken to eliminate the effects of hydrofluoric acid contamination.

2.1.3. Recommended Preheating Parameters:

Temperature = 250°F

Time = 1 hour (minimum)

2.1.4. As an aid to processing and handling, the boards should be stacked in full plasma chamber loads in the oven. The boards can then be conveniently transferred from the oven to the plasma system. An added benefit is that the stacked boards will retain heat for an extended period of time, while awaiting loading into the plasma system. The dwell time between the oven and plasma processing should be limited. After approximately ten minutes, it is recommended that the boards be returned to the oven for reheating.

3. PLASMA PROCESSING

3.1. Process Temperature Control

3.1.1. Process temperature control is used to maximize system etch rates and processing uniformity. Optimum etch rates are achieved by selecting a process temperature which is compatible with the board material type being processed.

3.1.2. The electrodes are temperature regulated via the temperature control system, which continuously recirculates a heat transfer fluid through the electrode stack.

3.1.3. Preheated boards are loaded directly onto the temperature regulated electrode surfaces and they quickly acquire the selected electrode temperature.

3.1.4. Recommended process temperatures for the common board materials are:

Flex = 225°F

Rigid/Flex = 225°F

Epoxy = 250°F

Polyimide = 250°F

Note: **Process temperatures above 300°F must be avoided, as they exceed the maximum safe operating temperature of the temperature control system.**

If a variety of materials are being processed during any given period, select the lowest temperature which is compatible with all the material types. This will avoid constant resetting and restabilization of the system temperature. It will have a minimal effect on process etch rates.

3.2. Chamber Loading

3.2.1. Partial chamber loads should be loaded into the system from the top down.

3.2.2. If partial loads are to be run, it is recommended that a full size dummy panel (18" X 24") be located below the lower most panel in the load. This will insure ptimum etch uniformity.

3.2.3. Permanent dummy boards can be fabricated from two-sided panels which have been copper panel plated (all exposed resin surfaces plated). Conventional unplated dummy boards can be used, but they will be etched away by repeated processing and will have to be replaced periodically.

3.3. Plasma Process Time

3.3.1. Etch rates are affected by laminate material type, laminate cure, board surface area, board exposed resin area (number of holes and board edges), drilled hole quality, plasma parameters (temperature, gas flow/mixture, R.F. power, vacuum, etc.), water vapor and other less dominate effects.

3.3.2. It may look like determining plasma process times is an impossible task. Fortunately this is not the case. For a given board manufacturer, most of these potential process variables can be treated as constants. Normally laminate cure and drilled hole quality are consistent for a given manufacturer and may be treated as constants. Furthermore, the design of the plasma system is such that essentially all plasma parameters are held constant and only plasma time is a variable. The true plasma variables are laminate material type, board surface area and board exposed resin area.

3.3.3. Experience has shown that the quickest and most effective way to establish plasma process time guidelines for your products is through experimentation. For each laminate material type, experiment with different plasma times. Remember you can under etch with plasma and always go back for more etching, but you can't recover from over etch. Start off with conservative plasma times in order to avoid over etch. The relationship of board exposed resin area and plasma time is linear relationship. After running the first experimental plasma sequence you can measure the etchback results and determine rerun process times.

3.3.4. The effect of laminate material on plasma process times must be generalized. Laminate material of the same generic type can have different etch characteristic, dependent on the specific supplier. In general laminates will etch in the following order of speed, from fastest to slowest:

Flex (the acrylic adhesive will etch at a much faster rate than the Kapton

Epoxy

Polyimide

3.3.5. The effect of board surface area is such that the copper surfaces react with the plasma (recombination effect) and shunt energy away from the resin etching process. The larger the surface area the more plasma loading effect and longer equivalent times required. This is a secondary effect and is much less dominate than the effect of exposed resin area.

3.3.6. The effect of exposed resin area is such that the larger the total area, the more plasma loading effect and longer equivalent times required. This is the dominant effect on plasma times.

3.3.7. For partial chamber loads, some adjustment to plasma time is necessary. The following general guidelines should be followed for full and partial loads:

1) 30% to 100% Loads = Full process time

2) Less than 30% Loads = 80% of full process time

4. POST PLASMA PROCESSING

4.1. Post plasma treatment is required to obtain consistent void free plating of the plasma treated hole walls. The plasma process produces a smooth hole wall that does not plate consistently without additional conditioning. Some additional treatment is required to roughen the hole wall and insure consistent void free plating. There is no industry standard to accomplish this hole wall conditioning. Some of the more commonly used methods are:

Permanganate

Vapor Hone

Hot Alkaline Cleaner

FIELD SERVICE BULLETIN - NO. 1

Subject: Use Of High Oxygen Concentration Plasmas

Dated; 8/26/91

IMMEDIATE ATTENTION REQUIRED

There are specific process conditions which have proven to be potentially damaging to the plasma system. When processing with oxygen concentrations in the range of 80% to 100%, it is imperative that the R.F. power level be limited to 1500 watts or less.

When processing with high oxygen concentration plasmas it is possible to permanently damage the system through erosion of the electrodes and temperature control system (oil recirculation system). This erosion has the potential to cause oil leaks within the vacuum chamber.

This same potential problem can exist with other plasma gasses (CF_4, Ar, He, N_2, etc.), when used in high concentrations. When using any gases in high concentration it is recommended that the maximum R.F. power level be limited to 1500 watts or less.

For all plasma processes it is recommended that the plasma never be operated with arcing present in the vacuum chamber, as viewed through the chamber viewport and evidenced by unstable reflected R.F. power readings. This can indicate conditions which are potentially damaging to the system.

Use of process parameters other than those specified by Plasma Etch should be reviewed with us prior to implementation.

SECTION IV

PREVENTIVE MAINTENANCE PROCEDURE

1. VACUUM SYSTEM

1.1. General

1.1.1. Proper maintenance of the vacuum system is necessary to insure system reliability. Adherence to recommended preventive maintenance procedures will greatly extend the service life of this equipment.

WARNING:

Oxygen service plasma requires that only the specified oil type may be used. Substitution of other than the specified oil type can result in an explosion.

Two oil types are required . Do not substitute or mix oil types.

Refer to the vacuum pump section in the system manual for the correct oil types.

1.2. Vacuum Pump Lubrication

1.2.1. Vacuum pump oil levels should be checked daily, while the vacuum pump is at operating temperature and under full vacuum (plasma mode).

1.2.2. Check and maintain the following vacuum pump oil levels (reference the vacuum pump manual for the location of the sight glasses and filling instructions):

1) Main Pump - Single sight glass must be maintained at ¼ to ½ full.

2) Blower - Three sight glasses must be maintained at ¼ to ½ full.

1.2.3. While checking the oil levels, also observe the oil for color and clarity. The oil color must be colorless to amber and the oil clarity must be clear.

1.2.4. Reference Section VII, "Spare Parts List", for the replacement vacuum pump oil.The specified oil types are stocked Plasma Etch.

1.3. Vacuum Pump Nitrogen Purging

Note: Continuous vacuum pump nitrogen purging is critical to vacuum pump reliability. Nitrogen purging prevents the formation of hydrofluoric acid (HF) in the vacuum pump.

1.3.1. Verify daily and adjust as required the nitrogen flow rates as monitored at the flow meters located inside bottom of the left hand plasma console cabinet door.

1) FM1 4.0 L/Min.

2) FM2 4.0 L/Min.

1.4. Oil Filter Replacement

1.4.1. Replace the system oil filter cartridge every two hundred fifty (250) hours of plasma run time, as indicated by the system running time meter.

1.4.2. A drain valve is located on the bottom of the oil filter canister. Always drain and replace the oil filter while the oil is hot and vacuum pump is off.

1.4.3. Reference Section VII, "Spare Parts List", for replacement oil filter cartridge part number. The specified filter is stocked by Plasma Etch.

1.5. Oil Replacement

1.5.1. In normal service the vacuum pump oil should not require replacement. The longevity of the oil is insured by nitrogen purging and oil filter replacement. The lubrication properties of the oil do not deteriorate with time.

1.6. Oil Mist Eliminator Filter Service

WARNING:

The oil mist eliminator and filter element will retain system process byproducts. Some amount of hydrofluoric acid (HF) can be present in this assembly. When inspecting or changing this filter, avoid breathing vapors from within this assembly and avoid direct skin contact with the filter and all internal surfaces of this assembly.

1.6.1. The filter element in the vacuum pump oil mist eliminator will lose efficiency after extended service. As efficiency of this filter decreases, the capture of the oil mist in the vacuum pump exhaust will decrease and vacuum pump oil consumption will increase.

1.6.2. It is recommended that this filter element be checked every five hundred (500) hours of plasma operation, as indicated by the system running time meter.

1.6.3. Loss of filter efficiency will be evidenced by a shrinkage and/or cracking of the outer surface of the polypropylene filter material. If any deterioration is noted, it is recommended that the filter element be replaced. Loss of filter efficiency will not impact the plasma process, but system operating costs will increase as oil consumption increases.

1.6.4. Reference Section VII, "Spare Parts List", for replacement oil mist filter element part number. The specified oil mist filter element is stocked by Plasma Etch.

1.7. Scheduled Vacuum Pump Maintenance

1.7.1. Lubricate the vacuum pump motor grease fitting (if applicable) every six (6) month, with a high quality lithium base #2 grease. On some vacuum pump models the motor bearings are sealed and no lubrication is required.

1.7.2. Reference the Stokes manual for additional recommended preventive maintenance procedures.

1.8. Vacuum Valve Maintenance

1.8.1. The vacuum valve is the large aluminum valve located above the vacuum pump.

1.8.2. After extended service the valve may exhibit a tendency to stick intermittently, on opening and closing.

1.8.3. To service the vacuum valve, perform the following procedure:

1) Power down the system with the vacuum chamber vented to atmosphere.

2) Disconnect the compressed air source from the vacuum valve solenoid.

3) Remove the eight Allen head bolts, located at the second bolt pattern down from the top of the valve.

4) Lift the valve assembly up and out of the valve body.

Note: Do not let contaminates fall into the valve body. Contaminates will enter the vacuum pump and can cause permanent damage.

5) Manually extend the valve shaft to its maximum length.

6) Check the valve shaft for deposits which will inhibit free travel. If deposits are present, they may be removed by wiping the shaft with alcohol. If the deposits cannot be removed effectively with alcohol, light sanding with a very fine grit sandpaper (320 grit or finer) is recommended. Reclean the shaft with alcohol before reassembly. This shaft is designed to operate without any lubricant. Do not lubricate.

7) Carefully reassemble the vacuum valve. Pay particular attention to the O-Ring seal between the two valve assemblies. Tighten the eight Allen head bolts in crisscross pattern. Do not over tighten these bolts, as they thread into an aluminum body and can be stripped.

8) Reconnect the compressed air source to the vacuum valve solenoid.

2. Electrode Temperature Control System Lubrication

2.1. The reservoir oil level should be checked monthly and maintained at ¼ to ½ full, when the oil is cold. Do not overfill or check when the oil is hot.

2.2. **Refill only with Dow Corning Type 210H oil.** The specified oil is stocked by Plasma Etch.

3. Equipment Cabinet Air Filters

Note: Do not operate the system with dirty or obstructed cabinet air filters. Full air flow through the system is required for maximum system service life.

3.1. Monthly inspect the plasma cabinet air filters for unobstructed air flow. Dirty air filters may be cleaned in place by vacuuming. The cabinet air filters are located at the lower rear of each of the two plasma console bays.

4. Vacuum Chamber Preventive Maintenance

4.1. Vacuum Chamber Door Seal

4.1.1. Monthly clean the vacuum chamber door O-Ring gasket and mating flange surface. To clean, lightly wipe both the O-Ring and flange surface with alcohol.

4.1.2. Inspect the O-Ring for cuts, abrasions or abnormal wear. Replace as required. The referenced O-Rings are stocked by Plasma Etch.

4.1.3. No lubrication (vacuum grease, etc.) of the O-Ring is required or recommended.

4.1.4. Inspect the mating flange area for scratches. Minor scratches can cause significant vacuum leaks. Scratched areas can be resurfaced using a orbital sander and number 320 grit or finer sand paper.

4.2. Vacuum Chamber Cleaning

4.2.1. Every three months inspect the vacuum chamber internal surfaces for debris from the plasma process.

4.2.2. If cleaning is warranted, carefully blow out the vacuum chamber with compressed air. Be careful not to mechanically strike or distort the four oil lines (running parallel to the bottom of the chamber) or the two vertical copper tubes from the water cooled R.F. feedthru (located at the bottom of the chamber).

5. Water Cooling System Cleaning

> **WARNING**
>
> **When cleaning the water cooling system, it is critical that bleach not be used as a cleaning agent. There are aluminium components in the cooling system which are not compatible with bleach.**

5.1. If a closed loop recirculating chiller is used, it is recommended that the unit be charged with tap water and approximately one quart of commercial grade ethylene glycol (antifreeze). Do not use automotive grade antifreeze.

5.2. .Do not use deionized water or high conductivity tap water.

6. Preventive Maintenance Procedure Complete

SECTION V

CALIBRATION PROCEDURE

1. GENERAL

1.1. This procedure defines the general calibration requirements for the MK II Series Plasma Desmear/Etchback and Surface Treatment Systems. This document is intended only as a guide to calibration. The specifics of actual calibration should be defined by the customer.

1.2. Referenced calibration instruments or equivalent, of the stated accuracy or better should be utilized.

1.3. It is assumed that calibration personnel have thoroughly familiarized themselves with the operation of the plasma system and the appropriate operating documents prior to commencing calibration.

1.4. This procedure utilizes computer stored calibration sequences to assist in the calibration. Reference Appendix A of this document for calibration part numbers and their related process parameters.

Note: Activation of computer stored calibration sequences requires that the system be controlled using a special software maintenance program. To enter this maintenance program perform the following steps:

1) At the bootup screen (Plasma Etch logo displayed), activate "Exit" and enter a valid "Password".

2) At the program prompt C:\PLASMA>, type "PLASMAX -M" (there must be a space after the X in PLASMAX).

3) The system will bootup up in the Maintenance Mode, as evidenced by the title "System In Maintenance Mode" appearing the "Misc. Message" block.

2. CALIBRATION EQUIPMENT REQUIRED

2.1. Calibrated digital multimeter, Fluke Model 8060A or equivalent (±2.0% accuracy).

2.2. Calibrated vacuum gauge, HPS Model 315 or equivalent (±1.0% accuracy).

2.3. Calibrated vacuum gauge tube, HPS Model 103150011 or equivalent. To be used in conjunction with the above vacuum gauge (¶ 2.2).

2.4. Calibrated mass flow meter, 0-2000 CC/Min. range, calibrated for CF_4 gas, Unit Instruments Model UTM-1100 or equivalent (±0.5% accuracy).

2.5. Calibrated mass flow meter display and power supply, Unit Instruments Model URS-20 or equivalent. To be used in conjunction with the above flow meter (¶ 2.4).

2.6. Calibrated thermocouple calibrator, Omega Model CL23 or equivalent (accuracy ±0.1% of reading +1°F).

2.7. Calibrated thermocouple probe, Omega Model SP-GP-J-6-SMP or equivalent. To be used in conjunction with the above thermocouple calibrator (¶ 2.6) and mounted in below referenced temperature calibration fixture (¶ 2.8).

2.8. Temperature calibration fixture (supplied by Plasma Etch as part of the standard calibration equipment package).

Note: Reference Attachment 1 of this procedure before proceeding.

2.9. Calibrated R.F. wattmeter, Bird Model 43 or equivalent (±5% accuracy).

Note: Reference Section VI, "Troubleshooting Procedures", for additional interface cabling and connector requirements (supplied by Plasma Etch as part of standard calibration equipment package).

2.10. Calibrated R.F. power sensing elements or equivalent. To be used with Plasma Etch system models as noted below and in conjunction with the above R.F. wattmeter (¶ 2.9).

a. Power sensing element (250 Watts), Bird Model 250H (MK II-0, MK II-1 & MK II-1.5.

b. Power sensing element (500 Watts), Bird Model 500H (MK II-2 & MK II-3).

c. Power sensing element (1000 Watts), Bird Model 1000H (MK II-0).

d. Power sensing element (2500 Watts), Bird Model 2500H (MK II-1)

e. Power sensing element (5000 Watts), Bird Model 5000H (MK II-1.5, MK II-2 & MK II-3).

2.11. Calibrated coaxial load resistor. To be used with Plasma Etch system models as noted below.

a. Calibrated coaxial load resistor (1000 Watts) Model 8251 (MK II-0).

b. Calibrated coaxial load resistor (2500 Watts) Model 8890-300 (MK II-1).

c. Calibrated coaxial load resistor (5000 Watts) Model 8890-300, with BA-300-115 (Fan) (MK II-1, MK II-1.5, MK II-2 & MK II-3).

Note: The load resistor is not a requirement for calibration, but is recommended in the event R.F. system troubleshooting is required.

3. SPECIAL PRECAUTIONS

WARNING:

When performing the R.F. generator calibration, all personnel who work with or are exposed to this equipment must take precautions to protect themselves against shock hazard, which can cause serious and/or fatal bodily injury. Do not be careless around High Voltage.

3.1. When operating the system with the high voltage interlocks bypassed, be especially conscious of contact with high voltage areas that may be exposed. Additionally, the doors form a integral part of the air cooling of the R.F. generator. Do not operate the system for extended periods with the R.F. power applied and the doors open, as R.F. generator overheating may occur.

3.2. Initiation of the system shutdown sequence, as detailed in Section II, "System Operating Instructions", starts an automatic ten minute cooldown of the system. Do not turn off the system out of sequence. Aborting the cooldown procedure can result in permanent damage to the system.

4. POWER SUPPLY CALIBRATION

4.1. Using the referenced calibration multimeter, monitor the following DC voltages (access to these voltage is at the calibration panel on the Gas Control & Power Supply Assembly, located inside the plasma cabinet left side door):

1) +24 VDC ± 0.1 VDC (Referenced to GND test point)

2) +15 VDC ± 0.1 VDC (Referenced to GND test point)

3) -15 VDC ± 0.1 VDC (Referenced to GND test point)

4) +5 VDC ± 0.1 VDC (Referenced to 5V RTN test point)

4.2. Adjustment of the these power supplies should not normally be required. If adjustment is required, the power supplies can be accessed by removing the lower filter panel below the vacuum chamber rear. The power supplies are located on the left side of the Gas Control and Power Supply Assembly. The rear most power supply contains the +5 VDC, +15 VDC and -15 VDC, in the order noted. The forward most power supply is the +24 VDC.

5. VACUUM MANOMETER CALIBRATION

5.1. Insert the referenced calibration vacuum gauge into the port located just below the system vacuum manometer.

Note: The vacuum chamber must be vented to atmosphere while installing or removing the calibration vacuum gauge.

5.2. Before a calibration check is performed, a thirty minute warm-up period is required.

5.3. Using the calibration vacuum gauge, verify the following system vacuum level, when compared with the system vacuum level as viewed at graphic display.

SYSTEM VACUUM	TOLERANCE
Blank Off Vacuum (See Note)	< 50 Microns

Note: To calibrate for blank off vacuum, select process part number, "Cal Vac 1". This part number inhibits process gas flow and R.F. power. Activate normal plasma sequencing and allow 15 minutes for the system to achieve maximum vacuum before performing the referenced vacuum measurement.

5.4. Calibration of the system vacuum manometer can be made by adjusting the potentiometer, accessible on the wiring side of the manometer.

6. MASS FLOW CONTROLLER CALIBRATION

6.1. Zero Calibration

6.1.1.A one-hour warm-up is required prior to calibration.

6.1.2. The vacuum chamber must be vented to atmosphere to perform this calibration.

6.1.3. Turn off plasma gases at their source and disconnect from gas maniford (Gas 1-Gas 5) at the plasma cabinet rear.

6.1.4. At the Runtime Screen perform the following steps:

a) Screens

a) I/O

a) Force I/O

a) Type "Plasma"/Enter

a) Force Discrete Inputs/Enter

a) Activate "Gas 1 Chan 1 Valve"

a) Activate "Gas 2 Chan 2 Valve"

a) Activate "Gas 1 Chan Valve" (If Applicable)

a) Exit

6.1.5. Reference the following table for specific calibration procedrue (access to these voltages is at the calibration panel on the Gas Control & Power Supply Assembly, located inside the plasma cabinet left side door):

CHANNEL	SWITCH (SET)	MONITOR	ADJUST (NOTE)	READ
MFC 1	OFF	TP (YEL) TO TP	ZERO ADJUST	0.001 VDC
MFC 2	OFF	TP (YEL) TO TP	ZERO ADJUST	0.001 VDC
MFC 3	OFF	TP (YEL) TO TP	ZERO ADJUST	0.001 VDC

Note: The mass flow controller Zero Adjust. potentiometer is located under the cover on the gas input side of the controller.

6.1.6. At the Runtime Screen perform the following steps:

a) Screens

b) I/O

c) Force I/O

d) Type "Plasma"/Enter

e) Unforce Discrete Inputs/Enter

f) Deactivate "Gas 1 Chan 1 Valve"

g) Deactivate "Gas 1 Chan 2 Valve"

h) Deactivate "Gas 1 Chan 3 Valve" (If Applicable)

6.1.7. Reconnect and turn on source gases disconnected in Step 6.1.2.

6.2. Flow Calibration

6.2.1. Insert the referenced calibration mass flow meter in series with the Gas 1 source, using O_2 as the calibration gas (oxygen gas is used for economic reasons).

Note: Gas 1 source may be accessed at the gas manifold on the plasma console rear.

6.2.2. Select the referenced process part numbers, activate normal plasma sequencing.

PART NUMBER	CF_4 (CC/MIN.)
"CAL FLOW 1"	500
"CAL FLOW 2"	1000
"CAL FLOW 3"	1500
"CAL FLOW 4"	2000

6.2.3. Select each mass flow controller channel as noted below and verify that flow rate tracks ±5%.

CHANNEL	SWITCH (SET)
MFC 1	MFC 1 ON
	MFC 2 OFF
	MFC 3 OFF
MFC 2	MFC 1 OFF
	MFC 2 ON
	MFC 3 OFF
MFC 3	MFC 1 OFF
	MFC 2 OFF
	MFC 3 ON

6.2.4. Repeat the above calibration for each system mass flow controller channel.

6.2.5. There are no field adjustments on the mass flow controllers. If calibration is necessary the mass flow controllers must be returned to the manufacturer for calibration.

6.2.6. Reconnect Gas 1 source at Gas 1 input.

7. TEMPERATURE CALIBRATION

7.1. Shut off all power to the system, observing the referenced shutdown sequence (¶ 3.2).

7.2. Disconnect the upper hot oil line at the rear of the plasma and insert the temperature calibration fixture in series with this oil line.

7.3. Connect the thermocouple mounted in the temperature calibration fixture to the input of the thermocouple calibrator.

7.4. Power up the temperature control system and allow system temperature to stabilize prior to performing the temperature calibration. Record the current system temperature as displayed on the graphic display.

7.5. At the thermocouple calibrator record the temperature.

7.6. The system temperature reading (¶ 7.4) and the thermocouple reading (¶ 7.5) must track ±5°F.

7.7. There are no field adjustments that can be made on the temperature control system. If calibration is necessary, contact the manufacturer for instructions.

7.8. Power down the system and reconnect the system oil line.

8. R.F. GENERATOR CALIBRATION

WARNING:

When performing the R.F. generator calibration, all personnel who work with or are exposed to this equipment must take precautions to protect themselves against shock hazard, which can cause serious and/or fatal bodily injury. Do not be careless around High Voltage.

8.1. When operating the system with the high voltage interlocks bypassed, be especially conscious of contact with high voltage areas that may be exposed. Additionally, the doors form an integral part of the air cooling of the R.F. generator. Do not operate the system for extended periods with R.F. power applied and the doors open, R.F. generator overheating may occur.

8.2. Initiation of the system shutdown sequence, as detailed in Section II, "System Operating Procedure", starts an automatic ten minute cooldown of the system. Do not turn off the system out of sequence. Aborting the cooldown procedure may result in permanent damage to the system.

8.3. Shut off all power to the system, observing the referenced shutdown sequence (¶ 8.2).

8.4. Remove the upper cover at the rear of the vacuum chamber.

8.5. Disconnect the larger single R.F. cable at the input to the matching network (rear of the matching network). Insert the referenced calibration R.F. power meter, with the specified power sensing element.

8.6. Select the referenced process calibration part number as referenced in the following table, activate normal plasma processing and verify system R.F. power levels track ±5%:

PART NUMBER	POWER (WATTS)
"CAL RF 1"	1000 (MK II-0)
"CAL RF 1"	1000 (MK II-1)
"CAL RF 2"	2000 (MK II-1)
"CAL RF 1"	1000 (MK II-2)
"CAL RF 3"	4000 (MK II-2)
"CAL RF 1"	1000 (MK II-3)
"CAL RF 3"	4000 (MK II-2)

8.7. There are no field adjustments that can be made on the R. F. generator. If calibration is necessary, contact the manufacturer for instructions.

8.8. Shut off all power to the system, observing the referenced shutdown sequence (¶ 8.2).

8.9. Remove the calibration R.F. power meter and reconnect the R.F. cable to the matching network sampling box.

8.10. Replace the upper cover at the rear of the vacuum chamber.

CALIBRATION PROCEDURE COMPLETE

APPENDIX A

The calibration part numbers have the following related process parameters:

	TEMP.	TIME	GAS FLOW	RF POWER
CAL VAC 1	225	60	0	0
CAL FLOW 1	225	60	500	0
CAL FLOW 2	225	60	1000	0
CAL FLOW 3	225	60	1500	0
CAL FLOW 4	225	60	2000	0
CAL RF 1	225	60	225	1000
CAL RF 2	225	60	225	2000
CAL RF 3	225	60	225	4000

ATTACHMENT 1

CALIBRATION PROCEDURE

OIL LINE QUICK DISCONNECT MODIFICATION

To facilitate temperature calibration the upper oil line quick disconnects must be replaced. The modified quick disconnects include check valves.

Modification instructions:

1. Remove quick disconnect from upper oil hose.

2. Remove quick disconnect from cabinet upper bulkhead oil fitting.

3. Install new female quick disconnect to upper oil hose. Use thread sealing compound provided.

4. Install new male quick disconnect to cabinet upper bulkhead oil fitting. Use thread sealing compound provided.

   Thread Compound Mixing Instructions:

   > Mix as required, with clean water only, to a consistency of light paste or thick oil. Mix in small quantities only as you use it.

SECTION VI

TROUBLESHOOTING PROCEDURE

1. R.F. OVERLOAD RECOVERY PROCEDURE

1.1. To recover from an R.F. generator overload, the following procedure should be followed:

1.1.1. The system must be temporarily switched from the Runtime Mode to the Maintenance Mode, using the following procedure:

1) At the Main Screen graphic (Plasma Etch system logo) initiate the Exit command.

2) At the program prompt, type the name of the program referenced, followed by a space and "-M" (PLASMA -M). The Maintenance Mode program will boot up, as evidenced by the message, "System In Maintenance Mode", appearing in the Miscellaneous Message section of the Runtime Screen graphic.

1.1.2. At the matching network remote chassis (located inside the plasma console), note the Load and Tune values referenced on the attached embossed labels.

1.1.3. At the matching network, adjust the Load and Tune meter readings to correspond to the label values referenced, using the following procedure:

1) Set the appropriate Local/Auto switch to the Local position.

2) Adjust the appropriate potentiometer (turns counting dial) for the reading referenced on the label.

3) Once both the Load and Tune meter readings correspond to the values referenced on the labels, reset both Local/Auto switches to the Auto position.

1.1.4. At the R.F. Generator Panel, set the Local/Remote switch to the Local position.

1.1.5. Set the system process time for sixty minutes, to allow sufficient time to perform the matching network alignment.

1.1.6. Activate the plasma sequence.

1.1.7. Once the plasma sequence is active (the sequence process timer is activated), perform the following steps at the R.F. Generator Panel:

1) Adjust the Output Level potentiometer slowly CW, until the Incident power meter reads approximately 300 watts (meter readings must be multiplied times ten).

2) The Reflected Power meter should slowly start to tune towards zero watts.

Note: If the Reflected Power meter does not tune toward zero watts, do not proceed with the remainder of this alignment and contact Plasma Etch for assistance.

3) Slowly increment the Output Level potentiometer CW, while observing the Reflected Power meter. After each incremental adjustment of the Output Level potentiometer, wait until the Reflected Power meter has returned to approximately zero watts.

4) Continue to slowly increment the Output Level potentiometer until the Incident Power meter is at the programmed system operating power level.

1.1.8. At the R.F. Generator Panel, set the Remote/Local switch to the Remote position.

1.1.9. At the R.F. Generator Panel, adjust the Power Level potentiometer fully CCW.

1.1.10. To disable the Maintenance Mode return to the normal Runtime Mode, simply reboot the computer.

SECTION IV

RECOMMENDED SPARE PARTS LIST

Note : Listed are all potential items of failure. This list may be modified to reflect your company's policy on spare parts stocking levels. Normal wear items are indicated by an asterisk (*) in the usage column.

DESCRIPTION	MANUFACTURER/PART NUMBER	USAGE
AC CIRCUIT BREAKER PANEL		
Alarm, Fast Chime, 24 VDC	Floyd Bell CH-V09-525 S (F)	1
Circuit Breaker, SPST, 277 VAC, 50/60 HZ	Potter Brumfield W67X2Q1215	1
Running Time Meter	Stewart Warner 611-5000	1
GAS CONTROL & POWER SUPPLY ASSEMBLY		
Flow Switch, 0.1 to 1.0 GPM	Proteus 100L	
Mass Flow Controller, 0-200 SCCM, Calibrated For O2 Gas, ¼" Swagelok, FS, DB Connector	MKS 1179A22CS1NV-S	3(Max.)
Power Supply, ±15 VDC @ 1.5 A, +5 VDC @ 6.0 A	Condor HCBB75W-A	
Power Supply, +24 VDC @ 2.4 A	Condor HC24-2.4-A	
Pressure Switch, 0.5 to 15 PSI	Barksdale Controls E1S-H15-T	
Solenoid Valve, N.C.,1/8", Brass	ASCO 8262G2,120 VAC 60 HZ	6(Max.)
Check Valve, 1/4" NPT	ASCO V0121	3(Max.)
PROCESS I/O ASSEMBLY		
Diode, 400 PIV, 1 A	1N4004	
Relay, 4PDT, 24 VDC Coil	Potter Brumfield KHU17D12-24	
Brainboard, Digital, 4/16 Channel	OPTO 22 B1	
Brainboard, Analog, 4/16 Channel	OPTO 22 B2	
DC Input Module, 2.5-28 VDC	OPTO 22 IDC5D	
DC Output Module, 5-60 VDC	OPTO 22 ODC5	
AC Output Module, 12-240 VAC	OPTO 22 OAC5	
Analog Output Module, 0 to +5 VDC	OPTO 22 DA4	
Analog Output Module, 0 to +10 VDC	OPTO 22 DA5	
Analog Input Module, 0 to +5 VDC	OPTO 22 AD6	
Analog Input Module, 0 to +10 VDC	OPTO 22 AD7	
Thermocouple Input Module, Type J	OPTO 22 AD5T	
VACUUM & TEMPERATURE CONTROL MODULE		
Capacitance Manometer, 10 Torr	MKS 722A11TBA2FJ	1
Motor Starter,120/230 VAC, 3 Phase, 120 VAC Coil	Square D LC1D0910F7	3(Max.)
	MK II-0	
	MK II-1	
	MK II-1.5	
	MK II-2	
	MK II-3	
	MK II-3 Custom (612/150 CFM Vacuum Pump)	
	MK II-3 Custom (1300/150 CFM Vacuum Pump)	
	MK II-3 Custom (2000/150 CFM Vacuum Pump)	

DESCRIPTION	MANUFACTURER/PART NUMBER	USAGE
Motor Starter,120/230 VAC, 3 Phase, 120 VAC Coil	Square D LC1D1210F7	3(Max.)
	MK II-0	
	MK II-1	
	MK II-1.5	
	MK II-2	
	MK II-3	
	MK II-3 Custom (612/150 CFM Vacuum Pump)	
	MK II-3 Custom (1300/150 CFM Vacuum Pump)	
	MK II-3 Custom (2000/150 CFM Vacuum Pump)	
Motor Starter,120/230 VAC, 3 Phase, 120 VAC Coil	Square D LC1D1810F7	3(Max.)
	MK II-3	
Motor Starter,120/230 VAC, 3 Phase, 120 VAC Coil	Square D LC1D3210F7	3(Max.)
	MK II-3 Custom (612/150 CFM Vacuum Pump)	
	MK II-3 Custom (1300/150 CFM Vacuum Pump)	
	MK II-3 Custom (2000/150 CFM Vacuum Pump)	
Overload Relay, 4-6A	Square D LR2D1310	2(Max.)
	MK II-0	
	MK II-1	
	MK II-1.5	
	MK II-2	
	MK II-3	
	MK II-3 Custom (612/150 CFM Vacuum Pump)	
	MK II-3 Custom (1300/150 CFM Vacuum Pump)	
	MK II-3 Custom (2000/150 CFM Vacuum Pump)	
Overload Relay, 6-9A	Square D LR2D1314	2(Max.)
	MK II-0	
Overload Relay, 8.5-12.5A	Square D LR2D1316	2(Max.)
	MK II-1	
	MK II-1.5	
Overload Relay, 13-19A	Square D LR2D1321	2(Max.)
	MK II-0	
	MK II-1	
	MK II-1.5	
	MK II-2	
	MK II-3	
	MK II-3 Custom (612/150 CFM Vacuum Pump)	
	MK II-3 Custom (1300/150 CFM Vacuum Pump)	
	MK II-3 Custom (2000/150 CFM Vacuum Pump)	
Overload Relay, 16-23A	Square D LR2D1322	2(Max.)
	MK II-2	
	MK II-3	
	MK II-3 Custom (612/150 CFM Vacuum Pump)	
Overload Relay, 23-32A	Square D LR2D2353	2(Max.)
	MK II-3 Custom (612/150 CFM Vacuum Pump)	
	MK II-3 Custom (1300/150 CFM Vacuum Pump)	
	MK II-3 Custom (2000/150 CFM Vacuum Pump)	
O-Ring Repair Kit, Pneumatic Cylinder, Angle Valve	Industrial Vacuum Engineering 3-AOP-R	
O-Ring, 3" Angle Valve	Parker 2-339 (Teflon)	
O-Ring, 6" Angle Valve	Parker 2-361 (Teflon)	
Oil Filter Cartridge, 3 Micron	Schroeder K3	
Oil Filter Cartridge, Oil Mist Filter Assembly	Plasma Etch 12-600E-382	
Pump Seal, Hot Oil Pump & Vacuum Pump Filtration	Viking Pump 471-052-999-00	

DESCRIPTION	MANUFACTURER/PART NUMBER	USAGE
Solenoid Valve, N.O., ¼" NPT, Brass (Vacuum Pump Vent)	ASCO 8262G265, 120 VAC, 60 Hz	
Temperature Switch, 50-450°F	Barksdale Controls L1C-H45	
Thermocouple, Type J	Wilcon Industries .250"-J-316-U-4½" X ½"	
Vacuum Switch, 20.3-762 MM HG	Barksdale Controls D1H-H18	
VACUUM CHAMBER ASSEMBLY		
O-Ring, Vacuum Chamber Door		
MK II-0	Reference "System Config" Section System Manual	
MK II-1	Reference "System Config" Section System Manual	
MK II-1.5	Reference "System Config" Section System Manual	
MK II-2	Reference "System Config" Section System Manual	
MK II-3	Reference "System Config" Section System Manual	
Solenoid Valve, N.C., 3/4" NPT, Brass (Chamber Vent)	ASCO 8210G95, 120 VAC 60 Hz	1
Switch, Momentary, SPST	Grayhill 39-101	1
Viewport, Pyrex Glass		1
MK II-0	McMaster Carr Supply 8477K45	
MK II-1	McMaster Carr Supply 8477K45	
MK II-1.5	McMaster Carr Supply 8477K45	
MK II-2	McMaster Carr Supply 8477K45	
MK II-3	McMaster Carr Supply 8477K15	
R.F. GENERATOR ASSEMBLY		
R.F. Generator		
Fuse, 3AG, 1.5 A, 250 VAC	Littelfuse 31201.5	
	MK II-2 (13.8 VDC Power Supply)	
	MK II-3 (13.8 VDC Power Supply)	
Fuse, 3AG, 3 A, 250 VAC	Littelfuse 312003	
	MK II-2 (500 Watt Amplifier)	
	MK II-3 (500 Watt Amplifier)	
Fuse, 3AG, 8 A, 250 VAC	Littelfuse 312008	
	MK II-0 (Circuit Breaker Panel)	
	MK II-1 (Circuit Breaker Panel)	
	MK II-2 (Circuit Breaker Panel)	
	MK II-3 (Circuit Breaker Panel)	
Fuse, 3AG, 6 A, 250 VAC	Littelfuse 312006	
	MK II-0 (13.8 VDC Power Supply)	
	MK II-1 (13.8 VDC Power Supply)	
Fuse, 3AG, 20 A, 250 VAC	Littelfuse 312020	
	MK II-0 (13.8 VDC Power Supply)	
	MK II-1 (13.8 VDC Power Supply)	
Fuse, 8AG, 1/8 A, 250 VAC	Littelfuse 361.125	
	MK II-2 (500 Watt Amplifier)	
	MK II-3 (500 Watt Amplifier)	
Fuse, 8AG, 1 A, 250 VAC	Littelfuse 361001	
	MK II-0 (Final Amplifier)	
Fuse, 8AG, 1.5 A, 250 VAC	Littelfuse 36101.5	
	MK II-1 (Final Amplifier)	
Fuse, 8AG, 2 A, 250 VAC	Littelfuse 361002	
	MK II-2 (Final Amplifier)	
	MK II-3 (Final Amplifier)	
Tube, Electron (Final Amplifier)	Eimac 3CX1000A7	
	MK II-0	
Tube, Electron (Final Amplifier)	Eimac 3CX3000A7	
	MK II-1	

DESCRIPTION	MANUFACTURER/PART NUMBER	USAGE
	MK II-1.5	
	MK II-2	
	MK II-3	
	MK II-3 Custom (612/150 CFM Vacuum Pump)	
	MK II-3 Custom (1300/150 CFM Vacuum Pump)	
Tube, Electron (Final Amplifier)	Eimac 3CX1000A7	
	MK II-3 Custom (2000/150 CFM Vacuum Pump)	
Tube, Electron (Exciter)	Eimac 4-400C	
	MK II-2	
	MK II-3	
	MK II-3 Custom (612/150 CFM Vacuum Pump)	
	MK II-3 Custom (1300/150 CFM Vacuum Pump)	
Tube, Electron (Exciter)	Eimac 3XC1200D7	
	MK II-3 Custom (2000/150 CFM Vacuum Pump)	
GAS & WATER DISTRIBUTION		
Flow Meter, Aluminum, 0.5 to 6.0 SLPM Air	Matheson Instruments J1-1B101-J802	2(Max.)
COMPUTER CONTROL SYSTEM		
Ribbon, Printer	Star LC9HD	
RS422/485 Adapter Card	OPTO 22 AC24AT	
SYSTEM PACKAGING		
Fan, 550 CFM, 10" Diameter	Rotron CL2T2	
Filter, Air, Cabinet	Metal Master 16" X 16" X ½", Commercial Grade	
CONSUMABLES		
Oil, Vacuum Pump Stocked By Plasma Etch	Fomblin Y25/6	(*)
Oil, Blower, Vacuum Pump	Fomblin Y25/6	(*)
Oil, Temperature Control System	Dow Corning Type 210H	(*)

SECTION VIII

MATERIAL INDEX

FROM	TO	GUAGE	REMARKS
220TB1-1	250TB2-1	#12	Twisted Pair
220TB1-2	250TB2-2	#12	“
220TB1-3	115 VAC OUTLETS	#16	AC Cord
220TB1-4	115 VAC OUTLETS	#16	“
220TB1-5	115 VAC OUTLETS	#16	“
220TB1-6	240TB1-1	#16	Twisted Pair
220TB1-7	240TB1-2	#16	“
220TB1-8	230TB1-7	#16	Twisted Pair
220TB1-9	230TB1-8	#16	“
220TB1-10	240TB1-13	#16	Twisted Pair
220TB1-11	240TB1-14	#16	“
220TB1-12	240R3M7-16		
220TB1-13	240R3M6-14		
220TB1-14	230TB1-13		
220TB1-15	240R1M9-19		
220TB1-16	230TB1-16		
220TB1-17	E1		Cabinet Chassis
220TB1-18	UNUSED		
220TB1-19	UNUSED		
220TB1-20	UNUSED		
230TB1-1	240R4M4-B		
230TB1-2	240R4M0-B		
230TB1-3	240R4M5-B		
230TB1-4	240R4M1-B		
230TB1-5	240R4M6-B		
230TB1-6	240R4M2-B		
230TB1-7	220TB1-8	#16	Twisted Pair
230TB1-8	220TB1-9	#16	“
230TB1-8	260V1		
230TB1-9	240TB1-4		

TITLE	System Wire List
DWG. NO.	MK II-400
CHG. LTR.	
SHEET	1 of 5

FROM	TO	GUAGE	REMARKS
230TB1-10	240TB1-5		
230TB1-11	240TB1-6	#16	
230TB1-12	240TB1-3	#16	
230TB1-13	220TB1-14	#16	
230TB1-13	240TB1-7	#16	
230TB1-14	E1	#16	Cabinet Chassis
230TB1-15	260S1-NO		
230TB1-15	270PS1P1-J		
230TB1-16	220TB1-16		
230TB1-16	250S1-C		
230TB1-17	250M1COM		
230TB1-18	250M1+15VDC		
230TB1-19	250M1-15VDC		
230TB1-20	240TB1-9		
230TB3-1	240R1M14-29		
230TB3-2	240R1M2-5		
230TB3-3	240R2M15-31		Cabinet Chassis
230TB3-4	240R2M14-29		
230TB3-5	240R1M15-31		
230TB3-6	240R2M0-1		
230TB3-7	240R2M1-3		
230TB3-8	240R2M2-5		
230TB3-9	240R2M3-7		
230TB3-10	240R2M4-9		
230TB3-11	240R2M5-11		
230TB4-1	240R2M6-13		
230TB4-2	240R2M7-15		
230TB4-3	240R2M8-17		
230TB4-4	240R2M9-19		
230TB4-5	240R2M10-21		

TITLE	System Wire List
DWG. NO.	MK II-400
CHG. LTR.	
SHEET	2 of 5

FROM	TO	GUAGE	REMARKS
230TB4-6	240R2M11-23		
230TB4-7	240R2M12-25		
230TB4-8	240R2M13-27		
230TB4-15	240R1M4-9		
230TB4-16	240R1M5-11		
230TB4-17	240R1M6-13		
230TB4-18	240R1M7-15		
230TB4-19	UNUSED		
230TB4-20	UNUSED		
240TB1-1	220TB1-6	#16	Twisted Pair
240TB1-2	220TB1-7	#16	“
240TB1-3	230TB1-12		
240TB1-4	230TB1-9		
240TB1-5	230TB1-10		
240TB1-6	230TB1-11		
240TB1-7	230TB1-13		
240TB1-8	E1	#16	Cabinet Chassis
240TB1-9	230TB1-20		
240TB1-10	UNUSED		
240TB1-11	UNUSED		
240TB1-12	UNUSED		
240TB1-13	220TB1-10		
240TB1-14	220TB1-11		
240TB1-15	UNUSED		
240TB1-16	UNUSED		
240TB2-1	AC INTLK (HOT)	#16	Twisted Pair
240TB2-2	AC INTLK (RTN)	#16	“
240TB2-3	UNUSED		
240TB2-4	UNUSED		
240TB2-5	UNUSED		

TITLE	System Wire List
DWG. NO.	MK II-400
CHG. LTR.	
SHEET	3 of 5

FROM	TO	GUAGE	REMARKS
240TB2-6	UNUSED		
240TB2-7	AUX FAN (HOT)		
240TB2-8	AUX FAN (RTN)		
240K1-2	270PS1P1-F		
240K1-1	270PS1P1-G		
240K1-10	270MN1P401-12		
250TB1-1	240R1M12-25		
250TB1-2	240R1M11-23		
250TB1-3	240R1M10-21		
250TB1-4	240R1M13-27	#16	Twisted Pair
250TB1-5	240R3M1-3	#16	“
250TB1-6	240R3M5-12		
250TB1-7	230TB1-17		
250TB1-8	240R3M4-9		
250TB2-1	220TB1-1	#12	Twisted Pair
250TB2-2	220TB1-2	#12	“
250TB2-3	270PS1TB701-1	#10	Twisted Four
250TB2-4	270PS1TB701-2	#10	“
250TB2-5	270PS1TB701-3	#10	“
250TB2-6	270PS1TB701-4	#10	“
250TB2-7	OIL PUMP	#14	Twisted Four
250TB2-8	OIL PUMP	#14	“
250TB2-9	OIL PUMP	#14	“
250TB2-10	OIL PUMP	#14	“
250TB2-11	OIL HEATER	#12	Twisted Four
250TB2-12	OIL HEATER	#12	“
250TB2-13	OIL HEATER	#12	“
250TB2-14	OIL HEATER	#12	“
250TB3-1	120/208 VAC PH A	#8	Twisted Four
250TB3-2	120/208 VAC PH B	#8	“

TITLE	System Wire List
DWG. NO.	MK II-400
CHG. LTR.	
SHEET	4 of 5

FROM	TO	GUAGE	REMARKS
250TB3-3	120/208 VAC PH C	#8	“
250TB3-4	120/208 VAC NEUT	#8	“
250S1-C	230TB1-16		
250S1-NO	240R1M8-17		
250S2-NO	240R1M3-7		
250R1-RED	240R4M9-		T/C Wire
250R1-WHT	240R4M9+		“
250M1+15VDC	230TB1-18		
250M1-15VDC	230TB1-19		
250M1COM	230TB1-17		
250M1OUTPUT	240R4M8-B		
250M1N/C	E1		Cabinet Chassis
260V1	240R3M0-1		
260V1	230TB1-8		
260S1-C	240R1M1-3		
260S1-NO	230TB1-15		
270PS1P1-A	240R1M0-1		
270PS1P1-D	240R4M7-B		
270PS1P1-F	240K1-9		
270PS1P1-G	240K1-1		
270PS1P1-J	230TB1-15		
270PS1TB701-1	250TB1-3	#10	Twisted Four
270PS1TB701-2	250TB1-4	#10	“
270PS1TB701-3	250TB1-5	#10	“
270PS1TB701-4	250TB1-6	#10	“

TITLE	System Wire List
DWG. NO.	MK II-400
CHG. LTR.	
SHEET	5 of 5

SECTION XII
I/O ASSIGNMENTS

Customer:

* Standard System Configuration
** Options

Function	Rack 1	Rack 2 Module	Rack 3 Module	Rack 4 Module	I/O Type
1. R.F. Generator Power On	0				*IDC5D
2. Door Open Switch	1				*IDC5D
3. Coolant Flow Sensor	2				*IDC5D
4. Overtemperature Sensor	3				*IDC5D
5. Gas Source Channel 1 Pressure Sensor	4				*IDC5D
6. Gas Source Channel 2 Pressure Sensor	5				*IDC5D
7. Gas Source Channel 3 Pressure Sensor	6				*IDC5D
8. Gas Source Channel 4 Pressure Sensor	7				*IDC5D
9. Vacuum Switch	8				*IDC5D
10. Emergency Off Switch	9				*IDC5D
11. Temperature Control System Power	10				*OAC5
12. Vacuum Pump Power	11				*OAC5
13. Vacuum Pump Blower Enable	12				*OAC5
14. R.F. Generator Power	13				*OAC5
15. Coolant Power	14				*OAC5
16. Gas 1 Select Valve Channel 1	15				*OAC5
17. Gas 2 Select Valve Channel 1		0			OAC5
18. Gas 3 Select Valve Channel 1		1			OAC5
19. Gas 4 Select Valve Channel 1		2			OAC5
20. Gas 5 Select Valve Channel 1		3			OAC5
21. Gas 1 Select Valve Channel 2		4			OAC5
22. Gas 2 Select Valve Channel 2		5			*OAC5
23. Gas 3 Select Valve Channel 2		6			OAC5
24. Gas 4 Select Valve Channel 2		7			OAC5
25. Gas 5 Select Valve Channel 2		8			OAC5
26. Gas 1 Select Valve Channel 3		9			OAC5
27. Gas 2 Select Valve Channel 3		10			OAC5
28. Gas 3 Select Valve Channel 3		11			OAC5
29. Gas 4 Select Valve Channel 3		12			OAC5
30. Gas 5 Select Valve Channel 3		13			OAC5
31. Plasma Gas Valve		14			*OAC5
32. N_2 Purge Gas Valve		15			*OAC5
33. Chamber Vent Valve			0		*OAC5
34. Blank Off Valve			1		*OAC5
35. System Status Lamp (Green)			2		OAC5
36. System Status Lamp (Red)			3		OAC5
37. Temperature Control Output (Cool)			4		OAC5

Function	Rack 1	Rack 2 Module	Rack 3 Module	Rack 4 Module	I/O Type
38. Temperature Control Output (Heat)			5		*ODC5
39. Plasma Running Time Meter			6		*ODC5
40. Audible Alarm			7		*ODC5
41. Pumpdown Bypass Valve			8		OAC5
42. Vacuum Pump Oil Overtemp Sensor			9		IDC5D
43. Unused			10		
44. Unused			11		
45. Unused			12		
46. Unused			13		
47. Unused			14		
48. Unused			15		
49. Gas Flow Channel 1 Control				0	*DA4
50. Gas Flow Channel 2 Control				1	*DA4
51. Gas Flow Channel 3 Control				2	DA4
52. R.F. Generator Control				3	*DA5
53. Gas Flow Channel 1 Monitor				4	*AD6
54. Gas Flow Channel 2 Monitor				5	*AD6
55. Gas Flow Channel 3 Monitor				6	AD6
56. R.F. Generator Monitor				7	*AD6
57. Vacuum Monitor				8	*AD7
58. Temperature Control Input				9	*AD5T
59. Unused				10	
60. Unused				11	
61. Unused				12	
62. Unused				13	
63. Unused				14	
64. Unused				15	

I/O COMPLEMENT	IDC5D	OAC5	ODC5	ODC5R	DA4	DA5	AD6	AD7	AD5T	PB16H	PB16AH	B1	B2
Standard System	9	11	3	0	2	1	3	1	1	3	1	3	1
Options													

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
A1	Alarm, Fast Chime, 24 VDC	Floyd Bell CH-V09-525 S (F)	
CB1	Circuit Breaker, SPST, 277 VAC, 50/60 HZ, Curve 2, 5 A	Potter Brumfield W67X2Q125	
M1	Running Time Meter, 4-40 VDC	Allied Electronics 611-5000	
S1	Switch, Mushroom	Alcoswitch M6057-2	
XS1	Contact Block, N.C.	Alcoswitch V40	
S2	Switch, Mushroom (Optional)	Alcoswitch M6057-2	
XS2	Contact Block, N.C. (Optional)	Alcoswitch V40	
TB1	Terminal Block	Cinch Jones 20-141	
XTB1	Marker Strip, Terminal Block	Cinch Jones MS-20-141	

TITLE	AC Circuit Breaker Panel
DWG. NO.	MK II-220
CHG. LTR.	A
SHEET	1 0f 1

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
C1-C3	Capacitor, Tantalum	4.7 UF, 16 VDC	3
F1	Fuse, Fast-Acting, 3AG, 2.0A, 250V	Littelfuse 312002	
F2	Fuse, Fast-Acting, 3AG, 1.5A, 250V	Littelfuse 31201.5	
F3	Fuse, Fast-Acting, 3AG, 0.5A, 250V	Littelfuse 312.500	
XF1-XF3	Fuseholder, Triple	Littelfuse 354802-GY/1/4"QC	
MFC1	Mass Flow Controller, 0-2000 SCCM, Gas CF4, 1/4" Swagelok, FS, H, DB Conn.	Unit Instruments 8100	
MFC2	Mass Flow Controller, 0-2000 SCCM, Gas CF4, 1/4" Swagelok, FS, H, DB Conn.	Unit Instruments 8100	
MFC3	Mass Flow Controller, 0-2000 SCCM, Gas CF4, 1/4" Swagelok, FS, H, DB Conn.	Unit Instruments 8100	
FM1-FM2	Reference Dwg. No. MK III-310		
PS1	Power Supply, +15 VDC @ 1.5 A, -15 VDC @ 1.5 A, +5 VDC @ 6.0 A	Condor HCBB75W-A	
PS2	Power Supply, +24 VDC @ 2.4 A, 50/60 Hz	Condor HC24-2.4-A	
S1-S3	Switch, Miniature, Toggle, SPDT, On-None-On	C & K 7101SYZQE	
S4-S7	Pressure Switch, 0.5 to 15 PSI	Barksdale Controls E1S-H15-T	
S8	Flow Switch, 0.1 to 1.0 GPM	Proteus 100L	
TB1-TB5	Terminal Block	Cinch Jones 10-141	
XTB1-XTB5	Marker Strip, Terminal Block	Cinch Jones MS-10-141	
TB6	Terminal Block	Cinch Jones 8-141	
XTB6	Marker Strip, Terminal Block	Cinch Jones MS-8-141	
TB7	Terminal Block	Cinch Jones 8-141	
XTB7	Marker Strip, Terminal Block	Cinch Jones MS-8-141	
TB8	Terminal Block	Cinch Jones 20-141	
XTB8	Marker Strip, Terminal Block	Cinch Jones MS-20-141	

TITLE	Gas Control & Power Supply Assembly
DWG. NO.	MK II-230
CHG. LTR.	A
SHEET	1 of 2

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
TP1, TP3, TP5	Tip Jack, Yellow	E.F. Johnson 105-0257-001	3
TP2, TP4, TP6, TP10	Tip Jack, Black	E.F. Johnson 105-0253-001	5
TP12			
TP7-TP9, TP11	Tip Jack, Red	E.F. Johnson 105-0252-001	4
V1-V18	Solenoid Valve, N.C., 1/8" NPT, Brass	ASCO 8262G2, 120 VAC, 60 Hz	17

TITLE	Gas Control & Power Supply Assembly
DWG. NO.	MK II-230
CHG. LTR.	A
SHEET	2 of 2

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
TB1	Terminal Block	Cinch Jones 16-141	
XTB1	Marker Strip, Terminal Block	Cinch Jones MS-16-141	
--	Mounting Rack, Digital, 16 Position	Opto 22 PB16H	3
--	Mounting Rack, Analog, 16 Position	Opto 22 PB16AH	
--	Brainboard, Digital, 4/16 Channel	Opto 22 B1	3
--	Brainboard, Analog, 4/16 Channel	Opto 22 B2	
--	DC Input Module, 2.5-28 VDC	Opto 22 IDC5D	11
--	DC Output Module, 5-60 VDC	Opto 22 ODC5	3
--	AC Output Module, 12-140 VAC	Opto 22 OAC5	28
--	Analog Output Module, 0 to +5 VDC	Opto 22 DA4	3
--	Analog Output Module, 0 to +10 VDC	Opto 22 DA5	
	Analog Input Module, 0 to +5 VDC	Opto 22 AD6	4
	Analog Input Module, 0 to +10 VDC	Opto 22 AD7	
	Thermocouple Input Module, Type J	Opto 22 AD5T	

TITLE	Process I/O Assembly
DWG. NO.	MK II-240
CHG. LTR.	A
SHEET	1 of 1

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
F1	Fuse, 250 VAC, 15 A	Bussman FRN-R 15	
XF1	Fuseholder	Marathon F30A1S	
K1	Contactor, 120/230 VAC, 3 Phase, 120 VAC Coil	Furnas	
	MK II-0 (1000 Watts) MK II-1 (2000 Watts)	21BF32AFE 21BF32AFE	
	MK II-1.5 (3000 Watts) MK II-2 (5000 Watts)	21BF32AFE 21BF32AFE	
	MK II-3 (5000 Watts) MK II-3 Custom (10000 Watts)	21BF32AFE 21QF32AFE	
K2-K3	Relay Solid State, 240 VAC, 25 A, 3-32 VDC Control	Opto 22 240D25	
	Capacitance Manometer, 10 Torr	Tylan General CMLB-11	
MS1	Motor Starter, 120/230 VAC, 3 Phase, 120 VAC Coil	Furnas	
	MK II-0 (30 CFM @ 1.5 HP) MK II-1 (50 CFM @ 2.0 HP)	21BF32AFE 21CF32AFE	
	MK II-1.5 (50 CFM @ 2.0 HP) MK II-2 (80 CFM @ 3.0 HP)	21CF32AFE 21CF32AFE	
	MK II-3 (100 CFM @ 5.0 HP) MK II-3 Custom (150 CFM @ 7.5 HP)	21DF32AFE 21QF32AFE	
XMS1	Overload Relay	Furnas	
	MK II-0 (30 CFM @ 1.5 HP) (6.0-9.0A) MK II-1 (50 CFM @ 2.0 HP) (8.5-12.5A)	48AH090 48AH125	
	MK II-1.5 (50 CFM @ 2.0 HP) (8.5-12.5A) MK II-2 (80 CFM @ 3.0 HP) (16.0-23.0A)	48AH909 48AH230	
	MK II-3 (100 CFM @ 5.0 HP) (16.0-23.0A) MK II-3 Custom (150 CFM @ 7.5 HP)	48AH230 48AH320	
MS2	Motor Starter, 120/230 VAC, 3 Phase, 120 VAC Coil	Furnas	
	MK II-0 (245 CFM @ 2.0 HP) MK II-1 (245 CFM @ 2.0 HP)	21CF32AFE 21CF32AFE	
	MK II-1.5 (245 CFM @ 2.0 HP) MK II-2 (400 CFM @ 2.0 HP)	21CF32AFE 21CF32AFE	
	MK II-3 (400 CFM @ 2.0 HP) MK II-3 Custom (612 CFM @ 3.0 HP)	21CF32AFE 21CF32AFE	

TITLE	Vacuum & Temperature Control Module
DWG. NO.	MK II-250
CHG. LTR.	A
SHEET	1 of 4

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
	MK II-3 Custom (1300 CFM @ 7.5 HP) MK II-3 Custom (2000 CFM @ 7.5 HP)	21QF32AFE 21QF32AFE	
XMS2	Overload Relay	Furnas	
	MK II-0 (245 CFM @ 2.0 HP) (12.0-17.0A) MK II-1 (245 CFM @ 2.0 HP) (12.0-17.0A)	48AH170 48AH170	
	MK II-1.5 (245 CFM @ 2.0 HP) (12-17A) MK II-2 (400 CFM @ 2.0 HP) (12.0-17.0A)	48AH170 48AH170	
	MK II-3 (400 CFM @ 2.0 HP) (12.0-17.0A) MK II-3 Custom (612 CFM @ 3.0 HP)	48AH170 48AH230	
	(16.0-23.0A) MK II-3 Custom (1300 CFM @ 7.5 HP)	48AH320	
	(23.0-32.0A) MK II-3 Custom (2000 CFM @ 7.5 HP)	48AH320	
	(24-32 A)		
MS3	Motor Starter, 120/230 VAC, 3 Phase, 120 VAC Coil	Furnas 21CF32AFE	
XMS3	Overload Relay (12.0-17.0A)	Furnas 48AH170	
MS4	Motor Starter, 120/230 VAC, 3 Phase, 120 VAC Coil	Furnas 21BF32AFE	
XMS4	Overload Relay (4.0-6.0A)	Furnas 48AH060	
MS5	Motor Starter, 120/230 VAC, 3 Phase, 120 VAC Coil	Furnas 21CF32AFE	
XMS5	Overload Relay (8.5-12.5 A) (208 VAC, 50 HZ Chiller Only)	Furnas 48AH125	
XMS5	Overload Relay (12.0-17.0A) (120 VAC, 60 HZ Chiller Only)	Furnas 48AH170	
MS6	Motor Starter, 120/230 VAC, 3 Phase, 120 VAC Coil	Furnas 21BF32AFE	
XMS6	Overload Relay (4.0-6.0 A)	Furnas 48AH060	
R1	Thermocouple, Type J	Wilcon Industries .250"-J-316-U-4½" X ½"	
S1	Vacuum Switch, 20.3-762 MM HG	Barksdale Controls D1H-H18	
S2	Temperature Switch, 50-450°F	Barksdale Controls L1C-H45	

TITLE	Vacuum & Temperature Control Module
DWG. NO.	MK II-250
CHG. LTR.	A
SHEET	2 of 4

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
S3	Temperature Switch, -100 to +700°F (Optional)	Mc Master Carr Supply 7079K18	
TB1	Terminal Block	Cinch Jones 8-141	
XTB1	Marker Strip, Terminal Block	Cinch Jones MS-8-141	
TB2	Terminal Block	Cinch Jones 14-142	
XTB2	Marker Strip, Terminal Block	Cinch Jones MS-14-142	
TB3	Terminal Block	Cinch Jones 4-151	
XTB3	Marker Strip, Terminal Block	Cinch Jones MS-4-151	
V1	Solenoid Valve, N.O., 1/4" NPT, Brass	ASCO 8262G265, 120 VAC, 60 Hz	
V2	Angle Valve, 3" Aluminum	Industrial Vacuum Engineering 3-AOP	
	Angle Valve, 6" Aluminium (Custom Application)	Industrial Vacuum Engineering 6-AOP	
XV2	O-Ring, 3" Angle Valve	Parker 2-339 (Teflon)	
	O-Ring, 6" Angle Valve (Custom Application)	Parker 2-361 (Teflon)	
--	Vacuum Pump Assembly, Oxygen Service	Stokes	
	MK II-0 (245/30 CFM)	900-146-572	
	MK II-1 (245/50 CFM)	900-148-572	
	MK II-1.5 (245/50 CFM)	900-148-572	
	MK II-2 (400/80 CFM)	900-149-582	
	MK II-3 (400/100 CFM)	900-149-582 (With Drive Pulley Ratio Change)	
	MK II-3 Custom (612/150 CFM)	900-170-536	
	MK II-3 Custom (1300/150 CFM)	900-170-561	

TITLE	Vacuum & Temperature Control Module
DWG. NO.	MK II-250
CHG. LTR.	A
SHEET	3 of 4

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
	MK II-3 Custom (2000/150 CFM)	900-170-561 (With Drive Pulley Ratio Change)	
--	Oil Filtration System	Plasma Etch	
--	Oil Filter Cartridge, Oil Filtration System, 3 Micron	Schroeder Type K3	
--	Hose Assembly, Oil Filtration System	Imperial Eastman Y9HU10-12NJ-12NJ-48" W/848FS12-08 (2 each)	
--	Pump, Heated Oil, 230 VAC, 3 Phase, ½ HP, 50/60 Hz Mechanical Seal W/Viton Lip Seal	Viking SG-40514-A001-M	
--	Heater, Heated Oil, 240 VAC, 3 Phase, 4.5 KW, 50/60 Hz	Caloritech EXF-11749-01	
--	Reservoir, Heated Oil, 1 GAL., ½" NPT	Oil-Rite B-966-17	
--	Metal Bellows Expansion Joint, 3" Dia., S/S	Unaflex Rubber Style S-1-142	
--	Metal Bellows Expansion Joint, 6" Dia., S/S (Custom Application)	Unaflex Rubber	
--	Water Miser Valve (Used With 612/150 CFM, 1300/150 & 2000/150 CFM)	Stokes 900-412-124	
--	Heat Exchanger, Liquid/Liquid (Custom Application)	ITT Standard Model SX2000, P/N S-230-03-014-005	

TITLE	Vacuum & Temperature Control Module
DWG. NO.	MK II-250
CHG. LTR.	A
SHEET	4 of 4

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
S1	Switch, Momentary, SPST	Grayhill 39-101	
V1	Solenoid Valve, N.C., 3/4" NPT, Brass	ASCO 8210G95, 120 VAC, 60 Hz	
	Muffler, Vacuum, 3/4" NPT	Mc Master Carr Supply 9850K75	
	O-Ring, Vacuum Chamber Door	Plasma Etch	
	MK II-0 MK II-1	Reference "System Config" Section System Manual	
	MK II-1.5 MK II-2	Reference "System Config" Section System Manual	
	MK II-3	Reference "System Config" Section System Manual	
	Viewport, Pyrex Glass	Mc Master Carr Supply	
	MK II-0 (5" Dia. X 3/8" Thk.) MK II-1 (5" Dia. X 3/8" Thk.)	8477K45 8477K45	
	MK II-1.5 (5" Dia. X 3/8" Thk.) MK II-2 (5" Dia. X 3/8" Thk.)	8477K45 8477K45	
	MK II-3 (8 3/8" Dia. X 3/4" Thk.)	8475K15	

TITLE	Vacuum Chamber Assembly
DWG. NO.	MK II-260
CHG. LTR.	A
SHEET	1 of 1

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
PS1	R.F. Generator	Henry Electronics	
	MK II-0 (1000 W @ 13.56 MHz) MK II-1 (2000 W @ 13.56 MHz)	1000D 2000D	
	MK II-1.5 (3000 W @ 13.56 MHz) MK II-2 (5000 W @ 13.56 MHz)	3000D 5000D	
	MK II-3 (5000 W @ 13.56 MHz) MK II-3 Custom (10000 W @ 13.56 MHz)	5000D 10000D	
MN1	Matching Network	R.F. Power Products	
	MK II-0 (1000 W @ 13.56 MHz) MK II-1 (2000 W @ 13.56 MHz)	AM-10PE AM-20PE	
	MK II-1.5 (3000 W @ 13.56 MHz) MK II-2 (5000 W @ 13.56 MHz)	AM-30PE AM-50PE	
	MK II-3 (5000 W @ 13.56 MHz) MK II-3 Custom (10000 W @ 13.56 MHz)	AM-50PE AM-100PE	

TITLE	R.F. Generator Assembly
DWG. NO.	MK II-270
CHG. LTR.	
SHEET	1 of 1

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
M1-M2	Fan, 500 CFM, 10" Dia.	Rotron CL2T2	2
XM1-XM2	Finger Guard, 10" Dia.	Rotron 476323	2
--	Extension Tube, 4"	Lintern XVA-CO2	
--	Flange, Metal	Lintern XVA-C11	
--	Base Unit	Lintern XVA-C21	
--	Green Lens, Constant	Lintern XVA-C33	
--	Red Lens, Constant	Lintern XVA-C34	
--	Bulb, 110 VAC, 7 Watts	Lintern DL1-BL110	2

TITLE	Cabinet Assembly
DWG. NO.	MK II 280
CHG. LTR.	
SHEET	Sheet 1 of 1

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
--	Computer, PC, 1.2 GB Hard Drive, 8 MB RAM, 1.44 MB Floppy Drive	Mitsuba MITPEN133MT	
--	Color Monitor, 14" (VGA)	Hyundai MHN-4848F	
--	RS422/485 Adapter Card	Opto 22 AC24AT	
--	Dot Matrix Printer, 9 Pin	Epson 317307	

TITLE	Computer Control System
DWG. NO.	MK II-290
CHG. LTR.	
SHEET	1 of 1

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
M1	Vacuum Controller	Tylan General AC-2	
XM1	Throttle Valve, 3"	Tylan General MDVX-030	
XM1	Cable, Throttle Valve	Tylan General 0-2C	
XM1	Cable, Power	Tylan General 57-005	
XM1	Throttle Valve, 6" (Custom Application)	Tylan General MDVX-060	

TITLE	Vacuum Controller
DWG. NO.	MK II-300
CHG. LTR.	
SHEET	1 of 1

BILL OF MATERIAL

REF. SYMBOL	DESCRIPTION	MANUFACTURER & PART NUMBER	QTY.
FM1-FM2	Flow Meter, 0.5 to 6.0 SLPM, Alum.	Matheson Instruments J1-1B101-J802	2
MFC1-MFC2	Reference Dwg. No. MK II-230		
S4-S7	Reference Dwg. No. MK II-230		
S8	Reference Dwg. No. MK II-230		
V1-V18	Reference Dwg. No. MK II-230		
--	Check Valve, 1/4" NPT	ASCO V0121	15

TITLE	Gas, Water & Oil Distribution Diagram
DWG. NO.	MK II-310
CHG. LTR.	
SHEET	1 of 1

FACILITIES REQUIREMENTS & SYSTEM INSTALLATION

Note: Please direct all questions regarding facilities installation to:

Plasma Etch
3522 Arrowhead Drive
Carson City, NV 89706
Phone: (702) 883-1336
Fax: (702) 883-2559
E-Mail: ddelarge@aol.com

Reference Figure I for System/Facilities Layout. Facilities are identified as follows:

1. AC Service
2. Compressed Air Source
3. Water Source & Drain
4. Gas Sources
5. Vacuum Exhaust Plumbing

Please make preliminary installations only, which includes items 2 through 4 terminated at the wall locations indicated. It is recommended that final connection to the system of items 2 through 4 be made with the assistance of Plasma Etch personnel at the time of final system installation.

It is recommended that facilities items 1 and 5 be fully installed prior to final system installation.

All system interconnection wiring, oil line plumbing and vacuum plumbing will be made with the assistance of Plasma Etch personnel at the time of final system installation. This procedure will greatly facilitate final system installation and system startup.

NOTICE:

Prior to scheduling final installation, please certify that preliminary installation has been completed by filling out the attached "Facilities Installation Check List" and faxing it to Plasma Etch.

The relative locations of items 1 through 4 are flexible. Item 5 (vacuum exhaust) location is fixed relative to the final vacuum pump location. All facilities elevations should be approximately four feet from the floor. Any significant deviation from referenced

facilities locations should be reviewed with Plasma Etch prior to commencing preliminary installation.

Note: The vacuum pump assembly must be securely anchored to the floor using the four mounting holes provided. For details on vacuum pump mounting, reference the vacuum pump manual. It is recommenced that vacuum pump anchoring be completed prior to scheduling final system installation.

Referenced system clearances (rear and sides) are recommended to meet electrical code requirements and to facilitate system maintenance. Plasma console cabinet sides (left and right) are hinged service access doors (magnetically latched).

Facility requirements are as follows (reference Figure I):

1. AC Service - 120/208 VAC, 3 Phase, 60/50 HZ, 5 Wire

Model MK II-0	-	35 A Service (20 A Full Load)
Model MK II-1	-	40 A Service (25 A Full Load)
Model MK II-1.5	-	45 A Service (30 A Full Load)
Model MK II-2	-	50 A Service (35 A Full Load)
Model MK II-3	-	50 A Service (35 A Full Load)
Model MK II-3 (Custom)	-	60 A Service (50 A Full Load) (612/150 CFM Vacuum Pump
Model MK II-3 (Custom)	-	70 A Service (60 A Full Load) (1300/150 CFM Vacuum Pump

Install a fused service disconnect (**fused per the above Service requirement**) at location. The system must be fused per the above referenced service requirement, as a current surge is created when the vacuum pump blower turns on and comes up to running speed.

Route the AC source to the one inch conduit opening on the bottom of the system electrical enclosure (NEMA Enclosure). Make electrical connections per the following:

250TB3-1 to Phase A
250TB3-2 to Phase B
250TB3-3 to Phase C
250TB3-4 to AC Neutral
Earth Ground to stud located above 250TB3

2. Compressed Air Source

Air pressure should be 80-125 PSIG, regulated and filtered. Higher pressure (100-125 PSIG) is recommended. Air consumption is minimal, as it is used only to periodically cycle the vacuum blank off valve.

Note: The system vacuum blank off valve receives lubrication from oil in the compressed air source. Use of oil-free compressed air or a nitrogen source will cause premature failure of the blank off valve seals. If the use of oil-free compressed air or nitrogen cannot be avoided, install an automatic oiler at the output of the air pressure regulator.

Air lines to be 1/4" OD X .040" wall thickness, black (UV inhibited) polyethylene tubing ***(user supplied).***

Final compressed air installation (connection from source to the system) will be made at the time of final system installation with the assistance of Plasma Etch personnel.

3. Water Source & Drain

The tap water source temperature should be approximately 70°F to 85°F and maintain a differential pressure across the source and drain of 30-60 PSIG. If severe pressure fluctuations are present the pressure must be regulated. Water usage is restricted to approximately 1/3 GPM by the system. The water source must be free of particulates.

If a facility closed loop water system is used that is shared with other machinery, care must be taken that the recommended pressure differential is maintained across the system inlet and outlet water ports at all time. Transient differential pressure fluctuations will be sensed by the system as a water flow fault. Typical of this type of water flow fault is a momentary pressurization in the water drain line or a momentary decrease in pressure in the water source.

WARNING:

The use of high conductivity water must be avoided. High conductivity will cause electrolytic action in the system plumbing and result in permanent damage to the system.

Water temperature of less than 65°F must be avoided. Low water temperature will cause potentially damaging condensation within high voltage areas of the system.

Do not use deionized water.

To eliminate the potentially damaging effects of high conductivity water and/or low water temperature, it is recommended that a closed loop cooling system be utilized.This is best accomplished by installing a recirculating chiller. The recirculator should be

charged with tap water and approximately one quart of laboratory grade ethylene glycol (antifreeze). Please contact Plasma Etch for recommendations on a source for the recirculating chiller.

Please direct all questions regarding water compatibility with the system to Plasma Etch.

Water lines to be 3/8" OD X .062" wall thickness, black (UV inhibited) polyethylene tubing ***(user supplied)***.

Source and drain water fittings ***(user supplied)*** to be compatible with 3/8" OD polyethylene tubing.

Final water installation (connection from source and drain to the system) should be made at the time of final system installation with the assistance of Plasma Etch personnel.

4. Gas Sources

Required Gases (desmear/etchback process only):

a. Tetrafluoromethane (CF_4) Grade Semiconductor (99.95% Purity Container Cylinder Size 44 (70 lb. by weight)
b. Oxygen (O_2) Grade Extra Dry (99.6% Purity) Container Cylinder Size 49 (377 SCF by volume)
c. Nitrogen (N_2) Grade Prepurified (99.998% Purity) Container Liquid Nitrogen Bulk Storage Liquid Nitrogen, Dewar (3936 SCF) Nitrogen Gas, Cylinder Size 49 (304 SCF by volume)

Note: Nitrogen consumption rate (8 l/min.) justifies the purchase of nitrogen in larger volume containers. The most economical source of nitrogen is in the liquid state (LN2). Alternately nitrogen may be purchased in the gaseous state, packaged in six packs (six cylinders manifolded and mounted on a cart).

The use of higher purity gases than those indicated are not recommended. They provide no process benefits and will significantly increase processing costs.

All gas cylinders to be equipped with two stage brass regulators (***user supplied***), with a low pressure range of 0-30 PSIG (15 PSIG midrange). ***Single stage regulators are not acceptable for this application.***

A correct fitting (CGA number) must be specified with each regulator. Fitting numbers are dictated by the gas type (i.e.; CF_4, oxygen, nitrogen, etc.) being ordered. Contact the gas supplier for correct CGA fitting numbers.

Gas lines to be 1/4" OD X .040" wall thickness, black (UV inhibited) polyethylene tubing (***user supplied)***.

Regulator output fittings ***(user supplied)*** must be compatible with 1/4" OD polyethylene tubing.

Final gas installation should be made at the time of final system installation with the assistance of Plasma Etch personnel.

5. Vacuum Exhaust Layout (reference Figure II)

The layout shown is the installation for exhausting the system directly to atmosphere. The vacuum system may be vented directly to atmosphere for many plasma processes. For certain plasma processes the use of a exhaust fume scrubber is recommended. Please contact Plasma Etch for specific recommendations on exhaust venting.

If a fume scrubber is used, reference the same layout but provide an air gap and butterfly damper in the vertical exhaust run (reference Figure II insert). Do not plumb the vacuum exhaust directly to the fume scrubber. Hard plumbing of the vacuum exhaust to the fume scrubber will result in excessive vacuum pump oil consumption.

Correct vacuum exhaust layout is critical to optimum system performance. The vertical exhaust piping is sized up from one and one quarter inch to three inch diameter to limit conductance losses. Any modification to the recommended exhaust layout should be reviewed with Plasma Etch prior to installation.

Peak vacuum flow rates are as noted (these are transient conditions that occur only at the time of pumpdown from atmospheric pressure):

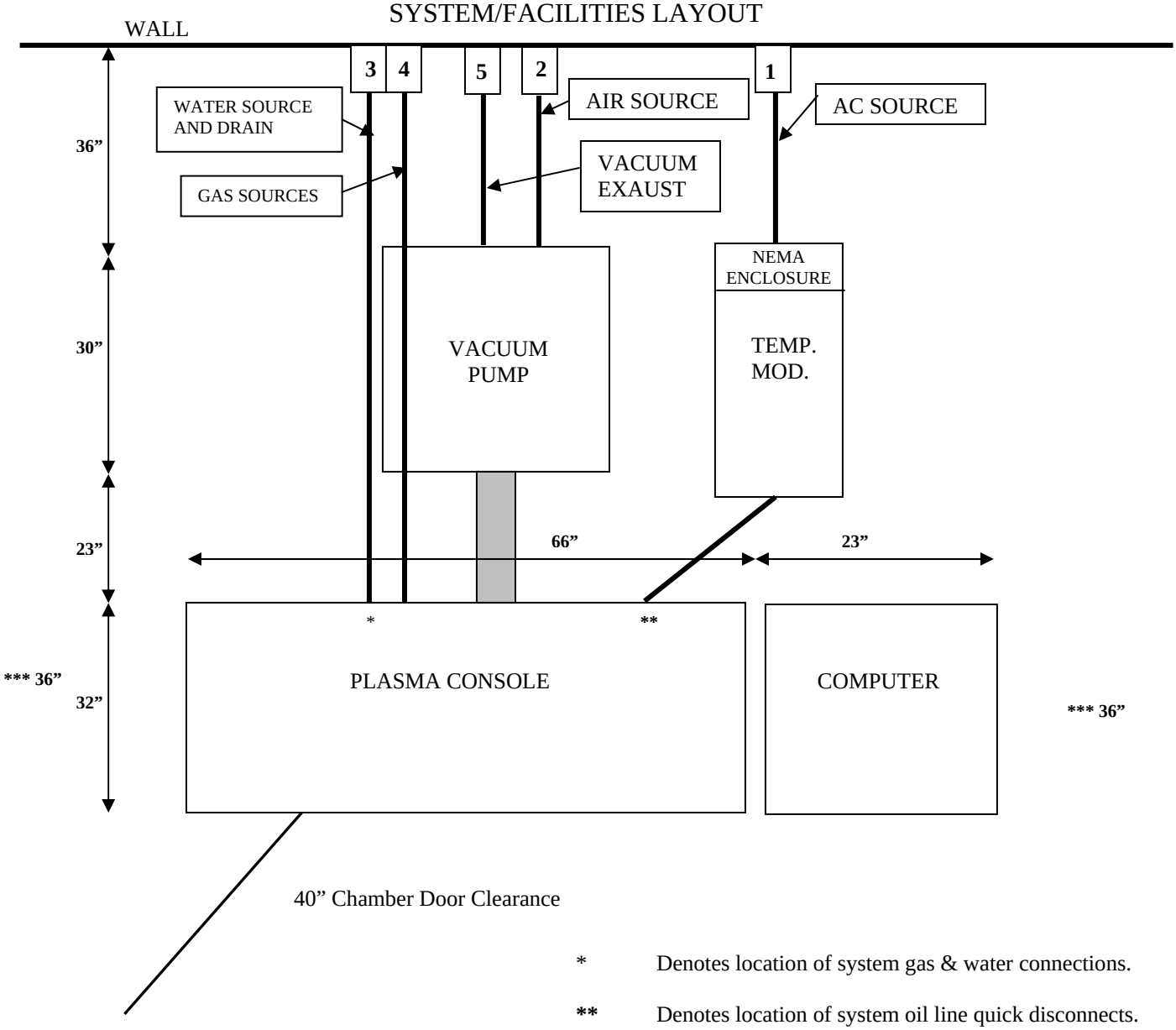
Model MK II-0	-	30 CFM
Model MK II-1	-	50 CFM
Model MK II-1.5	-	50 CFM
Model MK II-2	-	80 CFM
Model MK II-3	-	100 CFM
Model MK II-3 (Custom)	-	150 CFM (612/150 CFM & 1300 CFM Vacuum Pumps)

6. System Environment

The system and in particular the R.F. generator, requires sufficient heat dissipation to ensure maximum service life. To ensure maximum service life from the system, it is recommended that the plasma room temperature not exceed 80°F. The ideal room environment for the system is a controlled environment, such as the provided in the drill area.

To decrease building air conditioning heat load it is recommended that the heat generated by the system be ducted out of the room. This can be accomplished by ducting the two fan openings (10" diameter) located at the top of the plasma console.

FIGURE I
SYSTEM/FACILITIES LAYOUT



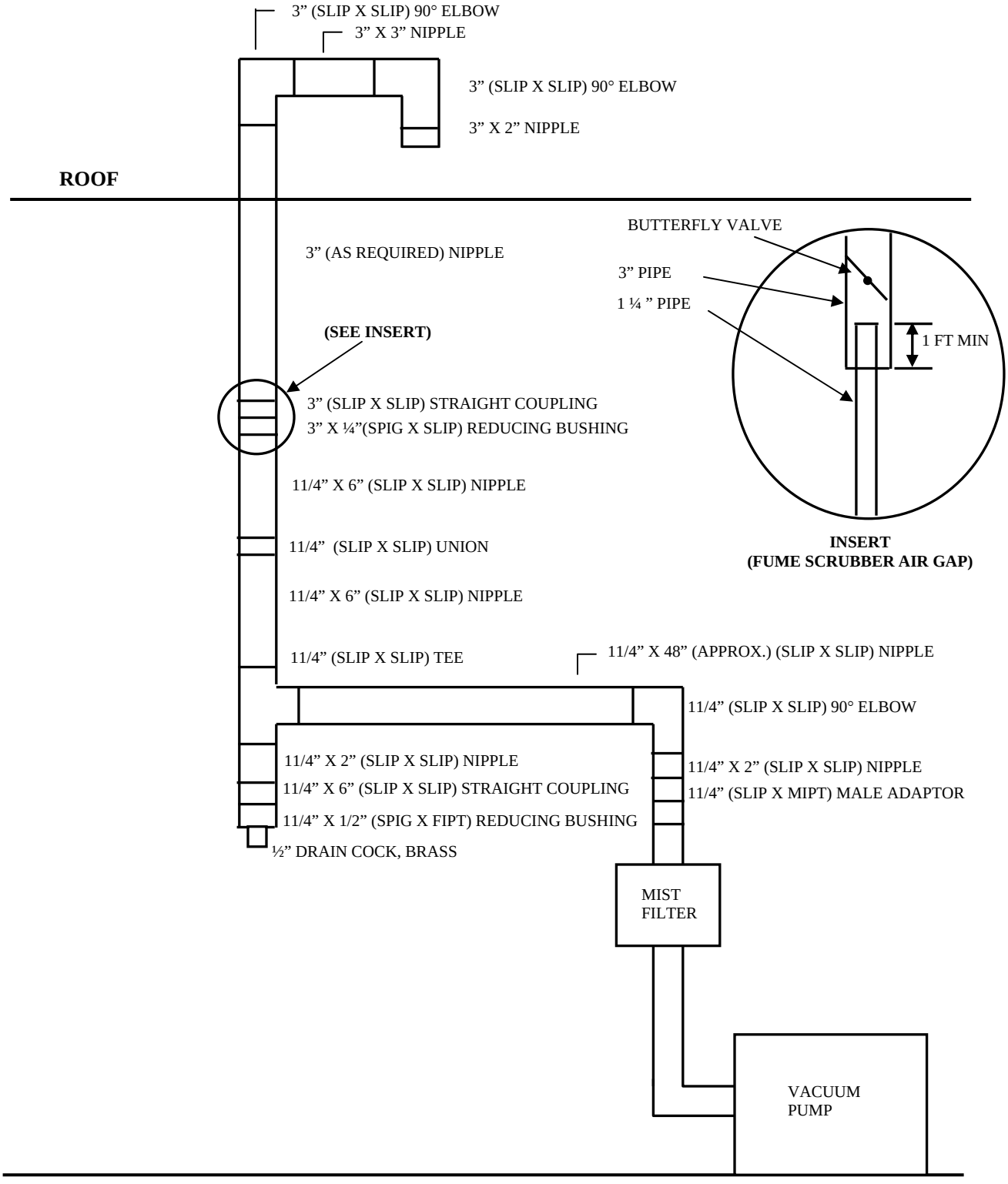
* Denotes location of system gas & water connections.

****** Denotes location of system oil line quick disconnects.

*** Recommended system side clearances (both sides).

System Height:	79” (Plasma Console)
	84” (Oil Reservoir)
System Weight:	3600 lb. Max.
Floor Space	14’W X 14’D

FIGURE II
VACUUM EXHAUST LAYOUT



NOTE: ALL EXHAUST PLUMBING TO BE PVC SCHEDULE 40.

Note ***The horizontal run from the vacuum pump to the vertical run must be sloped slightly downward toward the vacuum pump, allow condensed oil vapors to run back into the vacuum pump.***

The sizing up of the vertical exhaust plumbing from one and one quarter inches to three inches is required to reduce vacuum conductance loses.

The vertical exhaust run should be as direct and short as possible ***(no horizontal runs if possible).*** If a horizontal run cannot be avoided, it is recommended that two 45° vertical offsets be used.

The roof downspout is mandatory. Care must be taken that rainwater cannot enter at the exhaust outlet.

FACILITIES INSTALLATION CHECK LIST

Please certify that all preliminary facility installations have been performed prior to scheduling final installation and training. Please check all appropriate boxes, sign, date and fax to Plasma Etch.

- ❑ AC Service

  Type - 120/208 VAC, 3 Phase, 60 HZ, 5 Wire

Fused Service	Model MK II-0	35 A
	Model MK II-1	40 A
	Model MK II-1.5	45 A
	Model MK II-2	50 A
	Model MK II-3	50 A
	Model MK II-3 (Custom)	60 A (612/150 CFM Vacuum Pump)
	Model MK II-3 (Custom)	70 A (1300/150 CFM Vacuum Pump)

  Connections - 250TB3-1 to Phase A
  250TB3-2 to Phase B
  250TB3-3 to Phase C
  250TB3-4 to AC Neutral
  Earth Ground to stud located above 250TB3

- ❑ Compressed Air Source

  Type 80-125 PSIG, regulated and filtered

  Connections - Terminated near system, with 1/4" fitting, compatible with polyethylene tubing

  Materials Required For Final Installation - 1/4" OD X .040" polyethylene tubing, black

- ❑ Water Source and Drain

  Type Tap water, 70°F to 85°F, 30-60 PSIG

  Connections - Terminated near system, with 3/8" fittings, compatible with polyethylene tubing

  Materials Required For Final Installation - 3/8" OD X .062" polyethylene tubing, black

- Gas Sources (desmear/etchback process only)

  Type Tetrafluoromethane (CF_4), as specified
  Oxygen (O_2), as specified
  Nitrogen (N_2), as specified

  Equipment - Two stage gas regulators as specified for each of the referenced source gases

  Connections - Terminated near system, with 1/4" fittings, compatible with polyethylene tubing

  Materials Required For Final Installation - 1/4" OD X .040" polyethylene tubing, black

- Vacuum Exhaust Layout

  Connections - Per specification and Figure II

- System Environment

  Per specification

Certified By: _____

Date: _____