DENTON VACUUM
DISCOVERY® COATING SYSTEM
OPERATING MANUAL

DISCOVERY® COATING SYSTEM: Scale Sputter System

UNIVERSITY OF UTAH –

SYSTEM SERIAL NO. 69469

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SCOPE

Note: To schedule a service call please contact Denton.

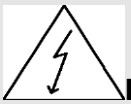
The system offers you a range of thin film process options. However, it is important to note that with all of this system's potential, safety considerations exist. Individuals who are to operate, service, or maintain this system should familiarize themselves with this manual.

If this equipment is used in a manner not specified by Denton Vacuum, the protection provided by the equipment may be impaired.

A complete understanding of this control system is recommended before operating the vacuum system.

This document contains the calibration procedures, available process, default configuration and software capabilities.

SAFETY WARNINGS

 **Lethal voltages, high temperatures, high pressures and powerful mechanical drive mechanisms are present throughout the system.**

 **Every attempt has been made to safeguard operating and maintenance personnel. Interlocking of subsystems provides a high degree of operator safety.**

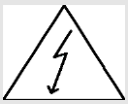
System/software interlocks should never be defeated unless servicing of the system requires temporary interlock overrides. Hardwired safety interlocks must never be defeated.

 **Operating and maintenance manuals have been provided and should be thoroughly understood before any operations are contemplated.**

Only personnel with proper training and process experience should operate the system. If the equipment is used in a manner not specified by the manufacturers, the protections provided by the equipment may be impaired.

It is the owner's responsibility to comply with local environmental and safety regulations. Requirements for exhaust treatment (if required), spill treatment and containment vary from region to region. It is the owners' responsibility to comply with all local government regulations, building codes, and safety requirements.

SAFETY SYMBOLS

 **CAUTION: Risk of Electrical Shock**

 **CAUTION: This symbol is intended to alert the user to the presence of important operation & maintenance instructions in this manual.**

 **Protective Conductor Terminal: this symbol indicates where the protective earth ground is connected.**

ENVIRONMENTAL CONDITIONS

The system is designed and intended for use in the following environmental conditions. If all specifications are not met, system components may malfunction and can possibly cause injuries.

- Altitude up to 2000m
- Temperature range from 5 to 40 C
- Maximum relative humidity 80% for temperature up to 31C decreasing linearity to 50% relative humidity at 40C
- Mains supply voltage fluctuations not to exceed +/-10% of the nominal voltage
- Other supply voltage fluctuations as stated by the manufacturer
- Pollution degree 2 in accordance with IEC 664

CALIBRATION PROCEDURES

FULL RANGE VACUUM GAUGE (INFICON BPG400)

(See vender manual for more details.)

6.1 Maintenance

DANGER

Caution: contaminated parts

Contaminated parts can be detrimental to health and environment.

Before beginning to work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

6.1.1 Cleaning the Gauge

Small deposits on the electrode system can be removed by baking the anode (Degas → 🖹 29). In the case of severe contamination, the baffle can be exchanged easily (→ 🖹 17). The sensor itself cannot be cleaned and needs to be replaced in case of severe contamination (→ 🖹 51).

A slightly damp cloth normally suffices for cleaning the outside of the unit. Do not use any aggressive or scouring cleaning agents.

Make sure that no liquid can penetrate the product. Allow the product to dry thoroughly before putting it into operation again.

Gauge failures due to contamination are not covered by the warranty.

6.2 Adjusting the Gauge

The gauge is factory-calibrated. Through the use in different climatic conditions, fitting positions, aging or contamination (→ 🖹 29) and after exchanging the sensor (→ 🖹 51) a shifting of the characteristic curve can occur and readjustment can become necessary. Only the Pirani part can be adjusted.

6.2.1 Adjustment at Atmospheric Pressure

At the push of a button the digital value and thus the analog output are adjusted electronically to 10 V at atmospheric pressure.

Adjustment is necessary if

- at atmospheric pressure, the output signal is <10 V
- the display reads < atmospheric pressure (if the gauge has a display)
- at atmosphere, the digital value of the RS232C interface is < atmospheric pressure
- at atmosphere, the digital value received by the bus controller of the fieldbus gauges (DeviceNet, Profibus or RS485) is < atmospheric pressure
- when the vacuum system is vented, the output voltage reaches 10 V (limited to 10 V by the software) before the measured pressure has reached atmosphere (gauges with display will show the error "5" at atmospheric pressure (Pirani sensor warning → 🖹 30))
- when the vacuum system is vented, the digital value of the RS232C interface reaches its maximum before the measured pressure has reached atmosphere
- when the vacuum system is vented, the digital value received by the bus controller of the fieldbus (DeviceNet, Profibus or RS485) reaches its maximum before the measured pressure has reached atmosphere.

Required tools

- Pin approx. ø1.3 X 50 mm (e.g. a bent open paper clip)

Procedure

Gauges BPG400-SD, -SP and -SR are mechanically slightly different from the BPG400. The adjustment opening of BPG400-SD, -SP and -SR is on one side of the gauge housing. However, the adjustment procedure is the same for all gauge versions.

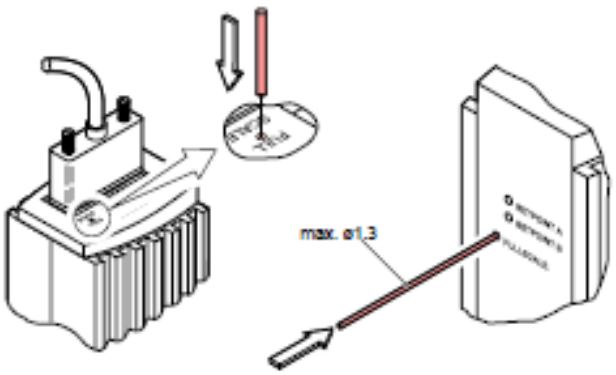
❶ Operate gauge for approx. 10 minutes at atmospheric pressure.

⚠ If the gauge was operated before in the BA range, a cooling-down time of approx. 30 minutes is to be expected (gauge temperature = ambient temperature).

❷ Insert the pin through the opening marked <FULL SCALE> and push the button inside for at least 5 s.

BPG400

BPG400-SD
BPG400-SP
BPG400-SR



Gauges with display will show the reading "1000 mbar" and the function "A" when the button has been pushed for 4 s. Upon completion of the adjustment, the function indication "A" disappears.

⌛ The gauge is automatically adjusted (≈10 s).

✓ The gauge is now adjusted at atmospheric pressure.

6.2.2 Zero Point Adjustment

A zero point adjustment is recommended

- after the sensor has been exchanged
- if display shows "FAIL 5" (→ 🕮 30)
- as part of the usual maintenance work for quality assurance

Required tools

- Pin approx. ø1.3 x 50 mm (e.g. a bent open paper clip)

Procedure

The push button <FULL SCALE> is also used for the zero point adjustment (→ illustration in "Adjustment at Atmospheric Pressure").

❶ Operate gauge for approx. 10 minutes at a pressure of ≤1x10^{-4} mbar.

❷ Insert the pin through the opening marked <FULL SCALE> and push the button inside for at least 2 s.

The adjustment is done automatically and ends after 2 minutes.

✓ The zero point of the gauge is now adjusted.

6.3 What to Do in Case of Problems

In the event of a fault or a complete failure of the output signal, the gauge can easily be checked.

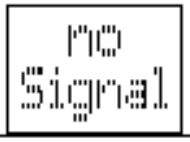
Required tools / material

- Voltmeter / ohmmeter
- Allen key, size 2.5 mm
- Spare sensor (if the sensor is faulty)

Troubleshooting (BPG400)

The output signal is available at the sensor cable connector (Pin 2 and Pin 12).

In case of an error, it may be helpful to just turn off the mains supply and turn it on again after 5 s.

Problem	Possible cause	Correction
Output signal permanently ≈0V	Sensor cable defective or not correctly connected	Check the sensor cable
	No supply voltage	Turn on the power supply
	Gauge in an undefined status	Turn the gauge off and on again (reset)
Output signal ≈0.3 V (Display: error = 8)	Hot cathode error (sensor faulty)	Replace the sensor (→ 51)
Output signal ≈0.5 V (Display: error = 9)	Pirani error (sensor defective)	Replace the sensor (→ 51)
Output signal ≈0.5 V	Electronics unit not mounted correctly on sensor	Check the connection
Display: 	Internal data connection not working	Turn the gauge off and on again after 5 s Replace the electronics unit
Gauge does not switch over to BA at low pressures	Pirani zero point out of tolerance	Carry out a zero point adjustment (→ 48)

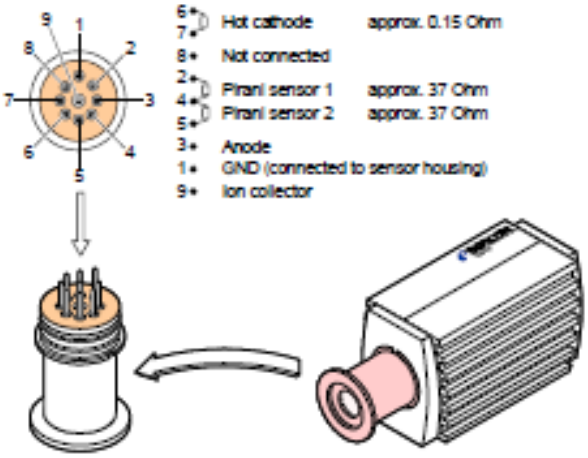
Troubleshooting (sensor)

If the cause of a fault is suspected to be in the sensor, the following checks can be made with an ohmmeter (the vacuum system need not be vented for this purpose).

Separate the sensor from the electronics unit (→ 🗎 14). Using an ohmmeter, make the following measurements on the contact pins.

Ohmmeter measurement between pins	👍	👎	Possible cause
2 + 4	≈37 Ω	>>37 Ω	Pirani element 1 broken
4 + 5	≈37 Ω	>>37 Ω	Pirani element 2 broken
6 + 7	≈0.15 Ω	>>0.15 Ω	Filament of hot cathode broken
4 + 1	∞	<<∞	Electrode - short circuit to ground
6 + 1	∞	<<∞	Electrode - short circuit to ground
3 + 1	∞	<<∞	Electrode - short circuit to ground
9 + 1	∞	<<∞	Electrode - short circuit to ground
6 + 3	∞	<<∞	Short circuit between electrodes
9 + 3	∞	<<∞	Short circuit between electrodes

View on sensor pins



Correction

All of the above faults can only be remedied by replacing the sensor (→ 🗎 51).

Troubleshooting on Fieldbus Gauges (BPG400-SD, -SP, -SR)

Error diagnosis of fieldbus gauges can only be performed as described above for the basic sensor and sensor electronics. Diagnosis of the fieldbus interface can only be done via the superset bus controller (→ 🕮 [1], [2] or 🗎 37).

For diagnosis of the BPG400-SD (DeviceNet) gauges, the status lights might produce some useful information (→ 🗎 35).

6.4 Replacing the Sensor

Replacement is necessary, when

- the sensor is severely contaminated
- the sensor is mechanically deformed
- the sensor is faulty, e.g. filament of hot cathode broken (→ 🖹 49)
- the sensor is faulty, e.g. Pirani element broken (→ 🖹 49)

Required tools / material

- Allen key, size 2.5 mm
- Spare sensor (→ 🖹 52)

Procedure

❶ Deinstall the gauge (→ 🖹 46).

❷ Deinstall the electronics unit from the faulty sensor and mount it to the new sensor (→ 🖹 14).

❸ Adjust the gauge (→ 🖹 47).

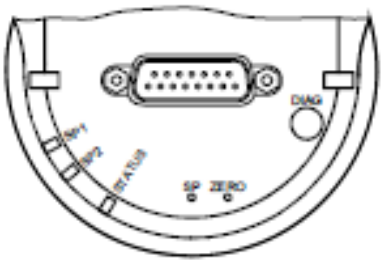
✓ The new sensor is now installed.

CAPACITANCE MANOMETER INFICON (INFICON CDG045)

(See vender manual for more details.)

A warm-up time of at least ½ hour should be allowed; for precise pressure measurements a warm-up time of at least 2 hours is required.

4.1 Displays



LED	State	Meaning
<STATUS>	dark	No supply voltage
	lit green	Measurement mode
	flashing green	Warming up, warning
	lit red	Error
<SP1>	lit green	p ≤ setpoint 1
	flashing green	Waiting for setpoint 1 input
	dark	p > setpoint 1
<SP2>	lit green	p ≤ setpoint 2
	flashing green	Waiting for setpoint 2 input
	dark	p > setpoint 2

4.2 Zeroing the Gauge

The gauge is factory calibrated while "standing upright" (→ "Calibration Test Report").

When the gauge is operated for the first time, a zero adjustment should be performed.

Due to long time operation or contamination, a zero drift could occur and zero adjustment may become necessary.

For adjusting the zero, operate the gauge under the same ambient conditions and in the same mounting orientation as normally.

The signal difference between the vertical and horizontal mounting orientation is:

F.S.	ΔU / 90°
1000 Torr/mbar	2 mV
100 Torr/mbar	10 mV
10 Torr/mbar	50 mV
1 Torr/mbar	300 mV

☞ If the gauge is operated via a controller, the zero of the whole measuring system has to be adjusted on the controller: first, adjust the zero of the gauge and then, the zero of the controller.

INFICON

4.2.1 <ZERO> Adjustment

The zero can be adjusted via

- the <ZERO> button on the gauge,
- the diagnostic port (→ 🕮 [6]),
- the digital input "Remote Zero" (briefly apply the supply voltage (+14 … +30 V) to pin 10),
- the RS232C interface (→ 🕮 [3]),
- an INFICON Vacuum Gauge Controller (VGC series).

While the gauge is being heated and/or under atmospheric pressure, the zeroing function is locked in order for operating errors to be prevented.

❶ Evacuate the gauge to a pressure according to the table below:

F.S.	Recommended final pressure for zero adjustment		
1100 mbar	–	<6.65×10^{0} Pa	<5×10^{-2} mbar
1000 Torr/mbar	<5×10^{-2} Torr	<6.65×10^{0} Pa	<5×10^{-2} mbar
500 Torr/mbar	<2.5×10^{-2} Torr	<3.33×10^{0} Pa	<2.5×10^{-2} mbar
200 Torr/mbar	<10^{-2} Torr	<1.33×10^{0} Pa	<10^{-2} mbar
100 Torr/mbar	<5×10^{-3} Torr	<6.65×10^{-1} Pa	<5×10^{-3} mbar
50 Torr/mbar	<2.5×10^{-3} Torr	<3.33×10^{-1} Pa	<2.5×10^{-3} mbar
20 Torr/mbar	<10^{-3} Torr	<1.33×10^{-1} Pa	<10^{-3} mbar
10 Torr/mbar	<5×10^{-4} Torr	<6.65×10^{-2} Pa	<5×10^{-4} mbar
5 Torr/mbar	<2.5×10^{-4} Torr	<3.33×10^{-2} Pa	<2.5×10^{-4} mbar
2 Torr/mbar	<10^{-4} Torr	<1.33×10^{-2} Pa	<10^{-4} mbar
1 Torr/mbar	<5×10^{-5} Torr	<6.65×10^{-3} Pa	<5×10^{-5} mbar
0.5 Torr/mbar	<2.5×10^{-5} Torr	<3.33×10^{-3} Pa	<2.5×10^{-5} mbar
0.25 Torr/mbar	<10^{-5} Torr	<1.33×10^{-3} Pa	<10^{-5} mbar
0.1 Torr/mbar	<5×10^{-6} Torr	<6.65×10^{-4} Pa	<5×10^{-6} mbar

If the final pressure is too high for zero adjustment (>50% of the F.S.), the zero cannot be reached and the <STATUS> LED flashes green. If this is the case, activate the factory setting and adjust the zero again (→ 🗎 29).

DEFAULT CONFIGURATION

MAGNETRON CONFOLCAL DEFAULT SETUP

Magnetron	Target	S-S Distance (in)	Angle (º)
#1	3" Al	4.25	31.2
#2	3" Ti	4.25	31.2
#3	4" Al	4.25	31.2
#4	4" Ti	4.125	31.2

PROCESS GAS DEFAULT SETUP

Gas #	**Gas Name**	**Correction Factor**	**MFC Full Scale (SCCM)**
1	Ar	1.39	100
2	Ar	1.39	100
3	N2	1.00	51
4	O2	0.99	51

PUMP DOWN DEFAULT CROSSOVER

Main process chamber	150 mTorr
Loadlock (factory setting)	100 mTorr

SPUTTER TARGET DEFAULT SETUP (AT FACTORY)

Cathode #1	Aluminum
Cathode #2	Titanium
Cathode #3	Aluminum

Cathode #4	Titanium

HEAT PID DEFAULT SETUP

Function	Range	Back-side
Proportional	0-32000	6000
Derivative	0-32000	0
Integral	0-32000	350
Upper Clamp	0-32000	8000
Lower Clamp	0-32000	0

Parameters are shown as raw digital values for the PLC temperature controller.

VENTING TEMPERATURE DEFAULT SETUP

Location	Default (ºC)	Range (ºC)
Main Chamber	75	50 - 100
Loadlock	75	50 - 100

TRANSFER TEMPERATURE DEFAULT SETUP

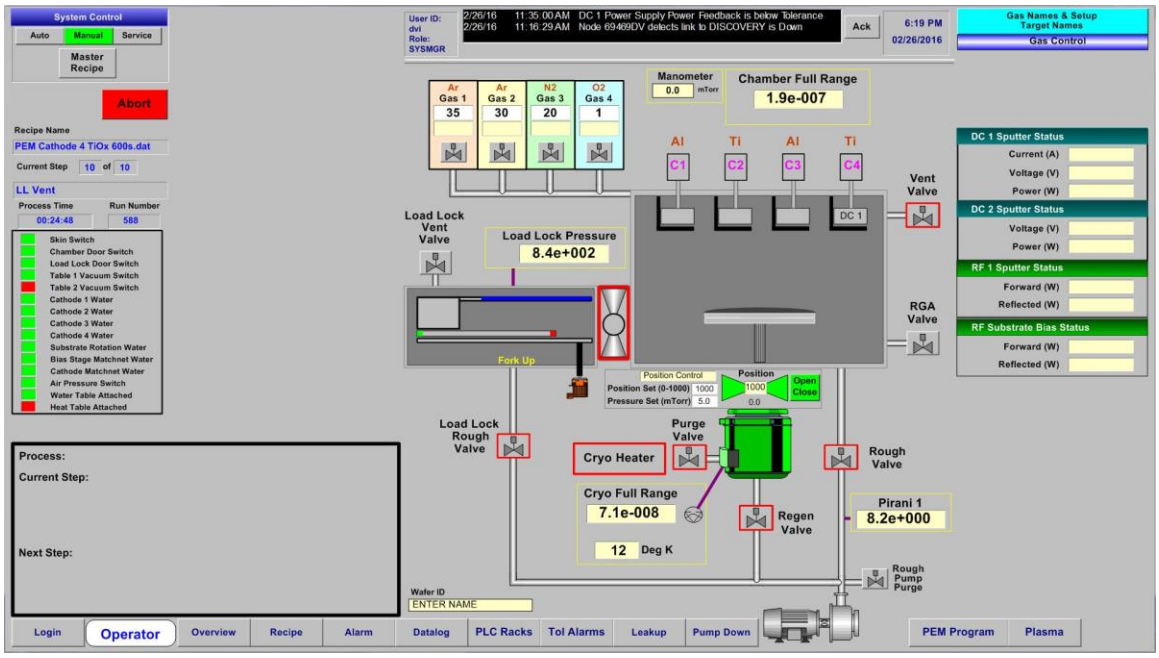
Location	Default (ºC)	Range (ºC)
Main Chamber/Loadlock	75	50 - 100

HIGH VACUUM VALVE PID DEFAULT SETUP

Sensor Number:	1
Voltage Range:	0 – 10 VDC
Display Range:	0 – 100 Torr.
Display Unit:	mTorr
Gain Factor:	0.1
Sensor Type:	Torr
Zero Adjust:	Enable

SOFTWARE CAPABILITIES

SOFTWARE OVERVIEW



The control system for the vacuum system is GE Cimplicity® HMI (Human Machine Interface). Cimplicity® runs on a Windows operating system. This should make the interface between operator and machine familiar and easy to learn.

This software links the operator to the PLC. It allows for data input and data display. Operators can use a mouse to select on-screen graphics by clicking on any active element on a screen. Data is input by pushing on-screen buttons or using the keyboard.

Security is implemented through the Login Panel. Multiple levels of security are available to control access to critical information. The System Administrator has complete access to the entire control system. The System Operator can access everything except the heat PID settings, Service Mode and the Configuration Screens in the Recipe Builder. System Security is described in detail in the System Security section of this manual.

This software is active when power is applied to the system.

Graphic display of the control system is arranged on seven screens:

- Login
- Operator
- Overview
- Recipe
- Alarm
- Datalog

- PLC Racks
- Tolerance Alarms
- Leak Up
- Pump Down
- PEM Program
- Plasma

Login is the first active screen when the system powered up. All users can log in and out from this screen and access to the other screens through the buttons at the bottom of the screen. Access to the Login software (Change Password and assign user) is through this screen too, see more details in the Security section of this manual.

Operator screen provides all the necessary push buttons and instant operating parameters on one screen for daily auto (batch) process.

Overview is the primary operating screen. All current system data is displayed on this screen. The operator can access all subsystems through this screen. The Auto, Manual, and Service Modes are selected on this screen. Automatic sequences are Started, Stopped and Reset on this screen. This screen is described in detail in this section of the manual.

Recipe screens are used to develop, store, and download recipes for automated processes. Recipe screens are fully described in the Recipe Builder section of this manual.

Alarm screen is used to display, acknowledge, and clear system alarms. Alarm View is fully described in the Alarm section of this manual.

Datalog provides access to the Datalog files of the operating system; event log and event log all. Those features are described in the Datalog section of this manual.

PLC Racks is a screen that displays the live status of the inputs to and outputs from the PLC. This screen is fully described in the PLC Racks section of this manual.

Tolerance Alarms is a screen that displays the adjustable alarm settings for all of the adjustable alarm setpoints. This screen is fully described in the Alarms section of this manual.

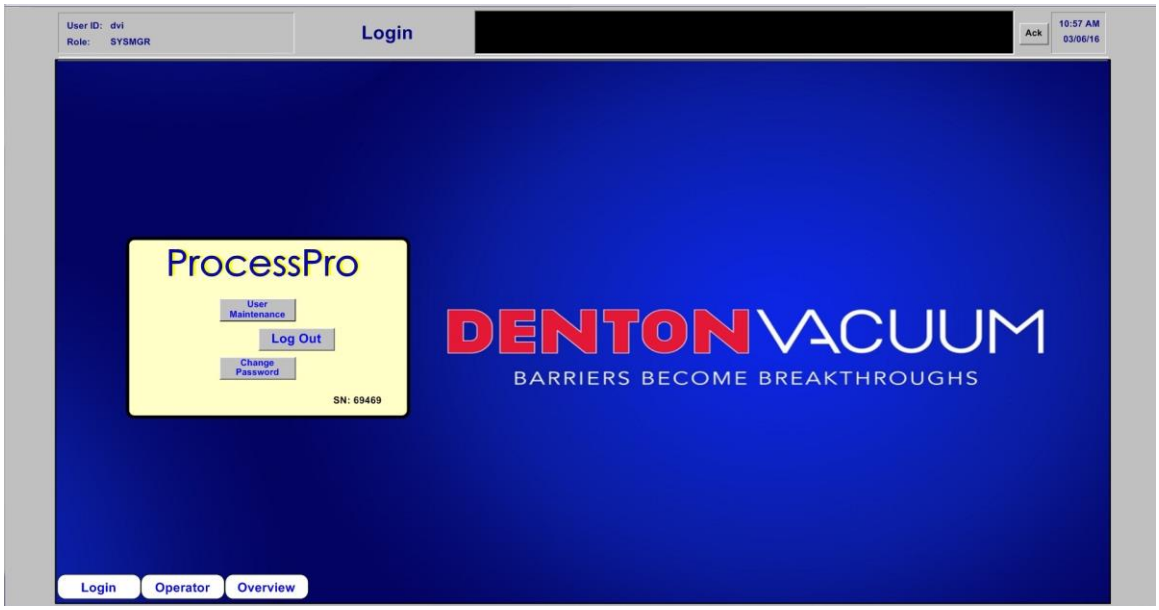
Leak Up - To access to the leak up data log file.

Pump Down - To access to the pump down data log file.

PEM Program - To access to the PEM Program.

Plasma - To access to the Plasma Control Screen.

LOGIN SCREEN



The Login Panel is used to Log In and Log Out of the system. The Login Panel is accessible when the system starts up or by clicking on the Login button at the bottom left of the screen.

LOGIN TO SYSTEM

To Log In,

Click the Log In box at the left center of the screen.	
Enter User Name.	
Enter Password.	
The upper right corner will indicate who is logged (User ID) on and what the user role is.	

SYSTEM SECURITY

GE Cimplicity® HMI software functions as the interface between the person operating the equipment and the machine. One component of this control system is a Login Panel. The Login Panel controls access to the overall system. The person operating the vacuum system can login to the software on any of five levels:

- System Manager (SYSMGR)
- Engineer
- Maintenance
- User
- Operator (Oper)

The table below outlines the level of access for each User Role.

USER ROLE	SYSTEM CONTROL			RECIPE CONFIGURATION EDITING				
	AUTO	MANUAL	SERVICE	RECIPE DOWNLOAD	MASTER RECIPE	AUTO PUMP	AUTO HEAT	AUTO DEPOSITION
SYSMGR	YES	YES	YES	YES	YES	YES	YES	YES
ENGINEER	YES	YES	NO	YES	YES	YES	YES	YES
MAINTENANCE	YES	YES	YES	YES	NO	NO	NO	NO
USER	YES	YES	NO	YES	NO	NO	NO	NO
OPER	YES	NO	NO	YES	NO	NO	NO	NO

ASSIGNING USERS AND ROLES

To change or add a User, (only a SYSMGR has access to do this) perform the following:

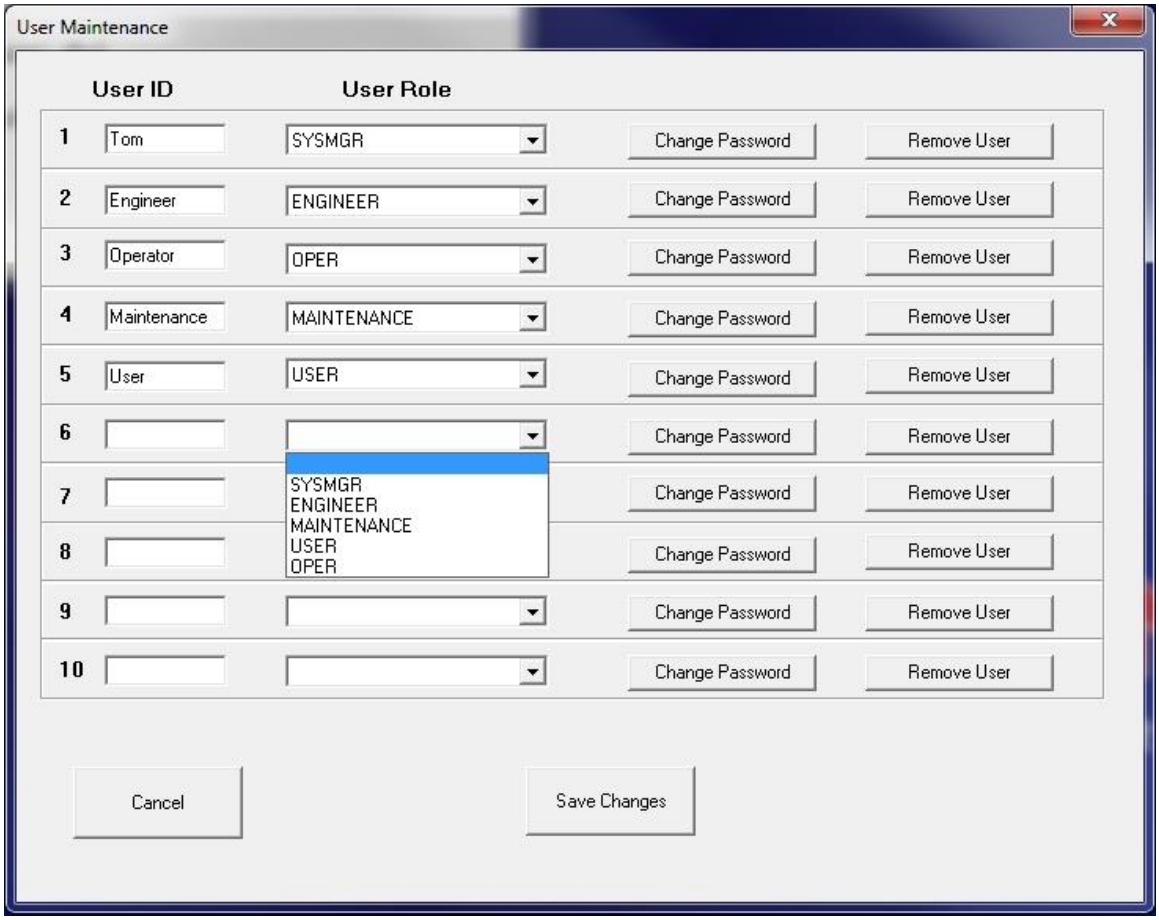
Login at the Login screen.

In the upper left corner, check that the User has SYSMGR role.

From the Login screen click on User Maintenance.

The following User Maintenance screen will appear.

Click on the **User Maintenance** button to access the following screen:



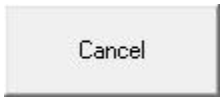
The current Users and their User Role will be displayed in the User Maintenance screen.

To add a new User, type in a User ID on the next available line. There is a maximum of 10 Users allowed. User role and/or password can also be changed from here.

From the drop down screen under User Role, select the appropriate user designation from the five choices. (See table in previous section for User Role screen access).

Click on Change Password box and enter a password. Re-enter the password when prompted.

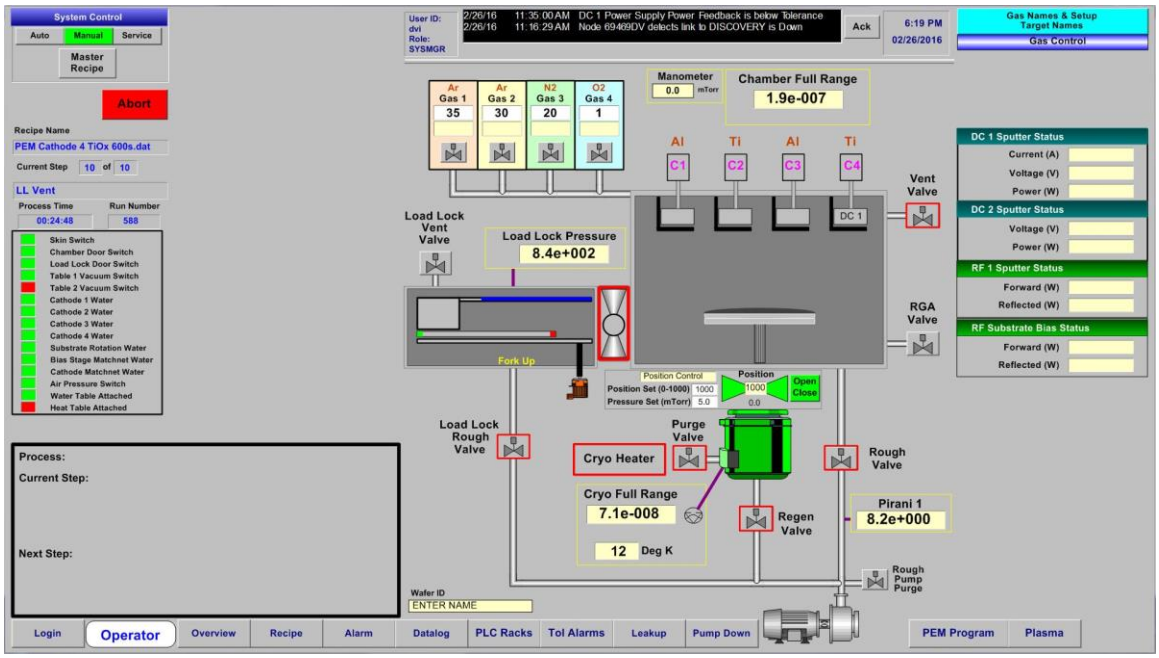
Click on Save Changes box at the bottom of the screen.



Click on Cancel box at bottom of screen to exit.

Close the User Maintenance box.

OVERVIEW SCREEN



The Overview screen is used to display current system data and provide manual control of subsystems. An understanding of this screen is required to proceed with the operation of the vacuum system. The system data and security access level are displayed across the top and down the left side of the screen. The current state of the vacuum chamber and the pumping system are graphically displayed in the center of the screen. Subsystem control boxes are accessible on the right side of the screen. Push buttons across the bottom are used to switch to Login, Operator, Overview, Recipe, Alarms, Datalog, PLC Racks, Tolerance Alarms, Leak Up, Pump Down, PEM Program and Plasma screens.

Pushbuttons change color to indicate the state of the switch. Valves, pumps, and interlocks change color to indicate current state. Graphic indicators are displayed on the vacuum system graphic when sputter sources, heater, mass flow controllers or bias table are active.

All operations are familiar Windows operations. All graphics that are accessible to the operator will display a white "lasso" when the cursor is near the graphic. The valves, pumps, timers, and individual control boxes are activated by a single click on the mouse. Data is input into a data box by clicking on the data box, typing in the data, and pressing the ENTER key.

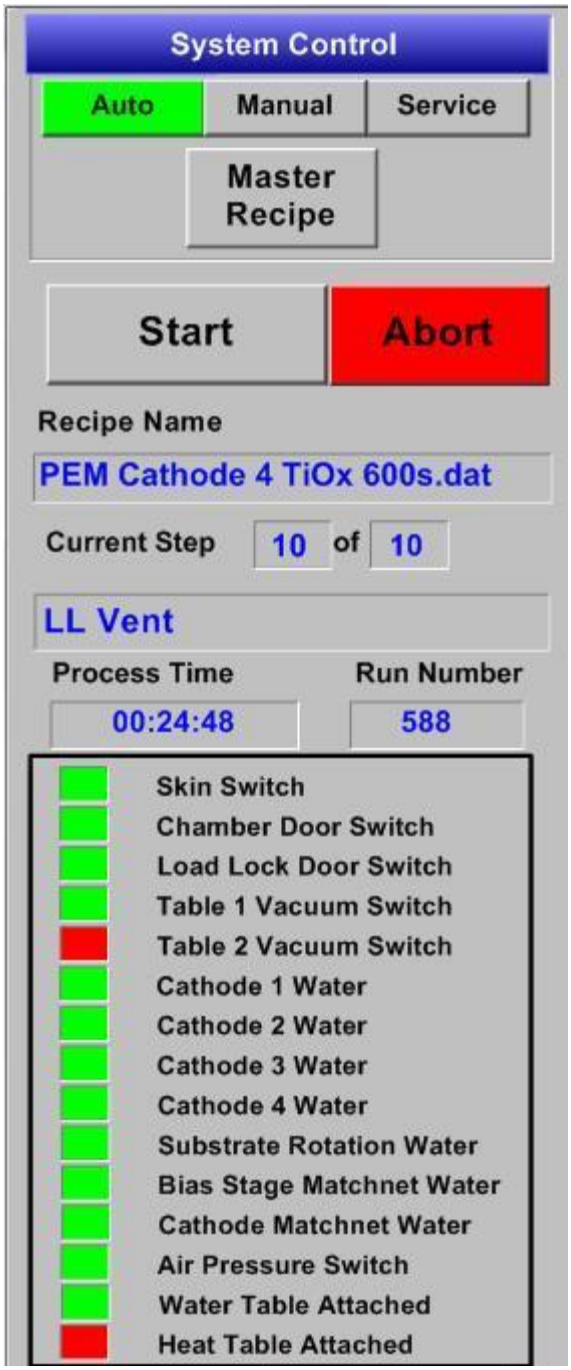
TOP OVERVIEW BAR

This section of the Overview screen displays current security data (User ID and Role), time of day and date. The User ID and Role are factory set in the control system software. The current Login name and role are displayed here. The time and date can be adjusted in the Windows Control Panel.

Alarm messages appear in this area. The ACK button can be used to acknowledge an active alarm.

Please note that the ACK button will silence an active audible alarm, but the audible alarm will reactivate in 60 seconds if the alarm condition is not corrected.

LEFT OVERVIEW SCREEN



The left side of the Overview screen is used for System Control nad Interlocks.

Three pushbuttons at the top select the mode of operation: Auto, Manual, & Service. The current mode is indicated in green.

Master Recipe – To access the Master Recipe Builder screen to select and download the recipe for a desired auto process.

Start Button – Starts the active recipe.

Abort Button – Stops the active recipe.

Recipe Name - The currently running Recipe Name is displayed here, as well as the active Sequence Running, Current Step, Run Number, Process Time and buttons to Start or Abort the recipe sequence.

Current Step - # of active recipe step and total # of recipe steps.

Sequence Running - Name of active recipe step.

Process Time - Total process time from Start button until end of last recipe step. Resets at next Start button.

Run Number - a sequential number applied to the Datalog file for identification. The run number can be reset in service mode.

Wafer and Operator ID – Operator input to these text blocks provide tracking information into the datalog files for each automatic process.

Step Timer – Display of a countdown timer (visible only when active) during an automatic process.

Start Button – Starts the active recipe.

Wafer ID – Operator input to these text blocks provide tracking information into the datalog files for each automatic process. The entry box is located in the center of the overview screen under the loadlock rough valve.

INTERLOCKS

To the left of each item in the interlock listing is a rectangle that is either Green or Red, indicating whether that particular interlock is met or not met, respectively.

Sputter guns and bias will not operate if any interlock is open. These are hardwired interlocks.

Interlock status is displayed in this area of the Overview screen. Green = Satisfied; Red = Open

AUTO MODE

Auto mode is used to run automatic recipes. The Start, Stop, and Reset buttons are active in this Mode. The current Recipe Running, Current Step, Sequence Running, and Total Process Time will advance as the automatic recipe is running.

The Run Number is incremented every time the 

button is pressed. This feature can be customized to match customer run numbering. Contact Denton Vacuum for more information.

The 

button starts the Recipe that is displayed. The 

button stops the automatic process immediately and resets the recipe back to the beginning and resets the Total Process Time.

All buttons change to green when active or ON.

Note: Access to all other on-screen controls is denied in the Auto mode. This interlock is built in to avoid manual operation of a subsystem in the Auto Mode.

AUTO MODE PROCESS DATA

0	Step Time (sec)	600
1	Rotation Velocity	50
2		
3	Vacuum Setpoint (Torr)	
4	Chamber Heat Setpoint	500
5	Heater Rate	50
6	Heater Cooling Rate	
7	Ignition Pressure	
8	VAT Throttle Control	YES
9	VAT Position Setpoint	
10	VAT Pressure Setpoint	5
11	Gas 1 - Setpoint (sccm)	35
12	Gas 2 - Setpoint (sccm)	
13	Gas 3 - Setpoint (sccm)	
14	Gas 4 - Setpoint (sccm)	
15	DC 1 Setpoint	600
16	DC 1 Cathode	3
17	DC 1 Shutter	Open
18		
19	DC 2 Setpoint	
20	DC 2 Cathode	
21	DC 2 Shutter	
22	RF 1 Setpoint	
23	RF 1 Cathode	
24	RF 1 Shutter	
25	Bias Setpoint	
26	Plasma Gas to Control	
27	Plasma Wavelength to Monitor	
28		
29	Plasma Setpoint	
30	Control Mode	Inverse
31	PID Proportional Gain	
32	PID Integral Rate	
33	End Process	

In Auto Mode, the programmed setpoints for each process step are displayed on the Overview screen. Each process step is programmed through the Recipe screen. Complete details on programming an Automatic deposition are contained in the Recipe section of this manual.

As each step becomes active, the active setpoints for the step will be displayed on the upper left corner of the Overview screen. This display id intended to provide information on the exact position of the automatic sequence.

The setpoint data is displayed to provide a comparison against the actual data displayed on the right side of the Overview screen.

AUTO VACUUM CONTROLS

Buttons are displayed on the Overview screen when the system is in the Auto Mode. These buttons can be used to start automatic vacuum operations. Each button will download a dedicated process recipe and start that recipe to safely operate the vacuum pumping components - pumps, valves, gauges – to pump out or vent the vacuum chambers.

MAIN CHAMBER AUTO PUMP

	▪ Click the "Auto Pump" button on overview screen in AUTO mode. The system will automatically pump the process chamber into high vacuum status. At the end of the auto pump down process, an "Auto Process End OK" warning will appear on the overview screen and alarm will sound five times. The process chamber now is under high vacuum.

LOADLOCK AUTO PUMP

	▪ Click the "LL Auto Pump" button on overview screen in AUTO mode. The system will automatically pump the loadlock into high vacuum status. At the end of the auto pump down process, an "Auto Process End OK" warning will appear on the overview screen and alarm will sound five times. The loadlock now is under high vacuum.

MAIN CHAMBER AUTO VENT

	▪ Click the "Auto Vent" button on the lower left corner of the overview screen in AUTO mode. The system will automatically vent the process chamber. At the end of the auto chamber vent process, an "Auto Process End OK" warning will appear on the overview screen and alarm will sound five times. The process chamber now is at atmosphere.

LOADLOCK AUTO VENT

	▪ Click the "LL Auto Vent" button on the lower left corner of the overview screen in AUTO mode. The system will automatically vent the Loadlock. At the end of the auto laodlock vent process, an "Auto Process End OK"warning will appear on the overview screen and alarm will sound five times. The Loadlock now is at atmosphere.

Note: The Auto Pump and Auto Vent processes are used to automatically evacuate or vent the chamber. All interlocks are active to safely operate the pumping system. The pumping system interlocks are NOT active in SERVICE Mode.

MANUAL MODE

The operator can safely run the system from the Overview screen in the Manual mode. All interlocks are active in Manual mode. Recipes are not active in Manual mode.

All on-screen control systems are available. Clicking on the graphic for that item can change the state of the valves, motors and fixture rotation. Clicking will change the state of simple on/off, open/closed devices or open control boxes for more sophisticated controls. Single-clicking activates all the Status & Control boxes on both sides of the screen. Pop-up boxes are displayed for operator input.

The Total Process Time will not advance and the Start and Stop buttons are inactive in Manual mode. The Abort button is inactive in the Manual mode.

SERVICE MODE

Service Mode is password protected. A pop-up entry screen will appear when Service Mode is selected. Enter the correct password to activate Service Mode.

Indicator will be visible on the Overview screen when Service Mode is active.

CAUTION: Software Interlocks are inactive in service mode. Caution must be taken to safely operate the vacuum system

NOTE: Service Mode is not accessible to System Operators. Service Mode is only accessible to System Administrator. See System Security for complete details

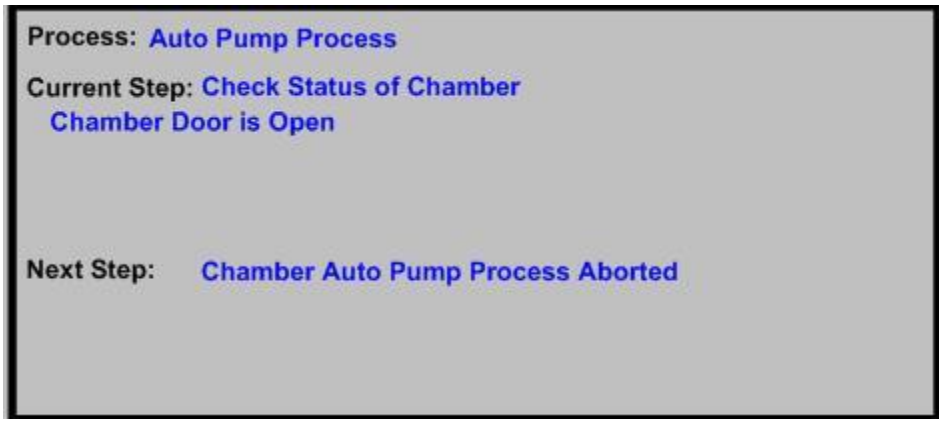
Use Service Mode for maintenance. Software interlocks are inactive in this mode. Hardwired interlocks are active in service mode. All control systems are active as in Manual mode.

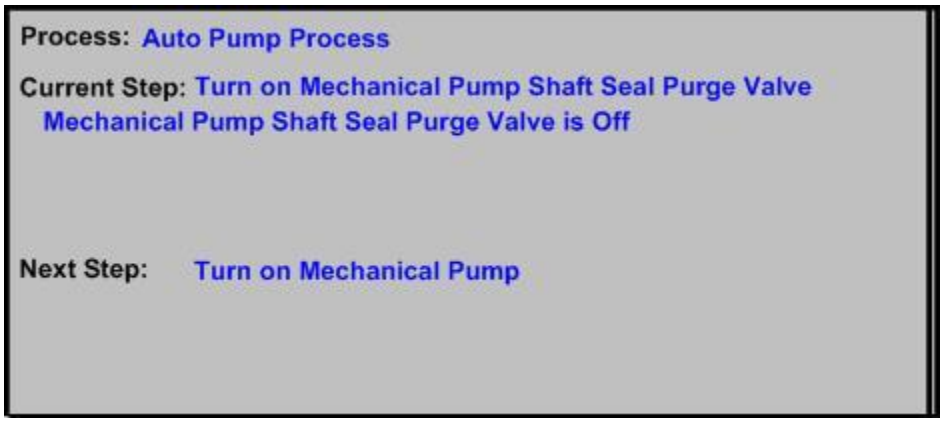
MESSAGE AREA

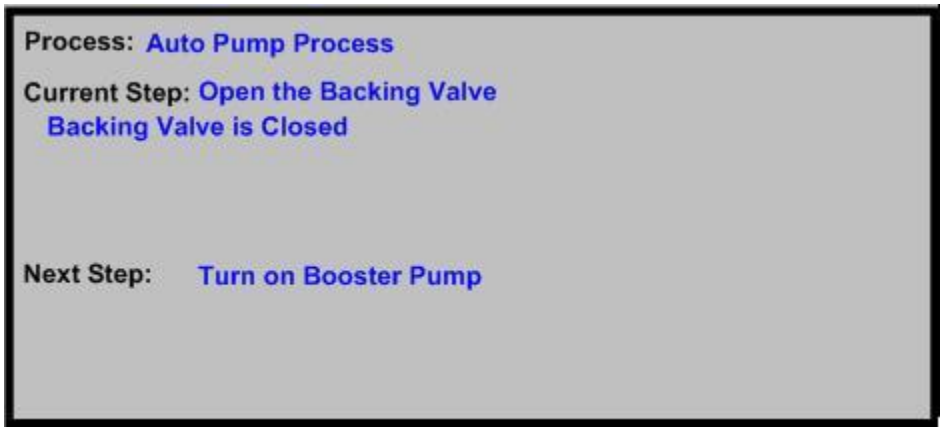
A text box will display on the Overview screen when:

- The system is in Manual Mode.
- The system is in Service Mode.
- An automatic process is running.

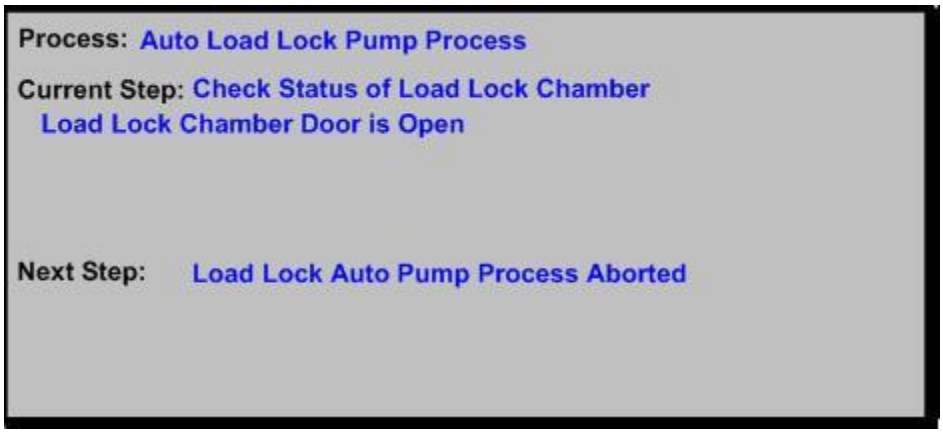
Various text messages will be visible in this box to provide information on the status of the system. Typical Messages displays are shown below. Custom messaging is available. For this reason, messages can vary between similar systems. The following screens are examples.

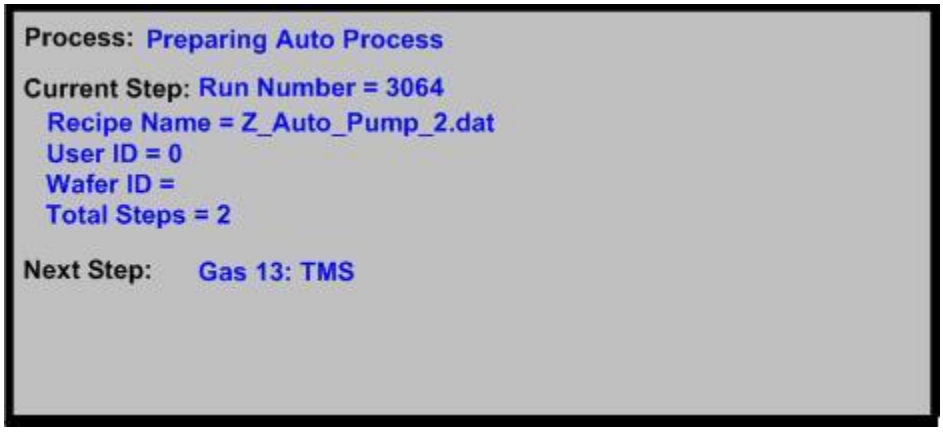

Process: Auto Pump Process
Current Step: Check Status of Chamber
Chamber Door is Open
Next Step: Chamber Auto Pump Process Aborted


Process: Auto Pump Process
Current Step: Turn on Mechanical Pump Shaft Seal Purge Valve
Mechanical Pump Shaft Seal Purge Valve is Off
Next Step: Turn on Mechanical Pump

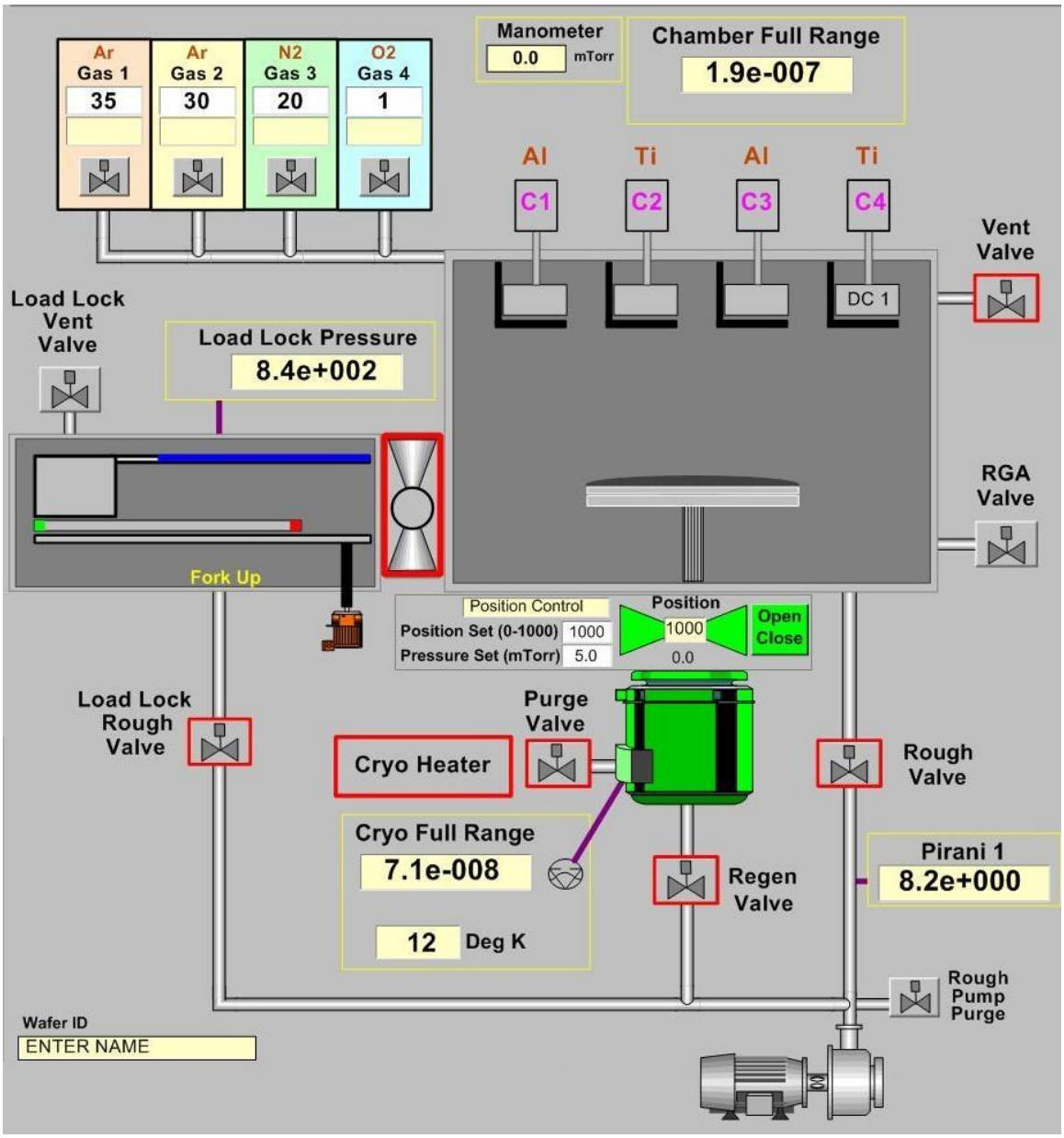

Process: Auto Pump Process
Current Step: Open the Backing Valve
Backing Valve is Closed
Next Step: Turn on Booster Pump


Process: Auto Pump Process
Current Step: Open the Backing Valve
Backing Valve is Open
Next Step: Open the High Vac Valve


Process: Auto Load Lock Pump Process
Current Step: Check Status of Load Lock Chamber
Load Lock Chamber Door is Open
Next Step: Load Lock Auto Pump Process Aborted


Process: Preparing Auto Process
Current Step: Run Number = 3064
Recipe Name = Z_Auto_Pump_2.dat
User ID = 0
Wafer ID =
Total Steps = 2
Next Step: Gas 13: TMS

CENTER OVERVIEW SCREEN



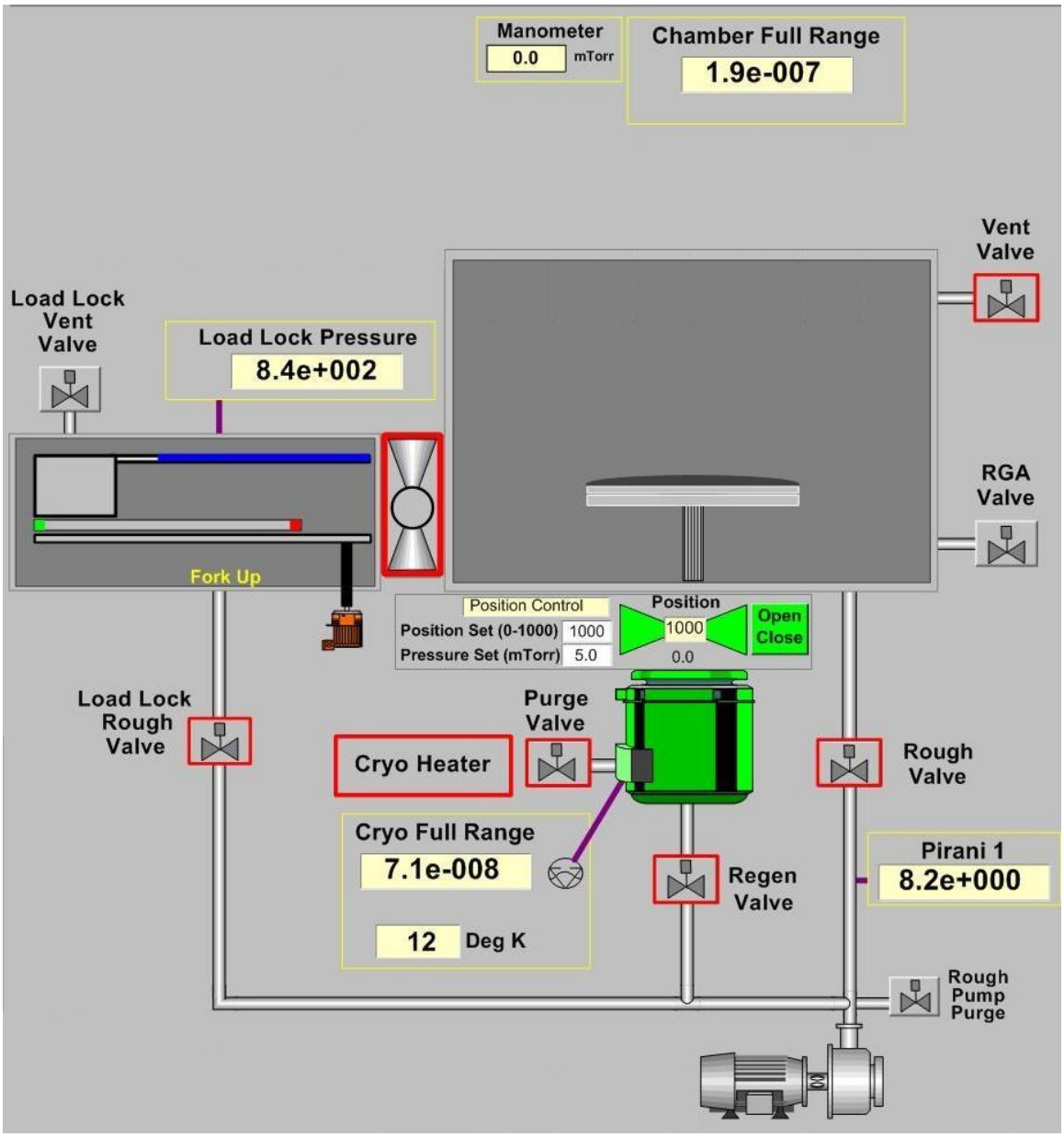
NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

A graphic representation of the Process Chamber, the Load Lock Chamber, substrate rotation, and pumping system is displayed on the center of the Overview screen. All components of the pumping system are accessible in Manual or Service modes. Single-click on a component to change the state (on/off, open/closed) of the component or Single-click on a component and a control box will pop-up for operator control input.

NOTE: Access to the manual controls is denied in Auto mode.

Vacuum chamber graphics are used to display the current condition of major subsystems. Components change from Off (**GREY)** to ON (**GREEN**). **YELLOW** is used to indicate a component that is between the open and closed state (not open or closed).

PUMPING SYSTEM

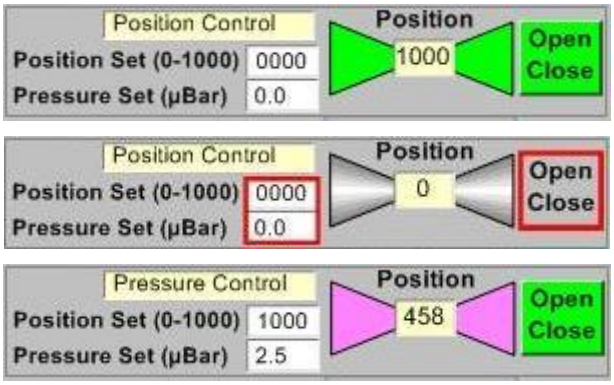


NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

NOTE: Access to the manual controls is denied in Auto mode.

Manual operation of the vacuum system is available from this area of the Overview screen. Pumps and Valves can be operated safely in Manual mode in accordance with the software interlocks. Vacuum pressure is displayed in real time at all times on the Overview screen.

HIGH VACCUM VALVE



The High Vacuum Valve on the Main Chamber can be operated in three modes: Open, Closed Position, Position Control and Pressure Control Mode.

Position Control Mode allows the operator to enter a position setpoint for the position of the sealing plate in the valve.

Pressure Control Mode is linked to the pressure feedback from the capacitance Manometer. The sealing plate of the valve will partially open or close in response to the pressure feedback from the capacitance manometer. See the operating instructions from the valve manufacturer for detailed instructions.

Enter a value into either data entry box and press Enter to activate Position or Pressure Mode.

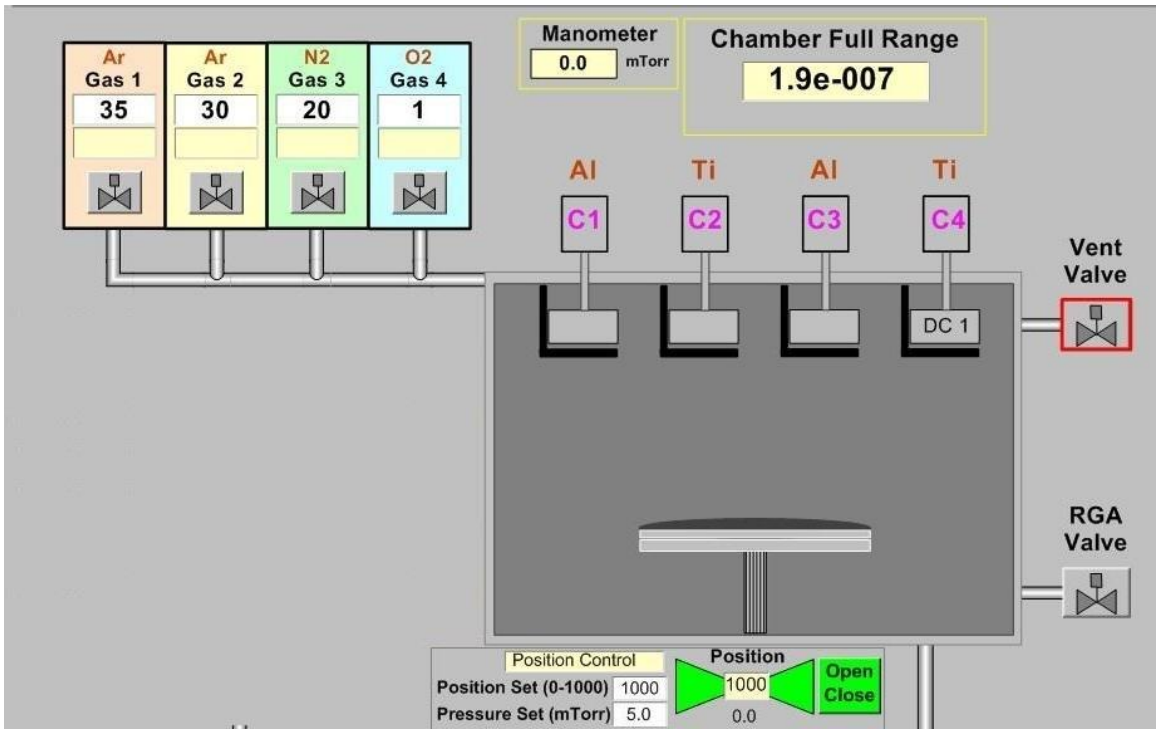
- Position setpoint are 0 – 1000.
- Pressure setpoint are 0 – 133 Torr (Sputtering) and 0 – 333 Torr (PECVD).

Green = On or Open; Gray = Off or Closed; Yellow = between Open and Closed.

Controls for the High Vacuum Valve are available on the Overview, Sputter Control and RF Bias Control screens.

NOTE: Software interlocks are NOT active in Service Mode. Care must be taken to operate the vacuum system in Service Mode.

PROCESS CHAMBER



NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

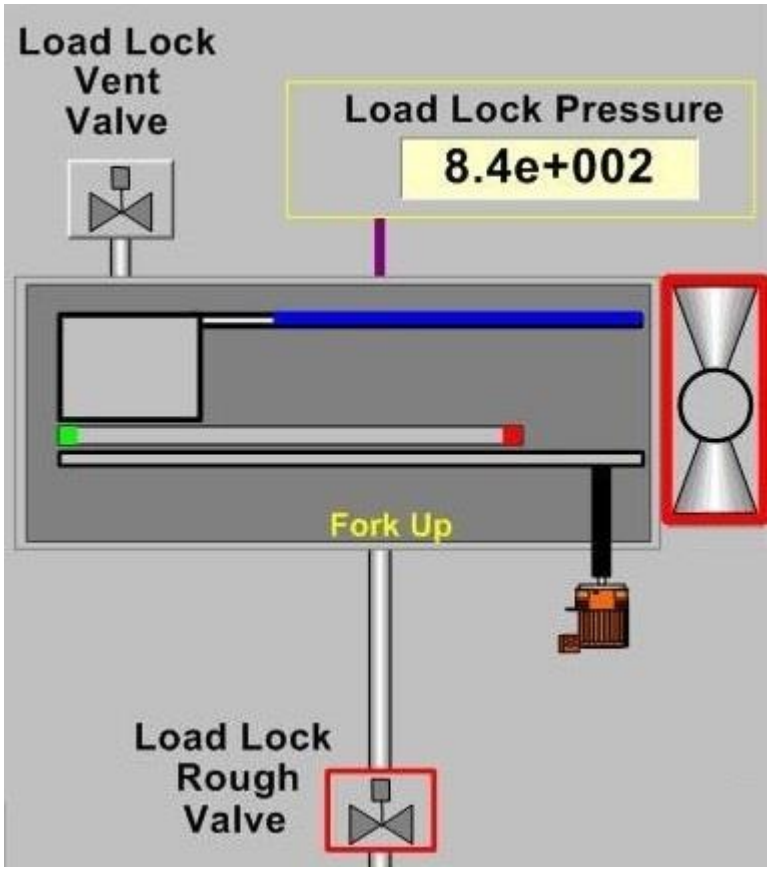
NOTE: Access to the manual controls is denied in Auto mode.

Graphical or digital displays active on the Overview screen at all times:

- The digital output of all vacuum gauges. (Torr).
- The digital output of the Capacitance Manometer (Sputter Pressure Torr).
- Actual Gas flow through each mass Flow Controller (SCCM).
- Heater temperature (ºC)
- Cathode Power (Watts)

- Cathode Voltage (Volts)
- Cathode Current (Amps)
- Cathode Frequency (kHz)
- Cathode invert Time (us)
- Cathode RF forward Power (Watts)
- Cathode RF reflect power (Watts)
- Cathode RF DC Bias Voltage (Volts)
- RF Bias forward Power (Watts)
- RF Bias reflect power (Watts)
- DC Bias Voltage (Volts)
- Gas Valves Open/Close.
- Cathode Shutters Open/Close.
- Substrate Shutters Open/Close
- Cathode power supply selection: DC, RF.
- Front-side heater On/Off
- Door Open/Close.
- Table Rotation On/Off.

LOAD LOCK CHAMBER



NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

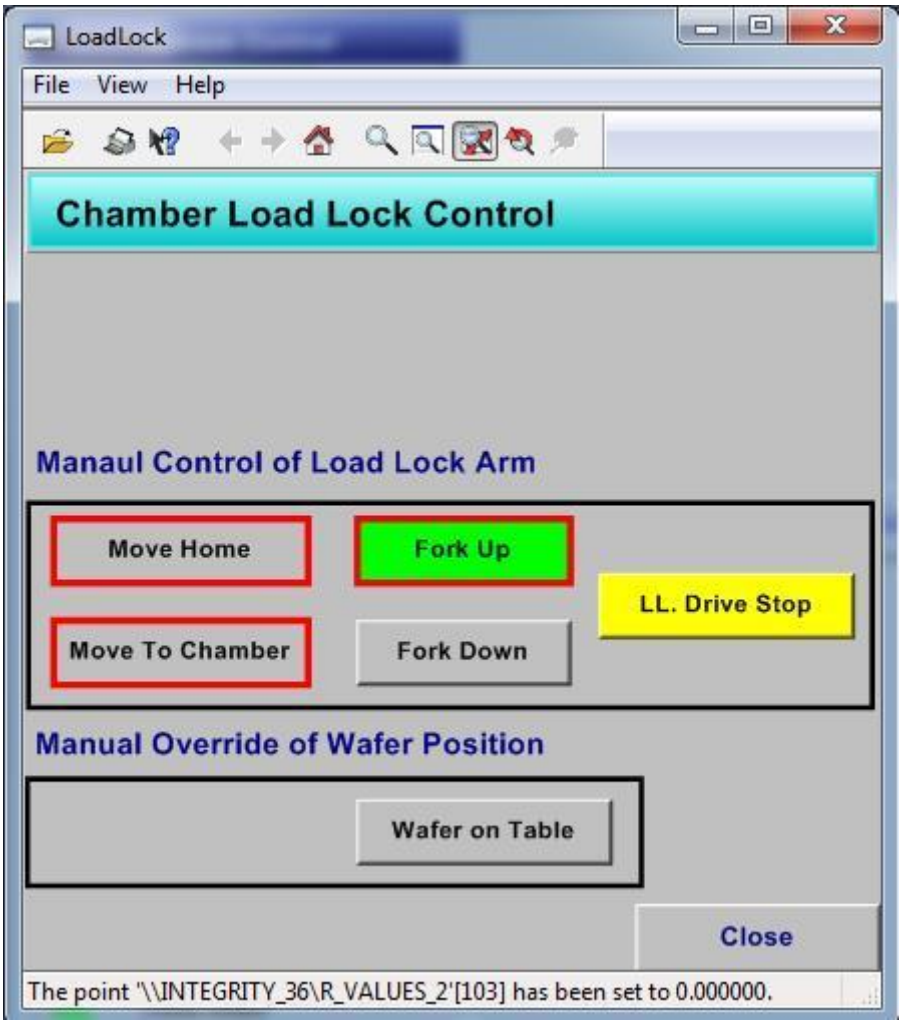
NOTE: Access to the manual controls is denied in Auto mode.

Graphical or digital displays active on the Overview screen at all times:

- The digital output of the Load Lock Chamber Pressure.
- Indicator of wafer loadlock arm position (Up/Down and Home/Chamber)
- Indicator for Load Lock Arm Load/Unload.

Click on the Load Lock Chamber graphic on the overview screen to access the Load Lock Control screen.

LOAD LOCK CONTROL



NOTE: Access to this screen is available in Manual and Service modes only.

NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

Manual operation of the Load Lock Arm and reset the wafer position. Software interlocks are active in Manual mode.

Operation section of this manual for complete instructions on the manual operation of the transfer arm.

- Move Home – Used for moving the loadlock arm back to Home position.

- Move To Chamber – Used for moving the loadlock arm in to the main process chamber.
- Fork Up – Used for moving the loadlock arm to Up position
- Fork Down – Used for moving the loadlock arm to low position.
- Wafer on Table/Wafer on Arm – Used for reset the wafer position indicator, click the "Wafer on Table" button then "Wafer on Arm" will be displayed on the screen, click the "Wafer on Arm" button then "Wafer on Table" will be displayed on the screen.

NOTE: All conditions necessary for a safe transfer must be satisfied before Load or Unload buttons are visible.

A complete set of instructions for operating the transfer arm manually are described in the Operation section of this manual.

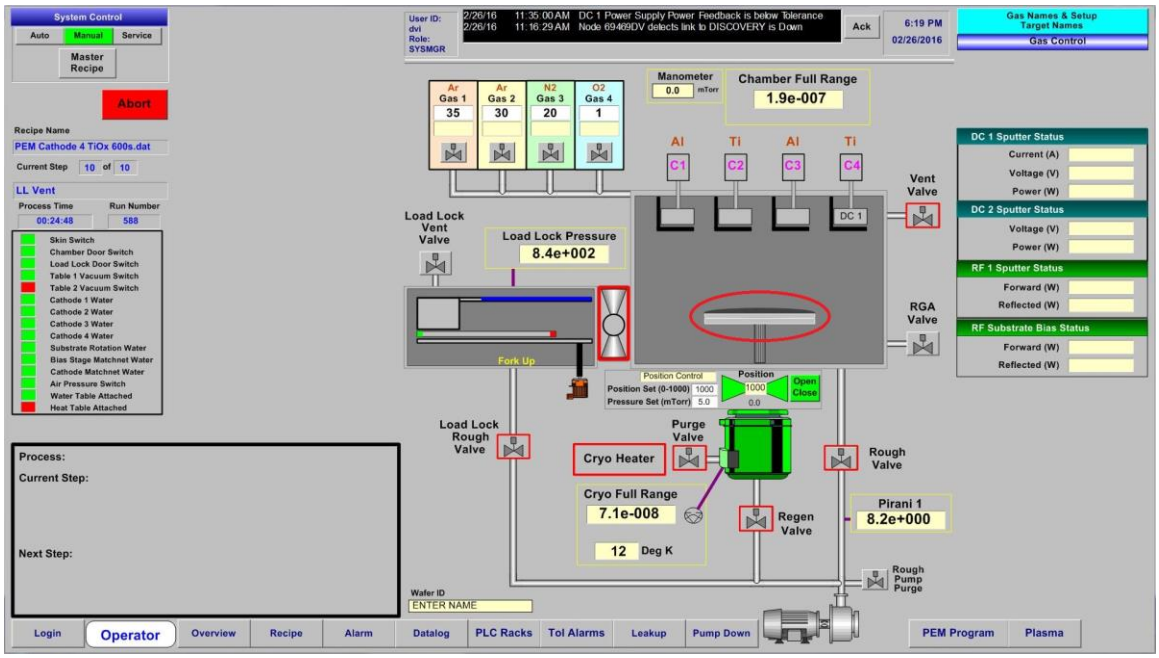
NOTE: Great care and a complete understanding of the control system is required to safely operate the Transfer Arm. Automatic operation is recommended. See the Operation section of this manual for complete instructions.

NOTE: Software interlocks are NOT active in Service Mode. Care must be taken to operate the vacuum system in Service Mode.

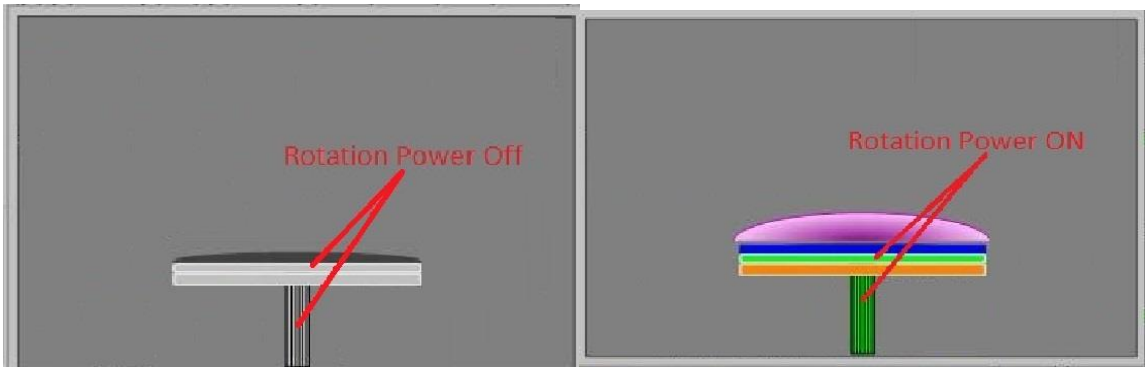
NOTE: Process Chamber Rotation MUST be OFF to load a wafer into the Process Chamber.

SUBSTRATE ROTATION

ON THE OVERVIEW SCREEN

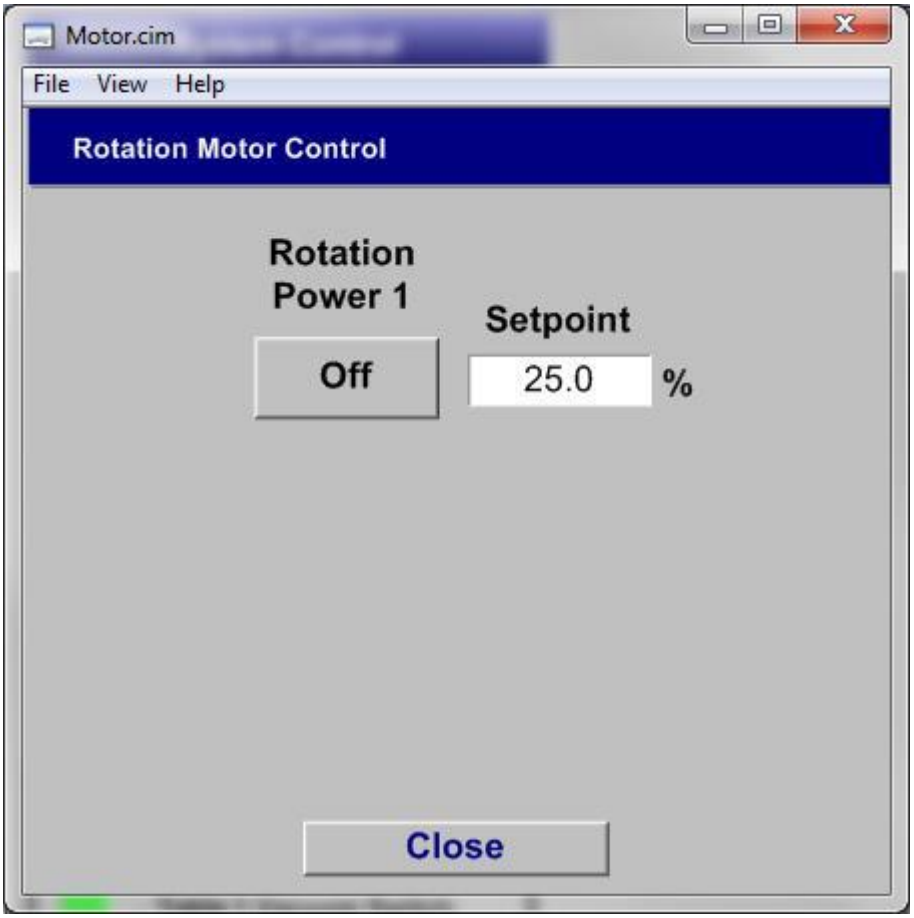


The substrate rotation on/off is graphically indicated on the center of the overview screen.



ROTATION CONTROL

Click the substrate stage on the center of overview screen to open the Rotation Control screen.

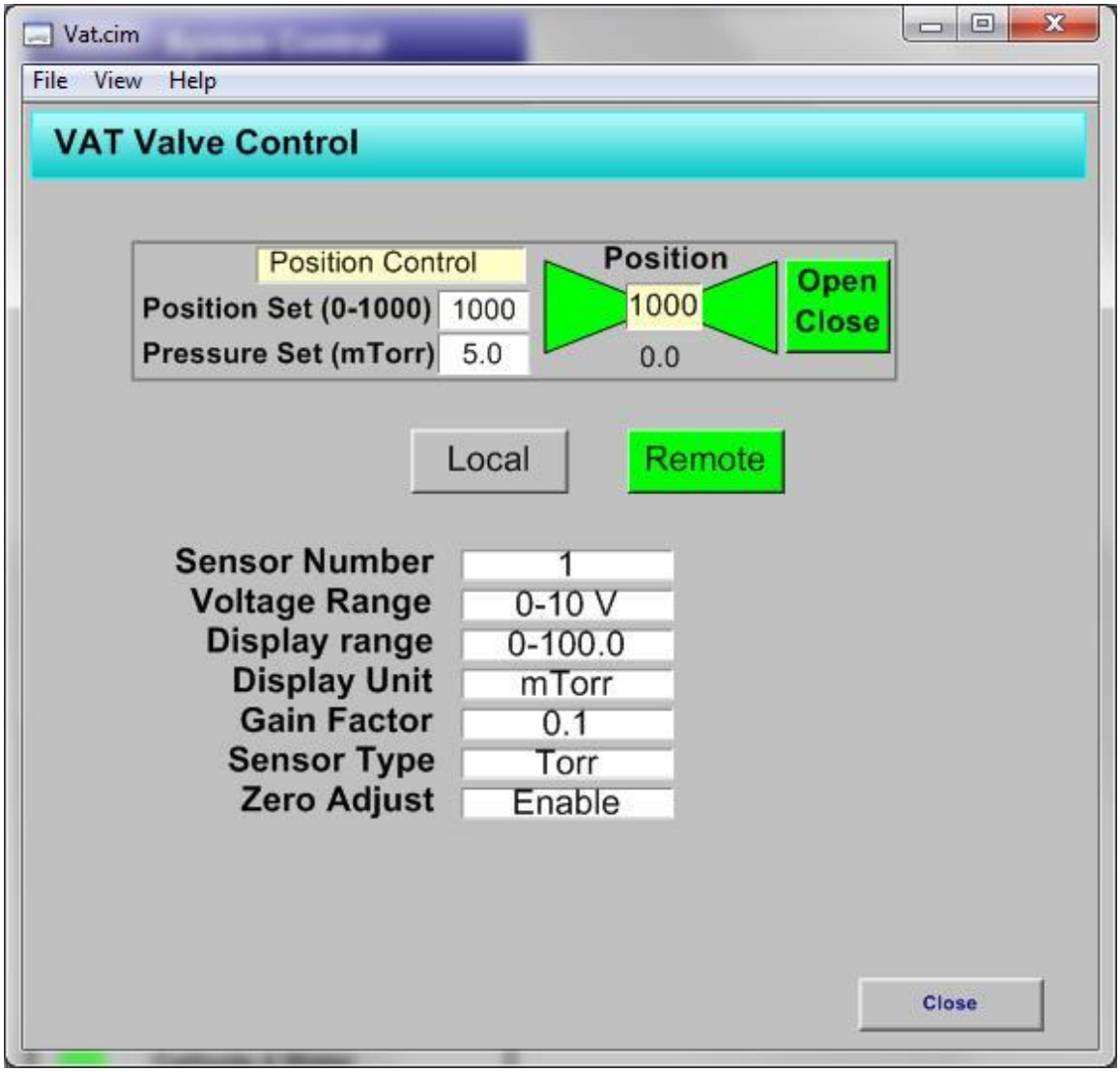


The Substrate Rotation controls are available from this screen:

- Rotation Power 1– To turn on/off the substrate rotation.
- Set Point (%) – To set the rotation power (%).
- Click "Close" button to go back the overview screen.

Automatic loading and unloading of substrate plate is recommended.

(VAT)VALVE CONTROL



The High Vacuum Valve on the Main Chamber can be operated in three modes: Open, Closed Position, Position Control and Pressure Control Mode.

Position Control Mode allows the operator to enter a position setpoint for the position of the sealing plate in the valve.

Pressure Control Mode is linked to the pressure feedback from the capacitance Manometer. The sealing plate of the valve will partially open or close in response to the pressure feedback from the capacitance manometer. See the operating instructions from the valve manufacturer for detailed instructions.

Enter a value into either data entry box and press Enter to activate Position or Pressure Mode.

- Position setpoint are 0 – 1000.
- Pressure setpoint are 0 – 133 Torr.

Green = On or Open; Gray = Off or Closed; Yellow = between Open and Closed.

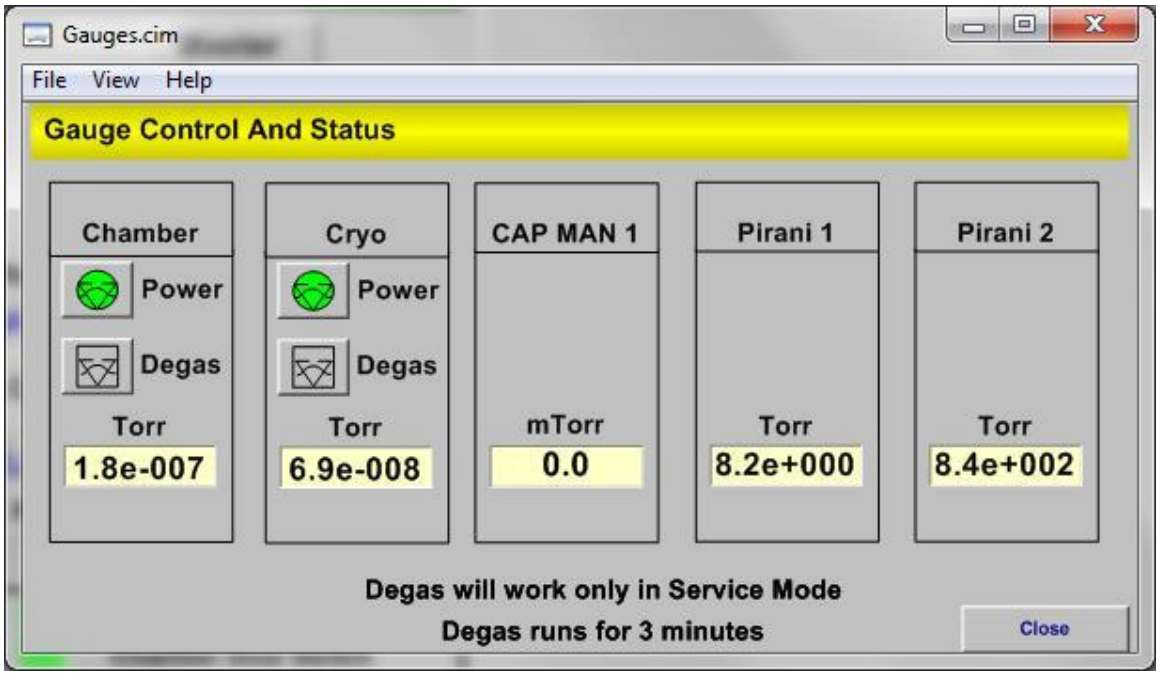
Controls for the High Vacuum Valve are available on the Overview, Sputter Control and VAT Control screens.

Digital displays from the VAT valve controller are active on this screen at all times:

- Sensor Number: #1
- Voltage Range: 0 – 10 VDC
- Display Range: 0 – 100 mTorr.
- Display Unit: mTorr
- Gain Factor: 0.1 (or lowest available setpoint)
- Sensor Type: Torr
- Zero Adjust: Enable

NOTE: Software interlocks are NOT active in Service Mode. Care must be taken to operate the vacuum system in Service Mode.

GAUGE CONTROL AND STATUS



NOTE: This screen is accessed in Service Mode only.

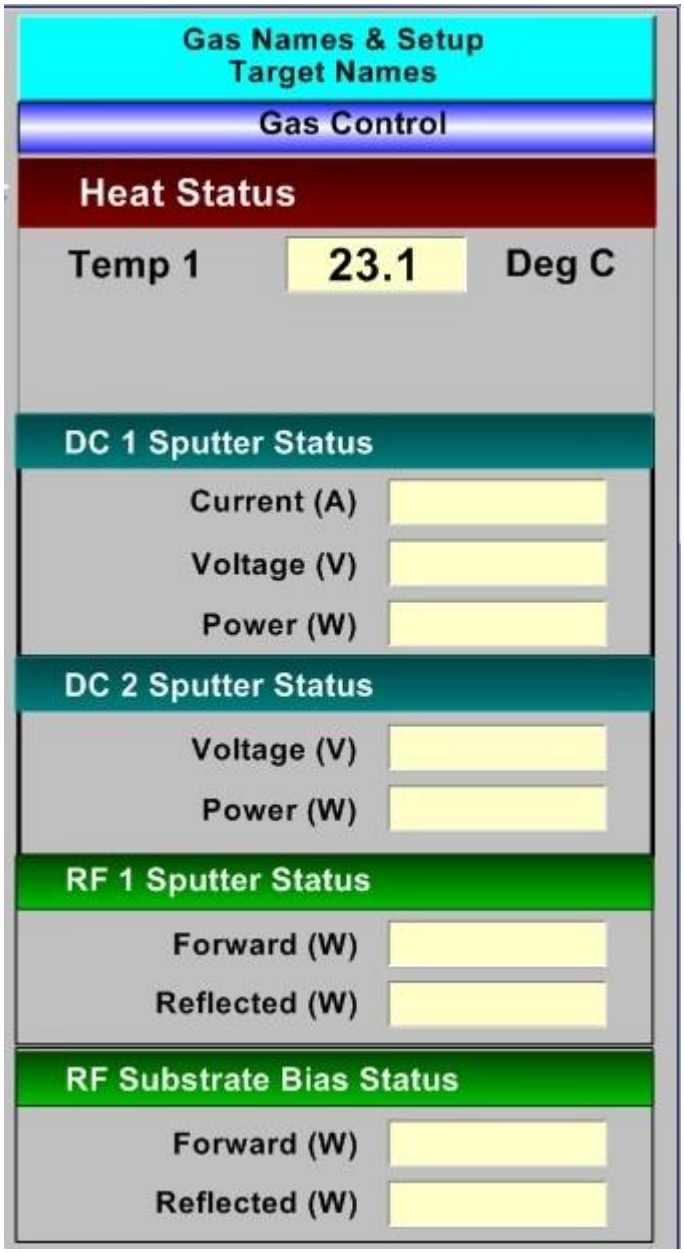
In Service mode, move the cursor over the any of the Vacuum Gauges and click it. The Gauge Control screen will be opened.

This screen allows the user to turn on/off the gauge power, degas the gauge when gauge is under high vacuum (below 5.0e-2 Torr), and also displays the Pressure (Torr), Voltage (0-10Volts) and Raw Date (0-32000) of all vacuum gauges. See gauge manual for more details about the full range gauge.

NOTE: Chamber pressure MUST be below 5.0e-2 Torr before activating the Degas feature.

Reset of the full range gauges is necessary only if the gauge fails to switch automatically. The Reset button will disconnect the gauge from the power supply. This is required to reset the gauge.

RIGHT OVERVIEW SCREEN



The control boxes for major subsystems are displayed on the right side of the Overview screen. The current condition of the subsystems is continuously displayed on the right side of the Overview screen in data boxes.

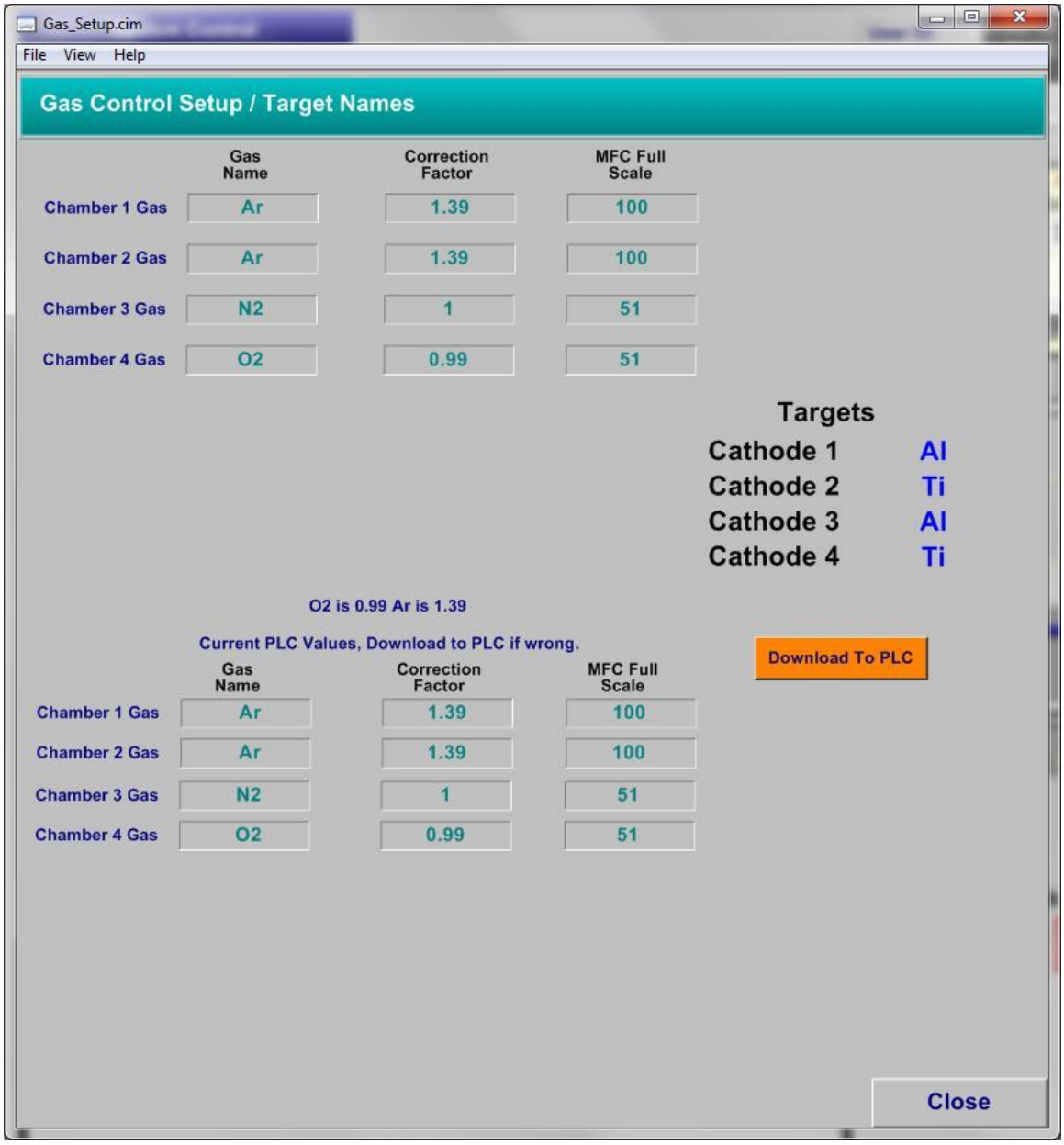
Single-clicking on the Status & Control box accesses the subsystems. A control box will pop-up with input boxes for operator interface with the subsystem. These are accessible in Manual and Service modes.

In normal operation the following data is continuously displayed on the Overview screen:

- Heat Status (Only available when Heater stage in installed)
  - Heat Temperature (°C)
- DC 1 Sputter Status
  - Current (Amps)
  - Voltage (Volts)
  - Power (Watts)
- DC 2 Sputter Status
  - Voltage (Volts)
  - Power (Watts)
- RF 1 Sputter Status
  - Forward Power (Watts)
  - Reflected Power (Watts)
- RF Substrate Bias Status
  - Forward Power (Watts)
  - Reflected Power (Watts)
  -

The individual subsystem screens are described below. They are accessible in Manual and Service modes.

GAS/TARGET NAMES SETUP



This screen is accessed in Service Mode only. The names of the inlet gases, the gas correction factors, the full scale range of the mass flow controllers and the names of the target materials can be programmed on this screen.

The Gas and Target Material Names will be displayed as text on the Overview screen in the appropriate areas. The gas correction and MFC Full Scale value are used to output the correct gas flow setpoints to the proper mass flow controllers.

The names of the inlet gases and the names of the target materials to be recorded in the datalog file can be programmed on bottom portion of this screen.

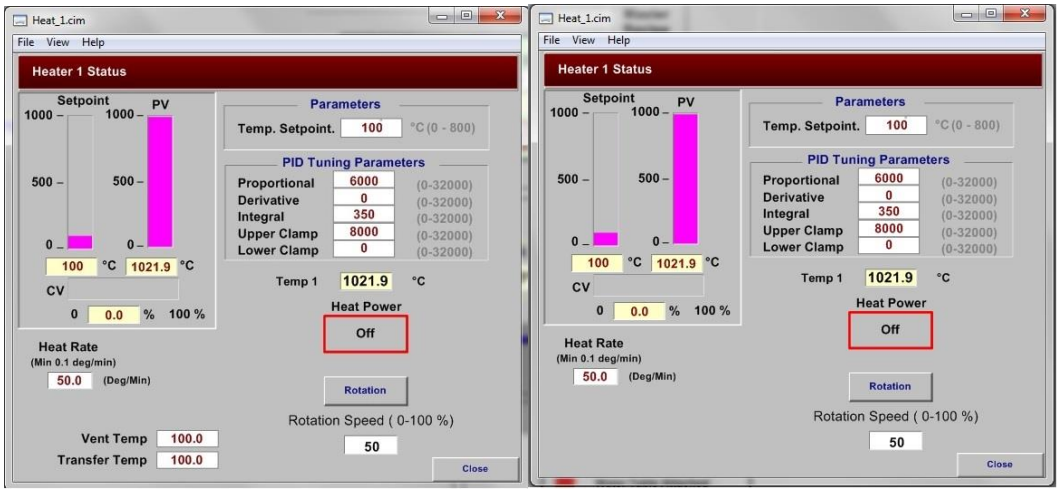
Press the Download to PLC button to make changes on this screen permanent in the control system.

NOTE: The Gas Correction Factor must be changed whenever the gas inlet supply is changed for each mass flow controller.

The MFC Full Scale setpoint must be changed whenever the mass flow controller is changed.

NOTE: Download to PLC button MUST be pressed to make changes on this screen permanent in the control system.

HEAT STATUS & CONTROL



Service Mode Manual Mode

NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

- Turn the Heat Control ON. The graphic displays will show the Setpoint, Present temperature Value (PV), and the Current power output Value (CV). The setpoint will be reached and held until it is changed.

This screen can be used to operate and monitor a manual substrate heat process in the Chamber.

All the pertinent controls and system feedback data are present here. The Temperature and Power bar blocks are color dependent based on system condition and control parameters. The Setpoint bar is a visual representation of the temperature setpoint. The PV bar shows the instantaneous temperature measured by the controlling thermocouple. The CV bar shows the percentage of power supply output applied at that moment.

The Heat Control ON button will activate the heat controls.

CAUTION: The PID parameters are factory set. Changing the PID parameters will affect the temperature control.

PARAMETERS

- Temperature Setpoint – Programmable temperature setpoint for the heater PID controller.
    - Enter a setpoint here.
    - The Temperature setpoint is also displayed on the Overview screen.
- Rotation Speed – Programmable speed setpoint for the substrate rotation.
    - Enter a setpoint here.
    - The Rotation Speed setpoint is also available on the Overview screen.
    - The Rotation Power button is on this screen to activate the rotation motor.
        - This button is also available on the Load Lock and the Overview screens.
- Heat Power – Turn on the heater power and activate the heat controls.

In Service Mode:

- Vent Temperature – Programmable interlock that prevents the opening of the Vent Valve while the substrate is at high temperature.
    - Enter a setpoint here.
    - The Vent Temperature setpoint is also displayed on the Overview screen.
- Transfer Temperature - Programmable interlock that prevents the transfer of a substrate carrier from the load lock to the process chamber while the substrate is at high temperature.
    - Enter a setpoint here.
    - The Transfer Temperature setpoint is also displayed on the Overview screen.
    - A text graphic is displayed on the Load Lock screen to indicate the status of this interlock.

PID TUNING PARAMETERS

Standard PID control loop technology is used and can be operator programmed. Proportional Gain - This term is KP for the below equation. For Watts/° C. Integral Gain - This term is KI for the below equation in Watts/°C/sec. Derivative Gain - This term is KD for the below equation Watts/°C*sec.

The KP, KI and KD are the programmable gains for the process. The Heat Output % of the PID function block is approximately equal to:

Heat Output %= KP* (FE + KD *derivative (FE) + I term)

Where: Iterm = integral (KI* (FE)

FE (following error) = temperature setpoint- actual chamber temperature

Overall:

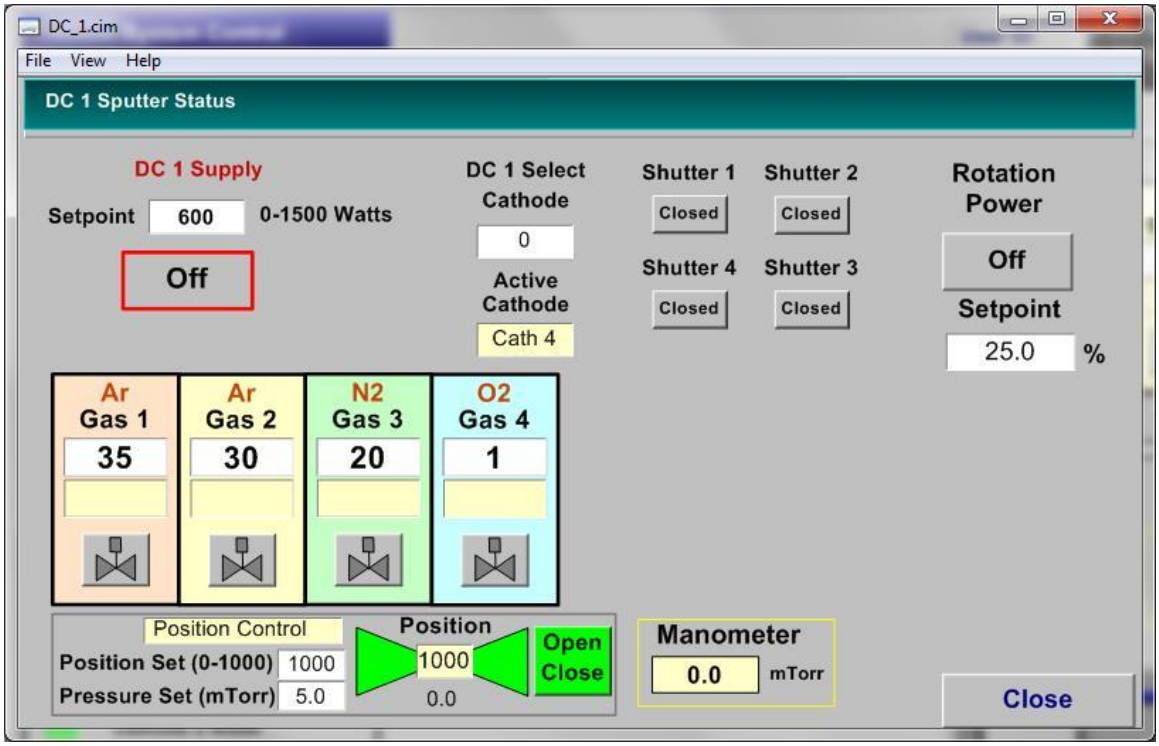
$$HO = KP\left[FE + KD\frac{d\,FE}{dt} + KI\int FE\ dt\right]$$

The Upper and Lower Clamp values govern the absolute range of the power supply.

- Lower Clamp - A minimum power output (CV) can be held by entering a value into the Lower Clamp data box. The range of input is 0 – 32000. It must be less than Upper Clamp. This represents the minimum power output. This value can be set in addition to the PID parameters to improve temperature control at high temperature setpoints.
- Upper Clamp - A maximum power output (CV) can be held by entering a value into the Upper Clamp data box. The range of input is 0 – 32000. It must be great than Upper Clamp. This represents the minimum power output. This value can be set in addition to the PID parameters to improve temperature control at high temperature setpoints.

Press the CLOSE button to close the Status & Control screen.

DC 1 SPUTTER STATUS AND CONTROL



NOTE: Access to this screen is available in Manual and Service modes only.

NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

Before trying to ignite a plasma, you must have the Process Gas flowing!!!

Description of Controls:

- DC 1 Power
  - Set Point – The DC 1 power setpoint (Watts, 0-1000Watts)
  - DC 1 Power Button – Turns the DC 1 power ON/OFF.
  - DC 1 Select Cathode – Select an active cathode (0- 4) for DC 1.
    - 0 – No cathode is selected.

- 1 – Cathode #1 is selected.
- 2 – Cathode #2 is selected.
- 3 – Cathode #3 is selected.
- 4 – Cathode #4 is selected.

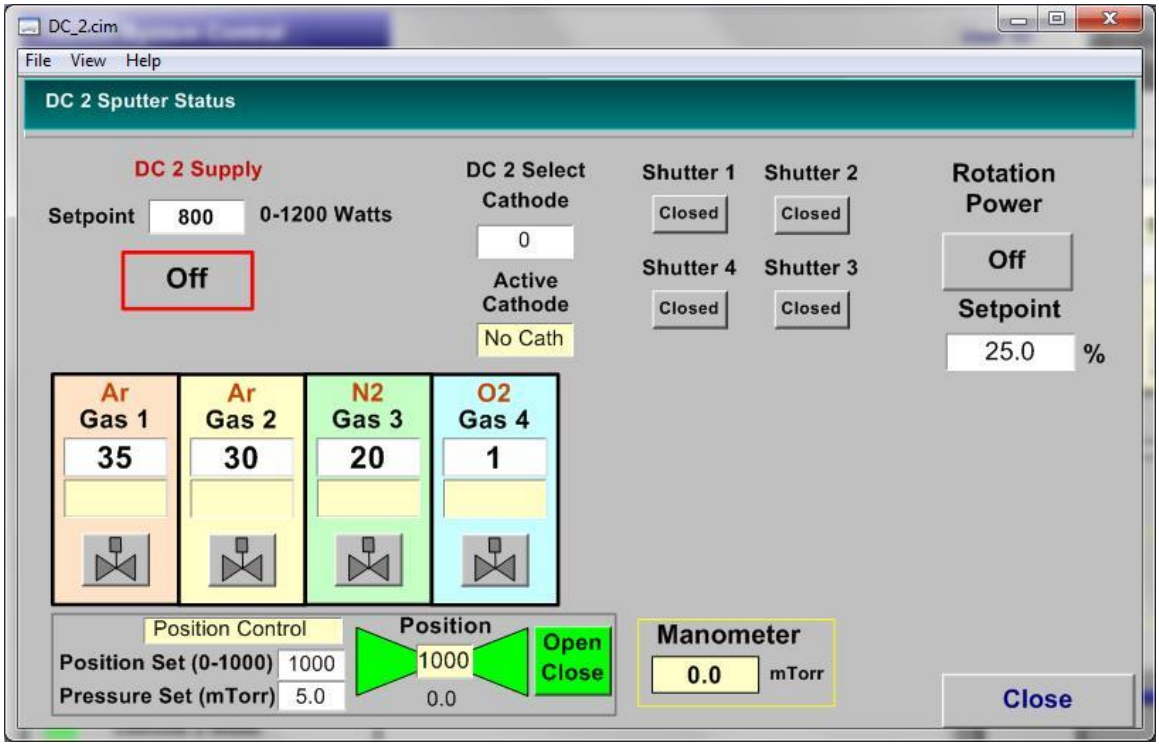
- Active Cathode - Display the (DC 1) active cathode number (0 – 4).

Please note: If more than one cathode is active during a deposition, the Frequency and Reverse Time setpoints for each cathode must be equal to the setpoints of DC1. This is to maintain the Sync/Pulse feature of the power supplies.

- Cathode Shutter (1-4)
  - Shutter Button – Opens and Closes the cathode shutter.
- Gas Controls (1-4)
  - Gas 1, 2, 3 and 4 Name can be edited in Gas Control Set Up screen in service mode.
  - Gas 1, 2, 3 and 4 Setpoint Entry boxes –Gas flow setpoints (SCCM).
  - Gas 1, 2, 3 and 10 flow display boxes – actual gas flow display (SCCM)
  - Gas 1, 2, 3 and 4 Valve Buttons – Turn On/Off the Gas flow.
- High Vacuum Valve
  - Position Set Box - The position setpoint for the High Vac Valve.
  - Pressure Set Box – The pressure setpoint for High Vac Valve in pressure control.
  - Open Close Button – Opens and Closes the High Vac Valve.
- Substrate Rotation
  - Rotation Control button – turn the rotation power on and off.
  - Rotation Speed Set Point – Set up rotation speed (%).
- Manometer
  - Display the main chamber process pressure (mTorr).

Press the CLOSE button to close the Status & Control screen.

DC 2 SPUTTER STATUS AND CONTROL



NOTE: Access to this screen is available in Manual and Service modes only.

NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

Before trying to ignite a plasma, you must have the Process Gas flowing!!!

Description of Controls:

- DC 2 Power
  - Set Point – The DC 2 power setpoint (Watts, 0-1000Watts)
  - DC 2 Power Button – Turns the DC 1 power ON/OFF.
  - DC 2 Select Cathode – Select a active cathode (0- 4) for DC 2.
    - 0 – No cathode is selected.

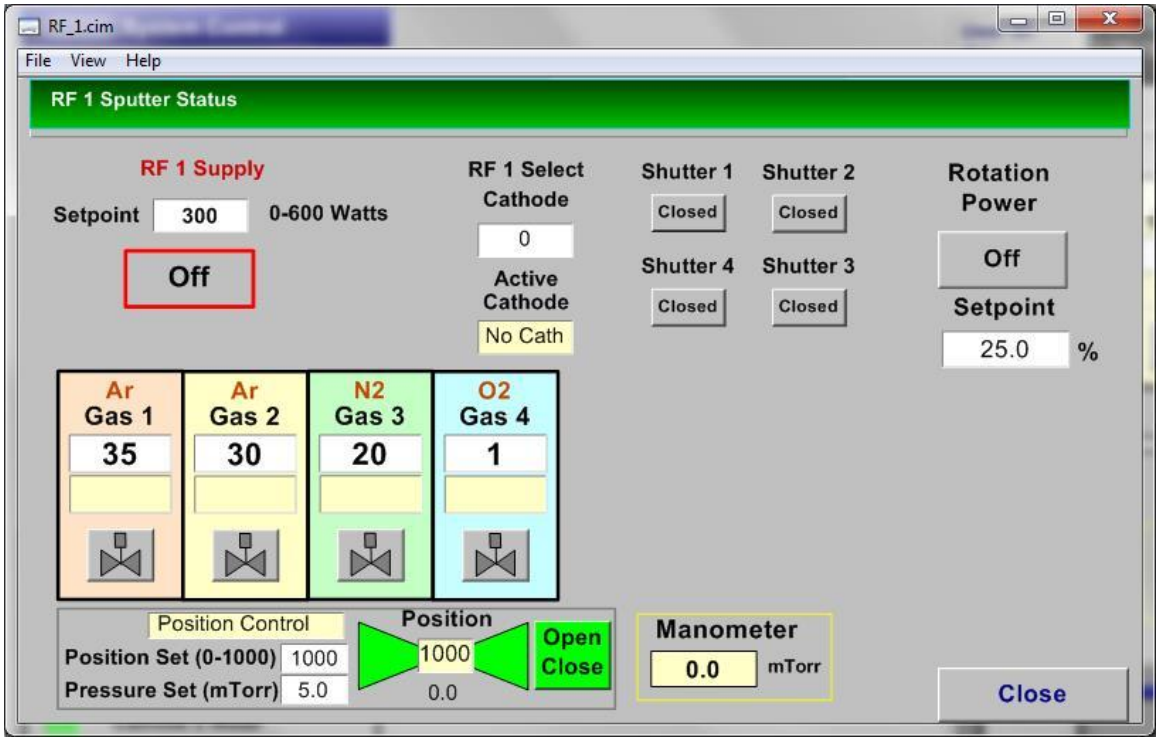
- 1 – Cathode #1 is selected.
- 2 – Cathode #2 is selected.
- 3 – Cathode #3 is selected.
- 4 – Cathode #4 is selected.

- Active Cathode - Display the (DC 2) active cathode number (0 – 4).

Please note: If more than one cathode is active during a deposition, the Frequency and Reverse Time setpoints for each cathode must be equal to the setpoints of DC1. This is to maintain the Sync/Pulse feature of the power supplies.

- Cathode Shutter (1-4)
  - Shutter Button – Opens and Closes the cathode shutter.
- Gas Controls (1-4)
  - Gas 1, 2, 3 and 4 Name can be edited in Gas Control Set Up screen in service mode.
  - Gas 1, 2, 3 and 4 Setpoint Entry boxes –Gas flow setpoints (SCCM).
  - Gas 1, 2, 3 and 10 flow display boxes – actual gas flow display (SCCM)
  - Gas 1, 2, 3 and 4 Valve Buttons – Turn On/Off the Gas flow.
- High Vacuum Valve
  - Position Set Box - The position setpoint for the High Vac Valve.
  - Pressure Set Box – The pressure setpoint for High Vac Valve in pressure control.
  - Open Close Button – Opens and Closes the High Vac Valve.
- Substrate Rotation
  - Rotation Control button – turn the rotation power on and off.
  - Rotation Speed Set Point – Set up rotation speed (%).
- Manometer
  - Display the main chamber process pressure (mTorr).
  - Press the CLOSE button to close the Status & Control screen.

RF 1 SPUTTER STATUS AND CONTROL



NOTE: Access to this screen is available in Manual and Service modes only.

NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

Before trying to ignite a plasma, you must have the Process Gas flowing!!!

Description of Controls:

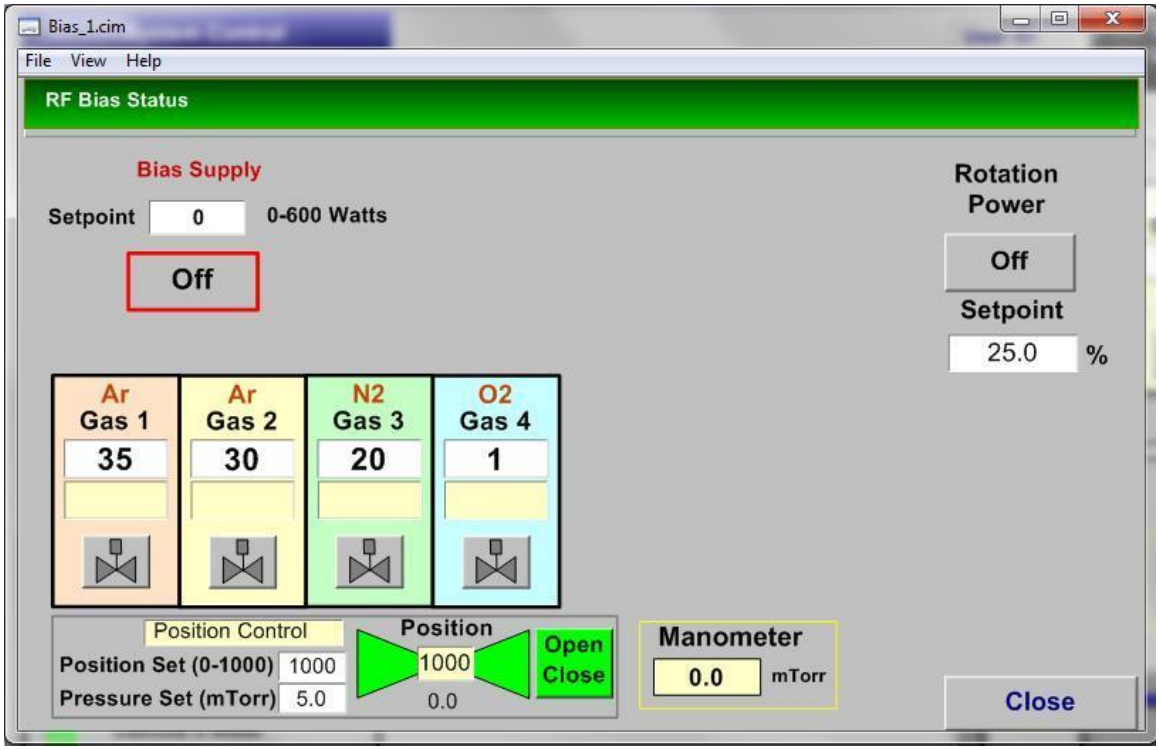
- RF 1 Power
  - Ste Point – The RF power setpoint of (Watts, 0-600Watts)
  - RF Power Button – Turns the RF power ON/OFF.
- RF 1 Select Cathode – Select a active cathode (0- 4) for RF 1.
  - 0 – No cathode is selected.

- 1 – Cathode #1 is selected.
- 2 – Cathode #2 is selected.
- 3 – Cathode #3 is selected.
- 4 – Cathode #4 is selected.

- Active Cathode - Display the (RF 1) active cathode number (0 – 4).
- Cathode Shutter (1-4)
  - Shutter Button – Opens and Closes the cathode shutter.
- Gas Controls (1-4)
  - Gas 1, 2, 3 and 4 Name can be edited in Gas Control Set Up screen in service mode.
  - Gas 1, 2, 3 and 4 Setpoint Entry boxes –Gas flow setpoints (SCCM).
  - Gas 1, 2, 3 and 10 flow display boxes – actual gas flow display (SCCM)
  - Gas 1, 2, 3 and 4 Valve Buttons – Turn On/Off the Gas flow.
- High Vacuum Valve
  - Position Set Box - The position setpoint for the High Vac Valve.
  - Pressure Set Box – The pressure setpoint for High Vac Valve in pressure control.
  - Open Close Button – Opens and Closes the High Vac Valve.
- Substrate Rotation
  - Rotation Control button – turn the rotation power on and off.
  - Rotation Speed Set Point – Set up rotation speed (%).
- Manometer
  - Display the main chamber process pressure (mTorr).

Press the CLOSE button to close the Status & Control screen.

RF SUBSTRATE BIAS STATUS AND CONTROL



NOTE: Access to this screen is available in Manual and Service modes only.

NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

Before trying to ignite a plasma, you must have the Process Gas flowing!!!

Description of Controls:

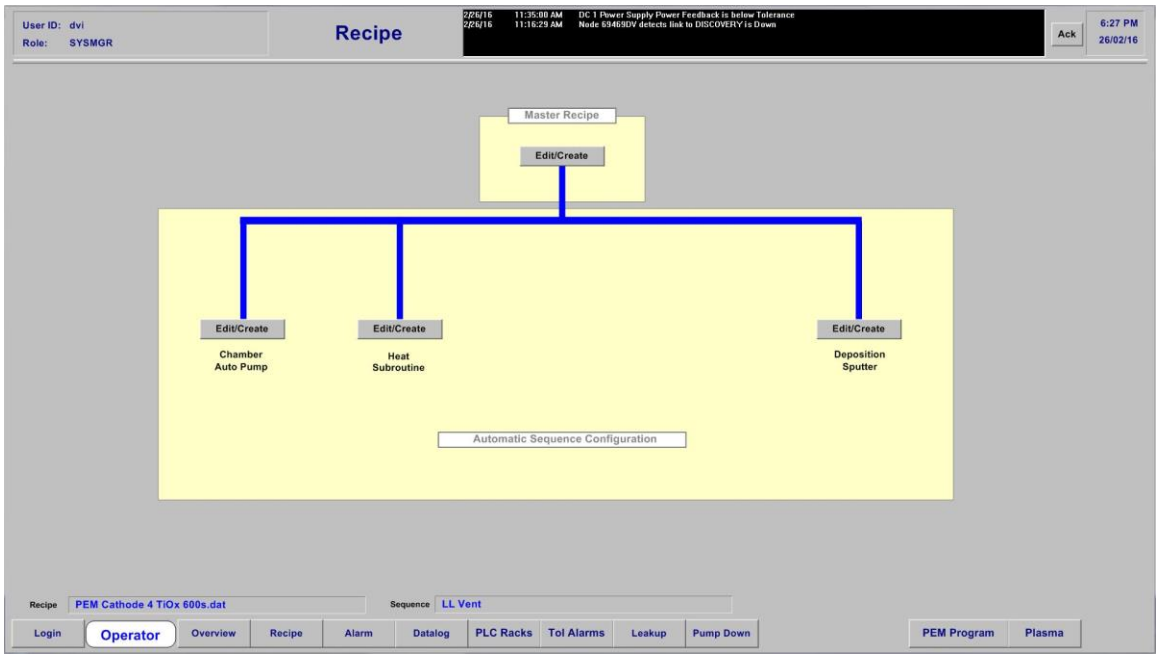
- RF Bias Power
  - Ste Point – The RF bias power setpoint of (Watts, 0-600Watts)
  - RF Power Button – Turns the RF Bias power ON/OFF.
- Gas Controls (1-4)

- Gas 1, 2, 3 and 4 Name can be edited in Gas Control Set Up screen in service mode.
- Gas 1, 2, 3 and 4 Setpoint Entry boxes –Gas flow setpoints (SCCM).
- Gas 1, 2, 3 and 10 flow display boxes – actual gas flow display (SCCM)
- Gas 1, 2, 3 and 4 Valve Buttons – Turn On/Off the Gas flow.

- High Vacuum Valve
  - Position Set Box - The position setpoint for the High Vac Valve.
  - Pressure Set Box – The pressure setpoint for High Vac Valve in pressure control.
  - Open Close Button – Opens and Closes the High Vac Valve.
- Substrate Rotation
  - Rotation Control button – turn the rotation power on and off.
  - Rotation Speed Set Point – Set up rotation speed (%).
- Manometer
  - Display the main chamber process pressure (mTorr).

Press the CLOSE button to close the Status & Control screen.

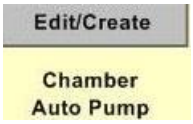
RECIPE SCREEN



The Main Recipe screen consists of three subscreens:

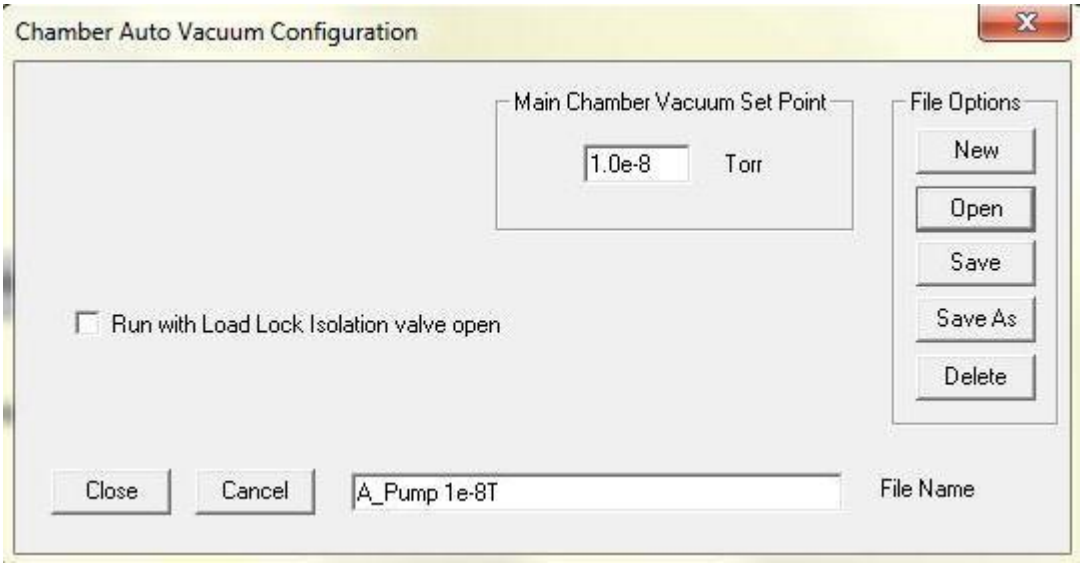
- Chamber Auto Pump
- Heat Subroutine
- Deposition T-Steps

AUTOMATIC PUMP CONFIGUTATION



AUTO MAIN CHAMBER PUMP CONFIGURATION

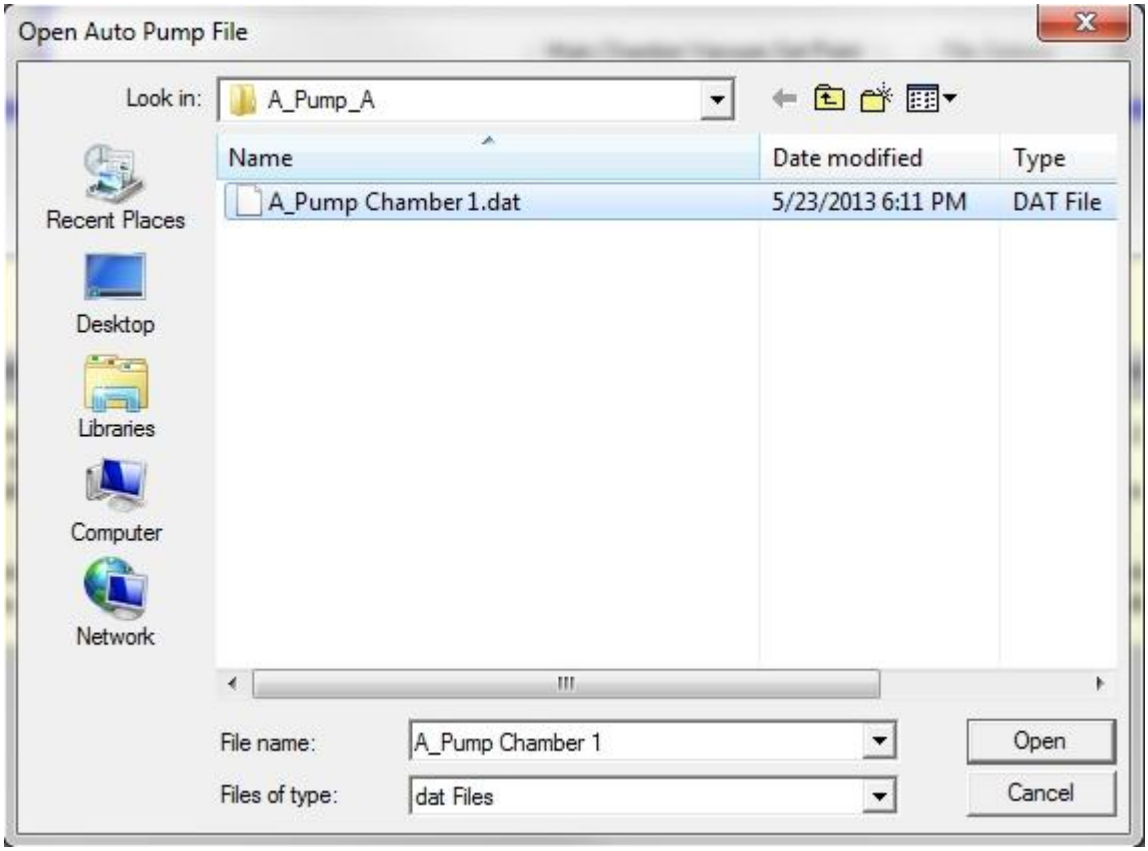
Clicking on the Edit/Create button opens the auto main chamber pump Configuration.



This subroutine is used to safely pump the process Chamber to a specified base vacuum pressure setpoint. It will perform an automated pumping sequence in accordance to system interlocks: rough pump the chamber if pressure is at atmosphere or above the crossover setpoint, automatically operate the mechanical pump, backing valve, rough valve, and then open the high-vac valve once the crossover pressure has been reached. The sequence will complete when the main chamber vacuum setpoint has been achieved.

The main chamber auto pump sequence will open the loadlock isolation valve prior to chamber pump down if the "Run with loalock isolation valve open" option box is checked.

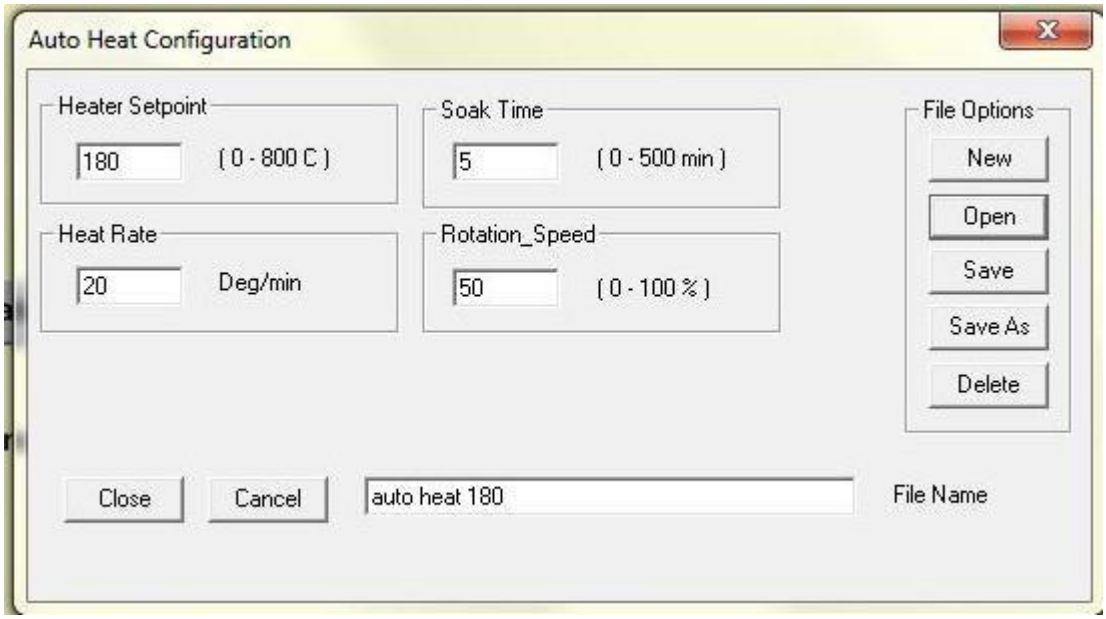
After entering the Main Chamber Vacuum Setpoint, select the **Save** or **Save As** button and name the file in the following screen in **File name** box:



The Auto Pump recipe will be downloaded to the Master Recipe Screen to be used as a standalone recipe or as a step in a recipe sequence.

AUTO HEAT CONFIGURATION

Clicking on the Edit/Create button opens the Auto Heat Configuration.



This subroutine is used to heat the substrate before or after the deposition. It will perform an automated heating sequence: the heat will ramped up to the heat set point (Heater Setpoint) at a programmed rate (Heat Rate) then heat the substrate at the set point for a programmed period (Soak Time). The sequence will complete when the soak time end.

PROGRAMMABLE FEATURES

Heater Setpoint - Enter desired heat and press enter; 0 - 800ºC

Soak Time - Enter desired soak time and press enter; 0 - 500min

Heat Rate - Enter desired heat raping rateand press enter; ºC/min

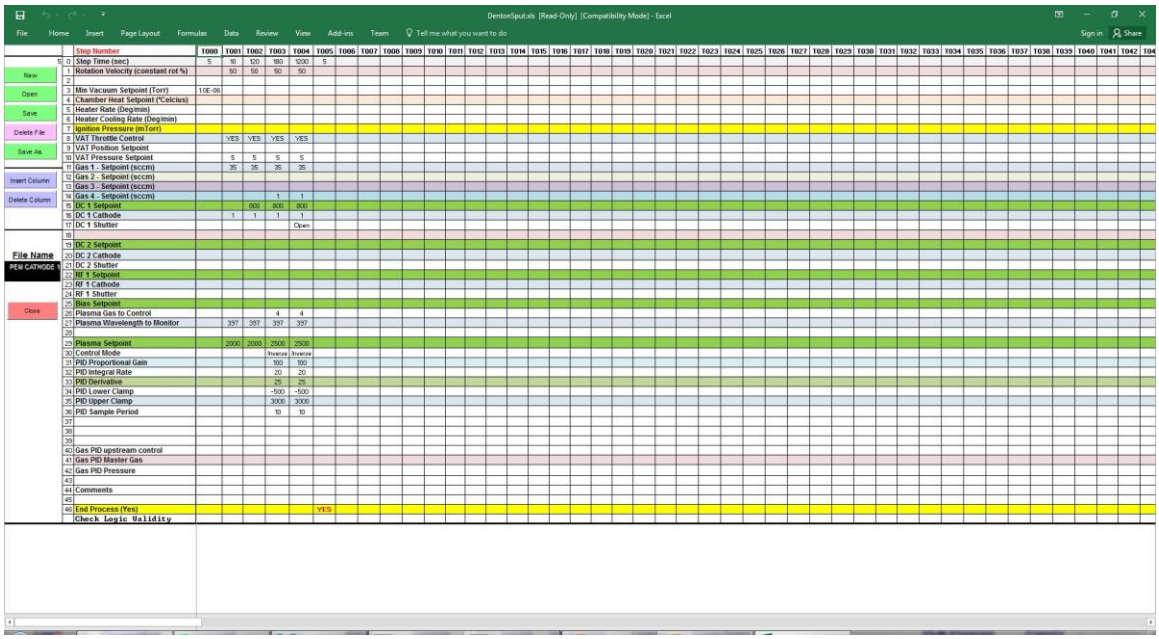
Rotation Speed - Enter the desired rotation (%) speed in this box and press enter. 0 - 100%

After entering the proper parameters, select the **Save** or **Save As** button and name the file in the following screen in **File name** box:

The Auto Heat recipe will be downloaded to the Master Recipe Screen to be used as a standalone recipe or as a step in a recipe sequence.

DEPOSITION T-STEPS

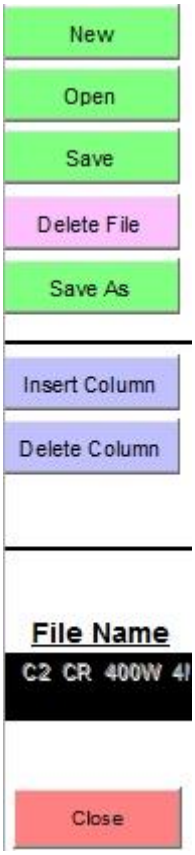
Clicking on the Edit/Create button opens the Deposition T-Steps spreadsheet.



The Automatic deposition process follows a programmable timeline. The programming of the automatic process is organized into a spreadsheet format. Each column within the spreadsheet is a step within the recipe, known as T-step, starting at step T000. The data in the column is active for the time programmed into the Step Time entry (row = 0) once the other programmed parameters have been meet. Some parameters may add additional time to the T-step if the system is waiting to achieve a pressure setpoint(i.e. Vacuum Setpoint).

PROGRAMMING A T-STEP FILE

FILE FUNCTIONS



- New – Opens a blank T-Step recipe spread sheet.
- Open – Opens an existing T-Step recipe spreadsheet.
- Save – Saves the recipe parameters.
- Delete File – Deletes unwanted files.
- Save As – Saves recipe with a new name.
- Insert Column – Inserts a column before the column selected.
- Delete Column – Deletes unwanted columns.
- File Name – Displays name of recipe file that is open.
- Close – Closes the T-Step recipe screen.

To create a new recipe from an existing one, use the OPEN button and click on a recipe to highlight it and use the OPEN button on that page. The spreadsheet will populate the data boxes with the stored information in that file. You may edit the values and the T-Step commands. Once the appropriate changes are made, click on the SAVE AS button, edit the recipe name for a new one, and ENTER.

- The new recipe name will show in the file box now. Click the CLOSE button to bring you back to the MASTER RECIPE screen.
- Once you have assigned a name and saved it, the recipe will be downloaded to the MASTER RECIPE FILE. It can now be retrieved in that page, by clicking on the EDIT/CREATE button.

T-STEP FUNCTIONS

Below is a description of the recipe steps and input limits to create a deposition recipe sequence. A recipe may consist of 250 steps (T000 – T250).

No	Function	Range	Description
0	Step Time (seconds)	0 - 3200	Enter a time for each step (column).
1	Rotation Velocity (Constant rot %)	0-100%	Enter a percentage power for rotation.
2	Blank Row.		
3	Min Vacuum Setpoint (Torr)	1.0E-8 – 760	Enter a setpoint if step requires a base vacuum pressure before proceeding with process.
4	Chamber Heat Setpoint (^{o}C)	(blank),0 - 500	Enter the Chamber heater temperature if required for each step.
5	Heaer Rate (^{o}C/min)	(blank),0 - 500	Enter the Table heater temperature rising rate if required for each step.
6	Heaer Cooling Rate (^{o}C/min)	(blank),0 - 500	Enter the Table heater temperature cooling rate if required for each step.
7	Ignition Pressure (x10^{-3} mbar)	0-100 Torr or (blank)	Enter ignition pressure if necessary to ignite plasma discharge.
8	VAT Throttle Control	(blank) or YES	Select value of YES to throttle HiVac valve to a preset intermediate pressure control position (PCM).
9	VAT Position Control	0-1000	Enter a setpoint and set the High-vac valve in Position Control mode. 0 = closed, 1000 = fully open.
10	VAT Pressure Control	0-100 mTorr	Enter a vacuum setpoint and set the High-vac valve in Pressure Control mode.
11	Gas 1 – Setpoint (sccm)	0-100	Enter Gas 1 flow.

No	Function	Range	Description
12	Gas 2 – Setpoint (sccm)	0-100	Enter Gas 2 flow.
13	Gas 3 – Setpoint (sccm)	0-100	Enter Gas 3 flow.
14	Gas 4 – Setpoint (sccm)	0-100	Enter Gas 4 flow.
15	DC 1 Setpoint (Watts)	0-5000Walts (Power Control Mode)	Enter a DC Power Setpoint
16	DC 1 Cathode	0 - 4	Select cathode for DC 1. 0 = No cathode is selected.
17	DC 1 Shutter	Open/Close	Select cathode shutter status for the current step. Blank = Close.
18	Blank.	Blank.	Blank.
19	DC 2 Setpoint (Watts)	0-5000Walts (Power Control Mode)	Enter a DC Power Setpoint
20	DC 2 Cathode	0 - 4	Select cathode for DC 2. 0 = No cathode is selected.
21	DC 2 Shutter	Open/Close	Select cathode shutter status for the current step. Blank = Close.
22	RF 1 Setpoint (Watts)	0-5000Walts (Power Control Mode)	Enter a RF Power Setpoint
23	RF 1 Cathode	0 - 4	Select cathode for RF 1. 0 = No cathode is selected.
24	RF 1 Shutter	Open/Close	Select cathode shutter status for the current step. Blank = Close.
25	RF Bias Setpoint	0-600	Enter a RF Bias Power Setpoint
26	Plasma Gas to Control (sccm)	0-100	Enter a desired Gas flow to start the gas PID control. .

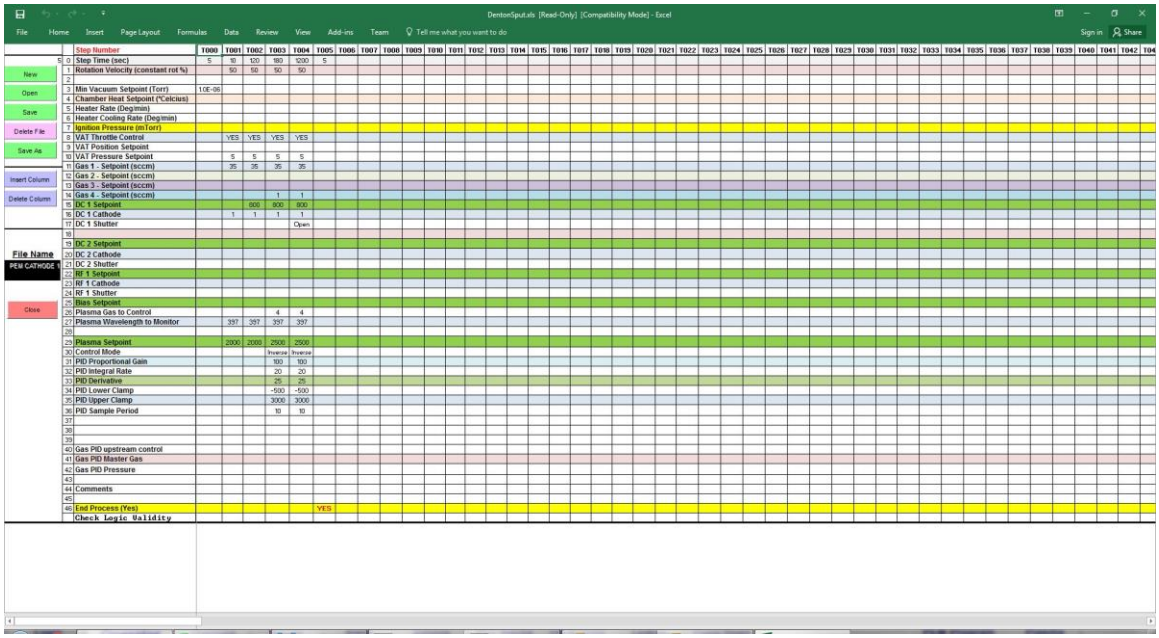
No	Function	Range	Description
27	Plasma Wavelength to Monitor	200 - 1100	Enter a desired plasma wavelength to monitor. (Detailed in Denton PEM Manual.)
28	Blank Row.		
29	Plasma Setpoint	0 – 64000	Select a desired Plasma set point.. (Detailed in Denton PEM Manual.)
30	Control Mode	Direct/Inverse	Select control mode. (Detailed in Denton PEM Manual.)
31	PID Proportional Gain	0 – 32000	Enter a desired proportional gain. (Detailed in Denton PEM Manual.)
32	PID Integral Rate	0 – 32000	Enter a desired integral rate. (Detailed in Denton PEM Manual.
33	PID Derivative	0 – 32000	Enter a desired derivative. (Detailed in Denton PEM Manual.
34	PID Lower Clamp	-32000– 32000	Enter a desired lower clamp. (Detailed in Denton PEM Manual.
35	PID Upper Clamp	32000– 32000	Enter a desired upper clamp. (Detailed in Denton PEM Manual.
36	PID Sample Period	0-32000	Enter a desired sample period. (Detailed in Denton PEM Manual.
37	Blank Row.		
38	Blank Row.		
39	Blank Row.		
40	Gas PID Upstream Control	(blank) or YES	Select value of YES to enable the gas PID Upstream Control. A blank entry defaults to as NO.
41	Gas PID Master Gas	1-4	Select a gas as a PID master gas.
42	Gas PID Pressure	0 – 32000	Enter PID pressure setpoint if running PID.

No	Function	Range	Description
43	Blank.		
44	Comments	Text	
45	Blank.		
46	End Process (Yes)	5 (Fixed)	The last step in every recipe must be YES.
	Check Logic Validity		

*** Please note: If more than one cathode is active during a deposition, the Frequency and Reverse Time setpoints for each cathode must be equal to the setpoints of DC1. This is to maintain the Sync/Pulse feature of the power supplies.**

T-STEP RECIPE EXAMPLE

Below is an example of a deposition recipe. The recipe consisting of 6 steps (columns).

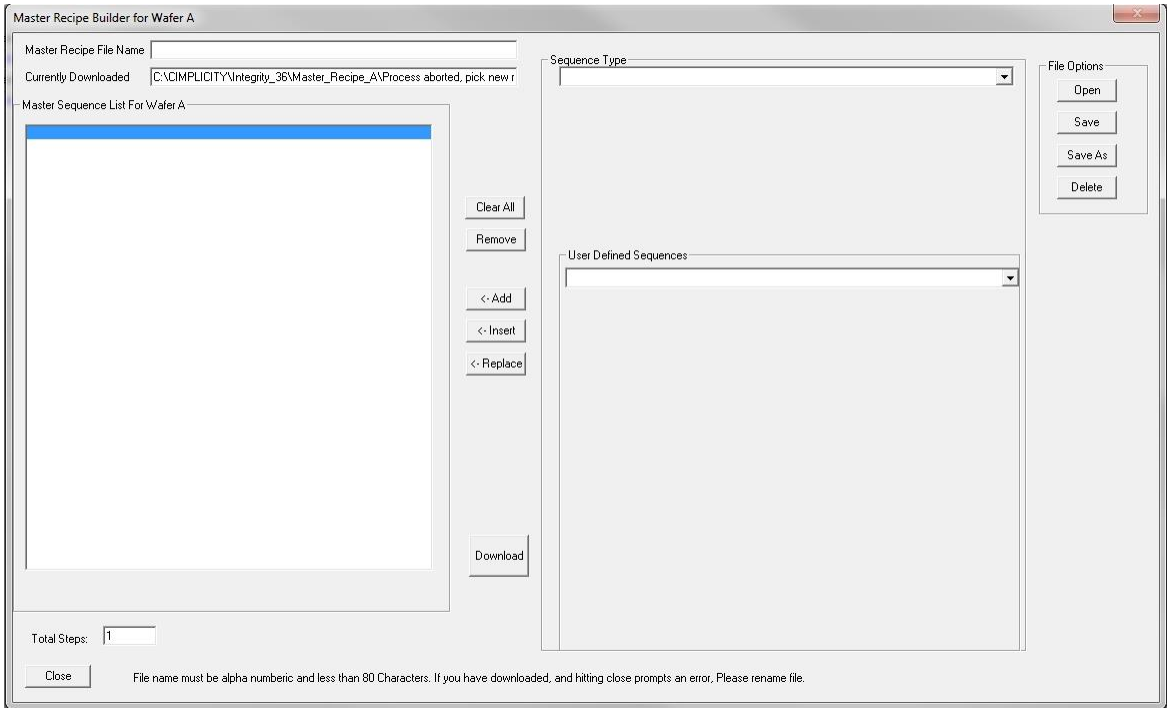


- To create a new recipe from an existing one, use the OPEN button and click on a recipe to highlight it and use the OPEN button on that page. The spreadsheet will populate the data boxes with the stored information in that file. You may edit the values and the T-Step commands.

- Using the COLUMN buttons you can insert steps as needed or delete steps Once the appropriate changes are made, click on the SAVE AS button, edit the recipe name for a new one, and ENTER.
- The new recipe name will show in the file box now. Click the CLOSE button to bring you back to the MASTER RECIPE screen.
- Once you have assigned a name and saved it, the recipe will be downloaded to the MASTER RECIPE FILE. It can now be retrieved in that page, by clicking on the EDIT/CREATE button.

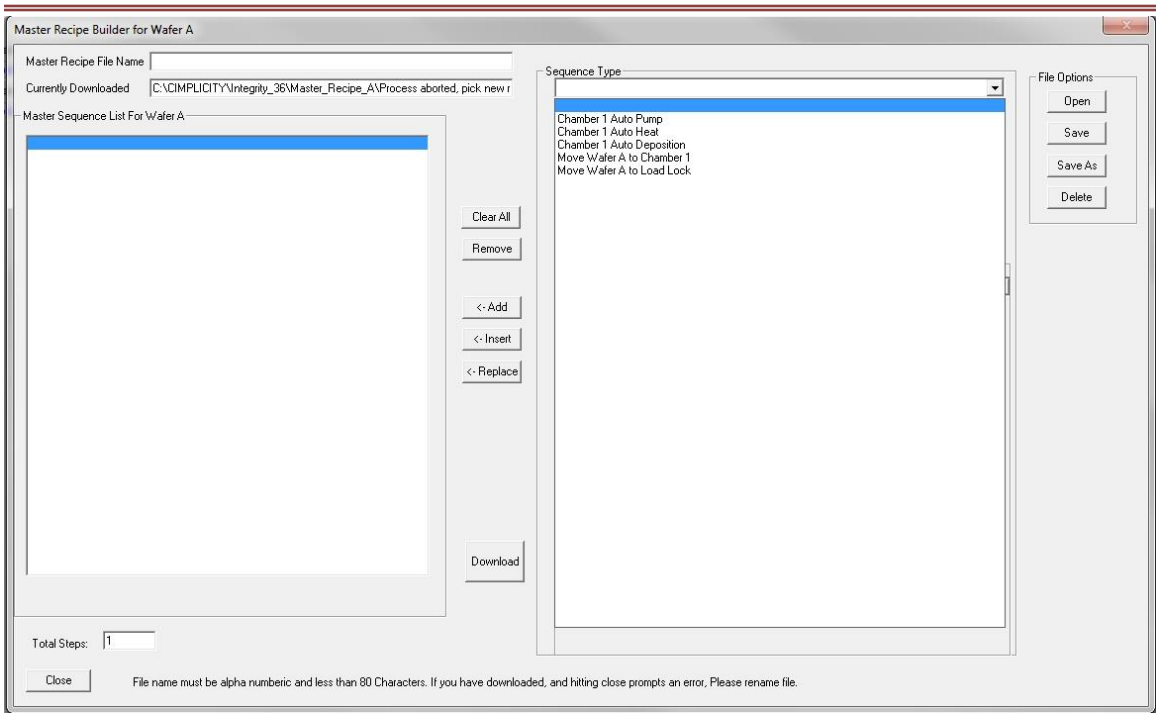
MASTER RECIPE BUILDER

Clicking on the Edit/Create button opens the blank **Master Recipe Builder** box.

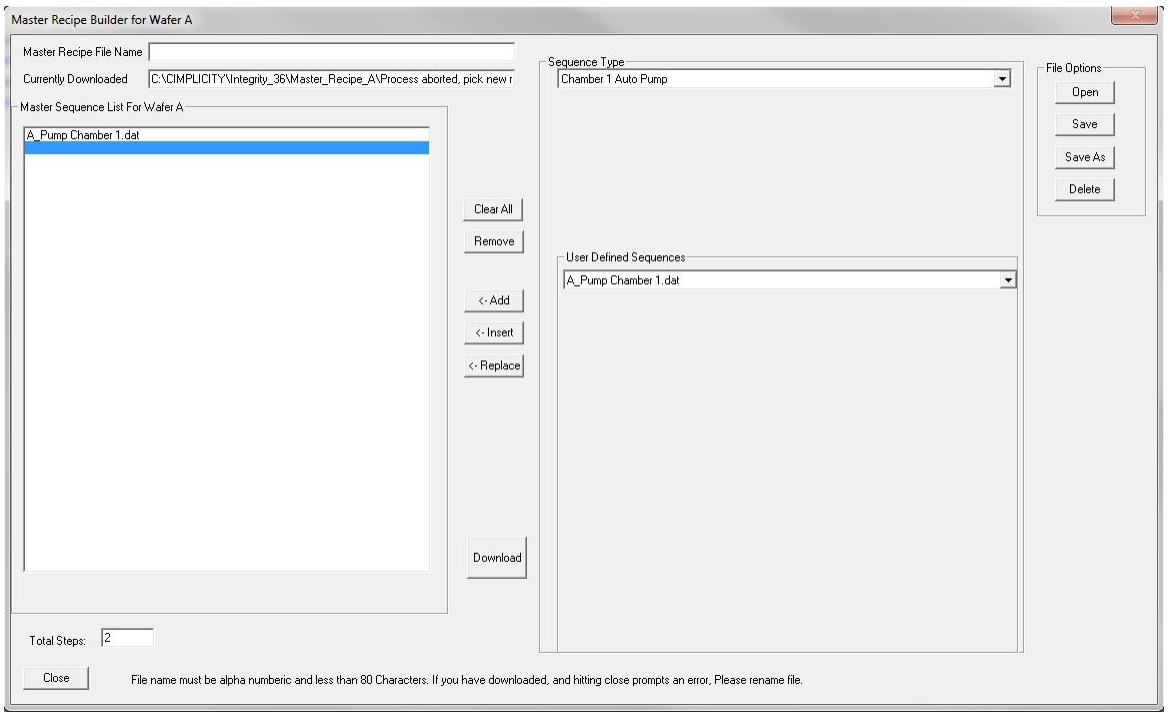


CREATE A NEW MASTER SEQUENCE RECIPE:

From the blank **Master Recipe Builder** box, open the dropdown box from the **Sequence Type** box:



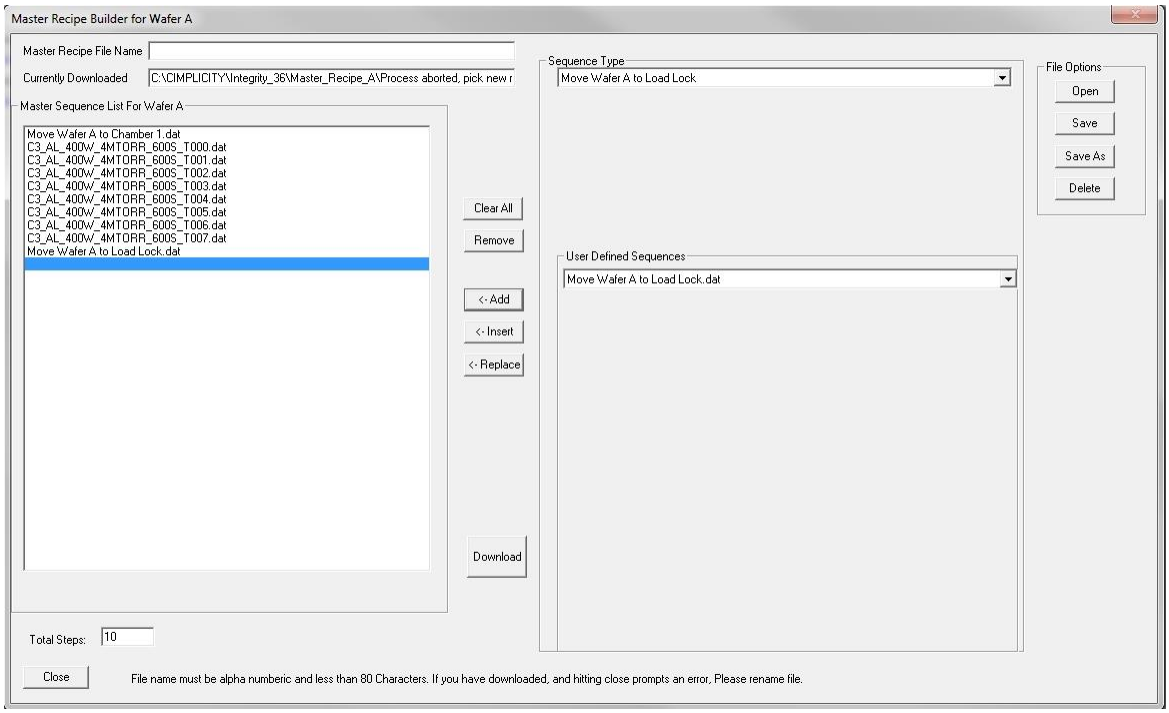
- Select any of the **Sequence Types**: Chamber Auto Pump, Chamber Auto Heat, Chamber Auto Deposition, Mover Wafer to Chamber, or Move Wafer to Load Lock. The sequence type will be highlighted in blue when properly selected.



- After selecting the Sequence Type (in this example, Auto Pump), open the dropdown box for the **User Defined Sequences**. In this box there will be recipes that were previously created in the Auto Pump Configuration screen.

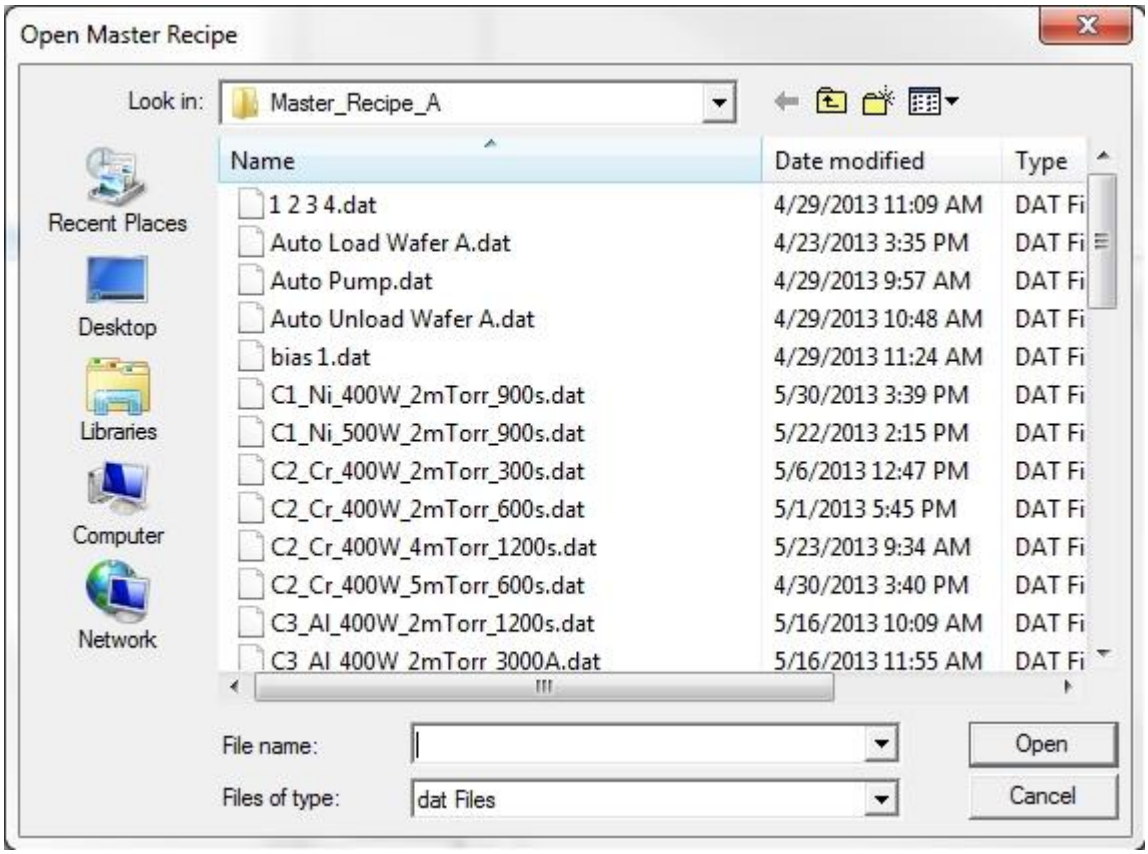
- Select the **User Defined Sequence** by highlighting in blue. Move the selected sequence to the **Master Sequence List** box by clicking on **Add** or **Insert**. In this example "A_Pump Chamber" was selected and added to the Master Sequence List.
- Repeat steps 1 – 4 until all the desired User Defined Sequences have been added to the **Master Sequence List. NOTE:** The previously created T-Step Recipes are stored in the **Auto Deposition Sequence Type**.
- After all the steps have been added, click on Save or Save As, and name the recipe.

Here is an example of a completed Master Sequence List:

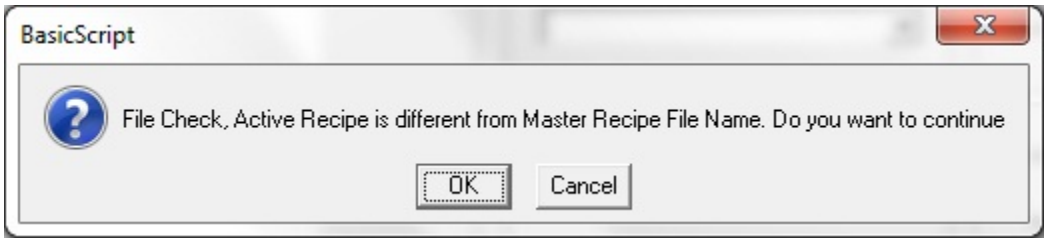


To edit an existing **Master Recipe** sequence:

From the **Master Recipe Builder** box, click on **Open** to display all recipes in the **Open Master Recipe** screen:



- Select the recipe to open or edit by highlighting it and clicking on **Open**.
- The Master Recipe Builder screen for the selected recipe will be opened.
- Edit the recipe using the **Clear All**, **Remove**, **Add, Insert** or **Replace** buttons.
- Click **Save** or (**Save As** and rename recipe if necessary)
- Click **Download** to make the current Master Recipe file displayed active and queued for process.
- Click on the **Close** button to close the Master Recipe Builder Screen.



- If the above screen appears, click **OK** to complete closing out of Master Recipe screen. Click **CANCEL** to keep the Master Recipe screen open and download the appropriate recipe.

FACTORY PROGRAMMED SEQUENCES

The following Non-Programmable Sequence Configurations are programmed at the factory and cannot be reprogrammed by an operator.

Auto Load is a factory-programmed recipe step used to automatically load a substrate from the load lock chamber to the substrate stage in the process Chamber. The Load Lock will automatically pump down if the pressure has exceeded the Crossover setpoint.

Auto Unload is a factory-programmed recipe step used to automatically unload a substrate from the substrate stage from the process Chamber to the Load Lock. The Load Lock will automatically pump down if the chamber pressure has exceeded the Crossover setpoint. The Unload sequence will NOT proceed until the Crossover pressure setpoint is reached.

Auto Loadlock Pump: is a factory-programmed recipe step used to automatically pumps down the Chamber. With reference to the loadlock vacuum gauge and relevant interlocks, the loadlock is automatically rough pumped from atmosphere via the mechanical to the crossover pressure. The sequence has completed once the crossover pressure is reached.

Auto Chamber Vent: The Chamber Auto Vent will automatically vent the chamber to atmospheric pressure with nitrogen. Upon executing the Chamber Auto Vent, the HiVac valve closes to isolate the pumping system, and then the Chamber Vent Valve opens. The Vent Valve remains open until the pressure reaches atmosphere and the door switch is disengaged.

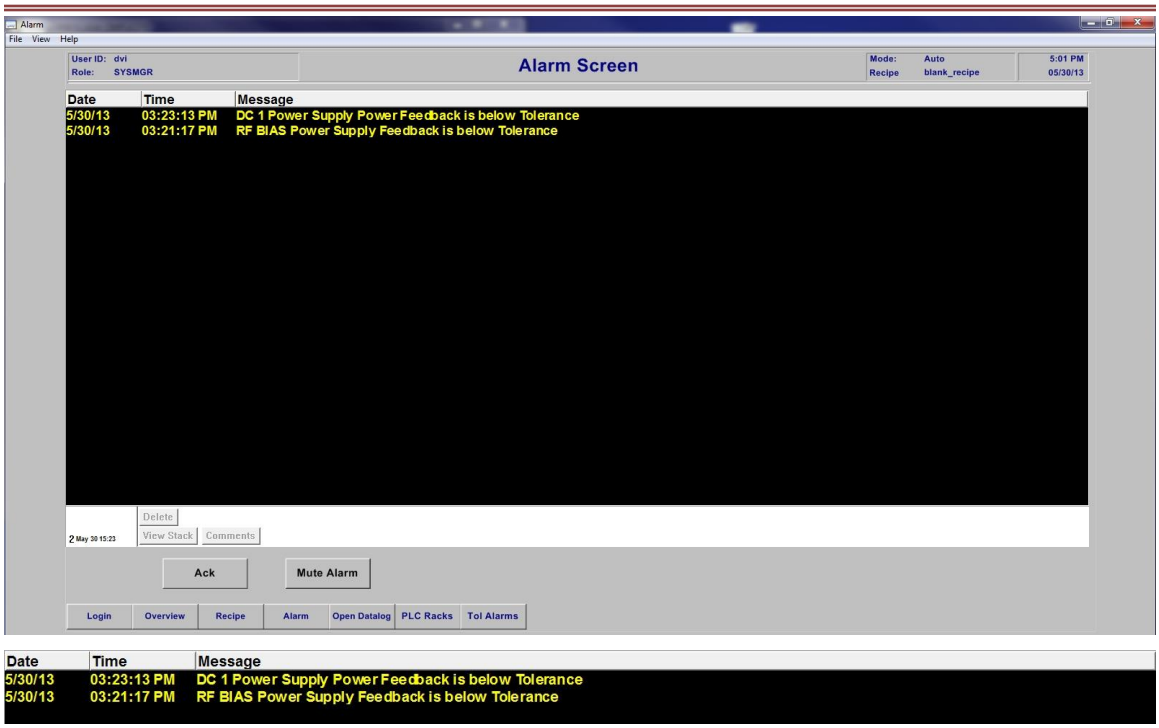
Auto Loadlock Vent: The Loadlock Auto Vent will automatically vent the loadlock to atmospheric pressure with nitrogen. Upon executing the Auto Loadlock Vent, the loadlock Vent Valve opens. The Vent Valve remains open until the pressure reaches atmosphere and the door switch is disengaged.

Auto Cryo Regen: is a factory-programmed recipe step used to automatically regen the cryogenic pump.

Auto Leak Up: is a factory-programmed recipe step used to automatically pumps performing the chamber leak up test for 30 minutes.

ALARM VIEW

When an alarm occurs, the information is posted in the Alarm View screen.

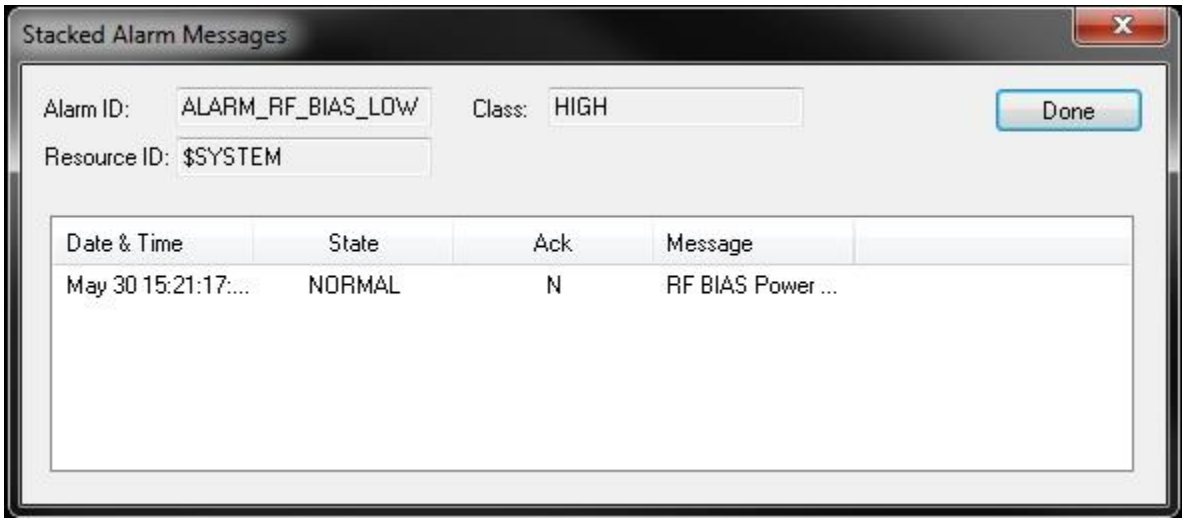


The Date, Time, Duration of alarm until it is acknowledged and Message describing the event are all listed on the Alarm View screen.

To silence the alarm, click on the **Ack** button on the lower left of the screen.

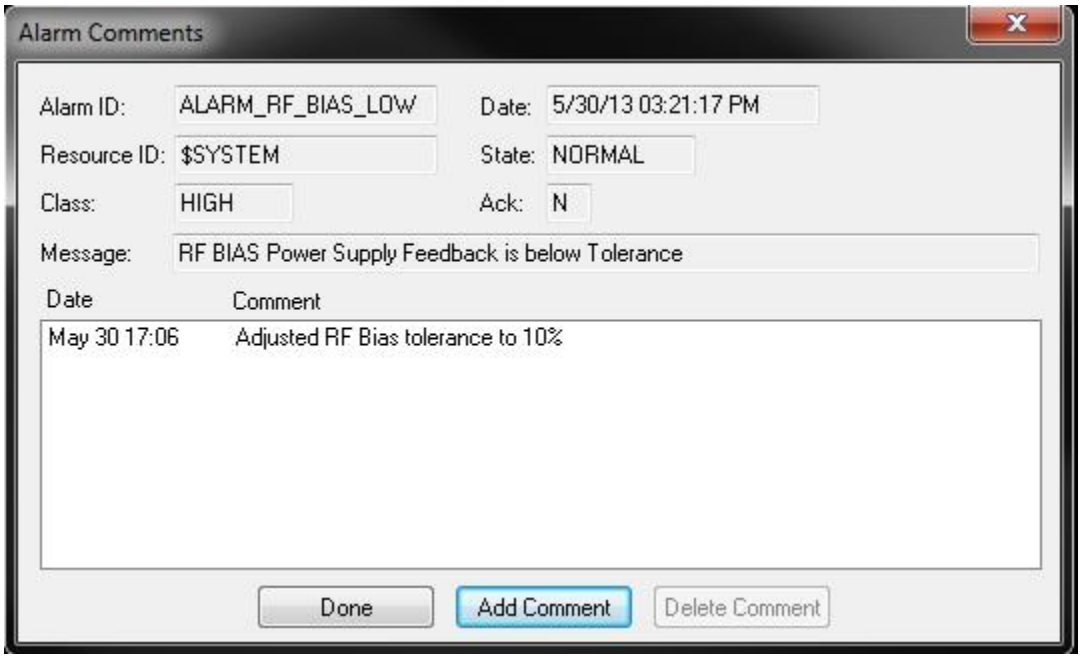
From this screen you can also access a history of an event. Highlight the event you want to access and select the **View Stack** button on the bottom left of the Alarm View screen.

The **Stacked Alarm Messages** screen for the selected event will appears as follows:

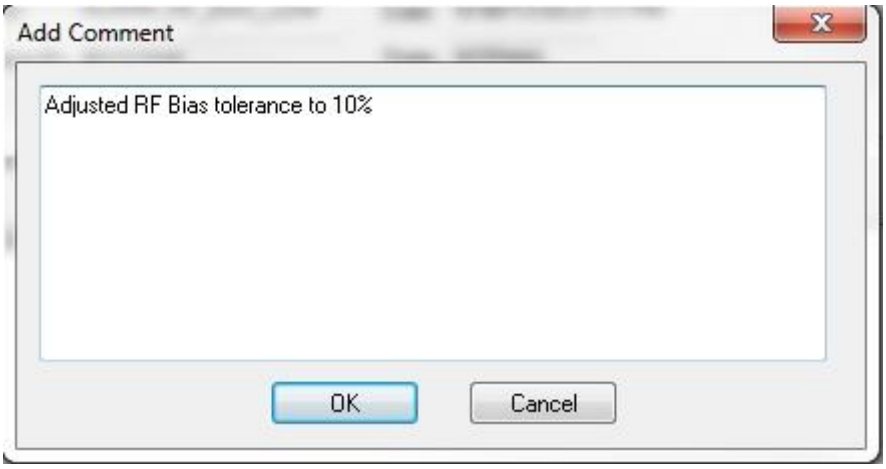


The Date & Time, State, if the alarm was acknowledged and Message describing the event of all the occurrences of this alarm will be listed.

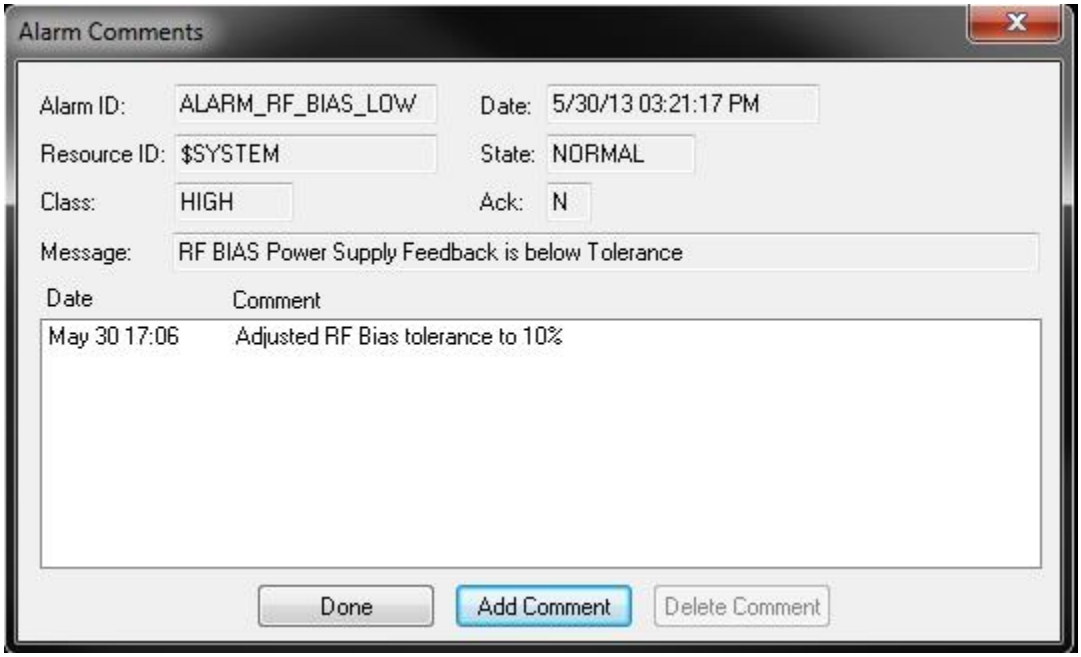
Comments pertaining to a specific event can also be added or viewed for the Alarm View screen. To view previously posted comments, highlight an event and select the **Comments** button. The **Alarm Comments** screen will appear as follows:



In order to add a comment, select the Add Comment button on the bottom of the **Alarm Comments** screen and the **Add Comment** screen will appear. Type in the comment you want to post for this event.

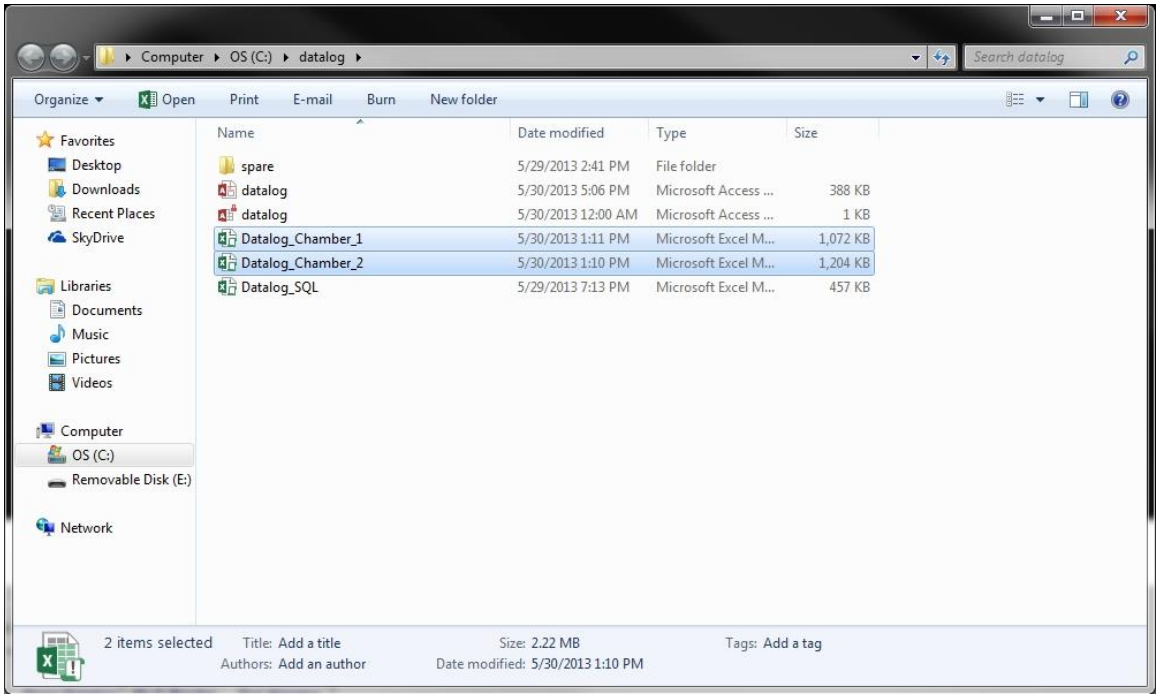


Press OK to post the comment to the Alarm Comments screen. The most recent comment will be posted on top:



Press Done to exit the Alarm Comments screen.

OPEN DATALOG

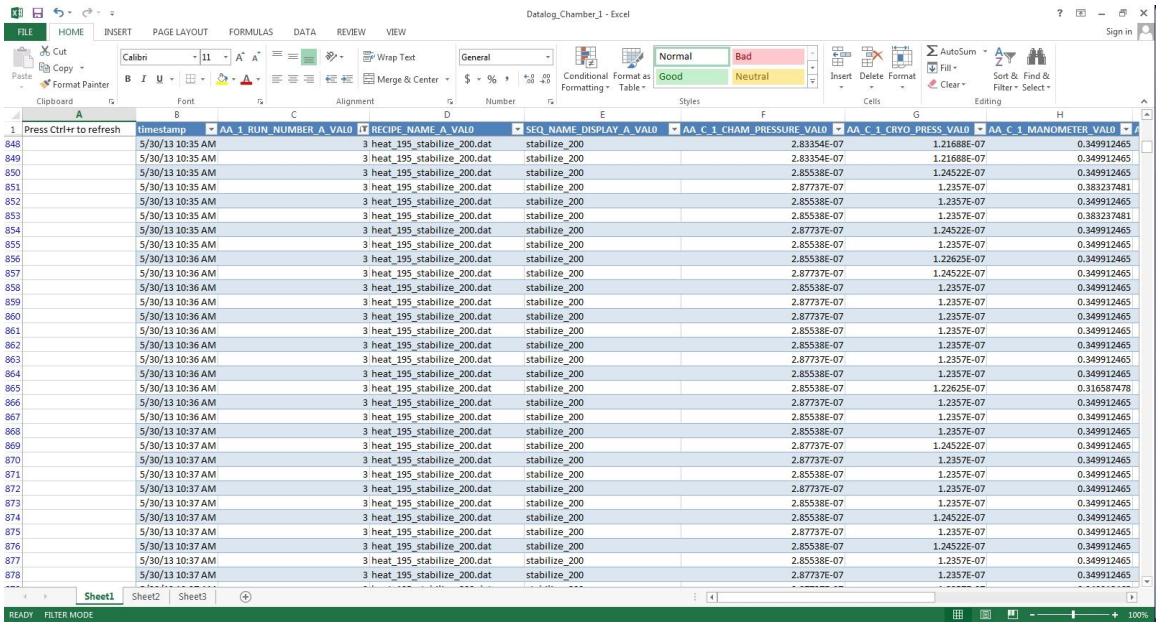


Process data is logged for each automatic process. An MS Access database file is generated per chamber. MS Access provides the ability for the end-user to develop customized Reports based on these database files.

Opening a file provides entrance to the MS Access database. Data from an automatic process is collected every five seconds and is available for analyses immediately after the process has

ended. At the completion of every automatic process, the datalog generates a database file and clears the datalog. A typical file is shown below.

NOTE: A number of Datalog functions are available on the PLC Racks screen.



- Data is time stamped.
- All displayed numeric values are recorded along with data specific to the process i.e. Recipe Name, Sequence Name, Operator, etc.
- Update by pressing Ctrl + r

NOTE: A number of Datalog functions are available on the PLC Racks screen.

DATALOG RESET

The Datalog Reset button clears and resets the Datalog files. This button is available in the PLC Racks screen in Service Mode only.

CAUTION: Datalog Reset will erase all of the data currently stored in the Datalog file.

MAXIMUM DATALOG FILE SIZE

NOTE: The maximum recommended file size for the Datalog file is 1 GB.

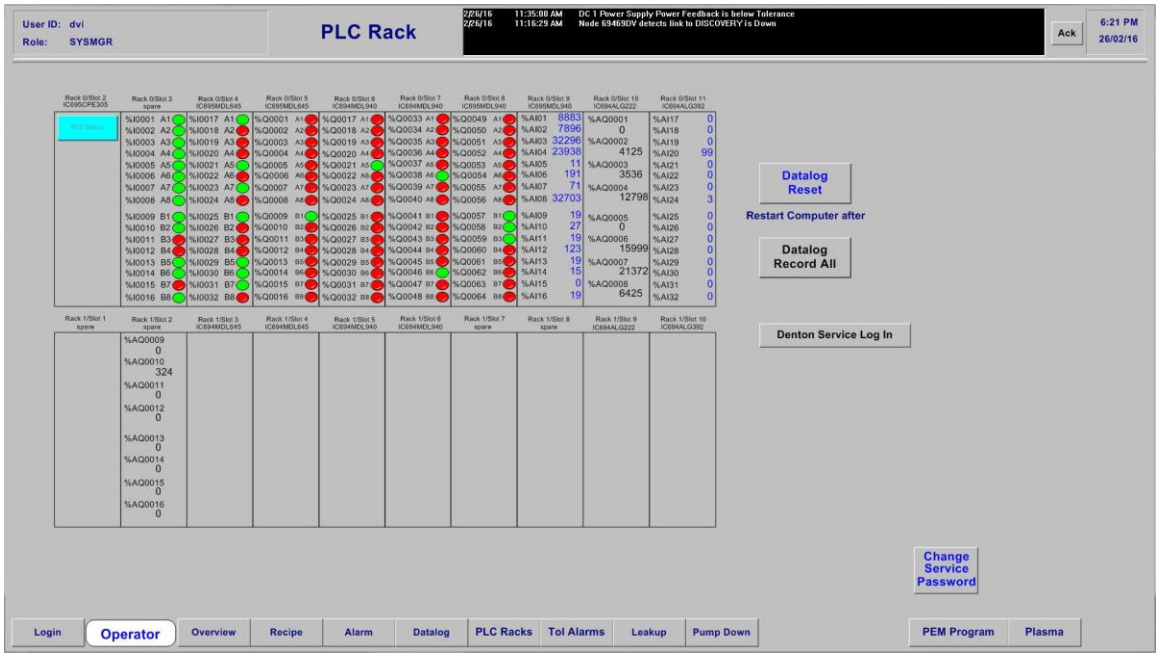
DATALOG ACTIVATION IN MANUAL MODE

NOTE: To activate the Datalog function in Manual Mode, use the Record All button on the PLC Racks screen.

RECORD ALL

The Record All button is used for troubleshooting purposes. It allows the continuous collection of system data while operating manually – similar to data logging during automatic recipe sequences.

PLC RACK



Service_Mode

The present status of all system I/O is displayed continuously on the PLC Rack screen.

This information along with the system schematics is used to troubleshoot the vacuum system controls. This screen can be used to verify the current status of an interlock, the current value of an analog input or output, or the current status of a digital input or output.

The PLC Status button provides access to operating software embedded in the PLC hardware that monitors the status of the PLC hardware.

CAUTION: Software interlocks are NOT active in Service Mode. Care must be taken to operate the vacuum system in Service Mode.

DATALOG RESET

The Datalog Reset button clears and resets the Datalog files. This button is available in the PLC Racks screen in Service Mode only.

CAUTION: Datalog Reset will erase all of the data currently stored in the Datalog file.

MAXIMUM DATALOG FILE SIZE

NOTE: The maximum recommended file size for the Datalog file is 1 GB.

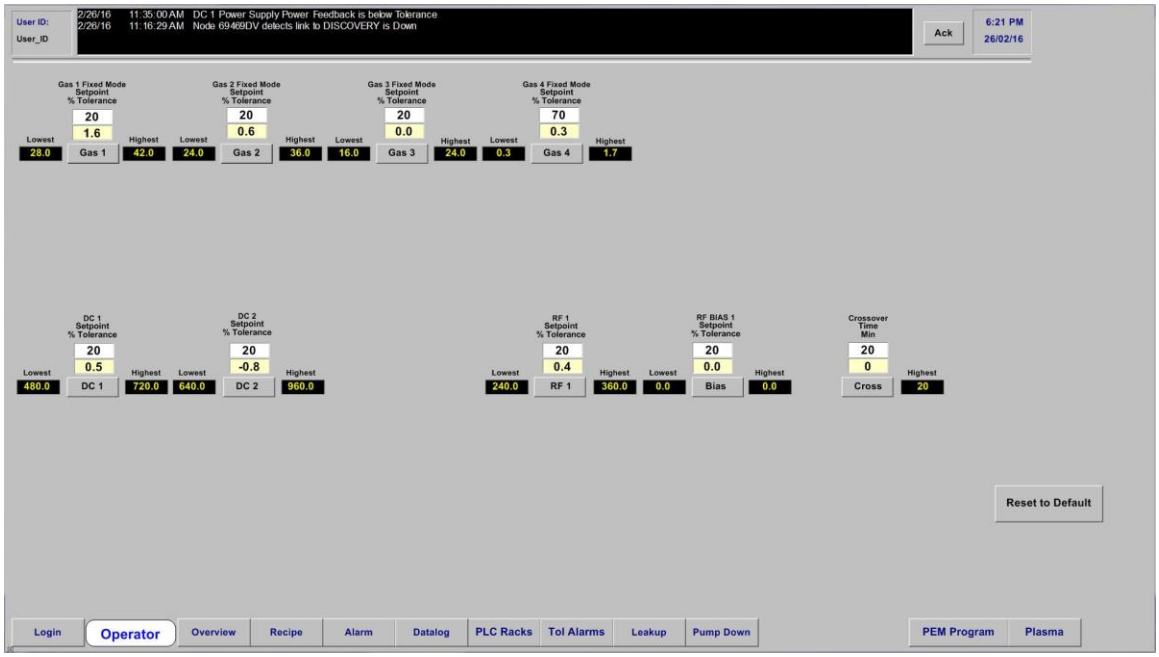
DATALOG ACTIVATION IN MANUAL MODE

NOTE: To activate the Datalog function in Manual Mode, use the Record All button on the PLC Racks screen.

RECORD ALL

The Record All button is used for troubleshooting purposes. It allows the continuous collection of system data while operating manually – similar to data logging during automatic recipe sequences.

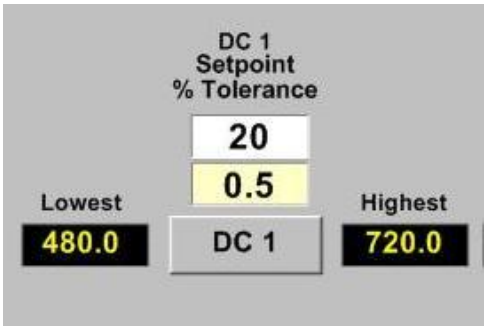
TOLERANCE ALARMS

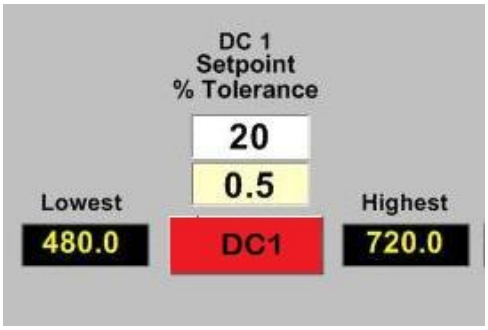


The **Tolerance Alarms** screen gives access to all of the adjustable setpoints for active Alarms. These tolerances can be modified on this screen.

CAUTION: Alarm setpoints can be adjusted at any time. Alarm setpoints should NOT be adjusted in Auto Mode.

Enter desired tolerance setpoint into the white data entry box. The digital value of the lowest and highsest setpoint will be displayed in two black boxes at all times. The actual value is displayed in the center yellow box. To set the alarm condition by press the button below the actual value display box: Grey = Alarm, Red = Abort Process.





TOLERANCE SETPOINT

When the actual value for a given parameter is displayed in grey and exceeds the tolerance limits, an audible alarm will sound and an Alarm message will be displayed. The process will continue to run.

When the actual value for a given parameter is displayed in red and exceeds the tolerance limits, an audible alarm will sound and an Alarm message will be displayed. The process will be ABORTED.

To set the system to abort the process if a value exceeds the tolerance setpoint, change the GREY readout button to RED by clicking on it.

 **CAUTION: Automatic processes can be ABORTED by setting the button below the slider to RED.**

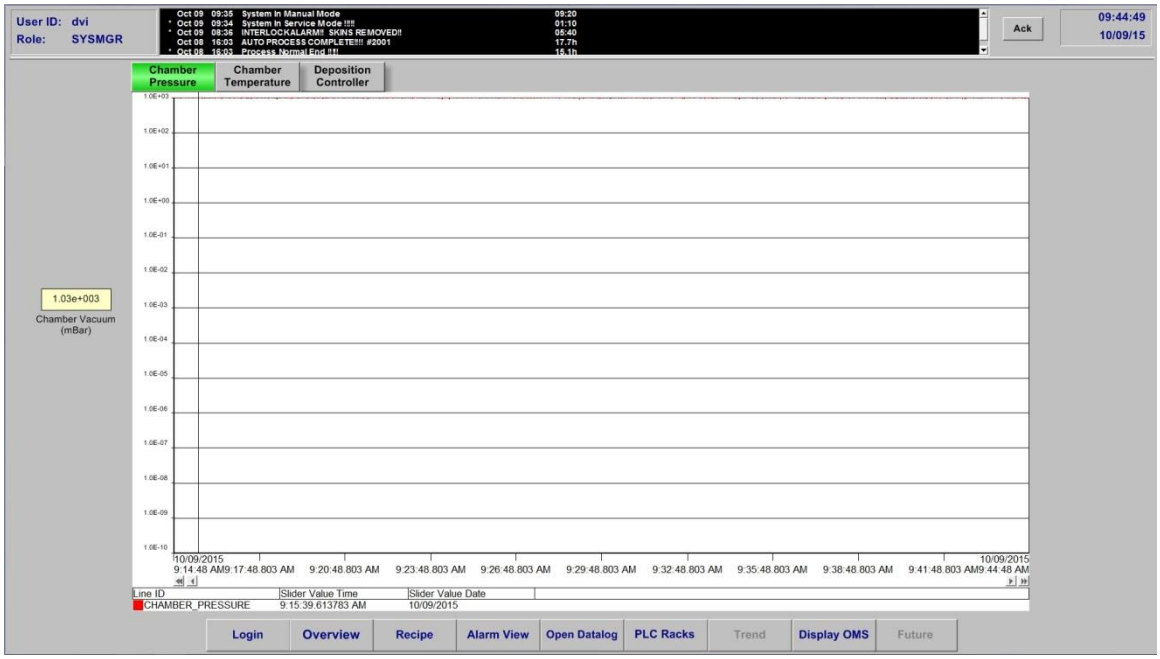
Text Messages linked to the Tolerance Alarms:

- Temperature Not at SetPoint!!!
- Gas #_ Not At Flow !!!!!
- DC Power Supply Not at Power !!!!
- RF Power Not at Power !!!!
- RF Bias Power Supply Not at Power !!!!
- Minimum Vacuum Pumpdown Not Met !!!!!

TRENDING

 **NOTE: The minimum scale on the vertical axis of the Trend screen is 0.01.**

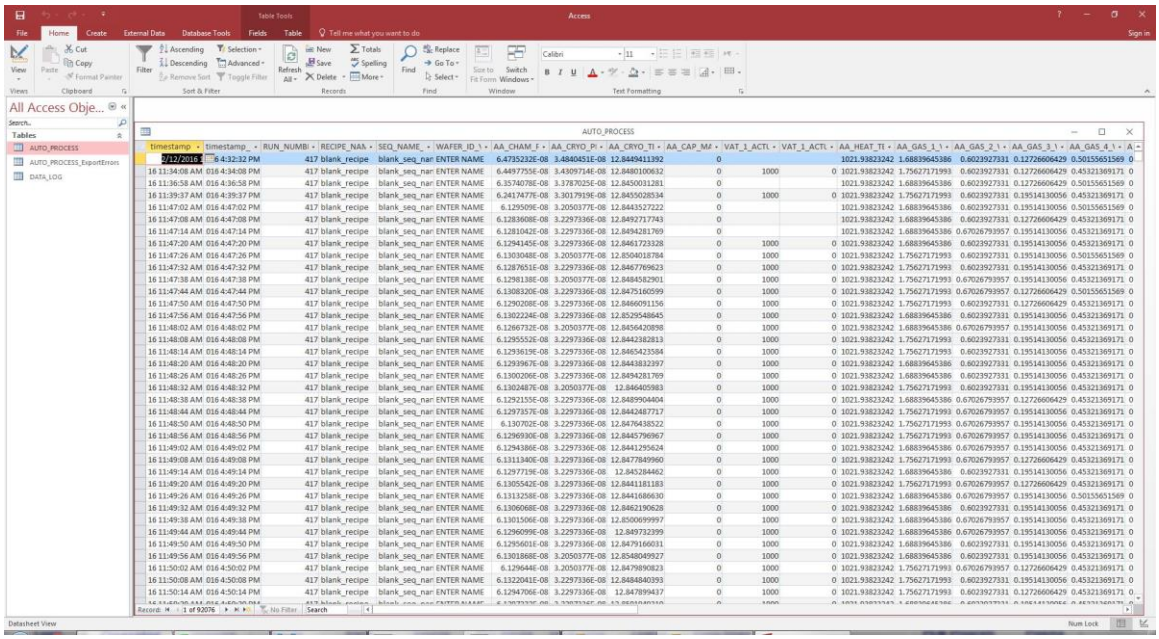
The Trend charts graphically display readings of main chamber pressure and temperature.



The charts can be modified for any length of time to track short term or long term trends. The Chamber Temperature scale can also be modified to a desired temperature range.

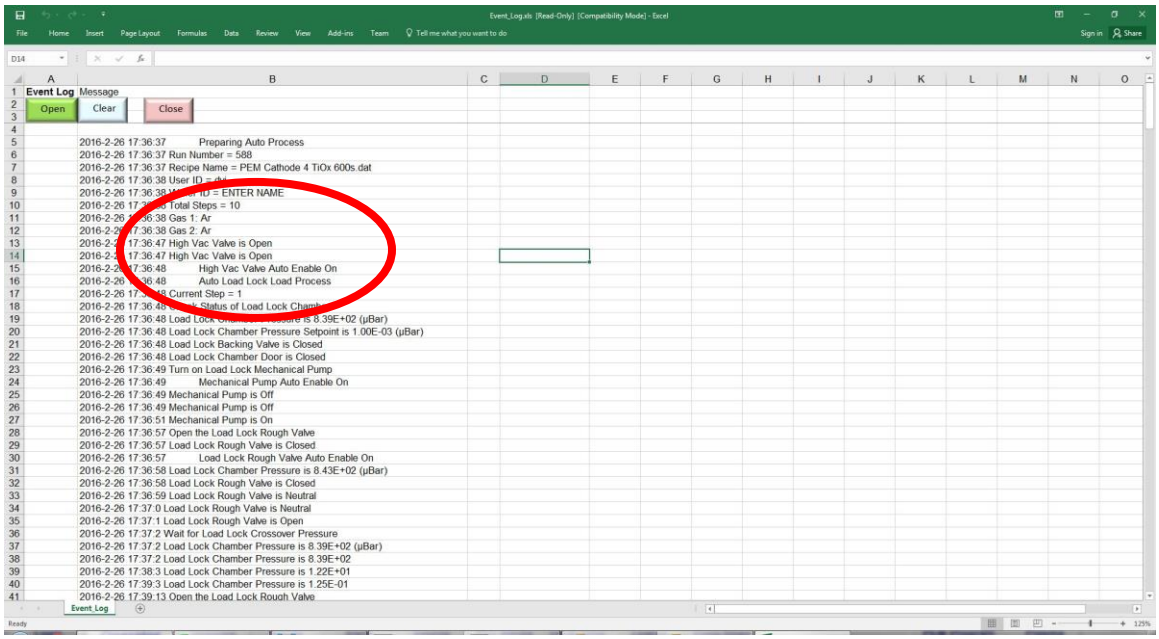
DATA LOG

ACCESS DATALOG



- Data Log File – Click Access Datalog on the datalog screen to access the data log file which logs all the auto deposition events.
- The data log file is in SQL format.

EVENT LOG

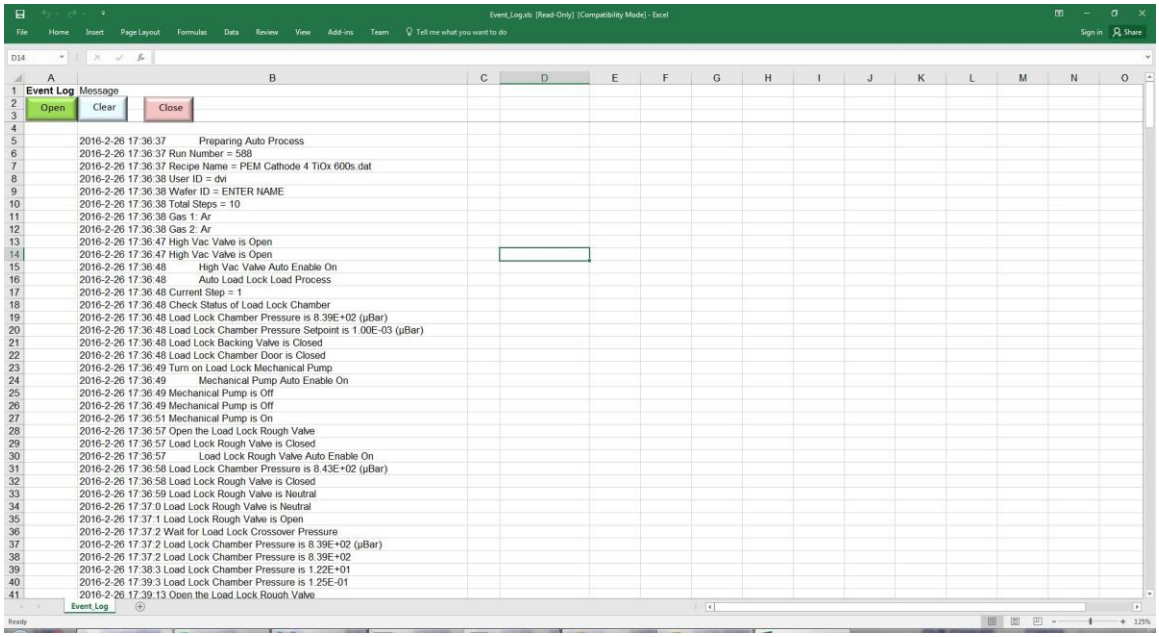


- Event Log – Click Event Log to access on the datalog screen the Event Log folder.
- The Event Log file is in Excel format.

- The Event Log file is in numerical order.
- The data which selected in the deposition file (T-steps) will be recorded in Event Log file.
- Two Event Log files, an (auto) event log file and a new (manual) event log file, will be created when an auto process is executed.
- The (auto) event log file will record the entire event of the current auto process.
- The (manual) Event Log file will save all the manual events happened between the previous auto process and the current auto process. The (manual) Event Log file will be deleted if there is no event between the previous auto process and the current auto process.

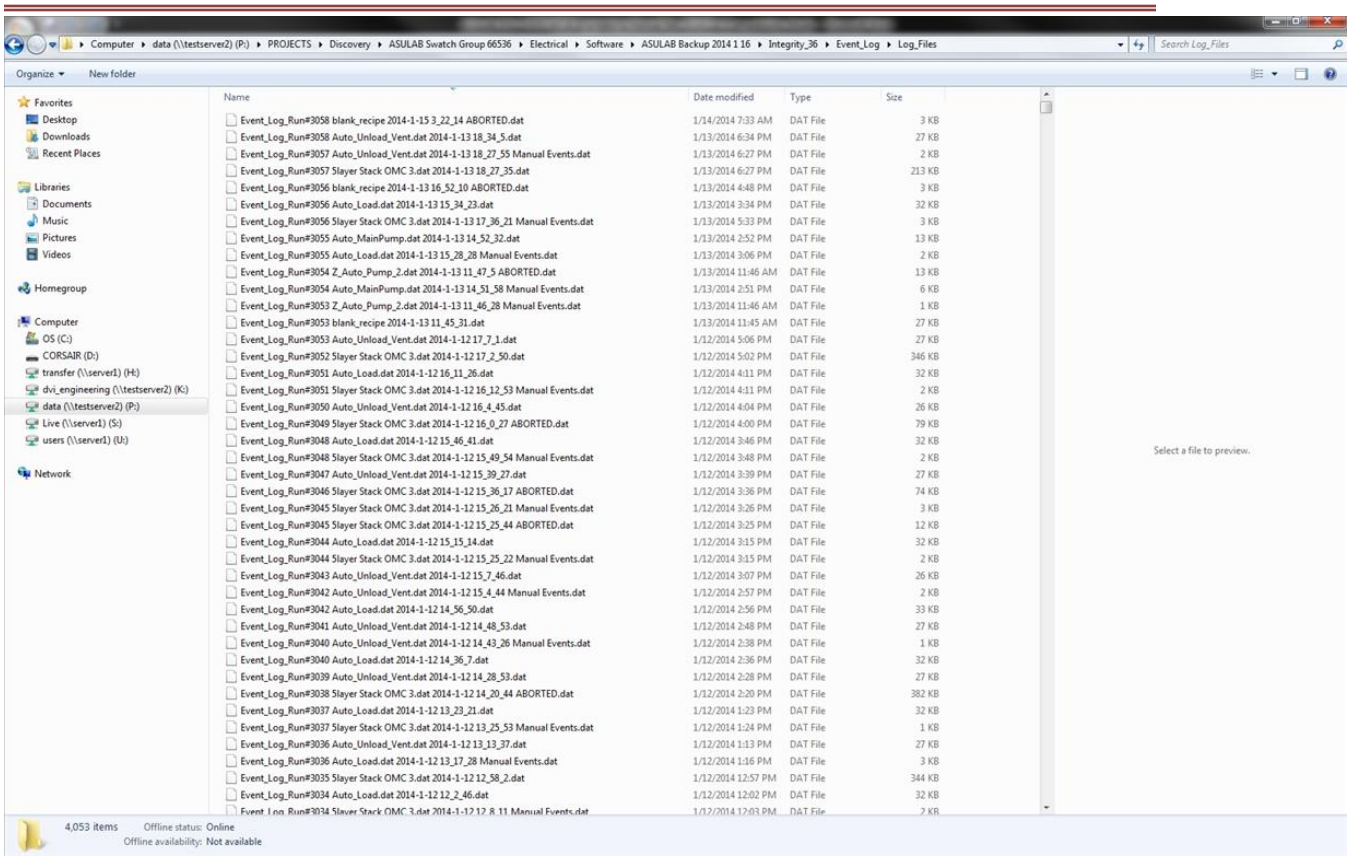
OPEN, CLEAR AND CLOSE THE EVENT LOG FILE

Click the "Event Log" button on Event Log Screen to access this screen.

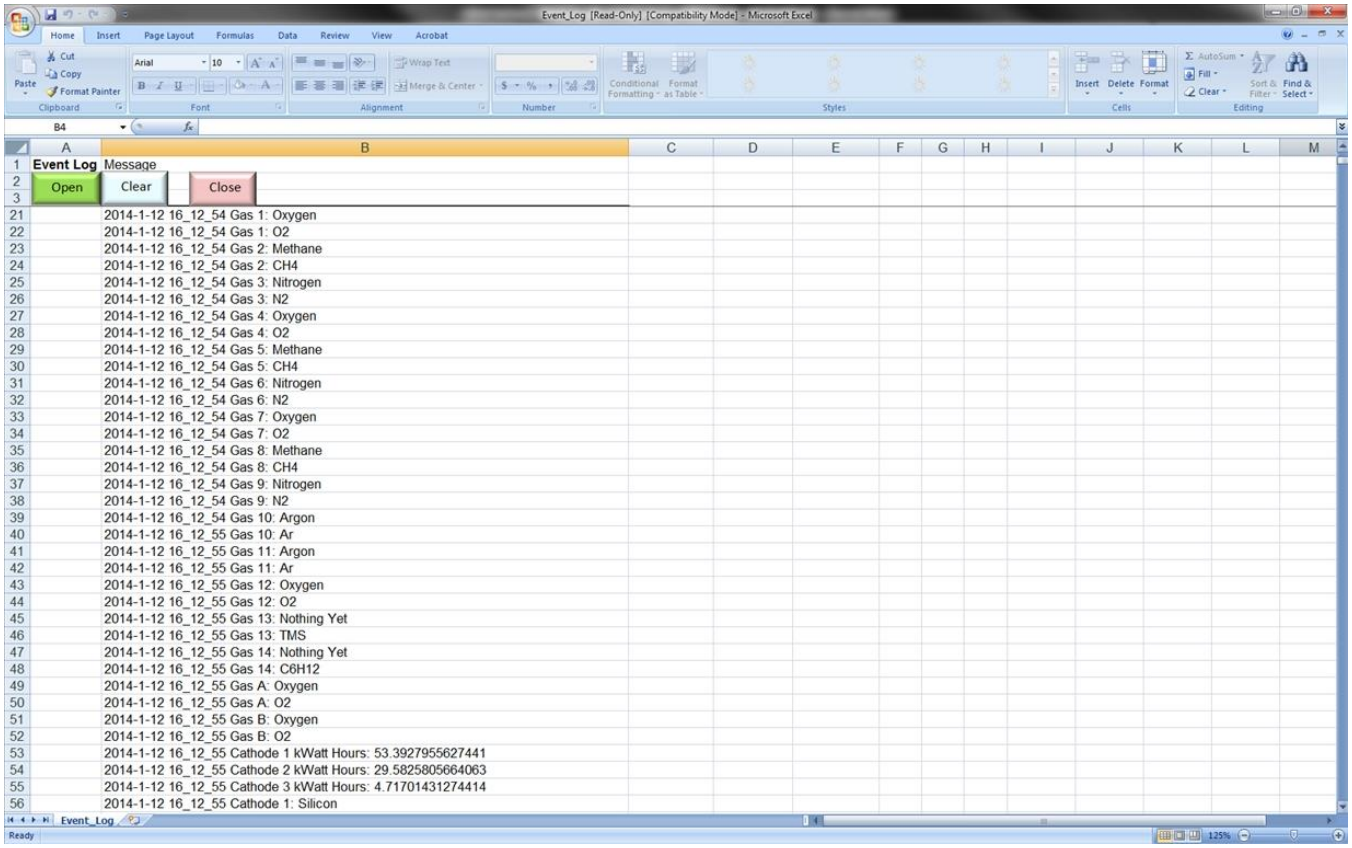


- Open – To open an Event Log file.
- Clear – To delete an Event Log file.
- Close – To close an Event Log file and return the Event Log Screen.

Click the "Open" button to open the Event Log folder.

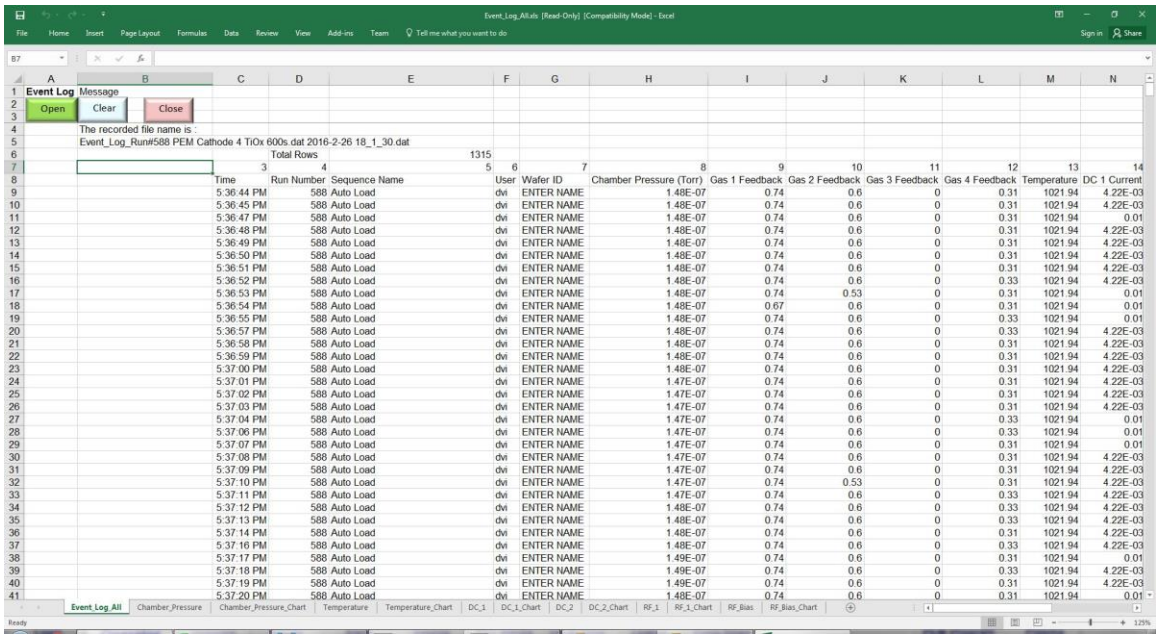


Select a desired event log file to open.



Event Log	Message
Open	Clear	Close
2014-1-12 16_12_54 Gas 1: Oxygen
2014-1-12 16_12_54 Gas 1: O2
2014-1-12 16_12_54 Gas 2: Methane
2014-1-12 16_12_54 Gas 2: CH4
2014-1-12 16_12_54 Gas 3: Nitrogen
2014-1-12 16_12_54 Gas 3: N2
2014-1-12 16_12_54 Gas 4: Oxygen
2014-1-12 16_12_54 Gas 4: O2
2014-1-12 16_12_54 Gas 5: Methane
2014-1-12 16_12_54 Gas 5: CH4
2014-1-12 16_12_54 Gas 6: Nitrogen
2014-1-12 16_12_54 Gas 6: N2
2014-1-12 16_12_54 Gas 7: Oxygen
2014-1-12 16_12_54 Gas 7: O2
2014-1-12 16_12_54 Gas 8: Methane
2014-1-12 16_12_54 Gas 8: CH4
2014-1-12 16_12_54 Gas 9: Nitrogen
2014-1-12 16_12_54 Gas 9: N2
2014-1-12 16_12_54 Gas 10: Argon
2014-1-12 16_12_55 Gas 10: Ar
2014-1-12 16_12_55 Gas 11: Argon
2014-1-12 16_12_55 Gas 11: Ar
2014-1-12 16_12_55 Gas 12: Oxygen
2014-1-12 16_12_55 Gas 12: O2
2014-1-12 16_12_55 Gas 13: Nothing Yet
2014-1-12 16_12_55 Gas 13: TMS
2014-1-12 16_12_55 Gas 14: Nothing Yet
2014-1-12 16_12_55 Gas 14: C6H12
2014-1-12 16_12_55 Gas A: Oxygen
2014-1-12 16_12_55 Gas A: O2
2014-1-12 16_12_55 Gas B: Oxygen
2014-1-12 16_12_55 Gas B: O2
2014-1-12 16_12_55 Cathode 1 kWatt Hours: 53.3927955627441
2014-1-12 16_12_55 Cathode 2 kWatt Hours: 29.5825805664063
2014-1-12 16_12_55 Cathode 3 kWatt Hours: 4.71701431274414
2014-1-12 16_12_55 Cathode 1: Silicon

EVENT LOG ALL INFO



Event Log	Message
Open	Clear	Close
The recorded file name is :
Event_Log_Run#588 PEM Cathode 4 TiOx 600s.dat 2016-2-26 18_1_30.dat
Total Rows	1315

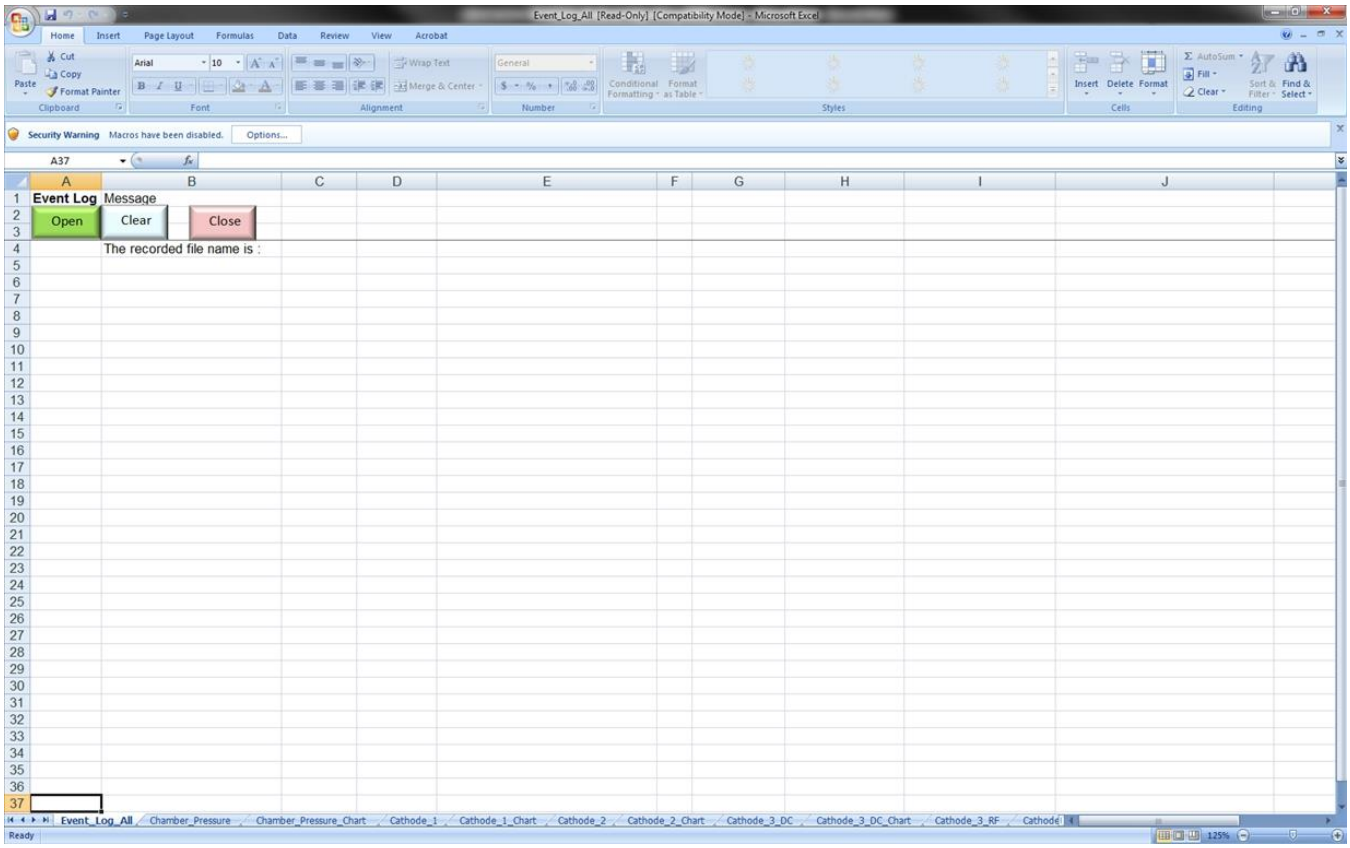
	3	4	5	6	7	8	9	10	11	12	13	14
	Time	Run Number	Sequence Name	User	Wafer ID	Chamber Pressure (Torr)	Gas 1 Feedback	Gas 2 Feedback	Gas 3 Feedback	Gas 4 Feedback	Temperature	DC 1 Current
	5:36:44 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:36:45 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:36:47 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	0.01
	5:36:48 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:36:49 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:36:50 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:36:51 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:36:52 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.33	1021.94	4.22E-03
	5:36:53 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.53	0	0.31	1021.94	0.01
	5:36:54 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.67	0.6	0	0.31	1021.94	0.01
	5:36:55 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.33	1021.94	0.01
	5:36:57 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.33	1021.94	4.22E-03
	5:36:58 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:36:59 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:37:00 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:37:01 PM	588	Auto Load	dvi	ENTER NAME	1.47E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:37:02 PM	588	Auto Load	dvi	ENTER NAME	1.47E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:37:03 PM	588	Auto Load	dvi	ENTER NAME	1.47E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:37:04 PM	588	Auto Load	dvi	ENTER NAME	1.47E-07	0.74	0.6	0	0.33	1021.94	0.01
	5:37:06 PM	588	Auto Load	dvi	ENTER NAME	1.47E-07	0.74	0.6	0	0.33	1021.94	0.01
	5:37:07 PM	588	Auto Load	dvi	ENTER NAME	1.47E-07	0.74	0.6	0	0.31	1021.94	0.01
	5:37:08 PM	588	Auto Load	dvi	ENTER NAME	1.47E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:37:09 PM	588	Auto Load	dvi	ENTER NAME	1.47E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:37:10 PM	588	Auto Load	dvi	ENTER NAME	1.47E-07	0.74	0.53	0	0.31	1021.94	4.22E-03
	5:37:11 PM	588	Auto Load	dvi	ENTER NAME	1.47E-07	0.74	0.6	0	0.33	1021.94	4.22E-03
	5:37:12 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.33	1021.94	4.22E-03
	5:37:13 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.33	1021.94	4.22E-03
	5:37:14 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:37:16 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.33	1021.94	4.22E-03
	5:37:17 PM	588	Auto Load	dvi	ENTER NAME	1.49E-07	0.74	0.6	0	0.31	1021.94	0.01
	5:37:18 PM	588	Auto Load	dvi	ENTER NAME	1.49E-07	0.74	0.6	0	0.33	1021.94	4.22E-03
	5:37:19 PM	588	Auto Load	dvi	ENTER NAME	1.49E-07	0.74	0.6	0	0.31	1021.94	4.22E-03
	5:37:20 PM	588	Auto Load	dvi	ENTER NAME	1.48E-07	0.74	0.6	0	0.31	1021.94	0.01

- Event Log All Info – Click Event Log All Info to access the Event Log All Info.
- The Event Log All Info is in numerical order too.

- The Event Log All is in Excel format.
- All the data associated with event will be recorded in Log Event All Info file.
- An Event Log All file will be created when an auto process is executed.
- The (auto) event log file will record the entire event of the current auto process.

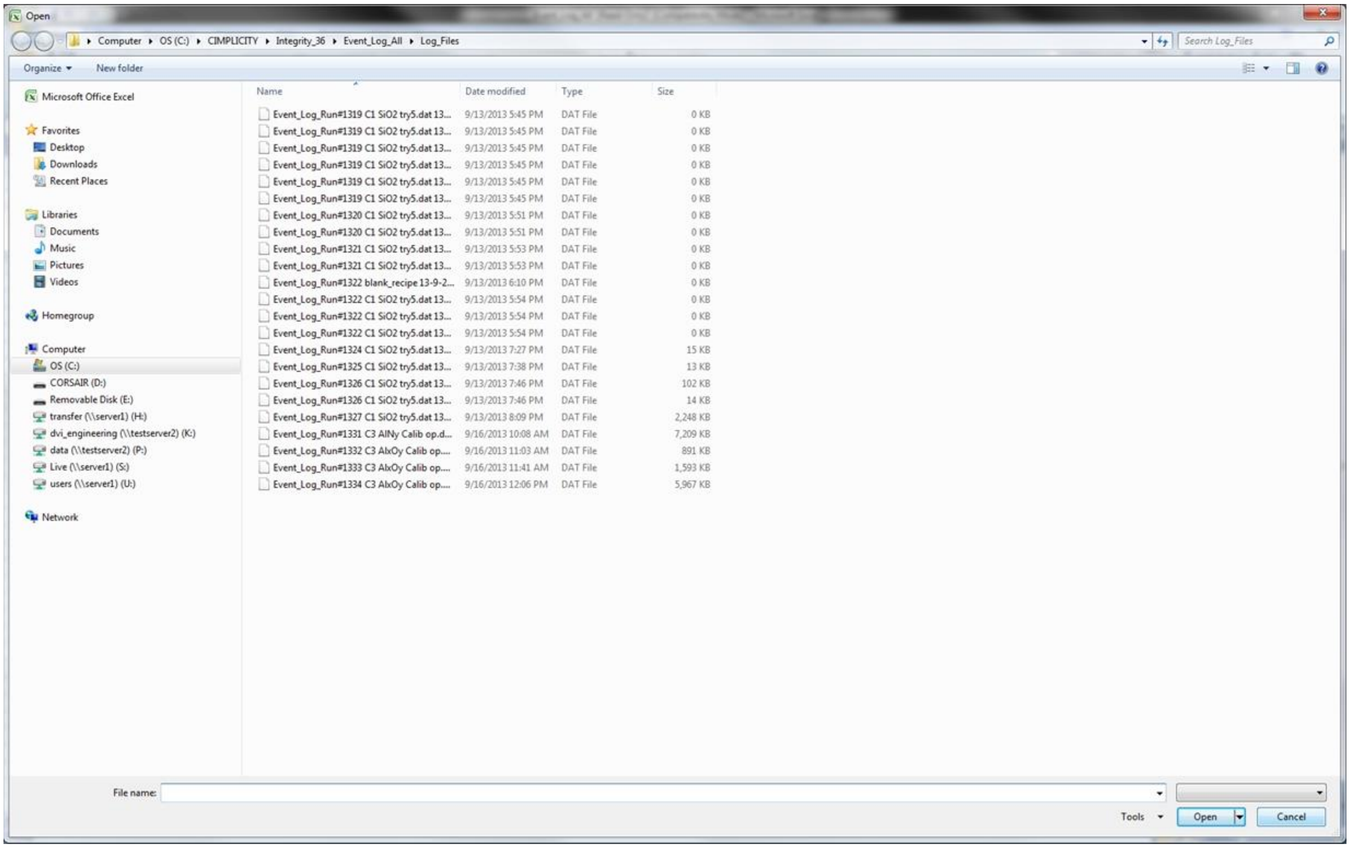
OPEN, CLEAR AND CLOSE THE EVENT LOG FILE

Click the "Event Log" button on Event Log Screen to access this screen.



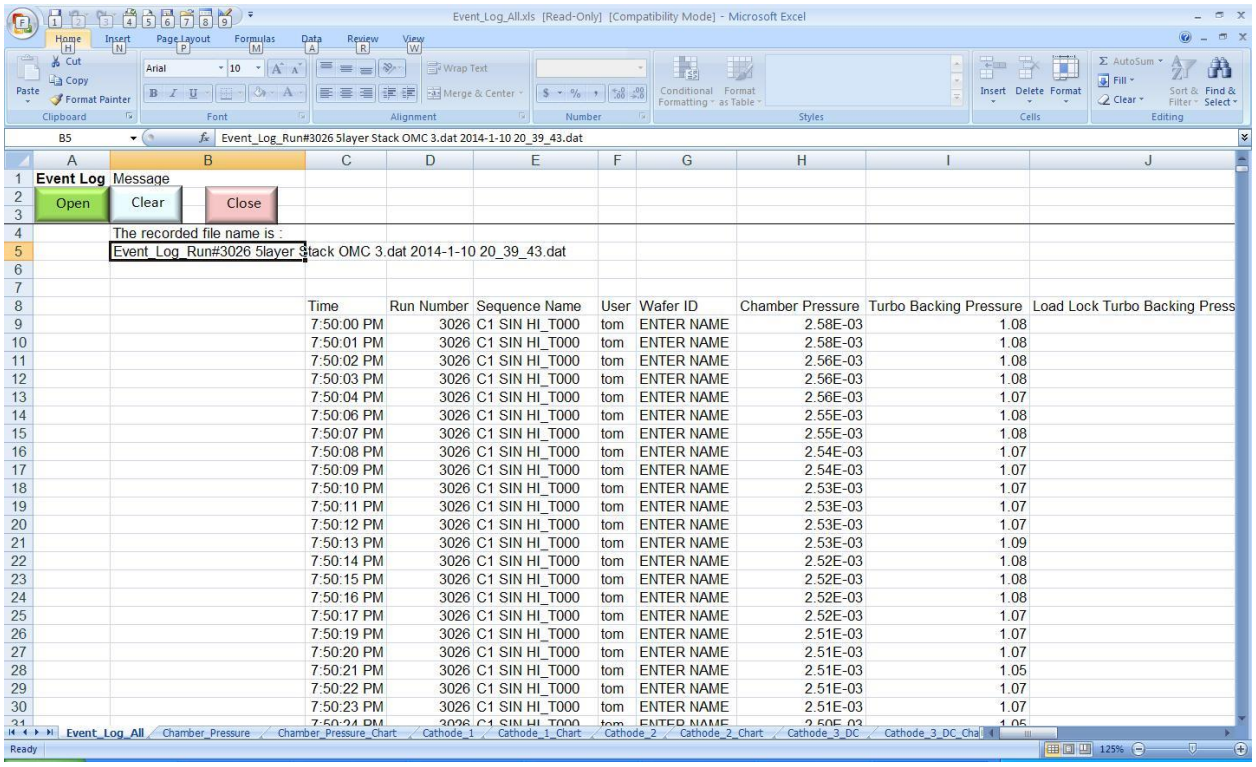
- Open – To open an Event Log All file.
- Clear – To delete an Event Log All file.
- Close – To close an Event Log file and return the Event Log screen.

Click the "Open" button to open the Event Log All folder.



Select a desired event log all file to open. Below are some Event Log All data file sample screens.

Event Log All Data:



Event_Log_All.xls [Read-Only] [Compatibility Mode] - Microsoft Excel

B5: Event_Log_Run#3026 5layer Stack OMC 3.dat 2014-1-10 20_39_43.dat

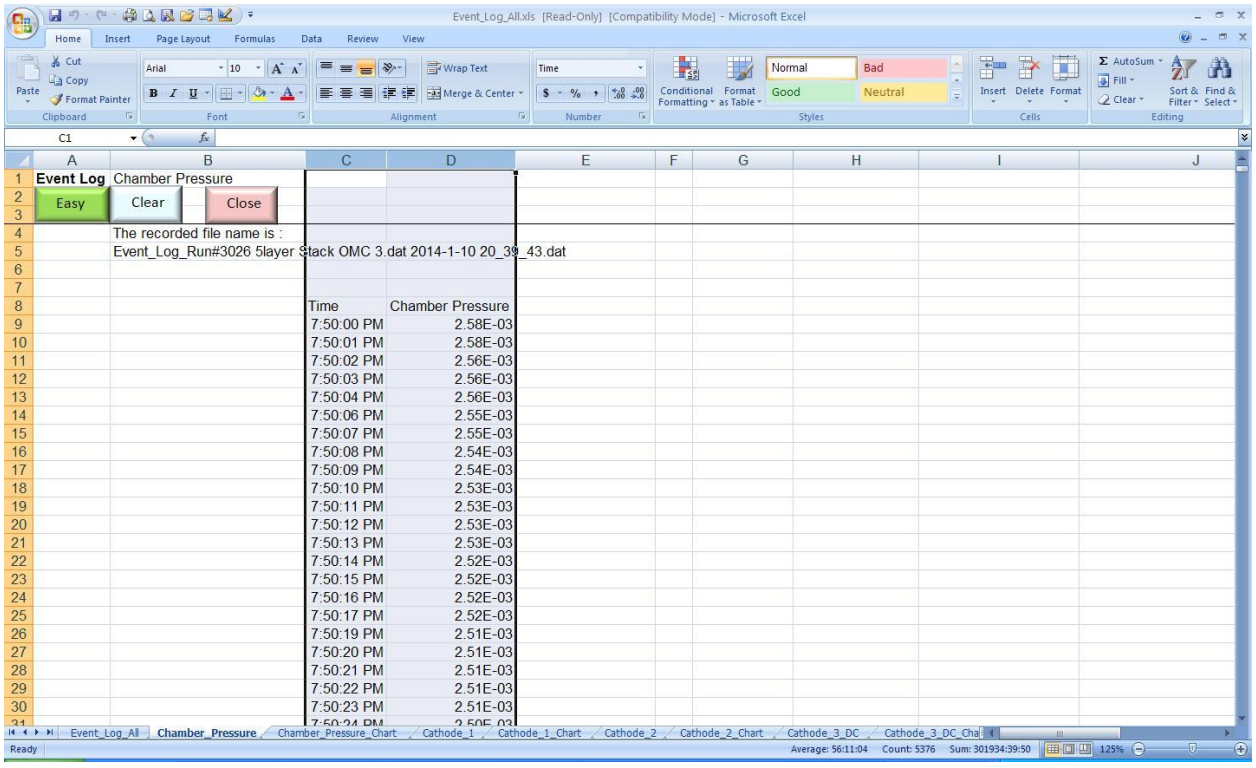
Event Log	Message
Open	Clear
Close	

The recorded file name is :
Event_Log_Run#3026 5layer Stack OMC 3.dat 2014-1-10 20_39_43.dat

Time	Run Number	Sequence Name	User	Wafer ID	Chamber Pressure	Turbo Backing Pressure	Load Lock Turbo Backing Press
7:50:00 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.58E-03	1.08	
7:50:01 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.58E-03	1.08	
7:50:02 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.56E-03	1.08	
7:50:03 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.56E-03	1.08	
7:50:04 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.56E-03	1.07	
7:50:06 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.55E-03	1.08	
7:50:07 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.55E-03	1.08	
7:50:08 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.54E-03	1.07	
7:50:09 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.54E-03	1.07	
7:50:10 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.53E-03	1.07	
7:50:11 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.53E-03	1.07	
7:50:12 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.53E-03	1.07	
7:50:13 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.53E-03	1.09	
7:50:14 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.52E-03	1.08	
7:50:15 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.52E-03	1.08	
7:50:16 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.52E-03	1.08	
7:50:17 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.52E-03	1.07	
7:50:19 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.51E-03	1.07	
7:50:20 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.51E-03	1.07	
7:50:21 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.51E-03	1.05	
7:50:22 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.51E-03	1.07	
7:50:23 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.51E-03	1.07	
7:50:24 PM	3026	C1 SIN HI_T000	tom	ENTER NAME	2.50E-03	1.05	

Sheets: Event_Log_All | Chamber_Pressure | Chamber_Pressure_Chart | Cathode_1 | Cathode_1_Chart | Cathode_2 | Cathode_2_Chart | Cathode_3_DC | Cathode_3_DC_Cha

Chamber Pressure Data:



Event_Log_All.xls [Read-Only] [Compatibility Mode] - Microsoft Excel

C1:

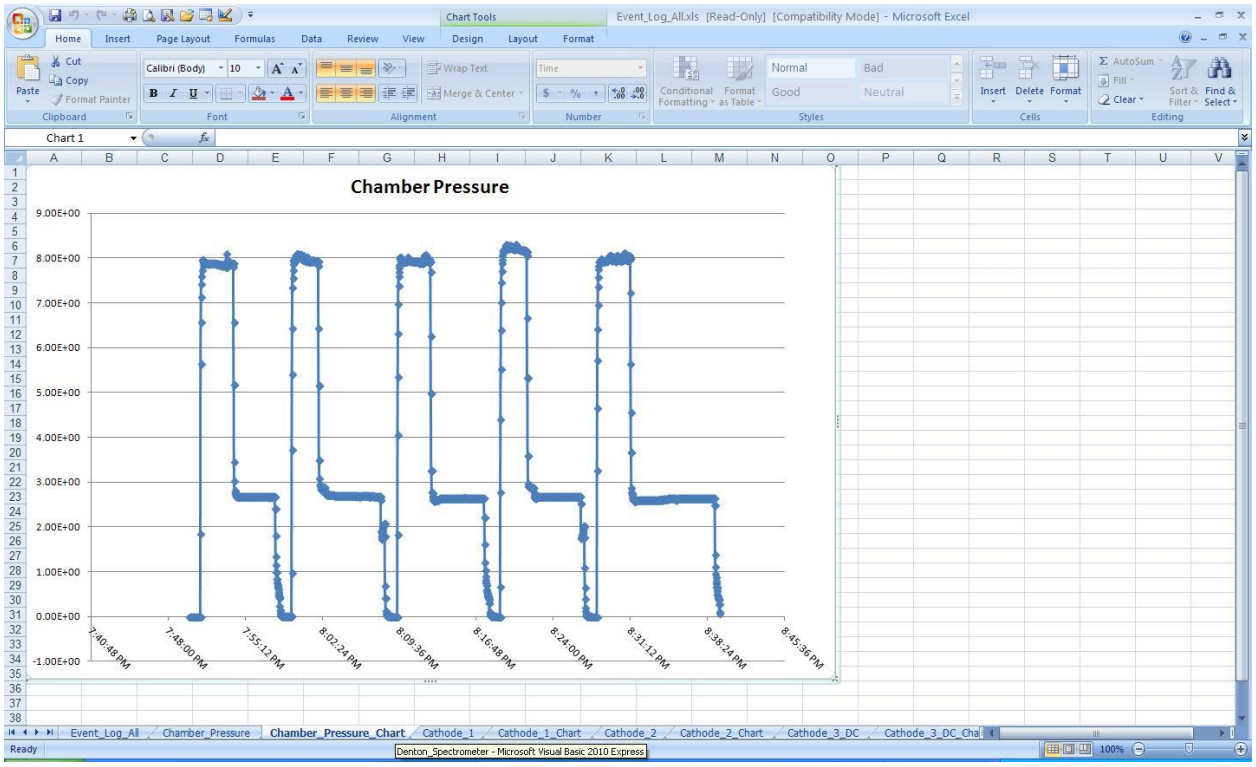
Event Log	Chamber Pressure
Easy	Clear
Close	

The recorded file name is :
Event_Log_Run#3026 5layer Stack OMC 3.dat 2014-1-10 20_39_43.dat

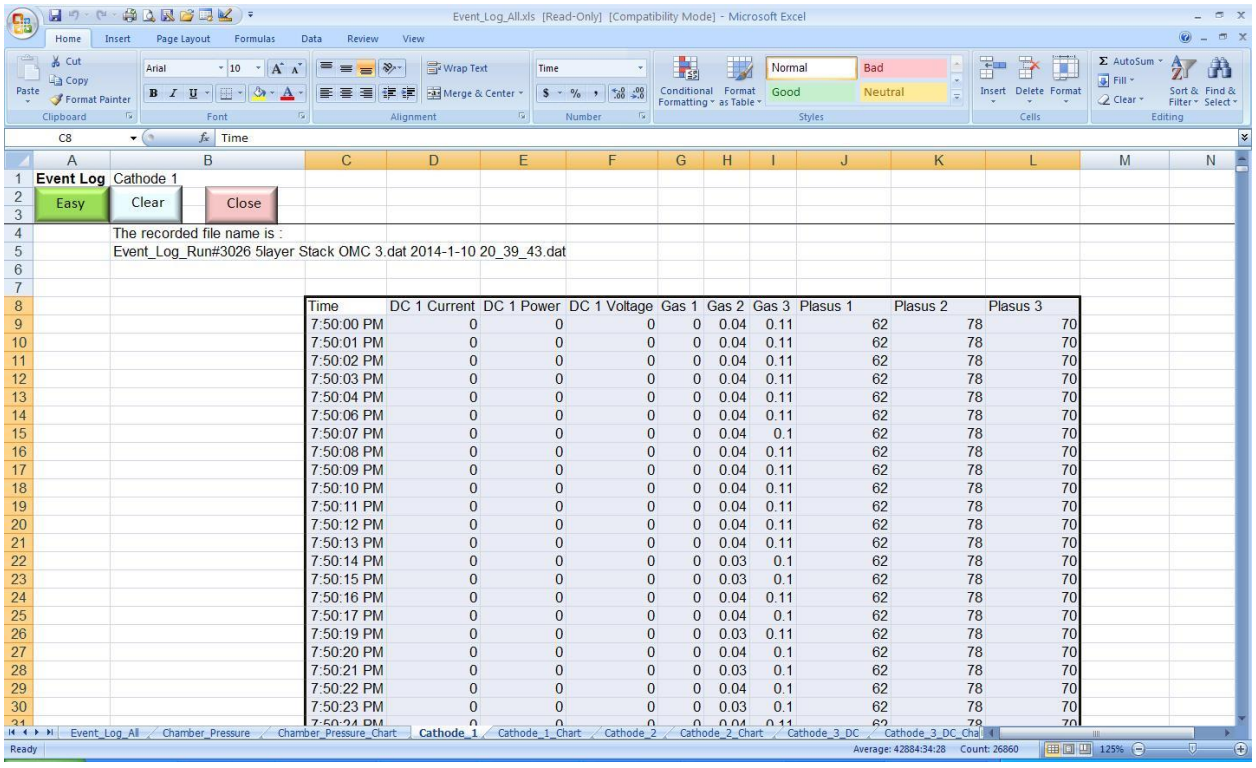
Time	Chamber Pressure
7:50:00 PM	2.58E-03
7:50:01 PM	2.58E-03
7:50:02 PM	2.56E-03
7:50:03 PM	2.56E-03
7:50:04 PM	2.56E-03
7:50:06 PM	2.55E-03
7:50:07 PM	2.55E-03
7:50:08 PM	2.54E-03
7:50:09 PM	2.54E-03
7:50:10 PM	2.53E-03
7:50:11 PM	2.53E-03
7:50:12 PM	2.53E-03
7:50:13 PM	2.53E-03
7:50:14 PM	2.52E-03
7:50:15 PM	2.52E-03
7:50:16 PM	2.52E-03
7:50:17 PM	2.52E-03
7:50:19 PM	2.51E-03
7:50:20 PM	2.51E-03
7:50:21 PM	2.51E-03
7:50:22 PM	2.51E-03
7:50:23 PM	2.51E-03
7:50:24 PM	2.50E-03

Sheets: Event_Log_All | Chamber_Pressure | Chamber_Pressure_Chart | Cathode_1 | Cathode_1_Chart | Cathode_2 | Cathode_2_Chart | Cathode_3_DC | Cathode_3_DC_Cha

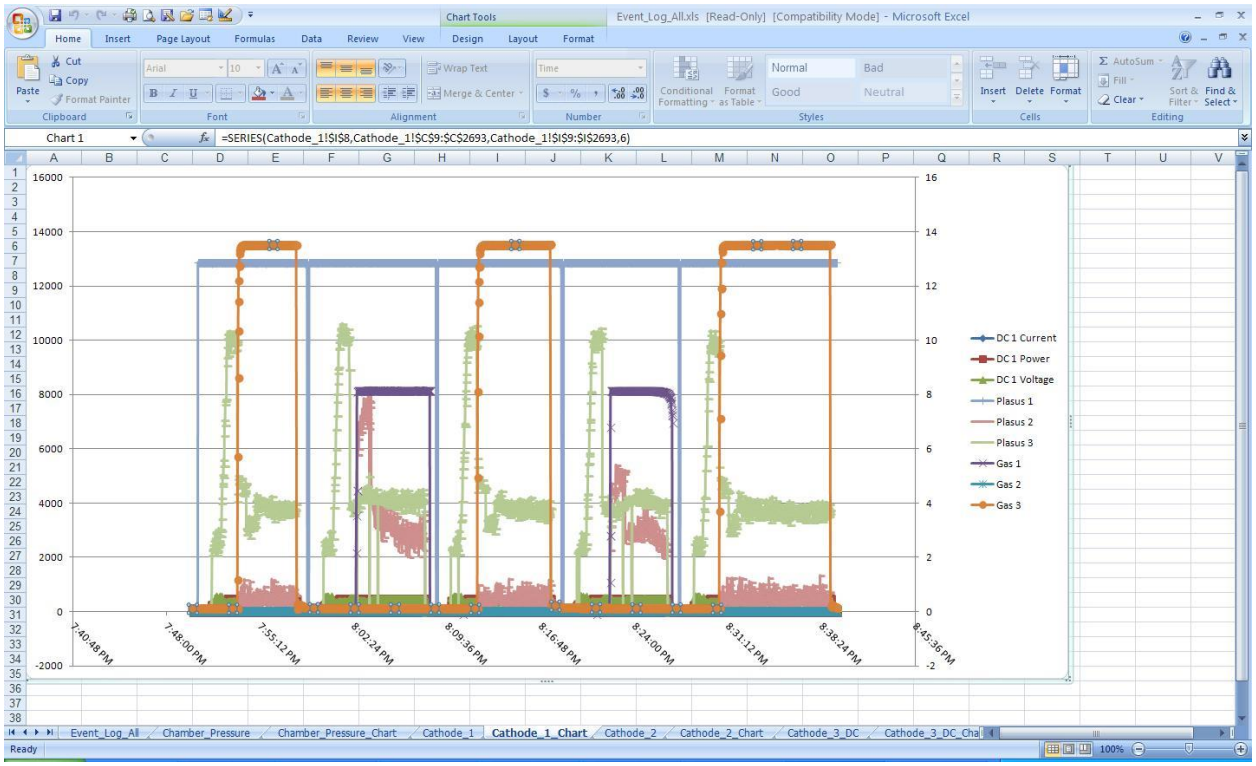
Chamber Pressure Chart



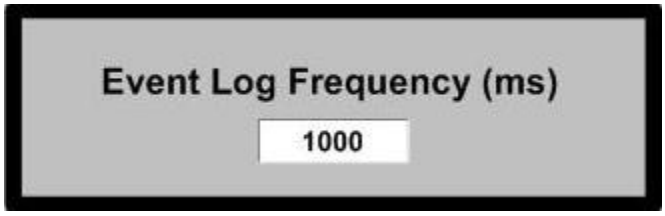
Cathode 1 Data:



Cathode 1 Chart:



EVENT LOG FREQUENCY (MS)

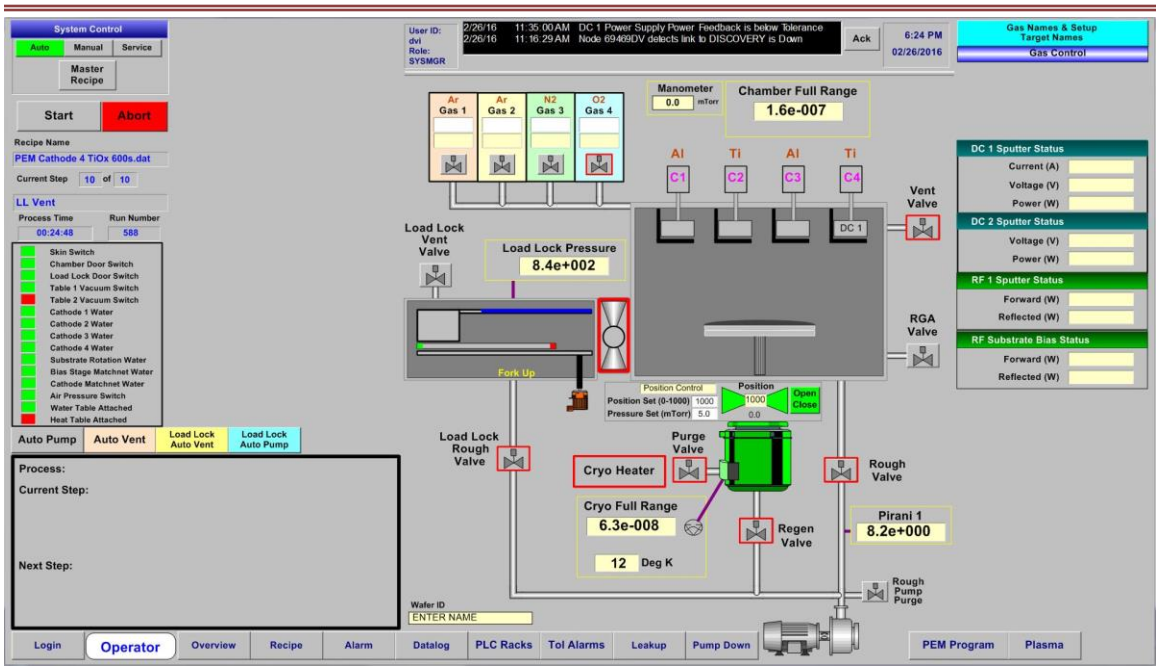


The frequency of the Event Log All info can be set on this screen (50 - 9999ms).

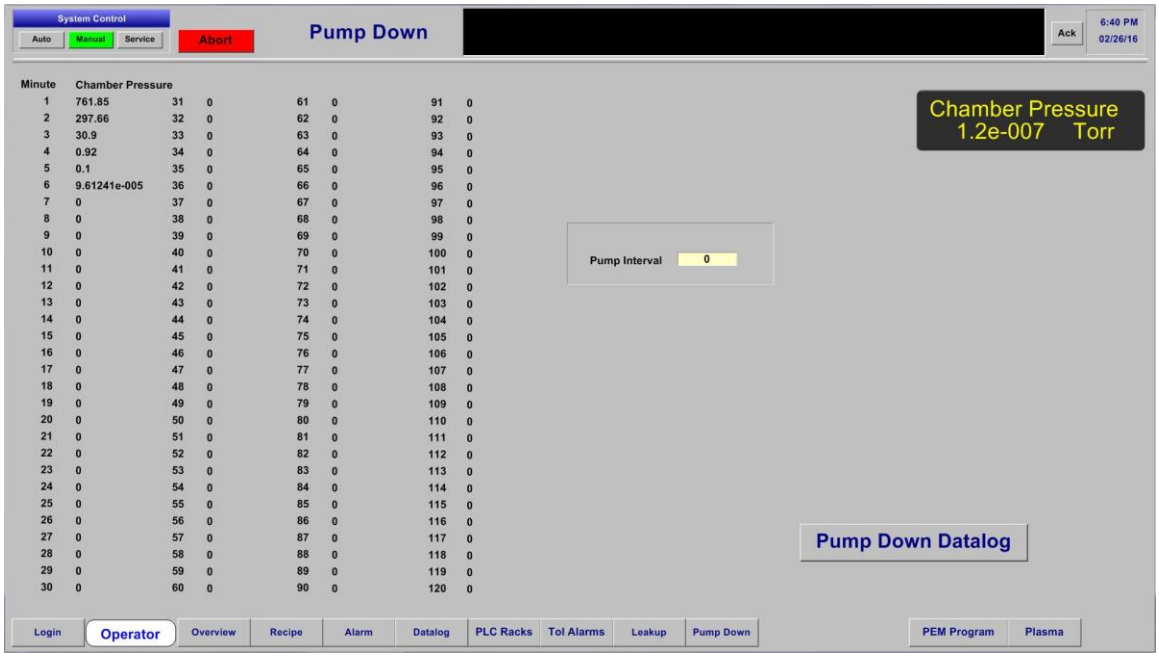
PUMP-DOWN TEST

To start a pumpdown test,

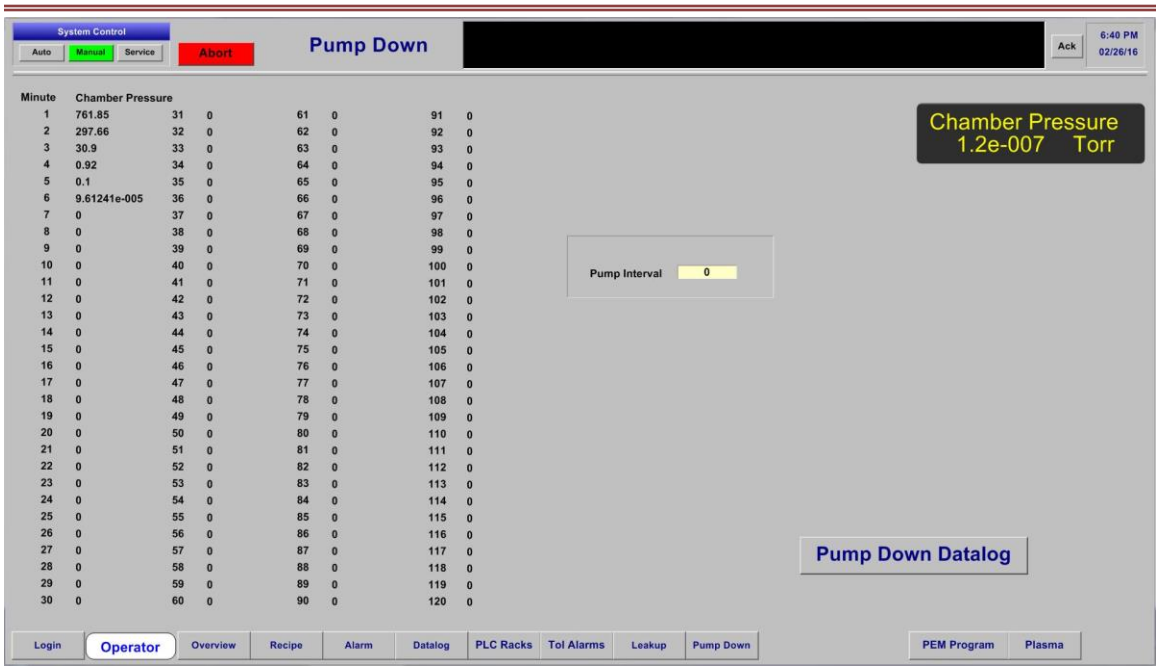
1) Click the "Auto Pump" button on Overview Screen in Auto mode to lunch an automatic pump down process.



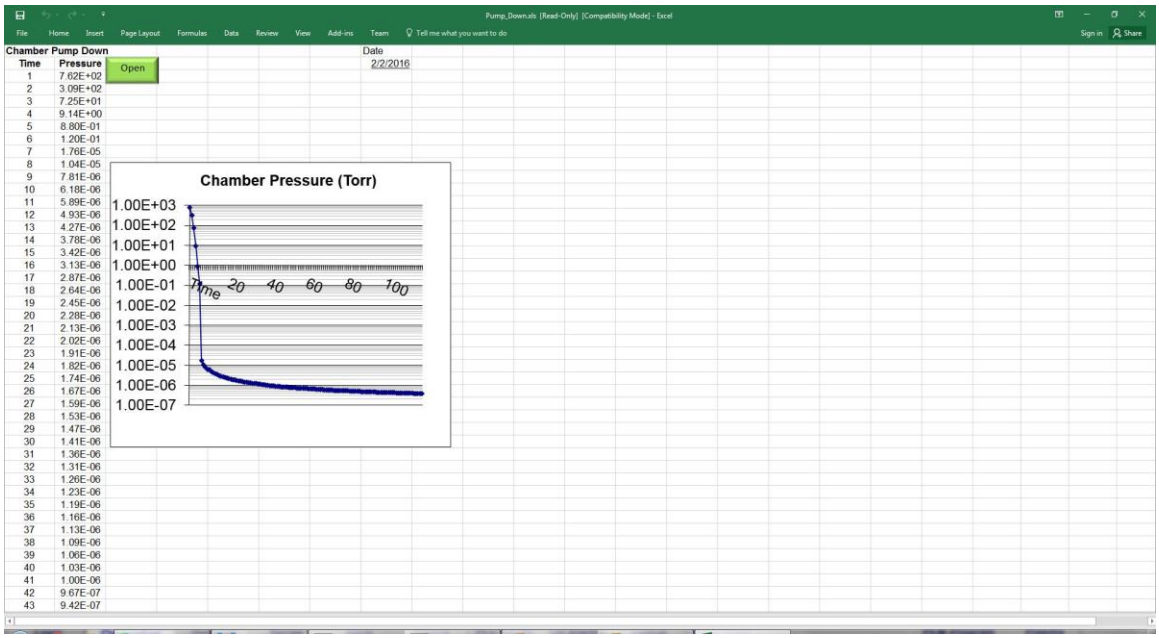
2) The pump down data is recorded on the screen and saved in Excel format. To view the live data, click the Pump Down button on Overview screen.



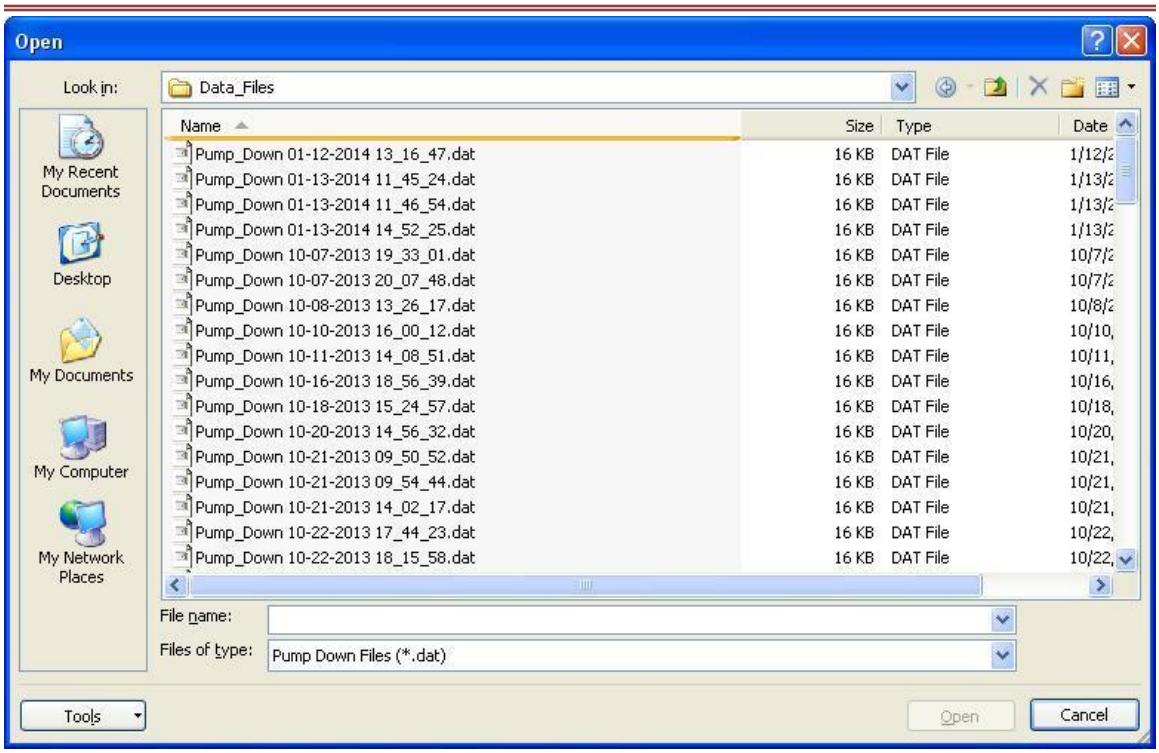
3) To retrieve the previous saved pump down data, click the PumpDown Datalog button on Pump Down screen.



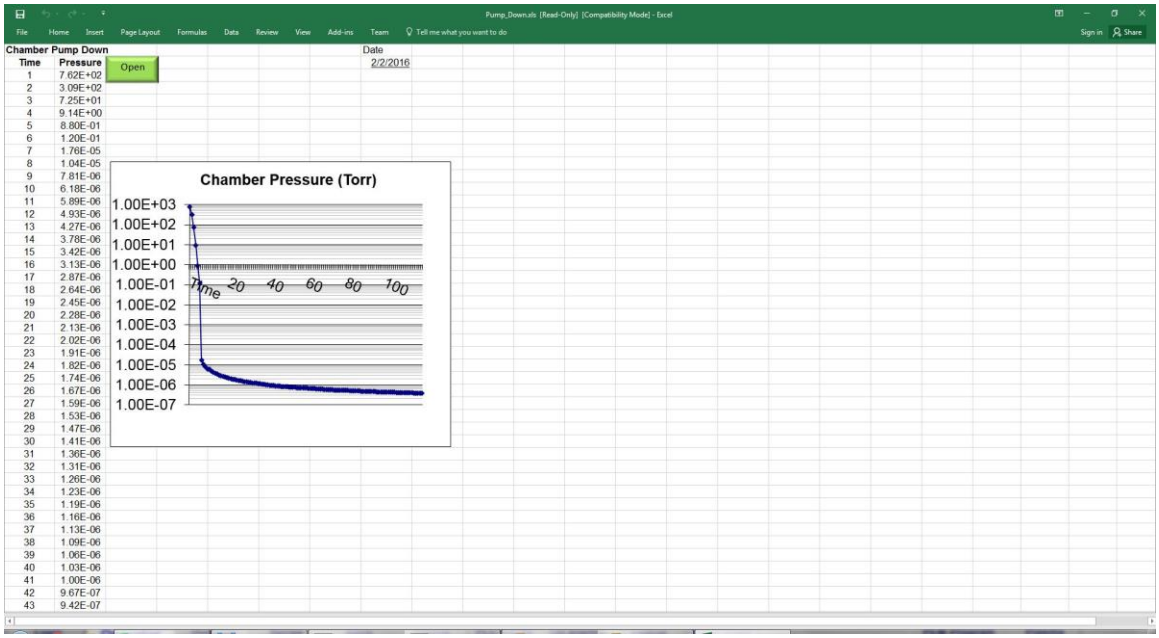
And click the open button on the following screen.



Then select a desired pump down datalog.



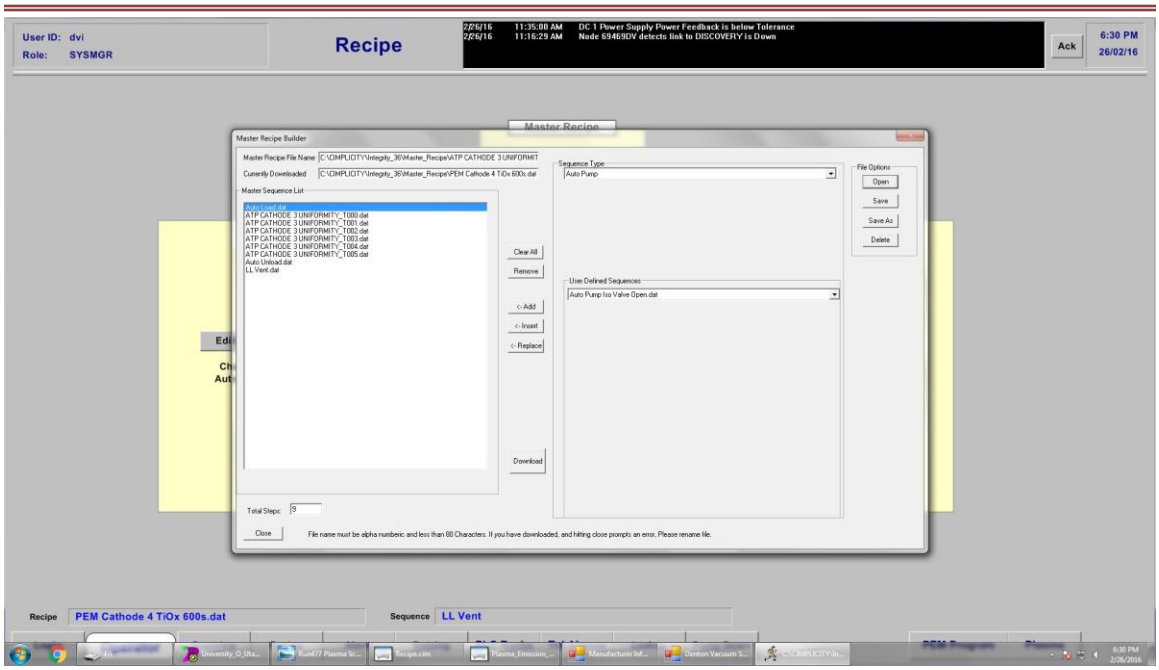
The desired Pumpdown data will be displayed on the screen.



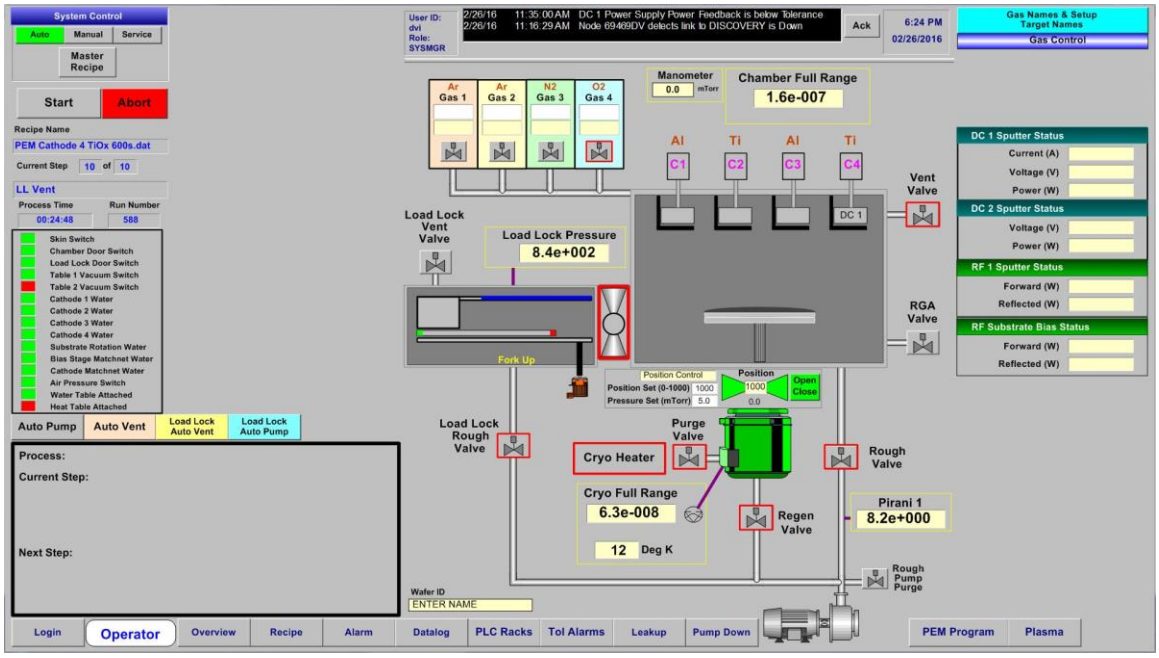
LEAKUP TEST

To start a leakup test,

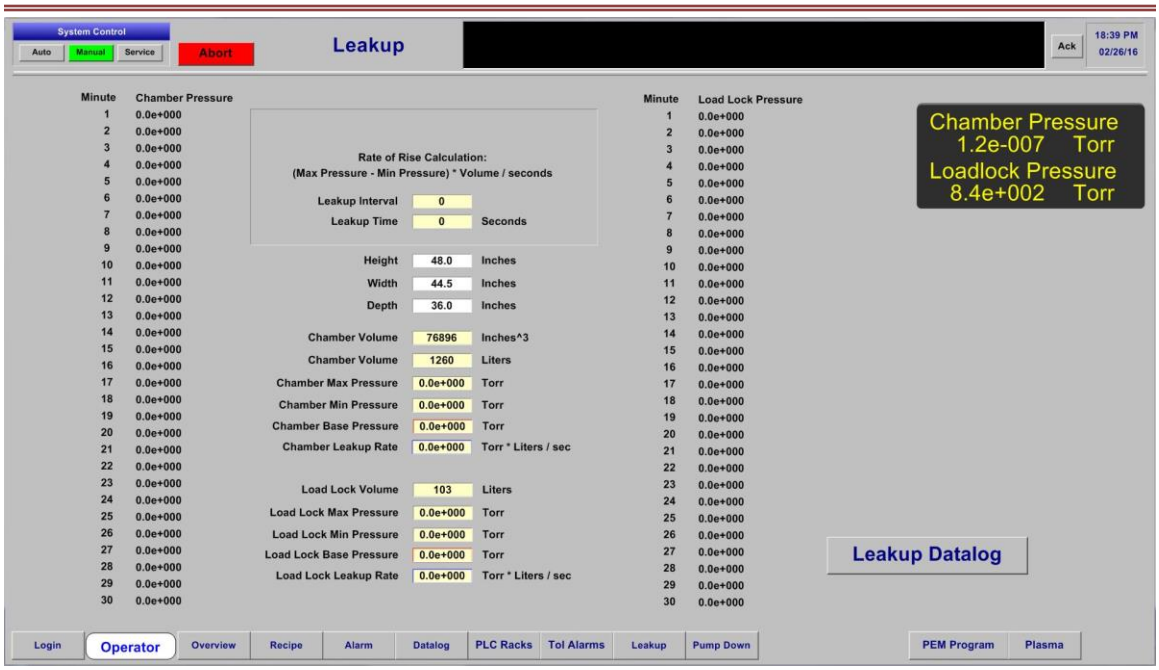
1) Download the factory-programmed "LeakUp" recipe from master recipe builder screen.



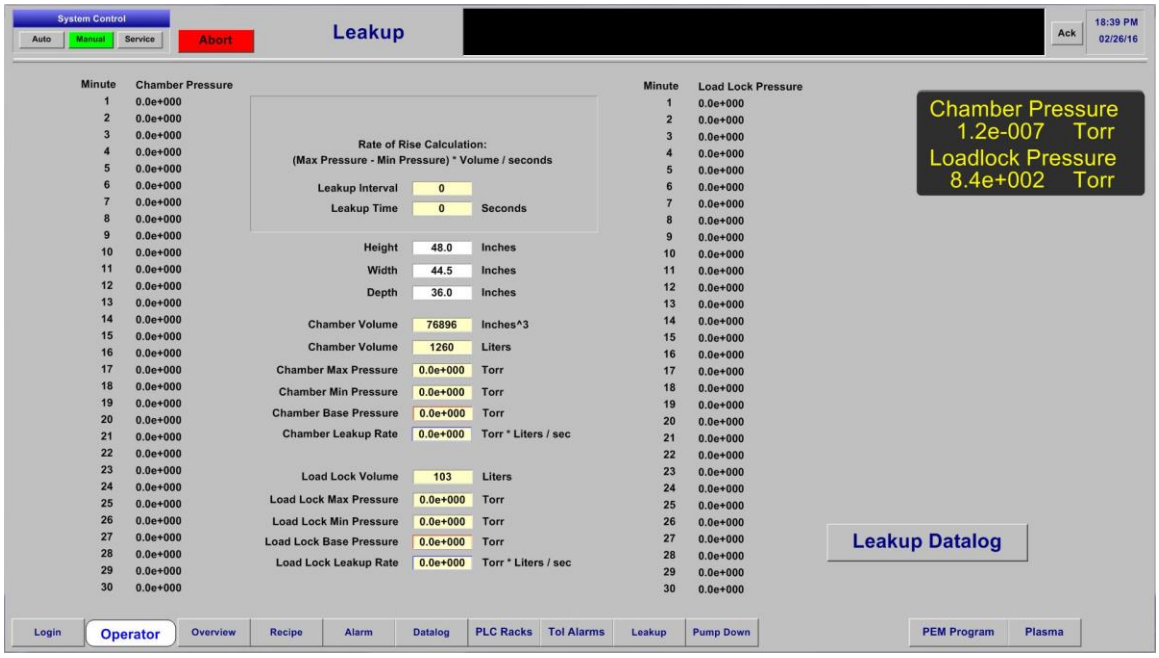
2) Click the "Start" button on Overview Screen in Auto mode to lunch an automatic leak up process.



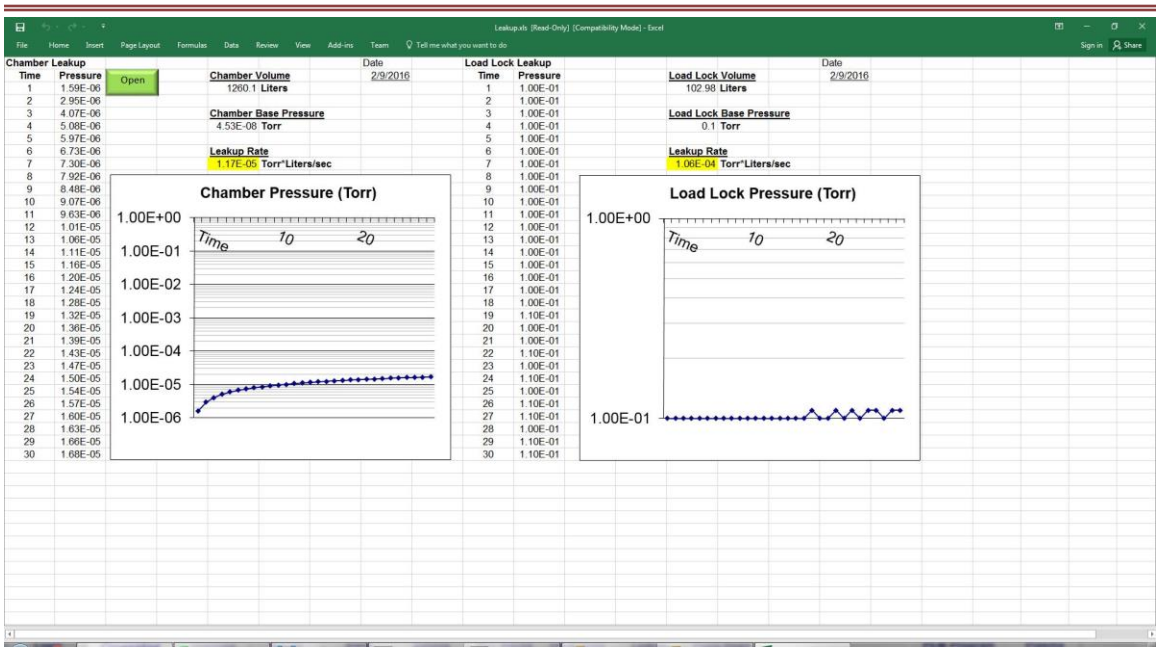
3) The leak up data is recorded on the Leak UP screen and saved in Excel format. To view the live data, click the Leak Up button on Event Log screen.



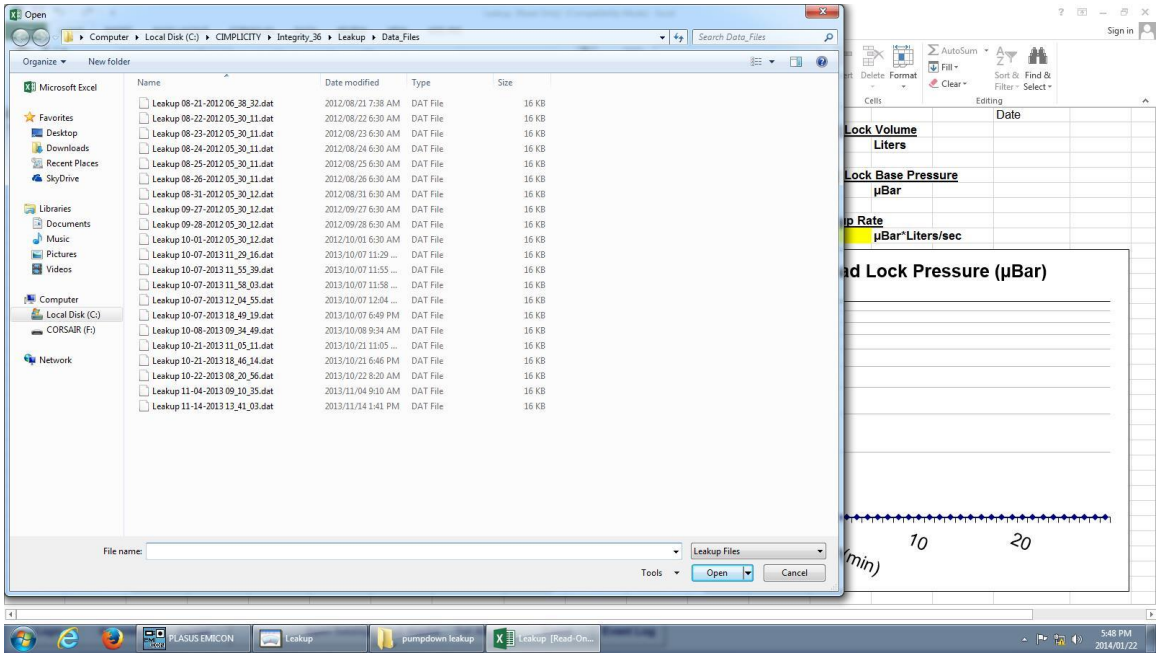
4) To retrieve the previous saved leak up data, click the leak Up Datalog button on Pump Down screen.



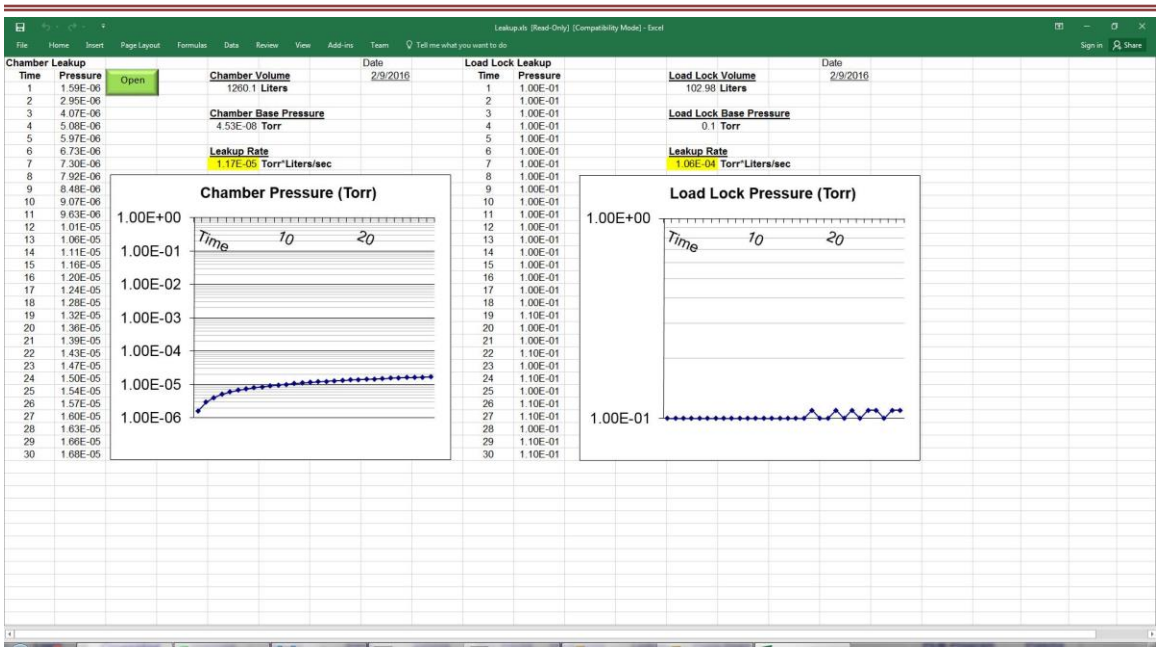
And click the open button on the following screen.



Then select and open a desired leak up datalog file.



The desired leak up data will be displayed on the screen.



LIST OF MECHANICAL DRAWINGS

DESCRIPTION	DRAWING NUMBER
.25” Dia. Rotary Motion Assy.	0041-001-008
Bias Rotation Assy.	044-017-024
Shutter Assy., -Swing	0058-138-022
Water Piping Assy.	0058-341-012
General Arrangement & Floor Plan	0058-344-002
Rotation Assy.	0058-344-010
Air Piping Assy.	0058-344-011
Vacuum Piping Assy.	0058-344-013
Rotation Assy.	0058-344-014
Gas Purge Assy.	0058-344-020
Table Assy. – Water Cooled	0058-344-021
Utility Arrangement	0058-344-100
Schematic, P & Id	0058-344-110
Shutter Assy.	0058-020-210
Shutter Drive Assy,	0058-020-275
Assy. Transfer Robot	0084-064-014
Assy. Slide St’d Transfer Loadlock Robot	0084-064-016
Assy. Drive St’d Vacuum Linear Positionner	0084-064-017

DESCRIPTION	DRAWING NUMBER
1” Blank Plug Assy.	0092-003-041
Process Gas Assy.	B-8053-047-SHT1
Process Gas Assy.	B-8053-047-SHT2

EQUIPMENT LIST – SERIAL NUMBERS & VENDOR MANUALS

EQUIPMENT	VENDOR	MODEL NUMBER	SERIAL NUMBER
Mass Flow Controller	MKS	GV50A013102RBV010	022055002 022055003 020055004 020055005
Capacitance Manometer	INFICON	CDG045D-3CC1-353-2300	540060237
Control Gate Valve	VAT	64246-PE52-ACV1	0008
HV Gate Valve	VAT	14048-4E24-0006	0017
Cryo Pump	CTI	8033167	15114CHE10898
Compressor	CTI	8032550G002	1511MON10069
Right Angle Valve	MKS	152-1040K 152-1040C	018388281 018396163
Right Angle Valve	MKS	152-1025K 152-1016K	018388280 018388296
Rea	MKS	E-VISION 2	7572770005
Full Range Gauge	INFICON	BPG400-353-500	136572 136765
Pirani Gauge	INFICON	PSG500-350-060	045282 045363
Mechanical Pump	ADIXEN	ACP40-V8SACSFAMF	AC672593
Monitor	DELL	P2214HB	CN-OKW14V- 74261-58N-257S
Dc Power Supply	HIGH VOLTAGE	HVCS12	1510230041
Dc Power Supply	PINNACLE	3152535-358	1022021
Mc2 Controller	SEREN	9200010032	7300 7301
RF Power Supply	SEREN	9600610041	R601-3596 R601-3595
Cryo Temp Display	BROOKS	196443	256
Controller Addaptive Pressure	VAT	225599	641PM-16AG- 002/0256

EQUIPMENT	VENDOR	MODEL NUMBER	SERIAL NUMBER
Computer	DELL	DOIT	79HBX52
Router	LINSYS	E1200	10822C61503068
Cathode Matching Network	SEREN	9400000053	AT6-1641 AT6-1642
Heat Transformer	HPS	Q007XEKF	B15M-CB00680788
Spectrometer	OCEAN OPTICS	USB2000-XRI-ES USB4000-XRI	V08544 4H09430
Bias Matching Network	SEREN	9400000053	AT6-1665

FUSE LIST

Fuse	Rating Amps (all are Slow-Blow Midget Class)	Circuit	Denton Vacuum Part Number
FU1	5	24 VDC Power Supply-Primary	FUS001-0023
FU4	10	24 VDC Power Supply-Secondary	FUS001-0022
FU5	20	Heat Power	FUS001-0025
FU6	20	Heat Power	FUS001-0025
FU7	1/4	Signal Transformer Primary	FUS001-0089
FU8	1/4	Signal Transformer Primary	FUS001-0089
FU9	1	Signal Transformer Secondary	FUS001-0091
FU11	10	Receptacle 1 - Power Bar 1	FUS001-0022
FU12	2	Rotation Motor	FUS001-0092
FU13	2	Rotation Motor	FUS001-0092
FU16	20	Mechanical Pump	FUS001-0025
FU19	10	Turbo Pump	FUS001-0022
FU10	10	Turbo Pump	FUS001-0022
FU23	2	Cryo Heater	FUS001-0092
FU24	2	Cryo Heater	FUS001-0092
FU25	1/2	Capacitance Monometer	FUS001-0090

Fuse	Rating Amps (all are Slow-Blow Midget Class)	Circuit	Denton Vacuum Part Number
FU26	15	DC Power Supply 1	FUS001-0022
FU27	15	DC Power Supply 1	FUS001-0022
FU28	15	DC Power Supply 1	FUS001-0022
FU29	10	DC Power Supply 2	FUS001-0022
FU30	10	DC Power Supply 2	FUS001-0022
FU32	10	RF Power Supply 1	FUS001-0022
FU33	10	RF Power Supply 1	FUS001-0022
FU34	10	RF Power Supply 2	FUS001-0022
FU35	10	RF Power Supply 2	FUS001-0022
FU50	2	Load Lock Power	FUS001-0092
FU54	1	PLC Power	FUS001-0091
FU57	1	Exhaust Fan 1	FUS001-0091
FU58	1	Exhaust Fan 1	FUS001-0091
FU59	1	Exhaust Fan 2	FUS001-0091
FU60	1	Exhaust Fan 2	FUS001-0091
FU61	1	Exhaust Fan 3	FUS001-0091
FU62	1	Exhaust Fan 3	FUS001-0091

ELECTRICAL SCHEMATICS

DESCRIPTION	DRAWING NO.
Cover Page	DIS6350101-69469.DWG
Power Distribution	DIS6350201-69469.DWG
Power Distribution	DIS6350202-69469.DWG
Power Distribution	DIS6350203-69469.DWG
Heat Control	DIS6350301-69469.DWG

DESCRIPTION	DRAWING NO.
Heat Control	DIS6350302-69469.DWG
Low Voltage Control	DIS6350401-69469.DWG
Low Voltage Control	DIS6350402-69469.DWG
Vacuum Control Gauging	DIS6350501-69469.DWG
Vacuum Control Gauging	DIS6350502-69469.DWG
Ion Source Control	DIS6350601-69469.DWG
Ion Source Control	DIS6350602-69469.DWG
Ion Source Control	DIS6350603-69469.DWG
Ion Source Control	DIS6350604-69469.DWG
Substrate Rotation Control	DIS6350701-69469.DWG
Load Lock Control	DIS6350702-69469.DWG
Load Lock Control	DIS6350703-69469.DWG
Load Lock Control	DIS6350704-69469.DWG
Pumping Control	DIS6350801-69469.DWG
Pumping Control	DIS6350802-69469.DWG
Pumping Control	DIS6350803-69469.DWG
Gas Control	DIS6350901-69469.DWG
Gas Control	DIS6350902-69469.DWG
Source Control	DIS6351001-69469.DWG
Source Control	DIS6351002-69469.DWG
Source Control	DIS6351003-69469.DWG
Source Control	DIS6351004-69469.DWG
Source Control	DIS6351005-69469.DWG
Deposition Control	DIS6351101-69469.DWG
Spare	DIS6351201-69469.DWG
Glow Discharge Control	DIS6351301-69469.DWG
Glow Discharge Control	DIS6351302-69469.DWG
Spare	DIS6351401-69469.DWG
PLC Control	DIS6351501-69469.DWG
PLC Control	DIS6351502-69469.DWG
PLC Control	DIS6351503-69469.DWG
PLC Control	DIS6351504-69469.DWG
PLC Control	DIS6351505-69469.DWG

DESCRIPTION	DRAWING NO.
Instrument Layout	DIS6351601-69469.DWG
Fan Layout	DIS6351602-69469.DWG

PEM PROGRAM

REFER TO DENTON VACUUM PLASMA EMISSION MONITOR OPERATING MANUAL FOR DETAILS.

PLASMA

REFER TO DENTON VACUUM PLASMA EMISSION MONITOR OPERATING MANUAL FOR DETAILS.

APPENDIX A

SOFTWARE UPDATES