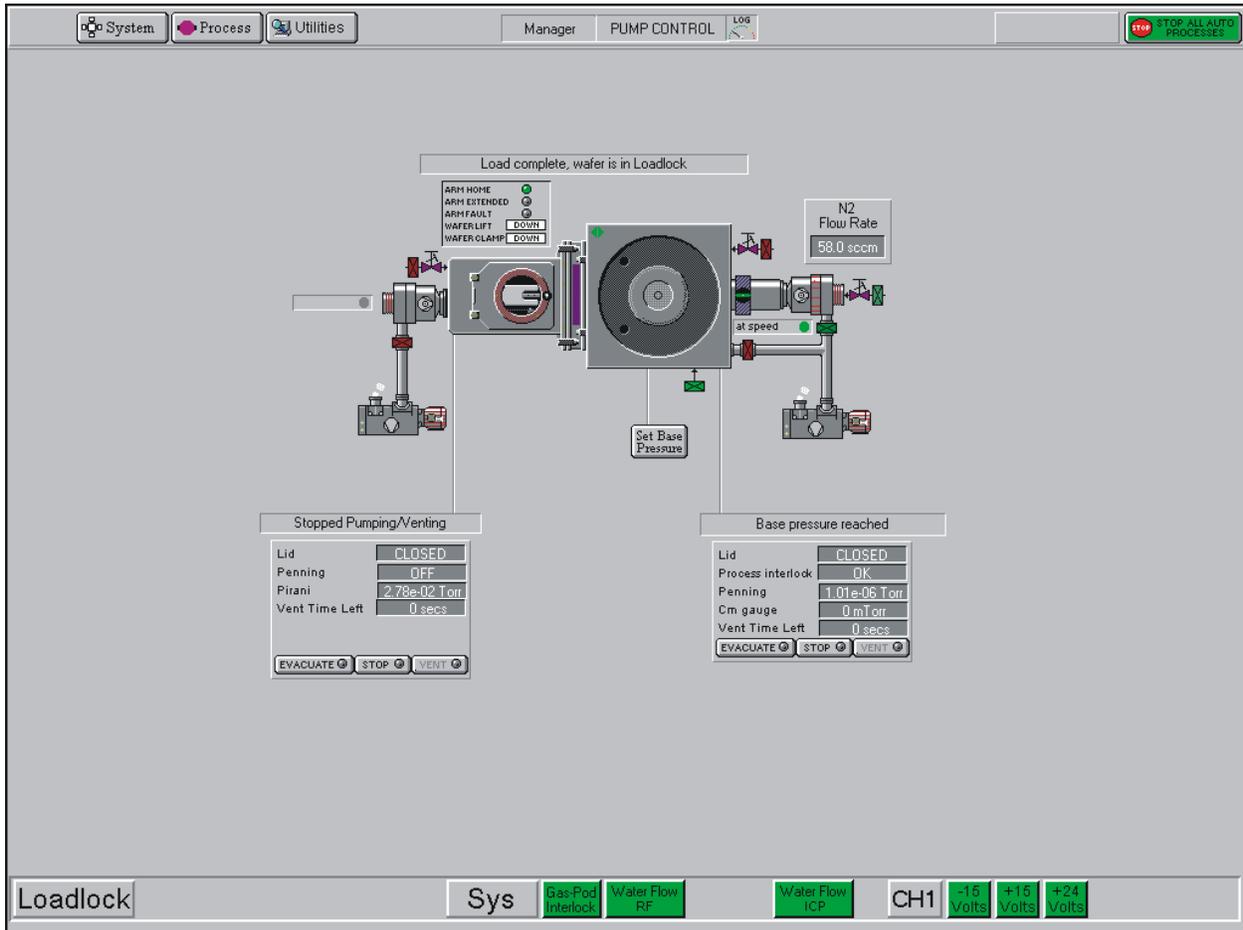


Oxford PlasmaLab System 100 Multipurpose Plasma Etcher Users Manual



Coral name: Oxford Etcher 2
Model: Oxford PlasmaLab System 100
Location: Nanofab, Building 215, Room A106
Contact: nanofab_dryetch@nist.gov

OVERVIEW:



Operator interface

Operation

Logging on

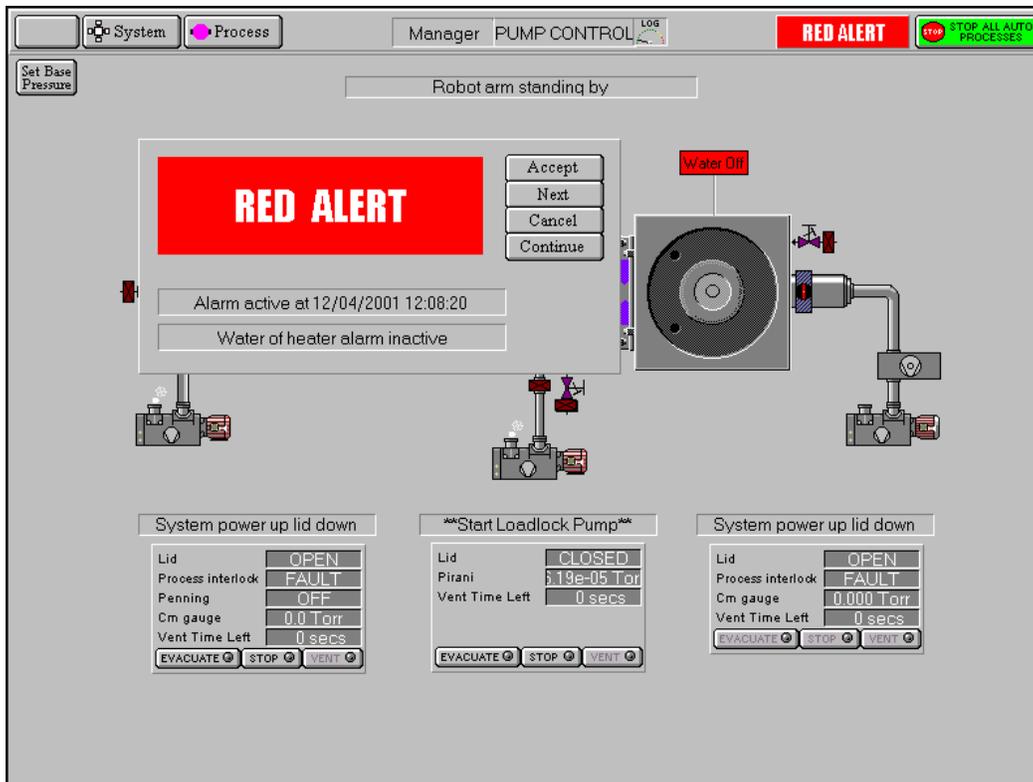
The tool is interlocked by Coral. Please logging on Coral as a user to access the tool.

Only qualified user can operate the tool!

Check the status before operation.

Chamber process page and Service mode page, give the status of the system and process chamber.

A typical system alert is shown below.



Typical system alert

There are three categories of alert indicated by the colour and text displayed in the banner and dialogue:

Blue Warning e.g. water flow low.

Yellow Hazard – not currently used.

Red Process abort, e.g. high-reflected RF power.

A user logged on at any access level can close the alert dialogue, but only a user logged on as a system manager can clear the alert banner from the menu bar. The dialogue options are:

Accept button: System Managers only. Clear the alert and log it.

Next button: View the next alert.

Cancel button: System Manager only. Clear the alert; do not log it.

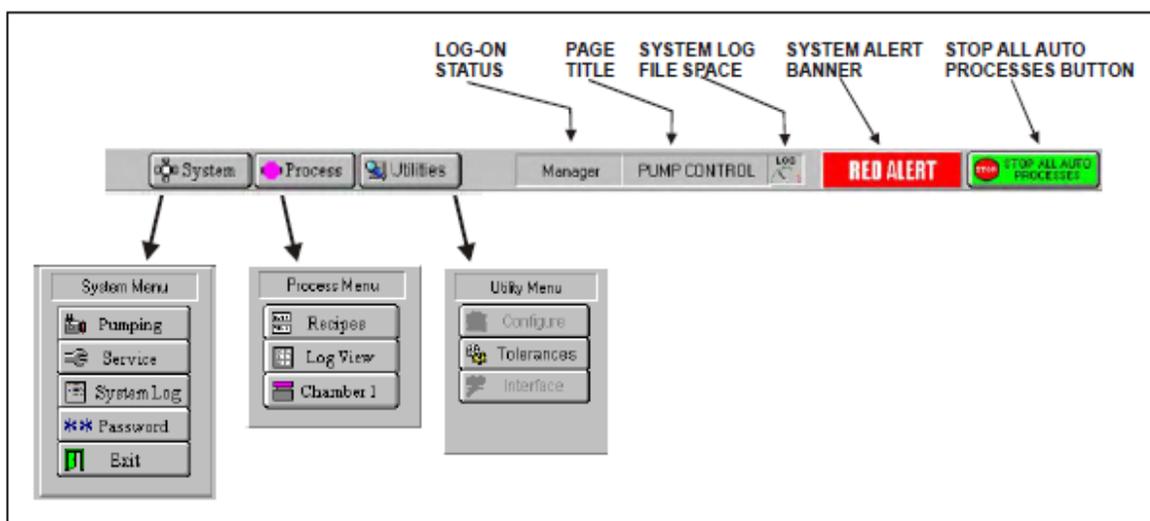
Continue button: Close the alert dialogue box – the alert banner remains displayed on the menu bar.

Note that option buttons that are not available (i.e. **Accept** and **Cancel** due to user ‘logged on’ status and **Next** when there is only one active alert) are greyed out.

The alert message usually contains an adequate description of the detected event. If it is a service fault (water flow, purge gas etc.) then verify that the service is available to the machine as soon as possible. Depending on the nature of the service, the system may allow the machine to continue to operate, so that the current process can be completed. Do not start a new process before checking the service.

The red alerts are often due to a process setpoint being out of tolerance for too long. In these cases, the process is halted by the system. If it is authorised to resume processing with a parameter deviation then:

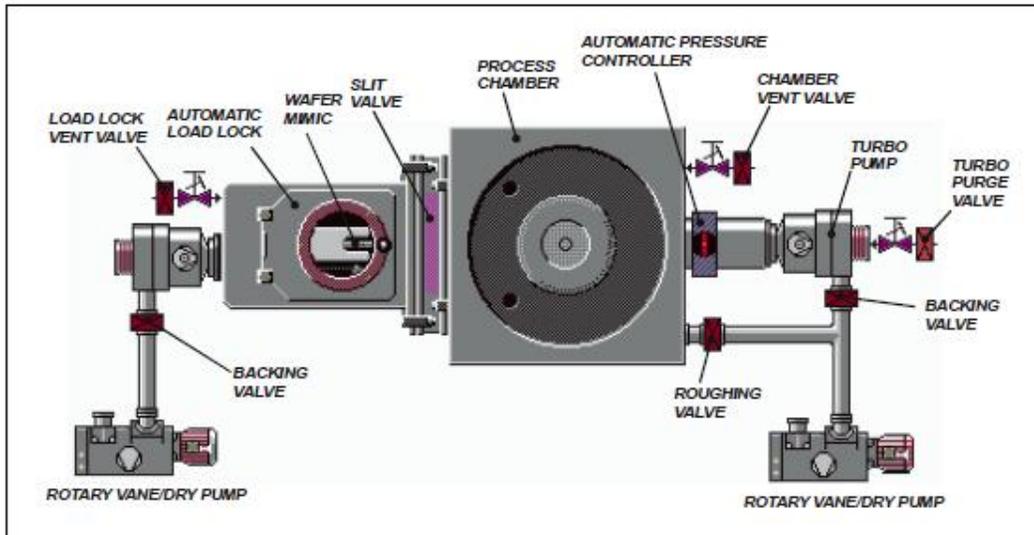
- 1) Check the most recent process log to find the process time remaining.
 - 2) Construct a new process with a modified process time and check the ‘Ignore tolerance’ option.
- Note that this removes all tolerance checking. The machine should be monitored by an operator for further deviations when operated in this condition.



Loading sample

Chamber and load lock are in vacuum at idle statue so please vent the load lock for sample loading

The vacuum system mimic is shown below. Each chamber contains a wafer indicator, which when coloured green indicates that a wafer is present in the chamber. Clicking on a green wafer indicator will display the Robot Control page showing the possible wafer destination. Note that the Automatic Pressure Controller (APC) mimic displays the current status of the valve, i.e. open, closed, mid position or fault (indicated by a red dot).

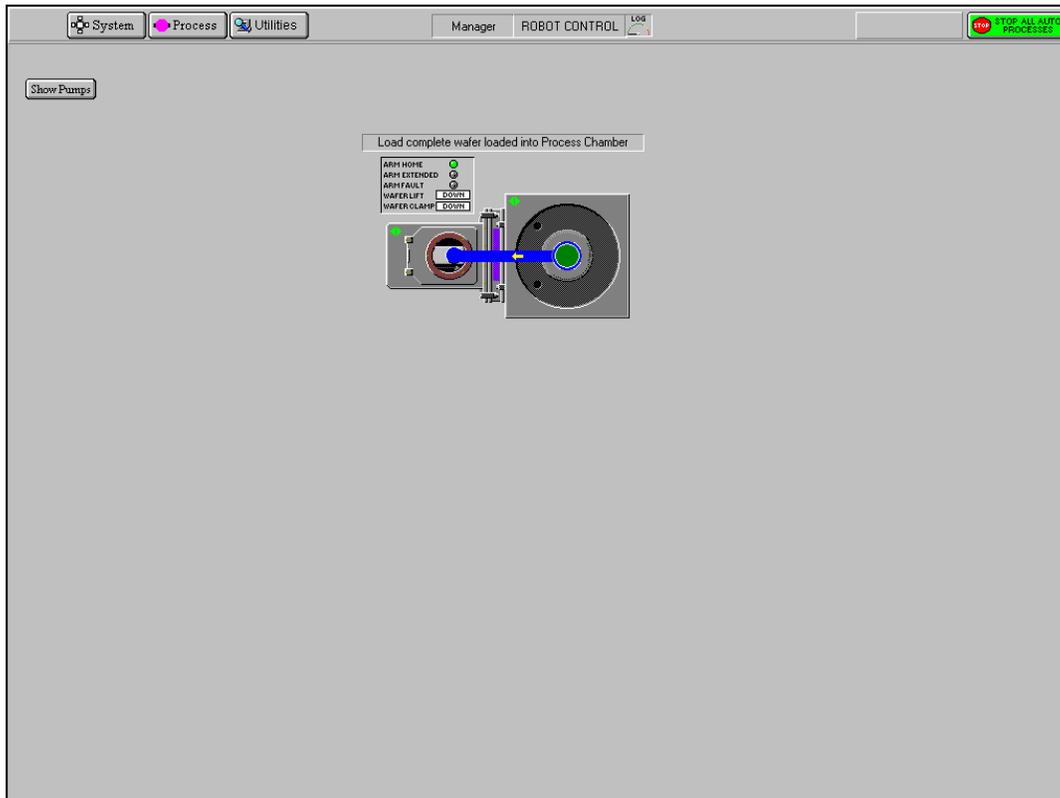


- 1) From the System menu, select the Pumping option.
- 2) On the Pump Control page, select the **STOP** button then the **VENT** button for load lock. Note that the vent sequence is controlled by a timer to allow time for the turbo pumps to ‘spin’ down.
- 3) When all of the ‘Vent Time Left’ timers have decremented to zero, all of the pumps have been switched off automatically, and the load lock has been vented.
- 4) Insert the wafer into the Automatic load lock.
- 5) Close the Automatic load lock’s lid.
- 6) Select the relevant **EVACUATE** button. A dialogue box will be displayed allowing entry of a Wafer Identity, if any.
- 7) Check that the system has pumped down to base pressure. (The process chamber message panel should display ‘Base Pressure reached’.)
- 8) Ensure that the Automatic load lock is at the required pressure. (Check the relevant panel on the Pump Control page). Green ‘ready for transfer’ indicators are displayed on each chamber mimic when it is available for vacuum transfer.

To transfer a wafer from the Automatic load lock to the process chamber to carry out a manual process, use the following steps:

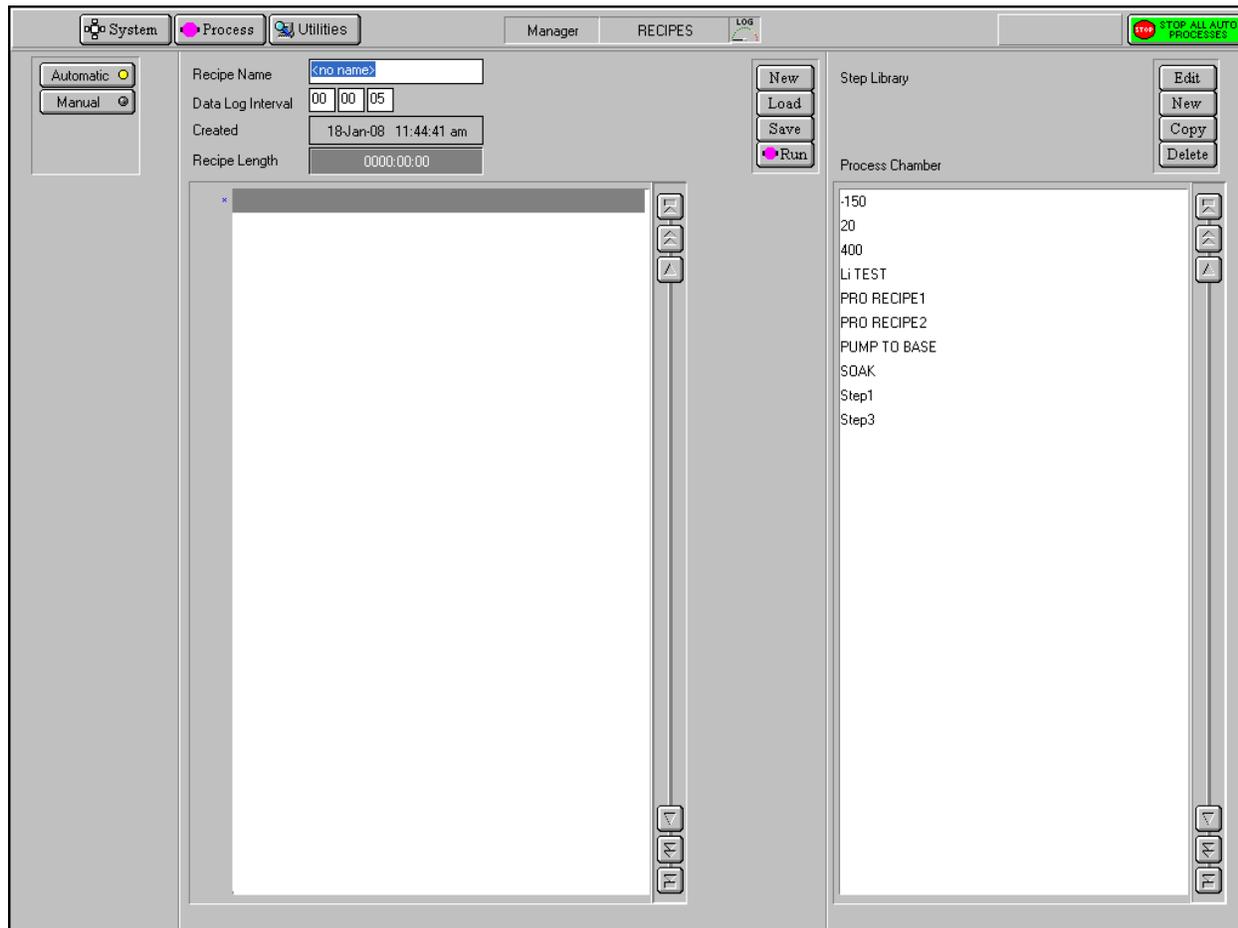
- 1) Click on the Automatic load lock wafer mimic. The blue arrowed path is displayed showing the available destination.
 - 2) Click on the process chamber wafer indicator. The wafer is transferred to the process chamber.
- To transfer a wafer from a process chamber to the Automatic load lock on completion of a manual process, use the following steps:
- 1) Click on the process chamber’s green wafer indicator. The blue arrowed path is displayed showing the available destination.

2) On the Automatic load lock mimic, click on the wafer indicator. The wafer is transferred to the Automatic load lock.



Manual wafer handling

Creating and editing recipes



Steps

Recipe steps are stored in the **Step Library** list. The list can contain any number of steps, depending on available hard disk space. When the displayed list is full, it becomes scrollable to allow you to view all of the list contents.

To create a new recipe step, use the following procedure:

- 1) In the Step Library panel, select the **NEW** button. The Step Edit page is displayed.
- 2) Enter the step parameters as required, then click on **OK**. The step is automatically saved.

To create a recipe step, based on an existing recipe step, use the following procedure:

- 1) Select a recipe step from the **Step Library** list, i.e. click on it to highlight it.
- 2) Select the **COPY** button. Enter a new step name.
- 3) Edit the step parameters as required, then click on **OK**. The new recipe step is automatically saved.

To edit an existing recipe, use the following procedure:

- 1) Select a recipe step from the **Step Library** list, i.e. click on it to highlight it.

- 2) In the Step Library panel, click on the **Edit** button.
- 3) Edit the step's process parameters as required, then click on **OK**. The step is automatically saved.

NOTE: Changing an existing recipe step will not alter saved recipes, which use the old version of that step.

To delete a recipe step, use the following procedure:

- 1) Select the recipe step from the **Step Library** list, i.e. click on it to highlight it.
- 2) Select the **DELETE** button; the selected recipe step is deleted.

Recipes

Recipes are 'built' using existing recipe steps, and edited as required.

Within a recipe, steps can be manipulated using the **Step Commands** pop-up menu (accessed by clicking on the Recipe Steps field).



Step Commands pop-up menu

The **Step Commands** pop-up menu provides the following options:

Edit Step Enables the selected (highlighted) step to be edited.

Repeat Step Repeats all subsequent steps until a Loop Step is reached. This group of steps can be repeated any number of times. (When you select this option, you are prompted to enter the number of times the group of steps is to be repeated.)

Loop Step Terminates a Repeat Step group.

Insert Step Creates a 'gap' above the selected step to allow another step to be dragged into the list.

Delete Step Deletes the selected step from the list.

Cancel Closes the **Step Commands** pop-up menu.

To build a recipe, use the following procedure:

- 1) In the Recipe panel, select the **NEW** button.
- 2) Click on a recipe step in the **Step Library** list, hold the left mouse button down then drag the mouse pointer to the **Step Name** field next to the asterisk (*) then release the mouse button. The step name is displayed in the **Step Name** field.

3) Repeat 2) as required to add further steps to the recipe. Note that once you have filled the Step Name field, the recipe step list becomes scrollable, enabling you to add a maximum total of 1000 steps.

4) To remove a step from the list, click on it to highlight it then select the **Delete step** button from the **Step Commands** pop-up menu. Any further steps will move up the list by one place.

5) To add a step before an existing step, click on the existing step then select the **Insert step** button from **Step Commands** pop-up menu. The selected step and all those following it will move down the list by one place. You can then drag another step from the **Step Library** list into the now vacant field.

6) When all steps have been added, enter a time into the **Data Log Interval** field, then enter a name for the recipe in the **Recipe Name** field. Finally, select the **SAVE** button.

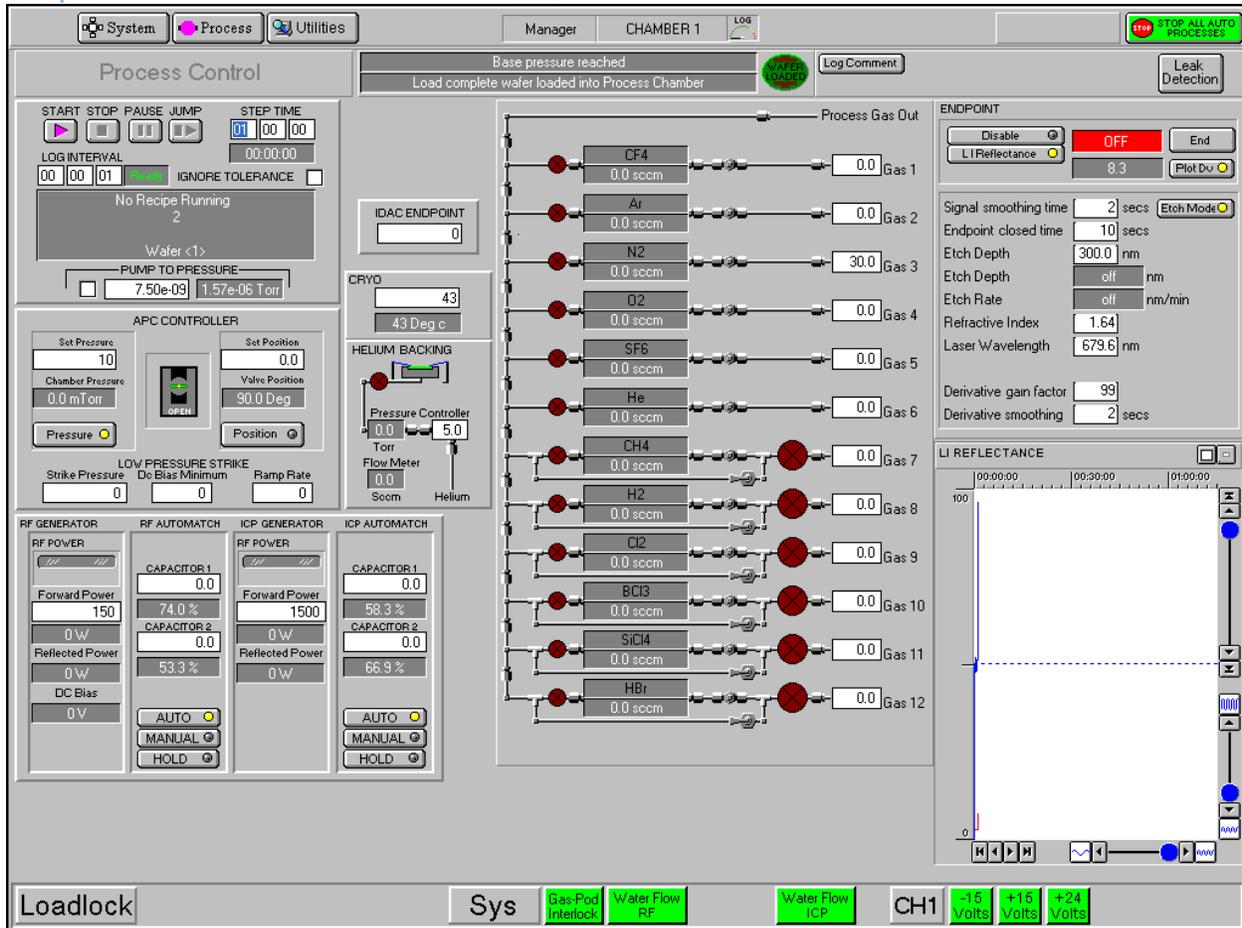
To edit a recipe, use the following procedure:

1) Select the **LOAD** button, then select the recipe to be edited.

2) In the Step Commands pop-up menu, click on the Edit Step button, then edit the process parameters as required. Note that editing a recipe step will not affect the associated step, i.e. a step having the same filename, in the Library of Available Steps.

3) To remove a step from the list, click on it to highlight it then select the **DELETE STEP** button from the **Step Commands** pop-up menu. Any further steps will move up the list by one place.

4) To add a step before an existing step, click on the existing step then select the **INSERT STEP** button. The selected step and all those following it will move down the list by one place. You can then drag another step from the **Step Library** list into the now vacant field.



Process window

The facilities available on the above process window are:

Process chamber message field

Displays context related messages about the process chamber.

Transfer status/

Log Comment message field

Displays context related messages about wafer transfer status. This field is also used to enter comments about the current process run which can be viewed on the log viewer page.

Wafer status field

Displays context related messages about the wafer currently in the Automatic load lock or process chamber.

Log Comment button

Allows comments about the current process to be entered in the

Transfer status/Log Comment message field. While entering a comment, the button title changes to OK to allow the comment to be accepted.

Leak Detection button Displays the leak detection page.

Start button Select to start a manual process run using the parameters set on this page.

Stop button Select to stop the current process step.

Pause button Select to pause the current process.

Jump button Select to jump to the next process step.

Recipe message field

Displays information about the current recipe, step, loaded wafer identity, etc..

Step Time fields Enter the required step time in hours:minutes:seconds. While a process is running, the adjacent field displays the time remaining to the end of the step.

Log Interval fields

Enter the interval required between data logging events.

Process status field

Indicates the process status; either Ready, Auto or Manual

Pump to Pressure checkbox

Select to create a pumping step. The system will pump down until the demanded pressure is reached. The step will remain active until this condition is met. Both RF Generators are automatically switched off during the step. (Indicates selected). All setpoints are automatically set to zero, except for base pressure.

Pressure fields Enter the required Process Chamber pressure for the step. The measured pressure is displayed in the adjacent field.

Ignore Tolerances checkbox

Select to disable tolerance

RF Generator panel

Enter the required forward power. The forward power, reflected power, power ON/OFF status and DC bias are displayed.

Clicking the **Set Fwd Power** button toggles the demand between a forward power set point and a DC bias set point. If a DC bias demand is set, the RF power will be varied to try to achieve the required bias.

Use this facility with care: if the plasma does not strike or if the DC bias cannot be read (by covering the table with insulator), then the RF power will increase to maximum.

RF AUTOMATCH panel

CAPACITOR 1 field

Enter the required position for variable AMU Capacitor 1. The position can be set between 0%, minimum capacitance, and 100%, maximum capacitance. The capacitor position read back is displayed.

CAPACITOR 2 field

Enter the required position for variable AMU Capacitor 2. The position can be set between 0%, minimum capacitance, and 100%, maximum capacitance. The capacitor position read back is displayed.

AUTO button

Select to enable the AMU to tune automatically when the RF generator is switched on. When the RF generator is switched off, the capacitors return to the park position.

MANUAL button

Select to enable the AMU to move the capacitors to the values defined in the CAPACITOR 1 and CAPACITOR 2 fields; the capacitors will remain in these positions.

HOLD button

Select to enable the AMU to tune automatically when the RF generator is switched on. When the RF generator is switched off the capacitors remain at the last position.

ICP GENERATOR panel

Enter the required forward power. The forward power, reflected power, ON/OFF status are displayed. **ICP**

AUTOMATCH panels

CAPACITOR 1 field

Enter the required position for variable AMU Capacitor 1. The position can be set between 0%, minimum capacitance, and 100%, maximum capacitance. The capacitor position read back is displayed.

CAPACITOR 2 field

Enter the required position for variable AMU Capacitor 2. The position can be set between 0%, minimum capacitance, and 100%, maximum capacitance. The capacitor position read back is displayed.

AUTO button

Select to enable the AMU to tune automatically when the RF generator is switched on. When the RF generator is switched off, the capacitors return to the park position.

MANUAL button

Select to enable the AMU to move the capacitors to the values defined in the **CAPACITOR 1** and **CAPACITOR 2** fields; the capacitors will remain in these positions.

HOLD button

Select to enable the AMU to tune automatically when the RF generator is switched on. When the RF generator is switched off the capacitors remain at the last position.

ENDPOINT panel

Enter a number 0 to 7 to select an endpoint script to run. Refer to the Verity SD 1024 'standalone' endpoint system manual for details. Note this system has a 'standalone' Endpoint Detection System. When the RF power is switched on, a start signal is sent to the Endpoint

Detection System, which will return an endpoint signal when an endpoint is detected. On receipt of the endpoint signal, the process will terminate immediately ignoring any preset process length.

CRYO panel Enter the required table temperature. The current table temperature is displayed.

HELIUM BACKING panel

Enter the required backing pressure. The current pressure (Torr) and flow rate (scm) are displayed. The open/closed status of the control valve is displayed.

APC CONTROLLER panel

Select either the **Pressure** or the **Position** button. Enter the required Chamber Pressure or APC valve position. The current Process Chamber pressure, Valve Position and valve status are displayed.

The low pressure strike feature allows plasma processing at low pressures. When the gas pressure is too low, it is not possible to strike a plasma; however it is possible to sustain a plasma to very low pressures once it has been ignited. This software feature enables the user to raise the pressure temporarily, strike a plasma, and automatically reduce the pressure to the desired value for processing.

The three data fields and their effects are:

LOW PRESSURE STRIKE panel

Strike Pressure field

DC bias Minimum field

Ramp Rate field

Enter the value in mTorr at which the RF should turn on and strike the plasma. If a zero is entered, the feature is disabled and the RF will turn on once the pressure has stabilised at the requested process pressure.

Enter a positive number for the minimum DC bias value expected once the plasma has struck. Enter zero if DC bias cannot be read because the substrate (and any wafer clamp) completely cover the electrode, or if the electrode has an insulating coating. A non-zero value is used by the software to detect if the plasma has been properly established. If a zero is entered, then the software assumes the plasma has struck once the RF reflected power goes low.

Enter a number to set the rate at which the pressure is reduced from the strike value to the set point. The higher the number entered, the faster the transition to process conditions will be. Note that too high a value can cause the plasma to go out if the plasma impedance changes faster than the RF matching unit can track.

Etching

An automatic process run can be carried out by a user logged on.

- 1) Select the Process menu, then the Recipe option. Click on the **Load** button then select the required recipe.
- 2) Click on the **Run** button. This will start wafer transfers and wafer processing.
- 3) When the 'Process Complete' message is displayed, select the Pump Control page and move the wafer from the process chamber to the Automatic load lock using the same method as the transfer in.
- 4) Open the Automatic load lock's lid and remove the wafer.

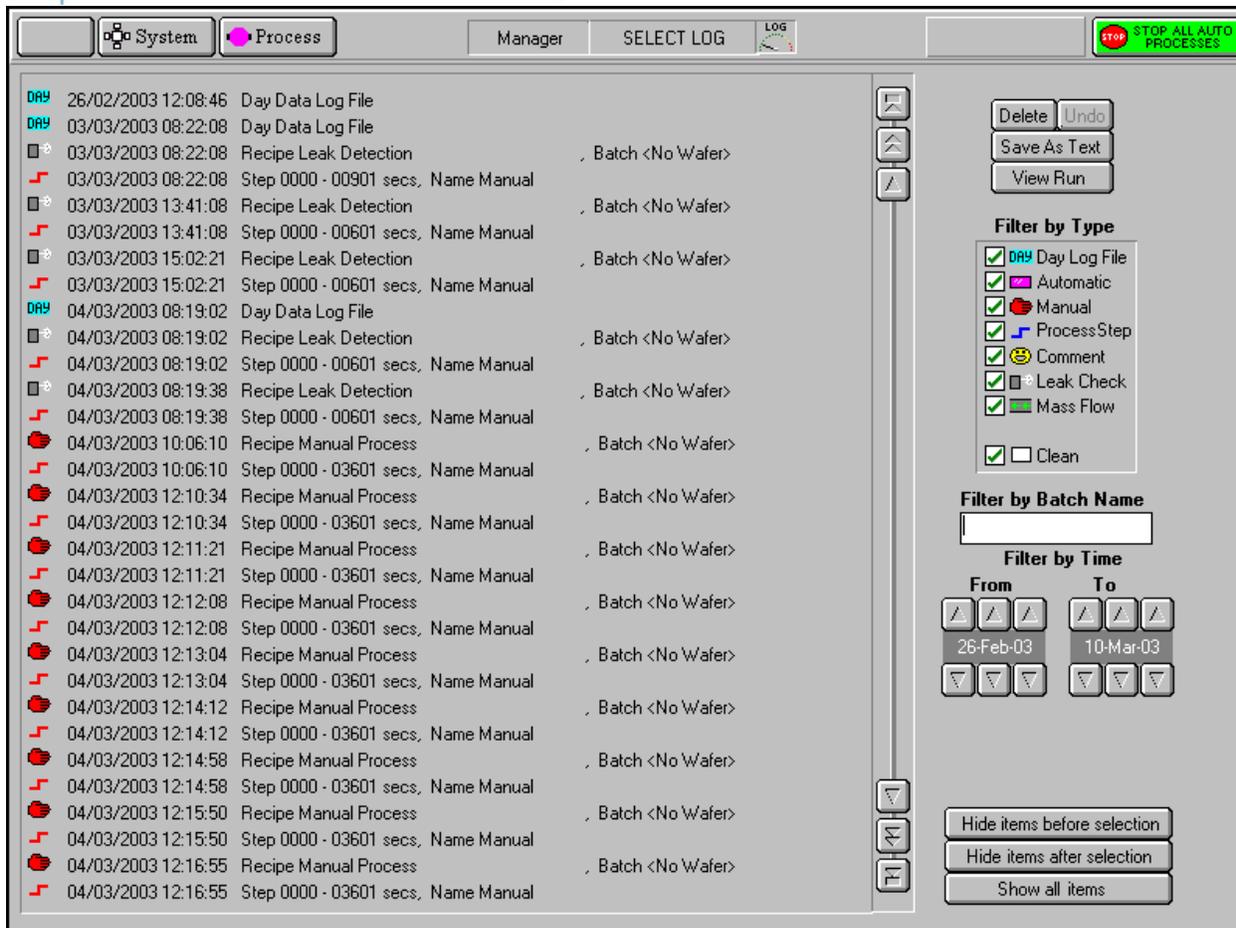
Process Datalog

All processes are automatically data-logged. The interval between logging events is set in the Recipe screen.

The Process Datalog facility allows you to view process data runs and associated comments. The facility comprises three pages:

- a) SELECT LOG page – allows you to select the process data to view.
- b) RUN LOG page – lists the selected process data, for all runs except Leak detection runs and MFC calibration runs, with respect to time.
- c) Leak detection and MFC calibration log page – displays the Leak detection runs and MFC calibration runs in text and graphical formats. These pages are described in the following text.

The Select Log page is displayed by selecting the **Process** button, then the **Log View** option.



Select Log page

The page comprises a list of logged events, which can be filtered by type, batch name and time. When the required events have been selected, they can be viewed on a Log View page.

The facilities provided on the page are as follows:

List of logged events

Displays a list of logged events in a date/time sequence. Each event is identified by an icon, date, time, title, duration, name and comments (if present). An event is selected (highlighted) by clicking on it.

Delete button Deletes the selected event

Undo button Undo the last action

Save As Text button

Save the selected event as a text file for use in spreadsheets etc.

View Run button

Opens either the Run Log page (see sub-section 5.7.2, page 5-29) or, if either a Leak detection run () or MFC calibration run () is selected, the Leak Detect and MFC calibration log page (see sub-section 5.7.3, page 5-30) with the selected log data displayed.

Filter by Type list

A list of event types with associated checkboxes. Use this panel to select the events to display in the Event list. A checkbox showing an 'x' indicates that the associated event type will not be displayed. A checkbox showing a '☐' indicates that the associated event type will be displayed.

Filter by Batch Name field

Enter a batch name to list only logged events associated with that batch.

Filter by time fields and buttons

Use these controls to select events occurring in a time range to be displayed.

Hide items before selection button

Displays all events after and including the highlighted event.

Hide items after selection button

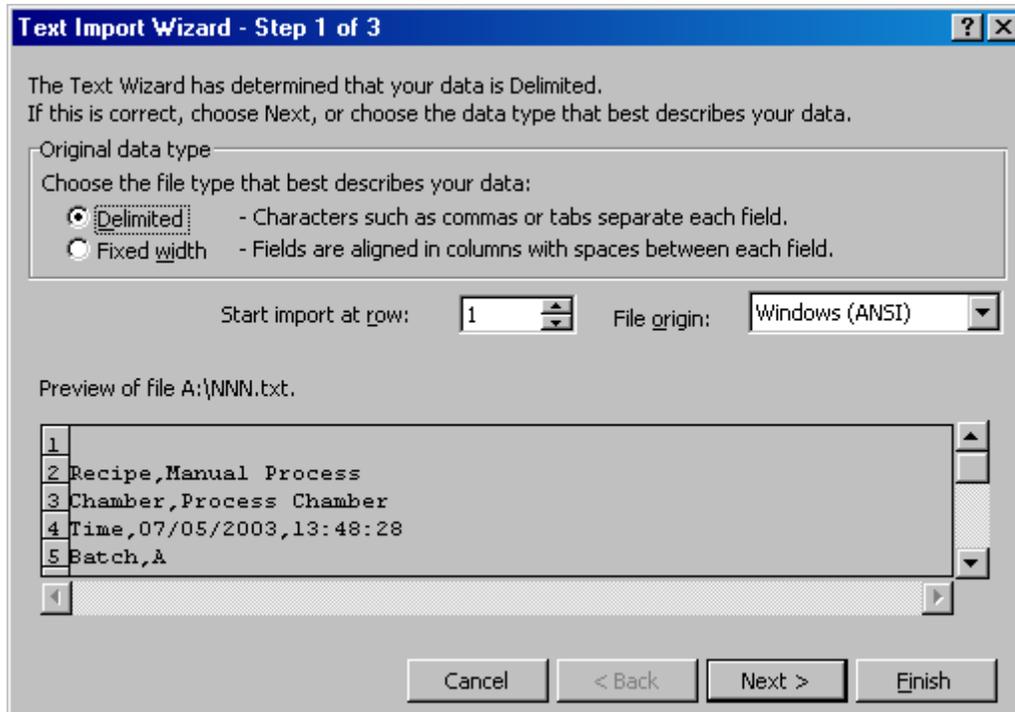
Displays all events before and including the highlighted event.

Show all items button

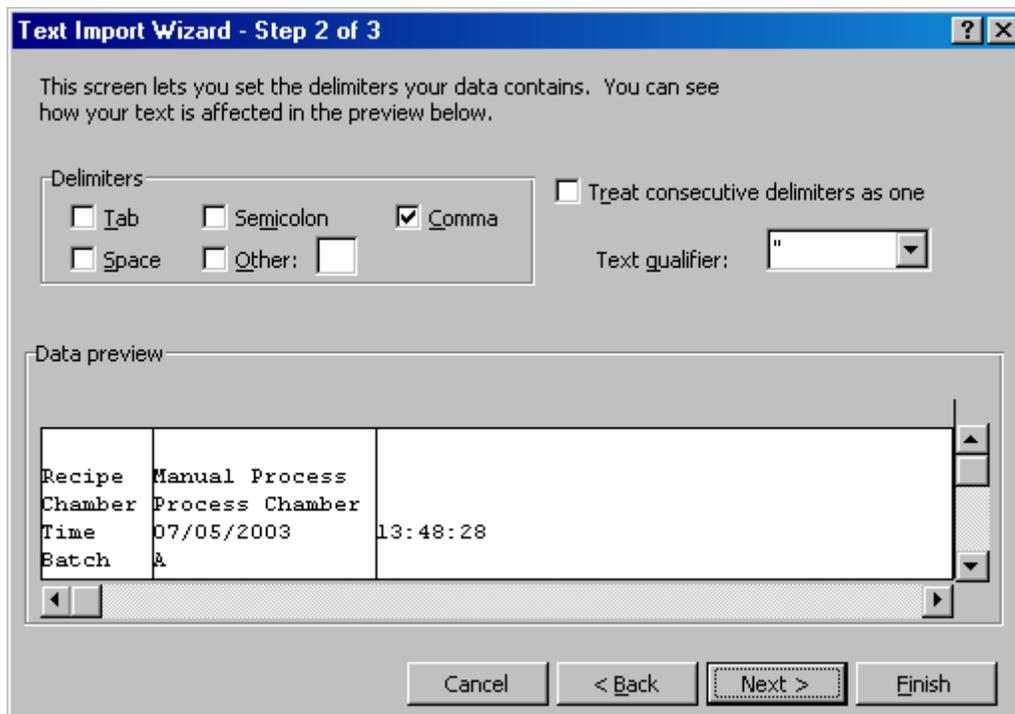
Displays all previously hidden events.

Any logged process run can be saved as text and then opened in Excel for viewing, analysing, etc. To do this, use the following steps:

- 1) On the Select Log page, select the required process run (any multiple steps will be automatically highlighted).
- 2) Select the **Save As Text** button. The **Save As** dialogue is displayed.
- 3) Navigate to the target location for the log text file, enter a filename and in the 'Save as type:' field select 'Log Text Files (*.Txt)' from the drop-down list. If saving to a floppy disk, label it and insert into the drive now.
- 4) Select the **Save** button. The text file is saved in your chosen location.
- 5) Start Excel and then in the File menu, select the Open option. The 'Open' dialogue is displayed.
- 6) Navigate to the location of the saved text file and in the 'Files of type:' field, select 'All Files (*.*)' from the drop-down list. Select the required text file and then select the **Open** button. The 'Text Import Wizard – Step 1 of 3' dialogue is displayed:

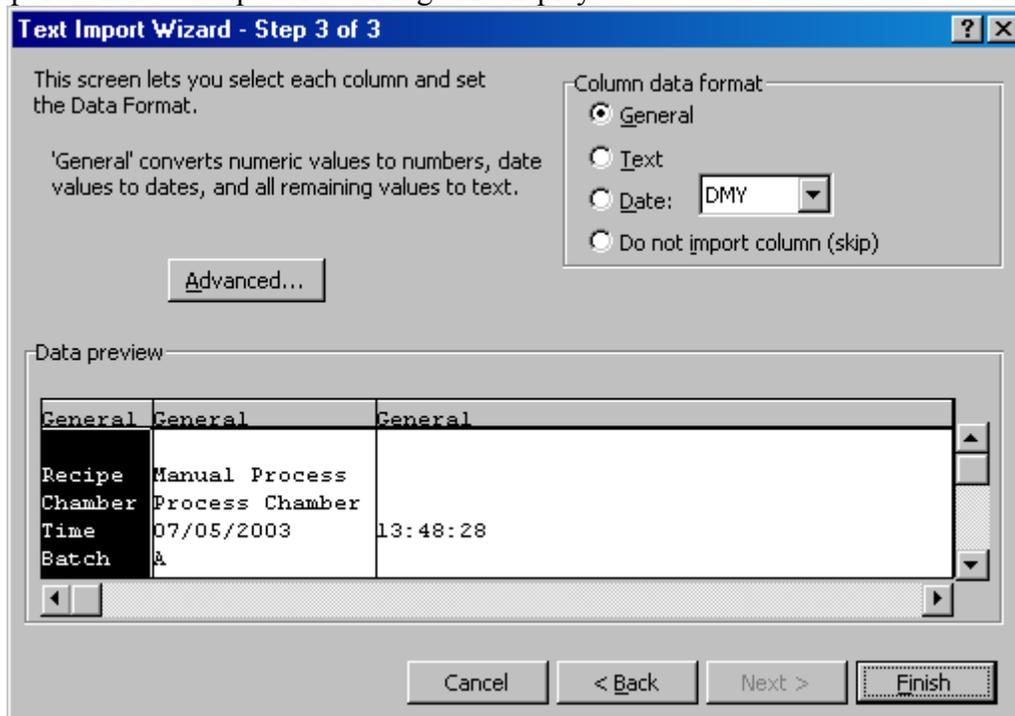


7) In the ‘Original data type’ panel, select the ‘Delimited’ option and then select the **Next >** button. The ‘Text Import Wizard – Step 2 of 3’ dialogue is displayed:



8). In the ‘Delimiters’ panel, select the ‘Comma’ checkbox. Select the **Next >** button. The

'Text Import Wizard – Step 3 of 3' dialogue is displayed:



9) In the 'Column data format' panel, ensure that the 'General' option is selected and then select the **Finish** button. The process run log data is now displayed in the Excel worksheet.

10) Adjust the column widths so that all text is visible and then save the spreadsheet.

Run log

The Run Log page is accessed from the Select Run page by clicking on the **View Run** button with any process run other than a leak detection run or MFC calibration run.

The page displays the Parameters, Demands and Readbacks for the selected log data.

The facilities provided on the page are as follows:

Select Run button

Displays the Select Log page.

Log information panel

Displays details about the selected log data.

Parameter list

Lists the logged parameter names

Demand list

Displays the demanded parameter value

Readbacks list

Displays the logged parameter values with respect to time at the log intervals specified for the process run. The list can be scrolled horizontally either by single readbacks or by page. The list can also be scrolled vertically to display further steps (for multi-step recipes).

Parameter	Demand	Readbacks														
Step Time	3601	0	0	0	3601	3595	3590	3586	3580	3575						
Pump Pressure	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09						
Pump Time	1	0	0	0	0	0	0	0	0	0						
C4F8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
SF6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
CHF3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
Ar	20.0	19.7	19.8	19.9	20.0	20.0	19.8	19.9	20.0	19.9						
O2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
Rf Power	100	0	0	0	97	97	97	97	97	97						
Rf Reflected Power		0	0	0	14	1	0	0	0	0						
DC Bias		0	0	0	325	352	347	345	343	342						
Table Temperature	20	20	20	20	20	20	20	20	20	20						
Set Pressure	20.0	0.9	16.6	19.8	20.0	20.0	19.9	19.9	19.9	19.9						
Set Position	0.0	39.2	9.8	9.9	10.2	9.9	10.0	10.0	10.0	10.0						
Pressure	Off															
Low Pressure Strike	0															
Low Pressure Strike	0															
Low Pressure Strike	0															
Icp Forward Power	0	0	0	0	0	0	0	0	0	0						
Icp Reflected		0	0	0	0	0	0	0	0	0						
Helium Pressure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
Helium Flow		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						

Run log page