System
Operator's Manual

The information contained in this manual is applicable to the following system:

System type:	Multiplex
Handling System:	MPX
Software Version:	Release 6.6

Version 2.2

Surface Technology Systems plc
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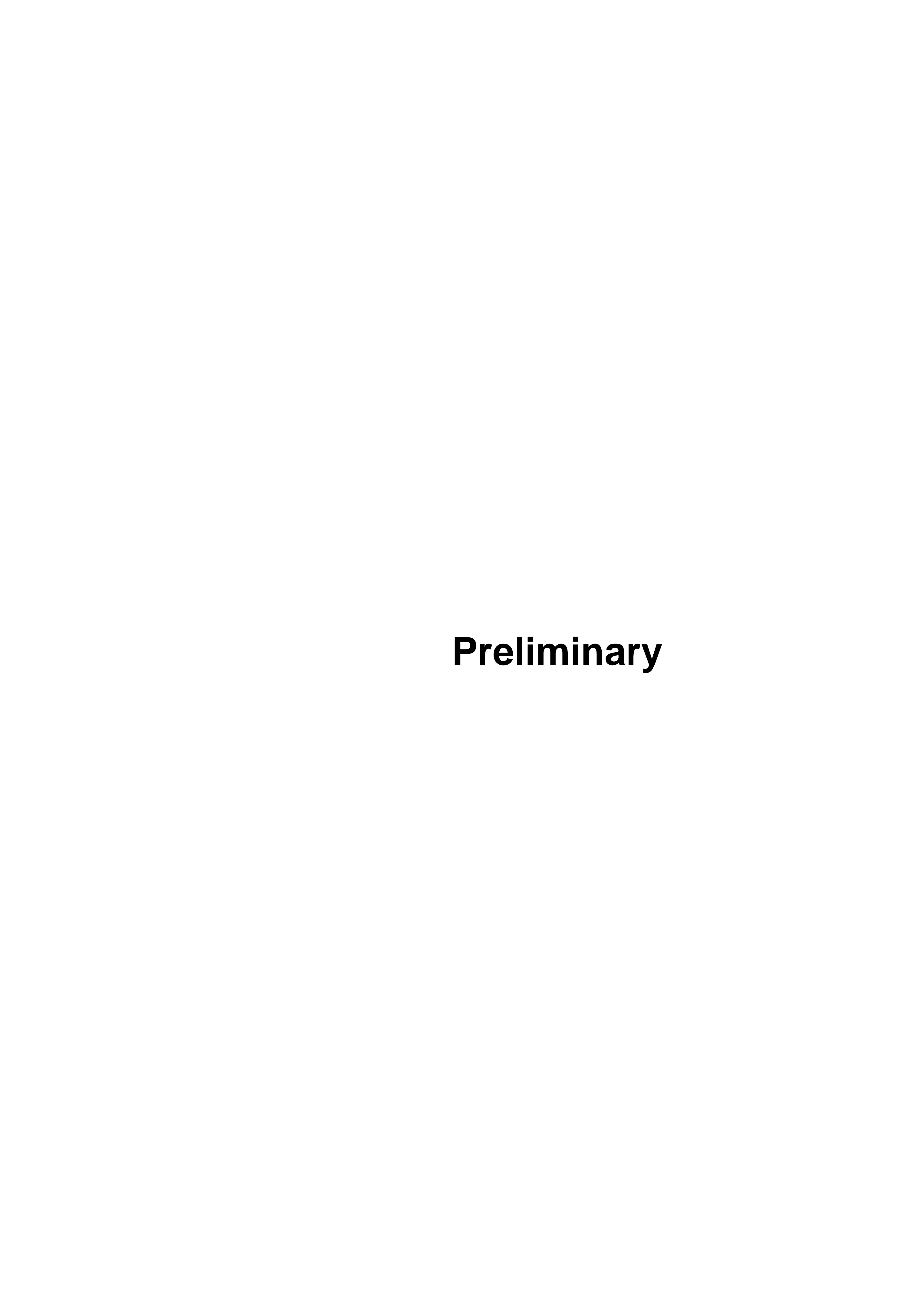

Preliminary

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P1 Preface

Welcome to the Operator’s Manual.

The manual is organised into chapters as follows:

Chapter 1 - Introduction

This chapter introduces the system, discusses its major components and summarises the main features.

Chapter 2 - Getting Started

This chapter provides an overview of the software components and their function. The descriptions will allow the user to gain a basic understanding of the system’s software controls. This chapter describes how the machine is operated via a series of control dialogs and editors using the Operator Station software.

Chapter 3 – System Operation

This chapter describes how to use the software controls described previously. Instructions are given on how to safely and correctly start up the system, set up basic operational parameters, process wafers and describes how to use the Data Logging Utility, which is used to record events that occur during a process.

P2 About this Manual

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Owing, in most part, to Surface Technology Systems equipment being used by purchasers for their unique applications, NO liability can be accepted for any inaccuracies or omissions in this publication, although every possible care has been taken to make it as complete and accurate as possible.

Surface Technology Systems plc reserves the right to make changes and alter specifications without prior notice and without incurring an obligation to make changes to products manufactured previously. You are advised to contact your nearest Surface Technology Systems office for the latest information on product improvements, incorporated after this publication.

All information contained in this manual is based on the latest product information available at the time of publication. Graphics and illustrations in this publication are intended for reference use only and may not depict actual machine configuration, or component parts.

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P3 Assumptions

This manual has been produced to assist operators and system engineers to perform their tasks safely and competently. Surface Technology Systems plc has assumed that personnel operating this equipment are fully conversant with all appropriate safety issues, familiar with the technology the system represents, and are competent users of Windows based computer operating systems.

P4 Acknowledgements

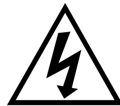
All product names mentioned are acknowledged as the trademarks or registered trade marks of their respective owners.

P5 Warnings, Cautions and Notes

Warnings, Cautions and Notes are used throughout this manual. Warnings are highlighted by use of an international hazard symbol. The following definitions of these notices are shown in the way that they are presented in the manual.

WARNINGS

A warning is given to alert the user of possible hazards which may cause loss of life, physical injury or ill health in any form. An example warning is shown below.



POTENTIALLY LETHAL VOLTAGES ARE PRESENT IN THIS EQUIPMENT. SWITCH OFF AND ISOLATE ALL ELECTRICAL SUPPLIES BEFORE REMOVING ANY COVERS. TAKE PRECAUTIONS AGAINST ELECTRIC SHOCK WHEN WORKING ON LIVE EQUIPMENT WITH THE COVERS REMOVED.

Warnings can be considered to fall into two categories, those due to hazardous materials and those due to hazardous operations. Where appropriate, a second international hazard symbol is used for specific hazards.

CAUTIONS

A caution is given to alert of possible hazards which may cause damage to equipment. An example caution is shown below.

CAUTION: Consult the safety procedures and carry out those that are necessary for switching off the system.

NOTES

A Note is used to convey or draw attention to information that is extraneous to the immediate subject of the text. An example note is shown below.

Note: *The screens shown in this manual represent a "typical" machine, and may NOT reflect the machine configuration exactly.*

P6 Safety Introduction

All the Safety precautions displayed in this chapter MUST be read and understood prior to operating, maintaining or repairing the equipment.

Owing, in most part, to Surface Technology Systems plc equipment being used by customers for their own unique applications, the information contained in this section is included as a guide ONLY.

It is recommended that ALL subsequent information contained in this chapter be used in conjunction with the customers national, local and in-house safety procedures and policies.

NO liability can be accepted for any inaccuracies or omissions in this publication, although every possible care has been taken to make it as complete and accurate as possible and represent the minimum safety precautions to be taken.

This chapter also contains guidance about additional health and safety procedures applicable to the equipment and its uses.

STS does not accept liability for any by-products resulting from the customer's application.

P6.1 Responsibilities

It is the responsibility of the service engineer/operator to be aware of:

- This document
- Their responsibilities and that they are provided with adequate resources to carry out their job whilst complying with all health and safety requirements

It is the responsibility of the service engineer/operator to comply with these procedures and with all local health and safety legislation.

P6.2 Guide for a Safe Way To Work

1. Start

Plan the **Task**
Consider the **Risks**
Think about the **Dangers**

Review environmental conditions and **Hazards**

Consider all the appropriate **Safety Precautions**

Familiarise yourself with all the relevant **COSHH**, **MSDS** and **RA**s associated with the task.
Any local procedures related to this must be followed.

2. Preparation

Ensure the **Work** area is **Free** of all extraneous material

Ensure appropriate **Safety Clothing** is Worn

Obtain permission to undertake work on the equipment from your supervisor

Assemble all necessary tools and spare parts to undertake the task

Ensure that all relevant **WARNING** and **CAUTION** safety notices are clearly displayed

Review the procedures associated with the task

3. Undertake the task

Work in a logical sequence

4. Completion

On completion of the task, test the system for serviceability

When the work is completed, inform the supervisor. Complete the required paperwork

Remove **All** safety notices from the equipment

Ensure the machine and work area is free of all extraneous material

P7 General Safety

P7.1 Actions in the Event of Fire or other Emergency

- Service engineers/operators must familiarise themselves with local procedures for raising and reacting to, fire, gas and any other alarms
- In particular, location of alarm call points, emergency exits and assembly points, various alarm sounds and roll call procedures must be known
- Procedures for obtaining first aid assistance must be known
- All of the above apply to procedures during and out of normal working hours

P7.2 Hazardous Conditions

- Service engineers/operators must be aware of, and act accordingly to, local conditions of high magnetic fields, RF radiation, laser radiation, high or low temperature or humidity
- Service engineers/operators must be aware that substrate samples may be at elevated temperatures after processing
- Service engineers/operators must be aware that substrate samples may contain substances hazardous to health

P7.3 Hazardous Locations

Service engineers/operators must be aware of the following specific hazardous locations

Hazard	Location	Description	Hazard Label
High Voltage	Inside AC Enclosure	High voltages are present within the AC enclosure	
	Inside DC Enclosure	High voltages are present within the DC enclosure	
	Electronics Rack AC Distribution Panel	High voltages are present within the electronic rack AC distribution panel	
	Electronics Rack PLC Drawer	High voltages are present within the E-Rack PLC drawer	
High RF Voltage	Source Matching Units	High RF voltages are present within the source matching units	DANGER High RF voltage area. Authorised personnel only.
	Bias Decoupling Unit	High RF voltages are present within the bias decoupling unit	
Hot Surface	Foreline	Hot surfaces are present on the heated foreline	
	Lower RF Enclosure	Hot surfaces are present within the lower RF enclosure	
	Loadlock	Hot surfaces are present within the loadlock (LPX only)	
Cold Surface	Lower RF Enclosure	Cold surfaces are present within the lower RF enclosure	
Crush Hazard	Lower RF Enclosure	A crush hazard is present within the lower RF enclosure	
Non-Ionising Radiation	Lower RF Enclosure	Non-Ionising radiation is present within the lower RF enclosure	
Strong Magnetic Field	Source Enclosure	Strong magnetic fields are present within the source covers	Warning Strong magnetic field at all times; Persons with a pacemaker or similar implant must not come into close proximity of this equipment
Laser	Loadlock	A class1 laser is present within the loadlock (MPX and MACS only)	
Note: The gasbox will contain gases that are specific to each process requirement. The actual hazard labels used will be dependant upon the gases present.			
Corrosive / Explosive / Flammable/ Oxidising / Toxic Gases	Gasbox	Corrosive / explosive / flammable / oxidising / toxic gases are present within the equipment located inside the gasbox	CORROSIVE, EXPLOSIVE, FLAMMABLE, OXIDISING AGENT, TOXIC

P.1 Hazardous Locations

P8 Personal Safety

Before undertaking any maintenance or repair of the equipment, review the guide to a safe way to work.

P8.1 Personal Protective Equipment

SUBJECT TO LOCAL SAFETY RULES, CERTAIN TYPES OF PERSONAL PROTECTIVE EQUIPMENT SHOULD BE WORN WHEN UNDERTAKING SPECIFIC TASKS. THE FOLLOWING RECOMMENDATIONS SHOULD BE CONSIDERED AS THE MINIMUM REQUIREMENT.

1. **Breaking Vacuum**

   Following an oxygen plasma clean for a minimum period of 60 minutes and any necessary etchback, full protective clothing should be worn. This includes air tight coveralls, gloves and breathing apparatus which comprises eye and face protection.

   If, after taking air samples (e.g. with a Draeger test set), the air is considered safe; the respirator and airtight coveralls can be removed and replaced with other protective clothing. Such clothing would include a clean room suit, gloves, face mask and safety goggles.

2. **Handling Of Process Chamber Components**

   Provided air sampling tests have proved safe, it is recommended that a clean room suit, industrial acid resistant gloves, face mask and safety goggles are worn when handling process chamber and associated vacuum components.

3. **Breaking Hazardous Gas Lines**

   Following decommissioning of hazardous gas lines and/or replacement of MFCs full protective clothing should be worn. This includes air tight coveralls, gloves and a respirator which comprises eye and face protection.

   If, after taking air samples (e.g. with a Draeger test set) and the source is isolated by at least two valves, the air is considered safe; the respirator and air tight coveralls can be removed and replaced with other protective clothing. It is recommended that a clean room suit, industrial acid resistant gloves, face mask and safety goggles are worn.

4. **Routine Maintenance**

   Provided the system is process contaminant free, routine maintenance can be undertaken wearing gloves and goggles.

BEFORE BREAKING SEALS AND UNDERTAKING AIR SAMPLING CHECKS, FULL PERSONAL PROTECTIVE EQUIPMENT MUST BE WORN INCLUDING A RESPIRATOR. THE IMMEDIATE AREA MUST BE WELL VENTILATED. ALL NON-ESSENTIAL PERSONNEL MUST BE EVACUATED TO A SAFE AREA AND AIR SAMPLING WARNING NOTICES MUST BE DISPLAYED IN THE IMMEDIATE VICINITY. WHEN UNDERTAKING AIR SAMPLING TESTS, CHECKS MUST BE MADE TO ASCERTAIN THE CONCENTRATION OF RESIDUAL GASES AND HAZARDOUS BY-PRODUCT GASES SUCH AS HCl AND HF.

IT IS RECOMMENDED THAT MAINTENANCE PERSONNEL WEAR SAFETY GOGGLES THAT CONFORM TO THE CURRENT LOCAL SAFETY STANDARDS OR MINIMALLY TO CE EN166B. ALSO ENSURE THAT SUITABLE GLOVES ARE WORN WHEN HANDLING VACUUM ASSOCIATED EQUIPMENT.

P9 Specific Physical Hazards

This section details the specific physical hazards that arise from materials used commonly in all system applications. Other hazardous materials may also be present, for example hazardous gases may be used for particular process requirements.

Always refer to the manufacturer's MSDS information for each of these hazardous materials before performing any maintenance or repair procedures.

P9.1 Viton Synthetic Rubber and Fluoroelastomer Products

SEVERE BURNS CAN RESULT FROM THE HANDLING OF VITON 'O'-RINGS WHICH HAVE BEEN EXPOSED TO EXCESSIVELY HIGH TEMPERATURES. HOWEVER, SERVICE ENGINEERS ARE ASSURED THAT WHEN USED UNDER THEIR DESIGN CONDITIONS THEY ARE SAFE.

Viton is a fluoroelastomer which is a synthetic rubber-like material containing fluorine. If this material is exposed to temperatures in the region of 400°C or higher, the material decomposes and one of the products formed is hydrofluoric acid. This is an **extremely corrosive substance** and is almost impossible to remove once it contaminates the skin and first aid assistance must be sought.

If it is required to inspect equipment which has been exposed to very high temperatures (e.g. if it has been involved in a fire), examine closely to ascertain if any seals have suffered decomposition, in which case they will appear charred.

If such indications are visible, do not touch the seals or the installation. Report the incident to your safety officer who should arrange to decontaminate the area.

DO NOT TOUCH ANYTHING IN THE VICINITY OF THE DECOMPOSED MATERIAL UNTIL IT HAS BEEN DECONTAMINATED.

Note: *There is no such hazard for natural rubber Nitrile seals.*

P9.2 IPA

IPA (Isopropyl Alcohol) is used for cleaning purposes.

Safe handling data applicable to Isopropyl Alcohol is as follows:

Manufacturer
Microchem Systems Ltd

Physical Data
Boiling point: 82 - 83°C.
Specific gravity: 0.785 - 0.786 (H_2O=1).
Vapour pressure: 4100 Pa.
Solubility in water: Completely miscible in water at 20°C
Evaporation rate: 1.5.

Fire And Explosive Hazard Data
Highly Flammable
Flash point: 12°C.
Extinguishing medium: Alcohol-resistant foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only. Do NOT use water in a jet.
Special fire fighting procedures: Keep adjacent containers cool by spraying with water.

Unusual fire and explosive hazards: Hazardous combustion products may include carbon monoxide. The vapour is heavier than air, spreads along the ground and distant ignition is possible.

Health Hazard Data
Skin: Wash skin with water using soap if available. If persistent irritation occurs, obtain medical attention.
Eyes: Flush eye with water. Obtain immediate medical attention.
Inhalation: Remove to fresh air. If rapid recovery does not occur, obtain medical attention.
Ingestion: Do not induce vomiting. If rapid recovery does not occur, obtain medical attention. Give water to drink, providing patient is conscious.
Incompatibility: Reacts with strong oxidising agents. Reacts with strong acids.

Spill Or Leak Procedures/Waste Disposal
Prevent contamination of soil and water. Prevent from spreading or entering into drains, ditches or rivers by using sand, earth or other appropriate barriers.
Risk of explosion. Inform the emergency services if liquid enters surface water drains. Vapour may form an explosive mixture with air.

Special Protection/Special Precautions
Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Extinguish any naked flames. Remove ignition sources. Avoid sparks. Do not smoke. Do not empty into drains. Earth all equipment used for product transfer.

P9.3 Acetone

Acetone is used for cleaning purposes.

Safe handling data applicable to Acetone is as follows:

Manufacturer
Microchem Systems Ltd

Physical Data
Boiling point: 55.8 - 56.6°C.
Specific gravity: Approx. 0.791 (H_2O=1).
Vapour pressure: 24.7 kPa.
Solubility in water: Completely miscible in water at 20°C
Evaporation rate: 5.6.

Fire And Explosive Hazard Data
Highly Flammable
Flash point: -18°C.
Extinguishing medium: Alcohol-resistant foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only. Do NOT use water in a jet.
Special fire fighting procedures: Keep adjacent containers cool by spraying with water.
Unusual fire and explosive hazards: Hazardous combustion products may include carbon monoxide. The vapour is heavier than air, spreads along the ground and distant ignition is possible.

Health Hazard Data
Skin: Remove affected person from source of contamination. Promptly flush contaminated skin with water. Promptly remove clothing if soaked through and flush the skin with water. Wash skin with water using soap if available.
Eyes: Promptly wash eyes with lots of water while lifting the eye lids. If persistent irritation occurs, obtain medical attention.
Inhalation: Move the exposed person to fresh air at once. Keep the affected person warm and at rest. Get prompt medical attention.
Ingestion: Do not induce vomiting. If rapid recovery does not occur, obtain medical attention. Give water to drink, providing patient is conscious.
Incompatibility: Reacts with strong oxidising agents. Reacts with strong acids.

Spill Or Leak Procedures/Waste Disposal
Prevent contamination of soil and water. Prevent from spreading or entering into drains, ditches or rivers by using sand, earth or other appropriate barriers.
Risk of explosion. Inform the emergency services if liquid enters surface water drains. Vapour may form an explosive mixture with air.

Special Protection/Special Precautions
Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Extinguish any naked flames. Remove ignition sources. Avoid sparks. Do not smoke. Do not empty into drains. Earth all equipment used for product transfer.

P10 Mechanical Safety

MAINTENANCE AND REPAIR PROCEDURES MAY ONLY BE UNDERTAKEN BY STS APPROVED TECHNICALLY QUALIFIED PERSONNEL WHO ARE FULLY AWARE OF ALL RELEVANT SAFETY PRECAUTIONS.

ENSURE THE CHAMBER IS AT AMBIENT TEMPERATURE BEFORE OPENING.

WHEN A CHAMBER HAS BEEN PROCESSING WITH TOXIC GASES, OR HAS TOXIC GASES CONNECTED, THE FOLLOWING SAFETY MEASURES SHOULD BE CARRIED OUT BEFORE THE CHAMBER IS VENTED TO ATMOSPHERE.

1. **ENSURE THE GAS LINES HAVE BEEN PUMP PURGED AND BACK FILLED WITH N2 BEFORE VENTING.**
2. **ENSURE ALL APPROPRIATE ANALYTICAL AND SAFETY EQUIPMENT IS AVAILABLE AND IS USED AS NECESSARY.**
3. **ENSURE THE CHAMBER IS IN A SAFE STATE TO BE VENTED. IF TOXIC GASES ARE PRESENT AFTER VENTING, BREATHING APPARATUS MUST BE WORN BEFORE OPENING THE CHAMBER.**

IF A CLEANING RECIPE CANNOT BE RUN, OR IF TOXIC GASES HAVE BEEN USED IN THE PROCESS CHAMBER THEN PPE MUST BE WORN BEFORE OPENING THE CHAMBER (SEE P8).

THE GASBOX CONTAINS EQUIPMENT THAT MAY CONTAIN HAZARDOUS GASES. ONLY STS APPROVED TECHNICALLY QUALIFIED PERSONNEL WHO ARE FULLY AWARE OF ALL RELEVANT SAFETY PRECAUTIONS MAY OPEN THE GASBOX.

ENSURE THAT THE GASBOX EXTRACT IS RUNNING BEFORE OPENING THE GASBOX DOOR.

ENSURE THE GASBOX DOOR IS CLOSED AND LOCKED DURING PROCESSING.

P11 Manual Handling

- All operations involving manual handling must be in accordance with the local manual handling operations regulations
- In particular all mechanical handling aids provided must be used
- Handling without mechanical aids must be a last resort and is in any case forbidden for any single person handling of any component weighing 25 kg or more
- Care must be taken with any component awkwardly located, or with any component which has any other potentially hazardous characteristics, such as high or low temperature, sharp edges, etc.

P12 Compressed Air

Many devices on the system are operated pneumatically.

EYE PROTECTION SHOULD BE WORN WHEN WORKING ON PNEUMATIC SYSTEMS AS A LOOSE PIPE WHICH IS PRESSURISED MAY CAUSE EYE DAMAGE.

ALWAYS DIRECT COMPRESSED AIR AWAY FROM EYES AND SKIN.

Compressed air is safe when used correctly. However, open ended pipes must never be brought into close contact with bare skin, since air may penetrate the skin and may form embolisms in the bloodstream.

If compressed air is used for blowing away dust or swarf or for cooling purposes, then appropriate eye protection must be worn to prevent particles of foreign matter from being blown into the eyes.

Hoses, fittings, regulators, and valves should be inspected periodically for leaks, damage and other defects.

P12.1 Pneumatic Isolation

Pneumatic isolation valves are located in the following areas:

- CPX / VPX systems
  On the air preparation assembly located in the lower enclosure below the handler.

- MPX systems
  On the air preparation assembly located between the carousel and the process module.

- LPX systems
  On the air preparation assembly located directly below the loadlock.

P13 Vacuum Pumps

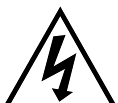
Refer to the manufacturer's instructions for all information on the safe operation of the pumping equipment.

ENSURE THAT THE MANUFACTURER'S RECOMMENDATIONS FOR NITROGEN PURGES ARE FOLLOWED BEFORE PERFORMING ANY SERVICE PROCEDURE ON THE PUMPING EQUIPENT.

THE SYSTEM'S HELIUM SUPPLY MUST BE ISOLATED BEFORE STOPPING THE LOCAL EXHAUST VENTILATION (LEV) SYSTEM.

P14 Electrical Safety

TO PREVENT RISK OF INJURY, ALL MAINTENANCE AND REPAIR PROCEDURES MUST BE UNDERTAKEN BY TECHNICALLY QUALIFIED PERSONNEL WHO ARE FULLY AWARE OF ALL RELEVANT SAFETY PRECAUTIONS ASSOCIATED WITH PROCESSING, OPERATING AND MAINTAINING THE EQUIPMENT. IN ADDITION, SUCH PERSONS MUST BE CAPABLE OF OPERATING SURFACE TECHNOLOGY SYSTEMS (STS) SOFTWARE.



POTENTIALLY LETHAL VOLTAGES (IN EXCESS OF 30 VOLTS AC AND 50 VOLTS DC) ARE PRESENT ON THE EQUIPMENT. TO PREVENT INJURY, ENSURE THE SYSTEM, CIRCUIT OR COMPONENT IS ISOLATED AND 'LOCKED OFF' FROM ITS SOURCE OF SUPPLY PRIOR TO UNDERTAKING ANY MAINTENANCE OR REPAIR OF THE EQUIPMENT. DO NOT RELY ON CONTROL SYSTEM INTERLOCKS OR VDU DISPLAYS AS AN INDICATION THAT IT IS SAFE TO WORK ON POTENTIALLY HAZARDOUS ITEMS.

WHEN UNDERTAKING ELECTRICAL MAINTENANCE AND REPAIR PROCEDURES, NEVER WORK ALONE.

P14.1 Radio Frequency (RF) Power

The system uses RF power during processing. All enclosures inside which RF power is present are clearly marked and the covers are fitted with electrical interlocks. Anyone requiring access to the source must be fully aware of the hazards of RF power.

The relevant parts of the system must be electrically isolated before any work is carried out inside these enclosures. Apart from the risk of electrical shock, severe burns are possible if live conductors are touched.

All securing fasteners on RF panels should be refitted before using the system.

P14.2 Magnetic Fields

The source contains strong magnetic fields. Strong magnetic fields may cause pacemakers to malfunction. Damage to magnetic-sensitive devices (bank/credit cards, watches, etc.) may also result. Magnetic field strength is negligible at distances over 30cm from the source.

P14.3 Live Works

Whenever work is being carried out on live conductors, suitable warning notices should be posted close to the machine to alert other people of the hazard. The machine should never be left unattended. Live electrical work should never be carried out by a lone worker.

If electrical equipment is to be isolated using a breaker tripped to 'off' a DVM must be used to ensure that the equipment is no longer energised.

P14.4 Uninterruptible Power Supply (UPS)

On MPX and MACS systems an uninterruptible power supply (UPS) will continue to provide power to specific areas of the loadlock after an emergency off (EMO) and / or after the main breaker is off. The UPS is located in the enclosure underneath the loadlock.

The power is used to enable a current wafer transfer operation to complete and for the gate valve to close thereby isolating the loadlock from the process module.

The areas that the UPS supplies power to are:

- Loadlock PC
- 24V DC PSU (including carousel)
- PC monitor
- Cleanroom panel interface
- Cleanroom panel adderlink (including KVM switch)

ALWAYS REFER TO THE POWER WIRING DIAGRAM FOR THE LOADLOCK SUPPLIED IN THE DRAWING PACKAGE BEFORE PERFORMING ANY MAINTENANCE WORK ON THE LOADLOCK

P14.5 Electro-Magnetic Radiation

To ensure that compliance with the electro-magnetic compatibility (EMC) directive is maintained, all covers should remain correctly fitted and secured at all times except when their removal is required for maintenance purposes. When refitting covers, ensure that they are secured with a full complement of the fixing items (i.e. screws, clips, wire locking, etc.) with which they were originally secured. Ensure that all earth leads are connected and all hardware interlocks are operating correctly.

Non-ionising radiation is located in the source and upper & lower electrodes and has the following properties:

Frequency	Power	Mode
13.56MHz	Upto 600W	Continuous
380KHz	Upto 1KW	Continuous

P14.6 Laser Devices

The system makes use of laser devices to map substrates.

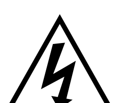
THE LASERS USED ARE CLASS 2 DEVICES. THIS CLASS IS SAFE FOR ACCIDENTAL VIEWING UNDER ALL OPERATING CONDITIONS. HOWEVER THIS CLASS IS CONSIDERED HAZARDOUS IF A PERSON STARES DIRECTLY INTO THE LASER BEAM.

The following table provides details of the laser devices fitted to each handling system:

Handling System	Laser Details
CPX / VPX	Each VCE contains a laser for cassette mapping. Please refer to the handler OEM documentation for details on the laser device.
MACS	A laser is located behind the carousel in front of the chamber gate and is used to map the carousel and verify a substrate's presence or absence during handling. The laser data sheet is as follows: Manufacturer: Omron, equipment model number: E3C-LD11, Wavelength: 650nm, Power: 2.5mW max., FDA: Class II, JIS: Class 2. A laser is also located on the robot situated directly adjacent to the carousel and is used to map the cassettes. Please refer to the robot OEM documentation for details on the laser device.
MPX	A laser is located behind the carousel in front of the chamber gate. The laser data sheet is as follows: Manufacturer: Omron, equipment model number: E3C-LD11, Wavelength: 650nm, Power: 2.5mW max., FDA: Class II, JIS: Class 2.
LPX	The LPX system does not make use of laser devices.

In addition to this, lasers may be used for optional EPD purposes. In such cases please refer to the EPD OEM documentation for details on the laser devices.

P14.7 Lock Off Procedure



ELECTRICAL SUPPLIES AT VOLTAGES ABOVE 30 VOLTS AC AND 50 VOLTS DC CAN KILL. BEFORE WORKING ON ANY OF THE SYSTEM'S ELECTRICAL EQUIPMENT, ALWAYS SWITCH OFF THE SUPPLY AT THE CIRCUIT BREAKER AND ENSURE IT IS LOCKED OFF.
TO PREVENT ANYONE FROM RE-CONNECTING THE SUPPLY, A SIGN 'DANGER ELECTRICIAN AT WORK' MUST BE DISPLAYED.

P14.7.1 Mains Isolation

Where practicable always isolate the power supply to the machine (equipment) at its mains isolator.

1. Identify the mains isolator.
   Refer to the Service Manual to ensure the correct isolator is identified.
2. Place the isolator in the OFF position.
3. Insert the lock-out and secure with a padlock.
4. Remove the key and retain it.
5. With the lock-out in place test the lockout to ensure that it prevents the isolator from being moved to the ON position.
6. If a lock-out clasp is already in place another lockout MUST be added to the clasp. The lock-out clasp should have the facility for at least two padlocks to be fixed to it.
7. Use a test lamp or DVM to ensure that the equipment is isolated.
8. After maintenance has been completed, ensure that all guards and interlocks have been replaced before removing the lockout.

P14.7.2 PDU / Electronics Rack Isolation

If the power supply cannot be isolated at the mains isolator then the following procedure must be followed:

1. Identify the PDU / electronics rack that serves the tool.
2. The PDU / electronics rack is fitted with a main circuit breaker and individual sub-circuit breakers. Where practicable, the main circuit breaker should be locked-out. Only when power is necessary on another part of the tool (e.g. to keep pumps running, etc.) should a sub-circuit breaker isolation be made. Appropriate lock-out toggles MUST be used to make isolations at the PDU / electronics rack.
3. Place the isolator in the OFF position.
4. Insert the lock-out and secure with a padlock.
5. Remove the key and retain it.
6. With the lock-out in place test the lockout to ensure that it prevents the isolator from being moved to the ON position.
7. If a lock-out clasp is already in place another lockout MUST be added to the clasp. The lock-out clasp should have the facility for at least two padlocks to be fixed to it.
8. Use a test lamp or DVM to ensure that the equipment is isolated.
9. After maintenance has been completed, ensure that all guards and interlocks have been replaced before removing the lockout.

P15 Gas Safety

TO PREVENT INJURY, ALL MAINTENANCE AND REPAIR PROCEDURES MUST BE UNDERTAKEN BY TECHNICALLY QUALIFIED PERSONNEL WHO ARE FULLY AWARE OF ALL RELEVANT SAFETY PRECAUTIONS ASSOCIATED WITH PROCESSING, OPERATING AND MAINTAINING THE EQUIPMENT. IN ADDITION, SUCH PERSONS MUST BE CAPABLE OF OPERATING SURFACE TECHNOLOGY SYSTEMS (STS) SOFTWARE.

Surface Technology Systems plc. recommend that customers contact their local gas supplier for all information about safety precautions and first aid treatment relating to the specific gases used on their systems before connection.

P15.1 General

1. Know the following:
   - 1.1 The location of the nearest manual gas leak alarm call point.
   - 1.2 The sound and sight of the gas leak alarm.
   - 1.3 The boundaries of the gas risk area.
2. On hearing the gas leak alarm, if you are in the gas risk area leave the gas risk area by the nearest exit.
3. Remain out of the gas risk area until it is safe to return.
4. After a gas leak alarm be ready to carry out a full building evacuation if the fire alarm is subsequently activated. In this event follow normal fire procedures.

P15.2 Discovering a Gas Leak

1. If the alarm has not already been activated by an automatic gas leak detection system, sound the gas alarm.
2. Leave the gas risk area by the nearest exit.
3. Go to the designated assembly point and provide the incident personnel with as much information as you can regarding the location and type of leak.

P15.3 Treatment of Exhaust Gases

It is the customer's responsibility to ensure exhaust gases from the backing pump are abated in a manner that conforms to national and/or local environmental and safety regulations. The following information is for guidance only.

There are three techniques for the treatment of harmful gases. Where more than one option is available, the choice of technique should be that which minimises overall environmental impact.

1. **Incineration/Oxidation**

   Most flammable gases can be readily oxidised either by passing them into a separately fuelled flame or, in some instances, by passing them into a suitable oxidising chemical reagent (solid or liquid). The properties of the resultant oxidised material (which may be gaseous, liquid or solid) should be considered with a view to establishing further treatment for environmentally appropriate disposal. Liquid and solid wastes may need to be referred to specialist disposal contractors. Where the incineration process results in the formation of particulate matter, further treatment in the form of filtration, water spray or other techniques for removing particles from gas, should be used before discharge of the gas to atmosphere or, if the gas remains an environmental hazard, the next treatment process.

2. **Chemical scrubbing**

   Some reactive gases can be absorbed by a suitable liquid or solid state chemical scrubber. Designs can include scrubber liquid baths into which the waste gas is bubbled; pumped scrubber liquor systems involving packed columns and/or spray nozzles to improve gas/liquor contact; and packed solid reagent beds into which the waste gas is passed. The chemical reagents used in all such equipment shall be closely monitored to ensure continued efficiency. The 'spent' scrubber liquid, or solid, will require disposal in an environmentally acceptable manner.

3. **Absorption**

   Some waste gases can be absorbed onto suitable materials, such as charcoal, molecular sieve and chemically impregnated absorbent. These are often appropriate for localised equipment or gas cabinet exhaust treatment, but usually still exhaust into a main duct leading to a main scrubber to ensure absolute risk minimisation. Again, 'spent' cartridges shall be correctly disposed to minimise environmental impact.

P15.4 Contamination of Components

Fluorocarbons will produce HF by-products and components in the gas train will become contaminated. The exact nature of by-products will depend on the gases used, substrates and processes. All parts of the system will have contamination, including the pumps and pump oil (if used).

P15.5 Flammable Gases

Where flammable gases are used (the exhaust must be non-flammable), there is dilution of the exhaust gases, which is controlled and monitored by the system's N_2 pump purge panel.

P15.6 Gas Lines (Toxic and Non-toxic)

WHEN A CHAMBER HAS BEEN PROCESSING WITH TOXIC GASES, OR HAS TOXIC GASES CONNECTED, THE FOLLOWING SAFETY MEASURES SHOULD BE CARRIED OUT BEFORE THE CHAMBER IS VENTED TO ATMOSPHERE.

1. **ENSURE THE CHAMBER IS IN A SAFE STATE TO BE VENTED. IF TOXIC GASES ARE PRESENT AFTER VENTING, BREATHING APPARATUS MUST BE WORN BEFORE OPENING THE CHAMBER.**
2. **ENSURE THE GAS LINES HAVE BEEN PUMP PURGED AND BACK FILLED WITH N2 BEFORE VENTING (see Chapter 3 for further information on purging the gas lines).**
3. **ENSURE ALL APPROPRIATE ANALYTICAL AND SAFETY EQUIPMENT IS AVAILABLE AND IS USED AS NECESSARY.**
4. **CHILLERS MUST BE SET AT AMBIENT TEMPERATURE BEFORE THE CHAMBER IS OPENED TO AVOID THE OPERATOR BEING EXPOSED TO HOT OR COLD SURFACES.**

EVACUATE HAZARDOUS GAS FROM THE GAS LINE AND BACK FILL THE GAS LINE WITH N2 BEFORE COMMENCING A PROCESS CHAMBER CLEAN PROCEDURE.

DECOMMISSION GAS LINES (HAZARDOUS AND NON HAZARDOUS) BEFORE CARRYING OUT MAINTENANCE ON GAS LINES BETWEEN THE CUSTOMER SUPPLIED GAS SOURCE ISOLATION VALVE AND THE GAS OUTLET VALVE TO THE PROCESS CHAMBER.

WHEN UNDERTAKING MAINTENANCE ON HAZARDOUS AND NON-HAZARDOUS GAS LINES, WARNING NOTICES MUST BE DISPLAYED TO IDENTIFY THE STATUS OF SPECIFIC GAS LINE VALVES AND ASSOCIATED SOLENOID VALVES. WHEN INDIVIDUAL GAS LINE VALVES ARE SHUT, THEY MUST BE LOCKED SHUT TO PREVENT INADVERTENT OPERATION.

TO PREVENT AN UNCONTROLLED HAZARDOUS GAS FLOW TO THE PROCESS CHAMBER, WHICH COULD RESULT IN PERSONAL INJURY, DO NOT OPEN THE BY-PASS VALVE WHEN FLOWING A HAZARDOUS GAS.

TO PREVENT RISK OF PERSONNEL INJURY, THE HELIUM LEAK CHECK MUST BE UNDERTAKEN BY TECHNICALLY QUALIFIED PERSONNEL WHO ARE FULLY AWARE OF ALL RELEVANT SAFETY PRECAUTIONS ASSOCIATED WITH PROCESSING, OPERATING AND MAINTAINING THE EQUIPMENT. IN ADDITION, SUCH PERSONS MUST BE CAPABLE OF OPERATING AND PROGRAMMING SURFACE TECHNOLOGY SYSTEMS (STS) SOFTWARE.

BEFORE UNDERTAKING HELIUM LEAK CHECK, CHECK THE STATUS OF THE CHAMBER WITH THE SYSTEMS PROCESS ENGINEER. SEEK GUIDANCE ON THE APPROPRIATE CHAMBER CLEANING PROCESS TO RUN.

BEFORE UNDERTAKING AIR SAMPLING CHECKS, FULL PROTECTIVE CLOTHING MUST BE WORN INCLUDING A RESPIRATOR. THE IMMEDIATE AREA MUST BE WELL VENTILATED. ALL NON-ESSENTIAL PERSONNEL MUST BE EVACUATED TO A SAFE AREA AND AIR SAMPLING WARNING NOTICES MUST BE DISPLAYED IN THE IMMEDIATE VICINITY. WHEN UNDERTAKING AIR SAMPLING TESTS, CHECKS MUST BE MADE TO ASCERTAIN THE CONCENTRATION OF RESIDUAL GASES AND HAZARDOUS BY-PRODUCT GASES SUCH AS HCL AND HF.

P16 Hazardous Substances

P16.1 Working with Hazardous Substances

- All work with any hazardous substance must be in accordance with the manufacturer's instructions, material safety data sheet (MSDS) and local regulations concerning the control of substances hazardous to health
- The substance's MSDS must be consulted prior to the start of any work if the user is not familiar with the hazardous material
- Special care must be exercised with substances provided by the customer
- It is the responsibility of the customer to ensure that any substance provided is suitable for its intended purpose and is safe to use in that context
- MSDSs must always be consulted for health and safety information for any substance with which the service engineer is not completely familiar

P16.2 Spillage of Hazardous Substances

If a spillage occurs:

- The manager of the area together with the environmental & safety manager must be informed immediately and the area cleared of personnel depending on the liquid released
- PPE may be required. Collect the spillage kit and immediately surround the spillage with the absorbent cloths, pillows, etc., until the spillage has been contained
- Obtain the MSDS and read the section which relates to emergency release measures. The MSDS will also give you the relevant information on the chemical make up of the liquid
- Clean up the spillage as quickly as possibly by following the instructions on the MSDS. Further information can be obtained by speaking with the environmental & safety manager
- The MSDS will also inform you of what disposal methods may be required. Some liquids do not mix with water and by adding water to dilute the spillage the following may occur: fumes or an acidic liquid. NEVER add water to a liquid spillage unless you have consulted the MSDS first
- Using the correct PPE (As stated on the MSDS), clean up the contaminated absorbent and place into the empty Spillage Kit
- Label the spillage kit stating that the kit has been used for a liquid spillage. Together with this place a copy of the MSDS onto the outside of the container
- Inform site services as soon as the clean up procedure has been completed so they can arrange for collection of the spillage kit into the designated holding area. Remember to inform site services of the location of this used spillage kit
- Inform the environmental & safety manager when the spillage has been dealt with so a report can be created
- When it is safe to re-enter the area inform this fact to the Manager of the area

P16.3 Additional Safety Notes

- To maintain cleanliness within the vacuum system and to prevent contamination, corrosion, and reduce particulate levels; consideration must be given to preventing air from coming into contact with gases or process by-products in the vacuum system. This can be achieved by means of nitrogen purging, oxygen plasma cleans, etc.

P16.4 System Cleaning

- An etchback process must be run before any system cleaning takes place. This will minimise the manual cleaning required
- During the cleaning procedures, contaminated particulate material will created. All appropriate safety precautions must be observed for this kind of hazard. Ensure that contaminated material is disposed of in accordance with appropriate site policy and procedures
- Cleanroom wipes and abrasives will become contaminated during cleaning procedures. Ensure that contaminated wipes and abrasives are placed inside a clearly labelled bag and disposed of in accordance with appropriate site policy and procedures

P16.5 Unintended and Intended Releases

The system is designed to operate at negative pressures, consequently any leaks will usually be ‘in to’ not ‘out of’ the system. These ingresses will therefore be pumped away by the pumping system to the customer’s local exhaust ventilation (LEV) system.

Should an over-pressure condition occur in the process module, an over-pressure relief valve rated at 5psig will release gas through the gasbox to the customer’s local exhaust ventilation (LEV) system.

The system does not produce intentional releases. After processing, all waste products are pumped away by the pumping system to the customer’s local exhaust ventilation (LEV) system.

P17 Disposal of STS Equipment

STS tools may make use of hazardous substances, gases and liquids during the processing of semiconductor substrates. Also, the residues that may be produced during processing can be hazardous. The exact chemistry of the hazards will depend on:

- Process chemicals
- Wafer type and composition
- Process conditions.

STS is not responsible for the decommissioning and disposal of its products. Furthermore, STS is not a specialist in the disposal of hazardous chemicals and their by-products used on or created by its goods. It is the user's responsibility to make certain that appropriate licensed disposal authorities and/or contractors are consulted to ensure that the disposal of the tool is in line with local safety and environmental laws.

When decommissioning the system, particular attention should be paid to those areas of the tool that may contain hazardous materials or by-products. These are typically going to be:

- Gas delivery system
- Process chamber
- Pumping system

P17.1 Decommissioning and Disposal Process

STS is not responsible for making any recommendation for the decommissioning or disposal of the facilities to the tool. These are wholly the user's responsibility.

P17.1.1 Hazardous Contamination List

When planning the decommissioning and disposal of an STS plasma-processing tool, a consideration must be made of all the process gases, liquids and their associated by-products that have been used and/or created during the tool's lifetime. STS recommends creating and maintaining a list of the following:

- All the process gases and fluids used during processing
- All the possible by-products that may have formed and passed through the pumping line

An example of such a table for a typical etch chamber is shown below:

Typical Inputs	Typical Contaminates	Form
For GaAs etching: BCl_3, Cl_2, HBr, N_2	HCl, As, $GaCl_3$, B_2O_3, $AsCl_3$, CN, $GaBr_3$, As, AsH_3, $AsBr_3$	Solid / Gas
For InP etching: N_2, Cl_2, HBr, N_2	HCl, P, $InCl_3$, PCl_3, $SiCl_4$, InBr, P, PH_3	Solid / Gas
For GaN etching: Cl_2,Ar, He	$GaCl_3$, $SiCl_4$.	Gas
For Si etching: SF_6, O_2, C_4F_8	HF, S variants, SO, SO_2, CO, CO_2	Solid / Gas

The site health & safety advisor's input should be sought to ensure that local and national regulations relating to the disposal of the potential by-products are complied with, where there are specific chemicals and by-products identified. No work should take place until a complete plan for decommissioning and disposal is completed, including the identification of specialist contractors who may be required to ensure that there is no exposure risk to site workers.

P17.1.2 Areas of Contamination

DI Water and Town Water

The STS tool does not contaminate the cooling water during use. Disposal of any fluids left in the tool should be in line with local practice.

Chiller Fluids (excluding DI water)

MSDS for these fluids (Syltherm XLT, Galden, DI ethanol mixtures, etc.) are provided with the tool. The disposal instructions contained in the MSDS should be followed when these products are drained from the tool. Chillers should then be disposed of, in line with local regulations, as recommended in the OEM manuals.

Process Chamber

The process chamber is likely to have significant contamination following processes that may be of a hazardous nature. The full decommissioning process should include:

- 30 minute etchback process or whatever duration is required by process flow to achieve a clean chamber
- Full chamber clean
- Isolation and pump out of gas lines
  To include a minimum of five pump purge cycles followed by a minimum pump out period of 24Hrs (see Chapter 3)
- Power down of the tool

P17.1.3 Disposal

Gas supply system

Following decommissioning, the gas lines should not contain residues that will cause exposure over the TLV. However, a specialist contractor should be consulted to ensure that the decommissioning procedure used will meet the minimum requirements for disposal of the pipework and valves.

Process chambers

Following decommissioning, the process chamber should not contain residues that will cause exposure over the TLV. However, a specialist contractor should be consulted to ensure that the decommissioning procedure used will meet the minimum requirements for the chamber's disposal.

Pumping system

The turbo molecular pump (if fitted), APC, HiVac, foreline and backing pump may contain a build up of process residues that may be toxic or corrosive and therefore represent a contact or vapour hazard. Some residues may react when exposed to atmospheric moisture. Local procedures or those of a specialist contractor should be consulted before creating the decommissioning and disposal plan. Some residues will require disposal within a time limit after breaking vacuum, or immediate sealing in appropriate containers for later decontamination and disposal. Pumps should be decontaminated and disposed of as described in the manufacturer's recommendations and in line with local practice, as directed by local policy.

OEM Equipment

All valves that are contacted by process chemicals should be dealt with as directed above.

All OEMs (and other components) that are contacted by cooling fluids represent no hazard and require no special precautions. Disposal should be in line with local regulations.

Electrical Items

STS tools are exempt from the RoSH directive. However all Pro tools manufactured after December 2006 use RoSH compliant components and many OEM components used on the tool before this date were already compliant. If there is any doubt, the OEM manufacturer should be consulted.

Before selling on any electrical equipment it is the responsibility of the user to ensure that these products are safe and in an appropriate condition for resale. STS accepts no liability for the forward sale of components used on its tools, or warranty on them.

P17.2 Recycling

STS equipment is comprised of the following materials:

Group	Material
Panelling	Mild Steel (Painted)
Chamber Components	Aluminium 6082, 5083 / Stainless Steel 316L, 304 / FKM / FFKM / Nickel
Chamber Block	Aluminium 6082
Frame	Mild Steel (Painted)
Ceramics	Alumina / Aluminium Nitride
Conductors	Copper
Electrical Isolators	Tufnol / PTFE / PEEK
General Plastics	Nylon / Polypropylene / PVC

Recycling can only apply to those assemblies and components that have not been contaminated or have been cleaned in accordance with local laws. A specialist contractor should be consulted to ensure that any contaminated materials have been cleaned sufficiently for recycling purposes.

Chapter 1
Introduction

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1.1 Introduction

The Pro Multiplex system is designed for maximum process flexibility and reproducibility. The process chamber has been designed to the highest vacuum engineering standards with the number of components kept to a minimum; particular consideration was given to the elimination of virtual leaks. This results in a very stable process chamber environment leading to high quality processes.

Each system is comprised of a handling system and a process module.

1.2 The MPX Handling System

The MPX substrate transport platform consists of a combined vacuum loadlock and carousel substrate transport mechanism. The carousel substrate transport mechanism provides a fully automated mode of operation for small batch processing without any need for cassettes.

Substrates are placed directly on the carousel substrate loading positions and, once the loadlock is under vacuum, can be either directly loaded and unloaded into the process module under manual control by the operator, or can be part of a batch process recipe, whereby once loaded will be fully processed without any intervention from the operator.

In manual operation, the operator vents the vacuum loadlock, removes any processed material from the carousel substrate loading positions and then places new material for processing in the available slots. Once the substrates have been loaded, the lid of the loadlock is manually closed and pumping the loadlock is selected from the operator interface software. The carousel is then mapped to indicate the location of the material to be processed. After mapping, the gate valve is opened and the carousel carrier transfers the substrate into the chamber. The operator can then select a recipe to process. Once a process is completed, the operator can transfer the substrate back to the carousel position before processing the next.

In batch operation, the operator vents the vacuum loadlock, removes any processed material from the carousel substrate loading positions and then places new material for processing in the available slots. Once the substrates have been loaded, the lid of the loadlock is manually closed and the desired batch recipe selected. The substrate is then transferred and processed according to the pre defined batch recipe.

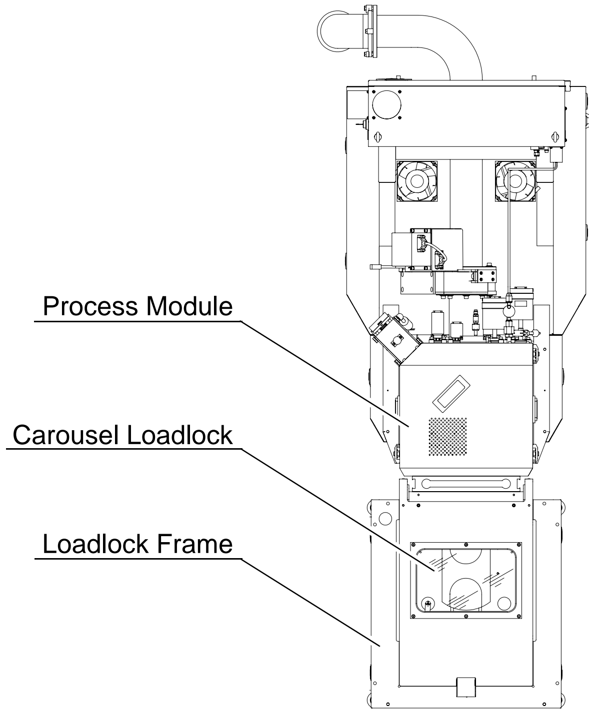


Figure 1.1 MPX System General View

1.2.1 Carousel Loadlock

The loadlock is the point of substrate access to and from the MESC Multiplex system. It has an aluminium body with a glass hinged lid that has the minimum possible volume to maximise throughput. A magnetic sensor switch is used to detect whether the lid is open or closed.

The loadlock enables the process chamber to remain constantly under a vacuum which reduces contamination of the process substrates.

The substrate to be processed is placed on a linear substrate carriage assembly in the loadlock. After processing the substrate is retrieved from the process chamber.

Principal components of the loadlock are:

- Loadlock chamber
- Gate valve
- Linear substrate carriage
- Vacuum gauge
- Position sensors
- Loadlock frame
- Venting and pumping system
- Services panel

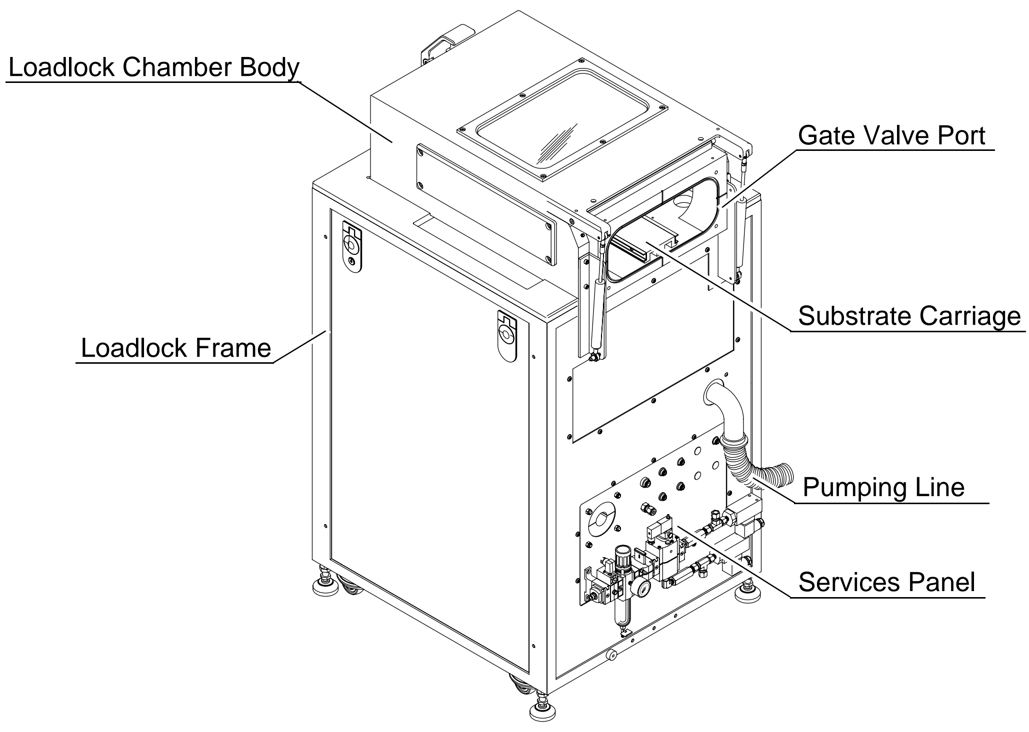


Figure 1.2 Loadlock (Rear View)

1.2.1.1 Carousel Loadlock Chamber

The carousel loadlock chamber is a low volume hinged lid enclosure containing a linear substrate carriage and positional sensors. There is a pirani gauge located on the chamber body to measure the chamber pressure during pumping and venting.

1.2.1.1.1 Linear Substrate Carriage Assembly

The linear substrate carriage assembly consists of a substrate carrier, complete with carousel spatula, which is attached to a fully automated transfer carriage. The transfer carriage is

propelled by an pneumatically actuated slide assembly. Magnetic switches automatically detect the end stops of the motor travel.

A pneumatic mechanism lifts the carousel spatula above the transfer carriage. This allows a second electric motor to rotate the carousel spatula into the required position for placement of the substrate onto the substrate platen. The two electric motors are controlled by a purpose built drive system housed on the control shelf. An encoder feeds position information back for the drive system to anticipate the end stop.

Oil free dual bearings provide a low friction, low particulate generating transport mechanism.

1.2.1.1.2 Gate Valve

A pneumatically operated gate valve is used to isolate the loadlock from the process chamber.

1.2.1.1.3 Vacuum Gauge

A pirani gauge measures the pressure in the carousel chamber and its output is sent to the control PC which displays it on the operator interface.

A pressure switch ensures that the carousel loadlock is at vacuum prior to opening the transfer gate. This is a safety interlock to prevent the process chamber being exposed to high pressures.

1.2.1.1.4 Position Sensors

There are multiple position sensors to ensure accurate placement of the substrate.

- A reed switch confirms when the carousel has been driven fully into the process module
- A second reed switch confirms when the carousel is in the retracted position ready for rotation
- A laser detects slots on the bottom of the carousel. Once a slot is detected the position of the substrate is accurately known

1.2.1.2 Loadlock Frame

The loadlock frame houses the following components:

- Industrial PC
  An industrial PC is house at the base of the loadlock frame. The PC runs the cluster tool control (CTC), scheduler, recipe downloader, datalogger and transport module control systems (see 1.4.2).
- Table Lift
  The table lift assembly enables substrate transfer between the loadlock and MACS systems.
- Control PCB
  The control PCB controls the various digital and analogue devices (valves, actuators, pneumatic and vacuum systems, etc.)
- 24V PSU
  The 24V PSU provides DC power for the loadlock system.
- UPS
  The UPS is used to provide power for a controlled shutdown in the event of a power failure or EMO event.

1.2.1.2.1 Pumping System

The pumping system components are located in the frame underneath the carousel loadlock chamber. The system consists of a combined soft & full pump valve with associated pipe work connecting via an ISO 25 port on the base of the loadlock to a dedicated external vacuum pump. A soft pump bypass line ensures the minimum particulate movement during the pumping sequence.

Upon the ‘Pump’ command the system is initially soft pumped until a pre-set threshold pressure is reached. It is then ‘full’ pumped to 80mTorr when the valve is closed and will only re-open if the carousel loadlock pressure exceeds 150 mTorr.

1.2.1.2.2 Venting System

The venting system components are located underneath the loadlock body. The common N_2 input line contains a pressure regulator, pressure gauge and filter. The vent/soft vent line also contains two calibrated valves connected in parallel and their associated pipe work.

1.2.1.2.3 Interlocks

The following table details the various interlocks on the MPX handling system:

Interlock Location	Interlock Function	Interlock Activation	Interlock Reset Method	Interlock Device	Interlock Setpoint Change
Loadlock Body	Lid Closed	Not able to proceed to process	Close Lid	Reed Switch	N/A
Loadlock Body	Gate Interlock	Not able to load wafer into chamber	Pump loadlock to <3.8Torr	Pressure Switch	Preset to 3.8Torr
Loadlock Foreline	Vacuum valve interlock	Not able to pump down loadlock	Ensure backing pump is on and working OK	Pressure Switch	Adjustment screw on switch
Service Panel	Compressed Air	Not able to proceed to process	Check compressed air supply pressure is >80PSI	Pressure Switch	N/A
Purge panel on pump	N2 purge gas interlock	Not able to pump down loadlock	Ensure N2 flow is > trip level specified on Gas Schematic	Flow Switch plus Flow Meter	Adjustment screw on switch, visible flow on meter

1.3 Description of Operation

1.3.1 General

All substrate handling operations (e.g. inter-chamber gate valve openings, closings, process chamber substrate lift mechanism, etc.) are governed and interlocked by the CTC and PMC control systems (see 1.4). This system also controls the associated pumping and venting procedures of the loadlock and differentially pumped seals, with the system interlocks preventing operation until the specified parameters for these procedures have been achieved.

A block schematic diagram of the vacuum pumping and instrumentation arrangements of the system is shown in Figure 1.3.

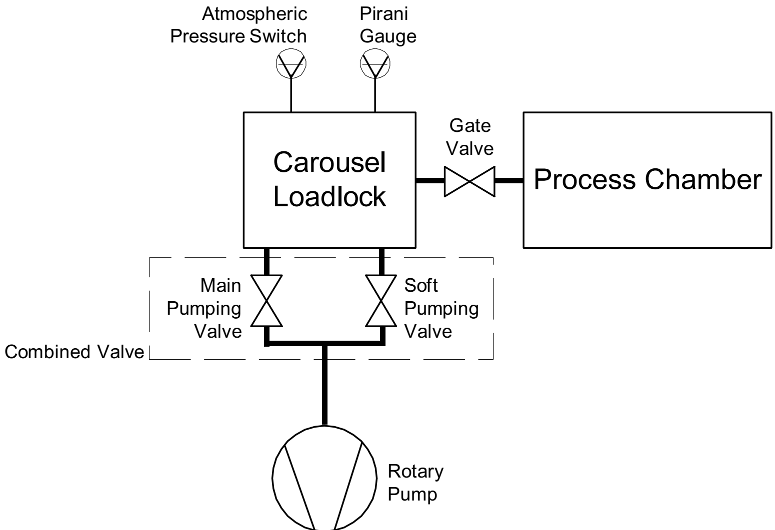


Figure 1.3 System Block Diagram

1.3.2 Typical Sequence

1. When 'Run' is selected on the sequencer the operator is prompted to load the next substrate in the carousel. Once loaded, the loadlock is pumped down to a pre-determined transfer pressure.
2. One transfer pressure is reached, the gate valve between the loadlock and the process chamber is opened and the substrate is transferred into the process chamber.
3. With the transfer carriage and a substrate positioned over the substrate platen, the substrate lift mechanism rises from recesses in the platen surface to lift the substrate off the carousel. The transfer carriage, minus the substrate, retracts into the loadlock and the gate valve is closed. The substrate lift mechanism lowers and processing begins. During processing, the loadlock remains pumped down at transfer pressure.
4. On completion of the processing period, the substrate lift mechanism lifts the substrate off the substrate platen. The gate valve between the process chamber and the loadlock opens and the transfer carriage fully extends into the process chamber to rest directly under the processed substrate. The substrate lift now retracts and the substrate is lowered onto the end effector. The transfer carriage then returns to the loadlock and the gate valve closes. The carousel rotates to position the next substrate for processing then transfers the next wafer to the process chamber.
5. The sequence is repeated from step 3 until the batch of substrates has been processed. Once the batch has finished, the gate valve closes and the loadlock is vented to atmosphere. The operator is prompted to remove the batch of substrates and load a new one.

1.3.2.1 Purge and Vent Sequences

After the appropriate command has been received from the system control computer, the venting sequence starts. Nitrogen is used during the purge and vent sequences. At the start of the venting sequence it is assumed that all valves are closed. The sequence is as follows (Refer to Figure 1.4):

1. Valve C closes, valve B opens for a pre-set time or until a pre-set pressure is reached for soft venting of the loadlock with nitrogen.
2. Valve B closes, valve C opens until the loadlock is pumped down to base pressure.

Note: *Steps 1 and 2 (the purge sequence) may be repeated a number of times depending on the process selected.*

3. Valve C closes, valve B opens for a pre-set time or until a pre-set pressure is reached for soft venting of the loadlock with nitrogen.
4. Valve B closes, valve A opens for full venting to atmosphere when the loadlock lid can be opened.

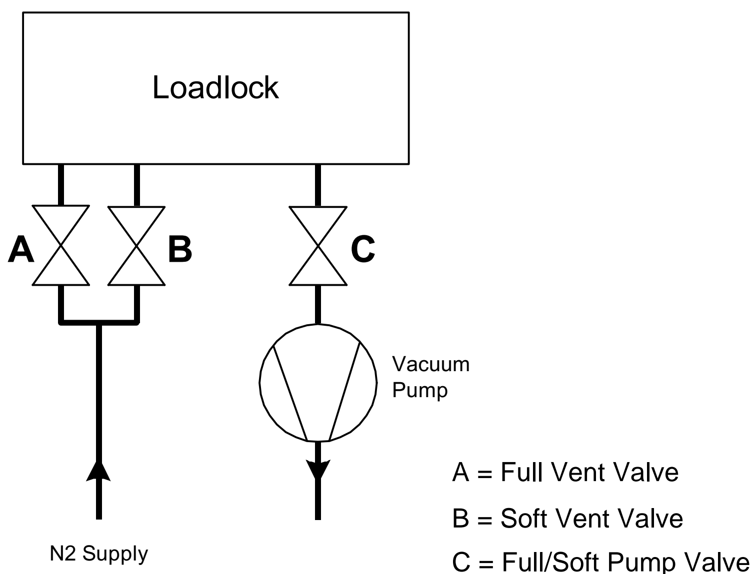
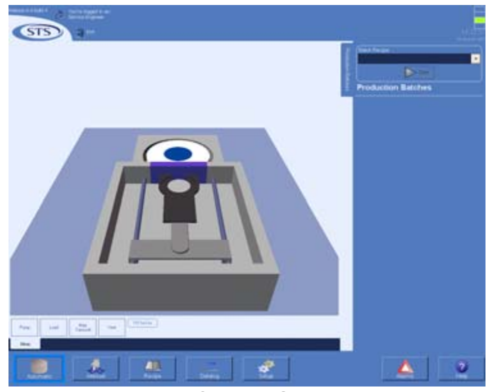


Figure 1.4 Loadlock Venting Block Diagram

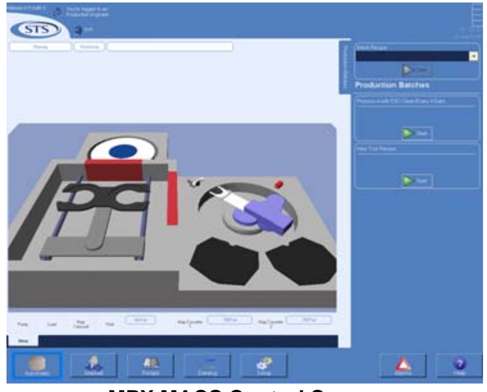
1.4 System Control

Overall system control is achieved using an industrial windows-based PC running the cluster tool control (CTC) application. The CTC application displays the system's status in accordance with the SEMI E95 standard for human interface design and enables the various system commands to be input and run. An example screen is shown below:



LPX Control Screen

MPX Control Screen



MPX MACS Control Screen

Figure 1.5 Typical CTC Control Screens

1.4.1 Process Module Control

The process module is controlled via a programmable logic controller (PLC) located in the DC drawer. Each controlled device is configured as a uniquely addressed node on a DeviceNet network and the PLC issues commands to regulate each node's operation.

1.4.2 Control System Architecture

The figure below shows the basic control architecture of a MPX / LPX tool. The cluster tool controller (CTC) component provides user interface and high level scheduling, the transport module controller (TMC) provides substrate transport services and the programmable logic controller (PLC) provides substrate processing services.

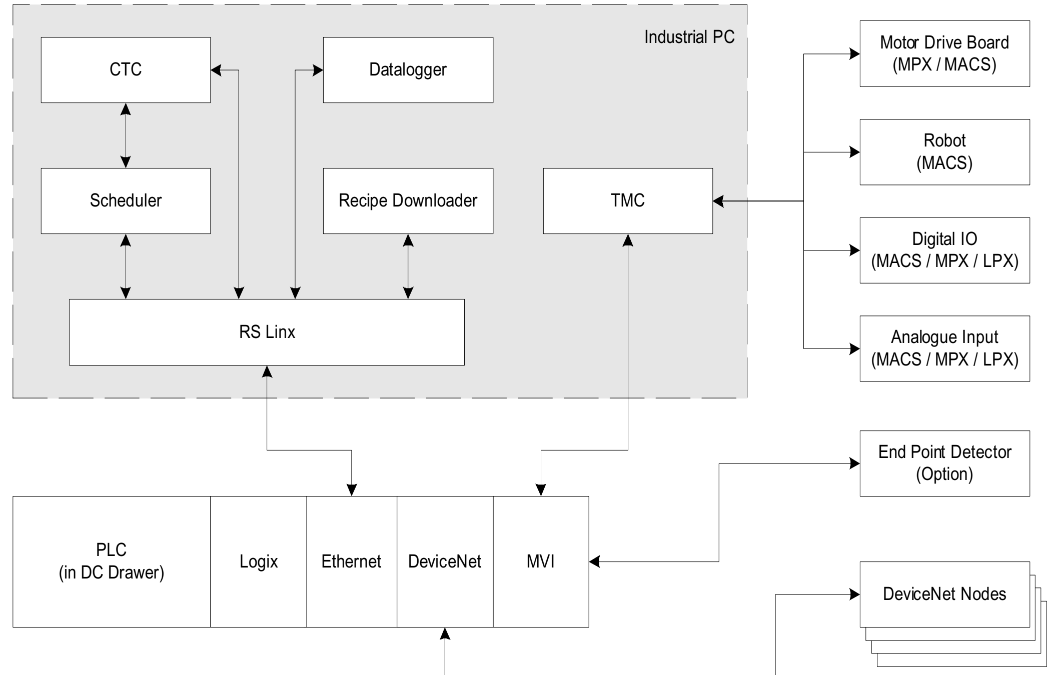


Figure 1.6 Control System Architecture

1.4.3 Programmable Logic Controller (PLC)

The PLC system consists of the following components:

Logix Controller	The Logix controller provides the central control for the system. The unit controls I/O located on nodes throughout the system.
Ethernet Card	The ethernet card allows the Logix controller to communicate with the industrial computer (Hub).
DeviceNet Card	The DeviceNet card allows the Logix controller to communicate with the system nodes.
MVI Card	An MVI card is used to provide communications between the TMC (running on the PC) and the PLC. It may also be used to communicate with an optional end point detection system.

1.5 Process Module

The process module assembly is shown in Figure 1.7. Its principal functional components are:

- Source assembly
- Lower assembly
- Gasbox
- Electrode assembly
- External components (not shown)

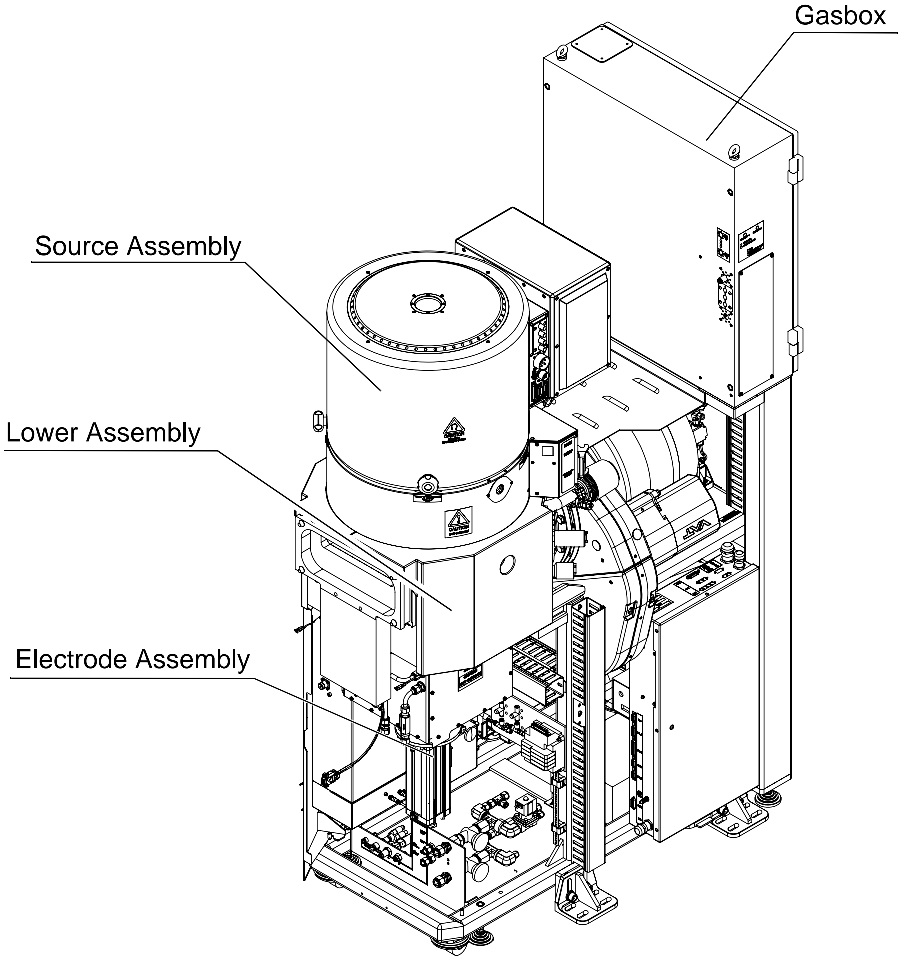


Figure 1.7 Process Module Assembly

1.5.1 Source Assembly

The source assembly consists of a plasma source enclosure, coil matching unit, hinge assembly and a magnetic confinement chamber.

Process gasses are introduced to the chamber under vacuum conditions. A plasma is then struck and maintained at 13.56MHz RF whilst the processing occurs. The plasma is confined by a series of multipolar magnets whilst ion attenuation is achieved by means of a solenoid assembly. The fast coil matching unit maintains optimum process conditions. Temperature controlled heaters are used within the source assembly to maintain process stability.

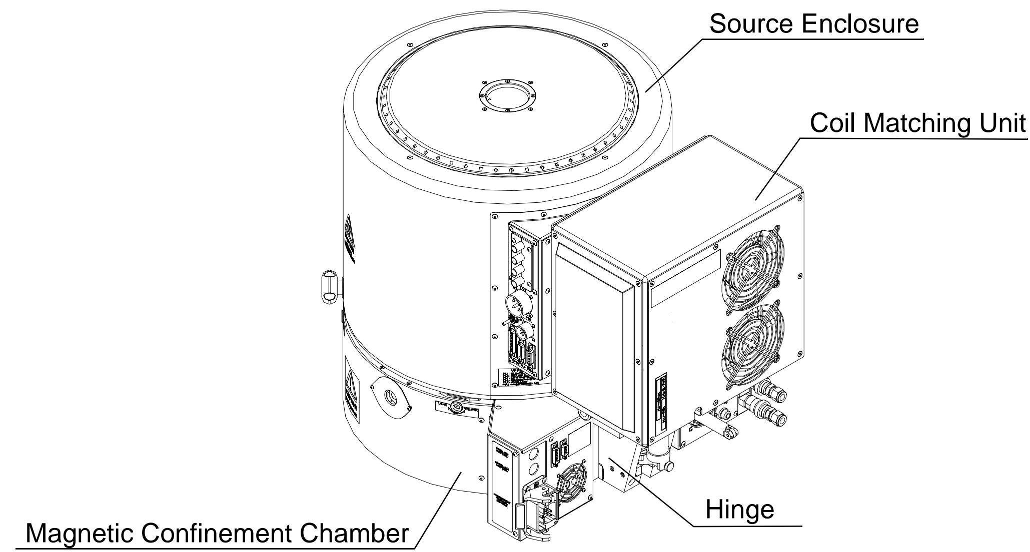


Figure 1.8 Source Assembly

1.5.1.1 Source Enclosure

The source enclosure forms the upper half of the source assembly and covers the magnetic confinement chamber. There is a spring damped hinge located at the back of the chamber allowing it to be opened manually thereby enabling easy access for cleaning and maintenance

The source enclosure contains the ceramics, RF antennae and solenoids. It also houses cartridge heaters and has a view port located on the top. End point detection systems can be attached the top of the source enclosure to make use of the view port.

1.5.1.2 Magnetic Confinement Chamber

The magnetic confinement chamber forms the lower half of the source assembly and is where the actual substrate processing takes place. This chamber houses a series of multi polar magnets which are used to confine the plasma. Process gasses enter the system through the lower chamber and are then internally routed to the top of the source enclosure and into the process area via a gas diffuser.

1.5.1.3 Hinge Assembly

The two halves of the source are joined together by a manually operated spring damped hinge assembly. The hinge is comprised of two halves:

- The upper floating hinge
- The lower fixed hinge.

The fixed hinge is thermally insulated from the magnetic confinement chamber to minimise heat transference.

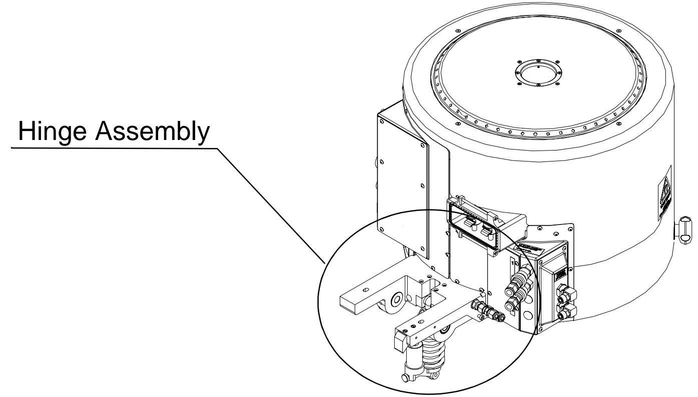


Figure 1.9 Hinge Assembly

1.5.1.4 Coil Matching Unit

The coil matching unit (CMU) is used to impedance match the RF source with that of the process chamber. The unit contains stepper motor driven capacitors that are rapidly tuned to maintain optimal power transfer.

Temperature control of the CMU is regulated by internal electrical fans.

1.5.2 Gasbox

The gasbox receives the process and purge gasses and distributes them to the process chamber. Flow rates for the process gasses are controlled by dedicated mass flow controllers (MFCs), which are in turn controlled via the I/O bus terminal located at the back of the gasbox.

Note: *The Pegasus and HRMSS process modules have their process gas MFCs located within the source enclosure.*

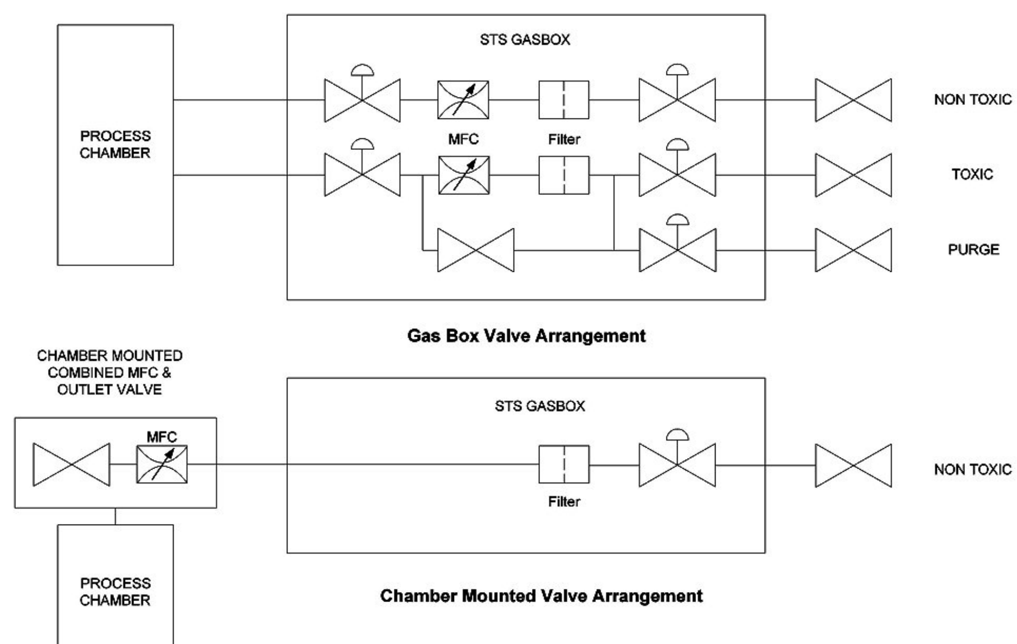


Figure 1.10 Gasbox Valve Arrangement

1.5.3 The Lower Chamber

The lower chamber, which is manufactured from a single block of aluminium, sits directly underneath the magnetic confinement chamber. Two openings are located on opposite sides near the top of the chamber. One provides access to the substrate platen for the transport module. The other is a port connecting to a combined automatic pressure control (APC) valve/ HiVac valve and a vacuum pumping system.

1.5.4 Electrode Assembly

The electrode assembly is housed within the lower chamber and is comprised of the electrode and substrate lift assemblies. The electrode consists of the platen block which is connected to RF power and helium back cooling supplies. If an electrostatic clamping system is fitted, a high voltage DC supply is connected through the electrode to the electrostatic chuck. The substrate platen is sealed with a stainless steel bellows and is connected to the electrode lift assembly, which is used to raise it to the processing height. The flexible bellows sits on an adapter which is secured to the process module base plate.

1.5.5 External Components

The external components consist of all those components fitted to the process module through its outside walls. These major functional components are:

- Combined APC/HiVac valve
- HiVac gauge
- Capacitance manometer
- Pressure switch
- Burst pressure assembly
- Process module wall heaters
- Anti-condensation measures (optional)
- End point detection system (optional)

1.5.5.1 Combined APC/HiVac Valve

The combined APC/HiVac valve is located at the back of the process chamber.

The APC valve can operate in either manual or automatic mode depending on the selection made in the recipe editor.

In manual mode, a percentage valve 'open' from 100 to 0% corresponding to an angle of opening between 0.1 and 90 degrees can be selected. The valve is driven to the selected position.

In automatic mode, the angle is pressure dependent. The valve operates to maintain the pressure set in the recipe editor under the control of a pressure controller.

1.5.5.2 HiVac Gauge

An AIM gauge is used to measure the process module base pressure. It operates in the range 1×10^{-2} to 1×10^{-6} Torr.

1.5.5.3 Capacitance Manometer Gauge

A capacitance manometer is used to measure the process module process pressure. The process pressure measured depends on the gauge fitted.

1.5.5.4 Over Pressure Switch

An over pressure switch is used as a safety interlock in the 24V DC supply to the gasbox solenoid. If the pressure exceeds 3.7 Torr, the pressure switch operates cutting off the gas supply to the process module. It operates in a fail-safe mode.

1.5.5.5 Over Pressure Check Valve

An over pressure check valve is used to protect the process module against over pressure during venting. It is rated at 5 psig. The extract from the valve is fed into the gasbox extract for safety.

1.5.5.6 Process Module Wall Heaters

Heaters are located in the magnetic confinement chamber, the lower chamber and the upper section of the source so as to keep plasma facing surfaces at temperatures suited to the required process.

1.5.5.7 Anti-condensation Measures

Nitrogen is supplied to the lower electrode RF enclosure to prevent condensation damage. When the chiller temperature drops below 10°C an electrically operated solenoid releases N_2 into the lower electrode RF enclosure, at a low pressure (3 psig and 1 to 2 l/m). Flow of N_2 continues until the chiller temperature rises above 20°C.

1.5.5.8 Electrode Lift Assembly

The electrode lift assembly is comprised of two separate lifts, a substrate lift and a platen lift. The substrate lift consists of an air cylinder and pin lift assembly which is used to raise the substrate off the end effector and then lower the substrate onto the platen surface. The platen lift consists of a pneumatic cylinder with associated components and is used to raise the entire electrode assembly to the required process height.

The electrode lift assembly is partly contained in the bottom RF enclosure with its air cylinders beneath this in the frame. The platen lift height is controlled by stops and is dependant on process height requirements.

1.5.5.9 End Point Detection

The process module can accommodate various types of end point detection systems including:

- **Single Frequency Optical Emission Spectroscopy (OES)**
- **Scanning OES**
- **Laser Interferometry**

1.6 Electronics Rack

The process module electronics are housed in a remote, free standing, electronics rack. All cluster systems' electronics racks house the following:

- AC unit
- PLC drawer
- RF generators

The following modules/controls may or may not appear in the E rack depending on the cluster system specification:

- Electromagnet (EM) power supply (if fitted)

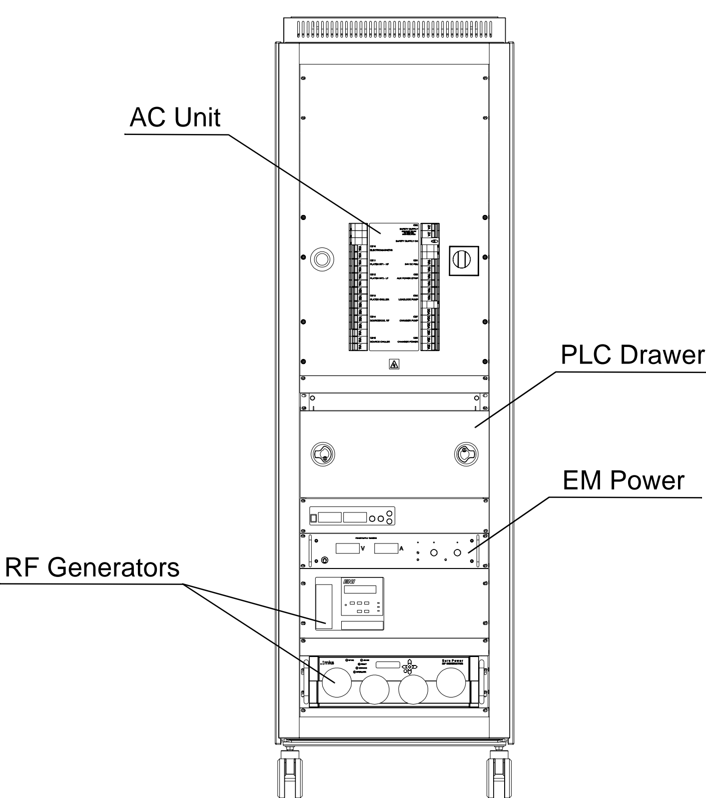


Figure 1.11 Typical Electronics Rack (E Rack)

1.6.1 AC Distribution Unit

The AC unit controls and distributes power to the process module.

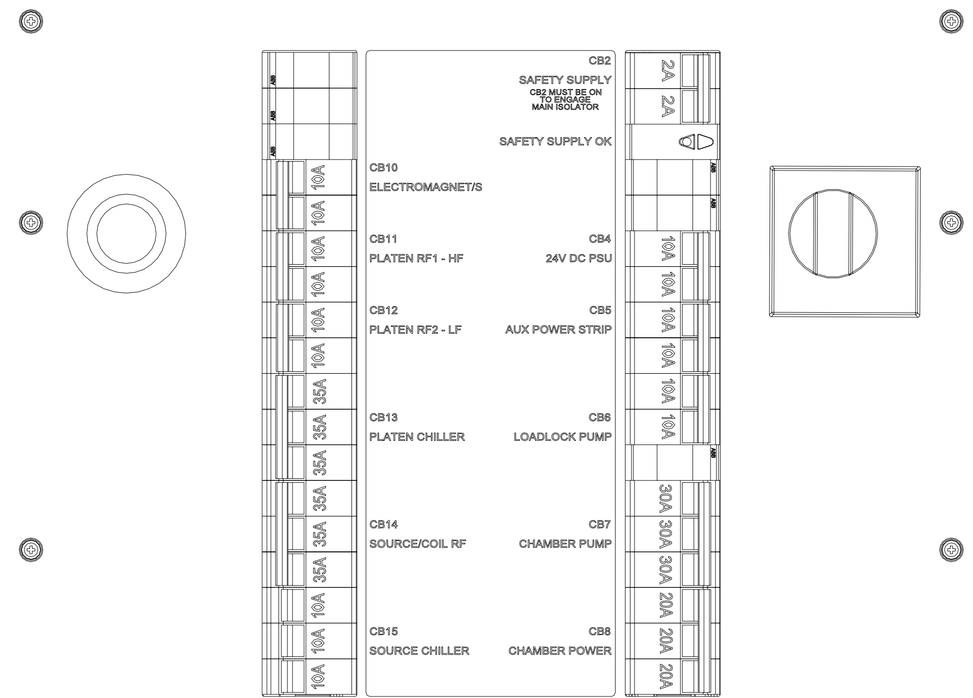


Figure 1.12 Typical AC Panel

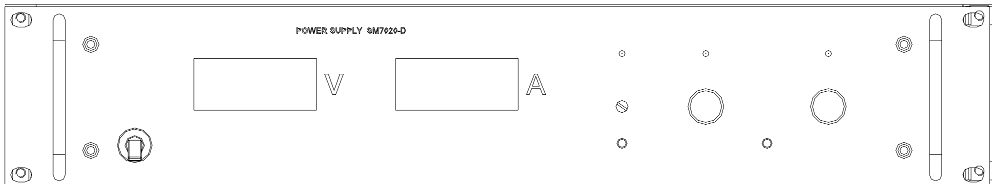
The following table contains details of the AC distribution unit components along with their description and function.

Component	200V System	400V System	Function
CB1	80 Amp	80 Amp	PM1 Power Supply (Optional)
CB2	80 Amp	80 Amp	PM2 Power Supply
CB3	80 Amp	80 Amp	PM3 Power Supply
CB4	80 Amp	80 Amp	PM4 Power Supply (Optional)
CB5	50 Amp	50 Amp	Core Supply (for CB13 to CB16)
CB6	Optional	Optional	PM1 Backing Pump (Optional)
CB7	Optional	Optional	PM2 Backing Pump (Optional)
CB8	Optional	Optional	PM3 Backing Pump (Optional)
CB9	Optional	Optional	PM4 Backing Pump (Optional)
CB10	20 Amp	10 Amp	Core Chiller
CB11	400 Amp (Max)	400 Amp (Max)	Mains Power
CB12	2 Amp	2 Amp	Safety Circuit
CB13	16 Amp	10 Amp	Core Pump 1
CB14	16 Amp	10 Amp	Core Pump 2
CB15	20 Amp	20 Amp	Transport Module Power
CB16	10 Amp	10 Amp	CTC Cabinet Power

1.6.2 Electromagnet Power Supplies (If Fitted)

The power supply units control the power supplies to the electromagnets.

Control of the power supply units is from the operator station.



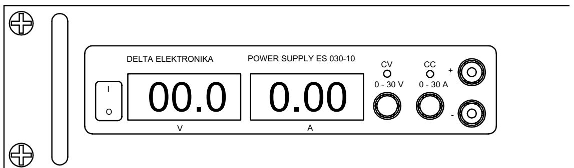


Figure 1.13 Typical Electromagnet Supply Units

<table>
<tr><th>Description</th><th>Function</th></tr>
<tr><td>On/Off</td><td>Switch the power control unit on/off.</td></tr>
<tr><td>Volts display</td><td>Displays the current voltage.</td></tr>
<tr><td>Amps display</td><td>Displays the current amperage.</td></tr>
<tr><td>Volts control dial</td><td rowspan="3">Not used.
All control of the power supply unit is via the operator station.</td></tr>
<tr><td>Amps control dial</td></tr>
<tr><td>Inputs (+ and -)</td></tr>
</table>

1.6.3 RF Generators

The RF generators are used in conjunction with the process gases to produce a plasma that is inductively coupled at 13.56 MHz via a matching unit and coil assembly located outside the process module. This provides a high-density plasma capable of operating in a very wide process range. Typically, two RF generators are used, one for the source and one for the platen bias.

1.6.3.1 Source RF Generator

The source RF generator output is the source of the RF excitation for the source. Its controls and indicators are described in the manufacturers literature.

1.6.3.2 Platen RF Generators

The platen RF generator is the source of the RF bias for the substrate platen. Its output is adjustable and its controls and indicators are described in the manufacturers literature.

Note: *There is an optional low frequency RF bias generator available for processes that require SOI etching. This generator is coupled at 380KHz RF and is applied in pulses defined by a software controlled pulse generator.*

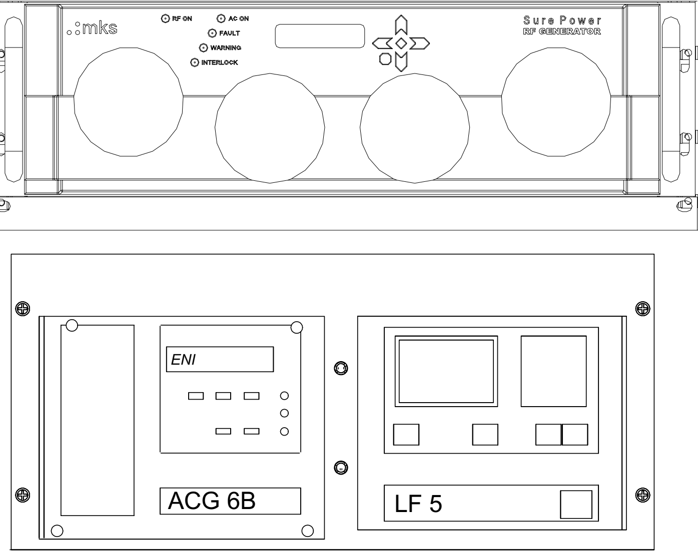


Figure 1.14 Typical RF Generator Drawers

1.7 Cooling and Heating Systems

Four heating/cooling systems are present within the system, as shown below

House Water	Cooling for the source (Pegasus systems only), magnetic confinement chamber (Pegasus and APS systems only), heated lid (ICP systems only), and turbo pump.
DI Water	Cooling for the source antenna (Pegasus and APS systems only), fed from a chiller.
Heat Transfer Fluid (HTF)	Heating/cooling for the lower electrode, fed from a chiller.
Cartridge Heaters	Heating for the chamber block, magnetic confinement chamber (Pegasus and APS systems only) and upper section of the source. Heating is provided by a number of insert cartridge heaters.

1.8 Pumping System

Vacuum pumps are used with the system to:

- Pump down the handling system for substrate transfer operations
- Pump down the process module for processing and transfer operations

Types and models of the pumps may vary but typically consist of an EBARA two stage pump for use with the process module and a Varian vacuum pump for use with the handling system. Please refer to manufacturer's literature for further information.

A block schematic diagram of the vacuum pumping and instrumentation arrangements of the MPX / LPX system is shown in Figure 1.15.

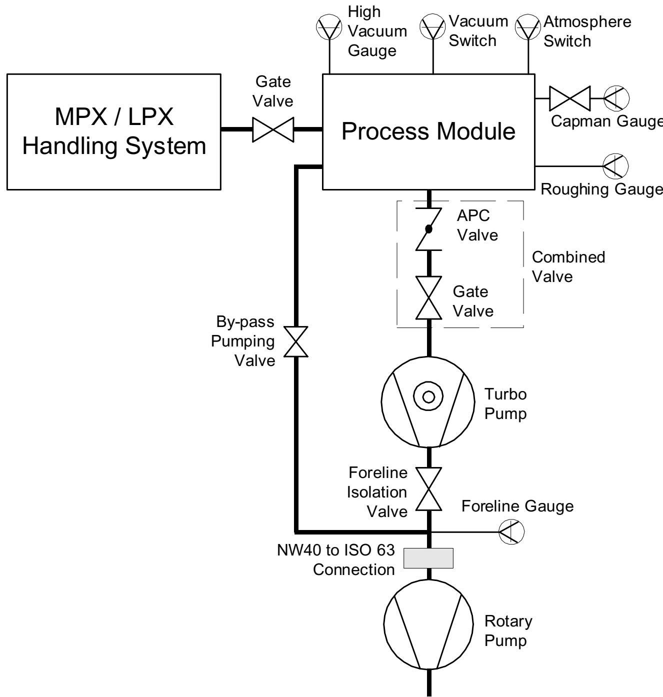


Figure 1.15 Pumping and Instrumentation Arrangement

1.8.1 Handling System

The handling system is pumped by a remote vacuum pump to maintain a transfer pressure of approximately 80mTorr.

1.8.2 Pumping Procedure

After a chamber vent or complete restart, the process module is pumped down (roughed) by the backing pump remote rotary pump via the bypass pumping system. Once the process module's pressure falls to a pre-defined level, the roughing valve is shut and the APC/HiVac valve opens. The turbo pump then pumps the system to a base pressure and maintains that pressure. Various gauges are used to measure the different pressures within the process module.

Roughing pressure in the chamber is measured by the roughing gauge. The APC/HiVac valve will not open until roughing pressure is reached.

> ***Note:*** *After a complete restart (i.e. after the turbo has been turned off) the rotary pump will first pump down the turbo pump (typically for 1 or 2 seconds) before commencing chamber roughing.*

Chapter 2
Getting Started

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2.1 Introduction

This chapter details the start-up and shutdown procedures and describes the user interface used to control the tool.

2.1.1 Use of Warnings and Cautions

WARNINGS, **CAUTIONS** and **NOTES** are used throughout this manual. **WARNINGS** are highlighted by use of an international hazard symbol. The following definitions of these notices are shown in the way that they are presented in the manual.

WARNINGS

A warning is given to alert the user of possible hazards which may cause loss of life, physical injury or ill health in any form. An example warning is shown below.

POTENTIALLY LETHAL VOLTAGES ARE PRESENT IN THIS EQUIPMENT. SWITCH OFF AND ISOLATE ALL ELECTRICAL SUPPLIES BEFORE REMOVING ANY COVERS. TAKE PRECAUTIONS AGAINST ELECTRIC SHOCK WHEN WORKING ON LIVE EQUIPMENT WITH THE COVERS REMOVED.

Warnings can be considered to fall into two categories, those due to hazardous materials and those due to hazardous operations. Where appropriate, a second international hazard symbol is used for specific hazards.

CAUTIONS

A caution is given to alert of possible hazards which may cause damage to equipment. An example caution is shown below.

CAUTION: Consult the safety procedures and carry out those that are necessary for switching off the system.

NOTES

A Note is used to convey or draw attention to information that is extraneous to the immediate subject of the text. An example note is shown below.

Note: *The screens shown in this manual represent a “typical” machine, and may NOT reflect the machine configuration exactly.*

2.2 Start-up and Shutdown Procedures

The system should only be switched on at the first instance after a successful installation by fully qualified STS service and installation engineers. Subsequent system starts should only be made after a thorough inspection of the system to ensure that it is safe to do so.

2.2.1 Start-up Procedure

Use the following procedure to switch the system on:

1. Switch on the water supply and check for leaks.
2. Switch on the compressed air supply at the isolation tap and check that the correct pressure is set.
3. Switch on the nitrogen and helium supplies.

BEFORE SWITCHING ON THE GAS LINES FOR THE FIRST TIME, OR AFTER ANY SERVICE WORK HAS TAKEN PLACE IN CONNECTION WITH THE GAS LINES, CHECK THE GAS LINES OPERATION. IF YOU ARE IN ANY DOUBT ABOUT HOW TO PROCEED, CONTACT STS FOR HELP.

4. Ensure that the process gas isolation valves are turned on.
5. Switch on the customer power supply.

Note: *Steps 6. to 9. are only for systems supplied with a Power Distribution Unit (PDU):*

6. On the PDU, ensure that CB12 (Safety Circuit) is on and that all EMO buttons are pulled out.
7. Turn the main isolation handle (CB11) to ‘ON’.
8. The isolator handle should now lock into the ‘ON’ position. If it does not:
   - 8.1 Turn the isolator handle to the yellow ‘Tripped’ zone and hold it there.
   - 8.2 Check that lamp XL1 is lit.
     If XL1 is not lit then re-check that the customer power supply is switched on.
     If XL1 is lit re-check to ensure that all EMO buttons are pulled out.

AFTER CARRYING OUT THE TASKS IN THE NEXT STEP (STEP 9.), ELECTRICAL POWER WILL BE RESTORED TO THE SYSTEM AND LETHAL VOLTAGES WILL BE PRESENT IN THE EQUIPMENT. OBSERVE ALL CURRENT SAFETY PRECAUTIONS.

9. Turn on all circuit breakers except for those labelled ‘Not Used’.

For each Process Module’s Electronics Rack:

10. On the Electronics Rack, ensure that CB2 ‘Safety Supply’ is on.
11. Ensure that Safety Supply lamp is lit.
12. Ensure that the main isolator is on. If the main isolator fails to stay in the ‘On’ position, re-check to ensure that all EMO buttons are pulled out.
13. Repeat steps 10. to 12. for all Process Modules.
14. Switch on the control PC and wait for it to load the system software.
15. Perform a system Pump To Base operation. This will automatically turn on the backing and turbo pumps.

2.2.2 Shutdown Procedure

Whenever possible, the system should be left switched on. Vacuum pumps should be left running with the process chamber under vacuum.

ENSURE THAT ALL PROCESSING HAS CEASED AND THAT THERE ARE NO SUBSTRATES LOCATED ANYWHERE IN THE SYSTEM BEFORE PERFORMING A SYSTEM SHUTDOWN.

IF THE SYSTEM IS TO BE PLACED INTO A DECOMMISSIONED STATE OR LEFT IDLE FOR A TIME PERIOD LONGER THAN THAT SPECIFIED BY LOCAL REGULATIONS, THEN THE PROCESS GASLINES MUST BE PURGED BACK TO THE ISOLATION VALVES AND ISOLATED AT SOURCE. USE THE MANUAL FUNCTIONAL AREA TO ACHIEVE THIS.

Use the following procedure to switch the system off:

Note: *A user with a Service Engineer profile is required when shutting down the system.*

1. Enter the **Manual Functional** area and close the APC/HiVac valve from within the **Process Module** tab.
2. Using the **Command** panel, stop the turbo pump.
3. Watch the turbo pump controller panel and wait until the turbo pump speed has reached zero.

Note: The turbo pump controller panel screen is located at the rear of the process module.

4. Using the **Command** panel, stop the rotary backing pump.
5. Turn off all the heaters.
6. Set the platen temperature to 20^{0}C and wait until it is reached.
7. Select ‘**Shutdown**’ from the menu option and confirm to exit the system software.
8. Close all Windows applications, shutdown and turn the computer off.
9. ***For systems with a Power Distribution Unit (PDU):***
   Turn the PDU main isolator handle to ‘Off’.
10. ***For systems without a Power Distribution Unit (PDU):***
    Switch off the Electronic Rack’s main isolator. Repeat for each Process Module.

The System is now shut down.

If the system is to be left idle for a time period longer than that specified by local regulations, the following steps must be completed:

1. Turn off all process gasses.
2. Turn off the compressed air supply.
3. Turn off the nitrogen and helium supplies.
4. Turn off the water supply to the system.

2.3 Emergency Stop Procedure

USE THE EMERGENCY STOP PROCEDURE TO IMMEDIATLY SHUTDOWN THE SYSTEM IF A FAULT IS SUSPECTED THAT COULD CAUSE INJURY TO PERSONNEL OR A FAILURE OF THE SYSTEM. IF IN DOUBT USE THE EMERGENCY STOP PROCEDURE, DO NOT INVESTIGATE SUSPECTED FAULTS WHILE THE SYSTEM IS OPERATING.

THE ROBOT ARM WILL RETRACT BACK INTO THE LOADLOCK OR TRANSPORT MODULE AFTER AN EMO EVENT.

Emergency Stop (EMO) buttons are located in the following areas:

- Front of cleanroom panel (if fitted)
- Front of loadlock (if fitted)
- Rear of process module
- Electronics rack (if fitted)

Note: *An additional customer-requested EMO button may also be fitted. Please refer to the drawing pack for details of its location.*

If an emergency condition is suspected, proceed as follows:

1. Depress fully one of the red EMO buttons located on the system.

Note: *When an EMO button is depressed, the main isolator is switched off and all power to the system is removed by the safety circuit becoming open circuit.*

The EMO button should only be used in an emergency, as the operation of the EMO could result in damage to the ceramics. To shut the system down in a non emergency situation see 2.2.2.

RED ‘STOP’ BUTTONS FITTED TO OEM EQUIPMENT WILL *ONLY* SHUTDOWN THE OEM UNIT.

Immediately after pressing the EMO button you must complete the following procedure:

1. Isolate at source any services associated with the suspected fault.
2. Isolate the gas supplies at source until the fault is found.
3. Initiate maintenance action relevant to the suspected fault.

Note: *Maintenance work should only be carried out after consulting the safety procedures that are applicable to the work required in order to rectify the fault.*

2.3.1 Start-up after an Emergency Stop

Starting the system after an EMO event should only be performed by qualified service personnel. Therefore this procedure is detailed in the STS Service Manual.

2.4 Introduction to the Tool Control Software

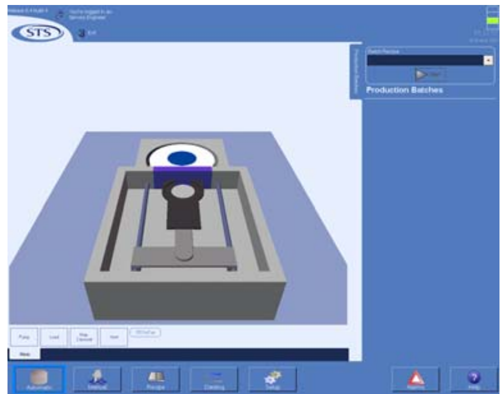
This chapter introduces the Tool Control Software and describes the views and tabs used to operate the system.

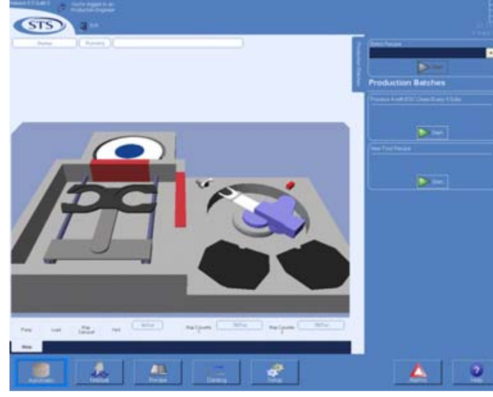
The Tool Controller can manage all system operations, including:

- Process recipes
- Substrate transfers
- Pumping and venting
- Manual control of devices

All operations are explained in detail in Software Operation.

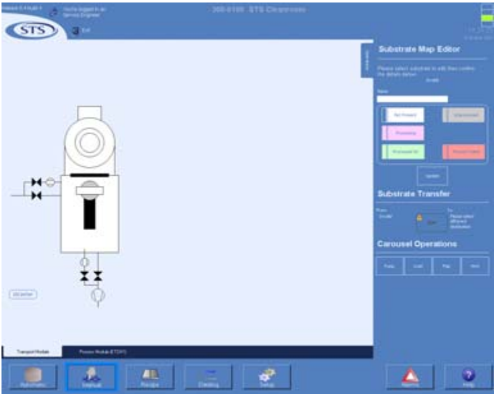
This manual uses screenshots from a multiplex tool configured fitted with a multipurpose atmospheric cassette system (MACS) to illustrate the various views and tabs. LPX systems may have slightly different screens, however the functionality is identical.





LPX Screen

MPX MACS Screen



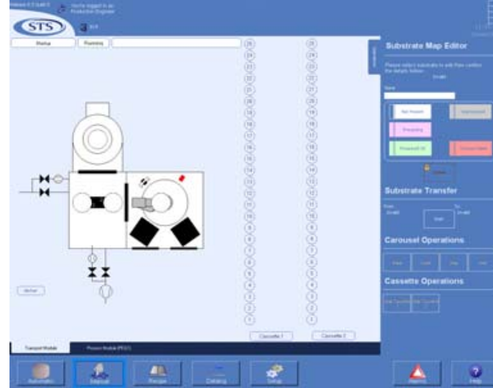


Figure 2.1 MPX and LPX Screenshots

2.5 User Interface

The user interface is based on SEMI E95-0200 (Specification for human interface for semiconductor manufacturing equipment), and uses touch-screen technology.

Control of the system can be either through the touch screen mounted on the cleanroom panel or via an operator station located at the rear of the tool (if fitted).

> ***Note:*** *Only one control station can be active at any one time. A KVM switch mounted on the rear of the cleanroom panel is used to choose the active station.*

When the computer system starts-up, a screen, similar to the following is shown:

> ***Note:*** *Before any operation can be performed, you must remove the virtual ‘Safety Substrate’ used to prevent any damage occurring in the tool. This is deleted using the substrate map editor see 2.8.2.1.*

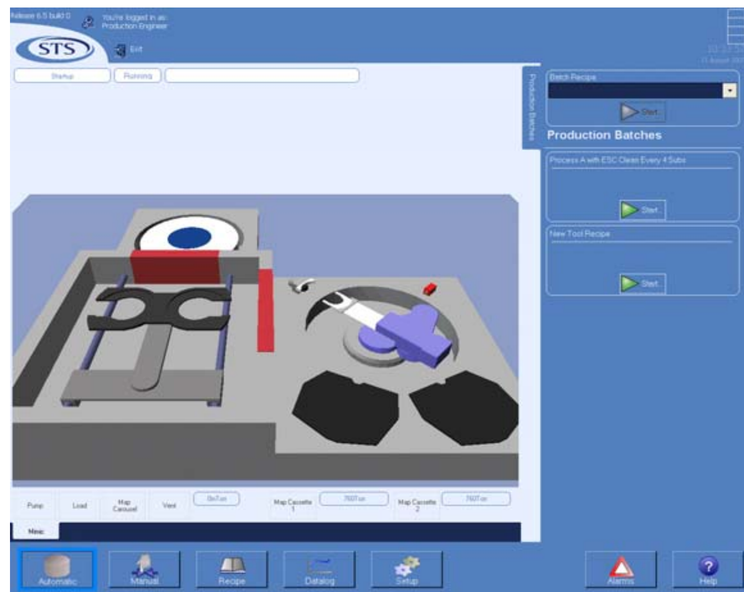


Figure 2.2 User Interface on Start-up

2.5.1 Using the Touch Screen

All operations can be activated by touching the required button, field, drop-down list option, etc.

Control	Description
Button	Activates the selected command.
Check box	Select or enable/disable the specified feature/function; a tick is displayed in the check box when an option is selected.
Radio button	Allows the selection of options; selecting one button de-selects the previously-selected option.
Field	Fields enable the input of information required by the system. Also allows the selection from a drop-down list. Fields are selected, either by pressing the **TAB** button, or moving the cursor onto the required field; the selected field can be edited by typing over the current entry.
Page tab	Displays the selected page. This area is also referred to as the sub-navigation panel (refer to para. 2.6.2).
Drop-down list	Displays a list of options. Select the required option from this list.

Note: *Greyed out controls cannot be selected, the required permission to access the control are not available in the present operator mode or this action is unavailable from the current view.*

2.5.2 Keyboard Controls

Arrow keys	Use the left and right keys to move through the selected field. Use the up and down keys to increment the selected value.
TAB key	Use the **TAB** key to move to the next field. **SHIFT+TAB** moves back to the previous field.
ENTER/RETURN key	Use to update the field entry.

2.6 Main Screen

The main screen is split into the following panels:

- Title (refer to para. 2.6.1)
- Information (refer to para. 2.6.2)
- Navigation Sub-Panel (refer to para. 2.6.2)
- Navigation (refer to para. 2.6.3)
- Command (refer to para. 2.6.4)

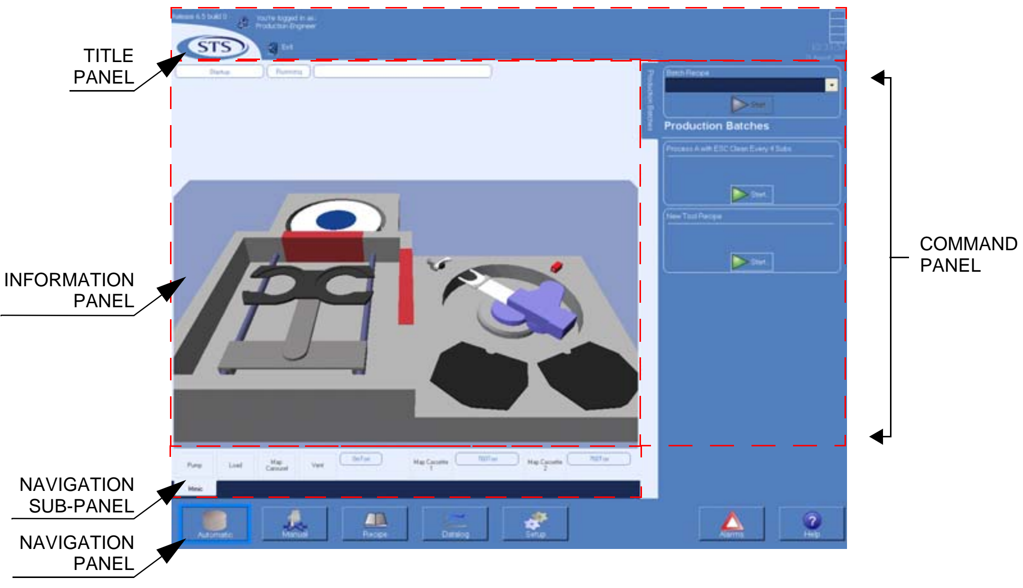


Figure 2.3 Panels on the User Interface

The contents of the **Information Panel**, **Navigation Sub-Panel** and **Command Panel** change according to the selection made from the **Navigation Panel**.

2.6.1 Title Panel

The title panel, at the top of the interface window, is always displayed and shows the following:

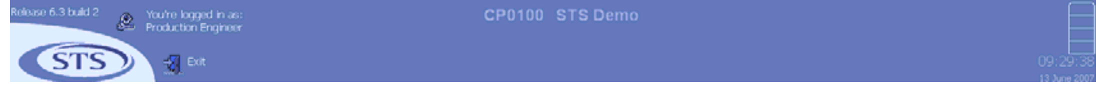


Figure 2.4 Title Panel

- Software Release
- Log in and Log out Icons
- Exit/Shutdown Icons
- Tool Number and Customer
- Current User Logged In
- Date and Time
- Lamp Tower Mimic
- Audible Alarm Mute/Sound

2.6.2 Information Panel

The management of all operations is via the **Information** panel. The contents of this panel are dictated by the button selection made from the **Navigation** panel. A number of the views displayed in the **Information** panel, have additional views which are selected by clicking on

the relevant tab from the **Sub-Navigation** panel. The tabs available are dependent on the displayed view.

Additional buttons may also be displayed at the right of the **Information** panel; these buttons are also dependent on the current view and tab selection.

2.6.3 Navigation Panel

The **Navigation** panel enables another view by selecting the required button.

Figure 2.5 Navigation panel

The buttons available from the **Navigation** panel are:

- **Automatic** (see 2.7)
- **Manual** (see 2.8)
- **Recipe** (see 2.9)
- **Datalog** (see 2.10)
- **Setup** (see 2.11)
- **Alarms** (see 2.12)
- **Help** (see 2.13)

When a button is selected from the **Navigation** panel, the selected button displays a depressed appearance, with a thick blue border around it. The related view is shown in the **Information** panel. Only one navigation button can be selected at any one time.

The navigation button border colours denote:

- Blue - a user is viewing a functional area or there is an unfinished task in an area which is not currently displayed
- Yellow - there is a new or unacknowledged error (this is only applicable to the **Alarms** button)
- Red - there is a new or unacknowledged alarm (this is only applicable to the **Alarms** button)
- Green - user action is required in the button's corresponding functional area

Note: *More than one navigation button can display the unfinished tasks border, that is, have a blue border.*

2.6.4 Command Panel

The command panel, displayed on the right of the main screen, contains buttons which relate to the view currently being displayed in the **Information** panel; each view has its own set of **Command** panel buttons.

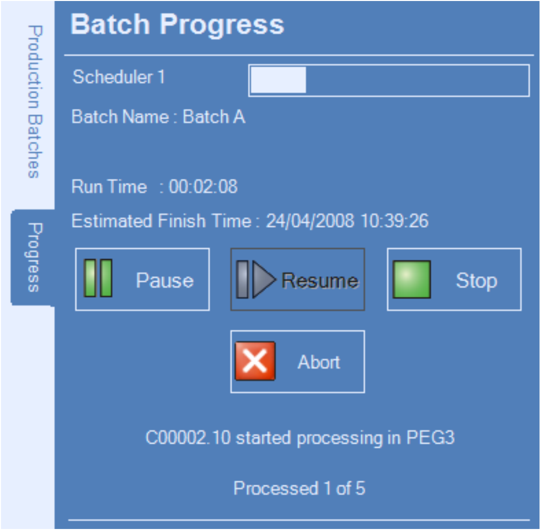


Figure 2.6 Command Panel

Buttons which are greyed out cannot be selected, because the required permissions to access the control are not available in the current operator mode, or this action is not available until another action is performed.

2.7 Automatic Functional Area

This area provides all the facilities that a Production User requires. This includes running, but not editing, recipes.Views available from this area are:

- Mimic View

2.7.1 Mimic View

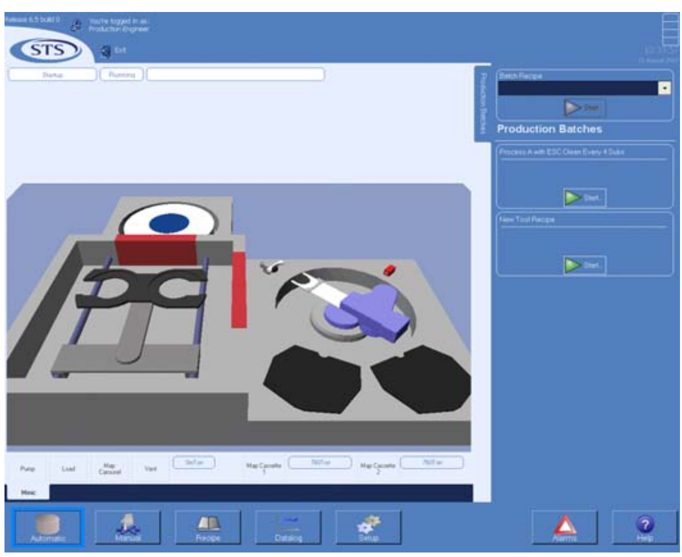


Figure 2.7 Typical Automatic area

Options available from this view are:

- create and run automatic processes
- monitor the progress of jobs through the system
- run pre- and post-process operations

Tabs available from this view are:

- **Production Batches** (see 2.7.1.1)

2.7.1.1 Production Batches

The **Production Batches** tab enables the user to run production batches.

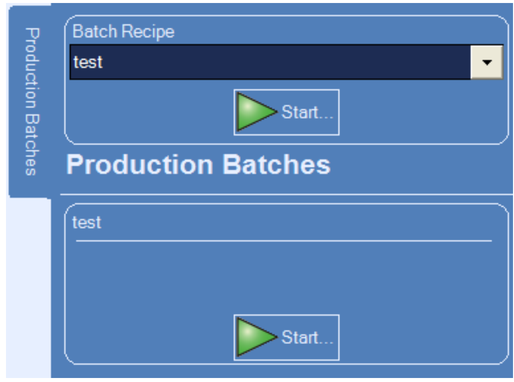


Figure 2.8 Typical Production Batches Tab

The following options are available from the command panel:

Button	Description
Batch Recipe	Starts a pre-defined batch recipe (see Chapter 3 - Production Batches).

During processing, the **Progress** tab is displayed providing information about the current batch progress.

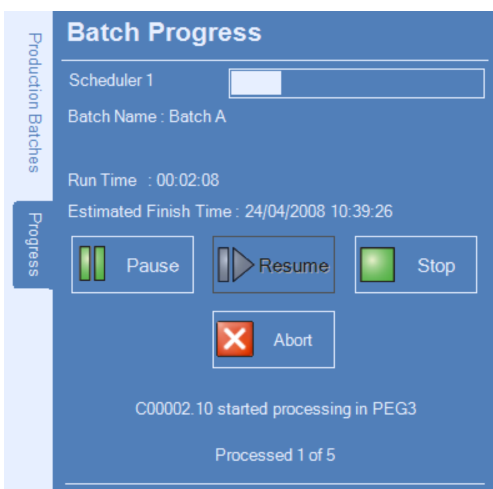


Figure 2.9 Typical Progress Tab

The progress tab displays the following:

- Bar graph of batch progress
- Batch ID
- Run time
- Estimated finish time
- Batch control buttons

2.8 Manual Functional Area

This area is used to diagnose or develop a process. Ordinarily, this area is not used by production users and production runs are not performed.

This area enables the individual operation of the tool's components and values. Each step is completed before the next step can be started. There is no restriction on the repetition of steps to allow a process to be run on the same substrate more than once.

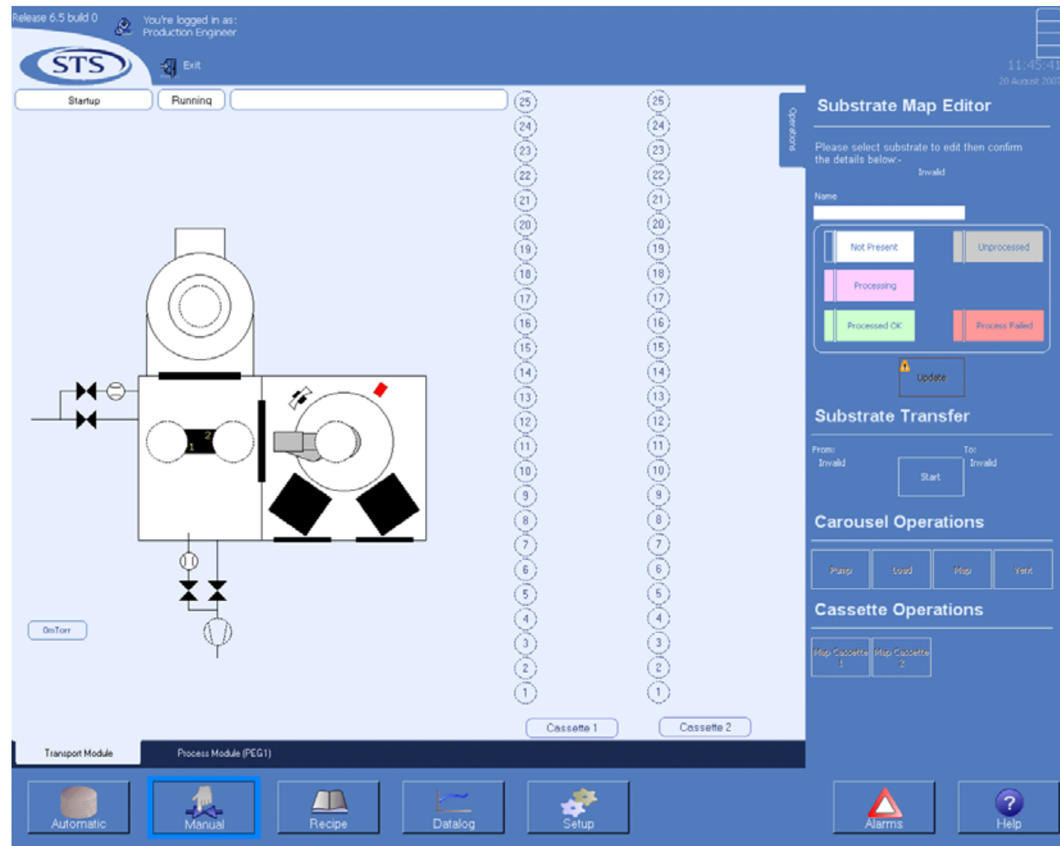


Figure 2.10 Typical Manual View

The information panel displays a graphical representation of the system's operation and is described further in 2.8.3. The contents of the command panel are determined by the selection made from the information panel. This area allows the selection of operations, refer to Chapter 3 for information on all operations available.

The command panel allows:

- Movement of the individual substrates
- Manual Control of devices (see 2.8.1)
- Updating of the substrate map (see 2.8.2.1)

Tabs available from this view are:

- **Transport Module** (see 2.8.2)
- **Process Module** (see 2.8.3)

2.8.1 I/O-Level Control

I/O-level control provides access to inputs and outputs of a selected device or piece of equipment.

When this mode is chosen and a device is selected from the mimic area, the parameters which can be changed and measured values are displayed in the control area.

To select I/O level control the device which is required to be manually controlled needs to be selected by clicking on the device. Once the device is selected a blue border appears around the device and the available options are displayed on the command panel.

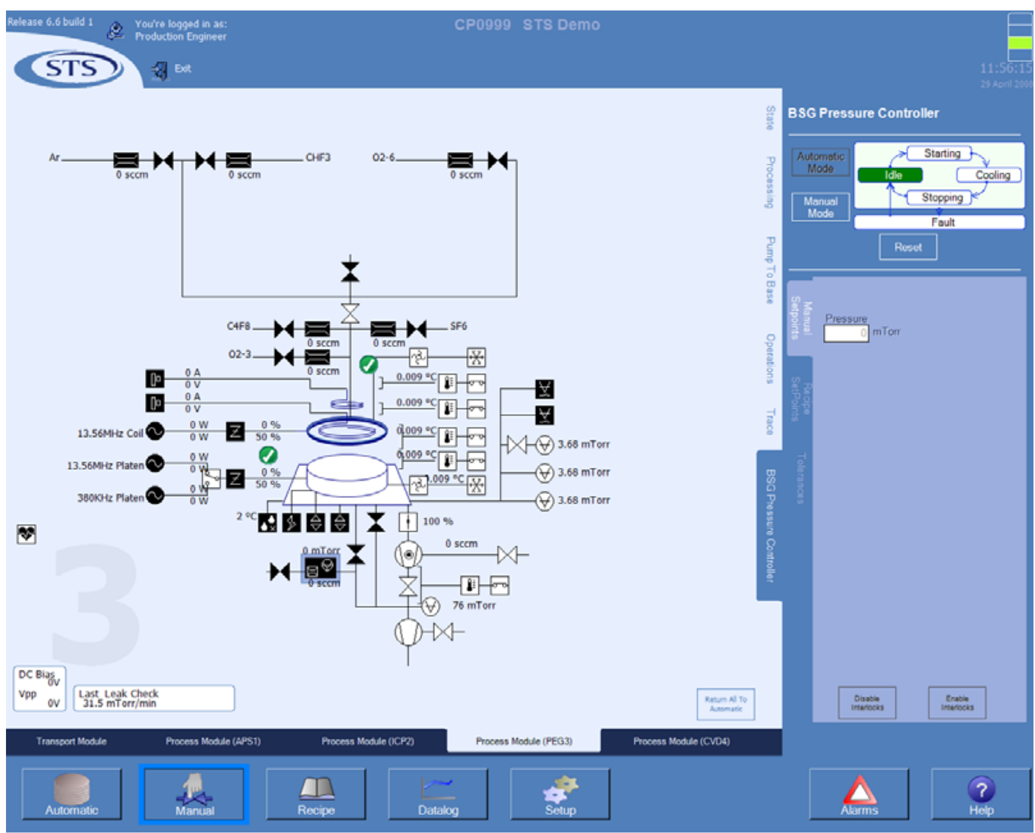


Figure 2.11 Typical Manual View with I/O level Control

2.8.2 Transport Module

The transport module view displays a graphical representation of the system and allows control of the handling system.

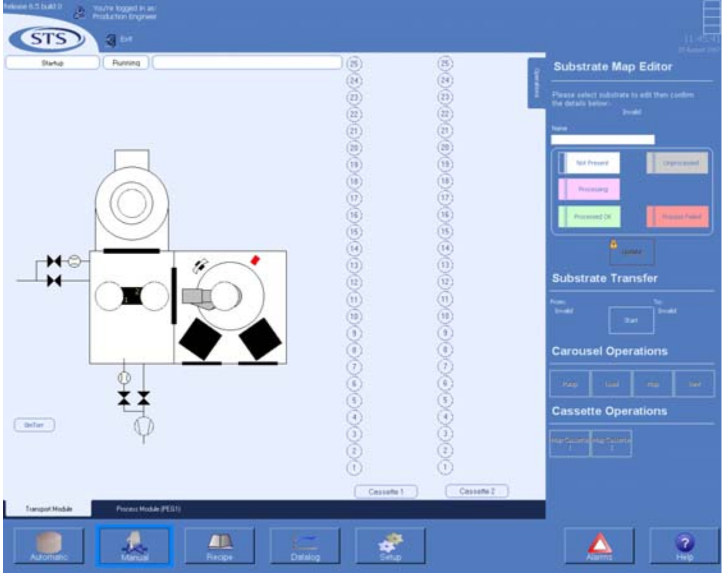


Figure 2.12 Typical Transport Module view

The Command Panel has the following options:

- **Substrate Map Editor**
- **Substrate Transfer**
- **Carousel Operations**
- **Cassette Operations**

2.8.2.1 Substrate Map Editor

The substrate map editor allows the user to manually create or delete wafers within the system. The map editor also enables the user to change the state of each substrate.

Substrate Creation / Deletion

To create a wafer the user must select where the wafer is to be located, enter the wafer name, click on the wafer's status and press the update button.

To delete a wafer the user must select where the wafer is located, select the wafer and deselect the present tick box.

Substrate Status

Each substrate has a status as described below:

State	Description
Not Present	Substrate not present.
Processing	Substrate currently undergoing a process.
Processed OK	Substrate has been processed successfully.
Unprocessed	Substrate awaiting processing.
Part Processed	Substrate has been processed and requires further processing to complete.
Process Failed	The substrate experienced a fault during processing or the process was aborted.

2.8.2.2 Substrate Transfer

The **Operations** tab also enables substrates to be manually transferred within the system.

To transfer a substrate the user must click on the substrate to be moved, click on the destination then click on the Start button.

2.8.2.3 Carousel Operations

This option allows the user to perform common handling operations on the carousel.

Button	Description
Pump	Pumps the loadlock down to transfer pressure
Load	Pumps the loadlock down to transfer pressure and maps the carousel
Map	Maps the carousel
Vent	Vents the loadlock to atmosphere

2.8.2.4 Cassette Operations

This option allows the user to perform common handling operations on the cassette.

Button	Description
Map Cassette 1/2	Maps the cassette

2.8.3 Process Module

The process module view displays a graphical representation of the system's operation and shows the system's components measured values.

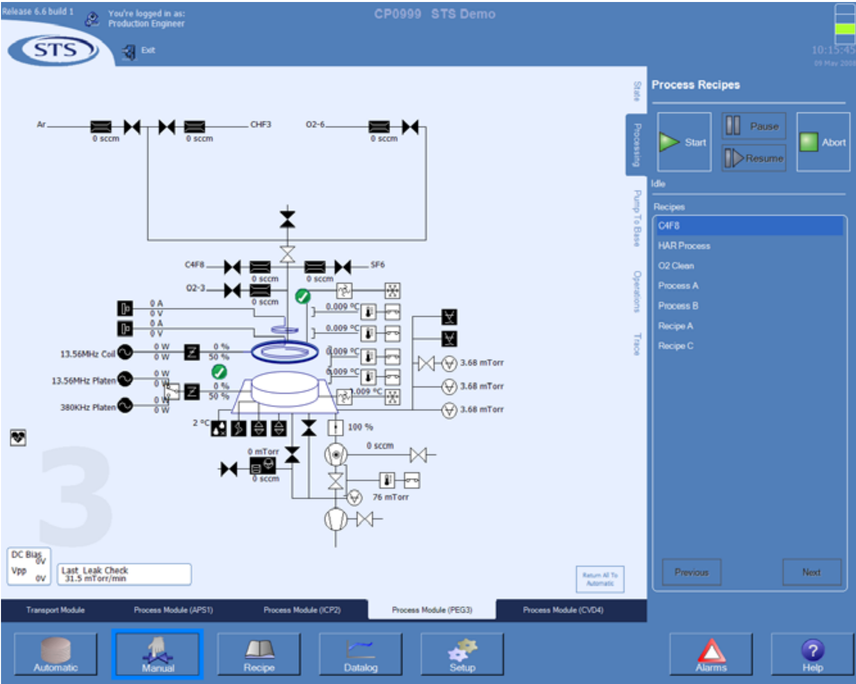


Figure 2.13 Typical Process Module View

Each process chamber has a mimic which displays the following:

- gas system configuration to the process chamber, including the gas type and measured flow rate
- vacuum pumping system configuration
- operating temperature of the lower electrode and, where applicable, the top electrode
- values and programmed configuration of the R.F. generators
- three status fields providing textual information on the operating conditions of the current process

Tabs available on the command panel are:

- **State**
- **Processing**
- **Dynamic Operation Tab**
  This tab displays the last operation selected (see 2.8.3.3).
- **Operations**
- **Trace**
- **Dynamic Device Control Tab**
  This tab displays options for the last device selected.

2.8.3.1 State

The **State** tab allows the user to view the Object Based Equipment Model (OBEM) of the process module.

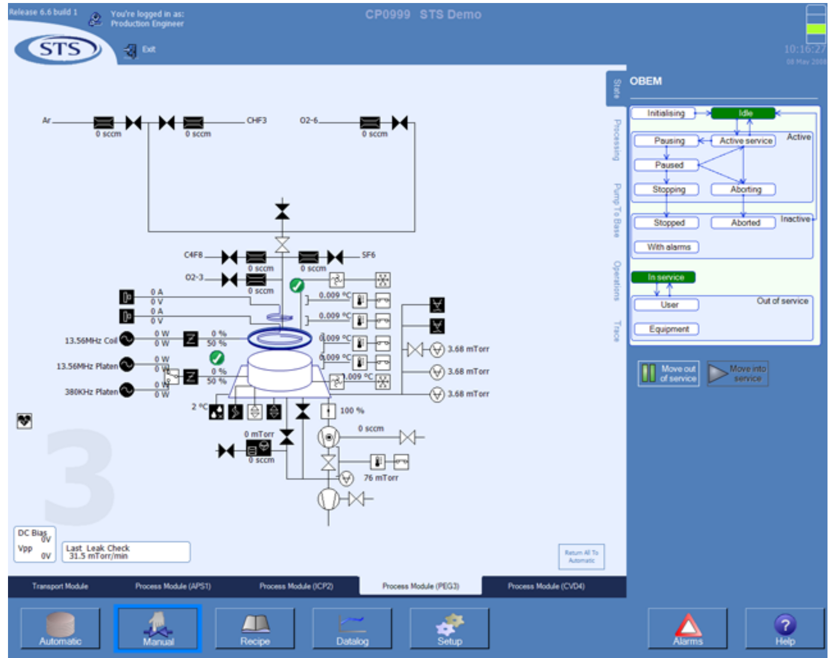


Figure 2.14 Typical Processing View

The OBEM model allows the user to place the process module in to or out of service.

The following buttons are available in the command panel:

Button	Description
Move Out Of Service	Places the process module out of service.
Move Into Service	Places the process module back into service.

The OBEM model displays a graphical representation of the process module’s current state.

When the user manually places the process module out of service, the ‘User’ state in the ‘Out of service’ block is highlighted. When equipment places the module out of service (e.g. equipment failure), the ‘Equipment’ state is highlighted.

For information on the other states, please refer to the SEMI E98-116 documentation.

2.8.3.2 Processing

The **Processing** tab allows the user to manually start a process.

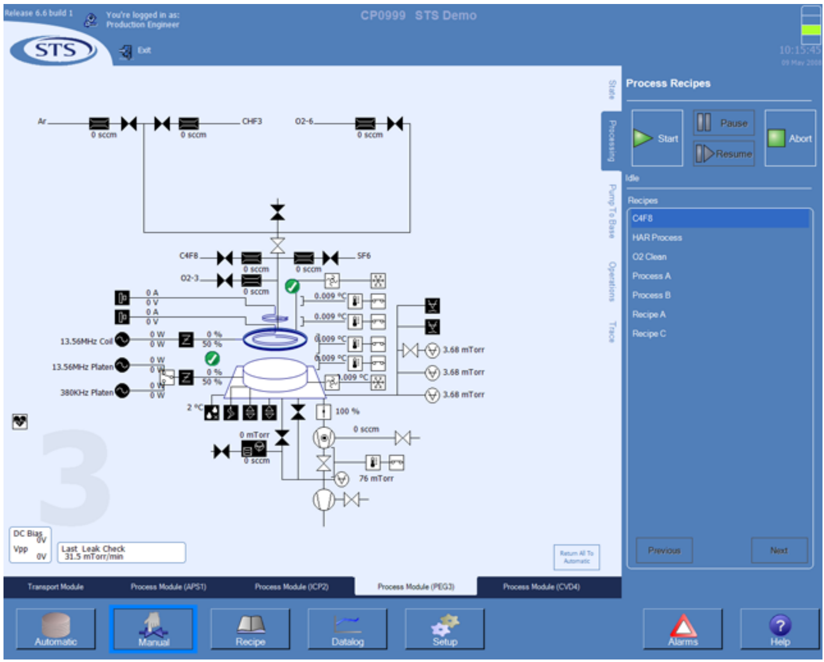


Figure 2.15 Typical Processing View

To start a process the user must select a process recipe from the list in the command panel.

The following buttons are available in the command panel:

Button	Description
Start	Starts the selected process.
Pause	Pauses the selected process.
Resume	Resumes the selected process.
Abort	Aborts the selected process.

2.8.3.3 Dynamic Operation Tab

The actual tab displayed here is the same as the most recently selected operation (see 2.8.3.4).

2.8.3.4 Operations

The **Operations** tab allows the user to manually perform common operations.

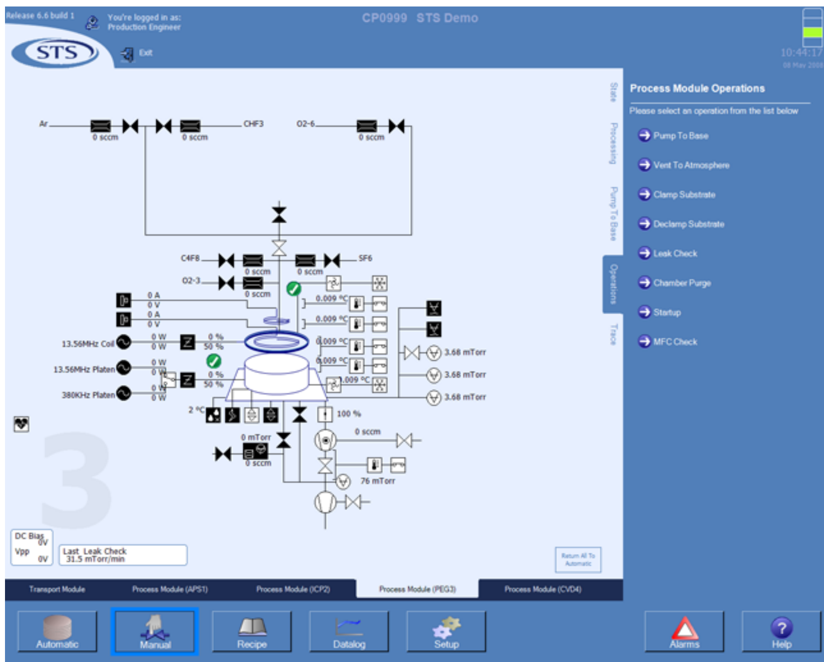


Figure 2.16 Typical Operations View

The following options are available in the command panel:

Figure 2.17 Typical Operations Options

Depending on the option selected the user may be required to enter parameters into text fields located on the command panel, for further details refer to Chapter 3.

The following buttons are available in the command panel in all available options:

Button	Description
Start	Starts the selected operation.
Pause	Pauses the selected operation.
Resume	Resumes the selected operation.

Button	Description
Abort	Aborts the selected operation.

2.8.3.5 Trace

The **Trace** tab allows the user to view various measured parameters in real-time. Each trace is displayed in the command panel. The number of traces and their contents is configured using the **Configure Traces** button.

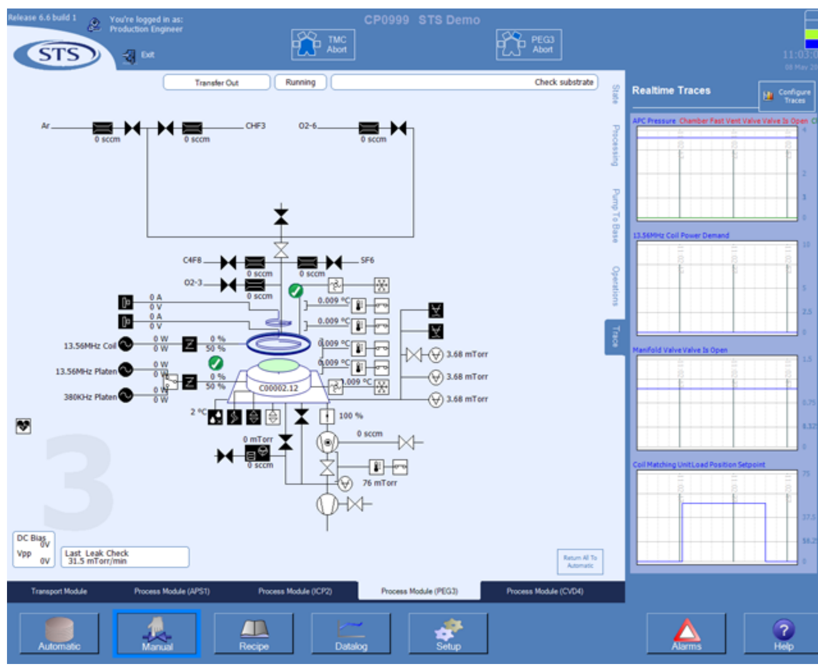


Figure 2.18 Typical Trace View

2.8.3.5.1 Configuring the Trace

Each trace can display up to four different values. The actual value measured is chosen using the **Change** button.

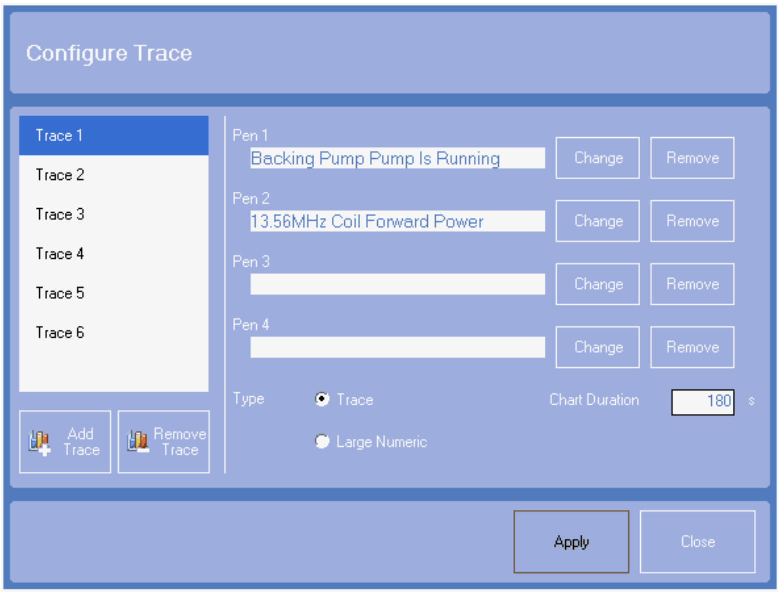


Figure 2.19 Configuring the Trace

Button / Field	Description
Add Trace	Adds a trace to the command panel.
Remove Trace	Removes a trace from the command panel.
Change	Displays a tree view of measurable items that the trace can display.
Remove	Removes the item from the trace.
Chart Duration	Defines the range of time that the trace displays.
Type	Defines if the trace is displayed as a line graph or as a numerical measured value.

2.8.3.6 Dynamic Device Control Tab

This tab displays manual operation options for the device last selected (see Chapter 3).

2.9 Recipe Editor

The Recipe button opens the Recipe Editor. The Recipe Editor enables recipes to be created, viewed, edited and deleted.

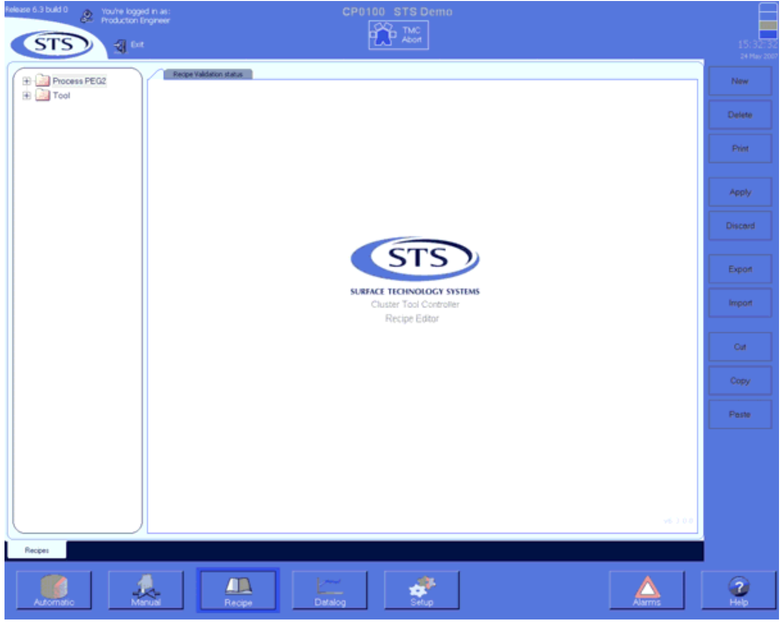


Figure 2.20 Typical Recipe Editor

A recipe is a reusable set of instructions or parameters which are used to determine each substrate’s path and environment whilst in the tool. There are two main types of recipe used:

- **Process recipes**
  Process recipes are associated with the process module and are used to define the environment within the chamber during processing. In addition process recipes can reference tolerance, logging and dechuck recipes.

- **Tool recipes**
  Tool recipes are associated with the overall tool and are used to define the substrate path through the tool as well as the process recipes to be run on each substrate or between substrates.

Recipes provide:

- Processing information
- Logging details
- Tolerance checking information
- Maintenance tasks
- Sequence information

The availability of each recipe is restricted by the user’s role and recipe release state. For example, a production user may only be permitted to select released recipes, whereas a service engineer would be permitted to select released and development recipes.

Note: *User roles are defined and administered via the* **Setup** *tab.*

A recipe which is marked “obsolete” must be changed to the released or development state before it can be selected using this method. The following command buttons are available from the **Recipe Editor**:

Button	Description
New	Creates a new recipe or step.
Delete	Deletes the displayed recipe or step.
Print	Prints the current recipe.
Apply	Saves any changes made to the recipe.
Discard	Disregards any changes that have been made since the last **Save**.
Export	Exports a recipe or step into XML format using the export wizard. This allows recipes to be copied between tools.
Import	Imports a recipe or step from XML format using the import wizard. This allows recipes to be copied between tools.
Cut	Cuts the recipe or recipe step to allow it to be inserted into another recipe folder or recipe.
Copy	Copies the recipe or recipe step to allow it to be inserted into another recipe folder or recipe.
Paste	Pastes a copied recipe or recipe step into a recipe folder or another recipe.

The following are displayed at the top of the **Recipe Editor**:

Field	Description
Name	The recipe name is user-defined and can be a maximum of 50 characters.
Description	The recipe description is user-defined and can be a maximum of 50 characters.
Version	The version number can be up to five characters, in the form “##.##”. The version number is not incremented automatically. The version control is the responsibility of the recipe’s author.
Author	The engineer who created the recipe; this field can be a maximum of 50 characters.
Edit Date	Displays the date and time that the recipe was last modified.
Release State	Displays the current state of the recipe, released and available for use, development, or obsolete.

The **Process Steps** section of the window displays the step name and where the step is positioned in the recipe.

2.9.1 Process Recipe

This recipe is used to define the environment inside the chamber during processing. A process recipe consists of a series of structured steps (see 2.9.1.1) and may also reference one or more of the following:

- Default Recipe (see 2.9.1.2)
- Logging Recipe (see 2.9.1.3)
- Tolerance Recipe (see 2.9.1.4)
- Dechuck Recipe (see 2.9.1.5)
- Compensation Recipe (see 2.9.1.6)

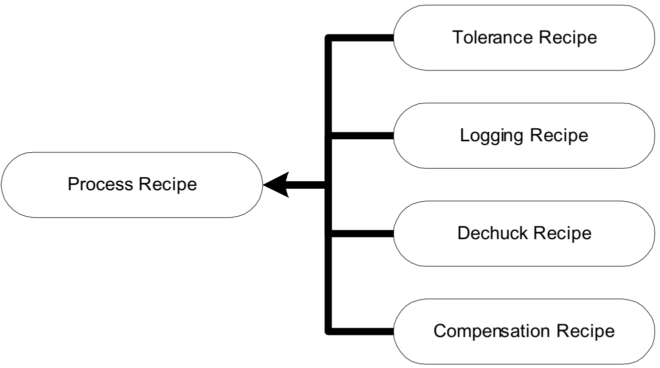


Figure 2.21 Process Recipe References

2.9.1.1 Process Module Recipe Steps

Each recipe step is related to one process module operation.

Operations which are available for inclusion as a step in a process recipe are:

- Purging the chamber (see 2.9.1.1.1)
- Standard material process (see 2.9.1.1.2)
- Purging gas line (see 2.9.1.1.14)
- Running a leak test (see 2.9.1.1.15)
- Pumping to base (see 2.9.1.1.16)
- Clamping and de-clamping a substrate (see 2.9.1.1.17 and 2.9.1.1.18)
- Vent the process chamber (see 2.9.1.1.19)

2.9.1.1.1 Chamber Purge Step

This step instructs the system to fill the process chamber with a purge gas, typically nitrogen, to dilute any contaminants that might be present. The mixture is then pumped out again, leaving the chamber uncontaminated. Multiple pump purge steps can be set.

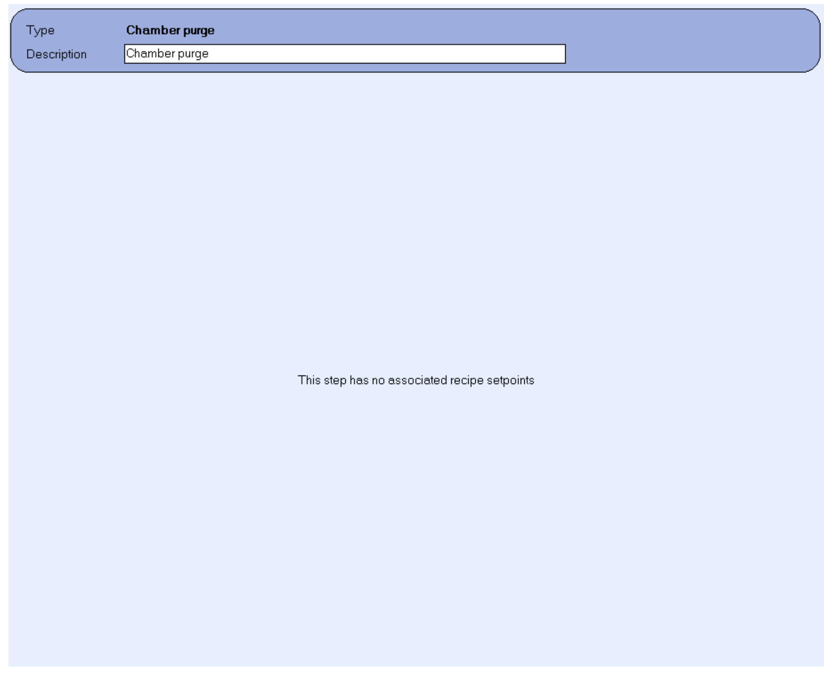


Figure 2.22 Chamber Purge Step

2.9.1.1.2 Etch/Deposition (Standard Material Process) Step

The standard material process step incorporates the majority of the parameters. With the exception of the gas flow specification, each parameter has a direct association with a specific device's set-point.

The standard material process step can also link to a tolerance recipe (see 2.9.1.4).

Note: *Depending on the system setup, template settings and process, all of the described fields in this section may not be available.*

Process Step Composition

Each process step is made up of one or more process cycles. Each cycle is made up of a deposition phase and/or an etch phase. Furthermore, each phase is divided into three sub-phases, namely:

- Delay sub-phase
- Boost sub-phase
- Main sub-phase

The sub-phases therefore allow three parameter changes to occur for each dep/etch phase.

2.9.1.1.3 General Tab

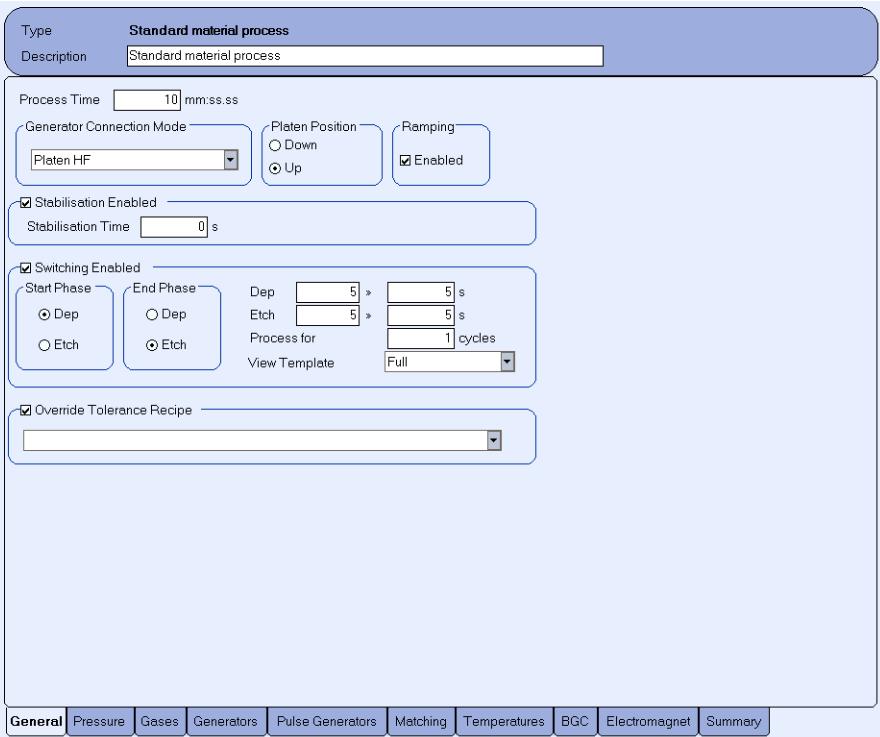


Figure 2.23 Typical General Tab

The following are available from the **General** tab:

Control	Description
Step Description	Enter a description for the step.
Process Time	Enter the total process time.
Generator Connect Mode	Enables the selection of the RF generators to be used.
Platen Position	Select whether the platen should be in the up or down position. Processing usually occurs with the platen in the raised position.
Ramping Enabled	Enables parameter ramping. Parameter ramping allows parameters to be increased/decreased during a process. During processing, there is a possibility that a parameter could reach its maximum or minimum value. If this happens, the parameter ramping stops, but the process continues without an error condition being raised.
Stabilisation Enabled	Enables stabilisation. Stabilisation defines whether gases should be introduced to the chamber before switching on the RF.
Stabilisation Time	Defines the time between the process gases being introduced into the chamber and the RF being switched on.
Switching Enabled	Enables switching between two sets of parameters in a cycle that repeats throughout the step. This is used for ASE recipes.
Parameter Switching: This allows switching within a process.	
Etch/Dep Step Time	Enter the required period of time for the step.
Start Phase	Phase begins with an etch or deposition process.

End Phase	Phase ends with an etch or deposition process.
No. of Cycles	Enter the number of complete switching cycles which are required in the process.
Ramp (>>)	Enter the process ramp time.
View Template	Allows the full range of options to be displayed, or only those required within a specific process.
Override Tolerance Recipe	Select a tolerance recipe to be run during processing. The recipe monitors equipment values and raises alarms/errors when equipment values are outside tolerance levels. *Note: This will override any tolerance recipe chosen by the default recipe or at the recipe level.*

2.9.1.1.4 Pressure Tab

Note: *The options available vary according to the configuration of the system and the parameters set on the* **General** *tab (see 2.9.1.1.3).*

This page sets the automatic pressure control (APC) valve to either **Manual** or **Automatic** mode. In **Automatic** mode, the valve moves to the optimum position to achieve the process chamber pressure.

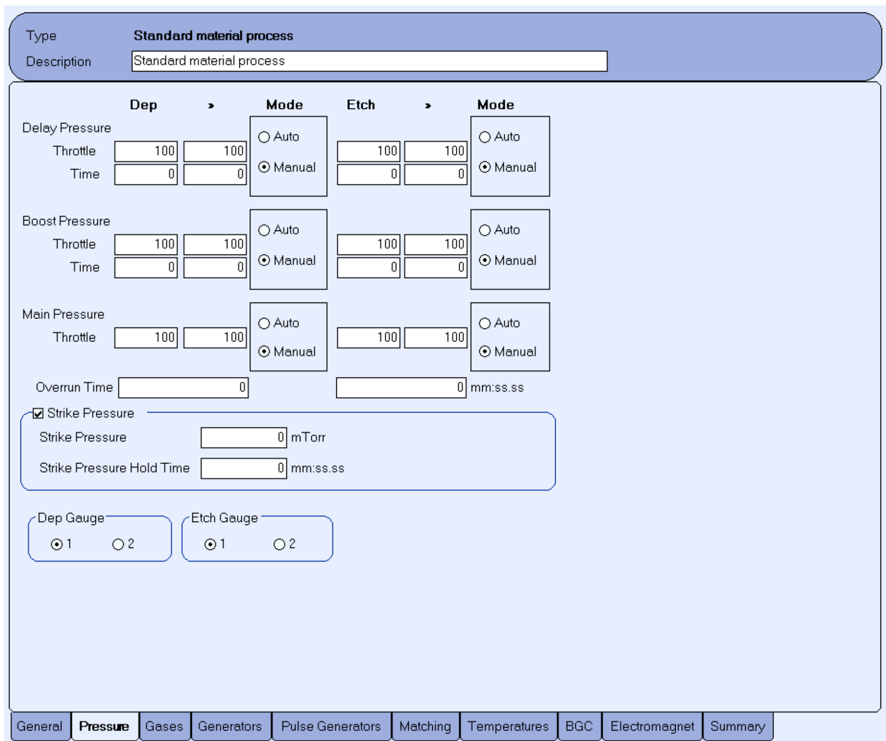


Figure 2.24 Typical Pressure Tab

The following options are available from the **Pressure** tab:

Field	Description
Description	Enter a description for the step.
Auto / Manual	The pressure mode to use: • Auto - The APC automatically adjusts to maintain a preset pressure • Manual - Manually set the angle of the APC
Delay Pressure	Enter a pressure / throttle percentage for the delay sub-phase.
Delay Time	Enter a time for the delay sub-phase.
Boost Pressure	Enter a pressure / throttle percentage for the boost sub-phase.
Boost Time	Enter a time for the boost sub-phase.
Main Pressure	Enter a pressure / throttle percentage for the main sub-phase.
Overrun Time	Enter the overrun time which will allow the selected pressure to run into the next etch or dep phase of the process.
Strike Pressure	Enter a pressure at which the plasma will strike. After striking, the pressure returns to the main pressure setting.
Strike Pressure Hold Time	Enter a time for the strike pressure to be maintained before returning to the main pressure setting.
Dep Gauge	Select the gauge to use when measuring the dep pressure.
Etch Gauge	Select the gauge to use when measuring the etch pressure.

2.9.1.1.5 Gas Tab

This tab is used to choose the gases for the recipe.

> ***Note:*** *This tab does not prevent the user from selecting incompatible gases to flow at the same time. However, the recipe will fail validation where this is the case.*
> *Also, the gasbox will mechanically prevent a hazardous gas combination from flowing.*

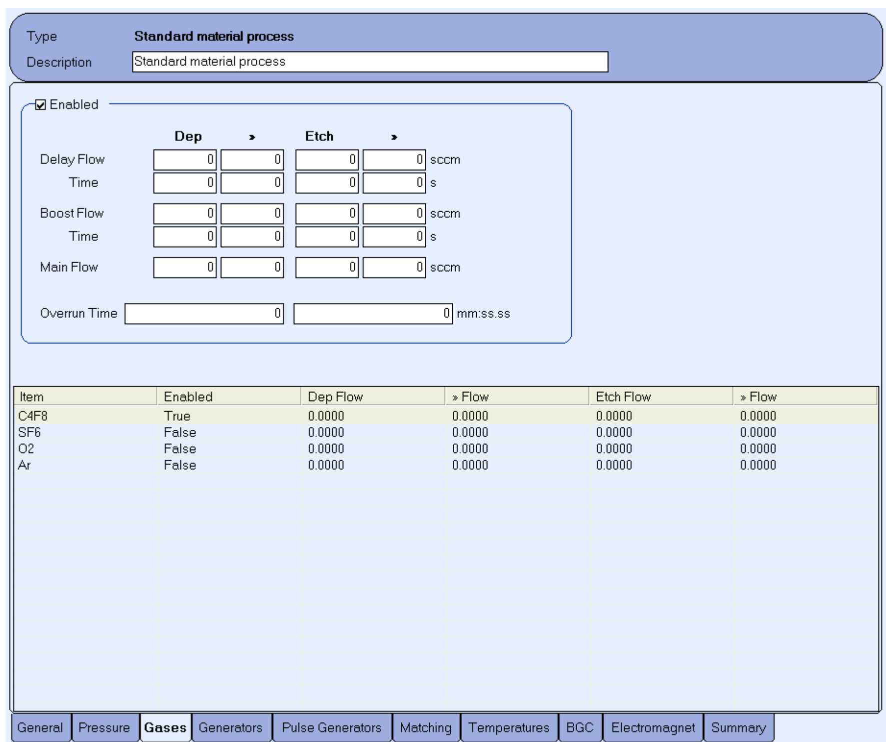


Figure 2.25 Typical Gas Tab

The following are available from the **Gas** tab:

Field	Description
Description	Enter a description for the step.
Delay Settings	
Delay Flow	Allows the required delay flow to be delivered before returning to the main flow rate.
Delay Time	Enter the amount of delay time required.
Boost Settings	
Boost Flow	Allows the required boost flow to be delivered before returning to the main flow rate.
Boost Time	Enter the amount of boost time required.
Main Settings	
Flow	Select the required flow rate for the gas selected.
Overrun Time Settings:	
Overrun Time	Enter the overrun time which will allow the selected gas to run into the next etch or dep phase of the process. ***Note:*** *This function is normally only used on processes with larger switching times, typically greater than 15 seconds.*

2.9.1.1.6 Generators Tab

Note: *The power generation options vary according to the configuration the system and the parameters set on the* **General** *tab (see 2.9.1.1.3).*

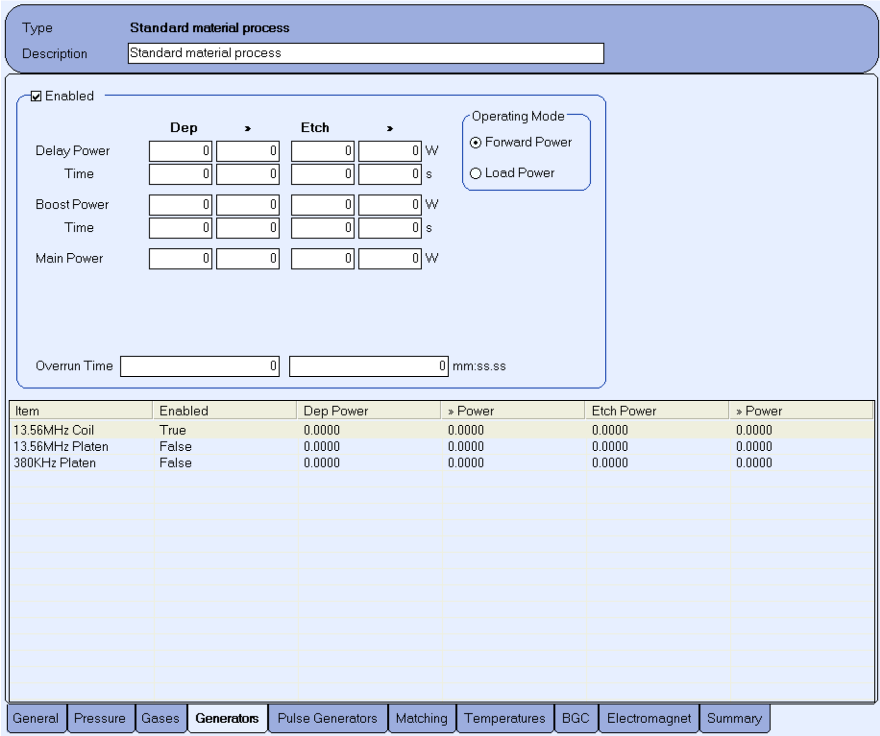


Figure 2.26 Typical Generators Tab

The following are available from the **Generators** tab:

Field	**Description**
Description	Enter a description for the step.
Delay Settings	
Delay Power	Allows the required delay power to be delivered before returning to the main power setting.
Delay Time	Enter the amount of delay time required.
Boost Settings	
Boost Power	Allows the required boost power to be delivered before returning to the main power setting.
Boost Time	Enter the amount of boost time required.
Main Settings	
Main Power	Select the required power.
Overrun Time Settings:	
Overrun Time	Enter the overrun time which will allow the selected power to run into the next etch or dep phase of the process. ***Note:*** *This function is normally only used on processes with larger switching times, typically greater than 15 seconds.*

2.9.1.1.7 Pulse Generators Tab

The pulse generator tab enables the operator to insert an RF pulse into the recipe.

Note: *The options available may vary according to the configuration of the system and the parameters set on the* **General** *tab (see 2.9.1.1.3).*

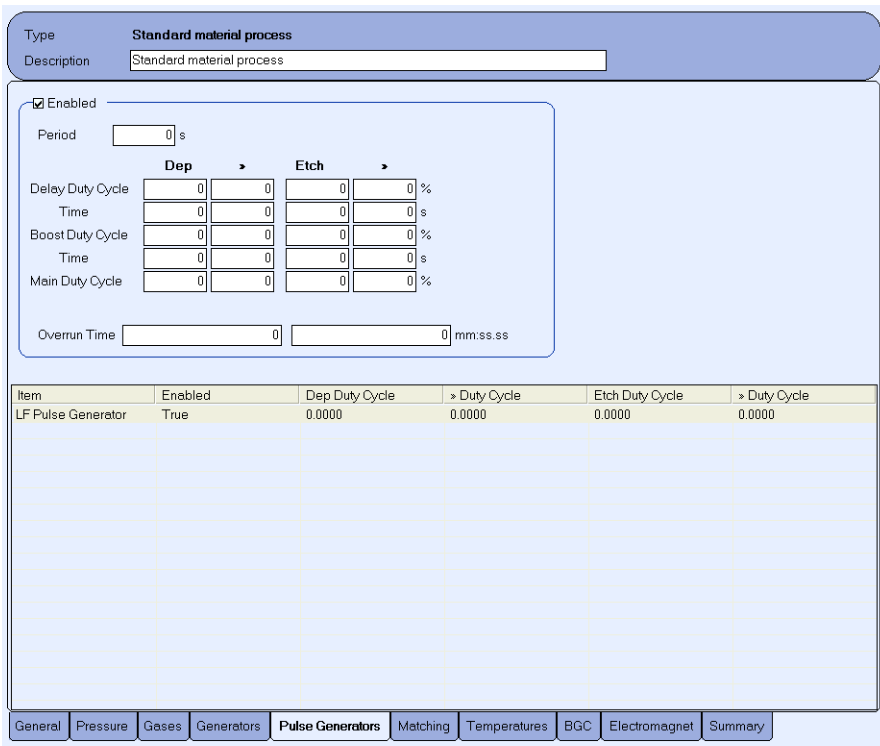


Figure 2.27 Typical Pulse Generators Tab

The following are available from the **Pulse Generators** tab:

Field	Description
Description	Enter a description for the step.
Period	Enter the required period in seconds.
Delay Settings	
Delay Duty Cycle	Enter a percentage of the period time that the delay duty cycle will be delivered.
Delay Time	Enter the delay time required.
Boost Settings	
Boost Duty Cycle	Enter a percentage of the period time that the boost duty cycle will be delivered.
Boost Time	Enter the boost time required.
Main Settings	
Main Duty Cycle	Enter a percentage of the period time that the main duty cycle will be delivered.
Overrun Time Settings:	
Overrun Time	Enter the overrun time which will allow the selected duty time to run into the next etch or dep phase of the process. ***Note:*** *This function is normally only used on processes with larger switching times, typically greater than 15 seconds.*

2.9.1.1.8 Matching Units Tab

The matching unit is positioned between the generator and the electrode and is responsible for maintaining a constant load to the generator.

> ***Note:*** *The options available vary according to the configuration of the system and the parameters set on the* **General** *tab (see 2.9.1.1.3).*

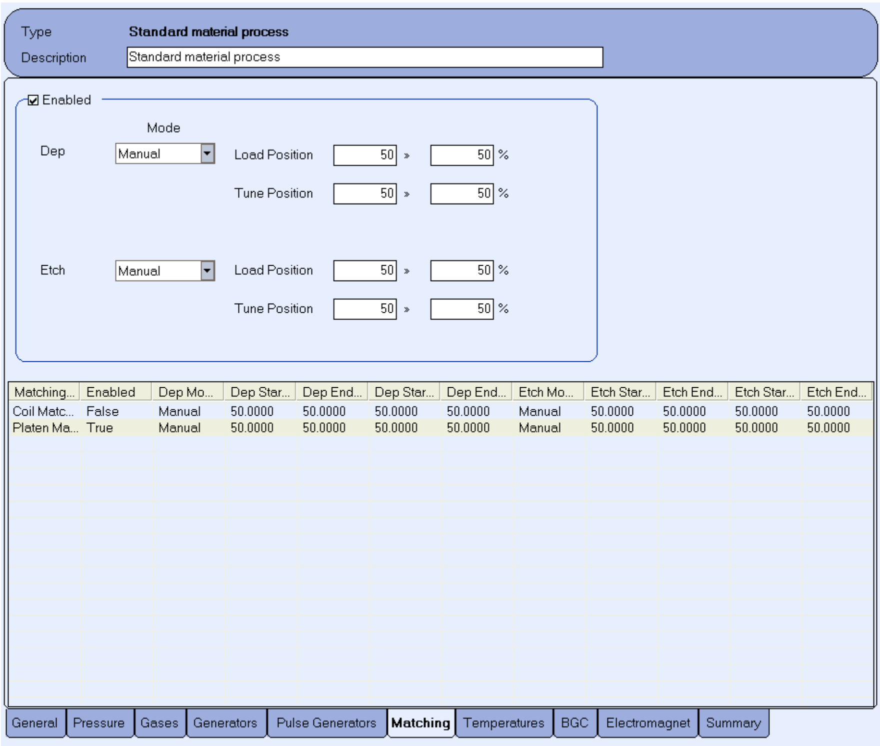


Figure 2.28 Typical Matching Units Tab

The following are available from the **Matching Units** tab:

Field	**Description**
Description	Enter a description for the step.
Mode	Select the mode required for both the etch and deposition steps: • Manual - both the load and tune settings remain in the set starting position • Load Auto - allows the load setting to change automatically, whilst the tune setting remains constant • Tune Auto - allows the tune setting to change automatically, whilst the load setting remains constant • Auto - allows both the load and tune settings to change automatically
Load Settings:	
Load Position	Defines the load capacitor's starting point for the matching unit as a percentage.
Tune Settings:	
Tune Position	Defines the tune capacitor's starting point for the matching unit as a percentage.
Ramp (>>)	Enter the final percentage value position of the capacitor.

2.9.1.1.9 Temperatures Tab

This tab allows the process temperature for each step in the recipe to be set.

Temperature-controlled zones are used to ensure thermal stability around the plasma and substrate as well as to reduce condensation or deposition in the gas and pumping systems.

Note: *The options available vary according to the configuration of the system and the parameters set on the* **General** *tab (see 2.9.1.1.3).*

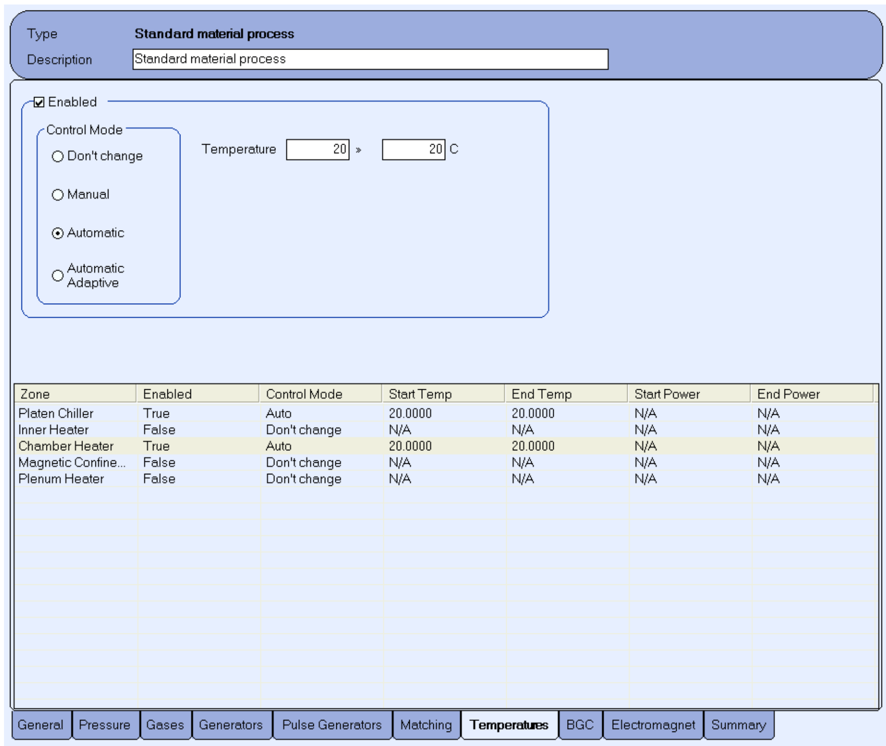


Figure 2.29 Typical Temperatures Tab

The following fields are available from the **Temperatures** tab:

Field	**Description**
Description	Enter a description for the step.
Control Mode	Displays the control mode for each zone: • Don't Change - The temperature will remain at the same setpoint for the duration of the process • Manual - Control of the heat/cool zones is to be handled manually • Automatic - Control of the heat/cool zones is to be handled automatically • Automatic Adaptive - Control of the heat/cool zones is to be handled automatically with the system remembering previous instructions and adapting these to the current process
Temperature	The temperature to be maintained for the step (automatic modes only).
Power	The percentage power to drive the zone heaters for the step (automatic modes only).

2.9.1.1.10 Backside Cooling Tab

This tab enables control the backside cooling of the substrate.

Note: *The options available vary according to the configuration of the system and the parameters set on the* **General** *tab (see 2.9.1.1.3).*

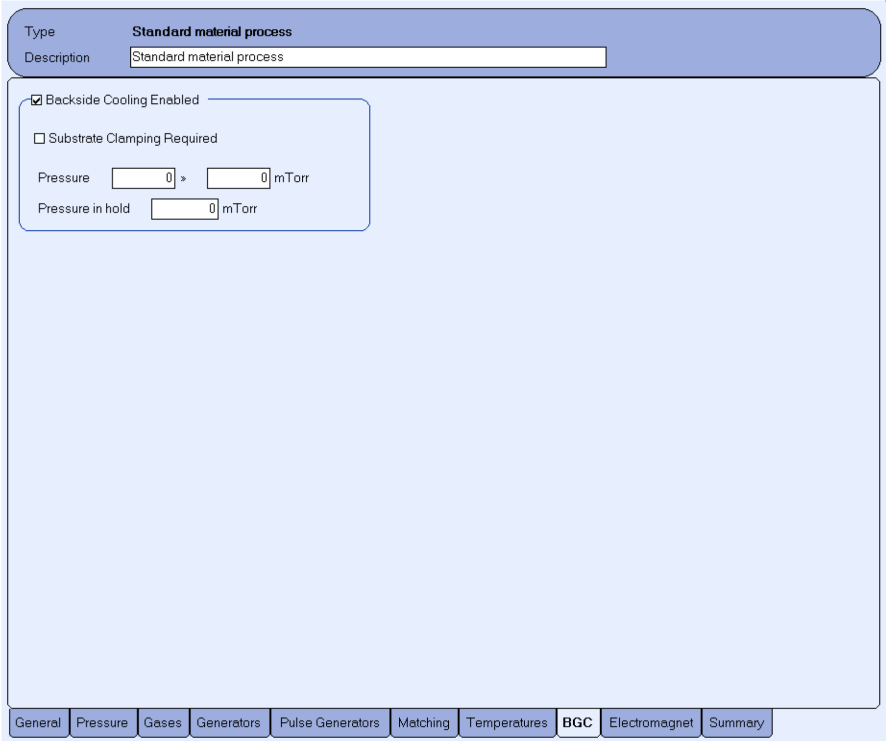


Figure 2.30 Typical Backside Cooling Tab

The following are available from the **Backside Cooling** tab:

Field	Description
Description	Enter a description for the step.
Backside Cooling:	
Backside Cooling Enabled	Select if backside cooling is required during the step (enabled is the default). Use the following fields to define the required parameters.
Clamping Required	Select if the substrate should be clamped during the step.
Pressure	Enter the set point pressure to be applied.
Pressure in hold	Enter the required Backside gas pressure to be used when holding.
Ramp (>>)	Enter the final backside pressure to ramp up to.

2.9.1.1.11 Electromagnet Tab

This tab allows the electromagnet's power to be defined for each etch and dep phase.

> ***Note:*** *The options available vary according to the configuration of the system and the parameters set on the* **General** *tab (see 2.9.1.1.3).*

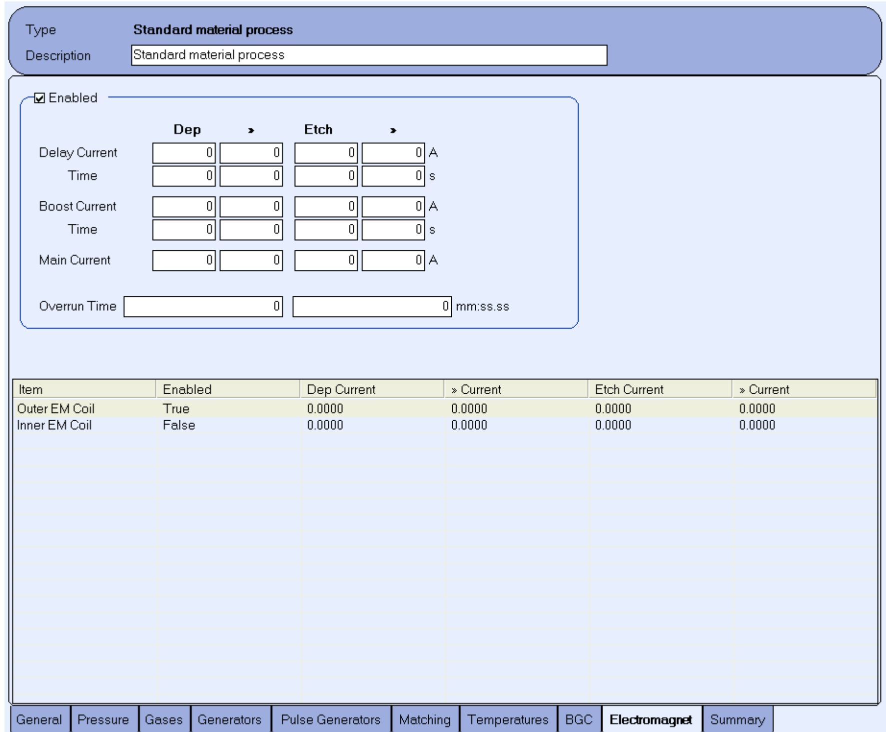


Figure 2.31 Typical Electromagnet Tab

The following are available from the **Electromagnet** tab:

Field	Description
Description	Enter a description for the step.
Delay Settings	
Delay Current	Enter the delay current to be delivered to the electromagnet.
Delay Time	Enter the delay time required.
Boost Settings	
Boost Current	Enter the boost current to be delivered to the electromagnet.
Boost Time	Enter the boost time required.
Main Settings	
Main Current	Enter the main current to be delivered to the electromagnet.
Overrun Time Settings:	
Overrun Time	Enter the overrun time which will allow the selected current to run into the next etch or dep phase of the process. ***Note:*** *This function is normally only used on processes with larger switching times, typically greater than 15 seconds.*

2.9.1.1.12 End Point Tab

Note: *The options available vary according to the configuration of the system and the parameters set on the* **General** *tab (see 2.9.1.1.3).*

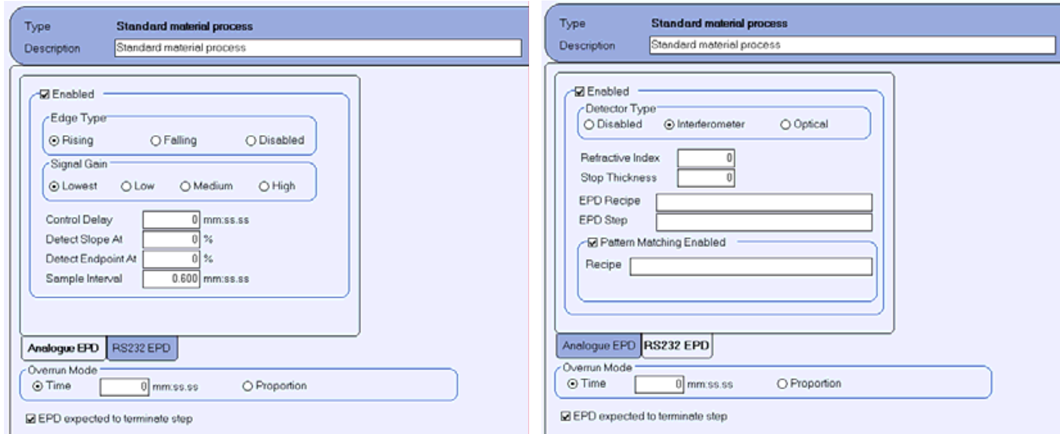


Figure 2.32 Typical Analogue and RS232 End Point Tabs

The following are available from the **Analogue End Point** tab:

Analogue EPD:	
Control	**Description**
Enabled	Enables end point detection.
Edge Type	Select whether a rising or falling edge should be used to detect the end-point, or if the edge type is disabled.
Signal Gain	Enter the required signal gain.
Control Delay	Enter the delay in minutes and seconds that allows for the plasma to stabilise before the signal is monitored.
Detect slope at [field]% of stable level	The first event sought by the detector - when the signal has fallen the pre-defined percentage below the maximum (falling edge detect) or risen the pre-defined percentage above the minimum (rising edge detect).
Detect endpoint at [field]% of max slope	The second event sought by the detector - when the slope of the signal has fallen the pre-defined percentage below the maximum signal slope.
Sample Interval	Enter the time interval between signal readings.
RS232 EPD:	
Control	**Description**
Enabled	Enables end point detection.
Detector Type	Select the required detector type.
Refractive Index	Enter the refractive index for the substrate material.
Stop Thickness	Enter the required stop thickness.
EPD Recipe	Select the pre-programmed EPD recipe to be used.
EPD Step	Enter the pre-programmed EPD step to be used.
Pattern Matching Enabled	Enables pattern matching

Pattern Matching Recipe	Enter the pre-programmed pattern matching recipe to be used.
Overrun Time	Select a time in seconds for the process to continue after the end point is detected.
EPD Expected to Terminate Step	When ticked, an alarm is raised if the EPD does not stop the step.

2.9.1.1.13 Summary Tab

Note: *The options available vary according to the configuration of the system and the parameters set on the* **General** *tab (see 2.9.1.1.3).*

This tab provides a graphical representation of the process.

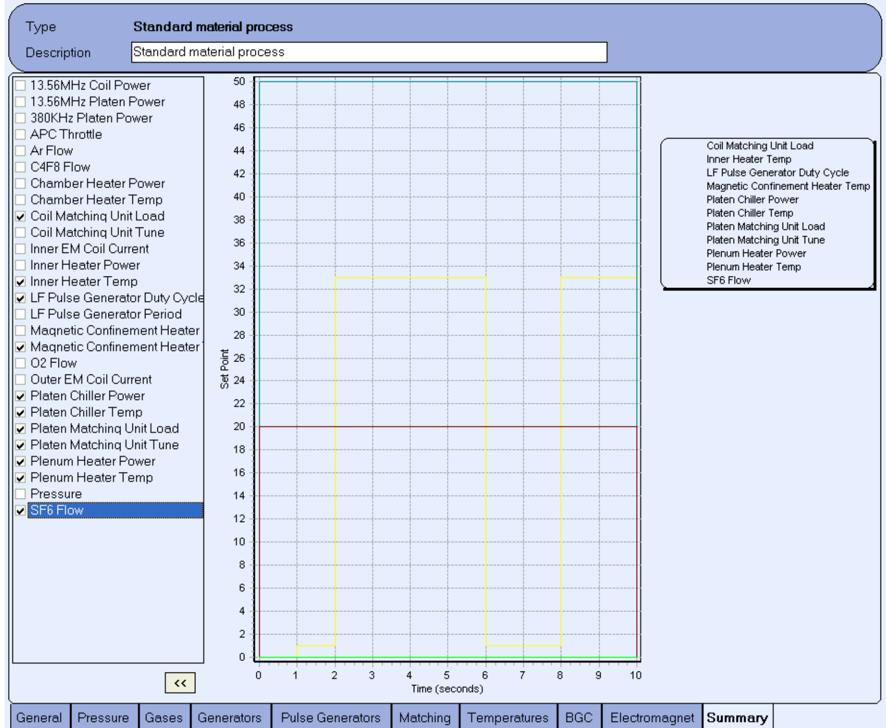


Figure 2.33 Typical Summary Tab

Select the check boxes from the left hand side of the screen to display the parameters within the graph. The graph displays set point against time over the period of the step.

Click at the top left then drag a box to the bottom right to zoom in to the graph. Click at bottom right the drag a box out to the top left to zoom out from the graph.

2.9.1.1.14 Gas Line Purge Step

This step enables purging of the gas lines to remove the hazardous gas.

> ***Note:*** *This step will ONLY purge the gas line between the gasbox and the chamber and NOT the gas line between the gasbox and the house supply.*

Hazardous gases (as defined in SEMI E49.8) used on the system can be toxic, pyrophoric and corrosive therefore each is given a gas line configuration incorporating a purge gas.

A safe gas, nitrogen, is flowed through the MFC to the chamber, which achieves:

- flushing the MFC of the dangerous gas, or to a safer concentration
- flushing the MFC of the corrosive gas, or to a safer concentration - this means that the gas will not corrode the MFC
- safely pumping away any residue of the dangerous gas along the full length of the gas pipe. This means that it is safe to flow an incompatible gas to the chamber without the risk of mixing the gases in this common length of pipe

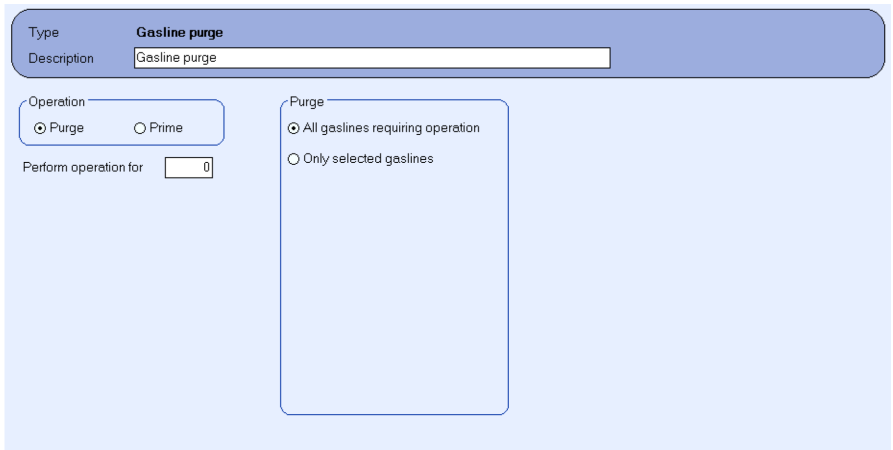


Figure 2.34 Typical Gas Line Purge Step

The following are available from the **Gas Line Purge/Prime** window:

Field	Description
Description	Enter a description for the step.
Operation	Select the required the required operation to be performed, purge or prime.
Perform operation for	Enter the number of gas line purge/prime cycles to perform.
All gaslines requiring operation	Use this radio button to select to purge/prime gas lines which have not been purged.
Only selected gaslines	Use this radio button to select the gas lines to be purged/primed. Select the check box adjacent to the required gas.

2.9.1.1.15 Leak Up Test Step

This step enables the acceptable parameters for a chamber, backside cooling and gasline leak up rate to be defined.

This test measures actual and virtual leaks in a chamber. This is achieved by isolating the chamber and measuring any rise in pressure over a defined period.

Leaks into the process chamber can also originate from the backside cooling system - the backside cooling gas escapes from under the substrate. A badly clamped substrate leaks more backside gas, so this test can detect if the substrate is correctly clamped.

If, during a recipe, the measured leak is greater than the value specified, the process is paused.

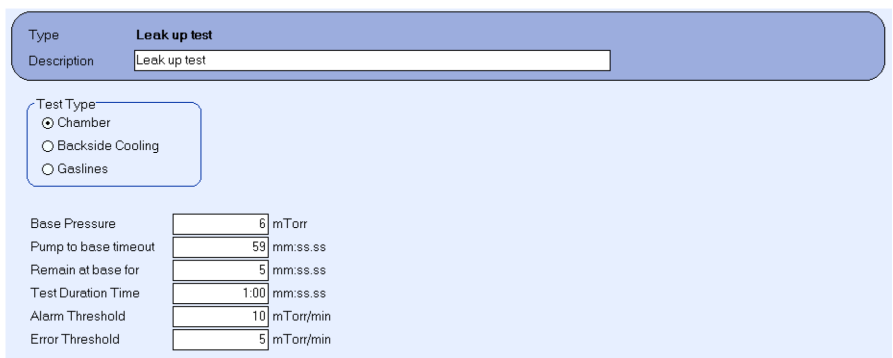


Figure 2.35 Typical Leak Up Step

The following are available from the **Leak Up Test** window:

Field	Description
Description	Enter a description for the step.
Test Type	Chamber: Select this radio button if a leak test is required to be carried out on the process chamber.
	Backside Cooling: Select this radio button if a leak test is required to be carried out on the backside cooling.
	Gaslines: Select this radio button if a leak test is required to be carried out on the gas lines. Select the check box adjacent to the gas line that requires testing.
Base Pressure	Enter the required base pressure.
Pump to Base Timeout	Enter the time period in which base pressure is to be reached.
Remain at Base For	Enter the time period at which base pressure should remain.
Alarm Threshold	Enter the pressure level at which an alarm should be raised.
Error Threshold	Enter the pressure level at which an error should be raised.
Gaslines	Use this radio button to select the gas lines to be purged/primed. Select the check box adjacent to the required gas. (Gasline leak up only).
Backside Gas Cooling Pressure	Enter the pressure required for the backside gas cooling. (Backside gas leak up only).

2.9.1.1.16 Pump to Base Step

This step enables you to define the parameters for the chamber to reach base pressure, i.e. the point after which the HiVAC valve will open.

This step is generally the first and last step of a recipe.

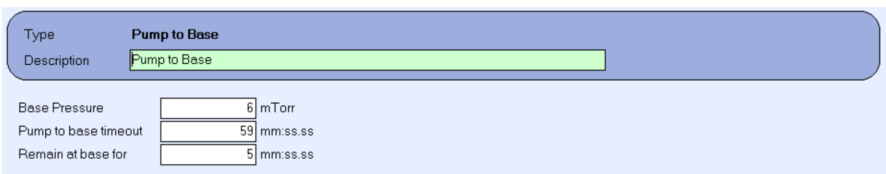


Figure 2.36 Typical Pump to Base Step

The following are available from the **Pump to Base** window:

Control	Description
Description	Enter a description for the step.
Base Pressure	Enter the required base pressure that is to be reached.
Pump to Base Time Out	Enter the time period in which base pressure is to be reached.
Remain at Base Time	Enter the time period at which base pressure should remain before the next process step starts.

2.9.1.1.17 Clamp Substrate Step

This step clamps the substrate prior to processing.

Note: *If this step is included in a recipe, a declamp substrate step must always be included (see 2.9.1.1.18).*

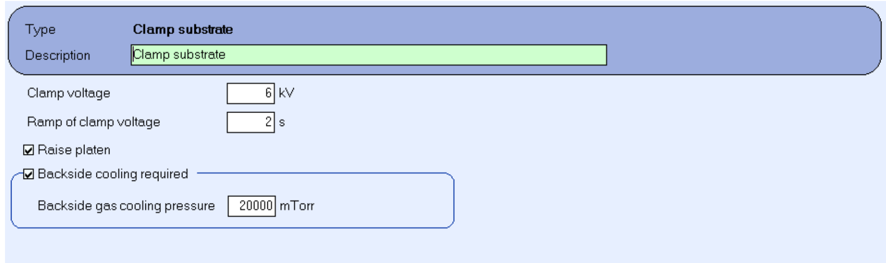


Figure 2.37 Typical Clamp Substrate Step

The following are available from the **Clamp Substrate** window:

Field	**Description**
Description	Enter a description for the step.
Clamp Voltage	Enter a voltage used to clamp the substrate.
Ramp of Clamp Voltage	Enter a time period over which the voltage will be raised to the clamping voltage.
Raise Platen	Select this check box if the platen is to be raised before clamping.
Backside Cooling Required	Select this check box if backside cooling is required.
Backside Gas Cooling Pressure	Select the required pressure of the backside gas cooling system.

2.9.1.1.18 Declamp Substrate Step

This step is used to release the substrate from clamping.

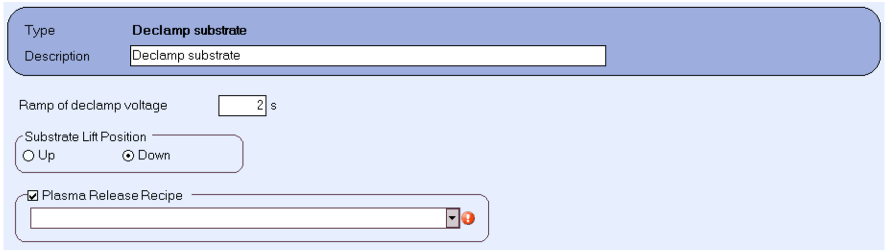


Figure 2.38 Typical Declamp Substrate Step

The following are available from the **Declamp Substrate** window:

Field	Description
Description	Enter a description for the step.
Ramp of Declamp Voltage	Enter a time period over which the clamping voltage will be removed.
Substrate Lift Position	Select the required radio button for the position of the lift following release: Up or Down.
Plasma Release Recipe	Select this check box if a dechuck recipe is required to assist in declamping the substrate (see 2.9.1.5).

2.9.1.1.19 Vent To Atmosphere Step

This step vents the process chamber.

There are no associated parameters with this process step.

Figure 2.39 Vent To Atmosphere Step

2.9.1.2 Default Recipe

The default recipe contains the process module global tolerance, logging and compensation recipes that will be used within the process recipe if no specific recipes are chosen.

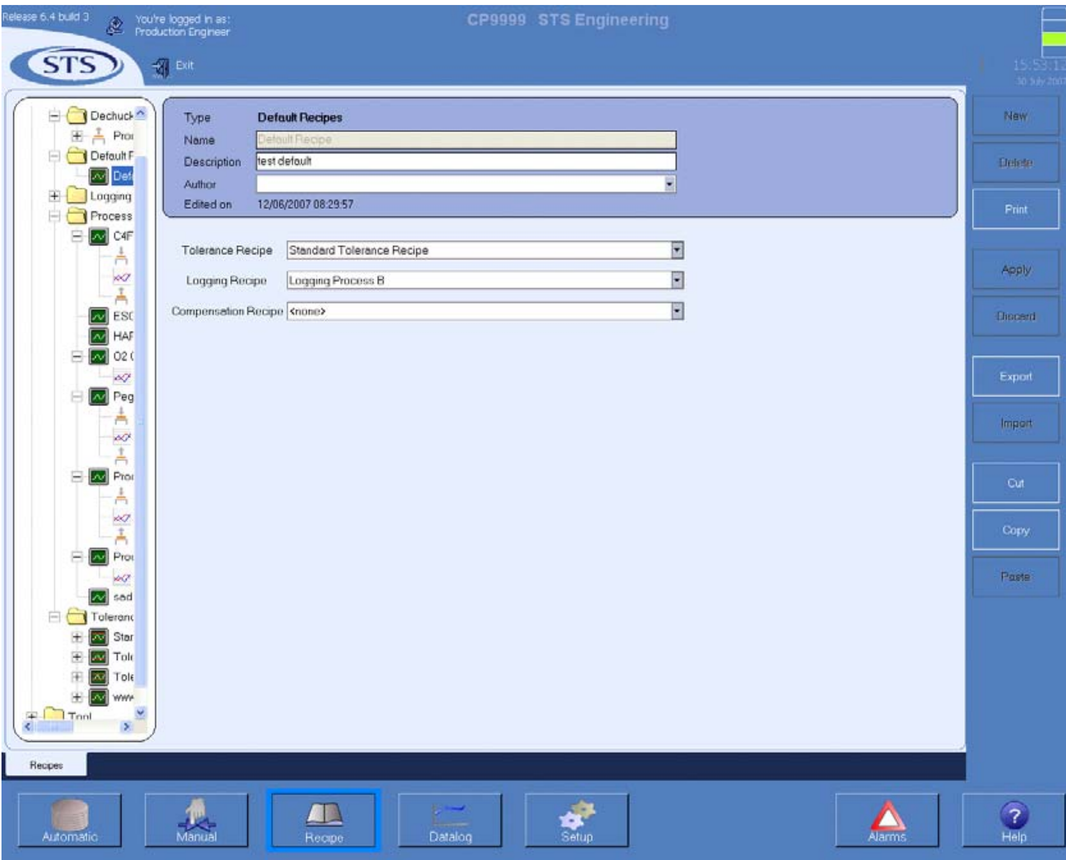


Figure 2.40 Typical Default Recipe

The tolerance, logging and compensation recipes can be selected from the drop down menus within the default recipe window.

Field	Description
Description	Enter a description for the recipe.
Author	Enter the name of the recipe's author.

2.9.1.3 Logging Recipes

Various parameters can be recorded during substrate processing. Examples include coil power, platen power & bias, APC position & pressure, backside gas cooling, chamber heating, gas flows, etc. A logging recipe specifies which of these parameters is recorded and the recording method.

A default logging recipe can be defined that will be used when a process recipe does not reference a specific logging recipe.

For display purposes, logging recipes group variables into their relevant sub-system classifications. A logging recipe can be linked to process module recipes (see 2.9.1).

Continuously variable data is logged in one of two ways:

- on change (default) - data is logged on change. The minimum and maximum logging periods are 500ms and 3600s. The default settings are 0.1% of full scale - 1s minimum and 60s maximum
- periodic - data is logged at a pre-defined time, which can be set between 500ms and 3600s.

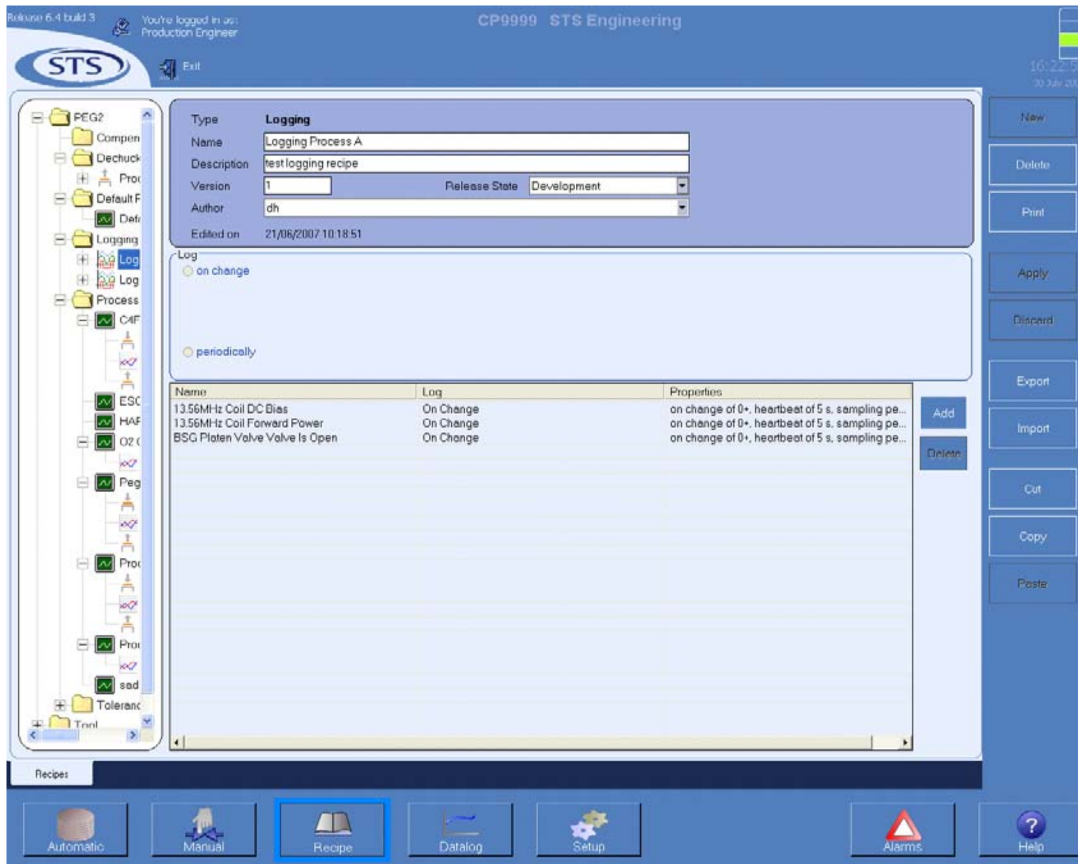


Figure 2.41 Typical Logging Recipe

The following are available when viewing a logging recipe:

Logging Parameter	
Parameters	Select the required machine event.
Logging Mode	• On Change • Periodically
Log On Change	
Change	Enter the minimum value for the change, before the event is logged.

Sampling Period	Enter the frequency in seconds the value is logged.
Heartbeat	Enter the time the value is logged, should no value change occur.
Periodic	
Period	Enter the sample time period the value is logged for.

Only one logging recipe, per module, can run at any one time.

2.9.1.4 Tolerance Recipe

A tolerance recipe defines the tolerances, error and alarm bands, trip levels and timeouts to be applied to measured values for a standard material process step when the recipe is loaded (see 2.9.1.1.2). The tolerance is specified at the lowest level (device level) where the set-point and measured value are controlled.

A default tolerance recipe can be defined that will be used when a process recipe does not reference a specific tolerance recipe.

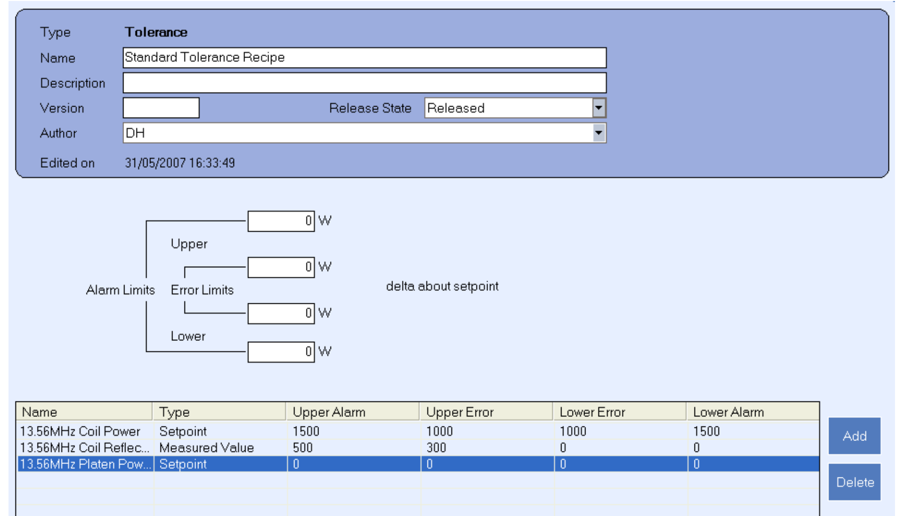


Figure 2.42 Typical Tolerance Recipe

The following buttons are available:

Button	Description
Add	Adds a new parameter to the tolerance recipe.
Delete	Deletes a parameter from the tolerance recipe.

The following values are available when viewing a tolerance recipe:

Tolerance Parameter	
Error Limits	The value for the selected parameter that is the upper and lower error limit.
Alarm Limit	The value for the selected parameter that is the upper and lower alarm limit.

Every process recipe and process recipe step contains a reference to a tolerance recipe. The tolerance recipe is loaded at the time the recipe is loaded and governs the raising of error conditions while the recipe is running.

2.9.1.5 Dechuck Recipe

A dechuck recipe is used to remove any residual charge build up that may be on the ESC after processing. It is comprised of standard material process steps. This recipe is chosen within the Declamp Substrate step (see 2.9.1.1.18).

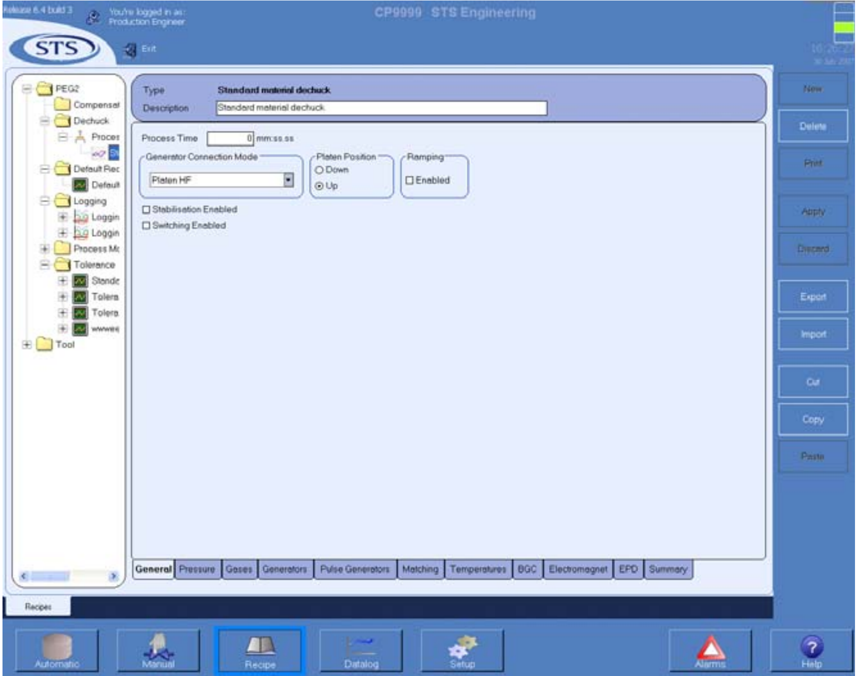


Figure 2.43 Typical Dechuck Recipe

Refer to 2.9.1.1 for further information on the standard material process steps.

2.9.1.6 Compensation Recipe

A compensation recipe is used to standardise a process across different process chambers. Each process chamber may produce slightly different results for a given process recipe. In order for the recipe to produce the same results in a different chamber, the process recipe values may need to be amended depending on which process module is being used. The value can be amended either by a multiplier (for example 10%) and/or by an offset (for example 20 Watts).

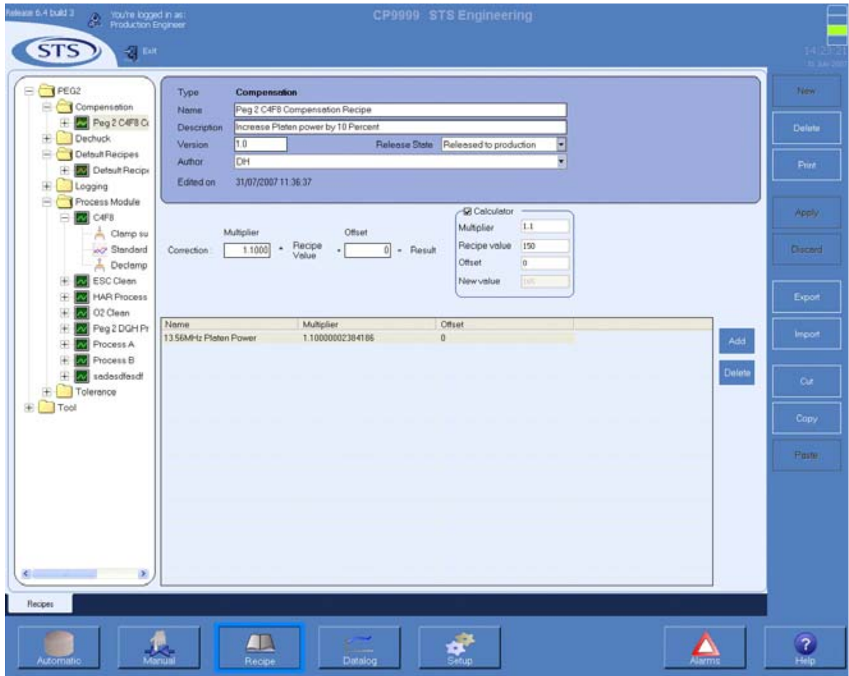


Figure 2.44 Typical Compensation Recipe

The following are available from the **Compensation Recipe** window:

Field	Description
Multiplier	The scaling factor by which the parameter will be multiplied.
Offset	The amount to be added to the parameter's recipe value.
Calculator	The calculator block provides an method of viewing the actual value to be applied. For example: If the multiplier = 1.5, the recipe value = 23, and the offset = 10 The new value applied = 44.5.

2.9.2 Tool Recipe

The tool process recipe defines the substrate processing order and recipes used during a processing sequence. The recipe consists of an ordered list of processing steps. Each step comprises of a substrate location with optional process module process recipes (see 2.9.1).

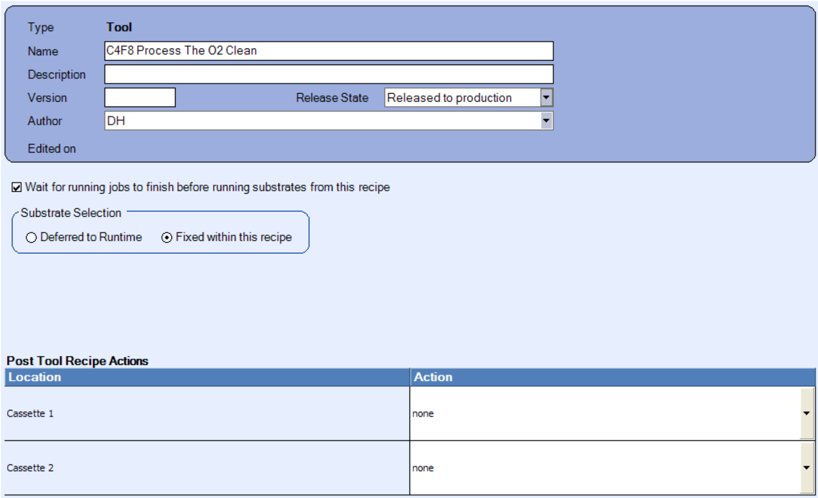


Figure 2.45 Typical Tool Recipe

The following are available when creating a tool recipe:

Recipe Type	The recipe type corresponds to the open folder displayed on the left of the screen.
Recipe Name	The recipe name is user-defined and can be a maximum of 50 characters.
Recipe Description	The description is entered by the user to give an overview of the function of the recipe.
Recipe Author	The engineer who created the recipe; this field can be a maximum of 50 characters.
Recipe Version	The version number can be up to five characters, in the form "##.##". The version number is not incremented automatically. The version control is the responsibility of the recipe's author.
Edit Date	The last time the recipe was edited.
Release State	Select the release state of the recipe from the drop down box.
Wait for running jobs to finish...	When ticked, this recipe will not run until any running tool recipes have finished.
Substrate Selection	Defines when to choose the substrates to be processed: Deferred to Runtime: The substrates are transferred as specified when the batch process is defined (see 2.7.1.1). Fixed with Recipe: The substrates are transferred as stated in the recipe.
Post Tool Recipe Actions	Allows the user to set the actions which occur after the process has finished: Vent the cassette, Unload the cassette, None or Unload without prompts.

2.9.2.1 Tool Recipe Step

The Tool Recipe step identifies from which positions the substrates are loaded from and returned to within the handling system and the recipes that are run within the process chamber.

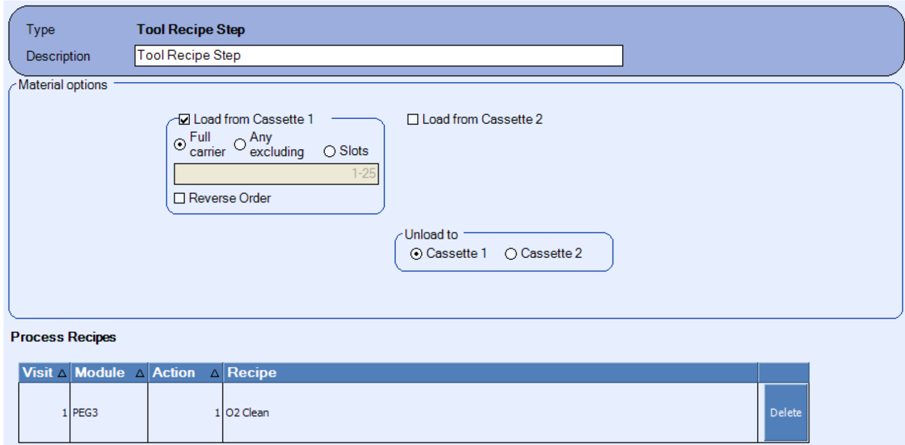


Figure 2.46 Typical Tool Recipe Step

The following are available when creating a Tool Recipe step:

Step	Description
Step Description	Enter a description for the step.
Material Options	
Load From	Enter the location from which the substrates should be loaded. Select the required radio button to select which substrates should be processed: Full Carrier - Uses all the substrates i.e. 1 -25 in a cassette, if the load positions do not contain a substrate the sequence will fail. Any Excluding - Uses any detected substrates except those specified here. Slots - Loads from the slots requested in the field located below. Select the reverse order check box to load the system in reverse order, e.g. the system will load substrate 25 first and substrate 1 last.
Unload to	Select the radio button for the destination of processed substrates.
Process Recipes	
Visit	Details the order in which the substrate is processed through the system.
Module	Details the process module in which the process will be performed.
Action	Details the order of the processes carried out in that module.
Recipe	The name of the recipe to be used.
Delete	Deletes the recipe.
Add	Adds a new recipe.

For more information on using the tool recipe step refer to Chapter 3.

2.9.2.2 Tool Recipe Interstep

A tool recipe interstep allows a specific process, e.g. a clean process, to be run after a specified number of wafers.

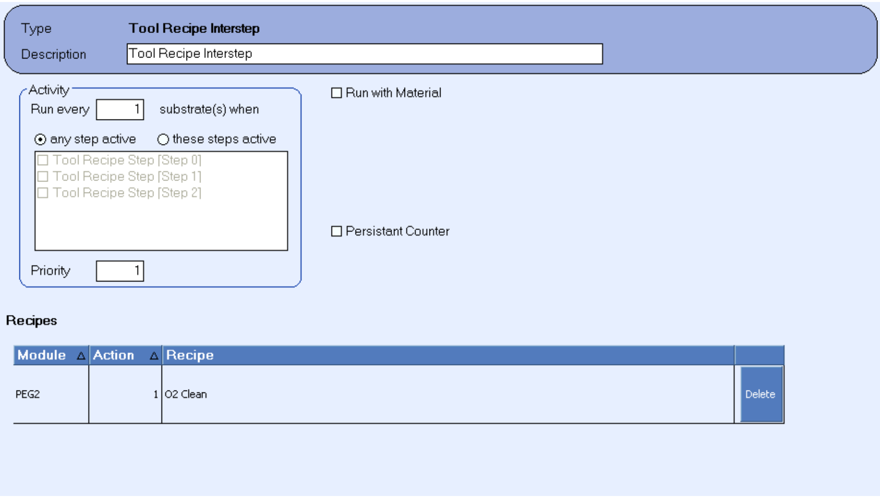


Figure 2.47 Typical Tool Recipe Interstep

The following are available when creating a tool recipe interstep:

Step	Description
Description	Enter a description of the step.
Job Definition	
Run Every	Enter the number of substrates to be processed before carrying out the tool process interstep.
Any Step Active/ These Steps Active	Select a radio button to select whether the interstep is to be run after a number of specific process steps, or after a number of any process steps.
Priority	Enter a priority for the interstep, 1 being the highest priority. Priorities are set so if two or more tool recipe intersteps conflict by being scheduled to run at the same time, the step with the highest priority will be run.
Run With Material	Select this check box if the tool recipe interstep is to be run with a substrate in the chamber. Select the radio button to select where the substrate is to be loaded from and from which slot number.
Persistent Counter	When unchecked, the substrate count is reset after each tool recipe. When checked, the substrate count is not reset and is stored with the specified name. For example, if a clean was required every three substrates and the cassette contained five, then three substrates would be processed then a clean would happen then the final two substrates would be processed. The tool recipe would finish and a new cassette would load. Three further substrates would be run before cleaning. Therefore a run of five substrates would be processed in the chamber before cleaning if the persistent counter was not used.
Recipes	
Module	Details the process module in which the process is to be carried out.
Action	Details the order of the processes carried out in that module.
Recipe	The name of the recipe to be performed.
Delete	Deletes the recipe.
Add	Adds a new recipe.

2.9.2.3 Pre and Post Process Recipes

The pre and post recipe options allows a specific process, e.g. a clean process, to be run before or after all other processing has been completed.

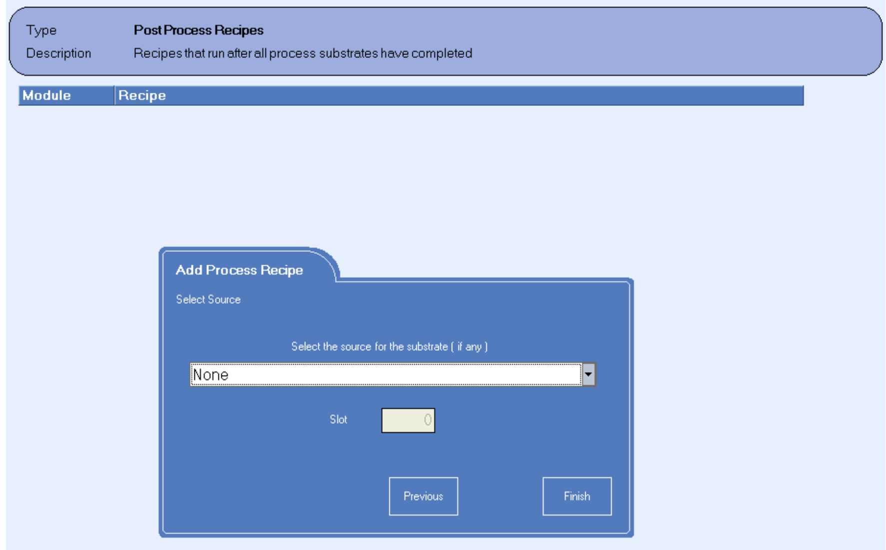


Figure 2.48 Typical Tool Recipe Pre and Post Recipes

The following are available when creating pre and post recipes:

Step	Description
Type	Describes either the pre or post recipe step.
Description	Shows a description for the step.
Module	Details the process module in which the process is to be carried out.
Recipe	The name of the recipe to be performed.
Delete	Deletes the recipe.
Add	Adds a new recipe.

2.9.2.4 Recipe Validation

Each process recipe is validated on creation. Should the recipe fail validation, an error message is displayed and an explanation of the error can be found by clicking on the validation tab at the top of the window. This is available from the splash screen by clicking on a folder node.

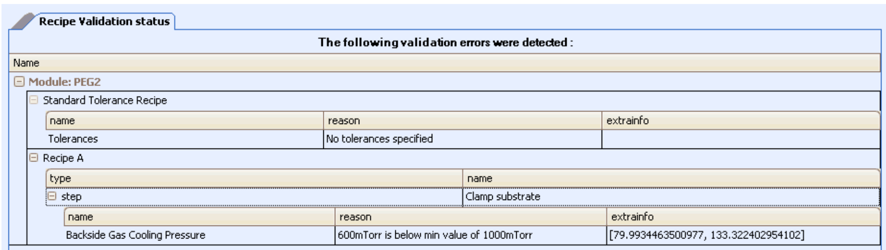


Figure 2.49 Recipe Validation

2.10 Datalog

The **Datalog** button opens the **Data Viewer**. From here the data parameters chosen by the logging recipe can be viewed. The data logger records two types of information: events and data.

- Events - an event is defined as any discrete action on the tool, for example, the opening or closing of control valves, the issuing of an alarm or error, etc. Events may also have data associated with them which is logged with the event. For example, a "pump to base" event records how long it took to reach base pressure
- Data - data is any continuous variable whose value is sampled on a time basis; these parameters are generally associated with the system's modules

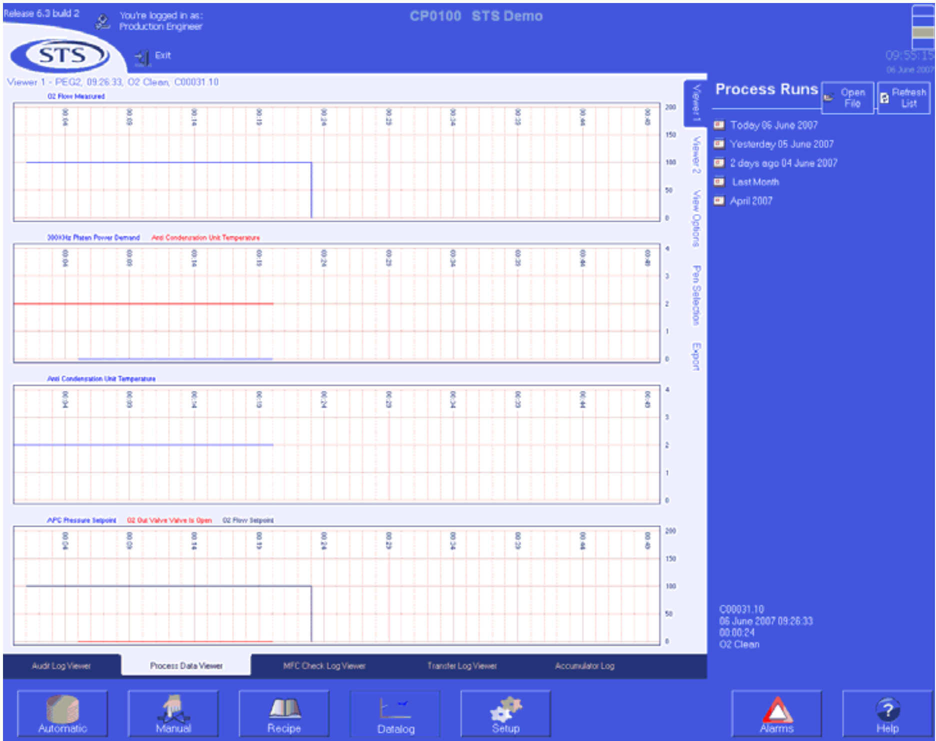


Figure 2.50 Typical Data View

Tabs available from this view are:

- **Process Data Viewer**
- **Audit Log Viewer**
- **Transfer Log Viewer**
- **Accumulator Log Viewer**
- **MFC Check log Viewer**

Note: *Data is only logged if that parameter is set under the logging tab (see 2.9.1.3).*

2.10.1 Process Data Viewer

Each data log is comprised of the parameters chosen to be logged in the logging recipe. Each parameter can be displayed as a graph. The actual parameter to be displayed is chosen using the Pen Selection tab on the command panel.

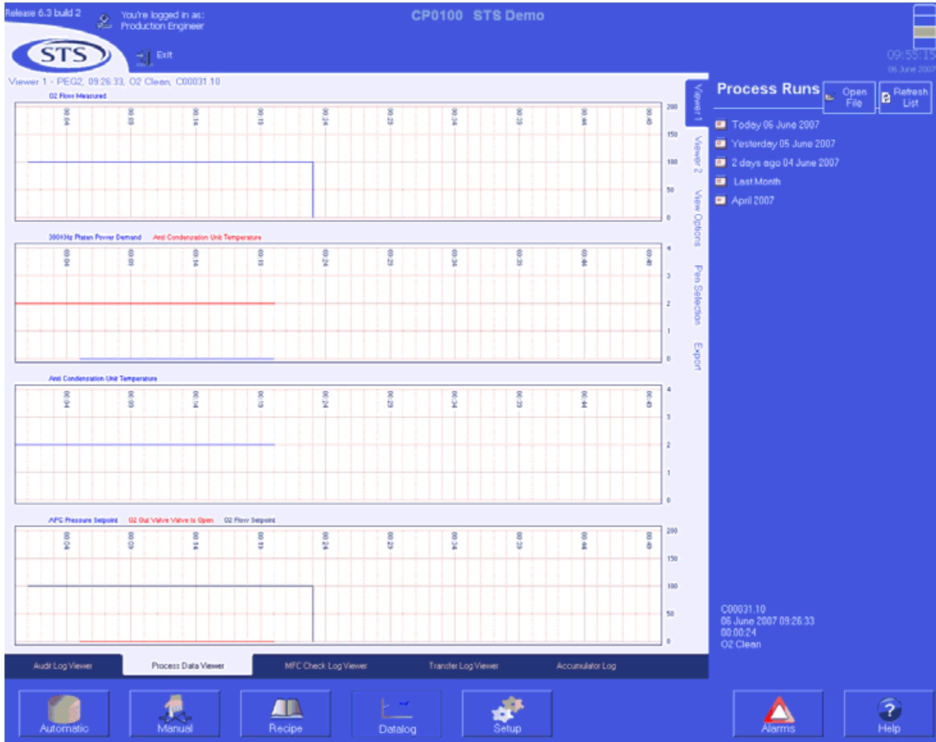


Figure 2.51 Typical Process Data Viewer View

The datalog to be viewed is selected using the command panel. However, an imported data log can also be viewed by using the **Open File** button and navigating to the desired log.

Tabs available on the command panel are:

- **Viewer 1**
- **Viewer 2**
- **Viewer Options**
- **Pen Selection**
- **Export**

2.10.1.1 Viewer 1

The process data viewer 1 allows the user to view data from a selected date/time on the command panel in graphical form.

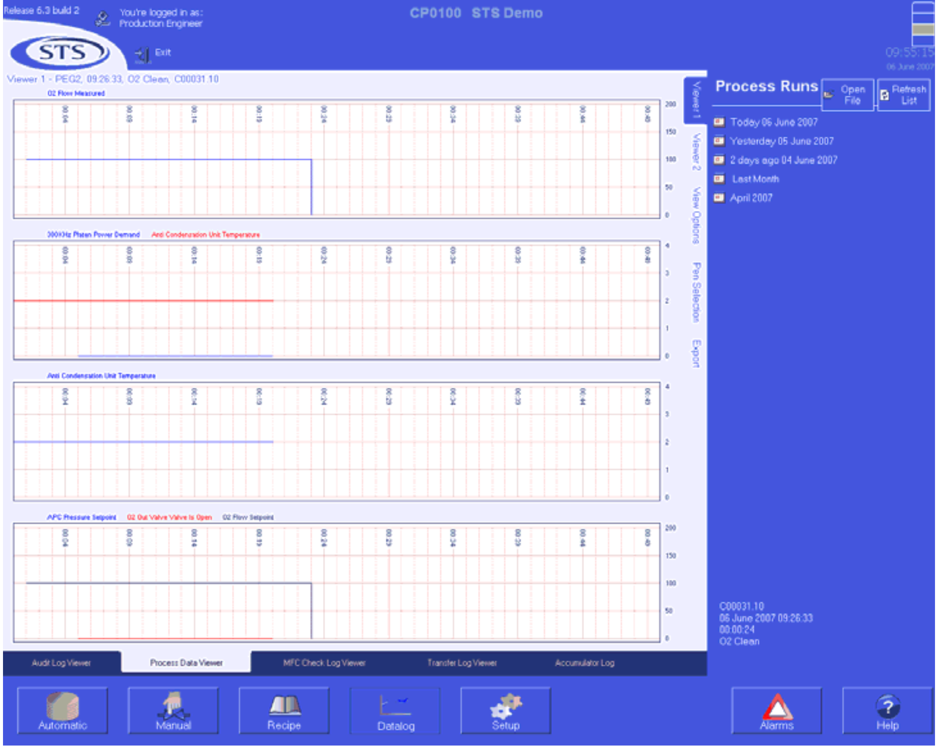


Figure 2.52 Typical Viewer 1 View

To display the required data the user must select the required date from the available dates in the command panel or use the **Open File** button to choose an imported data log.

> ***Note:*** *The navigation panel can display 1- 4 graphs. To change the number of graphs displayed select the view options tab.*

To change the information displayed within the graph use the pen selection tab in the navigation panel.

2.10.1.2 Viewer 2

The process data viewer 2 allows the user to view a second data log. This is useful when comparing parameters from run to run.

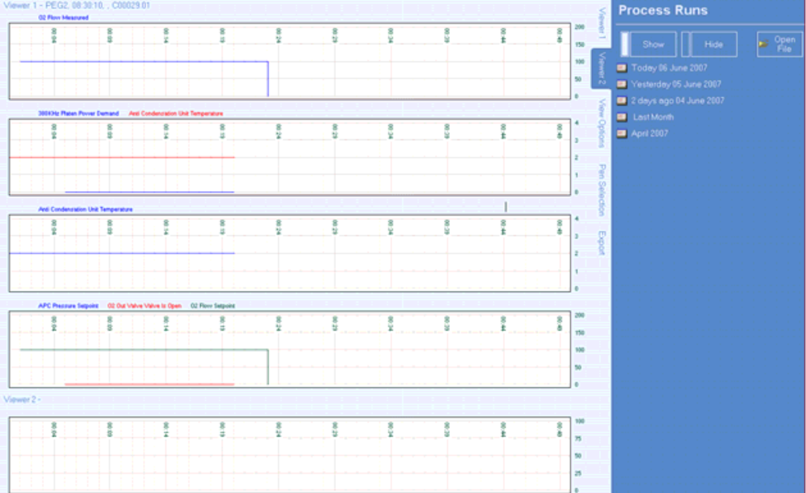


Figure 2.53 Typical Viewer 2 View

2.10.1.3 View Options

The view option allows the user to define the information displayed in the process runs view.

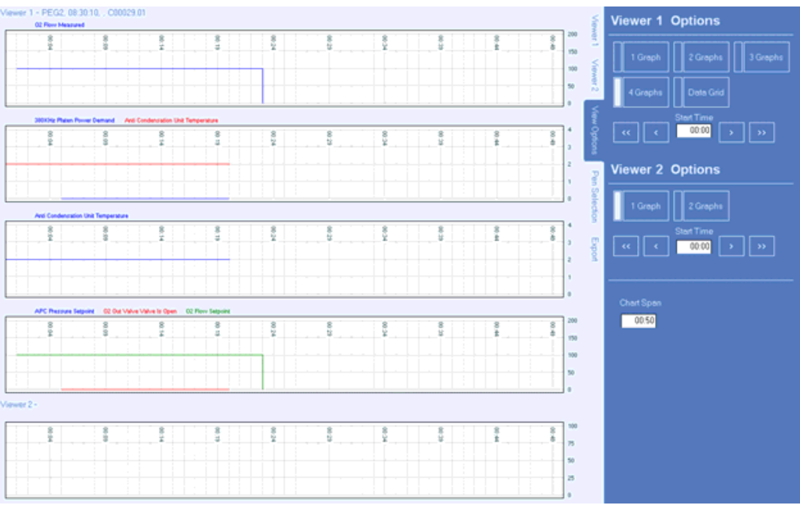


Figure 2.54 Typical View Options View

The display is changed by using the buttons located in the command panel:

Button	Description
One Graph	Displays one graph on the screen.
Two Graphs	Displays two graphs on the screen.
Three Graphs	Displays three graphs on the screen.
Four Graphs	Displays four graphs on the screen.
Data Grid	Displays the data as a grid.

The following text fields are located in the command panel:

Chart Span	Enter the time the chart display covers.
Start Time	Enter the time from the start of the process when the chart's display starts.

2.10.1.4 Pen Selection

The Pen selection tab allows the user to select the data to be displayed.

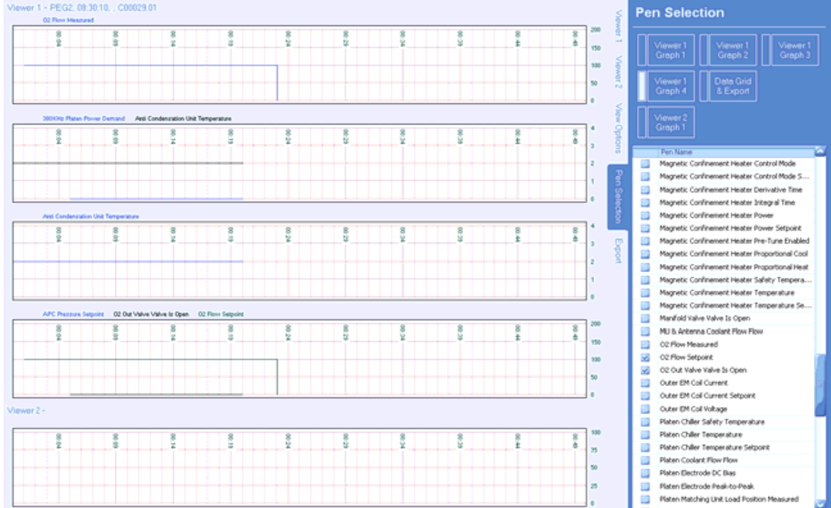


Figure 2.55 Typical Pen Selection View

The display is changed by using the buttons located in the command panel:

Button	Description
Viewer/Graph	Select the viewer and graph for which the pen selection is to be made.
Pen Name	Select the check boxes for the pens which are to be displayed on the selected viewer and graph.

2.10.1.5 Export

The **Export** tab allows the user to export the data in a '.CSV' (Comma Seperated Variable) format.

Figure 2.56 Typical Search View

The following options are available when exporting the data:

Step	Description
Options	Select whether to export the current viewer file or multiple files.
Pen Selection	Select whether to export all the available pen selections or only the selected pens (filtered).
Export Format	Select whether to export the data in a column or row based format.

The following drop down fields are located in the command panel:

Time Base	Enter the period of interpolation for a row based export format. Column-based datalogs record changes when an event happens Row-based datalogs will record data values at regular intervals. This field enables the time intervals to be defined.

Select the export button to export the data. After selecting the export button, a pop-up directory dialog enables you to name the file and define the export location.

2.10.2 Audit Log Viewer

The audit log viewer allows the user to view machine operations in a tabulated text format on a selected date.

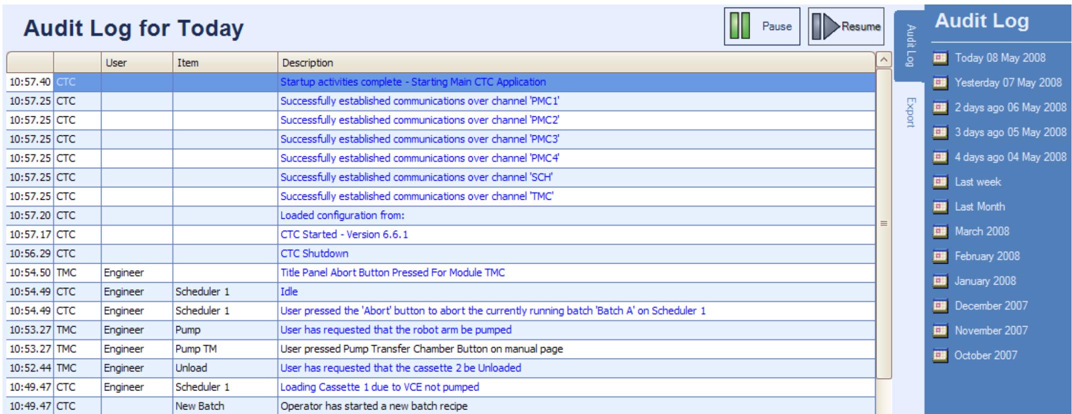


Figure 2.57 Typical Audit Log Viewer View

To display the required data the user must select the required date from the available dates in the command panel. The data is displayed in tabular form within the navigation panel.

The following buttons are available in the navigation panel:

Button	Description
Pause	Pauses the data flow.
Resume	Resumes the data flow.

The user can configure how the data is displayed by filtering the information using the drop down menu in the column header:

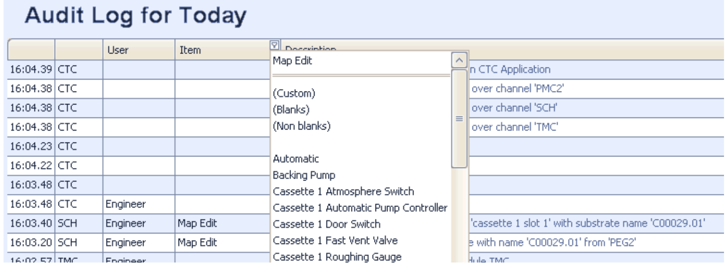


Figure 2.58 Typical Audit Log Filtering

Each record is displayed in one of three colours. The colours represent the following conditions:

- Blue - Messages
- Green - Warnings (may have an adverse affect on the process)
- Red - Alarms (will stop the process)

Tabs available on the command panel are:

- **Export**

2.10.2.1 Export

The Export tab enables the user to export the audit log. The transfer log can be exported in either a ‘XLS’ or ‘CSV’ format.

2.10.3 MFC Check Log Viewer

The MFC check log viewer allows the user to view the results of previous MFC check operations (see Chapter 3).

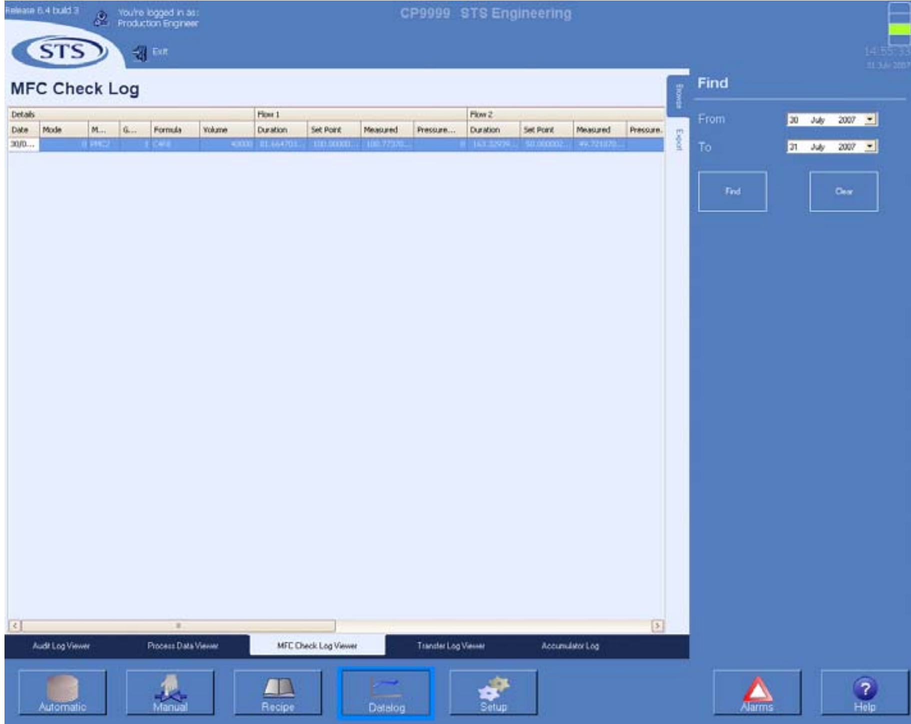


Figure 2.59 Typical MFC Check Log Viewer

The information displayed is as follows:

Date	The date of the MFC check.
Mode	MFC (0) or Volume Operation (1).
Module	Name of the Process Module.
Gasline	Name of the gasline.
Formula	Gas formula.
Volume	Chamber volume.
Duration	Duration (in seconds) of the flow test.
Set Point	Set MFC setpoint.
Measured	Measured MFC.
Pressure Change	The pressure change during the flow test.

Tabs available on the command panel are:

- **Browse**
- **Export**

2.10.3.1 Browse

The Browse tab enables the logs to be filtered by date. Select the ‘from’ and ‘to’ dates to display.

2.10.3.2 Export

The Export tab enables the user to export the displayed MFC Check logs. The log can be exported in either a ‘XLS’ or ‘CSV’ format.

2.10.4 Accumulator Log Viewer

Certain devices are monitored and their usage recorded by the system. For example, the RF running time for each generator or the number of pump starts, etc. These records can be viewed using the Accumulator log viewer.

Each record contains a user-amendable warning value that, when reached, will generate a pre-configured warning. For example, when the ‘Pump Run Hours’ warning value is reached, a ‘Perform Preventive Maintenance’ warning is displayed.

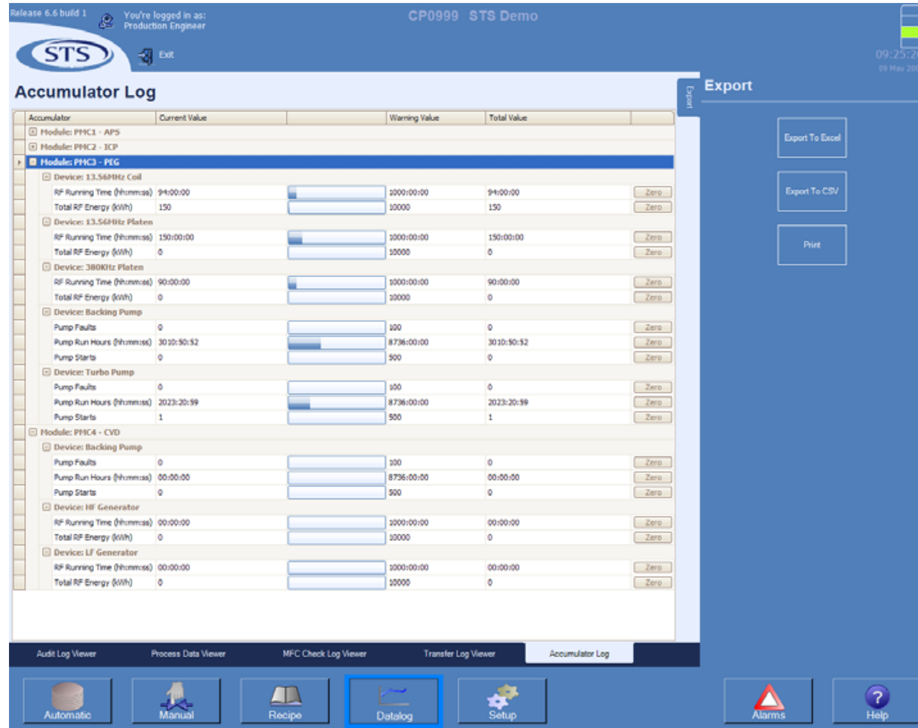


Figure 2.60 Typical Accumulator Log Viewer

The information displayed is as follows:

Device	The device being monitored
Accumulator	The parameter recorded.
Current Value	The accumulated value since last reset.
Warning Value	The value at which a pre-configured warning is displayed.
Total Value	The accumulated value since tool installation.
Zero	Resets the ‘Current Value’ counter.

2.10.4.1 Export

The Export tab enables the user to export the displayed Accumulator logs. The log can be exported in either a ‘XLS’ or ‘CSV’ format.

2.11 Setup

The **Setup** button opens the **Setup** view. This allows the user to define user profiles, user groups and user roles. The following can be carried out from this view:

- set-up users and groups
- configure users' roles
- configure the tool

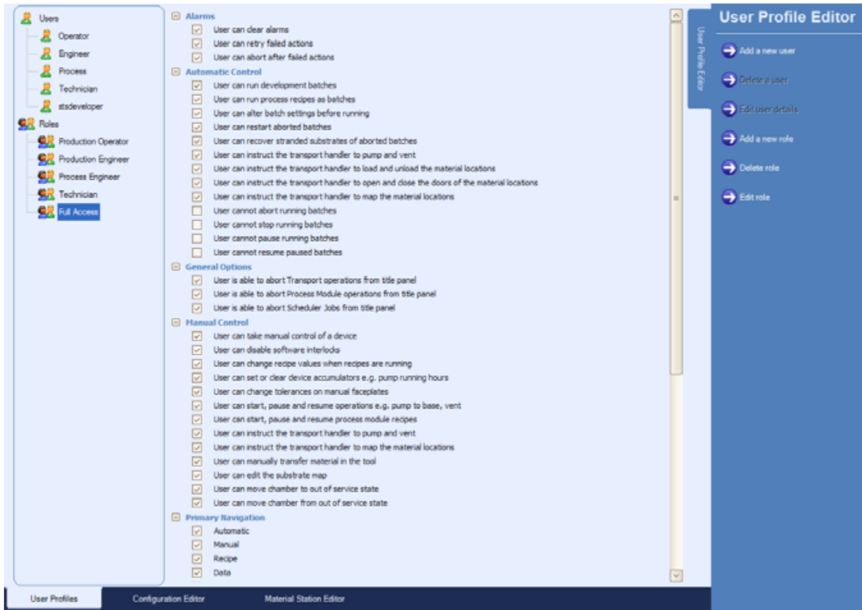


Figure 2.61 Typical Setup View

The following tabs are available from this view:

- **User Profiles**
- **Configuration Editor**
- **Material Station Editor** (Option)

Note: *The **Configuration Editor** tab enables the user to define various machine parameters. These parameters should only be amended by experienced system users and therefore this functionality is not covered in the Operator's Manual.*

Note: *The **Material Station Editor** tab enables the user to configure the system so that different sized substrates can be processed. This size change must only be done in consultation with STS and therefore this functionality is not covered in the Operator's Manual.*

2.11.1 User Profiles Tab

The **User Profiles** tab allows the user to amend users and their roles. Each user is assigned a role that defines permissions required to access various parts of the system. The same role can be assigned to many users so, for example, each production operator could be given a unique user name but all of these accounts could have the same role of 'Production Operator'. Therefore if a permission change were required then by altering the Production Operator role, all users with that role would be affected.

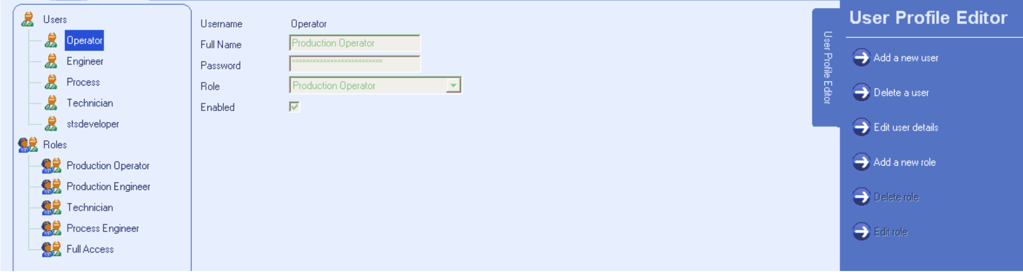


Figure 2.62 Typical User Profiles View

When adding and or amending users and their roles the following options are available in the command panel:

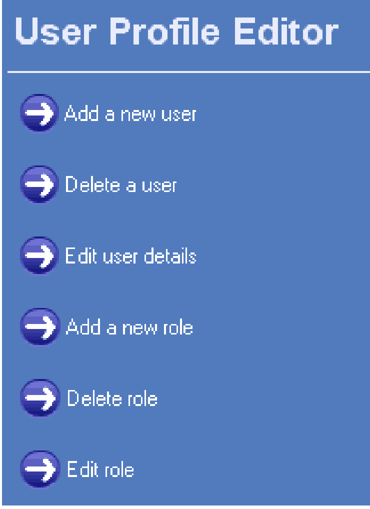


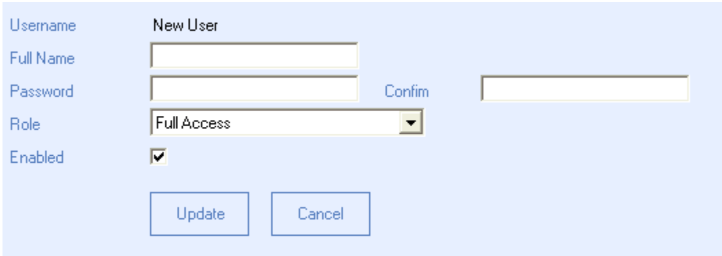
Figure 2.63 User Profile Editor

Note: *The availability of the options is dependant on the level of user logged in.*

2.11.1.1 Users

This section gives an overview of adding and deleting system users, modifying the user's details, plus setting the user's group membership.

When adding a user the following information must be entered:



Field	Description
User Name	Defines the name that the user will use to log in to the Tool Controller. The username must be unique and can be up to 30 characters in length.
Full Name	Defines the full name of the user.
Password	Defines the password that a user must input to access the Tool Controller. ***Note:*** *The password can have a maximum of 20 characters/digits.*
Confirm	Enter the same password as was entered into the password field.

<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td>Role</td><td>Every user is associated with a role. Role membership defines the access that the user has within the system. The roles available from the drop-down list are:

• Production Operator
The principal responsibility of a Production User is to process substrates through the tool. Ordinarily, Production Users only have access to this operation, plus functions relating to this operation. If a Production User encounters a problem, this is passed to an engineer-level user for resolving.
• Technician
Technicians qualify the tool following manufacture and have access to a wide range of functions. Operations available to the Technician include:
- accessing low-level hardware control
- running automatic processes
• Service Engineer
Service Engineers trouble-shoot, upgrade and maintain the tool and have access to a wide range of functions. Operations available to the Service Engineer include:
- accessing low-level hardware control
- creating and editing recipes
- running processes in manual and automatic modes.
• Process Development
Process Engineers develop and qualify the processing capability of the tool. Operations available to the Process Engineer include:
- creating and editing recipes
- running processes in manual and automatic modes
- viewing and analysing logs
- accessing low-level hardware control
Note: New groups cannot be added or deleted from the above groups.</td></tr>
</table>

2.11.1.2 Roles

Each role defines the access rights a user has to specific parts of the system.

Figure 2.64 Typical Roles View

The permissions for each role can be edited by checking or unchecking the check boxes and applying the changes.

2.12 Alarms

When running processes, alarms and errors may be generated by the system. Alarms are identified in the software as ‘exceptions’. These fault exceptions indicate abnormal occurrences within the system. Selecting the **Alarms** button, from the **Navigation** panel, opens the **Alarms** view. From this view exceptions can be managed and recovered from these conditions.

A red or yellow border around the **Alarms** button in the **Navigation** panel indicates that an alarm or error condition has occurred. Select the **Alarms** view to investigate the condition.

The **Alarms** button can display a yellow border indicating a new or unacknowledged error, or a red border indicating a new or unacknowledged alarm (a red border will be displayed to cover both events occurring simultaneously). If there are no alarms or errors present the **Alarms** button displays a blue border.

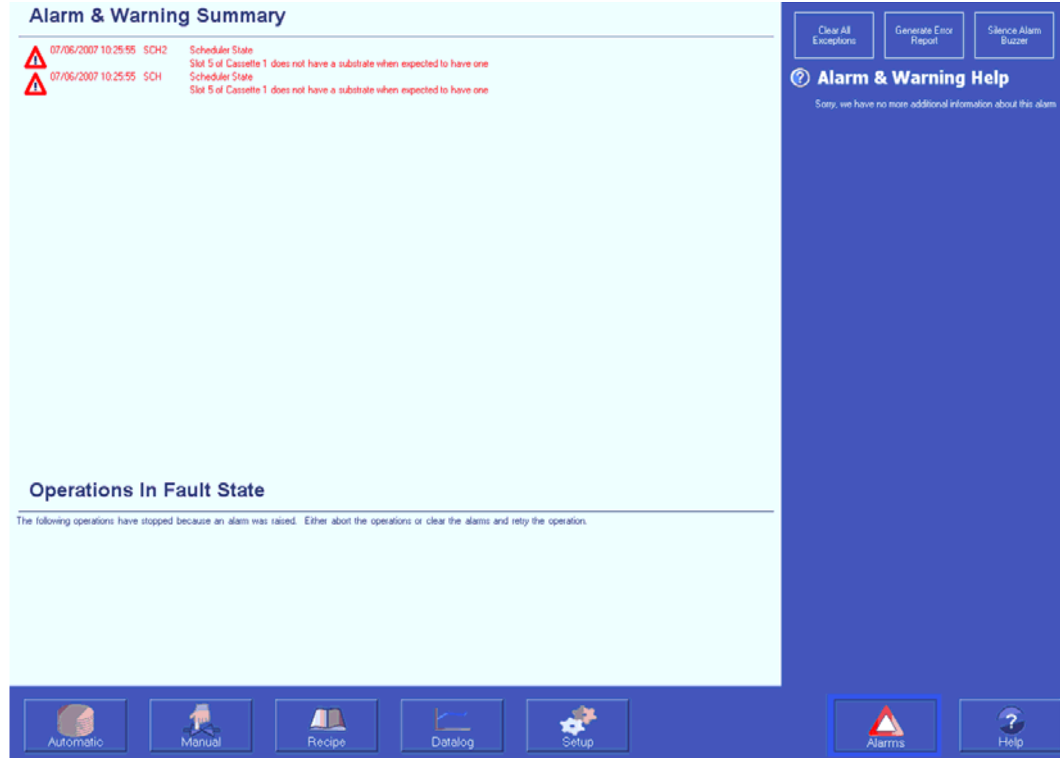


Figure 2.65 Typical Alarms View

The exception report includes:

- the date and time that the exception was raised
- the process or module that generated the exception
- description of the exception
- an exception code
- the severity of the exception (see below)
- access to the recovery actions associated with the exception

The following explains the colour-coding used to denote the severity of exceptions displayed on the **Alarms** view. Two types of exceptions are displayed: alarms and errors. Each exception has three state types:

- **In-exception** - an exception condition is present
  (red text - alarm, magenta text - error)
- **Out of exception** - the exception condition has been cleared
  (blue text)

- **Acknowledged** - the exception has been acknowledged, however, the exception condition is still present
  (purple text)

Following the discovery of the fault exception(s), the exceptions can be dealt with individually or collectively. An event is generated and logged in the database after acknowledging or selecting a recovery action. Refer to 2.10 for more information on the logging database. Following acknowledgement or selection of a recovery action, an event is generated which is logged in the database.

The following command buttons are available from the **Alarms** view:

Button	Description
Retry	Recovers the faults and attempts to continue the current task.
Abort	Recovers the faults and aborts the current task.
Clear Exceptions	Recovers the faults but does not abort or continue the current task.
Silence Alarm	Silences the audible alarm (if fitted).
Generate Error Report	Allows an error report to be generated before submission to STS (See 2.12.1).

2.12.1 Generating an Error Report

This button enables the user to generate an error report for submission to STS. Normally this will only be needed after a direct request from STS.

The STS Service Department will talk the user through the procedure for completing each of the report generation forms.

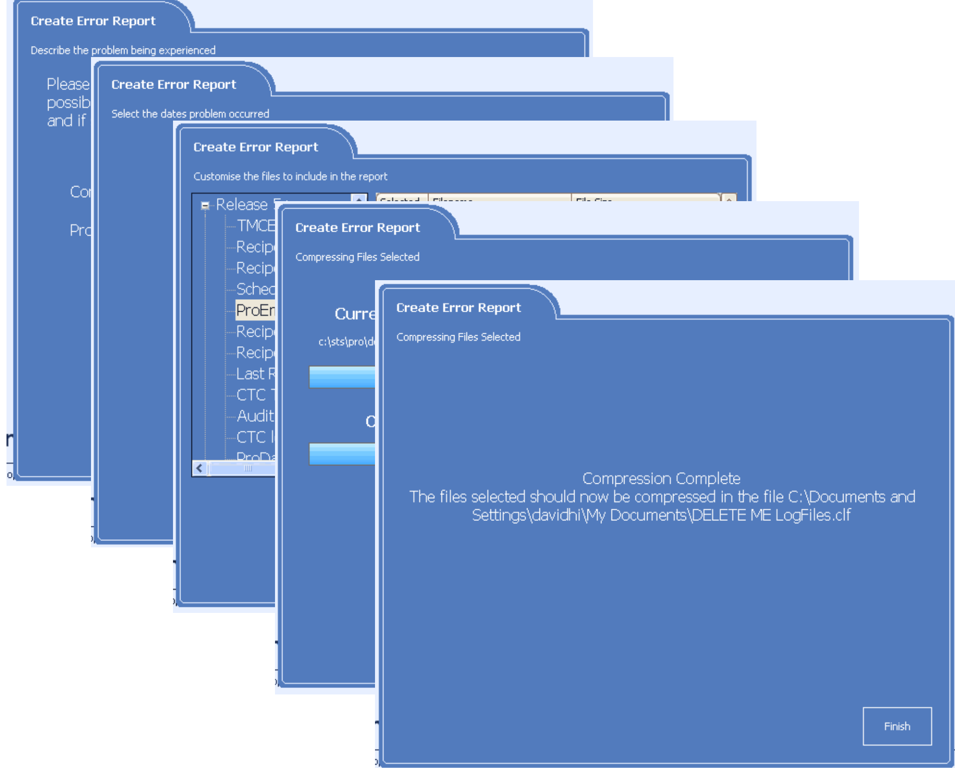


Figure 2.66 Error Report Forms

2.13 Help

The **Help** button enables the user to view the on-line manuals for the system.

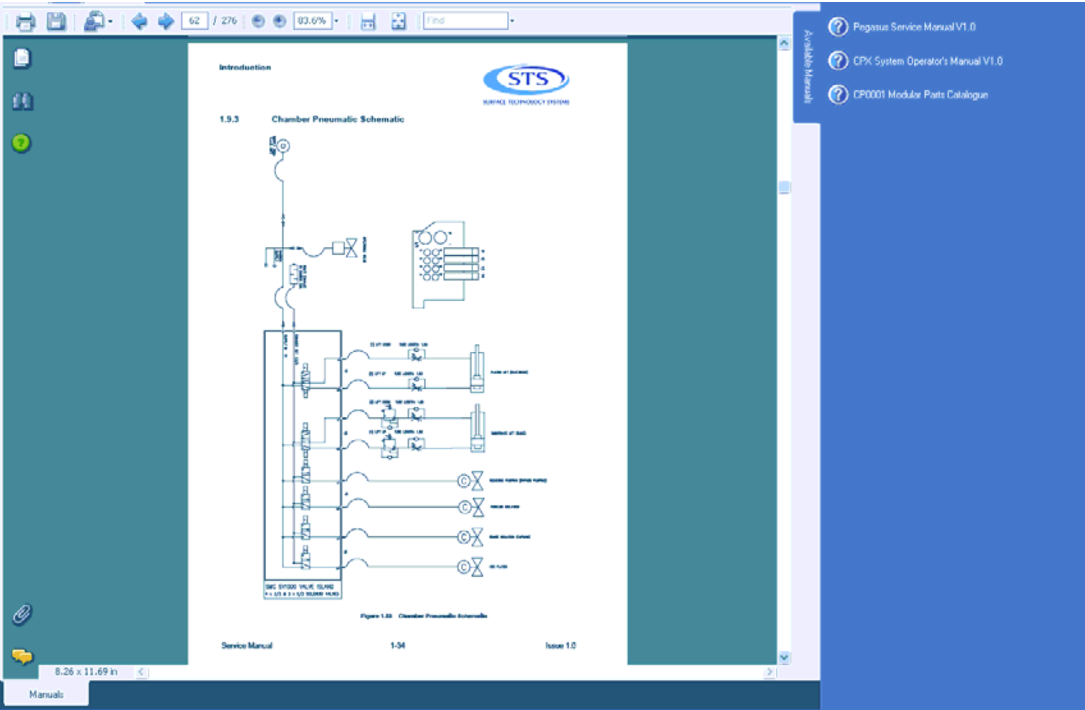


Figure 2.67 Help Screen

Chapter 3
System Operation

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3.1 Introduction

This chapter covers the operations available to system users. The actual operations available to a particular user will depend on their group membership.

3.2 General Information

This chapter assumes that the system has been correctly installed, all associated services have been checked and found satisfactory by an STS engineer or an approved STS representative and handed over to the operator in a safe condition.

PROCESS GASES MUST NOT BE RUN ON THIS SYSTEM UNTIL THE TEST CERTIFICATE HAS BEEN SATISFACTORILY COMPLETED.

THE SYSTEM IS DESIGNED AND TESTED ONLY TO USE THOSE GASES INDICATED ON THE SYSTEM AND THE ACCOMPANYING INSTRUCTIONS. MODIFICATION OF THE SYSTEM BY THE USER TO HANDLE DIFFERENT GASES AND/OR FLOW RATES MAY RENDER THE SYSTEM UNSAFE. REFER TO STS IF SUCH A NEED ARISES.

3.2.1 Group Membership

Every system user is associated with a group. Group membership defines the access that a user has within the system. Membership is explained in more detail below.

The four groups available are:

- Production Operator
- Technician
- Service Engineer
- Process Development

3.2.1.1 Production Operator

The principal responsibility of a Production User is to process substrates through the tool. Ordinarily, Production Users only have access to this operation, plus functions relating to this operation. If a Production User encounters a problem, this is passed to an engineer-level user for resolving.

3.2.1.2 Technician

Technicians qualify the tool following manufacture and have access to a wide range of functions. Operations available to the Technician include:

- accessing low-level hardware control
- running automatic processes

3.2.1.3 Service Engineer

Service Engineers trouble-shoot, upgrade and maintain the tool and have access to a wide range of functions. Operations available to the Service Engineer include:

- accessing low-level hardware control
- creating and editing recipes
- running processes in manual and automatic modes

3.2.1.4 Process Development

Process Engineers develop and qualify the processing capability of the tool. Operations available to the Process Engineer include:

- creating and editing recipes
- running processes in manual and automatic modes

- viewing and analysing logs
- accessing low-level hardware control

3.3 Starting-up and Shutting down the Software

This section describes the software start-up and shutdown procedures:

- Windows log in
- software start-up
- shutting down

3.3.1 Windows Log in

To start-up the system:

1. Switch on the PC and log in as **Administrator**.

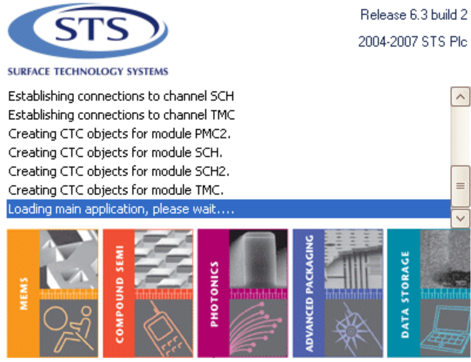
3.3.2 Software Start-up

After log in the CTC application must be started. When the Tool starts up, the system runs an initialisation routine. This routine performs the following functions:

- loads configuration data
- loads preferences and counters
- reads inputs
- starts the Tool Controller software
- displays the tool status
- where necessary, runs essential initialisation actions defined for specific devices

To start the system software:

1. Double-click on the CTC icon on the desktop. The STS splash screen is displayed.



2. When loaded, the mimic screen is displayed.

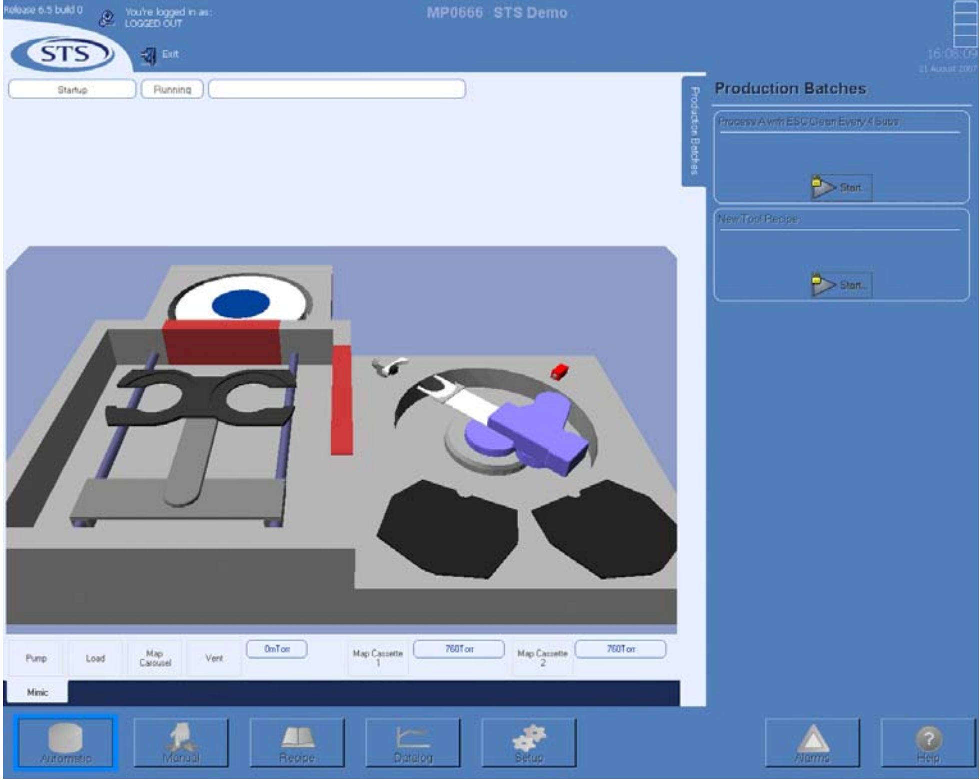


Figure 3.1 Typical Screen Following Initialisation

3. Click the **login** button to log in to the system.

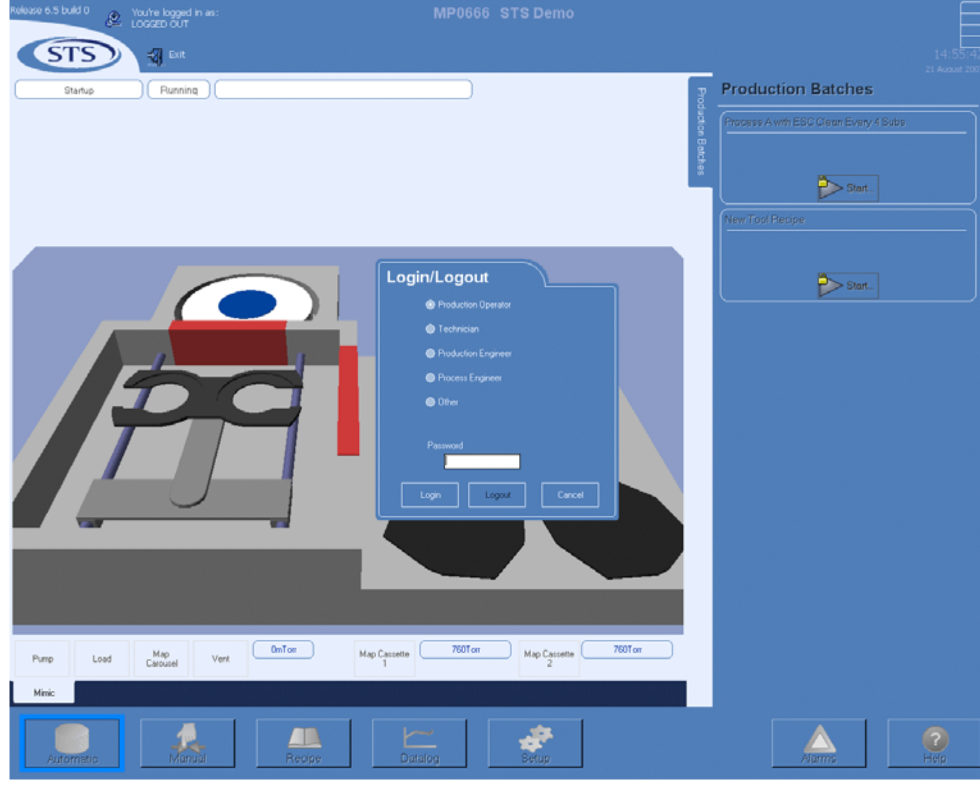


Figure 3.2 Typical Login Screen

4. Select the required operator mode (radio button) and enter the password.

3.3.3 Software Shutdown

To shut down the software:

1. From the title panel, select the **Exit** icon, refer to Figure 3.3.

   The Exit to Windows dialog is displayed with the following message:
   “Are you sure you want to exit?”.

2. Select the **Yes** button.

Note: *At this point the CTC application will close but other system applications (Recipe Downloader, Scheduler, Pro TMC and Datalogger) will remain active and can be found in the system notification area (system tray). To close these applications, complete the next step.*

3. Log off from Windows (either Start > Log Off or Start > Shutdown > Log Off depending on the Windows version).

Note: *This procedure will only close the software. To perform a full tool shutdown see Chapter 2.*

3.4 Logging-in and Passwords

3.4.1 Logging-in

To log-in:

1. Select the **Login** icon from the title panel.

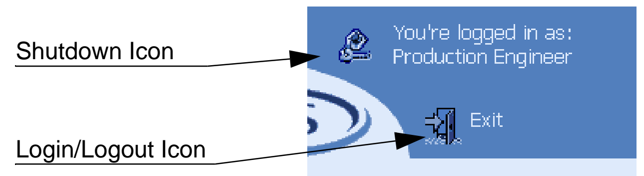


Figure 3.3 Login and Logout Icons

2. The Login dialogue is displayed, as shown in Figure 3.4.

Figure 3.4 Login Dialogue

3. Select the required operator mode (radio button) or other (key-in the user name).
4. Key-in the password.
5. Select the **Login** button.

3.4.2 Changing the Password

For security reasons, the password should be changed on a regular basis.

To change the password:

1. Log-in as described in para. 3.4.1, steps 1 to 5.
2. Select the user profiles tab and the edit user details button.
3. Enter the new password in the **Password** field.
4. Re-enter new password in the **Confirm** field.
5. Select the **Update** button.

3.4.3 Logging-out

To log-out:

1. Select the **Logout** icon from the title panel (see Figure 3.3).The Login dialogue is displayed, as shown in Figure 3.4.
2. Select the **Logout** button.

3.5 Production Batches

Production batches are used to run tool and process recipes on defined substrates. The user's profile restricts the available recipes in the following way:

- Production Operator
  Can only run tool recipes that have a status of 'Released to Production'.
- Technician and above
  Can run tool and process recipes that have a status of 'Released' or 'Released to Production'

3.5.1 Running Production Batches

To run a production batch:

1. Select **Automatic** from the navigation panel.

   The **Automatic** view is displayed.

2. Select the required recipe from the drop down list.
   Click on the desired process module button to see its associated process recipes:

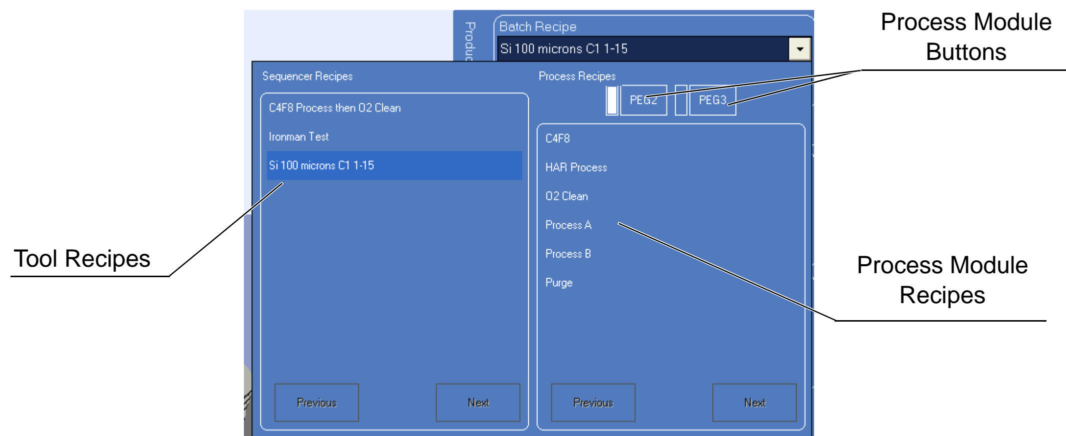


Figure 3.5 Typical Select Recipe Screen

3. Select the [button image] button, the **Batch Confirmation** dialog is displayed:

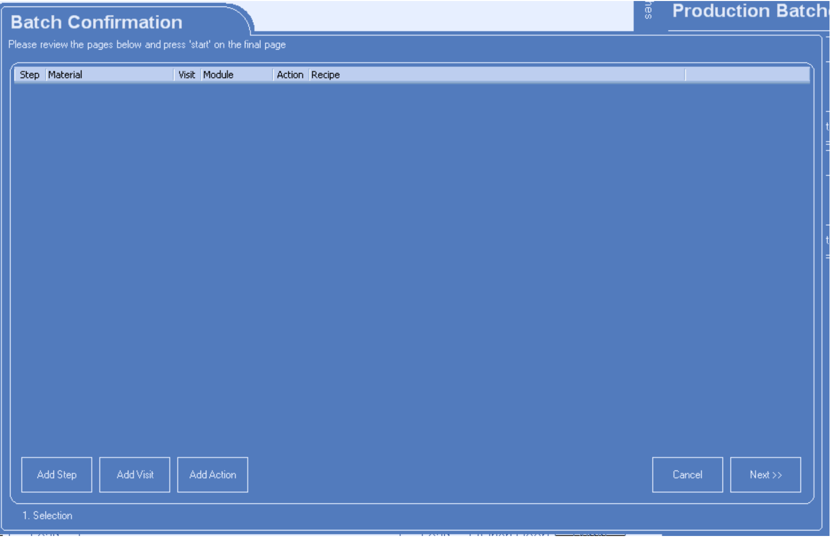


Figure 3.6 Batch Confirmation Dialogue

4. This dialog displays the substrate and processing options (if any) chosen using the recipe editor (see Chapter 2). If these options are correct then go to step 14.
5. Click on the **Add Step** button then click in the Material cell next to the new step.
6. The **Select Material Source** dialog is displayed.

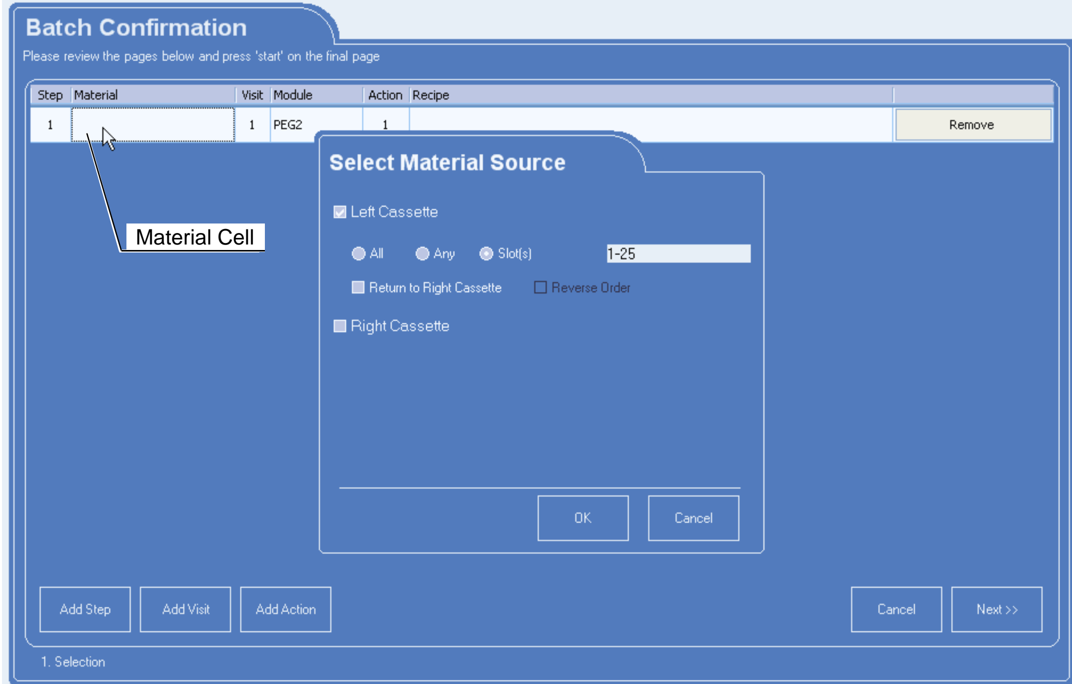


Figure 3.7 Select Material Source

Enter the substrate selection details as follows:

Left / Right Cassette	Select the checkbox against the source cassette
All / Any / Slot(s)	Enter the location from which the substrates should be loaded. Select the required radio button to select which substrates should be processed: All - Uses all the substrates i.e. 1-25 in a cassette, if the load positions do not contain a substrate the sequence will fail. Any - Uses any detected substrates. Slots - Loads from the slots requested in the field located below. Select the reverse order check box to load the system in reverse order, e.g. the system will load substrate 25 first and substrate 1 last.
Return to Right / Left cassette	Select this checkbox if the substrates are to return to the alternate cassette.

7. Click in the Recipe field and the Process Recipes dialog is displayed.

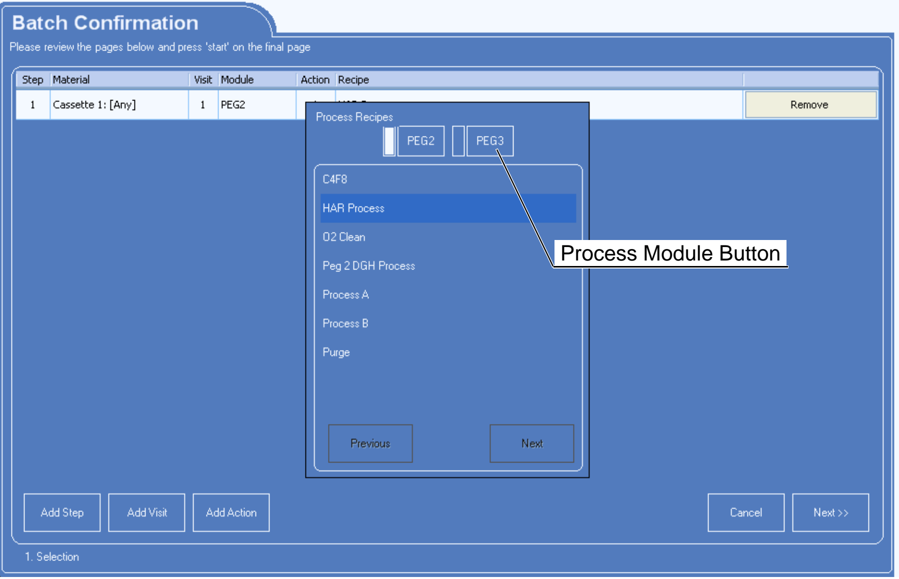


Figure 3.8 Process Recipes Dialog

8. Click on the process module button then select the required recipe.
9. If required, click the **Add Visit** button. A new visit is added to the current step.

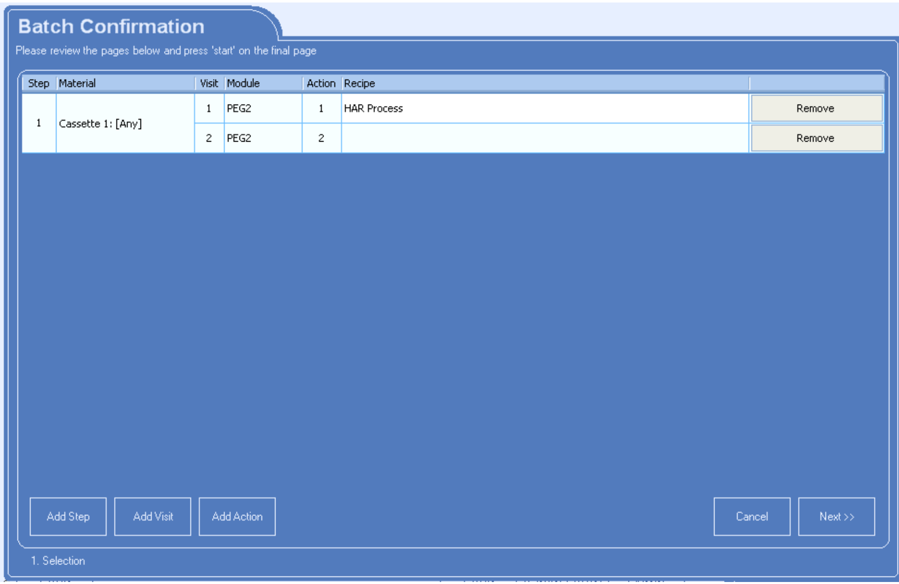


Figure 3.9 Add New Visit to Step

10. Click in the recipe field and choose a recipe for this visit.

11. If required, click the **Add Action** button. A new action is added to the current visit.

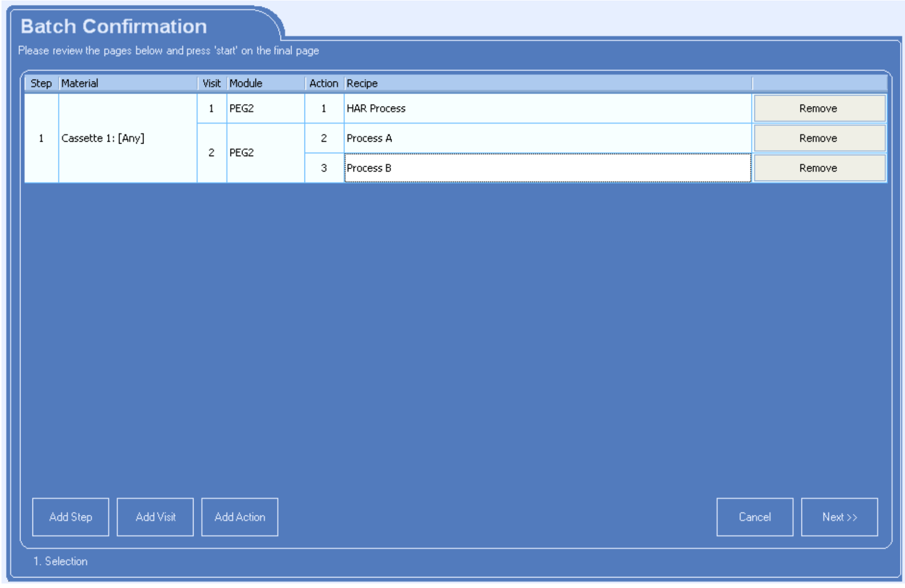


Figure 3.10 Add New Action to Visit

12. Click in the recipe field and choose a recipe for this action.
13. Continue to add steps, visits and actions until the sequence is complete.
14. When ready click the **Next** button
15. The final batch confirmation page is displayed:

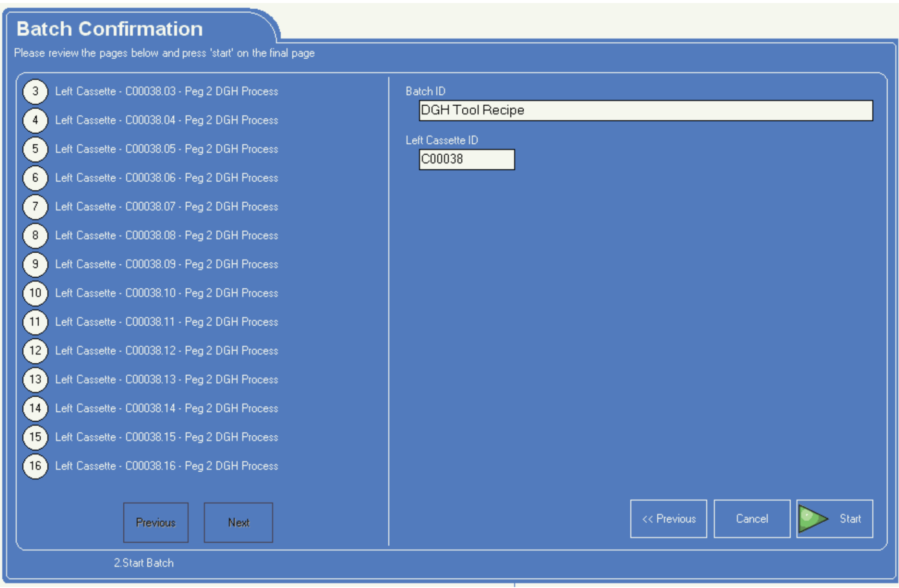


Figure 3.11 Confirm Batch Dialogue

16. Ensure the substrate information is correct and press start.
17. The batch will now start.

3.5.1.1 Stopping a Production Batch

Following a request to stop the current job, no new material can be processed, however, all material that is in mid-process continues to be processed and is returned to the specified destination.

For example, if the system is running a batch of 25 substrates, stopping the automatic process at the tenth substrate will result in the tenth substrate continuing to be processed until complete, however, an eleventh substrate will not be allowed to begin.

Note: *A stopped automatic process can not be restarted (refer to para. 3.5.1.3). To continue processing, a new automatic process must be started.*

To stop a production batch:

1. From the **Automatic** view, select the **Stop** button.

   The jobs stops at the end of the current action.

3.5.1.2 Pausing a Production Batch

This operation temporarily stops all, or the selected, production batches - all operations stop at the earliest point from where they can be resumed without adversely affecting the material that is being processed.

To pause a production batch:

1. From the **Automatic** view, select the **Pause** button.

   The job stops at the end of the current action.

Refer to para. 3.5.1.3 for instructions on re-starting the production batch.

Note: *If required, a paused job can be stopped (refer to para. 3.5.1.1) or aborted (refer to para. 3.5.1.4), instead of being re-started.*

3.5.1.3 Resuming a Paused Production Batch

This operation restarts the production batch following activation of the **Pause** button.

To resume a production batch:

1. From the **Automatic** view, select the **Resume** button.

   The job restarts.

3.5.1.4 Aborting a Production Batch

This operation terminates the currently running or paused production batch. All processing and material movement ceases immediately in a controlled and safe manner.

To abort a production batch:

1. From the **Automatic** view, select the **Abort** button.

   The jobs stops when it is safe to do so.

Note: *An aborted production batch can not be resumed (refer to para. 3.5.1.3). To continue processing, a new production batch a new process job must be started.*

3.6 Loadlock Operations

The following operations manage the loadlock.

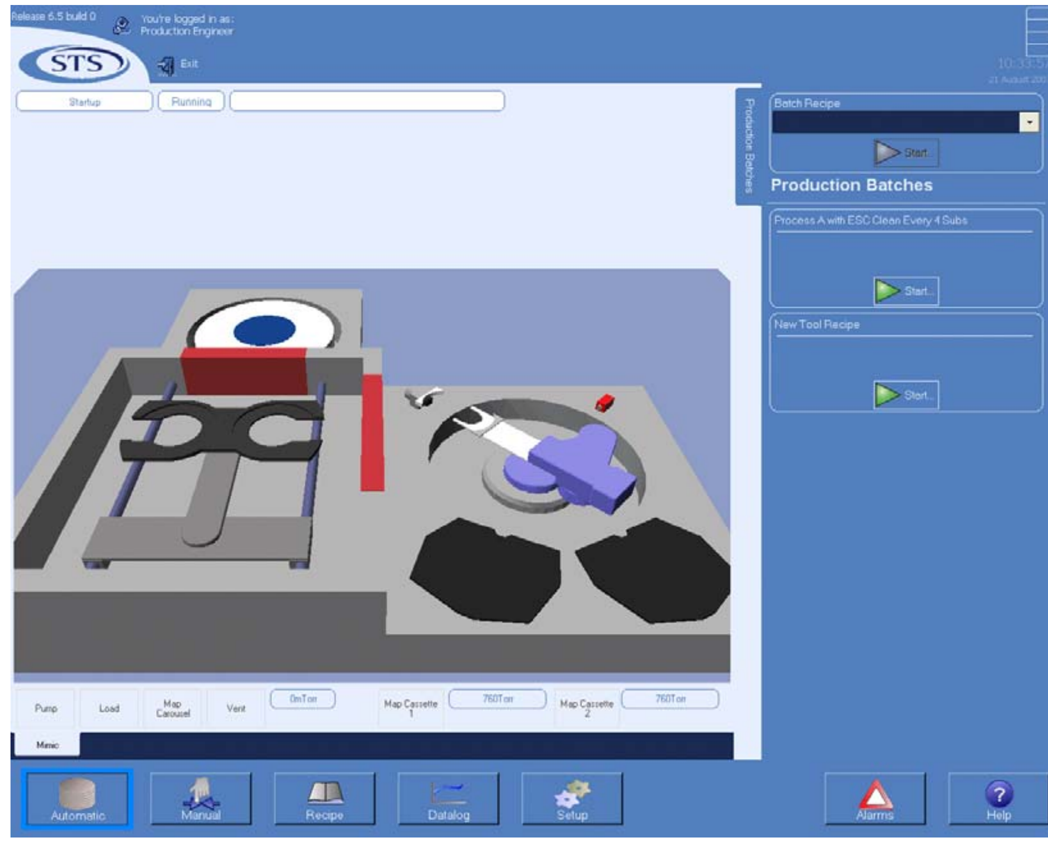


Figure 3.12 Typical Automatic View

The following loadlock operations are available:

Figure 3.13 Loadlock Operations

3.6.0.5 Pumping Down the Loadlock

This operation pumps down the loadlock to the pre-defined base pressure.

To pump down:

1. Select the **Pump** button.

Note: *The* sub navigation window *displays the pressure in real time until it reaches the pre-defined base pressure.*

3.6.0.6 Load

This operation down the loadlock to the pre-defined base pressure and maps the carousel.

3.6.0.7 Map Carousel

This operation maps the loadlock.

To unload a cassette:

1. Select the required loadlock.

2. Select the **Unload** button.

   The system checks for the presence of a cassette in the loadlock and whether the cassette is at vacuum. The system then vents the loadlock if required, automatically opens the loadlock door (CPX system only) and prompts the user to unload the cassette.

3.6.0.8 Opening and Closing the Loadlock Doors

This operation opens and closes the sliding loadlock doors, to remove or load substrates to and from the loadlock.

To open or close the loadlock:

1. Select the required loadlock.
2. Select the **Open/Close** button.

3.6.0.9 Pumping Down the Loadlock

This operation pumps down the loadlock to the pre-defined base pressure.

To pump down:

1. Select the required loadlock.
2. Select the **Pump** button.
3. The sub navigation window displays the pressure in real time until it reaches the pre-defined base pressure.

3.6.0.10 Venting the Loadlock

This operation returns the loadlock to atmospheric pressure, to remove substrates from the loadlock.

To vent the loadlock:

1. Select the required loadlock.
2. Select the **Vent** button.

Note: *The loadlock returns to atmospheric pressure. The sub navigation panel displays the pressure, in real time, until atmospheric pressure is reached.*

3.7 Manual Mode

The Manual mode allows devices to be driven manually by the operator to assist in fault finding operations.

THE MANUAL MODE ALLOWS INTERLOCKS TO BE OVERIDDEN. OPERATION BY UNTRAINED OR UNQUALIFIED PERSONNEL MAY LEAD TO PHYSICAL INJURY OR DEATH AND/OR DAMAGE TO THE EQUIPMENT.

The following options are available from the Manual view.

3.7.1 Transport Module

The following options are available from the Transport Module:

- Substrate Map Editor
- Substrate Transfer
- Carousel Operations
- Cassette Operations

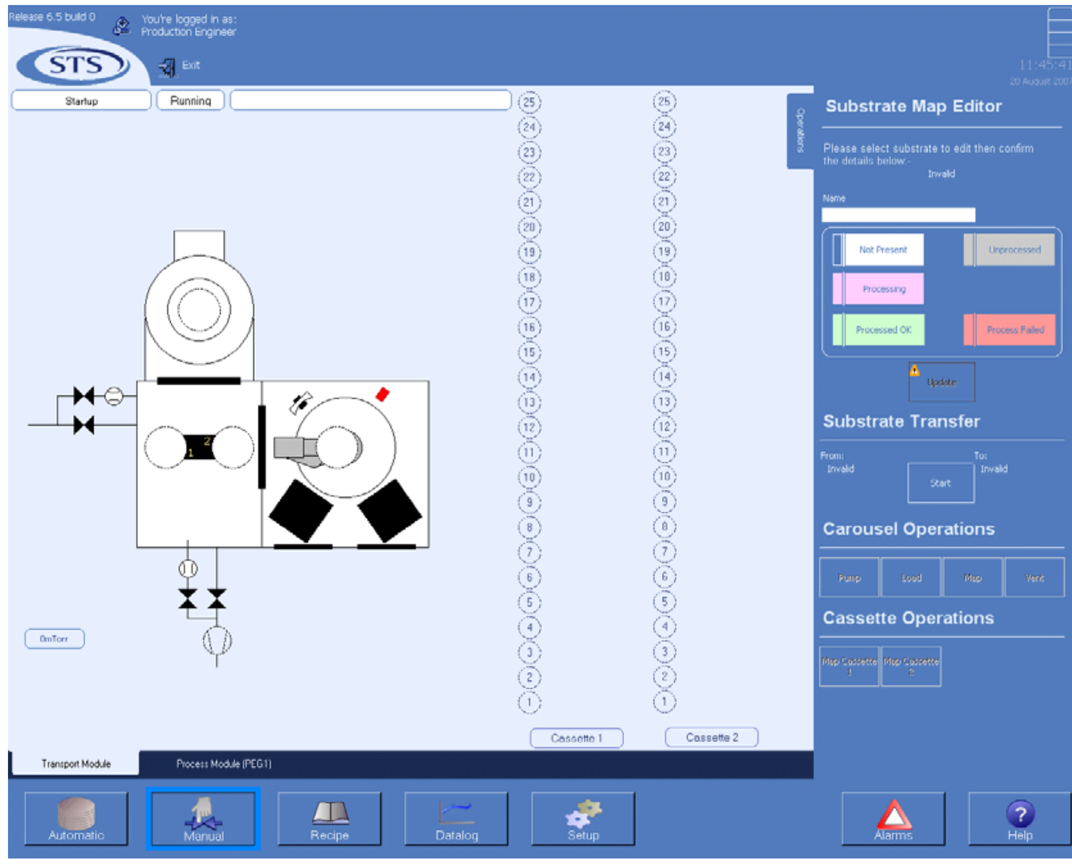


Figure 3.14 Typical Transport Mimic View

In addition, the movement of individual substrates can be accomplished by using the **Substrate Transfer** button (see 3.7.1.1).

3.7.1.1 Substrate Map Editor

The substrate map editor allows the user to manually create or delete substrates within the system. The map editor also enables the user to change the state of each substrate.

To edit a substrate:

1. From the **Manual** view, select the **Transport Module** tab.
2. Select the **Substrate Map Editor** tab from the command panel.
3. Select the substrate to be edited.
4. If the substrate is to be deleted, click **Not Present** button. If the substrate is to be created, use the status tick boxes to give the substrate a status.
5. Enter the substrate ID if required.
6. Select the **Update** button.

3.7.1.2 Substrate Transfer

This option allows the user to transfer substrates though the system.

Figure 3.15 Typical Transfer Substrate Window

To transfer substrates:

1. From the **Manual** view, select the **Operations** tab.
2. Click on the source substrate in the mimic.
3. Click on the destination in the mimic.
4. Select the **Start** button in the command panel.

3.7.1.3 Carousel Operations

This option allows the user to perform common handling operations on the carousel.

Button	Description
Pump	Pumps the loadlock down to transfer pressure
Load	Pumps the loadlock down to transfer pressure and maps the carousel
Map	Maps the carousel
Vent	Vents the loadlock to atmosphere

3.7.1.4 Cassette Operations

This option allows the user to perform common handling operations on the cassette.

Button	Description
Map Cassette 1	Maps the first cassette
Map Cassette 2	Maps the second cassette

3.7.2 Process Chamber Operations

Note: *If permissives are unhealthy the requested operation will be unable to be started.*

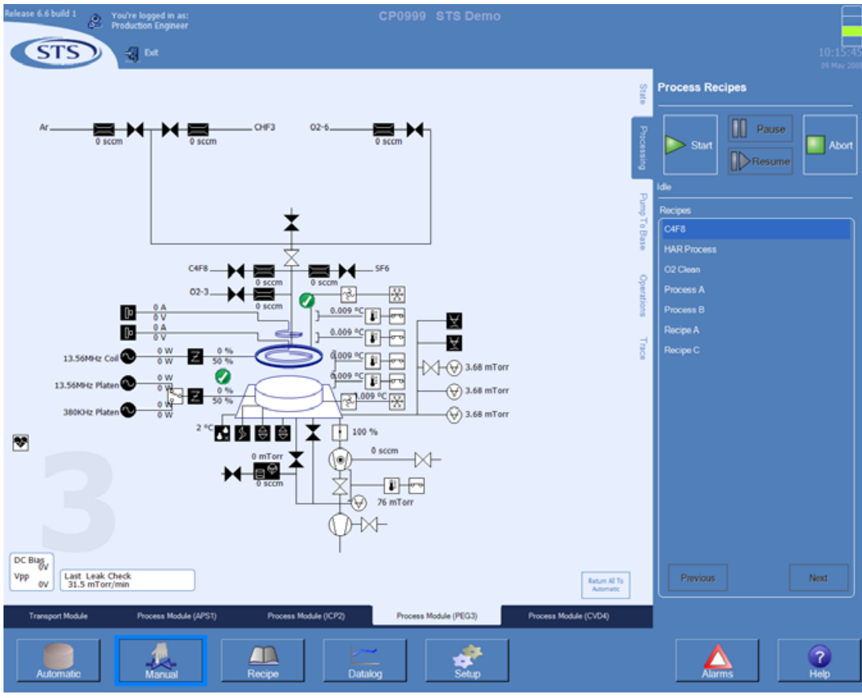


Figure 3.16 Typical Manual Chamber View

Note: *The symbol* ⚠ *indicates that the interlock chain is not made and that gas/RF operations will not be permitted.*

3.7.2.1 Processing

This operation selects a recipe to be run in the process chamber.

To select a process recipe:

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Processing** tab from the command panel.

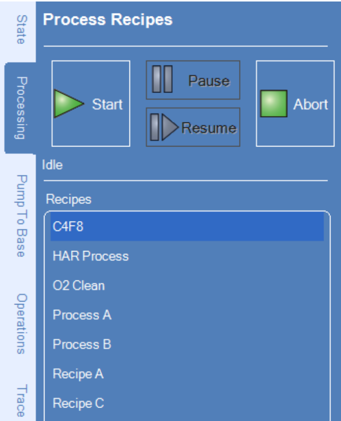


Figure 3.17 Typical Recipe selection View

3. Select the process recipe to be run from the list.
4. Select the **Start** button.

3.7.2.2 Dynamic Operation Tab

This tab displays manual operation options for the operation last performed (see 3.7.2.3):

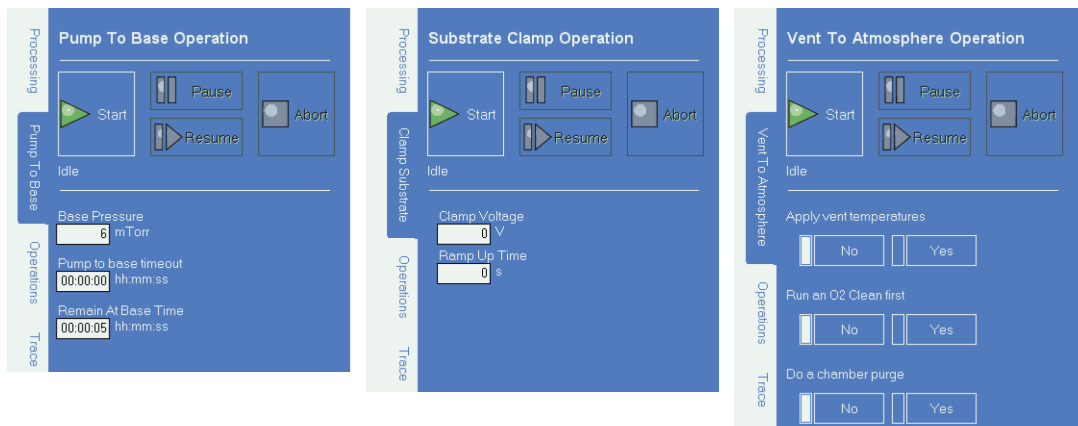


Figure 3.18 Dynamic Operation Tab

3.7.2.3 Process Module Operations

This operation allows common system operations to be carried out.

To perform Process Chamber operations:

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Operations** tab from the command panel, the following options are displayed:

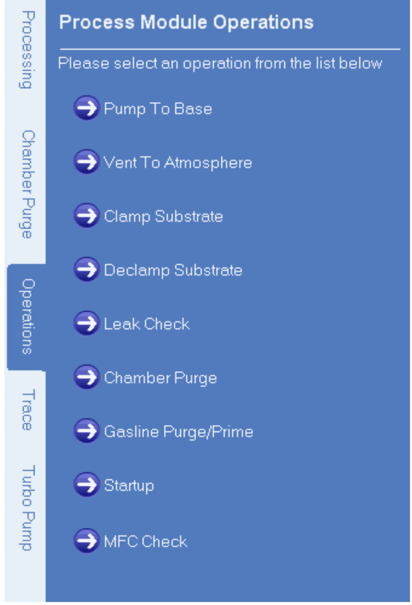


Figure 3.19 Process Module Operations Options

3. Select the required process chamber operation.

Note: *Once an operation is selected a new tab relevant to that operation will appear on the navigation panel (see 3.7.2.2).*

Individual operations available are detailed in sections 3.7.2.3.1 to 3.7.2.3.8.

3.7.2.3.1 Pump to Base

This operation pumps down the process chamber to base pressure.

To pump the process chamber to base pressure:

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Operations tab** from the command panel.
3. Select the **Pump to Base** option from the command panel.

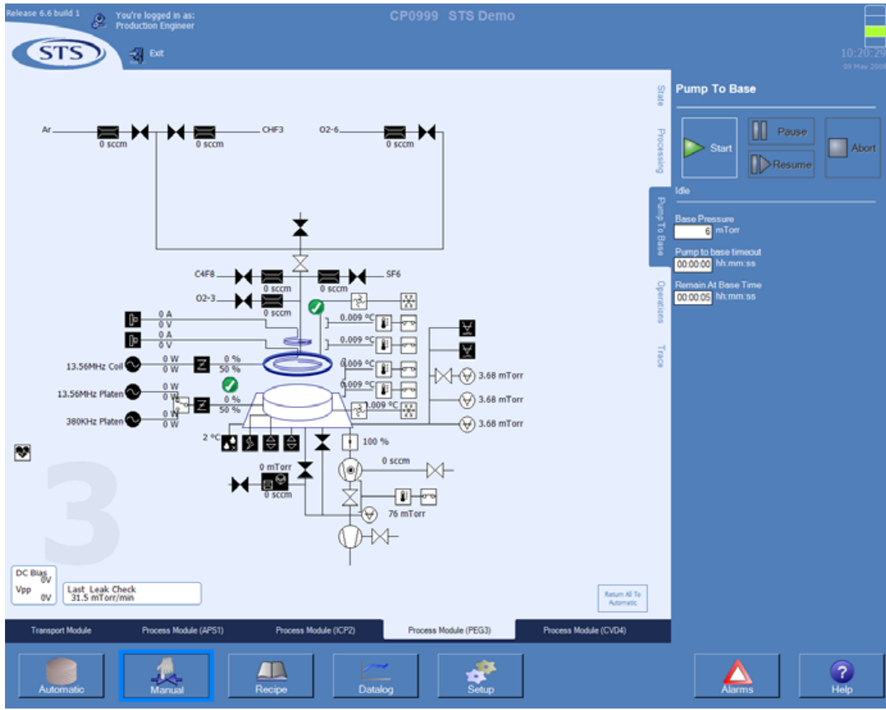


Figure 3.20 Typical Pump to Base View

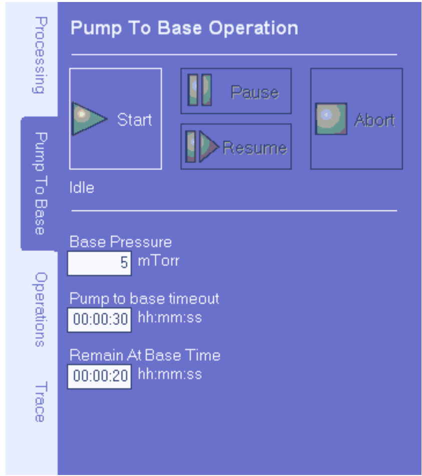


Figure 3.21 Typical Pump to Base Operation

4. Define the following settings as required.

- Base pressure
- The pump to base timeout
- The length of time that the pressure should remain at this level

Note: *The above mentioned settings will automatically reflect the default settings for the system.*

5. Select the **Start** button.

Note: *If required the operation can be paused or aborted at any time. To resume a paused operation select the resume button.*

Note: *If the operation is aborted the operation will stop at the next step and will not be able to be restarted.*

3.7.2.3.2 Vent to Atmosphere

The vent to atmosphere operation allows the user to vent the process module to atmosphere to allow maintenance to be carried out.

WHEN A CHAMBER HAS BEEN PROCESSING WITH TOXIC GASES, OR HAS TOXIC GASES CONNECTED, THE FOLLOWING SAFETY MEASURES SHOULD BE CARRIED OUT BEFORE THE CHAMBER IS VENTED TO ATMOSPHERE:

ENSURE THAT THE CHAMBER PURGE OPTION IS SELECTED BEFORE VENTING.

ENSURE ALL APPROPRIATE ANALYTICAL AND SAFETY EQUIPMENT IS AVAILABLE AND IS USED AS NECESSARY, E.G. BA SET, GAS DETECTORS.

ENSURE THE CHAMBER IS IN A SAFE STATE TO BE VENTED. IF TOXIC GASES ARE PRESENT AFTER VENTING, BREATHING APPARATUS MUST BE WORN BEFORE REMOVING CHAMBER LID.

THE PROCESS MODULE MUST BE AT 20°C BEFORE STARTING VENT TO MINIMISE THE RISK OF OPERATOR EXPOSURE TO HOT/COLD SURFACES INSIDE CHAMBER.

Note: *This function is intended to be used to allow minor maintenance operations, such as removing a damaged substrate, to be carried out. If the system is to remain at atmosphere for an extended period of time the pumping system should be safely shut down first.*

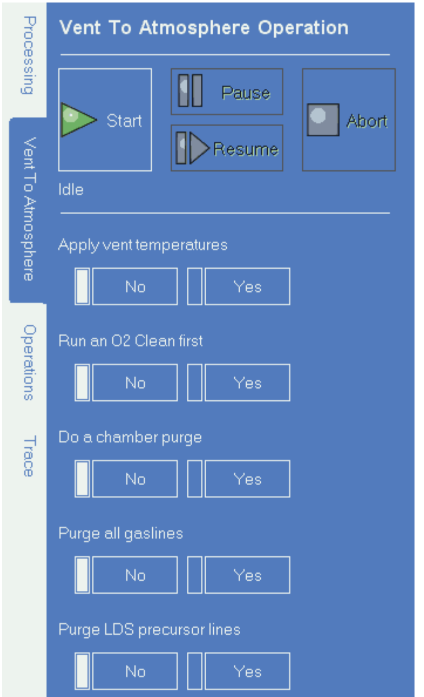


Figure 3.22 Typical Vent to Atmosphere Operation

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Operations tab** from the command panel.
3. Select the **Vent to Atmosphere** option from the command panel.
4. Define the following settings, as required.

- Apply vent temperatures - Select whether the heaters should drive to the pre-defined vent temperature settings. The temperatures are defined in the Configuration Editor
- Run an O_2 clean first - Select whether an O_2 clean should be carried out on the chamber prior to venting. The procedure for the O_2 clean is stored as a recipe within the Recipe Editor
- Do a chamber purge - Select whether the chamber should be purged with a purge gas before venting. This will perform the same procedure as that detailed in para. 3.7.2.3.6
- Purge all gaslines - Select whether the gas lines should be purged with a purge gas before venting. This will perform the same procedure as that detailed in para. 3.7.2.3.7 and will purge all the purgeable gaslines
- Purge LDS precursor lines - Select whether the liquid delivery system (if fitted) precursor lines should be purged before venting

Note: *The above mentioned settings will automatically reflect the default settings for the system.*

5. Select the **Start** button.

Note: *If required the operation can be paused or aborted at any time. To resume a paused operation select the **Resume** button.*

If the operation is aborted the operation will stop at the next step and will not be able to be restarted.

3.7.2.3.3 Clamp Substrate

The clamp substrate operation allows the user to clamp a substrate either electrostatically or mechanically depending on the system configuration.

Note: *If a process is to be run on the substrate or a helium leak up check etc. is to be run on the substrate, the clamp substrate operation must be carried out prior to running these options.*

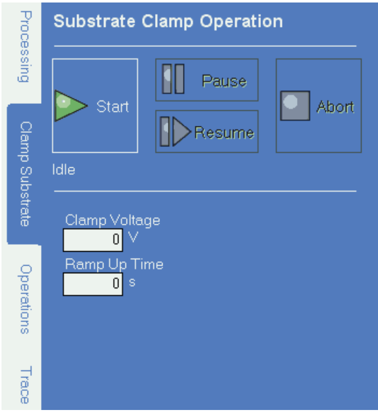


Figure 3.23 Typical Substrate Clamp Operation

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Operations tab** from the command panel.
3. Select the **Clamp Substrate** option from the command panel.
4. Define the following settings, as required.

- Clamp Voltage (Switching ESC only) - Enter the voltage used to clamp the substrate
- Ramp Up Time (Switching ESC only) - Enter the time during which the voltage is raised to the defined clamping voltage

5. Select the **Start** button.

Note: *If required the operation can be paused or aborted at any time. To resume a paused operation select the **Resume** button.*

Note: *If the operation is aborted the operation will stop at the next step and will not be able to be restarted.*

3.7.2.3.4 Declamp Substrate

The declamp substrate operation allows the user to declamp a substrate in the chamber.

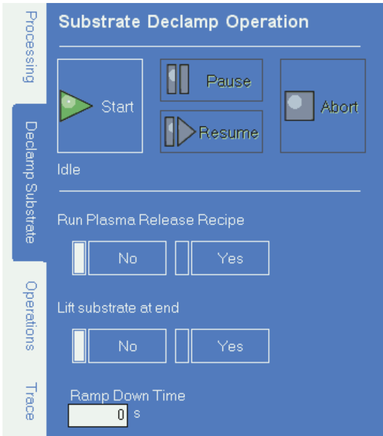


Figure 3.24 Typical Substrate Declamp Operation

1. From the **Manual** view, select the **Process Module** tab.

2. Select the **Operations tab** from the command panel.
3. Select the **Declamp Substrate** option from the command panel.
4. Define the following settings, as required.
    - Run plasma release recipe - Select whether a plasma release (dechuck) recipe should be run to release the clamping on the substrate
    - Lift substrate at end - Select whether the substrate lift should raise at the end of the operation in preparation for the substrate to be recovered to the Transport Module
    - Ramp Down Time - Enter the time during which the clamp voltage is removed
5. Select the **Start** button.

Note: *If required the operation can be paused or aborted at any time. To resume a paused operation select the* ***Resume*** *button.*

Note: *If the operation is aborted the operation will stop at the next step and will not be able to be restarted.*

3.7.2.3.5 Leak Check

The leak check operation allows the user to check the vacuum integrity of the process module and gas lines and the rate of leak into the chamber from the backside gas system.

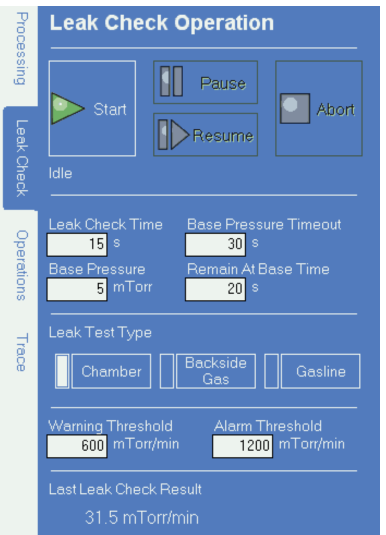


Figure 3.25 Typical Leak Check Operation

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Operations** tab from the command panel.
3. Select the **Leak Check** option from the command panel.
4. Define the following settings, as required.
    - Leak check time - Enter the time for which the leak check is to be carried out
    - Base pressure timeout - Enter the maximum time the process module has to pump to base pressure before the test before an alarm is raised
    - Base pressure - Enter the base pressure to be reached before the test is to be carried out
    - Remain at base time - Enter the amount of time the base pressure is to be maintained before the test is carried out
    - Leak test type - Select which leak test type is to be carried out
    - Warning and alarm thresholds - Enter the values at which an alarm and warning are executed

Note: *The above mentioned settings will automatically reflect the default settings for the system.*

5. Select the **Start** button.

Note: *If required the operation can be paused or aborted at any time. To resume a paused operation, select the **Resume** button.*

Note: *If the operation is aborted the operation will stop at the next step and will not be able to be restarted.*

3.7.2.3.6 Chamber Purge

The chamber purge operation allows the user to purge the process chamber. This operation is normally carried out prior to opening the chamber to perform maintenance operations.

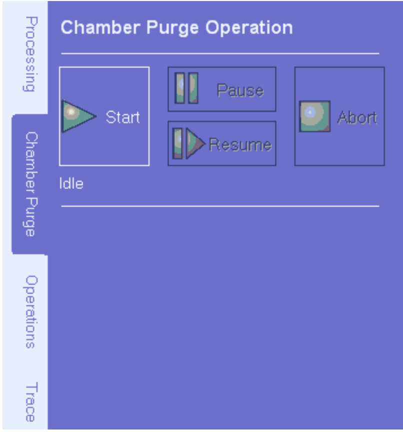


Figure 3.26 Typical Chamber Purge Operation

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Operations tab** from the command panel.
3. Select the **Chamber Purge** option from the command panel.
4. Select the **Start** button.

Note: *If required, the operation can be paused or aborted at any time. To resume a paused operation select the **Resume** button. If the operation is aborted the operation will stop at the next step and will not be able to be restarted.*

3.7.2.3.7 Gasline Purge/Prime

The gas line purge/prime operation allows the user to either purge selected gas lines as far as the gas out valve with a suitable purge gas or to prime the selected process gas lines prior to processing.

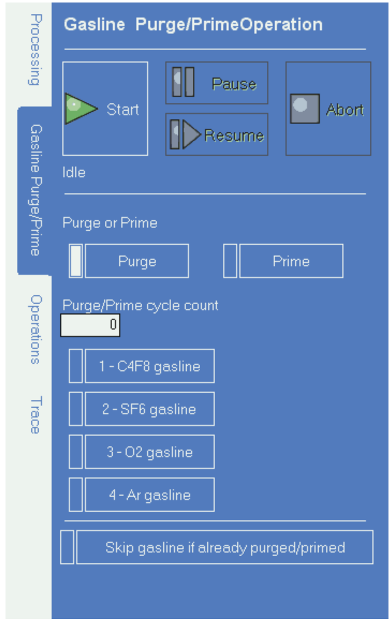


Figure 3.27 Typical Leak Check Operation

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Operations tab** from the command panel.
3. Select the **Gasline Purge/Prime** option from the command panel.
4. Define the following settings, as required.
   - Purge - Fills the gas lines with a suitable purge gas
   - Prime - Fills the lines with the selected process gas prior to processing
   - Purge/Prime cycle count - Enter the number of cycles that are to be carried out
   - Gasline selection - Select the gaslines on which the operation will be carried out
   - Skip gasline - Skip those gaslines that have already been purged/primed
5. Select the **Start** button.

Note: *If required the operation can be paused or aborted at any time. To resume a paused operation select the* ***Resume*** *button.*

Note: *If the operation is aborted the operation will stop at the next step and will not be able to be restarted.*

3.7.2.3.8 Start-up

The Start-up operation enables the user to place the process module in a state ready for processing. Generally this operation is performed after a system shutdown.

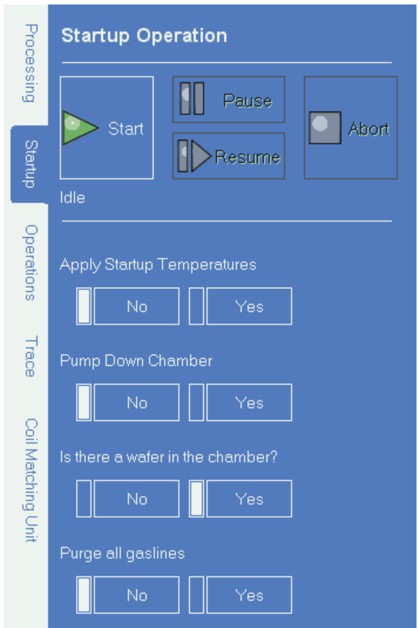


Figure 3.28 Start-up Operation

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Operations tab** from the command panel.
3. Select the **Startup** option from the command panel.
4. Define the following settings, as required.
   - Startup Temperatures - Applies the start-up temperatures specified in the configuration editor.
   - Pump Down Chamber - Performs a chamber pump to base operation (to the parameters set in the configuration editor)
   - Wafer in Chamber? - Select if there is a substrate in the process module or not.

CAUTION: Ensure there is no substrate present in the process module if the ‘No’ option is chosen. Damage to the substrates and tool will occur if a substrate is present and ‘No’ is chosen.

   - Purge All Gaslines - Performs a purge operation on all the gaslines
5. Select the **Start** button.

Note: *If required the operation can be paused or aborted at any time. To resume a paused operation select the **Resume** button.*

Note: *If the operation is aborted the operation will stop at the next step and will not be able to be restarted.*

3.7.2.3.9 MFC Check

The MFC check operation enables each gasline's MFC to be monitored over time. When performing this operation, the software uses the ideal gas law to measure the flow rate of the MFC. The result of each check is stored and can be viewed using the MFC check log viewer in the Datalog (see Chapter 2). Each MFC can therefore be monitored over a period of time to ensure that its flow rate does not drift.

This operation also enables the chamber volume to be calculated using each gasline's MFC. After commissioning, each gasline's MFC should be used to perform a chamber volume calculation. This value will then be used to measure the MFC's flow rate when performing MFC check operations. It is important not to overwrite this initial volume calculation so that any MFC flow rate drift can be observed.

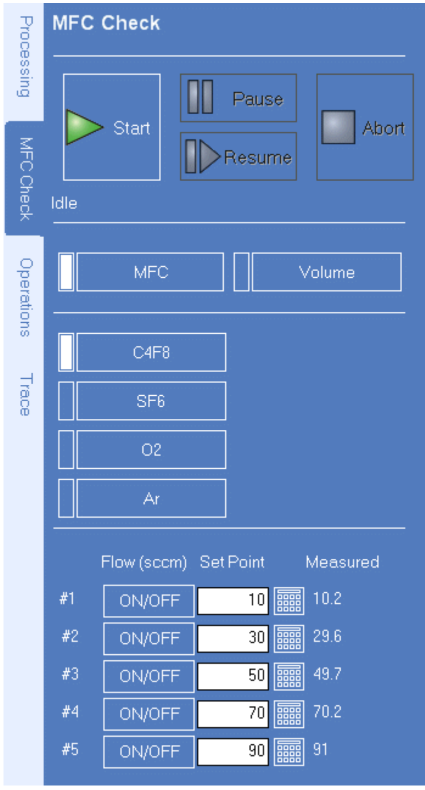


Figure 3.29 MFC Check Operation

To perform an MFC check:

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Operations tab** from the command panel.
3. Select the **MFC Check** option from the command panel.
4. Chose MFC check.
5. Choose the gasline to be used.
6. A maximum of 5 flows can be run for each MFC. Choose On/Off for each run required.
7. For each, run enter a set point.

   Note: *To display an entry keypad, click on the icon next to the setpoint field.*
8. Select the **Start** button.

A chamber volume calculation can also be performed using the MFC and this volume will be recorded and used in future MFC check operations.

Note: *The volume calculation should only be performed once, after commissioning. If the volume is recalculated on a regular basis, it will hide any MFC drift that would otherwise be shown.*

To perform a volume calculation:

1. From the **Manual** view, select the **Process Module** tab.
2. Select the **Operations tab** from the command panel.
3. Select the **MFC Check** option from the command panel.
4. Chose Volume.
5. Choose the gasline to be used.
6. Enter a duration in seconds for the flow.
7. Enter the flow rate (in SCCM).
8. Select the **Start** button.

3.7.3 Device Control

This option allows individual system devices to be operated manually. System devices that can be operated from the manual mode include valves, MFCs, generators and pumps.

THE MANUAL I/O MODE ALLOWS INTERLOCKS TO BE OVERIDDEN. OPERATION BY UNTRAINED OR UNQUALIFIED PERSONNEL MAY LEAD TO PHYSICAL INJURY, DEATH AND/OR DAMAGE TO THE EQUIPMENT.

To allow devices to be operated manually:

1. From the **Manual** view, select the **Process Module** tab.

2. Select a device to be operated by clicking on the device in the navigation panel.

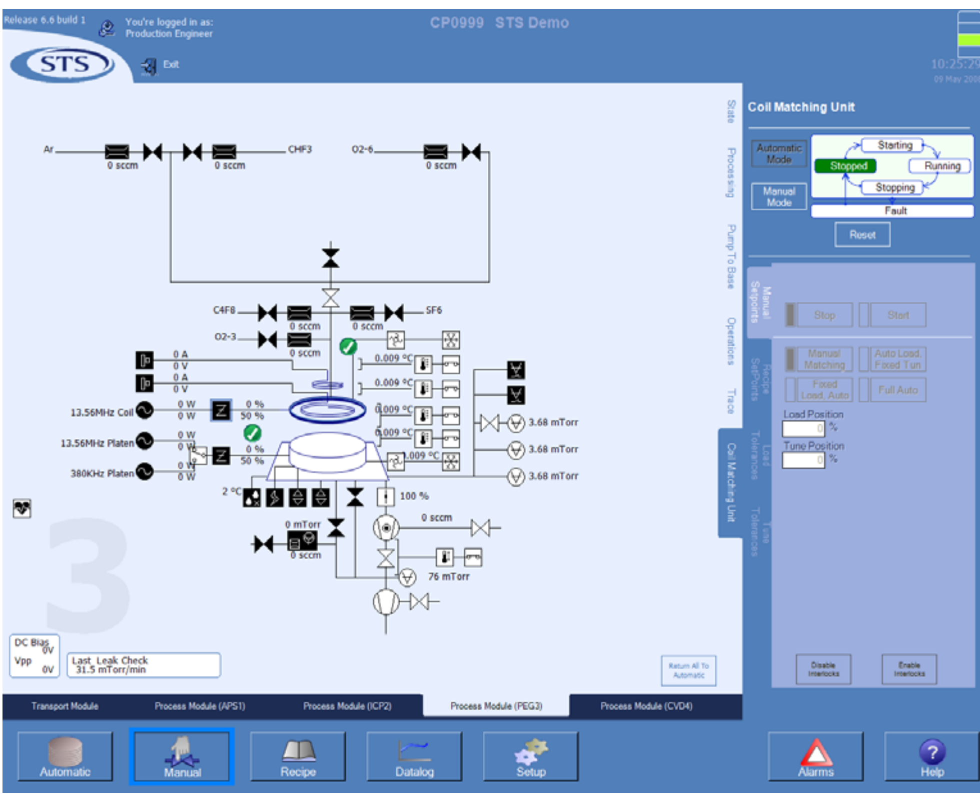


Figure 3.30 Typical I/O Options

3. A new tab appears on the command panel, detailing the device being controlled.

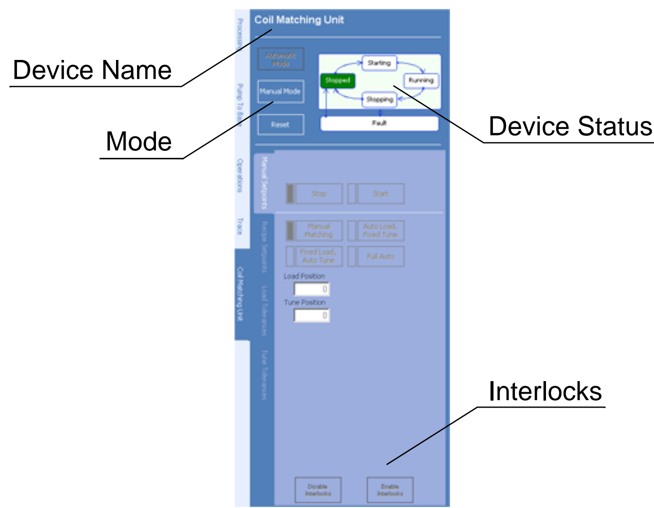


Figure 3.31 Typical I/O Control

The manual control options available to the user will depend on the device selected.

Device Details	
Device Name	Displays the device name e.g. ‘Line 4 Output Valve’.
Device Status	Displays the current status of the device e.g. ‘Stopped’.
Device Control Mode	Displays the current control mode either ‘Manual’ or ‘Automatic’.

Interlocks	Displays whether the interlocks are enabled or disabled.
Mode	
Automatic	The Device is controlled via the system.
Manual	The device is controlled by the operator.
Reset	Resets the device.
Interlocks	
Enable	Software Interlocks are Enabled.
Disable	Software Interlocks are Disabled.

3.8 Creating and Managing Recipes

A recipe is a re-usable set of instructions or parameters that are used to specify the path and environment that a substrate will experience while in the tool.

There are two major types of recipe

Recipes that are run on the system fall into two main categories:

- Process Module Recipes
- Tool Recipes

The recipe tree displays a hierarchical view of all the tool and process module recipes that have previously been configured.

The command panel buttons enable recipes to be created, edited, copied, pasted and deleted.

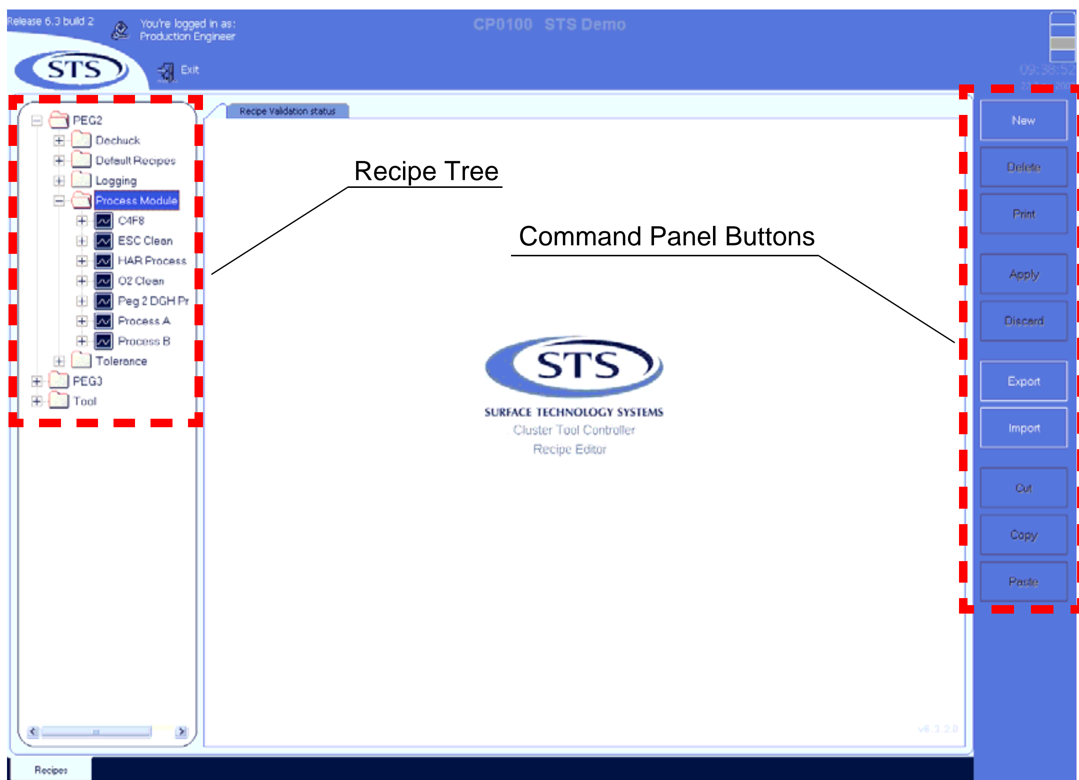


Figure 3.32 Typical Main Recipe Editor Screen

3.8.1 Process Module Recipes

A process module recipe is used to define the environment inside the chamber during processing. A process recipe consists of a series of structured steps (see 3.8.1.4) and may also reference one or more of the following:

Dechuck Recipe (see 3.8.1.1)

Default Recipe (see 3.8.1.2)

Logging Recipe (see 3.8.1.3)

Tolerance Recipe (see 3.8.1.5)

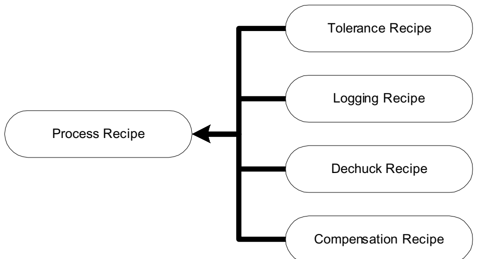


Figure 3.33 Process Recipe References

The recipe tree displays a hierarchical view of each process module, recipe type and recipe as follows:

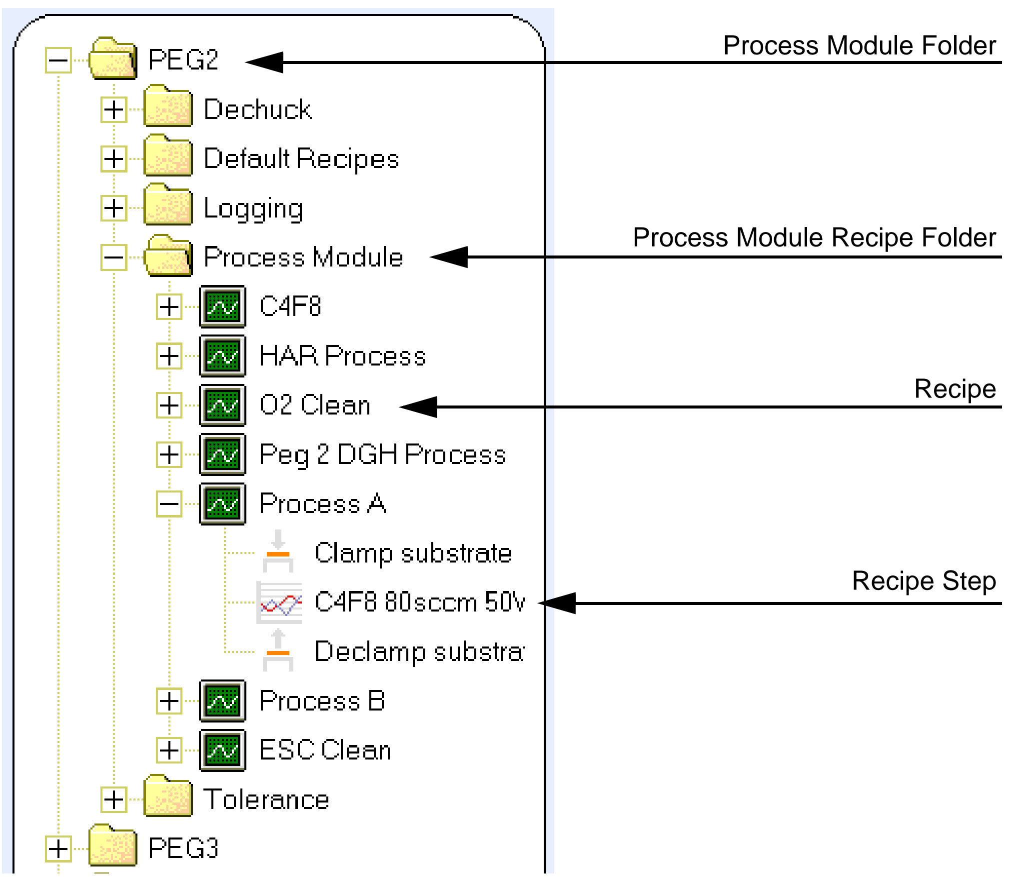


Figure 3.34 Typical Process Module Recipe Tree

In this example the system has two process modules, ‘PEG2’ and ‘PEG3’. Immediately below the process module are its associated Dechuck, Default, Logging, Process and Tolerance recipe folders.

3.8.1.1 Dechuck Recipe

The dechuck recipe is used to release the substrate after it has been clamped to allow it to be retrieved to the transport module.

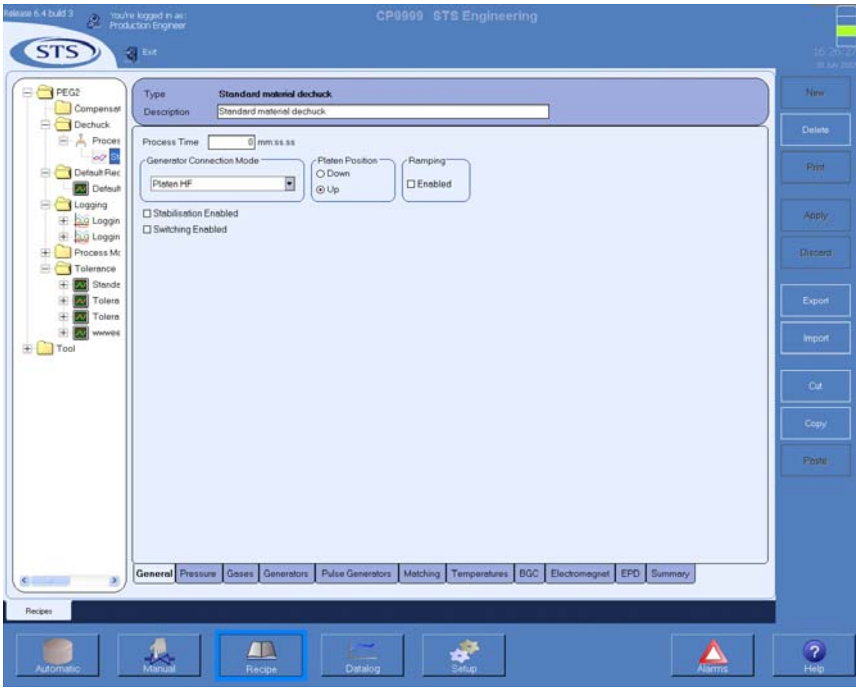


Figure 3.35 Typical Main Dechuck Recipe View

To write a dechuck recipe:

1. From the **Recipe** view, select the required **Process Module** folder and **Dechuck** folder.
2. On the command panel select the **New** button, a screen similar to the one shown below is displayed:

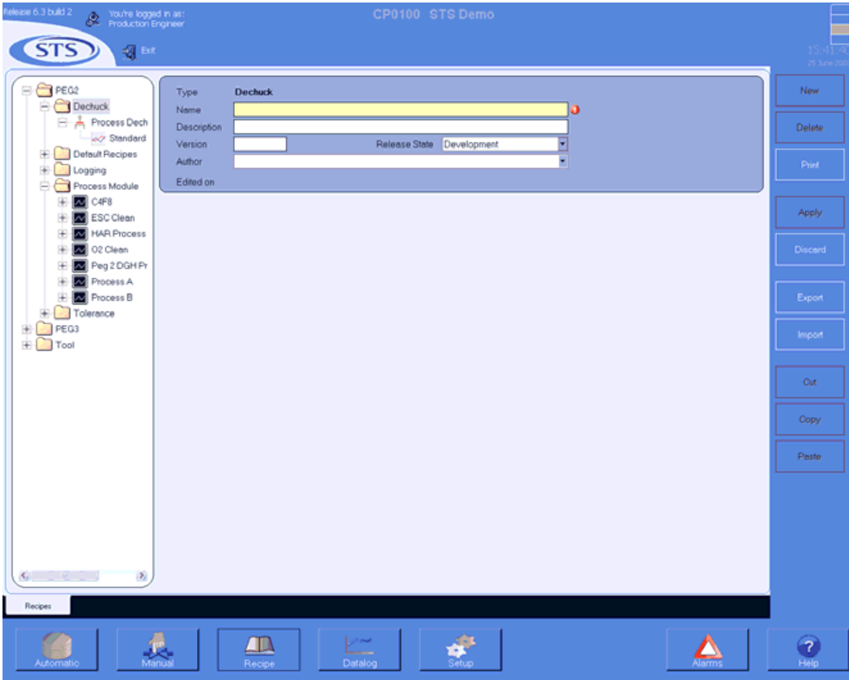


Figure 3.36 Typical Dechuck Recipe View

3. Type in the recipe name in the **Recipe Name** field.

   Note: *This field is mandatory.*

4. Type in the recipe's author or select available authors from the drop down list.

5. Type in the recipe description and the version number.

   Note: *These fields are not mandatory, however, STS recommend that you complete these fields for tracking purposes.*

6. Select the recipe status from the drop down list:

Figure 3.37 Typical Recipe Status View

Recipe Status	Description
Development	The recipe is still in a development stage and can only be run by users with sufficiently high access rights e.g. Process Engineers.
Released	The recipe is allowed to be run by all users however, normally only manual batches will be run using this recipe.
Released to Production	The recipe is allowed to be run by all users and will have a one button press function to make recipe selection easier.
Obsolete	The recipe has been made obsolete and so can no longer be run in any mode.

7. Select the **Apply** button in the command panel to create the recipe.

8. Select the **New** button from the command panel to create a new step.

9. Select the required step from the drop down list and select next:

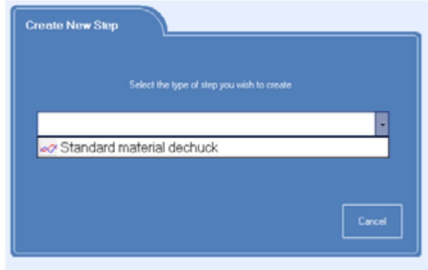


Figure 3.38 Typical Dechuck Select Step View

10. Select the position to insert the step, typically the end and select finish:

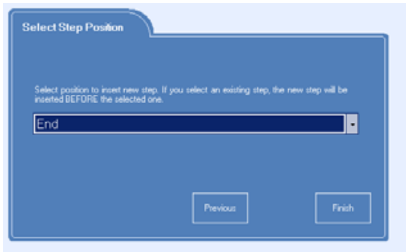


Figure 3.39 Typical Select Step Position View

11. The new recipe step now appears in the recipe tree.

12. To set the parameters for the dechuck recipe, select the dechuck recipe name and the standard material dechuck recipe step associated with it:

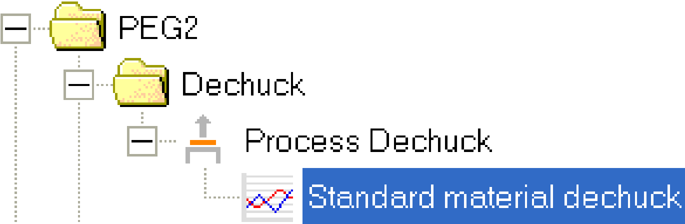


Figure 3.40 Dechuck Material Process Step

13. Set the required dechuck parameters (see Chapter 2 Getting Started).

14. Save the changes to the dechuck recipe by selecting the **Apply** button.

3.8.1.2 Default Recipe

The default recipe contains the default tolerance and logging information for the system. If a tool recipe is created without specifying specific tolerance and logging recipes the default values will be used.

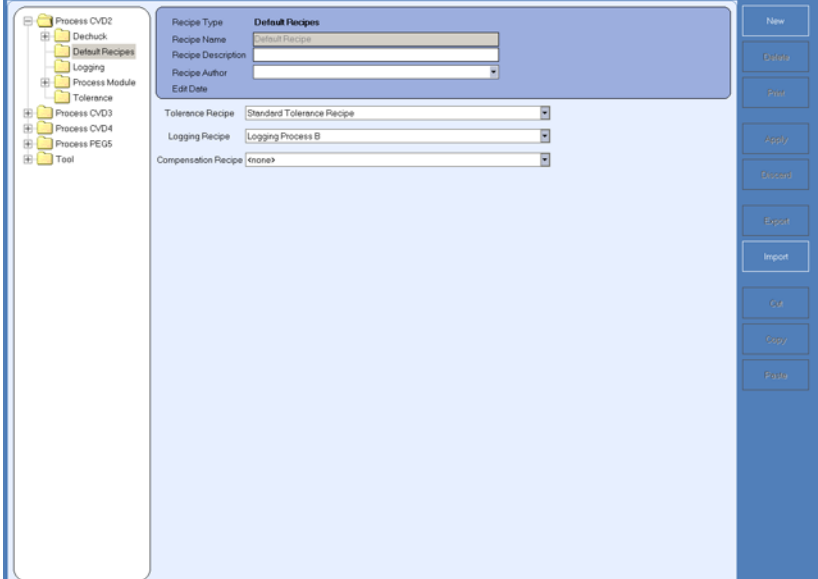


Figure 3.41 Typical Default Recipe View

To set the default recipe:

1. From the **Recipe** view, select the required **Process Module** folder and **Default** folder.

2. On the command panel select the **New** button, a screen similar to the one shown below is displayed:

Figure 3.42 Typical Default Recipe View

3. Type in the recipe's author or select available authors from the drop down list.

4. Type in the recipe description and the version number.

Note: *These fields are not mandatory, however, STS recommend that you complete these fields for tracking purposes.*

5. Select the recipe status from the drop down list:

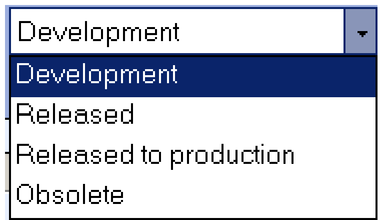


Figure 3.43 Typical Recipe Status View

Recipe Status	Description
Development	The recipe is still in a development stage and will not be allowed to run on the system.
Released	The recipe is allowed to be run in any mode above production level, i.e. normally only manual batches will be run using this recipe.
Released to Production	The recipe is allowed to be run in any mode including production, i.e. automatic batches can be run using this recipe.
Obsolete	The recipe has been made obsolete and so can no longer be run in any mode.

6. From the drop down lists select the logging and tolerance recipes to be used for the default recipes.

7. Save the changes to the default recipe by selecting the **Apply** button.

3.8.1.3 Logging Recipe

Logging recipes define the parameters that are logged during a process, for example matching unit positions and gas flows.

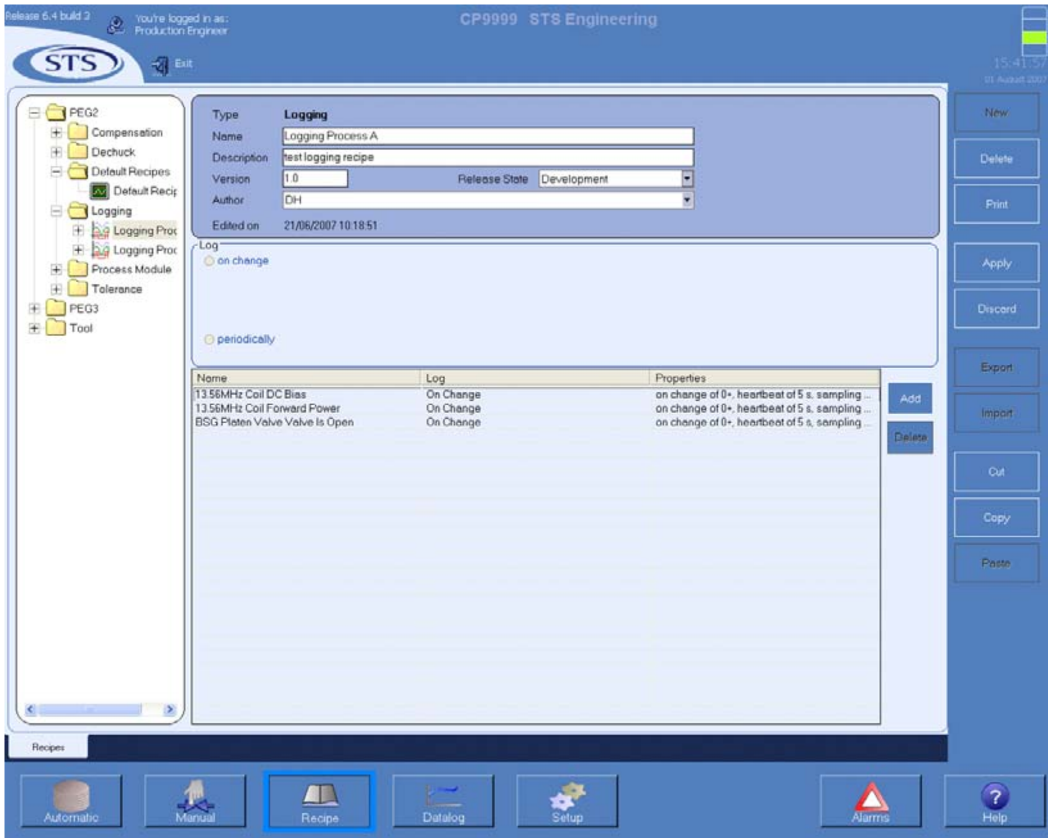


Figure 3.44 Typical Logging Recipe View

To write a logging recipe:

1. From the **Recipe** view, select the required **Process Module** folder and **Logging** folder.
2. On the command panel select the **New** button, a screen similar to the one shown below is displayed:

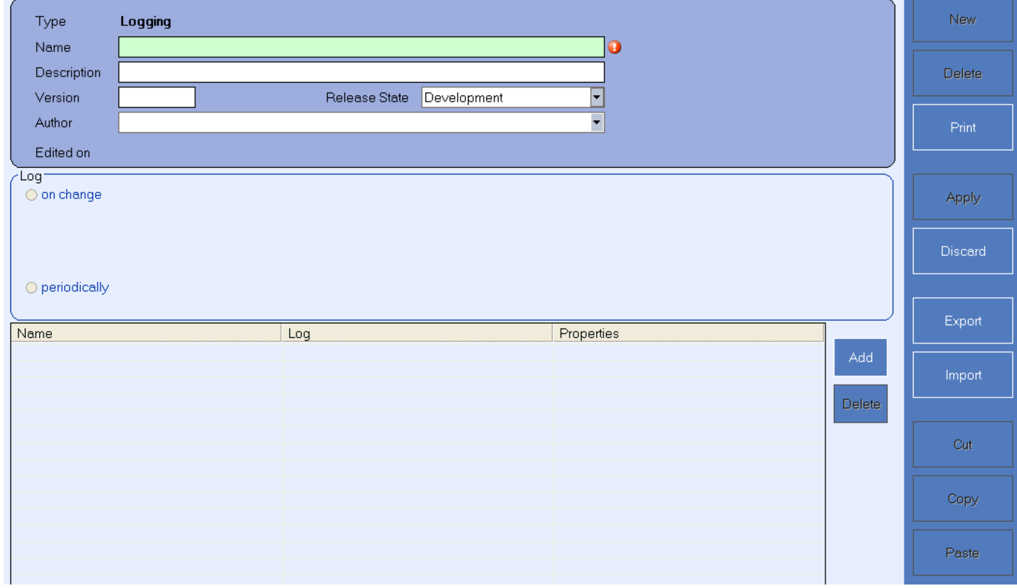


Figure 3.45 Typical Default Recipe View

3. Type in the recipe name in the **Recipe Name** field.

   Note: *This field is mandatory.*

4. Type in the recipe's author or select available authors from the drop down list.

5. Type in the recipe description and the version number.

   Note: *These fields are not mandatory, however, STS recommend that you complete these fields for tracking purposes.*

6. Select the recipe status from the drop down list:

Figure 3.46 Typical Recipe Status View

Recipe Status	Description
Development	The recipe is still in a development stage and will not be allowed to run on the system.
Released	The recipe is allowed to be run in any mode above production level, i.e. normally only manual batches will be run using this recipe.
Released to Production	The recipe is allowed to be run in any mode including production, i.e. automatic batches can be run using this recipe.
Obsolete	The recipe has been made obsolete and so can no longer be run in any mode.

7. Select the **Add** button in the command panel and select the required parameter to be added from the drop down list.

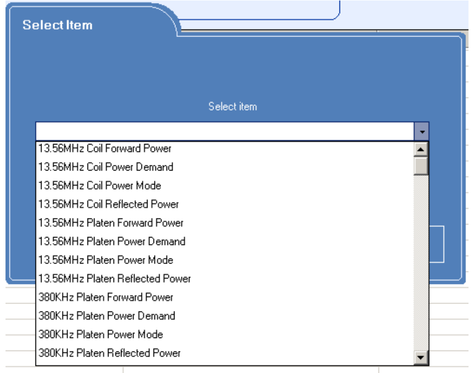


Figure 3.47 Typical Add logging Parameter View

8. Click the **Finish** button and the parameter is added to the list.

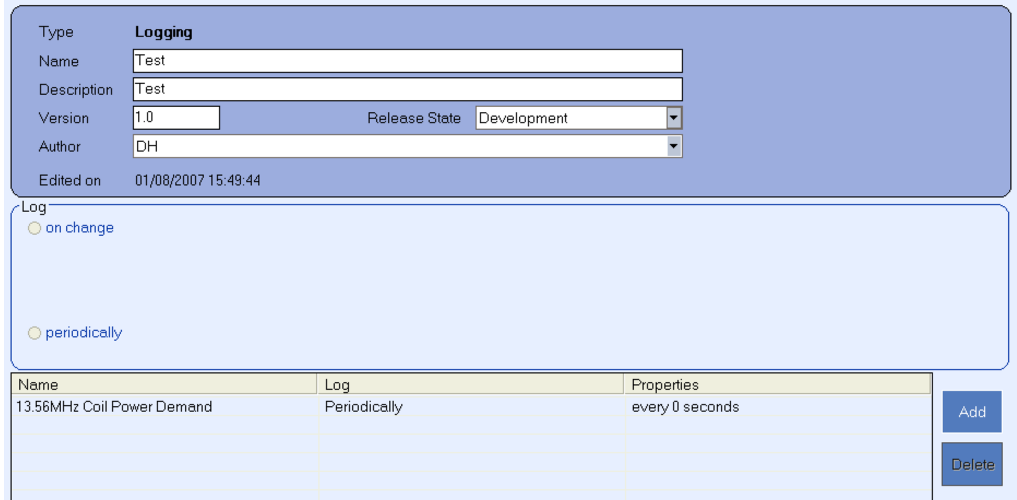
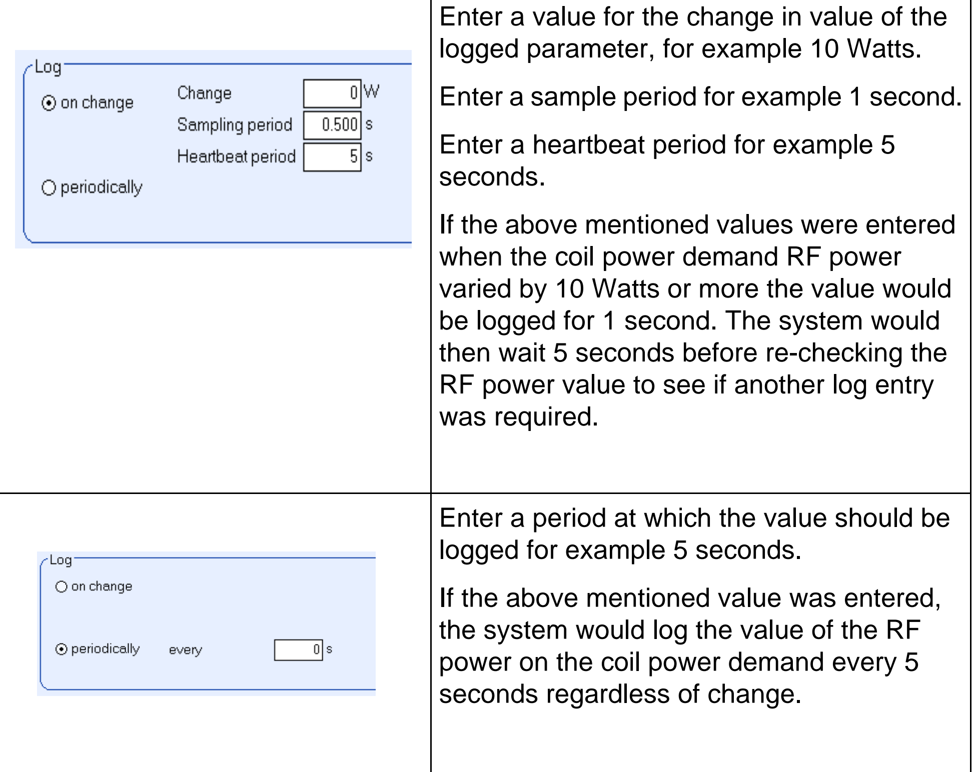


Figure 3.48 Typical Logging Parameter View

9. Select whether the value is to be logged periodically or on change using the radio buttons, the following options are available:



	Enter a value for the change in value of the logged parameter, for example 10 Watts. Enter a sample period for example 1 second. Enter a heartbeat period for example 5 seconds. If the above mentioned values were entered when the coil power demand RF power varied by 10 Watts or more the value would be logged for 1 second. The system would then wait 5 seconds before re-checking the RF power value to see if another log entry was required.
	Enter a period at which the value should be logged for example 5 seconds. If the above mentioned value was entered, the system would log the value of the RF power on the coil power demand every 5 seconds regardless of change.

10. Repeat steps 7. to 9. to select any further values that are required to be logged.

11. Save the changes to the default recipe by selecting the **Apply** button.

3.8.1.4 Process Module Recipe

This recipe defines the total environment that a substrate experiences during its time within a process module.

Parameters specified in this recipe require indicators regarding the permissible ranges, plus gas line configuration, generator names, etc. The parameters are provided for range and configuration information only.

Note: *Not all available process module steps are required to be entered into a process module recipe and multiples of one type of step can be used.*

To create a process recipe:

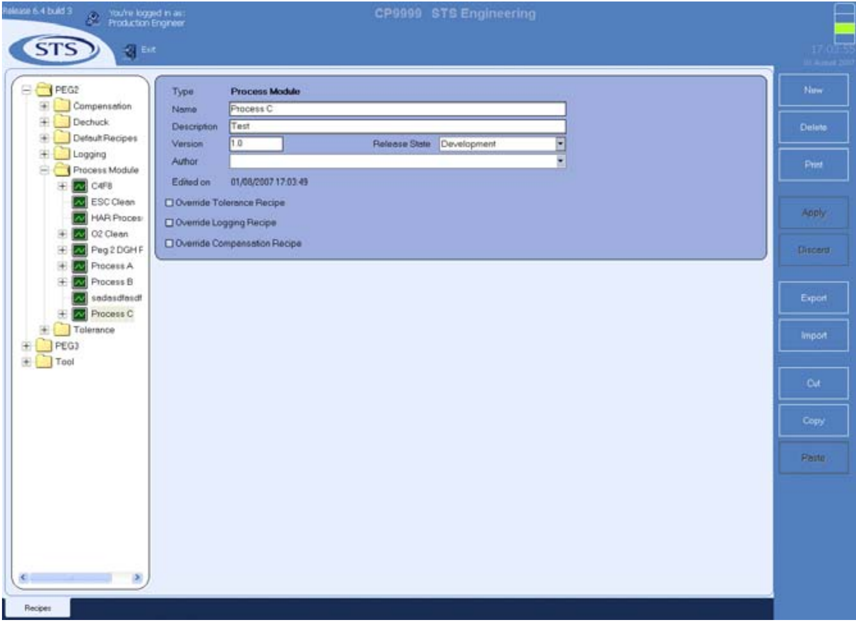


Figure 3.49 Typical Process Recipe View

1. From the **Recipe** view, open the **Process Module** folder.
2. Highlight the **Process Module** folder.
3. Select the **New** button, located on the control panel.
4. Type in the recipe name in the **Recipe Name** field.

Note: *This field is mandatory.*

5. Type in the recipe's author or select available authors from the drop down list.
6. Type in the recipe description and the version number.

Note: *These fields are not mandatory, however, STS recommend that you complete these fields for tracking purposes.*

7. Select the recipe status from the drop down list:

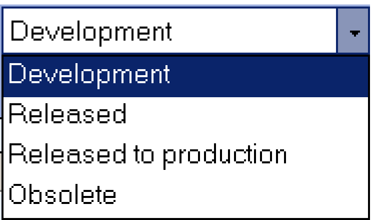


Figure 3.50 Typical Recipe Status View

Recipe Status	Description
Development	The recipe is still in a development stage and will not be allowed to run on the system.
Released	The recipe is allowed to be run in any mode above production level, i.e. normally only manual batches will be run using this recipe.
Released to Production	The recipe is allowed to be run in any mode including production, i.e. automatic batches can be run using this recipe.
Obsolete	The recipe has been made obsolete and so can no longer be run in any mode.

8. Select Tolerance, Logging and Compensation recipes if required.

Figure 3.51 Override Default

Note: *If Logging, Tolerance or Compensation Recipes are not selected the process will run with the Logging, Tolerance and Compensation Recipes stored within the Default Recipe.*

9. Select the **New** button to select the process step to be added from the drop down list:

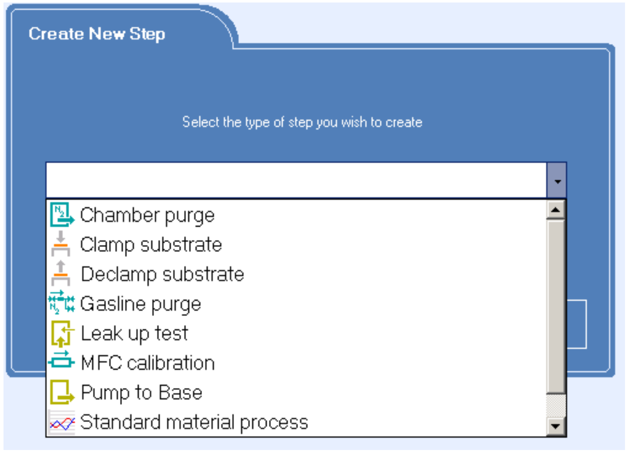


Figure 3.52 Typical Process Module Step Selection View

10. Select the step to be added and select the **Next** button.

11. Select the position in which the step is to be carried out in the recipe and select the **Finish** button.

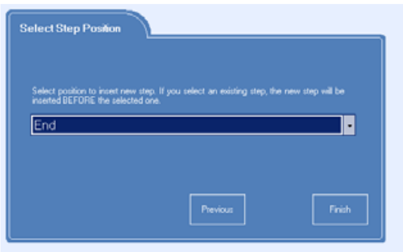


Figure 3.53 Typical Select Step Position View

12. Repeat steps 9. to 11. until all the required steps are added.
13. Save the changes to the process module recipe by selecting the **Apply** button.
14. The parameters within the recipe steps can now be modified by selecting the individual steps within the process module recipe.

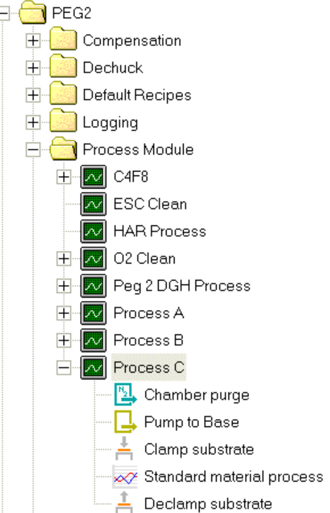


Figure 3.54 Typical Process Module Recipe Steps

3.8.1.4.1 Changing the Chamber Purge Step

To change the chamber purge step highlight the step from the process module recipe.

Figure 3.55 Typical Chamber Purge Step

Note: *There are no associated setpoints at present for this step.*

3.8.1.4.2 Changing the Pump to Base Step

To change the chamber pump to base step highlight the step from the process module recipe.

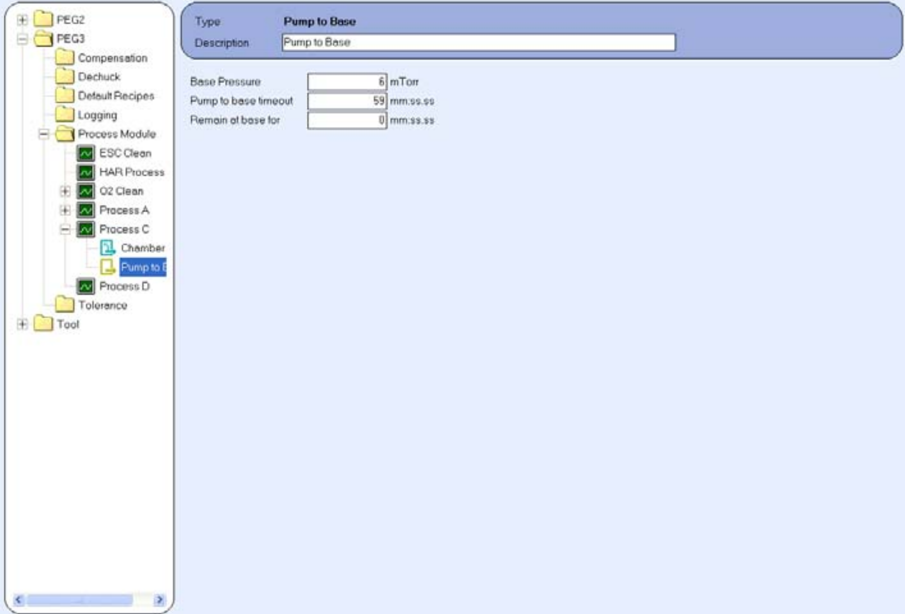


Figure 3.56 Typical Pump to Base Step

1. Enter a description for the step if required.
2. Enter the base pressure to which the chamber should pump to.
3. Enter the pump to base timeout, which is the time the system allows the chamber to get to base pressure before an alarm is raised.
4. Enter the remain at base pressure time which is the time the chamber remains at base pressure before the next step is carried out.

5. Save the changes to the pump to base step by selecting the **Apply** button.

Note: *When the step is opened the system default values are displayed. If no different values are entered into the text fields the step will use the default values.*

3.8.1.4.3 Changing the Gasline Purge Step

To change the gasline purge step highlight the step from the process module recipe.

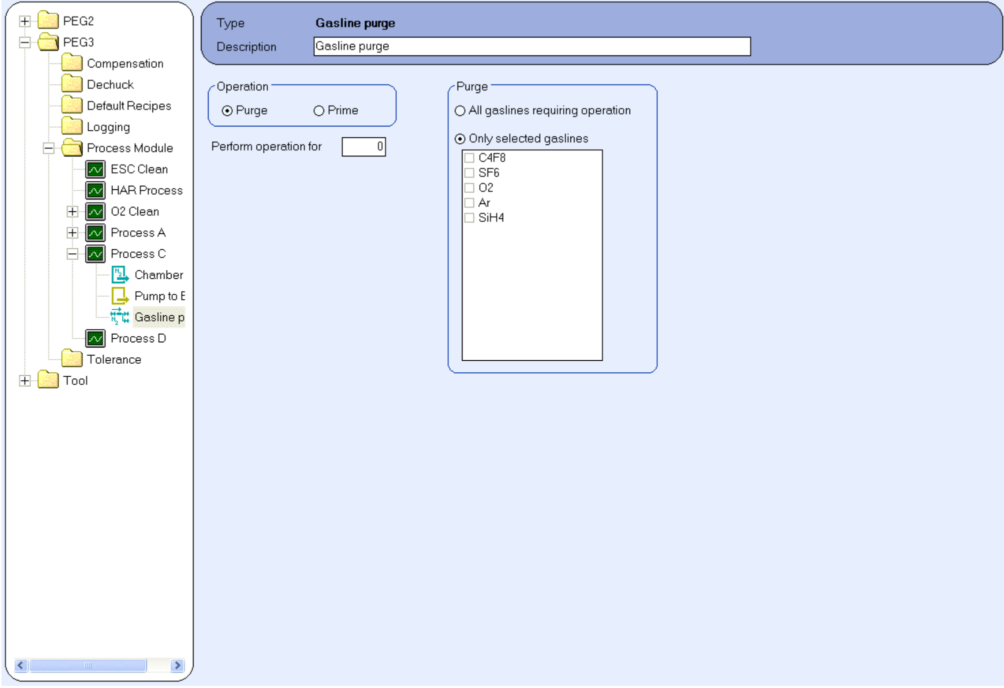


Figure 3.57 Typical Gasline Purge Step

1. Enter a description for the step if required.
2. Enter whether the gaslines are to be purged or primed by selecting the relevant radio button.
3. Enter the number of cycles for which the operation is to be carried out.
4. Enter whether all the gas lines or only those selected should be purged/primed.
5. Save the changes to the gasline purge step by selecting the **Apply** button.

3.8.1.4.4 Changing the Clamp Substrate Step

To change the clamp substrate step highlight the step from the process module recipe.

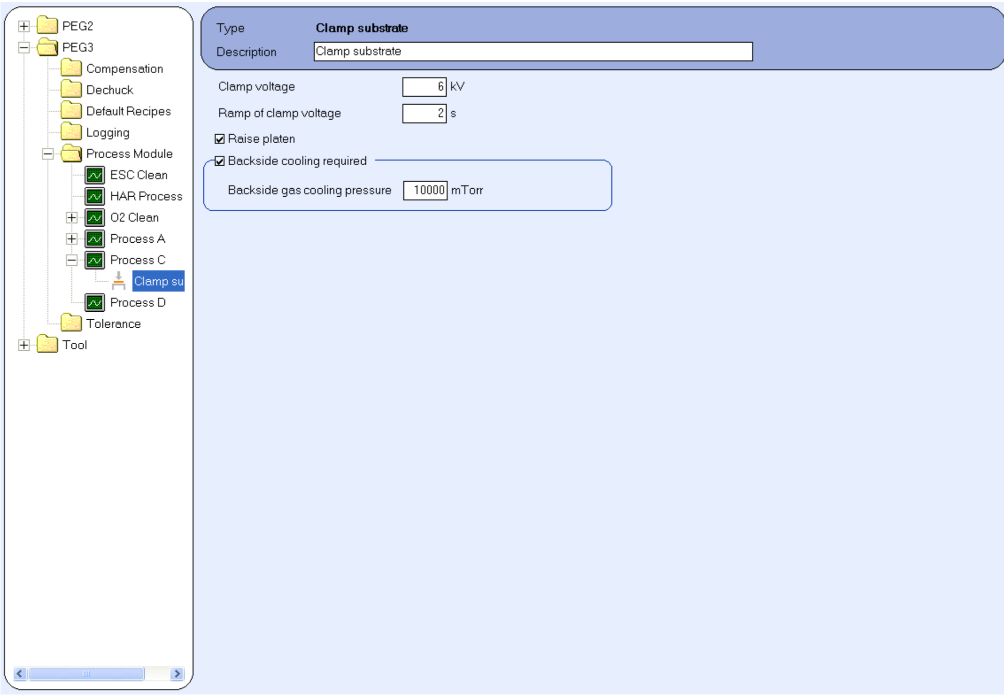


Figure 3.58 Typical Clamp Substrate Step

1. Enter a description for the step if required.
2. Enter the clamping voltage.
3. Enter the time period to ramp up to the clamping voltage.
4. Enter whether the platen is to be raised after clamping by selecting the tick box.
5. Enter whether the backside gas cooling option is required by selecting the tick box
6. If required enter the backside gas cooling pressure.
7. Save the changes to the step by selecting the **Apply** button.

Note: *When the step is opened the system default values are displayed. If no different values are entered into the text fields the step will use the default values.*

3.8.1.4.5 Changing the Leak Up Rate Step

To change the leak up rate step highlight the step from the process module recipe.

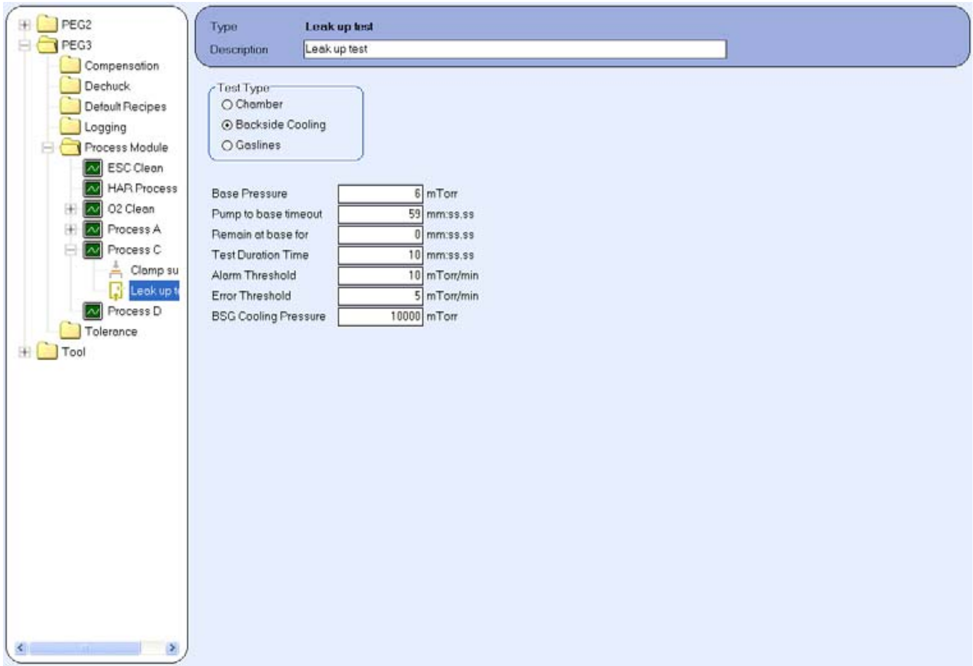


Figure 3.59 Typical Leak Up Rate Step

1. Enter a description for the step if required.
2. Using the radio buttons select whether a chamber, gasline or backside cooling leak up rate check is to be carried out.
3. Enter the base pressure to which the chamber should pump to.
4. Enter the pump to base timeout, which is the time the system allows the chamber to get to base pressure before an alarm is raised.
5. Enter the remain at base pressure time which is the time the chamber remains at base pressure before the next step is carried out.
6. Enter the duration of the test in seconds.
7. Enter the pressure rises at which an error or alarm condition are raised.
8. If a backside gas leak up rate has been selected, enter the backside gas pressure.
9. If a gasline leak up rate check has been selected, enter the gaslines to be checked.
10. Save the changes to the leak up rate step by selecting the **Apply** button.

Note: *When the step is opened the system default values are displayed. If no different values are entered into the text fields the step will use the default values.*

3.8.1.4.6 Declamp Substrate

To change the declamp substrate step highlight the step from the process module recipe.

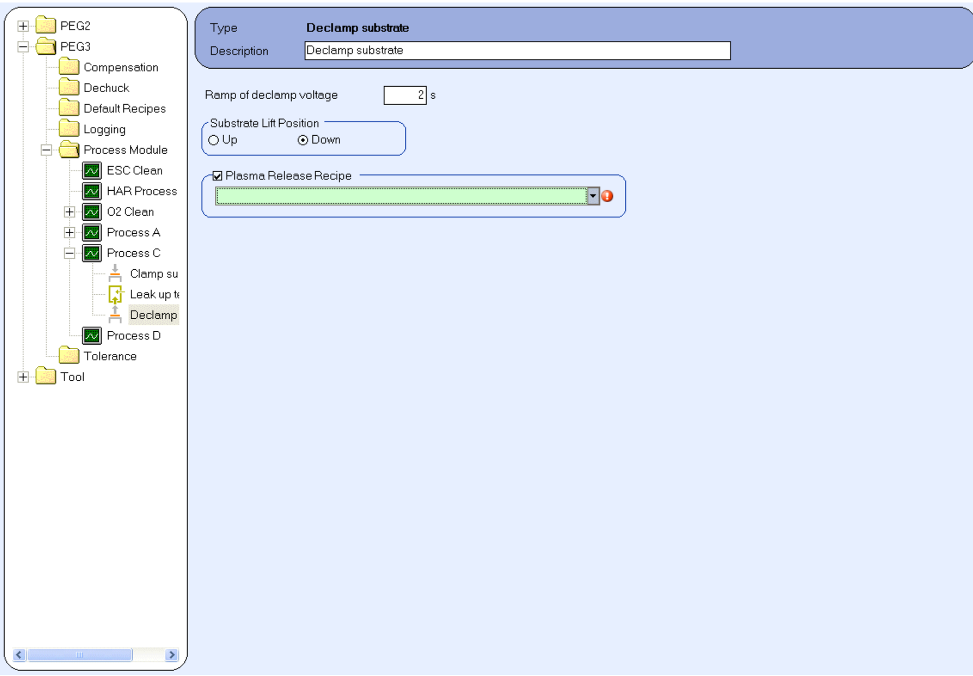


Figure 3.60 Typical Declamp Substrate Step

1. Enter a description for the step if required.
2. Enter the time period to ramp down from the clamping voltage.
3. Using the radio buttons select whether a the substrate lift should be raised or left lowered after the declamp step.
4. Using the tick box select whether a declamp recipe is used.
5. If a declamp recipe is to be used, select the required recipe from the drop down list.
6. Save the changes to the leak up rate step by selecting the **Apply** button.

3.8.1.4.7 Changing the Vent to Atmosphere Step

To change the vent to atmosphere step highlight the step from the process module recipe.

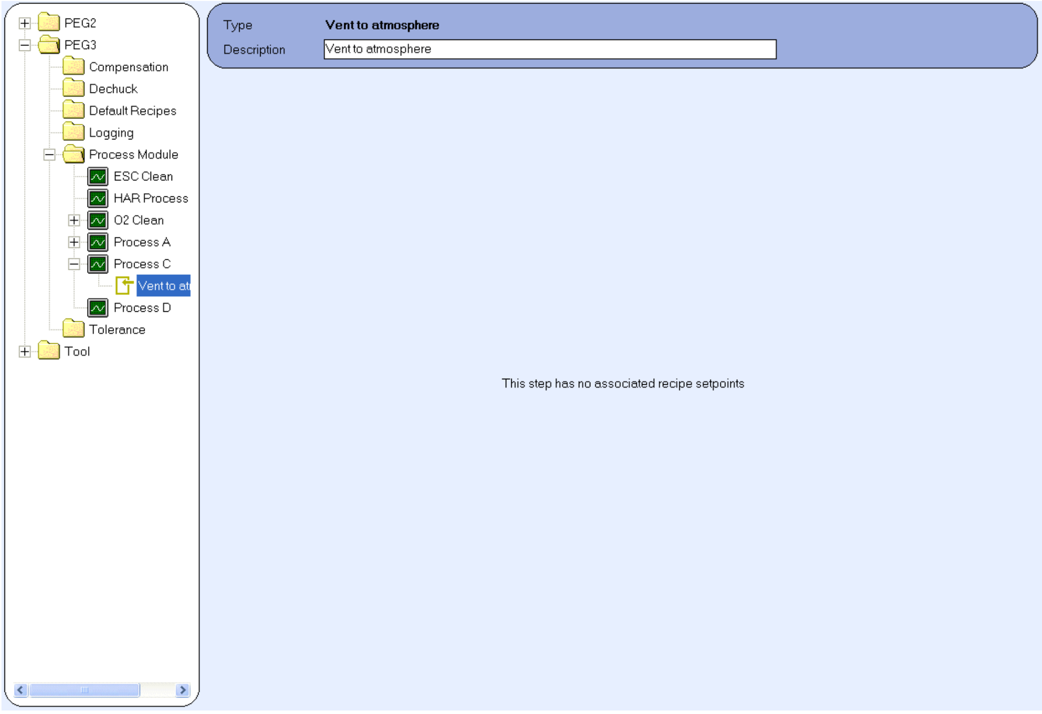


Figure 3.61 Typical Vent to Atmosphere Step

Note: *There are no associated setpoints at present for this step.*

3.8.1.4.8 Changing the Standard Material Process Step

Note: *Depending on machine configuration some of the views and options shown below may not be present on all system configurations.*

To change a standard process material step, highlight the step in the process module recipe.

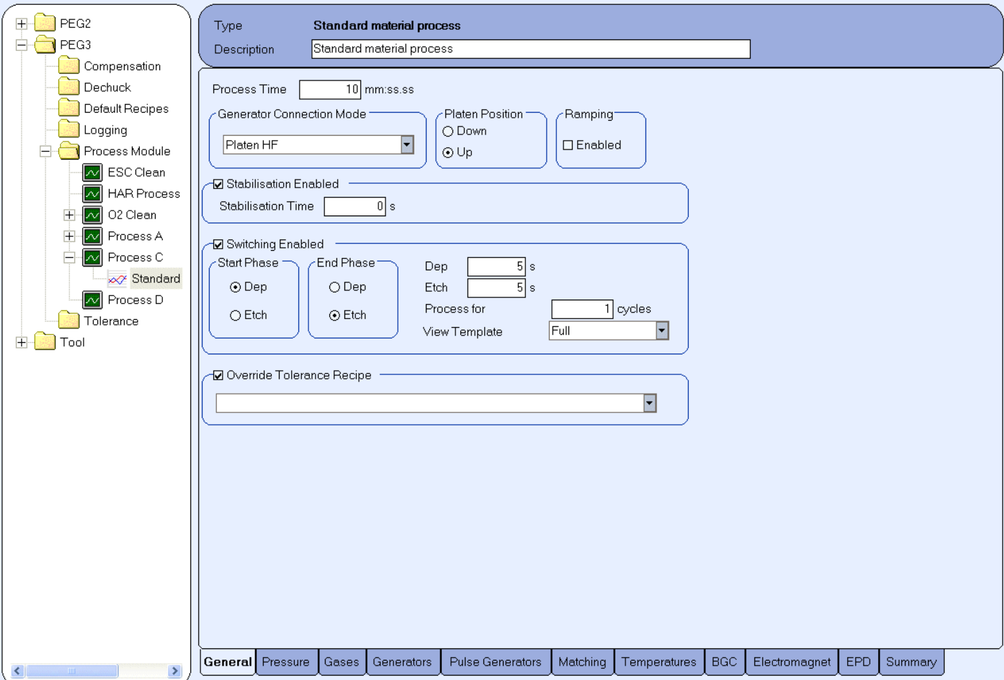


Figure 3.62 Typical Standard Process Material Step

1. To navigate through the standard material process step use the tabs located at the bottom of the information panel.
2. On opening the standard material process step, the general page is displayed.To set the parameters on the general page:

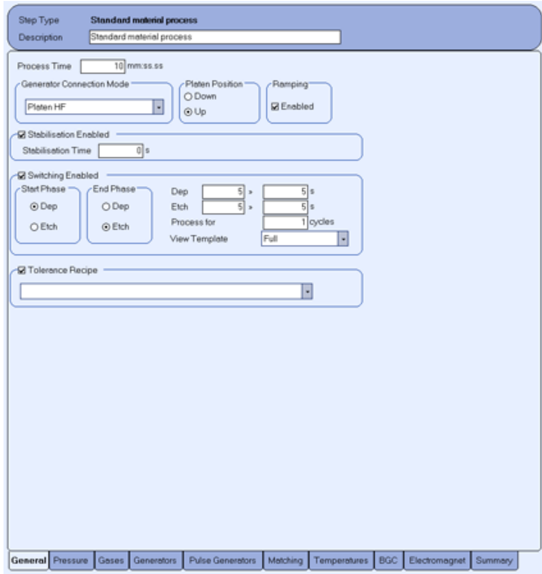


Figure 3.63 Typical General Page

3. Enter the total process time.
4. Enter the generator connection mode for example HF platen.
5. Enter whether the platen should be rased or lowered for processing.
6. Select whether parameter ramping is required for the process.

Note: *Parameter ramping is used to allow the user to set a start and end value for the system parameters to allow the selected parameters to increase or decrease over the full course of the process.*

7. Select whether gas stabilisation is required to allow the pressure within the chamber to stabilise before the step begins and enter a time for the stabilisation.

Note: *If a fast matching unit is fitted, the gas stabilisation time must be set to a minimum of 15 seconds.*

8. Select whether a switched process is required which consists of an etch cycle and a deposition cycle (ASE systems only).

   Using the radio buttons select whether the step should start and end on either an etch or deposition cycle.

   Enter the time in seconds for both the etch and deposition cycles and any required ramp rate (if selected).

   Using the dropdown list select whether to view the full (all information shown) or partial template.

9. Using the drop down menu select the tolerance recipe to be used for the step.

Note: *If no tolerance recipe is selected the default recipe will be used for the step.*

10. Save the changes by selecting the **Apply** button.

11. Select the pressure tab from the bottom of the navigation panel, the pressure page is displayed:

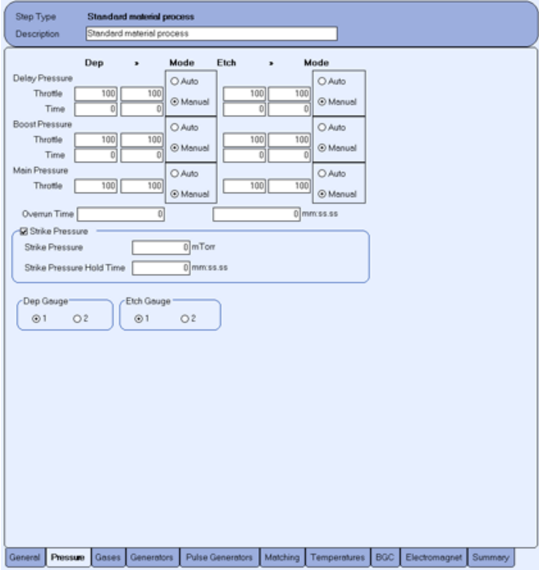


Figure 3.64 Typical Pressure Page

12. Select whether the delay, boost and main pressures should be controlled automatically or manually.

Note: *The delay and boost settings add more functionality to the process (ASE systems only).*

The delay settings allow a lower pressure to be applied and so with higher platen power allow deposition to be removed more effectively for a short period of time.

The boost setting is used to allow a greater initial etch rate before returning to the main pressure.

13. If automatic is selected enter the pressure for the step and the duration of the step including the ramp rate if required.

14. If manual is selected enter the throttle (APC) position for the step and the duration of the step including the ramp rate if required.

15. Enter the overrun time which will allow the selected pressure to run into the next etch or dep step of the process.

Note: *This function is normally only used on processes with larger switching times, typically greater than 15 seconds.*

16. Enter the strike pressure, which allows the plasma to be created and for the duration for which the strike pressure is held.

Note: *This function is normally only used on processes with very low process pressures and allows the plasma to be struck at a higher pressure before the chamber pressure reduces to the lower processing pressure.*

17. Using the radio buttons select which pressure gauges are to be used to monitor the process pressure (if multiple gauges are available).

18. Save the changes by selecting the **Apply** button.

19. Select the gases tab from the bottom of the navigation panel, the gases page is displayed:

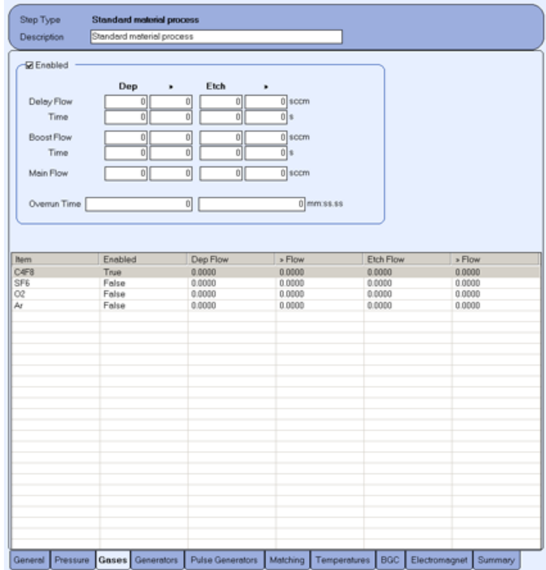


Figure 3.65 Typical Gases Page

20. Highlight the required gas from the table located on the information panel.
21. To use the gas selected within the step, select the tick box to enable the gas.

Note: *When the gas is enabled the enabled column in the row of the selected gas becomes true in the table located in the navigation panel.*

22. Enter the delay, boost and main flow for the selected gas and the ramp rate if required.
23. Enter the overrun time which will allow the selected gas to run into the next etch or dep step of the process.
24. Repeat steps 20. to 23. for the remaining required gases.

Note: *If two gases can not be used together for safety reasons, for example Oxygen and Hydrogen, the system will not allow the user to select both these gases.*

25. Save the changes by selecting the **Apply** button.

26. Select the generators tab from the bottom of the navigation panel, the generators page is displayed:

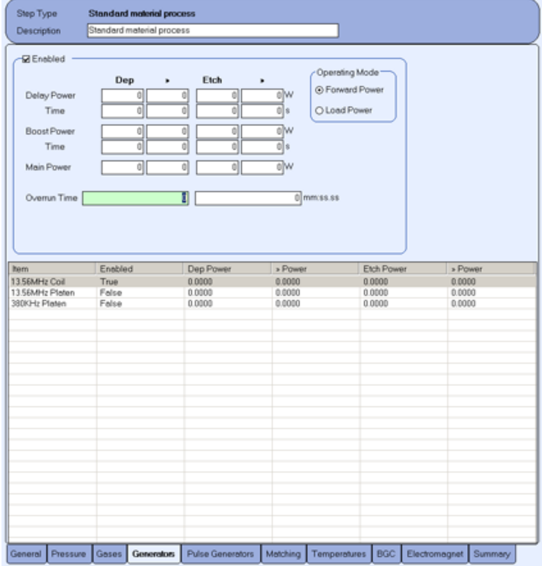


Figure 3.66 Typical Generators Page

27. Highlight the required generator from the table located on the information panel.
28. To use the generator selected within the step, select the tick box to enable the generator.

Note: *When the generator is enabled the enabled column in the row of the selected generator becomes true in the table located in the navigation panel.*

29. Enter the delay, boost and main power for the selected generator and the ramp rate if required.
30. Enter the overrun time which will allow the selected generator power to run into the next etch or dep step of the process.
31. Enter whether the generator operates in forward or load power using the radio buttons.
32. Repeat steps 27. to 31. for the remaining required generators.
33. Save the changes by selecting the **Apply** button.

34. Select the pulse generators tab from the bottom of the navigation panel, the pulse generators page is displayed:

Figure 3.67 Typical Pulse Generators Page

35. Highlight the required pulse generator from the table located on the information panel.

36. To use the pulse generator selected within the step, select the tick box to enable the generator.

Note: *When the pulse generator is enabled the enabled column in the row of the selected pulse generator becomes true in the table located in the navigation panel.*

37. Enter the delay, boost and main duty cycle as a percentage and time period.

Note: *The pulse generator function allows discharging of the substrate and so reduces the notching effect when a stop layer is reached.*

The duty cycle is the wave form of the RF and the pulse generator is switched on for a period during the duty cycle expressed as a percentage.

*The percentage value entered into the text field represents the time that the pulse generator is **off**. For example if 75% was entered into the field, the pulse generator would be **off** for 75% of the duty cycle.*

38. Save the changes by selecting the **Apply** button.

39. Select the matching units tab from the bottom of the navigation panel, the matching units page is displayed:

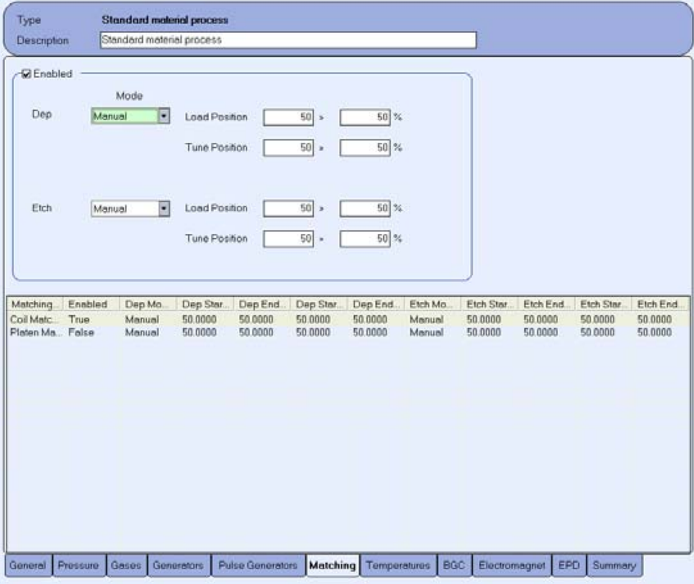


Figure 3.68 Typical Matching Units Page

40. Highlight the required matching unit from the table located on the information panel.

41. To set up the matching unit selected within the step, select the tick box to enable the generator.

Note: *When the matching unit is enabled the enabled column in the row of the selected matching unit becomes true in the table located in the navigation panel.*

42. For both the Dep and Etch fields, use the drop down box to select how the matching unit should be controlled.

- Manual - Both the load and tune settings remain in the set starting position
- Load Auto - Allows the load setting to change automatically, whilst the tune setting remains constant
- Tune Auto - Allows the tune setting to change automatically, whilst the load setting remains constant
- Full Auto - Allows both the load and tune settings to change automatically

43. Select the starting positions for the matching units, expressed as a percentage of their full travel.

44. Repeat steps 40. to 43. for the remaining required matching units.

45. Save the changes by selecting the **Apply** button.

46. Select the temperatures tab from the bottom of the navigation panel, the temperatures page is displayed:

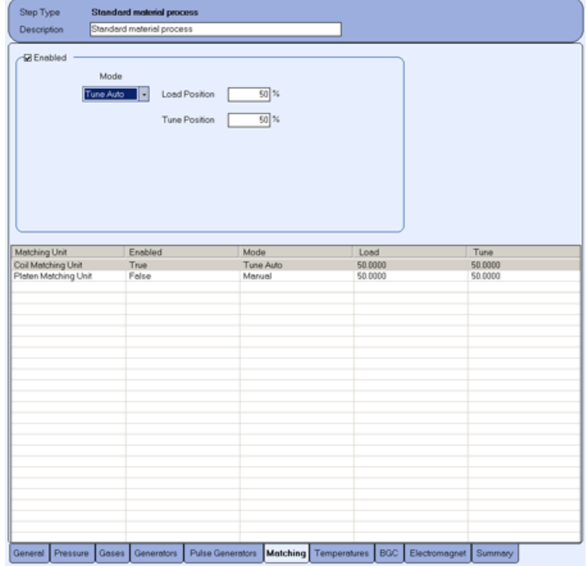


Figure 3.69 Typical matching Units Page

47. Highlight the required heating zone or external chiller from the table located on the information panel.

48. To set up the heater zone/chiller selected within the step, select the tick box to enable the heater zone/chiller.

Note: *When the heater zone/chiller is enabled the enabled column in the row of the selected heater zone/chiller becomes true in the table located in the navigation panel.*

49. If an external chiller is selected set the chiller temperature using the text field.

50. If a heater zone is selected, using the radio buttons, select how the heaters should be controlled.

- Don’t Change - The temperature will remain at the same setpoint for the duration of the process
- Manual - Control of the heat/cool zones is to be handled manually
- Automatic - Control of the heat/cool zones is to be handled automatically
- Automatic Adaptive - Control of the heat/cool zones is to be handled automatically with the system remembering previous instructions and adapting these to the current process

51. Enter the temperature for the heater zone.

52. Repeat steps 47. to 51. for the remaining required chillers/heater zones.

53. Save the changes by selecting the **Apply** button.

54. Select the backside gas cooling tab from the bottom of the navigation panel, the backside gas cooling page is displayed:

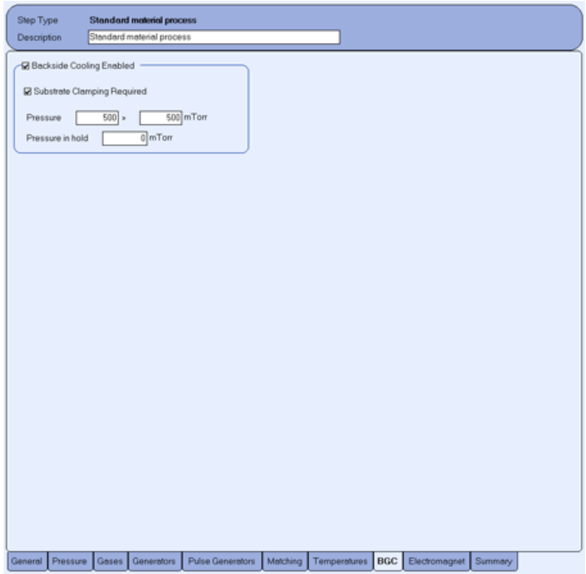


Figure 3.70 Backside Gas Cooling Page

55. Using the tick box select whether backside gas cooling is required.

56. Using the tick box select whether the substrate clamping is required.

57. Enter the backside gas cooling pressure and ramp rate (if required).

58. Enter the backside gas cooling pressure in hold.

Note: *The hold pressure is the pressure that is supplied to the substrate between process steps.*

59. Save the changes by selecting the **Apply** button.

60. Select the electromagnet tab (if fitted) from the bottom of the navigation panel, the electromagnet page is displayed:

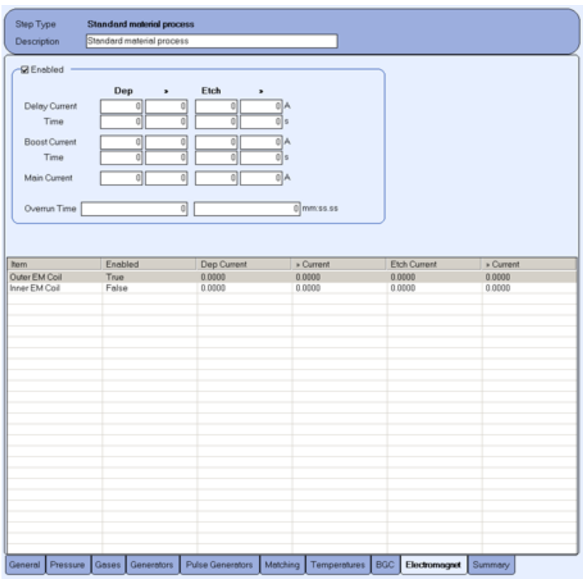


Figure 3.71 Typical Electromagnets Page

61. Highlight the required electromagnet from the table located on the information panel.

62. To use the electromagnet selected within the step, select the tick box to enable the electromagnet.

Note: *When the electromagnet is enabled the enabled column in the row of the selected electromagnet becomes true in the table located in the navigation panel.*

63. Enter the delay, boost and main power for the selected electromagnet and the ramp rate if required.

64. Enter the overrun time which will allow the selected electromagnet power to run into the next etch or dep step of the process.

65. Repeat steps 61. to 64. for the remaining required electromagnets.

66. Save the changes by selecting the **Apply** button.

67. Select the summary from the bottom of the navigation panel, the summary page is displayed:

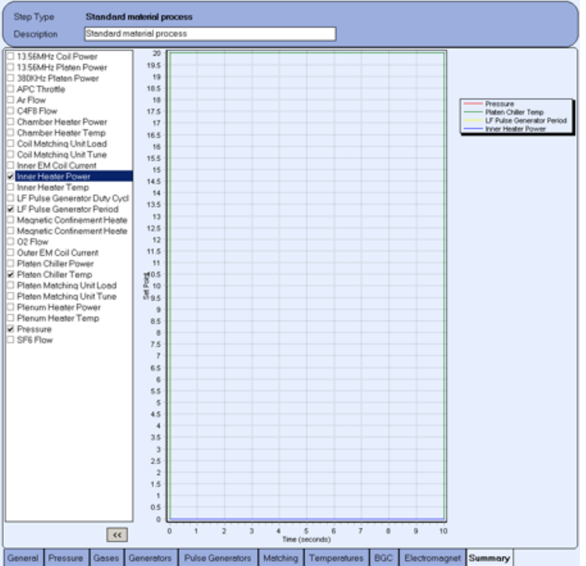


Figure 3.72 Typical Summary Page

68. Highlight the required fields to be viewed within the chart from the table located on the left of the information panel.

Note: *When the tick boxes are selected the selected the description and associated line colour appear in a table on the right hand side of the information panel.*

Note: *To remove the fields to be viewed selection boxes from view select the* **<<** *button on the information panel.*

69. Save the changes by selecting the **Apply** button.

3.8.1.5 Tolerance Recipe

The tolerance recipe dictates which parameters are to be monitored and the variation which is permitted before an error or fault condition is raised.

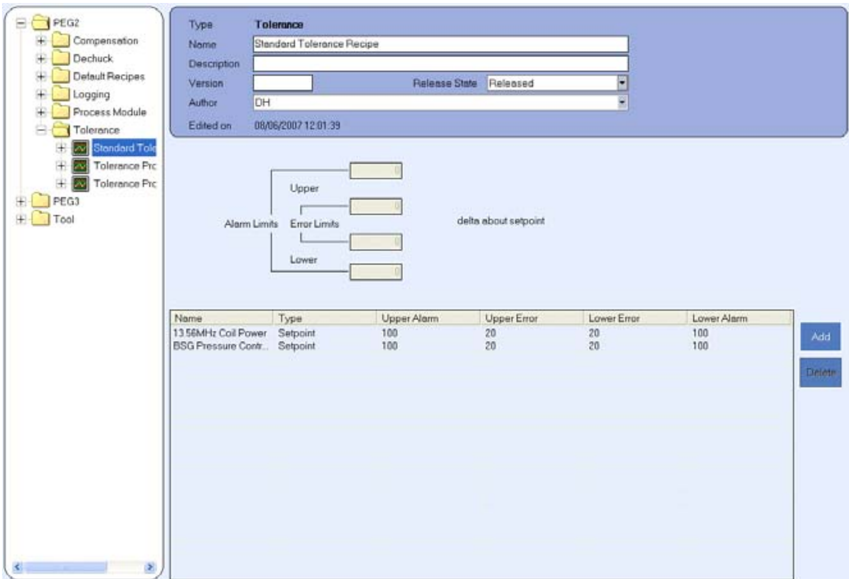


Figure 3.73 Typical Tolerance Recipe View

To write a tolerance recipe:

1. From the **Recipe** view, select the required **Process Module** folder and **Tolerance** folder.
2. On the command panel select the **New** button, a screen similar to the one shown below is displayed:

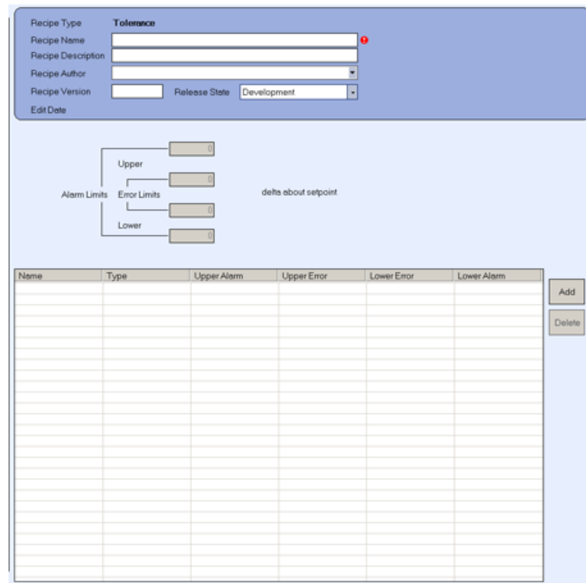


Figure 3.74 Typical Default Recipe View

3. Type in the recipe name in the **Recipe Name** field.

   Note: *This field is mandatory.*

4. Type in the recipe's author or select available authors from the drop down list.
5. Type in the recipe description and the version number.

Note: *These fields are not mandatory, however, STS recommend that you complete these fields for tracking purposes.*

6. Select the recipe status from the drop down list:

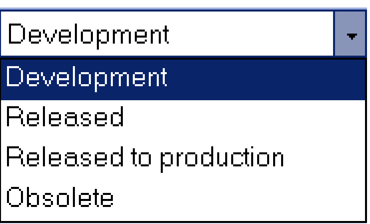


Figure 3.75 Typical Recipe Status View

Recipe Status	**Description**
Development	The recipe is still in a development stage and will not be allowed to run on the system.
Released	The recipe is allowed to be run in any mode above production level, i.e. normally only manual batches will be run using this recipe.
Released to Production	The recipe is allowed to be run in any mode including production, i.e. automatic batches can be run using this recipe.
Obsolete	The recipe has been made obsolete and so can no longer be run in any mode.

7. Select the **Add** button in the command panel and select the required parameter to be added from the drop down list.

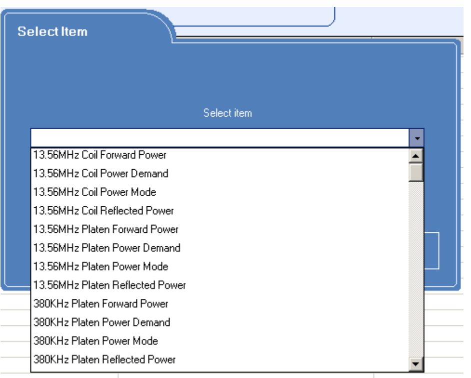


Figure 3.76 Typical Add Tolerance Parameter View

8. Click the **Finish** button and the parameter is added to the list.

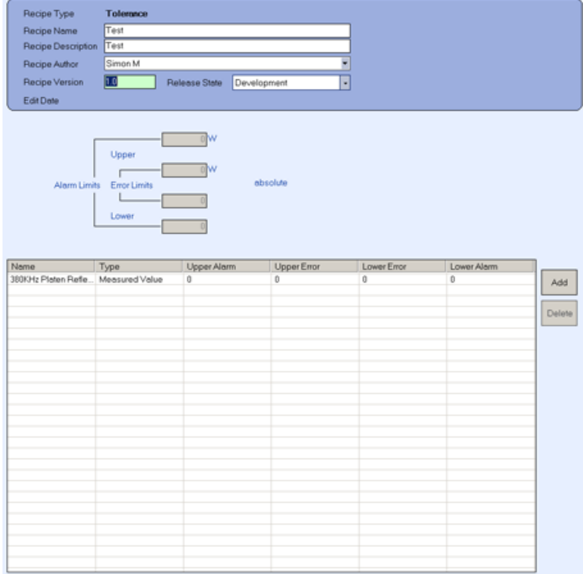


Figure 3.77 Typical Tolerance Parameter View

9. Enter the upper and lower alarm and error limits, if available.

Note: *Alarm and error limits must be entered and their values must not be zero. The recipe will fail with 'Out of Tolerance' errors if tolerance bands are not entered.*

Note: *If a value exceeds an error limit threshold the user will be made aware of the error and the current operation will continue. If an alarm threshold is reached the current operation will stop and the user will need to clear the alarm from the* ***Alarms*** *screen.*

10. Repeat steps 7. to 9. to select any further values that are required to have associated tolerance limits.

11. Save the changes to the tolerance recipe by selecting the **Apply** button.

3.8.2 Tool Recipes

Tool recipes are used to define the substrate path through the tool as well as the process recipes to be run on each substrate or between substrates. A tool recipe comprises of the following steps and intersteps:

Pre-Process
(e.g. Pre-Clean, Preparation)
Without Substrate

Process Recipe
Tolerance Recipe
Logging Recipe
Compensation Recipe

Tool Recipe Step
With Substrate

Process Recipe
Tolerance Recipe
Logging Recipe
Compensation Recipe
Dechuck Recipe

Tool Recipe Interstep
(Cleaning, etc.)
With or Without Substrate

Process Recipe
Tolerance Recipe
Logging Recipe
Compensation Recipe
Dechuck Recipe

Post Process
Without Substrate

Process Recipe
Tolerance Recipe
Logging Recipe
Compensation Recipe

Figure 3.78 Tool Recipe Block Diagram

3.8.2.1 Creating a Tool Recipe

The following procedure describes how to create a tool recipe that states that the actions defined should be applied to all associated substrates.

1. To create a new Tool Recipe select the **Tool** folder and select the new button:

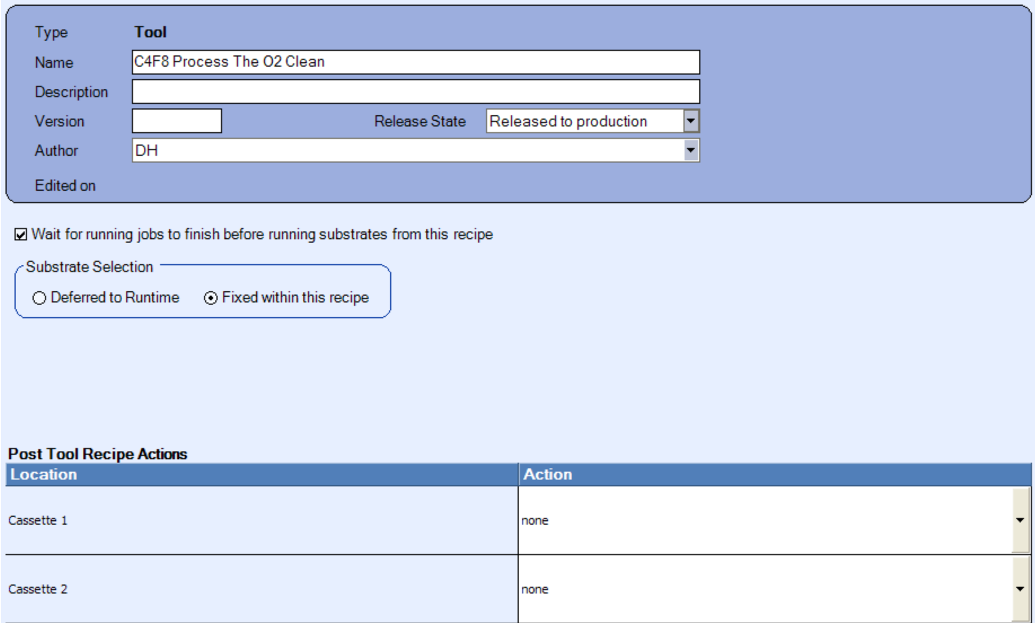


Figure 3.79 Typical Tool Recipe New Step

2. Type in the recipe name in the **Recipe Name** field.

Note: *This field is mandatory.*

3. Type in the recipe's author or select available authors from the drop down list.
4. Type in the recipe description and the version number.

Note: *These fields are not mandatory, however, STS recommend that you complete these fields for tracking purposes.*

5. Select the recipe status from the drop down list:

Figure 3.80 Typical Recipe Status View

Recipe Status	Description
Development	The recipe is still in a development stage and will not be allowed to run on the system.
Released	The recipe is allowed to be run in any mode above production level, i.e. normally only manual batches will be run using this recipe.
Released to Production	The recipe is allowed to be run in any mode including production, i.e. automatic batches can be run using this recipe.

Recipe Status	Description
Obsolete	The recipe has been made obsolete and so can no longer be run in any mode.

6. Select the 'Wait for running jobs to finish before running substrates from this recipe' tick box if this recipe cannot run until all other processes have finished.

7. Enter whether substrates are to be processed as dictated in the recipe or deferred to runtime using the radio buttons.

   Deferred to Runtime - The substrates are transferred as specified when the batch process is defined (see 3.5).

   Fixed with Recipe - The substrates are transferred as stated in the recipe.

8. Select the post schedule actions for the cassettes. This option allows the cassettes to either remain at vacuum (none), vent to atmosphere, request an unload operation from the operator or unload the cassette without any prompts after the Tool Recipe has been completed.

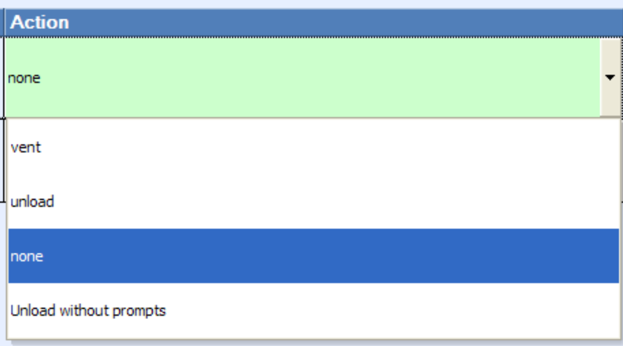


Figure 3.81 Post Recipe Actions

9. Save the changes to the tool recipe by selecting the **Apply** button.

10. Select the **New** button to add steps to the Tool Recipe.

3.8.2.2 Adding a Tool Recipe Interstep

The tool recipe interstep allows a process to be run after a pre-defined number of substrates, e.g. an oxygen clean.

To create a tool recipe interstep:

1. Select the required tool recipe and press the **New** button.

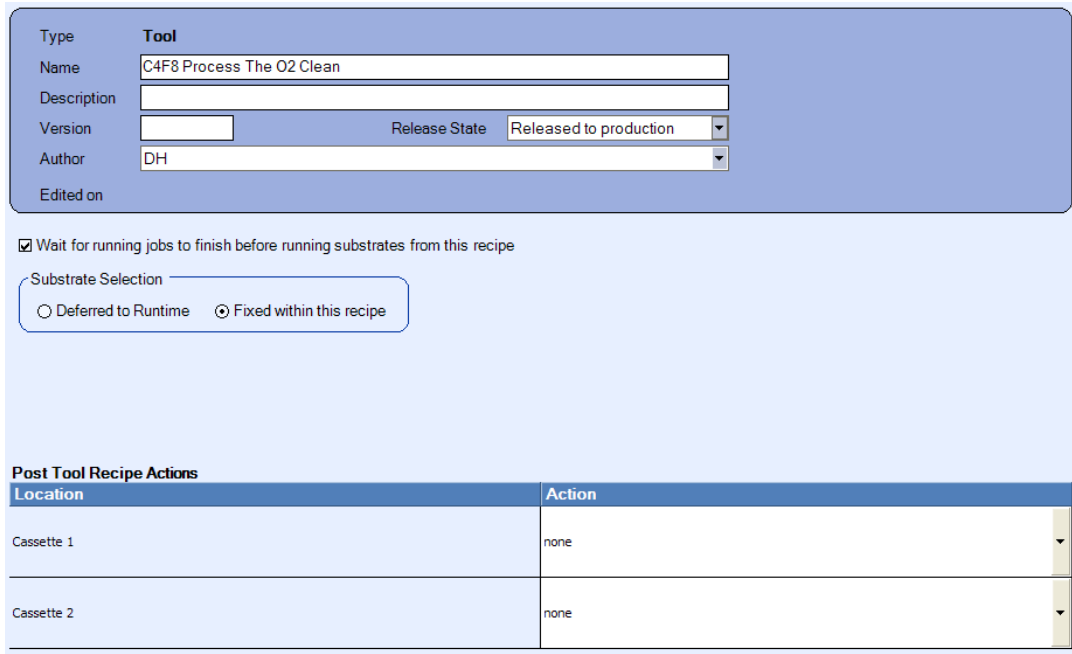


Figure 3.82 Typical Recipe Interstep New View

2. Select Tool Recipe Interstep.

Figure 3.83 Typical Tool Recipe Select Interstep View

3. Select where the interstep is to be performed within the tool recipe.

Note: *The position of the interstep within the recipe hierarchy may not actually show when the interstep will be run. The interstep will run when specifications set within the step itself are met,e.g. after a certain number of substrates have been run etc.*

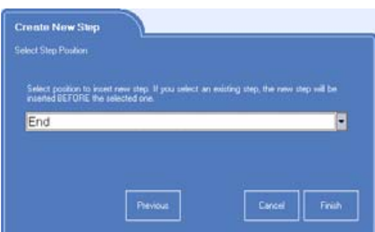


Figure 3.84 Typical Select Step Position View

4. To edit the tool recipe interstep, select the tool recipe and the tool recipe interstep.

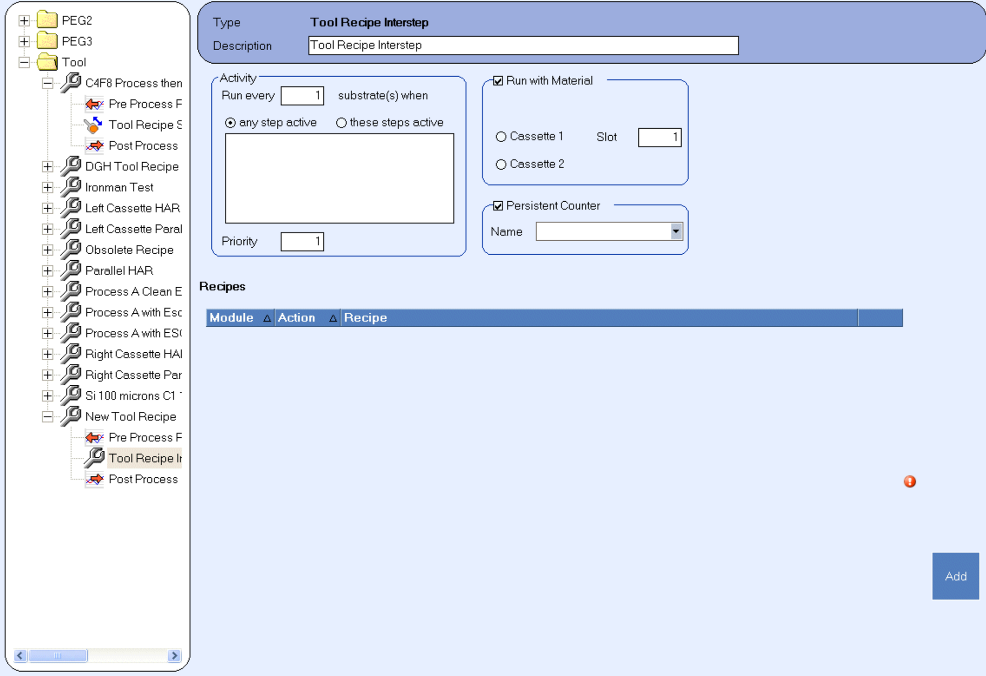


Figure 3.85 Typical Tool Recipe Interstep View

5. Enter when the interstep is to be run in the 'run every' text box. This allows the user to select how many substrates are run before the interstep is run.

6. Using the radio buttons select whether the interstep is to run when any step is active or when only certain steps are active. Use the check boxes to select which steps require the interstep to be run.

7. Enter the priority of the interstep (1 being highest). This function is used when two or more intersteps may conflict whit each and the highest priority will be run.

8. Select the 'Run with Material' tick box if the interstep is to be run with a substrate in the chamber. Select the radio button to choose where the substrate is to be loaded from and from which slot number.

9. Select the 'Persistent Counter' tick box if a persistent counter is to be used. When unchecked, the substrate count is reset after each tool recipe. When checked, the substrate count is not reset and is stored with the specified name. For example, if a clean was required every three substrates and the cassette contained five, then three substrates would be processed then a clean would happen then the final two substrates would be processed. The tool recipe would finish and a new cassette would load. Three further substrates would be run before cleaning. Therefore a run of five substrates would be processed in the chamber before cleaning if the persistent counter was not used.

10. Select the **Add** button to select which process module is to run the interstep and which process recipe is to be run.

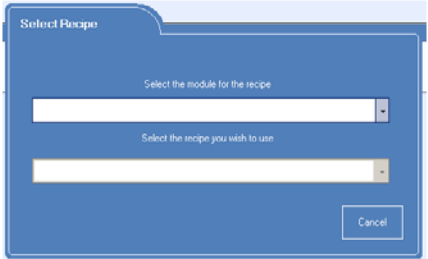


Figure 3.86 Tool Recipe Interstep Select Module and Recipe View

11. Repeat step 10. to add further process module recipes to the interstep.

12. Save the changes to the tool recipe interstep by selecting the **Apply** button.

3.8.2.3 Adding a Tool Recipe Step

The tool recipe step defines the following:

- Which positions the substrates are loaded from and returned to within the handling system
- The recipes that are run within the process chamber
- The order the recipes are run
- The priority of the recipes

1. To create a tool recipe step select the required tool recipe and press the **New** button.

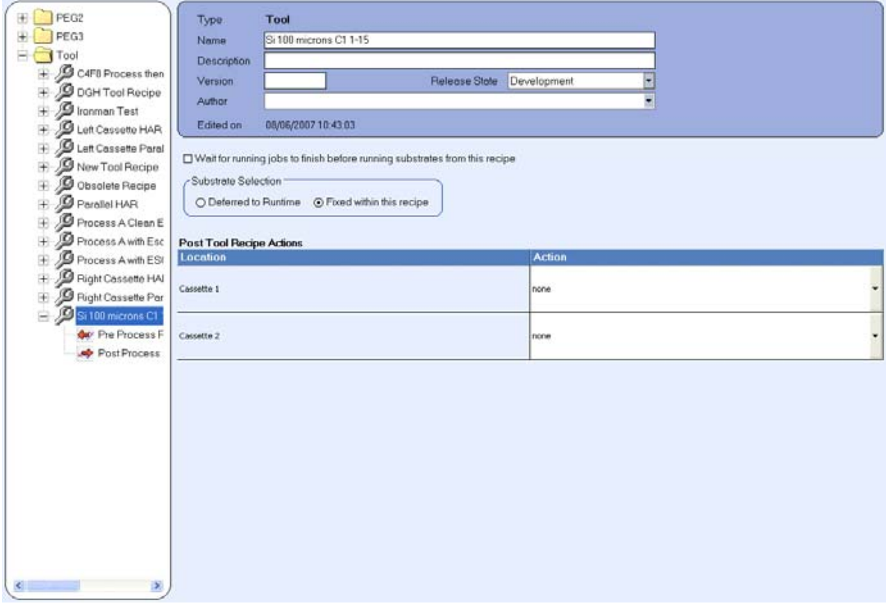


Figure 3.87 Typical Tool Recipe New View

2. Select Tool Recipe step and press **Next**.

Figure 3.88 Typical Tool Recipe Select Interstep View

3. Select where the step is to be performed within the tool recipe.

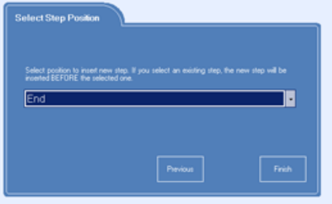


Figure 3.89 Typical Select Step Position View

4. To edit the tool recipe step, select the tool recipe and the tool recipe step.

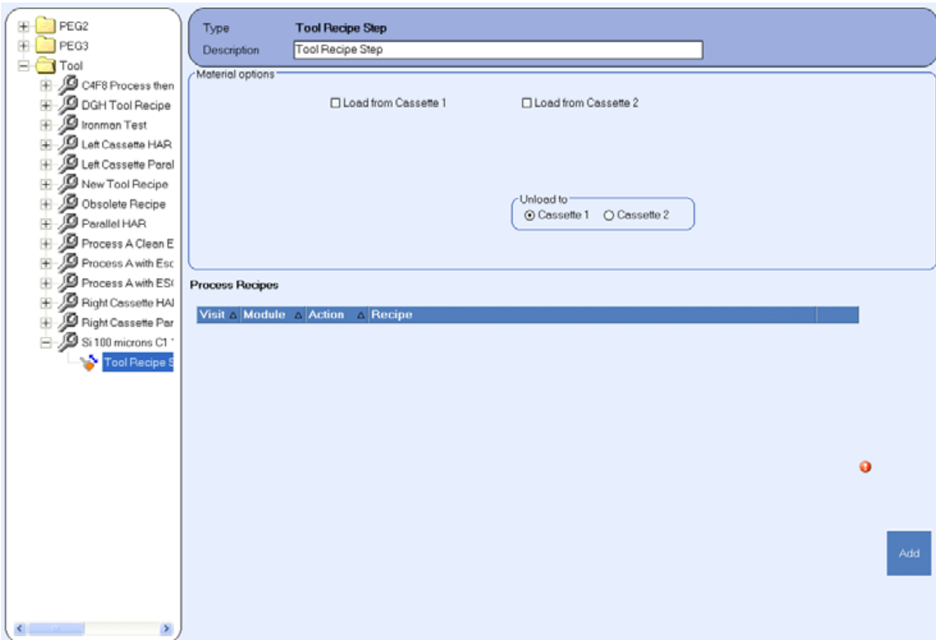


Figure 3.90 Typical Tool Recipe Step View

5. If required, use the Material Options block to define the substrates that this recipe will process (see Chapter 2 for details on the Material Options block).

Note: *Substrates defined here can be overridden when running the batch process.*

6. Select the **Add** button to select a Process Module and recipe.

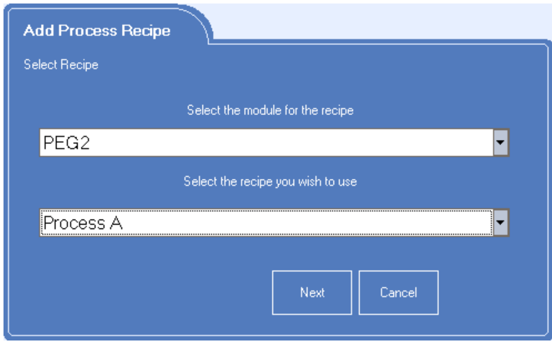


Figure 3.91 Typical Select Module and Recipe View

7. Select **Next** to add a new visit or to add to an existing visit.

Note: *A 'visit' can be thought of as a tool recipe sub-step. It allows a substrate to be transferred between chambers when required (CPX/VPX systems only).*
A visit also allows for 'alternatives'. For example, if the required process is available in several chambers then these could be added as alternatives for the same visit, i.e. 'place the substrate in either chamber 1 or chamber 2 or chamber 3' etc.

If the same visit number is selected for processes within the same chamber, the processes will be run consecutively.

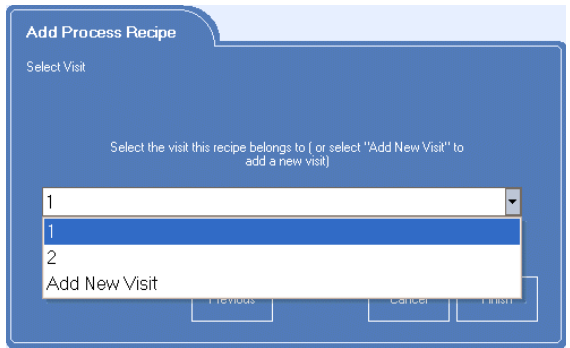


Figure 3.92 Typical Select Visit View

8. Repeat steps 6. to 7. to add the required recipes to be run.
9. Save the changes to the tool recipe step by selecting the **Apply** button.

A finished tool recipe will look similar to the one shown below:

Figure 3.93 Typical Completed Tool Recipe

Using the above example a substrate would travel through the process modules in the following order:

1. Visit 1, the first step of the process, will be carried out in either PEG2 or PEG3 process modules depending on which was available first.
2. Once the substrate is in the chamber the recipe ‘Process A’ will be carried out, this will be action 1 in that particular chamber.
3. Next the substrate will undergo ‘Process B’, this will be action 2 in that particular chamber.
4. The substrate will then have visit 2, i.e. the second step of the process carried out in PEG2 running ‘HAR Process’, this will be the first action in this chamber.

3.8.2.4 Adding a Pre Process Recipe

Pre process recipes allow the user to run a selected process(s) before the main tool recipe starts to allow, for example, the chamber to be conditioned.

To create a pre process recipe select the tool recipe and the pre process recipe option.

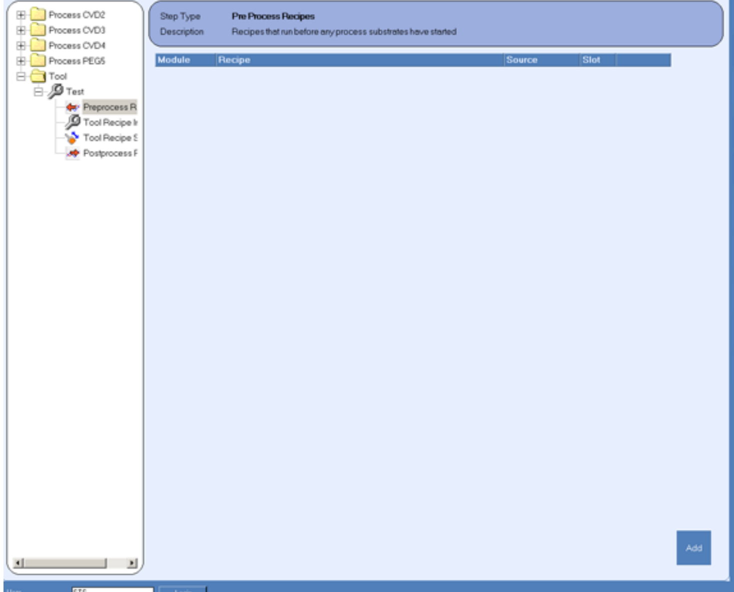


Figure 3.94 Typical Pre Process Recipe View

1. To add a new step to the recipe select the **Add** button.

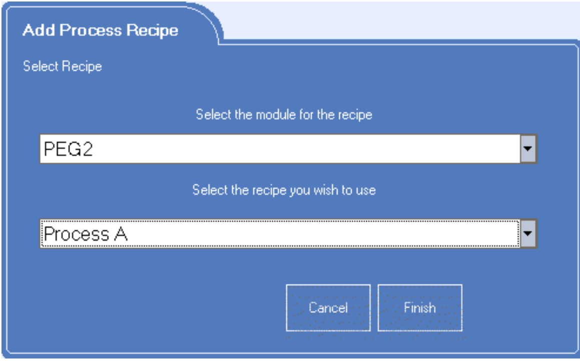


Figure 3.95 Typical Add Step View

2. Select the required process module and process step to be added.
3. Select the **Finish** button.
4. Repeat steps 1. to 3. to add the required recipes to be run.
5. Save the changes to the pre process recipe step by selecting the **Apply** button.

3.8.2.5 Adding a Post Process Recipe

Post process recipes allow the user to run a selected process(es) after the main tool recipe has finished to allow, for example, an oxygen clean to be run.

To create a post process recipe select the tool recipe and the post process recipe option.

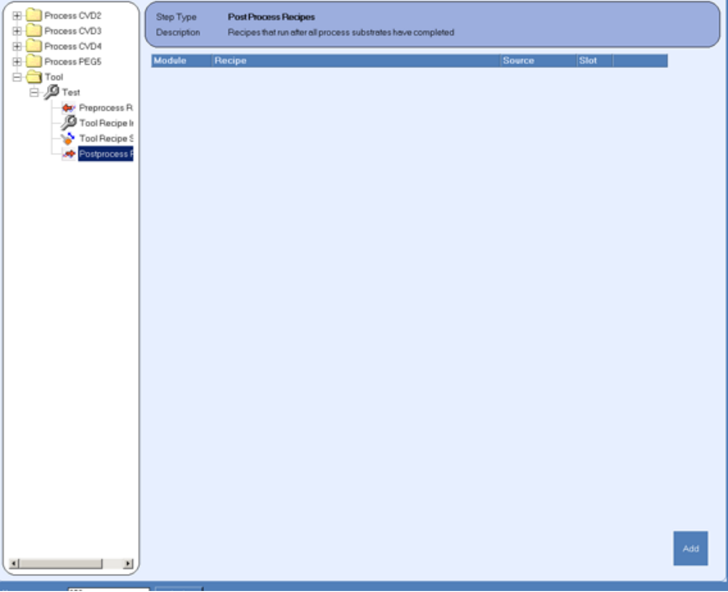


Figure 3.96 Typical Post Process Recipe View

1. To add a new step to the recipe select the **Add** button.

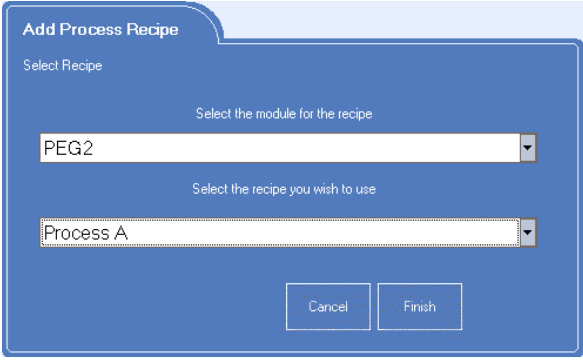


Figure 3.97 Typical Add Step View

2. Select the required process module and process step to be added.
3. Select the **Finish** button.
4. Repeat steps 1. to 3. to add the required recipes to be run.
5. Save the changes to the pre-process recipe step by selecting the **Apply** button.

3.9 Viewing the Datalogs

Various values, parameters and events are recorded during the operation of the tool. These records are stored as log files and the Datalog enables these log files to be viewed. There are five viewers available from the Datalog tab:

- Process Data Viewer
- Audit Log Viewer
- MFC Check Log Viewer
- Transfer Log Viewer
- Accumulator Log Viewer

3.9.1 Process Data Viewer

When a logging recipe is used to record various parameters of the process, the results are stored on the system and can be viewed using the process data viewer.

To monitor device readings:

1. From the **Main** view, select the **Datalog** tab.

   A window, similar to the one shown in Figure 3.98, is displayed.

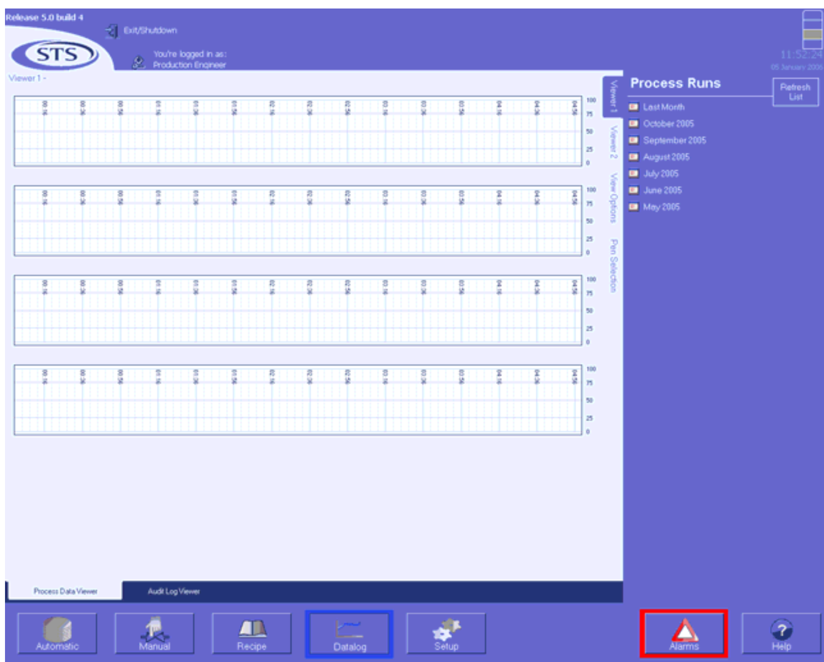
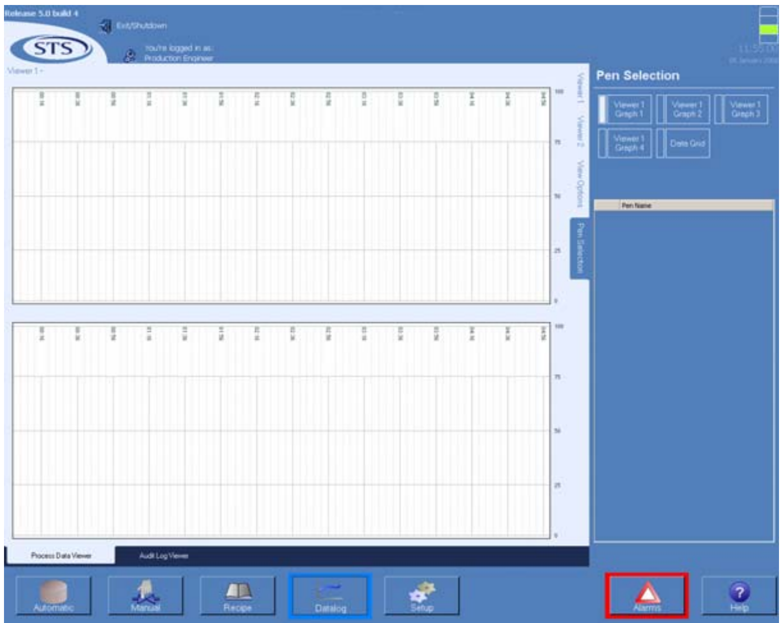


Figure 3.98 Typical Data Viewer Window

2. From the list on the left of the screen, select the required parameters by date to display.

3. To select the parameters to be displayed within the graph, select the **Pen Selection** tab.



4. Using the buttons in the command panel, select which viewer and graph the pens are to be applied to.
5. Using the check boxes, select which parameters are to be displayed.
6. Select how the data is to be displayed by selecting the **View Options** tab located in the Navigation panel.

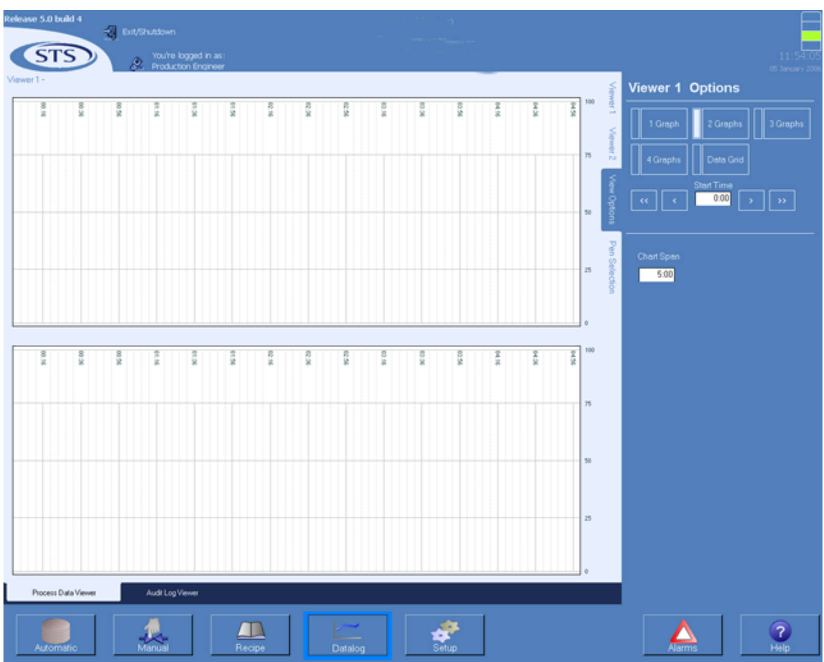


Figure 3.99 Typical View Options Tab

7. Select the number of graphs to be displayed, or whether a data grid is to be displayed, using the buttons in the command panel.
8. Enter the start time for the display.

Note: *Using the <<, <, > and >> allows the user to scroll backwards and forwards through the duration of the chart.*

9. Enter the span time of the chart displayed in minutes, for example, the chart shown in Figure 3.99 shows a span time of 5 minutes.
10. Select the **Viewer 1** tab to view the selected data.

An option has been incorporated to allow the user to compare two sets of data using the **Viewer 2** tab located in the command panel. To use the viewer 2 option:

1. Repeat steps 2. to 10. to set up the **Viewer 1** Options.
2. Select the **Viewer 2** tab.

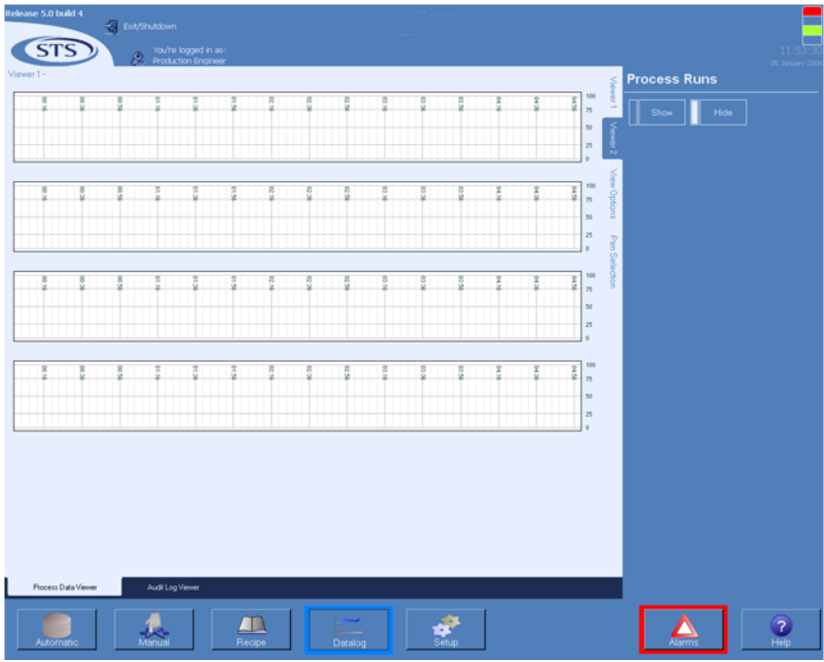


Figure 3.100 Typical Viewer 2 Tab

3. Select the **Show** button located in the command panel.
4. Set up the data viewer pen selections and options as detailed previously.
5. The **viewer 2** is now shown on screen below **viewer 1**.

3.9.1.1 Exporting Data

The user can export the data selected for fault finding or backup purposes.

1. From the **Main** view, select the **Datalog** tab.

2. Select the **Export** tab.

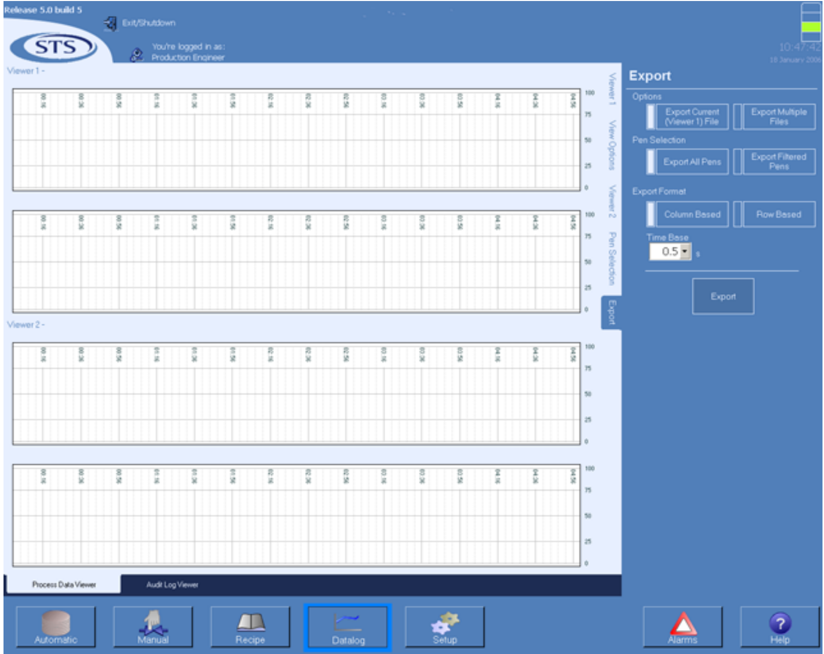


Figure 3.101 Typical Export Tab View

3. Select whether the current viewer is to be exported, or multiple viewer files.
4. Select whether to export filtered pen selections, those chosen on the pen selection tab or all available pens.
5. Select whether the exported data should be in a column or row base format.
6. Select the **Export** button
7. When prompted select where the .csv file should be exported to and the name it is to be saved under.

3.9.2 Audit Log Viewer

The audit log viewer allows the user to view all the system operations carried out over a period of time. Each record is displayed in one of three colours. The colours represent the following conditions:

- Blue - Messages
- Green - Warnings (may have an adverse affect on the process)
- Red - Alarms (will stop the process)

To use the audit log viewer:

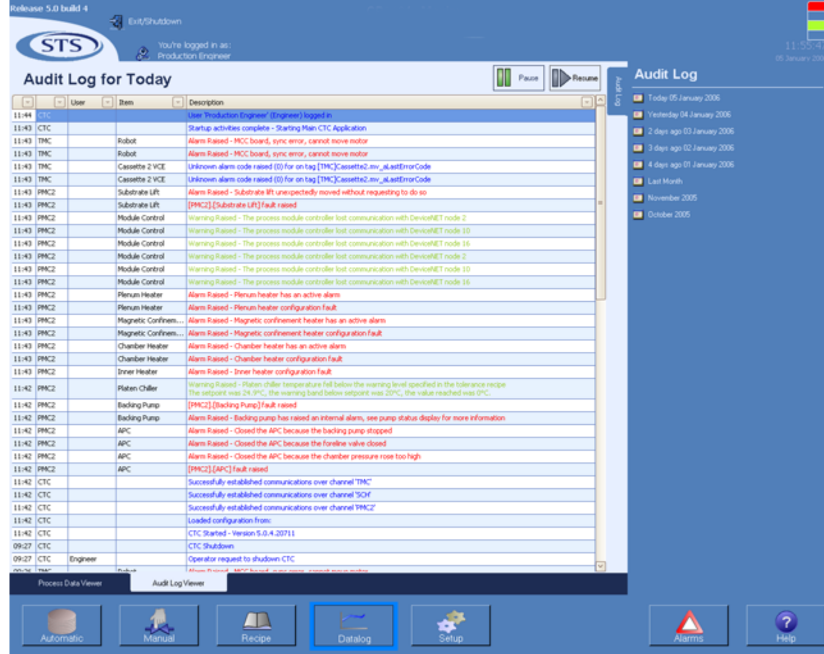


Figure 3.102 Typical Audit Log View

1. From the **Main** view, select the **Datalog** tab.
2. From the navigation panel, select the **Audit Log Viewer** tab.
3. From the available dates in the command panel, select the date and time of the log to be viewed.
4. The requested information will start scrolling down the screen in the command panel.
5. The user can configure how the data is displayed by sorting the information using the drop down menu in the navigation panel:

Figure 3.103 Typical Audit Log Drop Down Options

6. To pause the scrolling select the **Pause** button located in the navigation panel.
7. To resume the scrolling select the **Resume** button located in the navigation panel.

3.9.3 MFC Check Log Viewer

MFC Check operations are carried out using the process module operations function (see 3.7.2.3.9). The results of these MFC checks are viewed using the MFC check log viewer and the results can be compared with previous results to indicate if any MFC drift is happening over time.

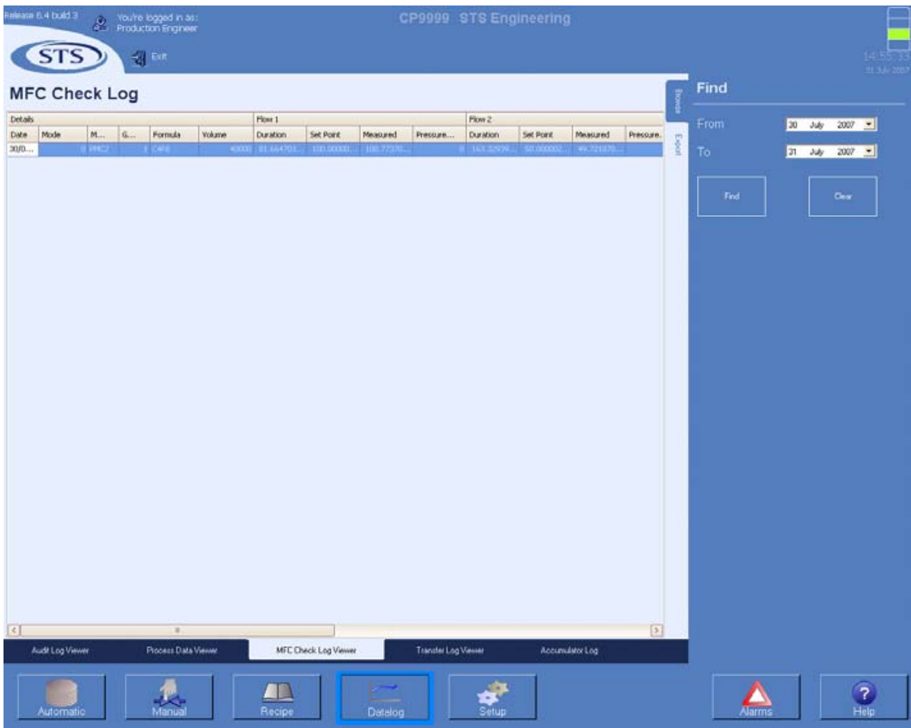


Figure 3.104 Typical MFC Check Log Viewer

To use the MFC check log viewer:

1. From the **Main** view, select the **Datalog** tab.
2. From the navigation panel, select the **MFC Check Log Viewer** tab.
3. From the available dates in the command panel, select the date and time of the log to be viewed.
4. The records can be sorted by clicking on a column heading

3.9.3.1 Exporting Data

The user can export the data selected for fault finding or backup purposes.

1. From the **Main** view, select the **Datalog** tab.
2. Select the **Export** tab.

3. Choose if the file is to be exported as an XLS or CSV file.

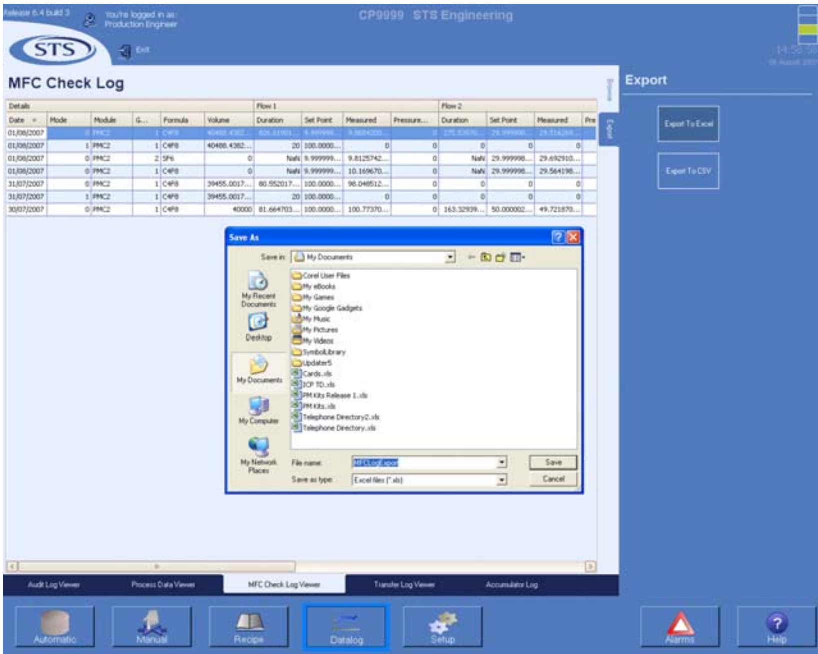


Figure 3.105 Typical Export Tab View

4. Use the Save As dialog to save the file in the desired directory.

3.9.4 Accumulator Log Viewer

Certain devices are monitored and their usage recorded by the system. For example, the RF running time for each generator or the number of pump starts, etc. These records can be viewed using the Accumulator log viewer.

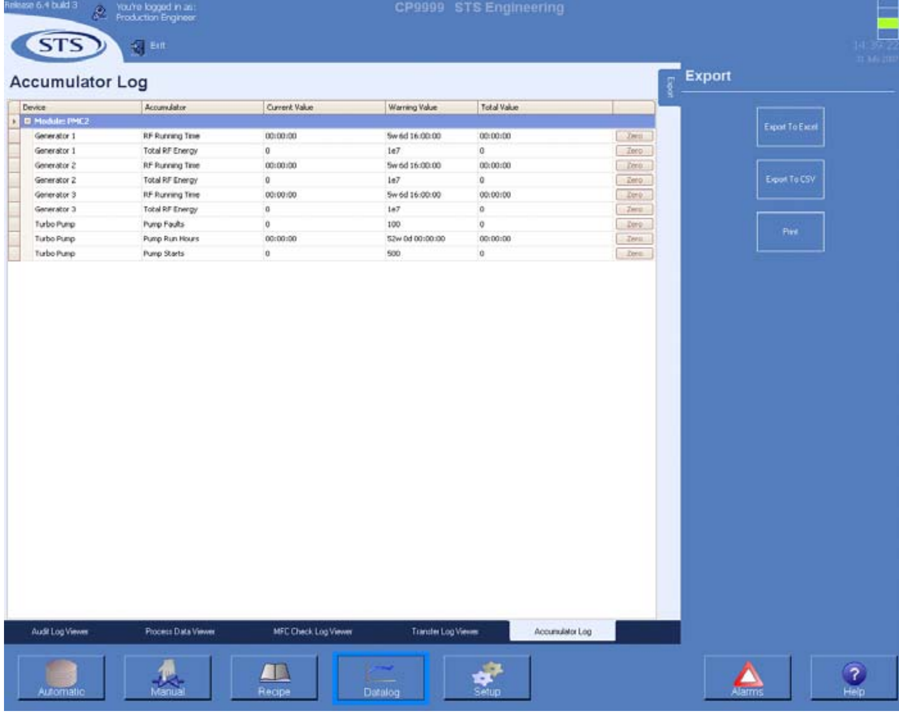


Figure 3.106 Typical Accumulator Log Viewer

To use the transfer log viewer:

1. From the **Main** view, select the **Datalog** tab.

2. From the navigation panel, select the **Accumulator Log Viewer** tab.
3. The Current Value field can be reset by selecting the **Zero** button.

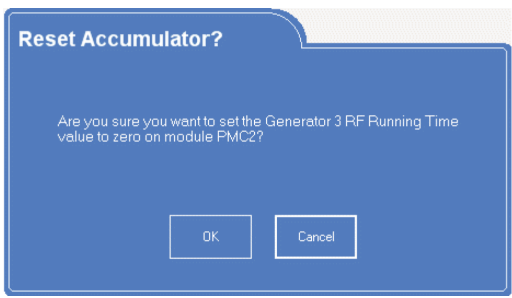


Figure 3.107 Resetting the Current Value Field

3.9.4.1 Exporting and Printing Data

The user can export the data selected for fault finding or backup purposes.

1. From the **Main** view, select the **Datalog** tab.
2. Select the **Export** tab.
3. Choose if the file is to be exported as an XLS or CSV file.

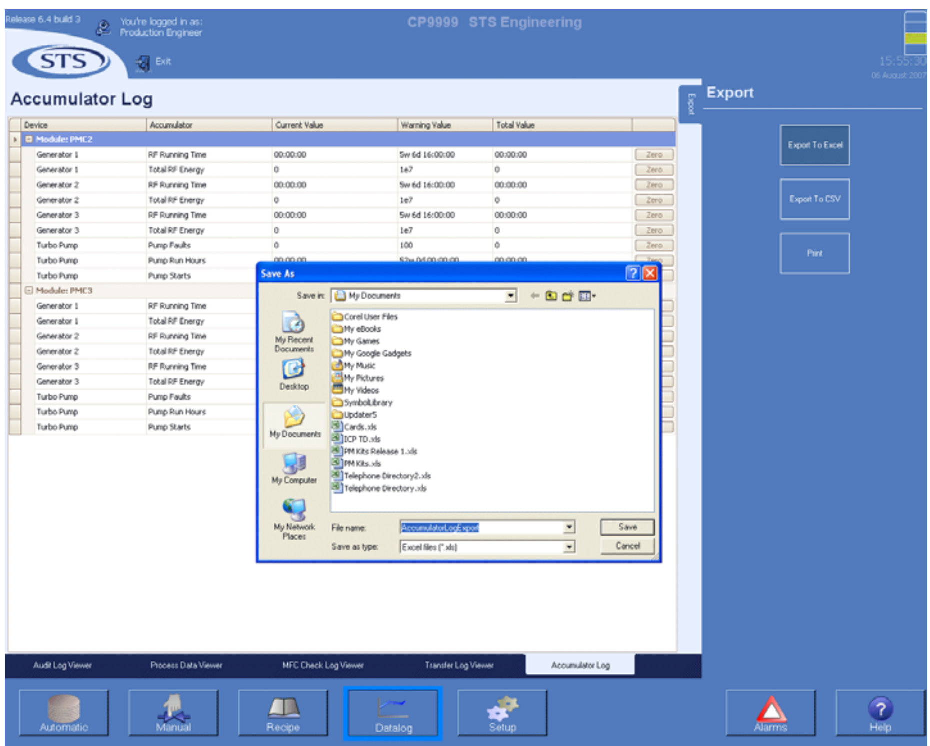


Figure 3.108 Typical Export Tab View

4. Use the Save As dialog to save the file in the desired directory.
5. Alternatively select the **Print** button to print to the local printer.

3.10 Setup

The **Setup** button opens the **Setup** view. From here, Users, User roles and User groups can be defined. Also, there are additional tabs that enable advanced tool configuration to be accomplished.

The following tabs are available from this view:

- **User Profiles**
- **Configuration Editor**
- **Material Station Editor** (Option)

3.10.1 User Profiles

This section details how to set up users and roles and explains the configuration editor.

The following options are available from the **User Profiles** tab:

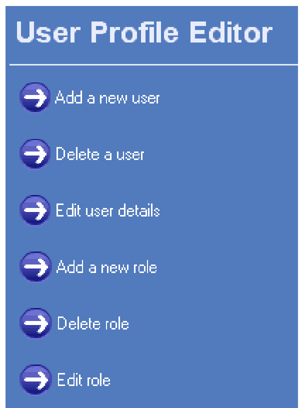


Figure 3.109 Typical Setup Options

3.10.1.1 Adding a User

This option adds a new system user, plus define the user's group membership. Group membership defines the type of access that a user has within the system.

To add a user:

Note: *If you make a mistake or wish to cancel the addition, press the* **Discard** *button at any time.*

1. Select the **Setup** button.
2. Select **Users** in the navigation window.

   A window, similar to the one shown in Figure 3.110, is displayed.

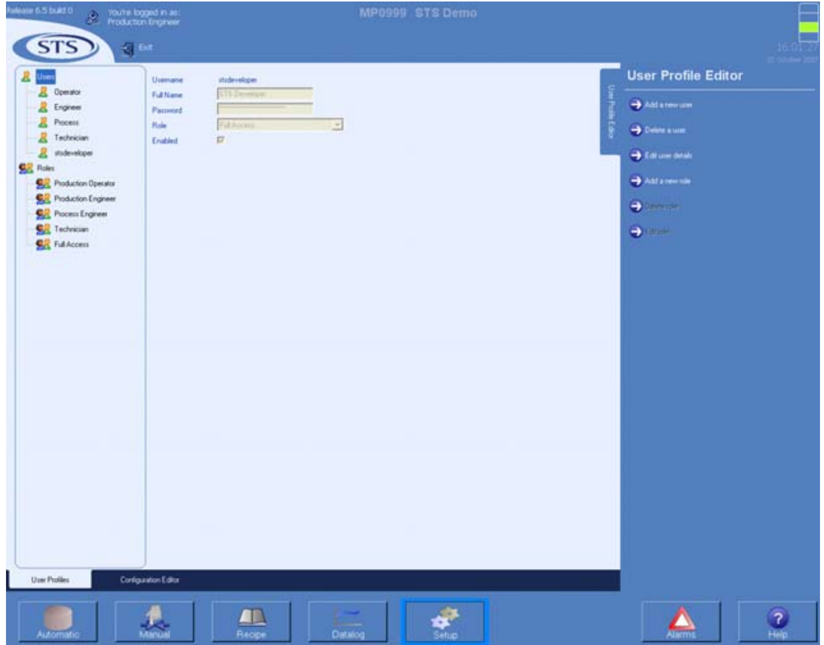


Figure 3.110 Typical User Group Membership Window

3. Select the **Add User** button in the command panel.
4. In the **UserName** field, type in the user name.

   The name must be unique and can be a maximum of 30 characters.

Figure 3.111 User Account Name Dialogue

5. In the **Full Name** field, key-in the full name of the user.
6. In the **Password** field, key-in the user's password.

   This field must be filled in, you cannot leave this field blank.
7. In the **Confirm** field, enter the password again.
8. From the **Role** field's drop-down list, select the group membership.

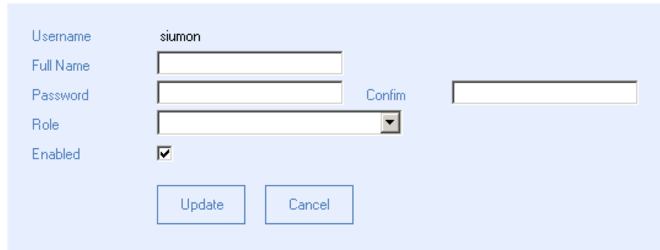


Figure 3.112 User Details Dialogue

9. Select the enabled check box and select the **Update** button to add the user.

3.10.1.2 Edit User's Details

This option allows you to change the selected system user's details.

To modify a user's details:

> ***Note:*** *If you make a mistake or wish to cancel the modification, press the* **Discard** *button at any time.*

1. Select the **Setup** button.
2. Select **Users** in the navigation window.

   A window, similar to the one shown in Figure 3.110, is displayed.
3. Select **edit users details** in the command panel
4. Highlight a user from the list displayed at the top of the window.

   The user's details are displayed.
5. Move to the field that requires modifying.
6. Make the required changes.
7. Repeat as required.
8. Select the **Update** button to save your modifications.

3.10.1.3 Deleting a User

To delete a user:

> ***Note:*** *If you make a mistake or wish to cancel the deletion, press the* **Discard** *button at any time.*

1. Select the **Setup** button.
2. Select **Users** in the navigation window.

   A window, similar to the one shown in Figure 3.110, is displayed.
3. Select **Delete user** in the command panel.
4. Highlight a user from the list displayed at the top of window.

   The user's details are displayed.
5. Select the **Delete** button.

3.10.1.4 Creating, Editing and Deleting Roles

This option enables you to define the access that each group has within the system.

> ***Note:*** *You can only allow or deny a group's access to the displayed privileges, you cannot add or delete the privileges.*

To edit a role's privileges:

1. Select the **Setup** button.
2. Select **Roles** in the navigation window.

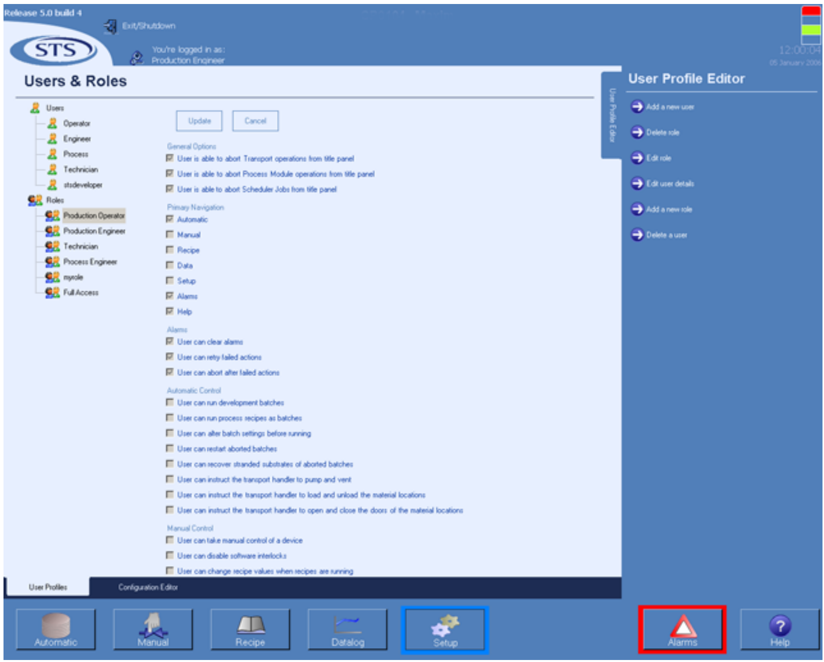


Figure 3.113 Typical Roles Window

3. Select **create, edit or delete role** in the command panel.
4. Open the folder for the user group that you wish to modify, for example, the **Production User** folder.
5. Save any changes by selecting the **Update** button.

3.10.2 Configuration Editor

The configuration editor allows the user to change device settings where available.

ALTERING SETTINGS WITHIN THE CONFIGURATION EDITOR CAN CAUSE DAMAGE TO THE EQUIPMENT AND/OR INJURY OR LOSS OF LIFE. SETTINGS SHOULD ONLY BE CHANGED BY SUITABLY TRAINED PERSONNEL OR STS SERVICE ENGINEERS. IF FURTHER ADVICE IS REQUIRED CONTACT STS DIRECT FOR ASSISTANCE.

Note: *If an option is not available to be altered a padlock symbol is located next to the value to indicate no changes can be made.*

Note: *This section gives a brief overview of the configuration editor. Further details can be found within the service manual supplied with the system.*

To use the configuration editor:

1. Select the **Setup** button.

2. Select the **Configuration Editor** tab.

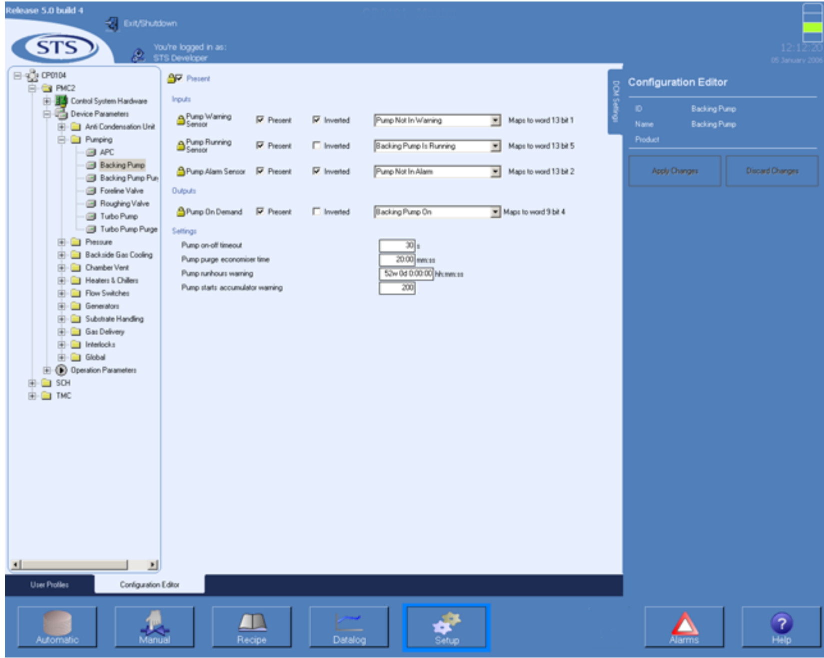


Figure 3.114 Typical Configuration Editor View

3. Select the device to be configured in the left hand pane of the navigation window.
4. Make the required changes and select the **Apply Changes** button in the command panel.

3.10.3 Material Station Editor

The material station editor enables the tool to be configured for different substrate sizes.

Note: *The* ***Material Station Editor*** *tab enables the user to configure the system so that different sized substrates can be processed. This size change must only be done in consultation with STS and therefore this functionality is not covered in the Operator's Manual.*

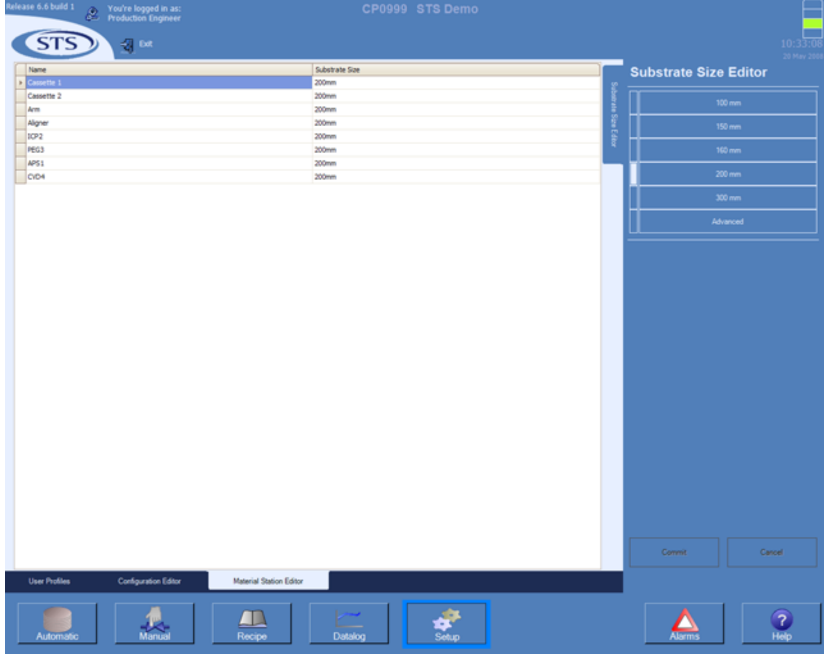


Figure 3.115 Typical Material Station Editor View

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