PLC50Cryogenic System

User Guide



* PLC 50 Cryogenic System

User Guide



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Before You Begin

About This Guide

Welcome to the *PLC50 Cryogenic System User Guide*. This guide contains information about unpacking, installing, operating, and maintaining the PLC50 system.

Notational Conventions

This manual uses the following conventions:



Note

Note is used to indicate important information about the product that is not hazard related.



CAUTION

Caution is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.



WARNING

Warning is used to indicate the presence of a hazard which can cause substantial personal injury or property damage if the warning is ignored.



DANGER

Danger is used to indicate the presence of a hazard which will cause severe personal injury, death or substantial property damage if the warning is ignored.

Safety

This equipment is designed to protect the user against all possible hazards. After review by qualified safety personnel, you should generate specific safety procedures with regard to your particular application and local codes. If the equipment is being used to probe high voltage devices, post the safety procedures in obvious locations.

Safety related checks should be performed in accordance with supplier specifications prior to the system acceptance. These safety checks, carried out at installation, should be accepted by both the supplier and the customer.

The installation site acceptance test should be signed by the supplier and the customer.



Note

See the national and international safety regulations, such as BGV A 2 and EC User Guidelines 89/655/EWG from November 1989, including the latest update.

	General Precautions	Ensure that the safety cover is in place during station operation.
		Do not touch the probe needles.
		Earthquake protection for the probe system consists of interlocking coupling between the table and the probe station.
	Electrical Precautions	The device operates under low voltage (up to 28 V DC). Voltage can remain in the system until the main switch is turned off, even during equipment failure. Do not touch the electrical connections.
		When probing high voltage devices, lethal voltages may be present at the probe tips, probe head connectors and on non-shielded or non-isolated probe arms. Avoid coming in to contact with these system components during testing.
		Do not open or remove covers. The ProberBench Electronics II contains electrical circuits with lethal voltage and current levels.
		Do not attempt switching of subassemblies or circuit cards. Also, switching of subassemblies under voltage can destroy the assembly. Contact a Cascade Microtech service representative for any service to the subassembly.
	Laser Precautions	Your station configuration may include a laser cutter. Avoid eye and skin exposure to direct or scattered radiation.
	Moving Parts	Risks during station operation include crushing, tripping, burning or being caught up in the equipment. Possible danger areas are marked with the labels on the following pages and will also be highlighted throughout this manual.
		Do not reach into the probe station when it is plugged into the mains. Avoid reaching into the chuck area as there is a risk of getting caught in moving parts. This risk is increased when working with a probe adapter, as the rear area remains open.
		Be careful to keep loose clothing or long hair from getting caught in the system.
		Be careful when raising and lowering the microscope to prevent injury.
	Magnetic Precautions	When handling components with powerful built-in magnets, take special care to avoid injury or damage to the equipment.
		If magnetic equipment is in close vicinity to iron, the abruptly acting forces may cause injury such as pinched fingers.
		If precision equipment such as watches or magnetic cards are brought close to the magnetic equipment, their functions may be damaged.
		If medical equipment, such as a pacemaker, comes into proximity to the magnetic equipment, there is a risk of degraded performance.
	Thermal Precautions	Illuminator bulbs reach very high temperatures. Allow adequate time for bulbs to cool before replacing.
		Your station configuration includes a cryogenic chuck, which operates at extreme, hot and cold temperatures that can cause injury upon contact. Allow adequate time for the chuck and shield to cool down or warm up to ambient temperature before servicing the parts.
/ 黎】		Use the PLC50 for temperatures below ambient only under vacuum condition (pressure < 1*10-3mbar) to prevent damage to the DUT or the equipment by condensation. Exception: Nitrogen gas purge of the chamber at warm-up to ambient temperature.
		Use the PLC50 for temperatures above ambient only under vacuum condition (pressure < 1*10-3mbar) to prevent damage to the DUT or the equipment by oxidation or excessive temperature.
		Use provided protective equiment when handling the liquid gas dewar and the liquid gas transfer line.

Labels



Attention, moving parts! Danger of injury! Do not touch the machine when switched on!

Achtung, bewegte Teile! Verletzungsgefahr! Im eingeschalteten Zustand nicht hineingreifen!

Attention, pièces en mouvement! Risque de blessures! Ne pas toucher pendant le fonctionnement de la machine!

Attenzione, parti in movimento! Pericolo, non toccare se la maccina è in funzione!



Attention, hot surfaces! Danger of burning! Do not touch when active!

Achtung, heiße Flächen! Verbrennungsgefahr! Im aktiven Zustand nicht berühren!

Attention, zones chaudes! Risque de brulures! Ne pas toucher si actif!

Attenzione superficie calda! Rischio di ustioni, non toccare una volta attivo!



Attention, cold surfaces! Danger of freezing! Do not touch when active!

Achtung, kalte Flächen! Erfrierungsgefahr! Im aktiven Zustand nicht berühren!

Attention, zones froides! Risque de brulures! Ne pas toucher si actif!

Attenzione superficie fredda! Rischio di congelamento, non toccare una volta attivo!



Attention, laser beams! Danger of getting hurt without eye protection!

Achtung, Laserstrahlen! Ohne Augenschutz Verletzungsgefahr!

Attention rayonnement Laser! Risque de cécité en l'absence de lunettes de securité!

Attenzionne raggio laser! Pericolo ustioni, non tocarre se la macchina è in fuzione!



Attention, high voltage! Danger of electrical shock! Do not touch during operation!

Achtung, spannungsführende Teile! Gefahr des elektrischen Schlages! Im eingeschalteten Zustand nicht berühren!

Attention, haute tension! Risque d'électrocution! Ne pas toucher pendant le fonctionnement de la machine!

Attenzione alta tensione! Pericolo, non toccare se la macchina è in fuzione!



Attention, general hazard! Pay attention to the information given in the manuals!

Achtung, allgemeiner Gefahrenhinweis! Informationen im Handbuch beachten!

Attention, danger! Consulter les informations fournies dans les notices de la machine!

Attenzione pericolo! Leggere attentamente il manuale!

For More Information

More information may be available from these sources:

World Wide Web: Cascade Microtech maintains an active site on the World Wide Web at
 <u>www.cascademicrotech.com</u>. The site contains current information about the company
 and locations of sales offices, new and existing products, contacts for sales, service, and
 technical support information. You can also send e-mail to Cascade Microtech using the
 web site. Requests for sales, service, and technical support information will receive a
 prompt response.



Note

When sending e-mail for technical support, please include information about both the hardware and software, with a detailed description of the problem, including how to reproduce it.

Other: If you purchased your Cascade Microtech product from a third-party vendor, you
can contact that vendor for service and support.

Chapter

1 Overview

Probe System Components

The PLC50 is designed for manual probing devices at low temperatures under vacuum conditions, condensation-free down to a temperature of 4K. It allows probing in a vacuum chamber with positioners on wafers and substrates typically up to a diameter of 80 mm, using up to six (6) specially designed cryogenic positioners for PLC50.



A specially designed vacuum-proof high precision X-Y stage is located inside the chamber. This stage carries an extremely well isolated cryogenic heat-exchanger (cryogenic chuck) as part of the continous-flow cryostat.

For reducing the heat transfer by radiation from the vessel walls to the DUT, a cryogenic shield is located above and around the cryogenic chuck which covers the whole stage travel range. This cryogenic shield is actively temperature controlled. The coolant flow can be switched between cold shield and cryogenic chuck and by that allows independent control of cold shield temperature and cryogenic chuck temperature. The cryogenic chuck and shield are connected with the bottom plate of the chamber by tube lines.

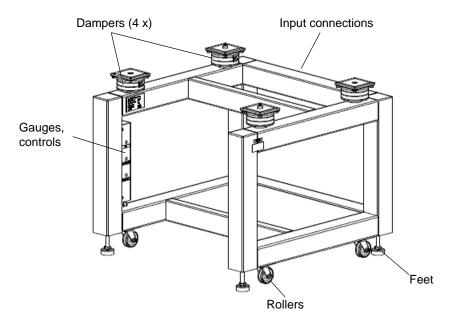
The high vacuum system consists of a pre-pump (diaphragm pump) and a high performance molecular pump achieving final absolute pressures of < 1*E-3 mbar.

The devices (wafers and substrates) are fixed onto special carriers. For loading and unloading these carriers onto the cryogenic chuck, the chamber top cover must be opened.

Depending on the necessary resolution, the DUT can be monitored with a Optem Zoom70 microscope (standard), or with a Mitutoyo FS70. Different C-mount cameras are available as accessory.

Vibration Isolation Table

The vibration isolation table is equipped with four (4) pneumatic dampers.



The input connections for compressed dry air and nitrogen gas are located at the rear side. Compressed dry air is used for the pneumatic dampeners and nitrogen gas for the chamber purge. The air is distributed between the four dampers.

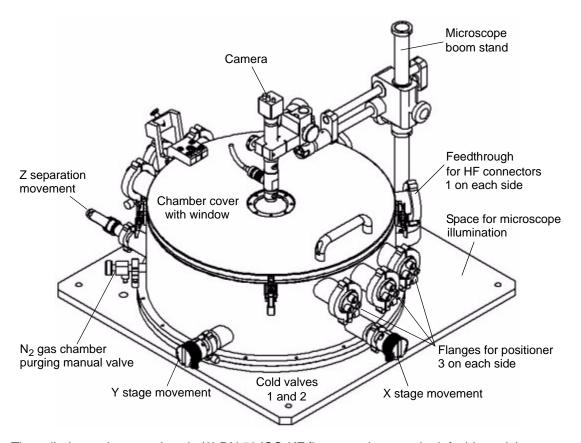
Base Plate

The base plate, located on top of the vibration isolation table, carries the vacuum chamber, the microscope unit and optional components.

Vacuum Chamber

The vacuum chamber includes a bottom plate, a cylinder casing made of stainless steel, and a hinged aluminium top cover with a view port. The diameter is approximately 600 mm and the height is 275 mm.

The bottom plate is equipped with several flanges for the connection to the vacuum pump unit, gauges, sensors, electrical feedthroughs, inlets and outlets for the cryogenic components. The DC measurement feedthroughs are also typically mounted into the bottom plate.



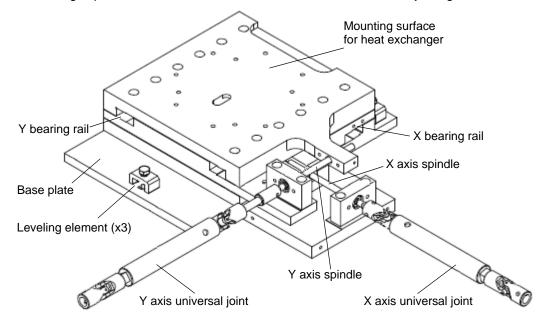
The cylinder casing contains six (6) DN 50 ISO-KF flanges—three on the left side and three on the right side—as mechanical feedthroughs to operate PH110HV positioners from outside the chamber, and also contains two flanges in the rear for measurement feedthroughs (HF signals, optical fibers etc.).

The cylinder also contains the mechanical feedthroughs for operating the XY chuck stage and the probe platen contact/separation stroke from outside, a flange with safety valve, and N_2 gas purging input.

The central optical window on the topside of the chamber is a 75 mm diameter view port for monitoring the substrate or wafer during probing with the microscope. The chamber top cover is used for loading or unloading a carrier with a substrate or wafer mounted to it, as well as for preparing or pre-aligning the positioners. Probing is also possible with opened chamber top cover.

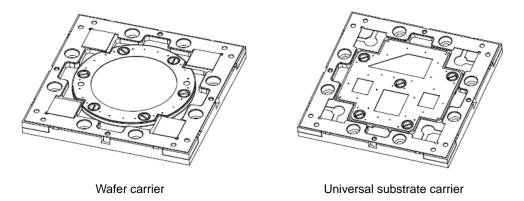
Stage

The X-Y vacuum stage is mounted on the base plate of the vacuum chamber. The movement ranges are X and Y each with 50mm (80mm optional). The stage is equipped with high resolution spindles. The X and Y universal joints are coupled to chamber feedthroughs. X and Y handling is performed from outside the vacuum chamber at the adjusting knobs.



Carrier for Fixing Samples

The carrier is shaped according to the sample type. Dedicated carriers for different wafer sizes up to 100mm and universal carriers for singulated chips or wafer fragments are available. The substrate or wafer is mechanically fixed onto the carrier using clamping springs.



Microscope

The default microscope is a Optem 7x Zoom microscope with internal focus and coaxial illumination. It has a working distance of 89 mm, magnification range of 0.38x - 2.6x and a resolveable feature size of 13.8–4.2.

A Mitutoyo FS70/FS70L compound microscope or Polytech MSA500 micro system analyzer are also available options. They can be equipped with objective lenses 2.5x (special, WD 78 mm), 5x (WD 34 mm), 10x (special, WD 48mm), 20x (WD 30.5 mm)

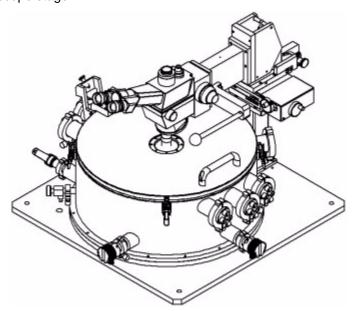
The halogen light source is connected to the microscope coaxial illumination port by an optical fiber cable. The microscope can be equipped with different 1/2" C-mount cameras (except Polytech MSA500).

The standard microscope mount is a ball-bearing boomstand with focus rack. It allows coarse XY adjustment and focusing. At this mount, the microscope is moved to the rear, and horizontally swivelled to the right or left side for opening the chamber top cover.

Optionally a manual, high-resolution microscope movement with 50 x 50 mm X-Y movement range is available. A swivel mechanism allows lifting the microscope from the lower working position to an upper park position for opening the chamber top cover. The swivel is locked in both positions.

The ball-bearing boom stand can only be combined with the Optem 7x Zoom microscope, while the optional high-resolution microscope movement is available for all above mentioned microscope types.

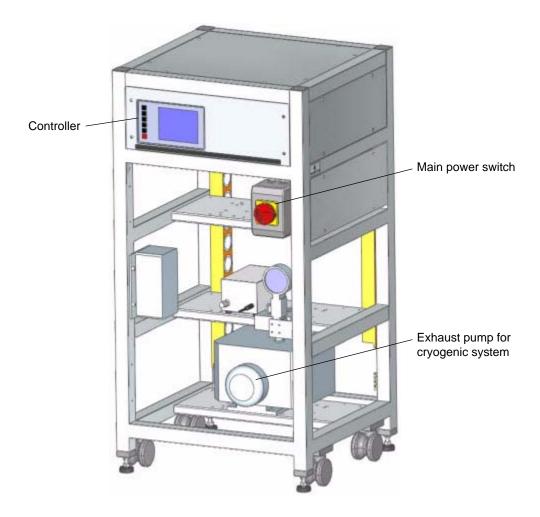
This example shows a PLC50 with optional Mitutoyo microscope and 50x50 mm high resolution microscope stage.



Pump Rack

The pump rack is situated to the right of the system and accommodates:

- One exhaust pump for the cryogenic system (He gas, N2 gas)
- · Main switch
- Different pressure gauges, manual valves and one automatic proportional valve
- Cryogenic temperature measurement and control unit (with microprocessor controlled, self optimizing digital PID controller with auto-tuning function, 19" rack design, front panel operation and display, Ethernet and RS-232 interface to PC for set and control specific temperature paths, two measuring boards for Si-diode thermal sensors)



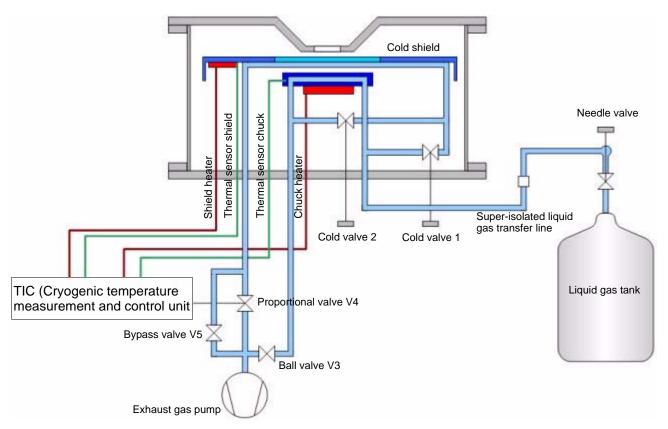
Positioners

Up to six specially designed single vacuum positioners can be used with the PLC50. Inside the chamber, they can be positioned freely on the left and right platen due to their magnetic base.

Cryogenic System

Overview

The continuous-flow cryostat system is designed for achieving low temperatures with a low consumption of liquid gas. The system contains several subcomponents which influence the cooling process.



Tank Overpressure

The overpressure in the liquid gas dewar pushes the liquid gas into the cooling lines. Therefore the pressure level influences the flow rate. The higher the pressure, the faster the cool down. Note that with a higher pressure the boiling point of the liquid gas is increased. Subsequently this leads to an increased temperature of the liquid gas inside the gas dewar. For example, at liquid Nitrogen the boiling point increases from approx. 77K (at ambient pressure) to approximately 81K at 1.5 bar overpressure. Therefore, a too high overpressure in the dewar can adversely impact the final chuck temperature.

Needle Valve

The needle valve is used for adjusting the flow. But the flow rate is depending on parameters like tank overpressure, actual temperature of the heat exchanger, and valve setting at the exhaust system. So opening the needle valve the same revolutions does not necessarily mean the same amount of liquid gas flowing through the system.

Cold Valve 1 and 2

The valves are located inside the chamber to direct the cooling media thru the system. Manipulation is done by air pressure from the outside. Depending on the switch setting the liquid is guided through the chuck, shield or both in sequence.

Ball Valve V3

The valve is open in precooling and hot-chuck mode. It will be partially closed when the system is at target temperature.

Proportional Valve V4

The proportional valve allows automated control of the flow by using the TIC (cryogenic temperature measurement and control unit). Since it is placed in the backflow, it takes time until changes show effect. Therefore this regulation is quite slow. The advantage is the automated control with the TIC's PID control, which makes this regulation mode a perfect tool for cool down without operator observation.

Bypass Valve V5

If the proportional valve is completely opened it still limits the flow. The bypass valve is in parallel to the proportional valve and overcomes this limitation.

Opening the bypass valve causes a higher flow and therefore a higher consumption. But it offers the ability to cool down the shield faster and to achieve the absolute minimum temperature with the system.

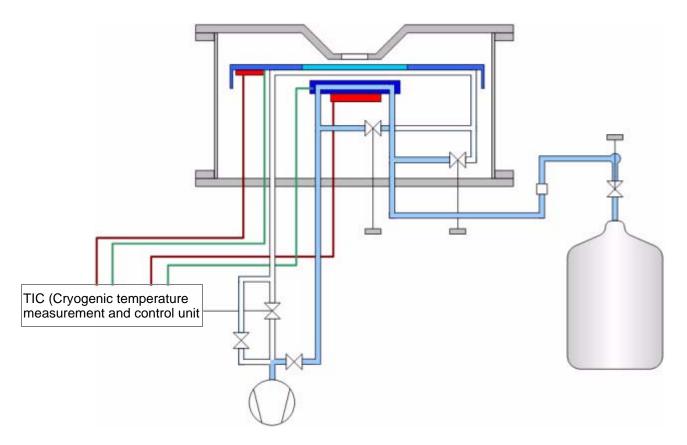
Cryosystem Pressure

Part of the basic concept of the continuous-flow cryostat system is to use underpressure at the exhaust side for achieving very low temperatures within the cryogenic heat exchanger. This is done with the exhaust pump which is a special vacuum pump for N2 gas or He gas. Lower pressure causes a lower boiling point of the liquid gas.

Subsequently this leads to an decreased temperature of the liquid gas inside the cryogenic heat exchanger. For example, at liquid Nitrogen the boiling point decreases from approx. 77 K (at ambient pressure) to approx. 72 K at 0.5 bar underpressure (0.5 bar abs.) and even to approx. 66 K at 0.8bar underpressure (0.2 bar absolute). Thus a lower heat exchanger temperature can be achieved.

Hot Chuck Mode

The hot chuck mode is only used when operating the cryogenic heat exchanger at or above room temperature. Only the heat exchanger is cooled and not the shield.



Cryo Heat Exchanger/Chuck

The substrate or wafer carrier is clamped on the top surface of the thermally isolated chuck/ heat exchanger. Please refer to the KONTI Cryostat manual for more information.

CryoShield

The CryoShield protects the heat exchanger and the DUT from incoming thermal radiation from the chamber wall. It is also used as fixing point for copper wires to connect the probes and cables for cooling.

Another purpose of the CryoShield is to trap any remaining residual gases within the vacuuum chamber to prevent contamination at the DUT. For this purpose the CryoShield is cooled down before the cryogenic heat exchanger (chuck). When the chuck temperature is below room temperature the CryoShield is always kept below the critical temperature (150 K) to prevent transfer of residual gases from the CryoShield to the DUT.

Cabling and Routing

The cryogenic tubes and electrical cables for the cryogenic chuck are kept flexible by cable routing. The heat exchanger and the CryoShield contain a thermal sensor.

LN₂ Tanks and Supply System

LN₂ or LHe supply systems are installed for supplying the cryo chuck and the CryoShield.

A pressurized LN_2 or LHe tank is located next to the system. A tank has a volume of 120 litres (typical value). The tank is on rollers and has brakes to stabilize it while stationary. The housing is made of stainless steel and contains a vacuum isolated inner container. The tank is connected to the system via a fixible transfer tube which runs from the top of the tank to the left rear corner of the PLC50. The transfer lines are also vacuum isolated. The needle valve to adjust the flow is located on top of the transfer line. The same transfer line is used for LN_2 and LHe dewars.

The pressure gauge, safety valve, and the shut-off valve for the pressurized gas are located at the top of the tanks. Look at the tank data sheet for maximum pressure and other information.

Inside the chamber, the gas is routed to the chuck and the shield with small flexible tubes. The evaporated gas comes out from the bottom plates through a thick heated vacuum tube to the exhaust pump.

For more information, please refer to the CRYOVAC manual.



WARNING

The same gas must be used for creating an overpressure. Use He gas for liquid helium and N_2 gas for liquid nitrogen.



WARNING

Never tilt, tip, or bump the tank. Take special care when moving the tank.

Chapter

2 Operating

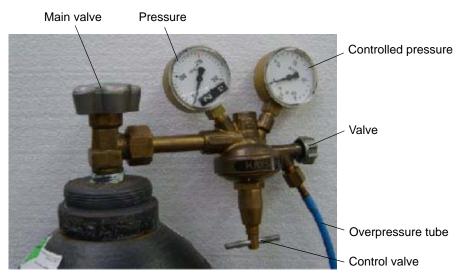
Controls

Main Power Switch with Emergency Off Function

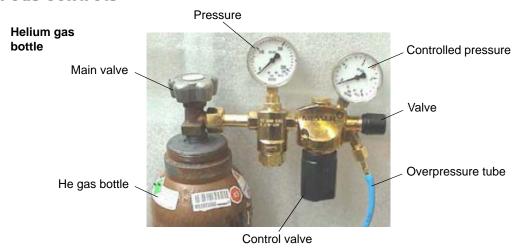
The main power switch is located at the front of the pump rack. When this switch is turned off, it removes electricity from the whole probe station including the power supply sockets.

Nitrogen Gas Controls





Helium Gas Controls



Using the System

The general order of operation is as follows:

- 1. Working with the microscope
- 2. Positioning the X-Y stage and probes
- 3. Fixing carriers onto the chuck
- 4. Fixing wafer/substrates onto the carrier
- 5. Preparing the vacuum system
- 6. Preparing the cryogenic system
- 7. Purging the cryogenic system
- 8. Cooling the cryogenic system
- 9. Heating the cryogenic system carrier
- 10. Loading/Unloading the substrate or wafer

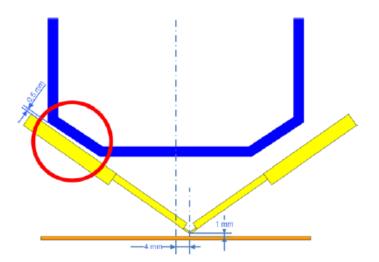
Working with the Microscope

The microscope unit can be swivelled from the working position to the park position.

See the microscope manuals for information specific to each system.

Positioning the X-Y Stage and Probes

Before moving the stage, be sure to check that the needles are not touching the device under test. Use the microscope to double check.



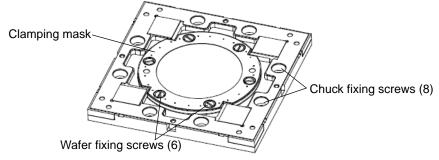
Using the locking screws, these knobs can be secured against unintentional turning.

For an optimal movement, the IZI probes should be placed in the center of the top cover view port. If the probe tips are 1 mm above the wafer surface, you can move the IZI probes in a radius of 4 mm around the center.

Fixing Carriers onto the Chuck

50mm Wafer Carrier

1. Loosen the eight (8) fixing screws on the chuck.



- 2. Switch the carrier.
- 3. Tighten the eight fixing screws again.

75-100mm Wafer Carrier

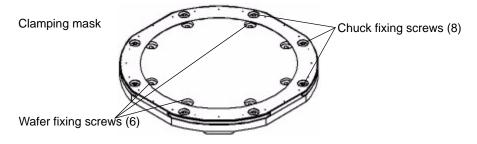


Note

The wafer on a 50mm wafer carrier can be exchanged outside the chamber.

For 75mm and 100mm size wafers the carrier need to be mounted first onto the heat exchanger. After that the wafer can be fixed. This is because the wafer covers the screws for mounting the carrier.

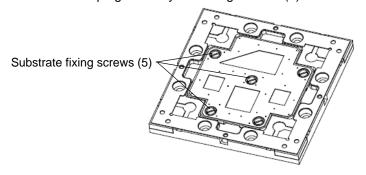
1. Remove the clamping ring



- 2. Change the wafer.
- 3. Place the clamping ring again.
- 4. Tighten the screws.

Fixing Substrates onto the Carrier

1. Loosen the clamping mask by removing the five (5) screws.



- 2. Remove the clamping mask.
- 3. Change substrate.
- 4. Place the clamping mask onto the carrier again and arrange the substrate to be clamped on three sides.
- 5. Tighten the screws.

Preparing the Vacuum System

Protective gloves must be worn at all times while loading the substrate/wafer onto its carrier. If any parts get contaminated, they must be cleaned with IPA using a dust-free cloth.

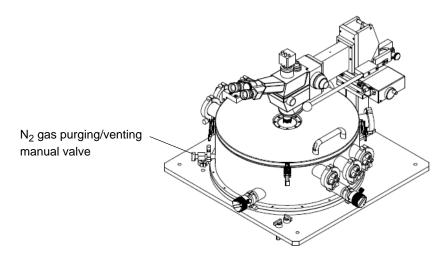
The carrier is shaped according to whether substrates or wafers are to be probed. The substrate or wafer is fixed onto the carrier by mechanical clamping at the edges.

Inside the Chamber

- 1. Use latex gloves for working inside the chamber.
- 2. Check the test equipment inside the vacuum chamber and all connections. Pay attention to the positioner configuration and the positions of needles.
- 3. Clean surfaces and seals with isopropanol (IPA).
- 4. Close (and open) the chamber carefully.

Outside the Chamber

- 1. Check the complete probe station for damages, inconsistencies, discrepancies.
- 2. The purging valve on the chamber should be closed.



- 3. Check the nitrogen current pressure: minimum input pressure 2.0 bar.
- 4. Turn on the high vacuum pump unit main power (and additional equipment).
- 5. Wait for the parameters to load, then check that all is working correctly.

Evacuation



CAUTION

The safety valve at the chamber rear side must never be disabled.

- 1. Turn on the high vacuum pump unit power to start evacuation, Then press the green button on the front display. The LED will be lit. Wait for the parameters to load.
- 2. Set the vacuum controller display by clicking the left and right arrows to read the pump speed.



Note

If the SET POINT is not reached within the SET TIME, the vacuum controller will cancel the process, and an error lamp will be illuminated.

SET POINT (switch point) parameter [701]	80% of maximum rotation speed
SET TIME (TMP runtime) parameter [700]	20 minutes

Check that the chamber is clean. Check all seals and connections.

Purging to Condition the Chamber

- 1. As soon as the vacuum is better than 1 x E-03 mbar mbar, turn off the power at the pump unit to switch off the vacuum pumps: Press the green button on the front display again, the LED is flashing now.
- 2. Wait for turning down the TMP to less than 500 Hz rotation speed before purging begins.
- 3. Open the purging valve.
- 4. Close the purging valve when atmospheric pressure is reached (watch the rough gauge at the chamber or wait until the safety valve opens).
- 5. Turn the power to the pump unit on again, green button on the front display, the LED will be lit. Wait for a vacuum of better than 1 x E-03 mbar.
- 6. Repeat this process as necessary (usually 1 or 2 times).

The system is ready to start the vacuum tests or the cooling process.

Preparing the Cryogenic System

Ensure that a pressurized cylinder of nitrogen gas is available for work with liquid nitrogen and a cylinder of helium gas is available for working with liquid helium.



DANGER

Never use N₂ for LHe. Never use nitrogen for applying overpressure to the liquid helium.

- 1. If cooling with LN₂, check the tube and the connections for overpressure in the liquid nitrogen tank.
- 2. If cooling with LHe, check the tube and the connections for overpressure in the liquid helium tank.
- 3. Check the vacuum inside the chamber; the value should be better than 1 x E-3 mbar.
- 4. Check the cooling medium for availability.



Note

Always use special isolated gloves and safety glasses.

- 5. Check and prepare the tanks for LN₂/LHe.
- 6. Verify that the volume of the cooling medium in the tanks is sufficient for cooling and testing. If no level unit is installed:
 - Check the pressure, and if needed, lower the pressure to 0 bar. There must be no pressure on the canister.
 - Loosen the swivel nut and carefully pull the lever up and out.

- Insert a clean plastic rod into the canister and leave in for approximately 1 minute.
- Pull out the rod and read the height of ice on the rod.
- 7. Check all adapters and necessary cryogenic parts for their availability.
- 8. Check all connections of the cryogenic system.
- 9. Check the overpressure in the tanks. If the transfer tubes are not inserted, bring the tanks to ambient pressure.
- 10. Close the needle valve at the transfer tubes.
- 11. Be sure that the transfer tubes are free from humidity and ice. Insert the cleaned and dry transfer tubes carefully into the tank. The end of the tubes should be approximately 50 mm above the bottom of the tank. Tighten the quick-lock. Shut off the tank valves.
- 12. After fine positioning of the tanks to the special cryostat connection, insert the transfer tubes and tighten the quick-locks. Put the brakes onto the tank rollers.
- 13. Pressurize the cooling medium tank as follows:

LHe/Liquid helium for chuck cooling	Connect pressurized helium (class 5) and open the overpressure valves using the pressure control valves (maximum overpressure according to tank specification, for example, 1.5 bar) to the LHe tank. Monitor the pressure either using the tank gauge or the control valve gauge.
LN ₂ liquid nitrogen for chuck cooling	Connect the pressurized nitrogen (class 5) and open the overpressure valves using the pressure control valves (maximum overpressure according to tank specification, for example, 1.5 bar) to the LN ₂ tank. Monitor the pressure either using the tank gauge or the control valve gauge.

Purging the Cryogenic System

To prevent ice inside the heat-exchanger and the cryogenic lines, the whole cryogenic system has to be evacuated using the cryogenic pump and refill with dry gas (nitrogen or helium) three times to make sure that there is only dry gas in the line.

- 1. Check the vacuum inside the chamber. The value should be better than 1 x E-3 mbar.
- 2. Close cold valve 1.
- 3. Open cold valve 2.
- 4. Close ball valve V3.
- 5. Press the Output Enable button to enable outputs and open V4.
- 6. Close the bypass valve V5.







Valve closed



Repeat the following procedure three times, if the transfer lines were disconnected before (for example, when changing the tank). Refer to the cryogenic flow diagram for understanding the procedure.

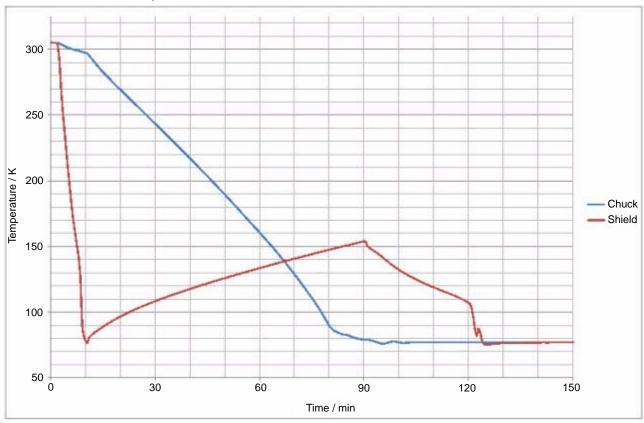
- 1. Switch on the cryogenic pump at the pump rack.
- 2. Switch off the pump as soon as the manometer unit shows a vacuum of <200 mbar (after approximately 5 seconds).
- 3. Open the needle valve in the transfer tube approximately 4 rotations.
- 4. Close it if a vacuum of >800 mbar is reached.

Cooling the Cryogenic System

- 1. Refer to the cryogenic flow diagram for understanding the cryogenic procedure.
- 2. Check the parameters of the TIC500:
- Turn on Output Enable, then press Setup button.
- Open the Chuck page:
 - Min: 2K; Max: 305K
- Open the Shield page:
 - Min: 2k; Max: 305K
- · Open the Heater C page:
 - Low Imt: 10W; Hi Imt: 80W
 - P=5.0; I=0.3; D=50
 - Setpoint=77K
- Open the Heater S page:
 - Low Imt: 10W; Hi Imt: 80W
 - P=2.0; I=0.1; D=50
 - Setpoint=77K
- Press Setup again to access the PV page:
 - Value: 10V
- Turn off Output Enable, then open the data page with 'Show Data.'
- 3. Switch on the cryogenic vacuum pump.
- 4. Start the cool down by adjusting the following valve settings:
- · Open cold valve 1
- · Close cold valve 2
- Open ball valve V3
- Open ball valve V5
- Open needle valve by 4 turns

- 5. After approximately 10 minutes, when the shield temperature reaches 80K, adjust the following valve settings:
- Close ball valve V5
- Close cold valve V1
- 6. After approximately 75 minutes, when the chuck reaches 80K, adjust the following valve settings:
- Open V1
- Open V5
- 7. After approximately 2 minutes, when the shield reaches 80K, adjust the following valve settings:
- Close V5
- Open V3 approximately 50%
- Close the needle valve by 3.5 turns. Note that the needle valve will remain open by one half turn.
- Turn on Output Enable (V4 will be opened and heaters begin controlling temperature).
- 8. After temperature stabilization, the needle valve can be closed by approximately 0.1 turn. Watch the pressure in the shield exhaust line; the pressure should stay between 700 and 800 mbar.

PLC50 Temperature Curve



Heating the Cryogenic System

- 1. Close the needle valve in the transfer tube.
- 2. Change the following parameters:
- · Press Setup.
- · Open the Heater C page:
 - Setpoint=300K
- · Open the Heater S page:
 - Setpoint=300K
- 3. Switch off the cryogenic vacuum pump.
- 4. If chuck and shield temperature have reached 300K (approximatly 45 minutes) shut the high vacuum pumping station off.
- 5. If the pump speed is below 500 Hz (parameter 309) venting can be started.
- 6. If an overpressure of 0.1 bar is reached, the venting valve should be closed.
- 7. Wait for another 60 minutes to warm up all parts inside the chamber.



Note

If chamber is opened before warming is finished, cold parts can be covered with ice.

Finishing

- 1. Be sure that the needle valves at the transfer tubes are closed.
- 2. Close the N_2 or He overpressure valves/control valves.
- 3. Close the venting/purging and compressed air input valves.
- 4. Switch off the heaters (chuck, shield, back flow).
- 5. Switch off the power supply.
- 6. Check the machine.

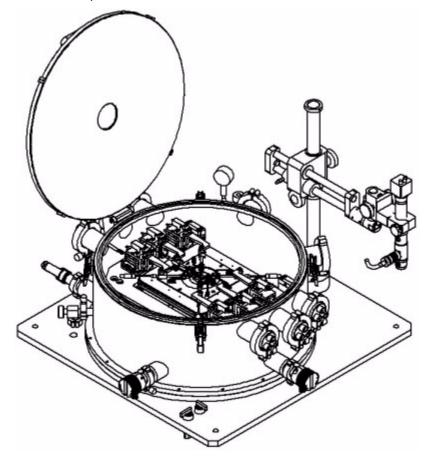
Loading and Unloading the Substrate or Wafer

Before venting, move the probe tips up in Z direction to avoid unintended overtravel or scratches on the device under test.

Venting the Chamber

- 1. Switch off the vacuum pumps.
- 2. Swing the microscope into park position.
- 3. Loosen the 4 latch clamps at the chamber casing.
- 4. If the TMP rotation speed is less than 500 Hz open the purging valve.
- 5. If the pressure inside the chamber reaches atmosphere (check the rough gauge or wait until the overpressure valve opens), shut the purging valve.

6. Open the chamber top cover.



Loading

- 1. Move the X-Y stage to the middle position.
- 2. Move the positioners up, release the magnetic foot and place the needle outside the cryogenic shield. Fix the magnetic foot again.
- 3. Remove the center of the cryogenic shield.
- 4. Loosen the slotted screws of the carrier clamping with a screwdriver and remove the clamping parts.
- 5. Put the substrate or wafer onto the contact surface of the carrier and make a coarse alignment.
- 6. Insert the clamping parts and tighten the slotted screws.
- 7. Set the positioners coarsely in the right configuration. Use the microscope for the alignment procedure.
- 8. Close the chamber top cover and shut the four (4) latch clamps.
- 9. Fine-position the probe tips with the vacuum chamber closed.
- 10. Contact the probe tips after evacuation only.

Chapter

3 Maintenance & Service

Maintenance



CAUTION

Solvents or other aggressive cleaners must not be used to clean this equipment.

Preventive Maintenance

Visual Checks	Perform a thorough visual check of the system before each use. Key areas include the carrier surface, the X-Y movements of the wafer stage, microscope movement, platen and the individual positioners. These parts should be free of dust, residue, rust, and signs of wear and tear. All movements should exhibit smooth transit without any irregularities.
Vacuum Areas	It is very important to keep all areas and parts clean where vacuum is applied, especially the whole inner area of the vacuum chamber. Avoid all contaminations including oil, grease, sweat, hair, dust, etc. Gassing plastic parts or synthetic materials must not be placed in the chamber.
	Always use latex gloves when working in the vacuum chamber.
	Keep the vacuum chamber closed whenever possible. Open it only when necessary.

Scheduled Maintenance

The following service on a probe station should be performed only by a Cascade Microtech service representative.

Vacuum Gauge	Clean the vacuum measuring gauge annually. It should also be cleaned after any contamination of the vacuum system. This ensures optimal measuring and control. The cleaning procedure depends on the vacuum.
Vacuum Equipment Lubrication	Lubrication inside the chamber must be done very carefully using the accurate dose of special grease. The recommended grease is KLUEBERALFA HX 83-302.
Probe System Lubrication	Clean the spindles and rails before applying grease or oil to them. Use fine fibrous textile material and alcohol for cleaning. Once per year, lubricate the chuck X-Y stage drive spindles.

Pump Maintenance

Turbo Molecular Pump (HiPace 80)	The lubricant reservoir should be replaced at least once a year.
MVP040 Diaphragm Pump	With normal wear, the diaphragms and valves should last more than 10,000 operating hours. See the MVP 040 operating instructions for more information.
Vacuum Gauge PKR 251	For details, refer to the compact FullRange™ vacuum gauge manual.

Troubleshooting

This section discusses diagnostic and repair actions for some common issues. This section does not cover invasive troubleshooting or component level repair. Attempting to troubleshoot beyond the instructions in this section may cause further damage to the probe station or related equipment, and may also void the station warranty.

Problem	Solution
System or accessories do not power up.	Check that power is supplied to the system at the specified voltage and VA or watts.
Vacuum system	Check all connections. Be sure that all seals are clean and free of damage.

Returning for Service

RMA Number

Before shipping a probe station to Cascade Microtech, obtain a Return Material Authorization number (RMA #). Contact the nearest Cascade Microtech sales office, or in the U.S., call customer service at (800) 550-3279 or (503) 601-1000.

Write the following information on a tag and attach it to the probe station:

- · Owner's name and address
- RMA number
- · Probe station model number
- Probe station serial number (back left of probe station)
- Description of the service required or failure indications

Repacking

To retain the validity of the warranty, always use the original packing materials. Contact a Cascade Microtech representative for replacement shipping materials or hardware.

Remove all probes and accessories from the probe station, including the microscope. Do not ship them unless they are associated with the failure symptoms.

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