



UHV LHe/LN2 Cryogenic Probe Station

The ARS PS-L-UHV Probe Station is designed for the ultimate in flexibility for non-destructive device testing and maximum vacuum cleanliness. The ability to upgrade and modify this system for further device testing has been considered in the forefront of this design.

The core of the system is identical for both the Liquid and Closed Cycle Cryogenic Probe Stations. The system share the same table top, vacuum chamber, and probe arms. This enables the Flow Cryostat to be removed and replaced with a closed cycle (cryogen free) as desired.

This model of Probe Station uses ARS's Liquid Helium/ Nitrogen flow cryostats. The sample stage will reach temperatures of <math><4\text{K}</math> or <math><77\text{K}</math> depending upon the cryogen used and flow rate.

This system is designed to provide a large, **bakeable Ultra-High Vacuum sample environment**. The vacuum chamber is made out of welded stainless steel and the radiation shield is made out of bare OFHC copper. The high conductivity of the copper allows for a colder radiation shield and larger net refrigeration at the sample space. The high quality welded knife-edge conflat flanges and large pump-out ports are critical as it allows for true 10^{-11} Torr UHV Vacuum Levels resulting in the cleanest samples possible.

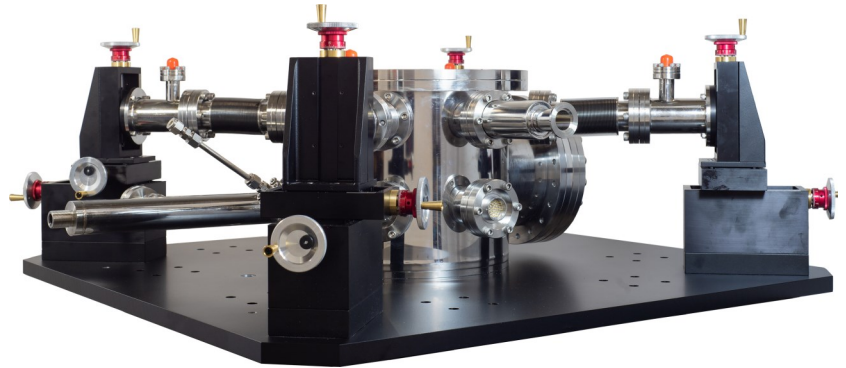
ARS' integrated approach of manufacturing for both the cryocooler and the probe station ensures ideal performance, with diagnostics and service over the life of the probe station.

Applications

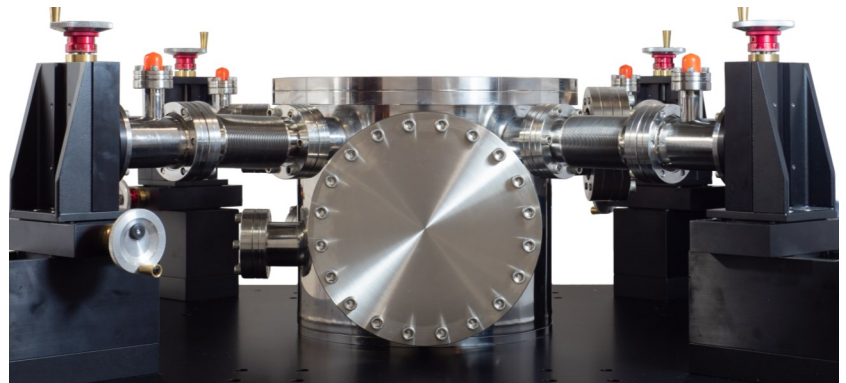
- Microwave Properties
- DC, RF Properties
- MEMS
- Nanoscale Electronics
- Superconductivity
- Electrical and Optical Properties of Nano Circuits
- Quantum Dots and Wires
- Non Destructive Device Testing

Typical Configuration

- Liquid Flow Cryostat
- Transfer Line - Standard 6' (8' or 10' optional)
- Flow Meter Panels
- 10" Diameter Stainless Steel Vacuum Chamber with 5 Micromanipulated Probe Ports and 2 Spare NW 80 Accessory Ports Mounted on an Anodized Aluminum Table Top with Extruded Aluminum Support System
- 8" Diameter Nickel Plated OFHC Copper Radiation Shield
- 2.25" Diameter Grounded Sample Holder made out of OFHC Copper
- DC, Microwave, or Fiber Optic Probes
- 4 Sensors and 2 Heaters for temperature control and monitoring
- High Conductance Turbomolecular Vacuum Pump
- (4) Channel Temperature Controller with interconnecting cable to the cryostat
- 7:1 Zoom Microscope with <math><2</math> micron resolution and coaxial or ring light. Includes a High Resolution 24" Wide Screen LCD Display and a light source for the microscope



Side profile of a UHV Cryogenic Probe Station



High Conductance 8" Vacuum Pump Out Port



UHV LHe/LN2 Cryogenic Probe Station

Cooling Technology

LT3	Open Cycle Cryostat
Liquid Cryogen Usage	Liquid Helium or Liquid Nitrogen

Temperature Range*

Liquid Helium	-3.5K - 400K ** max flow
Liquid Nitrogen	-77K - 400K **
Stability	0.1K (Can tune better with PID Control)

**500K and 800K Options are also available

*Based on bare cold head with a closed radiation shield, and no additional sources of experimental or parasitic heat load

Radiation Shield

Material	Nickel Plated OFHC Copper
Diameter	8" (203 mm)
Ports	6 (standard) Empty ports have removable blanks installed
Lid	Removable Lid with Sapphire Cold Window
Mounted On	Standoffs for ideal thermal gradient
Optical Access	
Window Material	Sapphire
Window Diameter	2.5" (63 mm)
Window Clear View	2.25" (57 mm)

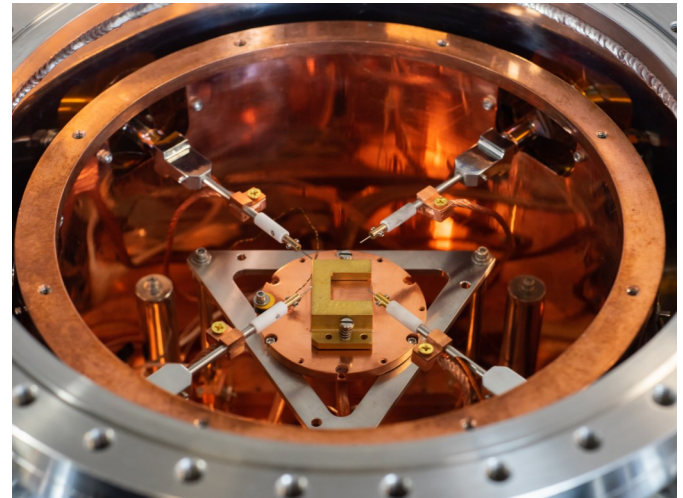
Sample Holders*

Grounded	2.25" Diameter (standard)
Load Lock - Grounded	1" Diameter: Custom Sizes available
Electrically Isolated	2.25" Diameter (Optional)
Coaxial (Biased)	2.25" Diameter (Optional) Includes BNC Feedthrough with Coaxial Cable to sample stage
Triaxial (Biased with Guard)	2.25" Diameter (Optional) Includes Triaxial Feedthrough with Coaxial or Triaxial wire.

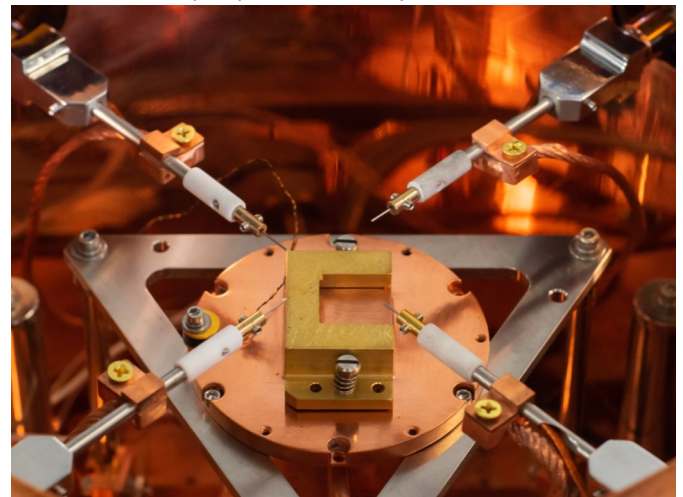
*Custom sample holders also available.

Vacuum Chamber

Material	Welded Conflats, Stainless Steel
Diameter	11.97" (304 mm)
Probe Ports	4 (standard) 6 - 8 available upon request
Spare Accessory Ports	(2) UHV Flanges installed with blanks (1) 8" Diameter UHV Pump out
Lid	Conflat Flanged Lid with Quartz Window
Mounted On	31" x 31" Powder Coated Aluminum Plate
Optical Access	
Window Material	High Purity Quartz
Window Diameter	2.75" (69 mm)
Window Clear View	2.37" (60 mm)



Sample space of the UHV probe station.



Close-up view of the Load-lock sample holder and 4 DC probes



UHV LHe/LN2 Cryogenic Probe Station

Micromanipulator Stages

Drive	Direct Drive
Bellows	Stainless Steel, Edge Welded
Motion	
X-Motion (Axial)	2" (50 mm) Standard
Y-Motion (Lateral)	1" (25 mm) Standard
Z-Motion (Vertical)	2" (50 mm) Optional
Z-Motion (Vertical)	0.5" (12.5 mm) Standard
Graduations	10 micron
Sensitivity	5 micron

Cool Down and Pump Down Time

Pump down Time* (<5 mTorr)	
Mechanical Pump (VPS-2)	- 30 minutes
Turbo Pump (VPS-3)	- 15 minutes
Cool down time to ~ 4.5 K**	- 10 minutes

*The pump down time listed are approximate timelines using an ARS supplied vacuum pumping system. Actual vacuum levels of the system will be dependent of the vacuum pump itself. The system is capable of allowing for vacuum levels of 10^{-11} Torr with an appropriate vacuum pumping system and baking.

**The cool down time to 5K is listed for the cryocooler under typical conditions. If customizations are made, 5K sample stage temperatures may not be achievable.

Vibration Levels

Sample Stage Vibrations	< 1 micron
Vibration Dampening	Self Leveling Feet



Instrumentation for Temperature Control*

Temperature Sensors	Silicon Diodes
DT-670B-SD	Installed on the radiation shield
DT-670B-SD	Installed on the underside of the sample chuck for temperature control
DT-670B-SD	Installed on the cryocooler cold tip for diagnostics
DT-670-CU-4M	Calibrated Silicon Diode installed on top of the sample stage for accurate temperatures

Heaters

50W Cartridge Heater	Installed on the under side of the sample stage for temperature control
(2) 50W Cartridge Heaters	Installed in parallel on the radiation shield to allow for 100W of heater power to assist in fast warm up of the system
Temperature Controller	LS-336 4 Channel Temperature Controller with 150W heater power

*Interconnecting cables from the probe station to the temperature controller are supplied.



UHV LHe/LN2 Cryogenic Probe Station

GSG Microwave Frequency Probe Arms*

*All GSG Microwave Frequency Probe Arms include the Translation Stages. Probe arms are thermally anchored to the sample chuck and include +/- 5° Theta Planarization

40 GHz	Optional
Connector	K
Cable	Semirigid Coaxial
Frequency	0 to 40 GHz
Tip Material	Tungsten Beryllium Copper
Pitch	50 - 2450 micron (100 or 150 micron typical)
50 GHz	Optional
Connector	2.4
Cable	Semirigid Coaxial
Frequency	0 to 50 GHz
Tip Material	Tungsten Beryllium Copper
Pitch	50 - 1250 micron (100 or 150 micron typical)
67 GHz	Optional
Connector	1.85
Cable	Semirigid Coaxial
Frequency	0 to 67 GHz
Tip Material	Tungsten Beryllium Copper
Pitch	50 - 1250 micron 100 or 150 micron typical

Fiber Optic Probe Arms*

Range	UV/VIS or VIS/IR
Connector	Male SMA 905
Sample Termination	Bare Polished
Size (Typical)	100 micron - 400 micron
Mode	Single Mode or Multi Mode
Cable Material	Polyimide, Fused Silica

*All Fiber Probe Arms include the Translation Stages. This does not include a light source or detector.

DC/Low Frequency Probe Arms*

*All DC/Low Frequency Probe Arms include the Translation Stages. Probe arms are thermally anchored to the sample chuck.

Microminiature Coax Cable	Standard
Connector	SMA or BNC
Frequency	0 to 100 MHz
Impedance	50 Ohm
Includes Outer Ground Shield with Clip Connector	
Triaxial Cable	Optional
Connector	Triaxial - 3 Lug
Frequency	0 to 100 MHz
Impedance	50 Ohm
Kelvin Probes**	Optional
Cable	Coaxial or Triaxial
Connector	SMA, BNC, or Triaxial
Frequency	0 to 100 MHz
Probe Tips:	
Material	Tungsten (Standard) Gold Plated Tungsten (Optional) Beryllium Copper (Optional)
Tip Radius	0.5 micron (standard) Other radius' also available

**Kelvin Probes use 2 cables and 2 connectors, but converge down to a single tip.

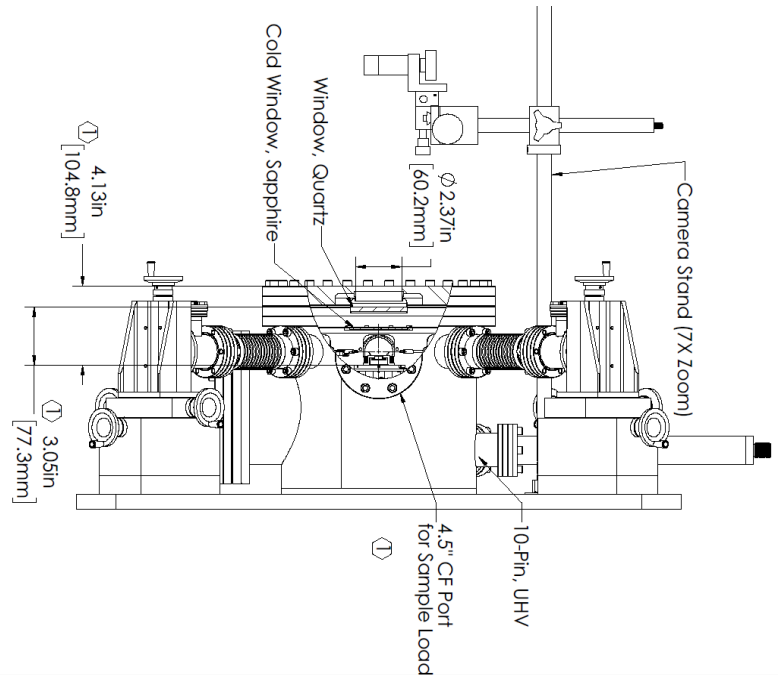
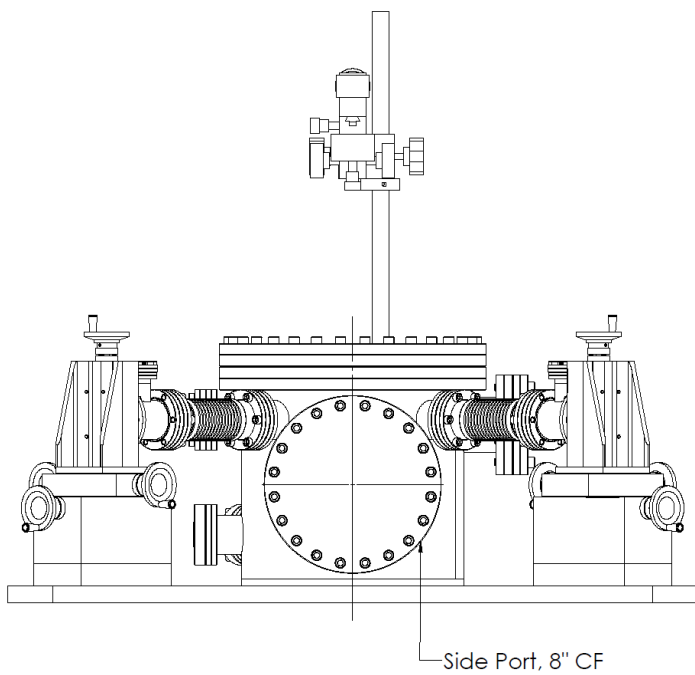
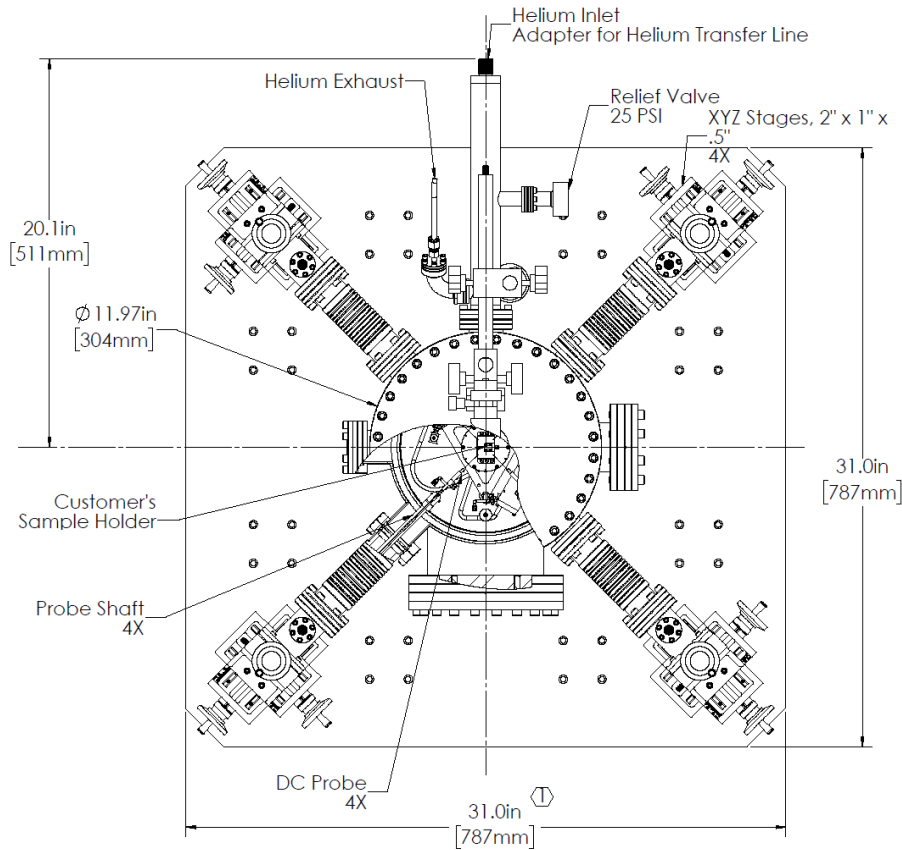
GigE Microscope with Zoom Lens*

Zoom	7:1 (Standard)	16:1 (Optional)
Sensor	1/2" CMOS	1/2" CMOS
Field of View	4.2 mm - 0.61 mm	12.8 mm - 0.8 mm
Working Distance	89 mm	89 mm
N.A.:	0.024 - 0.08	0.0090 - 0.15
Light (Includes Light Source)	Ring or Coaxial	Ring of Coaxial
Resolution	3 microns	2 microns
Stand	Boom Stand with XYZ manipulation	Boom Stand with XYZ manipulation
Computer Interface	Ethernet Cable	Ethernet Cable
High Resolution Monitor	24"	24"



UHV LHe/LN2 Cryogenic Probe Station

PS-L-UHV Probe Station Outline Drawings



The above images shows a side profiles of a UHV probe station as well as a top down view.