

# 5 K Nanoscience Probe Station

## APPLICATIONS AT A GLANCE

- Ultra-Low Vibrations (< 50 nm)
- Microwave properties
- DC, RF properties
- MEMS
- Nanscale electronics
- Superconductivity
- Electrical and optical properties of nano-devices
- Quantum dots and nanowires
- Single electron, and low current physics

The ARS Nanoscience Probe Station is designed with maximum flexibility for non-destructive device testing. The probe configuration and system design can be customized to suit your specific experimental requirements.

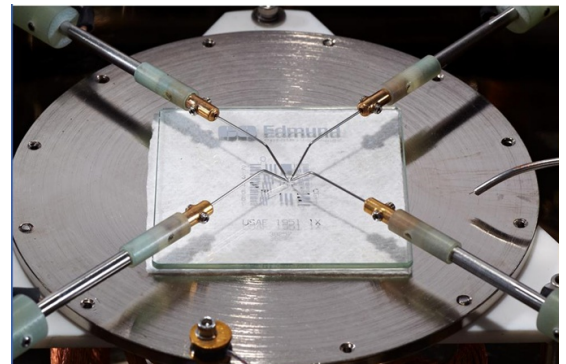
The system base temperature can be configured for as low as 5 K with optional 450 K and 800 K maximum temperature options. The probe station utilizes ARS closed cycle cryocoolers that are designed with high first stage cooling capacity for fast cool downs and dissipation of high radiative heat loads. The combination of the high first stage cooling capacity and inherently lower vibrations of the pneumatically drive GM cryocooler, make it ideal for nanoscience and sensitive device measurements.

A clean sample environment is provided by a welded stainless steel vacuum chamber and a nickel plated OFHC copper radiation shield. The low emissivity of the nickel plating and the high conductivity of the copper provide larger cooling capacity at the sample chuck. The high quality vacuum components are critical as it allows for deeper vacuum levels and cleaner samples with better electrical contact.

ARS' integrated approach of manufacturing for both the cryocooler and the probe station ensures consistent performance, and also facilitates diagnostics and service of the integrated system.



5 K nanoscience probe station configured for placement on vibrationally isolated optical table.



Custom sample chuck and four DC probe arms on test sample.

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## SPECIFICATIONS AND OPTIONS

Cooling Technology	
DE-204/DE-210	Closed cycle cryocooler
Refrigeration Type	Pneumatic GM Cycle
Liquid Cryogen Usage	None, cryogen free

Temperature*	
DE-204AF	< 15 K - 350 K
DE-204PF	< 12 K - 350 K
DE-210SF	< 6 K - 350 K
With 800K Interface	(Base temp + 2 K) - 800 K
With 450K Interface	Base temp - 450 K
Stability	< 50 mK (with PID control)
*Based on bare cold head with a closed radiation shield, and no additional sources of experimental or parasitic heat load	

Vacuum Chamber	
Material	Stainless steel
Diameter	8" (203 mm)
Probe Ports	6 (standard)
Spare Accessory Ports	(1) NW-80 flanged
Lid	Removable with quartz window
Optical Access:	
Window Material	High purity quartz
Window Diameter	2.75" (69 mm)
Window Clear-View	2.50" (63 mm)

Radiation Shield	
Material	Nickel plated OFHC copper
Diameter	7" (178 mm)
Ports	Matched to probe configuration
Lid	Removable with sapphire cold window
Optical Access	
Window Material	Sapphire
Window Diameter	2.5" (63 mm)
Window Clear View	2.25" (57 mm)

Sample Chuck*	
Grounded	2.25" Diameter (standard)
Electrically Isolated	2.25" Diameter (Optional)
Coaxial (Biased)	2.25" Diameter (Optional) Includes BNC feedthrough with coaxial cable to sample chuck
Triaxial (Biased with Guard)	2.25" Diameter (Optional) Includes Triaxial Feedthrough with Coaxial or Triaxial wire.
*Contact ARS for other custom options	



Probe Arm Translation	
Drive	Direct drive
Bellows	Stainless steel, edge welded
Motion	
X-Motion (Axial)	2" (50 mm) Standard
Y-Motion (Lateral)	1" (25 mm) Standard 2" (50 mm) Optional
Z-Motion (Vertical)	0.5" (12.5 mm) Standard
Graduations	10 micron
Sensitivity	5 micron

Cooldown and Pumpdown Times	
Pump down Time* (<5 mTorr):	
Mechanical pump (VPS-2)	- 45 minutes
Turbo pump (VPS-3)	- 10 minutes
Cool down time to 10 K**	- 4 hours
*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 <sup>-6</sup> Torr with an appropriate vacuum pumping system.	
**The cool down time to 10 K is listed for the DE210S cryocooler under typical conditions. If customizations are made, or only a 10 K cryocooler is chosen, then 10 K sample stage temperatures may not be achievable.	

Vibration Levels	
With DE-210SF (5 K)	Aluminum
Optical table mounting	< 150 nm (peak-to-peak)
With independent support stand for cryocooler	< 30-50 nm (peak-to-peak)

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## PROBE ARM AND MICROSCOPE OPTICS OPTIONS

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	
<b>40 GHz</b>	<b>Optional</b>
Connector	K
Cable	Semirigid Coaxial
Frequency	0 to 40 GHz
Tip Material	Tungsten or beryllium copper
Pitch	50 - 2450 µm (100 or 150 µm typical)
<b>50 GHz</b>	<b>Optional</b>
Connector	2.4
Cable	Semirigid coaxial
Frequency	0 to 50 GHz
Tip Material	Tungsten or beryllium copper
Pitch	50 - 1250 µm (100 or 150 µm typical)
<b>67 GHz</b>	<b>Optional</b>
Connector	1.85
Cable	Semirigid Coaxial
Frequency	0 to 67 GHz
Tip Material	Tungsten or beryllium copper
Pitch	50 - 1250 µm (100 or 150 µm typical)

DC/Low Frequency Probe Arms	
*All DC/low frequency probe arms include the translation stages. Probe arms are thermally anchored to the sample chuck.	
<b>Microminiature Coax Cable</b>	<b>Standard</b>
Connector	SMA or BNC
Frequency	0 to 100 MHz
Impedance	50 Ohm
Includes outer ground shield with clip connector	
<b>Triaxial Cable</b>	<b>Optional</b>
Connector	Triaxial - 3 Lug
Frequency	0 to 100 MHz
Impedance	50 Ohm
<b>Kelvin Probes**</b>	<b>Optional</b>
Cable	Coaxial or Triaxial
Connector	SMA, BNC, or Triaxial
Frequency	0 to 100 MHz
<b>Probe Tips:</b>	
Material	Tungsten (Standard)
Tip Radius	Gold Plated Tungsten (Optional)
	Beryllium Copper (Optional)
	0.5 micron (standard)
	Other tip sizes also available
**Kelvin Probes use 2 cables and 2 connectors, but converge down to a single tip.	

Fiber Optic Probe Arms*	
Range	UV/VIS or VIS/IR
Connector	Male SMA 905
Sample Termination	Bare polished
Size (Typical)	100 µm - 400 µm
Mode	Single mode or multi mode
Cable Material	Polyimide, fused silica
*All fiber probe arms include the translation stages. This does not	

GigE Microscope with Zoom Lens		
Zoom	7:1 (Standard)	16:1 (Optional)
Sensor	1/2" CMOS	1/2" CMOS
Field of View	4.2 - 0.61 mm	12.8 - 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 or Coaxial
Resolution	3 µm	2 µm
Stand	Boom Stand with XYZ manipulation	Boom stand with XYZ manipulation
Computer Interface	Ethernet Cable	Ethernet cable
High Resolution Monitor	24"	24"