Closed Cycle Superconducting Magnet Probe Station

The ARS Closed Cycle Superconducting Magnet probe station model is designed for the ultimate in flexibility for non-destructive device testing. This system enhanced with a 3T Vertical superconducting magnetic field. Those systems are ideal for the study of magneto-optical and magneto-electrical properties in variety of experiments, including quantum dots, spintronic devices and nanoscale electronics. The probe configuration and system design can be customized to suit your specific experimental requirements.

This model of Probe Station has our DE210 Series of cryocoolers. These cryocoolers allow for sample stage temperatures of 5K. All of the ARS Closed Cycle Cryocoolers are designed with high first stage cooling capacity which allows for fast cool downs and dissipation of high radiative heat loads.

The system comes with a polished stainless steel Vacuum Chamber and nickel plated OFHC Radiation Shield. The high quality materials allow for high vacuum levels and ultimately cleaner sample environments.

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

Applications

- Magnetic Properties
- Microwave Properties
- DC, RF Properties
- MEMS
- Nanoscale Electronics
- Superconductivity
- Electrical and Optical Properties of Nano- devices
- Quantum Dots and nanowires
- Single Electron and low current physics
- Non Destructive Device Testing

Features

- Cryogen-free operation
- 3T vertical field superconducting magnet with wide sample temperature range
- Easy to Operate
- Allows unsupervised cooldown
- High Vacuum
- Customization Available

Typical Configuration

- Two (qty.) 2 stage closed cycle refrigerators with 1W cooling power at 4.2K
- Cryogen-Free Superconducting Magnet
- 4 DC probe arm
- 7:1 zoom Microscope with <3 micron resolution and coaxial or ring light

Fig 1. The above picture shows overall closed cycle superconducting magnet probe station.

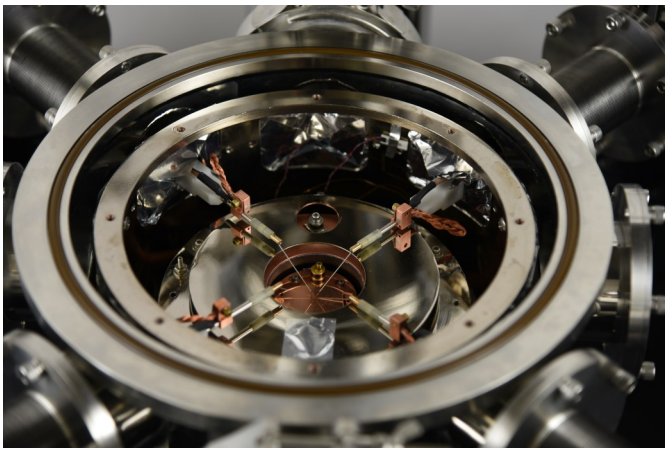

Fig 2. The above picture shows the sample space inside the probe station.

Closed Cycle Superconducting Magnet Probe Station

Specifications And Options

Magnetic, Superconducting

Magnet Type	Superconducting Solenoid
Magnetic Field Direction	Vertical (Perpendicular to sample plane)
Magnetic Field Strength	+/-3T(+/-30kOe) Maximum
Field homogeneity	0.5% over 10mm diameter; 1.0% over 25mm diameter
Ramp	6min at 1 volt per second to 3T
Cooled By	DE210S
Magnet Power Supply	Model 430
Gaussmeter	Model 475 DSP
Hall Sensor	Model HGCT-3020

*Power Supplies, Gaussmeters, and Temperature Controller are installed on a Rack System.

*Interconnecting cables from the Power Supplies and Gaussmeter to the Probe Station are Supplied.

Temperature

Magnetic Field	Temperature Range
+/-3T	5K
+/-2.5T	5K to 300K

Cool Down and Pump Down Time

Pump Down Time	2hr (90 min to reach <1X10^{-3} torr)
Room Temperature	<5X10^{-4} torr
Base Temperature	<1X10^{-5} torr
Cool Down Time	5hr

*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 and options. Outgasing of certain options can effect vacuum level

**The cool down time to 10K is listed for the DE210S cryocooler under typical conditions. Customizations can effect head load, cooldown time and minimum temperature.

Cooling Technology

DE-210	Closed Cycle Cryocooler
Refrigeration Type	Pneumatically Driven GM Cycle
Liquid Cryogen Usage	None, Cryogen Free

Vacuum Chamber

Material	Eletroless polished stainless steel 304
Diameter	11” (280mm)
Tall	11.75” (294 mm)
Probe Ports	Up to 6
Lid	Removable lid with quartz window
Chamber Access	9’’(229mm) diameter open
Optical Access	
Window Material	High purity quartz
Window Diameter	3” (76 mm)
Window Clear View	2.75” (67 mm)

Fig 3. The above picture shows the probe station with cover removed. The sample is located at one end of the warm bore of the magnet.

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Specifications And Options

Translation 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)	0.5” (12.5 mm) Standard
Graduations	10 micron
Sensitivity	5 micron

Radiation Shield

Material	Nickel plated OFHC
Sample Access	9’’ (229mm) diameter lid
Lid	Removable lid with Sapphire cold window
Mounted On	1st stage of Cryocooler
Optical Access	
Window Material	Sapphire
Window Diameter	3” (76 mm)
Window Clear View	2.7” diameter (69 mm)

Vibration Levels

Sample Stage Vibrations	< 1 micron
Vibration Dampening	3 Stages
Stage 1 (Low Frequency)	Soft air mount feet for high shock
Stage 2 (High Frequency)	Elastomeric Isolators installed between the frame and the table top.
Stage 3 (Sample Stage)	Supersoft Copper Braids to transmit maximum cooling power and minimal vibrations from the cold tip to the sample stage.

Fig 4. XYZ translation stages have hardened steel ball bearing for sooth and precise motion control, theta rotation for planarization

Control Stability

Sample Stage Temperature	Stability
Base Temperature (no heat control)	Not specified
<6K	+/-50mK
10K to 200K	+/-10mK
201K to 300K	+/-10mK

Sample Holders

1.75 inch electrical floating sample holder
1 in measureable area
2 in (51mm) diameter maximum sample size

*Custom sample holders also available.

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Instrumentation for Temperature Control*

Temperature Sensors	Silicon Diodes and Cernox RTD
DT-670B-CU	Installed on the radiation shield
CX-1070-SD-HT-4L	Calibrated Cernox Sensor installed on the top of the sample stage for accurate sample temperature
DT-670B-SD	Installed on the cryocooler cold tip for diagnostics
DT-670B-CU	Installed on the 1st stage of cryostat
CX-1070-CU-HT-4L	Calibrated Cernox Sensor installed on the top of magnet
Heaters	
50W Cartridge Heater	Installed on the under side of the sample stage for tempera-ture 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 or CC 4 Channel Temperature Controller with 150W heater power.

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

Cryocooler Compressor

Compressor Model		ARS-10HW	
Frequency		60 Hz	50 Hz
Standard Voltage	Min	208 V	190 V
	Max	230 V	210 V
High Voltage	Min	440 V	380 V
	Max	480 V	415 V
Power Usage	Phase	(3 Ph) 7.7 kW	
Refrigerant Gas		99.999% Helium Gas, Pre-Charged	
Noise Level		60 dBA	
Ambient Temperature		5 - 40 C (40 - 104 F)	
Cooling Water	Consumption	5.7 L / min (1.5 Gal. / min)	
	Temperature	< 20C (68F)	
	Connection	1/2 in. Swagelok fitting	
Dimensions:	L	483 mm (19 in)	
	W	533 mm (21 in)	
	H	617 mm (24.3 in)	
Weight		105 kg (230 lbs)	
Typical Maintenance Cycle		12,000 hours	

Probe Station Top Down Drawing

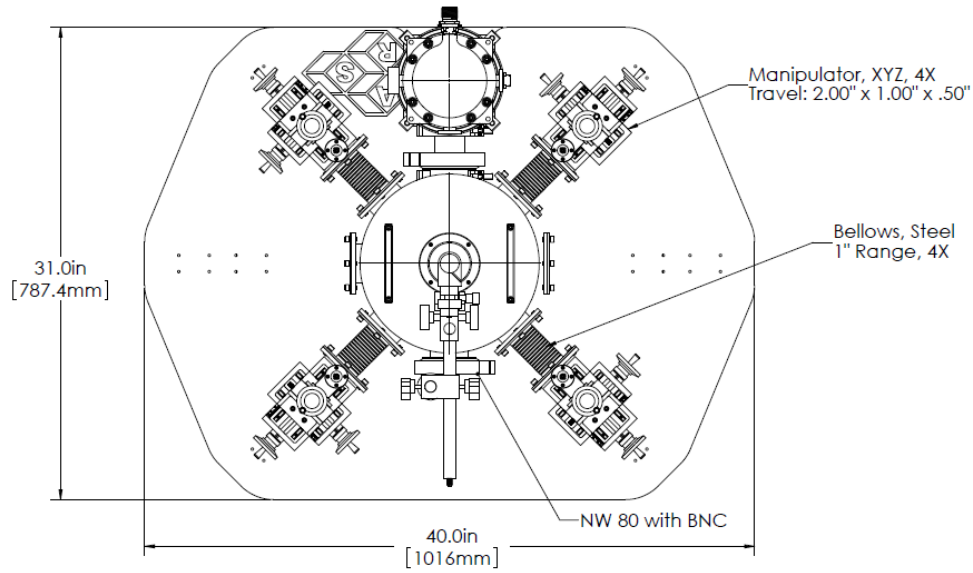

Fig 5. There are (4) DC/Low Frequency Probes. The system does allow for Fiber Optic or Microwave Probes as well.

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Probe Arm and Microscope 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

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	Ring or Coaxial	Ring of Coaxial
Resolution	3 microns	2 microns
Stand	Boom Stand with	Boom Stand with
Computer Interface	Ethernet Cable	Ethernet Cable
High Resolution Monitor	24"	24"

Closed Cycle Superconducting Magnet Probe Station Outline Drawing

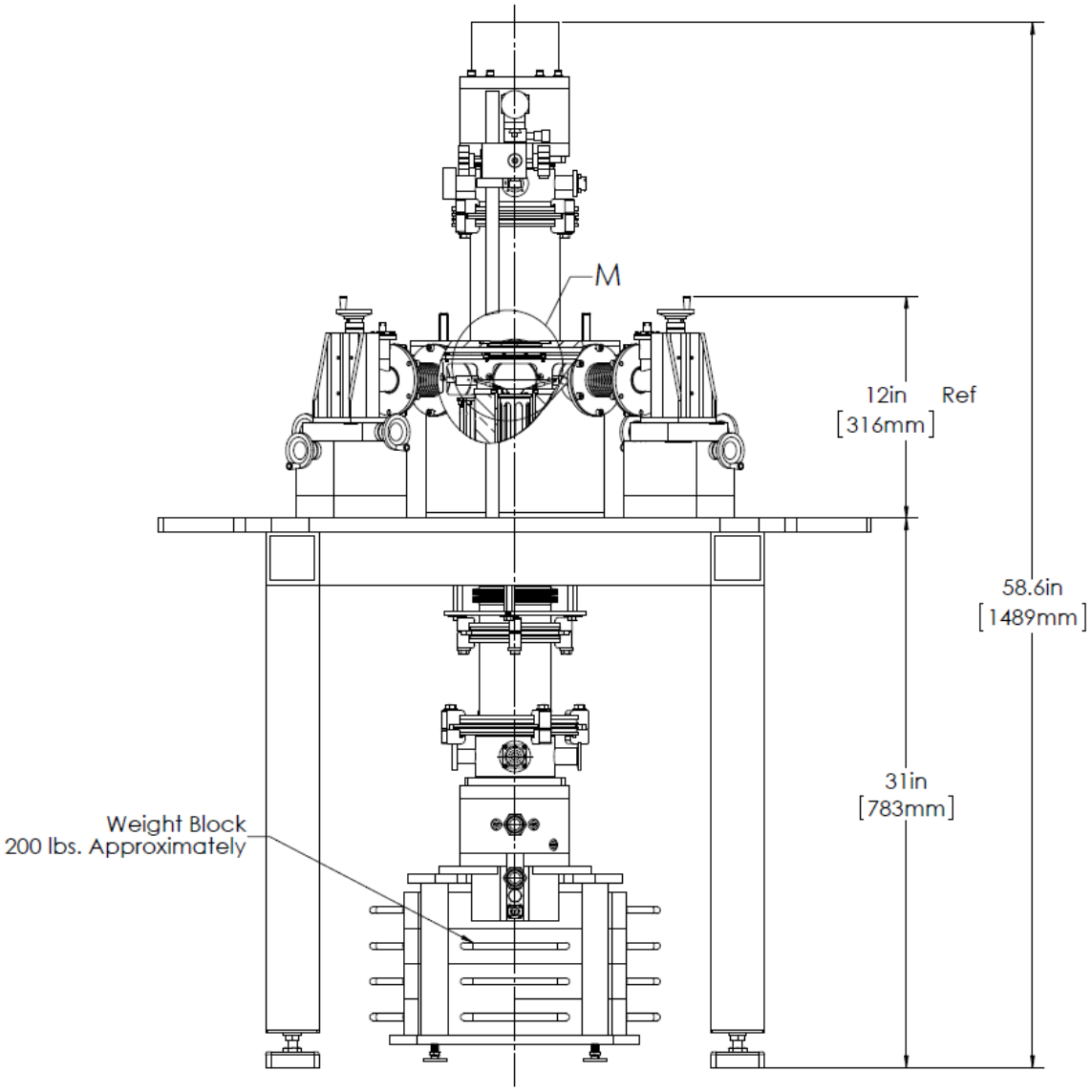

Fig 6. The above image shows a side profile of a probe station. The above system shows a DE210S Cryocooler.