

Micro-manipulated Cryogenic & Vacuum Probe Systems

Janis micro-manipulated probe stations are designed for non-destructive electrical testing using DC, RF, and fiber-optic probes. They are useful in a variety of fields including semiconductors, MEMS, superconductivity, electronics, ferroelectrics, material science, physics and optics. Liquid helium, liquid nitrogen, or a mechanical closed cycle refrigerator is used to cool the sample. A wide variety of system configurations are available, and may include high vacuum (HV), ultra-high vacuum (UHV), ultra-high temperature (to 675 K), and magnetic fields.

ST-500 family of cryogen cooled probe stations



UHV

**Permanent
Magnet**



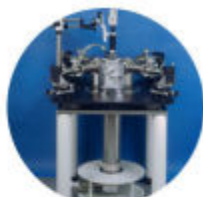
ST-500 Family



Electromagnet

**Superconducting
Magnet**

CCR family of cryogen-free probe stations



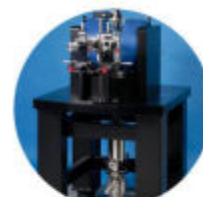
<6 K



80 K

10 K

**Superconducting
Magnet**



Electromagnet

CCR Family

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Micro-manipulated Cryogenic & Vacuum Probe Systems

Probe Station Specifications Overview

Probe Station Model	Cooling Method	Temperature Range with Four Probe Arms	Magnetic Field	Vacuum	# of Probes	Max Sample Size	Vibration Level
ST-500	LHe/LN ₂	~3.5 K - 475 K (8 K - 675 K optional)		10 ⁻⁵ -10 ⁻⁶ mbar (10 ⁻⁶ -10 ⁻⁹ mbar optional)	2-6 (8 optional)	50 mm (200 mm optional)	25 nm
ST-500-EM (electromagnet)	LHe/LN ₂	~3.5 K - 475 K (8 K - 675 K optional)	0.6 T horizontal	10 ⁻⁵ -10 ⁻⁶ mbar	4	50 mm	25 nm
ST-500-SCON (superconducting magnet)	LHe/LN ₂	5 K - 420 K	3 T vertical Vector: 1.0 T vertical 0.5 T horizontal	10 ⁻⁵ -10 ⁻⁶ mbar	2-6	50 mm	<1 micron
ST-500-PM (permanent magnet)	LHe/LN ₂	up to 350 K (up to 475 K optional)	0.1 T horizontal 0.2 T vertical	10 ⁻⁵ -10 ⁻⁶ mbar	4 (horizontal)	50 mm	25 nm
ST-500-UHV	LHe/LN ₂	Contact Janis		10 ⁻⁷ -10 ⁻⁸ mbar	Contact Janis	50 mm	
ST-500-MC (mobile chuck)	LHe/LN ₂	Contact Janis		10 ⁻⁵ -10 ⁻⁶ mbar	Contact Janis	50 mm	
CCR-4	Closed Cycle (cryogen free)	4.5 K - 350 K (6.5 K - 475 K or 675 K optional)		10 ⁻⁵ -10 ⁻⁶ mbar	2-6	50 mm	<1 micron
CCR-10	Closed Cycle (cryogen free)	9 K - 350 K (11 K - 475 K or 675 K optional)		10 ⁻⁵ -10 ⁻⁶ mbar	2-6	50 mm	<1 micron
CCR-80	Closed Cycle (cryogen free)	~80 K - 350 K (82 K to 475 K or 675 K optional)		10 ⁻⁵ -10 ⁻⁶ mbar	2-6	50 mm	<1 micron
CCR-EM (electromagnet)	Closed Cycle (cryogen free)	10 K - 350 K (12 K - 675 K optional)	0.6 T horizontal	10 ⁻⁵ -10 ⁻⁶ mbar	4	50 mm	<1 micron
CCR-SCON (superconducting magnet)	Closed Cycle (cryogen free)	5 K - 300 K	3T vertical	10 ⁻⁵ -10 ⁻⁶ mbar	2-6	50 mm	<1 micron
RT-500 (room temperature)	N/A	300 K - 500 K (300 K - 675 K optional)		10 ⁻⁵ -10 ⁻⁶ mbar (10 ⁻⁶ -10 ⁻⁹ mbar optional)	2-6	50 mm	25 nm

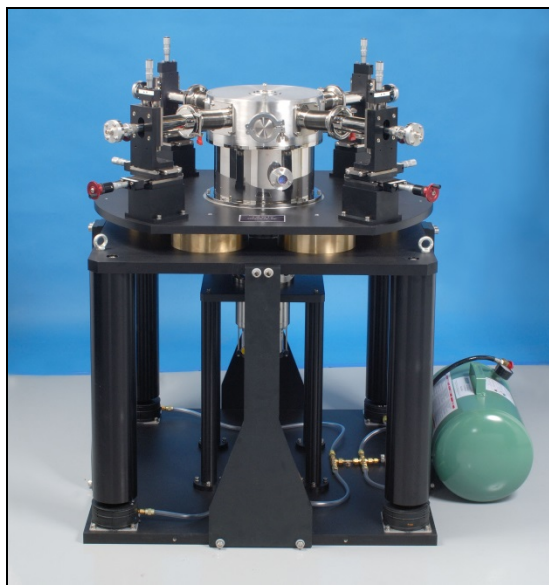
Temperature range varies depending on probe type. Specifications are subject to change without notice.

Micro-manipulated Cryogenic & Vacuum Probe Systems

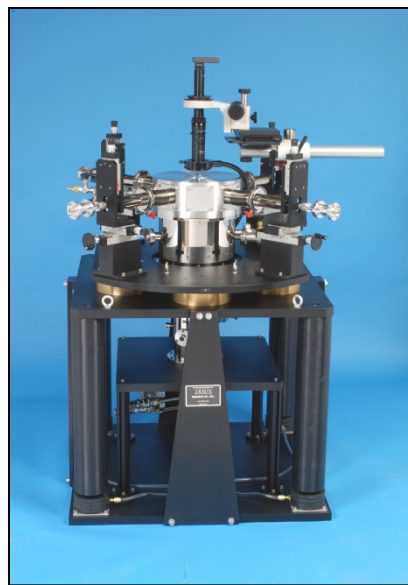
“Dry” Cryogen Free Systems

The Janis cryogen-free series probe stations provide the researcher with vacuum and cryogenic probing capabilities without requiring the use of liquid cryogenics. 10 K and 4 K cryocoolers utilize proven Gifford-McMahon (G-M) technology for reliable and affordable sample cooling.

Janis has worked closely with the world leaders in cryocooler technology through five decades. The successful application of this extensive experience now enables cooling and probing of samples without the use of cryogenics, and without the introduction of unwanted vibrations and noise to the sample. The sample is mounted on a removable sample holder (chuck); sample chucks are available in a variety of configurations including grounded, coaxial, and triaxial. The sample is fully surrounded by a thermal radiation shield, resulting in the lowest possible sample temperature. The cryocooler is connected to the chuck and thermal shield via proprietary low vibration / high thermal conductivity links. Silicon diode thermometers and a high wattage heater are used to monitor and control the sample temperature stability within 100 mK at any temperature within the operating range.



10 K Cryogen-free Probe Station



4 K Cryogen-free Probe Station

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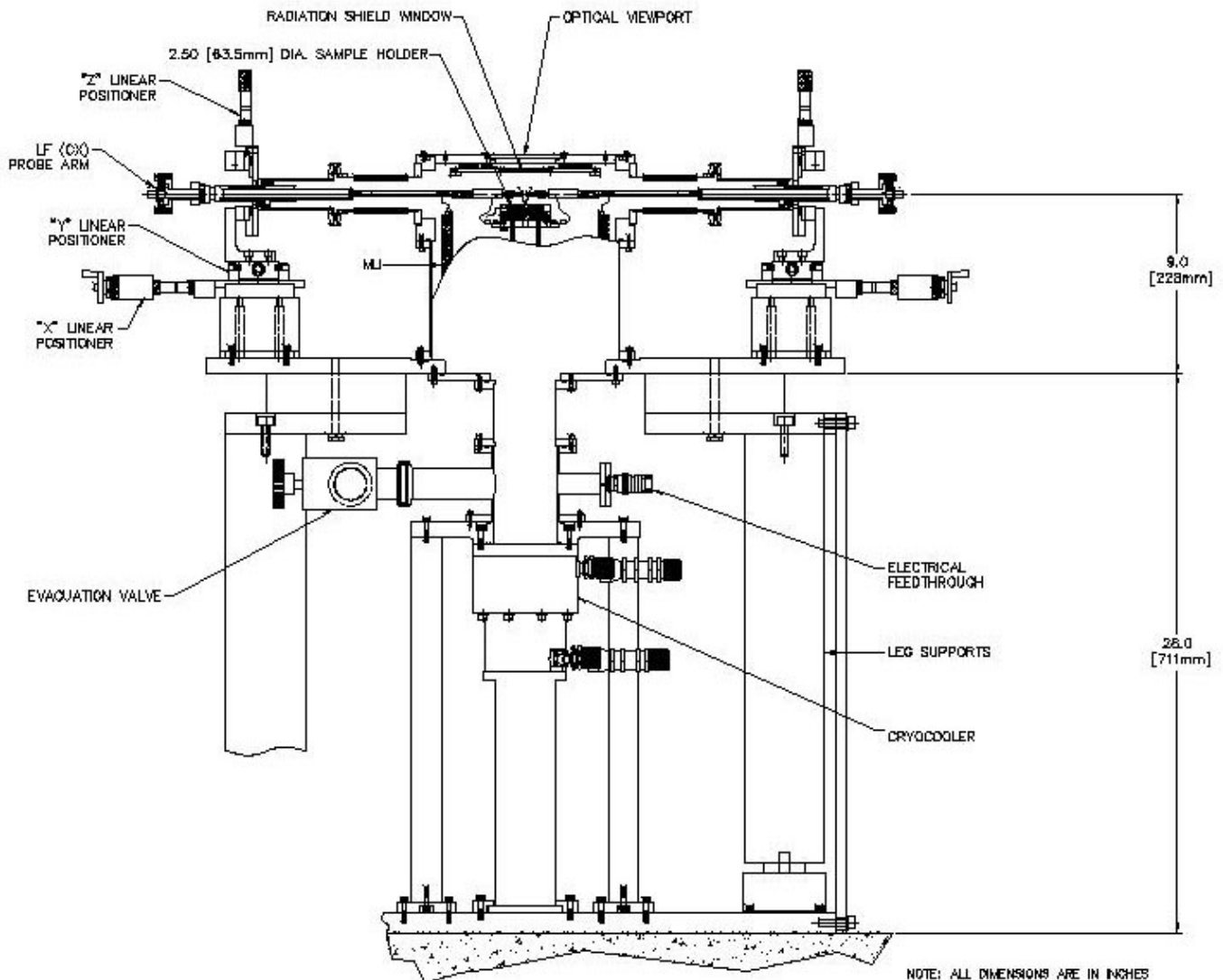
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Micro-manipulated Cryogenic & Vacuum Probe Systems

“Dry” Cryogen Free Systems

Drawing



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Micro-manipulated Cryogenic & Vacuum Probe Systems

“Dry” Cryogen Free Systems

CCR Probe Station Specifications

Vibration level:	Less than 1 micron	
Vacuum environment:	10 ⁻⁵ -10 ⁻⁶ mbar	
Temperature range* with four probe arms:	CCR4: ~4.5 K to 350 K (Optional: 6.5 K to 475 K or 6.5 K to 675 K) CCR5: ~5.5 K to 350 K (Optional: 7.5 K to 475 K or 7.5 K to 675 K) CCR10: ~9 K to 350 K (Optional: 11 K to 475 K or 11 K to 675 K) CCR12: ~11 K to 350 K (Optional: 13 K to 475 K or 13 K to 675 K) CCR80: ~80 K to 350 K (Optional: 82 K to 475 K or 82 K to 675 K)	
* Base temperature reduced with two probe arms.		
Temperature stability:	± 50 mK	
Cooling time (for standard 2" diameter sample mount and 325 K maximum temperature):	2.5 - 3 hours	
Warming up time:	~90 min with quick warm up option (~5 hours without)	
Sample mounts: 2" (51 mm) diameter standard up to 4" (101 mm) optional	Grounded Chuck Electrically Isolated Chuck with Bias Voltage Coaxial Cable Triaxially Guarded Chuck with Cryogenic Triaxial Cable Leadless Chip Carrier (LCC) Holder	
Interchangeable Probe Arms:	DC/LF probes: DC to 20 MHz with following tips available: - Tungsten tips with 0.1 to 200 micron tip radius (optional gold plating) - Special Tungsten bendable shank and tip (cat whisker) tips - Beryllium Copper soft tip with low contact resistance Coaxial or triaxial (typically 1 to 2 fA @ 1V leakage current) wiring 0.5 pA @ 1V Microwave probes: 0-40 GHz 0-50 GHz 0-67 GHz Fiber probes: Single Mode UV-VIS or VIS-IR Multimode Non-contact, non-destructive Kelvin probes Multi-tip probes	
Optical top viewport access:	Standard 2.0" (51 mm) clear aperture Optional up to 8" (200 mm) clear view	
Monoscopes with LCD 19" monitor or USB camera and <u>precise</u> translation stages	7:1 zoom, 5 microns resolution (216X magnification) 12.5:1 zoom, 3.4 microns resolution (508X magnification) 16:1 zoom, 2.2 microns (626X magnification)	
Probe travel:	CCR-1	CCR-2
X-axis:	1" (25 mm)	2" (51 mm)
Y-axis:	1" (25 mm) (15 mm with MW Probes)	2" (51 mm) (45 mm with MW Probes)
Z-axis:	10 mm (18 mm optional)	10 mm (18 mm optional)
X-, Y-, Z-axes probe translation (incremental units of graduation)	10 microns	12.5 microns
Probe translation resolution: X, Y, Z-axes	5 microns	6.25 microns
Motorized stages with higher translation resolution are available		



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Micro-manipulated Cryogenic & Vacuum Probe Systems

“Wet” ST-500 Series Cryogen Cooled Systems

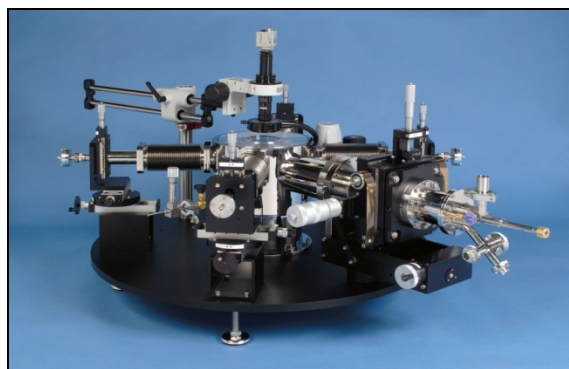
The Janis ST-500 series probe stations are high performance research instruments designed to provide affordable vacuum and cryogenic probing of wafers and devices. The proven ST-500 cryostat is the platform for these probe stations, and includes low vibration technology (originally designed for high spatial resolution optical microscopy) to provide outstanding sample positional stability. Researchers around the world are using these systems to conduct research in a wide variety of fields, including MEMS, nanoscale electronics, superconductivity, ferroelectrics, material sciences, and optics.



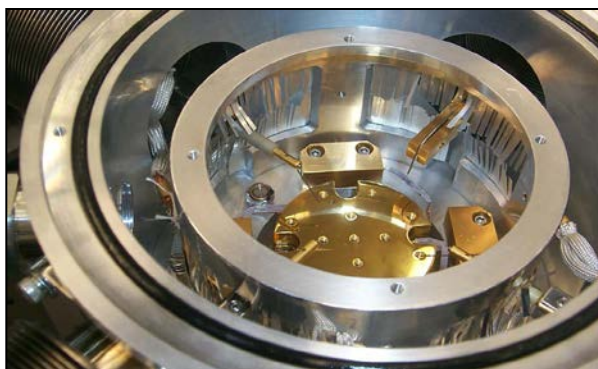
ST-500 Probe Station on Vibration Isolation Table



ST-500-UHT for 675 K Operation



ST-500 Probe Station with Mobile Chuck



ST-500 Probe Station Interior View

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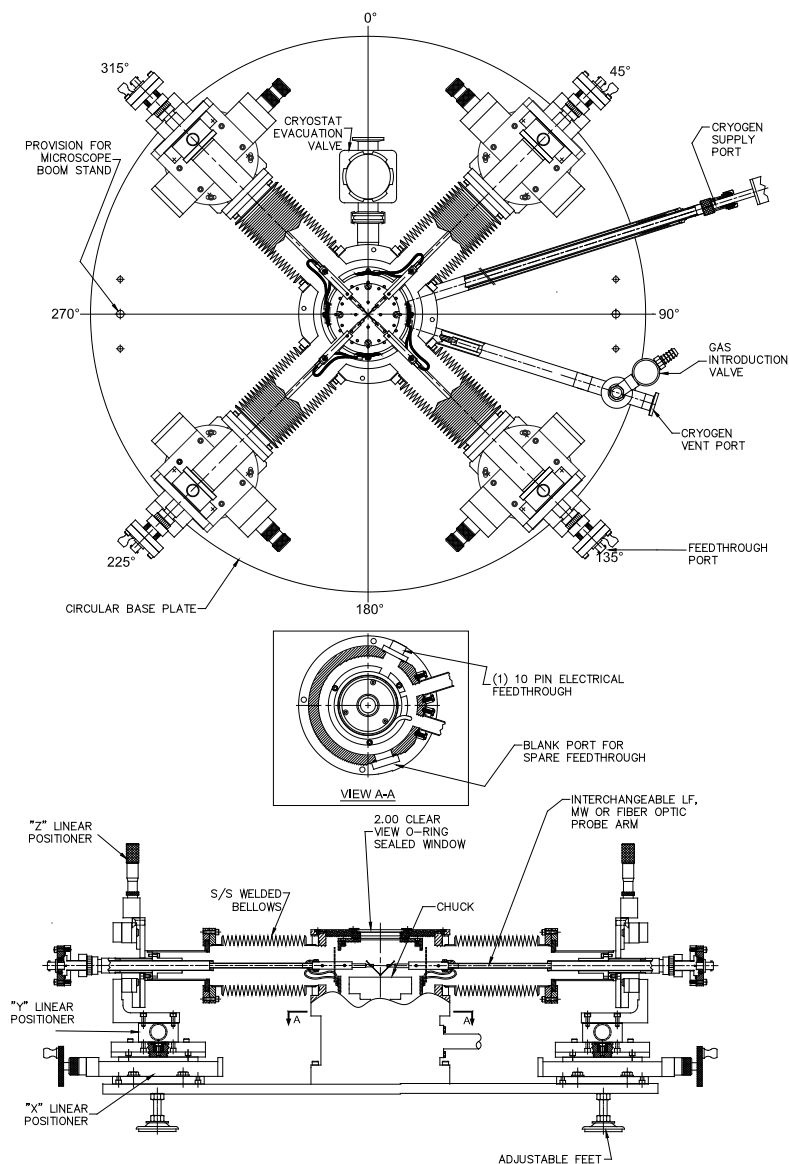
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Micro-manipulated Cryogenic & Vacuum Probe Systems

“Wet” ST-500 Series Cryogen Cooled Systems

Drawing



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Micro-manipulated Cryogenic & Vacuum Probe Systems

“Wet” ST-500 Series Cryogen Cooled Systems

ST-500 Series Probe Station Specifications

Temperature range:	~3.5 K to 475 K (DC Probes) (650 K optional), ~3.5 K to 450 K (MW Probes) (300 K – 535 K optional)	
Temperature stability:	+/- 50 mK	
Cooldown time:	~30 min to 10 K, 60 min to 5 K	
Vibration level:	+/- 25 nm	
Positional drift:	+/- 150 nm in 30 minutes	
Frequency range:	DC/LF Probe: DC to 20 MHz Microwave probe: 0-40 GHz, 0-50 GHz, 0-67 GHz	
Optical access:	2.0" clear aperture	
Optical resolution with monoscope:	7:1 zoom, 5 microns 12.5:1 zoom, 3.4 microns 16:1 zoom, 2.2 microns	
Maximum sample size:	52 mm diameter	
Probe travel:	ST-500-1	ST-500-2
X-axis:	25 mm	50 mm
Y-axis:	25 mm (15 mm with MW Probes)	40 mm * (35 mm with MW Probes)
Z-axis:	10 mm	10 mm (18 mm optional)
Probe translation (incremental units of graduation): X, Y, Z-axes:	10 microns	12.5 microns
Probe translation resolution: X, Y, Z-axes:	5 microns	6.25 microns

* 50 mm including Y-stage pivot.

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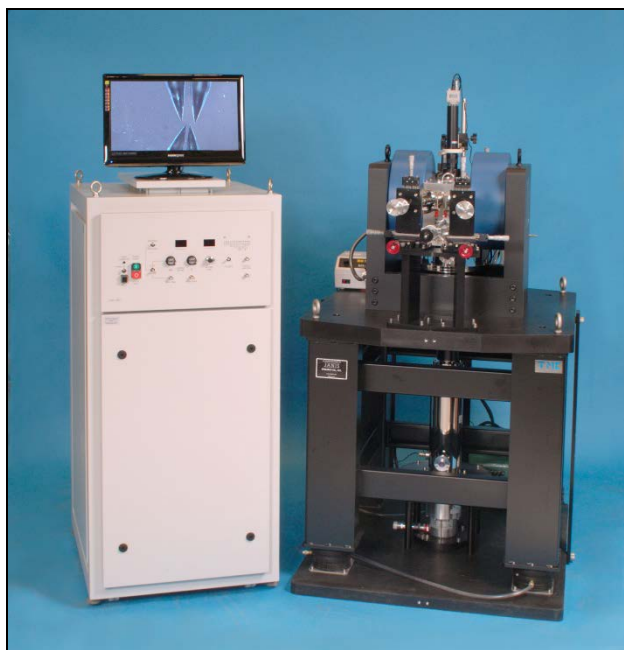
Micro-manipulated Cryogenic & Vacuum Probe Systems

Probe Stations for Magnetic Measurements

Probe station designs incorporating an electromagnet, superconducting magnet, or permanent magnets are available for magnetic field dependent measurements. These systems are ideal for the study of magneto-optical and magneto-electrical properties in a variety of experiments, including quantum dots, spintronic devices and nanoscale electronics.

Probe Stations with horizontal magnetic field parallel to the sample mount plane

Probe stations combined with a **room temperature electromagnet** offer a variable horizontal magnetic field of up to 0.6 T (6000 Gauss) with typical field homogeneity of 2% over a 25 mm diameter. They are available in both cryogen cooled and cryogen-free versions.



*Cryogen-free Probe Station
with Electromagnet*



*Cryogen Cooled Probe Station
with Electromagnet*

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Micro-manipulated Cryogenic & Vacuum Probe Systems

Probe Stations for Magnetic Measurements

Probe Stations with horizontal magnetic field parallel to the sample mount plane

Two (or four) **cylindrical permanent magnets** can be combined to create variable horizontal magnetic field up to 1000 Gauss. The field is varied by changing the location of the magnets relative to the sample, using calibrated spacers provided by Janis.



Probe Stations with vertical magnetic field perpendicular to the sample mount plane

Superconducting magnets offer a variable vertical magnetic field up to 3 Tesla with typical field homogeneity of 5% over a 10 mm diameter.

A **set of six ring permanent magnets**, incorporated into a cryogen cooled or cryogen-free probe station provide step varied field between 2000 Gauss and 300 Gauss.



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Micro-manipulated Cryogenic & Vacuum Probe Systems

Ultra High Vacuum (UHV) Probe Stations

Janis offers a complete range of probe stations suitable for making electrical measurements in a UHV environment. Several standard designs are available, and systems can be custom configured to meet a wide variety of user requirements. Janis has been manufacturing UHV compatible systems for over 50 years, and we apply this extensive experience to the design of every UHV probe station. Typical UHV probe stations include:

- All stainless steel vacuum chamber with metal sealed flanges (CF)
- UHV rated electrical feedthroughs and electrical probes
- UHV rated optical viewport
- Fully bakeable to 120 °C
- Room temperature or cryogenic configurations
- Sample size 25 – 50 mm diameter
- 2 – 8 integrated x-y-z probe manipulators, with electrical probes installed
- Temperature range from 5 – 675 K available
- Monoscope, camera, and monitor for viewing samples and probes

Probe Station Options include:

- Larger diameter vacuum chamber and sample mount
- Load lock option for sample exchange without opening the chamber
- Integrated UHV turbopump for maximum pumping speed and lowest base pressure
- Vibration isolated stand
- Special miniature vacuum chamber to transfer sample under vacuum from Glove Box to Probe Station and back to Glove Box after measurements
- Additional electrical feedthroughs
- Additional metering flow control valve with variable flow (3.6 to 72 Torr/l/sec) to introduce different gases into the vacuum chamber.

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Micro-manipulated Cryogenic & Vacuum Probe Systems

Ultra High Vacuum (UHV) Probe Stations



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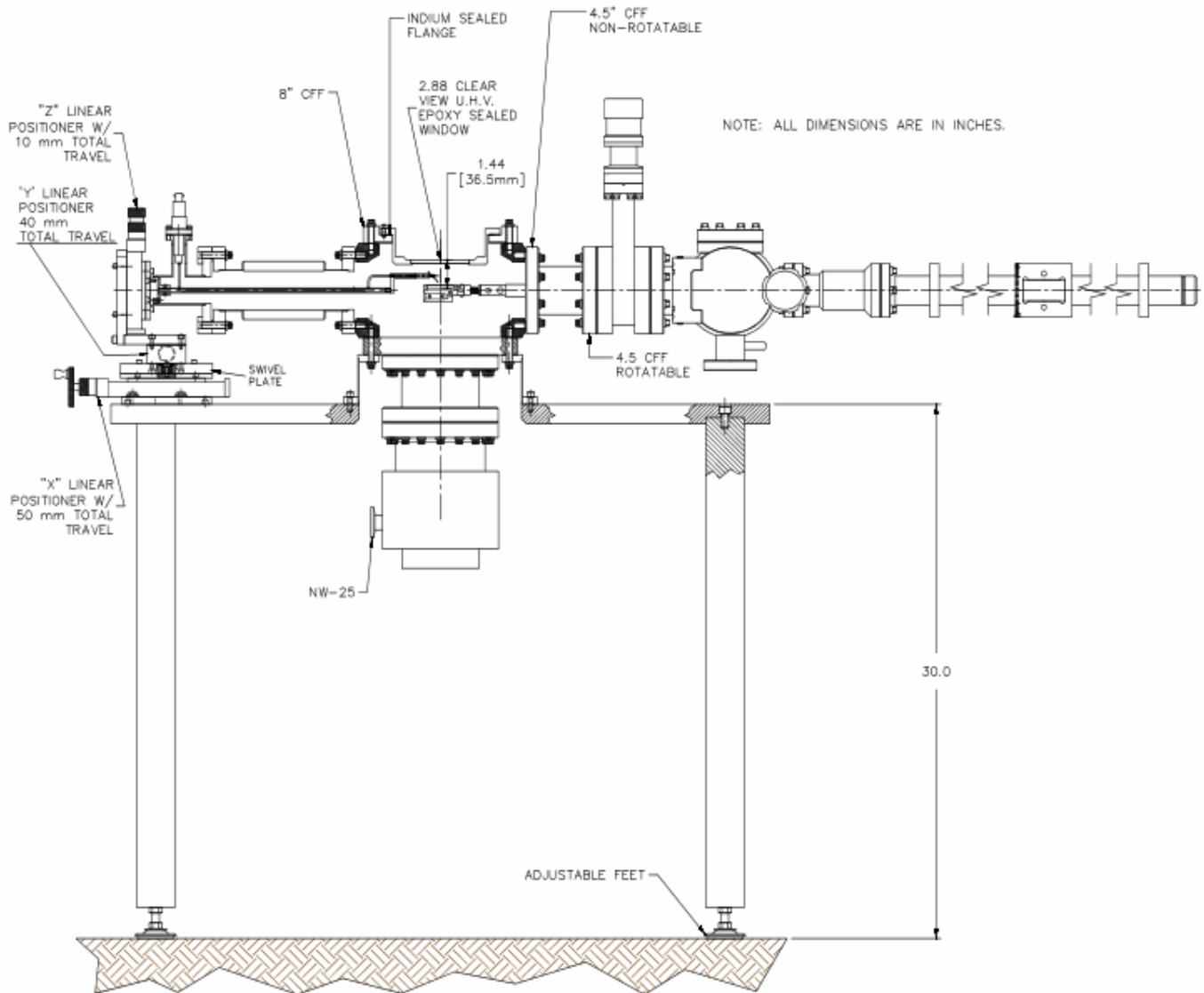
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Micro-manipulated Cryogenic & Vacuum Probe Systems

Ultra High Vacuum (UHV) Probe Stations

Drawing



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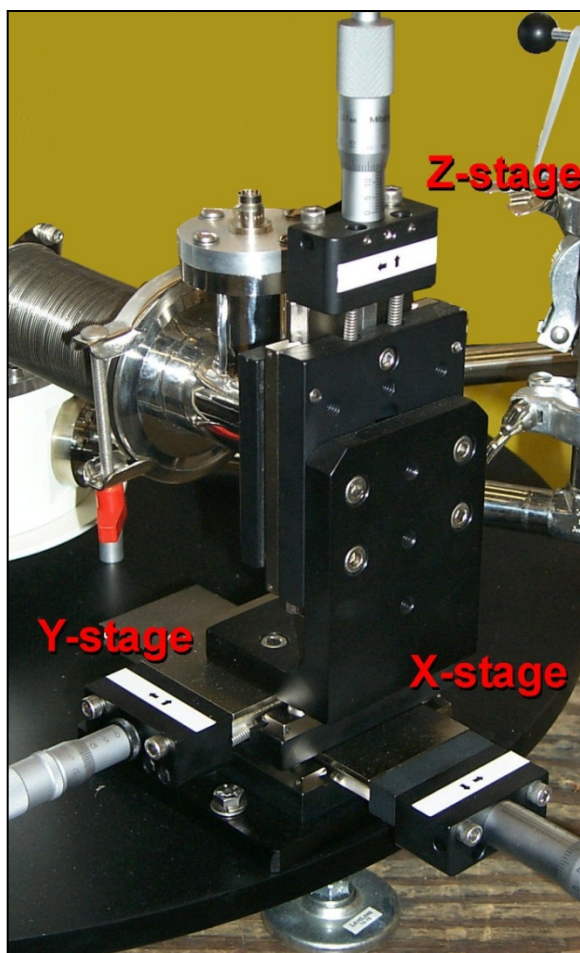
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Micro-manipulated Cryogenic & Vacuum Probe Systems

Probe Station Components

Micromanipulated Translation Stages

Up to eight independent X, Y, Z stages provide precise control over the probe motion within the range of travel. Each stage includes graduations in increments of 10 – 12.5 microns, with typical useful resolution of 5 – 6.25 microns. Stages used for microwave probes include theta rotation adjustment for planarization of the probe.



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Probe Station Components

Probe Options

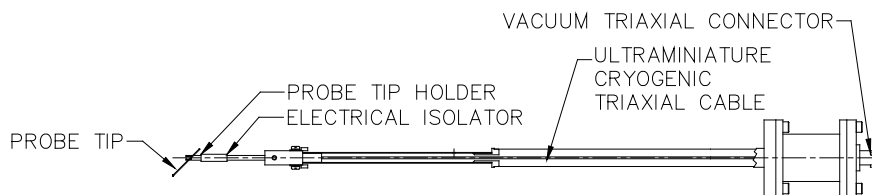
A wide variety of probe options are available and different options can be specified for each probe stage. Typical configurations include:

LOW FREQUENCY (DC) Tip diameter, radius, and material can be specified by the user to match a specific application and pad size. Configurations include coaxial (for general purpose measurements), triaxial (for high resistance, low current measurements), and Kelvin (for low resistance measurements).

HIGH FREQUENCY (MW) Microwave probes are available in 40, 50, and 67 GHz ranges, and include low profile probe holders with beryllium copper or tungsten spring loaded tips. The probe configuration and pitch can be specified by the user, as ground-signal-ground (GSG), GS, or SG, with pitch range from 50 - 1250 microns. Each probe is connected to a semi-rigid coaxial cable terminating in a type K or V connector designed for low insertion and low return loss.

FIBER OPTIC PROBE ARM One or more probe ports can be configured to accept an optical fiber, for precise optical excitation of wafers and devices.

INTERCHANGEABLE ARMS DC, MW and fiber optic probe arms can easily be interchanged with one another. Spare probe arms in various configurations can be supplied with the system or at a future time.



Triaxial Probe

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Micro-manipulated Cryogenic & Vacuum Probe Systems

Probe Station Components

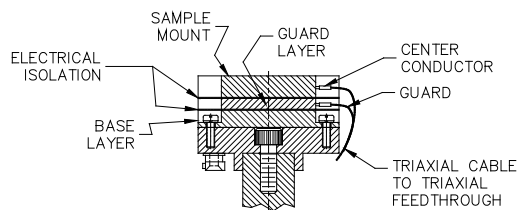
Chuck Options

Three different chuck configurations are available, and can be interchanged as required.

Grounded The chuck is attached directly to the probe station cold stage, and is electrically grounded to the body of the probe station.

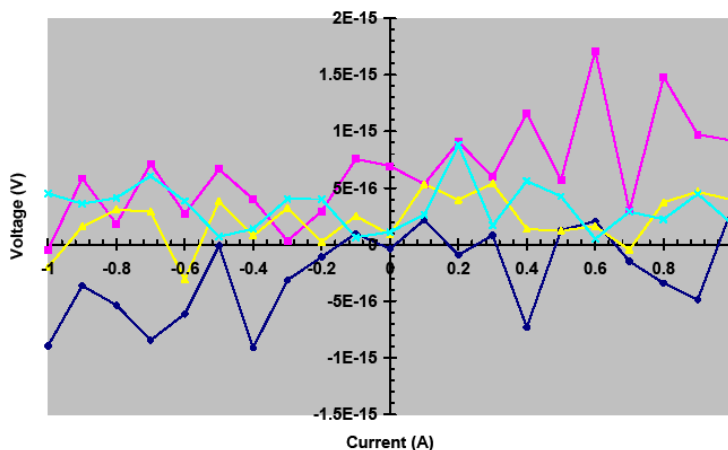
Coaxial The sample mounting surface is electrically isolated from the body of the probe station. The mounting surface is electrically connected to a BNC connector, for use in applying a bias voltage to the back side of the DUT.

Triaxial The chuck includes two electrically isolated sections, which can be driven by the same voltage as the backside of the DUT. This results in the lowest possible leakage current.



Triaxial Chuck

Janis Triaxial Probe Leakage Current Noise Measurements



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Probe Station Components

Optional Equipment

- Monoscope with fiber-optic light source, vertical boom stand with vertical and horizontal adjustment, CCD camera, LCD color monitor. Available models include zoom of 7:1, 12.5:1, 16:1.
- Cryogenic temperature controllers from the leading controller suppliers. Each controller supplied by Janis includes full integration and testing with the system.
- Turbopump station including 42 L/s turbomolecular pump, wide range vacuum gauge and readout, stainless steel flexible pumping line. Available with mechanical or dry diaphragm backing pump.
- Portable ultra-quiet air compressor for vibration isolation table.
- Micromanipulated optical port, for optical probing/excitation of samples.
- Integrated high temperature stage, to extend upper temperature limit to 675 K.
- Rapid warm-up option (45 minutes for “wet” systems and 90 minutes for “dry” systems).
- Pumping station vibration isolator.



Turbomolecular Pump Station



Temperature Controller

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