

Variable-Temperature Vertical Magnetic Field Probe Station Specifications Document

1.0 Item Description and Specifications:

NRL requires a low- and variable- temperature vertical-field magnetic cryogen-free probe station capable of enabling electrical and magnetic measurements of semiconductor-based devices over a temperature range of 10 -500 ° Kelvin. In particular, the required system must meet the following specifications:

2.0 CLIN 0001

Variable- Temperature Superconducting Vertical- Field Magnetic Cryogen- Free Probe Station

2.1 Temperature Control Requirements

2.1.1 Must provide sample temperatures ranging from 10° Kelvin to 500° Kelvin with a stability of at least +/- 50 m°K across the full temperature range. It is desired that the system be capable of providing sample temperatures ranging from 5° Kelvin to 500° Kelvin with a stability of at least +/- 50 m°K across the full temperature range.

2.1.2 Must be able to warm system from minimum temperature of 10°Kelvin to room temperature of 300°Kelvin in less than 4 hours. It is desired that the system is able to warm from a minimum of 5°Kelvin to room temperature in less than 4 hours.

2.1.3 Must be able to cool system from room temperature of 300°Kelvin to the minimum temperature of 10°Kelvin in less than 6 hours.

2.1.4 Must include all instrumentation required for user control, temperature measurement and monitoring of stage and sample temperature, including a stage-mounted temperature sensor with external read-out .

2.1.5 It is desired that the system be able to warm from 300°Kelvin to 500°Kelvin in less than 4 hours.

2.1.6 It is desired that the system be able to cool from 500°Kelvin to 300°Kelvin in less than 6 hours.

2.2 Magnet Requirements

2.2.1 Must provide vertical (relative to sample plane) magnetic field, fully adjustable from 0 Tesla to 2.0 Tesla for sample temperatures from 10° Kelvin to 300° Kelvin; reduction in magnetic field for sample temperatures greater than 300° Kelvin are acceptable.

2.2.2 Must include all instrumentation required for user control and monitoring of applied magnetic field, including all necessary power supplies and temperature controllers.

2.2.3 Must be cooled via completely cryogen-free system.

2.3 Sample Stage Requirements

2.3.1 Must be capable of accommodating planar samples up to 1.25" in diameter.

2.3.2 Must include one (1) electrically isolated from ground stage that must possess a triax connection to an external feed-through to enable electrical biasing of the backside of the sample (ie. back-gating).

2.3.3 Must include one (1) electrically grounded stage that can be user-installed for specific measurements. Removal and installation of stages should take no more than 2 hours to complete. Any custom tools required for stage removal and installation must be provided.

2.4 Manipulated Probe Arms Requirements

2.4.1 Must possess 6 manipulator probe arms, each of which meets the following specifications:

2.4.1.1 Must provide X and Y displacement of at least 1" and Z displacement of at least 0.5".

2.4.1.2 Must be electrically connected to a triaxial feed-through for external biasing and measurement.

2.4.1.3 Must possess a probe arm and tungsten probe tip of maximum radius 3 μm .

2.4.1.4 Must possess cabling and connections that support electrical measurement frequencies from DC up to at least 50 MHz.

2.5 System Optics

2.5.1 Must possess an optical system for viewing sample and probe connections including: microscope, light source, digital camera, video monitor, and any necessary cables and connectors.

2.5.2 Viewing system must provide minimum zoom of 16:1 and minimum resolution of 4 μm .

2.6 System Chamber, Vacuum, and Power Requirements

2.6.1 Must be housed in metal vacuum chamber with at least one optical port for sample viewing.

2.6.2 Once system is at room temperature, typical user should be able to exchange sample specimens and initiate cool-down within 0.5 hrs.

2.6.3 Must possess at least one unused spare port with inner diameter of at least 1" for potential custom attachment.

2.6.4 Must include pumping system to achieve vacuum levels of at least 10^{-7} Torr with system at minimum temperature of 10°Kelvin.

2.6.5 Must incorporate vibration isolation between vacuum pump and system stage.

2.6.6 Must include vibration-isolated support stand.

2.6.7 Any system components requiring external power must use US standard (120 VAC, 60Hz) or (240VAC, 60Hz) sources and connections.

2.7 System Cooling Requirements

2.7.1 Must possess completely cryogen-free cooling for all system components (ie. both the sample and the magnet).

2.7.2 If the proposed system is cooled by water, it must include appropriate recirculating chiller so that the attachment to plant chilled water is not necessary.

2.8 System Size

2.8.1 Entire system footprint, including all required accessories, power supplies, controllers, etc., must be no greater than 40 square feet total. System shall be no more than 6' in height.

2.9 Spare Parts and Consumables

2.9.1 Must include 10 spare tungsten probe tips of maximum radius 3 um.

2.9.2 Must include at least 1 ounce thermal grease used for sample attachment and thermal contact enhancement. Greases should be provided that meet applications over the full operating temperature range of 10° Kelvin to 300° Kelvin. Greases should be removable by common solvents such as acetone or isopropanol.

3.0 CLIN 0002

Installation, Testing and Acceptance

3.0.1 The contractor shall deliver the system to NRL (building 208, room 354A) no later than 182 days after contract award. Installation of the system shall be completed no later than 21 days after delivery. NRL shall provide the necessary facilities and utility hook-ups for proper installation and operation of the system. The contractor shall provide operational demonstration including functionality checks, machine calibration, and test cuts. The contractor shall also provide the necessary hardware for testing. The system shall be ready for immediate use following installation and set-up. Acceptance shall occur after installation and testing is complete.

4.0 CLIN 0003

Training

4.0.1 The contractor shall provide at least two (2) days of on-site training for at least three (3) people. The training shall occur no later than one month after installation and testing is complete.

5.0 CLIN 0004

Warranty

5.0.1 The contractor shall provide the standard commercial warranty offered to the general public for the operation and performance of all non-consumable components, assuming user compliance with recommended use and operation parameters. The period of warranty shall begin upon acceptance of CLIN 0001- CLIN 0005 and last a minimum of one year.

6.0 CLIN 0005

Documentation

6.0.1 The contractor shall provide two (2) sets of the following documentation at the time of system delivery:

1. All operation and maintenance manual(s) or equivalent.
2. All software manuals for the software included with the system, if customarily provided. This documentation must be received at NRL with the system hardware.
3. Drawings and schematics for full site preparation, operation, troubleshooting, servicing and repair of the system and its components.