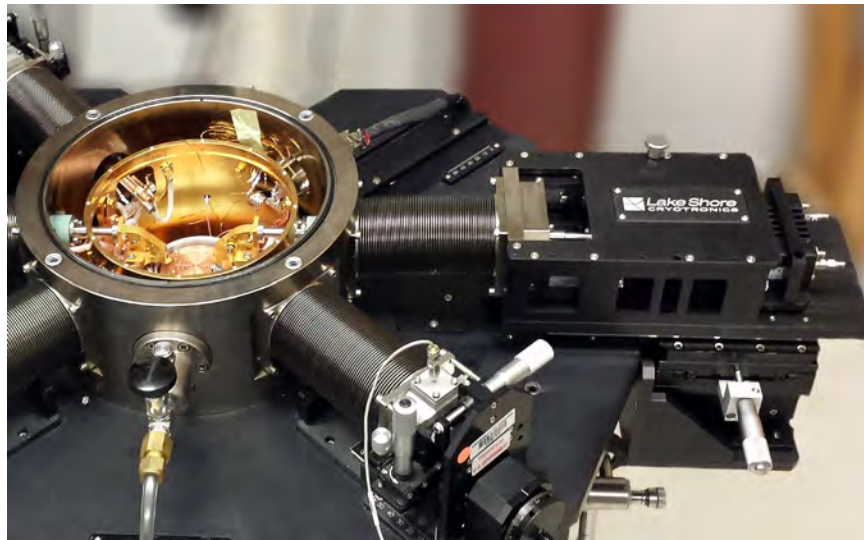


## Terahertz Cryogenic Probe Arm Option

### NEW! THz-frequency contact probing for cryogenic applications

- For precise on-wafer contact probing of millimeter wave devices at THz frequencies (75 GHz and up) in a Lake Shore cryogenic probe station
- Opens new measurement possibilities for next-generation electronics R&D
- Supports vector network analyzers (VNAs) with suitable frequency extenders
- Enables calibrated S-parameter and other high-frequency electrical measurements to be performed at cryogenic temperatures and in magnetic fields
- Combine two THz probe arms with standard DC/RF/microwave probe arms for a total of 6 simultaneous contact probes
- A breakthrough solution, only available from Lake Shore Cryotronics
- 3-year standard warranty



#### Low-loss THz waveguide

High-frequency contact measurements require careful consideration to how signals are conducted to and from the device under test. As frequencies rise above 75 GHz and into the previously unobtainable THz regime, signals can deteriorate rapidly using existing waveguides over paths as short as a few centimeters.

Room temperature probing solutions have typically addressed this issue by minimizing the path length between the frequency extender source/detector modules and the probe. However, the connecting waveguides can only be reduced so much before the bulky modules intrude upon the sample space, complicating arm mobility and limiting options for adding other probes.

In a cryogenic probe station, significantly longer signal paths (on the order of 25 cm) are required to traverse the station's vacuum chamber and interior structures. Lake Shore's new THz cryogenic probe arm with its specially developed low-loss THz-frequency waveguide ensures excellent signal integrity over these longer spans.



PRELIMINARY

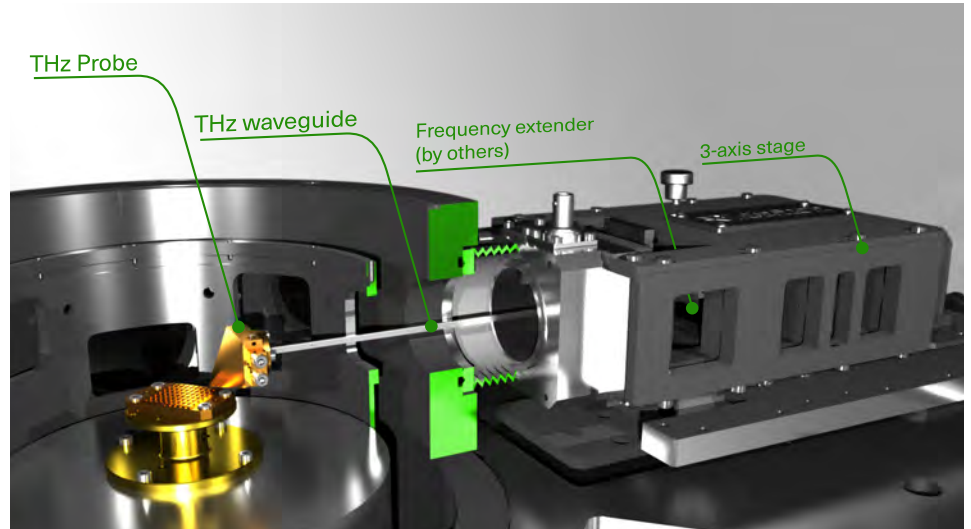
## Components of the THz cryogenic probing solution

### Probe arm

The THz cryogenic probe arm is a high-frequency probing option for Lake Shore probe station models CPX, CPX-VF, CRX-4K, and CRX-VF. It can be mounted in arm positions 2 or 5 on these stations. The option consists of a 3-axis micro-manipulated stage with stainless steel welded bellows and includes:

- The probe arm and base with integrated theta planarization
- A DC bias port
- A temperature sensor (for attachment to the probe)
- Feedthrough ports and mounting platform configured for use with a third party frequency extender
- High-frequency waveguide (selected to match the bandwidth of the frequency extender, see below)

Lake Shore supplies the probe arm only. Other required components are the frequency extender and probe, which are supplied by third parties as noted below.



### Frequency extender

Currently, the Lake Shore probe arm supports the newer, smaller MiniVNAX extenders from Virginia Diodes, Inc. ([www.vadiodes.com](http://www.vadiodes.com)). VDI extender modules work with most modern vector network and signal analyzers from suppliers like Keysight, Anritsu, and Rohde & Schwarz. The VDI modules are offered in a range of frequency bands, each band requiring a slightly different output coupling configuration. Lake Shore's waveguide topology must be matched to the frequency band of the extender module.

### Probe

The THz cryogenic probe arm supports custom probes developed by Dominion Microprobes. These T-wave™ probes are available from Cascade Microtech or Lake Shore

The micro-machined GSG probe features low-insertion loss coupling to the DUT and DC biasing of probed circuits. The required special version of this probe is cryogenically qualified.

At present, Lake Shore offers probe arms compatible with the following frequency bands from VDI:

WR-10 (75 to 110 GHz)

WR-5.1 (140 to 220 GHz)

Other frequency bands and other types of frequency extender modules can be accommodated—please contact Lake Shore with your needs.

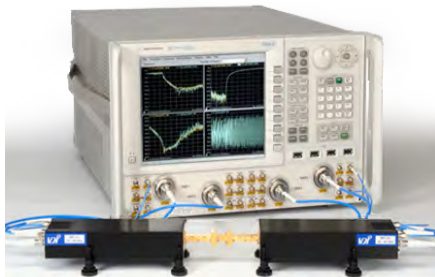
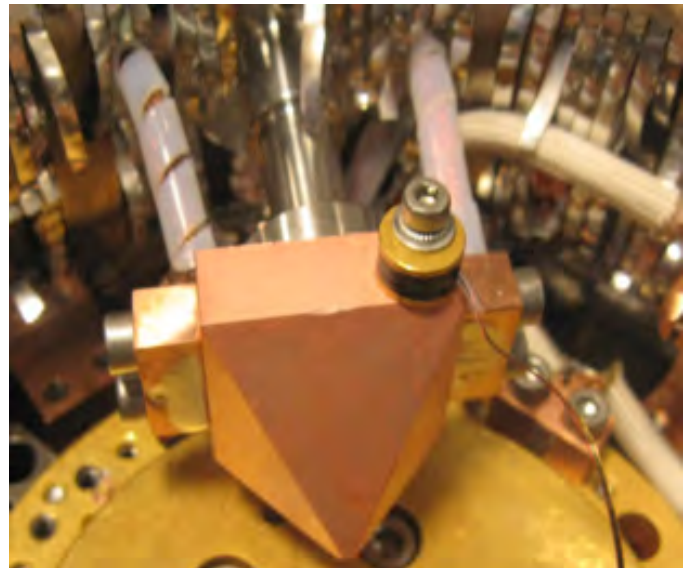


photo from Virginia Diodes, Inc.



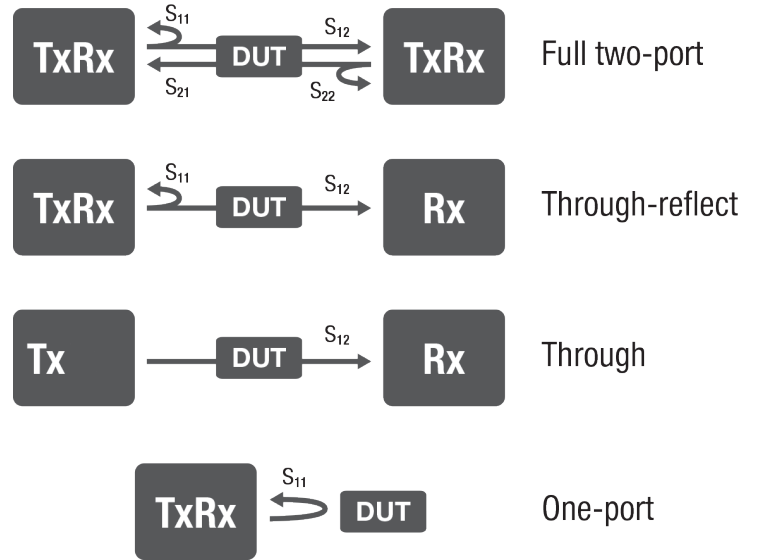
**PRELIMINARY**

## THz cryogenic probe arm compatibility details

- Compatible with Lake Shore probe station models: CPX, CPX-VF, CRX-4K, and CRX-VF
  - In compatible stations, up to two THz cryogenic probe arms can be used in conjunction with any other standard probe arms for a total of 6 simultaneous contact probes
  - THz cryogenic probe arms can be mounted in arm positions 2 and 5
- Compatible with frequency extenders from Virginia Diodes (VDI)—other brands by request.
  - Mini Vector Network Analyzer Extension Modules (MiniVNAX) (<http://www.vadiodes.com/index.php/en/products/mini-vector-network-analyzer-extension-modules>)
  - WR 10 and WR 5.1 bands available now—others available on request
  - VDI extenders are compatible with modern network analyzers/signal analyzers
- Compatible with special Cascade Microtech T-wave™ probes.
  - Micro-machined GSG low-loss probe, qualified for cryogenic applications
  - Braided thermal anchor included
  - Aluminum construction
  - Supports on-wafer measurements of 75 GHz and up.

## S-parameter measurements

Scattering parameters (S-parameters) describe the frequency-dependent electrical behavior of a device under steady-state traveling-wave current and voltage signals. Either a one-port or two-port configuration can be used. Based on signal direction (transmit/receive), the reflection ( $S_{11}$ ,  $S_{22}$ ) and transmission ( $S_{12}$ ,  $S_{21}$ ) components are measured independently to provide the complete device profile.



## Ordering information

### Part Number

MMS-09-THZ-MVNAX-XXXXX

### Description

THz cryogenic probe arm option—for use with VDI MiniVNAX frequency extender modules (modules must be purchased separately; for more information contact VDI). Requires selection of compatible waveguide from the list below.

### Select waveguide

One waveguide is included in each MMS-09-THZ cryogenic probe arm option. Select the waveguide that corresponds with the frequency extender band to be used. Add these letters to the option part number.

Frequency band	Frequency range	Append to option part number
WR-10	75 – 110 GHz	-WR10
WR-5.1	140 – 220 GHz	-WR51

## A collaborative development

The THz cryogenic probe arm was developed in collaboration with SWISSto12 ([www.swisst012.com](http://www.swisst012.com)), DMPI, VDI, and the University of Virginia School of Engineering and Applied Science ([www.ece.virginia.edu/uvml/](http://www.ece.virginia.edu/uvml/)). The parties worked closely together to model, design, implement, and validate the measurement capability of the probe arm in a Lake Shore CPX cryogenic probe station located at the University of Virginia.

Lake Shore Cryotronics, Inc.  
575 McCorkle Boulevard  
Westerville, OH 43082 USA  
Tel 614-891-2244  
Fax 614-818-1600  
e-mail [info@lakeshore.com](mailto:info@lakeshore.com)  
**[www.lakeshore.com](http://www.lakeshore.com)**

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