

**HPD**

## High-Precision Cryogenic Integrated Measurement Solutions

Full-featured line of chip-scale systems, cryostats and cryogenic magnetometry systems

## HPD Chip-scale Probe Stations

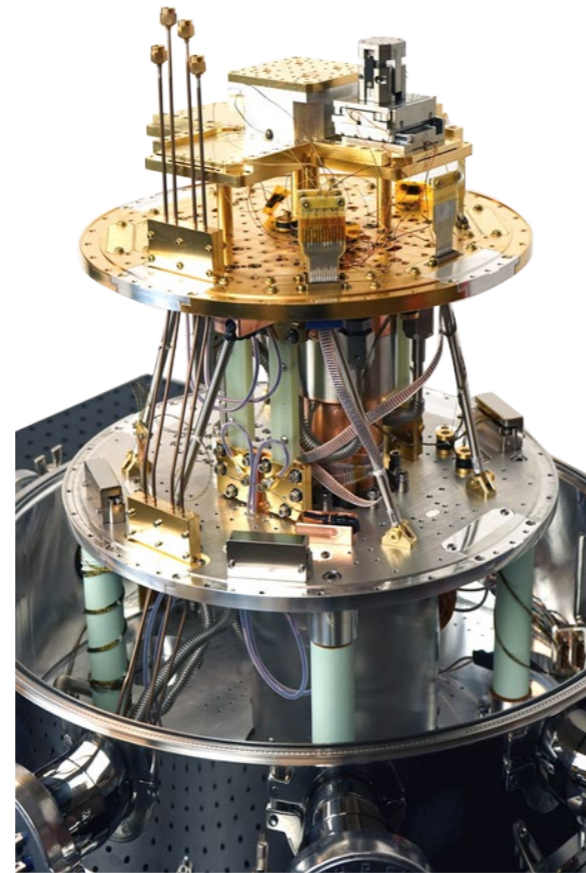
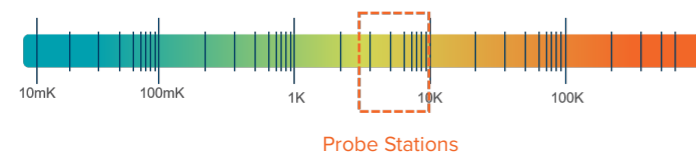
### Conducting High-Accuracy Measurements at True 4 K Cryogenic Temperatures

The HPD cryogenic chip-scale probe stations tackle problems like long turnaround times, high noise, and low signal capabilities. By employing world class technology, superior cryogenic probing knowledge, and test application engineering expertise, these systems enable accurate measurements at ultra-low temperatures. With a range of integrated measurement solutions enabling true 4 K sample temperature operation, FormFactor's HPD chip-scale probe stations can be customized to fit your sampling needs for whatever signal (DC, RF, FO) you need to get to your sample.

With advanced features to reduce mechanical vibration, block stray light from reaching the sample, and shield stray magnetic field, the systems are designed to eliminate noise and ensure temperature stability.

Optionally, choose a system with larger stage design and the ability to incorporate our scanning squid microscope. All of our systems offer a broad array of optional features to ensure the customized system will meet your probing needs today and in the future.

#### Operating Temperature



HPD Kilimanjaro 125 chip-scale semi-automated 4 K probe station with vibration isolation

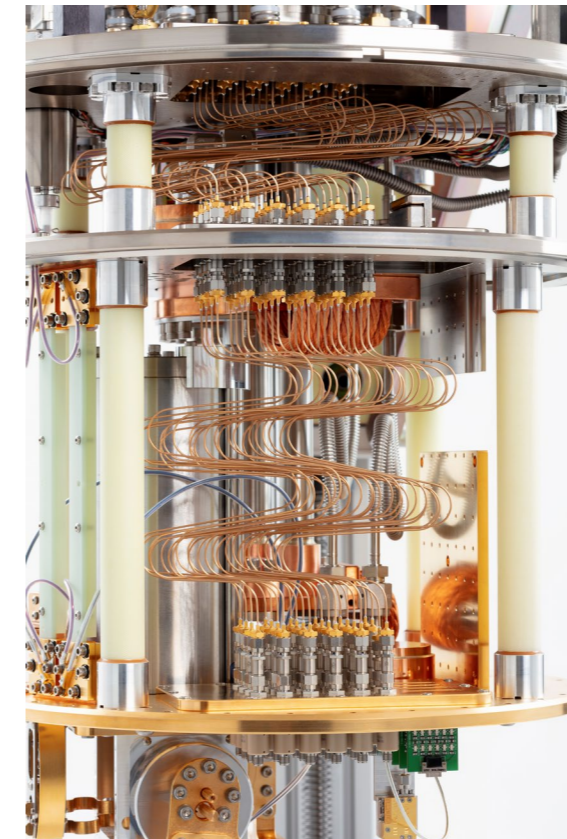
#### Customer Applications

- / Scanning SQUID Microscopy
- / Photonic QC
- / Trapped Ion QC
- / Spin QC
- / Cryo-CMOS

Family	Model	Sample Temperature	Cooling Power	Vibration Isolated
Kilimanjaro	122	< 4 K	1.5 W @ 4.2 K	Standard
	125			Enhanced
	1260			

## HPD ADR Cryostats

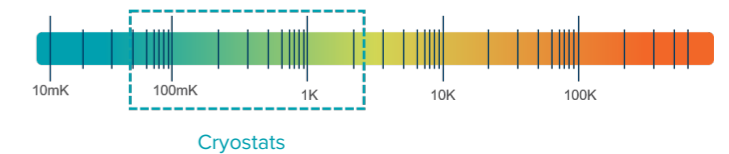
### Adiabatic Demagnetization Refrigerator (ADR) Cryostats for Easy, Affordable Access to mK Temperatures



HPD Shasta 106 ADR Cryostat

HPD Cryostats provide an alternative to more difficult-to-use, expensive, and space consuming dilution refrigerators (DR). These Adiabatic Demagnetization Refrigerators (ADR) are great for applications that do not need the full power of a DR, but still require sub Kelvin temperatures. Our solutions for interfacing with your samples eliminate time-consuming steps such as wirebonding. Our ADRs provide a faster, compact, and less costly path to integrated measurement solutions at temperatures a fraction of a degree above absolute zero.

#### Operating Temperature



#### Customer Applications

- / Astronomy
- / Spin QC
- / Photonic QC
- / Material Characterization
- / Condensed Matter
- / Physics
- / Superconducting QC
- / Quantum Computing Development

Family	Model	Base Temperature	Cooling Energy	Sample Space Volume (all dimensions in mm)
Denali	102	< 30 mK	120 mJ @ 100 mK	240 x 150 x 140 (LxWxH)
Rainier	103			250 x 260 (HxØ)
Olympus	104			600 x 440 (HxØ)
Shasta	106			490 x 340 (HxØ)
K2	107	< 25 mK	270 mJ @ 100 mK	200 x 340 (HxØ)

## HPD Cryogenic Magnetometry System

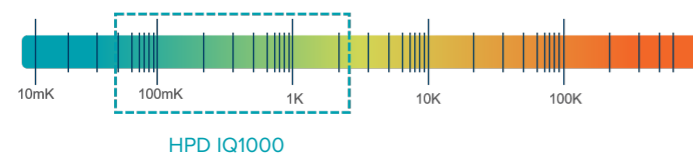
### Fully Automated Scanning SQUID Microscope

The HPD IQ1000 is a new fully integrated scanning SQUID<sup>1</sup> microscope used to study the dynamics of trapped magnetic flux (magnetic vortices) in superconducting circuits which can negatively impact circuit operation. This microscope enables superconducting device design teams to quickly and easily image magnetic vortices in devices cooled through the superconducting transition temperature in controlled magnetic fields.

With rapid scan speed and process automation, the IQ1000 is the first commercial product of its kind to enable unattended and high-throughput characterization. Device designers can now eliminate the guesswork involved in the design of resilient superconducting circuits, and significantly reduce development time by locating and capturing detrimental magnetic vortices with this integrated measurement system to enhance device performance.

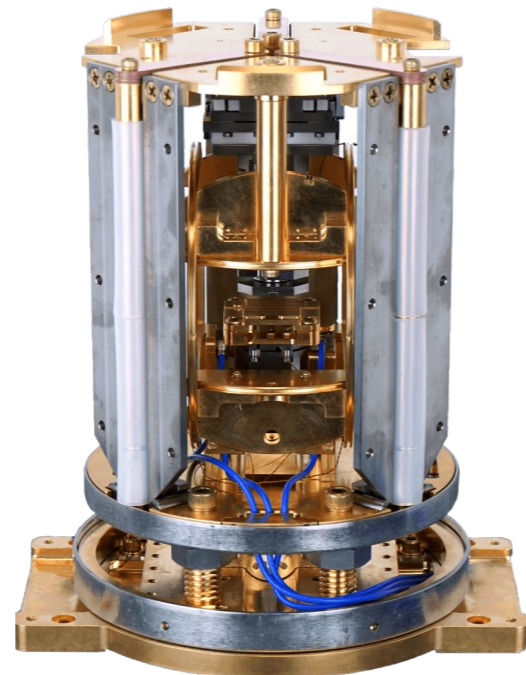
<sup>1</sup> SQUID stands for "superconducting quantum interference device".

#### Operating Temperature



#### Customer Applications

- / Superconducting Circuit Device Design
- / Quantum Computing Development



## HPD Cryogenic Wafer Prober

### Fully Automated Cryogenic Wafer Probing at 4 K

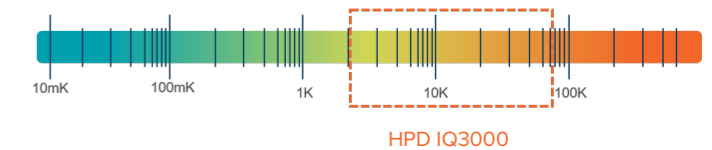


The HPD IQ3000 is a high precision fully automated probe station for 150 mm and 200 mm substrates in a 4 K environment, or optionally in a 77 K environment. To accelerate the realization of commercial quantum and superconducting computers, we provide chip developers with the tools they need to intelligently iterate on their designs.

The IQ3000 integrates configurable DC and RF cabling, with custom probe cards available for ultimate flexibility of test configurations. A robust design that minimizes vibration and with integrated magnetic shielding provides the stable environmental conditions necessary to ensure the highest quality data for the most sensitive superconducting devices. Fully automated wafer loading and the sophisticated Velox software suite allows for high throughput testing and unattended operation for rapid time to data.

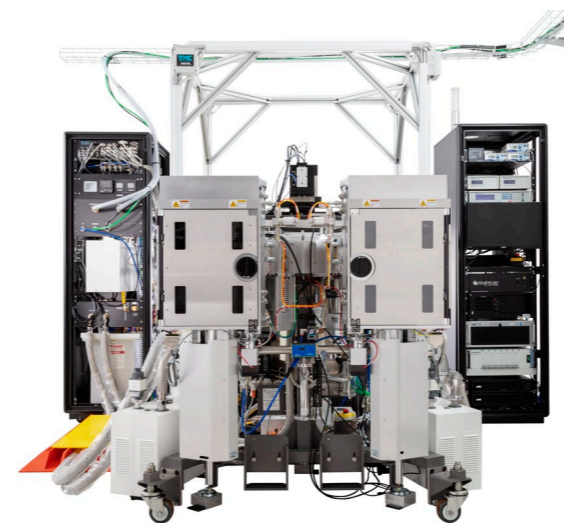
FormFactor's longstanding probing expertise and decades of precision cryogenic experience come together in this system to take superconducting device test and measurement out of the lab into fab.

#### Operating Temperature



#### Customer Applications

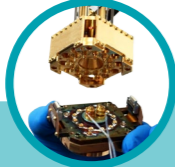

- / Quantum Computing
- / Superconducting Chip Development
- / Quantum Information Science



## HPD Cryogenic Test and Measurement Services

### Rapid Access to Cryogenic Temperatures to Boost Quantum Research and Improve Device Yield

Cryogenic systems are a major investment. Long waits for data can slow down development cycles and hinder production schedules. FormFactor's cryogenic test services allow you to avoid the high upfront capital cost of a complete system, enable immediate access to cryogenic data, and ensure you are obtaining the data you need to advance your program.

 <p><b>Qubit Pre-Test</b> Model 106 &amp; PQ500</p> <ul style="list-style-type: none"> <li>• &lt; 50 mK base temp</li> <li>• 10 mm Singulated die test</li> <li>• No wire bonding</li> <li>• Up to 12 RF (&lt; 12 GHz)</li> <li>• 48 shielded twisted pairs</li> <li>• Probe socket</li> </ul>	 <p><b>Wafer Testing</b> IQ3000</p> <ul style="list-style-type: none"> <li>• &lt; 4.5 K wafer probing</li> <li>• 200 mm wafer</li> <li>• 300 mm wafer fragment</li> <li>• Magnetic shielding (&lt; 200 nT)</li> <li>• 56 RF and &gt; 300 DC</li> <li>• Probe cards</li> </ul>
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At the HPD Cryogenic Test Lab in Boulder, Colorado, you can partner with FormFactor to collect the valuable cryogenic data you need. We will work with you to meet your unique test and measurement challenges:

- Screen for manufacturing defects at cryogenic temperatures to improve device sorting
- Statistically correlate room temperature data with cryogenic performance by obtaining high volume data at the wafer scale
- Pre-characterize Qubits prior to deployment to reduce QPU bring-up time
- Material characterization of superconducting devices

Collect high volume data with our cryogenic wafer scale probe station, or qualify your devices near deployment conditions with our < 50 mK ADR cryostats.

Each of our test packages leverages FormFactor's longstanding probing expertise and decades of precision cryogenic systems experience. We develop custom probing solutions for each system to eliminate the need for wire bonding. Materials are carefully selected to function in cryogenic and non-magnetic environments.

The four steps in our test services process are feasibility, quotation, preparation, and implementation. During the first phase we will work with you to understand the challenges and recommend the proper solution. In the second phase we will define a probing solution, configure the experiment, and develop a test plan. At this point a proposal is generated and submitted. Once accepted, a test date is reserved, and preparation begins. We will manufacture, set up, and evaluate your probing solution prior to the test date.

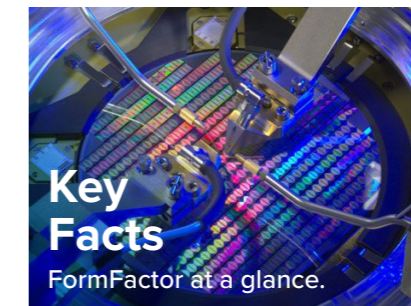
## FormFactor, Inc.

FormFactor, Inc. (NASDAQ:FORM) is a leading provider of essential test and measurement technologies along the full IC life cycle – from characterization, modeling, reliability, and design de-bug, to qualification and production test.



**Vision & Mission**  
Our heritage is innovation.

- / We constantly strive to help our customers solve the advanced test and measurement challenges of the broader semiconductor industry.
- / Our focus on customer partnership, innovation, agility and operational excellence allows us to earn sustainable business every day.



**Key Facts**  
FormFactor at a glance.

- / Founded in 1993, IPO 2003
- / #1 Advanced Probe Card Supplier
- / #1 Engineering Probe Systems Supplier
- / Named as a BEST Supplier in customer satisfaction surveys, year-after-year
- / Ship >50 million MEMS probes annually
- / Over 10,000 probe systems installed
- / 2020 revenue of ~694 million (USD)



**Customer Collaboration**  
Global and local.

- / Enable customer success through technology, partnerships, "First Time Right" product quality, global customer support
- / 2300 employees
- / 22 service and repair centers
- / 13 sales offices
- / 11 design centers
- / 9 production locations

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