Variable temperature research platforms
Integrated cryogenic application solutions
Variable temperature research platforms

Integrated cryogenic application solutions

"We serve pioneers of science with technologies that will help change the world – we are truly grateful for the opportunity we’ve been given to create instruments which help propel the advancement of society. Our number one priority is to ensure your success, and we will do everything we can to continue to bring the most innovative technologies to your lab."

Luke Mauritsen,
CEO & founder, Montana Instruments

Getting started
Low vibration optical cryostats
Selecting the proper variable temperature instrument should be straightforward. The engineers at Montana Instruments can assist in the selection of the appropriate platform given your performance requirements, sample and experimental set-up, and desired features and capabilities.

Platform configurations & product models
Choose from an available combination of the following attributes to create a system tailored to your research demands and budget.

<table>
<thead>
<tr>
<th>Research platform</th>
<th>Platform architecture</th>
<th>Size class number #</th>
<th>Add on modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core sample platform technology</td>
<td>System design &amp; mounting schemes, cooling technology, performance &amp; feature levels</td>
<td>50</td>
<td>CO - Cryo-Optic, MO - Magneto-Optic</td>
</tr>
<tr>
<td>Cryostation HILA</td>
<td>s - standard</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

Integrated solutions
Our integrated solutions combine proven third-party technology with our research platforms for high-performance, application specific solutions.

Configurable options, customization and accessories
Each platform can be configured with an array of standard options and accessories to meet various application requirements.

Leverage a team of dedicated application specialists and custom design engineers to create personalized solutions with custom designed parts and other special modifications.
Variable temperature research platforms
Standard series

Simplicity with unmatched stability
The standard s-series platform architecture utilizes a versatile tabletop mounting architecture which makes it easy to move the system without being tied to the table or an external support structure. Optimized performance parameters accommodate a wide range of configuration options and operating abilities.

<table>
<thead>
<tr>
<th>Cryostat class</th>
<th>High-end closed-cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance class</td>
<td>Low vibration, fully-automated</td>
</tr>
<tr>
<td>Application areas</td>
<td>Microscopy &amp; spectroscopy, condensed matter, photonics, quantum information, materials science</td>
</tr>
</tbody>
</table>

Thermal & vibrational stability
Active & passive thermal stabilization is used to achieve greater than a 20x reduction in cryocooler induced thermal fluctuations at the sample. Sample stage positional drift is virtually eliminated with the use of a thermal contraction canceling cryogenic support. This stability ensures great sample alignment throughout the full temperature range and dramatically reduces focal drift for each new temperature setpoint.

A patented vibration damping architecture isolates both the sample and the sensitive equipment on the optical table from the cryocooler vibrations. No dedicated table or external support structure is needed.

User interface laptop PC with control software
- simply press a button for fully automated cool down, warmup, temperature control & more
- monitor the status of system parameters with real time temperature & temperature stability readouts
- remote interface via TCP/IP for automation scripting, convenient external control, & instant remote support

Closed-cycle cryostat & vacuum space
- sample platform rigidly mounts at either 45° or parallel to the hole pattern in an inch or metric optical table for increased flexibility & modularity

Control unit: built-in electronics
- complete process automation & system monitoring to save time & complexity while protecting the system & sample
- self-activated dry nitrogen gas purge during warm up keeps the sample space clean

Variable speed helium compressor
- provides pressurized helium to the cryostat via the supply/return hoses, automatically adjusting parameters for optimal cool down time
- single-phase 50/60 Hz, 200-240 VAC, air cooled, 3 kW
Variable temperature research platforms

Cryostation®

General purpose optical cryostats
The CRYOSTATION line of general purpose optical cryostats offer a superior level of performance, flexibility, and usability in a closed-cycle system. The sample chambers are designed to accommodate a variety of configurations and experimental set-ups.

<table>
<thead>
<tr>
<th>Cryostat class</th>
<th>High-end closed-cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance class</td>
<td>Low vibration, fully-automated</td>
</tr>
<tr>
<td>Application areas</td>
<td>Quantum information, 2D &amp; topological materials, quantum dots, electrical transport, photoluminescence, THz spectroscopy, micro raman, on-chip photonics</td>
</tr>
</tbody>
</table>

- **Low thermal fluctuations** and <5 nm vibrations provide a stable measurement environment.
- **Wide temperature ranges** (3.2 K to 350 K) with fast cool downs make the instrument more productive.
- **Incredible sample, electrical, and optical access** provides total experiment flexibility. Simply lift off the window assembly and radiation shield for unobstructed access to the sample & wiring.
- **Configurable sample space** with RF, DC, fiber & gas tube interfacing options.
- **Cold circuit board** (S100 & S200) is pre-lagged for simple & robust sample wiring & optimized vacuum performance.

### Cryostation S100

<table>
<thead>
<tr>
<th>3.2 K</th>
<th>&lt;10 mK</th>
<th>&lt;5 nm</th>
<th>~2 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base temp</td>
<td>Temp stability</td>
<td>Vibrations</td>
<td>Cool down</td>
</tr>
</tbody>
</table>

Well suited for a variety of experimental set-ups requiring the lowest possible temperatures, vibrations, and cool down times. This smallest platform offers 5 optical access ports which can be configured for low working distance applications.

- **Cold space**: ø53 mm x 63 mm (can enlarge vertically)
- **Add on options**: Cryo-optic | Magneto-optic

### Cryostation S100

<table>
<thead>
<tr>
<th>4.3 K</th>
<th>&lt;20 mK</th>
<th>&lt;15 nm</th>
<th>~10 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base temp</td>
<td>Temp stability</td>
<td>Vibrations</td>
<td>Cool down</td>
</tr>
</tbody>
</table>

A large, flexible sample space with the ability to integrate components directly onto the cold breadboard platform. This largest platform offers 9 optical access ports and 7 interface side panels. User wiring is pre-lagged into the cold space.

- **Cold space**: ø195 mm x 72 mm (can enlarge vertically)
- **Add on options**: Cryo-optic

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or Dr. Tobias Adler: +49 6151 8806-479, t.adler@lot-qd.de

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Variable temperature research platforms

HILA®

Atomic resolution optical cryostats
The HILA® (High Inertia, Low Acceleration) platform combines convenient closed-cycle technology with an ultra-low acceleration sample space for the most sensitive measurements. A multi-stage vibration damping technique isolates the platform from both the vibrations of the cryostat itself and other sources of motion within a common lab environment.

<table>
<thead>
<tr>
<th>Cryostat class</th>
<th>High-end closed-cycle, specialized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance class</td>
<td>Low acceleration/vibration isolation, fully-automated</td>
</tr>
<tr>
<td>Application areas</td>
<td>Scanning Probe Microscopy (SPM) &amp; SNOM, Cavity QED, Optomechanical resonators, Super resolution microscopy, Quantum information, Quantum optics</td>
</tr>
</tbody>
</table>

- **Atomic level stability** suitable for AFM or micro-cavity experiments which demand low accelerations.
- **Platform easily tunable for a large range of mass and mass distributions.**
- **Low natural frequency** (<0.6 Hz) provides convenient & intuitive platform balancing and floating.
- **Integrated interface panel** at 4K has thermally lagged standard DC connections.
- **Eddy current damping** for further resonance suppression to decrease overall energy on isolated platform (optional).
- **Turbo pump port** for achieving a base pressure of 1 x 10^-5 Torr prior to cooling (optional).

Low vibration technology
The system leverages advanced vibration isolating technology featuring a very low natural frequency to minimize energy transfer to the cold space. The low natural frequency serves to isolate the sample platform from the closed-cycle cold head to drastically reduce the impact of the cryocooler pulse on sample vibrations.

**Accelerations - power spectral density**
- Inertial environment removes the energy that would normally excite any mechanical resonances, such as between cavity mirrors or a scanning probe & sample.
- *see datasheet for PSD plot

Scanning tunneling measurements
- Low temperature measurements will be as steady as room temperature experiments, with nearly identical stability whether the cryocooler is on or off.

Z Transmissibility
- For frequencies above 0.85 Hz, the HILA attenuates any vibrations from the rest of the system.
- Frequencies above 2 Hz are attenuated by more than a factor of 10.

Displacement
- The figure demonstrates the relative noise level in an SPM application & the suitability of the HILA for AFM scale experiments.

Line scan height profile across the edge of an atomic layer of HOPG
High NA imaging at low temperatures

The CRYO-OPTIC® products integrate an optical objective into the sample space of the Cryostation for high NA imaging at low temperatures. The revolutionary design of the room temperature objective mount eliminates the alignment and drift challenges associated with using high performance optics in a cryogenic set-up.

- Proprietary technology allows the objective to be held at room temperature within the sample space for highly stabilized position and focus control.
- The temperature of the high magnification objective and the sample are actively controlled to better than 10 mK, eliminating the need to refocus after small temperature changes.
- Time required to reach a stable measurement condition is drastically reduced by isolating the objective from both the cryostat & the laboratory environments.
- Optional Agile Temperature Sample Mount provides rapid temperature control and reduces drift.
- Built-in XYZ nanopositioners for sample translation & focus.

Cryostation S100 - CO

<table>
<thead>
<tr>
<th>Base temp</th>
<th>Temp stability</th>
<th>Sample drift</th>
<th>Stabilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8 K</td>
<td>&lt;10 mK</td>
<td>&lt;1 µm /K</td>
<td>~30 min</td>
</tr>
</tbody>
</table>

The vertical mounting scheme in this model was designed for confocal microscopy, with side optical access to allow the user to see the sample and approximate focal distance.

Cold space: ø53 mm x 63 mm (can enlarge vertically)

Objectives:
- 0.75 NA, 4 mm WD
- 0.90 NA, 310 µm WD

Cryostation S100 - CO

<table>
<thead>
<tr>
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<th>Temp stability</th>
<th>Sample drift</th>
<th>Stabilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8 K</td>
<td>&lt;10 mK</td>
<td>&lt;1 µm /K</td>
<td>~30 min</td>
</tr>
</tbody>
</table>

The horizontal mounting scheme of this model provides seamless integration with other optical measurement systems while maintaining easy access to the sample. A unique radiation shield design allows for quick, unobstructed sample exchange while keeping the objective in place and aligned to the optical system.

Cold space: ø95 mm x 100 mm (can enlarge vertically)

Objectives:
- 0.75 NA, 4 mm WD
- 0.85 NA, 850 µm WD

Cryostation S200 - CO

<table>
<thead>
<tr>
<th>Base temp</th>
<th>Temp stability</th>
<th>Sample drift</th>
<th>Stabilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.7 K</td>
<td>&lt;10 mK</td>
<td>&lt;1 µm /K</td>
<td>~20 min</td>
</tr>
</tbody>
</table>

The Cryo-Optic objective is available as a customization on the largest platform. The objective is mounted horizontally, with ample room remaining on the cold breadboard for free space optics, enabling transmission experiments and piezo interface control.

Cold space: ø195 mm x 72 mm (can enlarge vertically)

Objectives:
- 0.75 NA, 4 mm WD
- 0.85 NA, 310 µm WD

1 With ATSM 2. Sample Drift measurement taken over full temperature range.
2 Time to positional stability defined as the time required before which the sample position drifts by no more than 250 nm in 30 mins. Measurement taken with ATSM for 50 K temperature change over the full temperature range.
3 With ATSM for 50 K temperature change.
### Bipolar magnetic field integration

The MAGNETO-OPTIC modules integrate a magnetic field directly into the cryogenic sample chamber. This add-on module provides the same stability, automation, and control found in all Montana Instruments closed-cycle cryostats.

<table>
<thead>
<tr>
<th>Field strength</th>
<th>0.45 - 1 Tesla (depends on pole configuration)</th>
</tr>
</thead>
</table>

#### Base temperature with radiation shield

**Cryostation S50 - MO**

The unit inserts magnet poles into two of the four standard optical ports, with bores through the magnet cores to allow laser illumination of the sample. The top optical access port can be configured with a recessed objective for low working distance applications. An adjustable radiation shield accommodates various sample sizes and optical access configurations: ø 7-15 mm x 23 mm.

**Options**

GMW 5403, 3470, 3480 & custom

**Fields up to 500 mT**

For certain applications, permanent magnets can be used to achieve the necessary field requirements. These offer a cost-effective solution and can be integrated into most sample chamber set-ups. These magnets provide consistent fields at various field strengths. Adjustable & custom mounting options are available.

**Compatible with**

Cryo-optic objective

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### Demand

- **Bipolar magnetic field integration**
- **Spintronics**, **Magnon spectroscopy**, **Magneto-optical effects**, **2D & topological materials**, **Magneto-transport**, **Nanomagnetics**

### Integrated features

- **Base temperature stability**
- **<5 mK**
- **<5 nm**
- **Vibrations**
- **<10 mK**
- **Field²**
- **0.7 T**

### Application areas

- **Spintronics**, **Magnon spectroscopy**, **Magneto-optical effects**, **2D & topological materials**, **Magneto-transport**, **Nanomagnetics**

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Variable temperature research platforms

Solutions

Third-party measurement integrations
Montana Instruments has partnered with various third-party suppliers to offer integrated application specific solutions. Each system leverages Montana Instrument’s closed-cycle platform technology to ensure high-performance variable temperature measurements.

The platform is pre-modified with the necessary options and design details to integrate seamlessly with the third-party equipment. All integrations are tested prior to shipment.

<table>
<thead>
<tr>
<th>Field strength (Polar &amp; LT)</th>
<th>Base temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 T</td>
<td>4.5 K</td>
</tr>
<tr>
<td>Cryo Nanomake + Magneto-optic</td>
<td>This system combines the powerful capabilities of the NanoMORE3 with the flexibility of the Cryostation s50 - MO for low temperature Magneto-Optic Kerr Effect (MOKE) applications. This option allows the user to take measurements in the longitudinal and polar orientations. All optics, electronics, and software are included with the integration.</td>
</tr>
<tr>
<td>Partner</td>
<td>Princeton Instruments</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency bandwidth</th>
<th>Field resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 17 GHz</td>
<td>±21 µT</td>
</tr>
<tr>
<td>Cryo FMR + Magneto-optic</td>
<td>The CryoFMR integrates the Cryostation s50 - MO with a Coplanar Waveguide Ferromagnetic Resonance (CPW-FMR) spectrometer for sample characterization from 4 K - 350 K. The system boasts a low signal-to-noise ratio for applications that involve characterizing thin films and structures. The system comes with all electronics and software to take measurements and run the analysis.</td>
</tr>
<tr>
<td>Partner</td>
<td>NanOsc AB</td>
</tr>
</tbody>
</table>

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<th>Field resolution</th>
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<tbody>
<tr>
<td>2 - 17 GHz</td>
<td>±21 µT</td>
</tr>
<tr>
<td>Cryo Mössbauer + Cryostation</td>
<td>The Cryo Mössbauer offers a complete, integrated solution for variable temperature transmission Mössbauer spectra measurements. The MS96 spectrometer is coupled with the Montana Instruments Cryostation s50 sample chamber in a straightforward and user-friendly design.</td>
</tr>
<tr>
<td>Partner</td>
<td>Palacky University, RCPTM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>g^2(0): &lt;0.1 High count rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Photon + Cryo-optic</td>
</tr>
<tr>
<td>Second order coherence</td>
</tr>
<tr>
<td>The Single Photon Application Research Kit (SPARK) is a complete, integrated single-photon source to enable quantum research. The SPARROW single-photon source is based on self-assembled InAs quantum dots coupled to a slow-light photonic-crystal waveguide made using a unique processing technology. The ultra-stable environment of the Cryostation s100 - CO provides the ideal environment for the chip to operate.</td>
</tr>
<tr>
<td>Partner</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.85 NA3.2 K 10</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>Peak Quantum efficiency CCD</td>
</tr>
<tr>
<td>Cryo Raman + Cryo-optic</td>
<td>This low temperature Raman microscope integration is optimized for high collection efficiency and throughput, offering free space Raman signal collection via the Princeton Instruments FERGIE™ spectroscopy system. The ultra-stable optical design of the Cryostation s100 - CO allows for long, drift-free exposures. The ATSM™ enables rapid and precise explorations of temperature dependent phase transitions, frequency shifts, and linewidth sharpening.</td>
</tr>
<tr>
<td>Partner</td>
<td>Princeton Instruments</td>
</tr>
</tbody>
</table>
System accessories & configurations
Various configuration options and add-ons allow the system to fit the unique needs of each researcher and experiment. Configuration examples include mechanical designs to enable the use of external superconducting magnets, optical options for low working distance applications, feedthroughs for signal interfacing, and specially designed mounts for sample motion, electrical connections, and rapid temperature changes.

A system design engineer will help determine the set of standard options that are best suited to your application requirements.

One-of-a-kind application specific solutions
For researchers working on cutting-edge techniques, standard options may be limiting for certain applications. In these cases, custom designed parts and modifications are required to enable new measurements. A team of dedicated application specialists and custom design engineers are available to create a one-of-a-kind solution for your needs.

You will be paired with a design engineer who will work with you to understand your requirements and modify existing options or create personalized solutions to best meet your needs. Our team of cryogenic engineers specialize in creating mechanical designs to optimize the thermal performance of your set-up, with the ability to:

- Incorporate custom equipment (internal and external) into the sample chamber design
- Design special sample mounts for unique set-ups or experimental requirements
- Optimize the set-up for specific applications or performance requirements
Variable temperature research platforms

Configurable options

Mechanical sample chamber configurations
Montana Instruments research platforms are designed to provide the user flexibility in configuring the sample space and optical access. Depending on the platform, a range of both standard and custom sample space enclosure options (vacuum housing and corresponding parts) are available.

The temperature controlled sample platform is centered within the vacuum space. A radiation shield surrounds the sample space and insulates it from room temperature radiation. The vacuum housing & lid surrounds the radiation shield and defines the outer optical interface to the system.

Housings and Lids

The Cryostation design allows for flexible configurations of the sample space to accommodate various internal working volumes, beam heights, and optical access. There are several standard outer vacuum housing and lid options, with further customizations available.
- Low profile housing with 30 mm windows
- Tall housing with or without side windows
- 45° housing to rotate window orientation

A housing spacer can also be used to raise the height of the platform and housing an additional 25 mm.

Castles
Castle options are upward extensions of the sample housing which have been designed to accommodate various configurations and application requirements.
- Provide more room vertically for internal components, such as piezo positioners
- Allow external components close proximity to the sample, such as for low working distance transmission or external magnets

System engineers will work with users to determine the design that works best for the experimental setup.

Optical window configurations
Montana Instruments research platforms offer unobstructed optical access to the sample space through window ports on the side and top of the sample housing. The number of available optical ports is dependent on the base platform (refer to individual product specifications for details).

The window ports can be further customized for unique optical experiments. A custom tilted window holder can be incorporated to eliminate fringe patterns and avoid unwanted cavity feedback. Modifications for additional optical ports, such as a bottom window holder for vertical transmission, are also available. Please inquire for custom window configuration requests.

Window substrates

Both the outer vacuum housing (warm) and inner radiation shield (cold) windows may be easily replaced by the user within minutes.

A variety of optical materials are available for different wavelengths and applications. The standard option is a Fused Silica VIS-NIR (400-1000 nm) AR coating.

Typical sizes required are ø50 mm, 30 mm, and 20 mm. Not all windows are available in all sizes.

Low working distance

The low working distance (LWD) options allow users to use external optics and achieve a working distance as low as 1 mm. The components to achieve the LWD configuration include a thin vacuum window, a radiation aperture, and a thin radiation window.

The sample can be placed close to the overhead optic. A variation of this option allows translation of a larger sample. The low working distance option has a very thin window and can be fused silica, BK7, sapphire, or other materials upon request.
Interfacing connections, feedthroughs & user wiring
Montana Instruments research platforms support a variety of options for interfacing connections to the sample space. Along with these options, each platform includes several preinstalled electrical connections intended for low frequency and low power applications.

The 100 & 200 class models provide 25 electrical feedthroughs pre-routed directly to the 4 K sample space circuit board via flexible circuit connectors. This design eliminates the need to route and thermally lag wiring and reduces overall heat load to the sample.

Visit our website for a comprehensive cryogenic wiring guide with tips on how to choose and install wiring to reduce unnecessary heat loads.

Window feedthroughs

Some options can be routed through unused optical ports. These connections are typically easier to route, but must be removed when removing the housing for sample access.

Note: This option is often more difficult to use.

Base side panels

Interfacing plates on the base of the sample chamber provide options for routing connections to the sample. The number of available interface panels is dependent on the base platform. The side panels are designed to preserve sample chamber vacuum.

Interface extension housing

Signal interfaces can be added above the lower housing using a 25 mm spacer with four user specified side panels. The IEH configuration provides more room to the sample space and is useful when the user wants to easily add or remove the RF, fiber, and DC connections. It is also the preferred method for adding options to the Magneto-optic module.
Variable temperature research platforms

Configurable options

Wiring options
Simple low conduction DC cable harnesses are available with 2, 3, 4 or 5 pins. These generally have a straight section for thermal lagging.

New 12 and 25 pin flexible circuit connector options provide superior thermal anchoring and keep the wiring clean and organized. These flexible circuits come standard on the 100 & 200-class chambers, and are also used in various other options, such as the R2D12 electrical sample mount and platform heaters.

<table>
<thead>
<tr>
<th>Option</th>
<th>RF Coax</th>
<th>Fiber</th>
<th>Gas tube</th>
<th>Electrical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SMA/SMP</td>
<td>Fiber optics</td>
<td>1/16&quot; Gas tube</td>
<td>Micro D25</td>
</tr>
<tr>
<td>Overview</td>
<td></td>
<td></td>
<td></td>
<td>compression fitting for 1/16&quot; gas tube, includes tube routed to sample chamber</td>
</tr>
<tr>
<td>Side panels</td>
<td></td>
<td></td>
<td></td>
<td>single tube compression</td>
</tr>
<tr>
<td></td>
<td>quad RF</td>
<td>dual Swagelok or dual compression</td>
<td>single tube compression</td>
<td>single D25 connector</td>
</tr>
<tr>
<td>Window feedthroughs</td>
<td></td>
<td></td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innerface extension</td>
<td></td>
<td></td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample mounts</td>
<td>R2D12 R4</td>
<td>custom</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>Notes</td>
<td>1-4 coax cables 20 GHz semi-rigid</td>
<td>several fiber sizes &amp; types can be supported</td>
<td>multiple routing options in chamber</td>
<td>internal wires are 12&quot; phosphor bronze</td>
</tr>
</tbody>
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Variable temperature research platforms

Sample mounting

Orientation, positioning, interfacing & motion
Sample mounting is an integral part of the successful use of any cryogenic platform. Several options have been designed to fit a range of application requirements. Most sample mounting options are compatible with all research platforms.

For unique applications and configurations, custom designed sample mounts are commonly used to achieve the desired experimental requirements. System engineers have extensive experience designing custom mounting solutions to maximize the thermal and vibrational performance of the set-up.

Contact us for a detailed cryogenic sample mounting guide with tips on how to achieve optimal thermal performance.

Stock designs
This family of mounts are sized specifically to work with castles, magnets, or other special configurations.

System engineers will help pick the most appropriate mount to match your options, the window beam height, and your intended optical access.

Note: These mounts are not thermally damped, so the temperature stability may be slightly higher than the specification of the base platform.

Standard damped
This mount provides an easily configurable way to position samples at various distances and angles with respect to the side and top optical ports. It includes a thermally damped post with standard interface bolt pattern that can be mounted vertically or horizontally to position the sample near any of the windows.

Piezo positioning
Precision nano-positioning stages are used for translating, rotating, or tilting your sample. These are integrated into the cold space either on the standard platform or by using an optional recessed platform (as shown).

A proprietary flexible thermal link is used to thermally connect the cold stage to the sample mount.

Note: All stages are integrated and tested prior to shipment.
Variable temperature research platforms

Sample mounting

Electrical sample mounts
A family of electrical mounts allow the user to pre-mount samples on small chips or circuit boards to easily make electrical connections. These have been specially designed to work with other mounts and configurations, with an emphasis on preserving thermal performance.

<table>
<thead>
<tr>
<th></th>
<th>R2D12</th>
<th>ASTM D12</th>
<th>CB12</th>
<th>DIP 16</th>
<th>MO14</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overview</strong></td>
<td>circuit board with</td>
<td>circuit board with</td>
<td>circuit board with</td>
<td>holds standard DIP16</td>
<td>wire bonding pads on</td>
</tr>
<tr>
<td></td>
<td>electrical contact</td>
<td>electrical contact</td>
<td>electrical contact</td>
<td>chip carriers</td>
<td>narrow circuit board</td>
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<tr>
<td></td>
<td>pads, coax</td>
<td>pads, flexible</td>
<td>pads &amp; pins</td>
<td></td>
<td>with pitch connector</td>
</tr>
<tr>
<td></td>
<td>connections &amp;</td>
<td>circuit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>flexible circuit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Low voltage</strong></td>
<td>12 DC</td>
<td>12 DC</td>
<td>12 DC</td>
<td>16 DC</td>
<td>14 DC</td>
</tr>
<tr>
<td><strong>connections</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High frequency</strong></td>
<td>2 RF coax</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Configurations</strong></td>
<td>standard mount or</td>
<td>mounts on ASTM</td>
<td>standard mount or</td>
<td>fixed mount</td>
<td>parallel, normal,</td>
</tr>
<tr>
<td></td>
<td>piezo mount</td>
<td></td>
<td>fixed mount or piezo</td>
<td>mount</td>
<td>or 45° to lateral</td>
</tr>
<tr>
<td><strong>Best for</strong></td>
<td>capplanar waveguides,</td>
<td>low working distance</td>
<td>use with chip carriers &amp;</td>
<td>use with magneto-optic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>microwave excitation,</td>
<td>high impedance, &amp;</td>
<td>quick sample changes</td>
<td>module</td>
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<tr>
<td></td>
<td>&amp; low signal level</td>
<td>compact areas such as</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>experiments</td>
<td>castles</td>
<td></td>
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</tbody>
</table>

Agile temperature sample mount

The ATSM™ provides the solution for the highest level of positional stability for step-static and dynamic temperature changes from 4K to 350K while improving the speed to each set point.

- Eliminates the need to re-focus after small temperature changes
- Local heating of the sample for rapid thermal response & time to stability
- Optimizes high NA and low working distance set-ups, such as when used with the Cryo-optic products

A family of electrical mounts allow the user to pre-mount samples on small chips or circuit boards to easily make electrical connections. These have been specially designed to work with other mounts and configurations, with an emphasis on preserving thermal performance.
Variable temperature research platforms

Applications

Featured customer applications*

Xiaodong Xu | UNIVERSITY OF WASHINGTON
Ligand-field helical luminescence in a 2D ferromagnetic insulator
Nature Physics (2017) doi: 10.1038

Ania Jayich | UNIVERSITY OF CALIFORNIA SANTA BARBARA
Scanned probe imaging of nanoscale magnetism at cryogenic temperatures with a single-spin quantum sensor

David Awschalom | UNIVERSITY OF CHICAGO
Accelerated quantum control using superadiabatic dynamics in a solid-state lambda system

H. S. J. van der Zant | KAVLI INSTITUTE OF NANOSCIENCE, DELFT UNIVERSITY OF TECHNOLOGY
Direct and parametric synchronization of a graphene self-oscillator

Kartik Srinivasan | NIST GAITHERSBURG
Cryogenic photoluminescence imaging system for nanoscale positioning of single quantum emitters

Douglas Natelson | RICE UNIVERSITY
Photothermoelectric Effects and Large Photovoltages in Plasmonic Au Nanowires with Nanogaps

Jie Shan | PENNSYLVANIA STATE UNIVERSITY
Valley magnetoelectricity in single-layer MoS2

Ping-Heng Tan | CHINESE ACADEMY OF SCIENCES
Observation of forbidden phonons, Fano resonance and dark excitons by resonance Raman scattering in few-layer WS2
2D Materials, 2017, 4 (3)

Hugues de Riedmatten | INSTITUTO DE CIENCIAS FOTÓNICAS (ICFO)
Photonic quantum state transfer between a cold atomic gas and a crystal

Andrei Faraon | CALIFORNIA INSTITUTE OF TECHNOLOGY
Interfacing broadband photonic qubits to on-chip cavity-protected rare-earth ensembles
Nature Communications 8, 14107 (2017)

Mikhail Lukin, Hongkun Park | HARVARD UNIVERSITY
Probing dark excitons in atomically thin semiconductors via near-field coupling to surface plasmon polaritons

Jun Ye | JILA AND UNIVERSITY OF COLORADO
A silicon cavity in a 4 K closed-cycle cryostat with $1 \times 10^{16}$ instability

*Primary author referenced, et al. implied.
List of publications and researchers does not represent an official endorsement of Montana Instruments products
Variable temperature research platforms

Resources

System information
Visit the manufacturer website at www.montanainstruments.com for a full list of product specifications, detailed performance data, dimensions drawings, and in-depth overviews of components & features.

The website has a fairly extensive list of available options, but due to the highly configurable nature of the system, please consult with a sales representative for a full list of accessories.

Help & how-to information
For set-up, maintenance, and service information, an extensive directory of how-to articles and videos are available online at www.montanainstruments.com/help

A worldwide service network is available to support systems in the field. For general questions or real-time troubleshooting, contact your local service representative.

General cryogenic resources
A new series of White Papers, Application Notes & Technical Guides cover cutting-edge techniques, breakthrough technology developments, and best practices for various cryogenic research applications and measurements.

Download online at www.montanainstruments.com/help/Downloads

Cold science made simple