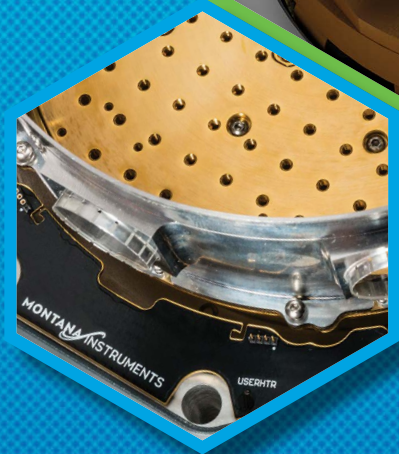
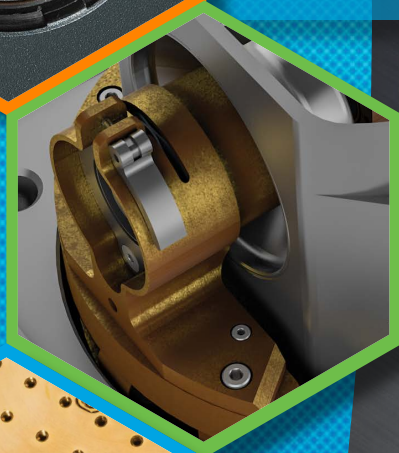


UMENTS
CRYOSTATION

MONTANA INSTRUMENTS®

COLD SCIENCE MADE SIMPLE



CRYOSTATION® BASE PLATFORMS

CRYO-OPTIC® TECHNOLOGY

MAGNETIC FIELD CONTROL

ACCESSORIES

SPRING 2017



"I'm passionate about **creating simple solutions** to problems people are facing... designing equipment to help scientists achieve their research goals is a privilege and a delight."

- David Schiff, Cryogenics Engineer

"My favorite part is meeting the user... they are all doing such interesting, creative, and **important work**, and I'm honored to even play a small part in that."

- Kerry Neal, Service Engineer



"I appreciate and connect with the freedom here; we encourage people to grow and learn, to try and fail and try again, to speak up and set trends, to **solve problems creatively**, and to succeed."

- Nathan Boyce, Lead Integration Technician

“ We believe in the power of science to enhance our understanding of the world around us and to propel the advancement of our society – we are truly grateful for the opportunity to serve researchers on the forefront of these discoveries. 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

"My first passion is people and relationships – working at a company that values a person over a dollar and **makes an impact on people's lives** all over the world has allowed me to live my passion each and every day."

- Ben Linkenhoker, Product Development Engineer



"It's unique to be able to serve as a customer's design advocate and create a system that **perfectly meets their needs**. That collaboration is the most satisfying part."

- Matt Rounds, Custom Engineering Manager

"It's exciting to work with bright, motivated researchers who are working together to unravel the mysteries of creation and improve our lives. I love **bringing people together** so they can stand taller and see farther than each can individually."

- Brian Smithgall, Director of Business Development



GETTING STARTED SELECTING A SOLUTION

Selecting the proper closed-cycle cryostat for your needs should be straightforward. At Montana Instruments, we continuously work to provide solutions for your application and experimental requirements.

OPTION A: APPLICATION BUNDLES pg. 27

Select a preconfigured system designed specifically for the needs of popular experimental techniques. These configurations offer a reassurance of functionality and performance, with a proven combination of options and accessories.

OPTION B: BASE PLATFORM WITH STANDARD OPTIONS pg. 8

Some users have unique experimental requirements that do not fit within the basic bundles. For these users, an array of standard options, add-ons, and accessories are available to customize the system. Montana Instruments will work with you to select the appropriate options for your needs, but you may follow the steps below to get started.

1. Choose Your Base Platform pg. 8
2. Select Any Add-on Modules pg. 10-15
3. Choose Your Mechanical Options pg. 16-17
4. Choose Your Optical Access Options pg. 18-19
5. Decide on Interfacing Needs pg. 20-21
6. Select a Sample Mount or Stages pg. 22-25
7. Add Any Final Accessories pg. 26

OPTION C: BASE PLATFORM WITH CUSTOM DESIGN MODIFICATIONS pg. 26

By serving researchers working on cutting-edge techniques, we understand standard options may be limiting for certain applications. In these cases, custom designed parts and modifications are required to create something nobody else has done before. A team of dedicated application specialists and custom design engineers are available to work with you to create a one-of-a-kind solution for your needs.

CRYOGENIC MEASUREMENT SOLUTIONS

TO FIT YOUR NEEDS

CRYOSTATION® BASE PLATFORMS



CRYOSTATION C2
3.2K - 350K low vibration closed-cycle cryostat.



FUSION F2
Intermediate sample chamber size with integrated cold sample electronics.



NANOSCALE WORKSTATION NW2
Large cooled breadboard platform with 8 optical access ports.

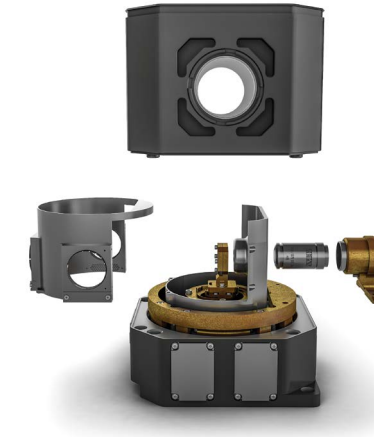
MAGNETIC FIELD CONTROL



CRYOSTATION MAGNETO-OPTIC
Integrated bipolar magnet capable of fields up to 0.7 Tesla.



CRYO-OPTIC MICROSCOPE
Vertical high NA objective with unparalleled accuracy.



CRYO-OPTIC X-PLANE
Horizontal high NA objective with optimized optical stability.

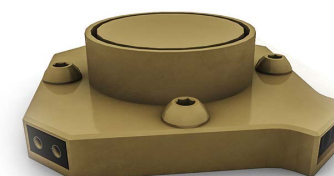
ACCESSORIES

STANDARD OPTIONS

Numerous modifications and add-ons have been developed to satisfy various application requirements. A design engineer will assist in finalizing system configuration details and options.

CUSTOM OPTIONS

We pride ourselves in being able to customize our platforms for a researcher's unique needs. Work with a design engineer to modify options or create personalized solutions.



AGILE TEMPERATURE SAMPLE MOUNT

Eliminates drift and allows for variable temperature studies.

A STRONG FOUNDATION: SIMPLICITY WITH UNMATCHED STABILITY

ACCESS AND FLEXIBILITY

The modular nature of the Cryostation allows the researcher to configure the sample space while still enjoying the benefits of a stable, automated, and controlled system. Simply lift off the entire window assembly and radiation shield for unobstructed access to the sample, which can be rigidly mounted to any optical table. Setup and begin your experiment with the sample completely accessible at room temperature. Then, when you're ready to cool down, simply replace the radiation shield and window assembly and continue the experiment at low temperatures. The sample alignment and electrical connections to the sample space remain undisturbed.

CONTROL AND AUTOMATION

The Cryostation's automation puts it in a different class from all other available instruments. Automatic pumpout, cooldown, and active temperature stabilization, as well as automatic warmup, vent, and clean gas purge save time and complexity and protect the system and sample from contamination. These processes are continuously monitored to detect leaks, identify thermometry problems, and perform other critical self-check functions. High-speed cooldown and power-saving standby modes make the instrument more productive and efficient. The computer-controlled user interface allows you to link the Cryostation to other instruments and software, such as LabView, via TCP/IP. Take control or monitor your experiments from your office computer or any other computer with network access.

FULLY-INTEGRATED SIMPLICITY

The turn-key system includes the Cryostat, Control Unit, Compressor, and User Interface PC. Simply set the target temperature and the Cryostation will do the rest.

FOUNDATION

The standard Base Platforms come with the following:

CONTROL UNIT

The control unit houses all of the electronics for the system. The vacuum gauge, nitrogen purge components, and vacuum pump are also located in the control unit. It connects to the User Interface PC via a USB cable.

COMPRESSOR

The compressor provides the pressurized helium via the supply/return hoses to the cryostat. The compressor will automatically start and actively adjust parameters for optimal cooldown.

USER INTERFACE PC

The laptop provides the user interface to control the cryostat. The software allows the user to monitor the status of the system parameters and automatically control sample temperature.

CRYOSTAT

The unique tabletop architecture of the cryostat easily integrates into any lab setup. The sample space includes a sample holder attached to the temperature controlled platform. The radiation shield surrounds the sample space and insulates it from room temperature radiation. The vacuum housing surrounds the radiation shield and defines the outer optical interface to the system.

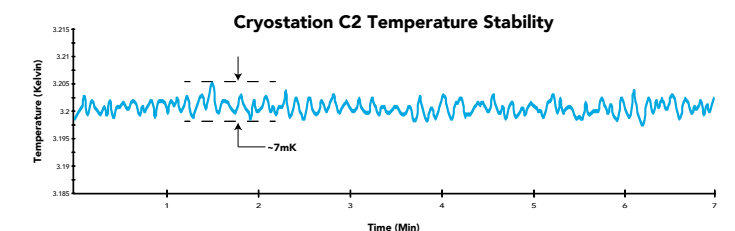


	KEY FEATURES	KEY BENEFITS
CRYOSTAT	Ultra-Stable Closed-Cycle Optical Cryostat cryogen-free systems do not consume liquid helium sample mounted in vacuum	hassle-free operation with minimal operating costs
SAMPLE SPACE	Tabletop Mounting Architecture flexible & modular design mounts to any optical table mount at 45° or parallel to hole pattern in inch or metric table	easily move the system without being tied to the table or an external support structure
SAMPLE DRIFT	CTE-Cancelling Sample Platform optimized at center of platform	observe low drift over the full temperature range
USER INTERFACE	Control Via Windows® Based Software on Mini-Laptop Computer displays real time temperature stability logs cool downs with built-in diagnostics	simply press a button for fully automated cool down, warm up, temperature control and more
REMOTE INTERFACE	TCP/IP and LabVIEW automation scripting external control	conveniently control from your office or cellphone solve issues quickly with remote customer service
CONTROL UNIT	Powerful Built-In Electronics complete process automation & system monitoring self-activated dry nitrogen clean gas purge when warming up	save time & complexity while protecting the system & sample
COMPRESSOR	Variable Flow Helium Compressor single-phase 50/60 Hz, 200-240VAC, air cooled compressor, 3kW	no need for water cooling infrastructure quiet and easy to work next to all day (60-65dB)

THERMAL STABILITY

Long term temperature stability of less than 10mK is achieved through the use of proprietary thermal damping technologies. Once at the setpoint temperature, the Cryostation applies active and passive thermal stabilization to achieve greater than a 20X reduction in cryocooler-induced thermal fluctuations at the sample.

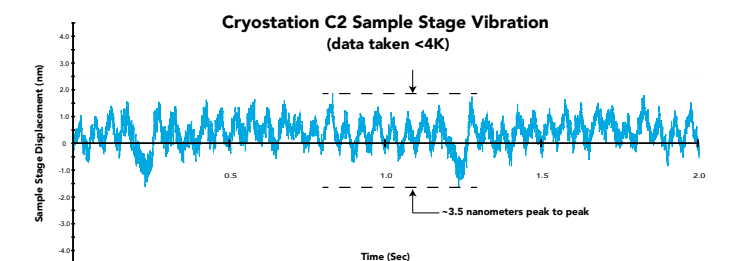
Sample stage positional drift has been virtually eliminated by the use of a thermal contraction cancelling cryogenic support. With this kind of stability, there is no need to re-align or refocus optics at each new temperature measurement point. This opens up the door to total experiment automation.



*Graphs show typical performance at base temperature

VIBRATIONAL STABILITY

The patented architecture of the Cryostation isolates both the sample and the sensitive equipment on the optical table from the cryocooler vibrations. Vibrations on each standard system measured at factory are less than **5 nanometers**. No dedicated table or external support structures are needed, and no liquid or gaseous helium is required. Simply set the instrument on any optical table, insert a sample and click "Cooldown". Visit our website to see how we measured vibrations with sub-nanometer accuracy.



BASE SAMPLE PLATFORMS

CONTROL THE ENVIRONMENT



3.6"

CRYOSTATION C2

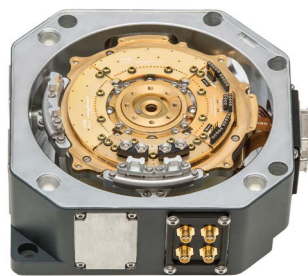
The CRYOSTATION is well-suited for a variety of experimental setups requiring the lowest possible temperatures, vibrations, and cooldown times.

APPLICATION EXAMPLES

Quantum Dot Photoluminescence

Transmission / Reflection Spectroscopy

Micro-Raman Imaging / Spectroscopy



5.9"

FUSION F2

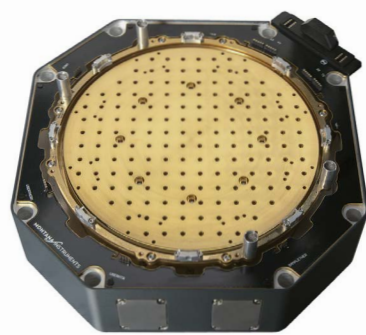
The FUSION is **volume optimized** to provide room for additional equipment, such as multiple piezo stacks, while still offering high levels of performance. The flexible sample space incorporates a **modular cold circuit board** with interchangeable, pre-lagged wedges for simple and robust sample wiring and interfacing.

APPLICATION EXAMPLES

Fiber Coupled Experiments (Precise Sample Alignment)

Quantum Information Science

Transport and Optical Properties of 2D Materials



9.8"

NANOSCALE WORKSTATION NW2

The NANOSCALE WORKSTATION is the largest platform, with a **versatile & spacious sample space** providing the ability to integrate a sample with multiple probes, nanopositioners, & free-space optics directly onto the cold breadboard. The chamber can fit **multiple experimental setups** simultaneously.

APPLICATION EXAMPLES

Nanomechanical Resonators Coupled to Waveguides

Quantum Computing

Large Cryogenic Sample Configurations

	CRYOSTATION C2	FUSION F2	NANOSCALE WORKSTATION NW2	
PERFORMANCE DATA				
Temperature Range	3.2K - 350K	3.2K - 350K	4.3K - 350K	
Temperature Stability	<10mK	<10mK	<20mK	peak to peak (w/ damped sample mount)
Vibrational Stability	0.65nm <5nm	- <10nm	<2nm <15nm	RMS peak to peak
Cool Down Time to 4.2K	~2hrs	~3hrs	~10hrs	
Cooling Power	150 mW @ 4.2K	100 mW @ 4.2K	25 mW @ 4.3K	at sample location
OPTICAL PROPERTIES				
Optical Access	5 optical ports	5 optical ports	8 optical ports	C2 & F2: 4 radial + 1 overhead, 6th optional NW2: 7 radial, 1 overhead
Acceptance Angle	60° full angle 80° full angle 120° full angle	30° full angle 80° full angle 120° full angle	16° full angle 80° full angle 120° full angle	sample at center of sample space sample located near cold window sample located near warm window
Working Distance	13.5mm horizontal 7.9mm vertical	21mm horizontal 7.9mm vertical	17.5mm horizontal 7.9mm vertical	options for <1mm available
INTERFACING				
Electrical Access	20 user connections ¹ 8 configurable ¹	25 user connections ² 8 configurable ²	20 user connections ¹ 8 configurable ¹	1) feedthroughs to mini-connector terminations near sample; 2) feedthroughs to mini-connectors pre-lagged @ 30K & 4K
Interface Side Panels	2	4	8	RF, DC, fiber or gas tube options available
Thermal Lagging	2 locations	4 locations	7 locations	to radiation shield
Temperature Sensors	2 Calibrated Cernox™	2 Calibrated Cernox™	2 Calibrated Cernox™	corresponding to platform and sample temperature location for 1 user thermometer available
DIMENSIONS				
Sample Space (Diameter x Height)	Ø 53mm x 63mm	Ø 95mm x 100mm	Ø 195mm x 72mm	standard & custom options available to enlarge
Beam Height	89.9mm	126.2mm	103.3mm	options available to modify
Breadboard Platform	n/a	modular	130mm or 190mm 12.5mm	25mm radiation shield lagging band grid of mounting holes
OPTIONS				
Sample Mounting	standard thermally damped adjustable	standard thermally damped adjustable	user specified	standard (fixed, adjustable, electrical) & custom alternatives available
Sample Motion	optional piezo stage integration	optional piezo stage integration	optional piezo stage integration	stages can be recessed or mounted on platform

MAGNETIC FIELD CONTROL

WITH MEASUREMENT INTEGRATION OPTIONS



MAGNETO-OPTIC MODULE

The MAGNETO-OPTIC MODULE integrates a bipolar magnet directly into the cryogenic sample chamber with fields up to 0.7 Tesla.

- **exchangeable pole tips** for controlling field strength or for specific requirements
- **optical access** through the poles, high NA access from the sides, and low working distance from the top
- easily remove magnets and window housing for **unobstructed sample access** during setup
- **adjustable radiation shield** accommodates various setups while preserving thermal performance



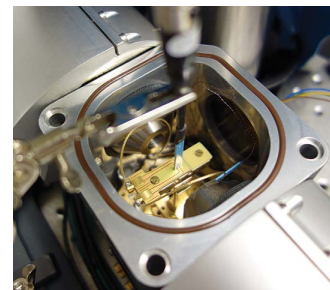
BIPOLAR POWER SUPPLY

MODULE INCLUDES

- **BIPOLAR POWER SUPPLY** and chiller unit for integrated control
- **HALL PROBE** fixture for field calibration

MEASUREMENT INTEGRATIONS

- **CryoFMR** (NanOsc) for variable temperature CPW-FMR spectroscopy
- **NanoMOKE** (Durham Magneto-Optics) for low temperature MOKE applications



CRYOFMR SETUP



EXTERNAL MAGNET OPTIONS

The CRYOSTATION can be configured for use with external high field superconducting magnets and electromagnets. Specially designed castles extend the housing, allowing external magnet poles to be integrated close to the sample.

See castle options on pg. 16 for more details.

	CRYOSTATION MAGNETO-OPTIC	
PERFORMANCE DATA		
Temperature Range	3.4K - 350K	w/ radiation shield
Temperature Stability	<10mK	peak to peak (w/ damped sample mount)
Vibrational Stability	<0.65nm <5nm	RMS peak to peak
Cool Down Time to 4.2K	~3hrs	
Cooling Power	150 mW @ 4.2K	at sample location
MAGNETIC FIELD		
Magnetic Field	0.45 Tesla 0.6 Tesla 0.7 Tesla 1 Tesla	20mm pole spacing 16mm pole spacing 12mm pole spacing 5mm pole spacing (higher base temp)
Resolution	<5 μ Tesla	
Calibration	Hall Probe	calibration sensor provided
OPTICAL PROPERTIES		
Optical Access	5 optical ports	one 50mm top port, two 50mm side ports two 6mm bores through magnet winding
Working Distance	44.4mm side window <4mm top window ¹	1) w/ recessed objective
INTERFACING		
Electrical Access	20 user connections ¹ 8 configurable ¹	1) Feedthroughs to mini-connector terminations near sample
Interface Side Panels	1	RF, DC, fiber or gas tube options available
Thermal Lagging	2 locations	to radiation shield
Temperature Sensors	2 Calibrated Cernox™	corresponding to platform and sample temperature location for 1 user thermometer available
DIMENSIONS		
Sample Space (Diameter x Height)	\varnothing 7mm x 23mm \varnothing 11mm x 23mm \varnothing 15mm x 23mm	12mm pole spacing 16mm pole spacing 20mm pole spacing
Beam Height	100 mm	options available to modify
OPTIONS		
Sample Mounting	Magneto-Optic flange	standard (fixed, adjustable, electrical) & custom alternatives available
Sample Motion	optional piezo stage integration	stages can be recessed or mounted on platform

Product specifications are based on a standard system; various options, configurations, and/or custom modifications may cause slight differences. Specifications and other information subject to change without notice.

CRYO-OPTIC® TECHNOLOGY

HIGH NA IMAGING

INTEGRATED SOLUTION

The revolutionary design of the Cryo-Optic eliminates the alignment and drift challenges associated with using high performance optics in a cryogenic setup. Focus on samples at temperatures below 4K with unparalleled accuracy.

ELIMINATE OPTICAL DRIFT

Proprietary Cryo-Optic 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.

BASED ON HIGH PERFORMANCE ZEISS OPTICS

The system is designed using a custom vacuum-compatible Zeiss LD EC Epiplan-Neofluar 100x infinity color corrected objective with 0.75 NA and 4.0mm working distance. For higher NA applications, the EC Epiplan-Neofluar 100x (0.85 NA or 0.90 NA) is also available.

COMPONENTS

The Cryo-Optic modules come with the following:

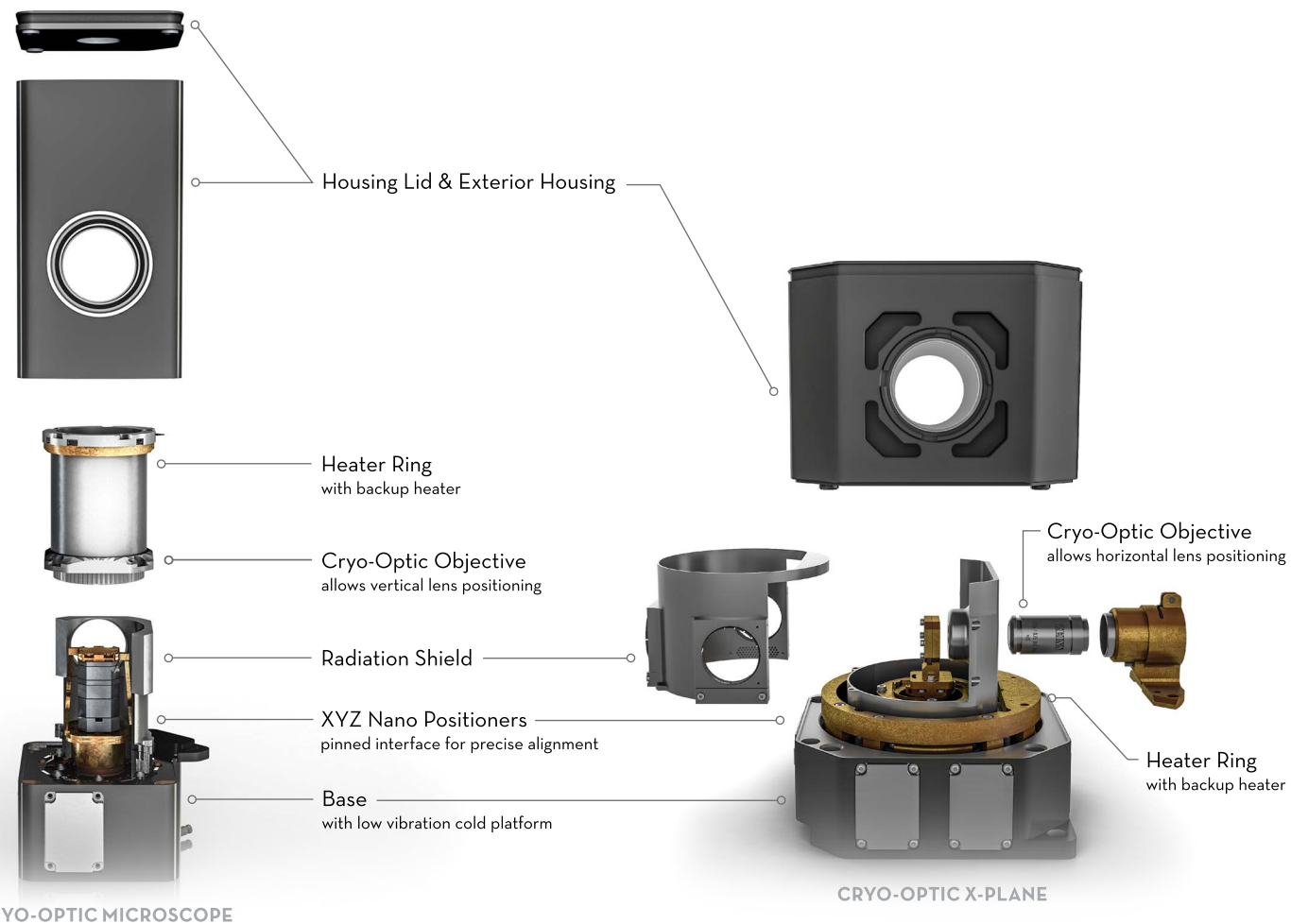


Figure 1

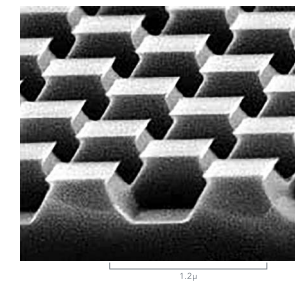
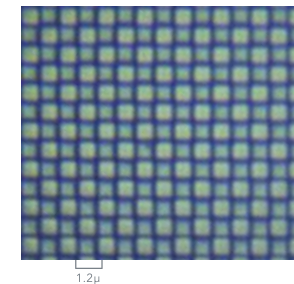


Figure 2



WHITE LIGHT IMAGING

A 3D calibration grid was imaged to demonstrate the system resolution. Fig. 1 shows the actual cal target. Fig. 2 was imaged by the system, with 14 pixels across the 1.2µm feature, or an effective pixel size less than 0.1µm.

DRIFT-FREE HIGH NUMERICAL APERATURE CONFOCAL MICROSCOPY OF SINGLE MOLECULES IN A CLOSED CYCLE HELIUM CRYOSTAT

Optical microscopy of individual quantum objects has been at the heart of some of the most outstanding new developments in quantum physics over the past decade, especially in quantum information processing, quantum sensing and quantum metrology. Optical measurements at low temperatures are key to future discoveries.

This experiment demonstrates drift free high numerical aperture confocal microscopy of single molecules at 3.7K in a closed cycle cryostat. The samples are nitrogen vacancy (NV) centers in diamond that are known to be relatively dark single photon sources, which can be imaged only with well corrected microscope objectives with the highest numerical apertures. Fig. 3 shows a schematic of the confocal cryogenic microscope setup.

RESULTANT IMAGES

Fig. 4 shows a 20µm x 20µm view of a Nitrogen Vacancy center. Fig. 5 shows a single dot with a 2µm x 2µm field of view. Fig. 6 is a plot of a data slice through the dot center, showing high collected return counts from the NV center.

Figure 3

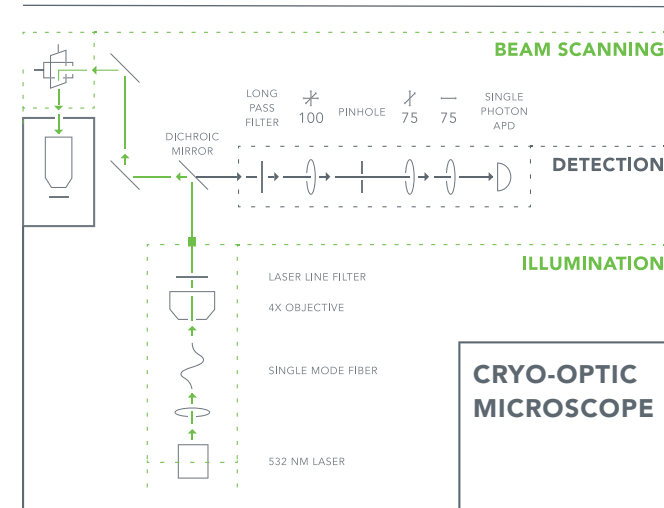


Figure 4

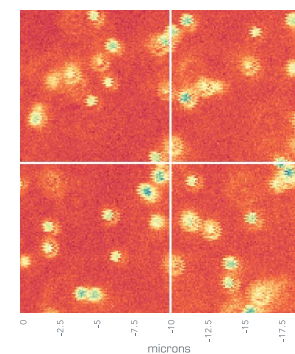


Figure 5

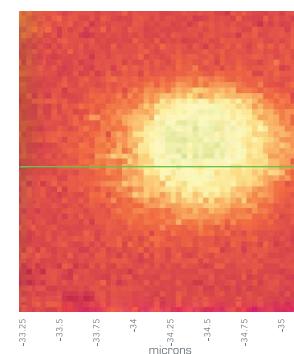
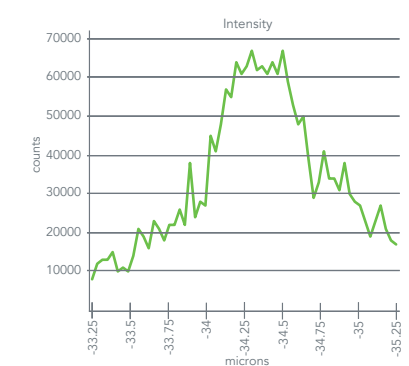


Figure 6



CRYO-OPTIC® TECHNOLOGY

FLEXIBLE PLATFORM INTEGRATIONS



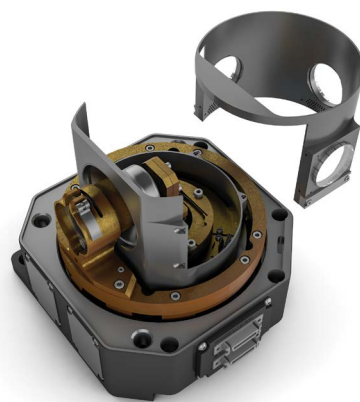
3.6"

CRYO-OPTIC MICROSCOPE

The original CRYO-OPTIC MICROSCOPE integrates a vertically mounted optical objective for high NA imaging at low temperatures. The vacuum housing has a side port to allow the user to see the sample and approximate focus distance.

APPLICATION EXAMPLES

- Confocal Microscopy
- Photoluminescence of Defects and Nanoscale Objects
- Photocurrent Measurements



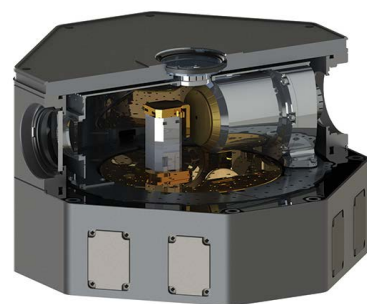
5.9"

CRYO-OPTIC X-PLANE

The CRYO-OPTIC X-PLANE integrates a horizontally mounted high NA objective for **seamless experimental integration** with an in-plane optical setup. A unique radiation shield design allows for quick, **unobstructed sample exchange** while leaving the objective in place and aligned to the optical system.

APPLICATION EXAMPLES

- Scanning Probe Microscopy
- Resonance Fluorescence Spectroscopy
- Time-Resolved Spectroscopy



9.8"

CRYO-OPTIC NW2

The CRYO-OPTIC can also be integrated horizontally into the Nanoscale Workstation for expanded experimental flexibility. The ample space on the cold breadboard provides the room to integrate extra equipment or run multiple experiments at the same time. Inquire for technical specifications.

	CRYO-OPTIC MICROSCOPE	CRYO-OPTIC X-PLANE†	
PERFORMANCE DATA			
Temperature Range	3.7K - 350K	3.8K - 350K	
Temperature Stability	<10mK	<10mK	peak to peak (w/ damped sample mount)
Vibrational Stability	<10nm <100nm	- <100nm	peak to peak w/ piezo positioners
Cool Down Time to 4.2K	~6hrs	~4.5hrs	
Cooling Power	100 mW @ 4.2K	100 mW @ 4.2K	at sample location
POSITIONAL STABILITY			
Objective-Sample Displacement Across 4.2 - 350K		<20 μm <32 μm	along optical axis in focal plane
Stabilization Time*	~20 minutes	~30 seconds	w/ ATSM for 50K temperature change (over full temp range)
Sample Drift	<1 μm / degree <100 nm	<1 μm / degree <100 nm	over full temperature range peak to peak during stable platform temperature conditions
OPTICAL PROPERTIES			
Optical Access	5 optical ports	5 optical ports	C2 & F2: 4 radial + 1 overhead
Numerical Aperture	0.75 or 0.90 NA	0.75 or 0.85 NA	
Working Distance	4mm or 310 μm	4mm or 850 μm	0.75 NA= 3.5 mm 0.85 NA= 850 μm 0.9 NA= 0.1 mm @ 4K
Objective Type	Zeiss 100x / 0.75 DIC Zeiss 100x / 0.90 DIC	Zeiss 100x / 0.75 DIC Zeiss 100x / 0.85 DIC	LD EC Epiplan-Neofluar EC Epiplan-Neofluar
INTERFACING			
Electrical Access	20 user connections ¹	25 user connections ²	1) feedthroughs to mini-connector terminations near sample; 2) feedthroughs to mini-connectors pre-lagged @ 30K & 4K
Interface Side Panels	2	4	RF, DC, fiber or gas tube options available
Thermal Lagging	2 locations	2 locations	to radiation shield
Temperature Sensors	2 Calibrated Cernox™	3 Calibrated Cernox™	corresponding to platform and sample temperature location for 1 user thermometer available
DIMENSIONS			
Sample Space (Diameter x Height)	Ø 53mm x 63mm	Ø 95mm x 100mm	standard & custom options available to enlarge
Beam Height		100mm	options available to modify
Breadboard Platform	n/a	modular	grid of mounting holes
OPTIONS			
Sample Mounting	optional ATSM	optional ATSM	standard (fixed, adjustable, electrical) & custom alternatives available
Sample Motion	integrated piezo stages	integrated piezo stages	stages can be recessed or mounted on platform

*Time to positional stability defined as the time required before which the sample position drifts by no more than 250nm in 30 mins.

Product specifications are based on a standard system; various options, configurations, and/or custom modifications may cause slight differences. Specifications and other information subject to change without notice.

MECHANICAL OPTIONS

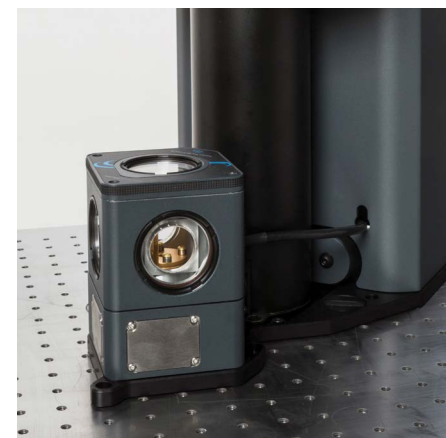
SAMPLE CHAMBER CONFIGURATIONS

The Cryostation base platforms are designed to provide the user with flexibility in configuring the sample space and optical access. Depending on the platform, a range of both standard and custom options are available.



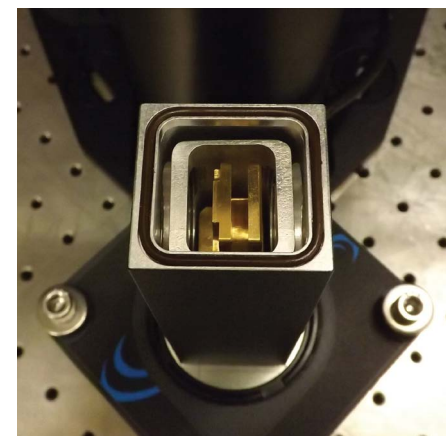
EXTENDED SAMPLE CHAMBER OPTION

The standard Cryostation has the sample chamber center approximately 80mm from the cryocooler tube. The extended option moves the sample chamber out 120mm more than the standard chamber. The extended option allows for better overhead access or the option to interface with larger optical equipment.



SAMPLE CHAMBER HOUSINGS & LIDS

The outer vacuum housing and lid can be configured for different internal working volumes, beam heights, and optical access (see table to the right). A platform spacer can also be used to raise the height of the platform an additional 25mm. Beyond the standard options shown, custom options may also be available.



CASTLE OPTIONS

Castles are upward extensions of the Cryostation sample housing which have been designed to accommodate various configurations and application requirements, such as low working distance transmission or external magnets (see table to the right). The engineers at Montana Instruments work with users to determine the design that works best for their research needs.

Option	CRYOSTATION HOUSING OPTIONS					LID OPTIONS	
	Standard	Low Profile	45° Rotated	100mm Tall	130mm Tall	50mm	30mm
#Optical Ports	4	4	3	4	0	1	1
Outer Warm Window Dia.	50mm	30mm	50mm	50mm	n/a	50mm	30mm
Inner Cold Window Dia.	30mm	20mm	30mm	30mm	n/a	30mm	20mm
Beam Height	90mm	75mm	90mm or 126mm	126mm	n/a		
Sample Space Height	63mm	38mm	63mm or 100mm	100mm	130mm		
Best For	general optical access	lower base temp, minimal sample hardware	large equipment near window	additional use of cold hardware, positioners	extra cold space, no side optical access required		

Option	CRYOSTATION CASTLE OPTIONS				
	Round Castle	Regular Tall Castle	Rectangular Tall Castle for Piezos	High Numerical Aperture Castle	Custom
#Optical Ports	1 overhead	2 side, 1 overhead	2 side	2 side	varies
Beam Height	n/a	178mm	178mm	177mm	varies
Added Sample Space Height	96mm	120 mm	114mm	78mm	varies
Application	superconducting magnet	low working distance for electromagnet	piezo nanopositioning	transmission	unique experimental requirements

OPTICAL OPTIONS

WINDOW CONFIGURATIONS

The Cryostation platforms offer optical access to the sample space through window ports on the sides and top of the sample housing. The number of available optical ports is dependent on the base platform (see specifications pg 9).



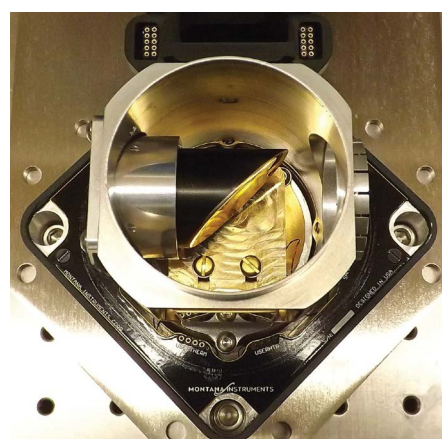
WINDOW MATERIALS

Both the outer housing and inner radiation shield windows may be easily replaced by the user within minutes. A variety of optical materials are available for different wavelengths and applications (see table to the right). The standard option is a VIS-NIR (400-1000nm) with AR coating.



LOW WORKING DISTANCE

The low working distance allows users to use external optics and achieve a working distance as low as 1mm. The components to achieve the LWD configuration include a thin vacuum window, a raised 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 larger samples.



CUSTOM WINDOW OPTIONS

The window ports can be customized for unique optical experiments. Custom tilted window holders can be incorporated to eliminate fringe patterns and avoid unwanted cavity feedback. Modifications for additional optical ports, such as a bottom window, are also available.

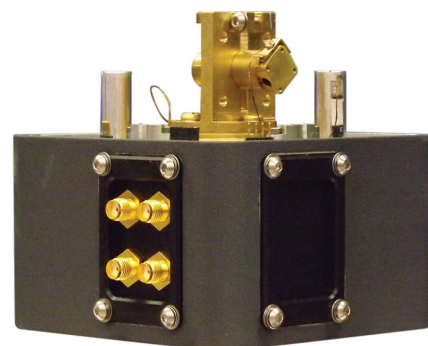
WINDOW SUBSTRATE	WAVELENGTH	APPLICATION NOTES
fused silica VIS-NIR coated	400 - 1000nm	standard windows
fused silica uncoated	200 - 2000nm	
BK7	350nm - 2 μ m	birefringent!
sapphire	300nm - 4 μ m	
calcium fluoride (CaF ₂)	200nm - 8 μ m	
potassium bromide (KBr)	250nm - 26 μ m	hygroscopic
potassium bromide (KBr)	3 - 12 μ m	hygroscopic
silicon (Si)	1.2 - 7 μ m	
sodium chloride (NaCl)	300nm - 10 μ m	water soluble!
zinc selenide (ZnSe) uncoated	0.7 - 20 μ m	only 70% transmission
zinc selenide (ZnSe) 3-12 μ m coating	3 - 12 μ m	over 95% transmission
TPX (for THz work)	80 μ m - 2mm	80% transmission
HRFZ-Si (for THz work)	100 μ m - 1mm	55% transmission
crystal quartz z-cut	100 μ m - 1mm	minimal birefringence
Spectrosil 2000	190 - 2000nm	deep UV, fluorescence free
BaF ₂	3 - 5 μ m	ultraviolet transmission
aluminized kapton		for x-ray work
other		user supplied

Visit our website for an Optical Windows Buyers' Guide.

INTERFACING OPTIONS

CONNECTIONS & FEEDTHROUGHS

The Cryostation 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 number of available feedthroughs is dependent on the base platform (see specifications pg 9).



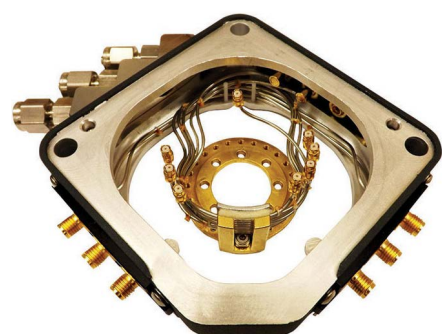
BASE SIDE PANELS

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 (see specifications pg 9). A side panel doubler is available which turns a single side panel opening into two side panel openings.



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.



INTERFACE EXTENSION HOUSING

The Cryostation can be configured to add signal interfaces above the lower housing by using a 25mm spacer with four user specified side panels. This option provides more room to the sample space and is recommended when the user wants to add interfaces to the Magneto-Optic option.

	RF COAX	FIBER OPTICS	GAS TUBE	ELECTRICAL OPTIONS			
Option	SMA/SMP	Fiber Optics	1/16 Gas Tube	Micro D25	MDR26	Fischer 24	R2D12
Description	for high frequency signals, SMA to SMP coax connectors	FC style connectors or compression (Swagelok) fittings	compression fitting for 1/16" gas tube, includes tube routed to sample chamber	welded Micro D25 connector with integrated internal wiring	soldered 26 pin connector with internal headers	standard Fischer 105 series 24 pin connector	soldered 14 pin connector + SMA to SMP coax connectors
Side Panels	quad RF	dual Swagelok	single tube compression	single D25 connector	single MDR26 connector	single Fischer 24	single MDR14 connector + dual RF
Window Feedthroughs*	single & quad RF	single & dual FC, dual Swagelok	n/a	n/a	n/a	n/a	n/a
Interface Extension	triple or quad RF	dual or triple FC	n/a	single D25 connector	n/a	n/a	n/a
Sample Mounts	R2D12	custom	n/a	ESM	ESM	ESM	R2D12
Notes	1-4 coax cables 20 GHz semi-rigid	several fiber types can be supported	multiple routing options in chamber	internal wires are 12" phosphor bronze	wiring harnesses plug into back/internal headers	internal solder cups, uses panel mount o-ring connector	flexible circuits route to R2D12 electrical sample mount

*Window feedthrough options are more difficult to use.



WIRING OPTIONS

All systems supply electrical feedthroughs for user connections into the sample space. Simple low conduction cable harnesses are available with 2, 3, 4 or 5 pins. These generally have a straight section for thermal lagging and a coiled section for thermal heat dissipation. New 12 and 25 pin flexible circuit connector options provide superior thermal anchoring and keep the wiring clean and organized.

Visit our website for additional resources, including a Wiring Guide to help calculate potential heat losses and a How To Article on proper thermal lagging techniques.

STAGES & SAMPLE MOUNTS

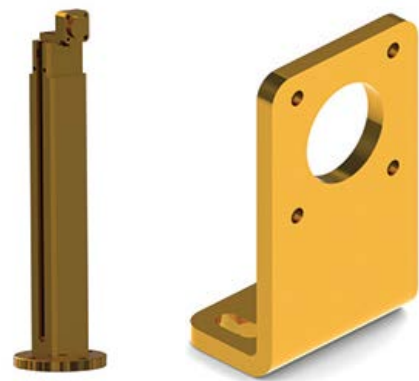
STANDARD & ELECTRICAL OPTIONS

A family of sample mounts have been specially designed for various applications and configuration. A wide range of both standard and custom mounting options are available. The engineers will work with users to determine the appropriate mount for the application and setup.



STANDARD GENERAL PURPOSE DAMPED SAMPLE MOUNT

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 that can be mounted vertically or horizontally.



STOCK DESIGN SIMPLE SAMPLE MOUNTS

This family of mounts are sized specifically to work with castles, magnets, or other special configurations. These mounts are not thermally damped, so the temperature stability may be slightly higher than the specification of the base platform.



CUSTOM DESIGNED SAMPLE MOUNTS

This category includes special purpose and adjustable mounts designed to fit unique experimental requirements. The engineers at Montana Instruments are able to incorporate a wide range of mounting options.

Visit our website for a detailed cryogenic sample mounting guide with tips on how to achieve optimal thermal performance.

ELECTRICAL SAMPLE MOUNTS

Option	R2D12	CB12	DIP16	MO14
				
Description	circuit board with electrical contact pads and coax connections	circuit board with electrical contact pads and pins	holds standard DIP16 chip carriers	wire bonding pads on narrow circuit board with pitch connector
Low Voltage Connections	12 DC	12 DC	16 DC	14 DC
High Frequency Connections	2 RF coax	n/a	n/a	n/a
Width	24mm	15.5mm	11mm	5.5mm narrowest
Required Space	26mm	17.5mm	13mm	7.5mm
Customizable	yes	no	no	yes
Configurations	standard mount or piezo mount	standard mount or fixed mounts	fixed mount or piezo mount	parallel, normal, or 45° to lateral field
Best For	coplanar waveguides, microwave excitation, & low signal level experiments	low working distance, high impedance, & compact areas such as castles	use with chip carriers and quick sample changes	use with Magneto-Optic module



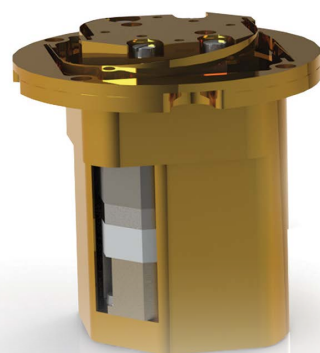
ELECTRIC SAMPLE MOUNTS

A family of electrical mounts allow the user to pre-mount samples on small chips or circuit boards to easily make electrical connections (see table above). These have been specially designed to work with other mounts and configurations.

STAGES & SAMPLE MOUNTS

PIEZO POSITIONING

The Cryostation base platforms can incorporate precision nano-positioning stages on the standard platform or by using an optional recessed platform. These piezo motion stages are integrated into the cold space for translating, rotating, or tilting your sample. Montana Instruments integrates and tests the unit so it is ready to be used right away.



RECESSED PIEZO PLATFORM

With the recessed platform option, a “nanopositioning insert” holds the stages and is inserted into a recessed pocket in the sample housing base for more efficient use of the cold space. This option also comes with a raised platform, so the system may be used without the pocket and stages, if desired.



PARALLEL PLATE FLEXIBLE THERMAL LINK

When piezos are used without the recessed platform, a flexible thermal link is required to thermally connect the cold stage to the sample mount. These specially designed links keep the sample within 0.2K of the platform. Sizes are available for 1 to 6 stages.

	DIRECT SUPPLIERS		INDIRECT SUPPLIERS
	Attocube	Janssen Precision Engineering	Other nano-positioners designed specifically for cryogenic environments are available with unique technological features and benefits.
Linear (x/y/z)	•		
Translation		•	
Rotation	•	•	
Tilt	•		
Hexapod		•	
Stackable	yes		
Feedback	closed or open loop		
Notes			

Consult with Montana Instruments for help choosing the best positioning solution for your setup and application.

STAGES & SAMPLE MOUNTS

AGILE TEMPERATURE SAMPLE MOUNT

The AGILE TEMPERATURE SAMPLE MOUNT (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.

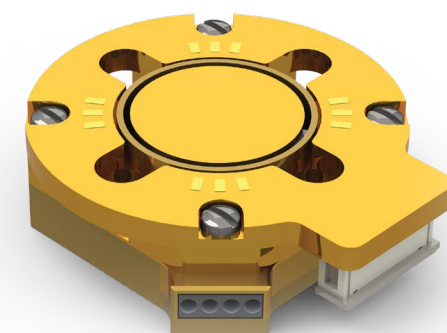


LOW DRIFT & FAST SETTLING TIME

The unique position stabilizing support structure optimizes stage mechanical stiffness and rigidity while providing the thermal performance required for fast temperature changes. The structure reduces thermal contraction to below 30µm over the entire temperature range.

THERMAL CONTROL & OPTIMIZED PERFORMANCE

Local heating of the sample, combined with a high speed temperature controller, results in rapid thermal response and time to stability. This technology eliminates the need to refocus after small temperature changes. The ATSM functionality is maximized in high NA and low working distance setups, such as when used with the Cryo-Optic® products.



ELECTRICAL SAMPLE MOUNT: ATSM - D12

A specially designed circuit board with 12 DC connections can be integrated with the ATSM for variable temperature electrical measurements. The wire bonding pads are connected to an exterior base side panel via a robust and flexible circuit.

ATSM SPECIFICATIONS			
Range	Base -350 K	Typical Heating Rate	300 K / 5 min
Temperature Stability	< 50 mK (p-p)*	Typical Cooling Rate	300 K / 5 min
Thermometer	Cernox CX-1050-HT	Temperature Gradient	0.2 K above platform
Drift Over Full T Range	< 30 µm**	Control Connections	2 heater + 4 thermometer
Resonance Frequency @ 292K	> 5 kHz		

*Stability over 15 minutes

**Measured at center and edge of 3x3mm calibration grating

OPTIONS & ACCESSORIES

ADDITIONAL CONFIGURATIONS

The Cryostation base platforms are designed to provide the user with flexibility in configuring the sample space and optical access. Depending on the platform, a number of both standard and custom options are available.



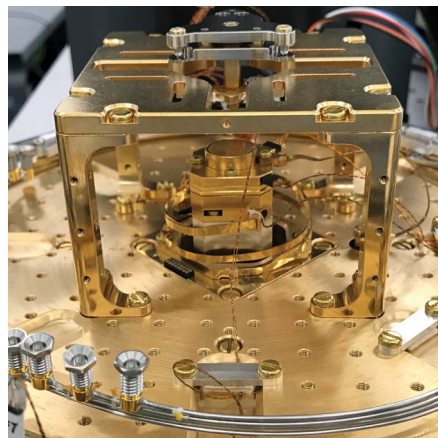
VACUUM FITTINGS

Both window port and base side panel options are available for additional vacuum pumps via KF16 or KF25 flanges. The window ports can also accommodate larger KF flanges or CF-flange options, such as CF2.75, CF3.37, or CF40. All of these options are designed to industry standards and will mate with any third-party fitting or pump.



LONG HOSES OPTION

A longer set of helium hoses and cables are available for users that want to separate the compressor further from the cryostat and optical table. Standard hoses are 10', while long hoses are 30'. Longer hoses do not affect system performance.



CUSTOM DESIGN WORK

While the family of standard options and accessories for the base platforms continues to grow, Montana Instruments is also able to customize options and system configurations to meet the unique needs of various experiments. Contact the engineers at Montana Instruments to discuss your customization request.

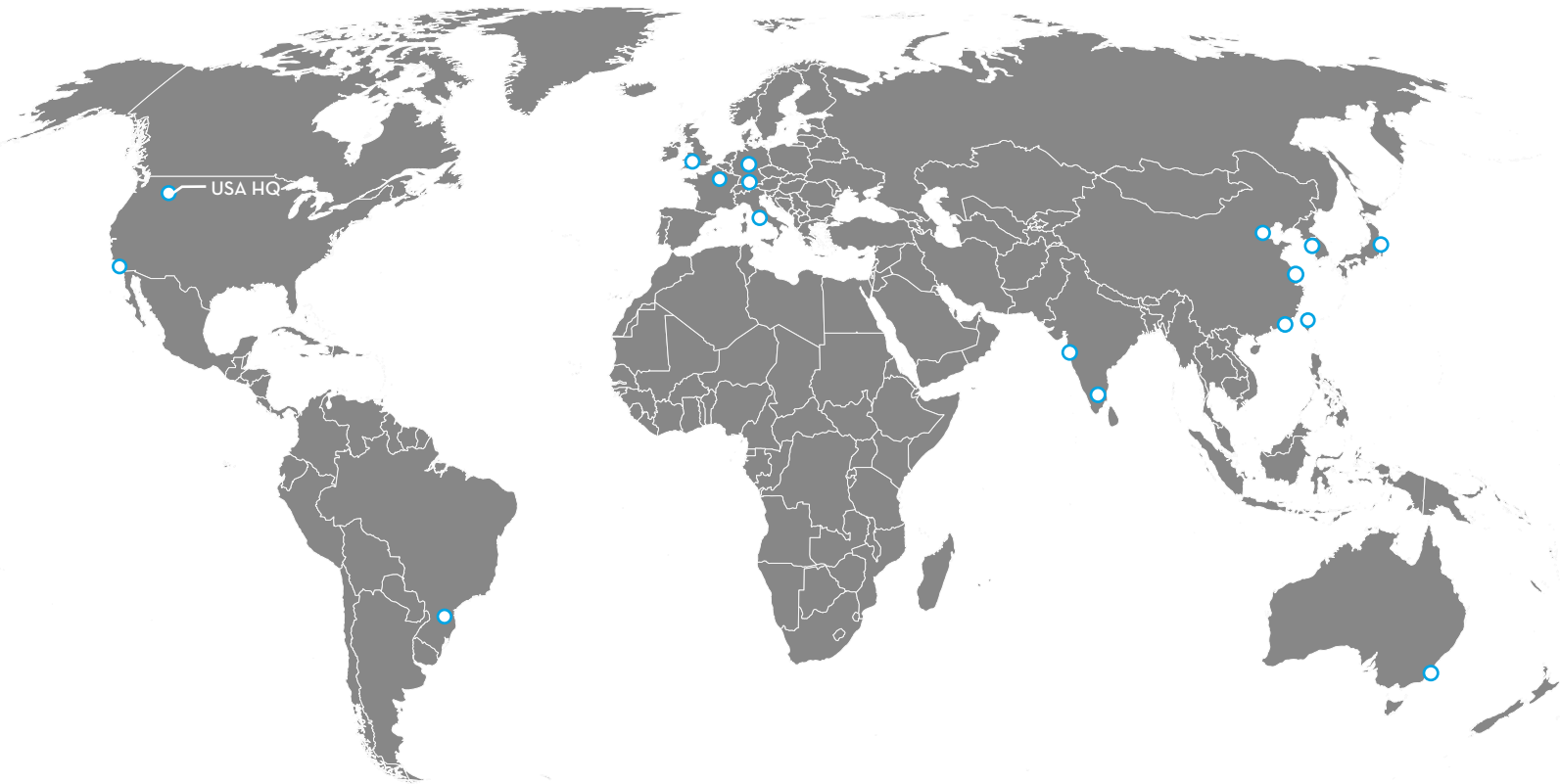
APPLICATION BUNDLES

COMMON CONFIGURATIONS

Having trouble deciding? No problem. Our application specialists have worked with our engineers to design packages of options designed specifically for popular techniques. These configurations will get you up and running quickly with the essential elements required for many general applications.

System Style	large field of view	low working distance	scanning	X-Plane with RF	dual-piezo stack (sample & fiber optic)	scanning magneto-optical	external magnet integration
System Model #	4106-A	4106-B	4106-C	4110-A	4111-A	4106-D	4106-E
Application Area	OPTICAL & ELECTRICAL					MICROSCOPY + MAGNETIC FIELD	
Cavity Physics	•	•					•
Diamond Color Center/ODMR	•	•	•	•	•		
Electrical Transport	•			•			
Optical Resonators					•		
Photocurrent Measurements	•	•	•	•			
Photoluminescence	•	•	•	•		•	•
Quantum Information				•	•		
Quantum Nonlinear Optics	•			•	•		
Resonance Fluorescence	•	•		•			
Single Photon Experiments				•	•		
Spintronics						•	•
Time Resolved Spectroscopy	•	•		•			•
Transmission/Reflection	•			•			
Confocal Microscopy	•	•	•	•	•		

More bundled configurations are being added. Check the applications page of the website for updates and details.



“Our mission is to make the researcher **more effective**. Our technology takes care of the cryogenics so researchers can **focus on results**.”

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