4400-DOC001

Module User Manual

OneK-Optic

CryoAdvance 100 | Cryostation s100

Version: 1.0
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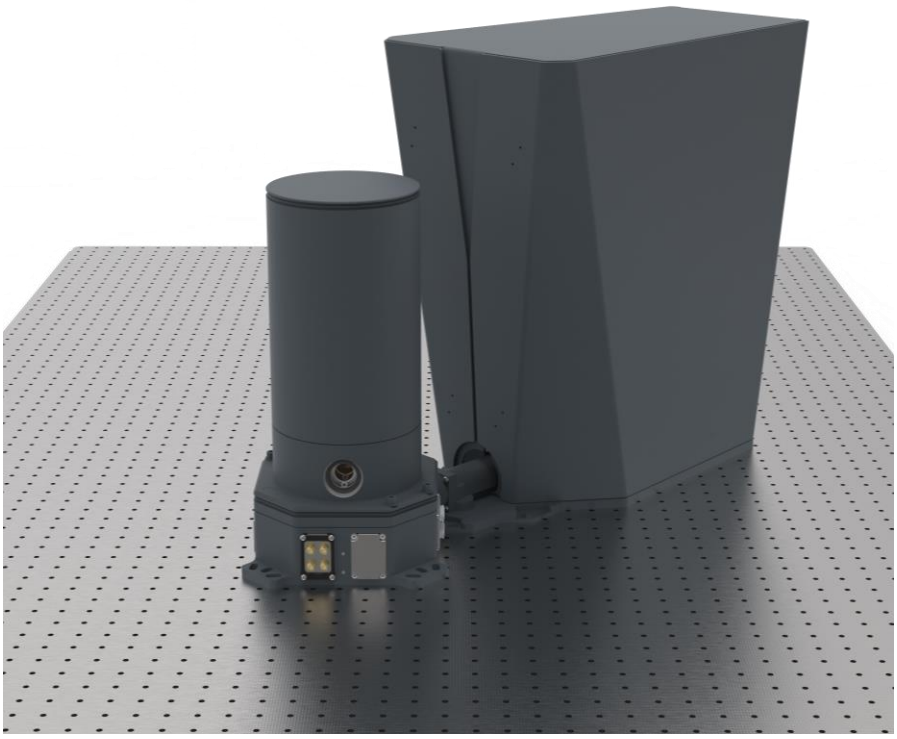
MONTANA INSTRUMENTS®



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Specifications and product information listed in this document are accurate at the time of publishing for a standard system. Options, custom designs, and other modifications may cause slight differences. Future design changes to the system, including software updates, may change information.

Table of Contents

Section 1 - Preface

⚠ WARNING

Read all the instructions before using this product

All users must read and understand this manual and all other safety instructions before using the equipment. Retain these instructions for future reference.

This manual is intended for users of Montana Instruments products and systems described herein. Users include anyone who may physically interact with the system or peripheral equipment, including installation, setup, or configuration. This includes anyone who may operate system components via control panels, the supplied user interface, or remote interfaces.

This manual may be used by facilities personnel to determine infrastructure requirements in the room or building where the equipment will be installed.

This manual is meant as a source of reference for authorized service personnel for important safety and hazard information and other product restrictions.

1.1 Conventions Used in this Manual

The following style conventions are used in this document:

- Vertical bar (|)
  - Indicates alternative selections. The bar may be used in place of "and" or "or".
- Alphanumeric List (1., 2., 3…| a., b., c…)
  - Indicates instructions or actions which should be completed in a specific ordered sequence.
- Bulleted List (• | ◦ | -)
  - Indicates instructions, commands, or additional information about an action.
  - May alternatively be used for unordered lists of materials or additional reference notes.
- `Courier Font`
  - Indicates a label or indicator on a physical product or part.
  - Indicates a system output, such as a display reading.

- May also be used for URLs, file paths, file names, scripting language, prompts, or syntax.

1.1.1 Abbreviation

The following abbreviations may be used:

- ACM: Ancillary Control Module
- CAN: Controller Area Network
- DMM: Digital Multimeter
- HDMI: High-Definition Multimedia Interface
- MI: Montana Instruments
- PCB: Printed Circuit Board
- TCM: Temperature Control Module
- UI: User Interface
- UPS: Uninterruptible Power Supply
- USB: Universal Serial Bus
- VNC: Virtual Network Computing

1.1.2 International System of Units (SI) Symbols

- C: Celsius
- cm: Centimeter
- K: Kelvin
- kg: Kilogram
- m: Meter
- mK: Millikelvin
- MPa: Megapascal
- mTorr: Millitorr
- mW: Milliwatt
- s: Second

1.1.3 System of Imperial Units Symbols

- ft, ' : Foot
- in, ": Inch

1.1.4 Explanation of Safety Warnings

Safety and hazard information includes terms, symbols, warnings, and instructions used in this manual or on the equipment to alert users of precautions in the care, use, and handling of the system. The following hazard levels and information are considered:

⚠ DANGER
Serious personal injury Imminent hazards which, if not avoided, will result in serious injury or death.

⚠ WARNING
Serious personal injury Potential hazards which, if not avoided, could result in serious injury or death.

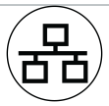
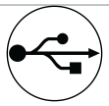
⚠ CAUTION
Possible personal injury Potential hazards which, if not avoided, could result in minor or moderate injury.

NOTICE
Command or Product Safety Notice Potential hazards which, if not avoided, could result in product damage.

» NOTE
Points of particular interest for more efficient or convenient equipment operation; additional information or explanation.

1.1.5 Graphical Symbols

The following symbols may be used in diagrams, supporting text, and on physical parts:

	Hazard Alert: General Warning		Hazard Alert: High Voltage
	Hazard Alert: Laser Radiation		HDMI port
	CAN bus module		USB port
	Hazard Alert: Hot Surface		Hazard Alert: Magnetic Field
	Waste Electrical and Electronic Equipment (WEEE)		Conformité Européenne (CE)
	Multimeter Required		Hand Push Button

1.2 General Hazard Information

The following descriptions are of general hazards and unsafe practices that may result in product damage, severe injury, or death.

- The products, parts, and components in this manual are to be serviced by authorized Montana Instruments service representatives only. Failure to do so will void the warranty and may damage the product and/or create a safety hazard.
- Only use components provided for the intended purpose described herein.
- If the equipment or any component is used or modified in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The following hazards may be typical for this product:

⚠ WARNING

Risk of injury when lifting or moving system components

System components, including standalone equipment and installed assemblies, may be heavy.

- Use caution when lifting or moving equipment or assemblies. Ensure proper lifting principles are used to avoid injury.
- Equipment or assemblies >20 kg should always be lifted by two or more people or with a suitable lifting device.

⚠ WARNING

High voltage: danger of electric shock

Electric shocks and burns from capacitor discharge or power circuits could lead to serious injury or death.

- Before turning on any power supply, the ground prong of the power cord plug must be properly connected to the ground connector of the wall outlet. The wall outlet must have a third prong or must be properly connected to an adapter that complies with these safety requirements.
- Only use replacement power cords or power plugs with the same polarity and power rating as that of the original ones. Do NOT use inadequately rated cables.

If the equipment or the wall outlet is damaged, the protective grounding could be disconnected.

- Do NOT use damaged equipment until its safety has been verified by authorized personnel.
- Do NOT disconnect or tamper with the operation of the protective earth terminal inside or outside the apparatus.

NOTICE

Only clean exterior surfaces with acceptable fluids

- Only use deionized water, glass cleaner, or isopropyl alcohol to clean the exterior surfaces of any enclosure. Do NOT use any volatile chemicals other than isopropyl alcohol.
- Apply fluid to a clean, lint-free cloth and wipe the surface with a cloth. Do NOT apply fluid directly to any surfaces or enclosures.

1.3 Technical Support Information

Any technical questions or issues with the system that cannot be resolved with the information in this manual should be referred to an authorized Montana Instruments service representative.

1.3.1 Warranty & Repairs

If the system or parts need to be returned to the Montana Instruments factory or an authorized service center for repair or service, contact an authorized service representative for a return merchandise authorization (RMA) number and instructions on returning the unit.

For a copy of the Limited Warranty Agreement, visit:
https://www.montanainstruments.com/support/warranty-information

1.3.2 Accessories & Replacement Parts

Only use cables, hoses, accessories, and parts provided or approved by the manufacturer. Follow all instructions for proper installation or replacement.

- To order spare or replacement parts, please contact your local service representative.
- To order new accessories or options, or for more information on other Montana Instruments products and technologies, please contact your local sales representative.

1.3.3 Contact Details

For a complete list of sales and service centers visit: www.montanainstruments.com/Contact

North American Authorized Service

- M-F 8:30am-5pm MST | Call: +1.406.551.2796
- Email: support@montanainstruments.com

North American Sales

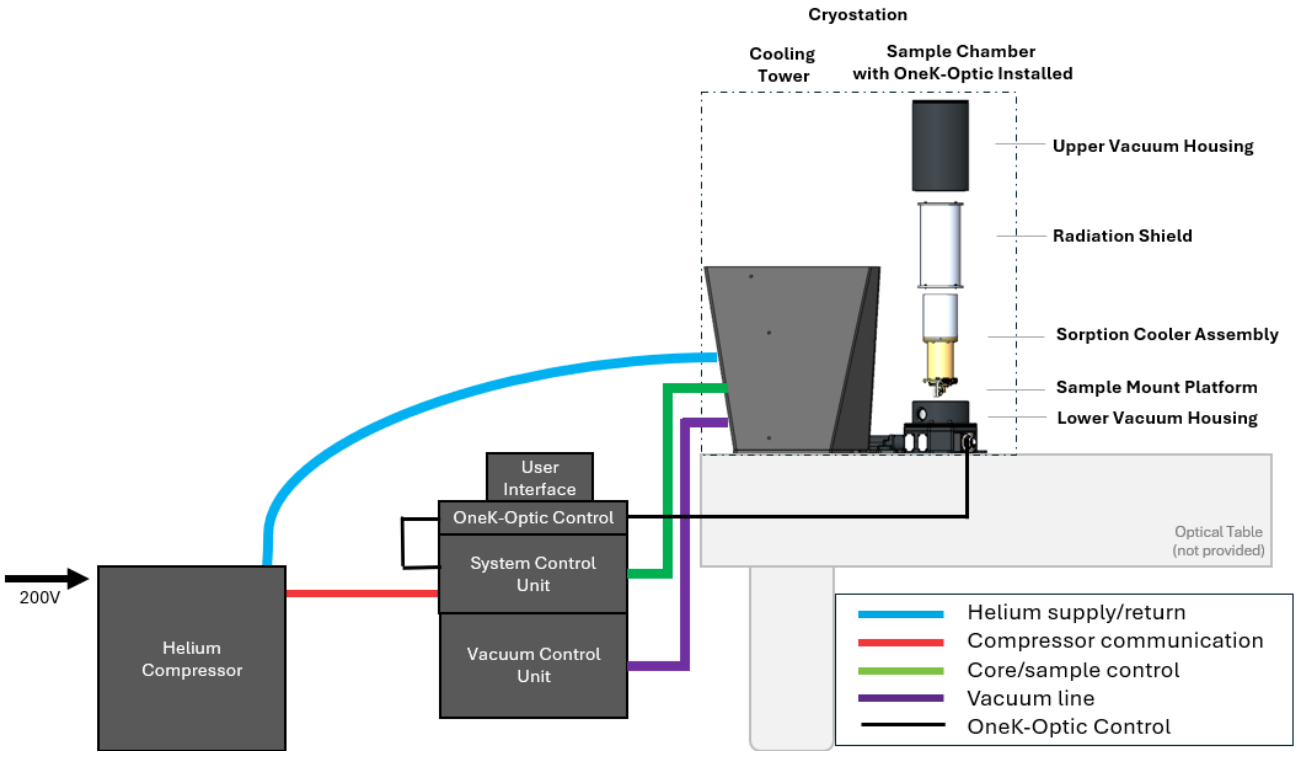
- M-F 8:30am-5pm MST | Call: +1.406.551.2796
- Email: sales@montanainstruments.com

International Sales & Authorized Service

- Visit www.montanainstruments.com/Contact for contact information for your local representative.

Section 2 - Module Overview

2.1 System Block Diagram



2.2 Intended Use

The OneK-Optic is an add-on module for the CryoAdvance 100 and Cryostation s100 systems utilizing generation 3 (touchscreen) controls. The OneK-Optic tower is installed on the base platform of the CryoAdvance 100 or Cryostation s100 4 Kelvin platform. The OneK-Optic tower is connected to an external temperature controller for regulation and control of the integrated sorption cooler for achieving 1.2 Kelvin base temperatures.

2.3 OneK-Optic Housing

Models
Standard Configuration

2.3.1 Components

The OneK-Optic Housing includes the sorption cooler, radiation shields, vacuum housing and all necessary electrical connections including a calibrated temperature sensor.

Lower Housing

The lower housing replaces the standard (or custom) vacuum housing and radiation shield on the CryoAdvance 100 or s100 system. The lower housing includes a vacuum housing with windows, 40K radiation shield and 4K radiation shield. Configurable side panels allow for up to 12 DC and 2 RF connections to the sample.

Upper Housing

The upper housing includes a vacuum housing, radiation shield, and sorption cooler module including the 1K sample platform.

2.3.2 Technical Specification

Environmental Specifications

Temperature of Environment	5 – 40 °C (41-104 °F)
Humidity	5 – 80% non-condensing
Altitude	<2000 m
Model	OneK-Optic
Mains Power Connector on Unit	IEC 60320-C14
Line Voltage	100 – 240 VAC
Frequency	50 – 60 Hz
Maximum Current Draw	0.3 A
Maximum Power Consumption	30 W

Physical Dimensions

Component	L x W x H	Mass
OneK-Optic	19 cm x 19 cm x 33 cm	8.9 kg

2.3.3 Safety Information

The following hazards may be typical for this product:

⚠ WARNING

Risk of serious injury due to hazards associated with cryocooling

All personnel working with the system must be aware of the potential hazards associated with cryocooling.

- Personnel working with the system should be trained in emergency measures that may be required in the event of an accident.

Risk of suffocation due to potential asphyxiates.

Nitrogen (N_2) and Helium (He) are potential asphyxiates if released into an enclosed area with poor ventilation. A decrease in air oxygen content can be caused by leaks.

- Ensure that proper tubing is used, and good connections are made at each connection point to prevent the release of these gases.

Risk of explosion due to high pressure if the system is not allowed to vent properly.

- Never bolt or otherwise fasten the lid of the sample chamber closed. The lid acts as a safety pressure release in the event of high-pressure accumulation in the Cryostation.

Risk of cold contact burns.

Parts of this system are very cold and may cause severe burns to the skin.

- Allow components to warm up to room temperature before touching. If contact occurs, consult a physician immediately.

NOTICE

Take care when moving the Cryostation

- Do NOT tilt the Cryostation more than 45 degrees. Inverting the Cryostation will cause damage.
- The Cryostation and sample chamber are a single unit. The attached sample chamber must be supported at all times. Do NOT lift the Cryostation by the sample chamber.
- Do NOT lift the Cryostation by the cryocooler tube or the top of the main body enclosure.
- The Cryostation ships with red locking plugs and shipping support to prevent damage to sensitive components. Do NOT remove these until the unit has been attached to the table.

Risk of product damage due to improper use

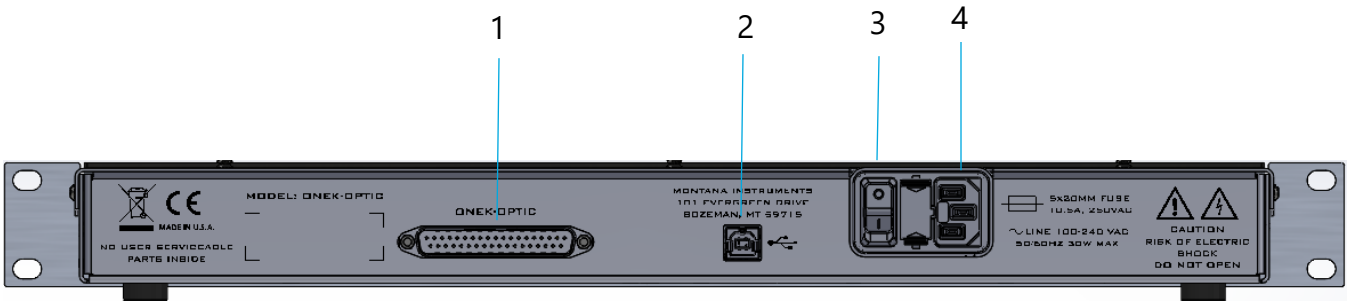
- Never disconnect the vacuum hose while the temperature of any stage of the Cryostation is below 285 K.
- Never open the case or vent valves when the temperature of any stage is below 285 K.
- Only use dry, high-purity nitrogen gas with the Cryostation. Do NOT substitute other gases for system venting.
- Avoid using any material in the sample chamber that may outgas or otherwise contaminate the optical windows and Cryostation surfaces.
- The sorption cooler contains sensitive components. Do not use or store the OneK-Optic above 310K.
- The OneK-Optic contains sensitive and fragile components. Always handle the unit with care.

2.4 OneK-Optic Controller

Model
OneK-Optic Controller

Front of enclosure

The OneK-Optic Controller includes two LED indicators on the front panel. The *Main Power* LED indicates that the main power to the unit is ON. The *OneK-Optic Power* LED indicates that power to the temperature control module for the OneK-Optic has been turned ON.



Rear of enclosure

2.4.1 Temperature Controller Inputs/Outputs (I/O)

1. OneK-Optic I/O interface, D-SUB 37 position Female Connector.
2. USB 2.0 Receptacle.
3. Controller Power Switch (I/O).
4. Power Input.

2.4.2 Technical Specifications

Environmental Specifications

Temperature of Environment	5 – 25 °C (41-77 °F)
Humidity	5 – 80% non-condensing
Elevation	<2000 m

Power Specifications

Model	OneK-Optic Controller
Mains Power Connector on Unit	IEC 60320 C14
Line Voltage	100 – 240 VAC
Frequency	50 – 60 Hz
Maximum Power Consumption	30 W

Physical Dimensions

Component	L x W x H	Mass
OneK-Optic Controller	38 cm x 49 cm x 5 cm	3 kg

2.4.3 Safety Information

The following hazards may be typical for this product:

⚠ WARNING

Risk of injury due to sharp edges

The enclosure contains sheet metal parts that may have sharp edges.

⚠ WARNING

High voltage: danger of electric shock

Electric shocks and burns from capacitor discharge or power circuits could lead to serious injury or death.

- No user serviceable parts inside, contact customer service for assistance.

NOTICE

Transportation and installation

- Do NOT move the unit during operation. Disconnect all cables before moving. Lift the enclosure by using both handles on the front face.

Section 3 - Installation, Handling, and Storage

3.1 Packaging Contents

The OneK-Optic will ship partially installed if purchased with a CryoAdvance 100 system. The sorption cooler assembly is packaged separately in a foam-insulated Pelican case to protect the sensitive components inside during shipping.

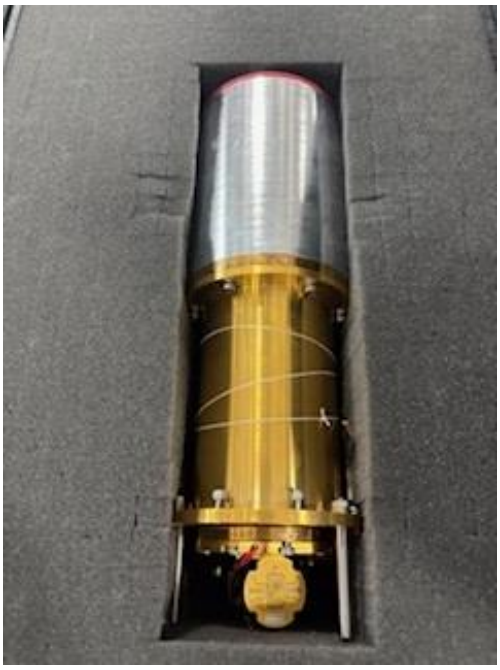
For OneK-Optic modules purchased as system add-ons, the majority of the parts will ship in standard Montana Instruments packaging. The sorption cooler assembly is packaged separately in a foam-insulated Pelican case to protect the sensitive components inside during shipping.

3.2 Installing the OneK-Optic

The OneK-Optic ships in a protective case (see below). When installing, the OneK-Optic sorption cooler can be set in a table-top holder until ready to install. Users will need an available side panel on the system to use the OneK-Optic.

Components included for the OneK-Optic:

- OneK-Optic Sorption Cooler Assembly
- Communication Side Panel and cable
- Platform Adapter
- 40K Radiation Shield
- 4K Radiation Shield
- Upper Vacuum Housing
- Lower Vacuum Housing (securing bolts included)
- Sample Mount Exchange Boss
- OneK-Optic Tabletop Holder Plate (securing bolts included)



OneK-Optic shipped in Pelican case (accessories not pictured).

⚠ WARNING

Avoid exerting lateral forces when on the OneK-Optic during installation and use

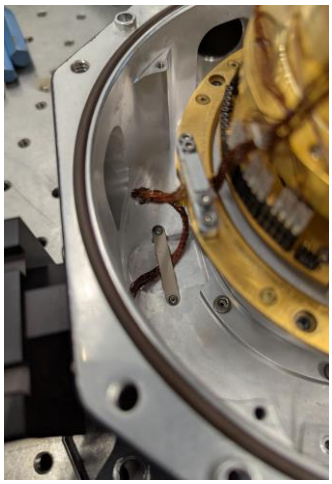
Excessive force placed on the OneK-Optic can cause damage to the sample chamber structure. Damage to this structure is not fixable in the field and requires repair at the factory.

To install the OneK-Optic Module:

1. Remove all installed options and add-ons from the sample chamber, down to the base platform. This includes the radiation shield, vacuum housing, and the sample chamber surround plate (Step 1).
2. Install OneK-Optic communication side panel (Step 2a). It is recommended to install this side panel in position 3 or 4, which are the side panels on the left front side of the vacuum housing when looking at the cryostat (Steps 2a and 2b).
3. Install the platform adapter by screwing in the four M3 screws into the circular hole pattern in the center of the base platform. Adapter screws into the circular hole pattern on the base platform (Step 3).

Step 1: Bare sample chamber (sample chamber surround plate installed).

Step 2a: OneK-Optic operational side panel installed in position 4.

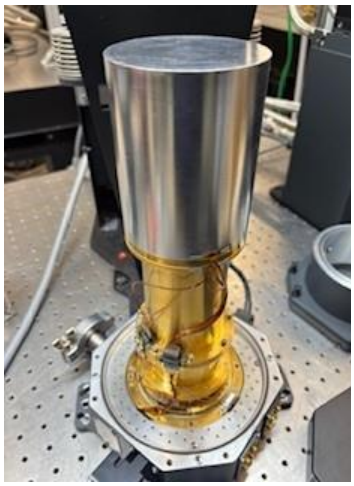


Step 2b: Wiring from OneK-Optic side panel to sorption cooler assembly.

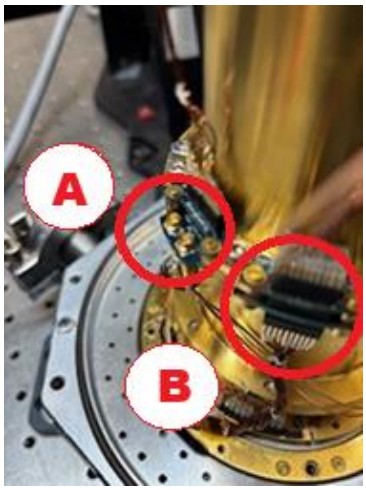
Step 3: Platform adapter installed to base platform.

4. Remove the pin shipping bracket. Bracket is secured by 3 M3 screws (Step 4).
5. Install the sorption cooler assembly to the platform adapter. The M3 screws in the sorption cooler assembly are captive (Step 5).
6. Connect all the wiring to the sorption cooler assembly. Note that your wiring configuration may look slightly different depending on the amount of DC or RF wiring installed in your configuration. For easier wiring connections, remove the PCB boards (2 pan head screws on each) and connect wires before reattaching the boards. The three operational wiring connectors are labeled on the pin connectors to indicate the order in which they need to be plugged in (Step 6).
7. Install CryoAdvance sample chamber surround plate. This plate covers wiring to side panels and helps route wiring to the thermal clamps. See section 4.2.2 for details on thermal lagging and routing wires under the thermal clamps (Step 7).

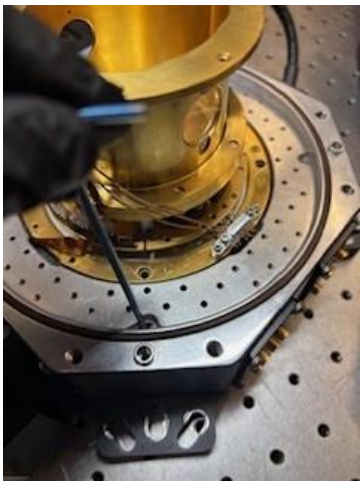
Step 4: Removing the pin shipping bracket.



Step 5: Sorption cooler assembly installed on platform adapter.

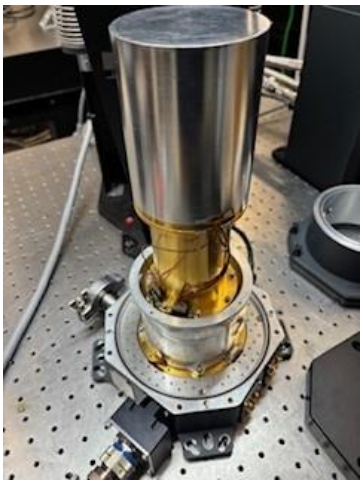


Step 6: Sorption cooler assembly operational wiring (B). RF user wiring (removed)(A).

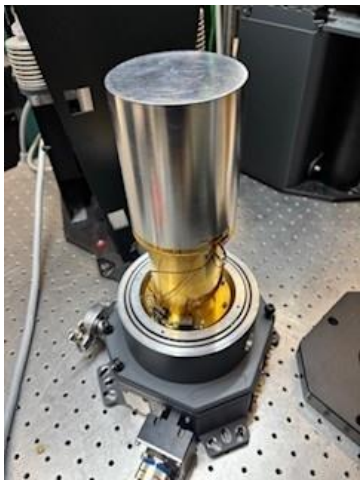


Step 7: Sample chamber surround plate installed.

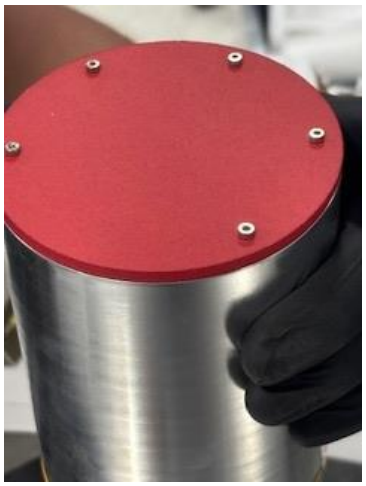
8. Install 4K lower radiation shield (Step 8).
9. Install the lower vacuum housing (Step 9).
10. Remove the sorption cooler shipping bracket (Step 10).
11. Replace the sorption cooler assembly lid (Step 11).
12. Install 40K upper radiation shield (Step 12).
13. Install upper vacuum housing (Step 13).
14. Connect the side panel to the Temperature Controller via DSUB cable and the Temperature Controller to the System Control Module via USB (Step 14a and 14b).



Step 8: 4K lower radiation shield installed.

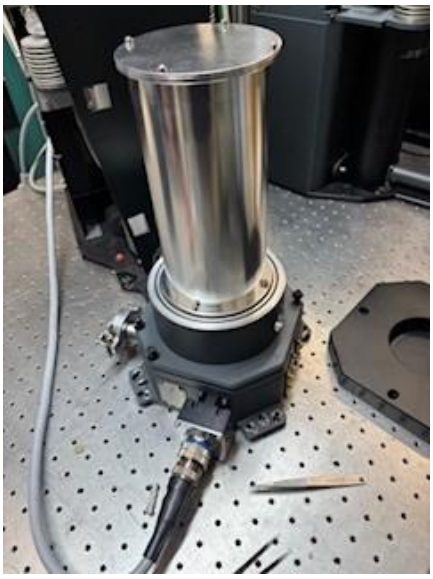


Step 9: Lower vacuum housing installed.



Step 10: Removing the sorption cooler shipping bracket.

Step 11: Installing the sorption cooler assembly lid.



Step 12: 40K upper radiation shield installed.

Step 13: Upper vacuum housing installed.

Step 14a: Connecting the side panel to the Temperature Controller.

Step 14a: Connecting the side panel to the Temperature Controller.

Step 14b: Connecting the Temperature Controller to the System Control Module (back of Temperature Controller).

Step 14b: Connecting the Temperature Controller to the System Control Module (back of System Control Module).

3.2.1 OneK-Optic Calibration

The OneK-Optic utilizes multiple internal thermometers and heaters to achieve sub-1K temperatures. For add-on orders, these need to be calibrated in your system so that they function and read out properly. The following instructions explain how to load the OneK-Optic calibration files to the system control unit.

Section 4 - Sample Installation

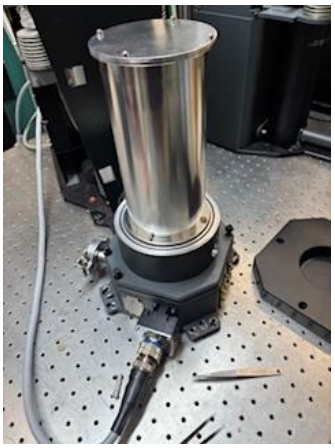
Before starting the Cryostation and OneK-Optic, check the sample space. Depending on the configuration, there may be foam inserts to remove before cooling the system down for the first time. Check for instructions specific to your configuration.

NOTICE
Keep sample chamber and surfaces clean • Always wear clean gloves when working in the sample chamber to avoid contaminating surfaces. • Take care not to touch the optical windows on the lid, vacuum housing, or the internal radiation shield. Window covers are provided to keep the windows clean. • Keep O-ring seals clean and free from debris. Do NOT place the housing with an O-ring or sealing surface positioned downwards unless there are protruding bosses to keep it from touching the surface. • When working inside the sample chamber, use extreme caution not to drop screws into the chamber assembly.

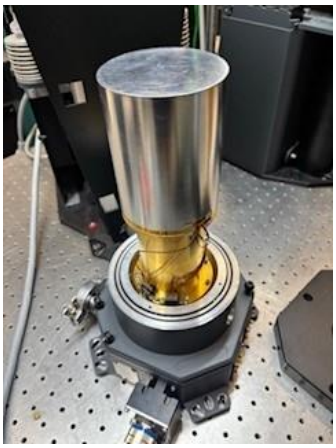
4.1 Installing and Removing a Sample Mount

Start with the system at room temperature and the chamber vented to atmosphere.

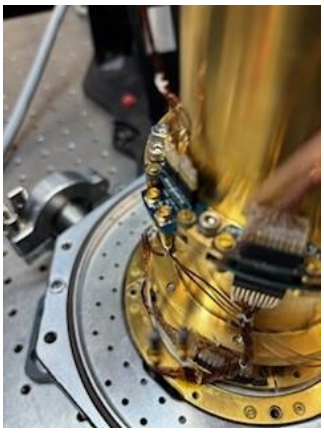
1. Carefully lift the upper vacuum housing from the sample chamber (Step 1).
2. Remove the large 40K radiation shield by unscrewing the four M3 screws along the bottom ring of the shield (Step 2).
3. Unscrew the sorption cooler assembly (screws are captive so they won't come out of the assembly completely). Using two hands, carefully lift the assembly from the sample chamber. For easier access, the lower portion of the vacuum housing can also be removed. If RF lines are installed, they will need to be disconnected to fully remove the sorption cooler assembly (Step 3).



Step 1: Lifting off the uppervacuum housing.

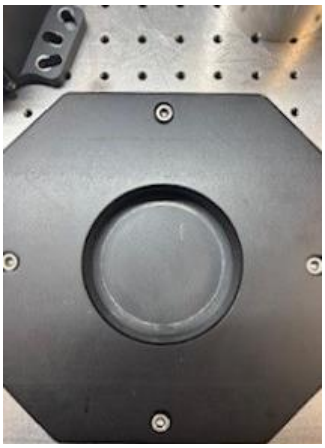


Step 2: Lifting off the 40K radiation shield.

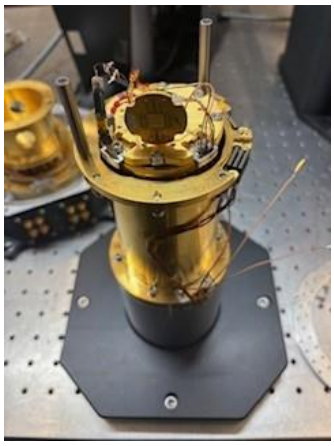


Step 3: Disconnect installed RF lines from sorption cooler assembly.

4. Rotate the sorption cooler assembly so that the sample mount is facing up and rest it in the tabletop holder. Ensure the holder is bolted to the tabletop before using it to hold the sorption cooler assembly (Step 4).
5. Exchange samples and mounts in this configuration. Sample mounts are attached to the exchange boss adapter with an M2 set screw (Step 5).
6. Reverse the steps to reinstall (Step 6).



Step 4: Tabletop soprtion cooler holder secured with bolts.



Step 5: Soprtion cooler assembly removed and set in tabletop holder.

Step 5: Sample mount exchange, set screw circled in red.

NOTICE
Take care when reassembling the sample chamber • Before replacing the upper vacuum housing, carefully check O-rings and sealing surfaces for any loose fibers or debris (contamination could affect vacuum performance). • Take care not to overtighten screws when replacing the radiation shield. Use of a torque screwdriver set to 5 in-lb is recommended.

4.2 Wiring

4.2.1 Types of Wiring

Various applications require different types of wiring. Always select the optimal wire for the application with the appropriate diameter (between 32-40 gauge). Longer wires are ideal -- the length of wiring between stages should be at least 2 in (5 cm).

- **32 AWG Phosphor Bronze wire**: *low thermal conductivity and good for moderate power transmission.*
    - Recommended use: Building additional wiring harnesses.
    - Raises temperature ~5.0 mK per wire.
- **Copper wire:** *high thermal conductivity and good for high power transmission.*
    - Recommended use: Wiring harness for high power transmission when high base temperatures are acceptable.
    - Raises temperature ~300 mK per wire.

» NOTE
See our Cryostation Wiring Guide for details, theory, and illustrations.

4.2.2 Thermal Lagging Techniques

To minimize the effects of heat loads through wiring on the base temperature, all incoming wiring (including coax cables) must be properly thermally lagged to Stage 1 of the cryocooler via the radiation shield.

CryoAdvance-100 models and the OneK-Optic provide “pre-lagged” connections for some user inputs and wiring. These wires, which plug directly into the 4 K circuit board “wedge” inside the sample space, do not need additional thermal lagging.

Wiring must route under the thermal clamp locations when pre-lagged connections are not available:

1. Unscrew the two M2 screws on the top of the thermal clamp. Remove the top cover.

2. Insulate the wires with a small piece of Kapton® tape to help prevent electrical shorts.
3. Place the wires on the felt pad. Wires should not cross or touch one another under the clamp.
4. Replace the top cover of the clamp and replace the two screws. Do NOT overtighten.
5. Check to ensure wires do not touch the inside of the radiation shield.

» NOTE
Ensure there are a few inches of wire before and after the thermal clamp. A 10-inch (25 cm) wire should be thermally lagged such that a 5.0 in. (12.5 cm) length is outside of the thermal clamp and the remaining 5.0 in. (12.5 cm) section is inside of the 4K sample space.

4.2.3 User Wiring Interfaces

The Cryostation provides integrated connectors for user DC feedthroughs, user thermometers, and heaters.

NOTICE
Do NOT remove sample chamber circuit boards • The standard 4 K circuit board "wedge" (contains USER, SAMPLE THERM, etc.) used on CryoAdvance-100 models should not be removed as it can lead to the disconnecting of the platform thermostat and heater. If this wedge needs to be removed for any reason, please contact an authorized service representative for detailed instructions. • The Operational cable and associated wiring must remain connected for the system to be operational. Do NOT modify these connections.

User DC Connections

User DC connections allow users to route wiring to header pins on the sample chamber circuit board. These available connections can be used to interface with external connections and devices. The accessory kit comes with pin connectors for interfacing user inputs to the external connectors. The OneK-Optic allows for up to 12 DC connections. Note that all internal system wiring is connected at the factory prior to shipping and is not accessible by the customer.

User Temperature Channels

User thermometer connections allow users to add additional thermometers (at the cost of 4 DC connections per additional thermometer) at header pin locations on the sample chamber circuit board. The system control unit provides open temperature channels (User 1 & 2) for manually controlling additional thermometers via the UI.

» NOTE
The sample thermometer provided is symmetric, so it can be connected to Pin 1 in either orientation.

4.2.4 Wiring Schematics

The wiring pin outfor the OneK-Optic is detailed below. For CryoAdvance 100 wiring schematics, refer to the User Manual.

One-K Optic Pin Out				
37 Pin connector	Location	Description	Typical Measurement (Approximately)	Typical Measurement (I- to V+ will be the same)
1	1K Platform Heater (+)	HTR	40 Ω	
20	1K Platform Heater (-)	HTR		
2	Pump Heater (+)	HTR	290 Ω	
21	Pump Heater (-)	HTR		
3	Switch Heater (+)	HTR	10 KΩ	
22	Switch Heater (-)	HTR		
7				
26	Head Thermometer (I-)	RTD	1 KΩ	
8	Head Thermometer (I+)	RTD		1 KΩ
27	Head Thermometer (V-)	RTD	1 KΩ	
9	Head Thermometer (V+)	RTD		
28	Film Burner Thermometer (I-)	Diode	7 MΩ	
10	Film Burner Thermometer (I+)	Diode		7 MΩ
29	Film Burner Thermometer (V-)	Diode	7 MΩ	
11	Film Burner Thermometer (V+)	Diode		
30	Main Plate Thermometer (I-)	Diode	7 MΩ	
12	Main Plate Thermometer (I+)	Diode		7 MΩ
31	Main Plate Thermometer (V-)	Diode	7 MΩ	
13	Main Plate Thermometer (V+)	Diode		
32	Switch Thermometer (I-)	Diode	7 MΩ	
14	Switch Thermometer (I+)	Diode		7 MΩ
33	Switch Thermometer (V-)	Diode	7 MΩ	
15	Switch Thermometer (V+)	Diode		
34	Pump Thermometer (I-)	Diode	7 MΩ	
16	Pump Thermometer (I+)	Diode		7 MΩ
35	Pump Thermometer (V-)	Diode	7 MΩ	
17	Pump Thermometer (V+)	Diode		
26	1K Platform Thermometer (I-)	RTD	56 Ω	
18	1K Platform Thermometer (I+)	RTD		56 Ω
37	1K Platform Thermometer (V-)	RTD	56 Ω	
19	1K Platform Thermometer (V+)	RTD		

4.3 Mounting a Sample

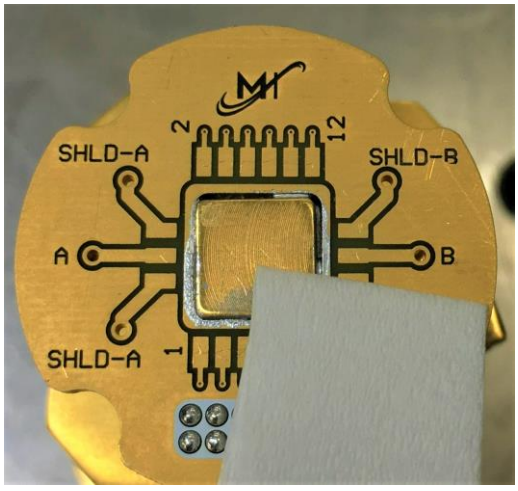
Most systems ship with a user-specified sample mount, depending on the option(s) purchased.

1. Remove the previous sample from the face of the mount if needed. Clean off residual grease with a Kimwipe, lens tissue, or lint-free cloth (use a small amount of isopropanol or acetone if needed) (Step 1).
2. Apply a thin layer of new N-grease to the sample mount surface. Use a flat tool (not metal or cotton) to spread the grease out evenly, taking care not to scratch the surface (Step 2).

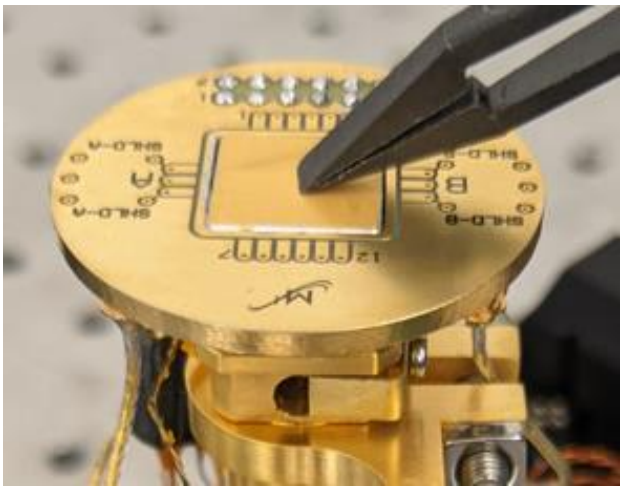
NOTICE
Do not use N-grease for temperatures above 300 K Apiezon® N-grease softens at 305 K. If the user plans to operate above 300 K, it is recommended to use an alternative sample mounting material to ensure a vertically mounted sample does not slide off the sample mount.

» NOTE
Depending on the sample, VGE, silver paint/paste, or copper SEM tape can be used in place of N-grease.

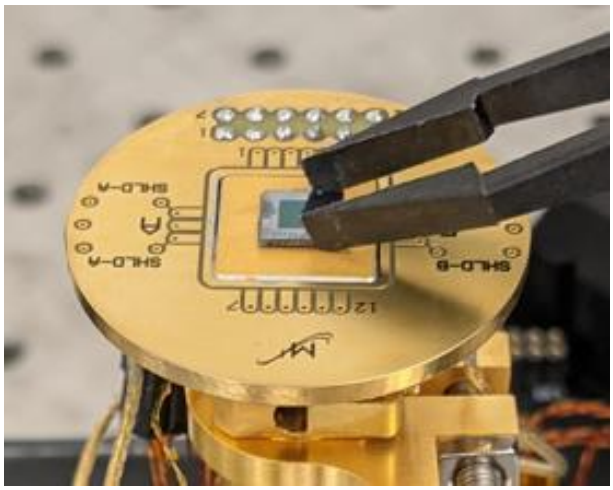
3. Using tweezers, set your sample on top of the grease layer and press down gently to ensure a good thermal connection (Step 3).



Step 1: Clean the surface of the mounting platform.



Step 2: Grease mounting surface.



Step 3: Attaching new sample.

» NOTE
To check if the sample is secure, hold the sample mount horizontally so the sample faces down and forcibly tap the mount with a finger.

4.4 Windows

4.4.1 Window Covers

The standard sample chamber has two optical access locations, one on each side of the lower vacuum housing. The window covers are removed by turning counter-clockwise until the notches are aligned with the openings in the window retaining ring. To replace the covers, re-align the notches and turn clockwise until the cover locks in place.

Window cover installed on standard vacuum housing.

» NOTE
Use care when removing the window covers if the system is running, as this may loosen the retaining ring holding the window in place.

4.4.2 Window Replacement

Vacuum Windows

For replacing outer (warm) vacuum windows, a special window tool is provided in the accessory kit:

1. Align the tabs on the window tool with the corresponding notches in the Delrin retaining ring holding the window in place.
2. Use the window tool to loosen the retaining ring by turning counter-clockwise.
3. Remove the retaining ring to access the window.
4. Before reinstalling the window, check the O-ring to ensure it is clean and free of debris and has a very thin layer of L-grease (just enough so the surface is shiny).
5. Carefully center the window over the O-ring during reinstallation. Ensure that the O-ring is fully covered by the window. Avoid repositioning the window, as this may spread L-grease onto the clear aperture.

Steps 1-2: Using window tool to unscrew the retaining ring.

Step 3-4: Retaining ring and window removed, L-grease applied.

Step 5: Window centered on O-ring.

NOTICE
Take care when handling and removing windows • Handle the radiation shield and windows carefully to prevent scratches or fingerprints. • Before using the window tool, remove the housing from the system. • Do not use too much force on the window tool as this could cause it to slip and damage the window.

Radiation Shield Windows

The inner (cold) windows on the radiation shield are held in place with two M2 screws.

1. The radiation window holders are removed by unscrewing the two M2 screws surrounding the window.
2. Before reinstalling the window, add a very thin layer of N-grease to the edge of the spring finger. This layer should be thin enough so none of the grease spreads onto the optic when re-assembled.
3. Reinstall the window by press-fitting the window in place.
4. Tighten the two M2 screws into place to secure the window.

Installed radiation shield window.

» NOTE
• Always ensure that no portion of the radiation shield touches the outer housing and that the radiation and vacuum windows do not touch. • If a radiation window is removed, the added heat load can be as much as 50 – 100 mW per window. Depending upon the emissivity and thermal conductivity of the sample, local heating of the sample from this excessive radiation can cause the sample to be significantly warmer than the cold platform it is mounted to.

4.5 System Care

Recommend system care procedures should be followed by any users of the system. For further information on any of these procedures, contact an authorized service representative for assistance.

4.5.1 When Working in the Sample Chamber

- Keep surfaces clean. Avoid touching any surfaces inside the sample space with your fingers as oils or other foreign contaminates can easily be transferred to the surfaces, the sample, or optics. **Always wear clean gloves.**
- Use proper grease and adhesives in the sample chamber. The accessory kit includes Apiezon® L-grease, N-grease, and the adhesive GE Varnish (VGE).
- Avoid using too much grease – a thin layer (just enough so the surface is shiny) is best for metal-to-metal surfaces, samples, and O-rings. Excessive grease can increase outgassing and contamination of other surfaces in the sample chamber.
- Inspect, wipe, and grease O-rings. Make sure that the O-rings are clean with a thin layer of L-grease. The exposed surface should be wiped with a dry Kimwipe or lens tissue and re-greased every 10-15 uses.
- Check to ensure wires are preserved: make sure wires do not overlap under thermal clamps and that the clamps are not overtightened; make sure wires do not contact the radiation shield or the sample mount (aside from the wire bond pads).

4.5.2 When Not Using the Module

- Keep the upper vacuum housing and 40K radiation shield installed to prevent dust from collecting on internal surfaces.
- Supply a small amount of nitrogen to keep the system clean and dry.
    - Use the `VENT` command with “Vent Continuously” enabled to keep nitrogen flowing through the chamber at atmospheric conditions.
- Keep the sample chamber under vacuum. Use the `PULL VACUUM` command button to pull and keep the chamber under a medium vacuum state.
- If the module will not be used for a long period of time, store the sorption cooler assembly in the foam-insulated Pelican case that it shipped in.

4.5.3 Standard Checks Before Every Cooldown

- Ensure the radiation shield is bolted down and secured. Make sure all radiation shield windows are in place.

- Ensure the sample is mounted properly.
- Ensure wiring from sample thermometers or other internal components does not touch the inside of the radiation shield.
- Check that the software starts up and reads all thermometers. The temperature channel values should be fluctuating a small amount, indicating the thermometer readings are active.
- Check helium pressure to ensure values are within appropriate values per the table below:

Configuration	Equalization Pressure
F20-L, any hose length	1447 kPa (203 psig)

4.5.4 Periodic Checks Every 6-12 Months

- O-rings rarely need to be replaced unless they are nicked or damaged. If damaged, use Teflon-tipped tweezers or your fingers to remove the O-ring. Do NOT use metal-tipped tweezers or other sharp objects as this could damage the aluminum housing and create leaks.

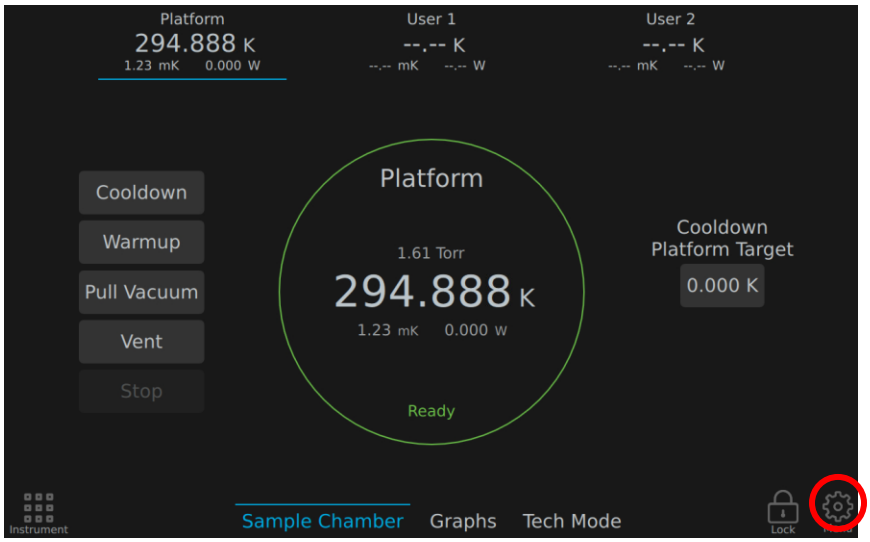
Section 5 - Module Usage & Operation

5.1 Module Control Options

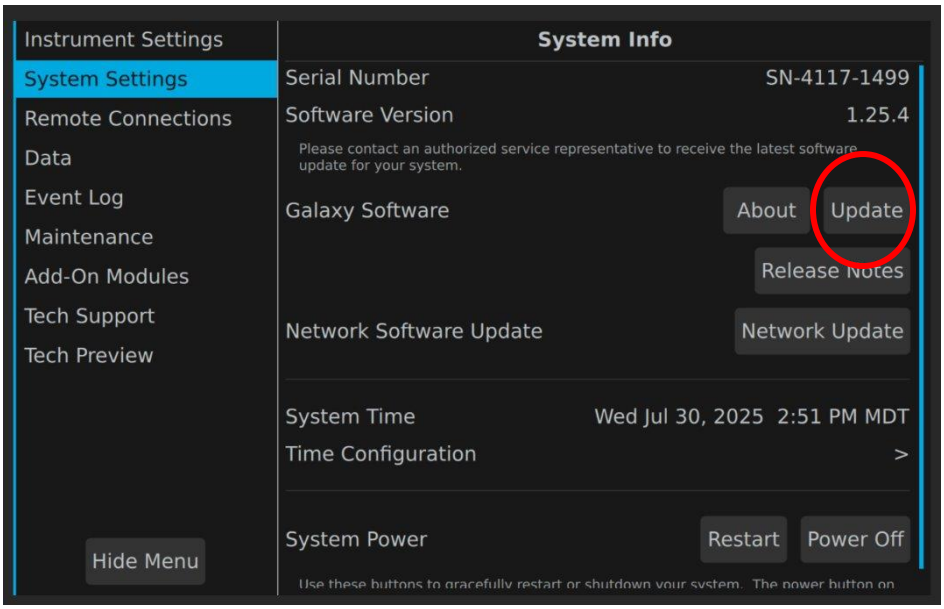
5.1.1 Updating the Software

Note that the system software will need to be updated to at least version 2.4 to be compatible with the OneK-Optic module. Contact support to update the software.

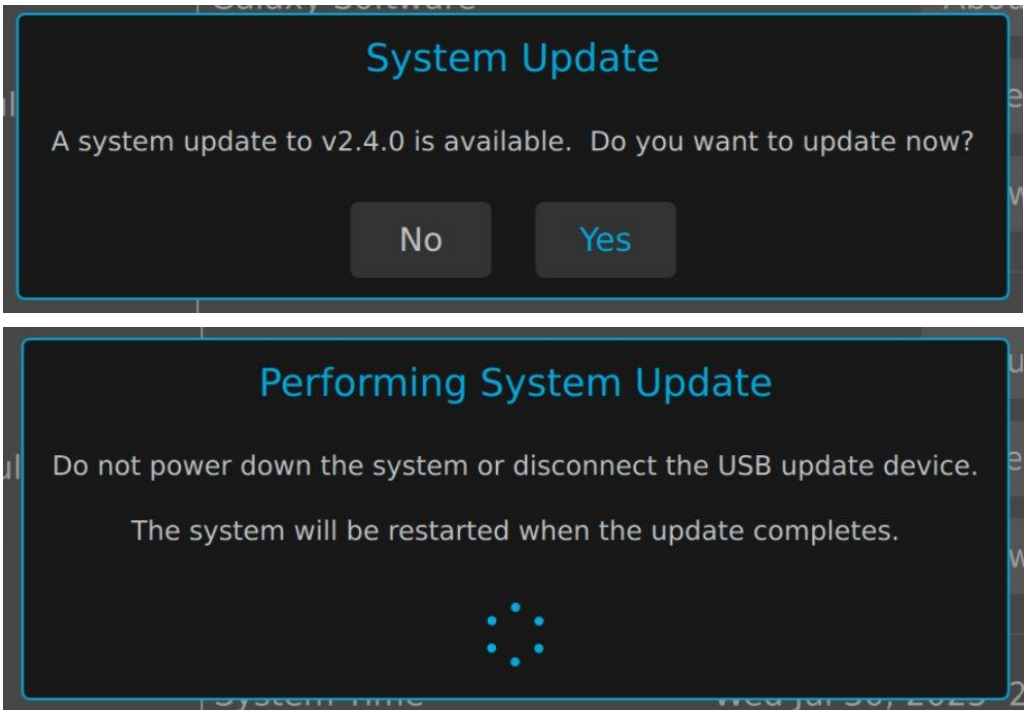
1. Navigate to System Settings by clicking `MENU`.



2. Software can be updated either over the network with the Service team remoting into the system, or by getting the latest software version sent by the Service team and saving it to a flash drive. For the flash drive method, plug the drive into the System Control Module. Clicking Update on the User Interface will find the software on the drive to install.

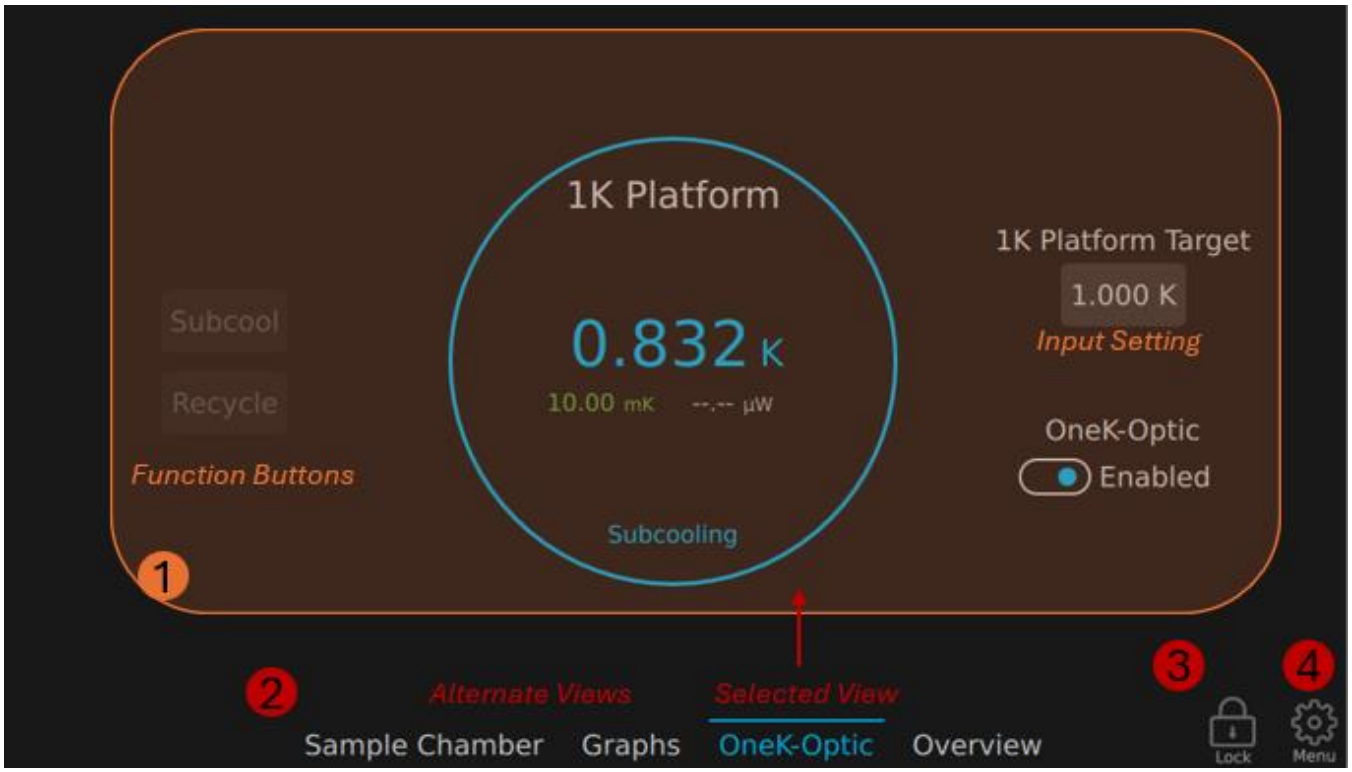


3. Select Yes to update.



5.1.2 User Interface

The touchscreen display provides the primary user interface control of the system.



General Navigation

The example screen above shows the general layout, navigation, and controls for the UI. Not all controls and views will be available for all instruments.

1. **Selected Operational View:** Displays the live status readouts and associated controls for the selected view.
    a. **Function Buttons:** Buttons with action statements tell the system to do something.
        i. **Subcool** - Begins cooling the system to set target temperature (can only be activated once system reaches initial base temperature of ~3.2K).
        ii. **Recycle** - The OneK-Optic module has a limited time to operate at low temperatures before needing to recycle the module. Pressing the Recycle button begins this process that should take approximately 3 hours.
    b. **Input Settings:** Buttons with numerical values and units show the current input settings for a given command. To set new values, use the adjustment controls (if available) or press the display box to open an input popup dialog. Use to set target temperature of OneK-Optic.
2. **Display Screens:** Choose which screen view to display. Alternate screens (when available) may show different readouts or have different control settings.

3. **Screen Lock:** Lock the touchscreen.
4. **Menu:** View or customize instrument and system settings. Other sub-menu features include:
    a. **Remote Connections:** VNC and scripting parameters.
    b. **Data:** Download system data onto a connected USB Flash Drive.
    c. **Event Log:** Historical log of system-level events for reference or diagnostics.
    d. **Maintenance:** Displays any recommended maintenance procedures.
    e. **Tech Support:** Settings for assisting technical support personnel.

NOTICE
Hold times at base temperature are affected by the duration of the recycle function. • The system will allow subcooling to occur after recycling before a "full" amount of liquid helium has been created. To achieve maximum system hold time at base temperature, allow the recycle function to run at least 2.5 hours before subcooling again.

» NOTE
• Press and hold a command or input settings button to show on-screen help for that operation. Drag off the button before releasing to avoid executing the operation. • The control buttons do not have on-screen help. Pressing and holding will execute the associated operation.

Application UI: Cryostation

Channel Types

- **Platform**: The primary channel used to control the system. These commands will drive control operations across the Cryostation, compressor, and vacuum control unit.
- **User 1**: The User 1 temperature channel displays the sample thermometer temperature readout.

» NOTE
• If the sample thermometer is not being used, it is recommended to turn it off to reduce noise on other temperature channels.   • Navigate to `MENU > INSTRUMENT SETTINGS > USER 1`. Toggle the Temperature Channel Enabled switch to the left to disable.

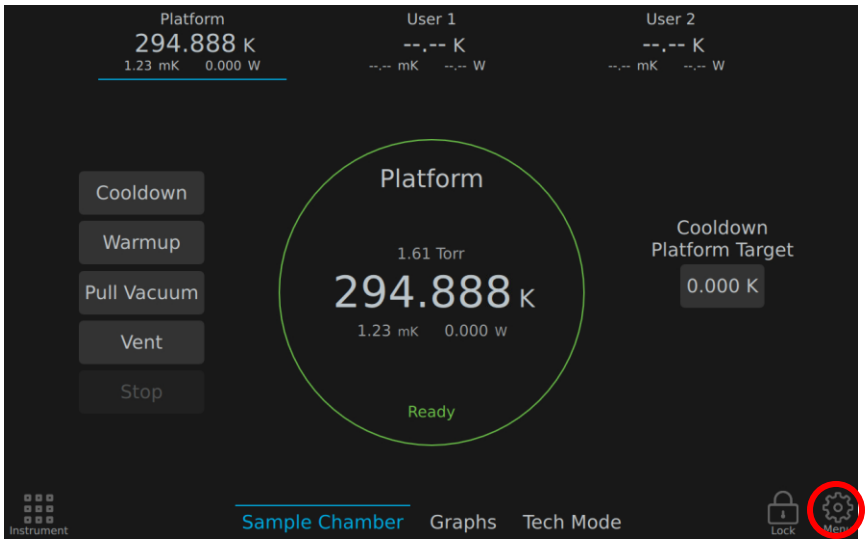
Display Screens

- **Sample Chamber:** Displays temperature channel controls and readouts. This screen is used to run most primary system operations.
- **Graphs**: Displays real-time system data in graphical form.
- **Overview:** Displays system status readouts for all connected sub-systems. Press any value to pull up detailed information and additional control settings (if available) for that parameter.
    - **Vacuum System:** status of pumps | valves | N_2 input | pressure gauges.
    - **Cooler:** status of the cryocooler/compressor | Stage 1 and Stage 2 temperature channels.
    - **Sample Chamber:** status of all sample chamber temperature channels.

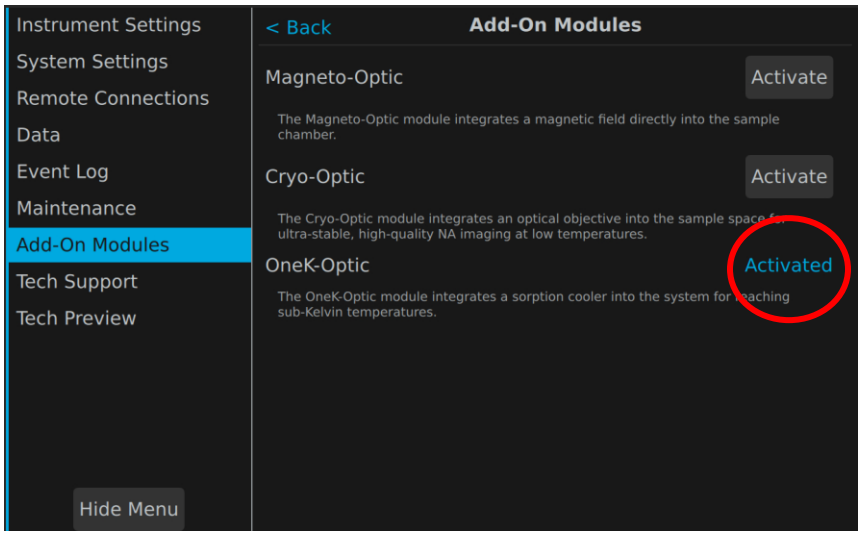
5.1.3 Enabling the OneK-Optic

Like other Montana Instruments add-on modules, the OneK-Optic must be enabled in the software settings prior to use.

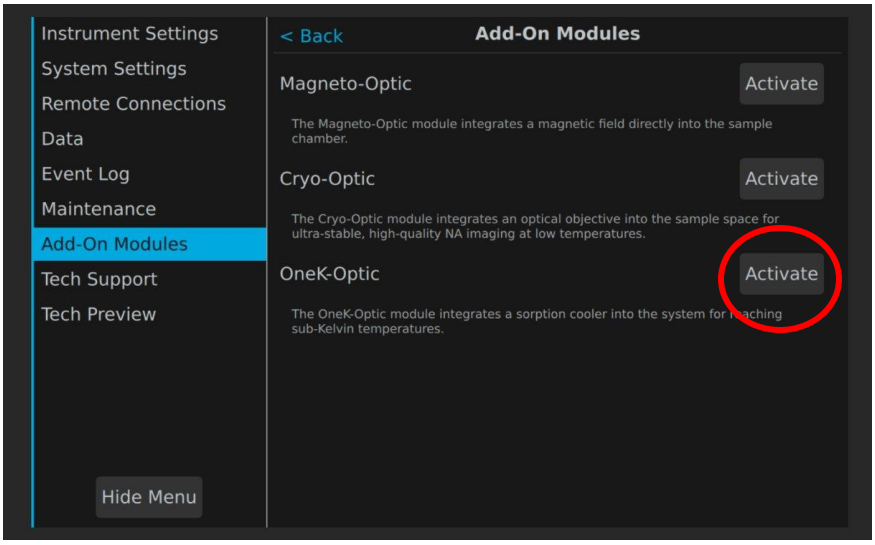
1. Navigate to Add- on Modules by clicking `MENU`.



4. Navigate to `ADD-ON MODULES` and ensure the OneK-Optic is Activated. If it is not activated, please contact Customer Service to activate the module.



Module activated in the software

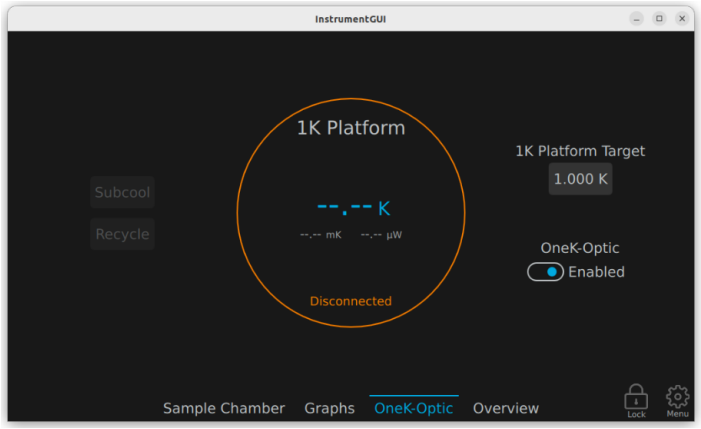


Module needs to be activated

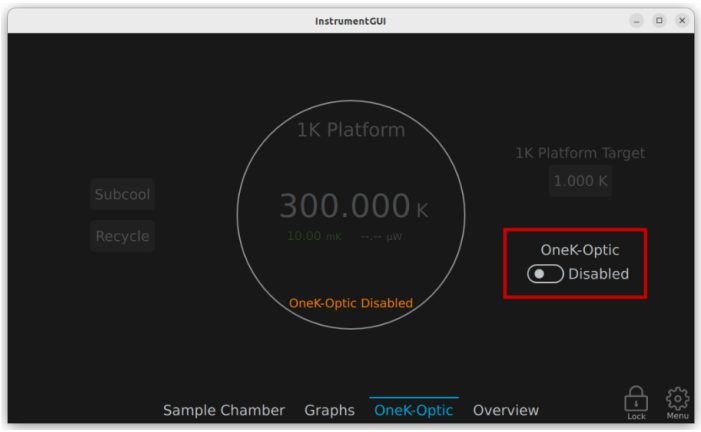
5.1.4 Module Status States

The OneK-Optic has multiple systems states that are displayed on the User Interface. The following section will go through each system state in detail.

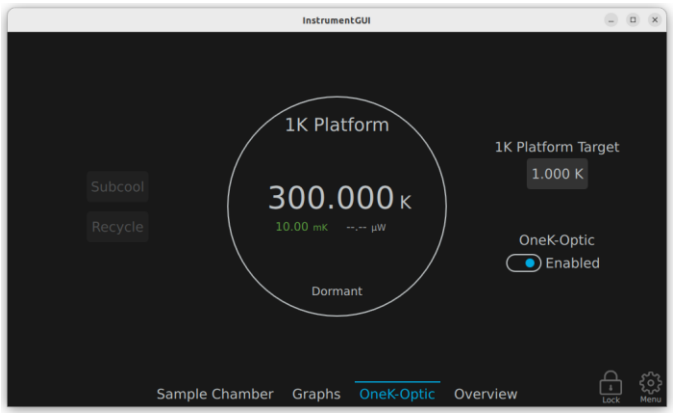
Disconnected - The system is unable to communicate with the OneK Temperature Control module (TCM). All OneK-Optic features are disabled, and the system will remain Disconnected until communications have been restored.



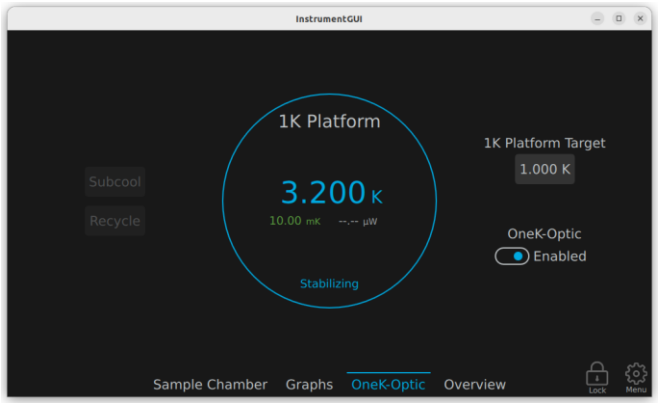
Disabled - The OneK-Optic device has been knowingly removed from the system. The user has informed the system that they wish to use the Cryostation without OneK-Optic functionality. They have done so by toggling the OneK-Optic Enabled switch to the Disabled position.



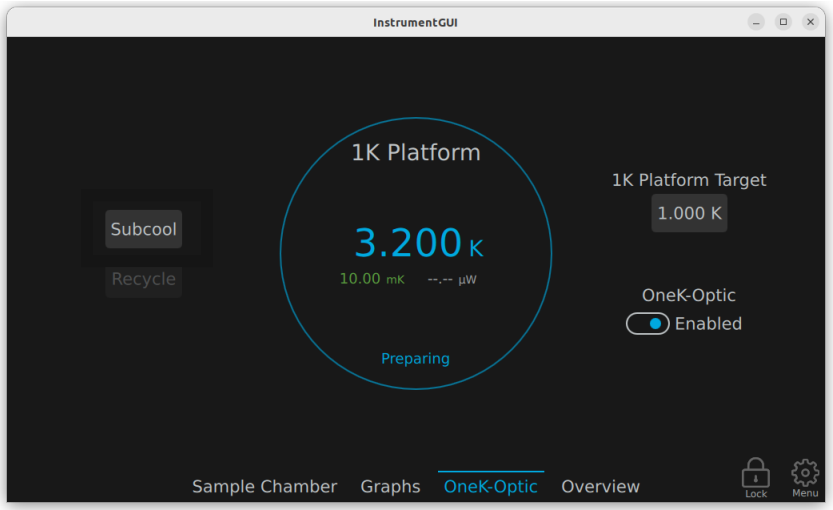
Dormant - The OneK-Optic device is above operational temperatures. The system remains in Dormant state until the Cryostation cools to near-base. This encompasses the Pre-Cooling mode.



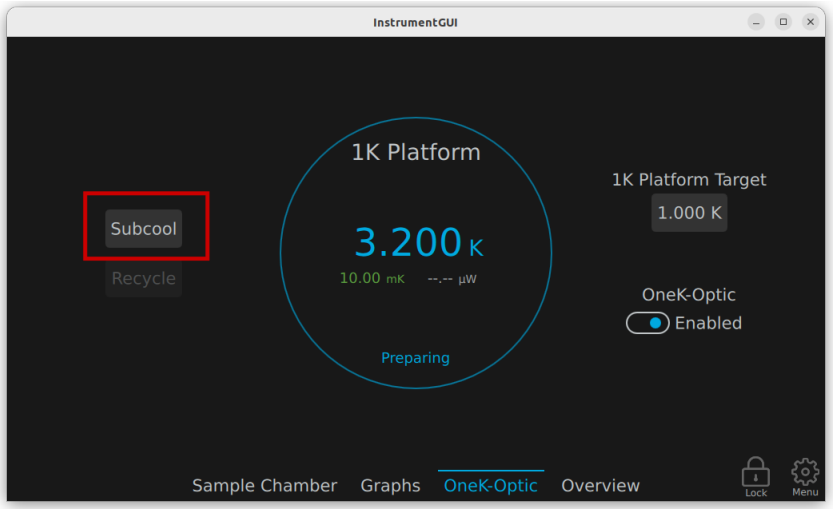
Stabilizing - The OneK-Optic device is waiting for internal temperature readings to settle at a range that allows for Helium Desorption mode. The system will enter Stabilizing state from Dormant state automatically when temperatures of the device have dropped low enough. The Stabilizing state will also be entered during Recycling.



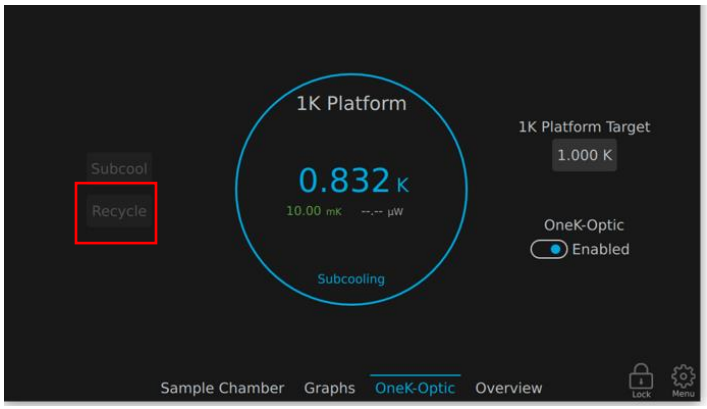
Preparing - The OneK-Optic device is in the process of Helium Desorption; liquifying the helium. The system enters the Preparing state from the Stabilizing state automatically when the system determines that temperatures have sufficiently stabilized to begin creating liquid helium.



Subcool- When the system determines that enough liquid helium has been created and subcooling can begin, the Subcool button will become available to press. Subcooling will only begin on user input. The longer the system is left in the Preparing state, the longer the Subcooling state will be (up to the max of ~8 hours).



Recycle- Brings system back to stabilizing state, can be done if liquid helium remains in the system or not. Note that there is a lockout period when the system is actively subcooling where Recycle cannot be engaged. It begins automatically if no liquid helium remains.

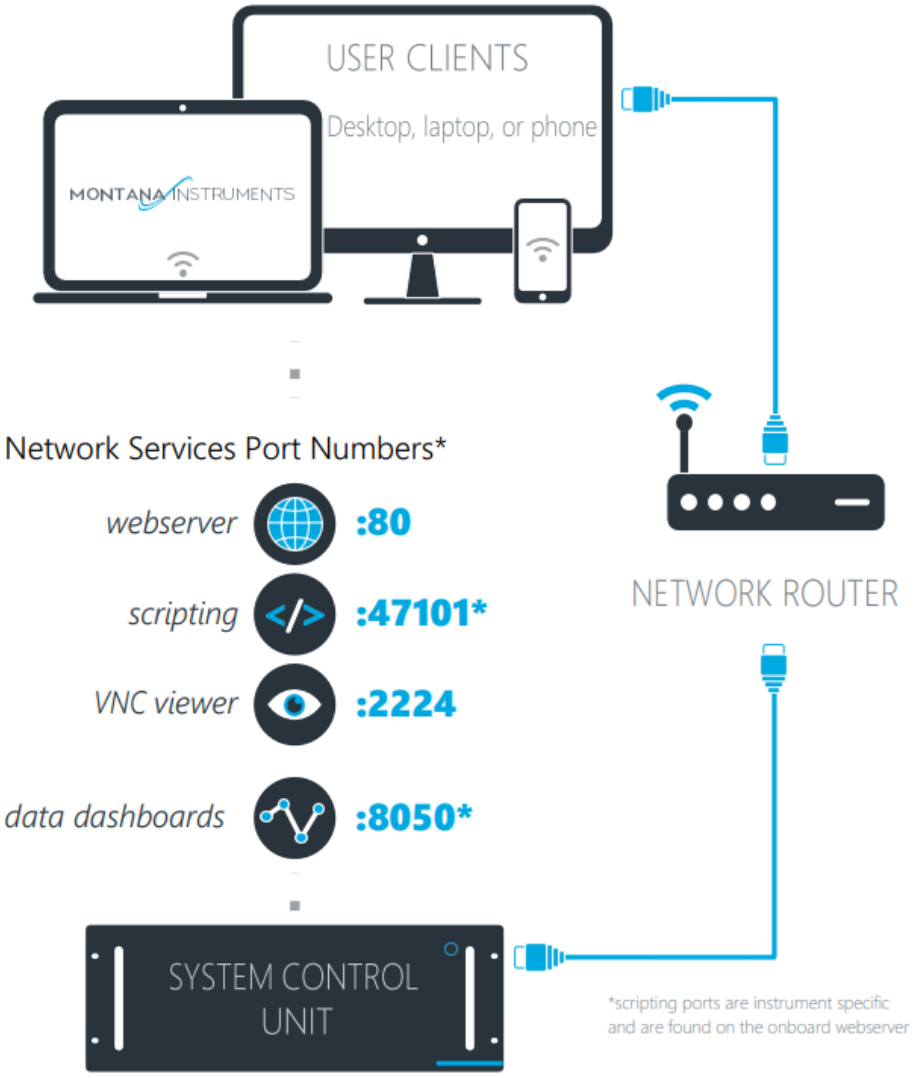


The Recycle process, once started, cannot be stopped. The Subcool button cannot be engaged again until Recycle is complete and the system enters the Stable state. During Recycle, the 4K and 1K platforms will warm up slightly. The chamber will still be under vacuum and under 5K during this time.

5.1.5 Network Interface

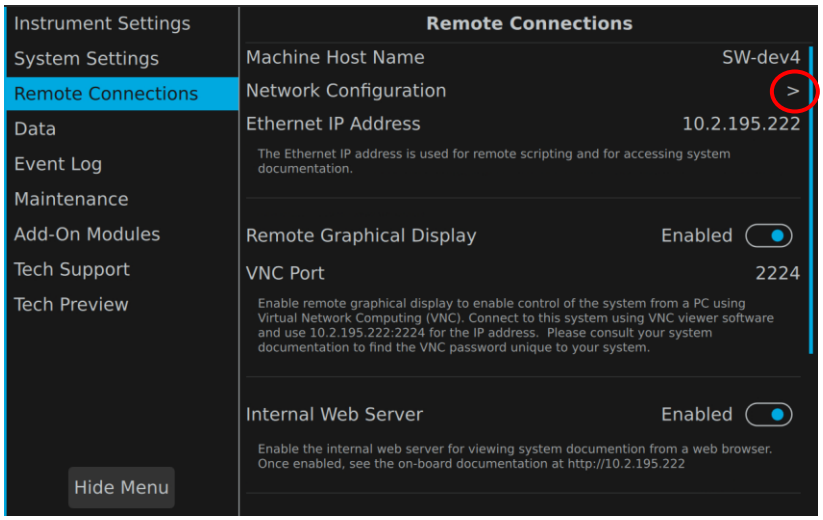
To utilize the network services provided, the system control unit must be connected to a local network using the Ethernet port on the rear face of the enclosure. This local network does not need to have internet access capabilities, nor is internet access required to use the following network services.

Each of the following services use a different network port number for communication. You will need to work with your IT department to configure these ports to be allowed through the firewall on your network. Port numbers can be found in the heading of each of the following sections and in the connection diagram below.

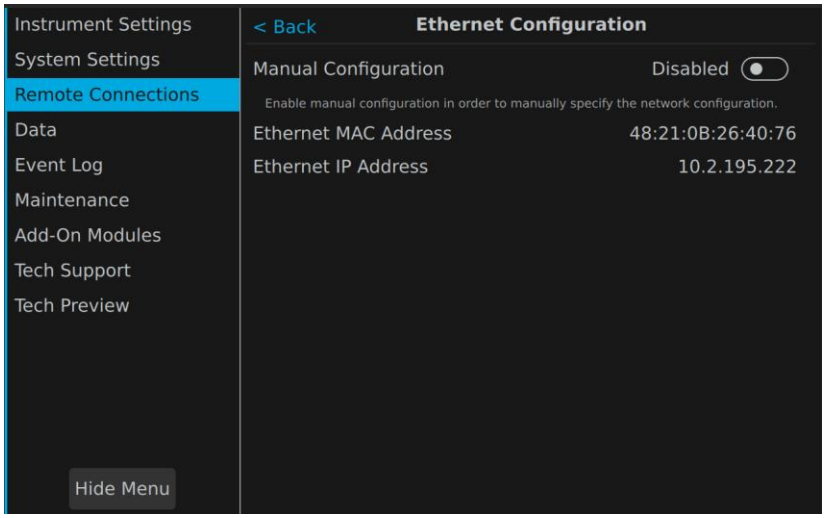


To find your system's IP and/or MAC address:

1. On the touchscreen UI, navigate to `MENU > REMOTE CONNECTIONS`



2. Scroll down to find the system's unique IP and MAC addresses. Your IT department may need to configure the network to provide network access to the device.

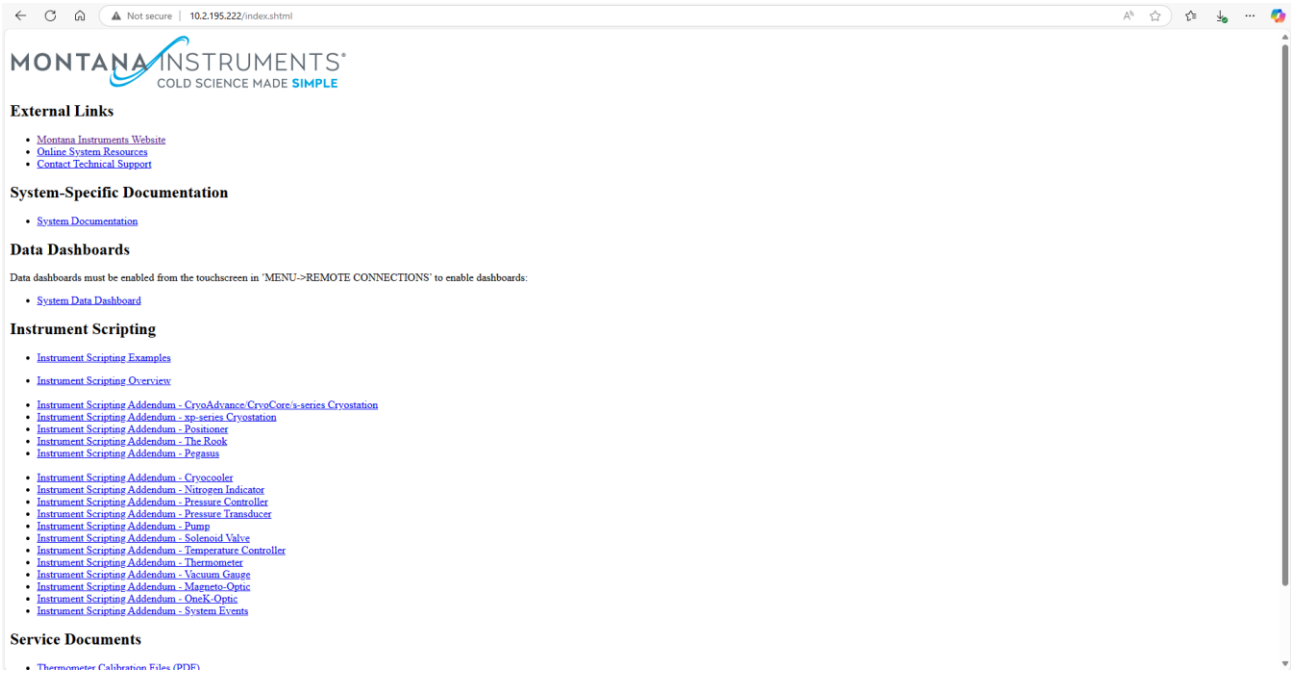


Webserver | Onboard Documentation Standard HTTP port 80

The onboard webserver provides direct access to system-specific documentation, instrument scripting documentation and examples, web-based data dashboard links, select service documents, and other support materials.

To access the onboard documentation:

1. From an external computer connected to the same local network, use a web browser to navigate to the system's IP address (example: http://10.2.195.222).



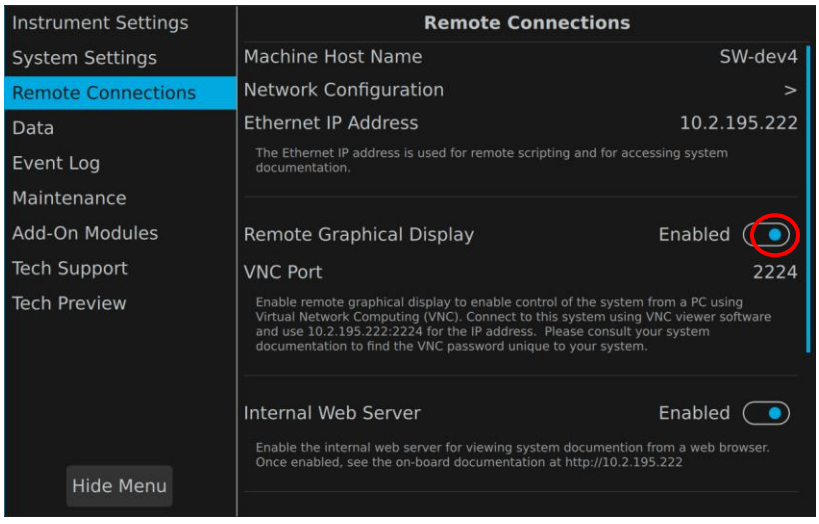
Remote Graphical Display | VNC Viewer

Non-standard HTTP port 2224

The user interface can alternatively be viewed or controlled via an external computer using Virtual Network Computing (VNC) technology. The external computer must have a VNC viewer program installed (*several free options are available, including www.realvnc.com and www.tightvnc.com*). When Remote Graphical Display is enabled, the VNC connection will mirror the UI control screen.

To enable Remote Graphical Display:

1. On the touchscreen UI, navigate to `MENU > REMOTE CONNECTIONS`
2. Toggle the Remote Graphical Display switch to `ENABLED`.



3. Follow your chosen VNC viewer software's onscreen directions for connecting to the system IP address.

The VNC connection is password protected using a unique password for each system. The password is provided with your printed system documentation and in the onboard webserver file `QUICK START GUIDE – NETWORK INTERFACE CONNECTIONS`. If lost, contact an authorized service representative to retrieve a copy.

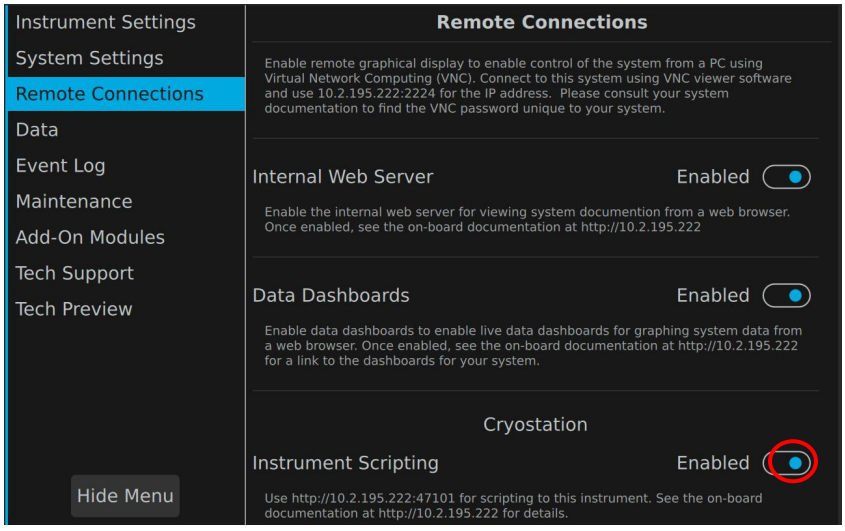
Remote Scripting

Non-standard HTTP port 47101

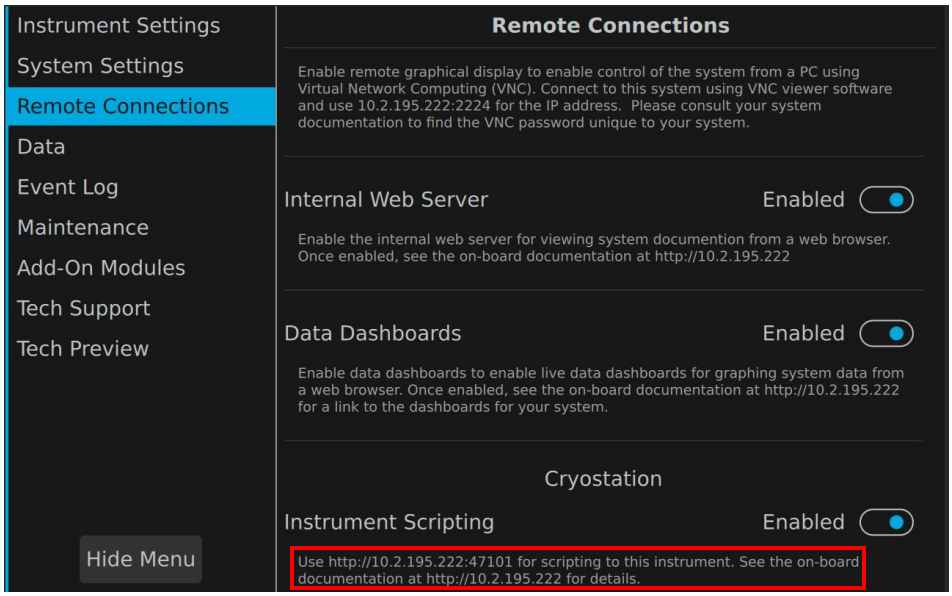
The instrument can alternatively be programmatically controlled via scripting commands using an external computer.

To use external scripting with the instrument:

1. On the touchscreen UI, navigate to `MENU > REMOTE CONNECTIONS`
2. Toggle the Instrument Scripting switch for the desired instrument to `ENABLED`



3. Follow the onscreen directions under the Scripting Toggle for opening the onboard scripting documentation, then use the available instructions for scripting with the instrument.



Remote scripting commands can be sent using an encrypted SSH tunnel. Refer to the onboard Instrument Scripting documentation on the webserver for further details.

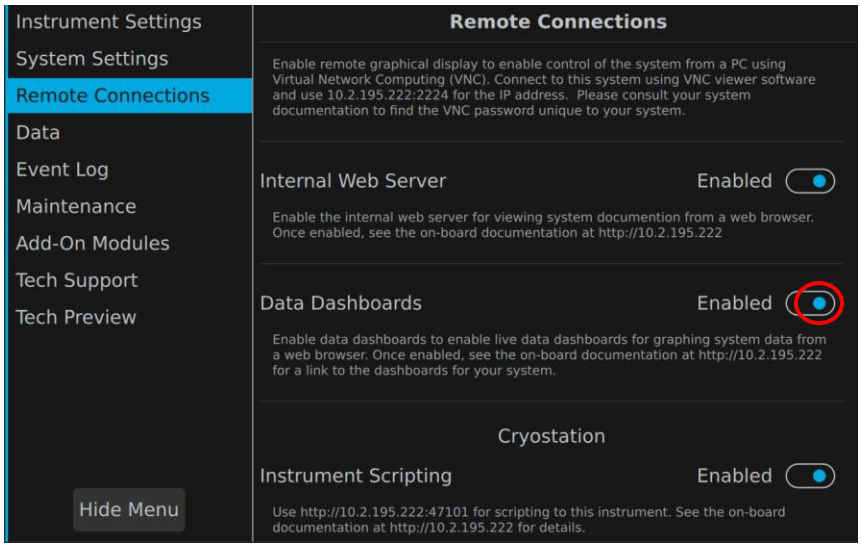
Data Dashboards

Non-standard HTTP port 8050

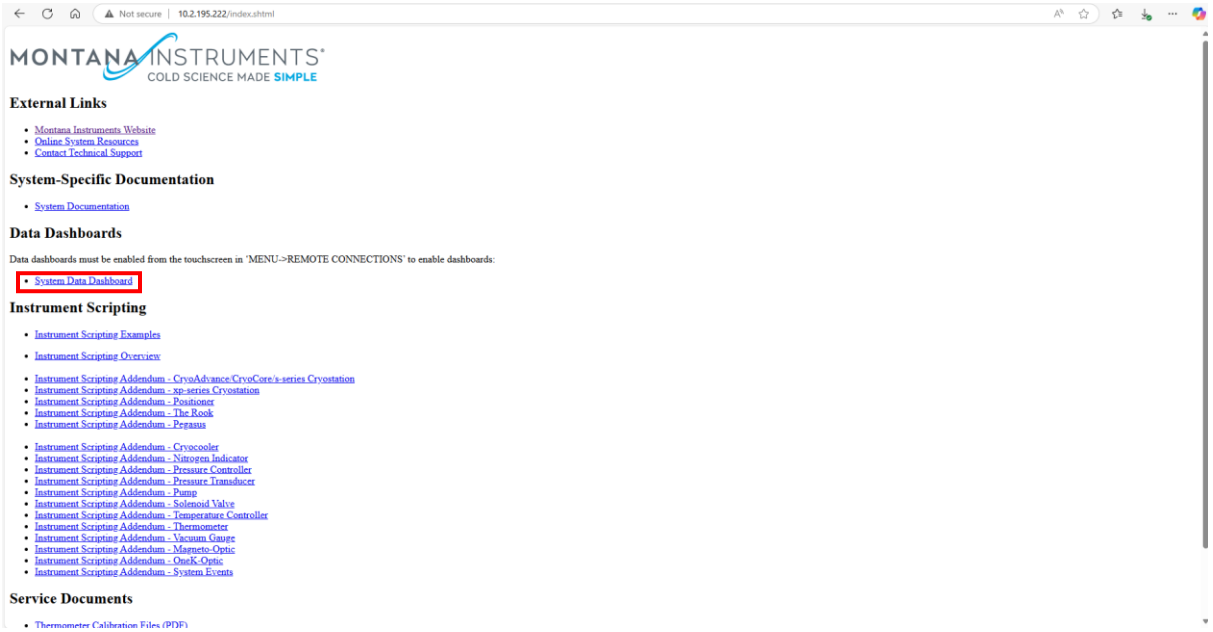
Data dashboards allow the user to view and analyze system data from a web browser.

To enable and view data dashboards:

1. On the touchscreen UI, navigate to `MENU > REMOTE CONNECTIONS`
2. Toggle the Data Dashboards switch to `ENABLED`



3. From the onboard webserver documentation (see page 47), click the `SYSTEM DATA DASHBOARD` link to access the system data.



MI Remote Support **Secure SSH tunnel port 2223**

The Montana Instruments Remote Support connection is used by authorized service representatives to remotely access your system to provide diagnostic and troubleshooting support. If the system is behind a NAT/Firewall, the firewall must allow the system to connect a Secure SSH tunnel on port 2223 to mirs.montanainstruments.com. Work with your IT department to configure the required NAT/Firewall access.

5.2 Primary Operations

5.2.1 Turning on the System

Before starting the power-up procedure, ensure that the power switches on the back of the system control unit and the front of the compressor are toggled to OFF (o).

1. If a dry nitrogen source is connected to the system, verify the supply pressure is set to ~15 psi for a standard system and ~50 psi for a turbo-equipped system.
2. Ensure the black circuit breaker switch on the front of the compressor unit is toggled to ON (|).

NOTICE
The green power switch should remain OFF (o) during operation as this is controlled by the remote ON/OFF control.

3. Turn on main power to the OneK-Optic Controller by pressing the power switch in the rear of the Temperature Control Module. The MAIN POWER button on the front of the unit will glow when the unit is on. When the OneK-Optic is enabled, the ONEK-OPTIC button on the front of the unit will also glow.
4. Turn on power to the vacuum control unit by toggling the power switch on the back of the unit ON (|).
5. Turn on power to the system control unit by toggling the power switch on the back of the unit ON (|).
6. Next, turn on the system control unit by pressing the power button on the front of the unit. This power button will glow when the unit is on.

NOTICE
The above steps for powering on the system must be followed for the OneK-Optic to establish communication with the system. If these steps are not followed and the OneK-Optic fails to establish a communication connection to the system, turn off the system control unit and then turn it back on to re-establish system communication with the OneK-Optic.

The software will initialize and run automatically. The UI will indicate the software is `INITIALIZING` while the system checks for and establishes a connection with the attached peripheral cards. After the screen shows `READY` the system is ready for operation.

5.2.2 Controlling System to 1.2K Using the OneK-Optic

The `PLATFORM` temperature channel is used to drive control operations across the Cryostation, compressor, and vacuum control unit.

Cooling Down the System

1. Ensure the OneK-Optic module is enabled and connected properly before starting the base cooldown. The system will not allow the OneK-Optic to be enabled once the cooldown begins.

2. In the UI for the CRYOSTATION instrument, navigate to the SAMPLE CHAMBER display screen and select the PLATFORM temperature channel to bring up its operation controls.
3. In the PLATFORM TARGET input box, enter the target temperature value. To reach the lowest possible base temperature, enter 0.0 K. Press SET to confirm.
4. Press the COOLDOWN command button. On the popup, confirm or adjust the custom parameters for the cooldown, then press COOLDOWN again to start.

The cooldown cycle will begin.

» NOTE
• The Stage 1 and Stage 2 temperatures will drop quicker than the platform temperature. The platform will drop faster after Stage 1 reaches 30 K. • When the platform has reached a stable temperature, the ring surrounding the platform status readouts will change from flashing to solid. • To avoid damage to the sorption cooler unit, bakeout is disabled when the OneK-Optic is installed.

Vacuum States During a Cooldown

- When a cooldown is initiated, the system will first establish a rough vacuum.
    - During this process, the system will automatically check for leaks. If a vacuum cannot be established, an error message will show in the UI and the cooldown process will be aborted. See *System Diagnostics* for troubleshooting information.
- After a proper vacuum level is established, the compressor will turn on; this may take up to 30 minutes.
- The pressure will continue to drop to a high vacuum state leveraging cryopumping.

» NOTE

- To achieve the best vacuum levels, set the cooldown target temperature to the system base temperature and allow the system to stabilize there before controlling to higher temperatures. This temperature set point is necessary to take full advantage of cryopumping.
- The VC1110 pressure gauge can only read out to ~0.1 mTorr. If pressure is below this value, the UI readout will indicate `HIGH VAC`.

Adjusting Platform Temperature

The platform temperature may be changed at any time by setting a new value using the `PLATFORM TARGET` input box for the initial base cooldown. To set platform temperature of the OneK-Optic module, use the `1K PLATFORM TARGET` input to set the target temperature when the module is enabled and running.

Warming Up the System

A warmup operation is used to bring the system to room temperature to access the sample chamber. The system may be warmed up actively with heaters at any time, including during a cooldown.

1. In the UI, navigate to the `SAMPLE CHAMBER` display screen and select the `PLATFORM` temperature channel to bring up its operation controls.
2. Press the `WARMUP` command button. On the popup, press `WARMUP` again to confirm.

An active warmup is much faster than using the `STOP` command. The heaters will automatically shut off when the entire system reaches 295 K, but the sample chamber will remain under vacuum.

Stopping a Cooldown or Warmup

At any time during a cooldown or warmup, the process can be stopped.

1. In the UI, navigate to the `SAMPLE CHAMBER` display screen and select the `PLATFORM` temperature channel to bring up its operation controls.
2. Press the `STOP` command button. On the popup, press `STOP` again to confirm.

This action will stop running the compressor/cryocooler and turn off any heater power going to the cryocooler stages and sample chamber platform. The system will begin to warm up naturally, but it will remain under a vacuum.

5.2.3 Venting and Pulling Vacuum

Vent to Access the Sample Chamber

After a cooldown and warmup cycle, the system remains under vacuum until the user is ready to access the sample chamber. To access the chamber:

1. Once at room temperature, vent the chamber. Both the OneK-Optic and base platform will need to be at room temperature before the system is able to vent.
2. In the UI, navigate to the SAMPLE CHAMBER display screen and select the PLATFORM temperature channel to bring up its operation controls.
3. Press the VENT command button. On the popup, confirm or adjust the custom parameters for the vent procedure, then press VENT again to confirm.

The sample chamber will then be vented to atmospheric conditions.

» NOTE
Choosing to “Vent Continuously” will cause nitrogen (when attached) to flow through the chamber, even after the chamber is opened. This can help to keep the vacuum space as clean as possible during quick sample exchanges. To stop the flow of nitrogen when “Vent Continuously” is used, press the STOP command.

Keep the Sample Chamber Under Vacuum

When the system is not in use, it is recommended to keep the sample chamber under a vacuum to prevent moisture and contaminants from entering the sample space. To keep the system under vacuum:

1. The OneK-Optic can be enabled or disabled for this process.
2. In the UI, navigate to the SAMPLE CHAMBER display screen and select the PLATFORM temperature channel to bring up its operation controls.
3. Press the PULL VACUUM command button. On the popup, confirm or adjust the custom vacuum parameters, then press PULL VACUUM again to start.

The sample chamber will pull vacuum until the target vacuum pressure threshold is met.

» NOTE
Since this is an independent operation without cryopumping, the system will likely only be able to achieve a rough vacuum state. To stop the vacuum pump(s), press the STOP command. The sample chamber will remain at the current vacuum level until a COOLDOWN or VENT procedure is initiated.

5.3 Moving and Storing the Module

If the OneK-Optic ever needs to be moved to a different lab or location, follow the steps below or reach out to the Montana Instruments Service team for guidance:

1. Save any important data on the system.
2. Power down the unit:
    a. Tap (press and release) the power button on the front of the system control unit -or-
    b. On the touchscreen UI, navigate to MENU > SYSTEM SETTINGS and select POWER OFF
3. Remove the helium and vacuum hoses, paying special attention to ensure the O-rings remain in place.
4. Remove the remaining cables and electrical connections.
5. Remove the OneK-Optic module.
6. Store the sorption cooler assembly in the foam-insulated Pelican case that it shipped in until ready to re-install.

If the OneK-Optic needs to be shipped for any reason, follow the remaining steps below:

1. Reverse the steps in the installation section.
2. Re-pack the system in original packaging. Sorption cooler assembly must be packed and shipped in the foam-insulated Pelican case to avoid damage during shipping.

NOTICE
• Follow all handling instructions for the individual components as outlined in the *General Hazard Information* section. • If you are uncomfortable with moving the system on your own, or if you need to order any replacement packaging, please contact an authorized service representative. • Do NOT attempt to disassemble any components of the system beyond the original state as shipped from the Montana Instruments factory.

5.4 System Diagnostics

5.4.1 Performance Issues

If a degradation in performance or other failures are experienced, check for these common issues:

Problem/Symptom	Possible Cause	Solution/Suggestion
The system is unable to reach target temperature or cooldown takes longer than expected	See *Temperature Optimization in section 5.3.1*	
The system does not meet vibration specifications on the sample stage	See *Vibration Mitigation in section 5.3.2*	
The system will not pull rough vacuum – leak check failed	Vacuum leak	See *Vacuum Check in section 5.3.3*
System condensing moisture on the sample, windows, exterior of the sample chamber, or vacuum case (black cylinder surrounding cryocooler). Exterior surfaces are cold to the touch.	Radiation (inner) and vacuum (outer) window are touching	Adjust windows so they do not touch.
Thermometer not working	Not properly installed or activated.	Make sure the temperature channel is enabled. Navigate to `MENU > INSTRUMENT SETTINGS > USER X`. Toggle the Temperature Channel Enabled switch to the right to enable. Contact Customer Service for further troubleshooting & documentation
Heater not working	Not properly installed or activated.	

5.4.2 Power and Communication Issues

If the system will not turn on, run commands, or display readouts, check for these common issues:

Problem/Symptom	Possible Cause	Solution/Suggestion
The system throws an electrical breaker	Wall power issue	1. Check the wall voltage using an AC voltmeter (digital multi-meter on the AC setting) to ensure it is in the defined ranges for each piece of equipment.
UI screen is black / does not turn on	Communication issue with system control unit	1. Make sure all cables and power cords are connected properly. See Connecting System Cables and Power section of the Installation Procedure for details. 2. Ensure the power switch on the back of the system control unit is ON (|). 3. Ensure the power button on the front panel is ON (glowing). 4. Power cycle the system control unit. Toggle the power switch on the back of the unit OFF (o) then back ON (|). 5. Press the RESET button on the back of the UI touchscreen display.
	Touchscreen is faulty	1. Contact MI Service for replacement 2. Connect the external monitor to HDMI and connect a USB mouse to control the system OR 6. Use VNC to control the system remotely
UI controls are frozen or non-responsive	Touchscreen display issue	1. Press the RESET button on the back of the UI touchscreen display.
The system does not initialize	Communication issue with the compressor	1. Make sure all cables and power cords are connected properly. See Connecting System Cables and Power section of the Installation Procedure for details.

		2. Ensure the power switch on the back of the compressor is ON (|). 3. Ensure the ENABLE switch on the front panel is ON (|). 4. Power cycle the compressor. Toggle the power switch on the back of the unit OFF (o) then back ON (|).
	Communication issue with vacuum control unit	1. Make sure all cables and power cords are connected properly. See Connecting System Cables and Power section of the Installation Procedure for details. 2. Ensure the power switch on the back of the vacuum control unit is ON (|). 3. Power cycle the vacuum control unit. Toggle the power switch on the back of the unit OFF (o) then back ON (|).
Vacuum pressure reading in UI indicates "SensorErr"		

5.4.3 Hardware Torque Specifications

Hardware in a Montana Instruments cryostat is torqued to specifications that ensure optimal and safe system operation. Over time, however, hardware can become loose, so it may be necessary for users to tighten the hardware themselves. The following tables show the torque specifications for screws used in the cryostat system, with values in in*lbs and N*m. The torque specifications are based on the material of the screw, the size of the screw, and the temperature environment the screw is present in. By following the instructions below, users can ensure their cryostats continue to operate at peak performance. For further questions or help, please contact our Customer Service team.

		Torque (in*lbs)[1]							
Application	Screw Material	M1.6	M2	M3	M4	M5	M6	M7	M8
Room Temp	Brass	0.5	1.1	3.9	9.0	18.1	30.8	51.6	74.8
	Stainless Steel	0.7	1.5	5.4	12.6	25.5	43.4	72.6	105.2
Cold, clamping aluminum	Brass	0.6	1.3	4.7	10.9	21.9	37.3	62.5	90.6
	Stainless Steel[2,3]	1.0	2.1	7.5	17.5	35.2	60.0	100.4	145.6
Cold, clamping copper	Brass	0.3	0.7	2.5	5.8	11.7	20.0	33.4	48.5
	Stainless Steel[2]	1.0	1.9	7.1	16.4	33.2	56.4	94.4	136.9

Notes:
1. Based on target of 70% of fastener yield stress (when cold) unless noted
2. Belleville washer recommended
3. Based on target of 20% of fastener yield stress

		Torque (N*m)[1]							
Application	Screw Material	M1.6	M2	M3	M4	M5	M6	M7	M8
Room Temp	Brass	0.06	0.1	0.4	1.0	2.0	3.5	5.8	8.4
	Stainless Steel	0.08	0.2	0.6	1.4	2.9	4.9	8.2	11.9
Cold, clamping aluminum	Brass	0.07	0.1	0.5	1.2	2.5	4.2	7.1	10.2
	Stainless Steel[2,3]	0.11	0.2	0.8	2.0	4.0	6.8	11.3	16.4
Cold, clamping copper	Brass	0.04	0.1	0.3	0.7	1.3	2.3	3.8	5.5
	Stainless Steel[2]	0.11	0.2	0.8	1.9	3.7	6.4	10.7	15.5

Notes:
1. Based on target of 70% of fastener yield stress (when cold) unless noted
2. Belleville washer recommended
3. Based on target of 20% of fastener yield stress

How to Torque Screws to Specification

1. Identify screw material, screw size, and temperature environment the screw is in.
2. Obtain a torque screwdriver of the appropriate size for the screw. Units in either in*lbs or N*m
3. Set the torque screwdriver value to the correct specification from the chart. NOTE: Ensure units match between chart and screwdriver to avoid damage to screws or screws being too loose.
4. Tighten the screw (clockwise) using a torque screwdriver. The screwdriver will click once the set torque value is achieved.

5.5 System Checks

There are several basic checks users can do to help diagnose general problems and help the system achieve optimal performance. Please handle these checks carefully and thoroughly, neglecting any one of these may have an impact on the base temperature or vibration performance.

5.5.1 Temperature Optimization

Cryostation platforms are optimized to control heat loads reaching the sample. To ensure the lowest possible base temperatures, follow the best practices below.

1. Use proper thermal lagging techniques for any wiring (including coax) entering the sample space. Ensure thermal clamps are properly tightened. See section 3.5.2 for details.
2. Avoid “touches” between the various stages (such as a platform component touching a Stage 2 component, or a Stage 2 component touching a Stage 1 component), as these become conductive paths for heat transfer.
    a. Ensure wiring or cabling does not contact the inside of the radiation shield.
    b. Ensure the radiation shield or radiation windows do not contact any part of the outer vacuum housing or windows.
3. Always use the appropriate wire material and gauge for the application. See section 3.5 for details.
    a. Avoid using copper wire unless required. The electrical conductivity of phosphor bronze is typically sufficient for most applications.
4. Ensure the screws holding the platform to the support base and the screws securing the radiation shield are in place and tightened (5 in-lb.). Failure to tighten the screws will reduce the ability of the system to pull heat from the sample platform and may increase vibrations.
5. Ensure a thin layer of N-grease or another thermal grease is used between metal-to-metal interfaces for proper thermal connection.
6. Use inner “cold” windows or blanks on the radiation shield whenever possible. Without them, the added heat load can significantly increase the base temperature of the platform.
7. Check the helium charge pressure. If there is a helium leak, cooling performance will be hindered significantly. See *Helium Check in section 5.3.4* for details.
8. Ensure the User temperature channel heater is NOT on.

» NOTE

During a cooldown, the system will steadily ramp down in temperature to 4.2 K, then can take longer to reach and stabilize at the base temperature. Options and energy inputs (laser power) may impact cooldown times and cause slightly higher base temperatures. Additional time to cooldown and stabilize OneK-Optic at 1.2K.

Identifying Heat Loads

The expected temperatures and temperature differences between Stage 1, Stage 2, Platform, and Sample under various operating conditions can be used to identify the source of an unwanted heat load. The temperatures below are examples to illustrate the troubleshooting process and should only be used as a general reference. **It is recommended to compare with actual data from a previously successful cooldown on your system as a more accurate reference guide.**

The base temperature for a standard CryoAdvance system under normal operating conditions is depicted below. The gradient between the platform and sample will change depending on the type of sample mount and other options.

	Stage 1	Stage 2	Platform	Sample
Temperature	27 – 28 K	2.4 – 2.7 K	2.7 – 3.0 K	2.8 – 3.2 K
Temperature Gradient			+0.2 – 0.4 K	+0.2 – 0.5K

Heat Load Between Stage 1 and Stage 2

In the example below, Stage 2 has a higher-than-normal temperature, as does the Platform and Sample. However, Stage 1 is colder than normal. The temperature gradient between Stage 2 and the Platform and the Platform and the Sample is normal. This indicates that the heat load is located between Stage 1 and Stage 2.

	Stage 1	Stage 2	Platform	Sample
Temperature	26 K	5.0 K	5.3 K	5.7 K
Temperature Gradient			+0.3 K	+0.4 K

Possible Cause: Crosslink rod touching the sidewall. Contact an authorized service representative for instructions to perform a touch test.

Heat Load Between Platform and Sample

In the example below, the Stage 2, Platform, and Sample temperatures are high. However, the most critical issue is the large temperature gradient between the Platform and Sample. The

heat load is most likely located in between the Platform and Sample, and since the Sample temperature is high, the temperatures of the Platform and Stage 2 are also being pulled up.

	Stage 1	Stage 2	Platform	Sample
Temperature	28 K	3.0 K	3.3 K	5.0 K
Temperature Gradient			+0.3 K	+1.7 K

Possible Causes: The most likely culprits are those described in the *Temperature Optimization in section 5.3.1*, such as wires touching the radiation shield, wires touching the sample mount directly after the thermal clamp, use of improper wires, loose screws, missing N-grease, or missing radiation windows.

Heat Load Between Stage 2 and Platform

In rare cases, a higher-than-normal gradient may exist between Stage 2 and the Platform. This is typically caused by loose screws underneath the platform, which should not be accessed by users. If this heat load is present, contact an authorized service representative.

Heat Load on Sample Thermometer

If the sample is reading higher than normal, but all other temperatures are in a normal range, the most likely cause is an improperly mounted or lagged sample thermometer. Refer to ***Error! Reference source not found.*** *in section 3.3*.

5.5.2 Vibration Mitigation

The Cryostation and sample chamber have several vibration-damping design features to reduce the effects of cryocooler mechanical vibrations on the sample platform. To ensure the lowest possible mechanical vibrations, follow the best practices below.

1. Rigidly bolt the system to the optical table using all available mounting locations in the baseplate.
    a. Bolts should be tightened sequentially, starting from one end of the Cryostation and progressing toward the other end.
        i. e.g. start at the sample chamber and move toward the back panel
2. Ensure all screws inside the sample space are tightened down.
3. Ensure that the red shipping rings and spacers beneath the shipping rings have been removed. The red shipping supports at the back of the Cryostation should be locked in the upper position off the tri-flange. See *Removing the Shipping Supports* section of the CryoAdvance Installation Procedure for details. Having any of these components installed can introduce vibrations on the order of several microns.

4. Ensure the helium hoses are not touching the cabling or the optical table. They should also not be pressed against a wall or another surface. There should be a gentle 180° bend in the hoses to avoid any lateral tugging on the Cryostation as helium runs through them.
5. Ensure the vacuum hose is not in contact with anything moving, as this hose is somewhat springy.
6. Vibrational performance may vary depending on the operating speed of the compressor/cryocooler. Vibrations are minimized when using a variable speed compressor running at 22 Hz/50 Hz, which is automatically used during stable conditions at platform temperatures <20 K.
7. Ensure that optics are rigidly mounted to the table. Optics could be vibrating due to the Cryostation on the table and mounting them should be carefully considered to reduce this effect.
8. Check temperature performance. An increase in Stage2 temperature and a decrease in Stage1 temperature could indicate a crosslink rod touch that could inherently degrade vibrational performance.
9. The OneK-Optic can easily become a source of vibrations if not installed correctly. Ensure all screws are tightened in the assembly.

5.5.3 Vacuum Check

The UI displays a pressure reading for the attached vacuum gauge sensor. If a system leak check fails, or if condensation or freezing is observed on or inside the chamber, a leak may be present. Please check the following:

1. Check to ensure the vacuum gauge properly reads atmospheric pressure (~500-770 Torr) when the system is at room temperature and vented. If it is not, the gauge may not be working properly.
2. Check that the vacuum housing and lid are in place and properly seated. Ensure no wires are pinched between the O-rings.
3. Check the O-rings on 1) the sample chamber vacuum housing 2) the vacuum housing lid and 3) the vacuum housing outer “warm” windows. Ensure the O-rings have a thin layer of L-grease and are completely free of debris or fibers.
    a. All side panels also have an O-ring interface. Do NOT remove the side panels before consulting with an authorized service representative.

4. Although nitrogen is optional, it helps keep the charcoal adsorbers clean and the inside of the Cryostation free from moisture. Using nitrogen is particularly important in humid environments.
    a. Nitrogen purge cycles, as well as a platform bakeout, will help rid the chamber of contaminants before cooldown.
5. If a leak detector is accessible, use it to leak check the sample housing, Cryostation, vacuum hose, vacuum connections to find the source of the leak.

If the leak persists, please contact an authorized service representative.

There is enough charcoal in the system to freeze particles that may be introduced from a small leak. If there has been a large leak, or if a small leak persists over a period of time, the charcoal adsorbers will need to be recharged. To do this, run a `COOLDOWN` or `PULL VACUUM` operation with `PLATFORM BAKEOUT` (350 K for 60+ mins) and `DRY NITROGEN PURGE` (3+ times) enabled.

5.5.4 Helium Check

The helium pressure in the system can be checked when the compressor is idle.

1. Warm the system to room temperature and leave idle for at least one hour. Do not start a cooldown.
2. Ensure the power on the back of the unit is ON (|) and the `ENABLE` switch on the front panel is ON (|).
3. In the UI, navigate to the `OVERVIEW` display screen, then press the `CRYOCOOLER` reading to show compressor details.
    a. Or, on the front panel of the compressor, toggle the `DISPLAY` button until it shows the supply and return values.
4. The values should be between 1.55 – 1.80 MPa (target 1.78 MPa) on both the supply and return. If the supply or return values are <1.55 MPa, helium will need to be recharged. See *Helium Recharge Process in section 5.3.4* for details.

Helium Hose Fittings

Improper connection or missing O-rings on the helium hose fittings can cause a loss in helium pressure and hinder the cooling performance.

To inspect fittings on the back of the compressor and Cryostation:

- Ensure the fittings are not cross-threaded.

- Ensure there is a **single** O-ring at each end of the hose and each connection point. The O-rings tend to dislodge from the hose and stay on the fitting (or vice versa).
    - If this happens, the errant O-ring must be carefully removed and replaced in the correct location before reconnecting, otherwise it will not seat properly.

Hose with extra O-ring

Extra O-ring removed

Left: Fitting missing O-ring
Right: proper O-ring fitment

Helium Recharge Process

If the helium pressure is low (below 1.55 – 1.80 MPa), it should be recharged using a 99.999% (UHP) tank of pressurized helium. The accessory kit comes equipped with vent and recharge valves that can be used to flush the system and recharge. Contact an authorized service representative for instructions on this process, or find the service document "CryoAdvance B-01 Compressor Recharge Procedure" on the appropriate product page on the Montana Instruments website.

NOTICE
Follow instructions carefully To avoid possible contamination, these instructions must be followed carefully.

⚠ **CAUTION**
Ear protection recommended Venting the helium lines typically creates a loud noise as pressure is released. Be prepared for venting noises when attaching the purge adapter to the helium lines.

Section 6 - Appendices

6.1 Related Documentation

For a copy of associated documentation, see below:

Document Title	Location
System Documentation	OneK-Optic
General Terms and Conditions of Sale	Direct Link to latest PDF Or find the link at the bottom of our homepage
Limited Warranty Agreement	https://www.montanainstruments.com/support/warranty-information
End-User License Agreement	Direct link to latest PDF
Patent Information	https://www.montanainstruments.com/patents

Bay Area Compliance Laboratories Corp.
1274 Anvilwood Ave., Sunnyvale, CA 94089, USA
Phone: (408) 732-9162, Fax: (408) 732-9164
www.baclcorp.com

ATTESTATION OF TEST RESULTS

Date of Issue: 2025-03-27 Attestation Number: R2502251

Bay Area Compliance Laboratories Corp. (BACL) hereby declares that testing has been completed and is compliant for the product and standards below:

Product Name / Description:	Add-On Module for CryoAdvance-100 cryostat
Model:	OneK-Optic
Manufactured by:	Montana Instruments
Project Number:	R2502251

Standard	**Test Result**
EN 61326-1:2013 IEC 61326-1:2020 BS EN IEC 61326-1:2021	Compliant

BACL tested the above equipment in accordance with the requirement with the above Standards. The results were being documented in Test Report #R2502251-17 listed in above table apply only to the tested sample under the condition and modes of operation as described herein.

Attestation by: Steven Lianto
EMC & RF Lead

Signature

2025-03-27
Date