Quantum Design

Magnetic Property Measurement System

MPMS 3 Oven Option User's Manual

Part Number 1505-200, A2

Quantum Design
10307 Pacific Center Court
San Diego, CA 92121
USA
Technical support (858) 481-4400
(800) 289-6996
Fax (858) 481-7410

Third edition of manual completed August 2016.

Trademarks

C O N T E N T S

Table of Contents

APPENDIX A

APPENDIX B

APPENDIX C

Figures

Tables

P R E F A C E

Contents and Conventions

P.1 Overview

In this chapter we describe the scope of the manual, the conventions used and most importantly the safety guidelines. Since the SQUID VSM oven option is a component in a system that uses cryogens and high power components, we strongly recommend being aware of all hazards in order to prevent injuries and system damage.

P.2 Scope of the Manual

This manual explains how to use the SVSM Oven option hardware and software and how to perform basic system maintenance and troubleshooting.

P.3 Contents of the Manual

File menu	Bold text identifies the names of menus, dialogs, options, buttons, and panels used in the MPMS 3 VSM MultiVu software.
File >> Open	The > symbol indicates that you select multiple, nested software options.
`.dat`	The Courier font indicates file, directory names, and computer code.
Important	Text is set off in this manner to signal essential information that is directly related to the completion of a task.
Note	Text is set off in this manner to signal supplementary information about the current task; the information may primarily apply in special circumstances.

The Following are an examples of something that you might see in a Quantum Design Manual.

This symbol signals specific caution or conditions that could result in system damage, bodily harm, or loss of life.

This symbols signals electrical hazards that could result in bodily harm or loss of life. Used at all accessible 200-240 V power outlets.

This symbol signals **cryogenic hazards** that could result in bodily harm and loss of life. Used wherever accessible parts could reach temperatures below 0°C (32°F).

This symbol signals **hot surface hazards** that could result in bodily harm and loss of life. Used wherever accessible parts could reach temperatures above 60°C (140°F).

This symbol signals information on **fusing**.

P.4 Safety Guidelines and Regulatory Information

Before using this product, please read the entire content of this User's Manual and observe all instructions, warnings and cautions. These are provided to help you understand how to safely and properly use the SQUID VSM and its options and how to reach its best performance.

Quantum Design Inc. disclaims any liability for damage to the system or injury resulting from misuse or improper operation of the system. Please contact your Quantum Design representative for any service issues.

This product is NOT operator-serviceable.
Observe the following safety guidelines when you use your system:

- In case of emergency, switch the power off at the rear of the main cabinet or unplug the main power cords from the laboratory power outlet.
- To prevent electrical shock, unplug the system before you install it, adjust it, or service it.

- For continued protection against fire hazard, electric shock and irreversible system damage, replace fuses only with same type and rating of fuses for selected line voltage. Information about user-accessible fuses and their replacement is summarized in Appendix A.3.9 of your SVSM System User's manual.

- Direct contact with cryogenic liquids, materials recently removed from cryogenic liquids, or exposure to the boil-off gas can freeze skin or eyes almost instantly, causing serious injuries similar to frostbite or burns. Wear protective gear, including clothing, insulated gloves, and eye protection, when you handle cryogenic liquids.

- Transfer cryogenic liquids only in areas that have adequate ventilation and a supply of fresh air. Nitrogen and helium gas can displace the oxygen in a confined space or room, resulting in asphyxiation, dizziness, unconsciousness, or death.

- Keep this system away from radiators and heat sources. Provide adequate ventilation to allow for cooling around the cabinet and pump console. The distance between the system and wall should be at least 30 cm. (12 inches) in each direction. Do not obstruct the ventilation openings on the top of the cabinet.

- Do not obstruct the ventilation outlet located on the left side of the pump console and air intake at the rear. The clearance around the pump console should be at least 20 cm. (8 inches) in each direction.

- Do not obstruct or pinch the pump exhaust line located at the rear of the pump console.

- Refer to the manuals for the pump and monitor for additional safety warnings and notices.

C H A P T E R 1

Oven Option Hardware

1.1 Introduction

This chapter contains the following information:

- Section 1.2 presents an overview of the operation of the oven option.
- Section 1.3 discusses the oven hardware.
- Section 1.4 describes the sample mounting and loading.

1.2 Option Overview

The Quantum Design MPMS 3 Oven option provides a way to make sensitive magnetometry measurements at controlled temperatures from 300 K up to 1,000 K. A heated sample holder allows reaching this temperature range while oscillating the sample inside the detection coils to perform SQUID-VSM measurements. The MPMS 3 Oven option includes a turbo pump for generating vacuum in the sample chamber to allow high temperatures without causing additional helium boil-off.

The key element of this option is the MPMS 3 oven sample holder, referred to as the *heater stick*. Heating of the sample is achieved by applying current to a resistive heating element, which is lithographically patterned onto the custom-designed sample holder. A thermocouple embedded on the back side of the sample holder measures the temperature in the sample region, and a thermistor at the top connector of the sample holder corrects for heating of the cold junction. To maximize thermal contact, the sample is attached to the heater stick using alumina-based cement. To retain heat and reduce thermal gradients between the sample and heater stick, the platinum heater region is wrapped securely with a thin copper-foil radiation shield.

In Chapter 1, we describe the option hardware as well sample mounting techniques. In Chapter 2, we describe the Oven specific MultiVu user interface.

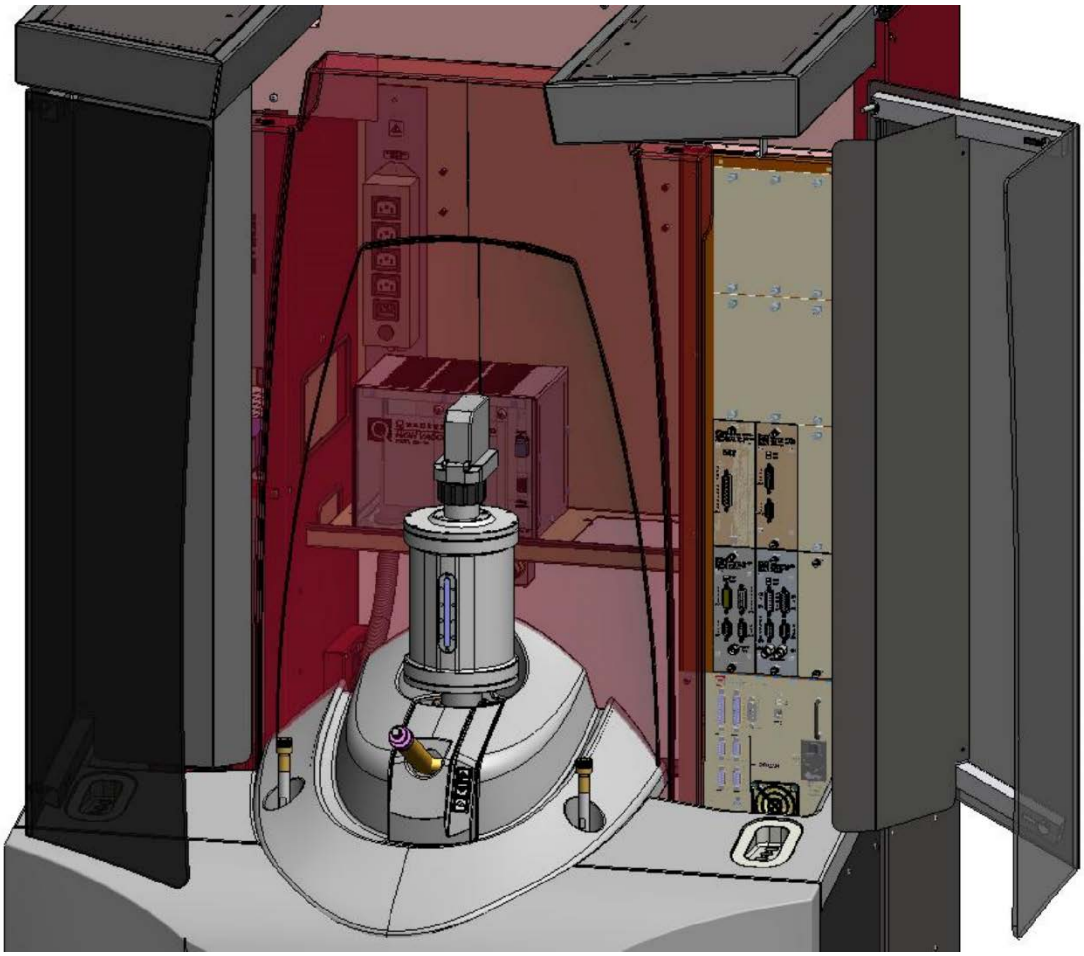


Figure 1-1. MPMS 3 VSM system installed with MPMS 3 Oven Option

1.2.1 Differences between an Oven and a Standard System

The MPMS 3 Oven option is designed to seamlessly integrate into the normal operation of the MPMS 3 system. A dedicated CAN module, the VSM Oven module (Model CM-C) handles the temperature control of the MPMS 3 Oven heater stick. This module plugs into one of the empty bays of the MPMS 3 module tower. The oven-control cable plugs into the front panel of the oven control module. This cable passes heater power and temperature read back information to the heater stick via the electrical feed through on the wired access port and the wired oven sample rod (see Figure 1-2).

In contrast to the standard setup, the oven option requires vacuum in the sample chamber to minimize the heating power required at the sample location and the helium boil-off. The vacuum is obtained by the HiVac Unit, which is installed in the cabinet. It houses a turbo pump, which evacuates the sample chamber to pressures below of what the normal sample chamber pump can achieve.

The following block diagram provides an overview of the MPMS 3 Oven Option hardware, which is described in more detail in section 1.3.

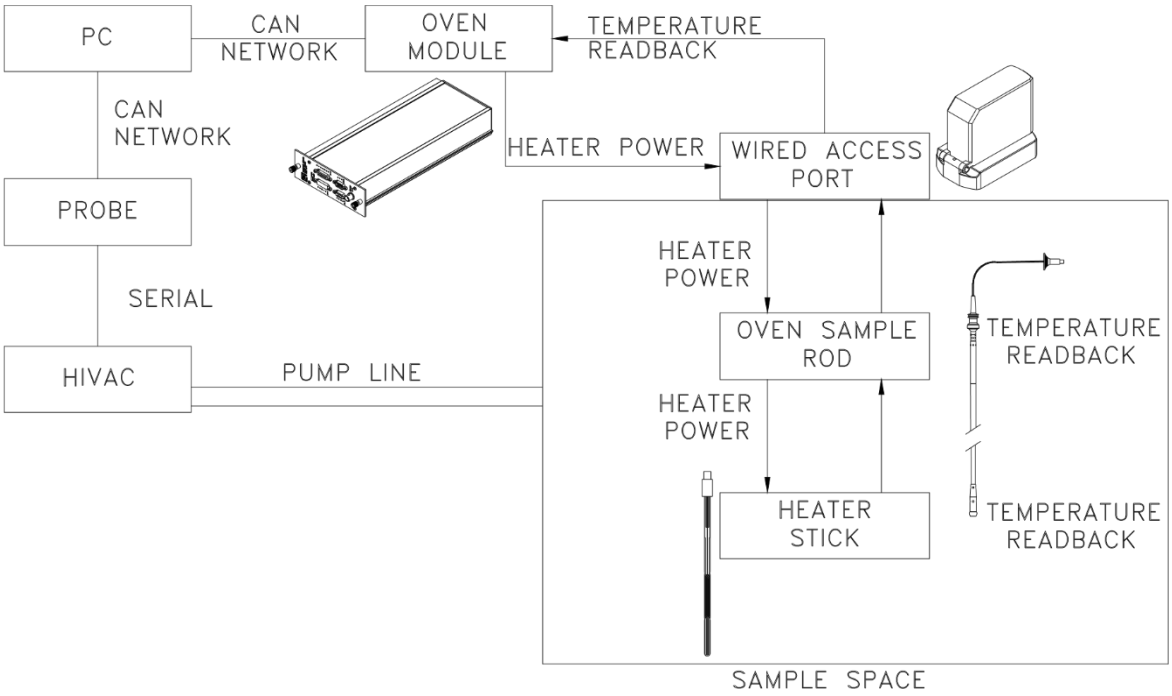


Figure 1-2. MPMS 3 Oven Option Block Diagram

1.2.2 Theory of Operation

The heater is driven synchronously to the peer sync frequency generated by the vibration of the sample by the VSM motor with a sinusoidal excitation that is four times the peer sync value. Magnetic crosstalk from the heater currents into the detection coils is minimized by patterning the heater non-inductively and by operating at 4f, where the MPMS 3 detection circuitry can easily reject the signal. The thermocouple voltage is monitored constantly by a sensitive low-drift DC microvolt preamp in the Oven module. The thermocouple junction is located in the middle of the heater region of the stick, and the thermocouple wires terminate at the connector at the top of the stick. Note that the thermocouple table is referenced to a cold junction at 273 K (0 ºC). Also located at the connector is a negative temperature coefficient thermistor that corrects for the thermocouple cold junction temperature. The thermistor is read at 2f using 2 ms current pulse.

The temperature at the sample T_{sample} is calculated from the thermocouple voltage ΔV_{TC} and thermistor resistance $R_{thermistor}$ as follows:

$$T_{sample} = T(\Delta V_{TC} + \Delta V(T(R_{thermistor})))$$

Where

$T(R_{thermistor})$	*standard table for temperature vs. thermistor resistance,*
$\Delta V(T)$	*standard table for type S thermocouple voltage vs. temperature standard,*
$T(\Delta V)$	*inversion of the $\Delta V(T)$ thermocouple table.*

In order to enable temperature control down to 300 K at the heater stick, the MPMS 3 sample chamber is set to 280 K while the system operates in Oven mode.

Figure 1-3 shows a simplified schematic of the control circuit for the heater stick. “PID” refers to the Proportional-Integrator-Differential temperature control of the A.C. drive for the heater.

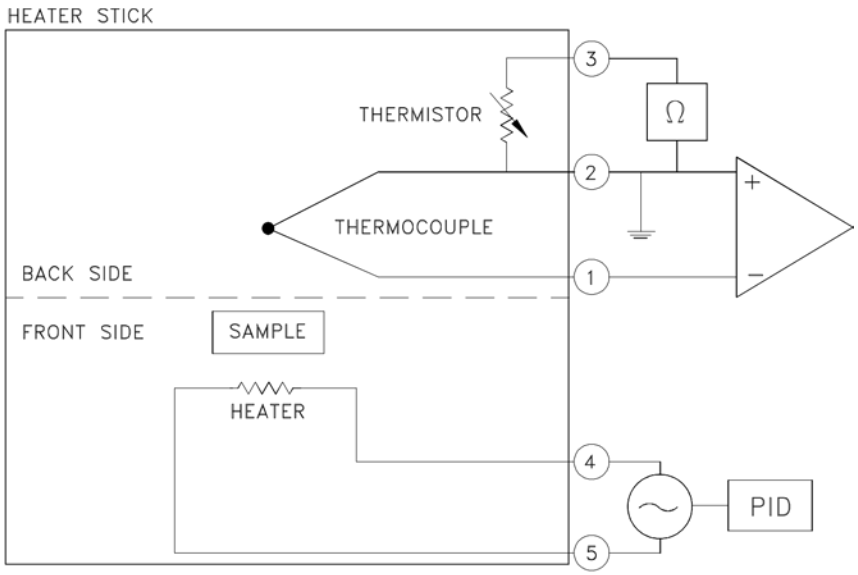


Figure 1-3. Control circuit for the Oven heater stick

1.3 Option Hardware Description

In the following section we describe each option hardware component.

1.3.1 Oven Heater Stick

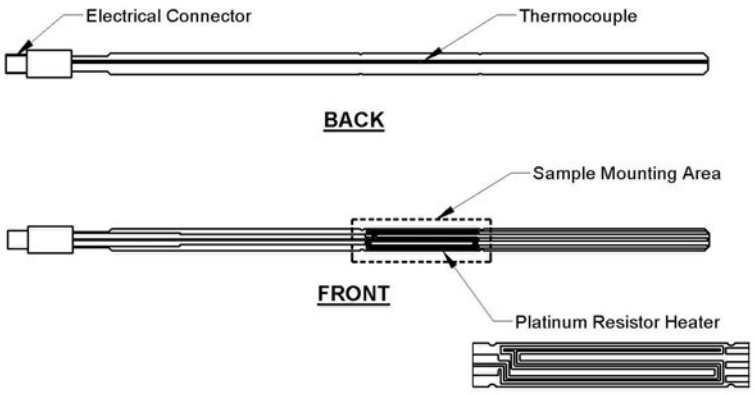


Figure 1-4. Back and front views of the MPMS 3 Oven heater stick.

The oven heater stick and its parts are illustrated in Figure 1-4. It can be seen that the heater stick is a combination device that contains the heater, thermometer, and sample holder for the oven option. Samples will be mounted directly on the heater stick, using the alumina cement included in the Oven Option User's Kit (Figure 1-11).

The heater stick is a long thin sheet of ceramic that has been silk-screened with a metallic meander pattern and then coated with a thin layer of hard glass encapsulant. The conductor acts as the heating element of the oven option. Samples are mounted directly on top of the heater meander in the indicated sample-mounting area.

The back of the heater stick has the temperature-detection system of the oven option. Inlaid in two grooves in the heater stick is a type S (platinum vs. platinum–10% rhodium) thermocouple. The thermocouple junction is located directly opposite the middle of the meander. This thermocouple provides a very precise measure of the sample temperature and it is rated for temperatures over 1,000 K.

A thermistor is embedded at the top of the heater stick, inside the protective connector housing. The function of this thermistor is to correct the cold junction temperature of the thermocouple, because the thermocouple table is referenced to a cold junction at 0 ºC.

At the top of the heater stick is the five-pin male electrical connector (Figure 1-4) that provides power for the heater and has voltage leads for the thermocouple and the thermistor. The heater stick connector plugs directly into the base of the Oven sample rod shown in Figure 1-5.

The MPMS 3 oven heater stick is a lightweight heated substrate on which the sample is glued. This design is in contrast to that of other high-temperature oven inserts for magnetometers, which often are bulky and have long thermalization times. By embedding the thermometry in the substrate along with the heater, we have made vast improvements on typical thermal-response times. Due to the low thermal mass of the heated substrate, it is possible to maintain heating rates at the sample of over +200 K/min throughout the full temperature range of the oven. Note that the cooling rate will depend on the current temperature of the heater stick, because cooling occurs through thermal radiation from the heater stick to the sample chamber walls.

1.3.2 Oven Sample Rod

The MPMS 3 Oven sample rod is specifically designed for the MPMS 3 Oven option—it is not compatible with the standard MPMS 3 option as the system will not be able to reach low temperatures with the Oven sample rod. The primary changes were introduced to accommodate and protect the necessary electrical connections to the oven heater stick.

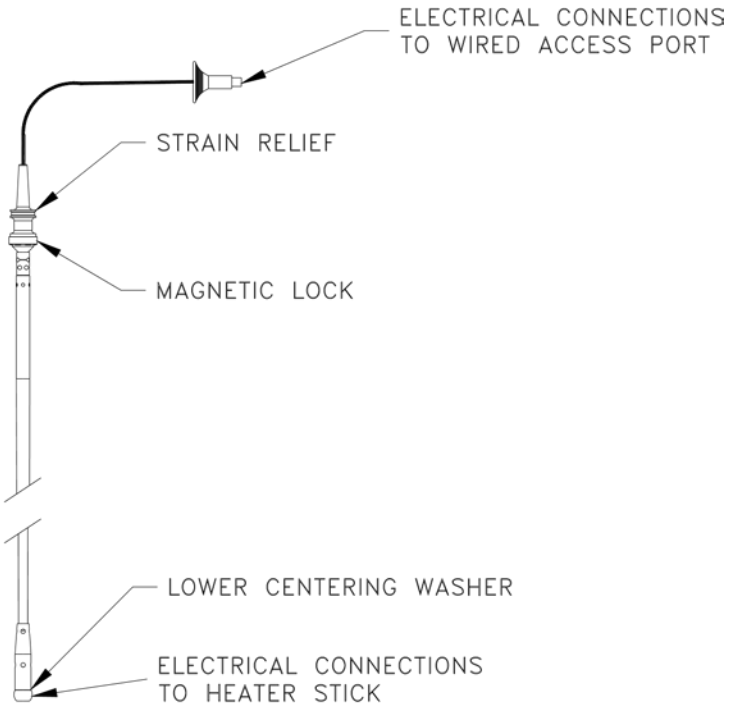


Figure 1-5. MPMS 3 Oven Sample Rod

Figure 1-5 shows the oven sample rod in the vertical position (with the magnetic lock and strain relief at the top of the rod). Beginning at the top of the figure, the oven sample rod consists of the following components:

- **ELECTRICAL CONNECTIONS (TOP)**

  The top electrical connector plugs into the feedthrough on the inside of the wired access port. It has a five-pin male connector identical to the heater connector and an anodized aluminum rim that helps you safely grip the connector when you plug it in and remove it.

  Important: Always handle the oven sample rod and its connectors by using the anodized aluminum rim of the electrical connector or the strain relief portion of the oven sample rod. *Never* pull on the cable while unplugging it, as you might damage the electrical connections.

- **Strain Relief**

  The strain relief portion of the oven sample rod is made of white Delrin plastic. When you install the sample rod, grip it by the strain relief portion.

  This portion of the rod is designed to prevent damage to the wiring as it is fed into the shaft of the oven sample rod. It also protects the wiring while the oven sample rod undergoes vibration.

  Important: Always grip the strain relief portion of the oven sample rod when you insert or remove the rod from the sample chamber. *Never* grip the cable of the oven sample rod while you remove it, as you might pull the electrical connections loose.

- **MAGNETIC LOCK**

  The magnetic lock is constructed of anodized aluminum. The lock contains six small, very strong magnets that attach the oven sample rod to the armature of the linear motor transport during measurement. Keep the magnets clean and prevent them from contacting any magnetic object.

- **CENTERING WASHER**

  The centering washer is made of a special self-lubricating plastic material. This washer slides through the sample tube and is precisely fitted to prevent rattling. The centering washer is integrated into the shaft and is designed to be low friction and to have a long lifetime, so long as it is kept clean and smooth. This washer is also designed to accommodate the electrical connections on the oven heater stick and to hold the heater stick in place.

- **Electrical Connections (Bottom)**

  This electrical connector is the bottom of the wiring that feeds through the oven sample rod. It connects to the oven heater stick and contains a five-pin female connector.

1.3.3 Wired Access Port

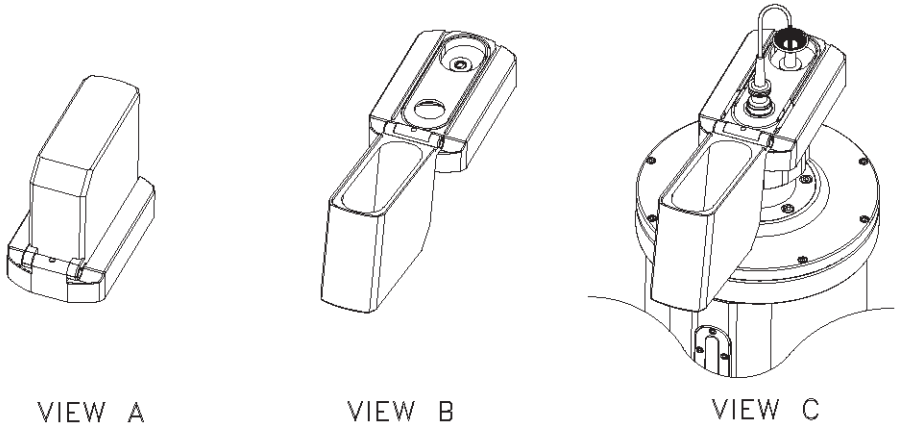


Figure 1-6. Wired Access Port

Figure 1-6 shows the wired access port that connects to the VSM linear motor transport. The access port is made of anodized aluminum and is designed to be vacuum tight. The oven sample rod is connected to the oven-control cable by an electrical connector at the back of the access port (5-pin connector on the inside of the port). This connector is specially designed: it maintains its vacuum seal and it is free to rotate. Hence, you can connect it to the oven sample rod without twisting the wiring of the rod.

In the front of the wired access port is the flange attachment port. This section of the access port has a hole that allows the oven sample rod to slide through and establish a magnetic lock with the VSM linear motor transport. This port screws onto the top of the VSM linear motor transport and locking nut (Figure 1-7) and forms a vacuum-tight seal.

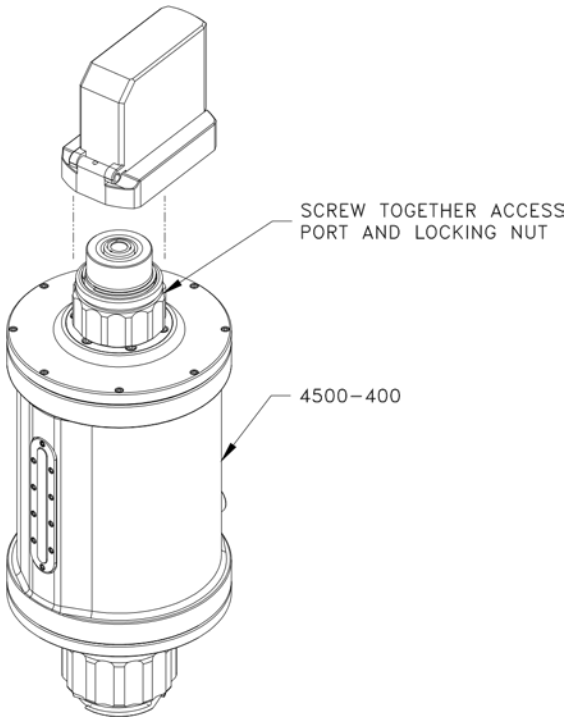


Figure 1-7. Attaching the wired access port to the VSM linear motor transport

1.3.4 VSM Oven Module (Model CM-C)

Figure 1-8 and Figure 1-9 show the front and back of the Model CM-C VSM Oven module, which provides the heater with current and reads back temperature information from the heater stick. The oven module also handles all the temperature control for the VSM Oven option. All configuration and control of this module is through the VSM application software on the computer via the CAN-bus connector on the back panel of the module.

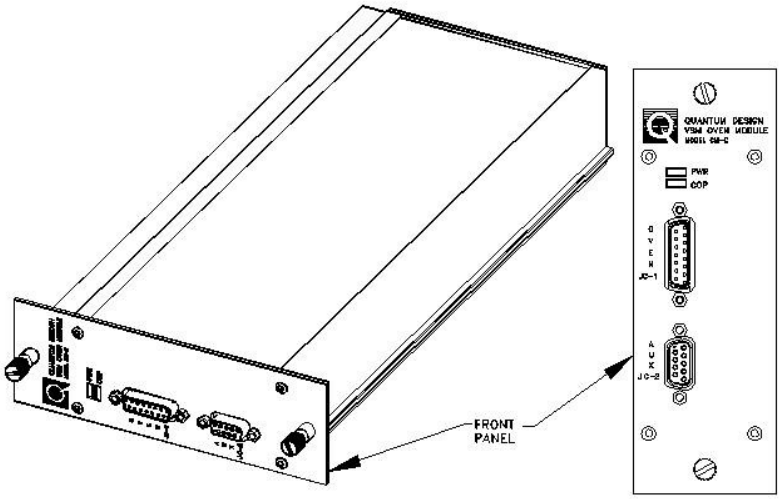


Figure 1-8. Front panel of the Model CM-C VSM Oven module

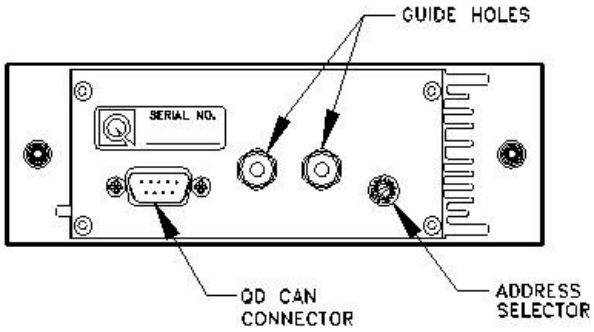


Figure 1-9. Back Panel of the Model CM-C VSM Oven module

1.3.5 The High Vacuum Unit (Model EM-QM)

The Oven Option requires a vacuum of about 50 mTorr in the sample space to reach high temperatures while minimizing helium boil-off and sample heater power. The Option comes with a High Vacuum Unit (Figure 1-10), called HiVac, which is installed inside the MPMS 3 cabinet (Figure 1-1). Its main component is a compact turbo drag pump, which is backed by the main system pump and which is directly connected to the sample space.

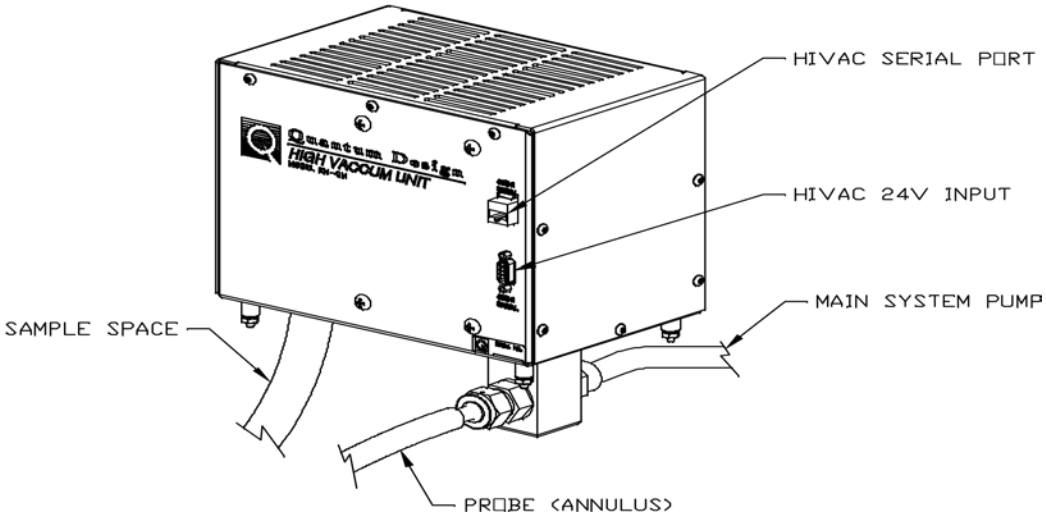


Figure 1-10. High Vacuum Unit (Model EM-QM)

The HiVac unit is powered with 24V DC from the Module Tower and controlled via RS485 by the Gas Handling Module located on the topplate of the probe. The operation of the HiVac unit is fully automated and integrated into the system software and does not require any specific intervention by the user.

1.3.6 MPMS 3 Oven Option User's Kit

The VSM Oven Option User's Kit (4505-150) contains miscellaneous hardware and supplies that you will use to mount samples (see section 1.4). The portable toolbox is a convenient way to organize these items, which are listed below.

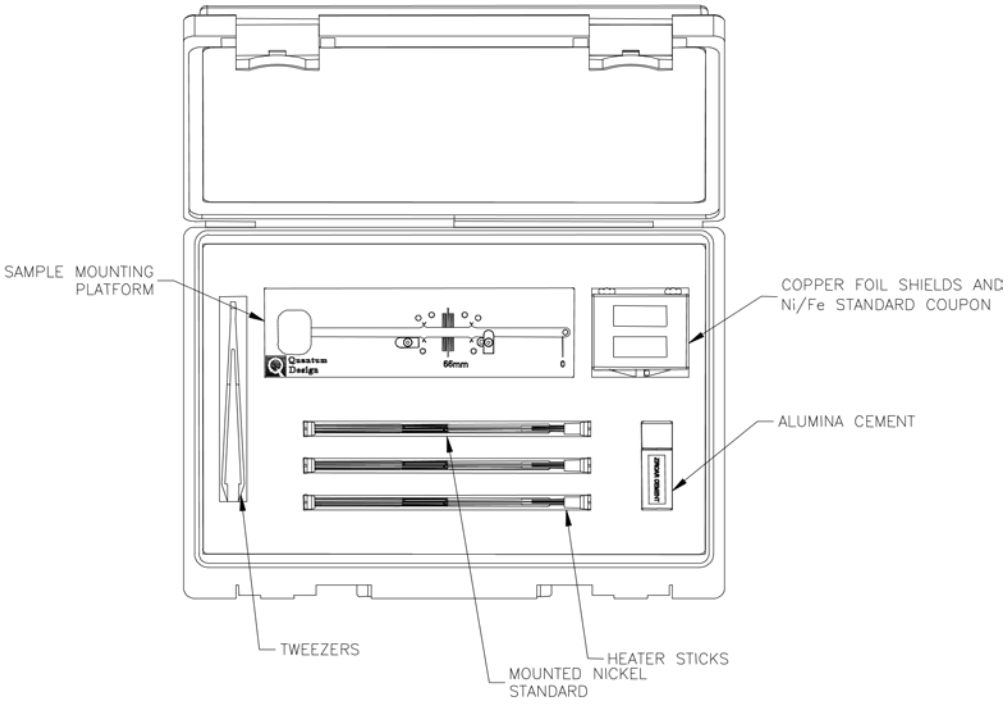


Figure 1-11. VSM Oven Option User's Kit

- **Sample-Mounting Platform**

  The sample-mounting platform is used to mount a sample on an oven heater stick and to properly position the copper shields around the sample-mounting area. Section 1-4 and Figure 1-13 provide more information about mounting samples

- **Copper-Foil Shields**

  The shields are annealed 0.001” slips of high-purity copper foil. You will wrap a shield around the sample and sample-mounting area of a heater stick to provide radiation shielding and thermal homogeneity over the sample. Refer to Section 1-4 for more information about how the shields are used.

- **Tweezers**

  A pair of Delrin tweezers is included for your use in the sample-mounting process.

- **Alumina Cement**

  The water-based alumina cement provides good thermal contact between the sample and heater stick. It also holds the sample firmly in place during vibration.

- **Heater Sticks**

  These heater sticks are used as the heater, thermometer system, and sample holder of the VSM Oven option. The heater stick plugs into the bottom of the oven sample rod. Sections 1.3.1 and Figure 1-4 provides more information about the heater sticks.

- **Mounted Nickel (Ni/Fe) Standard**

  The "mounted nickel standard" is an oven heater stick mounted with a small chip of pure nickel and pure iron. You can verify the temperature calibration of your VSM Oven option by measuring the Curie temperature (T_c = 627 K) of the nickel chip.

- **Unmounted Nickel (Ni/Fe) Standard**

  The "unmounted nickel standard" is a copper coupon with a small chip of pure nickel and iron inside. This is primarily used in learning how to mount samples to the VSM oven sample sticks. It is possible verify the temperature calibration of your VSM Oven option by measuring the Curie temperature (T_c = 627 K) of the nickel chip.

1.4 Sample Mounting and Loading

1.4.1 Sample Properties

Size and Shape

The sample should be no wider than 5 mm (0.196 in). The ideal sample geometry is a thin plate that can be glued flat to the heater stick, thus allowing optimal thermal contact to the heater. When you intend to measure physically large samples (generally larger than about 5 x 5 mm), refer to Section 4.2.1 in the *MPMS SQUID-VSM User's Manual* for information about the effect on accuracy of the reported moment.

Composition

Solid plates and thin films are ideal for use in the MPMS 3 Oven. The sample must tolerate being bonded to the heater stick with a high-temperature adhesive. We provide a vial of alumina-based cement in the MPMS 3 Oven Option User's Kit (Figure 1-11). The sample also must be strong enough to remain intact when it is chipped off the heater stick after it has been measured

1.4.2 Sample Mounting Platform

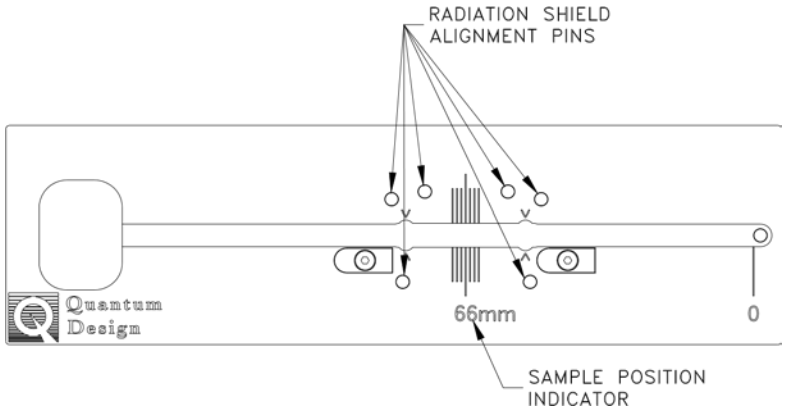


Figure 1-12. MPMS 3 Oven sample mounting platform

Shown in Figure 1-12 is the oven sample-mounting platform. This platform was designed specifically for use with MPMS 3 Oven heater sticks. The heater sticks are mounted in the center groove down the long axis of the platform, with the bottom of the stick aligned at the marker labeled “0”.

The heater stick locks are used to hold the heater stick firmly in place so that it does not slip out of position while you mount a sample. After you have positioned the heater stick properly, rotate the locks into place. The locks also prevent the heater stick from bowing upward when you place a copper-foil radiation shield beneath it and hold the heater stick stable while you wrap the radiation shield around the stick.

The radiation-shield alignment pins are designed to fit the copper-foil radiation shields. The pins function to properly position and hold the shields in place on the heater stick while you mount a sample.

The sample-position indicator is used to determine the sample offset of the material you have just mounted on the heater stick. This is useful if the moment of your sample is very low and the VSM centering algorithm cannot locate the position of the sample. This sample-position indicator can give you a precise measurement of the sample offset that you can enter into the **MPMS 3 Install/Remove Sample Wizard**.

1.4.3 Copper-Foil Radiation Shields

The copper-foil radiation shields are 0.001” thick slips of vacuum-annealed high-purity copper that has been specially selected to be free of magnetic impurities. Wrap a radiation shield around the sample-mounting area of a heater stick after mounting a sample.

The copper-foil radiation shields have a two-fold purpose. First, the high thermal conductivity of copper makes it an ideal medium for maintaining a thermally homogeneous region over the sample-mounting area.
Important: Tightly wrap the copper-foil radiation shield around the sample and heater stick—physical contact between the copper-foil shield and the sample-mounting area is important to maintaining thermal homogeneity.

The second function of the copper-foil radiation shields is to thermally isolate the heater stick and sample from the sample chamber walls. The copper foil has very low emissivity, which prevents excessive heat loss to the environment through radiation and allows the VSM Oven option to achieve a temperature of 1,000 K.

Important: The exterior of the copper-foil radiation shields must be shiny, clean, and untarnished. Copper oxide and other materials on the outer surface of the shield can raise its emissivity, preventing the MPMS 3 Oven option from achieving temperature stability or reaching 1,000 K.

1.4.4 Sample Mounting

Mount your samples on the heater stick (Figure 1-4) by using the steps below. The procedures are shown graphically in Figure 1-13.

C A U T I O N !

Handle the heater stick by the front side, which has the grey metal film patterns. Avoid touching the back side of the heater stick where the small thermocouple wires are embedded.

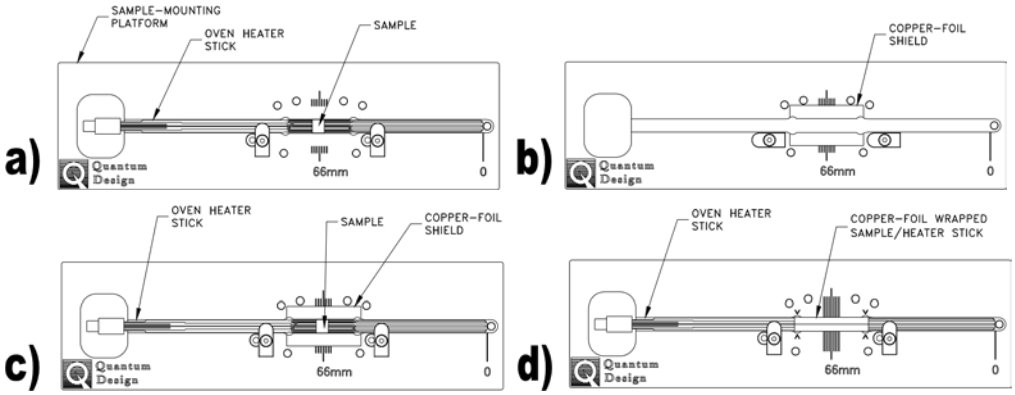


Figure 1-13. Using the sample mounting platform to mount a sample on the heater stick

1. Prepare the sample and heater stick and mount the sample (Figure 1-13a).
    a. Clean the sample and the surface of the heater stick with a soft cotton swab wetted with alcohol. See Section 1.3.1 for a more detailed description of the heater stick.
    b. After the surfaces are cleaned and dried, place the heater stick in the red samplemounting platform supplied in the MPMS 3 Oven User's Kit (Figure 1-11). Push the bottom end of the heater stick against the plastic post located at the "0" marker, and lock it in place by rotating the white plastic tabs.
    c. Mix the alumina cement thoroughly and apply a generous drop to the heater stick at the center of the heater meander pattern (at “66 mm” on the scale) where the sample will be placed. The cement should be thick but still fluid.
    d. Place the sample on the glue drop before it begins to dry, pressing the sample down so that it is as close as possible to the surface of the heater. Leaving a visible border of glue around the sample, wipe away any excess cement from the heater stick.

e. Record the sample offset by using the scale on the mounting platform. The offset should be a value between 64 mm and 68 mm for the best temperature accuracy, as shown in Figure 1-13A.

f. Carefully remove the heater stick from the mounting platform and cure the cement for 10 to 20 seconds by using a heat gun held about 20 cm (8 in) away. Heating the cement drives away the water base and greatly strengthens the bond.

g. Test the bond by gently pushing the sample from the side to verify that the sample does not easily come off the stick.

2. Wrap the sample and heater stick with a copper-foil shield (Figure 1-13B –Figure 1-13D).

h. Select a copper-foil shield that is shiny and free of tarnish and position it in the mounting station as shown in Figure 1-13B.

i. Place the heater stick with the sample on the shield (Figure 1-13C) and lock it in place with the tabs.

C A U T I O N !

Use a clean tool such as the tweezers in the MPMS 3 Oven Option User's Kit to handle the copper-foil shield. Do not handle the copper shield with your fingers, because it might tarnish.

j. Using a clean hard tool such as the handle of a pair of tweezers (included in the MPMS 3 Oven Option User's Kit), push down gently on the heater region so that the copper shield begins to bend around the stick.

k. Fold both flaps of the shield over the top of the heater stick so that the heater and sample are completely covered (Figure 1-13D). Flatten the shield so that it is flush with the surface of the stick.

l. Use the tweezers to pinch the shield at both ends of the heater region so that it grips the notches in the heater stick. The locations of the notches are indicated by four "^" marks on the platform. This compression will prevent the shield from slipping during MPMS 3 measurements.

3. Remove the heater stick from the mounting platform.

4. Plug the heater stick into the bottom end of the MPMS 3 oven sample rod.

5. Verify that the connector for the heater stick is fully engaged with the sample rod.

6. The sample is now ready to install in the MPMS 3.

1.4.5 Sample Rod Loading

1. Attach a new oven sample holder with mounted sample to an oven sample rod. Make sure that the mating surfaces of the adapters are clean. When inserting your oven sample holder into the oven sample rod, hold the rod at the blue bearing.
2. Select the software menu item "Sample > Install/Remove…

   The Install/Remove Sample Wizard begins. It guides through the rest of the sample loading process, including warming the chamber to room temperature and venting the chamber, specifying a data file for saving measurement data, entering sample and

sample holder information, and centering the sample. If you only wish to unload a sample, the wizard instructs you how to do this.

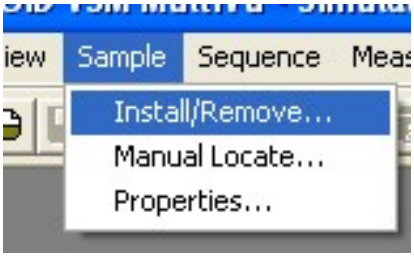


Figure 1-14. Sample Installation Menu

3. To install an oven sample select it from the following menu:

Figure 1-15. Sample Installation Wizard

4. Proceed through the rest of the sample installation as documented in the *MPMS SQUIDVSM User's Manual* section 1.3-1.4. After the installation procedure is complete, the chamber will begin to evacuate. The process will then wait for the appropriate vacuum to be reached (~50 mTorr.

C H A P T E R 2

Oven Option Software

2.1 Introduction

This chapter contains the following information:

- Section 2.2 describes the software changes of the Oven Option compared to a normal system.
- Section 2.3 gives a detailed description of the additional software features of the Oven Option and how to use them.

2.2 Overview

The Oven option software integrates seamlessly with the MultiVu software. If you have a SVSM with the oven option installed, the additional software features will automatically be available from within the application.

The main additions and changes to MultiVu for an EverCool system are:

- Oven status indicator in the control bar
- Extended temperature range available for sequences and measurements
- Additional step in the sample installation wizard allowing to switch between normal and oven operation

2.3 Oven Option Software Additions

The changes in MultiVu with the Oven Option installed are minimal – the options adds a new status display in the control center, adds an additional step to the sample installation wizard, and extends the temperature range for writing sequences and immediate control.

2.3.1 Oven Status Display

The Oven status display in the control center (see Figure 2-1) shows whether or not the oven is currently active – this has an impact on the temperature range the system is capable of achieving. When the current oven status is active, the temperature reported in MultiVu corresponds to the oven temperature (the chamber temperature is still accessible in the "Diagnostic Items" page of the "Log Data" window in MultiVu which can be accessed by selecting "Utilities > Log Data…" from the menu in MultiVu).

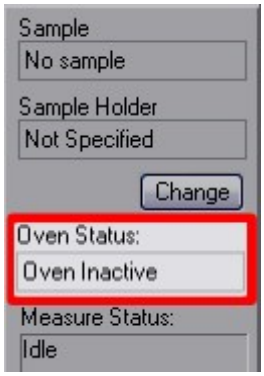


Figure 2-1. The MPMS 3 Oven status display in the MultiVu Control Center

2.3.2 Changes to the Sample Installation Wizard

When the SVSM Oven Option is installed on a system, the sample installation wizard will have an additional step allowing to specify whether the current system operation should be normal or oven mode as shown in Figure 1-16. This is the correct and only way to change the operation mode of the system and activate the oven option.

2.3.3 Available Temperature Ranges with Oven Option Installed

The actual available temperature range of the system depends on whether or not the oven option is currently active (see Table 2-1).

Table 2-1. Available temperature ranges depending on the oven status.

Status	Temperature Range (System & Sequence Control)	Temperature Range (Sequence Writing)
Oven Active	300K – 1,000K	1.8K – 1,000K
Oven Inactive	1.8K – 400K	

Even though it is possible to measure with an oven sample rod in non-oven mode, the system will not be able to attain base temperature in this configuration due to the additional heat leak from the wires inside the oven sample rod.

A P P E N D I X A

Troubleshooting

A.1 HiVac System

- Multiview leaves the HiVac state unexpectedly and returns to pre-HiVac shutting down the oven option. This is a hardware safety feature and can be caused by too much out gassing of the sample. The solution is to heat the sample at a more controlled rate or put periods of stabilization into your sequence to allow the gas to be pumped out.

- The cement that is used to mount the sample has a significant amount of water in it. As it is heated up, the water leaves the cement and enters the sample space. This can cause problems with the HiVac system as well if the samples are heated too fast. The suggested solution is to preheat your sample slowly to ~500K and dwell there for a little to allow the gas to be pumped out. If this is not acceptable, then a slow rate of heating is recommended to allow the gas to be pumped out.

A.2 Sample Temperature Accuracy

- Due to large thermal gradients between the heater stick and copper radiation shield, the real sample temperature can differ from the thermocouple temperature by several percent.

- Verify temperature accuracy by mounting the Ni/Fe standard in a similar way as you mounted your sample. Verify the Curie point of nickel (627K) using a low field of 100 Oe and similar T slewing settings and used on your sample if possible.

- Noise in the temperature reading in high magnetic fields is due to a loose cable in the sample rod. The recommended action is to contact a Quantum Design representative and replace the sample rod.

A.3 Unable to reach maximum temperature of 1000K

- Out gassing of the sample causing the vacuum to degrade which will cause a greater than normal thermal exchange between the heater region and the sample tube. The suggested solution is to wait for the sample to stop out gassing and the gas to be pumped out.

- Improperly mounted copper foil radiation shield which will also cause a greater than normal coupling of the heater region to the sample tube. The suggested solution is to properly mount the copper foil as outlined in section 1.4.3.

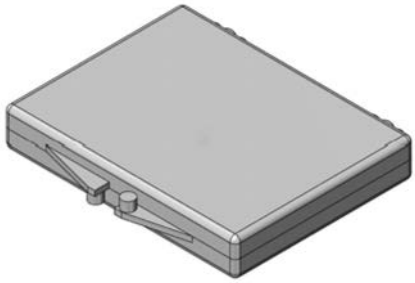
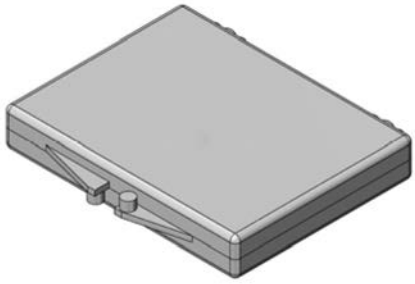
- Dirty or tarnished copper foil can cause an increase in the emissivity of the copper foil. The suggested solution is to replace the foil with a new sheet.

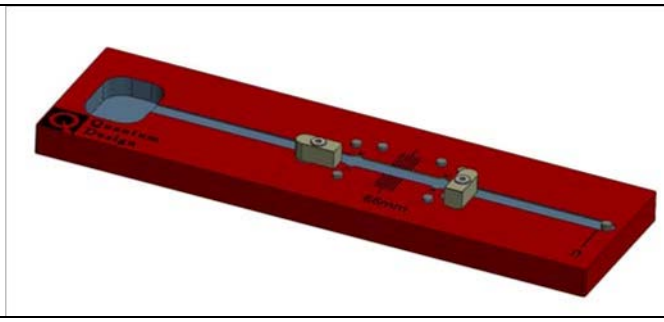
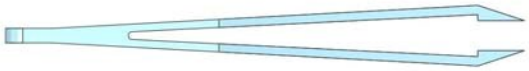
- Broken heater path which will cause a higher than normal resistance of the heater on the oven sample sticks. If this is the case, contact a Quantum Design representative and order a replacement oven sample stick.

A P P E N D I X B

Ordering Replacement Parts

Table B-1. Table for Ordering Replacement Parts

Picture	Name	Part Number
	Oven Sample Holder	4505-263
	Oven Sample Holder with Ni/Fe Standard	4505-146
	Annealed Copper Foil Packet	4505-141
	Ni/Fe Standard	4505-152
	Oven Sample Rod	4505-110

	Oven Sample Mounting Platform	4505-270
	Delrin Tweezers	HM118
	Zircar Cement	4097-030

APPENDIX C

Specifications and Interconnects

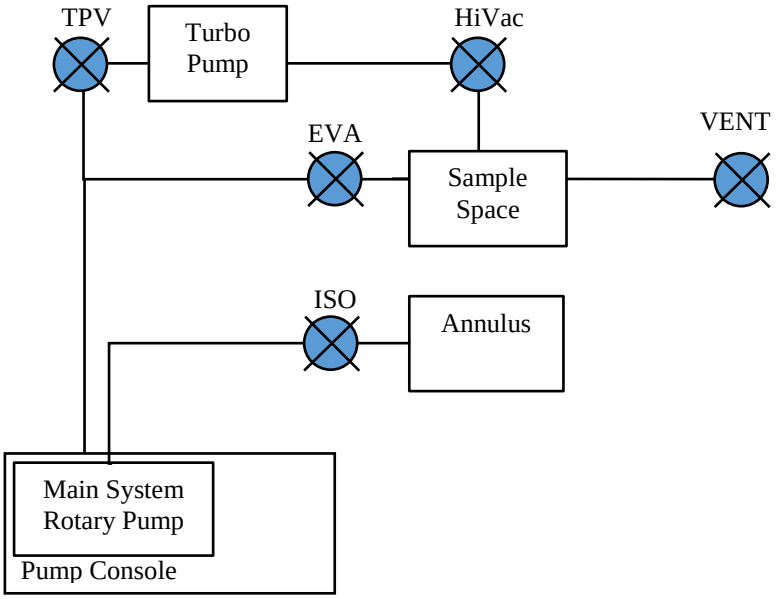


Figure C-1. Gas handling layout: Standard MPMS 3 system

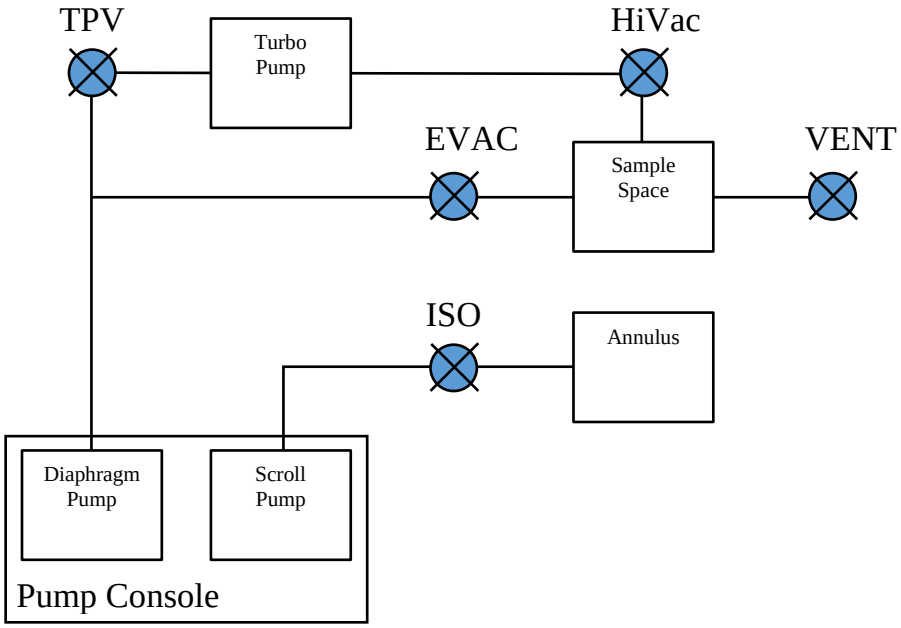


Figure C-2. Gas handling layout: MPMS 3 EverCool system