

Q u a n t u m D e s i g n



VSM Oven Option User's Manual

Part Number 1097-100, A3

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U.S. Patents

5,053,834 High Symmetry DC Squid System
5,139,192 Superconducting Bonds for Thin Film Devices
5,311,125 Magnetic Property Characterization System Employing a Single Sensing Coil Arrangement to Measure AC Susceptibility and DC Moment of a Sample (patent licensed from Lakeshore)
5,319,307 Geometrically and Electrically Balanced DC Squid System Having a Pair of Intersecting Slits
5,647,228 Apparatus and Method for Regulating Temperature in Cryogenic Test Chamber

Foreign Patents

U.K. 9713380.5 Apparatus and Method for Regulating Temperature in Cryogenic Test Chamber
Canada 2,089,181 High Symmetry DC Squid System
Japan 2,533,428 High Symmetry DC Squid System
Japan 2,533,428 High Symmetry DC Squid System

C O N T E N T S

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P R E F A C E

Contents and Conventions

P.1 Introduction

This preface contains the following information:

- Section P.2 provides an overview of the scope of the manual.
- Section P.3 outlines the contents of the manual.
- Section P.4 shows the conventions that appear in the manual.

P.2 Scope of the Manual

This manual contains background about the Vibrating Sample Magnetometer (VSM) Oven option; instructions for installing and using the VSM Oven software and hardware; and instructions for performing sensitive measurements when the VSM Oven option is installed.

P.3 Contents of the Manual

- Chapter 1 provides an overview of the VSM Oven option, the theory of operation, safety recommendations, and contact information for Quantum Design..
- Chapter 2 provides instructions for installation and removal of the VSM Oven option.
- Chapter 3 covers sample composition and how to mount samples for measurement with the VSM Oven.
- Chapter 4 summarizes the measurement process with the VSM Oven option and guides you through an immediate-mode measurement.
- Chapter 5 describes the hardware and electrical components of the VSM Oven option and the contents of the VSM Oven Option User's Kit.

- Chapter 6 describes the differences you will encounter when using MultiVu with the VSM Oven option compared to the standard VSM equipment.
- Appendix A provides a functional description of the Model CM-C VSM Oven module, including diagrams and electrical specifications.
- Index is a guide to information organized by key terms and phrases.

P.4 Conventions in the Manual

File menu	Bold text identifies the names of menus, dialogs, options, buttons, and panels used in the MultiVu and VSM software.
File >> Open	The >> symbol indicates that you select multiple, nested software options.
<code>.dat</code>	The Courier font indicates file and 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.

CAUTION!

Text is set off in this manner to signal conditions that could result in loss of information or damage to equipment.



WARNING!

Text is set off in this manner to signal conditions that could result in bodily harm or loss of life.



WARNING!

Text is set off in this manner to signal electrical hazards that could result in bodily harm or loss of life.

Introduction to the VSM Oven Option

1.1 Introduction

This chapter contains the following information:

- Section 1.2 is an overview of the VSM Oven option.
- Section 1.3 describes notable features of the VSM Oven option.
- Section 1.4 describes the VSM Oven option theory of operation.
- Section 1.5 outlines safety considerations for working with the VSM Oven option.
- Section 1.6 lists contact information at Quantum Design and its service centers.

1.2 Overview

The Oven for the VSM provides a way to make sensitive D.C. magnetometry measurements at controlled temperatures from 300 K up to 1000 K. Using a specially designed heated sample holder and VSM sample rod with electrical feedthrough, the VSM Oven vibrates the sample inside the VSM detection coilset. Both the standard VSM option and a high-vacuum option are required in order to operate the VSM Oven.

Heating of the sample is achieved by applying current to a Platinum resistive heating element 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. In this manual, we will refer to the VSM Oven sample holder as the *heater stick* (see Figure 5-1). To maximize thermal contact, the sample is attached to the heater stick using alumina-based cement (included in VSM Oven Option User's Kit, Figure 5-5). Then, the platinum heater region is wrapped securely with a thin copper-foil radiation shield that retains heat and reduces thermal gradients between the sample and heater stick.

The VSM Oven heater region is a 1 inch long 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 and sample-temperature accuracy. Due to the low thermal mass of the heated substrate, you can 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 VSM detection coilset.

Ease of use is another advantage of the Quantum Design VSM Oven option—it uses the same VSM detection coilset as the standard (low temperature) mode of the VSM option. To change from the standard VSM mode to the VSM Oven mode, you simply insert a different sample rod into the VSM.

1.3 Notable Features of the VSM Oven Option

Figure 1-1 illustrates the hardware and functional connections necessary for operating the VSM Oven. A new CAN module, the Model CM-C VSM Oven module, has been introduced to handle the temperature control of the VSM Oven heater stick. This module plugs into the Model 1000 Modular Control System, which communicates with the PC via the CAN network cable. The oven-control cable plugs into the front panel of the oven-control module. This cable passes heater power and temperature readback information to the heater stick via the electrical feedthrough on the wired access port and the wired oven sample rod.

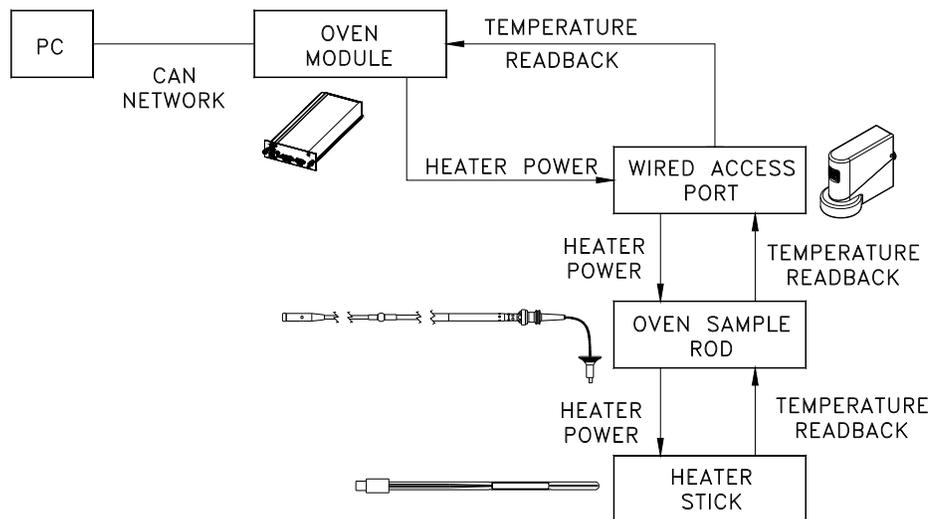


Figure 1-1. Operating principle for the VSM Oven option

1.4 Theory of Operation

The platinum heater is driven synchronously to the power line frequency (50 Hz or 60 Hz, depending on country and region) with a sinusoidal excitation. Magnetic feedthrough from the heater currents into the VSM detection coilset is minimized by patterning the heater noninductively and by operating at line frequency, where the VSM detection circuitry can easily reject the signal. The thermocouple voltage is monitored constantly by a sensitive low-drift DC microvolt preamp in the VSM 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 °C). Also located at the connector is a negative temperature coefficient thermistor that corrects for the

thermocouple cold junction temperature. The thermistor is read about 10 times a second using a 2 msec current pulse.

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

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

where

$T(R_{thermistor})$ = standard table for temperature vs. thermistor resistance,

$\Delta V(T)$ = standard table for type S thermocouple voltage vs. temperature standard, and

$T(\Delta V)$ = inversion of the $\Delta V(T)$ thermocouple table.

In order to enable temperature control down to 300 K at the heater stick, the VSM puck is set to 295 K while the system operates in VSM Oven mode. Due to the heat load from the heater stick when it is at high temperatures, the software lets the block temperature go as low as 283 K while it tries to maintain the puck temperature at 295 K.

Figure 1-2 below 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.

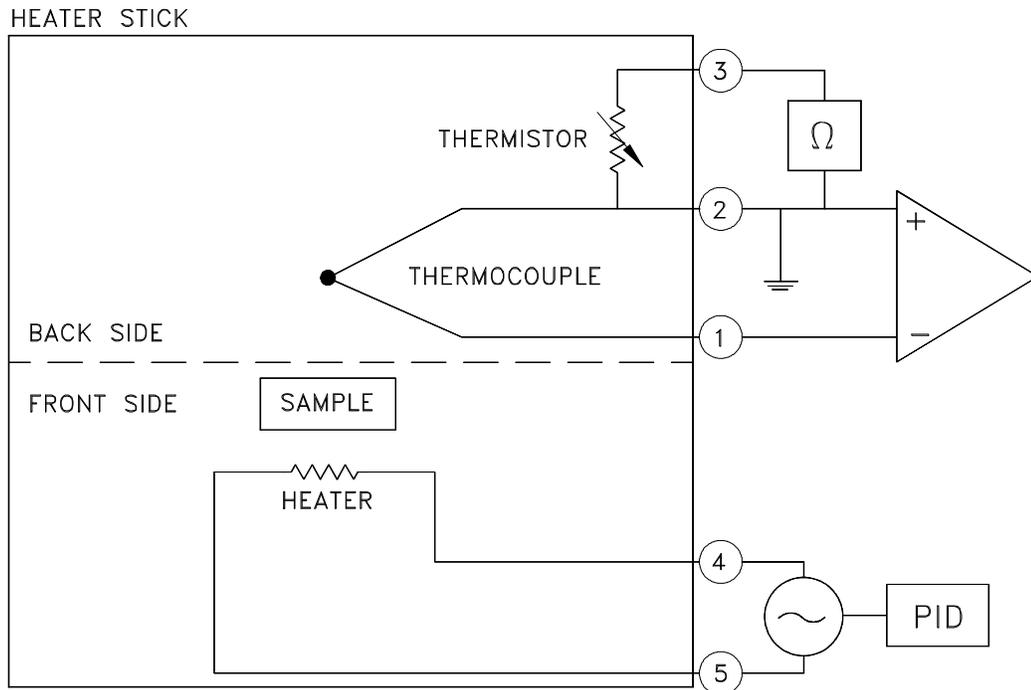


Figure 1-2. Control circuit for the VSM Oven heater stick

1.5 Overheating Prevention Mechanisms

To safeguard the equipment from overheating, the coilset temperature is set to 295 K while it is operating in oven mode, and the VSM Oven software uses the VSM coilset temperature as the primary diagnostic. In the event that the VSM coilset temperature rises above 350 K, the system shuts down the power to the oven heater.

1.6 Safety Precautions

	<p>WARNING!</p> <p>The VSM Oven option is used in conjunction with the Physical Property Measurement System (PPMS) family of systems, so you should be aware of the safety considerations for that equipment. PPMS-related safety precautions may include those for the use of superconducting magnets and the use of cryogenic materials (if applicable).</p>
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Above all, Quantum Design and its staff ask that you use standard safe laboratory procedures.

- ❖ Use common sense.
- ❖ Pay attention to the state of the system and to your surroundings.
- ❖ Investigate and take appropriate action if the behavior of the system appears abnormal—something could be wrong with it.
- ❖ Supervise inexperienced users and train them in laboratory safety and in general electrical safety procedures.

The VSM has safety features to prevent accidents from causing injury or serious equipment damage. *If you use the equipment in a manner that is not specified by Quantum Design, the protection afforded by the equipment may be impaired.*

1.6.1 VSM High-Temperature Heater

Handle the heater stick with caution when you remove it from the cryostat.

The heater stick should be near room temperature by the time you take it from the wired access port—it has very low mass (less than 1 gram of hot material) and cools substantially when the sample chamber is vented with helium gas. Yet, you should remember that the central region of the heater stick can reach temperatures up to 727 °C (1000 K), and this would cause severe burns if you touched it.

1.6.2 Cryogenics

	WARNING!
<p>Always wear protective clothing and ensure that the room has good ventilation when you work with cryogenic materials such as liquid helium and liquid nitrogen. These precautions will help protect you against cryogenic material hazards: (1) they can expand explosively when exposed to room temperature; (2) they can cause serious burns.</p>	

- ❖ Always wear protective clothing, including thermal gloves, eye protection, and covered shoes, when you work with liquid helium, liquid nitrogen, or other cryogenics. Avoid loose clothing or loose fitting gloves that could collect cryogenic liquids next to the skin. The extreme cold of liquid and gaseous cryogenics can cause serious burns and has the potential to cause loss of limbs.
- ❖ Work with cryogenic materials only in well-ventilated areas. In the event a helium container ruptures or there is a helium spill, vent the room immediately and evacuate all personnel. In a poorly ventilated area, helium can displace the air, leading to asphyxiation. Because helium rises, it is generally safest to work with it in well-vented rooms with high ceilings.

1.6.3 Magnets

	WARNING!
<p>Any person wearing a pacemaker, electrical medical device, or metallic implant must stay at least 5 m (16.5 ft.)¹ from the dewar. In addition, personnel must keep all ferromagnetic objects at least 5 m (16.5 ft.) from the dewar. Verify that magnetic fields are at zero (0) before handling the VSM linear motor transport in any way.</p>	

The following precautions should be followed to ensure the safety of personnel who work with or around a superconducting magnet. This material is covered in more depth in main system user manual.

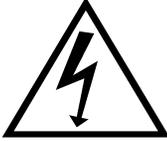
- ❖ Verify that any person who has a metallic implant or is wearing a pacemaker or electrical or mechanical medical device stays at least 5 m (16.5 ft.) from the dewar. Large magnetic fields are dangerous to anyone who has a metallic implant or is wearing a pacemaker or other electrical or mechanical medical device.

Important: The automated control system can turn on the magnet while the system is unattended. Furthermore, the three-dimensional magnetic field will penetrate nearby walls, the ceiling, and the floor. Therefore, your safety considerations should include such adjacent spaces.

¹ At the current time, 5 m should be a large enough distance to protect wearers of metallic implants or medical devices from most magnetic fields produced by Quantum Design magnets. However, the safe distance from newer magnets (in development) could be greater. Hence, personnel who work with and around the superconducting magnets should thoroughly review documentation for new equipment.

- ❖ Keep all iron, nickel, and other ferromagnetic objects at least 5 m (16.5 ft.) from the dewar. Large magnets, such as superconducting magnets, can attract iron and other ferromagnetic materials with great force.
- ❖ Never attempt to install, remove, or handle the VSM linear motor transport when there is a field set in the cryostat or in any other nearby equipment. In addition, the VSM linear motor transport must be secured when it is stored within 5 m (16.5 ft.) of the cryostat or any other large field source. The VSM linear motor transport presents a considerable hazard in a large magnetic field such as that produced by the cryostat or other laboratory equipment such as an NMR magnet, as the linear motor transport contains nearly 9 kg of iron.

1.6.4 Electricity

	<p style="text-align: center;">WARNING!</p> <p>The VSM is powered by nominal voltages between 100 V to 240 V AC. These voltages are potentially lethal, so you should exercise appropriate care before opening any of the electronics units, including turning off the equipment and disconnecting it from its power source.</p>
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- ❖ Turn off and unplug all electronic equipment before removing any equipment covers.
- ❖ Keep electrical cords in good working condition and replace frayed and damaged cords.
- ❖ Keep liquids away from the workstations.

1.7 Contacting Quantum Design

If you have questions or problems related to your QD equipment, please contact your local QD service representative. See www.qd-international.com for information about your location representative. You will be asked to describe the problem, the circumstances involved, and the recent history of your system.

Installing and Removing the VSM Oven Option

2.1 Introduction

This chapter contains the following information:

- Section 2.2 includes definitions and a list of the VSM Oven components.
- Section 2.3 describes the procedures for the *initial* installation of the VSM Oven option.
- Section 2.4 describes how to install VSM Oven hardware.

2.2 Overview of the VSM Oven Installation

This chapter describes the procedures you will use to install the hardware and software for the VSM Oven option. If you purchased the VSM Oven option as part of a complete Quantum Design (QD) system, many of these procedures will have been performed before you receive the equipment.

2.2.1 Terminology

To distinguish among the various activities that are involved in installing and operating the VSM Oven option, we offer the following usages and definitions:

- *Activate option* refers to the **Utilities >> Activate Option...** command in MultiVu, which incorporates option-specific commands into MultiVu. For example, when you activate the VSM option, the **VSM Control Center** will open so that you can set VSM-related parameters.
- *Install hardware* refers to activities involved in setting up equipment, such as plugging in the VSM Oven module, connecting cables, attaching the wired access port to the VSM head, and so on.
- *Install sample* refers to inserting a sample and sample rod into the PPMS using the **VSM Install/Remove Sample Wizard**. This wizard is available only while the VSM option is activated within MultiVu.

- **“Mode”** refers to the types of VSM measurements that can be made. When you have activated the VSM option in MultiVu, you can operate in either the *standard* (low temperature) mode or the *oven* mode. During installation, the VSM Oven software is automatically incorporated into the standard VSM software, so it does not have to be activated and deactivated separately from the standard VSM option.
- **VSM Oven-enabled** refers to the VSM MultiVu application when the VSM Oven hardware and software have been integrated.
- **VSM User's Manual** refers to the *Vibrating Sample Magnetometer (VSM) Option User's Manual*.

2.2.2 VSM Oven Components

Table 2-1 lists the components of the QD VSM Oven option. Please verify that you have received them all before you start the installation.

Table 2-1. System components of the VSM Oven option

COMPONENT	PART NUMBER	ILLUSTRATION
Model CM-C VSM Oven Module*	4101-200	Figures 1-1, 5-10-5-11, A-1, A-6
Wired Access-Port Assembly	4097-020	Figures 1-1, 5-3-5-4
VSM Oven Sample-Rod Assembly	4097-010 or 4097-075	Figures 1-1, 5-2
VSM Oven-Control Cable Assembly	3097-010-01 or 3097-010-02	Figure 5-9
Heater Stick Assembly**	4097-050	Figures 1-1, 3-1, 5-1, 5-5
VSM Oven Option User's Kit	4097-040	Figure 5-5
VSM Oven Option User's Manual	1097-100	
Copper-Foil Shields**	4097-042	Figures 3-1, 5-5
VSM Oven Sample Mounting Platform Assembly**	4097-041	Figures 3-1, 5-5-5-6
Mounted Nickel Standard**	4097-055	Figure 5-5
Model 6000 Firmware ROM*		
VSM/MultiVu Application Software*		

*These items might be pre-installed. **These items are shipped in the VSM Oven Option User's Kit.

2.3 Initial Installation of the VSM Oven Option

Important: The instructions in this section are only to be used the first time the VSM Oven hardware and software is installed on the system (for example, if the oven hardware was just purchased as an upgrade to an existing system). For routine installation and removal of the oven hardware, see Section 2.4.

The VSM Oven hardware requires the following items to be present and operational on the system:

- o Standard VSM hardware and control modules, see the *VSM Option User's Manual*
- o High Vacuum option, see the *PPMS Cryopump User's Manual* (PPMS only)
- o CAN network adapter and Model 1000 Modular Control System, see the *Model 1000 User's Manual* (PPMS only)
- o Up-to-date EPROMs in the Model 6000 (version 1.914 or later) (PPMS only)

To initially install the VSM Oven option on the system, follow these steps:

- 1) Deactivate any active options and close the MultiVu program
- 2) Turn off power to the CAN control tower
- 3) Insert the VSM Oven Module CM-C into a slot in the CAN control tower
- 4) Turn on the CAN control tower
- 5) In the file C:\Qdxxx\Vsm\System\VSM.INI (where xxx is Ppms, VersaLab, or DynaCool), open in Notepad and ensure that this line exists WITHOUT any semicolon (;) at the beginning of the line:
OVEN TYPE=1 ;
- 6) Save the VSM.INI file and close Notepad
- 7) To install remaining elements of the VSM oven hardware, continue to Section 2.4.

2.4 Installing the VSM Oven Hardware

It is assumed that the VSM hardware is installed on the cryostat before the following steps are taken, see the *VSM Option User's Manual* for information on installing the VSM hardware.

As the specific hardware for the VSM Oven option is minimal, it will be simple to change from standard to oven mode. Use the Install/Remove Sample wizard in the VSM Control Center to:

- o vent the sample chamber
- o remove any existing sample rod
- o choose Oven or Standard operating mode
- o Connect the Oven Control cable (Figure 5-9) between the VSM Oven Module CM-C and the back of the wired access port
- o install the wired access port (Figure 5-4) on top of the VSM motor

Preparing Samples for the VSM Oven

3.1 Introduction

This chapter contains the following information:

- Section 3.2 describes how to prepare a sample for high temperature measurements.
- Section 3.3 describes how to mount a sample on the heater stick so that high temperature measurements can be performed.

3.2 Sample Properties

3.2.1 Size and Shape

The sample should be no wider than 3 mm (0.120 in), as the heater stick itself is 3.6 mm (0.140 in) wide. 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.

3.2.2 Composition

Solid plates and thin films are ideal for use in the VSM Oven. The sample must tolerate being bonded to the heater stick with a high-temperature adhesive. We provide a vial of alumina-based cement (see below) in the VSM Oven Option User's Kit (Figure 5-5). The sample also must be strong enough to remain intact when it is chipped off the heater stick after it has been measured.

3.3 Sample Mounting

Mount your samples on the heater stick (Figure 5-1) by using the steps below. The procedures are shown graphically in Figure 3-1, A–D. A video of this process is also available, please contact apps@qdusa.com for access to this video.

CAUTION!

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.

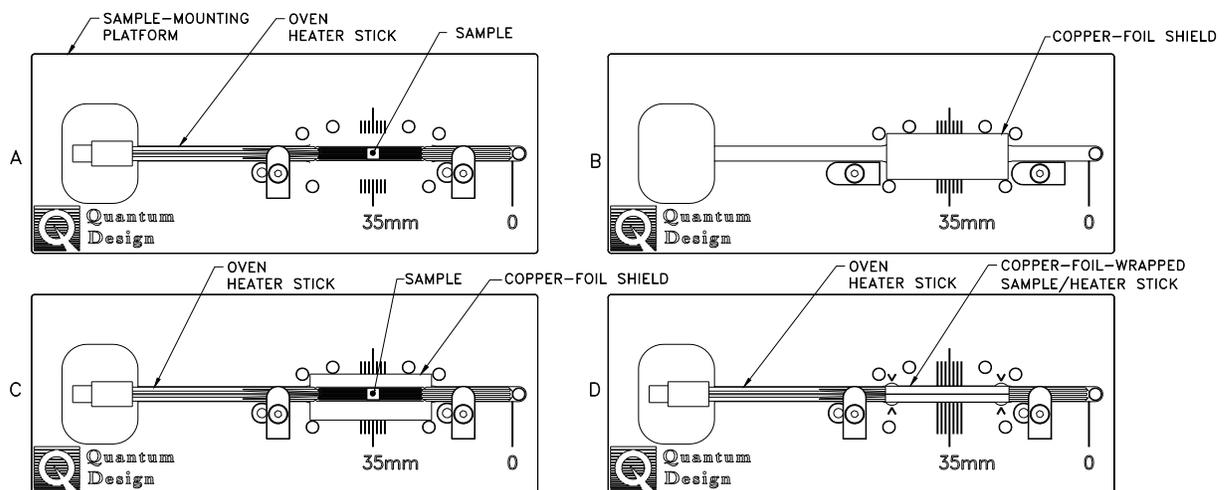


Figure 3-1. Using the sample mounting platform to mount a sample on the oven heater stick

1. Prepare the sample and heater stick and mount the sample (Figure 3-1A).
 - a. Clean the sample and the surface of the heater stick with a soft cotton swab wetted with alcohol. Clean only the patterned heater side of the stick. See Section 5.2.1 for a more detailed description of the heater stick.
 - b. After the surfaces are cleaned and dried, place the heater stick in the blue sample mounting platform supplied in the VSM Oven User's Kit (Figure 5-5). 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 "35 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 33 mm and 37 mm for the best temperature accuracy, as shown in Figure 3-1A.

- 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 (Figures 3-1B–3-1D).
 - a. Select a copper-foil shield that is shiny and free of tarnish and position it in the mounting station as shown in Figure 3-1B.
 - b. Place the heater stick with the sample on the shield (Figure 3-1C) and lock it in place with the tabs.

CAUTION!

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

- c. Using a clean hard tool such as the handle of a pair of tweezers (included in the VSM Oven Option User's Kit), push down gently on the heater region so that the copper shield begins to bend around the stick.
 - d. Fold both flaps of the shield over the top of the heater stick so that the heater and sample are completely covered (Figure 3-1D). Flatten the shield so that it is flush with the surface of the stick.
 - e. 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 VSM measurements.
3. Remove the heater stick from the mounting platform.
 4. Plug the heater stick into the bottom end of the VSM 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 system.

VSM Oven Measurements

4.1 Introduction

This chapter contains the following information:

- Section 4.2 summarizes the measurement process when using the Quantum Design VSM Oven option.
- Section 4.3 describes how to install samples for taking VSM Oven measurements.
- Section 4.4 describes how to take measurements with the VSM Oven option.

4.2 Overview of VSM Oven Measurements

The VSM Oven measurement process first involves locating the center position of the sample either visually or by synchronously oscillating the sample and detecting the voltage that has been induced in the coilset by the magnetized sample. This is the same procedure as for the standard VSM option.

In preparation for the measurement, you must use the automated **VSM Install/Remove Sample Wizard** to install the sample and set the system to take measurements in the VSM Oven mode.

The measurement process and use of the software are explained in the following sections. If you are experienced at taking measurements with the standard VSM, you will find that some of the MultiVu utilities and dialogs now have different capabilities and measurement limits.

Important: Before you begin the measurement process, verify that the VSM Oven option and the appropriate application software have been installed (Chapter 2) and the sample has been mounted on the heater stick (Chapter 3).

4.3 Installing a Sample

4.3.1 Attach Sample and Measure Sample Offset

Main points of the sample mounting and sample centering procedures are reviewed below. Chapter 3 has complete instructions on sample mounting—please review those procedures before you mount your sample.

4.3.2 Activate the VSM Option and the VSM Control Center

You will take measurements with the VSM Oven option by using the software for the standard VSM, which is activated and operated in MultiVu. See the *VSM Option User's Manual* for information on option activation.

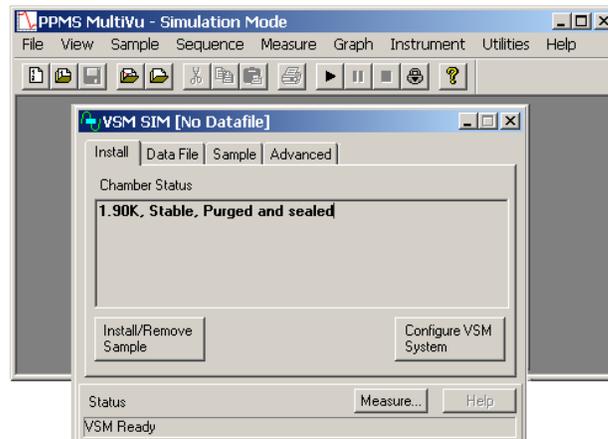


Figure 4-1. Main MultiVu window and main window of the VSM Control Center (in simulation mode)

4.3.3 Install the Sample

To install the sample you will use the **VSM Install/Remove Sample Wizard (VSM Install wizard for short)**, which is a set of automated instructions that guides you through the sample-installation process and allows you to select the VSM Oven mode or standard VSM mode.

The overall installation process involves warming and venting the sample chamber, moving the transport to the load position, choosing between operating in the standard VSM mode or the VSM Oven mode, characterizing the sample, designating a data storage file, installing the sample, and designating (or scanning for) the sample offset. This section will focus on the unique features of the VSM Install wizard in oven mode; see the *VSM Option User's Manual* for more detail about the dialogs in this wizard.

1. In the **Install** tab of the **VSM Control Center**, click on the **Install/Remove Sample** button.

2. Click on the **Open Chamber** button (below the **Instructions** area). The wizard will bring the sample chamber to room temperature, vent the chamber, and move the transport to the load position, and the **Instructions** area will show the status of these processes.
3. Now use the sequence outlined below to install the sample rod and sample. Note that you can insert or remove your sample from the cryostat at any stage of the **VSM Install** wizard, as long as the sample chamber is flooding and the transport is at the load position.
 - a. Install the wired access port on the VSM motor (Figure 5-4).
 - b. Attach the heater stick to the oven sample rod.
 - c. Open the lid on the wired access port on the VSM linear motor transport
 - d. Insert the sample rod into the wired access port until the magnetic lock at the top of the sample rod engages the magnetic lock ring in the linear motor transport. Verify that the magnetic lock has engaged the magnetic lock ring.
 - e. Plug the connector on the top of the sample rod into the plug inside the access port (see Figure 5-3).

Important: The sample will be subjected to vertical magnetic fields of up to approximately 300 gauss when it passes through the linear motor transport. If this is unacceptable for your samples, please contact Customer Service at Quantum Design.

4. Click on the **Next >>** button at the bottom of the window. This will open page 2 of the **VSM Install** wizard (Figure 4-2), in which you designate the mode of measurement (standard or oven).

Important: You can come back to this page and change your selection at any point during the **VSM Install** wizard. However, if you want to change the operating mode after the **VSM Install** wizard has ended, you must restart the wizard from the beginning.



Figure 4-2. VSM Install wizard, page 2: Selecting the VSM operating mode

From this point on in the sample-installation process, you will see some differences between the instructions and dialogs for measurements in the VSM Oven mode and those for the standard VSM mode. Here we show the instructions and dialogs for the VSM Oven.

5. Click in the option button next to **VSM Oven** and then click on the **Next >>** button at the bottom of the window. Page 3 of the **VSM Install** wizard, the **Output Data File/Sample Information** dialog box, will open so you can designate an output data file.
6. Click on the **Next >>** button at the bottom of the **Output Data File** dialog box. Page 4 of the **VSM Install wizard** will open (Figure 4-3) so that you can provide or obtain the sample offset.

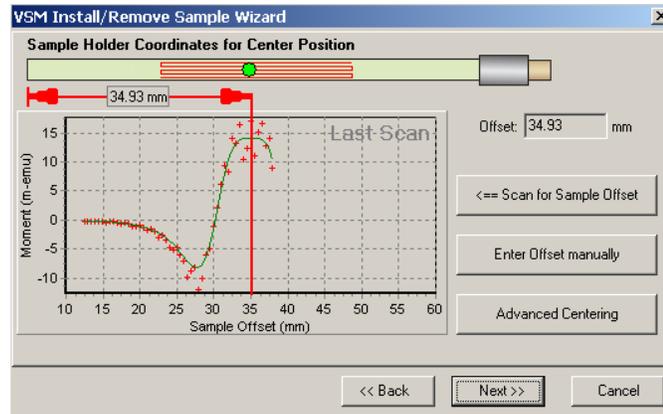


Figure 4-3. VSM Install wizard, page 4 (oven mode): Sample-holder coordinates for center position

Note that there are slight differences between the dialog boxes used for the VSM Oven mode and the standard VSM mode: for standard VSM mode, the illustration shows a sample holder, but for the VSM Oven, it shows a heater stick with a zigzag pattern that represents the heater region.

As in the case of the standard VSM sample holder, we recommend that you place the sample at a sample offset of 35 mm. The software will warn you if the sample is placed outside the heater region. The heater region includes sample offsets from 23 mm to 48 mm.

7. Click on the **Scan for Sample Offset** button if the sample signal is large enough to be detected, typically more than 10^{-5} emu. You may need to apply a magnetic field in order to create a magnetic moment. Click on **Enter Offset Manually** if you measured the offset while in the mounting platform.
8. Click on the **Next >>** button at the bottom of the dialog box. This button accepts the sample-offset value.
9. Click on the **Close Chamber** button, which is just below the **Instructions** area.
10. The **Instructions** area will indicate that a touchdown is being performed and it will report on the process as it takes place.
11. The software will then test the heater stick by measuring the resistance of the heater and thermistor and testing for continuity of the thermocouple. If all these tests succeed, this will be indicated (Figure 4-4), otherwise you must go back to the sample insertion page and check the electrical connections to the sample rod or use a different heater stick.

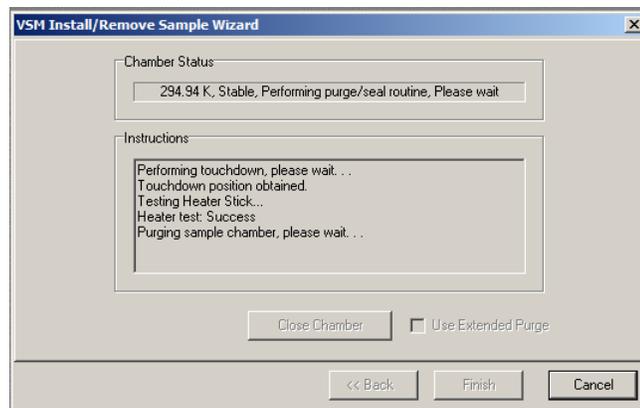


Figure 4-4. VSM install wizard, page 5: testing the heater stick.

12. The chamber will then be purged and high vacuum established. This process can take from 5 to 30 minutes, depending if the VSM hardware has recently been to high vacuum.
13. When high vacuum has been reached, the **Instructions** area will say "Sample Installation complete" and "Press 'Finish'."
14. Click on the **Finish** button at the bottom of the window. This button will return you to the **Install** tab of the **VSM Control Center**, which now will display the system temperature and other information. The **Status** area will display "VSM Oven Active" and "VSM Oven selected" (Figure 4-5).

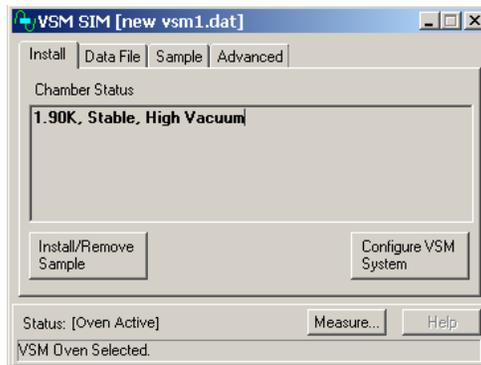


Figure 4-5. Install tab of the VSM Control Center after the VSM Oven mode has been selected.

15. You can now take measurements with the VSM Oven option.

4.4 Taking VSM Oven Measurements

Just like with the standard VSM mode, you can perform VSM Oven measurements by using immediate-mode commands (e.g., from command buttons or dropdown menus) or by constructing sequence files. See the *VSM Option User's Manual* for guidance in making measurements.

There are just a few differences when taking measurements in VSM oven mode which are noted below.

4.4.1 Touchdown Centering

Touchdowns are not required in the VSM Oven mode because the thermal expansion of the heater stick causes negligible movement of the sample relative to the detection coilset. Note, though, that if you have just changed to VSM Oven mode after operating at low temperatures in standard VSM mode, there will be a slight thermal expansion of the sample chamber. Hence, you will improve accuracy by using touchdowns for approximately 30 minutes after the sample reaches room temperature. Otherwise, we recommend selecting **No Automatic Centering** (Figure 4-6).

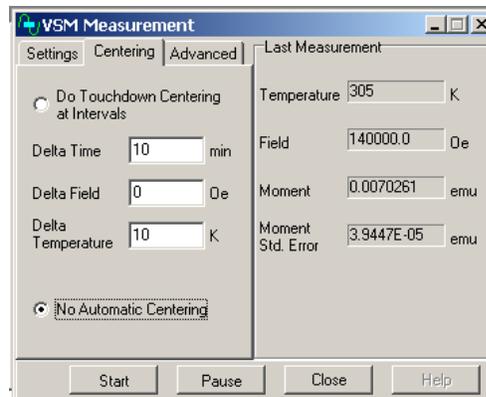


Figure 4-6. VSM Measurement dialog box: Centering tab

4.4.2 Peak Vibration Amplitude

The maximum **Peak Amplitude** is different for the standard VSM and the VSM Oven. As shown in Figure 4-7, the maximum oscillation amplitude of the VSM linear motor is 2 mm peak when the VSM Oven is operating, by comparison with 5 mm peak for the standard VSM. This is done in order to reduce heating of the linear motor drive coil in the high vacuum state.

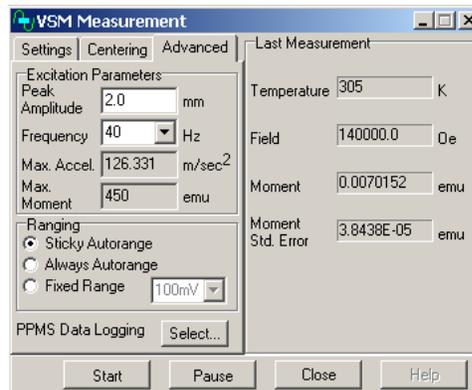


Figure 4-7. VSM Measurement dialog box: Advanced tab

VSM Oven Hardware

5.1 Introduction

This chapter contains the following information:

- Section 5.2 describes the VSM components that make up the oven option.
- Section 5.3 describes the contents of the VSM Oven User's Kit.
- Section 5.4 describes the electrical components of the VSM Oven option.

5.2 VSM Oven Hardware Components

This section describes each of the basic hardware components that make up the VSM Oven option: the oven heater stick, the oven sample rod, and the wired access port. Refer to Chapter 2 for instructions on installing the VSM Oven hardware.

5.2.1 VSM Oven Heater Stick

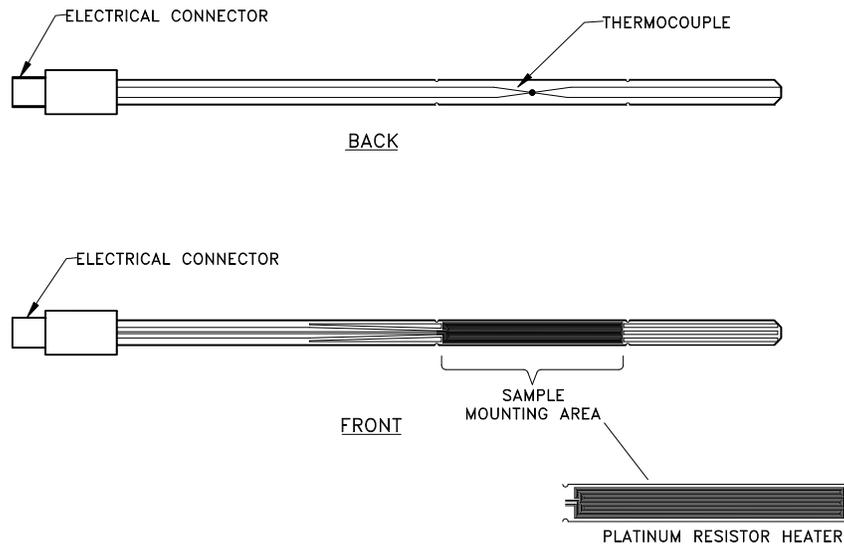


Figure 5-1. Front and back view of the VSM Oven heater stick

The VSM Oven heater stick and its parts are illustrated in Figure 5-1. It can be seen that the heater stick is a combination device that contains the heater, thermometer, and sample holder for the oven option. You will mount samples directly on the heater stick, using the alumina cement included in the VSM Oven Option User's Kit (Figure 5-5).

The heater stick is a long thin sheet of ceramic that has been silk-screened with a platinum meander pattern and then coated with a thin layer of dielectric. The ceramic has extremely low thermal conductivity, which allows the sample mounting areas to reach extreme temperatures while the electrical connections remain close to room temperature. The platinum conductor acts as the heating element of the VSM Oven option. Samples are mounted directly on top of the platinum resistor in the indicated sample mounting area.

The back of the heater stick has the temperature-detection system of the VSM 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 sample and platinum heater. This thermocouple provides a very precise measure of the sample temperature and it is rated for temperatures over 1000 K.

A thermistor is embedded at the top of the heater stick, inside the protective shield. 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 °C.

At the top of the heater stick is the five-pin male electrical connector (Figure 5-7) that provides power for the platinum heater and has voltage leads for the thermocouple and the thermistor. The heater-stick connector plugs directly into the base of the VSM Oven sample rod shown in Figure 5-2.

5.2.2 Oven Sample Rod

The VSM Oven sample rod is specifically designed for the VSM Oven option—it is not compatible with the standard VSM option. The primary changes were introduced to accommodate and protect the necessary electrical connections to the oven heater stick.

Figure 5-2 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 (Figure 5-7) 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 loosen the electrical connections.

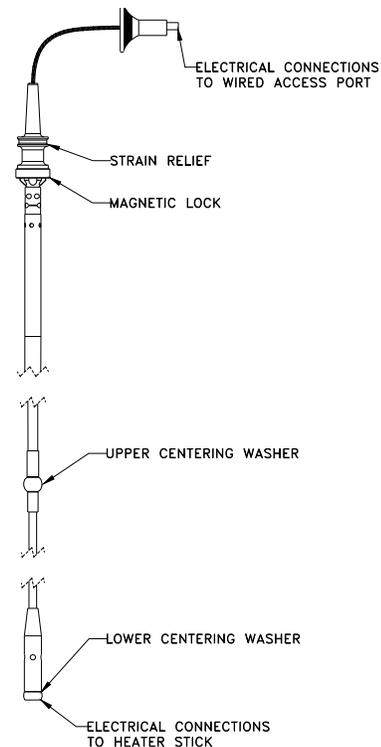


Figure 5-2. Oven sample rod

- **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 VSM. *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.

- **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.

5.2.3 Wired Access Port

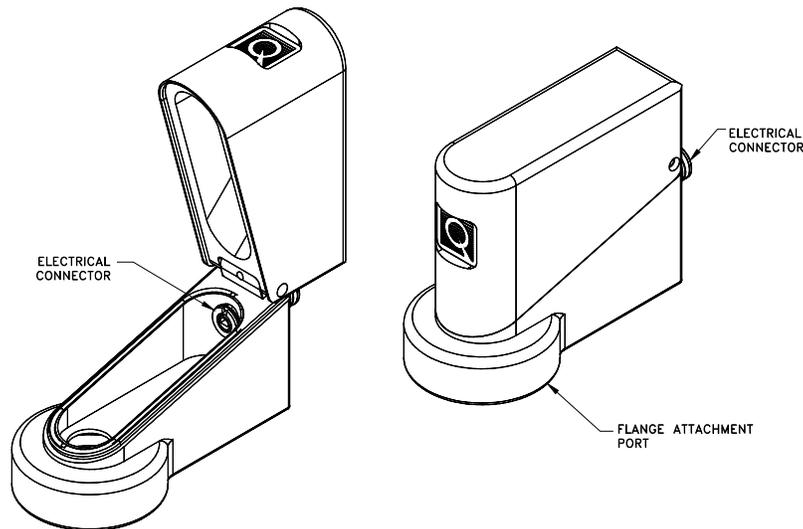


Figure 5-3. Wired access port

Figure 5-3 shows the wired access port that connects to the VSM linear motor transport. The access port is made of aluminum and is designed to be vacuum tight. The oven sample rod is connected to the oven-control cable by an electrical connector that can be seen on the back of the access port (inside and outside). 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.

On the bottom 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 5-4) and forms a vacuum-tight seal.

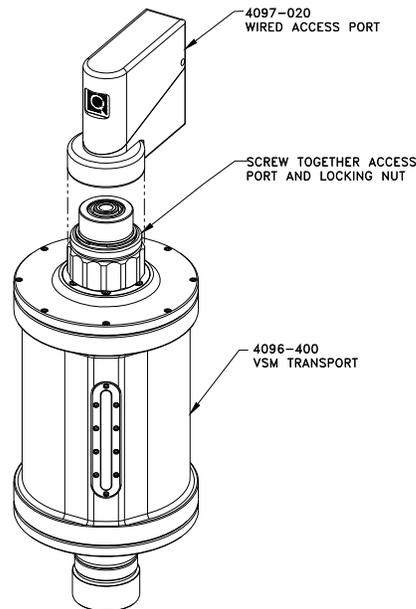


Figure 5-4. Attaching the wired access port to the VSM linear motor transport

5.3 VSM Oven Option User's Kit

The VSM Oven Option User's Kit (Figure 5-5) contains miscellaneous hardware and supplies that you will use to mount samples (see Chapter 3). The portable toolbox is a convenient way to organize these items, which are listed below.

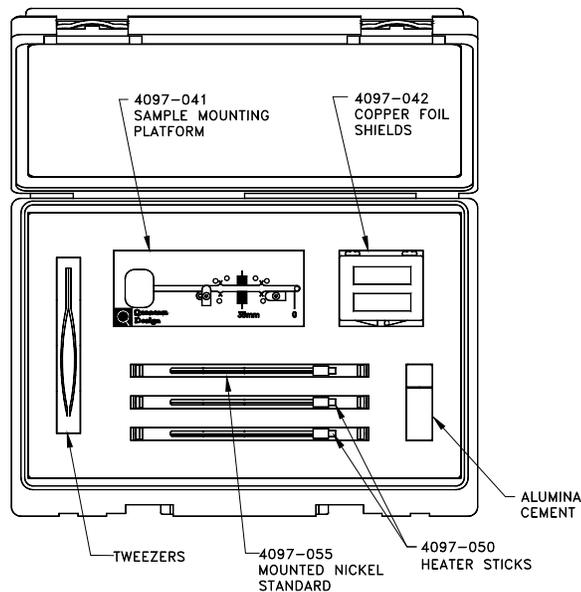


Figure 5-5. VSM Oven Option User's Kit

- **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 3.3 and Figure 5-6 provide more information about mounting samples.
- **Copper-Foil Shields**

The shields are slips of high-purity copper foil. You will wrap a shield around the sample and sample mounting area of a heater stick to provide thermal homogeneity over the sample. Refer to Section 5.3.2 for more information about how the shields are used.
- **Tweezers**

A pair of Delrin plastic 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 5.2.1 and 5.4.1 and Figures 5-1 and 5-7 provide more information about the heater sticks.
- **Mounted Nickel (Ni) Standard**

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

5.3.1 Sample Mounting Platform

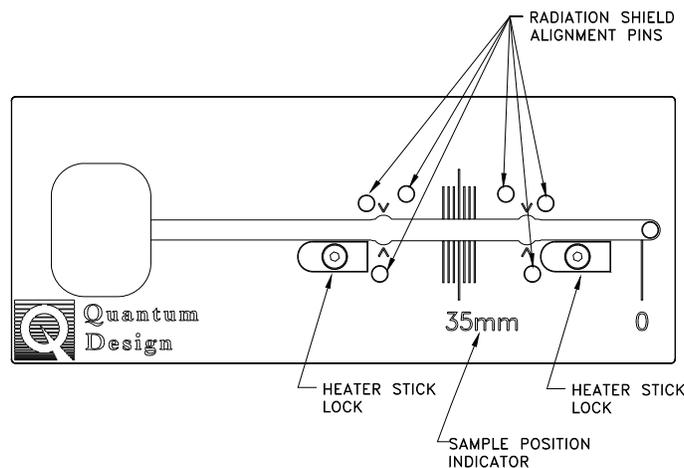


Figure 5-6. VSM Oven sample mounting platform

Shown in Figure 5-6 is the oven sample mounting platform. This platform was designed specifically for use with VSM 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". Section 3.3 has more information about mounting a sample.

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 **VSM Install/Remove Sample Wizard**. Refer to Section 3.3 for more information about sample centering.

5.3.2 Copper-Foil Radiation Shields

The copper-foil radiation shields are thin slips of vacuum-annealed high-purity copper that has been specially selected to be free of magnetic impurities. You will wrap a radiation shield around the sample mounting area of a heater stick after you have mounted 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 VSM coilset and the sample chamber. 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 1000 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 VSM Oven option from achieving temperature stability or reaching 1000 K.

5.4 VSM Oven Electronics

5.4.1 Heater-Stick Connector

Figure 5-7 shows the heater-stick connector, viewed from the outside. It attaches to the bottom of the oven sample rod, which provides a direct electrical feedthrough for each wire. The oven sample rod attaches to the wired access-port connector (Figure 5-8) with a connector identical to that in Figure 5-7. Refer to Figure 1-2 for a schematic of the heater stick.

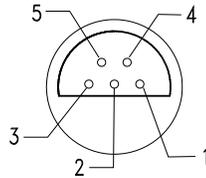


Figure 5-7. Pin assignments on the heater-stick connector

Table 5-1. Pinout connections for the heater-stick connector

PIN	FUNCTION
1	Thermocouple –
2	Thermocouple +/Thermistor B
3	Thermistor A
4	Heater A
5	Heater B

5.4.2 Wired Access-Port Connector

The wired access-port connector provides a feedthrough to the heater stick. Figure 5-8 shows the connector on the wired access port as viewed from the outside. Note that pins 4 and 5 are jumpered together inside the connector.

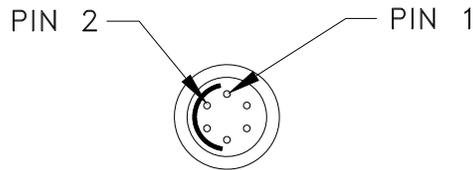


Figure 5-8. Pin assignments on the wired access-port connector (P1)

Table 5-2. Pinout connections for the wired access-port connector (P1)

PIN	FUNCTION
1	Heater A
2	Heater B
3	Thermistor A
4	Thermocouple +
5	Thermistor B
6	Thermocouple –

Table 5-3. Typical resistance values at P1 when heater stick is connected and at room temperature

PINS	RESISTANCE
1-2	200 Ω
3-5	10 k Ω
4-5	< 1 Ω
4-6	6 Ω

5.4.3 Oven-Control Cable

Figure 5-9 shows the oven-control cable (3097-010-01/-02) that connects the wired access port to the “Oven” port (JC-1) on the Model CM-C (the VSM Oven Module). The control cable provides the heater power as well as the temperature readback from both the thermocouple and the thermistor.

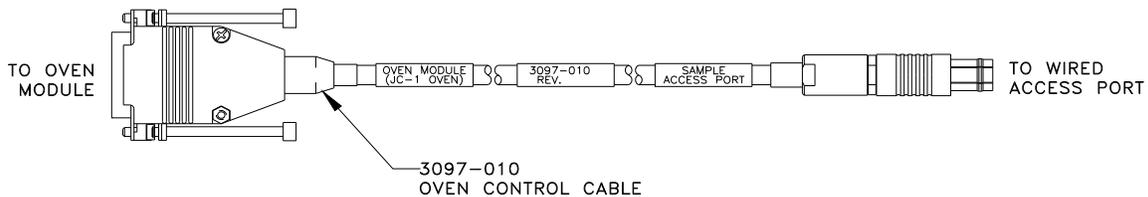


Figure 5-9. VSM Oven-Control cable

5.4.4 Model CM-C (VSM Oven Module)

Figures 5-10 and 5-11 show the front and back of the Model CM-C VSM Oven module (4101-200), 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 (PC) via the CAN-bus connector on the back panel of the module.

Appendix A contains a pinout diagram and connection table for the CAN connector.

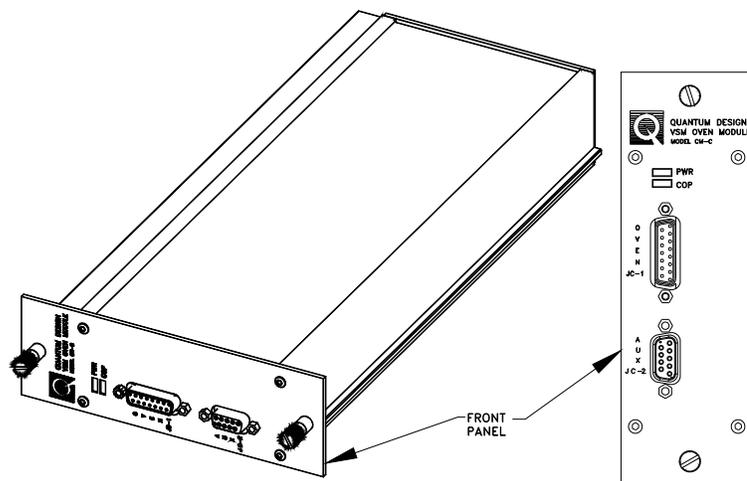


Figure 5-10. Front panel of the Model CM-C VSM Oven module

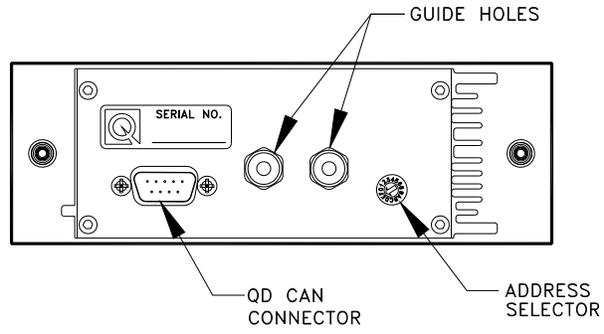


Figure 5-11. Back panel of the Model CM-C VSM Oven module

VSM Oven Software

6.1 Introduction

This document contains the following information:

- Section 6.2 summarizes the measurement process with the Quantum Design VSM Oven option.
- Section 6.3 describes some notable changes to operations associated with the VSM oven.
- Section 6.4 describes MultiVu and the VSM Oven-enabled software, focusing on changes associated with the VSM Oven.

6.2 Using the VSM Oven for Measurements

The procedures for using the Quantum Design VSM in the oven mode are almost identical to those for using it in the standard VSM mode. In fact, when you installed the VSM Oven software, it was incorporated into MultiVu as part of the standard VSM software, so you will use the same software to take measurements with the standard (low temperature) VSM and the VSM Oven. Assuming that the VSM and VSM oven hardware and software have been installed, then each time you use the **VSM Install/Remove Sample Wizard**, you will decide whether you will be measuring with the standard VSM (low temperatures) or with the VSM oven. Other than that, the same process is used for both types of measurements.

6.3 Changes Associated with the VSM Oven

6.3.1 Prevention of Overheating

To safeguard the equipment from overheating while it operates in oven mode, the cryostat sets the coilset temperature to 295 K, and the VSM Oven software uses the VSM coilset temperature as the primary diagnostic. In the event the VSM coilset temperature rises above 350 K, the system shuts down the power to the oven heater.

6.3.2 Changes to Cryopump High-Vacuum Operations

The VSM linear motor transport increases the volume of the sample chamber by comparison with options that do not use the VSM linear motor transport. Hence, when you are in VSM Oven mode, cryopump operations have been modified in the following ways:

- When a sample is installed, a purge/seal operation will be performed before the system begins any pre-pumping. This helps remove adsorbed gases and water from surfaces on the linear motor.
- After the cryopump valve has been opened, the timeout to reach high vacuum has been increased.
- In the event that the sample chamber does not reach the base pressure, the VSM oven software issues a "High Vacuum" error warning to the user and records the error in the `VsmLog.txt` file. The system does not stop VSM oven operations when there is a High Vacuum error.

6.4 MultiVu and VSM Oven-Enabled Software

This section provides an overview of MultiVu and the **VSM Control Center** when the VSM Oven has been enabled. Also discussed are changes to the standard VSM software that permit measurements with the VSM Oven option.

6.4.1 MultiVu Changes

6.4.1.1 WRITING SEQUENCES

If you have the VSM Oven hardware, MultiVu will allow you to write sequences containing temperatures up to 1000 K. In fact, you do not have to be in VSM Oven mode when you write a sequence that contains high temperatures—you can write high temperatures into a sequence even when the VSM option has not been activated. This approach streamlines the construction of high-temperature sequences, as it would be inconvenient if you could only write them while the system is in VSM Oven mode. (But remember that the VSM option must be activated before you can write sequences containing VSM-specific commands and before the system can interpret VSM sequence commands.) Then, when you activate the VSM option and run a VSM sequence, MultiVu will check the temperature limits of the sequence and abort it if the limits are not appropriate to the current VSM mode (for example, if temperatures above 400 K are requested but the system is operating in the standard, low-temperature VSM mode).

6.4.1.2 TEMPERATURE REPORT AND SETTINGS

When the VSM oven is operating, the **Temperature-System** dialog box and the **Temperature** panel of the MultiVu **Status** bar report the temperature of the oven heater stick. You can set the temperature of the VSM Oven to a value from 300 K to 1000 K by using MultiVu. The maximum recommended slew rate is 200 K/min (by comparison with 20 K/min in other options) because of

the very low thermal mass of the heater stick and the ease with which temperature can be controlled.

6.4.2 VSM Control Center Components

Figure 6-1 shows the **VSM Control Center** (in oven mode (“[oven active]”)).

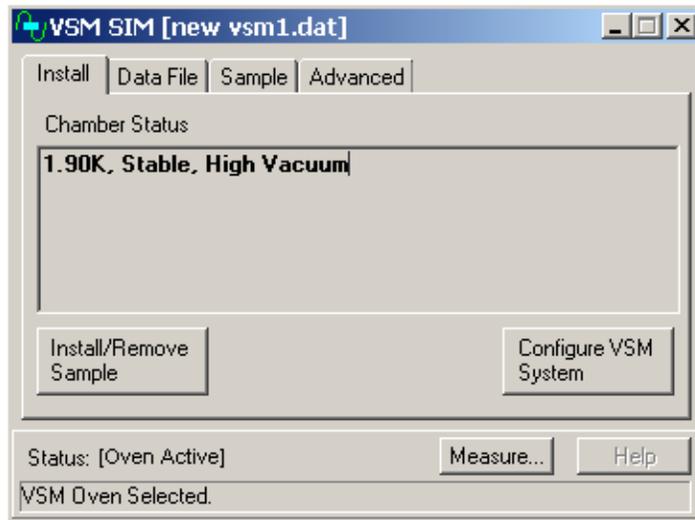


Figure 6-1. The VSM Control Center (oven enabled) after sample installation has been completed

6.4.2.1 STATUS AREA

The **Status** area at the bottom of the **VSM Control Center** includes new information such as the measurement mode you selected during the **VSM Install/Remove Sample Wizard**. For example, after you select VSM Oven mode and complete the **VSM Install/Remove Sample Wizard**, the **Status** area will report "Oven Active" and "VSM Oven Selected" (Figure 6-1). If you had selected standard VSM mode, the **Status** area would display "Standard VSM configuration selected."

6.4.2.2 THE VSM INSTALL/REMOVE SAMPLE WIZARD

The **VSM Install/Remove Sample Wizard** (**VSM Install** wizard for short) organizes the oven and sample-installation process through a set of automated dialog boxes. You start the **VSM Install** wizard by clicking on the **Install/Remove Sample** button located in the lower left of the **Install** tab (Figure 6-1). The initial pages of the **VSM Install** wizard for the VSM Oven-enabled software are somewhat different than those for the standard VSM software, most notably by including a dialog in which you choose to operate in Oven mode or standard VSM mode (Figure 6-2).

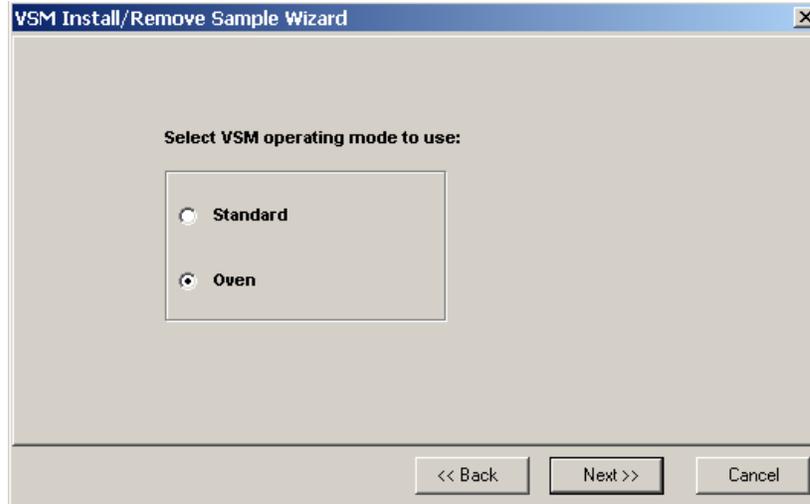


Figure 6-2. VSM Install wizard: Selecting the VSM operating mode

You can return to this page and change your operating mode during any part of the **VSM Install** wizard. However, if you want to change the operating mode after the **VSM Install** wizard has ended, you must restart the wizard from the beginning.

The **Sample Coordinates** pages for the two versions of the VSM software also differ. As shown in Figure 6-3, these pages display an oven heater stick instead of the VSM sample rod.

Note: A green dot appears in the illustration after a scan has been completed. The dot indicates the location of the sample on the heater stick.

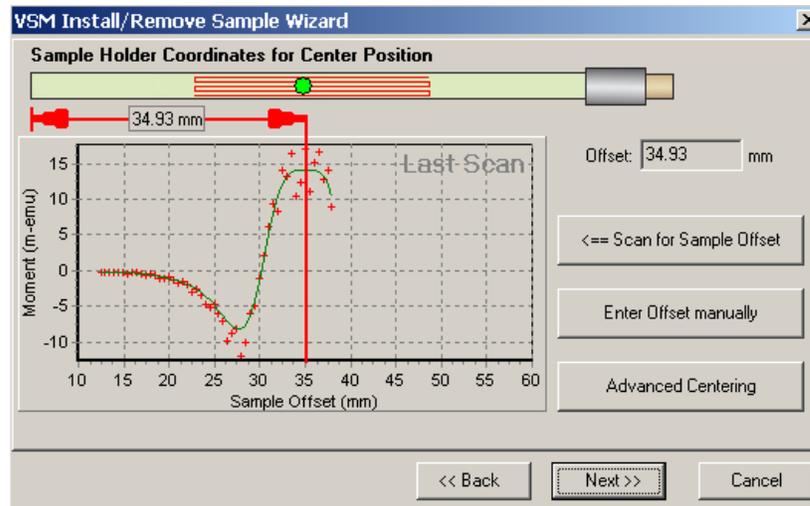


Figure 6-3. The Sample Coordinates page for determining sample offset

On the last page of the VSM Install wizard for the oven mode is a test for electrical continuity of the heater stick. Also, the system initiates high vacuum before completing the wizard.

Other than the above-mentioned changes to the **VSM Install** wizard, the same sample-installation process is used in the standard and oven modes.

6.4.3 VSM Oven Measurements

6.4.3.1 CENTERING TAB

While operating in VSM Oven mode, the normally recommended setting in the **Centering** tab is **No Automatic Centering**,¹ as is shown in Figure 6-4.

Because the thermal expansion of the 2.5 cm long heater region of the oven heater stick produces a negligible movement of the sample, touchdowns are typically unnecessary when you are using the oven mode.

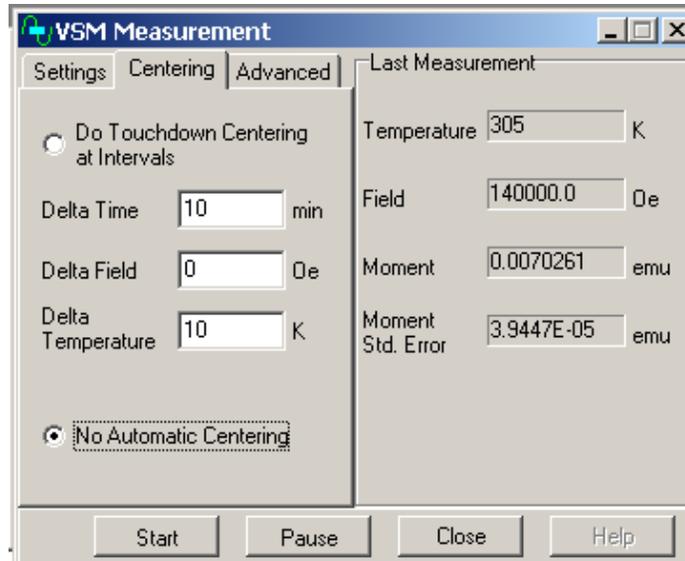


Figure 6-4. Centering tab of VSM Measurement dialog and default setting

Important: When you change to VSM Oven mode after operating at low temperatures in standard VSM mode, there will be a slight thermal expansion of the sample chamber. Hence, you will improve accuracy by using touchdowns for approximately 30 minutes after the sample reaches room temperature.

Refer to the *VSM Option User's Manual* for more information about touchdowns.

6.4.3.2 ADVANCED TAB

As is shown in the **Advanced** tab of the **Measure** dialog in Figure 6-5, the maximum VSM linear motor oscillation amplitude is 2 mm peak when the oven is operating, by comparison with 5 mm peak for the standard VSM. This difference is due to the increased heating of the linear motor drive coil when it is running in high vacuum instead of in the exchange gas atmosphere that is used for standard VSM measurements.

¹ Recall that **Do Touchdown Centering at Intervals** is the default in the standard VSM mode.

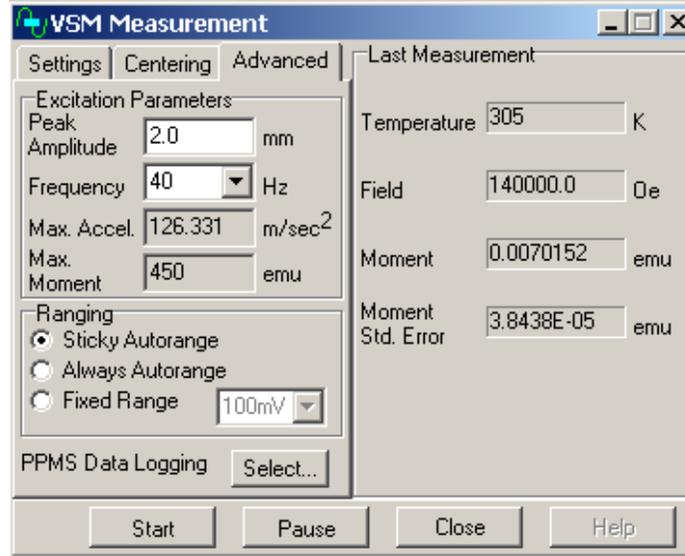


Figure 6-5. Advanced tab of VSM Measurement dialog box, showing peak amplitude during oven use

Model CM-C VSM Oven Module

A.1 Introduction

This appendix contains the following information:

- Section A.2 provides a functional overview of the Model CM-C VSM Oven module, including a block diagram and electrical specifications.
- Section A.3 describes the front panel and relevant components of the Model CM-C VSM Oven module.
- Section A.4 describes the rear panel and relevant components of the Model CM-C VSM Oven module.

A.2 Functional Overview

The Model CM-C VSM Oven module (4101-200) is a temperature-control module that was designed for the specific needs of the VSM Oven option. Figure A-1 shows the module and its front panel.

The principle function of this module is to provide the appropriate current to a platinum heater based on resistance feedback and temperature readings from a thermocouple and a thermistor. The maximum heater output is 25 V rms at either 50 Hz or 60 Hz with synchronous current readback detection. The temperature-control (PID) loop is closed digitally at about 10 Hz using a 16-bit current source. Other features include in-system programmable on-board flash memory for program storage and a serial ROM for calibration and other configuration data.

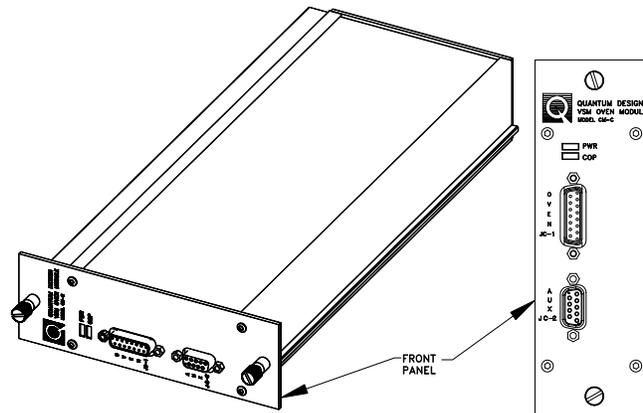


Figure A-1. Front panel of Model CM-C VSM Oven module

A.2.1 Functional Block Diagram

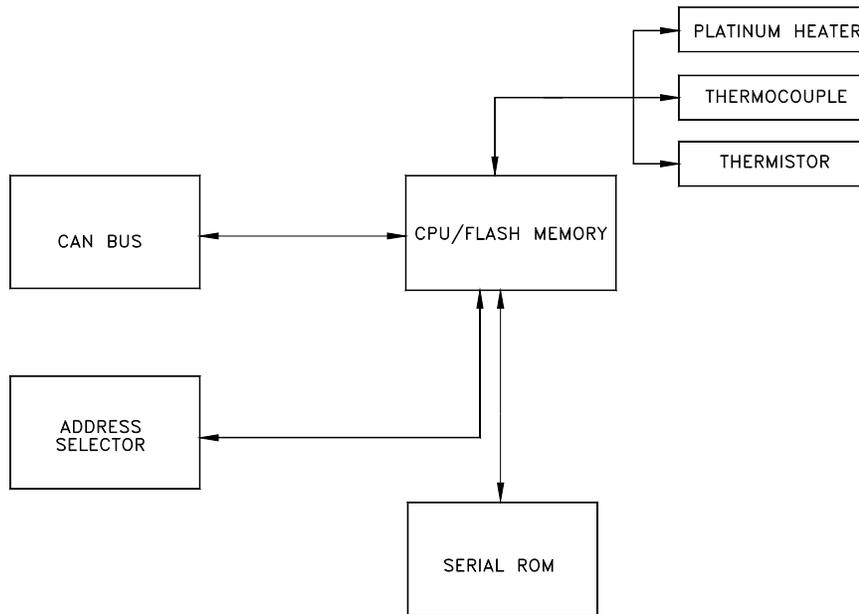


Figure A-2. Functional block diagram of Model CM-C VSM Oven module

A.2.2 Specifications

Table A-1. Electrical specifications for the Model CM-C VSM Oven module

Heater Voltage Compliance Limit	25 V rms
Supply Voltage	±24 V DC
Thermistor Resistance	10 k Ω at 25°C
Thermocouple Voltage (Max)	7.587 mV at 1000 K
Thermometer Sample Rate	14 Hz

A.3 Model CM-C VSM Oven Module: Front Panel

A.3.1 Indicator LEDs

The front panel of the Model CM-C VSM Oven module has two LEDs in the top left, as shown in Figure A-1. The PWR LED indicates the power-on status of the module. The COP (CANopen Protocol) LED indicates the status of the CAN network controller. Table A-2 outlines the LED states and provides solutions in the event of a problem.

Important: The error information in Table A-2 refers to situations that persist for longer than about 15 seconds. Typically, when the module is powered on, the LEDs might briefly flash red before they turn green. This is a normal part of the startup or reset sequence.

Table A-2. LED guide for Model CM-C VSM Oven module

LED	COLOR	STATUS	MEANING AND/OR SOLUTION
PWR	Green	On	The processor is running with no errors (normal).
	Red	Flashing	Errors were encountered during the self-test. The flashing sequence can be used to determine the cause of the failure.
COP	Green	On	CAN status is operational (normal).
		Flashing	CAN status is pre-operational. Verify that the cable is connected to PC.
	Red	On or flashing	Error on the CAN bus. Contact Quantum Design for assistance.

If you are unable to achieve operation with both LEDs green, please contact Quantum Design for assistance.

A.3.2 Front Panel Connectors and Pinout Tables

A.3.2.1 JC-1 OVEN CONNECTOR

This connector is used to supply current to the oven stick heater as well as to read temperature information from the thermocouple and the thermistor. Table A-3 shows the pinout connections from the oven-control cable to the oven module. Note that eight wires pass through to the JC-2 AUX connector (AUX1, AUX2, ..., AUX9).

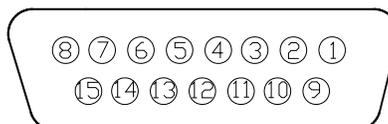


Figure A-3. JC-1 pin assignments on the Model CM-C VSM Oven module

Table A-3. JC-1 pinout connections from the oven-control cable to the Model CM-C VSM Oven module

PIN	FUNCTION
1	Thermocouple +
2	Thermistor A
3	AUX1
4	AUX2
5	AUX3
6	AUX4
7	Heater A
8	N/C
9	Thermocouple -
10	Thermistor B
11	AUX6
12	AUX7
13	AUX8
14	AUX9
15	Heater B

A.3.2.2 JC-2 AUX CONNECTOR

The JC-2 AUX connector is available for future expansion of the VSM Oven option, including transport measurements. Please contact Quantum Design before you attempt to use the connector. Note the pinout connections shown in Table A-3 for this connector.

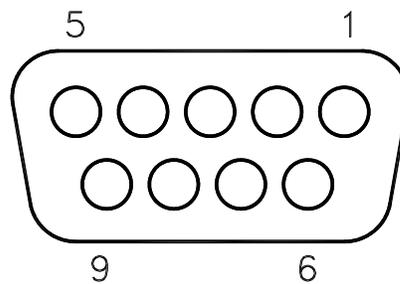


Figure A-4. JC-2 pin assignments on the AUX connector

A.4 Model CM-C VSM Oven Module: Rear Panel

The rear panel of the Model CM-C VSM Oven module contains an address selector, two guide holes, and the CAN connector through which the module sends and receives network data and receives power.

A.4.1.1 ADDRESS SELECTOR

Each module on the CAN bus must have a unique 5-bit binary address. The selector on the back panel is used to set the four least significant bits, while an internal jumper sets the most significant bit. If the selector is set to “0,” the module uses its default address. For a Model CM-C VSM Oven module, the default address is 12.

A.4.1.2 GUIDE HOLES

The two guide holes are used to align the connector with a low-power receptacle on the Model 1000 Modular Control System.

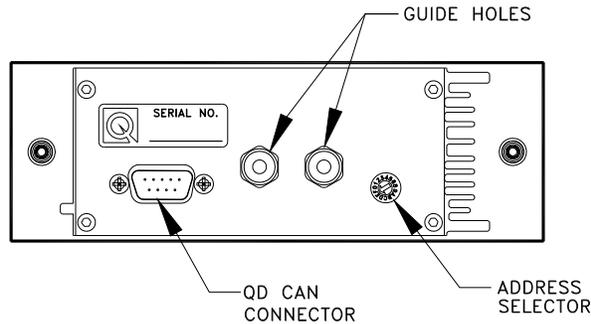


Figure A-5. Rear panel of Model CM-C VSM Oven module

A.4.1.3 QD CAN CONNECTOR AND PINOUT TABLE

The QD CAN connector is the main communication connection for controlling the Model CM-C VSM Oven module. The CAN network signals (CAN High, CAN Low) are connected to all other CAN modules on the bus and to the PC. Power (± 24 volts), reset, and sync signals also are sent to the module through this connector.

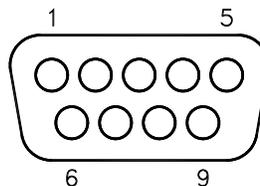


Figure A-6. QD CAN connector on rear of the Model CM-C VSM Oven module

Table A-4. Pinout table for QD CAN connector on rear of the Model CM-C VSM Oven module

PIN	FUNCTION
1	-24 V
2	CAN Low
3	Power Return (24V)
4	Sync Low
5	Line Sync
6	System Ground
7	CAN High
8	Sync High / Reset
9	+24 V DC

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