User Guides: Wiring

This guide explains what type of wiring is best to use in the sample space and techniques for installing wiring. When adding components to the sample space, such as positioners or user heaters, it is important to consider the wiring.

Note: When wiring in the sample space take care with the existing delicate wires. It is difficult to replace the platform thermometer and heater if they become broken or damaged.

Wiring Currently Used in the Cryostation

Currently what is used for wiring in the sample space is manganin, for both the thermometer wire and the platform heater wire. Manganin adds the least heat load of the materials considered to the base temperature of the system. The downside to using manganin is that it is hard to work with, being very thin and brittle.

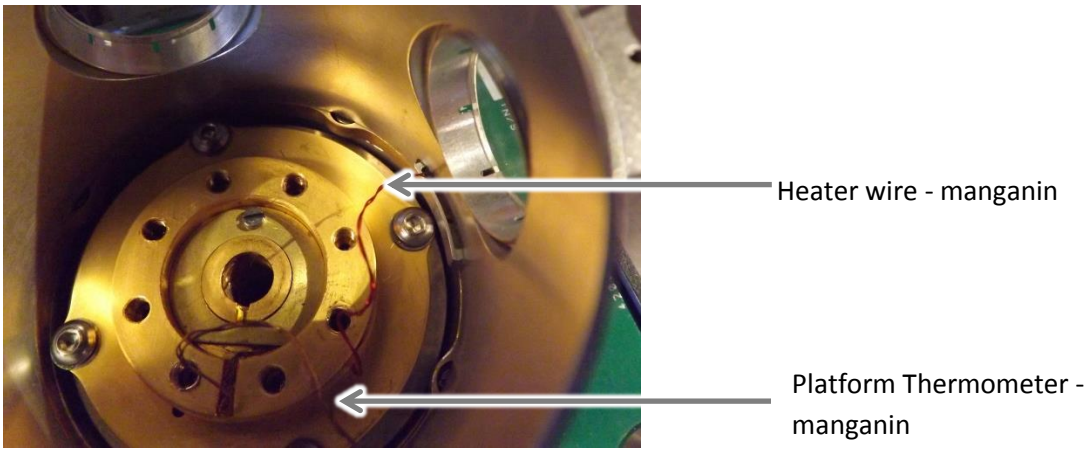

Figure 1: The standard platform incorporates the platform heater and thermometer.

Options that can be included in the Cryostation which require additional wiring are the thermally damped electric sample mount chips and the piezo positioners. For thermally damped electric sample mount chips and piezo positioners, phosphor bronze is used in the wiring harnesses. Phosphor bronze is easy to work with and only adds a slightly higher load than manganin.

Wiring Techniques

Manganin - User Heater

When adding a user heater, which can simply be a 200 ohm resistor, the user must build a wiring harness to connect the heater into the USERHTR connector on the PCB.

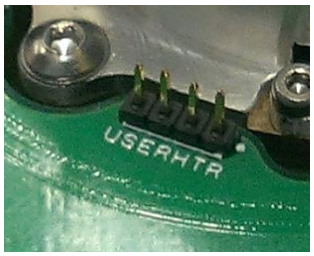

Figure 2: The User Heater connector, outside of the 4K stage.

Montana Instruments recommends using manganin wire that is provided in the accessory kit. Also included are connectors which interface with all pins and sockets on the PCB inside the sample housing.

Figure 3: Manganin wire included with the accessory kit.

As all other wires in the sample space go through the thermal clamp at the radiation shield, the wire for a user heater will also have to go through the thermal clamp. There should be about 3 inches of manganin wire before the thermal clamp, and an additional 3 inches or more inside the sample space. The excess wire outside of the thermal clamp can go under the PCB, as it is important that it not touch the outer housing or radiation shield. Inside the 4K stage space ensure that the manganin wire does not touch the radiation shield or sample mount.

Phosphor Bronze

Phosphor bronze is used to wire most other options in the 4K sample space, aside from the thermometers and heaters. Phosphor bronze is commonly used as wiring harnesses for the thermally damped electric sample mount options: LCC28 and CB12, and integrating piezo positioners. Again, this wire is found in the accessory kit that comes with the system, along with connectors.

Figure 4: Phosphor bronze wire included with the accessory kit.

Montana Instruments recommends using at least 8 inches of phosphor bronze wire to make a wiring harness. The wires need to go through the thermal clamp, and typically are routed to the user bridge where there are a series of 20 connectors available. It will take about 3 inches of phosphor bronze wire to route from the thermal clamp up through the hooks and into the connectors on the user bridge. Do not pull the wire tightly from the thermal clamp to the connector; allow it to loosely go between the thermal clamp and the user bridge connectors. For wire management, it is highly recommended that the wires go through the hooks shown in Figure 5 and then up to the user bridge connectors. This will ensure that the wires do not touch the thermal links underneath the PCB.

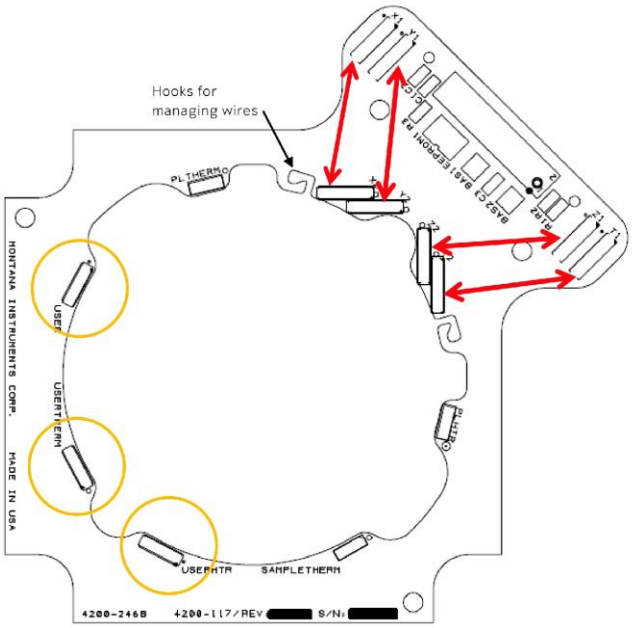

Figure 5: Connections available to the user in the sample space.

Inside the sample space should be at least 5 inches of wire. To manage the wires, coil them as shown in Figure 6. The wires can touch each other, but should not touch the sample mount or the radiation shield.

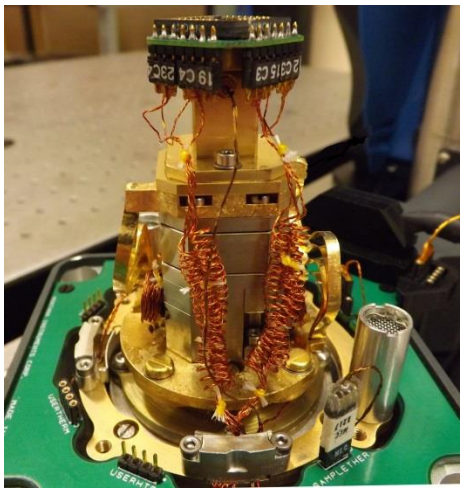

Figure 6: LCC28 Option uses coiled phosphor bronze wires. With the addition of positioners there are many wires to manage in the sample space.

If the PCB is removed while routing wires in the sample space, it is important to replace it in such a way that the wires are not caught between the o-ring and the PCB, this will cause a leak. The small Delrin screws need to also be replaced, but do not tighten these down, as this will deform the PCB into a cone shape, making the vacuum seal difficult to achieve. Leaving the Delrin screws loose will allow a good vacuum seal to form.

Troubleshooting

Ultimately, to check the performance of the system with added wiring a cool down to base temperature is necessary. If the system originally cooled to 3.0K on the platform, with an added user heater the base temperature change should be minimal. If 12 phosphor bronze wires were added, the base temperature change should be about 0.1K. The temperature gradient between the sample and the platform should remain whatever it was previously (<0.2K). If the system base temperature is larger than expected or if there is a large temperature gradient between the platform and sample, check to make sure that there are no wires touching in the sample space, the radiation shield, or the outer housing. Also, check that there is enough wire length in the sample space and between the thermal clamp and the connector. If there is not enough wire length, this could also increase the base temperature. If positioners have been integrated it is important that all directions in the manual are followed, note that it will take longer to reach base temperature due to the added mass of the positioners.

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Below is information on how each material, length, and gauge of wire affects the base temperature. Note that copper is not a good material for making wiring harnesses, as each wire can add up to 0.7K to the base temperature.

Gauge	Phosphor Bronze	Manganin	Copper
6” Wire Length			
28	16.3mK	8.6mK	743mK
32	6.4mK	3.4mK	294mK
36	2.6mK	1.3mK	116mK
40	1.0mK	0.5mK	44mK
10” Wire Length			
28	9.8mK	5.2mK	446mK
32	3.9mK	2.0mK	176mK
36	1.5mK	0.8mK	697mK
40	0.6mK	0.3mK	26.8mK
14” Wire Length			
28	7.0mK	3.7mK	318mK
32	2.8mK	1.5mK	126mK
36	1.1mK	0.6mK	5.0mK
40	0.4mK	0.2mK	19.1mK

Highlights

- Manganin is difficult to work with, but adds the lowest heat load. Manganin is a good material for user heaters.
- Phosphor bronze is easy to work with, and is recommended for use with PCB chip sample carriers and positioners.
- Copper is not recommended for use in the cold space, as it will significantly increase the base temperature.
- There should be several inches of wire before the thermal clamp. Never pull the wire straight between the clamp and connector.

Please contact us at support@montanainstruments.com if you have more questions about wiring in the Cryostation.