X-Cooler® III

Mechanical Cooler for HPGe Detectors

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Manual Revision F

0815

Advanced Measurement Technology, Inc.
("AMT")

WARRANTY

AMT warrants that the items will be delivered free from defects in material or workmanship. AMT makes no other warranties, express or implied, and specifically NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

AMT's exclusive liability is limited to repairing or replacing at AMT's option, items found by AMT to be defective in workmanship or materials within one year from the date of delivery. AMT's liability on any claim of any kind, including negligence, loss, or damages arising out of, connected with, or from the performance or breach thereof, or from the manufacture, sale, delivery, resale, repair, or use of any item or services covered by this agreement or purchase order, shall in no case exceed the price allocable to the item or service furnished or any part thereof that gives rise to the claim. In the event AMT fails to manufacture or deliver items called for in this agreement or purchase order, AMT's exclusive liability and buyer's exclusive remedy shall be release of the buyer from the obligation to pay the purchase price. In no event shall AMT be liable for special or consequential damages.

Quality Control

Before being approved for shipment, each AMT instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

Repair Service

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, AMT must be informed, either in writing, by telephone [(865) 482-4411] or by facsimile transmission [(865) 483-2133], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The AMT standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped PREPAID via Air Parcel Post or United Parcel Service to the designated AMT repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty should follow the same procedure and AMT will provide a quotation.

Damage in Transit

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify AMT of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

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SAFETY INSTRUCTIONS AND SYMBOLS

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

DANGER Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

WARNING Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

CAUTION Indicates a hazard that could result in property damage if the safety instruction is not observed.

In addition, the following symbols may appear on the product:

DANGER – Hazardous voltage

ATTENTION – Consult the manual in all cases where this symbol is marked in order to determine the nature of the potential hazards and any actions that must be taken to avoid them

Protective earth (ground) terminal

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

CLEANING INSTRUCTIONS

To clean the instrument exterior:

- Disconnect the instrument from the power source.
- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution. Do not use abrasive cleaners.

CAUTION	To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

- Allow the instrument to dry completely before reconnecting it to the power source.

1. INTRODUCTION

The ORTEC® X-Cooler® III is specifically designed to provide the cooling required for high-purity germanium (HPGe) detectors, at a lower cost and with more convenience than liquid nitrogen cooling systems. The X-Cooler III is field-replaceable and retrofittable to existing ORTEC PopTop® detectors. For use with other ORTEC models and other manufacturers' detectors, please contact your ORTEC representative.

1.1. The X-Cooler III vs. Liquid Nitrogen

In order for HPGe detectors to function properly, they must be cooled to a temperature in the range of 85 K to 105 K (kelvins). This low temperature allows the single crystalline germanium structure of the detector to operate as a diode, which produces current proportional to the energy deposited by a gamma ray interacting with that structure. There are two methods for getting HPGe detectors to this temperature: liquid nitrogen and mechanical coolers.

Liquid nitrogen (LN_2) is the most common current cooling method. With its boiling temperature at 77 K (at STP) and general widespread availability, LN_2 seems an ideal choice. LN_2 cooling systems consist of a vacuum jacketed dewar into which LN_2 is poured, and a thermal transfer device called a cryostat, which is usually made of copper to conduct "the cold" from the dewar to the crystal. Drawbacks to the use of LN_2 include safety hazards (skin contact with LN_2 causes frostbite) and the time required to fill the dewars. The largest standard dewar – 30 L – requires filling at least every 14 days; smaller dewars may have to be filled daily. Some areas do not have LN_2 available and in others one must pay a premium for using it.

Mechanical coolers are an ideal replacement for LN_2 because they do not suffer from the same safety hazards and they provide continuous cooling as long as electricity is available. The largest drawback to mechanical coolers is their cost. Kleemenko cycle coolers (also known as Joule-Thompson or J-T coolers) have traditionally had an initial cost of 8 to 10 times that of a cryostat and dewar. Kleemenko cycle coolers are characterized by having a compressor that compresses a special gas mixture called the refrigerant. This process is similar to the one used in standard household refrigerators. Stirling-cycle coolers often cost 20 to 40 times that of a cryostat and dewar. While their running costs are small (just the cost of electricity in kilowatt-hours), this initial cost has been a barrier to use at many facilities.

The X-Cooler III solves both LN_2 and mechanical cooler problems simply and innovatively. As with other mechanical coolers, the X-Cooler III is electric-powered so it requires no LN_2 to cool the HPGe detector. This eliminates the safety hazards associated with LN_2. Unlike other mechanical coolers, it uses patented technology in the cooling process to remove residual oil and other contaminants from the refrigerant, which allows the design to use standard, off-the-shelf compressors. This makes the cost of the X-Cooler III low compared to other mechanical coolers. The initial cost is as low as a standard LN_2 dewar and cryostat.

1.2. X-Cooler III Components

The X-Cooler III includes a compressor, transfer hose, heat exchanger, and coldhead (Fig. 1). All parts but the heat exchanger are visible to the user.

The compressor is the white box with a standard instrument plug on the rear for connecting ac power. There are no distinguishing features on the exterior of the compressor box other than the power switches on the rear and the fan filter on the front. Inside the white box is the compressor, a cooling fan, some ac wiring, and the plumbing of the refrigerant system.

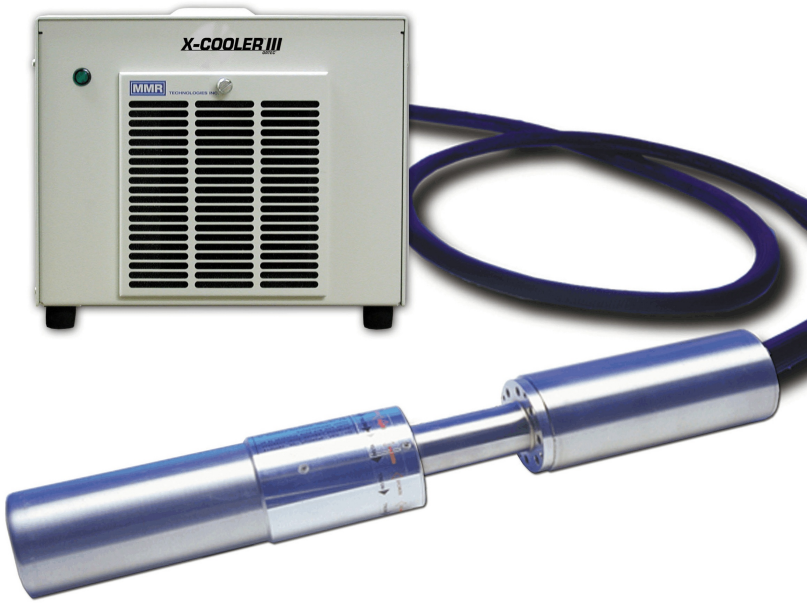

Fig. 1. The X-Cooler III.

NOTE	There are no serviceable parts inside the compressor box. We strongly recommend that you not open the compressor box except as directed by an authorized ORTEC service agent.

Attached to the rear panel of the compressor box is the transfer hose, which is made up of a stainless steel braid hose, 0.25 in. in diameter, that contains the gas pressure and return lines. Over the stainless steel braid hose is a black insulating material called Rubitex™ and around that is a black plastic protective netting material. The transfer hose is often called "the umbilical cord" and connects the heat exchanger to the compressor box. The standard length of the transfer hose is 10 ft (3 m), but is available at virtually any length from 1 to 50 ft (0.31 to 15.3 m).

At the end of the transfer hose is the heat exchanger. It is a coiled set of copper and stainless tubing mounted inside the 3 in. (7.62 cm) diameter stainless tube. It is in this heat exchanger that the gas expansion for necessary cooling takes place.

The heat exchanger is inside the assembly known as the coldhead. The coldhead also contains the thermal transfer devices and threaded coupling required to attach an ORTEC HPGe detector in a PopTop capsule to the X-Cooler III.

2. WARNINGS AND PRECAUTIONS

2.1. Electrical Hazard Warnings and Cautions

As with any electrical device, certain precautions should be taken:

- Always disconnect the power cord from the rear of the X-Cooler III before opening the compressor box or performing any maintenance.
- Replace blown fuses with the same model and performance specifications. Never short circuit a blown fuse.

- Ensure the unit is fused and marked for the proper voltage before plugging in the rear panel connector to ac power.

- Never change or remove the factory wiring of the ac power plug or internal components.

2.2. Temperature Hazard Warnings and Cautions

WARNING	While the X-Cooler III has no exposed components that reach extremely low or high temperatures, the following precautions should always be taken. As previously noted, there are no user-serviceable parts inside the compressor box and it should never be opened except as directed by an authorized ORTEC service agent.

- The coldhead could be below room temperature. Constant skin contact with the coldhead could cause discomfort.

- Should an ORTEC representative authorize you to open the compressor box, unplug the compressor from the ac power source first.

- Never touch any components inside the compressor box while the unit is operating. Allow the unit to cool at least 30 minutes before touching any internal components.

- The compressor (round, black object inside the compressor box) can be hot during operation. Skin contact with the compressor can cause severe burns.

- Other tubing inside the compressor box might be hot or cold, depending on its function.

2.3. Other Hazards

- The refrigerant gas is irritating when inhaled. The quantity of gas is not fatal but can cause nausea. Never release the gas from the system. Never charge the system with gas. Never bend, break, or cut any of the tubing in the system.

- The cooling fan inside the compressor box can cause damage to skin or tools. The fan is not accessible from outside the box. Again, there are no serviceable parts inside the compressor box and it should not be opened, except as directed by an ORTEC service agent. Before opening the compressor box, unplug the unit from the ac power source.

2.4. Other Precautions

- ***Never tilt the compressor box more than 10 degrees.*** If the unit is tilted more than 10 degrees, oil could spill into the gas return lines. A special oil trap has been installed, however, it is beneficial not to tip the compressor. If the compressor box is tilted more than 10 degrees, allow the unit to sit level for at least 6 hours (ideally up to 24 hours) prior to starting the compressor.

- ***We recommend that the X Cooler III not be moved while operating.***

- ***Do not bend the transfer hose to less than a 6 inch (18 cm) radius.*** Doing so might kink the hose and pinch off the gas expansion and return lines, causing the unit to be inoperative.

- Do not stack more than five (5) X-Cooler IIIs on top of one another.

The X-Cooler refrigerant is a mixture of gases which goes through a separation process when the compressor is running. ***Therefore, after about 15 minutes of initial cooling, the heat exchanger has started to cool and the refrigerant has started to separate. At this point, if the compressor is shut off, it must be allowed to come to room temperature to allow the refrigerant to return to equilibrium.*** If the cooler is started while the refrigerant is still separated, the compressor could be damaged because it is no longer operating on the complete mixture. Failure to allow the detector to come to room temperature could also cause detector failure from contaminants freezing out on the detector surface. It is possible that detector performance might be degraded and that you will not be aware of the problem immediately.

If the X-Cooler III should lose power for any reason, you can reapply power anytime within 10 minutes of initial power loss. ***If power loss persists for more than 10 minutes, the system should be warmed to room temperature before re-cooling.*** Typical warm-up time for most detectors is 24 hours; for higher-efficiency detectors (>70% efficiency), allow 36 hours warmup time.

3. GETTING STARTED

3.1. Unpacking the X-Cooler III

The X-Cooler III comes packed in its own shipping box. If a detector was ordered with the X-Cooler III, the cooler itself is often shipped separately from the detector capsule. In some cases, the capsule might already be installed on the X-Cooler III. To unpack the X-Cooler III:

1) Set the shipping box with “This End Up” arrows pointing upward.

2) Open the box and remove the uppermost packing material.

3) Lift the coldhead portion of the X-Cooler III up and uncoil it from around the compressor box.

4) Lift the compressor box out with two hands, making every effort to keep it level.

5) Place the packing materials back in the shipping box. We recommend that customers keep these boxes in case the cooler needs to be returned to the factory.

3.2. Coupling a Detector

Before turning the compressor on, an HPGe detector must be coupled to the coldhead. This procedure requires no special tools and can be done with one person. (A complete procedure for coupling a PopTop detector to any cryostat is included in the manual that accompanies the detector. Portions of this procedure are repeated here for convenience.)

Ensure that the detector being coupled to the X-Cooler III is an ORTEC PopTop brand capsule. The PopTop detector is supplied with a parts kit consisting of O-rings (not used with the X-Cooler III; the unit comes with a set of spare O-rings), unpowdered vinyl gloves, a container of Apiezon-L vacuum grease, cable ties, a black plastic plug, and a red plastic cap. Follow these steps to couple the detector to the X-Cooler III:

1) Remove the red plastic cap from the end of the coldhead.

2) Wearing the unpowdered vinyl gloves included in the parts kit, insert the supplied sieve pack into the open end of the coldhead. Ensure the sieve pack drops all the way to the bottom of the aluminum cylinder in the coldhead.

3) The top of the sieve pack should be approximately 1.3 cm from the top of the aluminum cylinder.

4) Ensure that a black rubber O-ring seal is on the end of the coldhead. Inspect the O-ring for damage. If damaged, remove the O-ring with a pin or needle. With clean, unpowdered gloves, lightly coat the new O-ring (be sure to use the O-rings supplied with the X-Cooler as these appear as four O-rings meshed into a single O-ring) with the supplied Apiezon-L vacuum grease and carefully insert it into the groove.

5) Hold the PopTop capsule so that it is pointed vertically upward and parallel with the coldhead so that the tip of the coldhead can be inserted into the back of the PopTop capsule (Fig. 2).

6) Slowly lower the capsule onto the coldhead. You should feel the cooling rod clamp (in the coldhead) engage in the detector capsule cooling rod.

7) Turn the PopTop capsule clockwise. Do not turn the coldhead. Do not force the rotation. The detector capsule should turn smoothly and without much friction.

8) Continue turning the PopTop capsule until it stops. It takes approximately five full turns of the capsule before the assembly is sealed. If the capsule stops prematurely, remove the capsule and repeat steps 5–8. Do not overtighten.

Fig. 2. Coupling of PopTop Capsule to X-Cooler.

The detector capsule is now coupled to the X-Cooler III. To decouple the capsule and the X-Cooler III, simply reverse these steps.

CAUTION Always ensure that the coldhead has warmed to room temperature before attempting to dismantle the PopTop cryostat from the X-Cooler III umbilical. We recommend a warmup period of at least 24 hours. *See the WARNING in Section 3.8.*

3.3. Positioning the X-Cooler III

With the detector attached, the assembled unit should be placed in its operating location prior to beginning the cool-down process. Place the compressor box on a flat, level surface.

WARNING ***Never tip the compressor more than 10 degrees, and do not operate the compressor on surfaces that could at any time become tilted to more than 10 degrees.***

Uncoil the transfer hose so that it can be pulled straight. Position the detector in the desired location, or attach it to the mounting stand or rack mount kit if purchased. The excess hose can be coiled around the base of the compressor if desired.

Flip the switch on the rear panel (integral to the plug receptacle) to the "O" or off position. Ensure that the plug receptacle reads the correct voltage for the unit as purchased (either 115 V ac or 230 V ac). Plug the supplied ac power cord into the back of the compressor but do not flip the power switch to its "on" position.

We recommend that the X-Cooler III sit for at least 6 hours (ideally up to 24 hours) once it is placed in its final location to allow any oil that might have spilled out of the compressor to return to the compressor.

3.4. Turning the Compressor On

Before turning on the compressor for the X-Cooler III, ensure that all the following are completed:

- Verify that the voltage and frequency for the input power to the X-Cooler III are correct.
- The ac power cord is plugged into the compressor and the wall outlet.
- The compressor box is sitting on a flat, level surface and has not been moved in several hours.
- The detector capsule is attached to the coldhead.

Turn on the main power switch. It is integrated into the power input module on the lower-left of the compressor box rear panel (see Fig. 4, page 9). You should immediately hear the fan inside the compressor box running. If the fan is not running, stop at once and contact your local ORTEC representative before continuing.

The X-Cooler III is equipped with a time delay function that prevents the compressor from re-starting, after short power outages, until the refrigerant pressure equalizes. When you turn on the X-Cooler III, the ac fan will engage; then, after 3 minutes, the compressor will start up and begin cooling.

3.5. Detector Cool-Down Time

The length of time it takes the X-Cooler III to cool an HPGe detector to an acceptable temperature depends on the size of the detector and the ambient environmental conditions. Small detectors, from planars up to about 20% relative efficiency, will take 12–14 hours to get to a stable operating temperature. Medium size detectors, from about 25% to 45% efficiency, will take 14–18 hours to cool. Large detectors, up to and exceeding 90% efficiency, can take up to 20 or more hours to be completely cooled and stable.

To determine if the detector is cool enough to be operated, attempt to turn on the bias to the detector from the high voltage supply. If the detector is still too warm, the bias shutdown circuit will prevent the bias from being applied. If the detector is cold enough, the bias will turn on to its normal voltage. Be sure to allow the voltage to stabilize (15–30 minutes) prior to taking data with the HPGe detector.

If after 36 hours of continuous cooling the detector will not accept bias, contact your ORTEC representative or our Global Service Center.

3.6. Normal Operations

The system should make very little noise during routine operations. Boiling in the coldhead can be heard as a low "gurgle" or "spitting" noise. This is normal.

3.7. Warming a Detector to Room Temperature

To warm up a detector to room temperature, turn the rear-panel power switch to the "Off" position. It takes approximately as much time to warm up a detector as it does to cool down (i.e., 12–20 hours or more).

3.8. Decoupling a Detector Capsule

WARNING Attempting to remove the PopTop capsule that has not fully warmed to room temperature will result in vacuum bellows damage. The damage may breach the vacuum; this may result in catastrophic failure of the detector's crystal. Bellows damage will void your detector warranty.

To ensure your detector is at room temperature, allow at least 36 hours of warmup time. If your application requires the fastest warmup possible, contact our Technical Services Group for information on measuring the PopTop's thermal element. This will allow you to accurately determine when the detector has warmed sufficiently for safe removal. Alternatively, if your detector has the SMART 1™ option, you can monitor warmup temperature and decouple the PopTop capsule as soon as temperature exceeds 290 K.

Decoupling a detector from the X-Cooler III might be necessary to move the system from one location to another, store the unit temporarily, or return the detector or X-Cooler III for service. For some types of service, it is not necessary to send both the detector and X-Cooler III. One of the advantages of the X-Cooler III is that it can be used with another PopTop capsule while one detector is being repaired and vice versa.

To decouple a detector capsule, follow these steps:

1) Disconnect any cables attached between the detector preamp and any electronics.

2) Hold the PopTop capsule in one hand and the coldhead in the other with the capsule pointing vertically upward.

3) Turn the PopTop capsule counter-clockwise. ***Do not turn the coldhead. Do not force the rotation.*** The detector capsule should turn smoothly and without much friction.

4) Continue turning until the capsule can be pulled apart from the coldhead.

5) Place the red plastic protective cover supplied in the parts kit over the open end of the coldhead.

3.9. Monthly Filter Change

The X-Cooler III compressor box has an internal fan for cooling the compressor and other internal components. As is the case for many heating and cooling devices, an air-intake filter is used to remove particulates that can reduce the capacity of the unit. This can be accomplished in about a minute without tools and without turning off the compressor. For optimum performance, the filter should be changed when dirt accumulates. In most laboratories a monthly change is adequate. Changing the filter more often might be needed when conditions are dusty or excessively dirty.

1) Locate the filter intake door on the front of the X-Cooler III unit (Fig. 3).

2) Turn the thumbscrew counterclockwise and remove the door from the housing.

3) Replace the filter and close the intake-filter door. Replacement filters are available from ORTEC (p/n 804346, box of 12).

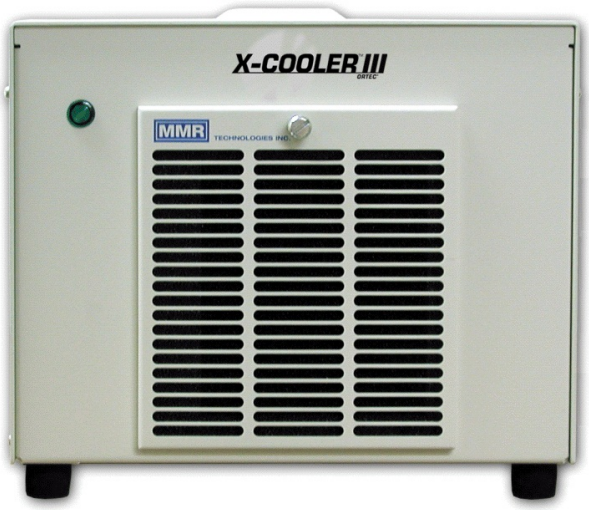

Fig. 3. Filter Intake Door.

3.10. Fuse Replacement

The X-Cooler III is equipped with a surge resistant fuse to protect the instrument from power surges (as are many analytical instruments and electronics). A blown fuse must be replaced for continued operation of the X-Cooler III. Fortunately, the replacement of a fuse is a simple procedure that can be carried out within a few minutes. Follow these steps to replace a fuse in the X-Cooler III. The 115 V model X-Cooler III uses 20 mm × 5 mm Littlefuse® Slo-Blo®, 250 V, 8 A fuses. The 230 V model uses 250 V, 6.3 A fuses with the same dimensions.

WARNING If the X-Cooler III should lose power for any reason, you can reapply power anytime within 10 minutes of initial power loss. ***If power loss persists for more than 10 minutes, the system should be warmed to room temperature before re-cooling.*** Typical warm-up time for most detectors is 24 hours; for higher-efficiency detectors (>70% efficiency), allow 36 hours warm-up time (see the final caution in Section 2.4).

1) Locate the fuse housing beside the On/Off switch located on the rear panel of the unit (Fig. 4).

2) Unplug the ac power cord from the wall socket and remove the ac power cord from the connection at the rear of the panel.

3) Using a small flat-ended screwdriver, carefully flip open the flip-housing that encloses the fuse assembly module (Fig. 5).

4) Carefully pry out the red fuse assembly module as shown in Fig. 6 using a flat-ended screwdriver (taking care to note the positioning of the fuse on the underside of the module). *The fuse must be replaced in exactly the same position in the housing in order for the X-Cooler III to operate.*

5) Turn the module upside-down to reveal the fuse to be replaced. Remove the old fuse and insert the replacement fuse in exactly the same position (Fig. 7).

Fig. 4.

Fig. 5.

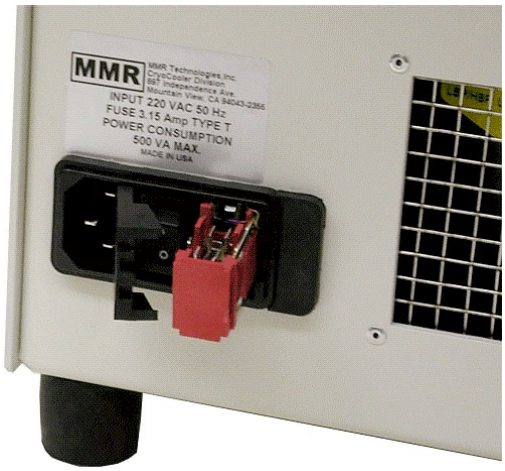

Fig. 6.

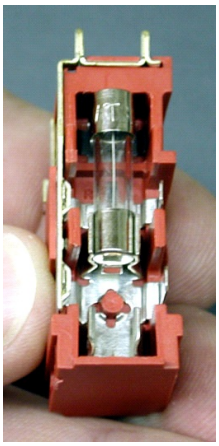

Fig. 7.

6) Once the replacement fuse is inserted. Turn the module right-side up again and reinsert the module into the receptacle as shown (Fig. 8).

7) Carefully close the flip-housing and replace the ac power cord, then reconnect the ac power cord back to the ac power supply. Remember that you can reapply power anytime within 10 minutes after turning off the power. If the power is off for more than 10 minutes, the system should be warmed to room temperature before re-cooling.

Fig. 8.

4. TROUBLESHOOTING

The following troubleshooting guide is intended for general use. It is not a comprehensive guide to maintaining or repairing X-Coolers. For specific problems that are not addressed by this guide, please contact your local service representative for assistance.

If the X-Cooler III should lose power for any reason, you can reapply power anytime within 10 minutes of initial power loss. If power is lost for more than 10 minutes, the system should be warmed to room temperature before re-cooling. See the final caution in Section 2.4.

4.1. Compressor Shuts off Before Detector Is Cold

If the X-Cooler III compressor unit shuts off before the detector is completely cold, most likely oil has gotten into the return lines because the compressor box was tipped during shipment or installation. Turn the power switch on the back panel to the "Off" position. Allow the unit to sit with the compressor off for 24–36 hours.

After the compressor has been off for the specified time period, turn the compressor switch back on and let the compressor run for 1 minute. Turn the power back off and the let compressor sit idle for 15 minutes. Turn the compressor on and let it run again for 1 minute. Turn the compressor back off and let it sit for 2 hours. After this cycle is complete, turn the compressor back on and let it perform its normal cool down. Performing this On/Off/ Idle procedure should force any residual oil in the return lines back into the compressor. The X-Cooler III should then run normally.

4.2. Compressor Does Not Turn on

Verify the following:

- AC power cord is plugged into receptacle and into wall outlet.
- No circuit breakers or fuses on the ac power line have been tripped.

- Any UPS in the system is powered "On."
- The main power switch (on power cord plug receptacle on the back panel of the compressor box) is in the "1" or "on" position.
- Fuse is correctly installed in the plug receptacle and the correct voltage is shown on the plug.
- The X-Cooler III is rated for the voltage being applied. X-Cooler IIIs must be ordered either as 115 V ac 60 Hz or 230 V ac 50 Hz units; they do not have universal power supplies.

If this does not remedy the problem, then an excessive amount of oil might have gotten into the compressor piston area and has frozen the piston in place. To fix this problem, stand the X-Cooler III on its right side (looking from the front) for 2 hours. Then, turn the X-Cooler III right-side-up and turn the power switch on. The X-Cooler III should now run normally.

If this does not remedy the problem, contact your ORTEC service representative or our Global Service Center.

4.3. Detector Does Not Take Bias

If the compressor is running normally and the compressor power never cuts out, then the detector should eventually get cold enough to take bias. If it does not, check that the bias shutdown circuit is operating properly (detector preamplifier must be powered for the bias shutdown circuit to operate). Check the preamplifier and the electronics.

If all items check out okay, contact your ORTEC service representative or our Global Service Center.

4.4. Bias Abruptly Stops

Verify all items listed in Section 4.2, then allow the unit to sit with the compressor off for 24–36 hours and restart it.

If the problem persists or the X-Cooler III cannot cool the detector again, contact your ORTEC service representative or our Global Service Center.

4.5. Coldhead Is Sweating and Detector Will Not Take Bias

Some amount of condensation, or "sweating," on the coldhead is normal. The condensation can occur because part of the heat exchanger is touching the stainless steel or because the ambient temperature or relative humidity has changed markedly. Sweating during initial cooldown is normal. If the coldhead section of the X-Cooler III is condensing large amounts of water on the surface and the ambient temperature has remained relatively stable after initial cooldown, then there has been a loss of vacuum in the coldhead. If this occurs, contact your ORTEC service representative or our Global Service Center.

4.6. Loss of Power

If the X-Cooler III should lose power for any reason, you can reapply power anytime within 10 minutes of initial power loss. If power is lost for more than 10 minutes, the system should be warmed to room temperature before re-cooling.

If the loss of power occurs during the initial cool down of the HPGe detector, the compressor will likely be unable to overcome the pressure built up in the system. Turn the red compressor power switch to the "Off" position and

allow the system to warm up to room temperature, then follow the normal procedure for turning the compressor on.

4.7. Ground Loops, Microphonics, and RF Pickup

As with any other analytical measurement, a gamma-ray spectrum can be described as being made up of two basic components. One component represents the "Signal" that carries information about the gamma-ray emitters present in the sample. The second component, called "noise", is made up of extraneous information that is unwanted because it degrades the resolution of the spectrum. The best resolution for high-purity germanium detector systems is obtained when "noise" is kept to a minimum. Noise problems with mechanical coolers are normally associated with ground loops, microphonics, and RF pickup. The following is a list of tips to help you to resolve problems at your site.

4.7.1. Ground Loops

One common form of noise is referred as a ground loop. Put simply, a ground loop can occur when there is more than one ground connection path between two pieces of equipment. The duplicate ground paths form the equivalent of a loop antenna which very efficiently picks up interference currents. In the case of HPGe measurements, this results in degraded resolution. To test for ground loops, unplug the X-Cooler III from the circuit (you must physically break the AC circuit) and see if the detector noise decreases (resolution improves).

To minimize the effect of ground loops:

- Use the same electrical circuit to supply X-Cooler III and system electronics power. Add a grounding cable from the cryostat to computer and/or DIM module. Tighten preamp, shroud screws, and DIM cable connectors.
- The HVSD (High Voltage Shutdown) cable BNC connector is "not" at ground and may cause pickup problems if in contact with the cryostat. This is particularly prominent when the HVSD is bypassed. Make sure it cannot come into electrical contact with the cryostat.
- Make sure that the detector endcap is not in electrical contact with any shielding or mechanical support assemblies you may be using.

4.7.2. Microphonics

The term microphonics refers to noise that is generated primarily by vibration. You can distinguish between ground loops and X-Cooler III microphonics by first turning off the compressor. If the detector noise improves, the fault is likely due to microphonics in your system. Microphonics may be a result of the positioning of the X-Cooler III relative to the detector, or the positioning of other equipment relative to the detector.

If the X-Cooler III should lose power for any reason, you can reapply power anytime within 10 minutes of initial power loss. If power is lost for more than 10 minutes, the system should be warmed to room temperature before re-cooling. See the final caution in Section 2.4.

To minimize the effects of microphonics:

- Dampen the detector with a foam pad.
- Position the detector as far from the compressor as possible.

- Turn off equipment that may be transmitting vibrations to the detector.
- Use amplifier baseline-restore settings.

4.7.3. Radio Frequency (RF) Pickup

RF noise refers to electromagnetic fields that are produced by power lines, equipment, and instruments. Thus, there are many potential sources of RF noise. In most cases, proper position-ing of your HPGe system relative to other equipment will minimize any potential for RF noise. Problems with RF are best observed from the amplifier output using an oscilloscope. They will appear as some variation of a sine wave. If an oscilloscope is not available, then systematically turn off all possible RF sources to find the offending source.

To minimize RF noise:

- Proper system geometry is key; the detector should be as far from the compressor, computer monitors and any other possible RF source as possible.
- On digital systems USB cables can be extremely susceptible to RF. Relocate the USB cable and/or add EMI shields to reduce pickup.
- In areas were RF is problematic; the addition of EMI shields (or aluminum foil) to the detector system cables may be required.
- If using a digiDART, unplug the battery charger to see if the charger is inducing noise in the detector.

5. SPECIFICATIONS[1]

Resolution Detector specifications are warranted to no degradation above 500 keV and <10% degradation less than 500 keV.

Mechanical:

- **Dimensions**
  - Compressor: 31.8 cm W × 31.8 cm D × 28 cm H (12.5 in. × 12.5 in. × 11 in.)
  - Coldhead Length with Detector Capsule:
    "-70" detector capsules 55.1 cm (21.7 in.)
    "-76" or "-83" detector capsules 58.4 cm (23 in.)
    "-95" detector capsules 61 cm (24 in.)
    "-108" detector capsules 62.5 cm (24.6 in.)
- **Weight**
  - Compressor: 16.4 kg (36 lbs)
  - Coldhead: 5 kg (11 lbs) not including crystal

Noise Less than 60 dB at 1 m.

[1] Subject to change without notice.

Input Power 110–120 V ac 57, 63 Hz; or 220–240 V ac 47 53 Hz. Input power must be selected by ordering the appropriate model number.

Power Consumption <500 W during initial cool-down; <400 W during normal operation.

Operating Temperature 5°C to 30°C (40°F to 85°F).

Relative Humidity 5–95% non-condensing.

Connector Hose 3 m (10 ft) gas hose connected between compressor box and coldhead assembly is included. Longer lengths available on special request. Contact ORTEC for more information and pricing on other hoses.

Refrigerant Mixed-gas, CFC-free refrigerant; MSDS available on request.

CE Conforms to CE standards for radiated and conducted emissions, susceptibility, and low-voltage power directives.