ORTEC®

ICS-P4®

Integrated Cryocooling System for ORTEC® PopTop®® Capsules

User Manual

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Manual Revision E

Advanced Measurement Technology, Inc.

a/k/a/ *ORTEC*®, a subsidiary of AMETEK®, Inc.

WARRANTY

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

ORTEC's exclusive liability is limited to repairing or replacing at *ORTEC*'s option, items found by *ORTEC* to be defective in workmanship or materials within one year from the date of delivery. *ORTEC*'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 *ORTEC* fails to manufacture or deliver items called for in this agreement or purchase order, *ORTEC*'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 *ORTEC* be liable for special or consequential damages.

Quality Control

Before being approved for shipment, each *ORTEC* 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, *ORTEC* 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 *ORTEC* 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 *ORTEC* 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 *ORTEC* 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 *ORTEC* of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

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.

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

In addition, the following symbol might appear on the product:

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

DANGER – Hazardous voltage

Protective earth (ground) terminal

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1. INTRODUCTION

Congratulations on your purchase of the *ORTEC® ICS-P4®* integrated cooling system. The *ICS-P4®* is specifically designed to cool *ORTEC* PopTop®® capsules at lower cost and with more convenience than liquid nitrogen cooling systems. The *ICS-P4®* is field-replaceable and retrofittable to existing *ORTEC* PopTop® detector capsules. If your HPGe cryostat is an integrated *ORTEC* model or is not an *ORTEC* product, please contact an *ORTEC* sales representative for other cooling options which may be applicable.

1.1. Mechanical Cryocoolers Versus Liquid Nitrogen

A HPGe detector must be cooled to a temperature of approximately 100K to function. This low temperature is necessary for a detector, which is basically a diode device fabricated from single-crystal HPGe, to withstand a large electric field when reversed biased without creating excessive leakage current. An electric field is required to collect charge carriers created in the detector crystal lattice by a gamma-ray or X-ray interaction. The most common methods for cooling HPGe detectors to operating temperature are liquid nitrogen or mechanical cryocoolers.

Liquid nitrogen (LN_2) is currently the most common cooling method for HPGe detectors. With a boiling point of 77K (at standard pressure) and widespread availability, LN_2 appears to be an ideal choice. Liquid nitrogen-based cooling systems comprise a vacuum-insulated vessel called a dewar in which LN_2 is maintained and a thermal transfer device called a cryostat. The cryostat includes a vacuum-insulated cooling path (usually copper) which transfers heat from the HPGe detector element to liquid nitrogen stored in the dewar. Drawbacks to using LN_2 include safety hazards (skin contact with LN_2 causes severe frostbite), inconvenience of maintaining a full dewar, and logistics of LN_2 availability. A dewar of 30 liter capacity may require refilling every 14 to 20 days, whereas smaller dewars may require daily refills. Some regions of the world do not have LN_2 readily available, and when it is available the cost of delivery and storage can be prohibitive. Mechanical cryocoolers are ideal replacements for LN_2 because they are safe and provide continuous cooling as long as electrical power is available.

The *ICS-P4®* solves both LN_2 and mechanical cryocooler problems simply and innovatively. A CryoTel® linear single-piston Stirling cryocooler manufactured by AMETEK Sunpower is used in the *ICS-P4®*. This CryoTel model provides sufficient heat lift capacity to cool even the largest HPGe detectors at ambient temperatures approaching 40°C. ***In addition to its high lift capacity the Sunpower CryoTel products are the most efficient cryocoolers commercially available.*** This feature results in lower input power for a given heat lift leading to reduced vibration and audible noise. In addition, the *ICS-P4®* incorporates Active Vibration Cancellation (AVC) developed by Sunpower which reduces mechanical vibration originating in the cryocooler to much lower levels than previously achievable.

1.2. Components of the *ICS-P4®*

The *ICS-P4®* comprises an integrated cryostat/cryocooler system ready out of the box to accept a PopTop® detector capsule. The power supply is internal and automatically adjusts to any AC power source from 100 V AC (50/60 Hz) to 260 V AC (50/60 Hz). The appropriate power cord connector can be selected from the provided kit to match any standard outlet.

Fig. 1. *ICS-P4®* System with and without PopTop® capsule.

NOTE:	There are no user serviceable parts inside the system enclosure. The enclosure should not be opened except as directed by an authorized *ORTEC* service representative. Opening the enclosure prior to receiving authorization may void the warranty.

The PopTop® capsule receptacle assembly contains the thermal interface and threaded coupling required to attach an *ORTEC* PopTop® capsule to the *ICS-P4®*.

2. WARNINGS AND PRECAUTIONS

2.1. Electrical Hazards 

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

- Be certain the mains power source is within the specifications as shown in this manual.
- If it becomes necessary to open the enclosure as instructed by an *ORTEC* service representative, always disconnect the power cord from the *ICS-P4®* power entry module before proceeding.
- Ensure the proper fuses as shipped with the *ICS-P4®* are installed correctly before plugging in the power cord connector into AC mains.
- Replace failed fuses with the same model and performance specifications as the ones shipped with the unit. ***Never bypass a blown fuse.*** NOTE: If a fuse fails, speak with an *ORTEC* service representative prior to installing a new one.
- Never change or remove the factory wiring of the AC power entry module or any other internal components of the *ICS-P4®*.

2.2. Temperature Hazards

WARNING: While the *ICS-P4®* 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 enclosure, and it should never be opened except as directed by an authorized *ORTEC* service representative.

- Should an *ORTEC* representative authorize you to open the enclosure, unplug the *ICS-P4®* unit from the AC-power source prior to proceeding.
- Never touch any components inside the cryocooler enclosure while the unit is operating. Allow the unit to cool at least 15 minutes after switching OFF electrical power before touching any internal components.
- The cryocooler (round, stainless-steel object inside the enclosure) can be very warm during operation, so avoid skin contact while it is operating.

2.3. Other Hazards

- The cooling fan inside the enclosure can cause injury or damage tools. Do not insert tools or other objects through the fan grill work. Again, there are no user serviceable parts inside the enclosure, and it should not be opened except as directed by an *ORTEC* service representative.

- ***Do not block the cooling fan inlet or exhaust ports as this may cause the unit to overheat.***

2.4. Other Precautions

If the *ICS-P4®* should lose power for any reason, you can reapply power within 10 minutes of initial power loss. ***If the power loss persists for more than 10 minutes the system should be warmed to room temperature before recooling.*** The warm-up time for detectors less than 70% relative efficiency is 12 hours; for larger detectors (>70% efficiency), allow 24 hours warmup time before recooling or removing the PopTop® capsule. Attempting to remove a capsule before the clamp assembly has disengaged the capsule cold finger will permanently damage the capsule.

3. GETTING STARTED

3.1. Contents of the Shipping Container

1. ICS-P4® Assembly
2. Accessory Kit
3. Universal Line Cord Kit
4. ICS-P4® User Manual
5. HPGe User Manual (if detector was purchased with the ICS-P4®)

Accessory Kit

Universal Line Cord Kit

3.2. Unpacking the *ICS-P4®*

The *ICS-P4®* is shipped in a custom container. If a detector was ordered with the *ICS-P4®* the capsule will normally be installed on the *ICS-P4®* at the factory. To unpack the unit please follow the steps outlined below.

1. Set the shipping box with “This End Up” arrows pointing upward.
2. Open the box and remove the top piece of packing foam.
3. While grasping the back of the enclosure and the cryostat barrel near its rear flange, carefully lift the unit from the shipping container and gently set it down pointing vertically up with the rubber feet resting on a flat surface.
4. Remove the accessory pack and any other parts which may have been shipped along with the *ICS-P4®*.
5. Place the packing materials back in the shipping container, and **be certain to retain the shipping container** to use in the event that your *ICS-P4®* unit is transported to a different location or is shipped to an *ORTEC* service center. A replacement shipping container may be purchased from *ORTEC* if the original is no longer available.
6. Install the fuses. The fuse block and fuses are packaged in zippered plastic bags so you can select the proper fuse for the mains power at your site. **Use the 250 VAC/10A time-delay fuses for 100 to 130 VAC**

(50/60 Hz) operation, and the 250 VAC/5A time-delay fuses for 200 to 240 VAC (50/60 Hz) operation. To install the fuses in the block, orient the block to match the alignment key to the key slot (Figure 2), then push the block into the power entry module until both end-tabs snap positively into place (Figure 3). (If your mains voltage does not fall within the two listed ranges then speak with an *ORTEC* service representative to determine which fuses to install.)

Figure 2

Figure 3

3.3. Coupling a PopTop® Capsule

Before applying mains power to the *ICS-P4®*, a PopTop® capsule must be coupled to the cold head. The procedure outlined below requires no tools and can be done by one person. Ensure the detector being coupled to the *ICS-P4®* is an *ORTEC* PopTop® brand capsule. The PopTop® capsule is supplied with a parts kit comprising O-rings, unpowdered vinyl gloves, a container of Apiezon-L vacuum grease, cable ties, a black plastic plug, and a red plastic cap. To couple a PopTop® capsule to an *ICS-P4®* please follow the steps outlined below.

1. Remove the red plastic cap from the receptacle end of the cryostat and the black protective plug from the PopTop® capsule.

2. Orient the *ICS-P4®* unit with the receptacle end of the cryostat pointing upward.

3. Ensure that a black O-ring seal is properly seated in the groove located on the end of the threaded receptacle. Inspect the O-ring for damage. If the O-ring is damaged remove it with a pin or needle. With clean, unpowdered vinyl gloves lightly coat the new O-ring with the supplied Apiezon-L vacuum grease then carefully insert it into the groove.

4. Wearing unpowdered vinyl gloves as included in the parts kit, remove the supplied sieve pack from its sealed plastic pouch, and insert it (brown tinted end up) into the receptacle end of the cryostat as shown in Figure 4. Ensure the sieve pack drops all the way to the bottom of the cylindrical clamp recessed in the

receptacle by gently tapping the threaded end of the receptacle with your fingers. The top of the sieve pack should be approximately 1.3 cm from the top of the cylindrical clamp.

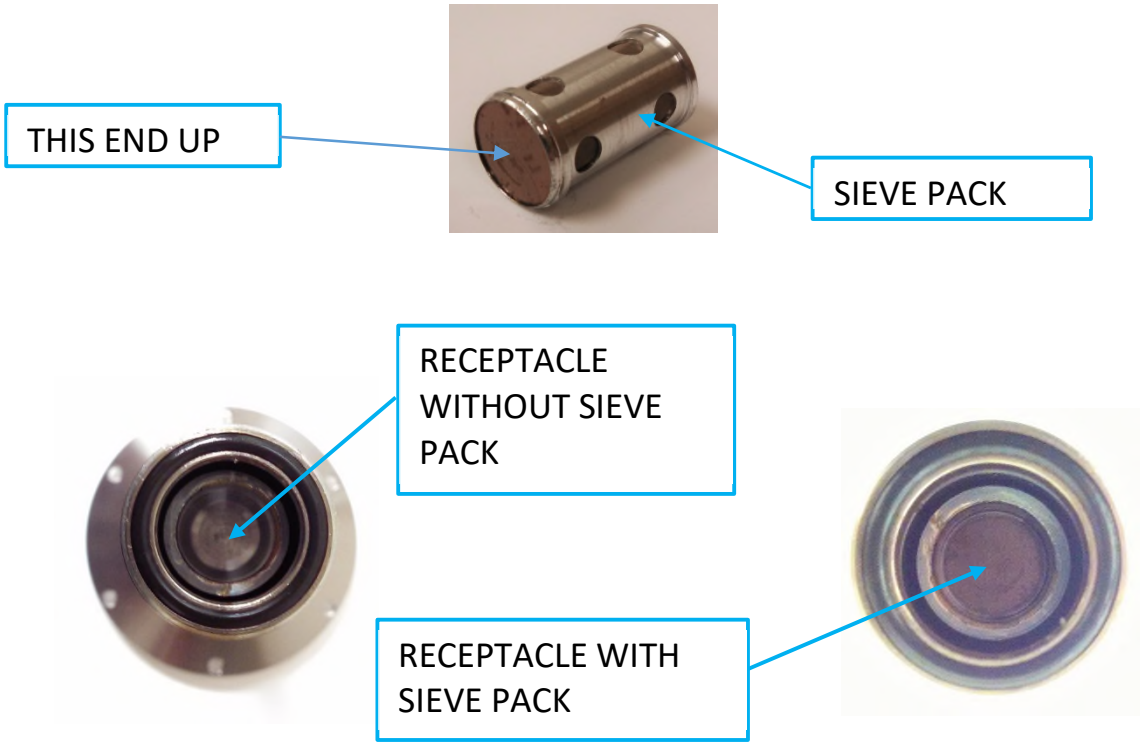

Figure 4. Installing the sieve pack.

5. Hold the PopTop® capsule so it is pointed vertically upward and parallel with the cryostat tube allowing the receptacle end of the cryostat to be inserted into the back of the PopTop® capsule (Figure 5).

CAUTION: Placing the ICS-P4 unit in the up-looking position as shown in Figure 5 is necessary to prevent misalignment of the interface components or cross threading the coupling when removing or installing a capsule.

Figure 5. Coupling a PopTop® Capsule to *ICS-P4®.*

6. Slowly lower the capsule onto the receptacle. You should feel the recessed cooling rod clamp in the receptacle engage the capsule cooling rod.

7. Carefully rotate the PopTop® capsule clockwise. (NOTE: Do not force the rotation.) The detector capsule should turn smoothly with little resistance.

8. Continue rotating the PopTop® capsule until it snuggly seals against the O-ring. Approximately five full turns of the capsule are required to seal the interface. If the capsule stops prematurely *carefully* remove the capsule, then repeat steps 5 through 8. ***Do not overtighten***.

The detector capsule is now coupled to the *ICS-P4®* and is ready to be cooled to operating temperature.

3.4. Positioning the *ICS-P4®*

With the PopTop® capsule attached, the assembled unit should be placed in its operating location prior to beginning the cool-down process. Place the system on a flat, stable surface, and be certain that all four rubber feet engage the surface. If the *ICS-P4®* is to be used in the horizontal orientation, the unit is supplied with a supplemental support to help balance the weight of larger detectors. Attach the support by threading it into the hole provided on the bottom edge of the flange (Figure 6).

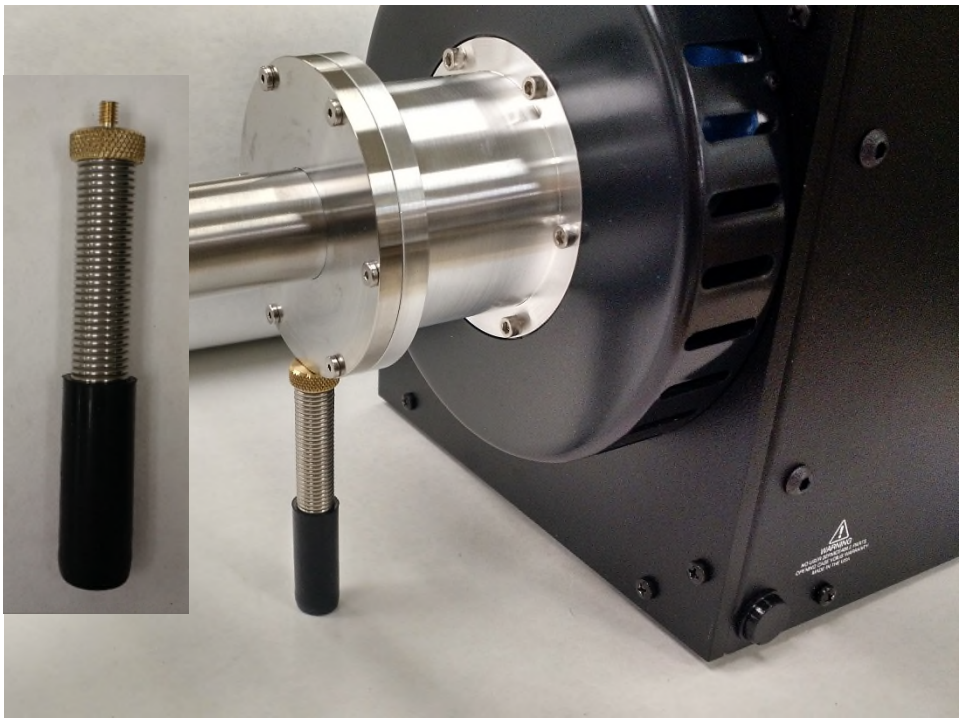

Figure 6. Horizontal orientation supplemental support installed.

Flip the switch on the side panel (integral to the power entry module) to the "O" or off position. **Do not place the cooling-fan air intake closer than 3 cm from a wall or other object to prevent the obstruction of air flow. Similarly, do not obstruct air flow from the effluent air vents located around the cowling.**

3.5. Applying Power to the *ICS-P4®*

Before applying power to the *ICS-P4®* ensure that all of the following conditions are met.

- Verify that the mains voltage and frequency match the *ICS-P4®* specifications and that the circuit can deliver the necessary current to allow the cryocooler to operate at maximum power during the cooldown period.
- Verify that the power switch is in the "O" position.
- Select and attach the proper AC-power cord adapter then connect the power cord to the power entry module and the mains outlet.
- Verify that the enclosure is sitting on a flat, stable surface or is attached firmly to a stand. (Note that the *ICS-P4®* is designed for all-attitude operation.)
- Be certain the PopTop® capsule is properly attached to the interface receptacle.
- Verify that ambient temperature is no greater than 40°C. (Note that the *ICS-P4®* will cool and maintain any detector at proper operating temperature with ambient temperatures up to 40°C.)

Switch the system power switch to the "on" position, and verify that the green power indicator located on the power entry module illuminates. If the power indicator does not illuminate, verify that mains power is available. If power is available but the unit will not start, contact an *ORTEC* customer representative for further instructions.

When power is applied to the *ICS-P4®* the cryocooler will undergo a brief start-up routine (~30 seconds) to calibrate the AVC controller. ***Do not move or otherwise touch the ICS-P4® unit during this calibration period.*** The unit should be cooled to operating temperature at its operating location so the AVC controller will calibrate optimally.

3.6. Detector Cool-Down Time

The time required to cool a HPGe detector to operating temperature depends on the size of the detector and the ambient temperature. Detectors up to 40% relative efficiency will require between 6 and 8 hours to reach stable operating temperature. Detectors from 40% to 70% relative efficiency will require between 12 and 14 hours to reach stable operating temperature. Larger detectors up to 100% relative efficiency may require between 14 and 18 hours to cool. Detectors exceeding 100% efficiency can take up to 20 or more hours to be completely cooled and stable. Be certain to connect the high voltage shutdown circuit as described in the appropriate detector manual and electronics manual(s) before attempting to apply bias to the detector.

To determine if the detector has reached operating temperature attempt to bias the detector from the high voltage supply. If the detector is still too warm, the high-voltage shutdown feature will prevent bias from being applied to the detector. When the detector has cooled to operating temperature the high-voltage shutdown feature will allow bias to be applied. When high voltage has been applied the system should stabilize 15 to 30 minutes prior to using the detector to acquire a spectrum. *Contact an ORTEC service representative if the high-voltage shutdown feature will not permit the high-voltage supply to apply bias after 24 hours of continuous cooling.*

3.7. Normal Operations

The system should emit only low-level white audible noise (typically, less than 55 dBA at 1 meter distance) after the detector has reached operating temperature. If a noise can be heard above the expected white noise, please describe it to an *ORTEC* service representative.

3.8. Warming a Detector to Room Temperature

To warm a detector to room temperature, press and release the “Cooler Shut Down” button. The button will begin to flash. Once the flashing stops, flip the power switch located on the *ICS-P4®* power entry module to the “O” position. Allow at least 12 hours warmup time for detectors up to and including 70% relative efficiency, or for large detectors (>70% efficiency), allow 24 hours warmup time before recooling or removing the PopTop® capsule. Condensation might be observed on the surfaces of the cryostat and capsule during the warming cycle if the ambient dew point is high. Condensation is caused by gas release from molecular sieve in the cryostat and capsule as the sieve warms to room temperature.

3.9. Decoupling a Detector Capsule

WARNING Attempting to remove the PopTop® capsule from a cryostat that has not fully warmed to room temperature will damage the capsule. Any damage to the capsule or cryostat due to premature decoupling of the capsule will void the warranty of the PopTop® detector assembly and/or the cryostat assembly. To ensure your detector is at room temperature, allow 12 hours warmup time for detectors up to and including 70% relative efficiency, or for large detectors (>70% efficiency), allow a warmup time of 24 hours before removing the PopTop® capsule. Alternatively, if your detector has the SMART-1® option, you can monitor the PopTop® capsule temperature to decouple the capsule when the detector temperature exceeds 290K. Consult the respective user manual for the SMART-1 option and DSP product for instructions how to monitor the detector temperature.

Decoupling a detector capsule from the *ICS-P4®* might be necessary to install the capsule onto another cryostat, to replace the original detector with another model, or to return either the detector capsule or the *ICS-P4®* unit for service. For some types of service, it is not necessary to send both the capsule and *ICS-P4®* unit. One advantage of the *ICS-P4®* is that it can be used with another PopTop® capsule while the original one is being repaired.

Decouple a PopTop® capsule by completing the steps which follow.

1. Disconnect any cables attached between the detector capsule and external electronics.

2. Orient the *ICS-P4®* unit with the capsule end of the cryostat pointing upward.

3. Rotate the PopTop® capsule counterclockwise. ***Do not force the rotation***. The detector capsule should turn smoothly with little resistance.

4. Continue rotating the capsule until it can be pulled from the cryostat interface assembly.

5. Place the red plastic protective cover supplied in the parts kit over the open cryostat receptacle.

6. Prior to shipping a detector capsule, insert the protective plug as shown in Figure 7 (contact an *ORTEC* customer service representative to order part number 803223) into the PopTop® capsule and rotate it clockwise to secure it. **Do not ship a detached capsule without inserting this plug.**

Figure 7. Inserting the shipping plug.

3.10. Monthly Filter Inspection

The *ICS-P4®* enclosure has an internal fan for cooling the cryocooler and other internal components. As is the case for most mechanical cooling devices, a filter is used to remove particulates from intake air that can accumulate on cooling surfaces thereby reducing the efficiency of the cryocooler. The filter can be changed in a few minutes without switching off the power (Figure 8). For optimum performance the filter should be cleaned or changed when dirt accumulates. In most laboratories a monthly inspection is recommended. Changing or cleaning the filter more often might be needed if conditions are dusty or excessively dirty.

Figure 8. Removing the air filter for cleaning or replacement.

Replacement filters are available from *ORTEC* (part number 1108003).

3.11. Fuse Replacement

The *ICS-P4®* is equipped with power-surge resistant fuses which can easily be replaced within a few minutes by executing the procedure outlined in section 3.2, step 6. If a replacement fuse fails after power is restored to the unit then contact an *ORTEC* service representative for further instructions.

WARNING	If the *ICS-P4®* should lose power for any reason, you can reapply power anytime within 10 minutes of initial power loss. If a power loss persists for more than 10 minutes, the system should be warmed to room temperature before recooling is initiated. Typical warm-up time for most detectors is 12 hours; for higher-efficiency detectors (>70% efficiency), allow 24 hours warm-up time before restarting the cryocooler or removing the PopTop® capsule.

4. TROUBLESHOOTING

The following troubleshooting guide is intended for general use. It is not a comprehensive guide to maintaining or repairing the *ICS-P4®*. For specific problems that are not addressed by this guide please contact an *ORTEC* service representative for assistance.

If the *ICS-P4®* 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 unit should be warmed to room temperature before re-cooling. See the caution in Section 2.4.

4.1. Cryocooler Halts Before Detector is Cold

If the *ICS-P4* cryocooler unit halts before the detector is completely cold, most likely the heat rejection temperature of the cryocooler has exceeded the safety limit. Flip the switch on the power entry module to the "O" position, then check the filter to be sure it is not clogged. If the filter appears to be clogged then remove it. If the cryocooler has been off less than 10 minutes restore power and monitor the cryocooler to ensure that it remains operational. The cryocooler should restart after the normal 30 second calibration period. Install a clean filter as soon as possible.

4.2. Power Indicator does not Illuminate

Verify the following:

- Be certain the AC-power cord is plugged into a known good mains outlet.
- Check the mains power line circuit breakers or fuses.
- Ensure that any UPS units in the system are powered and operating correctly.
- Be sure the power entry module switch is in the "on" position.
- Verify that the fuses are correctly installed in the power entry module.
- Verify that the mains power is within the limits denoted in the *ICS-P4®* specifications list at the end of this manual.

If the actions in the list given above do not remedy the problem then contact an *ORTEC* service representative to discuss further options.

4.3. High Voltage Bias Supply will not Activate

If the *ICS-P4®* unit has been operating for the minimum cooling time according to the size of detector attached to it, but the high voltage shutdown feature will not permit the bias supply to function. Verify the high voltage shutdown connector from the detector preamplifier is connected to the correct high voltage supply via a known good coaxial cable. In addition, if an *ORTEC* NIM bias supply (such as model 659 or 660) is the high

voltage source, be certain to select the "*ORTEC*" mode of operation as described in the respective user manual. Also, press the reset button on the front panel of the bias supply after switching on the module. If an *ORTEC* ***DSP^{EC}*** ™ or ***digiDART*** ™ product is the high voltage source, be certain to select "*ORTEC*" as the Shutdown option and "Internal" as the Source option if a standard detector capsule is being used. If the capsule is "SMART", then choose "SMART" as the Shutdown option and "DIM/SMART" as the Source option. Please refer to the respective user manuals for your MCA and NIM equipment. If all options have been properly selected, but the bias supply will not start, then contact an *ORTEC* service representative.

4.4. Detector Bias Voltage Abruptly Stops

If all items listed in section 4.3 have been verified, then switch off the unit by setting the power switch to the "O" position. Allow the *ICS-P4®* unit to remain switched off for the prescribed warm-up time then restart it. If the problem persists after the necessary cool-down time, contact an *ORTEC* service representative.

4.5. PopTop® Capsule or Cryostat Condenses Moisture

A PopTop® detector capsule which has been in service in excess of five years may develop some condensation during the first few hours of the cool-down process depending on the ambient dew point. Any observed condensation should dissipate as the molecular sieve contained in the capsule becomes cold enough to create a very good insulating vacuum space by adsorbing nearly all residual gases. On the other hand, if the ambient dew point is within a few degrees of room temperature, then expect the capsule and cryostat to develop condensation even if they are relatively new. This occurs because cryostat and capsule components cooled to cryogenic temperatures will slightly chill external structural components.

4.6. Loss of Power

If the *ICS-P4®* should lose power for any reason you can reapply power anytime up to 10 minutes after the loss of power. If power is unavailable for more than 10 minutes the system should be warmed to room temperature before recooling **(See the warning in Section 3.11)**. The *ICS-P4®* should be connected to an appropriate UPS if short-duration power failures occur frequently. In addition, the *ORTEC* **CryoSecure**™ can be used to automatically thermal cycle the *ICS-P4®* in the event of an extended power failure. Contact an *ORTEC* customer service representative about obtaining and deploying the **CryoSecure** for your particular application.

4.7. Excessive Vibration Noise During Shut-Off

If the ICS-P4® is shut off via the main power switch and excessive vibration noise is detected, turn the main power switch back to the "on" position. Wait until the ICS-P4® stops vibrating (only a few seconds) and then turn the main power switch back to the "off" position.

4.8. Ground Loops, Microphonics, and RF Pickup

A HPGe detector preamplifier output consists of two basic components. The primary component is the signal that carries quantitative information about the Gamma-ray and X-ray energies absorbed by the detector element. The second component is noise which contains no useful information and degrades the resolution of the energy spectrum. Therefore, the best performance of the system is obtained when noise is minimized.

Noise associated with mechanical cryocoolers often comprises ground loops, microphonics, or EMI. The following is a list of tips to help you resolve some of the external electrical noise issues.

Ground loops:

Ground loops are common sources of noise and can occur where more than one ground path is associated with a piece of equipment. The duplicate ground path forms an effective loop antenna which efficiently detects interference currents.

To minimize the effect of ground loops:

- Use the same mains power to supply the *ICS-P4®* and external electronics. If necessary, add a grounding cable from the PopTop® capsule to the external component supplying preamplifier power and bias voltage. Do not allow any of the detector capsule cable connectors to come into electrical contact with the cryostat assembly or the *ICS-P4®* enclosure.

- The high voltage shutdown cable BNC connector is not at ground potential and may cause pickup problems if it is in electrical contact with a cryostat component. The ground-loop effect can be particularly prominent if the high-voltage shutdown cable is not connected to external electronics to provide a definite ground to the cable shield.

- Be certain the detector endcap is not in electrical contact with shielding material or mechanical support structures.

- If using a ***digiDART*** unplug the battery charger to see if it is inducing noise into the system. In the event that the charger is a noise source, contact an *ORTEC* service representative to obtain the proper power-line filter.

- Power line and safety ground filters are commercially available and may be needed to isolate the *ICS-P4®* power and/or the power input to signal analysis equipment.

Electromagnetic Interference Noise:

EMI can be a source of noise from electromagnetic fields that are associated with power lines, electrical equipment, various kinds of electronic instrumentation, etc. In many cases proper positioning of your HPGe detector system relative to sources of EMI may minimize noise sufficiently. EMI noise is best observed by using an oscilloscope to observe the output of a shaping amplifier connected to the detector preamplifier output. Generally, EMI noise will appear as a sine wave or a cluster of sine waves of various frequencies. The magnitude of the offending signal will be affected by the amplifier shaping time which determines the amplifier's response bandwidth and center frequency. Signals above 1 MHz are not a substantial problem at shaping times normally used for HPGe detector spectrometry. However, lower-frequency signals originating from electrical equipment such as motors and electronic ballasts for fluorescent lighting are often problematic. If an oscilloscope is not available, then systematically turn off all possible EMI sources to find the offending source.

To minimize EMI noise:

- The *ICS-P4®* system should be placed as far away from known EMI sources as possible.

- USB cables can be extremely susceptible to EMI. Relocate the USB cable and/or add EMI shields or chokes to the cable to reduce pickup.

- In areas were EMI is problematic the addition of EMI shielding materials to detector-system cables may be required.

5. SPECIFICATIONS

Resolution: Typical detector resolution performance degradation below 100 keV is less than 10%, and typically no degradation above 100 keV.

Enclosure Dimensions: See Figure 10.

Weight: 28.5 lb (12.7 kg) without detector capsule.

Noise: Typically, less than 55 dBA at 1 meter distance from the fan filter at cold equilibrium.

Input Power: 100–240 VAC 50/60 Hz.

Power Consumption: 200 W during initial cool-down.
Typically, less than 80 W at cold equilibrium and 23°C ambient.

Ambient Temperature: -10°C to +40°C.

Humidity: Non-condensing.

Refrigerant: Helium.

CE / NRTL Approved: Pending.

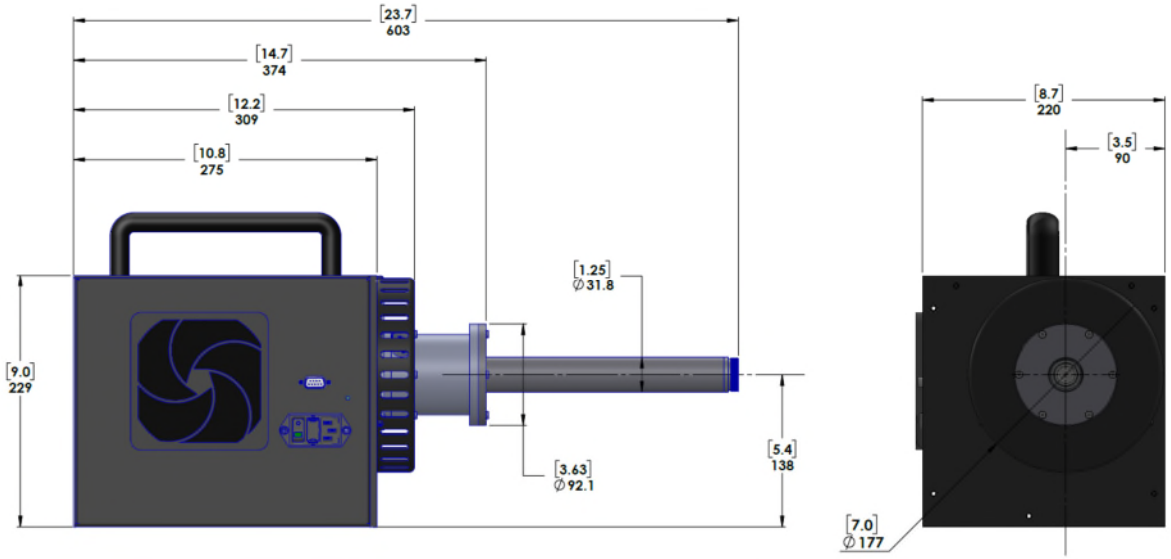

Figure 10. ICS-P4® DIMENSIONS.

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