

# Cryo-Pulse<sup>®</sup> 5 plus Electrically Refrigerated Cryostat

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## User's Manual

7073995E



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Mirion Technologies (Canberra), Inc., 800 Research Parkway, Meriden, CT 06450 Tel: 203-238-2351 FAX: 203-235-1347  
<http://www.canberra.com/>.

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For technical assistance, call our Customer Service Hotline at 1-800-255-6370 or email [techsupport@canberra.com](mailto:techsupport@canberra.com).

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# Important Safety Considerations

## Read Carefully



There are potential hazards in the use and handling of the Cryo-Pulse 5 Plus (CP5-plus) Electrically Refrigerated Cryostat that must be recognized and properly dealt with to avoid the risk of personal injury.

- *Never* open the controller or coldhead housing when the mains power supply is connected.
- *Never* disconnect the coldhead from the controller while the controller rear panel switch is ON or switch it ON when the coldhead is not connected to the controller.
- *Always* make sure the controller rear panel can easily be accessed to switch OFF the unit in case of emergency.
- The controller or coldhead housing should only be removed by CANBERRA trained service personnel.
- *Never* cover or close fan openings and/or holes in the coldhead or controller housing as this can cause overheating and possible fire hazard.
- *Never* try to insert tools in any opening of the coldhead or controller housing.
- *Never* put any objects on top of the controller.



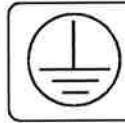
### General Safety



Indicates warning of mains or high voltage present at output labeled HV.  
Risk of electrical shock if covers are removed.



Caution – risk of danger. Refer to documentation for detailed explanation of caution symbol wherever marked.



Earth tree symbol – indicates the connection point for the primary earth (ground) supply.



Product complies with appropriate current EU directives (Low Voltage & EMC)



Product complies with appropriate current FCC / UL /CSA 61010-1 directives (Low Voltage & EMC)

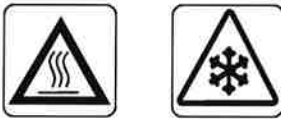
**Mechanical Safety: Caution – risk of injury due to moving parts.**



**Personal Safety: Protective gear is required.**



**Environmental Safety: Caution surfaces hot/cold.**



Mirion Technologies (Canberra), Inc.  
800 Research Parkway  
Meriden, CT. 06450 USA

# Note

# 1. Introduction

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The Cryo-Pulse 5 Plus (CP5-plus) is an electrically refrigerated cryostat for use with HPGe radiation detectors. It consists of two main components: a coldhead (CH) and a controller (CO).

- Coldhead (CH) to which the detector is attached and,
- Controller (CO), providing the required power and control logic to the cooler.

The heart of the coldhead is a 5 Watt pulse tube cooler. The pulse-tube cooler contains a CFC-free and non-flammable gas. The cooler is hermetically sealed, so no gas-refill is required. The compressor contains no oil or lubricant, so no contamination of the refrigerant occurs and no periodic filter exchange is required. This makes the Cryo-Pulse 5 Plus completely maintenance free.

The cooler is integrated in a compact coldhead-assembly which is directly attached to the detector housing. The unit can operate in all orientations. The coldhead-assembly is connected to a bench-top power controller that produces the necessary output voltage to drive the compressor. The controller also contains the logic to operate the CP5-plus in a safe and reliable way.

Most information in sections 1-4 of this manual is applicable to both the standard (air-cooled) version as well as the water-cooled version. Instructions specific to the water-cooled version are listed in section 5, *Water-Cooled Option*, on page 17.



## 2. Installation Guide

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This chapter describes:

- How to set up the coldhead.
- How to connect the coldhead to the controller.
- The controller's rear panel connectors.

### Setting up the Coldhead

When lifting the CP5-plus coldhead always use the two handles, which are integrated in the housing. In some configurations, when using a box-style preamplifier, the front handle can be blocked by the preamplifier. In this case, it is best to lift the coldhead with one hand in the rear handle and one hand place firmly under the detector hardware, as close to the coldhead as possible. *Never* lift the CP5-plus by the detector endcap or preamplifier!

The coldhead comes standard with 4 rubber feet attached to the bottom face of the housing. If the detector is used in any other orientation, these feet can be removed and mounted on the rear or side surfaces.

These or equivalent rubber feet should be used at any time to ensure proper electrical and mechanical isolation between the coldhead and the surrounding structure.

The (4) M5 tapped holes on each side of the coldhead can also be used to mount the detector onto a supporting structure, which can be used to position the detector in any desired orientation, as the CP5-plus is designed for all-attitude operation. Also in this case adequate measures should be taken to isolate the CP5-plus electrically and mechanically from the surrounding structure, especially if there is vibrating electrical equipment nearby.

### Connecting the Coldhead to the Controller

The CP5-plus coldhead should be connected to the controller through the custom cable that is supplied with it. As stated in the safety guidelines, *never* switch ON the controller if the coldhead is not connected to it.



## Controller Rear Panel Connections

This is a brief description of the Model CP5-plus controller rear panel connectors. For more detailed information, refer to the appendix, *Specifications* starting on page 19.

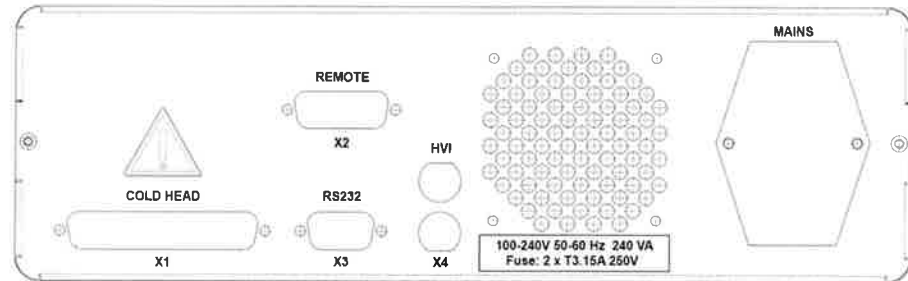


Figure 1 Controller Rear Panel Layout

The rear panel consists of:

- MAINS: mains power supply
- COLD HEAD (X1): DB37-F to connect the coldhead to the controller
- REMOTE (X2): DB15-F relay output
- RS232 (X3): serial interface for PC connection
- HVI (X4): two BNC-F connectors for High-Voltage inhibit signal

### Connecting the Controller to the Mains Power Supply

Always use a power cable equipped with a ground terminal. The controller is equipped with an auto ranging power supply between 100-240V and 50-60 Hz.

### Connecting the High-Voltage (HV) Inhibit

Both the detector and the coldhead are equipped with a temperature sensor that triggers the respective HV-inhibit signal from the preamplifier and the controller. These two HV-inhibit signals should be combined through the two BNC-connectors on the CP5-plus controller to ensure timely shut-off of the HV-bias supply and hence proper protection of the detector.

The HV-inhibit output from the preamplifier should be connected to one of the BNC-connectors on the controller rear panel. The other BNC-connector should be connected to the HV-inhibit input on the NIM HV-supply or digital MCA. It does not matter which of the two BNC-connectors are used as input or as output.

## REMOTE Connector

Through the REMOTE connector two logic signals, corresponding to the state of the yellow and red front panel LED's can be read out. See *Controller Front Panel LEDs* on page 7 for more information on the state of the LED's.

Pin #	Description
Pin 1	Detector T-alarm - NO
Pin 2	Detector T-alarm - NC
Pin 3	Detector T-alarm – common contact
Pin 4	Not connected
Pin 5	Stop cooling relay – NO
Pin 6	Not connected
Pin 7	Stop cooling relay - NC
Pin 8	Stop cooling relay – common contact
Pins 9-15	Not connected

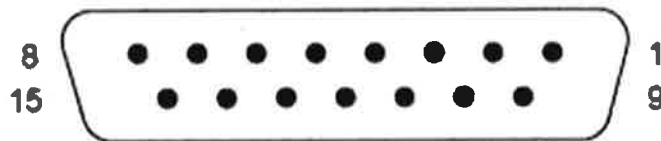


Figure 2 Connector Diagram

### Relays Specifications

- Type: GR2-2
- Manufacturer: OMRON
- Max rating: 48Vac/1A or 48Vdc/1A

## RS-232 Connector

The RS-232 connector can be used to connect the controller to the serial interface of a PC. A RS-232/USB adapter is supplied with the CP5-plus to accommodate PC's without a RS-232 port.

## Using a CP5-plus Controller on a CP5 Coldhead

For customers who have ordered a CP5-plus controller to operate on a previous version (CP5) coldhead, an adapter piece is provided to make them compatible. This adapter should be mounted on the side of the cable that is connected to the coldhead. A CP5-plus cable should be used.

All new features, except the active vibration reduction, of the CP5-plus controller are enabled when using it on a CP5 coldhead. The CP5 coldhead is not equipped with the accelerometer that is used in the active vibration reduction therefore it is not possible to retrofit an existing coldhead with this type of sensor.

## 3. Operating Instructions

---

This chapter describes:

- How to start and stop the cooler.
- How to connect the coldhead to the controller.
- The controller's front panel indicators.

### Starting and Stopping the Cooler

After the CP5-plus has been successfully installed, following the instructions in the previous section, the cooler can be started simply by switching **ON** the switch on the rear panel of the controller.

During operation, the cooler can be stopped at any time by pressing and holding the **ON/OFF** button on the front panel of the controller for 3 seconds. This stops the cooler but keeps the controller and cooling fans in the coldhead powered. Switching OFF the main switch on the rear panel cuts power to the controller completely.

### Controller Status Information

The CP5-plus controller is designed to start/stop the pulse tube cooler, to control the required cooling power and to prevent damage to the detector, cooler, and controller. This section gives an overview of the information available on the controller front panel and describes the controller logic during normal and erroneous operation.

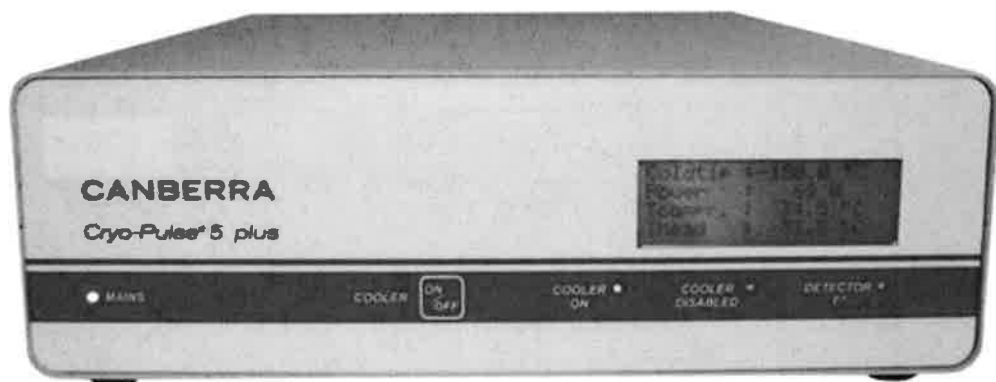


Figure 3 Controller Front Panel

During normal operation the controller sets the appropriate cooling power to achieve the desired coldtip temperature. This desired temperature is preset by the factory and should not be modified. When the system is cooling down the cooler will be operated at maximum power ( $\approx 180$  W) in order to cool down the system as quickly as possible. When the final temperature is reached, the cooler will operate at the input power required to keep the cold tip temperature constant. This power level depends on many variables like the detector/cryostat configuration, the ambient temperature and the coldhead orientation.

## Controller Front Panel LEDs

This is a brief description of the front panel LED indicators.

Mains – *White* LED, indicates the controller is connected to the mains power supply.

Cooler ON – *Green* LED, indicates the cooler is running.

Cooler Disabled – *Yellow* LED, indicates the cooler has stopped, either by the user or by an automatic controller command.

Detector T<sup>o</sup> – *Red* LED, indicates the cold tip temperature is  $> -160^{\circ}\text{C}$ . This also triggers the HV-inhibit output. LED is blinking when the cold tip temperature is  $> 0^{\circ}\text{C}$ .

## Front Panel Display

In normal operation, the front panel LCD displays the following parameters. The user can cycle through pages 1 and 2 by pressing the front panel **ON/OFF** button briefly ( $< 1$  sec).

### Page 1

When the controller is first turned on the display shows the following:

- Coldtip temperature ( $^{\circ}\text{C}$ )
- Cooler power (W)
- Compressor temperature ( $^{\circ}\text{C}$ )
- Temperature of the warm end of the coldhead ( $^{\circ}\text{C}$ )

**Page 2**

Press the **ON/OFF** button to display the second screen. The following information is shown:

- Coldtip temperature (°C)
- AC voltage output 1 (V) | AC current output 1 (A)
- AC voltage output 2 (V) | AC current output 2 (A)
- DT/Dt : cold tip temperature gradient °C/sec

During transient operation or in case of failure, a dedicated status or error message is displayed. The table below gives a complete overview of the possible messages, what they mean and what actions should be taken. A parameter between '< >' will be replaced by the actual measured value.

<b>Table 2 Status Messages</b>	
<b>Display</b>	<b>Explanation</b>
BOOTING Using defaults	Controller is booting. Message disappears after a few seconds.
Checking gradient this may take a while <blank line> - When time < gradient measuring time : Please wait - When time > gradient measuring time : Gradient: <Measured gradient> °C/Min	The controller checks the gradient of the cold-tip temperature to ensure that the detector has completed a full thermal cycle before restarting. This gradient check may take up to 5 minutes, depending on the actual status of the cooler.
The cryogenerator is in remote off status	The cooler has been switched OFF using the remote command through the serial interface. The cooler can only be switched ON using the remote command or by switching the controller OFF and back ON using the mains switch on the rear panel.
Cooler Off	The cooler has been switched OFF using the front panel ON/OFF button. The cooler can only be switched ON using the front panel ON/OFF button or by switching the controller OFF and back ON using the mains switch on the rear panel.
The cryogenerator needs to warm-up please wait Cold temp : <actual sensor temperature>	The detector has started to warm up and needs to complete a full thermal cycle before it can be restarted.

**Table 2 Status Messages**

Display	Explanation
The cryogenerator is ready to start  START MANUAL	The controller is set in manual mode. The detector has completed the full thermal cycle and the cooler can be restarted.

**Table 3 Error Messages**

Display	Explanation	Action
System halted Error V12	The internal +12V power supply has failed.	Perform one attempt to restart the controller using the rear panel button. Contact your local service representative if problem persists.
V48 error Cooler off  48Vint : <fail voltage>	The internal +48V power supply has failed.	Perform one attempt to restart the controller using the rear panel button. Contact your local service representative if problem persists.
System halted Ambient temperature too high Tambient : <Twe> <Twe> = Warm-end temperature at boot time	The temperature of the warm-end of the cooler is too high (+55°C) to allow the system to start.	Wait until the temperature has dropped below +55°C and restart the cooler. If indicated value on CP5-plus is wrong, contact your local service representative.
System halted Ambient temperature too low Tambient : <Twe> <Twe> = Warm-end temperature at boot time	The ambient temperature is lower than the minimum allowed value (+0°C).	Increase ambient temperature. If indicated value on CP5-plus is wrong, contact your local service representative.
EEprom error Using defaults	The settings stored in the EEPROM did not load correctly. The system runs with the default parameter settings.	Restart the controller using the rear panel switch. Contact your local service representative if problem persists. The system may continue to run correctly but should be monitored closely.

<b>Table 3 Error Messages</b>		
<b>Display</b>	<b>Explanation</b>	<b>Action</b>
Error Tint Internal temperature too high Cooler off	The temperature inside the controller is too high. The cooler can be restarted once the controller has cooled down.	Check controller fan. Check that ventilation holes are not blocked (dust, objects,...). Check that ambient temperature is < 40°C. Contact your local service representative if problem persists.
Error T_ext temperature too high Cooler off	The temperature of the compressor or the warm-end of the coldhead is too high. The cooler can be restarted once it has cooled down.	Check coldhead fans. Check that ventilation holes are not blocked (dust, objects,...). Check that ambient temperature is < 40°C. Contact your local service representative if problem persists.
Output error 01 Cooler off Va:<Vac output1>   Vb:<Vac output2> 12Vint :<voltage internal 12V>	There is too large of an imbalance between the drive voltages to the two sides of the compressor.	Perform one attempt to restart the controller using the rear panel button. Switch controller OFF immediately and contact your local service representative if problem persists.
Output error 02 Cooler off Iac1:<Iac output1> Iac2:<Iac output2> 12Vint :<voltage internal 12V>	There is a too large of an imbalance between the currents to the two sides of the compressor.	Perform one attempt to restart the controller using the rear panel button. Switch controller OFF immediately and contact your local service representative if problem persists.
Output error 03 Cooler off Iac1:<Iac output1> Iac2:<Iac output2> 12Vint :<voltage internal 12V>	The current to the cooler is too high.	Perform one attempt to restart the controller using the rear panel button. Switch controller OFF immediately and contact your local service representative if problem persists.



## Installing and Using the CP5-plus Software

This section provides an overview of the CP5-plus Control Panel application.

### Installing the Software



To install the Control Panel application, run the `setup.exe` from the provided CD. The application requires .NET 3.5 (or higher), which will be installed automatically if it is not yet present on the target computer (internet connection required).

#### USB/RS-232 adapter

The required drivers for the USB/RS-232 adapter supplied with the CP5-plus are located on the installation disk of the CP5-plus software. These drivers are compatible with Windows XP and Windows 7 operating systems. The latest version of these drivers can be downloaded from the website [www.ftdichip.com](http://www.ftdichip.com).

### Operating System Requirements

The minimal system requirement:

- Windows XP SP3 (32 bit)
- Windows 7 (32 bit)

5593	<del>5596</del>	
North	120 W	Left Control
South	94 W	Right Control
5596		

## Main Screen

The main screen of the CP5-plus Control Panel application is below. The CP5-plus status and parameters are displayed inside the main window, arranged in three panels. The information is refreshed approximately every 5 seconds.

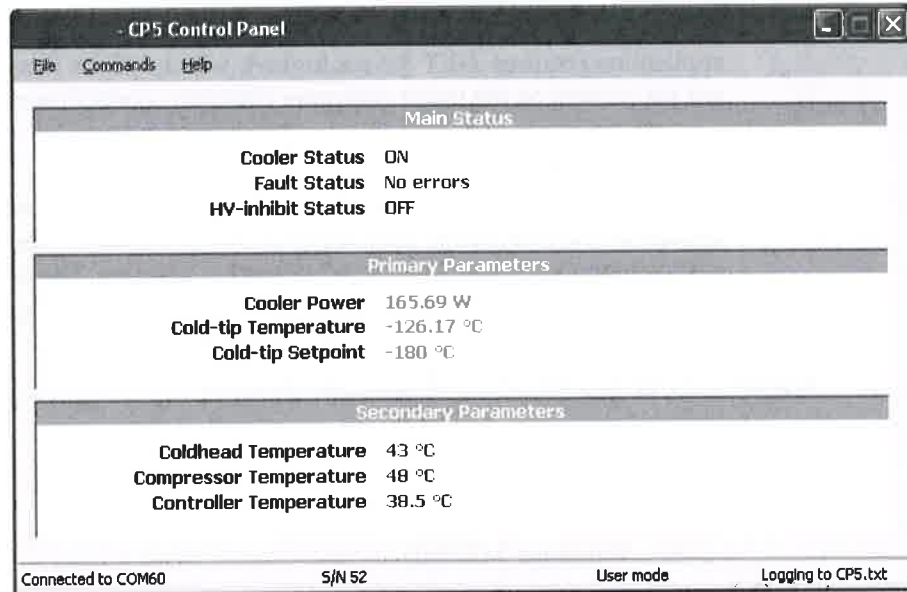


Figure 4 The Main Screen

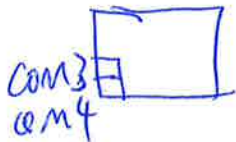
The title bar of the application shows the name of the CP5-plus unit it is connected to. The status bar at the bottom displays, from left to right:

- COM port the CP5-plus is connected to
- CP5-plus serial number
- Current access mode
- Log file name

COM3 ↔ 2358 N  
COM4 ↔ 2355 S

USER Mode

The full path to the log file is displayed in a tool-tip window when the mouse's cursor is positioned over the last panel of the status bar.



## Access Modes

The application has three different working modes: *User*, *Service*, and *Factory*, each allowing access to a different set of commands. ✓

The User mode (default) only allows starting or stopping the cooler remotely. The Service and Factory modes allow setting system parameters and are therefore only to be used by Mirion trained personnel.

## Menu Options

The CP5-plus Control Panel menu commands are briefly explained here.

### File

The **File** menu allows you to save the log file, close the log file, and exit the application.

#### Save Log As...

Used to specify the name of a file where the status and main parameters of the unit will be periodically (every 30 seconds) recorded. If the file exists, old data will be retained and the new one appended to it. The file name will be remembered and automatically reopened the next time the application starts. See next section for details about the log file format.

#### Close Log

Closes the log file, thus effectively disabling logging. The application will no longer open automatically a log file the next time it is launched.

#### Exit

Exits the application. The CP5-plus is switched back to User mode prior to exiting.

### Commands

The **Commands** menu allows you to connect or disconnect to a CP5-plus unit, change the current CP5-plus name, log in or out of Access Mode, or start or stop the cooler.

### Connect...

Invokes the Connect dialog. To connect to a CP5-plus unit, select the appropriate COM port from the drop-down list-box, check that the baud rate is correct and click **OK**. If you want the application to connect automatically to the same unit next time it is started, set the corresponding check box. If the connection is successful, the main screen will show the status and parameters.

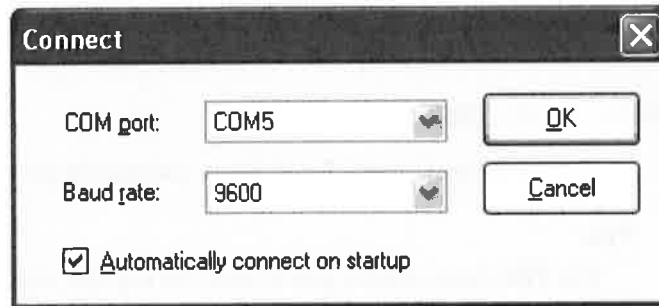


Figure 5 The Connect Dialog

### Disconnect

Resets the CP5-plus to User mode and closes the serial connection.

### System name...

Opens a dialog that can be used to change the current CP5-plus name. The name is stored internally in the CP5-plus controller and gets displayed on the title bar of the Control Panel application. It helps to identify which system is being controlled when there are several CP5-plus devices connected to the same computer.

### Login...

Invokes the Login dialog. Use the radio buttons to select the desired mode (**Service** or **Factory**), supply the appropriate password and then click **OK**.

### Logout

Switches the CP5-plus back to User mode.

### Start/Stop cooler

Used to start or stop the CP5-plus cooler.

### Help

The **Help** menu displays the About... dialog.

## Log File

The CP5-plus Control Panel application periodically records the current status and main parameters of the CP5-plus device into an ASCII text file that can be used to analyze performance. Sections of the file can be imported to Excel for further editing.

Each entry of the log file consists of a set of numeric values output using a fixed-width format with exception is the last field, which is a text string.

There are nine fields in total:

1. Date in DD.MM.YYYY format, where DD, MM and YYYY are the numerical representations of the day, month and year the entry was added.
2. Time in hh:mm:ss format, where hh, mm and ss represent the hour, minute and second the entry was added.
3. The cooler power in Watts, in floating point format with two digits after the decimal point.
4. The coldtip temperature in degrees Celsius, same format as above.
5. The coldtip setpoint value in degrees Celsius, same format as above.
6. The coldhead temperature in degrees Celsius, same format as above.
7. The compressor temperature, same format as above.
8. The controller temperature, same format as above.
9. The fault status message from the CP5-plus controller, as a variable-width string. This is the last field and is terminated by an end-of-line character pair (CR/LF).

The time interval between consecutive entries in the log file is preset to 600 seconds.

This parameter can be modified in the config-file located in the applications installation folder. The default location is C:\Program Files\CANBERRA\CP5 Control Panel. Open the config-file with a text editor, look for the "LogInterval" parameter, replace the value by the desired time interval (in seconds) and save.

Additionally, every time the log file is opened a couple of notification lines are added: one containing the date and time the logging was resumed; followed by a second line with the CP5-plus unit name, the detector serial number and the communication port to which it was connected. Notification lines always start with a string of five stars '\*'. A header describing the numeric fields will follow, in order to help inspecting the file visually. Similarly, when the program terminates another notification line telling when the log was ended is appended.

## 4. Maintenance

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The CP5-plus coldhead and controller do not require any periodic maintenance.

The CP5-plus is not fitted with air filters to prevent clogging if the system is operated in a particularly dirty or dusty environment. In case the ventilation holes would get filled with dirt or dust, they can be cleaned with a small brush or cotton swab or blown clean using compressed air or nitrogen.

If needed cooling fans on the coldhead or controller can be replaced on-site by a Mirion Technologies service engineer.

### **Cleaning and Decontamination**

Surface cleaning is best done with a damp cloth, using a mild detergent if necessary. Do not use chemical cleansers, which can cause deterioration of plastic and rubber components. Avoid abrasive cleansers. Do not allow water to enter the unit. Make sure unit is fully dry before restoring power.

### **Operating Protection Impairment**

Mirion Technologies (Canberra), Inc. is not liable for any operational malfunctions or personal injuries due to mishandling or unauthorized repair and maintenance not detailed in this manual.

## 5. Water-Cooled Option

### Coolant In- and Outlet

The coolant in- and outlet ports are located towards the back of the right-side panel of the coldhead. Although the in- and outlet are interchangeable, it is recommended to connect the coolant inlet to the top port and the outlet to the bottom, as is indicated on the physical unit.

The fittings are 1/8" female BSPT thread which is compatible with a wide variety of adaptors and couplings (quick-disconnect, compression, push-in,...) to be compatible with the coupling type used on the coolant lines.

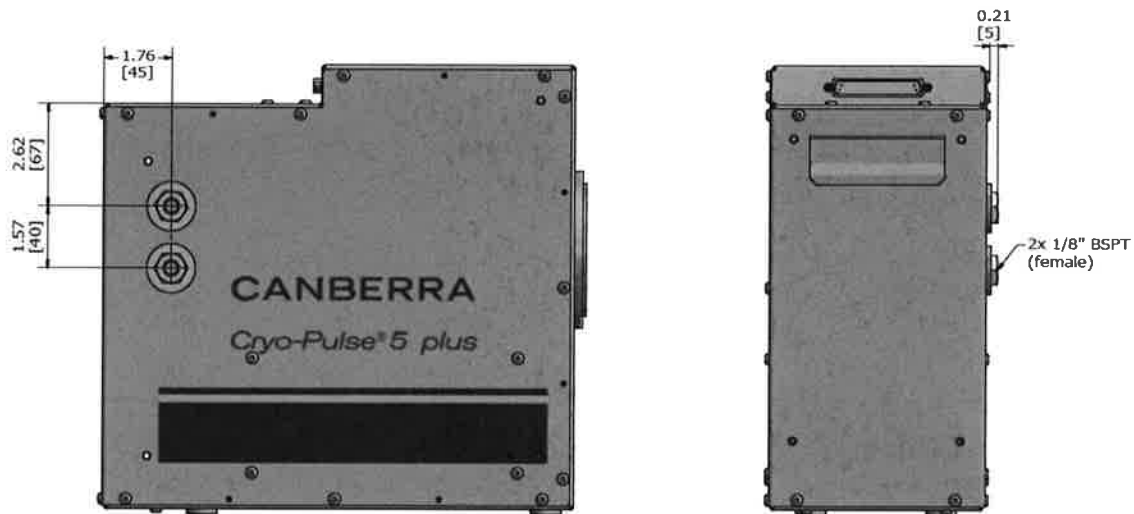


Figure 6 Position of the coolant in- and outlet on the CP5-plus coldhead

### Coolant Specifications

The coolant should respect following specifications:

- Coolant: water with corrosion inhibitor or de-ionized water (refer to the user manual of the selected chiller unit for detailed instructions)
- Min. flow rate: 1 l/min.
- Max. pressure: 10 bar (145 psi) OR as limited by the selected chiller (!)
- Max. coolant inlet temperature: 30°C (86°F).
- Min. coolant inlet temperature 5°C (41°F) AND above local dew point temperature to avoid condensation (see table below).

<b>Dew Point Temperature as function of Ambient Air Temperature and Relative Humidity</b>																
<b>Ambient Air Temperature (°C)</b>	<b>Relative Humidity (%)</b>															
		<b>20</b>	<b>25</b>	<b>30</b>	<b>35</b>	<b>40</b>	<b>45</b>	<b>50</b>	<b>55</b>	<b>60</b>	<b>65</b>	<b>70</b>	<b>75</b>	<b>80</b>	<b>85</b>	<b>90</b>
	<b>5</b>	-16	-12	-11	-9	-7	-5	-4	-3	-2	-1	0	1	2	3	4
	<b>10</b>	-12	-9	-7	-5	-3	-1	0	1	3	4	5	6	7	8	8
	<b>15</b>	-8	-5	-3	0	1	3	5	6	7	9	10	11	12	13	14
	<b>20</b>	-4	-1	2	4	6	8	9	11	12	13	14	16	17	17	18
	<b>25</b>	0	3	6	8	11	12	14	15	17	18	19	20	21	22	23
	<b>30</b>	5	8	11	13	15	17	18	20	21	24	24	25	26	27	28
	<b>35</b>	9	12	15	17	20	21	23	25	26	28	29	30	31	32	33
	<b>40</b>	13	16	19	22	24	26	28	29	31	32	34	35	36	37	38
	<b>45</b>	18	21	24	26	28	30	32	34	35	37	38	40	41	42	43
<b>50</b>	21	25	28	31	33	35	37	40	42	43	44	46	47	48	49	



# A. Specifications

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## **COLD HEAD (Excluding detector chamber)**

DIMENSIONS – 145 x 287 x 313 mm (5.7 x 11.3 x 12.3 in.) (W x H x D).

WEIGHT – 17 kg (37.5 lb) approx.

## **POWER CONTROLLER**

DIMENSIONS – 280 x 88 x 315 mm (11 x 3.5 x 12.4 in.) (W x H x D).

WEIGHT – 5.3 kg (11.6 lb).

POWER CONTROLLER CABLE LENGTH – 3 m (10 ft).

## **OPTION**

Model CP5-C-25 – Controller Cable 7.5 m (24.5 ft).

## **POWER REQUIREMENTS**

100–240 V ac, 50–60 Hz, 250 watts max. (auto ranging power supply).

FUSE – 2x T3.15 A 250 V.

## **CONNECTORS**

2X BNC-F – HV-inhibit.

RS-232 – Remote control and status read-out (USB/RS-232 adapter provided).

DB15-F – Relay output.

## **COOLING**

- Standard version: forced air (internal fans).
- Optional: water-cooled heat sinks Coolant inlet and outlet fittings: 1/8 in. female BSPT.

Max. coolant pressure: 10 bar (145 psi) – or as limited by the selected chiller unit.

Max. coolant inlet temperature: +30 °C (86 °F)

Min. coolant inlet temperature: above dew point temperature to avoid condensation inside the unit.

Min. coolant flow rate: 1 l/min (0.26 gpm).

Coolant: water with corrosion inhibitor or de-ionized water (refer to user manual of selected recirculating chiller for detailed specifications).

**OPERATING TEMPERATURE**

+5 to +40 °C (41 to 104 °F) on standard models and configurations. With water-cooled option: +5 to +50 °C (41 to 122 °F).

**AVAILABLE DETECTOR MODELS AND OPTIONS**

Cryo-Pulse 5 Plus can be ordered with all standard GC-, GX-, GR-, BE-, GL-, GUL- and GSW- detector models (see applicable detector specification sheets for details).

The RDC-option is only available on the Flanged version.

**PERFORMANCE**

Mirion Technologies (Canberra), Inc. guarantees detector performance as warranted by detector model with cooler in operation.

**ORDERING INFORMATION**

<b>Model</b>	<b>Description</b>
CP5-PLUS	Cryo-Pulse 5 plus
CCP5-PLUS/W	Water-Cooled Cryo-Pulse 5 plus(*)

(\*) Chiller and external coolant flow lines to be provided separately.

## **B. FCC Notice**

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The following paragraphs are notices required by Federal Communications Commission (FCC) rules, Part 15, Subpart A.

“The user is cautioned that any changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.”

Note: This equipment has been tested and found to comply with the limits for a class A digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

# Notes

# CANBERRA

## Warranty

Mirion Technologies (Canberra), Inc. (we, us, our) warrants to the customer (you, your) that for a period of ninety (90) days from the date of shipment, software provided by us in connection with equipment manufactured by us shall operate in accordance with applicable specifications when used with equipment manufactured by us and that the media on which the software is provided shall be free from defects. We also warrant that (A) equipment manufactured by us shall be free from defects in materials and workmanship for a period of one (1) year from the date of shipment of such equipment, and (B) services performed by us in connection with such equipment, such as site supervision and installation services relating to the equipment, shall be free from defects for a period of one (1) year from the date of performance of such services.

If defects in materials or workmanship are discovered within the applicable warranty period as set forth above, we shall, at our option and cost (A) in the case of defective software or equipment, either repair on a return to factory basis or replace the software or equipment, or (B) in the case of defective services, reperform such services.

### LIMITATIONS

EXCEPT AS SET FORTH HEREIN, NO OTHER WARRANTIES OR REMEDIES, WHETHER STATUTORY, WRITTEN, ORAL, EXPRESSED, IMPLIED (INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) OR OTHERWISE, SHALL APPLY. IN NO EVENT SHALL WE HAVE ANY LIABILITY FOR ANY SPECIAL, EXEMPLARY, PUNITIVE, INDIRECT OR CONSEQUENTIAL LOSSES OR DAMAGES OF ANY NATURE WHATSOEVER, WHETHER AS A RESULT OF BREACH OF CONTRACT, TORT LIABILITY (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE. REPAIR OR REPLACEMENT OF THE SOFTWARE OR EQUIPMENT DURING THE APPLICABLE WARRANTY PERIOD AT OUR COST, OR, IN THE CASE OF DEFECTIVE SERVICES, REPERFORMANCE AT OUR COST, IS YOUR SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY.

### EXCLUSIONS

Our warranty does not cover damage to equipment which has been altered or modified without our written permission or damage which has been caused by abuse, misuse, accident, neglect or unusual physical or electrical stress, as determined by our Service Personnel.

We are under no obligation to provide warranty service if adjustment or repair is required because of damage caused by other than ordinary use or if the equipment is serviced or repaired, or if an attempt is made to service or repair the equipment, by other than our Service Personnel without our prior approval.

Our warranty does not cover detector damage due to neutrons or heavy charged particles. Failure of beryllium, carbon composite, or polymer windows or of windowless detectors caused by physical or chemical damage from the environment is not covered by warranty.

We are not responsible for damage sustained in transit. You should examine shipments upon receipt for evidence of damage caused in transit. If damage is found, notify us and the carrier immediately. Keep all packages, materials and documents, including the freight bill, invoice and packing list.

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