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**P650 – UVA 100LHe**  
**COLD HEAD**  
**MANUAL**

**Febraury 2023**

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This manual may only be used on the customer's premises.

## 1. SAFETY

### GENERAL

Quantum Technology Corp. equipment is designed according to the national safety standards. The installation, operation and service are performed in accordance with the technical manual. You can find the information about Service Center in the service section of this manual.

### SPECIAL NOTICES

Three types of special notices -- WARNINGS, CAUTIONS and NOTES are used in this technical manual.

#### WARNINGS

WARNINGS pay attention to actions or conditions that can result in serious injury or death.

**CAUTIONS** pay attention to actions or conditions that can result in damage to the equipment or the abnormal performance.

#### NOTES

NOTES provide important, additional information to explain or suggest related problems or operations.

#### WARNINGS RELATED TO MAGNETISM

**AVOID INJURY.** When cryo-cooler is released in a high magnetic field, ferrous tools and parts can become hazardous projectiles. Do not use ferromagnetic tools when the magnet is in a magnetic field.

**AVOID EXPOSURE.** People with Cardiac Pacemakers, Defibrillators or Ferromagnetic Implants shall avoid exposure to strong field. Long-term effects of high magnetic fields have not been completely discovered. Shorten the personal exposure time in the magnetic field.

## WARNING RELATED TO ELECTRICITY

**AVOID ELECTRIC SHOCK.** All electrical supply equipment must meet applicable codes and be installed by qualified personnel. Permit only qualified electrical technicians to open electrical enclosures, to perform electrical checks or to perform tests with the power supply connected and wiring exposed. Failure to observe this warning can result in serious injury or death.

## WARNINGS RELATED TO CRYOGENICS

**AVOID INJURY.** Extreme cold may cause frostbite. Do not touch any parts with frost while handling system components.

Do not splash cryogenic liquids on any areas of clothing or exposed skin; otherwise, skin tissue will get damaged. Always wear eye protection and gloves.

**AVOID ASPHYXIATION.** Keep the operation environment properly ventilated.

## GENERAL WARNINGS

**AVOID ELECTRIC SHOCK.** All electrical supply equipment must meet applicable codes and be installed by qualified personnel.

**AVOID INJURY.** Never use compressed helium gas from system without a proper regulator. Overpressure can cause serious injury if the system equipment ruptures.

Always wear eye protection when handling pressurized gas lines and other pressurized equipment. Never heat up the pressurized gas line or other pressurized components.

Disconnect gas lines only when the compressor is stopped. Disconnect the cold head while the gas returns to the room temperature. Material failure and uncontrolled pressure release might cause serious injury.

Please disconnect or connect a gas line coupling to avoid loosening the cold head or compressor coupling according to the Q2.1CH-4K compressor operating manual. Gas pressure can push the coupling with enough force to cause serious injury.

## CAUTIONS

**PRESERVE YOUR WARRANTY.** Modification to equipment without the consent of the manufacturer will void the warranty. Helium gas with a purity of 99.999% is required. The unqualified high purity helium gas can damage the system and warranty is invalid in this condition.

**PREVENT EQUIPMENT DAMAGE.** Only disciplined persons are permitted to install and remove the coldhead.

Damage to gas lines can result from crimping by repeated bending and repositioning.

If the Q2.1CH-4K compressor is wired for 380/400 ( $\pm 10\%$ ) V3~, 50Hz electrical service, connecting to a

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higher voltage may damage the control circuit. Similarly, if it is wired for 480 V3~, 60 Hz, it can be damaged by connecting to 380/400 ( $\pm$ DC10%) V3~.

**AVOID GAS LEAKS.** Check the gasket seal on the male half of each Aeroquip coupling. Be sure that the gasket seal is in place and the sealing surfaces both on the male and female halves are clean before connecting. Replace the gasket seal if it is damaged or missing. Keep the gas line couplings aligned when making or breaking a coupling connection. Leaks might occur due to the weight of the gas line or due to a sharp bend near the connection.

**AVOID A MALFUNCTION.** Do not allow air to get into the helium gas cryogenic system. Moisture from the atmosphere can seriously degrade the performance of coldhead and produce an abnormal noise so that the system can't work normally.

**NOTE:** Please check the ring seal (usually it is black) in the self-sealing connector of the male before connect gas line. For some accidents, the ring seals might be lost. In the accessory, two seals will be supplied. You can use them and put it in the male connector if lost.



ring seal

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## 2. SERVICE

### Service Center:

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Hillsboro Street, Suite 107

Pittsboro NC 27312

Tel: 919.726.2017

Fax: +1-888-711-5222

[service@quantum-technology.com](mailto:service@quantum-technology.com)

<http://www.quantum-technology.com>

## 3. GENERAL INFORMATION

### Type Specification: Coldhead Q2.1CH-4K

Coldhead Q2.1CH-4K consists of a Cylinder, No.1 Displacer, No.2 Displacer, driver mechanism, and Drive Motor.

No.1 Displacer is connected to the scotch yoke which can be driven by the drive motor through the crank with bush so that the rotation of the drive motor can be varied to reciprocating motion of scotch yoke and displacers.

The rotary valve system is furnished to control the helium gas intake and exhaust timing. The rotary valve is also coupled to the drive motor through crank, so intake and exhaust operation is synchronized with the position of the displacer.

The displacer is a loose fit in the cylinder except the top in which it is equipped with a dynamic sliding seal to prevent leakage passed through the clearance between the displacer and cylinder. The Displacers consist of regenerator material which cools the gas when passing downwards to the cold space and heats the gas

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when passing upwards from the cold space. Rare earth regenerator material is used in the 2nd stage displacer to produce the cooling capacity at the temperature of 4.2K.

The pressure above and below the displacer is almost the same except for small pressure drops across the regenerator when gas is flowing through it. Virtually no physical work is required to move the displacer in the cylinder. No work is done on the gas and the gas does no work on the displacer. The pressure in the system increases or decreases due to the operation of the inlet or outlet valves.

## 4. SPECIFICATIONS

Cooling Capacity* First Stage Second Stage	40W@45K (50Hz) 1.25W@4.2K (50Hz)
Orientation**	Vertical Direction
Ambient Operating Temperature	4-30°C
Helium Gas Pressure (20°C) *** Static	1.60-1.65Mpa (232~239psig)
Operating (High Side)(for Reference)	2.20-2.30Mpa (319~333psig)
Pressure Relief Valve Setting	1.86-1.96Mpa (270~284psig)
Gas Supply Connector	1/2-inch Coupling
Gas Return Connector	1/2-inch Coupling
Dimension (approx) Width	180mm
Length	316mm
Height	556mm
Weight	18Kg--approx

\* Based on the KDC6000V compressor

\*\*The cooling performance is slightly different with various mounting direction. The vertical direction is the best.

\*\*\*The operating pressure varies according to the heat load of cold head and temperature around the equipment.

*Table 1.1 Q2.1CH-4K CRYOCOOLER SPECIFICATION*

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## 5. CONSTRUCTION

The Q2.1CH-4K Cryocooler is a two-stage G-M cycle cryocooler. The cryogenic temperature depending upon the head load imposed is produced by the cryocooler, especially less than 30 K for the first-stage cold station and less than 3.5K for the second-stage cold station with no heat load.

The Cryocooler has three major components: the drive unit; the cylinder; and the displacer-regenerator assembly, which is located inside the cylinder. With newly developed material and unique structure, the model Q2.1CH-4K Cryocooler has a performance of 1.25W at 4.2K at 2nd stage. Functionally, the high-pressure helium gas from the Compressor Unit will be supplied to the Cryocooler through the helium gas supply connector. The supply gas will pass into the displacer-regenerator assembly, and come out through the displacer-regenerator assembly to the crankcase through the motor housing, and finally return to the Compressor Unit through the helium gas return connector. The helium gas expansion work in the displacer-regenerator assembly will provide cooling power for the first and second-stage of cold head.

## 6. MAINTENANCE AND DISCLAIMER

Q2.1CH-4K Cryocooler is required to replace the sliding parts inside every 10,000h by the supplier. Please contact supplier approximately 3 months prior the Cryocooler reaches 10, 000h .

The following terms are not supported by the supplier :

- A. Sale beyond the warranty period (13,500h for cold head, 27,000h for compressor, 13,500h for whole system) ;
- B. Damage due to force majeure,( earthquakes, fires) ;
- C. Not in accordance with instructions for use, and maintenance, ;
- D. Use the unauthorized parts for maintenance ;
- E. Use the third party for maintenance without our license.

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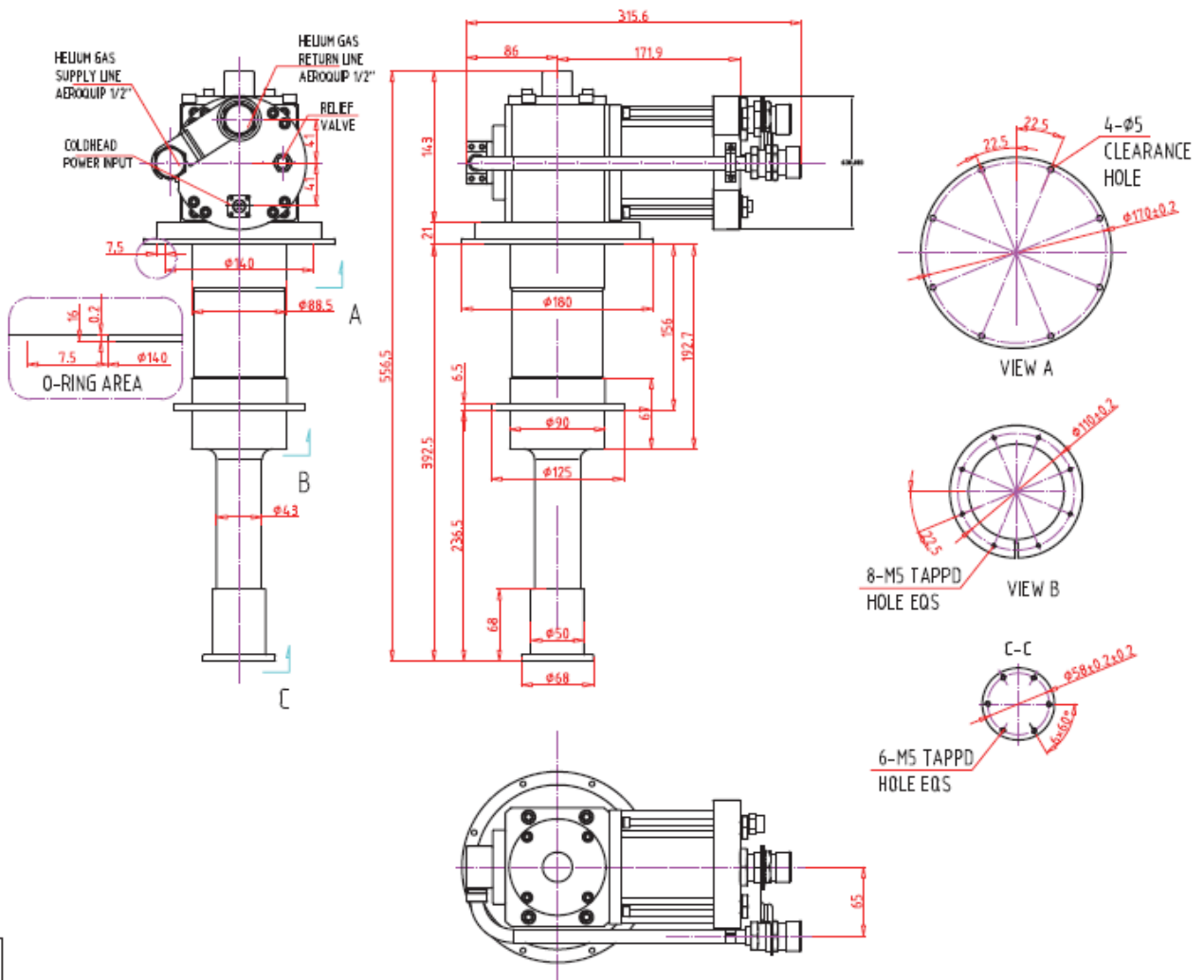
## 7. LABEL

<p><b>Quantum Technology</b> COLD HEAD 4K</p> <p>MODEL Q2.1-CH-4-1.5-2 S/N: P6502023-CH-4-1.5-2-1, 04124F7 VOLTAGE 200V CURRENT 0.52A FREQUENCY 60 Hz REV 72r/min COOLING CAPACITY @ 2nd STAGE: 1.5W @ 4.2K</p>	<p><b>Quantum Technology</b> COLD HEAD 4K</p> <p>MODEL Q2.1-CH-4-1.5-2 S/N: P6502023-CH-4-1.5-2-2, 04124F6 VOLTAGE 200V CURRENT 0.52A FREQUENCY 60 Hz REV 72r/min COOLING CAPACITY @ 2nd STAGE: 1.5W @ 4.2K</p>
<p><b>Quantum Technology</b> COLD HEAD 4K</p> <p>MODEL Q2.1-CH-4-1.5-2 S/N: P6502023-CH-4-1.5-2-3, 04124FC VOLTAGE 200V CURRENT 0.52A FREQUENCY 60 Hz REV 72r/min COOLING CAPACITY @ 2nd STAGE: 1.5W @ 4.2K</p>	<p><b>Quantum Technology</b> COLD HEAD 4K</p> <p>MODEL Q2.1-CH-4-1.5-2 S/N: P6502023-CH-4-1.5-2-4, 04124FD VOLTAGE 200V CURRENT 0.52A FREQUENCY 60 Hz REV 72r/min COOLING CAPACITY @ 2nd STAGE: 1.5W @ 4.2K</p>
<p><b>Quantum Technology</b> COLD HEAD 4K</p> <p>MODEL Q2.1-CH-4-1.5-2 S/N: P6502023-CH-4-1.5-2-5, 04124FE VOLTAGE 200V CURRENT 0.52A FREQUENCY 60 Hz REV 72r/min COOLING CAPACITY @ 2nd STAGE: 1.5W @ 4.2K</p>	

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## 8. APPENDIX



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