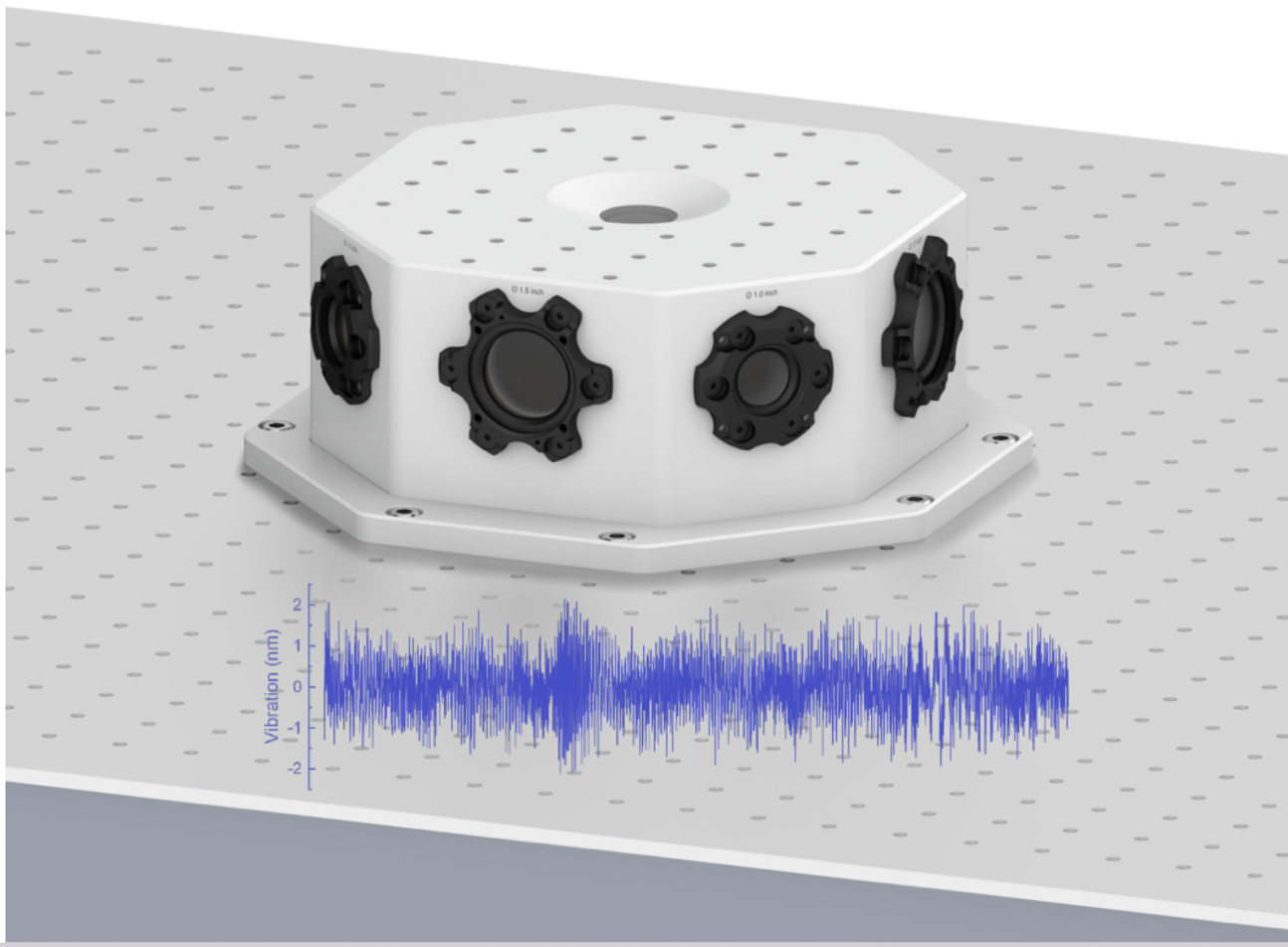
ColdTABLE

Ultra-low vibration & cryogen-free 4 K platform
for optical experiments



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✤ ColdTABLE , Introduction 1 – System Component

The system's basic set contains all necessary devices to keep ColdTABLE working properly. No extra instruments or accessories are needed before starting to run this platform.

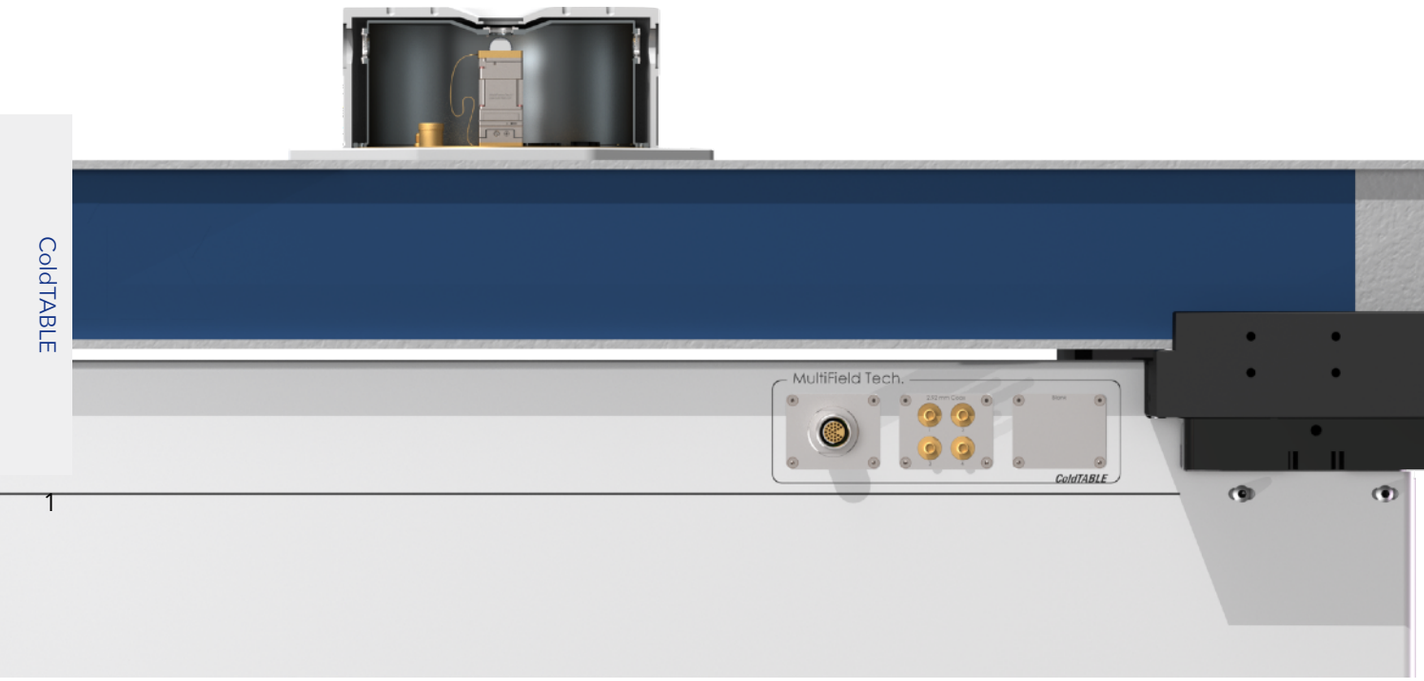


Figure 1. Overview of ColdTABLE's main body.

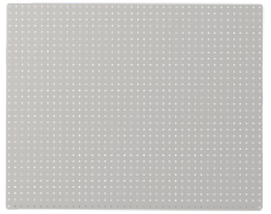
➡ Components of ColdTABLE System

Helium Compressor Unit

Vacuum Pump

Temperature Controller

Floating Isolation System



Optical Table

➡ Key Parameters (Detailed Specifications See Pg.41)

1. Vibration
   - < 5 nm P-P vibration level (3-axis) @ base temperature*
   - Floating isolation system with compressed air
2. Cooling
   - Below 2.8 K base temperature
   - 180 mins cooling time, from 300 K to 4 K
   - Variable temperature from 2.8 - 320 K
   - Cryogen-free
3. Objective & Piezoelectric Motion Set (Options)
   - LT objectives of N.A. 0.90, 0.60 & 0.36 , details in sec.4.1
   - Complete solution of piezoelectric motion, details in sec.4.2
4. Dimension & Optic Access
   - ⌀ 100 mm cold-plate (pure copper plate cooled to base temperature) for end-user
   - 8 side optical windows + 1 optical window at the top
5. Control
   - 12-inch screen for system control and status display

** For ColdTABLE.Quiet only*

✤ ColdTABLE , Introduction 1 – System Component

The system's basic set contains all necessary devices to keep ColdTABLE working properly. No extra instruments or accessories are needed before starting to run this platform.

➡ ColdTABLE

For general low-temperature and low-vibration application scenarios, ColdTABLE adopts a high-power cryocooler to ensure the low vibration of the system and bring excellent low temperature and refrigeration efficiency to end-users.

1. Vibration
   - **< 24 nm P-P vibration level (3-axis) @ base temperature**
   - Floating isolation system with compressed air
2. Cooling
   - **Below 2.8 K base temperature**
   - **Cooling power 220 mW @ 4.2 K**
   - 3 hrs cooling time, from 300 K to 4 K
   - Variable temperature from 2.8 - 320 K
   - Water-cooled compressor

➡ ColdTABLE.Quiet

For experiments that require higher vibration isolation and quieter platform, we also bring new choice to users - ColdTABLE.Quiet. With the ColdTABLE.Quiet even extremely sensitive measurements are possible.

1. Vibration
   - **< 5 nm P-P vibration level (3-axis) @ base temperature**
   - Floating isolation system with compressed air
2. Cooling
   - **Below 3.8 K base temperature**
   - Cooling power 40 mW @ 4.2 K
   - 270 mins cooling time, from 300 K to 6 K
   - Variable temperature from 3.8 - 320 K
   - Air-cooled compressor

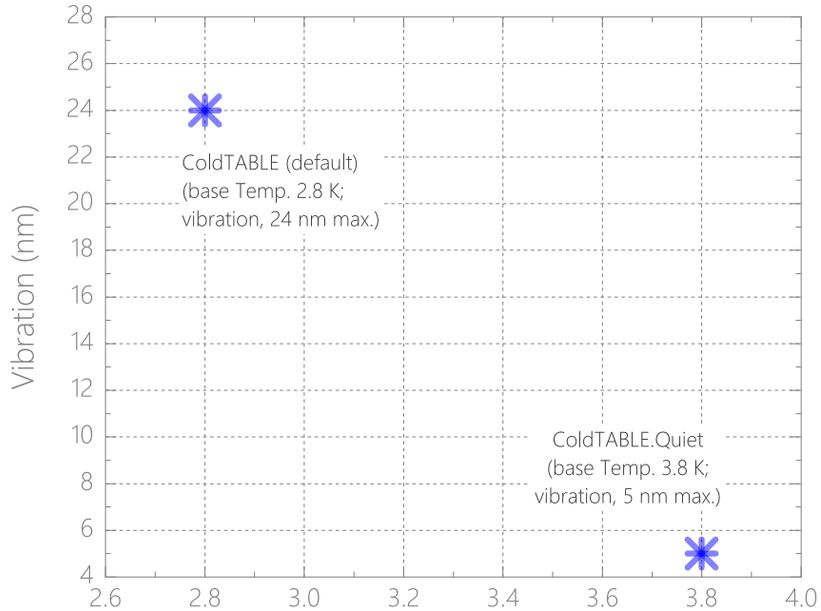
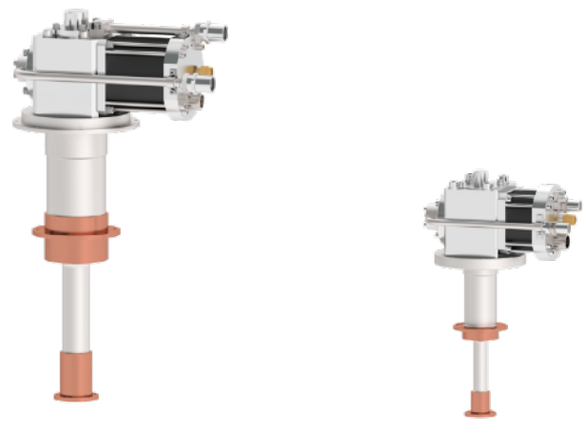


Figure 1. Performance of the two products of ColdTABLE series.



ColdTABLE ColdTABLE.Quiet

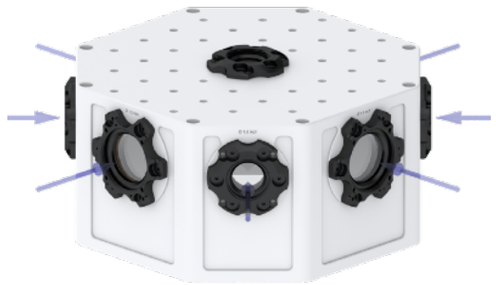
Figure 2. Two GM cryocoolers used in the ColdTABLE series.

✤ ColdTABLE , Sample Chamber 2.1 – Introduction

Sample chamber is where experiments are conducted, the end-user's experience mainly depends on the interaction experience when using the sample chamber.

It is where the important happens.

➡ Standard Optical Access Configuration



➡ Vacuum Chamber (upper part)

8 side optical windows distributed at 45 degrees;

1 optical window at the top;

Atmosphere surface of viewports support 30mm cage systems and SM1 Screw / SM1.5 screw.

➡ 50K Radiation shield

Pure aluminum frame is mirror-finished to provide light weight construction and a high level of thermal radiation shielding.

➡ Vacuum Chamber (bottom part)

Optical Fiber vacuum feedthroughs
Other functional vacuum feedthroughs

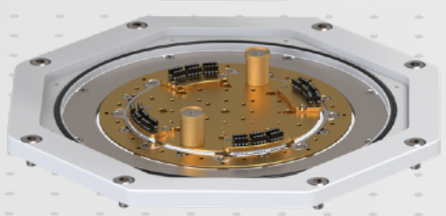


Figure 1. Schematic diagram of the sample chamber.

➡ Introduction to Sample Chamber Area Division

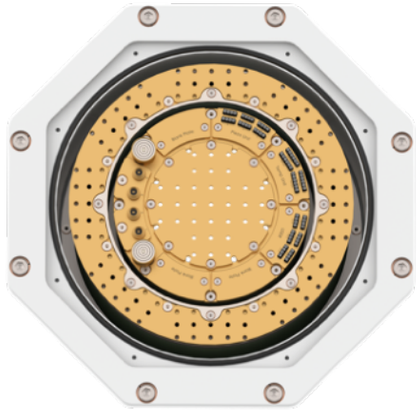
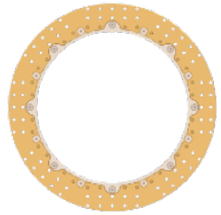
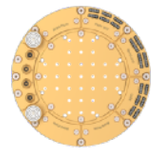


Figure 2. Top view of sample chamber without vacuum cover and thermal shield.



(1) 50K Ring Area

Designed for Heat Sinking and Radiation Shields for 4K Environments.



(2) 4K Cold-Plate

The whole area can reach base temperature . It is consisted by ring area + sample area, details in below parts.

(2.1) 4K Ring Area
(belonging to 4K Cold-Plate)

This is function zone. All electrical connections are put here to make sure the electrical wires are fully cooled and no samples get heated by them.

(2.2) 4K Sample Plate
(belonging to 4K Cold-Plate)

This area is completely left to the end customer to make experimental arrangements freely.

✤ ColdTABLE , Sample Chamber 2.2 – Size of 4K Cold-Plate

For variable experiments, we offer two chamber sizes to choose from. In summary, the smaller chamber has better vibration and lowest temperature performance. The larger chamber offers more free space to end-user.

Standard

⌀100 mm Cold-Plate

2.8 K Base temperature

- Dimension (mm)

50K Ring Area, I.D. ⌀120/O.D. ⌀170

4K Cold-Plate, ⌀100

4K Sample Plate, ⌀75

- Signal Connector Block (Default)

24 Pins DC for Measurement

24 pins for Piezoelectric Motion Control

1 pc A-type Block for spare

1 pc B-type Block for spare

- Thermometer & Heater

1 Cernox + 50 Watt Heater

- Others

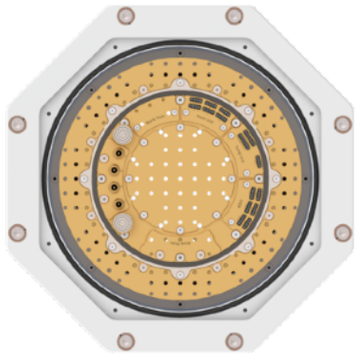


Figure 1. Top view of standard size of sample chamber with default electric connectors and function parts.

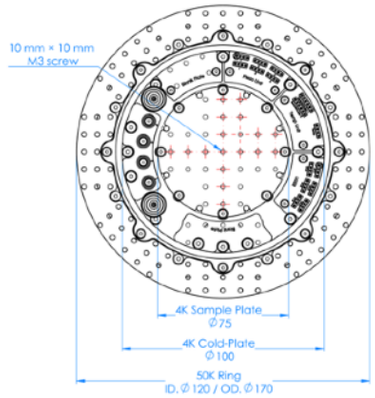


Figure 2. Dimension drawing with key parameters of standard size.

.Max

⌀200 mm Cold-Plate

3.3 K Base Temperature

- Dimension (mm)

50K Ring Area, I.D. ⌀210/O.D. ⌀280

4K Cold-Plate, ⌀200

4K Sample Plate, ⌀148

- Signal Connector Block (Default)

24 Pins DC for Measurement

24 pins for Piezoelectric Motion Control

1 pc A-type Block for spare

1 pc B-type Block for spare

- Thermometer & Heater

1 Cernox + 50 Watt Heater

- Others

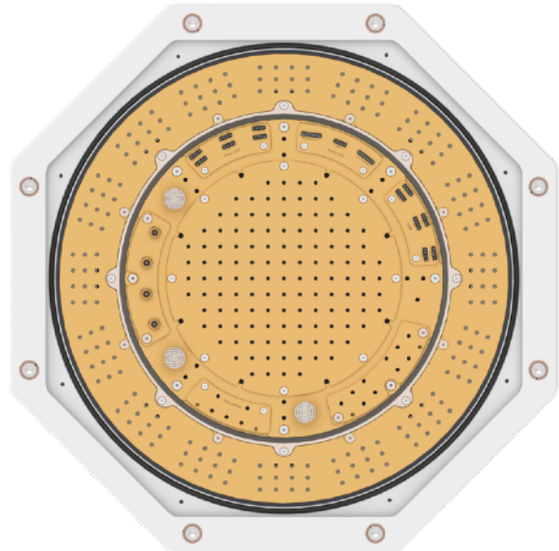


Figure 3. Top view of .Max size of sample chamber with default electric connectors and function parts.

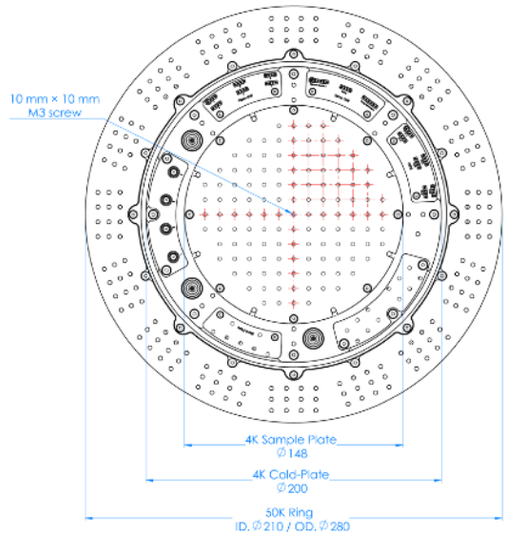


Figure 4. Dimension drawing with key parameters of .Max size.

✤ ColdTABLE , Sample Chamber 2.3 – Electrical Connecto rs & Function Parts in 4K Ring Area

MultiFields offers a variety of electrical connection options. In addition to the temperature control, piezoelectric motion control lines provided by default, ColdTABLE also have a wide range of options, including electrical connectors for high frequency signals, DC signals, and coaxial signals.

➡ Spatial Configuration of Electrical Connectors at 4K Ring Area (Function Zone)

1. ColdTABLE supplies 2 types of universal dimensions plate for electrical connector (details in below part of this page).
2. Unused area is covered by blank plate left for future upgraded.
3. Reserve installation locations within 4K Ring Area covered by blank plate (see right figures).

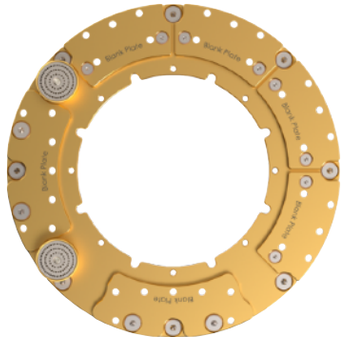
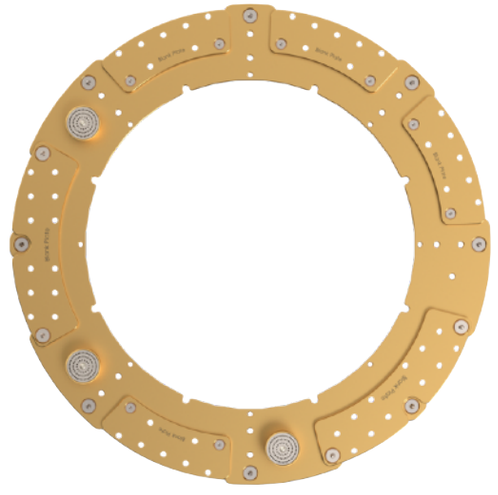


Figure 1. Top View of 4K Ring Area - Standard Version.



B-Type electric block,
4 pcs in total

A-Type electric block,
2 pcs in total

Figure 2. Top View of 4K Ring Area - .Max Version.

➡ List of Electrical Connector Plate & Function Parts

❖ "A-Type" Connector Plate

RF Block - Type (A-Type)
PN:AB1203

4 X 2.92mm Connectors for RF Signals Up to 40 GHz

❖ "B-Type" Connector Plate

PN:AB1204

■ DC Block (B-Type) – 24 Contacts

- 6 straight socket connector units
- 4pins in one unit, with single row arrangement

PN:AB1205

■ Temperature Block (B-Type)

Designed for 2 Temperature Control Units
- 6Pins for one temperature & Heater
- 2 sets

PN:AB1206

■ Piezoelectric Block (B-Type)

Designed for 3 piezo positioners & 2 scanners
- 5pins for one positioner, 3 sets
- 2pins for one-axis scanner, 2 sets

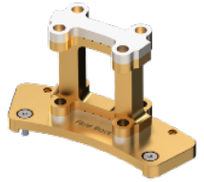
PN:AB1207

■ COAX Block (B-Type)

4 SMP Connectors for Low Noise Measurement
-3.5 dB @ 1 GHz

❖ Function Parts

Sorption Pump
Setup for Adsorbing Residual Gas



Optic Fiber Holder
Setup for Securing Up to 4 Optical Fibers

✤ ColdTABLE , Sample Chamber 2.4 – Optic Access Configuration

*As an optically optimized cryogenic platform, we retain a wealth of optical access channels, including **8** side optical windows distributed at 45 degrees for free beam light, **1** optical window at the top of the sample chamber, and multiple vacuum feedthroughs for fiber access.*

➡ Standard Optic Access Configuration

8 side optical windows distributed at 45 degrees;

1 optical window at the top;

Atmosphere surface of viewports support 30mm cage systems and SM1 Screw / SM1.5 screw.

Figure 1. Optic access to sample chamber, schematic of windows spatial configuration.

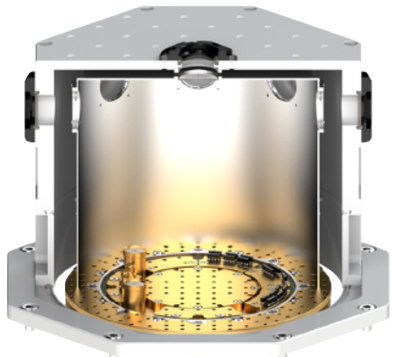


Figure 2. Cross-section of sample chamber.

➡ Vacuum Viewports Support Cage System & SM1.0 / SM1.5 Screw

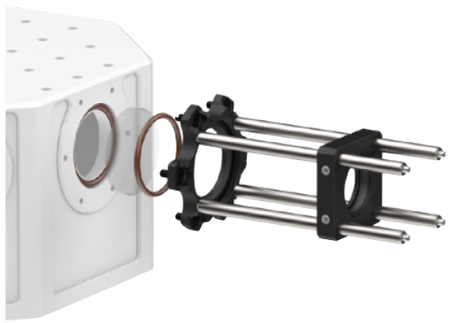


Figure 3.1 - ⌀1 windows, support 30mm cage systems and SM1 Screw.

Figure 3.2 - ⌀1.5 windows, support 30mm cage systems or SM1.5 Screw.

➡ Tech. note, Optical windows you need

1. Window formation
   - (Default) Flat windows
   - Wedged (30 arcmin) windows
2. Outer diameter
   - (Default) ⌀1 inch windows (bare mirror) / ⌀0.75 inch clear aperture after installed in vacuum viewports
   - ⌀1.5 inch windows (bare mirror) / ⌀1.2 inch clear aperture after installed in vacuum viewports
3. Thickness
   - (Default) 3 mm

	Materials	Wavelength range	Shape
1	Silica (UV Fused)	180 nm - 2.1 um	Flat / Wedged
2	Sapphire	200 nm - 5.0 um	Flat / Wedged
3	Calcium fluoride	180 nm - 8.0 um	Flat / Wedged
4	Infrasil®	300 nm - 3.0 um	Flat
5	Magnesium Fluoride (MgF_2)	200 nm - 6.0 um	Flat / Wedged
6	Zinc Selenide (ZnSe)	600 nm - 16.0 um	Flat / Wedged
7	Silicon (Si)	1.2 um - 8.0 um	Flat / Wedged
8	Germanium (Ge)	1.9 um - 16.0 um	Flat / Wedged

Other materials customer required

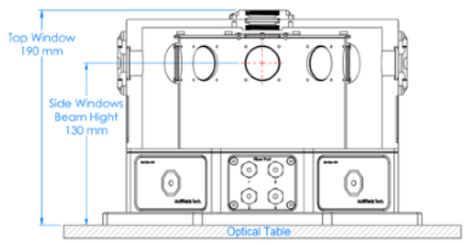


Figure 4.1 - Dimension drawing of optical windows height.

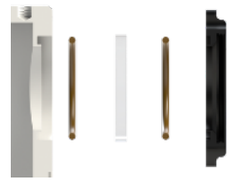


Figure 4.2 - Dimension drawing of ⌀1 inch / ⌀1.5 inch optical window viewports.

✤ ColdTABLE，Sample Chamber 2.5 – Optical Table

We provide various optical table sizes, thicknesses & table heights to meet the special conditions of the end-user's laboratory and experiments.

➡ Table Size

You are free to choose the table size to adapt to your own optical table system and laboratory conditions, and we are ready to fully match the right table size. The following are the available table sizes with specific dimensions (please consult us for other sizes).

Length (mm)	1000	2000	On request
Width (mm)	800	1000	On request
	Default		

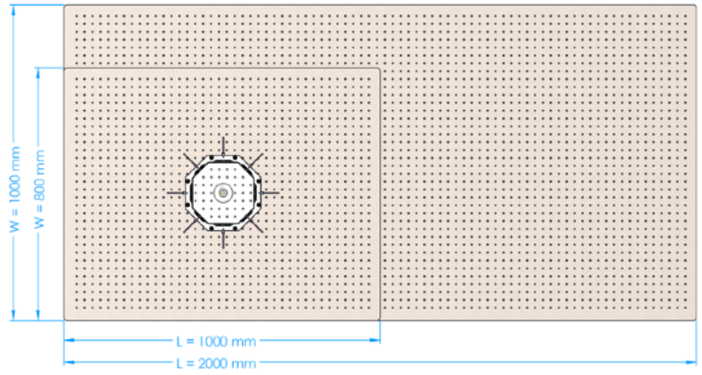


Figure 1. Table size.

➡ Thickness

The optical table of ColdTABLE features 304 stainless steel construction, M6 screw mounting holes on 25 mm x 25 mm matrix and broadband damping optimized for each table thickness. We generally offer three types of table thicknesses to choose from.

Thickness (mm)	100	200	On request
	Default		

* *Thicker Optical Table Means Stronger and Heavier Countertop, Which Usually Provide a More Reliable Anti-Vibration Level, That Is, Lower Vibration of 4K Cold-Plate. However, at the Same Time, Due to the System Structure, a Thicker Optical Table Will Cause a Longer Heat Transfer Path, so the Thicker Optical Table System Will Have a Slightly Longer Cooling Time and a Higher Base Temperature.*

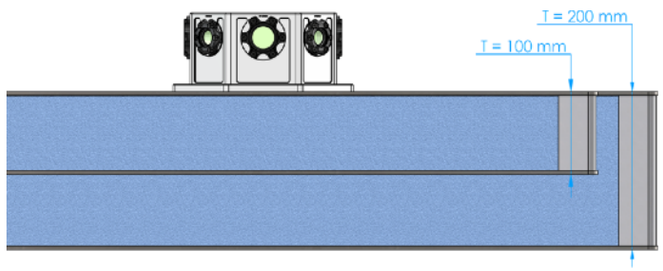


Figure 2. Thickness of Optical Table.

➡ Table Hight

Considering that the table hight of the end user's optical platform is different, in order to make it more convenient for users to carry out optical experiments, the existing experimental optical path and the optical window of ColdTABLE should be kept at the same horizontal level. We can provide a variety of dimensions of table hight for users to meet the conditions.

Hight (mm)	600	800	1000	On request
		Default		

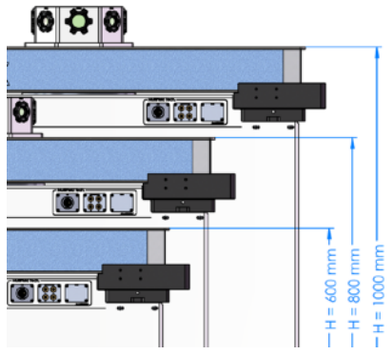
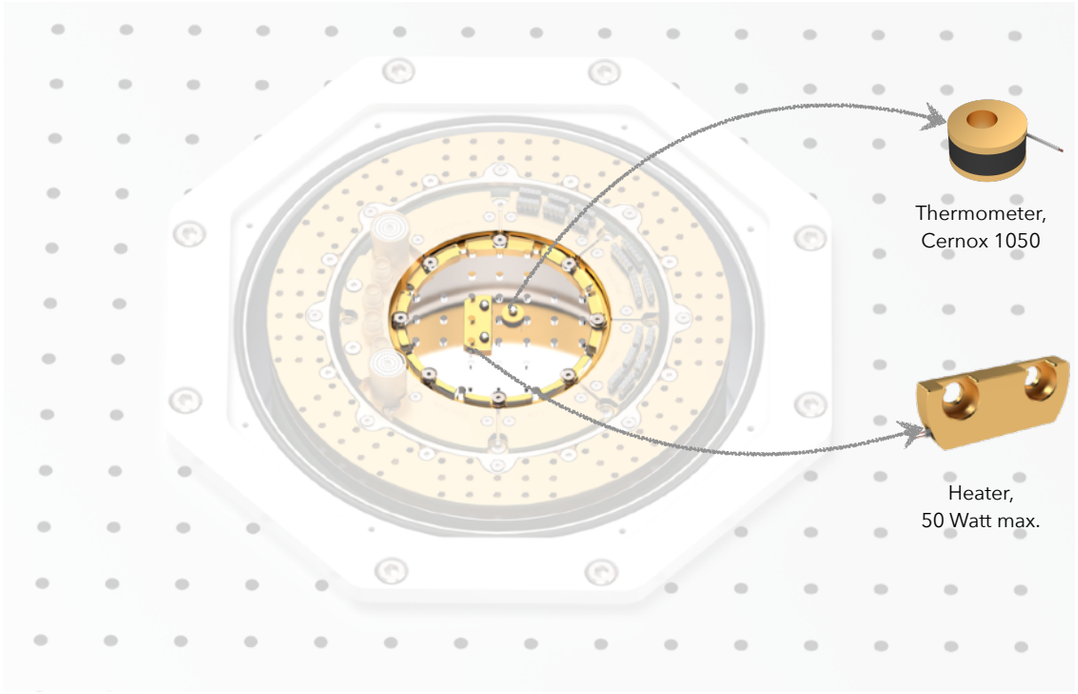


Figure 3. Table hight.

✤ ColdTABLE , Performance 3.1 – Cooling Time & Stability

Based on brilliant cryogenic design and MultiFields cutting-edge temperature controller KELVINION, super-reliable temperature performance is one high-light feature of ColdTABLE.



➡ Temperature Control Module of ColdTABLE System

Provide the most reliable temperature state of the system to the end user.

1. Components of temperature module
   - Thermometer, Cernox 1050
   - Heater, 50 Ω, max. 50 W
2. Location, temperature module
   - The system's default temperature control module (including thermometer and heater) is mounted directly on the underside of the 4K Sample Plate (about the 4K Sample Plate see section 1.2)
3. Meter for temperature control
   - "Kelvinion" temperature controller from MultiFields Tech. (see next page for details)
4. Upgraded option
   - ColdTABLE supports at most 4 pcs thermometers installed if customer required
5. Electrical connections
   - All electrical connections are placed at 4K Ring Area

➡ Temperature Stability, Better than 2 mK @ 4.5 K & 20 mK @ all range

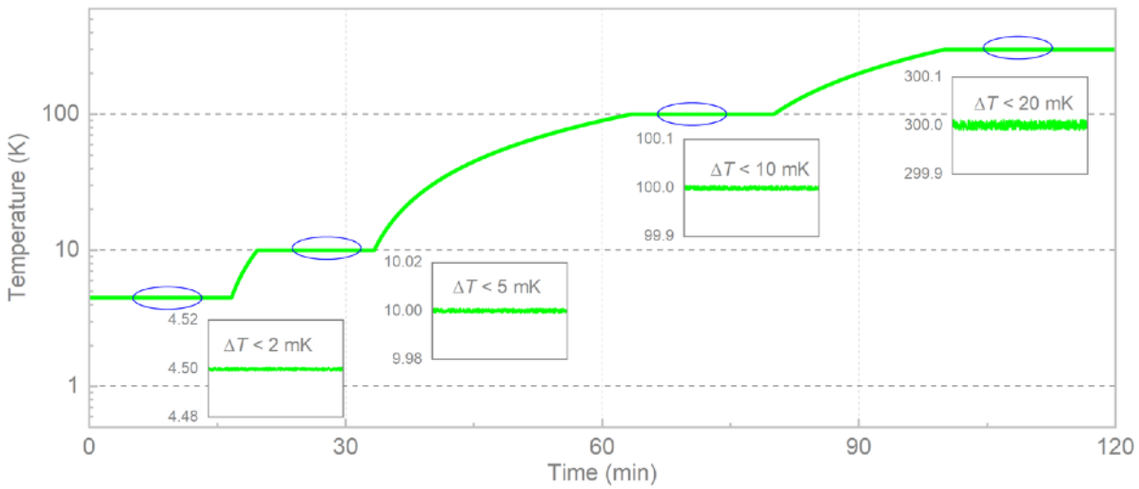


Figure 1. Temperature fluctuations data covering all workable temperature range.

➡ Cooling Time, 180 mins, from 300 K to 4 K

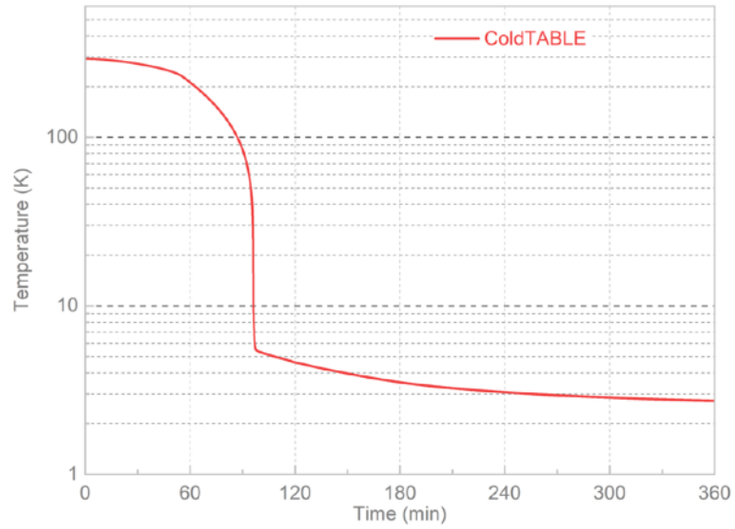
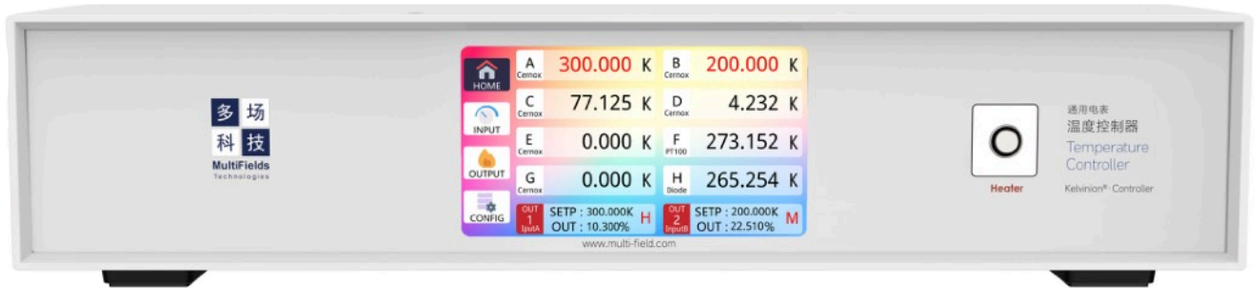


Figure 2. Results from ColdTABLE with no heat load.

✤ ColdTABLE , Performance 3.1 – Temperature Controller Meter, “Kelvinion”

Maximum 100 W power output and minimum 300 mK controlled temperature.



Temperature Controller · Kelvinion

Key Features

- Temperature range of measurement and control down to 300 mK;
- 8 independent monitoring channels with 0.1 mK resolution (24-bit ADC) ;
- Automatic switching of the excitation current for higher accuracy and lower heating;
- Support 1000+ user-defined curves;
- 2 PID output channel with maximum 100 W power output;
- Support 2 relay and 2 analog signal outputs;
- Support setting temperature ramp rate;
- PID parameters can be switched according to the zone table for different temperature ranges (Zone mode);
- Support USB (serial port), LAN and GPIB communications;
- Automatic protections such as heater short and open detection, set point limits are supported.

MultiFields Technologies developed the "Kelvinion", a powerful cryogenic temperature controller. It features 8 independent high-precision temperature monitoring channels and 2 high-power PID output channels (100 + 50 W), as well as 2 relay output and 2 analog output channels. The PID closed-loop control, Zone mode, variable temperature rate setting and active over-temperature detection, make the Kelvinion cryogenic temperature controller a excellent tool for low-temperature research.

✤ ColdTABLE , Performance 3.2 – Vibration Level, Results & Method

Vibration level is the most critical parameter for closed-cycle cryogenic optical platforms. We make ColdTABLE in nanometer vibration level.

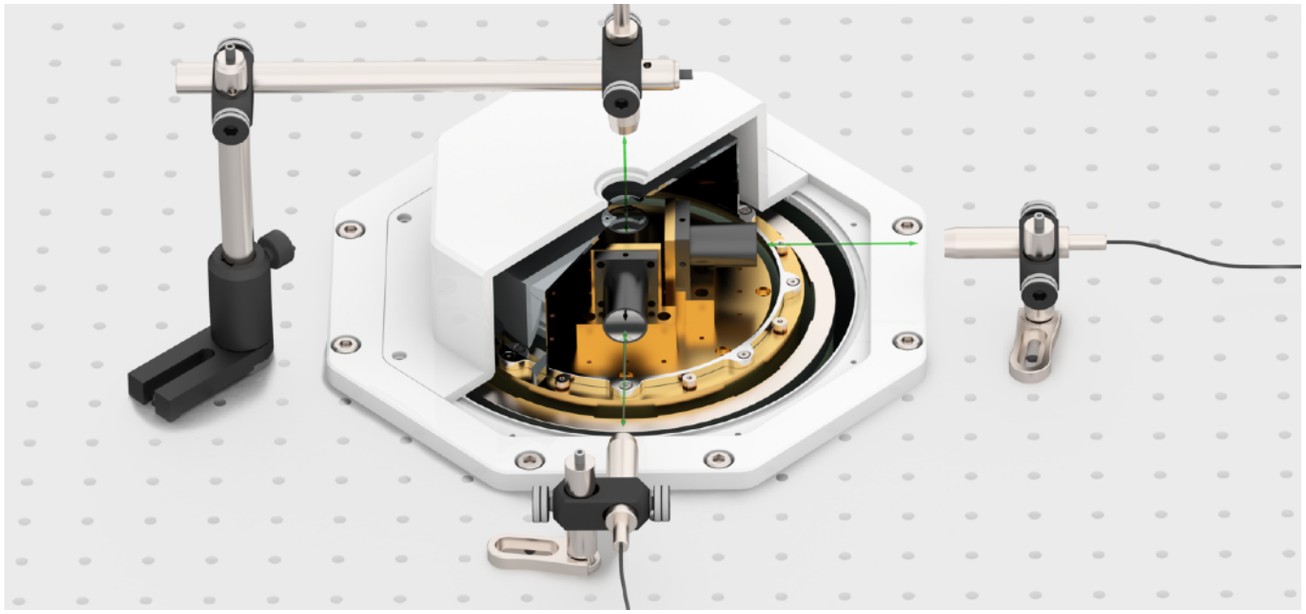


Figure 1. Setup on ColdTABLE for 3-axis vibration measurement by laser interferometer method.

➡ Methods

In terms of accuracy, laser interferometer is a more accurate method for measuring vibration compared to common capacitors or eddy current sensors. On the other hand, considering that the main application scenario of ColdTABLE is also optical, it is a more appropriate way to directly measure the vibration amplitude by means of laser.

According to the measurement method shown in the figure above, the 3-axis vibration amplitude we obtain is essentially the vibration of the 4K Cold-Plate relative to the optical platform plane.

➡ Bandwidth of Vibration Results

It is no good to discuss the magnitude of vibration displacement without considering the measurement bandwidth. In reality, all measurement systems have their own fastest sampling frequency, which is equivalent to a low-pass filtering process.

The main motion frequency of the GM cold head is about 1 Hz, however, this main motion induces vibrations across a wide range of frequencies, resulting in vibration components in the spectrum analysis that can reach several hundred Hertz, so we recommend that the sampling frequency should not be less than 1 kHz (in other words, the cut-off frequency of low-pass filtering should not be less than 1 kHz).

If we want our measured vibration results to be as close to the real experimental situation as possible, it is necessary to ensure that we do not miss the high-frequency components of the vibration. But on the other hand, if we let all the high-frequency signals in, it will produce a lot of electronic noise, and drown out the real vibration information.

Moreover, we strongly do not recommend adding low-frequency cutoff operations (low-frequency high-pass filtering) when testing vibration. After the low frequency cutoff, a large amount of GM cooler vibration information is missed.

➡ Vibration < 5 nm @ 4.5 K, ColdTABLE.Quiet

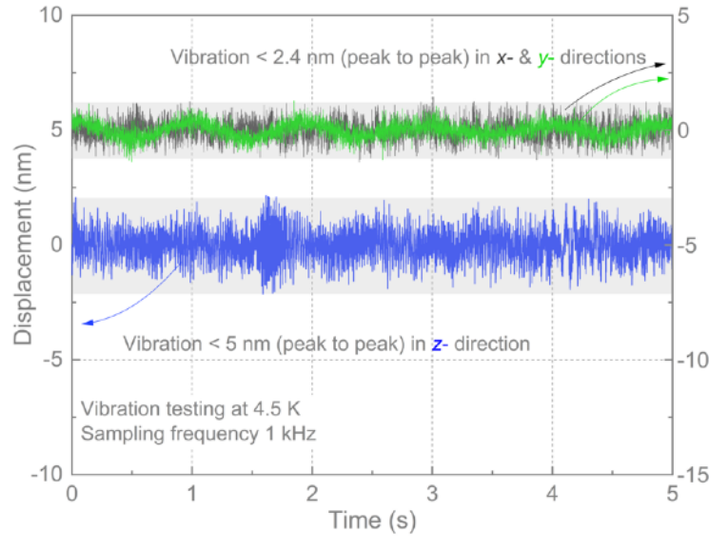


Figure 2. Vibration results of ColdTABLE.Quiet with 1 kHz sampling frequency when system hold at 4.5 K.

➡ Vibration (z-axis) < 24 nm @ 4.5 K, ColdTABLE

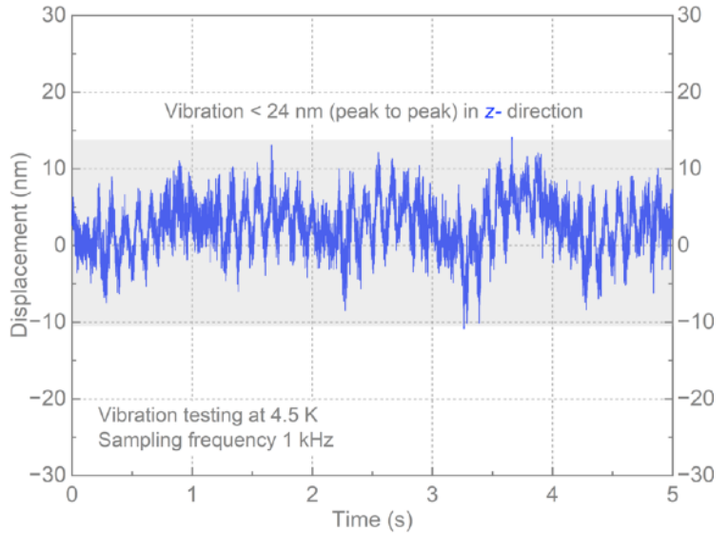


Figure 3. Vibration results of ColdTABLE with 1 kHz sampling frequency when system hold at 4.5 K.

✤ ColdTABLE，Options 4.1 – Low Temperature Compatible Objectives, " Huygens" Series, Specs

A selection of objective lenses with stable long-term cryogenic performance is offered as options.

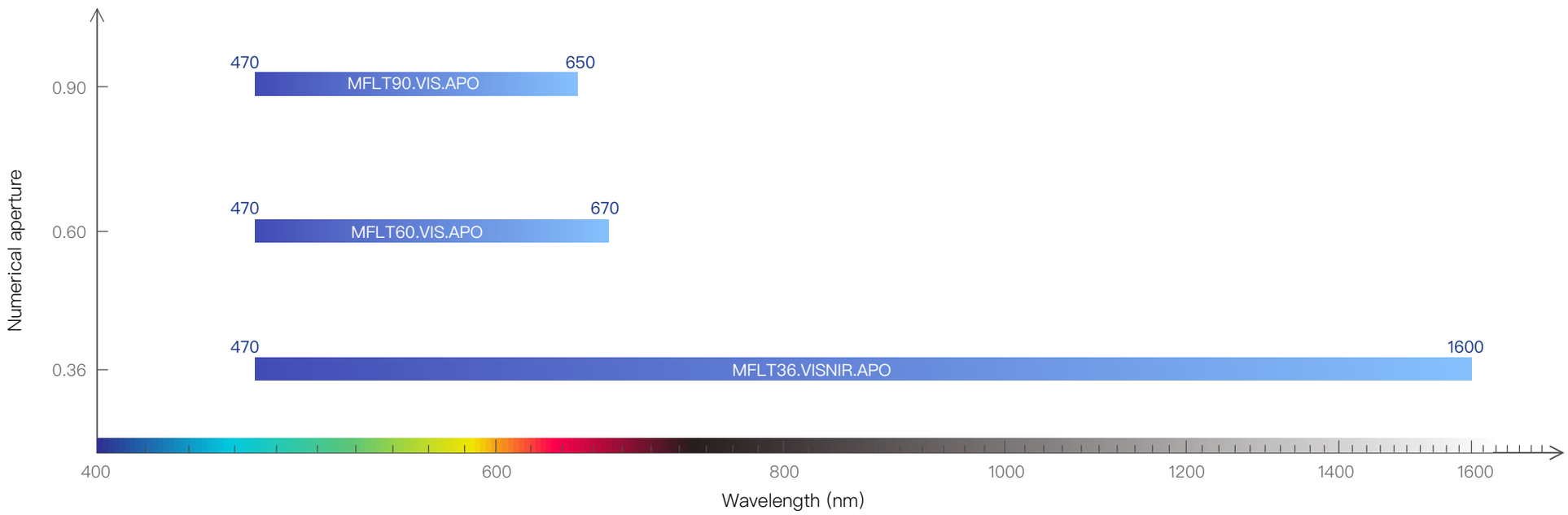
	Product Name / Number ➠		MFLT36.VISNIR.APO	MFLT60.VIS.APO	MFLT90.VIS.APO	MFLT90.VIS
1	Operating Temperature		10 mK ~ 320 K			
2	Maximum Operating Magnetic Field		18 Tesla			
3	Operating Pressure		Vacuum ~ 1 standard atmosphere			
4	Numerical Aperture[1]		0.36	0.6	0.9	0.9
5	Achromatic Range（T > 80%）		490 – 1400 nm	430 – 1050 nm	400-780 nm	400 – 750 nm
6	Anti-Reflective [2]		470 – 1600 nm	470 – 670 nm	470-650 nm	450 – 630 nm
7	Imaging Distance	Focal Length (f)	6.7 mm	3.9 mm	1.8 mm	1.8 mm
		Working Distance (W.D.)	13.8 mm	6.0 mm	1.0 nm	0.2 mm
		Parfocal Distance	72.1 mm	72.1 mm	45 mm	45 mm
8	Field of View		⌀ 200 μm	⌀ 120 μm	⌀ 265 μm	⌀ 220 μm
9	Entrance Pupil Diameter [3]		⌀ 4.8 mm	⌀ 4.7 mm	⌀ 3.2 mm	⌀ 3.2 mm
10	Magnification		×30	×51	×111	×111
11	Dimensions		⌀ 21.0 mm / 63.0 mm	⌀ 22.0 mm / 71.0 mm	⌀ 22.0 mm / 48.5 mm	⌀ 22.0 mm / 49.5 mm
12	Weight		69.0 g	76.5 g	48.0 g	104.0 g
13	Materials		Titanium Alloy	Titanium Alloy	Titanium Alloy	Copper Alloy
14	Thread		RMS (WJ4 / 5 "x 1 / 36")			
15	Storage Conditions		Clean Room at Room Temperature, RH < 40%			

* Numerical Aperture (N.A.): N.A. = n · sin(θ/2), where n is the refractive index of the medium between the objective and the sample, and θ is the aperture angle, defined as the maximum cone of light the system can accept. This parameter determines the resolution of microscopic imaging, with the minimum resolvable distance between two points given by d = 0.61 λ / N.A. (λ is the wavelength of the light source).
* Anti-Reflective Coating (A.R.): The percentage of transmitted light (T) at specific wavelengths after passing through the objective, relative to the incident light.
* Entrance Pupil Diameter: The maximum diameter of parallel light that can pass unobstructed through the objective.

✤ ColdTABLE , Options 4.1 – Low Temperature Compatible Objectives, " Huygens" Series, Data

The Huygens series of objective lenses is specifically designed for operation in extreme cryogenic and high magnetic field environments, featuring a broad apochromatic correction range and covering the visible to near-infrared (VIS-NIR) spectral range.

Offered with numerical apertures (N.A.) of 0.36, 0.60, and 0.90, these objectives cater to diverse application needs and operating conditions, all achieving diffraction-limited imaging quality.



The figure shows the layout of various apochromatic cryogenic objectives. The vertical axis denotes the numerical aperture; the rectangle edges mark the upper and lower wavelength limits of the apochromatic range. Within this band, focal point shifts (|df|) across wavelengths are contained within the depth of focus $\Delta = \frac{\lambda}{2NA^2}$, guaranteeing diffraction–limited performance.

*The apochromatic correction range of the above products is only an important indicator for objective selection; specific selection requires comprehensive evaluation of transmittance, dimensional parameters, etc.

➡ Dimensions

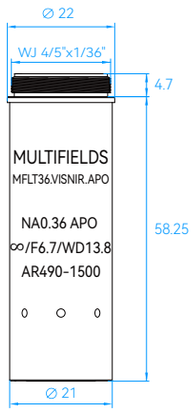


图 1. MFLT36.VISNIR.APO

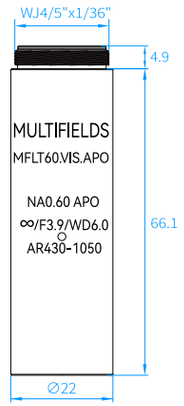


图 2. MFLT60.VIS.APO

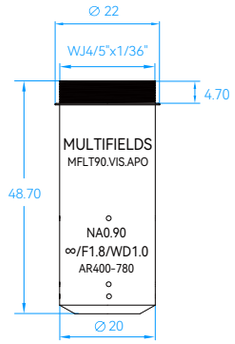


图 3. MFLT90.VIS.APO

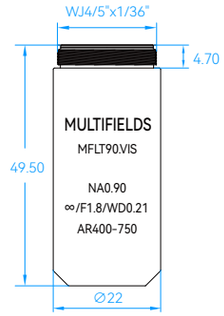


图 4. MFLT90.VIS

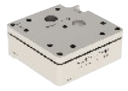
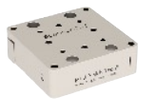
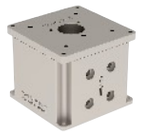
✤ ColdTABLE , Options 4.2 – Piezoelectric Motion Set, Products Family

MultiFields offer a complete range of low temperature piezoelectric motion solutions covering all the motion elements such as linear, rotary and tilting stages with long travel ranges and scanning units for high resolution and dynamic small range motion needs.

Piezoelectric motion units is one independent product line of MultiFields Tech., more details can be found in its catalog.

➡ Positioner Series Products

➡ Scanner Series Products

	"Linear" Series linear motion units, including x & z direction		"Rotator" Series Rotary motion units, 360° endless motion		"Goniometer" Series			XY	Z
16mm Series (Footprint Size)	 Linear16-x	 Linear16-z	 Rotator16	 Goniometer16-phi	 Goniometer16-theta	16mm Series (Footprint Size)	 Scanner16-xy	 Scanner16-z
25mm Series (Footprint Size)	 Linear25-x	 Linear25-z	 Linear25-z-LR	 Rotator25	 Rotator25-optic	 Goniometer25-phi	 Goniometer25-theta	25mm Series (Footprint Size)	 Scanner25-xy	 Scanner25-z
35mm Series (Footprint Size)	 Linear35-x	 Linear35-z-optic	 Rotator35	 Goniometer35-phi	 Goniometer35-theta	35mm Series (Footprint Size)	 Scanner35-xy	 Scanner35-z
	Linear stage, 7 Products		Rotator, 4 Products		Goniometer, 4 Products			Scanner, 6 Products	

✤ ColdTABLE , Options 4.2 – Piezoelectric Motion Set. II, Recommended Configurations

For universal optical experiments, ColdTABLE supply recommended combinations of piezoelectric motion units.

➡ Default Set

6mm x 6mm x 6mm motion range with closed-loop control.

1. Component of Motion Set
   - Linear25-x, 2 pcs, positioner
   - Linear25-z, 1 pc, positioner
   - Scanner25-xy, 1pc, scanner
2. Motion Controller
   - Positioner Controller, NewtonLT.06, 6 channels for end-user
   - Scanner Controller, ArchimedesLT.03, 3 channels for end-user

Figure 1. Schematic of default motion units

3. Key Parameters
   - 250 g, net load for end-user
   - 6mm x 6mm x 6mm, travel range
   - 48.5 mm height (without FTC)
   - 21 pins electric contacts in total

➡ Long Travel Range Set

20mm x 20 mm in XY plane and 6 mm in Z direction.

1. Component of Motion Set
   - Linear35-x, 2 pcs, positioner
   - Linear25-z, 1 pc, positioner
   - Scanner25-xy, 1pc, scanner
2. Motion Controller
   - Positioner Controller, NewtonLT.06, 6 channels for end-use.
   - Scanner Controller, ArchimedesLT.03, 3 channels for end-user

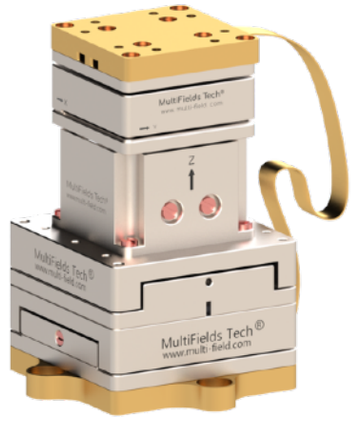


Figure 2. Schematic of long travel range motion units

3. Key Parameters
   - 250 g, net load for end-user
   - 20mm x 20mm x 6mm, travel range
   - 50.5 mm height (without FTC)
   - 21 pins electric contacts in total

➡ Large Load Set

For example, some end-users use this set to perform high pressure experiment, for the diamond anvil cell itself is very heavy.

1. Component of Motion Set
   - Linear35-x, 2 pcs, positioner
   - Linear35-z, 1 pc, positioner
2. Motion Controller
   - Positioner Controller, NewtonLT.06, 6 channels for end-user

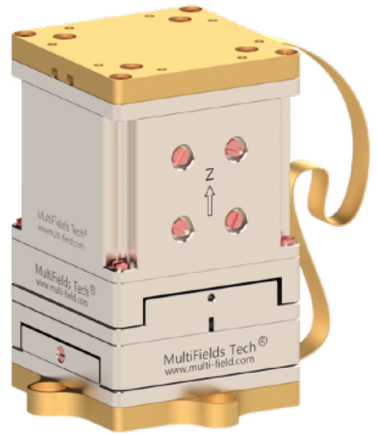


Figure 3. Schematic of large load motion units

3. Key Parameters
   - 450 g, net load for end-user
   - 20mm x 20mm x 10mm, travel range
   - 51 mm height (without FTC)
   - 17 pins electric contacts in total

➡ Flexible Thermal Link (FTC)

For the sake of structural rigidity and weight reduction, we chose titanium instead of using high thermal conductivity copper as the main frame in the conventional version. As a result, in the vacuum environment, we can not completely transmit the temperature of the 4K Sample Plate to the sample. In order to solve this problem, we designed flexible thermal conductive parts using oxygen-free copper with high thermal conductivity to ensure that the sample movement is not delayed and the sample temperature can be well lowered to base temperature.

✤ ColdTABLE , Options 4.2 – Piezoelectric Motion Units, Specs

Ultra-precise Nano Piezoelectric Motion solutions for cryogenic environment.

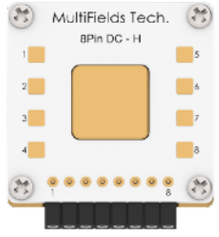
Piezoelectric Motion Units

	Motion Unit	Work Environment	Dimension	Travel Range	Max Load	Dynamic Drive Force	Pins Number	Weight
	Scanner25-xy	1 K & 18 Tesla & 2E-7 mbar	25 * 25 * 10 mm	55 * 55 um	100 g		4 pins	23 g
	Linear25-z		25 * 25 * 19.5 mm	6 mm	300 g	4 N	Drive - 4 pins Sensor- 3 pins	34 g
	Linear25-x		25 * 25 * 9.5 mm	6 mm	400 g	2 N	Drive - 2 pins Sensor- 3 pins	24 g
	Linear35-x		35 * 35 * 10.5 mm	20 mm	1 kg	2 N	Drive - 2 pins Sensor- 3 pins	38 g
	Linear35-z		35 * 35 * 30 mm	20 mm	500 g	5 N	Drive - 4 pins Sensor- 3 pins	118 g

✤ ColdTABLE , Options 4.3 – Sample Mounts

For different end-user research areas, we offer a variety of sample mount options compatible with DC, RF and coaxial signals.

➡ DC

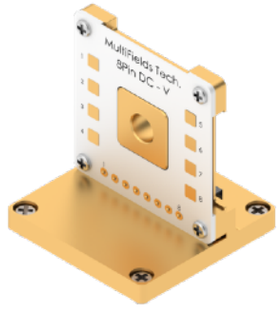


PN:AB1104

■ Horizontal DC sample holder

Designed for electrical/optical testing under optical/electrical fields

1. Electrical pads & connectors
   - 8 gold-plated pads for sample wiring
   - 2 mm pitch straight female socket
2. Materials
   - FR4/Copper composite
   - Central 10 mm x 10 mm copper area for sample mount



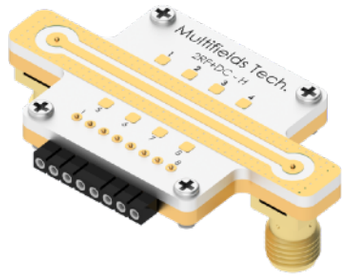
PN:AB1105

■ Transmission DC sample holder

Designed for optical transmission testing under electrical field

1. Electrical pads & connectors
   - 8 gold-plated pads for sample wiring
   - 2 mm pitch straight female socket
2. Materials
   - FR4/Copper composite
   - Central 10 mm x 10 mm copper area for sample mount
   - ⌀ 5 mm hole for light transmission

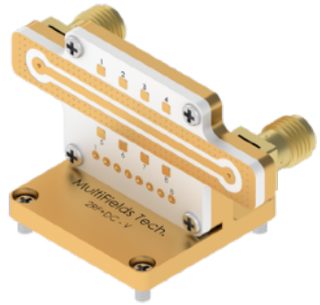
➡ RF & DC



RF block (Horizontal)
PN:AB1304

2 x 2.92mm connectors for RF signals up to 40 GHz.

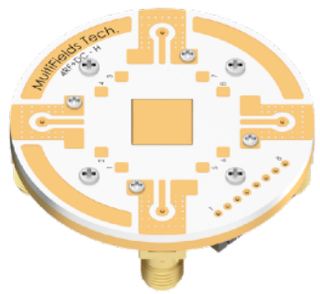
8 x gold-plated pads for DC wiring



RF block (Vertical)
PN:AB1305

2 x 2.92mm connectors for RF signals up to 40 GHz.

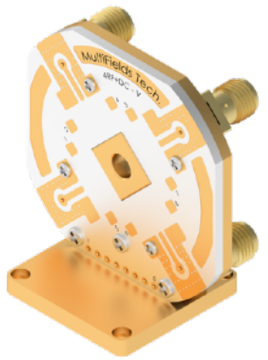
8 x gold-plated pads for DC wiring



RF block (Horizontal)
PN:AB1306

4 x 2.92mm connectors for RF signals up to 40 GHz.

8 x gold-plated pads for DC wiring



RF block (Transmission)
PN:AB1307

4 x 2.92mm connectors for RF signals up to 40 GHz.

8 x gold-plated pads for DC wiring

➡ Customization

We are very happy to help our end-users through customized services.

✤ ColdTABLE , Customization 5 – Customized 50 Kelvin Radiation Shield & Vacuum Chamber

MultiFields supply service that machine and deliver radiation shield and vacuum chamber as customer's drawings or design requirements.

➡ End-user, "We need the vacuum chamber designed in a specific way for our experiment."

➡ ColdTABLE team, "Of course, let's make that happen."

If we can decides the 4K Cold-Plate's size (mainly expanding the size) freely, there is no need to do customization and we can just set the design with big enough 4K space as default configuration. While in reality, larger 4K Cold-Plate normally means more mechanical structure needed to keep its rigidity, which cause more heat leakage from 300 K to 4 K low temperature. To keep the base temperature low enough, we have to use high-power cryocooler. Unfortunately, it leads to more vibration.

So, there is a delicate balance among **Size, Base Temperature** and **Vibration Level.**

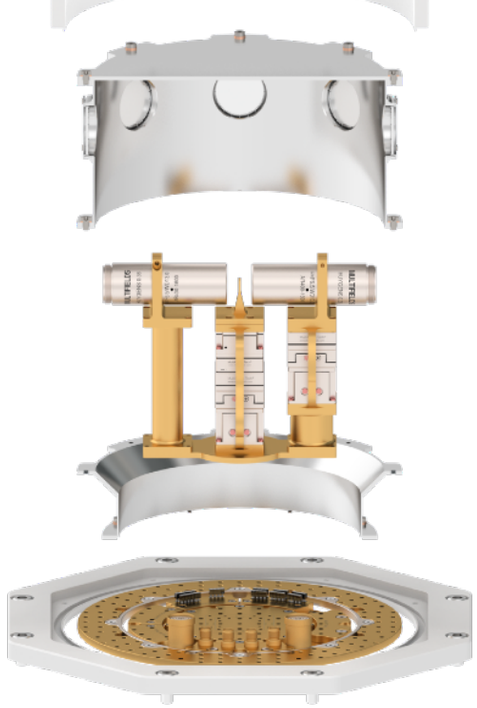
We do know that in some cases, end-users have to put many devices onto 4K Cold-Plate to complete the experiments with high quality. ColdTABLE team accepts customers' requirements for radiation shield and vacuum chamber's multiple features such as window height, space size, outer shape and so on.

➡ Customized radiation shield & vacuum chamber

- In the experiments depicted in Figure 1, we provided a tailored radiation shield design to meet the requirement for a large diameter, facilitating the placement of two horizontally aligned objectives.

- In the experiments shown in Figure 2, we not only customized the radiation shield but also delivered a bespoke vacuum chamber.

We are dedicated to supporting our end-users through our customization services, ensuring that their experimental setups are optimized for success.



➡ 50K Radiation Shield (upper part)

Pure aluminum frame is mirror-finished to provide light weight construction and a high level of thermal radiation shielding.

➡ 50K Radiation Shield (bottom part)

Figure 1. Schematic of transmission experiment with customized radiation shield and vacuum chamber.

Vacuum Chamber

8 side optical windows distributed at 45 degrees;

1 optical window at the top;

Atmosphere surface of viewports support 30mm cage systems and SM1 screw / SM1.5 screw.

➡ 50K Radiation Shield

Figure 2. Schematic of waveguide excitation experiment with customized radiation shield and vacuum chamber.

✤ ColdTABLE , Technique Note 6.1, How To Use Room Temperature Objectives in ColdTABLE

We share some of our customers' experiences with ColdTABLE's end-users about how to use room temperature objectives to perform low temperature optical experiments in ColdTABLE platform.

➡ We need room temperature objectives to complete low temperature optical experiments.

Although we provide as many types of low temperature objectives as possible, it still cannot be compared with the room temperature objective matrix with diverse categories and comprehensive functional coverage.

In many low temperature optical experiments, we still rely on room temperature objectives. After all, we cannot redesign all commercial objectives for low temperature compatibility.

➡ How to use room temperature objectives in ColdTABLE.

Considering that the operating temperature of most commercial objectives is near room temperature, it does not meet the requirements of our low temperature optical experiments. Thus there is a lot of work needed to ensure that the cryogenic experiment can be done without damaging the objective.

The solution is keeping the room temperature objective "warm", heating it to its working temperature by temperature controller Kelvinion ColdTABLE supplied.

❖The operation process is as following,

1. Where to install room temperature objective
   - Top window, the vacuum side (details in Figure 1)

     The objective lens is fixed to the inside of the top of the vacuum chamber through RMS thread or 30 mm cage system structure ColdTABLE supplied.
   - Side windows, the vacuum side (details in Figure 2)

     The objective lens is fixed to the side windows in vacuum chamber through RMS thread or 30 mm cage system structure ColdTABLE supplied.
2. Heating solution, protecting the objective from low temperature
   - Heater & thermometer, flexible Kapton film heater and PT100.
   - Parts, customized adaption to end-user's room temperature objective

➡ How to protect our 4K sample from "hot" objective's radiation in ColdTABLE.

Once we complete the room temperature objective mounting and heating protection, another problem arises: the sample will be radiatively heated by the "hot" objective and would not be able to reach the low temperatures required for experiment.

In order to solve this, we can only reduce the size of the optical window on the thermal radiation shield.

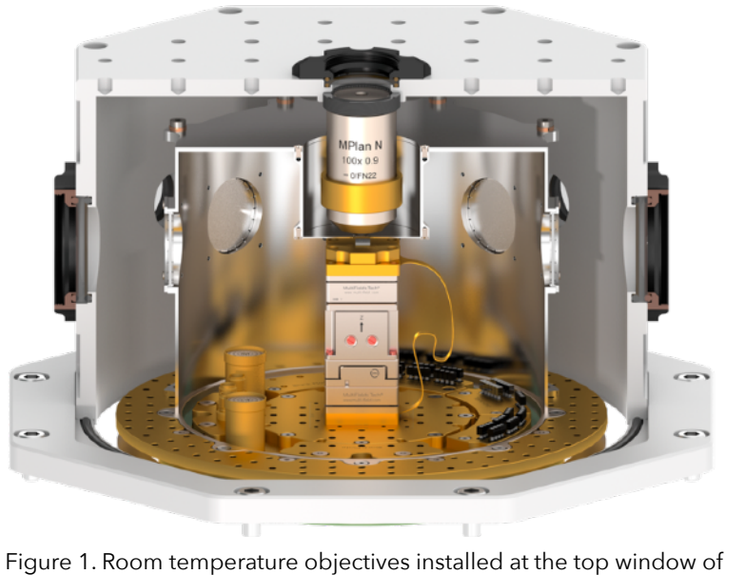


Figure 1. Room temperature objectives installed at the top window of the vacuum side.

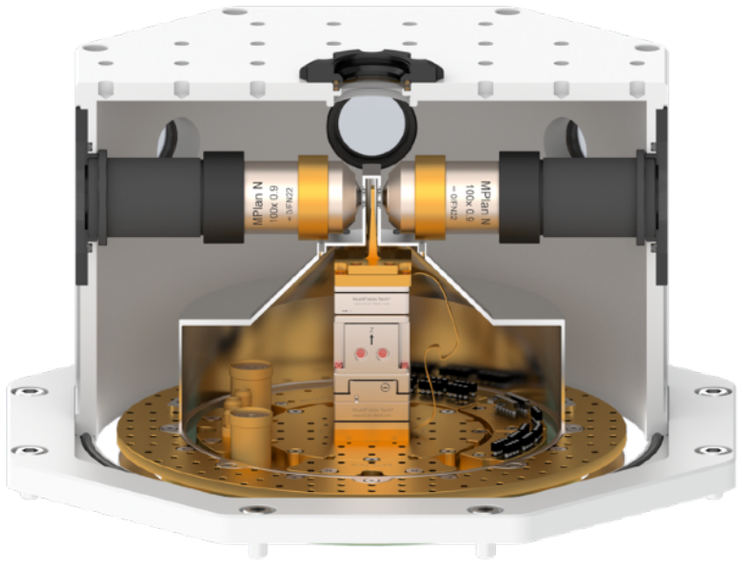


Figure 2. Room temperature objectives installed at side windows of the vacuum side.

✤ ColdTABLE , Cases Share 7.1, Optical Transmission Experiment

Optical transmission experiment is one of the most common optical experiments. We share an experimental configuration, hoping that it will be helpful for customers to perform transmission experiments on our platform.

➡ Optical path design in vacuum chamber

The throughput-window configuration of radiation shield and vacuum case allows for easy setup of transmission measurement. The excitation laser is focused onto a vertically mounted sample by using a low temperature objective. The sample position can be adjusted via a 3-axis positioners to optimize the focus of excitation beam. The transmission through the sample is then collected by a second objective that is also mounted on a 3-axis positioners. This freedom is needed for optimizing the collection efficiency of the transmitted beam.

Because of the width of two alined objectives, we also supply customized radiation with variable size to fit different objectives.

As for the sample mount, there are many series choices with different electric connections, RF, DC and Coax.

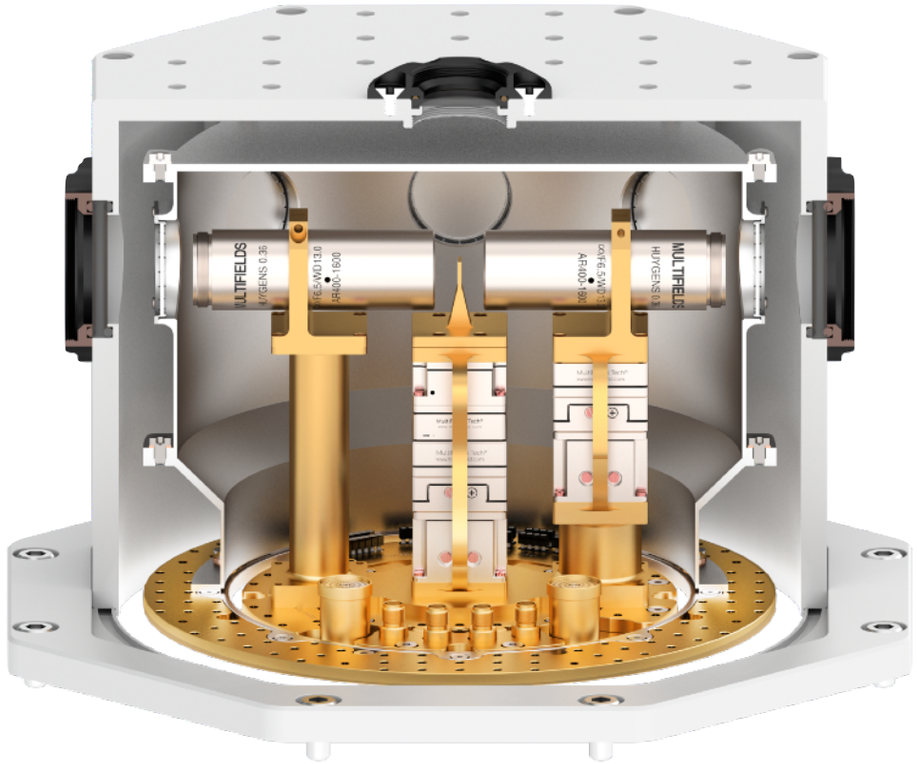


Figure 1. Configuration of Optical Transmission Experiment on ColdTABLE.

➡ List, Parts included to fulfill the experiment

	Parts	Model	Quantity	Remarks
1	Objective - excitation	MFLT036.VIS	1pc	Low temperature compatible objective with N.A. 0.36.
2	Objective - collection	MFLT036.VIS	1pc	Same as above
3	Motion set - sample			
		Linear25-x	2pcs	
		Linear25-z	1pc	
		Scannner25-xy	1pc	
		Scanner25-z	1pc	
		FTC25.100	1pc	Flexible thermal link fitting 25mm series piezoelectric motion products, with 100 mm length
4	Motion set - objective			
		Linear25-x	2pcs	
		Linear25-z	1pc	
		FTC25.65	1pc	Flexible thermal link fitting 25mm series piezoelectric motion products, with 65 mm length
5	Customized Shields set	Customization	1pc	Apart design
6	Mechanical parts	Customization		

✤ ColdTABLE , Cases Share 7.2, Optical Waveguide Excitation Experiment

For optical waveguide excitation experiment, we usually set two objectives 90 degree. One for excitation, another is for collection.

➡ Optical path design in vacuum chamber

The excitation laser is focused into a planar waveguide of the sample via its cleaved edge by using a high-NA LT objective mounted horizontally in the chamber. The sample is placed on a XYZ positioners to optimize the coupling efficiency of the side excitation beam. The coupled light interacts with various scattering centers residing within the structure leading to a resonance fluorescence from these centers. The scattered photons are collected by a second LT objective mounted on top of the sample with a fixed stage. These freedoms allow for optimizing the excitation and collection efficiencies of experiments and also selecting different scattering centers to study. Meanwhile, the scanners set up under the sample allow for raster imaging of the sample via non-resonant excitation.

As for the sample mount, there are many series choices with different electric connections, RF, DC and Co

Figure 1. Configuration of Optical Waveguide Excitation Experiment on ColdTABLE.

➡ List, Parts included to fulfill the experiment

	Parts	Model	Quantity	Remarks
1	Objective - excitation	MFLT060.VIS	1pc	Low temperature compatible objective with N.A. 0.36.
2	Objective - collection	MFLT036.VIS	1pc	
3	Motion set - sample			
		Linear25-x	2pcs	
		Linear25-z	1pc	
		Scannner25-xy	1pc	
		FTC25.100	1pc	Flexible thermal link fitting 25mm series piezoelectric motion products, with 100 mm length
4	Motion set - objective			
		Linear25-x	2pcs	
		Linear25-z	1pc	
		FTC25.65	1pc	Flexible thermal link fitting 25mm series piezoelectric motion products, with 65 mm length
5	Radiation shield	Customization	1pc	Apart design
6	Vacuum chamber	Customization	1pc	Apart design
7	Mechanical parts	Customization	1 set	

✤ ColdTABLE , System Specifications

Integrating cryogenic low-vibration techniques with nano-motion, cryogenic objectives, and other technologies to offer a comprehensive solution for cryogenic optical experiments.

ColdTABLE system, Specifications

	General	
1	Cooling method	Closed-cycle GM Cryocooler
2	Vibration damping technology	Passive: Air flotation isolation & Combined damping
3	Sample environment	Cryogenic vacuum
4	Base temperature area	⌀ 100 mm & ⌀ 200 mm
5	Sample mounting area	M3 Screws, 10 mm x 10 mm matrix
6	Heater & temperature sensors	1 sensor + 1 heater for system temperature, 1 extra sensor for sample temperature monitoring
7	Optical windows	1 top + 8 side windows
8	Operation & Control Interface	Automatic control software LabVIEW & Python drivers available
	Performance	
9	Temperature range	2.8 K - 320 K
10	Cooldown time	< 180 mins
11	Temperature stability	2 mK @ 4.5 K, 20 mK @ 300 K
12	Cooling power	220 mW @ 4.2 K
13	Vibration	< 24 nm P-P, < 5 nm P-P for ColdTABLE.Quiet
14	Vacuum limit	1E-8 mBar
	Electric & Optic access	
15	Electric	24 DC for customer + 24 DC for piezomotion
16	RF feedthroughs	4 x 2.92 mm feedthroughs, up to 40 GHz
17	Optical fiber feedthroughs	4 x single mode optical fiber feedthroughs
18	Configurable blank plate	3 pcs

	Option	
19	Cryogenic motion set	25 mm & 35 mm series linear nanopositioners and scanners
20	Cryogenic objective	N.A. ~0.90, 0.60 & 0.36 cryogenic and nonmagnetic objectives
	Closed-cycle Cryocooler	
21	Power consumption	8kW @ 380 V, 1.5 kW @ 220 V for ColdTABLE.Quiet
22	Cooling of compressor	Water cooling, Air cooling for ColdTABLE.Quiet
	Dimension & Weight	
23	Dimension (W x L x H)	800 mm x 1000 mm x 800 mm @ optical table 400 mm x 450 mm x 650 mm @ compressor
24	Weight	150 kg @ optical table component 118 kg @ compressor
	Upgrade	
25	Microscope	Confocal microscopy