User's Manual

MPS-PT & PTH

(Micro Probe System – Peltier heater type)
(Micro Probe System – Peltier heater Hole type)

Guidelines

NEXTRON
MICRO PROBE SYSTEM

DECLARATION OF CONFORMITY

Model Name	:	MPS -PTTC
Product Name	:	MPS Temperature Controller
Classification	:	Comply
Applicant	:	NEXTRON Co., Ltd.
Address	:	Room No. 609, V1 Tower, 273-20 Gaejwa-Ro Geumjeong-Gu, Busan City, 46257, Korea
Manufacture	:	NEXTRON Co., Ltd.
Address	:	Room No. 609, V1 Tower, 273-20 Gaejwa-Ro Geumjeong-Gu, Busan City, 46257, Korea

Conforms to the following Product Specifications and Regulations:
The product herewith complies with the requirements of the EMC Directive 2014/30/EU, the Low Voltage Directive 2014/35/EU and carries the CE marking accordingly.

EMC	:	EN 61326-1:2013 EN 61326-2-1:2013 EN 61000-3-2:2014 EN 61000-3-3:2013
Safety	:	EN 61010-1:2010 (Third Edition)

That the following machine complies with the appropriate basic safety and health requirements of the EU Directive based on its design and type, as brought into circulation by us. In case of alteration of the machine, not agree upon by us this declaration will lose its validity.

Signature
NEXTRON CORPOPATION
Hakbeom Moon
Hakbeom Moon / CEO
Name: Hak Beom Moon
(Date of issue: June 08, 2017)

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Introduction

Peltier Type Micro Probe System (MPS-PTH, MPS-PT) is a subminiature probe system with vacuum and temperature control functions. The system features an active cooling system that maintains the same heating and cooling rates. This equipment can measure the electrical and dielectric properties of thin films in the temperature range of, -40°C ~ 170°C (MPS-PTH) or -40°C ~ 200°C (MPS-PT). It is possible to use a sapphire (or fused silica) viewport cover on optical measurement, and a microscope to observe samples

Introduction

MPS-PT Specification

Item	Specification	Unit
Temperature range	-40 ~ 170 (MPS-PTH)	°C
	-40 ~ 200 (MPS-PT)	
Maximum cooling/heating rate	60	°C /min
Temperature accuracy[1]	±0.1	°C
Temperature Resolution[2]	0.1	°C
Chamber inner volume	< 100	cc
Chamber External Dimension	140 × 70 × 30.3 (excluding ports)	mm
Sample Stage Dimension	16 × 16 (MPS-PTH)	mm
	19 × 19 (MPS-PT)	
Hole on Sample Stage	Ø 3.2 (MPS-PTH)	mm
View Port Diameter	Ø 43 (Fused Silica)	mm
Probe Stroke-length (X-Axis)	12	mm
Probe Material	Tungsten	
Probe Tip Diameter	50 or 100	㎛
Vacuum Test[3]	10E-3 (with rotary pump)	mbar at RT
	10E-5 (with Turbo pump)	
Vacuum & Vent Line Fitting	1/4 inch	Swagelok tube fitting
Weight of main chamber	~650	g
Leakage current	< 100	pA (coaxial)
		fA (triaxial)
Maximum DC voltage	300	V
Maximum Current	1000	mA
Maximum Frequency[4]	300 (< 3dB)	MHz

[1] This accuracy is based on the temperature value of the sensor inside the heater.
[2] 0.01°C resolution from -40 to 100°C and 0.1°C resolution through the whole temperature range of -40 to 200°C.
[3] Vacuum tested with 1/4 inch tube line.
[4] For attenuation values, please refer to the seperate graph. (Available upon request)

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MICRO PROBE SYSTEM

Introduction

Application

- Raman
- EL & PL
- Gas Sensor
- Photovoltaic
- Photocurrent mapping
- I-V Measurement
- FET Characterization Test
- Reflectivity
- Thermal Conductivity (3-ω Method)
- Thermal Hysteresis
- Ferroelectric Domain Switching Observation

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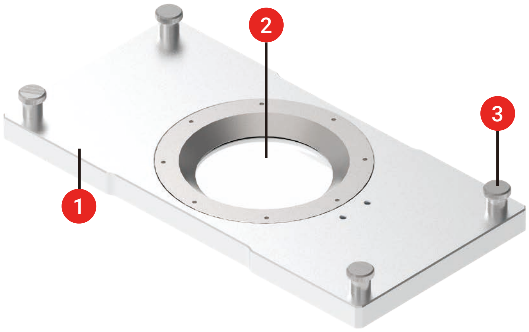
MICRO PROBE SYSTEM

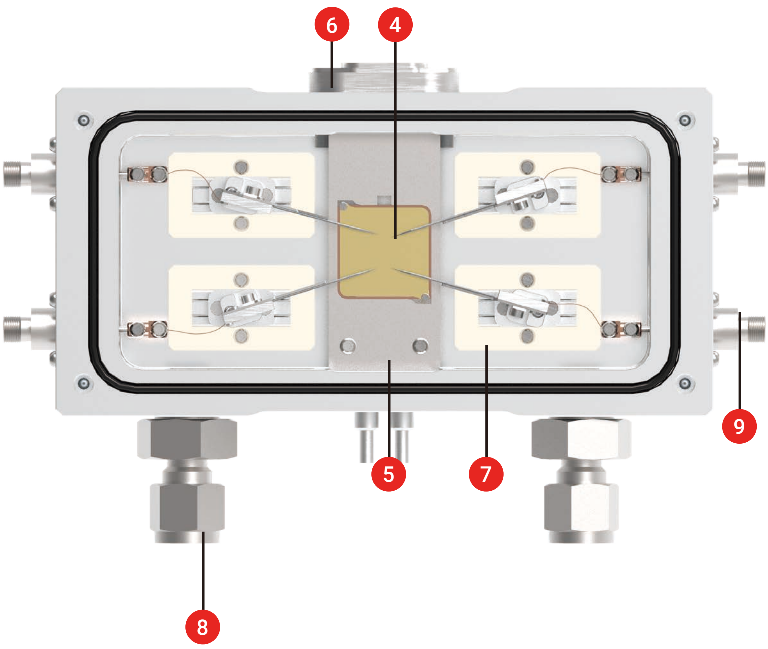
Product Configuration

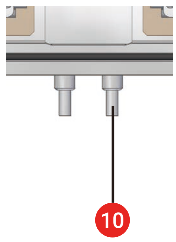
1. MPS-PT chamber
2. View port cover
3. MPS-PTTC (Temperature Controller)
4. Cables
    A. Heater & Temperature sensor cable
    B. SMA to BNC coaxial signal cable or optional SMA to TNC triaxial signal cable (yellow color)
    C. USB2.0 Type-A Plug to USB2.0 Type-B Plug communication cable
    D. Power cable
5. Titanium tweezer
6. USB stick (Temp. control software & Manual)
7. Tubes for connecting a chiller
    E. Silicone tube (1 m x 2ea)
    F. Teflon tube (5 cm x 2ea)
8. 1/4 inch Swagelok fitting Cap

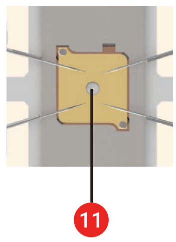
MPS – PT Chamber Structure

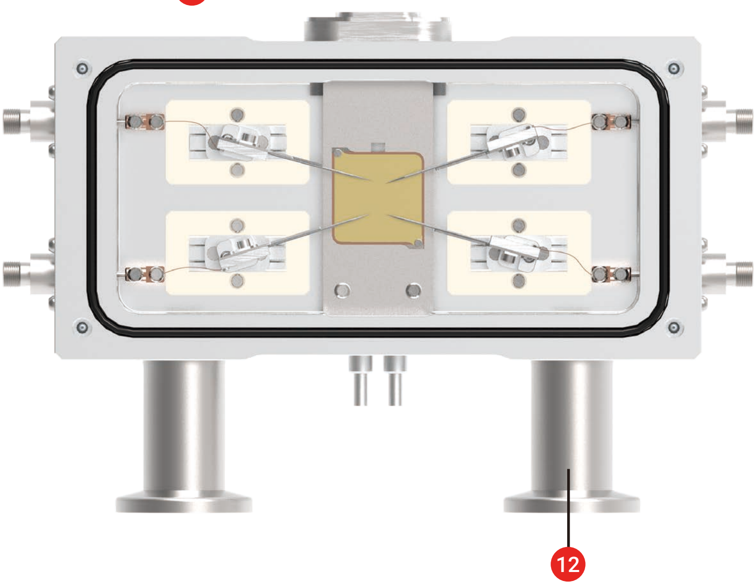


1. View port cover
2. Sapphire (or fused silica) window
3. Screw for clamp cover
4. Sample stage (Rhodium plating on copper)
5. Plate for protecting electric lines
6. 9-pin Sub-D feedthrough for Power & T/C
7. Probe module
8. Gas inlet/outlet
9. SMA feedthrough
10. Chiller inlet/outlet
11. Sample stage hole (Only PTH Model)
12. NW16 port (Optional)









Precautions Before Starting the System

Heating and Cooling Rates

The ceramic heater is not good for rapid changes in temperature. The rate should not exceed 30°C per minute. Thermal shock can damage the ceramic.

Water Circulation

A way to reduce envergy consumption. (CHH,CHU only)

When running the temperature below 450°C less than 1 hour, no coolant is needed. The thermal insulation of the deivce is well-designed to withstand the heat.

Cleaning

Metal parts such as aluminum and copper in the device are prone to oxidation when exposed to polar solutions such as water or acid/alkaline solutions. If contaminated, gently wipe off with ethyl alcohol.

Precautions Before Starting the System

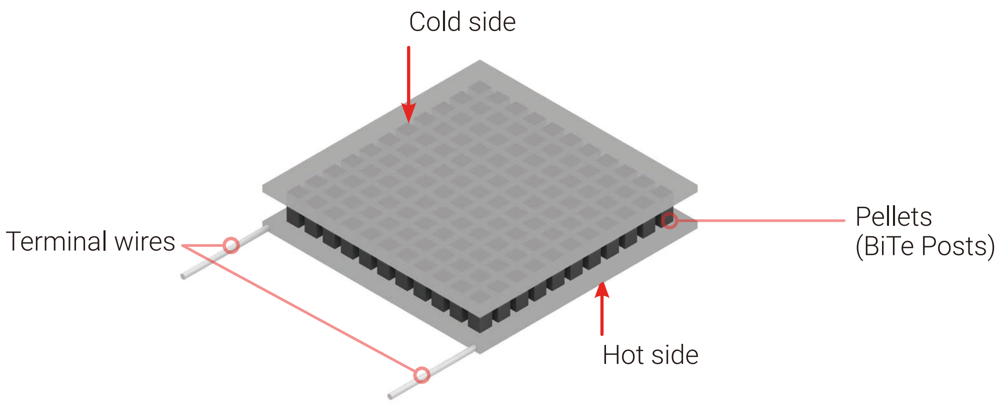
Understanding Thermoelectric Device

The sample stage is the Thermoelectric(Peltier) device. The material is AlN(aluminum nitrite). The conductivity of the AlN is about six times better than the one of Al2O3 of the typical Peltier device. It has also lower thermal expansion.

Ceramic Materials

	Al_2O_3	AlN
Thermal Conductivity, W(m·K)	30	>170
Thermal Expansion, $10^{-6}K^{-1}$	7.2	4.8
Electrical Resistivity, Ohm·cm	$>10^{14}$	$>10^{14}$

Peltier Device Structure



To lower the temperature of the Peltier sample stage to -40 °C, must maintain the hot side of the Peltier sample stage at [1] approximately under 5°C (the required temperature is depending on a sample and measurement environment).

[1] When water circulation is running in a stop state with the temperature controller turned on, the stage temperature displayed on the temperature controller should be set to 5 °C.

Precautions Before Starting the System

Typical Set Temperature and Required Coolant Temperature

Set Temperature (SV)	-40°C	Over than RT
Coolant Temperature	Near or below 0°C	Not needed

On the contrary, when the temperature is heated above 50°C, the use of cooling water makes it difficult to reach the set temperature and causes damage to the Peltier device due to current overload. Therefore, it is recommended not to use cooling water when setting the temperature to more than RT.

You should conduct the lowest temperature test because the stage temperature depends on the performance of the chiller used, the length of the cooling line, and other laboratory environments.

The Lowest Temperature Test

Step1. Operate the chiller (or any other circulation) and wait until the temperature reach to the minimum temperature. The stage temperature may differ from the chiller temperature; it depends on the laboratory environments such as the cooling line conditions and the coolant temperature.

Step2. Set the SV as -40°C and the ramping rate as 20°C /min and the test time as 00:03:00(HH:MM:SS) respectively.

Step3. Start the program and observe whether the PV value follows the SV value well. The lowest value of the PV of the program may be considered the lowest temperature value of your system. When creating a program recipe, use the minimum PV you just found. As you increase the ramping rate, the lowest value to follow the recipe is increased.

How to connect the electronic cables

A. Power & T/C cable

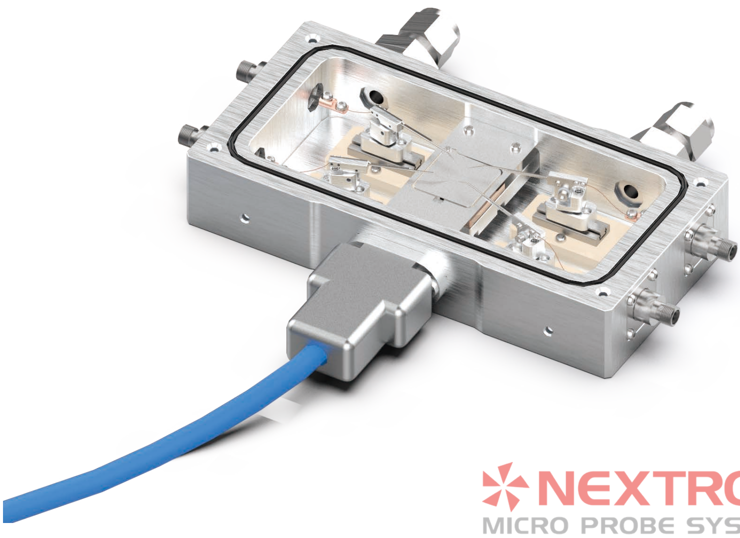
(The image below is MPS-PT model. The connectors are all the same.)

Connect the side labeled “MPS” of the Heater & Temp. sensor cable into the Sub-D feedthrough of the main chamber and tighten it. Connect the other side labeled “Controller” of the Heater & Temp. sensor cable into the Sub-D connector of the controller and tighten the screw.

† The Screws of sub-D connector must be leveled evenly when they are tightened

† After all cables are connected to the chamber and controller, turn on the power.

† Do not disconnect the cables from the chamber and controller while the power is on. If it is disconnected, electrical accidents may occur, which may cause safety problems.



How to connect the electronic cables

B. **Four SMA to BNC signal cable or optional SMA to TNC (yellow color)**

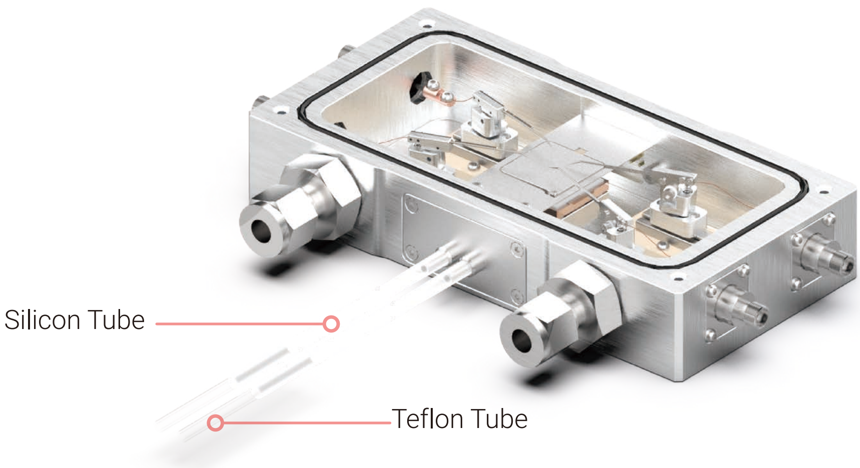
Tighten the SMA connectors of the four SMA to BNC cables to the SMA feedthroughs of the main chamber using hands or their own screws respectively.

You can purchase 'Banana to BNC adapter' and 'BNC to TNC adapter' for specific instruments as an option.

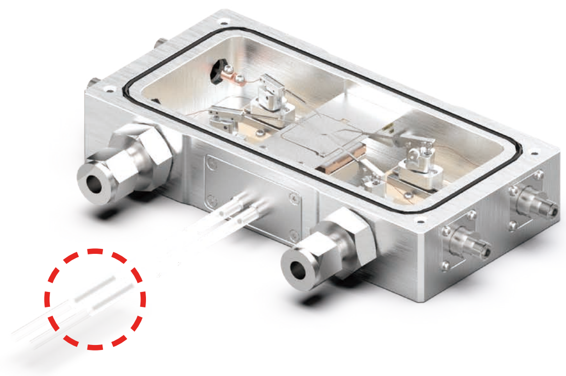
C. **USB(Type-A) to USB(Type-B) PC communication cable**

Connect the USB(Type-B) connector to the USB terminal of the controller and the other end(Type-A) to the PC.

How to Connect the Silicon and Teflon Tube



The water-cooling line of the chamber will be inserted inside the silicone tube. The Teflon tube is inserted inside the silicone tube. The outer diameter of the Teflon tube is 1/8 inch. The total length of the coolant line should be as short as possible for the cooling efficiency of the chiller. The order of connecting the tubes is as follows. The cooling line of the chamber→ silicone tube→ Teflon tube→ Proper reducer→ chiller (in / out, order does not matter)→Proper reducer→ Teflon tube→ silicone tube→ the cooling line of the chamber. The 1/8 inch Teflon tube is a standard product. The connection to the chiller is according to the chiller's in / out line specification.



† Beware. The silicone tube can be torn if the cross section of the Teflon tube is sharp.

† The Teflon tube needs to be inserted into the silicone tube for around 8mm at least in order not to disconnected. The margin depends on the experimental set up.

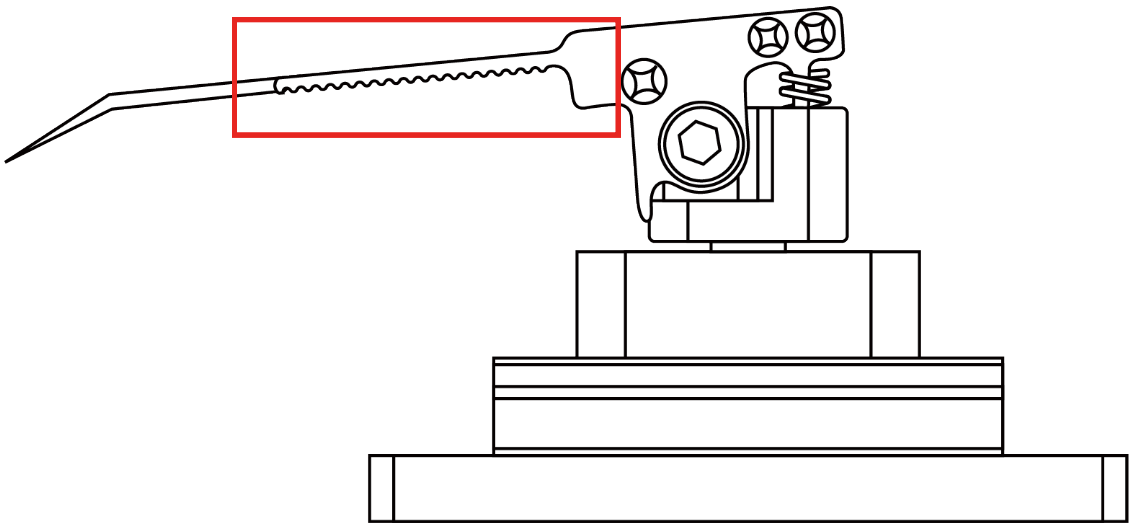
† **Allowed coolant: Pure ethyl alcohol.**

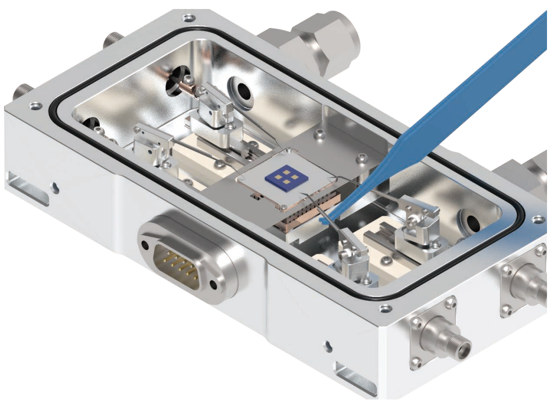
Manual Probe Operation

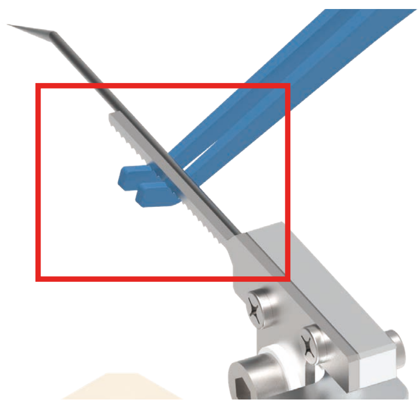
Probe Set Operation

The probe module has a spring structure and can be lifted using the enclosed tweezer. When lifting, use the toothed area under the probe shown in the red box in the image below.

The probe can be lifted on the tweezers and moved freely in the x-axis and rotational direction. Simply move the probe to the desired position and carefully lower it. The stroke of the linear guide is 12mm on the x side, and the rotational movement is not limited if there is no interference from surrounding parts.







You can find basic moving method of the probe at web site:

https://www.youtube.com/watch?v=r5386efLtu0

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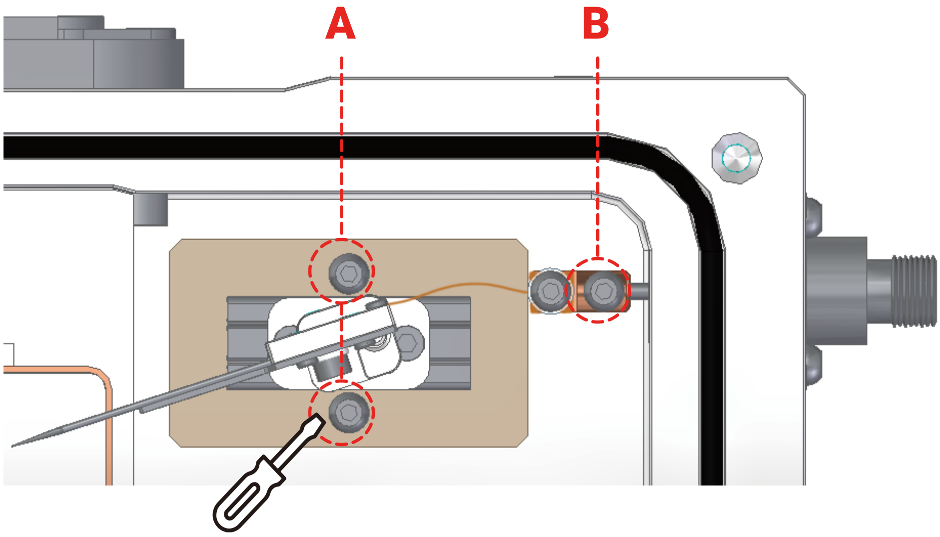
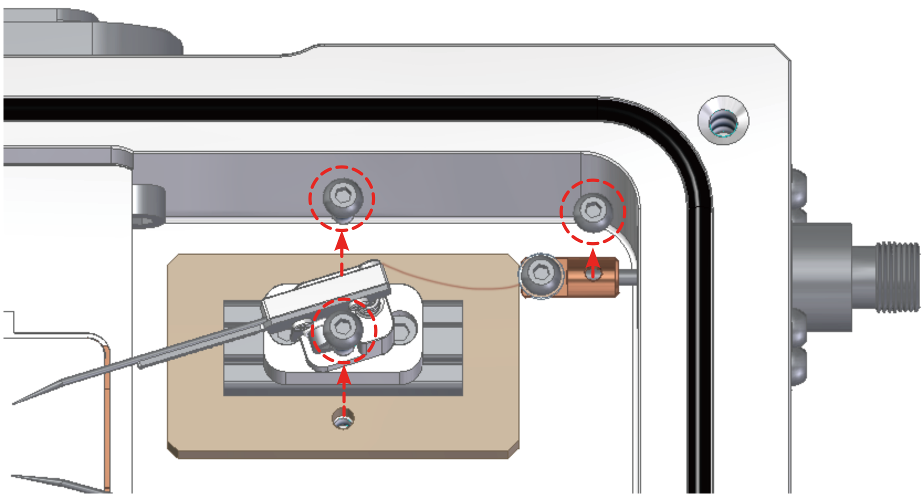
Manual Probe Operation

Replacement Instruction

1. Loosen the bolt A(M2x5mm, round), B(M2x3mm, round).



2. Disassemble the bolt A(M2x5mm) and B (M2x3mm).



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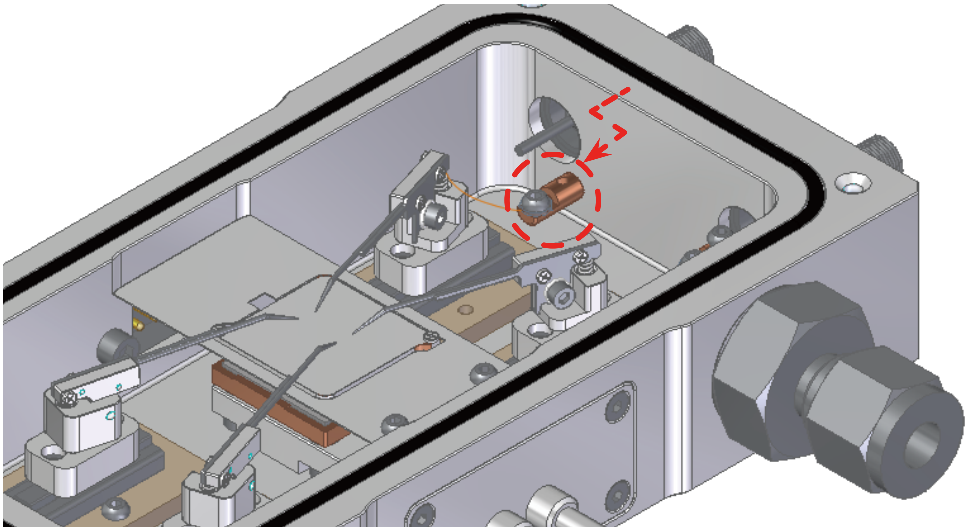
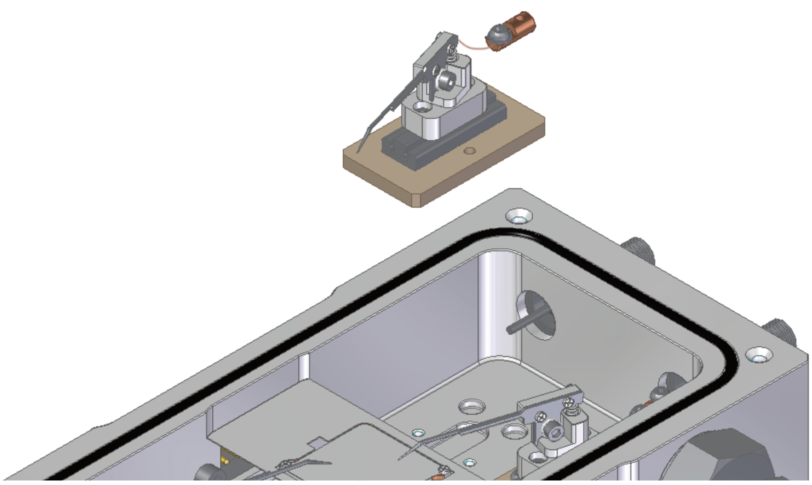
Manual Probe Operation

Replacement Instruction

3. Disassemble the BeCu connector from the SMA feedthrough.



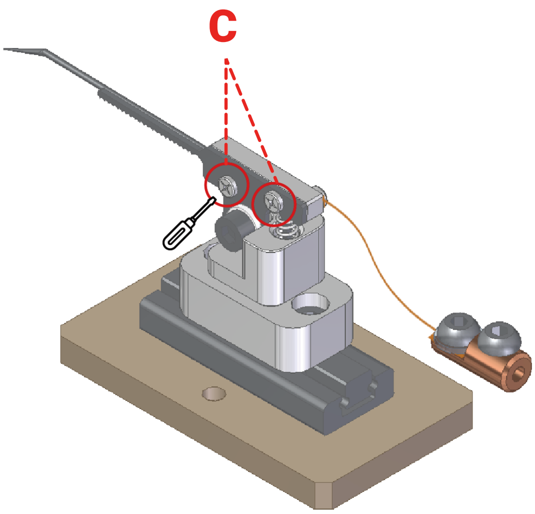
4. Disassemble the probe module assembly from the chamber.

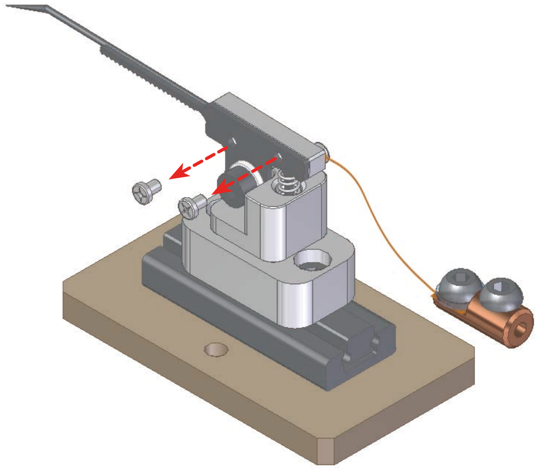


Manual Probe Operation

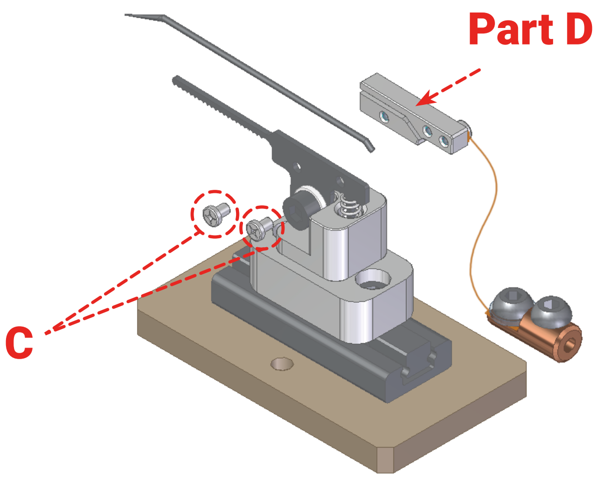
Replacement Instruction

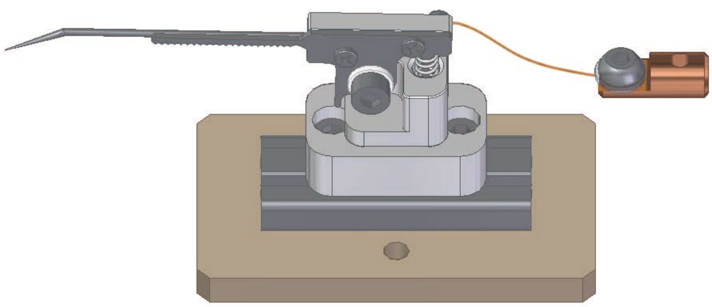
5. Loosen bolt C(M1x1.5mm) and disassemble bolt C(M1x1.5mm)





6. Replace a new probe tip into the groove of part D.
   Reassemble bolt C(M1x1.5mm).

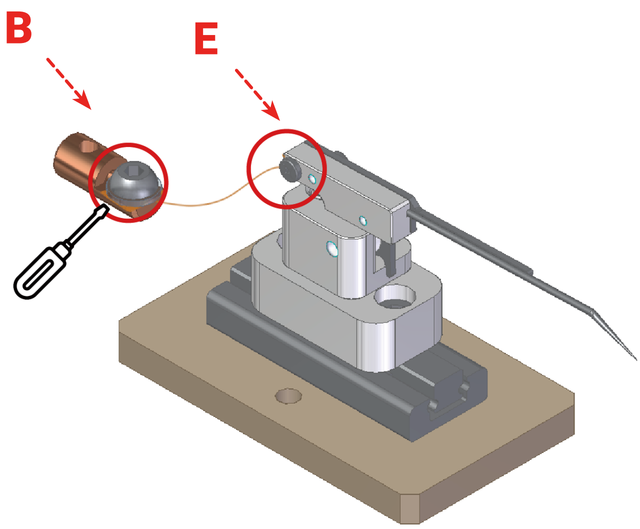




Manual Probe Operation

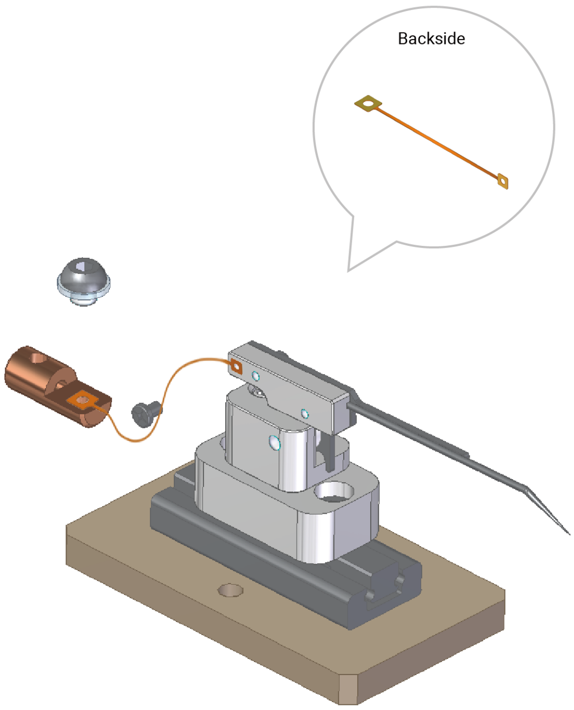
Replacement Instruction

7. To replace BeCu wire, loosen and disassemble bolt E(M1x1.5m) and bolt B(M2x3mm).



8. Replace the BeCu wire and tighten bolt B(M2x3mm) and bolt E(M1x1.5m).

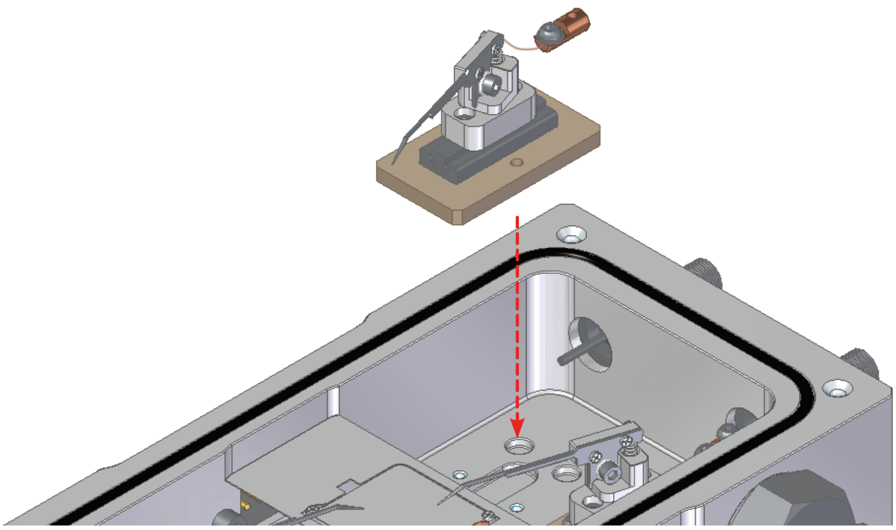
※ The gold coated should be put in contact with the probe and copper.



Manual Probe Operation

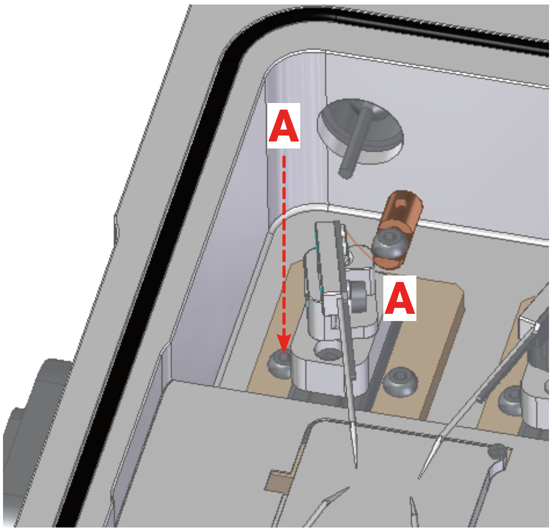
Replacement Instruction

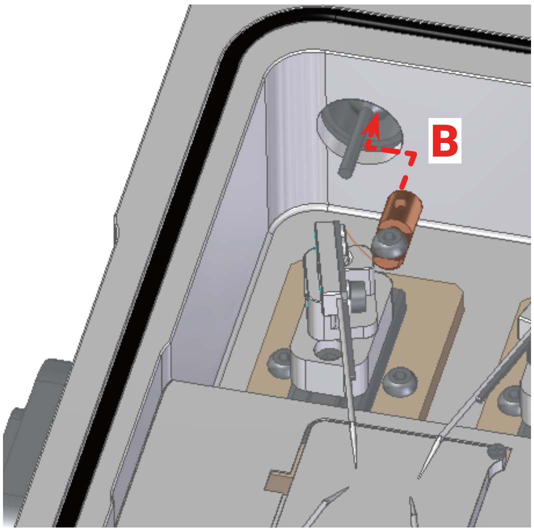
9. Reassemble the probe module assembly into the chamber.



10. Tighten the bolt A (M2x5mm)

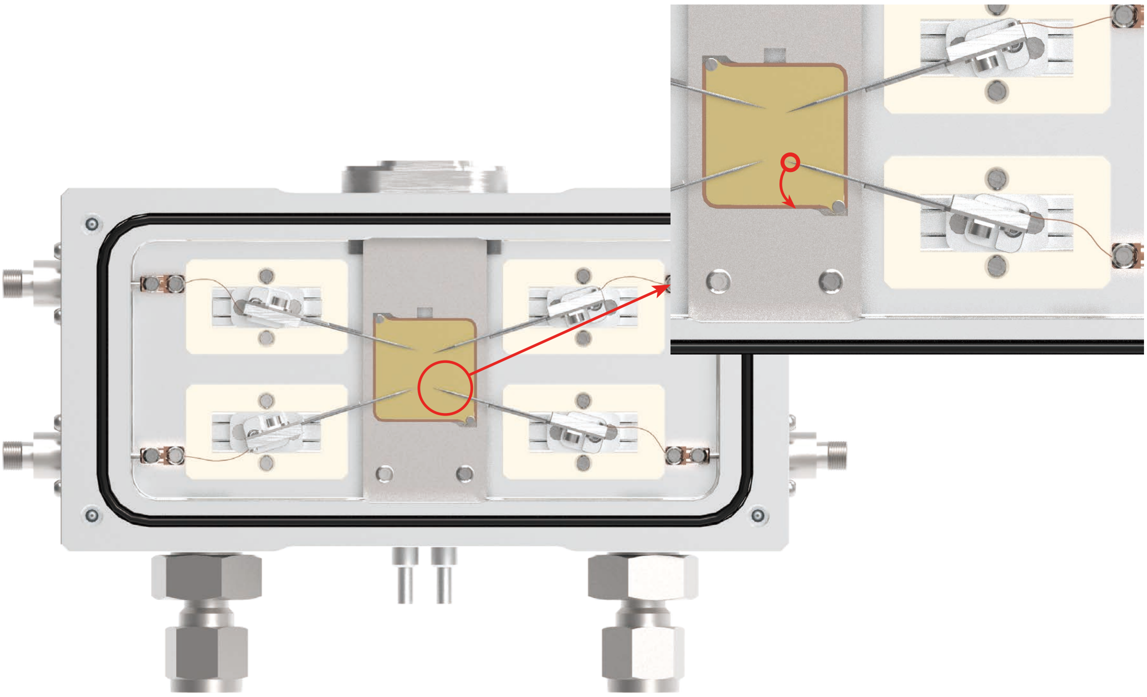
Reassemble the BeCu connector to the SMA feedthrough and tighten the bolt B (M2x3mm)again





Manual Probe Operation

† Beware. If the probe tip falls between the sample stage and the protect plate during probing, the tip of the probe tip may be bent. Use tweezers to sufficiently raise the probe tip before probing.



Sample Preparation (Contact pad)

The radius of the probe tip is 50/100/250μm (according to application). The minimum contact size is about 500μm for positioning the probe manually. Therefore, Making a pad about 1mm x1mm or more is recommended. Using the external positioner option, It can make contact up to 200μm while looking at the microscope. It is recommended to prepare a large contact pad as possible. For contacts smaller than 200μm, using the piezo option allows precise contact of several μm.

NEXTRON
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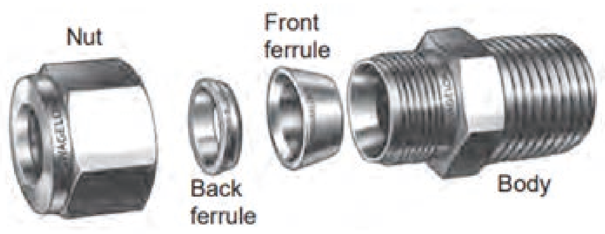
Vacuum/gas Line Fitting

Swagelok Tube Fitting

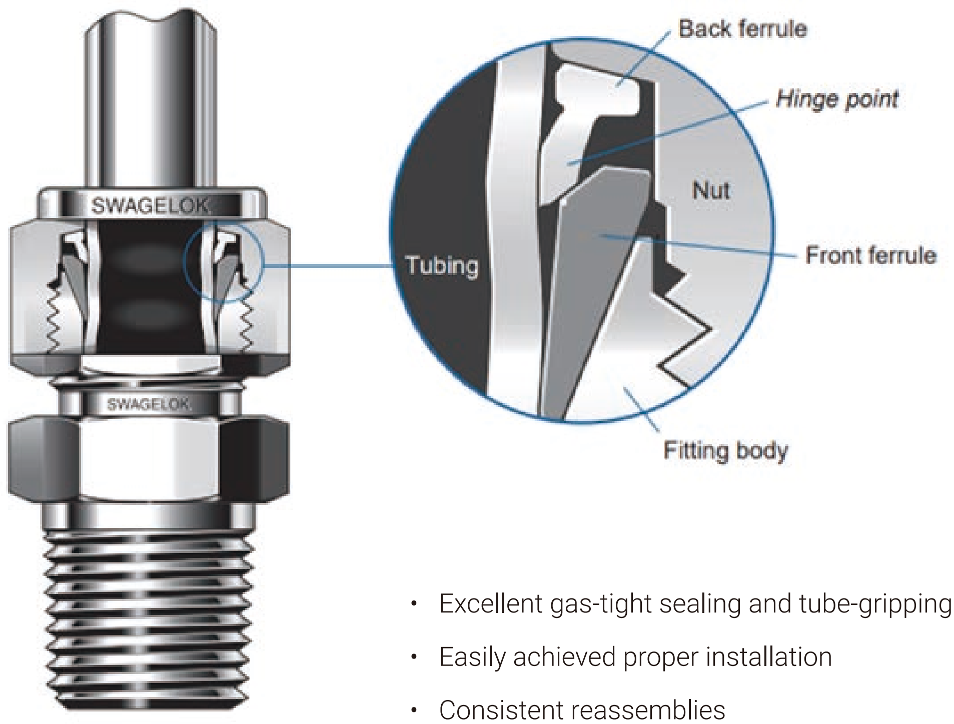
* Quoted from Swagelok Tub Fitter's Manual

Type: flareless, mechanical grip-type fitting

Configuration: nut, back ferrule, front ferrule



Advantage:



- Excellent gas-tight sealing and tube-gripping action
- Easily achieved proper installation
- Consistent reassemblies
- Excellent vibration fatigue resistance and tube support

Vacuum/gas Line Fitting

How the Swagelok Tube Fitting Works

The Swagelok tube fitting is a sequential-phase, controlled-action sealing and gripping device. Superior design, rigid manufacturing tolerances, and strict quality assurance programs produce an allmetal sealing and holding device that performs leak-tight when properly installed.

Consisting of a nut, back ferrule, front ferrule, and body, the Swagelok tube fitting functions as follows:

1. Tubing is inserted into the completely assembled fitting until it bottoms against the shoulder of the fitting.
2. The nut is tightened 1 1/4 turns from finger-tight. During this tightening, a number of different movements take place within the fitting in a preplanned sequence.

   a) Through threaded mechanical advantage, the nut moves forward, driving the back ferrule forward.

   b) The back ferrule drives the front ferrule forward.

   c) The front ferrule is forced inward by the fitting body bevel.

   d) The front ferrule takes up the tolerance between its inside diameter and the outside diameter of the tube.

   e) As the front ferrule moves forward and inward, its trailing edge is lifted by the back ferrule to a sealing position with the fitting body bevel.

   f) As greater resistance is encountered because more tubing is deformed and a greater area of body bevel and front ferrule is in contact, the back ferrule is driven inward to form a grip, or hold, on the tubing.

   g) At 1 1/4 turns of wrench pull-up, the nut has moved 1/16 in. forward. Within this 1/16 in. movement, the sequence of sealing and holding has been accomplished.

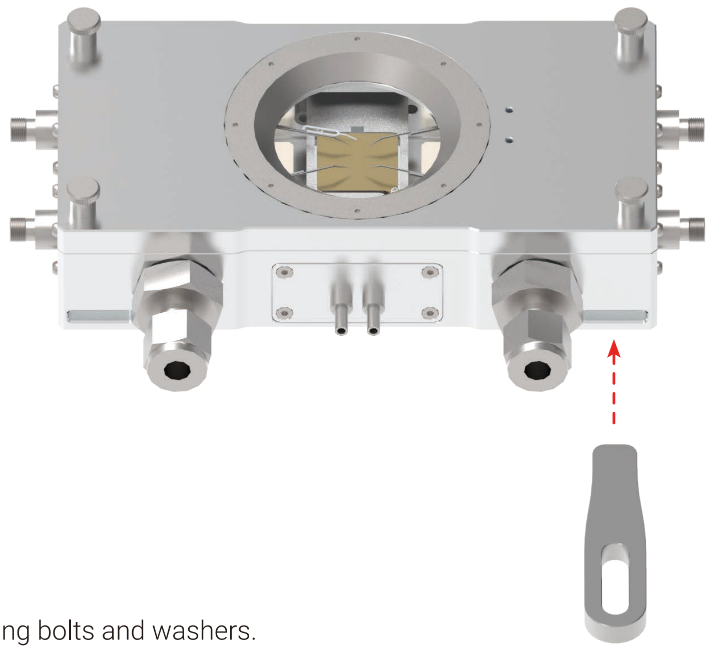
   h) One of the unique abilities of this proven design is the ability to seal and hold on a wide variety of tubing materials, wall thicknesses, and hardnesses. Because the amount of back ferrule grip is determined by the tube's resistance to front ferrule action, grip is much tighter when heavy wall tubing is encountered. This is an important design feature because heavy wall tubing is often used in service conditions such as high pressure or other unusual stresses, vibration, pulsation, or shock. Thus, the Swagelok tube fitting, by design, grips much more securely on heavy wall tubing than it does on thin wall tubing used for more moderate service

Chamber Holding Bracket (Optional)

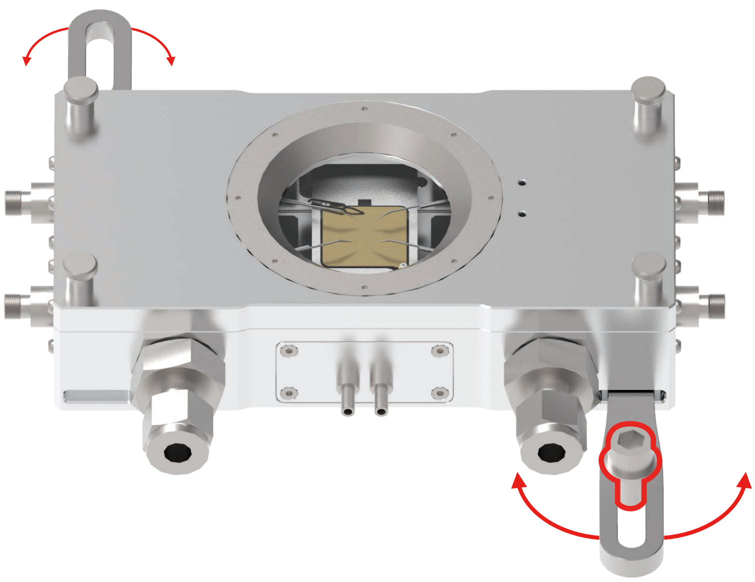
Chamber to Optical Table

(The image below is MPS-PT model. The Bracket is all the same.)

1. When fixing the chamber to an optical breadboard, insert the chamber holding bracket into the chamber groove.



2. Secure using bolts and washers.



Chamber Holding Bracket (Optional)

Chamber to Optical Table

3. The bracket is compatible to both Metric breadboard and Imperial breadboard.

Metric breadboard: M6 tap

Imperial breadboard: 1/4-20 UNC tap