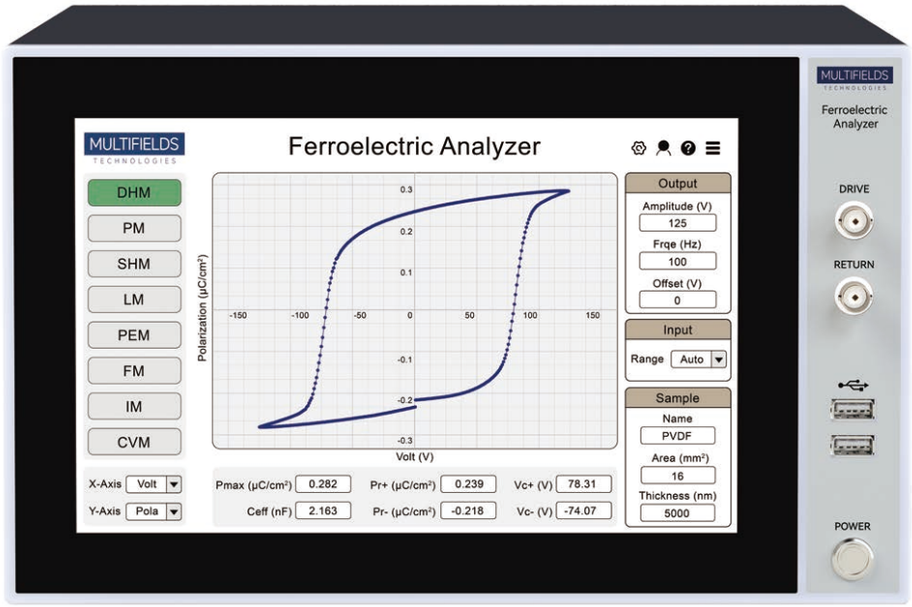

Materials Characterization - Product Catalog

Multifields Technologies | Beijing

Materials Characterization

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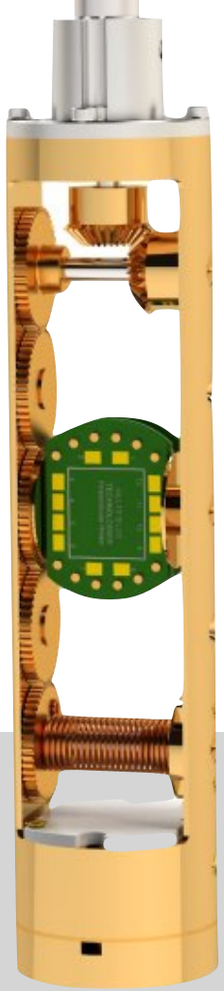
Materials Characterization

MultiFields
多场科技

General Measurement
ETM.Probe.30



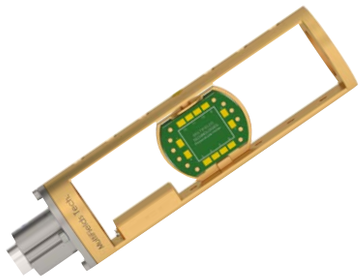
Single Axis Rotation
ETM.RotProbe.30

Dual Axes Rotation
ETM.3DRotProbe.50

Electrical Transport Measurement Module

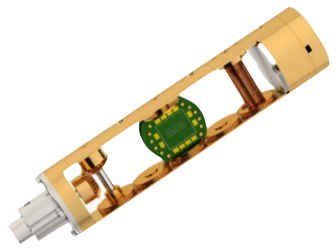
Electric Transport Measurement Series

Functions：resistance / Hall measurements (I-V, R-T, R-H, pulse), van de Paul, harmonic measurements, etc..



General Measurement - ETM.Probe.xx.xx

General DC & AC measurements can be realized.
Fiber, high voltage, coaxial cable and DAC are compatible.



Single Axis Rotation - ETM.RotProbe.xx.xx

Sample can be rotated along a single axis.
High voltage, coaxial cable and DAC are compatible.

Dual Axes Rotation - ETM.3DRotProbe.xx.xx

Integrate a piezoelectric rotator on the mechanical axis.
Completely cover three-dimensional space sphere.

	Functions			
1	Work environment	Temperature: 1.4 K ~ 400 K；Pressure：10^{5} ～ 10^{-5} Pa； Magnetic Field：0 ～ 18 Tesla;		
2	Diameter	dia-26 mm / dia-30 mm / dia-50 mm		
3	Rotation	manually fix sample direction	Single mechanical rotation axis	Mechanical rotation axis & Piezoelectric rotation axis
	Range	Limitless	0 ～ 370 °	Mechanical：0 ～ 370 ° Piezoelectric：-20 ～ 200 ° (dia-30 mm) -30 ～ 300 ° (dia-50 mm)
	Precision	Limitless	0.1 °	Mechanical：0.1 °; Piezoelectric：< 0.01 °
4	Withstand voltage	200 V		
5	Leakage current	< 100 pA @ 100 V		
6	Channel (STD/MAX)	12/24 (dia-26 mm, dia-30 mm) & 24/48 (dia-50 mm)	12/16	8/8 (dia-26 mm, dia-30 mm) & 16/16 (dia-50 mm)
7	Sample holder	see the sample holders brochure for details		
	PCB	Compatible	Compatible	Compatible
	LCC 28	Compatible	Only dia-50 mm compatible	Only dia-50 mm compatible
	LCC 44	Only dia-50 mm compatible	Only dia-50 mm compatible	N. A.
	DIP 16	Compatible	Compatible	Only dia-50 mm compatible
8	Coaxial cable upgrade	2 (dia-26 mm, dia-30 mm) & 4 (dia-50 mm)		N. A.
9	Vacuum option upgrade			
10	Compatible options	Matrix Switch System, Breakout Box, Check Stage and ETM Accessories are compatible for all above products.		

* The Multifields Technologies ETM series are seamlessly compatible with common platforms such as QD-PPMS, Oxford-TeslatronPT, Pride-CPMS, Cryogenic-CFMS and others；

** The above are all recommended configurations. Multifields Technologies provides customization services. If you have special requirements, please contact us.

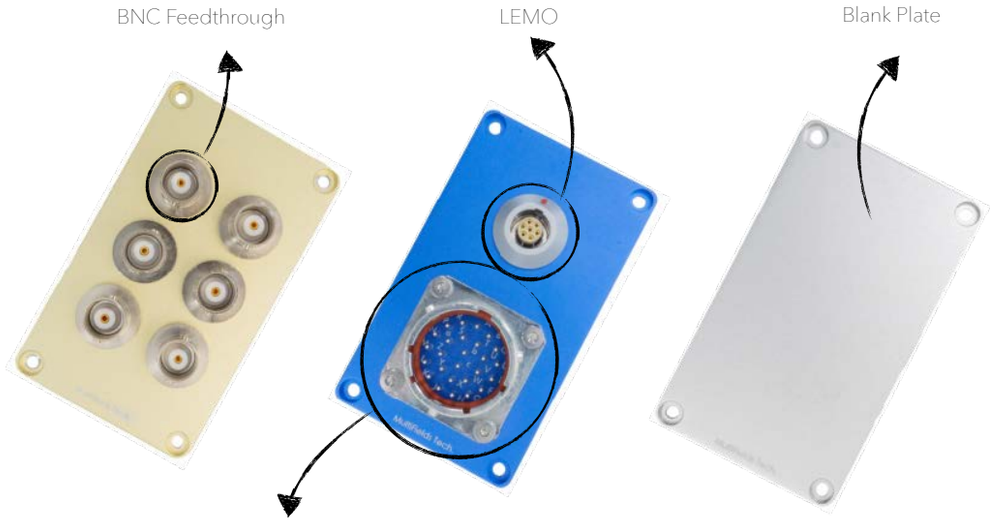
Materials Characterization

■ Electric Transport Measurement (ETM)

1.1 General ETM probe - Overview

Cover conventional electrical measurements such as resistance, Hall, etc., provide the options of optical fiber, high voltage and small signal measurement.

Multifields Technologies® general ETM probes are compatible with a variety of sample holders, including MF standard 12pins/16pins/24pins PCB sample holders, LCC / DIP ceramic sample holders, and customized sample holders. Multiple sample holders can also be mounted on a single probe for high throughput measurements.



Multifields Technologies® general ETM probes with multifunctional plate for fitting different feedthroughs, such as the commonly used LEMO, Fischer, mil-spec connectors, etc.. Coaxial Feedthroughs such as BNC, SMA, 2.92 connectors (40GHz) are also available as an option.

Key Features

- Sample direction can be freely fixed;
- Withstand voltage > 200 V (DC);
- Excellent leakage current;
- Provide vacuum options;
- Compatible with a variety of sample holders;
- Provide coaxial cable for option;
- Working temperature: 1.5~400K; Field: 18 Tesla;
- Compatible with QD-PPMS Dynacool, Oxford-TeslatronPT, Cryogenic and Pride-CPMS platforms.

Materials Characterization

1.1 General ETM probe - Models

General ETM probes with multiple functional options for cryogenic chambers with different bore sizes

Model Details - General ETM probe

ETM.MCProbe.aa.bb.cc.dd.ee.ff

	Chamber [1]	Sample Holder [2]	Vacuum Environment [3]	Slide Seal [4]	Options [5]
ETM.MCProbe	.25C	.MF12/ .MF16/ .LCC20	/	.SS .SL	
	.26P	.MF12/ .MF16/ .DIP16/ .LCC20/ .LCC28	/	/	.CX .Cn .OF
	.26		/	/	
	.30		.cone /	/	
	.30C		.cone /	.SS .SL	
	.50	.MF12/ .MF16/ .MF24/ .DIP16/ .LCC20/ .LCC28/ .LCC44	.cone .In	/	/
	.50C		.cone .In	/	.SL

[1] Chamber：***.26P*** - QD PPMS；***.26/.30/.50*** - Platforms with dia-26/30/50 mm chambers such as Oxford-TeslatronPT、Pride-CPMS；***.25C/.30C/.50C*** - Cryogenic with dia-26/30/50 mm chambers；

[2] Sample Holder：.MF12/16/24 - MF PCB12/16/24pin sample holders；.DIP16 - DIP - 16pin chip carrier；.LCC20/28/44 - LCC - 20/28/44pin chip carrier；

[3] Vacuum Environment：.Cone - Conical seal；.In - Indium wire seal；/ - No vacuum required；

[4] Slide Seal：.SS - Cryogenic original slide seal；.SL - MF slide seal & airlock；/ - No slide seal required；

[5] Options：.CX - Cernox temperature sensor..Cn - Upgrade n pcs of coaxial cables；.OF - Optical fiber；/ - No option required；

* This table is used as a guide for selecting general ETM probes. For specific selections or other options, please consult the sales staff of Multifields Technologies.。

➡Recommend Models：

- ETM.MCProbe.26P.MF12
- ETM.MCProbe.26P.2MF12
- ETM.MCProbe.26P.MF16
- ETM.MCProbe.26P.MF12.OF
- ETM.MCProbe.26P.MF16.OF
- ETM.MCProbe.26P.LCC28
- ETM.MCProbe.26P.DIP16
- ETM.MCProbe.30.MF12.CX
- ETM.MCProbe.30.2MF12.CX
- ETM.MCProbe.30.MF16.CX
- ETM.MCProbe.30.MF12.CX.OF
- ETM.MCProbe.30.MF16.CX.OF
- ETM.MCProbe.50.2MF12.CX
- ETM.MCProbe.500.MF16.CX
- ETM.MCProbe.50.MF12.CX.OF
- ETM.MCProbe.50.MF16.CX.OF

1.1 General ETM probe - Application

Designed for low-level signal measurements with ease and convenience

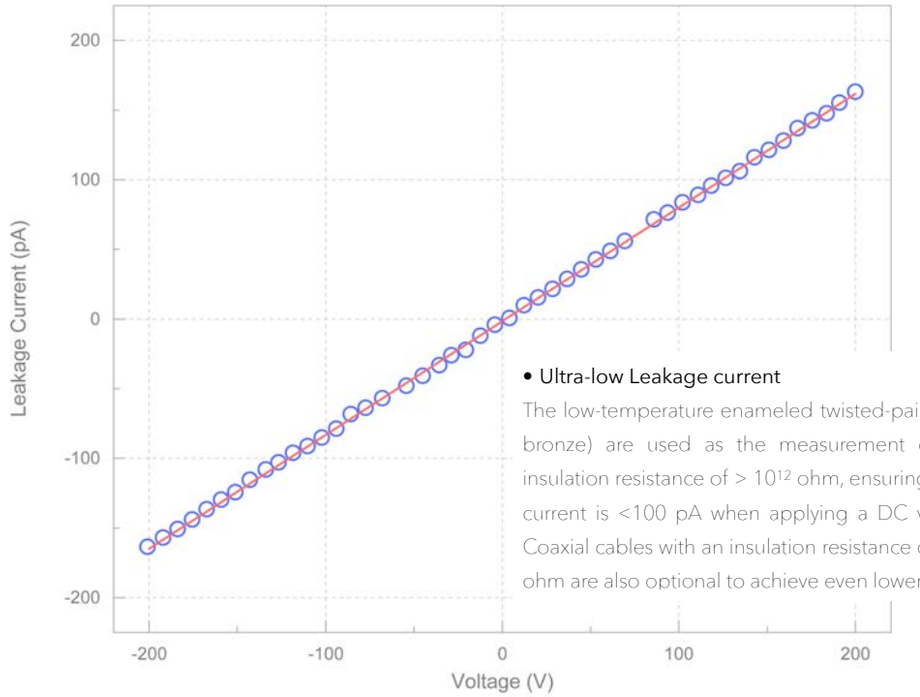
Application (1)–

Leakage Current Test

Sample Information	None
MultiFields Products	General ETM probe (ETM.Probe.26P) Angilent B1500
Platform	None

• Method

Without installing the sample, two channels remain disconnected from each other. Apply a voltage and measure the current between the two channels. We chose Agilent B1500 semiconductor analyzer for a reliable result.



• Ultra-low Leakage current

The low-temperature enameled twisted-pair wires (phosphor bronze) are used as the measurement channel, with an insulation resistance of > 10^{12} ohm, ensuring that the leakage current is <100 pA when applying a DC voltage of 100 V. Coaxial cables with an insulation resistance of more than 10^{13} ohm are also optional to achieve even lower leakage current.

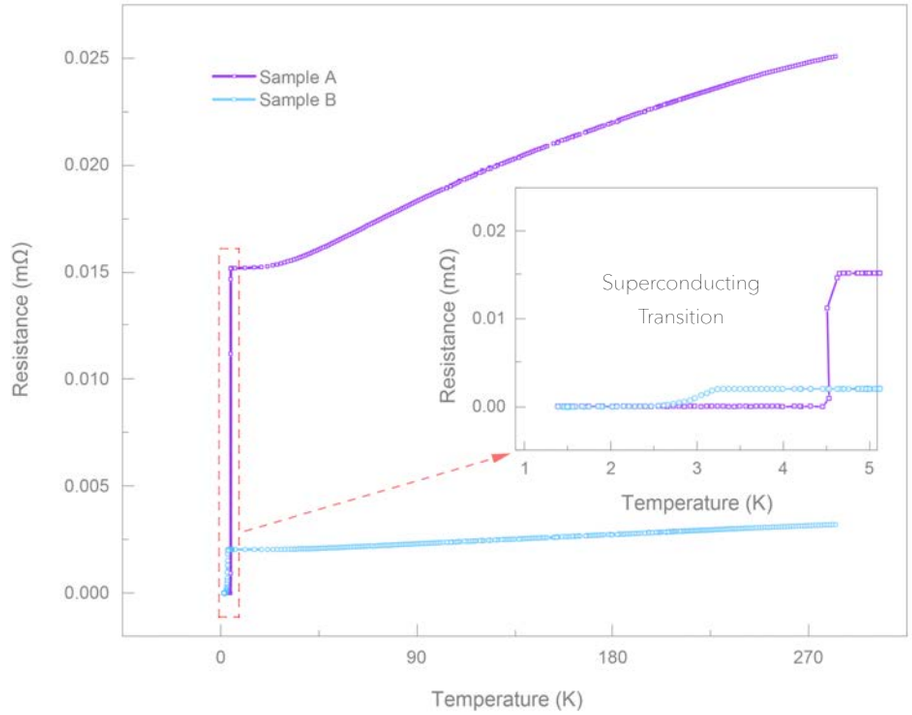
Application (2)–

Transition temperature of superconducting materials

Sample Information	Superconductor
MultiFields Products	General ETM probe (ETM.Probe.26P) Keithley 6221 & 2182A
Platform	Pride - CPMS- 1 4T

• Method

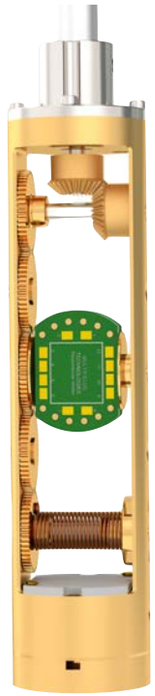
The four-wire method is used to measure the resistance of the sample. In order to obtain an accurate resistance value and exclude the noise, the positive and negative currents are applied alternately.



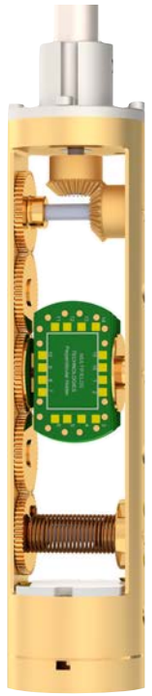
Materials Characterization

1.2 Single Axis Rotation ETM - Overview

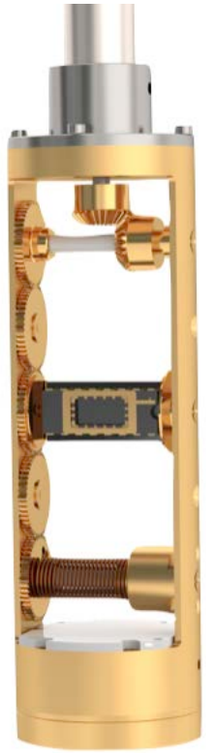
Rotating ETM probe allows for 360° sample rotation along a single axis.



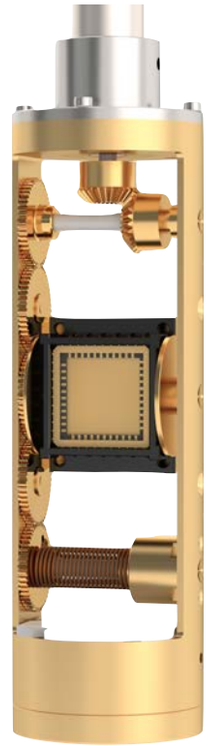
ETM.RotProbe.30.MF12



ETM.RotProbe.30.MF16



ETM.RotProbe.50.DIP16



ETM.RotProbe.50.LCC44

Key Features

- Range: -10° ~ 370°; Hysteresis error < 1°;
- Withstand voltage > 200 V (DC);
- Excellent leakage current;
- Provide vacuum options;
- Compatible with a variety of sample holders;
- Provide coaxial cable for option;
- Working temperature: 1.5~400K; Field: 18 Tesla;
- Compatible with QD-PPMS Dynacool, Oxford-TeslatronPT, Cryogenic and Pride-CPMS platforms.

1.2 Single Axis Rotation ETM - Models

MultiFields &Group

Single axis rotation ETM probes with multiple functional options for cryogenic chambers with different bore sizes

Model Details - Single Axis Rotation ETM probe

ETM.RotProbe.aa.bb.cc.dd.ee.ff

	Chamber [1]	Sample Holder [2]	Vacuum Environment [3]	Slide Seal [4]	Options [5]
ETM.RotProbe	.25C	.MF12/ .MF16	/	.SS .SL	.CX .Cn
	.26P	.MF12/ .MF16/ .DIP16/ .LCC20	/	/	
	.26		/	/	
	.30		.cone /	/	
	.30C		.cone /	.SS .SL	
	.50	.MF12/ .MF16/ .MF24/ .DIP16/ .LCC20/ .LCC28/ .LCC44	.cone .In	/ /	
	.50C		.cone .In	/ .SL	

[1] Chamber：***.26P*** - QD PPMS；***.26/.30/.50*** - Platforms with dia-26/30/50 mm chambers such as Oxford-TeslatronPT、Pride-CPMS；***.25C/.30C/.50C*** - Cryogenic with dia-26/30/50 mm chambers；

[2] Sample Holder：.MF12/16/24 - MF PCB12/16/24pin sample holders；.DIP16 - DIP - 16pin chip carrier；.LCC20/28/44 - LCC - 20/28/44pin chip carrier；

[3] Vacuum Environment：.Cone - Conical seal；.In - Indium wire seal；/ - No vacuum required；

[4] Slide Seal：.SS - Cryogenic original slide seal；.SL - MF slide seal & airlock；/ - No slide seal required；

[5] Options：.CX - Cernox temperature sensor..Cn - Upgrade n pcs of coaxial cables；.OF - Optical fiber；/ - No option required；

* This table is used as a guide for selecting general ETM probes. For specific selections or other options, please consult the sales staff of Multifields Technologies.。

➡Recommend Models：

- ETM.RotProbe.26P.MF12
- ETM.RotProbe.26P.MF16
- ETM.RotProbe.30.MF12.CX
- ETM.RotProbe.30.MF16.CX
- ETM.RotProbe.50.MF12.CX
- ETM.RotProbe.50.MF16.CX
- ETM.RotProbe.30C.MF12.SS.CX
- ETM.RotProbe.30C.MF16.SS.CX
- ETM.RotProbe.30C.MF12.SL.CX
- ETM.RotProbe.30C.MF16.SL.CX
- ETM.RotProbe.50C.MF12.SS.CX
- ETM.RotProbe.50C.MF16.SS.CX
- ETM.RotProbe.50C.MF12.SL.CX
- ETM.RotProbe.50C.MF16.SL.CX

1.2 Single Axis Rotation ETM - Components

Complete system including probe, controller and measurement software.

• Automatic Control and Measurement Software

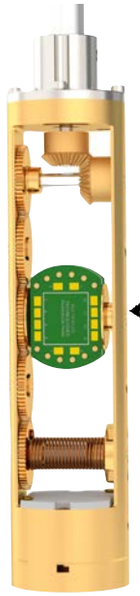
With Multifields Technologies measurement software, users can connect external instruments and platforms as desired. Using sequence-written interfaces can conduct the measurement of a variety of functions such as V-H, R-H, R-T, I-V and others. It are also compatible with matrix switch system or breakout boxes for high throughput automatic measurement.

• Motor controller

MF provides complete LabVIEW drivers for the convenience of user programing.

• Temperature Controller

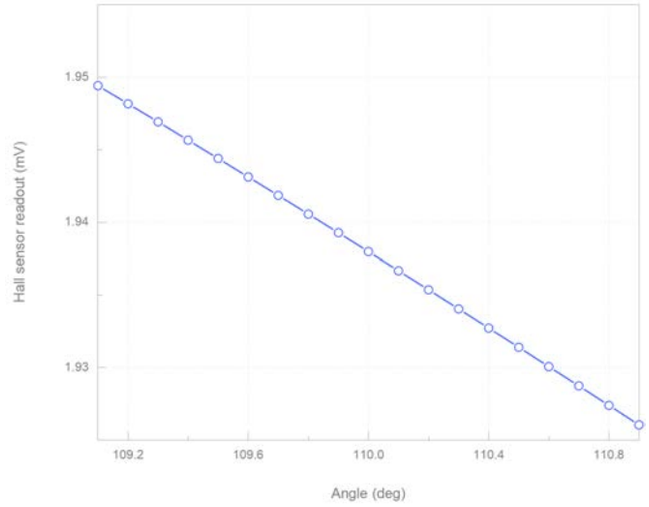
Kelvinion series temperature controllers for real-time temperature monitoring and precise control of sample temperature.



• Pluggable Sample Holders

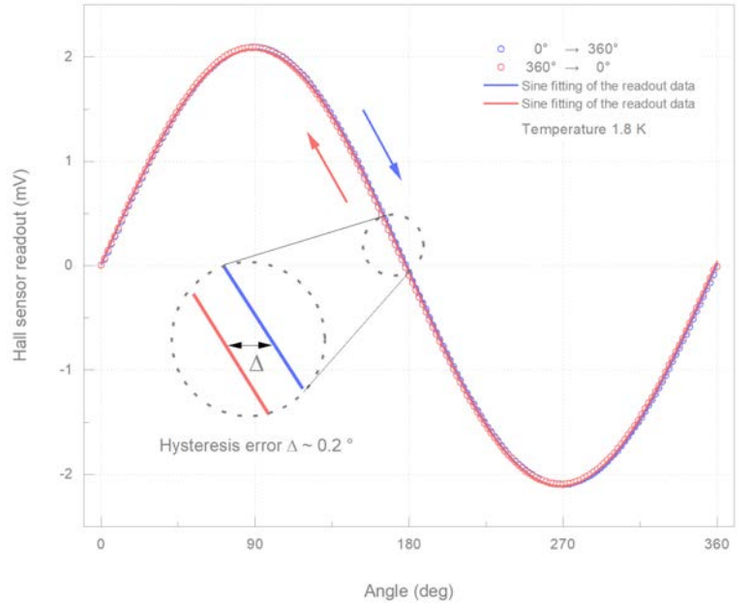
Various sample holders are available, including MF standard PCB sample holders, ceramic chip carriers for LCC / DIP packages and customized sample holders.

Feel free to consult Multifields Technologies sales staff for specific selections.



• High Precision

Stepper motor of Single Axis Rotation ETM offer high precision, enabling measurements with step sizes of 0.1°.



• Repeatability

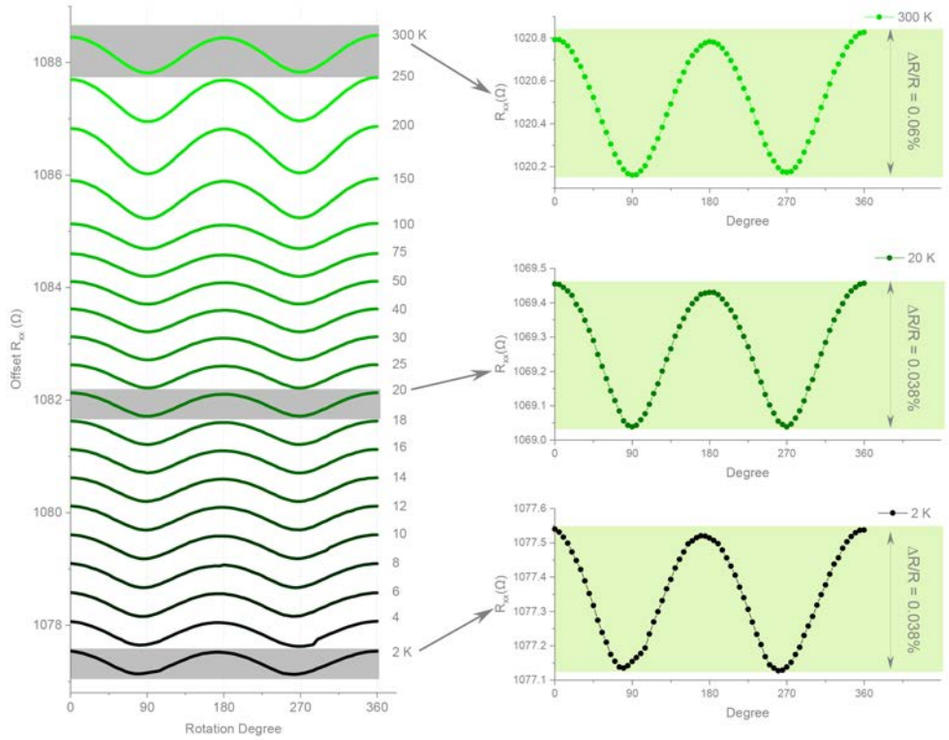
Using a spring to counter hysteresis error for excellent repeatability. The typical hysteresis error is 0.2°, within multiple repetitions of full-travel rotation.

1.2 Single Axis Rotation ETM - Applications

Application (1)–

Spin Hall magnetic field angle dependence at different temperatures

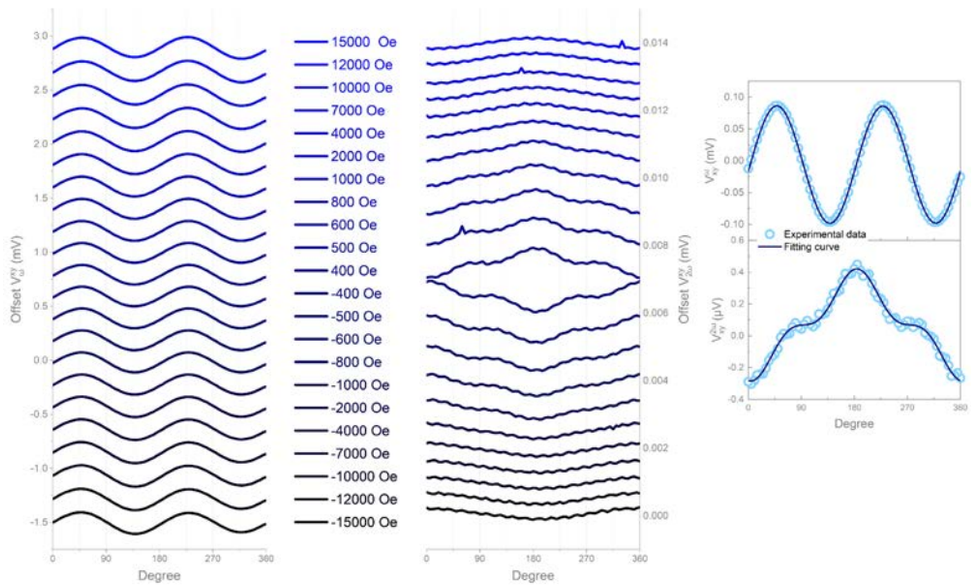
Sample Information	W(5)/CoFeB(0.9)/MgO(2)/Ta(2 nm)
MultiFields Products	1. ETM.RotProbe.30.MF12 2. MF.Breakout Box.Pro.Max
Electric Meters	1. Keithley 2182A 2. Keithley 6221



Application (2)–

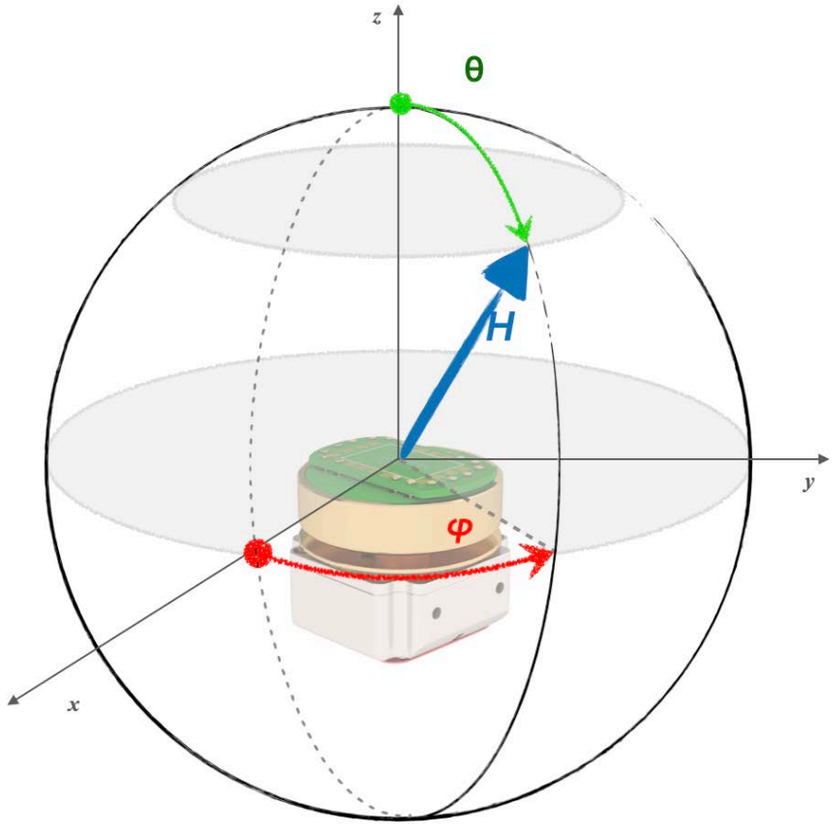
The magnetic field angle dependence on the second harmonic electric transport measurement

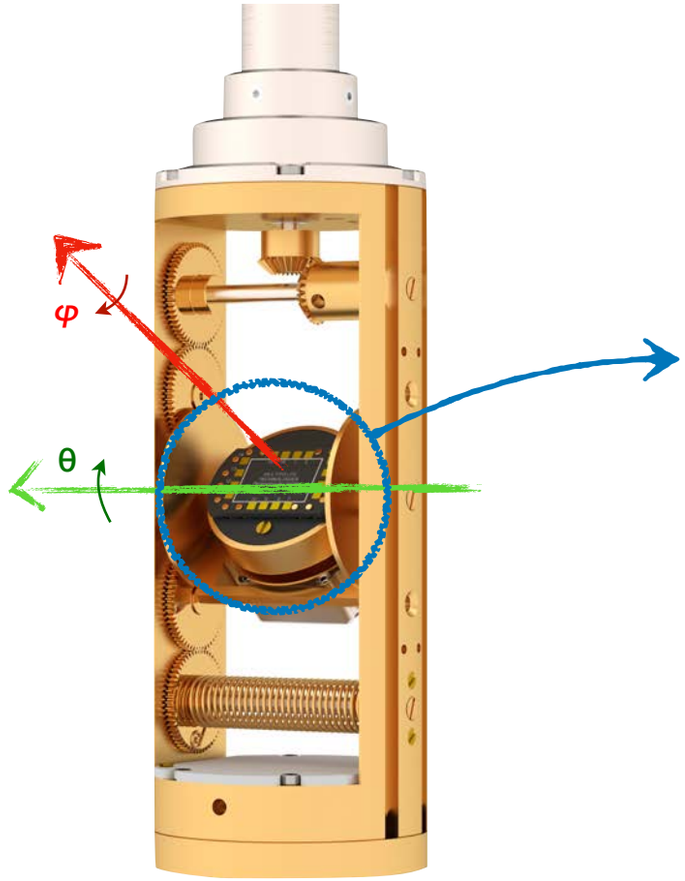
Sample Information	Co(3nm)/Pt(5 nm)
MultiFields Products	1. ETM.RotProbe.30.MF12 2. MF.Breakout Box.Pro.Max
Electric Meters	1. Stanford SR830 *2 2. Keithley 6221



1.3 Dual Axis Rotation - Overview

Completely cover three-dimensional space sphere (using 3D polar coordinates to name rotation angle, theta & phi).





MultiFields Rotator 25* (Special edition)
low temperature piezoelectric motor

• Completely cover three-dimensional space sphere

The direction between magnetic field and the sample could be rotated through rotating the sample. The mechanical axis is fixed and the piezoelectric axis is the following axis. If we consider the orientation of the magnetic field with respect to the sample, as shown in the figure above, the two angles of the spherical coordinates: the elevation angle θ corresponds to the mechanical axis angle, and the azimuth angle ϕ corresponds to the piezoelectric axis angle.

Features

- Mechanical axis rotation range: -10° to 370°;
- Piezo rotator with closed-loop control and 0.01° resolution
- Maximum withstand voltage: 200 V (DC);
- Excellent leakage current;
- Compatible with vacuum option;
- Compatible with various sample holder: PCB, LCC & DIP customization;
- Support upgrade of high-precision and low-noise coaxial cable;
- Operating temperature 1.5 to 400K; Maximum magnetic field 18 Tesla;
- Compatible with QD-PPMS Dynacool, Oxford TeslatronPT, Cryogenic and Pride CPMS system, etc.

Dual Axis Rotation· ETM

Functions：resistance / Hall (I-V, R-T, R-H, etc.)， van de Paul， lock-in (AC resistance / Hall, harmonic) measurement

Dual Axis Rotation (ETM.2DRotProbe.30.MF8)

Dual Axis Rotation (ETM.2DRotProbe.50.MF16)

1	Work environment		Temperature: 1.4 K ~ 400 K；Pressure：10^{5} ～ 10^{-5} Pa； Magnetic Field：0 ～ 18 Tesla;	
2	Diameter		dia-26 mm / dia-30 mm / dia-50 mm	
3	Rotation		Integrated piezoelectric rotator on a mechanical rotating axis, rotation range cover a complete sphere	
	Range	mechanical axis	0° ～ 370°	0° ～ 370°
		Piezoelectric axis	-20° ～ 200°	-30° ～ 300°
	Precision	mechanical axis	0.1°	
		Piezoelectric axis	< 0.01°	
4	Withstand voltage		200 V	
5	Leakage current		< 100 pA @ 100 V	
6	Channel (STD/MAX)		8	16
7	Sample holder		see the sample holders brochure for details	
	PCB		Only MF8	Only MF12 / MF16
	LCC 28		N. A.	Compatible
	LCC 44		N. A.	N. A.
	DIP 16		N. A.	Compatible
8	Coaxial cable upgrade		2	4
9	Vacuum option upgrade		Compatible	Compatible
10	Compatible options		MF. Breakout Box; MF.CheckStage; MF.Matrix.6-24 etc.	

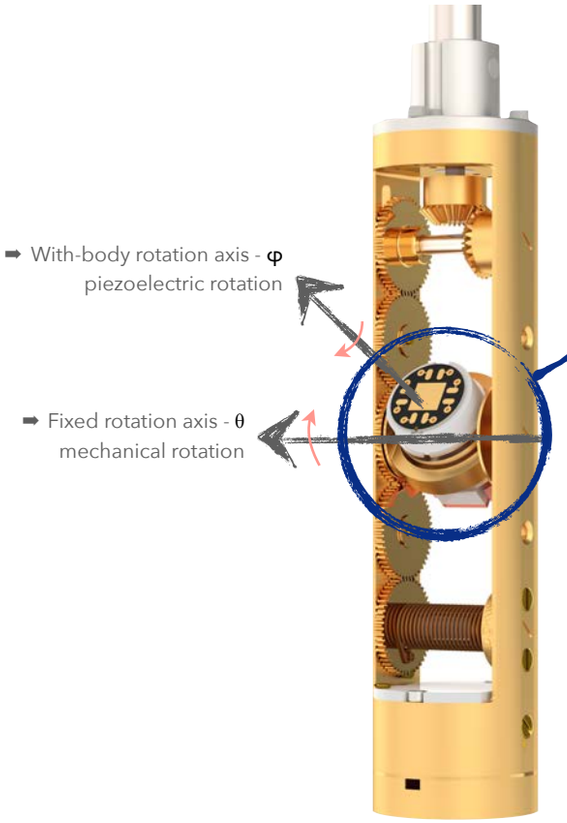
* The Multifields Technologies ETM series are seamlessly compatible with common platforms such as QD-PPMS, Oxford-TeslatronPT, Pride-CPMS, Cryogenic-CFMS and others；

** The above are all recommended configurations. Multifields Technologies provides customization services. If you have special requirements, please contact us.

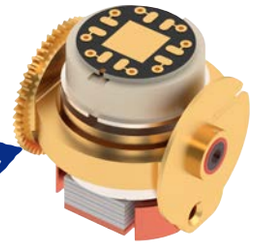
Materials Characterization

1.3 Dual Axis Rotation - Key Parts

Piezoelectric rotator with16 mm size, compatible with the chamber of dia.26~30 mm



ETM.2DRotProbe.30.MF8

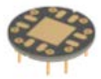


• Multifields Technologies ® Piezoelectric Rotator

Ultra-compact piezoelectric rotator made entirely of non-magnetic materials with closed-loop position control, requiring the specialized controller MC - NewtonLT.06.

Multifields Technologies ® Piezoelectric Motion Piezoelectric Motion Controller

MC - NewtonLT.06

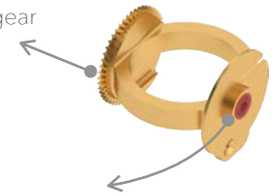


• Sample holder，8 channels (.MF8)

• Cernox™ 1050 thermometer

• PEEK sample holder

• Non-magnetic gear



• Mechanical base

• Bearings

• Angular sensor

• Rotator.16.SE
16 mm Piezoelectric rotator
Multifields Technologies - Piezoelectric Motion Product

Rotator.16.SE - Specifications

1. Work environment	Temperature: 1.4 ~ 400 K;	5. Driving Voltage	20V ~ 200 V
	Pressure: 1 × 10^{-7} mbar;	6. Max. Load	100 g
	Max. Field: 35 Tesla	7. Sensor	Resistance sensor
2. Weight	10 g	8. Sensor Range	270 °
3. Range	-20° ~ 200°	9. Sensor Precision	0.01°
4. Max. Speed	~ 10 °/s @300 K	10. Repeatability	~ 0.05°

1.3 Dual Axis Rotation - Key Parts

Piezoelectric rotator with25 mm size, compatible with the chamber of dia.50 mm

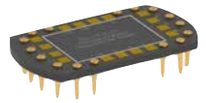
ETM.2DRotProbe.50.MF16

• Multifields Technologies ® Piezoelectric Rotator

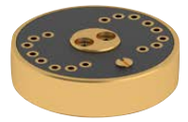
Piezoelectric rotator made entirely of non-magnetic materials with closed-loop position control, requiring the specialized controller MC - NewtonLT.06.

Multifields Technologies ® Piezoelectric Motion Piezoelectric Motion Controller

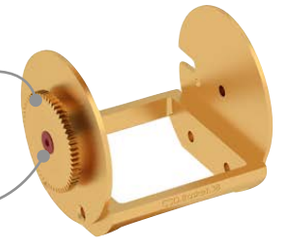
MC - NewtonLT.06



• Sample holder，16 channels (.MF16)



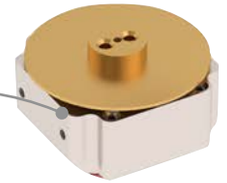
• PEEK sample holder



• Non-magnetic gear

• Mechanical base

• Bearings



• Angular sensor

• Rotator.25.SE
25 mm Piezoelectric rotator
Multifields Technologies - Piezoelectric Motion

Rotator.25.SE - Specifications

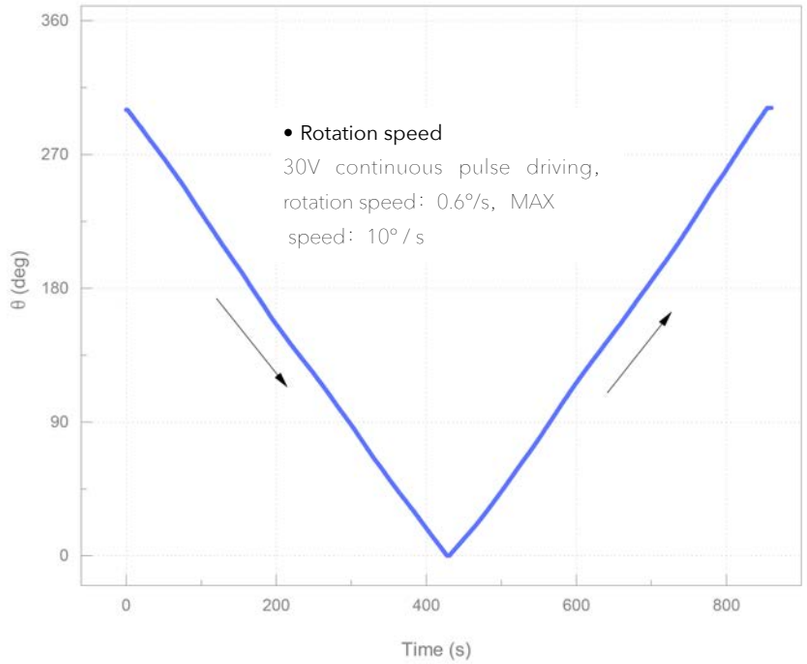
1. Work environment	Temperature: 1.4 ~ 400 K； Pressure: 1 × 10^{-7} mbar； Max. Field: 35 Tesla	5. Driving Voltage	20V ～ 200 V
		6. Max. Load	100 g
		7. Sensor	Resistance sensor
2. Weight	10 g	8. Sensor Range	270 °
3. Range	-20° ～ 200°	9. Sensor Precision	0.01°
4. Max. Speed	~ 10 °/s @300 K	10. Repeatability	~ 0.05°

1.3 Dual Axis Rotation - Applications

Application (1)–

Rotation in full range

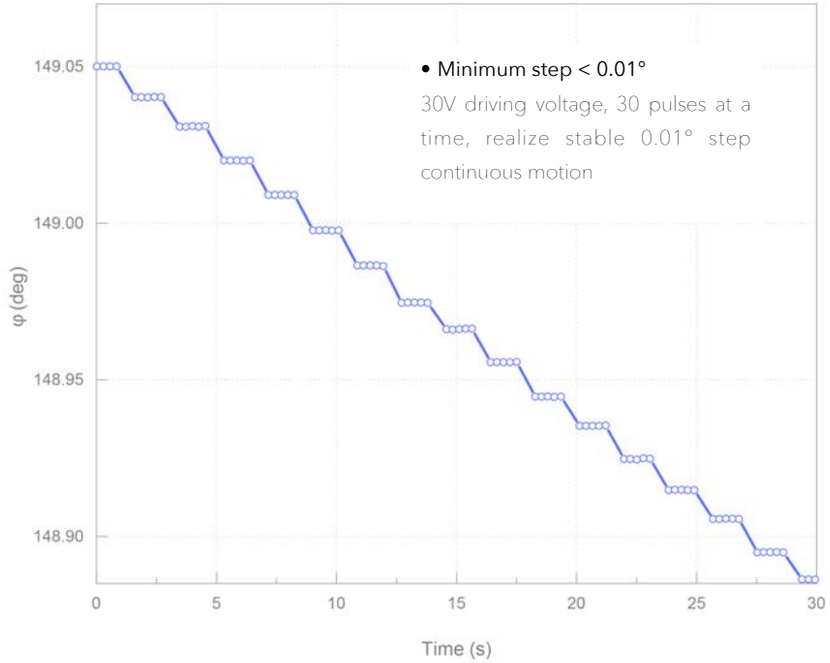
Sample Information	Empty
Multifields Products	1. ETM.2DRotProbe.50.MF16 2. MC - NewtonLT.06
Platform	Oxford TeslatronPT



Application (2)–

Step precision test

Sample Information	Empty
Multifields Products	1. ETM.2DRotProbe.50.MF16 2. MC - NewtonLT.06
Platform	Oxford TeslatronPT



Materials Characterization

1.4 ETM Accessories - Overview

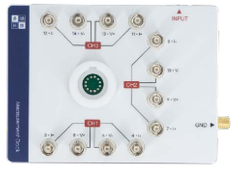
Essential & recommended options for electric transport measurement

Matrix Switch

MF.Matrix.6-24

Breakout Box

MF.BreakoutBox.Pro.Max



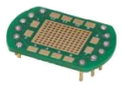
MF.CheckStage.PP12.BNC

Accessories

ETM.BondingCube.PP12

ETM.R-Cube.1-2

Cables



Sample Holders

1.4.1 Matrix Switch System

Arbitrarily switch the connection between the source meter and the device to make the measurement as you wish!

MF.Matrix.6-24

Matrix switch system support a wide range of signals in the test and measurements industry. DC switching capabilities from 10 nV to 0.5 kV make MultiFields matrix system a versatile production test tool for a wide array of applications. Touch-screen directly control eliminates the need for the computer to control every step of the test procedure. The status of every channels all shows on screen simultaneously.

Key Features

- 6 row - BNC connectors; 24 columns - Lemo.3B.26pins
- Max. Voltage allowed to use is 250 V;
- The line switching time is about 3ms;
- Software supports automatic switching of multiple samples and van de Paul method;
- The touch-screen real-time monitors and controls the state of all available channels;
- IEEE-488 & RS232 interface;

MF.Matrix.6-24 · Specification

General Information	
Matrix Configuration	6 * 24 each of the 144 cross-points is made up of a relay switch. By closing the appropriate crosspoint switch, any matrix row can be connected to any column in the matrix.
Connectors	6 rows ~ BNC connectors; 24 columns ~ Lemo.3B.26pins;
Size	19 inch rack unit, 2U
Work environment	0 ~ 50 °C;
Technique Details	
Max. DC Voltage	220V DC between any two pins, 2A switched.
Max. AC Voltage	250V AC peak between any two pins, 2A switched.
Common Mode Voltage	175 V Peak
Contact Life	Cold Switching 10^8 times
Channel Resistance	< 1 Omega
Offset Current	< 100pA
Contact Potential	< 500nV
Actuation time	3ms
Isolation	Above 10^9 omega between paths
Crosstalk between Channels	< -35 dB
Relay Drive Current	16 mA
Interface & Communication	
Trigger Sources	RS232 / GPIB / Manual (Touch-Screen)
Communication	GPIB / RS232
Software	Labview VI

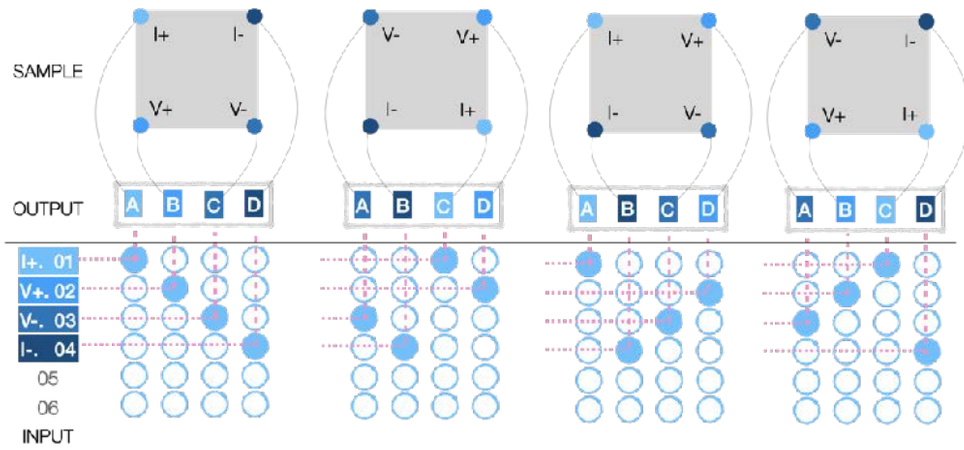
1.4.1 Matrix Switch System - Applications

Arbitrarily switch the connection between the source meter and the device to make the measurement as you wish!

Application (1)–

van de Pauw Method

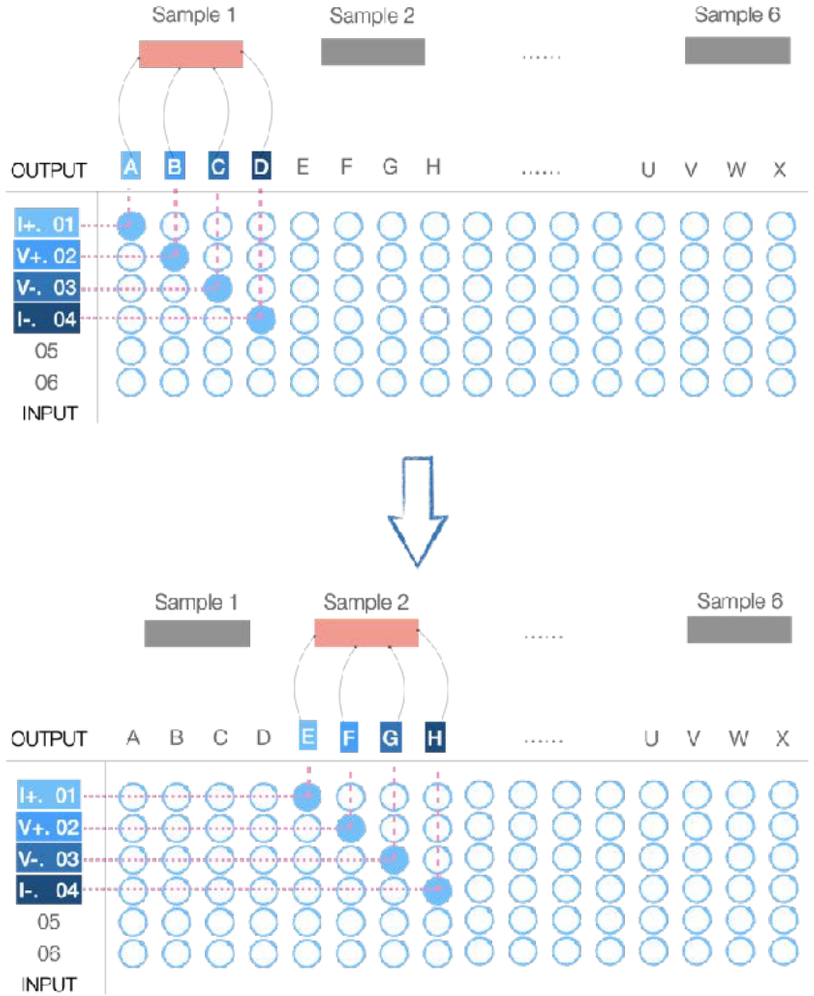
It is a technique commonly used to measure the resistivity and hall coefficient of a homogenous and isotropic sample with arbitrary shape. Using the built -in algorithm, the switch matrix automatically switch current I and voltage V among the four contacts of the sample according to Van De Pauw procedure, and calculate the resistivity or hall coefficient, precisely.



Application (2)–

Multiple sample measurement

To improve efficiency, researchers often use multiple sets of SMU(Source meter unit) to perform high throughout sample measurements, which cannot be afforded by most labs. One set of SMU plus MultiFields switch matrix can perfectly solve this problem at much lower cost: Switch matrix supports automatic switching between different samples and simultaneous test of up to six samples.



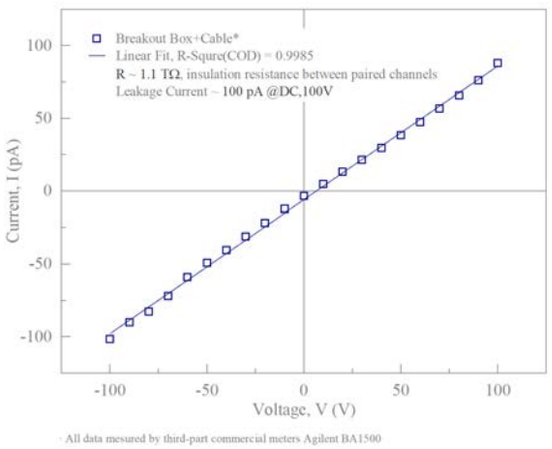
1.4.2 Breakout Box with ESD Protection

Low leakage current guarantees a higher signal accuracy and better resolution.

MF.BreakoutBox.Pro.Max

Breakout Box is designed to play a role of connector adaptor between sample probe and commercial electric meters. The **leakage current** and pick-up **noise level** are key parameters for a better weak-signal quality. As the research field of low-dimension materials and nano-device raising, **ESD (electrostatic discharge) protection** becomes indispensable function for a breakout box.

"Breakout Box Pro 24pins" is a perfect solution, whose leakage current and noise level are strictly constrained to a very low level. And it supples a complete ESD protection throughout the sample measurement, (1) sample & meters first connect to systems; (2) sample & meters in standby statues.



All data mesured by third-part commercial meters Agilent BA1500

Key Feature

- 3 status prepared for end user's experiments, Float, GND and Measurement
- Paired with MultiFields original cable(2.5m length) only 100 pA leakage current @ DC-100V voltage
- Max. Voltage allowed to use is 500 V
- 12pins & 24pins two versions available

	Breakout Box 24pins	Breakout Box^{Pro} 12pins	Breakout Box 24pins
	MF.BreakoutBox.Max	MF.BreakoutBox.Pro	MF.BreakoutBox
Advanced Function	Low noise Low leakage current	Low noise Low leakage current ESD protection	Low noise Low leakage current
Output channels	24 channels	12 channels	12 channels
Installation	19-inch Rack Size		
Hight	2U	1U	1U
Input	Lemo.3B.26pin		
Output	Standard BNC		
Leakage current	100 pA@ DC 100V		
Shield & GND	All BNC connectors' shield and metal box are electric-connected. One individual banana connector is left to end user, connecting to GND or keeping it float.		

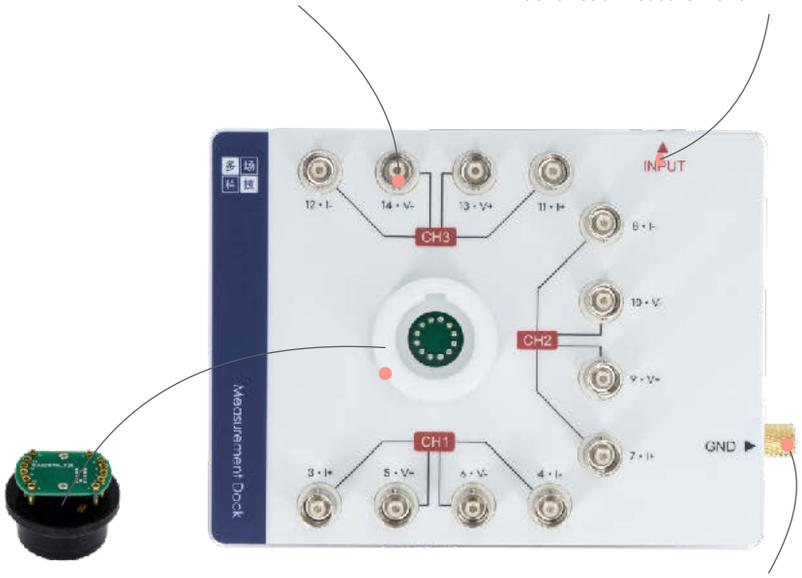
1.4.3 Check Stage

MultiFields &Group

Flexible desktop breakout box for device measurements anytime & anywhere

• BNC connectors
Directly connect meters for quick-check

• Lemo.3B.26pins connector
Connect with MultiFields Breakout Box and Matrix Switch System by standard MultiFields cable for advanced measurement.



• Removable Holder Base
Holder base can be flexibly adapted to a variety of sample holders

• Banana (F) Connector
BNC shields and the box's metal housing are electric-connected with this connector.

MF.CheckStage.PP12.BNC

Compatible with all sample holder MultiFields supplied in various measurement solution.

- Electric transport
- Thermal transport
- Dielectric & Ferroelectric
- ……

	Sample Holder - 8pin	Sample Holder - 12pin	Sample Holder - 16pin
	MF.CheckStage.MF8.BNC	MF.CheckStage.MF12.BNC	MF.CheckStage.MF16.BNC
Advanced Function	Low noise Low leakage current	Low noise Low leakage current ESD protection	Low noise Low leakage current
Channel	8 channels	12 channels	16 channels
适配样品托	ETM.SH.MF8.OP	ETM.SH.MF12.OP ETM.SH.MF12.OP.Cu ETM.SH.MF12.IP	ETM.SH.MF16.OP ETM.SH.MF16.OP.Cu ETM.SH.MF16.IP
Input	Lemo.3B.14pin	Lemo.3B.14pin	Lemo.3B.26pin
Output	Standard BNC		
Leakage current	100 pA@ DC 100V		
Shield & GND	All BNC connectors' shield and metal box are electric-connected. One individual banana connector is left to end user, connecting to GND or keeping it float.		

1.4.4 ETM Accessories

Options for Electric Transport Measurement

ETM.BongdingCube.PP12

Bonding Cube series

- ETM.BongdingCube.PP12
- ETM.BongdingCube.MF8
- ETM.BongdingCube.MF12
- ETM.BongdingCube.MF16
- ……

BondingCube (Wire-bonding ESD protection cube) →

Wire bonding is the process of creating electric connection between sample and sample-holder using bonding wires, such as aluminum and gold. For many low-dimension or nano-device, the ESD protection is very important during sample transferring and bonding process.

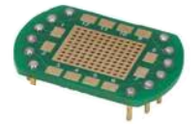
All the sample holder's pins are electric-connected with the whole bulk copper cube and one banana(f) connector left for linking to GND.

ETM.R-Cube.1-1

ETM.R-Cube.1-2

R - Cube →

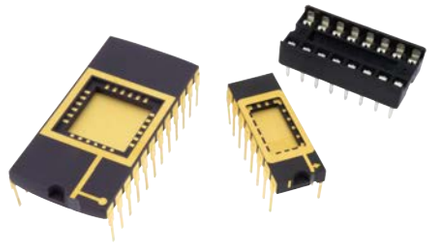
A resistor with switchable resistance values, providing a 5-position switch for switching between 5 different resistances. "1 - 2" for splitting the core and shell of one BNC connector to two BNC connectors while connecting the resistor; "1 to 1" for connecting the resistor directly between two cores BNC connectors.



ETM.SH.MF12.OP.Cu

ETM.SH.MF12.OP

ETM.SH.MF12.IP



ETM Sample Holder series

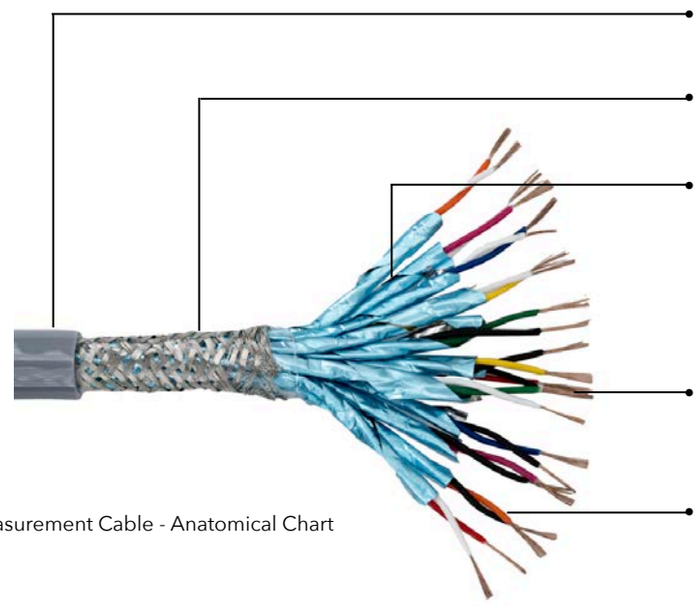
- ETM.SH.MF8.OP
- ETM.SH.PP12.OP
- ETM.SH.PP12.OP.Cu
- ETM.SH.PP12.IP
- ETM.SH.MF12.OP
- ETM.SH.MF12.OP.Cu
- ETM.SH.MF12.IP
- ETM.SH.MF16.OP
- ETM.SH.MF16.OP.Cu
- ETM.SH.MF16.IP
- ETM.SH.MF24.OP
- ETM.SH.MF24.OP.Cu
- ETM.SH.MF24.IP
- ETM.SH.DIP8m
- ETM.SH.DIP8
- ETM.SH.DIP16m
- ETM.SH.DIP16
- ETM.SH.DIP24
- ETM.SH.LCC20
- ETM.SH.LCC24
- ETM.SH.LCC28
- ETM.SH.LCC44
- ……

Sample Holder→

A variety of sample holders, including MF standard 12pins/16pins/24pins PCB sample holders, LCC / DIP ceramic sample holders, and customized sample holders.

1.4.4 ETM Accessories - Cables

Options for Electric Transport Measurement



Measurement Cable - Anatomical Chart

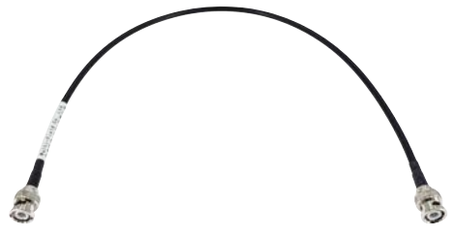
ETM.Cable.HC19-Lemo26

Measurement Cable →

Multifields Technologies provides high-quality twisted shielded cables, coaxial cables, etc. as measurement cables. Connectors can be adapted to mil-spec connectors, LEMO, Fischer and other connectors as required.

➡Recommend Models:

- ETM.Cable.HC19-Lemo26
- ETM.Cable.HC26-Lemo26
- ETM.Cable.HC19-Lemo14
- ETM.Cable.HC26-Lemo14
- ETM.Cable.Lemo14-Lemo26
- ETM.Cable.Lemo14-Lemo26
- ETM.Cable.Fischer16-Lemo26
- ETM.Cable.Fischer24-Lemo26
- ……



Instrumentation Cables→

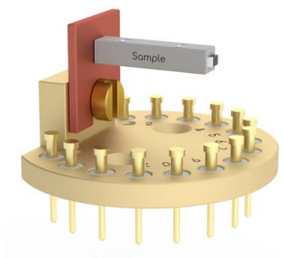
Multifields Technologies provides cables for a variety of electrical source meters, such as Keithley 2400/6221/2182A/6517B/4200, etc., SRS SR830/850/860, etc., and Keysight 4980A(L)/3446x, etc. The professional modifications and upgrades make the cables more convenient and flexible to use.

➡Recommend Models:

- ETM.Cable.6221M
- ETM.Cable.6221T
- ETM.Cable.2182M
- ETM.Cable.2BNC
- ETM.Cable.BNC-SMA
- ETM.Cable.2Ban-BNC
- ETM.Cable.Cryo.SS
- ETM.Cable.Cryo.SC
- ……

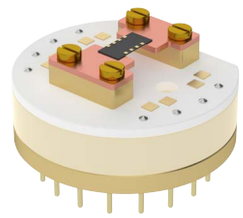
Thermal Measurements · Series

Functions: Thermal conductivity, thermoelectricity, heat capacity and dilatometer



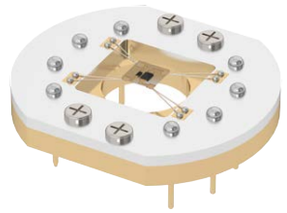
Thermal Transport Measurement (TTM)

Thermal conductivity and thermoelectric effect for bulk materials



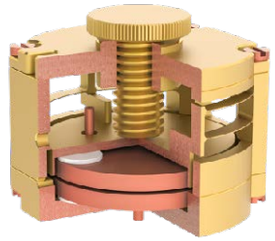
Thermal Transport Measurement (TTM)

Thermoelectric potential for thin-film materials



Heat Capacity Measurement (HCM)

Excellent adiabatic control and accurate measurement of the heat capacity



Thermal Expansion Measurement (ThE)

Sensing small displacement with temperature/field using a parallel plates capacitor

Functions					
1 Work environment	·Temperature: 1.4 K ~ 400 K; Pressure: 10^{5} ~ 10^{-5} Pa; Magnetic Field: 0 ~ 18 Tesla;				
2 Diameter	dia-26 mm / dia-30 mm / dia-50 mm				
3 Sample Types	Bulk		Thin Film	Bulk	Bulk
4 Functions	Thermal conductivity	Seebeck effect, Nernst effect, Peltier effect	Seebeck effect, Nernst effect,	Heat capacity measurement	Thermal expansion / magnetostriction effect
5 Sample Requirements	Size < 3 mm * 3 mm * 10 mm (bulk)		Size < 5 mm * 8 mm (thin film)	Size < 3 mm * 3 mm * 5 mm; Weight 1 ~ 300 mg	Thickness: 0.1 ~ 6 mm
6 Meas. Range	Conductivity: 10 μW/K ~ 100 mW/K	Seebeck coefficient: 0.1 μV/K ~ 1 V/K*	Seebeck coefficient: 0.1 μV/K ~ 1 V/K*	Heat capacity:	expansion and contraction: ΔL: -0.1 ~ 0.1mm
7 Accuracy	± 5%, 1.5 ~ 400 K		± 5%, 1.5 ~ 400 K	± 5%, 1.5 ~ 400 K	
8 Resolution	Conductivity: 1 μW/K	Thermal voltage: 2 nV (Minimum range)	Thermal voltage: 2 nV (Minimum range)	10 nJ @ 2K	50 pm for AH Series and 0.5 nm for Keysight Series

* Measurement range of Seebeck coefficient depends on the measurement temperature;

* The Multifields Technologies thermal measurements series are seamlessly compatible with common platforms such as QD-PPMS, Oxford-TeslatronPT, Pride-CPMS, Cryogenic-CFMS and others;

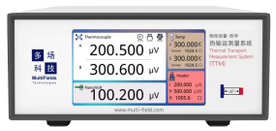
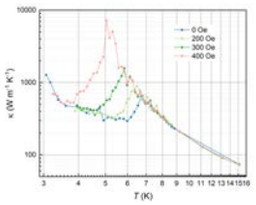
** The above are all recommended configurations. Multifields Technologies provides customization services. If you have special requirements, please contact us.

Materials Characterization

2. Thermal Transport Measurement (TTM)

An integrated solution for thermal conductivity, Seebeck and resistance measurement

Thermal Transport Measurement Systems , Delivery List

1	TTM Meter (§ 2.1) *TTM.Meter.Basic ; TTM.Meter.NanoV-01 / 02*		23
2	TTM Probe (§ 2.2) *TTM.Probe.26P*；*TTM.Probe.30.In* *TTM.Probe.30.Cone*；*TTM.Probe.50.In* *TTM.Probe.50.Cone*		25
3	TTM Accessories (§ 2.3) *TTM.Toolbox*；*TTM.SH.Bulk; TTM.SH.Film;*		27
4	TTM Measurement Software (§ 2.4) *AutoLab.TTM*		29
5	TTM Applications (§ 2.5)		30

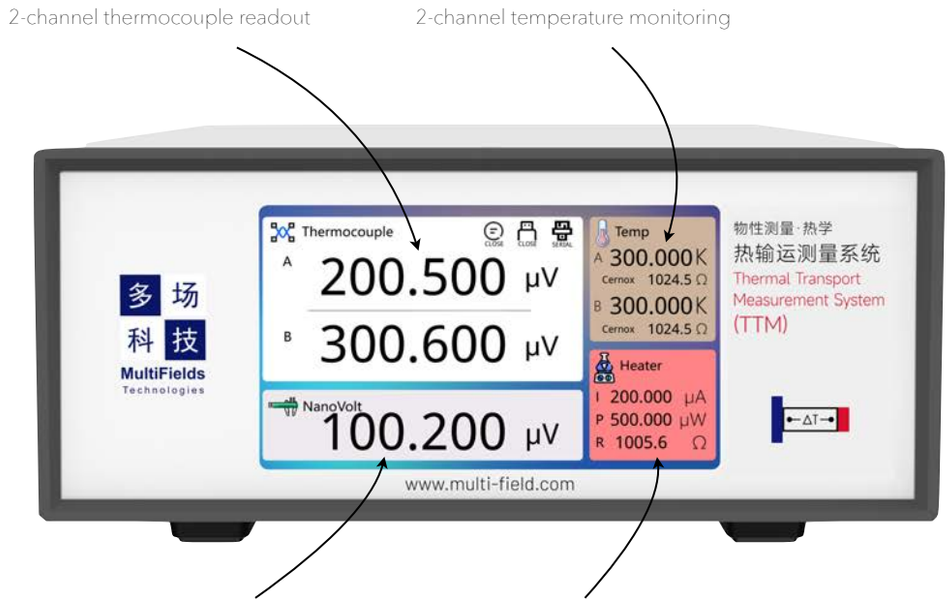
Thermal Transport Measurement Systems - Specification

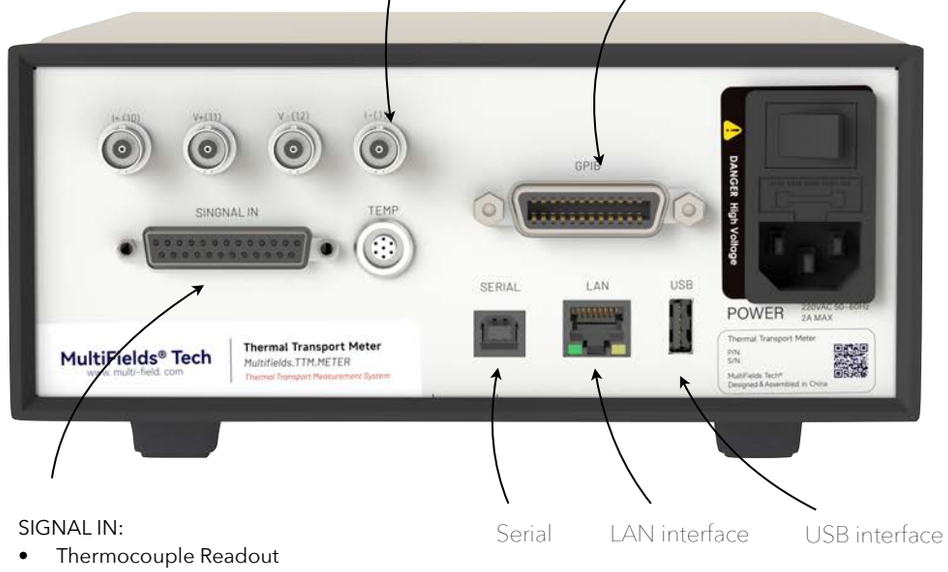
Work Environment		
Work Environment	Temperature: 1.5 ~ 400 K; Field: 0~18 Tesla	
Compatible Platforms	Oxford TeslatronPT, PPMS, Cryogenics, etc..	
TTM System Performance		
Sample Types	Bulk & thin film*	
Thermal Conductivity	Accuracy	± 5%, 1.5 ~ 400 K
	Range	10 μW/K ~ 100 mW/K
Seebeck Coefficient	Accuracy	±5% or ± 100 nV
	Range	0.1 μV/K ~ 1 V/K**
Sample Size (Recommend)	- 2.5*1.5*6 mm^3 for 0.1 ~ 2.5 W/m·K - 1.5*1.5*6 mm^3 for 2 ~ 50 W/m·K - 1.5*1.5*10 mm^3 for >30 W/m·K	
TTM Meter		
Functions	- 2-channel thermocouple readout - 1-channel heater output - 2-channel temperature monitoring - 1-channel nano-volt measurement***	
Size	280 mm * 220 mm * 88 mm (W*H*L)	
Interfaces	USB & GPIB	
TTM Software		
Environment Control	Temperature, magnetic field, state of chamber	
Measurements	Thermal conductivity, Seebeck effect, Nernst effect, Peltier effect, resistivity and thermal Hall effect	
Automatic Function	Auto-tuning of ΔT at different temperatures avoiding radiation losses	

* Details will be discussed in next section;
** Measurement range of Seebeck coefficient depends on the sample temperature;
*** Nano-volt module.

2.1 TTM Meter

Built-in thermocouple and thermometer monitoring module for precise control of thermal gradients. Optional multiple nanovolt measurement channels





SIGNAL IN:

- Thermocouple Readout
- Thermometer Monitor
- Heater Power Supply

TTM. Meter.Basic
TTM.Meter.NanoV01 / 02 / 03

Key Features

- High precision steady-state measurement method makes batter than 5% accuracy for thermal conductivity and Seebeck susceptibility
- Built-in automatic iterative algorithm for optimal deltaT selection at different temperature
- Specialized measuring meter enables one-stop high precision measurement
- Supporting bulk thermal transport measurement and thin film thermoelectric coefficient by switching to different measurement modules
- Available from 1.5 to 400 K and up to 18 Tesla magnetic field
- Compatible with Oxford® TeslatronPT, QD® PPMS, Cryogenics® and other third-party systems

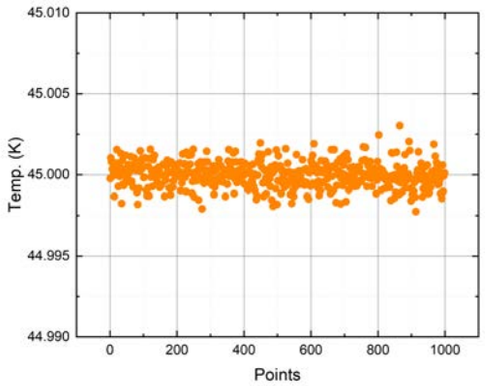
2.1 TTM Meter

TTM Meter - Sepecifications

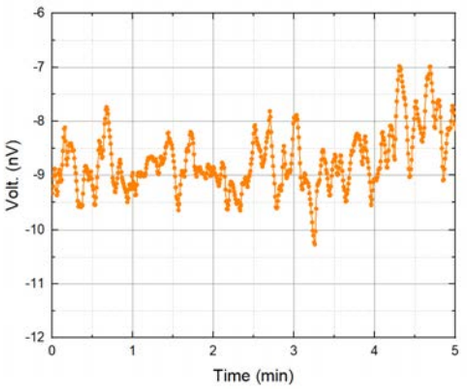
Funtion.01	Thermocouple Readout	
Channel	2	
Range	±2 mV	
Resolution (RMS)	30 nV	
Rate	10 SPS*	
Thermalcouple	S/K/E/J/T/AuFe	
Funtion.02	**Thermocouple Readout**	
Channel	1	
Range	0~10 mA (Current)	0~100 mW (Power)
Heater Resistance	1 kOhm	
Accuracy	<0.1 % (Power)	1 uV (Voltage)
Rate	10 SPS	
Funtion.03	**Temperature Sensor**	
Channel	2	
Sensor Types	Cernox™ & PT100 & PT1000 & Diodes	
Measurement Range	0.3 ~ 420 K (Cernox™ CX-1030)	
Auto Range	YES	
Reverse Current	YES	
Curves	300 points. Max. 100 curves	
Filters	Kalman Filter	
Resolution (see example data 1)	0.001%	

* SPS: Sample per second

Funtion.04	Nanovolt Meter		
Channel	1		
Range	±2 V		
Resolution (RMS) (see example data 2)	Input Range	Gain	Resolution (RMS)
	± 2 μV	1 M	2 nV
	± 20 μV	100 k	2 nV
	± 200 μV	10 k	2 nV
	± 2 mV	1 k	20 nV
	± 20 mV	128	50 nV
	± 200 mV	8	200 nV
	± 2 V	1	2 uV
Rate	10 SPS		
Input Resistance	> 1 GOhm		
Funtion.05	**Communication & Connectors**		
Communacation	GPIB & USB		
Display	5.0 inch TFT touch-screen with 1280 x 720 pixels		
Power	220 VAC, 1 Amp MAX		



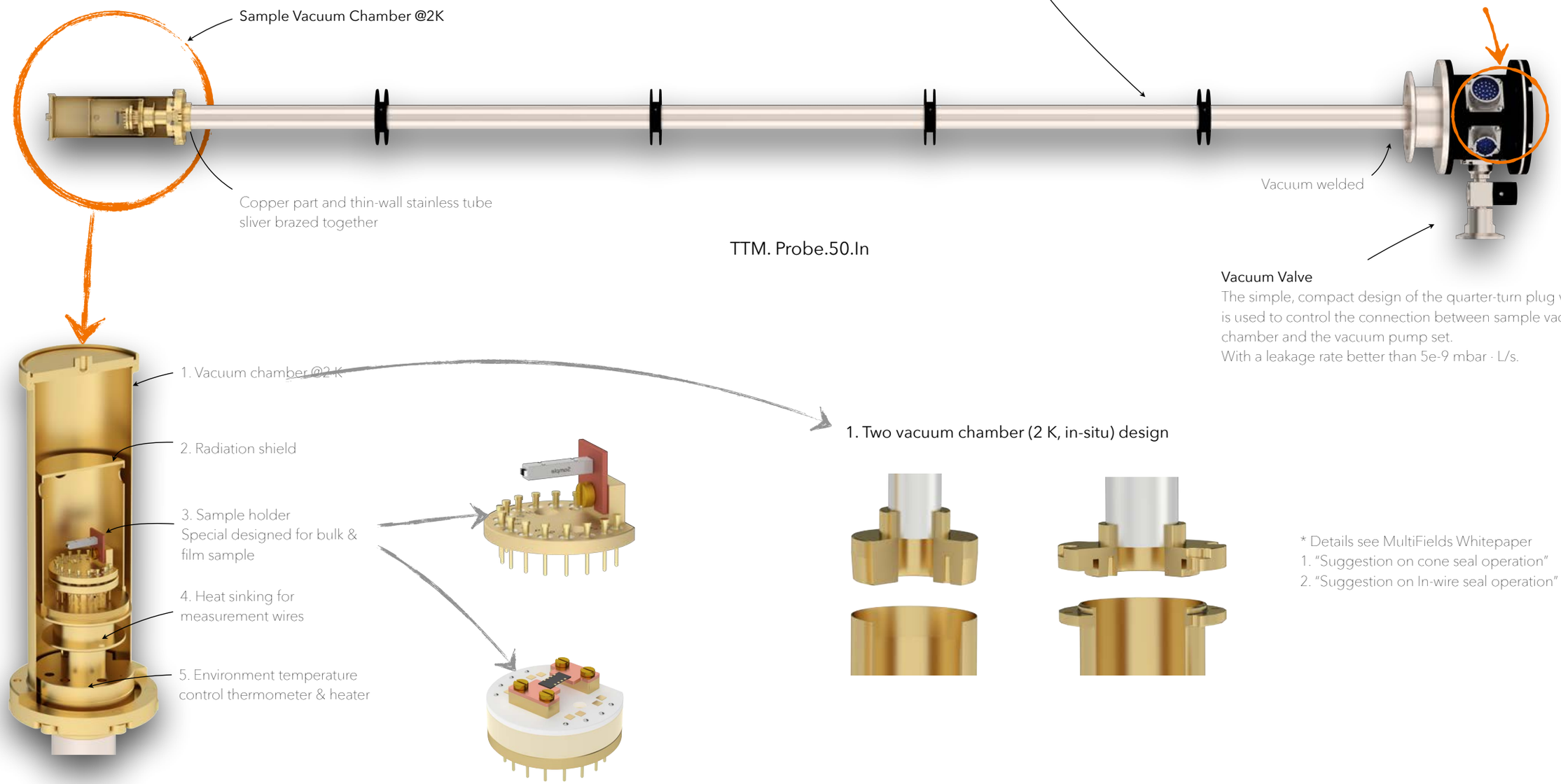
Example Data 1



Example Data 2

2.2 TTM Probes

The TTM probe with a 2 Kelvin in-situ vacuum chamber guarantees no heat leakage caused by gas flow around sample. Two different design sample holder.



Seamless S316L Tube with 0.5mm thin wall.
All measurement wires & support structure pass through the tube. And it also plays a pump line connect low temperate end sample chamber with vacuum pump.

Electric vacuum feedthrough
19pins Feedthrough, measurement wires used for thermal transport measurement. Work with MultiFields original cable.
10pins Feedthrough, sample environment temperature control, 4pins for thermometer and 2pins for heater. Work with MultiFields original cable.

Vacuum welded

TTM. Probe.50.In

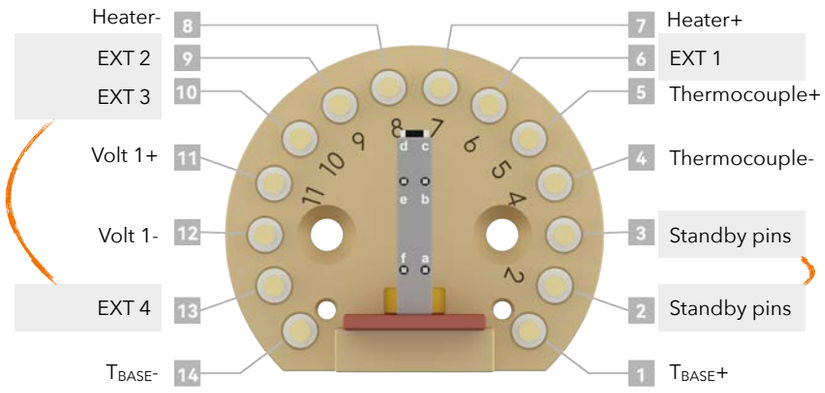
Vacuum Valve
The simple, compact design of the quarter-turn plug valves is used to control the connection between sample vacuum chamber and the vacuum pump set.
With a leakage rate better than 5e-9 mbar · L/s.

1. Two vacuum chamber (2 K, in-situ) design

* Details see MultiFields Whitepaper
1. "Suggestion on cone seal operation"
2. "Suggestion on In-wire seal operation"

2.3 TTM Accessories - Sample holder

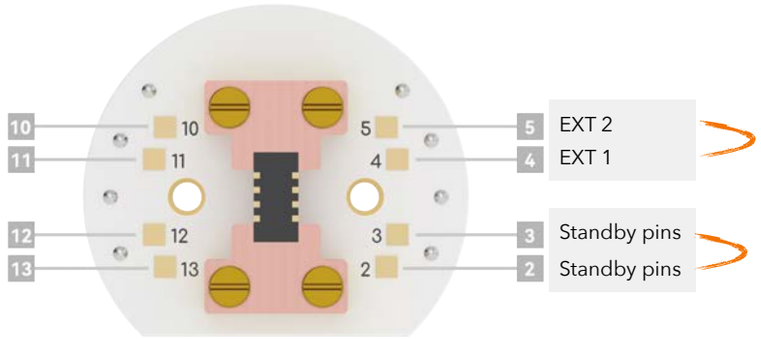
For bulk/film sample MultiFields® supplied two sample holder design.



Bulk sample holder

TTM. SH.Bulk

Pin function		Specification	Pin Number	Note
Function pins				
1	Termometer 1	Cernox™ thermometer, monitor base temperature	1 & 14	Paired
2	Termalcouple	Measure temperature difference, ΔT	4 & 5	Paired
3	Heater	1k~10k Ohm heater, voltage and current are measured simultaneously to accurately obtain heating power	7 & 8	Paired
4	Thermal Votage	Used to measure thermopower voltage. Pure copper wire guarantees lower voltage offset.	11 & 12	Paired
Standby pins				
5	Standby pins	Pure copper wire. Suggest used for low voltage signal measurement. One pair independent connectors at probe	2 & 3	Paired
6	EXT 1, 2	Spare for customer use, BNC connectors on MultiFields TTM meter	6 & 9	Paired
7	EXT 3, 4	Spare for customer use. Recommend: Current source for R measurement. BNC connectors on MultiFields TTM meter	10 & 13	Paired



Thin-film sample holder

TTM. SH.Film

Pin function		Specification	Pin Number	Note
Function pins				
1	Thermometer 1	Cernox™ thermometer, monitor base temperature	1 & 14	Paired
2	Thermometer 2	Cernox™ thermometer, monitor high-T end	6 & 9	Paired
3	Heater	1 k~10 k Ohm heater, voltage and current are measured simultaneously to accurately obtain heating power	7 & 8	Paired
4	Thermopower voltage	Used to measure thermopower voltage. Pure copper wires guarantees lower voltage offset.	11 & 12	Paired
Standby pins				
5	Standby pins	Pure copper wire. Suggest used for low voltage signal measurement. One pair independent connectors at probe	2 & 3	Paired
6	EXT 1, 2	Spare for customer use	4 & 5	Paired
7	EXT 3, 4	Spare for customer use. Recommend: Current source for R measurement. BNC connectors on MultiFields TTM meter	10 & 13	Paired

2.3 TTM Accessories - ToolBox

Thermal transport measurements require skilled operation and well-prepared experimental accessories for higher accuracy

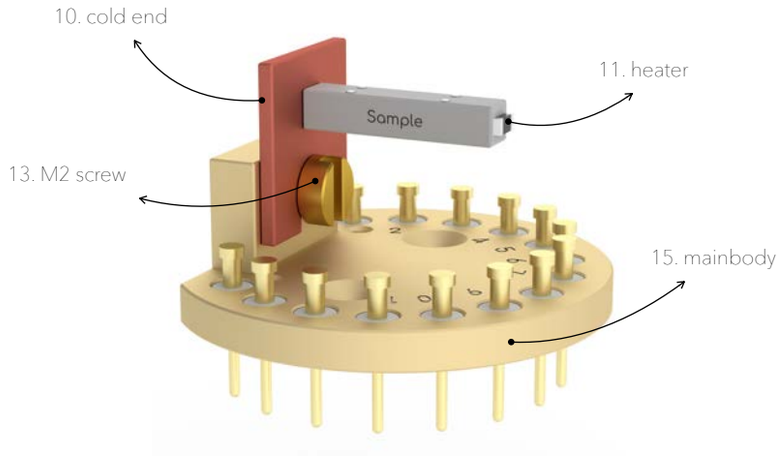
TTM. Toolbox

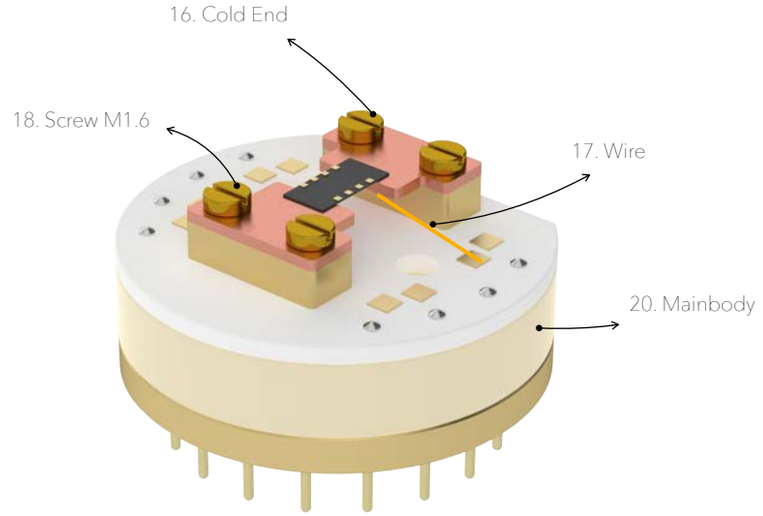
ToolBox List

	items	Specification	Quantity
Standard Sample			
1	Pb 4N	Pb metal wire, 99.99%, Φ2.0 mm, Length 2 cm Alfa	1 pc
2	Fused Quartz	Quartz cubic block, 99.99% 3 mm x 3 mm x 2mm	10 pcs
Adhesive			
3	N-Grease		
4	Adhesive-Black Part A	Electric insulted, good thermal conductivity at 2K, epoxy.	5 g
	Adhesive-Black Part B	Electric insulted, good thermal conductivity at 2K, catalyst.	5 g
5	Adhesive-Sliver Part A	Good electric conductivity , good thermal conductivity at 2K, epoxy.	5 g
	Adhesive-Sliver Part B	Good electric conductivity , good thermal conductivity at 2K, catalyst.	5 g
Thermocouples wires			
6	Thermocouple 1 Part A	E-Type thermocouple, Chromel wire, Φ25 μm	1 m
	Thermocouple 1 Part B	E-Type thermocouple, Constantan wire, Φ25 μm	1 m
7	Thermocouple 2 Part A	Chromel wire, Φ25 μm	1 m
	Thermocouple 2 Part B	AuFe wires, Φ25 μm	10 cm
Auxiliary			
8	Tweezer	Non-magnetic, 140 mm (length)	1 pc
9	Syringe		

2.3 TTM Accessories - ToolBox

The toolbox is designed for bulk and film samples with matching accessories.





TTM. SH.Bulk

items	Specification	Quantity
Sample installation accessaries - bulk version		
10 Cold End	Oxygen free copper, 8mm * 9mm * 0.8 mm	20 pcs
11 Heater	1 kΩ, 0.6mm*0.8mm*0.4mm	20 pcs
12 Wire	Phosphor copper, Φ 50 μm	1 m
13 M2 Screw	Brass Screw, non-magnetic	20 pcs
14 Part Fixture	Only used for bulk sample preparing, aluminum alloy	1 pc
15 Mainbody	The pure copper plate with BeCu pins and one thermometer Cernox™ 1050 installed.	1 pc

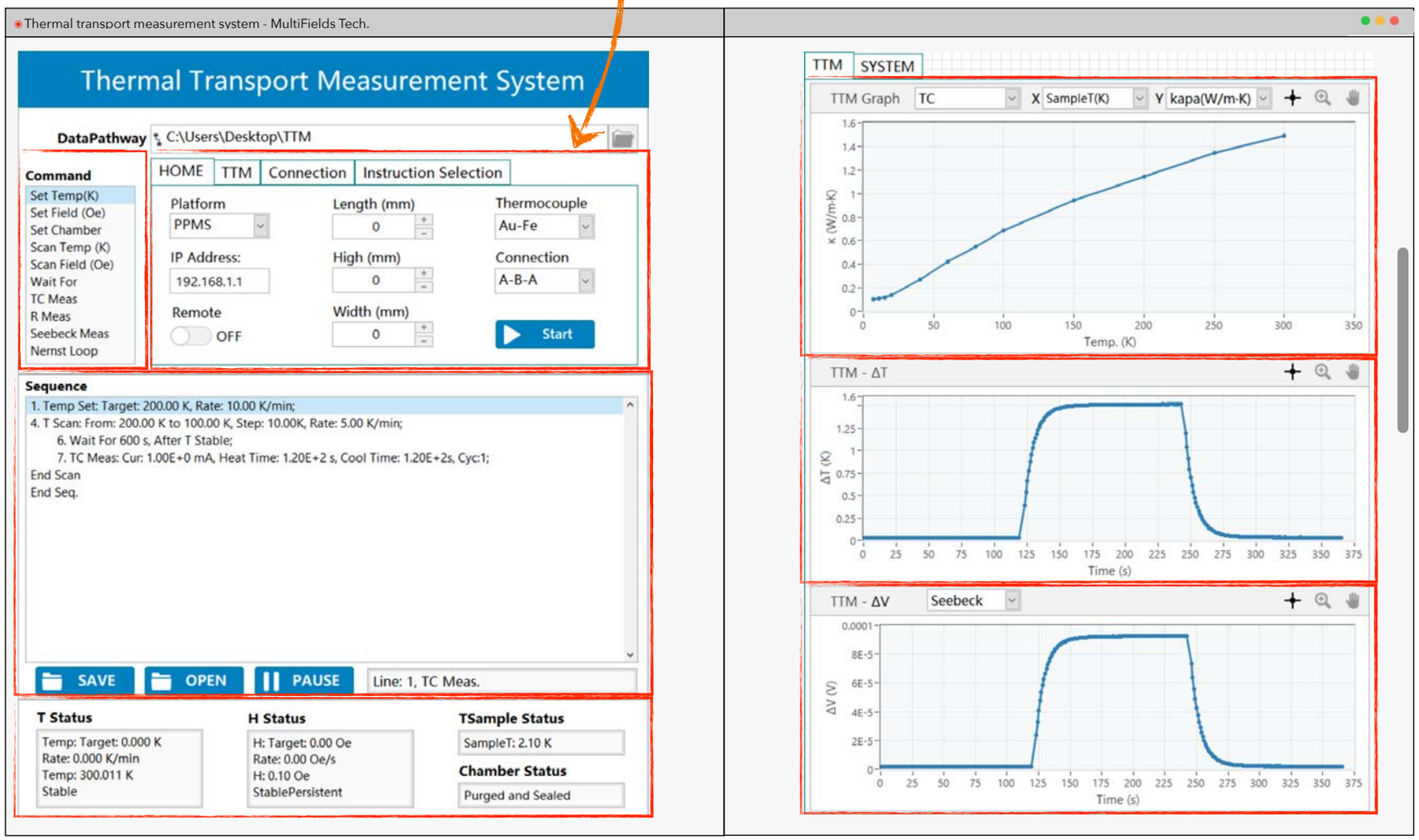
TTM. SH.Film

items	Specification	Quantity
Sample installation accessaries - film version		
16 Cold End	Oxygen free copper, mm * mm * mm	20 pcs
17 Wire	1 kΩ, 1m*1m*0..5mm	1 m
18 M1.6 Screw	Brass Screw, non-magnetic	20 pcs
19 Part Fixture	Only used for film sample preparing, aluminum alloy	1 pc
20 Mainbody	The pure copper plate with BeCu pins and one thermometer Cernox™ 1050 installed.	1 pc

2.4 TTM Software

The measurement and system data is shown here in real time.

●Setting Zone
The platform, sample information, instrument selection can be setting in this zone.



●Measurement command
All measurement commands are listed, including temperature and field settings, TTM commands. The arrangement of these commands allows for automated measurements.

●Sequence list
The command list is shown in this section. You can modify or delete one of them. Besides, the command list can be save or open. The sequence status is shown in the status bar.

●System Status
The temperature, field and chamber status can be display and modified quickly.

●Measurement Result
The TTM results will be shown in this figure. We can plot the figure with different X axis and Y axis.

●TTM - ΔT Curve
The temperature vs. time curve will be plot in this figure in real time.

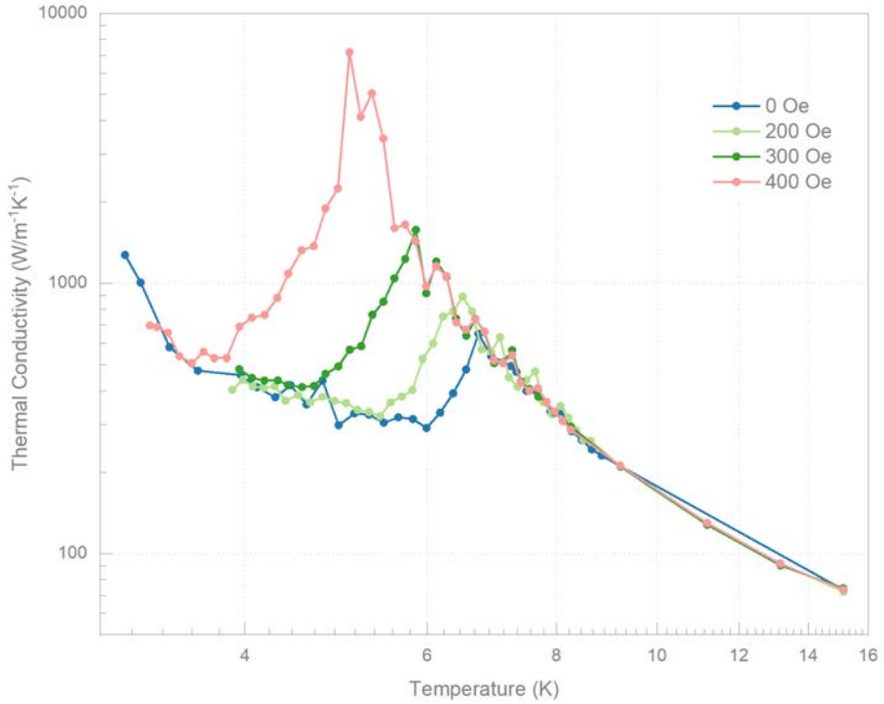
●TTM - ΔV Curve
The voltage change will be plotted in this figure. The x-axis can be time or magnetic field when Seebeck or Nernst susceptibility is measured.

2.5 TTM - Applications

Application (1)–

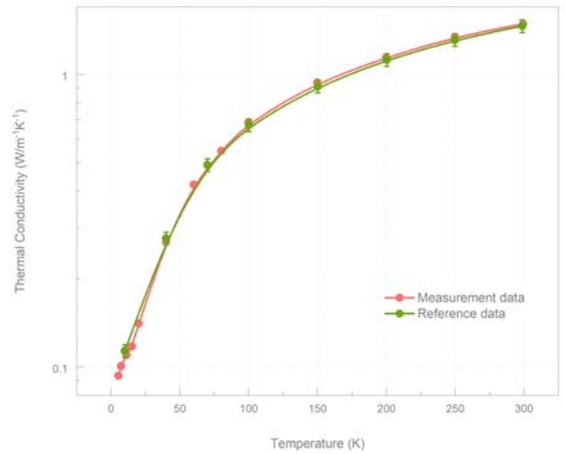
Thermal conductivity behavior during superconducting transitions of Pb

Sample Information	pure Pb / 99.99% , Alfa
MultiFields Products	1. TTM.Meter 2. TTM.Probe
Electric Meters	Oxford TeslatronPT



Application (2)–

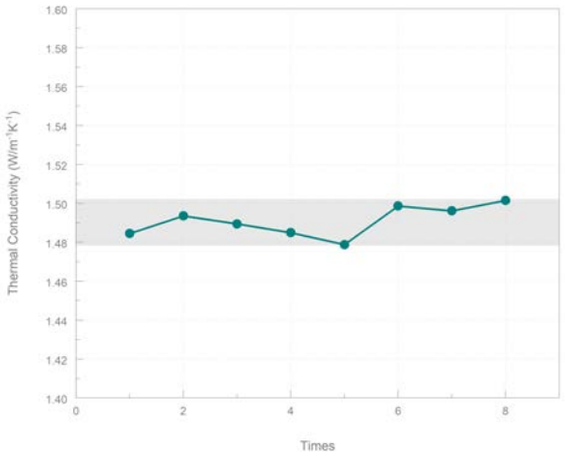
Thermal conductivity of fused quartz rods



Sample Information	fused silica rod
MultiFields Products	1. TTM.Meter 2. TTM.Probe
Electric Meters	QD - PPMS

- Accuracy < 5%

Accuracy refers to the deviation of the measurement result from the "true value". Thermal conductivities obtained from MF TTM system are accurate to within 5%, comparing the measured value with a reference value of the standard sample.



- Repeatability < 2%

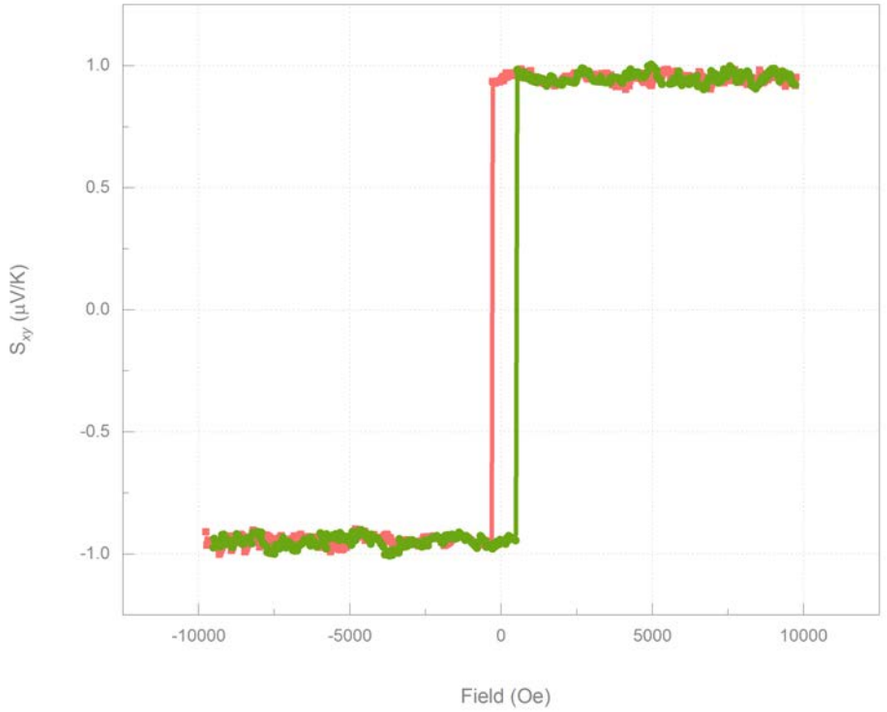
Repeatability is the deviation between multiple measurements. By repeating the thermal conductivity measurement several times under the same conditions, the repeatability of the thermal conductivity measurement of MF TTM system was obtained to be within 2%.

2.5 TTM - Applications

Application (3)–

Anomalous Nernst effect in magnetic Wyel semimetals

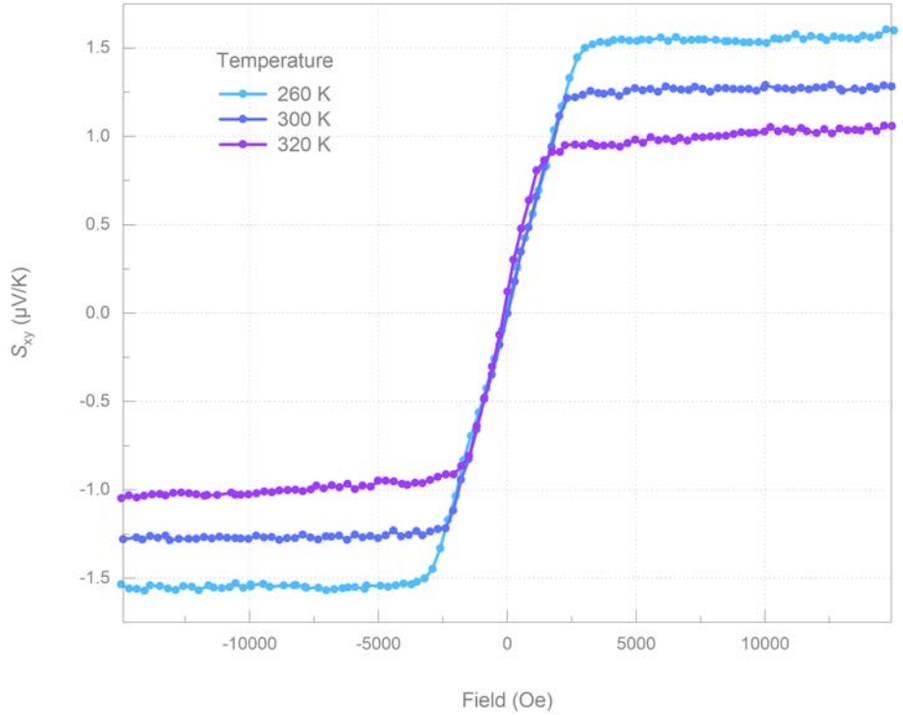
Sample Information	magnetic Wyel semimetals
MultiFields Products	1. TTM Systems, meter 2. TTM Systems, probe
Electric Meters	Oxford TeslatronPT



Application (4)–

Anomalous Nernst effect in the non-collinear antiferromagneticmaterial $NdMn_2Ge_2$

Sample Information	$NdMn_2Ge_2$
MultiFields Products	1. TTM Systems, meter 2. TTM Systems, probe
Electric Meters	Oxford TeslatronPT

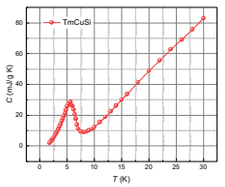


Materials Characterization

3. Heat Capacity Measurement (HCM)

Integrated solutions for specific heat capacity measurement

Heat Capacitance Measurement (HCM) , Delivery List

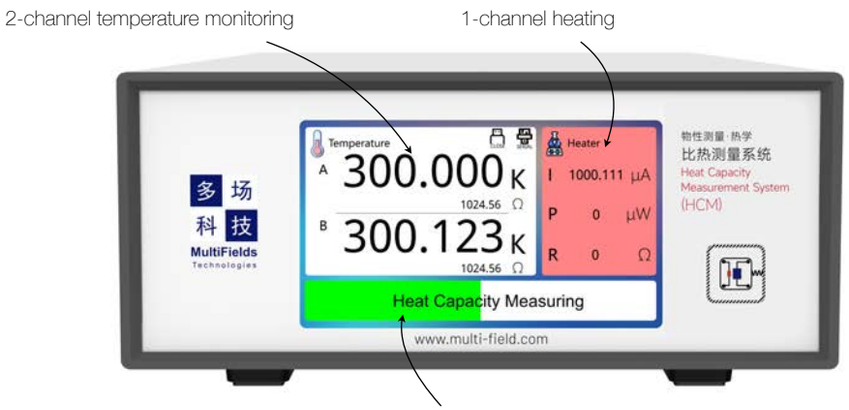
1	HCM Meter（§ 3.1) *HCM.Meter*		33
2	HCM Probe（§ 3.2) *HCM.Probe.26P*；*HCM.Probe.30.In* *HCM.Probe.30.Cone*；*HCM.Probe.50.In* *HCM.Probe.50.Cone*		34
3	HCM Accessories（§ 3.3) *HCM.Toolbox*；*HCM.SH*		35
4	HCM Software（§ 3.4) *AutoLab.HCM*		36
5	HCM Applications（§ 3.5)		37

Heat Capacitance Measurement (HCM) - Specification

Work Environment	
Work environment	Temperature: 1.5 ~ 400 K; Field: 0~18 Tesla
Compatible Platforms	Oxford TeslatronPT, PPMS, Cryogenics, etc..
HCM System Performance	
Sample Weight	1 mg ~ 500 mg
Accuracy	5% error @ 1.5 ~400 K
Resolution	10 nJ @ 2K
Max Sample Size	3 * 3 mm^2
Fitting Model	1-τ & 2-τ
HCM Meter	
Function	- 1-channel heater output - 2-channel temperature monitoring - Built-in heat capacity measurement processes; Auto fitting
Size	280 mm * 220 mm * 88 mm (W * H * L)
Interface	USB & GPIB
Software	
Environment Control	Temperature, magnetic field, state of chamber
Measurements	Heat capacity vs. Magnetic Field / Temperature
Automatic Function	Thermal relaxation method for measuring heat capacity; Built-in 1-τ & 2-τ models

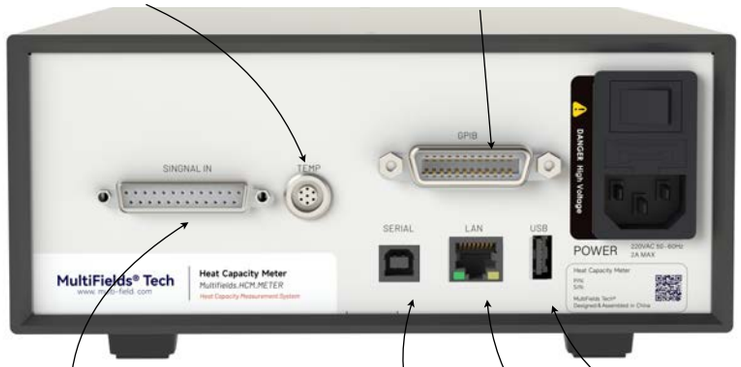
3.1 HCM Meter

Built-in heating and high-speed temperature monitoring channels, collecting temperature changes for real-time fitting



The optimal heating time can be calculated automatically based on the measurement results, making the measurement results more reliable.

Temperature Monitoring Interface



GPIB Communication

SIGNAL IN:
- Thermometer Monitor
- Heater Power Supply

Serial

LAN

USB

Key Features

- Highly accurate heat capacity measurements based on thermal relaxation methods;
- Integrated low-temperature specific heat capacity measurement solution, including: HCM Meter, probe, automatic data acquisition, and algorithms; ;
- Compatible with Oxford® TeslatronPT, QD® PPMS, Cryogenics® and other third-party systems

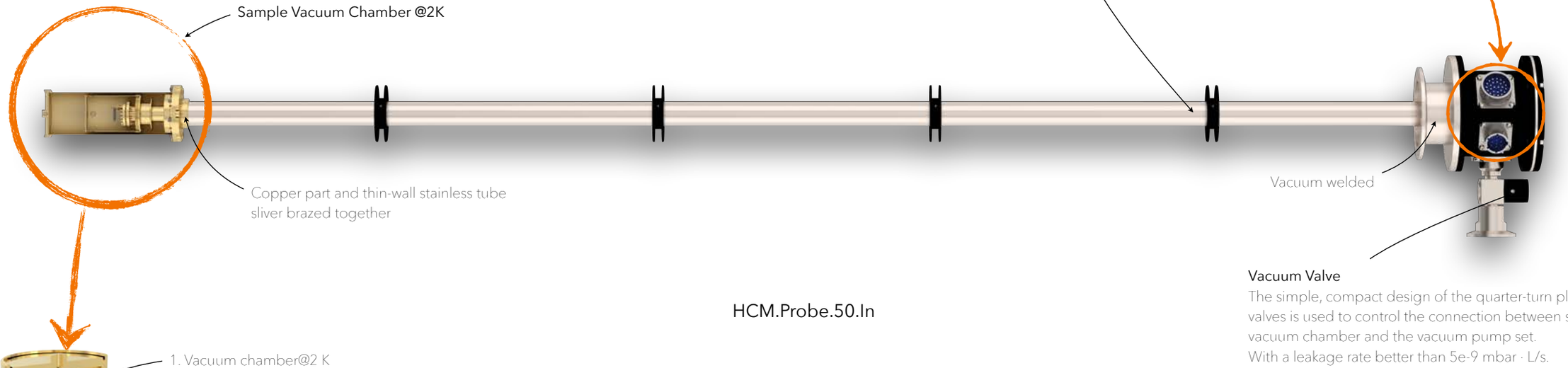
Heat Capacitance Measurement System - Specification

Function.01	Temperature monitor	
Channel	2	
Sensor Type	Cernox™ & PT100 & PT1000 & Diode	
Range	0.3 ~ 420 K (Cernox™ CX-1030)	
AutoRange	YES	
Current Reverse	YES	
Calibration Curve	300 Points and 100 Curves MAX	
Resolution	0.001%	
Funtion.02	**Heater modular**	
Channel	1	
Range	0~10 mA (Current)	0~100 mW (Power)
Heater Resistance	1 kOhm	
Accuracy	<0.1 % (Power)	1 uV (Voltage)
Rate	10 SPS	
Funtion.03	**Communication & Connector**	
Electric Connetor	D-Sub 25	
Communacation	GPIB & USB	
Display	5.0 inch TFT touch-screen with 1280 x 720 pixels	
Power	220 VAC, 1 Amp MAX	

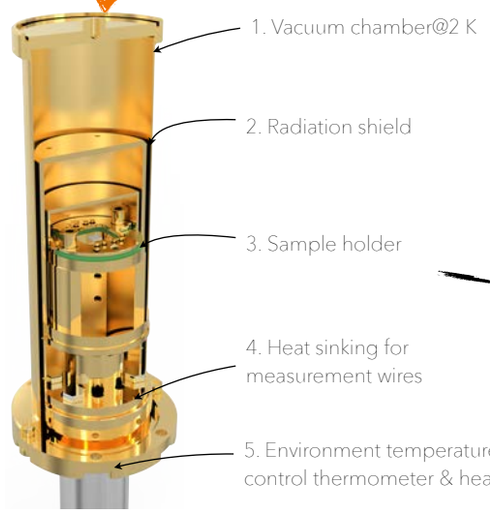
* SPS: Sample per second

3.2 HCM Probe

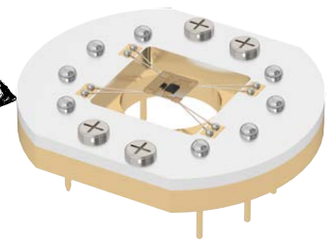
The HCM probe with a 2 Kelvin in-situ vacuum chamber guarantees no heat leakage caused by gas flow around sample.



Vacuum Valve
The simple, compact design of the quarter-turn plug valves is used to control the connection between sample vacuum chamber and the vacuum pump set.
With a leakage rate better than 5e-9 mbar · L/s.

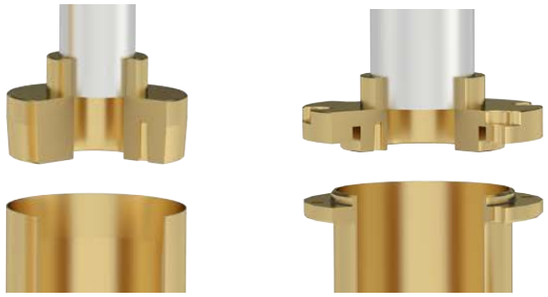


HCM.Probe.50.In



➡ HCM.SampleHolder

1. Two vacuum chamber (2 K, in-situ) design



Cone seal

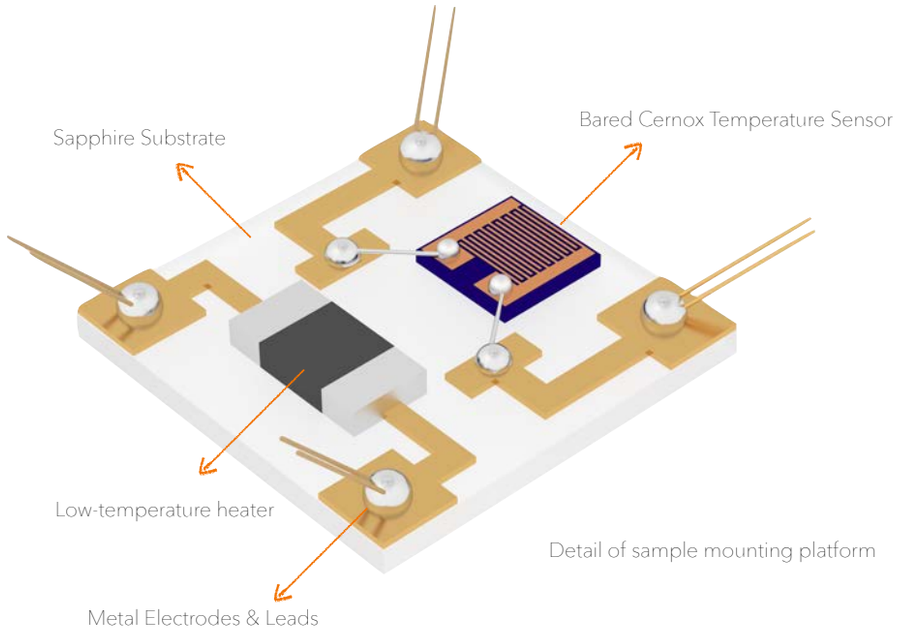
In-wire seal

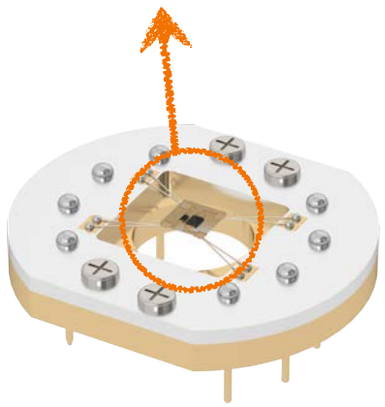
*Details see MultiFields® whitepaper
1. "Suggestion on cone seal operation"
2. "Suggestion on In-wire seal operation"

Materials Characterization

3.3 HCM Accessories

Specific heat capacity measurement is made easy with specialized mounting tools and accessories.





HCM Sample Holder

HCM.SH

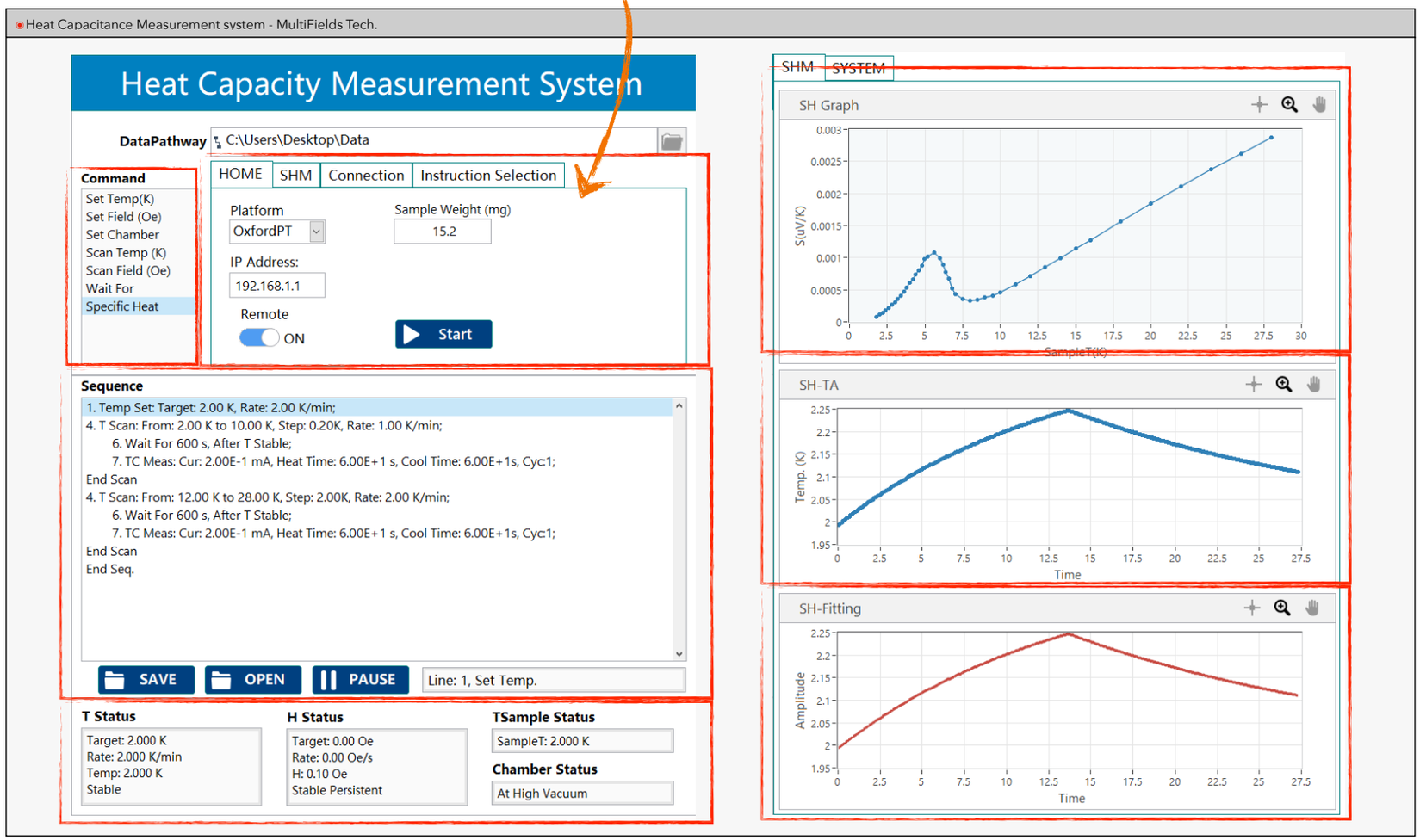
HCM. Toolbox

items	Specification	Quantity
Standard Sample		
1 Pure Pb	Pb rod, purity 99.99%, Φ2.0 mm, Length 2 cm Alfa	1 pc
Adhesives		
2 N-Grease	Thermally conductive grease	5 g
3 H-Grease	Vacuum Grease	5 g
4 GE-Vanish	Low-temperature adhesive	5 g
Tools		
5 HCM Sample Holder	For specific heat capacity measurements	1 pc
6 Sample Holder Fixture	For mounting samples	1 pc
5 Tweezer	Non-magnetic tweezer, 140 mm	1 pc
7 Screws		1 pc
8 Scalpel		1 pc

3.4 HCM Software

Automation software controlled by computer. compatible with a variety of low-temperature superconducting third-part commercial platforms

●Setting Zone
The platform, sample information, instrument selection can be setting in this zone.



- Measurement command

All measurement commands are listed, including temperature and field settings, HCM commands. The arrangement of these commands allows for automated measurements.

- Sequence list

The command list is shown in this section. You can modify or delete one of them. Besides, the command list can be save or open. The sequence status is shown in the status bar.

- System Status

The temperature, field and chamber status can be display and modified quickly.

- Measurement Result

The HCM results will be shown in this figure. We can plot the figure with different x and y axis.

- HCM - T vs time Curve (real-time)

The temperature vs. time curve will be plot in this figure in real time.

- HCM - Fitting Curve

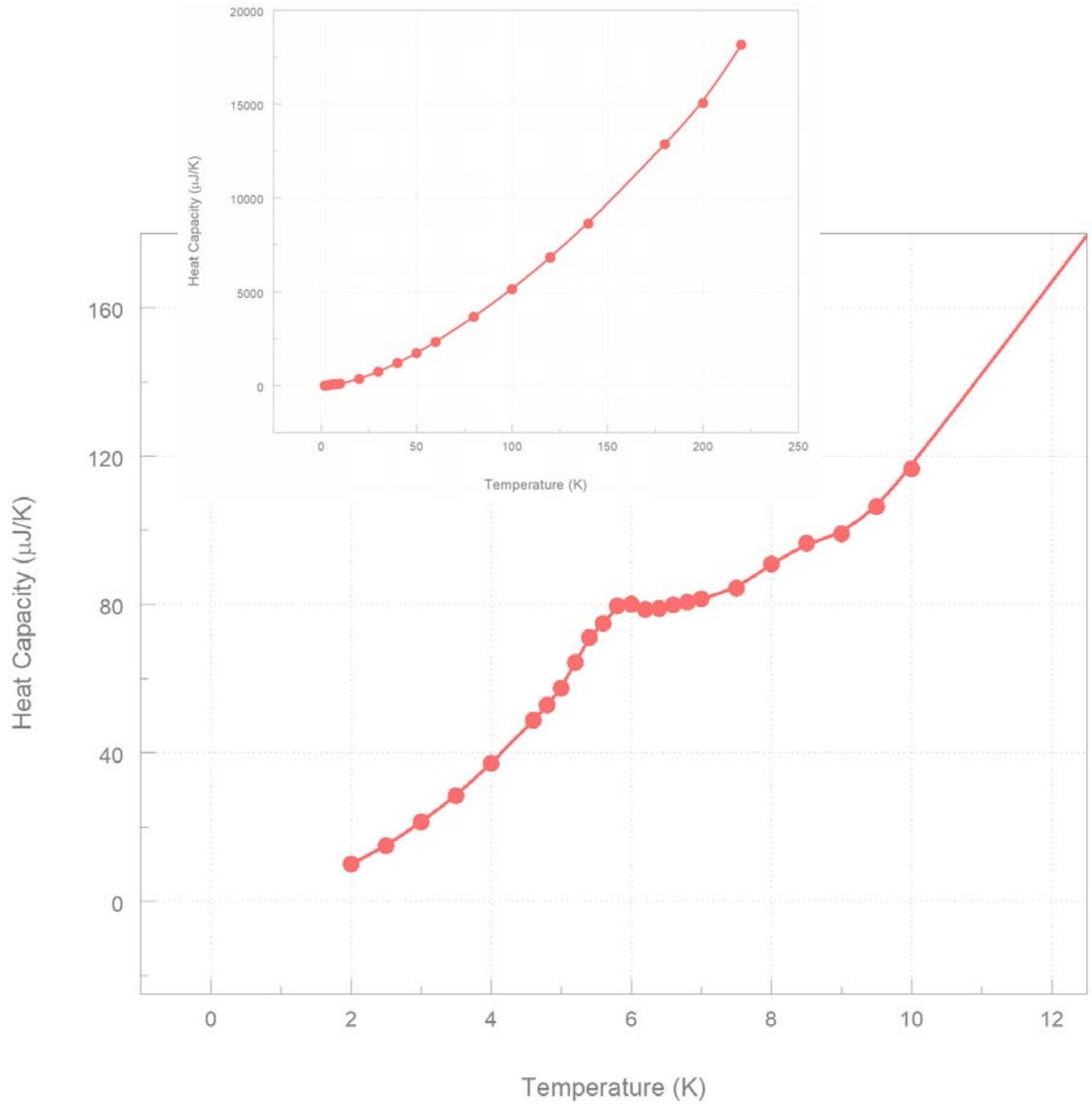
After one complete measurement, the experiment data curve will be fit here by relaxation model of heat capacity. One curve fit out one heat capacity data which is presented in the top figure.

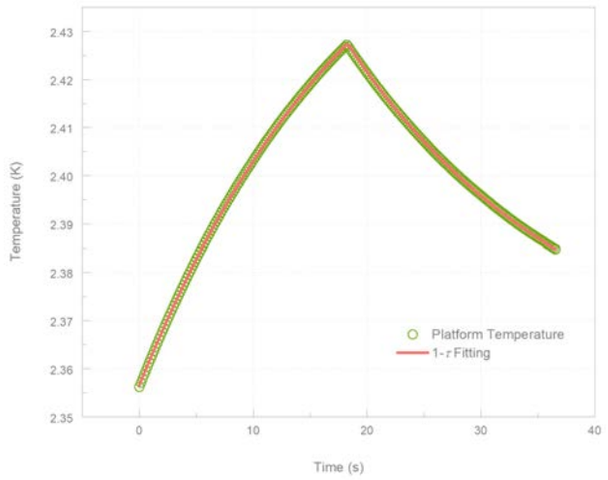
Materials Characterization

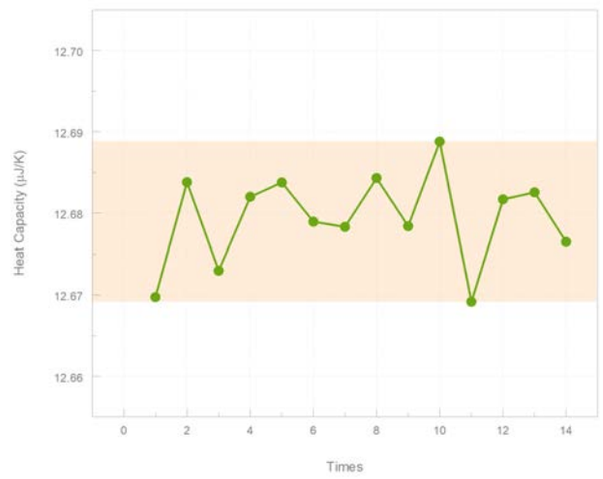
3.5 HCM - Applications

Application (1)–

Heat Capacity Behavior of TmCuSi Phase Transition







Sample Information	
MultiFields Products	1. HCM.Meter 2. HCM.Probe
Electric Meters	QD-PPMS

- Repeatability < 20 nJ/K

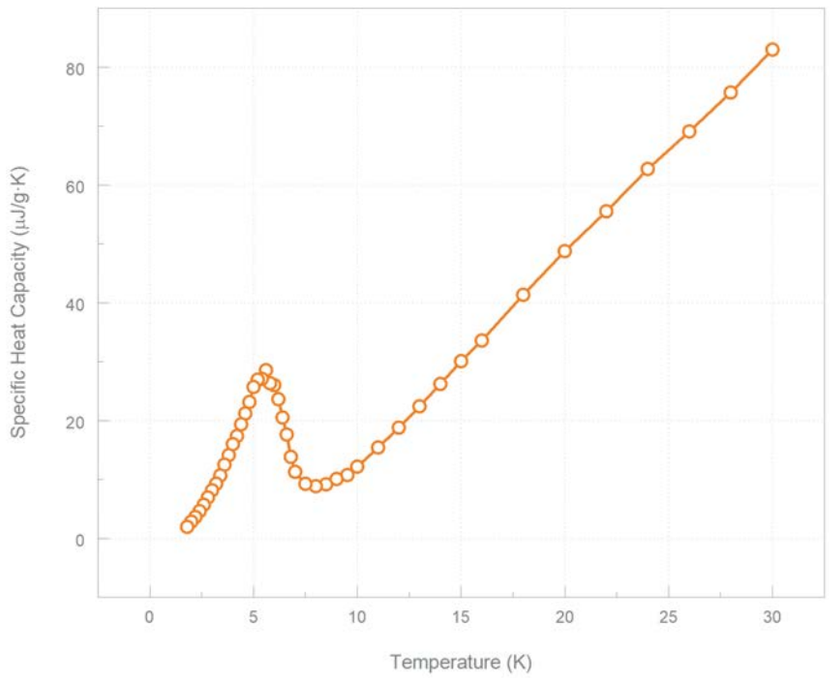
Repeatability is the deviation between multiple measurements. By repeating the thermal conductivity measurement several times under the same conditions, the repeatability of the thermal conductivity measurement of MF TTM system was obtained to be within 20 nJ/K.

3.5 HCM - Applications

Application (2)–

Specific heat capacity behavior during magnetic entropy transition of TmCuSi

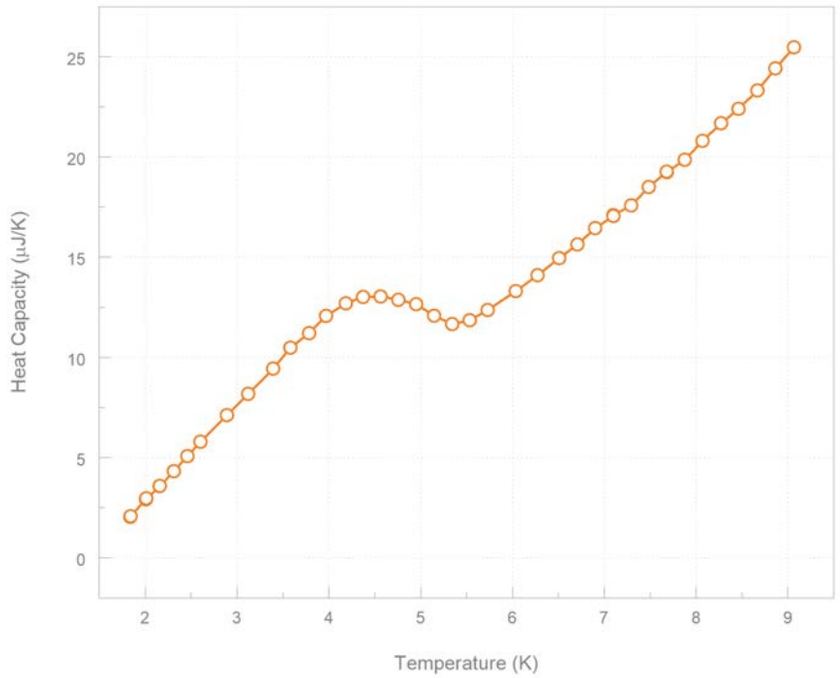
Sample Information	TmCuSi
MultiFields Products	1. HCM.Meter 2. HCM.Probe
Platform	QD-PPMS



Application (3)–

Specific heat capacity behavior of superconductor during phase transition

Sample Information	Superconductor
MultiFields Products	1. TTM Systems, meter 2. TTM Systems, probe
Platform	Pride - CPMS

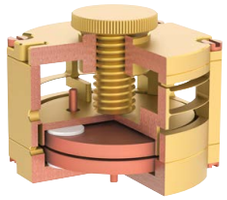
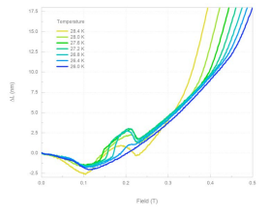


Materials Characterization

4. Thermal Expansion Measurement (ThE)

Integrated solution for thermal expansion measurement

Thermal Expansion Measurement (ThE), Delivery List

1	Striction Cell (§ 4.1) *ThE.Probe.26P*； *ThE.Probe.50* *ThE.RotProbe.50* *ThE.RotProbe.PE.50*		41
2	ThE Accessories (§ 4.2) *ThE.Toolbox*		42
3	ThE Software (§ 4.3) *AutoLab.ThE*		43
4	ThE - Applications (§ 4.4)		44

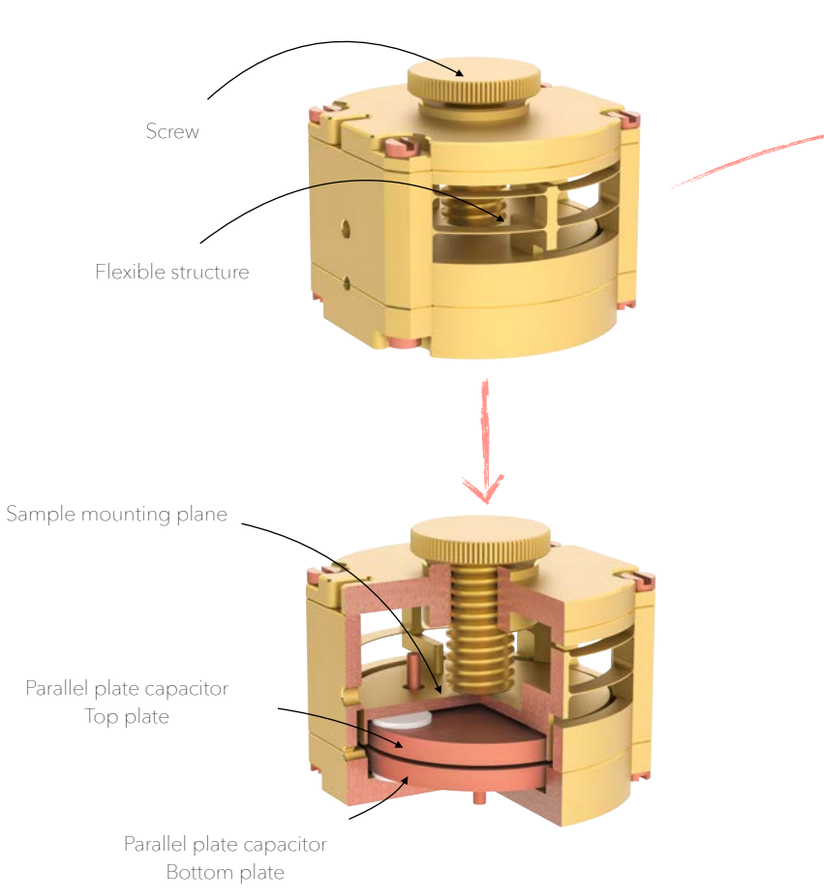
Thermal Expansion Measurement (ThE) - Specifications

Work Environment	
Work environment	Temperature: 1.5 ~ 400 K; Field: 0~18 Tesla
Compatible Platforms	Oxford TeslatronPT, PPMS, Cryogenics, etc..
Specifications	
Function	Expansion (ΔL vs T) & magnetostriction (ΔL vs H)
Sample Size	Thickness *L*： 0.1 mm ～ 6 mm
Method	Highly precise capacitive position sensing
Resolution	0.05 nm (AH Series capacitance bridge) 0.5 nm (Keysight Series LCR Meter)
Measurement Range	*Δ*L: -0.1 ~ 0.1mm
Direction of Field	*H* //*Δ*L and *H*⊥*Δ*L
Background Deduction	Based on data of oxygen-free copper standard samples
Sample Mounting	Mechanical fixing, adhesive-free
Options	Electrostriction cell

Materials Characterization

4.1 Striction Cell

Highly precise capacitive position sensor monitors sample size variation



Sample size：$L + \Delta L$ → Plate spacing：$d - \Delta L$

Manual Rotation
ThE.Probe.26P

Mechanical Rotation
ThE.RotProbe.50

Piezoelectric Rotation
ThE.RotProbe.PE.50

		Manual Rotation ThE.Probe.26P	Mechanical Rotation ThE.RotProbe.50	Piezoelectric Rotation ThE.RotProbe.PE.50
1	Work Environment	Temperature: 1.4 K ~ 400 K； Pressure： 10^{5} ～ 10^{-5} Pa； Magnetic Field： 0 ～ 18 Tesla;		
2	Diameter	dia. 26/30/50 mm	dia. 50 mm	
3	Rotation	manually fix sample direction	Rotation controlled by a stepper motor	Rotation controlled by a piezoelectric rotator
	Range	Limitless	0 ° ～ 370 °	- 30 ° ～ 300 °
	Precision	Limitless	0.1 °	0.01 °

- Measurement Method

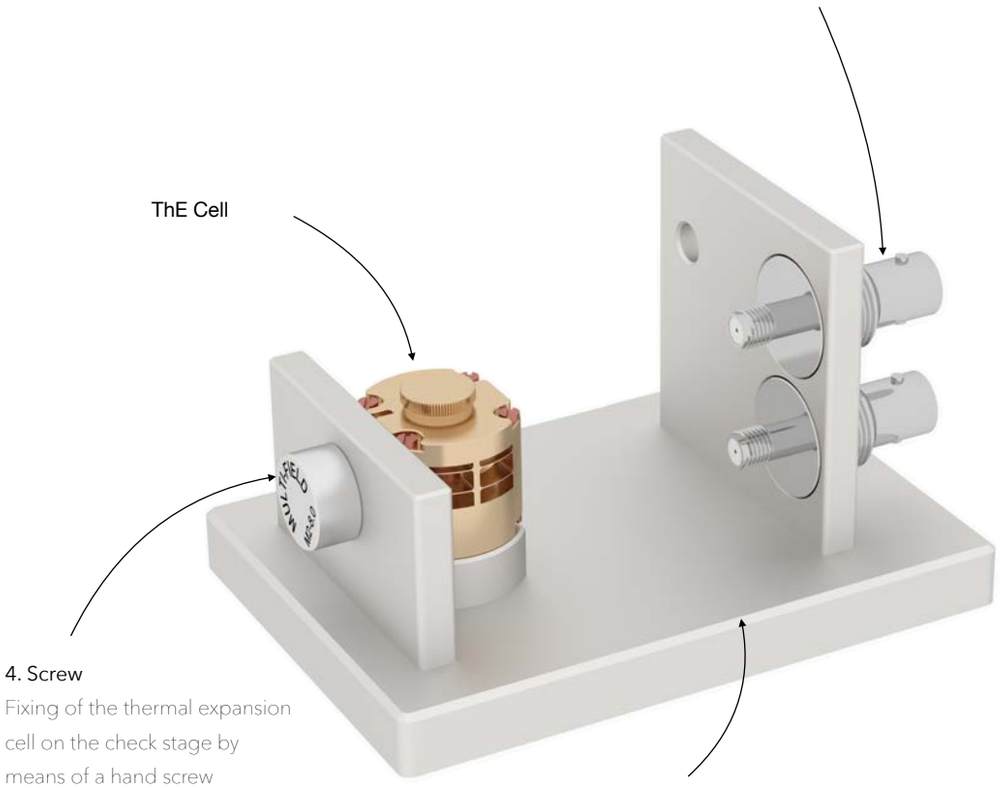
A variation in the sample size ***L*** causes a change in the position of the top plate and a consequent change in the plate spacing ***d***. The capacitance between the two plates is monitored to reflect this variation.

4.2 ThE Accessories

Dedicated room temperature installation & calibration tool

Coaxial Connector (SMA - BNC)

The coaxial cable of the cell is connected to the SMA connector and the other end is connected to an LCR meter or capacitance bridge via a cable with a BNC connector, which allows measuring the capacitance of the cell on your desktop, and tune the preload for mounting the sample.



The Accessories List

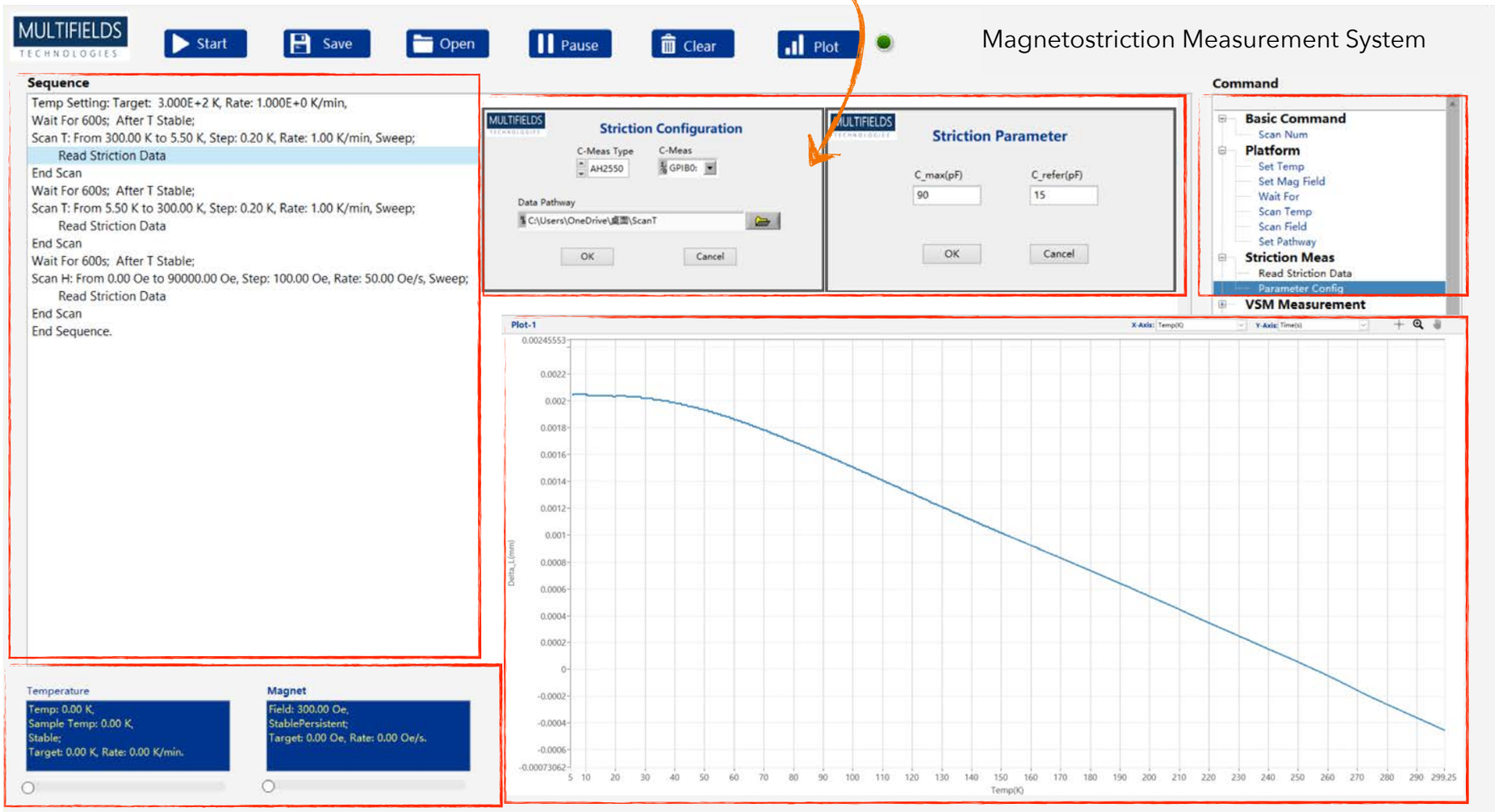
items		Specification	quantity
Standard Sample			
1	Pure Cu Rod	Cu rod, purity 99.99%, Φ3.12 mm, Length 1，2，3 mm Alfa	1
2	Pure Al Rod	Al rod, purity 99.99%, Φ3.12 mm, Length 1，2，3 mm Alfa	1
Checking Tools			
3	Check Stage	For tuning the preload of the ThE cell	1
4	Screw	For fixing the ThE cell	1
5	Coaxial Cable	For the capacitance measurement	2
Installation Tools			
5	Wrench	For installing/removing SMA connectors	1
6	Tweezer	Non-magnetic tweezer, 140 mm (length)	1

Materials Characterization

4.3 ThE Software

Automation software controlled by computer. compatible with a variety of low-temperature superconducting third-part commercial platforms

●Setting Zone
The platform, sample information, instrument selection can be setting in this zone.



- Sequence list
The command list is shown in this section. You can modify or delete one of them. Besides, the command list can be save or open. The sequence status is shown in the status bar.

- System Status
The temperature, field and chamber status can be display and modified quickly.

- Measurement command
All measurement commands are listed, including temperature and field settings, capacitance measurement commands. The arrangement of these commands allows for automated measurements.

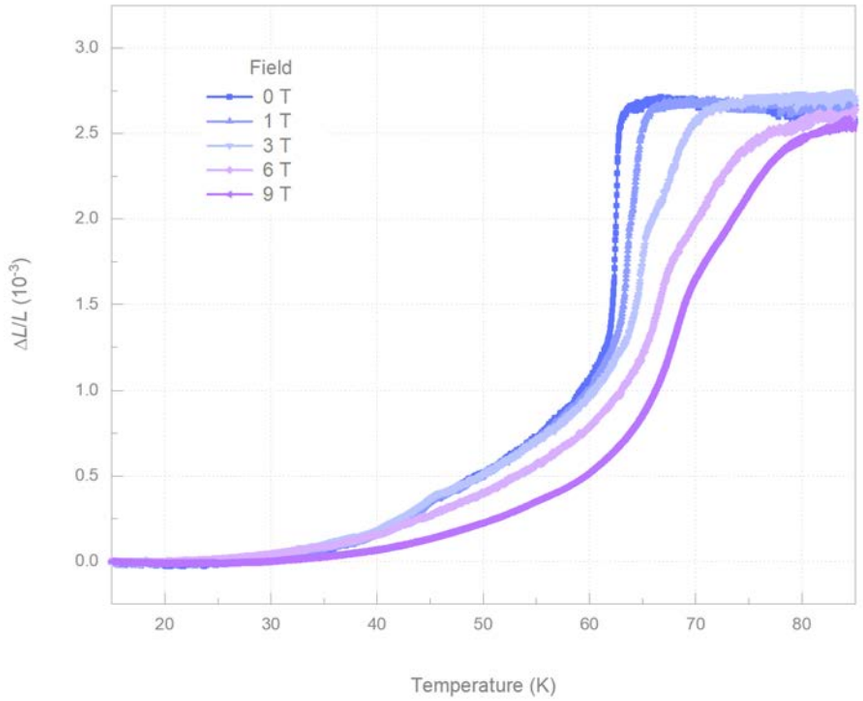
- Measurement Result
The results of displacement vs. temperature will be shown in this figure. We can plot the figure with different x and y axis.

4.4 ThE - Applications

Application (1)–

Thermal expansion behavior of $CaBaCo_4O_7$ under magnetic field

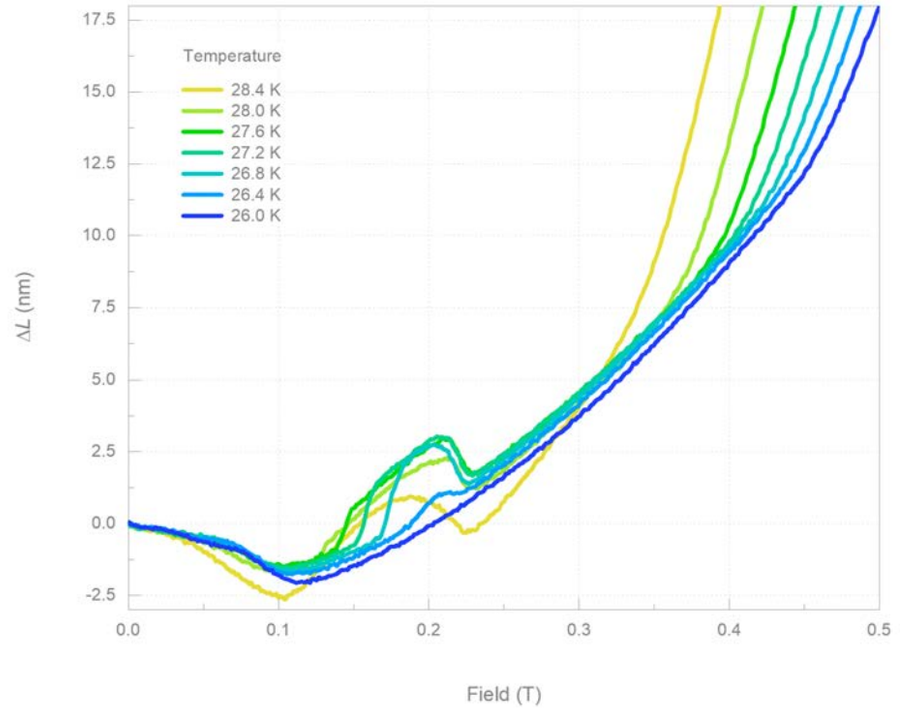
Sample Information	$CaBaCo_4O_7$
MultiFields Products	ETM.Probe.30.ThE
Platform	Oxford TeslatronPT



Application (2)–

Magnetostriction behavior of MnSi at different temperatures

Sample Information	MnSi
MultiFields Products	ETM.Probe.30.ThE
Platform	Oxford TeslatronPT

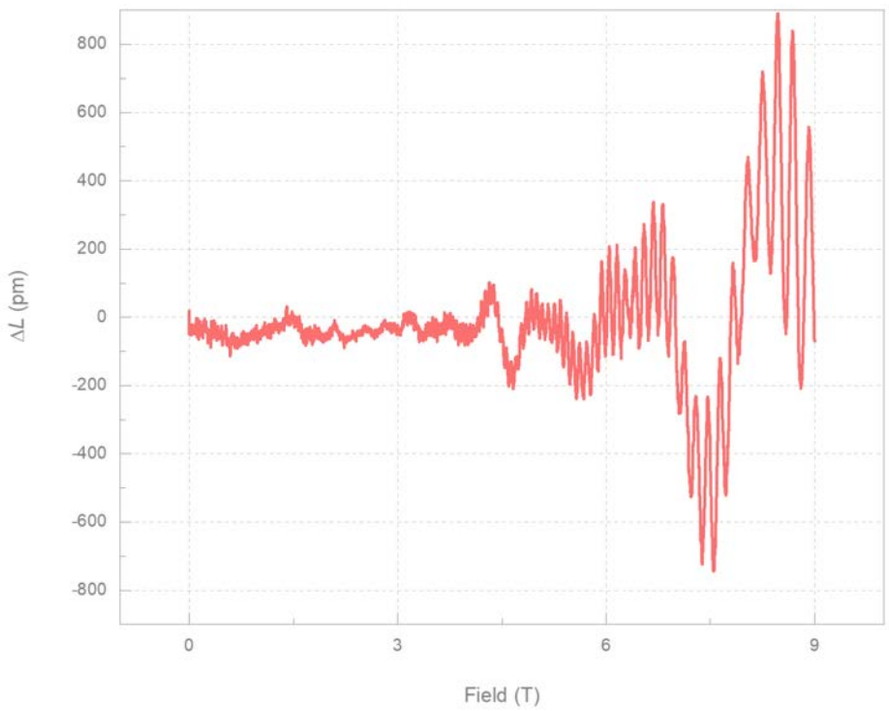


4.4 ThE - Applications

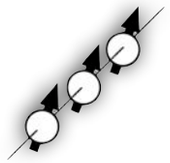
Application (3)–

Magnetostriction behavior of polycrystal aluminum at low temperatures

Sample Information	Al, purity 99.99%, Alfa Length 2.2 mm
MultiFields Products	ETM.Probe.30.ThE
Platform	Oxford-TeslatronPT T = 5.0 K

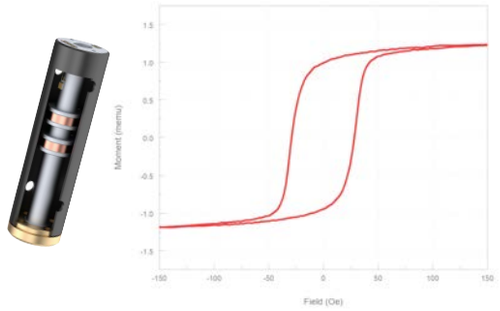


Materials Characterization



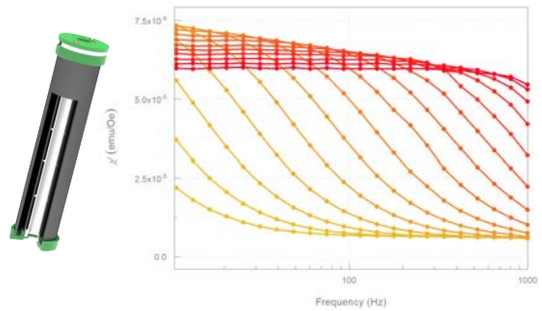
Magnetic Measurements · Series

Functions：M-H (magnetic hysteresis loop), M-T, AC susceptibility, etc..



VSM

Suitable for magnetic moments measurements
Various probes are designed for kinds of materials measurements



ACSM

Suitable for AC susceptibility measurements
Various probes are designed for kinds of materials measurements

Function			
1	Work environment	Temperature: 1.4 K ~ 400 K；Pressure：10^{5} ～ 10^{-5} Pa；Magnetic Field：0 ～ 18 Tesla;	
2	Diameter	dia-26 mm / dia-30 mm / dia-50 mm	
3	Functions	DC Susceptibility，M-H (hysteresis loop)，M-T，FORC (first-order reversal curves), etc..	AC Susceptibility vs. frequency / temperature / field, etc..
4	Sample Types	Suitable for all shapes of bulks, films, powders and other forms	
5	Sample requirements	Weight：< 20 g；length in radial dimension：< 3 mm；	
6	Measurement Range	1×10^{-5} emu ～ 40 emu	1×10^{-5} emu/Oe ～ 40 emu/Oe
7	Accuracy	± 0.5%，（using dia. 2.383 mm sphere）	Amplitude：± 0.5% Phase：± 0.5 °
8	Nosie Floor	< 1×10^{-6} emu （1 s）	< 1×10^{-8} emu/Oe（1s）
9	Compatible options	Standard quartz probe, oxygen-free copper probe, electrically controlled magnetic probes, optically controlled magnetic probes and high-voltage probe are available.	

* The Multifields Technologies magnetic measurements series are seamlessly compatible with common platforms such as QD-PPMS, Oxford-TeslatronPT, Pride-CPMS, Cryogenic-CFMS and others；

** The above are all recommended configurations. Multifields Technologies provides customization services. If you have special requirements, please contact us.

Materials Characterization

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Magnetic Measurements · Series

Functions：M-H (magnetic hysteresis loop), M-T, AC susceptibility, etc..

Vibrating Sample Magnetometer (VSM)

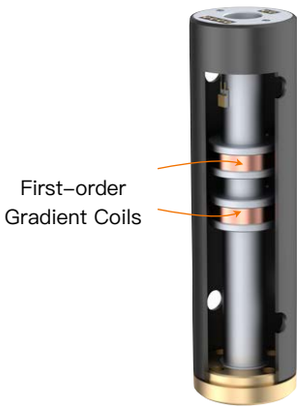
VSM Meter

- Built-in precise motor control algorithm realize accurate control of sample position and vibration frequency & amplitude;
- Built-in multi-gain low-noise amplifier makes system suitable for wide-range signal measurement.

VSM Probe

- Low-noise first-order gradient coils for magnetic moment detection;
- Low-noise coaxial cable is used for signal collecting;
- Low heat leakage ensures low temperature applications.

• VSM Meter · VSM.Controller



Detection Coils for
Magnetic moments

High-speed Linear Motor
VSM.motor

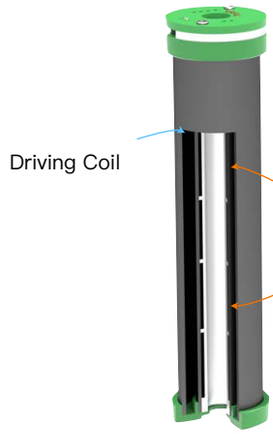
AC Susceptibility Meter (ACSM)

ACSM Probe

- AC field excitation coil, low-noise detection coils and calibration coil for AC susceptibility measurement;
- Low-noise coaxial cable is used for signal collecting;
- Low heat leakage ensures low temperature applications.

ACSM Meter

- Built-in precise voltage-controlled current source control the alternating magnetic field;
- Built-in three AC susceptibility measurement methods, including one-point, three-point and five-point methods, meets a variety of measurement requirements.



Detection Coils for
AC Susceptibility

• ACSM Meter · ACSM.Controller

VSM Module - Products List

- VSM Meter · VSM.Controller
- VSM Sensing Probe · VSM.Probe.Coil
- VSM Sample Probe · VSM.Probe.Sample
- Toolbox for Magnetic Measurements · VSM.ToolBox

ACSM Module - Products List

- ACSM Meter · ACSM.Controller
- ACSM Sensing Probe · ACSM.Probe.Coil
- ACSM Sample Probe · VSM.Probe.Sample
- Toolbox for Magnetic Measurements · VSM.ToolBox

5.1 VSM Module - Linear Motor

Complete system including probe, controller, tool box and measurement software.

High-Speed Linear Motor - Sepecifications

Performance	
Vibration Frequency	10 ~ 80 Hz
Vibration Amplitude	0.5 ~ 4 mm
Full Range	65 mm
Max Force	76 N
Resistance of Coil	3.1 Ohm
Inductance of Coil	3.1 mH
Position Control	
Position Sensor	Optical encoder
Position Resolution	< 1 um
Control Method	PID close-loop control
Dimensions and Interface	
Dimensions	155 * 155 * 232 (mm)
Flange	KF40
Electric Interface	LEMO 26pin (Famale)
Max Power	60 W

5.1 VSM Module

Complete system including probe, controller, tool box and measurement software.

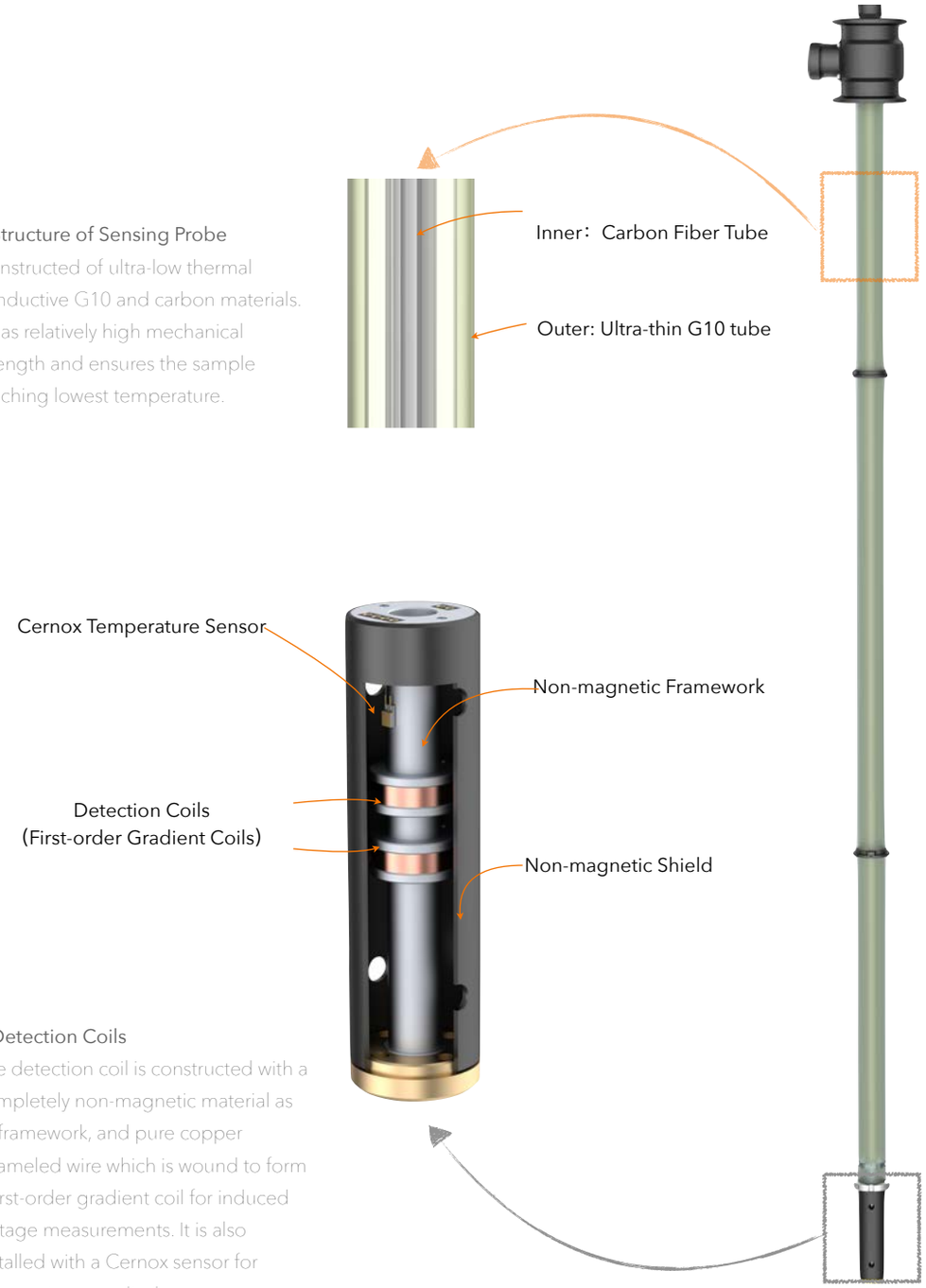
VSM.Controller

- Structure of Sensing Probe

Constructed of ultra-low thermal conductive G10 and carbon materials. It has relatively high mechanical strength and ensures the sample reaching lowest temperature.

- Detection Coils

The detection coil is constructed with a completely non-magnetic material as its framework, and pure copper enameled wire which is wound to form a first-order gradient coil for induced voltage measurements. It is also installed with a Cernox sensor for temperature monitoring.



VSM.Probe.Coil

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5.1 VSM Module

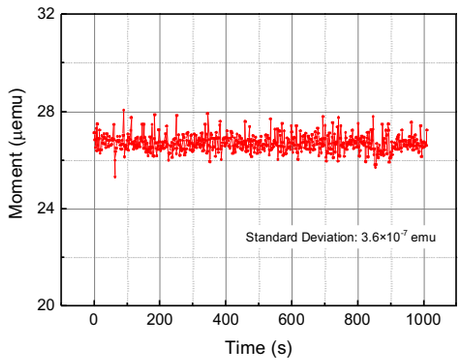
Complete system including probe, controller, tool box and measurement software.

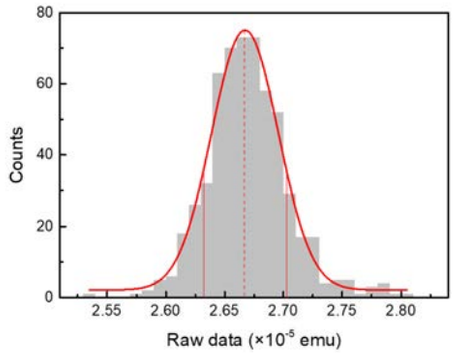
Vibrating Sample Magnetometer - Specifications

Magnetic Moment Measurement	
Temperature	1.4 K ~ 300 K
Magnetic Field	± 18 T
Accuracy	± 0.5% (using dia-2.383mm sphere)
Noise Floor (See example data)	$<5\times10^{-7}$ emu
Measurable Max Moment	40 emu
Vibration Amplitude	2 mm (p - p)
Vibration frequency	40 Hz ~ 65 Hz, 40 Hz (typical)
Average Time	0.5 ~ 100 seconds, 1 second (typical)
Coils Parameters	
Bore Diameter	7.0 mm
Coil Spacing	9.0 mm
Sample Requirements	
Sample Type	Suitable for all shapes of bulks, films, powders and other forms
Sample Requirements	Weight：< 20 g；length in radial dimension：< 3 mm；
Standard Holders	Quartz rod(STD)；Quartz tube(STD) Electrically-controlled magnetic probes; Optically-controlled magnetic probes, etc..

VSM Options - Specifications

Electrically–controlled Magnetism	
Withstand Voltage	< 200 V (DC)
Leakage Current	< 100 pA @ 100 V (DC)
Electric Channel	2
Additional Noise	$< 1\times10^{-7}$ emu
Optically–controlled Magnetism	
Fiber Diameter	0.2 mm
N. A.	N.A.0.22
Interface	SMA905
Max Power	20 mW
Transmission	0.95 @ 300 K
Additional Noise	$< 1\times10^{-7}$ emu





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5.1 VSM Module - Software

- Sequence list

The command list is shown in this section. You can modify or delete one of them. Besides, the command list can be save or open. The sequence status is shown in the status bar.

- VSM Centering

The software has a built-in automated sample centre finding process, where the signal-position relationship is determined by scanning the sample position and fitted by a built-in algorithm to accurately determine the sample centre position.

- Results

Results of magnetic moment measurement can be displayed in real time using the Plot command. Users can plot the graph with different xy axes.

- 设置窗口

可设置平台、数据保存路径、测量和仪表等

- System Status

The temperature, field and chamber status can be display and modified quickly.

- Measurement command

All measurement commands are listed, including temperature and field settings, magnetic moment measurement commands. The arrangement of these commands allows for automated measurements.

- Sample instal / uninstall

Automatic sample installation/ uninstallation process is built into the software, which automatically controls the motor to move the sample probe to the loading port without any unnecessary operation.

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5.1 VSM Module - Application

Complete system including probe, controller, tool box and measurement software.

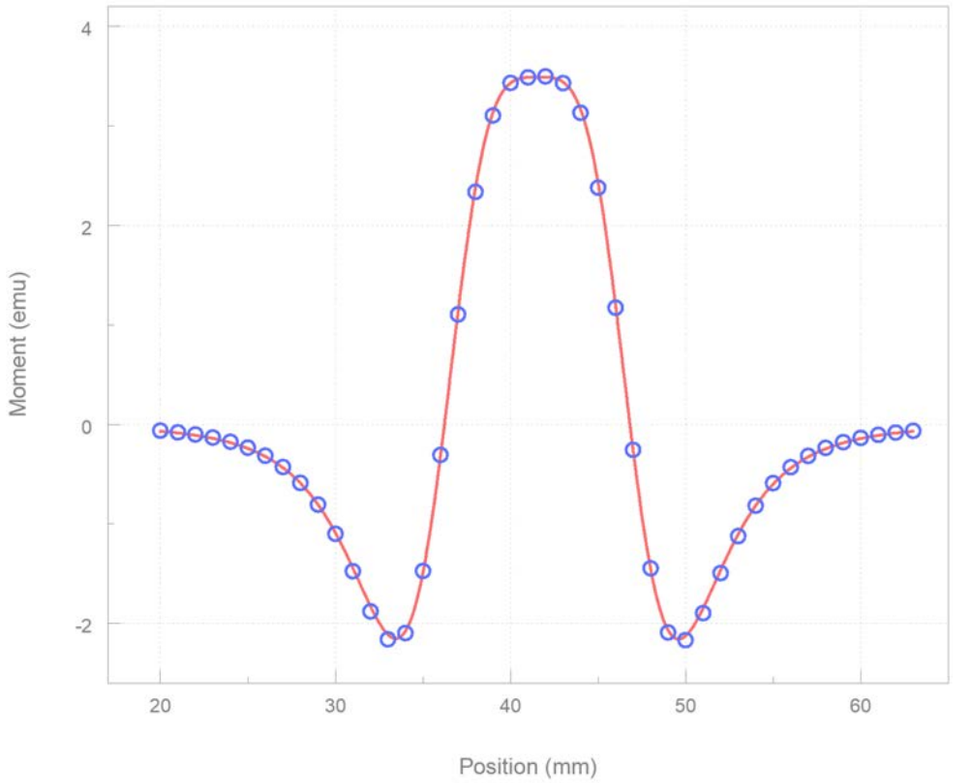
Application (1)–

Demonstration of the VSM automatic center finding

Sample Information	NIST 772-a
MultiFields Products	1. VSM Module
Platforms	QD-PPMS

• Method

Before the magnetic moment measurement, the sample needs to be placed at the centre of the sensing coils. Multifields VSM includes an automatic centering procedure, which accurately moves the sample to the center of the coils.



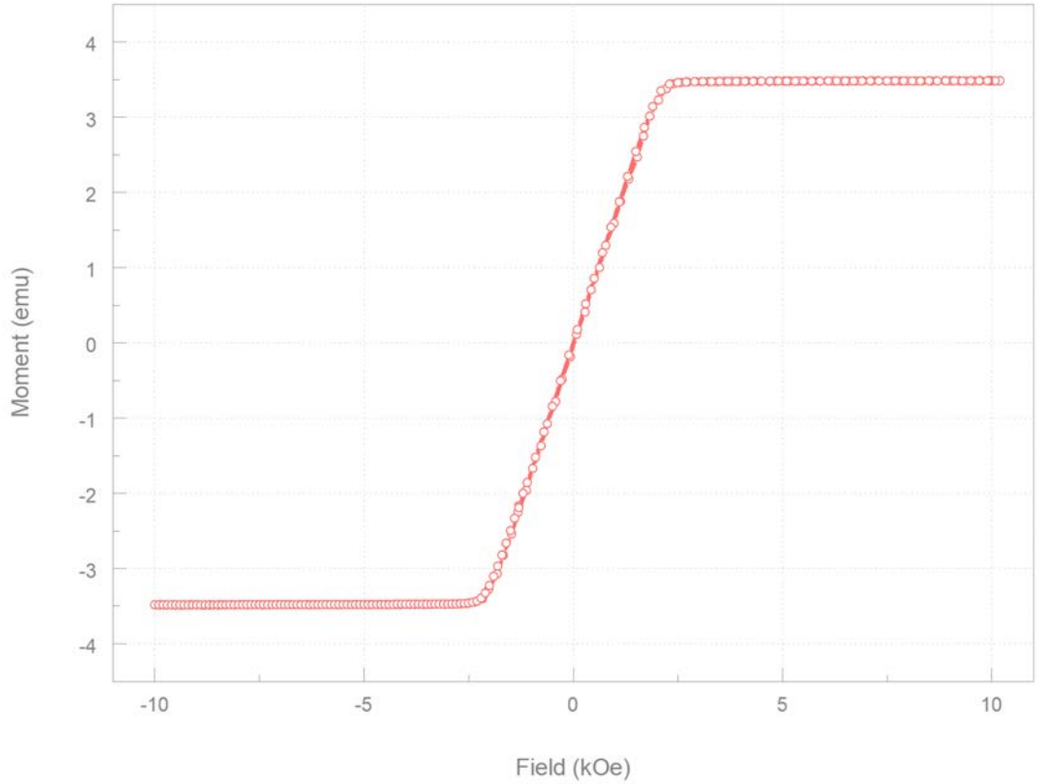
Application (2)—

Hysteresis loop of pure Ni sphere (NIST 772-a)

Sample Information	NIST 772-a
MultiFields Products	1. VSM Module
Electric Meters	QD-PPMS

• Accuracy

We conducted measurement on the traceable standard sample NIST 772-a using the Multifields VSM module, and the obtained accuracy is better than ± 0.5%



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5.1 VSM Module - Application

Complete system including probe, controller, tool box and measurement software.

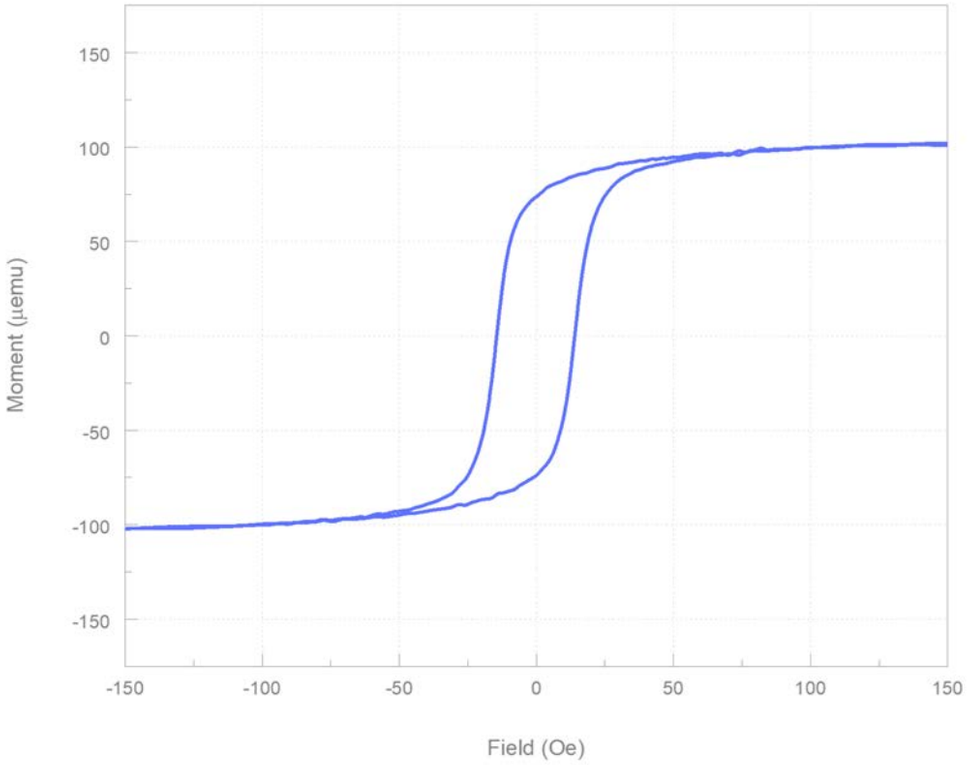
Application (3)—

Hysteresis loops of ferrimagnetic YIG thin-film

Sample Information	YIG film, thickness 50nm
MultiFields Products	1. VSM Module
Platforms	QD-PPMS

• Sensitivity

Multifields VSM has a noise level of approximately 5 x 10^{-7} emu at the minimum range, allowing a reliable measurement results for samples with a magnetic moment of 10^{-6} emu.



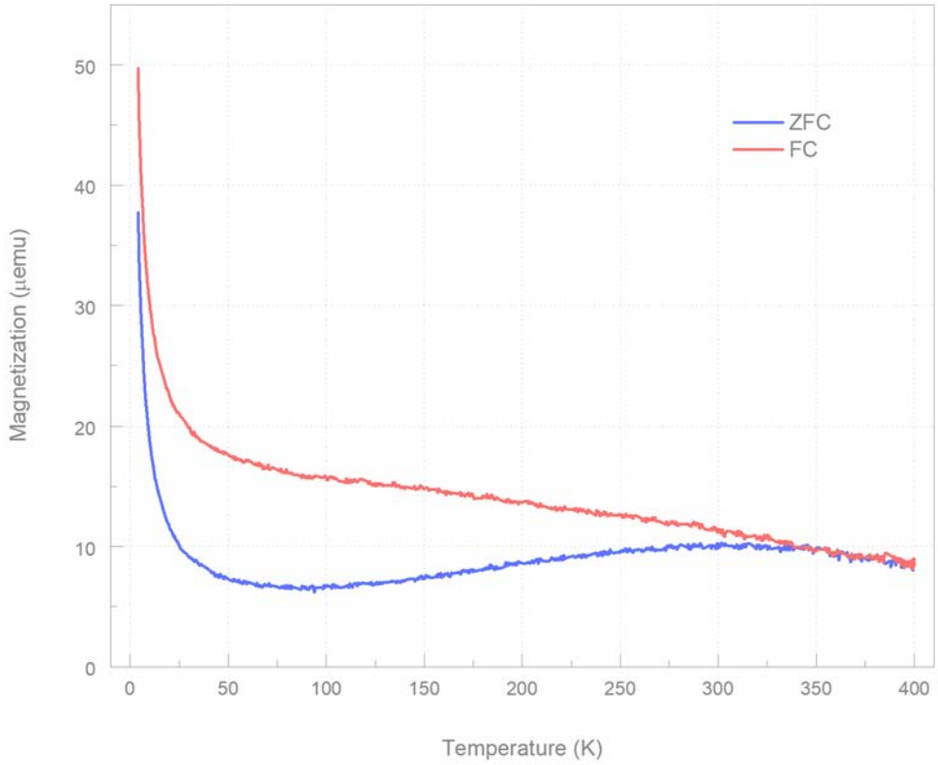
Application (4)—

M-T curves of magnetic nanotubes with FC and ZFC

Sample Information	Magnetic nano tube (powder)
MultiFields Products	1. VSM Module
Platforms	QD-PPMS

• Method

After cooling the sample with / without magnetic field, conducting the magnetization measurement during the warming precess could obtain the FC and ZFC curves, which reflects the magnetic transition of the sample.



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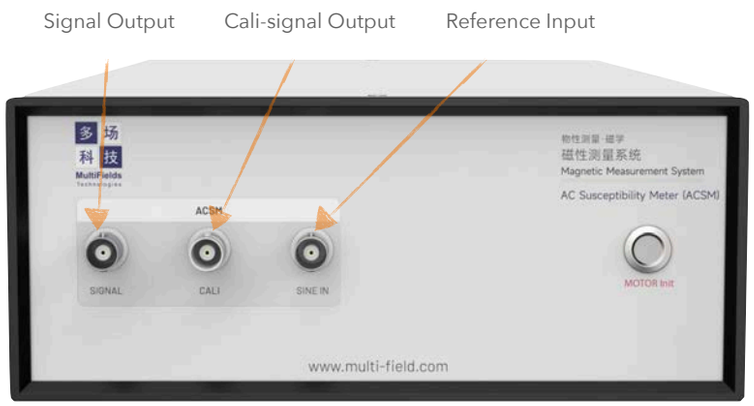
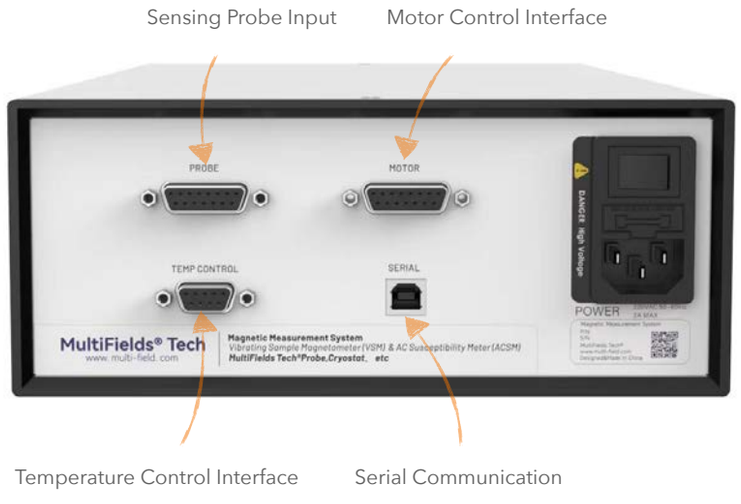
Materials Characterization

5.2 ACSM Module

Complete system including probe, controller, tool box and measurement software.

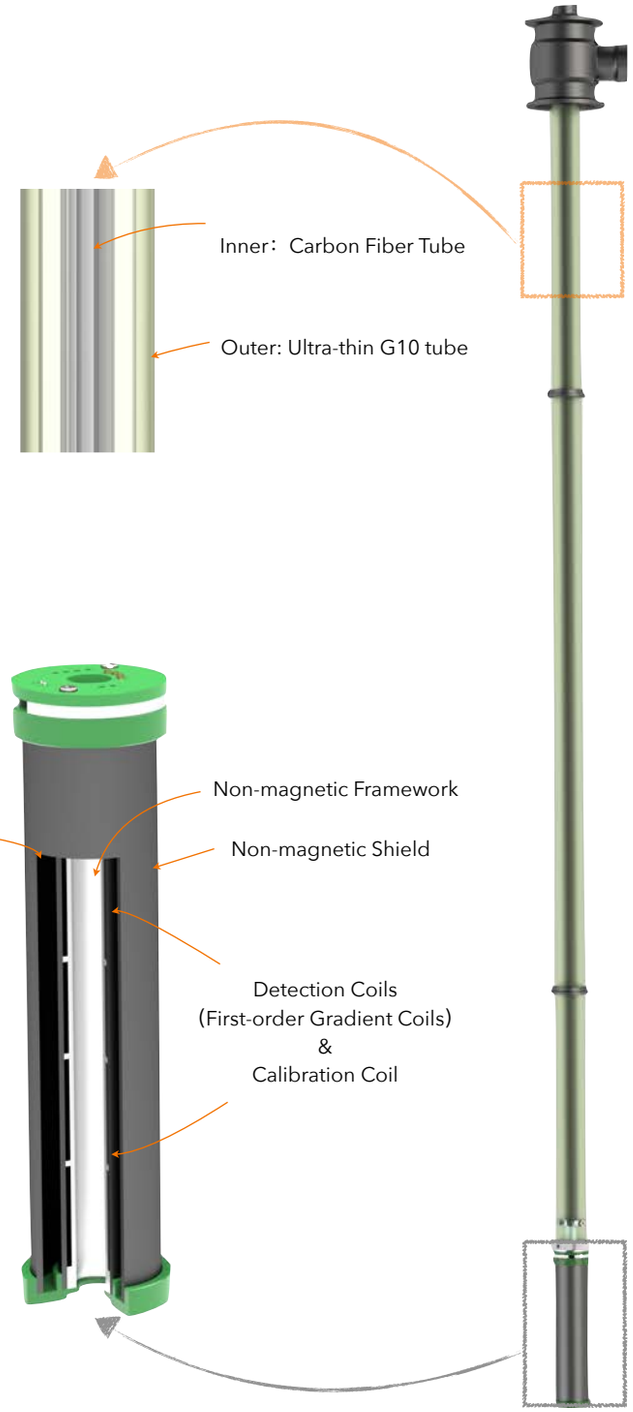




ACSM.Controller

- Structure of Sensing Probe

Constructed of ultra-low thermal conductive G10 and carbon materials. It has relatively high mechanical strength and ensures the sample reaching lowest temperature.



- Detection Coils

The detection coil is constructed with a completely non-magnetic material as its framework, and pure copper enameled wire which is wound to form a first-order gradient coil for induced voltage measurements. It is also installed with a Cernox sensor for temperature monitoring.

ACSM.Probe.Coil

5.2 ACSM Module - Specifications

Complete system including probe, controller, tool box and measurement software.

AC Susceptibility Meter - Specifications

Measurement	
Temperature	1.4 K ~ 300 K
Magnetic Field	± 18 T
Sensitivity	1×10^{-8} emu/Oe
Phase Accuracy	± 0.5 °
Driving Field	0.05 ~ 15 Oe
Frequency	10 Hz ~10 kHz
Average Time	0.5 ~ 100 seconds, 1 second (typical)
Coils Parameters	
Bore Diameter	8.0 mm
Detection Coil Spacing	9.0 mm
Sample Requirements	
Sample Type	Suitable for all shapes of bulks, films, powders and other forms
Sample Requirements	Weight：< 20 g；length in radial dimension：< 3 mm；
Standard Holders	Quartz rod(STD)；Quartz tube(STD) Electrically-controlled magnetic probes; Optically-controlled magnetic probes, etc..

ACSM Options - Specifications

Electrically–controlled Magnetism	
Withstand Voltage	< 200 V (DC)
Leakage Current	< 100 pA @ 100 V (DC)
Electric Channel	2
Additional Noise	< 1×10^{-7} emu
Optically–controlled Magnetism	
Fiber Diameter	0.2 mm
N. A.	N.A.0.22
Interface	SMA905
Max Power	20 mW
Transmission	0.95 @ 300 K
Additional Noise	< 1×10^{-7} emu

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Materials Characterization

5.2 ACSM Module - Software

Complete system including probe, controller, tool box and measurement software.

- Sequence list

The command list is shown in this section. You can modify or delete one of them. Besides, the command list can be save or open. The sequence status is shown in the status bar.

- ACSM Centering

The software has a built-in automated sample centre finding process, where the signal-position relationship is determined by scanning the sample position and fitted by a built-in algorithm to accurately determine the sample centre position.

- Results

Results of AC Susceptibility measurement can be displayed in real time using the Plot command. Users can plot the graph with different xy axes.

- System Status

The temperature, field and chamber status can be display and modified quickly.

- Measurement command

All measurement commands are listed, including temperature and field settings, magnetic moment measurement commands. The arrangement of these commands allows for automated measurements.

- Sample instal / uninstall

Automatic sample installation/ uninstallation process is built into the software, which automatically controls the motor to move the sample probe to the loading port without any unnecessary operation.

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Materials Characterization

5.2 ACSM Module - Application

Complete system including probe, controller, tool box and measurement software.

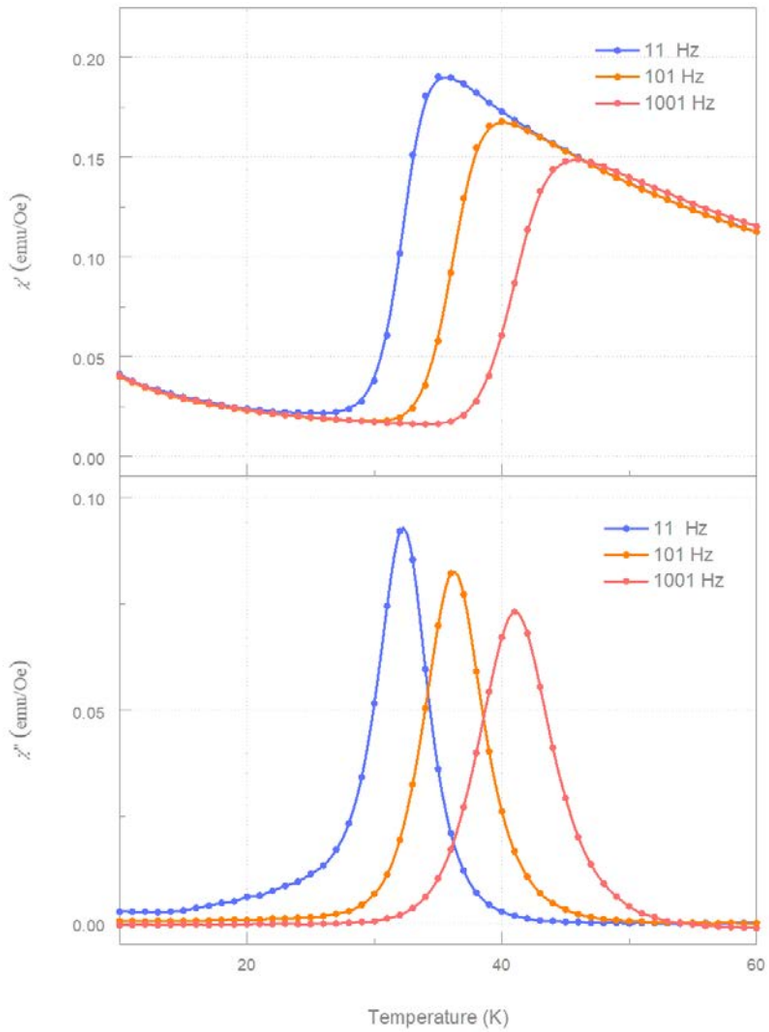
Sample Information	Dy-based organic magnets
MultiFields Products	1. VSM Module
Plantform	QD-PPMS

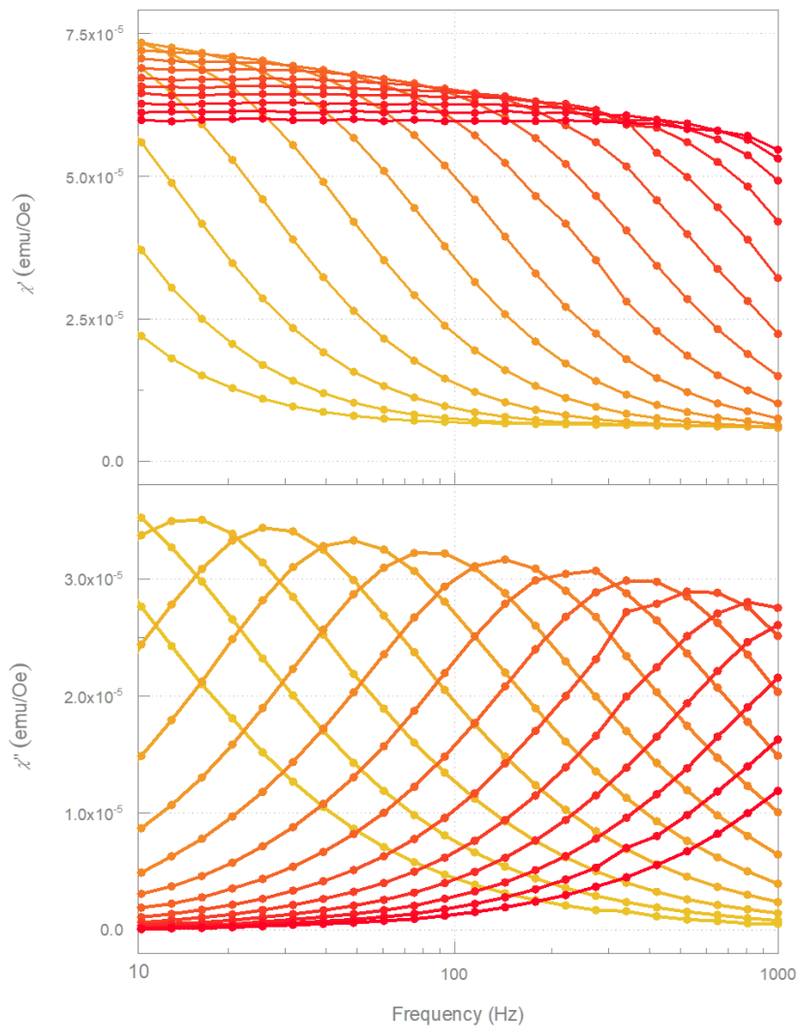
• Measurement Method

AC susceptibility measurement can be conducted in a variety of methods. Two-points, three-points, and five-points measurements are commonly used, which are also built in the Multifields ACSM system.

Application (1)—

AC susceptibility of Dy-based organic magnets as a function of frequency and temperature





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Materials Characterization

5.3 VSM & ACSM - Accessories

Complete system including probe, controller, tool box and measurement software.

VSM.ToolBox

VSM.SampleBase

VSM & ACSM Accessories List

Items	Specifications	Quantity
Standard Sample		
1 Standard Sample	Pure Pd，0.27g	1
Sample Holder		
2 Quartz Rod	dia.3 mm，length 120 mm	2
3 Quartz Tube	dia.3 mm，length 120 mm	2
4 Sample Base		1
Adhesive		
5 GE-Vanish	Low-temperature adhesive，20 mL	1
Tools		
6 Sticks	Non-magnetic，length 140 mm	1 pc
7 Screws	M3，L3	2 pc
8 Scissor		1 pc

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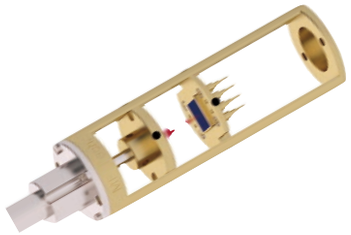
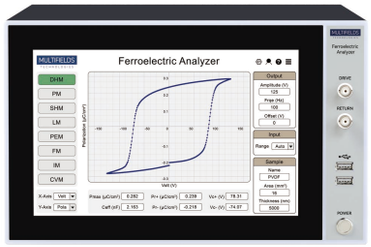
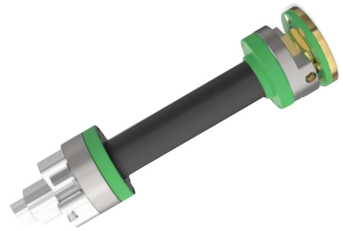
Materials Characterization

Magnetoelectric Measurements · Series

Function：Dielectric coefficient and impedance measurement, ferroelectric properties (P-E loop, fatigue, etc.) and magneto-electric coupling coefficients, etc..







		Dielectric Measurement	Ferroelectric Measurement	Magneto-electric Coupling Measurement
	Function	Capacitance, dielectric coefficient, high resistance, P-E loop (< 200 V) measurements can be realized;	Measurements of ferroelectric properties such as P-E loop (1000 V), fatigue, and imprint can be realized; High-voltage protected design compatible with third-party platforms	Measurement of the magneto-electric coupling coefficient can be realized, and the direction of the magnetic field can be changed by using sample holders with different configurations.
1	Work Environment	Temperature: 1.4 K ~ 400 K；Pressure：10^{5} ～ 10^{-5} Pa； Magnetic Field：0 ～ 18 Tesla;		
2	Diameter	dia-26 mm / dia-30 mm / dia-50 mm		
3	Function	Capacitance, dielectric coefficient, impedance and high resistance Compatible with P-E loop and other ferroelectric measurements.	P-E loop, fatigue, imprint and pyroelectric, etc.; Compatible with capacitance, dielectric coefficient, impedance measurements.	Magneto-electric coupling coefficient measurement
4	Sample Type	Bulks & thin-film	Bulks	Bulks & thin-film
5	Sample Requirements	< 10 mm × 10 mm × 5 mm	< 8 mm × 8 mm × 3 mm	< 6 mm × 6 mm × 3 mm
6	Voltage Range	< 200 V DC	< 1000 V DC	N. A.
7	Frequency Range	0.1 Hz ～ 10 MHz；	0.1 Hz ～ 300 kHz	0.1 Hz ～ 100 kHz
8	Leakage Current	～ 10 fA @ 100 V		< 1 pA @ 100 V
9	Parasitic Capacitance	< 10 fF		
10	Options	Ceramic sample holder with ultra-low leakage current、Ferroelectric Analyzer; Optional optical fiber for combined optoelectronic measurements.		Perpendicular/in-plane magnetic-electric sample holders; commercial lock-in amplifiers and other instruments

* The Multifields Technologies magnetoelectric measurements series are seamlessly compatible with common platforms such as QD-PPMS, Oxford-TeslatronPT, Pride-CPMS, Cryogenic-CFMS and others；

** The above are all recommended configurations. Multifields Technologies provides customization services. If you have special requirements, please contact us.

Materials Characterization

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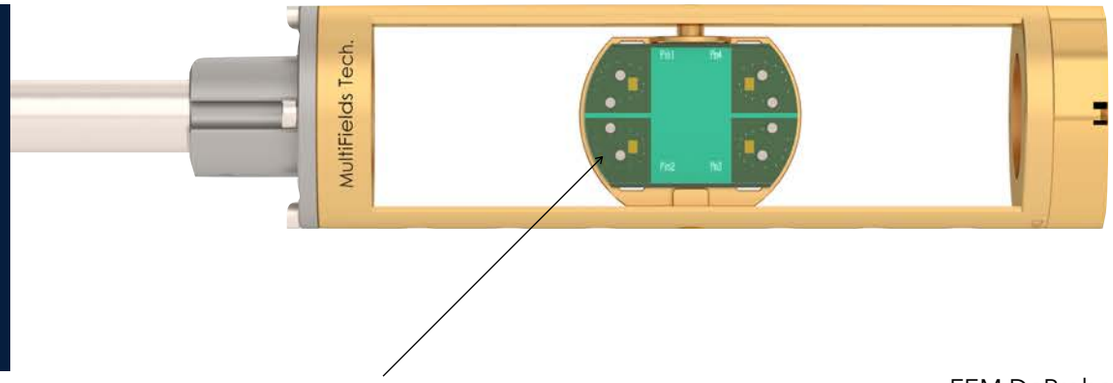
6 Dielectric Measurement (DEM)

Compatible with dielectric, ferroelectric, pyroelectric, etc. measurements for bulks and films



Pluggable Sample Holder

FEM.DeProbe.26P

1. Ultra-low parasitic capacitance，< 10 fF
2. Ultra-high Voltage，> 3 kV
3. Ultra-low background current，~ 10 fA

Key Features

- Working temperature: 1.5 ~ 400 K, Max field: 18 T;
- Dielectric probe enables dielectric/ferroelectric/multiferroic measurement
- Dielectric, ferroelectric and pyroelectric measurements for thin-film and bulk samples can be realized.
- Pluggable sample holder with unique guard design for extremely low parasitic resistance
- Optional low-temperature optical fiber for combined optical-electric measurements
- Compatible with QD-PPMS Dynacool，Oxford-TeslatronPT，Cryogenic and Pride-CPMS platforms.

Dielectric Measurement - Specifications

Probe	
Temperature	1.5 ~ 400 K
Magnetic Field	0 ~ 14 T
Withstand voltage	400 V
Frequency Range	20 Hz ~ 300 kHz
Measurement Precision	0.05%
Leakage current	< 5×10^{-14} A
Parasitic Capacitance	< 10 fF
Channel	4
Cable Type	Cryogenic coaxial cable
Function	Dielectric, ferroelectric and pyroelectric measurements for thin-film and bulk samples
Dielectric Sample Holder	
Parasitic Capacitance	< 10 fF
Withstand voltage	3000 V
background current	~ 1×10^{-14} A
Current Range	0.1 pA ~ 1 A

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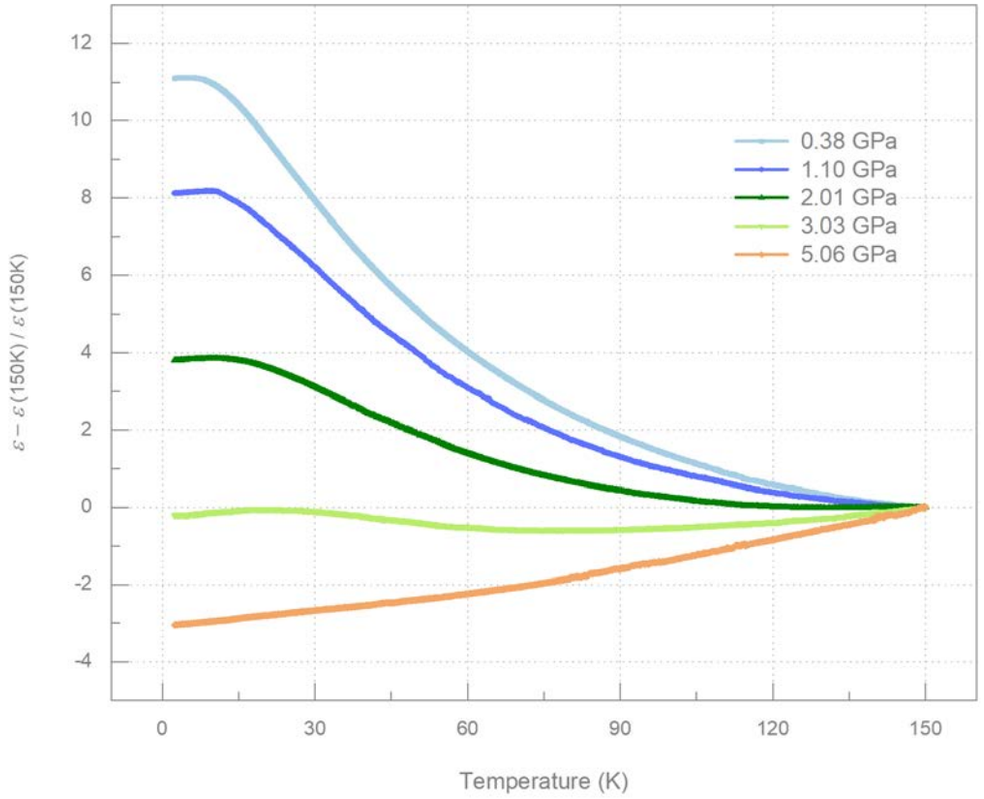
6 DEM - Application

Application (1)—

Dielectric constant of $BaFe_{12}O_{19}$ under different pressures

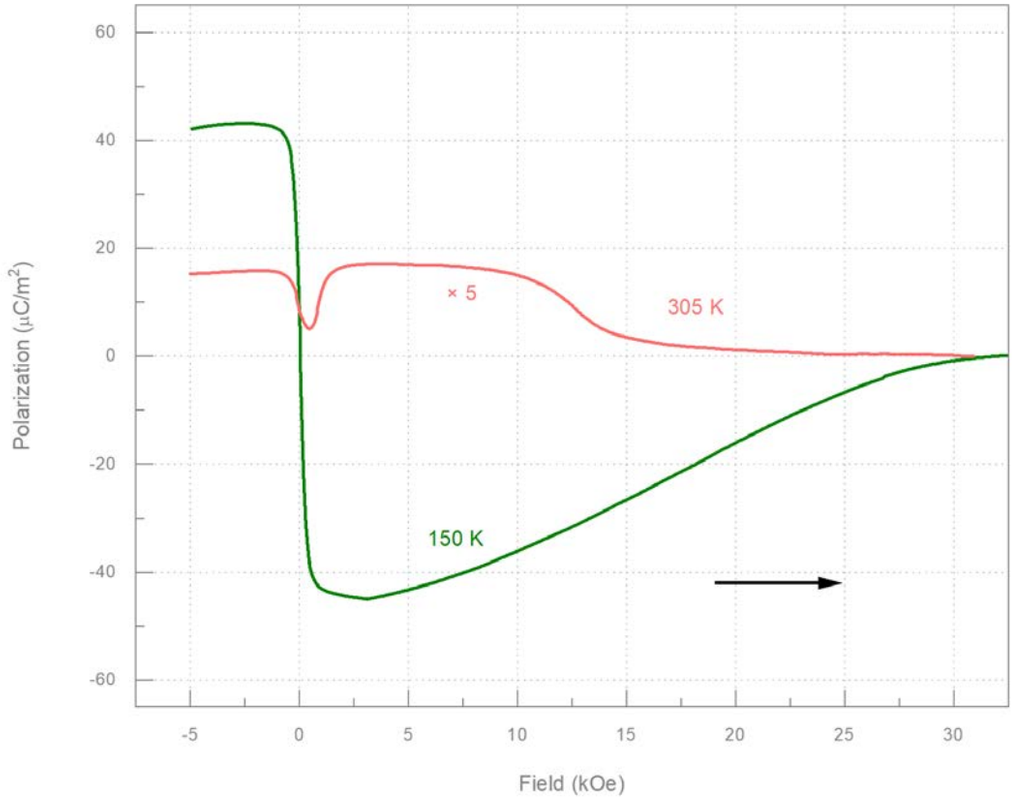
Sample Information	$BaFe_{12}O_{19}$
MultiFields Products	1. DEM.Probe
Platform	PPMS



Application (2)—

Magneto-current measurement at different temperature of Fe Oxide

Sample Information	Fe Oxide
MultiFields Products	1. DEM.Probe
Platform	Oxford TeslatronPT



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Materials Characterization

6 DEM - Application

Application (3)—

Pyroelectric effect of $YFeO_4$ under different magnetic fields

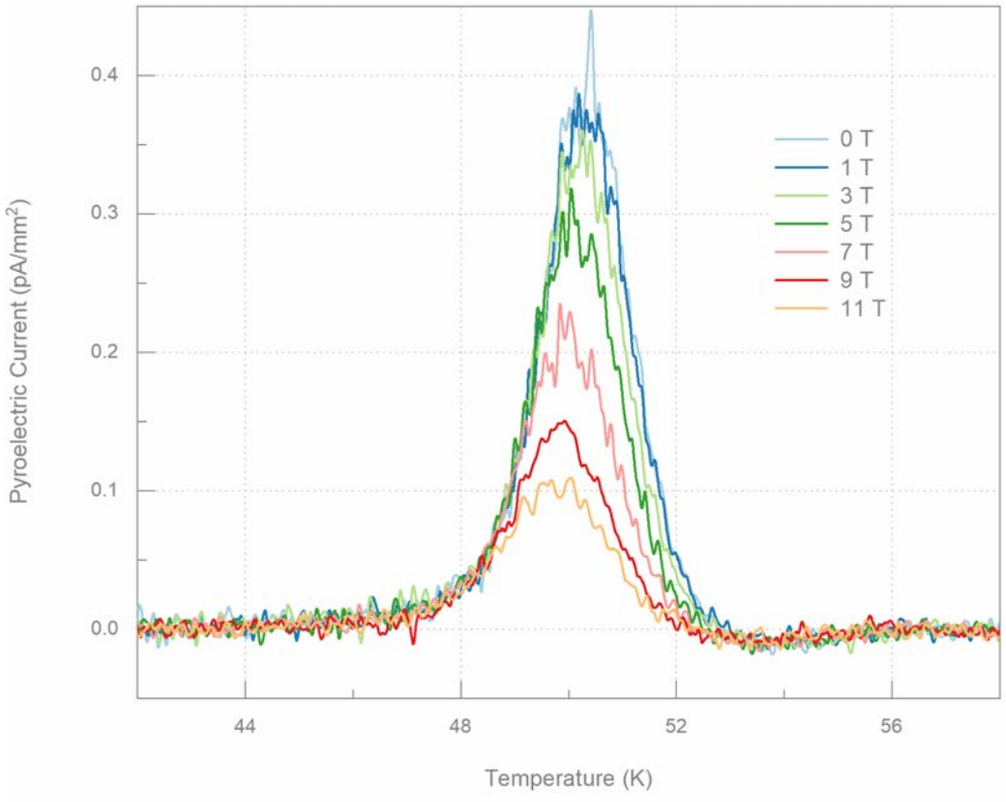
Sample Information	$YFeO_4$
MultiFields Products	1. DEM.Probe
Platform	

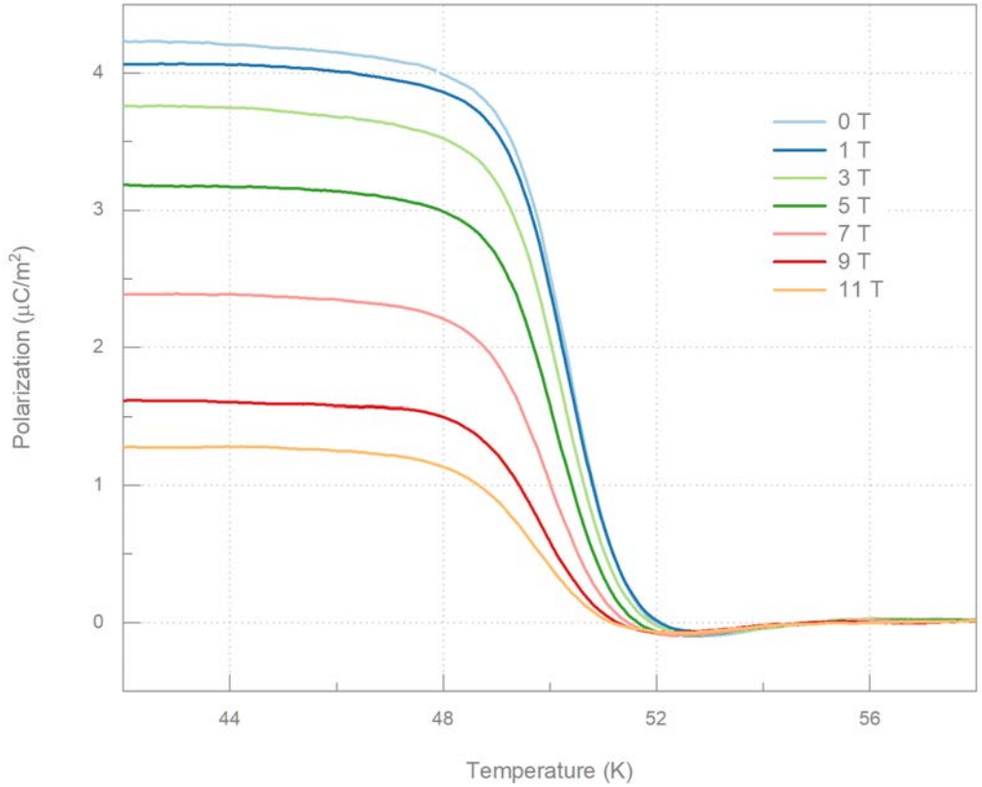
- What is the pyroelectric effect?

When the temperature changes, the macroscopic polarization of the material changes. As a result, the shielding charge on the surface of the material is out of balance and the excess shielding charge is released to form a detectable current, i.e. the pyroelectric effect.

- How to measure pyroelectric effect?

1. Pre-polarization: apply a voltage to the ends of the sample while cooling the sample to desired temperature; 2. Current measurement: withdraw the voltage, connect an electrostatic meter, and increase the temperature at a fixed rate while monitoring the current of the electrostatic meter. The current show peaks when the electrostatic polarization variation is greatest (as shown in the left figure below). Integrate the current against the time to obtain the relationship between polarization and temperature (as shown in the right figure below).





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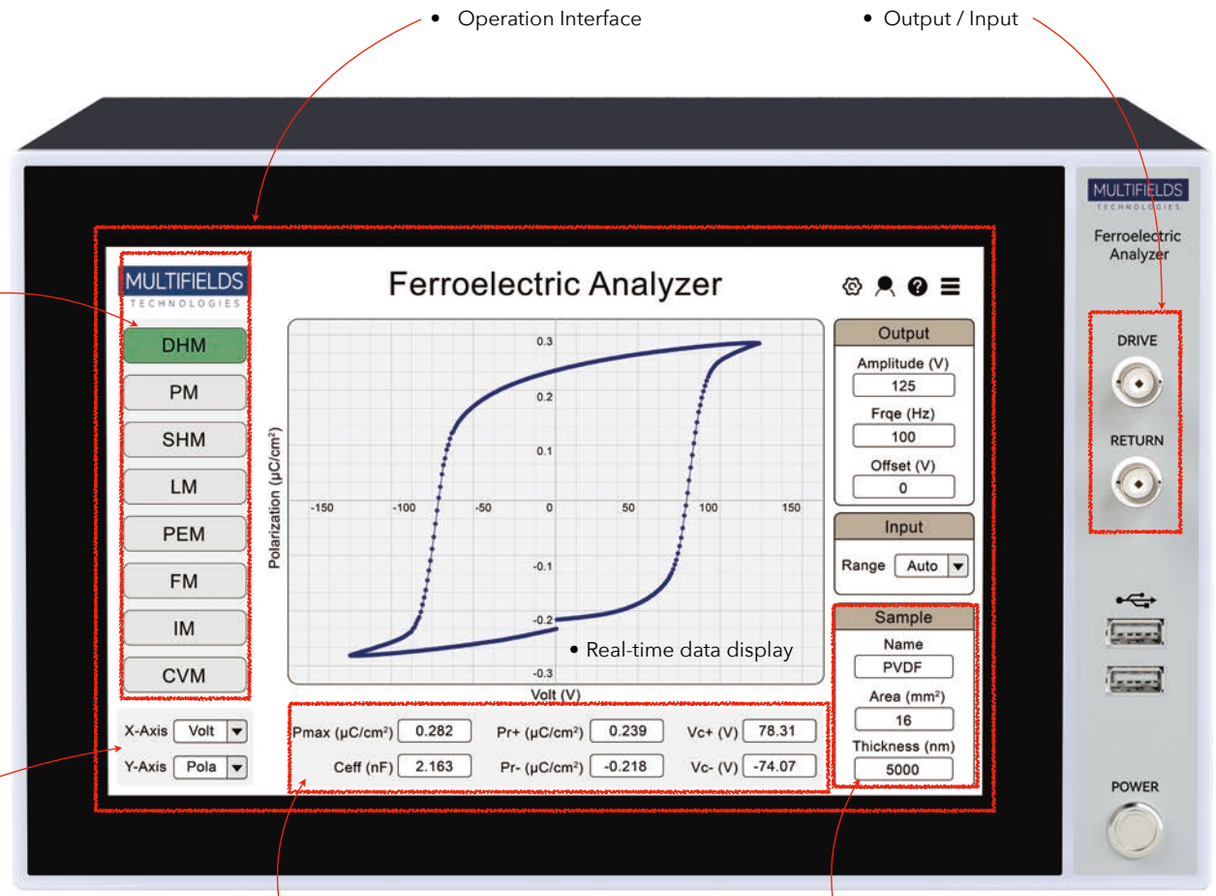
7 Ferroelectric Measurement (FEM) - Analyzer

Complete system including probe, controller and measurement software.



• Function Select

Multiple ferroelectric measurement functions can be selected, such as dynamic hysteresis loop measurement (DHM), PM pulse measurement (PM), static hysteresis loop measurement (SHM), leakage current measurement (LM), fatigue measurement (FM), etc..

• X / Y Axis

Select the parameters represented by the X and Y axes to plot different graphs.

• Parameters

Analysis of ferroelectric parameters such as saturation polarization, residual polarization, coercivity, etc..

• Sample Information

Enter the sample name, area, thickness and other information, the software can automatically convert the voltage, electric field, and polarization, etc..

• Rear Panel

Including standard power connector, two LAN ports, three HDMI ports, four USB 3.0 ports

FEM.Analyser

Key Features

- Ferroelectric analyzer combining FEM probes provides a integrated ferroelectric measurement solution;
- Dielectric, ferroelectric and pyroelectric measurements for thin-film and bulk samples can be realized.;
- Fatigue and imprint measurement can be realized.
- Optional low-temperature optical fiber for combined optical-electric measurements
- Compatible with QD-PPMS Dynacool，Oxford-TeslatronPT，Cryogenic and Pride-CPMS platforms.

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7 FEM - Ferroelectric Analyzer

Ferroelectric Analyzer - Specifications

Ferroelectric Measurement	
Arbitrary Waveform Generator	50 MSa/s *
Analog Output	2 MHz，24 bits
Output Volltage	± 10 V
Output Impedance	10 Ohm
Max Hysteresis Frequency	100 kHz
Min Hysteresis Frequency	0.01 Hz
Min Pulse Width	0.5 μs
Min Rise Time	100 ns
Max Fatigue Frequency	2 MHz
Slew Rate	> 200 V / μs
Max Capacitive Load	1 μF
Max Output Current	± 1 A
Current Range	1 pA ~ 1 A
Function	Dynamic hysteresis loop measurement (DHM), fatigue measurement (FM) retention measurement (RM), imprint measurement (IM) leakage current measurement (LM), capacitance measurement (CVM) piezoelectric measurement (PZM), pulse measurement (PM) pyroelectric measurement (PYM), dielectric measurement (DEM)
Suitable Probe	FEM.DeProbe, FEM.FeProbe

* SPS: Sample per second

High-Voltage Amplifier (Optional) - Specifications

	Amplifier - 10k	Amplifier - 1k
Voltage Range	± 10 kV	± 1 kV
Current Range	0 ~ 2 mA	0 ~ 20 mA
Max Frequency	600 Hz	40 kHz
Input Impedance	10 kOhm	10 kOhm
DC Voltage Gain	1000 V / V	100 V / V
DC Voltage Gain Accuracy	优于 0.3 %	优于 0.5 %
DC Voltage Bias	< 2 V	< 1 V
Output Noise	< 700 mV rms	< 30 mV rms
Slew Rate	35 V / μs	150 V / μs
Stabilization time for 1% change	< 1 ms	< 30 μs
Inner Capacitance	300 pF	300 pF
Voltage Monitoring	**Amplifier - 10k**	**Amplifier - 1k**
Analog Output Scale	1/1000 of the output voltage	1/100 of the output voltage
Noise	< 20 mV p-p	5 mV rms
DC Accuracy	< 2 %	< 2 %

Materials Characterization

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7 FEM - Probe

High-voltage ferroelectric probe, compatible with dielectric and pyroelectric measurements

• Sample Capsule

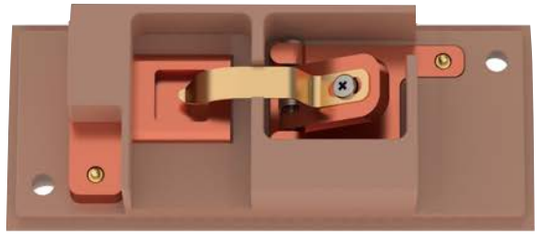
Highly insulating Vespel material is used to increase breakdown voltage and ensure stable use under high voltage.

• Measurement Cable

High-voltage resistant cables to increase the range of working voltage

• Sample Fixture

The sample to be measured can be directly clamped between the two electrodes, with convenient and quick operation.



FEM.FeProbe.30

Key Features

- Temperature：1.5 ~ 400 K; Magnetic field: 18 T
- FEM probe combining Ferroelectric analyzer provides a integrated ferroelectric measurement solution;
- Dielectric, ferroelectric and pyroelectric measurements for bulk samples can be realized.;
- Fatigue and imprint measurement can be realized.
- Optional low-temperature optical fiber for combined optical-electric measurements
- Compatible with QD-PPMS Dynacool，Oxford-TeslatronPT，Cryogenic and Pride-CPMS platforms.

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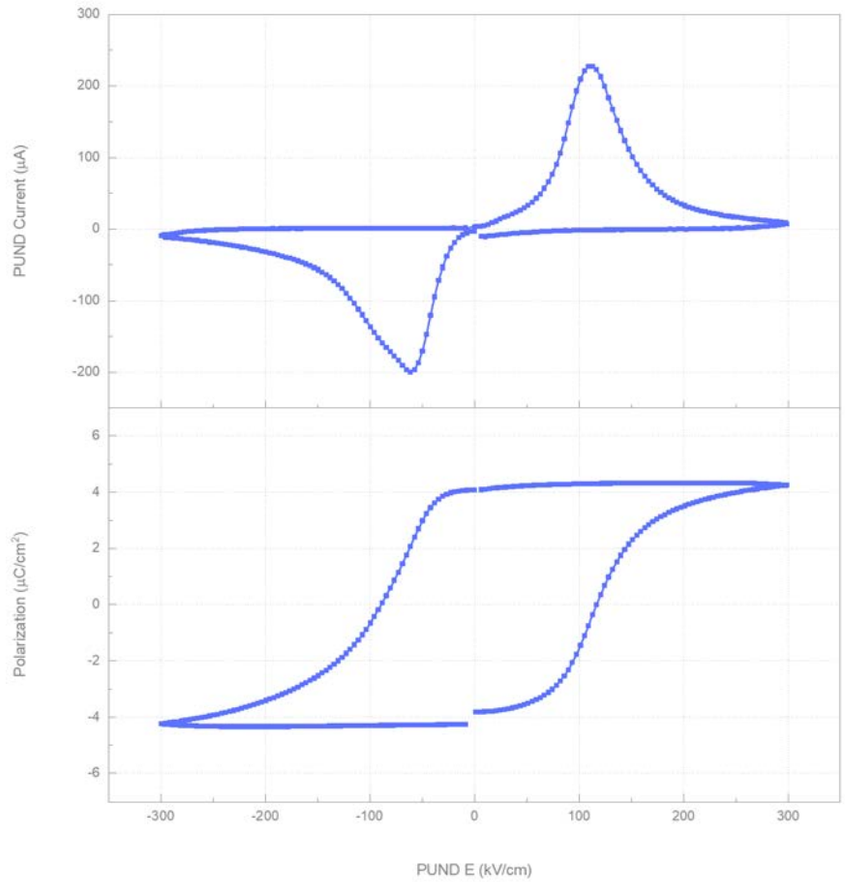
Materials Characterization

7 FEM - Application

Application (1)—

P-E loop of PZT thin film

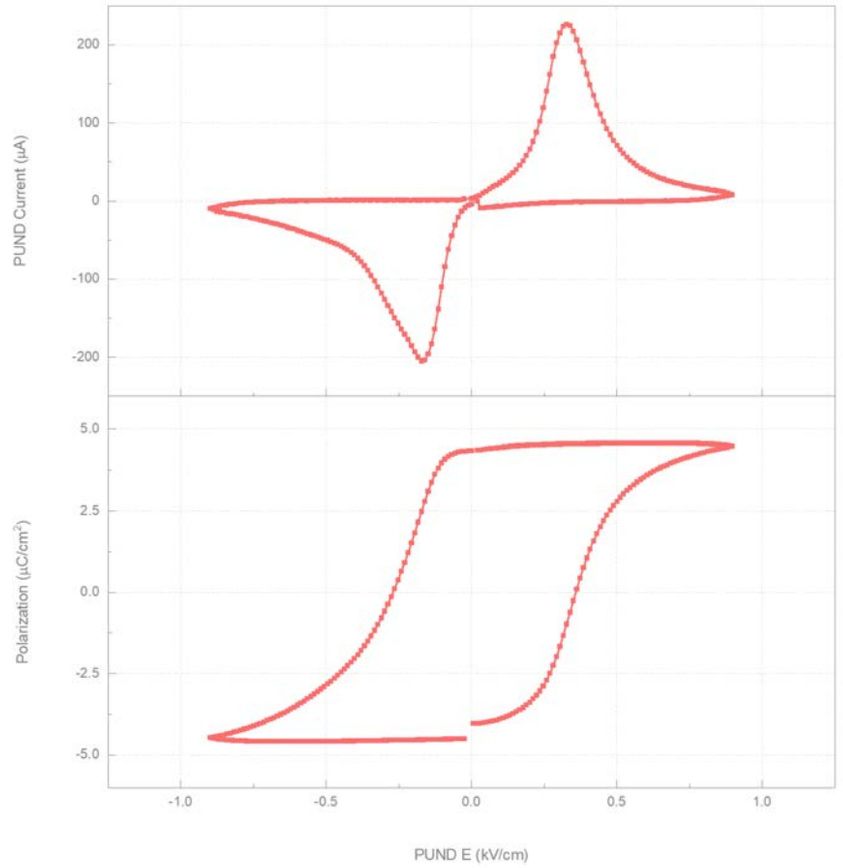
Sample Information	500nm PZT thin film
MultiFields Products	1. FEM.Analyser 2. FEM.Probe



Application (2)—

P-E loop of PMN-PT Bulk

Sample Information	PMN-PT bulk 5 mm× 5 mm × 0.2 mm
MultiFields Products	1. FEM.Analyser 2. FEM.Probe



Materials Characterization

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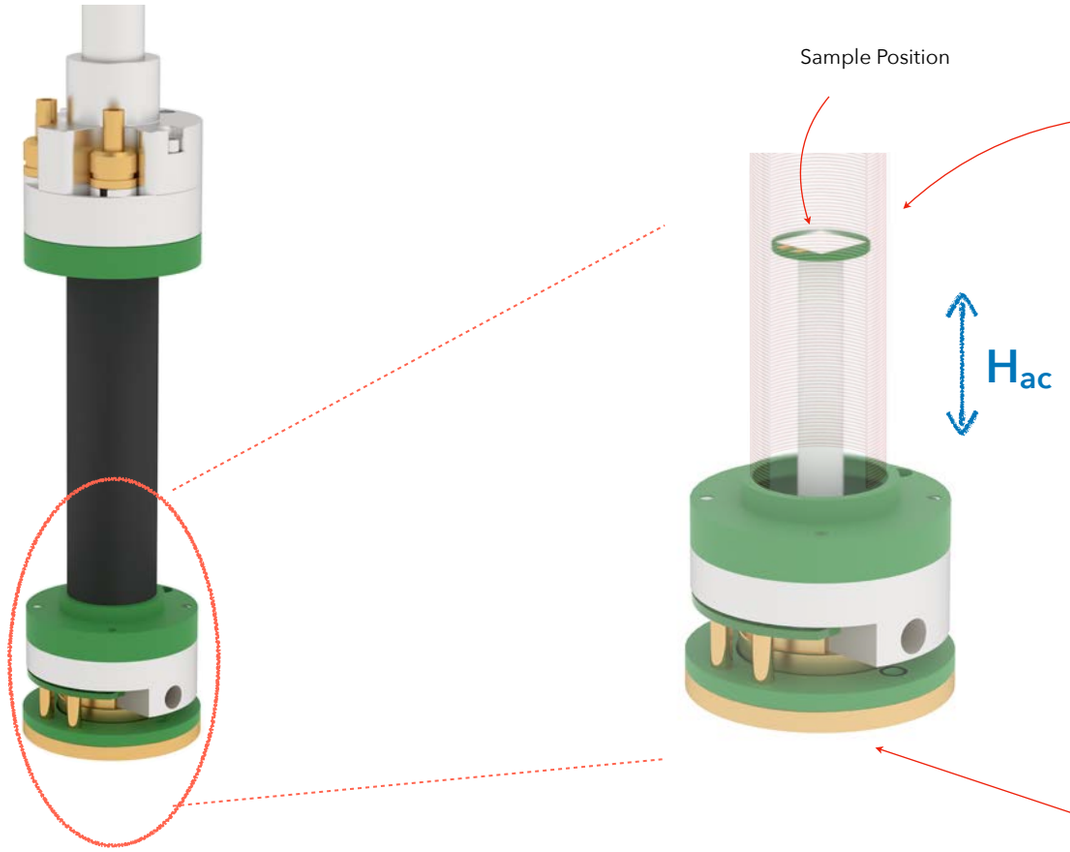
8 Magneto-electric Coupling Measurement

Magneto-electric coupling coefficient measurement system with ultra-high sensitivity



• Modulation Solenoid

It is used to apply a small alternating magnetic field H_{ac} to the sample. Due to the presence of the magneto-electric coupling effect, sample generates an induced voltage with corresponding frequency, which can be measured by a lock-in amplifier.

• Removable Sample Holder

The small circuit board for mounting sample is carried by a thermally conductive quartz rod, which does not introduce eddy current and at the same time ensures good thermal conduction.

There are two types of sample holders: sample parallel to the field and sample perpendicular to the field.

Key Features

- Magneto-electric coupling coefficient measurement system with ultra-high sensitivity
- Compatible with QD-PPMS Dynacool，Oxford-TeslatronPT，Cryogenic and Pride-CPMS platforms.

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8 Magneto-electric Coupling Measurement - Application

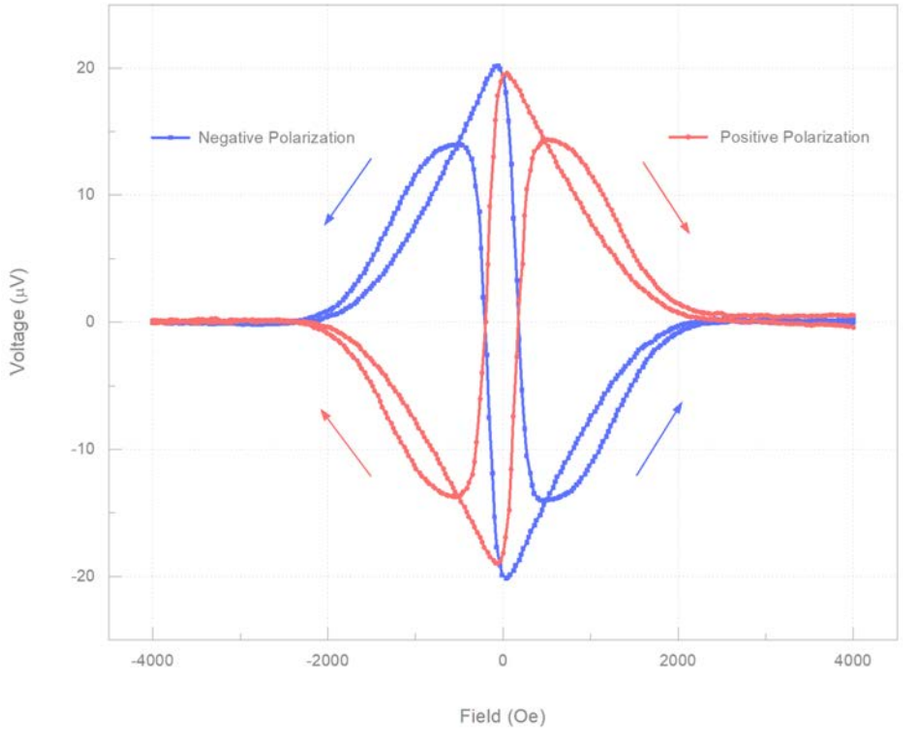
Application (1)—

Magneto-electric coupling effect of FeGa/PMN-PT/FeGa heterojunction

Sample Information	FeGa/PMN-PT/FeGa
MultiFields Products	1. MES.Probe
Platform	Oxford TeslatronPT

• Method

A thin film of FeGa layer, a material with magnetostriction effect, is grown on a piezoelectric substrate PMN-PT. This composite magneto-electric coupling material generates an induced voltage under the excitation of a magnetic field, which can be detected by a lock-in amplifier.



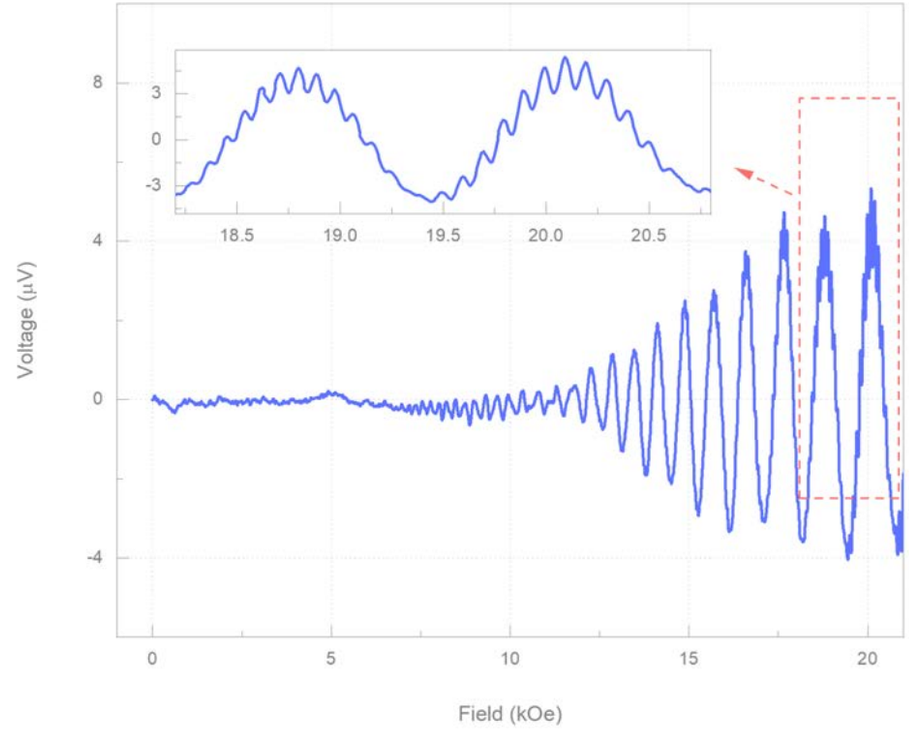
Application (2)—

Measure de Haas oscillation of Al Magneto-electric Coupling Measurement

Sample Information	Al / PMN-PT
MultiFields Products	1. MES.Probe
Platform	Oxford TeslatronPT

• Principle

The aluminum with de Haas oscillation effect is bonded with the piezoelectric material PMN-PT. A extremely slight dimensional oscillation occurs in Al under the magnetic field, which is converted into a piezoelectric voltage on the PMN-PT.



Materials Characterization

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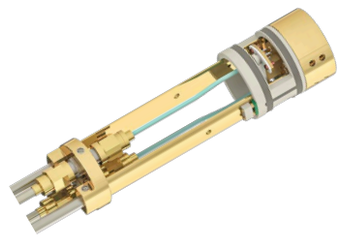
DancingSPIN

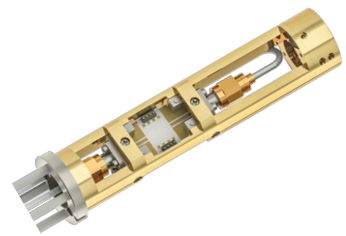
Ferromagnetic Resonance Measurement · Series

Function: ferromagnetic resonance (FMR), spin torque ferromagnetic resonance(ST-FMR), Spin pumping - ISHE measurements

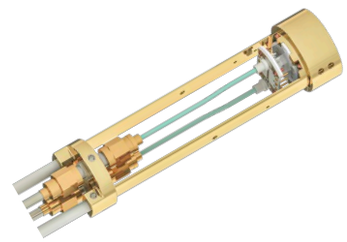
FMR (H in plane)



FMR (H out of plane)



ST-FMR (H in plane)



ST-FMR (H out of plane)

	Function	FMR、Spin pumping & ISHE measurements for thin-film and bulk can be realized. Provides DC channels for electric-modulated FMR researches.		ST-FMR、Spin pumping & ISHE measurements for device can be realized. Provides DC channels for electric-modulated ST-FMR researches.	
1	Work environment	·Temperature: 1.4 K ~ 400 K；Pressure：10^{5} ～ 10^{-5} Pa； Magnetic Field：0 ～ 18 Tesla;			
2	Diameter	dia-26 mm / dia-30 mm / dia-50 mm			
3	Max Frequency	20 / 40 GHz			
4	RF loss (Input to sample)	20 GHz version：-6 dB (@ 20 GHz)，-18 dB (@ 40 GHz) 40 GHz version：-4 dB (@ 20 GHz)，-9 dB (@ 40 GHz)			
5	Leakage current	< 100 pA @ 100 V			
6	RF Channel	2			
7	DC Channel	6	6	8	6
8	Magnetic Field	Field parallel to sample plane	Field perpendicular to sample plane	Field parallel to sample plane	Field perpendicular to sample plane
9	Sample Type	Thin-film / bulk sample（mounting on CPW surface）		Micro / nano device（wire-bonding the CPW and device）	
10	Function	FMR，Spin Pumping - ISHE voltage measurement		ST - FMR，Spin Pumping - ISHE voltage measurement	
11	Compatible Meters	Multifields FMR Workstation, commercial vector network analyzer, etc..		Multifields FMR Workstation, commercial signal generator, etc..	

* The Multifields Technologies FMR measurements series are seamlessly compatible with common platforms such as QD-PPMS, Oxford-TeslatronPT, Pride-CPMS, Cryogenic-CFMS and others；

** The above are all recommended configurations. Multifields Technologies provides customization services. If you have special requirements, please contact us.

Materials Characterization

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9. FMR Measurement

Integrating FMR, ST-FMR, Spin Pumping & ISHE into one system and exhibiting extraordinary sensitivity to measure magnetic film.

FMR Measurement System - Specifications

Operating Environment		
Frequency Range	1～20 GHz	1～40 GHz
Max Power	27 dBm	27 dBm @ < 35 GHz 22 dBm @ 35~40 GHz
Power Step	0.1 dBm	
Frequency resolution	0.01 GHz	
Frequency Stability/Accuracy	2 ppm	
SSB Phase Noise	< -70 dBc/Hz @ 1 kHz	
Nonharmonics	< -60 dBc	
Harmonics	< -35 dBc (@ 6GHz以上) < -25 dBc (@ 6GHz以下)	
Measurement Function	FMR, ST-FMR, ISHE& Spin pumping	
Auxiliary function	AC modulation current output; Amplitude modulation	
Hight	2 U	
Communication	RS232	
Software		
Environmental control	Temperature, magnetic field	
Application	FMR, ST-FMR, ISHE&Spin pumping	
Data fitting	Lorentzian fitting, Gaussian fitting, Kittel fitting,	
Parameters	Resonance magnetic field (H_r) , Resonance frequency (f_r) , Resonance linewidth (△H) , Damping (α) , Gyromagnetic ratio (γ) , g factor, Effective magnetization (M_{eff}) , ISHE voltage	
Sweeping mode	Field Sweeping: RF frequency is kept constant and field is swept	

*If you want to use other instruments for FMR measurement, please consult us.

FMR Probe		
Type	In plane	Out of Plane
Function	FMR, ST-FMR, ISHE&Spin pumping (thin-film and bulk)	
Frequency Range	0～20 GHz, 0～40 GHz	
Compatible Platforms	1) Multifields cryogenic and magnetic field platform Coldtube 2) PPMS, TeslatronPT, Cryogenic, Pride-CPMS, etc..	
CPW	Through CPW, 6 DC channels	
Sample Area	10 mm x 10 mm	
Helmholtz Coils (Modulation Coils)	Max Frequency: 10 kHz	
	Max Current: 100 mA	
	Field/current coefficient 0.08 Oe/ mA	
ST-FMR Probe		
Type	In plane	Out of Plane
Function	FMR, ST-FMR, ISHE&Spin pumping (micro-size device)	
Frequency Range	0～20 GHz, 0～40 GHz	
Compatible Platforms	Dia.25mm, compatible with third-party cryogenic superconducting magnet platforms; Low-temperature rotating ST-FMR measurement can be realized by using ColdTUBE provided by Multifields Technologies	
CPW	2 channels, open GSG electrodes	
	8 DC channels	6 DC channels
Sample Area	8 mm x 9 mm	6 mm x 7 mm

Materials Characterization

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9.1 FMR Workstation

Integrating FMR, ST-FMR, Spin Pumping & ISHE into one system and exhibiting extraordinary sensitivity to measure magnetic film.

MultiFields® FMR Measurement Meter is a very powerful. It can replace expensive VNA to perform the FMR measurements with a high output power up to 27 dBm, which is suitable for high-frequency measurements under extreme conditions (usually large RF loss) . Thanks to MultiFields® Technologies advanced measurement and integration technology, a multifunctional measurement meter includes FMR, ST-FMR & ISHE & Spin pumping is achieved. It is aimed for testing films with high signal-to-noise ratio that attributes to combine with the (built-in) lock-in amplifier, AC modulated coils and special FMR probe for cryogenic and magnetic platform.

- RF Output

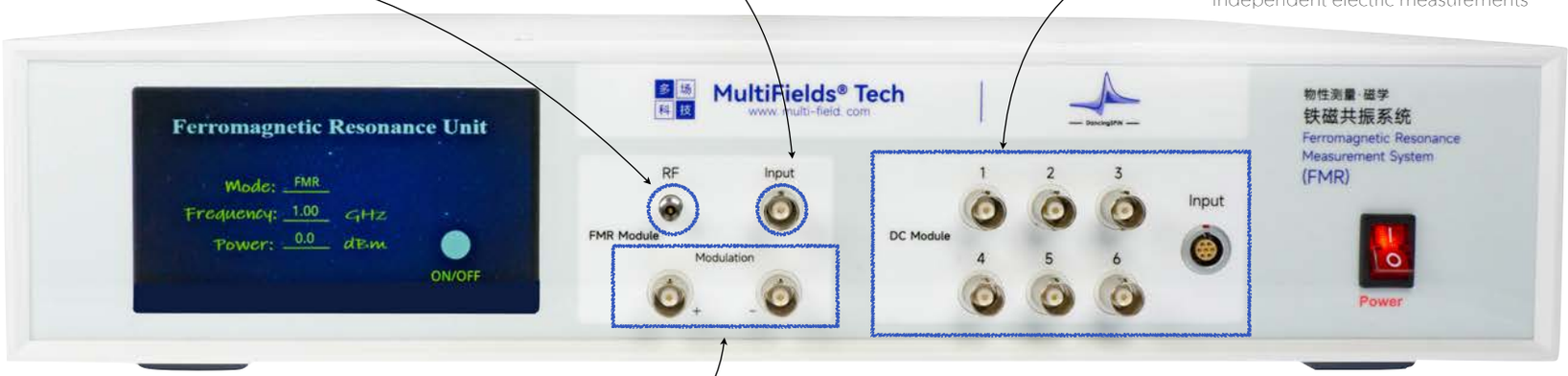
Outputs microwave signal up to 20/40 GHz with continuous wave or amplitude modulation modes.

- Reference Input

External low-frequency modulation signals are fed to the instrument to control the current output of the AC modulation coil (FMR Mode) or to control the amplitude modulation of the microwave (ST-FMR Mode).

- DC Breakout Module

The DC electrodes on the probe are converted to 6 BNC connectors and connected directly to a DC source meter, which enables electrically-modulated (ST-)FMR measurement or independent electric measurements



FMR.Meter.20/40

- Modulation Current Output

The modulated current is applied into Helmholtz coils. Introducing an AC small magnetic field during the FMR measurement, together with a lock-in amplifier to read the output signal, a microwave absorption differential spectrum with a high signal-to-noise ratio can be obtained

Key Features

- Max frequency: 20 GHz & 40 GHz;
- Max power output: 27 dBm；
- Extraordinary sensitivity to measure magnetic film with thickness of 1 nm；
- Tunable frequency with resolution of 10 MHz; tunable power with resolution of 0.1 dBm,；
- The FMR workstation with a voltage controlled current source and microwave amplitude modulation can conduct FMR, ST-FMR, ISHE & Spin-Pumping measurements;

9.1 FMR Measurement - Software

Integrating FMR, ST-FMR, Spin Pumping & ISHE measurements into one software

- Setting Zone

The platform, sample information, instrument selection can be setting in this zone.

- Measurement sequence

Selecting the file path to save the data and setting the parameters such as frequency and field.

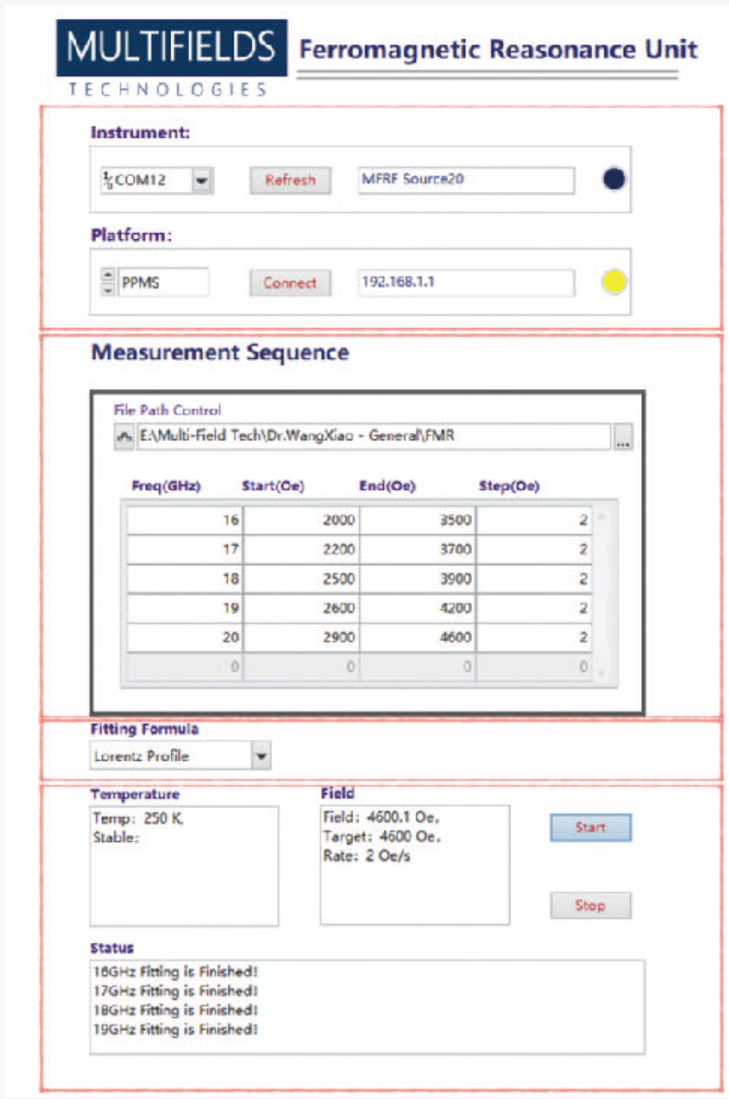
- Data Fitting

Selecting appropriate function/model to fitting the FMR spectra. The extracted parameters are subsequently plotted and fitted to calibrate the key results.

- System Status

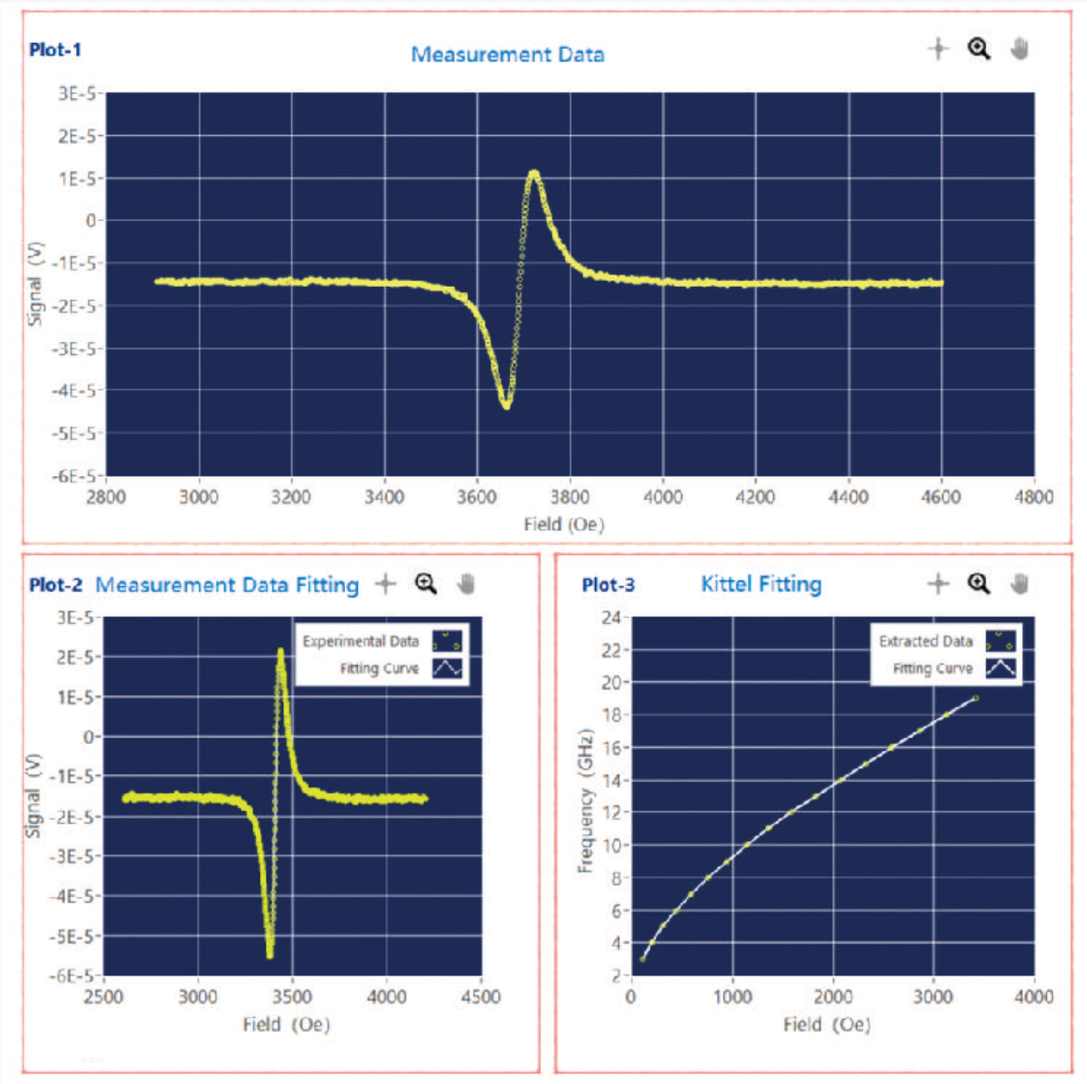
The temperature, field and chamber status can be display and modified quickly.

Thermal transport measurement system - MultiFields Tech.



- Measurement Result

The HCM results will be shown in this figure.



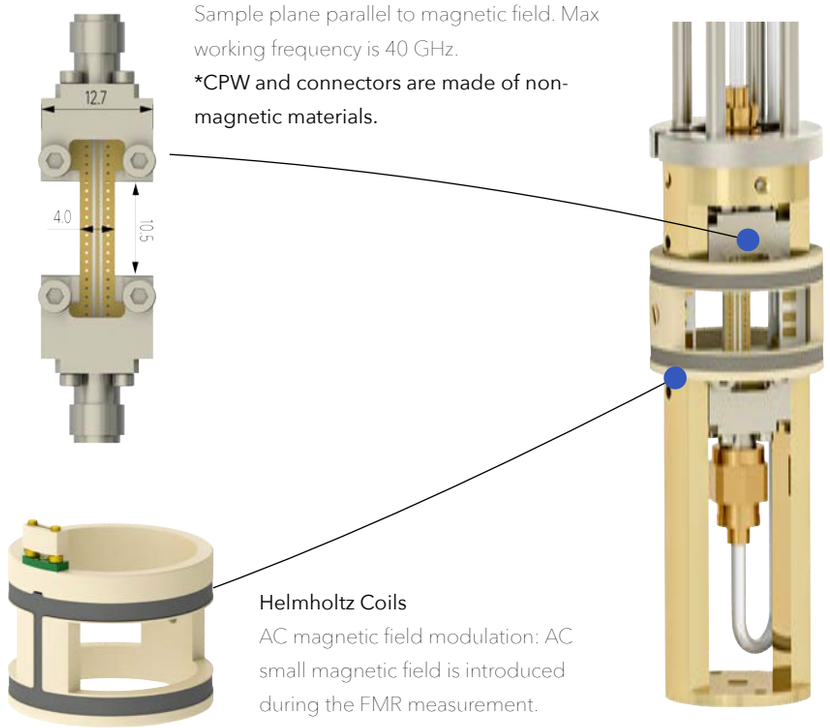
The fitting result of the FMR spectra obtained from the latest measurement. The parameters (resonant frequency and field) are extracted.

The fitting result using Kittel equation. Parameters such as effective magnetization, anisotropic field, Landé g-factor and damping coefficient can be obtained.

9.2 FMR Measurement - Probe

High-frequency measurements on thin-film samples, with sample perpendicular/parallel to magnetic field configurations

The CPW with 50 Ω-characteristic impedance is fabricated on the Rogers 4003C substrate. In order to improve the signal-to-noise ratio, a compact Helmholtz coil is assembled near the sample to provide a modulation field. The change of microwave absorption induced by the sample placed on the CPW of the **MultiField® FMR probe**, can be detected by the MF Microwave Core or a lock-in amplifier. Thus, differentiation of microwave absorption signals can be obtained.



CPW (IP)

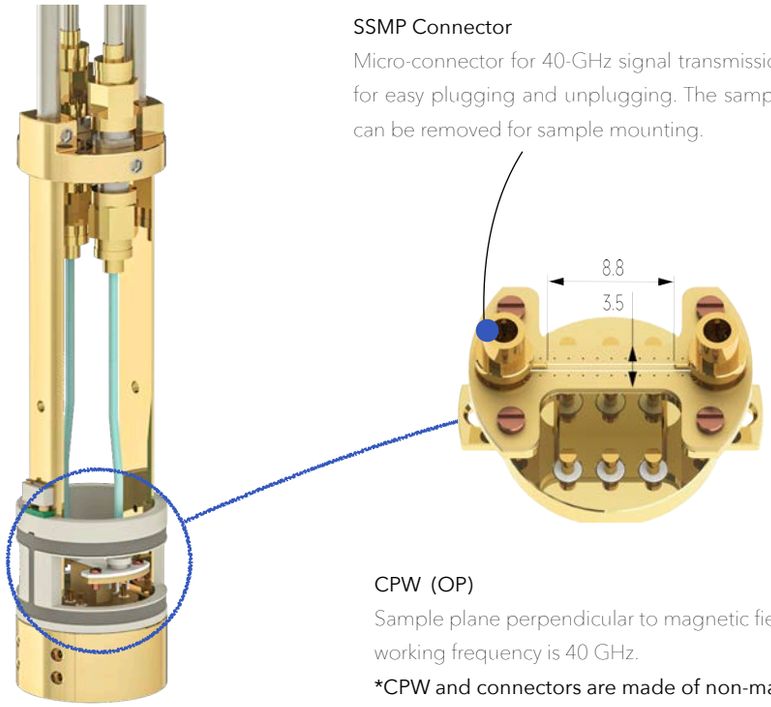
Sample plane parallel to magnetic field. Max working frequency is 40 GHz.

*CPW and connectors are made of non-magnetic materials.

Helmholtz Coils

AC magnetic field modulation: AC small magnetic field is introduced during the FMR measurement. Together with the lock-in amplifier extracting the output signal, the microwave absorption differential spectrum with high signal-to-noise ratio can be obtained.

FMR.Probe.30.IP.40G



SSMP Connector

Micro-connector for 40-GHz signal transmission, allows for easy plugging and unplugging. The sample holder can be removed for sample mounting.

CPW (OP)

Sample plane perpendicular to magnetic field. Max working frequency is 40 GHz.

*CPW and connectors are made of non-magnetic materials.

FMR.Probe.30.OP.40G

Key Features

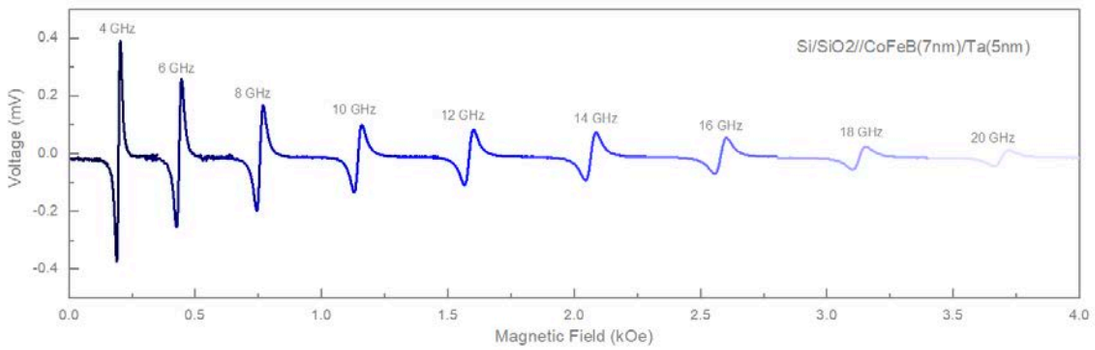
- Max frequency: 20 GHz & 40 GHz;
- Extraordinary sensitivity to measure magnetic film with thickness of 1 nm；
- Two configuration satisfy most measurement requirements；
- Probe working temperature: 1.5 ~ 400 K； Max magnetic field: 18 Tesla；
- Rotating FMR measurement can be conducted using **Multifields ColdTUBE**;
- Compatible with QD-PPMS Dynacool， Oxford-TeslatronPT， Cryogenic and Pride-CPMS platforms.

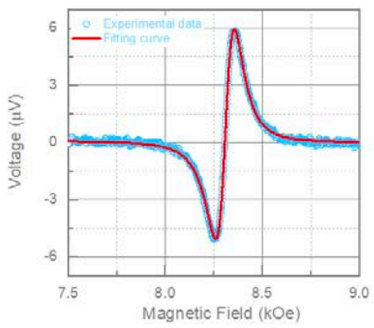
Materials Characterization

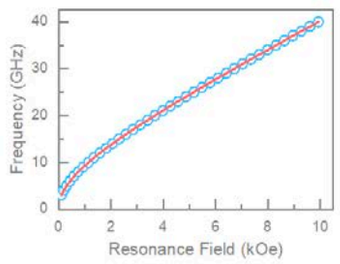
9.2 FMR Measurement - Applications

Application (1)–

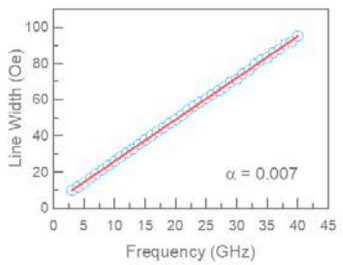
FMR results of ferromagnetic film







$$f = (\gamma/2\pi)[\mu_0 H_0(\mu_0 H_0 + 4\pi M_{eff})]^{1/2}$$

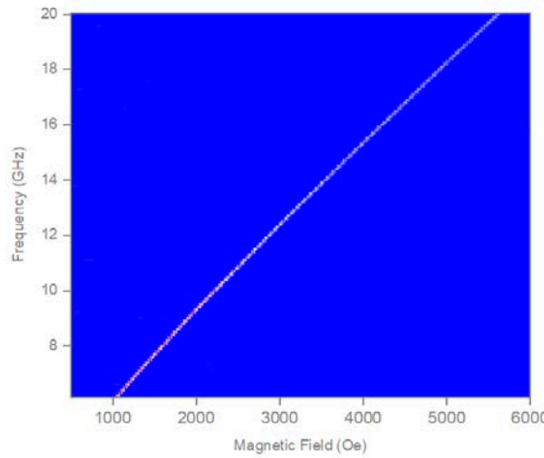


$$\Delta H = \left(\frac{2\pi}{\gamma}\right)\alpha f + \Delta H_0$$

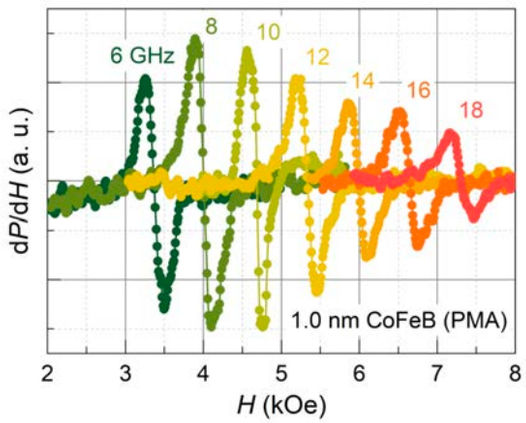
Sample Information	Si/SiO_2/CoFeB (7 nm) /Ta (5 nm)
MultiFields Products	1. FMR.Meter.40 2. FMR.Probe.26P.IP.40G
Platform	QD-PPMS

- In-plane CoFeB Thin-film

Significant FMR spectra induced by a thin-film sample with structure of CoFeB (7nm) /Ta (5nm) are obtained, it shows a good SNR even the frequency up to 40 GHz. The measurement data can be well fitted to a Lorentzian function consisting of a symmetric and an anti-symmetric Lorentzian component. The figures show the resonance frequency as a function of the resonant field, they are perfectly fitted by the Kittel equation.



Sample Information	$SrTiO_3$// (La, Sr) MnO_3
MultiFields Products	1. FMR.Meter.40 2. FMR.Probe.26P.IP.40G
Platform	QD-PPMS



Sample Information	Si/SiO_2//Ta (5) /CoFeB (1) / MgO (2) /Ta (2 nm)
MultiFields Products	1. FMR.Meter.40 2. FMR.Probe.26P.IP.40G
Platform	QD-PPMS

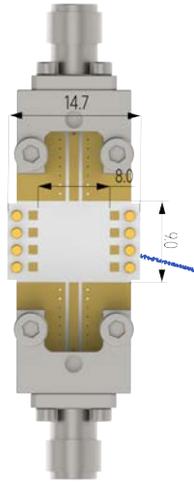
- Perpendicular CoFeB thin-film

Benefiting from the ultra-high signal-to-noise ratio, 1nm CoFeB thin film with perpendicular anisotropy is well detected by MultiFields® FMR Probe.

9.3 ST-FMR Measurement - Probe

High-frequency measurements on micro-size devices, with sample perpendicular/parallel to magnetic field configurations

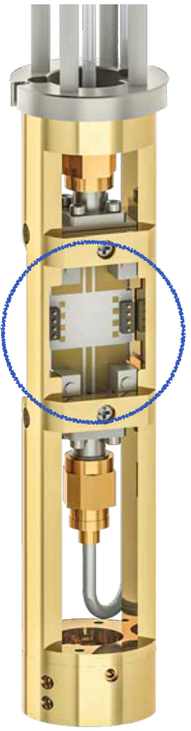
For the micro-fabricated magnetic device, spin rectification which originates from magnetoresistance effect is a powerful method to characterize its FMR properties. Especially in the field of spintronics, this method is commonly called spin-torque ferromagnetic resonance (ST-FMR). In addition to characterizing the fundamental magnetic properties, it is very useful to characterize the spin-related properties such as spin-orbit torque efficiency, spin transport etc…

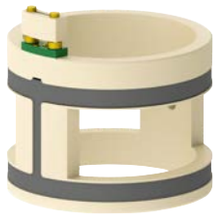


Open-CPW (IP)

The sample holder contains 2 open GSG electrodes and 6 DC electrodes, all of which can be directly wire bonded by ultrasonic welding.

*CPW and connectors are made of non-magnetic materials.

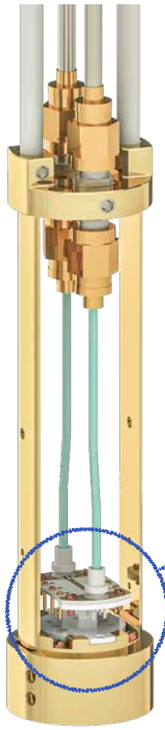




Option：Helmholtz Coils

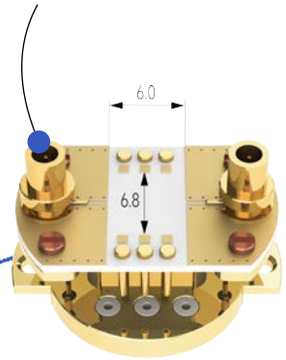
ST-FMR measurement generally utilizes the microwave amplitude modulation method and the Helmholtz coil is not installed as standard. However it can be installed as an option to meet unique requirements.

ST-FMR.Probe.30.IP.40G



SSMP Connector

Micro-connector for 40-GHz signal transmission, allows for easy plugging and unplugging. The sample holder can be removed for sample mounting.



Open-CPW (OP)

The sample holder contains 2 open GSG electrodes and 6 DC electrodes, all of which can be directly wire bonded by ultrasonic welding.

*CPW and connectors are made of non-magnetic materials.

ST-FMR.Probe.30.OP.40G

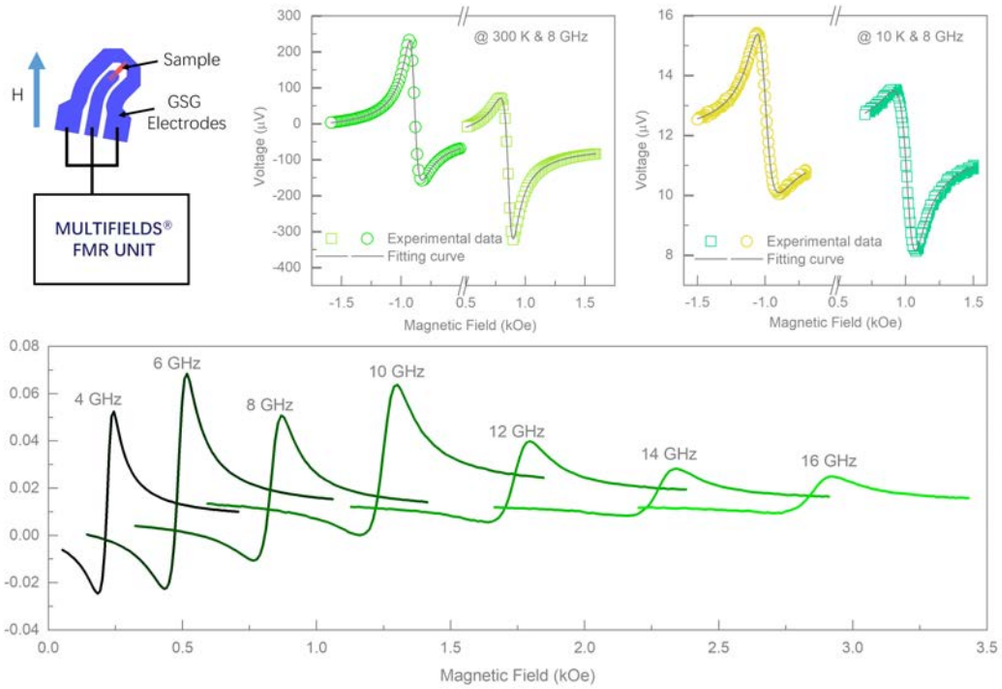
Key Features

- Max frequency: 20 GHz & 40 GHz;
- Connect the samples by wire bonding directly on the sample holder (CPW);
- Two configuration satisfy most measurement requirements；
- Probe working temperature: 1.5 ~ 400 K；Max magnetic field: 18 Tesla；
- Rotating FMR measurement can be conducted using Multifields ColdTUBE;
- Compatible with QD-PPMS Dynacool，Oxford-TeslatronPT，Cryogenic and Pride-CPMS platforms.

9.3 ST-FMR Measurement - Applications

Application (1)–

ST-FMR measurement of FM / HM device



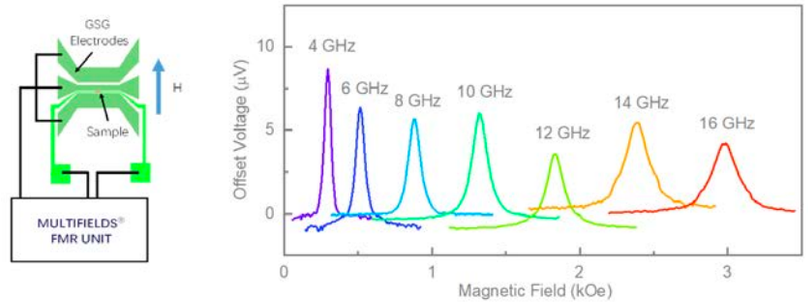
Sample Information	Si/SiO_2/CoFeB (7 nm) /Ta (5 nm)
MultiFields Products	1. FMR.Meter.40 2. ST-FMR.Probe.26P.IP.40G
Electric Meters	QD-PPMS

- ST-FMR of NiFe/Pt

One patterned device with structure of NiFe (5 nm) /Pt (5 nm) are connected with the ST-FMR Probe by wire-bonding (Au wires recommended for higher frequency) . A microwave-frequency (GHz) charge current with a power of 10 dBm and amplitude-modulated (773 Hz) by the lock-in amplifier was applied to the Probe. The rectified voltage was detected by a lock-in amplifier.

Application (2)–

Spin pumping & ISHE measurement of FM / HM device



Sample Information	Si/SiO_2// NiFe (7 nm) /Ta (5 nm)
MultiFields Products	1. FMR.Meter.40 2. ST-FMR.Probe.26P.IP.40G
Electric Meters	QD-PPMS

- Spin-pumping of NiFe/Ta

The patterned device with structure of NiFe (7 nm) /Ta (5nm) are connected with the MultiFields® ST-FMR Probe by wire-bonding (Au wires recommended for higher injection efficiency). An in-plane magnetic field with a fixed direction that cross the sample stripe was swept. The inverse spin Hall voltage can be well fitted to a Lorentzian function.

Spin pumping is a common way to generate a spin current, which can be detected by inverse spin Hall effect (ISHE) . Combination of these two effects can measure many important spin-related properties of the materials, such as interfacial spin transport, spin Hall efficiency etc.. Meanwhile, because the spin pumping effect is accompanied with ferromagnetic resonance, the fundamental magnetic properties are also reflected.

Confocal Optical Measurement - Overview

All-in-one solution for cryogenic confocal measurement, including confocal scanning microscopy, Raman / fluorescence spectroscopy and magneto-optical Kerr effect measurements

CFM.Probe.26P

Stackable Function Module (SFM)

CFM.SFM.Raman

- Confocal scan
- Raman spectroscopy
- Fluorescence Collection
- MOKE Measurement

Electric feedthrough

- Sample positioning control
- Transport/gate applications
- Temperature monitor and control
- Microwave/radio frequency cables

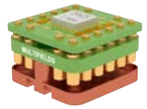
Low-temperature objective

CFM.LTAC.X60

- Achromatic: 450~800 nm
- AR coating: 400~1100 nm
- NA 0.85
- WD 0.4 mm
- Focal length 3.1 mm

Sample mount

- Up to 12 -pin connections
  Prewired to the system electronics
- Integrated Cernox sensor



Nanoscale motion set

- Linear positioners, 16mm
  25mm series
- Linear scanner, 16mm
  25mm series

Sample tube

- Integrated sample positioning
- Easy sample-replacement
- Compatible with PPMS cryostat

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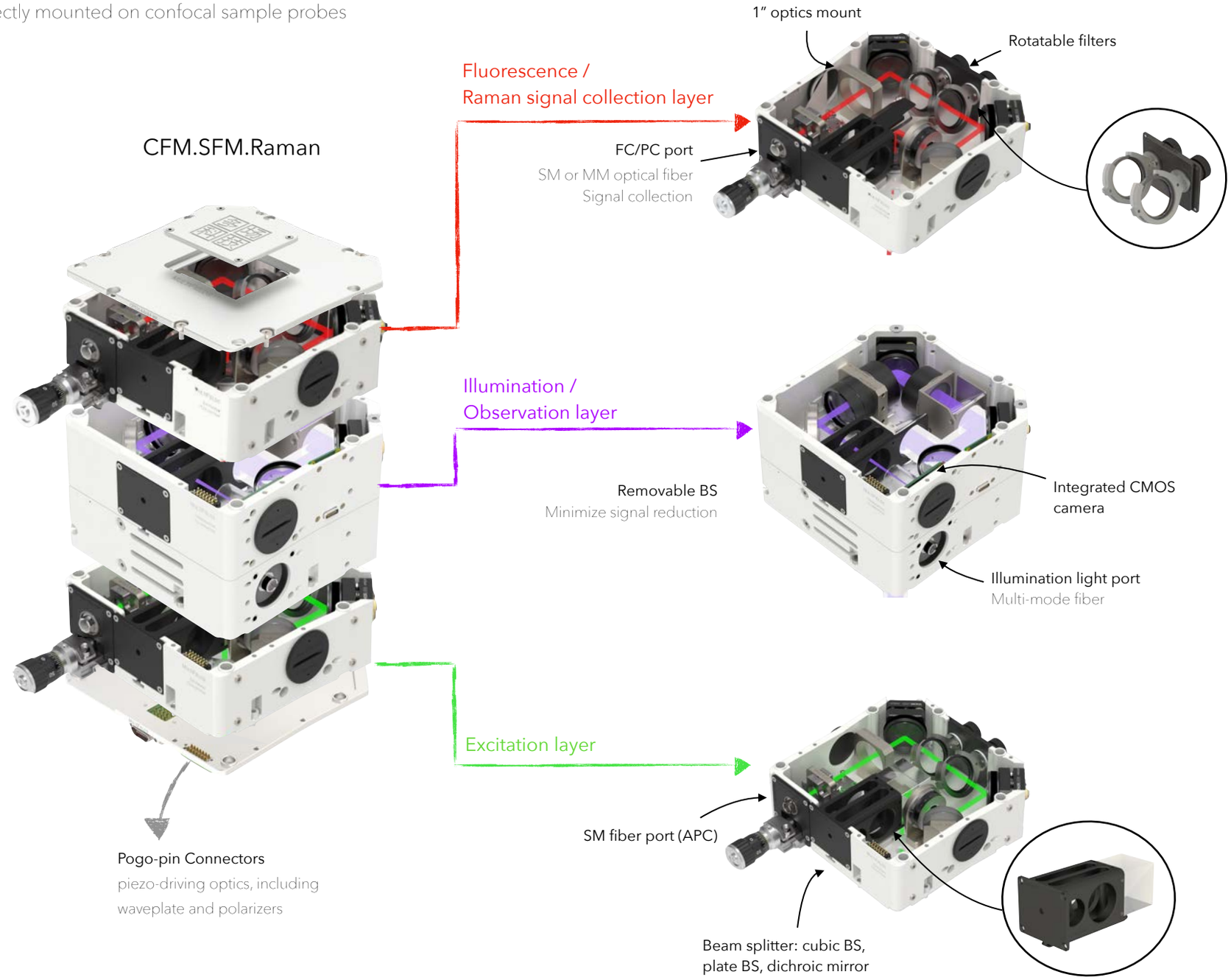
10.1 SFM - Raman / Fluorescence Spectroscopy

Integrated Raman/fluorescence measurement module, which can be directly mounted on confocal sample probes



Key Features:

- Confocal scanning probe based on optical fiber
  Available core dimensions: 4, 10, 25, 50, 100, 200 μm
- Exchangable optics for various wavelength applications
- Kohler illumination enabled large-area/homogeneous illumination
  Φ_{FOV}~30 μm
- Integrated CMOS camera with type-C connection
- Manually rotating mount for 1″ or 0.5″ optics

Abbreviations

*APC - Angled Physical Contact
*PC - Physical Contact
*FC - Ferrule Connector
*SM - Single-mode
*MM - Multi-mode
*BS - Beam Splitter
*FOV - Field Of View

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10.1 Raman Spectroscopy - Application

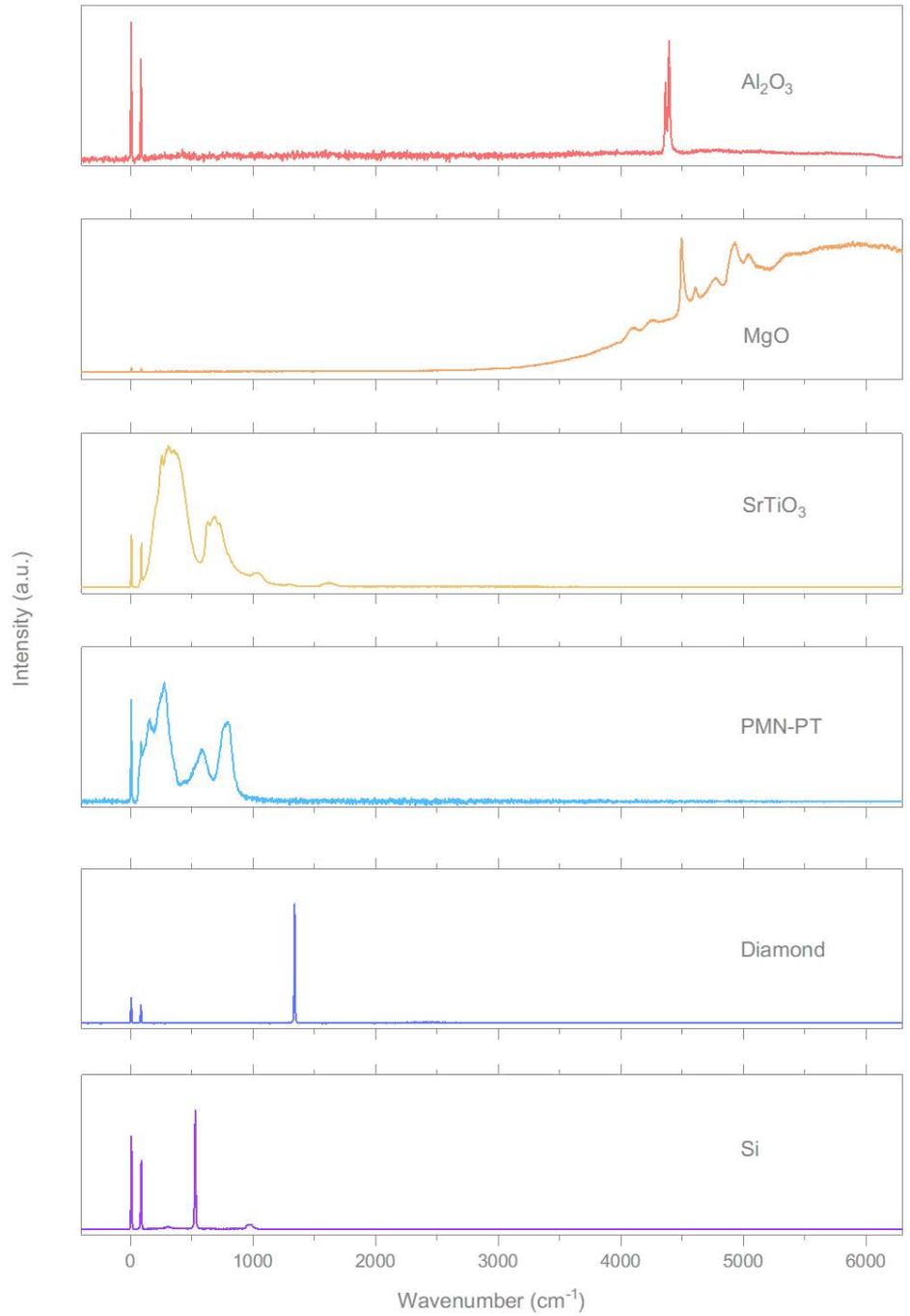
Fluorescence / Raman Module - Specifications

Basic Function	
Filter size	Φ < 25.4 mm, thickness < 6mm
Focused spot size	Φ < 1 um with LTAC objective @ 633 nm
Excitation wavelength	450 nm ~ 700 nm
Fluorescence collection	single-mode or multi-mode fiber
Spectral resolution	0.02 nm
Transmission edges tuning	Rotatable filter mount allows easy tuning of transmission edges

Application (1)–

Raman spectra of several typical samples

Sample Information	Al_2O_3, MgO, $SrTiO_3$, PMN-PT, Diamond, Si
MultiFields Products	CFM system, CFM.Probe with Raman spectroscopy module
Instruments	532 nm CW excitation; LP03-532RE long-pass filter; PI HRS spectrometer 300 line/mm, Integration time 5s



Materials Characterization

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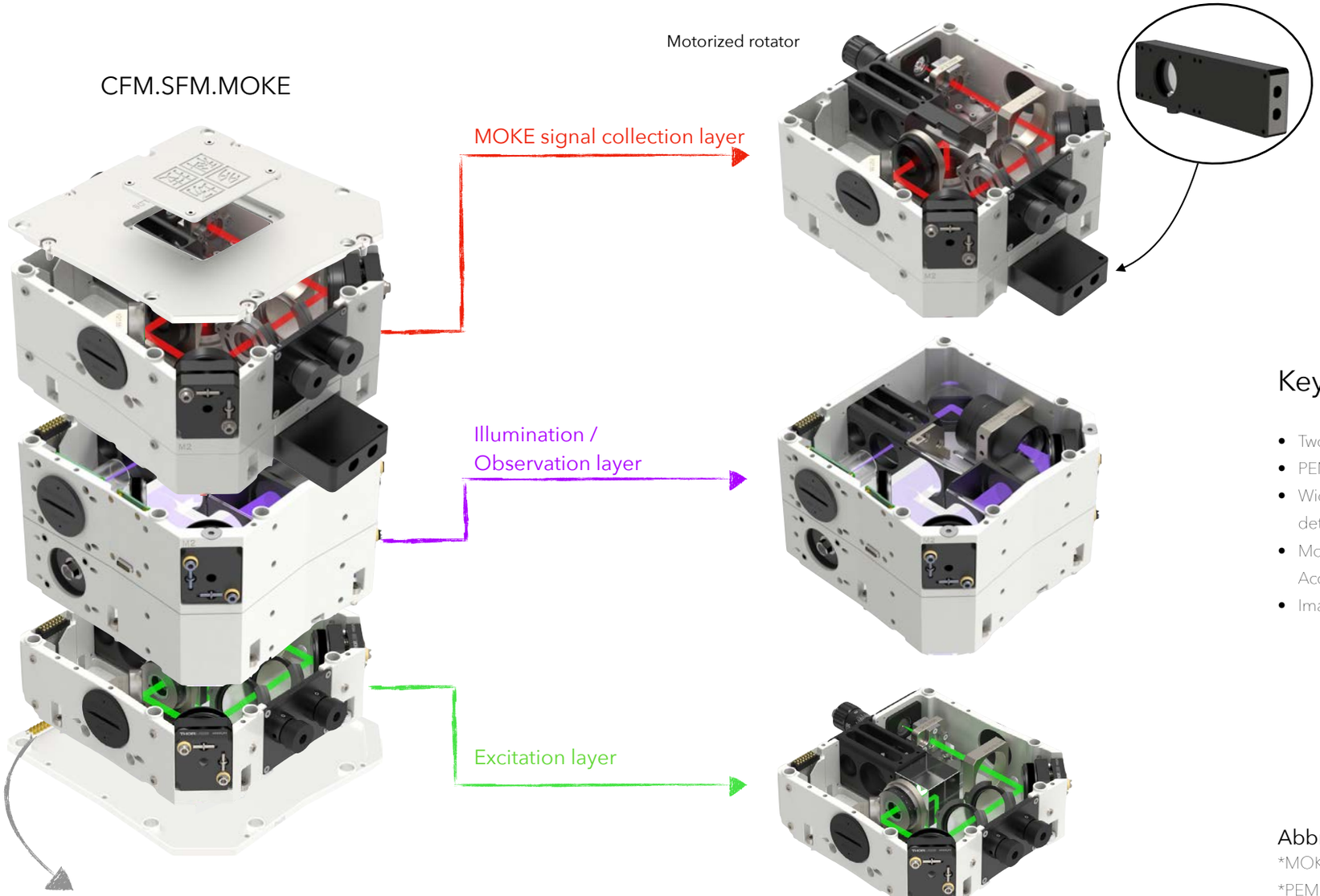
10.2 SFM - MOKE Measurement

Integrated MOKE measurement module, which can be directly mounted on confocal sample probes



Photoelastic Modulator (PEM)

- Two characterization measurement modes in one setup:
- PEM-based single point mode

Key Features:

- Two characterization measurement modes in one setup:
- PEM-based single point mode
- Wide-field imaging mode hysterisis with modulation enhanced detection sensitivity
- Motorized rotators with precise angular positioning
  Accurate alignment of polarizers to the fast axis of PEM
- Imaging mode at 532 nm

Abbreviations

*MOKE - Magrceto-optical Kerr Effect

*PEM - Photoelastic Modulator

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10.2 MOKE - Application

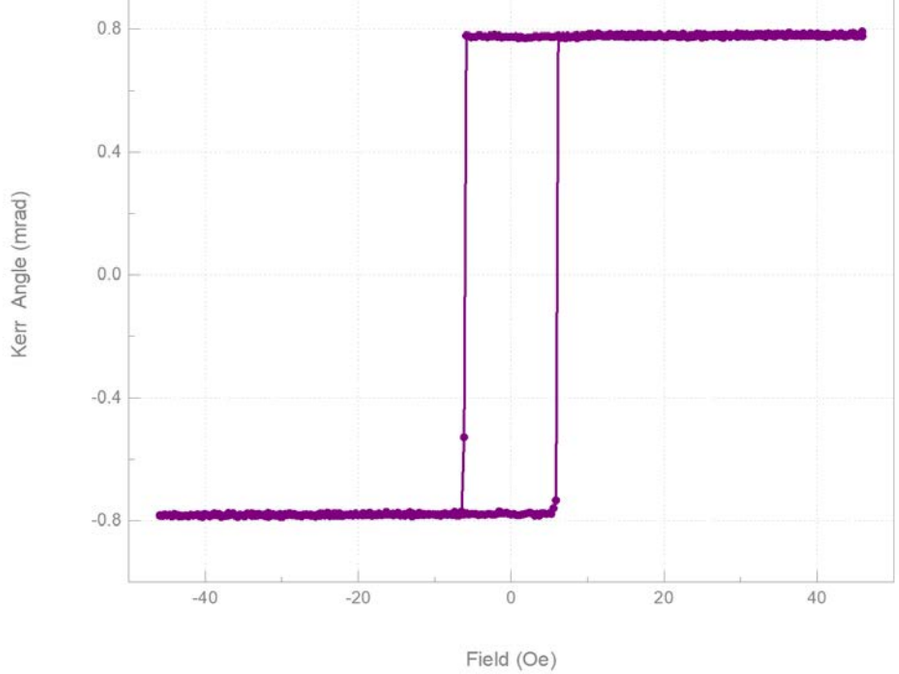
MOKE Module - Specification

Basic Function	
Temperature range	4 K ~ 300 K
Detection noise	<1 mdeg (Kerr angle)
Reflectivity noise	< 0.05% rms
Focused spot size	Φ < 1 um with LTAC objective
Wavelength range	450 nm to 700 nm
Lens option	1. Single aspheric lens 2. High-NA low-temperature objective

Application (1)–

MOKE Hysteresis loop of ferromagnetic thin film

Sample Information	Si/SiO2//Ta(3)/CoFeB(1.1)/MgO(2)/Ta(2 nm)
MultiFields Products	CFM system, CFM.Probe with MOKE module
Experiment conditions	Polar configuration, 633nm CW excitation,



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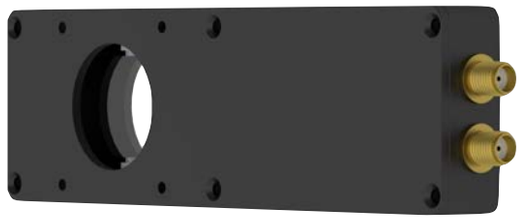
Materials Characterization

10.2 MOKE - Photoelastic Modulator (PEM)

Compact photoelastic modulator that can be mounted on a confocal module or used as a stand-alone device

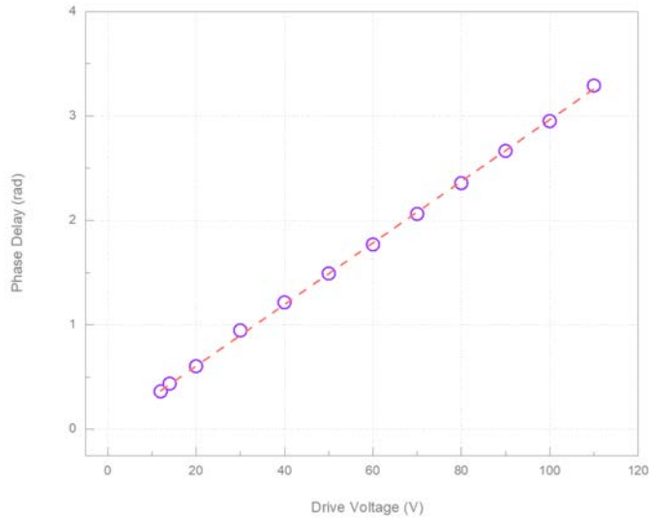


Photoelastic Modulator - Specification

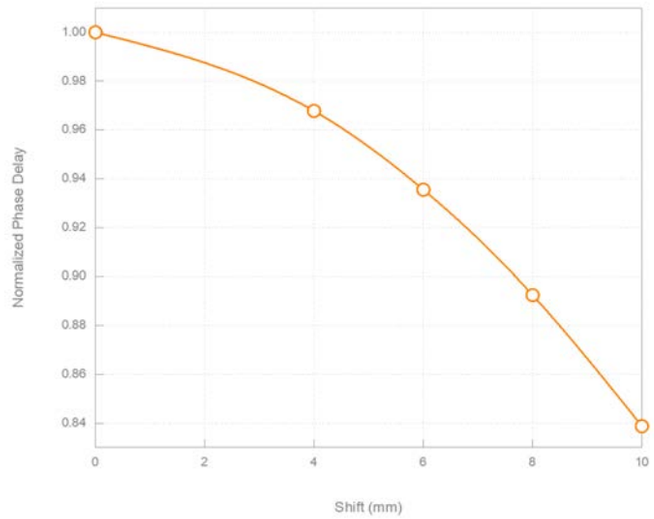
基本参数	
Optical Material	Fused Silica
Nominal frequency	50 kHz
Transmission Range	200 nm ~ 2.6 um
Half-Wave Retardation	200 nm ~ 1 um
Clear Aperture (1)	Φ 16mm
Operating frequency	0.1 Hz ~ 200 kHz
Frequency lock resolution	0.03 Hz
Frequency display	1 Hz
Duty cycle, f and 2f	50% 0.001%
Operating temperature	0C ~ 50C
Power consumption	20 W
Weight	100 g
Size	30 mm * 100 mm *10 mm

Application (1)–

Photoelastic Modulator Performance



- Wide-field imaging mode hysteresis with modulationPhase delay is the amplitude of phase oscillations induced by the PEM. Experimentally, the PEM is placed between two crossed polarizers and is oriented 45 degrees with respect to the first polarizer. The 633 nm transmitted laser light is detected by a photo diode and read out by a DAQ. Our PEM exhibits an excellent linear response to the driving voltage up to 200 Vpp.



- Due to the standing-wave nature of the PEM, the phase delay along the wave propagation direction cannot be a constant.Our PEM shows a useful optical aperture of 15 mm within which the delay variation is less than 10%.

Materials Characterization

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10.3 Confocal Optical Probe

Suitable for cryogenic confocal measurement and compatible with the most superconducting magnet platforms

- The frame of the probe is an optical cage structure that ensures the alignment of the free laser path
- Multifields Technologies 25-mm positioning and scanning stages, suitable for dia. 50 mm cryogenic chambers

CFM.Probe.50Ox

- Multifields Technologies 16-mm positioning and scanning stages, suitable for dia. 26 mm cryogenic chambers

CFM.Probe.26P

	Model	CFM.Probe.50Ox	CFM.Probe.26P
2	Function	Compatible with all stackable function modules and suitable for confocal scanning microscopy, confocal fluorescence/Raman spectroscopy, magneto-optical Kerr effect measurements	
3	Work environment	Temperature: 1.4 K ~ 400 K； Pressure： 10^{5} ～ 10^{-5} Pa； Magnetic Field： 0 ～ 18 Tesla;	
4	Flange/Diameter	KF50 / dia-50 mm	KF40 / dia-26 mm & dia-30 mm
5	Position range	x: 3mm; y: 3mm; z: 3mm	x: 2mm; y: 2mm; z: 2mm
6	Position resolution	x: 1um; y: 1um; z: 1um	x: 1um; y: 1um; z: 1um
7	Scan range	x: 3mm; y: 3mm; z: 3mm	x: 2mm; y: 2mm; z: 2mm
8	Scan resolution	x: 1um; y: 1um; z: 1um	x: 1um; y: 1um; z: 1um
9	Bore diameter	25.4 mm(1'')	12.7 mm(0.5'')
10	Objective lens	Phi < 25.4 mm	Phi < 20 mm,M9 x 0.5 Threaded
11	Sample space	X,Y < 9 mm,Z <9 mm	X,Y < 10 mm,Z <10 mm
12	Electric channel	12	16

- Cage frame with SM1 optical apertures for mounting various optical elements

CFM.Spacer.50

CFM.Spacer.26

Materials Characterization

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10.4 Low-Temperature Objective - LTAC Series

Optical objective for long-time stable working at low temperature

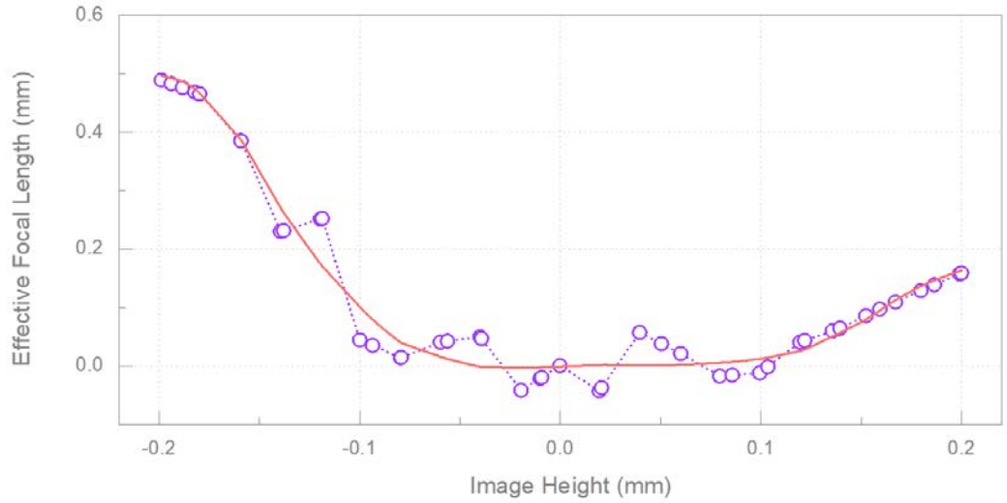
Infinite Conjugate Low-Temperature Objective (LTAC Series)

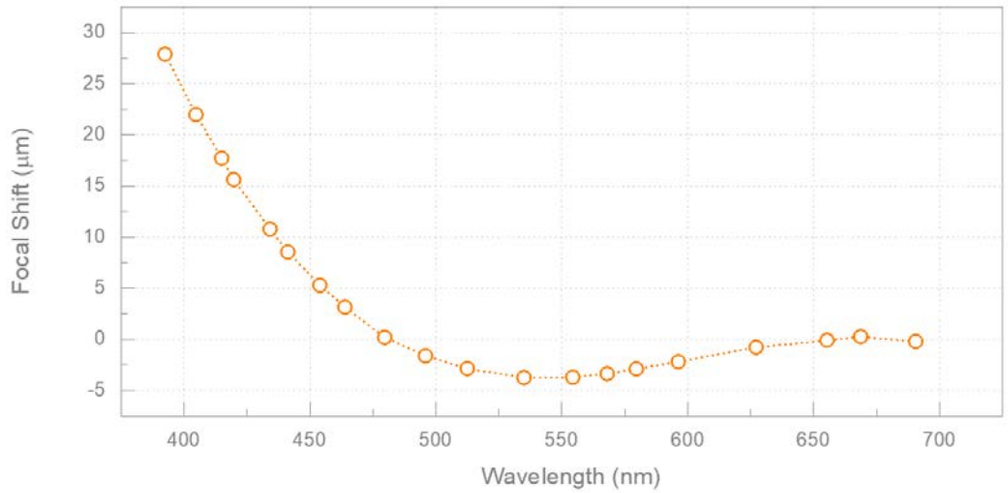
Specifications

Basic Parameters	
Temperature range	down to 4 K
Pressure range	10-6 mbar ~ 1 bar
Magnetic field range	0 T ~ 14 T
Numerical aperture (NA)	0.85
Focal length (f)	3.1 mm
Working distance (WD)	0.4 mm
Magnification	X60 for 180mm tube lens
Back aperture	Ø 6.15 mm
Anti-reflective coating	400 ~ 1100 nm
Achromatic correction	450 ~ 800 nm
Case Material	Titanium

Application (1)–

Performance of Infinite Conjugate Low-Temperature Objective





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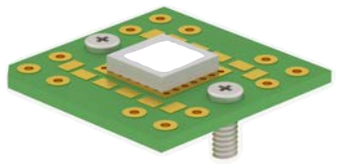
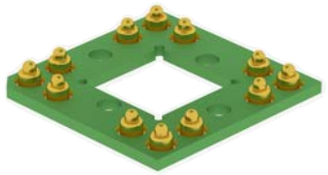
10.5 Sample Mount

Flexible and convenient sample mounting for combined optical-electric measurements



- Sample Holder

A platform on which the sample is mounted and which can be removed for wire-bonding the sample.

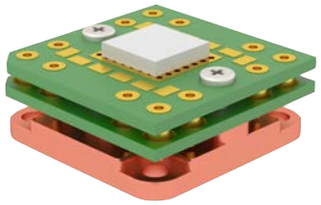


- Sample Base

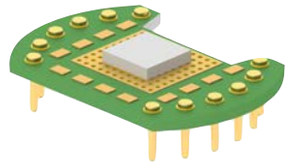
12 pogo-pins are installed to ensure good electrical contact while maximizing sample space.

- Oxygen-free Copper Base

Ensures excellent thermal conductivity and incorporates a Cernox thermometer.

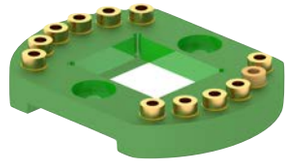


- Compact sample holder design for most combined optical-electric measurements.



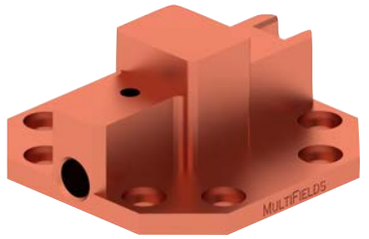
- Sample Holder

A platform on which the sample is mounted and which can be removed for wire-bonding the sample.



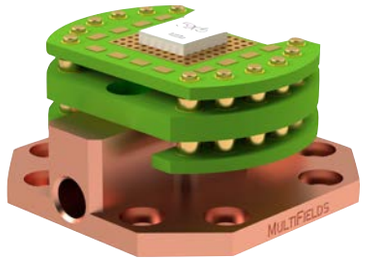
- Sample Base

12 circlip pins are installed to ensure good electrical contact while maximizing sample space.



- Oxygen-free Copper Base

Ensures thermal conductivity and incorporates a Cernox thermometer and heater for independent temperature control.



- Compact sample holder design for most combined optical-electric measurements.

10.6 Nano Motion Units - 16-mm Series

Ultra-precise nano-motion units using in minimum dia.26mm chamber

Nano Motion Set

- Linear Positioners：16-mm Series
- Linear Scanners：16-mm Series

CFM·ϕ25 - Piezoelectric Motion Units

	Motion Unit	Work Environment	Dimension	Travel Range	Max Load	Dynamic Drive Force	Pins Number	Weight
➡	Scanner16-xy	1 K & 18 Tesla & 2m-7 mbar	16 * 16 * 9 mm	30 * 30 um	100 g		4 pins	8 g
➡	Scanner16-z		16 * 16 * 6 mm	30 um	100 g		2 pins	7 g
➡	Linear16-y		16 * 16 * 10.5 mm	3 mm	50 g	1.5 N	Drive - 2 pins Sensor - 3 pins	10 g
➡	Linear16-x		16 * 16 * 10.5 mm	3 mm	50 g	1.5 N	Drive - 2 pins Sensor - 3 pins	10 g
➡	Linear16-z		16 * 16 * 16 mm	3 mm	250 g	3 N	Drive - 4 pins Sensor - 3 pins	12 g

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10.6 Nano Motion Units - 25-mm Series

Ultra-precise nano-motion units suitable for dia.50mm chamber

Nano Motion Set

- Linear Positioners：25-mm Series
- Linear Scanners：25-mm Series

CFM·Φ50 - Piezoelectric Motion Units

	Motion Unit	Work Environment	Dimension	Travel Range	Max Load	Dynamic Drive Force	Pins Number	Weight
➡	Scanner25-z	1 K & 18 Tesla & 2m-7 mbar	25 * 25 * 12 mm	55 um	100 g		2 pins	20 g
➡	Scanner25-xy		25 * 25 * 13.5 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-y		25 * 25 * 9.5 mm	6 mm	400 g	2 N	Drive- 2 pins Sensor - 3 pins	24 g
➡	Linear25-x		25 * 25 * 9.5 mm	6 mm	400 g	2 N	Drive - 2 pins Sensor- 3 pins	24 g

Materials Characterization

www.multi-field.com | MultiFields Technologies

10.6 Nano Motion Units - Controller

Precision motion solutions including instrumentation and software

Scanner Controller
MC - ArchimedesLT.03

*All data below is measured with 50 ohm wires. Though there is no requirement on wires' conductance, we recommend resistance below 50 ohm.

	Optional Versions ⇨	ArchimedesLT.03
1	Output channels	3 channels
2	Max output voltage	-150 V ~ +150 V
3	Drive frequency range	Max. 1kHz
4	Encoder	Capacity encoder
5	Sensor output voltage	DC 2.5 V
6	Resolution of read voltage	50 uF (18-bit)
7	Connectors	3 channels, BNC
8	Input resistance	10 kOhm
9	Compatible Scanners	Scanner16-xy, Scanner16-z, Scanner25-xy, Scanner25-z,

Positioner Controller
MC - NewtonLT.06

*All data below is measured with 50 ohm wires. Though there is no requirement on wires' conductance, we recommend resistance below 50 ohm.

	Optional Versions ⇨	MC - NewtonLT.06
1	Output channels	6 channels
2	Max output voltage	-200 V ~ +200 V
3	Drive frequency range	1 ~ 10 kHz
4	Encoder	Resistive encoder
5	Sensor output voltage	DC 2.5 V
6	Resolution of read voltage	50 uF (18-bit)
7	Connectors	6 channels
8	Input resistance	10 kOhm
9	Compatible Positioners	Positioner 16-xy, Positioner 16-z, Positioner 25-xy, Positioner 25-z,

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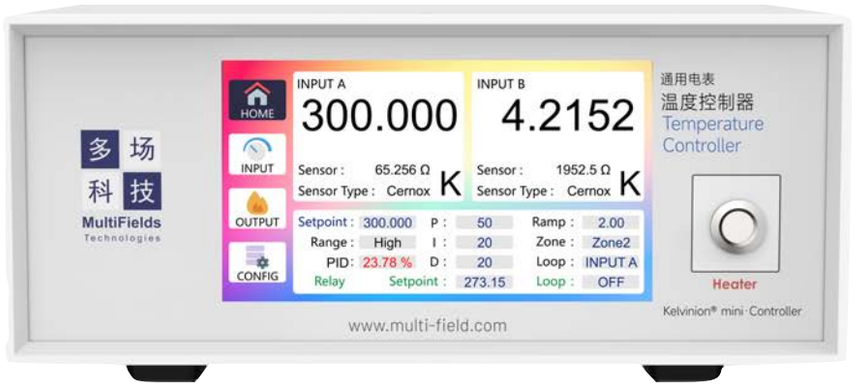
“Kelvinion Series” Temperature Monitor & Control Products

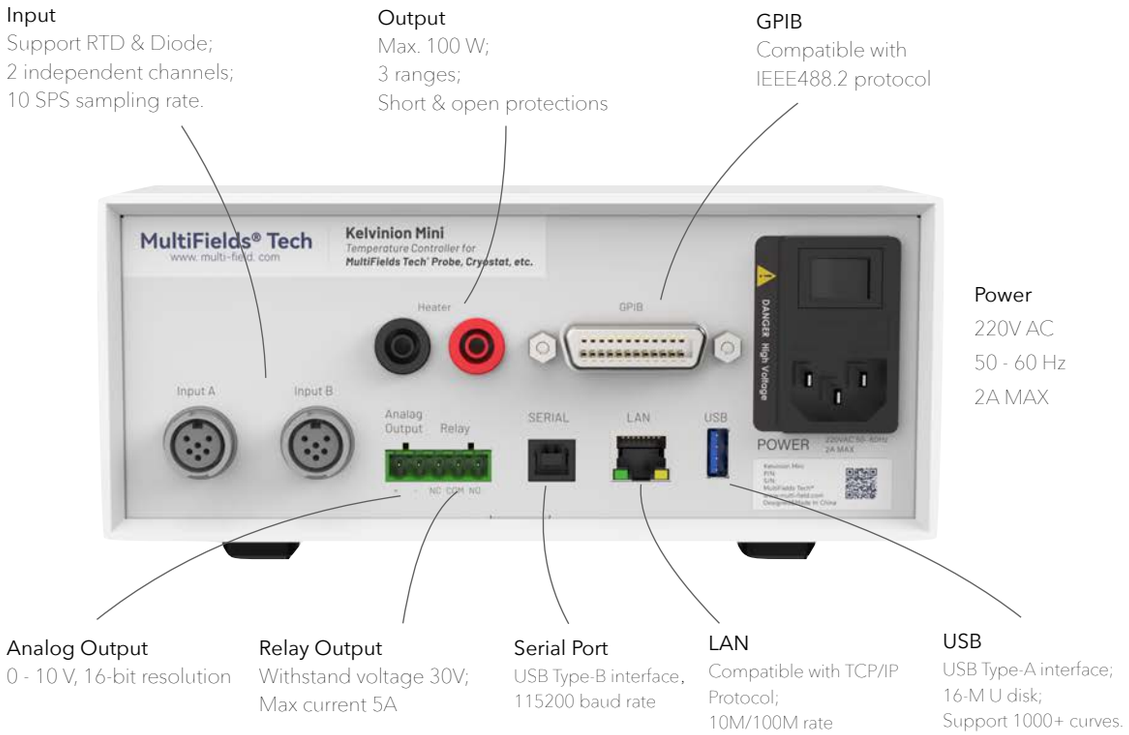
	Kelvinion Controller	Kelvinion mini Controller	Kelvinion Monitor	Kelvinion Monitor. X
Product Number	MKC-08	MKC-02	MKM-12	MKM-2-X
Number of Input	8 8 independent input channels, instead of 3 independent + 5 switching chnnels	2 2 independent input channels	12 2 independent input channels	2N Input can be freely configured to desired number of channels and max. 32 independent monitoring channels.
Control Channel	2	1	/	/
Temperature Monitoring				
Supported sensor	Resistive, diode temperature sensor			
User Curves	> 1000			
Lower Limit	300 mK			
Measurement Type	Variable DC current source; Current is automatically tuned upon ranges			
Min Current	100 nA			
Precision with 100-nA Current	1.5 Ω + 50 ppm of rdg			
TC Output				
Max Power	100 W + 50 W	100 W	/	/
Heating Range	3	3	/	/
Communication Interface				
LAN	Yes			
Serial Port (USB)	Yes			
GPIB	Yes		N. A.	
RS-485	N. A.		Yes	

11.1 Temperature Controller · Kelvinion mini

Maximum 100 W power output and minimum 300 mK controlled temperature



Temperature Controller · Kelvinion mini



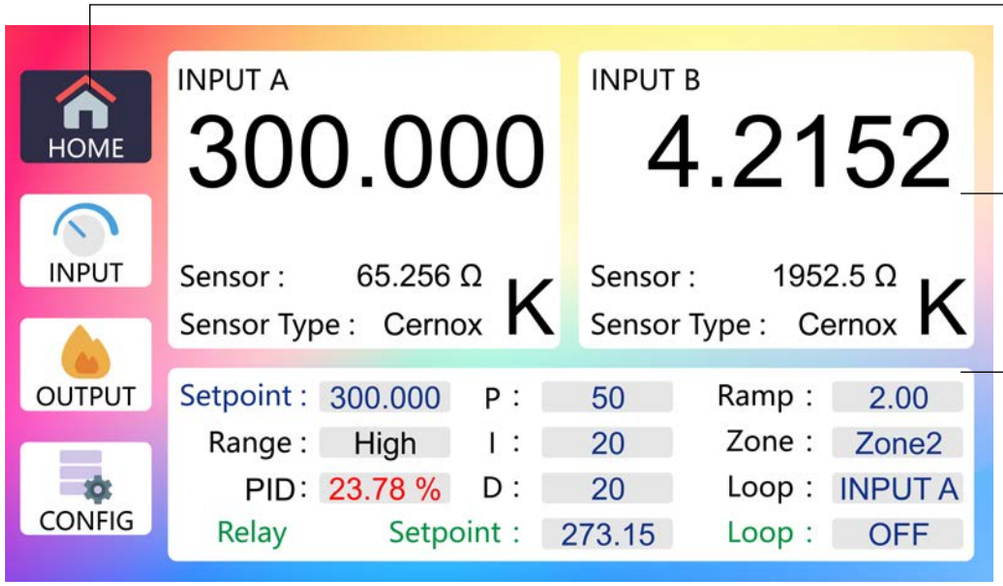
Key Features

- Temperature range of measurement and control down to 300 mK;
- 2 independent monitoring channels with 0.1 mK resolution (24-bit ADC) ;
- Automatic tuning of the excitation current for higher accuracy and lower heating;
- Supports 1000+ user-defined curves;
- 1 PID output channel with 100 W power output;
- Supports 1 relay and 1 analog signal outputs;
- Supports 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, setpoint limits are supported.

Diode and resistive sensors (PTC or NTC) have become the preferred solution for temperature monitoring at low temperature and in environments with strong magnetic fields. MultiFields Technologies designed the "Kelvinion mini", a compactly designed cryogenic temperature controller. It consists of 2 independent high-precision temperature monitoring channels and one high-power PID output channel (100 W), as well as one relay output and one analog output channel. The PID closed-loop control, Zone mode, variable temperature rate setting and active over-temperature detection, make the Kelvinion mini cryogenic temperature controller a great tool for low-temperature researches.

11.1 Kelvinion mini - Touch-screen Interface

Touch-operated temperature controller interface, quick and easy to use



Navigation Bar

Quickly switch between different interfaces

Temperature Display

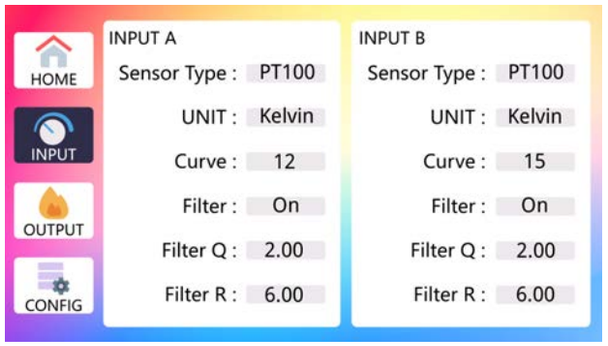
Display the information of the temperature monitoring channel for a quick view of input temperature, sensor value and sensor type

Parameters Setting

Set the target temperature, PID parameters, temperature ramp rate, output power, relay output and other key parameters here.

HOME Interface

This interface displays the current temperature, setpoint of temperature, PID parameters, temperature ramp rate, and output power, etc..



INPUT Interface

This interface allows the user to set the sensor type, display unit, calibration curve and filter parameters for the input channel.

OUTPUT Interface

This interface allows the user to set parameters such as PID output, relay output, safe temperature, ZONE mode, etc..

CONFIG Interface

This interface allows the user to set communication modes, GPIB and IP address.

11.1 Kelvinion mini - Specifications

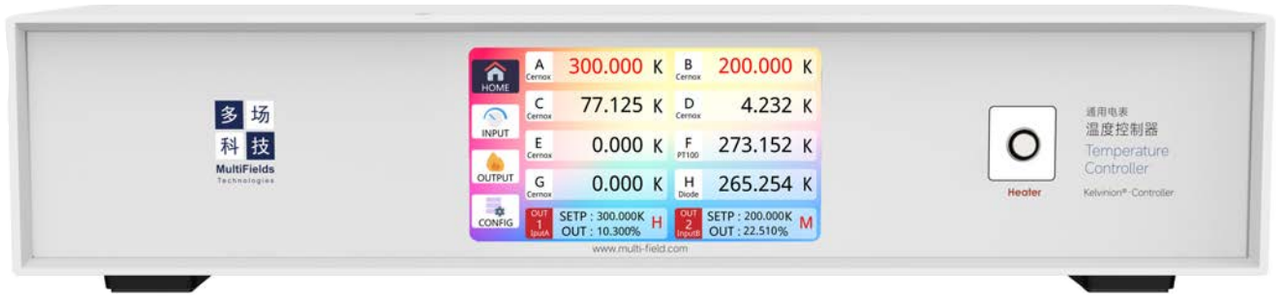
Input									
Number of Input	2								
Isolation	Sensors inputs optically isolated from other circuits								
ADC Resolution	24 bit								
Max update rate	10 reads/s on each input								
User Curves	1000+ curves (400 points Max in single curve)								
Filter	Kalman Filter								
Input Specifications									
Sensor Type	Diode / RTD								
Measurement Type	4 leads								
Excitation	Constant current with current reversal for RTDs								
Supported Sensors	Diodes: Si, GaAlAs; RTDs: 100 Ω & 1000 Ω Pt, Ge, Carbon-Glass, Cernox®, and Rox™								
NTC-Input Range	0 ~10 Ω	0 ~30 Ω	0 ~100 Ω	0 ~300 Ω	0 ~1 kΩ	0 ~3 kΩ	0 ~10 kΩ	0 ~30 kΩ	0 ~100 kΩ
NTC-Excitation Current	1 mA	0.3 mA	0.1 mA	30 µA	10 µA	3 µA	1 µA	0.3 µA	0.1 µA
NTC-Measurement Resolution	0.15 mΩ	0.45 mΩ	1.5 mΩ	4.5 mΩ	15 mΩ +0.02‰ of rdg	45 mΩ +0.02‰ of rdg	150 mΩ +0.02‰ of rdg	450 mΩ +0.02‰ of rdg	1.5 Ω +0.05‰ of rdg
NTC-Accuracy	8 mΩ	20 mΩ	50 mΩ	120 mΩ	0.5 Ω +0.02‰ of rdg	1.2 Ω +0.02‰ of rdg	5 Ω +0.02‰ of rdg	15 Ω +0.02‰ of rdg	15 Ω +0.05‰ of rdg
Control									
Control Loops	1								
PID Tuning	Autotune (one loop at a time)								
PID Parameters	P (Gain): 0 to 1000 with 0.01 setting resolution I (Reset): 0 to 1000 with 0.01 setting resolution D(Rate): 0 to 200 % with 0.01% setting resolution Manual output: 0 to 100% with 0.01 setting resolution								
Zone Mode	5 temperature zones with PID and heater range								
Setpoint Ramping	0.1 K/min ~ 20 K/min								

Output Loop	25-Ω Heater	50-Ω Heater
Output Type	Variable DC current source	
DAC Resolution	16 bit	
Max. Power	100 W	50 W
Max. Current	2 A	1 A
Voltage Compliance	50 V	
Heater Load Range	10 to 100 Ω	
Output Range	3	
General		
Relay Output	1	
Analog Output	1，0~10V，16 bit	
Communication	Serial port (USB)：USB-TypeB interface，baud rate: 115200 GPIB：IEEE488.2，support setting address LAN：TCP/IP，10M/100M rate，support setting address and pot	
Display	5.0 inch TFT touch-screen with 1280 x 720 pixels	
Safety Limit	Short & open circuit protection Setpoint & temperature limit protection	
Size	215(W) * 88.9(H) * 358(L) （unit: mm）	

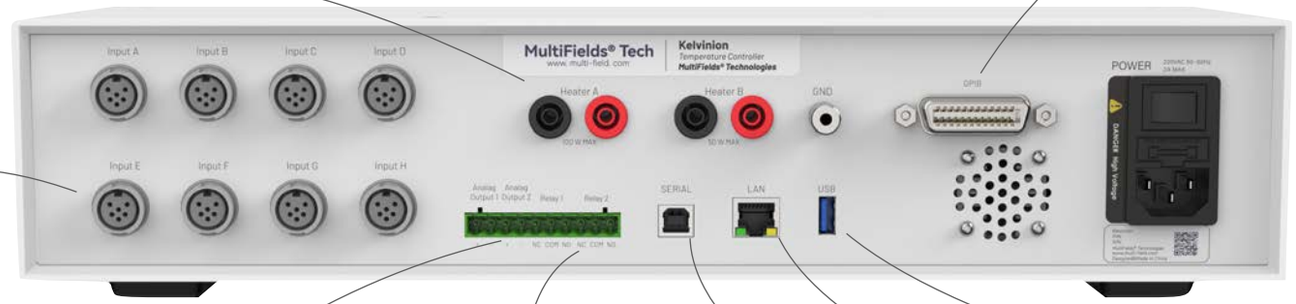
Kelvinion mini – Controller

11.2 Temperature Controller · Kelvinion

8 independent temperature monitoring channels & 2 temperature control channels, max. power 100 + 50 W



Temperature Controller · Kelvinion



Output
2 channels;
Max. 100 W;
3 ranges;
Short & open protections

Input
Support RTD & Diode;
8 independent channels;
10 SPS sampling rate.

GPIB
Compatible with IEEE488.2 protocol

Power
220V AC
50 - 60 Hz
3A MAX

Analog Output
2 independent channels;
0 - 10 V, 16-bit resolution

Relay Output
2 independent channels;
Withstand voltage 30V;
Max current 5A

Serial Port
USB Type-B interface,
115200 baud rate

LAN
Compatible with TCP/IP Protocol;
10M/100M rate

USB
USB Type-A interface;
16-M U disk;
Support 1000+ curves.

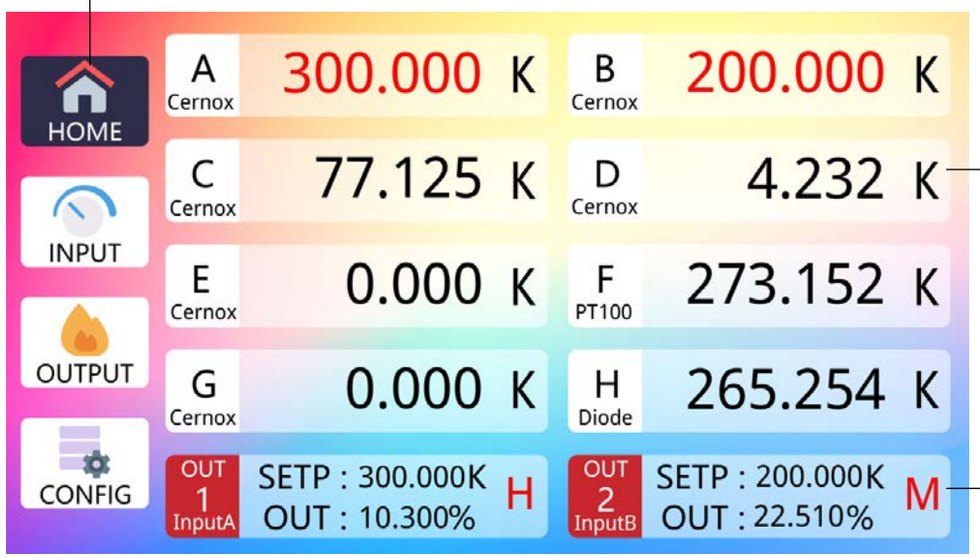
Key Features

- Temperature range of measurement and control down to 300 mK;
- 8independent monitoring channels with 0.1 mK resolution (24-bit ADC) ;
- Automatic tuning of the excitation current for higher accuracy and lower heating;
- Supports 1000+ user-defined curves;
- 2 PID output channel with 100 W power output;
- Supports 2 relay and 2 analog signal outputs;
- Supports 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, setpoint limits are supported.

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

11.2 Kelvinion - Touch-screen Interface

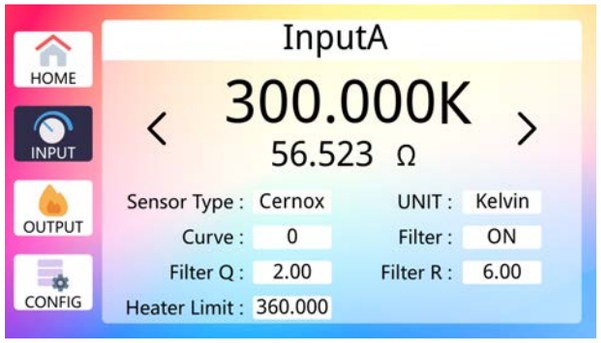
Touch-operated temperature controller interface, quick and easy to use



Navigation Bar
Quickly switch between different interfaces

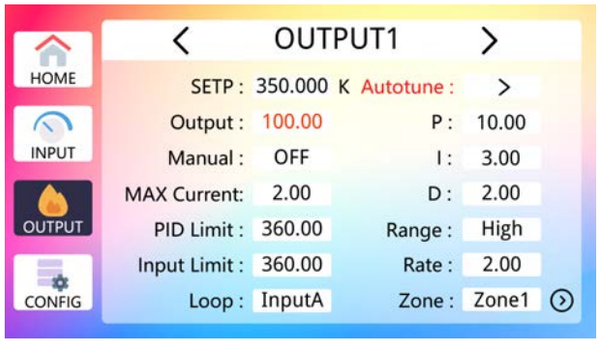
Temperature Display
Display the temperatures and sensor types of 8 channels. Click to enter the INPUT interface of the selected channel.

Control Display
Display the setpoint, power output and input temperature control channel. Click to enter the OUTPUT interface of the selected control channel.



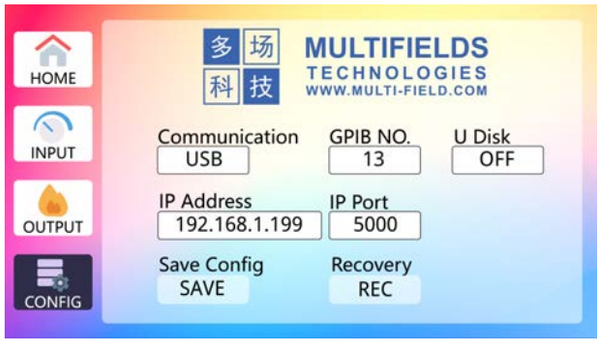
INPUT Interface

This interface displays the temperature and sensor value, allows the user to set the sensor type, display unit, calibration curve, filter parameters and heater limit for the input channel.



OUTPUT Interface

This interface allows the user to set parameters such as PID output, relay output, safe temperature, ZONE mode, etc.. Users can also enter the PID autotune interface.



CONFIG Interface

This interface allows the user to set communication modes, GPIB and IP address.

Kelvinion – Controller

11.2 Kelvinion - Specifications

Input									
Number of Input	8								
Isolation	Sensors inputs optically isolated from other circuits								
ADC Resolution	24 bit								
Max update rate	10 reads/s on each input								
User Curves	1000+ curves (400 points Max in single curve)								
Filter	Kalman Filter								
Input Specifications									
Sensor Type	Diode / RTD								
Measurement Type	4 leads								
Excitation	Constant current with current reversal for RTDs								
Supported Sensors	Diodes: Si, GaAlAs; RTDs: 100 Ω & 1000 Ω Pt, Ge, Carbon-Glass, Cernox®, and Rox™								
NTC-Input Range	0 ~10 Ω	0 ~30 Ω	0 ~100 Ω	0 ~300 Ω	0 ~1 kΩ	0 ~3 kΩ	0 ~10 kΩ	0 ~30 kΩ	0 ~100 kΩ
NTC-Excitation Current	1 mA	0.3 mA	0.1 mA	30 μA	10 μA	3 μA	1 μA	0.3 μA	0.1 μA
NTC-Measurement Resolution	0.15 mΩ	0.45 mΩ	1.5 mΩ	4.5 mΩ	15 mΩ +0.02‰ of rdg	45 mΩ +0.02‰ of rdg	150 mΩ +0.02‰ of rdg	450 mΩ +0.02‰ of rdg	1.5 Ω +0.05‰ of rdg
NTC-Accuracy	8 mΩ	20 mΩ	50 mΩ	120 mΩ	0.5 Ω +0.02‰ of rdg	1.2 Ω +0.02‰ of rdg	5 Ω +0.02‰ of rdg	15 Ω +0.02‰ of rdg	15 Ω +0.05‰ of rdg

Control	
Control Loops	2
PID Tuning	Autotune (one loop at a time)
PID Parameters	P (Gain): 0 to 1000 with 0.01 setting resolution I (Reset): 0 to 1000 with 0.01 setting resolution D(Rate): 0 to 200 % with 0.01% setting resolution Manual output: 0 to 100% with 0.01 setting resolution
Zone Mode	5 temperature zones with PID and heater range
Setpoint Ramping	0.1 K/min ~ 20 K/min

Output Loop 1	25-Ω Heater	50-Ω Heater
Output Type	Variable DC current source	
DAC Resolution	16 bit	
Max. Power	100 W	50 W
Max. Current	2 A	1 A
Voltage Compliance	50 V	
Heater Load Range	10 to 100 Ω	
Output Range	3	

Output Loop 2	25-Ω Heater	50-Ω Heater
Output Type	Variable DC current source	
DAC Resolution	16 bit	
Max. Power	50 W	25 W
Max. Current	1.4 A	1 A
Voltage Compliance	50 V	
Heater Load Range	10 to 100 Ω	
Output Range	3	

General	
Relay Output	1
Analog Output	1，0～10V，16 bit
Communication	Serial port (USB)：USB-TypeB interface，baud rate: 115200 GPIB：IEEE488.2，support setting address LAN：TCP/IP，10M/100M rate，support setting address and pot
Display	5.0 inch TFT touch-screen with 1280 x 720 pixels
Storage	16 M，PC driver-free connection
Safety Limit	Short & open circuit protection Setpoint & temperature limit protection
Size	430(W) * 88.9(H) * 358(L) （unit: mm）

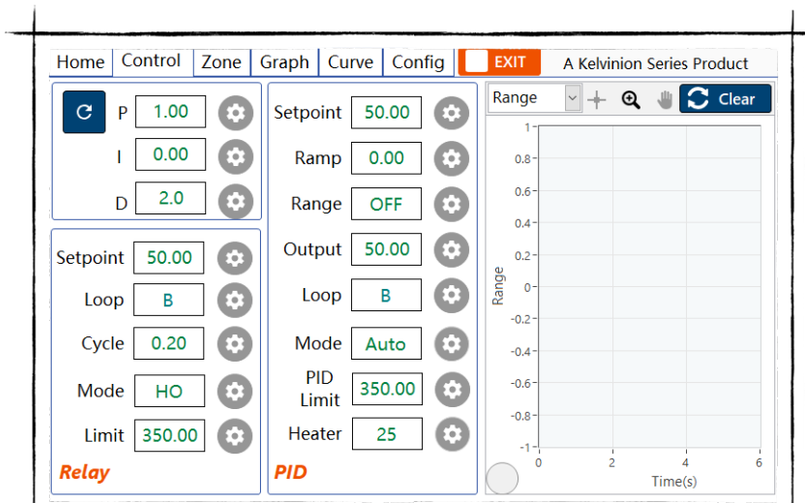
Kelvinion – Controller

11.2 PC Software - Kelvinion Series- Controller

Provide dedicated operating software, complete communication commands and LabVIEW drivers

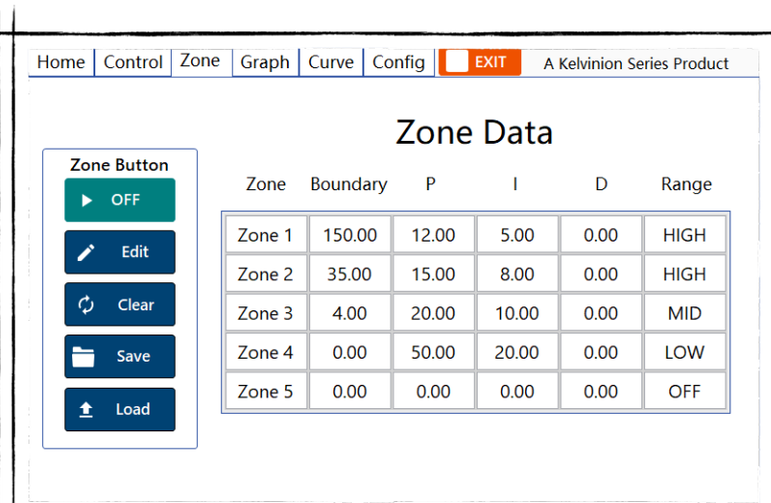
PC Software

Kelvinion temperature controllers are supported by a computer software, which can configure all parameters of the instrument and support functions such as calibration curve editing and uploading. Users can realize remote control of Kelvinion. In addition, a set of communication commands and LabVIEW™ drivers are available to help professional users quickly integrate Kelvinion into their systems.



Control Interface

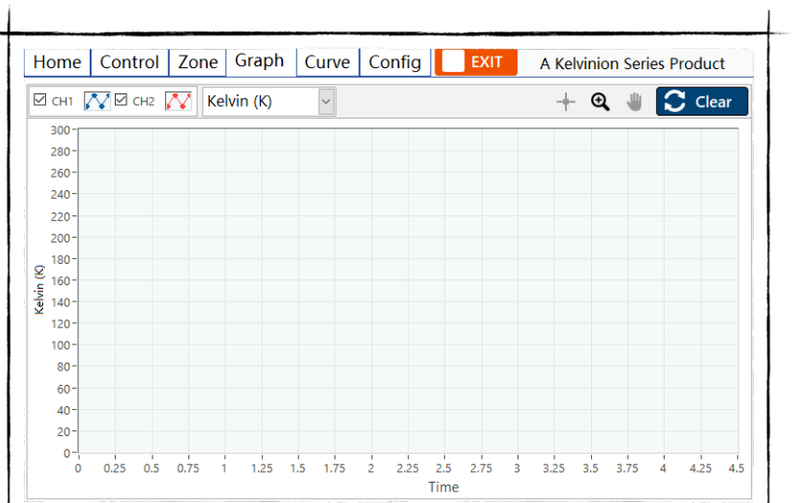
This interface allows user to set the temperature control parameters of the controller and display them in the figure on the right.



Zone	Boundary	P	I	D	Range
Zone 1	150.00	12.00	5.00	0.00	HIGH
Zone 2	35.00	15.00	8.00	0.00	HIGH
Zone 3	4.00	20.00	10.00	0.00	MID
Zone 4	0.00	50.00	20.00	0.00	LOW
Zone 5	0.00	0.00	0.00	0.00	OFF

Zone Interface

In this interface, users can set the control parameters under different ZONE, and can save the above parameters locally or import them into a new controller.



Graph Interface

Historical temperature profiles are displayed on this interface and the data can be saved locally.

Kelvinion – Controller

11.3 Temperature Monitor · Kelvinion Monitor

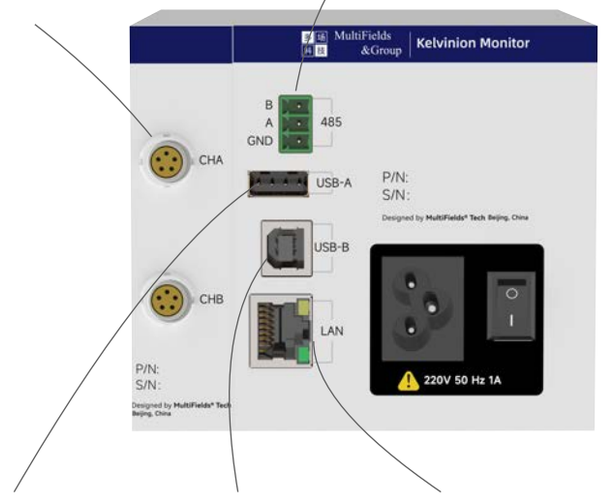
Standard 12 independent monitoring channels. Support 2-32 independent monitoring channels.

Temperature Monitor · Kelvinion Monitor

Temperature Monitor · Kelvinion Monitor. X

Input
Support RTD & Diode;
12 independent channels;
10 SPS sampling rate for each channel;
Synchronization time < 100us.

RS485 Interface
With isolation protection function
Isolation voltage 2500 VDC,
9600 baud rate



Power
220V AC
50 - 60 Hz
1A MAX

USB
USB Type-A interface;
16-M U disk;
Support 1000+ curves.

Serial Port
USB Type-B interface,
115200 baud rate

LAN
Compatible with TCP/IP Protocol;
10M/100M rate

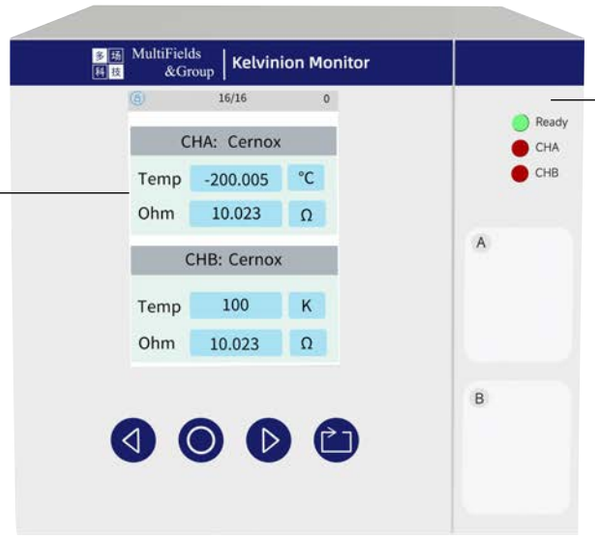
Key Features

- Temperature range of measurement and control down to 300 mK with 0.1 mK resolution (24-bit ADC)
- Standard 12 independent monitoring channels. Support 2-32 independent monitoring channels;
- Each channel is isolated from the other, with a sampling rate of 10 SPS.
- Support synchronous sampling function, the synchronization time is better than 100us
- Automatic tuning of the excitation current for higher accuracy and lower heating;
- Supports 1000+ user-defined curves；
- Support USB (serial port), LAN and RS485 communications；

In large cryogenic installations, it is necessary to monitor the temperatures at several positions simultaneously. To meet the multi-channel temperature monitoring requirement, MultiFields Technologies designed the "Kelvinion Monitor". It consists of 12 independent high-precision temperature monitoring channels with 10 SPS sampling rate and synchronous sampling function. The unique design allows us to freely extend the number of monitoring channel from 2 to 32. It is also compatible with the standard cabinets.

11.3 Kelvinion Monitor - Interface and Control

Flexible to increase or decrease monitoring channels



Temperature Display

Display the information of the temperature monitoring channel for a quick view of input temperature, sensor value and sensor type

Indicators

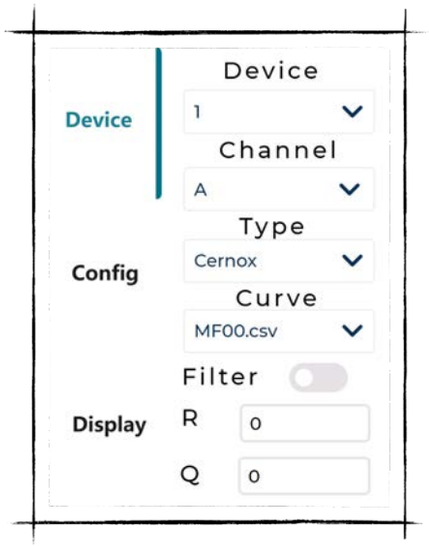
Ready Green light: module is working; Light-off: hardware error;
CHA Red light: channel A sensor connection error; Blink: hardware error;
CHB Red light: channel B sensor connection error; Blink: hardware error;

Left Arrow Switch to previous channel / Move cursor upwards

Enter Lock the screen / select the option

Right Arrow Switch to next channel / Move cursor downwards

Switch Switch the interface between display and setting

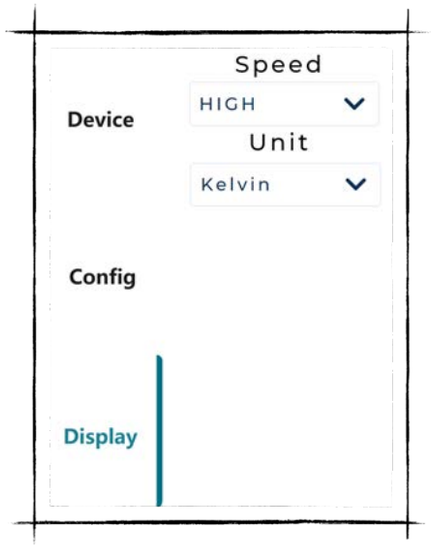


Device Interface

Set the sensor type, calibration curve and filter parameters for each channel.

Config Interface

Set the instrument communication mode and set the USB memory function on or off.



Display Interface

Set the temperature display interface scrolling speed and display unit.

Kelvinion Monitor

11.3 Kelvinion Monitor - Specifications

Temperature Monitor · Kelvinion Monitor - Specifications

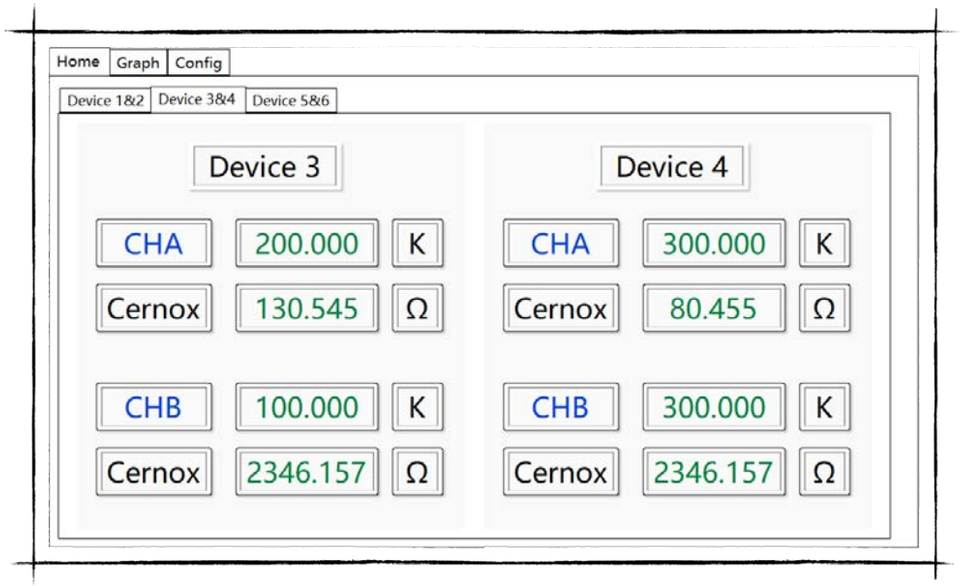
Input									
Number of Input	8								
Isolation	Sensors inputs optically isolated from other circuits								
ADC Resolution	24 bit								
Max update rate	10 reads/s on each input								
User Curves	1000+ curves (400 points Max in single curve)								
Filter	Kalman Filter								
Synchronization Time	< 100 μs								
Input Specifications									
Sensor Type	Diode / RTD								
Measurement Type	4 leads								
Excitation	Constant current with current reversal for RTDs								
Supported Sensors	Diodes: Si, GaAlAs; RTDs: 100 Ω & 1000 Ω Pt, Ge, Carbon-Glass, Cernox®, and Rox™								
NTC-Input Range	0 ~10 Ω	0 ~30 Ω	0 ~100 Ω	0 ~300 Ω	0 ~1 kΩ	0 ~3 kΩ	0 ~10 kΩ	0 ~30 kΩ	0 ~100 kΩ
NTC-Excitation Current	1 mA	0.3 mA	0.1 mA	30 μA	10 μA	3 μA	1 μA	0.3 μA	0.1 μA
NTC-Measurement Resolution	0.15 mΩ	0.45 mΩ	1.5 mΩ	4.5 mΩ	15 mΩ +0.02‰ of rdg	45 mΩ +0.02‰ of rdg	150 mΩ +0.02‰ of rdg	450 mΩ +0.02‰ of rdg	1.5 Ω +0.05‰ of rdg
NTC-Accuracy	8 mΩ	20 mΩ	50 mΩ	120 mΩ	0.5 Ω +0.02‰ of rdg	1.2 Ω +0.02‰ of rdg	5 Ω +0.02‰ of rdg	15 Ω +0.02‰ of rdg	15 Ω +0.05‰ of rdg
General									
Communication	Serial port (USB)：USB-TypeB interface，baud rate: 115200; LAN：TCP/IP，10M/100M rate，support setting address and pot; RS-485: With isolation protection function; Isolation voltage 2500 VDC, 9600 baud rate								
Display	2.4 inch screen with 320 x 240 pixels								
Size	Host：79(W) * 88.9(H) * 135(L) （unit: mm） Subs：22.5(W) * 88.9(H) * 135(L) （unit: mm）								

11.3 PC Software - Kelvinion Series - Monitor

Provide dedicated operating software, complete communication commands and LabVIEW drivers

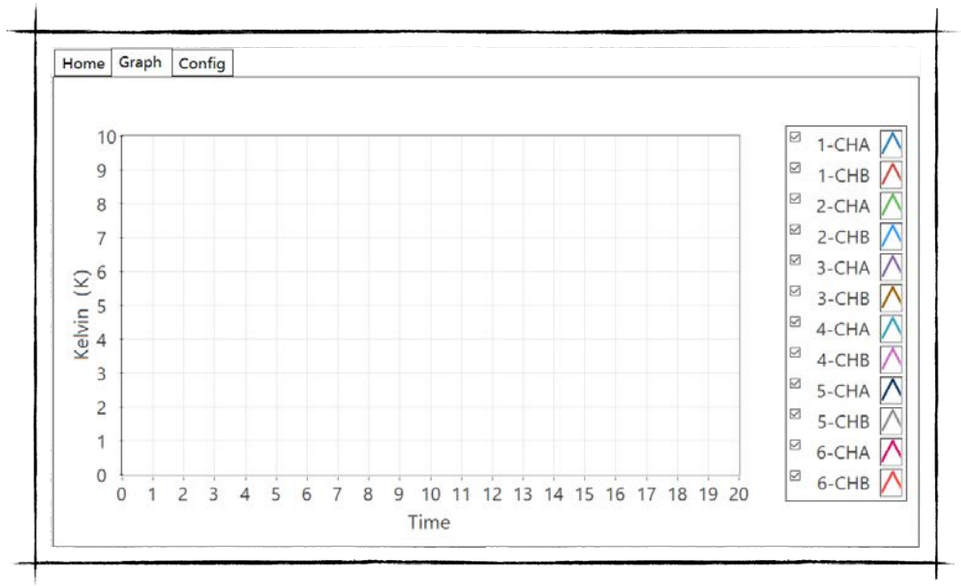
PC Software

Kelvinion temperature controllers are supported by a computer software, which can configure all parameters of the instrument and support functions such as calibration curve editing and uploading. Users can realize remote control of Kelvinion. In addition, a set of communication commands and LabVIEW™ drivers are available to help professional users quickly integrate Kelvinion into their systems.



Home - Device Interface

Display the information of the temperature monitoring channel for a quick view of input temperature, sensor value and sensor type



Graph Interface

Historical temperature profiles are displayed on this interface and the data can be saved locally.

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