

テンプレート使用上の注意

1. スタイルは変更しない：標準および見出し 1 から 4 をそのまま使用する
2. 目次は自動生成です。本文が作成できたら、目次を右クリックして「フィールド更新」する。

USER MANUAL

FP-CND conductivity Measurement Fabry-Perot resonator

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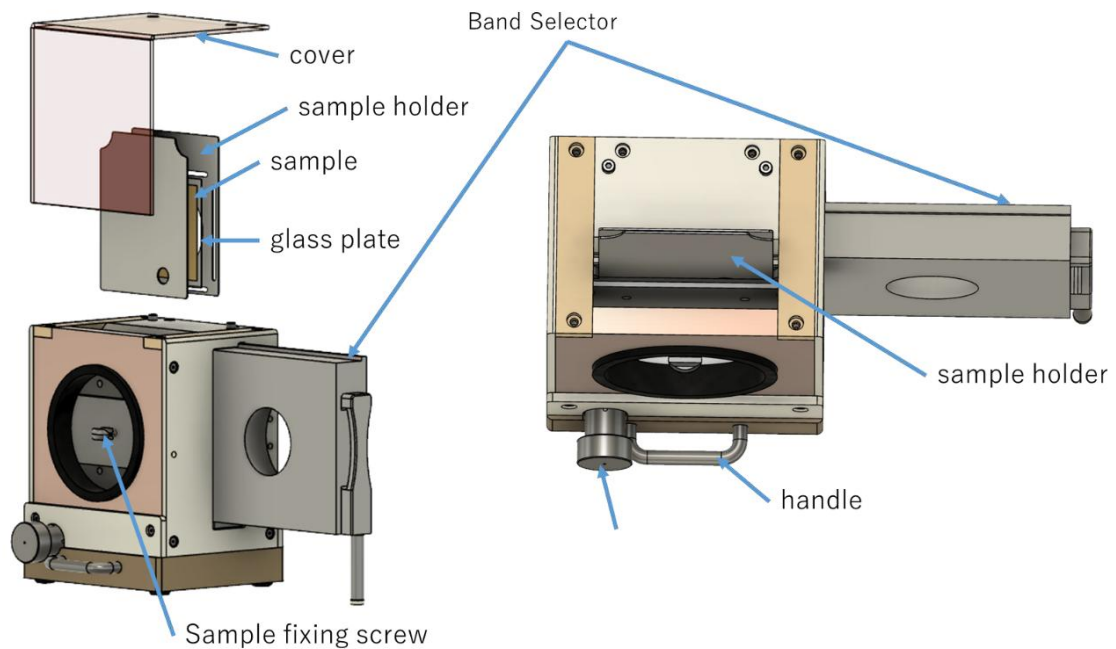
1. Product Overview

The FP-CND series Fabry-Pérot resonator is designed for measuring relative conductivity with a network analyzer. It can accurately measure even high-conductivity materials, thanks to its extremely low intrinsic loss. Its design prioritizes ease of use and repeatability, ensuring consistent measurement results regardless of the operator or measurement environment. By following the instructions in the FP-CND-MA conductivity measurement software, you can automatically capture the frequency characteristics within the band in one go.

Relative conductivity refers to the conductivity of a material when the conductivity of soft copper ($5.8 \times 10^7 \text{ S/m}$) is defined as 1.

Appearance and Structure of the Resonator

For details on the operation of each part, please refer to the FP-CND-MA user manual.



Cover: Set onto the resonator body during measurement.

Glass for Sample Attachment: Used to maintain the flatness of the sample when attached to the glass plate.

Sample Plate: Two sample plates are used to sandwich the sample attached to the glass for sample attachment.

Sample Fixing Screw: Tighten the screw after inserting the sample to stabilize it.

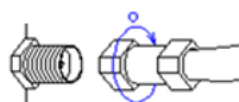
Sample Holder: Holds the sample plates.

Adjustment Micrometer: Used to adjust the position of the sample holder after inserting the sample (FP-CND-BB only).

Band Selector: Pull out or insert according to the software instructions.

Notes

1. When lifting the resonator body, always hold it by the handle. Holding other parts may cause damage.
2. The sample plate may bend due to external pressure. Handle with care.



Product Specifications

Model Number	Frequency (GHz)	Unloaded Q	Mode	Connector
FP-CND-BB	23-110	$\geq 60,000$	TEM	1 mm(f)
FP-CND-D	110-170	$\geq 100,000$	TEM	Waveguide WR12

Included Accessories

FP-TB Waveguide Connection Millimeter-Wave Module Table and Clamp Set (2 sets each)

→ Required accessories for waveguide connection.

Glass for Sample Attachment

→ Necessary for measuring copper foil.

Connection cables and adapters are required depending on the network analyzer used.

2. Measurement

This section explains the measurement procedure

It also outlines handling precautions for the resonator and important points to ensure stable measurements.

Sample Preparation

The sample size varies depending on the resonator frequency.

Attach the sample, cut to the recommended size, to the glass plate without trapping air bubbles.

Resonator type	Recommended sample size
FP-CND-BB	□80 mm
FP-CND-D	□50 mm

In the case of a Fabry-Pérot resonator, conductivity is measured using a vertically oriented electric field. Anisotropy can be evaluated by rotating the sample mounting direction by 90 degrees. It is recommended to mark the sample orientation for consistency.

Measurement of Copper Foil with Dielectric

Using the optional function of FP-CND-MA, it is possible to measure the conductivity at the interface between the copper foil and the dielectric while the dielectric is attached. In this case, the thickness, permittivity, and dielectric loss tangent of the dielectric must be known. Permittivity needs to be measured separately, but measurement results obtained with the recommended models (FP-BB, FP-D) can be imported into the software for smoother measurement.

Checklist Before Starting the Measurement

Before starting the actual measurement using the dielectric constant measurement software, ensure the following preparations are complete:

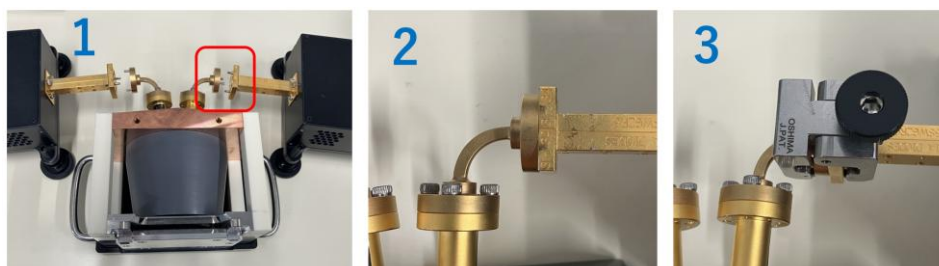
- **Resonator Temperature:** Ensure that the resonator's temperature has stabilized. It is recommended to wait at least 30 minutes after setting up in the measurement environment before starting measurements.
- **Network Analyzer Warm-Up:** Confirm that the network analyzer has been sufficiently warmed up (follow the recommended warm-up time for the specific network analyzer).
- **Sample Size:** Ensure the sample size has been measured and recorded.
- **Tools for Connector Connection:** Ensure that a torque wrench and spanner are available for the connector connection. Additionally, have tweezers or gloves ready if needed for handling the sample.

How to connect

The resonator's connection connector and the network analyzer's port are connected using a waveguide/cable. The type of connector varies depending on the frequency range. The connector type is specified in the product specifications.

Waveguide Connector Connection

1. Align the height of the resonator and waveguide connectors.
2. Couple the connectors together.
3. Secure the connection using the clamp (tighten the clamp's knob).



Coaxial Connector Connection

Connect the resonator to the network analyzer using the appropriate cable.

Note

When tightening the nut of the coaxial connector, it is important to use a torque wrench to apply the correct torque. Excessive torque can damage the connector, while insufficient torque can cause measurement errors or issues with the center conductor rotating. Also, ensure that only the nut of the male connector rotates. Rotating the center conductor can

cause wear or damage to the connector.

For Accurate Measurements

The Fabry-Pérot resonator is designed and manufactured with precision to measure conductivity with high accuracy. To fully utilize its performance, it is important to pay attention to the following points:

- 1.

Glass Plate

Attach the sample to the glass plate (sold separately) to ensure flatness. If air bubbles larger than the wavelength are trapped, measurement results may become unreliable. Make sure to attach the sample carefully to avoid trapping air.

Cover

Keep the dedicated cover on the resonator when not inserting or removing the sample. This will help stabilize the measurement results.

Vibrations

Avoid touching the resonator or millimeter-wave module during the measurement. Vibrations or mechanical stress can affect the measurement results. There is no need to use a vibration isolation table.

Measurement table

If the resonator is placed on the same table as the network analyzer, vibrations from the analyzer's fan may affect the measurement results. For high-precision measurements or if the results are unstable, it is recommended to place the resonator on a table that minimizes vibration transmission.

Loud Noise During Measurement

The Fabry-Pérot resonator works by resonating with the sample. The resonator and sample must remain in position with an accuracy of 10 nm. Loud noises can cause the sample to vibrate, which may disrupt the measurement at the frequency being measured. Avoid generating loud noises during the measurement.

Cables

During measurement, avoid moving the cables. Once the resonator is connected to the network analyzer, do not touch the cables until the measurement is complete. Also, avoid moving the resonator itself during the measurement.

Measurement Procedure

Launch the FP-CND-MA conductivity measurement software and follow the on-screen instructions to perform the measurement. For detailed steps, refer to the FP-CND-MA software manual.

3. Maintenance and Repair

Daily Maintenance and Response to Abnormalities

Verification of Measurement Values with Stable Sample Characteristics

It is recommended to regularly measure stable samples with known characteristics to verify the measurement system.

Daily Cleaning

The Fabry-Perot resonator is basically maintenance-free. If the sample plate becomes dirty, wipe it with a non-woven fabric lightly moistened with alcohol.

NOTE

Disassembling for cleaning may cause malfunctions, so please avoid it. Specifically, do not touch the inside of the resonator, as it could significantly degrade its performance.

What to Do if Something Seems Wrong

This section explains how to respond when abnormal measurement values occur. First, ensure that the connectors are properly connected. Next, check that no noticeable foreign objects are attached to the sample plate. If the issue persists, repair may be necessary.

Repairs

If repairs are needed, please contact us directly via our website.

<https://www.emlabs.jp>