



OPERATION MANUAL

FP-MA permittivity measurement software

EM LABS INC.

March 11, 2024

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1. Product Overview

FP-MA Permittivity Measurement Software is designed to efficiently perform complex relative permittivity measurement using FP series Fabry-Perot resonators. It controls a Keysight Technologies network analyzer to automatically acquire the necessary parameters and output the complex permittivity.

2. System Requirement

This section describes the operating environment required to use the software.

OS

- Windows OS (Windows 10 /11)
- Keysight IO Libraries

Usable analyzers

- Keysight PNA Series Network Analyzers

NOTE

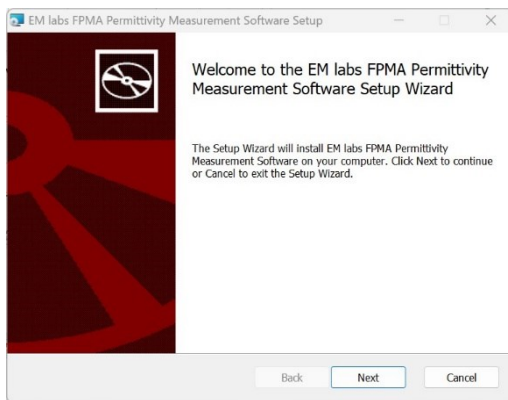
PNA series with firmware A07.50.48 and later is supported.

3. Install and Uninstall

This section provides detailed instructions on how to install and uninstall this software.

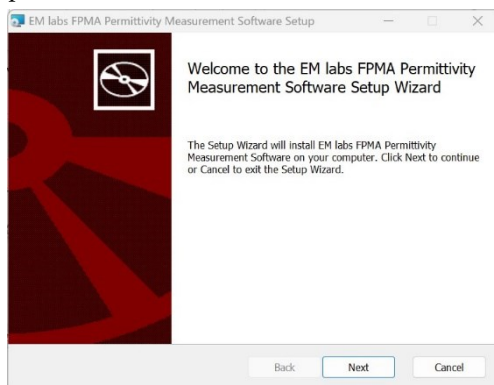
How to Install

1. Please have the following items ready at hand.
 - FPMASetup.msi software installer
 - 16-digit product key provided at the purchase
2. Run FPMASetup.msi on a Windows PC and follow the on-screen instructions to proceed with the installation.



How to uninstall

Run FPMASetup.msi on your Windows PC and follow the on-screen instructions to proceed with the uninstallation.



NOTE

You can also uninstall the permittivity measurement software using the standard "Uninstall app" feature of Windows. In that case, follow the Windows instruction.

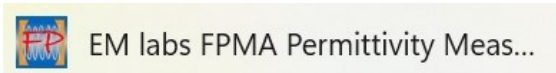
4. Preparation for measurement

Instruments connection and sample preparation

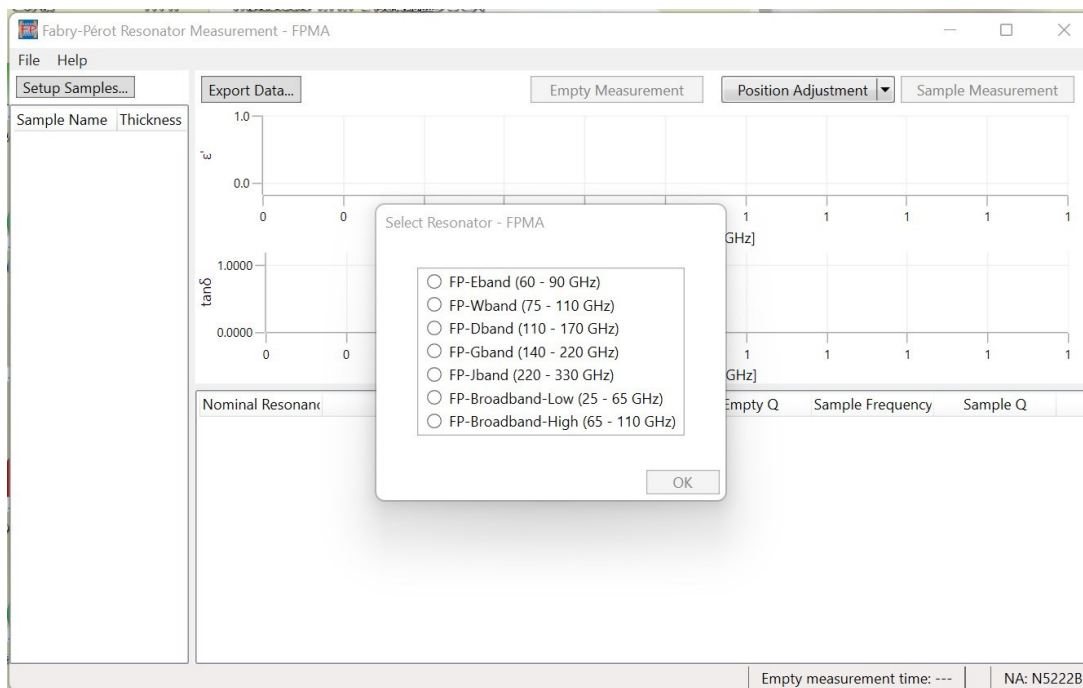
Before starting this software, prepare the hardware referring to FP series OPERATION MANUAL.

Start the Software

Start [EM Lab FPMA Permittivity Measurement Software] from Windows.

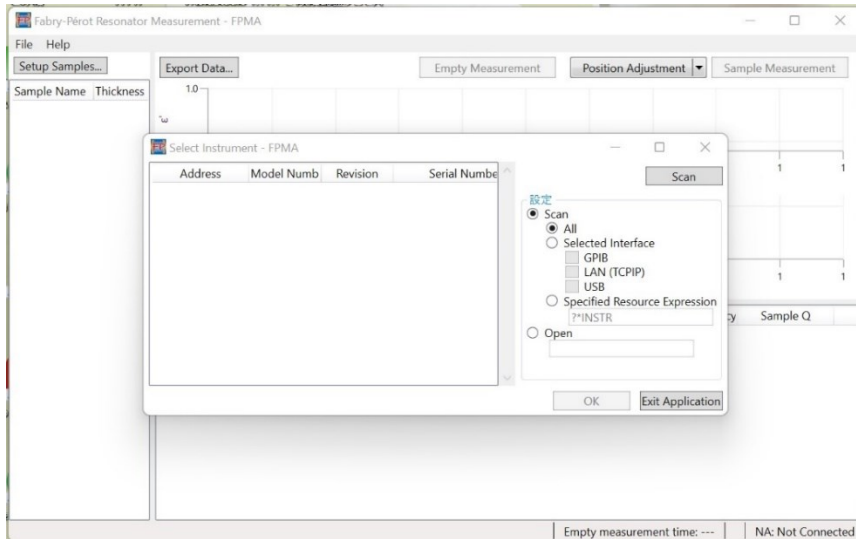


The start screen is followed by Select Resonator box.

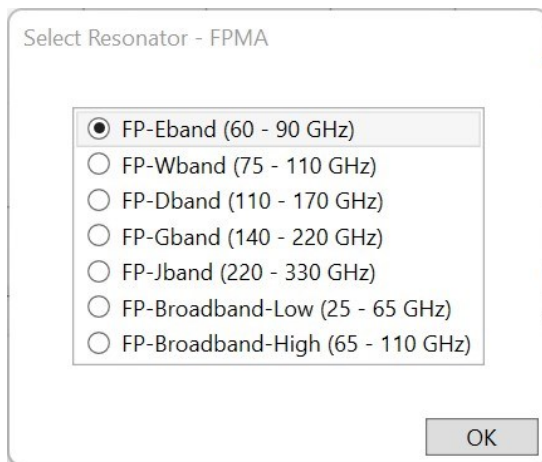


NOTE

If the window below opens, the network analyzer is not properly connected to the PC. Check the connection and click **Scan**.



Select the Resonator



Select the resonator you are using.
(Here, **FP-Eband** is selected.)
Click on **OK**.

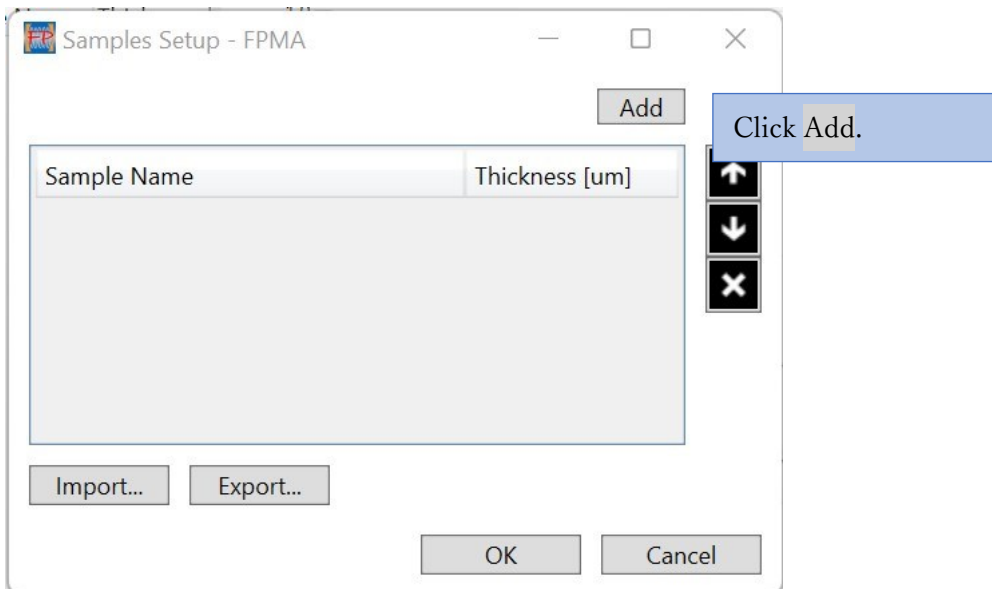
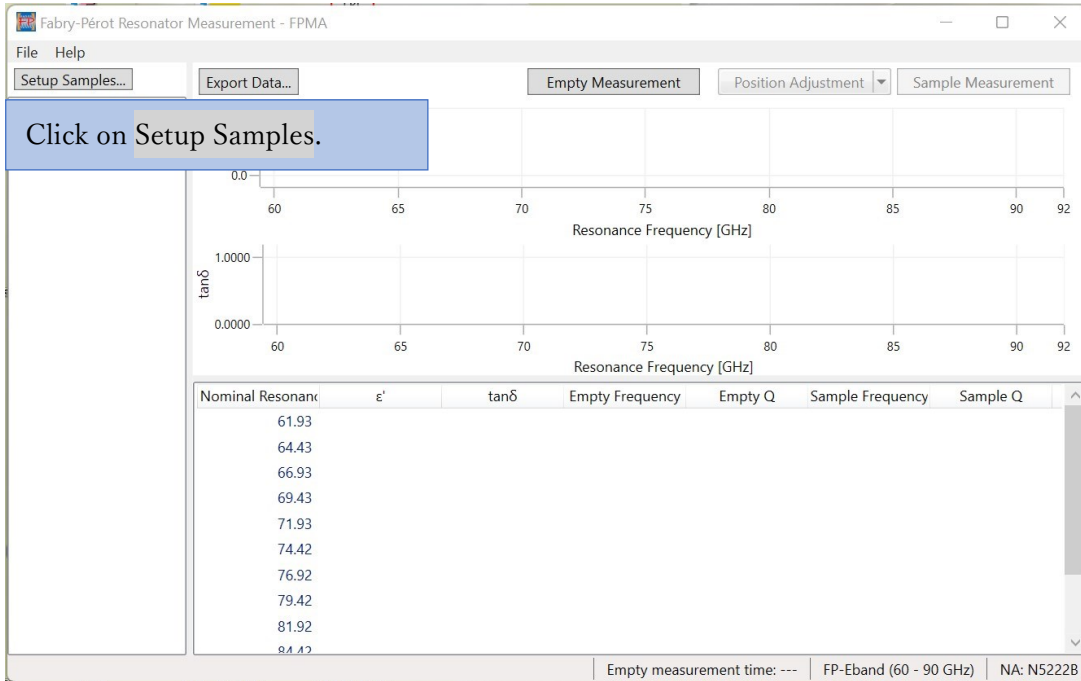
NOTE

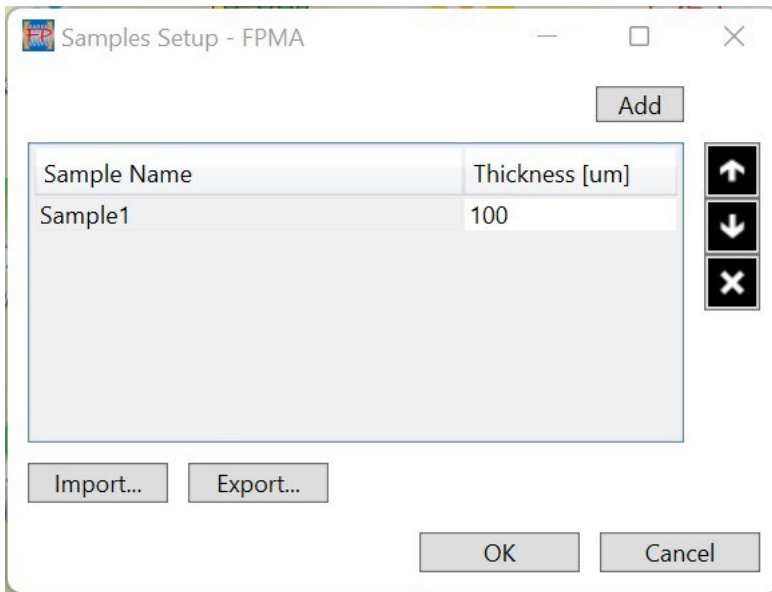
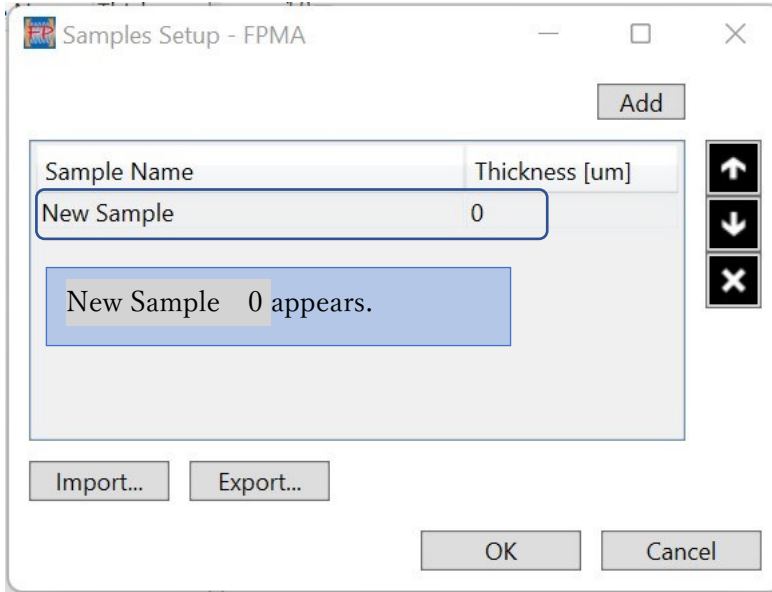
To change the resonator selection after clicking **OK** in Select Resonator box, quit and re-start the software.

NOTE

For the broadband model, the user must operate the band selector to switch between Low and High. for details, see Chapter 7 Reference .

Setup Samples

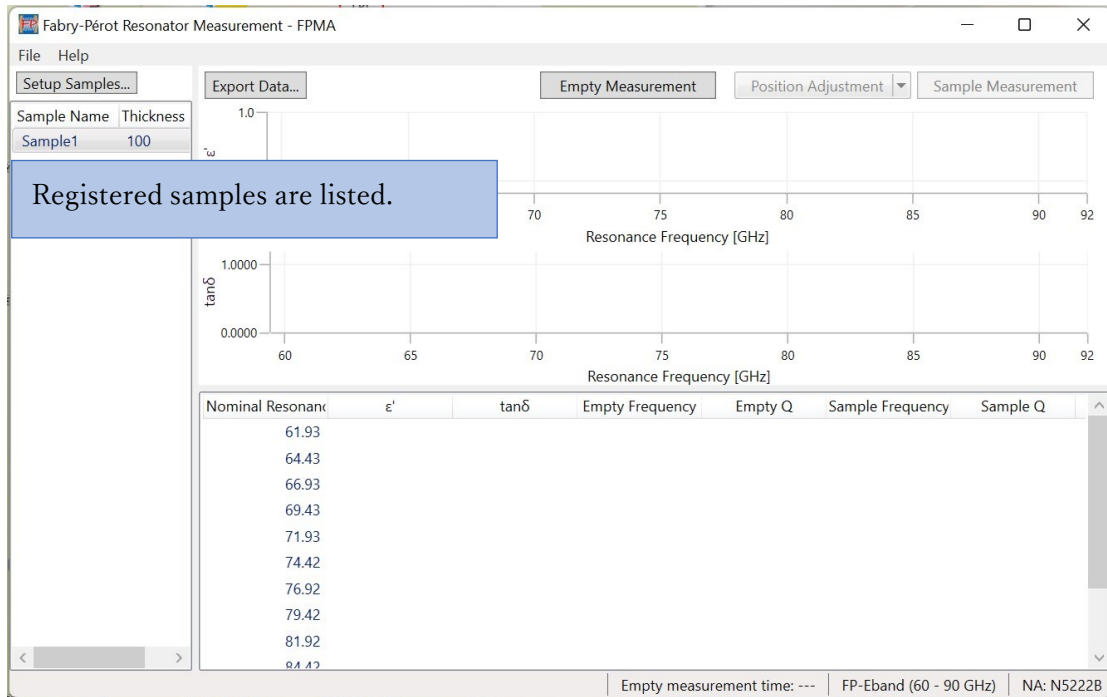




Enter any value* for:
Name: (e.g. Sample1)
Thickness: (e.g. 100)

Click OK.

*Unit of thickness is μm .



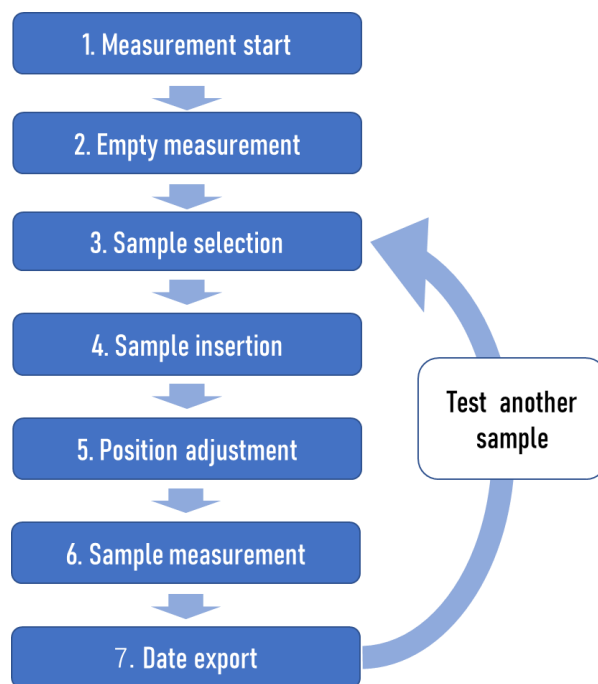
NOTE

Multiple samples can be registered. In addition, you can [Import] or [Export] the sample information. For details, please refer to Chapter 7.

5. Measurement Procedure

We will focus on basic measurement procedures here. Refer to Chapter 7 for more details on each function.

Overall flow



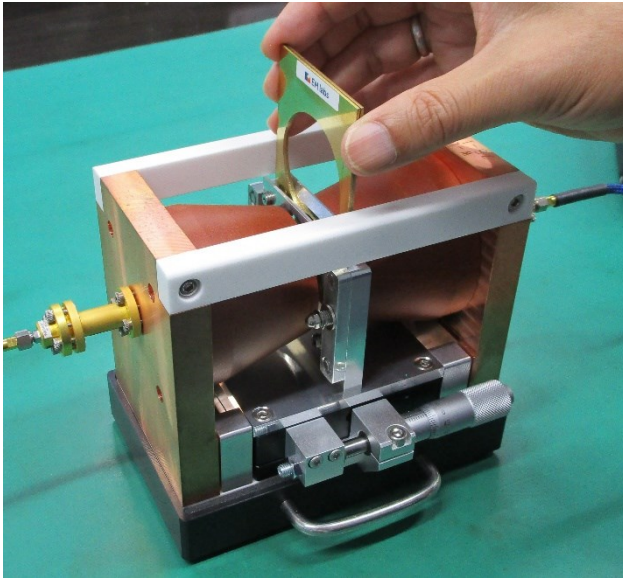
The measurement proceeds as shown in the figure above, according to the display. The following is an explanation of each step based on the screen display.


1. Measurement start

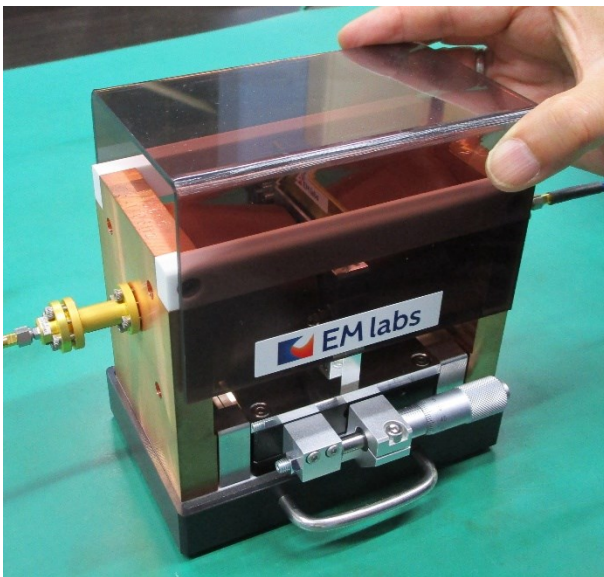
Completing the preparations described in the previous chapter, proceed the measurement steps.

2. Empty measurement

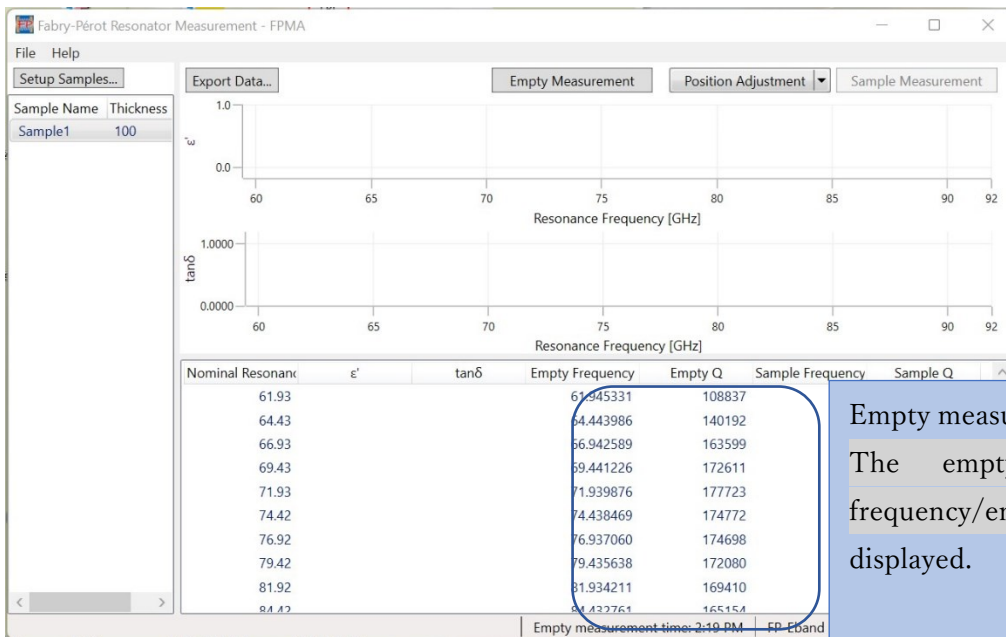
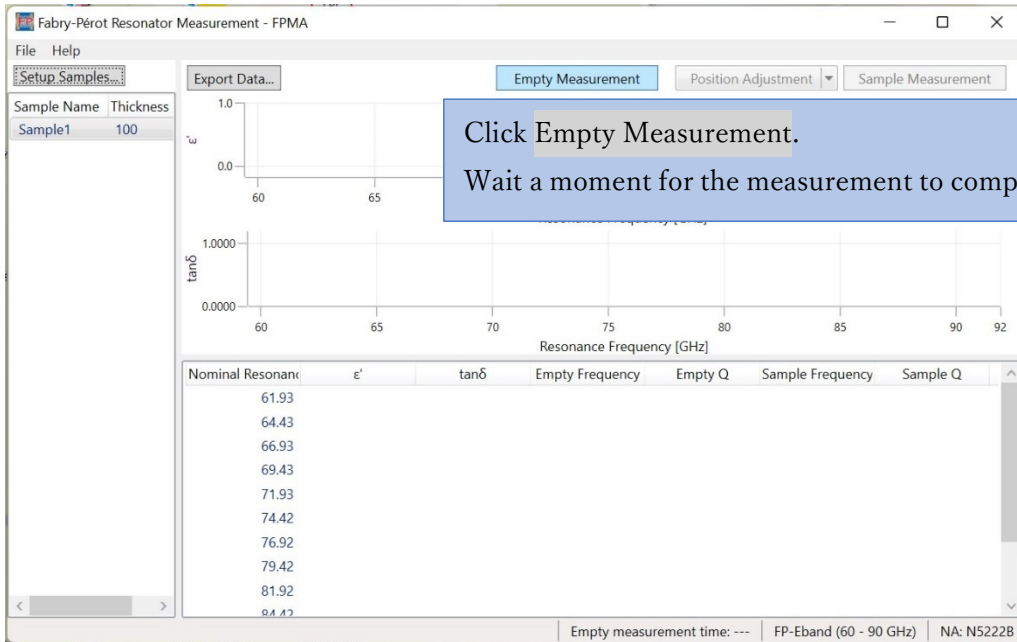
Perform 'Empty' (without a sample) measurement.



Insert the sample plates to the sample holder. Make sure  mark on each sample plate comes outside.



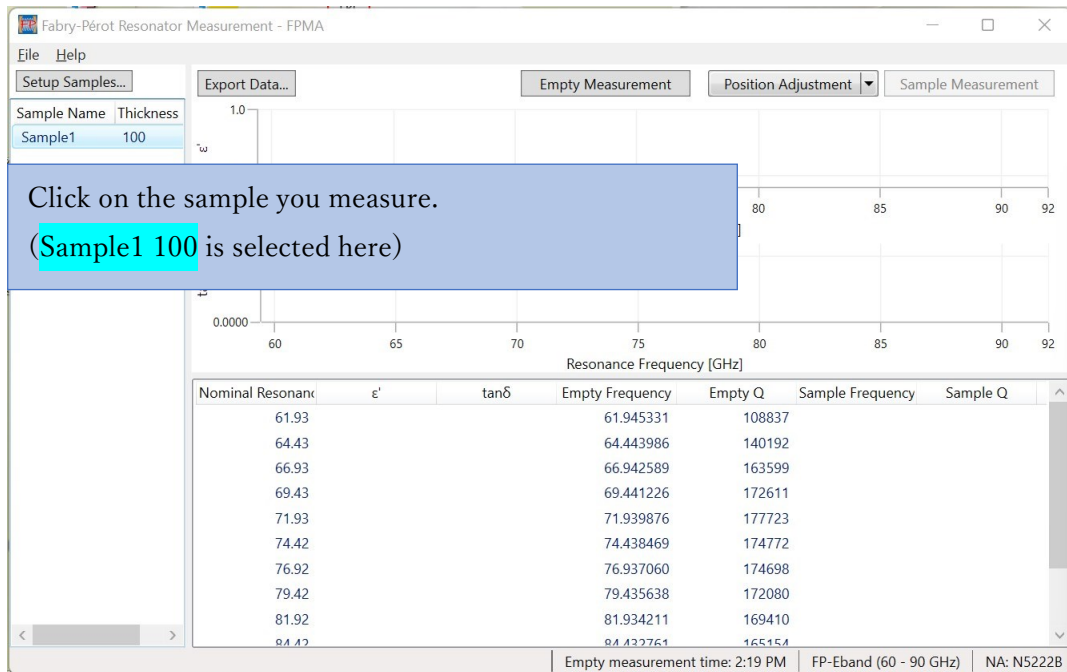
Set the cover.



NOTE

When using FP-Broadband, the message 'Please push in the band selector' or 'Please pull out the band selector' will be displayed as required. Follow the message and operate the band selector on the resonator. For more information, refer to 7. Reference FP-Broadband: Operating the band selector.

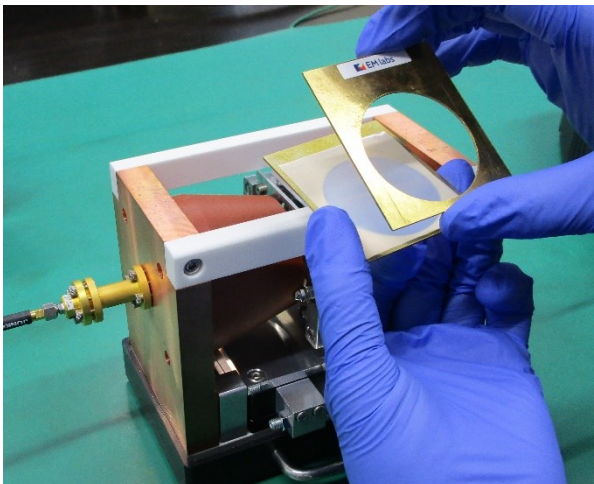
3. Sample selection



NOTE

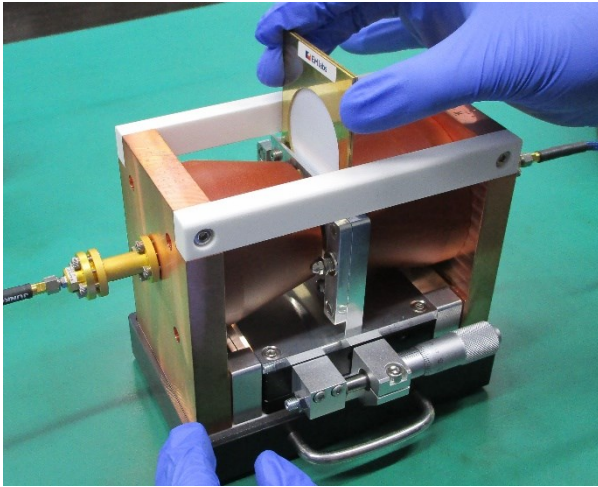
You can register additional samples using **Setup Samples**. (Refer to the previous chapter.)

4. sample insertion

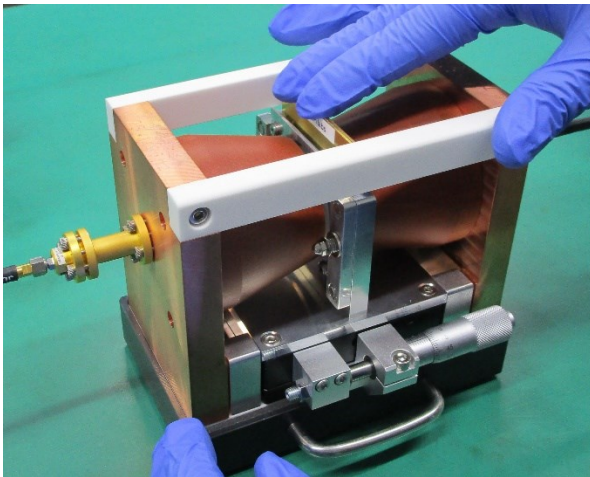


Place the sample between the sample plates. At this time, observe the following precautions.

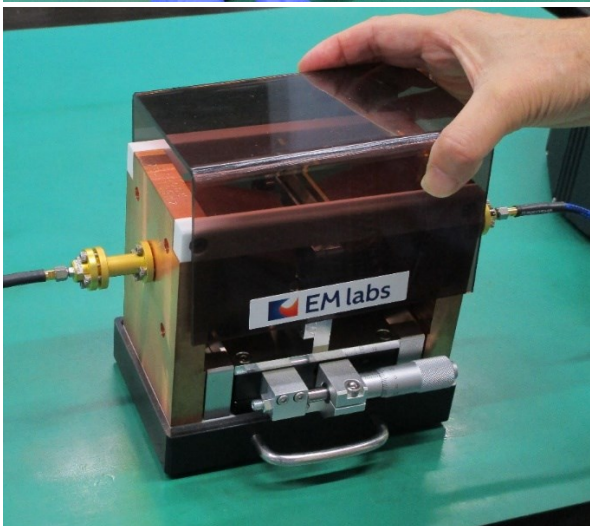
1. Align the sample plates so that **EM labs** marks come on the outside.
2. The sample should completely cover the holes of the sample plates.
3. The sample should not protrude from the sample plate.



Insert the sample plates into the sample holder.

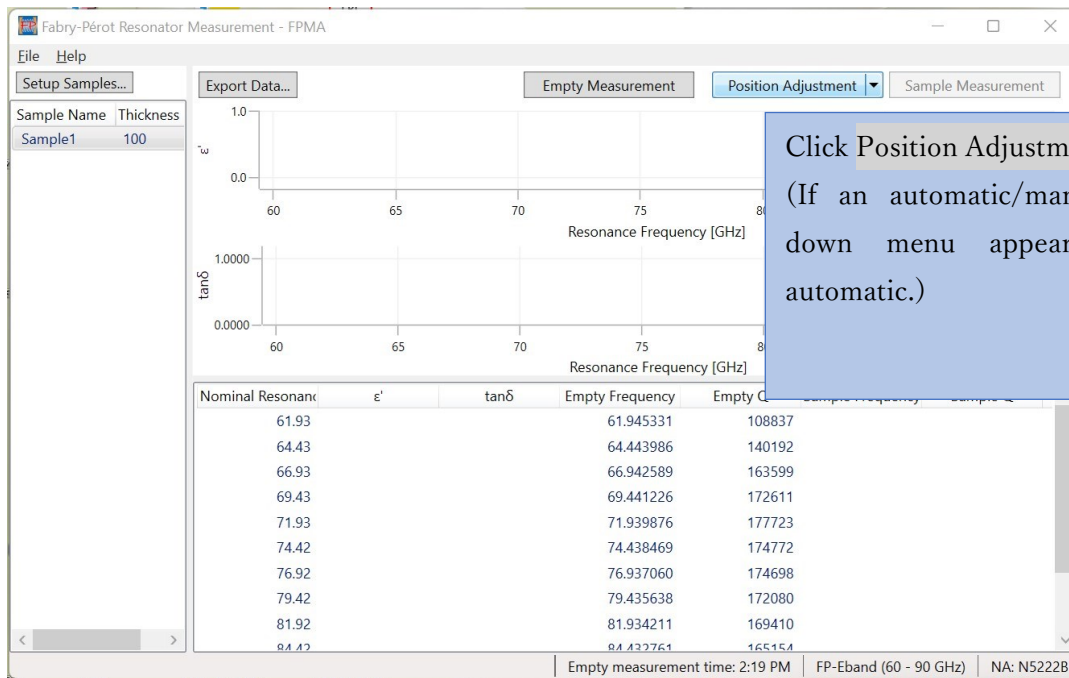


Push the sample plates firmly into the bottom of the sample holder.



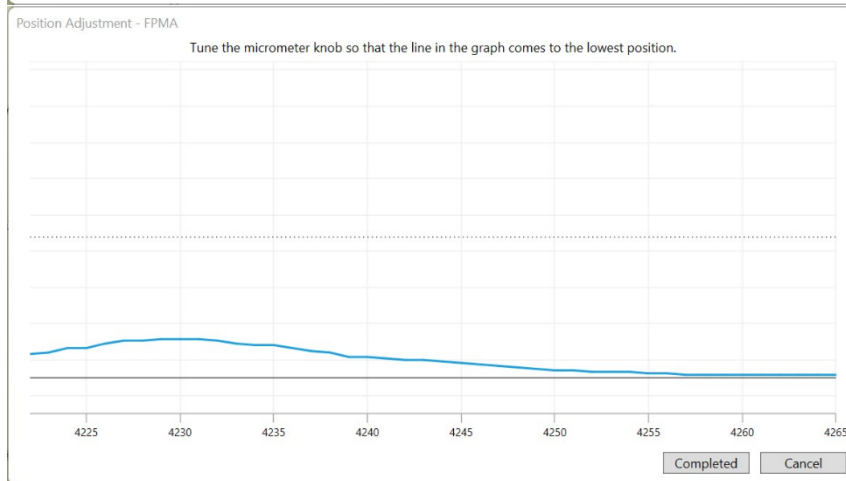
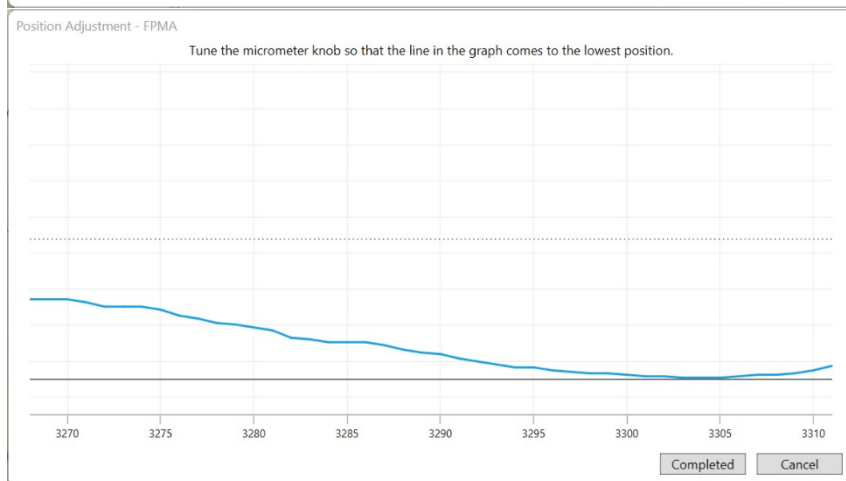
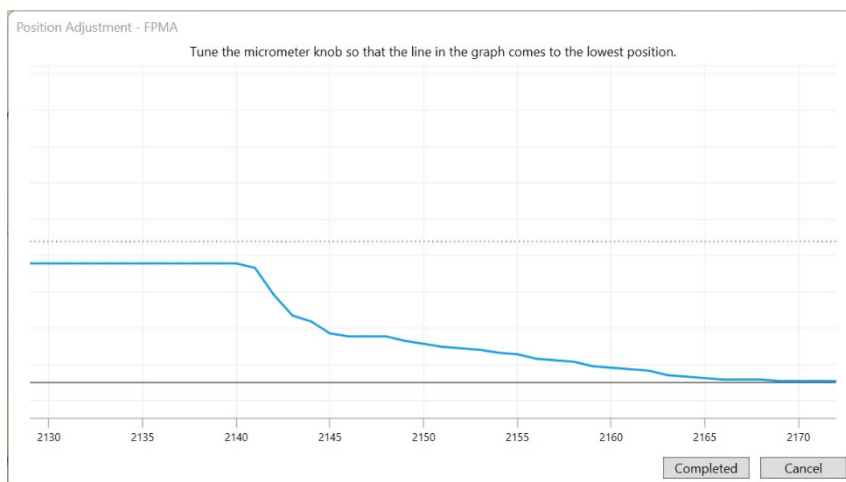
Set the cover.

5. Position adjustment



"Tune the micrometer knob so that the line in the graph comes to the lowest position." is displayed, then operate the adjustment micrometer as follows.

(If resonance is not detected, refer to "Sample Positioning" in Chapter 7 Reference.)



Watching the screen, turn the adjustment micrometer in the direction that the trace sticks to the bottom.

← This line corresponds to a measurement error of 1% for the permittivity.

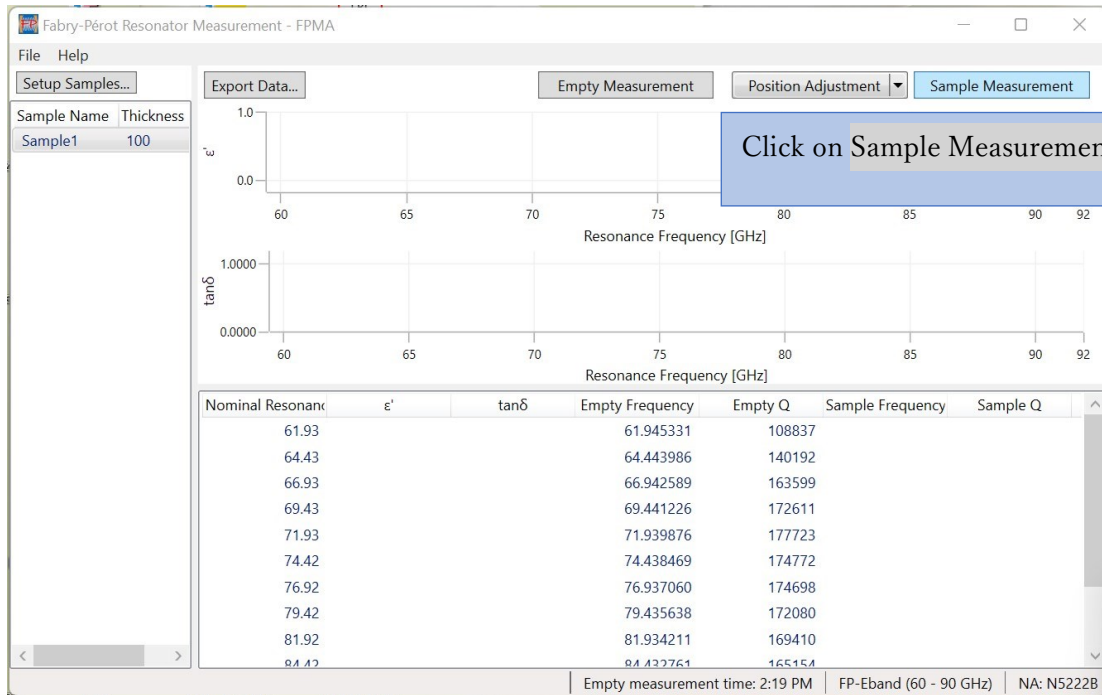
(If the trace does not stick to the bottom by turning the micrometer, refer to "Sample Position Adjustment" in Chapter 7.)

Keep turning the micrometer slowly until the trace begins to rise in order to confirm the bottom.

When it begins to rise, turn the micrometer back and when the trace sticks to the bottom again, the adjustment is complete.

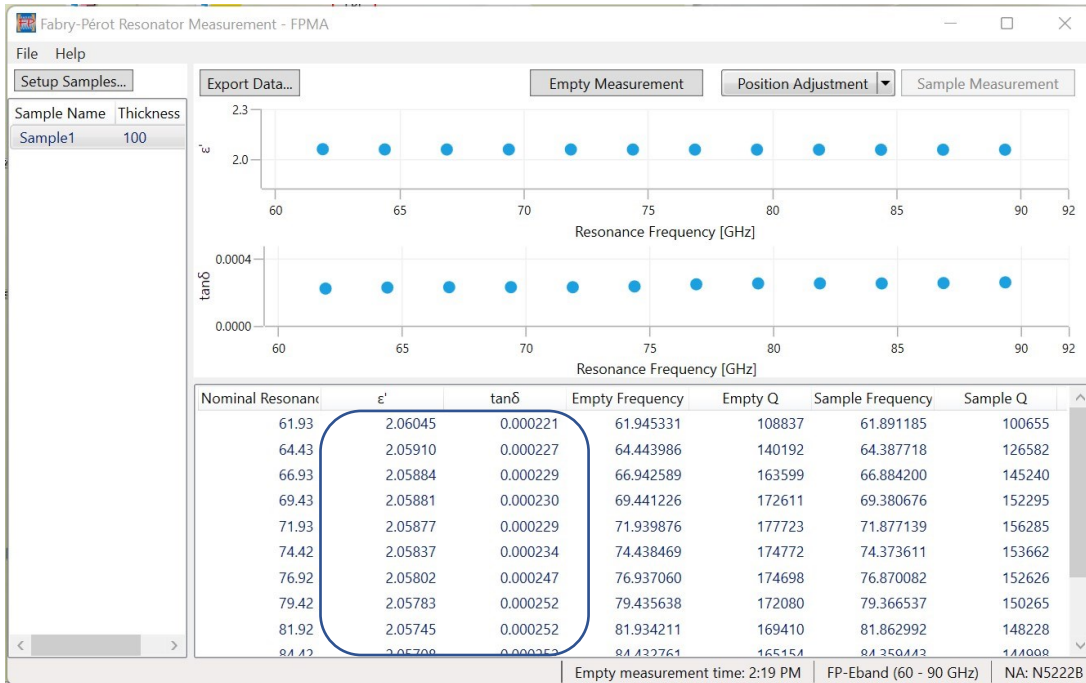
Click Exit.
After a while, you come to the main screen.

6. Sample measurement



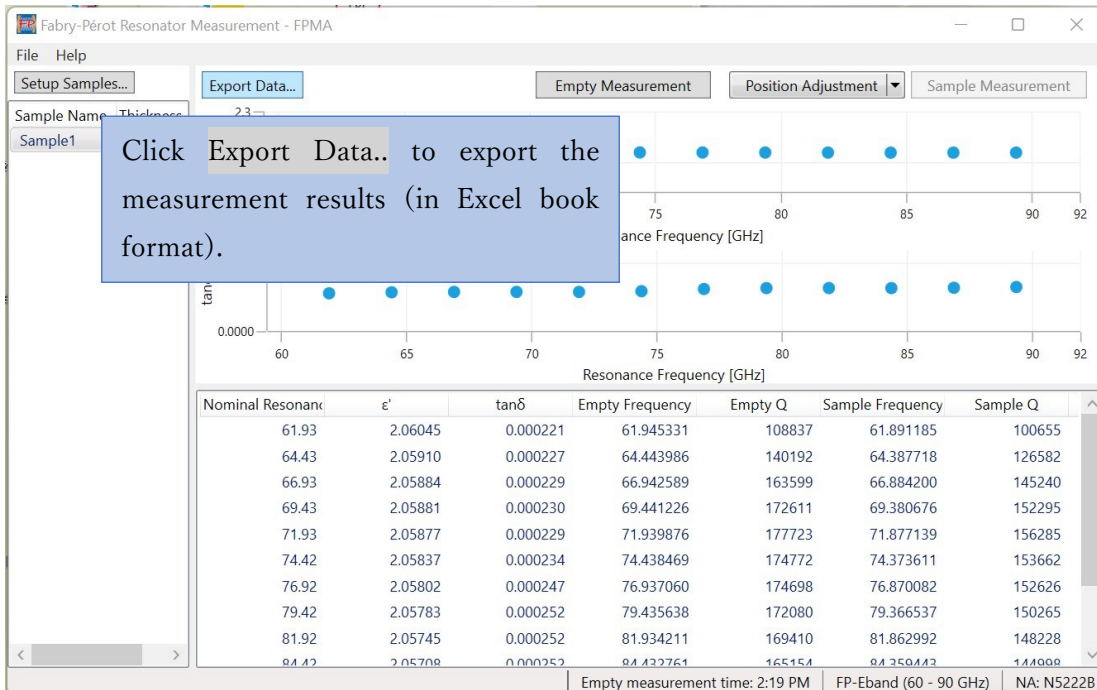
NOTE

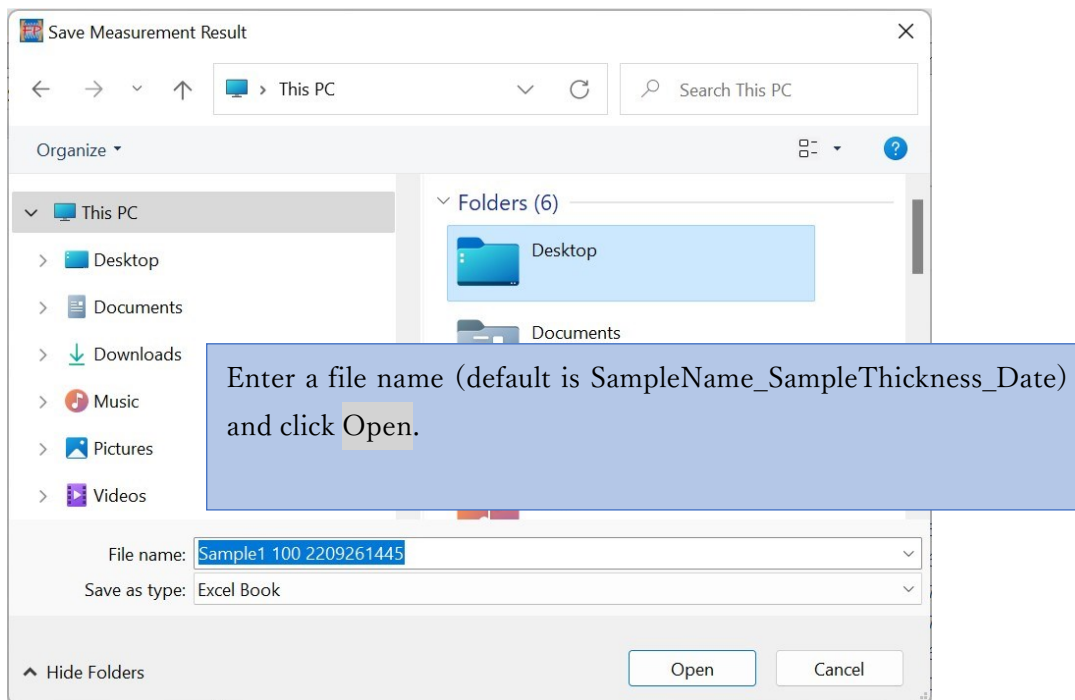
When using FP-Broadband, the message 'Please push in the band selector' or 'Please pull out the band selector' will be displayed as required. Follow the message and operate the band selector on the resonator. For more information, refer to 7. Reference FP-Broadband: Operating the band selector.



When all the measurement results are displayed, the measurement is complete.

7. Data export





6. If you think something is wrong...

When problems such as installation failure and software freeze occur, please contact us directly from our website for support..

<https://www.emlabs.jp>

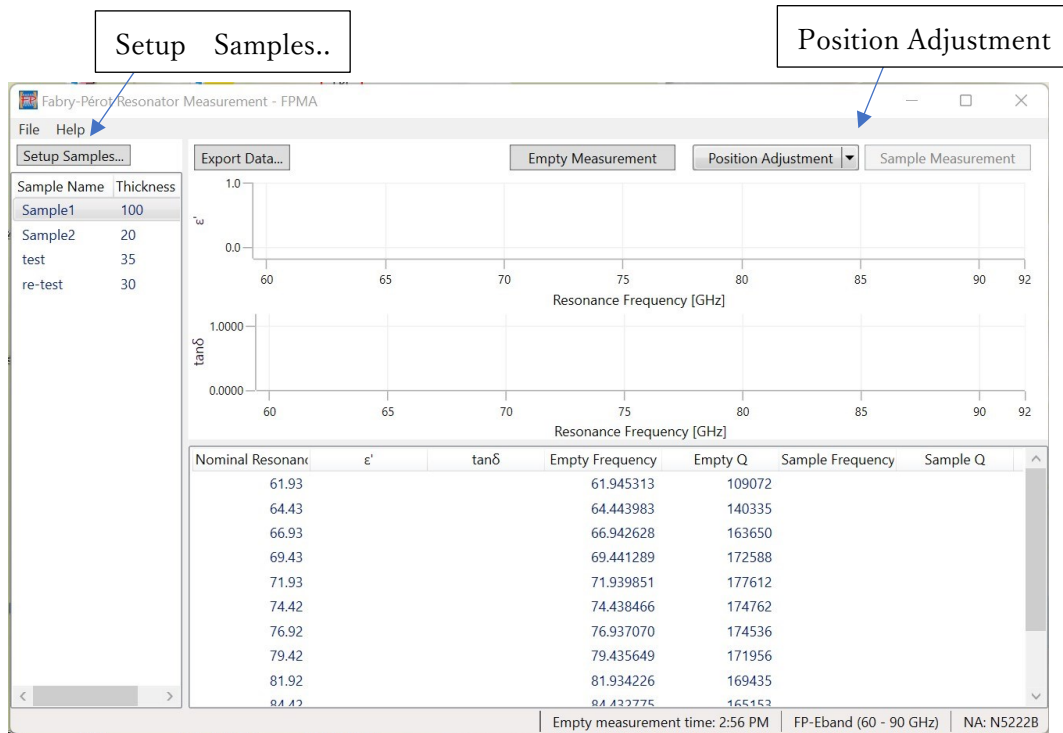
For effective support, please provide the following information:

- This software version
- PC OS version
- Keysight IO Libraries version
- Network Analyzer model number and its firmware version

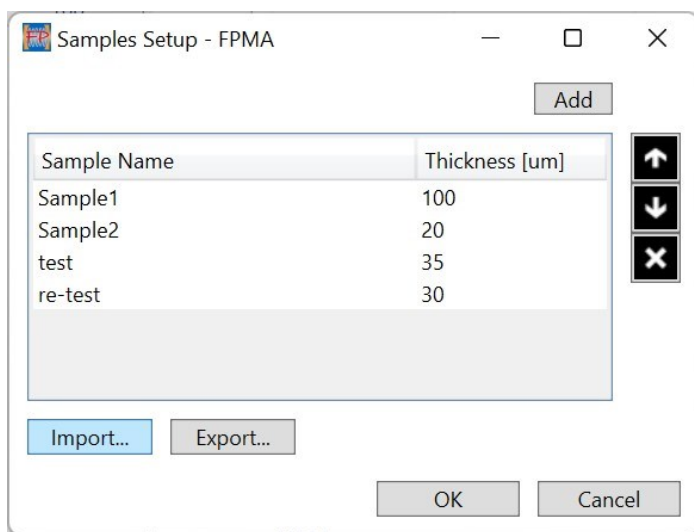
7. Reference

Supplementary explanation of each function

We provide further explanations of the functions shown in the figure below.



Sample Setup



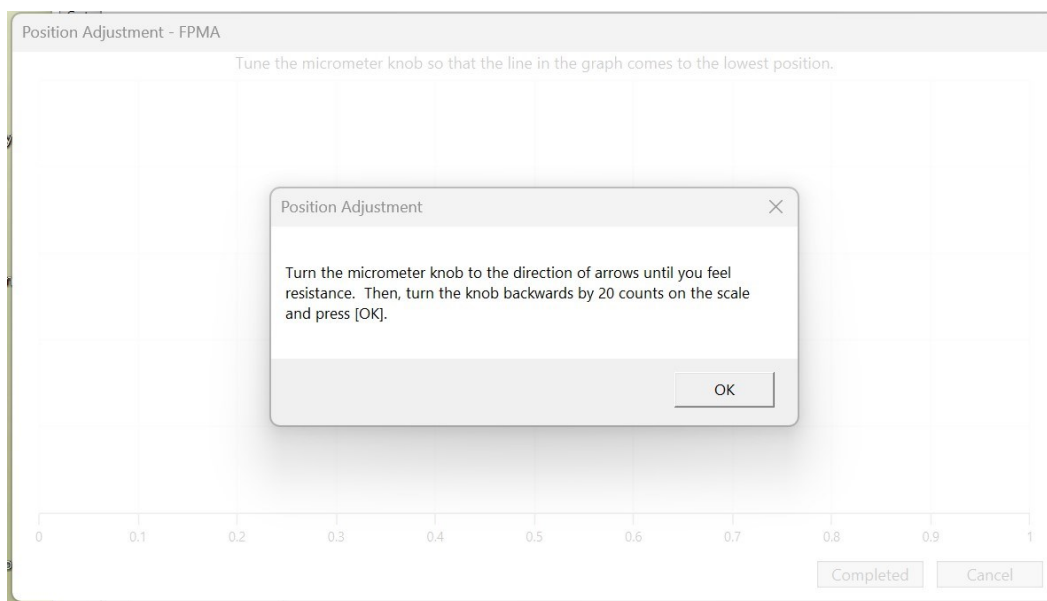
Click **Export** to export the sample information in Excel book format. Click **Import** to import a previously prepared sample information file in Excel book format. The sample information file will be created in the following format.

	A	B	C	D
1	Sample Name	Thickness [um]		
2	Sample1	100		
3	Sample2	20		
4	test	35		
5	re-test	30		
6				

Position Adjustment

Click on **Position Adjustment** and the network analyzer will detect the resonance peak. If the position adjustment fails, please refer to the following items.

1. if no peak is detected, or if the following message appears, the sample holder may be positioned too far from the center.



As instructed, turn the micrometer knob in the arrow direction until you feel it tight (the sample holder has moved to the left limiter), and back off for 20 counts.

Click OK to re-search for peaks.



NOTE

The sample holder is moved left or right by turning the micrometer. To prevent excessive movement, there are limiters on the left and right sides of the sample holder. If the sample holder hits the left limiter, the micrometer cannot be turned any further. Do not turn it by force, or it may be damaged. If the sample holder hit the right limiter, you can continue to turn the micrometer, but the sample holder will not move any further.

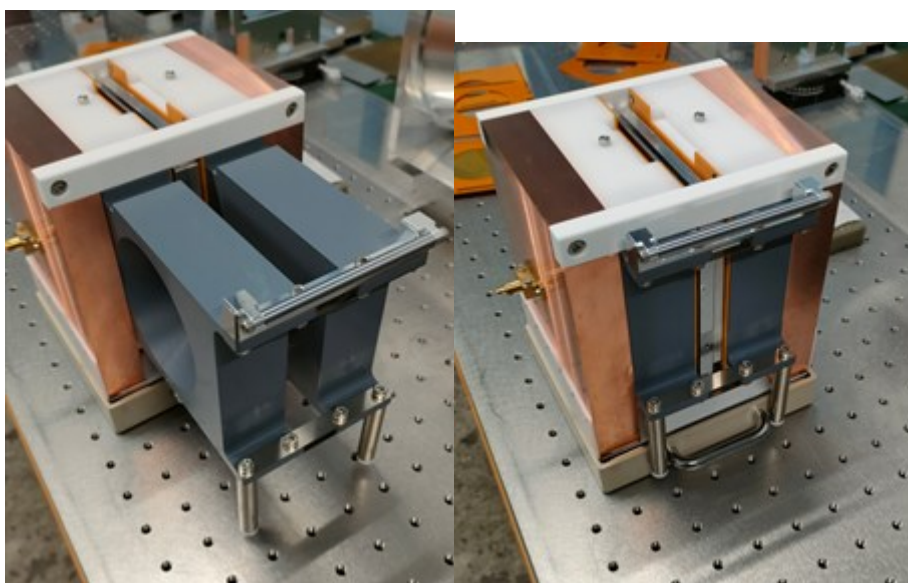
2. If the sample holder hits the right or left limiter before the trace in the screen reaches the bottom and cannot be adjusted any further, the following causes may be considered.

- The sample is warped or undulated.
- The sample is not firmly seated between the sample plates.
- The sample plates are not firmly seated in the sample holder.

Place the sample between the sample plates so that the warp or waviness of the sample is as small as possible, and then place the sample plate firmly in the sample holder. Swapping the left and right sides of the sample plates may work. If this does not work, the sample may need to be processed flatter.

FP-Broadband: Operating the band selector

Pull the handle on the top of the band selector on the back of the resonator to operate it. Below, on the left is the pulled-out state, and on the right is the pushed-in state.



FP-Broadband : Switching Low/High

Set the band selector on the back of the FP-BB resonator properly: on Low, pull the band selector out completely by holding the top handle; on High, push it in completely.



In the case of High band, $\Phi 45$ mm sample plates with a small aperture can be used. This is useful when measuring warped samples or samples smaller than $\Phi 65$ mm.

NOTE

When measuring in Low band, always use $\Phi 65$ mm sample plates; using $\Phi 45$ mm sample plates in Low band will result in a large measurement error.