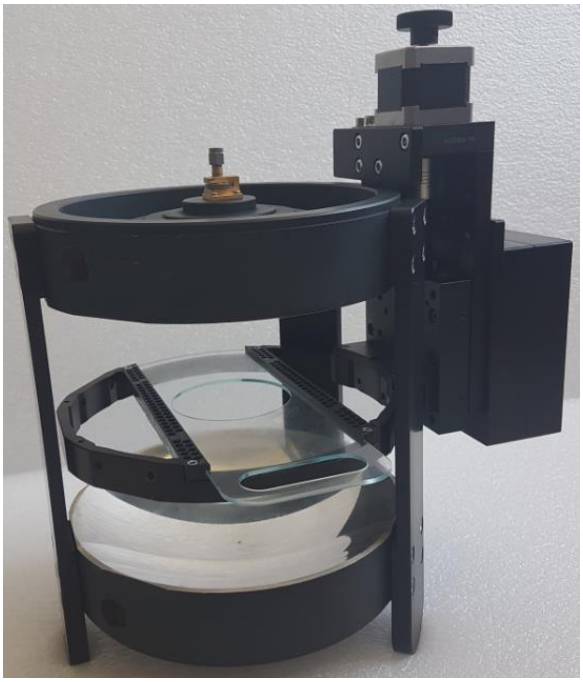
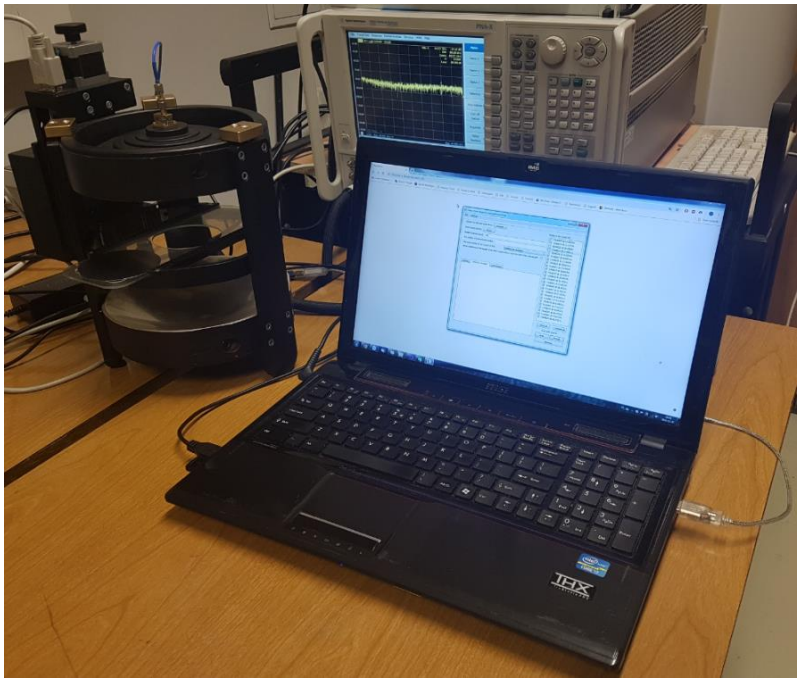
FABRY-PEROT OPEN RESONATOR 20-50 GHZ (MODEL FPOR50.1) TECHNICAL SPECIFICATION

QWED manufactures a novel type of a **Fabry-Perot open resonator (FPOR)** with Gaussian mirrors for automated broadband and precise room temperature resonant measurements of electromagnetic properties of flat samples of low-loss dielectrics in the **20-50 GHz** frequency range. The FPOR system is equipped with a specialized software controlling the measurement process and extracting complex permittivity of the material under test from the measured frequency and quality factor.



FPOR



FPOR measurement setup

The whole measurement setup consists of a computer, where the aforementioned control software is installed, connected to the FPOR system and to a vector network analyzer (PNA-X N5245A, Keysight) via a GPIB cable, so that the whole measurement can be easily processed. The FPOR operates at consecutive $TEM_{0,0,q}$ odd modes spaced every 1.5 GHz, so the total number of measured frequency points is 20.

The system allows measuring samples with the following properties:

1. **dielectric constant**: $\varepsilon' = 1 \ldots 15$ (accuracy: $\Delta\varepsilon'/\varepsilon' < 0.5\%$)
2. **loss tangent**: $\tan\delta < 10^{-2}$ (accuracy: $\Delta\tan\delta/\tan\delta < 2\%$)
3. **thickness**: 50µm – 3mm
4. **diameter**: >75mm

Due to a sophisticated adaptive algorithm implemented in the control software dedicated to precise and robust tracking of the modes during the measurement, total measurement time usually does not exceed **10 minutes**.

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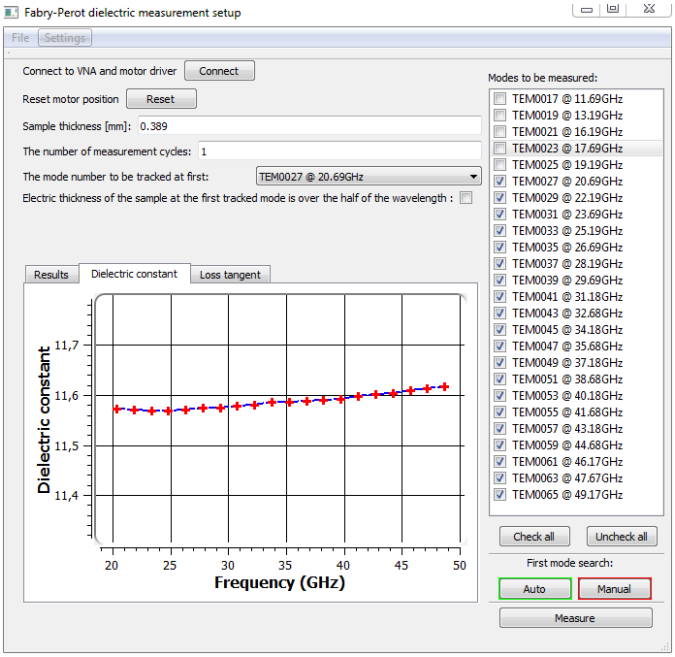
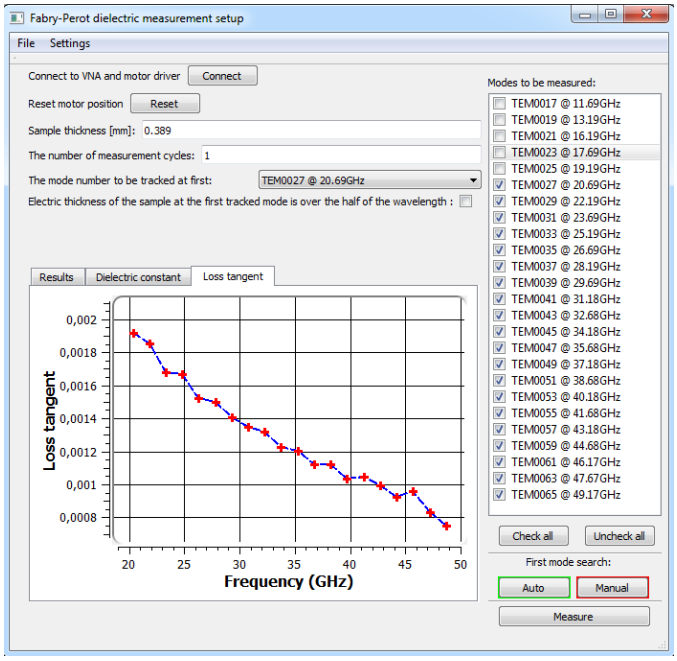
Control software with measurement results for silicon (t=389 μm)





Parameters of a Fabry-Perot Open Resonator (FPOR)

Application	FPOR is intended for the measurements of the complex permittivity of low-loss laminar dielectric materials.
Accuracy of measurements	$\Delta\varepsilon/\varepsilon$ = ±0.5% for ε = 1…15 $\Delta\tan\delta/\tan\delta$ = ±2% for $\tan\delta \leq 2\%$
Operational frequency range	FPOR uses consecutive $TEM_{0,0,q}$ odd modes spaced every 1.5 GHz, so the total number of measured frequency points is 20 in the 20-50 GHz range.
Operational temperature range	room temperature
Additional equipment needed to perform measurement	Vector Network Analyser (e.g. Keysight, N5245A) and National Instruments 488.2 GPIB controller
Measurement procedure	The whole measurement is automated and controlled via dedicated software installed on a PC computer. At first, resonant frequencies and Q-factors of $TEM_{0,0,q}$ odd modes of the empty resonator are measured. Afterwards, sample is inserted onto the holder and all the modes of interest are adaptively sought for and the changed resonant frequencies and Q-factors are measured in order to extract dielectric constant and loss tangent by comparing the results with a look-up table computed with a dedicated FPOR electromagnetic model.
Additional information	The thickness of the sample should be in the 50□m – 3mm range, while the diameter should exceed 75 mm.