MEMS characterization tests

Key Moku instruments needed for MEMS device characterization

Microelectromechanical systems (MEMS) require painstaking testing and validation. With the right tools for verification, you can streamline MEMS integration and design while ensuring peak performance.

Waveform Generator	Oscilloscope / Spectrum Analyzer	Lock-in Amplifier	Frequency Response Analyzer	Digital Filter Box	Data Logger	Time & Frequency Analyzer
Generate signals to apply to the device under test (DUT)	Measure the output of the DUT in the time and frequency domains	Extract information from low-SNR results	Perform Bode analysis on the DUT	Filter excess noise or provide signal preemphasis	Log data at rates up to 10 MSa/s	Configure thresholds, measure intervals, and timestamp events

Performing common MEMS tests with Moku

Measuring response time

Instruments needed: Waveform Generator, Oscilloscope, Time & Frequency Analyzer

1. Establish device baseline output without changing the input.
2. Apply a step input signal to the DUT.

Note: The type of signal depends on the type of DUT. Feel free to use a different signal.

3. Measure the time it took the device to transition from the baseline state to the response from the step input, or 10–90% of the final value, using the configurable event thresholds of the Time & Frequency Analyzer.

4. Repeat this measurement under different operating conditions.

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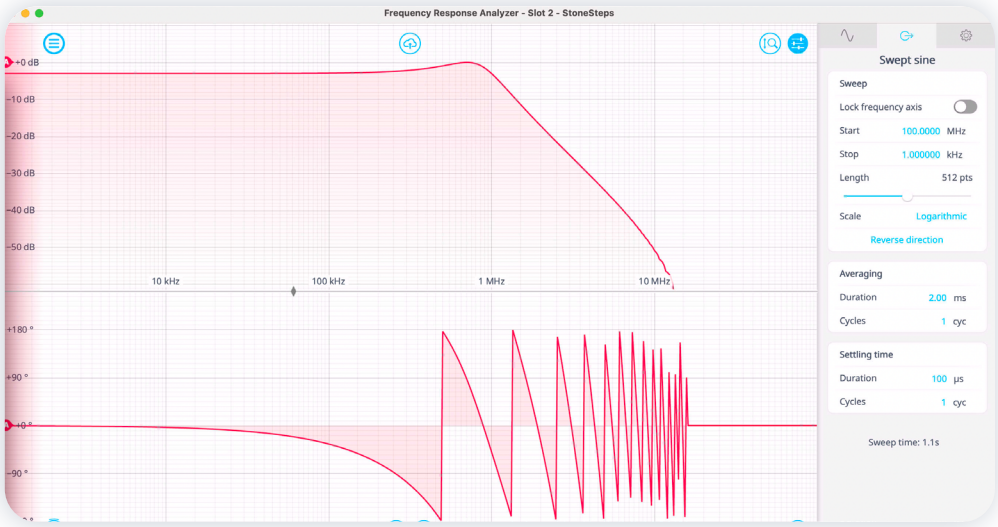
Frequency response analysis

Instruments needed: Frequency Response Analyzer, Digital Filter Box

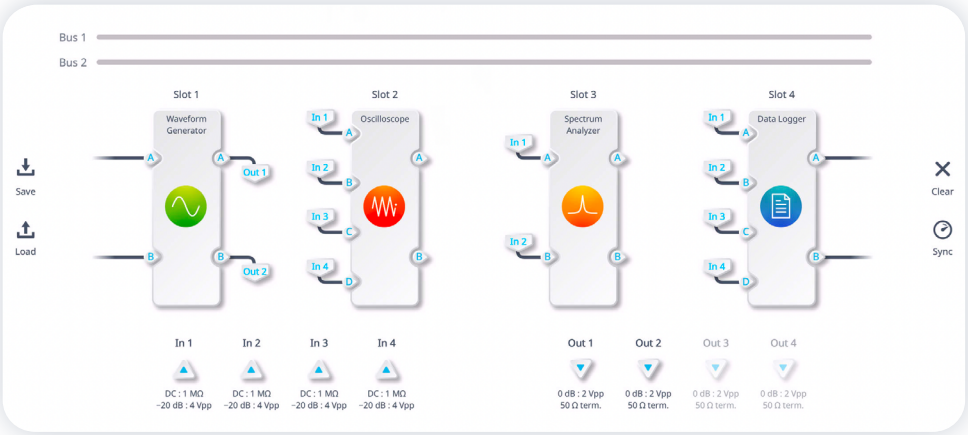
1. Set up a Multi-instrument Mode configuration with a Digital Filter Box (for filtering and amplification) and Frequency Response Analyzer.
2. Perform a frequency sweep to measure the amplitude of the MEMS device's response at each frequency. Look at the phase shift introduced by the device at different frequencies.
3. Identify any resonance frequencies, where the MEMS device exhibits the highest transmission amplitude.
4. Calculate the 3 dB cutoff frequency/bandwidth of the device to identify the operating range of the device.
5. Check for distortion and nonlinearities.
6. Perform this test under different environmental and temperature conditions.



Calibrating your MEMS device

Instruments needed: Waveform Generator, Data Logger, Oscilloscope, or Spectrum Analyzer

1. Use a trusted, stable source to generate a known signal.
2. Measure the response of the DUT to the known signal.
3. Record the results using a Data Logger or Oscilloscope.
4. Establish a relationship between the input and output, or a calibration curve.



5. Determine correction coefficients based on this curve. Apply these to the DUT and repeat measurements.

MEMS characterization tests

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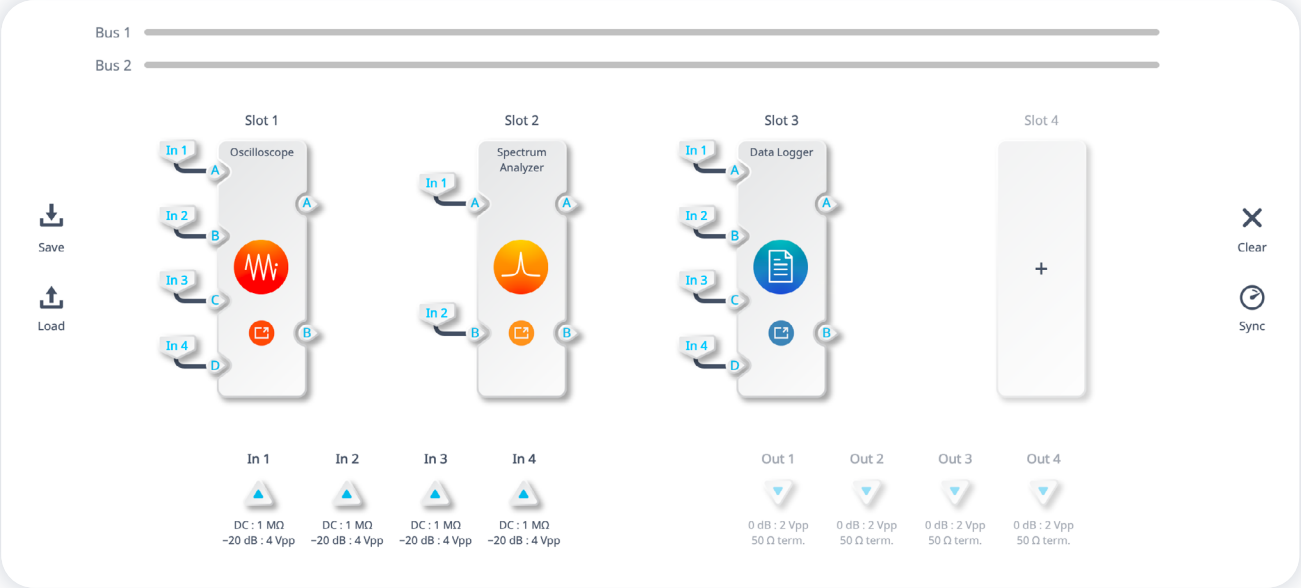
Measuring the mean time between failures (MTBF) for device reliability

Instruments needed: Data Logger, Spectrum Analyzer, Oscilloscope



1. Define what the failure events include: hardware failures or software failures.
2. Operate the device over a defined period of time and record the number of failures.
3. Calculate the MTBF for each type of failure:

$$MTBF = \frac{\textit{Total operational time}}{\textit{Number of failures}}$$

4. Monitor the failure rate over time for the most meaningful data.

Ready to test?

Explore configurations →

Have questions?

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