

# Accelerate Electret-Based Energy Harvesters Development with Precision Low-Level Dynamic Current Evaluation

## Development of Electret-Based Energy Harvesting Devices (Energy Harvesters) Is in Demand

- Energy harvesting system market is expanding rapidly with the acceleration of IoT technologies.
- The electret-based energy harvester is expected to be broadly used in sensor network systems since its simple structure can be easily miniaturized.

## Characteristics of Electret-Based Energy Harvesters

- Can maintain charges or polarization stably for long-duration and generate energy from minute vibrations.
- Its impedance is large, typically MΩ or more range.
  - Typical voltage probing method cannot evaluate the vibration power generation characteristics accurately since its input impedance is lower than the energy harvesters, that affects the energy harvester's circuit.
- The generated energy caused by the vibrations is in the range of several tens to several hundreds μW. The resultant current typically fluctuates at a very small nA range.
  - Low-level dynamic current measurement approach is required to evaluate the vibration power generation characteristics.

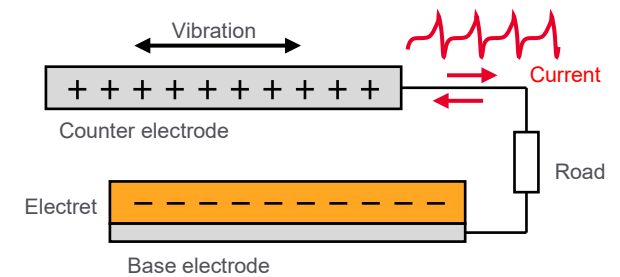


Figure 1. Schematic diagram of the electret-based vibration power generation

**Table 1. Challenges of Electret-Based Energy Harvesters Development**

Challenges	Requirements	Issues using conventional instruments
Power consumption levels are very low since the size reduction of the device leads to lower power generation levels.	<ul style="list-style-type: none"> <li>• Accurate low-level dynamic current characterization down to nA to precisely evaluate the electret power generator performance.</li> </ul>	<ul style="list-style-type: none"> <li>• Oscilloscope with I/V amplifier cannot measure low current at nA level due to large noise and low resolution.</li> <li>• Digital multimeter (DMM) cannot measure the dynamic current waveform precisely due to limited bandwidth and sampling rate.</li> </ul>
Assure high-reliability without anomalies for long-duration operation since the energy harvester is expected to be used maintenance-free once installed.	<ul style="list-style-type: none"> <li>• Long-duration high sampling measurement without interruptions to capture rare anomalies that can cause device malfunctions such as spike noise.</li> </ul>	<ul style="list-style-type: none"> <li>• Oscilloscope, DMM, and data logger can miss rare anomalies due to the limitations of memory depth, bandwidth, or sampling rate.</li> </ul>
Shorten time-to-market of the device yet ensure it achieves both low-power consumption and high-reliability to early establish competitive advantage in the expanding market early.	<ul style="list-style-type: none"> <li>• Powerful data analysis functions to accelerate debugging.                             <ul style="list-style-type: none"> <li>◦ Quick and easy identification of intermittent anomalies from extensive data collection.</li> <li>◦ Long-duration trend analysis of the amount of the electric power generated by vibration.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Design validation and debugging are time-consuming.                             <ul style="list-style-type: none"> <li>◦ Waveform data analysis functions of Oscilloscope, DMM, and data logger are very limited or none.</li> <li>◦ Manual identification and analyzing rare anomalies from extensive data is almost impossible.</li> </ul> </li> </ul>

## The CX3300 Series Waveform Analyzer Helps You with Electret-Based Energy Harvesters Development

**You can easily measure low-level dynamic current precisely.**

- CX3300A Series waveform analyzer has 200 MHz wide bandwidth, high-resolution / high-speed sampling at 16-bit (75 MSa/s) / 14-bit (1 GSa/s).
- CX1103A low-side current sensor provides low current sensitivity down to 150 pA and maximum 200 MHz wide bandwidth.

**You can perform long-duration measurement with a high sampling rate that captures rare anomalies such as spike noise.**

- The data logger mode measures up to 100 hours with a maximum of 10 MSa/s.

**You can debug quickly by using waveform classification and detailed waveform analysis features.**

- The Anomalous Waveform Analytics feature classifies large waveform data exceeding a terabyte to enable the identification of rare anomalies.
- The trend analyzer feature takes an in-depth look into the inflection nt from the entire waveform's visualized statistical trend.

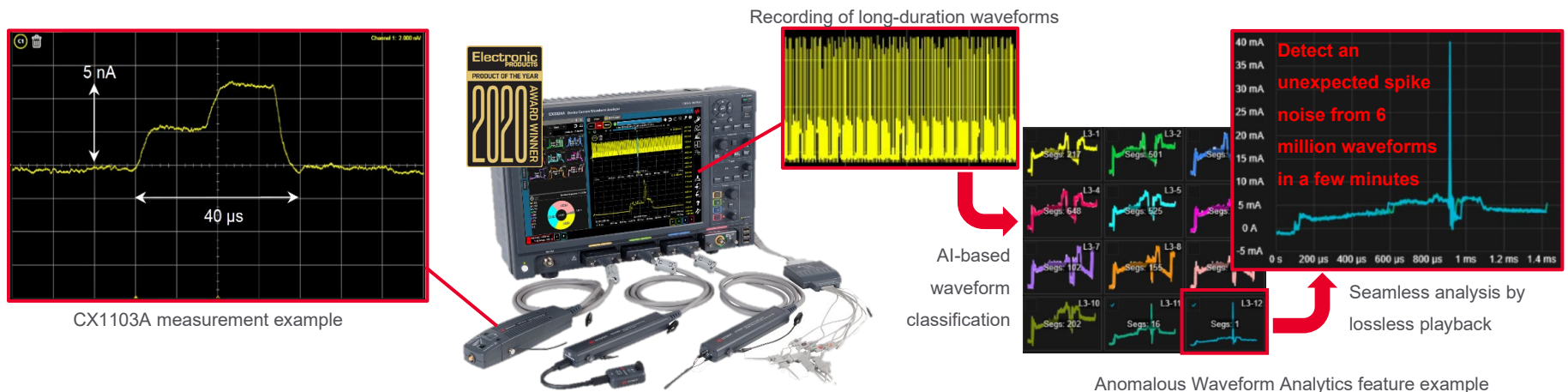


Figure 2. CX3300A device current waveform analyzer solution

### Summary

The CX3300 Series waveform analyzer has precision low-level dynamic current measurement capability at pA level and powerful waveform analytics features so you can:

- Improve the device design and power consumption performance by accurate characterization.
- Ensure the device's reliability by capturing rare anomalies during the long-duration operation.
- Shorten time-to-market of high-performance and high-reliability devices by quick anomalies identification and analysis from massive waveform data.

As a result, you can accelerate the development of electret-based energy harvesters with downsizing, low-power consumption, and high-reliability.

Learn more at: [www.keysight.com](http://www.keysight.com)

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