FRANÇAIS ENGLISH

cea leti

# Smart Predictive Maintenance

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## AI-assisted ultrasonic sensors for the predictive maintenance of power components

### What it is

This predictive maintenance solution, designed for power converters, is based on an ultrasonic probe and a physics-informed neural network. A MEMS sensor integrated with the converter will replace the current external probe used to test the converter, detecting and locating any faults and providing an idea of the converter's health.

The results include a recommendation to replace the converter if necessary, an estimated remaining service life, and optionally a recommended adjustment to the converter's operating regime to extend the remaining service life of the components and of the converter itself.

### What it can do

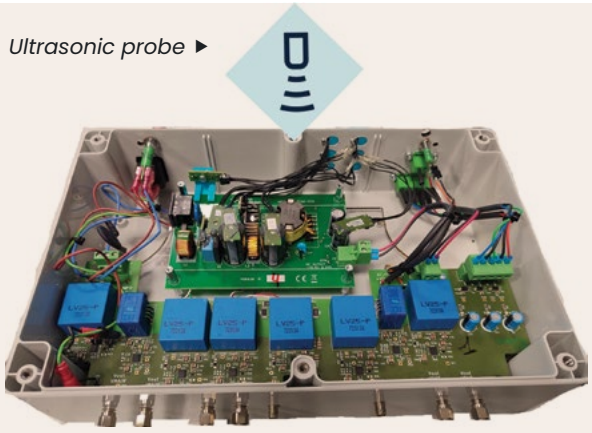
The electrification of equipment in virtually all industries, from mobility to renewable energy, has made power converters more important than ever. The ability to monitor power converters remotely and in real time would enable truly predictive maintenance, reducing the maintenance costs and environmental impacts associated with:

- Any system or machine that has a power converter, electric drivetrains, etc.
- Electric vehicle charging stations (e.g., for monitoring the health of a fleet of charging stations)
- Wind turbines—especially offshore—smart grids
- Datacenters

## What makes it unique

The combination of CEA-Leti's physics-informed neural network with ultrasonic sensors, the major innovation in this new solution, offers several advantages:

- Totally non-invasive for remote (and, potentially, integrated) monitoring, without the need to modify or shut down the system monitored.
- Physics-informed AI guarantees the physical nature of the data and reduces model sizes, lowering computational overhead for more frugal AI with no tradeoffs concerning the accuracy of the results.
- The inference (decision-making) layer can be tailored to specific applications.




▲ *System under test*

## Working with CEA-Leti

This solution is designed for the end-users of products with power converters, power conversion system integrators, and OEMs in the automotive, aerospace, rail, and datacenter industries. Power converter manufacturers can leverage CEA-Leti's characterization capabilities to bolster their factory quality control processes.

Companies of all types and sizes can work with CEA-Leti on projects spanning the entire value chain through single-partner R&D contracts or multi-partner programs. And, with CEA-Leti's "lab-to-market" partnership model, each project is supported until the technology is ready for transfer.

## Key figures

- A component efficiency-estimation error rate of less than 1%
- Fault detection and location 99%+ accurate in under 3 ms
- Effective at distances of up to 10 cm between the probe and converter

## Scientific publications


- Fassi, Y., et al. (2026). *Explainable and Non-Invasive Ultrasound-Based Capacitor Condition Monitoring in Power Converters.* International Power Electronics Conference
- Fassi, Y., et al. (2025). *Ultrasound-Based Condition Monitoring of Power Converters with Physics-Informed Compression.* European Conference on Power Electronics and Applications. doi: 10.34746/epe2025-0144.


## Interested in this technology?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