Insight VNA Calibration and Measurement Software

DATA SHEET / 4T-023

INSIGHT SOFTWARE SUITE MODULES:
MT940A – Insight Calibration and Measurement
MT940B – Insight Real Time Uncertainty Add-On

insight™
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Introduction

From their introduction in the 1980s, Vector Network Analyzers, VNAs, have been used to measure network scattering parameters, S-parameters, of linear electrical networks. Since that time, S-parameters have become so common that they are used in nearly all aspects of an RF device's life cycle including research and development, design validation test and production test.

It is not uncommon to walk into an RF lab and see VNAs from various vendors spanning multiple generations being used interchangeably, from the original HP 8510 to the latest Keysight PNA-X. With so many different VNAs in use, each with different interfaces and capabilities, several challenges arise:

- How can we ensure VNA users are properly trained on every model available in their labs?
- How can simple mistakes due to differences in terminologies, calibration standards definitions and calibration flows be avoided?
- How can we validate VNA calibrations in a meaningful way so that users can have confidence in their measurements?

And it's not enough to think about a single lab; today's global organizations have multiple labs across various countries and multinational teams that collaborate on projects. This introduces another set of challenges:

- How can users save important measurement data in a format that is usable by everyone?
- How can the visualization and analysis process be simplified yet made more powerful to that better decisions can be made more efficiently?

And finally, as we strive to understand more about our RF device's performance, challenges related to uncertainty arise:

- How can we identify all the sources of uncertainty in our measurement setup?
- How can we quantify the uncertainty and use it in making better decisions?

Insight VNA Calibration and Measurement Software

Welcome to Insight, the industry's first commercial software suite designed to empower VNA users and help them make better decisions. Insight represents a paradigm shift in the way users approach VNA calibration, validation, measurement, visualization and analysis. With Insight, users can:

- Use a single software platform with most commercial VNAs*
- Define mechanical calibration standards from any vendor and use with all VNAs
- Avoid common errors with a simplified calibration process empowered by an intuitive GUI and wizard
- Validate VNA calibration using airlines and individually characterized verification kits
- Measure S-parameters and save S2P files for easy sharing
- Understand measurement results better with advanced visualization and analysis tools
- Identify and quantify the individual contributions of uncertainty**
- Display uncertainty boundaries alongside measurement results

** Insight ships with an extensive library of VNA drivers; additional drivers may be added upon request*
***Utilizing techniques described by EURAMET*

MT940A Insight Calibration and Measurement

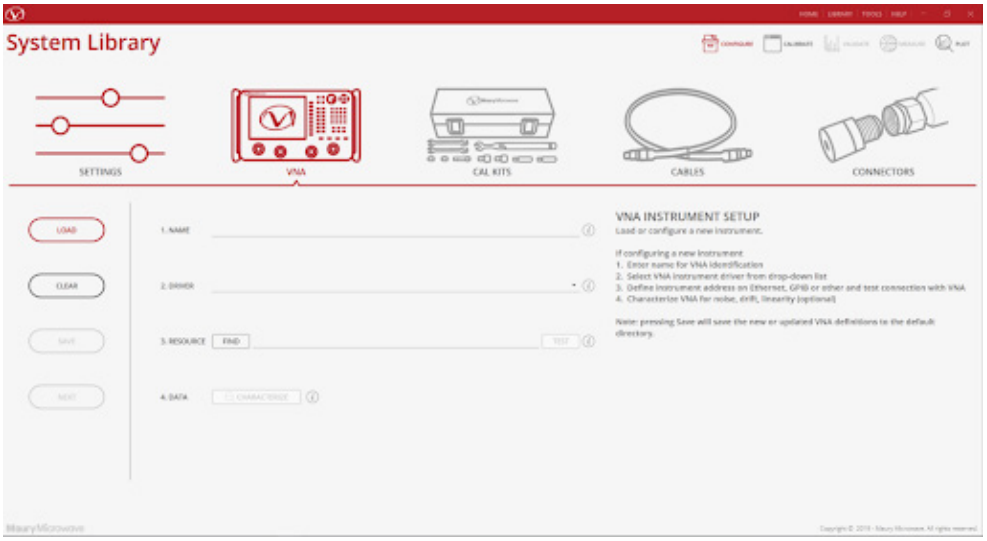
MT940A Insight Calibration and Measurement software module includes everything needed to calibrate a VNA, validate VNA calibration, measure an RF device's S-parameters, and visualize and analyze the measurement results. Features of MT940A include:

- System library
- Calibration wizard
- Calibration validation wizard
- Real-time measurement interface
- Visualization and data analysis tool

System library

The system library is the database of instruments and accessories used to calibrate, validate and measure an RF devices' S-parameters. This includes:

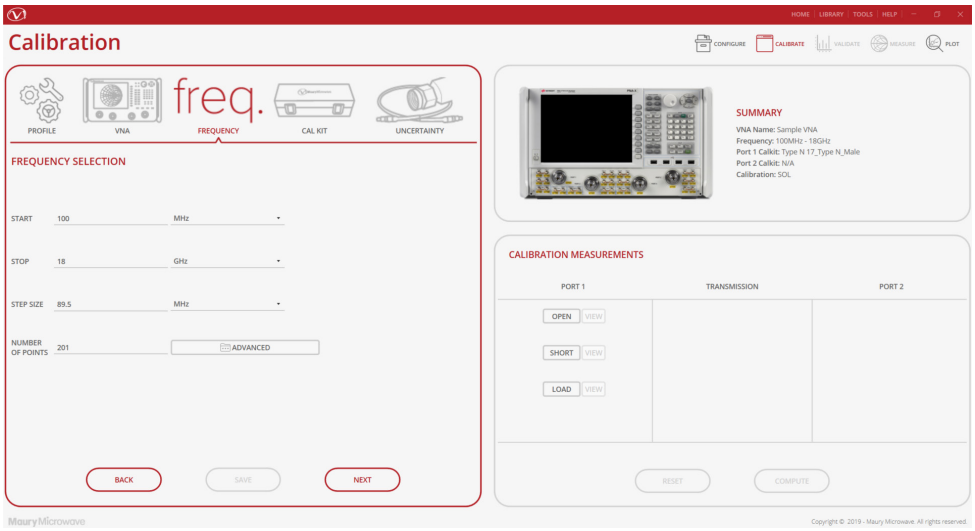
- VNA – create a database of available VNAs including selecting the appropriate VNA driver and defining the GPIB or network address
- Cal kits – create a database of available VNA calibration kits, including connector type and gender, and whether the kit uses polynomial definitions or individually Characterized Device (CD) standards
- Verification kits – create a database of available Maury VNA calibration verification kits



Calibration wizard

The calibration wizard guides users through the calibration process, including:

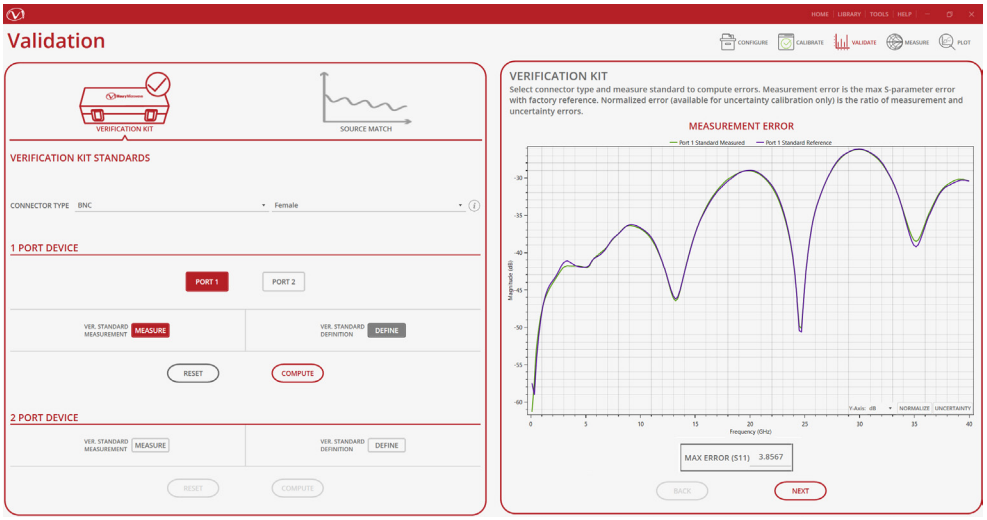
- Selecting the VNA from the database and defining the VNA properties (port numbers, power, averaging, IF bandwidth...)
- Defining the frequencies for calibration (linear step or custom list)
- Selecting the calibration kit from the dataset and defining the calibration method
- Calibrating by connecting and measuring each standard and computing error terms



Calibration validation wizard

The calibration validation wizard guides users through the validation process, including:

- Selecting the VNA calibration verification kit from the database
- Validating Source Match using beadless airlines
- Validating using Characterized Device (CD) verification kit which compares a user's measured data against factory-measured data and calculates error vector



Real-time measurement interface

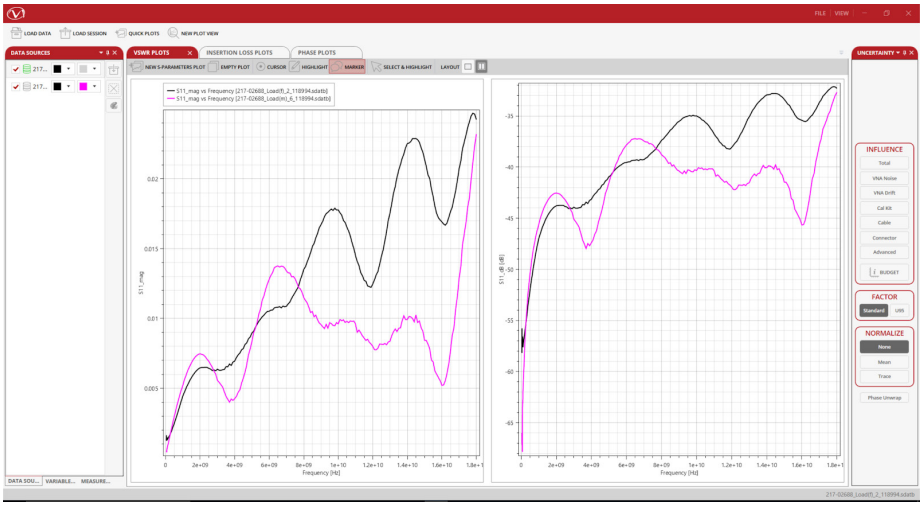
The real-time measurement interface empowers RF device measurements, including:

- Setting VNA options (IF bandwidth, averaging, port power)
- Defining plots to visualize measurement data
- Setting sweep mode (single, continuous, hold)
- Saving measurement data to memory or as S2P files
- Comparing/normalizing data sets for analysis
- Creating specifications files for comparison and analysis

Visualization and data analysis tool

The visualization and data analysis tool empowers users to visualize and analyze measurement data, by:

- Creating, saving and sharing visualization templates, or use a quick plot, to ensure consistent and repeatable measurement analysis
- Creating sessions (template and measurements data) to share among collaborators
- Loading and comparing multiple saved data sets
- Creating custom expressions from measured S-parameters
- Exporting data as CSV and image files



MT940B Insight Real Time Uncertainty Add-On

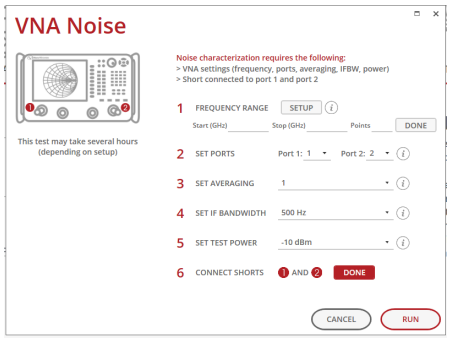
MT940B is an add-on module for MT940A which enables real-time uncertainty analysis based on EURAMET guidelines, including:

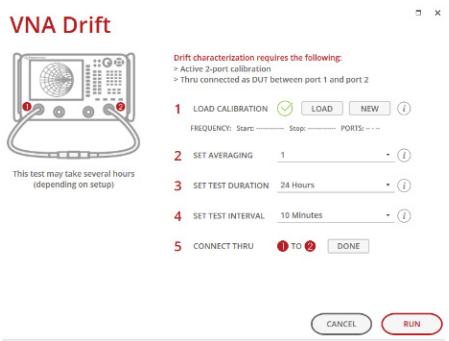
- Uncertainty quantification
- Uncertainty calibration validation
- Uncertainty measurements
- Uncertainty budget

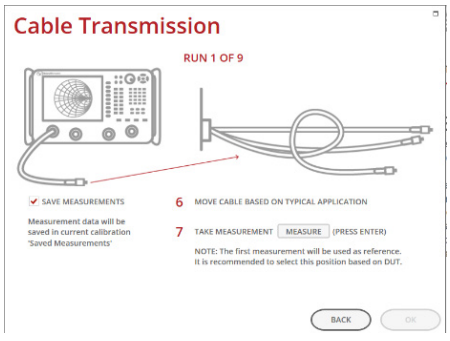
Uncertainty quantification

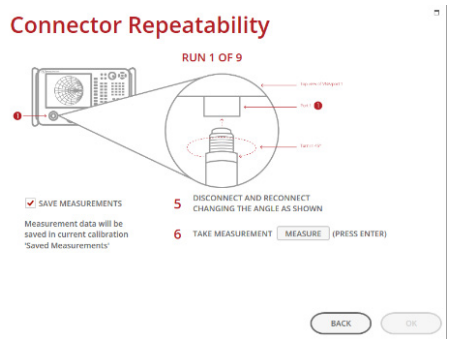
Identifies and quantifies the uncertainty contribution of each component in a measurement setup. This includes:

- VNA – characterize VNA drift and noise floor
- Cal kit – load factory uncertainty data
- Cables – characterize the transmission and reflection stability of the cables used in a measurement setup (related to amplitude and phase stability with flexure)
- Connectors – characterize connector repeatability of the connectors used in a measurement setup (related to the impact of pin depth, concentricity, user etiquette)



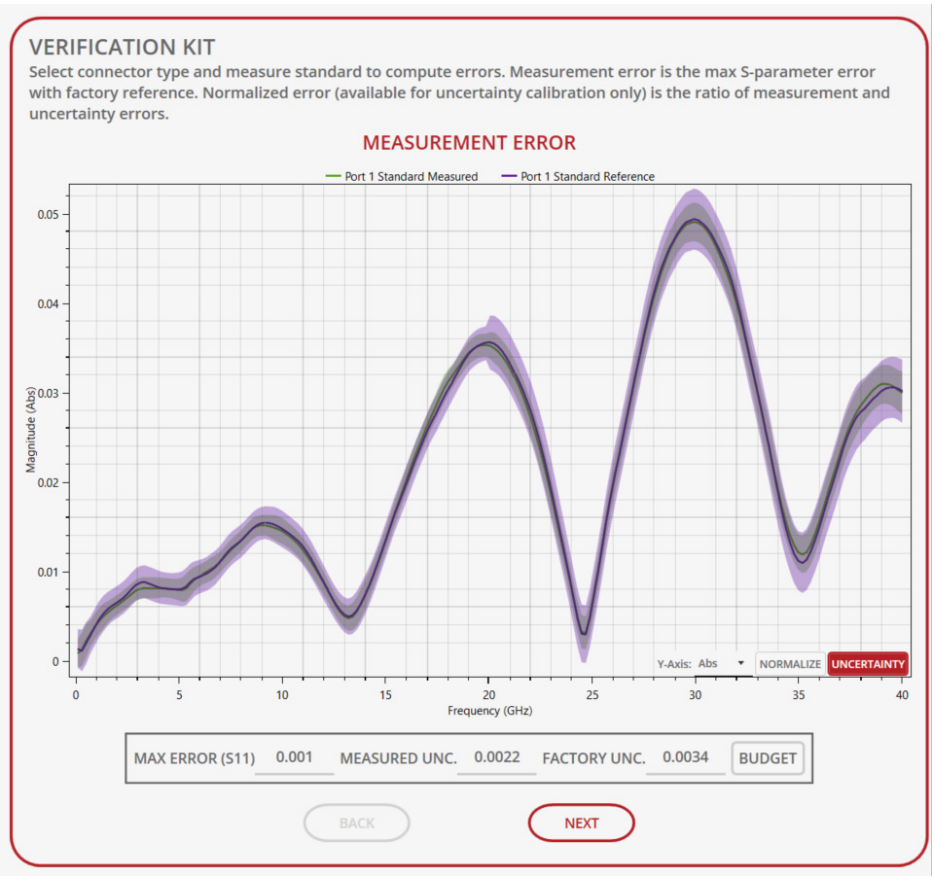


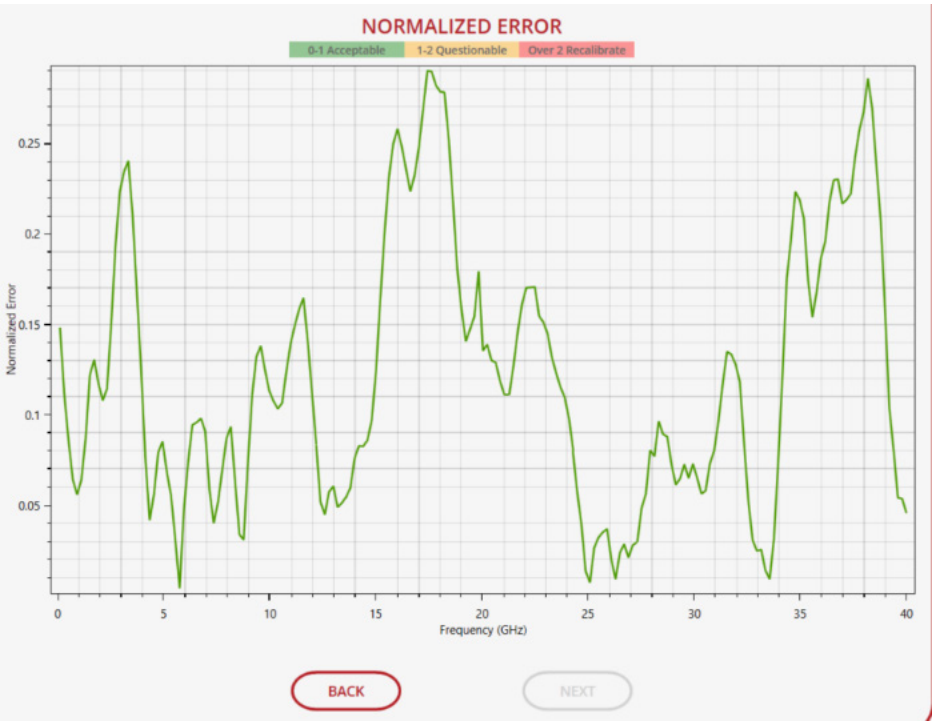




Uncertainty calibration validation

When used with a Characterized Device (CD) calibration kit and Characterized Device (CD) verification kit, uncertainty calibration validation compares the uncertainty boundaries measured on a verification device by the user with the uncertainty boundaries measured on the same verification device at the factory, and defines a passing validation as one where the measurement uncertainty boundaries overlap.



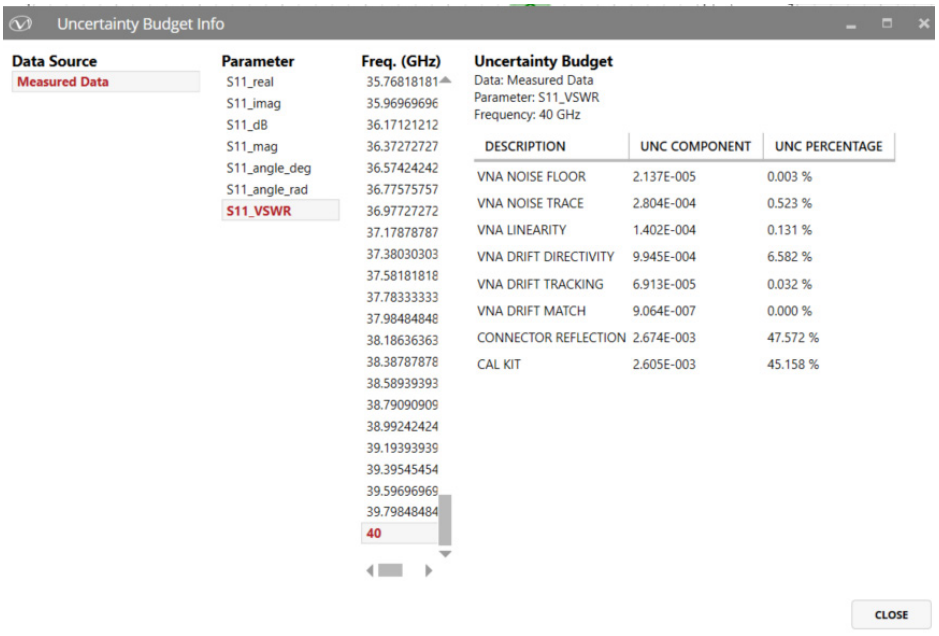


Uncertainty measurements

Individual uncertainty contributors can be activated, or de-activated and measurement data can be plotted with uncertainty boundaries.

Uncertainty budget

Reports the individual uncertainty contributions of VNA, cal kit, cable and connector as a percentage of the total for each frequency and enables users to concentrate on improving the largest contributors for more certain measurement results.



A Note About Validating a Calibration by Using Uncertainty Boundaries

Validation is by far the most important step in a measurement process; without validating, how can RF device measurements be trusted?

Conventional validation techniques rely on an estimate of the residual errors after a calibration, source match, directivity and tracking, and are typically evaluated by measuring peak-to-peak ripple through a TDR method. These techniques rely on an airline as the validation standard, and the accuracy of the validation can be severely impacted by how well the airline has been machined and handled.

A more thorough approach is based on the use of verification standards. This method involves a user measuring pre-characterized verification devices with similar performances to their own device. However, there is no clear pass-fail criteria that identifies whether a calibration is sufficiently accurate to proceed to device measurement, or whether a calibration needs to be repeated.

Insight solves the problem by defining clear pass-fail criteria based on using uncertainty boundaries. When the uncertainty boundaries measured on a verification device by the user overlaps the uncertainty boundaries measured on the same verification device at the factory, it is defined as an accurate calibration. If the boundaries do not overlap, then recalibration is recommended. Insight automates this process by guiding users through the calibration validation and clearly identifies whether the calibration can be used or must be repeated

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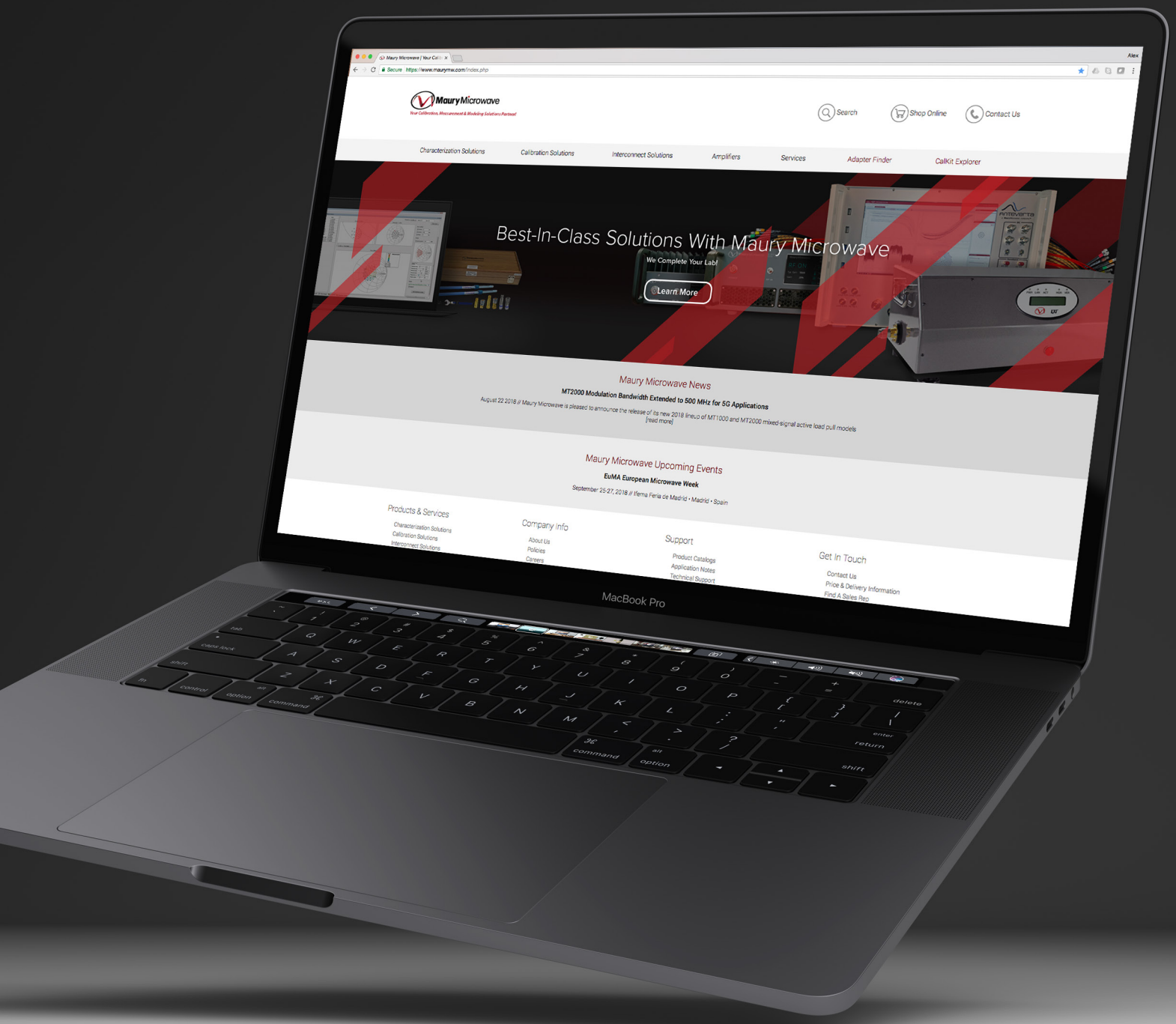

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