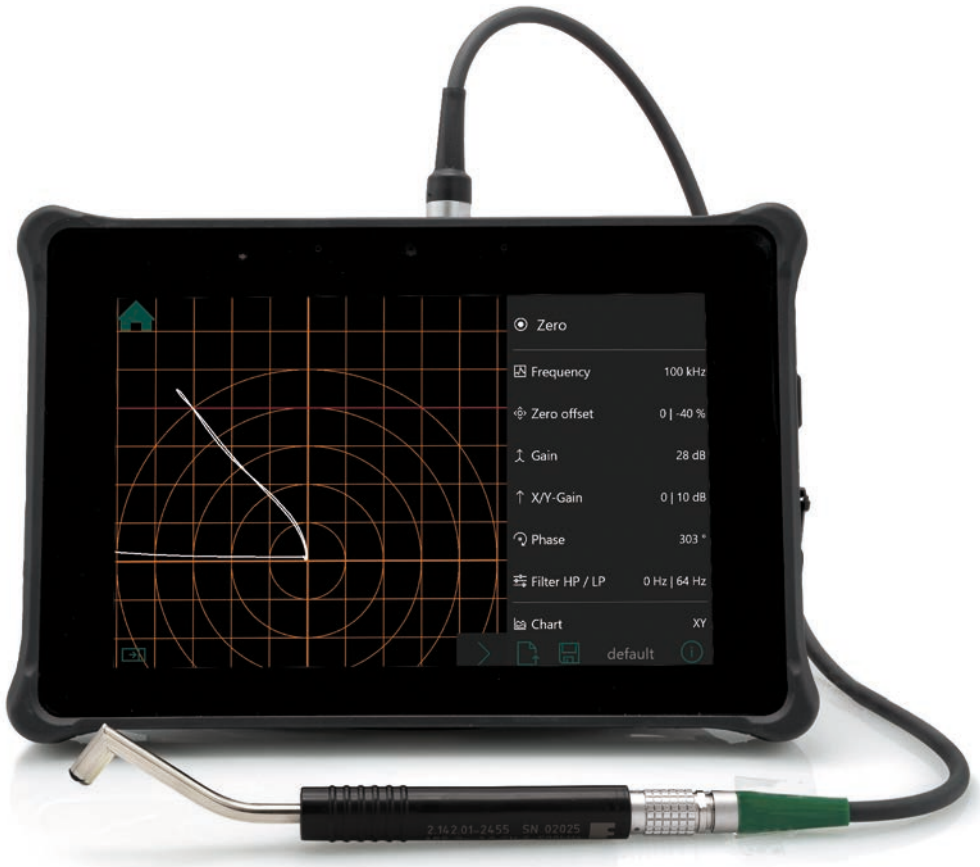
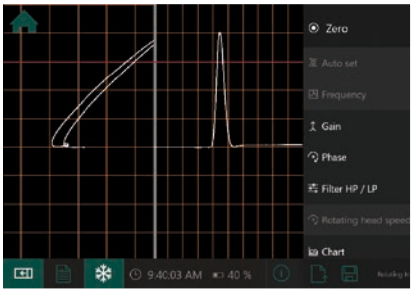
FOERSTER

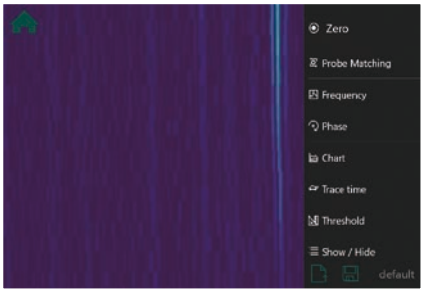
TCM 2.142

Mobile universal device for non-destructive eddy current testing



TCM 2.142 – One platform for all your eddy current testing tasks





Designed for multipurpose use

Mobile testing often requires a variety of testing systems. FOERSTER's versatile new TCM serves as a unifying platform for established eddy current testing products.

Deep-penetrating low frequency (LF) testing with DEFECTOSCOP for measuring residual wall thickness and high frequency (HF) testing with DEFECTOMETER for detection of the smallest cracks are now integrated in a single device. The TCM platform also covers conductivity measurement of non-ferromagnetic materials.

The intuitive touch interface allows the user to select the individual tasks via corresponding apps. Automatic probe recognition helps you set the optimal test and measurement parameters to achieve the best possible results.

Software modules available

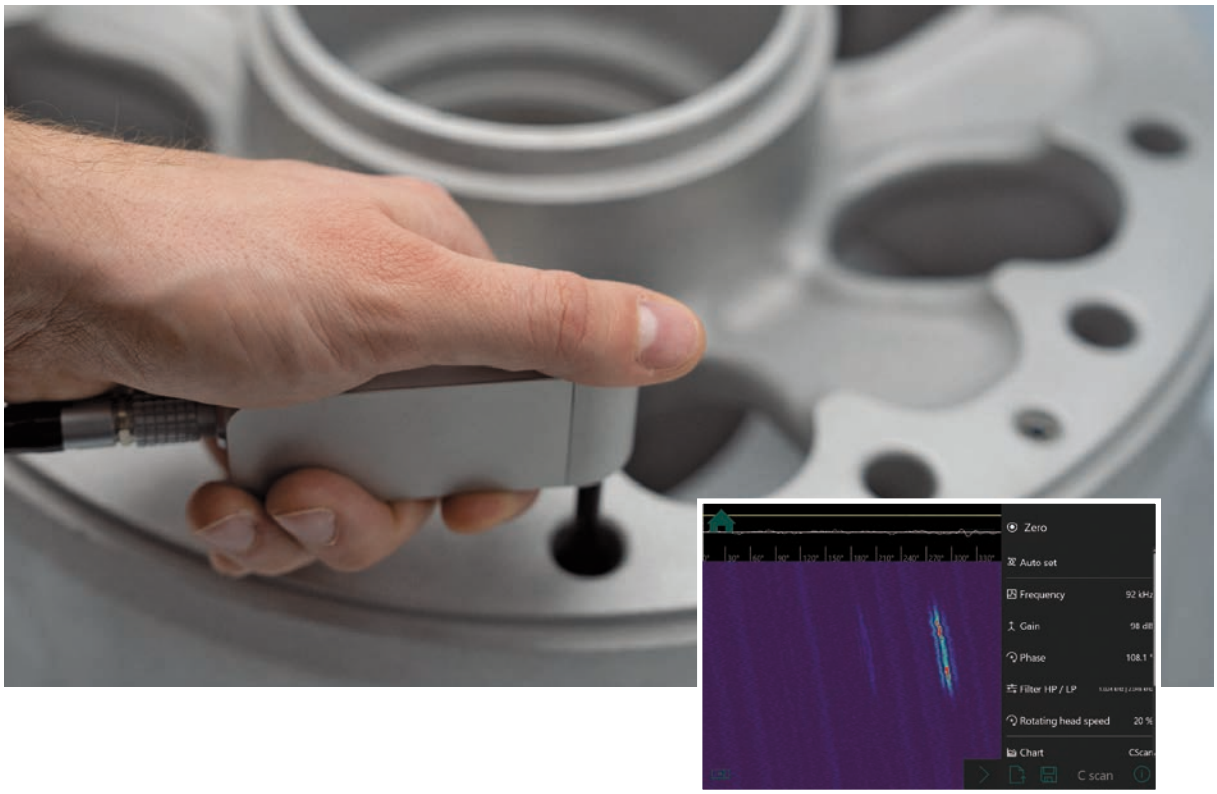
- **DEFECTOSCOP:** universal eddy current testing with rotating, HF and LF probes.
- **SIGMATEST:** measures electrical conductivity of non-ferromagnetic metals.
- **ECA (Eddy Current Array):** eddy current testing via sensor arrays with up to 512 channels.

Ready for a wide variety of applications

With its robust design and all the functional modules that work with it, the TCM is a single-point solution for applications such as:

- **Sorting tests:** differentiating between materials or sorting out hard from soft components.
- **Conductivity measurement** on aircraft structures, for example.
- **Crack testing on bridges and rails**
- **Crack testing on ground surfaces:** detecting cracks as shallow as 20 µm.

Universal eddy current testing with DEFECTOSCOP



The benefits

- **Eddy current testing with rotating, HF, LF applications, etc.** to solve a wide variety of test tasks, either using your own sensors or sensors adapted by FOERSTER.
- **C-scan:** data from a hand-held rotating probe can be displayed in a high-resolution C-scan
- **Multi-frequency inspection with up to 8 frequencies** to check at different material depths for discontinuities in a single pass, or to reduce interference via frequency mixing.
- **Post-processing of 'frozen' eddy current data:** freeze an eddy current signal and then edit parameters such as gain, phase, high-pass and low-pass filters.
- **Flexible probe selection:** connect a wide variety of sensors, such as parametric, transformer or bridge probes.

Conventional eddy current testing in impedance plane view

The DEFECTOSCOP module uses all typical parameters of a universal eddy current tester and displays the measurement data in the impedance plane. A user working in expert mode can easily customize the list of available parameters and store them in the test program. Additionally, favorites can be defined so the module starts up quickly the next time. Switching from expert mode back into operator mode locks the parameter list and system settings for editing, saving time and effort.

Optionally, multiple frequencies can be added to the test program so that parallel testing can be carried out at different eddy current penetration depths. The color representation of the frequencies can be adjusted as desired.

Recordings of spinning components or hand-held rotating probes can be displayed directly in a high-resolution C-scan, allowing the test area to be easily evaluated and fully documented. Or, the raw data of the eddy current signal can be recorded and exported for later evaluation on the workstation computer.

Measurement of electrical conductivity with SIGMATEST

The benefits

- **Wide frequency range** allows for measurement of different material thicknesses.
- **Shielded probes** help avoid edge effects.
- **Reduced wear:** specially designed probes with durable titanium protection ensure long service life.
- **Easy handling:** automatic recognition of the probes and loading of the correct calibration curves.

Precise and reliable conductivity measurement

Conductivity measurement determines physical and technical material properties. Ideal for quality control on manufactured products, the SIGMATEST is also useful for testing material compositions and sorting metals, alloys and scrap. Further applications include the detection of heat damage during aircraft maintenance, as well as process control in production in the metals industry.

The SIGMATEST module is used with special conductivity probes that are calibrated to traceable conductivity standards (PTB/NIST or NPL) at 20°C in the FOERSTER calibration laboratory. The calibration data are stored on the sensor and retrieved by the TCM. This enables exact conductivity measurements.

A single measurement is triggered by touch. If a scan of the surface is required, measured values can be output continuously and displayed in a time diagram.

Large-area testing with ECA

The benefits

- **Large-area testing** with arrays of up to 512 probe elements in parallel.
- **Easy handling:** automatic detection of probes and setting of relevant hardware parameters.
- **Localization of defects:** spatially resolved eddy current data for positionally accurate defect detection.
- **100% documentation:** eddy current images can be saved as PNG or PDF.

Eddy current testing with sensor arrays

When the areas to be scanned are large, conventional eddy current inspection can be very time-consuming. Plus, there's the risk that manual probe guidance will leave some areas uninspected. The ECA module makes it possible to run both large-area and shape-matched array probes. This permits large areas to be scanned both quickly and comprehensively.

Array probes consist of several individual sensors arranged in a row inside a housing, for example. Connecting multiple sensors together in this way allows a larger area to be scanned at the resolution of each individual sensor.

Probes and standards for eddy current testing and conductivity measurement

The right probe for every application

A wide variety of probe elements with corresponding properties are available for **crack detection**.

- **Absolute probe:** not direction-dependent; high influence from the base material.
- **Difference probe:** directional (blind to longitudinal defects); low material influence.
- **Cross-winding probe:** directional (blind to 45° defects); low material influence.

Each of these probe elements can be incorporated into a wide variety of probe shapes. Besides a wide selection of standard sensors, FOERSTER also offers customized sensor shapes to access even the most hard-to-reach test positions. Likewise, a probe can be built with other options, such as integrated guidance or wear protection made of e.g. titanium. Each probe element can also be constructed as an array probe with up to 512 integrated elements.

All the probes available for the proven SIGMATEST 2.070 system can be used for **conductivity measurement**; they are also offered in a robust version with titanium protection. The following diameters are available.

- **14 mm**
- **8 mm**
- **5 mm**

Crack- and reference standards increase accuracy

For **crack testing**, the sensitivity of the testing system is adjusted using primarily flat crack standards made of the material under test. Since test sensitivity depends on the quality of the standard, the standards must comply with the highest dimensional tolerances. In order to additionally assure the quality after a point-by-point measurement, FOERSTER optionally offers an exact determination of the dimensions with a laser microscope.

Setting up test systems with rotating probes for crack testing requires standards – again, made of the material to be tested – with representative holes. These standards are offered in two variants:

- **Calibration block SCCS (split)**
- **Calibration block CSRP (with groove)**

Appropriate conductivity standards are used to check and set up **conductivity measurement** with the SIGMATEST module. The better the quality of this reference standard, the better the final measurement result. Therefore, even the raw material must meet strict requirements. For example, it must have a homogeneous material structure. FOERSTER offers conductivity standards traceable to an AC measurement of the NPL (National Physical Laboratory) as well as to a DC measurement of the PTB (Physikalisch-Technische Bundesanstalt).

Extensive range of accessories for diverse applications

Hand-held rotating head for inspecting boreholes
The hand-held rotating head drives the respective probe and transmits the sensor signals to the test instrument. FOERSTER's hand-held rotating head turns at up to 3000 rpm.

Docking station expands TCM's utility
The docking station turns the TCM into a full-fledged workstation. The high-performance Intel processor and Windows 10 provide for familiar handling, just like with a laptop. The docking station, along with an external monitor and keyboard, turns the TCM into a convenient workstation, allowing the user to write and edit reports or other documentation directly on the device.

Extended runtime with additional batteries
Batteries can be charged either externally, in a separate charging station, or directly in the TCM. A quick-charge function ensures the battery is full again after just a few minutes.

Shoulder strap for testing on the go
For testing tasks that take a little longer or require walking around, FOERSTER offers a comfortable shoulder strap that facilitates mobile use – and leaves your hands free for other purposes.

Ideally equipped, even under adverse conditions
The robust TCM can go with you on any field application. Signals are clearly displayed on the 8" HD touch display. With 800 nits (measure of the luminous intensity), its screen is easy to read even in strong sunlight. And the TCM's rugged design protects it even if dropped from a height of 1.8 m and against temperatures up to 50°C. And if it ever gets wet, this is no problem due to the IP 66 protection.

There's also a voice-controlled mode to execute commands like ZERO or FREEZE.

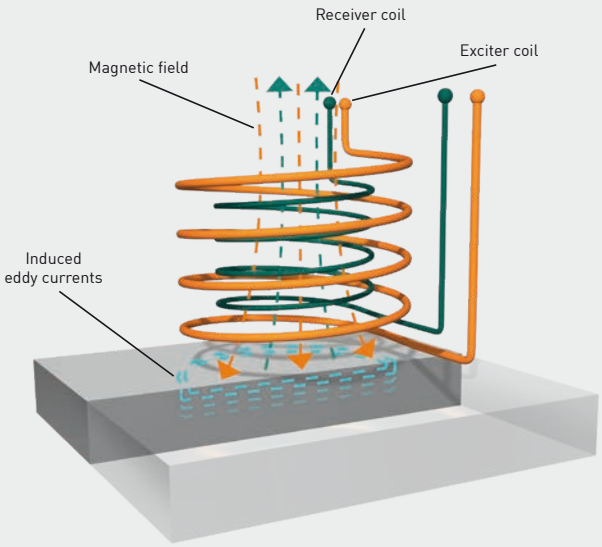
Visit our YouTube channel for foundation and operator videos.

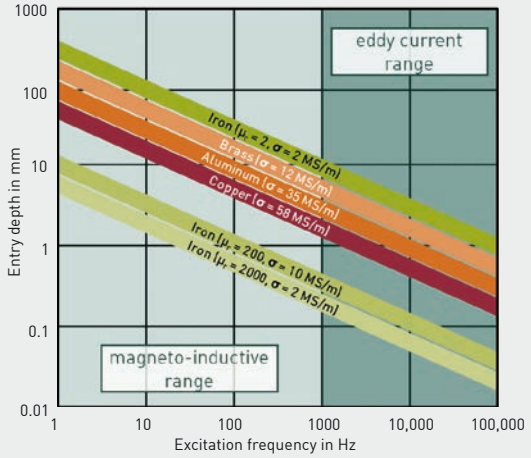
Technical data

Product features	TCM – General features
Display	■ 8.0" touchscreen, 1280 x 800, 800 nits, readable in sunlight ■ Switch between usage with finger or gloves ■ Choose different colors for signal view ■ Choose either grid or vector view
Protection	IP 66, 1.5 m drop height
Weight	1.3 kg
Dimension	234 x 157 x 51 mm (L x W x H)
Temperature	-20°C to +50°C operating range
Power	Battery time: 6 h
Power supply, mains	100 – 240 V, 50 – 60 Hz, 65 W
Power supply USB-C	5 V, 2 A (connection to a standard power bank)
Battery	7.6 V, 7,200 mAh
Camera	Back camera with 8.0 MP, front camera with 2.0 MP
Storage	128 GB SSD
Connection ports	19-pin LEMO, Thunderbolt 4, USB 3.2 Gen2 (type C), microSD reader
Connectivity	Wi-Fi 6E, Bluetooth V5.2
Audio	Audio in/out (combo jack)
Documentation	Save/export raw data, screenshots, reports
Operating system	Windows 10 LTSC (Long Term Servicing Channel)
Embedded Help	Find information in every setup and dialog for fast and save usage
Languages	English, German, Spanish, Japanese, Chinese, Czech, Italian, French, further languages on request

Product features	TCM – Test channel
Frequency range	4 Hz – 20 MHz adjustable in 1 Hz steps
Multi Frequency	▪ Up to 8 frequencies in parallel ▪ Mix two frequencies for reducing disturbing signals
Filter	Low-pass filter and high-pass filter 1 Hz – 20,000 Hz
Gain	-20 dB to +120 dB in 0.1 dB steps
Phase	0 – 360° in 0,1° steps
X- and Y-Gain	0 – 60 dB in 0,1 dB steps
X/Y Offset	-50/+50 in 5 % steps
Probe recognition	Automatically adjusts pre-amplifier, max output current
Pre-amplifier	-18, -12, -6, 0, 6, 12, 18, 24, 30, 36 dB
Max output current	400 mA (peak), 10 V peak-peak
Data resolution	32 bit
Sample rate	Up to 40,000 samples/ second
Trace time	0.1 – 60 seconds, Infinite, Rot-Sync
Charts	x/y, t, x/y + t, C-scan
Thresholds	Lines, circle, box, sector
Freeze mode	Freeze your signal and adjust parameters like gain and phase
Documentation	▪ Customizable PDF reporting ▪ Take screenshots as PNG ▪ Record raw data and load them afterwards for further analysis ▪ Automatic documentation of all eddy current parameters
Array technology	Up to 512 probe elements
Supported probes	▪ Rotating head and probes (5 – 24 V) ▪ All separate transmit-receive probes (reflection) e.g. absolute, differential and parametric probes like DEFECTOMETER probes ▪ Bridge probes (adjustable resistance 5, 25, 50, 100, 200 Ω) ▪ Probes from other manufacturers are compatible with TCM
Conductivity measurement frequency	60, 120, 240, 480 kHz
Conductivity measurement accuracy	+/- 1.0% of measured value at 60 kHz, 14 mm probe
Conductivity measurement resolution	+/- 0.1% of measured value
Conductivity measurement range	0.5 to 65 MS/m (1-112% IACS)
Wizards	Auto-set wizard for: ▪ absolute probe and lift-off setup ▪ setting up filters for rotating probes
Fulfilled standards	DIN EN ISO 15548

Eddy current testing





Dependence between frequency and penetration depth

The safe operation of aircrafts, rail vehicles or power plants would be unthinkable without regular maintenance, which also includes non-destructive testing of critical areas and 100% inspections of those compnents and structures.

The eddy current method

The eddy current method according to DIN EN ISO 15548 is a non-destructive, non-contact way to test metallic materials.

A current-carrying coil placed on the surface of a component generates eddy currents via its alternating electromagnetic field. Defects or irregularities cause changes in the behavior of the eddy currents and thus changes in the impedance of the coil. Such voltage differences can be used to check samples for their material composition, to test whether they have been heat-treated, to detect cracks and to measure residual wall thickness.

The test frequency: a decisive factor

It can be challenging to select the right test frequency for a particular application. This is because the test frequency, together with the electrical conductivity and magnetic permeability of the material, significantly influences the eddy current penetration depth.

Choosing the correct eddy current penetration depth is critical to the success of an application. For example, when testing the residual wall on an aluminum sheet, the frequency must be set low enough for the material to be completely penetrated. When measuring the conductivity, it must be ensured that the material thickness is not less than three times the penetration depth of the eddy currents, otherwise measurement errors will occur. For crack detection, a high frequency is selected for small cracks, since a high frequency means a low penetration depth and thus a high spatial resolution.

With the new TCM platform from FOERSTER, all these different applications can be carried out using just one device.