



Low frequency electromagnetic testing system Corsair-16

Operation manual

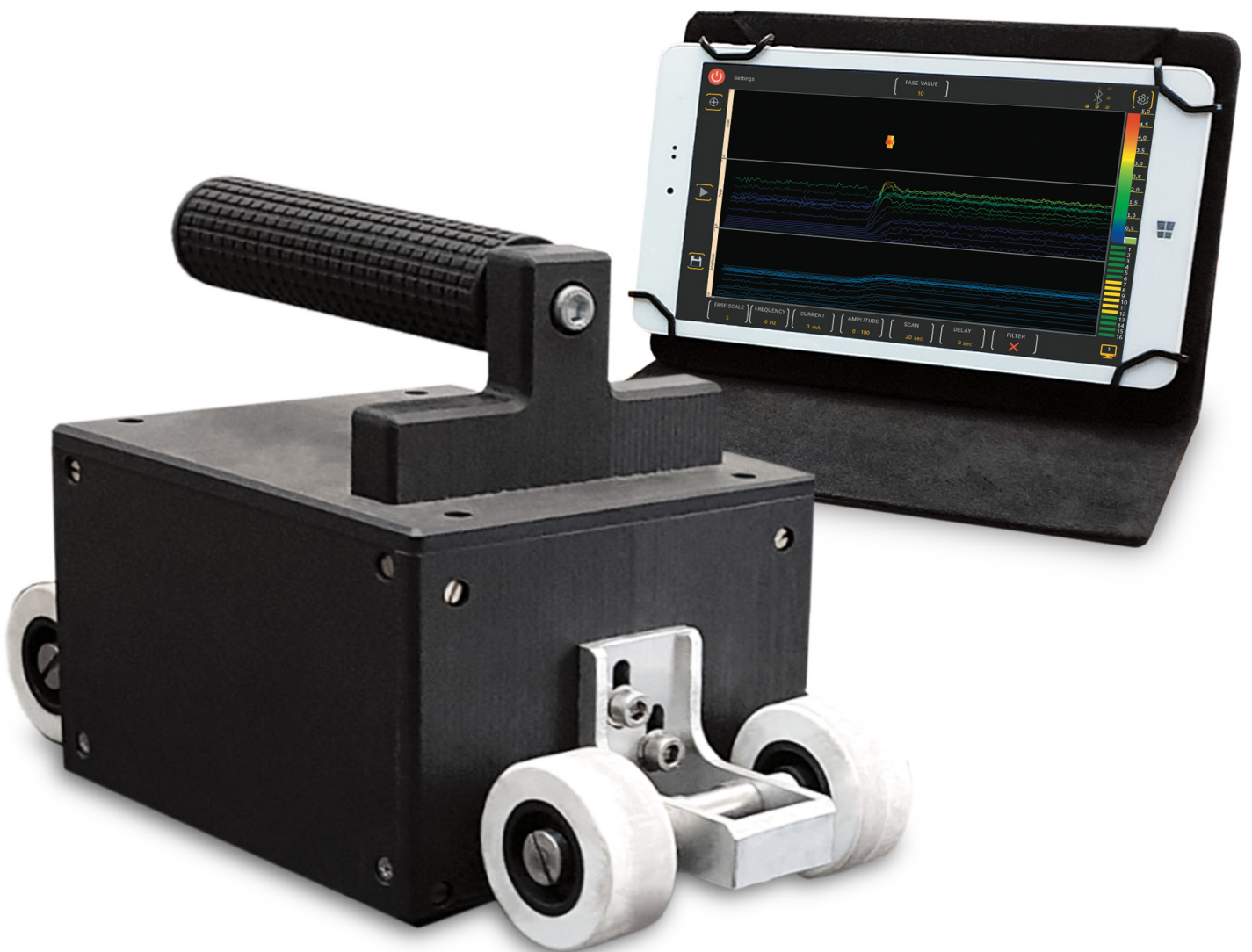


Table of contents:

1. FEATURES	1
2. TYPES OF TRANSDUCERS	1
3. OPERATING PRINCIPLE	1
4. DATA PRESENTATION	2
5. TECHNICAL SPECIFICATIONS	3
6. DELIVERY KIT	4

Non-contact detection of local metal thinning in ferromagnetic items

Multichannel device Corsair-16 is intended for electromagnetic control of metallic items when access from just one side is available. The device carries out detection and quantitative assessment of metal loss (walls thinning and pitting corrosion of various origins). Corsair-16 allows inspection of boilers heating surfaces, process furnaces, bottoms and walls of storage tanks, pipelines and vessels.

1. FEATURES

- A single device for inspection of storage tanks bottoms, pipelines (from the outer side) and in-line inspection
- Non-contact inspection through a gap and/or coating of **up to 9 mm**
- No surface grinding/cleaning needed (unless in case of in-line inspection)
- Uniform rust, scale, as well as water inside a non-ferrous vessel or pipe, do not affect inspection results
- Comparative evaluation of the detected defects
- Detection and differentiation of inner and outer defects in one run
- No blind zones in the course of testing
- Absence of permanent magnets: alternating magnetic field is created by excitation winding of the electromagnet. Due to this the transducer does not gather magnetic particles, does not cause magnetization and does not lose its properties with time
- Wireless on-line data transfer to a laptop via Bluetooth
- Signal value (strength) depends on the speed of transducer movement – so this speed should be relevantly constant
- Wide frequency range: from **1 to 30 000 Hz**
- The device can be calibrated with the application of test blocks

2. TYPES OF TRANSDUCERS

Depending on test objects characteristics and inspection tasks the user may apply different specialized multichannel electromagnetic transducers:

- **Transducer with flat working surface** – for inspection of storage tanks or pipelines of more than 700 mm in diameter. The transducer is installed onto a wheelbase allowing steady movement and setting a correct gap between the transducer and the object
- **Concave surface transducers (to fit the pipeline diameter)** – for pipeline inspection from the outside. The transducer is installed onto a wheel base allowing steady movement and setting of a correct gap between the transducer and the object.
- **In-line cylindrical transducers** - for in-line inspection (e.g. pipes of heat exchangers)
- **Eddy current transducers for balanced field** – for inspection (crack detection) of welds, weld proximity zones and core metal parts.

3. OPERATING PRINCIPLE

Electromagnetic principle of the device operation is based on the interaction between alternating magnetic field and metal. The system can operate in a wide frequency range: **1 – 30000 Hz**.

During the application of the lowest frequencies (**5 - 30 Hz**) eddy currents inside a metal object are negligible, so at such frequencies the system operates as a low-frequency electromagnetic one. When the low-frequency electromagnetic method is applied, the transducer receives effective signal by means of identifying smaller and larger zones where there is alteration of the value of the magnetic field energy that is absorbed by the tested metal in combination with curvatures and redistributions of the magnetic flux during cyclic reversal magnetization.

In other words, signal of a defect appears in the zones of alterations in the resistance (inertia) of the tested

metal towards cyclic reversal magnetization due to the decrease in the “magnetic mass” at the area of pitting corrosion and metal thinning. The device produces what can be described as “magnetic swing” of metal, calculates the mass of “magnetic pendulum” under the sensitive element of transducer channel, presenting it in the form of alteration in the amplitude and phase of this channel signal. The system will also indicate an increase in “magnetic mass”, which would mean wall thickening or passing of a pipeline support structure during in-line inspection.

Low frequency electromagnetic method (5 - 30 Hz) is applied only for ferromagnetic objects. Thanks to the wide range of operating frequencies of the device (0 – 30 000 Hz) at frequencies above 1 000 Hz the system can operate as an eddy current one, enabling the inspection (cracks detection) of non-ferromagnetic items.

4. DATA PRESENTATION

Working data is presented on a laptop or tablet screen in the form of A-Scan amplitude, A-Scan phase or C-Scan.

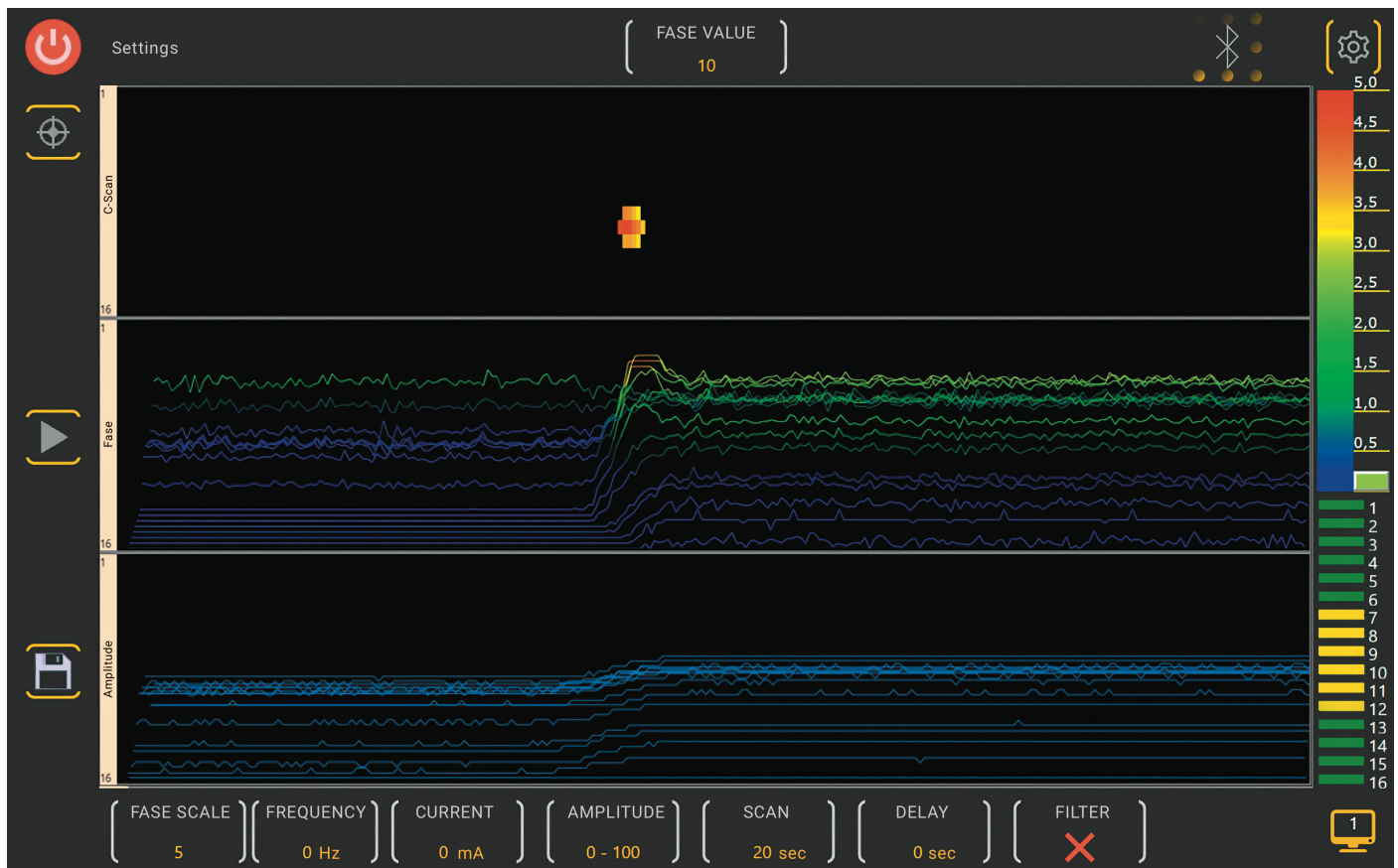
The A-Scan window synchronously displays lines of time mappings for amplitude and phase of the signals received from the transducer probes. The resulting grid of lines on the screen represents a 3D model of the reverse side of the inspected item wall. Areas of growth or short bursts of signal values indicate metal thinning or pitting corrosion.

The C-Scan window presents the data obtained through the A-Scan as a color coded plan.

The received data is saved as a file. After that, using on-screen cursors, the user can obtain estimated quantitative data on the size of metal thinning and pitting corrosion. To obtain quantitative data of enhanced precision it is necessary to execute calibration on a control sample.

The screenshot on Figure 1 presents visualization of detecting a local metal thinning (diameter – 12 mm, depth equals 40% of the initial steel wall thickness, working gap – 4 mm).

Figure 1



5. TECHNICAL SPECIFICATIONS

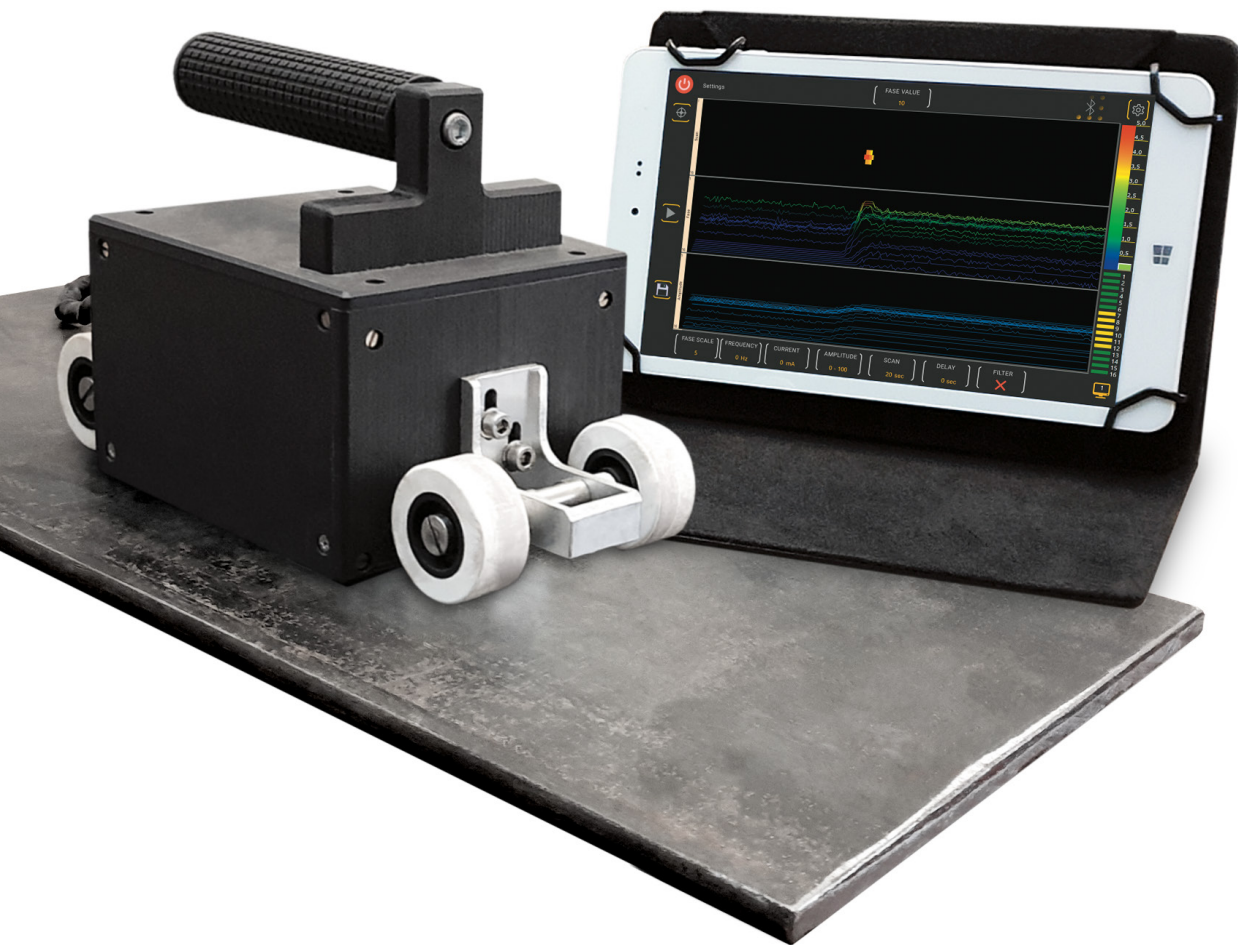
Minimum detectable defects parameters	<p>The system detects continuous wall thinning of 5% from the initial wall thickness.</p> <p>Minimum detectable defect – pitting corrosion of 3 mm in diameter, depth – 30% from the initial wall thickness.</p> <p>Guaranteed detectable defect – pitting corrosion with a diameter equal to the pipe wall thickness and with depth of 20% from the initial wall thickness and more. The thicker the wall, the bigger the size of a minimum detectable defects.</p>
Accuracy of the defects size evaluation	<p>Measurement accuracy is of estimative nature. Defects depths are proportional to the magnitudes of signals registered by the system. Differentiated depths: 20%, 50%, 70%. Length of a defect is determined by the length of the path, along which the device registers a signal. Width is determined by the number of probes which registered the signal.</p>
Used frequencies	<p>5 – 30 Hz for ferromagnetic steel. 1000 - 30 000 Hz for non-magnetic austenite steel, non-magnetic metals and alloys.</p>
Maximum speed of inspection	0,3 m/s
Width of the transducer testing zone	<p>Depends on the model of transducer. 16-element flat transducer with normal density of probes installation has 165 mm wide test zone; in case of increased density of probes installation – 100 mm wide.</p>

Dimensions of the manual 16-channel transducer	Length x Width x Height: 230 x 119 x 140 mm
Mass of the transducer 16-channel flat transducer weights approx. 1,3 kg	<p>Depends on the model of transducer. 16-element flat transducer with normal density of probes installation has 165 mm wide test zone; in case of increased density of probes installation – 100 mm wide.</p>
Operating conditions	Field conditions
Power consumption, W	10
Battery (accumulator) life	up to 10 hours
Number of channels	from 1 to 16
Range of operating temperatures	from -30 to + 50 °C



6. DELIVERY KIT

- Electronic data unit for data processing
- Multichannel electromagnetic transducer (precise type is outlined in the technical enquiry)
- Laptop /Tablet /Industrial tablet (the preferred variant outlined in technical enquiry)
- Cable for connecting the electronic unit with the transducer
- AC adapter
- Accumulator
- Software (SD card)
- Carry and storage case



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