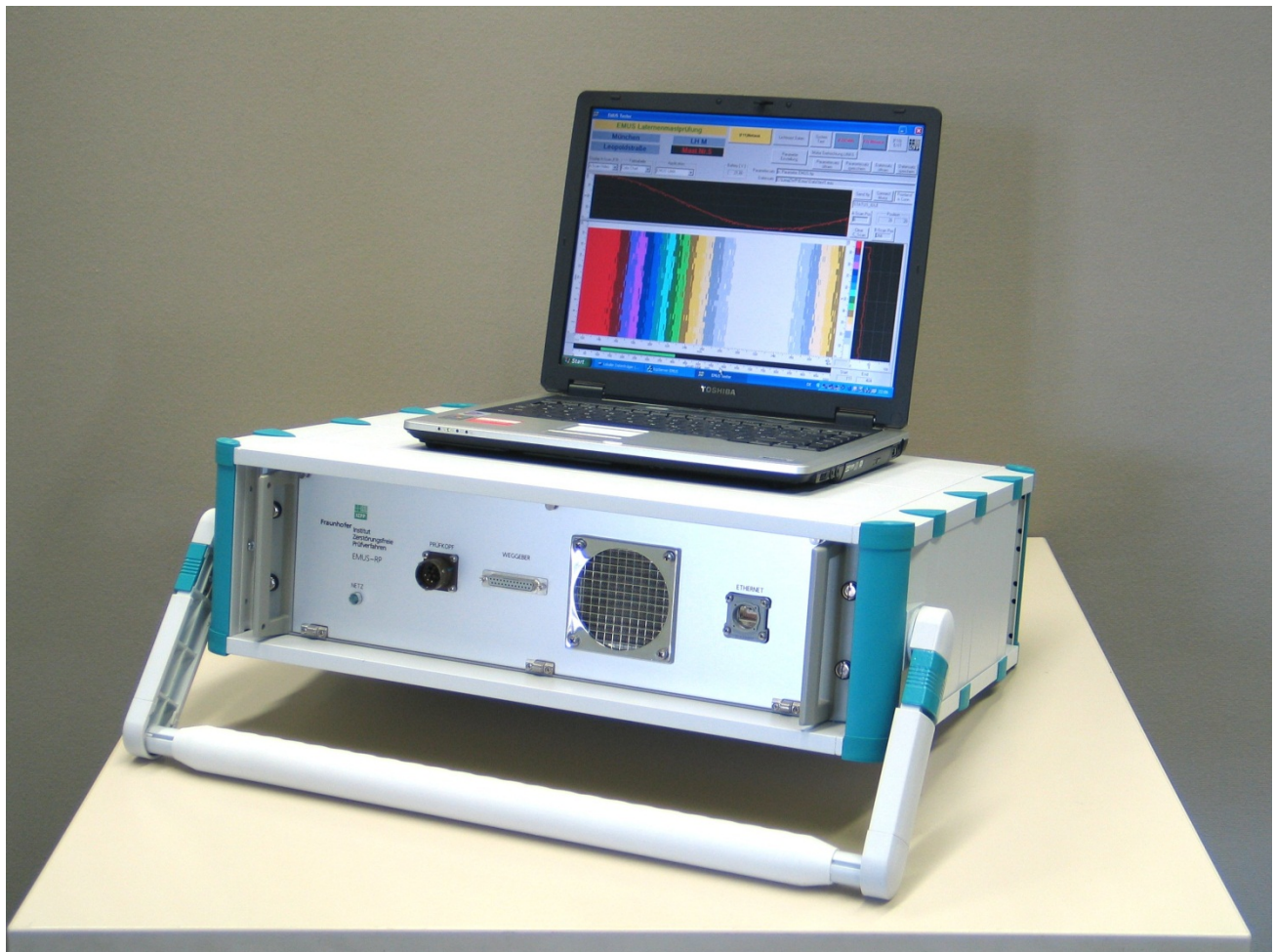


Multi-Channel EMAT System

General Description



Multi-Channel EMAT System

The Electro-Magnetic Acoustic Transducer (EMAT) System is a computer controlled multi-channel electronic system to operate EMAT transducers for couplant-free transmitting and receiving of oblique incident bulk ultrasonic waves and guided waves in ferromagnetic materials.

The system serves as signal-generating and processing component. It provides time-delayed RF signals for transmitter stages, amplification, filtering and summation of the received signals and the power supply for the transducer electromagnets.

The control of the system, such as frequency, beam angle, pulse length (number of cycles), pulse repetition rate, transducer selection, etc., is performed by the system setup program.

1. Technical Data

The system consists of two main components:

- Base Unit
- Magnetization Unit

Base Unit

The components of the Base Unit are:

- Synthesizer board
- Burst generator board (frequency range: 0.4 – 2.0MHz); burst length (number of cycles) and frequency are adjustable via PC
- Two transmitter power stages
- Receiver board with two delayed receiver channels (time delay of all channels can be modified separately.)
- Output amplifier and video unit
- Control PC for system control and parameter settings
- Power supplies

The burst generator produces burst signals with a center frequency given by the synthesizer. These burst signals are digitally delayed, then amplified by the driver stages and transmitted to the transducer(s).

The signals received from the receiver coils are pre-amplified in the transducer by the built-in preamplifiers and are transmitted to the system. There, the signals are further amplified and filtered by the filter stages and are then time delayed. After the combination unit, the received RF signals are summarized and transmitted to the video output. At this stage, either RF output or rectified output is selected.

Technical Data:

Frequency Range:	0.4 – 2.0MHz, adjustable in 10kHz steps (2.0MHz is upper 3dB cut-off frequency)
Burst duration:	1 – 15 cycles, adjustable in steps of 1
Pulse repetition rate:	2.5ms – 20ms, adjustable in 1 μ s steps
Time Delay:	0 – 10 μ s, adjustable in 2ns steps (transmitter) 0 – 1.5 μ s, adjustable in 25ns steps (receiver)
Overall amplification:	Maximum 50dB; 40dB adjustable in 255 steps

Magnetization Unit

The Magnetization Unit provides AC power for the transducers and consists of an electromagnet. Amplitude and frequency of the magnetization are adjustable. Only transducers with permanent magnets are operated by the Base Unit.

The components of the Magnetization Unit are:

- Frequency generator and a synchronization board for synchronization of the trigger signal of the Base Unit with AC current for the transducer(s) electromagnet.
- LF amplifier for amplification of AC current for magnetization

2. Computer Controlled Functions and Parameters

- Trigger-Mode (internal, external, software trigger)
- Pulse repetition rate
- Ultrasonic frequency
- Number of cycles/bursts
- Time delay for each transmitter and each receiver channel
- Selection of filters (0.4 -1.3MHz, 0.4 – 2.0MHz)
- Adjustment of receiver amplifier

3. Technical Data - Transmitter Channels

- Transmitter output impedance: 8 – 9 Ω
- Transmitter output short-circuit protected for burst signals
- Transmitter-current: 30App (real impedance of 22 Ω)
- Transmitter-output voltage (open circuit): \cong 1KVpp

4. Technical Data – Receiver Channels

Transducers: 30dB pre-amplification by pre-amplifiers

Base Unit:

- Amplification 50dB; 40dB adjustable in 1dB steps
- Noise level at output of summarized signals: 100mV (for band-pass filter 0.4 - 1.3MHz)
- Bandwidth(-3dB): 0.4 – 2.0MHz
- Two switchable band-pass-filters with 3dB cutoff-frequencies: 0.4-1.3MHz; 0.4-2.0MHz
- Input/output impedance: 50Ω
- Input sensitivity: 50μV for pre-amplifier; 1.5 - 2mV for main amplifier
- Maximal amplitude of the RF-signal at the output: 5V_{pp}

5. Time Delays (Transmitter/Receiver Side)

- Technical performance: digital at the transmitter side
 analog at the receiver side
- Maximum time of delay: 20μs Transmitter
- Minimum time of delay: 1.5μs Receiver

6. Trigger Signal Input/Output

- Trigger IN: TTL, 1kΩ input impedance
- Trigger OUT: TTL, 50Ω output impedance
- BNC connectors