

3MA-II Data Sheet

- 3MA = Multi-parameter Micro-magnetic Microstructure and stress Analyzer
- Combination of 4 different micro-magnetic measuring modules
 - Multi-Frequency Eddy Current (3MA-MFEC)
 - Magnetic Field Strength (3MA-K), Upper Harmonics
 - Incremental Permeability (3MA- μ)
 - Barkhausen Noise (3MA-M)

Micro-magnetic module	Measuring quantities
3MA-MFEC	At 4 frequencies: - Real parts of impedance values (Re_1, Re_2, Re_3, Re_4) - Imaginary parts impedance values (Im_1, Im_2, Im_3, Im_4)
3MA-K	- Coercivity (H_{CO}, H_{RO}, H_{CO}) - Distortion factor (K) - Amplitude of 3 rd and 5 th upper harmonics (A_3, A_5, A_7) - Phase of 3 rd and 5 th upper harmonics (P_3, P_5, P_7)
3MA- μ	- Coercivity ($H_{C\mu}$) - Maximum amplitude ($\mu_{max}, \mu_{mean}, \mu_r$) - Width at 25 % of maximum ($Wid_{1\mu}, \Delta H_{25\mu}$) - Width at 50 % of maximum ($Wid_{2\mu}, \Delta H_{50\mu}$) - Width at 75 % of maximum ($Wid_{3\mu}, \Delta H_{75\mu}$)
3MA-M	- Coercivity (H_{CM}) - Maximum amplitude (M_{max}, M_{mean}, M_r) - Width at 25 % of maximum ($Wid_{1M}, \Delta H_{25M}$) - Width at 50 % of maximum ($Wid_{2M}, \Delta H_{50M}$) - Width at 75 % of maximum ($Wid_{3M}, \Delta H_{75M}$)

- Simultaneous detection of up to 41 measuring quantities (see table above)
- Different weighted sensitivities towards microstructure (composition, interstitials, dislocations, precipitations, grain boundaries, 2nd phases, etc.) and stress
 - Complementary and redundant information about mechanical properties
 - Suppression of disturbing influences
 - Quantitative determination of mechanical properties and residual stress
 - Target quantities:
 - Tensile strength (R_m)
 - Yield strength ($R_{p0.2}$)
 - Vertical anisotropy (r_m)
 - Planar anisotropy (Δr)
 - Surface Hardness (HV, HRC) and Core Hardness
 - Hardening depth (induction-, case-, laser-, hardening, nitrating)
 - Toughness
 - Residual austenite content
 - Creep strain
 - Residual stress in different depths
 - Hardness

Technical data

The 3MA-II system consists of the following components:

- Magnetization power supply
 - Output power: 300 W
 - Distortion factor: < 0.1%
 - Band width: 5 Hz - 120 kHz
 - Amplification: 26 dB
- Sensor system
 - Generally designed and built according to customer requirements
 - Sensor coil array technique for 3MA-MFEC, 3MA- μ , 3MA-M
 - Magnetic field measurements with ultra-sensitive GMR sensors
- Driving unit
 - Function generator with sine wave output (frequency range 1 - 250 Hz)
 - Interface to external analog part
- Signal detection and processing
 - A/D converter
 - Signal processing unit
- Interface
 - Ethernet
 - Protocol TCP/IP
- Software
 - Processing and control software
 - Additional software modules w/ multiple regression analysis
- Optional: PC plus monitor (Windows user desktop)

Advantages

- Real quantitative and precise results
- Compact, rugged design allows mobile, stationary or production-line process-integrated application
- Provides quick and clear assessment of the processing sequences such as heat treatment and machining
- Fast test results, only few seconds for a single measurement
- Can be applied for a broad range of different materials, including carbon steel and cast-iron materials
- Can be applied to oxidized, milled, ground and polished surfaces, i.e. no special preparation is required
- Measurements results can be checked during production without process interruption



3MA-II System