MAGNAFLUX®

Operating Manual



FSM-2 Field Strength Measuring Gauge
Part number 133033

CE

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This operation manual must be kept at the place of work and be accessible to operators and maintenance personnel at all times.

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1. APPLICATION

The field strength meter FSM-2, in conjunction with the tangential field probe, digitally registers and displays magnetic field strengths (H) in the range of ± 400 A/cm, enabling you to measure direct magnetic fields as well as alternating magnetic fields.

Use the FSM-2 for:

- Measuring of the magnetic field strength during magnetisation to check whether the required field strengths for the magnetic powder test are achieved.
- Measuring the residual field strength on test parts which have already been inspected.

Magnetic fields of up to H_{komp} = 12 A/cm can be compensated for, so that the sensitive detection of magnetic field variations is also accessible to the meter.

An RS232 output on the bottom of the device enables the transfer of the measurement values to (for example) a computer for subsequent evaluation, analysis and/or registration.

1.1 SAFETY INFORMATION

The FSM-2 must only be used for measuring tangential magnetic field strengths on workpiece surfaces.

- DO NOT USE NORMAL BATTERIES for continuous operation when connected to an external power supply.
- The sensor tip of the tangential field probe must be handled with care. DO NOT - under any circumstances - use it as a screwdriver or lever; this will lead to the destruction of the sensor.
- Modifications to the FSM-2 are not permitted.
- Unauthorised use of the FSM-2 will invalidate any guarantees and/or warranties

2. IDENTIFYING PARTS



LCD display with selectable backlight

ON/OFF button (see below)

MODE or RMS/PEAK button (see below)

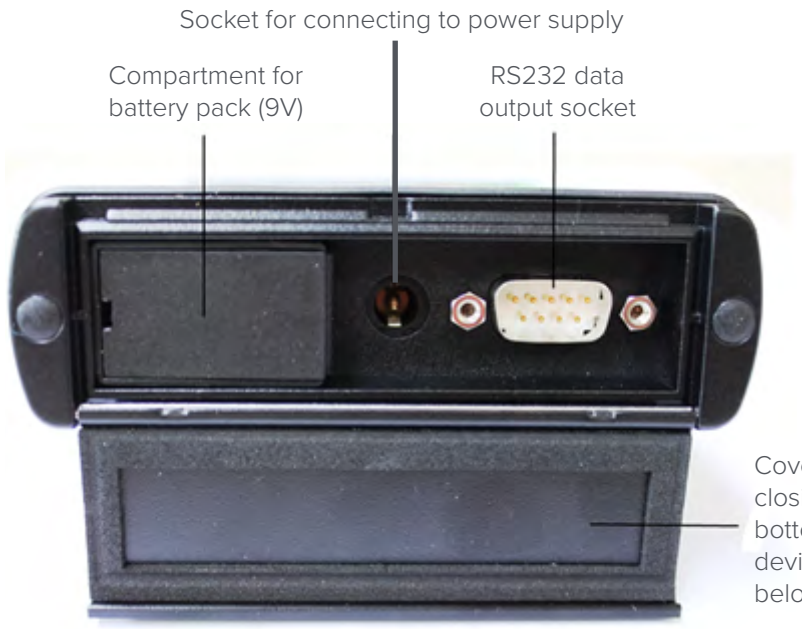
HOLD or RESET button (depending on the model): stores the displayed maximum value and implements an offset compensation for direct fields.

ON/OFF button:

- Turns the unit on and off
- Activates the display background lighting
- Activates the functions selected in the setup

MODE or RMS/PEAK button (depending on the model):

- Selects the operating mode for the device
- Selects the measuring unit
- Calls the Setup Function



Cover for closing the bottom of the device (see below)'.

Opening and closing the bottom cover

Hold the device horizontally in one hand, as per the diagram above. With your other hand, press the cover slightly upwards on the lower edge while, at the same time, gently pulling the upper edge of the cover away from the device.

Close the cover by gently pressing it shut until the slight closing resistance is overcome.

Battery compartment

Open the cover for the battery compartment with a screwdriver (NOT with the probe tip).

NOTE: If the device has been out of service for a long time, replace the battery.

Power supply socket

The FSM-2 meter is suitable for operation with an external power supply (12 V = / 125 mA) in combination with a 9V battery (NiCd or NiMH). The battery is permanently fed with a small current (maintenance charge).

NOTE: the FSM-2 meter does not automatically switch off when used with the power supply.

A rechargeable 9V battery can be installed in the unit and will be charged while the power supply is connected. IMPORTANT: the FSM-2 is NOT equipped with an overload control so you must:

- adhere to the battery manufacturer´s recommended charging time to prevent the battery being overcharged;
- Remove the battery block if the device is being used continually with the power supply.

Power supply



- Efficiency level VI,
- Overload protection
- Overvoltage protection
- Permanent short-circuit proof

Protection Class:	II
Frequency	50 / 60 Hz
Storage temperature	-40 to 70 °C
Working temperature	0 to 45 °C
Humidity	10 to 95
Input voltage	100 - 240 V
Input tolerance	±10%
DC output	USB socket Type A
Current	1400 mA
Output voltage	5 V
Standards	IEC60950-1, IEC60065, IEC60335
Colour	Black

To use this device, you will need an adapter.

Adapters



UK version



EURO version



USA/Japan version

RS232 data output socket

You can connect the FSM-2 to a PC via the RS232 socket, by using a commercially available null modem cable. Approximately 10 measurement values per second can be received via a terminal program and subsequently processed by the user.

All measured values (RMS, positive PEAK, negative PEAK) are transmitted as ASCII characters, including a number which stands for the set measurement unit.

The transfer protocol is:

- 1 stop bit
- No parity
- 8 bits
- 9600 baud

Data format ASCII:

- +000.0; +000.0; +000.0; 1
- RMS; positive PEAK; negative PEAK

Unit:
1 = A/cm; 2 = kA/m; 3 = mT; 4 = G; 5 = Oe;

This allows you to easily log data as a text download with a terminal program. This text file can then be analysed using, for example, Microsoft Excel.

2.1 SUPPLY

The FSM-2 field strength meter is supplied with:

- Power supply with three adapters
- Tangential field probe
- Certificate
- 9V battery pack
- Reference standard 200 A/cm (optional)
- Carry case (optional)

2.2 TECHNICAL DATA

Measuring range	± 400 A/cm
Resolution	0.1 A/cm and/or 0.2 A/cm (depending on the model)
Effective value for mixed fields with a peak value of up to:	400 A/cm (True-RMS)
Frequency range	0Hz - 1 kHz (-6 dB)
Warning function	When peak value is exceeded, a clipping indicator is displayed on the upper right corner of the display:  or  or 
Measurement value, stop function	Digital trailing pointer
Measurement units available	A/cm, kA/m, mT, G, Oe
Battery:	9V-Block Model 6LR61
LCD display, top left-hand side:	Indicates current voltage in the battery
LCD display resolution	120 × 32 pixel
Data transfer via RS232	Optional
Operating temperature	0°C to +40°C
Device protection mode	IP65 with a closed base cover (splashproof)
Dimensions	168 x 109 x 35 mm
Weight	675 g (FSM-2 with probe and battery)

3. OPERATION

3.1 SWITCHING ON

A short press on the ON/OFF key will turn the device on. The operating mode which was active when the device was last used, will be reactivated. A longer press of the button will turn the device off.

NOTE: If no measured value is recorded above 12.6 A/cm for about 5 minutes after switch-on, the device will switch off automatically.

3.2 BACKLIGHT

Once the device is turned on, a short press on the ON/OFF key will activate the backlight of the LCD display. NOTE: using the backlight will significantly reduce battery life.

3.3 DISPLAY AND OPERATING ELEMENTS

Setup

Press and hold down the MODE (or RMS/PEAK) and ON/OFF keys together for approx. 2 seconds. This will take you to the setup menu so you can set the following:

Functions:

- RMS, PEAK, DC
- RMS, PEAK, DC, MAX, MIN

Measurement units: A/cm, kA/m, mT, G, Oe

Press the MODE or RMS/PEAK key to cycle through the settings; select them by pressing the ON/OFF key. To cancel setup without saving any changes, press HOLD/RESET key.

NOTE: the LCD display backlight remains activated during setup.

RMS

The RMS function measures the true effective value (True Root Mean Square) of the magnetic field. The smallest measurable field strength in RMS mode is 2 A/cm; smaller field strengths will be displayed as ”<2 A/cm“.

NOTE: RMS will often only display the effective value of the alternating field proportion. The term ‘True RMS’ has been adopted here to differentiate the measurements in an arbitrary mixed field.

PEAK

The PEAK function displays the highest values of the positive or negative peak values for the actual magnetic field without a sign. This allows a quick assessment of the maximum field strength without considering the polarity.

DC

Displays the DC field proportion of an existing mixed field (the calculated median). This is an arithmetical median for symmetrical, alternating field parts which are displayed by a rotary coil instrument.

MAX/MIN

MAX: displays the maximum magnetic field strength value.
MIN: displays the minimum magnetic field strength value.

Magnetic field strength units

- A/cm
- kA/mm [1kA/m = 10 A/cm]
- Oe [1 Oe = 0.796 A/cm]

Magnetic flux density

The FSM-2 field strength meter primarily measures the magnetic tangential field strength **H**. It is related to the so-called magnetic flux density **B** according to:

$$B = \mu_0 \cdot \mu_r \cdot H$$

Where [μ_0] is a constant value (magnetic field constant).

The relative permeability [μ_r] is dependent on the magnetic flux line of the material ($\mu_r = 1$ is valid for a vacuum).

According to the above formula, the FSM-2 will convert the magnetic field strength **H** into the magnetic flux density **B** where $\mu_r = 1$ will be a set value.

The following applies:

- 1 mT = 10 G (Gauss)
- 1 G ~ 0,796 A/cm ~ 1 Oe (Oersted)

Operational mode selection

With the FSM-2 in normal operating mode (not in setup mode), press the MODE or RMS/PEAK button (depending on the model) to cycle through the following display modes:

- RMS, PEAK, DC
- RMS, PEAK, DC MAX, MIN

The selected operating mode is displayed in the upper left corner of the LCD display.

HOLD or RESET key (depending on the model)

A short press of the HOLD / RESET button activates the digital trailing-pointer mode. The function is indicated by the words HOLD / RESET at the top of the display.

Depending on the selected operating mode, a measured value will be displayed until a new value is measured which exceeds the displayed value. The new value will then be displayed instead.

This function can be deactivated by pressing the HOLD / RESET button again, or by pressing the MODE or RMS/PEAK key. (NOTE: the HOLD / RESET key cannot be activated during DC operating mode, but DC can be measured in RSM mode, please note that AC cannot be measured in DC mode).

Offset compensation (tare function)

A zero offset and the offset compensation are only useful for DC fields, although they must not exceed 12.6 A/cm.

To implement zero compensation, place the probe in a “field-free” location then press the HOLD / RESET button for approx. 3 seconds. Once the compensation is successfully completed, the FSM-2 will display a value of approx. 0.0 A/cm and the symbol **0->** will be displayed in the upper right corner to achieve the activated tare function.

You can now measure the changes in the magnetic field with regard to the location where the compensation was performed.

The compensation can be deactivated by pressing on the HOLD / RESET key again for approx. 3 seconds.

NOTE: the tare function cannot be executed in RMS mode due to mathematical reasons.

3.4 TANGENTIAL FIELD PROBE

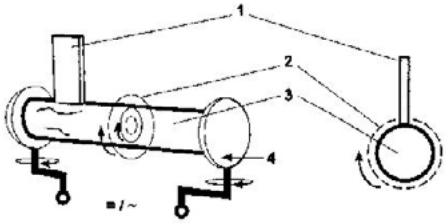
The tangential field probe can be permanently connected to the FSM-2 via the socket on top of the unit.

Hold the probe vertically and place the tip onto the surface being tested, ensuring that there is no gap between the sensor tip and the surface. The magnetic field component which comes into contact with the wide side of the sensor tip will be measured accordingly.

If the probe is rotated by 180° on its longitudinal axis while in DC mode, this will cause a sign reversal of the displayed value, because the magnetic field vector will now come into contact with the sensor tip on the other side.

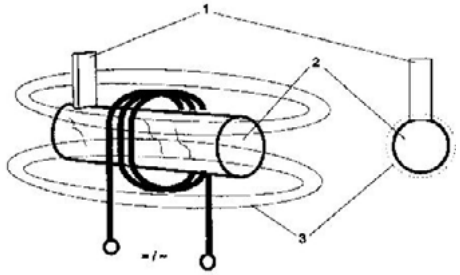
NOTE: the sensor tip must be handled with care. It should never be used as a screwdriver or lever, as this will cause permanent damage to the sensor.

Positioning the tangential field probe to measure circular fields



1. Probe
2. Direction of magnetic field lines
3. Test part
4. Current flow

Positioning the tangential field probe to measure longitudinal fields



1. Probe
2. Test part
3. Magnetic field lines

3.5 CALIBRATION

Using long-life robust components reduces the need for daily calibrating. If required, we can supply a reference standard of 200 A/cm (part number 133042) as an accessory to help you check the proper functioning of the device.

NOTE: if you order a reference standard once you have started using the FSM-2, you will need to send the entire unit to Magnaflux GmbH for calibration.

3.5.1 Tangential field probe FSM-2 with reference standard (optional)

The display accuracy of the FSM-2 should be periodically checked using a reference standard. To do this, lay the probe flat and flush with the groove of the reference standard, with the white point pointing upwards. There should be a reading of 200 A/cm ± 4% in the display.

If the displayed value differs by more than 4% from the target value of 200 A/cm, send the FSM-2, with the probe and reference standard, back to Magnaflux GmbH for calibration. We recommend that you do this on an annual basis anyway.

3.5.2 Tangential field probe FSM-2 without reference standard

We recommend that the FSM-2 meter, along with its probe, is returned to Magnaflux GmbH once a year for recalibration.

4. DISPOSING OF THE DEVICE

Before disposing of the FSM-2, check that the power supply is disconnected and the battery is removed.

Refer to your local waste disposal regulations as chargers, batteries, and button cells are hazardous waste and pose risks to health and the environment.

Procedure:

- Take the machine out of service.
- Separate the components of the FSM-2 into metals, plastics, composite materials, electrical components, batteries.
- Dispose of all parts in accordance with local regulations.

If you have any questions, please contact Magnaflux GmbH.

EC/EU DECLARATION OF CONFORMITY

FOR MAGNAFLUX MEASURING INSTRUMENTS

We hereby declare that this equipment complies with the following EU standards. The device has been tested and approved. Any modification made to the device without our written consent will invalidate this declaration.

Equipment name: FSM-2 Field Strength Meter

EU Directives:
2014/30/EU The Electromagnetic Compatibility Directive
2011/65/EU The Restriction of Hazardous Substance Directive

Applicable standards:
DIN EN ISO 9934-1:2017-03
DIN EN ISO 9934-3:2015-12
DIN EN 61010-1:2020-03

Address:
Magnaflux GmbH, Bahnhofstr. 94-98, D-73457 Essingen, Germany

Person responsible:
Operations/Engineering Manager
Mr. Markus Kirchner

Signature:



Date: 13.10.2022

UKCA DECLARATION OF CONFORMITY

FOR MAGNAFLUX STANDARD SMALL DEVICES

We hereby declare that this equipment complies with the following EU Directives. The device has been tested and approved. Any modification made to the device without our written consent will invalidate this declaration.

Equipment name: FSM-2 Field Strength Meter

Applicable UKCA Directives:
Electromagnetic Compatibility Regulations 2016
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Applicable standards:
DIN EN ISO 9934-1:2017-03
DIN EN ISO 9934-3:2015-12
DIN EN 61010-1:2020-03

Address:
Magnaflux GmbH, Bahnhofstr. 94-98, D-73457 Essingen, Germany

Person responsible:
Operations/Engineering Manager
Mr. Markus Kirchner

Signature:



Date: 13.10.2022