Manual

MP-4000

OPERATION MANUAL

MAGNETIC FIELD METER

MP-4000

Firmware-Version 491 and up

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INTRODUCTION

Experience a completely new and unique measurement technique with the professional magnetic field meter **List-Magnetik MP-4000**. Externally connected digital axial and transverse field probes perform perfect measurements of direct and alternating magnetic fields, and especially pulsed fields of all kinds. The field of application ranges from the earth's magnetic field up to a field strength of 40,000 A/cm.

The **MP-4000** has a graphical LCD touch panel with an innovative user interface and a resolution of 320x480 pixels. An outstanding feature of the new probe electronics is the fast, digitized measurement processing with up to 200 kHz, which makes it possible to record and display pulse waveforms as fast as 0.1 msec. This eliminates the need for an external oscilloscope. An accurate picture of the pulse curve of a magnetic field is obtained. Maximum value and pulse length are accurately displayed. Alternating field waveforms up to 20 kHz frequency can also be displayed and stored. The pulse curves generated in this way can be displayed and stored in the MP-4000 as a graph, providing an accurate picture of the pulse curve of a magnetic field.

The device supports all areas of magnetic field measurement with flexible data storage, combined digital and analog display, and peak value measurement. The Bluetooth interface can be used to transfer data to a Windows PC as well as to the Android or iOS app. The USB-C interface allows the device to be connected to an external power source for continuous operation. An optional external power supply can also be connected.

Especially at very low magnetic field strengths, an absolutely interference-free and precise measurement is crucial. The measurement electronics work directly in the probe and digitize the signals from the Hall sensor.

In the range of stable DC fields, a magnetic field can be detected over a large area and statistically evaluated with the scan function. This display is very useful for recording the multipole magnetization of all kinds of magnetic systems.

WARNINGS AND HAZARDS

List-Magnetik expressly states that the magnetic field meter MP-4000 may only be used for its intended purpose: the measurement of magnetic fields. Any use not in accordance with the intended purpose is not permitted and involves incalculable risks for the instrument and the operator.

The operator of the equipment must ensure that the equipment is operated only by persons who have had access to, read, and understood this operating manual.

The instrument or probe must never be connected to sources that are not adequately insulated. Failure to observe this warning may endanger the life of the user.

Although the device is splash proof, it is not waterproof.
is not waterproof. Do not immerse the device in water or other liquids or clean it with water.
immersed in water or other liquids, or cleaned with water. If the device gets into a liquid medium, it must be switched off immediately.

Do not use the device in an explosive environment (smoke, gases).
The use of any electrical device, including this battery-powered meter, in such an environment may cause an explosion.

Do not open the unit except to replace the battery. Do not attempt to repair the electronics yourself, but return the unit to us for diagnosis.

OPERATION WITH MEASURING DUMMY

When using the MP-4000 with a special measuring dummy for measurement in a magnetizing system instead of a probe, be sure to observe the following safety instructions:

The complete measuring unit consisting of MP-4000, measuring dummy and connecting cable may only be operated behind a closed and locked safety door on the magnetizing coil according to performance level PLe ISO 13849.

QUICK START GUIDE

- First connect the probe cable to the probe and the instrument.
- Turn on the **MP-4000** with the red power button.
- The probe will be recognized by the instrument and the model will be automatically displayed in the upper left corner of the status bar.
- When the instrument is turned on, an automatic zero adjustment is performed. The probe should not be in a magnetic field during this process.

DISPLAY STRUCTURE

The display is divided into 5 sections.

The **status bar** shows the title of the current menu position and the battery status.

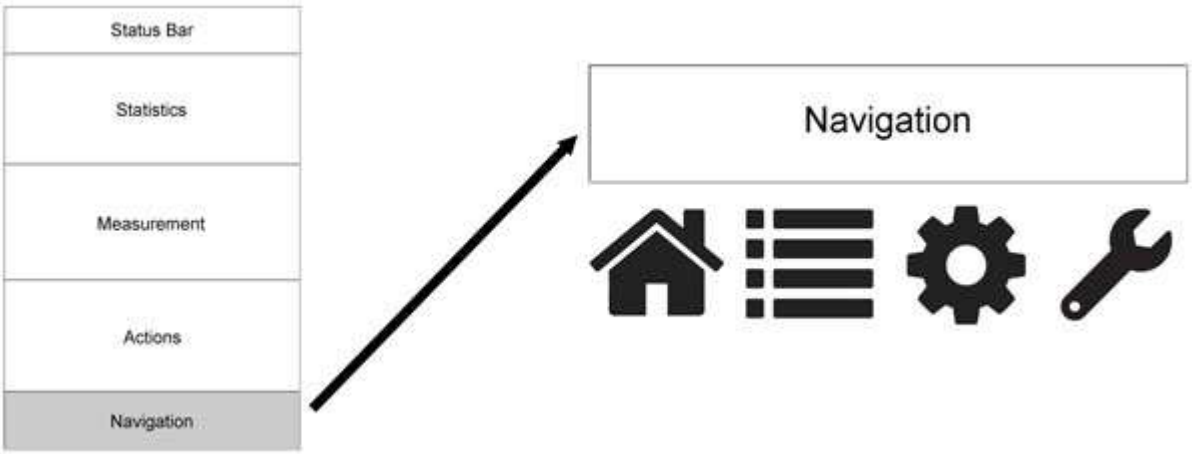
The **statistics** area displays statistics for a series of measurements. If no memory batch is active, the List-Magnetik logo is displayed here.

In the center is the **measurement** display with the current measurement and additional information about it.

Depending on the current display, there are symbols in the **action** area that trigger appropriate processing and special functions.

NAVIGATION

At the bottom of the screen is the **navigation** area. Here it is possible to jump to different service areas.



	Measurement "Home": Here you can always return to the measurement
	Data Log The individual measurements of the currently active memory batch or, if the data logger is off, of the last active memory batch are displayed.
	Setup This section allows you to set the language, unit of measure, and other measurement and display parameters, as well as power management settings.
	Info and System Turn off the unit, view hardware and software status, or perform a factory reset.

MEASUREMENT

	**This icon in the navigation will take you directly to the measurement**

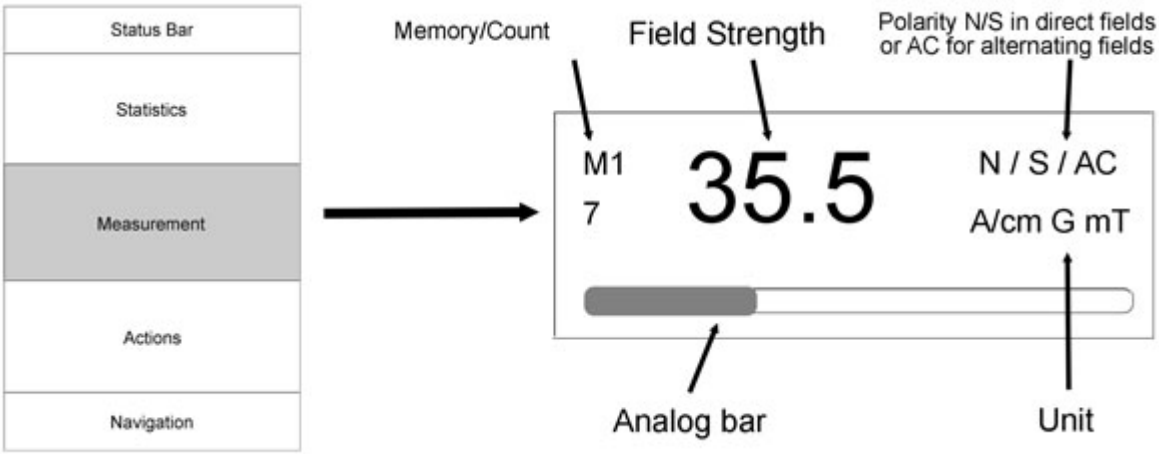
The measurement continuously takes 5-6 readings per second.
The display is constantly updated.

The middle section shows the measured value, the measuring range (Auto, Range 1/2), the polarity (N/S) and the measuring unit (A/cm, G, mT). The left side shows the currently active memory batch and its fill level.

The color of the reading is black. If limits are set, the reading will be red if it is below the lower limit and blue if it is above the upper limit.

Below the reading is an analog bar graph. It represents the ratio of the reading to the maximum field strength of your probe. **If limits are set, the bar represents the range between the lower and upper limit.**

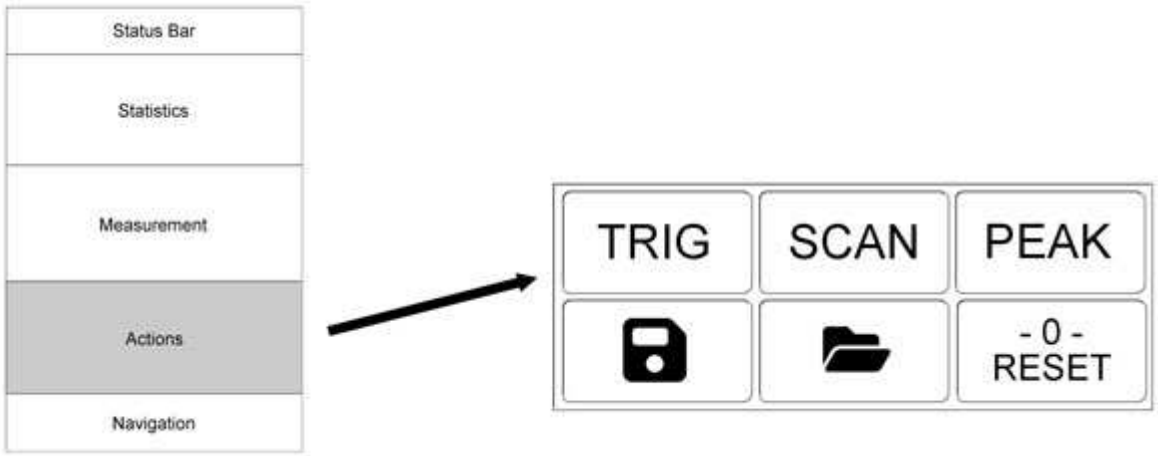
If you want to store a measurement, you can add the current measurement to the current memory batch by briefly touching the diskette icon. This is confirmed by a beep. The statistics of this memory batch are displayed in the area above the measurement display as in normal measurement.



If you have activated a memory batch, the statistics for this memory batch will be displayed in the area above the reading instead of the logo.

Actions

Overview of the action area in the measurement display.



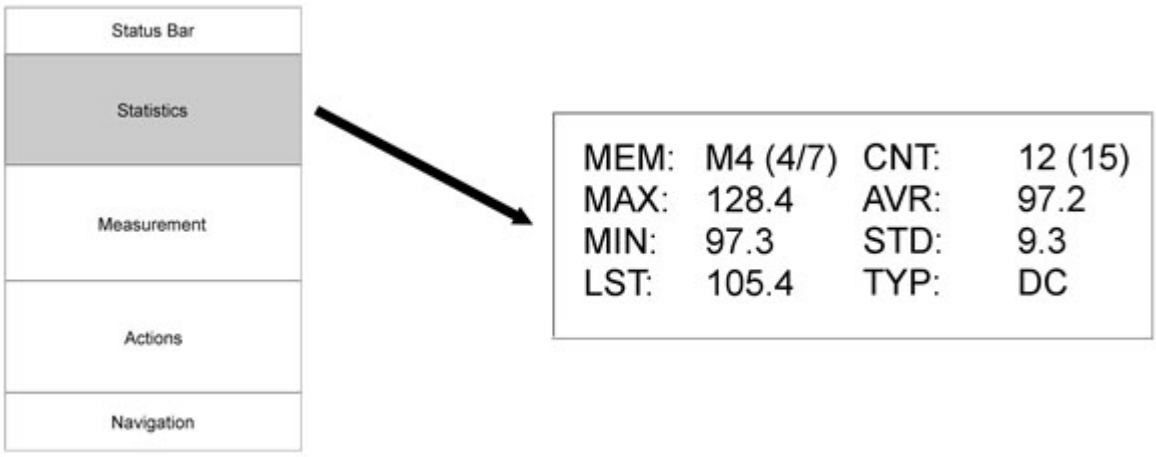
When the floppy disk icon is displayed in normal color like the other buttons, you can tap it to save a measurement.

If the floppy disk icon is not visible, no memory batch is active.

- 0 -	Zeroing the measurement. The reading will rarely be exactly 0.0 - the earth field will be visible in the display at about +/- 0.2 A/cm as soon as you move the probe slightly.
PEAK	Peak value measurement: The Peak Detection function records the peak value of a magnetic field, and instead of displaying the continuous reading, only displays a value that is greater than the previous peak value. Pulse fields as short as 0.1 msec can be very accurately determined with this measurement function. There may be a change in sign: -2700 A/cm is contractually higher than +2300 A/cm. Negative means it is a south pole, and positive means it is a north pole. If you set the correct range before activating, you will work with the "**fast peak**". Via Setup (⚙) / Probe Settings / Range you will find the selection Range 1/2 (Range 1 below 3.000 A/cm, Range 2 also above 3.000 A/cm). If Auto Range is selected, the "**slow peak**" is used, which records the maximum value with approx. 5-6 measurements per second. If the peak value measurement is active, the button is highlighted. To return to normal measurement, press the button again.
RESET	Resetting the peak value during peak measurement. After resetting, the peak value is determined again in ascending order from 0.
	To activate a memory batch, switch to data log management with this icon "Folder". From the moment of activation, measurements can be stored
TRIG	Special Function Trigger Measurement See separate chapter "Special Measurement Methods". The jump to the trigger measurement is only possible if the peak value measurement / PEAK is switched off. Before activation, the correct range must be set. Select Setup (⚙) / Probe Settings / Range to select Range 1/2 (Range 1 below 3,000 A/cm, Range 2 also above 3,000 A/cm).
SCAN	Special Function Scan Measurement See separate chapter " Special Measurement Methods ". The jump to the scan measurement is only possible if the peak value measurement / PEAK is switched off.

Statistics display

Only when a memory batch is active, a statistical evaluation of the previous readings of this memory batch is created.



The statistics shown in the example state:

Memory batch number 4 is active (M4). There are 7 memory batches in total (4/7).

A total of 15 values are stored in this batch 4, 12 of which are DC values (NUM: 12(15) as well as TYP: DC). The other 3 values fill the AC batch. The statistics are always displayed separately for DC and AC and the view can be changed by tapping.

Maximum, minimum, average and standard deviation are calculated from these 12 values.

The last stored value was 105.4.

MEMORY MANAGEMENT

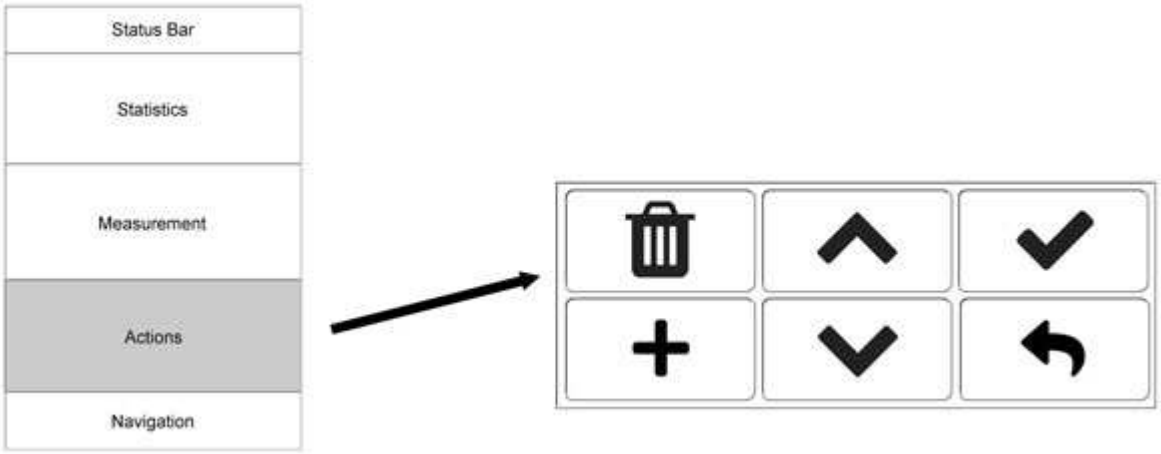
Memory batches hold both automatically stored single measurements and values actively stored during continuous measurement. The scan batches are separately managed memory batches and are not considered here.

You can create any number of memory batches. The batches are assigned a unique free number and a leading "M". A maximum of 10,000 measurements can be stored in the M memory batches.

If you have not created or activated a memory batch, the floppy disk icon will not be visible during the measurement.

Actions

Overview of the action area in the data log.



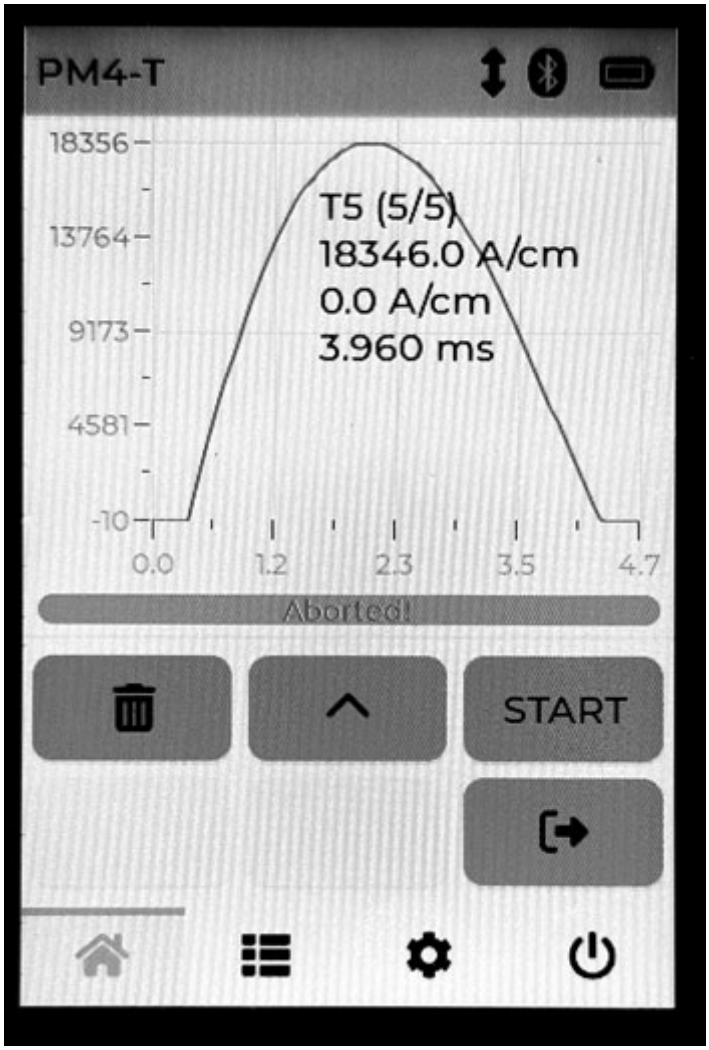
	Back to measurement
	Create a new memory batch. You can enter additional text to describe the new series of measurements. The newly created memory batch is active immediately. After returning to the display, the disk symbol is highlighted and the next measurement is recorded in the memory batch.
	Scroll through the memory batches. The additional text entered will be displayed. You can view the individual values by clicking on the navigation icon of the data log.
	Select a memory batch for immediate use
	Delete the currently displayed memory batch

SPECIAL MEASUREMENT METHODS

TRIGGER

The trigger measurement processes pulse field measurements at an enormous speed of less than 0.1 msec. The measured values generated in this way can be displayed in the MP-4000 as a graph and give an accurate picture of the pulse progression of a magnetic field.

After starting the measurement (**START** button), the following values are measured in the set maximum duration (80, 320, 1300 msec), a large amount of data is collected in the probe. This amount of data is then transferred to the MP-4000, which takes a few seconds and is indicated by the progress bar below the graph. At the end of the transmission the graph is processed.



In the graphic area you can see the curve as a representation of the magnetic field strength over time, as well as information about the minimum, maximum and actually recorded time.

You must select a measurement range before trigger measurement, **trigger measurements are not possible in Auto-Range mode**. See also Setup (⚙) / Probe Settings / Range. (Range 1 below 3,000 A/cm, Range 2 also above 3,000 A/cm).

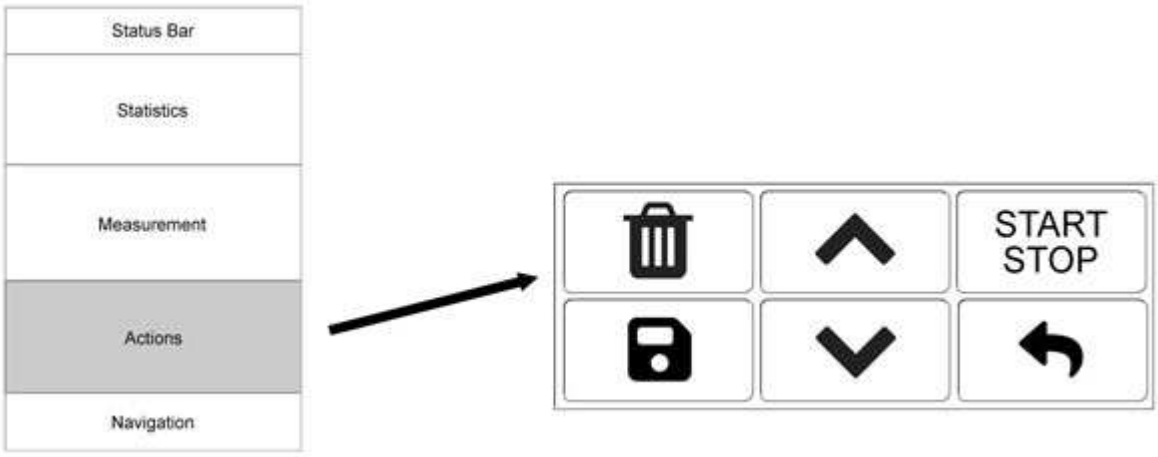
To perform a trigger measurement, settings should be made first. Via Setup (⚙) / Probe Settings / Trigger you will find the entries Single Trigger, Level as well as an expected time selection (<= 80, 320, 1280 msec).

If the single trigger is switched off, a trigger measurement is started every time the minimum value (set as "Level") is exceeded.

A triggered measurement can be stored.

Actions

Overview of the action area in the trigger measurement display.



START	Start of a trigger process. Then the text changes to STOP and the button is highlighted.
STOP	End of a trigger process
	Back to normal measurement
	Save the trigger event. You can enter a short text that will be displayed later when scrolling below the statistics. You can create as many trigger batches as you like. The batches are given a unique free number and a prefixed "T".

	Browse through the previously stored trigger events. The statistics, short text, and graphical history are displayed
	Delete the currently displayed trigger operation

SCAN

The scan measurement function records a magnetic field as it changes over time - this can be a fixed position probe measuring a moving multipole magnet, or moving the probe over a fixed position magnet. For example, you can scan a bar magnet all the way around with the probe.

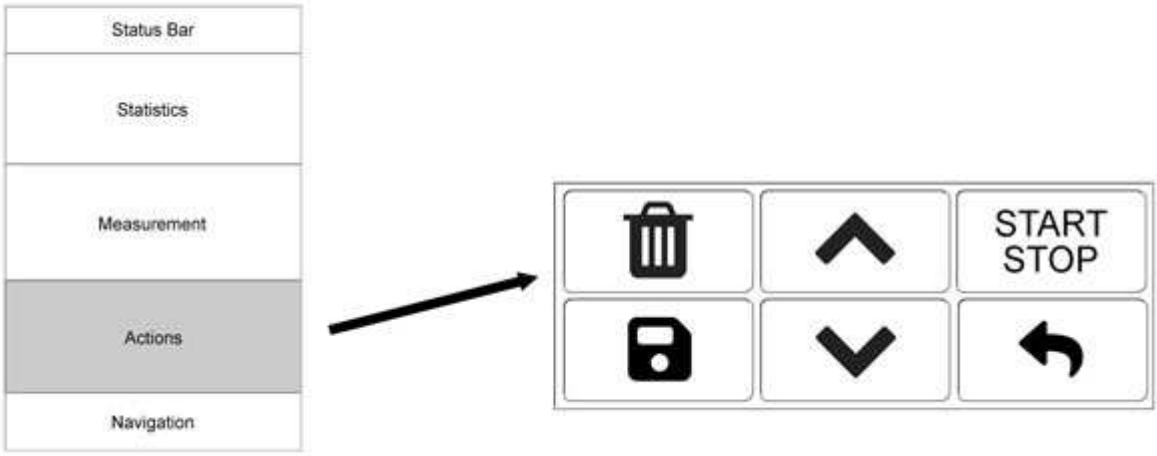
After starting the measurement (**START** button), slowly move the probe around the magnet. Or, depending on the measurement setup, start moving the magnet over the probe. Approximately **20 measurements per second** are performed automatically.

The measurement is shown graphically on the display. In the statistics display, the count, minimum, maximum and average values are calculated and displayed.

To stop scanning, press the **STOP** button.

Actions

Overview of the action area in the scan measurement display.



START	Start of a scan. After that, the text changes to STOP and the button is highlighted.
STOP	End of a scan
	Back to normal measurement
	Save the scan process. You can enter a short text that will be displayed later when scrolling below the statistics. You can create as many scan memories as you like. The memory batches are given a unique free number and a prefixed "S"
	Browse through the saved scans. The statistics, short text, and graphical progress curve are displayed
	Delete the currently displayed scan

DATA LOG

	**This icon in the navigation takes you directly to the data log.**

When you navigate to the data log, the measurements of the current M memory batch are displayed. The current M batch is the same as the one shown in the reading display on the left, whose statistics are displayed above the reading.

For each entry, the current number, date and time of the measurement are displayed in the format MM-DD hh:mm (month, day, hour, minute), the DC/AC field type, and the measured value.

"PDC" and "PAC" indicate that the measurement was a DC peak or an AC peak, respectively.

The color of the reading is black. If limit values are set, the measured value is displayed in red if it is below the lower limit value and in blue if it is above the upper limit value.

Tapping a line inactivates the reading and marks it for deletion; it changes color and is crossed out. Tap again to reactivate the reading.

	8 readings are displayed per page. You can use the scroll buttons to view the next/last 8 values.
	The trash can icon deletes the entire series of measurements. The memory batch remains active, however, so that further measurements will be written to this memory batch.
	If an individual reading is inactive, it can be permanently deleted by clicking the scissors icon.

SETUP

	**This icon in the navigation takes you directly to the setup.**

INTERFACE

Language, backlight and volume can be adjusted in the interface area.

LANGUAGE

The available languages are English, German, Italian, French and Spanish.

After changing the language, the unit will shut down and must be restarted.

BACKLIGHT

You can use the slider to make the display brighter or darker. Higher brightness uses more power.

VOLUME

Use the slider to adjust the volume of the beep.

POWER

You can set the automatic shutdown time: 5 minutes, 10 minutes, 30 minutes or "never off" if you do not want the device to turn off automatically.

The power save mode switches the brightness back to 10% after 1 minute.

PROBE SETTINGS

UNITS (SELECTION A/CM, KA/M, OE, G, MT)

The units supported are A/cm (Ampere per centimeter), kA/m (Kiloampere per meter), G (Gauss), Oe (Oersted), and mT (Millitesla).

1 A/cm = 0.1 kA/m = 1.256 Gauss = 1.256 Oersted = 0.1256 mT

Internally, the unit always operates in A/cm; if a different unit is selected, the display will be converted.

RANGE SELECTION

The settings affect peak and trigger measurements.

If you have already activated peak or trigger measurement in the measurement display, please leave this display and return to the normal measurement display. As long as you are in peak or trigger measurement, selecting the range is not possible.

Normally, MP-4000 works in auto-range mode, which automatically switches between the two measuring ranges 1 (below 3,000 A/cm) and 2 (above 3,000 A/cm).

With the quick Trigger measurement method, however, you have to explicitly preselect the range; with Peak, you can do this in order to use the "quick peak" with better results.

<u>If the wrong range is selected, the following can happen:</u>

Range 1 selected, measurement above 3,000 A/cm: The trigger curve is just cut off at the top. The peak value is frozen at 3000 A/cm and displayed in red. The R1 display will also be red.

Range 2 selected, reading well below 3,000 A/cm: Values are less accurate than expected.

MODE (SELECTION DC-AC)

You have the option of measuring DC fields (constant fields) or AC fields (alternating fields). Depending on the selection, the DC or AC symbol is displayed behind the current reading.

For sinusoidal AC fields, the true RMS value is displayed. The conversion factors for full-wave and half-wave rectification are given in DIN standard 54 131 part 1.

When measuring AC fields, you must select the frequency range in which your measurement will be made. Selecting an incorrect frequency range will reduce the stability of the measurement. The frequency ranges are "up to 20 Hz", "20 Hz - 1 kHz" and "above 1 kHz" (up to 20 kHz).

If you want to make a peak value measurement in the AC range, first select a measurement range (Range 1 below 3000 A/cm, Range 2 above) and then the function "AC < 20 Hz + AC Peak".

TRIGGER

The settings only affect pulse field trigger measurements.

The level (in A/cm) is the threshold at which the display of a trigger measurement starts. As long as the field strength is below this threshold, the instrument assumes that the magnetic field is negligible and does not evaluate the pulse. The default setting is 50 A/cm.

With single triggers, each trigger measurement must be started manually. If the single trigger is switched off, a trigger measurement is started every time the minimum value (set as "Level" in the trigger area) is exceeded.

The time selection (80 msec, 320 msec, 1.30 s) determines how long the trigger measurement measures the pulse. The longer you record the pulse, the longer it takes to prepare the waveform.

LIMITS

Setting an upper and lower limit influences the display of the measured values. The values must always be entered in the selected unit of measurement.

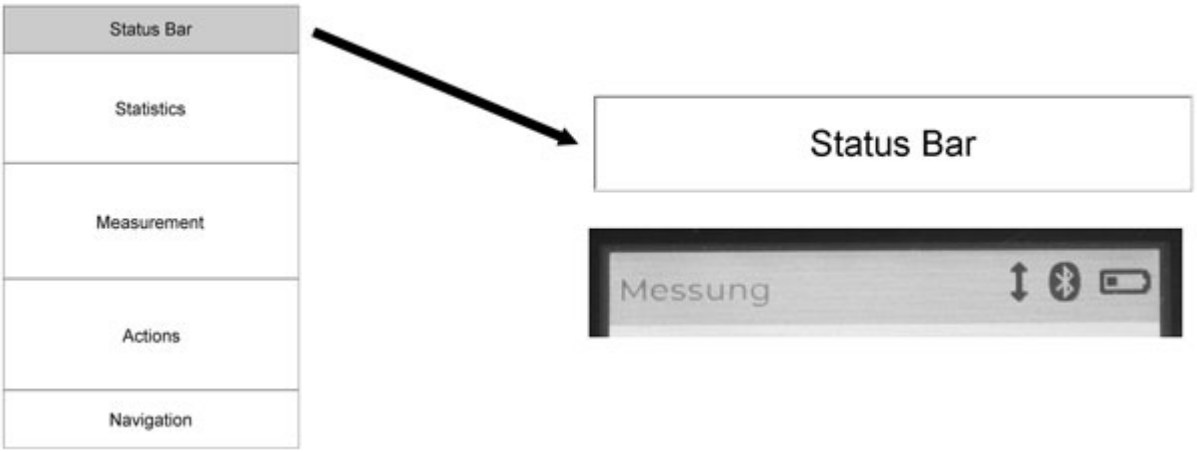
Upper limit value exceeded: measured value red
Falling below the lower limit: measured value blue

The color change occurs both in the measurement display and in the data log.

INFO AND SYSTEM

	This icon in the navigation takes you directly to the info and system functions.

STATUS BAR



The system display includes the contents of the status line. The status line shows the menu position on the left, and there are three symbols on the right for probe, Bluetooth and power supply.

The symbol for the probe and for Bluetooth is highlighted when an action takes place: for the probe a measurement, for Bluetooth a data transfer.

The power supply is either an external power supply via USB or a battery with an approximate remaining capacity.

POWER OFF

There are two ways to turn off the unit: press and hold the red on/off button until you hear the beep, or use the System Menu to turn off the unit.

DATE & TIME

Date and time can be set manually or via the PC application **Lima Connect**.

When setting manually, please note the notation xxxx-xx-xx (with hyphens) for the date and xx:xx:xx (with colons) for the time.

DELETE MEMORY

All memory batches from individual measurements, trigger or scan are cleared. Settings will not be cleared.

FACTORY RESET

The factory reset restores all pre-installed settings of the instrument. All memories (data logger and calibration profiles) are erased. This function should be used when settings have been changed and the instrument does not work properly or the calibration of the probe does not work properly.

SYSTEM

The device data shows, for example, the serial number, the firmware version, the current battery voltage and the MAC address for the Bluetooth connection. This data helps in the event of support.

Battery voltage must be above 2.8V. Below 2.8V, the unit will automatically shut down.

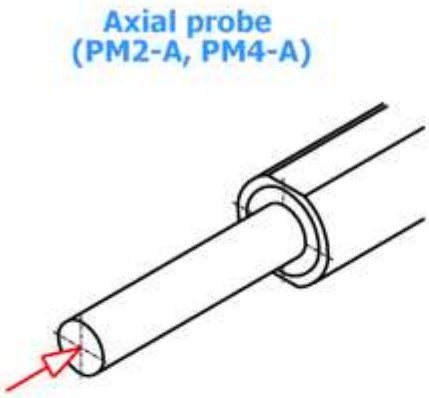
PROBE

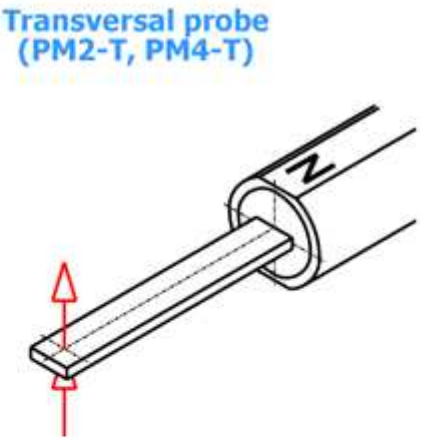
Probe and device are independently configured. The probe can be plugged into another MP-4000. The probe data includes the serial number and firmware version of the probe and the configuration.

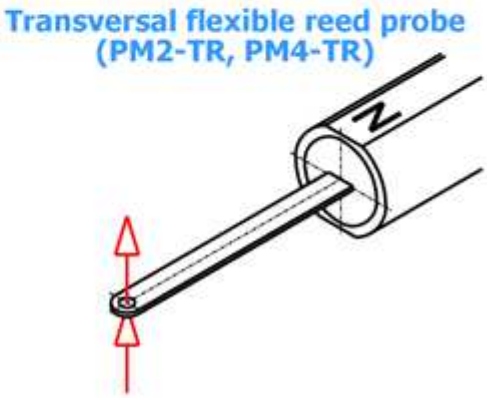
TECHNICAL DATA

Measuring units:	A/cm - kA/m - Gauss / Oersted - Tesla switchable (1 A/cm = 0.1 kA/m = 1.256 Gauss = 1.256 Oersted = 0.1256 mT)
Applicable probes:	Axial probes PM2-A and PM4-A, transversal probes PM2-T, PM2-TR, PM4-T and PM4-TR
Measuring range direct field / DC:	0-40,000 A/cm
Measuring range alternating field / AC:	0-40.000 A/cm
Accuracy:	in homogeneous field ± 1 A/cm to 50 A/cm, ± 2% of measured value from 50 A/cm, ± 3% of measured value from 20.000 A/cm
Resolution:	0-1000 A/cm: 0.1 A/cm > 1000 A/cm: 1 A/cm
Frequency range AC:	2 Hz – 20 kHz
Peak value memory:	at pulse time >= 0.1 msec
Display:	LCD touch panel color 320x480 pixel
Multilingual menu navigation:	German, English, Italian, French, Spanish
Data logger:	10,000 measurements, flexibly divisible
Statistics:	Count / Maximum / Minimum / Average / Standard deviation
Interface:	Bluetooth Low Energy interface for communication with Android, iOS and Windows
App for Android, iOS, Windows:	free of charge via Google Play Store, Apple App Store, List-Magnetik website
Power supply:	3x 1.5 V AA Mignon. External power supply can be connected via USB-C
Operating time:	approx. 25 hours with battery, unlimited with external power supply
Dimensions:	150 x 85 x 35 mm
Weight:	320 g with batteries

MEASURING PROBES







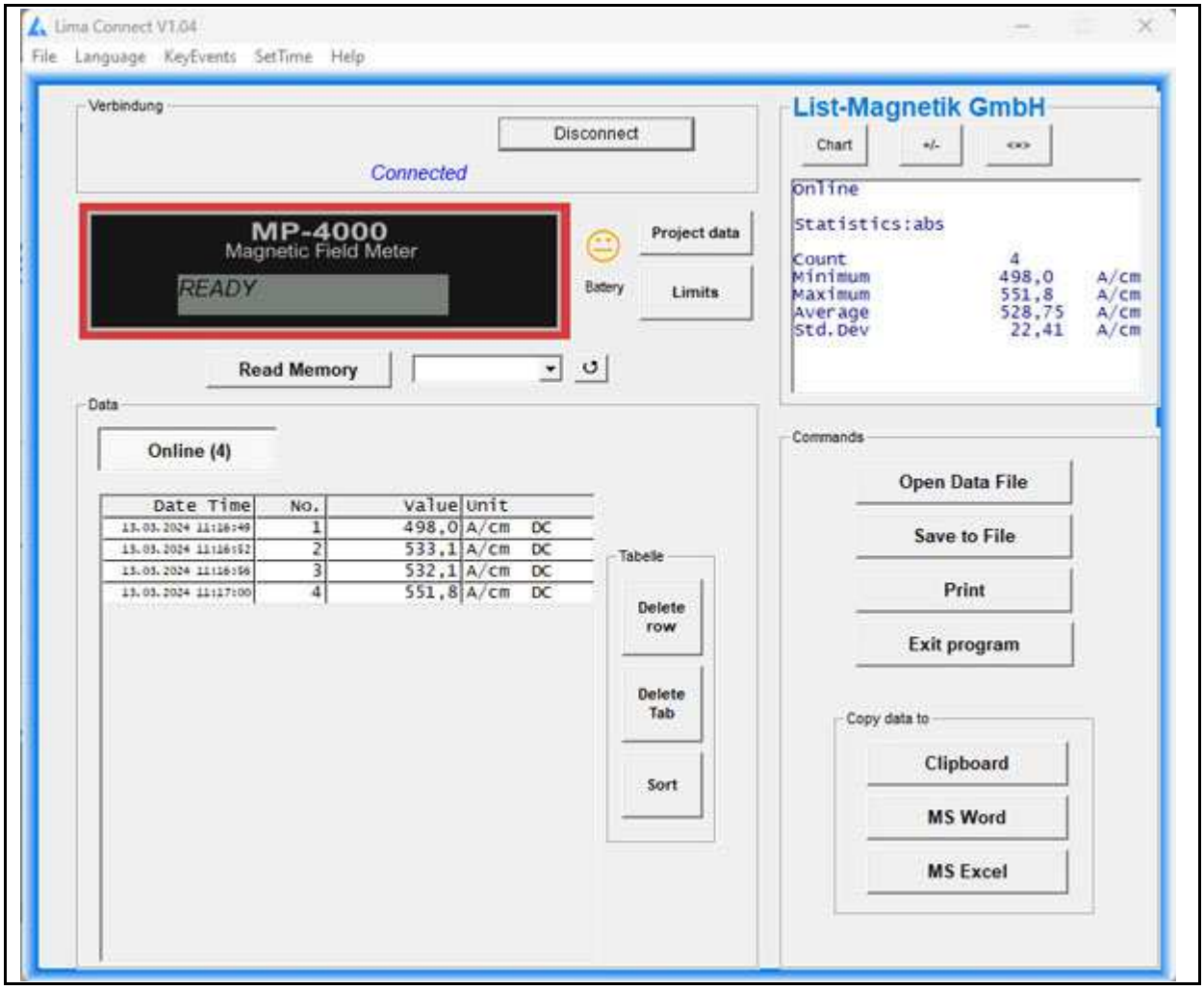
Measuring range: **0-20,000 A/cm / 0-20,000 Gauss / 0-2 T**	**Measuring range:** **0-40,000 A/cm / 0-40,000 Gauss / 0-4 T**
Axial Field Probe PM2-A	**Axial Field Probe PM4-A**
The axial field probe measures the field along the longitudinal axis of the probe and is suitable for measuring on planar or curved surfaces and particularly in bores. The hall sensor in the axial probe is placed at a precise distance of 2 mm to the surface	
Hall Sensor distance: 2.0 mm Total length of the probe: 126 mm Length of the probe handle: 54 mm Diameter of the probe tube: 8 mm	
Transversal Field Probe PM2-T	**Transversal Field Probe PM4-T**
The transversal field probe measures the field in a 90 degree angle to the axis of the probe	
Hall Sensor distance: 0.9 mm Probe thickness: 1.7 mm Total length of the probe: 127 mm Length of the probe handle: 52 mm Width of the probe tube: 5.5 mm	
Transversal Flexible Reed Probe PM2-TR	**Transversal Flexible Reed Probe PM4-TR**
The transversal reed probe measures the field in a 90 degree angle to the axis of the probe. It is flexible by approx. 5 degrees	
Hall Sensor distance: 0.5 mm Probe thickness: 0.9 mm Total length of the probe: 125 mm Length of the probe handle: 52 mm Width of the probe reed: 4.6 mm	

APPLICATIONS FOR WINDOWS, ANDROID, IOS

LIMA CONNECT FOR WINDOWS

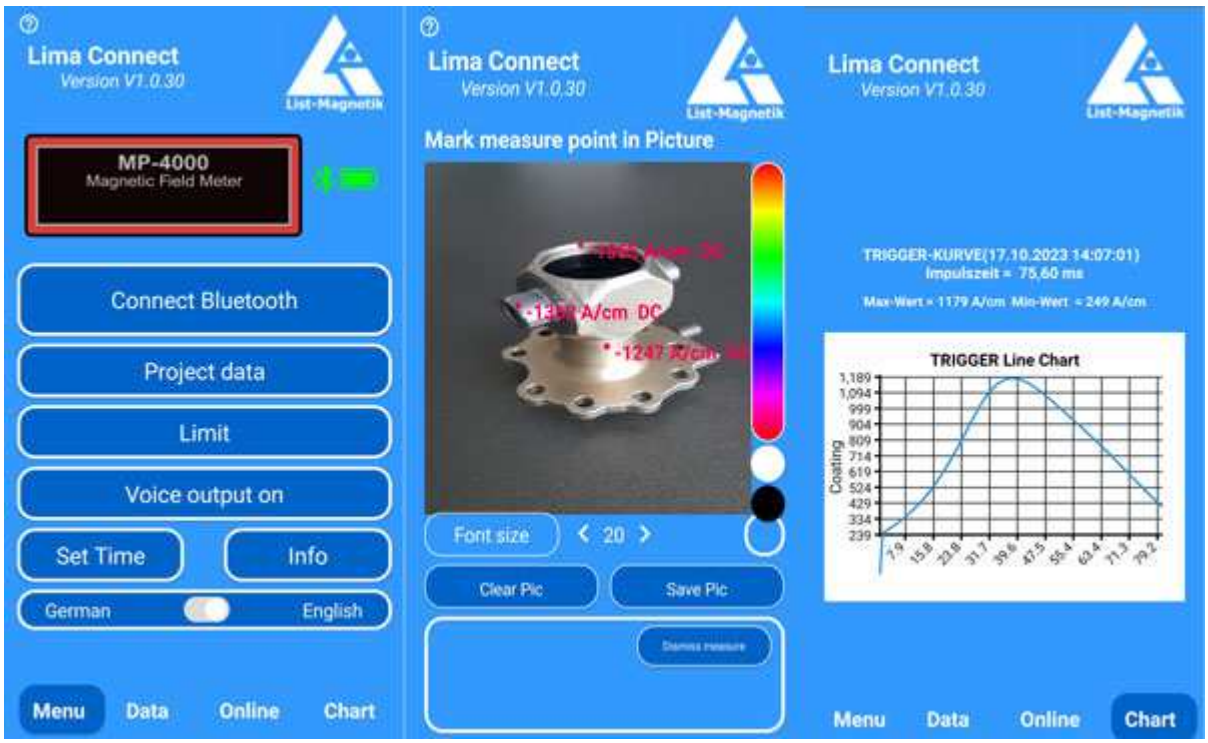
The free Lima Connect application for data transfer to the PC can be downloaded from the Applications section at www.list-magnetik.com.

With Lima Connect you can connect to a Windows PC using Bluetooth Low Energy (BLE) technology, take online measurements or read out the device's memory, statistically evaluate the data and display it as a graph. You can print the results or transfer them to subsequent applications such as Microsoft Word and Microsoft Excel.



LIMA CONNECT FOR ANDROID AND IOS

To further process your measurement data, you can also pair your device with mobile Android and iOS devices. You can measure online or read the device memory with Lima Connect for Android and iOS. Exclusively in these two mobile versions you can manage projects and assign the measuring points on a photo. The measurement results can be statistically evaluated and displayed graphically. The app for Android and iOS is also free.


Lima Connect
Version V1.0.30
List-Magnetik
MP-4000
Magnetic Field Meter
Connect Bluetooth
Project data
Limit
Voice output on
Set Time
Info
German
English
Menu
Data
Online
Chart
Lima Connect
Version V1.0.30
List-Magnetik
Mark measure point in Picture
Font size
20
Clear Pic
Save Pic
Lima Connect
Version V1.0.30
List-Magnetik
TRIGGER-KURVE(17.10.2023 14:07:01)
Impulszeit = 75,60 ms
Max-Wert = 1179 A/cm Min-Wert = 249 A/cm
TRIGGER Line Chart
Coating
Menu
Data
Online
Chart

Android	iOS

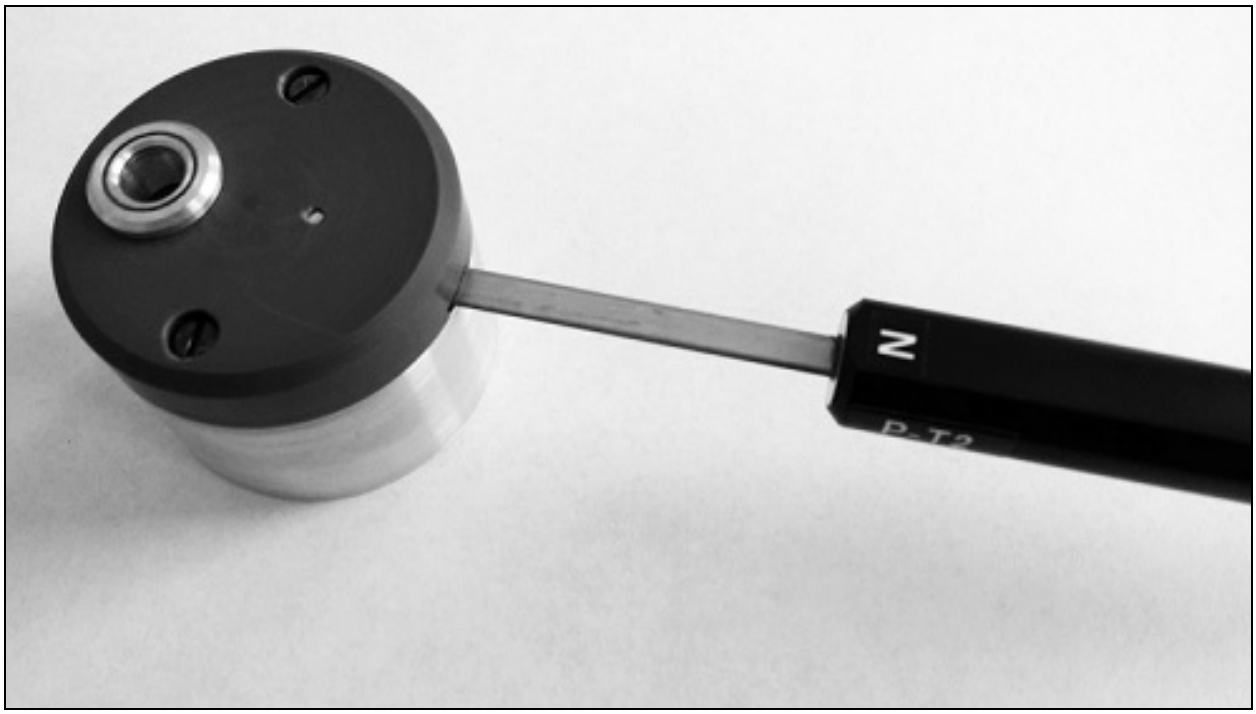
CHECKING MP-4000 WITH CALIBRATION STANDARD

It is not necessary to calibrate the device. The measuring probes are pre-calibrated and are interchangeable.

A precision calibration standard with **180 A/cm** is optionally available in order to check the device with a measuring probe.

Transversal field probe:

Insert the probe with the lettering N = north pole pointing upwards into the slot of the calibration standard until the probe latches at the front. Compare the displayed value with the value of the calibration standard.



Axial field probe:

Insert the probe vertically into the round recess of the calibration standard until the maximum value is displayed. Compare the displayed value to that of the calibration standard.

Flexible reed probe:

With the precision calibration standard, it is not possible to check the flexible reed probe. In the slot for the transversal probe, it can even be damaged.

Instead, you can obtain a calibration standard with positioning point, which unfortunately works less accurately, but does not damage the probe.

IMPORTANT INSTRUCTIONS

PRESERVE STORED MEASUREMENTS WHEN CHANGING THE BATTERY

The saved measured values are retained even after the device is switched off or when the device is stored without a battery.

CHANGING THE PROBE

To replace the measuring probe, switch off the device beforehand. Connect the desired measuring probe to the probe cable, then switch the device on again.

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