

OPERATION MANUAL

MAGNET PERMEABILITY METER

FerroPro compact

Firmware Version 300 and up

2024-01



List-Magnetik



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Introduction	2
Warnings and Hazards.....	3
Quick Start.....	3
General Information.....	4
Residual Magnetism / Remanence.....	5
Dimensions of the part to measure	5
Display structure.....	6
Navigation	7
Measurement.....	8
Calibration.....	12
Memory Management	13
Special Measurement Methods.....	14
Scan	14
Data log	16
Setup	17
Interface	17
Language.....	17
Backlight.....	17
Volume	17
Power	17
Mode (Switching the excitation field strength)	18
Calibration.....	18
Set the reference value	18
Limits.....	18
Info and System	19
Status Bar	19
Power Off.....	19
Date & time.....	19
Delete Memory	20
Factory reset	20
System.....	20
Technical Data	21
Applications for Windows, Android, iOS	22
Lima Connect for Windows.....	22
Lima Connect for Android and iOS	22
Important Instructions.....	24
Preserve stored Measurements when changing the battery	24
Changing the probe	24

INTRODUCTION

The **List-Magnetik Magnetic Permeability Meter FerroPro compact** can be used to determine the relative magnetic permeability μ_r of materials and components in the range between 1.000 and 5.000.

Magnetic permeability or magnetic conductivity provides information on how strongly a material can be magnetized.

Applications include quality control of stainless steels, non-destructive testing of structural components, material selection for electron/ion physics and nuclear magnetic resonance equipment, and detection of material changes in highly stressed parts.

The instrument is calibrated against precisely calibrated reference standards traceable to the Physikalisch-Technische Bundesanstalt PTB (Braunschweig, Germany). Recalibration is easily possible. A calibration standard is supplied with each instrument. The magnetic permeability of a material is usually strongly dependent on the strength and frequency of the magnetizing field. The probe of the FerroPro compact can be adjusted to different excitation field strengths. FerroPro compact can be used to perform standard-compliant permeability measurements according to ASTM A342 test methods 1 and 4, EN 60404-15 method 6 and VG 95578.

FerroPro compact has a graphical LCD touch panel with an innovative user interface and a resolution of 320x480 pixels.

The scan function allows the user to scan the surface of a part and statistically evaluate the data. The additional analog display complements the visualization of measured values, allowing you to see trends and peaks even out of the corner of your eye.

With flexible data logger, combined digital and analog display, and peak value measurement, the instrument supports all areas of permeability 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.

The measured permeability value depends on the dimensions of small objects. The sensitivity of the device increases with the thickness of the object. From a material thickness of 5 mm and an extension of about 20 mm, the measurement is independent of size.

WARNINGS AND HAZARDS

Do not use the unit in an explosive environment.

The manufacturer is not liable for any consequential damage resulting from the use of the device.

Keep the probe away from magnets and magnetic materials. Contact of the probe with magnets or magnetic material may damage the instrument.

Please read the entire manual before using the instrument.

This manual and the instrument are subject to change without notice. without prior notice.

QUICK START

- First connect the probe cable to the probe and the instrument.
- Switch on **FerroPro compact** with the red power button.
- An automatic zero is performed when the instrument is turned on. During this process, the probe should be away from metal parts and out of a magnetic field.
- If you want to switch the instrument to German when it is set to English, go to Settings (⚙️), Interface and Language

GENERAL INFORMATION

The **FerroPro compact** permeability tester is designed to measure the relative magnetic permeability μ_r of weakly magnetizable materials and structures with μ_r between 1,000 and 5,000.

With the **FerroPro compact** you can perform standard-compliant permeability measurements according to **ASTM A342 test methods 1 and 4, EN 60404-15 method 6 and VG 95578**.

Relative magnetic permeability is dimensionless.

It is the relationship between the magnetic flux density **B** and the magnetizing field **H**:

$$B = \mu_r \mu_0 H$$

where μ_0 is the vacuum permeability with

$$\mu_0 = 4 \times \text{Pi} \times 10^{-7} \frac{\text{m kg}}{\text{A}^2 \text{s}^2}$$

FerroPro compact is used for material selection in applications where absolutely non-magnetic materials must be used, such as in the electron microscope, electron or ion spectroscopy, in nuclear magnetic resonance equipment, and in the vicinity of compass navigation equipment.

In addition to quality control of stainless steels and other alloys, the is also used to detect material changes in highly stressed parts.

For permeability measurement, the probe is placed vertically on the surface of the workpiece so that the probe tip touches the workpiece. Tilting the probe can slightly distort the result. The measured value in μ_r of the relative magnetic permeability is shown directly on the display.

FerroPro compact is calibrated against precisely calibrated reference standards traceable to the Physikalisch-Technische Bundesanstalt PTB (Braunschweig, Germany) and the National Physical Laboratory NPL (Teddington, UK). Checking the calibration is easy. A calibration standard is supplied with each instrument.

The calibration standard is traceable to PTB standards.

To check the calibration, place the probe exactly vertically on the calibration standard so that the probe tip touches the top exactly in the center. The displayed value should match the value printed on the calibration standard. If necessary, the calibration can be changed in the instrument under the "Calibrate" menu item.

RESIDUAL MAGNETISM / REMANENCE

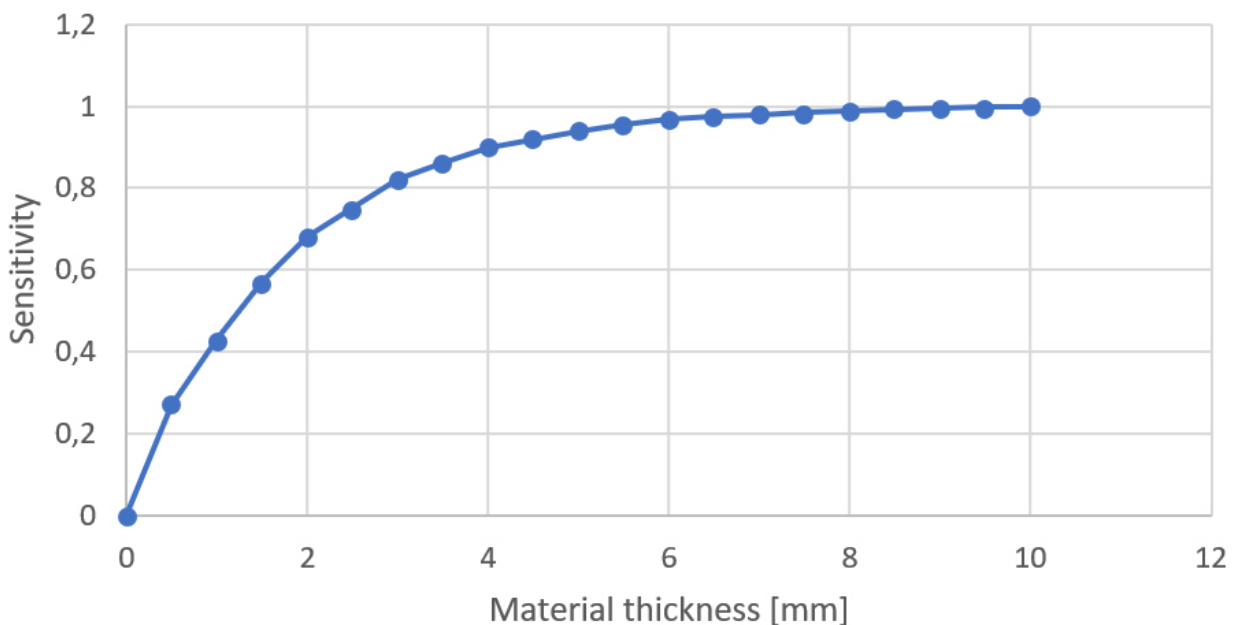
Many materials, such as stainless steel, can be permanently magnetized by a strong magnetic field. The residual magnetization (residual field strength or remanence) when the external field is turned off affects the permeability measurement because the magnetic field sensors in the probe react to inhomogeneous fields emanating from the workpiece. Therefore, it is recommended that magnetized workpieces be demagnetized in a decaying AC field prior to permeability measurement.

DIMENSIONS OF THE PART TO MEASURE

The measured value of the permeability depends on the dimensions of small workpieces. The sensitivity of the instrument increases with their thickness. From a thickness of about 5 mm and an extension of about 2 cm, the measurement is independent of the size. The approximate dependence of sensitivity on thickness is shown in the following diagram.

The sensitivity is defined as $(\mu_{\text{displayed}} - 1) / (\mu_{\text{true}} - 1)$.

Relationship Material Thickness - Sensitivity



DISPLAY STRUCTURE



The display is divided into 5 sections.

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

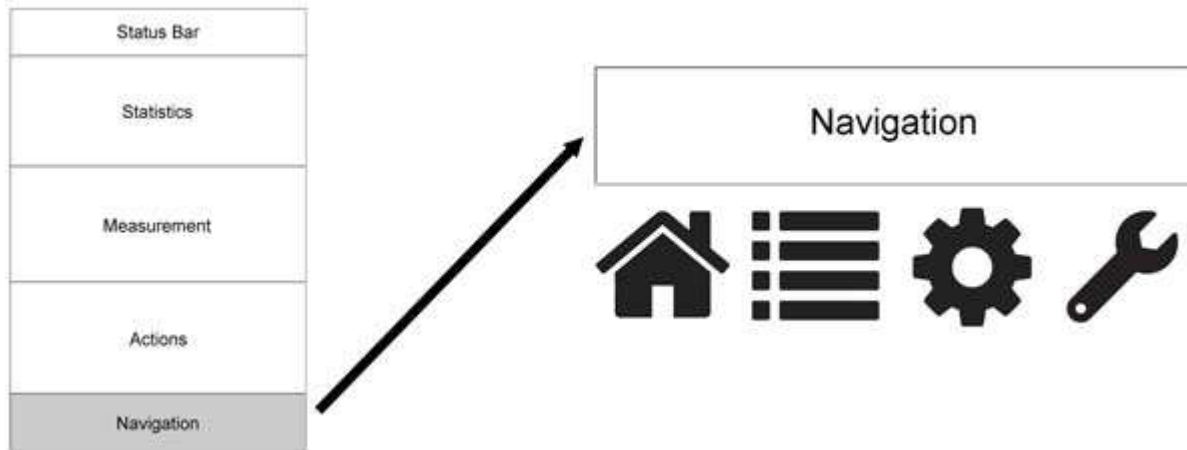
The **statistics** area displays statistics for a series of measurements. If no memory batch is active, the List-Magnetik logo is displayed here.





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.



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

MEASUREMENT

	<p>This icon in the navigation will take you directly to the measurement</p>
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The measurement continuously takes 5-6 readings per second.
The display is constantly updated.

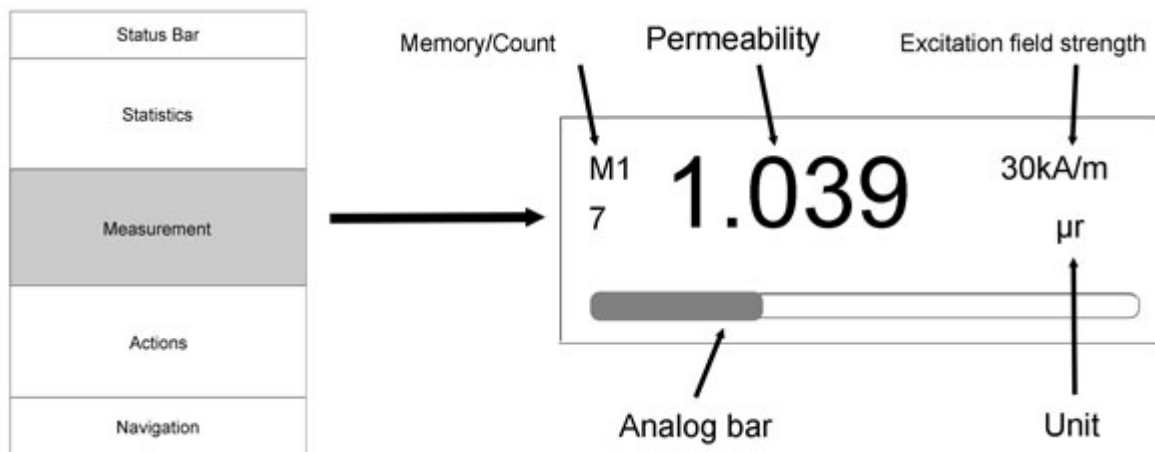


The middle section shows the measured value, the excitation field strength and the unit of measurement, μr . On the left, the currently active memory and its capacity are displayed.

The normal color of the measurement is black. If limit values are set, the measured value is displayed in red if the value falls below the lower limit value and in blue if the measured value exceeds the upper limit value.

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

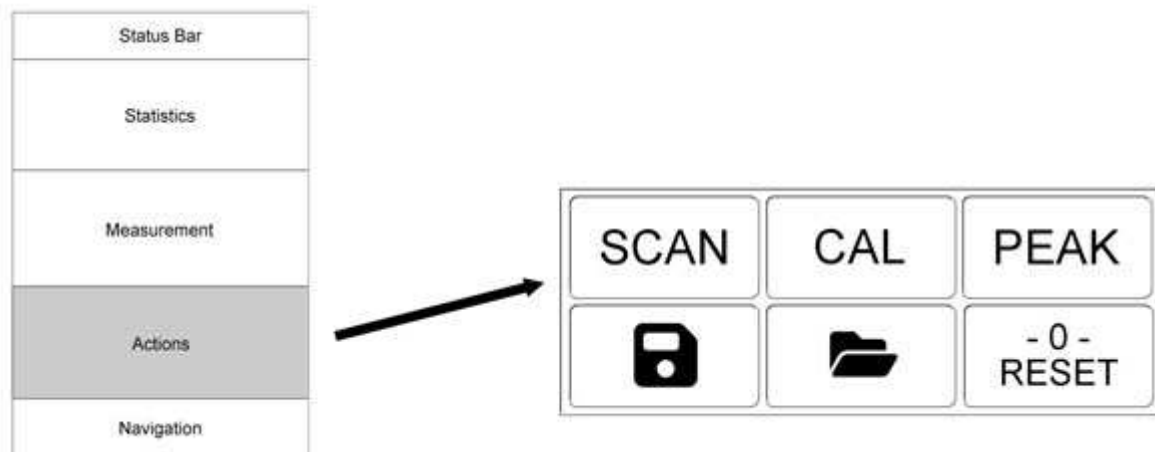
If you want to save a reading, you can transfer the current reading to the current memory by briefly tapping the diskette icon. The transfer is confirmed by a beep. The statistics of this memory are displayed in the area above the measurement display as in a normal measurement.



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.

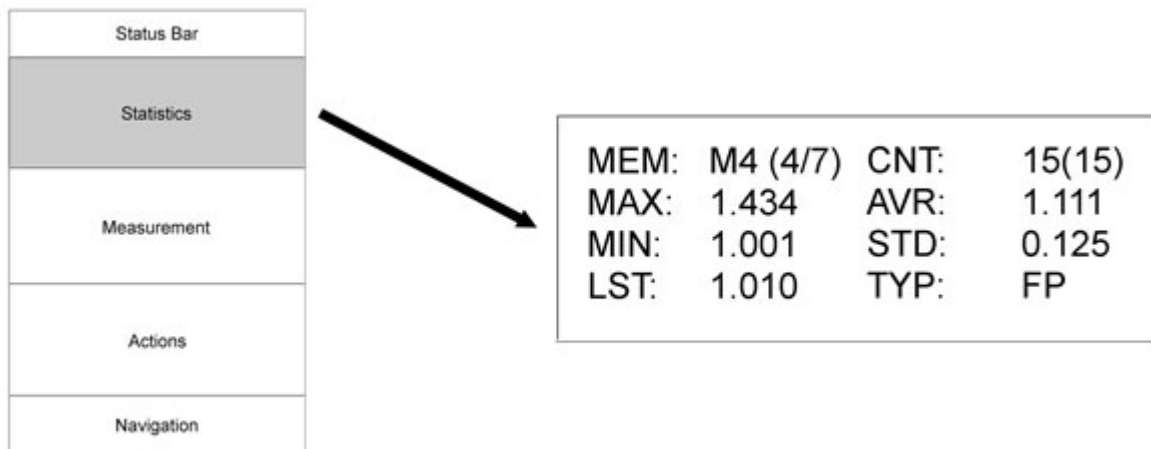


Zeroing the measurement.

CAL	<p>Entry into the calibration function.</p> <p>Here you can recalibrate the probe</p>
PEAK	<p>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.</p> <p>If the peak value measurement is active, the button is highlighted. To return to normal measurement, press the button again.</p>
RESET	<p>Resetting the peak value during peak measurement.</p> <p>After resetting, the peak value is determined again in ascending order from 0.</p>
	<p>To activate a memory batch, switch to data log management with this icon "Folder".</p> <p>From the moment of activation, measurements can be stored</p>
SCAN	<p>Special Function Scan Measurement</p> <p>See separate chapter " Special Measurement Methods ".</p> <p>The jump to the scan measurement is only possible if the peak value measurement / PEAK is switched off.</p>

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 memory batch 4.

Maximum, minimum, average and standard deviation are calculated from these 15 values.

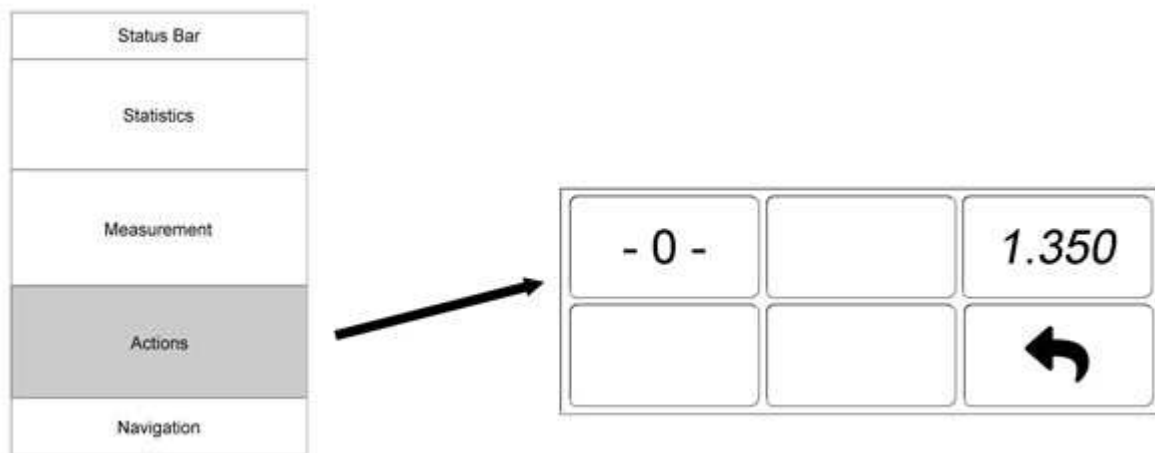
The last stored value was 1.010

CALIBRATION

If the instrument has already been used and calibrated correctly, the last calibration value entered is automatically adjusted or corrected for any temperature fluctuations that may have occurred after the instrument was turned on. A new calibration is only necessary if the measured value is no longer correct when measured against the calibration standard.

Actions

Overview of the Calibration Display Action Area.



- 0 - Zero calibration in air.

1.350 $\mu r=1.350$ or another value depending on the instrument setting.

You can adjust the reference value for your calibration standard in the Settings menu (accessible via the navigation bar).


Make sure that the measurement type is set to the correct excitation field strength. Calibration Standards Provided by List-Magnetik are referenced to 30 kA/m.

A detailed explanation follows this overview



Back to measurement

The action button displays a value, such as 1.350 or similar. Look at your calibration standard. Does the value match? If not, the instrument must first be set to the reference value.

To do this, use the navigation to go to  Setup / Calibration.

When you select 1.350, the button is highlighted. The instrument is now ready for calibration. Place the probe on the calibration standard and the reading will adjust to the pre-set value. The color changes to normal and the probe can be removed.

MEMORY MANAGEMENT

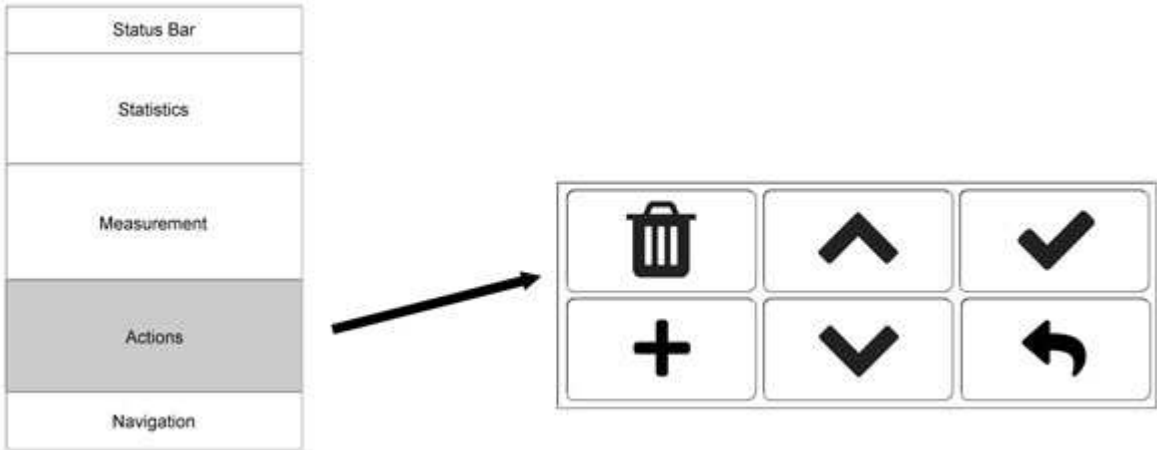
The data loggers record both the automatically stored individual measurements and the values actively stored during continuous measurement. The scan memories are separately managed memories that are not considered here.






You can create as many sample memories as you like. The memories are assigned a unique free number and a leading "M". A maximum of 10,000 measurements can be stored in the M memories.

If you have not created or activated a memory batch, not all results will be stored. The floppy disk symbol is then not visible during continuous measurement.

Actions

Overview of the data log management action area.



	Back to measurement
	<p>Create a new memory batch.</p> <p>You can enter additional text to describe the new series of measurements.</p> <p>The new memory batch is active immediately. When you return to the measurement display, the floppy disk icon is highlighted and the next measurement is recorded in the memory batch.</p>
	<p>Scroll through the memory batches.</p> <p>The additional text entered will be displayed. You can view the individual values by clicking on the navigation icon of the data log.</p>
	Selection of a memory batch, for use immediately
	Deletion of the currently displayed memory batch

SPECIAL MEASUREMENT METHODS

SCAN

The scan measurement function takes permeability values as they change over time - this can be a fixed position probe measuring a moving part, or the probe moving over a fixed position part. For example, you can scan a pipe with the probe all the way around.

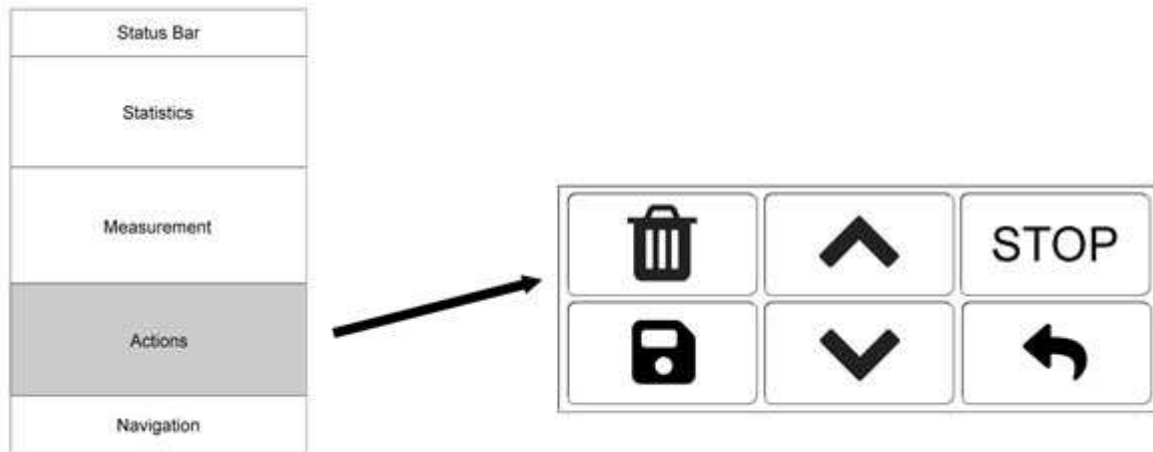
After starting the measurement (**START** button), you slowly move the probe around the workpiece. Or, depending on the measurement setup, you start moving the workpiece over the probe. Approx. **20 measurements per second** are performed automatically.





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
	<p>Save the scan process.</p> <p>You can enter a short text that will be displayed later when scrolling below the statistics.</p> <p>You can create as many scan memories as you like. The memory batches are given a unique free number and a prefixed "S"</p>
	<p>Browse through the saved scans.</p> <p>The statistics, short text, and graphical progress curve are displayed</p>
	Delete the currently displayed scan

DATA LOG

	This icon in the navigation takes you directly to the data log.
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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 constant "FP" (means FerroPro), and the measured value.


"PFP" indicates that the measurement was a peak.

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.
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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.

MODE (SWITCHING THE EXCITATION FIELD STRENGTH)

The supported excitation field strengths are 30 kA/m, 25 kA/m, and 200 Oe.

The 30 kA/m and 25 kA/m values refer to reference standards traceable to the Physikalisch-Technische Bundesanstalt PTB (Braunschweig, Germany) and the National Physical Laboratory NPL (Teddington, UK).

The reference value of 200 Oe is specified in MIL-1-17214.

CALIBRATION

SET THE REFERENCE VALUE

The reference value is factory set to the calibration standard supplied. The value is approximately $\mu_r = 1.35$. The exact value is printed on the standard.

If you are using a different calibration standard, you can set the correct value here.

From now on, the calibration display will show the value just set on the calibration action button.


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.

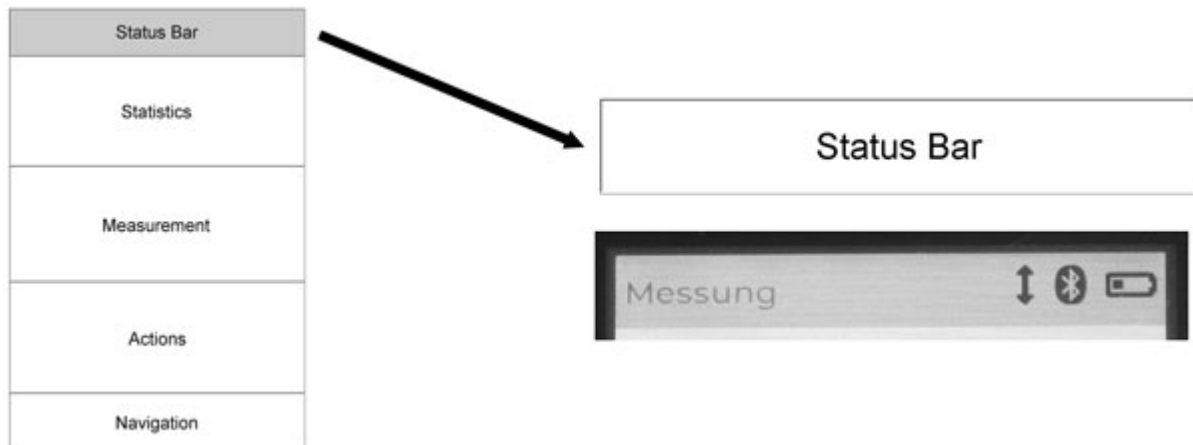
Upper limit value exceeded: measured value red
Falling below the lower limit: measured value blue

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.
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STATUS BAR



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

The symbol for Bluetooth is highlighted when a data transfer is active.

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 or scan are cleared. Settings will not be cleared.

FACTORY RESET

The factory reset restores all pre-installed settings of the instrument. All memory batches are cleared. 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.

TECHNICAL DATA

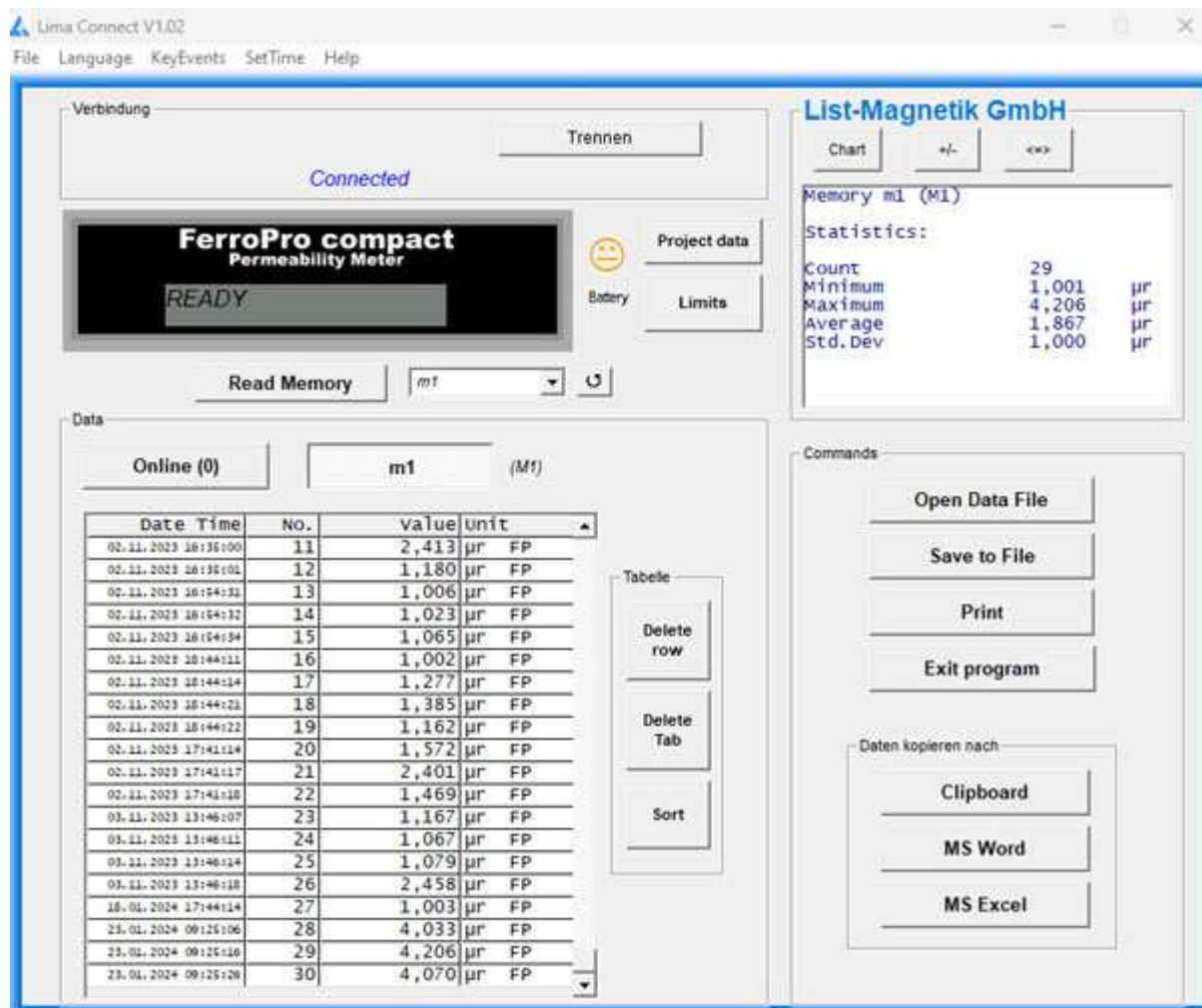
Measuring range:	$\mu\text{r} = 1.000$ to 5.000
Probe:	FPC-5, interchangeable, with separately interchangeable cable
Accuracy at 20°C:	$(\mu\text{r} - 1) \times 5\%$, against traceable calibration standards, can be readjusted
Resolution:	0.001
Ambient temperature range:	0 - 50° C
Display:	LCD color touch panel 320x480 pixels
Multilingual menu:	English, French, German, Italian, Spanish
Data logger:	10,000 measurements, flexibly divisible
Statistics:	Count / Maximum / Minimum / Average / Standard deviation
Interface:	Bluetooth Low Energy interface to communicate with Android, iOS and Windows
App for Android, iOS, Windows:	free via Google Play Store, Apple App Store, List-Magnetik website
Power supply:	3x 1.5V AA Mignon. External power supply connectable via USB-C
Operating time:	Approximately 25 hours with battery, unlimited with external power source.
Dimensions:	150 x 85 x 35 mm
Weight:	320 g with batteries

APPLICATIONS FOR WINDOWS, ANDROID, IOS

LIMA CONNECT FOR WINDOWS

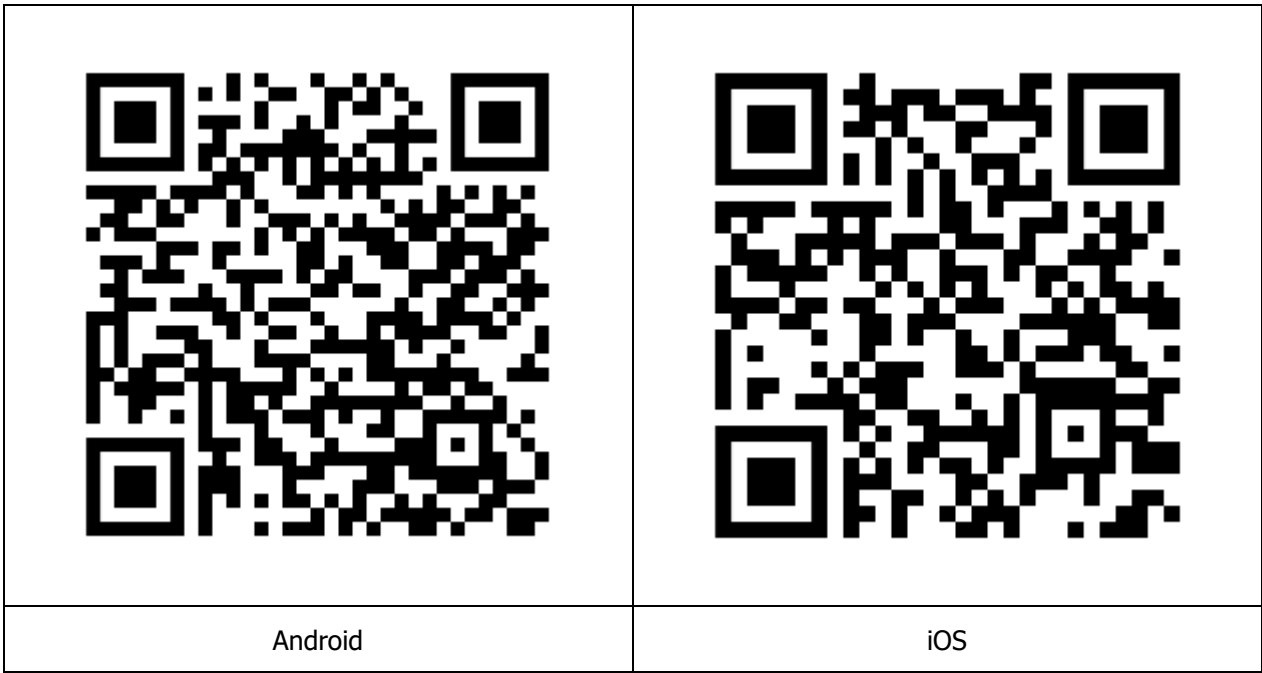
The free Lima Connect application for data transfer to the PC can be downloaded from the Applications section at www.list-magnetik.com.

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.



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.

We supply:

- Coating Thickness Meters
- Magnetic Field Meters
- Devices for Materials Testing
(Permeability and Ferrite content)

We provide expert advice and design metrology solutions tailored to your specific needs.

Fast calibration and repair service



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