



# General Information

The operational safety and functioning of the device can only be guaranteed if both the general safety and accident prevention regulations given by legislator, as well as the safety instructions provided in this Operation Manual are fully considered. We assume no liability for damages caused by the improper use or incorrect device operation.



Make sure that persons responsible for the device and its operation have read and understood this Operation Manual.

After you have read this manual, keep it in a safe place where it can be accessed at any time if necessary.

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## Table of Revisions

Version	Changes	Date	Release
3.3	-	03.18	-
3.4	Added warning and handling instructions for 3MTS-2	09.20	Senis/ru

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# 1 Safety Precautions

## 1.1 Awareness of Operation Manual

Any commissioning and handling on the device requires the exact awareness of and compliance to these operating instructions. The device is intended for use according to the described application notes only. In this manual, particularly important comments are highlighted as follows:

### WARNING !



This is a warning that points to risks and dangers. Disregarding this warning can lead to life-threatening situations. These warnings must be considered and respected.

### Information !



This is an information which points to certain necessary, characteristics.

## 1.2 Informal Security Measures

The Operation Manual must always be kept at the place where the device is used. In addition to the operating instructions, the general regulations as well as the local regulations for accident prevention and environmental protection must be provided and respected. All safety precautions for the device must be kept in readable condition.

## 1.3 Operator Training

The device may only be operated by trained personnel. Apprentices should work on the device under the supervision of an experienced person.

## 1.4 Constructional modifications to the device

Modifications or alterations to the device which influence the functioning of the device, without the manufacturer's permission, are prohibited. All device modifications require a written confirmation by the manufacturer. The device or its parts must be replaced by the manufacturer with original spare parts.

## 1.5 Warnings

### Risk of injury from electric strike!



Before cleaning, the device must be disconnected from the supply voltage by removing the USB cable from the USB port of the personal computer or tablet.

Do not modify, bend, mechanically stress, pull, heat, or expose the USB cable to heat or cold sources. Do not squeeze the cable or damage it by sharp edges. The cable guide on the device must not be loaded by pulling. There must always be a sufficient cable length from the probe to the personal computer.

If damage is observed, the device must be taken out of operation immediately. Contact the manufacturer in this case.

### Danger by liquids!



To reduce the risk of fire or electric shock, do not expose the unit to rain or moisture. No liquid must penetrate the housing, nor may the electrical components come into contact with a liquid. The device must be completely dry before turning it on again.

### Danger due to magnetic fields!



The device measures magnetic fields, such as the magnetic field of permanent magnets. Never stick unsecured magnets together. There is a risk of crushing and cutting. Do not allow any iron parts (e.g. tools) to lie around.

Do not put the credit cards near the magnets. These could be deleted or damaged.

Heart pacemakers can be interfered by the magnetic field, so inform your employees on dangers that might be caused by strong magnets!

### Danger of damage!



The probe tip of the 3MTS-2 and the cables are fragile! Do not modify, bend, mechanically stress, pull, the cable. Please handle it with a special care.

## 2 Application Notes

The **3MTS** can be commissioned by the customer according to the operating instructions. In case of problems the manufacturer has to be immediately contacted.

### 2.1.1 Installation Site

Proper installation site.



The device is to be kept and used for measurement in a dry (humidity <60%, no direct or indirect water effect), dust-free and low-vibration environments.

All components and connectors must be freely accessible and must not be blocked by obstructions.

The manufacturer accepts no liability for infringements.

### 2.1.2 Device Transportation

Transportation after the measurement.



The customer is free to change the location of the measuring system. Switch the device off by disconnecting the USB cable and protect the device using the original packaging.

### 2.1.3 Store and protect during the interruption of normal use

Store and protect.



Switch off the device by disconnecting the USB cable and protect the device using the original packaging.

Store the device in the original packaging in a safe and protected place to protect it from environmental influences and from damage. Before re-using the device, check for external damages. If damage is detected, do not switch on the device and inform the manufacturer accordingly.

## 3 Product Description

### 3.1 Introduction

The 3MTS is a handheld Teslameter / Gaussmeter with integrated USB interface. It was developed in cooperation between the two companies SENIS and Matesy.

The 3MTS has a fully integrated three-axis Hall probe (see Figure 1).

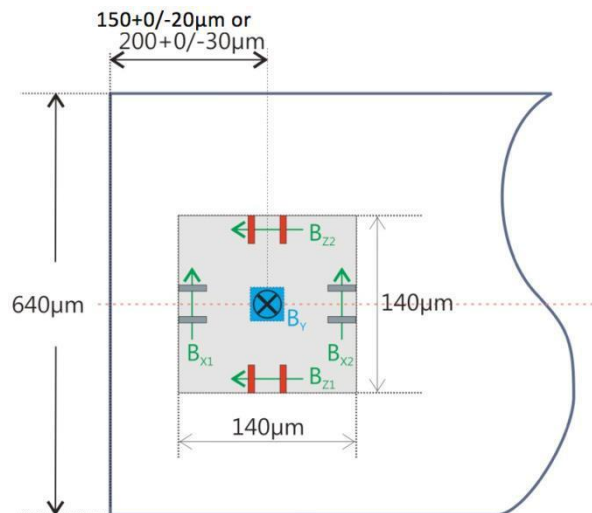


Figure 1: Dimension of the field-sensitive volume of the fully integrated 3-axis Hall sensor chip

The Hall probe is connected to a compact and light electronic module that provides the measured signal acquisition and signal-conditioning; Integrated 12-bit AD conversion; the device calibration; and an USB connection to the host computer. The temperature sensor integrated in the Hall probe chip allows a temperature-compensated output signal for all three magnetic field components (Bx, By and Bz). The easy-to-use Teslameter software running on a MS Windows computer, tablet or smartphone is used for the data acquisition, Teslameter power supply and control and for measured data visualization. The measured data are visualized in numerical and graphical colored displays, allowing an easy readability and intuitive setup of alarm triggers, hold function and measured data storage. The total value of the magnetic field, as well as all three components of the magnetic field and the probe temperature are displayed. In addition, the min/max values of the magnetic field components can be presented.

The 3MTS Teslameter has two versions:

- Version 1 (3MTS-1): Carbon-fiber probe holder for extreme robustness and flexibility;
- Version 2 (3MTS-2-X m): Probe connected by a thin cable (cable lengths: 1 m, 2 m, 5 m).



### 3.1.1 3MTS-1

The 3MTS-1 utilises a fully integrated three-axis Hall probe, which is integrated into a specially developed carbon fiber holder to ensure the mechanical protection of the probe (see Figure 2 and Figure 3).

The probe holder is 5 mm wide and only 1 mm thick to allow a measurement of the magnetic field in narrow air gaps. In the region of the tip of the probe holder, the three-axis magnetic field sensitive Hall sensor chip is integrated (see A in Figure 3).

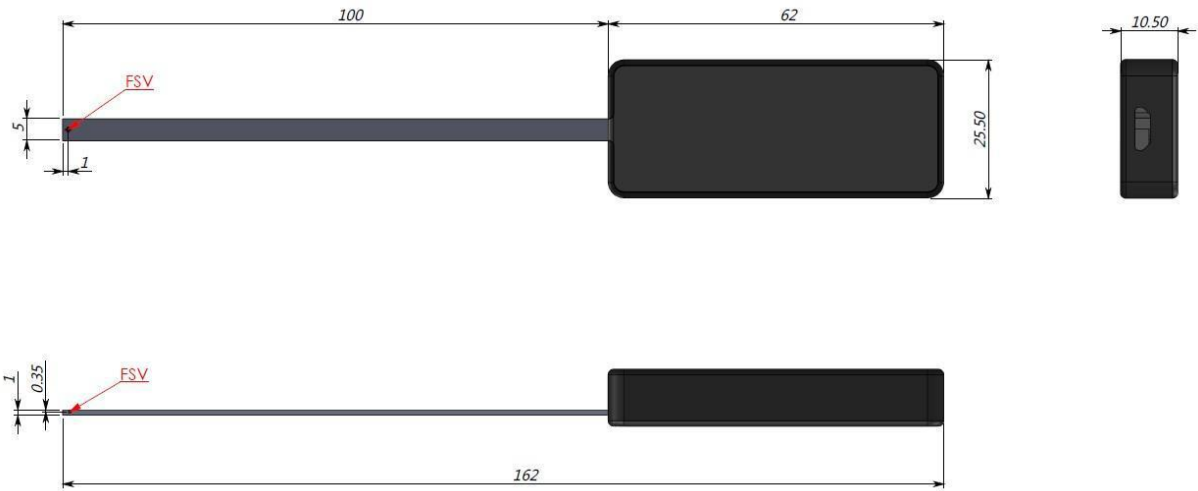


Figure 2: Standard Dimensions 3MTS-1 Handheld Teslameter (side view). All measures are given in millimeters.

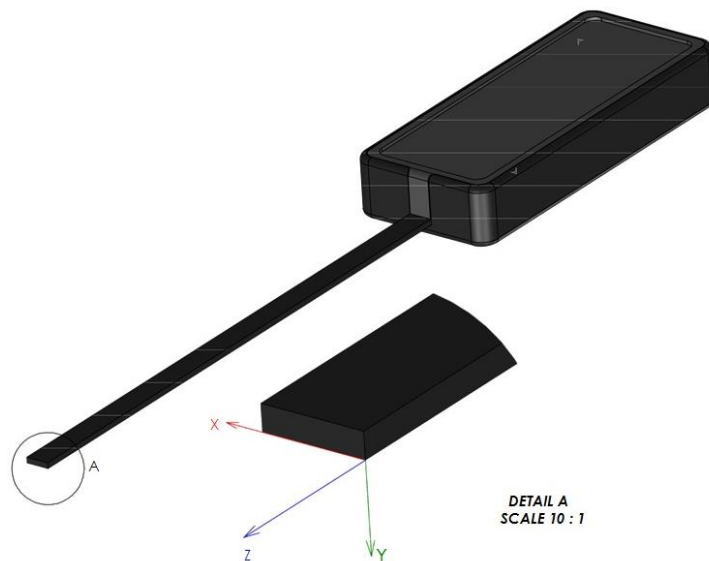


Figure 3: 3MTS-1 Handheld Teslameter (carbon fiber probe holder)

Dimensions	X [mm]	Y [mm]	Z [mm]
Magnetic Field Sensitive Volume (MFSV)	0.14	0.01	0.14
Position of the center of MFSV	$2.5 \pm 0.1$	$-0.65 \pm 0.05$	$-1 \pm 0.1$

### 3.1.2 3MTS-2-X m

The 3MTS-2-X m utilises a fully integrated three-axis Hall probe, which is connected to the electronic module through a thin cable (see Figure 4). The thin CaH cable can be provided in three different lengths: 1 m, 2 m and 5 m. The probe can be fixed on a customer-made probe holder.

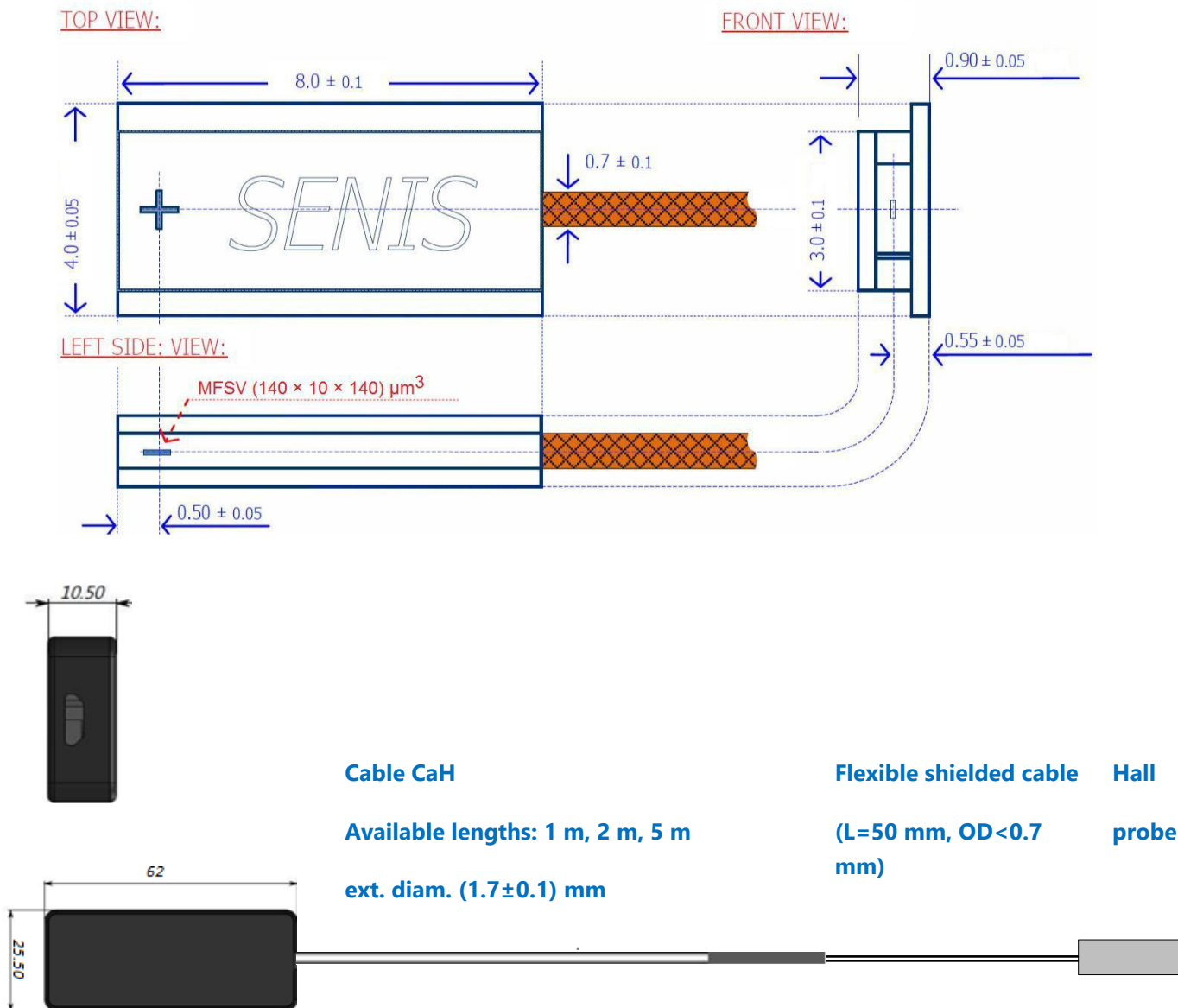


Figure 4: Dimensions of the C-type Hall probe, electronic module and Cable CaH (available lengths: 1 m, 2 m, 5 m). All measures are given in millimeters

Dimensions	X [mm]	Y [mm]	Z [mm]
Magnetic Field Sensitive Volume (MFSV)	0.14	0.01	0.14
Position of the center of MFSV	2.0 ± 0.1	-0.55 ± 0.05	-0.5 ± 0.1
Total probe external dimensions	4.0 ± 0.1	0.90 ± 0.05	8.0 ± 0.1

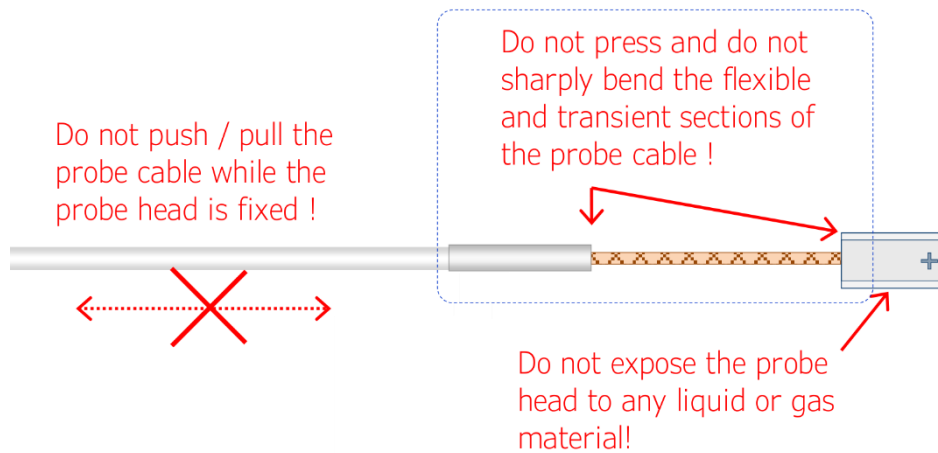
### 3.1.3 3MTS-2-X m probe and cable handling

Although the 03C probe is very robust with respect to its size, it should be handled with special care. Considering that we deal with a high-precision device of very small dimensions, following precautions should help to avoid damage to the probe during installation and handling, and ensure that the device's accurate calibration remains preserved:

- The Hall Probe is sensitive to Electrostatic Discharge (ESD). Please follow the proper ESD protection procedures when handling the Hall probe.
- The mounting of the probe should be carried out by application of very low pressure to its head and particularly on the thin cable.
- Do not apply more force than required to hold the probe in its place. Damage to either the ceramics package of the Hall sensor or thin wiring could destroy the Probe. We strongly suggest storing the probe in its protective case when not in use.

 **NOTE:** The Probe tip is fragile!  
Please handle it with a special care.

- If the probe head is clamped, the user needs to make sure that the environment surface in contact with the reference plane of the probe is flat and covers as much of the probe reference surface as possible (see image below). Do not apply more force than required to hold the probe in its mounting.



- In order to prevent rupture of the thin probe wiring, the user should fix and secure the probe cable in the proximity of the head. The thin wires of the flexible section of the probe can be folded only with a special care. Any repetitive sharp bending must be strongly avoided:



- Avoid any high pressure and bending of the connection between the thin and thick Probe cables.
- Avoid the immersion of the probe of any liquid, and its exposure to moisture and aggressive gasses.

## 3.2 Magnetic and Electrical Specification

Unless otherwise noted, the specifications summarized in the table below apply for all three measurement channels Bx, By, and Bz at the room temperature (23°C) and after a 15 minutes device warm-up time.

Parameter	Value			
Standard measurement ranges	± 100 mT	± 500 mT	± 3 T	± 20 T
Linear/Calibrated range of magnetic flux density ( $\pm B_{LR}$ )	± 100 mT	± 500 mT	± 2 T	± 2 T
Total Accuracy (@ $B < \pm B_{LR}$ )	< 1 % of $B_{range}$			
Planar Hall Voltage impact (@ $B < \pm B_{LR}$ )	< 0.01 % of $B_{perpendicular}$			
Long-term instability	< 1 % over 10 years			
Magnetic Resolution (no averaging)	< 400 $\mu$ T	< 1.8 mT	< 11 mT	-
Magnetic Resolution (with averaging; integration time 1s)	< 20 $\mu$ T	< 70 $\mu$ T	< 320 $\mu$ T	-
AD Conversion	12 bits			
Sampling frequency [fs]	1 kHz per measurement channel			
Frequency bandwidth [fc]	$f_c \gg f_s$			
Operating temperature range	-20 °C to +85 °C			

## 4 Application Program

### 4.1 Software Installation

If you purchased a PC together with the Teslameter, the software is already installed and the system can be used immediately. Otherwise, the supplied CD-ROM contains system drivers and the application program, as a set-up file. For a successful software installation follow the steps below:



Depending on the security settings of the PC, the administrator rights may be necessary for the installation. If problems occur, please contact your network administrator.

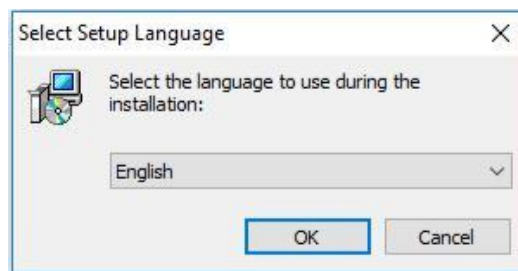


Figure 5: Setup-Language selection

1. Open the setup file of the 3MTS software and select the desired language.

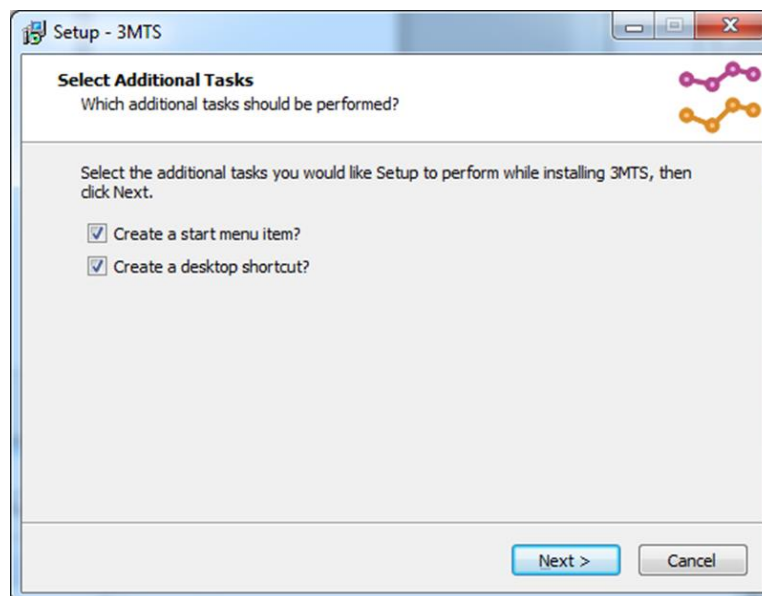


Figure 6: Select additional tasks

2. Now you can select whether you want to create a start menu entry or a desktop shortcut, then confirm it with "Next"

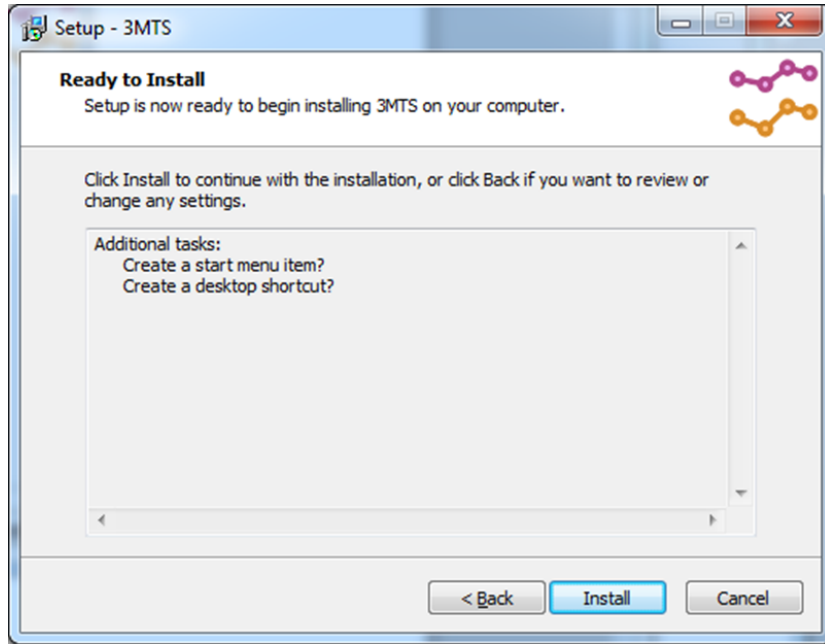


Figure 7: Ready to install

3. Now confirm the installation process by pressing the "Install" button.

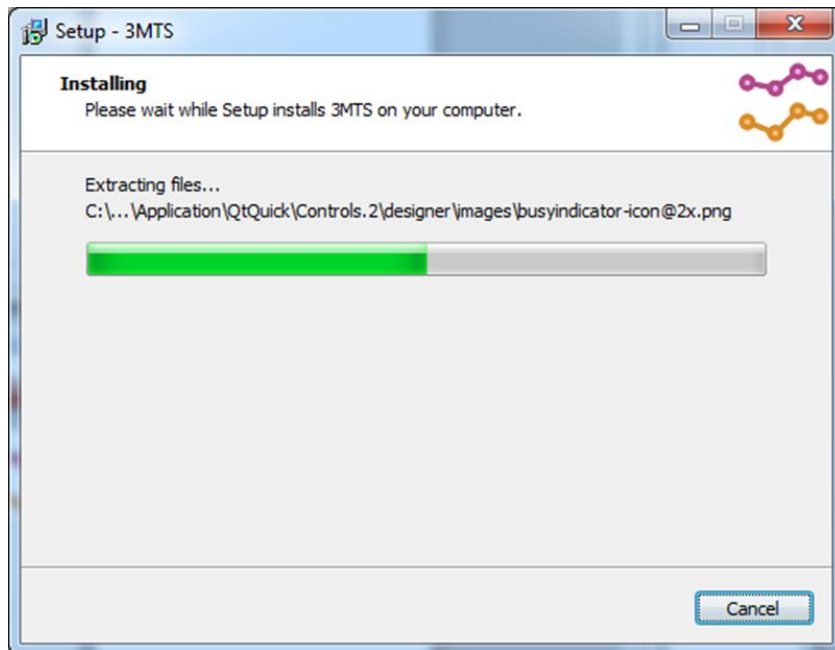


Figure 8: Installation progress

4. Here you can see the installation progress.



Figure 9: Create start menu and desktop link

5. Check “Install Driver?” to automatically install necessary drivers. Uncheck “Start application?” if you do not want to start the software at this time. Click “Finish” to complete installation.

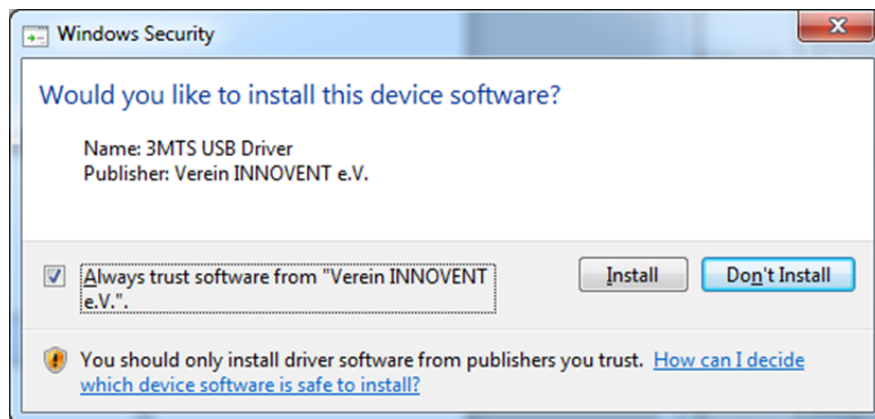


Figure 10: Confirm installation

6. Check “Always trust software from “Verein INNOVENT e.V.” if you want to always trust software from this publisher. Click “Install” to proceed with driver installation.

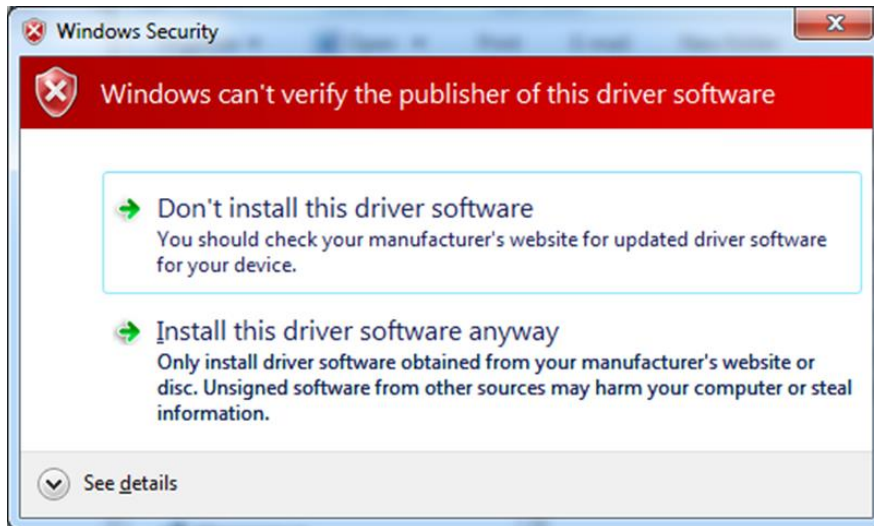


Figure 11: Windows security

7. If the following window pops up, click “Install this driver software anyway” to confirm driver installation.



## 4.2 Start the Application Program 3MTS

Open the installation folder and start the application **3MTS.exe** (Figure 12).

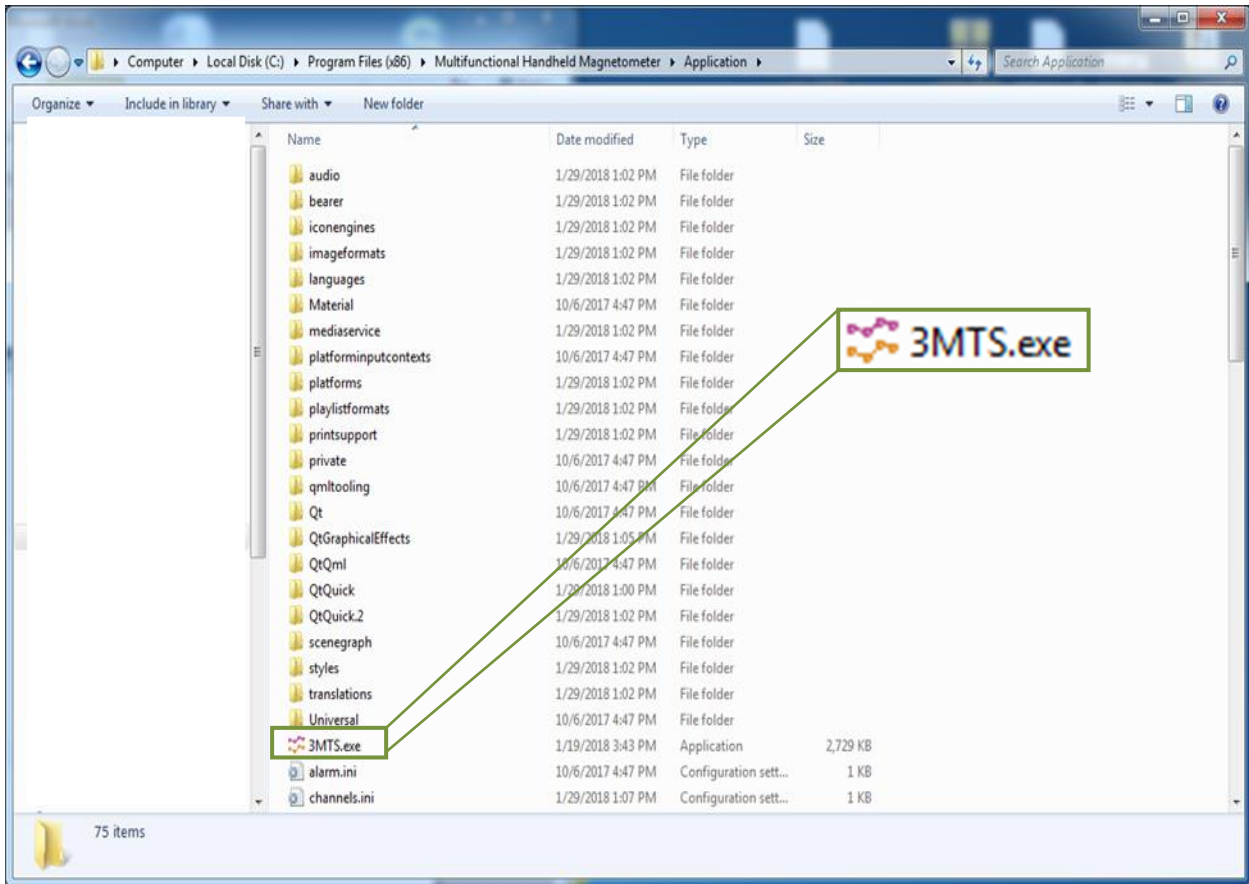


Figure 12: Start of the Application Program 3MTS

### 4.3 Main Application

After the software was started, the main application window opens.

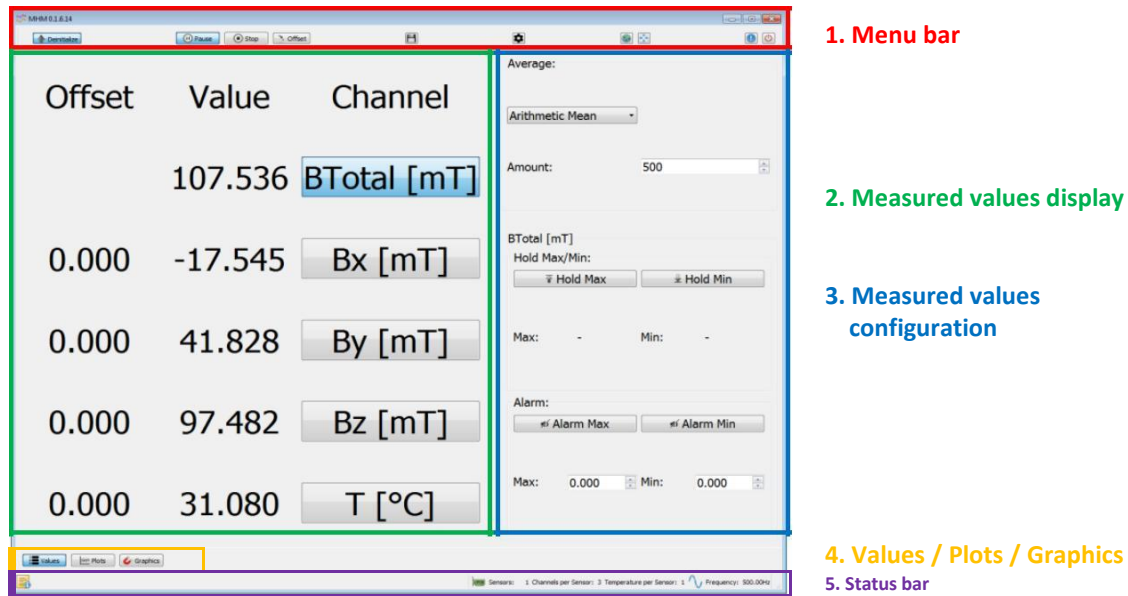








Figure 13: 3MTS main application window - Values

#### 4.3.1 Menu bar

Button	Description	Detailed description
	Initialization	The probe can be initialized and de-initialized using the button.
	Measurement	<ul style="list-style-type: none"> <li>- Pause a measurement</li> <li>- Measurement stop, clears the offset values</li> <li>- Offset, sets the current measured values to zero value. A performed offset can be undone.</li> </ul>
	Save	After pressing the "Save" button you can select "Save plot" or "Save measurement". 
	Setup	Use the Settings button to access the global settings

	Language	Use the World button to change the language of the software.
	Window size	Use the "Window Size" button to adjust the size of the display elements. 
	Information	Use the "Info" button to access the information page
	Close	Exits the software 

### 4.3.2 Measurement Display

Display for each measured component (3):

- BTotal (total magnetic field value)
- Bx (X-axis measured by Hall probe)
- By (Y-axis measured by Hall probe)
- Bz (Z-axis measured by Hall probe)
- T Temperature of the probe

The instantaneous measured value (2) with its corresponding Offset value (1) is shown. The offset value is displayed only after an offset has been performed. This is done via the "Offset" button in the menu bar. In this case, the current measured value (2) becomes the offset value (4) and the measured value is set to zero (5)

1	2	3	4	5	6
Offset	Value	Channel	Offset	Value	Channel
	90.488	BTotal in mT		0.248	BTotal in mT
0	-52.887	Bx in mT	-52.884	0.021	Bx in mT
0	-53.386	By in mT	-53.425	0.011	By in mT
0	-50.408	Bz in mT	-50.442	0.017	Bz in mT
0	34.920	T in °C	34.000	0.001	T in °C

Figure 14: 3MTS Software – Values

### 4.3.3 Values / Plots / Graphics

With the "Values / Plots" buttons, the measured values can be displayed as numeric "Values" (see Figure 14) and graphically ("Plots") as shown in Figure 15. The individual sensor channels can be switched on and off on the left side of the "Plots" window (1). The plot color can be assigned to each individual sensor channel by the right click on the corresponding button in the "Plots" window (Figure 16). The offset values and the current measured values are also displayed. On the right (2), the X and Y axes can be selected for manual scaling and can be set with the mouse wheel. The default setting is the "autoscale", after which the diagram area (3) automatically adapts to the measured values. Furthermore, the screen can be moved with the arrow keys. The averaging over a defined number of measured samples can also be set under (2). With the "Graphics" button, magnetic field orientation can be shown (Figure 17).

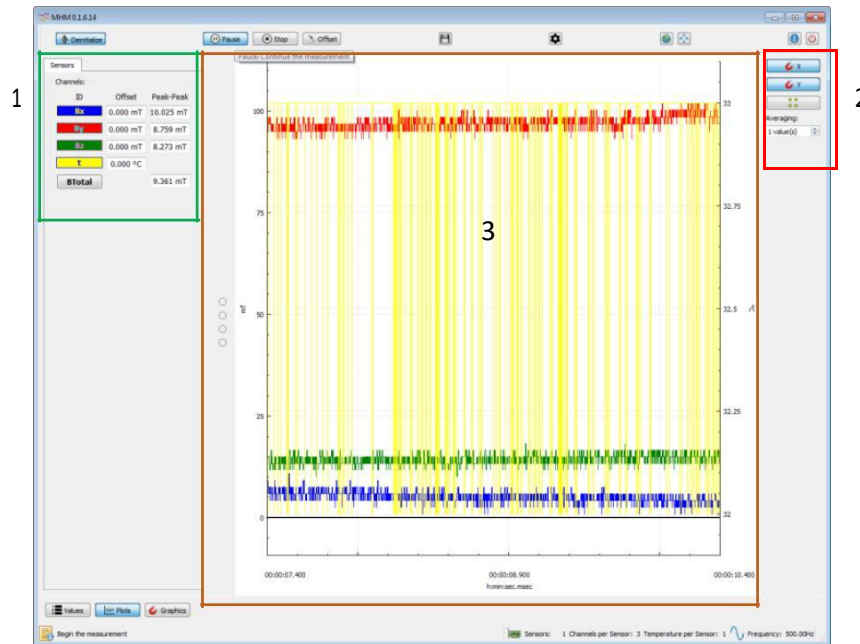


Figure 15: Main application window of the 3MTS software – Plots

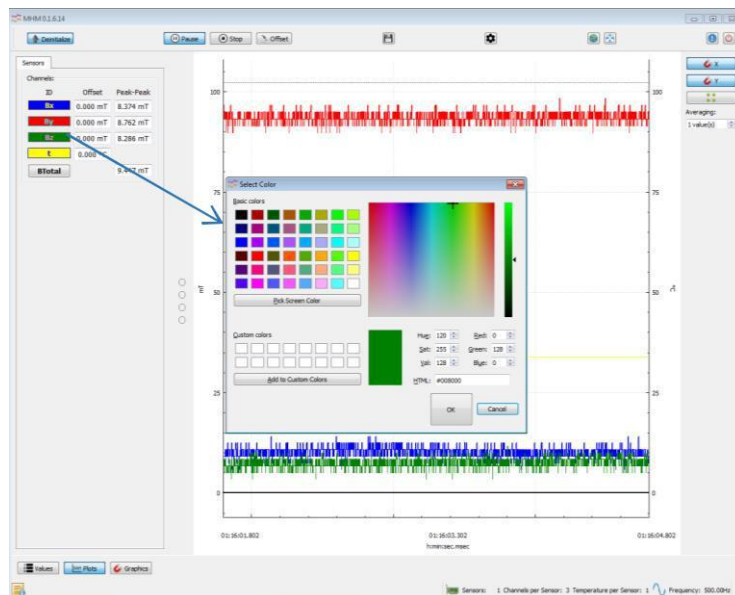


Figure 16: Plots window – Assigning a color to the plot

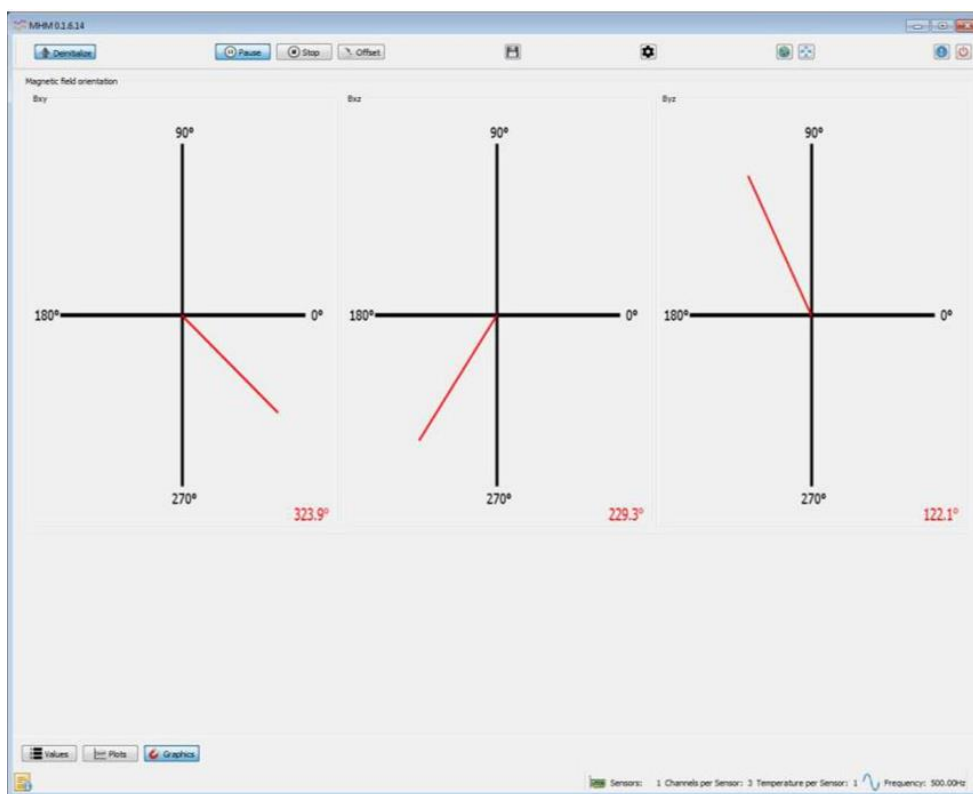

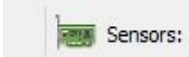
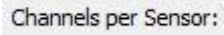




Figure 17: Main application window of the 3MTS software – Graphics

### 4.3.4 Measurement Configuration - Values

Display	Description	Detailed Description
<p>Average:</p> <p>Arithmetic Mean Arithmetic Mean Root Mean Square</p> <p>Amount: 500</p>	Average	The calculation method of the mean value can be selected and the number of samples can be set.
<p>BTotal in mT</p> <p>Hold Max/Min:</p> <p>Hold Max    Hold Min</p> <p>Max: -    Min: -</p>	Hold Max / Min	If the Hold Min / Hold Max key is activated, the current maximum or minimum value is stored and displayed.
<p>Alarm:</p> <p>Alarm Max    Alarm Min</p> <p>Max: 0.00    Min: 0.00</p>	Alarm	Minimum and maximum limits can be set in this input field. If the limit values are reached or exceeded, a signal tone is issued, if this setting is activated under "Settings"

### 4.3.5 Status bar

Display	Description	Detailed Description
	Status	Status messages
	Number of probes	Provides the number of probes connected
	Number of probe channels (axes)	Number of magnetic field probe channels/axis. The three probe channels correspond to Bx, By and Bz in three directions X, Y and Z.
	Temperature sensors per Probe	Number of temperature sensors per probe
	Frequency	Displays the set measuring frequency of the Teslameter

### 4.4 Setup

The following parameters can be set in the "Settings" window (see Figure 18):

Area	Field	Description
Data	Data rate	Describes the speed at which measured values are acquired and stored
	Measurement range	4 measuring ranges can be selected: 100mT, 500mT, 3T and 20T
	Unit	Unit of the displayed value [mT, $\mu$ T, G]
Plot	Display refresh rate	Defines the time at which measured values are refreshed.
	X-axis range	Defines the time interval during which measured values are displayed
Alarms	System beep	The beep sound can be switched on or off for the acoustic signaling of an alarm.
	Interval	Defines the time when a beep is switched on and off.

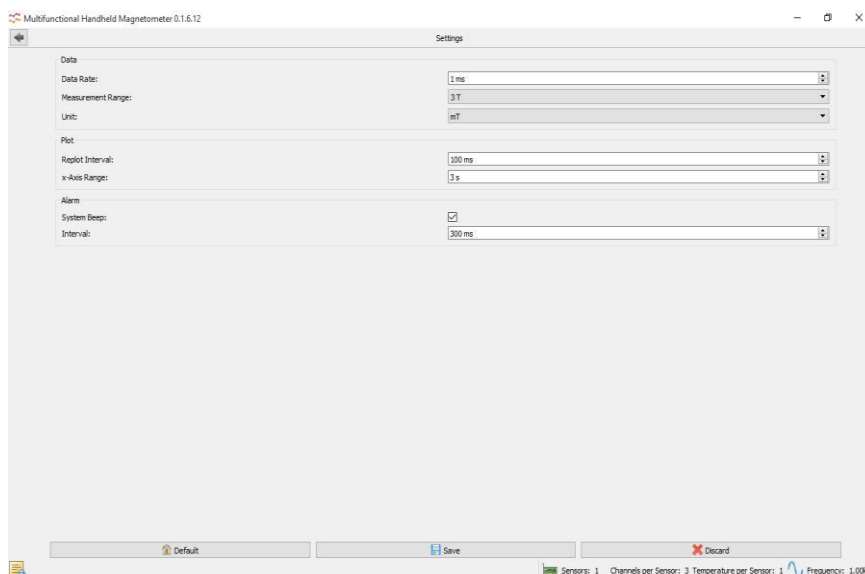


Figure 18: 3MTS Software – Setup

## 4.5 Change the Language

With this option, the user can select and confirm the language pack English or German by using the drop-down menu (see Figure 19).

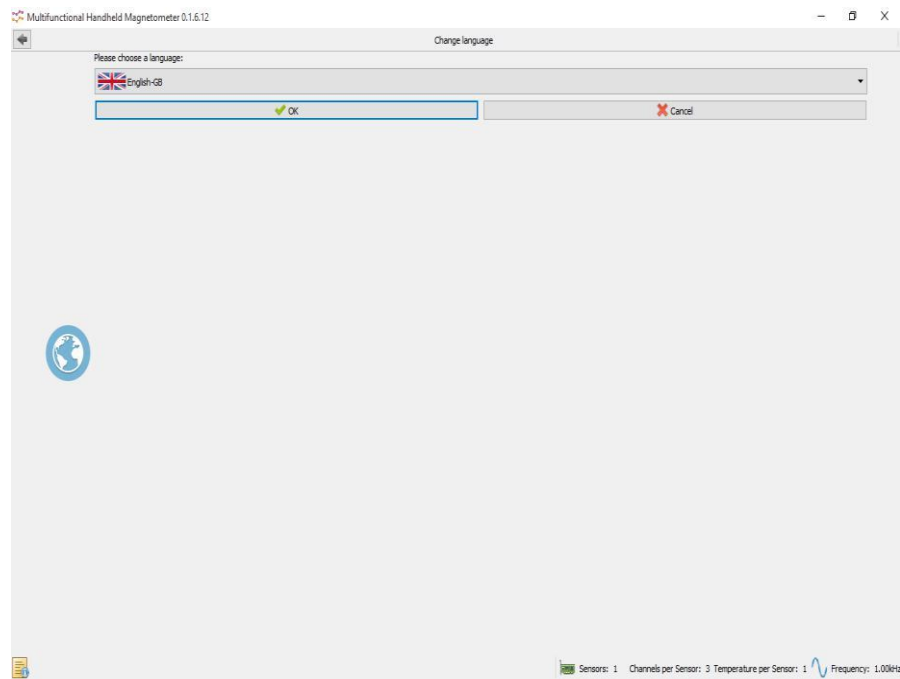


Figure 19: 3MTS Software – Change the Language



## 4.6 Save/Record Measurement

In the menu bar, you can select the option "Save" to save a plot. The saving path can be set by pressing the "Change Directory" button (1) (see Figure 20). There is also the option to change the file types (3) and to select a time stamp (2) for the file name creation. The complete file name is displayed in a preview (4). The measurement data acquisition is started by pressing the button "Start saving measurement" (5). In the main application window, the symbol "Save" changes its color and is shown in red (see Figure 22), which indicates an active recording. By pressing the "Save" symbol again, the data recording can be stopped (see Figure 23).

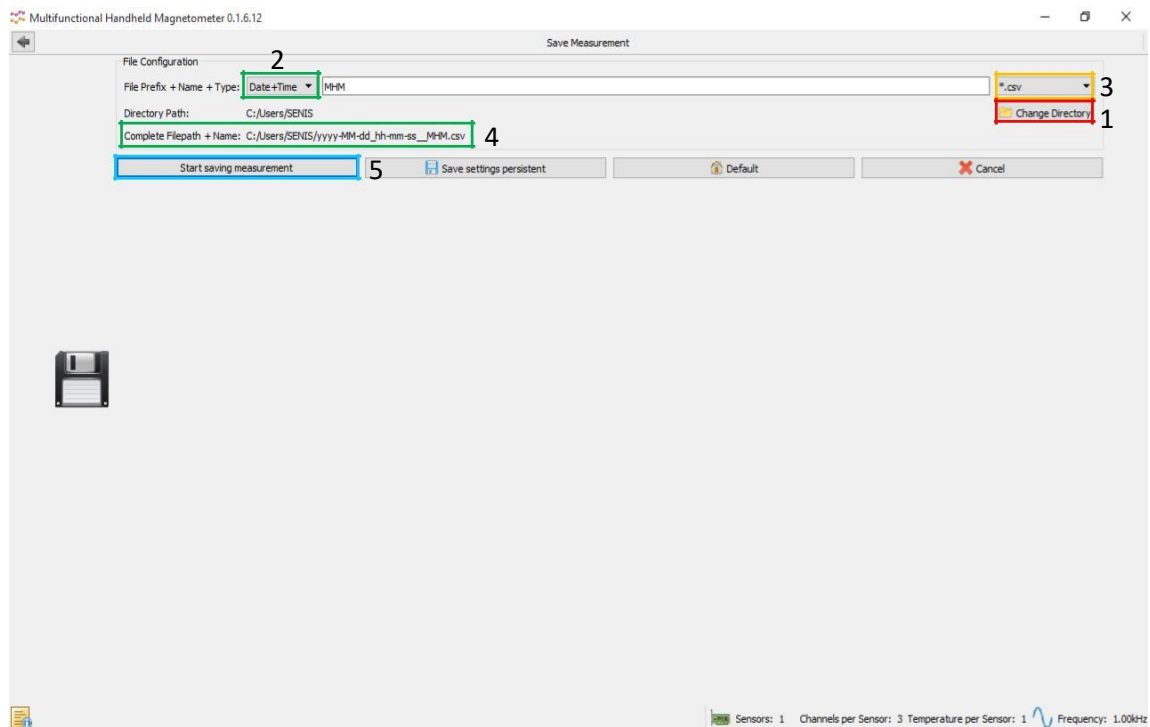


Figure 20: 3MTS Software – Save Measurement

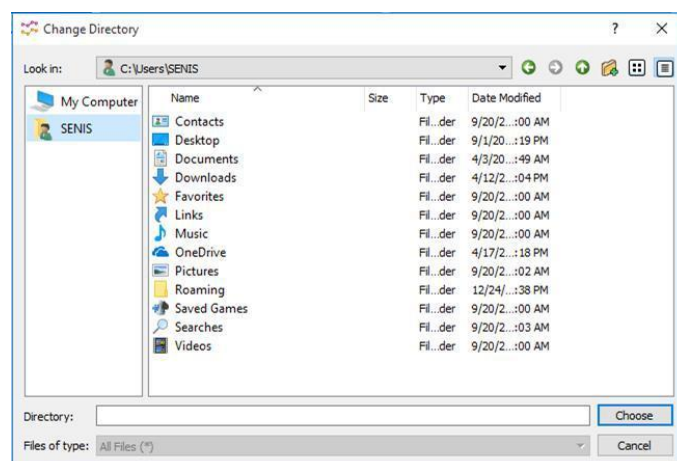


Figure 21: 3MTS Software – Change saving path

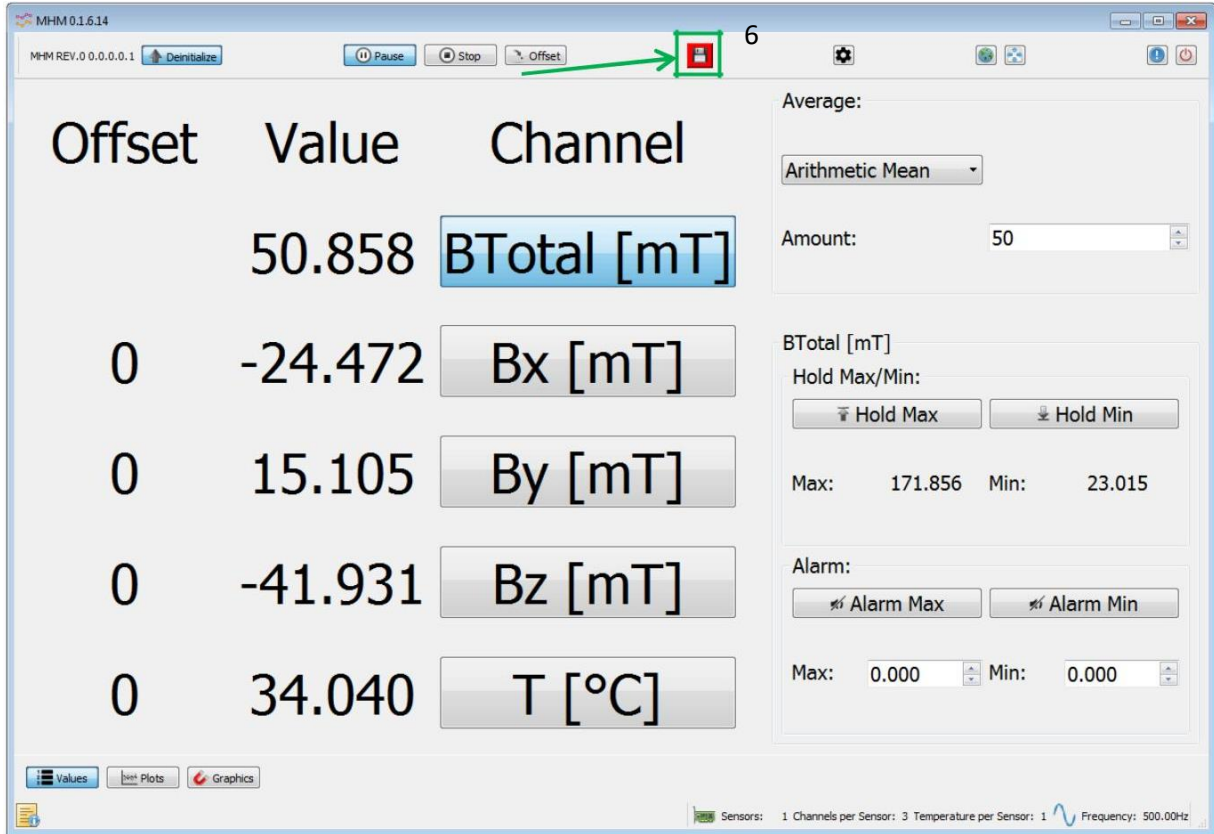


Figure 22: 3MTS Software – Measurement is recorded

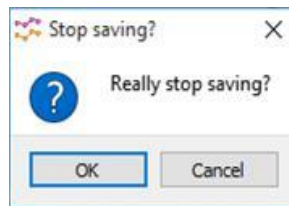


Figure 23: 3MTS Software – Stop saving

## 4.7 Save Plot

In the menu bar, you can select the option "Save" to save a plot. The path can be set by pressing the "Select path" button (see the Figure 24). There is also the option to adjust the image size and to view the image directly after saving the plot. These fields must be selected accordingly and then press "Save" to save the image.

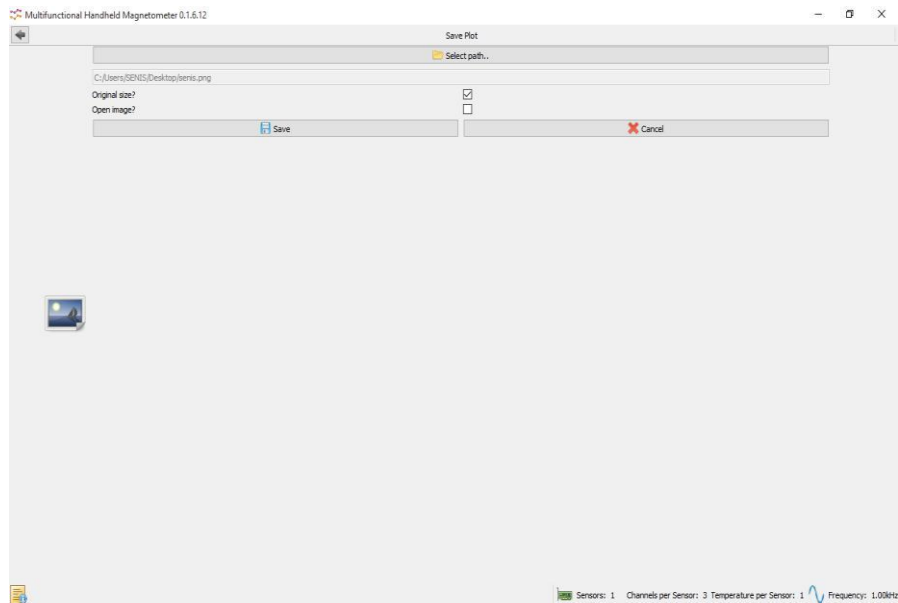


Figure 24: 3MTS Software – Save Plot

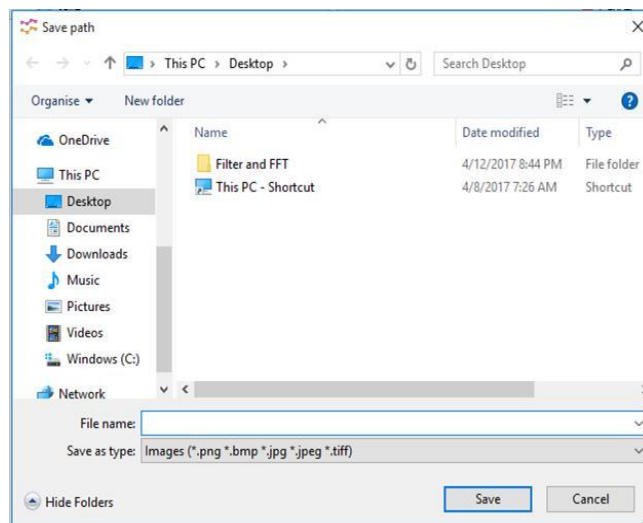


Figure 25: 3MTS Software - Select the folder for storing plots

## 4.8 „Information“ Window

In the menu bar, the "Information" option displays all relevant information about the software and system version.



Figure 26: 3MTS Software - „Information“ Window

## 4.9 Close Application

The Application can be closed in the menu bar via the "Close" button.



Figure 27: 3MTS Software – Close the Application