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Operating Manual

AS-active-probe

Teslameter FM 302

AS-Adapter 3

AS-probe adapter

Made in Germany

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1. Warning

Observe personal protection rules!

☞ Please read this Operating Manual carefully!

When measuring magnetic fields, consider and observe the regulations concerning potential dangers caused by DC and AC magnetic fields.

The direct influence of magnetic fields (for limits see DIN VDE 0848) may be harmful to one's health.

The operation of cardiac pacemakers may be affected dangerous!

Examples for sources of potentially hazardous magnetic fields:

- ultrasonic sources
- induction heaters and furnaces
- magnetic resonance tomographs
- medical magnetic fields

More information can be obtained in the following documentation:

- Electromagnetic Compatibility (Elektromagnetische Verträglichkeit), VDE, Vol. 1 to 4
- DIN VDE 0848

☞ Please read this Operating Manual carefully!

2.1 Transverse Probe

☞ The transverse probe has a blue protective cap which have to be unscrewed before measurement.

Utmost care and attention are needed if magnets have to be measured that are not mechanically fixed. Clashing poles can destroy the Hall element!

As the Hall element (ceramic) is very sensitive to pressure or shock, mechanical stress must be avoided (risk of breakage)!

2.2 Transverse Probe Brass

When measuring fields of $B > 20$ mT and $f > 10$ kHz, the probe brass should not be operated for more than 1 min in order to prevent excessive heating of the brass tube with the Hall element inside!

Attention should be paid to the fact that at the probe a connection exist between plug shield, plug case, cable shield and brass tube. If used with Teslameter FM 302, AS-probe adapter or AS-Adapter 3 the shield is connected to GND. Possibly an isolated installation of the probe and/or plug would be necessary to prevent an unintended connection between measuring ground and protective earth.

2.3 Transverse Probe Hot

☞ The transverse probe has a protective cap which have to be drawn off before measurement.

Only the probe, the handle and the cable are temperature-resistant. The probe connector with the electronic may only be operated up to +50 °C.

2.4 Transverse Probe Flex

☞ The transverse probe has a protective cap which have to be drawn off before measurement.

Only the probe itself is temperature-resistant. The handle, the cable and the probe connector with the electronic may only be operated up to +50 °C.

No pressure shall be applied to the hall element (ceramic) because it is very pressure sensitive (risk of breaking)!

2.5 Transverse Probe Wire

The wire probes are very sensitive. The wires of the probe may not be bend at the element and may not be pulled.

Only the probe itself is temperature-resistant. The handle, the cable and the probe connector with the electronic may only be operated up to +50 °C.

No pressure shall be applied to the hall element (ceramic) because it is very pressure sensitive (risk of breaking)!

2.6 Axial Probe UAP

☞ To be able to gain best stability in the 2 µT range the probe should be switched on for at least 30 minutes.

The axis of the compensation potentiometer should not be exposed to bending forces to prevent the axis and the potentiometer from damage.

2.7 AS-Probe Adapter

Attention should be paid that in the adapter cable, there is a connection between GND and connector shield, connector housing as well as cable shield. At brass probes this is also connected to shield. Possibly an isolated installation of the probe is necessary to prevent an unintended connection between measuring GND and protective earth.

2.8 AS-Adapter 3

One should be aware, that the probes and all outputs have a common ground. Especially when using the brass version of AS-probes (AS-NTM, AS-LTM) an isolation between probe and other parts of the measurement setup can be necessary. It should be noted that the three adapter cables (X, Y, Z) and the probes provide a connection between the GND and the cable shield as well as the connector shield and connector housing. Possibly an isolated installation of the probe is necessary to prevent an unintended connection between measuring GND and protective earth.

2.9 ESD

Electrostatic discharges (> 0.5 kV) to the sensor can damage it. Structural safety measures would affect measurement accuracy due to loss of sensitivity.

2.10 Minimum Operation Conditions (EMC)

Measurement results may vary up to 2 % in the presence of strong HF fields (> 3 V/m).

2.11 Ground Connection / Earthing

It should be observed, that in the probe a connection between plug shield, plug case and cable shield is made. At bass probes, this is also connected to the shield. If used with Teslameter FM 302, AS-probe adapter or AS-Adapter 3 the shield is connected to GND. Possibly an isolated installation of the probe is necessary to prevent an unintended connection between measuring GND and protective earth.

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5. Description

5.1 Purpose of a Magnetic Field Meter

The Teslameter FM 302, the AS-active-probes, the AS-probe adapter and the AS-Adapter 3 form a handy measuring system which allows to measure magnetic fields in a wide scope of application. This includes alternating fields of electromagnets as well as constant magnetic fields of permanent magnets. For normal use of the instrument, please refer to section 6 Operation.

5.2 General Description of Operation

The measuring system consists of the Teslameter FM 302 and/or AS-probe adapter and/or AS-Adapter 3 at least one pluggable AS-active-probe which contains the sensor.

By the use of pluggable probes, the system may be fast and easily adopted to different measuring tasks. Depending on the probe, fields from a few nano-Tesla up to 12 Tesla can be measured. After plugging in the desired probe one can start to measure immediately without adjustment of zero and scale since the AS-active-probes have an active electronic which matches the properties of the sensor to the measuring range of the probe.

There are different probes available which fulfill the requirements

- to the geometry of the cavity to be measured,
- to the strength of the magnetic flux,
- to the treatment,
- to the size of the active sensor area,
- or to the operating temperature.

The selection of probes is regularly extended. This is done especially by requests of customers.

5.2.1 Teslameter FM 302

The Teslameter FM 302 has a 4 ½ digit display and three measuring ranges. The sensitivity of the ranges depends on the used probe and differ in factor 10 and factor 100. The polarity is displayed by the sign. The displayed unit can be switched between Tesla, Gauss, Oersted, A/m and (with firmware version 1.4 and later and hardware version V2) A/cm.

The Teslameter FM 302 can used to measure steady as well as alternating magnetic fields up to 100 kHz (depending on the probe type).

5. Description

For DC-fields it is displayed (with firmware version 1.4 and later) if there is a north pole or south pole under the probe.

For AC-fields alternatively the mean value (DC) or the effective value (true RMS) can be displayed (see section 6.3.2 Usage of The Teslameter FM 302).

Another feature of the Teslameter FM 302 is the calibrated analog output, which is useful for display purposes (oscilloscope, plotter), data logging (computer) and field control. Here the measured signal in DC or AC coupling can be selected.

The operation of the Teslameter FM 302 is done via the keypad with 8 keys which allow to set the functions of the device. For example the measuring time can be adjusted to meet the requirements of the respective measuring task, depending if a rather fast capturing of measured values or low noise measured values are more important. For further filtering a digital filter can be activated which works as a moving average filter on the measured values.

In addition to absolute measurement the Teslameter FM 302 offers a function to relative measurement and for measuring the minimal, maximal and (with firmware version 1.4 and later) absolute maximal value.

Moreover the Teslameter FM 302 features a USB interface which allows to control the device and read out the measured values. There are even more control options available. Also the device can be powered via the USB connection. At the computer side the Teslameter FM 302 appears as a virtual serial port so it is easy to integrate the device into existing systems.

The Teslameter FM 302 with its AS-active-probes is not disturbed in its function by stronger magnetic fields. The device works reliable even at a DC field of 350 mT. Neither the actual measurement nor the communication with the computer is interfered. It has just to be considered the occurring action of force of the device. The main reasons are the battery and the probe connector.

5.2.1.1 Control Software FM 302 Control

For the Teslameter FM 302 you can download a control software. This software allows to control all settings of the Teslameter via the PC. Thereby the software offers the complete range of functions which are possible with the commands via the USB interface.

Besides the simple display of the measured value the software offers an oscilloscope like display of the last 100 measured values. The time axis depends on the selected measuring time. The scale of the amplitude axis is given by the connected probe and the selected sensitivity of the FM 302.

Additionally a higher sensitivity (x1, x10, x100, x1000) of the measurement range can be activated. The created chart can be saved in different graphic formats.

The control software do not just allow to display the measured values of the FM 302 but also allows to save them into a log file. For this two different modes are offered. In the mode “single value logging” single measured values can be saved with a key press (mouse or keyboard). This mode is suitable for manual controlled measurements where a number of single values has to be measured. Otherwise in the mode “continuous value logging” the measured value are automatically stored continuously into the log. This mode is suitable to record traces over longer periods of time.

For storing there can be chosen from two different formats. The log can be saved in classic csv format (comma separated values) where the single data blocks are separated by a comma and the period is used as decimal separator. Alternatively the semicolon may be used for separating the data blocks which makes available the comma as decimal separator. This settings simplifies the import into software with German localization.

As another function the software offers a limit comparator. An upper and a lower limit may be entered. The software shows if the current measured value is below the lower limit, between both limits or above the upper limit. This function allows e.g. the quick incoming inspection of permanent magnets.

The polarity can be ignored while checking the compliance with the given limits. Additionally the set limits can be displayed in the oscilloscope-like display.

5.2.2 AS-Active-Probe

The AS-active-probes are active probes to measure the magnetic induction. In contrast to most other available probes, the AS-probes contain an active electronic so that a calibrated analog signal is available at the plug.

The transverse probe made of glass fiber fabric (AS-NTP 0,6) with their slight thickness make it possible to measure in narrow air gaps and difficult-to-reach locations. For transportation the probe is protected by a cap. Further-more the probe carrier is temperature resistant up to 100 °C.

For rough operating conditions the transverse probe is provided in a design with brass protective tube (AS-LTM, AS-NTM). However they are thicker than the AS-NTP 0,6.

The transverse probe AS-NTP-Flex 0,6 is made with a strip of very thin, extreme flexible and bendable material. They are qualified to measure remarkable hard to reach locations and smallest air gaps. Furthermore the probe carrier is temperature resistant up to 100 °C at the AS-NTP-Flex and even up to 150 °C at the AS-NTP-Flex 0,6.

The transverse AS-VTP is suitable especially for the measurement of small fields. It qualifies due to their small zero drift and their low noise.

The probe AS-NCu-Wire is an extra thin sensor connected with very light wires. Thus the probe is suited to measure at closed quarters and to mount into complex measurement setups.

At very high demands to accuracy and temperature stability the probe AS-NTM-2 may be used. Linearity error and temperature drift have been highly reduced compared to the other probes.

The transverse high-temperature probe AS-NTP-Hot-05 is designed to measure even at high temperatures up to 150 °C and at low temperatures down to –40 °C. The probe itself and the probe cable are constructed to permanently endure those temperatures.

The also available axial probes (AS-VAP-90, AS-LAP-90, AS-NAP-90, AS-HAP-90) have a small diameter and thus are suitable to measure fields in small coils.

With the axial AS-UAP GEO-X probes particularly small fields can be measured with a resolution down to one nano Tesla. Furthermore it has the facility to compensate ±70 µT which for example provides the possibility to compensate the earth magnetic field. So only differences are measured which can be done with higher resolution.

All AS-active-probes can be used without the Teslameter as transducer at an PLC, see section 6.4.14.2 Usage as Autonomous Transducer.

5.2.2.1 Probe Extension Cord

Based on the fact, that the AS-active-probes are active probes, whose electronic outputs a calibrated voltage signal related to the measured flux density, a probe extension cord can be inserted between AS-active-probe and Teslameter FM 302, AS-Adapter 3 or PLC without negative influence on the measuring signal. So even wider distances between measured object and measuring device can be bridged.

Appropriated extension cords are optional available in different lengths.

5.2.3 AS-Probe Adapter

The AS-probe adapter is designed to autonomously operate our AS-active-probes without Teslameter.

As a result of the wide supply voltage range of 9 V_{DC} to 36 V_{DC} the AS-probe adapter may be used universal in different system configurations. Furthermore the AS-probe adapter galvanically isolates the power supply from the probe supply and the measuring electronic.

The AS-probe adapter provides high stable ±3 V necessary to supply the AS-active-probes. To ease the connection of the AS-active-probe to existing analog inputs with ±10 V input range, the AS-probe adapter contains an integrated amplifier. This amplifies the output signal of the AS-active-probes from ±2 V to ±10 V. With a switch, an additionally 10times higher gain can be chosen which allows to perform even sensitive measurements.

The analog output of the adapter is calibrated and thus can be used e.g. for displaying magnetic pulses in the µs-range (oscilloscope), recording of measurements and for field control. The bandwidth of the analog output reaches from DC to a least 100 kHz. Therefore it is suitable for measuring both constant magnetic fields and alternating magnetic fields.

Included in delivery is an adapter cable which allows the easy connection of the 15-pole SubD connector of the AS-active-probes with the screw terminals of the AS-probe adapter.

5.2.4 AS-Adapter 3

The AS-Adapter 3 is used for the autonomous operation of 1-axis and 3-axis AS active probes. The signals from all 3 probes are available simultaneously and in parallel via the BNC connections or via the terminal contacts.

The AS-Adapter 3 supplies the AS active probes with ± 3 V in a highly stable manner. The probe signals are amplified with x5 or x50, so that with ± 2 V or ± 0.2 V they can output ± 10 V for a PLC system and Provide oscilloscope.

The wide supply voltage range is 9 VDC to 36 VDC. The signals and supply of the probes are galvanic isolated from the operating voltage.

The analog output of the AS-adapter 3 is calibrated and thus can be used e.g. for displaying magnetic pulses in the µs-range (Oscilloscope), recording of measurements and for field control. The bandwidth of the analog output reaches from DC to a least 100 kHz. Therefore it is suitable for measuring both constant magnetic fields and alternating magnetic fields. The actual usable bandwidth depends on used AS-active probe.

After connecting the desired probe, the measurement can start without adjusting zero and scale because all AS-active probes are calibrated. Hence replacement probes can be used at any time.

5. Description

All of our AS-active probes may be connected to the AS-Adapter 3. This allows the fast adaptation to different measuring task by simply plugging in a different probe. Depending on the type of AS-active probe fields from a few nano Tesla up to 12 Tesla can be measured. Further information can be found in the data sheet of the AS-active probes.

The AS-Adapter 3 has table feet's and a DIN rail holder mount for cabinet device mounting.

5.3 Items Supplied

The delivered content depends on the concrete order. It may contained::

Teslameter FM 302
- case with replacement battery
- calibration certificate
- 1.8 m USB cord
- power adapter (optional)
- top hat rail adapter fixed to the device (optional)

AS-active-probe
- calibration certificate
- zero chamber (optional)
- test curve / linearity curve (optional)
- probe extension cord (optional)

AS-Probe Adapter
- 5 m adapter cable for probe connection
- calibration certificate
- 9 V plug-in power supply unit for AS-probe adapter (optional)

AS-Adapter 3
- 3 pieces 5 m adapter cable for probe connection
- calibration certificate
- 9 V plug-in power supply unit for AS-probe adapter (optional)

operating manual

Figure 1 Example of an order of FM 302 with three probes and options

6. Operation

6.1 Introduction

☞ This Operating Manual should be read carefully before measuring instrument is operated for the first time.

Projekt Elektronik GmbH will not be responsible for damage to the instrument caused by disregarding this Operating Manual. Neither will responsibility be assumed for consequential damage resulting from such mishandling of the instrument.

Also before initial operation, the content of the case should be checked for completeness of the items supplied (see section 5.3 Items Supplied)!

6.2 Safety Notes

In order to ensure safe operation of the instrument, be sure to observe the following recommendations:

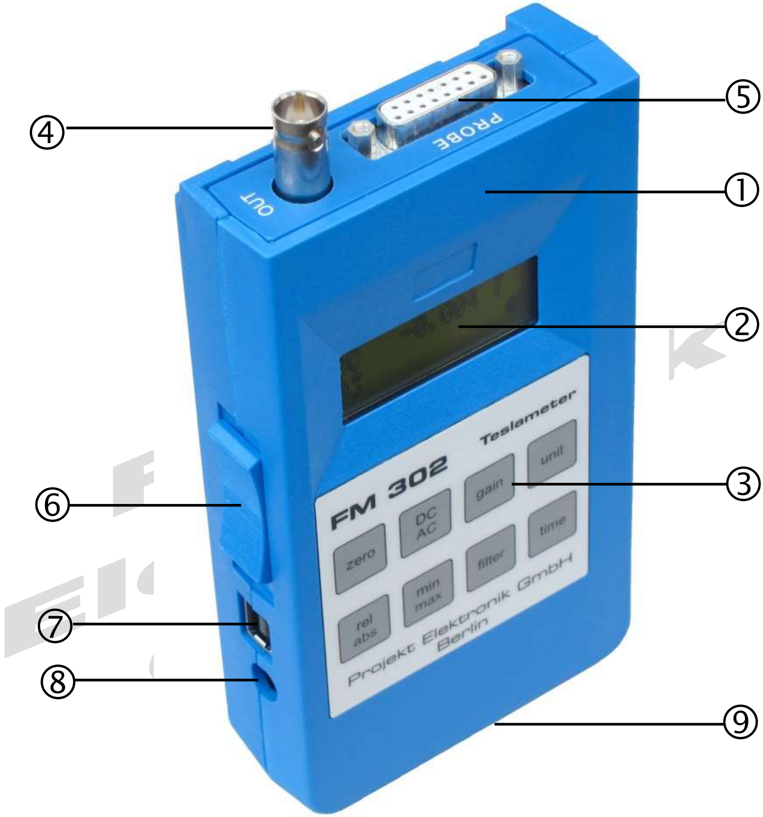
- The magnetic field meter was tested after manufacture for compliance with all applicable safety standards and regulations. To preserve this condition and to ensure safe operation, the user should be sure to observe all safety notes and cautions included in this Operating Manual.
- Before measurements, check your probe, probe cord, probe housing, Teslameter housing, AS-Probe Adapter-housing, AS-Adapter 3-housing, power adapter and power cord for damage.
- If you believe that the instrument cannot be operated safely any longer, switch it OFF, mark it accordingly and keep it in a manner to prevent unintentional use.

  Safe operation will not be possible if the unit, the probe, any connecting cable, the battery or the accumulator, power adapter or power cord show visible damage, or if the unit fails to operate.

- **This instrument must not be handled by children!**
- Due attention should be given to the accident prevention rules issued by authorized bodies, especially to any rules concerning electromagnetic fields.

6.3 Teslameter FM 302

6.3.1 Controls and Connectors



① Housing
② 2 line LCD display
③ Keypad
④ Analog output
⑤ Probe connector
⑥ Power switch
⑦ USB connector
⑧ Power input
⑨ Battery compartment

Figure 2 Controls and connectors FM 302

6.3.1.1 Housing

The screwed housing is a plastics material resistant to scratches and fracture to protect the electronics from outside influence.

6.3.1.2 Handle

The handle swings out of the bottom and can be used to support the Teslameter FM 302 on a horizontal surface or - if replaced - to suspend it.

6.3.1.3 top hat rail adapter (optional)

With the optionally available top hat rail adapter fix mounted to the Teslameter FM 302, the device can be mounted to a top hat rail. For release the locking bar has to be pulled up with a screw driver.

6.3.1.4 Power Switch

On the left side of the Teslameter FM 302 is a sliding switch to switch it on and off.

6.3.1.5 Keypad

The Teslameter FM 302 has a keypad which allows to control major device functions. For the usage of the single keys see section 6.3.1.7 to 6.3.1.14.

Figure 3 Keypad of Teslameter FM 302

The control with the keypad can be locked with a command via the USB interface (see section 6.3.3.15 Command “keys). After switching the device off and on again, the keys are unlocked.

6.3.1.6 Display

The Teslameter FM 302 has a two-line LCD display.

After power on the device initializes itself. During that the display shows the manufacturer and device name.

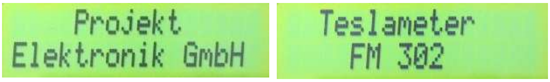


Figure 4 Display of Teslameter FM 302

Afterwards the display shows the device number / serial number and the firmware version.

Figure 5 Display of serial number and firmware version

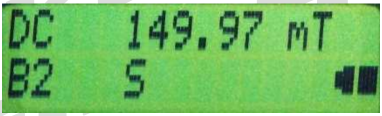


Figure 6 Display of Teslameter FM 302

In the upper line on the left side it is shown if DC fields or AC fields are measured.

Next to it the current measured value is displayed 4½ -digit. In measuring mode DC that is the mean value of the probe signal. In AC the effective value (true RMS) of the alternating component of the probe signal is displayed. See also section 6.3.1.8 Key “DC AC” – Measuring Mode.

Positive measurement results are displayed without a sign.

Rightmost the unit of the measured value is displayed. The unit can be switched between Tesla, Gauss, Oersted, A/m and (with firmware version 1.4 and later and hardware version V2) A/cm. See also section 6.3.1.10 Key “unit” – Unit.

The prefix of the unit and the resolution and consequently the position of the decimal point of the measured value are derived from the sensitivity of the connected probe and the selected measuring range. See also Table 4 at page 95.

If no probe is connected to the device, the display shows “no probe“ instead of measured value and unit.

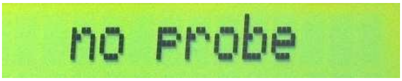


Figure 7 Display without probe

If the measured value is to large for the selected measuring range the display shows “overload”.

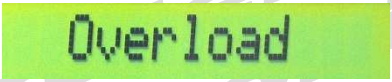


Figure 8 Display while range overflow

In the lower line of the display in absolute measurement left the currently selected range (B3, B2, B1) is displayed. See also section 6.3.1.9 Key “gain” – Measuring Range to change the measuring range.

Next to it, it is displayed (with firmware version 1.4 and later) if there is a north pole or south pole under the probe.

Also see 6.4.1 Polarity.

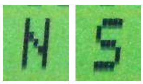


Figure 9 Display polarity of magnet

In the lower left the state of the power supply of the Teslameter FM 302 is displayed. A full battery symbol denotes, that the Teslameter FM 302 is running on battery and that the voltage of the battery is sufficient to power the device. An empty battery symbol signalizes that the voltage of the battery has run significantly low and the battery should replaced (see section 8.2 Checking Battery and 8.3 Maintaining Accumulators).

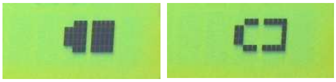


Figure 10 Display battery state

If the Teslameter FM 302 is powered with a power adapter “EXT” is shown instead of the battery symbol. If the device is connected via USB and is powered via the USB connection the display shows “USB”.

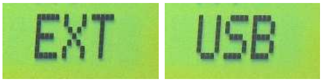


Figure 11 Display supply by power adapter or USB

In the measuring modes relative measurement, minimal measurement, maximal measurement and (with firmware version 1.4 and later) absolute maximal measurement the lower line shows the measuring mode in the left and the reference value or minimal or maximal value with unit in the right.

If the Teslameter FM 302 runs on battery as power supply and if the battery is nearly empty, instead of the unit, the empty battery symbol is shown in lower right.

The update rate of the display is determined by the setting of the measuring time. Each time the measuring time has passed a new measured value is available and printed out at the display. To set the measuring time see section 6.3.1.13 Key “time” – Measuring Time.

6.3.1.7 Key “zero” – Offset Compensation

The Teslameter FM 302 offers the possibility to compensate an offset of the zero point. The compensation range is > ±4500 digit of the most sensitive measuring range. With a measuring range of 2 mT that means a compensation range of > ±450 µT. With this function a deviation of the zero point caused by temperature change of sensor and electronic can be removed.

The possibility to compensate the offset is only available in the measuring mode DC.

After pressing the key “zero” the device automatically performs the compensation. The message “zeroing” is displayed and a number of dots shows the progress of the compensation process.

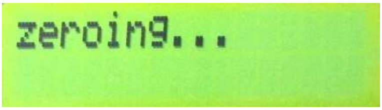


Figure 12 Display while offset compensation process

If the offset is larger than the compensation range, the error message “offset out of range” is displayed. The compensation is reset to zero.

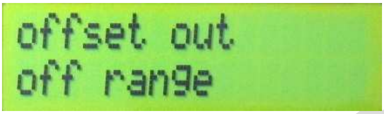


Figure 13 Display error message offset out of range

To reset the compensation to zero, the key “zero” has to be pressed a second time while the compensation process is running. The FM 302 confirms the reset of the compensation with the message “reset zero to midscale”.

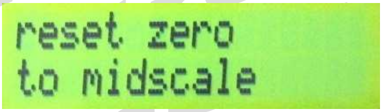


Figure 14 Display reset offset compensation

There are two possibilities to compensate the zero point.

- At the AS-UAP probes in the less sensitive range and all other AS-probes in the most sensitive range and measuring mode DC the measuring direction of the probe is positioned orthogonal to the earth magnetic field in east-west direction. With the “zero” key a compensation of the zero point is performed. Afterwards the probe should show the same value only differing in the sign if aligned in north-south and south-north direction. The typical value of the earth magnetic field in the area of Europe is 30 µT to 50 µT.
- Insert the probe into the zero chamber and the offset compensation can be performed by pressing the “zero” key.

The offset compensation is an additive correction which doesn't have an impact on the linearity.

See also section 6.3.3.25 Command "zero" for controlling the offset compensation via the USB interface.

Optional a zero chamber is attainable for our instruments (see also 6.4.15 Zero Chamber (optional)).

Further information about the zero chamber and its use can be found in our application note PE012 – zero chamber - zero adjustment.

6.3.1.8 Key "DC AC" – Measuring Mode

With the key "DC AC" the measure mode is switched between DC field and AC field measurement. Correspondingly the coupling is switched. The selected measuring mode is shown in the upper left of the display.

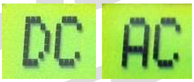


Figure 15 Display measuring mode

DC: The LCD display shows the arithmetic mean of the magnetic field signal.
The signal of the magnetic field in the frequency range from 0 to 100 kHz (-3 dB) is available at the analog output.

AC: In this position the true effective value (true RMS) of an overlaying alternating field in the range of 5 Hz to 100 kHz (-3 dB) is displayed.
The analog output provides the time response of the overlaying AC-field in the range of 5 Hz to 100 kHz.

For the time response of the display and the analog output see section 6.3.2.1 Time Response of Display and Analog Output.

See also section 6.3.3.8 Command "coupling" for controlling the measuring mode via the USB interface.

6.3.1.9 Key “gain” – Measuring Range

With the key “gain” the measuring range can be selected. There are available the three ranges B3, B2 and B1. These correspond to a sensitivity of x1, x10 and x100 of the analog signal. The selected measuring range is shown in the lower left of the display.

To which measuring range the ranges B1, B2 and B3 correspond can be read on the imprint of the connector housing of the probe. According to the chosen range the decimal point and the unit prefix is set at the display.

The chosen range determines the sensitivity of the display and the analog output.

See also section 6.3.3.13 Command “gain” for controlling the measuring range via the USB interface.

6.3.1.10 Key “unit” – Unit

With the key “unit” the unit to display the measured value can be selected. One can choose from the units Tesla, Gauss, Oersted, A/m and (with firmware version 1.4 and later and hardware version V2) A/cm. Every key press cyclically chooses the next unit.

A/cm is available with firmware version 1.4 and later and hardware version V2.

The prefix of the display unit is automatically set depending on the type of the connected probe and the chosen measuring range.

For exemptions see section 6.3.2.6 Display of Units with older AS-Active-Probe.

See also section 6.3.3.23 Command “unit” for controlling the unit via the USB Interface.

6.3.1.11 Key “rel abs” – Relative Measurement

With this key the measuring mode is set to relative measurement. With pressing the key, the current measured value is taken as reference value and shown with unit in the lower line of the display.

From now on the measured values in the upper display line are shown relative to this reference value.

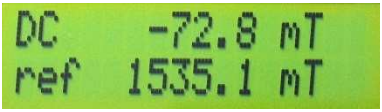


Figure 16 Display in relative measurement

relative value = absolute value – reference value

If the key is pressed again, the Teslameter FM 302 switches back to the measuring mode absolute measurement.

The relative measurement has no influence on the analog output of the Teslameter FM 302. The analog output always delivers the current absolute signal.

See also section 6.3.3.20 Command “relative” and 6.3.3.7 Command “absolute” for switching between absolute measurement and relative measurement via the USB interface.

6.3.1.12 Key “min max” – Minimal Measurement, Maximal Measurement, Absolute Maximal Measurement

With this key it is switched cyclically between the measuring modes minimal measurement, maximal measurement, (with firmware version 1.4 and later) absolute maximal measurement and absolute measurement.

In minimal measurement the upper display line shows still the current measured value while the lower line displays the mathematical smallest value since start of the measuring mode.

-100 mT < +200 mT → display -100 mT

Figure 17 Display in minimal measurement

In maximal measurement the upper display line shows still the current measured value while the lower line displays the mathematical greatest value since start of the measuring mode.

100 mT > -200 mT → display 100 mT

Figure 18 Display in maximal measurement

In absolute maximal measurement the upper display line shows still the current measured value while the lower line displays the greatest absolute value since start of the measuring mode.

|-200 mT| > |+100 mT| → display 200 mT

Absolute maximal measurement is available with firmware version 1.4 and later.

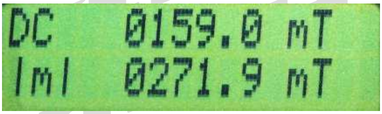


Figure 19 Display in absolute maximal measurement

The minimal measurement or maximal measurement has no influence to on analog output of the Teslameter FM 302. The analog output always delivers the current absolute signal.

See also section 6.3.3.18 Command “minimum”, 6.3.3.17 Command “maximum” 6.3.3.6 Command “amax” and 6.3.3.7 Command “absolute” for switching between minimal measurement, maximal measurement and absolute measurement via the USB interface.

6.3.1.13 Key “time” – Measuring Time

With the key “time” the measuring time is set. This also sets the update rate of the display. Each time the measuring time has passed a new measured value is available and printed out at the display.

The internal sample rate of the Teslameter FM 302 is 10 Hz. From the samples taken during the measuring time, the measured value is computed. So a longer measuring time reduces the noise of the measured values.
With the key “time” the measuring times 100 ms, 200 ms, 500 ms, 1 s 2 s and 5 s can be set.

A short press of the key displays the currently set measuring time. Subsequent presses cyclically rise the measuring time.

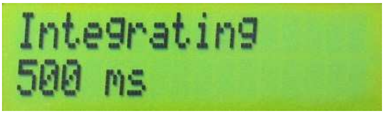


Figure 20 Display measuring timeout

After a fast change of the flux density it is advisable to wait filter x time before using the measured value.

The setting of the measuring time has no influence on the analog output of the Teslameter FM 302. The analog output always delivers the unfiltered absolute signal with full bandwidth.

See also section 6.3.3.14 Command “inttime” or “time” for extended possibilities for controlling the measuring time via the USB interface.

6.3.1.14 Key “filter” – Filter

With the key “filter” an additional moving average filter of selectable length can be activated. As the filter works moving about the measured values, the update rate of the display is kept unchanged.

With the key “filter” a filter length of 1 (filter off) 2, 4, 8, 16, 32 or 64 measured values can be set. A larger filter length results in less noise of the measured values.

A short press of the key displays the currently set filter length. Subsequent presses cyclically rise the filter length.

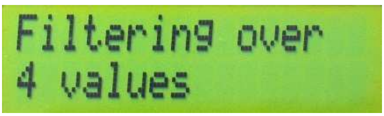


Figure 21 Display filter length

After a fast change of the flux density it is advisable to wait filter x time before using the measured value.

The setting of the filter length has no influence on the analog output of the Teslameter FM 302. The analog output always delivers the unfiltered absolute signal with full bandwidth.

See also section 6.3.3.11 Command “filter” for extended possibilities for controlling the measuring time via the USB interface.

6.3.1.15 Acoustic Feedback

Every new setting is acknowledged acoustically by a two-tone. At an error message the feedback is a disharmonic tone.

See also section 6.3.3.22 Command “sound” for switching acoustic feedback on and off via the USB interface.

6.3.1.16 Analog Output

The calibrated analog output is a BNC female connector. The output impedance is 50 Ohm.

With the key “gain” the sensitivity (see section 6.3.1.9 Key “gain” – Measuring Range) of the analog output is set, too.

The coupling (DC or AC) is determined by the setting of the measuring mode(see section 6.3.1.8 Key “DC AC” – Measuring Mode).

The settings done with key “time” (see section 6.3.1.13 Key “time” – Measuring Time) and “filter” (see section 6.3.1.14 Key “filter” – Filter) have no influence on the analog output. The analog output always delivers the unfiltered absolute signal with full bandwidth.

Also the measuring modes relative measurement (see section 6.3.1.11 Key “rel abs” – Relative Measurement) as well as minimal measurement, maximal measurement and absolute maximal measurement (see section 6.3.1.12 Key “min max” – Minimal Measurement, Maximal Measurement) do not influence the analog output.

The output voltage range is ±2.3 V. The transfer factor depends on the set measuring range. For example a measuring range of 2000 mT results in a transfer factor of 1 V/T.

6.3.1.17 Probe Connector

The AS-active-probes will be connected to this connector. Thereby the probes should also be screwed. To connect / disconnect the probe the Teslameter FM 302 should be switched off.
Plugging in the AS-UAP-probe care should be taken not to mechanically stress the control elements at the probe connector.

If no AS-probe is connected to the Teslameter FM 302 the display shows “no probe”“ (see also section 6.3.1.6 Display).

6.3.1.18 USB Interface

The Teslameter FM 302 offers a USB interface compatible to USB 1.1 and USB 2.0.

To this port a USB cord with type B plug can be connected to connect the Teslameter FM 302 with a PC. A suited cable is included in delivery (see also section 5.3 Items Supplied).

Via the USB interface the Teslameter FM 302 may be controlled and the measured values read out (see also section 6.3.3 USB Interface). . Also the device can be powered via the USB connection so the battery is preserved and there is no need for a power adapter.

6.3.1.19 Power Connector

If the instrument is powered externally, it is supplied with 9 V through this connector. (see section 6.3.2.4 Power Adapter Operation). The inner port is the negative supply voltage.

6.3.1.20 Battery Compartment

The battery compartment houses the 9 V battery or a 9 V accumulator (see section 8.2 Checking Battery and 8.3 Maintaining Accumulators).
To open the battery compartment the cap at the rear of the device is drawn away.

6.3.2 Usage of The Teslameter FM 302

Usually the AS-active-probe is simply connected to the Teslameter. The Measurement can be started immediately.

Also all extended possibilities of the Teslameter FM 302 are usable in that way. The calibrated analog output can be connected with e.g. with an oscilloscope to display fast signal sequences A cable with BNC connector has to be used.

To control via USB interface the FM 302 has to be connected to the computer. The connection also can be made to a USB hub. Therefore an ordinary cable with USB-B connector has to be used. Such a cable is included in delivery.

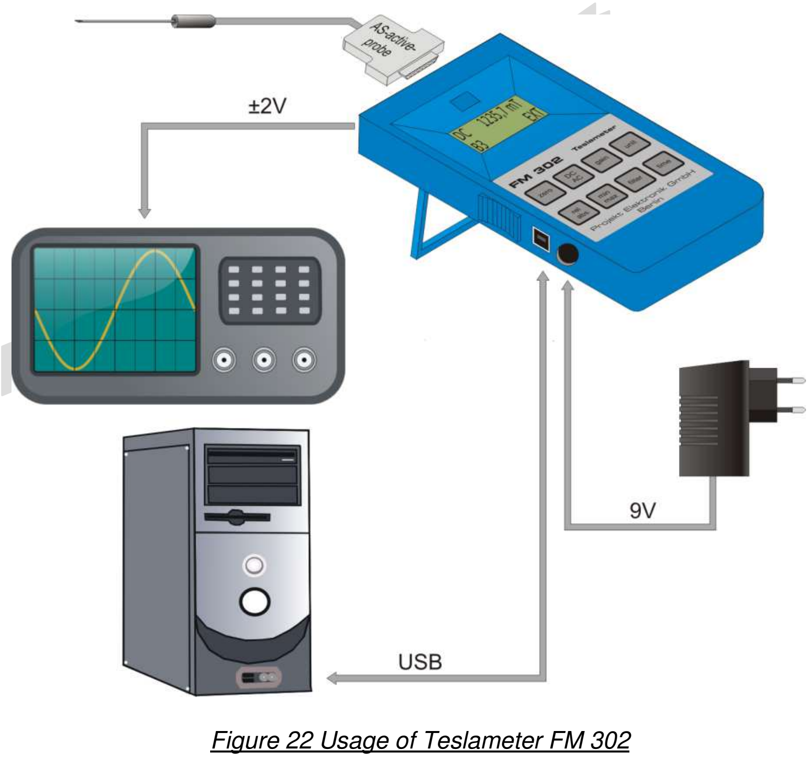


Figure 22 Usage of Teslameter FM 302

To power the device externally a 9 V power supply can be uses. A suitable power adapter may optionally ordered with the FM 302. Alternatively the device can be powered via the USB connection. See also section 6.3.2.2 Power Supply.

6.3.2.1 Time Response of Display and Analog Output

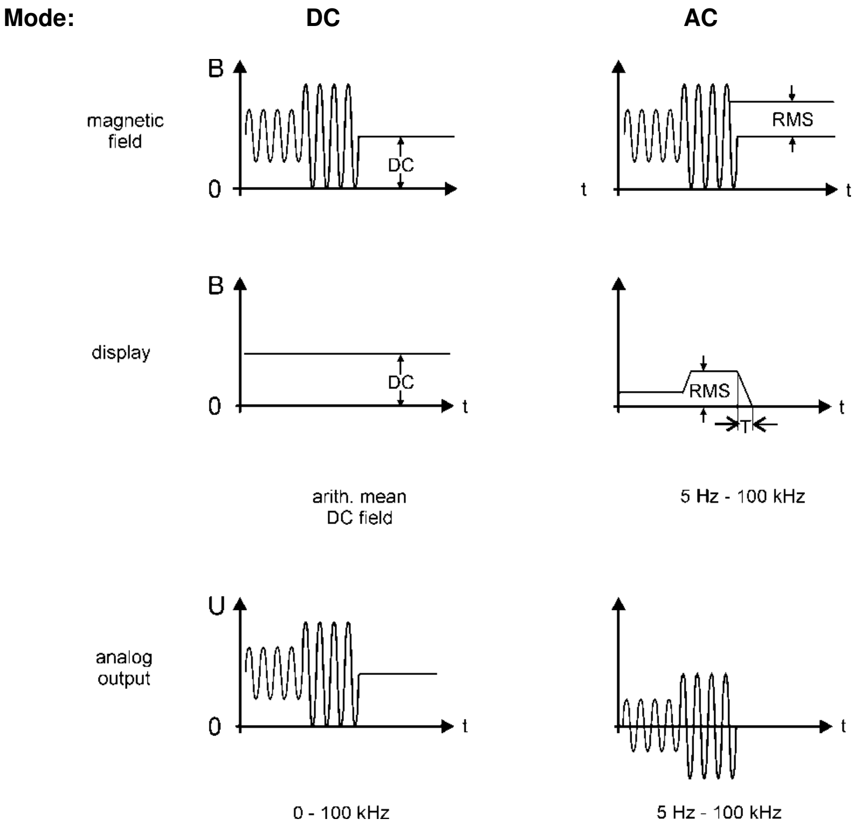


Figure 23 Time response

For the upper bandwidth see the technical date of the probe (see section 7.2 Technical Specifications - AS-Active-Probes).

6.3.2.2 Power Supply

The Teslameter FM 302 may be powered by three different ways. The device can run from an internal battery / accu (see section 6.3.2.3 Battery / Accumulator Operation), an external 9 V power adapter (see section 6.3.2.4 Power Adapter Operation) or from the USB connection (see section 6.3.2.5 USB Operation).

The instrument automatically is powered from the power adapter or, while available, the USB connection and uses the battery only if no other power source is available. So the battery is preserved.

The switching between the different sources is done automatically and without interrupting the operation of the device.

The state of the power supply is shown in the display of the Teslameter FM 302 (see also section 6.3.1.6 Display).

6.3.2.3 Battery / Accumulator Operation

- Open the case (printed lettering up) and remove the Teslameter FM 302.
- Take the desired probe, connect to Teslameter FM 302 and screw.
- At the AS-NTP 0,6 probe unscrew and remove the protective cap. At the AS-NTP-Flex probe and AS-NTP-Hot-05 probe careful draw of the protective cap.
- Switch the instrument ON with the power switch on the left hand side (see section 6.3.1.4 Power Switch).
- Insert the probe into the zero chamber and the offset compensation can be performed by pressing the “zero” key (see section 6.3.1.7 Offset Compensation).
- Set the desired parameters with the keys of the keypad. Especially set the appropriate measuring range with key “gain” (see section 6.3.1.9 Key “gain” – Measuring Range and measuring mode DC or AC/RMS with key “DC AC” (see section 6.3.1.8 Key “DC AC” – Measuring Mode.
- The magnetic field can now be measured with the probe.
- The battery life (operating time) is approx. 20 hours, depending on the probe type.

6.3.2.4 Power Adapter Operation

- Open the case (printed lettering up) and remove the Teslameter FM 302 and the power adapter.

- Take the desired probe, connect to Teslameter FM 302 and screw.
- Plug the power adapter into a 230 VAC mains socket.
- Plug the small plug from the power adapter into the 9 V-power connector at the lower left side of the Teslameter FM 302 (see section 6.3.1.19 Power Connector).
- At the AS-NTP 0,6 probe unscrew and remove the protective cap. At the AS-NTP-Flex probe and AS-NTP-Hot-05 probe careful draw of the protective cap.
- Switch the instrument ON with the power switch on the left hand side (see section 6.3.1.4 Power Switch).
- Insert the probe into the zero chamber and the offset compensation can be performed by pressing the “zero” key (see section 6.3.1.7 Offset Compensation).
- Set the desired parameters with the keys of the keypad. Especially set the appropriate measuring range with key “gain” (see section 6.3.1.9 Key “gain” – Measuring Range and measuring mode DC or AC/RMS with key “DC AC” (see section 6.3.1.8 Key “DC AC” – Measuring Mode.
- The magnetic field can now be measured with the probe.

6.3.2.5 USB Operation

- Open the case (printed lettering up) and remove the Teslameter FM 302.
- Take the desired probe, connect to Teslameter FM 302 and screw.
- Connect the USB port of the Teslameter FM 302 (see section 6.3.1.18 USB Interface) and the USB port of the PC with a USB cord.
- At the AS-NTP 0,6 probe unscrew and remove the protective cap. At the AS-NTP-Flex probe and AS-NTP-Hot-05 probe careful draw of the protective cap.
- Switch the instrument ON with the power switch on the left hand side (see section 6.3.1.4 Power Switch).
- Insert the probe into the zero chamber and the offset compensation can be performed by pressing the “zero” key (see section 6.3.1.7 Offset Compensation).

- Set the desired parameters with the keys of the keypad or the USB commands. Especially set the appropriate measuring range with key “gain” (see section 6.3.1.9 Key “gain” – Measuring Range and measuring mode DC or AC/RMS with key “DC AC” (see section 6.3.1.8 Key “DC AC” – Measuring Mode.
- The magnetic field can now be measured with the probe.

6.3.2.6 Display of Units with older AS-Active-Probe

The AS-active-probes are coded with information to display the measuring range and unit. To, in contrast to the Teslameter FM 205, show not only the unit Tesla but also Gauss, Oersted and A/m at the Teslameter FM 302 an extension of that coding was necessary. Since September 2011 the AS-active-probes have the extended coding.

At the AS-active-probes without extended coding, the Teslameter FM 302 is unable to distinct between probes for the low and probes for the ultralow range. Therefore instead of a unit “??” is displayed. Switching the unit via key or interface command is not possible in that case, too.

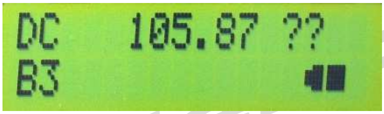


Figure 24 Display with not representable unit

The display of the decimal point however is correspondent to the ranges of the probes. The information about the unit can be found, like at the Teslameter FM 205, at the imprint of the probe.

The AS-active-probes for normal or high range with production date before September 2011 are not affected by this problem.

AS-active-probes with older production date may be upgraded with the extended coding.

6.3.3 USB Interface

6.3.3.1 General

The USB interface of the Teslameter FM 302 is realized with the FT232R, a USB-to-serial converter from Future Technology Devices International Ltd. (FTDI, http://www.ftdichip.com/).

That means, that the Teslameter FM 302 creates a virtual serial port after it has been connected to a PC. For communication every ordinary terminal or terminal program is suited. The control takes place text oriented which makes it easy to integrate the Teslameter into existing environments.

The necessary USB driver can be found at the downloaded software-pack which is included in delivery (see also section 5.3 Items Supplied). The newest drivers can be found at the homepage of FTDI under the menu Drivers – VCP Drivers
(http://www.ftdichip.com/Drivers/VCP.htm).

6.3.3.2 Driver Installation Windows

Windows 7 and above contain the driver for the FTDI chip. Connect the instrument to a free USB port of your computer. Windows automatically detects the new device and installs the driver. This may take a moment.

Alternatively the driver from the downloaded software-pack or from the website of FTDI can be used.

Further installation guides for different versions of Windows are available (in English language) at the homepage of FTDI.
(http://www.ftdichip.com/Support/Documents/InstallGuides.htm)

6.3.3.3 Driver Installation Linux

Linux contains the necessary drivers since kernel version 2.6.31. A separate driver installation is not necessary.

6.3.3.4 Configuration of the Virtual Serial Port

To communicate with the Teslameter FM 302 the virtual serial port has to be configured as follows.

baud rate	9600
data bits	8
parity	none
stop bits	1
flow control	non

6.3.3.5 General about Commands

The Teslameter FM 302 has a simple command structure consisting of the command name followed by one optional parameter. Command and parameter are separated by a space. Supplementary whitespaces will be tolerated. Every command line is finished with a newline character (LF/10d/0Ah). A preceding carriage-return character (CR/13d/0Ch) will be tolerated too.

All commands (but not the parameters) may abbreviated as long as they are distinguishable. The commands are not case-sensitive.

typographic convention of the examples:

normal script output FM 302
bold script input user
[ ] optional-brackets; brackets are not entered

6.3.3.6 Command “amax”

command:	amax
without parameter	switches to absolute maximal measurement

see also section 6.3.1.12 Key “min max” – Minimal Measurement, Maximal Measurement, Absolute Maximal Measurement

example:

```
amax
display is amax
```

6.3.3.7 Command “absolute”

command:	absolute
without parameter	switches to absolute measurement

see also section 6.3.1.11 Key “rel abs” – Relative Measurement

example:

```
absolute
display is absolute
```

6.3.3.8 Command “coupling”

command:	coupling [{DC|AC}]
without parameter	shows the currently set measuring mode / coupling.
with parameter	switches to selected measuring mode
parameter	DC, AC

see also section 6.3.1.8 Key “DC AC” – Measuring Mode

examples:

```
coupling
coupling is DC
```

```
coupling AC
coupling is AC
```

6.3.3.9 Command “default”

command:	default
without parameter	reset instrument to factory configuration

example:

```
default
factory settings restored
```

6.3.3.10 Command “digits”

command:	digits [digits]
without parameter	shows number of blinded out decimals
with parameter	blinds out given number of decimals
parameter	0, 1

examples:

```
digits
decimals blinded out 0
```

```
digits 1
decimals blinded out 1
```


6.3.3.11 Command “filter”

command:	filter [taps]
without parameter	shows current filter length
with parameter	sets filter length to given value
parameter	1 ≤ taps ≤ 64

see also section 6.3.1.14 Key “filter” – Filter

examples:

```
filter
filter is 5
```

```
filter 10
filter is 10
```

6.3.3.12 Command “fmstatus” or “status”

command:	fmstatus status
without parameter	shows the list of current settings

example:

```
status
FM 302 status
-------------
serial no. is 1808827582
firmware version is v1.4
coupling is DC
analog gain is x1
unit is T
range is 2000.0 mT
integration time is 500 ms
filter is 1
decimals blinded out 1
zero compensation value is 0
sound is on
keys are unlocked
external offset is 400000
external slope is 0
factory offset is 0
factory slope is 25100
factory calibration active
```


6.3.3.13 Command “gain”

command:	gain [{1|10|100}]
without parameter	shows current sensitivity
with parameter	sets the measuring range to the given sensitivity
parameter	1, 10, 100

see also section 6.3.1.9 Key “gain” – Measuring Range

examples:

```
gain
analog gain is x1
```

```
gain 10
analog gain is x10
```

6.3.3.14 Command “inttime” or “time”

command:	inttime [time] time [time]
without parameter	shows the current measuring time in milli-seconds
with parameter	sets the measuring time to the given value (interpreted as milli-seconds, rounded to a multiple of 100 ms)
parameter	100 ≤ time ≤ 25500

see also section 6.3.1.13 Key “time” – Measuring Time

examples:

```
time
integration time is 500 ms
```

```
time 1250
integration time is 1300 ms
```


6.3.3.15 Command “keys”

command:	keys [{on|off}]
without parameter	shows if the keypad is locked or not
with parameter	switches keypad on (unlocked) or off (locked) After switching the device off and on again, the keys are unlocked.
parameter	on, off

examples:

```
keys
keys are unlocked
```

```
keys off
keys are locked
```

6.3.3.16 Command “logging”

command:	logging [{number|off|on}]
without parameter	switches between permanent logging and no logging
with parameter	The parameter “on” switches to permanent logging. The parameter “off” deactivates a running logging. Also the number of values to log may be given
parameter	on, off, 1 ≤ number ≤ 65534

examples:

```
logging
logging is on
1462.7 mT
1462.1 mT
logging off
logging is off
```

```
logging 2
logging 2 records
1247.0 mT
1248.7 mT
```


6.3.3.17 Command “maximum”

command:	maximum
without parameter	switches to maximal measurement

see also section 6.3.1.12 Key “min max” – Minimal Measurement, Maximal Measurement, Absolute Maximal Measurement

example:

```
maximum
display is max
```

6.3.3.18 Command "minimum"

command:	minimum
without parameter	switches to minimal measurement

see also section 6.3.1.12 Key "min max" – Minimal Measurement, Maximal Measurement, Absolute Maximal Measurement

example:

```
minimum
display is min
```

6.3.3.19 Command "range"

command:	range
without parameter	shows the current measuring range determined by probe and gain setting

example:

```
range
range is 2000.0 mT
```


6.3.3.20 Command "relative"

command:	relative [{reference|set}]
without parameter	show the current measuring mode and if in relative measurement the reference value
with parameter	"set" as parameter switches to relative measurement and takes the current measured value as reference value. A number as parameter switches to relative measurement and uses the given number as reference (interpreted in the currently set unit and rounded to the current resolution).
parameter	„set" or a reference value The given reference value may not exceed the display range of the Teslameter FM 302 of 25100 digit. Float point numbers with "." as decimal separator and numbers in scientific notation (e.g. 12E-2) are accepted.

see also section 6.3.1.11 Key “rel abs” – Relative Measurement

examples:

```
relative
display is relative, reference = 1247.8 mT
```

```
relative set
display is relative, reference = -23.3 mT
```

```
relative 1.2706
display is relative, reference = 1.3 mT
unit Gs
unit is Gs
relative 1.2706
display is relative, reference = 1.271 kGs
```

6.3.3.21 Command “serial”

command:	serial
without parameter	shows the serial number of the device

example:

```
relative
serial no. is 1109827002
```

6.3.3.22 Command “sound”

command:	sound [{on|off}]
without parameter	shows if acoustic feedback is activated or deactivated
with parameter	switches acoustic feedback on or off
parameter	on, off

see also section 6.3.1.15 Acoustic Feedback

examples:

```
sound
sound is on
```

```
sound off
sound is off
```

6.3.3.23 Command "unit"

command:	unit [{T|G|Gs|Oe|A/m|A/cm}]
without parameter	shows currently set unit
with parameter	sets unit to given unit The unit prefix of the display is automatically set depending on the probe and selected measuring range
parameter	T, G, Gs, Oe, A/m, A/cm

A/cm is available with firmware version 1.4 and later and hardware version V2.

see also section 6.3.1.10 Key "unit" – Unit

exceptions see section 6.3.2.6 Display of Units with older AS-Active-Probe.

examples:

```
unit
unit is T
```

```
unit a/m
unit is A/m
```

6.3.3.24 Command "version"

command:	version
without parameter	shows the version of the installed firmware

example:

```
version
firmware version is v1.4
```

6.3.3.25 Command “zero”

command:	zero [{offset|set}]
without parameter	shows the current value of the offset compensation
with parameter	With “set” as parameter the automatic offset compensation process is started. If a number is given as parameter, it is taken as new value for the offset compensation. The exact transfer factor is device dependent.
parameter	set, -39320 ≤ offset ≤ 26213

see also section 6.3.1.7 Key “zero” – Offset Compensation

examples:

```
zero
zero compensation value is -7365
```

```
zero set
zeroing.....
zero compensation value is 10610
```

```
zero -12345
zero compensation value is -12345
```

6.3.4 Control Software FM 302 Control

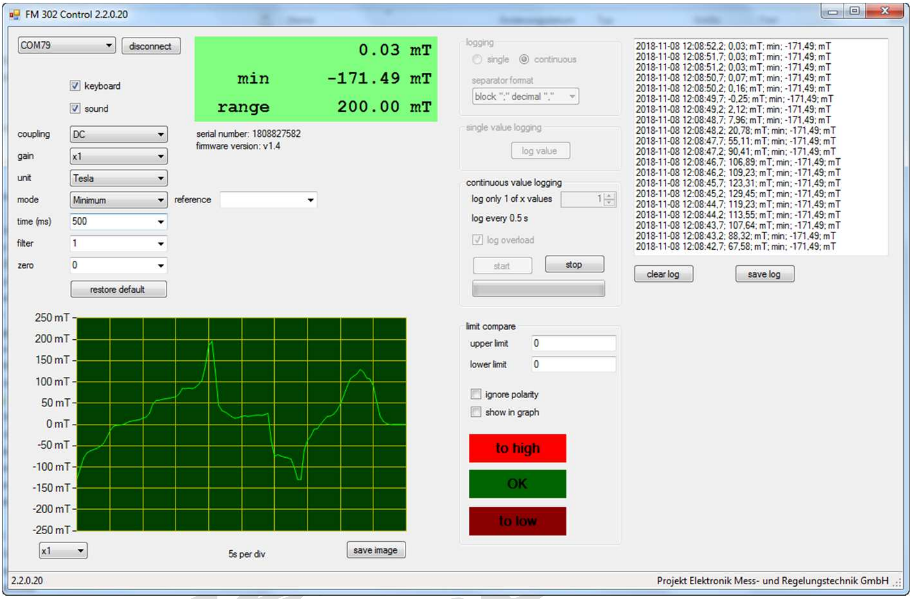


Figure 25 Control software FM 302 Control

6.3.4.1 General Description

Included in delivery is a control software for the Teslameter FM 302. The software allows to control all settings of the Teslameter via the PC. Thereby the software not only allows to control the settings accessible via the keypad of the device, but offers the complete range of functions which are possible with the commands via the USB interface.

The software runs on all platforms where the Microsoft .NET Framework 4.0 is available. Currently (September 2011) that are all Windows version from Windows XP on.
Detailed information are available at http://msdn.microsoft.com/en-us/library/bb882520.aspx

The provided source code demonstrates the software control of the device and can be used as a base for the development of an own software.

All in all the software is given as a demo only. The usage in a productive environment is done at your own risk.

6.3.4.2 Installation

The software FM 302 Control is delivered with a ClickOnce installation routine. To install the software the `setup.exe` has to be executed which can be found at the downloaded software-pack in the folder `\FM 302 Control\` and there in the subfolder with the current version. The installation runs automatically and starts FM 302 Control afterwards.

To run the software the Microsoft .NET Framework 4.0 is necessary. If that is not available at the computer, it is automatically installed by the installation routine too.

During installation an entry in the start menu is created so for later use the software can be started via Start → program → Projekt Elektronik GmbH → FM 302 Control.

6.3.4.3 Connection to Teslameter FM 302

To use the software FM 302 Control the Teslameter FM 302 has to be connected to the USB port of the PC.

After the start of FM 302 Control select the virtual serial port created by the FM 302 in the drop down box in the upper right. Then click “Connect” to establish the connection. If the Teslameter is connected to the PC after the software has been started, the new interface will appear automatically in the list after a few moments.

If the connection was established successfully the other controls of the software are enabled. The currently set parameters of the Teslameter FM 302 are read out and the selection fields are preset with these values. Furthermore the firmware version and the serial number of the FM 302 are shown.

The graphical user interface of FM 302 Control clearly shows the extended possibilities of the USB interface commands.

6.3.4.4 Display and Setting of parameters

The software has a display field whose design is based on the display of the real device. Like at the device the current measured value plus the measuring mode and its value are displayed. Additionally the measuring range (“range”) is shown which is defined by the connected probe and the sensitivity set at the FM 302.

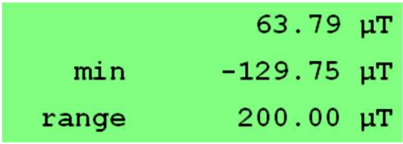


Figure 26 Value display of the control software

With checking “keyboard” and “sound” the keypad respectively the acoustic feedback can be activated/deactivated.

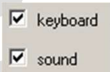


Figure 27 Control of keypad lock and acoustic feedback

☞ **We recommend to always lock the keypad of the Teslameter while using the control program. This prevents from making settings at the device which maybe are not reflected correctly by the control software.**

In the drop down boxes the corresponding parameter is set. Therefor one of the preset values may be chosen or where permitted an arbitrary value (in the defined borders) may be entered. Selected values are taken immediately. Values entered with the keyboard are taken when the cursor leaves the input field (e.g. by clicking into an other field). The input field will be updated with the value actually confirmed by the FM 302. For the exact function and the value range of the parameters see the descriptions in section 6.3.3 USB Interface.

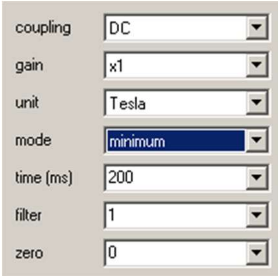


Figure 28 Control of the FM 302 settings

6.3.4.5 Oscilloscope Display

Besides the simple display of the measured value the software offers an oscilloscope-like display of the last 100 measured values. The time axis depends on the selected measuring time. The used scaling is displayed below the diagram.

The scale of the amplitude axis is given by the connected probe and the selected sensitivity of the FM 302. It covers the full range of values possible in the set configuration. In measuring mode relative measurement the baseline is moved corresponding to the set reference value. See also section 6.3.1.11 Key “rel abs” – Relative Measurement and section 6.3.3.20 Command “relative.

To better display the change of small values, with the drop down box below left at the display a higher sensitivity (x1, x10, x100, x1000) can be set. The displayed value range is reduced accordingly.

By pressing the button “save image” the current image will be saved. The file format can be chosen from the formats JPEG, PNG, BMP, TIFF, GIF and EMF.

☞ **For the display the values are taken from the digital sampling. With minimum measuring time of 0.1 s the maximal possible sampling rate is 10 Hz. For displaying faster signals a real oscilloscope can be connected to the analog output of the Teslameter FM 302.**

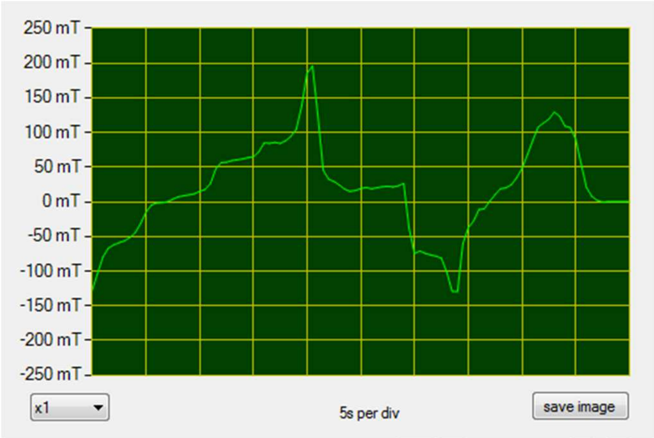


Figure 29 Oscilloscope-like display

6.3.4.6 Logging of Measured Values

The control software not only permits to display the measured values of the FM 302 but also to save them into a log file. There are two different modes and two different file formats to chose from. The selection can be made in the section "logging".

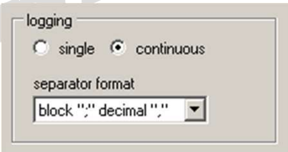


Figure 30 Setting logging parameter

It is always stored one measured value per line with the current time stamp with 0.1 s resolution, the current measured value and its unit. If one of the measuring modes relative measurement, maximal measurement or minimal measurement is active the corresponding mode abbreviation and the corresponding reference or measured value and its unit is also stored.

Below is printed an extract from a log file as an example. The measured values are chronological one below the other. The last measured value is at the lowest line.

```
2012-03-28 12:48:39,0; 0,67; mT; min; -0,81; mT
2012-03-28 12:48:39,5; 0,57; mT; min; -0,81; mT
2012-03-28 12:48:40,0; -1,47; mT; min; -0,81; mT
2012-03-28 12:48:40,5; -7,33; mT; min; -1,47; mT
2012-03-28 12:48:41,0; -19,95; mT; min; -7,33; mT
2012-03-28 12:48:41,5; -35,88; mT; min; -19,95; mT
2012-03-28 12:48:42,0; -51,29; mT; min; -35,88; mT
2012-03-28 12:48:42,5; -46,67; mT; min; -51,29; mT
2012-03-28 12:48:43,0; -23,17; mT; min; -51,29; mT
2012-03-28 12:48:43,5; 5,86; mT; min; -51,29; mT
```

Figure 31 Log file example

For storing the log file there can be chosen from two different formats The log can be saved in classic csv format (comma separated values). In this format the single data blocks are separated by a comma. The period is used as decimal separator. Alternatively the semicolon may be used for separating the data blocks which makes available the comma as decimal separator. The second format simplifies the import into software with German localization.

The created log files can easily be imported to every common program for data evaluation like Microsoft Excel, OpenOffice Calc, Mathlab or gnuplot. This allows to individually evaluate and process the measured data.

Depending on the selection in the logging settings, the corresponding logging section is enabled.

In the mode “single value logging” single measured values can be saved with a key press (mouse or keyboard). At every press of the button “log value” the current measured value is stored to the log. This mode is suitable for manual controlled measurements where a number of single values has to be measured.

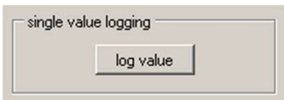


Figure 32 Single value logging

In contrast in the mode “continuous value logging” the measured value are automatically stored continuously into the log. This mode is suitable to record traces over longer periods of time.

A click on the button “start” starts the recording of measured values. With a click on “stop” the recording is halted. By clicking “start” again the logging can be continued. The new measured values are appended to the existing log.

To reduce the amount of data at long time recordings it is possible to write only every x-th value to the log. X can be set between 1 (take every measured value) and 10,000. The logging cycle given by measuring time and setting of x is displayed at the window. In that way intervals between 100 ms and barely 3 days can be set.

By checking the check box “log overload” it can be determined if an “overload” is written to the log file in case of exceeding the measuring range or if no value is logged in this case.

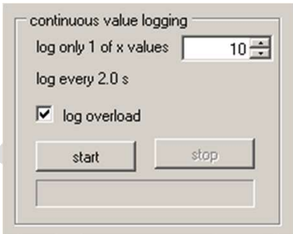


Figure 33 Continuous value logging

Switching between the modes “single value logging” and “continuous value logging” is possible at any time. New measured values are always appended to the existing log.

The software shows a preview of the log with the last 20 stored values. At this preview the last logged value is at the top.

With the button “clear log” the existing log can be erased.

With the button “save loge” the recorded log can be stored. The log is kept in the program so it can be continued afterwards.

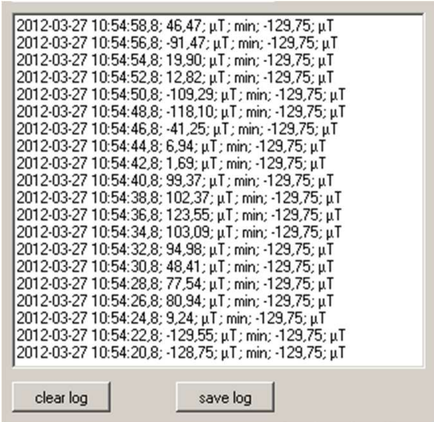


Figure 34 Log preview

6.3.4.7 Limit Comparator

Furthermore, the software offers a limit comparator function. Here an upper and a lower limit can be defined. Thereupon the software shows if the current measured value is below the lower limit ("to low"), between the limits ("OK") or above the upper limit ("to high"). The corresponding field thereby changes its color from dark to light.

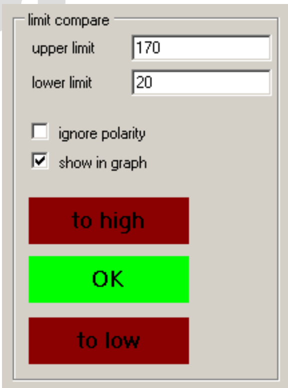


Figure 35 Limit comparator

The limits are taken in the unit, the current measured value is display in. If the display unit or the sensitivity is changed or if even the probe is change, an adjustment of the limits may be necessary in some cases.

The limits may have positive, negative or mixed sign. Greater and less are taken in the mathematical way where –10 is greater than –20.

The upper limit has to be greater or equal than the lower limit. Otherwise the software will display a warning message and disable the display of the relation of the current measured value and the display of the limits in the oscilloscope display.

If the check box “show in graph” is checked, the limits are shown as colored dashed lines in the oscilloscope display.

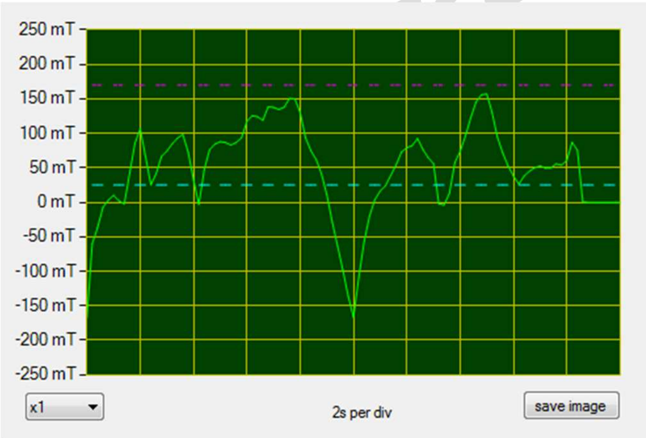


Figure 36 Oscilloscope display with limits of limit comparator

6.3.4.8 Restore Factory Settings

With “restore defaults” the Teslameter FM 302 can be reset to the factory settings. Here too see the description in section 6.3.3.9 Command “default”.

Figure 37 Reset to the factory settings

6.3.4.9 Uninstall

FM 302 Control can be uninstalled under Start → Settings → Control Panel → Add or Remove Programs.

6.3.4.10 Source Code

FM 302 Control was written in Visual Basic 2010 Express.
At the downloaded software-pack in the folder `FM 302 Control` there is a subfolder with the current version. In this folder is a subfolder `Source` which contains the Visual Basic project with the complete source code. The source may be used as a base to develop an own software or to integrate in an existing system.

6.4 AS-Active-Probe

6.4.1 Polarity

6.4.1.1 Transverse Probe

A positive reading is obtained when the lines of magnetic force enter the white ceramic surface of the flexible transverse probe or the engraved black cross of the transverse probe brass.

In this case the Teslameter FM 302 will (with firmware version 1.4 and later) display a south pole.

Figure 38 polarity transverse probe

6.4.1.2 Axial Probe

A positive reading is obtained when the lines of magnetic field left the black end face of the axial probe at right angle.

In this case the Teslameter FM 302 will (with firmware version 1.4 and later) display a south pole.

Figure 39 polarity axial probe

6.4.2 Angle of Field

Maximum flux density is measured if the lines of magnetic field perpendicularly traverse the Hall element!

If the lines of magnetic force do not enter the Hall element at right angle, the displayed value results from the true magnetic flux density according to the following relation:

$$B_{Display} = B_{max} \cdot \cos\alpha$$

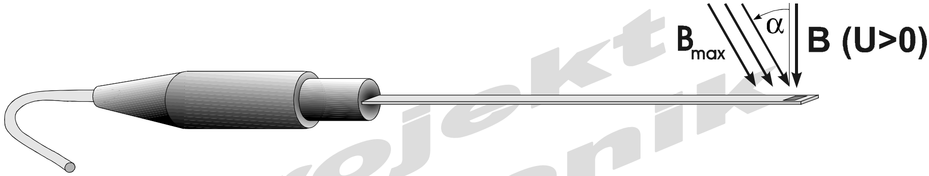


Figure 40 Trigonometric of the measuring arrangement

6.4.3 Measuring Arrangement

The outlet flux density of a bar magnet may be measured by plain lay a transverse probe (as seen right in the image) or by orthogonal place an axial probe (as seen left in the image) on the magnet.
Reversing the transverse probe does not produce the same value because the active area of the hall element is not exactly in the center of the probe.

According to the states about polarity of the measured value (see section 6.4.1 Polarity) the axial probe shown in the image would produce a positive measured value. If the cross of the transverse probe in the image points to the magnet, this probe also would produce a measured value with positive sign.

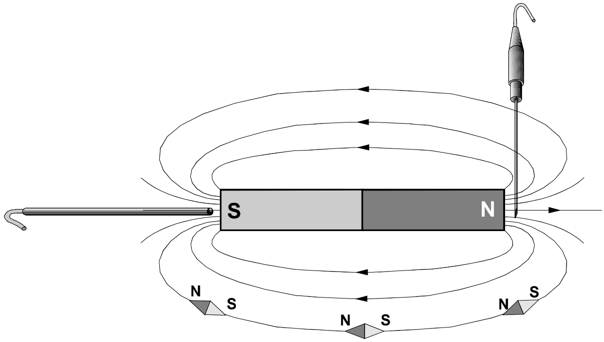


Figure 41 Measuring arrangement bar magnet

The field within a cylindrical coil is measurable with an axial probe. If a probe is feed into the coil the lines of field are along the probe axis. For the axial probe that is also the measuring direction. At the transverse probe the lines of field would be perpendicular to the measuring direction so no useable measuring signal may be generated. Like at the bar magnet with both probe types the outlet flux density may be measured.

Here too the polarity (see section 6.4.1 Polarity) of the axial probe shown in the image will produce a positive measured value. If the cross of the transverse probe in the image points to the coil, this probe also would produce a measured value with positive sign.

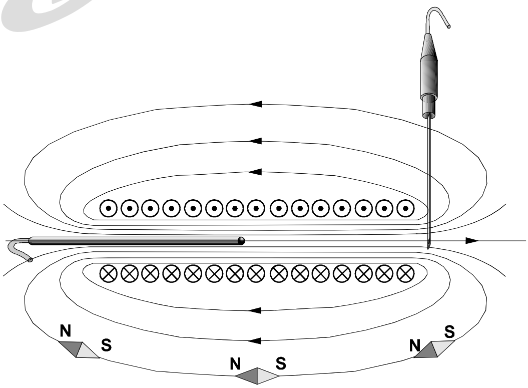


Figure 42 Measuring arrangement cylindrical coil

6.4.4 Precision and Repeatability

The flux density is a vector. To measure the exact value of that vector, the probe has to be highly perpendicular to the direction of the flux density.
For example to measure a flux density of 1 T accurate to 1 mT, the angle deviation may not be lager than 2.56 °.
To further illustration: At a rotation with a radius of 100 mm this is only a distance of 4.47 mm.
The repeatability extremely depends on the quality of the mechanically fixation of the probe.

6.4.5 Winding up of Cables

Cables always should be wound up in a way that no knots or twists occur. To ease you the winding up of the cable we have collected and mentioned below some instructions available on the Internet.

- https://www.youtube.com/watch?v=0yPcJD7RVuY
- https://www.youtube.com/watch?v=pEd7ru24Vx0
- https://www.youtube.com/watch?v=3j1Wdc-ymbI
- https://www.popularmechanics.com/technology/how-to/tips/a-solution-for-tangled-headphones-15413257

6.4.6 Transverse Probe AS-NTP 0,6

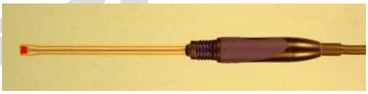


Figure 43 Transverse probe 0,6

☞ The transverse probe has a blue protective cap which have to be unscrewed before measurement.

Utmost care and attention are needed if magnets have to be measured that are not mechanically fixed. Clashing poles can destroy the Hall element!

As the Hall element (ceramic) is very sensitive to pressure or shock, mechanical stress must be avoided (risk of breakage)!

6.4.7 Transverse Probe Brass AS-NTM, AS-NTM-2, AS-LTM

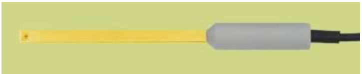


Figure 44 Transverse probe brass

For fields of B > 20 mT and f > 10 kHz , probes brass should not be operated for more than 1 min in order to prevent excessive heating of the brass tube with the Hall element inside!

Attention should be paid to the fact that at the probe a connection exist between GND, cable shield, plug housing and brass tube. Possibly an isolated installation of the probe can be necessary to prevent an unintended connection between measuring ground and protective earth.

6.4.8 Transverse Probe Hot AS-NTP-Hot-05

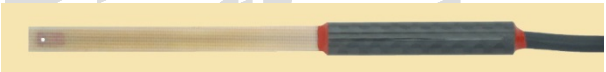


Figure 45 Transverse probe Hot

☞ The transverse probe has a protective cap which have to be drawn off before measurement.

Only the probe, the handle and the cable are temperature-resistant. The probe connector with the electronic may only be operated up to +50 °C.

6.4.9 Transverse Probe Flex AS-NTP-Flex 0,6

Figure 46 Transverse probe Flex 0,6

☞ The transverse probe has a protective cap which have to be drawn off before measurement.

Only the probe itself is temperature-resistant. The handle, the cable and the probe connector with the electronic may only be operated up to +50 °C.

No pressure shall be applied to the hall element (ceramic) because it is very pressure sensitive (risk of breaking)!

6.4.10 Transverse Probe Wire AS-NCu-Wire

Figure 47 Transverse probe Wire

The wire probes are very sensitive. The wires of the probe may not be bend at the element and may not be pulled.

Only the probe itself is temperature-resistant. The handle, the cable and the probe connector with the electronic may only be operated up to +50 °C.

No pressure shall be applied to the hall element (ceramic) because it is very pressure sensitive (risk of breaking)!

6.4.11 Transverse Probe AS-VTP

Figure 48 Transverse probe AS-VTP

6.4.12 Axial Probe (AS-HAP-90, AS-NAP-90, AS-LAP-90, AS-VAP-90)

Figure 49 Axial probe

6.4.13 Axial Probe AS-UAP GEO-X

Figure 50 Axial probe AS-UAP GEO-X

The AS-UAP-active probes are used for measurements of the earth magnetic field and up to ±200 µT.

Because the earth magnetic field is present everywhere with ca. 50 µT, the probe has a compensation trimmer to set the base value to zero. So it is possible to measure in the x10 and x100 more sensitive ranges the changes of the base value.

This compensation can be switched off, so it is possible to measure absolute values (without compensation) at any time.

6. Operation

☞ **To be able to gain best stability in the 2 µT range the probe should be switched on for at least 30 minutes.**

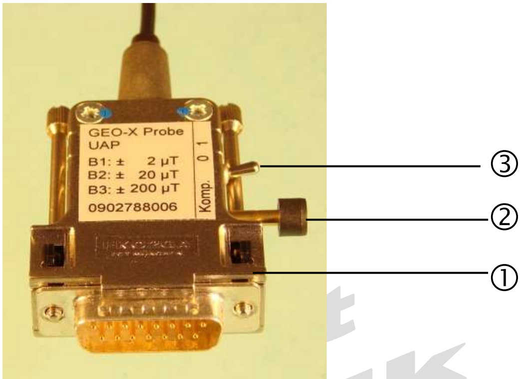


Figure 51 Controls connector AS-UAP

① connector housing
② trimmer for compensation
③ switch for compensation

The axis of the compensation trimmer should not be bend to not damage the axis or the trimmer.

6.4.14 Usage of the AS-Active-Probes

6.4.14.1 Usage with the Teslameter FM 302

Usually the AS-active-probe is simply connected to the Teslameter. The measurement can be started immediately.

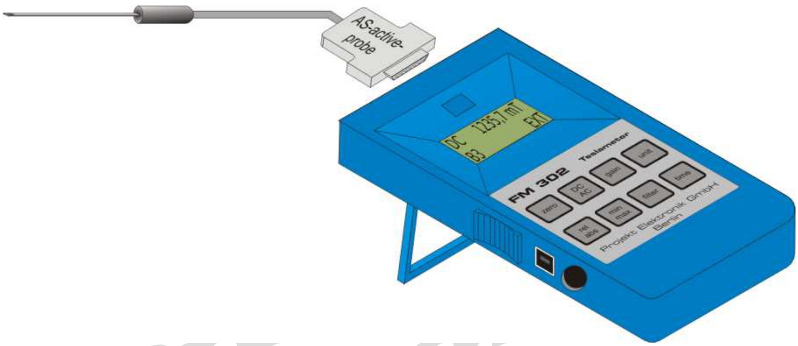


Figure 52 Usage of AS-active-probe with FM 302

Also all extended possibilities of the Teslameter FM 302 like calibrated analog output, control via USB interface or power supply with power adapter are usable in that way. Further details can be found in section 6.3.2 Usage of The Teslameter FM 302.

6.4.14.2 Usage as Autonomous Transducer

Our AS-active-probes can be operated stand-alone. Therefore they simply have to be supplied with ± 3 V (± 1 %) with max. 20 mA. The analog output signal can be feed e.g. into the input of a programmable amplifier of a PLC.

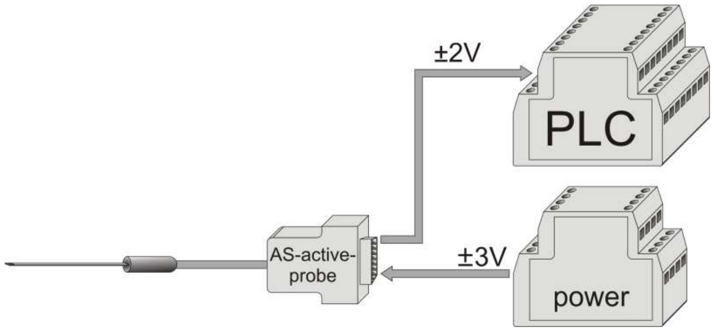


Figure 53 Usage AS-probe at ±3 V

The pin configuration of the probe is shown in the graphic below. All other pins are reserved for future use ore are only relevant in combination with the Teslameter FM 302. These pins have to remain unconnected.

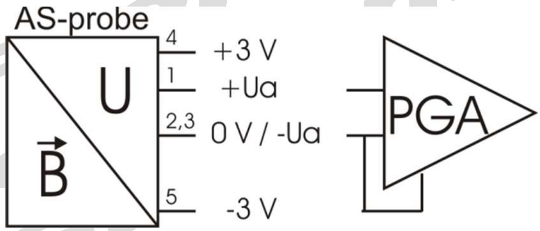


Figure 54 Pin configuration AS-probe at ±3 V

Like shown in the inner structure schematic the output signal at pin 1 is always referred to the ground signal at pin 2 and 3. This ground and the supply voltages +3 V (pin 4) and –3 V (pin 5) have to be provided from the outside.

The AS-active-probes may not be powered with asymmetric voltages.

It should be observed, the in the probe a connection between plug shield, plug case and cable shield is made. At probes with brass protective tube, this is also connected to shield. If used with Teslameter FM 302, AS-probe adapter or AS-Adapter 3 the shield is connected to GND. Possibly an isolated installation of the probe is necessary to prevent an unintended connection between measuring GND and protective earth.

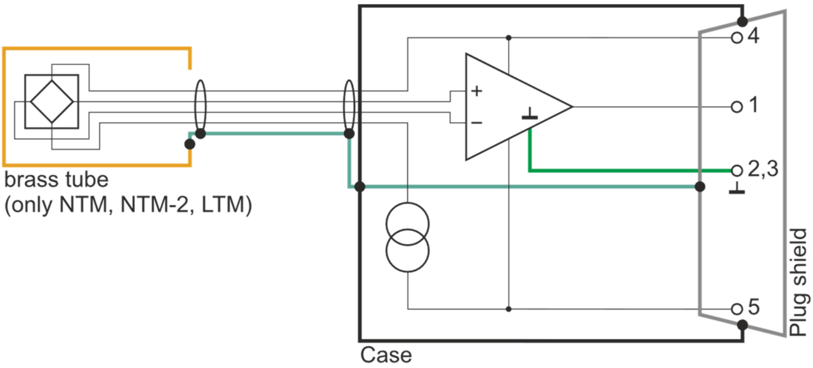


Figure 55 Structure AS-active-probe

6.4.14.3 Usage with the AS-Probe Adapter

To simplify the usage of the AS-active-probe as autonomous transducer, the AS-probe adapter can be used. It provides high stable ±3 V to supply the probe and amplifies the output signal to ±10 V.

For further details see section 6.5.4 Usage of the AS-probe adapter.

6.4.14.4 Usage with the AS-Adapter 3

Up to three AS probes simultaneously can be operated on the AS-Adapter 3.
The AS-Adapter 3 ensures the supply of all connected probes.
Further details can be found in chapter 6.6.4 Usage of the AS-Adapter 3.

6.4.15 Zero Chamber (optional)

Optional a zero chamber is attainable for our instruments.

The zero chamber is a one side closed pipe of good magnetic shielding metal where in the inside the magnetic field is strongly attenuated compared to the outer field. Normally at least the earth's magnetic field has to be shielded. In addition there may be other interfering fields from the environment.

Figure 56 Zero Chamber

With the help of a zero chamber you can check the zero-field and compensate it, if necessary. Therefor the AS-probe is feed into the zero chamber. Now one can assume that the magnetic field is sufficient shielded. With the “zero” key of the Teslameter FM 302 (see section 6.3.1.7 Key “zero” – Offset Compensation) the display may set to zero in the most sensitive range.

Further information about the zero chamber and its use can be found in our application note PE012 – zero chamber - zero adjustment.

6.4.16 Test Curves / Linearity Curves (optional)

Test Curves / linearity curves are optionally available for the AS-active-probes. The test curves / linearity curves are used for determining exact field values at up to five temperatures. These three curves serve to determine the deviation of the measuring instrument for specific field strength and temperature readings so as to correct the field values displayed. So a measurement accuracy of 0.1% is achievable.
Each AS-active-probe have its own individual test curve / linearity curve. If an AS-probe is replaced, the test curve / linearity curve have to be renewed too.

Examples of typical test curves / linearity curves can be found at our application note PE003 – Test Curves / Linearity Curves.

The test curve / linearity curve serves as a test record.

The following illustration shows an exemplary set of test curves / linearity curves:

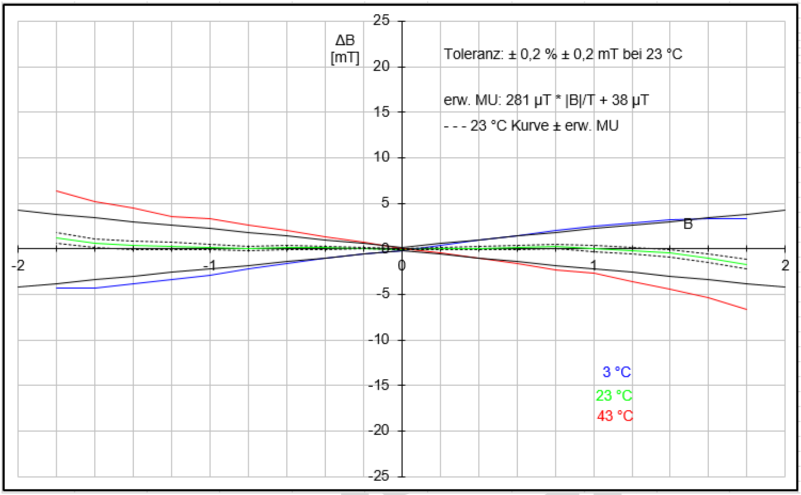


Figure 57 Typical test curves / linearity curves

6.5 AS-Probe Adapter

6.5.1 Controls and Connectors

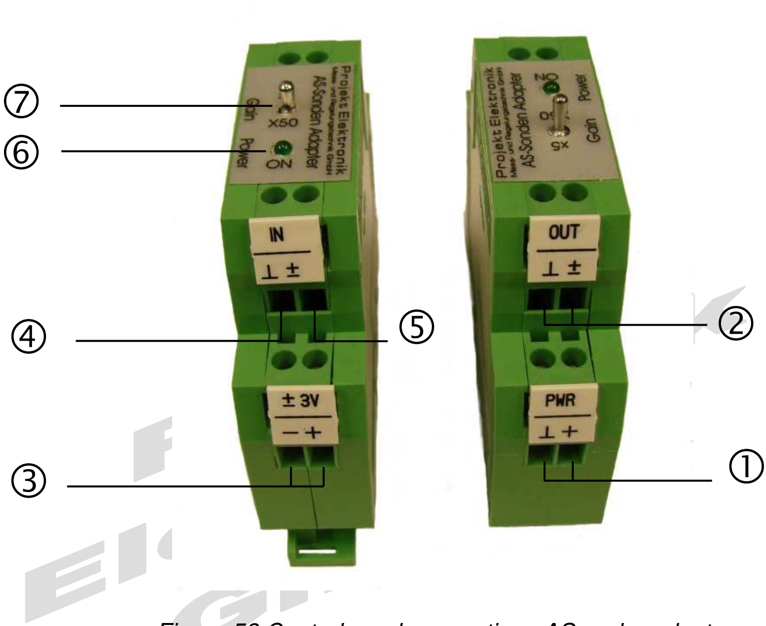


Figure 58 Controls and connections AS-probe adapter

① supply voltage inputs

② measurement signal output

③ ±3 V for probe supply

④ GND for probe supply and probe signal

⑤ probe signal input

⑥ power LED

⑦ gain switch

6.5.2 Structure

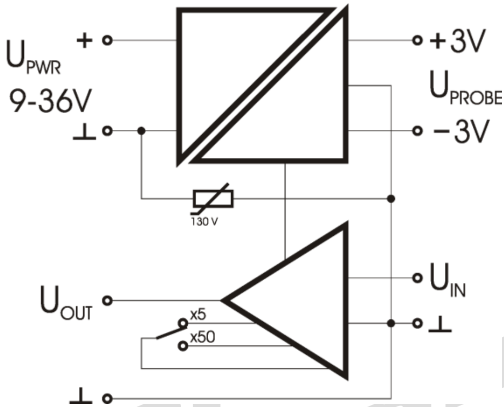


Figure 59 Structure AS-probe adapter

The AS-probe adapter basically consists of two components, the voltage converter and the amplifier.

The voltage converter has a wide input range which allows to supply the adapter with any constant voltage between 9 V and 36 V. The voltage converter also generates a galvanic isolation form the supply voltage. The potential difference between primary and secondary side is limited to 130 V by a varistor. Therefore the potential difference during operation should not exceed 100 V.

The voltage converter generates high stable ±3 V necessary to supply the AS-active-probes. Furthermore it provides the voltage to supply the rest of the circuit.

The amplifier boosts the probe signal from ±2 V to ±10 V (gain x5). With a switch an again ten times higher amplification (x50) can be selected. In this setting ±0.2 V are converted to ±10 V.

6.5.2.1 Supply Voltage Inputs

With these inputs the AS-probe adapter is connected to the power supply. The adapter can be supplied with a DC voltage between 9 V and 36 V. Since the adapter internally uses a DC/DC converter the current consumption depends on the supply voltage. The higher the supply voltage, the lower the current which is drawn by the adapter.

The input is equipped with an inverse polarity protection diode. Furthermore besides an overvoltage suppressor the input has a protection circuit which shortens the input in case of permanent overvoltage to protect the circuit. In this case the also integrated resettable fuse will trigger after a few moments. The threshold of the protection circuit is ~39 V. To reset the triggered protection circuit the adapter has to be disconnected from the power supply.

6.5.2.2 Power LED

This LED lights up if the adapter is correctly supplied with power. If the LED does not light up even though the adapter is connected to power supply maybe the overvoltage protection circuit has triggered.

6.5.2.3 Probe Supply

At these outputs the ±3 V necessary to supply the AS-active-probe is available. The outputs deliver a maximum current of 20 mA.

The supply of the probe and the input of the probe signal use the same GND connection

6.5.2.4 Probe Signal Input

At this input the measurement signal delivered from the probe is connected. The maximal converted input voltage range is ±2 V with gain x5 and ±0.2 V with x50.

The supply of the probe and the input of the probe signal use the same GND connection

6.5.2.5 Measurement Signal Output

At this output the amplified measurement signal is available. At maximum amplitude the maximal output current is 2 mA. Correspondingly the load has to be at least 5 kΩ. For smaller amplitudes the output can deliver even higher currents.

The outcome of the given current drive capability is that higher capacitive loads results in a reduction of bandwidth.

Unloaded the amplifier has a bandwidth of >100 kHz whereby even fast transient signals can be transferred.

6.5.2.6 Gain Switch

With this switch the gain can be switched between x5 (±2 V → ±10 V) and x50 (±0.2 V → ±10 V).

6.5.3 Adapter Cable

With the AS-probe adapter an adapter cable is delivered. This cable has a 15pol SubD female connector at one site and four single wires at the other side. Therefore with this cable a AS-active-probe can easily be connected to the AS-probe adapter.

The cable can be extended at the side of the SubD connector with probe extension cords as well as at the side of the single wires.

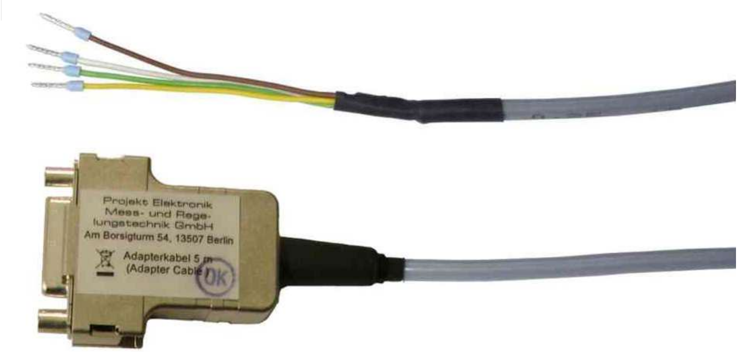


Figure 60 Adapter cable

The assignment of the single wires to the corresponding pins of the probe and the connectors of the AS-probe adapter can be found in the table below.

wire color	probe function	connector adapter
white	probe signal	IN ±
yellow	+3 V	±3V +
green	-3 V	±3V -
brown	ground	IN ⊥

Table 1

One should be aware, that the probes and all outputs have a common ground. Especially when using the brass version of AS-probes (AS-NTM, AS-LTM) an isolation between probe and other parts of the measurement setup can be necessary.

6.5.4 Usage of the AS-probe adapter

To use the AS-probe adapter three connections have to be made.

At first the AS-active-probe is connected via the delivered adapter cable with the connectors "±3V" and "IN" of the AS-probe adapter.
For connection assignment of the adapter cable see Table 1 on page 79.

For power supply the input "PWR" has to be connected to a power supply which delivers a DC voltage between 9 V and 36 V.

As third the output "OUT" has to be connected with the analog input of a data acquisition system like e.g. a PLC.

The gain switch is set to the desired position (x5 or x50).

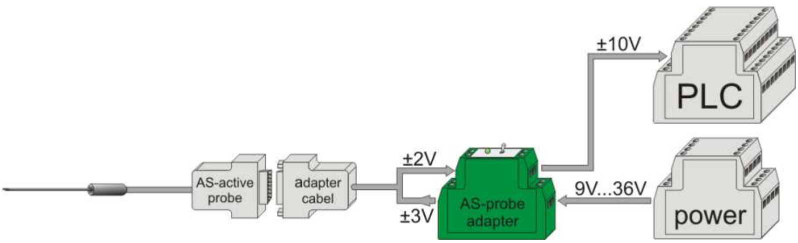


Figure 61 Connection AS-probe adapter

6.6 AS-Adapter 3

6.6.1 Controls and Connectors

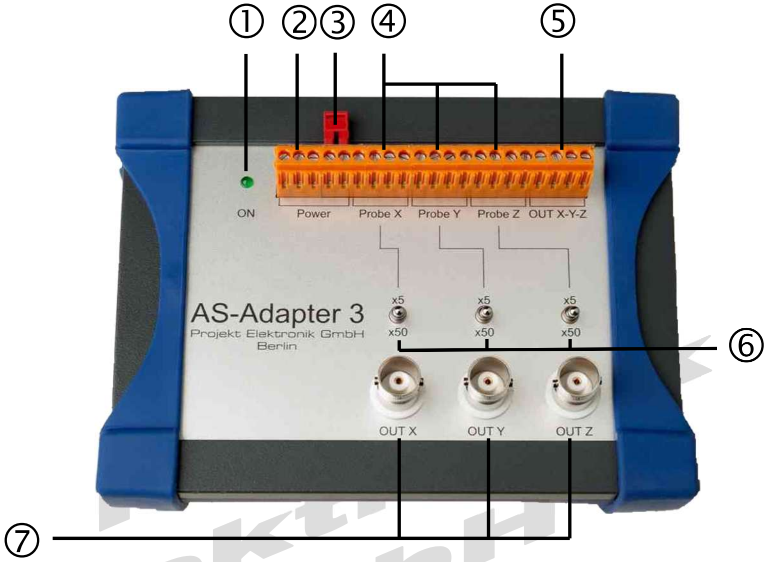


Figure 62 Controls and connectors AS-Adapter 3

① Power LED

② Clamping contacts for Power and PE

③ Bridge for connection of Ground connection and GND

④ Clamping contacts for input signals IN X, IN Y, IN Z

⑤ Clamping contacts for output signals X, Y, Z

⑥ gain switch

⑦ BNC Sockets output signals OUT X, OUT Y, OUT Z

6.6.2 Overview of Controls and Connections

The AS adapter 3 consists of two components, the voltage converter and the amplifiers.

The voltage converter has a wide-range input whereby the AS adapter 3 can be supplied with an operating voltage range of 9 VDC to 36 VDC. The signals and supply of the probes are galvanically isolated from the operating voltage. The potential difference between the primary and secondary side is limited to 130 V by a varistor.

Therefore, the potential difference in operation should not become greater than 100V.

The AS-Adapter 3 supplies the AS active probes with ± 3 V in a highly stable manner. The probe signals are amplified with x5 or x50, so that with ± 2 V or ± 0.2 V they can output ± 10 V for a PLC system and Provide oscilloscope.

The AS adapter 3 offers the possibility of a separate connection of a PE conductor. Furthermore, a connection between GND and the ground terminal of the housing can be made by means of a bridge.

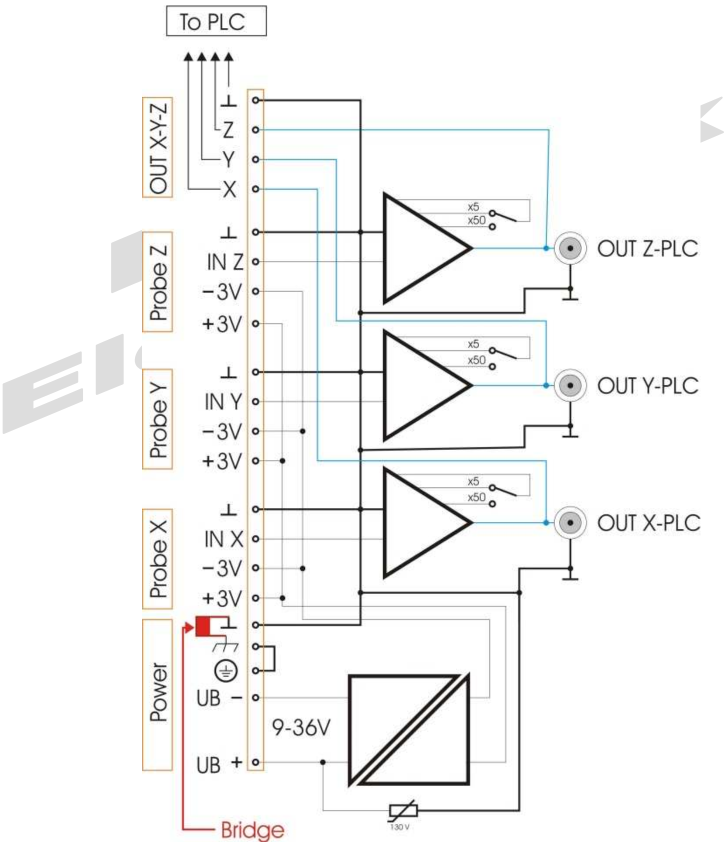


Figure 63 Structure AS-Adapter 3

6.6.2.1 Supply Voltage Inputs

With these inputs the AS-probe adapter is connected to the power supply. The adapter can be supplied with a DC voltage between 9 V and 36 V. Since the adapter internally uses a DC/DC converter the current consumption depends on the supply voltage. The higher the supply voltage, the lower the current which is drawn by the adapter.

The input is equipped with an inverse polarity protection diode. Furthermore besides an overvoltage suppressor the input has a protection circuit which shortens the input in case of permanent overvoltage to protect the circuit. In this case the also integrated resettable fuse will trigger after a few moments. The threshold of the protection circuit is ~39 V. To reset the triggered protection circuit the adapter has to be disconnected from the power supply.

6.6.2.2 Power LED

This LED lights up if the adapter is correctly supplied with power. If the LED does not light up even though the adapter is connected to power supply maybe the overvoltage protection circuit has triggered.

6.6.2.3 Probe Supply

At these outputs, the AS-active probes required for supply are ± 3 V highly accurate. The outputs deliver a maximum current of 20 mA per AS-active probe.

The supply for the probes and the inputs for the probe signals use the same GND connection.

6.6.2.4 Probe Signal Input

At this input the measurement signal delivered from the probe is connected. The maximal converted input voltage range is ±2 V with gain x5 and ±0.2 V with x50.

The supply of the probe and the input of the probe signal use the same GND connection.

6.6.2.5 Measurement Signal Output

At this output the amplified measurement signal is available. At maximum amplitude the maximal output current is 2 mA. Correspondingly the load has to be at least 5 kΩ. For smaller amplitudes the output can deliver even higher currents.

The outcome of the given current drive capability is that higher capacitive loads results in a reduction of bandwidth.

Unloaded the amplifier has a bandwidth of >100 kHz whereby even fast transient signals can be transferred.

6.6.2.6 Gain Switch

With this switch the gain can be switched between x5 (±2 V → ±10 V) and x50 (±0.2 V → ±10 V).

6.6.3 Adapter Cable

3 pieces of 1-axis adapter cable are supplied with the AS-Adapter 3. These cables have a 15-pin SubD socket on one side and four individual wires on the other side. Thus, with this adapter cables 3 AS-active probes can be easily connected to the AS-adapter 3. For ease of use, the 3 adapter cables are assigned according to the channels "X, Y, Z".

The cables can be extended both on the side of the SubD socket with probe extension cables and on the side of the single conductors.

The assignment of the individual conductors to the respective connection of the probe or the connection of the AS-probe adapter is shown in Table 2 below.

cabel	wire color	probe function	connector AS-Adapter 3
X	YE	+3V	+3V
	GN	-3V	-3V
	WH	probe signal	IN X
	BN	ground	IN GND
Y	YE	+3V	+3V
	GN	-3V	-3V
	WH	probe signal	IN Y
	BN	ground	IN GND
Z	YE	+3V	+3V
	GN	-3V	-3V
	WH	probe signal	IN Z
	BN	ground	IN GND

Table 2

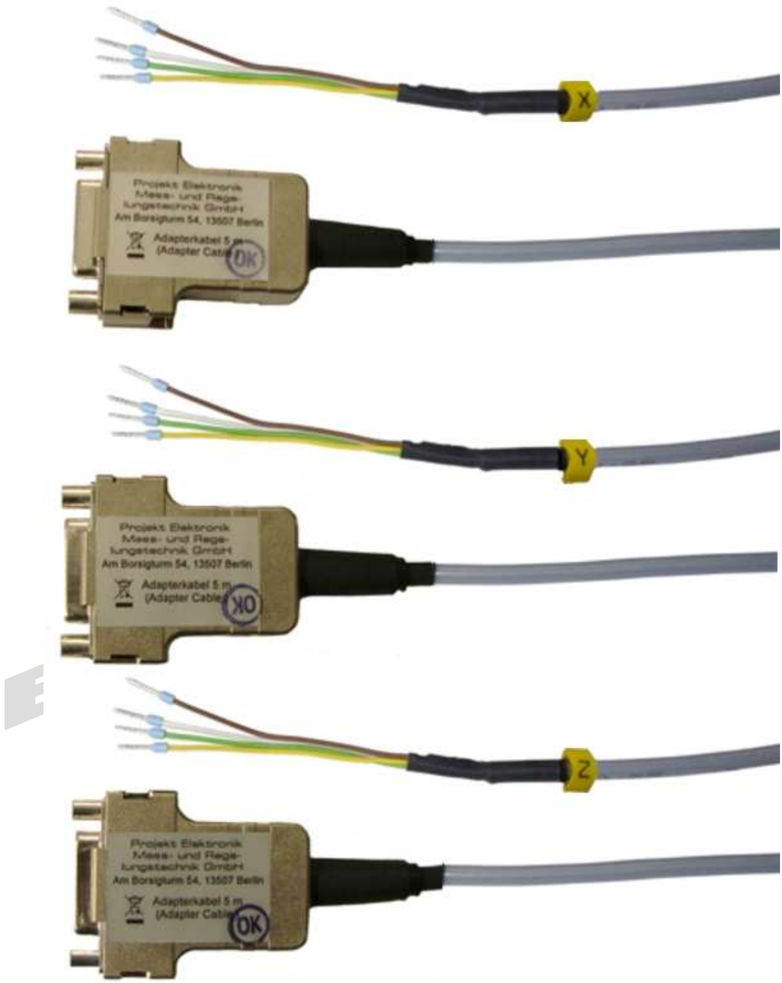


Figure 64 Adapter cable „X, Y, Z"

Attention should be paid that there is a connection between GND and cable shield as well as the connector housing in the adapter cable. At brass probes this is also connected to GND. Possibly an isolated installation of the probe is necessary to prevent an unintended connection between measuring GND and protective earth.

6.6.4 Usage of the AS-Adapter 3

There are three connections to use the AS-Adapter3.

First, the AS active probes are connected to the "± 3V" and "IN X", "IN Y", "IN Z" terminals of the AS adapter 3 using the 3 enclosed adapter cables. For pin assignment of the adapter cable, see table 2 on page 80.

For power supply, the input "Power" is connected to a voltage source, which provides a DC voltage between 9 V and 36 V.

Third, the outputs "OUTX", "OUTY", "OUTX" are connected to the analog input of a measuring transducer, such as a PLC or connected to an oscilloscope.

The gain switch is moved to the desired position (x5 or x50).

On the following pages 86 and 87 two different connection options are shown.

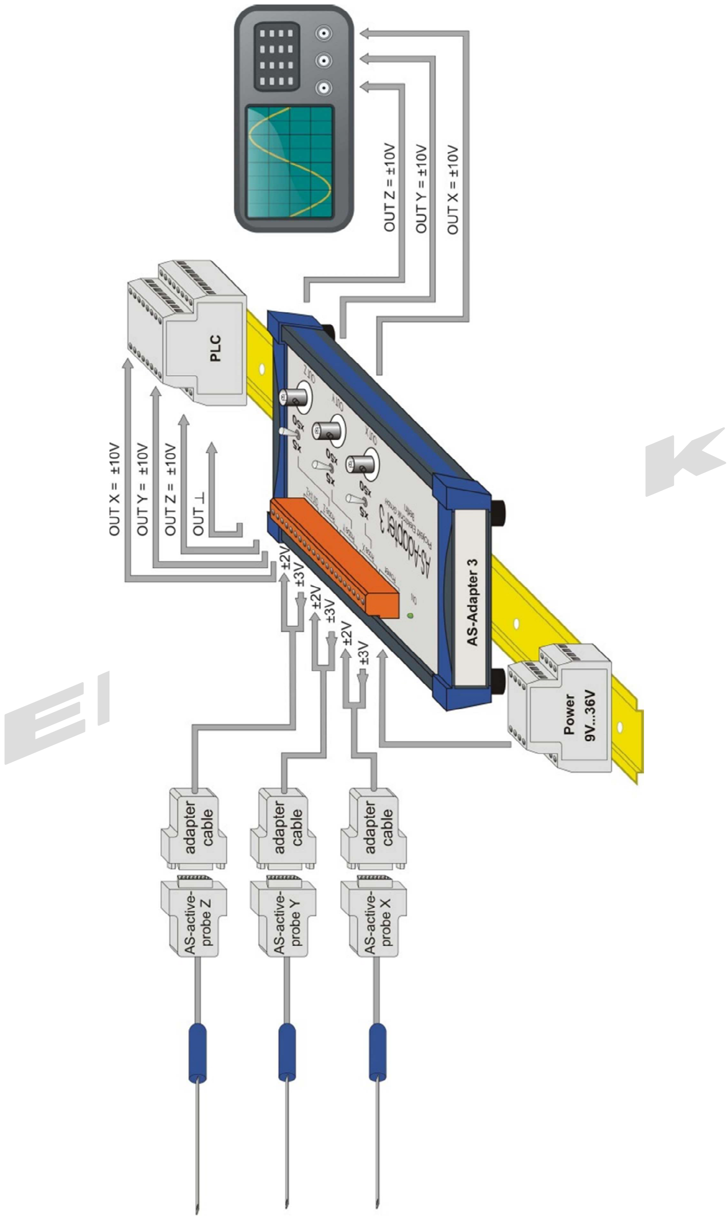


Figure 65 Connection AS-Adapter 3 with 1-axis AS-active probes

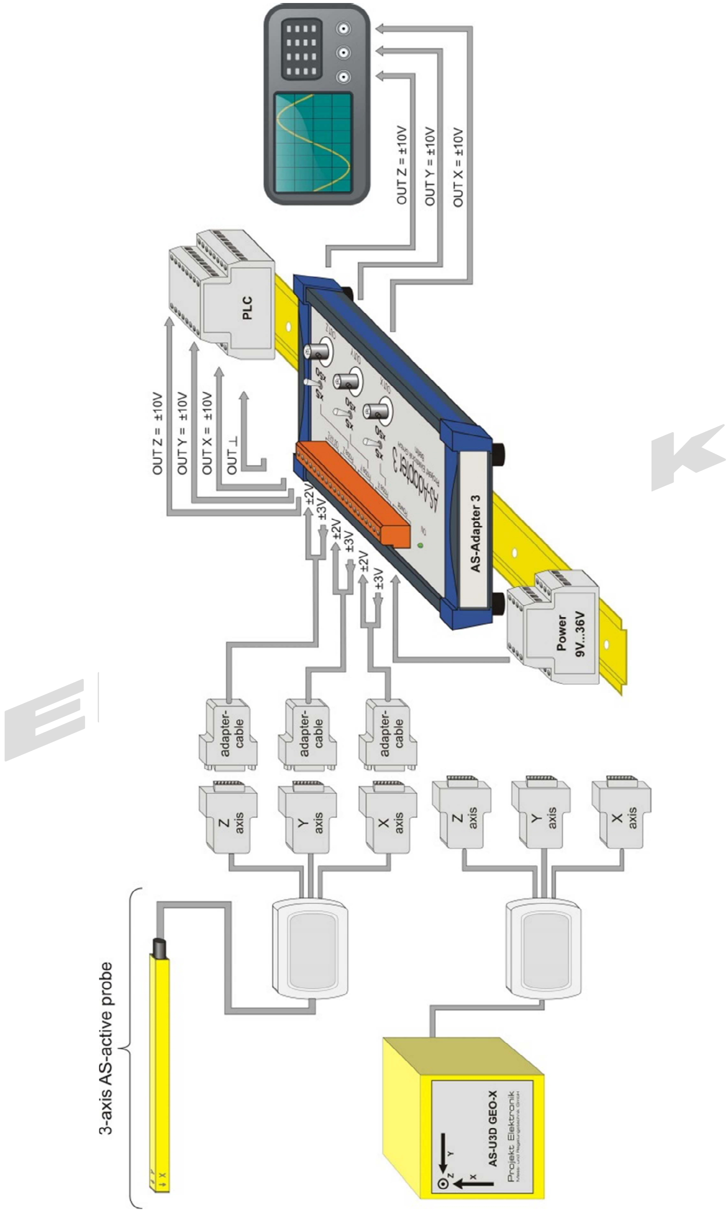


Figure 66 Connection AS-Adapter 3 with 3-axis AS-active probe

7. Technical Specifications

7.1 Teslameter FM 302 (without AS-Active-Probe):

Measuring modes	DC / AC(RMS)
Ranges	3 ranges per probe, see technical specification of the AS-probes sensitivity x1; x10; x100
Bandwidth (-3 dB)	DC: DC – ≥100 kHz AC: <5 Hz – ≥100 kHz depends also on the used probe
Measurement uncertainty DC	in x1: <0,1 % ±2 Digit (at 23 °C ±1 °C) in x10: <0,1 % ±5 Digit (at 23 °C ±1 °C) in x100: <0,1 % ±20 Digit (at 23 °C ±1 °C) after offset compensation with zero-function
Adjustable offset	±4500 digit at most sensitive range (x100)
Measurement uncertainty RMS	16.7 Hz: ≤-0.3 dB (at 23 °C ±1 °C) 50 Hz: ≤ -0.1 dB (at 23 °C ±1 °C) with level ≥5 % of range, sine wave
Temperature coefficient	max. ±0.01 %/K, typ. <±0.003 %/K
Zero drift	max. ±3 digit/1K, typ. ±1 digit/1K (DC at most sensitive range
Input resistance	10 kΩ ±0.1 %
Operation	keypad with 8 keys USB interface
Operation temperature range	+5 °C to +50 °C
Storage temperature range	-10 °C to +50 °C
Max. relative humidity	70 % at +35 °C
Operation in magnetic field	undisturbed up to at least 350 mT observe action of force!
Power	9 V battery at least 400 mAh battery or accumulator, life time > 20 h, depending on probe type, jack for 9 V power adapter 9 V DC, 40 mA, minus at inner port USB interface (low power device)

Dimension:

Length	166 mm (without connected plugs)
Width	88 mm (without connected plugs)
Thickness	31 mm
Weight	225 g (without 9 V battery) 271 g (with 9 V battery)

7. Technical Specifications

LCD display:

Display	4½ digit two line LCD display
Display range	±25100 digit
Resolution	$^{1}/_{20.000}$ of each measurement range of probe (e.g. 0.1 mT at range of 2 T)
Measuring modes	mean value (DC) true effective value (AC / true RMS)
Polarity	sign (in DC) N(orth pole) or S(outh pole) (in DC) (with firmware version 1.4 and later)
Measuring modes	absolute measurement relative measurement minimal measurement maximal measurement absolute maximal measurement (with firmware version 1.4 and later)
Display unit	Tesla, Gauss, Oersted, A/m A/cm (with firmware version 1.4 and later and hardware version V2)
Update rate	given by measuring time
Rise time RMS meas.	typ. 0.3 s
Measuring time	settable 0.1 s (10 Hz) to 5 s (via keypad) or 25.5 s (via USB interface)
Digital filter	moving average filter with settable filter length 1 to 64 values

Analog output:

Output voltage	±2.7 V
Factor	±2 V per full scale of probe (e.g. range 2 T → factor 1 V/T) see also Table 5 at page 96
Bandwidth (-3 dB)	DC: DC – ≥100 kHz AC: <5 Hz – ≥100 kHz depends also on the used probe
Rise time	< 2 µs
Output connector	BNC
Output impedance	47 Ω

7. Technical Specifications

USB Interface:

Connector	USB-B jack
Standard	USB 1.1 / USB 2.0 compatible
Driver	Windows, Linux, Mac
PC interface	creates a virtual serial port Control via ASCII-commands

Control Software at the software-pack to download:

control possibilities	all control possibilities accessible via the USB interface
measured value display	current measured value as number with unit value of the set display mode as number with unit oscilloscope-like display limit comparator
oscilloscope display	last 100 measured values display range as given by probe and sensitivity setting x1, x10, x100, x1000
file format	as JPEG, PNG, BMP, TIFF, GIF or EMF image
data logging	single values via key press or continuously automatic
Log format	comma separated and period as decimal separator (CSV) semicolon separated and comma as decimal separator time stamp with 0.1 s resolution, measured value, unit
Limit comparator	with lower and upper limit display if measured value below, between or above limits possibility to ignore polarity display of the limits in oscilloscope display

7. Technical Specifications

System requirements	Windows with .NET Framework 4.0 available (since Windows XP) .NET Framework 4.0 (will be installed by control software)
Source code	as Visual Basic 2010 Express project

Technical specifications are subject to change without prior notice!

7.2 AS-Active-Probes

Transversal

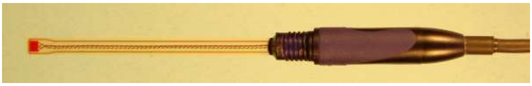


Figure 67 AS-NTP 0,6 transverse probe


Figure 68 AS-NTM, AS-LTM and AS-NTM-2 transverse probe brass


Figure 69 AS-NTP-Hot-05 transverse probe


Figure 70 AS-NTP-Flex 0,6 transverse probe


Figure 71 AS-VTP transverse probe


Figure 72 AS-NCu-Wire transverse probe Wire

Axial

Figure 73 AS-NAP-90, AS-LAP-90, AS-VAP-90 and AS-HAP-90 axial probe

Figure 74 AS-UAP GEO-X axial probe

7.2.1 Sensitivity Classes – Overview

Every AS-active-probe delivers a calibrated, analog output signal whose level depends on the measured field. Our probes are offered in different sensitivity classes. Table 3 shows the measuring ranges and transfer factors in dependence of the class.

class	range probe without Teslameter			transfer factor probe
High:	(1) 20 T	200 kG	15.915 MA/m	2 V / 20 T (1)
Normal:	2 T	20 kG	1591.5 kA/m	2 V / 2 T
Low:	0.2 T	2 kG	159.15 kA/m	2 V / 0,2 T
Verylow:	20 mT	200 G	15.915 kA/m	2 V / 20 mT
Ultralow:	200 µT	2 G	159.15 A/m	2 V / 200 µT

Table 3

(1) calibrated up to 1.8 T

7. Technical Specifications

The Teslameter FM 302 offers the opportunity to switch the sensitivity between x1, x10 and x100. Thus with every probe a wide measuring range can be covered. Furthermore the Teslameter FM 302 offers switching of the display unit. Table 4 shows the resulting measuring ranges and Table 5 the transfer factors for the analog output.

class	ranges with Teslameter FM 302 (FM 205) range x1, x10, x100			
High(1)**:**	x1	20.000 T	200.00 kG	200.00 kOe
	x10	2000.0 mT	20.000 kG	20.000 kOe
	x100	200.00 mT	2000.0 G	2000.0 Oe
Normal:	x1	2000.0 mT	20.000 kG	20.000 kOe
	x10	200.00 mT	2000.0 G	2000.0 Oe
	x100	20.000 mT	200.00 G	200.00 Oe
Low:	x1	200.00 mT	2000.0 G	2000.0 Oe
	x10	20.000 mT	200.00 G	200.00 Oe
	x100	2.0000 mT	20.000 G	20.000 Oe
Verylow:	x1	20.000 mT	200.00 G	200.00 Oe
	x10	2.0000 mT	20.000 G	20.000 Oe
	x100	200.00 µT	2.0000 G	2.0000 Oe
Ultralow:	x1	200.00 µT	2.0000 G	2.0000 Oe
	x10	20.000 µT	200.00 mG	200.00 mOe
	x100	2.0000 µT	20.000 mG	20.000 mOe

class	ranges with Teslameter FM 302 (FM 205) range x1, x10, x100		
High(1)**:**	x1	15.915 MA/m	159.15 kA/cm
	x10	1591.5 kA/m	15.915 kA/cm
	x100	159.15 kA/m	1591.5 A/cm
Normal:	x1	1591.5 kA/m	15.915 kA/cm
	x10	159.15 kA/m	1591.5 A/cm
	x100	15.915 kA/m	159.15 A/cm
Low:	x1	159.15 kA/m	1591.5 A/cm
	x10	15.915 kA/m	159.15 A/cm
	x100	1.5915 kA/m	15.915 A/cm
Verylow:	x1	15.915 kA/m	159.15 A/cm
	x10	1.5915 kA/m	15.915 A/cm
	x100	159.15 A/m	1.5915 A/cm
Ultralow:	x1	159.15 A/m	1.5915 A/cm
	x10	15.915 A/m	159.15 mA/cm
	x100	1.5915 A/m	15.915 mA/cm

Table 4

(1) calibrated up to 1.8 T

7. Technical Specifications

class	transfer factors with Teslameter FM 302 (FM 205) range x1, x10, x100	
High:	x1	2 V / 20 T (1)
	x10	2 V / 2 T
	x100	2 V / 0,2 T
Normal:	x1	2 V / 2000 mT
	x10	2 V / 200 mT
	x100	2 V / 20 mT
Low:	x1	2 V / 200 mT
	x10	2 V / 20 mT
	x100	2 V / 2 mT
Verylow:	x1	2 V / 20 mT
	x10	2 V / 2 mT
	x100	2 V / 200 µT
Ultralow:	x1	2 V / 200 µT
	x10	2 V / 20 µT
	x100	2 V / 2 µT

Table 5

(1) calibrated up to 1.8 T

7. Technical Specifications

To ease the connection of the AS-active-probe to existing analog inputs with ±10 V input range, the AS-probe adapter contains an integrated amplifier. This amplifies the output signal of the AS-active-probes from ±2 V to ±10 V. With a switch, an additionally 10times higher gain can be chosen which allows to perform even sensitive measurements.

Table 6 shows the measurement ranges as well as the transfer factors for the analog output resulting from the different probes.

class	ranges and transfer factors with AS-probe adapter range x5, x50		
High:	x5 x50	(1) 20 T 2 T	10 V / 20 T 10 V / 2 T
Normal:	x5 x50	2000 mT 200 mT	10 V / 2000 mT 10 V / 200 mT
Low:	x5 x50	200 mT 20 mT	10 V / 200 mT 10 V / 20 mT
Verylow:	x5 x50	20 mT 2 mT	10 V / 20 mT 10 V / 2 mT
Ultralow:	x5 x50	200 µT 20 µT	10 V / 200 µT 10 V / 20 µT

Table 6

(1) calibrated up to 1.8 T

Units
- T – Tesla
- G – Gauss
- Oe – Oersted
- A/m – Ampere per Meter
- A/cm – Ampere per centimeter

For conversion of magnetic units see our application note “PE005 – Magnetic units of measurement and their conversion”.

7.2.2 AS-active-probes – Overview Normal

For most application our AS-active-probe of class normal are suited. The fields typically occurring in technical areas can be measured with this probes.

class	model	type	linearity error (2)	thick mm	operation temp. °C
Normal:	AS-NTP 0,6	T	< 0.5 % ±0.2 mT	0.6 ± 0.1	**5 – 100** (4)
	AS-NTM	T-Ms	< 0.2 % ±0.2 mT	1.4 ± 0.1	5 – 50
	AS-NTM-2	T-Ms	**< 0.05% ±0.2 mT**	1.4 ± 0.1	5 – 50
	AS-NAP-90	A	< 0.5 % ±0.2 mT	Ø 6.0	5 – 50
	AS-NTP-Hot-05	T	< 0.5 % ±0.2 mT	1.5 ± 0.1	**-40 – 150** (3)
	AS-NTP-Flex 0,6	T	< 0.5 % ±0.2 mT	0.6 ± 0.1	**5 – 150** (4)
	AS-NCu-Wire	T	< 0.5 % ±0,2 mT up to 1.5 T	0.6 ± 0.1	**5 – 100** (5)

<u>*Table 7*</u>

(2) at +23 °C
(3) probe, handle and cable = -40 °C to +150 °C;
probe plug = +5 °C to +50 °C
(4) at first 70 mm = +5 °C to +100 °C;
handle, cable and probe plug = +5 °C to +50 °C
(5) at first 150 mm = +5 °C to +100 °C;
handle, cable and probe plug = +5 °C to +50 °C
(7) at first 70 mm = +5 °C to +150 °C;
handle, cable and probe plug = +5 °C to +50 °C

7.2.3 AS-active-probes – Overview Earth Magnetic Field

For the measurement of very small fields like e.g. the earth magnetic field we offer our probes of class Ultralow. With the possibility of compensation of ±70 µT the overlaying earth magnetic field can be masked. So even very small stray and noise fields can be measured with this probes.

class	model	type	linearity error (2)	thick mm	operation temp. °C
Ultralow:	AS-UAP GEO-X	A	< 0.8 % ±0.2 µT	Ø 17	5 – 50

Table 8

(2) at +23 °C

7.2.4 AS-active-probes – Overview High Field

Especially for the measurement of very high field the probe AS-HAP-90 of class High has been developed. Such high permanent fields are normally only achieved with superconductors. Temporary they can be generated with other setups, too.

class	model	type	linearity error (2)	thick mm	operation temp. °C
High:	AS-HAP-90	A	< 2.0 % ±20 mT	Ø 6.0	5 – 50

Table 9

(2) at +23 °C

7.2.5 AS-active-probes – Overview Low Field

If only small fields shall be measured, also the probes of class Low can be used.

class	model	type	linearity error (2)	thick mm	operation temp. °C
Low:	AS-LTM	T-Ms	< 0.2 % ±0.1 mT	1.4 ± 0.1	5 – 50
	AS-LAP-90	A	< 0.5 % ±0.1 mT	Ø 6.0	5 – 50

Table 10

(2) at +23 °C

7.2.6 AS-active-probes – Overview Very Low Field

For even smaller fields, probes of class verylow can be used. Typically they are used to measure residual magnetism at produced parts or to control compliance with limit values (e.g. employee safety, pacemaker).

class	model	type	linearity error (8)	thick mm	operation temp. °C
Verylow:	AS-VTP	T	< 0.5 % ±10 µT	1.7 ± 0.1	5 – 50
	AS-VAP-90	A	< 0.5 % ±10 µT	Ø 6.0	5 – 50

Table 11

(8) at +23 °C

7.2.7 AS-active-probes – Overview Further Data

class	model	bandwidth (-3 dB)	active area	temperature coefficient or. error
High:	AS-HAP-90	DC – 35 kHz	0.2 mm²	-0.05 %/K
Normal:	AS-NTP 0,6	DC – 35 kHz	0.2 mm²	-0.03 %/K
	AS-NTM	DC – 25 kHz	0.2 mm²	-0.03 %/K
	AS-NTM-2	DC – 25 kHz	0.12 mm²	**±0,005 %/K**
	AS-NAP-90	DC – 35 kHz	0.2 mm²	-0.03 %/K
	AS-NTP-Hot-05	DC – 35 kHz	0.5 mm²	±1.0% ±0.4 mT (6)
	AS-NTP-Flex 0,6	DC – 35 kHz	0.2 mm²	-0.03 %/K
	AS-NCu-Wire	DC – 35 kHz	0,2 mm²	-0.03 %/K
Low:	AS-LTM	DC – 10 kHz	0.2 mm²	-0.03 %/K
	AS-LAP-90	DC – 10 kHz	0.2 mm²	-0.03 %/K
Verylow:	AS-VTP	DC – 1 kHz	0.02 mm²	±0.03 %/K
	AS-VAP-90	DC – 1kHz	0.02 mm²	-0.06 %/K
Ultralow:	AS-UAP GEO-X	DC – 0.5 kHz	Ø 5 mm x 22 mm	±0.1 %/K
	AS-UAP Lot	DC – 0.5 kHz	Ø 5 mm x 22 mm	±0.1 %/K

<u>*Table 12*</u>

(6) in range of –10 °C to +150 °C

7.2.8 Axial Probe 12 T (AS-HAP-90)

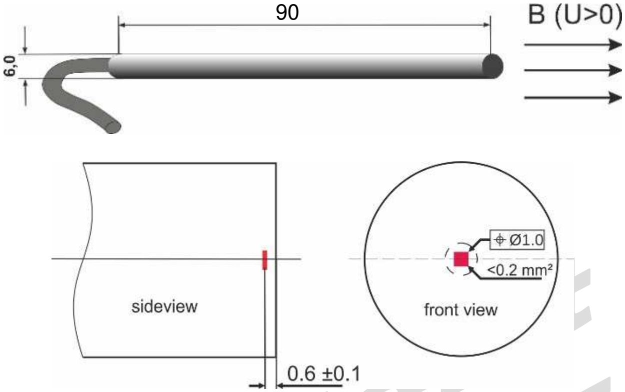


Figure 75 Size axial probe 12 T (AS-HAP-90)

Ranges (with FM 302)	±0.2 T; ±2 T; ±20 T (calibrated up to ±1.8 T)
Stem size (L x Ø)	90 mm x 6.0 mm PVC
Front face plate	bronze
Effective area	0.2 mm²
Transfer factor	0.1 V/T
Bandwidth (-3 dB)	0 – 35 kHz
Rise time	<3 µs
Linearity error	<2,0 % ±20 mT (at 23 °C)
Temperature coefficient	max. -0.1 %/K, typ. -0.05 %/K (0 to 50 °C)
Zero drift	max. ±0.05 mT/K, typ. 0.03 mT/K (DC)
Noise	typ. 173 μT_{RMS} (10 Hz – 10 kHz)
	typ. 43 μT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +50 °C
Storage temperature	-10 °C to +60 °C
Max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	2.95 m

Technical specifications are subject to change without prior notice!

7.2.9 Transverse Probe 2000 mT (AS-NTP 0,6)

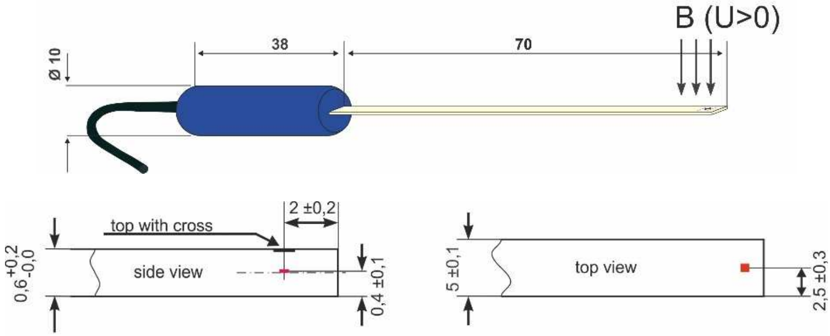


Figure 76 Size transverse probe 2000 mT (AS-NTP 0,6)

Ranges (with FM 302)	±20 mT; ±200 mT; ±2000 mT
Stem size (L x W x T)	70 mm x 5 mm x 0.6 mm GFRP
Effective area	0.2 mm²
Transfer factor	1 V/T
Bandwidth (- 3 dB)	0 - 35 kHz
Rise time	<3 µs
Linearity error	<0.5 % ±0.2 mT (at 23 °C ±1 °C)
Temperature coefficient	max. -0.05 %/K, typ. -0.03 %/K (0 to 50 °C)
Zero drift	max. ±0.020 mT/K, typ. ±0.010 mT/K (DC)
Noise	typ. 21 μT_{RMS} (10 Hz – 10 kHz) typ. 18 μT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +100 °C (only at first 70 mm) +5 °C to +50 °C (grip, cable, probe connector)
Storage temperature	-10 °C to +60 °C
Max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1.5 m

Technical specifications are subject to change without prior notice!

7.2.10 Transverse Probe Brass 2000 mT (AS-NTM)

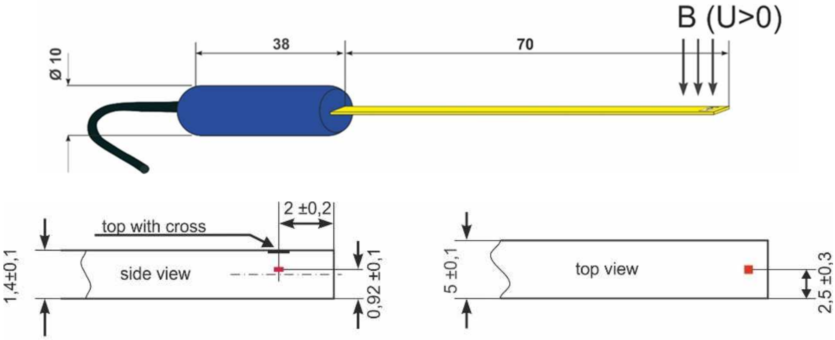
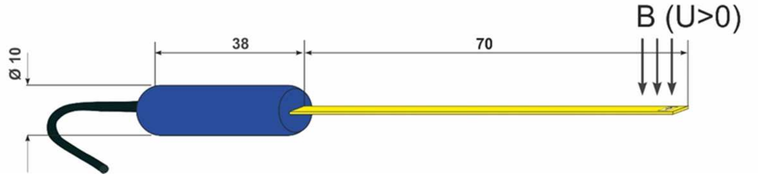


Figure 77 Size transverse probe brass 2000 mT (AS-NTM)

Ranges (with FM 302)	±20 mT; ±200 mT; ±2000 mT
Stem size (L x W x T)	70 mm x 5 mm x 1.4 mm Brass
Effective area	0.2 mm²
Transfer factor	1 V/T
Bandwidth (-3 dB)	0 - 25 kHz
Rise time	<6 µs
Linearity error	<0.2 % ±0.2 mT (at 23 °C ±1 °C)
Temperature coefficient	max. -0.05 %/K, typ. -0.03 %/K (0 to 50 °C)
Zero drift	max. ±0.020 mT/K, typ. ±0.010 mT/K (DC)
Noise	typ. 21 µT_{RMS} (10 Hz – 10 kHz) typ. 18 µT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +50 °C
Storage temperature	-10 °C to +60 °C
Max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1.5 m

Technical specifications are subject to change without prior notice!

7.2.11 Transverse Probe Brass with Very High Precision 2000 mT (AS-NTM-2)



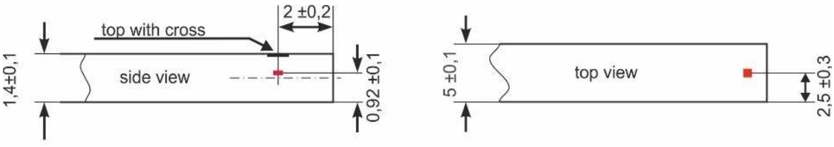


Figure 78 Size transverse probe brass 2000 mT (AS-NTM-2)

Ranges (with FM 302)	±20 mT; ±200 mT; ±2000 mT
Stem size (L x W x T)	70 mm x 5 mm x 1.4 mm Brass
Effective area	0.12 mm²
Transfer factor	1 V/T
Bandwidth (- 3 dB)	0 – 25 kHz
Rise time	<6 µs
Linearity error	<0.05 % ±0.2 mT (DC, at 23 °C ±1 °C)
Temperature coefficient	max. ±0.005 %/K (5 °C to 50 °C)
Zero drift	max. ±0.005 mT/K, typ. ±0.003 mT/K
Noise	typ. 21 μT_{RMS} (10 Hz – 10 kHz)
	typ. 12 μT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +50 °C
Storage temperature	-10 °C to +60 °C
Max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1.5 m

Technical specifications are subject to change without prior notice!

7.2.12 Axial Probe 2000 mT (AS-NAP-90)

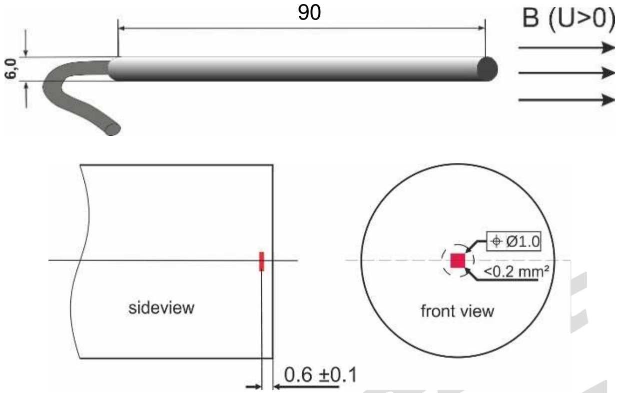


Figure 79 Size axial probe 2000 mT (AS-NAP-90)

Ranges (with FM 302)	±20 mT; ±200 mT; ±2000 mT
Stem size (L x Ø)	90 mm x 6.0 mm PVC
Front face plate	bronze
Effective area	0.2 mm²
Transfer factor	1 V/T
Bandwidth (- 3 dB)	0 - 35 kHz
Rise time	<3 µs
Linearity error	<0.5 % ±0.2 mT (at 23 °C ±1 °C)
Temperature coefficient	max. -0.05 %/K, typ. -0.03 %/K (0 to 50 °C)
Zero drift	max. ±0.020 mT/K, typ. ±0.010 mT/K (DC)
Noise	typ. 21 μT_{RMS} (10 Hz – 10 kHz) typ. 18 μT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +50 °C
Storage temperature	-10 °C to +60 °C
Max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1.5 m

Technical specifications are subject to change without prior notice!

7.2.13 Transverse Probe Hot with Improved Temperature Characteristics 2000 mT (AS-NTP-Hot-05)

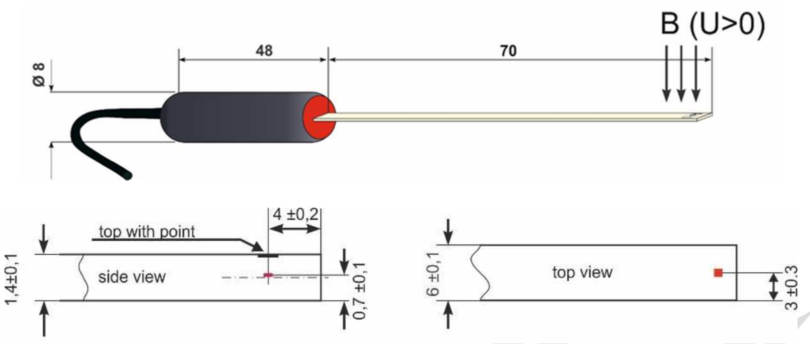
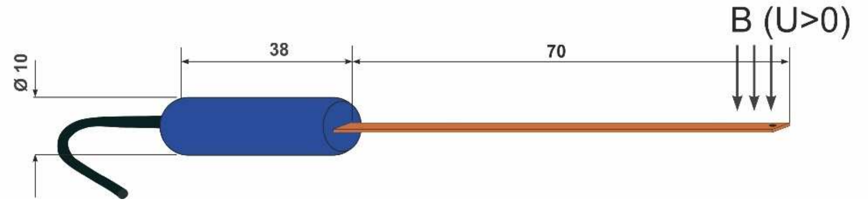


Figure 80 Size transverse probe Hot 2000 mT (AS-NTP-Hot-05)

Ranges (with FM 302)	±20 mT; ±200 mT; ±2000 mT
Stem size (L x W x T)	70 mm x 6 mm x 1.4 mm GFRP
Effective area	0.5 mm^2
Transfer factor	1 V/T
Bandwidth (- 3 dB)	0 - 35 kHz
Rise time	<3 µs
Linearity error	<0.5 % ±0.2 mT (at 20 °C ± 1 °C)
Temperature error	<±1.0 % ±0.4 mT (-10 °C to +150 °C)
Noise	typ. 21 μT_{RMS} (10 Hz – 10 kHz) typ. 18 μT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	-40 °C to +150 °C (only probe, grip and cable) +5 °C to +50 °C (probe connector)
Storage temperature	-10 °C to +60 °C
Max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	2.95 m

Technical specifications are subject to change without prior notice!

7.2.14 Transverse Probe Flex 2000 mT (AS-NTP-Flex 0,6)



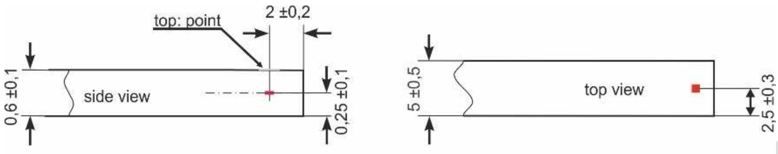


Figure 81 Size transverse probe Flex 2000 mT (AS-NTP-Flex 0,6)

Ranges (with FM 302)	±20 mT; ±200 mT; ±2000 mT
Stem size (L x W x T)	70 mm x 5 mm x 0.6 ±0.1 mm Kapton
Effective area	0.2 mm^2
Transfer factor	1 V/T
Bandwidth (- 3 dB)	0 - 35 kHz
Rise time	<3 µs
Linearity error	<0.5 % ±0.2 mT (at 23 °C ±1 °C)
Temperature coefficient	max. -0.05 %/K, typ. -0.03 %/K (0 to 50 °C)
Zero drift	max. ±0.020 mT/K, typ. ±0.010 mT/K (DC)
Noise	typ. 21 µT$_{RMS}$ (10 Hz – 10 kHz) typ. 18 µT$_{PP}$ (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +150 °C (only at first 70 mm) +5 °C to +50 °C (grip, cable, probe connector)
Storage temperature	-10 °C to +60 °C
max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1.5 m

Technical specifications are subject to change without prior notice!

7.2.15 Transverse Probe Wire 2000 mT (AS-NCu-Wire)

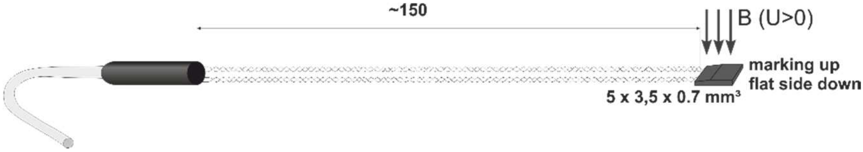


Figure 82 Size transverse probe Wire 2000 mT (AS-NCu-Wire)

Ranges (with FM 302)	±20 mT; ±200 mT; ±2000 mT
Sensor thickness / guide	0.6 ±0.1 mm x approximately 150 mm
Effective area	0.2 mm²
Transfer factor	1 V/T
Bandwidth (-3 dB)	0 – 35 kHz
Rise time	<3 µs
Linearity error	<0.5 % ±0.2 mT (0 to ±1.5 T, at 23 °C ±1 °C)
Temperature coefficient	max. -0.05 %/K, typ. -0.03 %/K (0 to 50 °C)
Zero drift	max. ±0.020 mT/K, typ. ±0.010 mT/K (DC)
Noise	typ. 25 μT_{RMS} (10 Hz – 10 kHz) typ. 15 μT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +100 °C (only at first 150 mm) +5 °C to +50 °C (grip, cable, probe connector)
Storage temperature	-10 °C to +60 °C
Max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1.5 m

Technical specifications are subject to change without prior notice!

7.2.16 Transverse Probe Brass 200 mT (AS-LTM)

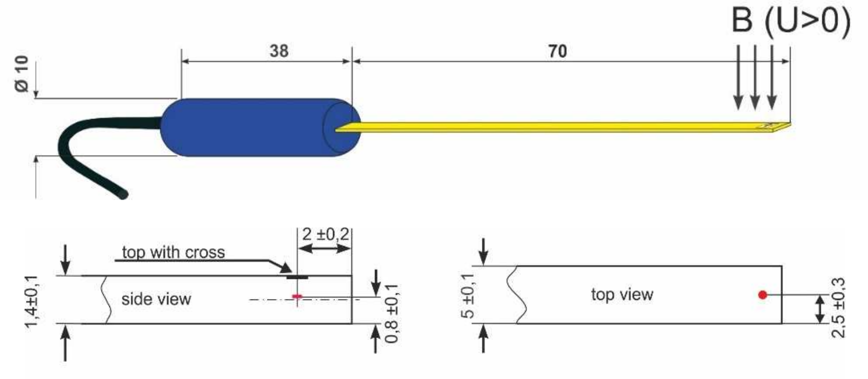


Figure 83 Size transverse probe brass 200 mT (AS-LTM)

Ranges (with FM 302)	±2 mT; ±20 mT; ±200 mT
Stem size (L x W x T)	70 mm x 5 mm x 1.4 ±0.1 mm Brass
Effective area	0.2 mm^2
Transfer factor	10 V/T
Bandwidth (-3 dB)	0 to 10 kHz
Rise time	<30 µs
Linearity error	<0.2 % ±0.1 mT (at 23 °C ±1 °C)
Temperature coefficient	max. -0.05 %/K, typ. -0.03 %/K (0 to 50 °C)
Zero drift	max. ±0.010 mT/K, typ. ±0.005 mT/K (DC)
Noise	typ. 14 µT$_{RMS}$ (10 Hz – 10 kHz) typ. 34 µT$_{PP}$ (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +50 °C
Storage temperature	-10 °C to +60 °C
max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1.5 m

Technical specifications are subject to change without prior notice!

7.2.17 Axial Probe 200 mT (AS-LAP-90)

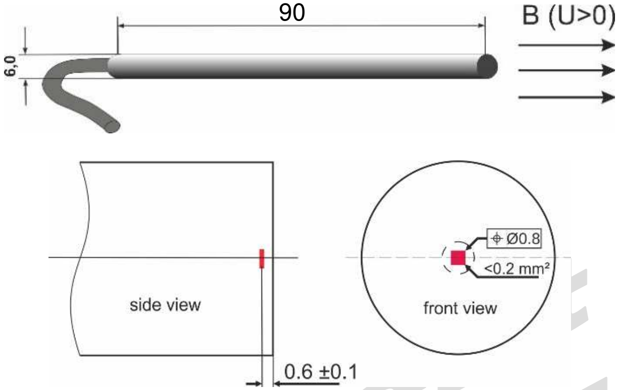


Figure 84 Size axial probe 200 mT (AS-LAP-90)

Ranges (with FM 302)	±2 mT; ±20 mT; ±200 mT
Stem size (L x Ø)	90 mm x 6.0 mm PVC
Front face plate	bronze
Effective area	0.2 mm^2
Transfer factor	10 V/T
Bandwidth (-3 dB)	0 – 10 kHz
Rise time	<30 µs
Linearity error	<0.5 % ±0.1 mT (at 23 °C ±1 °C)
Temperature coefficient	max. -0.05 %/K, typ. -0.03 %/K (0 to 50 °C)
Zero drift	max. ±0.010 mT/K, typ. ±0.005 mT/K (DC)
Noise	typ. 14 µT_{RMS} (10 Hz – 10 kHz) typ. 34 µT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +50 °C
Storage temperature	-10 °C to +60 °C
Max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1.5 m

Technical specifications are subject to change without prior notice!

7.2.18 Transverse Probe 20 mT (AS-VTP)

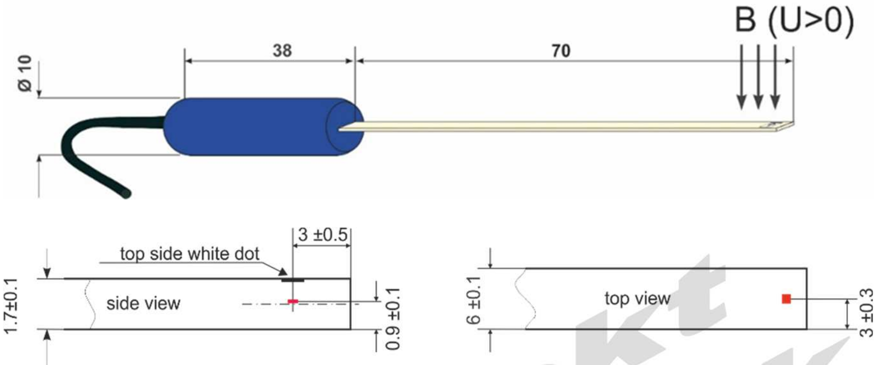


Figure 85 Size transverse probe 20 mT (AS-VTP)

Ranges (with FM 302)	±200 µT; ±2 mT; ±20 mT
Stem size (L x W x T)	70 mm x 6 mm x 1.7 ±0.1 mm GFRP
Effective area	0.02 mm^2
Transfer factor	1 V / 10 mT
Bandwidth (-3 dB)	0 to 1 kHz
Rise time	<300 µs
Linearity error	<0.5 % ±10 µT (at 23 °C ±1 °C)
Temperature coefficient	max. ±0.06 %/K, typ. ±0.03 %/K (0 to 50 °C)
Zero drift	max. ±2 µT/K (DC)
Noise	typ. 5 μT_{RMS} (10 Hz – 1 kHz) typ. 2 μT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +50 °C
Storage temperature	-10 °C to +60 °C
max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1.5 m

Technical specifications are subject to change without prior notice!

7.2.19 Axial Probe 20 mT (AS-VAP-90)

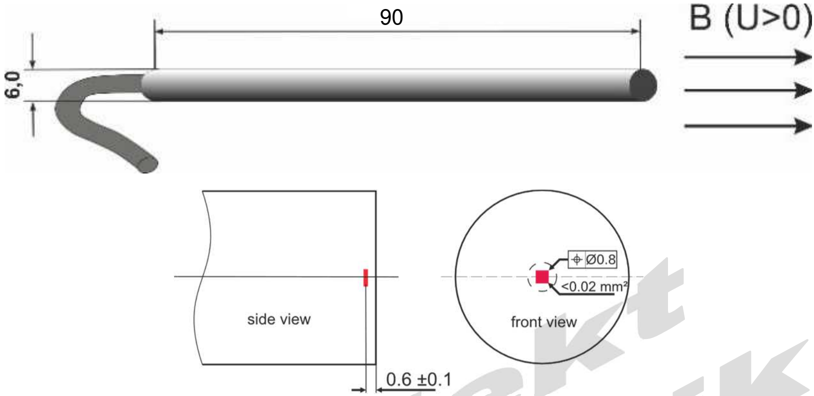


Fig. 1 Axial Probe 20 mT (AS-VAP-90)

Range (with FM 302)	±200 µT; ±2 mT; ±20 mT
Stem size (L x Ø)	90 mm x 6.0 mm PVC
Front face plate	bronze
Effective area	0.02 mm²
Transfer factor	±2 V / ±20 mT
Bandwidth (-3 dB)	0 – 1 kHz
Rise time	<300 µs
Linearity error	<0.5 % ±10 µT (at 23 °C ±1 °C)
Temperature coefficient	max. -0.06 %/K, typ. -0.03 %/K (0 to 50 °C)
Zero drift	max. ±2 µT/K (DC)
Noise	typ. 5 μT_{RMS} (10 Hz – 1 kHz) typ. 3 μT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +50 °C
Storage temperature	-10 °C to +60 °C
Max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1,5 m

Technical specifications are subject to change without prior notice!

7.2.20 GEO-X Axial Probe 200 µT (AS-UAP GEO-X)

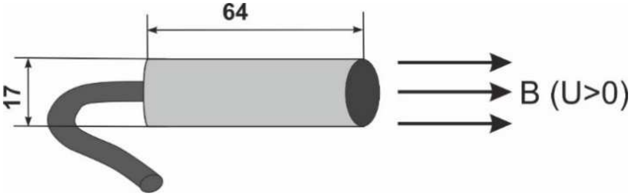


Figure 86 Size GEO-X axial probe 200 µT (AS-UAP GEO-X)

Ranges (with FM 302)	±2 µT; ±20 µT; ±200 µT
Case size (L x Ø)	64 mm x 17 mm
Effective volume	Ø 5 mm x 22 mm
Transfer factor	1 V / 100 µT
Bandwidth (-3 dB)	0 – 500 Hz
Rise time	<0.3 ms
Linearity error	<0.8 % ±0.2 µT (at 23 °C)
Temperature coefficient	max. ±0.1 %/K (10 °C to 50 °C)
Zero drift	max. ±10 nT/K
Hysteresis	max. 0.1 % of value
magnetic flux density	max. ±200 µT or 140 μT_{eff}
Noise	typ. 4,5 nT_{RMS} (10 Hz – 1 kHz) typ. 6 nT_{PP} (DC – 10 Hz, 50 s)
Operation temperature	+5 °C to +50 °C
Storage temperature	-10 °C to +60 °C
Max. relative humidity	70 % at +35 °C
Power	±3 V through FM 302, AS-probe adapter, AS-Adapter 3 or PLC
Connector	15 pol. SubD
Output impedance	<1 Ω
Length of cable	1.5 m

Technical specifications are subject to change without prior notice!

7.3 AS-Probe Adapter

Figure 87 AS-probe adapter

Supply

Supply voltage	9 V – 36 V DC
Power consumption	<1.5 W
Output voltage probe supply	±3 V
Output current probe supply	max. 20 mA

Signal

Gain	switchable x5,x50	
Offset at output	in x5:	<±0.25 mV (at 23°C)
	in x50:	<±2.5 mV (at 23°C)
Zero drift at output	in x5:	<±0.025 mV/K
	in x50:	<±0.25 mV/K
Gain error	typ. ±0.1 %, max. ±0.4 % (DC, at 23°C)	
	typ. ±0.005 %/°C	
Input voltage range	in x5:	±2 V
	in x50	±0.2 V
Input resistance	22 kΩ	
Output voltage	±10 V	
Output current	max. 2 mA to keep specification	
Load resistance	min. 5 kΩ to keep specification	

7. Technical Specifications

Short-circuit proof	yes
Output resistance	<1 Ω
Bandwidth (-3 dB)	100 kHz depends also on the used probe

Isolation

Galvanic isolation	supply – signal: 100VDC, 70VAC with varistor protection

mechanics

Housing	Phoenix COMBICON DIN-rail housing width 20 mm
Operation temperature	+5 °C to +50 °C
Storage temperature	-10 °C to +50 °C

Adapter cable for probe connection:

Connectors	probe side: 15pol SubD female connector adapter side: 4 single wires
Structure	4pol, shielded shield and connector housing connected to analog ground!
Length	5 m

Technical specifications are subject to change without prior notice!

7.4 AS-Adapter 3

Figure 88 AS-Adapter 3

Supply		
Supply voltage		9 V – 36 V DC
Power consumption		max. 3 W
Output voltage probe supply		±3 V
Output current probe supply		max. 60 mA (20mA each probe)
Signal		
Gain		switchable x5,x50
Offset at output X, Y, Z:	in x5:	max ±0.25 mV (at 23°C)
	in x50:	max ±2.5 mV (at 23°C)
Zero drift at output	in x5:	max ±0.025 mV/K
	in x50:	max ±0.25 mV/K
Gain error		typ. ±0.1 %, max. ±0.4 % (DC, at 23°C) typ. ±0.005 %/°C
Input voltage range		in x5: ±2 V in x50 ±0.2 V
Input resistance		22 kΩ
Output voltage		max. ±10 V, at load min. 5 kΩ Short-circuit proof
Output resistance		<1 Ω
Load resistance		min. 5 kΩ to keep specification
Bandwidth (-3 dB)		100 kHz; depends also on used probe

7. Technical Specifications

Isolation

Galvanic isolation	supply – signal: 100VDC, 70VAC With varistor protection Bridge option: PE-GND Bridge option: GND-Case

Mechanics

Case	Alu-Style-Case isolated with bumpers, DIN rail with table feet,
Operating temperature	+5°C bis +50°C
Storage temperature	-10°C bis +65°C
Dimensions	135 x 105 x 53 mm (L x B x H)
Weight (incl. Adapter Cable)	1045 g

Adapter Cable for Probe Connection

For 3x 1-axis AS-Active probe
or 1x 3-achsige AS-Active probe

Connector	3 piece: probe side: 3x15polige SubD socket Adapter side: 3x4 single leads
Setup	4pole, screened screen and socket house to

analog-ground!

Length	5 m

Technical specifications are subject to change without prior notice!

8. Maintenance

8.1 Visual Inspection

Be sure before any measurement that the probe itself, the probe cable, the probe housing, the Teslameter housing, the power adapter and the power cord are undamaged and in a proper safety condition.

Check that the housing shows no cracks.

Check the cables for breakage or chafing.

Check the probe for cracks or similar damage.

Check the power adapter for cracks.

8.2 Checking Battery

To check the battery of the Teslameter FM 302 open the battery compartment on the rear (remove and lift the lid from the instrument). The battery can be removed now.
Check the battery for leaked fluid at regular three-months intervals, but in any case after extended inactivity.
If the battery is low (see section 6.3.1.6 for FM 302), replace it by a fresh 9 V E-block, e.g. Panasonic type 6LR61.

Pay attention to polarity when inserting a new battery!

8.3 Maintaining Accumulators

If the instrument is run with a 9 V block accumulator, it must be checked for leaked fluid at regular monthly intervals, but after extended inactivity at any rate.

☞ **Accumulators have a self-discharge. That means that the accumulator looses charge even if the device is switched off.**

To check the accumulator of the Teslameter FM 302 open the battery compartment on the rear (remove and lift the lid from the instrument). The accumulator can be removed now.

8. Maintenance

If the rechargeable battery is low (see section 6.3.1.6 for FM 302), it have to be recharged using a suitable charger.

Pay attention to polarity when inserting the accumulator!

8.4 Cleaning

Do not use a strong cleaner on the instrument.

Clean the instrument with a soft cloth moistened slightly with soap suds or methylated spirits.

8.5 Warranty Provisions

Projekt Elektronik Mess- und Regelungstechnik GmbH guarantees for the duration of two years after delivery that the device will function dependably.

Warranty repairs occurring within this period will be carried out free of charge.

Violation of the rules set forth in this Operating Manual voids any warranty claims. No responsibility will be assumed for damage resulting from such actions.

The opening of or willful damage to the device will void all warranty claims!

Great care should be used when using movable magnets. Clashing poles can destroy the Hall element!

Since the Hall element (ceramic) is very pressure sensitive, all mechanical stress must be avoided (danger of breakage)!

9. Customer Service

9.1 Calibration

As manufacturer we recommend the regularly recalibration (ca. once per year). We have available the test equipment necessary for this device and have the confirmation about the traceability to national standards (PTB). The confirmation is given with a factory calibration certificate.
If measurements require the linearity curve (see section 6.4.16 Test Curves / Linearity Curves (optional)), it must be re-created during calibration after readjustment. This requirement should be noted in the order.

9.2 Repairs

For repairs send the instrument to the following address:

Projekt Elektronik Mess- und Regelungstechnik GmbH
Am Borsigturm 54 Tel. +49 (0)30 - 43 03 22 40
13507 Berlin Fax +49 (0)30 - 43 03 22 43

9.3 Follow-up Orders

Follow-up orders can be placed at Projekt Elektronik Mess- und Regelungstechnik GmbH by letter, telephone or fax.

9.4 Disposal

Should disposal of the instrument be necessary, it can be returned to

Projekt Elektronik Mess- und Regelungstechnik GmbH
Am Borsigturm 54
13507 Berlin

freight/postage prepaid, together with a declaration of assignment.

Spent batteries or accumulators must not be discarded to general garbage!

Spent batteries or accumulators should be turned over to an approved hazardous waste collection site.

EU Declaration of Conformity

Name of manufacturer	Projekt Elektronik Mess- und Regelungstechnik GmbH
Manufacturer's address	Am Borsigturm 54 D-13507 Berlin Germany Tel.: +49 (0)30 - 43 03 22 40 Fax.: +49 (0)30 - 43 03 22 43 http://www.projekt-elektronik.com Email: info@projekt-elektronik.com
declares that this product	
Teslameter FM 302	Series F827
with AS-active-probes	Series F788, F792 and F797
with AS-probe adapter	Series F852
with AS-Adapter 3	Series F901
Short description	The Teslameter FM 302, AS-probe adapter, AS-Adapter 3 with its AS-active-probes is a measuring instrument for the measurement of the magnetic induction, especially of the static magnetic induction.
under EMC directive	2014 / 30 / EU
and RoHS directive	2011 / 65 / EU
complies with the following standards and/or standardizing documents	EN 61326 – 1:2013
Supplemental information	As to the restrictions regarding EN 61000-4-3 see also Minimum Operation Conditions (EMC) on page 5
Berlin, 11. November 2020	Dipl.-Ing. Hartmut Heinze Managing Director / CE Coordinator

11. Index