3MH6-E TESLAMETER with Interchangeable Hall Probes

DESCRIPTION

Low Noise Teslameter with integrated Hall probe incorporates a high accuracy magnetic field-to-analog-voltage transducer with a high-level, temperature compensated output signal for each of the three components of the measured magnetic flux density: Bx, By and Bz. A digital module is additionally applied to the analog transducer to form the digital Teslameter. Digital Teslameter provides the possibility of automatic data acquisition via a USB serial interface by a host computer. In this way, customers can easily integrate a measurement routine into their measurement system using its programming tools such as C, C++, C#, Python, Delphi, LabVIEW, etc.

The temperature measurement feature allows user to obtain current temperature values while monitoring the magnetic field.

The transducer consists of two modules:

1. Interchangeable Hall probe with various cable length (Module H), and
2. Electronics (Module E).

The Low-Noise Digital Teslameter is a high accuracy, temperature very stabilized device for the precise measurement of magnetic field.

Each Teslameter is calibrated with the individual correction data for the connected probe, so the Hall probe is interchangeable, by keeping the same accuracy of 100ppm.

KEY FEATURES

- Teslameter with integrated C type 3-axis Hall Probe (Bx, By, Bz) and Temperature sensor
- Measurement of DC & AC magnetic fields
- Four selectable magnetic field ranges: 100mT, 500mT, 2T, 20T (calibrated up to 9T)
- Probe interchangeability is ensured
- Very high magnetic DC resolution: better than 1ppm (@2T range: 1µT for perpendicular (By) and 2µT for planar (Bx and Bz) components of magnetic field)
- DC Accuracy: better than 0.01% (100ppm)
- AC Accuracy: see the Table 2. below
- Frequency bandwidth: DC – 2.5kHz (-3dB)
- Selectable sampling rate up to 7.5ks/sec
- High temperature stability: < 20ppm/°C
- 24-bit A/D Convertor
- Auto range, zeroing, hold, Max/Min values
- Triggers internal and external - Single shot, Manual and Continuous
- Interchangeable Hall probes with calibration data stored in an integrated EEPROM
- TFT LCD graphic display (108 x 65mm) for Bx, By, Bz, Btot, and the Th probe temperature
- Numerical, graphical and statistical measurement visualization
- Magnetic vector visualization
- Measured data recording with selectable sampling rate (0.5s - 60s, i.e. 2.5 - 300 days)
- Selectable units in gauss (G) and tesla (T)
- Embedded computer (GUI on Android)
- Remote data acquisition & visualization PC Software runs on Windows 10/7 (over USB device port)

3MH6-E TESLAMETER with Interchangeable Hall Probes
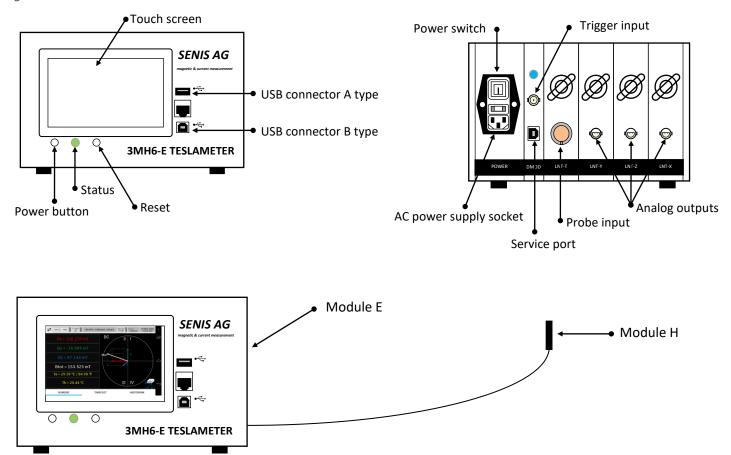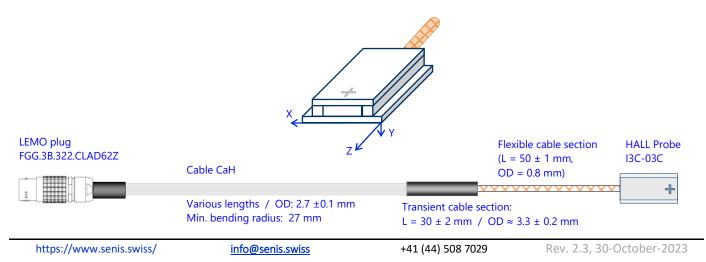
Figure 1: **3MH6-E Teslameter**

Figure 2: **3MH6-E Structure – Module H (Hall Probe of Type C) and Module E (analog and digital electronics)**
Electronic box dimensions (W x H x L): 240 x 150 x 260 mm

HALL PROBE SPECIFICATIONS (Module H):

The Hall Probe of Type C contains a CMOS integrated circuit, three groups of mutually orthogonal Hall elements and a temperature sensor. The integrated Hall elements occupy very small area (100µm x 100µm), which provides very high spatial resolution of the probe.

The output of the Hall Probe are high-level analog voltages proportional to the measured components of a magnetic field and a voltage proportional to the probe temperature for in-electronics compensation of offset and sensitivity temperature drift.

The probe calibration data are stored in an integrated EEPROM allowing for interchangeable.

3MH6-E TESLAMETER with Interchangeable Hall Probes

TOP VIEW:

8.0 ± 0.1

4.00 ± 0.05

FRONT VIEW:

0.90 +0.05/-0.00

0.8 ± 0.1
Min. bending radius: 8 mm

3.00 ± 0.05

0.55 +0.03/-0.00

0.25 ± 0.01

LEFT SIDE: VIEW:

MFSV (100 x 10 x 100 μm³)

0.50 ± 0.05

Figure 3: **Module H, Hall Probe of Type C – Dimensions**

Parameter			
Dimensions	X (mm)	Y (mm)	Z (mm)
Magnetic field sensitive volume (MFSV)	0.10	0.01	0.10
Position of the MFSV centre (Fig. 3)	2.00 ± 0.05	-0.55 -0.05/+0.00	-0.50 ± 0.05
External dimensions of the probe	4.00 + 0.05/-0.00	0.90 +0.05/-0.00	8.0 ± 0.1
Positioning accuracy			
Angular accuracy of the measurement axes of the Hall probe	< ±2° with respect to the reference surface < ±0.2° determined during calibration		
Temperature range			
Operating Temperature range of the Probe	+5°C to +45°C		
Cable properties			
Length:	- Standard: 2 m (H-Module notation: I3C-03C02L) - Option: X m (H-Module notation: I3C-03C0XL)		
Thin cable:	Copper braided flexible cable, OD 0.8 mm		
Conductor:	Silver plated soft copper core, 7 x 44 AWG		
Insulation:	PFA (Perfluoro Alkoxy), diameter 0.30 mm		
Safe cable twisting:	15 x OD Thin (red) cable 10 x OD Thick (white) cable **(minimum for fixed instalation)**		
Shield:	Silver plated soft copper braid		
Jacket:	PFA (Perfluoro Alkoxy)		
Service temperature:	-196 / +200 °C		
Linear resistance:	1.4 Ω/m		
Rated voltage:	150 Vac		
RoHS compliance:	Yes		

Table 1. **C type Hall probe parameters**

3MH6-E TESLAMETER with Interchangeable Hall Probes

MAGNETIC AND ELECTRICAL SPECIFICATIONS:

4 selectable magnetic field measurement ranges:	± 100mT, ±500mT, ±2T, ±20T (calibrated up to ±9T)
DC measuring accuracy:	0.01% (100ppm) of measurement range
Probe Interchangeability:	**available for all 4 Ranges**
Magnetic resolution:	2ppm (24bit A/D conversion)
Frequency bandwidth:	DC – 2.5kHz (-3dB)
Selectable Sampling rate:	10SPS, 30SPS, 50SPS, 60SPS, 100SPS 500SPS, 1kSPS, 2kSPS, 3.75kSPS and 7.5kSPS
Selectable Averaging rate:	1 Sample to 100 Samples
Temperature stability of sensitivity:	±20ppm/°C of reading
External trigger:	*Single Shot* and *Manual* (measurement time interval: 0.1sec to 5min) / *Continuous* (up to 7.5kHz)
Measured data recording:	selectable storage interval 0.5 – 60sec (up to 300 days)

PRELIMINARY FREQUENCY BANDWIDTH vs. RESOLUTION:

Conditions:

- Range: ±2T, Probe cable length: 2m

- Internal Sampling rate: 30ks/s

- Bandwidth: DC to fc(-x), where f(-x) is the B signal frequency at which the measurement error with respect to DC reaches x.

Sampling rate [SPS]	10	30	50	60	100	500	1000	2000	3750	7500
Averaging time [ms]	100	33.333	20	16.667	10	2	1	0.5	0.267	0.133
Resolution [µT rms]	0.8	0.9	1	1.1	1.2	2	2.5	3	4	5
f(-10 ppm) [Hz]	0.03	0.08	0.13	0.15	0.27	1.4	2.6	5	9	10
f(-100 ppm) [Hz]	0.08	0.24	0.39	0.47	0.8	4	8	18	25	30
f(-0.1%) [Hz]	0.25	0.74	1.23	1.48	2.5	12.5	24	50	75	90
f(-1%) [Hz]	0.78	2.34	3.9	4.69	7.8	39	77	155	230	300
f_C(-3 dB) [Hz]	4.4	13.3	22.2	26.5	44	220	434	880	1340	2500

Table 2. **The table shows the combinations of the magnetic signal frequencies, measurement resolutions and bandwidth that are achievable with the 3MH6-E. Displayed values apply to each measurement axis Bx, By and Bz.**

Notations:

Data rate [SPS], samples per second: is the rate with which the measurement data appear at the teslameter's digital output. In the teslameter specifications it is called the **"Selectable sampling rate"** and it goes up to 7.5ks/sec. This is one of the main parameters that a user should select on the teslameter's front panel. Once a data rate is chosen, this will define the Data **Averaging time [ms]** as the inverse of the data rate. For example, if the data rate of 10 samples per second is chosen, then the teslameter will spend 100 milliseconds with averaging the raw measurement results.
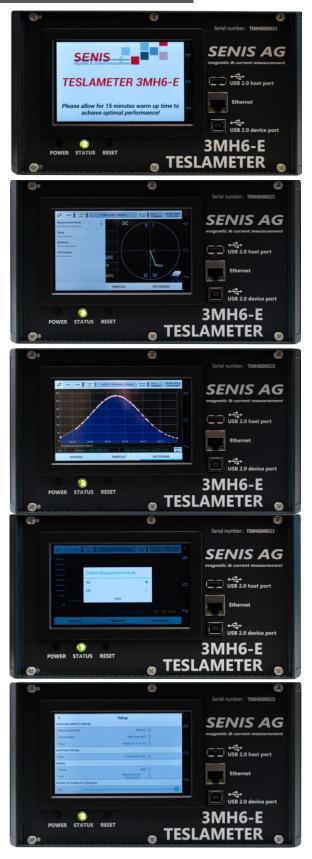
Resolution [µT rms]: The minimal magnetic flux density change that can be detected by 3MH6-E teslameter - for example, if the data rate of 100SPS is chosen, then the measurement resolution will be about 1.2µT(rms).

f(-"x"): These are the frequencies at which the measured signal attenuation with respect to the DC value reach a given value (this, due to various low-pass filtering effects within the Teslameter). For instance, the line "f(-100ppm)" shows that if the data rate is 3.75ks/s, at the signal frequency of 25Hz, the measured B-field amplitude will appear 100ppm lower than its true value.
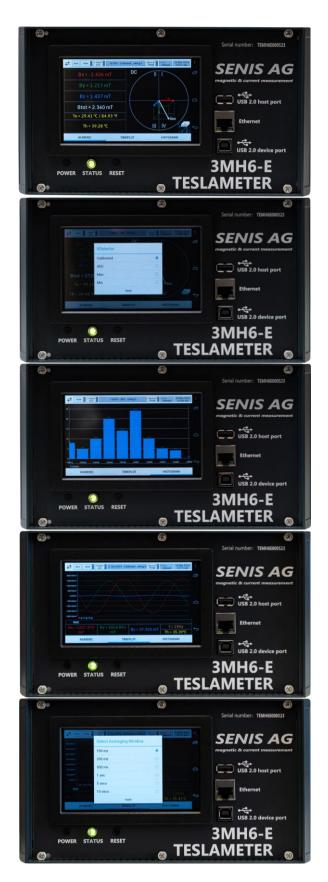
GRAPHICAL USER INTERFACE:

Figure 4: **Visualization Modes (Numeric, Timeplot, Histogram) and Setting possibilities: External/Internal Triggers; Data Recording; Auto range; Zeroing; Min/Max; Hold reading; Sampling Rate; Averaging Rate; Storage interval**