

## 1- KEY SPECIFICATIONS

### 1-1 THREE-AXIS MAGNETOMETERS

#### 1-1-1 Introduction

Metrolab's Three-axis Magnetometers are used to measure magnetic flux density. Simultaneous measurement of all three components of the magnetic field provides the total field no matter the probe's orientation, which significantly facilitates many measurement tasks such as field mapping.



THM1176-LF

Three-axis Hall Magnetometer – Low Field



THM1176-MF

Three-axis Hall Magnetometer – Medium Field



THM1176-HFC

Three-axis Hall Magnetometer – High Field Compact



TFM1186

Three-axis Fluxgate Magnetometer



Laptop connected to THM1176-LF



Tablet connected to THM1176-LF, front and side view



THM1176-MF





THM1176-LF



TFM1186

## 1-1-2 EZMag3D Software

### EZMag3D Software functions:

Windows, macOS, or Linux

Meter mode:

Vector components, magnitude, and oscillations

Numeric, plot, compass, vector, and table displays

Spectrum mode:

Spectral plot of vector components, magnitude or oscillations

Table of spectral peaks

AC Analysis mode:

RMS, Peak-peak, Standard Deviation

Plot, numeric, and table displays

Mapping mode:

Manual or mechanized mapping

Numeric, plot, table, and vector plot display

Exposure limits: graphic overlays and alarms

Control of range, units, trigger, acquisition & display rates, oversampling

Auto-ranging, Hold, Max, and Alarm functions

Zero offset correction

Save and replay from memory or disk

Save and restore settings

Context-sensitive help

## 1-1-3 Measurement

### Data output

Bx, By, Bz (ASCII or binary, single point or array, calibrated or not)

Temperature (uncalibrated) (not available with TFM1186)

Timestamp (167 ns resolution)

### Sample rate:

- Immediate trigger (default)

Approx. 6.8 kSa/s (free-running, until internal buffer is full)

Into internal buffer: 0.36 Sa/s to 5.3 kSa/s (jitter ~ 0.2  $\mu$ s std. dev.)

- Timed trigger

During USB readout: 0.36 Sa/s to 2.3 kSa/s (jitter ~ 1.2  $\mu$ s std. dev.)

Up to approx. 400 Hz (until the internal buffer is full)

<b>- Bus trigger (via USB)</b>	Note: 1 sample = (Bx, By, Bz); Internal buffer size = 4096 samples
<b>Bandwidth</b>	DC to 8 kHz
<b>Interface</b>	USB 2.0, full speed (12 Mbps)
<b>Class / USB driver</b>	USBTMC (USB Test & Measurement Class) / USB488 DFU (Device Firmware Upgrade)
<b>Protocol</b>	IEEE 488.2, SCPI (Standard Commands for Programmable Instruments)
<b>Connector</b>	USB Type-A
<b>Power</b>	USB bus-powered, 4.3 V to 5.25 V 35 mA min (idle, power-saver on), 90 mA max
<b>Wake-up time from power-saver</b>	100 ms
<b>Operating temperature</b>	0°C to +40°C
<b>Storage temperature</b>	-20°C to +60°C
<b>Operating magnetic field</b>	Instrument electronics: 3 T max
<b>Warranty</b>	Two years
<b>Recommended calibration interval</b>	18 months
<b>Certification</b>	CE approved
<b>Maintenance</b>	Firmware and software upgradable by end-user

#### 1-1-4 Definitions of often confused words


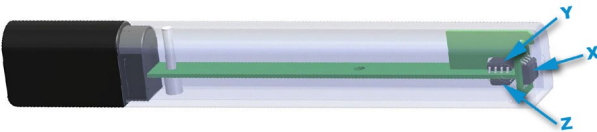
<b>Resolution</b>	Measures the ability of a magnetometer to distinguish ("resolve") two nearly identical field values. Averaging of N measurements improves the resolution by approximately square root (N).
<b>Accuracy</b>	How close a measurement confirms to reality! – i.e. the internationally accepted value in Tesla. The accuracy is given for arbitrary field orientation; typically, it is x10 better along the primary axes.
<b>Precision</b>	How closely multiple measurements will be clustered. Also called reproducibility or repeatability.

## 1-2 THE THM1176 FAMILY, THREE-AXIS HALL MAGNETOMETERS

### 1-2-1 Measurement

**MEASUREMENT PRINCIPLE: HALL EFFECT**

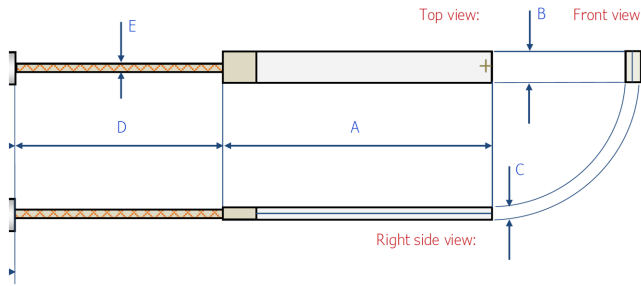
### 1-2-2 THM1176-LF

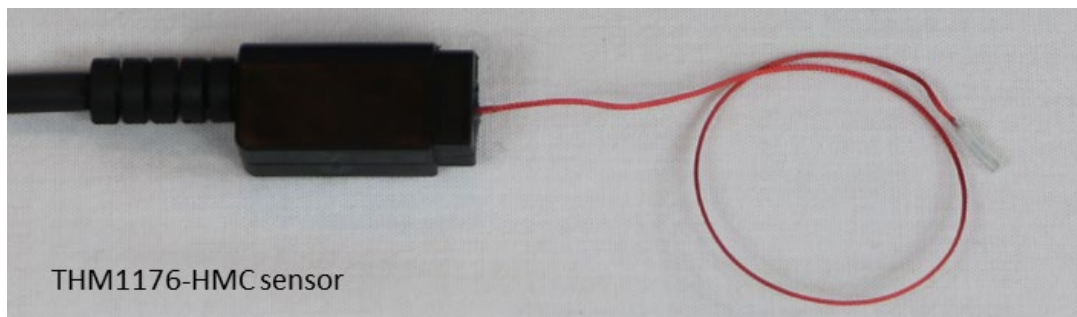
<b>Sensor</b>	Assembly of 3 single-axis Hall sensors, with on-chip flux concentrators Integrated temperature sensor
<b>Ranges</b>	8.0 mT
<b>Units</b>	T, mT, $\mu$ T, G, mG
<b>Calibration range</b>	Up to 8.0 mT
<b>Resolution</b>	2 $\mu$ T
<b>Accuracy</b>	$\pm 20 \mu$ T
<b>Field Sensitive Volume</b>	6 x 3.4 x 3 mm <sup>3</sup>
<b>Dimensions:</b>	
- Instrument electronics	76 x 22.5 x 14 mm <sup>3</sup>
- Probe with housing	113 x 16 x 10 mm <sup>3</sup>
<b>Cable length</b>	3 m, optionally 6 m Note: Includes 1 m of USB cable.
<b>Weight</b>	160 g (3 m cable); 290 g (6 m cable)
<b>Axis orientation</b>	
<b>Sensor locations</b>	

**1-2-3 THM1176-MF**

<b>Sensor</b>	Single-chip 3-axis Hall sensor Integrated temperature sensor
<b>Ranges</b>	100 mT, 300 mT, 1 T, 3 T You should try to use the lower ranges whenever possible; the best is to leave the instrument in auto-ranging mode
<b>Units</b>	T, mT, $\mu$ T, G, kG, MHz p (proton NMR frequency)
<b>Calibration range</b>	Up to 3 T
<b>Resolution</b>	0.1 mT
<b>Accuracy</b>	Up to 1.5 T $\pm 0.5$ % of reading or specified resolution, whichever is greater Above 1.5 T $\pm 1$ % of reading or specified resolution, whichever is greater
<b>Axis orientation relative to the sensor</b>	
<b>Axis orientation relative to the housing</b>	
<b>Field sensitive volume</b>	200 $\mu$ m x 200 $\mu$ m x 5 $\mu$ m
<b>Dimensions:</b> - Instrument electronics - Probe with housing - Probe without housing	76 x 22.5 x 14 mm <sup>3</sup> 113 x 16 x 10 mm <sup>3</sup> 
<b>Cable length</b>	3 m, optionally 6 m Note: Includes 1 m of USB cable
<b>Weight</b>	160 g (3 m cable); 290 g (6 m cable)
<b>Sensor dimensions</b>	"+" marks the center of the field sensitive volume. All dimensions are in mm. Tolerances are $\pm 0.1$ mm PCB length: 17.2 mm 

**1-2-4 THM1176-HFC**

<b>Sensor</b>	Single-chip 3-axis Hall sensor with integrated temperature sensor
<b>Ranges</b>	100 mT, 500 mT, 3T, 20T
<b>Units</b>	T, mT, $\mu$ T, G, kG, MHz p (proton NMR frequency)
<b>Calibration range</b>	The 20 T range is only calibrated up to 1.5 T Use lower ranges whenever possible; best is to stick to auto-ranging mode.
<b>Resolution</b>	0.3 mT
<b>Accuracy</b>	Up to 1.5 T $\pm 0.5$ % of reading or specified resolution, whichever is greater
<b>Location of field sensitive point and axis orientation relative to the sensor</b>	Marked by "+" on the top of the chip. $X = 1.0 \pm 0.1$ mm $Y = -0.25 +0.05/-0.00$ mm $Z = -0.3 \pm 0.05$ mm
<b>Field sensitive volume</b>	150 $\mu$ m x 150 $\mu$ m x 10 $\mu$ m
<b>Dimensions:</b> - Instrument electronics - Probe dimensions	<div> <div> <div>76 x 22.5 x 14 mm<sup>3</sup></div> <div>A = 8.0 <math>\pm</math> 0.2 mm</div> <div>B = 2.0 <math>\pm</math> 0.5 mm</div> <div>C = 0.5 + 0.05/- 0.00 mm</div> <div>D = 50 <math>\pm</math> 1 mm</div> <div>E = <math>\varnothing</math> 0.8 <math>\pm</math> 0.1 mm</div> </div>  </div>
<b>Cable length:</b>	3 m, optionally 6 m Note: Includes 1 m of USB cable.
<b>Weight:</b>	150 g (3 m cable); 280 g (6 m cable)
<b>Small and fragile probe</b>	Be very careful when handling; even the instrument cable's weight is sufficient to damage the probe. Damage to either the sensor package or signal cable will destroy the sensor. We strongly suggest storing the probe in its protective case when not in use.
<b>Electrostatic Discharge (ESD)</b>	The sensor is sensitive to ESD. Be sure to ground yourself and follow the proper procedure when handling the sensor.





## 1-3 THE TFM1186 THREE-AXIS FLUXGATE MAGNETOMETER

### 1-3-1 Measurement

#### MEASUREMENT PRINCIPLE: FLUXGATE

### 1-3-2 TFM1186

<b>Sensor</b>	3-axis fluxgate sensor No temperature sensor
<b>Ranges</b>	100 $\mu$ T (200 $\mu$ T special order)
<b>Units</b>	T, mT, $\mu$ T, nT, G, mG
<b>Calibration range</b>	Up to 100 $\mu$ T Note: recommended every 18 months
<b>Resolution</b>	4 nT
<b>Accuracy</b>	$\pm 0.5\%$ of reading and $\pm 100$ nT
<b>Axis orientation</b>	Printed on the sensor
<b>Field Sensitive Volume</b>	Several mm
<b>Dimensions:</b>	
- Instrument electronics	76 x 22.5 x 14 mm <sup>3</sup>
- Probe housing	70 x 30 x 32 mm <sup>3</sup>
<b>Cable length</b>	3 m Note: Includes 1 m of USB cable.
<b>Weight</b>	310 g

#### Sensor package



## 1-4 PC TABLET HANDHELD KIT (OPTIONAL)

### 1-4-1 System

<b>Dimensions (W x H x D)</b>	208.5 x 150.6 x 27 mm
<b>Weight</b>	520g with battery
<b>IP Rating</b>	IP54
<b>Drop Resistance</b>	1.2m
<b>Regulatory</b>	CE
<b>CPU</b>	Intel® Atom™ x5-Z8350 Processor (2M Cache, up to 1.84 GHz)
<b>Graphic</b>	Intel® HD Graphic Chipset
<b>OS</b>	Windows 10 Enterprise 2016 LTSB
<b>Memory</b>	2GB DDR3L / 4GB DDR3L
<b>Storage</b>	64GB eMMC
<b>Audio</b>	1 x integrated microphone 2 x 0.5W integrated stereo speaker 1 x 3.5mm headphone jack

### 1-4-2 Peripherals and Devices

<b>Camera</b>	Front: 2.0 MP camera Rear: 8.0 MP camera with autofocus
<b>Sensor</b>	Gyroscope, E-compass, light sensor
<b>WLAN</b>	IEEE 802.11 a/b/g/n/ac
<b>Bluetooth</b>	Bluetooth® 4.1
<b>NFC</b>	ISO 14443A/B, ISO15693 (On back cover)
<b>Display</b>	8" TFT LCD (4:3) 1024 x 768
<b>Touch screen</b>	10-point Projected Capacitive Touch w/ Corning® Gorilla® Glass
<b>Tablet I/O Interface</b>	1 x Micro USB 2.0 port (OTG support) 1 x microSD card slot

### 1-4-3 Tablet battery consumption and power supply

<b>Operating Mode</b>	3.5 hours (continuously playing YouTube video)
<b>Standby Mode</b>	29 to 33 hours
<b>Battery Type</b>	Lithium-ion rechargeable battery

**Battery Capacity** 3.8V, 4000mAh

**Operating Temp.** -10°C to 45°C

**Storage Temp.** -20°C to 60°C

**1-4-4 Accessories included in handheld kit**

**Charging Temp.** 0°C to 40°C



Hand strap



Pistol grip w/ 8000mAh power bank and power status LED



Tablet connected to THM1176-LF; front view



Tablet and pistol grip connected to THM1176-LF, side view



Tablet and handstrap, back view

**1-5 WARRANTY, CALIBRATION, CERTIFICATION AND MAINTENANCE**

<b>Warranty</b>	2 years
<b>Recommended calibration interval:</b>	18 months (3-Axis Hall Probe only)
	Note that for logistical reasons, Metrolab recalibrates the THM1176 in batches. Four weeks in the year are fixed to perform batch calibrations:
	Week 10, Week 24, Week 37, Week 48
	To benefit from the discounted pricing for this batch operation, you must ensure that your instrument arrives at Metrolab the week before.
<b>Certification:</b>	CE approved
<b>Maintenance:</b>	Firmware and software upgradable by end user