Fields at Work GmbH, Hegibachstrasse 41, 8032 Zürich, Schweiz
Tel. +41 (44) 382 38 31
info@fieldsatwork.ch
www.fieldsatwork.ch

ExpoM - ELF

Magnetometer and Data Logger

3-Axis; DC – 100 kHz

Applications

- Tracking personal exposure to Extremely Low Frequency magnetic fields
- Long-term monitoring at home and at work
- Monitoring of magnetic field generated by power lines and transformers

Key Features

- Frequency range: DC to 100 kHz (continuous)
- Time domain magnetic field measurements
- High sensitivity: <5 nT/$\sqrt{\text{Hz}}$
- Three-Axis sensor for accurate and orientation independent measurements
- Large dynamic range: > 100 dB
- High field strength mode up to ±45 mT
- Smartphone App with real-time data streaming
- Built-in GPS with data export to Google Earth
- Integrated data logger (> 250k measurements)
- Easy to use, light weight (300g) and small size (16 x 8 x 3.5 cm)

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Specifications

1. Frequency Bands and Measurement Range

Detection method	Time-domain sampling (4096 samples) with digital processing and filtering
Sensors	Tree axis TMR sensor; Hall sensors
Measurement interval	User-selectable; from 4 seconds to 6000 seconds in steps of 0.25 second

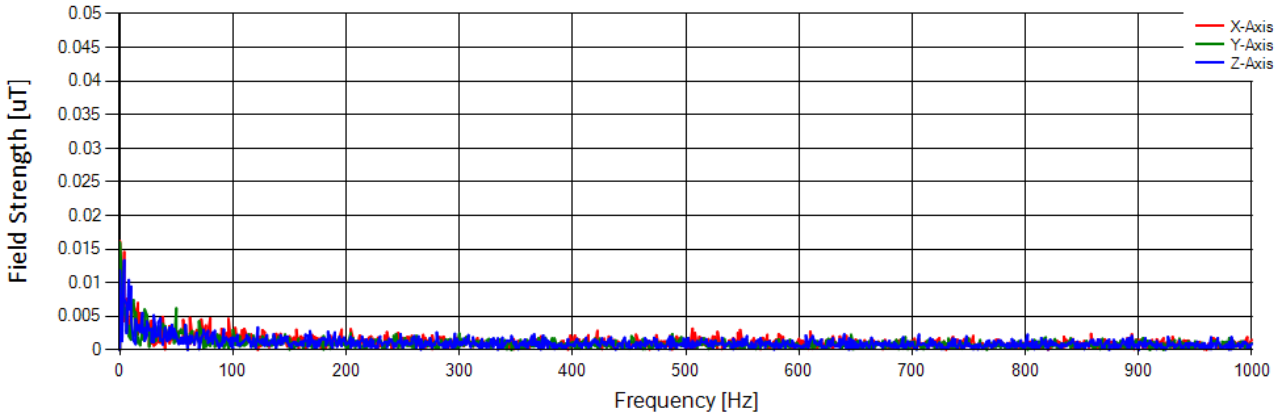
2. Bandwidth, Resolution, Measurement Range

The measurement range of the device is subdivided into four bands: Three high sensitivity ranges with variable frequency resolution cover the frequency range from DC to 1 kHz, 10 kHz, and 100 kHz, respectively. An additional high field strength mode allows measurement up to 30 mT (RMS) from DC to 1 kHz.

Band Name	Bandwidth	Resolution Bandwidth	Maximum Field Strength
LF (high resolution)	DC – 1 kHz	1 Hz	1000 µT RMS (±1500 µT peak)
MF	DC – 10 kHz	10 Hz	1000 µT RMS (±1500 µT peak)
HF (high bandwidth)	DC – 100 kHz	100 Hz	1000 µT RMS (±1500 µT peak)
High-B	DC – 1 kHz	1 Hz	30 mT RMS (±45 mT peak)

3. Sensitivity

Band	Frequency Range	Spectral Noise Density	
LF, MF, HF Band	16 Hz - 150 Hz	< 5 nT /$\sqrt{\text{Hz}}$	(see noise floor spectra below)
LF, MF, HF Band	150 Hz – 100 kHz	< 2 nT /$\sqrt{\text{Hz}}$	(see noise floor spectra below)
High-B Band	DC – 1 kHz	< 0.2 µT/$\sqrt{\text{Hz}}$	(see noise floor spectra below)



Typical noise floor: LF band (DC – 1 kHz)

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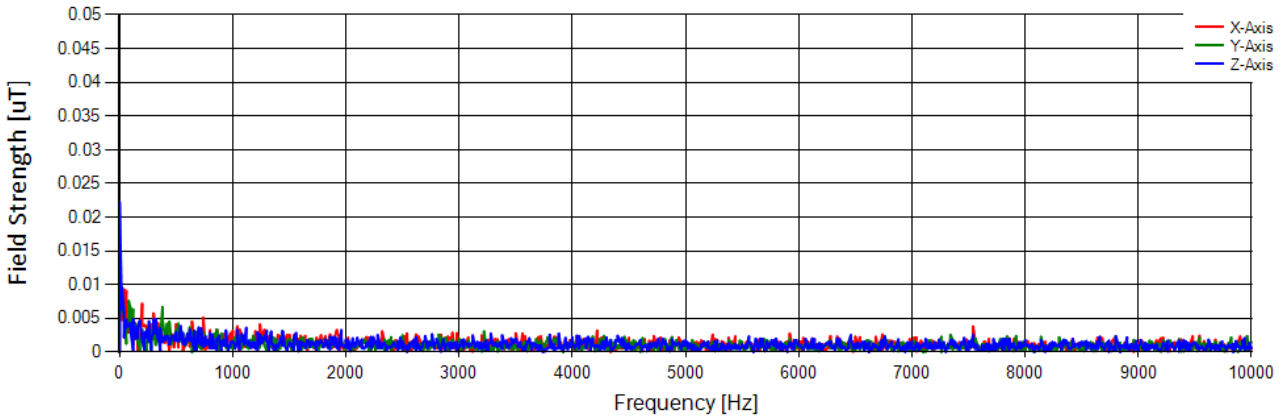
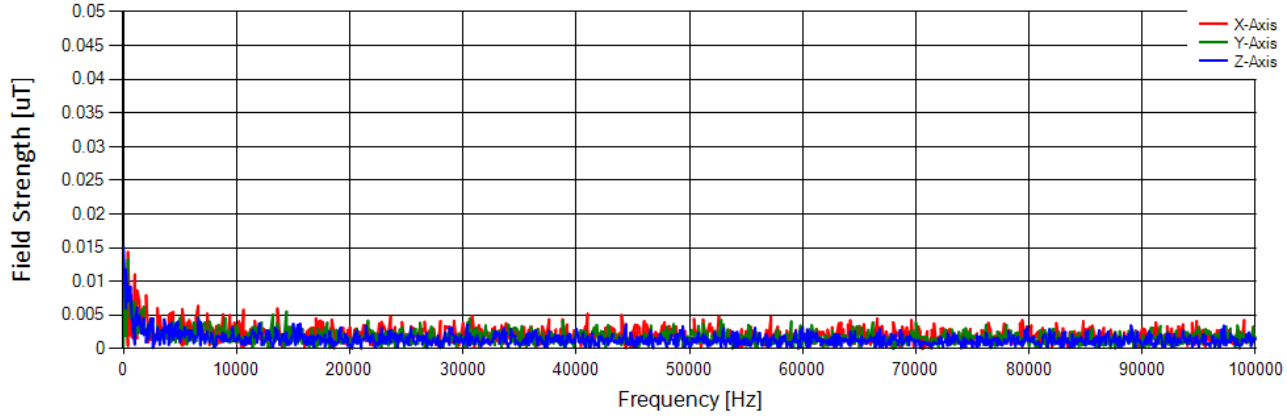
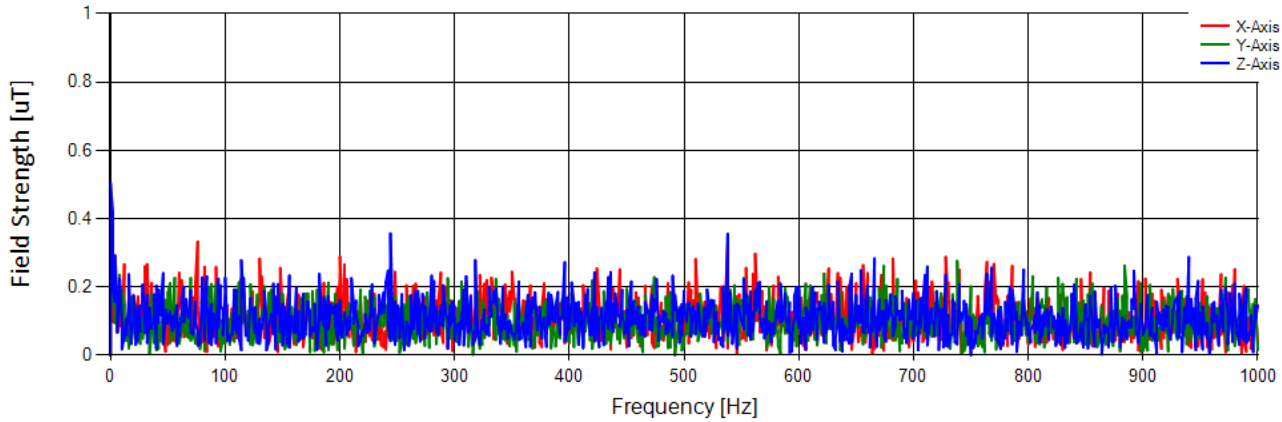


Typical noise floor: MF band (DC – 10 kHz)



Typical noise floor: HF band (DC – 100 kHz)



Typical noise floor: High-B band (DC – 1 kHz)

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4. Accuracy and Drift

Band	Basic Accuracy 25°C ±10°C	Typical DC Offset 25°C ±10°C	Temperature Drift 0°C to +50°C	Axis Crosstalk
LF	± 3%	± 5 µT	Sensitivity: 0.1% / °C DC Offset: <0.8 µT / °C	< 30 dB
MF	± 3%	± 5 µT		< 25 dB
HF	± 3%	± 5 µT		< 10 dB
High-B	± 3%	± 0.05 mT	Sensitivity: 0.05% / °C Offset: <2.5 µT / °C	< 25 dB

Note: Exposing the device to very strong DC magnetic fields (e.g. large Neodymium magnet) may cause a permanent shift of the zero field DC offset (can be corrected by re-calibration).

5. Linearity (DC & AC)

DC linearity: < 1% (typ. maximum relative deviation) within the specified measurement range

Total Harmonic Distortion	Band	Test Condition
< -45 dB	LF Band	100 µT RMS; Sinusoidal field at f = 100 Hz
< -45 dB	MF Band	100 µT RMS; Sinusoidal field at f = 1 kHz
< -45 dB	HF Band	100 µT RMS; Sinusoidal field at f = 10 kHz
< -45 dB	High-B Band	1 mT RMS; Sinusoidal field at f = 100 Hz

6. Automatic Data Logging

All measurements performed with the device are automatically stored to the internal memory. The device can be configured to take a measurement on one or multiple bands (see section 2) within one measurement interval. If multiple bands are selected it may be necessary to increase the measurement interval. The recommended minimum measurement interval settings are given in the following table (Table 1).

Measurement Settings	GPS ON	GPS OFF
One band	4 seconds	4 seconds
Two bands	5 seconds	4 seconds
Three bands	6 seconds	5 seconds
All bands (LF + MF + HF + High-B)	7 seconds	6 seconds

Table 1: Recommended minimum measurement interval

Selecting a measurement interval shorter than the recommended value may lead to individual samples being taken at irregular (i.e. longer than expected) time intervals.

7. Calibration

The factory calibration includes amplitude, DC offset, and frequency response at 10 points per decade. The recommended calibration interval is 1 - 2 years depending on the intensity of use.

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8. Connectivity and Data Management

Time	Integrated precision (± 2 ppm) real time clock
Connectivity	USB interface (Micro-USB), Wi-Fi (802.11b/g/n), GPS/GLONASS receiver
Marker	Built-in marker button to highlight specific events
Storage	Internal data logger memory for >250'000 measurements

9. Device Movement detection

An integrated 3-Axis gyroscope and accelerometer (IMU) allows for device movement detection and earth magnetic field artifact identification.

10. Battery Management

Battery	Built-in rechargeable Li-ion battery
Typical operating time	> 24h (10 sec measurement interval, GPS disabled)
Charging	Micro-USB interface USB compliant chargers are supported (≥ 1.5A recommended) A full charge takes 2-3 h.

11. Other

Size	16 cm x 8 cm x 3.5 cm (L x W x H)
Weight	300 g
Operating Conditions	Temperature: -5°C to +50°C (charging battery above +40°C must be avoided) Rel. humidity: 0% to 90% (non-condensing)
Case protection	IP64

12. ExpoM-RF Utility Software

Processor	Dual core processor recommended
Operating Systems	64-bit Windows 7, 8, 10; (32-bit software version available upon request)
Memory	4 GB RAM (8-16 GB recommended for large measurement files)
License	No license required; free download: www.fieldsatwork.ch/downloads

13. Smartphone App

Operating System	Android (Version 4.1 "Jelly Bean" or newer)
License	No license required; free download: www.fieldsatwork.ch/downloads

14. Scope of Delivery

- ExpoM - ELF Magnetometer Device
- Hardcase
- USB cable
- Software – Free download for Windows (Windows 7 and higher)