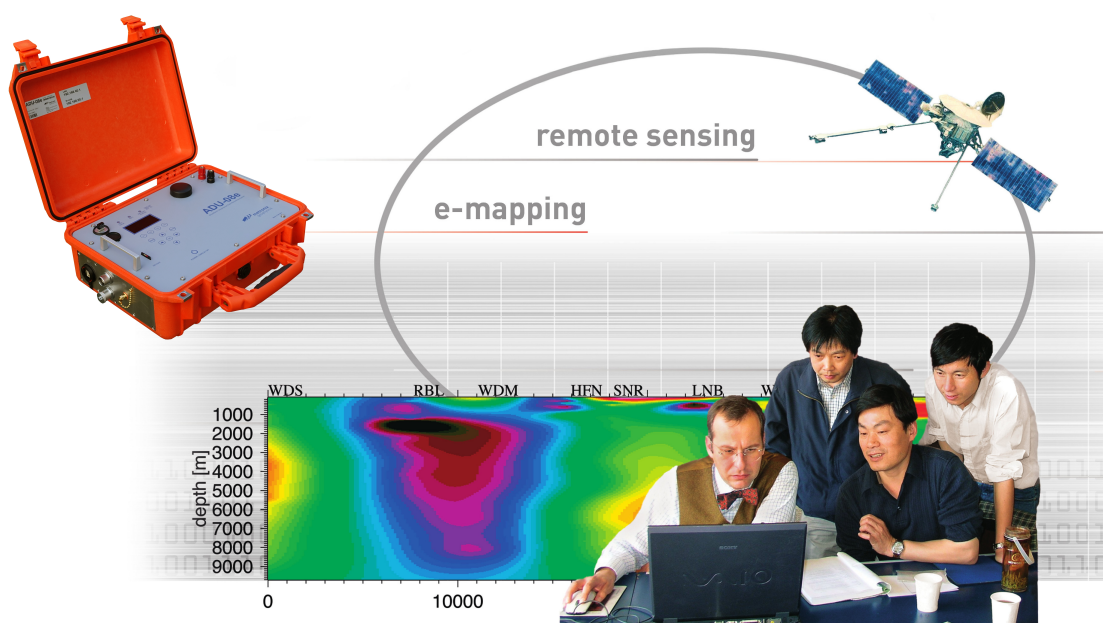


METRONIX GEOPHYSICS



Magnetotellurics, CSAMT

- ▶ Remote Control
- ▶ Integrated Web-Server
- ▶ Remote File Access
- ▶ Linux Operating System

Linux® is a registered trademark of L. Torvalds

World, Germany

Metronix

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www.metronix.de/geo

China

BOST Beijing Ohualian Science and Technology LTD

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www.ouhualian.com

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D-3, Mohit House, SC-II

Mansarovar Garden

New Delhi 110 015, India

Japan

Geothermal Energy Research &Development (GERD) Co., LTD.

Shinkawa Nittei Annex Bldg., 22-4, Shinkawa 1-Chome,

Chuo-ku, Tokyo 104-0033, Japan.

www.gerd.co.jp

Indonesia

PT. Andalan Tunas Mandiri

Jl. Raya Penggilingan Aneka Elok A2/16

Cakung, Jakarta Timur 13940, Indonesia

<http://ptandalan.com/>

Chile

Geoexploration

Luis Thayer Ojeda Norte 0191, Of. 1204

Providencia. Santiago, Chile

www.geo-exploration.com/

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KayaC Yerbilimleri ve Tasarım Ltd.

Üsküp Caddesi 16/28 06900

Çankaya- Ankara

Turkey

www.kayac.com.tr

Mexico

Geotem Ingenieria,S.A. de C.V.

Alhelí Mz. 7 Lt13A, Col. Ejidos San Pedro Martir

Tlalpan, México, D.F. C.P. 14640,

www.geotem.com.mx

Taiwan

All-Star Technology Corporation

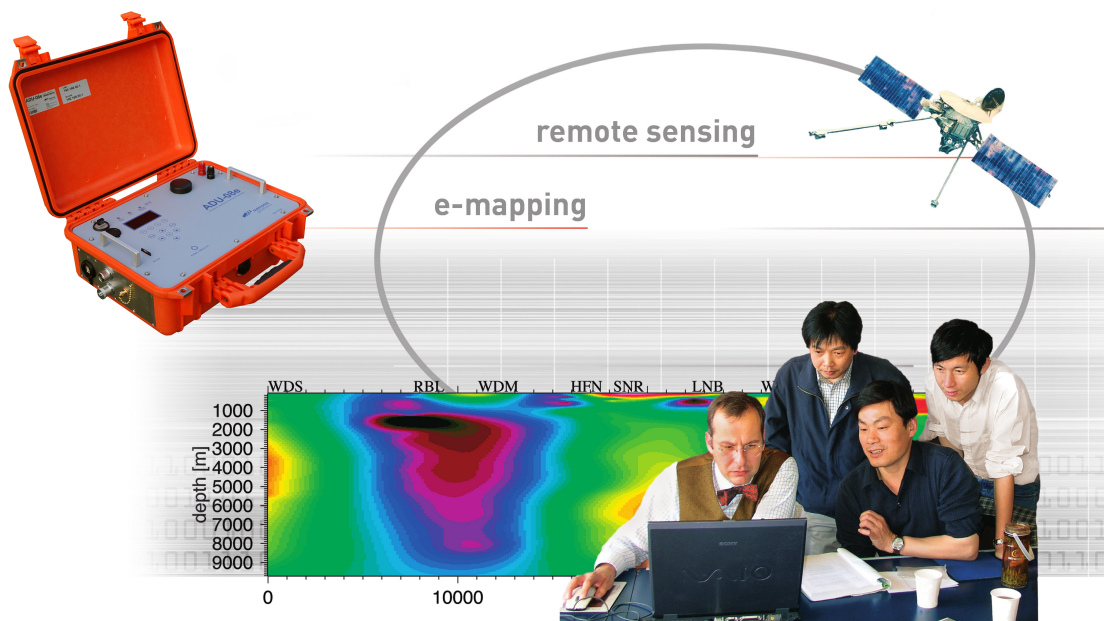
1F, No. 36, ChengGong Road

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Metronix

Metronix is a medium sized company in Germany with an excellent engineering department and a long tradition in geophysics and since thirty years also in manufacturing and designing of servo drives and computer controlled systems.



We are working user orientated and use the chance to provide special solutions to our customers.

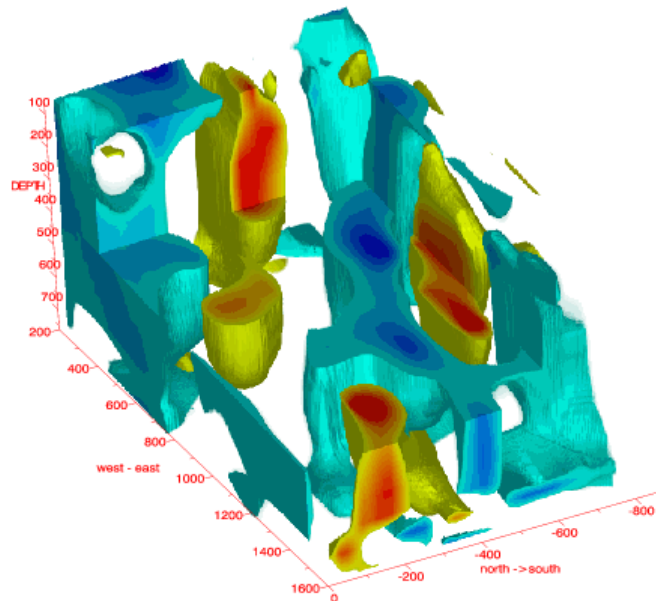
After all these years our philosophy is to provide products with open interfaces; we do not try to bind the customer by making proprietary interfaces. Our products are world class and the relation to our customers is close - a simple recipe which does not need some "extra salt"

Electromagnetic Exploration

Electromagnetic exploration – here magnetotellurics MT and transient electromagnetic TEM – are used for defining targets such as:

- minerals (copper, zinc, ore, iron, etc)
- water (fresh, salt water, water pollution, aquifers, water tables)
- geothermal reservoirs
- oil and gas
- coal
- and everything else which differs in conductivity from its host rock

3D display of
a mining area.
Data recorded with
controlled source.



For local studies in addition CSAMT can be used. Advantages are:

- high resolution data
- no problems with AMT gap (3 kHz to 1 kHz frequency range)
- recordings in noisy area possible (near villages for example)

ADU-08e

24(HF) / 32(LF)-Bit Geophysical EM Measurement System

As in seismics, technological advances in electromagnetic recording systems have emphasised the requirement for simultaneous multi-channel data acquisition.

The Multi-Method Network Geophysical Measurement System ADU-08e is the result of over 40 years of metronix's experience in the design and manufacture of electromagnetic geophysical instruments. The electric and/or magnetic field sensors are connected directly to the ADU-08e (**A**nalog/**D**igital Signal Conditioning **U**nit), which is the core unit of this system. Multiple ADU-08e units can be connected to a network using simple, light-weight and inexpensive network cable or WiFi.

Each ADU-08e can be operated as a stand alone system, in a network or as part of an array in which each unit is synchronized by its in-built GPS clock.

Hardware

The ADU-08e electronics are housed in a small waterproof box only 7kg in weight. It comprises the complete circuitry for analog signal conditioning, 24/32 Bit A/D conversion and data storage. A very precise GPS-controlled time base guarantees synchronous recordings even under difficult GPS reception conditions.

The ADU-08e can be tailored according to the user's requirements.

The ADU contains 6 slots which can be equipped with different types of A/D converter boards. The A/D converter type broadband is optimized for lower frequency recordings in a range from DC up to 1024 Hz with 32 bit precision whilst the signal range from 1 Hz up to 250 kHz is measured with 24 bit precision. The 6th slot can contain an autonomous 5 channel module: a fluxgate sensor can be connected for low-frequency sounding and induction coils cover the higher frequency range simultaneously.

ADU-08e



Features

- High data quality due to 24/32 Bit Analog/Digital conversion technology
- Can be operated as a stand alone or as a multi-channel network system when connecting multiple ADU-08e in a Local Area Network (LAN, WiFi)
- Multiple stand alone systems are synchronized with GPS clock accuracy
- Compatible with all metronix sensors
- Automatic unattended recording mode
- Automated system self check of ADU-08e and sensors during set up
- Automatic input offset compensation eliminates self potential of electrodes
- Realtime display of time series and spectra
- Automatic determination of best setup of gains and filters on site
- 12 V battery powered. Only a single battery is required for each ADU incl. sensors
- Compact, light-weight, ruggedized and water-proof instrument design
- Wide operating temperature range from -30° C to +50° C

Software

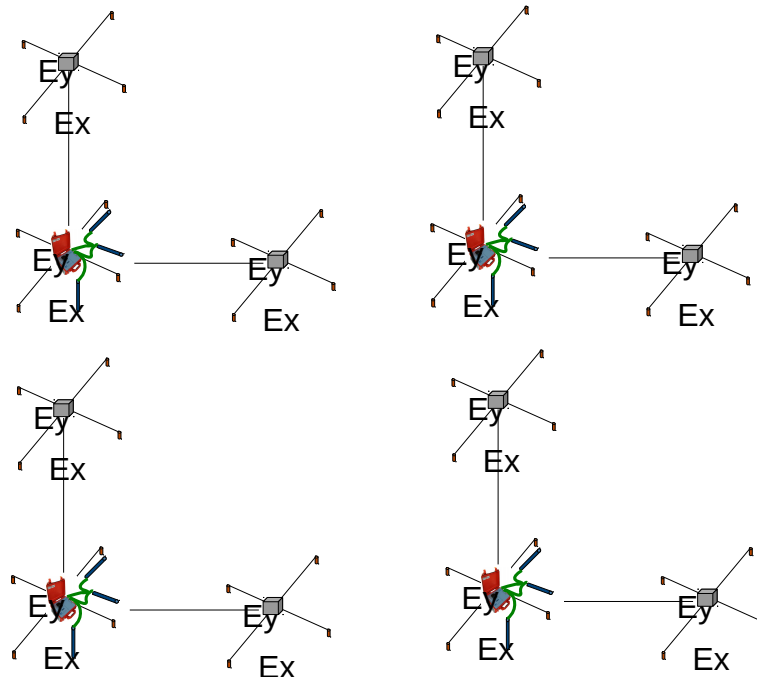
The ADU-08e has a built-in web server. All necessary setups to run a measurement are controlled by the web interface and can be accessed by any web browser; no software needs to be installed on your laptop or tablet. Additionally the system can be controlled by easy to use *Android / iOS* mobile app.

The software ProcMT (free) performs standard and remote reference processing of the time series data using robust algorithms. Online processing inside the ADU-08e with unattended data publishing on the ADU's web server is available.

Using an external GPS controlled transmitter the ADU-08e provides CSAMT / CSEM recordings with real-time stacking.

Cluster MT

Together with the 2 channel ADU-08e contiguous EMAP measurements can be realized.



ADU-08e data sheet

Sample rates	256 Hz to 524 kHz; lower 8, 64 Hz by online filtering
Number of channels	1 up to 10 per ADU-08e (5 broadband, 5 multi purpose)
Bands	Free choice of recording frequencies
A/D conversion	32 Bit (max. data rate 4096 samples/sec) LF mode 24 Bit (max. data rate 524,288 samples/sec) HF mode
Dynamic range	> 130 dB
System controller	32 bit embedded controller with 4 CPU cores, Linux® System
Storage media	Pluggable SD card 32GB, max. 128GB; USB devices
Test facilities	Automatic power up self test of all important system functions including sensors, and display of results on the instrument.
Calibration	Automatic calibration of all channels
E-field connector	input resistance > 10 MOhm, ODU G32KON-T06QP00-000 (ADU E socket) ODU S22KON-T06MPL0-4000 (E-Field cable plug)
H-field connector	input resistance 20 kOhm, socket ODU G32KON-T10QJ00-000 (ADU H socket) ODU S22KON-T10MJG0-7000 (H-Field cable plug)
Multipurpose connector (E/H)	input resistance > 10 MOhm (E), 20 kOhm (H) ODU G33KON-T30QF00-000 (ADU socket) ODU S23KOC-T30MFG0-7000 (cable plug)
Network connection	standard 1 Gbit Twisted Pair RJ45, USB 2.0, WiFi
Synchronization	GPS + GLONASS + Galileo clock +/- 30ns to satellite reference. Station position is also determined and stored
Interfaces	network, magnetometers, E-field lines, 3 battery inputs, GPS antenna, USB, WiFi
Case	ruggedized, waterproof polycarbonate case
Weight	appr. 7 kg
External dimensions	400 x 330 x 170 mm
Power consumption	Approx. 5W @ max. sample rate 4096Hz (LF mode) Approx. 12W @ higher sampling rates (HF-mode)
Operating temperature range	-30°C to + 50°C ambient temperature

Metronix Sensors

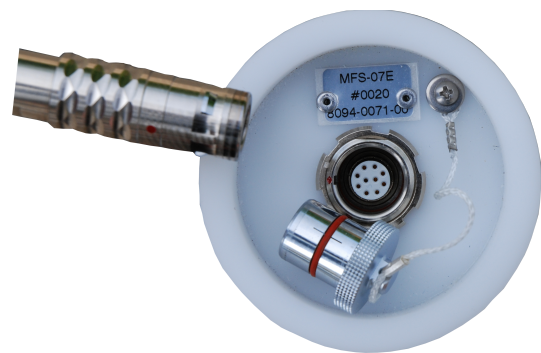
Our inductions coils are most famous in the world.

1976 we started a new design with integrated preamplifiers and reduced size.

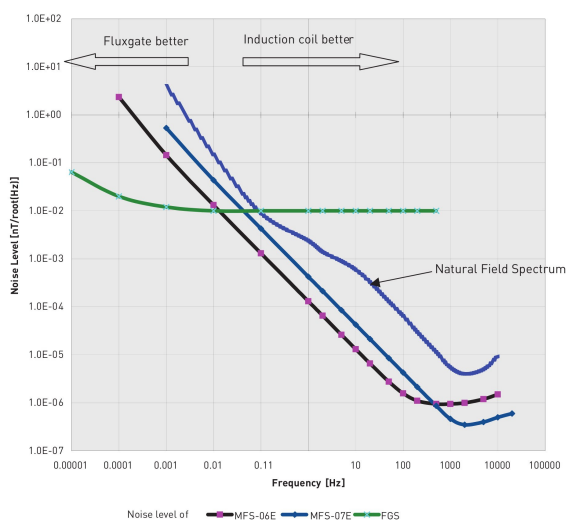
Today we are offering the first sensors which store their calibration data inside the coil on a chip. Together with the digital bus interface the coil is recognized by the data logger and the transfer functions are loaded automatically.

With this option Metronix offers the first MT system with full auto-detection:

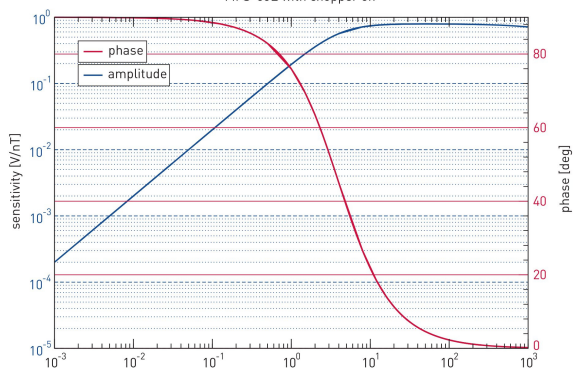
- plug and play of the boards the system detects and calibrates the boards automatically
- plug and play of the MFS, FGS and SHFT sensors
- automated load of calibration data from the coil
- stable calibration for many years



Noise Level MFS-06E, MFS-07E and F6S
(Equivalent Magnetic Field Noise)



Sensitivity and Phase
MFS-06E with chopper on

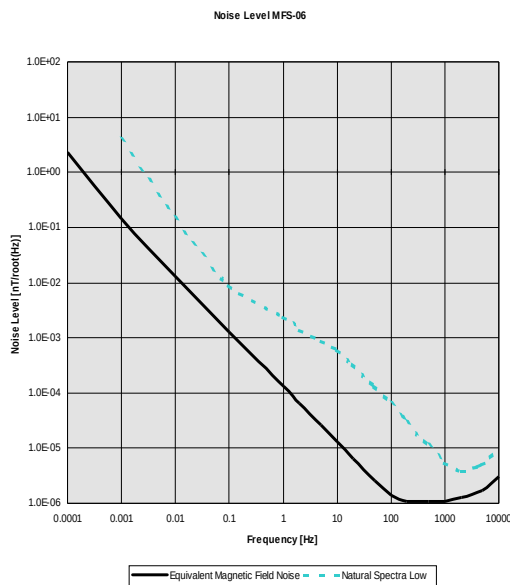


- ▶ Ultra low noise induction coils
- ▶ Chopper stabilized output
- ▶ Integrated feedback coil
- ▶ Calibration winding included

MFS-06e

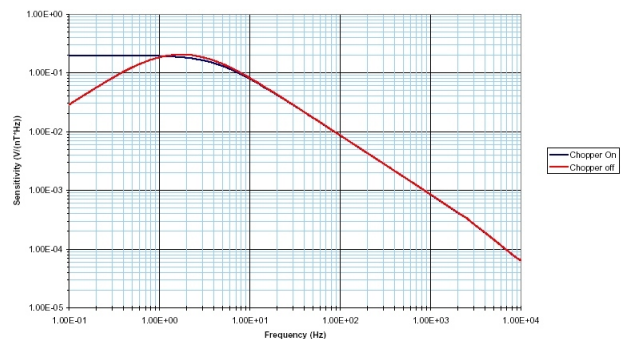
Broad Band Induction Coil Magnetometer

The broadband induction coil magnetometer MFS-06e has been developed to measure variations of the Earth's magnetic field, particularly for applications in Magnetotellurics (MT) and Controlled Source Audio Magnetotellurics (CSAMT). It covers a wide frequency range from 0.0001 Hz up to 10 kHz. In spite of its wide bandwidth, the MFS-06e shows outstanding low-noise characteristics, extremely low temperature drift of input offset voltage and offset current and a very stable transfer function over temperature and time.



Metronix takes special care of the initial calibration of all MFS-06e magnetometers as part of the ISO 9001 certified production process. Tests have demonstrated an excellent long time stability of the transfer function.

The integrated calibration facility makes it easy for the user to perform an online calibration or test of the coil.



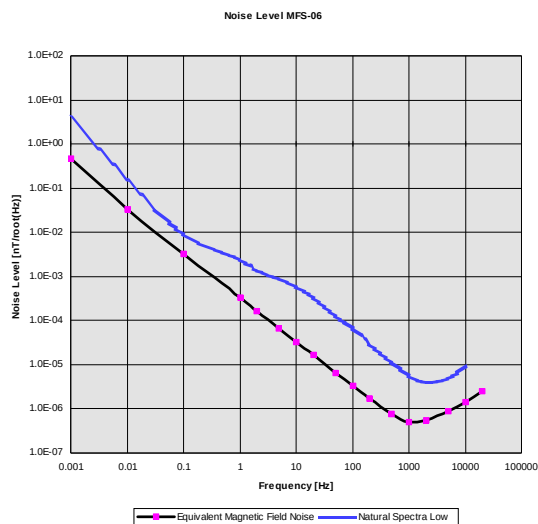
Technical data:

Frequency range	0.00025 Hz 10 kHz	
Frequency bands	0.00025 Hz 10 Hz	500 Hz (chopper on) 10 kHz (chopper off)
Sensor noise	1.1 * 10 ⁻² nT/√Hz 1.1 * 10 ⁻⁴ nT/√Hz 1.0 * 10 ⁻⁶ nT/√Hz	@ 0.01 Hz @ 1 Hz @ 1000 Hz (chopper off)
Output sensitivity	0.2 V / (nT*Hz) 0.8 V / nT for exact values refer to individual calibration file	f << 4 Hz f >> 4 Hz
Output voltage range	+/- 10V	
Function	Induction coil with magnetic field feed back	
Connector	ODU G32KON-T10QJ00-000 (coil socket) ODU S22KON-T10MJG0-7000 (cable plug)	
Calibration input sensitivity	4 nT / V	
Feedback cut-off frequency	4 Hz	
Supply voltage	+/- 12V to +/- 15V stabilized and filtered	
Supply current	+/- 25mA	
Case	ruggedized, waterproof case	
Weight	appr. 8.0 kg	
External dimensions	length 1140 mm, Ø 75mm	
Operating temperature range	-25°C + 70°C	

MFS-07e

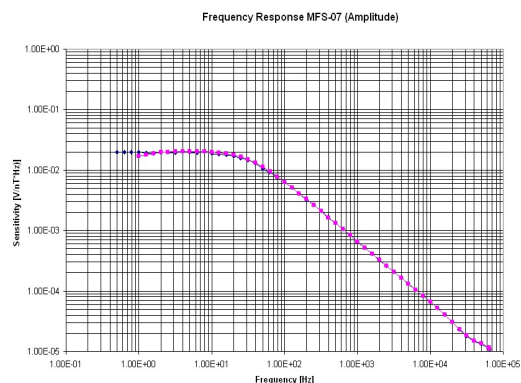
High-Frequency Induction Coil Magnetometer

The high-frequency induction coil magnetometer MFS-07e has been developed for applications in Audio Magnetotellurics (AMT) and Controlled Source Audio Magnetotellurics (CSAMT). Nevertheless, it covers a wide frequency range from 0.001 Hz up to 50 kHz and can also be used for standard MT applications. The MFS-07e shows outstanding low-noise characteristics, very low temperature drift of input offset voltage and offset current and a very stable transfer function over temperature and time.



Metronix takes special care of the initial calibration of all MFS-07e magnetometers as part of the ISO 9001 certified production process. Tests have demonstrated an excellent long time stability of the transfer function.

The integrated calibration facility makes it easy for the user to perform an online calibration or test of the coil.



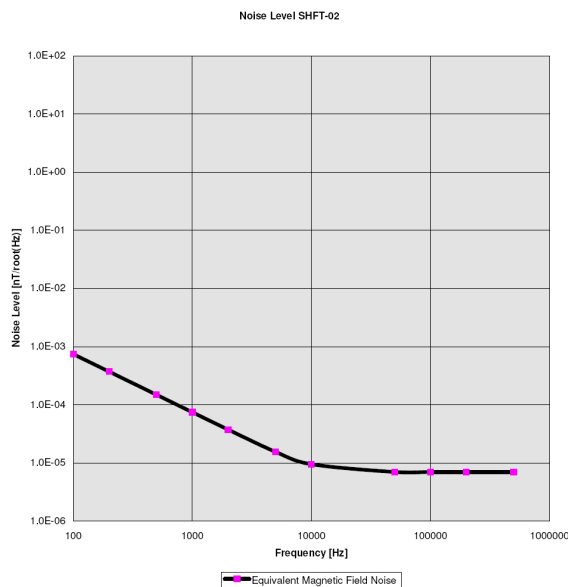
Technical data:

Frequency range	0.001 Hz 50 kHz	
Frequency bands	0.001 Hz 10 Hz	500 Hz (chopper on) 50 kHz (chopper off)
Sensor noise	3 * 10 ⁻² nT/√Hz 3 * 10 ⁻⁴ nT/√Hz 5 * 10 ⁻⁷ nT/√Hz	@ 0.01 Hz @ 1 Hz @ 1000 Hz (chopper off)
Output sensitivity	0.02 V / (nT*Hz) 0.64 V / nT for exact values refer to individual calibration file	f << 32 Hz f >> 32 Hz
Output voltage range	+/- 10V	
Function	Induction coil with magnetic field feed back	
Connector	ODU G32KON-T10QJ00-000 (coil socket) ODU S22KON-T10MJG0-7000 (cable plug)	
Calibration input sensitivity	1.6 nT / V	
Feedback cut-off frequency	32 Hz	
Supply voltage	+/- 12V to +/- 15V stabilized and filtered	
Supply current	+/- 25mA	
Case	ruggedized, waterproof case	
Weight	appr. 5.5 kg	
External dimensions	length 700 mm, Ø 75mm	
Operating temperature range	-25°C + 70°C	

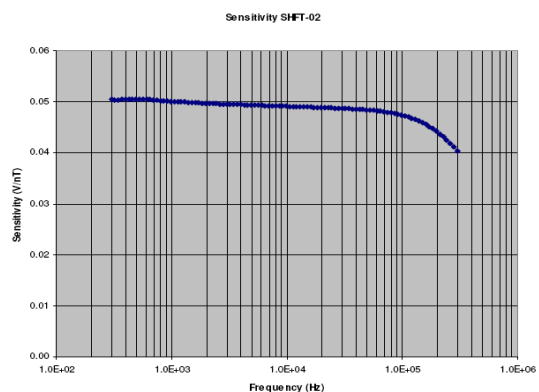
SHFT-02e

Super-High-Frequency Triple

The Super High-Frequency induction coil Triple SHFT-02e has been developed for applications in Audio Magnetotellurics (AMT), Radio Magnetotellurics (RMT) and Controlled Source Magnetotellurics (CSMT). It covers a frequency range from 1 kHz up to more than 300 kHz.. The SHFT-02e shows outstanding low-noise characteristics, and a stable transfer function over temperature and time.



Only one SHFT-02e is required to measure the magnetic field variations in 3 orthogonal axis. The sensors and its electronics are enclosed in a shock resistant plastic case. The SHFT-02e is connected to the metronix ADU-08e data logger (or any other custom electronics) by a cable of up to 10 m length. Ultra low noise preamplifier are making this sensor superior to others.



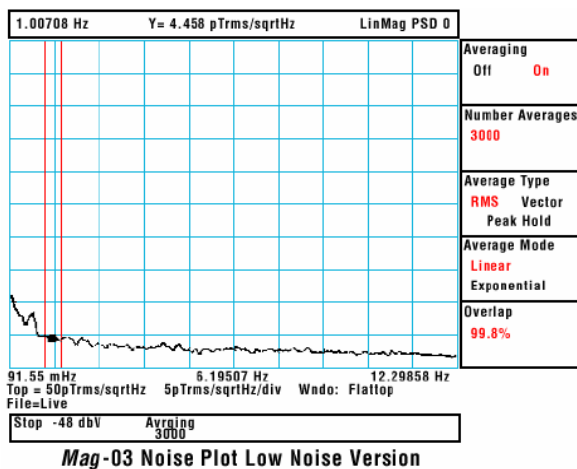
Technical data:

Frequency range	1 kHz 300 kHz	
Frequency bands	1 kHz 300 kHz n/a	(chopper off) (chopper on)
Sensor noise	5 * 10-5 nT / $\sqrt{\text{Hz}}$ 8 * 10-6 nT / $\sqrt{\text{Hz}}$ 6 * 10-6 nT / $\sqrt{\text{Hz}}$	@ 1 kHz @ 10 kHz @ 100 kHz
Output sensitivity	0.05 V / nT	f > 1kHz
	for exact values refer to individual calibration file	
Output voltage range	+/- 10V	
Function	Induction coil with current amplifier	
Connector	17 pole M23 connector	
Supply voltage	+/- 12V to +/- 18V internally stabilized and filtered	
Supply current	+/- 60 mA	
Case	ruggedized, waterproof	
Weight	appr. 5.5 kg	
External dimensions, without tripod	170 x 190 x 170 mm (LxWxH)	
Operating temperature range	-25°C + 60°C	

FGS-03e

Low Noise Fluxgate

The FGS-03e is a low noise 3-axis fluxgate sensor. It extends the frequency range for MT measurements down to DC. The sensor core unit is a Bartington Mag-03. The FGS-03e also provides automatic sensor detection by ADU-08e.

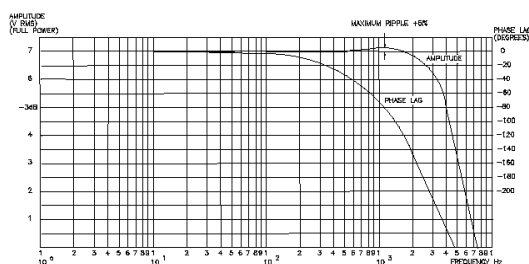


For lower frequencies all transfer functions are linear.

This sensor is designed for crustal studies where periods of 10,000 seconds and more are needed.

Recording time for those periods are three to eight weeks depending on the data quality (magnetic activity and external interferences by man made noise).

Typical frequency dependent ampl.:



FGS-03e Fluxgate

Technical data, models L100 and L70:

Frequency range	DC 3 kHz DC – 30 sec for MT measurements
Sensor noise	< 0.006 nT √ Hz @ 1Hz
Output sensitivity	0.1 mV / nT (model L100) 0.143 mV / nT (model L70)
Orthogonality error	< 0.5°
Output voltage range	± 10V
Measuring range	± 100,000 nT (model L100) ± 70,000 nT (model L70)
Connector	ODU G32KON-T10QJ00-000 (FluxGate socket) ODU S22KON-T10MJG0-7000 (cable plug)
Offset temperature coefficient	± 0.1 nT / °C
Offset error	± 5 nT
Supply voltage	± 12V to ± 15V stabilized and filtered
Supply current	+26mA, -6mA (+1.4 mA per 100 µT for each axis)
Case	ruggedized, waterproof case
Weight	Approx. 3 kg
External dimensions	Length 300 mm, Ø 75mm
Operating temperature range	-40°C + 70°C

Crustal Studies, Plate Tectonics, Seismic Risks

ADU-08e MFS-06e FGS-03e

The MFS-06e coils are designed to work from 10 kHz down to 4096 s.

The FGS-03e fluxgate is designed for periods from 100 s to 100,000 s.



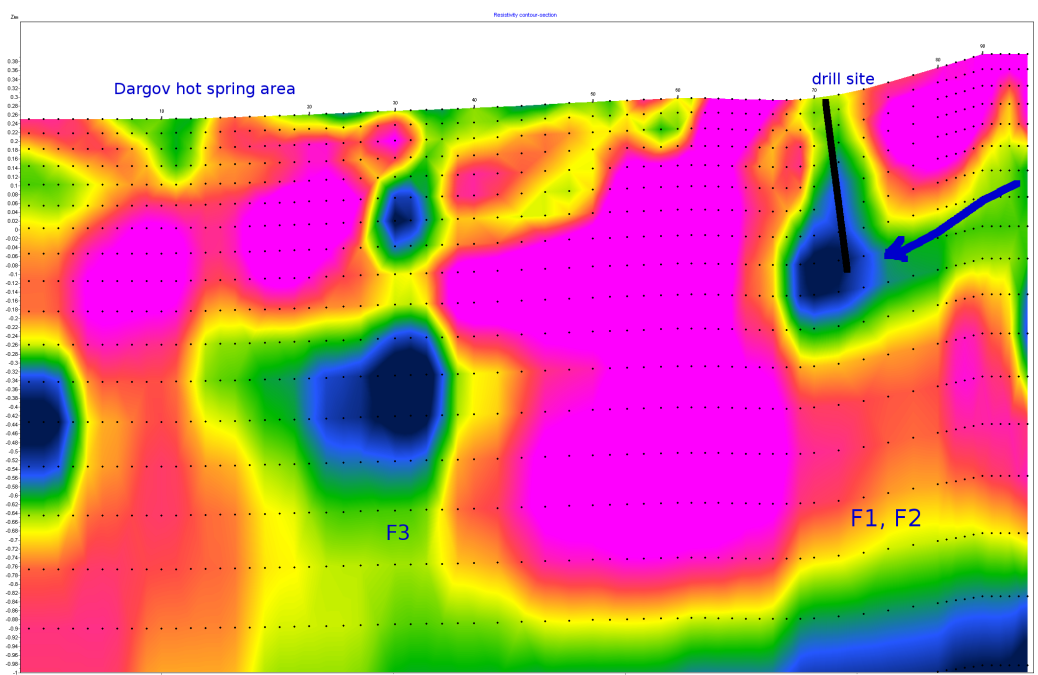
If you do not focus on AMT data with many recordings and sites per day, this is the ideal combination for deep studies. Both – coils and fluxgate – can be operated simultaneously.

In most cases a fluxgate is not needed if your studies are limited to 10 km (conductive environment) or 200 km (resistive environment).

Geothermal - Hydrothermal

Geothermal exploration needs depths around 3-5 km in order to resolve the reservoir and possible structures supplying the water.

Hydrothermal structures are more shallow and used for hot water supply and heating locally. CSAMT may be used here



The cross section shows several fault zones (F1, F2, F3); showing higher conductivities related to water intrusion.

At the drill site a channel becomes visible which is connected to a mountain area North of the profile.

A low temperature (65°C) reservoir was found.

ADU-08e MFS-07e SHFT-02e

The MFS-07e coils are designed to work from 50 kHz down to 1000 s.

The SHFT-02e coil triplet is designed to work from 400 kHz down to 1 kHz.



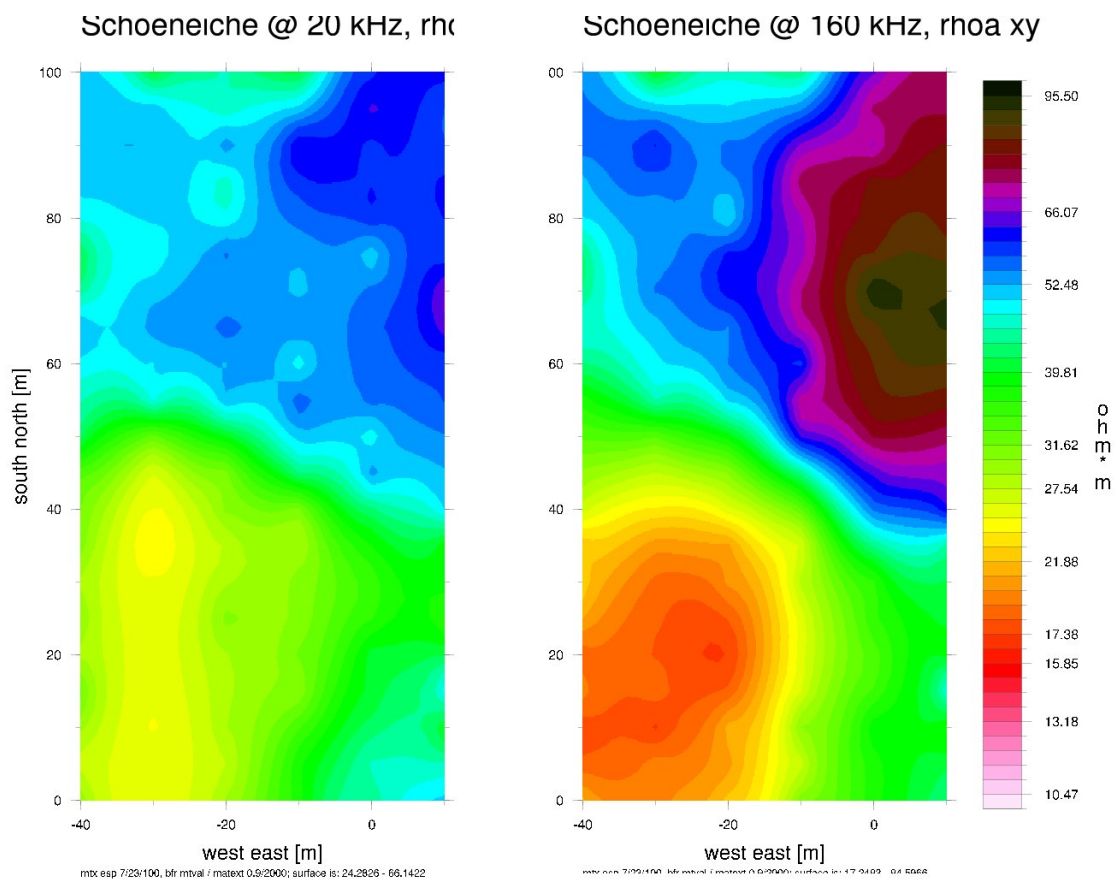
This system is focusing on AMT data and CSAMT

Water Pollution

One of the most upcoming issues is the exploration and determination of fresh water.

High frequency MT can be used to determine fresh and salt water boundaries at coastline (salt water intrusion) as well as polluted areas from fresh water areas (waste deposit leakage).

HF measurements in additions are used at construction sites.



Shown is the conductivity at different depths, according to the frequencies of 20 kHz and 160 kHz.

Polluted water appears in general more conductive than fresh water.

Interface for Mobile Phones & Tablets



... please watch the new generation

