



Rev 2.5  
29.12.2015

# EMC Spectrum Analyzer *SPECTRAN*<sup>®</sup> NF Series

Affordable low-frequency Signal Analyzer

## References / examples of proof:

- ◆ BOEING, USA
- ◆ NATO, Belgium
- ◆ Rohde & Schwarz, Belgium
- ◆ Shell Oil Company, USA
- ◆ ATI, USA
- ◆ Australian Government Department of Defence, Australia
- ◆ Daimler AG, Germany
- ◆ BMW, Germany
- ◆ Eurocontrol, Belgium
- ◆ DLR, Germany
- ◆ ThyssenKrupp, Germany
- ◆ Siemens AG, Germany
- ◆ PHILIPS, Netherlands



## Product of the year 2009

Our 3D magnetic-field measurement coil with homogeneous centre won the **first price** of Europe's biggest electronic newspaper "Elektronik" in the category passive components. **This coil is installed in each NF-Spectran unit.**



Distributed by: Reliant EMC LLC, +1 408 916-5750, info@reliantemc.com, www.reliantemc.com

# Specifications

## SPECTRAN® NF-1010E (10Hz to 10kHz)

- ◆ Frequency range: 10Hz to **10kHz\***
- ◆ Typ. level range E-Field: 1V/m to 2.000 V/m\*
- ◆ Typ. level range H-Field: 10nT to 100.000nT\*
- ◆ Typ. precision: 5% \*
- ◆ REAL TIME FFT spectrum display
- ◆ High-performance DSP (Digital Signal Processor)
- ◆ 3D magnetic field measurement
- ◆ Frequency and signal strength display!
- ◆ High-resolution multi-function display
- ◆ DIN/VDE 0848 Exposure limit calculation!
- ◆ Internet Flash Software-Updates
- ◆ **USB 2.0 Interface**
- ◆ Simultaneous M-Display X, Y, Z axes
- ◆ Average (AVG) measurement
- ◆ PEAK Hold
- ◆ Incl. battery, charger & aluminum transportcase
- ◆ Dimensions (L/W/D): (260x86x23) mm
- ◆ Weight: 420gr
- ◆ **Warranty: 10 years**

## SPECTRAN® NF-5030 (1Hz to 1MHz / 20MHz / 30MHz)

- ◆ Frequency range: 1Hz to 1MHz (**30MHz**)
- ◆ Typ. level range E-Field: 0,1V/m to 5.000 V/m at 50Hz
- ◆ Typ. level range H-Field: 1pT to 500µT at 50Hz
- ◆ Typ. level range Analog in: **200nV** to 200mV / -150dBm (Hz)
- ◆ Typ. accuracy: 3%
- ◆ **65 MSPS**
- ◆ Lots of options
- ◆ NEW: 30MHz Option
- ◆ Superfast FFT spectrum analysis
- ◆ High-performance DSP (Digital Signal Processor)
- ◆ 3D magnetic field measurement
- ◆ Frequency and signal strength display
- ◆ High-resolution multi-function display
- ◆ DIN/VDE 0848 Exposure limit calculation
- ◆ Simultaneous M-Display X, Y, Z axes
- ◆ True RMS signal strength measurement
- ◆ Average (AVG) measurement
- ◆ Internal data logger
- ◆ Internet Flash Software-Updates
- ◆ USB 2.0 Interface
- ◆ Dimensions (L/W/D): (260x86x23) mm
- ◆ Weight: 420gr
- ◆ **Warranty: 10 years**

## SPECTRAN® NF-3020 (10Hz to 400kHz)

- ◆ Frequency range: 10Hz to **400kHz**
- ◆ Typ. level range E-Field: 0,1V/m to 5.000 V/m
- ◆ Typ. level range H-Field: 1pT to 100.000nT
- ◆ Typ. precision: 5%
- ◆ Superfast FFT spectrum analysis
- ◆ High-performance DSP (Digital Signal Processor)
- ◆ 3D magnetic field measurement
- ◆ Simultaneous M-Display X, Y, Z axes
- ◆ True RMS signal strength measurement
- ◆ Average (AVG) measurement
- ◆ PEAK Hold
- ◆ Frequency and signal strength display
- ◆ High-resolution multi-function display
- ◆ "Clear text" signal identification
- ◆ DIN/VDE 0848 Exposure limit calculation
- ◆ Internal data logger
- ◆ Multi-function controls (single hand usage)
- ◆ USB 2.0 Interface
- ◆ Internet Flash Software-Updates
- ◆ Incl. battery, charger & aluminum transportcase
- ◆ **External SMA signal input**
- ◆ Dimensions (L/W/D): (260x86x23) mm
- ◆ Weight: 420gr
- ◆ **Warranty: 10 years**

## SPECTRAN® NF-5030S (1Hz to 1MHz / 20MHz / 30MHz)

- ◆ Identical to NF-5030, in addition:
- ◆ Vastly expanded measurement range
- ◆ Measurement range up to **DIN/VDE 0848**
- ◆ Typ. level range E-Field: 1V/m to **50 kV/m\*** at 50Hz
- ◆ Typ. level range H-Field: 100pT to **20mT\*** at 50Hz





## CONFORMING TO STANDARDS

Measurement of electric and magnetic fields in this price range has never been this professional.

Find radiation sources in your surroundings. Find their respective frequencies and signal strengths, including direct display of exposure limits. This used to be impossible in this price category, professional units often costing several thousand euros and being excessively complicated in handling.

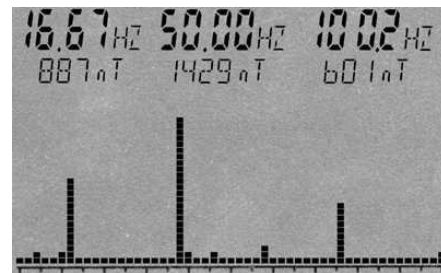
The highly complex calculations in spectrum analysis incl. exposure limit calculation is being performed, unnoticed in the background, by a high-performance DSP (digital signal processor). This ultra-fast processor even allows, depending on the settings, REAL-TIME display with a NF-5030 (could you ask for more?).

## Spectrum ANALYSIS

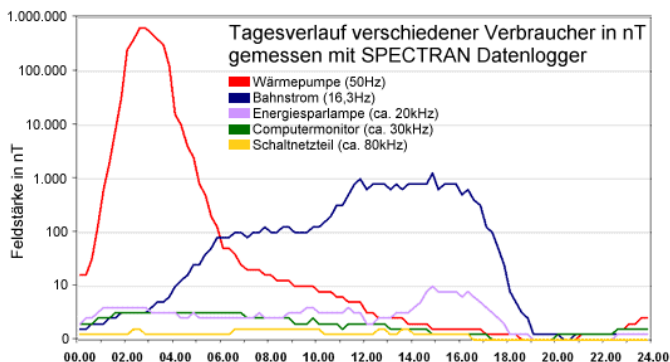
Professional EMF measurement devices use a frequency dependant measurement approach, the so-called spectrum analysis. In a certain frequency range, the individuals signals and their respective strengths are being broken down, for example into a "bargraph" display (see SPECTRAN® screenshot on the right). The height of the individual bars represents the corresponding signal strength. For the 3 strongest signal sources, SPECTRAN® can automatically displays the frequency and signal level, thanks to its "Auto Marker" feature. Of course, you can also setup the filter width and the frequency range to be analysed as you like.

In the EMF (LF) spectrum shown here, a frequency range of approx. 20Hz to 60Hz from left to right is being analysed. During analysis, the Auto Marker feature has determined - fully automatic - two main signal sources:

Signal#1=30Hz at 45 $\mu$ T  
Signal#2=50 (mains power) at 75 $\mu$ T



LF spectrum display and automatic multi-marker display on the digital screen of SPECTRAN® (Screenshot)



Daily variation of various radiation sources discloses MASSIVE variation in exposure

## LONG-TERM MEASUREMENT (Data logging feature)

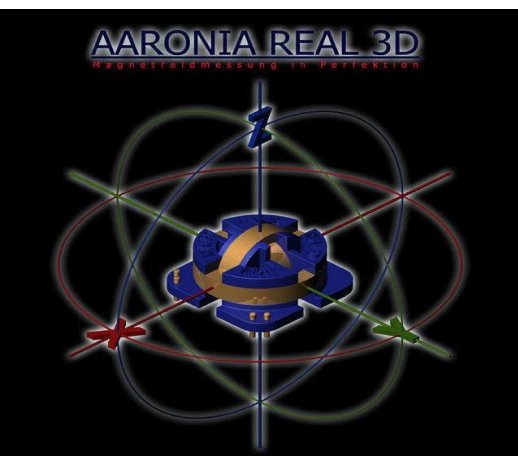
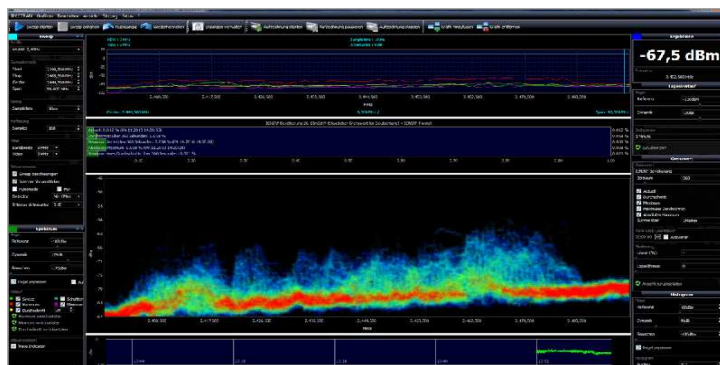
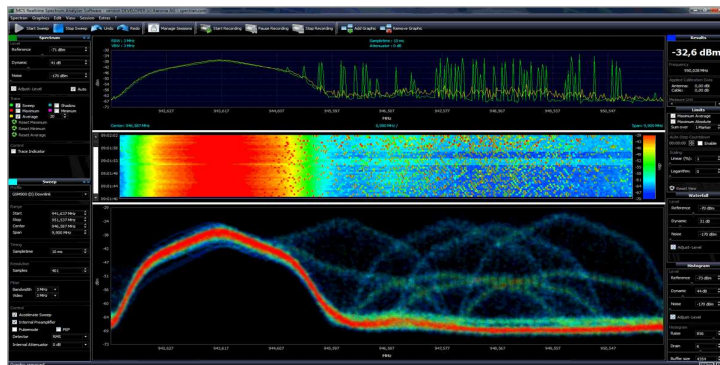
SPECTRAN® measurement devices with data logger allow long-term recordings of measurement results over a freely adjustable period of time. This is particularly indispensable for serious evaluation of exposure by appliances and machinery which have a changing power consumption or radiation strength over time. Examples for these include railroads, power lines and plants, but also home appliances and their respective power cables, and various high-frequency transmission facilities like mobile phone transmission towers, mobile phones, radar etc. Depending on the time of day, considerable variation of exposure can occur (see attached graphics). Without long-term recordings, MASSIVE misinterpretation of total exposure can occur. With long-term data logging using SPECTRAN®, the daily variation of exposure can be recorded and analysed. Thus, the actual total exposure can be evaluated precisely.

With this functionality, you can even discover sporadic EMC problems which would otherwise be very hard to detect.

## Free PC Analysis Software „MCS“

The cross-platform Spectrum Analyzer Software MCS for Windows, Linux and MAC OS shows the full potential of the SPECTRAN units. The measurement results and controls work in realtime, which means without any delay between the reception and the display of the signal on a monitor.

- ◆ Works on all important operating systems like Windows, MAC OS and Linux
- ◆ Multi-Device capable, remote control function of several units which can be controlled simultaneously from the same PC
- ◆ Real-Time remote control with any Spectran Spectrum Analyzer
- ◆ Unlimited number of limits e.g. EN55011, EN55022, ICNIRP and more, inclusive limit lines and beam indicator as well as a special limit editor to create and save custom limits
- ◆ Multi window support
- ◆ Powerful Undo-Feature
- ◆ Customer-specific skins and color-settings
- ◆ Record and Replay function
- ◆ Advanced Trigger and alarm functions
- ◆ Unlimited number of markers
- ◆ Multiple views at the same time: Spectrum, Waterfall, Histogram, Limits, Chanelpower, Providerdisplay, Time Domain, Results...
- ◆ Personal sessions handling
- ◆ Simultaneous display of multiple units like dBm, dBμV, V/m, W/m<sup>2</sup> etc. with powerful autorange
- ◆ and many more features that are constantly evolving...



Aaronia REAL-3D magnetic field sensor

## The new standard: 3D MEASUREMENT

Mismeasurement caused by wrongly adjusting the measurement device in space or troublesome and complex 3D calculations with a calculator are a problem of the past from now on, thanks to SPECTRAN® EMF (LF) measurement devices. All SPECTRAN® EMF measurement devices can measure magnetic fields directly in 3D! Starting with the SPECTRAN® NF-1010E, field strengths of the individual X, Y and Z axes can even be shown separately. This has become possible thanks to the newest development from the Aaronia laboratories: Our high-tech REAL 3D miniature sensor coil. Consisting of a specially crafted nylon base with 3 independent windings made of ultra-thin, 0,05 mm! wire, it impresses with its extremely high sensitivity. It allows measurement of magnetic fields in all 3 spacial dimensions. The signal processor (DSP) of the SPECTRAN® performs the resulting highly complex calculations. You receive 3D measurement results which can otherwise only be achieved by using highly professional equipment.

## INCLUDED WITH DELIVERY

- ◆ LF spectrum analyser SPECTRAN NF-50xx
- ◆ Sturdy aluminum-design carrycase (with custom padding!)
- ◆ 1300mAh Aaronia power battery with charger
- ◆ PC Software MCS (on CD)
- ◆ Exhaustive manual with lots of basic information, hints and exposure limit tables (PDF file)



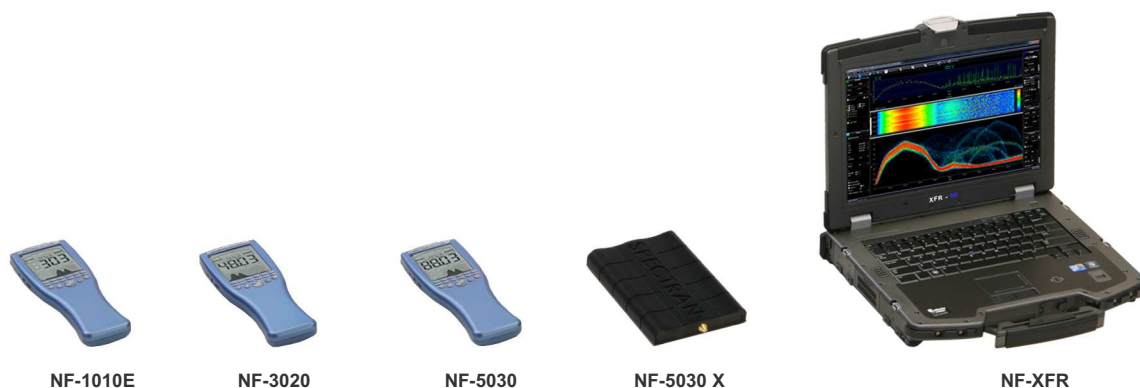
Package contents SPECTRAN 50xx devices

# SPECTRAN® NF (EMF) Spectrum Analyser

**APPLICATION EXAMPLES:** Traction power, power lines and cables incl. harmonics, transformer, switching power supplies, RFID, TFTs, DSL etc. Various appliances in home and office.

Specifications base unit <sup>(1)</sup>	NF-1010E	NF-3020	NF-5030	NF-5030X	NF-XFR
Frequency Range (min)	10Hz	10Hz	1Hz	1Hz	1Hz
Frequency Range (max)	10kHz	400kHz	30MHz <sup>(2)</sup>	1MHz	30MHz <sup>(2)</sup>
Electric field [V/m] (min) (typical)	1V/m	1V/m	0,1V/m <sup>(2)</sup>	see opt.PBS2	see opt.PBS2
Electric field [V/m] (max) (typical)	2.000V/m	5.000V/m	5.000V/m	see opt.PBS2	see opt.PBS2
Magnetic field [Tesla] (min) (typical)	1pT <sup>(2)</sup>	1pT <sup>(2)</sup>	1pT <sup>(2)</sup>	see opt.PBS2	see opt.PBS2
Magnetic field [Tesla] (max) typical	100µT	100µT	500µT <sup>(1)</sup>	see opt.PBS2	see opt.PBS2
Magnetic field [Gauss] (min) (typical)	10nG <sup>(2)</sup>	10nG <sup>(2)</sup>	10nG <sup>(2)</sup>	see opt.PBS2	see opt.PBS2
Magnetic field [Gauss] (max) typical	1G	1G	5G <sup>(1)</sup>	see opt.PBS2	see opt.PBS2
Analog input [V] (min) typical	-	2µV	200nV <sup>(2)</sup>	200nV <sup>(2)</sup>	200nV <sup>(2)</sup>
Analog input [V] (max) typical	-	200mV	2V <sup>(2)</sup>	2V	2V <sup>(2)</sup>
RBW (resolution bandwidth) (min)	1Hz	1Hz	0,3Hz	0,3Hz	0,3Hz
RBW (resolution bandwidth) (max)	3kHz	100kHz	1MHz	1MHz	1MHz
Demodulator	-	AM	AM/FM	AM/FM	AM/FM
Units (additional units via PC software)	V/m, T, G	V, V/m, T, G	V, V/m, T, G, A/m	V, dBV	V, dBV
Detector	RMS	RMS/MinMax	RMS/MinMax	RMS/MinMax	RMS/MinMax
Internal Datalogger (size). Expandable to 1MB (option 001)	-	64K	64K	-	harddisk
FFT resolution (points)	64	64	1024	1024	1024
Lowest Sample Time	50mS	50mS	10mS	10mS	10mS
Accuracy (typical)	5%	5%	3%	3%	3%
<b>Highlights</b>					
Real-time remote control via USB	✓	✓	✓	✓	internal
Integrated electric (E) & isotropic magnetic (H) sensor/antenna	✓	✓	✓	-	-
3D, 2D or 1D mode switchable (only magnetic field sensor)	✓	✓	✓	-	-
Calibration setup (selected antenna)	✓	✓	✓	✓	✓
Exposure limit calculation according to ICNIRP, BGV B11, BlmSchV etc.	✓	✓	✓	✓	✓
Extended full ICNIRP range	-	-	✓	✓	✓
Suitable for Pre-Compliance test	-	-	✓	✓	✓
Real-time limit calculation with simultaneous percentage display	✓	✓	✓	Analyser Software	Analyser Software
Vector power measurement (I/Q) and True RMS	-	✓	✓	✓	✓
Enhanced DFT spectrum analysis	✓	✓	✓	✓	✓
Simultaneously displays frequency and signal strength	-	✓	✓	Analyser Software	Analyser Software
Up to 3 marker (showing both frequency and field strength)	✓	✓	✓	unlimited	unlimited
Jog Dial controlled manual marker readout	-	✓	✓	-	Key- & Touchpad
Linear or logarithmic spectrum display (log10, log100, log1000)	✓	✓	✓	unlimited	unlimited
Automatic reference level adjustment (switchable)	✓	✓	✓	✓	✓
Hold function	✓	✓	✓	unlimited	unlimited
Free of charge firmware update (via Internet)	✓	✓	✓	✓	✓
Supports programming of custom P-Code & C++ based custom software	-	✓	✓	✓	✓
High performance DSP (Digital Signal Processor)	✓	✓	✓	✓	✓
Large, high resolution multifunctional LCD (95mm)	✓	✓	✓	-	14" TFT
Spectrum display (51x25 pixel)	✓	✓	✓	Analyser Software	Analyser Software
High resolution 50 segment bargraph (trend display)	✓	✓	✓	Analyser Software	Analyser Software
Enhanced, much sharper Aaronia LCD display (3d generation)	-	-	✓	-	14" TFT
Integrated battery charger (supports our optional LiPo battery)	✓	✓	✓	-	XFR charger
Internal speaker	Piezo	✓	✓	-	✓

Please continue on next page



# SPECTRAN® NF (EMF) Spectrum Analyser

**APPLICATION EXAMPLES:** Traction power, power lines and cables incl. harmonics, transformer, switching power supplies, RFID, TFTs, DSL etc. Various appliances in home and office.

Connectors / Interface	NF-1010E	NF-3020	NF-5030	NF-5030X	NF-XFR
SMA input (f) with high impedance	-	✓	✓	✓	✓
USB 1.1/2.0	✓	✓	✓	✓	2x
Audio output (2,5mm jack)	✓	✓	✓	✓	3,5mm jack
Charger plug (max. 15V)	✓	✓	✓	✓	✓
Jog Dial (easy usage of menu, marker and volume control)	-	✓	✓	-	key & touchpad
1/4" tripod connector	✓	✓	✓	-	in-Vehicle docking
<b>Included In Delivery</b>					
Integrated electric (E) & isotropic magnetic (H) sensor/antenna	✓	✓	✓	-	-
SPECTRAN 1300mAh rechargeable battery (integrated)	✓	✓	✓	-	6 cell battery
Battery charger and power supply incl. international adapter set	✓	✓	✓	✓	no adapter set
Aluminum carrying case with foam protection	✓	✓	✓	✓	-
Detailed English manual (on CD)	✓	✓	✓	✓	installed
Analyzer Software for MAC-OS, Linux and Windows (on CD)	✓	✓	✓	✓	installed
SMA tool	-	-	✓	✓	✓
<b>Available Options (extra charge)</b>					
<b>Option 001</b> (1MB memory expansion)	✓	✓	✓	-	harddisk
<b>Option 005</b> (12Bit DDC for ultra high sensitivity)	installed	installed	installed	installed	installed
<b>Option 006</b> (Isotropic static magnetic field sensor) <sup>(1)</sup>	-	-	✓	-	-
<b>Option 008</b> (20MHz expansion. New range: 1Hz-20MHz)	-	-	✓	✓	installed
<b>Option 009</b> (24Bit resolution for Option 006)	-	-	✓	-	-
<b>Option 010</b> (30MHz expansion. New range: 1KHz-30MHz)	-	-	✓	✓	✓
<b>Option UBBV2</b> (40dB external preamplifier DC-8GHz)	-	-	✓	✓	✓
<b>Optional Accessories</b>					
USB Cable (Special Version)	✓	✓	✓	inclusive	installed
3000mAh Lithium Polymer (LiPo) Power-Battery	✓	✓	✓	-	-
Car Power Adapter (operate or charge via cigarette lighter)	✓	✓	✓	-	-
Outdoor Rubber Protection (perfect for outdoor usage)	✓	✓	✓	-	-
Pistol Grip / Miniature Tripod	✓	✓	✓	-	-
Aluminum Tripod (big version)	✓	✓	✓	-	-
DC-Blocker (protects the input against DC voltage)	-	-	✓	✓	✓
20dB Attenuator (offers a higher maximum voltage up to 2V)	-	-	✓	✓	✓
PBS1 Near Field Probe Set (passive)	-	-	✓	✓	✓
PBS2 Near Field Probe Set (active, incl. UBBV2 preamplifier)	-	-	✓	✓	✓
ADP1 Active Differential Probe (conductive measurement)	-	-	✓	✓	✓
GEO10 Vibrationsensor (4Hz-1kHz)	-	-	✓	✓	✓
GEO14 Vibrationsensor (10Hz-1kHz)	-	-	✓	✓	✓
Calibration Certificate	✓	✓	✓	-	-
Heavy Plastic Carrying Case	✓	✓	✓	-	-

<sup>(1)</sup> Preliminary specifications dated 17.04.2012. Range, sensitivity and accuracy can change depending on frequency, setup, antenna and used parameters. Precision datas are based on Aaronias calibration-reference under specific test conditions. Unless otherwise stated, these specifications are according to the following reference conditions: Ambient temperature 22±3°C, relative air humidity 40% to 60%, continuous wave signal (CW), RMS detection.

<sup>(2)</sup> Option 006 offers a range of 100µG-6G (10nT-600µT). You can "zero" the static field sensor (Option 006) by using our "Zero Gauss" chamber.  
NF standard: 1MHz. Only with option 010 up to 30MHz. NF standard: 1nT. Only with option 005 down to 1pT. NF standard 2µV. Only with option 005 down to 200nV. NF standard: 200mV. Only with optional 20dB Attenuator up to 2V.



NF-1010E



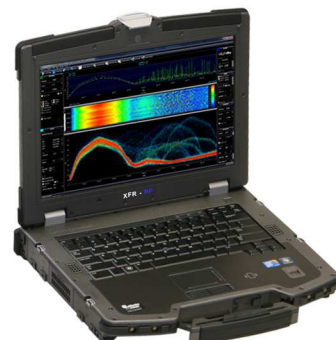
NF-3020



NF-5030



NF-5030 X



NF-XFR

# Options for Spectran NF-50xx series

## Option 001: 1MB memory expansion

**Available for: NF-1010E, NF-3020, NF-5030, NF-5030S**

This memory expansion is a MUST-HAVE particularly when using the data logger, as the standard capacity can quickly become exhausted in this mode. The memory expansion provides space for more than 10,000 logs, while the standard memory will only accommodate approximately 100 of them.

Standard memory size is 64K.

*Order/Art.-No.: 180*

## Option 005: 12Bit Dual DDC frequency filter

**Already installed in: NF-1010E, NF-3020, NF-5030, NF-5030X, NF-5030S, NF-XFR**

This cutting edge 12Bit DDC frequency filter allows extremely fast, crisp and accurate frequency filtering, while at the same time drastically enhancing the sensitivity. As an example, magnetic fields can (depending on their frequency) still be measured down to 1pT (0.001nT), compared to 0.1nT without the option. *Order/Art.-No.: 186*

## Option 006: 3D sensor for static magnetic fields

**Available for: NF-5030, NF-5030S**

This top-grade geomagnetic field sensor provides the ability to conduct geophysical assessments and measurement of geomagnetic field anomalies. However, it can also be used to turn the instrument into a Gaussmeter, measuring the difference between field strengths (static fields) of permanent magnets. Thanks to its ISOTROPIC (3D) construction, measurements can be performed in all three spacial dimensions AT ONCE (or seperately). Sensitivity is about 10nT-600µT.

*Order/Art.-No.: 188*

## Option 008: 20MHz frequency extension

**Available for: NF-5030, NF-5030S (inclusive at NF-XFR)**

This 20MHz frequency extension option vastly enhances the frequency range of the NF-5030. Amongst others, it brings the ADSL and 13.56MHz RFID frequency bands in range. What's more, we are already developing a PC-based analysis software for decoding RFID.

The maximum frequency range of the NF-5030 without option 008 is 1MHz.

*Order/Art.-No.: 179*

## Option 009: 24Bit resolution for 3D static magnetic field sensor

**Available for: NF-5030, NF-5030S**

Option 006 provides a significantly higher resolution for the optional 3D magnetic field sensor for measurement of static magnetic fields (option 006); it is ABSOLUTELY mandatory for geomagnetic surveys.

The standard resolution of the NF-5030 without option 009 is 14Bit.

*Order/Art.-No.: 178*

## Option 010: 30MHz frequency extension

**Available for: NF-5030, NF-5030S, NF-5030X**

Our 30MHz frequency extension extends the frequency range to the absolute maximum. The new frequency range is 1kHz - 30MHz. Amongst others, it even allows measurement of VDSL2. The higher clock frequency of the DDC provided by this option is a MUST HAVE for technicians and authorities needing ACCURATE assessment of signal sources of up to 30MHz. The maximum frequency of the NF-5030 / NF-5030X without option 010 is 1MHz.

*Order/Art.-No.: 179-1*

# Recommended accessories

## Heavy Plastic Carrycase PRO

Shock resistant, heavy version with padding. Offers spaces for 2 SPECTRAN units with all accessories and a HyperLOG 70xx or 60xx antenna. A MUST for the professional user or outdoor usage!

Order/Art.-No.: 243



## Calibration Certificate

Available for all SPECTRAN® units. With detailed calibration sheet.

Order/Art.-No.: 786



## 3000mAh LiPo Power-Battery

Offers a MUCH higher runtime of your SPECTRAN (up to 400%). Strongly recommended for autonomic measurement! The 1300mAh standard-battery will be replaced.

Order/Art.-No.: 254



## Pistol grip / miniature tripod

Detachable handle with super-practical miniature tripod mode: this handle is attachable to the backside of the unit and allows optimal handling (esp. for directional measurement) and even fixed installation of the unit. STRONGLY recommended for PC use!

Order/Art.-No.: 280



## USB Cable (Special Version)

To connect your Spectran to the PC. Special version with high performance EMC-ferrite. STRONGLY recommended for PC use!

Order/Art.-No.: 774



## Car power adapter for mobile use

With power-LED. For charging batteries or operating our units in your car, including special plug.

Order/Art.-No.: 260



## Aluminum tripod

Height adjustable, high stability. STRONGLY recommended for PC use! Max. height: 105cm.

Order/Art.-No.: 281



## Protection rubber

Protect and personalize your SPECTRAN with a sturdy rubber case and keep it scratch-n-dent free. Allows full access to all functions.

Order/Art.-No.: 290



## DC-Blocker (SMA)

It prevents the RF-input of the SPECTRAN to be destroyed by the DC-voltages of f.e. DSL/ISDN lines.

Order/Art.-No.: 778





# References

## Cross-Section of Aeronia Clients

### Government, Military, Aeronautic, Astronautic

- ◆ NATO, Belgium
- ◆ Department of Defense, USA
- ◆ Department of Defense, Australia
- ◆ Airbus, Germany
- ◆ Boeing, USA
- ◆ Bundeswehr, Germany
- ◆ NASA, USA
- ◆ Lockheed Martin, USA
- ◆ Lufthansa, Germany
- ◆ DLR, Germany
- ◆ Eurocontrol, Belgium
- ◆ EADS, Germany
- ◆ DEA, USA
- ◆ FBI, USA
- ◆ BKA, Germany
- ◆ Federal Police, Germany
- ◆ Ministry of Defense, Netherlands

### Research/Development, Science and Universities

- ◆ MIT - Physics Department, USA
- ◆ California State University, USA
- ◆ Indonesien Institute of Science, Indonesia
- ◆ Los Alamos National Laboratory, USA
- ◆ University of Bahrain, Bahrain
- ◆ University of Florida, USA
- ◆ University of Victoria, Canada
- ◆ University of Newcastle, United Kingdom
- ◆ University of Durham, United Kingdom
- ◆ University Strasbourg, France
- ◆ University of Sydney, Australia
- ◆ University of Athen, Greece
- ◆ University of Munich, Germany
- ◆ Technical University of Hamburg, Germany
- ◆ Max-Planck Institute for Radio Astronomy, Germany
- ◆ Max-Planck Institute for Quantum Optics, Germany
- ◆ Max-Planck-Institute for Nuclear Physics, Germany
- ◆ Max-Planck-Institute for Iron Research, Germany
- ◆ Research Centre Karlsruhe, Germany

### Industry

- ◆ APPLE, USA
- ◆ IBM, Switzerland
- ◆ Intel, Germany
- ◆ Shell Oil Company, USA
- ◆ ATI, USA
- ◆ Microsoft, USA
- ◆ Motorola, Brazil
- ◆ Audi, Germany
- ◆ BMW, Germany
- ◆ Daimler, Germany
- ◆ Volkswagen, Germany
- ◆ BASF, Germany
- ◆ Siemens AG, Germany
- ◆ Rohde & Schwarz, Germany
- ◆ Infineon, Austria
- ◆ Philips, Germany
- ◆ ThyssenKrupp, Germany
- ◆ EnBW, Germany
- ◆ RTL Television, Germany
- ◆ Pro Sieben – SAT 1, Germany
- ◆ Channel 6, United Kingdom
- ◆ CNN, USA
- ◆ Duracell, USA
- ◆ German Telekom, Germany
- ◆ Bank of Canada, Canada
- ◆ NBC News, USA
- ◆ Sony, Germany
- ◆ Anritsu, Germany
- ◆ Hewlett Packard, Germany
- ◆ Robert Bosch, Germany
- ◆ Mercedes Benz, Austria
- ◆ Osram, Germany
- ◆ DEKRA, Germany
- ◆ AMD, Germany
- ◆ Keysight, China
- ◆ Infineon Technologies, Germany
- ◆ Philips Semiconductors, Germany
- ◆ Hyundai Europe, Germany
- ◆ JDSU, Korea
- ◆ Wilkinson Sword, Germany
- ◆ IBM Deutschland, Germany
- ◆ Nokia-Siemens Networks, Germany