

Low Frequency



Precision test equipment for safety in electric and magnetic fields



Your One-Stop Shop for Safety in Electromagnetic Fields

Narda Safety Test Solutions develops and produces a comprehensive line of measuring devices for:

- **Low-frequency fields**
- **HF / RF / microwave fields and**
- **Human safety applications.**

Our highly practical user support program includes:

- Equipment and application consultation by our worldwide sales network
- Repair and calibration service
- Expert advice on standards and current developments
- Training and measurement services.

“Just power on and measure!”

Simple operation is important when you need dependable results. This requires **device technologies** capable of simplifying the highly complex measurements found in EMF applications. With any device you purchase from Narda Safety Test Solutions, the basic tenet is: “Just power on and measure!”

With **95% of all patents** in electromagnetic field measurement technology, Narda Safety Test Solutions is clearly a powerhouse in its business sector. Our portfolio includes the patent for frequency response shaping, which greatly simplifies measurements in a multifrequency RF environment.

All of our measurement products hold up well under demanding ambient conditions. Robust designs are built to take physical punishment and stand up to a radiation-prone workplace.

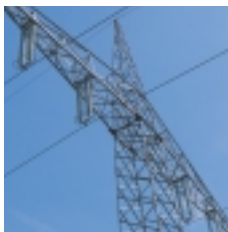
CE certification is another standard feature: All equipment is



Narda Safety Test Solutions' device technologies highly simplify complex test scenarios for the user.



Narda Safety Test Solutions holds 95% of all patents worldwide in the area of electromagnetic field measurement technology.



Application areas	Planning
Cross-country lines and systems	EFC-400LF
Transformer stations	EFC-400ST
Railways	EFC-400LF
Smelting	
Welding	
Medicine (MRI)	
RF communications systems, e.g. on masts (see HF, RF & Microwave brochure)	EFC-400TC

manufactured in our ISO 9001-compliant production facilities located in Germany and the US.

All Narda Safety Test Solutions products are calibrated and comply with the country-specific standards of their users.



The low frequency (LF) product line

Like all equipment from Narda Safety Test Solutions, the low frequency product line delivers excellent measurement reliability. All of the functions were designed for straightforward and reliable testing.

Precision measurements of low frequency fields are required mainly in the following areas:

- Power delivery
- Railways
- Smelting furnaces
- Welding systems
- Medicine (MRI).

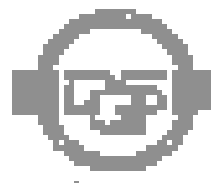
Narda Safety Test Solutions is dedicated to meet your exact requirements with a comprehensive product line. Whether you are a specialist in charge of **qualifying** facilities, or a technician who must regularly inspect facilities and/or equipment, we have the right test solution.



Qualification, inspection, documentation and human safety: Narda Safety Test Solutions has the right test equipment no matter what your requirements.



Operation and Monitoring	
	EFA-300
	EFA-200/300, ELT-400
	EFA-200/300, ELT-400, ETM-1
	EFA-200, ELT-400
	EFA-200, ELT-400
	ETM-1
	RadMan XT*, Nardalert XT
	* also available as "ELF immune"



To view our equipment recommendations for any application area, please visit our Website at www.narda-sts.com.



EFA-200 and EFA-300 Electromagnetic Field Analyzers

The EFA line is ideal for making isotropic measurements of electric and magnetic fields. Users no longer have to know anything about the signal shape thanks to the innovative measurement technique known as **STD** (shaped time domain). The field strength is displayed as a percentage of the limit. Frequency analysis is performed by computing the FFT function. These instruments include memory for data and can be remotely controlled.

With the EFA-300, you get two measuring devices: A basic instrument for the magnetic field and an E-field module (cube). The E-field module is operated via the basic instrument or a PC.



The **STD** measurement technique indicates the measured value directly as a percentage of the value from the standard. With the EFA-200/300, you can choose between six different standards, e.g. ICNIRP occupational and general public

The EFA-200 measures the magnetic field isotropically, and has an integrated coil system.



Specifications*

Sensor
Directional characteristic, selectable
Frequency range (broadband), selectable
Frequency range (bandpass/bandstop filters), selectable
Measuring quantity, selectable
Measurement range
STD shaping, frequency range
STD measurement range (ICNIRP occ.)
FFT frequency range
FFT frequency resolution (with marker)
Memory for measurement data up to

The electric field is recorded by the EFA-300 module (cube). You can call up the current and stored **measured values** via

the EFA-300 basic instrument, or you can import them directly into your PC.

Besides magnetic field measurements, you can also use the separate E-field module of the EFA-300 to make isotropic measurements of electric fields.



EFA-300 Electric Fields Module

Most Narda Safety Test Solutions measurement products include memory for storing data. If you need to monitor field strengths or make long-term measurements, you should consider exporting the **measured values** to a PC using the optical interface included in the instruments. These instruments can also be remotely controlled via this same interface.

EFA-200	EFA-300
Integrated coil system (B field)	Integrated coil system (B field), electrode (E-field module)
Triaxial (isotropic) or monoaxial	
5 Hz to 2 kHz, 30 Hz to 2 kHz, 5 Hz to 32 kHz or 30 Hz to 32 kHz	
15 Hz to 2 kHz	
RMS value (averaging time = 1 sec) or peak value (with proper phase)	
4 nT (100 cm ² probe) to 32 mT	4 nT (100 cm ² probe) to 32 mT, 0.7 V/m to 100 kV/m
5 Hz to 32 kHz	
< 0.4 % to 200 %	< 0.4 % to 200 % (H field) < 5 % to 200 % (E field)
5 Hz to 2 kHz or 40 Hz to 32 kHz	
0.01 Hz or 0.1 Hz	
3600 single values or 22 spectral analyses	3600 single values or 22 spectral analyses (each for B field or E field)



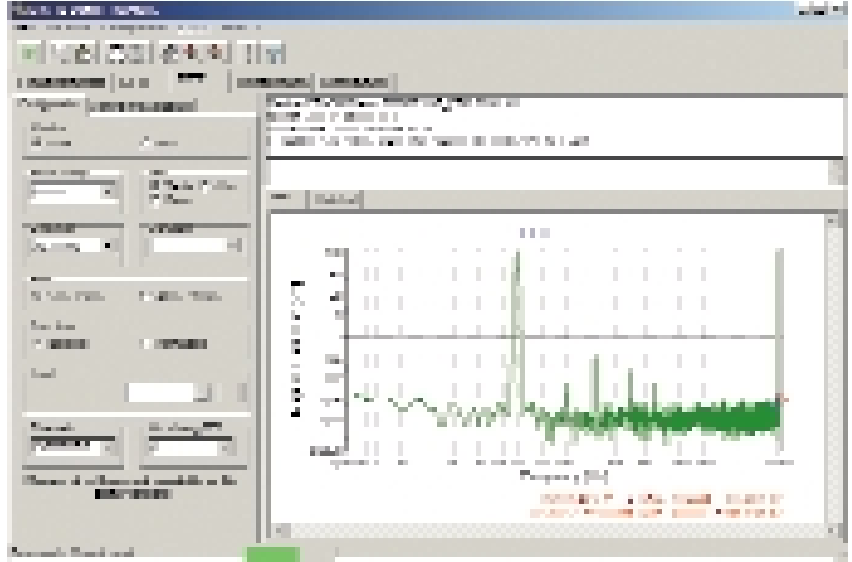
* See data sheet for more detailed specifications.

EFA-TS Remote Control Software

EFA-TS offers **extended analysis and presentation capabilities**:
Lines and bar graphs, tables of measured values and measurement reports.

The EFA-TS software enables remote control via a graphical user interface (GUI). At the same time, EFA-TS offers

extended analysis and presentation capabilities for both stored and on-line measured values.



The isotropic magnetic field probe has 100 cm² of coil area and is very sensitive. It must be used for standard-compliant measurement of non-homogeneous magnetic fields for some standards.

A small (3 cm diameter) “sniffer” probe is very useful for measurements in hard to reach places.

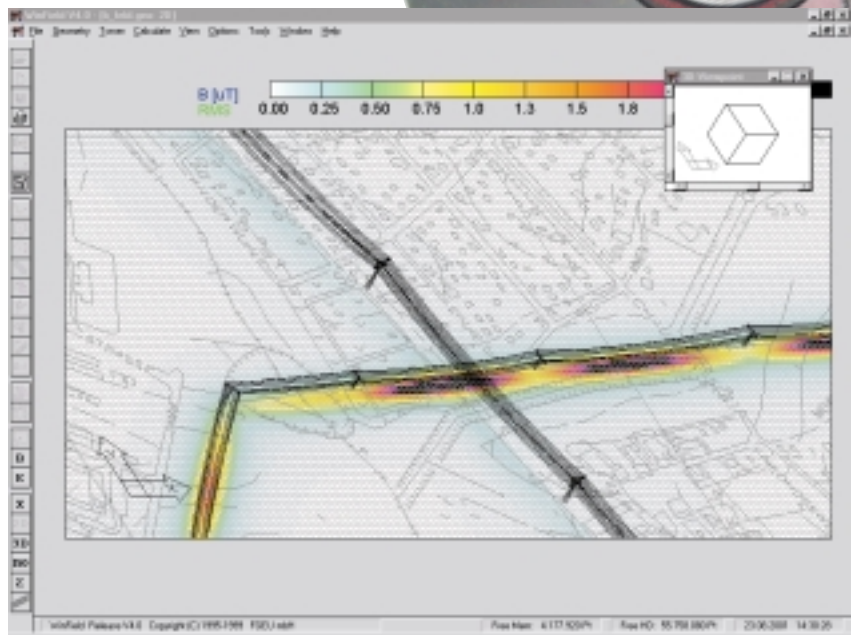


EFC-400LF and EFC-400ST Simulation Software

The EFC-400LF software computes electric and magnetic fields around power lines and other power delivery equipment. It handles different field sources from 0 to 30 kHz with proper phase. To speed up the planning process, the EFC library includes a selection of predefined mast types. The terrain topography can be processed in grid or vector format. Measurement data (e.g. from the EFA devices) can be taken into account if so desired. The documentation complies with the DIN, VDE, ICNIRP and BImSchV standards.

Magnetic field distribution is computed according to Biot-Savart's law. You can compute the RMS value, the peak value and the individual components.

The EFC-400ST version of the software allows documentation of magnetic flux density at 50 Hz or 60 Hz transformer stations.



	EFC-400LF	EFC-400ST
Magnetic field (H)	●	●
Electric field (E)	●	
Library of predefined masts	●	
Importing of maps, sketches, construction plans	●	●
Exporting of ISO lines, color surface presentations, etc.	●	●
3-D computation	●	●

ELT-400 Magnetic Field Tester

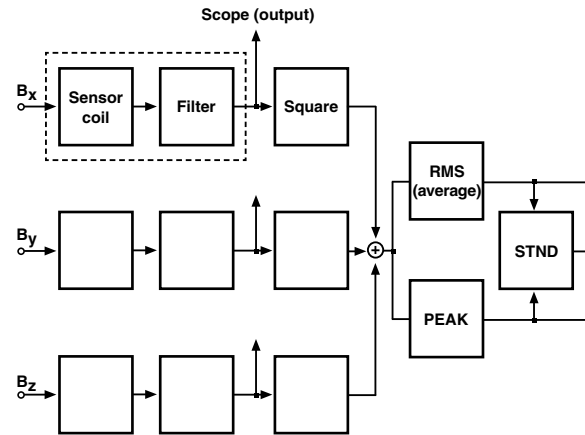
Occupational Magnetic Fields

The ELT-400 evaluates magnetic fields according to various standards, such as ICNIRP, BGV B11 and EN 50366. Results are immediate and exact, even when different field sources with different frequencies are present. This makes the ELT-400 the ideal solution for industrial safety officers and for environmental service providers.

CE certification

CE certification of instruments is not just concerned with electromagnetic compatibility. In

future, the **human safety limit values** will also have to be taken into account. Magnetic field measurements made with the ELT-400 represent the simplest way of proving conformance with the EN 50366 standard.



ELT-400 provides full **implementation of the EN 50366 Reference Method** by means of time-domain evaluation, standard-compliant transfer function and direct display of the measurement results as a percentage of the limit value. The **STD method** (Shaped Time Domain)

developed and **patented** by Narda Safety Test Solutions delivers the results immediately.

The ELT-400 combines all functions: Manual measurements, robot-controlled measurements during production, with data recorded on a PC, and for further processing of the analog measurement signal using an FFT analyzer or an oscilloscope.

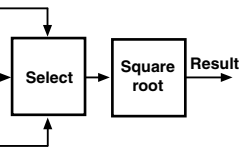
	ELT-400
Sensor	Isotropic coil system for measuring B fields
Measurement range	Selectable 320 μ T, 8 mT and 80 mT
Frequency range	1 Hz to 400 kHz
Display type	3 1/2 digit LCD display
STD measurement range (ICNIRP, BGV B11, EN 50366)	1600 %

ETM-1 Teslameter

The ETM-1 measures constant magnetic fields such as those found in medicine (magnetic resonance imaging or MRI), in metal production and in railway systems.

The **isotropic** measurement recorder and automatic ranging simplify handling. The teslameter is equipped with an RS232 interface for remote control purposes.

Isotropic probes measure signals in all three spatial directions, making it unnecessary to go through the time-consuming process of precisely orienting the measuring device in the field.



Specifications

ETM-1
Isotropic Hall-effect sensor system for B fields
Selectable 20, 200 and 2000 mT
Static, DC (0 Hz)
3 1/2 digit LCD display

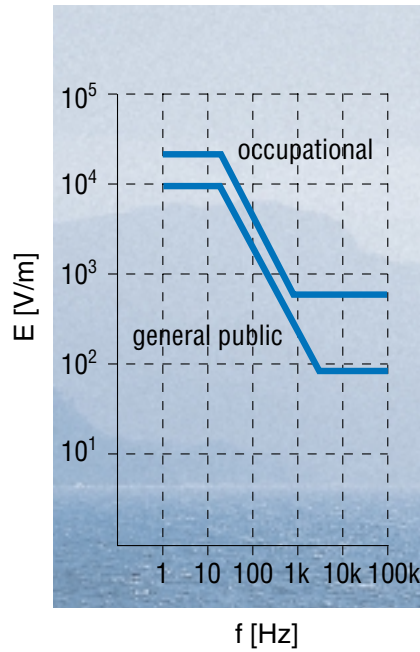


Standards-Compliant Measurements with Convenient Test Equipment

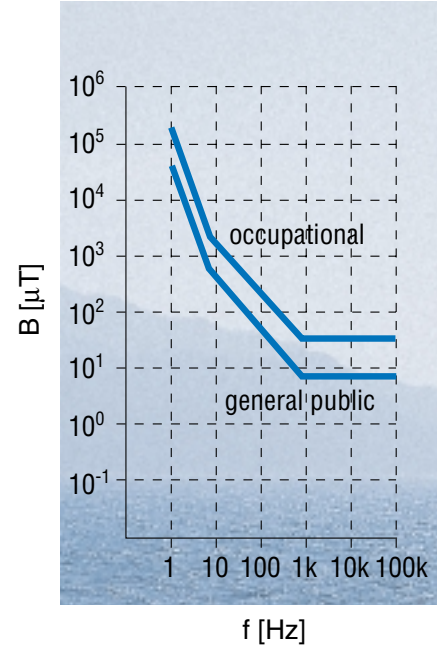
Equipment from Narda Safety Test Solutions was developed especially for applications involving occupational safety and protection of the general public in electric and magnetic fields, and includes all of the functions you need to make standards-compliant measurements with ease.

ICNIRP
is the "International Commission on Non-Ionizing Radiation Protection".
For more information, visit www.icnirp.de

ICNIRP limits



Limits for human exposure to electric and magnetic fields are governed by various national and international standards. Many of these standards are based on the recommendations of the **ICNIRP**.

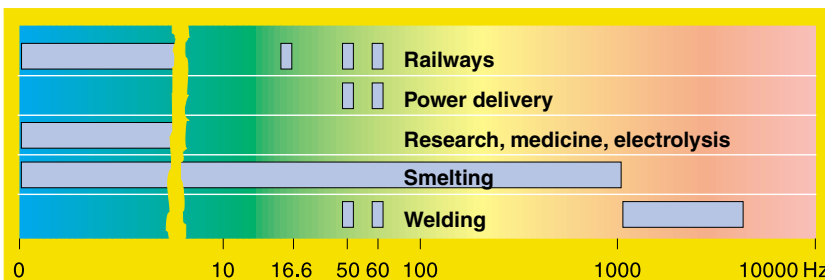


Frequency ranges and application fields

The frequency spectrum is usually broken down into two ranges: Low frequency up to about 30 kHz and high frequency from 30 kHz to 300 GHz. This includes the RF & microwave ranges.

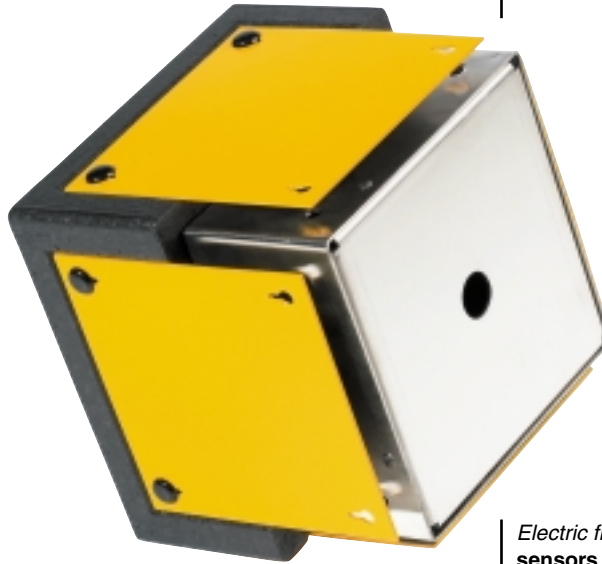
Various applications in power delivery, railways and industry (e.g. smelting, welding) are all associated with certain LF ranges. When monitoring electric and magnetic fields, it is necessary to know the frequency since the limits are frequency-dependent. The one exception to this is when you are measuring in STD mode. This mode provides automatic evaluation of all the low frequencies detected as a percentage of the limit. This makes it much easier to determine compliance with a standard.

Applications and their typical frequencies



Non-directional measurements

In an industrial environment, you are usually dealing with multiple sources of low frequency radiation. To properly assess exposure, **isotropic** (non-directional) measurements are required. This entails holding the measuring device in three different directions and then computing the final result from these measured values. However, using instruments with an isotropic **sensor** system, the correct result is obtained no matter how the instrument and fields are oriented.



Standardized measurements must be **isotropic**, i.e. non-directional. The formula is as follows:

$$E(t) = \sqrt{E_x^2(t) + E_y^2(t) + E_z^2(t)}$$

Electric fields are measured using **sensors** based on the plate-capacitor principle. Different potentials are generated at the plates when they are subjected to an electric field. The electric field module computes the overall field from each of the sensors used for the three spatial axes.

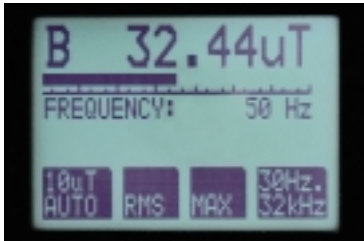
Reliable measurements of unknown fields

When you are dealing with unknown fields, STD mode provides an immediate indication of the total exposure referenced to the limit. FFT analysis allows you to read off the different frequencies and their amplitudes. Using selective and broadband measurements, you can evaluate the exact field strength of individual frequencies or entire frequency ranges.

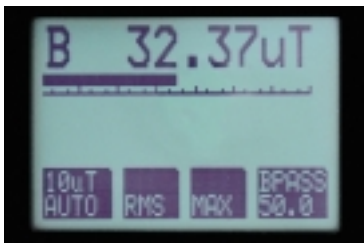
As a basic rule, the electric and magnetic fields must be measured separately at low frequencies since these two components are independent of one another.

When measuring magnetic fields, coils are used as **sensors**. The induced voltages serve as a measure of the field strength. Here too, the instrument computes the overall field from the contributions of each of the three coils.





① *Broadband 30 Hz to 32 kHz*



② *Selective 50.0 Hz*

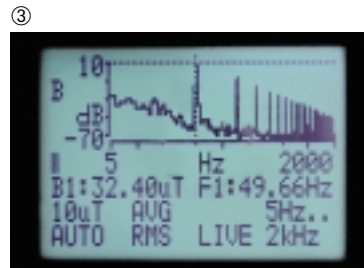
Broadband and selective measurements

All Narda Safety Test Solutions measurement products allow broadband measurements, which provide an indication of the total field strength exposure. With its built-in frequency counter, the EFA series also provides additional information about the frequency of the strongest signal components. ①

Selective measurements ② can be used to measure or suppress individual frequencies. The EFA instruments provide bandpass and band reject filters for this purpose. With these individual measurements, you can choose to see either the RMS value or the peak value.

Automatic FFT spectrum analysis

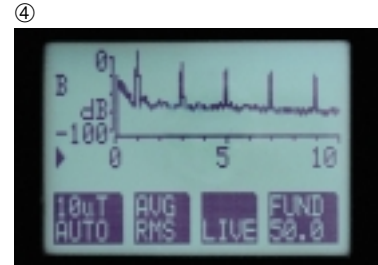
The FFT mode in the EFA instruments also greatly simplifies your job. ③ You can rapidly assess multifrequency signals up to 32 kHz using spectrum analysis, and just read off the magnitude at each frequency. The time domain behavior of the signal recorded via the probe is automatically converted using a Fast Fourier Transform (FFT), which analyzes the spectral components simultaneously. The EFA instruments are powerful enough to even analyze transients as fast as 2 kHz in real time.



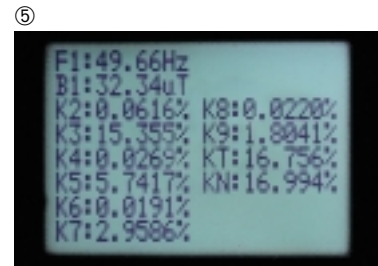
③

Evaluation of the harmonic spectrum

Harmonic analysis can be used to automatically measure the entire harmonic spectrum with the EFA. ④ The instrument display shows the fundamental frequency and its harmonics (multiples of the fundamental), providing a fast overview of the quality of service. This function can also be used to determine the percentage proportions of non-harmonics. ⑤



④



⑤

*K2 to K9: Harmonics
KT: Total harmonics
KN: Total harmonics and non-harmonics*

Shaped FFT

In FFT mode, it is possible to normalize the display to a selected limit curve. The measured value is displayed relative to the associated limit. In graphical terms, the limit curve becomes a straight line. This

makes it easy to read off the importance of each spectral component. ⑥



Selected standard ICNIRP
General public

Innovative “Shaped Time Domain” (STD) measurement technique

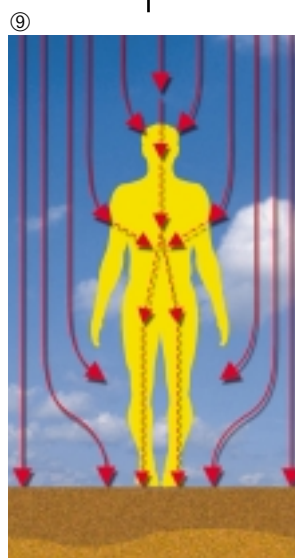
In order to properly evaluate exposure due to low frequency fields, you need exact knowledge of the field and the measuring devices in many situations. Here, the **STD** mode provided by the EFA instruments greatly simplifies everyday measurements. The frequency variations of the different limits are automatically taken into

account. Suitable detectors are provided to measure the RMS and peak values. The phase shift of the individual components is also taken into account in the result. The B or E field is measured over the entire frequency range in real time, and displayed as a percentage of the limit value. Signals with one or more frequencies are correctly evaluated, as are pulsed signals. ⑦

STD
is an innovative measurement technique for making non-signal-shape-dependent field measurements.



Magnetic field



Electric field

Interaction between
body and field lines



Selected standard ICNIRP
General public

Remote measurement of electric fields

While the magnetic field ⑧ is barely affected by ambient conditions, the electric field ⑨ is sensitive to condensation, humidity, fog and even the presence of people. Eliminating the influence of the body entails measuring with a remote sensor and using the EFA-300's remote E-field module with the tripod. ⑩

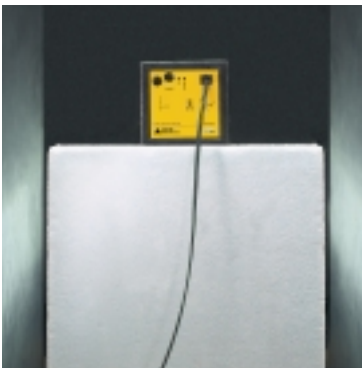


Our Calibration and Repair Service

Setup for magnetic field calibration



Setup for electric field calibration



Test equipment and probes from Narda Safety Test Solutions are supplied in calibrated form. Traceability to national standards as per ISO/IEC 17025 is directly indicated on the calibration certificate for the majority of our products.

Recalibration of instruments in the EFA and ELT ranges as well as of low frequency probes is done in Germany, where our

repair service is also located. You can send probes and instruments to us directly or via one of our sales associates.

Seminars, Courses and Safety Training

The American and German sites both offer comprehensive occupational safety training as well as training for HF / RF / Microwave. Participants will become familiar with:

- Basic fundamentals
- Individual measurement techniques
- Guidelines for an overall safety concept.

If you want customized training, please contact your sales associate or Narda Safety Test Solutions in the US or Germany.

Seminars are given in the local language of the country where they take place.



For current information about our **seminars**, visit www.narda-sts.com



Our 3 Level Training covers the basic principles, measurement procedures and on site application training.

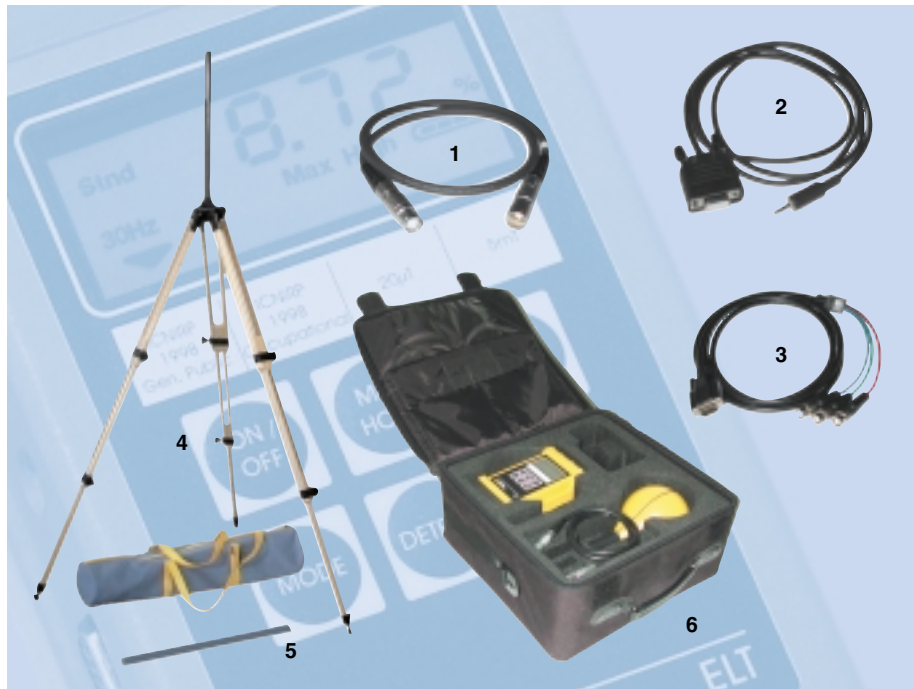
Accessories for EFA-200/300

1. EFA Tools
(included with the EFA-200/EFA-300)
2. Transport Bag
(included with the EFA-200/EFA-300)
3. Tripod
(included with the EFA-300)
4. Tripod Extension Rod
5. Precision B-Field Probe, 100 cm²
6. B-Field Probe, F Ø 3 cm
7. Antenna Extension Cable
8. EFA-TS
Analysis software



Accessories for ELT-400

1. Antenna Extension Cable
2. RS232 Interface Cable
3. Analog Interface Cable
4. Tripod
5. Tripod Extension Rod
6. Transport Bag



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