Field Analyzer System

EFA-3

REG.NO 10 572 - 02
Wandel & Goltermann Germany

EFA-3

Analyzes magnetic and electric fields from 5 Hz to 30 kHz

- **Isotropic (non-directional) measurement**
- **Measuring range from 5 nT to 10 mT; 0.1 mG to 100 G and 0.1 V/m to 100 kV/m**
- **True RMS and peak value measurement**
- **Spectral recording of field components**
- **Built-in frequency counter**
- **Adjustable alarm threshold (visible/audible)**
- **User-definable filter frequency in 0.1 Hz steps**
- **Timed measurements**
- **User-definable setups**
- **Calibrated**

Applications

Measurement of magnetic and electric field strength in the low-frequency range for ensuring workplace safety in areas subject to electromagnetic radiation. Additional applications in EMC testing.

Characteristics

The EFA-3 Field Analyzer System is compact, battery-powered and simple to use. It is optimized for personal-safety applications, as are described in recommendations published by the ICNIRP (International Commission on Non-Ionizing Radiation Protection), WHO (World Health Organization) and many other national bodies (e. g. VDE, NRPB, IEEE). One special feature offered by the devices is spectral evaluation of field components, allowing selective investigation of the field. The devices also set a new standard for precision in the handheld category, and their technical specifications are traceable back to national standards.

Probes

To supplement the built-in three-dimensional magnetic-field probe and the external E-field probe, precision H-field probes conforming to VDE and IEEE standards (A = 100 cm^2) are available. A miniature version (∅ 3 cm) is useful for recording local fields in extremely tight spaces.

Data recording and management

Three-dimensional isotropic probes are used to record data, allowing non-directional measurement. The recorded data can be printed directly via the printer interface or exported to a suitably equipped PC for further evaluation. EFA-3 makes it easy to record, store and evaluate series of measurements. The timed recording function makes long-term measurements (lasting up to 24 h) very simple.

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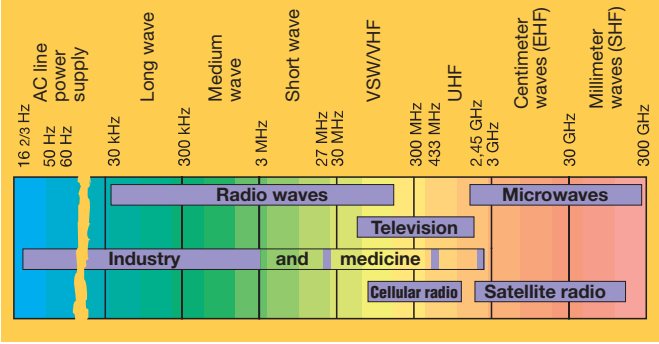
Fields of application

The diagram shows some typical applications where electromagnetic radiation occurs or is utilized. The frequency spectrum is normally divided into two areas:

1: Low frequencies up to about 30 kHz,
2: High frequencies above 30 kHz (see EMR data sheets).

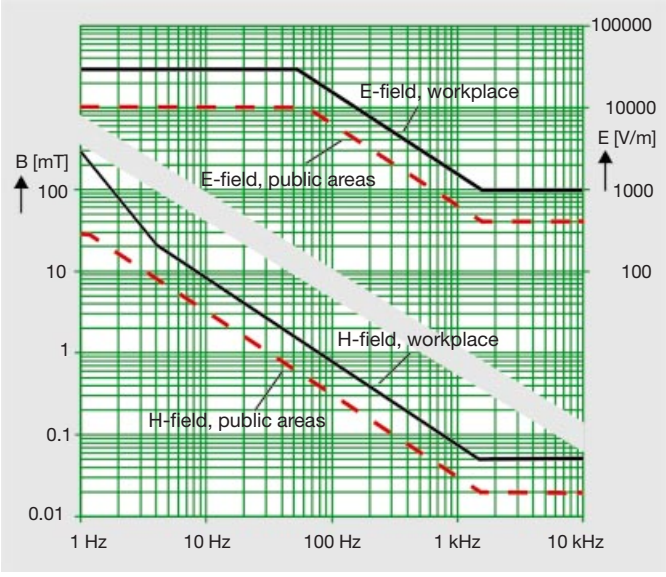
Knowledge of the frequency is important when monitoring limit values for electromagnetic fields because these limit values vary with frequency.



Frequency ranges of electromagnetic radiation encountered in everyday life.

Limit values

Work on defining legally binding limit values for electromagnetic radiation is currently being done at national and international levels. The limit values specified in the draft CENELEC European standard are quoted here as an example.



Limit values for electromagnetic radiation. Further details are found in the draft European standard CENELEC 50166-1.

Limit values for common industrial frequencies, derived from the above-mentioned draft standard:

	16 2/3 Hz	50 Hz	60 Hz	400 Hz
Workplace	30 kV/m 4.8 mT	30 kV/m 1.6 mT	25 kV/m 1.33 mT	3.75 kV/m 0.2 mT
Public areas	10 kV/m 3.25 mT	10 kV/m 0.64 mT	10 kV/m 0.53 mT	1.5 kV/m 0.08 mT

Electric and magnetic fields

An electromagnetic field can be split into two components: the electric field E [measured in V/m] and the magnetic induction B [measured in G or T]. The low frequency means that the electric field and the magnetic field must be measured independently. The direct conversion of E to H, possible under far-field conditions at high frequencies, cannot be used in this case.

The EFA-3 Measuring System

The EFA-3 Measuring System consists of two parts, the main instrument with built-in sensors for measuring magnetic fields, and the E-field sensor which is connected to it by a fiber optical cable. In contrast with magnetic fields, electric fields are easily distorted by the presence of conductive material (including the human body with its high water content). The sensor therefore has no display and no controls. The main instrument performs these functions via the optical cable.
A magnetic field probe with a coil area of 100 cm^2 can also be connected to the main instrument, allowing non-homogeneous fields to be measured in accordance with the relevant standards.

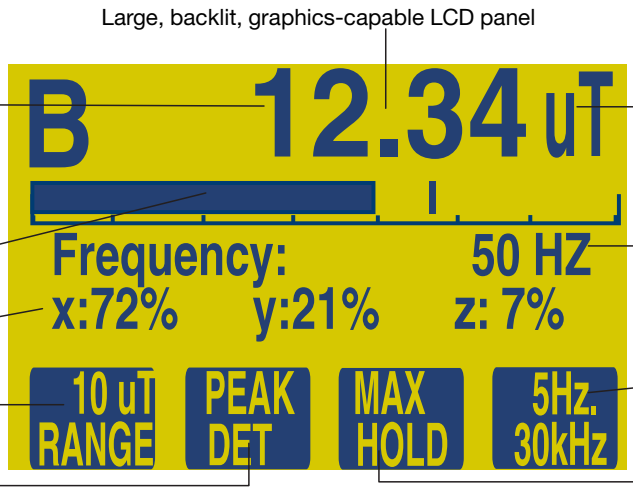
Non-directional measurement

Often, an electromagnetic field will not be due to a single source, but it will generally be caused by several sources from different directions. To be able to correctly determine the radiation exposure, any measurement must be non-directional, i.e. isotropic. The value measured by an isotropic instrument is also not affected by the position in which the instrument is used. For these reasons, the EFA-3 and all of the external probes which can be used with it are equipped with three sensors which measure the field strength of the X, Y and Z directions separately. The instrument calculates the equivalent field strength from these three values and displays this along with the polarization of the field.

Selective measurement and frequency counter

When measuring an unknown field, the built-in frequency counter indicates the frequency of the strongest signal measured. This allows an initial guess as to the source of the field. If more information regarding the nature of the field is required, the selection filters allow a more detailed analysis of the field components. This

EFA-3 display



makes it easy, for example, to determine the radiation level emanating from a VDU workstation which is due to the power supply (50 or 60 Hz) and that due to the display refresh rate (e.g. 72 Hz). The variable filter is a particularly useful feature. This can be set to any frequency between 15 Hz and 2000 Hz.

The EFA also has fixed selection filters for the main power supply line frequencies of 16⅔ Hz (railways), 50/60 Hz (domestic a.c. power) and 400 Hz (aircraft and shipboard power), and for the first and second harmonics of these frequencies:

Fundamental	2nd harmonic	3rd harmonic
16⅔ Hz	33⅓ Hz	50 Hz
50 Hz	100 Hz	150 Hz
60 Hz	120 Hz	180 Hz
400 Hz	800 Hz	1200 Hz

All of the above features can be used when measuring the magnetic field as well as the electric field.
Additional Notch filters (16⅔, 50 and 60 Hz) are available.

Applications and tips:

- Workplace, 115 V/230 V power supply
  Minimal electric field, can easily be screened by metal or metallized casings. Measurement of magnetic field is normally sufficient.

- VDU workstation
  Magnetic fields due to the power supply and the magnetic and electric fields caused by the screen refresh rate can be detected by the EFA-3. Components due to higher frequencies such as the line scan frequency can be detected with products from the EMR range.

- AC power supply line switching equipment and high-tension cables
  The high voltages involved here mean that both the electric field and the magnetic field measurements are of importance; EFA-3 measures both.

- Domestic
  Mainly interference caused by power supply-induced magnetic fields. Microwave ovens can be checked using products from the EMR range.

PC Transfer Set

If high field strengths are to be measured or long-term monitoring is required, the measured values can be transferred to a PC or printer using an optical interface and the Transfer Set. The ETS-1 PC-Tansfer Set is the link between the EFA and your PC. A simple mouse click reads the measurement data into the computer where it can be further processed using standard evaluation software such as Excel™. The EFA-3 can, in fact, store up to 4000 measured values, complete with timestamp and all parameters, so it is capable of long-term monitoring without needing to be connected to a PC or printer. The results can be displayed later or read out together with all major parameters by using the Transfer Set mentioned above.

	with internal sensor	with option BN 2245/90.10	with external E-field sensor
Frequency range	5 Hz to 30 kHz (3 dB)		
Measurement principle	true triaxial RMS or peak value measurement		
Directional pattern H/V	switchable: isotropic (three-dimensional) or unidirectional		
Measuring range at 50/60 Hz	50 nT to 10 mT or 5 nT to 10 mT with selective filter	10 nT to 10 mT or 1 nT to 10 mT with selective filter	0,5 V/m to 100 kV/m with selective filter
Display resolution	0.1 %	0.1 %	0.1 %
Measurement accuracy	for f = 50 to 400 Hz, broadband (5 Hz to 2 kHz) or selective		
	±5 %, B ≥ 500 nT	±3 % ±1 nT, B ≥ 40 nT	±5 % ±1 V/m, E ≥ 6 V/m
	for f = 50 Hz to 5 kHz, broadband (5 Hz to 30 kHz)		
	±8 %, B ≥ 500 nT	±3 % ±1 nT, B ≥ 40 nT	±5 % ±1 V/m, E ≥ 6 V/m
	for f = 16,7 Hz, broadband (5 Hz to 2 kHz) or selective		
	±6 %, B ≥ 500 nT	±5 % ±1 nT, B ≥ 40 nT	
Filter functions	Broadband measurement with frequency counter: 5 Hz to 2 kHz / 5 Hz to 30 kHz / 30 Hz to 2 kHz / 30 Hz to 30 kHz Selective measurement: 16.67 Hz / 50 Hz / 60 Hz / 400 Hz / 2nd and 3rd harmonics		

Display and warning device
Display refresh rate . . . . . approx. 3/s
Settling time (100 %) . . . . . approx. 2 s
Display type . . . . . liquid crystal display (LCD), backlit
Visible warning . . . . . red LED
Audible warning . . . . . built-in beeper

Selection of measurement range . . . . . manual or fully automatic

Measurement functions
Units . . . . . nT, µT, mT, mG, G, V/m, kV/m
Detection . . . . . RMS or peak rectification, selectable
Result indication . . . . . current equivalent field strength and field components
Alarm functions . . . . . threshold adjustable, ON/OFF
Frequency display . . . . . frequency of max. signal
Calibration data . . . . . probe factors settable

Self-tests
Automatic self-test after power-on

Calibration
Calibration included, calibration report as option
Recommended confirmation interval . . . . . 24 months

Interfaces
Interface for calibration and measurement data transfer . . . . . V.24 (RS232) optical

Results storage
Automatic timed measurement or manual storage of results (4000 complete results incl. instrument setup and time)

User-definable setups
Storage and recall of four independent device setups

Additional filters
User-defined selective filter (any frequency 15 Hz to 2 kHz)

General specifications

Power supply, main instrument
Rechargeable cells . . . . . 5 × KR14 (1.2 V)
Dry batteries . . . . . 5 × R14 (1.5 V)
Operating time, rechargeable cells/dry batteries . . . . . typ. 10 h/typ. 20 h
Time controlled measurements up to 24 h with rechargeable cells
Charging . . . . . with LNT-1x charger supplied

Power supply, external E-field sensor
fixed built-in rechargeable cells
Operating time . . . . . typ. 10 h
Time controlled measurements up to 24 h
Charging . . . . . with LNT-1x charger supplied

Ambient temperature
Range of use . . . . . 0 to +50 °C

Dimensions (w × h × d) in mm
Main instrument . . . . . approx. 110 × 200 × 60
E-field sensor . . . . . 104 × 104 × 104

Weight (incl. batteries)
Main instrument . . . . . approx. 1000 g
E-field sensor . . . . . approx. 1000 g

Ordering information

Field Analyzer System EFA-3 incl. Notch filter/Remote control	**BN 2245/03**
Supplied with: external E-field sensor, carrying bag, fiber cable (10 m), tripod, NiCd battery set	
2 Charger units (please specify type):	
LNT-10 Euro version	BN 7510/90.02
LNT-11 UK version	BN 7510/90.15
LNT-15 US version	BN 7510/90.21
LNT-12 Australien version	BN 7510/90.18
LNT-14 Japan version	BN 7510/90.20

Options:	
Calibration report	BN 2245/90.03
Precision H-field sensor A = 100 cm²	BN 2245/90.10
Precision H-field sensor ∅ 3 cm with conn. cable 1.2 m	BN 2245/90.20
Accessories:	
Extension cable for BN 2245/90.10	BN 2244/90.35
NiCd battery set (replacement)	BN 2245/90.04
ETS-1 PC Transfer Set (O/E converter, fiber cables 2 m and 20 m, software disks)	BN 2244/90.34
Warning sign "Electromagnetic Radiation"	
large, 2 pieces	BN 2244/90.36
small, 10 pieces	BN 2244/90.37

Other accessories on request

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