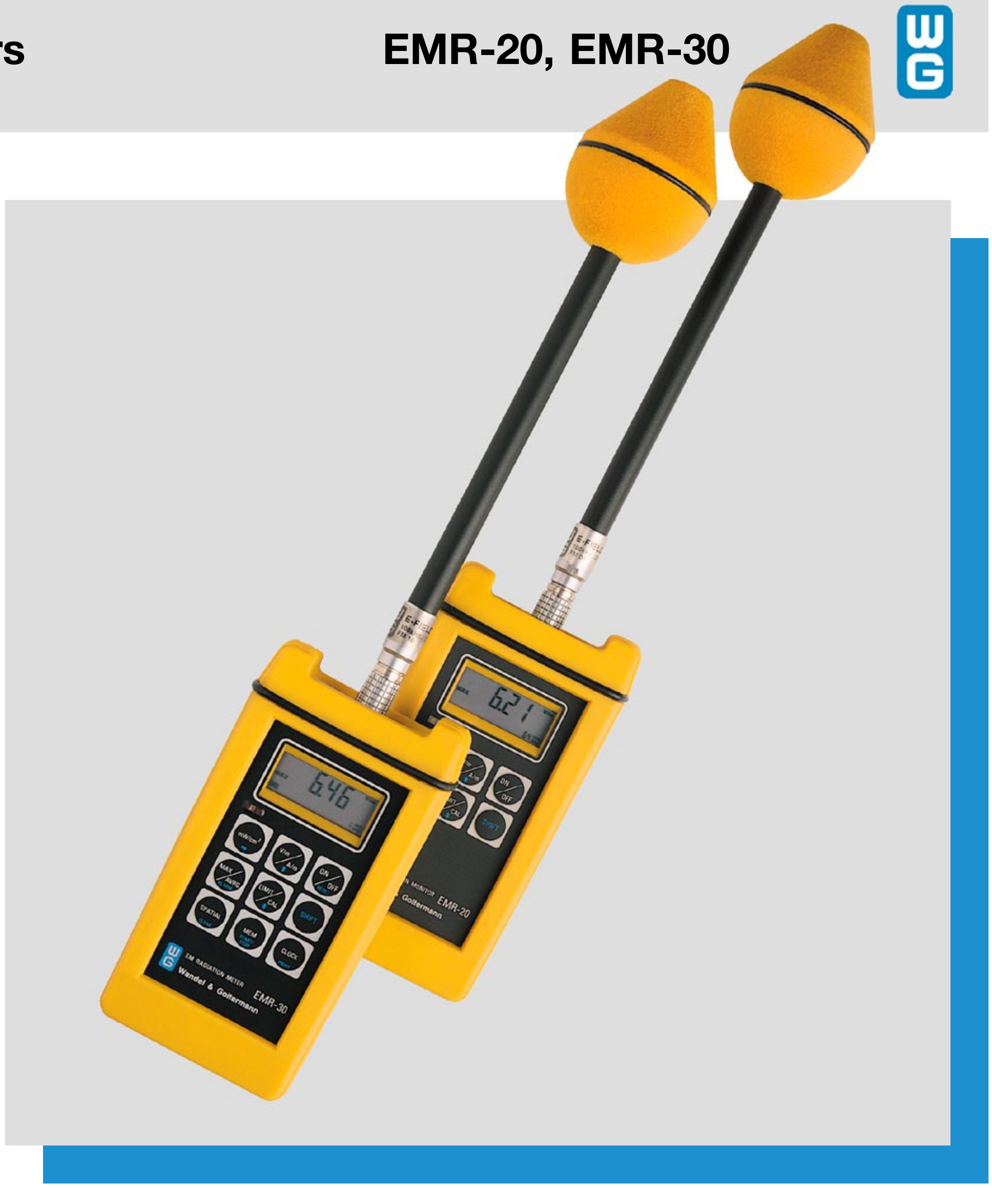
Radiation Meters

EMR-20, EMR-30



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Wandel & Goltermann Germany

CE

EMR-20, EMR-30

100 kHz to 3 GHz
For isotropic measurements of electric fields

- **Non-directional (isotropic) measurement with three-channel measurement probe**
- **High dynamic range due to three-channel digital results processing**
- **Optical interface for calibration and result data transfer**
- **Excellent measurement accuracy with automatic zeroing even during field exposure**
- **Easy to use**
- **Shock, dust and water-resistant**
- **Built-in stand and tripod bush**
- **Calibrated**

Applications
Precision measurement of electric field strength for personal safety at work where high radiation levels are present, and for applications involving electromagnetic compatibility (EMC), such as:
- Service work on transmitting equipment
- Working with plastic welding machines
- Operating diathermy equipment and other medical instruments producing short-wave radiation
- Drying equipment in the tanning and timber industries
- Field strength measurements in TEM cells and absorber chambers

Features
The EMR-20 and EMR-30 Radiation Meters are compact, battery-powered, and easy to operate. The remote sensor is a non-directional measurement probe. The built-in optical interface allows each of the three axes to be evaluated separately and also allows complete remote-control of all instrument functions.

Long operating time from batteries
The EMR-20/30 is equipped with rechargeable batteries as standard. These can be recharged while still fitted in the instrument, and give about 8 hours operating time. If dry batteries are used, up to 30 hours operating time can be expected.

Calibration
Every instrument in the EMR range is calibrated for absolute level and linearity vs. level. Typical frequency response values are also provided (CAL factor) together with a calibration certificate. The frequency response of every C-series instrument (EMR-20C/30C) is measured individually, and a calibration report containing all the measured values is included with the instrument. The instruments can be calibrated automatically via the bi-directional optical interface. This allows easy calibration by the user or by recognized national calibration laboratories, resulting in a significant reduction

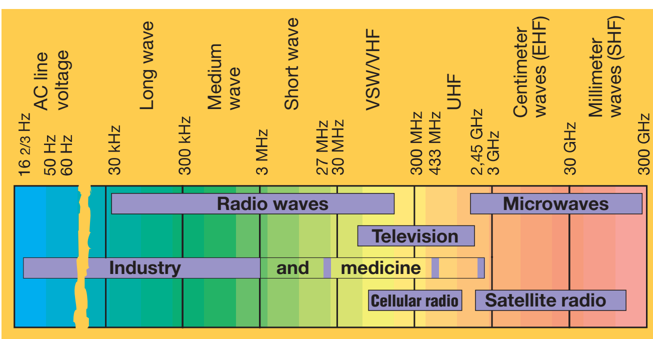
in the cost of regular re-calibration, which is recommended for all field measuring instruments.

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.
This region includes some railway system overhead power supplies running at 16⅔ Hz, domestic a.c. power at 50/60 Hz and extends up to VDU workstations at 30 kHz (see EFA data sheets).

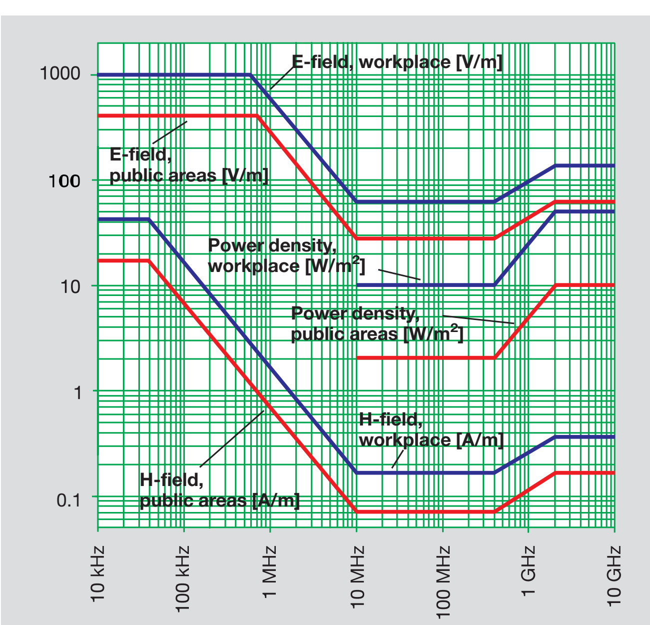
2: High frequencies above 30 kHz.
Typical frequencies encountered here are FM radio (88 to 108 MHz), television signals (40 to 900 MHz), mobile radio (400 to 1800 MHz) and satellite communications (up to 18 GHz). Other frequencies which are often used in industry and medicine are 27, 433 and 2450 MHz. Knowledge of the frequency is important when monitoring limit values for electromagnetic fields because these limit values depend on the 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.

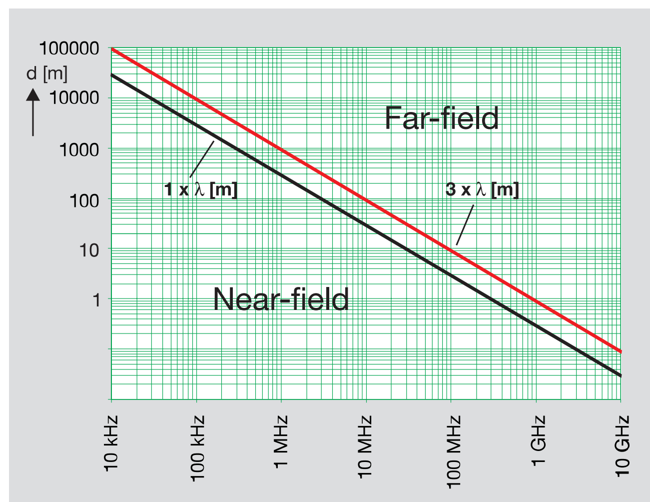


Limit values for common industrial and medical frequencies, derived from the above-mentioned draft standard:

	27 MHz	433 MHz	2.45 GHz
Workplace	61.4 V/m 0.16 A/m 10 W/m^2	63 V/m 0.17 A/m 11 W/m^2	137 V/m 0.36 A/m 50 W/m^2
Public areas	27.5 V/m 0.07 A/m 2 W/m^2	28 V/m 0.08 A/m 2.2 W/m^2	61.4 V/m 0.16 A/m 10 W/m^2

Near-field and far-field

Electromagnetic fields can be split into two components: the electric field E [measured in V/m] and the magnetic field H [measured in A/m]. The E-field and H-field are strongly interdependent for the far-field, i.e. anywhere more than a certain distance from the source (see diagram). If, say, the H-field is measured in this region, the magnitude of the E-field and the power density S [W/m] can be calculated from it. In contrast, the H-field and E-field must be measured separately in the near-field region.



Near-field and far-field definition. Measurements at a distance d of 1 x wavelength λ (better: 3 x λ) from the source are made under far-field conditions.

Applications and tips

- Induction heaters, RF welding equipment and erosion machines: Electric fields are less important here, the magnetic fields need to be monitored. Use EMR-10/EMR-10C Magnetic Field Meter
- Radio and TV transmitters/antennas: As long as the location is in the far-field region, an E-field sensor is preferable due to the large bandwidth (EMR-20/EMR-30). When working close to antennas (near-field) separate checking of the E-field and the H-field is unavoidable (use EMR-20/EMR-30 for E-field, EMR-10 for H-field)
- Diathermy equipment (RF equipment for medical therapy): Very high field strengths are present at the electrodes and on the connecting leads to the electrodes. The main component is normally the electric field (use EMR-20/EMR-30).
- Microwave ovens: The very short wavelength means that exposure is normally in the far-field. E-field measurements are therefore sufficient (use EMR-20/EMR-30)

◀ Limit values for electromagnetic radiation.
Further details are found in the draft European standard CENELEC 50166-2.

Spatial averaging

The spatial distribution of a field is seldom homogeneous, even within the confines of a low-reflection absorber chamber. Measurements at several points within the area are thus needed. By measuring at different positions, it is also possible to estimate complete body exposure levels. The root mean square of these values is required. The EMR-30 makes light work of this. When set to Spatial Averaging mode, a new measurement is made simply by pressing a key. The squares of these values are summed automatically, providing a display of the average field strength for the area. If the “Spatial” key is held down, the EMR-30 will calculate the average for the time that the key was pressed.
All instruments in the EMR range are also equipped with an averaging function for the 6-minute average specified by the relevant standards.

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 ETS-1 Transfer Set.
All products in the EMR range can also be fully remote-controlled via this interface. The software supplied with the Transfer Set makes it easy to record the results and then process them using programs such as Excel. The EMR-30 can, in fact, store up to 1500 measured values, complete with timestamp and all parameters, so it is capable of monitoring for a whole day 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 ETS-1 Transfer Set.
The Transfer Set allows independent output of the measured values, i.e. spatial field strength and the three measurement axes X, Y and Z.

Spatial averaging

Non-directional measurement

Free-space electromagnetic fields are seldom due to a single source, but are generally the result of several transmitters 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 probe of the EMR-20/EMR-30 is fitted with three sensors which measure the field strength of the X, Y and Z directions separately. The field strength is calculated by the instrument’s processor by summing the squares of the three measured values. This method has the advantage over conventional analog summing within the probe that all three sensors can be independently calibrated to achieve very high linearity. It also eliminates dependence on the square-law sensor characteristic which leads to large measurement errors as it no longer holds true at high field strengths. Use of this novel, innovative method means that the EMR-20 and EMR-30 can measure the entire field strength range from 1 V/m to 800 V/m for the first time using just a single probe. This simplifies measurement and makes the purchase of additional probes unnecessary.

Zeroing

Normally, an instrument for measuring electromagnetic radiation requires zeroing every time it is switched on or the temperature changes, if accurate measurements are to be obtained. Up till now, the instrument had to be placed in a room where no field was present in order to zero it. More often than not, such a room is not available, and the whole procedure is inconvenient. A new zeroing method is used in the EMR range of products that is fully automatic and which is also valid even in the presence of high field strengths. The measurement errors due to inaccurate zeroing can be excluded as far as the EMR range of instruments is concerned.

Rugged casing

The casing is specially constructed to withstand shocks and impacts, to allow use under difficult conditions, e.g. outdoors or at industrial sites. The basic unit includes anti-slip, impact-resistant shock protection. All mechanical connections such as the test probe are designed to withstand rough handling. Practical details like the tripod bush and built-in stand make the instrument equally suitable for laboratory applications.

Radiation measurement

Type . . . electrical field (E)
Frequency range . . . 100 kHz to 3 GHz
Specified measurement principle . digital triaxial measurement
Directional pattern . . . isotropic, 3-dimensional
Measurement range
CW signals (f > 300 kHz) . . . 0.6 V/m to 800 V/m
true RMS . . . 0.6 V/m to 20 V/m
Range selection . . . one single continuous range with > 62 dB dynamic
Display resolution . . . 0.01 V/m
Absolute error at 27.5 V/m and 27.12 MHz . . . ±1 dB
Linearity referred to 27.5 V/m and 27.12 MHz
from 0.6 V/m to 1.25 V/m . . . ±3 dB
from 1.25 V/m to 2.5 V/m . . . ±1 dB
from 2.5 V/m to 400 V/m . . . ±0.5 dB
from 400 V/m to 800 V/m . . . ±0.7 dB
Frequency response:
EMR-20C/-30C with consideration of CAL factor and inclusive of calibration accuracy
from 100 kHz to 100 MHz . . . ±0.45 dB
from 100 MHz to 3 GHz . . . ±1.4 dB
EMR-20/-30 with consideration of typical CAL factor
from 100 kHz to 100 MHz . . . ±1.0 dB
from 100 MHz to 1 GHz . . . ±1.5 dB
from 1 GHz to 3 GHz . . . ±2.4 dB
Isotropic deviation
Field sensor only . . . typ. ±0.5 dB for f > 1 MHz
Field sensor plus radiation meter . . . typ. ±1.0 dB for f > 1 MHz
Temperature dependency (0 to +50 °C) . . . +0.2/–1 dB
Overload protection CW / impulse . . . 0.7 W/cm² / 70 W/cm²
Suppression H/E
from 100 kHz to 5 MHz . . . > 35 dB – 20 dB × log (f/MHz)
above 5 MHz . . . typically > 20 dB
Settling time . . . typically 1 s (0 to 90% of meas. value)
Display refresh rate . . . typically 400 ms

Display and warning circuits

Display type . . . LCD, instrument specific
Visible warning . . . bright red LEDs in the foil keypad
Audible warning . . . built-in piezoelectric device, tone sequence depending on measured value

Measurement functions

Units . . . V/m, A/m, mW/cm², W/m², % of limit value
Detection . . . diode rectifier
Result display . . . current result or maximum value since switch-on
Averaging . . . current result or 6-minute average
Alarm functions . . . variable threshold and on/off
Calibration data . . . one CAL factor settable

Self tests

Automatic switch-on self test of
A/D converter, battery, supply voltages, memory and zero adjustment.
Periodical zero adjustment and battery check during operation.
All tests can be performed during exposure to the field.

Calibration

EMR-20/-30 with linearity calibration certificate and typical CAL factors for frequency response included.
EMR-20C/-30C with calibration report and special calibration of frequency response, isotropy and linearity.
Recommended confirmation interval . . . 24 months

Interfaces

Serial interface for results transfer, remote operation and calibration . . . V.24 (RS232) optical/bidirectional

Additional functions EMR-30/EMR-30C

Result storage . . . 1500 values
Real-time clock
Spatial averaging within a time period or over measurement points.

General specifications

Power supply
Rechargeable batteries . . . 2 × Mignon (AA) 1.2 V
Dry batteries . . . 2 × Mignon (AA) 1.5 V
Operating time
rechargeable / dry batteries . . . typ. 8 h / > 15 h
Recharging . . . using NT-20 Charger Unit supplied

Ambient temperature
Operating range . . . 0 to +50 °C

Dimensions (w × h × d) in mm . . . approx. 96 × 64 × 465 (incl. sensor and impact protection)

Weight (incl. batteries) . . . approx. 450 g

* Unless otherwise stated, the data are valid for the following conditions:
sinusoidal signals;
instrument in the far-field of the source, sensor showing to the source;
ambient temperature 23 °C ±3 °C;
relative air humidity 25 to 75 %.

Ordering information

EMR-20 Radiation Meter	**BN 2244/20**
EMR-20C Radiation Meter with special calibration	**BN 2244/70**
EMR-30 Radiation Meter	**BN 2244/30**
EMR-30C Radiation Meter with special calibration	**BN 2244/80**
Supplied with:	
Impact protection with strap and tripod bush	
NiCd cells, Mignon (AA) size	
NT-20 Charger Unit (please specify type)	
Euro version	BN 2238/90.02
UK version	BN 2238/90.03
US version	BN 2238/90.04
Australian version	BN 2238/90.05
Accessories:	
Soft case	BN 2244/60
Tripod, non-metallic	BN 2244/90.31
Support, non-metallic	BN 2244/90.32
Warning sign “Electromagnetic Radiation”	
large, 2 pieces	BN 2244/90.36
small, 10 pieces	BN 2244/90.37
ETS-1 PC Transfer Set (O/E converter, fiber cable, floppy disk)	BN 2244/90.33
NiCd/NiMH battery charger (Euro version)	BN 2237/90.03
Handheld test generator, 27 MHz	BN 2244/90.38
Sensor extension, 1.2 m, flexible	BN 2244/90.35
Storage case, aluminium-lined	BN 2244/62

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