

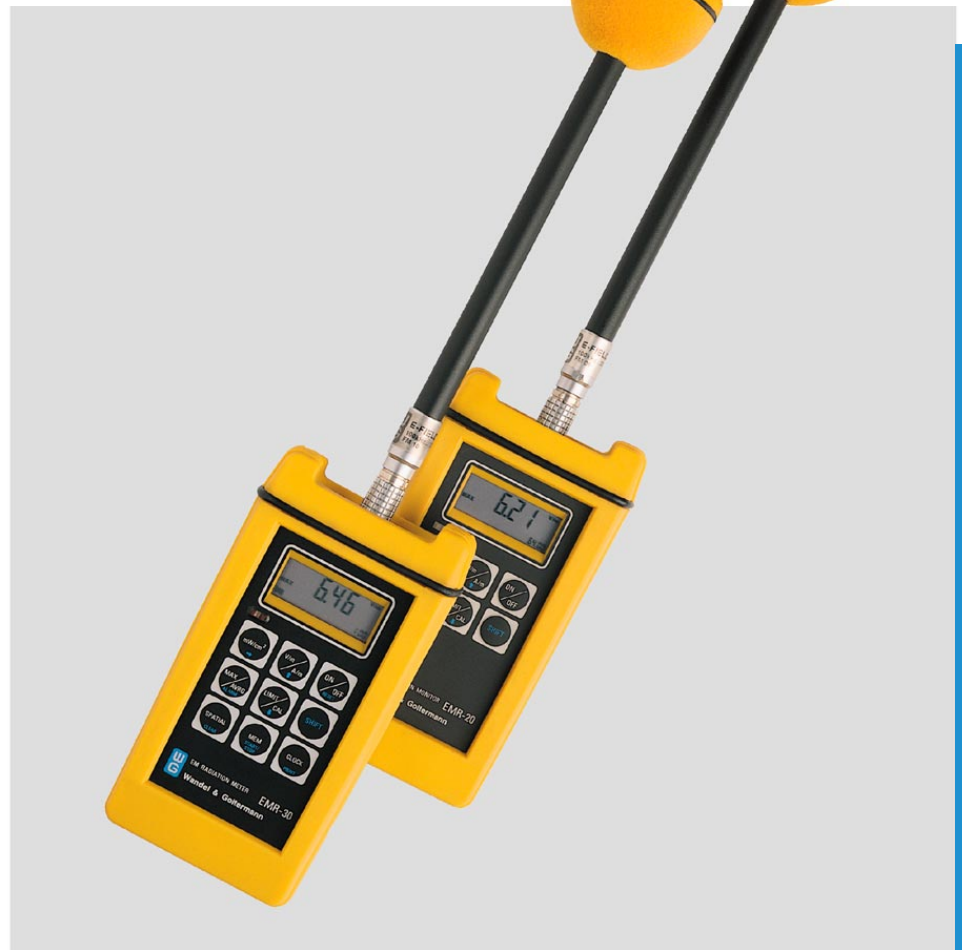


REG. NO. 572-02
Wandel & Goltermann Germany



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

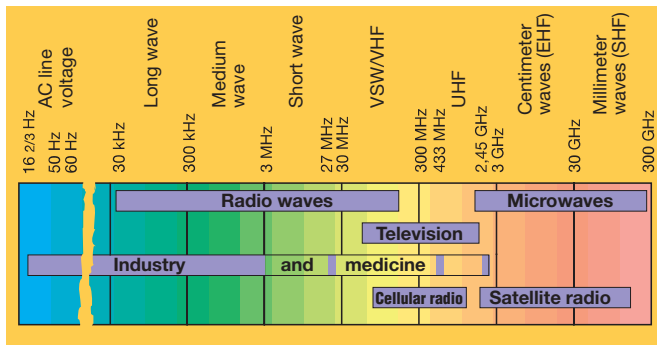
The diagram shows some typical applications where electromagnetic radiation occurs or is utilized. The frequency spectrum is normally divided into two areas:

1: Low frequencies up to about 30 kHz.

This region includes some railway system overhead power supplies running at $16\frac{2}{3}$ 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.

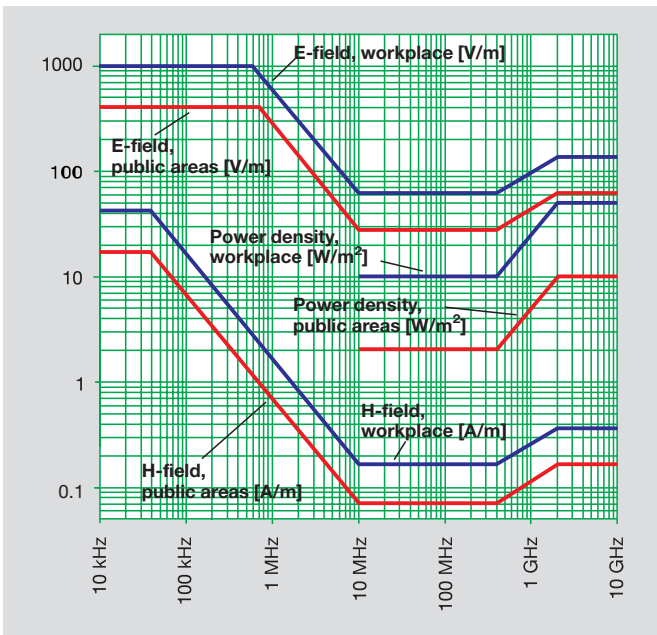
Typical frequencies encountered here are FM radio (88 to 108 MHz), television signals (40 to 900 MHz), mobile radio (400 to 1800 MHz) and satellite communications (up to 18 GHz). Other frequencies which are often used in industry and medicine are 27, 433 and 2450 MHz. Knowledge of the frequency is important 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.

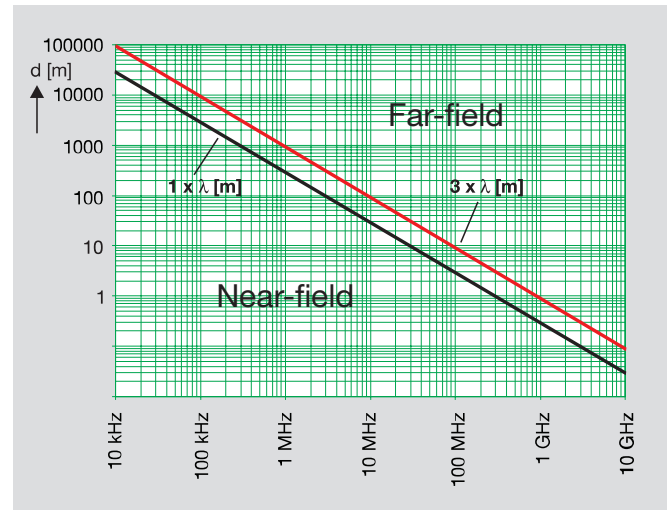


Limit values for common industrial and medical frequencies, derived from the above-mentioned draft standard:

	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/m²] 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: $3 \times \lambda$) 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.



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.

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.



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.

<p>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</p> <p>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</p> <p>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</p> <p>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</p> <p>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</p> <p>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</p>	<p>Averaging current result or 6-minute average</p> <p>Alarm functions variable threshold and on/off</p> <p>Calibration data one CAL factor settable</p> <p>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.</p> <p>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</p> <p>Interfaces Serial interface for results transfer, remote operation and calibration V.24 (RS232) optical/bidirectional</p> <p>Additional functions EMR-30/EMR-30C Result storage 1500 values Real-time clock Spatial averaging within a time period or over measurement points.</p> <p>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</p> <p>Ambient temperature Operating range 0 to +50 °C</p> <p>Dimensions (w × h × d) in mm approx. 96 × 64 × 465 (incl. sensor and impact protection)</p> <p>Weight (incl. batteries)..... approx. 450 g</p> <p>* 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 %.</p>
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Ordering information

<p>EMR-20 Radiation Meter BN 2244/20 EMR-20C Radiation Meter BN 2244/70 with special calibration</p> <p>EMR-30 Radiation Meter BN 2244/30 EMR-30C Radiation Meter BN 2244/80 with special calibration</p> <p>Supplied with: Impact protection with strap and tripod bush NiCd cells, Mignon (AA) size NT-20 Charger Unit (please specify type)</p> <p>Euro version BN 2238/90.02 UK version BN 2238/90.03 US version BN 2238/90.04 Australian version BN 2238/90.05</p>	<p>Accessories:</p> <p>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 BN 2244/90.33 (O/E converter, fiber cable, floppy disk) 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</p>
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