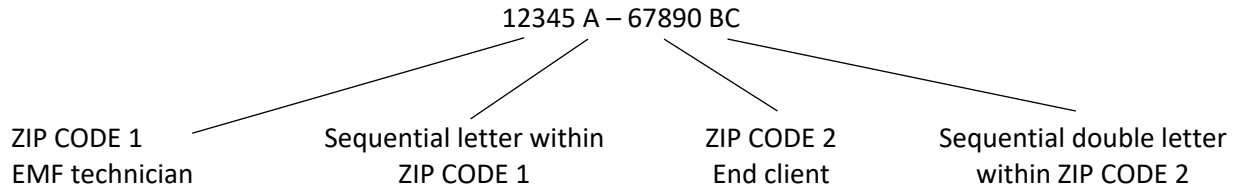
1 Purpose of the data collection form

The Physics Section of the German Association of Building Biology Professionals (VDB) has set itself the goal of collecting EMF measurement data that provide information on typical EMF exposure levels in sleeping areas – similar to the AGÖF percentiles for indoor air pollutants – and that can be statistically evaluated.

To collect the data, a data collection form has been developed that allows the exposure levels to extremely low frequency (ELF) electric and magnetic fields and radio frequency (RF) radiation to be recorded according to a standardized scheme and under as identical testing conditions as possible. This standardization is a necessary prerequisite for the comparability of measurement results obtained in different bedrooms by different EMF technicians and for meaningful statistical evaluation.

The data recorded by the EMF technician on the data collection form are stored in a database at the VDB. During the pilot phase of the project, the data will be entered into the database at the VDB office; later, online data entry by the EMF technician is planned.

The data in the database are recorded anonymously with regard to the measurement site or the client of the EMF technician by means of a code number, which only the EMF technician can use to establish the relationship between the data and the client. The code has the following structure:



The first six digits of the code identifying the technician are issued by the VDB office after registration in the project; the last six digits are assigned by the technician in sequential order.

It is not planned to record medical parameters such as mood disorders and disease symptoms, as this would be very time-consuming and would require medical expertise.

2 Measuring instruments

The measuring instruments used for data collection must meet the following specifications:

ELF electric fields (ELF EF)

3D probes without ground reference (floating) only, RMS detector

To account for the approximation effect of any metal parts in the mattress, place a very clean 2 in (5 cm) high polystyrene block between the electric field meter and the mattress.

ELF magnetic fields (ELF MF)

3D probes only, RMS detector

Sampling rate during long-term recording should not exceed 2 seconds. Record 16.7 Hz and 50 Hz / 60 Hz fields separately.

Radio frequency (RF) radiation

Use of
- Broadband RF meter or
- Spectrum analyzer with calibrated measurement antenna and antenna cable.

Exposure values are expressed in µW/m².

3 Measurement location

The measurement location is the sleeping area (bedrooms and children's rooms).

4 Section 1: Testing conditions and description of the environment

Wherever possible, different alternatives are offered for selection in this section. The selection is made by underlining or circling the applicable parameters. Some of the other sections also contain checkboxes.

Key to abbreviations:

SFDH	Single-family detached house
SDH	Semi-detached house (duplex)
THC	Town house, interior unit
THE	Town house, end unit
MFH	Multifamily house
GF	Ground floor
UF	Upper floor no. … (UF 1, UF 2, etc.)
TF	Top floor

5 ELF electric and magnetic fields

5.1 ELF electric and magnetic field measurement points (3 x 3 measurement grid)

Because the exposure levels across a bed area can vary widely if the field source(s) are coming from inside the home, it is not sufficient to measure at just one point, but the bed area is divided into a grid of 3 x 3 measurement points for the measurement of ELF electric and magnetic fields, as shown in Figure 1.

Since bed dimensions can vary widely in length and width, the grid is defined by the center and sides of the bed. The center grid line is at the center of the bed (horizontal or vertical), and the side grid lines are 4 in (10 cm) from the edges of the mattress.

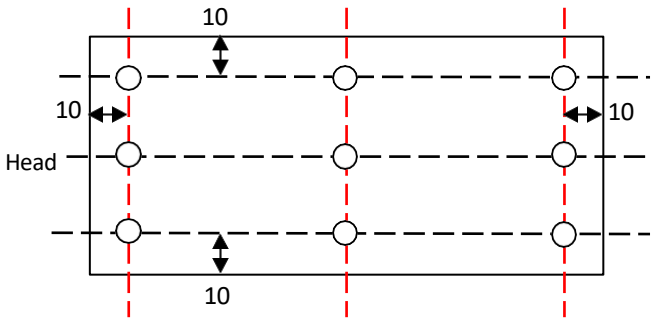


Figure 1:
3 x 3 measurement grid for single and double beds

The 3 x 3 grid above applies to both single and double beds (or two beds are directly adjacent to each other). If there are two separate beds in the bedroom, a separate grid must be created for each bed; for this latter case, two measurement grids are provided on the data collection form. In the case of bunk beds with two bunk levels, two grids must also be created.

The sex of the person(s) is indicated by circling the appropriate symbol when recording the baseline for ELF electric fields, as well as whether the bed is that of an adult or a child (see Figure 2).

First bed or single bed

Head	①	④	⑦	♀ / ♂
	②	⑤	⑧	CH / AD
	③	⑥	⑨	

Second bed / upper bed

Head	①	④	⑦	♀ / ♂
	②	⑤	⑧	CH / AD
	③	⑥	⑨	

CH = child, AD = adult

Figure 2: Section of the data collection form with the 3 x 3 measurement grid for ELF electric and magnetic fields

Note: The order and numbering of the measurement points in the software of different meters varies from manufacturer to manufacturer. The grid layout in the data collection form must always correspond to the scheme given here!

5.2 Situations recorded during ELF measurements

The initial condition is always recorded first (Situation A in the recording sheet). Only the maximum and minimum values need to be entered in the recording sheet, in the correct position at the corresponding grid points. However, the entire grid can be filled in.

5.3 Section 2: ELF electric fields (ELF EF)

If one or more cutoff switches are already present, the initial state for ELF electric fields is the situation where the power is not disconnected (as if no cutoff switch were present). For most cutoff switches, this state can be set manually.

It is also recorded whether the cutoff switch is working at all. To do this, it must disconnect the power when all the lights in the room are turned off. Also, no other devices are turned off and no power cords are unplugged. It will also be recorded whether the cutoff switch disconnects the power only in the bedroom tested or in other rooms as well.

After testing field reduction measures (switching circuit breakers/fuses, reversing the polarity of plugs, testing shielding materials), the resulting exposure levels are also measured and documented as remediation recommendations (Situation B in the recording sheet).

5.4 Section 3: ELF Magnetic Fields (ELF MF)

The first step is to record the current baseline exposure levels found during the site visit (Situation A), and then to record the exposure levels after field reduction measures have been taken, by removing or switching off field sources near the sleeping area (Situation B, remediation recommendations).

A distinction is made between field sources located in the immediate vicinity of the bed (typically less than 2 m), which give different readings at the nine measurement points (non-uniform field), and more distant field sources, which result in a uniform field (the readings at all nine grid points are the same at the same time).

Two meters are used to check the uniformity of the field. One of the nine grid points is used as a reference point at which one meter is placed. The other meter is first placed at the second measurement point and it is observed whether both meters show the same reading at the same time. Repeat this procedure for the other points. It is best to use meters of the same type for this comparison measurement. In any case, make sure that the measurement parameters are set identically (filter, detector).

The magnetic fields of the railway current (16.7 Hz) can always be considered uniform (it would have to be a great coincidence for stray currents from a railway power system to flow through a metal pipe, such as a heating pipe, in the immediate vicinity of the bed).

Relevant loads in the vicinity of the bed – such as clock radios or other devices with a power supply/transformer on the bedside table or power adapters plugged into an outlet next to the bed – are then removed and these exposure levels are also measured and documented (Situation B).

5.5 Section 4: Long-term recording (ELF MF)

In addition, a long-term recording is made with a magnetic field data logger for Situation B (Points C, D, and E on the recording sheet).

The magnetic field data logger shall be placed near or under the bed so that it gives the same readings as a meter at the reference point of the measurement grid (uniform field). It must also be positioned so that it cannot be inadvertently shaken or knocked during the recording period, as this may simulate magnetic field peaks that were not actually present.

The recording period shall be at least 48 hours on workdays, Monday through Friday. If data are recorded over a longer period, only 48 hours from Monday through Friday are selected for statistical analysis (minimum [MIN], maximum [MAX], arithmetic average [AVG], and 95th percentile or centile) (Point C). In addition, the two night intervals from 10:00 p.m. to 06:00 a.m. are evaluated (Points D and E).

When performing a statistical analysis, make sure that only the specified intervals are evaluated and not the entire volume of data – if necessary, use appropriate software that allows this.

6 Radio frequency (RF) radiation

6.1 Measurement point for radio frequency radiation (spatial volume)

For RF measurements, the spatial volume above the bed area is scanned with the Max (Peak) Hold function and a single measurement value is determined for the examined volume (no grid with multiple measurement points!). If there are two beds in the same room (separate beds or bunk beds), only the exposure level in the more exposed sleeping area is documented.

6.2 Situations recorded during RF measurements

Only the current situation is recorded. With the Max (Peak) Hold function, the spatial volume above the bed surface is scanned and the maximum exposure value is recorded.

6.3 Section 5: Radio frequency radiation

Broadband RF meter

Broadband RF meters are used to measure the current exposure level at the time of measurement. In the case of mobile phone base stations, for example, this exposure level depends on the current traffic load.

Broadband RF meters without filters for a specific radio service (RS) only display the sum of all exposure levels. Depending on the antenna used, this exposure value is entered on the corresponding line for the frequency range 800 – 2,500 MHz, 27 – 2,500 MHz, or for another frequency range to be specified on the third line.

If a filter for a specific radio service is available, the exposure values for a single radio service are entered on the corresponding lines under "Sum of RS."

If the filter range in question is used by several radio services (e.g. DVB-T filter of DVB-T and LTE 800 or GSM 1800 of GSM 1800 and LTE 1800), no further distinction between these radio services is possible.

Spectrum analysis

When using frequency-selective spectrum analysis, however, it is important to distinguish between radio services when they share the same frequency band. The table in the data collection form provides many options. In addition to the table field for radar (the radar frequency must be added here), there is a field for an additional relevant radio service to be specified by the EMF technician.

The total exposure level of a given radio service is always recorded as the exposure level (only permanently active control/pilot channels; current value for UMTS) in the corresponding band as the peak value.

If a radio service with a higher crest factor – such as UMTS, DAB+, DVB-T, LTE, or WLAN (Wi-Fi) in active mode (not in standby mode!) – is measured with the RMS detector, the measured value must be increased by 12 dB (factor 4 for power density) to make it comparable with the results from broadband RF meters.