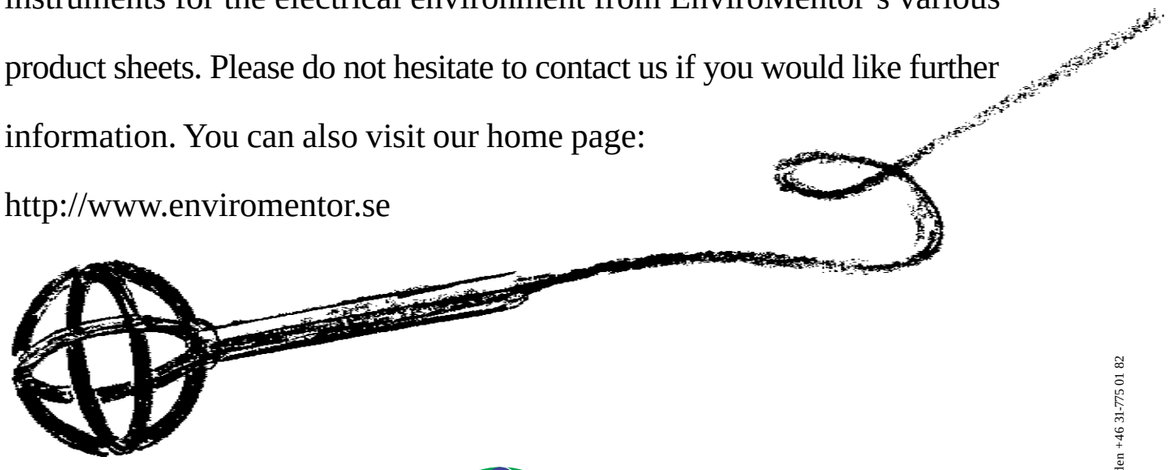
EnviroMentor has both the measuring instruments and the expertise

EnviroMentor AB is a young, skills-based company, yet is also one of the oldest in its field. All of our measuring instruments have been developed in extremely close cooperation with researchers at Chalmers Institute of Technology in Göteborg. EnviroMentor AB is wholly owned by Radians Innova AB, a company which in turn is owned by two of Sweden's most powerful financial institutions. This combination of excellent skills and good financial resources provides us with the potential to carry on continual product development, keeping pace with the latest discoveries made by researchers. You can find out all about our current range of measuring instruments for the electrical environment from EnviroMentor's various product sheets. Please do not hesitate to contact us if you would like further information. You can also visit our home page:

http://www.enviromentor.se



EnviroMentor

A Company in the Radians Innova Group

Postal address: EnviroMentorAB, Box 5124, SE-402 23 Göteborg, Sweden.
Address (visitors): Gamla Almedalsvägen 6, Göteborg. Tel: +46-31-703 44 30. Fax: +46-31-703 44 33.
E-mail: jorgen@enviromentor.se Home page: http://www.enviromentor.se

Karlssons Språkservice AB, Gothenburg, Sweden +46 31-775 01 82

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English

Magnetic Field Meter BMM-5 user instructions

CE

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Report form for measuring magnetic fields around an object

Magnetic field, band II 2 kHz–400 kHz			Measuring equipment: **Magnetic Field Meter**	
Object:			Model: BMM-5	
Address:			Room:	
Measured by:			Date:	
Distance 50 cm				
Height	30 cm	0 cm	-30 cm	Comments
0°	µT	µT	µT	
22.5°	µT	µT	µT	
45°	µT	µT	µT	
67.5°	µT	µT	µT	
90°	µT	µT	µT	
112.5°	µT	µT	µT	
135°	µT	µT	µT	
157.5°	µT	µT	µT	
180°	µT	µT	µT	
202.5°	µT	µT	µT	
225°	µT	µT	µT	
180°	µT	µT	µT	
247.5°	µT	µT	µT	
270°	µT	µT	µT	
292.5°	µT	µT	µT	
315°	µT	µT	µT	
337.5°	µT	µT	µT	
Distance 30 cm, 0°		µT	Measuring in accordance with TCO	

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Report 98:15, Magnetic Field Meter © EnviroMentor AB, Gothenburg, Sweden

Report form for measuring magnetic fields around a VDU

Magnetic field, band II 2 kHz–400 kHz			Measuring equipment: **Magnetic Field Meter**	
VDU type:			Model: BMM-5	
Address:			Room:	
Measured by:			Date:	
Distance 50 cm				
Height	30 cm	0 cm	-30 cm	Comments
0°	µT	µT	µT	
22.5°	µT	µT	µT	
45°	µT	µT	µT	
67.5°	µT	µT	µT	
90°	µT	µT	µT	
112.5°	µT	µT	µT	
135°	µT	µT	µT	
157.5°	µT	µT	µT	
180°	µT	µT	µT	
202.5°	µT	µT	µT	
225°	µT	µT	µT	
180°	µT	µT	µT	
247.5°	µT	µT	µT	
270°	µT	µT	µT	
292.5°	µT	µT	µT	
315°	µT	µT	µT	
337.5°	µT	µT	µT	
Distance 30 cm, 0°		µT	Measuring in accordance with TCO	

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Report 98:14, Magnetic Field Meter © EnviroMentor AB, Gothenburg, Sweden

1 Introduction

Measuring instrument BMM-5

Thank you for buying a Magnetic Field Meter BMM-5 from EnviroMentor AB.

The equipment comprises:

- Magnetic Field Meter BMM-5
- User instructions
- Case
- Calibration document
- CE certificate
- Cable for external power supply

BMM-5 measures magnetic alternating fields in the frequency range 2 kHz to 400 kHz (band II) and displays the RMS value in nT on an LCD. The value is updated at one second intervals.

BMM-5 has primarily been developed to measure magnetic fields emitted by VDUs. It has been designed in accordance with the standards set by SWEDAC (formerly MPR) and TCO 92.

The hand-held probe means that it is possible to measure many different positions quickly. The instrument displays the measurement results directly in nT (nanotesla).

The instrument has two sensitivity ranges: 0–200 nT and 0–2,000 nT. The front panel includes an output for the RMS value, while the back panel includes individual outputs for the three search coils. The output signal for all the outputs is a direct current voltage proportional to the measurement reading, with 2V corresponding to full scale.

2 Technical data

Measurement range	0–200 nT/0–2,000 nT
Frequency range	2 kHz–400 kHz
Accuracy	±1.5 nT + 5 %
Outputs	
Display	31/2 character LCD
RMS value	BNC, 2V corresponds to full measurement range. Output impedance: 1.8 kΩ
Direct outputs	3 x BNC, one for each axis, 2V corresponds to full measurement range. Output impedance: 200 Ω
Weight	2.0 kg (incl. batteries)
Power supply	6 x 1.5 V (LR14) batteries or via cable 7–9 V DC, centre pin minus. The external voltage source must be floating in relation to the instrument's earth.
Power consumption	70 mA
Dimensions	
Electronics unit, L x W x H	210 x 150 x 80 mm
Test probe, length	430 mm
Temperature range	-10 to +50 °C
Tripod mount	Normal camera tripod thread on the test probe

Report form B for measuring magnetic fields in a room

Magnetic field, 2 kHz – 400 kHz				Measuring equipment: **Magnetic Field Meter**			
Object:				Model: BMM-5			
Address:				Room:			
Measured by:				Date:			
	Measurement result µT			Background field µT			
Measurement point \ Height above floor	0 m	0.8 m	2 m	0 m	0.8 m	2 m	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Notes

Report form A for measuring magnetic fields in a room

Sketch of the room with measurement points marked.

Report 98:13A, Magnetic Field Meter © EnviroMentor AB, Gothenburg, Sweden

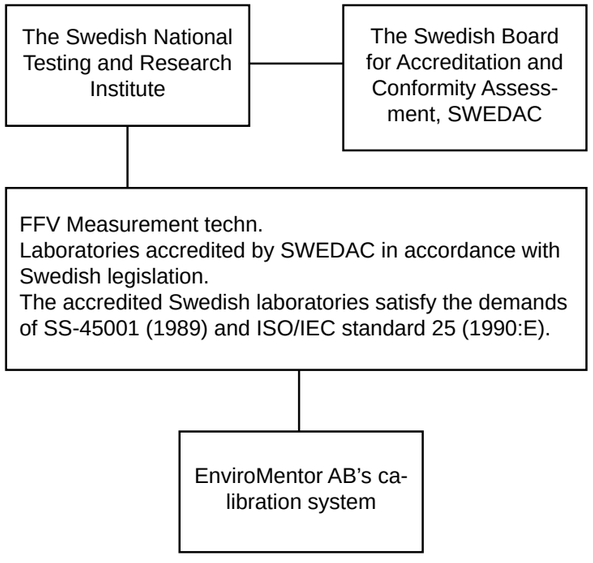
CE assurance

Our product satisfies the demands of the Low Voltage and EMC directive as well as the following EMC standards:

EN 50 081-1:1992	Emissions standard class B
EN 50 082-1	Immunity standard
Manufacturer	EnviroMentor AB Box 5124 SE-402 23 Gothenburg Sweden

Traceability

Traceability means that it should be possible to relate a measurement result to national or international standards via an unbroken chain of comparisons.



Traceability chart.

3 Use

3.1 Measuring magnetic fields

Start up the instrument with the switch. The RMS value of the field strength appears in the display. Set the sensitivity switch to the 200 nT mode. Switch to 2,000 nT if the overload light comes on or if the reading exceeds the full reading (199.9) on the display. For a more detailed analysis of the signal, the direct outputs may be connected to an oscilloscope or a spectrum analyser. When lengthy measurements are being carried out, the RMS output can be connected to a data logger or a printer.

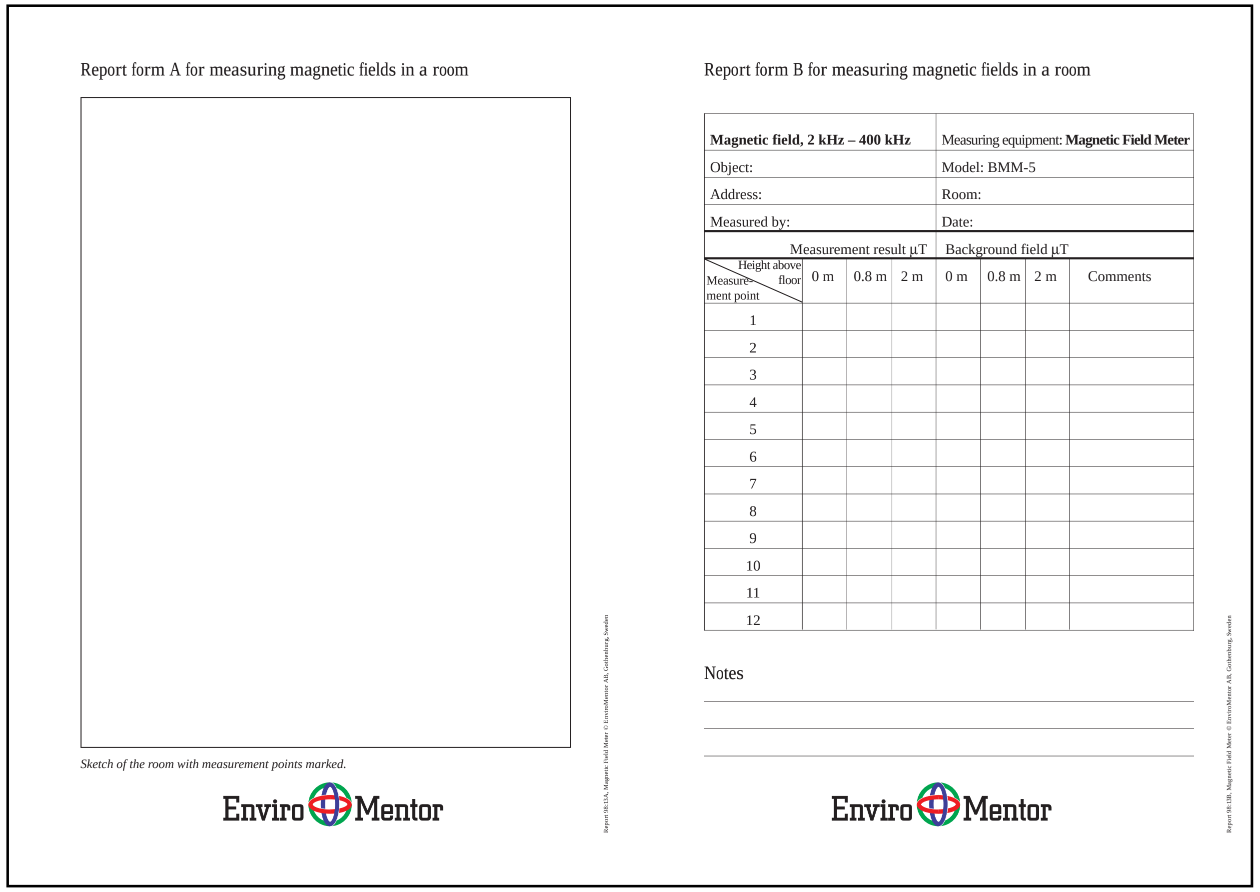
In order to achieve the highest possible level of accuracy, the test probe should be mounted on a tripod.

Internal noise means that the instrument never gives a zero reading. The internal noise level typically lies at 0.8 nT. The noise is added quadratically to the measurement signal in accordance with

$$\text{displayed reading} = \sqrt{\text{noise level}^2 + \text{signal level}^2}$$

This means that even at 3 nT, the error resulting from instrument noise is less than 0.1 nT.

The instrument can be used for measuring VDUs in accordance with SWEDAC (MPR) in the frequency range 2 kHz–400 kHz.



Report form A for measuring magnetic fields in a room

Sketch of the room with measurement points marked.

Report form B for measuring magnetic fields in a room

Magnetic field, 2 kHz – 400 kHz	Measuring equipment: **Magnetic Field Meter**
Object:	Model: BMM-5
Address:	Room:
Measured by:	Date:

	Measurement result µT			Background field µT			
Height above floor / Measurement point	0 m	0.8 m	2 m	0 m	0.8 m	2 m	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Notes

Report form for measuring magnetic fields in a room.

8 Report forms

Report form for measuring magnetic fields around a VDU

Magnetic field, band II 2 kHz–400 kHz			Measuring equipment: **Magnetic Field Meter**	
VDU type:			Model: BMM-5	
Address:			Room:	
Measured by:			Date:	
Distance 50 cm				
Height	30 cm	0 cm	-30 cm	Comments
0°	µT	µT	µT	
22.5°	µT	µT	µT	
45°	µT	µT	µT	
67.5°	µT	µT	µT	
90°	µT	µT	µT	
112.5°	µT	µT	µT	
135°	µT	µT	µT	
157.5°	µT	µT	µT	
180°	µT	µT	µT	
202.5°	µT	µT	µT	
225°	µT	µT	µT	
180°	µT	µT	µT	
247.5°	µT	µT	µT	
270°	µT	µT	µT	
292.5°	µT	µT	µT	
315°	µT	µT	µT	
337.5°	µT	µT	µT	
Distance 30 cm, 0°		µT	Measuring in accordance with TCO	

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Report form for measuring magnetic fields around a VDU.

Report form for measuring magnetic fields around an object

Magnetic field, band II 2 kHz–400 kHz			Measuring equipment: **Magnetic Field Meter**	
Object:			Model: BMM-5	
Address:			Room:	
Measured by:			Date:	
Distance 50 cm				
Height	30 cm	0 cm	-30 cm	Comments
0°	µT	µT	µT	
22.5°	µT	µT	µT	
45°	µT	µT	µT	
67.5°	µT	µT	µT	
90°	µT	µT	µT	
112.5°	µT	µT	µT	
135°	µT	µT	µT	
157.5°	µT	µT	µT	
180°	µT	µT	µT	
202.5°	µT	µT	µT	
225°	µT	µT	µT	
180°	µT	µT	µT	
247.5°	µT	µT	µT	
270°	µT	µT	µT	
292.5°	µT	µT	µT	
315°	µT	µT	µT	
337.5°	µT	µT	µT	
Distance 30 cm, 0°		µT	Measuring in accordance with TCO	

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Report form for measuring magnetic fields around an object.

On the following pages you will find report form templates for measuring magnetic fields. Copy the templates, fill them out and then file them in a folder. You can then go back and make comparisons with previous measurements.

Section 4 gives examples of how to carry out measurements.

3.2 Measurement principle

The instrument uses three perpendicular coils (A, B and C) to take readings irrespective of the direction of the magnetic field.

The signals that are induced in the coils correspond to the time differential of the magnetic flux density

$\frac{dB_{A,B,C}}{dt}$ where A, B and C are the signals from each of the three coils

These signals are integrated and filtered to correspond to the magnetic flux density in the frequency range 2 kHz–400 kHz. The effective value (RMS value) of the magnetic field is calculated electronically as

$$B_{eff} = \sqrt{\text{average value}(B^2_A + B^2_B + B^2_C)}$$

Measurements can be carried out for all frequencies between 2 kHz and 400 kHz.

The time-variable signals B_A, B_B, B_C are available on the instrument's rear panel.

Battery symbol.

3.3 Changing the batteries

When the battery light starts flashing, the batteries should be replaced immediately. Remove the cover on the left side of the instrument, remove the old batteries and install new ones (6 x 1.5V LR14).

4 Measuring magnetic fields in accordance with MPR

4.1 Introduction

Below is a description of the most important stages when measuring magnetic alternating fields in accordance with MPR 1990:8 “Test Methods for Visual Display Units” issued by SWEDAC on 1 December 1990. A complete measurement which satisfies all the requirements of MPR 1990:8 can only be performed in a laboratory environment. A number of compromises may be necessary when carrying out measurements in an office environment. Always note down these deviations from the standard on the test report form.

Note!
BMM-5 measures magnetic fields in band II. A measurement in accordance with MPR 1990:8 also encompasses measurements of electric fields in bands I and II and magnetic fields in band I. We recommend measuring instruments EMM-4 and BMM-3000.

4.2 Frequency range

The standard specifies that the magnetic alternating fields have to be measured in two frequency bands:

Band I	5 Hz–2 kHz
Band II	2 kHz–400 kHz

Band I includes magnetic alternating fields from picture deflection 50–80 Hz and 50 Hz fields from the power supply. Band II includes magnetic alternating fields from line deflection 15 kHz–100 kHz and from switched mains units and fluorescent tubes.

All appliances connected to the mains produce magnetic fields in band I. The magnetic alternating field often diminishes rapidly with distance. A building’s electrical installation can itself give rise to an increase in the magnetic field.

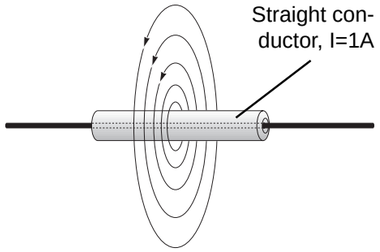
4.3 Measurement points

The measurement points are placed around a circle whose centre is in the middle of the VDU. The distance from the centre of the screen to the

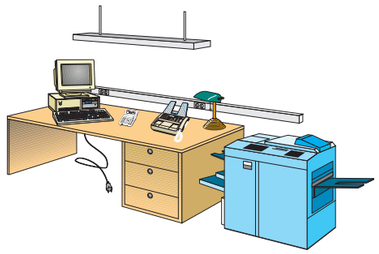
7 References to authorities and organisations

Publication	Publisher/Author	May be ordered from
Magnetic fields and health risks based on what we know	The National Electrical Safety Board	Elsäkerhetsverket Box 1371 SE-111 93 STOCKHOLM SWEDEN Tel. +46 8-519 112 00 Fax. +46 8-519 112 01
Cancer and magnetic fields in workplace	The Swedish Trade Union Confederation	LO-distribution Strömsätragränd 10 SE- 127 35 SKÄRHOLMEN SWEDEN Tel. +46 8-796 25 00
Questions and answers about electric and magnetic fields associated with the use of electric power	National Institute of Environmental Health Sciences and U.S. Dep. of Energy	Superintendent of Documents U.S. Goverment Printing Office WASHINGTON, D.C. 20 402 USA Tel. +1 202-512-1800
A report of non-ionizing radiation	Microwave News	Microwave News Louise Slesin P.O. Box 1799 Grand Central Station NEW YORK, N.Y. 10 163 USA +1 212-517-28000 +1 212-734-0316 mwn@pobox.com

6 How magnetic fields arise



At 1 m from the conductor, the magnetic flux density is 0.2 µT.



A modern office has many sources of magnetic fields.

Magnetic fields are caused by electrical currents and always occur in continuous closed paths around the currents that cause them. A live conductor gives rise to a magnetic field, the strength of which is always proportional to the current in the conductor. Magnetic fields are usually depicted with the aid of field lines. The strength of the magnetic field is constant along the conductor in closed paths around the live conductor. In the event of other sources, magnetic fields tend to have a complicated appearance which usually cannot be calculated but have to be measured instead. The unit used to measure the magnetic flux density is called the tesla [T]. Magnetic fields can be caused by electrical devices and installation cables. In certain cases, stray currents can give rise to magnetic fields. In Sweden, for example, the electricity systems generally entail four conductors leading to each building, which can result in major problems with currents of this type. The decay current can pass through the neutral conductor as intended, but it can also pass through the earth conductor and into the plumbing pipework to the transformer's earth point. This increases the magnetic field both along the path of the stray current and along the supply cable. It is also commonplace for stray currents to exist in computer networks. As well as causing magnetic fields, they can also lead to communication problems. In industrial environments, common sources include welding equipment, electric motors and cable clusters.

Note!
Measurement points in accordance with TCO are the same as MPR but with the addition of a measurement point 30 cm directly in front of the screen.

centre of the test probe should be 50 cm. Measure 16 measurement points at 22.5° intervals in the centre plane. Then carry out corresponding measurements 30 cm above and below the centre plane. Any points that are less than 25 cm from the VDU should be excluded.

4.4 Screen

The screen should be filled with the letter "H" in white on a black background (or vice versa). This is not always possible. If this is the case, use an image that is typical for the operator.

4.5 Other

If the VDU has a standby mode, a couple of measurements should be taken in both normal and standby mode.

If these readings differ by more than 5%, all the points should be measured in both normal and standby mode.

4.6 Background levels

The background levels in the test laboratory, including internal noise in the measurement system, should be less than 40 nT in band I and 5 nT in band II.

This is usually easy to achieve in band II, while background levels of up to 100 nT are common in band I. In general, the background levels should not be subtracted from the measurement readings. The background levels should be noted down separately on the measurement report form.

If the background levels are high, you can search for sources holding the test probe in your hand. Switch off and unplug powered ap-

pliances or move them away one by one, taking a new reading each time. Possible sources include desktop lamps, printers, radios connected to the mains, ceiling lighting, typewriters, battery eliminators, etc. Electrical installations in some buildings can give rise to magnetic fields which are so powerful that the VDU cannot be measured. In extreme cases, the stability of the image can even be affected.

4.7 Recommendations

There are no hygiene limits for magnetic alternating fields emitted by VDUs. When the MPR standard was set, the following guidelines were issued:

Band I, 5 Hz–2 kHz	MPR-2	TCO	Background
50 cm all around	250 nT	200 nT	40 nT
30 cm directly in front	200 nT		

Band II, 2 kHz–400 kHz			
50 cm all around	25 nT	25 nT	5 nT
30 cm directly in front	25 nT		

Report form for measuring magnetic fields around an object

Magnetic field, band II 2 kHz–400 kHz			Measuring equipment: **Magnetic Field Meter**	
Object: Photocopier			Model: BMM-5	
Address: 1 North Street			Room: Porter's office	
Measured by: J. Smith			Date: 10 March 1995	
Distance 50 cm				
Height	30 cm	0 cm	-30 cm	Comments
0°	0.2 µT	0.2µT	0.1 µT	
22.5°	0.3 µT	0.1µT	0.1 µT	
45°	0.1 µT	0.2µT	0 µT	
67.5°	0.3 µT	0.1µT	µT	
90°	µT	µT	µT	
112.5°	µT	µT	µT	
135°	µT	µT	µT	
157.5°	µT	µT	µT	
180°	µT	µT	µT	
202.5°	µT	µT	µT	
225°	µT	µT	µT	
180°	µT	µT	µT	
247.5°	µT	µT	µT	
270°	µT	µT	µT	
292.5°	µT	µT	µT	
315°	µT	µT	µT	
337.5°	µT	µT	µT	
Distance 30 cm, 0°		µT	Measuring in accordance with TCO	

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Report SR 5, Magnetic Field Meter © EnviroMentor AB, Gothenburg, Sweden

Example of a completed report form for measuring magnetic fields around an object.

5.3 Examples of report forms for measuring magnetic fields

When you measure magnetic fields, you should produce a report form which can act as a basis for any remedial action. Below is an example of a completed report form. Report form templates which you can copy can be found at the back of these user instructions. Once you have filled out the forms, they should be filed in a folder. You can then go back and make comparisons with previous measurements.

Report form for measuring magnetic fields around a VDU

Magnetic field, band II 2 kHz–400 kHz	Measuring equipment: **Magnetic Field Meter**
VDU type: Sony	Model: BMM-5
Address: 1 North Street	Room: Porter's office
Measured by: J. Smith	Date: 10 March 1995

Distance 50 cm

Height	30 cm	0 cm	-30 cm	Comments
0°	0.2µT	0.2µT	0.1µT	
22.5°	0.3µT	0.1µT	0.1µT	
45°	0.1µT	0.2µT	0 µT	
67.5°	0.3µT	0.1µT	µT	
90°	µT	µT	µT	
112.5°	µT	µT	µT	
135°	µT	µT	µT	
157.5°	µT	µT	µT	
180°	µT	µT	µT	
202.5°	µT	µT	µT	
225°	µT	µT	µT	
180°	µT	µT	µT	
247.5°	µT	µT	µT	
270°	µT	µT	µT	
292.5°	µT	µT	µT	
315°	µT	µT	µT	
337.5°	µT	µT	µT	
Distance 30 cm, 0°		µT	Measuring in accordance with TCO	

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Example of a completed reported form for measuring magnetic fields around a VDU.

5 Measurement examples

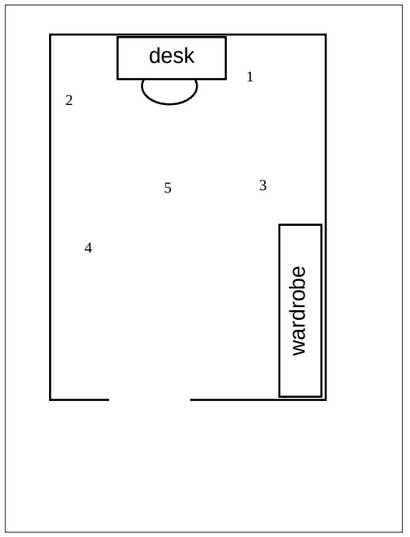
5.1 Measuring magnetic fields in a room

Below is a suggestion as to how to measure the magnetic field in a room within the frequency range 2 to 400 kHz.

1. Start by carrying out a preliminary measurement with all the pieces of electrical equipment switched on and make a rough estimate of what field sources are present in the room. Draw a sketch of the room. Then measure a number of points at 1-3 metre intervals and write down the values measured on the sketch. Measure the magnetic field at floor level as well as at 0.8 and 2 meters above the floor.

Cont.

Report form A for measuring magnetic fields in a room



Sketch of the room with measurement points marked.

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Report form B for measuring magnetic fields in a room

Magnetic field, 2 kHz – 400 kHz	Measuring equipment: **Magnetic Field Meter**
Object:	Model: BMM-5
Address: 3 High Street	Room: 123
Measured by: P Jones	Date: 13 May 1998

	Measurement result µT			Background field µT			
Measurement point \ Height above floor	0 m	0.8 m	2 m	0 m	0.8 m	2 m	Comments
1	0.01	0.02	0.01	0	0	0	
2	0.02	0.03	0.01	0	0.01	0	
3	0.2	0.02	0.01	0.2	0.02	0.01	
4	0.3	0.02	0.01	0	0	0	
5	0.02	0.01	0	0	0	0	Fluores-
6							cent-tube in
7							the ceiling
8							
9							
10							
11							
12							

Notes

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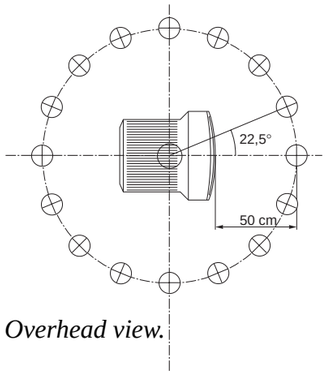
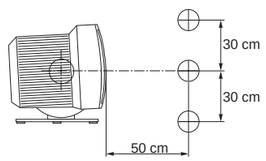
Example of a completed report form for measuring magnetic fields in a room.



Overhead view.



Side view.

2. Then carry out a measurement with all the electrical apparatus in the room switched off to get an idea of the extent of the background fields in the room. Remember that it is probably not sufficient simply to switch off the pieces of apparatus - you will usually need to unplug them in order to completely eliminate the fields. In some cases, the background magnetic fields can be more powerful than the fields from the apparatus in the room.

5.2 Measuring magnetic fields around a VDU

This section describes step by step how to measure magnetic fields around a VDU using BMM-5 and the accessory kits VRB-1 and TBS-2.

1. Place the VDU on the turntable VRB-1 so that the centre of the VDU is directly above the centre of the turntable. Ensure that the cables are not obstructed and that they are sufficiently long.
2. Mount the test probe on the tripod TBS-2. Ensure that the pillar is in the central position. Place the tripod close to the screen and adjust it vertically and horizontally so that the test probe is directly in front of the middle of the screen. Move the tripod back until a distance of 50 cm between the centre of the test probe and the screen surface is achieved. Turn the VDU through 180° and check that the distance between the rear of the VDU and the centre of the test probe is also 50 cm.
3. Set the measurement range to 200 nT and turn on the instrument.

4. Measure and note down the background levels with the VDU switched off. Raise and lower the probe 30 cm, measuring the background field in each position. According to MPR, the background level should be below 5 nT. If it is higher than this, try to lower it. Remove the test probe from the tripod and look for background field sources.
5. Switch on the VDU and wait for a few minutes until the screen has stabilised. In some cases, the readings are lower when the screen is first switched on. This may be due to the fact that the screen is emitting fields with the same frequency as the background field, but in the opposite direction. If the readings gradually move up and down, there may be two extremely close frequencies (often the image frequency and the mains supply's 50 Hz). If this is the case, make an estimate of the average value.
6. Read off the measurement on the display.
7. Turn the table in 22.5° stages with the aid of the markings on the turntable and note down the readings. BMM-5 displays the effective value (RMS value) of the magnetic alternating field directly in nanotesla (nT) within the frequency range 2 kHz–400 kHz. Internal noise in the instrument produces a small reading, even when there is no magnetic field present. The reading typically lies at 0.8 nT.
8. Raise the test probe by raising the central pillar to its highest position. Repeat point 7.
9. Lower the test probe 60 cm to the lowest position and repeat point 7.
10. Raise the test probe to its original position and place it 30 cm from the screen. Note down the value.