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

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Karlssons Språkservice AB, Gothenburg, Sweden +46 31-75 01 82

EnviroMentor

English

Magnetic Field Meter BMM-3000 user instructions

CE

Contents

Report form for measuring magnetic fields around an object

Magnetic field, band I 5 Hz–2 kHz			Measuring equipment: **Magnetic Field Meter**	
Object:			Model: BMM-3000	
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

Magnetic field, band I 5Hz–2 kHz			Measuring equipment: **Magnetic Field Meter**	
Object:			Model: BMM-3000	
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 9818, Magnetic Field Meter © EnviroMentor AB, Gothenburg, Sweden

1 Introduction

Measuring instrument BMM-3000.

Thank you for buying a Magnetic Field Meter BMM-3000 from EnviroMentor AB.

The equipment comprises:

- Magnetic Field Meter BMM-3000
- User instructions
- Case
- Calibration document
- CE certificate
- Cable for external power supply

BMM-3000 measures magnetic alternating fields in the frequency range 5 Hz to 2 kHz (band I) and displays the RMS value in nT, µT or mT on an LCD and an analog moving coil instrument. The value is updated at one second intervals.

BMM-3000 has been developed to measure magnetic fields emitted by VDUs, electric cables and other electrical equipment. The instrument 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 measurement results directly in nT (nanotesla), µT (microtesla) or mT (millitesla).

The instrument has five sensitivity ranges: 0–200 nT, 0–2 µT, 0–20 µT, 0–200 µT and 0–2 mT. The rear panel includes an output for the RMS value and 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.

Report form for measuring magnetic fields around a VDU

Magnetic field, band I 5 Hz–2 kHz			Measuring equipment: **Magnetic Field Meter**	
Object:			Model: BMM-3000	
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 9:8:7, Magnetic Field Meter © EnviroMentor AB, Gothenburg, Sweden

Report form for measuring magnetic fields around a VDU

Magnetic field, band I 5 Hz–2 kHz			Measuring equipment: **Magnetic Field Meter**	
VDU type:			Model: BMM-3000	
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 9817, Magnetic Field Meter © EnviroMentor AB, Gothenburg, Sweden

2 Technical data

Warning!
Manages fields up to 200 µT at 400 kHz

Manages fields up to 40 mT at 2 kHz

Measurement ranges	200 nT, 2 µT, 20 µT, 200 µT, 2 mT. The highest measurable field strength at 2 kHz is 1 mT.
Frequency ranges	
Broadband, without sweep	5–2,000 Hz (-3 dB)
Fixed pass filter, without sweep	16.7; 50; 100 and 150 Hz band-pass Q = 10
Adjustable band-pass filter	Adjustable from 50 to 1,500 Hz in 74 stages, Q = 10
Accuracy	
broadband	Highest ± (10 nT + 5 % of read value + 0.2 % of measurement range)
Displays	Analog moving coil meter with 240° scale and LCD
Outputs	
VDU	BNC, 2 V corresponds to full reading. 1 kΩ output impedance
Direct output	3 BNC, one for each coil. 2 V corresponds to full reading. Approx.

	100 Ω output impedance. The cable may not exceed 3 metres in length.

Data output

Type	RS232
Transmission speed	9600 baud
Format	8 data bits, 1 stop bit, no parity, no handshake, asynchronous half duplex. The cable may not exceed 3 metres in length.

Power supply

Batteries	4 x LR20
External power supply	6–9 V direct current voltage, floating
Power consumption	175 mA

Dimensions

Electronics unit L x W x H	180 x 190 x 108 mm
Test probe, length	430 mm
Tripod mount	Normal camera tripod thread on test probe
Weight, incl. batteries	2.5 kg
Temperature range	-10 to +50°C

The above specifications may be subject to change without prior notification

Report form B for measuring magnetic fields in a room

Magnetic field, 5 Hz–2 kHz				Measuring equipment: **Magnetic Field Meter**			
Object:				Model: BMM-3000			
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

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Report form A for measuring magnetic fields in a room

Sketch of the room with measurement points marked.

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Report 98:16A, Magnetic Field Meter © EnviroMentor AB, Gothenburg, Sweden

CE

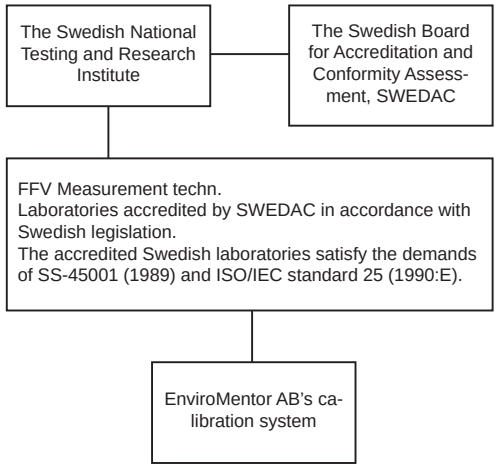
CE assurance

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

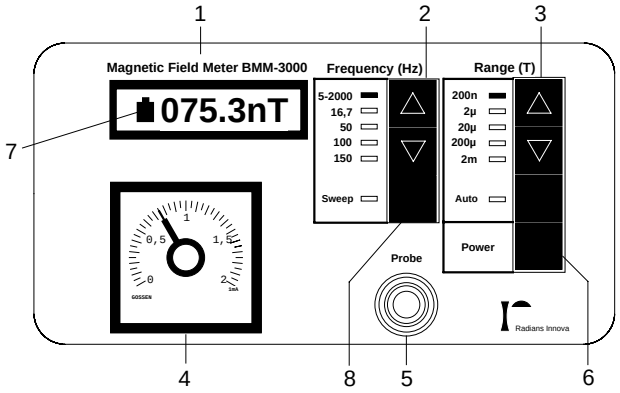
Traceability

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



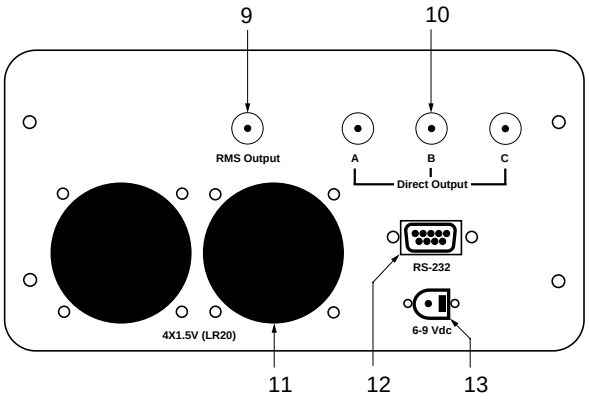
Traceability chart.

3 Use



Front panel

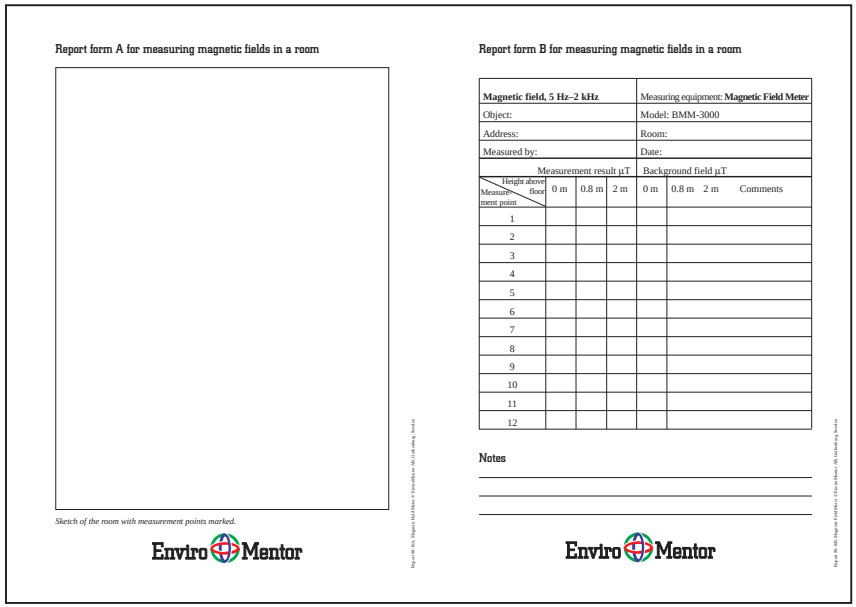
1. Digital display
2. Filter selector
3. Measurement range selector
4. Display instrument
5. Connection for test probe
6. Switch
7. Low battery symbol
8. Sweep



Rear panel

9. RMS output
10. Direct outputs
11. Battery cover
12. RS232 serial port
13. Connection for external power supply

Notes



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, 5 Hz–2 kHz				Measuring equipment: **Magnetic Field Meter**			
Object:				Model: BMM-3000			
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

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Report form for measuring magnetic fields in a room.

3.1 Measuring magnetic fields

Connect the probe to the output on the front of the apparatus.

Start up the instrument with the switch. The basic setting for the instrument is broadband measurement (5–2,000 Hz) and auto-mode (automatic selection of measurement range). The basic setting is used in most cases, such as when you want to carry out a general assessment of the field levels in a room and when taking measurements around a VDU in accordance with MPR II. In order to achieve the highest possible level of accuracy, the test probe should be held still or mounted on a tripod. The test probe is supplied with a standard thread for a camera tripod.

The instrument can be used to carry out a more detailed measurement of the magnetic field levels at various frequencies as it is equipped with an adjustable band-pass filter with 74 stages. There is a quick selection feature for the most common frequencies: 16.7, 50, 100 and 150 Hz. To select one of the quick settings, use the up or down buttons or press the sweep button and then the up or down buttons until the desired central frequency appears in the display. The frequency will disappear after three seconds and the display will switch to the current measurement reading. You can switch to a different frequency band at any time using the up or down buttons. Press the sweep button again to revert to the basic setting.

The instrument is less sensitive to movements when carrying out measurements within fixed frequency bands. During manual searching (holding the test probe in your hand) for sources, it may be best to set the frequency band at the level you suspect the highest field levels to be.

Internal noise means that the instrument never gives a zero reading. The internal noise level

typically lies at 6.5 nT during broadband measurements and less than 1 nT for the fixed frequencies. 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 25 nT, the error resulting from instrument noise is less than 1 nT.

More powerful signals or signals outside the selected frequency range may result in the text “Overld” appearing in the display.

When carrying out measurements within high fixed frequencies (above 500 Hz), the measurement result must be corrected. A table giving the correction factors for the 74 fixed frequencies can be found at the end of this section.

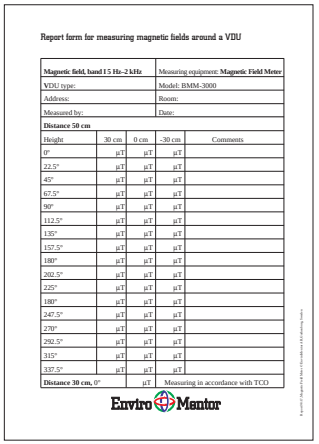
When measurements are taken in AUTO-mode, the measurement range is not altered when “overload” is displayed.

Both the display instrument and the digital display can be used for readings. The digital display is more accurate. The display instrument shows variations in readings more effectively.

The instrument can be connected to an oscilloscope or a spectrum analyser via the three direct outputs. When lengthy measurements are being carried out, the RMS output can be connected to a data logger or a printer. BMM-3000 can easily be controlled with the aid of a specially developed computer program which is described in separate user instructions.

If the text “Coil f” appears in the display, the test probe is either not connected or is faulty.

9 Report forms



Report form for measuring magnetic fields around a VDU

Magnetic field, band 1 5 Hz–2 kHz			Measuring equipment: Magnetic Field Meter	
VDU type:			Model: BMM-3000	
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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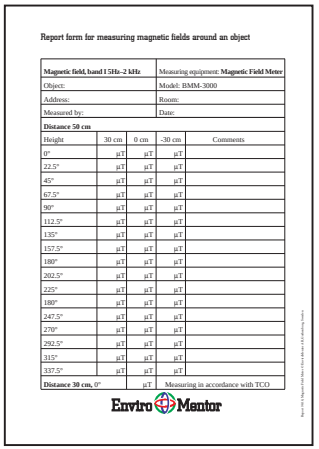
Report form for measuring magnetic fields around a VDU.



Report form for measuring magnetic fields around an object

Magnetic field, band 1 5Hz–2 kHz			Measuring equipment: Magnetic Field Meter	
Object:			Model: BMM-3000	
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.

8 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

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 5–2,000 Hz. The effective value (RMS value) of the magnetic field is calculated electronically as

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

Measurements can be carried out for all frequencies between 5 Hz and 2,000 Hz.

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

The fixed filters are narrow band-pass filters. This means that the measured frequency must be close to the filter's central frequency (± 1.5 %) in order for the accuracy of the measurement to be satisfactory (> 95 %).

The result must be multiplied by a correction factor in the case of frequencies in excess of 500 Hz (see table at the end of this section).

Battery symbol.

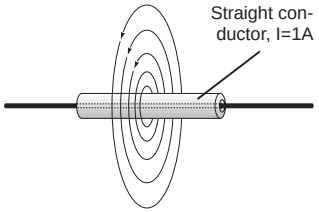
3.3 Changing the batteries

When the battery symbol in the display 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 (4 x 1.5V LR20).

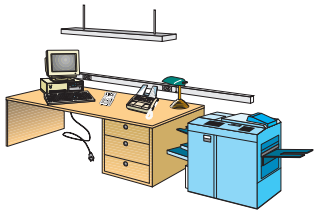
No.	f [Hz]	c	No.	f [Hz]	c	No.	f [Hz]	c
01	16,7	1,04	28	172	1,00	55	566	1,04
02	50,0	1,00	29	180	1,00	56	600	1,03
03	52,4	1,00	30	190	1,00	57	625	1,05
04	54,7	1,00	31	200	1,00	58	667	1,05
05	57,3	1,00	32	210	1,00	59	698	1,05
06	60,0	1,00	33	219	1,00	60	732	1,05
07	63,0	1,00	34	229	1,00	61	769	1,06
08	66,4	1,00	35	240	1,00	62	811	1,08
09	70,1	1,00	36	250	1,00	63	833	1,09
10	73,5	1,00	37	261	1,01	64	882	1,07
11	77,3	1,00	38	273	1,01	65	938	1,10
12	81,5	1,00	39	286	1,01	66	968	1,10
13	86,2	1,00	40	300	1,01	67	1030	1,13
14	90,4	1,00	41	316	1,01	68	1070	1,11
15	94,9	1,00	42	333	1,01	69	1110	1,14
16	100	1,00	43	349	1,01	70	1200	1,17
17	104	1,00	44	361	1,01	71	1250	1,15
18	110	1,00	45	380	1,01	72	1300	1,16
19	115	1,00	46	400	1,01	73	1360	1,18
20	120	1,00	47	423	1,02	74	1430	1,20
21	126	1,00	48	435	1,01	75	1500	1,24
22	131	1,00	49	448	1,02			
23	1327	1,00	50	462	1,03			
24	144	1,00	51	476	1,04			
25	150	1,00	52	500	1,02			
26	157	1,00	53	517	1,03			
27	164	1,00	54	536	1,04			

Filter och korrektionsfaktorer.

7 How magnetic fields arise

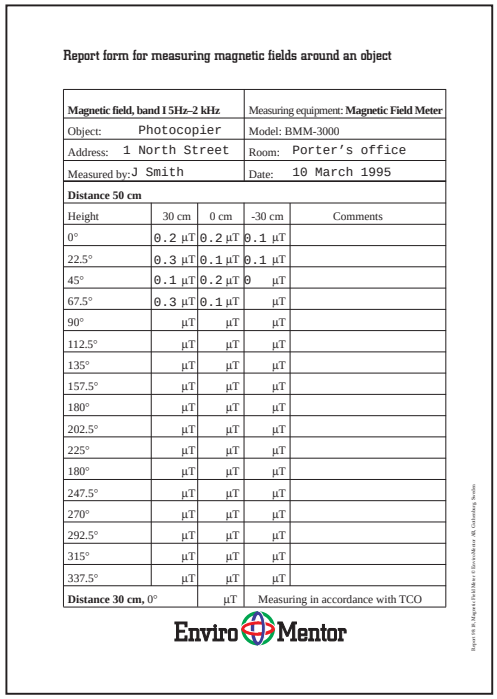


At 1 m from the conductor, the magnetic flux density is 0.2 µT.



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.



Report form for measuring magnetic fields around an object

Magnetic field, band I 5Hz–2 kHz			Measuring equipment: **Magnetic Field Meter**	
Object: Photocopier			Model: BMM-3000	
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	0.2 µT	0.1 µT	
22.5°	0.3 µT	0.1 µT	0.1 µT	
45°	0.1 µT	0.2 µT	0 µT	
67.5°	0.3 µT	0.1 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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Example of a completed report form for measuring magnetic fields around an object.

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

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

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 appliances or

6.3 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 I 5 Hz–2 kHz			Measuring equipment: **Magnetic Field Meter**	
VDU type: Sony			Model: BMM-3000	
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.

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-3000 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.

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		

5 Computer control

5.1 Introduction

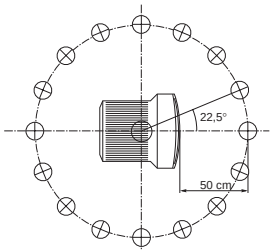
BMM-3000 can be controlled via the serial port (RS232) e.g. com1, using a transmission protocol of 9600 baud, 8 data bits, 1 stop bit, no parity and no handshake. The protocol has just 12 commands, but they are extremely effective. Using a simple program in e.g. “Quick Basic”, it is possible to carry out various types of measurement series.

You can use both upper and lower case letters in the commands, which are also available as short commands.

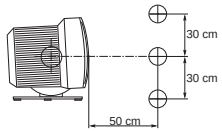
5.2 The following commands can be used:

Name	Command	Short command
MEASURE-MENT RANGE	RANGE	RANG
CHECKING MEASURE-MENT RANGE	RANGE?	RANG?
FREQUENCY	FREQUENCY	FREQ
CHECKING FREQUENCY	FREQUENCY?	FREQ?
FILTER	FILTER	FILT
CHECKING FILTER	FILTER?	FILT?
BUTTON LOCK	LOCAL	LOCA
CHECKING BUTTON LOCK	LOCAL?	LOCA?
RESETTING	RESET	RESE
CHECKING RMS	RMS?	RMS?
CHECKING SETTING	STATUS?	STAT?
CHECKING VERSION	VERSION?	VERS?

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.



Overhead view.



Side view.

6.2 Measuring magnetic fields around a VDU

This section describes step by step how to measure magnetic fields around a VDU using BMM-3000 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.

6 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 30 to 2,000 Hz.

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, 5 Hz–2 kHz				Measuring equipment: **Magnetic Field Meter**			
Object:				Model: BMM-3000			
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-cent-tube in the ceiling
6							
7							
8							
9							
10							
11							
12							

Notes

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

Commands without a question mark must be followed by a separator (a space) and a string variable (e.g. SETUP$). All commands are concluded with ENTER (carriage return).

The computer responds to every command with a confirmation “0” (approval) or “1” (error). In response to the command RMS?, any error messages are also left:

“3” (coil failure)	probe not connected or broken
“4” (overload)	overload
“5” (low battery)	low battery

The response is concluded with a carriage return.

All reported program examples should have the following main program as a framework.

Main program
10 OPEN “COM1:9600,N,8,1,cs,ds” for random as #1
20 Program example:
……..
……..
480 CLOSE #1
490 END
500 IF ACK$=“1” THEN PRINT “Command error”
ELSEIF ACK$= “2” THEN PRINT “Coil Failure”
ELSEIF ACK$= “3” THEN PRINT “Overload”
ELSEIF ACK$= “4” THEN PRINT “Low Battery”

5.3 Description of commands

5.3.1 Setting the measurement range

Aim
To set the instrument to auto-mode

“AUTO”

or to one of the manual ranges

"200 nT"

"2 µT"

"20 µT"

"200 µT"

"2 mT"

Command
Enter the command as follows:

"RANGE", space, string variable and conclude with ENTER.

Example
Enter: "RANGE 200 nT" and press ENTER.

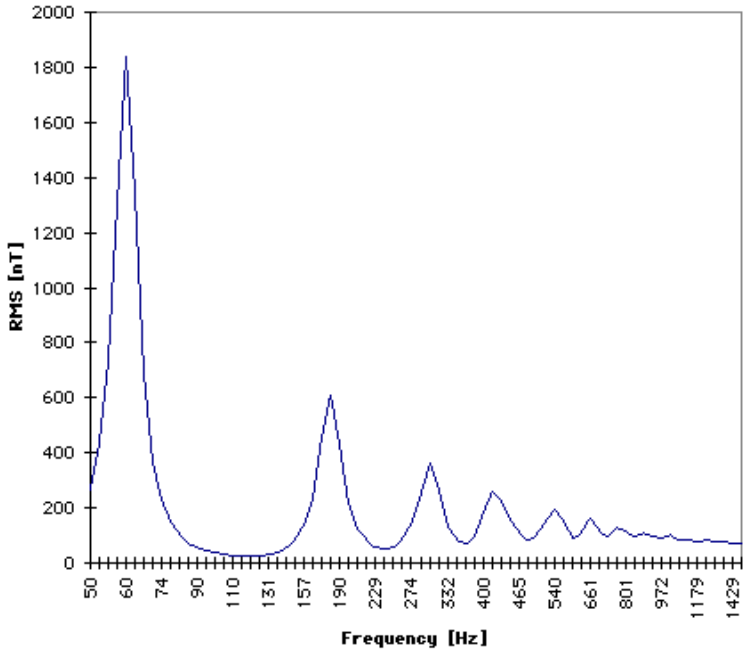
Response
The computer then confirms with "1" or "0", where 1 means an incorrect command and 0 means approved.

Program example:
```
20   PRINT #1, "RANGE  200nT"
30   INPUT #1, ACK$
40   IF ACK$ <>"0" THEN GOSUB 500
```

5.3.2 Checking measurement range

Aim
Specify the set measurement range (data1$) and automatic or manual measurement range (data2$).

Command
Enter "RANGE?" and conclude with ENTER.



Frequency spectrum for a square wave with 60 Hz fundamental tone measured with BMM-3000.

Overtone	Frequency	Filter No.	Frequency	Filter No.
1	50	02	60	06
2	100	16	120	20
3	150	25	180	29
4	200	31	240	35
5	250	36	300	40
6	300	40	360	44*
7	350	43*	420	47*
8	400	46	480	51*
9	450	49*	540	54*
10	500	52	600	56

* nearest filter

Overtones to 50 and 60 Hz

```
IF ACK$<>"0" THEN GOSUB 500
INPUT#1,SETUP$
60    PRINT SETUP$
```

5.4 Analysis of frequency spectrum

BMM-3000 can easily be used to analyse the frequency distribution in the magnetic radiation. The adjustable band-pass filter is activated by pressing the SWEEP button. To perform a manual sweep of the frequency band, press the UP and DOWN buttons.

By connecting BMM-3000 to a computer, the sweep function, for instance, can be controlled by a computer program between optional frequencies. The figure shows a diagram which has been created in a spreadsheet. A simple Quick Basic program has been written to control the filter frequency and to measure the magnetic field.

Example of response
"200 nT MAN"

Program example:

```
20    PRINT #1, "RANGE?"
30    INPUT #1, ACK$
IF ACK$ <>"0" THEN GOSUB 500
INPUT #1, SETUP$
60    PRINT SETUP$
```

5.3.3 Setting frequency range

Aim
Selecting frequency band 1 – 75.

"#01"
"#02"
.
.
"#75"

This command automatically shuts off the selection of fixed filters (see 5.3.5) and connects the sweep function. These functions cannot be used at the same time.

The table displays the central frequencies for the various frequency bands.

Command
Enter the command as follows:

"FREQ", space, string variable and conclude with ENTER.

Example
Enter: "FREQ #25" and press ENTER.

Response
The computer then confirms with "1" or "0", where 1 means an incorrect command and 0 means approved.

Program example:
20 PRINT #1,“FREQ #25”
30 INPUT #1,ACK$
40 IF ACK$<>”0” THEN GOSUB 500

5.3.4 Checking the frequency range

Aim
Specify the set string variable for filter or frequency.

If the sweep function is on (a frequency range has been selected), the number of the frequency range is displayed.

If the sweep function is off (broadband setting or fixed filter has been selected), the current frequency is displayed. The response is the same when checking the filter (FILT?)

Command
Enter “FREQ?” and conclude with ENTER.

Example of response
“#25”

Program example:
20 PRINT #1,“FREQ?”
30 INPUT #1,ACK$
IF ACK$<>“0” THEN GOSUB 500
50 INPUT #1, SETUP$
PRINT SETUP$

5.3.5 Setting the filter

Aim
Selecting broadband measurement or fixed filter.

“5-2000Hz”

“16.7Hz”

followed by any error messages

CF interruption	(coil failure)
OV overload	(overload)
LB low battery	(low battery)

Command
Enter “STATUS?” and press ENTER.

Example of response
“2µT MAN #75 ON CF LB”
(i.e. manual measurement range 0 - 2µT, filter no. 75, button lock on, test probe not connected and low battery.)

Example 2
“2mT AUTO 50 Hz OFF OV”
(i.e. automatic measurement range, frequency band 50 Hz, button lock off, overload).

Program example:
20 PRINT#1,“RESET”
30 INPUT#1,ACK$
40 IF ACK$<>“0” THEN GOSUB 500

5.3.12 Checking version

Aim
Information about the instrument type, program version, year of manufacture and serial number.

Command
Enter “VERSION?” and press ENTER.

Example of response
“BMM3000 V2.0 1995 #254”

Program example:
20 PRINT #1,“RANGE-200nT”
30 INPUT#1,ACK$

Program example:
20 PRINT #1,“RESET”
30 INPUT #1,ACK$
40 IF ACK$<>“0” THEN GOSUB 500

5.3.10 Checking RMS

Aim
To read off a measurement result in Tesla.

The string variable is in the form of a power of ten, “XE-Y”, where X is a factor and Y is the exponent.

Permitted values are 0000 – 2048 for X and 6 – 10 for Y.

Command
Enter “RMS?” and press ENTER.

Example of response
“4” (i.e. overload)
“1204E-07” (i.e. 1204*10-7, or 120.4 µT).

Program example:
20 PRINT #1,“RMS?”
30 INPUT #1,ACK$
IF ACK$ <>“0” THEN GOSUB 500
INPUT #1,SETUP$
PRINT SETUP$

5.3.11 Checking setting

Aim
To obtain complete instrument setting.

Setup1$: measurement range
Setup2$: filter or frequency
Setup3$: button lock

“50Hz”

“100Hz”

“150Hz”

The command automatically shuts off the selection of frequency range (see 5.3.3) and disconnects the sweep function. These functions cannot be used at the same time.

Command
Enter the command as follows:

“FILT”, space, string variable and conclude with ENTER.

Example
Enter: “FILT #25” and press ENTER.

Response
The computer then confirms with “1” or “0” and a carriage return, where 1 means an incorrect command and 0 means approved.

Program example:
20 PRINT #1,“FILTER 5-2000Hz”
30 INPUT #1,ACK$
40 IF ACK$<>“0” THEN GOSUB 500

5.3.6 Checking the filter setting

Aim
Indicates set string variable for filter or frequency.

If the sweep function is on (a frequency range has been selected), the number of the frequency range is displayed.

If the sweep function is off (broadband setting or fixed filter has been selected), the current

frequency is displayed. The response is the same when checking the frequency (FREQ?)

Command
Enter “FILT?” and conclude with ENTER.

Example of response
“5-2000Hz”

Program example:
```
20    PRINT #1,“FILT?”
30    INPUT #1,ACK$
IF ACK$<>“0” THEN GOSUB 500
INPUT #1,SETUP$
60    PRINT SETUP$
```

5.3.7 Button lock

Aim
Shutting off or connecting the buttons on the control panel. Does not affect the switch.

“ON” = buttons connected
“OFF” = buttons shut off

Remote control via RS232 cannot be shut off.

Command
Enter the command as follows:

“LOCA”, space, string variable and conclude with ENTER.

Example
Enter: “LOCA OFF” and press ENTER.

Response
The computer then confirms with “1” or “0” and a carriage return, where 1 means an incorrect command and 0 means approved.

Program example:
```
20    PRINT #1,“LOCAL OFF”
30    INPUT #1,ACK$
IF ACK$<>“0” THEN GOSUB 500
```

5.3.8 Checking the button lock

Aim
Indicates whether the buttons are on or off.

Command
Enter “LOCA?” and conclude with ENTER.

Example of response
“OFF”

Program example:
```
20    PRINT #1,“LOCA?”
30    INPUT #1,ACK$
IF ACK$<>“0” THEN GOSUB 500
INPUT #1,SETUP$
60    PRINT SETUP$
```

5.3.9 Resetting

Aim
To reset the instrument.

Sets the instrument in standard mode in the same way as at start-up.

Command
Enter “RESET” and press ENTER.

Example of response
“0”

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