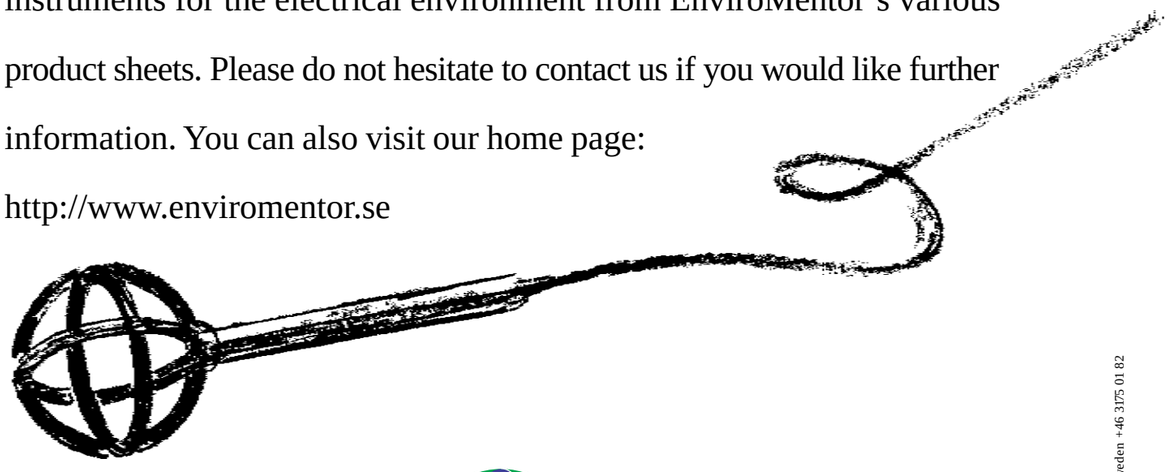
EnviroMentor has both the measuring instruments and the expertise

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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English

Electric Field Meter EMM-4 user instructions

CE

Contents

Report form for measuring electric fields around a VDU

Electric field, band I 5 Hz–2 kHz			Measuring equipment: **Electric Field Meter**
VDU type:			Model: **EMM-4**
Address:			Room:
Measured by:			Date:
	TCO 30 cm	MPR+TCO 50 cm	Comments
0°	V/m	V/m	
90°	–	V/m	
180°	–	V/m	
270°	–	V/m	
Background field		V/m	

Electric field, band II 2 kHz–400 kHz			Measuring equipment: **Electric Field Meter**
VDU type:			Model: **EMM-4**
Address:			Room:
Measured by:			Date:
	TCO 30 cm	MPR+TCO 50 cm	Comments
0°	V/m	V/m	
90°	–	V/m	
180°	–	V/m	
270°	–	V/m	
Background field		V/m	

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Report form for measuring electric fields around a VDU

Electric field, band I 5 Hz–2 kHz			Measuring equipment: **Electric Field Meter**
VDU type:			Model: **EMM-4**
Address:			Room:
Measured by:			Date:
	TCO 30 cm	MPR+TCO 50 cm	Comments
0°	V/m	V/m	
90°	–	V/m	
180°	–	V/m	
270°	–	V/m	
Background field		V/m	

Electric field, band II 2 kHz–400 kHz			Measuring equipment: **Electric Field Meter**
VDU type:			Model: **EMM-4**
Address:			Room:
Measured by:			Date:
	TCO 30 cm	MPR+TCO 50 cm	Comments
0°	V/m	V/m	
90°	–	V/m	
180°	–	V/m	
270°	–	V/m	
Background field		V/m	

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Report98:11, Field Finder © EnviroMentor AB, Gothenburg, Sweden

1 Introduction

Measuring instrument EMM-4

Thank you for buying an Electric Field Meter EMM-4 from EnviroMentor AB.

The equipment comprises:

- Electric Field Meter EMM-4
- User instructions
- Case
- Calibration document
- Earth cable
- Earth cable contact
- CE certificate
- Cable for external power supply

EMM-4 measures electric alternating fields and displays the RMS value in V/m on an LCD. The reading is updated every second.

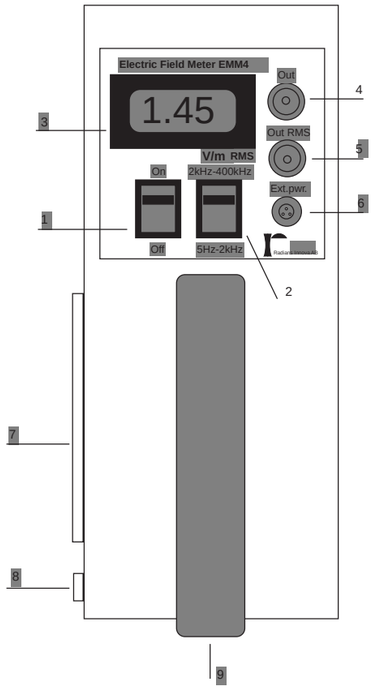
EMM-4 has primarily been developed to measure electric fields in rooms and electric fields emitted by VDUs. It has been designed in accordance with the standards set by SWEDAC (formerly MPR) and TCO 92.

EMM-4 measures the electric fields within two frequency ranges: 5 Hz–2 kHz and 2 kHz–400 kHz.

The hand-held probe means that it is possible to measure many different positions quickly. The instrument displays the measurement results directly in V/m (volts per metre).

The instrument has two outputs: one for RMS values which can be connected to a data logger or a printer, and one direct output which can be connected to an oscilloscope or a spectrum analyser.

2 Technical data



Switch

2. Band switch

3. Display

4. Direct output, BNC

5. RMS output, BNC

6. External power supply

7. Battery cover

8. Earth contact

9. Tripod mount (normal camera thread)

Band I

Frequency range	5 Hz–2 kHz (-3 dB)
Measurement range	0–2,000 V/m
Filter attenuation	-80 dB/decade below 5 Hz -40 dB/decade above 2 kHz
Scale factor	RMS output 1 mV/(V/m) Analog output 2 mV/(V/m)
Accuracy	± 0.2 V/m + 3% of read value

Band II

Frequency range	2 kHz–400 kHz (-3 dB)
Measurement range	0–200 V/m
Filter attenuation	-80 dB/decade below 2 kHz -40 dB/decade above 400 kHz
Scale factor	RMS output 10 mV/(V/m) Analog output 20 mV/(V/m)
Accuracy	±0.03 V/m + 3% of read value

Report form B for measuring electric fields in a room

Electric field, 5 Hz–2 kHz		Measuring equipment: **Electric Field Meter**	
Object:		Model: EMM-4	
Address:		Room:	
Measured by:		Date:	
Measurement points	Measurement reading* V/m	Background field* V/m	Comments
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

* In the direction of the arrow on the sketch. ‘C’ stands for ‘ceiling’, ‘F’ stands for ‘floor’.
**The background field does not need to be measured at all measurement points.

Notes

Report form A for measuring electric fields in a room

Sketch of the room with measurement points marked.

Measurement method	RMS effective value
Dimensions	Diameter 300 mm, depth 125 mm
Weight	1.4 kg (incl. batteries)
Power supply	2 x 9 V (6LR61) batteries or via cable red + 12 V, black 0 V, blue - 12 V
Power consumption	22 mA
Outputs/impedance	Analog/200 W RMS / 1 kW
Temperature range	-10 to +50 °C

CE assurance

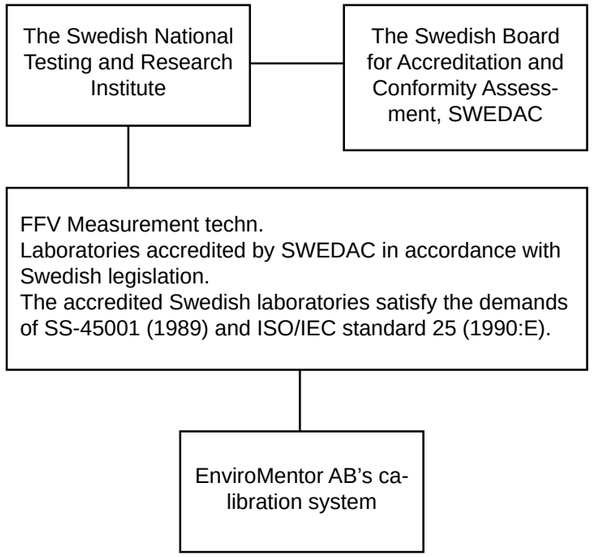
Our product satisfies the demands of the Low Voltage and EMC directive as well as the following EMC standards:

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

Report 98:10A, Electric Field Meter © EnviroMentor AB, 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.

Notes

8 Report forms

Report form for measuring electric fields around a VDU

Electric field, band I 5 Hz–2 kHz			Measuring equipment: **Electric Field Meter**
VDU type:			Model: **EMM-4**
Address:			Room:
Measured by:			Date:
	TCO 30 cm	MPR+TCO 50 cm	Comments
0°	V/m	V/m	
90°	–	V/m	
180°	–	V/m	
270°	–	V/m	
Background field		V/m	

Electric field, band II 2 kHz–400 kHz			Measuring equipment: **Electric Field Meter**
VDU type:			Model: **EMM-4**
Address:			Room:
Measured by:			Date:
	TCO 30 cm	MPR+TCO 50 cm	Comments
0°	V/m	V/m	
90°	–	V/m	
180°	–	V/m	
270°	–	V/m	
Background field		V/m	

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Report form for measuring electric fields around a VDU.

Report form A for measuring electric fields in a room

Sketch of the room with measurement points marked.

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Report form B for measuring electric fields in a room

Electric field, 5 Hz–2 kHz		Measuring equipment: **Electric Field Meter**	
Object:		Model: EMM-4	
Address:		Room:	
Measured by:		Date:	
Measurement points	Measurement reading* V/m	Background field* V/m	Comments
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

* In the direction of the arrow on the sketch. ‘C’ stands for ‘ceiling’, ‘F’ stands for ‘floor’.
**The background field does not need to be measured at all measurement points.

Notes

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Report form for measuring electric fields in a room.

On the following pages you will find report form templates for measuring electric 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.

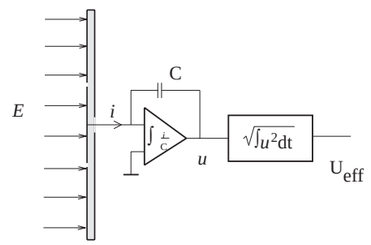
3 Use

3.1 Measuring electric fields

Start up the instrument with the switch. The RMS value of the field strength is shown on the display. For a more detailed analysis of the signal, the direct output 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 instrument should be mounted on a tripod. When performing measurements, the earth cable should be connected between the earth contact and the measuring object’s or the supply mains’ earth. The person carrying out measurements should stand a least one metre to the side of the instrument to ensure that there is no interference to the measurements.

The instrument can be used for measurements of VDUs in accordance with SWEDAC (MPR). The frequency range in band I covers emissions from the vertical deflection coils while band II covers the horizontal ones.



Measuring principle

3.2 Measuring principle

The test-probe comprises a disc of fibreglass laminate coated with copper. On the front side, the copper surface is divided into an inner circle and an outer ring. This design imitates the influence of the human body on the electric field.

The measurement surface is kept virtually earthed via an operations amplifier. The electric field E which strikes the measurement surface causes a current in

$$i = dE/dt \times A \times e$$

where A is the measurement area and e is the dielectric constant.

The current is converted to a voltage u in an integrated current/voltage converter in accordance with

$$u=Ii/Cdt$$

and is thereby proportional to the electric field E. After filtration, the signal goes to the RMS converter which creates the effective value (RMS) of the signal in accordance with:

$$U_{eff}=\sqrt{\overline{u^2}}$$

Measurements can be carried out at frequencies between 5 Hz and 400 kHz. The time-variable signal u is available at the instrument's direct output.

Battery symbol.

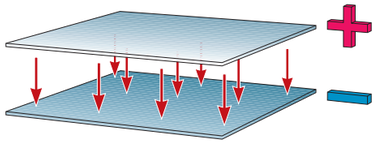
3.3 Changing the batteries

When the battery symbol is displayed to the left of the measurement reading, the batteries should be replaced immediately. Remove the cover on the left side of the instrument, remove the old batteries and install new ones (2 x 9V 6LR61 batteries).

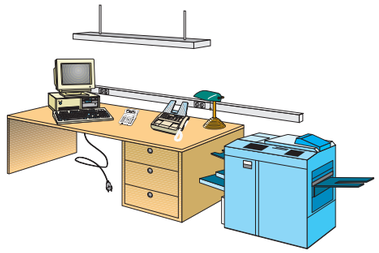
7 References to authorities and organisations

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 electric fields arise



Electric field.



A modern office has many sources of magnetic fields.

An electric field arises between two objects with different electric potentials. If two plates made of electrically conductive material are connected to a voltage source, one of the plates will have a positive charge while the other will have a negative charge. A voltage arises between the plates and thereby an electric field. The strength of the field depends on how high the voltage is and the distance between the objects.

In a similar way, we are continually exposed to electric fields from pieces of apparatus and electrical installations in our surroundings. The size of the fields around us are difficult to predict as they depend on the connection between the sources of the fields, the people and earthing. There are often a number of different sources of varying strengths in a single room.

Objects that are not connected to electricity can also be affected by electric fields. A metal object can be capacitively charged by nearby cabling or other objects connected to electricity. In simple terms, the metal object functions as an antenna, capturing the electric field and helping it to grow. Examples of such objects include desk frames and electrical devices with non-earthed metal casings. Some types of building material (plasterboard walls, chipboard) can also capture electric fields and increase their spread. When measuring fields in a room which has plasterboard walls, it can sometimes be seen that the fields spread out along an entire wall surface with the highest readings being concentrated around sockets and switches.

Electric fields can be reduced through screening and earthing. It is possible to use shielded cabling or to place screening material around the object that is to be screened off. In order for the screening to be effective, it is important for the screening material to be properly earthed. If this is not the case, screening can have the opposite effect – the fields increase in size.

4 Measuring electric fields in accordance with MPR

4.1 Introduction

Below is a description of the most important stages when measuring electric 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!
EMM-4 measures electric fields in bands I and II. A measurement in accordance with MPR 1990:8 also encompasses measurements of magnetic fields in bands band I and II. We recommend measuring instruments BMM-3000 and BMM-5.

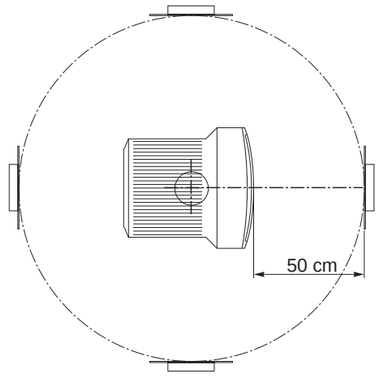
4.2 Frequency range

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

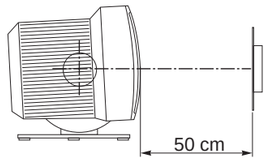
Band I	5 Hz–2 kHz
Band II	2 kHz–400 kHz

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

All appliances connected to the mains produce electric fields in band I. Non-earthed appliances and appliances with plastic cases often produce high readings. The electric alternating field often diminishes rapidly with distance.



Overhead view.



Side view.

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.

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 centre of the test probe should be 50 cm. In band I, measurements should be taken from directly in front. In band II, measurements should be taken at four points at 90° intervals. 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. The readings in band I often vary depending on which image is being shown.

4.5 Other

1. The test probe should be connected to earth.
2. Connect the test probe to the supply mains’ earth. Ideally, use the same socket that the VDU is connected to. Alternatively, earth the test probe by connecting it to a metal part of the VDU, provided that the VDU has protective earthing.
3. During the measurement process, the distance between the probe and any large metal objects should be at least 1 metre.
4. Large metal objects can both raise the background level and interfere with the actual measurement. As far as possible, move any such objects away.

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

EMM-4 displays the effective value (RMS value) of the electric alternating field directly in volts/metre (V/m) within the selected frequency range. Internal noise in the instrument produces a small reading, even when there is no electric field. This reading typically amounts to 0.2 V/m in band I and 0.03 V/m in band II.

Report form for measuring electric fields around a VDU

Electric field, band I 5 Hz–2 kHz			Measuring equipment: **Electric Field Meter**
VDU type: Sony			Model: **EMM-4**
Address: 1 North Street			Room: Porter’s office
Measured by: J. Smith			Date: 10 March 1995
	TCO 30 cm	MPR+TCO 50 cm	Comments
0°	20 V/m	10 V/m	Slight flickering
90°	–	V/m	
180°	–	V/m	
270°	–	V/m	
Background field		V/m	

Electric field, band II 2 kHz–400 kHz			Measuring equipment: **Electric Field Meter**
VDU type: Sony			Model: **EMM-4**
Address: 1 North Street			Room: Porter’s office
Measured by: J. Smith			Date: 10 March 1995
	TCO 30 cm	MPR+TCO 50 cm	Comments
0°	30 V/m	8 V/m	Slight flickering
90°	–	12 V/m	
180°	–	21 V/m	
270°	–	9 V/m	
Background field		4 V/m	

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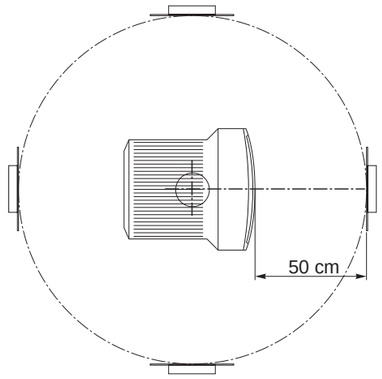
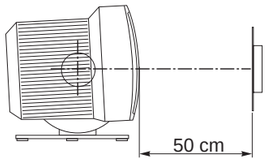
Examples of a report form for taking measurements around a VDU.



Overhead view.



Side view.

3. Earth the meter using the accompanying cable. One end should be connected to the earth contact on the measuring instrument, while the other end should be connected to the supply mains' earth conductor. Alternatively, the cable can be connected to a metal part of the VDU, provided that the VDU has protective earthing.
4. Measure and note down the background levels with the VDU switched off. According to MPR, the background reading should be less than 2 V/m in band I and 0.2 V/m in band II. If the level is higher, you should try to lower it. Disconnect the test probe from the tripod and search 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. Sudden jumps in the measurement reading may be due to discharges of static fields. Wait until the readings have stabilised or try carefully to discharge the screen surface.
6. When taking measurements, you should stand still, ideally behind the measuring instrument. Read off the values in both frequency bands from directly in front of the VDU at 30 cm and 50 cm. Turn the table in 90° stages and read off band II at a distance of 50 cm. Always note down the background values on the report form.

4.6 Background levels

The background levels in the test laboratory, including internal noise in the measurement system, should be less than 2 V/m in band I and 0.2 V/m in band II.

This is usually easy to achieve in band II, while levels between 10–50 V/m 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. Switch off the powered appliances 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. Metal structures such as desk frames may need to be earthed at times.

4.7 Recommendations

There are no hygiene limits for electric and magnetic 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	25 V/m		2 V/m
30 cm directly in front	10 V/m		
Band II,			
2 kHz–400 kHz			
50 cm all around	2.5 V/m	1 V/m	0.2 V/m
30 cm directly in front	1 V/m		

5 Measurement examples

5.1 Measuring electric fields in a room

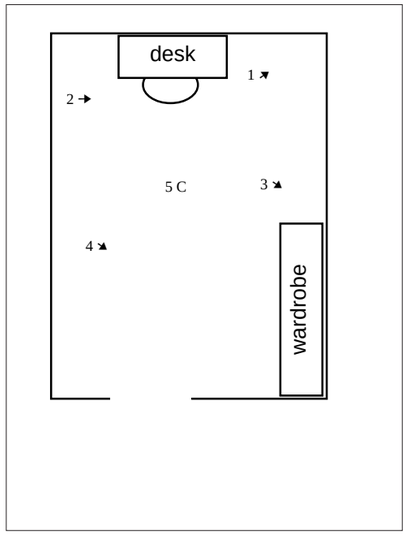
Below is a suggestion as to how to measure the electric field in a room within the frequency ranges 5 Hz–2 kHz and 2 kHz–400 kHz.

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 by taking readings in all directions in a circle around you. Write down the highest value measured at each point on the sketch. Using an arrow, mark the direction in which you obtained the value you have written down. Ideally, note the field levels towards the ceiling and the floor.
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 fields can as high as the fields from the apparatus in the room.

5.2 Examples of report forms for measuring electric fields in a room

When you measure electric 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 A for measuring electric fields in a room



Sketch of the room with measurement points marked.

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Report form B for measuring electric fields in a room

Electric field, 5 Hz–2 kHz		Measuring equipment: **Electric Field Meter**	
Object:		Model: EMM-4	
Address: 3 High Street		Room: 123	
Measured by: P. Jones		Date: 13 May 1998	
Measurement points	Measurement reading* V/m	Background field* V/m	Comments
1	14		
2	18		
3	21		
4	7		
5	5		Fluorescent-tube in the ceiling
6			
7			
8			
9			
10			
11			
12			

* In the direction of the arrow on the sketch. 'C' stands for 'ceiling', 'F' stands for 'floor'.
**The background field does not need to be measured at all measurement points.

Notes

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Example of a report form for measuring electric fields in a room.

5.3 Measuring electric fields around a VDU

This section describes step by step how to measure electric fields around a VDU using the electric field meter EMM-4 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 EMM-4 on the tripod TBS-2. Place the tripod close to the screen and adjust it vertically and horizontally so that the test probe is directly in front of the centre of the screen.