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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EnviroMentor

English

Magnetic Field Logger ML-1 user instructions

CE

Contents

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Report form for measuring magnetic fields around an object

Magnetic field, 30 Hz–2 kHz			Measuring equipmen: **Magnetic Field Logger**
Object:			Model: **ML-1**
Address:			Room:
Measured by:			Date:
Meas. distance	30 cm	50 cm	Comments
0°	µT	µT	
90°	µT	µT	
180°	µT	µT	
270°	µT	µT	
Background field	µT	µT	

Notes

Report 98:7, Magnetic Field Logger © EnviroMentor AB, Gothenburg, Sweden

Report form for measuring magnetic fields around an object

Magnetic field, 30 Hz–2 kHz			Measuring equipment: **Magnetic Field Logger**
Object:			Model: **ML-1**
Address:			Room:
Measured by:			Date:
	30 cm	50 cm	Comments
0°	µT	µT	
90°	µT	µT	
180°	µT	µT	
270°	µT	µT	
Background field	µT	µT	

Notes

1 Introduction

Magnetic Field Logger ML-1 measuring instrument.

Thank you for buying a Magnetic Field Logger ML-1, from EnviroMentor AB.

The equipment comprises:

- ML-1, measuring instrument for triaxial measurement of magnetic alternating fields and registration of measurement series
- User instructions
- Leather case
- Calibration document
- Interface cable
- CE certificate
- Diskette containing software

ML-1 measures and registers the RMS value of the magnetic alternating field in the X, Y and Z directions, irrespective of the direction in which the instrument is pointing in relation to the magnetic fields. The instrument stores series of measurements at intervals of between 1 and 150 seconds, and can store up to 8,192 readings. This means that you could take series of readings lasting more than two weeks without stopping. The measurement process can be started and stopped at any time - the instrument stores a measurement series for every start and stop until the memory is full.

The series of measurements are transmitted to a computer using the accompanying cable, which is connected to the RS232 port. The analysis program enables you to analyse and document the series of measurements in a way that has not previously been possible.

The instrument can also be used for direct measurement. The reading is displayed on the LCD and updated every second. During direct measurement, ML-1 sends out the readings every second via the RS232 port, for transmission to a computer that has communication software loaded.

You can use ML-1 whenever you want to measure or document magnetic fields, such as from electrical installations, power cables, VDUs, computers and other electrical equipment in the office, industrial and home environments. Note however that some of these objects create magnetic alternating fields that are outside the instrument's frequency area.

ML-1 retains all measurement readings, even if the battery runs out or is removed.

The ML-1 contains a band-pass filter for the measurement of magnetic fields with a frequency of 50 Hz. The filter can be connected and disconnected at any time, both for direct measurement and logging.

Report form B for measuring/registering magnetic fields in a room

Magnetic field, 30 Hz–2 kHz				Measuring equipment: **Magnetic Field Logger**				
Object:				Model: **ML-1**				
Address:				Room:				
Measured by:				Date:				
	Direct measurement µT			Registration µT				
Height above floor / Measurement point	0 m	0.8 m	2 m	Start	Stop	Int. (s)	average	Max
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Notes

Report 98:6B, Magnetic Field Logger © EnviroMentor AB, Gothenburg, Sweden

Report form A for measuring/registering magnetic fields in a room

Sketch of the room with measurement points marked.

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Report 98:6A, Magnetic Field Logger © EnviroMentor AB, Gothenburg Sweden

2 Technical data

Measurement range	0,05 µT–100 µT
Accuracy	±10 % ±0,05 µT
Frequency range	30 Hz–2 kHz (-3dB)
Band-pass filter	4th sequence, Q-value 3.2, Connection time 3 seconds
Measurement method	Triaxial, RMS effective value
Memory locations	8,192
Measurement interval	Manual, 1–150 seconds
Dimensions, L x W x H	152 x 83 x 34 mm
Weight	260 g (incl. batteries)
Batteries	2 x 1.5 V LR6 Lithium batteries CR 2032 or F2AWS for the clock
Communication	Serial RS232, 9600 baud, 8 bits, no parity, no handshake
Power consumption	38 mA in clock mode, 25 mA during measurement and 45 mA during transmission
Temperature range	-10 to +50 °C
Other	Microprocessor, 10 bit A/D-converter, three-dimensional sensor, EEPROM memory, clock, calendar

CE

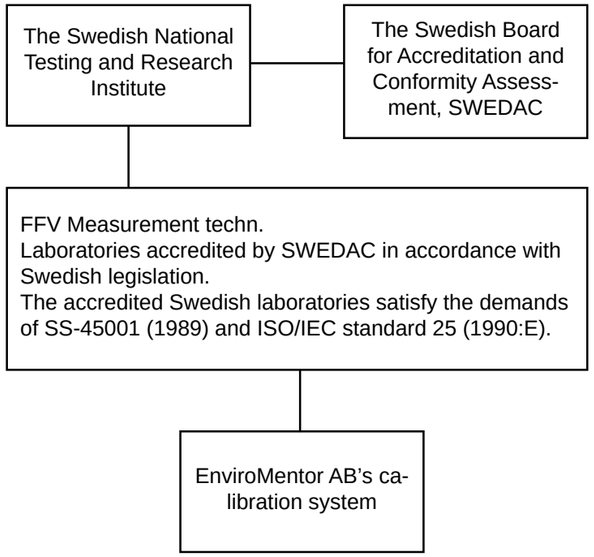
CE assurance

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

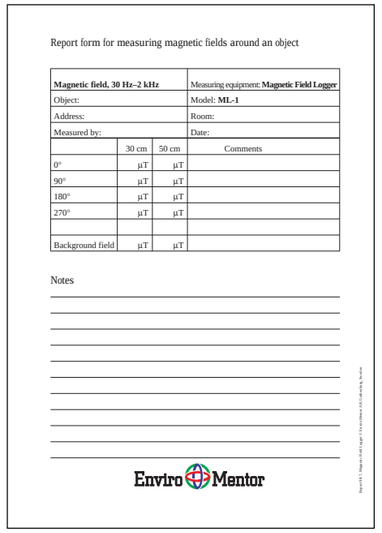
Traceability

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.

7 Report forms



Report form for measuring magnetic fields around an object

Magnetic field, 30 Hz–2 kHz			Measuring equipment: **Magnetic Field Logger**
Object:			Model: **ML-1**
Address:			Room:
Measured by:			Date:
	30 cm	50 cm	Comments
0°	µT	µT	
90°	µT	µT	
180°	µT	µT	
270°	µT	µT	
Background field	µT	µT	

Notes

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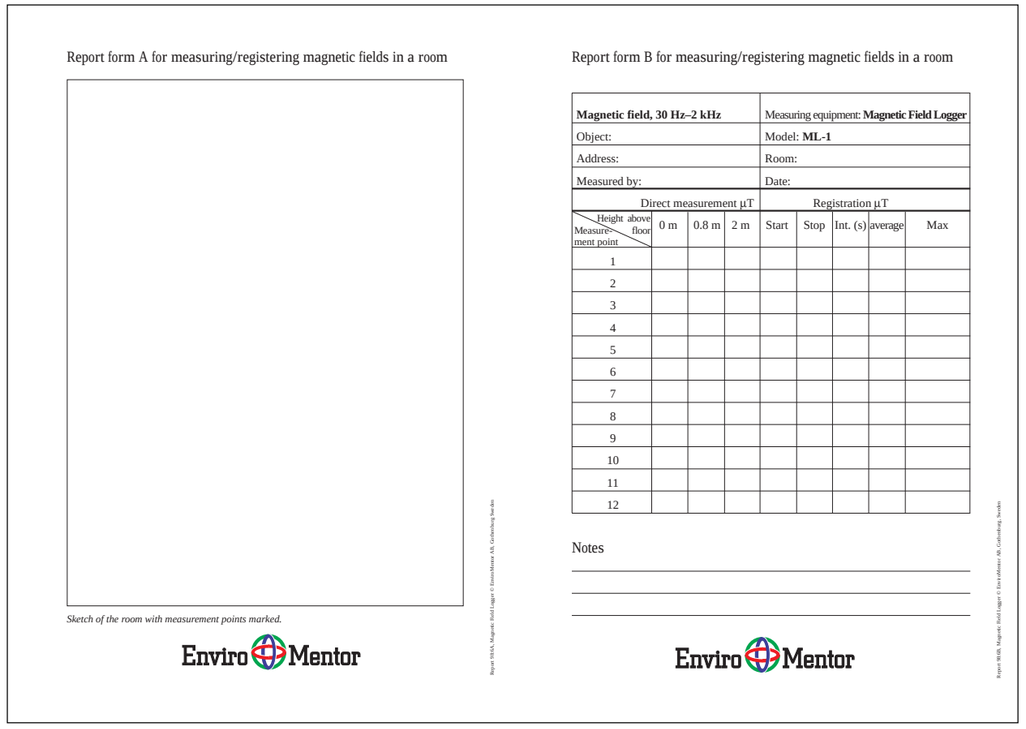
Report form for measuring magnetic fields around an object.

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, while subsection 4.3 details how to fill out the report forms.



Report form A for measuring/registering magnetic fields in a room

Sketch of the room with measurement points marked.

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Report form B for measuring/registering magnetic fields in a room

Magnetic field, 30 Hz–2 kHz				Measuring equipment: **Magnetic Field Logger**				
Object:				Model: **ML-1**				
Address:				Room:				
Measured by:				Date:				
	Direct measurement µT			Registration µT				
Measurement point \ Height above floor	0 m	0.8 m	2 m	Start	Stop	Int. (s)	average	Max
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Notes

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Report form for measuring/registering magnetic fields in a room.

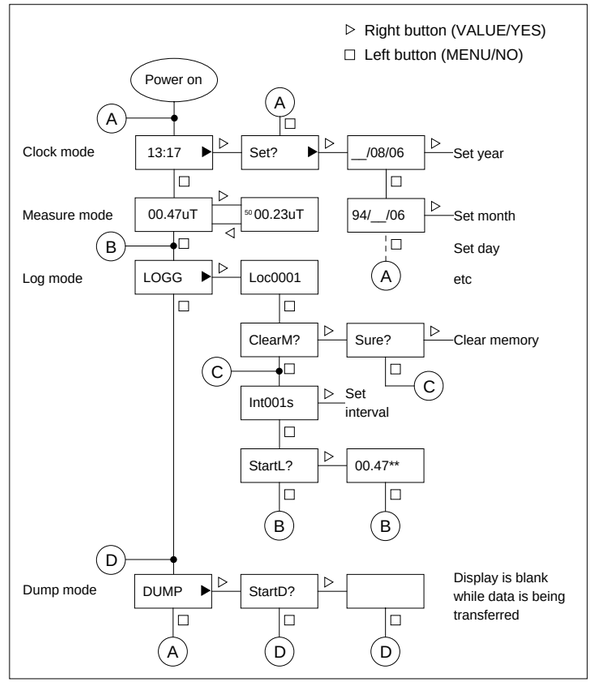
6 References to authorities and organisations

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

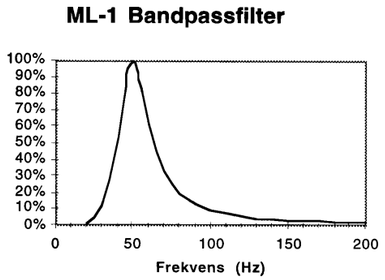
3 Use

3.1 Menu

ML-1 has a menu that you can move around in using the two function keys. The main menu contains four submenus - clock mode, measurement mode, registration mode and transmission mode. The full menu tree is shown below. You can use this for reference purposes once you are familiar with the instrument. Sections 4 and 5 describe step by step how to use the various functions.



Menu structure in ML-1.



The Q-value of the band-pass filter is 3.2, which means that the signal is attenuated approximately 30 times at 150 Hz.

3.2 Setting the clock

When the instrument has been connected, it will be in clock mode. To set the clock:

- Press YES. *Set?* appears in the display.
- Press YES.

YY/MM/DD appears in the display

- Press YES until the correct year is displayed, then press NO
- Press YES until the correct month is displayed, then press NO
- Press YES until the correct day is displayed, then press NO

HH:MM appears in the display

- Press YES until the correct hour is displayed, then press NO
- Press YES until the correct minute is displayed, then press NO

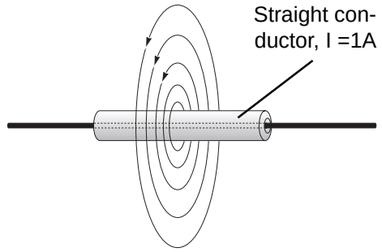
The clock is now set (the seconds are always set to zero) and the instrument reverts to clock mode in the main menu.

3.3 Direct measurement

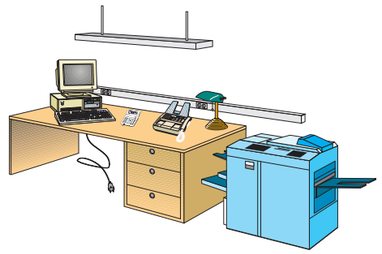
- Start up the instrument with the switch
- Press the NO button once.
- Press YES once if you want to disconnect the 50 Hz filter.
- Press YES again to connect the 50 Hz filter.

ML-1 now measures the magnetic fields and displays the effective value in µT. This value is updated at 1 second intervals. ML-1 can be pointed in any direction in relation to the magnetic field source as it has a three-dimensional sensor. “50” appears in front of the measurement reading in the display if the filter is connected.

5 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.

5. Conclude registration after e.g. a day and continue in the same manner with the other measurement points.

4.3 Example of report form 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 an object

Magnetic field, 30 Hz–2 kHz			Measuring equipment: **Magnetic Field Logger**
Object: Photocopier			Model: **ML-1**
Address: 1 North Street			Room: Porter's office
Measured by: J. Smith			Date: 10 March 1995
	30 cm	50 cm	Comments
0°	20 µT	10 µT	During copying
90°	30 µT	10 µT	
180°	40 µT	20 µT	
270°	30 µT	10 µT	
Background field	3 µT	3 µT	

Notes
The background fields are OK, but perhaps should screen off the copier or rearrange the furniture.

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Report 98:5 Magnetic Field Logger © EnviroMentor AB, Gothenburg, Sweden

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

Software settings:

Transfer speed	9600 baud
Data bits	8
Parity	none
Flow regulation/ handshake	none

You also have to select the correct serial communications port in the software (COM1, COM2…).

[s]	max. measuring time
1	2 hour 17 mins
2	4 hours 23 mins
3	6 hours 50 mins
4	9 hours 6 mins
5	11 hours 23 mins
10	22 hours 46 mins
20	1 day 21 hours 46 mins
40	3 days 19 hours 12 mins
80	7 days 14 hours 24 mins
100	9 days 11 hours 34 mins
150	14 days 5 hours 20 mins

Maximum measuring time at different measurement intervals [s].

3.3.1 Transmission during direct measurement

During direct measurement, the readings are transmitted via the RS232 port at one second intervals. The readings can be received by a computer with communication software or some similar terminal program. In the computer, the readings are stored as a text file on the hard disk. From there, they can be imported into a calculation program and used to produce diagrams or statistical calculations for the measurement. Connect the accompanying cable between RS232 on the instrument and one of the ports (COM 1, COM 2 or COM 3) on the computer. The settings for the communication software are listed in subsection 3.3.2 below.

3.3.2 Transmission protocol during direct measurement

During direct measurement, the readings are transmitted as in the following example: 01.75 01.74 012.0, i.e. ML-1 separates each reading with a space. Most communication programs can receive measurement data, e.g. Terminal in Windows.

3.4 Registering readings (Logging)

- Start up the instrument
- Press NO twice. *LOGG* appears.
- Press YES. *LocXXXX* shows how many memory locations have been used. *Loc8192* means that the memory is full.
- Press NO. *ClearM* appears.
- Press NO if you want to store additional values or YES if you want to delete the memory. *IntXXX* now appears, which is the current measurement interval.
- Press YES until the desired interval is displayed. You can select from Manual, 1, 2, 3, 4, 5, 10, 20, 40, 80, 100 and 150 seconds.

- Press NO when you have selected the interval. *StartL?* now appears.
- Press YES to start registration.
- Press YES once if you want to connect the 50 Hz filter.
- Press YES again to disconnect the 50 Hz filter.

ML-1 now measures the magnetic field and updates the reading in the display at the selected interval. After the reading, ****** appears, which indicates that registration is in progress. When the 50 Hz filter is connected, “50” appears in front of the measurement reading in the display. When connecting and disconnecting the filter, it takes approximately 3 seconds for the reading to stabilise.

ML-1 connected to a computer.

- Press NO if you want to interrupt registration. The instrument reverts to the measurement mode in the main menu.

You can now commence a new measurement series, provided you have sufficient memory space. Press NO until *LOGG* appears, then repeat the above procedure. If you want, you can select a different interval. The maximum measuring time depends on the measurement interval you have selected. The table to the left shows the maximum measuring times for measurement series with different intervals.

Note!
The instrument retains the stored readings, even if the batteries run out or are removed.

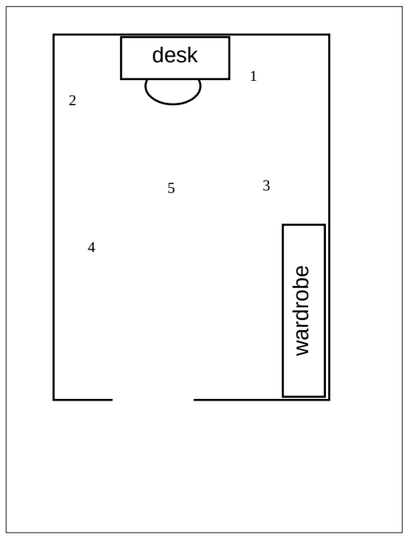
some distance away, and magnetic fields can penetrate almost all building materials.

4.2 Logging magnetic fields

Below is a suggestion as to how to measure the variations in the magnetic field in a room within the frequency range 30 Hz to 2,000 Hz.

1. Draw a sketch of the room and mark the points where you want to register the variations in the field strength.
2. Check that the clock is set and that the battery is charged.
3. Position the instrument at measurement point 1, mark this on the sketch and note the start time on the report form.
4. Set the measurement interval and start the registration process (see subsection 3.4).

Report form A for measuring/registering magnetic fields in a room



Sketch of the room with measurement points marked.

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Report form B for measuring/registering magnetic fields in a room

Magnetic field, 30 Hz–2 kHz				Measuring equipment: **Magnetic Field Logger**				
Object:				Model: **ML-1**				
Address:	3 High Street			Room:	123			
Measured by:	P. Jones			Date:	13 May 1998			
Direct measurement µT				Registration µT				
Measurement point \ Height above floor	0 m	0.8 m	2 m	Start	Stop	Int. (s)	average	Max
1	0.01	0.02	0.01	19:30	07:30	150	0.02	0.05
2	0.02	0.03	0.01	18:30	06:30	150	0.01	0.03
3	0.2	0.02	0.01	18:00	06:00	150	0.05	0.21
4	0.3	0.02	0.01	18:15	06:15	150	0.03	0.3
5	0.02	0.01	0	19:10	07:10	150	0.015	0.02
6								
7								
8								
9								
10								
11								
12								

Notes

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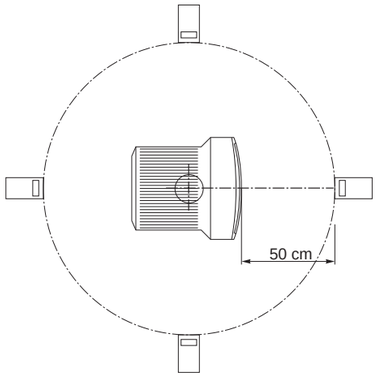
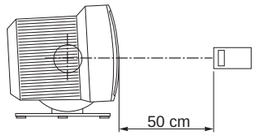
Example of completed report form for measuring/registering magnetic fields in a room.

4 Measurement examples



Overhead view.

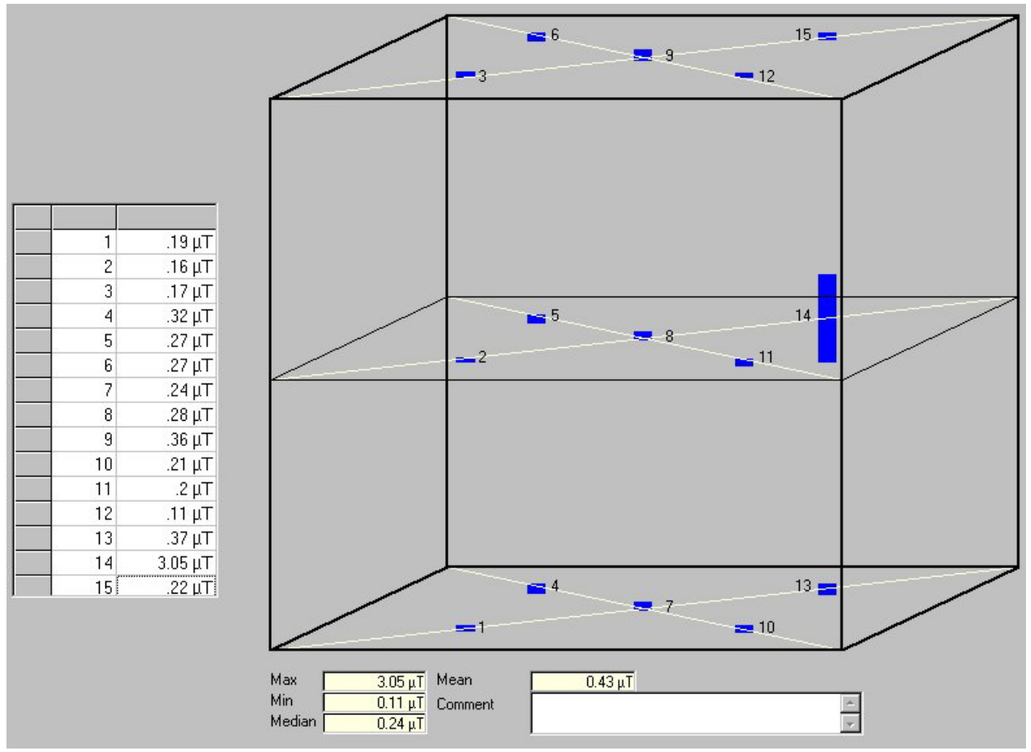


Side view.

4.1 Direct measurement of magnetic fields

Below is a suggestion as to how to measure the magnetic field in a room within the frequency range 30 Hz 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.
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 magnetic fields from the apparatus in the room.
3. Connect the pieces of apparatus one at a time and measure the magnetic fields in the directions 0°, 90°, 180° and 270° at distances of 30 cm and 50 cm from the outer edge of the piece of apparatus in question or in the direction the operator is facing (see figure) . Summarise the measurement readings in a report form. An example of how to fill out a report form can be found on page 16. You must not subtract the background values of the magnetic fields from the measured values. They should always be noted as a comparison.
4. Analyse the measurement readings and assess the need for remedial action, such as rearranging the furniture in the room and/or moving pieces of electrical apparatus. The sources of the magnetic fields may be located



Example of the presentation of a 15-point measurement in the "Field Analyzer" program.

3.5 Manual registration of the measurement readings (15-point measurement)

Set the interval manually and start registration as described in subsection 3.4. ML-1 will now measure the magnetic field and update the measurement reading in the display at 1 second intervals.

In the display, *> appears after the measurement reading, which indicates that ML-1 is in standby mode.

- Press YES to register the first point. The display now shows 01 after the measurement reading for a short while before reverting to *>.
- Press YES again to register the second point, and the display will show 02. When the 15th and last point has been registered, the instrument will revert automatically to the LOGG menu.

3.6 Transmitting measurement series (Dumping)

To transmit measurement series to a computer:

- Connect ML-1 to the computer using the accompanying cable and the adapter if required. Use the COM 1, COM 2 or COM 3… port on the computer.
- Start up the instrument.
- Press NO three times. *DUMP* appears.
- Press YES. *StartD* appears.
- Start up the "Field analyzer" program on the computer
- Select instrument ML-1.
- Select the "Communication" menu.
- Select the correct serial communication port (COM 1, COM 2 or COM 3…) in the software
- Select "Communication" again
- Select "Start ML-1 dump".
- Name the file. The program is now ready to receive series of measurements.
- Press YES on ML-1. Transmission starts immediately. The display remains blank while transmission is in progress. Transmission takes place at a rate of around 50 readings a second. Once transmission is completed, the instrument reverts to transmission mode in the main menu.

Note!
The analysis program can process a maximum of 99 measurement series.

3.6.1 Transmission protocol during dumping

Data transmission during dumping comprises ASCII characters, i.e. normal text in accordance with the following:

Every measurement series begins with a plus sign. At a 100 second interval, "00" appears in the display, at 150 seconds "50" appears and during manual logging "15" appears.

This is followed by the start time, date and interval for the measurement series as well as a space. These are followed by the readings in µT, separated by spaces. A complete series is concluded with a space, with the next series beginning with a plus sign. The final series is concluded with an asterisk.

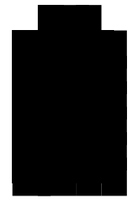
Example:
+301514079701 00.08 00.07 00.06 ……
……00.10 +020915079740 00.05 00.45 …00.33 *

indicates that the first measurement series began at 15.30 on 14/07/1997 with a measurement interval of 1 second and produced the readings 0.08 µT; 0.07 µT; 0.06 µT… 0.1 µT, while the final measurement series began at 09.02 the following day with a measurement interval of 40 seconds and produced the series 0.05 µT; 0.45 µT … 0.33 µT.

3.7 Deleting the memory

Once you have transmitted the readings to the computer, it may be a good idea to delete the memory.

- Follow the instructions under point 3.4 (registering readings) until *Clear?* appears.
- Press YES. *Sure?* appears.
- Press YES. The memory has now been deleted.
- Press NO twice to revert to the measurement mode in the main menu.



Battery symbol.

Note!
Remember that power consumption is considerably greater when the RS232 port is in use.

3.8 Changing the batteries

When the battery symbol is displayed to the left of the measurement reading, the batteries should be replaced (2 x 1.5 V LR6). If the batteries run out while logging is in progress, the logging process will be interrupted but the readings will be saved. If the batteries start to run low while ML-1 is connected to a computer via the interface cable, it may be impossible to exit the direct measurement mode. This is because power consumption is considerably higher during transmission. In this case, the instrument goes back up in the menu in order to prevent transmission errors. Disconnect the RS232 cable and check that it is possible to move forward to the DUMP mode in the menu. If the problem recurs when you reconnect the cable, the batteries should be replaced. The instrument has an integral back-up battery that enables you to replace the batteries without losing any data.