Operating Instructions

Feldmeter FM6

Measuring
electric and magnetic
alternating fields

Fauser
Elektrotechnik

Contents

1. General Information

1.1 Introduction

The Feldmeter FM6 enables you to measure electric and magnetic alternating fields in the frequency range 16 Hz to 100 kHz with constant accuracy (flat frequency response). With the directional characteristic of the external measuring probe you can locate field causes, i.e. sources of electrosmog, in order to remove these or to render them harmless through shielding measures.

1.2 Instrument models

The Feldmeter FM6 is available in three different models:

Feldmeter FM6: standard model

Feldmeter FM6S: with recorder connection

On the bushing of the recorder connection the measuring signal can be used as direct voltage or alternating voltage for frequency analysis, acoustic reproduction, storing and evaluating.

Feldmeter FM6T: with audio oscillator.

Feldmeter FM6ST: with recorder connection and audio oscillator.

The audio oscillator (acoustic indicator) enables acoustic perception of field strength.

The company Fauser Elektrotechnik can retrofit instruments that do not have the audio oscillator or recorder connection.

1.3 Contents

The package is delivered with the following contents:

- Feldmeter FM6
- measuring probe
- earthing cable (length: 5 mm) with copper earthing band
- this manual

1.4 Accessory equipment

The following accessory and supplementary equipment is available for the FM6 Feldmeter:

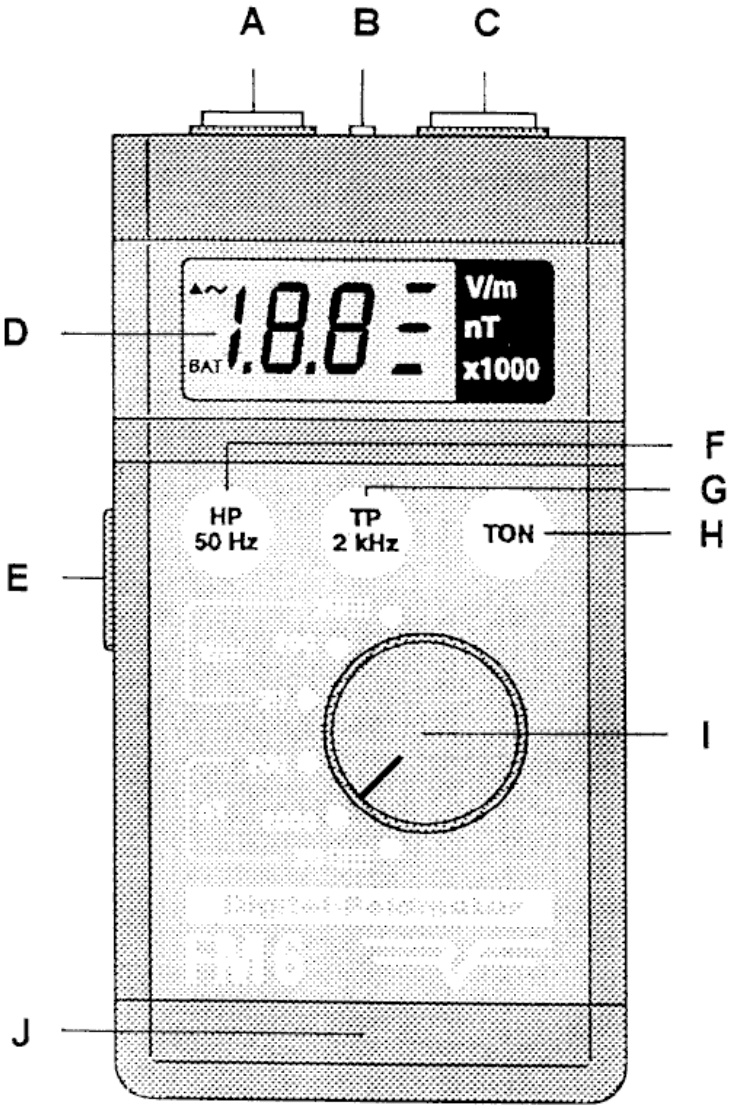
- measuring cable with hand electrode and measuring tip for measuring body and object voltage (capacitive coupling)
- earthing cable with a length of 10 metres to allow greater freedom of movement

Only for instruments with recorder outlet:

- connection box with standardised BNC and banana bushing for connecting various measuring, analysing and recording instruments
- head phones with amplifier for direct acoustic perception of the audible part of the measured alternating field
- measured value converter MK8 with UNIVERS software enables a personal computer or notebook to be connected to the FM6, allowing long-term recordings, storage, analysis and graphic reproductions of the measured values. A diskette with the free UNIVERS demonstration version will be supplied upon request
- spectrum analyser SP10 for indicating the individual frequency parts of the measured alternating fields

2. Operating instructions

2.1 Instrument Description



A) Recorder connection
Using this connection an external instrument to further process measuring signals can be plugged into instrument types FM6S and FM 6ST. The connection box, the spectrum analyser SP 10, the measured value converter MK8 with a p.c. notebook or other writing instruments are further possibilities. The exact specification of the recorder connection can be taken from appendix 5.3.

B) Earthing socket
When measuring electric fields and body voltage the black earthing cable is plugged into the earthing socket. The other end is earthed with the crocodile clip at, for example, a power point earthing contact (do not plug into the holes!) or with the aid of an earthing band on a water pipe or the bare metal part of a radiator.

C) Measuring socket
The measuring probe is plugged into this socket to measure electric or magnetic fields; to measure body voltage, the red measuring cable is used. To ensure a tight fit and good contact, the plug must be screwed in tightly.

D) Display
This displays digitally the measured values and the instrument functions. More information can be found in Chapter 2.2, Display functions.

E) On/Off switch
If the switch on the left-hand side of the instrument is shifted forward, the instrument is switched on.

F) Button "HP 50 Hz''
The high pass filter with a cut-off frequency of 50 Hz can be switched on with this button, which suppresses frequencies of less than 50 Hz. In this way, that part of the traction supply is not registered and the measured value shown is correspondingly lower. If the High-pass filter is active, the "~" appears on the display.

G) Button ”TP 2kHz’’
With this button the low pass filter with a cut-off frequency of 2 Hz can be switched on, which attenuates frequencies above 2 kHz, according to the standards TCO and MPR. With the aid of this function, the measured values shown and the size of the high-frequency fields such as those generated by computer monitors, are reduced. When the low-pass filter is active, the "▲“ appears on this display.

H) Sound button
The sound signal (acoustic indicator) can be switched on and off with this button. By pressing the button, a signal in the recorder connection can also be produced. (see appendix 5.3).

I) Range selection switch
By turning this switch the following measurement ranges can be selected:
Electrical field in V/M (volts per metre):
- 0 - 20 V/m
- 0 - 200 V/m
- 0 - 2000 V/m

Magnetic field in nT (Nano Tesla):
- 0 - 200 nT
- 0 - 2000 nT
- 0 - 20000 nT

J) Battery compartment
This compartment is located at the rear of the instrument and can be opened with a flat object, such as a screw driver, key, etc. The instrument requires a 9V block battery or the equivalent accumulator.

2.2 Display functions

The following diagram shows all of the display elements

K) Low pass display 2 kHz
When "▲" can be seen, the low pass filter is switched on and frequencies above 2 kHz are suppressed.

L) High pass display 50 Hz
When the "~" symbol can be seen, the high pass filter is switched on and frequencies under 50 Hz are suppressed.

M) Battery display
When "BAT" can be seen the battery should be changed as soon as possible as wrongly measured values may otherwise appear.

N) Measured value and
O) Measurement range are explained with the help of the following examples:

This shows an electric field of 10.0 V/m

This shows a magnetic field of 100 nT

This shows a magnetic field of
1.00 x 1000 nT = 1000 nT

This shows an electrical field of
0.50 x 1000 V/m = 500 V/m

2.3 Setting up

Before taking the first measurements, the following steps should be taken in this order.

- Open the battery compartment at the rear of the instrument with a flat object; ensure that the instrument is switched off (push the on /off switch back).
- Insert a 9V block battery or the equivalent accumulator.
- Close the battery compartment.
- To measure electric and magnetic fields, plug in the measuring probe, or to measure body voltage, plug in the red measuring cable and screw the plug in tightly.
- If necessary earth the instrument using the earthing cable.
- Switch the instrument on (switch forward).
- Turn the range selection switch to the desired field type and level of sensitivity.

3. Taking measurements

3.1 Preparing a measurement

In order to achieve an effective measurement and accurate results, it is necessary to first undertake certain preparations. The following points should be noted when doing this.

You should be clear as to the area in which you want to perform your measurements, and prepare a ground plan of this area. The field strengths you measure can then be entered on the plan. Each of the exact values is read by the immobile measuring probe.

The purpose of a measurement is always two-fold:
First, peak values as found in a particular place should be recognised and their sources located, with the object of reducing these extreme levels of pollution as far as possible. For this purpose, as many power-consuming objects (consumers) as possible should be switched on, including those which are otherwise only in operation from time to time, such as the refrigerator, stove, and so on. Then the greatest disturbing sources can be determined by means of specific measuring and by testing by switching various appliances on and off, and these can then be removed from the sensitive area to another place. Second, the average level of pollution the inhabitants are subjected to should not exceed certain limits. This means that places where people spend longer periods of time, i.e. in the workplace, in bedrooms and in recreation rooms, fields should be kept especially low.

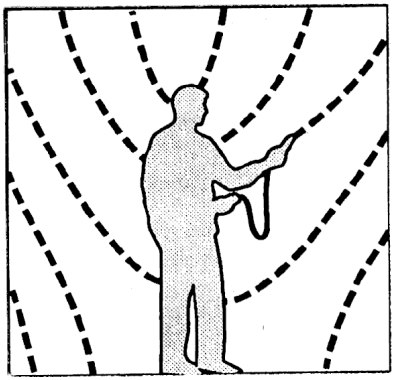
The aim should be as low a value as possible. Often even simple measures, such as unplugging extension cords and power boards when not in use (for example at night), are sufficient to considerably reduce the amount of pollution.

It should also be noted that the strength of electric and magnetic fields lessens with increasing distance to the field source.

3.2 Measuring electric alternating fields

3.2.1 Physics basics

Electric alternating fields arise around all conductive materials, such as cables, metal lamps, and bedsteads, damp walls which house electric alternating voltage. The higher the voltage and the larger the live object, the greater the field strength given off.
The production of the field around electric cables is independent of whether or not connected appliances are in use.



The electric field is effectively shielded by all materials, even those with weak conductivity and connected to the earth, such as walls or humans. Therefore when conducting measurements in inner rooms only cables and consumers which are in the room or in the adjacent walls must be taken into consideration, as influences located outside the room are largely shielded by the walls.

An exception to this is any high-voltage cables in the vicinity, as high voltage also produces very strong electrical fields.

3.2.2 Probe

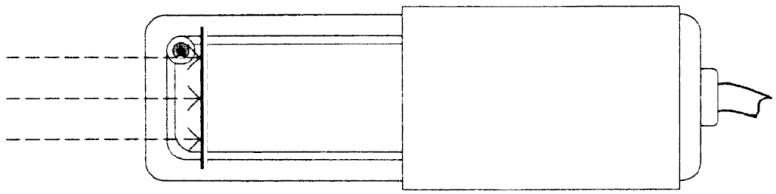


Fig 1: Position of the electrical sensor in the probe housing

The sensor for measuring electric alternating fields is located at the end wall of the measuring probe. Due to the directional characteristic of the sensor, the field lines which extend back to join the probe are completely covered, while the sensitivity to field lines on the side is continually reduced. This makes it possible to steer towards and locate the field cause by turning the probe.
In order to achieve the cited measurement accuracy, a minimum distance of 50 cm to the cause and other objects in the room must be maintained (accuracy is normally achieved at a distance of 25cm).

The front part of the probe housing should be protected from contamination of all sorts (including finger prints), and when necessary be cleaned with a paper towel that has been dipped in pure alcohol. Never use detergents! If it becomes very dirty, please contact the manufacturer.

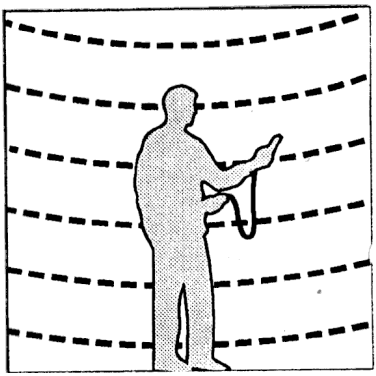
3.2.3 Carrying out measurements

To measure an electric alternating field, the measuring probe is connected to the Feldmeter. When measuring inner rooms, especially with synthetic flooring and rubber soled shoes, the Feldmeter must be earthed by the earthing cable. This can be done at the protective contact of the power point (do not plug it into the holes!) or by placing the earthing band on a water pipe.
When measuring outdoors, the instrument does not generally have to be earthed because the ground contact of the person conducting the measurements is sufficient. In order not to falsify

the results, the measuring probe must be held by the special conductive rubber handle when taking measurements. The probe must not be influenced by any shielding effects of the human body. Further, the front part must not be shielded by the hand, and it should be held away from the body and approximately in the assumed direction of the source of the electrical field. The measuring probe should be wielded calmly and evenly, as sudden movements result in short-term artificially exaggerated measured values by electrostatic fields.

3.3 Measuring magnetic alternating fields

3.3.1 Physics basics



Magnetic fields are produced around every cable through which electric power flows. The field lines form as rings around the conductor. This means they arise only when the connected power consumer is switched on. The greater the current flow the stronger the field. Especially strong magnetic alternating fields are produced by appliances which are based on the principles of electromagnetics. This applies in particular to transformers and electric motors. It is practically impossible to shield the magnetic field. Therefore, when measuring, disturbance sources which are beyond the measurement area must also be taken into consideration. As an example, it is possible to detect the magnetic field of high voltage overhead transmission lines at a distance of several hundred metres.

3.3.2 Probe

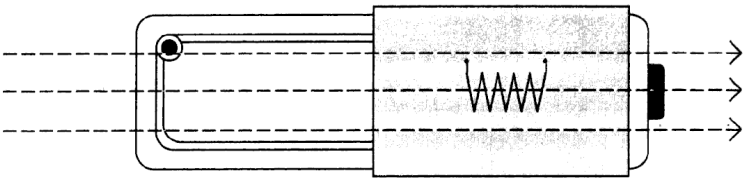


Fig. 2 Position of the magnetic sensor in the probe

The measuring coil for recording magnetic alternating fields is located in the rear part of the measuring probe under the black rubber handle. The coil is aligned so that it encompasses the electric flux lines which run in the longitudinal direction of the probe housing. Electric flux lines that deviate from this direction are not as important, in accordance with the co-sinusoidal function of the intermediate angle.

3.3.3 Carrying out measurements

In order to measure the magnetic alternating field, the measuring probe is plugged into the Feldmeter. Earthing is not required. The measurement of the magnetic field is highly dependent on the direction. Therefore the probe must be turned slowly in all directions until the field metre shows the maximum measured value. If the probe is then slowly shifted in various directions without being turned, the source of the field can be located, because when the probe approaches the source, the measured value increases.

It must be noted that particularly in the lower range of measurement (200 nT) the measuring probe shows artificially high values when moved quickly, because the movement of the probe causes the magnetic constant field (geomagnetic field) to work the same way as an alternating field and is so registered.

3.4 Measuring body voltage

For these measurements the voltage measuring cable with hand electrode and measuring tip (article no. 110) - available as an extra accessory - is used.
If the human body is located in an electric alternating field, it is inevitably coupled to the field. Alternating voltage in the body is produced and can attain a value of up to several dozen volts.
To measure body voltage the red measuring cable with the hand electrode must be connected to the Feldmeter. The person whose body voltage is to be measured holds the electrode in the hand. When measuring in this way, the Feldmeter must be earthed. The range selection switch is set to electrical field area (V/m), but the voltage unit is only volts and not volts per metre. A person's body voltage can be reduced by reducing the surrounding electric alternating field.
The value measured of the body voltage is not an absolute standard for the amount of pollution the person is exposed to by electric fields, as the value is highly dependent on the degree of earthing of the person even in the same fields. A poorly earthed person (synthetic soles or flooring, etc.) forms a considerably higher body voltage than a well earthed person in the same place, from whom the coupled voltage is drained.
Measurements taken under varying conditions (different clothing, different humidity, etc.) cannot be compared with one another so as to give any meaningful results.
More meaningful results can be achieved when measuring body voltage when the following method is used:
Body voltage of a person in a given place (e.g. in bed) is ascertained. During the measurement the surrounding electrical field is reduced, for example by unplugging electrical appliances and cables and unscrewing fuses, and the effects on the body voltage of the person are observed. If the body voltage is reduced, then the changes made to the electrical installations are suitable for reducing the pollution caused by electric alternating fields.

To measure the voltage of an appliance, the measuring point on the red measuring cable is used instead of the measuring bolt. The measuring point must NOT come into contact with any articles that are directly under mains voltage. For example, it must NOT be plugged into a power point!

The coupled voltage in appliances can be removed by professional earthing of these.

4. Corrective measures

Once you have ascertained the degree of electro-smog with the help of the Feldmeter it is then necessary to reduce it as far as possible, especially in places where you frequently spend longer periods of time (in bed, at the work place, and so on). There are various measures that can be taken in this regard:

4.1 Reducing electric alternating fields

- Unplugging unnecessary extension cords, power boards and appliances.
- Installing a switch independent of the mains which automatically separates at the fuse box the electrical cables of a circuit of a dwelling from the mains as soon as the last appliances is switched off. Continuously consuming appliances, such as refrigerators, must first be connected to a special main.
- Laying shielded cables in new buildings and during renovations.
- Shielding walls that house cables that generate particularly strong electric field, through conductive plaster and paint. It must be observed that the shielding materials can be earthed perfectly.
- Expert earthing of non-earthed metal electrical appliances, such as desk lamps.

4.2 Reducing magnetic alternating fields

- Unplugging appliances when not in use.
- Maintaining distance to causes. As a rule of thumb, when the distance is doubled, the pollution is reduced to a quarter.
- Laying transposed cables in new buildings and in renovated ones.
- Replacing mains-operated appliances with battery / accumulator battery-powered appliances, such as radio alarm clocks with battery-powered alarm clocks, electric razors with accumulator razors (or by wet shaving)

5. Appendix

5.1 Limits

	Anomaly			
Field	Extreme	Strong	Weak	none
Electric in V/m	>50	5-50	1-5	<1
Magnetic in nT	>500	100-500	20-100	<20

Table 1: Construction – biological recommended values

	Norms			
Field	DIN/VDE	IRPA	MPR	TCO
Electric in V/m	5000	5000	25	10
Magnetic in nT	100.000	100.000	250	200

Table 2: Limits according to various norms

Explanations:
DIN/VDE0848: German limits (50 Hz)
IRPA: Limit set by the International Radiation Protection Association
MPR: Norm for video display terminals
TCO: Norm for video display terminals

5.2 Guarantee

The manufacturer guarantees the materials and manufacturing for twelve months. The guarantee does not apply if the Feldmeter has been improperly used, particularly if the housing has been opened.

5.3 Specification of the recorder connector

5.3.1 General information

The six-terminal recorder connection of the Feldmeter FM6S/ST has two signal outputs, a control output and supply voltage. The Spectrum analyser SP10 (article no. 220) perception can be achieved by using the head phones (article no. 150)..

5.3.2 Connection description

instrument mass - This connection forms the relationship to all outputs of the recorder connector. It is also connected to the earthing socket of the Feldmeter. If one of the connected instruments is earthed, the Feldmeter is then also earthed.

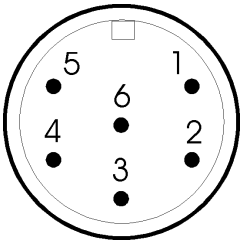
Output DC - Here is a unidirectional signal for the temporal recording of measurement data, e.g. with the measured value converter MK8 or a recorder.

Output AC - At this alternating voltage output instruments for analysing measuring signals can be connected such as the oscilloscope, spectrum analyser or audio amplifier.

Entry 9V - Using this entry the Feldmeter can be run for long-term measurements with a voltage supply. If the on/off switch of the Feldmeter is then switched off, the battery or accumulator can remain in the Feldmeter with no danger of it overloading. It must be ascertained that the voltage supply is potential-free, i.e. it has no connection to the instrument mass.

Key switch - The switch “Sound” of the Feldmeter has an additional function to switching on the acoustic indicator (in the FM6ST). As long as this switch is depressed, it is connected to the instrument mass. This function comes into use when using the measured value converter MK8. It can also be used to trigger other instruments, e.g. to start a recorder.

5.3.3 Connection plan



1 Entry 9V
2 Output AC
3 Key switch
4 Output DC
5 Entry 9V +
6 Instrument mass

5.3.4 Connection data

Socket type:	KGR 60
Outputs:	
Output resistance	500 Ω
Output voltage DC	0 - 2 V, 1 digit = 10mV
Output voltage AC	0 - 200 mV, 1 digit = 1 mV
Entry:	
Supply	7,5 V - 9,5 V, potential-free
Switches:	
Switch element	Transistor (open collector)
Maximum voltage	30 V
Maximum power	0,2 A

5.4 Technical data

Dimensions im mm:	
FM6	156 x 85 x 45
Probe	138 x 40 x 20
Weight:	
FM6 with battery	265 g
Probe	110 g
Display:	LCD, 2 1/2
Parallel direction:	TRMS
Frequency band:	
Without filter	16 Hz - 100 kHz ± 1 dB
Without filter HP50	50 Hz -100 kHz ± 1 dB residual sensitivity bei 16,7 Hz: 6%
With filter TP2k	16 Hz - 2 kHz ± 1 dB According to the MPR standard
Measuring fields:	
Electric field	20/200/2000 V/m
Magnetic field	200/2000/20000 nT
AC voltage	20/200 (/2000) V
Accuracy (at 50Hz):	
Electric field	± 10 % (assuming set measuring procedure)
Magnetic field	± 5 %
Voltage	± 2,5 %
Operating temperature range:	0 ºC - 50 ºC
Relative humidity:	max. 70% rH, without condensation
Amperage:	7 mA
Battery or accumulator:	9 V E-Block