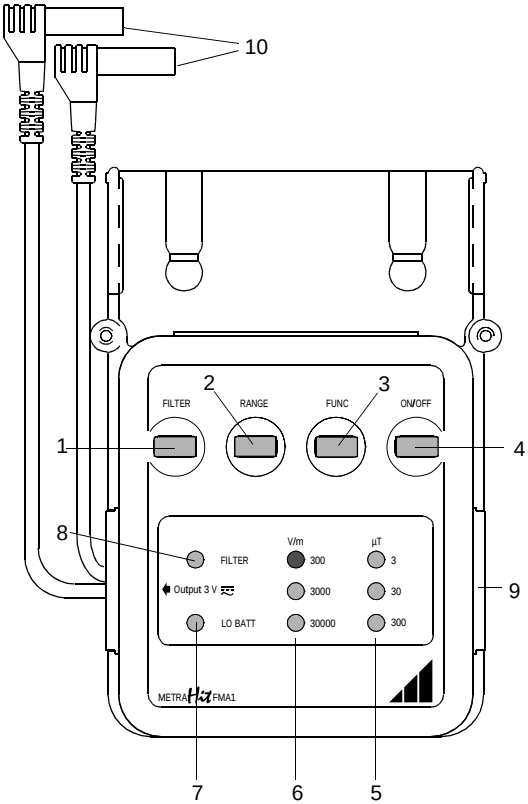
Operating Instructions

GOSSEN METRAWATT CAMILLE BAUER

METRAHit® FMA1

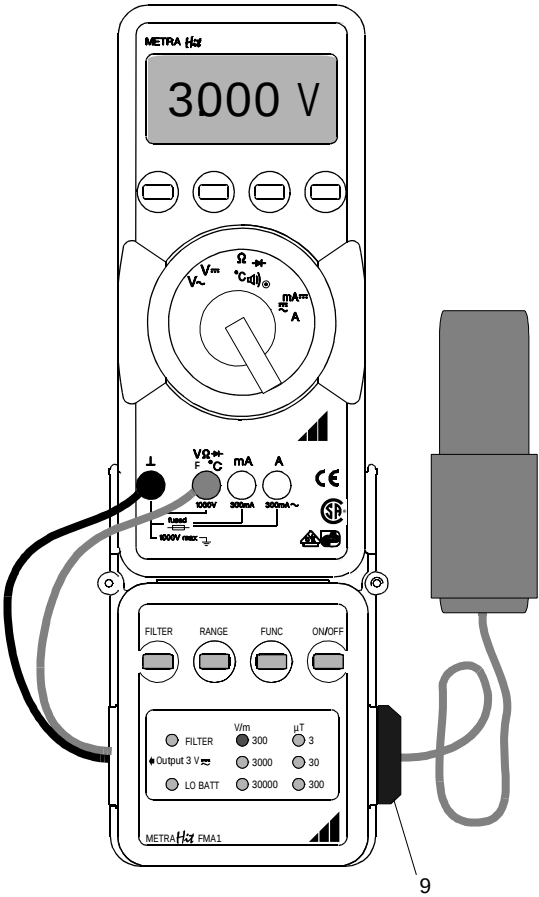
Field Measurement Adapter

3-348-853-02
3/7.00



METRA*Hit* FMA1 Operating Elements and Connectors

1 Low-pass filter activation key
2 Measuring range selection key
3 Measurement function selection key (electric or magnetic field)
4 ON/OFF key
5 Measuring range display for magnetic field measurements
6 Measuring range display for electrical field measurements
7 Low battery display
8 Filter selection display
  – LED not lit: no filter active
  – LED lit: low-pass filter active (frequencies greater than 2 kHz are suppressed)
9 9 pole SUB-D port for probe
10 Contact protected plugs for connection to multimeter
  – black for EARTH input
  – red for VOLT input



METRA*Hit* Multimeter Display

Measurement values are always displayed in the selected 3 V~ multimeter voltage measuring range regardless of the measuring range which has been selected at the field measurement adapter. In order to determine the correct decimal place for field strength values, multiply the reading at the multimeter by the corresponding factor:

Electrical Field Strength		Magnetic Field Strength	
Meas. Range	Factor	Meas. Range	Factor
300 V/m	100/m	3 µT	1 µT/V
3000 V/m	1000/m	30 µT	10 µT/V
30000 V/m	10000/m	300 µT	100 µT/V

Contents Page

1 Safety Features and Precautions

You have selected an instrument which provides a high level of functional safety.

The field measurement adapter is manufactured and tested in accordance with the regulations IEC 61010–1 / EN 61010–1 / VDE 0411–1. If used for its intended purpose, functional safety of the instrument is assured. Safety is however not guaranteed, if the instrument is operated improperly or handled carelessly.

In order to maintain flawless technical safety conditions, it is imperative that you read the operating instructions carefully and thoroughly before placing your instrument into service, and that you follow all points contained therein.

Observe the following safety precautions:

- The instrument may only be operated by persons who are capable of recognizing contact hazards, and taking the appropriate safety precautions. Contact hazards exist anywhere, where voltages of greater than 30 V may occur (effective value).
- Make certain that the measurement cables are in flawless condition, i.e. no damage to insulation, no interruptions in cables or plugs etc.
- Be absolutely certain, that the *measuring ranges are not overloaded beyond their allowable capacities*. Limit values can be found in the table “Measuring Ranges” in chapter 9, "Characteristic Values".

Meaning of symbols on the instrument

Warning concerning a point of danger
(Attention: observe documentation)

Indicates EU conformity

Repair, Parts Replacement and Balancing

When the instrument is opened, voltage conducting parts may be exposed. The instrument must be disconnected from the multimeter and from the probe prior to repair, replacement of parts or balancing. If repair or balancing of a live, open instrument cannot be avoided, this may only be carried out by trained personnel who are familiar with the dangers involved.

Errors and Extraordinary Strains

If it may be assumed that the instrument can no longer be safely operated, it must be removed from service and secured against unintentional use.
Safe operation can no longer be relied upon,

- if the instrument demonstrates visible damage,
- if the instrument no longer functions,
- after a long period of storage under unfavorable conditions,
- after extraordinary stresses due to transport.

2 Applications

The FMA1 is an adapter device for digital multimeters of the METRA*Hit* series for the measurement of low frequency, alternating electrical and magnetic fields. It consists of a control unit with LEDs and a screw-on field measuring probe. The instrument provides for the recognition of localized peak values and comparison with allowable limit values, as well as the tracing of interference sources.

- *Electrical Power Utilities:*
  Measurement of middle to high-voltage lines, transformer stations and underground cables
- *Public Transportation Operators:*
  Measurements at elevated railway systems
- *Technical Monitoring and Radiation Protection Authorities:*
  Testing in accordance with federal emissions regulations
- *Authorized Personnel for the Monitoring of Work Station Monitor Screens:*
  Testing for observance of MPR II or TCO standards
- Institutes for Biologically Sound Building Practices and Environmental Protection Projects
- *Clinics and Health Spas*

3 Initial Start-Up

Batteries

Please observe instructions in chapter 10.1, page 17 before replacing batteries.

Attention!
The field measurement adapter must be electrically disconnected from the multimeter and from the probe before the instrument is opened!

Mounting

➪ Push the bottom of the multimeter onto the field measurement adapter as far as possible. The tracks for the multimerter's rubber feet securely fix both instruments in the proper position.

Connection to the Multimeter

➪ First set the rotary selector switch to V~, so that the "Volt" socket is made available.

➪ Insert the black, contact protected plug into the earth socket at the multimeter, and the red plug into the voltage measurement socket.

Connecting the Probe

Connect the probe cable to the RS232 port at the field measurement adapter.

Connecting the Earthing Cable

If required, an earthing cable can be connected between the black, contact protected plug and the multimeter earth input, see chapter 7.2.3, page 11.

Switch the Field Measurement Adapter On

➪ Press the yellow ON/OFF key. The LED for magnetic field measurement in the 3 µT range lights up.

Switch the Multimeter On

➪ Make sure that the rotary selection switch is set to the V~ position.

➪ Switch the multimeter on.

➪ Select the measuring range manually as required.

Automatic Shut-Off

The device is switched off automatically if none of the keys are activated for a period of about 10 minutes, or if the “LO BATT” LED lights up after a long period of operation.

Continuous Operation

➪ Press and hold the FILTER key, and then press the ON/OFF key. The FILTER LED lights up briefly. Release both keys.

Switching Back On

➪ Activate the yellow ON/OFF key.

Note!
After automatic shut-off, a waiting period of about 3 seconds must be observed, before the instrument can again be switched on.

Switching the Field Measurement Adapter Off

➪ Activate the yellow ON/OFF key.

4 Measurement Function and Measuring Range

The desired measurement function can be selected with the FUNC key; either electric or magnetic field measurement. The appropriate LED lights up in either the V/m or µT column. Repeated activation of the RANGE key allows for selection of one of the 3 measuring ranges within the desired measurement function.

5 Multimeter LCD Display

➪ Select the alternating voltage measuring function at the multimeter.

V AC is displayed as the unit of measure.

Note!
If a measurement value of greater than 3,000 or overflow, OL, is displayed, the next highest measuring range must be selected at the adapter.

6 Registration of Field Strength Time Characteristics (optional METRA*Hit*® SI232-II)

Field strength time characteristics can be recorded with the "METRA*Hit*® SI232-II" memory adapter and a "METRA*Hit*" multimeter. Select the desired sampling rate and perform measurement in accordance with your requirements. Be aware that field strengths can fluctuate greatly during lengthy periods of measurement, and that peak values are often incorrectly recorded, if the selected measuring range is too low. For this reason, a sufficiently low measuring range must be selected at the FMA1 after the measuring probe has been adjusted (maximum value).

7 Measurement

7.1 Measurement Preparation

In order to obtain an effective measurement and meaningful results, certain preparations should be made in advance. The following points must be observed:

- The spatial area to be encompassed by the measurement should be well defined and laid out on paper. The measured field strengths are recorded into the layout sketch. The probe must be stationary during read-out of each precise value.
- It is the objective of this measurement to recognize locally existent peak values and to locate their sources. The goal is a reduction of peak loads to the greatest possible extent. To this end, all possible sources must be activated, even those which are normally only operated intermittently. The strongest sources are then located by means of targeted measurements and activation and deactivation of sources at random. These sources can later be removed from the acutely sensitive zone, or provided with improved shielding.
- Limit values for average exposure for occupants must also be observed. This means that especially low field contamination levels must be maintained at locations which are occupied for lengthy periods of time, such as work, sleep and rest areas, as well as passenger cabins. An attempt should always be made to obtain the lowest possible value, in order to reduce exposure to a minimum.
- The fact that the strength of electrical and magnetic fields is reduced in proportion to the distance from the source, must be taken into consideration during measurement.

7.2 Measurement of Alternating Electrical Fields

7.2.1 Physical Properties

Alternating electrical fields irradiate from all conductive materials, such as power cables, metal lamps and damp walls, to which an electrical alternating voltage has been applied. The strength of the generated electrical field increases with the strength of the voltage and the size of the electrically charged object.

Whether or not the load components connected to a given power cable are switched on or off, has no effect on the occurrence of fields at such power cables.

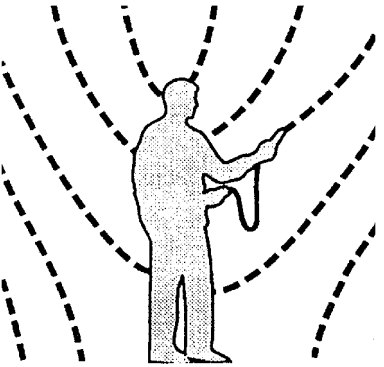


Fig. 1 Measurement within an Alternating Electrical Field

Electrical fields are effectively shielded by all grounded materials, even those with poor conductive properties, e.g. massive walls, earthing conductors, as well as by the human body.

For this reason, measurements taken within enclosed areas need only take power cables and load components into consideration, which are situated within the effected room or in adjacent walls, because outside influences are shielded to a great extent by the walls.

High-voltage cables within close proximity represent an exception to this rule, because these generate extraordinarily strong electrical fields.

7.2.2 Probe

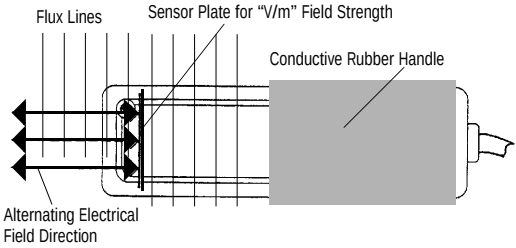


Fig. 2 Position of Electrical Sensor in Probe Housing

The sensor for the measurement of alternating electrical fields is located at the front of the probe. The directional pattern of the sensor provides for full sensitivity to flux lines which strike the front of the probe, whereas sensitivity to flux lines from the sides is continuously reduced. Thus a bearing can be taken on the source of the field, and its position can be determined by rotating the probe.

The measuring probe registers the same field strengths, to which an object (person or device) at the same location would be exposed.

In order to assure correct measurement accuracy, a minimum clearance of 50 cm from the field source, as well as from other objects within the room, must be maintained (in general, accuracy is also assured with a clearance of 25 cm).

7.2.3 Grounding the Field Measurement Adapter

As a rule, the instrument does not have to be grounded for outdoor measurements, because ground contact via the operator is usually sufficient. In this case, grounding is accomplished via the conductive rubber handle.

In the event that measurements are taken in enclosed rooms with rubber soled shoes or on insulating plastic floor surfaces, additional grounding is recommended.

➪ Ground the field measurement adapter with an earthing cable, one end of which is connected between the black connector plug of the field measurement adapter and the earth socket at the multimeter. The end to be grounded can be connected to the earthing contact at a mains outlet, to a central heating system with an earthing strap or to a water pipe.

7.2.4 Performing the Measurement

- During measurement, hold the probe by its special conductive rubber handle and point towards the suspected source.
- Move the probe in a steady, smooth fashion. Avoid abrupt movements.

Note!
Abrupt movements result in short-term, artificially elevated measurement values due to unidirectional electrical fields.

Note!
Hold the probe as far as possible from your body as possible. Measurement results are distorted if the probe is shielded by the human body.

7.3 Measurement of Alternating Magnetic Fields

7.3.1 Physical Principals

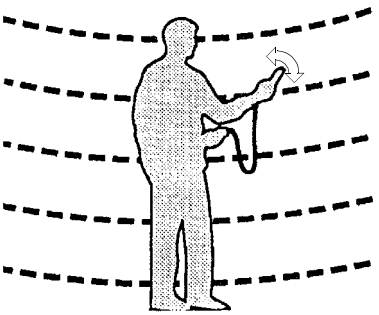


Fig. 3 Measurement within an Alternating Magnetic Field, Maximum Value Determination

Magnetic fields are irradiated by all cables which conduct electrical currents. The flux lines occur as rings around the cable. They only occur if the connected load component is in operation. The strength of the field increases with current flow. Especially strong alternating magnetic fields are generated by devices which function according to the principle of electromagnetism. Above all, these include transformers and electric motors.

The magnetic field can only be partially shielded. Thus interference sources located outside of the room to be measured must also be taken into consideration during measurement. The magnetic field generated by a high-voltage, overland power cable at great distance can also be detected.

7.3.2 Probe

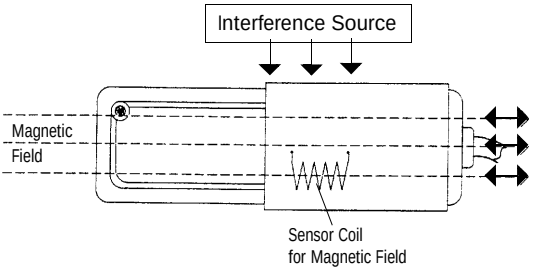


Fig. 4 Position of Magnetic Sensor in Probe Housing

The measuring coil for the detection of alternating magnetic fields is located at the back of the probe beneath the black rubber handle. The coil is aligned such that it detects flux lines, which are oriented longitudinally in relation to the probe housing. Flux lines which deviate from this orientation are weighted to a lesser degree in accordance with the cosine function of the intermediate angle.

7.3.3 Performing the Measurement

The detection of magnetic fields is dependent upon distance and direction to the source.

- ⇨ First, turn the probe slowly over its own axis in order to determine the direction of maximum field strength.
- ⇨ Then move the probe in the direction which demonstrates increasing field strength without changing the axial position determined in the previous step, until the source is identified.

☞ Note!
Please note that abrupt movements of the probe, especially in the lower measuring range (3 µT), cause the display of excessively high values. This is due to the fact that movement of the probe causes the earth's unidirectional magnetic field (geomagnetic field) to act upon the probe as an alternating field, which is registered as an interference signal.

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8 Corrective Measures for Internal Electrical Systems

After having determined the source and strength of alternating electrical or magnetic fields, an attempt should be made to reduce their strengths and influences, especially in work areas. Various corrective measures can be implemented to this end:

8.1 Reduction of Alternating Electrical Fields

- Use shielded cables for new installation or renovations.
- Shield walls containing cables which generate especially strong fields with conductive plasters, paints and wall papers. The shield materials must be well grounded.
- Proper earthing of non-grounded, metallic electric appliances, such as desk lamps.
- Removal of unnecessary extension cables, multiple electrical outlets and load components.
- *Sleep and rest areas:* Installation of a mains interruption switch, which automatically disconnects household power circuits from the mains at the fuse box, as soon as the last load component has been switched off. Appliances such as refrigerators which operate continuously, must be previously connected to a separate circuit.

8.2 Reduction of Alternating Magnetic Fields

- Unplug unnecessary devices.
- Maintain sufficient distance from source. Rule of thumb: if the distance is doubled, exposure is reduced by 75%.
- Use braided wire for new installation or renovations.
- Replace mains powered devices with battery or storage battery powered devices.

9 Characteristic Values

Meas. Quantity	Measuring Range	Resolution	Inherent Deviation
Alternating Electrical Field [2]	0.0 ... 300.0 V~/m	0.1 V/m	±10%of rdg. ± ...[1] D
	0.0 ... 3000.0 V~/m		
	0.0 ... 30000.0 V~/m		
Alternating Magnetic Field	0.0 ... 3.0 µT~	0.1 µT	±5% of rdg. ± ...[1] D
	0.0 ... 30.0 µT~		
	0.0 ... 300.0 µT~		

[1] Deviation dependent upon multimeter

[2] Measurement relative to potential, similar to MPR

Frequency Range without Filter	16 Hz ... 100 kHz (±1 dB)
Frequency Range with Filter	16 Hz ... 2 kHz (±1 dB)

Display

Red LED: filter setting, battery condition,
Green LED: measurement function and measuring range

Operating Functions

Keys: ON/OFF, meas. function, meas. range and filter

Reference Conditions

Ambient Temperature	+23 °C ±2 K
Relative Humidity	45 ... 55%
Meas. Magnitude Frequency	sine, 50 Hz
Operating Voltage	3 V ±0.1 V

Ambient Conditions

Operating Temperature	0 °C ... + 55 °C
Storage Temperature	–25 °C ... + 70 °C (without batteries)
Relative Humidity	max. 75%, no condensation
Elevation	to 2000 m

Power Supply

Battery	2 ea. 1.5 V mignon cell alkali manganese cell per IEC LR6
Service Life	with alkali manganese cell: approx. 130 hours
Battery Test	LED Display
Power Consumption	20 mA typical

Electromagnetic Compatibility, EMC

Interference Emission	EN 50081-1: 1992
Interference Immunity	EN 50082-1: 1992

Mechanical Design

Protection	IP40
Dimensions	WxHxD: Control Unit: 97 mm x 135 mm x 39 mm Probe: 43 mm x 130 mm x 28 mm
Weight	Control Unit: 210 g with battery Probe: 130 g

Note!
Disconnect the instrument from the multimeter before opening to replace batterries !

10.1 Batteries

Make certain that no battery leakage has occurred before initial start-up of your instrument, or after it has been in storage. Repeat this inspection in the future at regular, short intervals.

If battery leakage has occurred, the battery electrolyte must be carefully and completely removed with a dampened cloth, and the batteries must be replaced before the instrument is placed back into service.

If the “LO BATT” LED lights up, the batteries should be replaced as soon as possible. You can continue to take measurements for 1 ... 2 hours, before the instrument shuts down automatically due to insufficient supply voltage.

Replacing Batteries

The housing base must be removed in order to replace batteryies.

- Loosen the two screws at the bottom of the housing and remove the housing base.
- Insert two 1.5 V mignon cells poled according to the polarity symbols in the battery compartment.
- Replace the housing base and press until it audibly snaps into place. Retighten the screws.

10.2 Field Measurement Adapter Housing

No special maintenance is required for the housing. Excessive contamination impairs insulation. Outer surfaces must be kept clean for this reason. Use a slightly dampened cloth for cleaning. Avoid the use of cleansers, abrasives and solvents.

10.3 Probe Housing

The front part of the probe housing should be protected against all types of contamination (including fingerprints), and should be cleaned with a paper towel moistened with pure alcohol if necessary. Do not, under any circumstances, use cleansers, abrasives or solvents. If excessive contamination should occur, please contact the manufacturer.

11 Appendix

11.1 Limit Values

Recommended Values for Biologically Sound Building Practices

	Anomaly			
Field	extreme	strong	weak	none
Electrical in V/m	> 50	5-50	1-5	< 1
Magnetic in nT	> 500	100-500	20-100	< 20

Limit Values in Accordance with various Standards

	Standard			
Field	BImSchG	IRPA	MPR	TCO
Electrical in V/m	5000	5000	25	10
Magnetic in nT	100,000	100,000	250	200

Explanations:

BImSchG: German Federal Emission Control Legislation German Limit Values (50 Hz)

IRPA: International Radiation Protection Association Limit Values

MPR/TCO: Standard for Work Station Monitor Screens

12 Repair and Replacement Parts Service DKD Calibration Lab and Rental Instrument Service

When you need service, please contact:

GOSSEN-METRAWATT GMBH
Service-Center
Thomas-Mann-Straße 20
90471 Nürnberg, Germany
Phone +49 911 86 02 - 410 / 256
Fax +49 911 86 02 - 2 53
e-mail fr1.info@gmc-instruments.com

This address is only valid in Germany.
Please contact our representatives or subsidiaries for service in other countries.

13 Product Support

When you need support, please contact:

GOSSEN-METRAWATT GMBH
Produkt Support Hotline
Phone +49 911 86 02 - 112
Fax +49 911 86 02 - 709

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GOSSEN-METRAWATT GMBH
Thomas-Mann-Str. 16-20
D–90471 Nürnberg
Telefon +49 911 8602-0
Telefax +49 911 8602-669
e-mail: info@gmc-instruments.com
http://www.gmc-instruments.com