

EFA-200/-300 EM Field Analyzer

Operating Manual

BN 2245/98.22



**EFA-200/-300
EM Field Analyzer**

BN 2245/20, 30, Series A ...

Operating Manual

If you have any questions
about this product, please contact
the Sales Company for your locality.

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Sandwiesenstr. 7
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© 2005

Order no.: 2245/98.22

Edition: 04/05.03, A ...

Previous Edition: 03/02.01, A ...

Subject to change without notice.

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Printed in Germany

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Annex A: Glossary

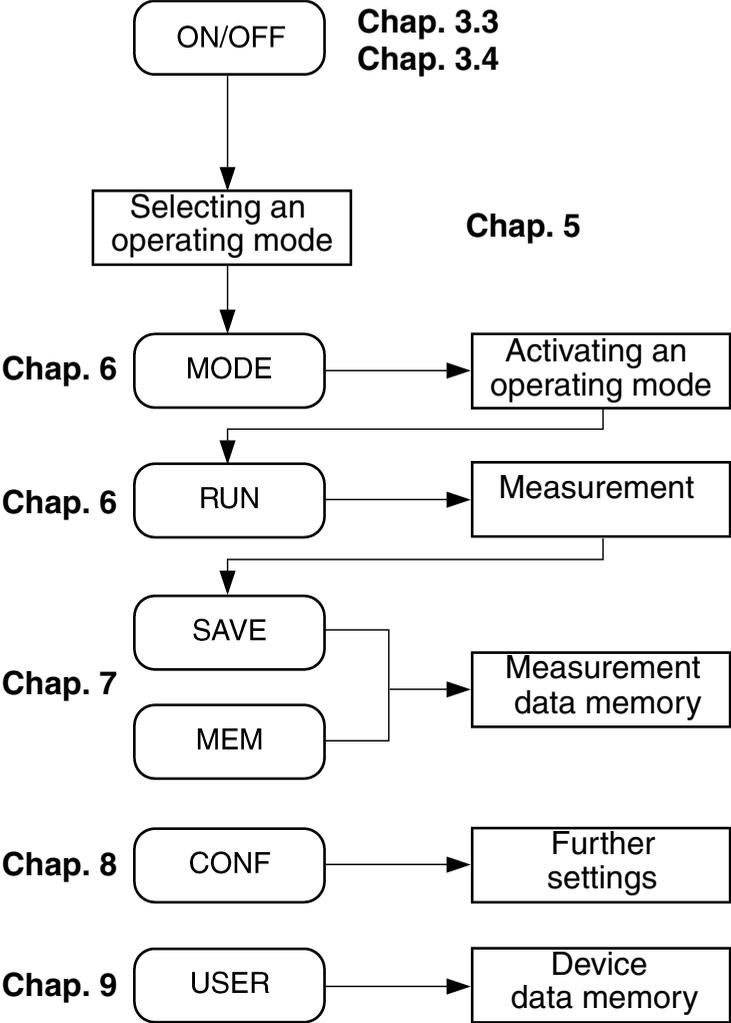
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Operating concept



1 Introduction

1.1 About these instruments

1.1.1 Applications

Many people live and work in the vicinity of power lines and power distribution equipment. For safety's sake, it must be ensured that these people are not exposed to any electromagnetic fields that could be injurious to health.

Global efforts to introduce effective protection in recent years have led to a range of national and international guidelines and standards. These set permitted limit values for electric and magnetic field strengths for various frequency ranges and signal shapes.

In practice, this means using simple equipment to measure the fields that occur at a particular location or place of work with sufficient accuracy to check the effectiveness of protective measures, ensure that the limit values stipulated by the standards and guidelines are not exceeded and to dispel any doubts in the minds of those affected. Lightweight, portable, battery-operated measuring instruments, which cover the dynamic range and frequencies of interest are needed for this. They must also be easy to use and deliver results that can be directly compared with the current limit values.

1.1.2 Common features

The EFA-200 and EFA-300 Field Analyzers are devices for monitoring low-frequency fields in the range 5 Hz to 32 kHz.

All instrument functions are designed for ease of use under practical conditions. Operation has been arranged so that the instruments can be set as simply as possible using function keys and menu keys. Menu keys are used to switch between the four main menus: MODE, CONFIGURATION, MEMORY and USER.

The **MODE** key thus gives access to up to 5 different operating modes. These modes can be activated individually at any time as needed, so you can always adapt your EFA to the specific task at hand.

The **MEM** key allows you to record a timer-controlled set of measurements or to save the measured values in a spatial matrix, and to recall the stored results as required.

The **CONF** key enables access to additional functions such as activation of an alarm, entry of date and time information or the selection of stored limit value curves.

Function keys are used in all menus to enable access to further measurement functions.

By default, the parameters set the last time the instrument was used are set automatically when you switch on again. You can continue measuring straight away. You can also save your own settings under any name and recall these as required using the **USER** key.

1.1.3 Differing features

The main differences between the EFA-200 and EFA-300 result from the different measurement objectives. They are readily apparent from the different measurement setups that are used.

EFA-200 – magnetic field measurements

The EFA-200 is for measuring magnetic fields.

The measurement setup consists of the Basic Unit and a B-field probe. One B-field probe is already built in to the Basic Unit. Two external B-field probes of different designs are available for making more accurate measurements.

EFA-300 – electric and magnetic field measurements

The EFA-300 additionally measures electric fields.

The measurement setup also includes a Basic Unit, which is identical to the B-field measuring instrument as regards function and operation. An internal B-field probe is also fitted and the same external probes can also be used.

E-field measurements become possible when the cube-shaped E-Field Unit – a precisely aligned plate condenser – is connected. The connection between the Basic Unit and the E-Field Unit is a fiber optic cable. This allows the highly-sensitive E-Field Unit to be operated from a distance to ensure that the effects on the field caused by the operator do not influence the measurement.

In this measurement setup, the Basic Unit is only used to operate the E-Field Unit. The E-Field Unit performs all measurement functions and also stores the results independently of the Basic Unit. This unusual solution makes it possible to start a long-term measurement with the E-Field Unit and then to disconnect the Basic Unit and the fiber optic cable and make magnetic field measurements using the Basic Unit without the E-Field Unit.

1.2 About this operating manual

The two device types EFA-200 and EFA-300 differ in their measurement objectives (magnetic flux density or electric field strength). However, operation of the devices is to a large extent identical since the basic functions of the EFA-300 and EFA-200 are the same.

This is why it is possible to include both devices in a single operating manual and consider the two side by side. Important differences in handling and specifications are covered in the chapters “Preparation for use”, “Control and display elements” and “Specifications”.

Major differences are found, however, in chapters 5 to 9, which consider the operation of the devices.

In these chapters, indications that apply to both units refer to the common name of EFA.

Functions or restrictions that apply to only one of the instruments are preceded by an appropriate note, e.g. **For EFA-200 only**.

Restrictions in function are also preceded by appropriate notes. For example, some of the types of data set cannot be saved as individual values in the memory. The section “Saving individual values” is therefore prefixed with the note: **For data set types Normal, List, Vector only**.

Notes:

2 Safety instructions

2.1 Before connecting up

This instrument left the factory in perfect condition. To ensure safe usage and to preserve it in good condition, please follow the safety instructions below.

2.2 Correct use

The instrument must only be used under the conditions and for the purposes for which it was designed.



Electric shock

The EFA range of instruments is not provided with any special insulation features.

Danger

⇒ Do not touch any parts carrying dangerous voltages with the measuring instrument or the probe.

Strong fields

Very strong fields occur in the vicinity of powerful radiation sources.

⇒ Persons fitted with electronic implants (pacemakers, etc.) must avoid such areas.

Danger of explosion

Alkaline batteries can explode if you attempt to recharge them.

⇒ Before starting to recharge the batteries, make sure that rechargeable cells and not alkaline batteries are fitted in the battery compartment.

⇒ Check that the switch inside the battery compartment is set correctly.



Malfunction

The accuracy and function of the instrument can be impaired by incorrect use, damage and unauthorized repairs.

Caution

- ⇒ Only use the instrument under the conditions and for the purposes for which it was designed.
- ⇒ Regularly check the instrument for any signs of damage.
- ⇒ Only allow repairs to be made by trained service engineers.

Unsuitable measuring range

The EFA series of instruments has a limited frequency range that extends from 5 Hz up to 32 kHz. Fields outside this range will normally be assessed incorrectly.

- ⇒ Select a suitable measuring range.
- ⇒ Only measure within the valid measuring ranges.

2.3 AC Power Supply Unit



Electric shock

Parts carrying live voltages, which may cause injury can be exposed if the Power Supply Unit is damaged.

Danger

- ⇒ Never use a damaged Power Supply Unit.



Damage

Incorrect AC line voltages, condensation, extreme temperatures and poor ventilation can all result in damage to the Power Supply Unit.

Caution

- ⇒ **Before connecting up the** Power Supply Unit check that the operating voltage of the Power Supply Unit matches the local AC line voltage.
- ⇒ Do not use a Power Supply Unit if condensation has formed on it. If condensation is unavoidable, such as when the Power Supply Unit is cold and is brought into a warmer environment, it must be allowed to dry out completely before it is connected up.
- ⇒ Only use the Power Supply Unit indoors at temperatures between +5 °C and +45 °C.
- ⇒ Ensure adequate ventilation for cooling during operation.

2.4 Faults and excessive stresses

The instrument must be taken out of service and secured against unauthorized use if safe operation can no longer be guaranteed. This is the case, for example:

- if the instrument shows visible signs of damage
- if the instrument no longer functions
- if the instrument has been subjected to excessive stresses of any kind that are beyond the permitted limits.

In such cases, please contact your local Service Center. The addresses are listed at the end of this operating manual.

Notes:

3 Preparation for use

3.1 Unpacking

3.1.1 Packaging

Do not discard the packing materials. These items have been specially designed to be reused if they are not damaged. Always use the original packaging when transporting the instrument if possible.

3.1.2 Checking the package contents

Ordering information: see page 12-23

3.1.3 Checking for transport damage

After unpacking, check the instrument and all accessories for transport damage. Such damage is likely if the packaging itself has been severely damaged. Do not attempt to use an instrument which is visibly damaged.

3.1.4 Recovery after transport and storage

Condensation may form on an instrument which has been stored or transported at a low temperature when it is brought into a warm environment. To prevent any damage, wait until all signs of condensation on the instrument surfaces have disappeared before switching the instrument on. The instrument is only ready for use when it has reached the guaranteed operating temperature range of 0 to +50 °C.

3.2 Power supply

- The EFA-200 / -300 Basic Unit operates from dry cells or rechargeable batteries.
- The E-Field Unit for the EFA-300 contains built-in rechargeable batteries.

3.2.1 Operation from rechargeable batteries / dry cells

Replacing the rechargeable batteries / dry cells: see page 10-1

Operation from rechargeable batteries

The Basic Unit is operated from five 1.2 V NiMH batteries (baby or size C, IEC R 14).

Fully charged batteries will provide power for about 10 hours of operation. The batteries are supplied pre-charged, but will need to be fully charged before the device is used for the first time.

Operation from dry cells

Basic Unit only

Five 1.5 V alkaline batteries (baby or size C, IEC LR 14) can be used in the Basic Unit instead of rechargeable batteries.

These batteries will provide power for about 20 hours of operation.

Low battery display

The message "LOW BATTERY" appears in the display when the rechargeable or dry batteries are almost discharged.

Note: You can continue measurements for about 15 minutes after the "LOW BATTERY" warning appears.

The built-in lithium battery provides power for the result memory when the batteries are completely discharged or when they are being replaced.

Lithium battery: see page 10-3

3.2.2 Charging the rechargeable batteries

A complete recharge takes about 3 hours.



Danger

Danger of explosion

Alkaline batteries can explode if you attempt to recharge them.

- ⇒ Before starting to recharge the batteries, make sure that rechargeable cells and not alkaline batteries are fitted in the battery compartment.
- ⇒ Check that the switch inside the battery compartment is set correctly.

Starting the charging cycle

- ✓ The local AC line voltage matches the operating voltage of the Power Supply Unit.
- ✓ The correct AC line adapter has been selected.
 1. Connect the Power Supply Unit to the EFA charger socket.
 2. Connect the Power Supply Unit to the AC line power supply.
 - The charge cycle starts.
The yellow CHARGE indicator LED lights up.
 - When the batteries are fully charged, the Power Supply Unit switches to trickle charge mode automatically. The yellow CHARGE indicator LED flashes rapidly.

Possible malfunctions

The yellow CHARGE indicator LED flashes slowly.

Batteries are not ready to be charged, e.g. because they have not yet reached the charging temperature range (+10 °C to +40 °C).

⇒ Stop the charging cycle and start again later.

– or –

⇒ Place the Power Supply Unit and the EFA in a warmer room.

3.3 Preparing for B-field measurements

3.3.1 Measurement setup

The complete measurement setup for measuring a B-field consists of:

- the Basic Unit
- an external B-Field Probe (optional)

No person or object should be between the radiation source and the probe while the measurement is being made.

3.3.2 Selecting the probe type

B-Field Probes are used to measure magnetic fields. Three different types are available for use in different environments or for different measurement purposes.

- Internal B-Field Probe
 - The internal B-Field Probe is used when fields are to be detected and measured with a minimum of work.
 - Measurement accuracy: approx. 6 %
- External B-Field Probe with $d = 3$ cm
 - This very small B-Field Probe can be used for pinpoint measurements in locations that are narrow or difficult to access.
 - Measurement accuracy: approx. 6 %
- External precision B-Field Probe with 100 cm^2 cross-sectional area
 - A probe with an effective cross-sectional area of 100 cm^2 is stipulated for measurements conforming to VDE standard 0848. The large surface eliminates the effects of small eddy fields and guarantees highly accurate measurements.
 - Measurement accuracy: approx. 3%

Note: Physical constraints result in a higher background display level when the built-in B-Field Probe and the external 3 cm diameter B field probe are used.

It is possible that the sensitive measurement ranges are only completely usable when the external precision B-Field Probe with 100 cm^2 cross-sectional area is used.

3.3.3 Connecting / disconnecting the external B-Field Probe

The 12-way connector socket for the external B-field probe is on the head of the EFA.

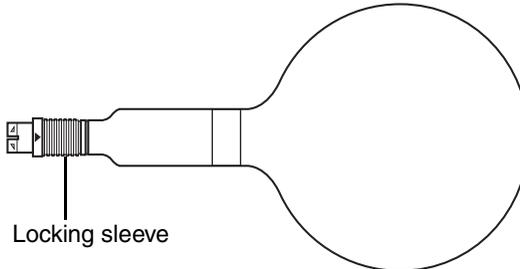


Figure 3-1 External B-Field Probe

Connecting the B-Field Probe

1. Place the probe on the Basic Unit so that the red triangle on the probe points in the same direction as the red dot on the Basic Unit.
 - Push the plug into the Basic Unit with the locking sleeve until the plug lock engages.
 - The probe is now connected.
 - The Basic Unit automatically detects the probe type that has been connected.

The display shows “B” for B-Field Probe.

Removing the B-Field Probe

- ⇒ Pull the locking sleeve on the plug towards the probe.
The plug lock disengages and the probe can be removed.

3.3.4 Switching on the Basic Unit

- ✓ You have made sure that the batteries have enough power for the measurement.
- ⇒ Briefly press the **ON/OFF** key.
The Basic Unit switches on.
The green ON indicator LED lights up.
The function test starts.

Function test

The function test checks the internal memory, display, signal processor and the internal signal path.

- While the function test is running:
 - the test screen is displayed
 - the red Alarm LED flashes.

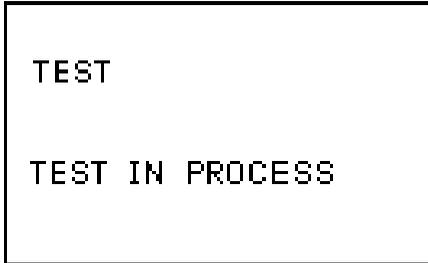


Figure 3-2 Test screen

- If the function test is completed successfully:
 - all the settings from the last measurement are retained
 - a beep is heard
 - the measurement screen is displayed.
 - Measurements can now be started.

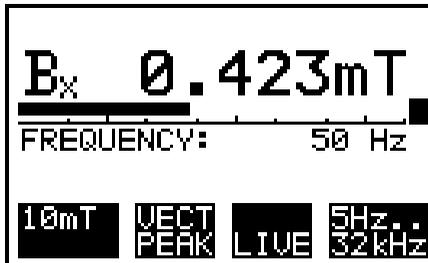


Figure 3-3 B-field measurement screen

Possible malfunctions

The instrument does not operate.

The batteries are completely discharged.

⇒ Recharge the rechargeable batteries or replace the dry cells.

Charging the rechargeable batteries: see page 3-3

Replacing the rechargeable batteries / dry cells: see page 10-1

– or –

A fatal error has occurred.

⇒ Perform a reset, possibly also recall basic settings.

Basic Unit keyboard: see page 4-1

Display remains blank after switching on.

Display contrast is set too high / too low.

⇒ Check the display contrast setting.

Contrast: see page 4-5

The default setting always appears after switching on.

The lithium battery is exhausted.

⇒ Contact the Service Center.

Lithium battery: see page 10-3

Two beeps are heard close together.

The self test detected missing data in the device configuration.

⇒ The instrument will be reset to the default setting automatically.
Measurements can be started.

Three beeps are heard close together and the error message “ERROR DETECTED” appears in the display.

The function test cannot be completed because of an internal fault in the instrument.

⇒ Contact the Service Center.

3.4 Preparing for E-field measurements

3.4.1 Measurement setup

For EFA-300 only

The E-Field Unit is used to measure electric fields.

Unlike measurements of magnetic fields, electric field measurements are easily influenced by persons or objects in the vicinity of the sensor.

The complete EFA-300 measurement setup for electric fields includes:

- The E-Field Unit fitted on a tripod
- The Basic Unit
- A fiber optic cable for connecting the E-Field Unit to the Basic Unit

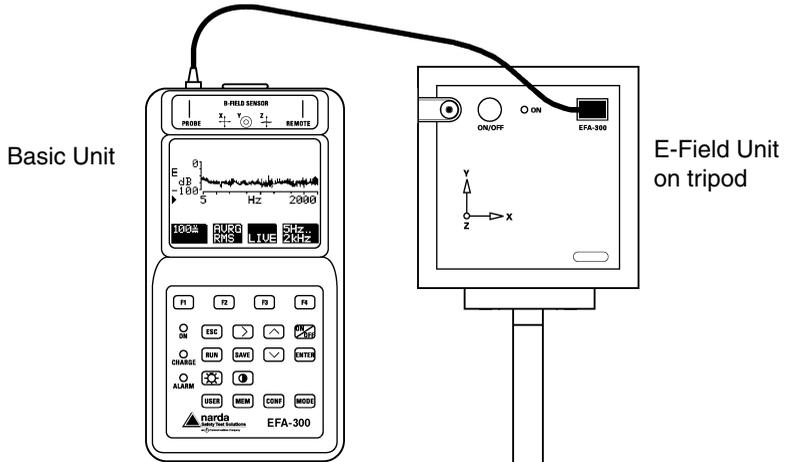


Figure 3-4 E-Field Unit measurement setup

The E-Field Unit is a stand-alone instrument that takes care of all processes, measurements and result storage. The EFA-300 Basic Unit serves only as a remote control unit in this setup, and can be used for other measurements once the settings have been made.

Table 3.1 shows the various functions of each part of the measurement setup.

Example: The connection to the Basic Unit can be disconnected while the E field unit makes measurements and stores the results as a stand alone unit. You can then use the EFA-300 Basic Unit to measure magnetic fields independently of the E-Field Unit.

	EFA-300 Basic Unit	E-Field Unit
Operation	x	
Measurement		x
Functions		x
Data memory		x

Table 3-1 Functions of measurement setup elements for E-field measurements

Using the E-Field Unit

- The E-Field Unit has excellent isotropic characteristics. It does not need to be aligned precisely.
- The E-Field Unit, Basic Unit, tripod and fiber optic cable must be completely dry when the measurement is made.
- Any objects within the electric field and also the floor can distort the field. The following conditions must be met when the measurement is made:
 - The E-Field Unit is mounted on a tripod and insulated from it.
 - The tripod and mounting rod have been extended as far as possible.
 - No persons are in the immediate vicinity of the sensor.
 - No objects, including the Basic Unit, are in the immediate vicinity of the sensor.

3.4.2 Assembling the E-Field Unit measurement setup

1. Screw the E-Field Unit to the tripod.
2. Connect the fiber optic cable to the E-Field Unit connector socket.
3. Connect the fiber optic cable to the **PROBE** connector socket of the EFA-300 Basic Unit. Avoid kinking or bending the fiber optic cable.
 - Once switched on, the Basic Unit detects the switched on and connected sensor and switches to E-field measurement automatically.
 - The status of the E-Field Unit is shown on the display of the Basic Unit.
 - The internal B-field probe and any external B-field probe that may be connected are disabled.

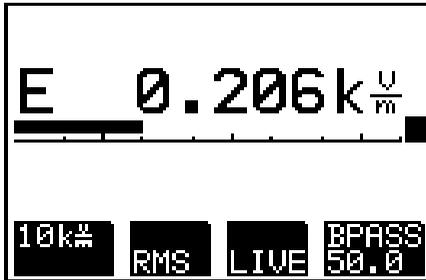


Figure 3-5 E-field measurement screen

3.4.3 E-Field Unit function test

Switching on the E-Field Unit

1. Switch on the Basic Unit.

Switching on the Basic Unit: see page 3-5

2. Press the **ON/OFF** key on the E-Field Unit.
A green LED on the E-Field Unit indicates that the device is ready.

Possible faults



Faulty operation

Data will be lost in transmission down the fiber optic cable if the cable is kinked or bent sharply.

Caution

⇒ When assembling the measurement setup, avoid kinking or bending the fiber optic cable.

The message “LOW BATTERY” appears in the display of the basic unit.

The remaining operating time is about 15 minutes.

The rechargeable batteries in the basic unit must be recharged.

– or –

The rechargeable batteries in the E-Field Unit must be recharged.

1. To determine which set of rechargeable batteries needs recharging, briefly disconnect the E-Field Unit from the basic unit.
2. If the “LOW BATTERY” message disappears, recharge the batteries in the E-Field Unit.

– or –

If the message is still displayed, recharge the batteries in the basic unit.

Charging the rechargeable batteries: see page 3-3

A connection between the E-Field Unit and the Basic Unit cannot be established.

The fiber optic cable plug is incorrectly or incompletely inserted.

⇒ Check the connection of the fiber optic cable to the Basic Unit and the E-Field Unit. During setup, avoid kinking or bending the fiber optic cable.

Notes:

4 Control and display elements

For an overview of the position of all control and display elements, see the figure in the back.

4.1 Basic Unit keyboard

Element	Function
	ON/OFF key <ul style="list-style-type: none">• Powers up the device with the settings that were active when it was last powered down.• Reset: Restarts the instrument when a fatal error occurs if you hold down the key until the ON indicator goes out (about 3 seconds).
Function keys	
   	F1, F2, F3, F4 keys Direct access to functions or sub-menus. <ul style="list-style-type: none">• Function changes according to operating mode and current menu.• Current functions are displayed in the display fields F1 through F4 above the keys.
	RUN key Starts the measurement <ul style="list-style-type: none">• Starts measurement process immediately.• Start and stops measurement processes in Spectrum FFT and Harmonic Analysis modes.• Allows jump back to the Measure menu from any sub-menu.

Table 4-1 Keyboard overview

Element	Function
	<p>SAVE key</p> <p>Saves sets of data.</p> <ul style="list-style-type: none"> • Triggers the save action in the MEM menu. • Saves <ul style="list-style-type: none"> – individual data sets – individual spectra – individual result lists
Navigation keys	
	<p>UP key</p> <p>Step key for entering numerical data or selecting from menus.</p> <ul style="list-style-type: none"> • Increments the numerical value by 1. • Shifts the selection up one line. • Changes the contrast if the contrast setting is activated. <p>Hold down the key to increase the rate of change.</p>
	<p>DOWN key</p> <p>Step key for entering numerical data or selecting from menus.</p> <ul style="list-style-type: none"> • Decrements the numerical value by 1. • Shifts the selection down one line. • Changes the contrast if the contrast setting is activated. <p>Hold down the key to increase the rate of change.</p>
	<p>NEXT key</p> <p>Step key for moving from one number field to the next.</p> <ul style="list-style-type: none"> • Shifts the active entry field for a numerical parameter one place to the right. • Enables operation of the cursor in Spectrum FFT mode. • Enables the results list in Harmonic Analysis mode. • Enables fast access to the frequency ranges in Field Strength mode.

Table 4-1 Keyboard overview

Element	Function
	<p>ESC key</p> <p>Jumps from a sub-menu back to the next higher menu level.</p> <ul style="list-style-type: none"> • Rejects a change in a numerical entry. • Rejects a change in a selection.
	<p>ENTER key</p> <p>Concludes entries and exits from the menu</p> <ul style="list-style-type: none"> • Confirms: <ul style="list-style-type: none"> – a selection from a list – entries – changes in a numerical value • Opens sub-menus. • Opens entry fields for numerical values. • Toggles between two possibilities for a function.
Menu keys	
	<p>USER key</p> <p>Opens the USER menu.</p> <ul style="list-style-type: none"> • Saves up to four user-defined settings. • Opens: <ul style="list-style-type: none"> – user defined settings (User Setup) – factory settings (Factory Default Setup)
	<p>MEM key</p> <p>Opens the MEM menu.</p> <ul style="list-style-type: none"> • Selects: <ul style="list-style-type: none"> – timer controlled measurement sequences – spatially assigned measurement values • Displays saved data sets. • Deletes individual data sets or the entire data memory.

Table 4-1 Keyboard overview

Element	Function
	<p>CONF key</p> <p>Opens the CONFIG menu.</p> <ul style="list-style-type: none"> • Enables: <ul style="list-style-type: none"> – selection of the alarm function – selection of the measurement unit – selection of current value documentation – setting of date and time – editing of the frequency list – selection of standards – selection of measurement axes – readout of service information • Reset: Resets the instrument to the default settings and clears the measurement data and instrument memories if you hold down the key until a double beep is heard when switching on.
	<p>MODE key</p> <p>Opens the MODE menu.</p> <ul style="list-style-type: none"> • Selects operating modes.
Display optimization keys	
	<p>LIGHT key</p> <p>Switches the display backlight on or off.</p>
	<p>CONTRAST key</p> <p>Switches the contrast function on.</p>

Table 4-1 Keyboard overview

4.2 Basic Unit display

4.2.1 Liquid crystal display

The content and format of the display vary greatly according to the operating mode. Section 6 (Operating modes) explains these displays with illustrations.

4.2.2 Backlight

Note: The display backlight uses a lot of energy and should therefore only be used when absolutely necessary.

Switching on the backlight

⇒ Press the **LIGHT** key.
The display backlight switches on.

Switching off the backlight

The display backlight switches off automatically after one minute.

– or –

⇒ Press the **LIGHT** key.
The display backlight switches off.

4.2.3 Contrast

Setting the contrast

1. Press the **CONTRAST** key.
The **CONTRAST** menu appears.
2. Use the **UP/DOWN** keys to change the contrast setting.
The bar indicates the display contrast. Its length depends on the setting.
3. Press any key except **UP/DOWN**.
The **CONTRAST** menu closes. The menu previously activated is displayed again.

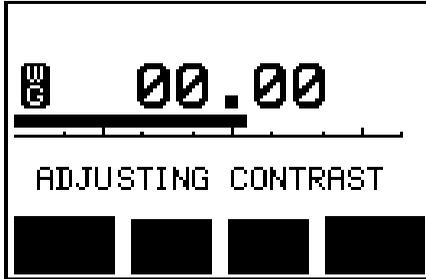


Figure 4-1 Display when setting the contrast

4.3 Basic Unit indicators

Element	Function
 ON	ON INDICATOR, GREEN Indicates that the instrument is ready to use.
 CHARGE	CHARGE INDICATOR, YELLOW Battery charging indicator <ul style="list-style-type: none"> • On continuously during charging. • Flashes slowly if there is a fault during charging. • Flashes rapidly when trickle-charging.
 ALARM	ALARM INDICATOR, RED Alarm indicator <ul style="list-style-type: none"> • Flashes during the self test. • Flashes if the alarm threshold is exceeded when the alarm function is activated.
	BEEP ALARM Built-in audible alarm indicator <ul style="list-style-type: none"> • Emits a continuous tone when the alarm threshold is exceeded. • Emits a continuous tone when the measured value is outside the measurement range. • Emits two beeps after a successful self test. • Emits two or three beeps when a fault occurs.

Table 4-2 Overview of indicators

4.4 E-Field Unit controls

Element	Function
 ON/OFF	ON/OFF key <ul style="list-style-type: none"> Starts the E-Field Unit.
 ON	ON INDICATOR, GREEN Indicates that the device is ready to use.
 CHARGE	CHARGE INDICATOR, YELLOW Battery charging indicator <ul style="list-style-type: none"> On continuously during charging. Flashes slowly if there is a fault during charging. Flashes rapidly when trickle-charging.

Table 4-3 E-Field Unit controls

Notes:

5 Selecting an operating mode

5.1 Operating mode applications

	Suitable for evaluating:		
	Fields of one specific frequency	Multiple frequency fields	Pulsed fields
	<ul style="list-style-type: none"> • Transformer stations • Railroad lines • High tension lines • RF heating / smelting 	<ul style="list-style-type: none"> • Transformer stations • Railroad lines • Offices • Production lines 	<ul style="list-style-type: none"> • Welding equipment
Field strength	very good	satisfactory	–
Exposure STD	very good	very good	very good
Spectrum FFT	good	very good	restricted
Harmonic Analysis	–	very good	restricted

Table 5-1 Overview of the suitability of operating modes for various measurement tasks

5.2 Operating mode features

5.2.1 Field Strength mode

Selective and broadband time-domain measurements

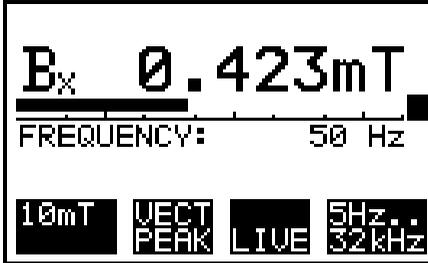


Figure 5-1 Field Strength mode measurement screen

- Measurement aim:** Measurement of overall field strength or the field strengths of individual frequency components.
- Measurand:** RMS or peak field strength value.
Frequency of main field source.
- Display:** Numerical display of measurement result.
- Special features:** Freely selectable bandpass and stop-band filters.

5.2.2 Exposure STD mode (Shaped Time Domain)

Broadband measurement with simultaneous limit value evaluation in real time

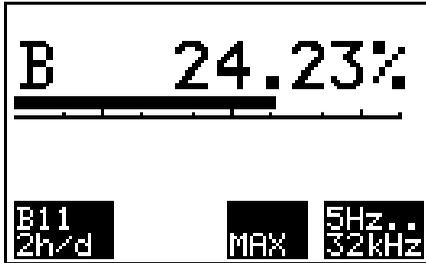


Figure 5-2 STD evaluation mode measurement screen

Measurement aim:	Rapid, reliable evaluation of field exposure with reference to a prescribed limit value curve.
Measurand:	Field exposure as a percentage of the field strength limit.
Display:	Numerical display of measurement result.
Special features:	Various limit value curves can be selected. Easy to use.

5.2.3 Spectrum FFT mode (Fast Fourier Transformation)

Recording of curves (time domain) with subsequent determination of spectra (frequency domain)

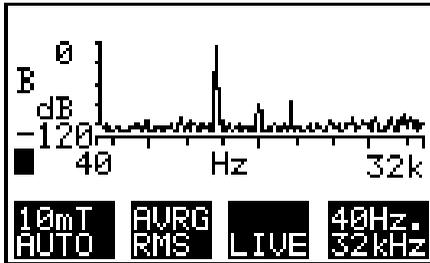


Figure 5-3 Spectrum FFT mode measurement screen

- Measurement aim:** Measurement of the field strengths of all frequency components.
Spectrum analysis of simultaneously occurring fields.
- Measurand:** RMS or peak field strength value for each frequency component analyzed.
- Display:** Graphical display of spectrum.
Precise display of frequency and field strength possible using cursor functions.
- Special features:** Rapid assessment of relevance by means of a display standardized on the limit curve.

5.2.4 Harmonic Analysis mode

Spectrum analysis with subsequent result evaluation

```

F1:401.3Hz
B1:20.76uT
K2:0.0012% KH:0.0023%
K3:0.0526% K9:0.0012%
K4:0.0014% KT:0.0623%
K5:0.0007% KN:0.0712%
K6:0.0023%
K7:0.0012%
  
```

Figure 5-4 Harmonic Analysis mode measurement screen

Measurement aim:	Measuring the harmonics of a fundamental wave. Contactless check of quality of an energy supply.
Measurand:	RMS or peak value of fundamental wave field strength and fundamental wave frequency. Harmonic ratios.
Display:	Graphical display of spectrum during the measurement. Evaluation results are then shown as a table.
Special features:	–

5.3 Checking the EFA operating modes

Field Strength and Exposure STD modes are always available.

Other operating modes can be enabled.

Is the selected operating mode enabled?

⇒ Press the **MODE** key.

All available operating modes will be displayed.

Enabling an operating mode

Enabling operating modes: see page 10-9

6 Operating modes

6.1 Field Strength mode

The magnetic flux density or the electric field strength (RMS value or peak value) within a selected frequency range is determined in “Field strength” mode.

Frequency range classes

You can select one of the following three frequency range classes (frequency filters):

Frequency range class	Explanation
BROAD BAND (broadband filter)	Measurement of all the signal components that are within a selected (broad) frequency range.
BAND PASS (bandpass filter)	Measurement of all the signal components that are within a narrow frequency range.
BROAD BAND (stop band filter)	Measurement of all the signal components that are within the frequency range [5 Hz to 2 kHz] with the exception of a narrow frequency range. The signals in this “unwanted” frequency range are suppressed.

Table 6-1 Frequency range classes (frequency filters)

Frequency measurement

A frequency measurement is additionally performed for the “BROAD BAND” frequency range class.

This frequency measurement is based on counting the number of zero crossings of the signal and is therefore basically suitable for measuring fields with one dominant frequency.

The field strength required for a measurement depends on the selected measurement range.

6.1.1 Activating Field Strength mode

1. Press the **MODE** key.
The MODE menu lists all available operating modes.
2. Use the **UP/DOWN** keys to select the “FIELDSTRENGTH” function.
3. Press the **ENTER** key to confirm your selection.
The Field Strength measurement screen is displayed.

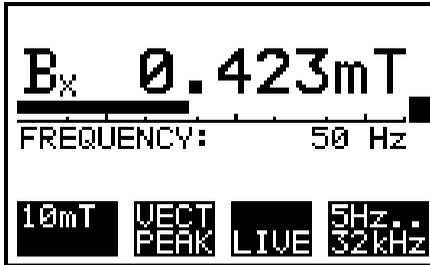


Figure 6-1 Field Strength mode measurement screen

6.1.2 Selecting the measurement range

There are two ways to select the measurement range:

- By selecting a value from a selection menu
- By activating the “AUTO” function
The instrument selects the range matching the measured value automatically.

Selecting a value from a selection menu

1. Press key **F1** to open the selection menu.
2. Select the range using the **UP/DOWN** keys.
3. Press the **ENTER** key to confirm your selection.
The selected measurement range is shown in the display field F1.

Note: If the Alarm function is used, a higher measurement range than the alarm threshold must be selected.

– or –

Activating the “AUTO” function

1. Press key **F1** to open the selection menu.
2. Select the “AUTO” function using the **UP/DOWN** keys.

3. Press the **ENTER** key to confirm your selection.
The automatically selected measurement range is shown with “AUTO” below it in the display field F1.

Possible faults

The over-range screen is displayed.

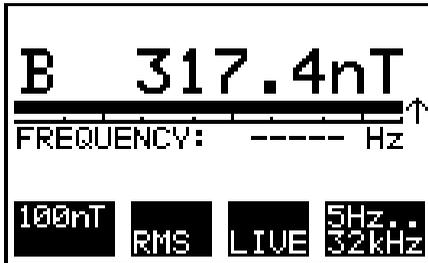


Figure 6-2 Over-range screen

The selected range is not suitable for the field being measured. The measurement range has been exceeded.

⇒ Select a higher measurement range.

The selected range remains active even after the “AUTO” function has been selected.

The “MAX” function is activated.

⇒ Switch off either the “AUTO” or the “MAX” function.

6.1.3 Selecting the detection mode

Two detection modes can be selected:

- **RMS:** The overall RMS value is calculated from the RMS values for the three measurement axes (isotropic measurement only).
- **VECT PEAK:** The peak value is calculated from the peak values of the field vector. The phases of the three measurement axes are taken into account (isotropic measurement only).

⇒ Press key **F2** to toggle between the two detection modes.
The selected detection mode is shown in display field F2.

6.1.4 Selecting the display mode

Two display modes can be selected:

- LIVE: Digital and analog displays show the current measurement value.
 - MAX: Digital and analog displays show the highest measurement value that has occurred since the "MAX" function was activated.
- ⇒ Press key **F3** to toggle between the two display modes.
The selected display mode is shown in display field F3.
The "MAX" display value is cleared when you switch to LIVE mode.

6.1.5 Selecting the frequency range

The available frequency ranges are split into three broad classifications:

- BROAD BAND (broad band filter): Four settings covering the frequency range from 5 Hz to 32 kHz are defined in a selection list.
- BAND PASS (bandpass filter): Six values are defined in a selection list. Only the selected frequency is observed during the measurement.
- BAND STOP (stop band filter): Six values are defined in a selection list. The frequency range between 5 Hz and 2 kHz except for the selected stop band frequency is observed during the measurement.

For the two last filters, one of these values can be entered as a variable frequency range.

Entering a variable filter frequency: see page 6-5

All six predefined frequency ranges can be varied in the CONFIG menu.

Editing the frequency selection list: see page 8-8

Tip: You can save your defined frequency ranges as a user setup.

Calling up a device setting (User Setup): see page 9-1

Selecting the frequency range

1. Press key **F4** to open the FILTER sub-menu.
The functions for keys **F1** to **F4** change.
 - Key **F1**: BROAD BAND
 - Key **F2**: BAND PASS
 - Key **F3**: BAND ST00P
2. Use one of the keys **F1** to **F3** to select the filter required.
A selection list pops up.
3. Use the **UP/DOWN** keys to select the frequency range.
4. Press the **ENTER** key to confirm your selection.
The selected filter is shown in display field **F4**.
The measurement screen is displayed.

Entering a variable filter frequency

In addition to the fixed filter frequencies, you can enter one variable frequency per filter in the range from 15 Hz to 2 kHz with a resolution of 0.1 Hz.

- ✓ The FILTER menu is open.
1. Press key **F4**.
The FILTR / VAR sub-menu opens.
The first digit of the active filter is highlighted in black.
 2. Change the digit using the **UP/DOWN** keys.
 3. Move to the next digit using the **NEXT** key.
 4. Repeat steps 2 and 3 for the remaining digits.
 5. Press the **ENTER** key to confirm the change.
The altered value is now present in the selection list for the active filter and can be selected from there.

Fast switching between filters

The **NEXT** key can be used during the measurement to access a mode allowing rapid switching between the various filters.

- ✓ The measurement screen is displayed.
1. Press the **NEXT** key.
The functions of keys **F1** through **F4** change.
 - Key **F1**: BROAD BAND
 - Key **F2**: BAND PASS
 - Key **F3**: BAND STOP

2. Switch between the filters using keys **F1** through **F3**.
The last active frequency range of the selected filter is activated and indicated in the display field F4.
The measured value changes according to the selected frequency range.
3. Press the **ESC** key to return to normal measurement mode.

6.1.6 Evaluating the results

Evaluating the measurement screen

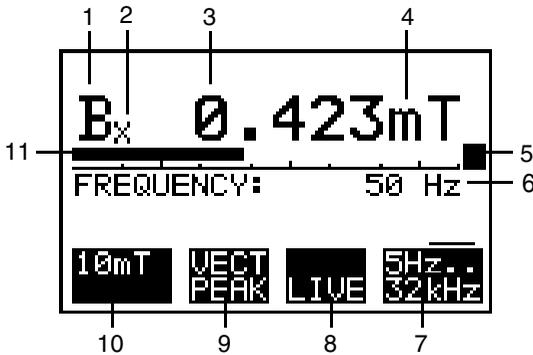


Figure 6-3 Display elements in the measurement screen for Field Strength mode

No.	Function
1	Field quantity, in this case B-field.
2	Measurement axis, in this case X axis. Without subscript: ISOTROPIC measurement
3	Digital display of measured value.
4	Units of measurement.

Table 6-2 Screen evaluation for Field Strength mode

No.	Function
5	Result validity indicator: <ul style="list-style-type: none"> • No icon: Computation of measured value complete • “■”: Note Internal calculation of result in progress, duration 1 sec. • “↑”: Warning Measurement range exceeded The selected range is unsuitable for measuring the field under observation.
6	Frequency counter value (for broadband filter frequency range only).
7	Display field F4: Display of selected frequency range.
8	Display field F3: Display of selected display mode.
9	Display field F2: Display of selected detection mode.
10	Display field F1: Display of selected measurement range.
11	Bargraph: Analog display of measured value.

Table 6-2 Screen evaluation for Field Strength mode

Evaluating the bargraph

The analog display provides support in evaluating the result. The display scale depends on the selected measurement range.

Selected measurement range	Display range	Example
AUTO	10 nT to 100 mT in logarithmic steps of 1, 2, 5	Figure 6-4, left
Fixed range (from selection list)	(0.002 to 2) x fixed range in logarithmic steps of 1, 2, 5	Figure 6-4, right

Table 6-3 Bargraph evaluation

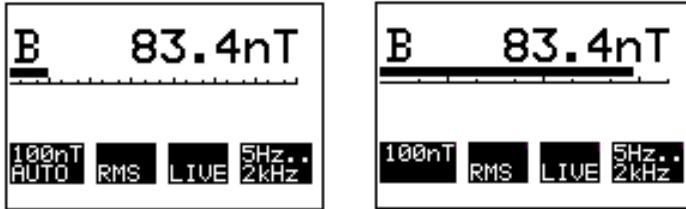


Figure 6-4 Analog result display scaling
Left: Result display for AUTO range mode
 logarithmic scale 10 nT to 100 nT
Right: Result display for fixed ranges
 logarithmic scale, here from 0.2 nT to 200 nT

6.1.7 Saving data

Data can be captured and stored in the measurement data memory in the following ways in Field Strength mode:

- Save individual values
 Saving individual values: see page 7-2
- Record measurement values over a defined period of time
 Recording timer-controlled measurement sequences
 (AUTO): see page 7-3
- Save measurement values for a spatial area
 Recording spatially assigned measurement sequences
 (MATRIX): see page 7-7

6.2 Exposure STD mode (Shaped Time Domain)

The features of the “Exposure STD” mode are very versatile, providing useful results for various application areas. This includes:

- Consideration of different limit curves (standards) in measurement.
The smallest value that can be shown in the basic display depends on the selected standard.
- Measurement at unknown frequencies
- Measurement of pulsed fields
- Simultaneous detection of several fields on different systems

6.2.1 Activating STD mode

1. Press the **MODE** key.
The MODE menu lists all available operating modes.
2. Use the **UP/DOWN** keys to select EXPOSURE STD mode.
3. Press the **ENTER** key to confirm your selection.
The measurement screen for Exposure STD mode is displayed.

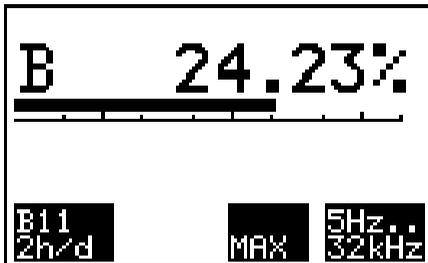


Figure 6-5 Exposure STD measurement screen

6.2.2 Selecting the measurement range

Six limit value curves are loaded in the STANDARDS menu. Special instrument settings that can only be changed by the manufacturer are defined for each of these limit value curves.

- ⇒ Select a limit value curve from the STANDARDS menu.
Display field F1 shows the name of the selected limit value curve.

6.2.3 Selecting the display mode

Two display modes can be selected:

- LIVE: Digital and analog displays show the current measurement value.
- MAX: Digital and analog displays show the highest measurement value that has occurred since the "MAX" function was activated.

⇒ Press key **F3** to toggle between the two display modes.

The selected display mode is shown in display field F3.

The "MAX" display value is cleared when you switch to LIVE mode.

6.2.4 Frequency range

- The frequency range is pre-set at 5 Hz to 2 kHz and cannot be changed.
- The frequency range is displayed in display field F4.

6.2.5 Evaluating the results

Evaluating the measurement screen

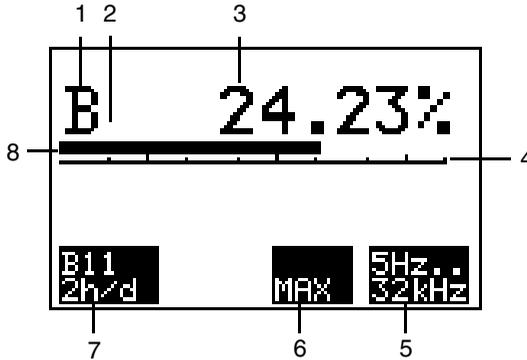


Figure 6-6 Exposure STD mode measurement screen display elements

No.	Function
1	Field quantity, in this case B-field
2	Measurement axis shown as suffix; no suffix in this example = ISOTROPIC measurement
3	Digital display of measured value The measured value is displayed as a % of the field strength limit defined in the limit curve.
4	Result validity indicator: <ul style="list-style-type: none"> • No icon: Computation of measured value complete • “■”: Note Internal calculation of result in progress, duration 1 sec. • “↑”: Warning Measurement range exceeded The selected range is unsuitable for measuring the field under observation.
5	Display field F4: Display of fixed frequency range setting.
6	Display field F3: Display of selected digital display mode
7	Display field F1: Name of the limit value curve selected in the STANDARDS menu.
8	Bargraph: Analog display of measured value Display range: 0.2 % to 200 % in logarithmic steps of 1, 2, 5

Table 6-4 Exposure STD mode screen evaluation

Note: The displayed field exposure takes into account all signals in the fixed frequency range setting and the shape of the selected limit curve. Depending on the selected limit curve, the basic display can range up to 4%.

6.2.6 Saving data

Data can be captured and stored in the measurement data memory in the following ways in Exposure STD mode:

- Save individual values
Saving individual values: see page 7-2
- Record measurement values over a defined period of time
Recording timer-controlled measurement sequences (AUTO): see page 7-3
- Save measurement values for a spatial area
Recording spatially assigned measurement sequences (MATRIX): see page 7-7

6.3 Spectrum FFT mode

The Spectrum FFT mode has two operating states:

- Run: The spectrum is continuously measured and displayed. After selecting the mode, “Run” is the default active state. Measurement begins immediately. The “Run” state is indicated using the  icon in the measurement screen.
- Stop: Recording of measured values is halted. In this state you can evaluate previously recorded measured values. The “Stop” state is indicated by the  icon in the measurement screen.

6.3.1 Activating Spectrum FFT mode

1. Press the **MODE** key.
All modes are listed in the MODE menu.
2. Use the **UP/DOWN** keys to select “SPECTRUM FFT”.
3. Press the **ENTER** key to confirm your selection.
The measurement screen for Spectrum FFT mode appears.

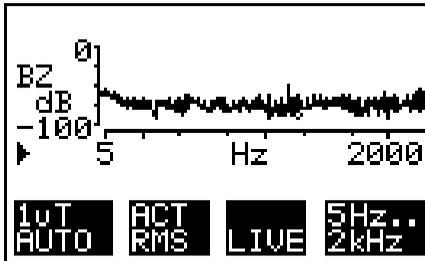


Figure 6-7 The Spectrum FFT mode measurement screen

6.3.2 Selecting the measurement range

There are three ways to choose the measurement range:

- Choose a value from the selection menu
- Activate the “AUTO” function.
The device automatically uses the proper measurement range.
- Activate a limit curve
The standard chosen in the STANDARDS menu is activated when choosing the measurement range.
Choosing a limit curve: see page 8-5

Choosing a value from a selection menu

- ✓ The device should be in the “RUN” state.
 - ✓ The measurement screen should be active.
1. Press the **F1** key until the selection list appears.
 2. Use the **UP/DOWN** keys to choose the measurement range.
 3. Press the **ENTER** key to confirm your selection.
The selected measurement range will appear in display field F1.

– or –

Activating the “AUTO” function

- ✓ The device should be in the “RUN” state.
 - ✓ The measurement screen should be active.
1. Press the **F1** key until the selection list appears.
 2. Use the **UP/DOWN** keys to choose the “AUTO” function.
 3. Press the **ENTER** key to confirm your selection.
The automatically selected measurement range will appear in display field F1 with “AUTO” below it.

– or –

Activating a limit curve

- ✓ The device should be in the “RUN” state.
 - ✓ The measurement screen should be active.
1. Press the **F1** key until the selection list appears.
 2. Use the **UP/DOWN** keys to select the name of the standard entered in the STANDARDS menu.
Choosing a limit curve: see page 8-5

3. Press the **ENTER** key to confirm your selection.
The name of the standard entered in the STANDARDS menu will automatically appear in display field F1.

Note: Recording of measured values begins after the measurement range is selected. If AVG RMS was chosen as the detection range, averaging is also restarted.

6.3.3 Selecting the measurement mode (detection mode)

Annex C: Fundamentals of FFT: see page C-1

You can choose among three detection modes:

- **ACT RMS:** The RMS value of each spectral line can be measured. The measurement result is not a function of the signal's polarization.
- **AVG RMS:** The spectrum is averaged over a number NAVG of successive spectra. This is a way of reducing noise, displaying lower measured values and choosing an averaging time. The progress is displayed using the validity indicator.
Setting the averaging parameter NAVG: see page 8-7
- **VECT PEAK:** The peak value of individual spectral lines can be measured.
Depending on the signal's polarization, this measured value lies between ACT RMS and a value 3 dB higher.

✓ The device should be in the "RUN" state.

⇒ To switch between detection modes, press the **F2** key.
The selected detection mode appears in display field F2.

Note: When you switch to the AVG RMS mode, averaging is restarted.

6.3.4 Selecting the display mode

Annex C: Fundamentals of FFT: see page C-1

You have a choice of two display modes:

- **LIVE:** The resulting spectrum is displayed.
 - **MAX:** For each spectral line, the maximum value is determined and displayed on the screen. For the functions "ZOOM" and "MARKER", the full resolution is available.
- ✓ The device should be in the "RUN" state.

- ⇒ To switch between display modes, press the **F3** key.
The selected display mode appears in display field F3.
The display value "MAX" is cleared when switching to LIVE.

Note: When switching from MAX to LIVE, averaging is restarted if AVG RMS was chosen as the detection mode.

6.3.5 Selecting the frequency range

There are two possible frequency ranges:

- 5 Hz...2 kHz,
Internal resolution of the display with the graphical marker: 0.1 Hz
Overlapping real-time operation: see page C-2
- 40 Hz...32 kHz,
Internal resolution of the display with the graphical marker:
1 Hz

Selecting the frequency range

- ✓ The device should be in the "RUN" state.
 - ✓ The measurement screen should be active.
1. Press the **F4** key until the selection list for the frequency ranges appears.
 2. Use the **UP/DOWN** keys to select the frequency range.
 3. Press the **ENTER** key to confirm your selection.
The selected filter is shown in display field **F4**.
The frequency axis in the display is set to the selected frequency range.

Note: Recording of measured values begins after the frequency range is selected. If AVG RMS was chosen as the detection range, averaging is also restarted.

6.3.6 Starting and stopping a measurement

Starting a measurement

- ✓ The device should be in the “Stop” state. The “Stop” state is indicated with the  icon in the measurement screen.
- ⇒ Press the **RUN** key.
The device should now be in the “RUN” state.
The “Run” state is indicated with the  icon in the measurement screen.
Recording of measured values begins anew, and the validity indicator appears until the end of the computation.

Stopping a measurement

- ✓ The device should be in the “RUN” state. The “Run” state is indicated with the  icon in the measurement screen.
- ✓ The validity indicator is no longer displayed.
- ⇒ Press the **RUN** key.
The device should be in the “Stop” state.
The “Stop” state is indicated with the  icon the measurement screen.
The **F2** and **F3** keys are deactivated.

Note: The measurement should not be halted to evaluate results until the validity indicator no longer appears in the display.
The validity indicator indicates that internal measured value computation is still underway. In this case, the averaging of the measurement results has not yet taken place over the defined number of single values (NAVG) at the start of the measurement. Until this state occurs, the displayed measured value has not yet obtained its final value.

6.3.7 Evaluating measurement results

Evaluating the measurement screen

- Note:** To be able to simultaneously display the extensive measurement range on the measurement screen, the measured value axis is scaled in dB.
Scaled measured value axis (dB scale): see page A-5

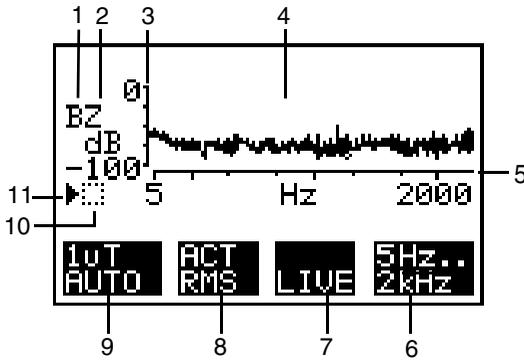


Figure 6-8 Display elements of the measurement screen for Spectrum FFT mode

No.	Function
1	Field quantity, here the B field
2	Measurement axis, here the Z axis without footnote: ISOTROPIC
3	Measured value axis
4	Graphical display of the measured values
5	Frequency axis
6	Display field F4: Display of the selected frequency range
7	Display field F3: Display of the selected display mode
8	Display field F2: Display of the selected detection mode

Table 6-5 Screen evaluation for Spectrum FFT mode

No.	Function
9	Display field F1: Display of the selected measurement range
10	Validity indicator: <ul style="list-style-type: none"> • No icon: Internal measured value computation complete. • “■”: Note Internal measured value computation is underway. The displayed measured value has not yet reached its final value. • “↑”: Warning Measurement range violation The selected measurement range is unsuitable for the field being measured.
11	Display of the operating state <ul style="list-style-type: none"> • “⚙”: Run state Measurement is underway. The spectrum is continuously recorded and displayed. • “ ”: Stop state: Recording of further measured values has halted.

Table 6-5 Screen evaluation for Spectrum FFT mode

Evaluating a measurement curve

There are three tools available to evaluate a measurement curve.

- **Zoom:**
The resolution can be individually selected for each of the axes to enable more accurate monitoring of individual ranges.
Zoom can be used in the “Stop” state and also in the “Run” state.
- **Markers:**
A graphical tool for direct display of the nine highest measured values within the measured frequency range. Evaluations with the marker are possible only in the “Stop” state.
- **Normalized display:** Only with the “Standard” measurement range.
Display of measured values referred (normalized) to the limit.

6.3.7.1 Zooming in on the frequency axis

The frequency axis can be displayed in two modes.

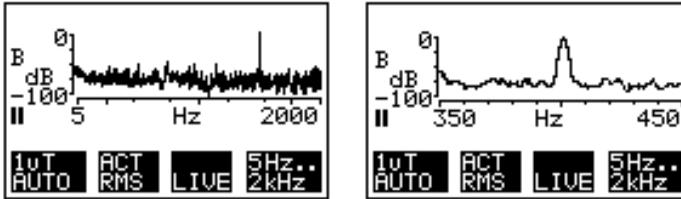


Figure 6-9 Frequency axis display modes:

Left: Full scale

The frequency axis is logarithmic and represents the entire frequency range shown in display field F4.

Division of the logarithmic frequency axis: 1, 2, 5, 10

Right: Zoom

The frequency axis is displayed with linear division in a defined range. The displayed range is a section of the frequency range from display field F4.

Division of the linear frequency axis: 10 Hz/smaller line or 100 Hz/smaller line, depending on the frequency range

1. Press the **F4** key.
Display fields F2 and F3 change their usage.
F2: XSCAL; F3: XPOS (displayed only if “Zoom” is already activated)
Display field F1 disappears.
 2. Press the **F2** key (only if “Zoom” is already activated. Otherwise continue with 3).
The black background changes to display field F3.
The “ZOOM” function is activated.
 3. Use the **UP/DOWN** keys to switch between the “Zoom” display range and the “Full Scale” range.
Depending on the zoom selection, the X axis will either be logarithmic or linear.
 4. If the “Zoom” range is selected, press the **F3** key.
The black background switches to display field F2.
 5. Use the **UP/DOWN** keys to change frequency section in the zoom range by steps.
 6. Press the **ESC** to return to the next higher level.
- or –
7. Restart the measurement with the **RUN** key.

6.3.7.2 Zooming in on the measured value axis

1. Press the **F1** key.
Display fields F2 and F3 change their meaning.
F2: YSCAL
F3: YPOS (black background)
Display field F4 disappears.
2. To activate setting of the display resolution, press the **F2** key.
3. Use the **UP/DOWN** keys to changes the screen resolution in steps from 20 to 120 dB (5 dB stepsize).
The largest value on the measured value axis remains. The smallest value on the measured value axis is changed depending on the setting.
4. To activate the shift of the screen content in the selected resolution, press the **F3** key.
The black background changes to display field **F2**.
5. Use the **UP/DOWN** keys to shift the screen content in the desired resolution.
6. Use the **UP/DOWN** keys to change the measured value section in the zoom range.
7. Press the **ESC** key to return to the next higher level.
– or –
8. Restart the measurement with the **RUN** key.

6.3.7.3 Marker

The marker is a graphical tool for displaying the nine largest measured values within the measured frequency range. It is displayed as a signal marker in the measurement curve and indicated numerically as a pair of values (field strength and frequency).

Activating the marker

- ✓ The device should be in the “Stop” state.
- ✓ The measurement screen in the “Spectrum FFT” mode should be active.

⇒ Press the **NEXT** key.

The graphical marker for the measured value appears above the measurement curve.

A status bar with the field strength and frequency of the measured value is inserted below the frequency axis. The value pair has an index.

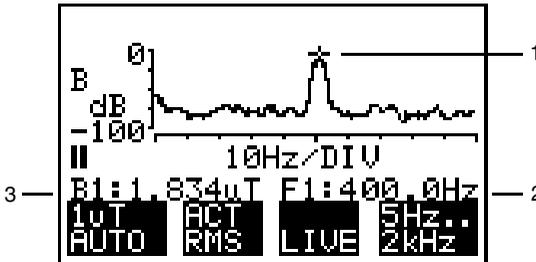


Figure 6-10 Measurement screen with the marker

No.	Function
1	Graphical marker
2	Frequency of the spectral line indicated by the marker. An index of 1 is given here as an example.
3	Measured value of the spectral line indicated by the marker. An index of 1 is given here as an example.

Table 6-6 Elements of the measurement screen with the marker

Positioning the marker

✓ The marker should be activated.

1. Press the **UP/DOWN** keys.

The signal marker will jump within the measurement curve from the measured value to the next lower value.

The graphical maker is displayed over the next lower measured value. Below the frequency axis, the pair of values is displayed for the given point with an index of 2.

2. Use the **UP/DOWN** keys to mark further measured values or to change between the individual marker positions.

Tip: If you display the frequency axis in zoom mode, the measured value appears with the marker in the center of the measured curve. This position is retained even when switching between the individual marker positions with the **UP/DOWN** keys, which makes it easy to study the nine largest measured values.

Note: If there are several high points on a spectral line, the marker remains on the line and just the numerical display of the marker position changes.

Deactivating the marker

⇒ Press the **ESC** key.

Measurement will halt.

The graphical and numerical indications for the marker will disappear.

The screen content remains unchanged for further examination.

– or –

⇒ Press the **RUN** key.

The measurement re-starts.

The graphical and numerical displays for the marker disappear.

The previous marker positions are replaced by the new measurement.

6.3.7.4 Normalized display

In this display mode, the selected limit curve is computed to appear as a straight line in the display, i.e. the 0 dB line. The actual measured values are recomputed in the same manner and the values are normalized. This lets you directly read off values with respect to the limit. If a value hits the 0 dB line, then it has violated the limit by the given amount.

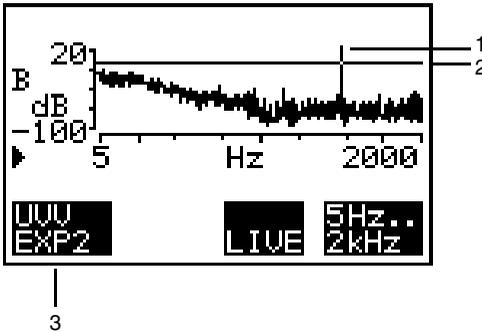


Figure 6-11 Normalized display

No.	Function
1	Measured value; here, the field strength exceeds the limit
2	0 dB line, simultaneously limit 100 %
3	Selected limit curve

Table 6-7 Elements of the measurement screen with the normalized display

Tip: The zoom and marker tools can be used during normalized display.

6.3.8 Saving data

In Spectrum FFT mode, you can save data as follows in the data memory:

- Saving a single measurement

Saving individual values: see page 7-2

Note: Since each stored spectrum consists of a number of values, the memory capacity is limited to about 16 spectra.

6.3.9 Possible problems

The settings (measurement range, detection mode, display mode, frequency range) cannot be changed.

The device is in the “Stop” state.

⇒ Press the **RUN** key to put the device in the “Run” state.

No measurement curve is displayed.

The selected zoom is not right for the measured value axis.

⇒ Display the measured value axis in “Full Scale” mode.
Zooming in on the measured value axis: see page 6-21

Keys F1 to F4 cannot be used.

The marker is activated.

⇒ Use the **ESC** or **RUN** key to deactivate the marker.

6.4 Harmonic analysis mode

After you enter a fundamental frequency, the field strength and the harmonic content are determined. You do not have to enter the fundamental frequency exactly because the evaluation algorithm has a certain tolerance.

The results are displayed in a table.

Harmonic Analysis mode has two operating states:

- **Run:** The spectrum is continuously recorded and displayed. Once you select the mode, the “Run” state is the default active state. Measurement begins immediately. The “Run” state is indicated with the  icon in the measurement screen.
- **Stop:** Recording of further measured values halts. In this mode, you can evaluate previously recorded values. The “Stop” state is indicated with the  icon the measurement screen.

6.4.1 Activating Harmonic Analysis mode

1. Press the **MODE** key.
In the MODE menu, all operating modes are listed.
2. Use the **UP/DOWN** keys to select “HARMONICS”.
3. Press the **ENTER** key to confirm your selection.
The measurement screen for Harmonic Analysis mode should appear.

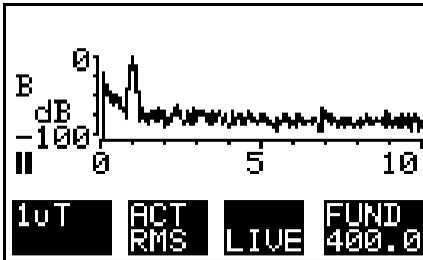


Figure 6-12 Measurement screen, Harmonic Analysis mode

6.4.2 Selecting the measurement range

The measurement range can be selected in two ways:

- Select a value from a selection menu
- Activate the “AUTO” function
The device automatically selects the proper measurement range.

Selecting a value from a selection menu

- ✓ The device should be in the “RUN” state.
 - ✓ The measurement screen should be active.
1. Press the **F1** key until the selection list appears.
 2. Use the **UP/DOWN** keys to choose the measurement range.
 3. Press the **ENTER** key to confirm your selection.
The selected measurement range will appear in display field F1.

– or –

Activating the “AUTO” function

- ✓ The device should be in the “RUN” state.
 - ✓ The measurement screen should be active.
1. Press the **F1** key until the selection list appears.
 2. Use the **UP/DOWN** keys to choose the “AUTO” function.
 3. Press the **ENTER** key to confirm your selection.
The automatically selected measurement range will appear in display field F1 with “AUTO” below it.
- Note:** Recording of measured values begins after the measurement range is selected. If AVG RMS was chosen as the detection range, averaging is also restarted.

6.4.3 Selecting the measurement mode (detection mode)

Note: If the “Standard” measurement range was chosen, the detection mode is preselected and cannot be set. The **F2** key and display field are deactivated.

You can choose among three detection modes:

- **ACT RMS:** The RMS value of each spectral line can be measured. The measurement result is not a function of the signal's polarization.
- **AVG RMS:** The spectrum is averaged over a number NAVG of successive spectra. This is a way of reducing noise, displaying lower measured values and choosing an averaging time. The progress is displayed using the validity indicator.
Averaging of the resulting spectrum: see page C-2
Setting the averaging parameter NAVG: see page 8-7
- **VECT PEAK:** The peak value of individual spectral lines can be measured.
Depending on the signal's polarization, this measured value lies between ACT RMS and a value 3 dB higher.

✓ The device should be in the “RUN” state.

⇒ To switch between detection modes, press the **F2** key.
The selected detection mode appears in display field F2.

6.4.4 Selecting the display mode

You have a choice of two display modes:

- **LIVE:** The resulting spectrum is displayed.
- **MAX:** For each spectral line, the maximum value is determined and displayed on the screen.

✓ The device should be in the “RUN” state.

⇒ To switch between display modes, press the **F3** key.
The selected display mode appears in display field F3.
The display value “MAX” is cleared when switching to LIVE.

Note: When switching from MAX to LIVE, averaging is restarted if AVG RMS was chosen as the detection mode.

6.4.5 Selecting the fundamental frequency

When measuring, only the selected fundamental frequency and its harmonics are considered. The evaluation algorithm used can cope with imprecise specifications of the frequency.

Six values are defined in the selection list. One of these values can be entered as a variable fundamental frequency.

Entering a variable fundamental frequency: see page 6-29

All six predefined fundamental frequencies can also be varied in the CONFIG menu.

Editing the frequency selection list: see page 8-8

Tip: The defined fundamental frequencies can be saved as user setups.

Saving device settings (User Setup): see page 9-4

Choosing a fundamental frequency from the selection list

✓ The device should be in the “RUN” state.

1. Press the **F4** key until the selection list for fundamental frequencies appears.
2. Use the **UP/DOWN** keys to choose fundamental frequencies.
3. Press the **ENTER** key to confirm your selection.

In display field **F4**, the term “FUND” and the selected fundamental frequency are displayed.

The display range of the frequency axis is automatically determined and set.

Measurement begins.

Entering a variable fundamental frequency

One of the predefined frequencies can be entered as a variable fundamental frequency in the range 5 Hz to 500 Hz with a resolution of 0.1 Hz.

✓ The device should be in the “RUN” state.

1. Press the **F4** key until the selection list for fundamental frequencies appears.
2. Use the **UP/DOWN** keys to choose the line VAR FREQ.

3. Press the **F4** key.
The window FUND opens with the current value for the variable fundamental frequency. The first digit of this value has a black background.
4. Use the **UP/DOWN** keys to change the digit.
5. Press the **NEXT** key to go to the next digit.
6. Repeat steps 4 and 5 for the remaining digits.
7. Confirm your change with the **ENTER** key.
The modified value is now in the selection list, where you can choose it.

Note: Recording of measured values begins after the frequency range is selected. If AVG RMS was chosen as the detection range, averaging is also restarted.

6.4.6 Starting and stopping a measurement

Starting a measurement

- ✓ The device should be in the “Stop” state. The “Stop” state is indicated with the  icon in the measurement screen.
- ⇒ Press the **RUN** key.
The device should be in the “RUN” state.
The “Run” state is indicated with the  icon in the measurement screen.
Recording of measured values begins anew, and the validity indicator appears until the end of the computation.

Stopping a measurement

- ✓ The device should be in the “RUN” state. The “Run” state is indicated with the  icon in the measurement screen.
- ✓ The validity indicator is no longer displayed.
- ⇒ Press the **RUN** key.
The device should be in the “Stop” state.
The “Stop” state is indicated with the  icon in the measurement screen.
The **F2** and **F3** keys are deactivated.

Note: The measurement should not be halted to evaluate results until the validity indicator no longer appears in the display. The validity indicator indicates that internal measured value computation is still underway. In this case, the averaging of the measurement results has not yet taken place over the defined number of single values (NAVG) at the start of the measurement. Until this state occurs, the displayed measured value has not yet obtained its final value.

6.4.7 Evaluating measurement results

Note: To be able to simultaneously display the extensive measurement range on the measurement screen, the measured value axis is scaled in dB.

Scaled measured value axis (dB scale): see page A-5

Evaluating the measurement screen

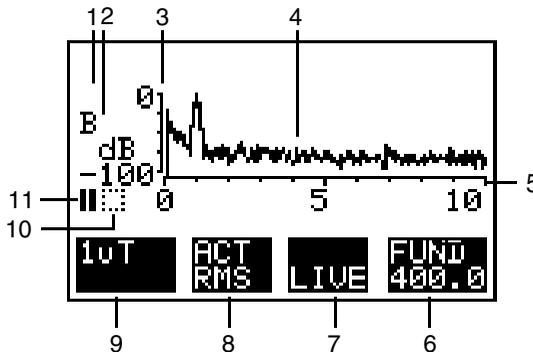


Figure 6-13 Display elements of the measurement screen for Harmonic Analysis mode

No.	Function
1	Field quantity, here the B field
2	Measurement axis, here without footnote: ISOTROPIC
3	Measured value axis
4	Graphical display of the measured values
5	Frequency axis scaled as an index (multiple of the fundamental frequency selected in F4)
6	Display field F4: Display of the selected fundamental frequency
7	Display field F3: Display of the selected display mode
8	Display field F2: Display of the selected detection mode
9	Display field F1: Display of the selected measurement range
10	Validity indicator: <ul style="list-style-type: none"> • No icon: Internal measured value computation complete. • “■”: Note Internal measured value computation is underway. The displayed measured value has not yet reached its final value. • “↑”: Warning Measurement range violation The selected measurement range is unsuitable for the field being measured.
11	Display of the operating state <ul style="list-style-type: none"> • “⚡”: Run state Measurement is underway. The spectrum is continuously recorded and displayed. • “ ”: Stop state: Recording of further measured values has halted.

Table 6-8 Screen evaluation for Harmonic Analysis mode

Generating a result list

- ✓ The device should be in Stop mode.
- ✓ The main screen of Harmonic Analysis mode should be visible.

⇒ Press the **NEXT** key.

The result list is displayed.

F1: 400.0Hz	_____	1
B1: 1.002uT	_____	2
K2: 0.0912%	K8: 0.0339%	3
K3: 0.0426%	K9: 0.0222%	4
K4: 0.0414%	KT: 0.1303%	5
K5: 0.0387%	KN: 3.9004%	
K6: 0.0773%		
K7: 0.0222%		

Figure 6-14 Result list for Harmonic Analysis mode

No.	Function
1	Actually measured fundamental frequency
2	Measured value of the fundamental
3	K1 ... K9: Harmonic factor (field strength of harmonics as percentage of fundamental)
4	KT: Total harmonic content (all harmonics) (not in VECT PEAK detection mode)
5	KN: Overall noise/harmonic factor (not in VECT PEAK detection mode)

Table 6-9 Result list for Harmonic Analysis mode

6.4.8 Saving data

In harmonic analysis mode, you can save data as follows in the data memory:

- Saving a single measurement

Saving individual values: see page 7-2

6.4.9 Possible problems

The settings (measurement range, detection mode, display mode, frequency range) cannot be changed.

The device should be in the “Stop” state.

⇒ Press the **RUN** key to put the device in the “Run” state.

7 Measurement data memory

7.1 Saving data

- The EFA can save individual values and the changes in field strength over a period of up to 24 hours can be monitored and recorded.
- The date and time are recorded with each data set.
Note: Make sure that the date and time settings are correct before recording data to ensure that the correct date and time are assigned to the data sets.
- There are up to 4095 memory positions available.
- The memory positions are assigned to the incoming data sets in ascending order.
- Every data set is uniquely identified by a data set number.
- Five **types of data set** can be saved:

Data set type	Data set contents (extracts)	Available in operating mode
Normal	Current measured value	Field Strength, Exposure STD
Auto	Timer-controlled measurement sequences	Field Strength, Exposure STD
Matrix	Spatially assigned measurement sequences	Field Strength, Exposure STD
Vector	Frequency spectrum	Spectrum FFT
List	List of measured values	Harmonic Analysis

Table 7-1 Content and availability of data set types

7.1.1 Saving individual values

Only for data set types normal, vector and list

Saving a value

- ✓ Date and time have been set correctly.
Setting the date and time: see page 8-9.
- ⇒ Press the **SAVE** key.
The content of the data set is stored to the next free memory location.
The message “MEM:” followed by the data set number (up to 4 digits) appears as confirmation that the value has been saved.

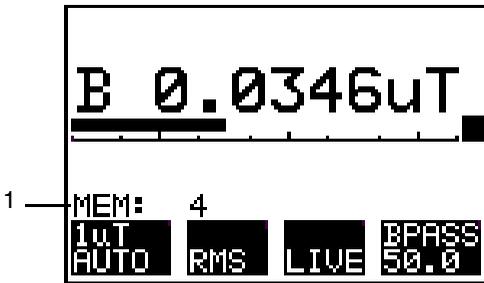


Figure 7-1 Confirmation that a measured value has been saved
Example: Field Strength mode

No.	Function
1	Data set number (up to 4 digits)

Table 7-2 Confirmation that a measured value has been saved

Possible faults

The display shows the message “MEMORY FULL”.

All memory spaces are filled.

1. Press the **ESC** key to return to the measurement screen.
2. Delete data sets that are no longer required.

Deleting data: see page 7-18.

7.1.2 Recording timer-controlled measurement sequences (AUTO)

Timer-controlled storage of data allows you to record the measured values over a defined time period in Field Strength and Exposure STD modes.

The B-Field Unit and the E-Field Unit operate independently during recording of a timer-controlled test series. You can disconnect the E-Field Unit from the B-Field Unit at any time after you have initiated an E field measurement.

Note: If you perform a timer-controlled B field measurement using the B-Field Unit, the measurement series will be terminated as soon as you connect the E-Field Unit to the B-Field Unit. An audible signal will be heard.

Ensuring power supply for the recording period

Timer-controlled measurements generally run over a longer time interval. If a stepsize of at least 1 minute is chosen, the device goes into Stand By mode between two measurements. In this mode, very little power is consumed. Only the actual measurement uses power. However, the battery capacity still might be insufficient for the recording period.

Note: Changes in field strength that occur between measurements are not detected in standby mode.

Guideline values for fully charged batteries:

- Measurement time: 24 hours
Step width: 1 minute
Maximum number of measured values: 1440

– or –

- Number of measured values recorded: 4095
Step width: 10 seconds
Resulting measurement time: 11.3 hours

⇒ For long-term measurements or long recording intervals, make sure the batteries are fully charged.

Opening the AUTO menu

- ✓ Date and time have been set correctly.
Setting the date and time: see page 8-9.

Setting the date and time: see page 8-9

1. Press the **MEM** key.
The MEM menu opens.
2. Use the **UP/DOWN** keys to select the “AUTO” function.
3. Press **ENTER** to confirm your selection.
The MEM AUTO menu is displayed.



Figure 7-2 MEM AUTO menu

Selecting the measurement sequence recording method

There are two ways to record the measured values.

- By defining a time period for saving data: The precise start and stop times for the measurement are entered.
- Immediate start: The measurement is started immediately and runs until the data memory is full (max. 24 hours).

The instrument switches off automatically as soon as the final measured value has been saved.

Note: Start and stop times must be entered in the same format as that selected for the clock display (12- or 24-hour clock).

Defining a time period for saving data

- ✓ The MEM AUTO menu is open.
- 1. Use the **UP/DOWN** keys to select the “START” function.
- 2. Press **ENTER** to confirm your selection.
The first entry field for the start time is highlighted in black.
- 3. Use the **UP/DOWN** keys to define a value.
- 4. Press the **NEXT** key to move to the next entry field.
- 5. Repeat steps 3 and 4 for the remaining entry fields.
- 6. Press **ENTER** to complete entry.
The measurement start time has been entered.
- 7. Repeat steps 1 through 6 for the “STOP” and “STEP” (time between two measurements) functions.
The start, stop and step times are now set and are displayed in the MEM AUTO menu.
- 8. Press key **F4**.
 - The measurement will start precisely at the start time and end at the stop time specified.
 - The number of data sets MEM already saved and the last measurement value saved are displayed.
 - Progress of the measurement can be observed.
 - Keys **F1** and **F4** change function.
 - **F1**: no function
 - **F4**: BREAK – breaks off the measurement sequence

Recording spatially assigned measurement sequences (MATRIX): see page 7-7

– or –

Starting data storage immediately

- 1. Use the **UP/DOWN** keys to select the “STEP” function.
- 2. Press **ENTER** to confirm your selection.
The first entry field for the step time is highlighted in black.
- 3. Use the **UP/DOWN** keys to define a value.
- 4. Press the **NEXT** key to move to the next entry field.
- 5. Repeat steps 3 and 4 for the remaining entry fields.
- 6. Press **ENTER** to complete entry.
The measurement step time has been entered.

7. Press key **F1**.
 - The measurement starts immediately and runs until the data memory is full (max. 24 hours).
 - The STOP function is no longer shown in the display.
 - The number of data sets MEM already saved and the last measurement value saved are displayed.
 - Progress of the measurement can be observed.
 - Keys **F1** and **F4** change function.
 - **F1**: no function
 - **F4**: BREAK – breaks off the measurement sequence

Breaking off the measurement

- ⇒ Press key **F4**.
The measurement stops.
The data pool containing the recorded measured values is saved as a data set.

Possible faults

Error message “NOT ENOUGH MEMORY” appears.

The available memory space is insufficient for the programmed measurement for the selected time period.

1. Press the **ESC** key to return to the MEM AUTO menu.
2. Delete unwanted data sets or the entire data memory.

Deleting data: see page 7-18

– or –

1. Press the **ESC** key to return to the MEM AUTO menu.
2. Check the STEP time setting.

7.1.3 Recording spatially assigned measurement sequences (MATRIX)

Assigning measurement values to the spatial location where the measured value was obtained is very time-consuming when a series of measurements is evaluated. If the measured values are stored as a matrix, subsequent processing can be simplified with suitable computer programs.

Tip: Before recording a matrix for the first time, it is a good idea to look at the procedure as outlined in Annex B as this will give you a better understanding of the technical background.

Note:

- Measurement series using the B-Field Unit:
If you perform a spatial matrix B field measurement using the B-Field Unit, the measurement series will be terminated as soon as you connect the E-Field Unit to the B-Field Unit. An audible signal will be heard.
- Measurement series using the E-Field Unit:
The connected B-Field Unit serves as the control unit during recording of a spatial matrix measurement series with the E-Field Unit. The measurement series ends automatically if you disconnect the E-Field Unit from the B-Field Unit.

Operating sections

Operation is divided into two sections:

- “MEM MATRIX” sub-menu: Defining the spatial limits and the order of the coordinates
- Matrix measurement screen: Display of measured value and target coordinates, and operation of memory functions.

Note: Key **F4** is used to switch between the two menus as required.

Activating the MEM MATRIX function

- ✓ Date and time have been set correctly.
Setting the date and time: see page 8-9.
1. Press the **MEM** key.
The MEM menu opens.
 2. Use the **UP/DOWN** keys to select the MATRIX function.

- Press **ENTER** to confirm your selection.
The MEM MATRIX menu is displayed.

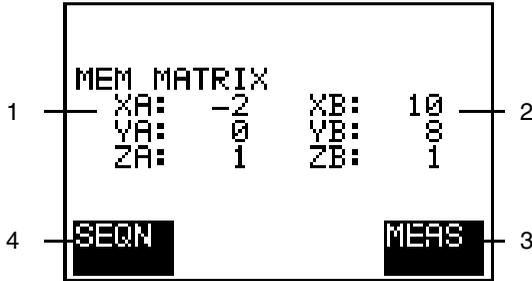


Figure 7-3 Entry screen for defining the limiting coordinates

No.	Function
1	Coordinates of limit "A"
2	Coordinates of limit "B"
3	Display field F4: Switch to matrix measurement screen
4	Display field F3: Switch to entry of ranking order

Table 7-3 Elements of the input screen for determining the limitation points

Changing the range limits

Entering the coordinates of limits "A" and "B"

Note: Each coordinate can have a value between -99 and +999.

- ✓ The MEM MATRIX menu is open.
- Use the **UP/DOWN** keys to select the coordinate.
The selected coordinate is highlighted in black.
 - Press **ENTER** to activate the coordinate entry fields.
The first entry field is highlighted in black.
 - Use the **UP/DOWN** keys to define a value.
 - Press the **NEXT** key to move to the next entry field.
 - Repeat steps 3 and 4 for the remaining entry fields.

6. Press **ENTER** to complete entry.

The value for the selected coordinate has been entered. The values for all remaining coordinates are defined in the same way.

Tip: Limits A and B can be used to define areas, lines or points, depending on how many coordinates are set to the same value.

Changing the limit coordinates

The defined spatial area can be increased, decreased or otherwise changed by entering new coordinates while the measurement is in progress. In such cases, the target coordinate in the matrix measurement screen will be set to limit "A" automatically.

Entering the coordinates of limits "A" and "B": see page 7-8

Selecting the coordinate ranking

The coordinate ranking determines the order in which the target coordinates for the next measurement point will be calculated. The selection depends on the intended direction of movement within the measurement area. Remember to use the same convention to express the direction as you used to assign the axes defining the coordinates.

✓ The MEM MATRIX menu is open.

1. Press **F1**.

The MEM SEQN menu opens showing the possible ranking as a selection list.

2. Use the **UP/DOWN** keys to select a ranking.

3. Press **ENTER** to confirm your selection.

The selected ranking will be applied to the Matrix measurement screen.

Note: When the target coordinates are calculated, the coordinate that is shown farthest to the right in the ranking will be incremented first. If the ranking is changed during the course of the measurement, the target coordinate in the Matrix measurement screen will be set to limit "A" automatically.

Tip: These settings can be saved in the device data memory for other applications.

Saving device settings (User Setup): see page 9-4

Collecting measurement values

All the values measured during the measurement are initially collected and stored in a data pool.

Measured values are stored only when the Matrix measurement screen is active.

All the values recorded and saved during a sequence of measurements are only saved as a contiguous data set when the sequence of measurements has been completed.

Switching between the MEM MATRIX menu and the Matrix measurement screen

⇒ Press **F4**.

If MEM MATRIX was active, the Matrix measurement screen appears.

If the Matrix measurement screen was active, the MEM MATRIX menu opens.

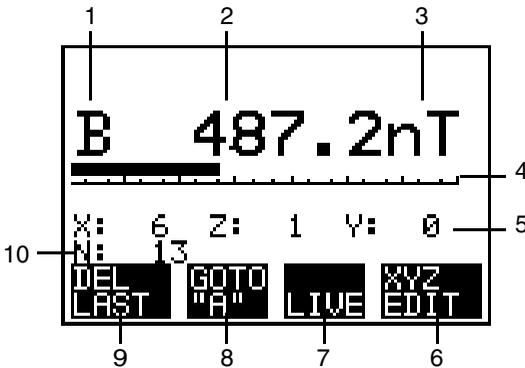


Figure 7-4 Matrix measurement screen

No.	Function
1	Field quantity, here B-field
2	Digital display of measured value
3	Units of measurement
4	Analog display of measured value
5	Target coordinates that will be saved with the next measured value: <ul style="list-style-type: none"> • The listing depends on the selected ranking • The coordinate shown farthest to the right is calculated first, i.e. the Y coordinate in this case.
6	Display field F4: Switch to MEM MATRIX menu.
7	Display field F3: Indication of selected display mode.
8	Display field F2: Switches the target coordinates to limit "A".
9	Display field F1: Deletes the last measured value saved in the data pool.
10	Number of measured values saved in the data pool.

Table 7-4 Matrix measurement screen elements

Storing measured values

- ✓ The Matrix measurement screen is active.
- ✓ The intended measurement position corresponds to the displayed target coordinates. If necessary, alter the target coordinates.

Note: If the measurement is being made in MAX display mode, you must switch to "LIVE" and then back to "MAX" before storing the value. This resets any stored MAX value.

⇒ Press the **SAVE** key.

The indicated measured value, the indicated target coordinates and a timestamp will be stored in the data pool.

The following appears in the display as confirmation:

- The new target coordinates.
- The number of measured values already stored in the data pool increments by one.

Note: When the target coordinates are calculated, the coordinate that is shown farthest to the right in the ranking will be incremented first.

Changing the target coordinates

The target coordinates can be changed within the defined spatial area at any time.

⇒ Press the **UP** key.

The next target coordinate is calculated and displayed.

– or –

⇒ Press the **DOWN** key.

The previous target coordinate is calculated and displayed.

– or –

⇒ Press **F2**.

The target coordinate changes to the coordinates of limit “A”.

Note: No values are saved when you change the target coordinates. A further measured value is stored in the data pool only when the **SAVE** key is pressed.

Reaching the range limits

When the target coordinate reaches one of the spatial limits defined by the limits “A” and “B”, the calculation shifts to the next directional axis in the coordinate ranking. A single beep indicates the change of direction. A double beep indicates that the target coordinate has reached one of the limit values “A” or “B”.

Deleting a measured value from the data pool

⇒ Press **F1**.

The last measured value saved in the data pool will be deleted without changing the indicated target coordinates.

Saving a data set

At the conclusion of the measurement, all the measured values recorded and saved in the data pool are stored as a contiguous data set.

1. Press **F4**.

This returns you to the MEM MATRIX sub-menu.

2. Press the **ESC** key.

The data pool is closed and saved under a common data set number.
The MEM menu is displayed.

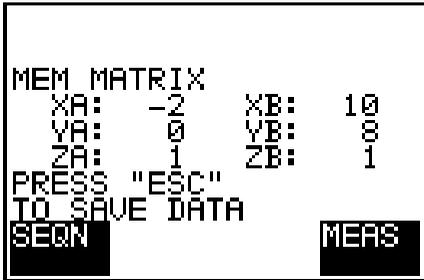


Figure 7-5 A data set can be saved from the MEM MATRIX menu.

Note: The data set is saved automatically if one of the following occurs:

- The “LOW BATTERY” warning is displayed.
- The EFA is switched of using the **ON/OFF** key.

Tip: The last target coordinates displayed are retained when the “MEM MATRIX” function is activated again. This means, for example, that a measurement sequence can be resumed from the same position if it was previously saved.

Possible faults

Error message “NOT ENOUGH MEMORY” is displayed.

The available data memory is insufficient for the measurement.

1. Press **ESC** to return to the MEM MATRIX menu.
2. Delete measured values from the data pool.

Deleting a measured value from the data pool: see page 7-12

7.2 Displaying a data set

The contents of the MEM SHOW menu depend on the intended measurements for the different measurement modes.



Figure 7-6 MEM SHOW menu in Field Strength mode

No.	Function	Operating mode			
		Field Strength	Exposure STD	Spectrum FFT	Harmonic Analysis
1	Remaining capacity of data memory [%]	x	x	x	
2	Data set number	x	x		
3	Operating mode used for measurement	FIELDST	EXP.STD	SPECTRUM FFT	HARMONICS
4	Type of data set	N: Normal A: Auto M: Matrix	N: Normal A: Auto M: Matrix	V: Vector	L: List
5	Date of measurement	x	x		
6	Time of measurement	x	x		

Table 7-5 Overview of MEM SHOW menu elements according to operating mode

No.	Function	Operating mode			
		Field Strength	Exposure STD	Spectrum FFT	Harmonic Analysis
7	Frequency range used for measurement	BP: Bandpass BS: Bandstop			
8	Value	Field strength# [T, G, V/m]	Exposure# [%]	Frequency resolution DF [Hz]	Field strength of fundamental [T, G, V/m]
9	Validity marker	x	x	x	x
<p># With data set of type "A" and "M": Position "8" shows the maximum value of all the individual values included in the measurement series. The individual values can be displayed on a PC after they have been exported. Exporting data: see page 7-16</p>					

Table 7-5 Overview of MEM SHOW menu elements according to operating mode

Opening the MEM SHOW menu

1. Press the **MEM** key.
The MEM menu opens.
2. Use the **UP/DOWN** keys to select the "SHOW" function.
3. Press **ENTER** to confirm your selection.
 - The MEM SHOW menu opens.
 - The last data set that was saved is displayed.

Selecting and displaying data sets

- ✓ The MEM SHOW menu is open.
- 1. Use the **UP/DOWN** keys to select a data set between 1 and the highest number assigned.
- or –
- 1. Press the **ENTER** key to activate the data set number entry field.
The first digit field in the data set number is highlighted in black.
- 2. Use the **UP/DOWN** keys to change the number.
- 3. Press the **NEXT** key to move to the next entry field.
- 4. Repeat steps 2 and 3 for all remaining entry fields.
- 5. Confirm the changes by pressing **ENTER**.
The selected data set will be displayed.

Note: The selected data set number must be between 1 and the highest assigned data set number (max. 4095). If this is not the case, the data set with the highest number will be displayed automatically when you press the **ENTER** key.
A beep will also be heard.

7.3 Exporting data

Stored measured values can be saved in a *.txt oder *.csv file and exported. This means you can print out files or further process them with other programs (e.g. a spreadsheet).

Stored measured values can be saved in a *.txt or *.csv file and exported. This means you can print out files or further process them with other programs (e.g. a spreadsheet).

Note: You must connect the basic unit to a PC if you want to transfer data from the basic unit. If you want to export data directly from the E-Field Unit, connect the E-Field Unit directly to the PC.

- ✓ Basic Unit or E-Field Unit is connected to a PC.
Setting up the EFA – PC connection: see page 10-6
- ✓ The software “EFA-200/-300 Tools” must be installed.
Installing the software “EFA-200/-300 Tools”: see page 10-5
- 1. Start the “Datalog.exe” application.
The “Datalog” window should open.
The data set types (“DataType”) and the number of data sets saved for the respective data set types (“No.”) are displayed.

2. Activate the “Enable” box for the data set type to be exported.
3. Enter in the “From” and “To” boxes the numbers of the data sets in the selected data set type to be exported.
4. Select the desired export format (*.txt or *.csv) from the EXPORT menu.

Note: You can select various separator characters for the “*.csv” format. The separator character that you select here must correspond to the one used by the program that is to be employed for further processing of the results.

5. Select a suitable separator character.
6. Press the **WRITE DATA TO FILE** key.
The directory window opens for defining the name and directory for the exported data.
7. Enter and confirm the name and directory.
The transfer begins.
The “Loading” box indicates the progress of the transfer.
Press the **BREAK** key to halt the transfer.

Opening exported files with the program used for further processing

Note: Open an exported CSV file in the program used for further processing by using the “Open File” menu command. Do not double click on the CSV file to open it as this may result in an incorrect display of the file.

7.4 Deleting data

The following can be deleted using the CLEAR menu:

- The data set with the highest data set number
- The entire data memory

Opening the MEM CLR menu

1. Press the **MEM** key.
The MEM menu opens.
2. Use the **UP/DOWN** keys to select the "CLEAR" function.
3. Press **ENTER** to confirm your selection.
The MEM CLR menu opens.

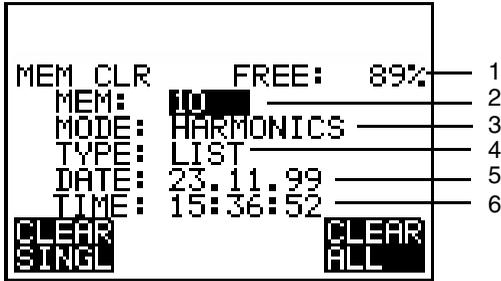


Figure 7-7 MEM CLR menu in Field Strength mode

No.	Function
1	Remaining memory space
2	Data set number
3	Operating mode
4	Type of data set
5	Date
6	Time

Table 7-6 MEM CLR menu elements

Deleting the data set with the highest number

✓ The MEM CLR menu is activated.

1. Press **F1**.
 - The data set with the highest data set number will be deleted.
 - The data set with the next lower data set number will be displayed.
2. Press the **ESC** to return to the measurement screen.

Deleting the entire data memory

✓ The MEM CLR is activated.

Note: Pressing **F1** or **F4** results in immediate, irreversible deletion of the data set(s). You will not be prompted to confirm that you want to delete the data.

1. Press **F4**.

The entire data memory will be cleared.
The display will indicate: "MEM: 0"
2. Press the **ESC** to return to the measurement screen.

Notes:

8 Optional functions

Activating the CONFG menu

- ⇒ Press the **CONF** key.
The CONFG menu will open.

For Spectrum FFT and Harmonic Analysis modes only

For the Spectrum FFT and Harmonic Analysis modes, all settings in the CONFG menu are possible only in the “RUN” state.

- Tip:** You can exit the CONFG menu in two ways:
Press the **RUN** key: Return to measurement screen
Press the **ESC** key: Return to previous menu

8.1 Selecting an alarm

For Field Strength and Exposure STD modes only

When the Alarm function is activated, a visible and (if required) audible alarm signal is triggered when a defined alarm threshold is exceeded.

8.1.1 Activating the “ALARM” function

- ✓ The CONFG menu should be activated.
1. Use the **UP/DOWN** keys to select the “ALARM” function.
 2. To activate the CONFG ALARM sub-menu, press the **ENTER** key.

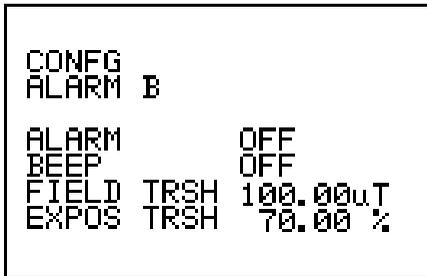


Figure 8-1 CONFG ALARM menu

8.1.2 Entering the alarm threshold

- ✓ The CONFIG ALARM sub-menu is activated.
- ✓ You have determined the intended alarm threshold value.

Note: The threshold must always lie within the selected measurement range, otherwise the alarm cannot be triggered.

Entering the threshold value

There are three threshold values that can be entered:

- **FIELD TRSH:** Threshold for field strength.
This entry field is provided for B-field and E-field measurements.
 - **EXPOS TRSH:** Threshold for Exposure STD.
This entry field is common to both B-field and E-field measurements.
1. Use the **UP/DOWN** keys to select the required function.
 2. To activate the entry fields, press the **ENTER** key.
The first entry field is highlighted in black.
 3. Use the **UP/DOWN** keys to define a value.
 4. Use the **NEXT** key to move to the next entry field.
 5. Repeat steps 3 and 4 for the remaining entry fields and the units field.
 6. Press **ENTER** to complete entry.
The alarm threshold has been selected.

Note: The following ranges of values are available for the alarm threshold: 10 nT to 31.6 mT, 100 µG to 316 G, 0.1 V/m to 100 kV/m, 0.1 % to 100 %

8.1.3 Activating alarm signals

The alarm signals must be activated in order to trigger a visible or audible alarm. There are two alarm signals.

- **Visible alarm signal:** The red Alarm LED on the front panel flashes.
 - **Audible alarm signal:** A continuous tone sounds in addition to the visible alarm signal.
- ✓ The CONFIG/ALARM sub-menu is activated.
 - ✓ The intended alarm threshold value has been entered.

Activating the visible alarm signal

1. Use the **UP/DOWN** keys to select the “ALARM” function.
2. Press the **ENTER** key until “ALARM ON” is displayed.
If the alarm threshold is exceeded, the red Alarm LED flashes. If the field value drops below the alarm threshold again, the red Alarm LED continues to flash, indicating that an alarm event has occurred.

Deactivating the visible alarm signal

The visible alarm signal can be deactivated after an alarm event in two ways.

- Disable visible alarm signal: The alarm will not be triggered by a further alarm event.
 - Enter new alarm threshold value: The alarm will be activated if the new threshold value is exceeded.
1. Use the **UP/DOWN** keys to select the “ALARM” function.
 2. Press the **ENTER** key until “ALARM OFF” is displayed.
The visible and audible alarms are both deactivated.

– or –

Entering the alarm threshold: see page 8-2

Activating the audible alarm signal

- ✓ The visible alarm signal is activated.
1. Use the **UP/DOWN** keys to select the “BEEP” function.
 2. Press the **ENTER** key until “BEEP ON” is displayed.
If the visible alarm signal has already been activated, a continuous tone will be heard when the alarm threshold is exceeded. The tone stops when the field value drops below the alarm threshold again.

Deactivating the audible alarm signal

1. Use the **UP/DOWN** keys to select the “ALARM” function.
2. Press the **ENTER** key until “BEEP OFF” is displayed.
The audible alarm signal is deactivated.

8.2 Recording current values

If recording of current values is activated, two selectable current values are saved with each data set. These data sets can be the actual wire current and the nominal current of an installation, for example.

8.2.1 Activating the CURRENT function

- ✓ The CONFIG menu should be activated.

 1. Use the **UP/DOWN** keys to select the “CURRENT” function.
 2. To activate the CONFIG CURRENT sub-menu, press the **ENTER** key.

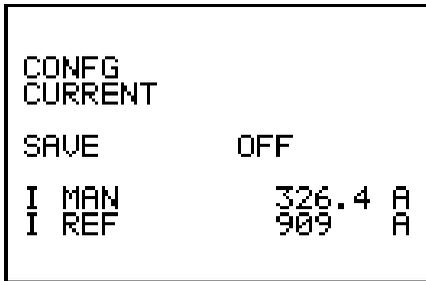


Figure 8-2 CONFIG CURRENT menu

Tip: You can exit from the CONFIG menu in two ways:
Press the **RUN** key: Returns you to the measurement screen.
Press the **ESC** key: Returns you to the previous menu.

8.2.2 Entering current values

There are two current values that can be entered:

- I MAN: e.g. the actual current flowing in an installation
- I REF: e.g. the nominal current for the installation
- ✓ The CONFIG CURRENT sub-menu is activated.
- ✓ The current values to be entered have been determined.

Entering current values

1. Use the **UP/DOWN** keys to select the required function.
2. To activate the entry fields, press the **ENTER** key.
The first entry field is highlighted in black.
3. Use the **UP/DOWN** keys to define a value.
4. Use the **NEXT** key to move to the next entry field.
5. Repeat steps 3 and 4 for the remaining entry fields and for the units.
6. Press **ENTER** to complete entry.
The current values have been selected. To save these values within a data set of field measurement values, the current value memory must be activated.

Note: The current values can be set in the range from 0 to 99999.9 A.

8.2.3 Activating recording of current values

- ✓ The CONF CURRENT sub-menu is activated.
 - ✓ The current values to be recorded have been entered.
1. Use the **UP/DOWN** keys to select the “STORE” function.
 2. Press the **ENTER** key until “STORE ON” is displayed.

Note: Storage of current values is automatically deactivated when you switch the EFA off.

8.3 Choosing a limit curve

- There are currently up to six limit value curves permanently stored in the STANDARDS menu.
- If the limit value curves change due to a revision of the standards, they will be adapted by the manufacturer. They can be re-loaded with a software update but cannot be edited by the user.

Software update: see page 10-4

The following limit value curves are currently stored:

- UVV 2H/D: BGV 11 increased limit value (1999)
- UVV EXP 1: BGV 11 exposure range 1 (1999)
- UVV EXP 2: BGV 11 exposure range 2 (1999)
- ICNIRP OCC.: ICNRP occupational (1998)
- ICNIRP PUB: ICNIRP general public (1998)
- VDE Exp.1: DIN VDE 0848 (Draft 1999)

- ✓ The CONFIG menu should be activated.
- 1. Use the **UP/DOWN** keys to select the “STANDARDS” function.
- 2. To activate the CONFIG STANDARDS sub-menu, press the **ENTER** key.
- 3. Use the **UP/DOWN** keys to highlight the required limit curve in black.
- 4. Press the **ENTER** key to confirm your selection.
The limit value curve is selected.

8.4 Selecting the measurement axis

Selection of the measurement axis specifies the main direction of the field measurement. The following choices are available:

- Single axis measurement: Only the result for the chosen axis (X, Y, or Z) is displayed.
 - Triaxial measurement (isotropic): The main direction of the field is determined from the coordinates of all three axes and is displayed.
- ✓ The CONFIG menu should be activated.
 - 1. Use the **UP/DOWN** keys to select the “CHANNELS” function.
 - 2. To activate the CONFIG CHANNELS sub-menu, press the **ENTER** key.
 - 3. Use the **UP/DOWN** keys to select the desired measurement axis.
 - 4. Press the **ENTER** key to confirm your selection.

Note: The selected measurement axis is shown as a subscript in the display of the field quantity (e.g. B_X = X channel of B-Field Probe). The results of an isotropic measurement are shown without subscript.

8.5 Selecting the measurement units

For B-field measurements only

You can toggle between Tesla and Gauss for the B-field value measurement units.

✓ The CONFIG menu should be activated.

1. Use the **UP/DOWN** keys to select the “AUX” function.
2. To activate the CONFIG AUX sub-menu, press the **ENTER** key.
3. Use the **UP/DOWN** keys to select the “B MEAS UNIT” function.
4. Press the **ENTER** key until the desired units are displayed.

The displayed measurement value will be shown in the selected units.

8.6 Setting the averaging parameter NAVG

For Spectrum FFT and Harmonic Analysis modes only

Annex C: Fundamentals of FFT: see Page C-1

In case of activation of detection mode AVG RMS, the spectra for several successive measurements are averaged. The number of spectra to use is determined by the NAVG parameter. A larger value for NAVG reduces the noise in the screen so that smaller signals can be detected.

For the frequency range 5 Hz...2 kHz, the averaging time can be computed exactly (averaging time = NAVG x 0.25 s) so that the averaging time of 1 second provided in many standards can be set.

✓ The CONFIG menu should be activated.

1. Use the **UP/DOWN** keys to select the “AUX” function.
2. To activate the CONFIG AUX menu, press the **ENTER** key.
3. Use the **UP/DOWN** keys to select the “NAVG..” function.
4. Press the **ENTER** key.

A list with the four possible averaging values appears (4, 8, 16, 32).

5. Use the **UP/DOWN** keys to select the desired value.
6. Confirm the value with the **ENTER** key.

During the measurement, the measured values are averaged over the selected value.

8.7 Editing the frequency selection list

In Field Strength (bandpass and bandstop filters only), Spectrum FFT and Harmonic Analysis modes, six frequency ranges are available in the selection lists. You can individually modify these frequency ranges with the “FREQ LISTS” function.

8.7.1 Activating the “FREQ LISTS” function

- ✓ The CONFIG menu should be activated.
- 1. Use the **UP/DOWN** keys to select the “FREQ LISTS” function.
- 2. To activate the CONFIG FREQ LISTS sub-menu, press the **ENTER** key.

8.7.2 Changing the frequency values

- ✓ The CONFIG FREQ LISTS sub-menu is activated.
- 1. Use the **UP/DOWN** keys to highlight the required filter type in black.
- 2. Press the **ENTER** key to confirm your selection.
A selection list of frequency ranges pops up.
- 3. Use the **UP/DOWN** keys to select a value.
The selected value is highlighted in black.
- 4. To activate the entry fields, press the **ENTER** key.
The first digit of the value is highlighted in black.
- 5. Change the value using the **UP/DOWN** keys.
- 6. Press the **NEXT** key to move to the next digit.
- 7. Repeat steps 5 and 6 for the remaining digits.
- 8. Press the **ENTER** key to confirm the changes.
The altered value is shown in place of the original value in the selection list for the selected filter.

8.8 Setting the date and time

8.8.1 Activating the “CLOCK” function

✓ The CONFG menu should be activated.

1. Use the **UP/DOWN** keys to select the “CLOCK” function.
2. To activate the CONFG CLOCK sub-menu, press the **ENTER** key.
The CONFG CLOCK menu opens.

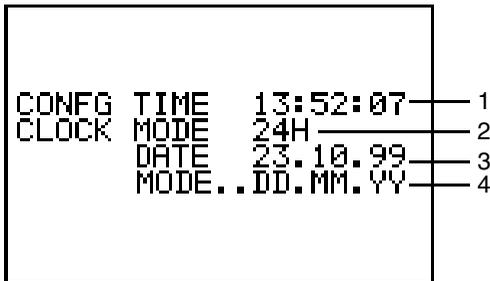


Figure 8-3 CONFG CLOCK menu

No.	Function
1	Time
2	Time display mode
3	Date
4	Date display mode

Table 8-1 CONFG CLOCK menu elements

8.8.2 Setting the current time

- ✓ The CONFIG CLOCK sub-menu is activated.

Selecting the time display format

The time can be displayed using the 12-hour or 24-hour clock formats.

1. Use the **UP/DOWN** keys to select the “MODE” function (directly below “TIME”).
2. Press the **ENTER** key until the required format (12-hour or 24-hour) is set.

The time will be displayed in the selected format.

Setting the current time

1. Use the **UP/DOWN** keys to select the “TIME” function.
2. To activate the entry fields, press the **ENTER** key.
The first entry field is highlighted in black.
3. Use the **UP/DOWN** keys to define a value, bearing the display mode in mind.
4. Press the **NEXT** key to move to the next entry field.
5. Repeat steps 3 and 4 for the remaining entry fields.
6. Press the **ENTER** key to complete entry.
The clock starts running from the set time (including the seconds).

8.8.3 Setting the date

- ✓ The CONFIG CLOCK submenu should be activated.

Selecting the date display mode

The following formats are available for displaying the date:

- DD.MM.YY Day.Month.Year
- MM/DD/YY Month/Day/Year
- YY-MM-DD Year-Month-Day

1. Use the **UP/DOWN** keys to select the “MODE” function (directly below “DATE”).
2. Press the **ENTER** key to confirm your selection.
3. Use the **UP/DOWN** keys to select the desired display mode.
4. Press the **ENTER** key to confirm your selection.
The date will be shown in the format you selected.

Entering the date

1. Use the **UP/DOWN** keys to select the "DATE" function.
2. Proceed as indicated under "Setting the current time".

Setting the current time: see page 8-10

Notes:

9 Device data memory

Whenever the EFA is switched on again, the settings that were active just before it was last switched off will be re-activated.

Settings that you use often can be saved as a USER setup and re-activated when needed.

9.1 Calling up a device setting (User Setup)

1. Press the **USER** key.
The USER menu opens.
2. Use the **UP/DOWN** keys to select a USER name.
3. Press key **F4**.
The settings saved under the selected USER name will be activated.
4. Press the **ESC** key to exit from the USER menu.

9.2 Scope and content of the default settings (Factory Default Setup)

The data in Table 9.1 is stored by default in the Factory Default Setup and in the four USER setups.

The Factory Default Setup cannot be changed, but the settings in the four USER setups can be overwritten and saved under different names.

Saving device settings (User Setup): see page 9-4

The Factory Default Setup settings are shown in Table 9.1.

Parameter	Section	Value
Display mode	Sect. 6	LIVE
Measurement range, E field	Sect. 6	AUTO
Measurement range, B field	Sect. 6	AUTO
CONFIG menu		
Limit curve from selection list	Sect. 8.4	Index 1

Table 9-1 Factory Default Setup

Parameter	Section	Value
Measurement axis	Sect. 8.4	Isotropic
Measurement units	Sect. 8.5	T (Tesla)
Visible alarm	Sect. 8.1.3	OFF
Audible alarm (BEEP)	Sect. 8.1.3	OFF
Alarm threshold, B-field	Sect. 8.1.2	10 mT
Alarm threshold, E-field	Sect. 8.1.2	100 kV/m
Alarms threshold referred to limit value curve	Sect. 8.1.2	70%
Selection list, band-pass filters	Sect. 8.7.2	BP1 = 16.7 Hz BP2 = 50 Hz BP3 = 60 Hz BP4 = 150 Hz BP5 = 250 Hz BP6 = 400 Hz
Selection list, stop-band filters	Sect. 8.7.2	BS1 = 16.7 Hz BS2 = 50 Hz BS3 = 60 Hz BS4 = 150 Hz BS5 = 250 Hz BS6 = 400 Hz
Selection list, fundamental frequency	Sect. 8.8.2	FUND1 = 16.7 Hz FUND2 = 50 Hz FUND3 = 60 Hz FUND4 = 150 Hz FUND5 = 250 Hz FUND6 = 400 Hz
Averaging parameter (NAVG)	Sect. 8.6	4
Time / Format	Sect. 8.8.2	24 h
Date / Format	Sect. 8.8.3	DD.MM.YY
Current value recording	Sect. 8.2.3	OFF
MEM menu		
Start time	Sect. 7.1.2	00:00:00
Stop time	Sect. 7.1.2	23:59:59
Step time	Sect. 7.1.2	00:01:00

Table 9-1 Factory Default Setup

Parameter	Section	Value
Matrix block	Sect. 7.1.3	XA = 0 YA = 0 ZA = 1 XB = 10 YB = 10 ZB = 3
Current position in block	Sect. 7.1.3	XN = 0 YN = 0 ZN = 1
Ranking	Sect. 7.1.3	XYZ
MODE menu (operating modes)		
Operating mode	Sect. 6	Field Strength
Operating mode: Field Strength		
Detection mode	Sect. 6.1.3	RMS
Frequency range	Sect. 6.1.5	Broadband filter 5 Hz to 2 kHz
Bandpass filter from selection list	Sect. 8.7.2	50 Hz
Stop band filter from selection list	Sect. 8.7.2	50 Hz
Mode: Spectrum FFT / Harmonic Analysis		
Normalization (meas. range)	Sect. 6.3.2	OFF
Detection mode	Sect. 6.3.3 Sect. 6.4.3	ACT RMS
Frequency range	Sect. 6.3.5	5 Hz...2 kHz
Fundamental frequency	Sect. 6.4.5	50 Hz
Frequency axis scaling (X SCALE)	Sect. 6.3.7.1	5 Hz...2 kHz
Measured value axis scaling (Y SCALE)	Sect. 6.3.7.2	100 dB
Reference value, measured value (Y POS)	Sect. 6.3.7.2	0 dB

Table 9-1 Factory Default Setup

Activating the default setup

1. Press the **USER** key.
The USER menu opens.
2. Use the **UP/DOWN** keys to select the “FACTORY” function.
3. Press the **ENTER** key to confirm your selection.
The settings saved in the USER menus are retained. All other settings are reset to the default values.

9.3 Saving device settings (User Setup)

You can save the device settings under a name of your choice (USER name).

Note: For the modes Spectrum FFT and Harmonic Analysis, these settings are possible only in the RUN state.

Opening the USER menu

- ⇒ Press the **USER** key.
The USER menu opens.

Entering a USER name

- ✓ The USER menu is open.

Note: The “FACTORY” function is pre-assigned and cannot be used to save your own settings.

1. Use the **UP/DOWN** keys to select one of the four memory positions (USER1 through USER4).
2. To activate the menu, press the **ENTER** key.
The first entry field of the USER name is highlighted in black.
3. Use the **UP/DOWN** keys to define the entry.
4. Use the **NEXT** key to move to the next entry field.
5. Repeat steps 3 and 4 for the remaining entry fields.
6. Press the **ENTER** key to confirm your entry.
The current settings will be saved under the USER name that you entered.
7. Exit the USER menu by pressing key **F1**.

Saving user setups under a USER name

- ✓ The USER menu is open.
 - ✓ The desired USER name has been entered.
1. Use the **UP/DOWN** keys to select the USER name.
 2. Press key **F1**.
The current settings will be stored under the selected USER name.
 3. Exit the USER menu by pressing key **F1**.

Notes:

10 Maintenance and repairs

10.1 Dry cells and rechargeable batteries

10.1.1 Replacing the rechargeable batteries / dry cells

Note: You should only replace the rechargeable batteries or dry cells fitted in the Basic Unit. If the batteries in the EFA-300 sensor cube need to be replaced, return the instrument to one of our Service Centers.



Instrument damage

The EFA may be damaged if the battery compartment cover is removed while the instrument is still connected to the Power Supply Unit

Caution

⇒ Disconnect the EFA from the AC power supply **before opening** the battery compartment cover.

- ✓ The EFA is switched off.
- ✓ The EFA is disconnected from the Power Supply Unit.

Replacing rechargeable batteries / dry cells

1. Push down the locking button on the back of the instrument.
2. Remove the battery compartment cover.
The battery compartment is now accessible.

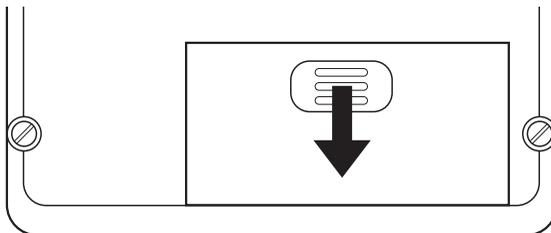


Figure 10-1 Removing the battery compartment cover

3. Pull the cloth tape to lift out the batteries and remove them.

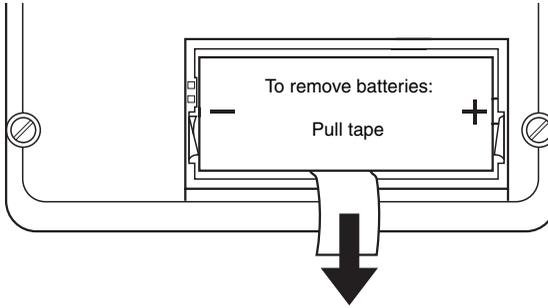


Figure 10-2 Removing the batteries

4. Check the position of the switch in the battery compartment:
 Switch -> Base of battery compartment: Use rechargeable batteries
 Switch -> Top of battery compartment: Use dry cells

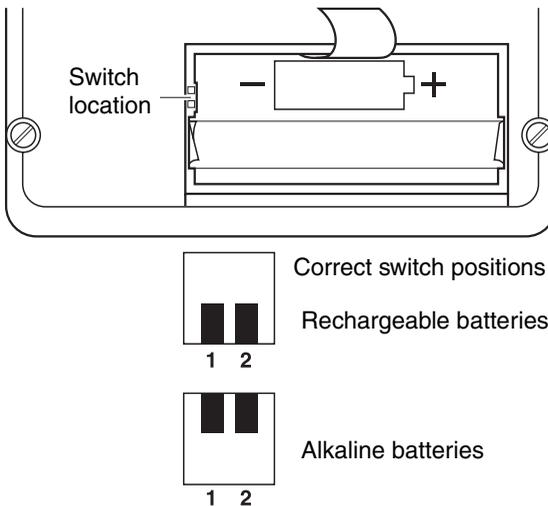


Figure 10-3 Checking the battery compartment switch settings

5. Place the new batteries into the compartment in such a way that the cloth tape is pulled back into the instrument.
6. Replace and close the battery compartment lid.
The instrument is once more ready for use.

Possible faults

The instrument does not work.

The battery was inserted the wrong way round (+ and - poles exchanged).
A fuse may have blown.

⇒ Contact the Service Center.

10.1.2 Handling rechargeable batteries

- Always handle rechargeable batteries with care.
- Do not short circuit the battery contacts (e.g. by touching both poles with a metal plate).
- Do not drop, damage or dismantle the batteries.
- Only recharge the batteries as directed in this operating manual.

Charging the rechargeable batteries: see page 3-3

- Do not continuously charge the batteries.
- Do not expose the batteries to high temperatures for long periods of time, whether inside or outside the instrument.
- Do not leave discharged batteries in the instrument for long periods.
- Do not store batteries for more than six months without discharging and recharging them.

10.1.3 Lithium battery

When the batteries are no longer able to supply sufficient power, the lithium battery provides power for:

- the data memory
- the clock
- the USER settings
- the settings used just before the instrument was last switched off.

Note: The lithium battery has a life of about 10 years. The first indication that it needs replacement might be an incorrect time or a loss of USER settings. If this happens, send the entire instrument to one of our Service Centers for a replacement lithium battery.

10.1.4 Battery disposal

The instruments contain one built-in lithium battery and five NiMH rechargeable batteries or 5 alkaline batteries.

- ⇒ Dispose of the rechargeable batteries or alkaline batteries in accordance with the regulations governing such waste in your locality.
- ⇒ Rechargeable batteries and alkaline batteries that were provided by the manufacturer can be returned to the manufacturer for disposal.

10.2 Software update

The procedure described below is the same for the basic unit and for the E-Field Unit. To update the software of the basic unit, connect the basic unit to the PC. To update the software of the E-Field Unit, connect the E-Field Unit to the PC.

10.2.1 Installing the software “EFA-200/-300 Tools”

Included with the EFA is a diskette containing the software “EFA-200/-300 Tools”. The software has three components:

datalog.exe	<ul style="list-style-type: none"> Exports the measurement data from the Basic Unit or the E-field Unit to a PC for further evaluation. Exporting data: see page 7-16
stnds.exe	<ul style="list-style-type: none"> Transfers the selectable STANDARDS to the Basic Unit or the E-Field Unit. Transferring STANDARDS parameters: see page 10-8
conf.exe	<ul style="list-style-type: none"> Loads the current firmware into the Basic Unit or the E-Field Unit. Loading the device firmware: see page 10-6 Enables additional operating modes on the Basic Unit or the E-Field Unit. Enabling operating modes: see page 10-9

Table 10-1 Components of the software “EFA-200/-300 Tools”

Note: You should be certain to always use the latest version of the software. It is available free of charge from your local dealer or via the Internet. Older versions of this software should not be used any longer.

- ✓ Disc 1 “EFA-200/ -300 Tools” should be in the computer’s disk drive.
1. Run the file “SETUP.EXE” on diskette 1.
This will open the installation program.
The screen “EFA-200 Tools Installation” will appear.
The default installation directory is “C:\EFA_TOOL”.
 2. Press the **CHANGE** key to modify the installation directory.
 3. **Do not change** the installation directory for the “LabWindows/CVI Run-Time Engine”. The default is “C:\CVI”.
 4. Complete the installation by pressing the **FINISH** key.
Once complete, you will see the message “EFA-200 Tools installed successfully” on the screen.
– or –
Halt the installation process by pressing the **CANCEL** key.

10.2.2 Setting up the EFA – PC connection

1. To update the software of the basic unit, connect the opto-electric adapter of the basic unit to a serial interface on the PC.
– or –
To update the software of the E-Field Unit, connect the opto-electric adapter of the E-Field Unit to a serial interface on the PC.
2. Connect the opto-electric adapter to the “REMOTE” socket in the head of the EFA or to the “EFA-300” socket of the E-Field Unit using a fiber optic cable.

Note: Do not kink or sharply bend the fiber optic cable.

3. Set the switch in the opto-electrical adapter to the “DTE” position (data terminal equipment).

10.2.3 Loading the device firmware

- ✓ The current version of the software “EFA-200/ -300 Tools” should be installed.
Installing the software “EFA-200/-300 Tools”: see page 10-5
 - ✓ The connection EFA – PC should be made.
Setting up the EFA – PC connection: see page 10-6
1. Copy the file “*.sof” with the current firmware (e.g. “efa01_10.sof”) to the hard drive of the PC.
 2. If possible, close all open applications on the PC.
 3. Power up the EFA and wait for it to boot up (approx 15 s).
 4. Launch the application “conf.exe”.
The “CONF” window should open.
 5. Click on the **FIRMWARE...** button.
The “COM Port” window should open.
 6. Activate the serial interface “COM” to which the opto-electrical adapter is connected and confirm your entry with **SELECT**.
The “Warning” window will open.
A message will indicate that the new configuration will cause the old firmware to be erased.
 7. To continue, enter the password and click on **DOWNLOAD**.

8. In the window “Download – Select File” double-click on the copied file “*.sof” or use the **SELECT** button.
A DOS window will open to show the progress (duration approx. 15 min.). Once completed, you will see the message “DOWNLOAD SUCCESSFUL”.
9. Close the window with **OK**.
10. Use the **QUIT** key in the “CONF” window to end the program.
11. Power the EFA off and back on again.

Tips:

- The firmware update can be repeated after powering the device back on again in case it was prematurely interrupted.
- Some computers will allow you to increase the baud rate, which shortens the transfer time. To find out if your computer will allow this, just give it a try.

Possible problems**Data communications not possible**

The serial interface “COM” to which the opto-electrical adapter is connected is not recognized or the switch on the opto-electrical adapter is not in the position “DTE”. The fiber optic cable might be kinked or bent.

⇒ In the window “COM Port”, activate the serial interface “COM” to which the opto-electrical adapter is connected.

– or –

⇒ Set the switch on the opto-electrical adapter to the “DTE” position.

10.3 Transferring STANDARDS parameters

The procedure described below is identical for the Basic Unit and for the E-Field Unit.

- ✓ The current version of the software “EFA-200/ -300 Tools” should be installed.
Installing the software “EFA-200/-300 Tools”: see page 10-5
 - ✓ The connection EFA – PC should be made.
Setting up the EFA – PC connection: see page 10-6
1. If possible, close all open applications on the PC.
 2. Power up the EFA and wait for it to boot up (approx 15 s).
 3. Launch the application “stnds.exe”.
The “CONF” window should open.
 4. Click on the **DOWNLOAD** button.
The “COM Port” window should open.
 5. Activate the serial interface “COM” to which the opto-electrical adapter is connected and confirm your entry.
The “STANDARDS” window should open.
The standards already programmed into the device will appear on the left side of the window.
This list of programmed standards can contain a maximum of six entries.
 6. In the right half of the window, select further standards for programming and activate the **WRITE** field.
 7. Start the programming with the **WRITE STANDARDS TO EFA** key.
A window will open to show the progress.
 8. Close the program when this is complete.
 9. Power the EFA off and back on again.

Note: Standards can be entered only into free spots in the list. If necessary, you can use the **ERASE** key to delete any unneeded standards from the EFA.

Possible problems

Data communications not possible

The serial interface “COM” to which the opto-electrical adapter is connected is not recognized or the switch on the opto-electrical adapter is not in the position “DTE”. The fiber optic cable might be kinked or bent.

⇒ In the window “COM Port”, activate the serial interface “COM” to which the opto-electrical adapter is connected.

– or –

⇒ Set the switch on the opto-electrical adapter to the “DTE” position.

10.4 Enabling operating modes

An authorized user or a service center can enable additional operating modes in the device.

Enabling additional modes requires device-specific code numbers that are provided by the sales organization.

In some cases, it might be necessary to update the device software beforehand. Software update: see page 10-4

To enable additional modes, please contact one of our service centers. You should provide the following information:

- Desired operating mode
- Type of device
- Serial number of the device

10.4.1 Entering the access code

The procedure described below is identical for the Basic Unit and for the E-Field Unit.

Note: You might have to enter multiple access codes to enable an operating mode.

- ✓ The current version of the software “EFA-200/ -300 Tools” should be installed.
Installing the software “EFA-200/-300 Tools”: see page 10-5
 - ✓ The opto-electrical adapter should be connected to a serial interface “COM” of your computer.
 - ✓ The document with the device-specific access codes for the desired operating mode should be handy.
1. If possible, close all open applications on the PC.
 2. Power up the EFA and wait for it to boot up (approx 15 s).
 3. Launch the application “conf.exe”.
The “CONF” window should open.
 4. Click on the **MODE...** button.
The window “COM Port” should open.
 5. Activate the serial interface “COM” to which the opto-electrical adapter is connected and confirm your entry with **SELECT**.
The “Enable Mode” window should open.
The device-specific identification number “ID” will be displayed.
Already enabled modes will be indicated with red lights next to their access code.
The access code is individually selected for each device.
 6. Check whether the “ID” given in the document exactly matches the one displayed in the output screen.
 7. Use the **EDIT CODE** key to open the input field for the specified access code.
 8. Enter the four-digit code and close the input field.
 9. Activate the “write” field next to the access code.
 10. Repeat steps 7 to 10 for each mode to be enabled.
 11. Begin programming with the **WRITE SELECTED CODE(S)** key.
A window will open to show the progress.
 12. Close the program when this is complete.
 13. Power the EFA off and back on again.

Possible problems

Data communications not possible

The serial interface “COM” to which the opto-electrical adapter is connected is not recognized or the switch on the opto-electrical adapter is not in the position “DTE”. The fiber optic cable might be significantly kinked or bent.

⇒ In the window “COM Port”, activate the serial interface “COM” to which the opto-electrical adapter is connected.

– or –

⇒ Set the switch on the opto-electrical adapter to the “DTE” position.

10.5 Reading out the device characteristics

In the SERVICE submenu, you can read out important device information. This will let you clearly identify the device and its version. Have this data handy in case of queries to the manufacturer.

Activating the “SERVICE” function

1. Press the **CONFIG** key.
The CONFIG menu should open.
2. Use the **UP/DOWN** keys to select the “SERVICE” function.
3. To activate the CONFIG/SERVICE submenu, press the **ENTER** key.

Reading out device information

✓ The “SERVICE” function should be activated.

1. Use the **UP/DOWN** keys to select the “INFORMATION” function.
2. Confirm your selection by pressing the **ENTER** key.
All of the information can be found in one screen.
 - Software version
 - Hardware version
 - Serial number of the device
 - Calibration date
 - Software date

```
CONFG
INFO

HW-VERSION: 20.00
SERIAL-NR  : A-0051
CAL-DATE   : 99-08-21
SW-VERSION: 1.00
SW-DATE    : 99-10-27
```

Figure 10-4 CONFIG INFO menu

Reading out the device identification

- ✓ The “SERVICE” function should be activated.
- 1. Use the **UP/DOWN** keys to select the “IDENTIFICAT” function.
- 2. Confirm your selection by pressing the **ENTER** key.
The ID number will appear in the display.
Each device has its own ID number.

10.6 Cleaning

- Do not use solvents to clean the EFA-200/-300 casing or probes or the Power Supply Unit. We recommend the use of lukewarm water to which a little liquid detergent has been added.
- Only use a slightly dampened cloth for cleaning. Water must not be allowed to get inside the instrument.
- To prevent streaks and spots when drying, wipe off the still damp surfaces of the instrument with a dry cloth.

10.7 Power Supply Unit

10.7.1 Opening the device



Electric shock

Opening the Power Supply Unit may expose parts carrying dangerous voltages.

Danger

- ⇒ Disconnect the Power Supply Unit from the AC line and all other voltage sources before opening it.
- ⇒ Repairs or maintenance of the opened instrument should only be performed by qualified persons who are familiar with the risks involved.

10.7.2 Repairs



Instrument damage

Unprofessional repairs can result in destruction of the Power Supply Unit caused by short-circuits in air gaps and creepage paths, for example.

Caution

- ⇒ Repairs should only be performed by qualified persons.

10.7.3 Spare parts



Instrument damage

If constructional changes are made to the Power Supply Unit, its safety for use can no longer be guaranteed.

Caution

- ⇒ Only use original spare parts for repairs on the Power Supply Unit.

Notes:

11 Remote control

11.1 Abbreviations used

The following abbreviations are used to represent the command structure:

<ws>	Space	(CHR\$32) or SP
<CR>	Carriage return	(CHR\$13) or ^M or \r
<LF>	Line feed	(CHR\$10) or ^J or \n
[...]	Optional entry	

The following numerical formats are used to define and read some commands:

<SCI>	Scientific notation, e.g. 1.234567E-2
<SCI4D>	Same as scientific notation but with the mantissa limited to four significant places, e.g. 1.234E-2
<FP4D>	Floating decimal format with four significant digits in range 0.001 to 99999

11.2 Making the connection from EFA to PC

1. Connect the opto-electrical adapter to a serial interface of the PC.
2. Connect the opto-electrical adapter via a fiber optic cable to the jack "REMOTE" in the head of the EFA or to the jack "EFA-300" in the E-Field Unit. Make sure the fiber optic cable is not kinked or bent.
3. Set the switch in the opto-electrical adapter to the position "DTE" (data terminal equipment).

Matching the parameters between the PC and EFA

✓ The connection between the EFA and PC has been established.

The following parameters for the PC and EFA must match:

- Baud rate: 9600
- Parity: None
- Data bits: 8
- Stop bits: 1
- Handshake: XON/XOFF

Note: The baud rate can be increased temporarily during remote operation.

Switching the EFA to remote operation

✓ The parameters for the EFA and PC are matched.

⇒ Enter the command **REMOTE** [**<ws>**]**<LF>**.

The following message appears:

REMOTE **<ws>****<instrument type>****<ws>****OK****<CR>****<LF>**

- The Basic Unit will be set to the Measure menu of the selected operating mode.
- Operation using the Basic Unit keyboard is now disabled.

Exiting from remote operation

⇒ Enter the command **LOCAL**[**<ws>**]**<LF>**.

The following message appears: **LOCAL****<ws>****OK****<CR>****<LF>**

- Operation using the Basic Unit keyboard is now enabled.
- The baud rate is set to 9600.

11.3 Structure of device-specific commands

A distinction is made between write / action commands and read commands.

Write / action commands

- Write / action commands are used to:
 - Enter parameter definitions
 - Trigger actions
- All write / action commands are shown in the first column of the table in section 11.4.
- Write / action commands always have even numbers.

Entering write / action commands

⇒ Enter the write / action command using the defined structure:

C<command number> [<ws><parameter list>] [<ws>]<LF>

- A successfully executed command is confirmed by:

“Q”<command number> <ws> “OK”<LF>

- If there is an error, the following messages appear:

– for a write command:

“Q”<command number> <ws>FAILED[<ws>–<error text>]
<CR><LF>

– or –

– for an action command:

ERROR[<ws>–<ws><error text>]<CR><LF>

Possible faults: see page 11-4

Read commands

- Read commands are used to query parameter definitions.
- All read commands are shown in the second column of the table in section 11.4.
- Read commands always have odd numbers. The read command numbers are always one higher than the corresponding write command numbers.

Entering a read command

⇒ Enter the read command using the defined structure.

C<command number>[<ws>]<LF>

The following message is the response:

Q<command number><ws><parameter><CR><LF>

In this case, <parameter> is the active parameter selected from the parameter list by the corresponding write / action command.

Possible faults

Error message: “ERROR - CMD not beginning with “C””

The command was not entered correctly, e.g. “c30 1” instead of “C30 1”.

⇒ Be sure to enter upper and lower case letters correctly.

Error message: “ERROR - no command number”

The command was not entered correctly. There is a space between the C and the command number, e.g. “C 30 1” instead of “C30 1”.

⇒ Correct the command entry.

Error message: “Q<command number>FAILED-command number out of range”

The command number is incorrect or the command was not entered correctly (e.g. “C301” instead of “C30 1”) or the command number is outside the defined range.

⇒ Correct the command entry.

Error message: “Q<n> FAILED - illegal sub fct nr”

The command was not entered correctly.

⇒ Correct the command entry.

Error message: “Q<n> FAILED - arg out of range”

Some arguments are outside the allowed range.

⇒ Check the entries.

Error message: “Q<n> FAILED - wrong selected”

The data sets selected for data export are unavailable or the selection was not made in ascending order of data set number.

⇒ Check the entries.

Error message: “Q<n> FAILED - not implemented yet”

The command is not implemented.

Error message: “Q<n> FAILED - not enough memory”

There is not enough free memory to record a timer-controlled series of measurements.

⇒ Delete all or part of the data memory contents (see C222 or C224).

Error message: “Q<n> FAILED - mode not available“

The operating mode is not enabled.

⇒ Enabling operating modes: see page 10-9

Error message: “Q<n> FAILED - improper device type“

The setting is being transferred to an improper device type.

⇒ Connect the proper device type (Basic Unit or E-Field Unit).

Error message: “Q<n> FAILED - no standard available“

No limit curve implemented.

⇒ Load the limit curves.

Software update: see page 10-4

Error message: “Q<n> FAILED - matrix empty“

The data set cannot be saved because no measured values were saved in the data pool.

⇒ Restart the measurement.

Error message: “Q<n> FAILED - command ignored“

The remote control command was not executed since it does not agree with the device status (e.g. measurement range switching during recording of timer-controlled measurement sequences).

⇒ Check the device status.

Status messages**Message: “Q<n> OK”**

Command C<n> was accepted and executed.

Message: “Q<n> FAILED - already running”

A timer-controlled measurement is being recorded.

Message: “Q<n> FAILED - not running”

A timer-controlled measurement cannot be terminated as there is no such measurement running.

Message: “Q<n> FAILED matrix not open”

A spatial curve cannot be recorded because the function has not been activated.

Message: “Q<n> FAILED- standard not available”

The selected limit value curve is not implemented.

⇒ Enabling operating modes: see page 10-9

Message: “LOCAL ALREADY OK”

The instrument is in LOCAL mode, i.e. it can only be operated using the keyboard of the Basic Unit.

Message: “LOCAL OK”

The LOCAL command was accepted.

11.4 Remote control commands

Common commands

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Activate remote operation			
REMOTE	REMOTE?	0 = local 1 = remote	Keyboard is disabled
Deactivate remote operation and return to local operation			
LOCAL	–	–	Keyboard is enabled

Table 11-1 Remote control commands: Common commands

11.4.1 Measurement settings

- ✓ Remote operation is activated.

Global parameters

Write / action commands	Read commands	Range of values of p	Meaning or units of p
Select / read operating mode			
C142 <p>	C143	0 = Field strength 1 = Exposure STD 3 = Spectrum FFT 4 = Harmonic Analysis	
Select / read B-field measurement range			
C138 <p>	C139	0 = AUTO 1 = 100 nT 2 = 316 nT 3 = 1 μ T 4 = 3,16 μ T 5 = 10 μ T 6 = 31.6 μ T 7 = 100 μ T 8 = 316 μ T 9 = 1 mT 10 = 3.16 mT 11 = 10 mT 12 = 31.6 mT	

Table 11-2 Remote control commands, global parameters

Write / action commands	Read commands	Range of values of p	Meaning or units of p
Select / read E-field measurement range			
C140 <p>	C141	0 = AUTO 1 = 10 V/m 2 = 31.6 V/m 3 = 100 V/m 4 = 316 V/m 5 = 1 kV/m 6 = 3.16 kV/m 7 = 10 kV/m 8 = 31.6 kV/m 9 = 100 kV/m	
Select / read display mode			
C36 <p>	C37	0 = LIVE 1 = MAX	

Table 11-2 Remote control commands, global parameters

Field Strength mode

Write / action commands	Read commands	Range of values of p	Meaning or units of p
Select / read frequency range			
C146 <p>	C147	0 = BROAD BAND 1 = BAND PASS 2 = BAND STOP	
Select / read BROAD BAND filter			
C148 <p>	C149	0 = 5 Hz to 2 kHz 1 = 30 Hz to 2 kHz 2 = 5 Hz to 32 kHz 3 = 30 Hz to 32 kHz	
Select / read BAND PASS filter (for definition see filter frequencies)			
C150 <p>	C151	0 to 5	Consecutive number within the available list.

Table 11-3 Remote control commands, Field Strength mode

Write / action commands	Read commands	Range of values of p	Meaning or units of p
Select / read BAND STOP filter (for definition see filter frequencies)			
C152 <p>	C153	0 to 5	Consecutive number within the available list.
Select / read detection mode			
C144 <p>	C145	0 = RMS 1 = VECT PEAK	

Table 11-3 Remote control commands, Field Strength mode

Spectrum FFT mode

✓ The “Run” state should be activated.

Write/action commands	Read commands	Range of p	Meaning or Unit of p
Select/read frequency range (see enabling of frequency range extension)			
C160 <p>	C161	0 = 5 Hz..2 kHz 1 = 40 Hz..32 kHz	
Display spectrums			
C156 <p>	C157	0 = absolute 1 = normalized to standard	
Select/read detection mode			
C158 <p>	C159	0 = ACT RMS 1 = AVG RMS 2 = VECT PEAK	
Select/read averaging parameter			
C120 <p>	C121	0 = 4 1 = 8 2 = 16 3 = 32	NAVG

Table 11-4 Remote control commands, Spectrum FFT mode

Write/action commands	Read commands	Range of p	Meaning or Unit of p
Start measurement			
C190	–	–	
Stop measurement			
C192	–	–	
Read measurement status			
–	C 195	0 = Stop 1 = Run	

Table 11-4 Remote control commands, Spectrum FFT mode

Harmonic Analysis mode

✓ The “Run” state should be activated.

Write/action commands	Read commands	Range of p	Meaning or Unit of p
Select/read fundamental FUND (for definition see fundamental frequencies)			
C164 <p>	C165	1...6	Running index within available list
Select/read detection mode			
C162 <p>	C163	0 = ACT RMS 1 = AVG RMS 2 = VECT PEAK	
Select/read averaging parameter			
C120 <p>	C121	0 = 4 1 = 8 2 = 16 3 = 32	NAVG

Table 11-5 Remote control commands, Harmonic Analysis mode

11.4.2 Reading out current measurement values

For Field Strength and Exposure STD modes only

Write / action commands	Read commands	Range of values of p	Meaning or units of p
Read measurement value units			
–	C177	0 = T 1 = G 2 = V/m 3 = %	
Query result validity			
–	C179	0 = valid 1 = in processing 2 = overdriven	
Select / read frequency measurement value			
C182 <p>	C183	0 = OFF 1 = ON	Complements field measurement value
Transfer of individual measured values			
Read measured value			
C254 0	–	<SCI4D><ws><valid > [<ws> 5 to 32000]	Units as selected Frequency only in Field Strength: BROAD BAND mode.
Read header and measured value			
C254 1	–	<header><ws> <SCI4D><ws><valid > [<ws> 5 to 32000]	Units as selected Frequency only in Field Strength: BROAD BAND mode.

Table 11-6 Remote control commands, read current measured values

Write / action commands	Read commands	Range of values of p	Meaning or units of p
Continuous transmission of measured values Select / read measured value rate			
C180 <p>	C181	1 to 240	Time interval = p * 250 ms, default = 1 s
Select transmission of header / label			
C184	–	–	Settings and label for measured value
Start transmission of measured values			
C186	–	–	End of line: <CR><LF>
Cancel transmission of measured values			
C188	–	–	–

Table 11-6 Remote control commands, read current measured values

Only for Spectrum FFT, Harmonic Analysis modes

Write/action commands	Read commands	Range of p	Meaning or Unit of p
Read unit of measured values			
–	C177	0 = T 1 = G 2 = V/m	
Query validity of measured values			
–	C179	0 = valid 1 = in processing 2 = overdriven	

Table 11-7 Remote control commands, reading out current measured values, only for Spectrum FFT, Harmonic Analysis modes

Only for Spectrum FFT mode

✓ The “Stop” state should be activated.

Write/action commands	Read commands	Range of p	Meaning or Unit of p
Marker tool			
C196 <p>	C197	0 = Deactivated 1 = Activated	NEXT or ESC
Choose marker position			
C198 <p>	C199	1...9	Running index
Read measured value at marker position			
–	C201	–	Unit: like selection Format: <SCI4D>
Read frequency at marker position			
–	C203	–	Unit: Hz Format: <FP4D>
Read reference value of display			
–	C205	–	Unit: like selection Format: <SCI4D>
Start measured value transfer			
C206	–	–	Spectral values normalized to reference value
Interrupt measured value transfer			
C208	–	–	

Table 11-8 Remote control commands, reading out current measured values, only for Spectrum FFT mode

Only for Harmonic Analysis mode

✓ The “Stop” state should be activated.

Write/action commands	Read commands	Range of p	Meaning or Unit of p
List tool			
C216 <p>	C217	0 = Deactivated 1 = Activated	NEXT or ESC
Read frequency of fundamental			
–	C219 0	–	Unit: Hz Format: <FP4D>
Read measured value of fundamental			
–	C219 1	–	Unit: like selection Format: <SCI4D>
Read harmonic factors			
–	C219 <p>	2...9	Unit: % Format: <FP4D>
Read total of harmonic factors			
–	C219 10	–	Unit: % Format: <FP4D> not with detection mode VECT PEAK
Read total noise/harmonic factor			
–	C219 11	–	Unit: % Format: <FP4D> not with detection mode VECT PEAK

Table 11-9 Remote control commands, reading out current measured values, only for Harmonic Analysis mode

11.4.3 Measurement data memory

Write / action commands	Read commands	Range of values of p	Meaning or units of p
Save data set			
C220	–	–	SAVE
Clear last data set			
C222	–	–	CLEAR LAST
Clear all data sets			
C224	–	–	CLEAR ALL
Read free memory space in %			
–	C241	0 to 100	% of data memory capacity

Table 11-10 Remote control commands, measurement data memory

Timer-controlled measurements for Field Strength, Exposure STD modes only

Write / action commands	Read commands	Range of values of p	Meaning or units of p
Define / read start time of timer-controlled data storage			
C72 0 <p>	C73 0	<hh><ws><mm> <ws><ss>	Read only: <hh:mm:ss>
Define / read stop time of timer-controlled data storage			
C72 1 <p>	C73 1	<hh><ws><mm> <ws><ss>	Read only: <hh:mm:ss>
Define / read step width of timer-controlled data storage			
C72 2 <p>	C73 2	<hh><ws><mm> <ws><ss>	Read only: <hh:mm:ss>

Table 11-11 Remote control commands, timer-controlled measurements

Start measurement series immediately			
C74	–	–	START IMMED
Start measurement series as programmed			
C76	–	–	START PGRD
Cancel measurement series			
C78	–	–	BREAK
Read status			
–	C79	0 = not activated 1 = activated	

Table 11-11 Remote control commands, timer-controlled measurements

**Spatially assigned measurements
for Field Strength, Exposure STD modes only**

Write / action commands	Read commands	Range of values of p	Meaning or units of p
Change to limitation point "A"			
C256	–	–	GOTO POS A
Calculate next measurement position			
C230	–	–	UP
Calculate previous measurement position			
C232	–	–	DOWN
Define / read XA coordinate matrix			
C128 0 <p>	C129 0	-99 to 999	XYZ EDIT
Define / read YA coordinate matrix			
C128 1 <p>	C129 1	-99 to 999	XYZ EDIT
Define / read ZA coordinate matrix			
C128 2 <p>	C129 2	-99 to 999	XYZ EDIT
Define / read XB coordinate matrix			
C128 3 <p>	C129 3	-99 to 999	XYZ EDIT
Define / read YB coordinate matrix			
C128 4 <p>	C129 4	-99 to 999	XYZ EDIT
Define / read ZB coordinate matrix			
C128 5 <p>	C129 5	-99 to 999	XYZ EDIT

Table 11-12 Remote control commands, spatially arranged measurements

Define / read coordinate ranking in matrix			
C130 <p>	C131	0 = XYZ 1 = YXZ 2 = XZY 3 = ZXY 4 = YZX 5 = ZYX	
Activate / read measured value recording			
C226 <p>	C227	0 = not activated 1 = activated	Deactivation: Saves stored measured values in a data set
Save measurement point			
C234	–	–	SAVE
Delete last measurement point			
C236	–	–	DEL LAST
Read number of saved measurement points			
–	C239	0 to 8191	–

Table 11-12 Remote control commands, spatially arranged measurements

Exporting data

Write / action commands	Read commands	Range of values of p	Meaning or units of p
Read total number of data sets			
–	C243 0	0 to 4095	–
Read number of NORMAL data sets			
–	C243 1	0 to 4095	–
Read number of AUTO data sets			
–	C243 2	0 to 4095	–

Table 11-13 Remote control commands, exporting data

Read number of MATRIX data sets			
–	C243 3	0 to 4095	–
Read number of data sets LIST			
–	C243 4	0 to 4095	–
Read number of data sets VECTOR			
–	Read C243 5	0 to 4095	–
Select / read data set type			
C244 <p>	C245	0 = all data sets Data set types 1 = NORMAL only 2 = AUTO only 3 = MATRIX only 4 = LIST only 5 = VECTOR only	–
Select / read first data set			
C246 0 <p>	C247 0	1 to 4095	Within the selected data set type
Select / read last data set			
C246 1 <p>	C247 1	1 to 4095	Within the selected data set type
Select / read scope of data set			
C248 <p>	C249	0 = complete 1 = reduced	NORMAL data set type only
Select / read scope of data set			
C250 <p>	C251	0 = complete 1 = reduced 2 = minimized	–
Select/read data set scope (for definition see “Current” function)			
C262 <p>	C263	0 = without Iman, Iref 1 = with Iman, Iref	–

Table 11-13 Remote control commands, exporting data

Start data export of selected data set type			
C86	–	–	–
Cancel data export			
C88	–	–	–
Output device info as header			
C252	–	–	–

Table 11-13 Remote control commands, exporting data

11.4.4 Optional functions

“Alarm” function

For Field Strength, Exposure STD modes only

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Activate / read visible alarm function			
C50 <p>	C51	0 = OFF 1 = ON	
Activate / read audible alarm function			
C52 <p>	C53	0 = OFF 1 = ON	
Define / read alarm threshold (B-field only)			
C122 <p>	C123	10E-9 to 31.6E-3 0.1E-3 to 316	Units T or G as for B-field measurement, Write only: <SCI> Read only: <SCI4D>
Define / read alarm threshold (E-field only)			
C124 <p>	C125	1 to 100E3	Units: V/m Write only: <SCI> Read only: <SCI4D>
Define / read alarm threshold referred to limit value curve			
C126 <p>	C127	0.1 to 100	Units: % Write only: <SCI> Read only: <SCI4D>

Table 11-14 Remote control commands, “Alarm” function

“Current” function**for Field Strength, Exposure STD modes only**

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Define / read current value I REF			
C260 0 <p>	C261 0	0 to 99999.9	Units A, e.g. nominal current
Define / read current value I MAN			
C260 1 <p>	C261 1	0 to 99999.9	Units A, e.g. wire current
Activate / read recording of current values			
C260 2 <p>	C261 2	0 = OFF 1 = ON	

Table 11-15 Remote control commands, “Current” function

“Standards” function**for Field Strength, Exposure STD modes only**

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Select / read active limit value curve			
C116 p	C117	1 to 6	Consecutive number of available limit value curves

Table 11-16 Remote control commands, “Standards” function

Select / read limit value curve			
–	C105 1	<text><ws><text>_ _____<ws>_____ = no standard	Max text length = 5 characters
–	C105 2		
–	C105 3		
–	C105 4		
–	C105 5		
–	C105 6		

Table 11-16 Remote control commands, “Standards” function

Measurement axes

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Select / read measurement axes			
C118 <p>	C119	0 = ISOTROPIC 1 = X 2 = Y 3 = Z	

Table 11-17 Remote control commands, measurement axes

Magnetic field measurement unit

not for Exposure STD mode

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Select / read units for B-field measurement			
C58 <p>	C59	0 = T 1 = G	

Table 11-18 Remote control commands, measurement units

Filter frequencies
for Field Strength mode only

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Bandpass filter: Define / read filter frequency			
C132 0 <p>	C133 0	15.0 to 2000.0	Units: Hz List index: 0
C132 1 <p>	C133 1	15.0 to 2000.0	Units: Hz List index: 1
C132 2 <p>	C133 2	15.0 to 2000.0	Units: Hz List index: 2
C132 3 <p>	C133 3	15.0 to 2000.0	Units: Hz List index: 3
C132 4 <p>	C133 4	15.0 to 2000.0	Units: Hz List index: 4
C132 5 <p>	C133 5	15.0 to 2000.0	Units: Hz List index: 5
Bandstop filter: Define / read filter frequency			
C134 0 <p>	C135 0	15.0 to 2000.0	Units: Hz List index: 0
C134 1 <p>	C135 1	15.0 to 2000.0	Units: Hz List index: 1
C134 2 <p>	C135 2	15.0 to 2000.0	Units: Hz List index: 2
C134 3 <p>	C135 3	15.0 to 2000.0	Units: Hz List index: 3
C134 4 <p>	C135 4	15.0 to 2000.0	Units: Hz List index: 4
C134 5 <p>	C135 5	15.0 to 2000.0	Units: Hz List index: 5

Table 11-19 Remote control commands, filter frequencies

**Fundamental frequencies
for Harmonic Analysis mode only**

Write/action commands	Read commands	Range of p Meaning	Explanation
Bandpass filter: Define/read filter frequency			
C136 0 <p>	C137 0	10.0 ... 10000.0	Unit: Hz List index: 0
C136 1 <p>	C137 1	10.0 ... 10000.0	Unit: Hz List index: 1
C136 2 <p>	C137 2	10.0 ... 10000.0	Unit: Hz List index: 2
C136 3 <p>	C137 3	10.0 ... 10000.0	Unit: Hz List index: 3
C136 4 <p>	C137 4	10.0 ... 10000.0	Unit: Hz List index: 4
C136 5 <p>	C137 5	10.0 ... 10000.0	Unit: Hz List index: 5

Table 11-20 Remote control commands, fundamental frequencies

CLOCK

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Select / read clock mode			
C62 <p>	C63	0 = 24 h 1 = 12 h	Display only
Select / read data mode			
C66 <p>	C67	0 = dd.mm.yy 1 = mm/dd/yy 2 = yy-mm-dd	Display only
Define / read real-time clock			
C60 <p>	C61	<hh><ws><mm><ws><ss>	Read only: <hh:mm:ss>
Define / read real tim clock date			
C64 <p>	C65	<yy><ws><mm><ws><dd>	Read only: <yy-mm-dd>

Table 11-21 Remote control commands, clock

Device data memory

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Define / read USER names			
C92 1 <p>	C93 1	<user 1name>	Max 12 characters
C92 2 <p>	C93 2	<user 2name>	Max 12 characters
C92 3 <p>	C93 3	<user 3name>	Max 12 characters
C92 4 <p>	C93 4	<user 4name>	Max 12 characters

Table 11-22 Remote control commands, device data memory

Save device settings			
C172 <p>	–	1 to 4	Consecutive number of setup
Recall device settings			
C174 <p>	–	0 = Factory 1 to 4	Consecutive number of setup

Table 11-22 Remote control commands, device data memory

11.4.5 General functions

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Select / read baud rate			
C100 <p>	C101	0 = 9600 1 = 19200	Units: baud
Activate / read display backlight			
C108 <p>	C109	0 = OFF 1 = ON	
Define / read display contrast			
C114 <p>	C115	0...31	

Table 11-23 Remote control commands, general functions

11.4.6 Test / Service

Write / action commands	Read commands	Range of values of p Meaning	Explanation
Read identification number			
–	C103 0	<id number>	16 characters, hexadecimal

Table 11-24 Remote control commands, test / service

Read firmware version			
–	C103 1	<version><ws> <yy-mm-dd><ws> <hh:mm:ss>	Version = X.XX
Read error messages after self test			
–	C103 2	\$_<error>	4 characters, hexadecimal
Read battery charge state			
–	C103 3	0 = OK 1 = LOW	The remaining operating time is about 15 minutes when the “LOW” charge state warning is output.
Read Basic Unit instrument designation			
–	C103 4	<device type>	Max 8 characters
Read Basic Unit hardware version			
–	C103 5	<version>	
Read Basic Unit calibration data			
–	C103 6	<yyyy>-<mm>-<dd>	
Read Basic Unit serial no.			
–	C103 7	<serial number>	Max 7 characters
Read active probe			
–	C103 8	0 = B-Field Probe / 90.10 (100 cm ²) 1 = B-Field Probe / 90.20 (3 cm) 8 = E-Field Unit 9 = B-Field Probe (built in)	
Read battery voltage			
–	C103 10	0.1 to 9.9	Units: V

Table 11-24 Remote control commands, test / service

Read "Exposure STD" enabled			
–	C107 1	0 = OFF 1 = ON	
Read "Spectrum FFT / Harmonic Analysis" enabled			
–	C107 2	0 = OFF 1 = ON	5 Hz to 2 kHz
Read expanded frequency range enabled (Spectrum FFT / Harmonic Analysis modes only)			
–	C107 3	0 = OFF 1 = ON	5 Hz to 32 kHz
Read "Exposure SFD" enabled			
–	C107 4	0 = OFF 1 = ON	
Execute / read visible alarm signal test			
C110 <p>	C111	0 = OFF 1 = ON	
Execute / read audible alarm signal test			
C112 <p>	C113	0 = OFF 1 = ON	

Table 11-24 Remote control commands, test / service

12 Specifications

All specifications in this chapter apply to both device types unless otherwise indicated. Differing specifications for the B and E field are indicated as follows:

- B field: **For Basic Unit only (B field)**
- E field: **For E-Field Unit only**

12.1 Principle of operation

The voltage induced in a measuring coil (probe) is evaluated to measure the magnetic flux density. The signal voltage is digitized and evaluated in a digital signal processor (DSP). The DSP emulates the selected filter characteristics and calculates the flux density resulting from the induced voltage.

The orthogonal arrangement of the three measurement coils allows isotropic (i.e. independent of spatial direction) measurement of the field. Various external field probes are available in addition to the built-in probe.

In the E-Field Unit, three pairs of orthogonally arranged plate electrodes take the place of the measurement coil. They are used to measure the dielectric current caused by the electric field strength.

12.2 Field Strength mode

12.2.1 Brief description

- Measurement of the magnetic flux density or electric field strength based on a broadband or selective evaluation of the signal under test.
- Display of the measurement result in units of Tesla or Gauss (or V/m).
- In the Broadband setting, additional display of the predominant frequency.

12.2.2 Frequency range

Broadband (+0/-3 dB), selectable	5 Hz to 2 kHz, 30 Hz to 2 kHz, 5 Hz to 32 kHz, 30 Hz to 32 kHz
Bandpass filter freely definable	15 Hz to 2 kHz Resolution 0.1 Hz Filter characteristic pre-set
Band stop filter freely definable	15 Hz to 2 kHz Resolution 0.1 Hz Frequency range 5 Hz to 2 kHz, plus band stop filter with pre-set filter characteristic
Filter characteristic	See Glossary

12.2.3 Measurement range, dynamic range

Nominal measurement range

B-field measurement ranges, selectable	100 nT, 316 nT,..., 31.6 mT (corresponding to 1 mG...316 G) in steps of 1, 3, 10,...
E-field measurement ranges, selectable	10 V/m ... 100 kV/m in steps of 1, 3, 10
Range selection	Manual or automatic

Dynamic range limit

Basic Unit

The maximum magnetic flux density that can be measured is twice the measurement range setting. The frequency-dependent overload limit as indicated in figure 12-1 must also be taken into account.

Example:

The dynamic range limit is 2 mT in the 1 mT measurement range when the 100 cm² probe is used (trace 1). The available dynamic headroom is reduced above a frequency of 4000 Hz as shown in Fig. 12-1.

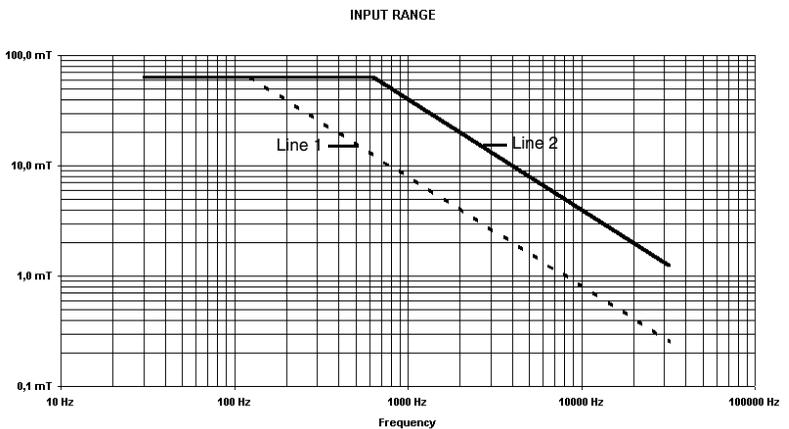


Figure 12-1 Dynamic range (for measurement range 31.6 mT)
 Trace 1: 100 cm² probe
 Trace 2: Built in probe or 3 cm probe

E-Field Unit

The maximum field strength that can be measured is twice the measurement range setting.

Background display level due to intrinsic noise

RMS detection mode

Typical values:

Setting	B field unit			E-Field Unit (EFA-300 only)
	100 cm ² probe (2245/90.10)	Built-in probe	3 cm probe (2245/90.20)	
Broadband, 30 Hz to 2 kHz	4 nT	100 nT	20 nT	0.7 V/m
Broadband, 5 Hz to 32 kHz	10 nT	200 nT	50 nT	4.5 V/m
Bandpass filter, centerfrequency 50 Hz to 400 Hz	0.8 nT	25 nT	5 nT	0.14 V/m

Dynamic range

The dynamic range for a given measurement range is calculated from the difference between the dynamic range limit and the intrinsic noise indication for the specific measurement range.

Physical constraints result in a higher background display level when the built-in B-Field Probe and the external 3 cm diameter B-Field Probe are used. This can mean that the sensitive measurement ranges can only be used sensibly with the 100 cm² cross-sectional area probe.

12.2.4 Measured value detection

Detection, selectable	RMS: root mean square value – or – VECT PEAK: peak value, true phase
Evaluated measurement axes, selectable	3-dimensional (isotropic), X, Y or Z

12.2.5 Averaging time / Refresh rate

The averaging time for the RMS value meter is 1 second.

The peak value meter indicates the maximum instantaneous value of the vector that occurred during the past 250 ms.

The measured values are updated every 250 ms.

12.2.6 Measurement uncertainty

The measurement uncertainties specified in the table apply under the following conditions:

- Signal shape: sine wave; Detection: RMS; Display mode: LIVE
- Drive level at least 10 % of the selected measurement range
- See Annex A regarding additional measurement uncertainties for signal frequencies close to the band limits.

Typical values:

Setting	B field unit			E-Field Unit (EFA-300 only)
	100 cm ² probe (2245/90.10)	Built-in probe	3 cm probe (2245/90.20)	
Broadband, 5 Hz to 2 kHz	±3% @ ≥ 40 nT	±5% @ ≥ 1 μT	±4% @ ≥ 200 nT	±3% @ ≥ 5 V/m
Broadband, 5 Hz to 32 kHz	±3% @ ≥ 80 nT	±8% @ ≥ 2 μT	±5% @ ≥ 400 nT	±3% @ ≥ 40 V/m
Bandpass filter, center frequency 50 Hz to 400 Hz	±3% @ ≥ 10 nT	±5% @ ≥ 250 nT	±4% @ ≥ 50 nT	±3% @ ≥ 1 V/m

12.2.7 Result display

Result display, selectable	Instantaneous value (LIVE) or maximum value (MAX)
Display mode	Digital and analog (bargraph), logarithmic scale
Resolution of digital display	4 digits
Refresh rate	4/s
Units, selectable	Tesla (T), Gauss (G) (or V/m)

12.2.8 Frequency measurement (Broadband setting only)

Measurement range	10 Hz to 32 kHz
Resolution	1 Hz
Trigger threshold	0.1 x measurement range (measurement range -20 dB)

This frequency measurement is based on counting the number of zero crossings of the signal. It is suitable for analyzing signals with one dominant frequency at a sufficiently high field strength.

12.2.9 Auxiliary functions

Alarm function, visible and audible	On / Off and adjustable threshold
USER device setups (etc.)	1 list each for the bandpass and bandstop filters, each containing 6 center frequencies

12.3 Exposure STD (Shaped Time Domain) mode

12.3.1 Brief description

- Measurement of the magnetic flux density or electric field strength based on a broadband measurement with simultaneous consideration of the limit curve corresponding to the chosen setting.
- RMS and peak values are simultaneously measured and computed.
- Measurement of the magnetic flux density or electric field strength as a percentage. 100 % indicates the limit is reached.

12.3.2 Frequency range

Broadband (+0 /-3 dB)	5 Hz to 32 kHz
-----------------------	----------------

12.3.3 Measurement range, dynamic range

Nominal measurement range

The fixed measurement range setting is nominally 100% of the selected limit value curve.

Dynamic range limit

The maximum exposure that can be measured is 200%, regardless of the signal form that is present.

Background display level due to intrinsic noise

The background display level depends on the limit value curve that is selected.

Typical values:

Setting	B-Field Unit			E-Field Unit (EFA-300 only)
	100 cm ² probe (2245/90.10)	Built-in probe	3 cm probe (2245/90.20)	
BGV01 EXP1	< 2%	< 4%	< 3%	< 2.5%
ICN98 OCCUP	< 0.4%	< 2%	< 1%	< 5%

Dynamic range

The dynamic range is calculated from the difference between the measurement range limit and the intrinsic noise indication.

The dynamic range is typically > 54 dB for sine wave signals.

12.3.4 Limit value curves

Up to six limit value curves can be implemented. The following standards are available, among others:

Standard, selectable	• BGV01 EXP2	Unfallverhütungsvorschrift, Germany (June 2001)
	• BGV01 EXP1	
	• BGV01 2H/D	
	• ICN98 GNUPB	ICNIRP Guidelines, April 1998
	• ICN98 OCCUP	
	• VDE01	

Note: The available curves can be updated if needed using the “EFA-200/-300 Tools” software.

Transferring STANDARDS parameters: siehe Seite 10-8

12.3.5 Measurement value detection

Detection	RMS and vectorial peak value are determined simultaneously and evaluated according to the selected limit value curve.
Evaluated measurement axes	3-dimensional (isotropic), X, Y or Z

12.3.6 Averaging time / Refresh rate

The averaging time for the RMS value meter is 1 second. The peak value meter indicates the maximum instantaneous value of the vector that occurred during the past 250 ms. RMS and peak values are weighted together according to the selected limit value curve. The measured values are updated every 250 ms.

12.3.7 Measurement uncertainty

The measurement uncertainties specified in the table apply under the following conditions:

- Sine wave signal and LIVE result display
- Drive level 16 dB above the intrinsic noise floor

Overall measurement uncertainty, typical values

B field unit			E-Field Unit (EFA-300 only)
100 cm ² probe (2245/90.10)	Built-in probe	3 cm probe (2245/90.20)	
±4%/%	±9%/%	±6%/%	±4%/%

The frequency response of the BROAD BAND 5 Hz to 32 kHz filter given in Annex A should be taken into account at the range limits if it is more than 0.1 dB. An additional systematic uncertainty of up to 3 dB may occur at the turning points of the limit value curves.

12.3.8 Result display

Result display, selectable	Instantaneous value (LIVE) or maximum value (MAX)
Display type	Digital and analog (bargraph), logarithmic scale
Digital display resolution	4 digits
Refresh rate	4/s
Units	Percent (%)

12.3.9 Additional functions

Alarm function, visible and audible	On / Off and adjustable threshold
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12.4 Spectrum FFT

Optional operating mode. Two different frequency ranges; see Ordering information.

12.4.1 Brief description

- Measurement of the magnetic flux density or electric field strength based on spectrum analysis through a Fast Fourier Transformation.
- Overlapping real-time operation for the frequency range 5 Hz...2 kHz, also suitable for non-stationary fields (e.g. pulsed fields).
Sequential operation for the frequency range 40 Hz...32 kHz, useful for stationary fields.
- Measurement status switchable between ongoing (RUN) and halted (STOP)

Annex C: Fundamentals of FFT: see page C-1

12.4.2 Frequency range

Range, selectable	5 Hz to 2 kHz	40 Hz to 32 kHz
Resolution, internal	1 Hz	10 Hz
Time window of ongoing sampling	1 sec, overlapping	100 ms

12.4.3 Measurement range

Nominal measurement range

Measurement range, selectable	100 nT to 31.6 mT (corresponding to 1 mG to 316 G) in steps of 1, 3, 10
Measurement range, selectable	10 V/m to 100 kV/m in steps of 1, 3, 10
Range selection	Manual or automatic

Dynamic range limits

B-Field Unit

The maximum magnetic flux density that can be measured is twice the measurement range setting. A frequency-dependent overload limit as per Fig. 12-1 must also be taken into account.

Example:

The dynamic range limit is 2 mT in the 1 mT measurement range when the 100 cm² probe is used (trace 1). The available dynamic headroom is reduced above a frequency of 4000 Hz as shown in Fig. 12-2.

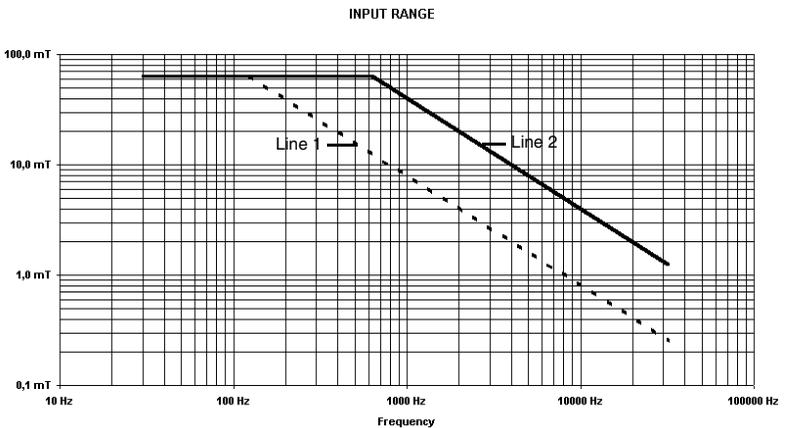


Figure 12-2 Dynamic range (for measurement range 31.6 mT)
 Trace 1: 100 cm² probe
 Trace 2: Built in probe or 3 cm probe

E-Field Unit

The maximum field strength that can be measured is twice the measurement range setting.

Background display level due to intrinsic noise and interference

Detection mode: RMS

Typical values:

Setting	B field unit			E-Field Unit (EFA-300 only)
	100 cm ² probe (2245/90.10)	Built-in probe	3 cm probe (2245/90.20)	
5 Hz to 2 kHz	< 45 nT @ ≤48 Hz < 4 nT @ > 48 Hz < 0.05 nT @ intrinsic noise	< 400 nT @ ≤48 Hz < 42 nT @ > 48 Hz < 2 nT @ intrinsic noise	< 260 nT @ ≤48 Hz < 23 nT @ > 48 Hz < 2 nT @ intrinsic noise	< 0.3 V/m @ ≤48 Hz < 0.1 V/m @ > 48 Hz < 0.02 V/m @ intrinsic noise
40 Hz to 32 kHz	< 2 nT @ < 200 Hz < 0.3 nT @ 200 Hz to 20 kHz < 0.6 nT @ > 20 kHz < 0.07 nT @ intrinsic noise	< 22 nT @ < 200 Hz < 11 nT @ 200 Hz to 20 kHz < 11 nT @ > 20 kHz < 1.5 nT @ intrinsic noise	< 10 nT @ 200 Hz < 2 nT @ 200 Hz to 20 kHz < 3 nT @ > 20 kHz < 0.3 nT @ intrinsic noise	< 0.1 V/m @ ≤20 kHz < 3 V/m @ > 20 kHz < 0.05 V/m @ intrinsic noise

Dynamic range

The dynamic range within a given measurement range is calculated from the difference between the dynamic range limits and the background display level due to intrinsic noise in the relevant measurement range.

Physical constraints result in a higher background display level when the built-in B-Field Probe and the external 3 cm diameter B-Field Probe are used. This can mean that the sensitive measurement ranges can only be used sensibly with the 100 cm² cross-sectional area probe.

12.4.4 Recording of measured values

The following detection modes can be selected:

- ACT RMS: actual root mean square value
- AVG RMS: averaged root mean square value
- VECT PEAK: peak value, true phase for each spectral component

12.4.5 Averaging / measured value rate

Annex C: Fundamentals of FFT: see page C-1

Spectra are computed in an ongoing fashion every 250 ms and used for subsequent internal processing. In AVG RMS detection mode, display of the spectra to be averaged is selectable in steps of 4, 8, 16 and 32.

The averaging time for the frequency range 5 Hz to 2 kHz can be exactly computed (averaging time: 1, 2, 4 or 8 s). In this frequency range, the spectra are obtained through interruption-free, overlapping sampling.

Measurement uncertainty

The measurement uncertainties specified in the table below apply when the marker is used to evaluate the results and under the following conditions:

- Signal shape: sine wave; detection: RMS; display mode: LIVE
- Drive level at least 10% of the set measurement range

Typical values:

Setting	B field unit			E-Field Unit (EFA-300 only)
	100 cm ² probe (2245/90.10)	Built-in probe	3 cm probe (2245/90.20)	
Broadband, 5 Hz to 2 kHz	±3% @ ≥ 40 nT	±5% @ ≥ 1 μT	±4% @ ≥ 200 nT	±3% @ ≥ 5 V/m
Broadband, 40 Hz to 32 kHz	±3% @ ≥ 80 nT	±8% @ ≥ 2 μT	±5% @ ≥ 400 nT	±3% @ ≥ 40 V/m

12.4.6 Result display

Graphical display	<ul style="list-style-type: none"> • Spectrum (measured value, frequency) • Units of decibels (dB) and reference value (T, G or V/m)
Zoom of frequency ranges, selectable	<ul style="list-style-type: none"> • Logarithmic division (like frequency range) • Linear division (scale size: 100 Hz or 1 kHz)
Zoom of measurement ranges	<ul style="list-style-type: none"> • Size, selectable 20 dB ... 120 dB • Reference value, selectable

The internally determined spectra cannot be displayed with the same speed so that under certain circumstances individual spectra are available exclusively for determining AVG RMS and MAX.

12.4.7 Additional functions

Markers	<ul style="list-style-type: none"> • The 9 largest measured values are displayed with their value and frequency. • Units of T or G (or V/m) • Frequency resolution better than 0.1 Hz • Center of zoom range (frequency axis)
Normalized display	<ul style="list-style-type: none"> • Spectrum displayed referred to selectable limit curve • Measured value readable directly as above/ below limit • Marker display as percentage of limit

12.5 Harmonic Analysis mode

Optional operating mode. Two different frequency ranges; see ordering information.

The specifications apply in "Spectrum" operating mode unless otherwise stated below.

12.5.1 Brief description

- Measurement of the magnetic flux density or electric field strength based on spectrum analysis through a Fast Fourier Transformation.
- Determination of the exact fundamental frequency by entering an approximate value
- Measurement of the field strength of the fundamental and harmonics.

12.5.2 Frequency range

Frequency of fundamental, selectable	10 Hz...500 Hz Resolution 0.1 Hz	10 Hz...10 kHz Resolution 0.1 Hz
Frequency range, internal	5 Hz...2 kHz	40 Hz...32 kHz

12.5.3 Result display

Graphical display	<ul style="list-style-type: none"> • Spectrum (measured value, index of fundamental/harmonics) • Units of decibels (dB) and reference value (T, G or V/m)
Result list, tabular	<ul style="list-style-type: none"> • Frequency of fundamental • Measured value of fundamental • Harmonic factors of 2nd to 10th harmonic • Overall harmonic factor (not VECT PEAK) • Noise/harmonic factor (not VECT PEAK)

The number of displayable harmonics is limited by the ratio of the selected fundamental frequency and the available frequency range.

12.6 Miscellaneous

12.6.1 Display type and warning devices

Basic Unit only

Display type	LCD dot matrix, with backlight
Visible warning	Red LED
Audible warning	Built in beeper

12.6.2 Data memory

Both the basic unit and the E-Field Unit are equipped with a data memory. All the information below applies to both the basic unit and the E-Field Unit.

The data memory of the E-Field Unit can also be used independently of the basic unit in “Measurement sequence, timer-controlled” memory mode. This requires settings to be made on the E-Field Unit first using the basic unit.

12.6.2.1 Brief description

- Measured values, all relevant instrument settings and a date/time stamp are stored in a data set for each save action.
- Control of save actions and the contents of the data set depend on the selected operating mode.

Operating mode	Data set control	Data set contents
Field Strength	<ul style="list-style-type: none"> • Single value: manual • Sequence: timer-controlled • Sequence: spatial matrix 	Magnetic flux density (absolute), in Tesla or Gauss or electric field strength in V/m
Exposure STD (Shaped Time Domain)	<ul style="list-style-type: none"> • Single value: manual • Sequence: timer-controlled • Sequence: spatial matrix 	Magnetic flux density or electric field strength, weighted, in percent
Spectrum FFT	<ul style="list-style-type: none"> • Single value: manual 	Spectral values, depending on frequency range 2001 or 3201 single values
Harmonic Analysis	<ul style="list-style-type: none"> • Single value: manual 	<ul style="list-style-type: none"> • Frequency and field strength of fundamental • Harmonic factors

12.6.2.2 Memory capacity

The data memory holds up to 4095 data sets.

The capacity depends mainly on the type of data set to be stored. Typical capacities are 3600 single values or 22 spectra.

12.6.2.3 Clock

Built-in clock with calendar function. The time can be set to the nearest second.

12.6.3 Device settings memory

User defined settings for all available operating modes are stored in four independent memories.

12.6.4 Self test

Automatic self test after switch-on:

- Warning function
- Converter test
- Memory test
- Operating voltage test

12.6.5 Remote control interface (serial)

Type	Optical, bi-directional
Fiber, connector	POF 1 mm, DNP
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Handshake	XON / XOFF

12.6.6 Power supply

12.6.6.1 Battery operation

Basic Unit only

Built-in exchangeable NiMH batteries	5 size C (Baby), IEC R14
Operating life with rechargeable batteries at 23 °C	Typically 10 hours
Measurement sequence, timer-controlled	Typically 24 hours
Charging time for rechargeable battery, measurement off	Typically 3 h

– or –

Alkaline batteries	5 size C (Baby), IEC LR14
Operating life with alkaline batteries at 23 °C	Typically 20 h

E-Field Unit only

Built-in NiMH batteries	Can only be exchanged by a service agent
Operating life at +23 °C	Typically 10 hours
Measurement sequence, timer-controlled	24 hours
Charging time	Typically 3 hours

12.6.6.2 Charger unit

Type	SNT-91, BN 2259/92.01 or BN 2259/92.02
Nominal voltage range	100 to 240 V AC
Nominal voltage range switching	Automatic
AC line frequency, operating range	47 to 63 Hz

12.7 General specifications

12.7.1 Climatic environment conditions

Environment classes

Environment class standard	Storage	Transport*	Operation**
IEC 721-3	Class IE 12	Class IE 23 with 2M3	Class IE 72 with 7M3
ETS 300 019-1	Class 1.1	Class 2.3 with 2M3	Class 7.1 with 7M3
		Low air temperature and restricted humidity	Extended air temperature range, (without AC adapter / charger)

Selected climatic parameters

	Storage	Transport	Operation
Temperature	-5 °C to +45 °C	-30 °C to +70 °C	0 °C to +50 °C briefly: -10 °C to +50 °C With AC adapter / charger: +5 °C to +40 °C
Humidity	5 to 95% @ ≤30 °C 1 to 29 g/m ³ @ > 30 °C	≤95% @ ≤40 °C	5 to 85% @ ≤30 °C 1 to 25 g/m ³ @ > 30 °C
Condensation	Yes	Yes	Permitted for brief periods occasionally

12.7.2 Conformance marks

Noise emission and noise immunity	Conforms to EN 61 326-1
Safety	Conforms to EN 61 010-1

The conditions for affixing the CE mark are therefore fulfilled.

12.7.3 Maintenance**12.7.3.1 Calibration interval**

The recommended calibration interval is 24 months.

12.7.3.2 Data memory battery (lithium battery)

It is recommended that the lithium battery is replaced approximately every 10 years.

12.8 Dimensions and weight

	B field unit	E-Field Unit (EFA-300 only)
Dimensions w x h x d	110 x 200 x 60 mm	105 x 105 x 105 mm
Weight (incl. batteries)	approx. 1000 g	approx. 1000 g

12.9 Ordering information

<p>EFA-200 (including Field Strength and Exposure STD modes)</p> <ul style="list-style-type: none"> • Basic Unit • SNT-91 charger • Transport bag • Opto-electrical adapter • Fiber optic cable (2 m) • Software EFA-200/EFA-300 Tools • Operating manual 	BN 2245/20
<p>EFA-300 (including Field Strength and Exposure STD modes)</p> <ul style="list-style-type: none"> • Basic Unit • E-Field Unit • Two SNT-91 chargers • Transport bag • Opto-electrical adapter • Fiber optic cables (2 m and 10 m) • Tripod (BN 2244/90.31) • Software EFA-200/EFA-300 Tools • Operating manual 	BN 2245/30

12.9.1 Options

Spectrum FFT and Harmonic Analysis modes (5 Hz ... 2 kHz)	BN 2245/95.10
Spectrum FFT and Harmonic Analysis modes (5 Hz ... 32 kHz)	BN 2245/95.15
Calibration report, EFA-200	BN 2245/91.02
Calibration report, EFA-300	BN 2245/91.03
Precision B-Field Probe, A=100 cm ²	BN 2245/90.10
B-Field Probe, D=3 cm	BN 2245/90.20
Calibration report, B-Field Probe, A=100 cm ²	BN 2245/90.11
Calibration report, B-Field Probe, D=3 cm	BN 2245/90.21
Extension cable for probe (1.2 m)	BN 2245/90.35
Tripod	BN 2244/90.31

Annex A: Glossary

Measurement axes (isotropic / single axis measurement)

The measurement of the magnetic flux density / field strength present at a given point requires the determination of the field strength components in the three orthogonal vector directions. These three mutually perpendicular measurement axes are normally designated as x, y and z respectively.

If the sensors in the measurement probe are suitably aligned (on three axes), the probe itself does not need to be specially aligned in the field. This is known as an isotropic measurement.

It is easier to localize hidden field sources / leaks if the measurement is made in one axis only. In this case, only one of the sensor signals is evaluated. The probe is moved to give the maximum readout during the measurement. The markings on the probe can then be used to deduce the location of the field source.

Field probes

All the field probes available are suitable for isotropic measurements. The directions of the x, y and z measurement axes are clearly marked on the probe.

If an external B-Field Probe / E-Field Unit is connected to the Basic Unit, this will be detected automatically and the measurement input switched accordingly.

RMS value (RMS)

The RMS value of the magnetic flux density \tilde{B} is calculated from the RMS values \tilde{B}_x through \tilde{B}_z for the magnetic flux densities in the three measurement axes.

$$\tilde{B} = \sqrt{\tilde{B}_x^2 + \tilde{B}_y^2 + \tilde{B}_z^2}$$

The RMS value is independent of the time-domain phases of the three field components.

The RMS value for electric field strength is calculated in the same manner.

Peak value (VECT PEAK)

The peak value of the magnetic flux density \hat{B} is calculated from the variation in time $B_x(t)$ through $B_z(t)$ of the magnetic flux densities in the three measurement axes.

$$\hat{B} = \text{Max} \left\{ \sqrt{B_x^2(t) + B_y^2(t) + B_z^2(t)} \right\}$$

The peak value is always dependent on the phase alignment of the measured field component. This fact is taken into account in the vectorial addition of the components.

The peak value of the electric field strength is calculated in the same manner.

Averaging

Every measurement must be made over a sufficiently long period of time to allow for variations in field strength over time. In accordance with the latest standards and regulations, the EFA uses an observation period of precisely one second.

This feature is of particular importance in certain situations:

Situation	Effect
<ul style="list-style-type: none"> • Change of measurement range, detection mode • Change in field at point of measurement • Measurement of pulsed signals 	<ul style="list-style-type: none"> • The RMS value rises to the final, correct value within one second. • The RMS value is shown in accordance with the standards. • The displayed measurement value \leq RMS value within one pulse width.

Field exposure evaluation

Evaluation criteria that appear to be dependent on the variation with time of the field are quoted in the safety standards.

Field type	Evaluation
<ul style="list-style-type: none"> • Single-frequency fields • Multiple-frequency fields • Pulsed fields 	<ul style="list-style-type: none"> • Derived limit for field strength • Summation formulae • Variation in field with time

These criteria can be summarized and lead to an evaluation expressed as a percentage.

(Note: Envisaged in the standards, compare “Summation formula”)

The EFA is equipped with a suitable automatic evaluation function. This takes account of the variation with frequency of the limit values as well as the prescribed measurement of the RMS and peak values.

Selection filters / Equalization

The following graphs show the typical responses of the built-in broadband and selective filters.

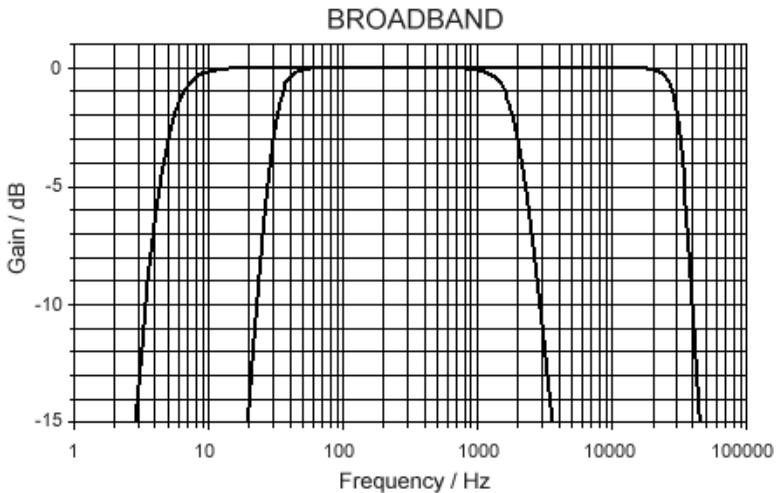


Figure A-1 Typical response of BROADBAND filter

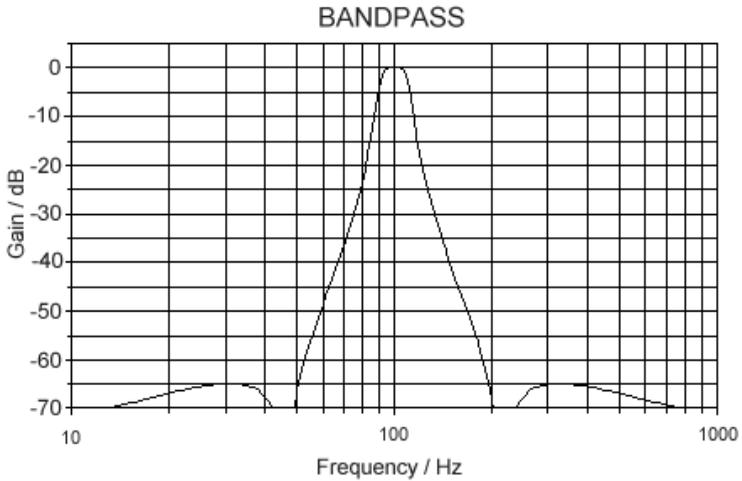


Figure A-2 Typical response of BANDPASS filter with filter frequency $f_m = 100$ Hz
For other filter frequencies, multiply the frequency axis by $f_m / 100$ Hz.

Example of measurement uncertainty for a small frequency deviation:
The additional measurement uncertainty for a deviation of up to 5% between the selected center frequency and the signal frequency (in the frequency range between 95 and 105 Hz in the above figure) is just 1%.

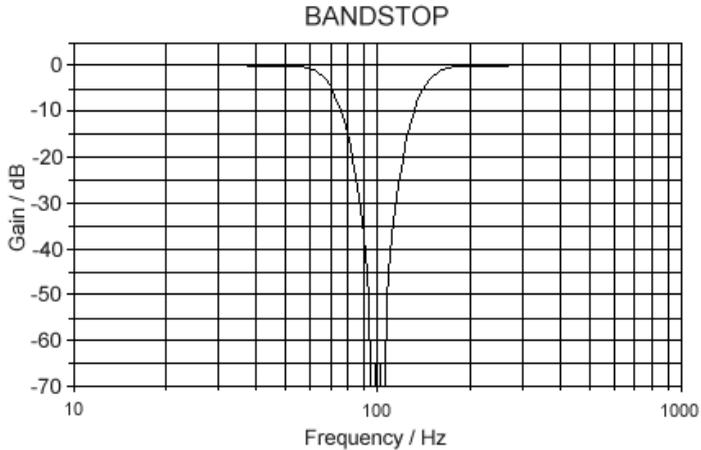


Figure A-3 Typical response of BANDSTOP filter for filter frequency $f_m = 100$ Hz
For other filter frequencies, multiply the frequency axis by $f_m / 100$ Hz.

The selective filters from 16.7 Hz through to 50 Hz and 60 Hz (AC line frequencies) up to 180 Hz are suitable for determining the fundamental and harmonic fields caused by public power supply utilities.

The filters from 400 Hz up to 1200 Hz are suitable for determining the fundamental and harmonic fields due to on-board (ship / aircraft) power supplies.

Scaled measured value axis (dB scale)

In the Spectrum FFT and Harmonic Analysis modes, a very large measurement range with a wide dynamic range is available. To be able to clearly display both large and small measured values, the measured values are normalized with respect to a reference value (see display field F1) and plotted on a logarithmic axis (Y axis). The unit is known as the decibel (dB).

The field strength measured value can be directly read off with the marker. However, it can also be computed as follows:

$$\text{MeasuredValue} = \text{ReferenceValue} \times 10^{\frac{(\text{DisplayValue}[\text{dB}])}{20}}$$

A display value of 0 dB corresponds exactly to the reference value shown in display field F1. The position of the reference value can be shifted along the measured value axis with Y POS. The display scale of the measured value axis can be modified with Y SCAL.

One very practical feature is the ability to quickly compare several measured values: Based on the distance between two measured values on their axis, you can easily read off their relative size (factor of the field strength).

dB	Factor	dB	Factor
40	100.00	-3	0.71
20	10.00	-6	0.50
10	3.16	-10	0.32
6	2.0	-20	0.1
3	1.41	-40	0.01
1	1.12	-60	0.001
0	1.00	-80	0.0001
-1	0.89	-100	0.00001

This table is also printed on the back of the device.

Annex B: Determining the matrix

Defining the spatial area and spatial points

The actual space within which the measurement is to be made (e.g. an office or the area around a transformer station) is represented by a coordinate space.

Every point in this space can be described exactly by means of a set of coordinates. The user assigns a coordinate axis (x , y , z) to each of the three spatial axes (e.g. length, width, height). The spatial limits are described by the coordinates of the two limiting points, designated “A” and “B” in the diagram.

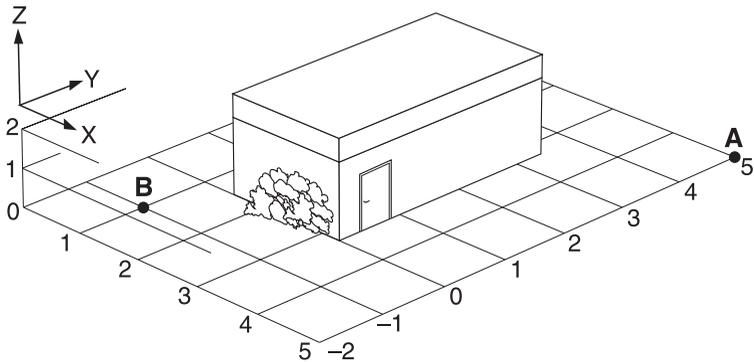


Figure B-1 Overlaying an imaginary coordinate space around the object under investigation

Coordinates that lie within these coordinate limits (spatial limits) can be selected as required. Visualization can be improved by using positive and negative values. The limits can be changed at any time during the measurement to allow additional areas of interest to be included in the set of measurements.

One or two coordinates can be set to any fixed value for measurement points located on a surface or line.

Organizing data

The area under investigation is traversed systematically within the spatial limits during the measurement. Any direction can be chosen and this can be altered at any time. A measurement value is recorded along with the displayed coordinate value by pressing a button at each point in the space that is of interest. These values are initially stored in a data pool. The target coordinates for the next measurement are then calculated and displayed on the screen.

The proposed target coordinates can be altered if required or ignored if the proposed point is inaccessible or of no interest, for example.

Each individual measurement point is uniquely identified by means of a sequence index N and a timestamp. This allows repeat measurements to be made at the same point (identical coordinates but different timestamps).

All the values collected and stored during the series of measurements are stored together in a data set only after the series of measurements has been completed.

Annex C: Fundamentals of FFT

In Spectrum FFT mode, spectrum analysis is performed using a Fast Fourier Transformation (FFT). This is based on recording of the signal shape (“sampling”), following by computation.

The individual steps are as follows:

Sampling

The signal shape is monitored for each active measurement axis (isotropic or single channel) over a certain time period (“time window”) and internally represented through ongoing sampling.

The sampling is free-running, i.e. it does not require any trigger signal derived from the measurement signal or external trigger signal.

Transformation (FFT)

Based on the samples of the time-domain signal available internally, the frequency spectrum is computed (“transformation”). The internal resolution of individual spectral lines is automatically determined by the length of the time window.

During selection of all measurement axes (isotropic), three separate spectra are available internally.

Computation of the resulting spectrum

Upon selection of all three measurement channels (isotropic), the three individual spectra are put together to form a resulting spectrum.

In the ACT RMS and AVG RMS detection modes, the three corresponding spectral lines of each measurement channel are put together through quadratic addition (RSS) to form an internal spectral line. The measurement result is independent of the polarization of the field and allows direct read-off of the RMS value.

In the VECT PEAK detection mode, the three corresponding spectral lines for each measurement channel are formed through vectorial addition of their peak values. This result is basically dependent on the field polarization. The measured value can thus be up to 3 dB greater than the result in ACT RMS detection mode. The peak value of an individual spectral component can be read off.

Averaging of the resulting spectrum

In the ACT RMS and VECT PEAK detection modes, each computed spectrum is used for evaluation.

In the AVG RMS detection mode, a selectable number (averaging parameter NAVG) of successive power spectra are averaged. Larger averaging parameters result in a reduction of the noise shown on the screen and allow you to read off smaller measurement results.

For the frequency range 5 Hz...2 kHz, the averaging time can be computed exactly (averaging time = NAVG x 0.25 s) so that the averaging time of 1 s provided in many standards can be set.

Display of the resulting spectrum

The large number of spectral lines present internally can be displayed in the logarithmic screen only after compressing multiple lines. This compression is important particularly in the upper screen area in which many internal spectral lines have to be compressed into just a few screen spectral lines. With linear scale division, the full resolution is also available on the screen.

Evaluation with the marker

High-resolution evaluation of the spectrum with the marker is possible at any time since all spectral lines are available internally. When using the marker, the frequency resolution and the accuracy of the field strength measurement are improved by at least a factor of ten through an interpolation technique.

Overlapping real-time operation

For the frequency range 5 Hz...2 kHz, the recording of the field (sampling) goes on with no interruptions in an overlapping fashion during the ongoing computation of the spectrum. This is unique since it prevents the device from becoming blind to field changes, as occurs during sequential processing.

In this setting, it is also possible to analyze brief fields (pulsed alternating fields 5 Hz...2 kHz) or fields that vary over time. It is recommended to use the AVG RMS or ACT RMS detection mode in combination with MAX display mode, which keeps the spectrum in the screen for subsequent monitoring.

For the frequency range 40 Hz...32 kHz, brief field changes such as pulsed fields cannot be recorded. A stationary field is required to produce correct measurement results.

Annex D: Data export format

Exporting data: see page 7-16

Exported data are available as *.txt or *.csv files.

Individual data items are separated using the separator chosen for the export operation.

Each export document is preceded by an information block summarizing the device data.

The exported measurement data differ as a function of the mode and the data set type. Their differences are described below.

Information block

Parameter	Code
Device type	Device:
Serial number	SN:
Calibration date	CAL_DATE:
Hardware version	HW-Version:
Software version	SW-Version:
Software creation date	SW-Date:
Software creation time	SW-Time:

Exported measurement data

Field Strength mode

- Data set type NORMAL

Parameter	Code	Values
Data set number	MEM#	Number
Data set type	D	N = Normal
Probe used	PROBE	INT_PRB = Internal probe EXT_PRB_1 = Probe 100 cm ² EXT_PRB_2 = Probe 3 cm
Meas. axis	CHN	ALL = Isotropic X, Y, Z = Single axis
Mode	MODE	FIL = Field strength
Date	DATE	yy-mm-dd
Time	TIME	hh:mm:ss
Frequency range	FILTER	5 Hz...2 kHz to 30 Hz...32 kHz BP = Bandpass BS = Bandstop
Detection mode	DET	RMS = RMS PEAK = Vector Peak
Display mode	MAX	LIVE MAX
Measured value, unit	VALUE [x] T = Tesla G = Gauss V/m	Number
Validity indicator	VALID	OK !A = Computation incomplete !O = Overdriven
Frequency counter	FREQ [HZ]	Number

- Data set type AUTO (differences with respect to data set type NORMAL)

Data set type	D	A = AUTO
Index in data set	N	Number
Time step	STEP	hh:mm:ss

- Data set type MATRIX (differences with respect to data set type NORMAL)

Data set type	D	M = Matrix
Index in data set	N	Number
X-Index	X	Number
Y-Index	Y	Number
Z-Index	Z	Number

Exposure STD mode

- Data set type NORMAL

Parameter	Code	Values
Data set number	MEM#	Number
Data set type	D	N = Normal
Probe used	PROBE	INT_PRB = Internal probe EXT_PRB_1 = Probe 100 cm ² EXT_PRB_2 = Probe 3 cm
Meas. axis	CHN	ALL = Isotropic X, Y, Z = Single axis
Mode	MODE	STD = Exposure STD
Limit curve	STANDARD	Text
Date	DATE	yy-mm-dd
Time	TIME	hh:mm:ss
Display mode	MAX	LIVE MAX
Measured value, unit	VALUE [%]	Number
Validity indicator	VALID	OK !A = Computation incomplete !O = Overdriven

- Data set type AUTO (differences with respect to data set type NORMAL)

Data set type	D	A = AUTO
Index in data set	N	Number
Time step	STEP	hh:mm:ss

- Data set type MATRIX (differences with respect to data set type NORMAL)

Data set type	D	M = Matrix
Index in data set	N	Number
X-Index	X	Number
Y-Index	Y	Number
Z-Index	Z	Number

Spectrum FFT mode

- Data set type VECTOR

Parameter	Code	Values
Data set number	MEM#	Number
Data set type	D	V = Vector
Index in data set	N	Number
Probe used	PROBE	INT_PRB = Internal probe EXT_PRB_1 = Probe 100 cm ² EXT_PRB_2 = Probe 3 cm
Meas. axis	CHN	ALL = isotropic X, Y, Z = Single axis
Mode	MODE	FFT = Spectrum FFT
Limit curve	STANDARD	Text
Date	DATE	yy-mm-dd
Time	TIME	hh:mm:ss
Frequency range	F_RANGE	5 Hz...2 kHz 40 Hz...32 kHz
Resolution	DF[HZ]	Number
Detection mode	DET	ACT = ACT RMS AVG = AVG RMS PEAK = Vector Peak

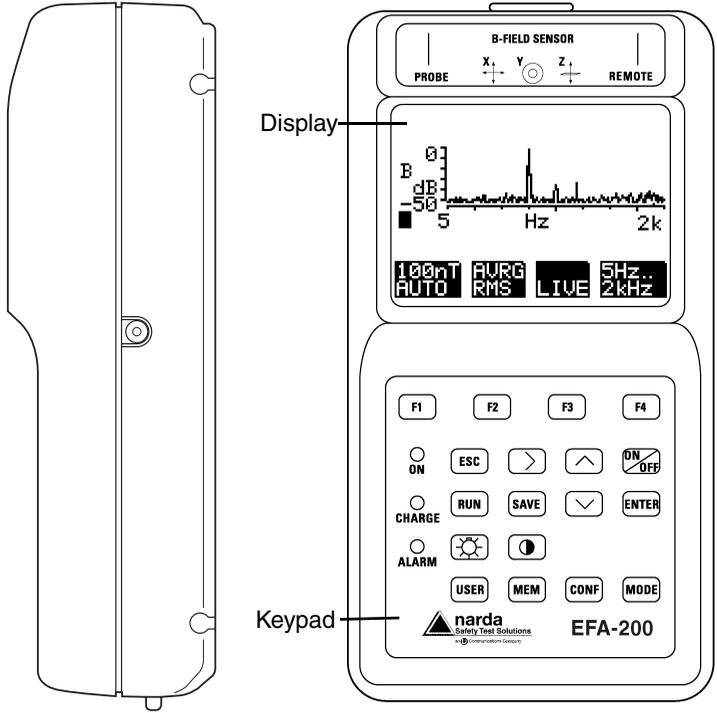
Display mode	MAX	LIVE MAX
Spectral value, unit	VALUE [x] T = Tesla G = Gauss V/m	Number
Validity indicator	VALID	OK !A = Computation incomplete !O = Overdriven

Harmonic Analysis mode

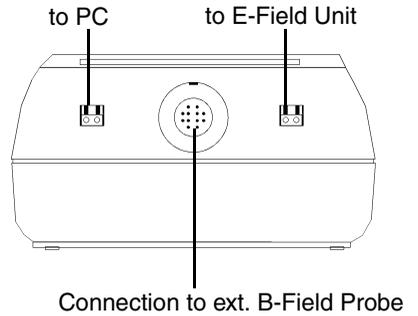
- Data set type LIST

Parameter	Code	Values
Data set number	MEM#	Number
Data set type	D	L = List
Probe used	PROBE	INT_PRB = Internal probe EXT_PRB_1 = Probe 100 cm ² EXT_PRB_2 = Probe 3 cm
Meas. axis	CHN	ALL = Isotropic X, Y, Z = Single axis
Mode	MODE	HAR
Date	DATE	yy-mm-dd
Time	TIME	hh:mm:ss
Detection mode	DET	ACT = ACT_RMS AVG = AVG_RMS PEAK = Vector Peak
Display mode	MAX	LIVE MAX
Frequency, fundamental	F1 [HZ]	Number
Measured value, fundamental, unit	VALUE [x] T = Tesla G = Gauss V/m	Number
Harmonic factors	K2 [%] ... K9 [%]	Number
Total harmonic factor	KT [%]	Number

Total noise/harmonic factor	KN [%]	Number
Validity indicator	VALID	OK !A = Computation incomplete !O = Overdriven



Serial optical interfaces:



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