3-Axis RF Meter

840047

Instruction Manual

SPER
SCIENTIFIC

Environmental Measurement Instruments

3-Axis RF Meter 840047

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3-AXIS RF METER
QUICK START GUIDE

This meter contains many functions such as memory, alarm, date/time, average, etc. which will require some study of the manual to use properly.

However, you can quickly and easily begin making measurements right out of the box. Just follow these simple steps:

1. Insert 9V battery.
2. Press the "⓪" button to power the meter on.
3. Press "(▼XYZ MEM)" button until all three letters (XYZ) are displayed on the screen (to the left of the main number).
4. Press "(UNIT ENTER)" button until the desired units are displayed below the main number (we recommend using mV/m).

You are now ready to make your first measurements!

INTRODUCTION

The Sper Scientific 3-Axis RF Meter model 840047 is designed for measuring and monitoring Radio–Frequency electromagneticfield strength. The meter is calibrated precisely over the frequency range of 50 MHz to 3.5 GHz.

With its simple method of operation this meter will measure electromagnetic pollution generated artificially. Wherever there is a voltage or a current, electric (E) and magnetic (H) fields arise. All types of radio broadcasting and TV transmitters produce electromagnetic fields. They also arise in industry, business and the home.

Electric field strength (E):
A field vector quantity that represents the force (F) on an infinitesimal unit positive test charge (q) at a point divided by that charge. Electric field strength is expressed in units of volts per meter (mV/m). This meter measures electric field strength directly.

Magnetic field strength (H):
A field vector that is equal to the magnetic flux density divided by the permeability of the medium, Magnetic field strength is expressed in units of amperes per meter (A/m). In far field situations, one can calculate the magnetic field from the electric field value. This meter can display the calculated Magnetic field strength.

Power density (S):
Power per unit area perpendicular to the direction of propagation, usually expressed in units of Watts per square meter (W/m2) or, for convenience, units such as mili/Watts per square centimeter (mW/cm2).

The characteristic of electromagnetic fields:
Electromagnetic fields propagate as waves and travel at the speed of light (C). The wavelength is proportional to the frequency:

(wavelength) = C (speed of light) / f (frequency)

If the distance to the field source is less than three wavelengths, then we are usually in the near field. If the distance is more than three wavelengths, the far-field conditions usually hold. In near field conditions, the magnetic field value cannot be calculated from the electric field value.

This meter is designed for reliable far field measurements only.

APPLICATIONS

- Routine, maintenance and service in active electromagnetic fields, e.g. broadcasting stations, etc.
- High frequency (RF) electromagnetic wave field strength measurement.
- Mobile phone base station antenna radiation power density measurement.
- Wireless communication applications (CW, TDMA, GSM, DECT).
- RF power measurement for transmitters.
- Wireless LAN (Wi-Fi) detection, installation.
- Spy camera, wireless bug finder.
- Cellular/Cordless phone radiation safety level.
- Personal environment EMF safety.

FEATURES

- Monitors high- frequency radiation in the range from 50 MHz to 3.5 GHz
- Auto-ranging units of measurement
- Meter can be set to display instantaneous value, maximum value, measured or average value
- Non-directional (isotropic) measurement with three-axis measurement sensor
- High dynamic range due to three- channel digital results processing
- Non-directional electric field antenna and high sensitivity also allows measurements of electric field strength in TEM cells and absorber rooms
- Configurable alarm threshold and memory function
- Low battery detector "⊟⊞"
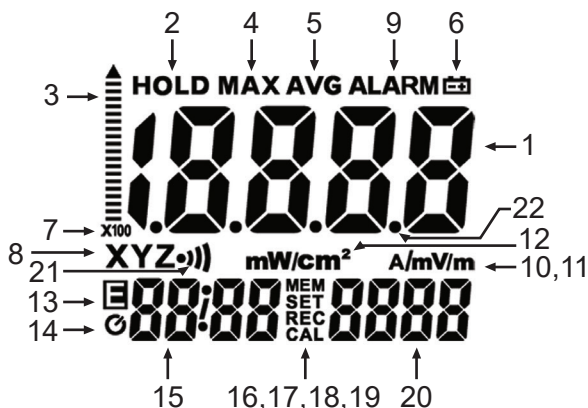- Over load indication "OL"

INCLUDED ACCESSORIES

- Soft case
- 9V battery

IDENTIFYING PARTS

1. RF 3-Axis Sensor
2. Liquid-crystal LCD
3. MAX / AVG / ▶ Button
4. Record / Time / ◀ Button
5. Power Button
6. UNIT / ENTER Button
7. Hold / ALARM / ▲ Button
8. Backlight/Set
9. XYZ / MEM / ▼ Button
10. Tripod mounting screw (not pictured - back of unit)
11. Battery cover (not pictured - back of unit)

LCD DESCRIPTION

1. Primary Display
2. Hold symbol
3. Analogue bar graph
4. MAX symbol
5. AVG symbol
6. Low battery symbol
7. x1x10x100 unit
8. X.Y.Z unit
9. ALARM unit
10. mV/m,V/m (E)
11. µA/m mA /m unit (H)
12. µW/m, µW/cm2 unit
13. E symbol
14. Auto power off symbol
15. Time unit (month:day)
    (hour: minute) (second)
16. MEM reading symbol
17. SET symbol
18. REC symbol
19. CAL symbol
20. Secondary Display
21. Alarm symbol
22. Decimal point

MEASUREMENT PROCEDURES AND PREPARATION

Remove the battery cover and install a 9V battery. (Battery replacement: When the low battery symbol $\boxed{-+}$ appears on the LCD display, the battery should be replaced.)

Power button:
Press "$\textcircled{0}$" button to power meter on.
Press "$\textcircled{0}$" button to power meter off.

Data hold button:
Press the "$\overset{\text{HOLD}}{\text{ALAM}}$" button to enter hold mode. "HOLD" appears on the screen and the reading is frozen to allow you to read the data.

Press the "$\overset{\text{HOLD}}{\text{ALAM}}$" button again to return to measurement mode.

Units button:

Select the unit of measure with the "$\overset{\text{UNIT}}{\text{ENTER}}$" button as follows:

Electric field strength (mV/m)

Computed magnetic field strength (mA/m)

Computed power density (mW/m²)

Computed power density (μW/cm²)

Press "$\overset{\text{UNIT}}{\text{ENTER}}$" button to change the unit.

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MAX / AVG Record:

Press the "$\binom{MAX}{AVG}$" button to switch to the next display. The display switches from MAX to AVG to MAX/AVG and back to MAX.

Press and hold the "$\binom{MAX}{AVG}$" button for 3 seconds to disable this function.

The maximum averaging storage is up to 99 minutes and 99 seconds. After this period of time, updating will stop automatically and the LCD displays **E**.

Manual data memory storing

Push the "$\binom{REC}{TIME}$" button and the meter will save the current measurement. REC with a number from 001 to 200 will be displayed.

Manual data memory storage capacity: 200 data sets.

Over load indication: "OL".

Backlight Display and Reading in The Dark

Press the "$\binom{\cdot\!\cdot\!\cdot}{SET}$" key to turn the backlight light on and off. Backlight light will turn off automatically after 30 seconds.

XYZ:

Press the "$\blacktriangledown^{XYZ}_{MEM}$" button to change the sensor axis selection: "XYZ (All axis)", "X axis ", "Y axis", "Z axis".

```
10000 10000 10000 10000
XYZ         mV/m X    mV/m Y    mV/m Z    mV/m
☼01:08    ☼01:08    ☼01:08    ☼01:08
```

Alarm ON/OFF Setup

Press and hold "$\textcircled{0}$" then press the "$\blacktriangle^{HOLD}_{ALAM}$" button to turn the alarm function on. The "ALARM" symbol in the display indicates that the alarm function is on. Press and hold "$\textcircled{0}$" and "$\blacktriangle^{HOLD}_{ALAM}$" to turn off the alarm function. When the Alarm sounds, the display shows ●)).

```
              ALARM
   888    888
XYZ●))  A/mV/m XYZ●))  A/mV/m
☼88:88    ☼88:88
```
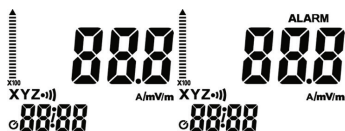
Viewing Data Records

Hold the "$\textcircled{0}$" button and press the "$\blacktriangledown^{XYZ}_{MEM}$" button to view saved data records.

Use the ▲ or ▼ buttons to see the next or previous records.

Press the "$^{UNIT}_{ENTER}$" button return to measurement mode.

```
   80.0    888    888
X100        mV/m X100      mV/m X100      mV/m
☼07:00ᴹᴱᴹ 001 ☼08:01ᴹᴱᴹ 002 ☼08:00ᴹᴱᴹ 003
```

Clock LCD Display

Hold the "⓪" button and press the "(REC TIME◀)" button to display the current Year, Month, Date, Hour, and Second settings. The meter's clock uses 24 hour time setting. Default time mode setting is: "2010/01/07 00:02" ":00".

00:2013/3 12009:15

Setup Mode

While the meter is on, hold the "⓪" button and press the "(☼ SET)" button to enter the setup mode. "**SET**" will be displayed in the center of the lower line display.

Press the "(☼ SET)" button to scroll through the setup function.

Push the "(UNIT ENTER)" button to save setup data.

You can set up 6 different functions in the setup mode:

setup 1: Clock Setup
setup 2: Setting the alarm limit value (ALARM)
setup 3: Clear data logger memory
setup 4: Analogue bar graph x1 x10 x100
setup 5: Auto Power Off Time
setup 6: Setting the calibration factor (CAL)

Clock Setup

Hold the "$\textcircled{0}$" button and press "$\overset{\cdot\cdot}{\underset{\text{SET}}{\cdot}}$" button to enable the Clock Setup. This meter clock is 24 hour time setting.

After releasing the "$\textcircled{0}$" button, use "$\underset{\text{TIME}}{\text{REC}}$" or "$\underset{\text{AVG}}{\text{MAX}}$" to select the digit you want to adjust.

Use "$\underset{\text{ALAM}}{\text{HOLD}}$" or "$\underset{\text{MEM}}{\text{XYZ}}$" to change digit (Hour.day.Month.year.Minute).

Press "$\underset{\text{ENTER}}{\text{UNIT}}$" button to save the setting.

Date/Time default format : 2009/12/21 12:12.
Year format : 2000 to 2099 display as 00 to 99.

$$1231 \quad 1231 \quad 1221$$
$$08{:}38\text{ set }2013 \quad 09{:}38\text{ set }2013 \quad 09{:}38\text{ set }2013$$

Setting the alarm limit value (ALARM)

The alarm limit value determines the level at which the alarm will sound. The alarm limit value can be edited only in the V/m unit. The ALARM setting range is from 0.001 to 999.9 V/m. **ALARM** default is set at 999.9 V/m. Alarm limit function is only used for total three axial value.

While the meter in ON, hold the "$\textcircled{0}$" button and press the "$\overset{\cdot\cdot}{\underset{\text{SET}}{\cdot}}$" button to enter Setup Mode.

After releasing the "$\textcircled{0}$" button, press the "$\overset{\cdot\cdot}{\underset{\text{SET}}{\cdot}}$" button again to enter the alarm setting mode, "ALARM" will be show in the upper right corner of the display, 1st digit of the readout value will flash and "V/m" is the displayed unit of measure.

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Press the "$\overset{MAX}{AVG}$" key to move decimal.

Press the "$\overset{REC}{TIME}$" key to select the desired digit.

Press the "$\overset{HOLD}{ALAM}$" and the "$\overset{XYZ}{MEM}$" buttons to change digit's value.

Press the "$\overset{UNIT}{ENTER}$" button to save the new value and exit.

Clear Datalogger Memory

While the meter is on, hold the "$\textcircled{O}$" button and press the "$\overset{\cdot\cdot\cdot}{SET}$" button to enter Setup mode.

After releasing the "$\textcircled{O}$" button, press the "$\overset{\cdot\cdot\cdot}{SET}$" button twice more to enter the clear data logger memory mode.

$\overset{no}{\underset{SET}{MEM}\ 088}$ will show on the display.

To exit without clearing memory, press "$\overset{UNIT}{ENTER}$" key.

To clear the memory, press "$\overset{HOLD}{ALAM}$" and "no" will change to "yes". Press the "$\overset{UNIT}{ENTER}$" button to erase the memory and exit.

Analog bar graph setup

While the meter is ON, hold the "$\textcircled{O}$" button and press the "$\overset{\cdot\cdot\cdot}{SET}$" button to enter Setup Mode.

After releasing the "$\textcircled{O}$" button, press the "$\overset{\cdot\cdot\cdot}{SET}$" button 3 more times to: enter the analogue bar graph setting mode. The "graph" unit is flashing.

Current setting of x1, x10, or x100 is displayed
at bottom of graph. X1 is normal setting. X10 is
10 times more sensitive, x100 is 100 times
more sensitive.

Press the "$\binom{\text{HOLD}}{\text{ALAM}}$" to increase the sensitivity or
"$\binom{\text{XYZ}}{\text{MEM}}$" to reduce the sensitivity:
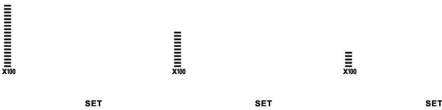
Press the "$\binom{\text{UNIT}}{\text{ENTER}}$" key to save the setting value
and exit.

Auto Power Off Time function setup

While the meter is on, hold the "$\binom{\text{O}}{}$" button and
press the "$\binom{\phi}{\text{SET}}$" button to enter Setup mode.

After releasing the "$\binom{\text{O}}{}$" button, press the "$\binom{\phi}{\text{SET}}$"
button 4 more times to enter the Auto power off set
mode. Press "$\binom{\text{HOLD}}{\text{ALAM}}$" and "$\binom{\text{XYZ}}{\text{MEM}}$" button to change
the value. Auto power off time default setting is 15
minutes. Maximum auto power off time setting is
99 minutes. Set the value to :00 to disable auto
power off.

Press "$\binom{\text{UNIT}}{\text{ENTER}}$" button to store the new setting and
exit. The ☾ symbol is not displayed if auto power
off is disabled.
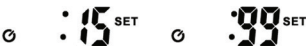
Setting the calibration factor (CAL)

While the meter is ON, hold the "$\textcircled{0}$" button and press the "$\textcircled{\substack{\unicode{x263C} \\ SET}}$" button to enter Setup Mode.

After releasing the "$\textcircled{0}$" button, press the "$\textcircled{\substack{\unicode{x263C} \\ SET}}$" button 5 more times to enter the calibration factor setup mode. "CAL" will show at the center bottom of the display. The CAL setting range is from 0.10 to 9.99. Default is 1.00, which is appropriate for most situations.

Use the "$\textcircled{\substack{REC \\ TIME \blacktriangleleft}}$"or "$\textcircled{\substack{MAX \\ AVG \blacktriangleright}}$" buttons to select the desired digit.

Press the "$\textcircled{\substack{HOLD \\ \blacktriangle ALAM}}$" or "$\textcircled{\substack{XYZ \\ \blacktriangledown MEM}}$" button to change the digit.

Press "$\textcircled{\substack{UNIT \\ ENTER}}$" button to save the new value and exit.

$$1.00 \qquad 0.01 \qquad 9.99$$

CAL   CAL   CAL

Note…

Calibration factor (CAL):
The calibration factor CAL serves to calibrate the display for a specific frequency when the frequency of a single signal is known. The field strength value measured internally is multiplied by the value of CAL that has been entered and the resulting value is displayed. The CAL factor is often used as a means of entering the sensitivity of the field sensor in terms of its frequency response in order to improve measurement accuracy.

Taking measurements

Note…

If the sensor is moved quickly, inaccurate field strength values could be displayed as caused by electrostatic charges. Hold the meter steady during measurement.

Making Short-term measurements

If the characteristics and orientation of the electromagnetic field to be measured are unknown, use either the "instantaneous" or the "Max instantaneous" mode.

Instantaneous: The display shows the last value measured by the sensor. Instantaneous mode is the default setting when the meter is turned on. No symbol is displayed.

Maximum instantaneous (MAX): The digital display shows the highest instantaneous value measured so far. The "MAX" symbol is displayed.

Measurement Procedure:

Hold the meter steadily at arm's length. Take several measurements at various locations within your measurement area.

Pay special attention to measuring in the vicinity of possible radiation sources. Note that components connected to a electromagnetic source may also act as radiators. For example, the cables used in diathermy equipment may also radiate electromagnetic energy and metallic objects within the field may concentrate or amplify the electromagnetic field from a distantly located source.

Long-term exposure measurements

Place the meter between yourself and the suspected source of radiation. Make measurements at those points where parts of your body are nearest to the source of radiation. A maximum level of 614 mV/m is recommended for prolonged exposure.

Use the "Average" or "Max average" modes when the instantaneous measurement modes are fluctuating greatly. Average (AVG): The digital display shows the average value measured, the "AVG" symbol is displayed.

You may fix the meter to a wooden or plastic tripod.

SPECIFICATIONS

General Specifications

Display type	Liquid-crystal (LCD), 4.5" digits max reading 19999
Measurement method	Digital, triaxial measurement
Directional characteristic	Isotropic (triaxial)
Measurement range selection	One continuous range
Display resolution	0.1 mV/m, 0.1 µA/m, 0.001 µW/m², 0.001 µW/cm²
Setting time	Typically 1.5 s (0 to 90% measurement value)
Sample rate	3 times per second
Audible alarm	Buzzer
Units	mV/m, V/m, µA/m, mA/m, µW/m², mW/m², µW/cm²
Display value	Instantaneous measured value, maximum value, average value, or maximum average value
Alarm function	Adj. threshold with ON/OFF
Calibration factor CAL	Adjustable
Manual data memory and read storage	200 data sets
Batteries	9V NEDA 1604, IEC 6F 22 or JIS 006P
Battery life	Approximate 15 hours
Auto power off	Default time 15 minutes (Adj. threshold 0 to 99 min.)
Operating temperature range	0°C to +50°C
Operating humidity range	25% to 75% RH
Storage temperatures range	-10°C to +60°C
Storage humidity range	0% to 80% RH
Dimensions	60(L) X 60(W) X 195(H) mm
Weight (including battery)	Approximate 200 g

EMC

This tester was designed in accordance with EMC Standards in force and its compatibility has been tested in accordance with EN61326-1 (2006).

Electrical specifications

Unless otherwise stated, the following specifications hold under the following conditions:

The meter is located in the far field of a source; the sensor head is pointed towards the source.

Ambient temperature	+23°C ±3°C
Relative air humidity	25% to 75%
Sensor type	electrical field (E)
Frequency range	50 MHz to 3.5 GHz

Specified measurement range:

CW signal (f >50 MHz)	38 mV/m to 11.00 V/m, 53.0 uA/m to 29.28 mA/m, 0.1 uW/m^2 to 323.3 W/m², 0.001 uW/cm^2 to 32.33 uW/cm^2
Dynamic range	Typically 75 dB
Absolute error at 1 V/m and 2.45 GHz	±1.0 dB
Frequency response	
Sensor taking into account the typical CAL factor	±2.4 dB (50 MHz to 1.9 GHz) ±1.0 dB (1.9 GHz to 3.5 GHz)
Isotropy deviation	Typically ±1.0 dB (f 2.45 GHz)
Overload limit	0.42 mW/cm² (11 V/m) per axis
Overload limit	(0 to 50°C): ±0.2 dB

8.3 Units of measurement

The meter measures the electrical component of the field; the default units are those of electrical field strength (mV/m or V/m). The meter converts the measurement values to the other units of measurement, i.e. the corresponding magnetic field strength units (µA/m or mA/m) and power density units (µW/m² , mW/m² or µW/cm²) using the standard far-field formulae for electromagnetic radiation.

Note…

The bar graph display always shows the instantaneous measured dynamic range value. The digital display shows the value according to one of three modes, which can be selected:

Instantaneous: The display shows the last value measured by the sensor. Instantaneous mode is the default setting when the meter is turned on. No symbol is displayed.

Maximum instantaneous (MAX): The digital display shows the highest instantaneous value measured so far, the "MAX "symbol is displayed.

Average (AVG): The digital display shows the average value measured, the "AVG" symbol is displayed.

The following graph shows Instantaneous (actual), MAX (hold), AVG and MAX/AVG:
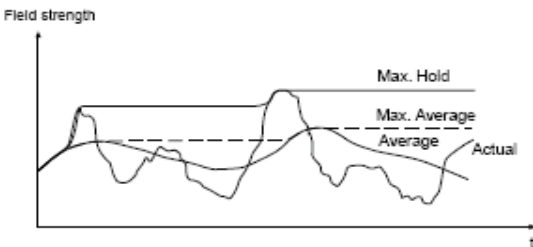
SAFETY INFORMATION

CAUTION

Before making a measurement, check if the low battery symbol "⊟" is shown on the display as soon as the meter is switched on. Change the battery if the symbol is displayed.

In the case of prolonged storage, it is preferable to remove the battery from the meter.

Avoid shaking the meter, particularly in the measurement mode.

The atmospheric condition outside specified limits and improper handling may adversely affect the accuracy and function of the meter.

DANGER

In some cases, work in the vicinity of powerful radiation sources can be a risk to your life.

Be aware that persons with electronic implants (e.g. cardiac pacemakers) are subject to particular dangers in some cases.

Observe the local safety regulations of the facility operation.

Observe the operating instructions for equipment, which is used to generate, conduct, or consume electromagnetic energy.

Be aware that secondary radiators (e.g. reflective objects such as a metallic fence) can cause a local amplification of the field.

Be aware that the field strength in proximity to radiators increases proportionally to the inverse cube of the distance. This means that enormous field strengths can result in the immediate vicinity of small radiation sources (e.g. leak in wave guides, inductive ovens)

Field strength measuring devices can underrate pulsed signals. Particularly with radar signals, significant measurement errors can arise.

All field strength measuring devices have a limited specified frequency range. Fields with spectral components outside of this frequency range are generally incorrectly evaluated and tend to be underrated. Before using field strength measuring devices, you should thus be certain that all field components to be measured lie in the specified frequency range of the measuring device.

BATTERY REPLACEMENT

Turn off the instrument, remove the battery cover, replace the battery, then install the battery cover.

Be sure to turn unit off after use to conserve battery life.

SAFETY PRECAUTION

• For cleaning the instrument use a soft dry cloth. Never use a wet cloth, solvents or water, etc.
• Operation Altitude: Up to 2000M.
• Operating Environment: Indoors use.

This instrument has been designed for being used in an environment of pollution degree 2.

END OF LIFE

Caution: this symbol indicates that equipment and its accessories shall be subject to a separate collection and correct disposal.

WARRANTY

Sper Scientific warrants this product against defects in materials and workmanship for a period of **five (5) years** from the date of purchase, and agrees to repair or replace any defective unit without charge. If your model has since been discontinued, an equivalent Sper Scientific product will be substituted if available. This warranty does not cover probes, batteries, battery leakage, or damage resulting from accident, tampering, misuse, or abuse of the product. Opening the meter to expose its electronics will break the waterproof seal and void the warranty. To obtain warranty service, ship the unit postage prepaid to:

SPER SCIENTIFIC LTD.
8281 E. Evans Rd., Suite #103
Scottsdale, AZ 85260
(480) 948-4448

The defective unit must be accompanied by a description of the problem and your return address. Register your product online at www.sperwarranty.com within 10 days of purchase.

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