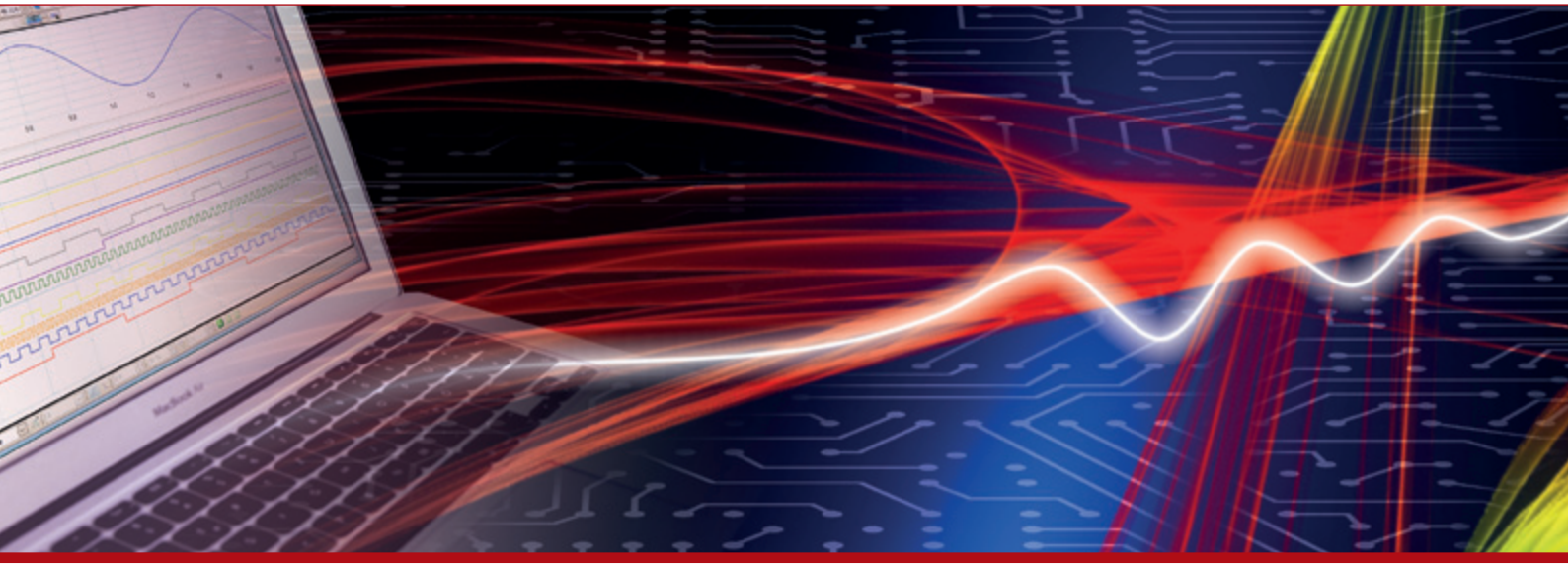
Product Datasheet - Technical Specifications



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Keysight Technologies
V3500A Handheld RF Power Meter

Demonstration Guide

KEYSIGHT TECHNOLOGIES

Contents

Key Features

- Wideband frequency, 10 MHz to 6 GHz for average RF power measurements.
- Large dynamic range of +20 dBm to –63 dBm.
- Both sensor and display housed in the same compact handheld package.
- Built-in LCD display allowing measurement in a single-function unit.
- Universal Serial Bus (USB) control interface.
- Flexibility of drawing operating power from an on-board battery, an optional external power supply, or a computer via the USB interface.
- Internal power reference, enabling self-calibration and eliminating the need for the user to perform an independent calibration before the instrument can be used.
- Ability to compensate for cable losses with the Relative Offset function that can add an offset to the display ranging between –99.99 dB and +99.99 dB.

Keysight's First Handheld RF Power Meter for Average Power Measurement

Conventional power measurements were performed using bench-top power meters with power sensors and USB power sensors. These require external power supply (115 V/230 V) and powered-up USB respectively. When working in the outdoors or in the field, external power supplies or PCs are not available, so power measurement could not be carried out. Today, Keysight Technologies, Inc. introduces its first handheld RF power meter—V3500A, which can be used in both outdoor and field and research-and-development (R&D) laboratory environments. The Keysight V3500A handheld RF power meter is a low-cost solution for measuring average power with a frequency range up to 6 GHz and a dynamic range up to 83 dB (+20 to -63 dBm), which comes with a built-in LCD display.

This guide explains how to measure average power and average pulse power using the V3500A. It also covers the key features of the V3500A that enable you to optimize your measurement speed and accuracy.

Introduction

The Keysight V3500A handheld RF power meter is a compact handheld instrument designed for making RF power measurements in both the field and in R&D laboratory environments. Its built-in power sensor eliminates the need for users to carry both an instrument and a separate sensor module, and the same sensor is used when duplicating tests or measurements for better repeatability. To optimize flexibility, the V3500A is capable of drawing operating power from batteries, an AC-DC converter module, or a computer via the USB interface. The Keysight 3500A handheld RF power meter is suitable for a wide variety of RF measurement applications.

In the laboratory, the V3500A handheld RF power meter can be used as an RF power data logger by transferring data through its built-in USB interface to a computer, allowing for trend or drift analysis. It is ideal for production testing, R&D or design-verification applications.

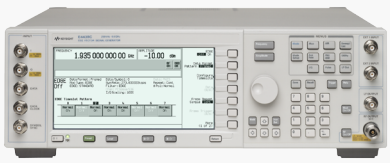
For use in the field, the compact size of the V3500A handheld RF power meter allows it to be placed in a toolkit. Users do not have to carry both an instrument and a separate sensor module (the V3500A has a built-in sensor). The V3500A is ideal for installation and maintenance (I&M) or outdoor field (satellite or base station) applications.

Demonstration Preparation

This demonstration focuses on average power measurement and pulse power measurement.

The following instruments are used in this demonstration guide :

1. E44380 ESG Vector Signal Generator[1]
2. V3500A Handheld Power Meter



E44380 ESG Vector Signal Generator

V3500A Handheld Power Meter

To download and update instrument firmware and software, please visit:

– www.keysight.com/find/V3500A
– www.keysight.com/find/esg
– www.keysight.com/find/mxg

Required Option

- E4438C firmware revision: C.04.98 or later.
- Frequency range option: 503 or 506.
- Baseband generator option: 601 or 602.

Required Option

- Standard option.

Connecting the ESG and V3500A instruction:

Connect the ESG and V3500A as shown in Figure 1.

Figure 1. *ESG signal generator and V3500A handheld power meter setup diagram*

1. *Alternatively, you can use the N5812A MXG vector signal generator to generate the CW or pulse signal.*

Average Power Measurement Demonstration

Objective

To demonstrate the capability of the V3500A handheld power meter for average power measurement.

Note:

Keystrokes surrounded by [ ] represent front-panel keys of the instrument.

Keystrokes surrounded by { } represent softkeys of the instrument.

Instructions	Keystrokes
On the ESG :	
1. Turn on the ESG.	Press [] standby button to "ON" (green LED light displays).
2. Set the instrument to its default setting.	Press [**Preset**].
3. Set the frequency and amplitude.	Press [**Frequency**] **1000 MHz**. Press [**Amplitude**] **0 dBm**.
4. Turn ON the RF Output.	Toggle [**RF On/Off**] to "**ON**".

Instructions	Keystrokes
On the V3500A :	
1. Turn on the V3500A.	Press [] **ON/OFF** button to turn on V3500A.
2. Set the frequency to 1000 MHz.	Press [] **OR** [] to change frequency to **1000 MHz.**
3. Set the average count to 4.	Press [] button to enter menu mode. Press [] or [] until "Averaging mode" menu is displayed. Press [] or [] to increase averaging count to **<4>**. Press [] button to exit.

Average Power Measurement Demonstration (continued)

Instructions	Keystrokes
On the V3500A :	
4. Save the instrument state.	Press [MENU] button to enter menu mode. Press [▲] or [▼] until "SAVE STATE" menu is displayed. Press [◀] or [▶] to select <Save> mode.
Note : Saving the state of the instrument places all menu values in the memory of the unit so that they can be recalled after power cycling. Frequency settings are not saved or recalled. *The "Save State" feature is only functional when the batteries are stored in the instrument.*	
5. Read the measurement.	The measurement, **0.01 dBm** displayed at left-hand corner of the display.
Note : The top line of the display shows the measured power of the signal. The measured power will be updated continuously and displayed accordingly. In the upper right- hand corner of the display, an "at" symbol (@) is displayed whenever a new measurement is completed and the results have been displayed.	

Zeroing the Sensor

The zeroing function is used to zero the V3500A handheld power meter. When [Z] is pressed, the V3500A handheld power meter measures the offset voltages in the signal path and zeroes the power meter. This allows a more accurate measurement at low power levels. The V3500A RF input may be left disconnected when it is zeroed, or it may be connected to other hardware, but make sure that no signals are present on the RF input (inaccurate readings will result). For example, if the V3500A is connected to a signal generator, turn off the signal generator's output before pressing the zero key. When the V3500A is zeroed, the display will show "ZEROING." The entire operation takes approximately 30 seconds.

Average Pulse Power Measurement Demonstration

Pulse power is determined by measuring the average power of the pulse and then dividing the measurement results by the pulse-cycle value to obtain the pulse power reading, as expressed by the following equation:

$$P_p = \frac{P_{avg}}{\text{Duty Cycle}}$$ in linear term. (See Figure 2)

The measurement result is a mathematical representation of the pulse power rather than the actual measurement with the assumption of constant peak power. To ensure accurate pulse power readings, the input signal must be a repetitive rectangular pulse with a constant duty cycle.

There are some advantages to using duty cycle to calculate the pulse power. The duty-cycle technique provides the lowest-cost solution, with average power meters and sensors being less expensive than peak and average power meters and sensors. Average power meters also have the ability to measure over a wide power and frequency range.

In this demonstration, we are supplying a pulsed signal with the pulse width of 20 µs and a pulse period or pulse repetition interval (PRI) of 40 µs. The pulse signal is set to the power level of approximately 0 dBm. (See Figure 3).

Using a V3500A handheld power meter to measure the average power of the signal, the measurement result is –3.04 dBm. We can see from the results that the average power over the full PRI is –3.04 dBm lower than the pulse itself. The measured value is therefore very close to the calculated –3.01 dB difference provided by the duty-cycle method, which was for the 'perfect' pulse shape.

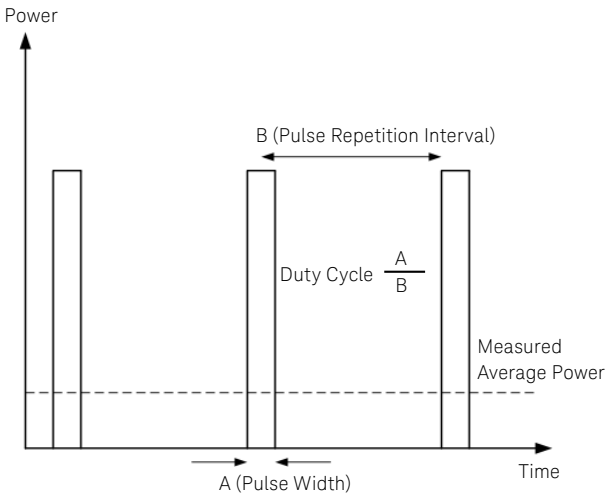


Figure 2. *Pulse power calculation*

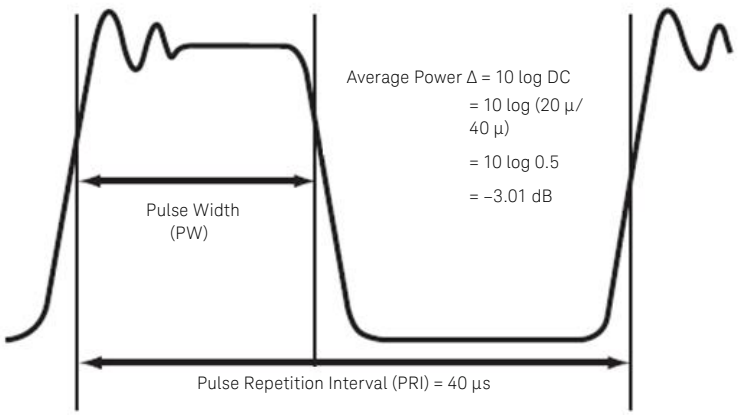


Figure 3. *Measuring pulse power using duty cycle*

Objective

To demonstrate the capability of the V3500A handheld power meter for average pulse power measurement.

Instructions	Keystrokes
On the ESG :	
1. Set the instrument to its default setting.	Press **[Preset]**.
2. Set the frequency and amplitude.	Press **[Frequency] 1000 MHz.** Press **[Amplitude] 0 dBm.**
3. Set the pulse signal.	Press **[Pulse], {Pulse Period} 40 µs** and **{Pulse Width} 20 µs.**
4. Activate the pulse signal.	Toggle **{Pulse On/Off}** to "**ON**".
5. Turn ON the RF Output	Toggle **[RF On/Off]** to "**ON**".

Instructions	Keystrokes
On the V3500A :	
1. Turn on the V3500A.	Press [] **ON/OFF** button to turn on the V3500A.
2. Set the frequency to 1000 MHz.	Press [] **OR** [] to change frequency to **1000 MHz.**
3. Set the average count to 4.	Press [] button to enter menu mode. Press [] or [] until "Averaging mode" menu is displayed. Press [] or [] to increase averaging count to **<4>**. Press [] button to exit.
4. Read the measurement.	Press [] to exit menu. The measurement, **–3.04 dBm** displayed at left hand corner of the display.

Conclusion

The Keysight V3500A RF Handheld power meter provides accurate average power measurement as well as average pulse power measurement, as demonstrated in this document. The V3500A handheld power meter also provides the following features when performing outdoor (satellite or base station) power measurement:

- Both sensor and display housed in a compact handheld package.
- Wideband up to 6 GHz average RF power measurement.
- Easy-to-use interface with LCD display.
- Flexibility of drawing operating power from an on-board battery.

Ordering Information

Product Type	Model Number
Handheld RF Power Meter	V3500A
Power supply	V3500A-PWR
Holster carrying case with shoulder strap	V3500A-SHL
USB interface cable (Standard-A to Type-B), 2.5 meter	V3500A-CA1

Related Keysight Literature

Publication Title	Publication number
Keysight V3500A Handheld RF Power Meter User's Guide	V3500-90001
Keysight V3500A Handheld RF Power Meter, Data Sheet	5990-5483EN

Related Web Resources

For the latest and most complete applications and information, please refer to the following URL:
www.keysight.com/find/V3500A