



SPS USB Power Sensor

Quick Start Guide

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About this document

This document explains how to use the Aeroflex SPS USB Power Sensor, either with an S-Series SGA or SGD Signal Generator, or as a stand-alone measuring device using a PC and the SPS software supplied.

Intended audience

Persons engaged in the design and manufacture of RF and microwave systems.

Familiarity with the terms used in RF and microwave measurements is assumed.

Associated publications

SPS USB Power Sensor Operating Manual (PDF version 47090/178, printed version 47000/178)

SPS-8 CW and Pulse USB Power Sensor data sheet

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Precautions

These terms have specific meanings in this manual:

WARNING information to prevent personal injury.

CAUTION information to prevent damage to the equipment.

Note important general information.

Hazard symbols

The meaning of hazard symbols appearing on the equipment and in the documentation is as follows:

Symbol	Description
	Refer to the operating manual when this symbol is marked on the instrument. Familiarize yourself with the nature of the hazard and the actions that may have to be taken.
	Toxic hazard

WARNING

Suitability for use

This equipment has been designed and manufactured by Aeroflex to make RF power measurements.

If the equipment is not used in a manner specified by Aeroflex, or if it is damaged, the protection provided by the equipment may be impaired.

Aeroflex has no control over the use of this equipment and cannot be held responsible for events arising from its use other than for its intended purpose.

General conditions of use

Equipment should be protected from the ingress of liquids and precipitation such as rain, snow, etc. When moving the equipment from a cold to a hot environment, it is important to allow the temperature of the equipment to stabilize before it is connected to the supply to avoid condensation forming. The equipment must only be operated within the environmental conditions specified in the data sheet, otherwise the protection provided by the equipment may be impaired.

This product is not approved for use in hazardous atmospheres or medical applications or safety-critical applications.

WARNING

Electrical hazards (DC supply voltage)

This equipment conforms with IEC safety Class III, meaning that for continued safety it must only be connected to supplies and signal sources which conform to 'Separated Extra-Low Voltage' (SELV and SELV-E) voltage and insulation requirements. No hazardous voltages are generated internally. See the data sheet for the maximum permitted voltage levels that can be applied.

WARNING

Toxic hazards

Some of the components used in this equipment may include resins and other materials which give off toxic fumes if incinerated. Take appropriate precautions, therefore, in the disposal of these items.

WARNING



Beryllium copper

It is possible that some mechanical components within this instrument may be manufactured from beryllium copper. This is an alloy with a beryllium content of approximately 5%. It represents no risk in normal use.

The material should not be machined, welded or subjected to any process where heat is involved.

It must be disposed of as "special waste".

It must NOT be disposed of by incineration.

CAUTION



Static-sensitive components

This equipment contains static-sensitive components which may be damaged by handling.

Introduction

This document provides information to install and quickly start using your Aeroflex SPS USB Power Sensor. The SPS USB Power Sensor makes Avg, Pk, and Pulse measurements in a 10 MHz video bandwidth. It has a VSWR or 1.09:1 and a dynamic range of -60 to +20 dBm.

You can use the power sensor:

a) with an Aeroflex SGA or SGD Signal Generator (software is pre-installed on the S-Series instrument)

or

b) with a compatible computer with available USB 2.0 port; and the software media supplied.

For details on how to use the SPS USB Power Sensor with an SGA or SGD instrument, see [Using the SPS USB Power Sensor with an Aeroflex S-Series Instrument](#).

For details on how to use the power sensor with a PC, see [Using the SPS USB Power Sensor with a compatible computer](#).

Using the SPS USB Power Sensor with an Aeroflex S-Series instrument

Introduction

The Aeroflex SPS USB Power Sensor is a compact self-contained device that connects directly to an Aeroflex S-Series instrument using the instrument's USB port and a standard USB cable. The SPS Power Sensor covers the frequency range from 10 MHz to 8 GHz and RF levels from -60 to $+20$ dBm. For full details of the power sensor's performance, refer to its data sheet at aeroflex.com.

Software pre-installed on the standard S-Series instrument provides a measurement window that turns the instrument and power sensor into a power measurement system. The power sensor converts RF and microwave power into digital data at the point of measurement. No other connections are needed as the sensor is powered via the USB cable.

S-Series instruments currently support average power measurements when used with the SPS USB Power Sensor. A full suite of measurement options, including pulse power measurements, is available when using the PC-based soft front panel provided on the USB flash drive supplied with the power sensor (see [Using the SPS USB Power Sensor with a compatible computer](#)).

No Zero, No Cal™

A key feature of the SPS is that it does not require any zeroing or reference calibrations to compensate for temperature changes. The power sensor contains cal. data of level vs. frequency vs. temperature. As the sensed temperature changes, the cal. factor automatically adjusts.

SPS documentation

This section gives a brief explanation of the features available and how to use the power sensor with an S-Series instrument. Refer to the [SPS USB Power Sensor Operating Manual](#) supplied with the power sensor for full details of the product's capabilities.

Warm-up time

Little, if any, warm-up time is required for measurements above -40.0 dBm. However, to make accurate measurements below -40 dBm, allow the power sensor to stabilize thermally for one hour.

Installation

Ensure that the power level at the signal source does not exceed the maximum allowable input level of the power sensor, which is $+20$ dBm (100 mW).

Assuming the power level is less than $+20$ dBm, you can connect the power sensor directly to the signal source without fear of damage. If the signal source produces power levels greater than $+20$ dBm, you must add an attenuator pad between the power sensor and the signal source. You may find it useful to enter offset or response correction (using the S-Series instrument's RF level offset facility) if you add an attenuator.

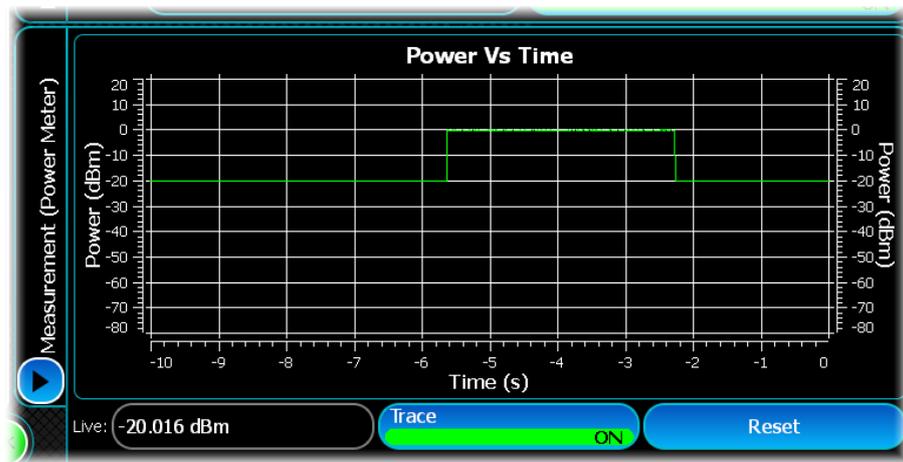
- You can plug the power sensor into a powered or unpowered S-Series instrument. If the instrument is powered up, you need to restart it so that it recognizes the power sensor and displays the power sensor menu.
- Plug the 2-meter high speed USB cable supplied with the power sensor into the back of the sensor (USB-B connector). Plug the other end into a USB port on the front or rear panel of the S-Series instrument. Switch the instrument on or restart it. The green LED on the power sensor lights to show that it is active.
- Connect the N-type connector on the power sensor to the port at which you want to measure the power.

Menu tab

The menu tab now displays a Power Meter button, showing that the instrument has recognized the power sensor.



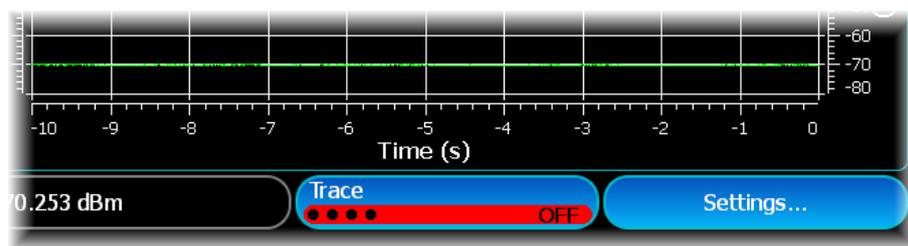
- Touch the Power Meter button to display the power meter's Measurement window.



This displays the power recorded by the power sensor in real time.

Trace settings

- Turn the trace off and touch the Settings... button...



...to see the Trace Settings window:



Unit

Use this to set the measurement units.

Frequency

Use this to set the power sensor's calibration frequency to that of the frequency being measured. The power sensor is calibrated at specific frequencies over its operating range, which corrects for amplitude flatness and temperature variation. It is important therefore to set the frequency at which the power sensor makes its measurements, as not doing so can be a significant source of error.

Averages

Use this to select an averaging factor from 1 to 30000 measurements. The number of averages depends on signal stability and power level. More averaging may be required for low-level signals. Increasing the number of averages also increases the measurement time. Each measurement takes about 250 ms.

Capture Length

Use this to set the length of time over which measurement results are displayed. The capture length is a rotating buffer that retains only the measurements within the window defined by the capture length; measurements outside this window are discarded. The range is from 10 s to 86.4 ks (that is, 24 h).

Period

Use this to set the time intervals at which a reading is taken. Shorter Period settings may affect the general speed of response of the instrument as more processing power is allocated to power meter measurements.

Using the SPS USB Power Sensor with a compatible computer

The remainder of this document explains how to use the SPS USB Power Sensor with a PC, using the software supplied with the sensor. You need the sensor with USB cable; a compatible computer with available USB 2.0 port; and the software media. More detailed information is available in the [SPS USB Power Sensor Operating Manual](#) contained on the media supplied with your unit.

Installing the software and the sensor

Operating system and computer requirements

The SPS USB Power Sensor is compatible with Windows 2000 (SP2 or greater), Windows XP and Windows 7 operating systems with software version 4.5 or higher. Support is available for various test development environments including MS Visual Basic 6.0; MS Visual Basic .NET; MS C# .NET; NI LabVIEW; NI LabWindows; and Agilent VEE.

Recommended minimum PC configuration:

- Pentium D
- 1 G RAM
- 1.0 GHz processor
- CD drive
- USB 2.0 port*

** The USB port or hub must be able to supply 500 mA at 5 V for each power sensor operation. Refer to the 'USB Considerations' section of the [SPS USB Power Sensor Operating Manual](#) to determine if your computer has a USB 2.0 port(s).*

Installing the software

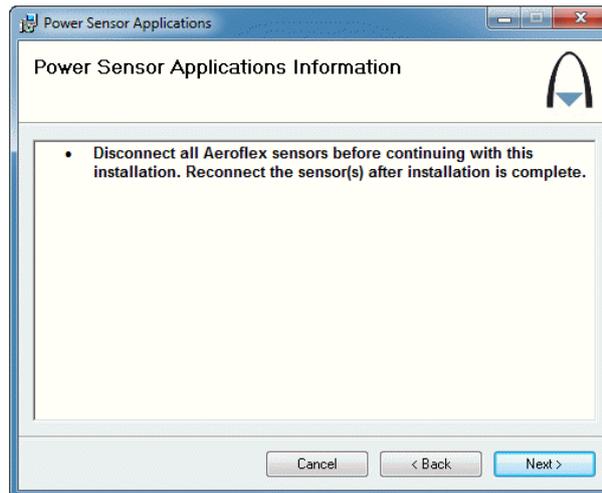
- Insert the Aeroflex SPS USB flash memory drive into your computer.
- Double-click on *Setup.exe*.

The following Welcome window appears:



- Click **Next>** to continue.

The next window asks you to disconnect any sensors that may currently be connected:



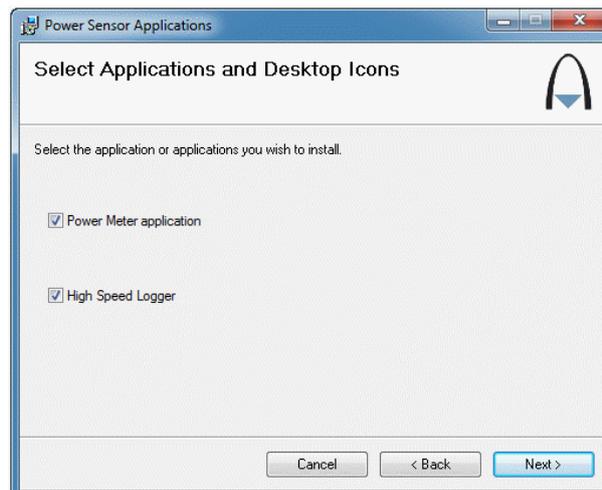
- Click **Next>** to continue.

The next window presents the license agreement. To proceed with the installation, you must accept the agreement.



- Click **Next>** to continue.

The next window asks you to choose which applications to install. By default, both boxes are checked.



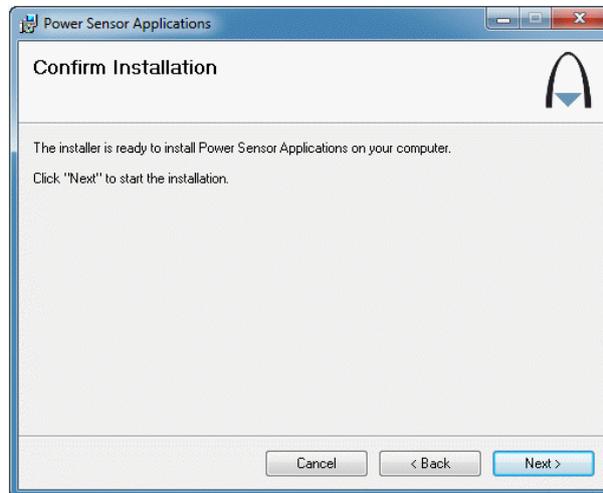
- Click **Next>** to continue.

The next window lets you choose where to install the software (the default location is *C:\Program Files*).



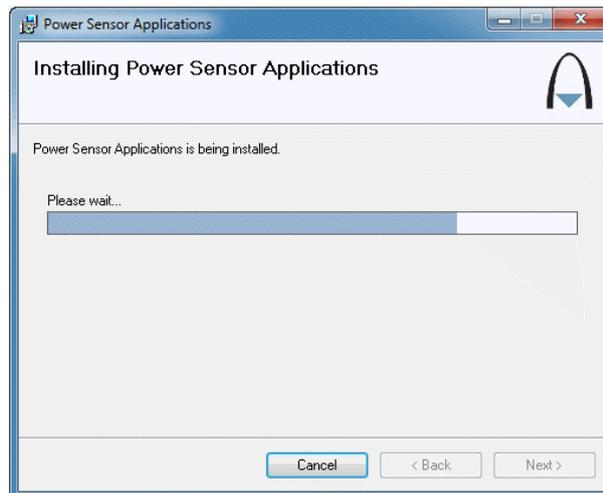
- Click **Next>** to continue.

You are now ready to install the power sensor application.



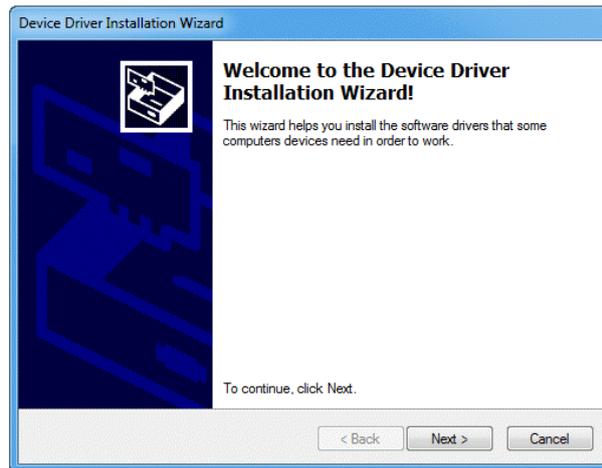
- Click **Next>** to start the installation.

The installation begins.



If the hardware drivers for the SPS power meter have not been installed already, the installation of the power sensor application is paused to allow this to happen.

- If the following window appears, click **Next** to continue with the hardware installation.

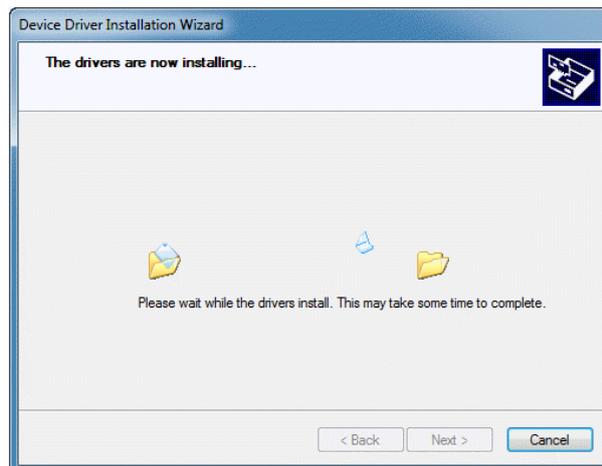


The computer requests you to confirm the security of the software:

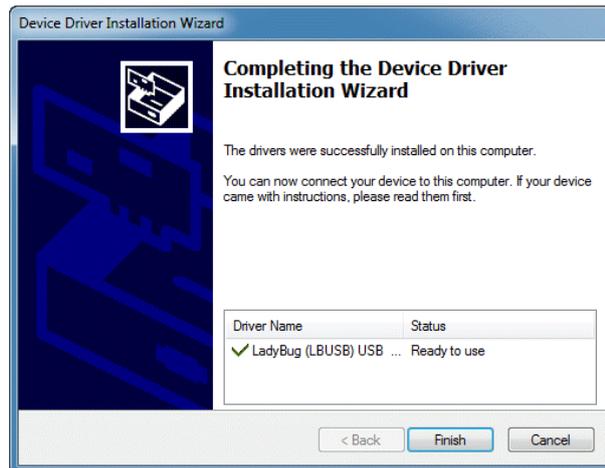
- Check the 'Always trust software...' box and click **Install**.



The drivers install...

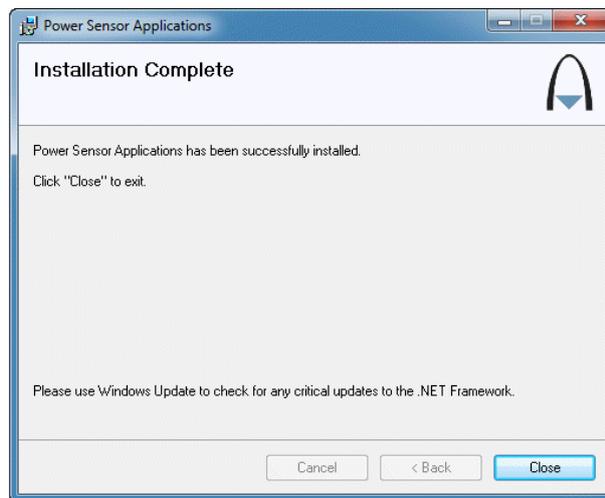


...and complete their installation:



- Click **Finish** to continue.

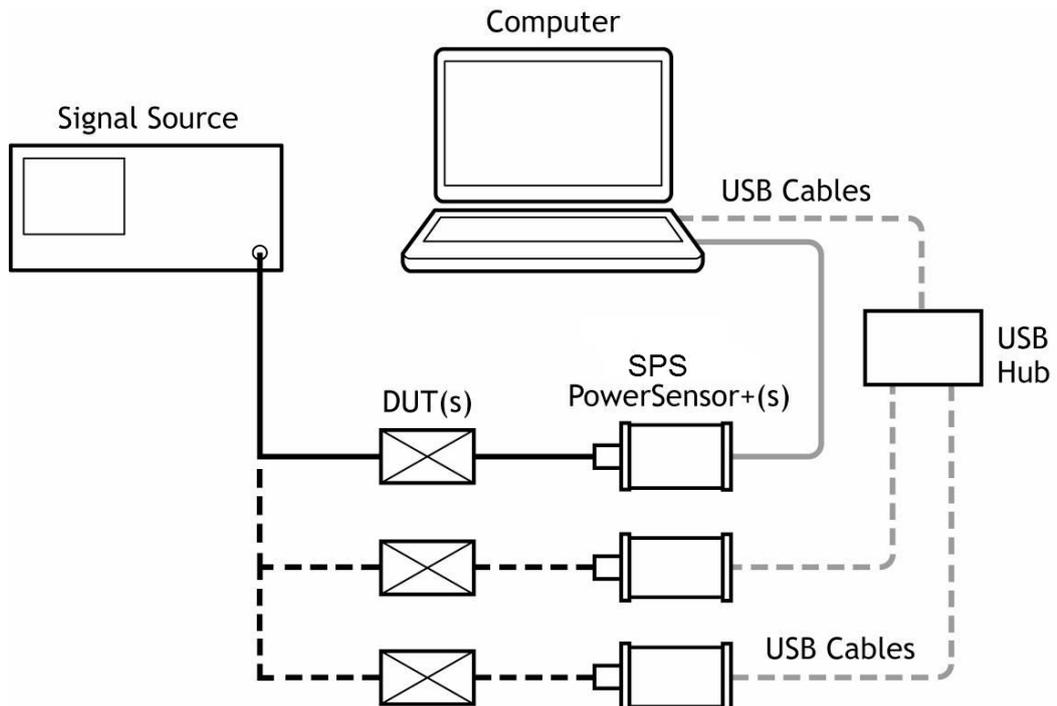
The installation of the power sensor application completes:



- Click **Close** to exit. The power sensor application is installed.

Connecting the sensor

Connect the sensor to the computer using the USB cable. You may connect directly to the computer or through a hub. The green LED on the sensor illuminates. The USB port or hub must be able to supply 500 mA at 5 VDC for each meter-sensor operation. The diagram below shows various options for connecting the sensor(s) to the computer.



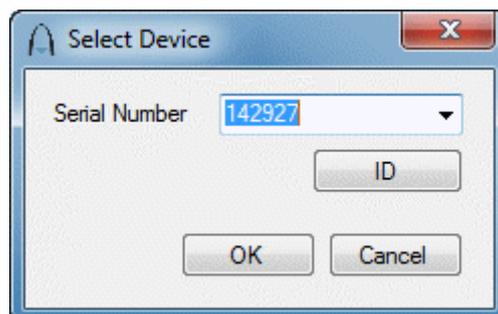
Start the application

- Double-click the Aeroflex power meter shortcut icon on the computer desktop to start the application:

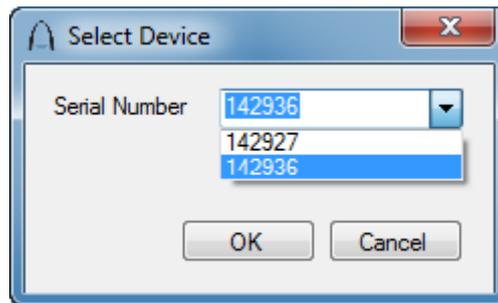


When you have multiple sensors connected, the Select Device window appears as shown below, to identify the sensor(s) connected by serial number.

The six-digit serial number of a unit is located under the USB port on the sensor.

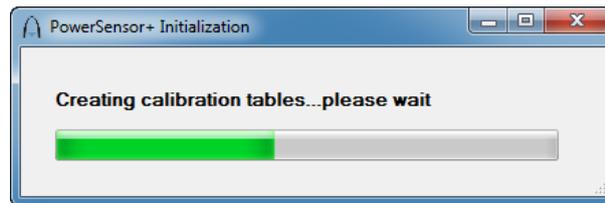


- Select the down arrow and highlight the sensor serial number of the intended unit.

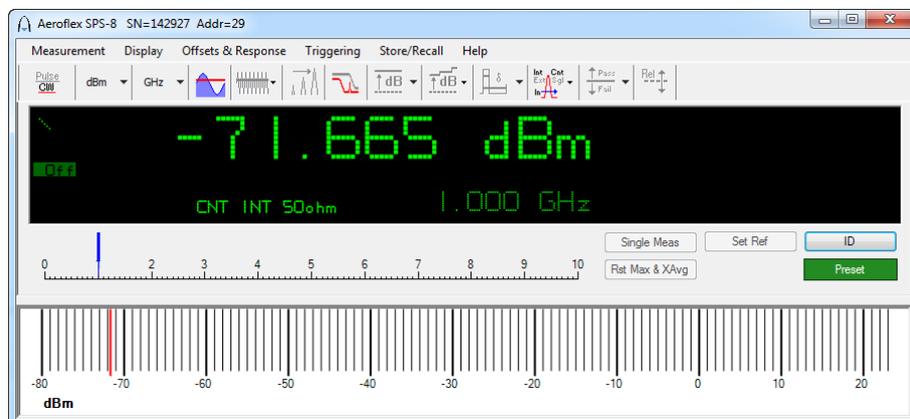


- To positively identify the sensor you have chosen, click the **ID** button on the panel to blink the LED on the selected sensor. Click **OK** to continue.

The calibration window below appears briefly after the device is selected...



...and then the default measurement interface opens:



Basic operating instructions

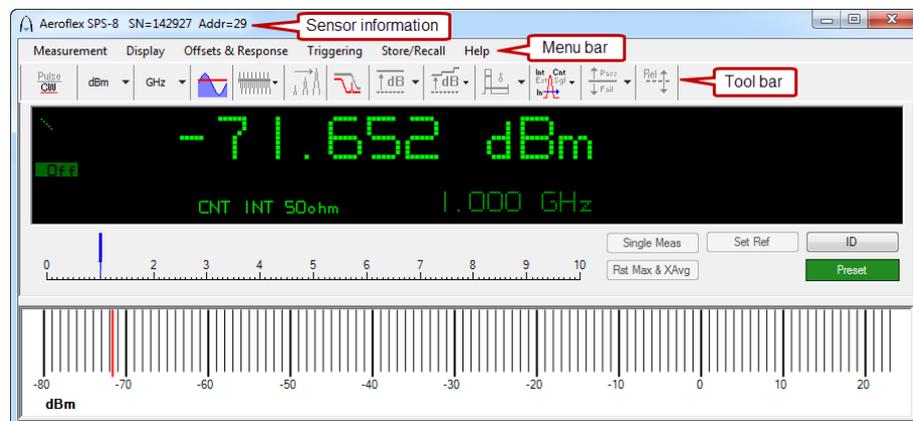
Operating precautions

Observe the warnings about maximum input power. Ensure that the RF input connector on the sensor is clean and undamaged as well as the mating connector. The following procedures assume the software and hardware have been installed according to the installation process outlined in the preceding section of this document.

Program startup

- Start the software if it is not currently running by clicking on the desktop icon  or launch it from its program location (select *Start > All Programs > Aeroflex > Power Meter > Power Meter Application*).
- Select the sensor(s) by serial number as shown [above](#) if more than one sensor is connected to the computer.

The GUI (Graphical User Interface) opens by default in the average power or CW mode of operation for all models; frequency is set to 1 GHz; averaging is set to 75 measurements; measurement update rate is medium; offsets and frequency response are disabled. These parameters are accessible from the Measurement menu. The **Preset** button returns the interface to the default state.



A separate GUI with unit model, serial number and address appear for each active device when you open a new instance of the Power Meter Application. The GUI allows identification of the individual sensor(s) by blinking the LED on the sensor body.

- Clicking the **ID** button shown above causes the LED on the bar the sensor to blink four times in quick succession. The ID and Preset functions are duplicated on the Measurement menu.

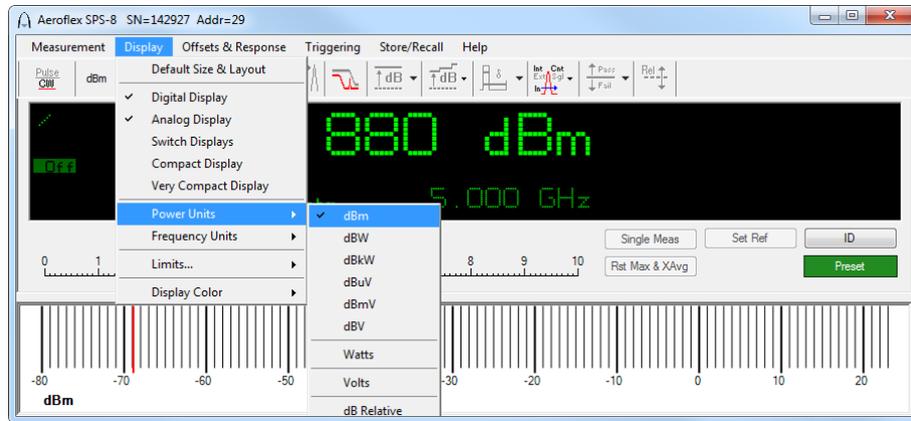
Zeroing and reference power calibration

The design of the SPS USB Power Sensor does not require zeroing or power calibration and there is no provision for zeroing or calibration. However, for the purpose of software compatibility, the programmatic interface has 'null' function calls for zeroing and calibration.

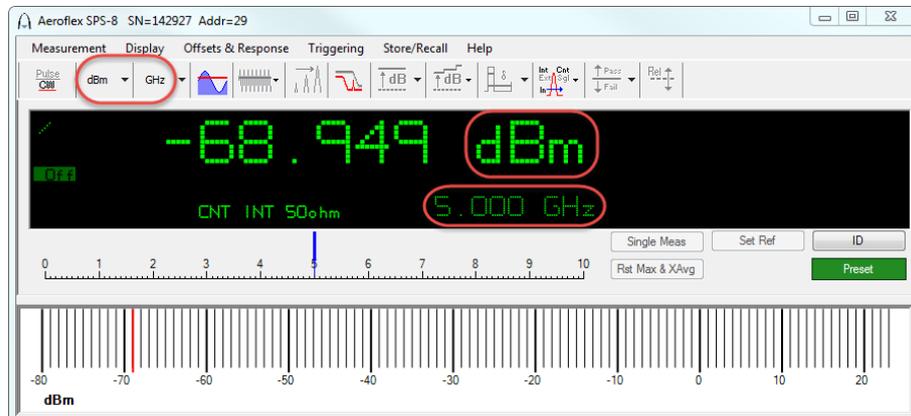
Setting the units of measurement and center frequency

Select the display preferences and measurement units (power and frequency) from the Display menu as shown below. There are selections for digital or analog presentations of frequency and power; an analog frequency scale; and an analog power scale. You can also switch between displays and size the display from compact to very compact.

Refer to the 'GUI Functions' section of the [SPS USB Power Sensor Operating Manual](#) for more information about menu items and toolbar functions.

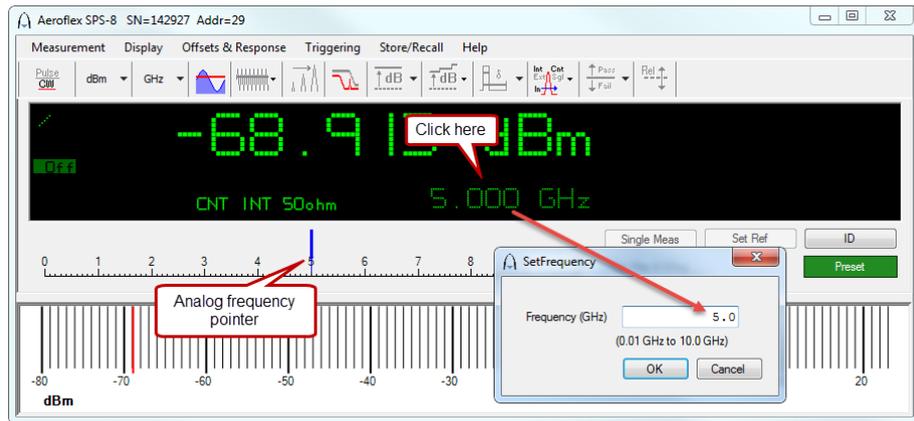


The power and frequency units are also selectable from the toolbar (as shown circled below). Or you can change the power units by clicking on the units label to the right of the power reading itself.



Basic operating instructions

You can change the center frequency by clicking anywhere on the frequency reading in the active display.



Note: you **must** update the center frequency whenever the incoming signal frequency changes. This frequency setting is used to correct for amplitude flatness and temperature variation. Measurement accuracy requires the frequency to be set and not doing so can be a significant source of error.

The frequency can also be set by sliding the blue analog frequency scale pointer. The pointer changes color from blue to red when the center frequency is beyond the measurement range of the sensor. The pointer is less accurate but is more convenient than entering a frequency value.

You can also set the frequency by selecting Measurement > Set Frequency... from the menu bar.

Measurement resolution

The amplitude resolution is fixed to a thousandth of a measurement unit. Frequency is selectable in MHz or GHz ranges.

Making an average power (CW) measurement

Complete the following steps to make a typical CW measurement (all models).

- Using a signal generator or other appropriate source, provide a signal source with the following parameters:

CW frequency: 1 GHz

Power level: 0 dBm (1 mW)

Modulation: OFF

RF power: OFF

CAUTION: DO NOT EXCEED +20 dBm or 100 mW. Refer to the specifications in the data sheet for maximum allowable limits by model number.

- Set up the GUI to receive the RF source input as shown below, including the power and frequency units. All parameters shown can be disabled for this example except for Triggering (option 003), which can be set to continuous and internal mode:
 - Select: Measurement > CW Power (or activate the CW button on the toolbar)
 - Select: Measurement > Set Frequency
 - Enter: 1 GHz
 - Select: (Optional) Triggering > Continuous > Internal



- Connect the sensor to the RF source and turn the RF power on. The GUI display should now indicate approximately 0 dBm at 1 GHz.
- Vary the source power to see if the GUI display tracks the source power.

Making a pulse power measurement

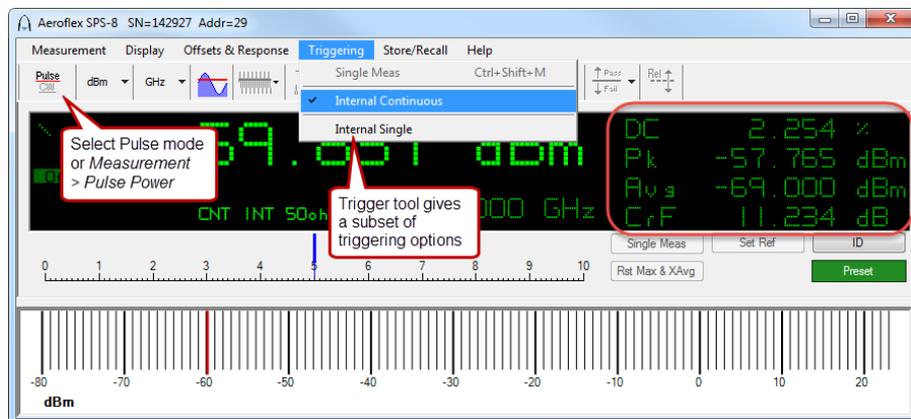
Complete the following steps to make a typical pulse power measurement.

- Using a signal generator or other appropriate source, set the RF source for a pulse modulated output as indicated below:

Power level: 0 dBm (1 mW)
 CW frequency: 1 GHz
 PRF 10 kHz (or a PRI of 0.1 ms)
 Pulse modulation: 50% duty cycle (or a pulse width of 50 μ s)
 RF power: OFF

CAUTION: DO NOT EXCEED +20 dBm or 100 mW. Refer to the specifications in the data sheet for maximum allowable limits.

- Set up the GUI to receive the RF source input as shown below, including the power and frequency units. All parameters shown can be disabled for this example except for Triggering (option 003), which should be set to continuous and internal mode.
 - Select: Measurement > Pulse Power (or click the **Pulse** button on the toolbar)
 - Select: Measurement > Set Frequency
 - Enter: 1 GHz
 - Select: (Optional) Triggering > Internal > Continuous



The active display above indicates input Duty Cycle (DC); Peak power (Pk); Average power (Avg); and Crest Factor (CrF) when in the Pulse Power mode. The larger reading indicates the pulse power.

- Connect the sensor to the RF source and turn the RF power on.

The GUI display should now indicate the source power at 1 GHz: ~0 dBm pulse power; ~50% DC; ~0 dBm peak; ~-3 dBm average; and ~3 dB CrF (Crest Factor is the ratio between peak and average power or PAR).

- Vary the source power and duty cycle to see if the GUI display tracks the source.

Note: the default pulse measurement setup is the automatic or 3 dB points below peak power. This “dB below peak” value can be changed by deselecting automatic and entering a different value if the specific pulse characteristics are known. Refer to the ‘Pulse measurement criteria’ and ‘Pulse peak criteria’ sections of the [SPS USB Power Sensor Operating Manual](#) under ‘Detailed operating instructions’ for further information.

Related information

SPS USB Power Sensor measurements are real-time presentations of power. They are not a type of calculated measurement made by most CW sensors. You will notice a corresponding change in the duty cycle reported in the GUI if you change the duty cycle of your source. You will notice a change in the pulse power (the large display), peak power, and average power if you change the power level but the duty cycle remains unchanged.

The SPS USB Power Sensor can measure 350 nsec pulses at -55 dBm (and lower) with a PRF of 1 kHz (or lower). Such measurements may require averaging to be set between 5000 and 10000.

This document is intended to touch on the basics of instrument operation. Refer to the [SPS USB Power Sensor Operating Manual](#) for more detailed information about the user interface:

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