6 GHz True RMS Power Meter with Bus-Powered USB Connectivity

NI USB-5680 *NEW!*

- True RMS power measurements
- Diode power meter
- -40 to +23 dBm power range
- 50 MHz to 6 GHz frequency range
- 10 and 100 Hz typical channel bandwidth
- ±0.13 dB accuracy at <+18 dBm
- ±0.18 dB accuracy at ≥+18 dBm
- Internal zeroing capability
- <3 percent sensor linearity
- Standing wave ratio <1.2 to 6 GHz
- 100 mA typical power consumption
- USB bus connectivity
- N-type connector

Operating System
- Windows Vista/XP/2000

Recommended Software
- LabVIEW
- LabWindows™/CVI

Driver Software (included)
- NI-568x

Calibration
- Gain and offset self-calibration
- 1-year external calibration cycle

>> For complete specifications, visit **ni.com/manuals** and search for *USB-5680 Specifications*.

Overview

The National Instruments USB-5680 is a 6 GHz true RMS (root-mean-square) power meter that features high measurement accuracy and wide dynamic range. As a true RMS power meter, the NI USB-5680 is ideal for measuring the power of continuous wave (CW) signals. In addition, it offers better than ±0.18 dB of linearity across all frequency ranges and all power levels. This functionality, combined with a flexible API, makes it ideal for measuring path loss in automated test applications. In addition, its small size (less than 9.6 cubic in.) frees up valuable rack space without sacrificing performance. One of the biggest benefits of the USB-5680 is its USB connectivity. Powered solely from the USB cable, it consumes only 100 mA of current. Thus, you can use this power meter in both production test and field applications with a laptop. Moreover, USB connectivity helps you easily integrate the power meter with PC and PXI systems in an automated test environment.

Architecture

The USB-5680 RF power meter features a dual-path architecture to achieve 63 dB of dynamic range. This architecture improves power measurement accuracy by ensuring that the diode sensors are used in their most linear region. A block diagram of the USB-5680 architecture is shown in Figure 1.

As Figure 1 shows, the first measurement range is from -5 to +23 dBm and the second is from -40 to -5 dBm. This accounts for a combined dynamic range of -40 to +23 dBm with a single power head.

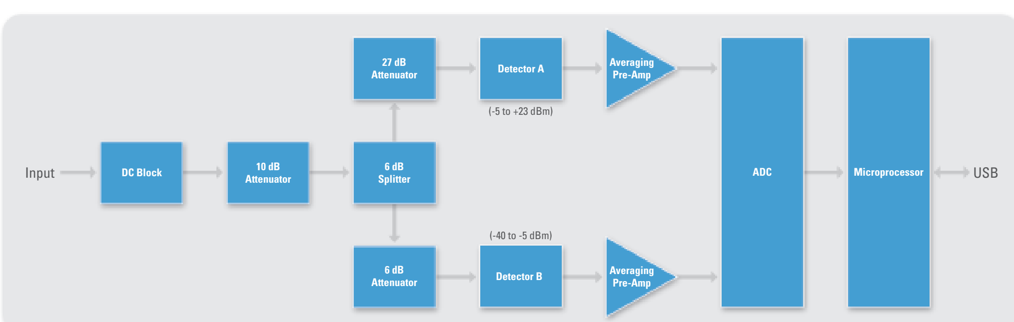

Figure 1. Block Diagram of the NI USB-5680

Flexible Software

You can operate the USB-5680 as a benchtop instrument or as an automated measurement device. For benchtop use, the soft front panel (see Figure 2) helps you configure multiple instrument settings on the fly. This program runs in Windows Vista, Windows XP, and Windows 2000 operating systems.

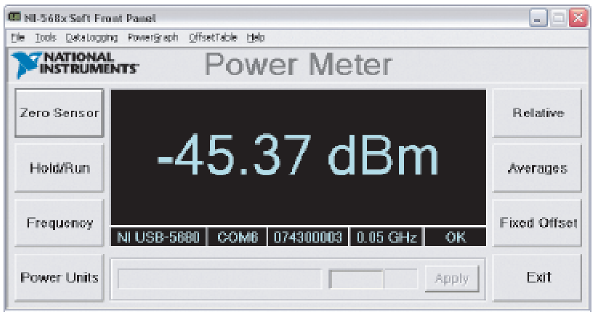

Figure 2. Soft Front Panel Screenshot

As Figure 2 illustrates, the soft front panel not only returns power measurements but also helps you configure settings such as autozero, number of averages, and predetermined power offsets.

In addition, you can fully program the USB-5680 with the NI-568x driver in languages such as LabVIEW, LabWindows/CVI, C, C++, and .NET. Using the NI-568x driver, you can fully control the instrument and integrate it into existing automated test applications. A screenshot of the API is shown in Figure 3.

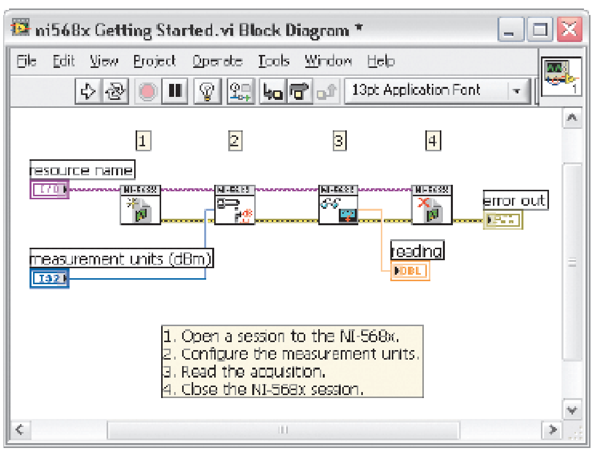

Figure 3. NI-568x Driver API Screenshot

Absolute Accuracy

Power meter linearity is one of the most important characteristics of a power meter because it greatly influences absolute accuracy. In addition, linearity is dependent on the power level of the signal you are measuring. As Table 1 illustrates, you can use the power meter in its most linear region when power levels are less than 18 dBm. Thus, the sensor is able to provide more accurate measurements at this power level. Linearity across all power levels is illustrated in Table 1.

Power level <18 dBm	±0.13 dB
Power level ≥18 dBm	±0.18 dB

Table 1. Sensor Linearity According to Power Level

Note that sensor linearity is only one of many factors that contribute to the absolute accuracy of an RF power measurement. Because impedance mismatch (standing wave ratio, or SWR) and noise can also add uncertainty, it is important to consider all of these characteristics when determining overall measurement uncertainty. National Instruments recommends downloading the Power Uncertainty Calculator on the USB-5680 product page at **ni.com** to determine your absolute measurement accuracy.

With the uncertainty calculator, you can enter signal characteristics such as power, frequency, and signal type. You also can enter measurement characteristics such as number of averages and aperture mode. In addition to providing the absolute accuracy, the uncertainty calculator highlights individual sources of error. As Figure 5 shows, you can attribute an absolute accuracy of 4.45 percent to a wide range of factors, the most significant of which include sensor nonlinearity and mismatch uncertainty.

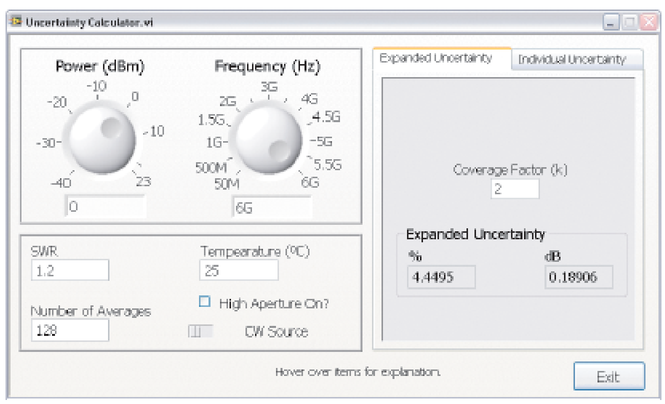

Figure 4. USB-5680 Uncertainty Calculator Screenshot

Note that the USB-5680 uses an internal auto-zero calibration routine to reduce errors associated with zero offsets. To do this, an internal source is used to calibrate the power meter, and external connectivity is not required.

Figure 5. Expanded Sources of Error from the USB-5680 Uncertainty Calculator

Averaging and Noise Level

Because noise can have a significant effect on the accuracy of RMS power measurements, settings such as aperture time and averaging are often employed to mitigate the effects of noise on measurement accuracy.

To improve flexibility, the USB-5680 features two aperture time settings to offer both high-speed and high-accuracy options. In "Low-Aperture" mode, the power meter features 15 measurements per second and in "High-Aperture" mode, the USB-5680 features 1 measurement per second. With these two options, you can choose the aperture mode and, number of averages to obtain the desired noise level of measurement. Table 2 shows the number of averages required in both aperture modes to achieve less than ±0.10 and ±0.01 dB noise levels.

High-Aperture Mode

Input Power (dBm)	Input Power (mW)	Number of Averages Needed for <±0.10 dB Noise	Number of Averages Needed for <±0.10 dB Noise
>0	>1.00	1	1
-5	0.32	1	5
-10	0.100	1	1
-15	0.032	1	1
-20	0.0100	1	1
-25	0.0032	1	4
-30	0.00100	1	38
-35	0.00032	4	—
-40	0.000100	39	—

Table 2. Number of Averages, High-Aperture Time Mode

Low-Aperture Mode

Input Power (dBm)	Input Power (mW)	Number of Averages Needed for <±0.10 dB Noise	Number of Averages Needed for <±0.10 dB Noise
>10	>10.0	1	1
5	3.2	1	2
0	1.0	1	16
-5	0.32	1	78
-10	0.10	1	1
-15	0.032	1	1
-20	0.010	1	7
-25	0.0032	1	61
-30	0.0010	7	—
-35	0.00032	62	—
-40	0.000100	—	—

Table 3. Number of Averages, Low-Aperture Time Mode

Ordering Information

NI USB-5680 780167-01

Includes NI-568x driver featuring soft front panel and API for LabVIEW, LabWindows/CVI, C, C++, and .NET.

BUY NOW!

For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to **ni.com/rf**.

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