# Keysight Technologies
# USB Power Sensors
# Single/Multi-Channel Power Measurement

Application Note

– Simple Setup

– Affordable

KEYSIGHT TECHNOLOGIES

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# Situation Analysis

In many of today's power measurement applications there is a need to make multiple power measurements simultaneously. Added complexities occur when the measurements need to be obtained from places where access is inconvenient, or when the distance to the measurement location exceeds the IEEE industry-specified USB cable length of 5 meters (16 feet).

For instance, a base station commonly includes a compact equipment shelter or outdoor enclosure panels along with antennas that may be mounted on a roof, the wall of a building, or on a free-standing mast. A given base station may operate several channels (typically two or three), where each channel uses a specific set of frequencies: one for the uplink and one for the downlink. Depending on the communication technique, each channel can simultaneously process communications from one or several active handsets.

These sites require routine maintenance and present several challenges. The distance between the antenna and control room may necessitate that measurements be obtained over distances beyond 5 meters and sometimes as far as 50 meters. Measurements may be required from different power sensors and at hourly, daily or monthly intervals.

Traditional power-measurement methodologies require you to connect a power sensor to a power meter. As a result, the setup for multi-channel power measurement demands plenty of rack space to accommodate both the power meter and the power sensors. This situation increases the costs of a test system significantly.

# USB Power Sensor Solution

To address such challenges, using a Keysight Technologies, Inc. USB power sensor is an ideal power measurement solution for measuring the transmitter/receiver power of outdoor base stations for system characterization (Figure 1). Its small form factor is convenient for site technicians that need to climb the antenna for installation and maintenance. In situations where the USB cable length must exceed 5 meters, USB extenders allow the USB protocol to be transmitted via LAN cable for single channel power measurement (Figure 2).

Figure 1. Keysight USB power sensors

A USB extender consists of a transmitter and a receiver that are interconnected by the LAN cable. This allows data to be transferred at distances up to 100 meters These USB extenders are plug-and-play and work efficiently with all major operating systems.

For long-distance applications where multiple power (multi-channel) measurements must be made simultaneously, multiple USB power sensors can be connected to a USB hub installed at the base station and networked to the control room (Figure 3.)

The Keysight U2000 Series USB power sensor is a combination of a power meter and a power sensor that converts RF and microwave power directly into digital data, and allows this data to be analyzed using a Windows-based software application – Keysight N1918A Power Analysis Manager. The power-measurement readings are retrieved using standard SCPI commands or VIV-COM/IVI-C drivers. The SCPI-based command set provides a user-friendly programming environment and allows the use of the same method of communication for both the power sensor and the power meter. Keysight offers three families of USB power sensors:

- U2000A Series USB average power sensors
- U2020 X-Series USB peak and average power sensors
- U8480 Series USB thermocouple power sensors

This demo guide shows the setup for the multi-channel power measurement using the Keysight USB power sensors and a networked USB hub. It also describes the methodology for lengthening the USB power sensor connection via a USB extender (without requiring an external power source) for single-channel power measurement.

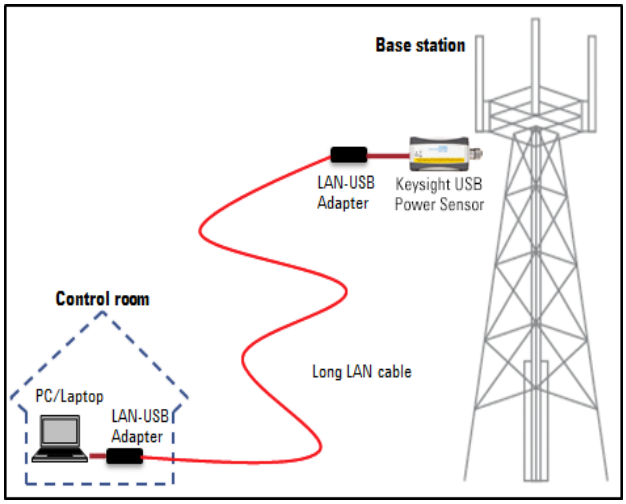


Figure 2. Single channel power measurement of USB power sensor using LAN-USB extender to extend the measurement distance for base station antenna application

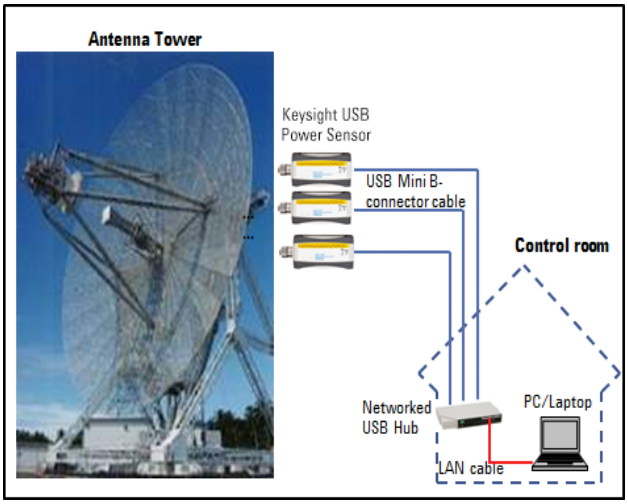


Figure 3. Multi-channel measurements via networked USB hub for antenna measurement simultaneously

# Keysight N1918A Power Analysis Manager

Keysight N1918A Power Analysis Manager is Windows-based application software that allows you to perform power analysis. This application interfaces with various front-end hardware devices to obtain time records and perform pulse analysis.

N1918A is available in two versions. The basic version, the Keysight Power Panel, offers a standard graphical user interface (GUI) for basic power measurement as well as multi-channel power measurement. The advanced version, the Keysight Power Analyzer, is available as an additional software license that allows you to perform advanced pulse analysis, multi-channel power measurements, and statistical analysis as well as measurement-reading recording.

This demo guide describes power measurements using the basic version, Power Panel. You must install the Power Panel before performing the power measurements.

For more information on power measurements using Keysight N1918A, refer to Keysight N1918A Power Analysis Manager Technical Overview. For installation procedures, refer to Keysight N1918A Power Analysis Manager Installation Guide.

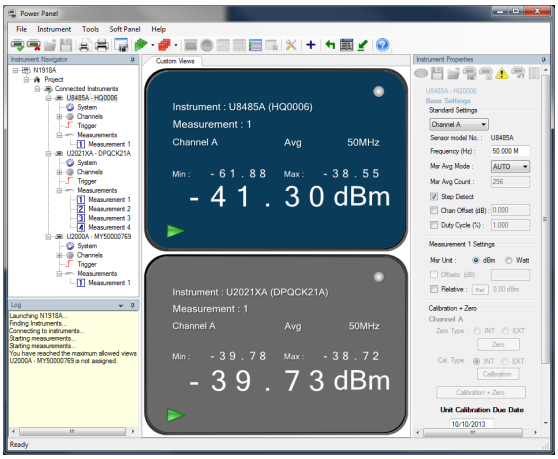


Figure 4. Power Panel (free version) software allow to support 2 USB power sensors measurement display only at once. Multilist view features offer in this version support multiple (more than 2) USB power sensors measurements.

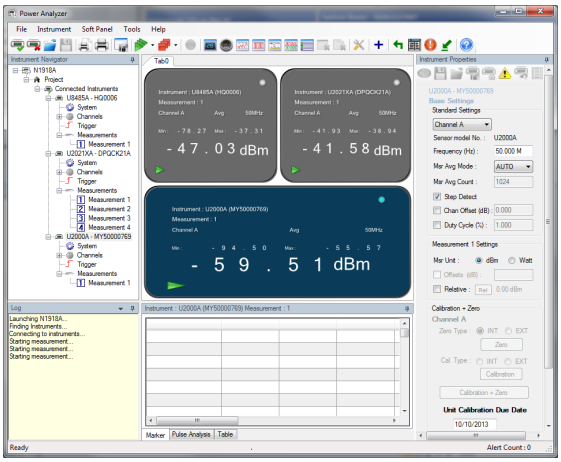


Figure 5. Power Analyzer (paid version license) support multiple power measurement display (max 4 display) at once and also offer additional features on top of Power Panel software

# Demonstration Preparation

The instruments and software listed in the table to the right are required to perform the demonstrations.

You can download the latest version of software and instrument firmware at:
www.keysight.com/find/N1918A
www.keysight.com/find/usbsensor

| Product Type | Model Number/Version |
|---|---|
| Keysight U2000 Series USB power sensors | Refer to Keysight U2000 Series USB Power Sensor Data Sheet |
| Keysight U2020 X-Series USB peak and average power sensors | Refer to Keysight U2020 X-Series USB Peak and Average Power Sensor Data Sheet |
| Keysight U8480 Series USB thermocouple power sensors | Refer to Keysight U8480 Series USB Thermocouple Power Sensors Data Sheet |
| Network 5-port USB Hub | |
| Keysight USB 2.0 compliant cable, Mini-B connector with locking mechanism | U2031A/B/C |
| Networked Hub Configuration Utility driver | |
| Keysight N1918A Power Analysis Manager | R03.06.xx |
| Keysight IO Libraries Suite | IO Libraries Suite 16.2 or later |

# Demo 1

## Extended Distance Multi-Channel Power Measurement using Networked 5-Port USB Hub

### Objectives

- To show the ability of Keysight USB power sensors connected to networked 5-port USB hub to perform multi-channel power measurement
- To overcome the limitation of USB cable length (five meters according to the USB industry specification) and extend the connection range using networked 5-port USB hub
- To demonstrate the capability of Keysight N1918A Power Analysis Manager, Power Analyzer software to perform multi-channel power measurement and synchronize the measurement to ensure that each USB power sensor are acquiring the same number of measurement points

Using a LAN to communicate with your USB-interface test instruments allows you to control and program the instruments remotely without connection-distance limitation. The networked 5-port USB hub provides these advantages and also allows multi-channel power measurement to be taken simultaneously when multiple USB power sensors are connected to the networked hub.

The following sections show you how to extend the connection distance using the networked 5-port hub via a LAN cable for multi-channel power measurement with the Keysight USB power sensors.

### Networked 5-Port USB Hub

The networked 5-Port USB hub uses USB over an IP connection (LAN) to over-come the distance limitation. The USB power sensor can be remotely controlled from a PC or laptop via LAN. The networked 5-port USB hub can connect up to five units of the USB power sensors. In order for the USB power sensors to be detected by networked 5-port USB hub, you must to install networked hub configuration utility.

Figure 6. Networked 5-port USB hub

### Connecting the Keysight USB Power Sensors and Networked 5-Port USB Hub

#### Procedures

1. Connect your PC/laptop (installed with the N1918A Power Analysis Manager Power Analyzer version, Networked Hub Configuration Utility driver, and Keysight IO Libraries Suite) to the networked 5-port USB hub via LAN.
2. Connect the USB power sensors and networked 5-port USB hub via USB cable as shown in Figure 7.

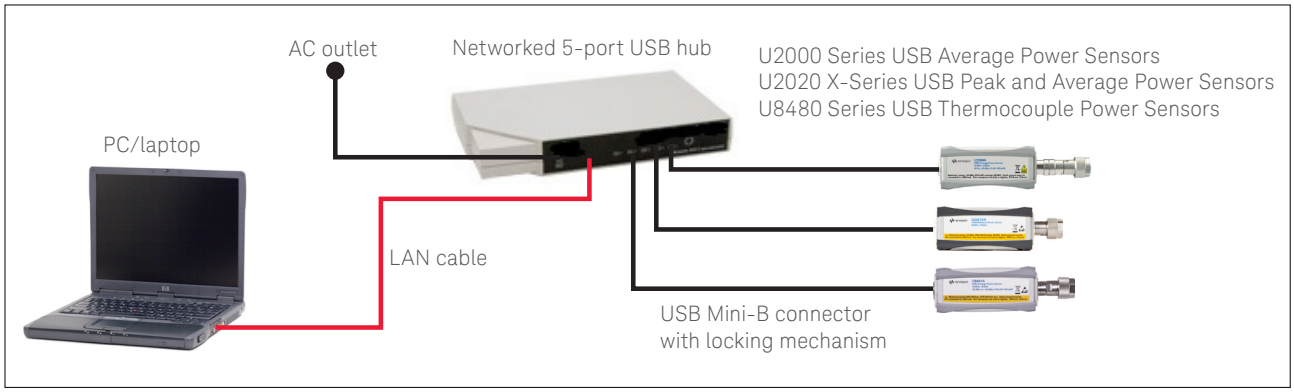


Figure 7. Keysight USB power sensors and networked 5-port hub setup diagram

| Instructions | | Keystrokes |
|---|---|---|
| | **To establish connection between networked hub and PC/laptop via LAN:** | |
| 1. | Run the networked hub configuration utility. | Double-click the Networked Hub Configuration Utility shortcut on the desktop or access the program via Windows start menu. |
| 2. | Configure the networked hub (See Figure 8). | Double-click the networked hub or select the device and click Configure to set the IP address, subnet mask, and default gateway. |
| 3. | Configure the IP address and subnet mask (See Figure 9). | Enter a device name that easily identifies the networked hub. Enter the IP address and subnet mask (base on the local network configuration). |
| 4. | Reboot the networked hub. | For the changes to take effect, click Update to reboot the device. |

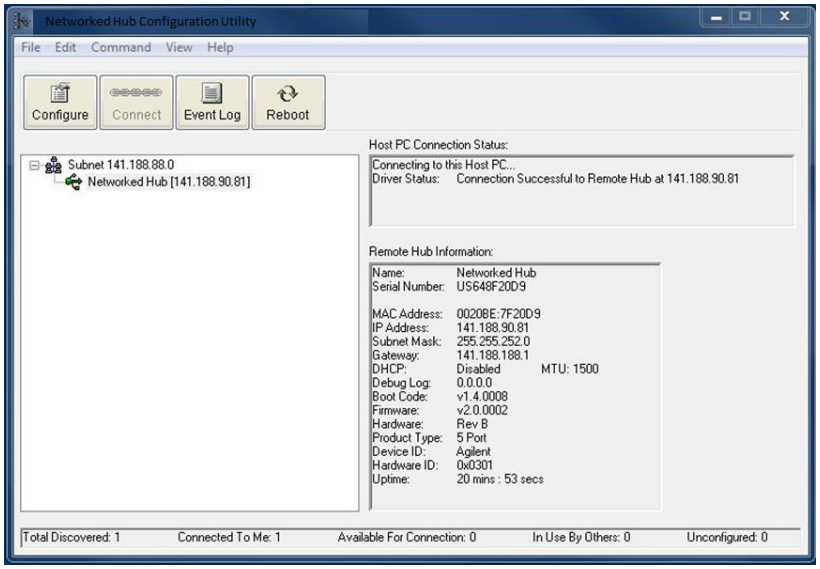


Figure 8. Networked Hub configuration utility display

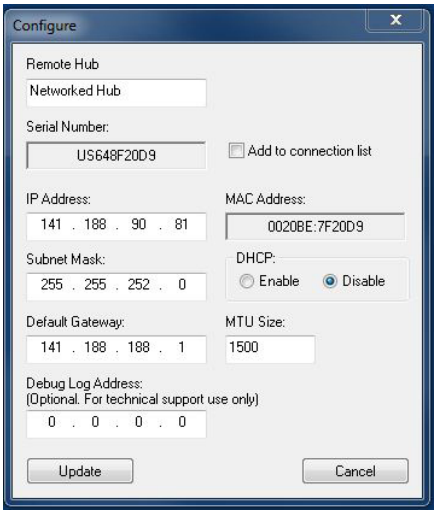


Figure 9. Configuring IP address, subnet mask, and default gateway in the networked hub configuration utility

# Connecting Keysight USB Power Sensors and Networked 5-Port USB Hub (Continued)

| Instructions | Keystrokes |
|---|---|
| **To establish USB connectivity with Keysight IO Libraries Suite:** | |
| Run the Keysight IO Libraries Suite (See Figure 10). | Double click the Keysight IO Libraries Suite shortcut on the desktop or access the program via Windows start menu. |

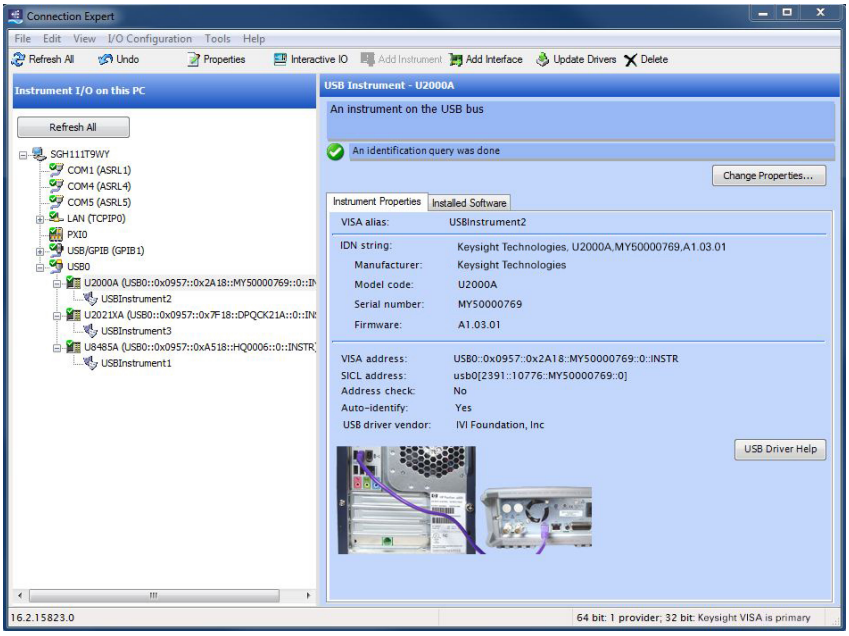


Figure 10. Keysight USB power sensors connectivity support auto-detected by Keysight IO Libraries Suite

## Performing Multi-Channel Power Measurement

Follow the instructions shown below to perform multi-channel power measurement using the N1918A Power Analysis Manager, Power Analyzer software.

| Instructions | Keystrokes |
|---|---|
| 1. Run the N1918A Power Analysis Manager, Power Analyzer software. | Double-click the Power Analyzer shortcut on the desktop or access the program via the Windows start menu. |
| 2. Stop measurement. | Click from toolbar. |
| 3. Synchronize measurement acquisition (see Figure 11). | From toolbar, click Tool and select Options & Settings. From Options & Settings menu, in General tab, click Enable synchronous measurement acquisition and click Apply to proceed. |
| 4. Start measurement. | Click from toolbar. |

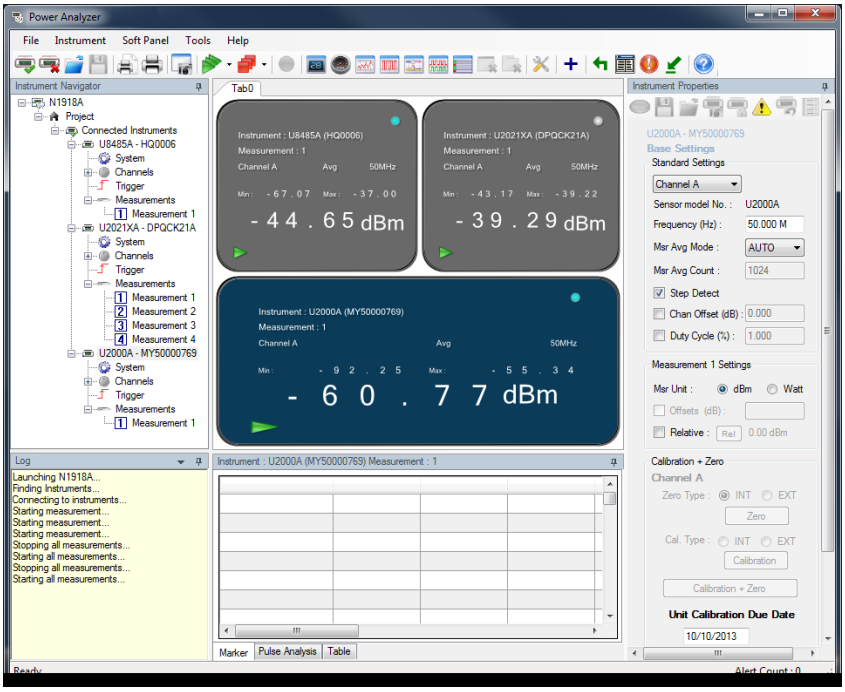


Figure 11. Multi-channel power measurement (in this example with 3 USB power sensors) via Keysight N1918A Power Analysis Manager, Power Analyzer software

# Demo 2

## Extended Distance Single-Channel Power Measurement with USB Extender

### Objectives

- To show the ability of Keysight USB Power Sensors connected to USB extenders to perform single-channel power measurement
- To overcome the limitation of USB cable length (five meters according to the USB industry specification) and extend the USB connection up to 50 meters via CAT-5 (LAN) cable
- To demonstrate the capability of Keysight N1918A Power Analysis Manager, Power Panel version to perform single-channel power measurement

Most of the time, users of USB peripheral devices are challenged to overcome the limitation of standard USB cable length (five meters only, as specified by the industry). For some applications, the users require extended connection ranges. By using an external USB extender, it is possible to lengthen the distance of the USB peripheral device. USB extenders are available in electronics shops at reasonable prices.

The following sections show you how to extend the distance of the USB peripheral device up to 50 meters (approximately 150 feet) using an USB extender via a CAT-5 (LAN) cable.

### USB Extender

The USB extender boosts the distance of a USB peripheral device up to 50 meters from a host computer using a regular LAN cable. The USB extender has a built-in buffer and actively regenerates signals to preserve data integrity. It consists of a transmitter and a receiver module (see Figure 10). The USB extender is self-powered, so it does not require an AC adapter.

The USB extender provides the following advantages:

- Extends USB signals up to 50 meters
- No drivers or external power needed
- True plug-and-play
- Compatible with USB 1.0 and USB 1.1, supporting transfer rates of 1.5 Mbps and 12 Mbps

Figure 12. USB extender with built-in USB cables, a transmitter, and a receiver module

# Connecting U8480 Series USB Thermocouple Power Sensors and USB Extender

## Procedures

1. Connect a PC/laptop (installed with the N1918A Power Analysis Manager, Power Panel software) to the USB extender through LAN cable. (See Figure 13).

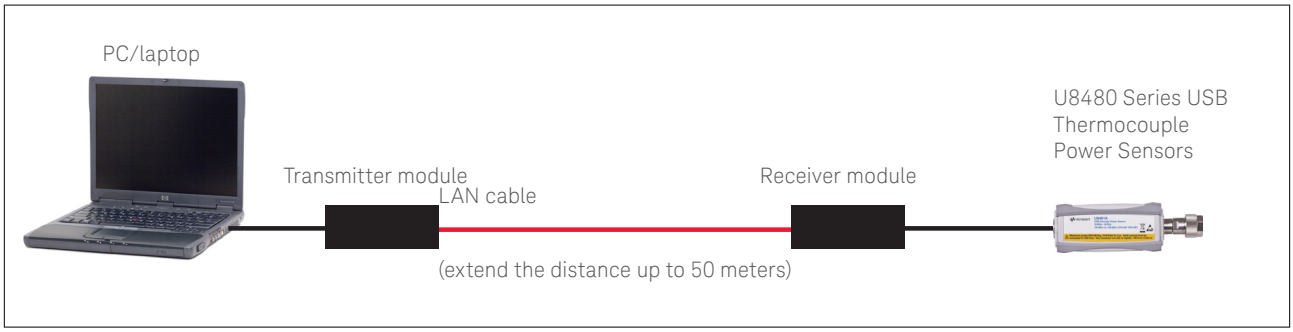


Figure 13. USB power sensor and USB extender configuration diagram

| Instructions | Keystrokes |
|---|---|
| **To establish USB connectivity with Keysight IO Libraries Suite:** | |
| Run the Keysight IO Libraries Suite (See Figure 14). | Double click the Keysight IO Libraries Suite shortcut on the desktop or access the program via Windows start menu. |

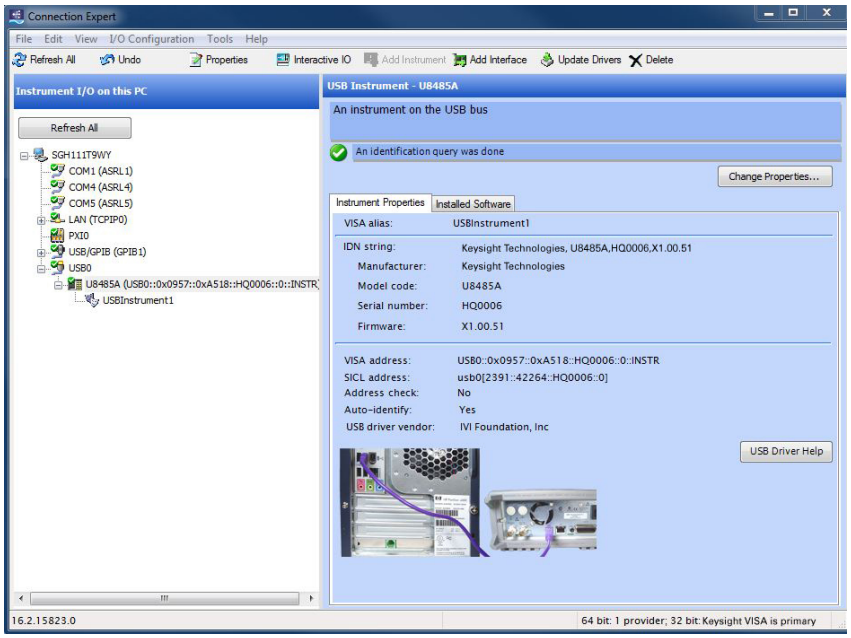


Figure 14. U8480 Series USB Thermocouple Power Sensor supported by USB extender and auto-detected by Keysight IO Libraries Suite

## Performing Single-Channel Power Measurement

Follow the instructions shown below to perform single-channel power measurement using N1918A Power Analysis Manager, Power Panel software.

| Instructions | Keystrokes |
|---|---|
| Run the N1918A Power Analysis Manager, Power Panel software. | Double-click the Power Panel software shortcut on the desktop or access the program via the Windows Start menu. |

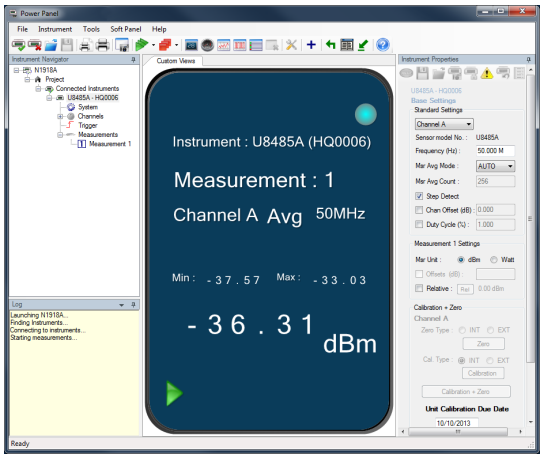


Figure 15. Single-channel power measurement via Keysight N1918A Power Analysis Manager, Power Panel software

## Conclusion

The most aggravating limitation of USB is the length restriction. USB has an accepted maximum length of only five meters, according to the USB industry specification. In order to go beyond the limit of five meters, you need to use a USB networked hub or a USB extender. Networked 5-Port USB hub is capable of extending the connection of Keysight USB power sensors when you perform multi-channel power measurement via Keysight N1918A Power Analysis Manager, Power Analyzer software.

This demo guide also describes single-channel power measurement with extended connection (up to 50 meters) from a host computer using a USB extender. This solution is especially useful for outdoor applications such as satellite base station testing.

## Related Literature

| Publication title | Pub number |
|---|---|
| Keysight U2000 Series USB Power Sensors, Data Sheet | 5989-6278EN |
| Keysight U2020 X-Series USB Peak and Average Power Sensors, Data Sheet | 5991-1221EN |
| Keysight U8480 Series USB Thermocouple Power Sensor, Data Sheet | 5991-1410EN |
| Keysight U2000 Series USB Power Sensor, Technical Overview | 5989-6279EN |
| Keysight N1918A Power Analysis Manager, Technical Overview | 5989-6613EN |
| Keysight N1918A Power Analysis Manager, Installation Guide | N1918-90002 |

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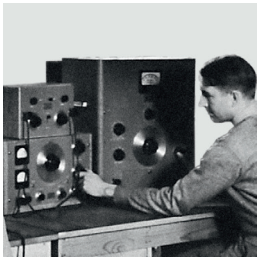
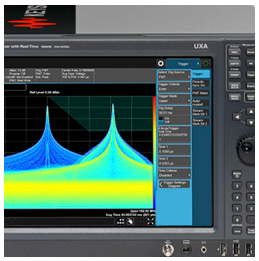

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