# Keysight 2050/60 X-Series Wide Dynamic Range Power Sensors

Wide dynamic range power sensors for any modulated signals





User's Guide

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## Environmental Conditions

The 2050/60 X-Series is designed for indoor use and in an area with low condensation. The table below shows the general environmental requirements for this instrument.

Environmental condition	Requirement
Tomporaturo	Operating condition - 0 °C to 55 °C
Temperature	Storage condition 40 °C to 70 °C
llumidity	Operating condition - Up to 95% RH at 40°C (non-condensing)
Humidity	Storage condition – Up to 90% RH at 65°C (non-condensing)
	Operating condition - Up to 3000 m (9840 ft)
Altitude	Storage condition - Up to 15420 m (50000 ft)

## **Regulatory Information**

The 2050/60 X-Series complies with the following Electromagnetic Compatibility (EMC) compliances:

- IEC 61326-1/EN 61326-1
- Canada: ICES/NMB-001
- Australia/New Zealand: AS/NZS CISPR11

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	The RCM mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australian EMC Framework Regulations under the terms of the Radio Communications Act of 1992.	ICES/NMB-001 ISM GRP 1-A	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives. ICES/NMB-001 indicates that this ISM product complies with the Canadian ICES-001. Cet appareil ISM est confomre a la norme NMB-001 du Canada. ISM GRP.1 Class A indicates that this is an Industrial Scientific and Medical Group 1 Class A product.
40	This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.	UK CA	The UKCA (UK Conformity Assessed) marking is a UK product marking that is used for goods being placed on the market in Great Britain (England, Wales, and Scotland)
X	This product complies with the WEEE Dire indicates that you must not discard this ele		
Ĩ	This symbol is a South Korean Class A EMO This equipment is Class A suitable for profe home.		ectromagnetic environments outside of the
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### Product category

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a "Monitoring and Control Instrument" product.

The affixed product label is as shown below.



Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

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- www.keysight.com/find/widedynamicsensor
   (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
   (worldwide contact information for repair and service)

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Keysight 2050/60 X-Series Wide Dynamic Range Power Sensors

User's Guide

## 1 Getting Started

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This chapter gets you started with the 2050/60 X-Series wide dynamic range power sensors.



### Overview

The 2050/60 X-Series wide dynamic range power sensors consist of 12 USB models and 13 LAN models:

- U2051XA USB average power sensor (10 MHz 6 GHz)
- U2052XA USB average power sensor (10 MHz 18 GHz)
- U2053XA USB average power sensor (10 MHz to 33 GHz)
- U2054XA USB average power sensor (10 MHz to 40 GHz)
- U2055XA USB average power sensor (10 MHz to 50 GHz)
- U2055XA option 053 USB average power sensor (10 MHz to 53 GHz)
- U2056XA USB average power sensor (10 MHz to 54 GHz)
- U2057XA USB average power sensor (10 MHz to 67 GHz)
- U2061XA USB peak and average power sensor (10 MHz 6 GHz)
- U2062XA USB peak and average power sensor (10 MHz 18 GHz)
- U2063XA USB peak and average power sensor (10 MHz to 33 GHz)
- U2064XA USB peak and average power sensor (10 MHz to 40 GHz)
- U2065XA USB peak and average power sensor (10 MHz to 50 GHz)
- U2065XA option 053 peak and average power sensor (10 MHz to 53 GHz)
- U2066XA USB peak and average power sensor (10 MHz to 54 GHz)
- U2067XA USB peak and average power sensor (10 MHz to 67 GHz)
- L2051XA LAN average power sensor (10 MHz to 6 GHz)
- L2052XA LAN average power sensor (10 MHz to 18 GHz)
- L2053XA LAN average power sensor (10 MHz to 33 GHz)
- L2054XA LAN average power sensor (10 MHz to 40 GHz)
- L2055XA LAN average power sensor (10 MHz to 50 GHz)
- L2055XA option 053 LAN average power sensor (10 MHz to 53 GHz)
- L2056XA LAN average power sensor (10 MHz to 54 GHz)
- L2057XA LAN average power sensor (10 MHz to 67 GHz)
- L2061XA LAN peak and average power sensor (10 MHz to 6 GHz)
- L2062XA LAN peak and average power sensor (10 MHz to 18 GHz)
- L2063XA LAN peak and average power sensor (10 MHz to 33 GHz)
- L2064XA LAN peak and average power sensor (10 MHz to 40 GHz)
- L2065XA LAN peak and average power sensor (10 MHz to 50 GHz)

- L2065XA option 053 LAN peak and average power sensor (10 MHz to 53 GHz)
- L2065XT TVAC LAN peak and average power sensor (10 MHz to 53 GHz)
- L2066XA LAN peak and average power sensor (10 MHz to 54 GHz)
- L2066XT TVAC LAN peak and average power sensor (10 MHz to 54 GHz)
- L2067XA LAN peak and average power sensor (10 MHz to 67 GHz)
- L2067XT TVAC LAN peak and average power sensor (10 MHz to 67 GHz)

The 2050/60 X-Series is capable of measuring the average and peak power of modulated, pulsed, and continuous wave (CW) signals in 10 MHz to 67 GHz frequency range and -70 dBm to 26 dBm power range.

The L2050/60 Series LAN power sensor is capable of long distance remote monitoring of up to 100 meters via the Power over Ethernet (PoE)/LAN connectivity. The PoE connectivity is compliant to the IEEE 3 W, 802.3af or 802.3at Type 1 standard.

#### **NOTE** The typical LAN port on your PC or Keysight instruments is not able to power up the L2050/ 60 Series LAN power sensor. The L2050/60 Series LAN power sensor must be connected to a PoE port, which supplies the DC power required to power up the L2050/60 Series LAN power sensor and to transfer data.

## **NOTE** The L2065XT/66XT/67XT is a thermal vacuum sensor for use within a thermal vacuum (TVAC) chamber.

### NOTE

As the L2065XT/66XT/67XT is fully enclosed in metal, it is strongly recommended to mount it on a cooling plate (with the thermal interface material provided) during operation to avoid overheating. Refer to "**Mount the L2065XT/66XT/67XT**" on page 39 for more information.

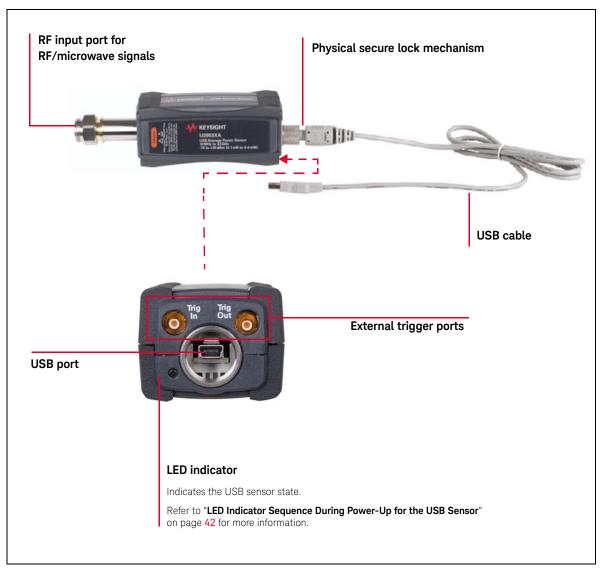
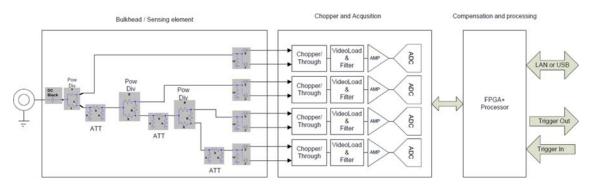


Figure 1-1 USB sensor



Figure 1-2 LAN sensor

## Theory of Operation





The 2050/60 X-Series sensors utilize 4 planer doped barrier diode in a 4-path microwave circuit that enables fast average power measurements over a wide dynamic range. The 4-path network splits the input signal into a different power range for each of the 4 diodes such that all of them can operate in their square-law region. Ensuring diode power sensors operate within the square-law region means that they can convert RF power to voltage in a linear manner, regardless of the signal being measured. A single diode sensor square-law behavior may only provide perhaps 40dB of fast dynamic range. Each of the diodes has their own signal conditioning and analog to digital converter which allow subsequent digital processing to select the best diode for further processing. This in turn presents a user experience indistinguishable from a single high dynamic range square-law power sensor.

As a truly universal power sensor, it has features that allow different kinds of power measurements to be made. Primarily it operates as an average power sensor and traditionally this type of measurement means that an instrument will output a numeric result at some rate determined by the instrument. In AVERAGE mode the sensor enables a chopper amplifier circuit that allows low level signals to be measured in the presence of low frequency noise. This chopper circuit operates by modulating the signal prior to amplification; the modulation takes the form of passing or negating the signal for halfperiods of the chopper signal. Recovering the original signal within the digital processing is achieved by averaging the 'passing' half-period samples together with the negated 'negating' half-period samples, to provide a new answer once for each period of the chopper. The corresponding "de-chopping" is carried out in digital section to allow proper correction and measurement of input signal. The chopper stabilization circuit essentially remove the offset and low frequency noise contribution of the signal condition stages from affecting input signal. In this series of sensor, the chopper concept is extended to allow the user to set an 'aperture' over which averaging is calculated. This aperture is selectable in 100ns resolution and provides a powerful mechanism for precisely tuning the instrument to the signal being measured. In addition to allowing the aperture to match a particular epoch of the RF signal, for example setting the aperture equal to a multiple of the modulation frequency in an AM signal, there is the ability to precisely trigger the occurrence of each measurement. This allows synchronization between the device under test and the measurement system.

Sometimes it is necessary to examine the time varying characteristics of the power envelope. This allows measurements of pulse duration time or pulse period for example. This series of sensor has NORMAL measurement mode to provide 20MHz sampling of the power envelope. In common with AVERAGE mode, the best diode from the 4 ranges is selected transparently within the digital processing. In contract to AVERAGE mode, no chopper switching is performed and the signal path is a direct coupled differential amplifier. The analog signal conditioning allows the load resistor and the low pass filter characteristics to be adjusted. Changing the load resistor also changes the response level (V/W) of the diode detector and its video bandwidth. Changing the load capacitance will affect the bandwidth but not the response level. Used together, these controls enable reduced noise on the measurement for low level signals at the expense of video bandwidth.

A high speed trigger Input and trigger output are also present in each sensor to allow proper synchronization between test instruments. Besides that, Average and Normal mode do support internal level trigger mode on top of external trigger mode. This allows flexibility in triggering on different input signal over a wide dynamic range.

A high speed acquisition and processing engine is also present in the sensor to enable a complex calibration scheme to track the performance of various modes across frequency, input power and temperature. The robust back end system also allows 2050/60 X-Series to be paired with either conventional USB or LAN based interface. With a LAN based interface, the prefix "U" is replaced with "L".

On top of that, the L2065XT/66XT/67XT sensor is also designed to be thermal vacuum compliant (TVAC) by controlling the outgas property of the components being used.

## Initial Inspection

When you receive your 2050/60 X-Series sensor, inspect the shipping container for damages. If the shipping container or packaging material is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is any mechanical damage, notify the nearest Keysight Sales and Service Office. Keep the damaged shipping materials (if any) for inspection by the carrier and a Keysight representative.

### Standard shipped items

Verify that you have received the following items. If anything is missing or damaged, please contact the nearest Keysight Sales Office.

### USB power sensor:



#### LAN power sensor:



#### 1 Getting Started

### Hardware Installation and Configuration

## **NOTE** For power measurements of < -60 dBm, it is recommended to turn on the 2050/60 X-Series for 1.5 hours (with the 2050/60 X-Series connected to the device-under-test).

Prior to using the 2050/60 X-Series, ensure that the following minimum requirements are met:

- PC with USB and LAN host capability
- Keysight IO Libraries Suite 17.0 or higher installed
- Keysight BenchVue installed

### Connect the USB sensor

1 Connect the power sensor to the PC. The sensor driver is detected and installed automatically.

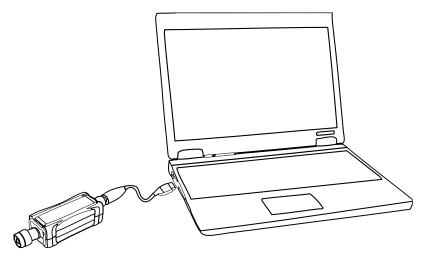


Figure 1-4 Connect the U2053XA/63XA sensor to the PC

2 Go to Start > All Programs > IO Control ( 1 ) to launch Keysight Connection Expert application. Click Start a Scan for connected instruments to auto-locate the sensor as shown in Figure 1-5.

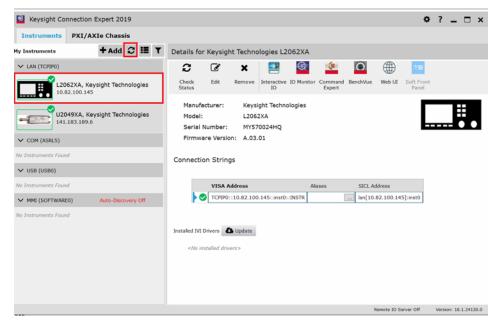


Figure 1-5 Auto-locate a USB instrument in Keysight Connection Expert

- 3 Click Interactive IO to verify the sensor is connected.
- 4 When the sensor is connected, go to Chapter 2, "Using the 2050/60 X-Series with the Keysight BenchVue" to launch the BenchVue Power Meter application, or proceed to operate the sensor via remote programming.

### Operating the sensor remotely using SCPI commands

You can send SCPI commands to operate the sensor. Refer to the 2050/60 X-Series *Programming Guide* for details.

### Connect the LAN sensor

Connect the LAN sensor via any of the following LAN operating modes:

- Dynamic IP (Dynamic Host Configuration Protocol or DHCP)
- Auto IP (Local PC control or isolated (non-site) LAN)
- Static IP (Manual mode)

The default LAN operating mode of the LAN sensor is Dynamic IP.

Dynamic IP and Auto IP are enabled on the LAN sensor shipped from Keysight. This allows the LAN sensor to automatically obtain an address on the network.

The LAN sensor communicates with the DHCP server to obtain the LAN interface configuration. If the DHCP server is not detected, then either the DHCP server is not present or it does not allow the LAN sensor to obtain an IP address. The LAN sensor will then try to obtain the LAN configuration using AutoIP if enabled, otherwise the LAN sensor will try to use the static IP set in the LAN sensor. If required, push the LAN reset switch to reset the LAN sensor LAN configuration to a known default state.

### NOTE

The LED indicator will turn red indicating the following error when the DHCP server is not detected:

-310, "System error; The sensor could not obtain a LAN configuration using DHCP. The sensor will try to obtain IP address using AutoIP if enabled".

For more information on LAN instrument connectivity, refer to the *Keysight IO Libraries Suite Connectivity Guide*.

### Dynamic IP mode

In this mode, the IP address, subnet mask, and default gateway values are obtained from a DHCP server.

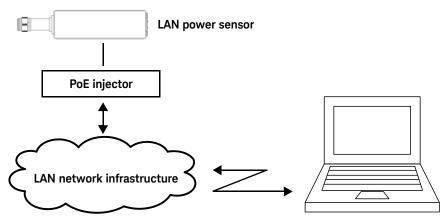


Figure 1-6 Connect the LAN sensor via Dynamic IP

- 1 Set up the connection as shown in Figure 1-6.
- 2 On your PC, set the LAN settings to the automatic configuration. Go to Start > Control Panel > Network and Internet > Network and Sharing Center > Local Area Connection > Properties and set the following properties.

Local Area Connection Properties	Internet Protocol Version 4 (TCP/IPv4) Properties
Networking Sharing	General Alternate Configuration
Connect using:	You can get IP settings assigned automatically if your network supports
Broadcom 440x 10/100 Integrated Controller	this capability. Otherwise, you need to ask your network administrator for the apoprint P settings.
Configure	
This connection uses the following items:	Obtain an IP address automatically
Client for Microsoft Networks	Use the following IP address:
VirtualBox Bridged Networking Driver	IP address:
QoS Packet Scheduler	
File and Printer Sharing for Microsoft Networks	Subnet mask:
Internet Protocol Version 6 (TCP/IPv6)	Default gateway:
Internet Protocol Version 4 (TCP/IPv4)	
🗹 🛶 Link-Layer Topology Discovery Mapper I/O Driver	<ul> <li>Obtain DNS server address automatically</li> </ul>
<ul> <li>Link-Layer Topology Discovery Responder</li> </ul>	Use the following DNS server addresses:
Install Uninstall Properties	Preferred DNS server:
Description	Alternate DNS server:
Transmission Control Protocol/Internet Protocol. The default	
wide area network protocol that provides communication across diverse interconnected networks.	
	Validate settings upon exit Advanced
OK Cancel	OK

Figure 1-7 Set automatic LAN settings on the PC

- **3** Go to **Start > All Programs > IO Control** ( 1 to launch Keysight Connection Expert application.
- 4 Select Add > LAN instrument. The Add a LAN device window is displayed.
- **5** Enter the instrument host name (**Figure 1-8**) in the **Hostname or IP Address** field. Every LAN sensor has a default host name in the form of:

K- + product model+ - + suffix five digits of the serial number Example: K-L2051XA-XXXXX

Add a LAN device					×
Select from List	Enter Add	Iress			
Set LAN Address:					
Hostname or IP A	ddress:	141.183.189.6			
TCPIP Interface ID	):	ТСРІРО	•		
Set Protocol:					
Set Flotocol.					
Instrument (\	/XI-11)	Remote Name:	inst0		
HiSlip		Remote Name:	hislip0		
Socket		Port Number:	5025		
Verify Connection:					
✓ Allow *IDN Q					
Test This VISA A	ddress				
Mah Daaa					
View Web Page:					
Instrument Web Int	erface				
				OK Car	icel

Figure 1-8 Add a LAN instrument in Keysight Connection Expert via host name

- 6 Select Allow \*IDN Query and click Test This VISA Address to verify the LAN sensor is connected. Once verified, click Accept.
- 7 Alternatively, click **Start a Scan for connected instruments** to auto-locate the sensor as shown in **Figure 1-9**.

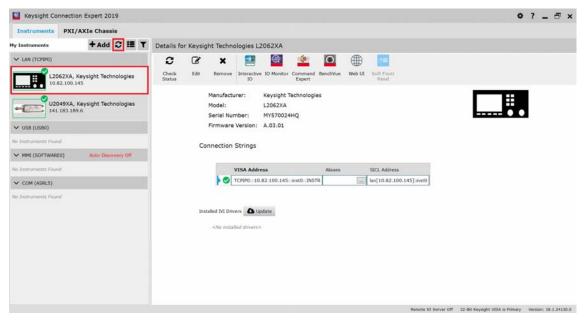


Figure 1-9 Auto-locate a LAN instrument in Keysight Connection Expert via Dynamic IP

- 8 Click Interactive IO to verify the LAN sensor is connected.
- **9** When the LAN sensor is connected, go to **Chapter 2**, "Using the 2050/60 X-Series with the Keysight BenchVue" to launch the BenchVue, or proceed to operate the LAN sensor via remote programming.

### Auto IP mode

Use this procedure if you require local PC control or you are working in a private (non-site) LAN environment.

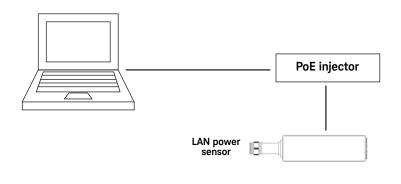


Figure 1-10 Connect the LAN sensor via Auto IP

- **1** Set up the connection as shown above.
- 2 On your PC, set the LAN settings to the automatic configuration. Go to Start > Control Panel > Network and Internet > Network and Sharing Center > Local Area Connection > Properties and set the following properties.

Local Area Connection Properties	) r	Internet Protocol Version 4 (TCP/I	(Pv4) Properties
Networking Sharing		General Alternate Configuration	]
Connect using:		Veu ere est ID estimate estimated	automatically if your network supports
Proadcom 440x 10/100 Integrated Controller			eed to ask your network administrator
Configure		Obtain an IP address autom	
This connection uses the following items:			,
Client for Microsoft Networks		Use the following IP address	s:
🗹 📮 VirtualBox Bridged Networking Driver		IP address:	
🗹 📮 QoS Packet Scheduler			
🗹 📮 File and Printer Sharing for Microsoft Networks		Subnet mask:	
Internet Protocol Version 6 (TCP/IPv6)      Internet Protocol Version 4 (TCP/IPv4)	<b>→</b>	Default gateway:	
🗹 🛶 Link-Layer Topology Discovery Mapper I/O Driver		Obtain DNS server address	automatically
Link-Layer Topology Discovery Responder		Use the following DNS serve	er addresses:
Install Uninstall Properties		Preferred DNS server:	
Description Transmission Control Protocol/Internet Protocol. The default		Alternate DNS server:	
wide area network protocol that provides communication across diverse interconnected networks.		Validate settings upon exit	Advanced
OK Cancel			OK Cancel

Figure 1-11 Set automatic LAN settings on the PC

**3** Go to **Start > All Programs > IO Control** ( 1 (1 ) to launch Keysight Connection Expert application. Click **Start a Scan for connected instruments** to auto-locate the sensor as shown in the figure below.

I Add C I     I Add C     I I Add C     I I Add C     I I Add C        I I I Add C <th>Keysight Connection Expert 2019</th> <th></th> <th>¢?_ 🗗</th>	Keysight Connection Expert 2019		¢?_ 🗗
LAN (TCPRPO)   LOS 2XA, Keysight Technologies   LOS 2XA, Keysight Technologies   LIAL (SCPTWARE)   VUSA (Keysight Technologies   LIAL (SCPTWARE)   Mati (SOPTWARE)   Auto-Decovery Off   Lindstature   Lindstature   VISA (Marces   VISA (Marces   Lindstature   VISA (Marces   Lindstature   VISA (Marces   Lindstature   Lindst	Instruments PXI/AXIe Chassis		
LOS2XA, Keysight Technologies         LOS2XA, Keysight Technologies         LIB.82.100.145         VUSB (USB0)         LIB.51.89.6         VUSB (USB0)         Models         LIB.02.100.145         Mill (SOFTWARE0)         Auto-Decovery Off         Lib.03.100.165         Lib.03.100.165         VISB (USB0)         Lib.03.100.165         Mill (SOFTWARE0)         Auto-Decovery Off         Lib.05.100.145         Lib.05.100.145      <	ly Instruments + Add 🖸 🗮 🕇	Details for Keysight Technologies L2062XA	
COM (ASRLS)     Com (ASRL	U2049XA, Keysight Technologies     I41.183.189.6      US8 (U580)      No Instruments Found	Check Status Edit Remove Interactive 10 Monitor Command BenchVue Web UI Soft Front Expert Web UI Soft Front Panel Model: L2052XA Serial Number: MY570024HQ Firmware Version: A.03.01	
Installed IVI Drivers 🛆 Update	Ve Instruments Found COM (ASRL5)		
	No Instruments Found		

Figure 1-12 Auto-locate a LAN instrument in Keysight Connection Expert

- 4 Click Interactive IO to verify the LAN sensor is connected.
- **5** When the LAN sensor is connected, go to **Chapter 2**, "Using the 2050/60 X-Series with the Keysight BenchVue" to launch the BenchVue, or proceed to operate the LAN sensor via remote programming.

NOTE

### Static IP mode (configuring the LAN manually)

In static IP mode, you must set up the IP address, subnet mask, and default gateway that are compatible with your network infrastructure (PC configuration).

Using a static IP address is useful if you always want to communicate with the instrument using the same IP address every time it is turned on.

After configuring LAN settings, you must first power cycle the LAN sensor. This enables the new network settings to become effective.

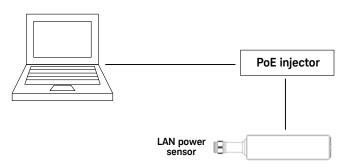


Figure 1-13 Connect the LAN sensor via Static IP

- 1 Set up the connection as shown above.
- 2 On your PC, set the LAN settings to the automatic configuration. Go to Start > Control Panel > Network and Internet > Network and Sharing Center > Local Area Connection > Properties and set the following properties.

Local Area Connection Properties	Internet Protocol Version 4 (TCP/IPv4) Properties
Networking Sharing	General Alternate Configuration
Connect using:	You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Configure This connection uses the following items:	Obtain an IP address automatically
Ident for Microsoft Networks     July July Box Bridged Networking Driver	Use the following IP address: IP address:
Elion S Packet Scheduler      Elie and Printer Sharing for Microsoft Networks      Anternet Protocol Version 6 (TCP/IPv6)	Subnet mask:
	Obtain DNS server address automatically
🗹 📥 Link-Layer Topology Discovery Responder	Use the following DNS server addresses:
Description	Preferred DNS server: Alternate DNS server:
Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.	Validate settings upon exit Advanced
OK Cancel	OK Cancel

Figure 1-14 Set automatic LAN settings on the PC

**3** Go to **Start > All Programs > IO Control** ( 1 (1 ) to launch Keysight Connection Expert application. Click **Start a Scan for connected instruments** to auto-locate the sensor as shown in the figure below.

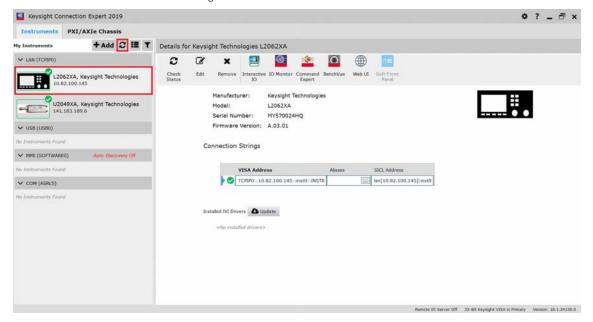


Figure 1-15 Auto-locate a LAN instrument in Keysight Connection Expert

#### 1 Getting Started

- 4 To enable static IP, click Interactive IO and send the following SCPI commands:
  - SYSTem:COMMunicate:LAN:DHCP[:STATe] 0 //Turns off Dynamic IP
  - SYSTem:COMMunicate:LAN:AIP[:STATe] 0 //Turns off Auto IP
  - SYSTem:COMMunicate:LAN:RESTart //Restarts the LAN network for the above setup to take effect

### NOTE

For more information on remote SCPI programming, refer to the 2050/60 X-Series Programming Guide.

Alternatively, you can set these configurations using the LAN sensor web-based interface (see "**Using the Instrument Web Browser**" on page **35**).

On the **Configuring your L20xxXA Power Sensor** page, set the **DHCP** and **Auto IP** buttons to **OFF**. Click **Save** to save the new settings. Then click **Renew LAN Settings** for the changes to take effect.

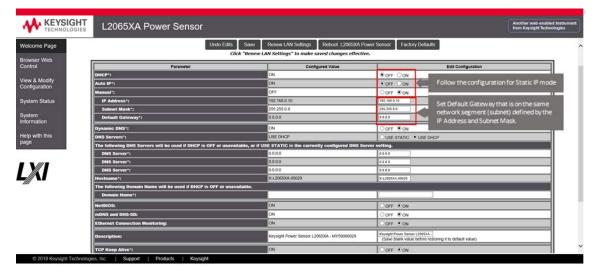


Figure 1-16 Modify and renew LAN configuration settings

5 Set the PC IP address and subnet mask. Go to Start > Control Panel > Network and Internet > Network and Sharing Center > Local Area Connection > Properties and set the following properties.

Local Area Connection Properties	Internet Protocol Version 4 (TC	P/IPv4) Properties
Networking Sharing	General	
Connect using:		ed automatically if your network supports u need to ask your network administrator s.
Configure This connection uses the following items:	<ul> <li>Obtain an IP address aut</li> <li>Obtain an IP address aut</li> </ul>	
VirtualBox Bridged Networking Driver	<u>I</u> P address:	192.168.0.1
<ul> <li>✓ ■QoS Packet Scheduler</li> <li>✓ ■ File and Printer Sharing for Microsoft Networks</li> </ul>	S <u>u</u> bnet mask:	255 . 255 . 255 . 0
	Default gateway:	
Link-Layer Topology Discovery Mapper I/O Driver     Link-Layer Topology Discovery Responder	Obtain DNS server addre	ess automatically
	Use the following DNS set	rver addresses:
Install Uninstall Properties	Preferred DNS server:	
Description Transmission Control Protocol/Internet Protocol. The default	<u>A</u> lternate DNS server:	
wide area network protocol that provides communication across diverse interconnected networks.	🔲 Valjdate settings upon e	xit Ad <u>v</u> anced
OK Cancel		OK Cancel

Figure 1-17 Set manual LAN settings on the PC

NOTE

- For the new network settings to become effective, you must first power cycle the LAN sensor.
- The static IP addresses for the host PC and the LAN sensor must be different from the IP address of the PoE injector to avoid conflict.
- 6 Go to Start > All Programs > IO Control ( 💿 ) to launch Keysight Connection Expert application. Click Start a Scan for connected instruments to auto-locate the sensor as shown in Figure 1-18.

Keysight Connection Expert 2019	¢?_5
Instruments PXI/AXIe Chassis	
Instruments + Add C III T	Details for Keysight Technologies L2062XA
	Check       Edit       Remove       Interactive 10 Monitor Command BenchWie       Web UI       Soft Froat Panel         Check       Edit       Remove       Interactive 10 Monitor Command BenchWie       Web UI       Soft Froat Panel         Model:       L2062XA       Serial Number:       M'570024HQ       Errmware Version:       A.03.01         Connection Strings
o Instruments Found ✓ COM (ASRL5)	VISA Address         Alases         SICL Address           ♥         TCPIP0::10.82.100.145::inst0::INSTR         Im [10.82.100.145]:inst0
o Instruments Found	Installed IVI Drivers Dupdate  Allo installed drivers>

Figure 1-18 Auto-locate a LAN instrument in Keysight Connection Expert via Static IP

7 Click Interactive IO to verify the LAN sensor is connected.

**NOTE** Alternatively, you can locate the LAN sensor by entering its default static IP address (192.168.0.10) in the **Add a LAN device (Add > LAN instrument)** window.

8 When the LAN sensor is connected, go to **Chapter 2**, "Using the 2050/60 X-Series with the Keysight BenchVue" to launch the BenchVue, or proceed to operate the LAN sensor via remote programming.

To revert to the Dynamic IP mode from the static IP mode, you can either:

- send the following SCPI commands.
  - SYSTem:COMMunicate:LAN:DHCP[:STATe] 1
  - SYSTem:COMMunicate:LAN:AIP[:STATe] 1
  - SYSTem:COMMunicate:LAN:RESTart
- configure and renew the LAN settings via the instrument web browser.

Refer to "**Dynamic IP mode**" on page 24 for the procedure. You will need to power cycle the LAN sensor for the new network settings to take effect.

NOTE

### Using the Instrument Web Browser

The LAN sensor can be programmed using its web-based interface (web browser). The web browser functions as a virtual front panel which can also be used for:

- interactive IO
- familiarization with instrument capabilities
- determining/changing instrument configuration
- 1 On the Keysight Connection Expert, click **Web UI** to launch the LAN sensor web-based interface.

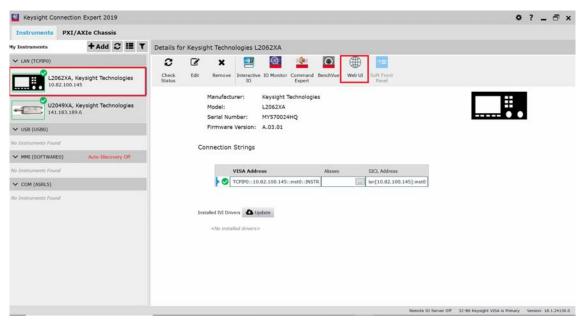


Figure 1-19 Start instrument web interface

### NOTE

The web-based interface can also be opened directly from a web browser by entering the LAN sensor's IP address or hostname in the 'address' bar of the browser.

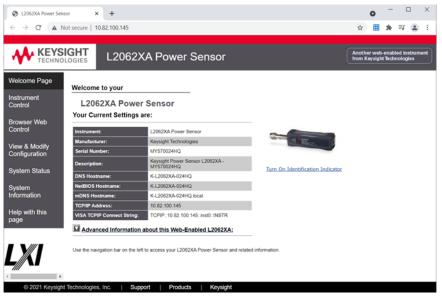


Figure 1-20 LAN sensor web-based interface (Welcome page)

2 Click View & Modify Configuration to access the LAN configuration settings.

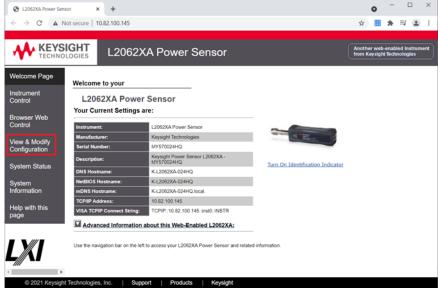


Figure 1-21 View and modify configuration

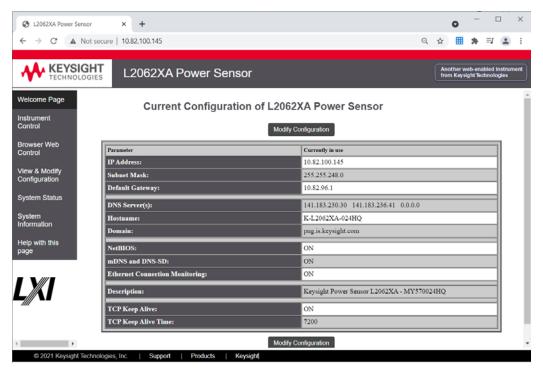


Figure 1-22 View and modify LAN configuration settings

**3** Click **Modify Configuration** to edit the LAN configuration settings.

Welcome Page	Current Configuration of L2062	Current Configuration of L2062XA Power Sensor					
Instrument Control	Modify Configuration						
Browser Web Control	Parameter	Currently in use					
	IP Address:	10.82.100.145					
View & Modify Configuration 255.255.248.0		255.255.248.0					
Conniguration	Default Gateway:	10.82.96.1					

Figure 1-23 Modify configuration

4 Enter the default password "keysight".

#### 1 Getting Started



Figure 1-24 Enter default password

**5** On this page, you can configure and renew the LAN settings, as well as power cycle the LAN sensor or reset the LAN settings.

KEYSIG	L2062XA Power Sensor				ĥ	Krysigi	enabled by Technology
ome Page		Configuring your L2062XA Powe	rSensor				
ment	Note: You must click "Save" before changes i		to require that you click "Renew LAN settings" before changes take effect.				
ol	Undo						
er Web		Click "Renew LAN Settings" to make saved changes effective					
	Parameter	Coofigured Value	Edit Configuration				
Modify	OHCP*:	ON	C 0/# 8 0N				
wration	Auto (P1)	ON	O OFF NON				
	Manual';	OFF	CON ON				
Status	IP Address")	182.565.8.18	162 198.0 10				
	Subset Mask*:	255 255 8 8	283833				
t tion	Default Caterway*	0.058	1012				
	Dynamic DNS*	ON	O ore Con				
th this	DNS Servers*:	USE DHCP	O USE STATIC USE DHCP				
0.1.01.0	The following DNS Servers will be ased if DHCP is OFF or unavailable, or if USE STATIC is the						
	DHS Server*1	1008	1818				_
	DN3 Server1	(433	1114				-
	DWS Server's	8 0 0 8 K-12082X6-024HQ	4111 Kullion-Deeg				_
M State	Hostname*: The following Domain Name will be used if DHCP is OFF or anavailable.	e-Loston of an	Company of the second s	_	_	_	
	Dunant Name*						
	Note(1):	CH CH	OFF TON				
	mDN3 and DN3-50t	ON	O DFF CH				-
	Ethernet Connection Moniforing:	01	OUT ON				-
	Description	Keysight Power Sensor L2042XA - M1570624HQ	(sayapit Powe Series (2002) A - 9/107 (Save Soate value before realizing if to default value)				1
	TCP Keep Alive*;	ON .	COTT CON				
	TCP Keep Alex Tena":	7200	1200				
	Charge Password	(Enter Out)	(Enter New) (Confere News)				

Figure 1-25 Modify and renew LAN configuration settings

NOTE

If you have changed the password, resetting the LAN configuration will reset the password to default as well.

### Configuring the LAN remotely using SCPI commands

You can send SCPI commands to automatically or manually configure the LAN settings for the LAN sensor. Refer to the 2050/60 X-Series Programming Guide for details.

## Mount the L2065XT/66XT/67XT

The L2065XT/66XT/67XT is strongly recommended to be mounted on a cooling plate for more effective heat dissipation when used in a TVAC chamber.

The cooling plate consists of four mounting threaded holes and the minimum thread height of each hole is 6 mm.

### Mounting dimensions

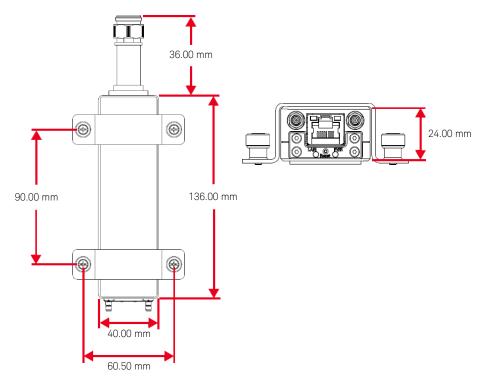
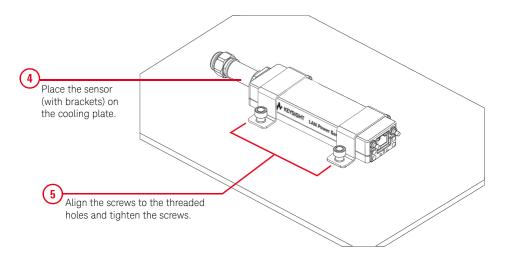
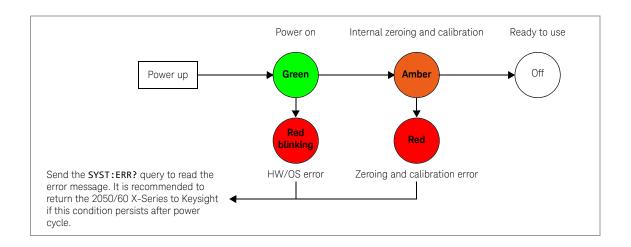


Figure 1-26 L2065XT/66XT/67XT mounting dimensions

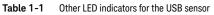
# Mounting procedure 1 LAN ₩ KEYSIGHT Clean the surface thoroughly with isopropyl alchohol and let it dry. Install the thermal interface material on to the sensor's surface. 2 KEYS Stick the silver layer onto the surface. The pink layer is facing outward. Briefly install the brackets. 3 Ø Y KEYSIGHT LAN POWER KEV. LAND

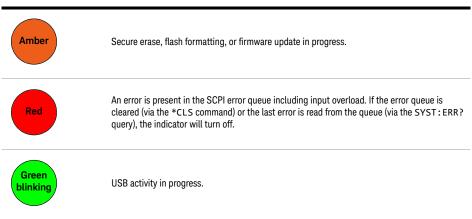


## LED Indicator Sequence During Power-Up for the USB Sensor

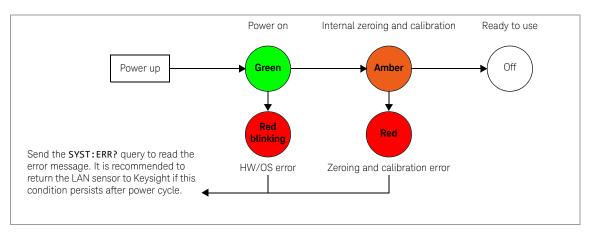


## Other LED indicators



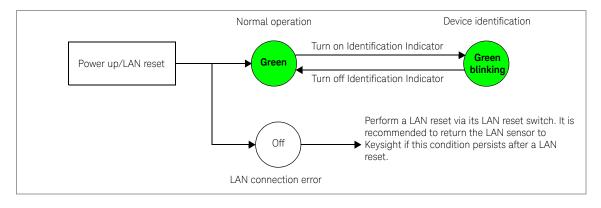


## LED Indicator Sequences for the LAN Sensor



## During power-up (via PWR LED indicator)

## For LAN activity (via LAN LED indicator)



#### 1 Getting Started

## Other LED indicators

#### Table 1-2 Other LED indicators for the LAN sensor

Amber	Secure erase, flash formatting, or firmware update in progress.
Red	An error is present in the SCPI error queue including input overload. If the error queue is cleared (via the *CLS command) or the last error is read from the queue (via the SYST: ERR? query), the indicator will turn off.

## Firmware Upgrade

To download the latest firmware version for the 2050/60 X-Series, go to www.keysight.com/find/pm\_firmware. The latest firmware includes the executable file and help file for installing the Firmware Upgrade Utility application in order to upgrade the 2050/60 X-Series.

Keysight 2050/60 X-Series Wide Dynamic Range Power Sensors User's Guide

## 2 General Operating Information

Using the 2050/60 X-Series with the Keysight BenchVue 46 Quick start example to perform an average power measurement 47 Quick start example to set up a measurement in the Trace view 51 Quick overview of the BenchVue Power Meter 55 57 Power meter settings in the Normal mode 60 Instrument Setup tab 63 Overview of Multiple Power Sensor Operation 65 Single bench operation 65 Multiple bench operation 68 Multiple bench display example 68 Exploring the 2050/60 X-Series Web Interface 69 Launching the web interface 69 Navigation Bar 69 Displaying the Instrument control page 70

This chapter describes the general operating information of the 2050/60 X-Series.



## Using the 2050/60 X-Series with the Keysight BenchVue

The BenchVue Power Meter application provides a virtual operating interface for the 2050/ 60 X-Series. This chapter describes the 2050/60 X-Series functions in the BenchVue Power Meter application in general.

**NOTE** For more information on how to configure each 2050/60 X-Series function or use each BenchVue Power Meter feature, refer to the Keysight BenchVue Power Meter help documentation.

Go to **Start > All Programs > Keysight > Keysight BenchVue > Keysight BenchVue** to launch the BenchVue Power Meter application.

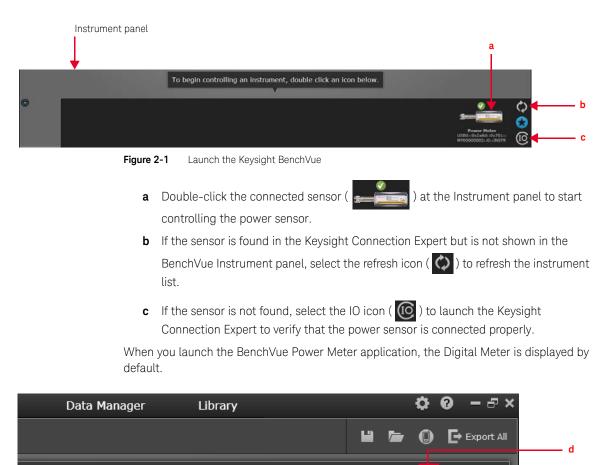


Figure 2-2 Accessing the BenchVue Power Meter help documentation

8 ×

? 🖸

d Click (?) ) to access the BenchVue Power Meter help documentation.

Quick start example to perform an average power measurement

The following example guides you on how to quickly measure average power via BenchVue. It is assumed that the 2050/60 X-Series is already connected to a signal generator.

- **1** Set up the signal generator as follows:
  - Amplitude: 0 dBm
  - Frequency: 1 GHz
  - Modulation: Disabled
- 2 Turn on the RF output of the signal generator. Launch the BenchVue Power Meter application (refer to **page 46**). By default the power meter mode is already set to Average only.
- 3 Perform calibration and zeroing for an accurate measurement result.



Figure 2-3 Performing calibration and zeroing

NOTE

For power measurements below –50 dBm, it is recommended to perform external zeroing and turn off the RF output for better accuracy and repeatability.

4 Set the frequency of the 2050/60 X-Series to 1 GHz.



Figure 2-4 Setting the frequency

**5** You should be able to view the average power measurement results in the Digital Meter display view.



Figure 2-5 Average power meter measurement results

- a Indicates acquisition of measurements in the Run mode
- **b** Indicates the measurement status
  - Change the title at the top of the display view



С

Reset the displayed Minimum/Maximum measured values

- **d** Summary of alert limit conditions for the current measurement
- 6 To monitor the average power over a period of time, create a Datalog display view by





Figure 2-6 Creating Datalog display view

Select one of the available measurements from the list and click **Ok**.

				^
Model No	Serial No	Meas ID	Channel	Meas Type
U2049XA	MY54480006	1	A	Avg
11204024	MV54400006	0	٨	Ava.

Figure 2-7 Selecting one of the measurements

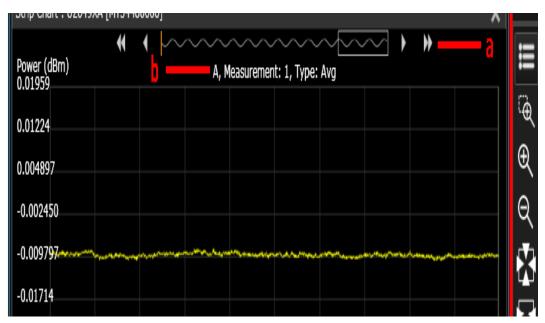


Figure 2-8 Data preview bar

- a Data preview bar
- **b** Indicates the channel name, measurement number, measurement type
- **c** Tools palette to provide control for the datalog chart (refer to the BenchVue Power Meter help documentation for details)
- **d** Summary of marker measurements and alert limit conditions for the current measurement.

7 Place a marker (or up to five markers) on the chart by clicking to obtain the reading.



Figure 2-9 Placing a marker on the chart

#### Quick start example to set up a measurement in the Trace view

The following example guides you on how to set up a basic peak power measurement for RF pulses via BenchVue.

### NOTE

The default power meter mode is Average only. It will change to the Normal mode when the Trace view is selected. As the Normal mode provides a lower dynamic range, the measurable power range will automatically narrow down.

To obtain a wider dynamic range for low power measurements (< -40 dBm), you will need to set to the Average only mode. If the measurement is in the Trace view, a warning message will appear as the Trace view is only applicable for the sensor's Normal mode.

It is assumed that the 2050/60 X-Series is already connected to a signal generator.

- 1 Set up the signal generator as follows:
  - Pulse period: 500 µs
  - Pulse width: 100 µs
  - Amplitude: 5 dBm
  - Frequency: 1 GHz
  - Pulse: Enabled
- 2 Turn on the RF output of the signal generator. Launch the BenchVue Power Meter application (refer to **page 46**).
- 3 Create a Trace display view by clicking





4 Perform calibration and zeroing for an accurate measurement result.

Presets	-1
Calibration	-8
Zero Cal Cal + Zero	-15
Zero Type : INT EXT	-22

Figure 2-11 Performing calibration and zeroing

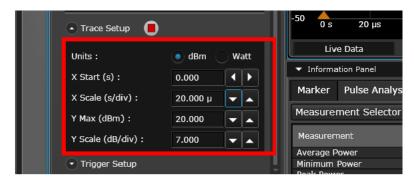
## NOTE

- For power measurement below -50 dBm, it is recommended to use external zero type for better accuracy and repeatability. Turn off RF output while performing external zeroing.
- Ensure that modulation is enabled.
- 5 Set the frequency of the 2050/60 X-Series to 1 GHz.

Mode :	Normal		-1	
Frequency (Hz) :	1.000 G		-8	
Averaging Mode :	AUTO	•	-15	



6 You can set the trace scales to configure the pulse on the trace display.





7 To enable gates on the trace, click  $\mathbf{I}$  at the Tools Palette.

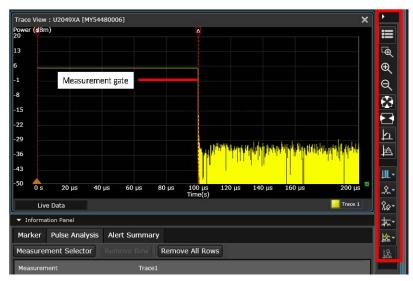


Figure 2-14 Adding marker or configuring the trace using Tools Palette controls

## NOTE

You can add markers or configure the trace using the Tools Palette controls. Refer to the **BenchVue Power Meter help** documentation for details on each control.

For more precise control of your gate parameters, you can set up the gates via the **Instrument Setup** tab and enter a starting point and length (in seconds) for each of the four gate controls.

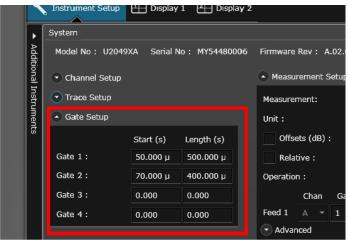
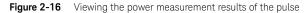


Figure 2-15 Setting the gates through Instrument Setup tab

8 View the power measurement results of the pulse at the **Pulse Analysis** tab under **Information Panel**.

Internation Panel         Marker       Pulse Analysis       Alert Summary         Measurement       Remove All Rows         Measurement       Trace1         Average Power       2.23 dBm         Minimum Power       -69.00 dBm         Peak Power       5.33 dBm         Sate 1 Delta Time       500.00 µs         Sate 1 Peak Power       5.33 dBm         Sate 2 Delta Time       400.00 µs         Sate 2 Delta Time       400.00 µs         Sate 2 Delta Time       400.00 µs	Live Data	Time(s)	Trace 1
Marker       Pulse Analysis       Alert Summary         Measurement       Remove All Rows         Measurement       Trace1         Average Power       2.23 dBm         Minimum Power       -69.00 dBm         eak Power       5.33 dBm         Sate 1 Delta Time       500.00 µs         Sate 1 Peak Power       5.33 dBm         Sate 1 Peak Power       5.33 dBm         Sate 2 Delta Time       400.00 µs         Sate 2 Delta Time       400.00 µs         Sate 2 Delta Time       400.00 µs	Live Data		
Measurement Selector       Remove All Rows         Measurement       Trace1         werage Power       2.23 dBm         Minimum Power       -69.00 dBm         Peak Power       5.33 dBm         Sate 1 Delta Time       500.00 µs         Sate 1 Peak Power       5.33 dBm         Sate 2 Delta Time       400.00 µs         Sate 2 Delta Time       400.00 µs         Sate 2 Delta Time       400.00 µs	<ul> <li>Information Panel</li> </ul>		
Measurement       Trace1         Average Power       2.23 dBm         Minimum Power       -69.00 dBm         Peak Power       5.33 dBm         Sate 1 Delta Time       500.00 µs         Sate 1 Average Power       -1.73 dBm         Sate 1 Peak Power       5.33 dBm         Sate 2 Delta Time       400.00 µs         Sate 2 Delta Time       400.00 µs         Sate 2 Delta Time       400.00 µs	Marker Pulse Analysis Al	ert Summary	
Average Power       2.23 dBm         Minimum Power       -69.00 dBm         Peak Power       5.33 dBm         Sate 1 Delta Time       500.00 µs         Sate 1 Average Power       -1.73 dBm         Sate 1 Peak Power       5.33 dBm         Sate 2 Delta Time       400.00 µs         Sate 2 Delta Time       400.00 µs         Sate 2 Average Power       -6.06 dBm	Measurement Selector	Remove All Rows	
Average Power 2.23 dBm 4inimum Power -69.00 dBm 4eak Power 5.33 dBm Sate 1 Delta Time 500.00 µs Sate 1 Average Power -1.73 dBm Sate 1 Peak Power 5.33 dBm Sate 2 Delta Time 400.00 µs Sate 2 Average Power -6.06 dBm	Measurement	Trace1	
Peak Power     5.33 dBm       Sate 1 Delta Time     500.00 μs       Sate 1 Average Power     -1.73 dBm       Sate 1 Peak Power     5.33 dBm       Sate 2 Delta Time     400.00 μs       Sate 2 Average Power     -6.06 dBm	Average Power	2.23 dBm	
Gate 1 Delta Time     500.00 µs       Gate 1 Average Power     -1.73 dBm       Gate 1 Peak Power     5.33 dBm       Gate 2 Delta Time     400.00 µs       Gate 2 Average Power     -6.06 dBm	Minimum Power	-69.00 dBm	
Sate 1 Delta Time     500.00 μs       Sate 1 Average Power     -1.73 dBm       Sate 1 Peak Power     5.33 dBm       Sate 2 Delta Time     400.00 μs       Sate 2 Average Power     -6.06 dBm	Peak Power	5.33 dBm	
Gate 1 Peak Power     5.33 dBm       Gate 2 Delta Time     400.00 µs       Gate 2 Average Power     -6.06 dBm	Gate 1 Delta Time	500.00 µs	
Sate 2 Delta Time 400.00 µs Sate 2 Average Power -6.06 dBm	Gate 1 Average Power	-1.73 dBm	
Sate 2 Delta Time 400.00 µs Sate 2 Average Power -6.06 dBm	Gate 1 Peak Power	5.33 dBm	
	Gate 2 Delta Time	400.00 µs	
Sate 2 Peak Power 5.27 dBm	Gate 2 Average Power	-6.06 dBm	
	Gate 2 Peak Power	5.27 dBm	



You can select additional pulse and gate measurements to display by clicking the **Measurement Selector** tab.

### Quick overview of the BenchVue Power Meter

NOTE

For details on each of the BenchVue Power Meter features, refer to the Keysight BenchVue Power Meter help documentation.

- **a** Access the common measurement settings for the current measurement display view.
  - Click 🗓 to create a new Digital Meter display view.
- -- Click [ Colline to create a new Analog Meter display view.
- -- Click to create a new Data Log display view.
- -- Click . to create a new Trace display view.
- -- Click 🛄 to create a new MultiList display view.
- Click 🕼 to assign a measurement to the selected display view.
- -- Click start estimate to start or stop all assigned measurements on all display views simultaneously.

For more information, refer to "" on page 57 and "Power meter settings in the Normal mode" on page 60.

Power Meter // U2049XA	// K-U2049XA-80006.pm	g.is.keysight.com		0	127	5
🔧 Instrument Setup 📘	Display 1	lav 2				
▲ Settings Datalog Set						•
		Digital Meter : U2049XA [M154480006] Meas: 1 Chan: A Avg 1 GHz			×	Ē
		Heas, I Chail, A Avy I Ghz				
U2049XA - MY54480006	Presets					Ŀ
<ul> <li>Calibration</li> </ul>						
Zero Ca	al Cal + Zero					
Zero Type :	INT EXT					
		0.01dBm				
Mode :	AVG only -					
Mode : Frequency (Hz) :	AVG only - 1.000 G	0:01001				
		0.0100				
Frequency (Hz) :	1.000 G 50.000 m					
Frequency (Hz) : Aperture (s) :	1.000 G 50.000 m	Min : 0.01	Max :	0.01		
Frequency (Hz) : Aperture (s) : Chan Offset (dB) :	1.000 G 50.000 m 0.000	Min: 0.01 ue tota		0.01		
Frequency (Hz) : Aperture (s) : Chan Offset (dB) : Duty Cycle(%) :	1.000 G 50.000 m 0.000 1.000	Min : 0.01 Les Das • Information Fanet		0.01		
Frequency (Hz) : Aperture (s) : Chan Offset (dB) : Duty Cycle(%) : Averaging Mode :	1.000 G 50.000 m 0.000 1.000 AUTO •	Min : 0.01 Une Data i Information Rend Nett Summary		0.01		
Frequency (Hz) : Aperture (s) : Chan Offset (dB) : Duty Cyclo(%) : Averaging Mode : Averaging Count :	1.000 G 50.000 m 0.000 1.000 AUTO 4 Reset Averaging	Min : 0.01 Let Data • Information famil Ment summary Clear All Save		0.01		
Frequency (Hz) : Aperture (s) : Chan Offset (dB) : Duty Cycle(%) : Averaging Mode :	1.000 G 50.000 m 0.000 1.000 AUTO 4 Reset Averaging	Min : 0.01 Une Data i Information Rend Nett Summary		0.01		

Figure 2-17 Common measurement settings pane

To access the data logger settings, click the **Datalog Settings** tab. To enable data logging, you need to stop the measurement acquisition.

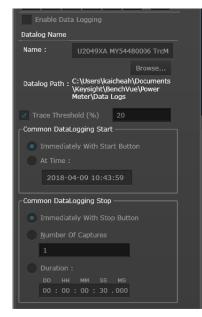


Figure 2-18 Datalog settings pane

Export the data log file and view the recorded data in Excel



**b** Save or load the instrument state of the current bench application in a proprietary format with a \*.*state* file extension.





**c** Access advanced settings such as corrections (frequency-dependent offset, gamma, and S-parameter), alert limits, recorder output, trace/pulse duration reference levels, input impedance, and trigger output.

For more information, refer to "Instrument Setup tab" on page 63.

1	Instrument Setup	Display 1 2 Display 2					
	System						
Addi	Model No: U2049XA	Serial No: MY54480006	Firmware Rev : A.02.0	2 Resource ID : TCPIP0:	::K-U2049XA-80006.png.is.	keysight.com::inst0::IN	ISTR Presets
► Additional Instruments	Channel Setup		Measurement Setup		Trigger Setup		
Instru	Mode :	Normal 👻	Measurement:	1 -	Mode :	Cont Trig 👻	
ment	Chan Offset (dB) :	0.000	Unit :	• dBm Watt	Source :	Internal 🝷	
ι N	Frequency (Hz) :	1.000 G	Offsets (dB) :		Enable Auto Level		
	Averaging Mode :	AUTO -	Relative :		Trigger Level (dBm) :		
	Averaging Count :		Operation :	None 👻	Delay (s) :	0.000	
		Reset Averaging	Chan Gat	е Туре	Slope Type :	• +Pos -Neg	
	Video Avg :			• Avg •	Advanced		
	Video B/W :	OFF -	Advanced		Holdoff (s) :	1.000 µ	
	Trace Setup		Alert Limits Enable Alert		Hysteresis (dB) :		
	Units :	AB 0 11/-14	Upper Limit (dBm) :	90.000	Qualification (s) :	100.000 n	
		dBm Watt	Lower Limit (dBm) :	-90.000	Input Impedance :	📃 Low 💿 High	
	X Start (s) :	0.000	Lower Linit (dbin) .	-90.000	Output Setting :	None 👻	
	X Scale (s/div) :	20.000 µ 🔻 🔺					
	Y Max (dBm) :	20.000 🗸 🔺					
	Y Scale (dB/div) :	7.000 🔻 🔺					
	Advanced						
	💽 Gate Setup						
	Calibration		Corrections				
	Zero Ca	al Cal + Zero	FDO Gamı	na S-Param			
[]	Zero Type :						

Figure 2-21 Instrument setup (advanced settings) pane

## Power meter settings in the Average only mode

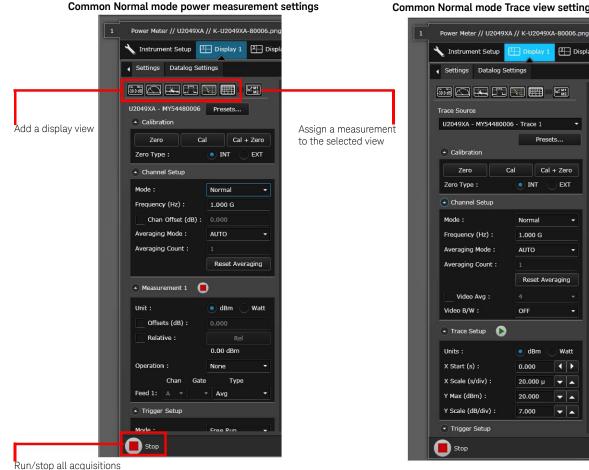
Power Meter // U2049XA // K-U2049XA-80006.png.is 1 2 Display Instrument Setup 1 Display 1 Settings Datalog Settings **∠**<sup>M1</sup><sub>M2</sub> -30.0 dB Add a display view Assign a measurement to U2049XA - MY54480006 the selected view Presets... Calibration Cal Cal + Zero Zero INT EXT Zero Type : Channel Setup Mode : AVG only • Frequency (Hz) : 1.000 G Aperture (s) : 50.000 m Chan Offset (dB) : Duty Cycle(%): Averaging Mode : AUTO Averaging Count : Reset Averaging Measurement 1  $\Box$ Start/Stop all acquisitions Figure 2-22 Power meter settings in the Average only mode

#### Common Average only mode power measurement settings

ltem	Description
Presets	<ul> <li>Preset the instrument to its default values or values appropriate for measuring the communications format. The data stored in the correction (FDO, gamma, and S-parameter) tables, the selected correction table, and the zeroing and calibration data are not affected by a preset.</li> </ul>
	- Perform a system reset.
Channel Setup	- Set the channel mode to the Normal or Average Only mode.
	- Set the measurement frequency.
	- Set the aperture size.
	<ul> <li>Set the channel offset which is applied to the measured power prior to any mathematical functions. Refer to "Simplified Measurement Path" on page 82.</li> </ul>
	- Set the duty cycle.
	<ul> <li>Set the automatic or manual measurement average mode. The number of readings averaged can range from 1 to 1024. Increasing the value of the measurement average reduces measurement noise, but increases measurement time. The measurement average filter can also be reset. Refer to "Typical Averaged Readings" on page 83.</li> </ul>
Calibration	Auto-calibrate the 2050/60 X-Series without having to connect it to a power reference, or auto-zero the 2050/60 X-Series internally or externally.
	Internal zeroing can be performed with or without the RF/microwave signal present, while external zeroing must be performed without any RF/microwave signal present.
Measurement	- Run/stop the measurement.
	- Set the logarithmic (dBm) or linear (Watt) measurement unit.
	<ul> <li>Set the measurement offset factor. The 2050/60 X-Series corrects every measurement by this factor to compensate for th gain/loss.</li> </ul>
	<ul> <li>Enable the relative mode, which computes the measurement result relative (as a ratio) to a reference value. When enabled the reference value can be set using the <rel> control. The relative reading is displayed in either dB or %.</rel></li> </ul>
	- Measurement feed operation is not available in the Average only mode.
Trigger Setup	- Set the single, free run, or continuous trigger mode. The free run mode does not allow any trigger setup.
	- Set the trigger source to an external source in the single or continuous trigger mode.
	- Set the delay time to be applied between the trigger event and all the gate start times. This allows you to time-shift all the gates by the same amount with one setting change.
	<ul> <li>Select the positive or negative slope type to determine if the trigger event is recognized on the rising or falling edge of a signal respectively.</li> </ul>
	- Set the holdoff time to disable the trigger mechanism after a trigger event occurs.
	- Set the qualification value.

 Table 2-1
 Power meter settings in the Average only mode description

## Power meter settings in the Normal mode



#### Common Normal mode Trace view settings

2 Displ

EXT

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Watt 1 >

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Figure 2-23 Power meter settings in the Normal mode

Item	Description
Presets	<ul> <li>Preset the instrument to its default values or values appropriate for measuring the communications format.</li> <li>The data stored in the correction (FDO, gamma, and S-parameter) tables, the selected correction table, and the zeroing and calibration data are not affected by a preset.</li> </ul>
	- Perform a system reset.
Channel Setup	- Set the channel mode to the Normal or Average Only mode.
	- Set the measurement frequency.
	<ul> <li>Set the channel offset which is applied to the measured power prior to any mathematical functions. Refer to "Simplified Measurement Path" on page 82.</li> </ul>
	<ul> <li>Set the automatic or manual measurement average mode. The number of readings averaged can range from 1 to 1024. Increasing the value of the measurement average reduces measurement noise, but increases measurement time. The measurement average filter can also be reset. Refer to "Typical Averaged Readings" on page 83.</li> </ul>
Calibration	Auto-calibrate the 2050/60 X-Series without having to connect it to a power reference, or auto-zero the 2050/60 X-Series internally or externally.
	Internal zeroing can be performed with or without the RF/microwave signal present, while external zeroing must be performed without any RF/microwave signal present.
Measurement	- Run/stop the measurement.
	- Set the logarithmic (dBm) or linear (Watt) measurement unit.
	<ul> <li>Set the measurement offset factor. The 2050/60 X-Series corrects every measurement by this factor to compensate for the gain/loss.</li> </ul>
	<ul> <li>Enable the relative mode, which computes the measurement result relative (as a ratio) to a reference value. When enabled, the reference value can be set using the <rel> control. The relative reading is displayed in either dB or %.</rel></li> </ul>
	- Enable the difference or ratio measurement, or disable all operations between feed 1 and feed 2.
	- Configure the gate and acquired measurement type for the feed.
Trigger Setup	- Set the single, free run, or continuous trigger mode. The free run mode does not allow any trigger setup.
	- Set the trigger source to an internal or external source.
	- Enable auto level or manually set the trigger level for the internal trigger source.
	<ul> <li>Set the delay time to be applied between the trigger event and all the gate start times. This allows you to time-shift all the gates by the same amount with one setting change.</li> </ul>
	<ul> <li>Select the positive or negative slope type to determine if the trigger event is recognized on the rising or falling edge of a signal respectively.</li> </ul>
	- Set the holdoff time to disable the trigger mechanism after a trigger event occurs.
	<ul> <li>Set the hysteresis to help generate a more stable trigger by preventing triggering unless the RF power level achieves the trigger level and the additional hysteresis value. It can be applied to both rising and falling edge trigger generation.</li> <li>Hysteresis is only available for the internal trigger source and manual trigger level.</li> </ul>
	- Set the qualification value.

 Table 2-2
 Power meter settings in Normal mode description

#### 2 General Operating Information

#### Table 2-2 Power meter settings in Normal mode description (continued)

Item	Description
Channel Setup (in the Trace view)	<ul> <li>Set the video averaging to average repetitions of a triggered signal, with a count of 1 to 256 in multiples of 2<sup>n</sup>. With video averaging, the average of a number of acquisitions is calculated to smooth the displayed trace and reduce apparent noise. The measurement requires a continuously repeating signal.</li> </ul>
	- Set the video bandwidth.
	The Low, Medium, and High pass band shapes achieved by the video bandwidth settings provide flat filter responses with very sharp cut-off points by applying digital signal processing techniques to ensure accurate power measurement within the specified band.
	When the video bandwidth is set to Off, it removes all digital signal conditioning. This provides less than 3 dB roll-off <sup>[a]</sup> and is best suited for capturing an accurate trace, minimizing overshoot, and removing any ringing effects caused by the sharp cut-off filters used in the Low, Med, and High settings. Refer to " <b>Bandwidth Filter Shapes</b> " on page 85.
Trace Setup	Set the trace unit, start time, X-axis scale, Y-axis maximum value, and Y-axis scale.
Trigger Setup (in the Trace view)	Select to enable trace for the single and continuous trigger modes.

[a] When the 2050/60 X-Series frequency is set to  $\geq$ 300 MHz.

## Instrument Setup tab

This tab provides you an option to configure additional instrument settings for your measurements as described in **Table 2-3**.

,	System					
۵dditi	Model No: U2049XA	Serial No: MY54480006	Firmware Rev : A.02.02	Resource ID : TCPIPO::I	K-U2049XA-80006.png.is.	keysight.com::inst0::INSTR
n al 1	Channel Setup		Measurement Setup		Trigger Setup	
Additional Instruments	Mode :	Normal 🔻	Measurement:	1 •	Mode :	Cont Trig 🔹
ment	Chan Offset (dB) :	0.000	Unit :	• dBm Watt	Source :	Internal 🔹
ń	Frequency (Hz) :	1.000 G	Offsets (dB) :	0.000	✓ Enable Auto Level	
	Averaging Mode :	AUTO 🔻	Relative :	Rel 0.00 dBm	Trigger Level (dBm) :	0.0
	Averaging Count :		Operation :	None 🔻	Delay (s) :	0.000
		Reset Averaging	Chan Gate	Туре	Slope Type :	• +Pos -Neg
	Video Ava :	4 •	Feed 1 A 🔹 1 🔹	Avg 🔹	• Advanced	

Figure 2-24 Instrument Setup tab

#### 2 General Operating Information

#### Table 2-3 Additional Instrument Setup tab settings description

Item	Available settings
	Advanced:
Trace Setup	<ul> <li>Set the trace reference levels to be used in the calculation of transition durations and occurrences. This allows transition measurements between non-standard reference levels.</li> </ul>
	- Set the trace reference level to be used in the calculation of pulse durations. This allows pulse duration measurements between non-standard reference levels.
	Set the gate start time and length.
Gate Setup	The gate start time is relative to the trigger event. Positive values set a measurement gate to a maximum time of 1 second after the trigger. Negative values set a measurement gate to a maximum time of 1 second before the trigger.
	Refer to " <b>Measurement Gates</b> " on page 86 for more information.
	<ul> <li>Set the frequency-dependent offset (FDO) which compensates for frequency-related changes in the response of your test system. The BenchVue Power Meter application can store 10 FDO tables with 512 frequency points each.</li> </ul>
Corrections	<ul> <li>Set the gamma and S-parameter corrections. The BenchVue Power Meter application can store 10 gamma/S-parameter tables with 1024 magnitude-phase pairs each. Also refer to "Simplified Measurement Path" on page 82 for the above corrections.</li> </ul>
	Advanced:
Measurement Setup	Enable alerts to detect when a measurement has crossed over a predefined upper and/or lower limit value. Refer to "Limit Checking Application Example" on page 87 for more information.
	Advanced:
	- Set the input impedance for the external TTL trigger to Low (50 $\Omega$ ) or High (100 k $\Omega$ ).
Trigger Setup	<ul> <li>Enable the trigger output where a TTL level high is produced at the Trig Out connector when the 2050/60 X-Series is triggered.</li> </ul>
	- Enable the 10 MHz timebase.
Additional Instruments	View all connected instruments and select any instrument to use on the BenchVue Power Meter application. You can connect up to 15 instruments per BenchVue Power Meter application.

## Overview of Multiple Power Sensor Operation

This section provides examples on how to operate multiple sensors using the BenchVue Power Meter application.

### Single bench operation

### Multiple Digital Meter display views

Select the instruments to use at  $\ensuremath{\mathsf{InstrumentSetup}}$  >  $\ensuremath{\mathsf{Additional Instruments}}$  . Add up to four

Digital Meter display views by clicking and selecting the measurement sources to display.

Instrument Setup	Measurement	Source Select	tion		×	c			
Connect All Disconnect All	Model No	Serial No	Meas ID	Channel	Meas Type	1			
	U2049XA	MY54480006			Avg				
CU2049XA	U2049XA	MY54480006	2	A	Avg				
Disconnect	U2049XA	MY54480006			Avg				
U2049XA	U2049XA	MY54480006		A	Avg				
HQ1000047	U2042XA	MY00000001			Avg				
Disconnect	U2042XA	MY00000001			Avg				
U2041XA	U2042XA	MY00000001	3	A	Avo -				
Disconnect					Ok	1			
wer Meter // U2049XA // K-U2049XA-80006.pr Instrument Setup 🔛 Display 1 🖽 Disp		12042XA // USB(	1::0x2A8D::0	<1C01::MY0000	0001::0::INSTR	R, U2041XA // USB0::0x2A	8D::0x0701::MY552	210011::0::INSTR 🕢	Ľ
Settings Datalog Settings	16					r			
CONTRACT DESCRIPTION OF A DESCRIPTIONO OF A DESCRIPTION O	Digital Meter	:: U2049XA [M	IY54480006]		×	Digital Meter : U2042X	A [MY00000001]		×
and the second s		: 02049XA [M 1 Chan: A		MHz	×	Digital Meter : U2042X Meas: 1 Chan		MHz	×
				MHz				MHz	×
049XA - HQ10000047 Presets	Meas: :	1 Chan: A	Avg 50			Meas: 1 Chan	: A Avg 50		× •
althration	Meas: :		Avg 50				: A Avg 50		×
Call Cal + Zero	Meas: :	1 Chan: A	Avg 50			Meas: 1 Chan	: A Avg 50		× •
Calification Calif	Meas: : - 6	1 Chan: A	Avg 50		¢	Meas: 1 Chan	: A Avg 50		•
Call Cal + Zero	Meas: : - 6 . Min : -6	1 Chan: A 1.2 1.36 ata	Avg 50 9 dE	8 <b>m</b> Max : -1	¢	Meas: 1 Chan - 78.0 Min : -93.96 Live Data	3 dB	m	•
Caltration Zero Cal Cal + Zero Cron Type : INT EXT Channel Setup Adde : AVG only -	Meas: : - 6 Min : -6 Live D Digital Meter	1 Chan: A 1.2 1.36 ata : U2041XA [M	Avg 50 9 de	5 <b>m</b> Max : -	50.86	Meas: 1 Chan - 7 8 . ( Min : -93.96 Live Data Digital Meter : U2049X	A Avg 50 D 3 d B	Max : -72.42	•
Caltration Zero Cal Cal + Zero Cro Type : INT EXT Channel Setup 40de : AVG only - Yrequency (Hz) : S0.000 M	Meas: : - 6 Min : -6 Live D Digital Meter	1 Chan: A 1.2 1.36 ata	Avg 50 9 de	5 <b>m</b> Max : -	50.86	Meas: 1 Chan - 78.0 Min : -93.96 Live Data	A Avg 50 D 3 d B	Max : -72.42	•
Image: Call         Call         Call + Zero           Zero         Call         Call + Zero           Zero         Call         Call + Zero           Zero         Call         Call + Zero           Catomonic         INT         EXT           Channel Setup         MVG only         •           Kode :         AVG only         •           requency (Hz) :         50.000 M         •           perture (a) :         S0.000 m         •	Meas: : - 6 ( Min : -6 Live D Digital Meter Meas: :	1 Chan: A 1.20 1.36 ata 1 U2041XA [M 1 Chan: A	Avg 50 9 de	Max : -(	50.86	Meas: 1 Chan - 7 8 . ( Min : -93.96 Live Data Digital Meter : U2049X Meas: 1 Chan	A Avg 50 D 3 dB A [HQ1000047] A Avg 50	Max : -72.42	•
Image: Call Call + Zero           Call Call + Zero           Zero         Call Call + Zero           Cero Type :         INT EXT           Channel Setup         INT EXT           Channel Setup         Ede :           AVG only •         so.000 M           perture (a) :         50.000 M           perture (a) :         50.000 M	Meas: : - 6 ( Min : -6 Live D Digital Meter Meas: :	1 Chan: A 1.20 1.36 ata 1 U2041XA [M 1 Chan: A	Avg 50 9 de	Max : -(	50.86	Meas: 1 Chan - 7 8 . ( Min : -93.96 Live Data Digital Meter : U2049X Meas: 1 Chan	A Avg 50 D 3 dB A [HQ1000047] A Avg 50	Max : -72.42	•
Image: Call         Call         Call + Zero           Zero         Call         Call + Zero           Zero         Call         Call + Zero           Zero         Call         Call + Zero           Catomonic         INT         EXT           Channel Setup         MVG only         •           Kode :         AVG only         •           requency (Hz) :         50.000 M         •           perture (a) :         S0.000 m         •	Meas: : - 6 ( Min : -6 Live D Digital Meter Meas: :	1 Chan: A 1.2 1.36 ata : U2041XA [M	Avg 50 9 de	Max : -(	50.86	Meas: 1 Chan - 7 8 . ( Min : -93.96 Live Data Digital Meter : U2049X	A Avg 50 D 3 dB A [HQ1000047] A Avg 50	Max : -72.42	•
Cal         Cal <td>Meas: : - 6 : Min : -6 : Live D Digital Meter Meas: : - 6 :</td> <td>1 Chan: A 1 . 2 ( 1.36 <sup>313</sup> <sup>120413XA [M 1 Chan: A 9 . 4 (</sup></td> <td>Avg 50 9 de</td> <td>Sm Max : -I MHz Sm</td> <td>50.86 ×</td> <td>Meas: 1 Chan - 7 8 . ( Min : -93.96 Live Data Digital Meter : U2049X Meas: 1 Chan - 6 6 . (</td> <td>A Avg 50 D 3 dB A [HQ1000047] A Avg 50</td> <td>т мах : -72.42 МНz т</td> <td>• 2 ×</td>	Meas: : - 6 : Min : -6 : Live D Digital Meter Meas: : - 6 :	1 Chan: A 1 . 2 ( 1.36 <sup>313</sup> <sup>120413XA [M 1 Chan: A 9 . 4 (</sup>	Avg 50 9 de	Sm Max : -I MHz Sm	50.86 ×	Meas: 1 Chan - 7 8 . ( Min : -93.96 Live Data Digital Meter : U2049X Meas: 1 Chan - 6 6 . (	A Avg 50 D 3 dB A [HQ1000047] A Avg 50	т мах : -72.42 МНz т	• 2 ×
Cal         Cal <td>Meas: : - 6 : Min : -6 : Digital Meter Meas: : - 6 : Min : -7</td> <td>1 Chan: A 1 . 2 ( 1.36 1 . 2 ( 1.36) 1 . 3 ( 1</td> <td>Avg 50 9 de</td> <td>Max : -(</td> <td>50.86 ×</td> <td>Meas: 1 Chan - 78. ( Min : -93.96 Uve Data Digital Meter : U2049X Meas: 1 Chan - 66. ( Min : -67.24</td> <td>A Avg 50 D 3 dB A [HQ1000047] A Avg 50</td> <td>Max : -72.42</td> <td>• 2 ×</td>	Meas: : - 6 : Min : -6 : Digital Meter Meas: : - 6 : Min : -7	1 Chan: A 1 . 2 ( 1.36 1 . 2 ( 1.36) 1 . 3 ( 1	Avg 50 9 de	Max : -(	50.86 ×	Meas: 1 Chan - 78. ( Min : -93.96 Uve Data Digital Meter : U2049X Meas: 1 Chan - 66. ( Min : -67.24	A Avg 50 D 3 dB A [HQ1000047] A Avg 50	Max : -72.42	• 2 ×
Cal         Cal <td>Meas: : - 6 Min : -6 Live D Digital Meter Meas: : - 6 Min : -7 Live D</td> <td>1 Chan: A 1 . 2 9 1.36 3ta 1 U2041XA (M 1 Chan: A 9 . 4 7 5.49 ata</td> <td>Avg 50 9 de</td> <td>Sm Max : -I MHz Sm</td> <td>50.86 ×</td> <td>Meas: 1 Chan - 7 8 . ( Min : -93.96 Live Data Digital Meter : U2049X Meas: 1 Chan - 6 6 . (</td> <td>A Avg 50 D 3 dB A [HQ1000047] A Avg 50</td> <td>т мах : -72.42 МНz т</td> <td>• 2 ×</td>	Meas: : - 6 Min : -6 Live D Digital Meter Meas: : - 6 Min : -7 Live D	1 Chan: A 1 . 2 9 1.36 3ta 1 U2041XA (M 1 Chan: A 9 . 4 7 5.49 ata	Avg 50 9 de	Sm Max : -I MHz Sm	50.86 ×	Meas: 1 Chan - 7 8 . ( Min : -93.96 Live Data Digital Meter : U2049X Meas: 1 Chan - 6 6 . (	A Avg 50 D 3 dB A [HQ1000047] A Avg 50	т мах : -72.42 МНz т	• 2 ×
Callbration Zero Cal Cal + Zero Zero Type : INT EXT Channel Setup Adde : AVG only - Frequency (Hz) : S0.000 M Aperture (a) : S0.000 m Chan Offset (dB) : 0.000 Duty Cycle(%) : 1.000 Averaging Mode : AUTO - Weeraging Count : 4 Reset Averaging	Meas: : - 6 Min : -6 Live D Digital Meter Meas: : - 6 Min : -7 Live D * Information	1 Chan: A 1 . 2 9 1.36 1 U204IXA [M 1 Chan: A 9 . 4 7 5.49 ata ata	Avg 50 9 de	Sm Max : -I MHz Sm	50.86 ×	Meas: 1 Chan - 78. ( Min : -93.96 Uve Data Digital Meter : U2049X Meas: 1 Chan - 66. ( Min : -67.24	A Avg 50 D 3 dB A [HQ1000047] A Avg 50	т мах : -72.42 МНz т	• 2 ×
Cal Cal - Zero Cal Cal - Zero Caro Type : INT EXT Channel Setup Channel Setup Channel Setup Chan Offset (dB) : 0.000 Chan Offset (dB) : 0.000 Duty Cycle(%) : 3.000 Wersaging Mode : 4 Reset Averaging Measurement 1	Meas: : - 6 Min : -6 Live D Digital Meter Meas: : - 6 Min : -7 Live D • Informator Alert Summ	1 Chan: A 1 . 2 9 1.36 1 . 2 9 1.36 1 . 2 9 1.36 1 . 2 9 1.36 5.49 3ta 5.49 3ta 5.49 3ta 5.49 3ta	Avg 50 9 de	Sm Max : -I MHz Sm	50.86 ×	Meas: 1 Chan - 78. ( Min : -93.96 Uve Data Digital Meter : U2049X Meas: 1 Chan - 66. ( Min : -67.24	A Avg 50 D 3 dB A [HQ1000047] A Avg 50	т мах : -72.42 МНz т	• 2 ×
Callbration Zero Cal Cal + Zero Zero Type : INT EXT Channel Setup Adde : AVG only - Frequency (Hz) : S0.000 M Aperture (a) : S0.000 m Chan Offset (dB) : 0.000 Duty Cycle(%) : 1.000 Averaging Mode : AUTO - Weeraging Count : 4 Reset Averaging	Meas: : - 6 : Min : -6 Live D Digital Meter Meas: : - 6 : Min : -7 Live D Min : -7 Live D - Information Alert Summ Clear All	1 Chan: A 1 . 2 9 1.36 1 U204IXA [M 1 Chan: A 9 . 4 7 5.49 ata ata	Avg 50 9 d B (1) Avg 50 2 d B	Sm Max : -( MHz Sm Max : -(	50.86 ×	Meas: 1 Chan - 78. ( Min : -93.96 Live Data Digital Meter : U2049X Meas: 1 Chan - 66. ( Min : -67.24 Live Data	A Avg 50 D 3 dB A [HQ1000047] A Avg 50	т мах : -72.42 МНz т	• 2 ×

Figure 2-25 Multiple Digital Meter display example

Additional
 Connect All

U2042XA

### Multi-list display view

Select the instruments to use at Instrument Setup > Additional Instruments. Add a Multilist

display view by clicking **mathematical selecting the measurement sources to display**.

6	0					
nt Setup 🖽 Dis	Measurement Source	e Selection			:	×
instruments	Model No	Serial No	Meas ID	Channel	Meas Typ	
Disconnect All	U2049XA	MY5448000	1	A	Avg	î
U2049XA	U2049XA	MY5448000			Avg	
MY54480006 connect	U2049XA	MY5448000			Avg	
U2049XA	U2049XA	MY5448000			Avg	
HQ10000047	U2042XA	MY0000000			Avg	
connect	U2042XA	MY0000000			Avg	
U2041XA	U2042XA	MY0000000	3	Α	Ava	-
MV55210011					Ok	
onnect						

Settings Datalog Set	iner	<b>1</b>									וה
Seconds Datalog Seco	ings	Multili	st View							×	
	VI 💷 🖂		Model No.	Serial No.	Result	Unit	Meas.	Chan	Туре		
U2049XA - MY54480006	Maas1 •	•	U2049XA	MY54480006	-61.22	dBm	1	A	Avg		
			U2042XA U2041XA	MY00000001 MY55210011	-71.13 -65.03	dBm		A	Avg		
	Presets		U2041XA U2049XA	HQ10000047		dBm dBm	1	A A	Avg Avg		
<ul> <li>Calibration</li> </ul>		Ľ.	0201920	11210000017	-00.05	OBIII			A19		
Zero Ca	I Cal + Zero										
Zero Type :											
Channel Setup										<u>i</u>	
	(	Oper	and#1	Operation	Operand#2	P	tesult				
Mode :	AVG only -						_				
Frequency (Hz) :	50.000 M										
Aperture (s) :	50.000 m										
Chan Offset (dB) :											
Duty Cycle(%) :											
Averaging Mode :	AUTO -										
Averaging Count :											
County County		<b>T</b> Inf	ormation Panel								2
	Reset Averaging										
• Measurement 1			t Summary								
	•	Cle	ar All	Save							

Figure 2-26 Multi-list display example

## Single Trace display view with multiple traces

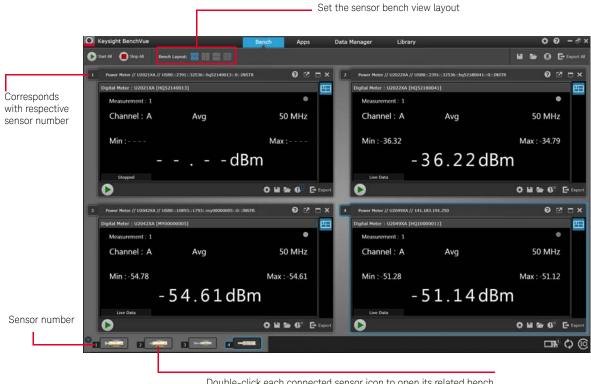
Select the instruments to use at Instrument Setup > Additional Instruments. Add a Trace

display view by clicking [] and selecting the trace sources to display.

Additional Instruments	Measurement Source Selecti	ion	×	
Connect All Disconnect All	Model Nc Serial No Channe 112049XA MY\$4480K A 112042XA MY\$0000K A 112049XA HQ10000 A	Trace 1 Trace 2 Trace 3	Trace 4	
3 Settings Datalog Settings Settings Datalog Settings Trace Source U2049XA - MY54480006 - Trace 3 Presets Calibration	/ 2 Multitrace View Power (dBm) 20 13 6 -1			×
Zero Cal Cal + Zero Zero Type : INT EXT Channel Setup Trace Setup Units : O.000 () X Scale (s/div) : 50.000 µ () Y Max (dBm) : 20.000 ()	-8 -15 -22 -29 -36 -43 -50 0 s 50 µs	100 µs 150 µs 200	In Ministry of the Ministry of	350 µs 400 µs 450 µs 500 µs ®
Y Scale (d0/div) : 2.000 ▼ ▲	Live Data  Tinformation Panel  Marker Pulse Analysis  Measurement Selector  Measurement  Average Power  Minimum Power  Data Rower	Alert Summary Remove Row Remove All Trace1 -69.00 dBm -69.00 dBm	i Rows Trace2 -2.07 dBm -69.00 dBm -0.32 dDm	Trace 3 3.66 dBm -69.00 dBm -6.64 dBm -6.64 dBm -6.64 dBm -6.65 dB

Figure 2-27 Multi-trace example

## Multiple bench operation



Double-click each connected sensor icon to open its related bench application window

Figure 2-28 Multiple bench display example

## Exploring the 2050/60 X-Series Web Interface

You can use the 2050/60 X-Series's Web Browser Interface for remote access and control of the instrument via a Web browser, such as Google Chrome, Microsoft Edge and Opera. Using the Web Interface, you can configure, troubleshoot, and monitor your system remotely. This section provides an overview of the 2050/60 X-Series Web Interface.

## Launching the web interface

- 1 Open your Internet browser from your computer.
- 2 From the **Tools > Internet Options** menu, navigate to **Connections** (exact navigation depends on your browser), and then select **LAN Settings**.
- **3** From the LAN Settings dialog, select/activate bypass proxy server for local addresses (exact terminology depends on your browser).
- 4 Exit the Options window.
- 5 Enter the IP address of the 2050/60 X-Series in the Address field and press Enter.
- **6** After entering the appropriate IP address, the 2050/60 X-Series Web Interface's Welcome Window should appear.

NOTE

The procedure in this section helps you understand the tasks commonly performed using the 2050/60 X-Series Web Interface. For additional help about using the interface, click **Help with the Page** tab on the lower-left corner of the Web Interface window.

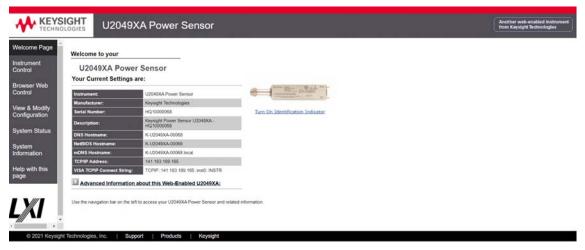


Figure 2-29 2050/60 X-Series Web Interface's Welcome Window

Navigation Bar

Welcome Page	Welcome page: Displays the detailed information.
Instrument Control	<b>Instrument Control:</b> Allows you to control the configuration of sensor setting, through different HTML input types (such as: buttons/text input/radio buttons and so on).
Browser Web Control	<b>Browser Web Control:</b> Displays the SCPI command interface for sending/reading SCPI commands.
View & Modify Configuration	<b>View &amp; Modify Configuration:</b> Displays the instrument configuration information. It also allows you to modify it.
System Status	<b>System Status:</b> Displays the status of the instrument (name, serial number and status).
System Information	System Information: Displays the instrument firmware information.
Help with this page	Help with this Page Displays the Help file



## Displaying the Instrument control page

- 1 From the Welcome Window, click **Instrument Control** tab on the left side of the window.
- 2 Click Enter Password.

A pop-up window appears, requesting for password.

**3** Enter password (default password is "keysight") and click **Submit**. You can view the instrument control panel of the 2050/60 X-Series sensors.

	ower Sensor	from Keysight Technologies	
Welcome Page Instrument Control		word to continue. You should see a password dialog. How ity allow popups and click the button below. Entor Password	ever, the dialog may have been
		C Inter Passed - GoogL - C × Not secure 192-165.5115/password Enter Password (Password coverly defa.t vsyspt?) Password Coverly defa.t vsyspt?) Cancel Submit Cancel	

Figure 2-31 Password Panel

**4** Using various available HTML buttons/text input/radio buttons, you can control configuration of sensor settings in the instrument control panel.

	Instrument Control Interface	
	Instrument Control for U2049XA	
Measurement	Digital Meter Display :	Acquisition Status
Channel	Preguency : 10:00 MHz	glebhaarmant Near (3
Calibration	Mode: AVER C	hen : A
System	Max Cher Ma I	L Alua
	-60.71 dBm	-60.71 dBr
	-60.71	dBm
	00.71	abiii

Figure 2-32 Instrument control panel

## Measurement Panel

Measurement panel allows you to configure unit selection, measurement offset and measurement relative settings.

- 1 Unit Sets the power measurement unit for the specified CALCulate block. By default, it is set to dBm. The corresponding SCPI command is UNIT[1]|2|3|4:POWer W|DBM.
- 2 Offset Sets the offset value on the specified CALCulate block. Select **Offset (dB)** check box for the offset text box to appear and enter the desired value to set the offset value. Deselect the check box to disable the offset field. By default, this field is disabled. The corresponding SCPI command is CALCulate[1]|2|3|4:GAIN[:MAGNitude].
- 3 Relative Enable/disables the relative mode. Select **Relative** check box to apply the current relative value set by CALCulate:RELative:MAGNitude:AUTO to the measurement signal. Deselect the

check box so that the measurement signal remains unchanged. By default, this field is disabled. The corresponding SCPI command is CALCulate[1]|2|3|4:RELative:STATe ON|OFF|1|0.

When the sensor is set to NORMAL mode in Channel panel, additional options are added in the measurement panel that allow you to configure the operation type and feed of the measurement signal.

Measurement	
Measurement : Unit :	● dBm ○ Watt
✓ Offset(dB) :	0.00
Relative :	Relative
	•,••

Figure 2-33 Measurement Relative setting

- 4 Operation Sets the specified CALCulate block to None, (single channel), Difference or Ratio measurement. The corresponding SCPI command is CALCulate[1]|2|3|4:MATH [:EXPRession] "(SENS1)"|"(SENS1-SENS1)"|"(SENS1/SENS1)".
- 5 Feed 1/Feed 2 Sets the input measurement mode to be fed into the specified input on the CALCulate block. Currently, the Channel and Gate options are set by the system and you cannot to change them in Phase1, the web interface allows you to set the Feed type to Avg, Peak, Pk-Avg and Min. The corresponding SCPI command is CALCulate[1]]2|3|4:FEED[1]|2 "POW:PEAK"|"POW:PTAV"|"POW:AVER"|"POW:MIN".

Measurement			
Measurement :			
Unit :	⊙dBm ⊂	⊃Watt	
✓ Offset(dB) :	0.00		
Relative :	Relative		
	-,		
Operation :	None	~	
	Chan :	Gate :	Type :
Feed 1 :	A 🗸	$\checkmark$	Avg 🗸

Figure 2-34 Operation and Feed Setting

### Channel Panel

In channel panel, you can configure channel mode, channel frequency, aperture time, channel offset, duty cycle and averaging mode settings.

When the sensor is set to NORMAL mode, you can configure channel mode, channel frequency, channel offset and averaging mode + averaging count

- 1 Channel Mode Sets the measurement mode to normal or average. Select Average or Normal mode from the drop down. By default, the power sensor is set to Average mode. The corresponding SCPI command is [:SENSe[1]:]DETector:FUNCtion.
- 2 Channel Frequency Sets the frequency of the signal. Select the desired unit from the drop down and enter the frequency value. The frequency range allowed for 2050/60 X-Series sensors is 1 kHz to 1000 GHz. By default, the frequency is set to 50 MHz. The corresponding SCPI command is [:SENSe[1]:]FREQuency[:CW|:FIXed] <numeric\_value>.
- 3 Chan Offset Sets the channel offset for 2050/60 X-Series sensors. Select Chan Offset (dB) check box for the channel offset text box to appear and enter the desired value to set the channel set value. Deselect the check box to disable the channel offset value. By default, this setting is disabled. The corresponding SCPI commands are [:SENSe[1]:]CORRection:GAIN2[:INPut]:STATE ON|OFF|1|0 and [:SENSe[1]:]CORRection:GAIN2[:INPut]:MAGNitude] <numeric\_value>
- 4 Averaging mode Sets the averaging mode. Select one of the averaging mode options (AUTO/MANUAL /OFF) from the drop down. By default, the averaging mode is set to AUTO.
  - **a** AUTO Enables averaging and automatic filter length. The corresponding SCPI command is [:SENSe[1]:]AVERage:COUNt:AUTO ON|1
  - **b** MANUAL Enables averaging, but disables automatic filter length, therefore the filter length can be manually set in the averaging count text box. The corresponding

SCPI command is [:SENSe[1]:]AVERage:COUNt:AUTO OFF| 0 + [:SENSe[1]:]AVERage:COUNt <numeric\_value>

 C OFF – Disables averaging. The corresponding SCPI command is [:SENSe[1]:]AVERage[:STATe] OFF |0
 When the sensor is set to AVERAGE mode, an additional setting is added in the channel panel that allows you to configure aperture time and duty cycle

Channel	
Channel Setup :	
Mode :	Normal 🗸
Frequency :	50.00 MHz 🗸
☑ Chan Offset(dB) :	10.00
Averaging Mode :	AUTO 🗸
	Reset Averaging

Figure 2-35 Channel Setup -Normal Mode

- 5 Aperture time Sets the aperture duration or measurement interval. Select the unit from the drop down and enter the aperture time value. The range of aperture time allowed for 2050/60 X-Series sensors is 20us to 200ms for >= 300 MHz. For <300 MHz, the minimum aperture size is 50us. By default, the aperture is 50ms. The corresponding SCPI command is [:SENSe[1]:]SWEep:APERture <numeric\_value>.
- 6 Duty cycle Sets the pulse power measurement value. Select Duty Cycle() check box for the duty cycle text box to appear and enter the desired value. Deselect the check box to disable the pulse power measurement value. By default, this field is disabled. The corresponding SCPI command is [:SENSe[1]:]CORRection:DCYCle|GAIN3:STATE ON|OFF|1|0 and [:SENSe[1]:]CORRection:DCYCle|GAIN3[:INPut][:MAGNitude] <numeric\_value>

Channel		
Channel Setup :		
Mode :	Average 🗸	
Frequency :	50.00	MHz 🗸
Aperture(s) :	50.00	ms 🗸
✓ Chan Offset(dB) :	10.00	
Duty Cycle() :	I	
Averaging Mode :	AUTO 🗸	
	Reset Averaging	

#### **Calibration Panel**

In calibration panel, the following three buttons can be used to trigger the calibration subsystem to perform zero calibration and auto calibration on the 2050/60 X-Series sensors:

- 1 Zero Click to execute the auto-zeroing routine on channel A. The corresponding SCPI command is CAL:ZERO:AUTO ONCE.
- **2** Cal Click to perform auto-calibration on channel A. The corresponding SCPI command is CAL:AUTO ONCE.
- 3 Zero + Cal Click to perform zero as well as auto calibration (CALibration[1]:ZERO:AUTO ONCE + CALibration[1]:AUTO ONCE) on Channel A. The corresponding SCPI command is CAL:ALL.
- **4** Zero Type Sets the external or internal zeroing mode. The corresponding SCPI command is CAL:ZERO:TYPE INT|EXT.

Calibration		
Calibration :	Cal	Zero + Cal
Zero Type :	©INT ○EXT	



### System Panel

The System panel allows you to select one of the following options:

- 1 Presets This button is still under development in Phase 1. Currently, only DEFAULT preset option is supported.
- 2 Reboot This button reboots the sensor..
- 3 IO Timeout Sets the timeout period for the sensor so that it waits before the complete execution of SCPI read command in case it fails to return the corresponding result. Currently the limit is set between 5s 60s.
- **4** Auto Measurement Time Sets the refresh rate of displaying the reading on Digital Meter Display Panel.
- 5 System Connection Status Shows the status of the web server connection. It shows "Connected" when the connection is established, else it shows "Disconnected. You may consider restarting the sensor in case you face any issues with the web server connection.

6 Toggle Dark Mode – Toggles between dark mode and bright mode layout for the web interface. Dark mode displays the background in black color, whereas bright mode background in white color.

System	
System :	
Presets	Reboot
IO Timeout :	60 s
Auto Measurement Time :	50 ms
System Connection Status :	Connected
	Toggle Dark Mode

Figure 2-38 System panel

Preset Instrument		
Please Select Preset Type :		
Category : All 🗸		
DEFAULT		
	Preset	
Reset Instrument		
	Reset	

Figure 2-39 System Panel - Presets and Reset

### Digital Meter Display Panel

In Digital Meter Display panel, the following buttons are used to trigger the measurement: 1) Start 2) Stop 3) Single Measurement and displaying information on current measurement such as 4) Current Measuring Information: Frequency, Mode, Feed Type, Meas, Chan 5) Min and Max measurement logged 6) A Clear the min and max button to clear the minimum and maximum value logged 7) Power Measurement Value.

Digital Meter Display :		Acquisition Status:
	Start Stop SingleMeasurement	
Frequency : 50.00 MHz	Meas:1	
Mode : AVER	Chan : A	
Feed Type : POW:AVER		
Min		Мах
-61.69 dB	Ciear Min & Max	-61.69 dB
	-61.69dB	

Figure 2-40 Digital Meter Display

### Footer

This Web Interface is supported and can be best viewed with the latest version of Google Chrome, Opera and Microsoft Edge web browsers.

Please use Google Chrome to view this webpage.						
© 2021 Keysight Technologies, Inc.	Support	I	Products	t	Keysight	

Figure 2-41 Footer

### System Error

There is a System Error bar on the top of the Web Interface, to display the error message returned from the execution of a SCPI command.



Figure 2-42 System error

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Keysight 2050/60 X-Series Wide Dynamic Range Power Sensors User's Guide

# 3 Characteristics and Specifications



For the characteristics and specifications of the 2050/60 X-Series, refer to the datasheet at http://literature.cdn.keysight.com/litweb/pdf/5992-0040EN.pdf.



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Keysight 2050/60 X-Series Wide Dynamic Range Power Sensors

### User's Guide

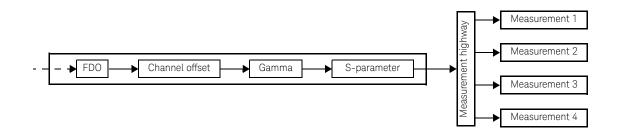
# A Appendix

Simplified Measurement Path 82 Typical Averaged Readings 83 Bandwidth Filter Shapes 85 Measurement Gates 86 Limit Checking Application Example 87



#### A Appendix

## Simplified Measurement Path



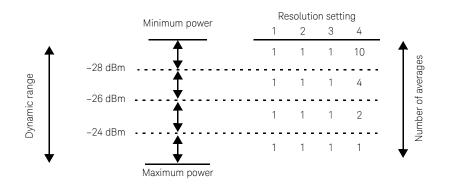
Number of averages

## Typical Averaged Readings

Below shows the typical number of averages for each range and resolution when the 2050/ 60 X-Series is in the auto-average mode and set to the normal speed mode.

	Minimum power		Resolution setting			
		1	2	3	4	
< −70 dBm	<b>‡</b>	100	100	100	100	
	\$	100	100	100	100	
–70 dBm	1	100	100	100	100	
–68 dBm	<u>1</u>	100	100	100	100	
–66 dBm	•••••	100	100	100	100	
–64 dBm						
–62 dBm		65 	100	100	100	
–60 dBm		26	100	100	100	
–58 dBm	\$	10	100	100	100	
	\$	4	100	100	100	
–56 dBm	1	2	100	100	100	
–54 dBm	•••••	1	65	100	100	
–52 dBm						
–50 dBm		1	26	100	100	
–48 dBm		1	10	100	100	
–46 dBm	<b>.</b>	1	4	100	100	
	1	1	2	100	100	
–44 dBm	••••••	1	1	65	100	
–42 dBm			<b></b> 1	26	100	
–40 dBm						
–38 dBm	·····¥	1	1	10 	100	
–36 dBm	<b>Ţ</b>	1	1	4	100	
-34 dBm	<b>‡</b>	1	1	2	100	
	\$	1	1	1	65	
–32 dBm	••••••••••••••••••••••••••••••••••••••	1	1	1	26	
◆ -30 dBm						

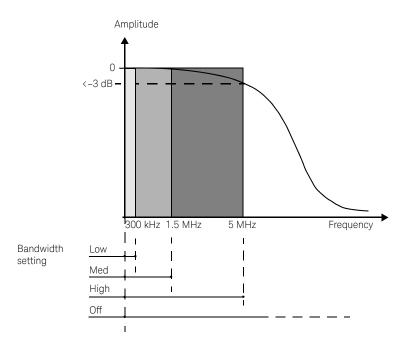
Dynamic range



The four resolution levels represent:

- 1, 0.1, 0.01, 0.001 dB respectively if the measurement suffix is dBm or dB.
- 1, 2, 3, or 4 significant digits respectively if the measurement suffix is W or %.

# Bandwidth Filter Shapes<sup>[1]</sup>



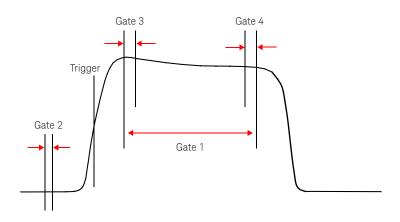
[1] When the 2050/60 X-Series frequency is set to  $\geq$ 300 MHz.

### Measurement Gates

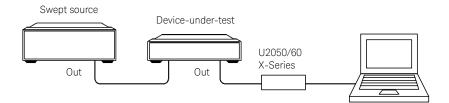
A measurement gate allows measurements to be performed on particular sections of the input signal. The gate is defined by a start time relative to the trigger event and a duration. Signal samples acquired during the time interval specified by the gate are used for the measurements in that gate. A system of up to four independent gates is provided.

Below is an example of a 4-gate setup to perform the following measurements simultaneously:

Average power level of the pulse	Gate 1, average measurement
Average "off" power level ahead of the pulse	Gate 2, average measurement
Peak-to-average ratio	Gate 1, peak-to-average measurement
Pulse droop	Gate 3, average measurement, minus Gate 4, average measurement



## Limit Checking Application Example



The limits have been set at +4 dBm and +10 dBm for the above application. A fail occurs each time the output power is outside these limits as shown below.

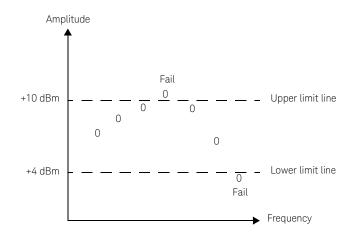


 Table A-1
 Range of values for limits

Unit	Maximum	Minimum	Default maximum	Default minimum
dB	+200 dB	-180 dB	60 dB	-120 dB
dBm	+230 dBm	–150 dBm	90 dBm	-90 dBm
%	10.0 Z%	100.0 a%	100.0 M%	100.0 p%
W	100.000 EW	1.000 aW	1.000 MW	1.000 pW

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This information is subject to change without notice. Always refer to the English version at the Keysight Web site for the latest revision.

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