Keysight U2040 X-Series Wide Dynamic Range Power Sensors

Wide dynamic range power sensors for any modulated signals











KEYSIGHT TECHNOLOGIES User's Guide

Notices

Copyright Notice

© Keysight Technologies 2015 No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Keysight Technologies as governed by United States and international copyright laws.

Manual Part Number

U2041-90002

Edition

Edition 1, May 20, 2015

Printed in:

Printed in Malaysia

Published by:

Keysight Technologies Bayan Lepas Free Industrial Zone, 11900 Penang, Malaysia

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Declaration of Conformity

Declarations of Conformity for this product and for other Keysight products may be downloaded from the Web. Go to http://www.keysight.com/ go/conformity. You can then search by product number to find the latest Declaration of Conformity.

U.S. Government Rights

The Software is "commercial computer software," as defined by Federal Acquisition Regulation ("FAR") 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement ("DFARS") 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at http://www.keysight.com/ find/sweula. The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinguish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), as applicable in any technical data.

Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DIS-CLAIMS ALL WARRANTIES. EITHER EXPRESS OR IMPLIED, WITH REGARD TO THIS MANUAL AND ANY INFORMA-TION CONTAINED HEREIN, INCLUD-ING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MER-CHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSE-QUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR OF ANY INFORMATION CON-TAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WAR-RANTY TERMS COVERING THE MATE-RIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT SHALL CONTROL.

Safety Information

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Environmental Conditions

The U2040 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
Temperature	Operating condition – 0 °C to 55 °C [For U2049XA Option TVA, this operating condition is applicable for both standard atmospheric environment and thermal vacuum environment.]
	Storage condition - -40 °C to 70 °C - -40 °C to 100 °C (for U2049XA Option TVA)
Humidity	Operating condition – Up to 95% RH at 40°C (non-condensing) Storage condition – Up to 90% RH at 65°C (non-condensing)
Altitude	Operating condition - Up to 3000 m (9840 ft) Storage condition - Up to 15420 m (50000 ft)

Regulatory Information

The U2040 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

Regulatory Markings

	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.	X	This product complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical/electronic product in domestic household waste.
MSIP-REM-Kst- XXXXXXXXX	This symbol is a South Korean Class A EMC Declaration. This is a Class A instrument suitable for professional use and in electromagnetic environment outside of the home.		

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/ 96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

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.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- 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)

1

Environmental Conditions3Regulatory Information3Regulatory Markings4Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC5Product category5
Sales and Technical Support
Getting StartedOverview14Initial Inspection17Standard shipped items17Hardware Installation and Configuration19Connect the U2041XA/42XA/43XA/44XA sensor19Connect the U2049XA sensor21Mount the U2049XA Option TVA36Mounting dimensions36Mounting procedure37LED Indicator Sequence During Power-Up for the U2041XA/42XA/43XA/44XA Sensor39Other LED indicators39LED Indicator Sequences for the U2049XA Sensor40Firmware Upgrade41
General Operating InformationUsing the U2040 X-Series with the Keysight BenchVue

2

Multiple bench operation
U2040 X-Series Features
Broadband coverage for any modulated signal formats
List mode/test sequencing67
Variable aperture size
Auto burst detection
20-pulse measurements
High average count reset
Built-in radar and wireless presets
Gamma correction
S-parameter correction
Tilt measurement

3 Characteristics and Specifications

A Appendix

Simplified Measurement Path	76
Typical Averaged Readings	77
Bandwidth Filter Shapes	79
Measurement Gates	80
Limit Checking Application Example	81

List of Figures

Figure 1-1	U2041/42/43/44XA sensor	15
Figure 1-2	U2049XA sensor	16
Figure 1-3	Connect the U2041XA/42XA/43XA/44XA sensor to the PC	19
Figure 1-4	Auto-locate a USB instrument in Keysight Connection	
	Expert	
Figure 1-5	Connect the U2049XA via Dynamic IP	21
Figure 1-6	Set automatic LAN settings on the PC	
Figure 1-7	Add a LAN instrument in Keysight Connection Expert via	
	host name	
Figure 1-8	Auto-locate a LAN instrument in Keysight Connection E	
	pert via Dynamic IP	
Figure 1-9	Connect the U2049XA via Auto IP	
Figure 1-10	Connect the U2049XA via Static IP	
Figure 1-11	Set manual LAN settings on the PC	
Figure 1-12	Auto-locate a LAN instrument in Keysight Connection E	
E. 1 10	pert via Static IP	
Figure 1-13	U2049XA web-based interface (Welcome page)	
Figure 1-14	View and modify LAN configuration settings	
Figure 1-15	Modify and renew LAN configuration settings	
Figure 1-16	U2049XA Option TVA mounting dimensions	
Figure 2-1	Launch the Keysight BenchVue	
Figure 2-2	Common measurement settings pane	
Figure 2-3 Figure 2-4	Datalog settings paneExport the data log file	
Figure 2-4	Save/load the instrument state	
Figure 2-6	Instrument setup (advanced settings) pane	
Figure 2-7	Power meter settings in the Average only mode	
Figure 2-8	Power meter settings in the Normal mode	
Figure 2-9	Instrument Setup tab	
Figure 2-10	Multiple Digital Meter display example	
Figure 2-11	Multilist display example	
Figure 2-12	Multitrace example	
Figure 2-13	Multiple bench display example	
Figure 2-14	DUT to U2040 X-Series connection diagram	
Figure 2-15	Non-ideal 2-port device	
Figure 2-16	Tilt measurement graph	

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

List of Tables

Table 1-1	Other LED indicators	39
Table 1-2	Other LED indicators	40
Table 2-1	Power meter settings in the Average only mode	
	description	57
Table 2-2	Power meter settings in the Normal mode description 59	
Table 2-3	Additional Instrument Setup tab settings description	62
Table 2-4	Aperture size	68
Table A-1	Range of values for limits	81

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Keysight U2040 X-Series Wide Dynamic Range Power Sensors

User's Guide

1 Getting Started

Overview 14 Initial Inspection 17 Standard shipped items 17 Hardware Installation and Configuration 19 Connect the U2041XA/42XA/43XA/44XA sensor 19 Connect the U2049XA sensor 21 Mount the U2049XA Option TVA 36 Mounting dimensions 36 Mounting procedure 37 LED Indicator Sequence During Power-Up for the U2041XA/42XA/43XA/44XA Sensor 39 Other LED indicators 39 LED Indicator Sequences for the U2049XA Sensor 40 Other LED indicators 40 Firmware Upgrade 41

This chapter gets you started with the U2040 X-Series wide dynamic range power sensors.



1 Getting Started

Overview

The U2040 X-Series wide dynamic range power sensors consist of four USB models and a LAN model:

- U2041XA USB wide dynamic range average power sensor (10 MHz to 6 GHz)
- U2042XA USB peak and average power sensor (10 MHz to 6 GHz)
- U2043XA USB wide dynamic range average power sensor (10 MHz to 18 GHz)
- U2044XA USB peak and average power sensor (10 MHz to 18 GHz)
- U2049XA LAN power sensor (10 MHz to 33 GHz, LXI Class C compliant)

The U2040 X-Series is capable of measuring the average and peak power of modulated, pulsed, and continuous wave (CW) signals in 10 MHz to 33 GHz frequency range and -70 dBm to 26 dBm power range.

The U2049XA 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 U2049XA. The U2049XA must be connected to a PoE port, which supplies the DC power required to power up the U2049XA and to transfer data.

The U2049XA is provided with two options; Option 100 and Option TVA. Option TVA is a thermal vacuum option for use within a thermal vacuum (TVAC) chamber.

CAUTION

Ensure that the U2049XA Option 100 is covered with the LAN sensor casing provided to meet performance specifications during operation. It is strongly recommended not to remove the sensor casing.

CAUTION

As the U2049XA Option TVA 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 U2049XA Option TVA**" on page **36** for more information.

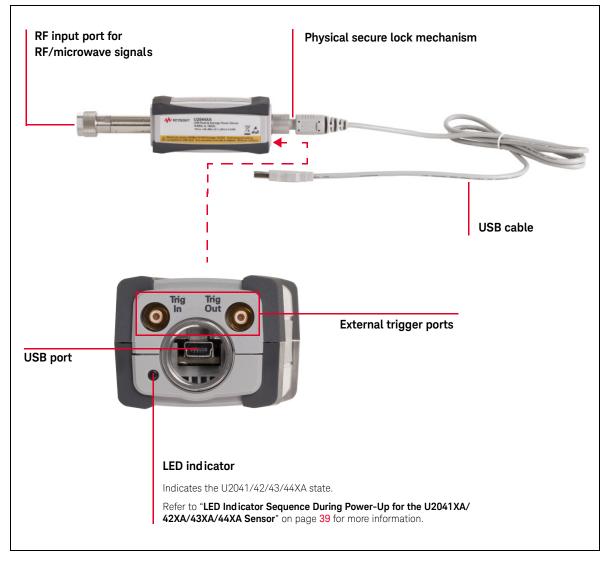
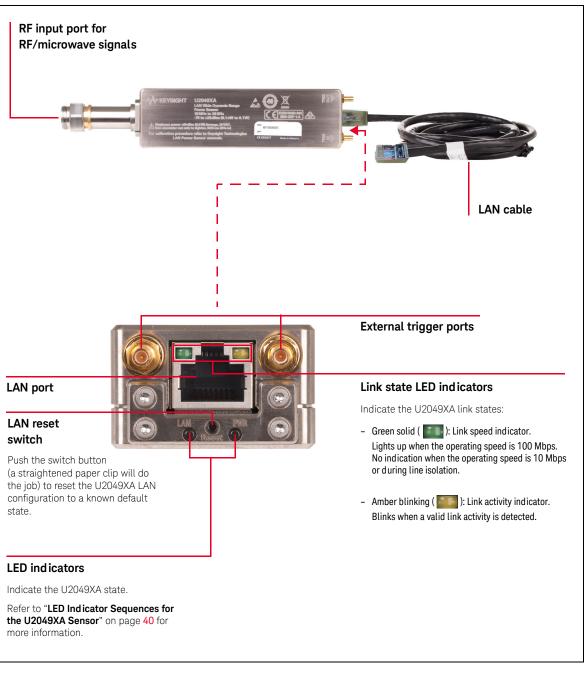


Figure 1-1 U2041/42/43/44XA sensor





Initial Inspection

When you receive your U2040 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.

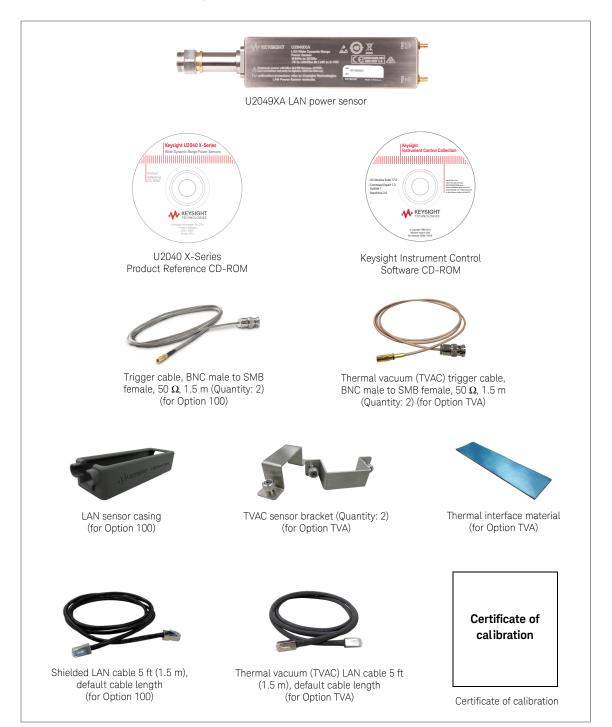
Standard shipped items

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



U2041XA/42XA/43XA/44XA USB power sensor:

U2049XA LAN power sensor:



Hardware Installation and Configuration

NOTE

For power measurements of < –60 dBm, it is recommended to turn on the U2040 X-Series for 1.5 hours (with the U2040 X-Series connected to the device-under-test).

Prior to using the U2040 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 U2041XA/42XA/43XA/44XA sensor

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

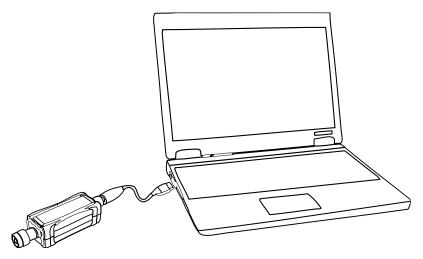


Figure 1-3 Connect the U2041XA/42XA/43XA/44XA sensor to the PC

2 Launch the Keysight Connection Expert by selecting the IO icon (💿). Auto-locate the sensor as shown in **Figure 1-4**. Click **Rescan** to start searching.

Keysight Connection Expert			
Instruments PXI/AXIe Chassis Manual Con	nfiguration Settings		
Rescan Filter Instruments: Clear			
U2042XA, Keysight Technologies	Details for Keysight Technologies U2042XA		
USB0::0x2a8d::0x701::MY00000005::0::INSTR	Manufacturer:Keysight TechnologiesModel:U2042XASerial Number:MY00000005Firmware Version:A.01.01	View Instrument Information Online	
	Connection Strings		
	VISA Addresses USB0::0x2a8d::0x701::MY00000005::0::INSTR	Send Commands To This Instrument Start IO Monitor	
	VISA Aliases	Add or Change Aliases	
	 SICL Addresses 		
	Installed Drivers		
		Update Drivers	
Messages: 9 Clear	Remote IO Server (Off Keysight VISA is Primary 17.0.18811.7	

Figure 1-4 Auto-locate a USB instrument in Keysight Connection Expert

- 3 Click Send Commands To This Instrument > Send & Read to verify the sensor is connected.
- 4 When the sensor is connected, go to **Chapter 2**, "Using the U2040 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 U2040 X-Series *Programming Guide* for details.

Connect the U2049XA sensor

Connect the U2049XA 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 U2049XA is Dynamic IP.

Dynamic IP and Auto IP are enabled on the U2049XA shipped from Keysight. This allows the U2049XA to automatically obtain an address on the network.

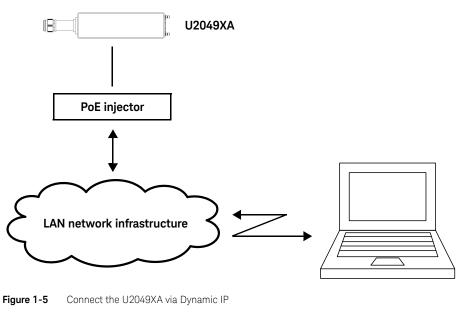
If there is a DHCP server on the network, the server will assign the address to the U2049XA. If the DHCP server cannot be found on your network, the U2049XA will wait for approximately 2 minutes to return to the Auto IP mode.

NOTE

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.

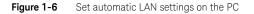


1 Set up the connection as shown in Figure 1-5.

1 Getting Started

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	x
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	
Configure This connection uses the following items:	for the appropriate IP settings. Obtain an IP address automatically 	
🗹 🖳 Client for Microsoft Networks	O Use the following IP address:	
VirtualBox Bridged Networking Driver	IP address:	
Gos Packet Scheduler Gos Packet Scheduler Gos Packet Scheduler Gos Packet Scheduler Gos Packet Scheduler	Subnet mask:	
✓	Default gateway:	
Link-Layer Topology Discovery Mapper I/O Driver	Obtain DNS server address automatically	
Link-Layer Topology Discovery Responder	Use the following DNS server addresses:	ъШ
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]
OK Cancel	OK Cancel	



3 Launch the Keysight Connection Expert by selecting the IO icon (100). Set the instrument host name (Figure 1-7). Every U2049XA has a default host name in the form of:

K-U2049XA-XXXXX

where "XXXXX" is the last five digits of the instrument serial number.

Keysight Connection Expert			? _	□ ×	;
Instruments PXI/AXIe Chassis	Manual Configuration	Settings			
Add New Instruments/Interfaces	Edit Existing Instruments	/Interfaces			
LAN instrument	Add a LAN device				
GPIB instrument Serial instrument on ASRL3 LAN interface	Set LAN Address:				Î
Remote GPIB interface	Hostname or IP Address	K-U2049XA-00004			
Remote USB interface Remote serial instrument	TCPIP Interface ID:	TCPIPO -			
	Set Protocol:				
	 Instrument 	Remote Name: inst0			
	Socket	Port Number: 5025			
	HISLIP	Remote Name: hislip0			l
	Verify Connection: Allow *IDN Query Test This VISA Address	s TCPIP0::K-U2049XA-00004::inst0::INSTR			
	View Web Page:				• •
		Accept	Cano	el	
Messages: 2 Clear		Remote IO Server Off Keysight VISA is Priv	mary 17.0.	19013.0	-

Figure 1-7 Add a LAN instrument in Keysight Connection Expert via host name

- 4 Select Allow *IDN Query and click Test This VISA Address to verify the U2049XA is connected. Once verified, click Accept.
- **5** Alternatively, you can auto-locate the U2049XA as shown in **Figure 1-8**. Click **Rescan** to start searching.

Keysight Connection Expert			
Instruments PXI/AXIe Chassis Manual	Configuration Settings		
Rescan Filter Instruments: Clear			
U2049XA, Keysight Technologies	Details for Keysight Technologies U2049XA		
TCPIP0::K-U2049XA-00004.local::inst0::INSTR	Manufacturer:Keysight TechnologiesModel:U2049XASerial Number:MY00000004Firmware Version:A.01.01	View Instrument Information Online Start Instrument Web Interface	
	Connection Strings		
	VISA Addresses TCPIP0::K-U2049XA-00004.local::inst0::INSTR TCPIP0::K-U2049XA-00004.local::5025::SOCKET	Send Commands To This Instrument Start IO Monitor	
	VISA Aliases	Add or Change Aliases	
	 SICL Addresses 		
	Installed Drivers		
		Update Drivers	
Messages: 10 Clear		17.0.19013.0	

Figure 1-8 Auto-locate a LAN instrument in Keysight Connection Expert via Dynamic IP

- 6 Click Send Commands To This Instrument > Send & Read to verify the U2049XA is connected.
- 7 When the U2049XA is connected, go to **Chapter 2**, "Using the U2040 X-Series with the Keysight BenchVue" to launch the BenchVue, or proceed to operate the U2049XA 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.

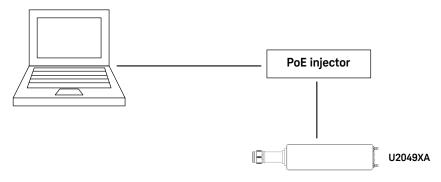


Figure 1-9 Connect the U2049XA via Auto IP

- **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		nternet Protocol Version 4 (TCP/I	(Pv4) Properties
Networking Sharing		General Alternate Configuration	
Connect using:		Vau and ant ID authing and	
Proadcom 440x 10/100 Integrated Controller	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 autom	natically
		O Use the following IP address	s;
 ✓ Client for Microsoft Networks ✓ United Box Bridged Networking Driver 		IP address:	
 Gos Packet Scheduler File and Printer Sharing for Microsoft Networks 		Subnet mask:	
		Default gateway:	
Link-Layer Topology Discovery Mapper I/O Driver		Obtain DNS server address	automatically
Link-Layer Topology Discovery Responder		Ouse 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		L	OK Cancel

3 Launch the Keysight Connection Expert by selecting the IO icon (). Auto-locate the U2049XA as shown below. Click **Rescan** to start searching.

Keysight Connection Expert						
Instruments PXI/AXIe Chassis Manual Configuration Settings						
Rescan Filter Instruments: Clear						
U2049XA, Keysight Technologies Details for Keysight Technologies U2049XA						
TCPIP0::169.254.34.132::inst0::INSTR	Manufacturer:Keysight TechnologiesModel:U2049XASerial Number:MY00000004Firmware Version:A.01.01	View Instrument Information Online Start Instrument Web Interface				
	Connection Strings VISA Addresses	Send Commands To This Instrument				
	VISA Aliases	Start IO Monitor				
		Add or Change Aliases				
	 SICL Addresses 					
	Installed Drivers					
		Update Drivers				
Messages: 5 Clear		17.0.19013.0				

- 4 Click Send Commands To This Instrument > Send & Read to verify the U2049XA is connected.
- **5** When the U2049XA is connected, go to **Chapter 2**, "Using the U2040 X-Series with the Keysight BenchVue" to launch the BenchVue, or proceed to operate the U2049XA via remote programming.

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.

NOTE

After configuring LAN settings, you must first power cycle the U2049XA. This enables the new network settings to become effective.

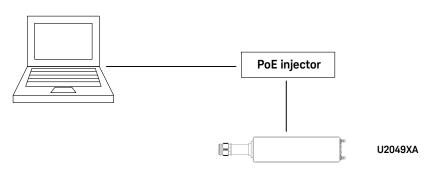


Figure 1-10 Connect the U2049XA via Static IP

- **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 Pro	otocol Version 4 (TCP/IPv4)	Properties
Networking Sharing	General	Alternate Configuration	
Connect using:			
Broadcom 440x 10/100 Integrated Controller Configure	this capa		matically if your network supports to ask your network administrator
This connection uses the following items:	Ob	tain an IP address automatica	ally
Client for Microsoft Networks	- 🔘 Use	e the following IP address: —	
VirtualBox Bridged Networking Driver	IP ad	dress:	
QoS Packet Scheduler	Subra	et mask:	
File and Printer Sharing for Microsoft Networks	Jubic	DU HIIDON,	
✓ <u>▲ Internet Protocol Version 6 (TCP/IPv6)</u> ✓ Internet Protocol Version 4 (TCP/IPv4)	Defau	ult gateway:	
Link-Layer Topology Discovery Mapper I/O Driver	O Ob	tain DNS server address auto	matically
Link-Layer Topology Discovery Responder		e the following DNS server ad	dresses:
Install Uninstall Properties	Ŭ	rred DNS server:	
Description Transmission Control Protocol/Internet Protocol. The default	Altern	nate DNS server:	
wide area network protocol that provides communication across diverse interconnected networks.	🗌 va	alidate settings upon exit	Advanced
OK Cancel			OK Cancel

Keysight U2040 X-Series User's Guide

3 Launch the Keysight Connection Expert by selecting the IO icon (). Auto-locate the U2049XA as shown below. Click **Rescan** to start searching.

Keysight Connection Expert				
Instruments PXI/AXIe Chassis Manual Co	nfiguration Settings			
Rescan Filter Instruments: Clear				
U2049XA, Keysight Technologies	Details for Keysight Technologies U2049XA			
	Manufacturer: Keysight Technologies Model: U2049XA Serial Number: MY00000004 Firmware Version: A.01.01 Connection Strings	View Instrument Information Online Start Instrument Web Interface		
	VISA Addresses VISA Addresses VISA Adiases	Send Commands To This Instrument Start IO Monitor Add or Change Aliases		
	 SICL Addresses 			
	Installed Drivers			
		Update Drivers		
Messages: 5 Clear		17.0.19013.0		

- **4** To enable static IP, click **Send Commands To This Instrument** 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 U2040 X-Series *Programming Guide*.

Alternatively, you can set these configurations using the U2049XA web-based interface (see "**Using the Instrument Web Browser**" on page <u>32</u>).

On the **Configuring your U2049XA 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.

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	1 r	Internet Protocol Version 4 (TCP/IP	V4) Properties
Networking Sharing		General	
Connect using:		You can get IP settings assigned a	utomatically if your network supports ed to ask your network administrator
Configure This connection uses the following items:		Obtain an IP address automa Output the following IP address:	
VirtualBox Bridged Networking Driver		IP address:	192.168.0.1
 BQoS Packet Scheduler File and Printer Sharing for Microsoft Networks 		Subnet mask:	255.255.255.0
Internet Protocol Version 6 (TCP/IPv6) Internet Protocol Version 4 (TCP/IPv4)		Default gateway:	
		 Obtain DNS server address and the comparison of the c	
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	Ad <u>v</u> anced
OK Cancel			OK Cancel

Figure 1-11 Set manual LAN settings on the PC

- NOTE
- For the new network settings to become effective, you must first power cycle the U2049XA.
- The static IP addresses for the host PC and the U2049XA must be different from the IP address of the PoE injector to avoid conflict.
- 6 Launch the Keysight Connection Expert by selecting the IO icon (💿). Auto-locate the U2049XA as shown in Figure 1-12. Click Rescan to start searching.

Keysight Connection Expert					
Instruments PXI/AXIe Chassis Manual Configuration Settings					
Rescan Filter Instruments: Clear					
U2049XA, Keysight Technologies	Details for Keysight Technologies U2049XA				
TCPIP0::K-U2049XA-00004.local::inst0::INSTR	Manufacturer: Keysight Technologies View Instrument Information Online Model: U2049XA Start Instrument Web Interface Serial Number: MY00000004 Firmware Version:				
Connection Strings					
VISA Addresses VISA Addresses CPIP0::K-U2049XA-00004.local::inst0::INSTR Send Commands To This Instru Start IO Monitor TCPIP0::K-U2049XA-00004.local::5025::SOCKET					
	VISA Aliases	Add or Change Aliases			
	✓ SICL Addresses				
	Installed Drivers				
		Update Drivers			
<)					
Messages: 10 Clear 17.0.19013.0					

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

7 Click Send Commands To This Instrument > Send & Read to verify the U2049XA is connected.

Alternatively, you can locate the U2049XA by entering its default static IP address (*192.168.0.10*) at the **Manual Configuration** tab.

8 When the U2049XA is connected, go to **Chapter 2**, "Using the U2040 X-Series with the Keysight BenchVue" to launch the BenchVue, or proceed to operate the U2049XA via remote programming.

NOTE

NOTE

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 21 for the procedure. You will need to power cycle the U2049XA for the new network settings to take effect.

Using the Instrument Web Browser

The U2049XA 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 **Start Instrument Web Interface** to launch the U2049XA web-based interface.

U2049XA, Keysight Technologies		Details for Keysight Technologies U2049XA		
	TCPIP0::169.254.34.132::inst0::INSTR	Manufacturer: Model: Serial Number: Firmware Version:	Keysight Technologies U2049XA MY00000004 A.01.01	View Instrument Information Online Start Instrument Web Interface

NOTE

The web-based interface can also be opened directly from a web browser by entering the U2049XA's IP address or hostname in the 'address' bar of the browser.

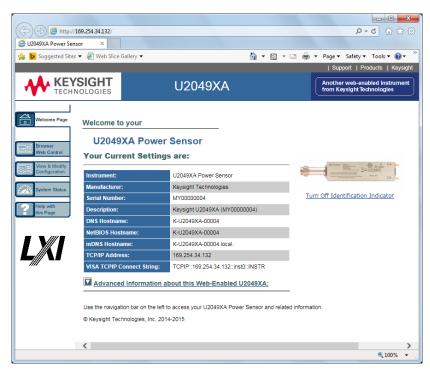


Figure 1-13 U2049XA web-based interface (Welcome page)

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



🔿 🥭 http://169	.254.34.132/			ይ-ሪ 🔐 🏡
J2049XA Power Sensor	×			
Suggested Sites -	Ø Web Slice Gallery ▼		🏠 🔻 🖾 👻 🚍 :	🔹 Page 🔹 Safety 👻 Tools 👻 🔞
				Support Products Keys
KEYS TECHNO		U2049XA		Another web-enabled instrume from Keysight Technologies
Welcome Page	(Current Configuration	of U2049XA Power Sensor	
Vveicome Page			Modify Configuration	
Browser Web Control	Parameter		Currently in use	
View & Modify Configuration	IP Address:		169.254.34.132	
Comigardation	Subnet Mask		255.255.0.0	
System Status	Default Gates	way:	0.0.0.0	
Help with this Page	DNS Server(s):	0.0.0.0 0.0.0.0 0.0.0.0	
	Hostname:		K-U2049XA-00004	
	Domain:			
_//\/	NetBIOS:		ON	
	mDNS and D	NS-SD:	ON	
	Ethernet Con	nection Monitoring:	ON	
	Description:		Keysight U2049XA (MY00000004)	
	TCP Keep Al	ive:	ON	
	TCP Keep Al	ive Time:	7200	

Figure 1-14 View and modify LAN configuration settings

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

		Modify Configuration	
Browser Web Control	Parameter	Currently in use	
View & Modify Configuration	IP Address:	169.254.34.132	
	Subnet Mask:	255.255.0.0	

4 Enter the default password "keysight".



5 On this page, you can configure and renew the LAN settings, as well as power cycle the U2049XA or reset the LAN settings.

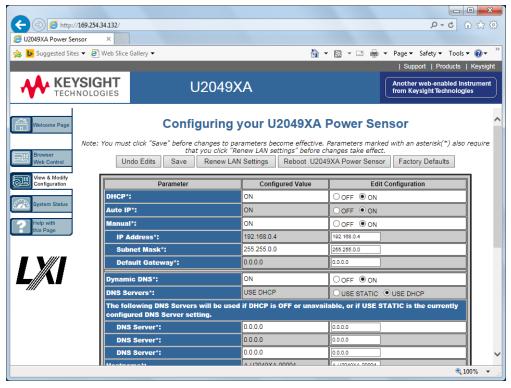


Figure 1-15 Modify and renew LAN configuration settings

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 U2049XA. Refer to the U2040 X-Series Programming Guide for details.

Mount the U2049XA Option TVA

The U2049XA Option TVA 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

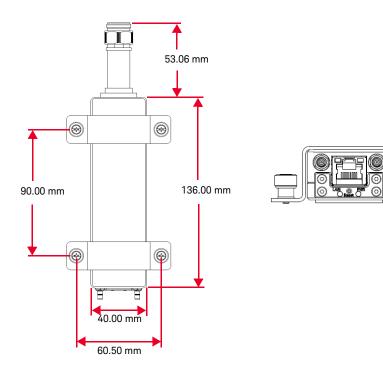
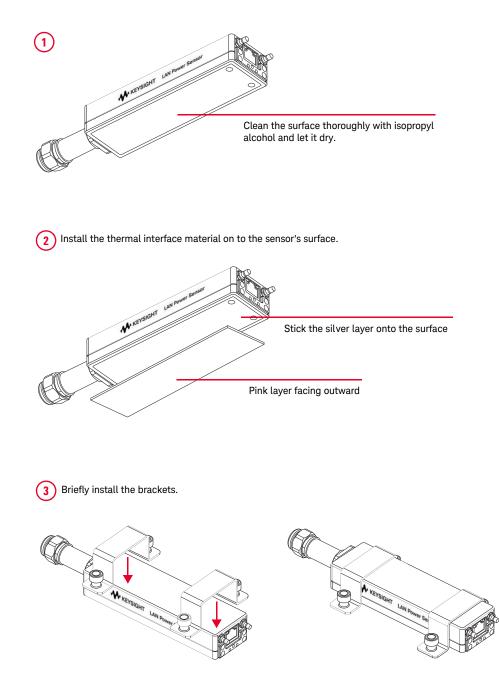
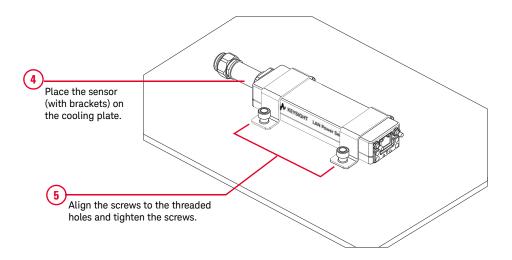


Figure 1-16 U2049XA Option TVA mounting dimensions

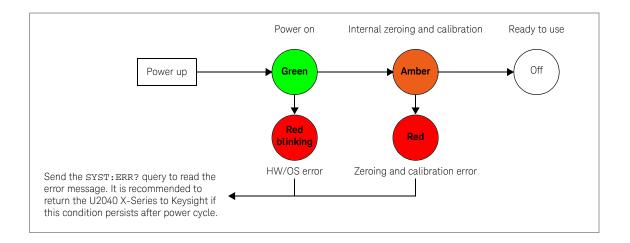
24.00 mm

Mounting procedure

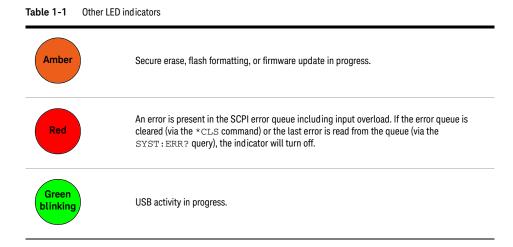




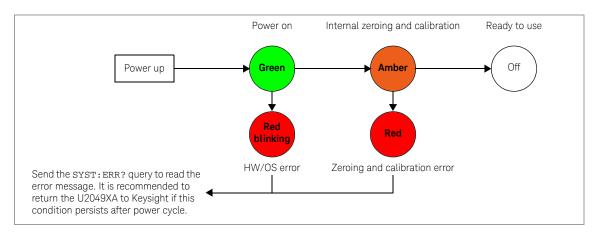
LED Indicator Sequence During Power-Up for the U2041XA/42XA/ 43XA/44XA Sensor



Other LED indicators

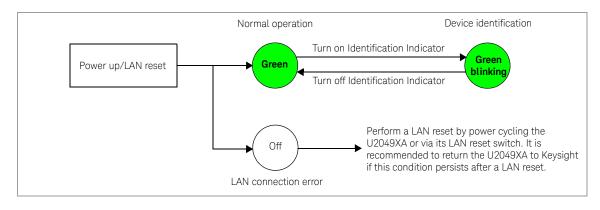


LED Indicator Sequences for the U2049XA Sensor



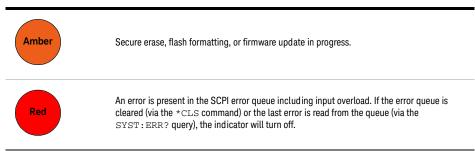
During power-up (via PWR LED indicator)

For LAN activity (via LAN LED indicator)



Other LED indicators

Table 1-2 Other LED indicators



Firmware Upgrade

To download the latest firmware version for the U2040 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 U2040 X-Series.

1 Getting Started

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Keysight U2040 X-Series Wide Dynamic Range Power Sensors User's Guide

2 General Operating Information

Using the U2040 X-Series with the Keysight BenchVue 44 Quick start example to perform an average power measurement 45 Quick start example to set up a measurement in the Trace view 49 Quick overview of the BenchVue Power Meter 53 Power meter settings in the Average only mode 56 Power meter settings in the Normal mode 58 Instrument Setup tab 61 Overview of Multiple Power Sensor Operation 63 Single bench operation 63 Multiple bench operation 66 U2040 X-Series Features 67 Broadband coverage for any modulated signal formats 67 List mode/test sequencing 67 Variable aperture size 67 Auto burst detection 68 20-pulse measurements 68 High average count reset 68 Built-in radar and wireless presets 68 Gamma correction 69 S-parameter correction 70 Tilt measurement 71

This chapter describes the general operating information of the U2040 X-Series.

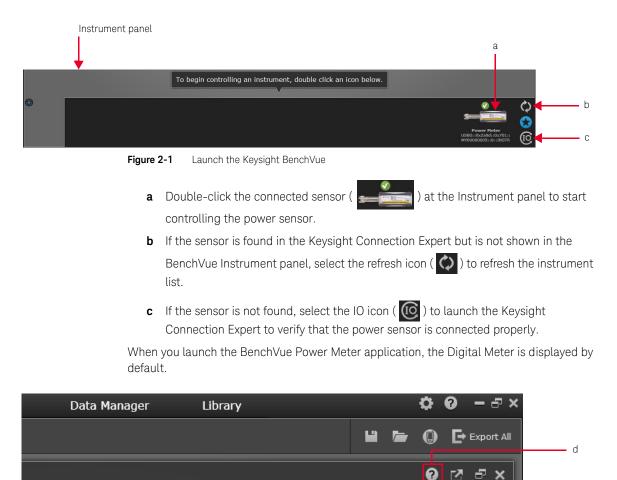


Using the U2040 X-Series with the Keysight BenchVue

The BenchVue Power Meter application provides a virtual operating interface for the U2040 X-Series. This chapter describes the U2040 X-Series functions in the BenchVue Power Meter application in general.

NOTE For more information on how to configure each U2040 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.



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 U2040 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 44**). By default the power meter mode is already set to Average only.
- 3 Perform calibration and zeroing for an accurate measurement result.

Chan Offset (dB): 0.000	
Duty Cycle(%) : 1.000	
Averaging Mode : AUTO	•
Averaging Count : 512	
Reset Average	_{ging} – 55.880
Calibration	
Zero Cal Cal + Ze	Live Data
Zero Type : INT	EXT Information Panel
Measurement 1 Stop	Alert Summary
Trigger Setup	Clear All Save

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 U2040 X-Series to 1 GHz.

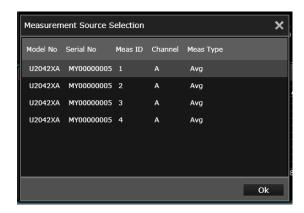


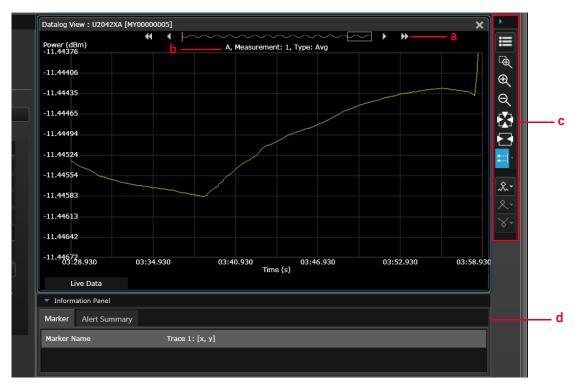
5 You should be able to view the average power measurement results in the Digital Meter display view.

Digital Meter : U2042XA [[MY000	00005]				×	
Measurement :	1				a —————————	III T	c
Channel :	A	Avg	9		1 GHz		
Min : -71.6	53				Max : -11.48		
		-11.4	48 c	Br	١		
Live Data	— b						
Alert Summary							
Clear All Save]						d
Model No. Serial No. Me	eas.	Result Unit	Limit Set	Туре	Time Stamp		
	а	Indicates acquisitio	on of measur	rements in	the Run mode		
	b	Indicates the meas					
	с	Change the	title at the to	op of the d	isplay view		
		Reset the dis	splayed Mini	imum/Max	imum measured value	es	
	d	Summary of alert li	imit conditio	ns for the	current measurement		
6	То	monitor the average	e power ove	r a period (of time, create a Datal	log displa <u>y</u>	y view by
	clic	king 🛄.					

 Settings Datalog Settings 	Digital Meter : U2042XA [MY
Run All Stop All	Measurement : 1

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





- 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.



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 U2040 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 44**).
- 3 Create a Trace display view by clicking

 Settings 	Datalog Settings	Digital Meter : U2042XA [MY
		Measurement · 1

4 Perform calibration and zeroing for an accurate measurement result.

Video B/W :	OFF -	-43 -50	0 s	10 µs	20 µs	30 µs	40 µs
Calibration			0.0	10 μ5	20 00	00 μο	10 μο
Zero Cal	Cal + Zero		Live D	ata			
		🔻 Inf	ormatio	n Panel			
Zero Type :		Mark	er Pu	Ilse Analysis	Alert Summ	nan/	
<u> </u>				ilibe Fillidiyolo	, ucre summ	ary	

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.
- Ensure that modulation is enabled.

5 Set the frequency of the U2040 X-Series to 1 GHz.



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

U2042XA - MY000	00005 - Trace	1 - Stop	-1		
Channel Setup			-8		
Trace Setup					
Units :	🔵 dBm	🔵 Watt	-15		
X Start (s) :	0.000		-22		
X Scale (s/div) :	10.000 µ	~	-29		
Y Max (dBm) :	20.000	~	-36		
Y Scale (dB/div) :	7.000	~	-43		

7 To enable gates on the trace, click **1** at the Tools Palette.



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.

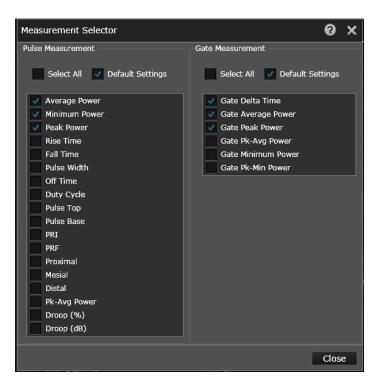
For more precise control of your gate parameters, you can set up the gates via the **Instrument Setup** tab and enter a starting point and length (in seconds) for each of the four gate controls.

•	System							
Additional Instruments	Model No : 1	J2042XA Seri	ial No: MY0000000	5 Firmware Rev	/: X.01.2	27.02 Re	source ID	: USB0::
al In	 Channel S 	etup		Measurer	ment Setu	р		
strum	👻 Trace Setu	ıp		Meas1	Meas2 M	4eas3 M	eas4	
Ients	Gate Setu	p		Unit :		💽 dBi	m 🔵 W	att
		Start (s)	Length (s)	Offsets	(dB) :	0.000		
	Gate 1 :	50.001 µ	499.999 µ	Relative	e:	Rel	0.00 dBr	
	Gate 2 :	70.000 µ	400.000 µ	Operation	:	None		•
	Gate 3 :	0.000	0.000	Feed 1				
	Gate 4 :	0.000	0.000	Channel :		А		

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

s 30 μs 40 μs 50 μs Time(s)	60 µs 70 µs	80 µs 90 µs 100 µs
		Trace 1
t Summary		
move Row Remove All Rows		
Trace1 Trace2	Trace3	Trace4
-5.62 dBm		
-69.00 dBm		
-5.58 dBm		
500.00 µs		
-12.60 dBm		
-5.48 dBm		
400.00 µs		
-16.84 dBm		
	Time(s) t Summary move Row Remove All Rows Trace1 Trace2 -5.62 dBm -69.00 dBm -5.58 dBm 500.00 µs -12.60 dBm -5.48 dBm 400.00 µs	Time(s) t Summary move Row Remove All Rows Trace1 Trace2 Trace3 -5.62 dBm -69.00 dBm -5.58 dBm 500.00 µs -12.60 dBm -5.48 dBm 400.00 µs

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.

- Access the common measurement settings for the current measurement display а view.
 - Click Vin Heal -30.0 dB to create a new Digital Meter display view.
 - to create a new Analog Meter display view. Click
- to create a new Data Log display view. Click
- Click to create a new Trace display view.
- to create a new MultiList display view. Click
 - Click to assign a measurement to the selected display view.
 - to start or stop all assigned measurements on all Stop All

Click

For more information, refer to "Power meter settings in the Average only mode" on page 56 and "Power meter settings in the Normal mode" on page 58.

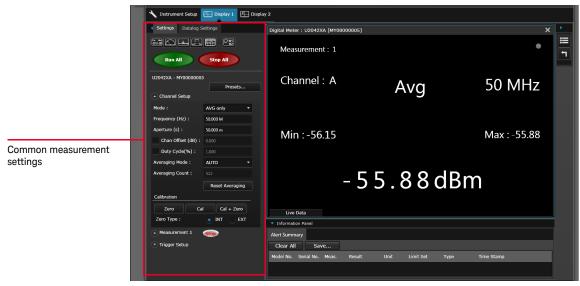


Figure 2-2 Common measurement settings pane

Run All display views simultaneously.

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



Figure 2-3 Datalog settings pane

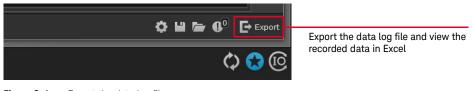
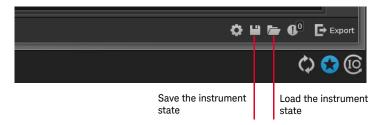


Figure 2-4 Export the data log file

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.

Instrument Setup Display 1 P Display 2 System Model No: U2042XA Serial No: MY00000005 Firmware Rev: X.01.27.02 Resource ID: USB0::0x2a8d::0x701::MY00000005::0::INSTR Presets... nal Instru Trigger Setup Channel Setup Measurement Setup Meas2 Meas1 Trigger Mode : Mode : Normal Cont Trig • ients Unit : 🔵 dBm Watt Chan Offset (dB) : Trigger Source : Internal Offsets (dB) : Frequency (Hz) : Trace Enable 50.000 M Averaging Mode : AUTO Relative : Enable Auto Level • Operation : Difference Averaging Count : Trigger Level (dBm) : Feed 1 Reset Averaging Delay (s) : 0.000 Channel : Slope Type : +Pos -Neg Video Avg : Gate : - Advanced Video B/W : OFF _ Holdoff (s) : 1.000 µ Type : Avg • Trace Setup Hysteresis (dB) : Feed 2 Units : dBm Watt Qualification (s) : 100.000 n Channel : X Start (s) : 0.000 • • Input Impedance : Low High Gate : • X Scale (s/div) : 10.000 µ ▼ | ▲ Output Setting : None • Type : Peak Y Max (dBm) : 20.000 -Advanced Y Scale (dB/div) : 7.000 **-**Alert Limits Advanced Enable Alert Trace Ref Level 1 (%) : 10.000 Upper Limit (dBm) : Trace Ref Level 2 (%) : 90.000 Lower Limit (dBm) : Pulse Duration Ref Level (%): 50.000 - Gate Setup Calibration Corrections Calibration Calibration + Zero FDO Correction... Gamma Correction... S-Param Correction... Zero Zero Type : 🔵 INT 💿 EXT

For more information, refer to "Instrument Setup tab" on page 61.

Figure 2-6 Instrument setup (advanced settings) pane

Power meter settings in the Average only mode

	Settings Datalog		
Add a display view		Stop All	Assign a measurement to the selected view
Run/stop all measurements	Kull All	Stop All	
	U2042XA - MY0000000	5	
		Presets	
	Channel Setup		
	Mode :	AVG only 🔹	
	Frequency (Hz) :	50.000 M	
	Aperture (s) :	50.000 m	
	Chan Offset (dB) :	0.000	
	Duty Cycle(%) :	1.000	
	Averaging Mode :	AUTO -	
	Averaging Count :	512	
		Reset Averaging	
	Calibration		
	Zero Ca	al Cal + Zero	
	Zero Type :		
	Measurement 1	Run	
	Unit :	💿 dBm 🕥 Watt	
	Offsets (dB) :	0.000	
	Relative :	Rel	
		0.00 dBm	
	Operation :	None -	
	Chan Ga	te Type	
	Feed 1: A 👻	- Avg -	
	 Trigger Setup 		

Common Average only mode power measurement settings

Figure 2-7 Power meter settings in the Average only mode

Item	Description
Presets	 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.
	- 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.
	 Set the channel offset which is applied to the measured power prior to any mathematical functions. Refer to "Simplified Measurement Path" on page 76.
	- Set the duty cycle.
	 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 77.
Calibration	Auto-calibrate the U2040 X-Series without having to connect it to a power reference, or auto-zero the U2040 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.
	 Set the measurement offset factor. The U2040 X-Series corrects every measurement by this factor to compensate for the gain/loss.
	 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>
	- 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.
	 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.
	- 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

2 General Operating Information

Power meter settings in the Normal mode

Common Normal mode power measurement settings

	Settings Datalog S	Settings	
Add a display view			Assign a measurement
Run/stop all measurements	U2042XA - MY0000000	to the selected view	
	Channel Setup		
	Mode :	Normal 👻	
	Frequency (Hz) :	50.000 M	
	Chan Offset (dB) :	0.000	
	Averaging Mode :	AUTO -	
	Averaging Count :	512	
		Reset Averaging	
	Calibration		
	ZeroCa		
	Zero Type :		
	Measurement 1	Run	
	Unit :	💿 dBm 🕥 Watt	
	Offsets (dB) :	0.000	
	Relative :	Rel	
		0.00 dBm	
	Operation :	None -	
	Chan Gat		
	Feed 1: A • 1	• Avg •	
	 Trigger Setup 		

Common Normal mode Trace view settings

Settings Datal	og Settings			
Run All	Stop All			
Trace Source				
U2042XA - MY0000	00005 - Trace 1 🔻 ၭ top			
Channel Setup				
Mode :	Normal 👻			
Frequency (Hz) :	50.000 M			
Averaging Mode :	AUTO -			
Averaging Count :	512			
	Reset Averaging			
Video Avg :				
Video B/W :	OFF 👻			
Calibration				
Zero Cal	Cal + Zero			
Zero Type :				
Trace Setup				
Units :	🔵 dBm 📄 Watt			
X Start (s) :	0.000			
X Scale (s/div) :	10.000 µ 🛛 🗸			
Y Max (dBm) :	20.000 🔻 🔺			
Y Scale (dB/div) :	7.000 🔻 🔺			
Trigger Setup				

Figure 2-8 Power meter settings in the Normal mode

Item	Description
Presets	 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.
	- Perform a system reset.
Channel Setup	- Set the channel mode to the Normal or Average Only mode.
	- Set the measurement frequency.
	- Set the channel offset which is applied to the measured power prior to any mathematical functions. Refer to "Simplified Measurement Path" on page 76.
	 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 77.
Calibration	Auto-calibrate the U2040 X-Series without having to connect it to a power reference, or auto-zero the U2040 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.
	 Set the measurement offset factor. The U2040 X-Series corrects every measurement by this factor to compensate for the gain/loss.
	 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>
	- 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.
	 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.
	 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.
	- Set the holdoff time to disable the trigger mechanism after a trigger event occurs.
	 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. Hysteresis is only available for the internal trigger source and manual trigger level.
	- Set the qualification value.

 Table 2-2
 Power meter settings in the Normal mode description

2 General Operating Information

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

Item	Description
Channel Setup (in the Trace view)	 Set the video averaging to average repetitions of a triggered signal, with a count of 1 to 256 in multiples of 2ⁿ. 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.
	- Set the video band width.
	The Low, Medium, and High pass band shapes achieved by the video band width 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 band width is set to Off, it removes all digital signal conditioning. This provides less than 3 dB roll-off ^[a] 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 " Band wid th Filter Shapes " on page 79.
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 U2040 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**.

*	Instrument Setup	Display 1 🛄 Display 2				
	System					
	Model No: U2042XA	Serial No: MY0000005	Firmware Rev : X.01.27	.02 Resource ID : USB	0::0x2a8d::0x701::MY0000	00005::0::INSTR
lition					Pres	ets
al Ins	 Channel Setup 		Measurement Setup		 Trigger Setup 	
Additional Instruments	Mode :	Normal 🔫	Meas1 Meas2 Me	eas3 Meas4	Trigger Mode :	Cont Trig 🗸
ents	Chan Offset (dB) :	0.000	Unit :	💿 dBm 🕥 Watt	Trigger Source :	Internal 🗸
	Frequency (Hz) :	50.000 M	Offsets (dB) :	0.000	Trace Enable	
	Averaging Mode :	AUTO -	Relative :	Rel 0.00 dBm	Enable Auto Level	
	Averaging Count :	512	Operation :	Difference -	Trigger Level (dBm) :	
		Reset Averaging	Feed 1		Delay (s) :	0.000
	Video Avg :		Channel :	A -	Slope Type :	• +Pos • -Neg
	Video B/W :	OFF -	Gate :	1 •	Advanced	
	Trace Setup		Type :	Avg 👻	Holdoff (s) :	1.000 µ
	Units :	odBm Watt	Feed 2		Hysteresis (dB) :	0.00
	X Start (s) : 0.000		Channel :	A -	Qualification (s) :	100.000 n
	X Scale (s/div) : 10.00		Gate :	1 -	Input Impedance :	Low Iligh
	Y Max (dBm) : 20.00		Type :	Peak 🔻	Output Setting :	None -
	Y Scale (dB/div) : 7.000		Advanced			
	Advanced		Alert Limits			
	Trace Ref Level 1 (%) :	10.000	Enable Alert			
	Trace Ref Level 2 (%) :	90.000	Upper Limit (dBm) :	90.000		
	Pulse Duration Ref Level		Lower Limit (dBm) :	-90.000		
	Gate Setup					
	Calibration		Correctio	ns		
	Zero	Calibration Calibrat			nrna Correction S-P	Param Correction
	Zero Type : 🔵 INT	EXT				

Figure 2-9 Instrument Setup tab

Table 2-3 Additional Instrument Setup tab settings description

Item	Available settings				
	Ad vanced:				
Trace Setup	- 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.				
	- 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 "Measurement Gates" on page 80 for more information.				
	 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. 				
Corrections	 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. Refer to "Gamma correction" on page 69 and "S-parameter correction" on page 70 for details. 				
	Also refer to "Simplified Measurement Path" on page 76 for the above corrections.				
	Ad vanced:				
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 81 for more information.				
	Ad vanced:				
	– Set the input impedance for the external TTL trigger to Low (50 Ω) or High (100 k Ω).				
Trigger Setup	 Enable the trigger output where a TTL level high is produced at the Trig Out connector when the U2040 X-Series is triggered. 				
	- 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 **Instrument Setup** > **Additional Instruments**. Add up to four Digital Meter display views by clicking and selecting the measurement sources to display.

1 Instrument Setup	🖽 Display	2 Measurem	ient Source S	election			×
Additional Instrumen Connect All Discor	ts nnect All	Model No	Serial No	Meas ID	Channel	Meas Type	
Connect Air Discor		U2021XA	HQ52140013	1	A	Avg	<u> </u>
U202:		U2021XA	HQ52140013	2	A	Avg	
Disconnect		U2021XA	HQ52140013	3	A	Avg	
U2049) A	U2021XA	HQ52140013		A	Avg	
HQ1000	0011	U2049XA	HQ10000011		A	Avg	
Disconnect							
U2042	2XA	U2049XA	HQ10000011		A	Avg	
MY0000 Disconnect	0005	U2049XA	HQ10000011	3	A	Avg	-
							Ok
U2022 HQ5218							
Disconnect							
(3)							
U							
🔧 Instrument Setup 🔛 Display 1 🖳 Displa	y 2						
Instrument Setup Desplay 1 Z Displa Settings Datalog Settings	y 2 Digital Meter : U2021XA	[HQ52140013]	×	Digital Meter :	: U2049XA [ŀ	4Q10000011]	×
	Digital Meter : U2021XA Measurement : 1	[HQ52140013]	•	Measureme	nt:1		•
Settings Datalog Settings	Digital Meter : U2021XA	[HQ52140013] Avg		-	nt:1	4Q10000011] Avg	
Settings Datalog Settings Settings Run All Stop All	Digital Meter : U2021XA Measurement : 1 Channel : A Min :-39.5250	Avg	• 50 MHz Max : -37.9815	Measureme	- A 078	Avg	50 MHz Max : -51.1622
Settings Datalog Settings	Digital Meter : U2021XA Measurement : 1 Channel : A Min :-39.5250		• 50 MHz Max : -37.9815	Measureme Channel :	- A 078		50 MHz Max : -51.1622
Settings Datalog Settings Settings Run All Stop All U2021XA - HQ52140013	Digital Meter : U2021XA Measurement : 1 Channel : A Min :-39.5250 - 3 Live Data	Avg 8 8 . 4 2 1 3 dBm	50 MHz Max : -37.9815	Measuremen Channel : Min : -51.20 Live Da	nt : 1 A 078 - 5 ta	Avg 1.1789	50 MHz Max : -51.1622 9 dBm
Settings Datalog Settings Run All Stop All U2021XA - HQ52140013 Presets Channel Setup Mode : Normal	Digital Meter : U2021XA Measurement : 1 Channel : A Min :-39.5250 – 3 Live Data Digital Meter : U2042XA	Avg 8 8 . 4 2 1 3 dBm	● 50 MHz Max:-37.9815	Measuremen Channel : Min : -51.20 Live Da	nt : 1 A 2778 - 5 ta : U2022XA [H	Avg 1.1789	50 MHz Max:-51.1622 9 dBm
Settings Datalog Settings Run All U2021XA - HQ52140013 Channel Setup Mode : Frequency (Hz) : South All South All South All Presets Presets Presets Normal Presets Presets.	Digital Meter : U2021XA Measurement : 1 Channel : A Min :-39.5250 - 3 Live Data Digital Meter : U2042XA Measurement : 1	Avg 8 8 . 4 2 1 3 dBm [MY00000005]	● 50 MHz Max:-37.9815] ×	Measuremen Channel : Min : -51.20 Live Da Digital Meter Measuremen	nt : 1 A - 5 ta : U2022XA [H	Avg 1.1789	50 MHz Max:-51.1622 9 dBm
Settings Datalog Settings Run All Stop All U2021XA - HQS2140013 Presets Channel Setup Mode : Normal	Digital Meter : U2021XA Measurement : 1 Channel : A Min :-39.5250 – 3 Live Data Digital Meter : U2042XA Measurement : 1 Channel : A	Avg 88.4213dBm	● 50 MHz Max : -37.9815	Measuremen Channel : Min : -51.20 Live Da Digital Meter Measuremen Channel :	nt : 1 A - 5 ta : U2022XA [H A	Avg 1.1789	50 MHz Max :-51.1622 O dBm
Settings Datalog Settings Settings Datalog Set	Digital Meter : U2021XA Measurement : 1 Channel : A Min :-39.5250 – 3 Live Data Digital Meter : U2042XA Measurement : 1 Channel : A Min :-55.2960	Avg 3 8 . 4 2 1 3 dBm [MY00000005] Avg	50 MHz Max : -37.9815 Max : -37.9815 X Max : -54.9608	Measuremen Channel : Min : -51.20 Live Da Digital Meter Measuremen	nt : 1 A - 5 ta : U2022XA [F A 156	Avg 1.1785 4052180041] Avg	• 50 MHz Max : -51.1622 • dBm * * • • • • • • • • • • • • • • • • • •
Settings Datalog Settings Settings Datalog Set	Digital Meter : U2021XA Measurement : 1 Channel : A Min : -39.5250 – 3 Live Data Digital Meter : U2042XA Measurement : 1 Channel : A Min : -55.2960 – 5	Avg 8 8 . 4 2 1 3 dBm [MY00000005]	50 MHz Max : -37.9815 Max : -37.9815 X Max : -54.9608	Measuremen Channel : Min : -51.20 Live Da Digital Meter Measuremen Channel : Min : -36.83	nt: 1 A - 5 - 5 ta - 1 - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 t - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - - 5 - 5 t - 5 t - 5 t - 5 - 5 1 5 5 - 5 - 5 - 5	Avg 1.1789	• 50 MHz Max : -51.1622 • dBm * * • • • • • • • • • • • • • • • • • •
Settings Datalog Settings Settings Datalog Set	Digital Meter : U2021XA Measurement : 1 Channel : A Min :-39.5250 Live Data Digital Meter : U2042XA Measurement : 1 Channel : A Min :-55.2960 5 Live Data	Avg 3 8 . 4 2 1 3 dBm [MY00000005] Avg	50 MHz Max : -37.9815 Max : -37.9815 X Max : -54.9608	Measuremen Channel : Min : -51.20 Live Da Digital Meter Measuremen Channel :	nt: 1 A - 5 - 5 ta - 1 - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 t - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - - 5 - 5 t - 5 t - 5 t - 5 - 5 1 5 5 - 5 - 5 - 5	Avg 1.1785 4052180041] Avg	• 50 MHz Max : -51.1622 • dBm * * • • • • • • • • • • • • • • • • • •
Settings Datalog Settings Run All Stop All U2021XA - HQ52140013 Presets Channel Setup Mode : Normal Chan Offset (dB): 0.000 Averaging Mode : AUTO Averaging Mode : AUTO Averaging Calibration Calibration Calibratio	Digital Meter : U2021XA Measurement : 1 Channel : A Min : -39.5250 – 3 Live Data Digital Meter : U2042XA Measurement : 1 Channel : A Min : -55.2960 – 5 Live Data	Avg 3 8 . 4 2 1 3 dBm [MY00000005] Avg	50 MHz Max : -37.9815 Max : -37.9815 X Max : -54.9608	Measuremen Channel : Min : -51.20 Live Da Digital Meter Measuremen Channel : Min : -36.83	nt: 1 A - 5 - 5 ta - 1 - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 t - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - - 5 - 5 t - 5 t - 5 t - 5 - 5 1 5 5 - 5 - 5 - 5	Avg 1.1785 4052180041] Avg	• 50 MHz Max : -51.1622 • dBm * * • • • • • • • • • • • • • • • • • •
Settings Datalog Settings	Digital Meter : U2021XA Measurement : 1 Channel : A Min :-39.5250 Live Data Digital Meter : U2042XA Measurement : 1 Channel : A Min :-55.2960 5 Live Data	Avg 8 8 . 4 2 1 3 dBm (MY00000005) Avg 5 4 . 9 6 0 8 dBm	50 MHz Max : -37.9815 Max : -37.9815 X Max : -54.9608	Measuremen Channel : Min : -51.20 Live Da Digital Meter Measuremen Channel : Min : -36.83	nt: 1 A - 5 - 5 ta - 1 - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 t - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - - 5 - 5 t - 5 t - 5 t - 5 - 5 1 5 5 - 5 - 5 - 5	Avg 1.1785 4052180041] Avg	• 50 MHz Max : -51.1622 • dBm * * • • • • • • • • • • • • • • • • • •
Settings Datalog Settings Run All Stop All U2021XA - HQ52140013 Presets Channel Setup Mode : Normal Chan Offset (dB): 0.000 Averaging Mode : AUTO Averaging Mode : AUTO Averaging Calibration Calibration Calibratio	Digital Meter : U2021XA Measurement : 1 Channel : A Min : -39.5250 – 3 Live Data Digital Meter : U2042XA Measurement : 1 Channel : A Min :-55.2960 – 5 Live Data • Information Panel Alert Summary	Avg 8 8 . 4 2 1 3 dBm (MY00000005) Avg 5 4 . 9 6 0 8 dBm	50 MHz Max : -37.9815 Max : -37.9815 X Max : -54.9608	Measuremen Channel : Min : -51.20 Live Da Digital Meter Measuremen Channel : Min : -36.83 Live Da	nt: 1 A - 5 - 5 ta - 1 - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 t - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 ta - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - 5 t - - 5 - 5 t - 5 t - 5 t - 5 - 5 1 5 5 - 5 - 5 - 5	Avg 1.1785 4052180041] Avg	• 50 MHz Max : -51.1622 • dBm * * • • • • • • • • • • • • • • • • • •

Figure 2-10 Multiple Digital Meter display example

Multilist display view

Select the instruments to use at **Instrument Setup** > **Additional Instruments**. Add a Multilist display view by clicking **[]** and selecting the measurement sources to display.



2 Measu	urement So	ource Selectio	on			×
	Model No	Serial No	Meas ID	Channel	Meas Type	
	U2021XA	HQ52140013	1	А	Avg	Â
	U2021XA	HQ52140013	2	А	Avg	
	U2021XA	HQ52140013	3	А	Avg	
	U2021XA	HQ52140013	4	А	Avg	
	U2049XA	HQ10000011	1	А	Avg	
	U2049XA	HQ10000011	2	А	Avg	
	U2049XA	HQ10000011	3	А	Avg	-
						Dk

3										
🔧 Instrument Setup	Instrument Setup 🖽 Display 1 🖽 Display 2									
Settings Datalog S	ettings	Multilist View								×
		Model No.	Serial No.	Result	Unit	Meas.	Chan	Туре		
		U2021XA	HQ52140013 HQ10000011		dBm dBm	1	A	Avg Avg		
Run All	Stop All	U2042XA	MY00000005		dBm	1	A	Avg		
U2021XA - HQ5214001	3- Meas1 🔻	• U2022XA	HQ52180041	-36.8361	dBm	1	A	Avg		
Channel Setup	Presets									
Mode :	Normal -	Operand#1	Operation	Operand#2		Result				
Frequency (Hz) :	50.000 M									
Chan Offset (dB) :										
Averaging Mode :	AUTO 👻									
Averaging Count :										
	Reset Averaging									
Calibration										إلىيي
Zero Ca	I Cal + Zero	 Information Panel 								
Measurement 1	Run	Alert Summary								
Trigger Setup	Kun	Clear All	Save							
- mgger setup		Meas. Re	sult Uni	t Limit Se	t Ty	/pe	Time	Stamp		

Figure 2-11 Multilist 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.

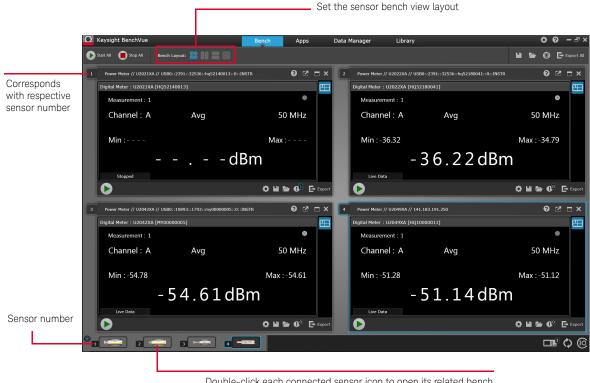


···									
Model No	Serial No	Channel	Trace 1	Trace 2	Trace 3	Trace 4			
U2021XA	HQ52140013	А							
U2042XA	MY00000005	А							
U2022XA	HQ52180030	А							
U2021XA	HQ52160021	А				•			



Figure 2-12 Multitrace example

Multiple bench operation



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

Figure 2-13 Multiple bench display example

U2040 X-Series Features

Broadband coverage for any modulated signal formats

The U2040 X-Series measures accurate average or time-gated average power for any modulated signal including all common wireless signals such as LTE, LTE-Advanced with 100 MHz bandwidth, and WLAN 802.11ac with 80/160 MHz bandwidth.

List mode/test sequencing

List mode is a mode of operation where a predefined sequence of measurement steps can be programmed into the power sensor and repeatedly executed as many times as required. This mode is suitable for power and frequency sweeps which normally require changing the parameters via the appropriate SCPI commands before performing a measurement. The hardware handshaking communication between the power sensor and the signal source provides the fastest possible execution time in performing the test sequences.

Trigger and gating parameters control which part of the waveform to be included or excluded from the measurement. The list mode helps to analyze modulated signals with regular and time-slotted or frame structure. For example, eight time-slotted GSM bursts, LTE-FDD and LTE-TDD frames and sub-frames, WCDMA frames and slots, and time-slotted measurements are supported in this mode. The desired number of slots and their duration and exclusion intervals can be easily programmed.

NOTE

Refer to the U2040 X-Series Programming Guide for more information.

Variable aperture size

In average mode and at normal/double/fast measurement speed, the time interval length used to measure the average power of the signal can be adjusted by setting the aperture size to between 20 μ s^[1] and 200 ms. This is useful for CW signals and noise-like modulated signals such as FDD-LTE and WCDMA by performing measurements over the full frames or sub-frames.

Decreasing the aperture size will improve the measurement throughput but reduce the signal-to-noise ratio of the measured signal. However, increasing the aperture size will improve the signal-to-noise ratio of the measured signal but reduce the measurement throughput.

[1] Only applicable for \geq 300 MHz. For <300 MHz, the minimum aperture size is 50 μ s. If the existing aperture size is set to <50 μ s and the frequency is changed from \geq 300 MHz to <300 MHz, the aperture size will automatically be changed to 50 μ s.

Measurement speed	Defaul t aperture size	Adjustable
Normal	50 ms	Yes
Double	25 ms	Yes
Fast	2 ms	Yes

Table 2-4Aperture size

Auto burst detection

Auto burst detection helps the measurement setup of the trace or gate positions and sizes, and triggering parameters on a large variety of complex modulated signals by synchronizing to the RF bursts. After a successful auto-scaling, the triggering parameters such as the trigger level, delay, and hold-off are automatically adjusted for optimum operation. The trace settings are also adjusted to align the RF burst to the center of the trace display.

20-pulse measurements

The U2040 X-Series can measure up to 20 pulses. The measurement of radar pulse timing characteristics is greatly simplified and accelerated by performing analysis simultaneously on up to 20 pulses within a single capture. Individual pulse duration, period, duty cycle and separation, positive or negative transition duration, and time (relative to the delayed trigger point) are measured.

High average count reset

When high averaging factors have been set, any rapid adjustments to the amplitude of the measured signal will be delayed due to the need to allow the averaging filter to fill before a new measurement can be taken at a stable power level. The U2040 X-Series allows you to reset the long filter after the final adjustment to the signal's amplitude has been made.

Built-in radar and wireless presets

The U2040 X-Series provides built-in radar and wireless presets for common signals such as DME, GSM, EDGE, WCDMA, WLAN, and LTE.

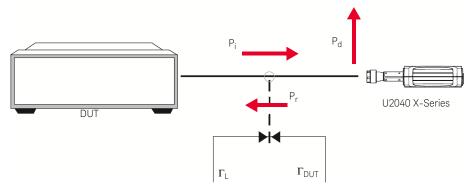


Figure 2-14 DUT to U2040 X-Series connection diagram

In a realistic measurement environment, the Device-Under-Test (DUT) impedance or the reference impedance (Z₀) is not equal to the U2040 X-Series impedance. The mismatch in impedance values causes a portion of the signal voltage to be reflected. This is quantified by the reflection coefficient, or gamma (Γ). A portion of the incident power to the U2040 X-Series, P_i, is reflected back to the DUT as P_r. The remaining power, P_d, gets delivered to the U2040 X-Series, and the reflected portion will be superimposed onto P_i. The nominal power, P_{z0} – the power generated after factoring in Z₀ – may be calculated as follows:

$$P_{zo} = P_i \left| 1 - \Gamma_{DUT} \Gamma_L \right|^2$$

Gamma correction compensates for impedance mismatch via two options, which are Single Point Gamma and Table-based Gamma.

Single Point Gamma

Single Point Gamma correction is used when you have a known and constant frequency, so a single gamma value can be used for calculation. The value for Γ_{DUT} may be entered as a Single Point Gamma which may be applied across all measurement frequencies in the U2040 X-Series operating range.

Table-based Gamma

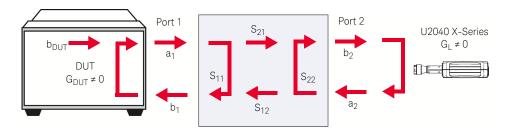
Table-based Gamma is used when there are multiple known frequencies, leading to multiple gamma values. This option supports a list of up to 1024 measurement frequency values.

NOTE

The U2040 X-Series supports up to 10 gamma tables that are retained across reset and power cycles.

The Γ_L values for factory calibration frequencies within the U2040 X-Series operating range are already pre-loaded in the U2040 X-Series. These Γ_L values are retained across reset and power cycles.

S-parameter correction





A Device-Under-Test (DUT) that has n number of ports has n² S-parameters. These S-parameters represent reflected energy which interferes with the power measurements. These errors are usually caused by additional components such as attenuators, adapters, or matching pads, which are inserted between the DUT and the U2040 X-Series. Typically, DUTs are non-ideal, as illustrated in **Figure 2-15**. When power is transmitted from the DUT, the U2040 X-Series will reflect a part of its incident wave back to the 2-port device. The 2-port device will reflect this wave back to the U2040 X-Series. The power from the DUT may therefore be calculated as follows:

$$b_{DUT} = b_2 \frac{(1 - S_{11}\Gamma_{DUT})(1 - S_{22}\Gamma_L)}{S_{21}} - S_{12}\Gamma_{DUT}\Gamma_L$$

The result is the same as if gamma correction was enabled. This feature enables you to correct for the effect of 2-port devices in your test setup. You may enter the S-parameter data for the DUT in the .S2P file format (magnitude-phase or dB-phase or real-imaginary).

NOTE

The U2040 X-Series supports up to 10 S-parameter tables that are retained across reset and power cycles.

Tilt measurement

Tilt measurement is used to measure the amount of tilted droop (A_D) of the input signal as shown below.

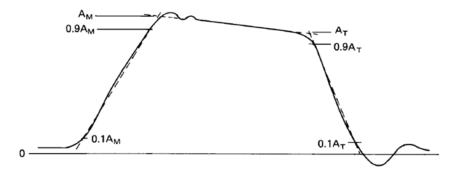


Figure 2-16 Tilt measurement graph

Pulse amplitude, A_M

The pulse amplitude quantity is determined by the intersection of a line passing through the points on the rising edge, where the instantaneous value reaches 10% and 90% of A_M and a straight line that is the best least-squares fit to the pulse in the pulse-top region.

Trailing edge (last transition) amplitude, AT

The trailing edge amplitude quantity is determined by the intersection of a line passing through the points on the falling edge where the instantaneous value reaches 90% and 10% of A_T , and the straight-line segment fitted to the top of the pulse in determining A_M .

Tilt, A_D

Tilt is the difference between A_M and A_T . It is expressed in percentage of A_M or in dB.

$$TILT(\%) = \frac{A_M - A_T}{A_M} \times 100$$

$$TILT(dB) = 10 \times \log 10 \left(\frac{A_M}{A_T}\right)$$

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Keysight U2040 X-Series Wide Dynamic Range Power Sensors User's Guide

3 Characteristics and Specifications



For the characteristics and specifications of the U2040 X-Series, refer to the datasheet at http://literature.cdn.keysight.com/litweb/pdf/5992-0040EN.pdf.



THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Keysight U2040 X-Series Wide Dynamic Range Power Sensors

User's Guide

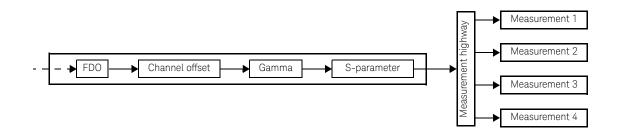
A Appendix

Simplified Measurement Path 76 Typical Averaged Readings 77 Bandwidth Filter Shapes 79 Measurement Gates 80 Limit Checking Application Example 81



A Appendix

Simplified Measurement Path



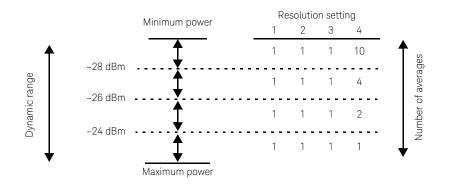
Number of averages

Typical Averaged Readings

Below shows the typical number of averages for each range and resolution when the U2040 X-Series is in the auto-average mode and set to the normal speed mode.

Minimum power	Resolution setting				
Minimum power	1	2	3	4	
↑ < -70 dBm	100	100	100	100	
1	100	100	100	100	
–70 dBm	100	100	100	100	
-68 dBm · · · · · · · · · · · · · · · · · · ·	100	100	100	100	
-66 dBm	100	100	100	100	
-64 dBm					
-62 dBm	65	100	100	100	
-60 dBm	26	100	100	100	
	10	100	100	100	
-58 dBm	4	100	100	100	
–56 dBm	2	100	100	100	
–54 dBm	 1	65	100	100	
-52 dBm					
-50 dBm	1	26	100	100	
-48 dBm	1	10	100	100	
	1	4	100	100	
-46 dBm	1	2	100	100	
-44 dBm	 1	 1	6 5	100	
-42 dBm					
-40 dBm	1	1	26	100	
-38 dBm	1	1	10	100	
	1	1	4	100	
-36 dBm	1	1	2	100	
-34 dBm	1	1	1	65	
-32 dBm	 1	 1	 1	26	
-30 dBm					

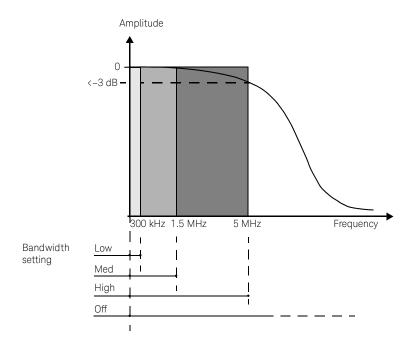
Dynamic range



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^[1]



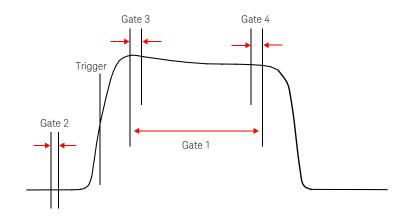
[1] When the U2040 X-Series frequency is set to \geq 300 MHz.

Measurement Gates

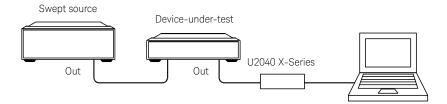
A measurement gate allows measurements to be performed on particular sections of the input signal. The gate is defined by a start time relative to the trigger event and a duration. Signal samples acquired during the time interval specified by the gate are used for the measurements in that gate. A system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

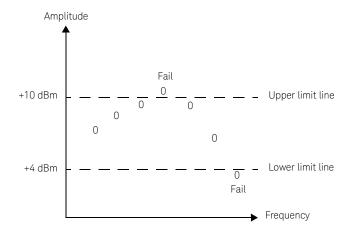


 Table A-1
 Range of values for limits

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

A Appendix

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

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

© Keysight Technologies 2015 Edition 1, May 20, 2015

Printed in Malaysia



U2041-90002 www.keysight.com

