DEMO GUIDE

U2040/50/60 and L2050/60 X-Series

USB/LAN Wide Dynamic Range Power Sensors with BenchVue Software Power Meter Application

GREENTEST® TECHNOLOGIES

Introduction

This demonstration guide explains how some of the most frequently-made measurements obtained using the Keysight U2040/50/60 and L2050/60 X-Series USB/LAN Wide Dynamic Range Power Sensors can be analyzed using the Keysight BenchVue software Power Meter Application.

Embedded in Keysight's BenchVue instrument control software is Windows-based, Power Meter Application, which supports all models of the U2040/50/60 and L2050/60 X-Series USB/LAN Wide Dynamic Range Power Sensors. This application software allows advanced power analysis measurement to be performed in real time and provides the ability to easily view, capture, and export measurement data and screen shots.

BenchVue software Power Meter App's graphical user interface supports multiple measurement display formats

Table of Contents

Demonstration Preparation 3
Demo 1: Average Power Measurement 5
Demo 2: Pulse Power Measurement 6
Demo 3: GSM Time-Gated Burst Power Measurement 11
Demo 4: Multi-Channel Pulse Measurement. 17
Demo 5: Multi-List with Multi-Channel Power Measurement 23

Demonstration Preparation

The following instruments, software, and auxiliary items are required to perform these demonstrations:

Product	Minimum system requirement
Keysight U2049XA LAN power sensor	Firmware version A.01.00 or later
Keysight U2042XA USB peak power sensor	Firmware version A.01.00 or later
Keysight N5182B MXG vector signal generator or Keysight E4438C ESG vector signal generator	Firmware version B.01.51 or later
Keysight I/O Libraries Suite (Connection expert)	Version 17.0.xx or later
Keysight BenchVue software Power Meter App	BenchVue Version 2.6
Power over Internet (PoE) injector	Quantity: 1
PC	Windows 8 or 7 32-bit or 64-bit
LAN cable	Quantity: 2
SMB cable	Quantity: 1
USB 2.0 compliance cable with USB Mini-B connector and locking mechanism	U2031A, U2031B, U2031C

To download and update instrument firmware and software, visit **www.keysight.com/find/powermeters**

Test configuration

Connect the PC, U2049XA, and signal generator as follows (see Figure 1):

1. Verify that the PC is installed with BenchVue software and the IO Libraries Suite.
2. Connect the U2049XA LAN power sensor to the RF Output of the signal generator.
3. Connect the LAN power sensor to the Data & Power Out port of the PoE injector using a LAN cable.
4. Connect the Data In port of the PoE injector to the LAN port of the PC using a LAN cable.
5. Connect the TRIG 1 port of the signal generator to the TRIG In port of the LAN power sensor using an SMB cable.
6. Connect the power cord of the PoE injector to any power outlet to power up the injector.

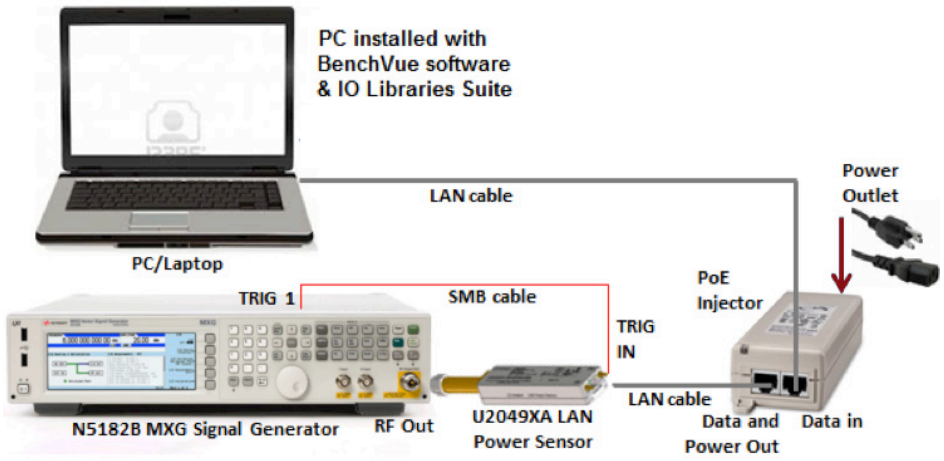


Figure 1. U2049XA LAN power sensor connection diagram with PoE injector

Establish the U2049XA LAN power sensor's LAN connection via the IO Libraries Suite.

7. Double click the "IO Libraries Suite" icon on the PC desktop.
8. IO Libraries Suite will auto-detect and establish the LAN connection of the U2049XA LAN power sensor as shown in Figure 2.

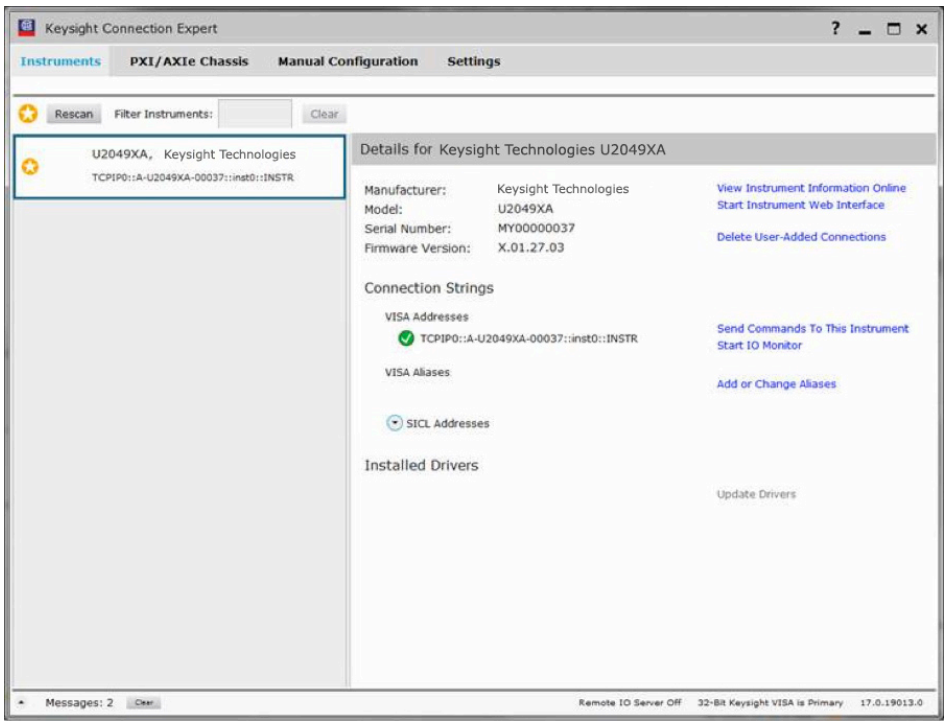


Figure 2. U2049XA LAN power sensor LAN interface detected and added through IO Libraries Suite

If the LAN power sensor's LAN connection is not established, perform the following steps to manually add the LAN power sensor's hostname:

1. From the IO Libraries Suite menu, select Manual Configuration > LAN instrument.
2. From the Add New Instruments/ Interfaces menu, manually key-in the LAN power sensor hostname in the Hostname or IP address textbox. Note: The Hostname starts with an "A" followed by the model number "U2049XA" and ends with the five-digit serial number of the LAN power sensor, for example: A-U2049XA-00037.
3. Click Test This VISA Address to verify the LAN connection as shown in Figure 3.
4. Click Accept to complete the LAN connection setup.

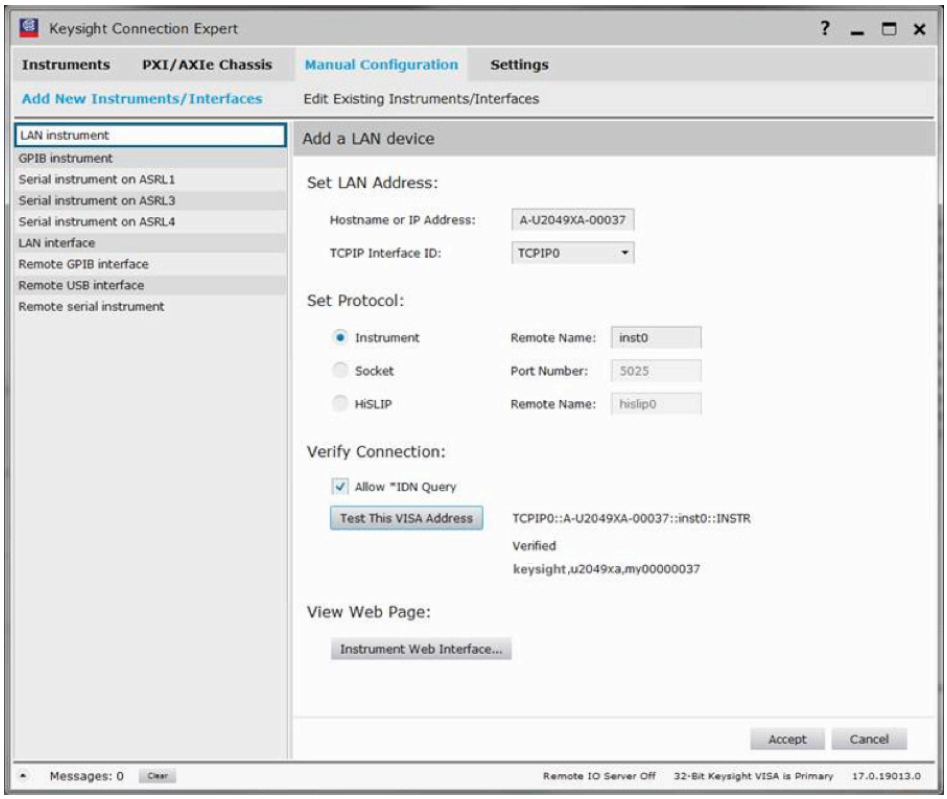


Figure 3. Manual configuration to add the LAN power sensor's LAN connection

Please refer to the U2040 X-Series power sensors User Guide for LAN setup configuration if encountering a LAN connection error.

For the demonstrations that follow, keystrokes surrounded by [ ] represent front panel keys of the instruments, while keystrokes surrounded by { } represent softkeys.

Demo 1. Average Power Measurement

Objective

– To demonstrate the BenchVue software Power Meter App's ability to perform average power measurement in digital display mode.

Test procedure

Instructions	Keystrokes
On the signal generator	
1. Set instrument to its default settings	Press [Preset]
2. Set frequency and amplitude	Press [Frequency] > [1] > {GHZ} Press [Amplitude] > [0] > {dBm}
3. Turn on modulation	Toggle [Mod On/Off] to "On"
4. Turn on RF Output	Toggle [RF On/Off] to "On"
On BenchVue software	
5. Run BenchVue software	Double-click on the BenchVue software shortcut on the desktop or access the program via the Windows Start menu
6. Add the U2049XA instrument	From the bottom panel of the BenchVue software menu, double click the U2049XA sensor icon: {  } Note: BenchVue software will automatically launch the Power Meter App with the supported model of power meter/sensor
7. Set frequency to 1 GHz	From the Channel Setup menu, set Frequency (Hz) to "1 G"

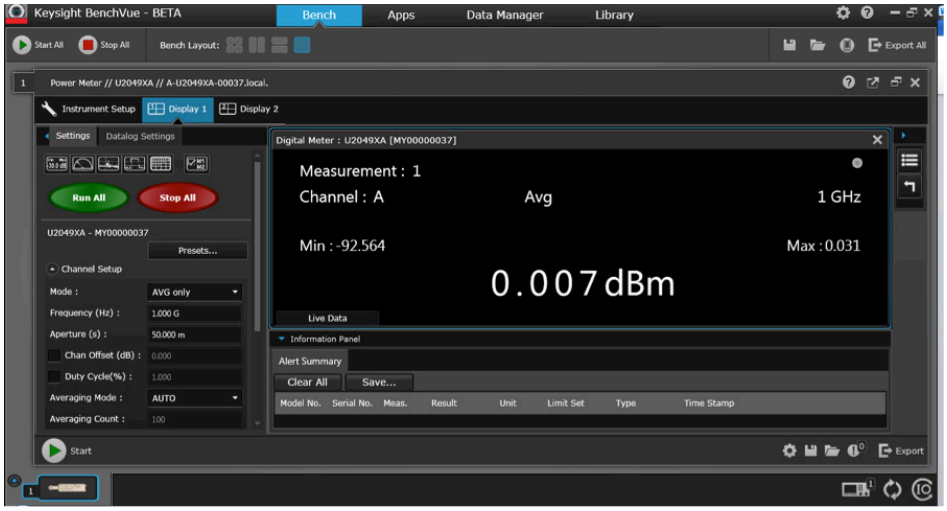


Figure 4. Average power measurement using BenchVue software Power Meter App

Demo 2. Pulse Power Measurements

Objectives

- To demonstrate the U2049XA LAN power sensor's ability to measure average time-gated pulse width and pulse period signal using aperture time and duty cycle features in Average Mode, and obtain measurements via the BenchVue software Power Meter App.
- To demonstrate BenchVue software Power Meter App's ability to automatically obtain 15-point pulse parameter values from the trace graph in Normal Mode.
- To use the U2049XA LAN power sensor to measure the average, peak, and peak-to-average of a pulse signal via dual-gated feature, using a signal generator to produce a pulse signal with a 10 ms pulse period and 1.2 ms pulse width.

Test procedure

Instructions	Keystrokes
On the signal generator	
1. Set instrument to its default setting	Press [Preset]
2. Set frequency and amplitude	Press [Frequency] > [1] > {GHz} Press [Amplitude] > [0] > {dBm}
3. Set pulse signal	Press [Pulse] > {Pulse Period} > [10] > {msec} Press {Pulse Width} > [1.2] > {msec}
4. Turn on pulse signal	Toggle [Pulse On/Off] to "On"
5. Turn on modulation signal	Toggle [Pulse On/Off] to "On"
6. Set external triggering to sync the pulse between signal generator and power sensor	Press [Pulse] > [More] > {Route Connectors & Set Polarity} > {Route to TRIG 1 BNC} > {Pulse Sync}
7. Turn on RF Output	Toggle [RF On/Off] to "On"
On BenchVue software	
8. Run BenchVue software	Double-click on the BenchVue software shortcut on the desktop or access the program via the Windows Start menu
9. Add U2049XA instrument	From the bottom panel of the BenchVue software menu, double click the U2049XA sensor icon: {  }
Measuring average power of pulse signal using aperture time with free run triggering in Average mode	
10. Set frequency to 1 GHz	From Channel Setup menu, set Frequency (Hz) to "1 G"
11. Set aperture time to 10 ms to capture pulse signal	From Channel Setup menu, set Aperture(s) to "10 m"
12. Set triggering mode to Free Run	From Trigger Setup menu, set Trigger Mode to "Free Run"

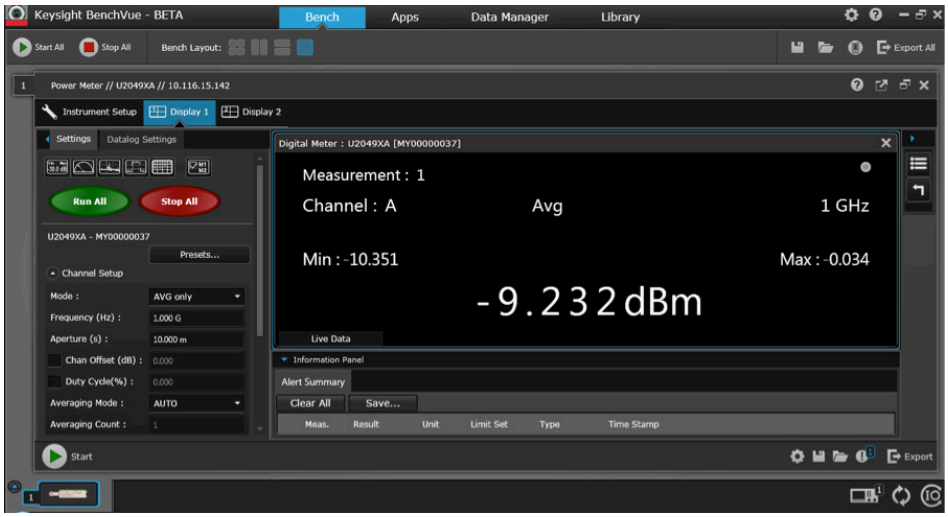


Figure 5. Average power measurement with aperture time set to 10 ms to capture entire pulse signal

Instructions	Keystrokes
Measuring time-gated average power of pulse width using aperture time and duty cycle feature in Free Run triggering in Average Mode	
13. Enable duty cycle and duty cycle to 12%	From Channel Setup menu click Duty Cycle (%) and set it to “12%”

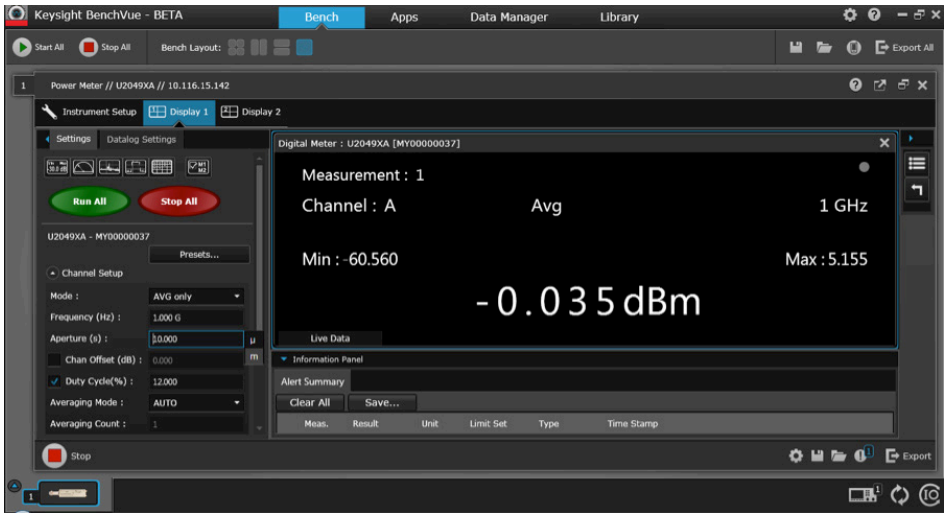


Figure 6. Time-gated average power of pulse width signal (1.2 ms) with aperture time of 10 ms and duty cycle of 12%

Instructions	Keystrokes
Measuring time-gated average power of pulse width using aperture time with external triggering in Average Mode	
14. Disable duty cycle	From Channel Setup menu, un-check the Duty Cycle (%) box
15. Set aperture time to 1.2 ms to capture 1.2 ms pulse period	From Channel Setup menu, set Aperture(s) to “1.2 m”
16. Set triggering mode to continuous	From Trigger Setup menu, set Trigger Source to “Cont Trig”
17. Set triggering source to external	From Trigger Setup menu, set Trigger Source to “External”

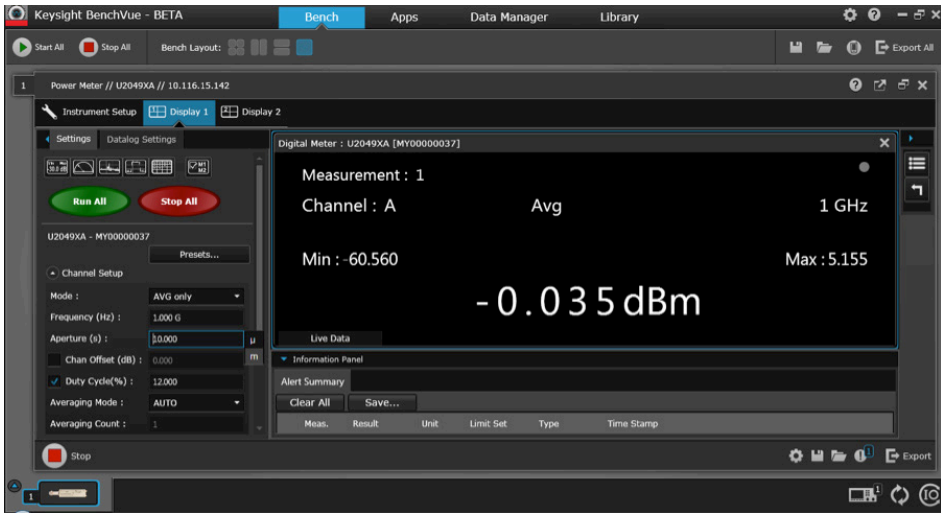


Figure 7. Time-gated average power of pulse width signal (1.2 ms) with aperture time set to 1.2 ms in external triggering mode

Instructions	Keystrokes
Setup trace display to capture pulse signal waveform with external triggering in Normal Mode	
18. Add trace view display to capture pulse signal	Select { } on the menu to add Trace View display
19. Delete digital meter view	Press { Stop All } on the menu. Move the cursor to highlight the Digital Meter view and click { } on the right hand corner to close the display
20. Configure trace display to capture 10 ms pulse signal	From Trace Setup menu, set Trace Start(s) to “1 m” and X Scale (s/div) to “1.2 m”
21. Set triggering mode to continuous trigger	From Trigger Setup menu, set Trigger Mode to “Cont Trig”
22. Set triggering source to internal triggering	From Trigger Setup menu, set Trigger Source to “Internal”
23. Enable trace display	From Trigger Setup menu, check Trace Enable box
24. Run the measurement	Press { Display 1 } > { Run All } to run the measurement

Figure 8. Pulse signal measurement

Instructions	Keystrokes
Add dual-gating feature to measure pulse width signal	
25. Add gating to measure pulse width signal	Select { } > Gating Settings > {Gate 1}. Move the dual-gated (vertical line) to highlight the pulse width signal

Figure 9. Pulse width measurement (delta time, average and peak) shown in Pulse Analysis table

Instructions	Keystrokes
Add dual-gating feature to measure pulse period signal	
26. Add gating to measure pulse period signal	Select { } > Gating Settings > {Gate 2}. Move the dual gated (vertical line) to highlight the pulse period signal.

Figure 10. Pulse period measurement (delta time, average and peak) shown in Pulse Analysis table (on top of pulse width measurement

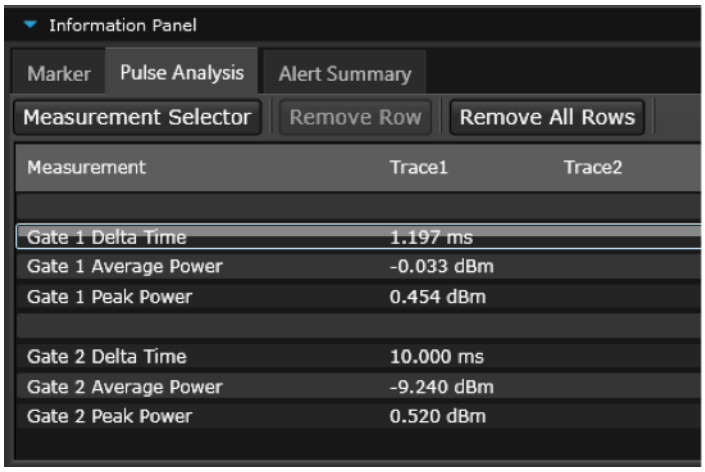


Figure 11. Overall of pulse width and pulse period measurement shown in Pulse Analysis table

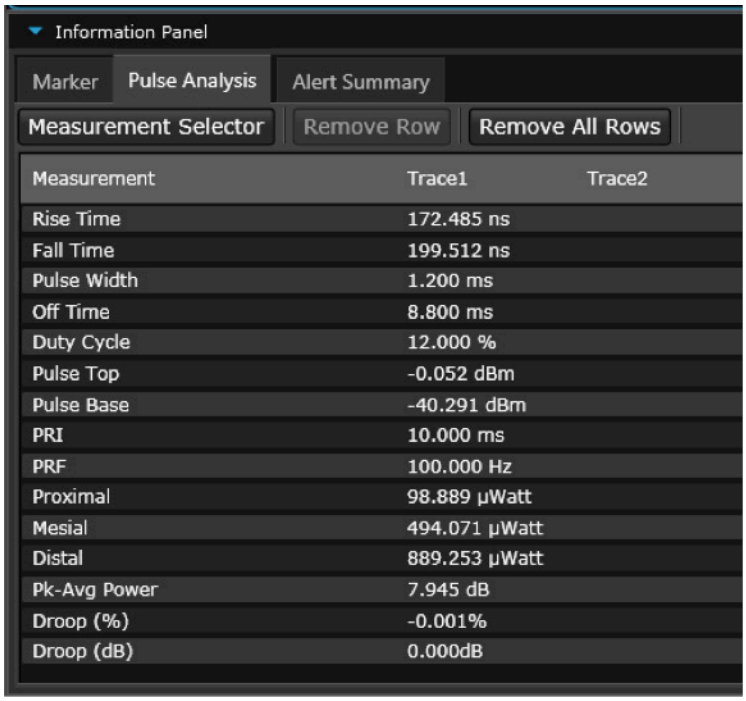


Figure 12. Pulse analysis table consists of pulse characteristic parameter values

Demo 3: GSM Time-Gated Burst Power Measurement

Objectives

- To demonstrate the U2049XA LAN power sensor's ability to measure the average time-gated burst power of a GSM modulation signal via the aperture time feature in Average Mode using the BenchVue software Power Meter App.
- To demonstrate the U2049XA LAN power sensor's ability to measure average, peak, and peak-to-average burst power of a GSM modulation signal via external/internal triggering methodology in Normal Mode, and have it automatically calculated by the BenchVue software Power Meter App through the gating feature on the trace view graph format.

In this demo, a GSM modulation signal will be generated from a signal generator, and external triggering from Event 1 of a signal generator will be used to synchronization with a U2049XA LAN power sensor via the Trig In port to capture the GSM waveform signal. GSM burst duration length is 4.613 ms and consists of 8 timeslots with each timeslot 577 µs (see Figure 13).

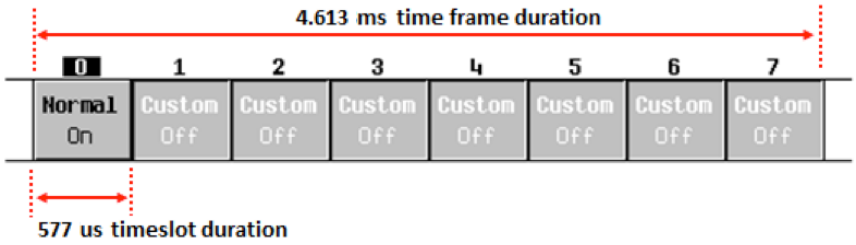


Figure 13. GSM timeslot pattern with timeslot 0 On

Test configuration

For this demo, connect a PC, U2049XA and signal generator by following the instruction shown on Figure 1 except connect "Event 1" port of signal generator to "TRIG In" port of LAN power sensor using SMB cable.

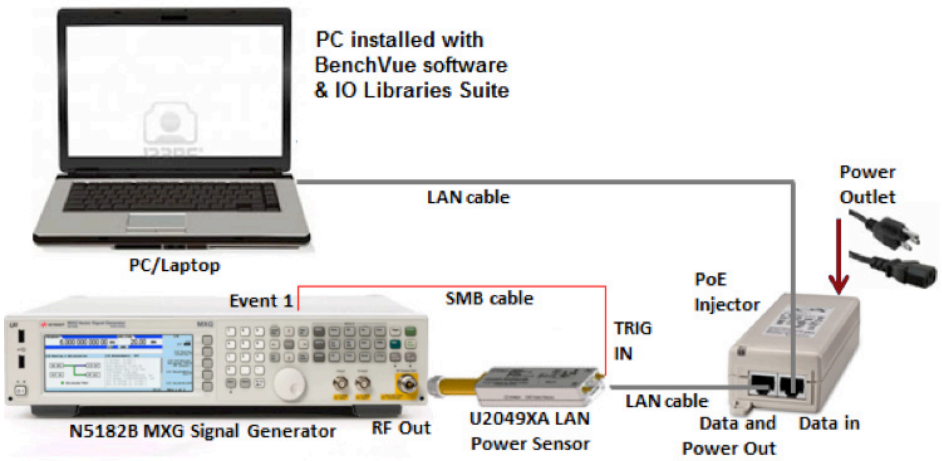


Figure 14. Setup diagram of external trigger port from signal generator to trigger LAN power sensor through its trigger input port

Test procedure

Instructions	Keystrokes
On the signal generator	
1. Set instrument to its default settings	Press [Preset]
2. Set frequency and amplitude	Press [Frequency] > [1] > {GHZ} Press [Amplitude] > [0] > {dBm}
3. Recall GSM modulation signal	Press [Mode] > {Dual ARB}> {Select Waveform} and {Waveform Segments}. Press [ ] or [ ] to select {GSM_BURST_WFM}
4. Set GSM modulation signal	Press [Mode] > {Dual ARB} > {Select Waveform}. Press [ ] or [ ] to highlight {GSM_BURST_WFM} then press {Select Waveform}
5. Turn on GSM signal	Toggle {ARB On/Off} to “On”
6. Set external triggering for GSM modulation signal	Press [Mode] > {Dual ARB} > [More] > {Marker Utilities} > {Route Connectors} > {Route To Event 1 BNC} > {Marker 2}
7. Turn on GSM modulation signal	Toggle [Mod On/Off] to “On”
8. Turn on RF Output	Toggle [RF On/Off] to “On”
On BenchVue software	
9. Run BenchVue software	Double-click on the BenchVue software shortcut on the desktop or access the program via the Windows Start menu
10. Add U2049XA instrument	From the bottom panel of the BenchVue software menu, double click the U2049XA sensor icon: {  }
Measuring average power of GSM waveform signal using aperture time with free run triggering in Average Mode	
11. Set frequency to 1 GHz	From Channel Setup menu, set Frequency (Hz) to “1 G”
12. Set aperture time to 4.613 ms to capture GSM signal	From Channel Setup menu, set Aperture(s) to “4.613 m”
13. Set triggering mode to Free Run	From Trigger Setup menu, set Trigger Mode to “Free Run”

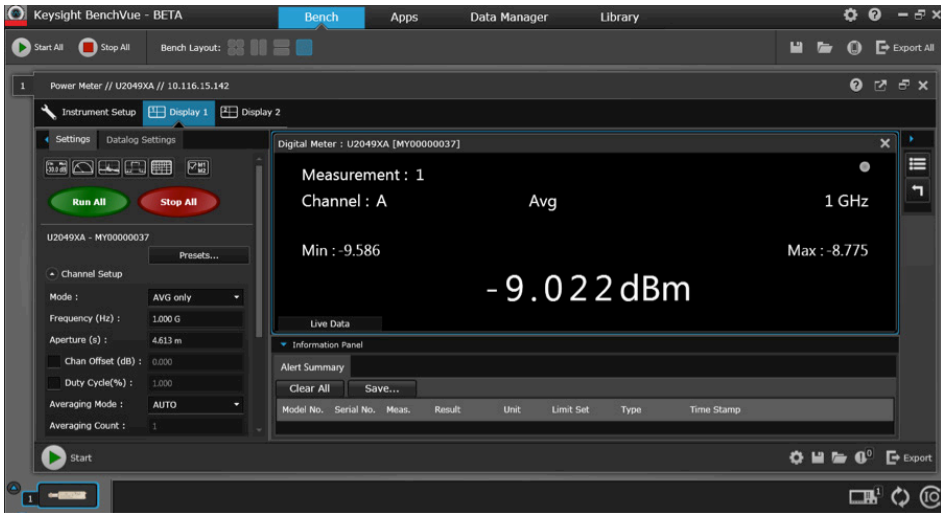


Figure 15. Average power measurement with aperture time set to 4.613 ms to capture entire GSM waveform signal

Instructions	Keystrokes
Measuring time-gated average power of GSM timeslot 0 signal using aperture time with external triggering in Average Mode	
14. Set aperture time to 577 µs to capture GSM timeslot 0 duration	From Channel Setup menu, set Aperture(s) to “577 µs”
15. Set triggering mode to Continuous Trigger	From Trigger Setup menu, set Trigger Mode to “Cont Trig”
16. Set triggering source to external triggering	From Trigger Setup menu, set Trigger Source to “External”

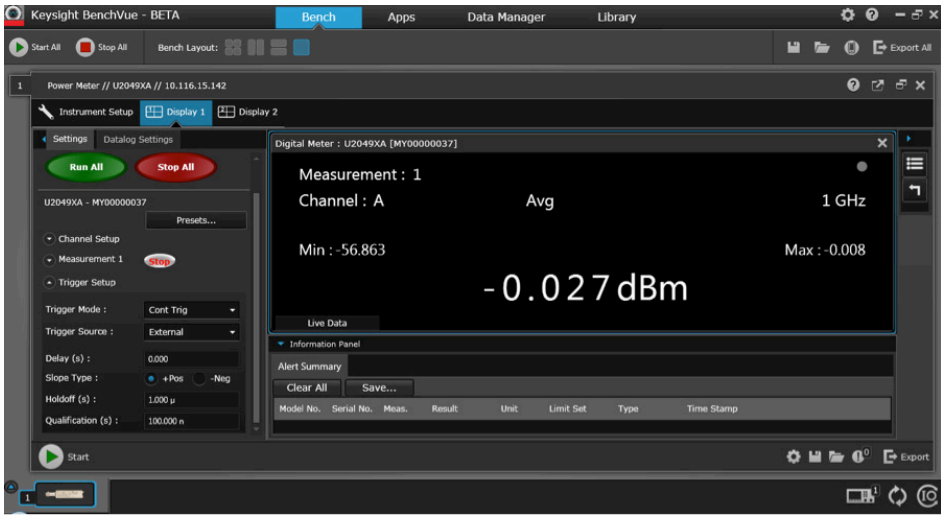


Figure 16. Average power of GSM time-gated signal using aperture time feature in external triggering mode

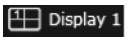
Instructions	Keystrokes
Setup trace view display to capture GSM waveform signal in Normal mode	
17. Add trace view display to capture GSM waveform signal	Select {  } to add Trace View display
18. Delete digital meter view	Click {  } on the menu. Move the cursor to highlight the Digital Meter view and click {  } on the right-hand corner to close the display
19. Configure trace display to capture GSM 4.613 ms waveform	From Trace Setup menu, set Trace Start(s) to “–100 µ” and X Scale (s/div) to “500 µs”
20. Set triggering mode to continuous trigger	From Trigger Setup menu, set Trigger Mode to “Cont Trig”
21. Set triggering source to external triggering	From Trigger Setup menu, set Trigger Source to “External”
22. Run the measurement	Click {  } > {  } to run the measurement

Figure 17. Trace view display capture entire GSM waveform signal

Instructions	Keystrokes
Add dual-gating feature to measure GSM time-gated burst average, peak, and peak-to-average power on timeslot 0	
23. Add trace view display to capture GSM waveform signal	Select {  } to add Trace View display
24. Add gating to measure GSM timeslot 0 duration (See Figure 18)	Select {  } > Gating Settings > {Gate 1}. Move the dual-gated (vertical line) to highlight the GSM timeslot 0 duration

Figure 18. Time-gated measurement on GSM timeslot 0 with Gate 1 feature

Instructions	Keystrokes
Add dual-gating feature to measure entire GSM waveform signal	
25. Add dual gates to measure GSM waveform signal whole waveform (See Figure 19)	Highlight the trace graph display. Right click on the trace graph display and select “Apply Gate Option” > “Gate 2.” Move the dual-gated (vertical line) to the highlight the GSM whole waveform

Figure 19. GSM waveform signal 4.613 ms duration show average, peak, and peak-to-average with Gate 2 feature

Figure 20. Average and peak power measurement of GSM timeslot 0 and GSM waveform signal

Demo 4: Multi-Channel Pulse Measurement

Objectives

- To demonstrate the BenchVue software Power Meter App's ability to enable multi-channel trace graph measurement on a one-instance trace window.
- Use the Power Meter App's vertical and horizontal markers feature to measure the time separation and power differential between two pulses from two different channels.
- Use the BenchVue's pop-up function to maximize the trace graph space for better pulse analysis measurement.

In this demo, two different pulse signals will be generated from two signal generators and the pulse will be measured with a U2049XA LAN power sensor and U2042XA USB peak power sensor respectively.

Test configuration

To perform this demo connect the PC, U2049XA, U2042XA, and two signal generators as shown in Figure 21 and detailed in the following procedures.

1. Connect the U2049XA LAN power sensor to the RF Output of signal generator 1.
2. Connect the LAN power sensor to the Data & Power Out port of the PoE injector using a LAN cable.
3. Connect the Data In port of the PoE injector to the LAN port of the PC/laptop using a LAN cable.
4. Connect the TRIG 1 port of the signal generator 1 to the TRIG In port of the LAN power sensor using an SMB cable.
5. Connect the power cord of the PoE injector to any power outlet to power-up the injector.
6. Connect the U2042XA USB peak power sensor to the RF Output of the signal generator 2.
7. Connect the PC/laptop to the U2042XA USB peak power sensor via USB Mini-B cable.

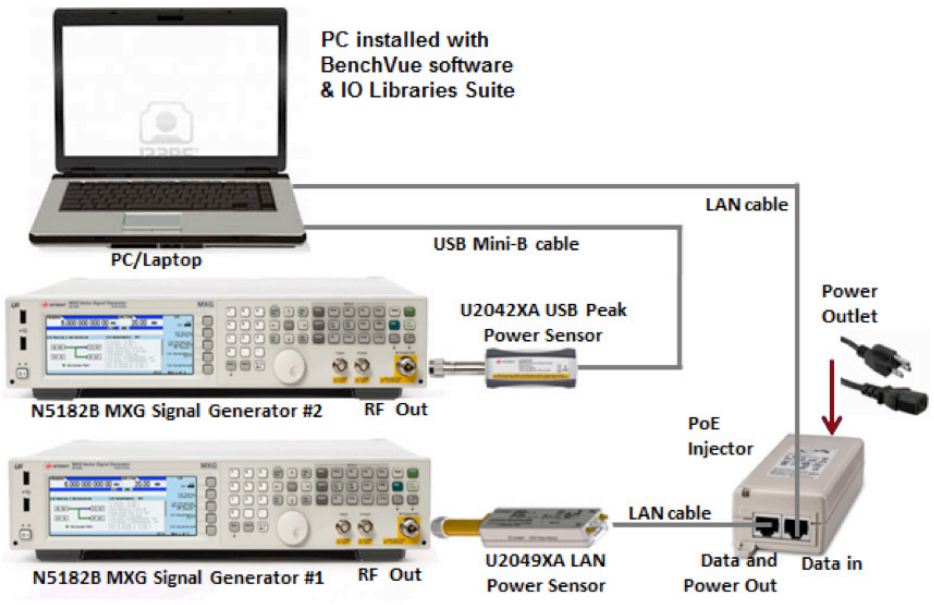


Figure 21. Set up diagram of the U2049XA and U2042XA power sensors with two signal generators

Test procedure

Instructions	Keystrokes
On signal generator 1	
8. Set instrument to its default settings	Press [Preset]
9. Set frequency and amplitude	Press [Frequency] > [1] > {GHz} Press [Amplitude] > [0] > {dBm}
10. Set pulse signal	Press [Pulse] > {Pulse Period} > [4] > {µsec} Press {Pulse Width} > [2] > {µsec}
11. Turn on pulse signal	Toggle [Pulse On/Off] to “On”
12. Turn on modulation signal	Toggle [Pulse On/Off] to “On”
13. Turn on RF Output	Toggle [RF On/Off] to “On”
On signal generator 2	
14. Set instrument to its default settings	Press [Preset]
15. Set frequency and amplitude	Press [Frequency] > [1] > {GHz} Press [Amplitude] > [0] > {dBm}
16. Set pulse signal	Press [Pulse] > {Pulse Period} > [5] > {µsec} Press {Pulse Width} > [2.5] > {µsec}
17. Turn on pulse signal	Toggle [Pulse On/Off] to “On”
18. Turn on modulation signal	Toggle [Pulse On/Off] to “On”
19. Turn on RF Output	Toggle [RF On/Off] to “On”
On BenchVue software	
20. Run BenchVue software	Double-click on the BenchVue software shortcut on the desktop or access the program via the Windows Start menu
21. Add U2049XA instrument	From the bottom panel of the BenchVue software menu, double click the U2049XA sensor icon: {  }
22. Set U2049XA frequency to 1 GHz	From Channel Setup menu, set Frequency (Hz) to “1 G”
23. Add trace view display to capture pulse signal	Select {  } to add Trace View display
24. Delete U2049XA digital meter view display	Move the cursor to highlight the Digital Meter view and click {  } on the right hand corner to close the display

Add U2042XA power sensor into Power Meter App	
25. Add U2042XA instrument	Select Instrument Setup tab > Additional Instruments tab > U2042XA > Connect
26. Add U2042XA into U2049XA trace view display	Press { Display 1 }. Move the cursor to select U2049XA's trace view display. Click { M1 M2 } to assign the measurement to selected view. From Measurement Source Selection menu, assign U2049XA to Trace 1 and U2042XA to Trace 2 then click OK
27. Delete U2042XA digital meter view display	Move the cursor to highlight the Digital Meter view of U2042XA and click { } on the right hand corner to close the display
28. Set U2042XA frequency to 1 GHz	From Trace Source menu, select U2042XA power sensor. Select Channel Setup menu, set Frequency (Hz) to "1 G"
29. Configure trace display to capture the pulse signal	From Trace Setup menu, set Trace Start(s) to "1 µ" and X Scale (s/div) to "–1 µ"
30. Set triggering mode to continuous trigger	From Trigger Setup menu, set Trigger Mode to "Cont Trig"
31. Set triggering source to internal triggering	From Trigger Setup menu, set Trigger Source to "Internal"
32. Enable trace display (see Figure 22)	From Trigger Setup menu, check "Trace Enable"

Figure 22. Two different pulses appear and shown in Power Meter App

Add vertical line marker to measure the time separation between two pulses	
33. Add vertical line marker	Select {  } (Vertical Line Marker). Move the vertical line (A) located at rising edge of 4 µs pulse (yellow trace). Move the another vertical line (B) located at rising edge of 5 µs pulse (green trace)
34. View the time separation between two pulses (See Figure 23)	From Information Panel menu, select Marker Tab to view the result

Figure 23. Vertical line marker indicates the time separation, 1 µs between two pulses

Add vertical line marker to measure the time separation between two pulses	
35. Add horizontal line marker (See Figure 24)	Select {  } (Horizontal Line Marker). Move the horizontal line (A) located at top edge of 4 µs pulse (yellow trace). Move the another horizontal line (B) located at top edge of 5 µs pulse (green trace)

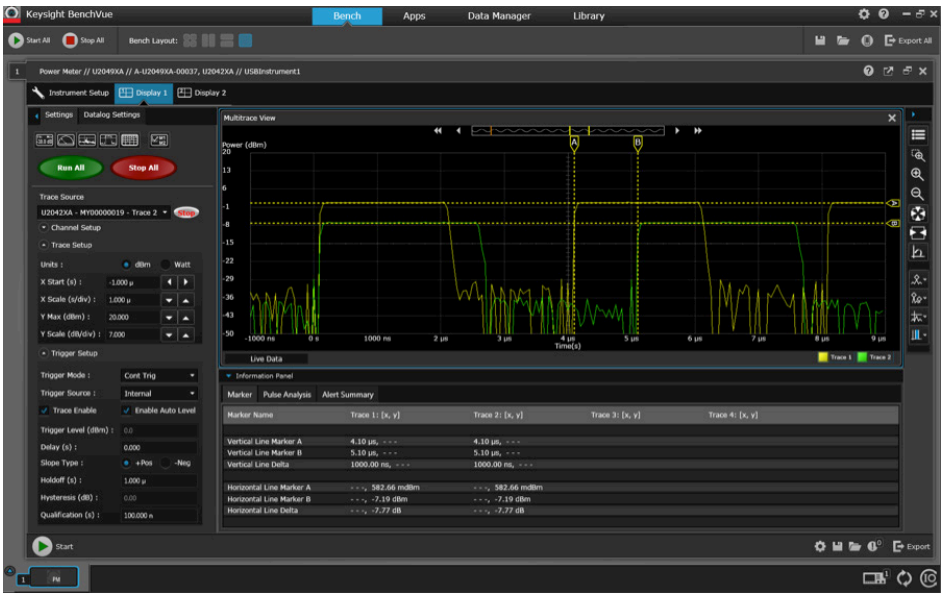


Figure 24. Horizontal line marker indicates the power differential, ~ –7.77 dB between two pulses

Open Power Meter App in new window via BenchVue pop out function	
36. Open Power Meter App in new window (see Figure 25)	Select {  } on the right hand corner to open in new window Note: To restore the window back to BenchVue screen, click {  }

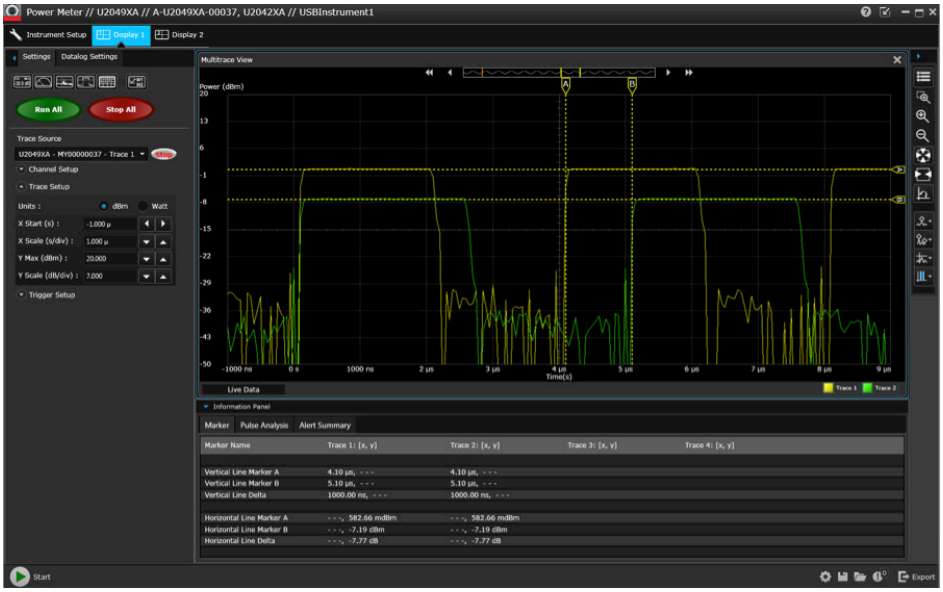


Figure 25. Power Meter App application shown in separate window, which allows the trace graph space to be maximized for better pulse analysis measurement

Demo 5: Multi-List with Multi-Channel Power Measurement

Objectives

- To demonstrate BenchVue software Power Meter App's ability to enable multi-list display view for multi-channel power measurement.
- Use datalog feature to save the specific power measurement with pre-defined timeframe and export the log data to specific format.

The Multi-list function provides the ability to capture more than two channel's power measurements simultaneously. In this example, we will refer to Figure 21 to generate two different power levels from two signal generators and measure the power with a U2049XA LAN power sensor and U2042XA USB power sensor respectively.

Test procedure

Instructions	Keystrokes
On signal generator 1	
1. Set instrument to its default settings	Press [Preset]
2. Set frequency and amplitude	Press [Frequency] > [1] > {GHz} Press [Amplitude] > [0] > {dBm}
3. Turn on RF Output	Toggle [RF On/Off] to "On"
On signal generator 2	
4. Set instrument to its default settings	Press [Preset]
5. Set frequency and amplitude	Press [Frequency] > [1] > {GHz} Press [Amplitude] > [–5] > {dBm}
6. Turn on RF Output	Toggle [RF On/Off] to "On"
On BenchVue software	
7. Run BenchVue software	Double-click on the BenchVue software shortcut on the desktop or access the program via the Windows Start menu
8. Add U2049XA instrument	From the bottom panel of the BenchVue software menu, double click the U2049XA sensor icon: {  }
9. Set U2049XA frequency to 1 GHz	From Channel Setup menu, set Frequency (Hz) to "1 G"
Add U2042XA power sensor into Power Meter App application	
10. Add U2042XA instrument	Select Instrument Setup tab > Additional Instruments tab > U2042XA > Connect
11. Set U2042XA frequency to 1 GHz	Press {  }. Highlight the U21042XA digital meter view display. From Channel Setup menu, set Frequency (Hz) to "1 G"
12. Add multi-list view display for U2049XA and U2042XA power sensor (see Figure 26)	Click on Multi-list icon: {  }. From Measurement Source Selection menu, select U2049XA Meas UD 1 and U2042XA Meas ID 1, then click "OK"
13. Delete U2049XA and U2042XA digital meter view display	Move the cursor to highlight the Digital Meter view of U2049XA and click {  } on the right hand corner to close the display. Repeat this procedure to delete U2042XA digital meter view

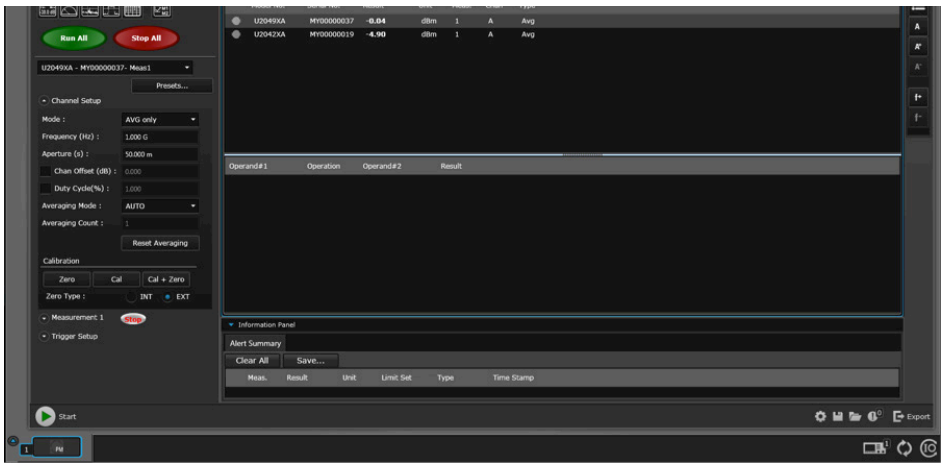


Figure 25. Multi-list view display supports multiple (more than two) power measurements simultaneously

Setup data logging with specific duration and export the data into Microsoft Excel	
14. Enable data logging	Click { Stop All } on the menu. Select Datalog Settings menu and check Enable Data Logging box
15. Specific data logging duration to 1 sec	From Common DataLogging Start menu, check Immediately With Start Button box From Common DataLogging Stop menu, check the Duration box and change to “1 sec”
16. Assign U2049XA power sensor for data logging	Highlight U2049XA on Multilist view. Click { Run All } to run the measurement.
17. Export the data logging data into Microsoft Excel (see Figure 27)	At the bottom of right hand corner, click on { Export } and select “Microsoft Excel”. From Export Data to Excel menu, specify the path to save the data log file and click “OK”

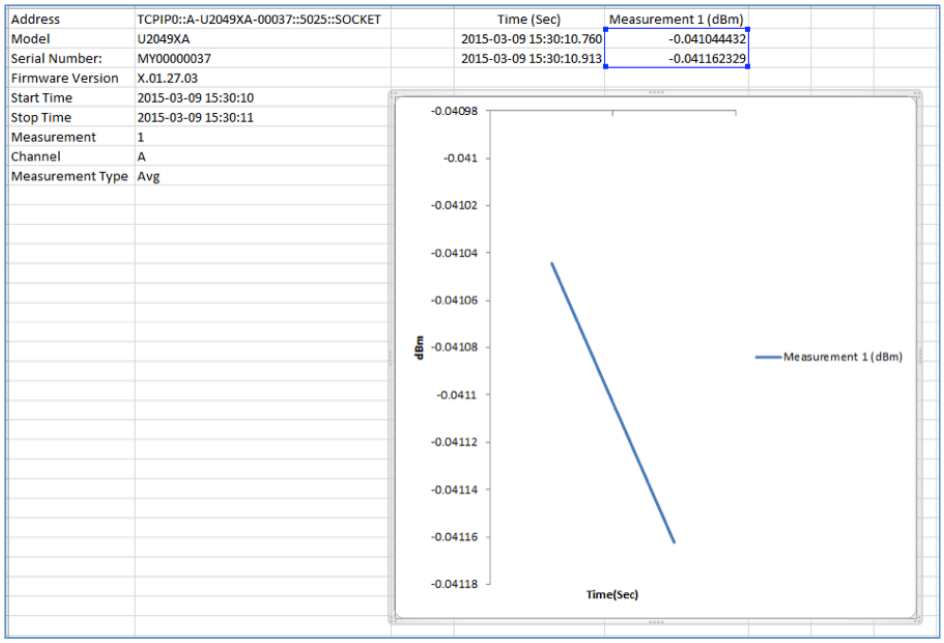


Figure 27. Microsoft Excel will auto open to view the data log of the measurement

GREENTEST TECHNOLOGIES

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