

Using the U9361 RCal Receiver Calibrator with 89600 VSA Software

Option 89601200C

Introduction

Signal analyzers deliver measurement precision at the reference plane of their RF port. Yet, in practical scenarios involving an actual device under test (DUT), elements like cabling, couplers, attenuators, and filters invariably introduce varying amounts of system loss. The pressing question is: how can these losses be effectively compensated to reveal the true performance of the DUT?

Enter the U9361 RCal receiver calibrator. Designed to optimize calibration efficiency, this tool elevates the accuracy of your test receiver system. It enables the calibrated power reference plane to be shifted from the equipment's RF port to the DUT. In doing so, the RCal ensures corrections for test fixture, down-converter and cable losses within the receiver system. This means that you can accurately measure power at the DUT reference plane. Furthermore, the U9361 Rcal can generate flatness corrections in both magnitude and phase for up to 5 GHz IF bandwidths and frequencies ranging from 10 MHz up to 110 GHz.

In the latest [89600 VSA 2024 Patch Release](#), integration with the RCal U9361 receiver calibrator is possible with any Keysight hardware that communicates with the VSA, including oscilloscopes, digitizers and signal analyzers. Now it is possible to perform a comprehensive receiver system calibration right up to the DUT reference plane. Moreover, the calibration coefficients can be seamlessly applied across all 89600 VSA measurements, including but not limited to Digital Demod, Flex Frame, Custom OFDM, 5G NR, and DVB-S2X.

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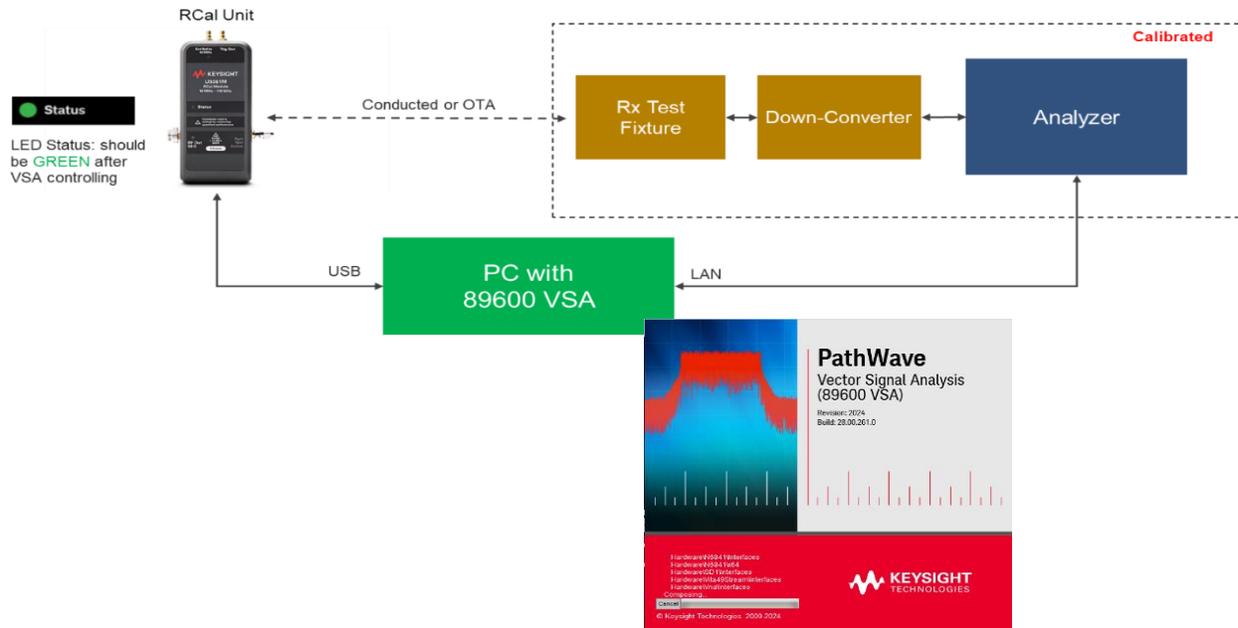
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Key Features of the RCal U9361 Receiver Calibrator

The U9361 RCal receiver calibrator is a versatile tool designed to streamline the calibration process. It singularly eliminates the need for multiple pieces of equipment to calibrate your whole receiver measurement system, making it a pivotal component in achieving precise measurements at the DUT reference plane.

- Enhanced Accuracy: Improve your test Rx system accuracy by an order of magnitude
- Flexible Reference Plane Migration: With its simple command structure and automation, moving the reference plane to the DUT's output becomes effortless.
- Wide Frequency Range: Models available for calibration frequencies up to 110 GHz.
- Broad IF Bandwidth: Supports bandwidths up to 5 GHz.
- Compact Design: Designed to be palm-size, USB-powered and controlled, making it user-friendly and space-efficient.
- Precision: Comes with ultra-stable and repeatable functions, supported with precision factory calibration data.
- Comprehensive Corrections: Provides both magnitude and phase corrections, using tunable BPSK comb modulation.
- Thought Leadership: Recognized with a US Patent for its BPSK modulation calibrator



Figure 1. Keysight U9361M Rcal Module with 10 MHz to 110 GHz

Licensing Requirements for RCal with 89600 VSA

To integrate the U9361 RCal with the 89600 VSA, you will need the 89601200C license on the same PC where the VSA software is installed. This license supports all the Keysight hardware instruments compatible with the VSA, including but not limited to:

- X-series signal analyzers, such as the UXA, PXA, MXA
- Oscilloscopes, such as the UXR or MXR
- PXI modular analyzers and transceivers
- Digitizers such as the M5200A

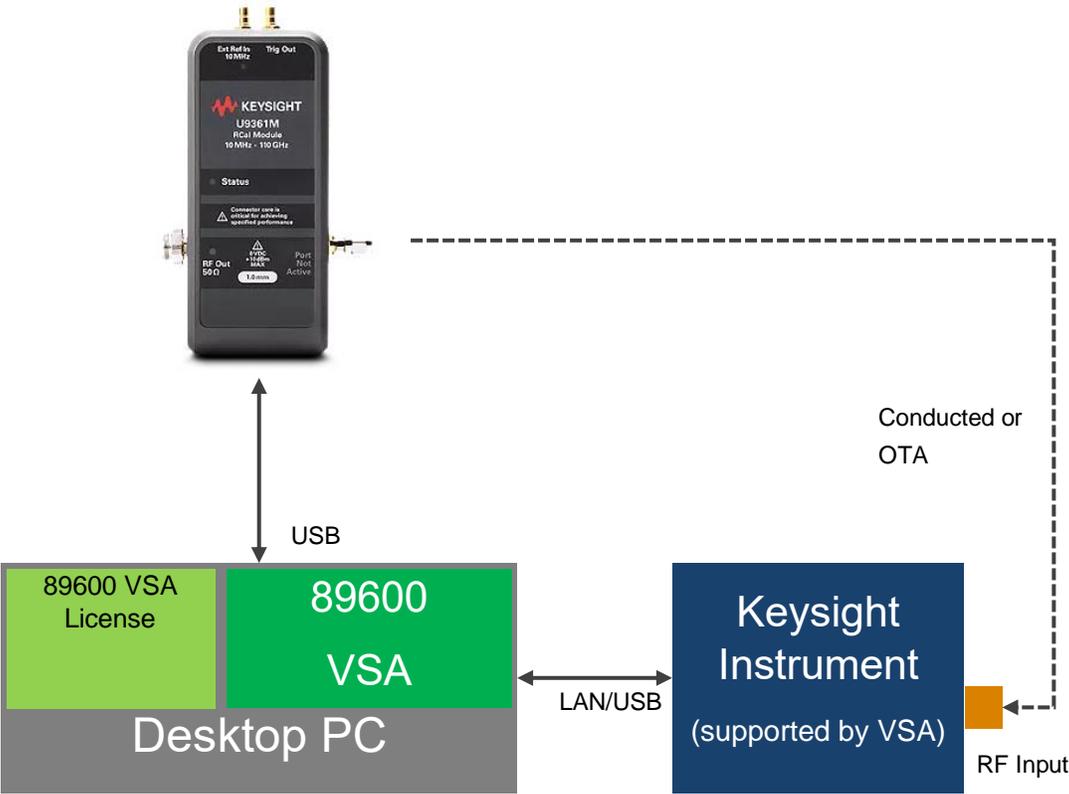


Figure 2. 89600 VSA with valid 89601200C license is required for RCal to connect Keysight instruments

Connecting the RCal to 89600 VSA Software

The process of integrating RCal with the 89600 VSA software mirrors the familiar steps taken when connecting other instruments to the VSA. Please refer to the step-by-step guide and corresponding figures below:

1. Add an instance of the RCal U9361 Receiver Calibration to the Keysight IO Library as a USB instrument referenced in the VISA address (shown in Figure 3)
2. Add a pointer to that RCal instance in the 89600 VSA Hardware Configuration (shown in Figure 4)
 - o Press Utilities->Hardware->Configuration,
 - o Click on the  button, which opens the "New Hardware Configuration" dialogue.
 - o Choose the "System Calibrator" category.
 - o Select the Keysight Technologies U9361 RCal receiver calibrator.
 - o Press the button  to add it into the Configuration.
 - o Now, all Rcal units should show up in the bottom window. (Chances are you will have only one.) Select the RCal unit that you had previously added to the Keysight IO library.

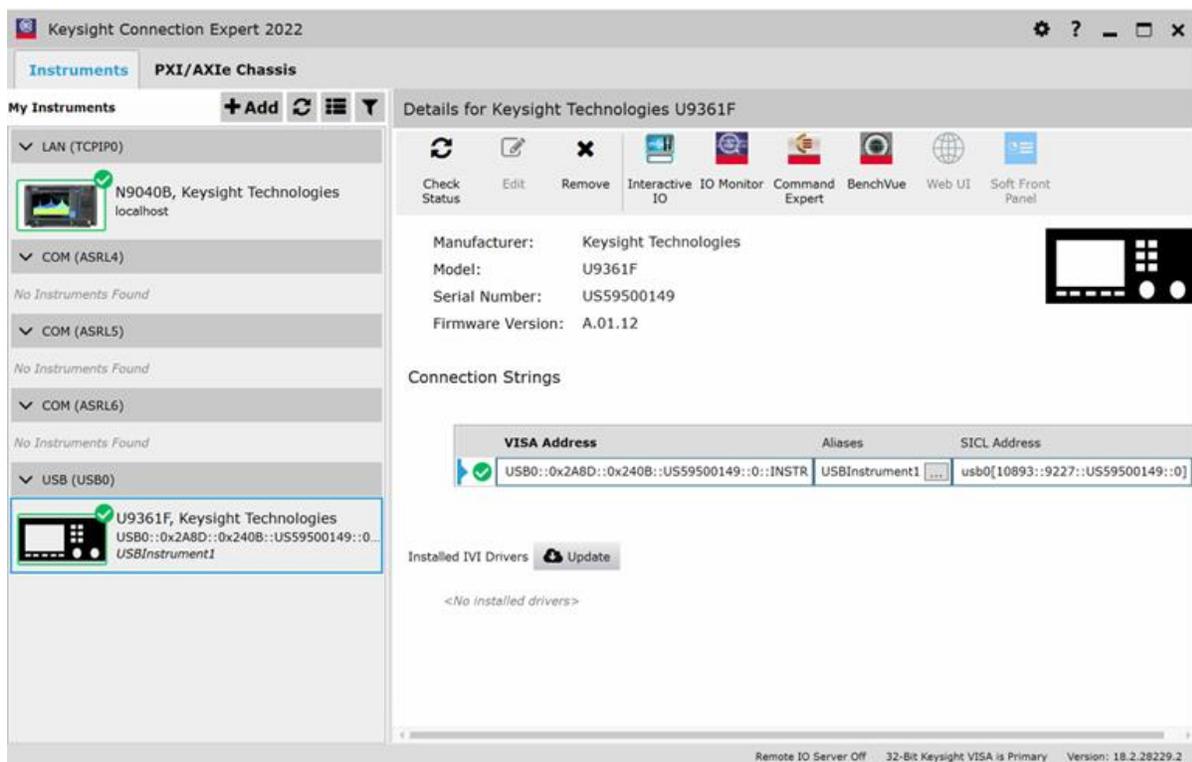


Figure 3. Add U9361 RCal in Keysight IO Library

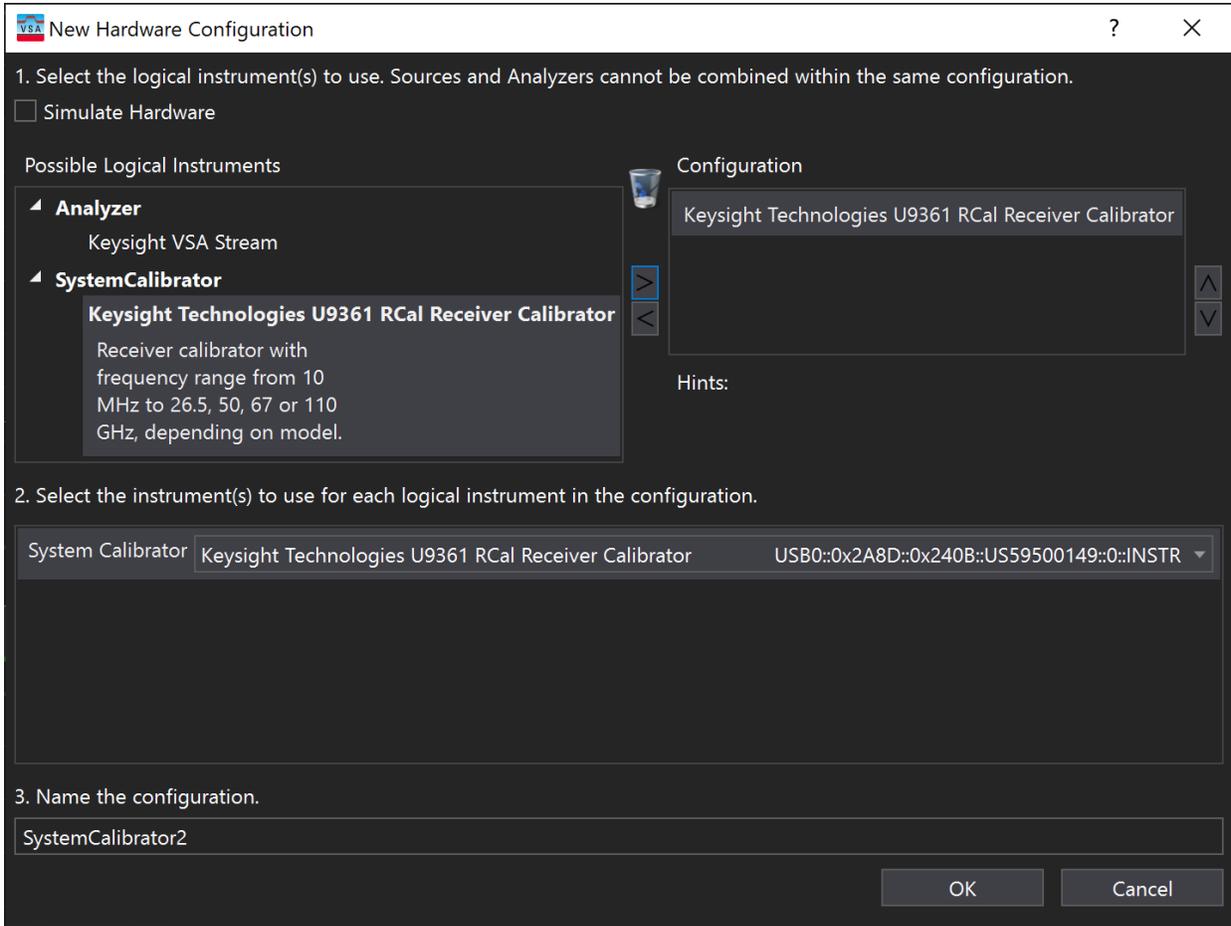


Figure 4. Add U9361 RCal in the 89600 VSA Hardware Configuration

Performing and Applying Receiver Calibration with the VSA

Once the RCal into successfully added to the 89600 VSA hardware configuration, you can perform the receiver calibration and apply the calibration on subsequent measurements.

Perform Receiver Calibration Using RCal

1. Under the 89600 VSA Utilities menu, select “System Calibration,” and then choose the RCal Calibrator as you add previously in Hardware Configuration. This action will open a dialogue as shown in Figure 5.
2. Within this dialogue, you can define parameters such as:
 - a. Start and Stop frequencies
 - b. Number of Points
 - c. Magnitude Flatness Threshold
 - d. Phase Linearity Threshold
 - e. Calibration File Name, in case you wish to later reuse the coefficients from this calibration.
 - f. Setup File Name, and more.
3. Click the “Calibrate” button at the bottom of the window to start the receiver calibration process.
4. After the calibration is finished, the calibration settings and coefficient files are saved at the default directory “C:\Users\~username\Documents\Keysight\89600B VSA\System Calibration\Analyzer1”.

Applying the RCal Calibration to VSA Measurements:

5. Proceed to Input->User Correction, you will open a dialogue shown in Figure 6.
6. The RCal calibration file will be shown in the RF Filter section. You may optionally load another pre-saved RF Calibration file manually.

The U9361 RCal receiver calibration file will now be applied to your VSA measurements.

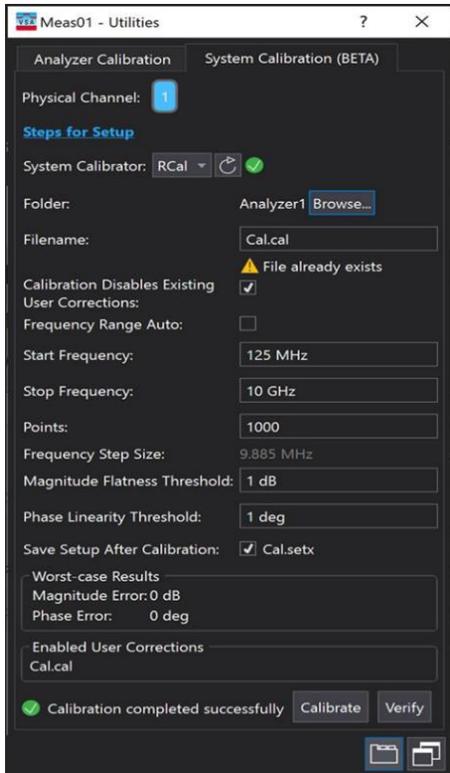


Figure 5. Perform Receiver Calibration with RCal

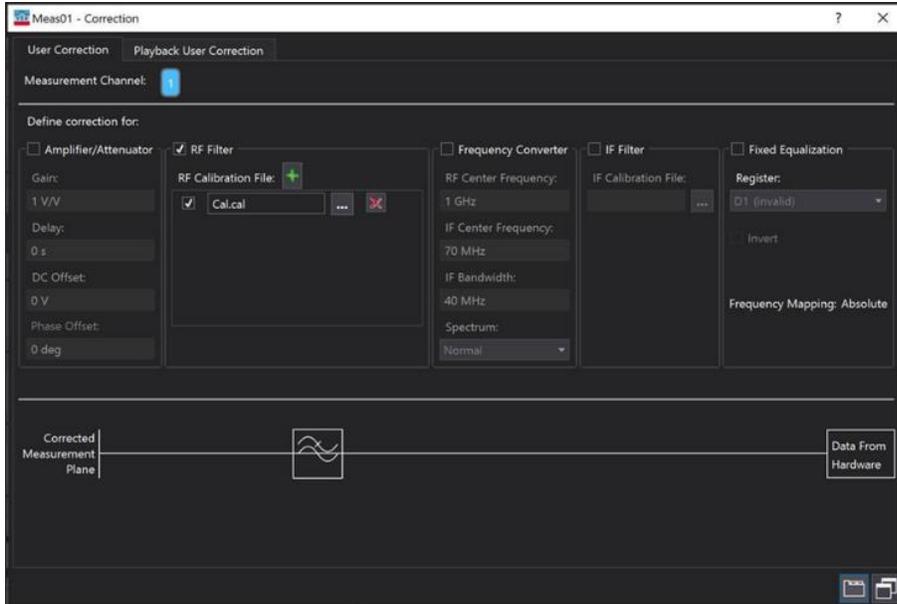


Figure 6. Apply Rcal calibration results with 89600 VSA measurement Using RCal with 89600 VSA to Calibrate the Whole Receiver System

Leveraging the RCal with the 89600 VSA enables you to calibrate the whole receiver system at the DUT reference plane, as shown in Figure 7 below. In this example system, we have a receiver test fixture, down-converter, and Keysight UXR oscilloscope, each with their respective losses as a function of frequency. Without receiver calibration, elements like the receiver test fixture and down-converter will introduce both amplitude and phase errors, leading to significant degradation in measurement system performance. Especially in the context of wideband and millimeter wave systems, this lack of calibration can render the system virtually ineffective.

To address this, you can connect the U9361 RCal receiver calibrator to the whole receiver system, either conducted or over-the-air (OTA). Then execute the calibration procedure as described in prior section and apply the resultant calibration coefficients to your 89600 VSA measurements. With the calibration process, it will improve the whole wideband receiver system performance including absolute power accuracy, and EVM result accuracy including the magnitude and phase error.

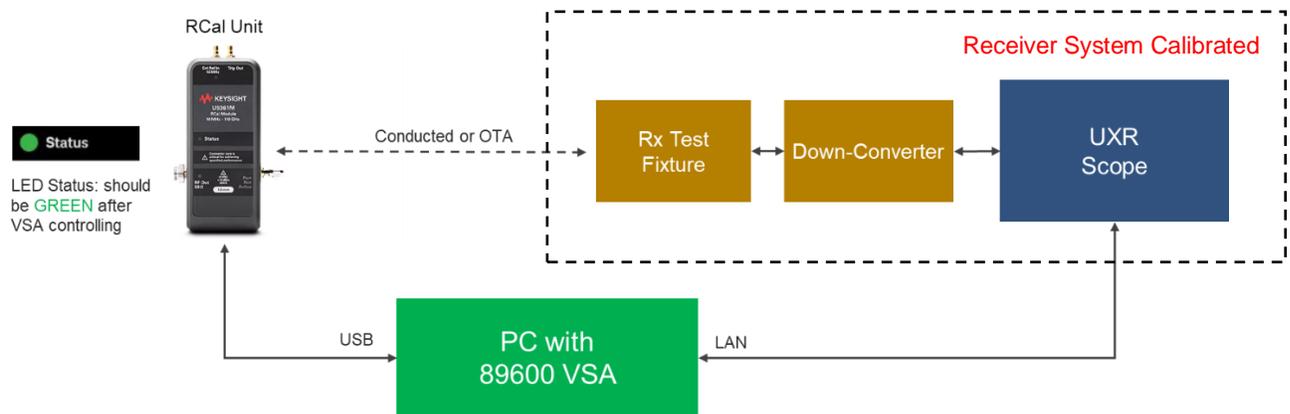


Figure 7. Using RCal with 89600 VSA software to calibrate the whole wideband receiver system at DUT reference plane

From a Receiver Calibration to a Comprehensive End-to-End Calibration

Having successfully calibrated the receiver system with the RCal with 89600 VSA, the next phase involves an end-to-end calibration. This is achieved with the N7618APPC PathWave AWU (Advanced Waveform Utility) software, encompassing both the source and analyzer. With the receiver already calibrated, the next step is to calibrate the source (and associated plumbing). The final outcome includes both source and analyzer calibrated to the reference plane of the DUT for precise measurements.

Figure 10 shows how to perform an end-to-end system calibration using RCal, 89600 VSA and PWSG AWU software.

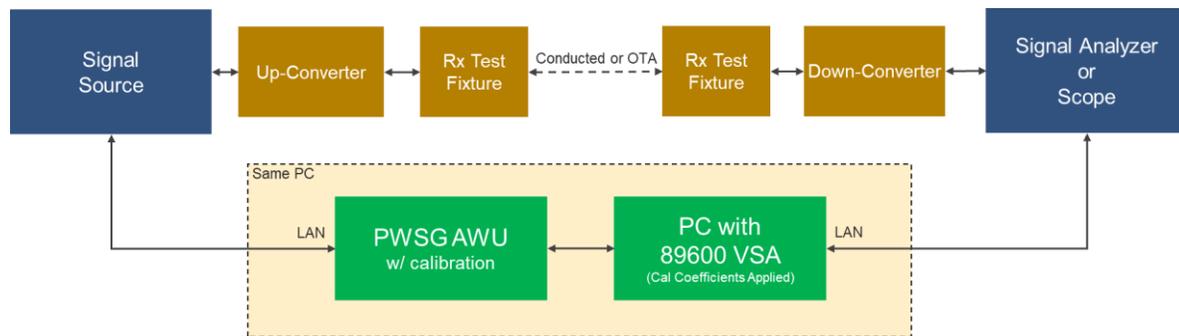


Figure 10. A measurement block diagram illustrating the use of RCal, the 89600 VSA and PWSG AWU in an end-to-end system calibration

Additional Information

Literature

- PathWave Vector Signal Analysis (VSA) Software, Brochure, literature number 5990-6553EN
- PathWave Vector Signal Analysis (VSA) Software, Configuration Guide, literature 5990-6386EN
- Keysight Vector Signal Analysis Basics, Application Note, literature 5990-7451EN
- U9361 RCal Receiver Calibrator, Technical Overview, 3120-1426EN
- PathWave Signal Generation (PWSG) Advanced Waveform Utility (AWU), Technical Overview, 3122-1430EN

Web

- www.keysight.com/find/89600vsa
- www.keysight.com/find/rcal
- <http://www.keysight.com/find/N7618APPC>

Conclusion

U9361 RCal receiver calibrators bring accuracy, efficiency and value to calibration of your test receiver system by allowing you to move the reference plane to the device under test (DUT). 89600 VSA software with 2024 patch release now can connect with RCal to perform the calibration and apply the calibration coefficients with your measurements. You can further use the PWSG AWU software to perform an end-to-end system calibration and get the calibrated source.

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