U9361 RCal Receiver Calibrator

U9361C 10 MHz – 26.5 GHz

U9361F 10 MHz – 50 GHz

U9361G 10 MHz – 67 GHz

U9361M 10 MHz – 110 GHz

Introduction

Move the reference plane to the device under test

As bandwidths grow wider and frequencies soar to millimeter wave and beyond, small margins for error on wideband measurements force RF engineers to look for new ways to reduce linear errors. Correcting for magnitude and phase errors in the measurement setup allows you to get the most out of your measurement and see the real performance of your device. Even short cables can exhibit significant losses at millimeter-wave frequencies. RCal allows you to correct for these cable losses and accurately measure power at the DUT reference plane. Generate flatness corrections in both magnitude and phase up to 5 GHz IF bandwidths.

With the 89600 VSA software, the U9361 RCal can now be directly connected and operated from within the VSA software itself. This integration significantly streamlines the calibration workflow and expands the utility of the RCal beyond X-series signal analyzers to include a wide range of hardware receivers compatible with the VSA software, such as oscilloscopes, logic analyzers, network analyzers, spectrum analyzers, and digitizers.

Keep your test setup efficient with the palm-sized, USB-powered and controlled U9361 RCal receiver calibrator. Drastically reduce the effort and complexity required to calibrate your test receiver system. Minimize the linear errors of the test receiver system using the ultra-stable reference and repeatable results, with precision factory calibration data.

The U9361 RCal receiver calibrator allows you to correct absolute power accuracy, magnitude flatness, and phase flatness with a single device. RCal receiver calibrator eliminates the need for multiple pieces of equipment to calibrate your signal analyzer measurement system.

KEYSIGHT

Key Features

- Improve your test Rx system accuracy by an order of magnitude

- Seamlessly move reference plane to the output of the DUT with easy-to-use, simple command structure and automation

- Models to 110 GHz

- Compact, palm-size, USB-powered and controlled

- Ultra-stable and repeatable, with precision factory cal data inside

- Both magnitude and phase corrections with tunable, BPSK comb modulation

The 89600 VSA software brings seamless integration with the U9361 RCal, offering several advantages:

- U9361 RCal can be connected and controlled directly from within the VSA software interface.

- Calibration is no longer limited to X-series signal analyzers. The RCal can now be used with any hardware receiver supported by the VSA software, including oscilloscopes, logic analyzers, network analyzers, spectrum analyzers, and digitizers.

- Efficiently perform receiver calibration and apply corrections without leaving the VSA environment, reducing potential errors.

- Calibration coefficients can be applied across all VSA measurements, ensuring consistent accuracy across different analysis types.

Figure 1. U9361M RCal receiver calibrator with N9041B UXA X-Series signal analyzer for calibration up to 110 GHz.

Specifications

Definitions and conditions

Specification (spec): The warranted performance of a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 0 to 40 °C and after a 60-minute warm up period. Specifications include measurement uncertainty. Data represented in this document are specifications unless otherwise noted.

Typical (typ): The characteristic performance, which 80% or more of manufactured instruments will exhibit with a 95% confidence level. This data is not warranted, does not include measurement uncertainty, and is valid only at room temperature (approximately 23 °C).

Nominal (nom): The expected mean or average characteristic performance, or the value of an attribute that is determined by design such as a connector type, physical dimension, or operating speed. This data is not warranted and is valid only at room temperature (approximately 23 °C).

Frequency

CW frequency range	
U9361C	0.01 to 26.5 GHz
U9361F	0.01 to 50 GHz
U9361G	0.01 to 67 GHz
U9361M	0.01 to 110 GHz
CW frequency resolution	
	1 Hz (nom)
Accuracy	
	Accuracy is equivalent to the internal or external frequency reference in use.
Internal timebase reference	
Initial calibration accuracy	± 10 ppm (nom)
Aging rate	< ± 1 ppm/year (nom)
Temperature effects	< ± 1 ppm over operating temperature range (nom)
External 10 MHz reference input	
Input Frequency	10 MHz
Lock Range	± 2 ppm (nom)
Input amplitude	-5 to +10 dBm (nom)
Input impedance	50 Ω (nom)

Power

Output power of calibration signal (nominal)

	U9361C	U9361F	U9361G	U9361M
0.01 to 1.875 GHz	> -10 dBm	> -10 dBm	> -10 dBm	> -10 dBm
> 1.875 to 15 GHz	> -8.5 dBm	> -8 dBm	> -8 dBm	> -8 dBm
> 15 to 26.5 GHz	> -9.5 dBm	> -9 dBm	> -9 dBm	> -9 dBm
> 26.5 to 50 GHz	N/A	> -9.5 dBm	> -9.5 dBm	> -9.5 dBm
> 50 to 67 GHz		N/A	> -20 dBm [1]	> -20 dBm [1]
> 67 to 80 GHz			N/A	> -23 dBm [1]
> 80 to 100 GHz				> -25 dBm [1]
> 100 to 110 GHz				> -28 dBm [1]

CW power level accuracy (nominal)

Fundamental power relative to stored cal data, into ideal 50 Ohm load

	U9361C	U9361F	U9361G	U9361M
0.01 to 26.5 GHz	± 0.15 dB	± 0.15 dB	± 0.15 dB	± 0.15 dB
> 26.5 to 50 GHz	N/A	± 0.25 dB	± 0.25 dB	± 0.25 dB
> 50 to 67 GHz		N/A	± 0.45 dB	± 0.45 dB
> 67 to 75 GHz			N/A	± 0.45 dB
> 75 to 110 GHz				± 0.55 dB

Temperature stability (nominal)

After 30-minute warmup, using internal temperature-compensated correction algorithm

	U9361C	U9361F	U9361G	U9361M
0.01 to 26.5 GHz	± 0.01 dB/degrees C	± 0.01 dB/degrees C	± 0.01 dB/degrees C	± 0.01 dB/degrees C
> 26.5 to 50 GHz	N/A	± 0.01 dB/degrees C	± 0.01 dB/degrees C	± 0.01 dB/degrees C
> 50 to 67 GHz		N/A	± 0.03 dB/degrees C	± 0.03 dB/degrees C
> 67 to 75 GHz			N/A	± 0.04 dB/degrees C
> 75 to 110 GHz				± 0.05 dB/degrees C

1. These signals are the third harmonic of the calibration signal – the fundamental signal with higher power is still present.

Output return loss (nominal)

Model	U9361C		U9361F		U9361G		U9361M
Connector gender	Male	Female	Male	Female	Male	Female	Male
0.01 to 8 GHz	> 25 dB	> 25 dB	> 25 dB	> 25 dB	> 25 dB	> 25 dB	> 25 dB
> 8 to 9.5 GHz					> 24 dB		
> 9.5 to 11.5 GHz	> 21 dB	> 19 dB		> 19 dB	> 20 dB	> 19 dB	
> 11.5 to 19 GHz	> 15 dB	> 17 dB	> 17 dB			> 17 dB	> 22 dB
> 19 to 25 GHz	> 22 dB	> 22 dB			> 18 dB	> 23 dB	
> 25 to 26.5 GHz	> 17 dB		> 16 dB			> 20 dB	> 18 dB
> 26.5 to 27.5 GHz	N/A		> 13.5 dB	> 14 dB	> 15 dB	> 14 dB	
> 27.5 to 29 GHz			> 12.5 dB	> 10.5 dB	> 11.5 dB	> 10.5 dB	
> 29 to 34 GHz			> 11 dB		> 9 dB		
> 34 to 35 GHz			> 15 dB	> 14 dB	> 15 dB	> 16 dB	> 13.5 dB
> 35 to 42 GHz				> 18 dB		> 20 dB	
> 42 to 47 GHz				> 14 dB	> 14 dB	> 16 dB	
> 47 to 49 GHz			> 14.5 dB		> 16 dB	> 14 dB	> 12.5 dB
> 49 to 50 GHz				> 13 dB	> 13 dB		
> 50 to 63.5 GHz			N/A		> 12.5 dB		
> 63.5 to 67 GHz					> 14 dB	> 15 dB	> 11 dB
> 67 to 75 GHz					N/A		
> 67 to 110 GHz							> 7.8 dB

Spectral Purity

Spectral purity	
Harmonics	Output waveform is a 50% (nom) duty-cycle square wave. Nominal odd harmonic amplitude in dB relative to the fundamental is -20*log(N), where N is the harmonic number.
Sub-harmonics	Sub-harmonics are > 15 dB (nom) below the fundamental output carrier, for 0.01 to 50 GHz fundamental
Phase noise	-105 dBc/Hz (nom) for 10 GHz fundamental at 100 kHz offset

Modulation

Modulation type			
Binary Phase Shift Keying (BPSK)			

Modulation frequency range			
100 kHz to 100 MHz; (comb tone spacing is 2x modulation frequency)			

Magnitude response accuracy (nominal)

Relative tone magnitude error compared to stored cal data, into ideal 50 ohm load

	U9361C	U9361F	U9361G	U9361M
0.01 to 26.5 GHz	± 0.15 dB	± 0.15 dB	± 0.15 dB	± 0.15 dB
> 26.5 to 50 GHz		± 0.3 dB	± 0.3 dB	± 0.3 dB
> 50 to 67 GHz	N/A		± 0.5 dB	± 0.5 dB
> 67 to 75 GHz		N/A		± 0.5 dB
> 75 to 110 GHz			N/A	± 0.6 dB

Phase response uncertainty

Relative tone phase error compared to stored cal data, into ideal 50 ohm load

	U9361C	U9361F	U9361G	U9361M
0.01 to 26.5 GHz	± 0.5 degrees	± 0.5 degrees	± 0.5 degrees	± 0.5 degrees
> 26.5 to 42 GHz		± 1 degree	± 1 degree	± 1 degree
> 42 to 50 GHz		± 2 degrees	± 2 degrees	± 2 degrees
> 50 to 67 GHz	N/A		± 5 degrees	± 5 degrees
> 67 to 85 GHz		N/A		± 6 degrees
> 85 to 102 GHz			N/A	± 10 degrees
> 102 to 110 GHz				± 14 degrees

General Specifications

Power and control requirements	
USB Type	USB 3.0
Voltage	+5 V, per USB 3.0 specifications
Current	< 900 MA, per USB 3.0 specifications
Temperature range	
Operating	*See Quick Start Guide, Instrument Information section*
Storage	*See Quick Start Guide, Instrument Information section*
Altitude	*See Quick Start Guide, Instrument Information section*
EMC	*See Quick Start Guide, Instrument Information section*
Safety	*See Quick Start Guide, Instrument Information section*
Humidity	*See Quick Start Guide, Instrument Information section*
Environmental testing	*See Quick Start Guide, Instrument Information section*
Security	Calibration data is stored in internal non-volatile memory. No user data is stored.
Dimensions	
U9361C, U9361F, U9361G female	129.1 mm L x 78.3 mm W x 37.0 mm H (5.1" L x 3.1" W x 1.5" H)
U9361C, U9361F, U9361G male	129.1 mm L x 82.8 mm W x 37.0 mm H (5.1" L x 3.3" W x 1.5" H)
U9361M male	129.1 mm L x 77.5 mm W x 37.0 mm H (5.1" L x 3.1" W x 1.5" H)
Weight	0.34 kg (0.75 lbs)
Recommended calibration cycle	The recommended calibration cycle is one year. Calibration services are available through Keysight.

More Information

For more information, visit www.keysight.com/find/rcal

For details on using U9361 RCal with X-Series Signal Analyzers, please visit U9361 RCal Measurement Guide

For details on using the U9361 RCal with the 89600 VSA software, including setup instructions and supported hardware receivers, please visit https://www.keysight.com/us/en/assets/3123-1631/technical-overviews/Using-the-U9361-RCal-Receiver-Calibrator-with-89600-VSA-Software.pdf

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