

Application Note

# SIGNAL SOURCE LEVEL CALIBRATION USING THE FSMR3000

## Products:

▶ R&S®FSMR3000

▶ R&S®NRP50T

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<https://www.rohde-schwarz.com/appnote/1SL377>

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# Contents

<b>1</b>	<b>Overview</b> .....	<b>3</b>
<b>2</b>	<b>Apparatus and Method</b> .....	<b>4</b>
2.1	Apparatus.....	4
2.2	Method .....	5
<b>3</b>	<b>Literature</b> .....	<b>10</b>
<b>4</b>	<b>Ordering Information</b> .....	<b>10</b>

# 1 Overview

The R&S® FSMR3000 (hereinafter FSMR) is a three-in-one instrument incorporating a Measurement Receiver, a Spectrum and Signal Analyser, and a Phase Noise Analyser.

This application note demonstrates the use of the Measurement Receiver to calibrate the signal output level of a Signal Generator.

Calibration in this application is a two-step process.

- ▶ The absolute output level of the signal source, at a fixed level, is measured using a thermal power sensor (e.g. NRP50T), which in turn outputs its reading to the FSMR.
- ▶ Output power calibration over a wider dynamic range (to lower power) is performed by connecting the FSMR to the signal source directly, and sweeping the power of the signal source.

The FSMR offers a nominal total measurement uncertainty of  $<0.015 \text{ dB} \pm 0.005 \text{ dB}$  per 10dB step. At 1GHz, the power measurement range covers -152 dBm to +30 dBm. It is this intrinsic linearity, that the accuracy of the calibration relies upon.

Absolute power measurement uncertainty, for the NRP50T thermal power sensor used in this Application Note, is 0.040 dB to 0.143 dB.

This process may be repeated at multiple frequencies. Calibration values are automatically stored and managed by the FSMR. Measurement frequencies for calibrations are stored, will be automatically recalled by the FSMR, by re-selection of those frequencies.

Finally, note that the overall measurement uncertainty may be calculated by the user, with knowledge of the cabling and signal source parameters. Example calculations were published in the earlier Application Note "RF Level Measurement Uncertainties with the Measuring Receiver R&S FSMR." [1]

# 2 Apparatus and Method




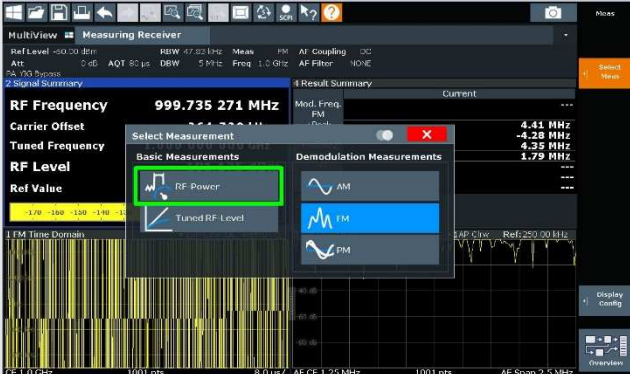
## 2.1 Apparatus

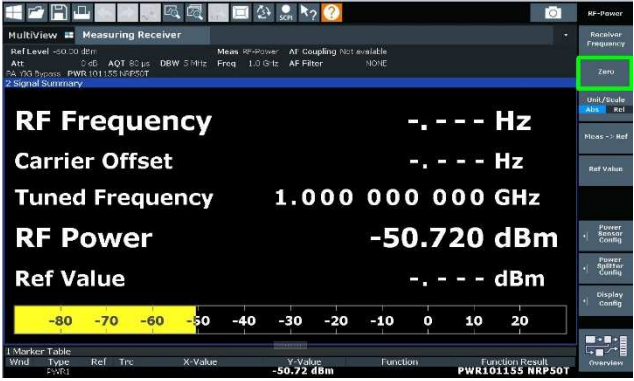
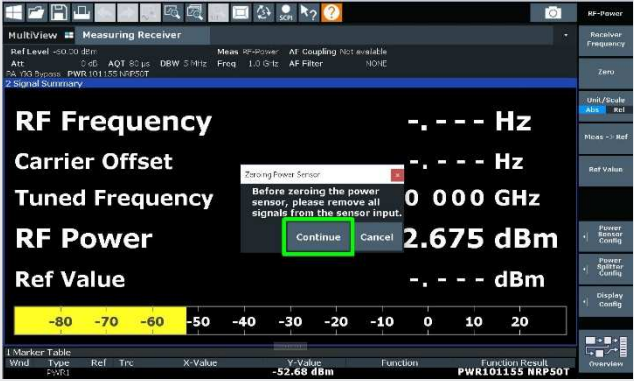
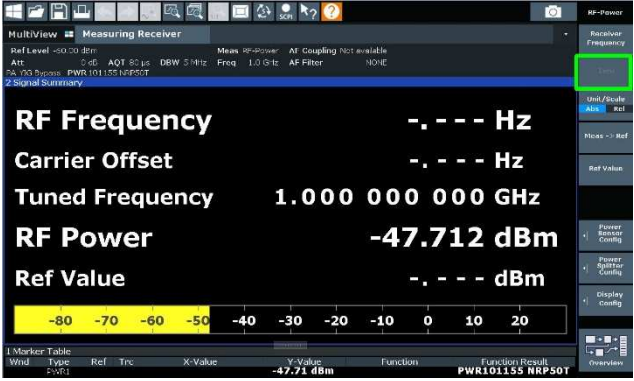

The following equipment was used in the creation of this Application Note


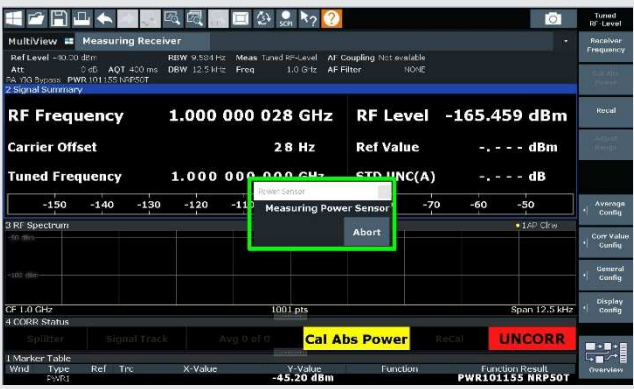


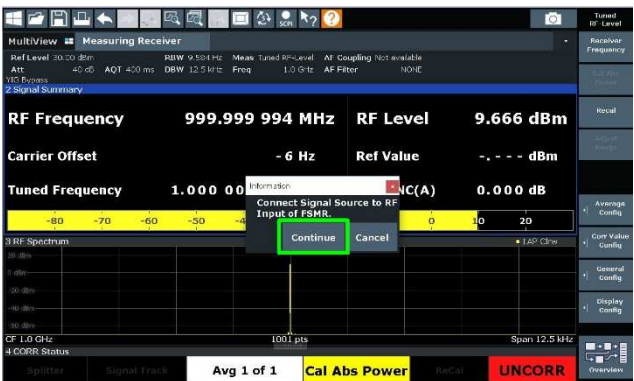
- ▶ FSMR3050            Measuring Receiver (to 50 GHz)
- ▶ NRP50T            Thermal Power Sensor (to 50 GHz)
- ▶ SMW200A          Vector Signal Generator
- ▶ Suitable coaxial cable

## 2.2 Method





The required steps, their associated SCPI commands, along with pictures of the set-up and screengrabs, are shown in the table.

Step	Action	SCPI	Screengrab / Set-Up
1	Preset the FSMR.	*RST	
2	Connect the NRP50T RF input to the Signal Source RF output.		
3	Connect the NRP50T output to the FSMR Power Sensor port.		
4	Connect an RF cable to the FSMR RF Input port. Leave the other end disconnected.		
5	Set FSMR Frequency to (e.g.) 1 GHz	:SENS:FREQ:CENT 1e9	
6	Set the Signal Source output frequency to the same (e.g. 1 GHz) and check that its output power is off.		
7	On the FSMR, press "MEAS" hardkey, select the "RF Power"	:CONF:MEAS:POWer	

Step	Action	SCPI	Screengrab / Set-Up
8	On the FSMR, press "Zero" softkey	:CAL:PMET:ZERO:AUTO ONCE	
9	Verify there is no incident power to the NRP50T, then press "Continue" on the FSMR		
10	Wait for Zero-ing to complete on the FSMR. ("Zero" softkey will be greyed out)		
11	Set the output power of the Signal Source to a level greater than 5 dBm, (e.g.) 10 dBm.		
12	Switch on the Signal Source output power		
13	On the FSMR, press "MEAS" hardkey, followed by "Tuned RF-level" softkey.	:CONF:MEAS TRFL	

Step	Action	SCPI	Screengrab / Set-Up
14	Press "MEAS CONFIG" hardkey, followed by "Cal Abs Power" softkey.		
15	... the FSMR will momentarily report "Measuring Power Sensor"...		
16	When the prompt appears, "Connect Signal Source to RF input of FSMR", disconnect the NRP50T from the Signal Source.		
17	Connect the FSMR3000, via the coaxial cable directly to the Signal Source.		
18	On the FSMR, hit "Continue".		



Step	Action	SCPI	Screengrab / Set-Up
19	<p>Whilst observing the FSMR screen "ReCal" indicator, change (decrease) the output power of the Signal Source, in e.g. increments of -1 dB ~ -10 dB.</p> <p>Note: In this picture, the ReCal indicator location is highlighted, but not illuminated.</p>		
20	<p>When the "ReCal" indicator illuminates, press "ReCal" softkey on the FSMR</p>	INP:ATT:AUTO REC	
21	<p>Once the intermediate calibration is performed, the "ReCal" indicator will extinguish, whilst the "CORR" indicator remains.</p>		
22	<p>Repeat the process steps #19 and #20 one more time. Typically the "ReCal" indicator will illuminate around -40 dBm.</p>		

The calibration procedure is now complete, and the FSMR ready for measurement across the whole of its dynamic range.

## 3 Literature

- [1 R. Minihold, "App. Note 1MA92 "RF Level Measurement Uncertainties with the Measuring Receiver R&S(R) FSMR", " 03 2006. [Online]. Available: [https://scdn.rohde-schwarz.com/ur/pws/dl\\_downloads/dl\\_application/application\\_notes/1ma92/1MA92\\_0e\\_RF\\_level\\_meas\\_uncertainties.pdf](https://scdn.rohde-schwarz.com/ur/pws/dl_downloads/dl_application/application_notes/1ma92/1MA92_0e_RF_level_meas_uncertainties.pdf). [Accessed 24 11 2021].

## 4 Ordering Information

Designation	Type	Order No.
Spectrum analyzer	R&S®FSMR3-B1	1345.3050.50
Thermal power sensor	R&S®NRP50T	1424.6173.02

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