R&S®NRPC-LS
RF POWER LINEARITY STANDARD

3 year warranty

For linearity calibration of
RF test and measurement equipment

Product Brochure
Version 04.00

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The R&S®NRPC-LS enables linearity calibration of RF power sensors. The calibration frequency of 1 GHz is optimized for reliable verification of RF power detectors using various technologies. The R&S®NRPC-LS is also suitable for linearity calibration of spectrum analyzers and network analyzers.

The R&S®NRPC-LS can be combined in a simple test setup with a PC, an RF signal generator and an R&S®NRX power meter to create a linearity calibration system for all R&S®NRP power sensors.

The integrated reference standard was derived from the R&S®NRQ6 frequency selective power sensor and can be configured with the same SCPI commands.

The accuracy of the linearity standard is intrinsic to its design. This accuracy negates the effects of drift and aging. The linearity uncertainty specification is traceable to Germany's national metrology institute (PTB). In a calibration certificate with an accreditation symbol, the linearity reference standard is traced back to SI units.

Key facts

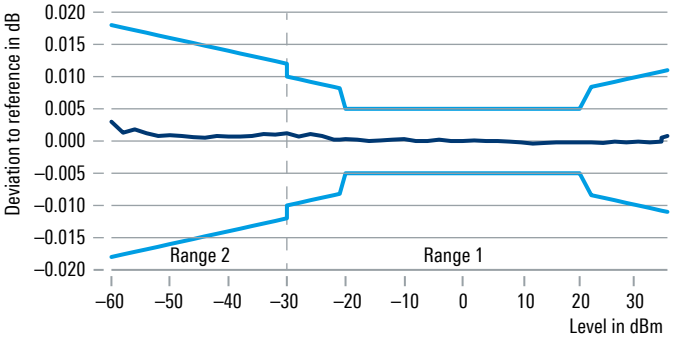
- 0.005 dB accuracy per 21 dB level difference
- –60 dBm to +35 dBm power range
- 1 GHz calibration frequency
- 65 dB dynamic range within one measurement range
- 95 dB extended dynamic range with calibration of the adjacent range at a level of –30 dBm
- Built-in web GUI with full power measurement support
- Remote monitoring via a network over any distance

EXCELLENT LINEARITY AND LEVEL STABILITY

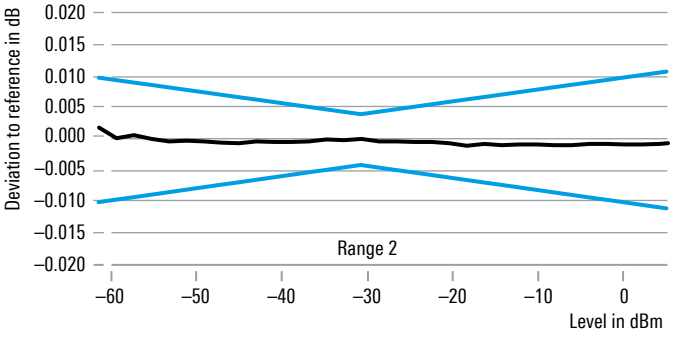
The linearity of the R&S®NRPC-LS is almost exclusively determined by calibration traceability limits. The measurand (linearity) is traced to RF standard attenuation measuring equipment at the PTB.

Typical linearity of the R&S®NRPC-LS

Typical linearity versus specified uncertainty of extended measurement range with reference level at 0 dBm. Levels below –30 dBm (range 2) are linked to range 1 by a second measurement at –30 dBm for range switching.



Typical linearity versus specified uncertainty of low-level measurement range (range 2) with reference level at –30 dBm.



OPERATION

The R&S®Recal+ calibration software is available free of charge and enables fast, interactive calibration of the R&S®NRP power sensors. If the R&S®NRPC-LS is chosen as the linearity reference for R&S®NRP power sensors during the installation of R&S®Recal+, a set of configuration files with specific optimizations for R&S®NRPC-LS is used. The R&S®NRPC-LS is then automatically used for all linearity calibration measurements of R&S®NRP power sensors.

A full recalibration cycle comprises:

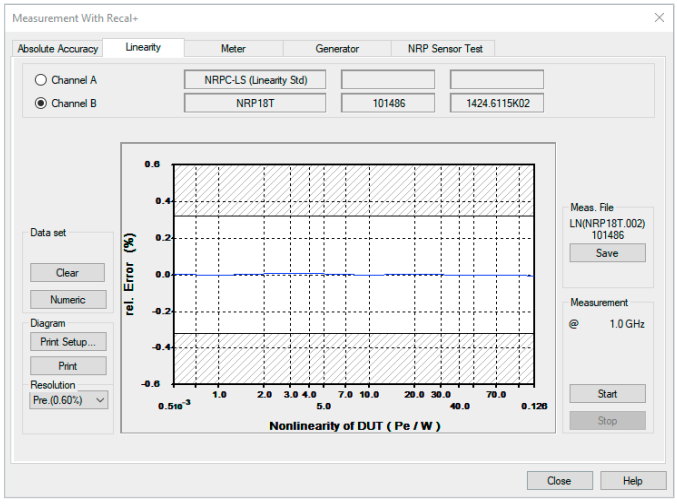
- Incoming measurement
- Adjustment of the device under test (DUT) by recalculating the linearization polynomial coefficients within the calibration data set
- Outgoing measurement

Steps 2 and 3 are optional, i.e. if the DUT is found to be within tolerance, no adjustment is necessary. A certificate of calibration can then be issued based on the data from the incoming measurement. There are also types of RF power sensors that are linear by design and cannot be adjusted with respect to linearity. If the linearity of such an RF power sensor is found to be out of tolerance, the sensor is damaged and must be repaired.

TEST SETUP

A simple test setup for linearity calibration comprises:

- A PC that is equipped with an IEEE 488 adapter, running Windows 7 (or later; Windows 10 is recommended) and R&S®Recal+ V. 5.00 (or later)
- An R&S®SMA100B signal generator (depending on the desired frequency range, this may include the ultra high output power option)
- An R&S®NRX power meter (for larger test setups, it may be advisable to use two power meters)
- An R&S®NRPC-LS linearity standard



User interface of the R&S®Recal+ PC software with graphical display of the calibration result for an R&S®NRP18T 18 GHz thermal power sensor

SPECIFICATIONS

Definitions

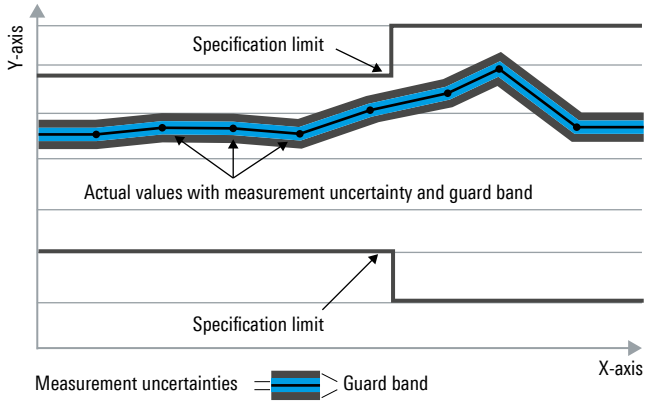
General

Product data applies under the following conditions:

- Three hours storage at ambient temperature followed by 30 minutes warm-up operation
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as <, ≤, >, ≥, ±, or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (for example, dimensions or resolution of a setting parameter). Compliance is ensured by design.

Typical data (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with <, > or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter (for example, nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are indicated as follows: “parameter: value”.

Typical data as well as nominal and measured values are not warranted by Rohde&Schwarz.

In line with the 3GPP/3GPP2 standard, chip rates are specified in million chips per second (Mcps), whereas bit rates and symbol rates are specified in billion bits per second (Gbps), million bits per second (Mbps), thousand bits per second (kbps), million symbols per second (Msps) or thousand symbols per second (ksps), and sample rates are specified in million samples per second (Msample/s). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

Specifications

Signal frequency		1 GHz
Measurand		RF linearity relative power measurement (ratio of two consecutive power measurements)
Test port power range [1]	1 GHz	–60 dBm to +35 dBm
	range 1, internal RF attenuator on	–30 dBm to +35 dBm
	range 2, internal RF attenuator off	–60 dBm to +5 dBm
Test port connector		N female
Output impedance		50 Ω
Insertion loss	between RF input and RF output	0.6 dB (meas.)
Uncertainty for relative power measurements referenced to the power level of 0 dBm (from –21 dBm to +21 dBm)		
	0 dB to 21 dB level difference	*0.005 dB*
Uncertainty for relative power measurements between any two power levels within one power range (from –30 dBm to +35 dBm or –60 dBm to +5 dBm)		
	level difference A	*0.0002 × A + 0.004 dB*
	0 dB to 5 dB	*0.005 dB*
	> 5 dB to 10 dB	*0.006 dB*
	> 10 dB to 15 dB	*0.007 dB*
	> 15 dB to 20 dB	*0.008 dB*
	> 20 dB to 30 dB	*0.010 dB*
	> 30 dB to 40 dB	*0.012 dB*
	> 40 dB to 50 dB	*0.014 dB*
	> 50 dB to 60 dB	*0.016 dB*
	> 60 dB to 65 dB	*0.017 dB*
Uncertainty for relative power measurements between any two power levels with range switching as well as calibration of the adjacent range at a level of –30 dBm (test port power range from –60 dBm to +35 dBm)		
	level difference A	*0.0002 × A + 0.006 dB*
	0 dB to 5 dB	*0.007 dB*
	> 5 dB to 10 dB	*0.008 dB*
	> 10 dB to 15 dB	*0.009 dB*
	> 15 dB to 20 dB	*0.010 dB*
	> 20 dB to 30 dB	*0.012 dB*
	> 30 dB to 40 dB	*0.014 dB*
	> 40 dB to 50 dB	*0.016 dB*
	> 50 dB to 60 dB	*0.018 dB*
	> 60 dB to 70 dB	*0.020 dB*
	> 70 dB to 80 dB	*0.022 dB*
	> 80 dB to 90 dB	*0.024 dB*
	> 90 dB to 95 dB	*0.025 dB*
Resolution bandwidth (RBW)	single sideband (SSB) mode	10 Hz to 40 MHz
	recommended for linearity measurement	1 kHz
Displayed average noise level (DANL)	test port power range 1, 1 GHz	< –106 dBm (1 Hz)
	test port power range 2, 1 GHz	< –136 dBm (1 Hz)
LO phase noise at 1 kHz offset, measurement bandwidth 1 Hz, measured at LO I/O connector		
	1 GHz	–92 dBc (nom.)
LO leakage at test port (LO frequency and frequency of harmonics)		
	test port power range 1, 1 GHz	–84 dBm (nom.)
	test port power range 2, 1 GHz	–86 dBm (nom.)

[1] The internal reference power sensor contains an RF attenuator that is switched on for high power levels.

Other characteristics

Sensor type		R&S®NRQ6 frequency selective power sensor
Measurement function	recommended	continuous average
Continuous average function	measurand	average power over acquisition interval
	aperture	8.3 ns to 30 s (depending on RBW)
	duty cycle correction	0.001 % to 100.0 %
	capacity of measurement buffer	1 reading to 8192 readings
Triggering	supported measurement functions	continuous average
	source	► INTernal: internal test signal ► EXTernal[1]: host interface trigger signal (8-pin male M12 connector) ► EXTernal2: coaxial trigger I/O (SMA (f) jack) ► BUS: remote control event (*trg)
Averaging filter	parameters	
	supported measurement functions	continuous average, trace
	averaging count	1 to 65536
	result output	
	moving mode	continuous result output, independent of averaging count
	repeat mode	final result only
Internal reference frequency	accuracy	$\pm 1 \times 10^{-6}$
Intermediate frequency (IF)	RBW ≤ 40 MHz	20 MHz to 30 MHz
Host interface (8-pin male M12 connector) ► USB interface to PC via R&S®NRP-ZKU interface cable (requires additional PoE+ power supply at LAN interface) ► USB interface to PC via R&S®NRP-ZK6 interface cable + R&S®NRP-Z5 USB sensor hub (requires additional PoE+ power supply at LAN interface) ► Interface to R&S®NRX power meter via R&S®NRP-ZK6 or R&S®NRP-ZK8 interface cable		
	mechanical	8-pin male M12 connector (A-coded)
	power supply	+5 V/0.1 A (USB low-power device; requires additional PoE+ power supply)
	speed	high-speed and full-speed mode in line with USB specification
	remote control protocols	USB test and measurement device class (USBTMC)
	trigger input EXTernal[1]	differential (0 V/+3.3 V)
	R&S®NRX common time base clock (only available with R&S®NRP-ZK8 interface cable)	
	signal level	LVDS
	input frequency	20 MHz
	permissible total cable length	≤ 5 m
Ethernet interface (LAN PoE+)	mechanical	RJ-45 jack
	power supply	power over Ethernet (PoE+) class 4
	speed	10/100/1000 Mbit/s
	remote control protocols	VXI-11, high-speed LAN instrument protocol (HiSLIP), SCPI-RAW (port 5025)
	permissible cable length	≤ 100 m
Trigger 2 I/O (TRIG2)	mechanical	SMA (f) jack
	impedance	
	input	10 kΩ or 50 Ω (software controlled)
	output	50 Ω
	signal level	
	input	compatible with 3 V or 5 V logic, max. –1 V to +6 V
	output	≥ 2 V into 50 Ω load, max. 5.3 V

Other characteristics		
Reference clock I/O (REF)	mechanical	SMA (f) jack
	impedance	
	input/output	50 Ω
	signal level	
	input	≥ –10 dBm
	output	≥ +7 dBm
	frequency	
	input	10 MHz
	output	10 MHz
Sample clock I/O (CLK)	mechanical	SMA (f) jack
	impedance	
	input/output	50 Ω
	signal level	
	output	≥ –10 dBm
	frequency	
	output	119 MHz to 121 MHz
Local oscillator I/O (LO)	mechanical	SMA (f) jack
	impedance	
	input/output	50 Ω
	signal level	
	input	≥ –5 dBm
	output	≥ 0 dBm
	frequency	
	input/output	70 MHz to 6.03 GHz

General data		
Temperature	operating temperature range	–19.7 °C to +26.3 °C
	permissible temperature range	0 °C to +40 °C
	storage temperature range	–40 °C to +70 °C
Climatic resistance	damp heat	+25 °C/+40 °C cyclic at 95 % relative humidity with restrictions: noncondensing, in line with EN 60068-2-30
Mechanical resistance	vibration	
	sinusoidal	5 Hz to 55 Hz, 0.15 mm amplitude, 1.8 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g constant, in line with EN 60068-2-6
	random	8 Hz to 500 Hz, 1.2 g (RMS), in line with EN 60068-2-64
	shock	45 Hz to 2 kHz, max. 40 g shock spectrum, in line with MIL-STD-810E, method 516.4, procedure I
Air pressure	operating	795 hPa (2000 m) to 1060 hPa
	transport	566 hPa (4500 m) to 1060 hPa
Electromagnetic compatibility		complies with harmonized standards: EN 61326-1, EN 61326-2-1, EN 55011 (class B)
Calibration interval	recommended	2 years
Dimensions	W × H × D	233 mm × 103 mm × 372 mm (9.18 in × 4.06 in × 14.65 in)
Weight		4.2 kg (9.26 lb)

ORDERING INFORMATION

Designation	Type	Order No.
RF power linearity standard	R&S®NRPC-LS	1421.7004.02
Power meter base unit + mandatory options		
Power meter	R&S®NRX	1424.7005.02
+ Second measurement channel	R&S®NRX-K2	1424.9208.02
+ GPIB/IEEE 488 interface	R&S®NRX-B8	1424.8301.02
Signal generator + mandatory frequency options		
RF and microwave signal generator (base unit)	R&S®SMA100B	1419.8888.02
+ Frequency range option, 8 kHz to 3 GHz [1]	R&S®SMAB-B103	1420.8488.02
+ Frequency range option, 8 kHz to 6 GHz [1]	R&S®SMAB-B106	1420.8588.02
+ Frequency range option, 8 kHz to 12.75 GHz [2]	R&S®SMAB-B112	1420.8688.02
+ Frequency range option, 8 kHz to 20 GHz [2]	R&S®SMAB-B120	1420.8788.03
+ Frequency range option, 8 kHz to 40 GHz [3]	R&S®SMAB-B140	1420.8988.02
+ Frequency range option, 8 kHz to 50 GHz [4]	R&S®SMAB-B150	1420.9049.02
+ Frequency range option, 8 kHz to 67 GHz [5]	R&S®SMAB-B167	1420.9149.02
Power sensor calibration kits		
Calibration kit, N, DC to 18 GHz, 10 µW to 100 mW	R&S®NRPC18	1418.0931.03
Calibration kit, 3.5 mm, DC to 33 GHz, 10 µW to 100 mW	R&S®NRPC33	1418.0677.03
Calibration kit, 2.92 mm, DC to 40 GHz, 10 µW to 100 mW	R&S®NRPC40	1159.6802.03
Calibration kit, 2.4 mm, DC to 50 GHz, 10 µW to 100 mW	R&S®NRPC50	1159.6883.03
Calibration kit, 1.85 mm, DC to 67 GHz, 10 µW to 100 mW	R&S®NRPC67	1418.1567.02

Warranty		
Base unit		3 years
All other items [6]		1 year
Service options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde&Schwarz sales office.
Extended warranty, two years	R&S®WE2	
Extended warranty with accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	

Extended warranty with a term of one and two years (WE1 and WE2)
Repairs carried out during the contract term are free of charge [7]. Necessary calibration and adjustments carried out during repairs are also covered.

Extended warranty with accredited calibration (AW1 and AW2)
Enhance your extended warranty by adding accredited calibration coverage at a package price. This package ensures that your Rohde&Schwarz product is regularly calibrated under accreditation, inspected and maintained during the term of the contract. It includes all repairs [4] and accredited calibration at the recommended intervals as well as any accredited calibration carried out during repairs or option upgrades.

[1] These frequency options require the R&S®SMAB-K31 and R&S®SMAB-B32 output power options (order numbers 1420.7100.02 and 1420.7200.02).
[2] These frequency options require the R&S®SMAB-K33 and R&S®SMAB-B34 output power options (order numbers 1420.7300.02 and 1420.7400.02).
[3] These frequency options require the R&S®SMAB-B35 and R&S®SMAB-K36 output power options (order numbers 1420.7500.02 and 1420.9178.02).
[4] These frequency options require the R&S®SMAB-B37 and R&S®SMAB-K38 output power options (order numbers 1420.7700.02 and 1420.9255.02).
[5] These frequency options require the R&S®SMAB-B39 and R&S®SMAB-K40 output power options (order numbers 1420.7900.02 and 1420.9278.02).
[6] For options that are installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1-year warranty.
[7] Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.

Service that adds value

- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

Rohde&Schwarz

The Rohde&Schwarz technology group is among the trailblazers when it comes to paving the way for a safer and connected world with its leading solutions in test and measurement, technology systems, and networks and cybersecurity. Founded more than 85 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

Sustainable product design

- Environmental compatibility and eco-footprint
- Energy efficiency and low emissions
- Longevity and optimized total cost of ownership

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

Rohde&Schwarz training

www.training.rohde-schwarz.com

Rohde&Schwarz customer support

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R&S®NRPC-LS RF Power Linearity Standard
Data without tolerance limits is not binding | Subject to change

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