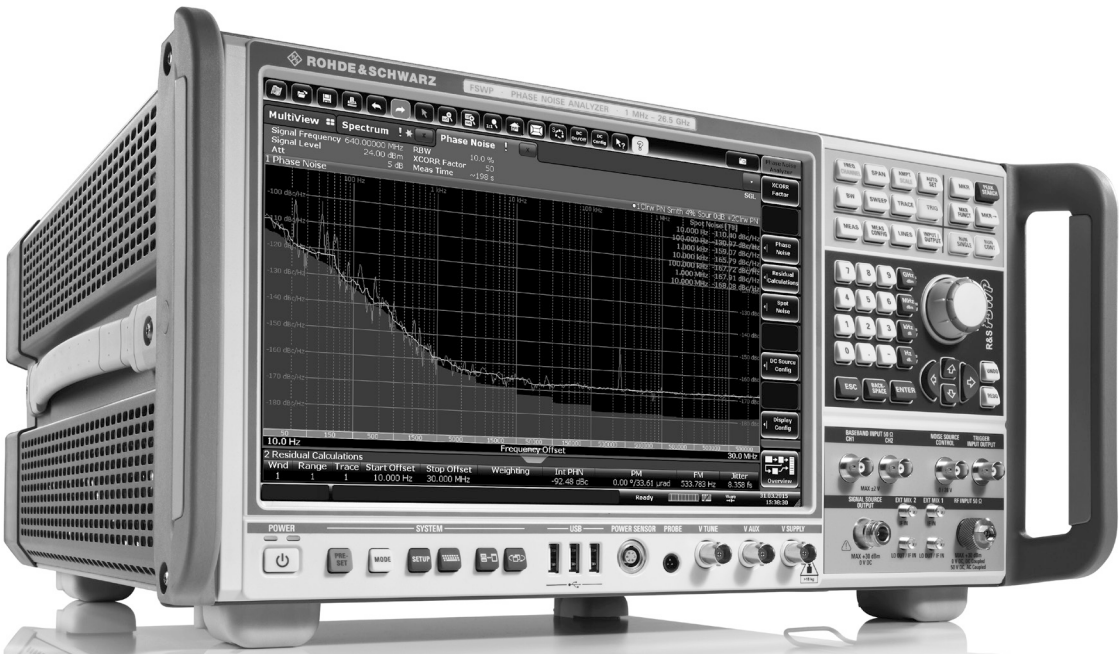


# R&S®FSWP

## Phase Noise Analyzer

### Specifications



# CONTENTS

|   |           |
|---|-----------|
| <b>Definitions .....</b>  | <b>4</b>  |
| <b>Specifications.....</b>  | <b>5</b>  |
| Frequency .....   | 5         |
| Phase noise measurements .....  | 5         |
| <i>Phase noise sensitivity with R&amp;S®FSWP-B61 cross correlation (low phase noise) option .....</i> | <i>6</i>  |
| <i>Phase noise sensitivity with R&amp;S®FSWP-B60 cross correlation option .....</i>                   | <i>6</i>  |
| <i>Phase noise sensitivity without R&amp;S®FSWP-B60/R&amp;S®FSWP-B61 option.....</i>                  | <i>7</i>  |
| Measurement speed, nominal values.....  | 7         |
| AM noise measurements .....   | 7         |
| <i>AM noise sensitivity.....</i>  | <i>7</i>  |
| Baseband noise measurement .....  | 8         |
| <i>Baseband noise level.....</i>  | <i>8</i>  |
| VCO characterization measurements (frequency, RF power, DC supply current) .....                      | 8         |
| Transient analysis.....   | 9         |
| <i>Frequency resolution, narrow mode .....</i>  | <i>9</i>  |
| <i>Frequency resolution, wide mode (256 MHz to 8 GHz).....</i>  | <i>9</i>  |
| <b>R&amp;S®FSWP-K4 pulsed phase noise measurements .....</b>  | <b>10</b> |
| <b>R&amp;S®FSWP-B64 additive phase noise measurements .....</b>                                       | <b>11</b> |
| Additive phase noise measurements .....   | 11        |
| Additive phase noise sensitivity .....  | 11        |
| Additive phase noise measurements with external signal source .....                                   | 11        |
| Additive phase noise sensitivity with external signal source <sup>5, 6</sup> .....                    | 11        |
| Auxiliary LO inputs <sup>6</sup> .....  | 11        |
| Additive phase noise measurements with external I/Q mixers.....                                       | 12        |
| Signal source.....  | 12        |
| Frequency translating additive phase noise measurements .....   | 13        |
| Frequency translating additive phase noise sensitivity .....  | 14        |
| <b>Inputs and outputs.....</b>  | <b>15</b> |
| <b>General data .....</b>   | <b>19</b> |

|   |           |
|---|-----------|
| <b>R&amp;S®FSWP-B1 spectrum analyzer</b> .....  | <b>21</b> |
| Frequency .....   | 21        |
| Sweep time.....   | 22        |
| Resolution bandwidths.....  | 22        |
| Level.....  | 23        |
| Intermodulation.....  | 23        |
| Sensitivity .....   | 24        |
| Spurious responses .....  | 25        |
| Level measurement uncertainty .....   | 25        |
| Trigger functions.....  | 27        |
| I/Q data (R&S®FSWP-B1 option required) .....  | 27        |
| <b>R&amp;S®FSWP-B13 highpass filters (R&amp;S®FSWP-B1 option required)</b> .....  | <b>29</b> |
| <b>R&amp;S®FSWP-B21 LO/IF connections for external mixers (for R&amp;S®FSWP26/R&amp;S®FSWP50)</b> .....                                       | <b>30</b> |
| Phase noise sensitivity with two external mixers in cross correlation mode (R&S®FSWP-B60/R&S®FSWP-B61 and R&S®FSWP-B64 options required)..... | 30        |
| Phase noise sensitivity with one external mixer, with R&S®FSWP-B4 or R&S®FSWP-B61 option.....   | 31        |
| Phase noise sensitivity with one external mixer, without R&S®FSWP-B4/-B61 options .....   | 31        |
| <b>R&amp;S®FSWP-B24 RF preamplifier (R&amp;S®FSWP-B1 option required)</b> .....   | <b>31</b> |
| <b>Ordering information</b> .....   | <b>32</b> |
| Options.....  | 32        |
| <i>Firmware</i> .....   | 33        |
| Recommended extras.....   | 33        |
| Power sensors supported (R&S®FSWP-B1 option required) .....   | 34        |
| Service options .....   | 35        |

# Definitions

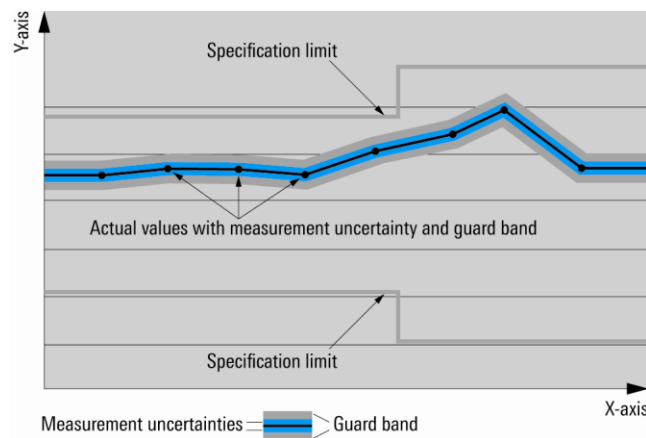
## General

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  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $\pm$ , 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 (e.g. 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 (e.g. 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.

# Specifications

## Frequency

| Frequency range, RF input               |  |   |
|---|--|---|
| Phase noise, AM noise measurements      | R&S®FSWP8  |   |
|   | DC coupled<br>(requires R&S®FSWP-B1 option)                | 1 MHz to 8 GHz  |
|   | AC coupled   | 1 MHz to 8 GHz  |
|   | R&S®FSWP26   |   |
|   | DC coupled   | 1 MHz to 26.5 GHz   |
|   | AC coupled   | 10 MHz to 26.5 GHz  |
|   | R&S®FSWP50   |   |
|   | DC coupled   | 1 MHz to 50 GHz   |
|   | AC coupled   | 10 MHz to 50 GHz  |
| Baseband noise measurements             | R&S®FSWP8  |   |
|   | DC coupled<br>(requires R&S®FSWP-B1 option)                | 10 mHz to 30 MHz  |
|   | AC coupled   | 1 MHz to 30 MHz   |
|   | R&S®FSWP26, R&S®FSWP50                                     |   |
|   | DC coupled   | 10 mHz to 30 MHz  |
|   | AC coupled   | 10 MHz to 30 MHz  |
| <b>Frequency resolution</b>             |  |   |
| <b>Reference frequency, internal</b>    |  |   |
| Accuracy                                |  | ±(time since last adjustment × aging rate + temperature drift + calibration accuracy) |
| Aging per year                          | standard   | ±1 × 10 <sup>-7</sup>   |
|   | with R&S®FSWP-B4 OCXO precision frequency reference option |   |
|   | first year of operation                                    | ±5 × 10 <sup>-8</sup>   |
|   | after first year of operation                              | ±3 × 10 <sup>-8</sup>   |
| Temperature drift                       | 0 °C to +50 °C   | ±1 × 10 <sup>-9</sup>   |
| Achievable initial calibration accuracy | standard   | ±1 × 10 <sup>-8</sup>   |
|   | with R&S®FSWP-B4 OCXO precision frequency reference option | ±5 × 10 <sup>-9</sup>   |

## Phase noise measurements

|                                     |   |   |
|-------------------------------------|---|---|
| Measurement results                 |   | SSB phase noise, spurious signals, integrated RMS phase deviation, residual FM, time jitter |
| Offset frequency range              | input signal ≤ 3.33 GHz   | 10 mHz to 30 % of carrier frequency   |
|                                     | input signal > 3.33 GHz   | 10 mHz to 1 GHz   |
| Signal level range                  | level setting = high  | -20 dBm to +30 dBm  |
|                                     | level setting = low   | -40 dBm to +30 dBm  |
| Number of traces                    |   | 6   |
| Phase noise measurement uncertainty | DUT phase noise ≥ 15 dB above phase noise sensitivity of R&S®FSWP |   |
|                                     | 10 mHz ≤ offset < 1 MHz   | < 1.5 dB  |
|                                     | 1 MHz ≤ offset ≤ 30 MHz   | < 2 dB  |
|                                     | offset > 30 MHz   | < 3 dB  |
| Level measurement uncertainty       | -20 dBm ≤ signal level ≤ 15 dBm, +20 °C to +30 °C                 |   |
|                                     | 1 MHz ≤ signal frequency ≤ 8 GHz                                  | < 1 dB  |
|                                     | 8 GHz ≤ signal frequency ≤ 18 GHz                                 | < 2 dB  |
|                                     | 18 GHz ≤ signal frequency   | < 3 dB  |
| Spurious level                      | f <sub>in</sub> < 1 GHz   |   |
|                                     | 10 Hz ≤ offset from carrier < 1 kHz                               | < -90 dBc   |
|                                     | offset from carrier ≥ 1 kHz                                       | < -100 dBc  |
|                                     | f <sub>in</sub> ≥ 1 GHz   |   |
|                                     | 10 Hz ≤ offset from carrier < 1 kHz                               | < -90 dBc + 20 log (f <sub>in</sub> /GHz)   |
|                                     | offset from carrier ≥ 1 kHz                                       | < -100 dBc + 20 log (f <sub>in</sub> /GHz)  |
| AM suppression                      | 10 mHz < offset < 1 MHz   | 40 dB (nom.)  |
|                                     | 1 MHz ≤ offset ≤ 30 MHz,<br>level setting = high                  | 30 dB (nom.)  |
|                                     | 1 MHz ≤ offset ≤ 10 MHz,<br>level setting = low                   | 30 dB (nom.)  |

**Phase noise sensitivity with R&S®FSWP-B61 cross correlation (low phase noise) option <sup>1</sup>**

For offset frequencies  $\geq 1$  Hz start offset = 1 Hz, for offset frequencies  $< 1$  Hz start offset = 0.01 Hz.  
 Correlation factor = 1, frequency reference internal, internal reference loop bandwidth 30 Hz, signal level  $\geq 10$  dBm <sup>2</sup>.  
 For instruments with R&S®FSWP-B64 option: signal source output = off. For sensitivity with signal source = on, see section "R&S®FSWP-B64 additive phase noise measurements".  
 Specified values in dBc (1 Hz). For typical values subtract 6 dB.

| RF input frequency | Offset frequency from the carrier |        |      |       |        |       |        |         |       |        |        |
|--------------------|-----------------------------------|--------|------|-------|--------|-------|--------|---------|-------|--------|--------|
|                    | 0.01 Hz                           | 0.1 Hz | 1 Hz | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz | 30 MHz |
| 1 MHz              | -60                               | -105   | -118 | -136  | -148   | -166  | -176   | -176    |       |        |        |
| 10 MHz             | -40                               | -86    | -115 | -132  | -142   | -160  | -170   | -170    | -170  |        |        |
| 100 MHz            | -20                               | -66    | -95  | -117  | -140   | -166  | -170   | -173    | -175  | -175   | -175   |
| 1 GHz              | 0                                 | -46    | -75  | -97   | -120   | -150  | -166   | -173    | -173  | -173   | -173   |
| 3 GHz              | +10                               | -36    | -65  | -87   | -110   | -140  | -156   | -158    | -163  | -170   | -170   |
| 7 GHz              | +17                               | -29    | -58  | -80   | -103   | -133  | -152   | -153    | -157  | -166   | -166   |
| 10 GHz             | +20                               | -26    | -55  | -77   | -100   | -133  | -152   | -153    | -157  | -173   | -175   |
| 16 GHz             | +24                               | -22    | -51  | -73   | -96    | -129  | -148   | -149    | -153  | -170   | -171   |
| 26 GHz             | +28                               | -18    | -47  | -69   | -92    | -125  | -144   | -145    | -149  | -166   | -167   |
| 50 GHz             | +34                               | -12    | -41  | -63   | -86    | -119  | -138   | -139    | -143  | -160   | -161   |

**Improvement of phase noise sensitivity by number of correlations (with R&S®FSWP-B61 option)**Offset frequencies  $\geq 1$  Hz <sup>3</sup>

|              |      |       |       |        |
|--------------|------|-------|-------|--------|
| Correlations | 10   | 100   | 1000  | 10 000 |
| Improvement  | 5 dB | 10 dB | 15 dB | 20 dB  |

**Phase noise sensitivity with R&S®FSWP-B60 cross correlation option**

Start offset 1 Hz, correlation factor = 1, frequency reference internal, signal level  $\geq 10$  dBm <sup>2</sup>, without R&S®FSWP-B4 option.  
 For instruments with R&S®FSWP-B64 option: signal source output = off. For sensitivity with signal source = on, see section "R&S®FSWP-B64 additive phase noise measurements".  
 Specified values in dBc (1 Hz). For typical values subtract 6 dB.

| RF input frequency | Offset frequency from the carrier |       |        |       |        |         |       |        |        |
|--------------------|-----------------------------------|-------|--------|-------|--------|---------|-------|--------|--------|
|                    | 1 Hz                              | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz | 30 MHz |
| 1 MHz              | -96                               | -128  | -140   | -158  | -170   | -170    |       |        |        |
| 10 MHz             | -96                               | -128  | -140   | -158  | -170   | -170    | -170  |        |        |
| 100 MHz            | -76                               | -108  | -136   | -163  | -170   | -173    | -175  | -175   | -175   |
| 1 GHz              | -56                               | -88   | -116   | -143  | -166   | -173    | -173  | -173   | -173   |
| 3 GHz              | -46                               | -78   | -106   | -133  | -156   | -158    | -163  | -170   | -170   |
| 7 GHz              | -39                               | -71   | -99    | -130  | -152   | -153    | -157  | -166   | -166   |
| 10 GHz             | -36                               | -68   | -96    | -128  | -147   | -150    | -155  | -173   | -173   |
| 16 GHz             | -32                               | -64   | -92    | -124  | -143   | -146    | -151  | -170   | -170   |
| 26 GHz             | -28                               | -60   | -88    | -120  | -139   | -142    | -147  | -166   | -166   |
| 50 GHz             | -22                               | -54   | -82    | -114  | -133   | -136    | -141  | -160   | -160   |

R&amp;S®FSWP-B4 option improves the phase noise sensitivity at 1 Hz offset by 5 dB (nom.).

At other offsets the above specification applies.

**Improvement of phase noise sensitivity by number of correlations (with R&S®FSWP-B60 <sup>4</sup> option)**Offset frequencies  $\geq 1$  Hz <sup>3</sup>

|              |      |       |       |        |
|--------------|------|-------|-------|--------|
| Correlations | 10   | 100   | 1000  | 10 000 |
| Improvement  | 5 dB | 10 dB | 15 dB | 20 dB  |

<sup>1</sup> The specifications in this table apply to instruments starting from the following serial numbers:

R&amp;S®FSWP8: 101142, R&amp;S®FSWP26: 101131, R&amp;S®FSWP50: 101114.

<sup>2</sup> For signal levels below 10 dBm the broadband noise floor is limited to nominal ( $-172$  dBm - (signal level in dBm)) dBc (Hz), whereas the close in phase noise is not affected. Example: with a signal level of  $-10$  dBm the nominal broadband noise floor is  $-162$  dBc (Hz).<sup>3</sup> For offset frequencies below 1 Hz the improvement impact of correlation is limited by the coupling between the two R&S®FSWP local oscillators. The improvement achievable in this case ranges from 15 dB (nom.) at 0.1 Hz frequency offset to 3 dB (nom.) at a frequency offset  $\leq 30$  mHz.<sup>4</sup> Without R&S®FSWP-B60/R&S®FSWP-B61 option the impact of cross correlation is limited by the residual phase noise of the R&S®FSWP local oscillators (1 set only). Therefore the phase noise does not improve with increasing number of correlations as indicated in this table. Instead the specifications indicated in section Phase noise sensitivity without R&S®FSWP-B60 option apply.

## Phase noise sensitivity without R&S®FSWP-B60/R&S®FSWP-B61 option

Start offset 1 Hz, correlation factor = 1, frequency reference internal, signal level  $\geq 10$  dBm<sup>2</sup>, without R&S®FSWP-B4 option. Specified values in dBc (1 Hz). For typical values subtract 6 dB.

| RF input frequency | Offset frequency from the carrier |       |        |       |        |         |       |        |        |
|--------------------|-----------------------------------|-------|--------|-------|--------|---------|-------|--------|--------|
|                    | 1 Hz (nom.)                       | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz | 30 MHz |
| 1 MHz              | -94                               | -122  | -138   | -155  | -168   | -168    |       |        |        |
| 10 MHz             | -94                               | -122  | -138   | -155  | -168   | -168    | -168  |        |        |
| 100 MHz            | -74                               | -102  | -130   | -155  | -167   | -170    | -170  | -170   | -170   |
| 1 GHz              | -54                               | -82   | -110   | -135  | -147   | -150    | -157  | -170   | -170   |
| 3 GHz              | -44                               | -72   | -100   | -125  | -137   | -140    | -147  | -167   | -170   |
| 7 GHz              | -37                               | -65   | -93    | -118  | -130   | -133    | -140  | -160   | -163   |
| 10 GHz             | -34                               | -62   | -90    | -115  | -127   | -130    | -137  | -157   | -160   |
| 16 GHz             | -30                               | -58   | -86    | -111  | -123   | -126    | -133  | -153   | -156   |
| 26 GHz             | -26                               | -54   | -82    | -107  | -119   | -122    | -129  | -149   | -152   |
| 50 GHz             | -20                               | -48   | -76    | -101  | -113   | -116    | -123  | -143   | -146   |

R&S®FSWP-B4 option improves the phase noise sensitivity at 1 Hz offset by 10 dB (nom.). At other offsets the above specification applies.

## Measurement speed, nominal values

The measurement times in the table below apply to the following conditions:

auto freq = off, correlation factor set to  $\geq 10$ , measurement times normalized to correlation factor = 1.

| Span           | Bandwidth in % of offset |        |        |
|----------------|--------------------------|--------|--------|
|                | 30 %                     | 10 %   | 3 %    |
| 1 Hz to 1 MHz  | 7 s                      | 8 s    | 25 s   |
| 1 kHz to 1 MHz | 0.03 s                   | 0.04 s | 0.07 s |

To obtain the measurement time for a given number of correlations (without automatic signal frequency search), multiply the above figures by the number of correlations.

## AM noise measurements

|                                  |  |                                     |
|----------------------------------|--|-------------------------------------|
| Offset frequency range           | input signal $\leq 100$ MHz  | 10 mHz to 30 % of carrier frequency |
|                                  | input signal $> 100$ MHz   | 10 mHz to 30 MHz                    |
| AM noise measurement uncertainty | 10 mHz $<$ offset $<$ 1 MHz  | $< 2$ dB                            |
|                                  | 1 MHz $\leq$ offset $\leq 30$ MHz                                  | $< 2.5$ dB                          |
| Level measurement uncertainty    | $-20$ dBm $\leq$ signal level $\leq +15$ dBm, $+20$ °C to $+30$ °C |                                     |
|                                  | 1 MHz $\leq$ signal frequency $<$ 8 GHz                            | $< 1$ dB                            |
|                                  | 8 GHz $\leq$ signal frequency $\leq 18$ GHz                        | $< 2$ dB                            |
|                                  | 18 GHz $\leq$ signal frequency                                     | $< 3$ dB                            |

## AM noise sensitivity

Start offset 1 Hz, correlations = 1, signal level  $\geq 10$  dBm<sup>2</sup>.

Specified values in dBc (1 Hz). For typical values subtract 6 dB.

| RF input frequency          | Offset frequency from the carrier |       |        |       |        |         |       |        |        |
|-----------------------------|-----------------------------------|-------|--------|-------|--------|---------|-------|--------|--------|
|                             | 1 Hz                              | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz | 30 MHz |
| 100 MHz $\leq f \leq 1$ GHz | -105                              | -120  | -135   | -150  | -158   | -165    | -165  | -165   | -165   |
| 1 GHz $< f \leq 12$ GHz     | -100                              | -115  | -130   | -145  | -155   | -160    | -165  | -165   | -165   |
| 12 GHz $< f \leq 18$ GHz    | -90                               | -105  | -120   | -135  | -150   | -160    | -165  | -165   | -165   |
| 18 GHz $< f \leq 33$ GHz    | -80                               | -95   | -110   | -125  | -140   | -150    | -160  | -165   | -165   |
| 33 GHz $< f \leq 50$ GHz    | -70                               | -85   | -100   | -115  | -130   | -140    | -150  | -160   | -160   |

### Improvement of AM noise sensitivity by number of correlations

|              |      |       |       |        |
|--------------|------|-------|-------|--------|
| Correlations | 10   | 100   | 1000  | 10 000 |
| Improvement  | 5 dB | 10 dB | 15 dB | 20 dB  |

## Baseband noise measurement

|                               |   |                  |
|-------------------------------|---|------------------|
| Frequency range               | RF input, DC coupled                      | 10 mHz to 30 MHz |
|                               | RF input, AC coupled                      | 1 MHz to 30 MHz  |
|                               | baseband input                            | 10 mHz to 30 MHz |
| Level measurement range       | RF input                                  | < +8 dBm         |
|                               | baseband input                            | < +4 dBm         |
| Level measurement uncertainty | +20 °C to +30 °C                          |                  |
|                               | 10 mHz < $f_{in}$ < 1 MHz                 | < 2 dB nom.      |
|                               | 1 MHz $\leq f_{in} \leq$ 30 MHz           | < 2.5 dB nom.    |
| Units                         | dBm (1 Hz), dB $\mu$ V (1 Hz), dBV (1 Hz) |                  |

## Baseband noise level

Start offset 1 Hz, correlation factor = 1, RF input 50  $\Omega$  terminated.  
Specified values in dBm (1 Hz). For typical values subtract 6 dB.

|                 |      |       |        |       |        |         |       |        |        |
|-----------------|------|-------|--------|-------|--------|---------|-------|--------|--------|
| Input frequency | 1 Hz | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz | 30 MHz |
| Noise level     | -120 | -130  | -145   | -154  | -160   | -160    | -160  | -160   | -160   |

## VCO characterization measurements (frequency, RF power, DC supply current)

|                               |   |                                  |
|-------------------------------|---|----------------------------------|
| Sweep parameters              | DC tune voltage ( $V_{tune}$ )                              |                                  |
|                               | DC auxiliary voltage ( $V_{aux}$ )                          |                                  |
|                               | DC supply voltage ( $V_{supply}$ )                          |                                  |
|                               | DC supply current ( $I_{supply}$ )                          |                                  |
| Measurement parameters        | frequency   |                                  |
|                               | RF power  |                                  |
|                               | DC supply current   |                                  |
|                               | tuning sensitivity  |                                  |
| Frequency resolution          | 100 mHz to 100 kHz in steps of 1, 10, ...                   |                                  |
| RF power measurement range    | 1 MHz $\leq$ signal frequency $\leq$ 100 MHz                | -15 dBm to +27 dBm               |
|                               | signal frequency > 100 MHz                                  | -20 dBm to +27 dBm               |
| Level measurement uncertainty | -20 dBm $\leq$ signal level $\leq$ 15 dBm, +20 °C to +30 °C |                                  |
|                               | 1 MHz $\leq$ signal frequency < 8 GHz                       | < 1 dB                           |
|                               | 8 GHz $\leq$ signal frequency < 18 GHz                      | < 2 dB                           |
|                               | signal frequency $\geq$ 18 GHz                              | < 3 dB                           |
| $V_{tune}$                    | setting range   | -10 V to +28 V                   |
|                               | setting resolution  | 0.75 mV                          |
|                               | setting uncertainty   | $\pm(0.2\%$ of reading + 8 mV)   |
|                               | reading uncertainty   | $\pm(0.5\%$ of reading + 25 mV)  |
|                               | output resistance   | 50 $\Omega$                      |
|                               | output settling time  | 7 ms/V                           |
|                               | noise level   | < 1 nV <sub>rms</sub> at 10 kHz  |
| $V_{aux}$                     | setting range   | -10 V to +10 V                   |
|                               | setting resolution  | 0.5 mV                           |
|                               | setting uncertainty   | $\pm(0.1\%$ of reading + 2 mV)   |
|                               | reading uncertainty   | $\pm(0.5\%$ of reading + 25 mV)  |
|                               | output resistance   | 5 $\Omega$                       |
|                               | output settling time  | 1 ms/V                           |
|                               | noise level   | < 10 nV <sub>rms</sub> at 10 kHz |
| $V_{supply}$                  | setting range   | 0 to 16 V                        |
|                               | setting resolution  | 0.3 mV                           |
|                               | setting uncertainty   | $\pm(0.1\%$ of reading + 1 mV)   |
|                               | reading uncertainty   | $\pm(0.5\%$ of reading + 25 mV)  |
|                               | output resistance   | 0.5 $\Omega$                     |
|                               | output settling time  | 50 ms/V                          |
|                               | noise level   | < 10 nV <sub>rms</sub> at 10 kHz |
| $I_{supply}$                  | setting range   | 10 mA to 2000 mA                 |
|                               | setting resolution  | 50 $\mu$ A                       |
|                               | setting uncertainty   | $\pm(0.5\%$ of reading + 0.5mA)  |
|                               | reading uncertainty   | $\pm(0.5\%$ of reading + 1.5mA)  |



## Transient analysis

|                               |   |  |
|-------------------------------|---|--|
| Frequency range               | R&S®FSWP8                                   |  |
|                               | DC coupled<br>(requires R&S®FSWP-B1 option) | 1 MHz to 8 GHz   |
|                               | AC coupled                                  | 1 MHz to 8 GHz   |
|                               | R&S®FSWP26                                  |  |
|                               | DC coupled                                  | 1 MHz to 26.5 GHz  |
|                               | AC coupled                                  | 10 MHz to 26.5 GHz   |
|                               | R&S®FSWP50                                  |  |
|                               | DC coupled                                  | 1 MHz to 50 GHz  |
| Measurement parameters        | narrow mode/wide mode                       | frequency  |
|                               | narrow mode additionally                    | phase  |
| Frequency transient bandwidth | narrow mode                                 | 40 MHz   |
|                               | wide mode                                   | 256 MHz to 8 GHz   |
| Frequency resolution          | narrow mode, span ≤ 1 MHz                   | 1 Hz   |
|                               | narrow mode, 1 MHz < span ≤ 40 MHz          | 20 Hz  |
|                               | wide mode                                   | see tables below   |
| Frequency uncertainty         |   | ± (resolution + reference frequency accuracy)                          |
| Phase uncertainty             | DUT signal locked to target frequency       | 0.05° + 0.1°/GHz   |
| RF input level range          | narrow mode                                 | -20 dBm to +20 dBm   |
|                               | wide mode                                   | -15 dBm to +20 dBm (256 MHz – 6 GHz)                                   |
|                               |   | -10 dBm to +20 dBm (6 GHz – 7 GHz)<br>0 dBm to +20 dBm (7 GHz – 8 GHz) |
| Time span                     |   | 1 µs to 16 s   |
| Time resolution               |   | > 20 ns  |
| Measurement trigger           | trigger mode                                | free run, external, frequency  |
|                               | external trigger polarity                   | positive, negative (3.3 V TTL level)                                   |
|                               | pretrigger delay                            | (-1) × time span to 16 s   |

### Frequency resolution, narrow mode

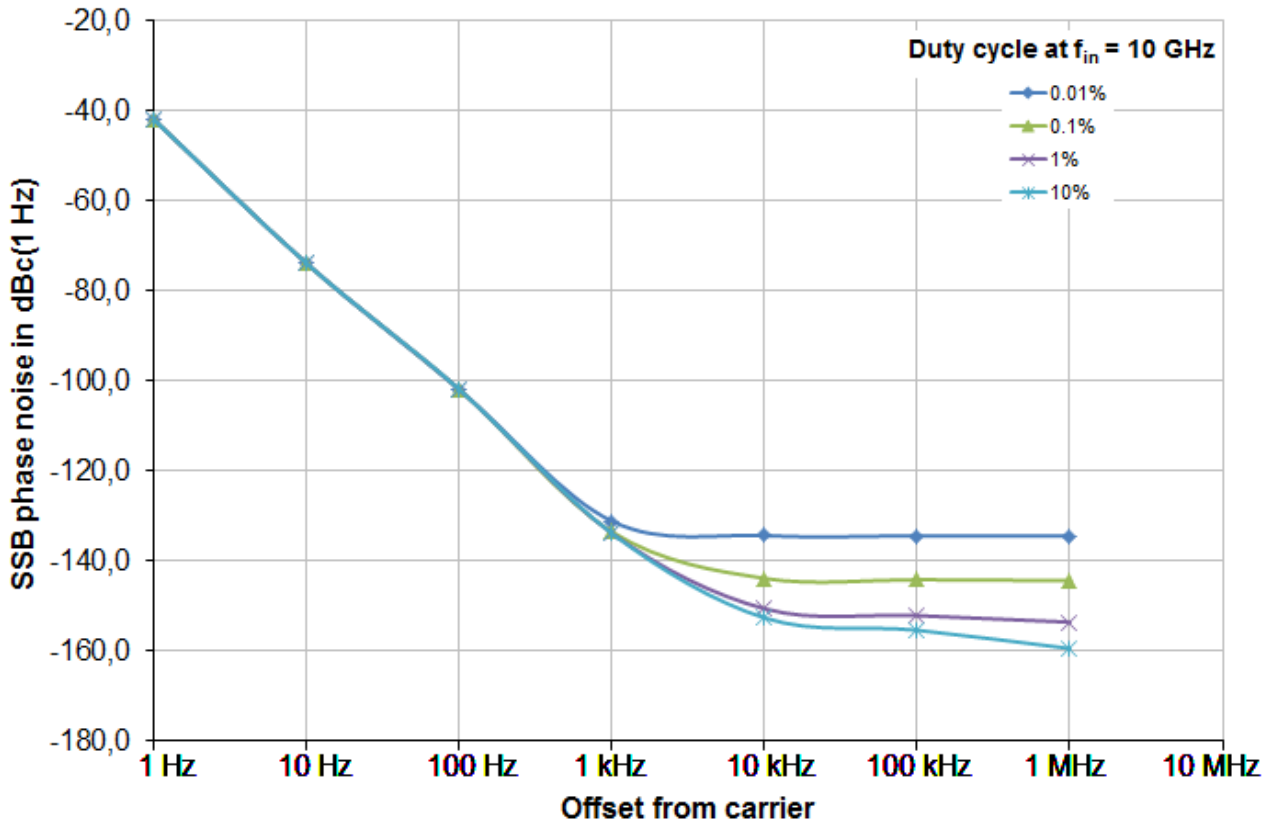
|   |        |        |        |        |         |        |        |        |        |
|---|--------|--------|--------|--------|---------|--------|--------|--------|--------|
| Observation time                                  | 1 µs   | 10 µs  | 100 µs | 1 ms   | 10 ms   | 100 ms | 1 s    | 10 s   | 16 s   |
| min. VBW  | 1 Hz   | 1 Hz   | 1 Hz   | 1 Hz   | 1 Hz    | 1 Hz   | 1 Hz   | 1 Hz   | 1 Hz   |
| max. VBW  | 5 MHz  | 5 MHz  | 5 MHz  | 5 MHz  | 625 kHz | 96 kHz | 10 kHz | 1 kHz  | 625 Hz |
| Measurement points                                | 51     | 501    | 5001   | 50001  | 62501   | 100001 | 100001 | 100001 | 100001 |
| Time resolution at max. VBW                       | 20 ns  | 20 ns  | 20 ns  | 20 ns  | 160 ns  | 1 µs   | 10 µs  | 100 µs | 160 µs |
| Frequency resolution at min. VBW for span > 1 MHz | 20 Hz  | 20 Hz  | 20 Hz  | 20 Hz  | 20 Hz   | 20 Hz  | 20 Hz  | 20 Hz  | 20 Hz  |
| Frequency resolution at min. VBW for span ≤ 1 MHz | 1 Hz   | 1 Hz   | 1 Hz   | 1 Hz   | 1 Hz    | 1 Hz   | 1 Hz   | 1 Hz   | 1 Hz   |
| Frequency resolution at max. VBW                  | 57 kHz | 57 kHz | 57 kHz | 57 kHz | 1.2 kHz | 500 Hz | 30 Hz  | 30 Hz  | 30 Hz  |

### Frequency resolution, wide mode (256 MHz to 8 GHz)

|                                  |         |         |         |         |         |        |        |        |        |
|----------------------------------|---------|---------|---------|---------|---------|--------|--------|--------|--------|
| Observation time                 | 1 µs    | 10 µs   | 100 µs  | 1 ms    | 10 ms   | 100 ms | 1 s    | 10 s   | 16 s   |
| min. VBW                         | 1 Hz    | 1 Hz    | 1 Hz    | 1 Hz    | 1 Hz    | 1 Hz   | 1 Hz   | 1 Hz   | 1 Hz   |
| max. VBW                         | 100 kHz | 100 kHz | 100 kHz | 100 kHz | 100 kHz | 96 kHz | 10 kHz | 1 kHz  | 625 Hz |
| Measurement points               | 51      | 501     | 5001    | 50001   | 62501   | 100001 | 100001 | 100001 | 100001 |
| Time resolution at max. VBW      | 20 ns   | 20 ns   | 20 ns   | 20 ns   | 160 ns  | 1 µs   | 10 µs  | 100 µs | 160 µs |
| Frequency resolution at min. VBW | 1 Hz    | 1 Hz    | 1 Hz    | 1 Hz    | 1 Hz    | 1 Hz   | 1 Hz   | 1 Hz   | 1 Hz   |
| Frequency resolution at max. VBW | 15 MHz  | 15 MHz  | 1 MHz   | 20 kHz  | 20 kHz  | 5 kHz  | 250 Hz | 20 Hz  | 20 Hz  |

# R&S®FSWP-K4 pulsed phase noise measurements

| Signal level ≥ 0 dBm                   |   |   |
|--|---|---|
| Offset frequency range                 |   | 10 mHz to 50 % of the pulse repetition rate   |
| Pulse repetition rate                  |   | 0.5 μs to 5 ms                                |
| Duty cycle                             | manual setting, auto search off   | 0.01 % to 50 %, pulse width > 100 ns          |
|  | auto search on  | 1 % to 50 %, pulse width > 250 ns             |
| Phase noise measurement uncertainty    | 10 mHz < offset < 1 Hz  | < 3 dB  |
|  | 1 Hz ≤ offset ≤ 1 MHz   | < 2.5 dB                                      |
| Phase noise sensitivity                | The phase noise sensitivity is limited by additional broadband noise dependent on the duty cycle of the input signal. As long as this broadband noise is more than 10 dB below the specified phase noise sensitivity for continuous wave signals, the phase noise sensitivity specification for CW signals applies. |   |
| Noise floor of phase noise sensitivity | start offset = 1 Hz, correlation factor = 1, signal level ≥ 10 dBm  |   |
| Gating = on                            | frequency < 18 GHz  | -175 dBc (1 Hz) - 10 × log(duty cycle) (nom.) |
|  | 18 GHz ≤ frequency < 30 GHz   | -165 dBc (1 Hz) - 10 × log(duty cycle) (nom.) |
|  | 30 GHz ≤ frequency ≤ 50 GHz   | -155 dBc (1 Hz) - 10 × log(duty cycle) (nom.) |
| Gating = off                           | frequency < 18 GHz  | -175 dBc (1 Hz) - 20 × log(duty cycle) (nom.) |
|  | 18 GHz ≤ frequency < 30 GHz   | -165 dBc (1 Hz) - 20 × log(duty cycle) (nom.) |
|  | 30 GHz ≤ frequency ≤ 50 GHz   | -155 dBc (1 Hz) - 20 × log(duty cycle) (nom.) |



Typical phase noise sensitivity with R&S®FSWP-B60 option at  $f_{in} = 10$  GHz (start offset = 1 Hz, correlation factor = 1, signal level = 10 dBm, gating = on).

# R&S®FSWP-B64 additive phase noise measurements

## Additive phase noise measurements

|                                     |  |                    |
|-------------------------------------|--|--------------------|
| Frequency range                     | R&S®FSWP8  | 9.95 MHz to 8 GHz  |
|                                     | R&S®FSWP26   | 9.95 MHz to 18 GHz |
|                                     | R&S®FSWP50   | 9.95 MHz to 18 GHz |
| Offset frequency range              |  | 10 mHz to 30 MHz   |
| Measurement uncertainty             |  | < 2 dB (nom.)      |
| Input level measurement uncertainty | -20 dBm ≤ signal level ≤ +15 dBm, +20 °C to +30 °C |                    |
|                                     | 1 MHz ≤ signal frequency < 8 GHz                   | < 1.5 dB           |
|                                     | 8 GHz ≤ signal frequency ≤ 18 GHz                  | < 2 dB             |

## Additive phase noise sensitivity

| Start offset 1 Hz, correlation factor = 10, signal level ≥ 10 dBm<br>Specified values in dBc (1 Hz). For typical values subtract 6 dB. |                                   |       |        |       |        |         |       |       |
|--|-----------------------------------|-------|--------|-------|--------|---------|-------|-------|
| RF input frequency   | Offset frequency from the carrier |       |        |       |        |         |       |       |
|  | 1 Hz                              | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 3 MHz |
| 10 MHz   | -106                              | -115  | -128   | -140  | -148   | -148    | -148  | -148  |
| 100 MHz  | -118                              | -132  | -143   | -152  | -155   | -155    | -155  | -153  |
| 1 GHz  | -115                              | -123  | -137   | -147  | -160   | -165    | -165  | -161  |
| 3 GHz  | -115                              | -128  | -143   | -147  | -165   | -165    | -160  | -156  |
| 10 GHz   | -85                               | -104  | -120   | -138  | -148   | -154    | -164  | -160  |
| 16 GHz   | -82                               | -98   | -120   | -138  | -148   | -154    | -164  | -160  |

## Additive phase noise measurements with external signal source <sup>5</sup>

With R&S®FSWP-B64 option the R&S®FSWP provides two auxiliary LO inputs to support the use of external signal sources. <sup>6</sup>  
This allows additive phase noise measurements with two or three DUTs, frequency translating or non-frequency translating.

|                                   |                                     |                   |         |
|-----------------------------------|-------------------------------------|-------------------|---------|
| Frequency range                   | R&S®FSWP8                           | 100 MHz to 8 GHz  |         |
|                                   | R&S®FSWP26, R&S®FSWP50              | 100 MHz to 18 GHz |         |
| Offset frequency range            |                                     | 10 mHz to 30 MHz  |         |
| Measurement uncertainty           |                                     | < 2 dB (nom.)     |         |
| Required LO drive level per input | 100 MHz ≤ signal frequency < 12 GHz |                   | +5 dBm  |
|                                   | 12 GHz ≤ signal frequency < 16 GHz  |                   | +7 dBm  |
|                                   | 16 GHz ≤ signal frequency ≤ 18 GHz  |                   | +10 dBm |

## Additive phase noise sensitivity with external signal source <sup>5, 6</sup>

| Start offset 1 Hz, correlation factor = 10, signal level ≥ 10 dBm.<br>Values in dBc (1 Hz) measured with a low phase noise reference <sup>7</sup> . |                                   |       |        |       |        |         |       |        |
|---|-----------------------------------|-------|--------|-------|--------|---------|-------|--------|
| RF input frequency  | Offset frequency from the carrier |       |        |       |        |         |       |        |
|   | 1 Hz                              | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz |
| 100 MHz   | -125                              | -136  | -150   | -160  | -170   | -173    | -175  | -177   |
| 500 MHz   | -118                              | -135  | -148   | -160  | -175   | -175    | -175  | -175   |
| 10 GHz  | -100                              | -112  | -124   | -140  | -150   | -160    | -160  | -160   |

## Auxiliary LO inputs <sup>6</sup>

| Inputs                  |               |                          |
|-------------------------|---------------|--------------------------|
| LO aux input, channel 1 | SMA (f), 50 Ω | max. input level +20 dBm |
| LO aux input, channel 2 | SMA (f), 50 Ω | max. input level +20 dBm |

<sup>5</sup> Auxiliary LO inputs required.

<sup>6</sup> The auxiliary LO inputs are standard for instruments with R&S®FSWP-B64 option, starting from serial number 101236 (R&S®FSWP8), 101222 (R&S®FSWP26) and 101167 (R&S®FSWP50).

<sup>7</sup> Explanation of measured values: see section "Definitions"

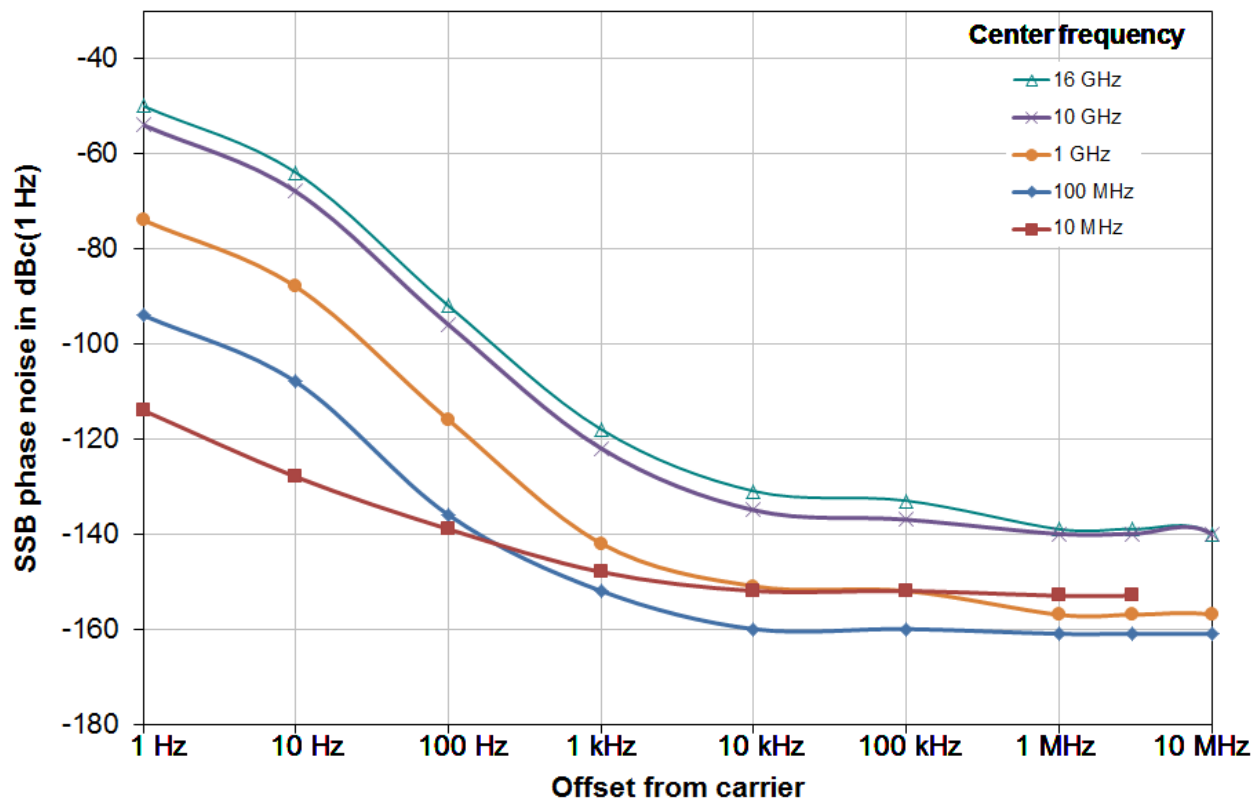
## Additive phase noise measurements with external I/Q mixers

To extend the frequency range of the additive phase noise measurement, external I/Q mixers are supported.

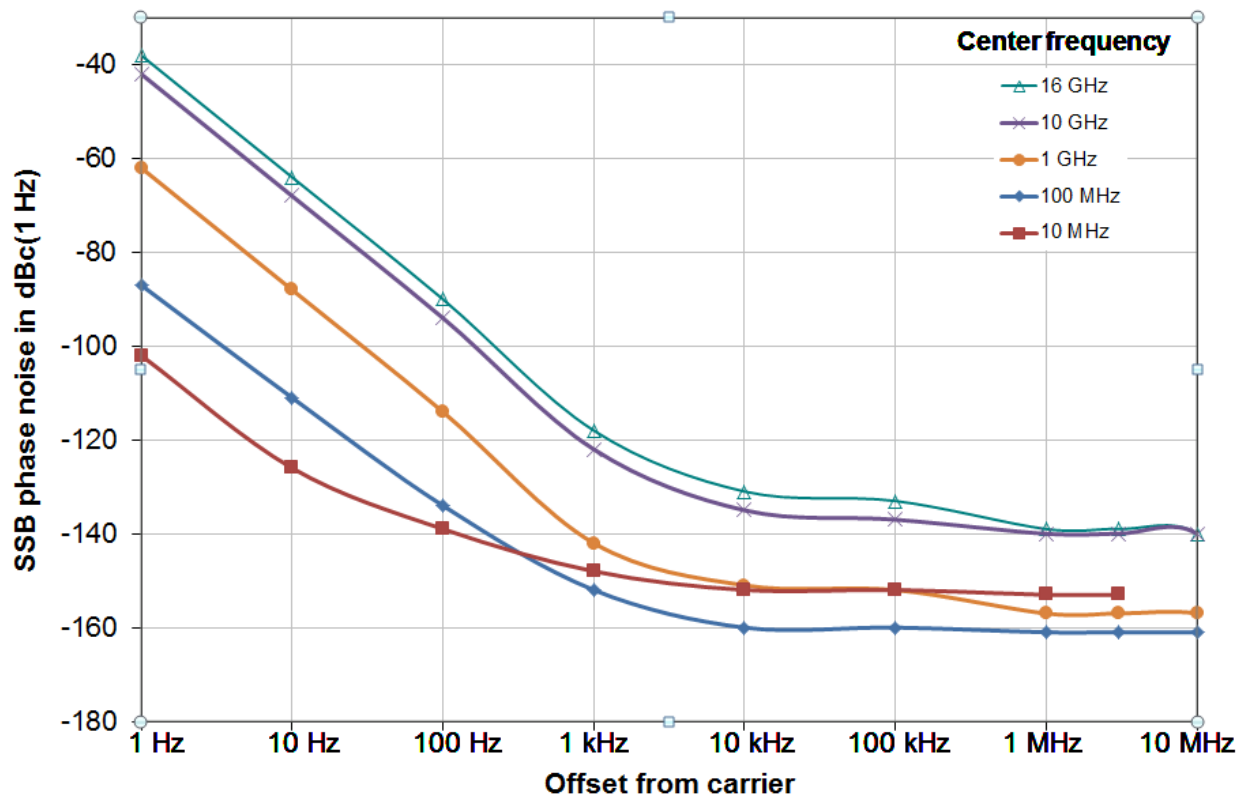
|                         |                                |              |
|-------------------------|--------------------------------|--------------|
| Frequency range         | dependent on used mixer        |              |
|                         | e.g. Marki Microwave MLIQ1845L | 18 to 45 GHz |
| Offset frequency range  | 10 mHz to 30 MHz               |              |
| Required LO drive level | dependent on used mixer        |              |
|                         | e.g. Marki Microwave MLIQ1845L | 11 to 18 dBm |

## Signal source

|   |                                 |                |
|---|---------------------------------|----------------|
| Output level range                                      | -50 dBm to +10 dBm, 10 dB steps |                |
| Output level accuracy<br>(temperature +20 °C to +30 °C) | frequency 10 MHz to 16 GHz      | ± 2 dB         |
|   | frequency 16 GHz to 18 GHz      | +2 dB to -5 dB |



Typical phase noise of signal source output with R&S®FSWP-B61 option.



Typical phase noise of signal source output, with R&S®FSWP-B60 option.

## Frequency translating additive phase noise measurements

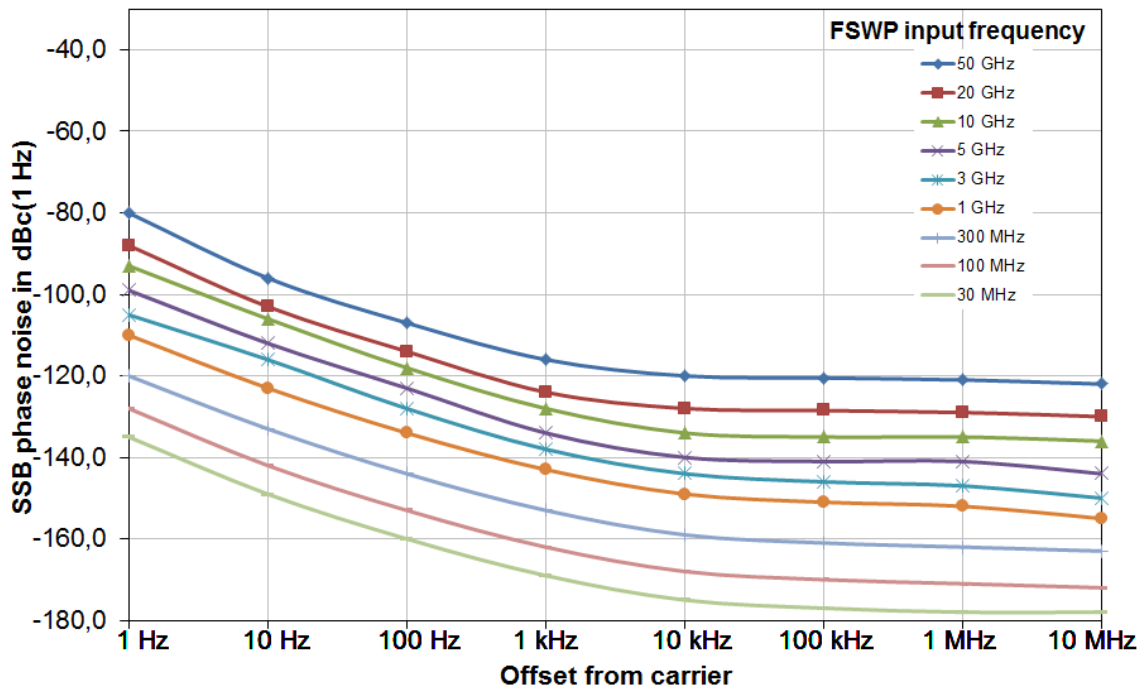
This measurement is performed in phase noise mode with the signal source used as input signal for the frequency translating device. In this test setup the signal source and the receiving signal path use the same internal reference frequency for the synthesizers. Therefore the close in phase noise cancels if the DUT is a frequency divider, a frequency multiplier or a DDS chip (which uses the signal source output as clock signal). For this measurement the phase noise sensitivity depends mainly on the input frequency of the R&S®FSWP.

Using the R&S®FSWP it is also possible to measure frequency converters with internal local oscillator. In this case the sensitivity is dependent on the frequency difference between RF input and signal source output.

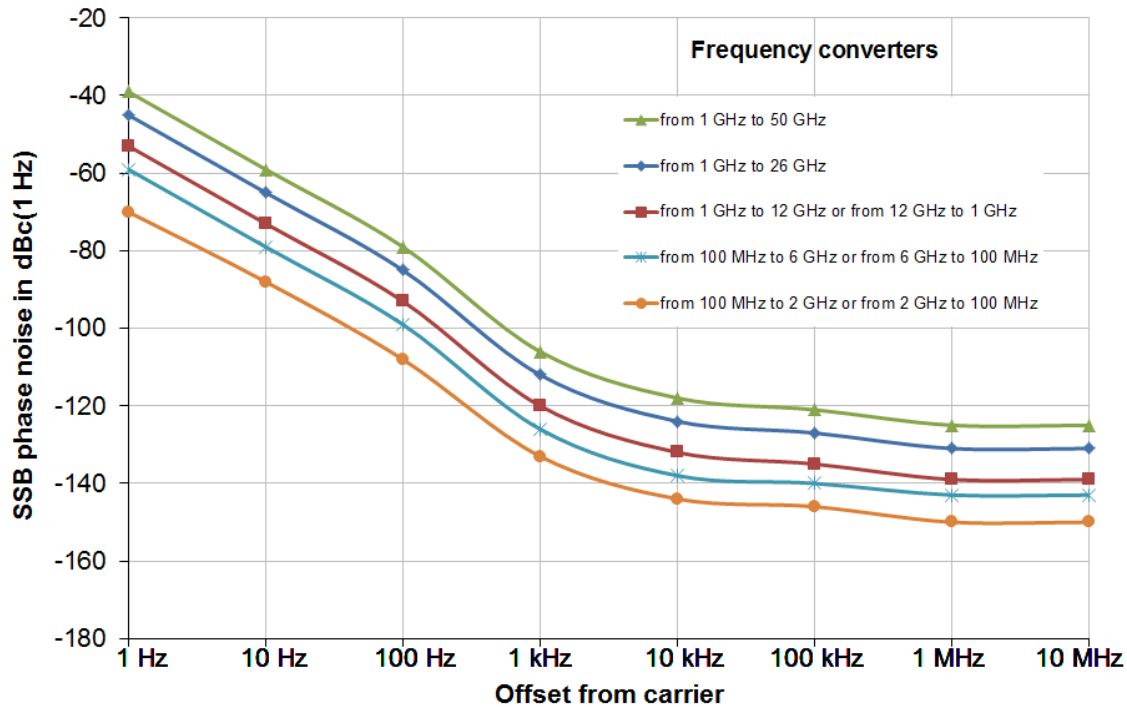
For typical phase noise sensitivity see the diagrams below.

|   |            |                                       |
|---|------------|---------------------------------------|
| Frequency range of signal source output | R&S®FSWP8  | 9.95 MHz to 8 GHz                     |
|   | R&S®FSWP26 | 9.95 MHz to 18 GHz                    |
|   | R&S®FSWP50 | 9.95 MHz to 18 GHz                    |
| Frequency range of input signal         |            | see additive phase noise measurements |
| Offset frequency range                  |            | see additive phase noise measurements |
| Measurement uncertainty                 |            | see additive phase noise measurements |

## Frequency translating additive phase noise sensitivity <sup>8</sup>



Typical phase noise sensitivity of frequency divider or frequency multiplier measurements.  
start offset = 1 Hz, correlation factor = 10



Typical phase noise sensitivity of frequency converter measurements with R&S®FSWP-B61 option.  
start offset = 1 Hz, correlation factor = 10.

<sup>8</sup> The typical data shown in the diagrams apply to instruments starting from the following serial numbers:  
R&S®FSWP8: 101233, R&S®FSWP26: 101221, R&S®FSWP50: 101165.

## Inputs and outputs

| RF input                                     |   |  |
|--|---|--|
| Impedance                                    |   | 50 $\Omega$                                |
| Connector                                    | R&S®FSWP8   | N female                                   |
|  | R&S®FSWP26  | APC 3.5 mm male (compatible with SMA)      |
|  | R&S®FSWP50  | 1.85 mm male (compatible with 2.4 mm)      |
| VSWR of R&S®FSWP8 without R&S®FSWP-B1 option | 10 MHz $\leq$ f < 3 GHz                                   | 1.5 nominal                                |
|  | 3 GHz $\leq$ f $\leq$ 8 GHz                               | 2.0 nominal                                |
| VSWR of R&S®FSWP8 with R&S®FSWP-B1 option    | RF attenuation $\leq$ 4 dB                                |  |
|  | 10 MHz $\leq$ f $\leq$ 8 GHz                              | typ. 1.87 <sup>9</sup>                     |
|  | 5 dB $\leq$ RF attenuation $\leq$ 9 dB                    |  |
|  | 10 MHz $\leq$ f < 1 GHz                                   | < 1.5, typ. 1.20 <sup>9</sup>              |
|  | 1 GHz $\leq$ f < 3.6 GHz                                  | < 1.5, typ. 1.31 <sup>9</sup>              |
|  | 3.6 GHz $\leq$ f $\leq$ 8 GHz                             | < 2.0, typ. 1.51 <sup>9</sup>              |
|  | RF attenuation $\geq$ 10 dB                               |  |
|  | 10 MHz $\leq$ f < 1 GHz                                   | < 1.2, typ. 1.09 <sup>9</sup>              |
|  | 1 GHz $\leq$ f < 3.6 GHz                                  | < 1.5, typ. 1.19 <sup>9</sup>              |
|  | 3.6 GHz $\leq$ f $\leq$ 8 GHz                             | < 2.0, typ. 1.42 <sup>9</sup>              |
| VSWR of R&S®FSWP26, R&S®FSWP50               | RF attenuation $\leq$ 4 dB                                |  |
|  | 10 MHz $\leq$ f $\leq$ 26.5 GHz                           | typ. 1.87 <sup>9</sup>                     |
|  | 26.5 GHz < f $\leq$ 40 GHz                                | typ. 2.0 <sup>9</sup>                      |
|  | 40 GHz < f $\leq$ 50 GHz                                  | 2.0 (nom.)                                 |
|  | 5 dB $\leq$ RF attenuation $\leq$ 9 dB                    |  |
|  | 10 MHz $\leq$ f $\leq$ 3.5 GHz                            | < 1.5, typ. 1.24 <sup>9</sup>              |
|  | 3.5 GHz < f $\leq$ 8 GHz                                  | < 1.8, typ. 1.26 <sup>9</sup>              |
|  | 8 GHz < f $\leq$ 18 GHz                                   | < 1.8, typ. 1.39 <sup>9</sup>              |
|  | 18 GHz < f $\leq$ 26.5 GHz                                | < 2.0, typ. 1.43 <sup>9</sup>              |
|  | 26.5 GHz < f $\leq$ 40 GHz                                | < 2.5, typ. 1.8 <sup>9</sup>               |
| 40 GHz < f $\leq$ 50 GHz                     | 2.0 (nom.)  |  |
| VSWR of R&S®FSWP26, R&S®FSWP50 (cont.)       | RF attenuation $\geq$ 10 dB                               |  |
|  | 10 MHz $\leq$ f $\leq$ 3.5 GHz                            | < 1.2, typ. 1.12 <sup>9</sup>              |
|  | 3.5 GHz < f $\leq$ 8 GHz                                  | < 1.5, typ. 1.19 <sup>9</sup>              |
|  | 8 GHz < f $\leq$ 18 GHz                                   | < 1.5, typ. 1.25 <sup>9</sup>              |
|  | 18 GHz < f $\leq$ 26.5 GHz                                | < 2.0, typ. 1.37 <sup>9</sup>              |
|  | 26.5 GHz < f $\leq$ 40 GHz                                | < 2.5, typ. 1.7 <sup>9</sup>               |
| 40 GHz < f $\leq$ 50 GHz                     | 2.0 (nom.)  |  |
| Setting range of attenuator                  | R&S®FSWP8   |  |
|  | without R&S®FSWP-B1 option                                | no user accessible attenuator              |
|  | with R&S®FSWP-B1 option                                   | 0 dB to 75 dB, in 5 dB steps <sup>10</sup> |
|  | R&S®FSWP26, R&S®FSWP50                                    | 0 dB to 75 dB, in 5 dB steps <sup>10</sup> |
| Max. RF input level                          |   |  |
| DC voltage                                   | AC coupled  | 50 V                                       |
|  | DC coupled  | 0 V  |
| CW RF power                                  | R&S®FSWP8 without R&S®FSWP-B1 option                      |  |
|  | input frequency < 5 MHz                                   | 20 dBm (= 0.1 W)                           |
|  | input frequency $\geq$ 5 MHz                              | 30 dBm (= 1 W)                             |
|  | R&S®FSWP8 with R&S®FSWP-B1 option, R&S®FSWP26, R&S®FSWP50 |  |
| RF attenuation = 0 dB                        | 20 dBm (= 0.1 W)  |  |
| RF attenuation $\geq$ 10 dB                  | 30 dBm (= 1 W)  |  |
| Pulse spectral density                       | RF attenuation = 0 dB,<br>RF preamplifier off             | 97 dB $\mu$ V/MHz                          |
| Max. pulse voltage                           | R&S®FSWP8 without R&S®FSWP-B1 option                      |  |
|  | any hardware setting                                      | 50 V                                       |
|  | R&S®FSWP26, FSWP50, R&S®FSWP8 with R&S®FSWP-B1 option     |  |
|  | RF attenuation < 10 dB                                    | 50 V                                       |
| RF attenuation $\geq$ 10 dB                  | 150 V   |  |

<sup>9</sup> Typical VSWR performance: performance expected to be met in 95 % of the cases with a confidence level of 95 %, temperature +20 °C to +30 °C, input set to "DC coupling". These values are not warranted and are subject to modification if a significant change in the statistical behavior of production instruments is observed.

<sup>10</sup> With R&S®FSWP-B1 option in spectrum analyzer mode: 0 dB to 79 dB, mechanical RF attenuator: 5 dB steps. Electronic IF attenuator: 1 dB steps.

|  |   |         |
|--|---|---------|
| Max. pulse energy,<br>pulse duration $\tau = 10 \mu\text{s}$ | R&S®FSWP8 without R&S®FSWP-B1 option                      |         |
|  | any hardware setting                                      | 0.5 mWs |
|  | R&S®FSWP26, R&S®FSWP50, R&S®FSWP8 with R&S®FSWP-B1 option |         |
|  | RF attenuation $\geq 10 \text{ dB}$                       | 1 mWs   |

|                           |  |                    |
|---------------------------|--|--------------------|
| <b>U<sub>supply</sub></b> |  |                    |
| Connector                 |  | BNC female         |
| Impedance                 |  | 50 $\Omega$ (nom.) |
| Output voltage            |  | 0 V to 16 V        |
| Output current            |  | 0 mA to 2000 mA    |

|                        |  |                      |
|------------------------|--|----------------------|
| <b>U<sub>aux</sub></b> |  |                      |
| Connector              |  | BNC female           |
| Impedance              |  | 50 $\Omega$ (nom.)   |
| Output voltage         |  | -10 V to +10 V       |
| Output current         |  | $\pm 100 \text{ mA}$ |

|                         |  |                     |
|-------------------------|--|---------------------|
| <b>U<sub>tune</sub></b> |  |                     |
| Connector               |  | BNC female          |
| Impedance               |  | 50 $\Omega$ (nom.)  |
| Output voltage          |  | -10 V to +28 V      |
| Output current          |  | $\pm 20 \text{ mA}$ |

|                                 |  |                    |
|---------------------------------|--|--------------------|
| <b>Baseband input channel 1</b> |  |                    |
| Connector                       |  | BNC female         |
| Impedance                       |  | 50 $\Omega$ (nom.) |
| Input frequency range           |  | DC to 30 MHz       |
| Maximum input level             |  | $\pm 2 \text{ V}$  |

|                                 |  |                    |
|---------------------------------|--|--------------------|
| <b>Baseband input channel 2</b> |  |                    |
| Connector                       |  | BNC female         |
| Impedance                       |  | 50 $\Omega$ (nom.) |
| Input frequency range           |  | DC to 30 MHz       |
| Maximum input level             |  | $\pm 2 \text{ V}$  |

|                           |  |   |
|---------------------------|--|---|
| <b>Probe power supply</b> |  |   |
| Supply voltages           |  | +15 V DC,<br>-12.6 V DC and ground,<br>max. 150 mA (nom.) |

|                             |  |  |
|-----------------------------|--|--|
| <b>Noise source control</b> |  |  |
| Connector                   |  | BNC female                               |
| Output voltage              |  | 0 V/28 V, max. 100 mA, switchable (nom.) |

|                       |  |                    |
|-----------------------|--|--------------------|
| <b>Trigger in/out</b> |  |                    |
| Connector             |  | BNC female         |
| Impedance             |  | 50 $\Omega$ (nom.) |

|                     |  |  |
|---------------------|--|--|
| <b>Power sensor</b> |  |  |
| Connector           |  | 6-pin LEMOSA female for R&S®NRP-Zxx<br>power sensors |

|  |  |   |
|--|--|---|
| <b>Reference input 1 MHz to 20 MHz</b> |  |   |
| Connector                              |  | BNC female  |
| Impedance                              |  | 50 $\Omega$ (nom.)                                      |
| Input frequency range                  |  | 1 MHz $\leq f_{in} \leq 20 \text{ MHz}$ , in 1 Hz steps |
| Required level                         |  | $> 0 \text{ dBm}$                                       |



| <b>Reference input 100 MHz</b> |  |                    |
|--------------------------------|--|--------------------|
| Connector                      |  | SMA female         |
| Impedance                      |  | 50 $\Omega$ (nom.) |
| Input frequency range          |  | 100 MHz            |
| Required level                 |  | 0 dBm to 10 dBm    |

| <b>Reference output 10 MHz</b>   |      |                    |        |       |        |         |       |       |
|--|------|--------------------|--------|-------|--------|---------|-------|-------|
| Connector  |      | BNC female         |        |       |        |         |       |       |
| Impedance  |      | 50 $\Omega$ (nom.) |        |       |        |         |       |       |
| Output frequency   |      | 10 MHz             |        |       |        |         |       |       |
| Level  |      | 10 dBm (nom.)      |        |       |        |         |       |       |
| <b>Nominal phase noise with R&amp;S®FSWP-B61 or with R&amp;S®FSWP-B4 option. internal reference loop bandwidth 30 Hz</b> |      |                    |        |       |        |         |       |       |
| Offset frequency from the carrier  | 1 Hz | 10 Hz              | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 3 MHz |
| Phase noise in dBc (1 Hz)  | -110 | -134               | -146   | -157  | -165   | -166    | -167  | -168  |

| <b>Reference output 1 MHz to 20 MHz</b> |                    |                                |
|---|--------------------|--------------------------------|
| Connector                               |                    | BNC female                     |
| Impedance                               |                    | 50 $\Omega$ (nom.)             |
| Output frequency                        | internal reference | not active                     |
|   | external reference | same as reference input signal |
| Level                                   |                    | same as reference input signal |

| <b>Reference output 100 MHz</b>  |      |                    |        |       |        |         |       |        |
|--|------|--------------------|--------|-------|--------|---------|-------|--------|
| Connector  |      | SMA female         |        |       |        |         |       |        |
| Impedance  |      | 50 $\Omega$ (nom.) |        |       |        |         |       |        |
| Output frequency   |      | 100 MHz            |        |       |        |         |       |        |
| Level  |      | 6 dBm (nom.)       |        |       |        |         |       |        |
| <b>Nominal phase noise with R&amp;S®FSWP-B61 or with R&amp;S®FSWP-B4 option. internal reference loop bandwidth 30 Hz</b> |      |                    |        |       |        |         |       |        |
| Offset frequency from the carrier  | 1 Hz | 10 Hz              | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz |
| Phase noise in dBc (1 Hz)  | -91  | -116               | -133   | -154  | -162   | -163    | -164  | -164   |

| <b>Reference output 640 MHz</b>  |      |                    |        |       |        |         |       |        |
|--|------|--------------------|--------|-------|--------|---------|-------|--------|
| Connector  |      | SMA female         |        |       |        |         |       |        |
| Impedance  |      | 50 $\Omega$ (nom.) |        |       |        |         |       |        |
| Output frequency   |      | 640 MHz            |        |       |        |         |       |        |
| Level  |      | 16 dBm (nom.)      |        |       |        |         |       |        |
| <b>Nominal phase noise with R&amp;S®FSWP-B61 or with R&amp;S®FSWP-B4 option. internal reference loop bandwidth 30 Hz</b> |      |                    |        |       |        |         |       |        |
| Offset frequency from the carrier  | 1 Hz | 10 Hz              | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz |
| Phase noise in dBc (1 Hz)  | -77  | -101               | -117   | -145  | -160   | -165    | -166  | -167   |

| <b>IF/video output (only supported with R&amp;S®FSWP-B1 option in spectrum analyzer mode)</b> |   |                                |
|---|---|--------------------------------|
| Connector   |   | BNC female, 50 $\Omega$ (nom.) |
| <b>IF out</b>   |   |                                |
| Bandwidth   |   | equal to RBW setting           |
| IF frequency  |   | (RBW/2) to (240 MHz – RBW/2)   |
| Output level  | center frequency > 10 MHz, span = 0 Hz<br>or I/Q analyzer on, signal at reference<br>level and center frequency | 0 dBm (nom.)                   |
| <b>Video out</b>  |   |                                |
| Bandwidth   |   | equal to VBW setting           |
| Output scaling  | log. display scale  | logarithmic                    |
|   | lin. display scale  | linear                         |
| Output level  | center frequency > 10 MHz, span = 0 Hz,<br>signal at reference level and center<br>frequency                    | 1 V at 50 $\Omega$ load (nom.) |

| <b>IEC/IEEE bus control</b> |  |  |
|-----------------------------|--|--|
| Command set                 |  | SCPI 1997.0                                      |
| Connector                   |  | 24-pin Amphenol female                           |
| Interface functions         |  | SH1, AH1, T6, L4, SR1, RL1, PP1, DC1,<br>DT1, C0 |

|                      |  |                   |
|----------------------|--|-------------------|
| <b>LAN interface</b> |  | 10/100/1000BASE-T |
| Connector            |  | RJ-45             |

|                         |  |                            |
|-------------------------|--|----------------------------|
| <b>External monitor</b> |  |                            |
| Connector               |  | DVI-D, DisplayPort Rev 1.1 |

|                      |  |                                   |
|----------------------|--|-----------------------------------|
| <b>USB interface</b> |  | 7 ports, type A plug, version 2.0 |
|                      |  | 1 port, type B plug, version 2.0  |

## General data

|   |                      |  |
|---|----------------------|--|
| <b>Display</b>                          |                      |  |
| Resolution                              |                      | 30.7 cm (12.1") WXGA color touchscreen   |
| Pixel failure rate                      |                      | 1280 × 800 pixel (WXGA resolution)   |
|   |                      | < 1 × 10 <sup>-5</sup>   |
| <b>Data storage</b>                     |                      |  |
| Internal                                | standard             | solid state disk ≥ 32 Gbyte  |
| External                                |                      | supports USB 2.0 compatible memory devices   |
| <b>Temperature</b>                      |                      |  |
| Operating temperature range             |                      | +5 °C to +50 °C  |
| Permissible temperature range           |                      | 0 °C to +55 °C   |
| Storage temperature range               |                      | -40 °C to +70 °C   |
| Climatic loading                        | without condensation | +40 °C at 90 % rel. humidity,<br>in line with EN 60068-2-30  |
| <b>Altitude</b>                         |                      |  |
| Max. operating altitude                 | above sea level      | 4600 m (approx. 15100 ft)  |
| <b>Mechanical resistance</b>            |                      |  |
| Vibration                               | sinusoidal           | 5 Hz to 55 Hz<br>displacement: 0.15 mm constant<br>amplitude (1.8 g at 55 Hz);<br>55 Hz to 150 Hz<br>acceleration: 0.5 g constant<br>in line with EN 60068-2-6   |
|   | random               | 10 Hz to 300 Hz,<br>acceleration 1.2 g (RMS),<br>in line with EN 60068-2-64  |
| Shock                                   |                      | 40 g shock spectrum,<br>in line with MIL-STD-810E method<br>no. 516.4, procedure I,<br>MIL-PRF-28800F, class 3   |
| <b>EMC</b>                              |                      |  |
|   |                      | in line with EMC Directive 2004/108/EC<br>including: <ul style="list-style-type: none"> <li>• IEC/EN 61326-1 <sup>11, 12</sup></li> <li>• IEC/EN 61326-2-1</li> <li>• CISPR 11/EN 55011 <sup>11</sup></li> <li>• IEC/EN 61000-3-2</li> <li>• IEC/EN 61000-3-3</li> </ul> |
| <b>Recommended calibration interval</b> |                      | 1 year   |

<sup>11</sup> Emission limits for class A equipment.

<sup>12</sup> Immunity test requirement for industrial environment (EN 61326 table 2).

| <b>Power supply</b>    |                  |   |
|------------------------|------------------|---|
| AC input voltage range |                  | 100 V to 240 V  |
| AC supply frequency    |                  | 50 Hz to 60 Hz/400 Hz   |
| Max. input current     |                  | 7.3 A to 4.6 A (100 V to 240 V)   |
| Power consumption      | R&S®FSWP8        |   |
|                        | without options  | 150 W   |
|                        | with all options | 250 W (meas.)   |
|                        | R&S®FSWP26       |   |
|                        | without options  | 175 W   |
|                        | with all options | 275 W (meas.)   |
|                        | R&S®FSWP50       |   |
|                        | without options  | 200 W   |
|                        | with all options | 300 W (meas.)   |
| Safety                 |                  | in line with IEC 61010-1, EN 61010-1, UL 61010-1, CAN/CSA-C22.2 No. 61010-1 |
| Test mark              |                  | VDE-GS, cCSA <sub>US</sub>  |

| <b>Dimensions and weight</b> |  |   |
|------------------------------|--|---|
| Dimensions (nom.)            | W x H x D, including front handles and rear feet | 462 mm x 240 mm x 504 mm<br>(18.15 in x 9.44 in x 19.81 in) |
| Net weight (nom.)            | R&S®FSWP8  |   |
|                              | without options                                  | 18.6 kg (41.01 lb)  |
|                              | with all options                                 | 22 kg (48.5 lb)   |
|                              | R&S®FSWP26, with all options                     |   |
|                              | R&S®FSWP50, with all options                     |   |
|                              |  | 24 kg (52.9 lb)   |
|                              |  | 24.5 kg (54 lb)   |

# R&S®FSWP-B1 spectrum analyzer

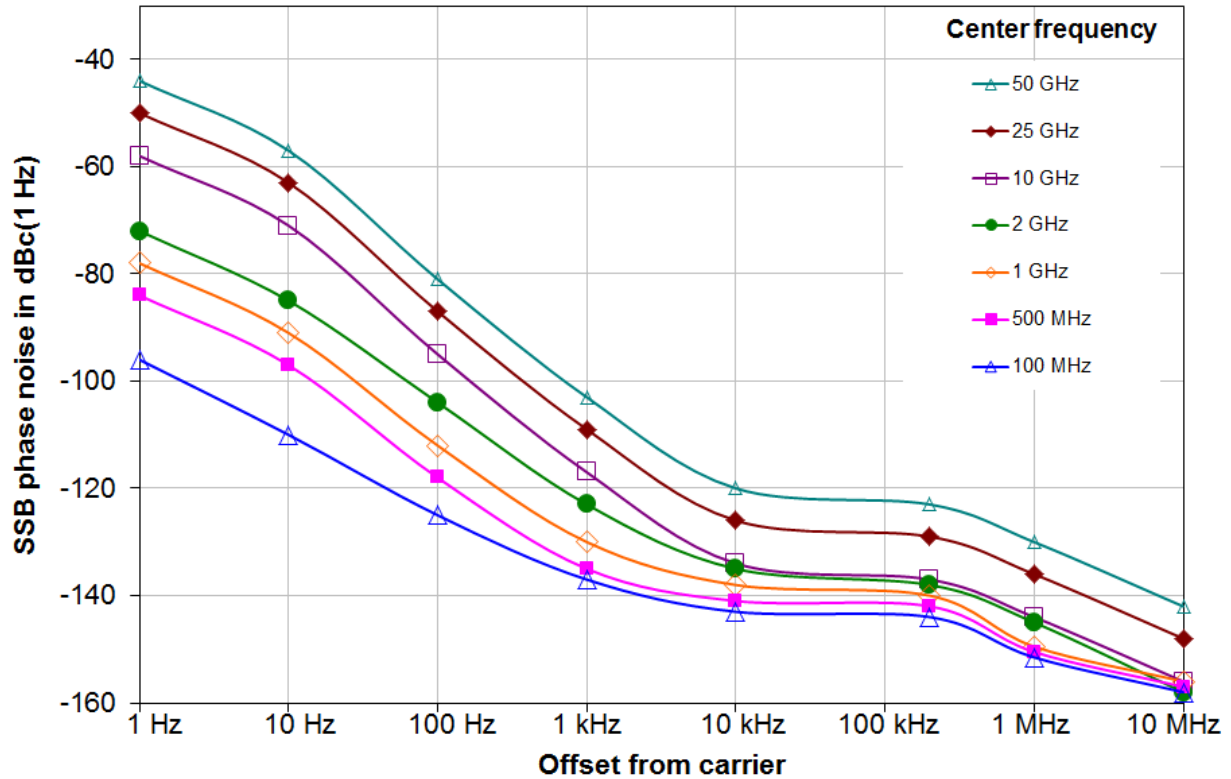
The following specifications apply for operation of the R&S®FSWP in spectrum analyzer mode unless otherwise stated.

## Frequency

|                             |            |                    |
|-----------------------------|------------|--------------------|
| <b>Frequency range</b>      | R&S®FSWP8  |                    |
|                             | DC coupled | 10 Hz to 8 GHz     |
|                             | AC coupled | 10 MHz to 8 GHz    |
|                             | R&S®FSWP26 |                    |
|                             | DC coupled | 10 Hz to 26.5 GHz  |
|                             | AC coupled | 10 MHz to 26.5 GHz |
|                             | R&S®FSWP50 |                    |
|                             | DC coupled | 10 Hz to 50 GHz    |
|                             | AC coupled | 10 MHz to 50 GHz   |
| <b>Frequency resolution</b> | 0.01 Hz    |                    |

|                                   |                                 |   |
|-----------------------------------|---------------------------------|---|
| <b>Frequency readout</b>          |                                 |   |
| Marker resolution                 |                                 | 1 Hz  |
| Uncertainty                       |                                 | $\pm(\text{marker frequency} \times \text{reference accuracy} + 10\% \times \text{resolution bandwidth} + \frac{1}{2}(\text{span}/(\text{sweep points} - 1)) + 1 \text{ Hz})$ |
| Number of sweep (trace) points    | default value                   | 1001  |
|                                   | range                           | 101 to 100001   |
| Marker tuning frequency step size | marker step size = sweep points | $\text{span}/(\text{sweep points} - 1)$   |
|                                   | marker step size = standard     | $\text{span}/(\text{default sweep points} - 1)$   |
| Frequency counter resolution      |                                 | 0.001 Hz  |
| Count accuracy                    |                                 | $\pm(\text{frequency} \times \text{reference accuracy} + \frac{1}{2}(\text{last digit}))$   |
| Display range for frequency axis  |                                 | 0 Hz, 10 Hz to max. frequency   |
| Resolution                        |                                 | 0.1 Hz  |
| Max. span deviation               |                                 | $\pm 0.1\%$   |

|                        |  |   |
|------------------------|--|---|
| <b>Spectral purity</b> |  |   |
| SSB phase noise        | frequency = 1000 MHz, carrier offset                   |   |
|                        | 10 Hz, without R&S®FSWP-B4 option                      | -80 dBc (1 Hz) (nom.)                   |
|                        | 10 Hz, with R&S®FSWP-B4 option                         | -95 dBc (1 Hz) (nom.)                   |
|                        | 100 Hz   | -106 dBc (1 Hz), typ. -112 dBc (1 Hz)   |
|                        | 1 kHz  | < -125 dBc (1 Hz), typ. -130 dBc (1 Hz) |
|                        | 10 kHz   | < -134 dBc (1 Hz), typ. -138 dBc (1 Hz) |
|                        | 100 kHz  | < -136 dBc (1 Hz), typ. -140 dBc (1 Hz) |
|                        | 1 MHz  | < -145 dBc (1 Hz), typ. -149 dBc (1 Hz) |
|                        | 10 MHz   | -156 dBc (1 Hz) (nom.)                  |
| Residual FM            | frequency = 1000 MHz, RBW = 1 kHz, sweep time = 100 ms | < 0.1 Hz (nom.)                         |



Typical phase noise at different center frequencies in spectrum analyzer mode (with R&S®FSWP-B4 option for offsets ≤ 10 Hz).

### Sweep time

|                     |              |                               |
|---------------------|--------------|-------------------------------|
| Sweep time range    | span = 0 Hz  | 1 μs to 16000 s               |
|                     | span ≥ 10 Hz | 3 μs to 16000 s <sup>13</sup> |
| Sweep time accuracy | span = 0 Hz  | ±0.1 % (nom.)                 |
|                     | span ≥ 10 Hz | ±3 % (nom.)                   |

### Resolution bandwidths

| Sweep filters and FFT filters |                         |                                     |
|-------------------------------|-------------------------|-------------------------------------|
| Resolution bandwidths (-3 dB) | standard                | 1 Hz to 10 MHz in 1/2/3/5 sequence  |
|                               | with R&S®FSWP-B8 option | 20 MHz, 50 MHz, 80 MHz additionally |
| Bandwidth uncertainty         |                         | < 3 % (nom.)                        |
| Shape factor 60 dB:3 dB       |                         | < 5 (nom.)                          |

| Video bandwidths |                         |                                     |
|------------------|-------------------------|-------------------------------------|
|                  | standard                | 1 Hz to 10 MHz in 1/2/3/5 sequence  |
|                  | with R&S®FSWP-B8 option | 20 MHz, 50 MHz, 80 MHz additionally |

| Signal analysis bandwidth |                          |               |
|---------------------------|--------------------------|---------------|
|                           | standard                 | 10 MHz (nom.) |
|                           | with R&S®FSWP-B80 option | 80 MHz (nom.) |

<sup>13</sup> The selected sweep time is the net data acquisition time (without the extra time needed for hardware settling or FFT processing).

## Level

| Level display                    |                           |  |
|----------------------------------|---------------------------|--|
| Display range                    |                           | displayed noise floor up to +30 dBm  |
| Logarithmic level axis           |                           | 1 dB to 200 dB, in steps of 1/2/5  |
| Linear level axis                |                           | 10 % of reference level per level division, 10 divisions or logarithmic scaling    |
| Number of traces                 |                           | 6  |
| Trace detector                   |                           | max. peak, min. peak, auto peak (normal), sample, RMS, average                     |
| Trace functions                  |                           | clear/write, max. hold, min. hold, average, view                                   |
| Setting range of reference level |                           | -130 dBm to (-10 dBm + RF attenuation - RF preamplifier gain), in steps of 0.01 dB |
| Units of level axis              | logarithmic level display | dBm, dB $\mu$ V, dBmV, dB $\mu$ A, dBpW  |
|                                  | linear level display      | $\mu$ V, mV, $\mu$ A, mA, pW, nW   |

## Intermodulation

|  |   |                                     |
|--|---|-------------------------------------|
| 1 dB compression of input mixer (two-tone) | RF attenuation = 0 dB, RF preamplifier off  |                                     |
|  | $f_{in} \leq 3$ GHz   | +15 dBm (nom.)                      |
|  | 3 GHz < $f_{in} \leq 8$ GHz   | +10 dBm (nom.)                      |
|  | $f_{in} > 8$ GHz  | +7 dBm (nom.)                       |
|  | with R&S®FSWP-B24 option, RF attenuation = 0 dB, RF preamplifier on   |                                     |
|  | $f_{in} \leq 3$ GHz   | -13 dBm (nom.)                      |
|  | 3 GHz < $f_{in} \leq 8$ GHz   | -20 dBm (nom.)                      |
| Third-order intercept point (TOI)          | RF attenuation = 0 dB, level 2 x -15 dBm, $\Delta f > 5 \times$ RBW, YIG preselector on, RF preamplifier off  |                                     |
|  | $f_{in} < 10$ MHz   | 28 dBm (nom.)                       |
|  | 10 MHz $\leq f_{in} < 1$ GHz  | > 25 dBm, typ. 30 dBm               |
|  | 1 GHz $\leq f_{in} < 3$ GHz   | > 20 dBm, typ. 25 dBm <sup>14</sup> |
|  | 3 GHz $\leq f_{in} < 8$ GHz   | > 17 dBm, typ. 20 dBm               |
|  | 8 GHz $\leq f_{in} < 10$ GHz  | > 8 dBm                             |
|  | 10 GHz $\leq f_{in} \leq 50$ GHz  | > 10 dBm                            |
|  | R&S®FSWP8, R&S®FSWP26 with R&S®FSWP-B24 option, RF attenuation = 0 dB, level 2 x -50 dBm, $\Delta f > 5 \times$ RBW, YIG preselector on, RF preamplifier on |                                     |
|  | 10 MHz $\leq f_{in} < 1$ GHz  | -10 dBm (nom.)                      |
|  | 1 GHz $\leq f_{in} < 8$ GHz   | -13 dBm (nom.)                      |
|  | 8 GHz $\leq f_{in} \leq 26.5$ GHz   | -15 dBm (nom.)                      |
|  | R&S®FSWP50 with R&S®FSWP-B24 option, RF attenuation = 0 dB, level 2 x -55 dBm, $\Delta f > 5 \times$ RBW, YIG preselector on, RF preamplifier on            |                                     |
|  | 10 MHz $\leq f_{in} < 1$ GHz  | -5 dBm (nom.)                       |
|  | 1 GHz $\leq f_{in} < 4$ GHz   | -10 dBm (nom.)                      |
| $f_{in} > 4$ GHz                           | -20 dBm (nom.)  |                                     |
| Second-harmonic intercept point (SHI)      | RF attenuation = 0 dB, level = -5 dBm, YIG preselector on, RF preamplifier off  |                                     |
|  | 1 MHz < $f_{in} \leq 500$ MHz   | > 45 dBm, typ. 55 dBm               |
|  | 500 MHz < $f_{in} < 1.5$ GHz <sup>15</sup>  | > 47 dBm, typ. 56 dBm               |
|  | 500 MHz < $f_{in} < 1.5$ GHz <sup>16</sup>  | > 52 dBm, typ. 60 dBm               |
|  | 1.5 GHz $\leq f_{in} \leq 4$ GHz  | > 62 dBm, typ. 70 dBm               |
|  | 4 GHz < $f_{in} \leq 25$ GHz  | 65 dBm (nom.)                       |
|  | with R&S®FSWP-B24 option, RF attenuation = 0 dB, level = -50 dBm, YIG preselector on, RF preamplifier on  |                                     |
|  | 50 MHz < $f_{in} \leq 21.75$ GHz  | 10 dBm (nom.)                       |

<sup>14</sup> With R&S®FSWP-B13 highpass filter option, highpass off. With highpass on, the TOI degrades by 5 dB (nom.).

<sup>15</sup> Without R&S®FSWP-B13 highpass filter option or highpass off.

<sup>16</sup> With R&S®FSWP-B13 highpass filter option, highpass on.

## Sensitivity

All noise level data in this section not marked as typical (typ.) or nominal (nom.) are specified values whose compliance is ensured by testing.

| <b>Displayed average noise level</b>   |   |              |
|--|---|--------------|
| Without R&S®FSWP-B24 option and RF preamplifier off                          | RF attenuation = 0 dB, termination = 50 Ω, normalized to 1 Hz RBW, trace average, average mode log, sample detector, +5 °C to +40 °C          |              |
|  | 10 Hz ≤ f ≤ 100 Hz  | -110 dBm     |
|  | 100 Hz < f ≤ 1 kHz  | -120 dBm     |
|  | 1 kHz < f < 9 kHz   | -135 dBm     |
|  | RF attenuation = 0 dB, termination = 50 Ω, log. scaling, normalized to 1 Hz RBW, RBW = 1 kHz, VBW = 1 Hz, +5 °C to +40 °C, YIG preselector on |              |
|  | 9 kHz ≤ f ≤ 1 MHz   | -145 dBm     |
|  | 1 MHz < f ≤ 1 GHz   | -149 dBm     |
|  | 1 GHz < f < 3 GHz <sup>17</sup>   | -150 dBm     |
|  | 1 GHz < f < 3 GHz <sup>18</sup>   | -153 dBm     |
|  | 3 GHz ≤ f < 8 GHz   | -150 dBm     |
|  | 8 GHz ≤ f < 13.6 GHz  | -148 dBm     |
|  | 13.6 GHz ≤ f < 18 GHz   | -147 dBm     |
|  | 18 GHz ≤ f < 25 GHz   | -145 dBm     |
|  | 25 GHz ≤ f ≤ 34 GHz   | -140 dBm     |
|  | 34 GHz < f ≤ 40 GHz   | -137 dBm     |
|  | 40 GHz < f ≤ 43.5 GHz   | -135 dBm     |
|  | 43.5 GHz < f ≤ 47 GHz   | -133 dBm     |
| 47 GHz < f ≤ 49 GHz  | -131 dBm  |              |
| 49 GHz < f ≤ 50 GHz  | -129 dBm  |              |
| R&S®FSWP8 or R&S®FSWP26 with R&S®FSWP-B24 option and RF preamplifier = 30 dB | RF attenuation = 0 dB, termination = 50 Ω, log. scaling, normalized to 1 Hz RBW, RBW = 1 kHz, VBW = 1 Hz, +5 °C to +40 °C, YIG preselector on |              |
|  | 100 kHz < f ≤ 60 MHz  | -160 dBm     |
|  | 60 MHz < f ≤ 3 GHz  | -165 dBm     |
|  | 3 GHz < f ≤ 8 GHz   | -162 dBm     |
|  | 8 GHz < f ≤ 18 GHz  | -162 dBm     |
|  | 18 GHz < f ≤ 23 GHz   | -160 dBm     |
| 23 GHz < f ≤ 26.5 GHz  | -156 dBm  |              |
| R&S®FSWP50 with R&S®FSWP-B24 option and RF preamplifier = 30 dB              | RF attenuation = 0 dB, termination = 50 Ω, log. scaling, normalized to 1 Hz RBW, RBW = 1 kHz, VBW = 1 Hz, +5 °C to +40 °C, YIG preselector on |              |
|  | 100 kHz < f ≤ 60 MHz  | -160 dBm     |
|  | 60 MHz < f ≤ 3 GHz  | -165 dBm     |
|  | 3 GHz < f ≤ 8 GHz   | -160 dBm     |
|  | 8 GHz < f ≤ 18 GHz  | -162 dBm     |
|  | 18 GHz < f ≤ 23 GHz   | -160 dBm     |
|  | 23 GHz < f ≤ 40 GHz   | -156 dBm     |
|  | 40 GHz < f ≤ 43 GHz   | -152 dBm     |
| 43 GHz < f ≤ 50 GHz  | -146 dBm  |              |
| Improvement with noise cancellation  | for noise-like signals  |              |
|  | 100 kHz < f ≤ 43 GHz  | 13 dB (nom.) |
|  | 43 GHz < f ≤ 50 GHz   | 0 dB (nom.)  |

<sup>17</sup> Without R&S®FSWP-B13 highpass filter option or highpass off.

<sup>18</sup> With R&S®FSWP-B13 highpass filter option, highpass on.



## Spurious responses

|                                    |   |  |
|------------------------------------|---|--|
| <b>Spurious responses</b>          | YIG preselector on for $f \geq 8$ GHz, mixer level $\leq -10$ dBm <sup>19</sup> , sweep optimization: auto or dynamic |  |
| Image response                     | $f_{in} - 2 \times 8997$ MHz (1st IF)   | < -90 dBc                                  |
|                                    | $f_{in} - 2 \times 1317$ MHz (2nd IF)   | < -90 dBc                                  |
|                                    | $f_{in} - 2 \times 37$ MHz (3rd IF)   | < -90 dBc                                  |
| Intermediate frequency response    | 1st IF (8997 MHz)   | < -90 dBc                                  |
|                                    | 2nd IF (1317 MHz)   | < -90 dBc                                  |
|                                    | 3rd IF (37 MHz)   | < -90 dBc                                  |
| Residual spurious response         | RF attenuation = 0 dB, signal source of option R&S®FSWP-B64 (additive phase noise measurements) turned off            |  |
|                                    | $f \leq 1$ MHz  | < -90 dBm                                  |
|                                    | 1 MHz < $f \leq 8900$ MHz   | < -110 dBm                                 |
|                                    | 8900 MHz < $f \leq 26.5$ GHz  | < -100 dBm                                 |
|                                    | 26.5 GHz < $f \leq 50$ GHz  | < -100 dBm (nom.)                          |
| $f$ = receive frequency            |   |  |
| Local oscillators related spurious | signal source of option R&S®FSWP-B64 (additive phase noise measurements) turned off                                   |  |
|                                    | $f_{in} < 1$ GHz  |  |
|                                    | 10 Hz $\leq$ offset from carrier < 200 Hz   | < -90 dBc                                  |
|                                    | offset from carrier > 200 Hz  | < -100 dBc                                 |
|                                    | $f_{in} \geq 1$ GHz   |  |
|                                    | 10 Hz $\leq$ offset from carrier < 200 Hz   | < -90 dBc + 20 log ( $f_{in}/$ GHz)        |
|                                    | offset from carrier > 200 Hz  | < -100 dBc + 20 log ( $f_{in}/$ GHz)       |
| Vibrational environmental stimuli  | max. 0.21 g (RMS)   | < -60 dBc + 20 log ( $f_{in}/$ GHz) (nom.) |

## Level measurement uncertainty

|  |  |                                 |
|--|--|---------------------------------|
| Absolute level uncertainty                                   | RBW = 10 kHz, level = -10 dBm, reference level = -10 dBm, RF attenuation = 10 dB<br>$f = 64$ MHz |                                 |
|  |  | < 0.2 dB ( $\sigma = 0.07$ dB)  |
| Frequency response, referenced to 64 MHz, YIG preselector on | RF attenuation = 10 dB, 20 dB, 30 dB, 40 dB, RF preamplifier off, +20 °C to +30 °C               |                                 |
|  | 10 Hz $\leq f < 9$ kHz   | < 1 dB (nom.)                   |
|  | 9 kHz $\leq f < 10$ MHz  | < 0.45 dB ( $\sigma = 0.17$ dB) |
|  | 10 MHz $\leq f < 3.6$ GHz  | < 0.3 dB ( $\sigma = 0.10$ dB)  |
|  | 3.6 GHz $\leq f \leq 8$ GHz  | < 0.5 dB ( $\sigma = 0.17$ dB)  |
|  | 8 GHz < $f < 22$ GHz, span < 1 GHz   | < 1.5 dB ( $\sigma = 0.50$ dB)  |
|  | 22 GHz $\leq f \leq 26.5$ GHz, span < 1 GHz  | < 2 dB ( $\sigma = 0.67$ dB)    |
|  | 26.5 GHz < $f \leq 50$ GHz, span < 1 GHz   | < 2.5 dB ( $\sigma = 0.83$ dB)  |
|  | any RF attenuation, +15 °C to +40 °C   |                                 |
|  | 10 Hz $\leq f < 9$ kHz   | < 1 dB (nom.)                   |
|  | 9 kHz $\leq f < 3.6$ GHz   | < 0.6 dB ( $\sigma = 0.20$ dB)  |
|  | 3.6 GHz $\leq f \leq 8$ GHz  | < 0.8 dB ( $\sigma = 0.27$ dB)  |
|  | 8 GHz < $f < 22$ GHz, span < 1 GHz   | < 2 dB ( $\sigma = 0.67$ dB)    |
|  | 22 GHz $\leq f \leq 26.5$ GHz, span < 1 GHz  | < 2.5 dB ( $\sigma = 0.83$ dB)  |
|  | 26.5 GHz < $f \leq 50$ GHz, span < 1 GHz   | < 3 dB ( $\sigma = 1.0$ dB)     |
|  | RF attenuation $\leq 20$ dB, RF preamplifier on, +20 °C to +30 °C                                |                                 |
|  | 10 MHz $\leq f < 3.6$ GHz  | < 0.6 dB ( $\sigma = 0.2$ dB)   |
| 3.6 GHz $\leq f \leq 8$ GHz                                  | < 0.8 dB ( $\sigma = 0.27$ dB)   |                                 |
| 8 GHz < $f < 22$ GHz, span < 1 GHz                           | < 2 dB ( $\sigma = 0.67$ dB)   |                                 |
| 22 GHz $\leq f \leq 26.5$ GHz, span < 1 GHz                  | < 2.5 dB ( $\sigma = 0.83$ dB)   |                                 |
| 26.5 GHz < $f \leq 50$ GHz, span < 1 GHz                     | < 3 dB ( $\sigma = 1.0$ dB)  |                                 |

<sup>19</sup> Mixer level = signal level – RF attenuation + preamplifier gain.

|   |   |                                    |
|---|---|------------------------------------|
| Frequency response, referenced to 64 MHz, YIG preselector off | RF attenuation = 10 dB, 20 dB, 30 dB, 40 dB, RF preamplifier off, +20 °C to +30 °C, electronic attenuator off |                                    |
|   | f < 8 GHz   | same values as with preselector on |
|   | 8 GHz ≤ f < 22 GHz  | < 1.5 dB (σ = 0.5 dB)              |
|   | 22 GHz ≤ f ≤ 26.5 GHz   | < 2 dB (σ = 0.6 dB)                |
|   | 26.5 GHz < f ≤ 50 GHz, span < 1 GHz   | < 2.5 dB (σ = 0.83 dB)             |
|   | any RF attenuation or electronic attenuator on, +15 °C to +40 °C  |                                    |
|   | f < 8 GHz   | same values as with preselector on |
|   | 8 GHz ≤ f < 22 GHz  | < 2 dB (σ = 0.6 dB)                |
|   | 22 GHz ≤ f ≤ 26.5 GHz   | < 2.5 dB (σ = 0.75 dB)             |
|   | 26.5 GHz < f ≤ 50 GHz, span < 1 GHz   | < 3 dB (σ = 1.0 dB)                |
|   | RF attenuation ≤ 20 dB, RF preamplifier on, +20 °C to +30 °C  |                                    |
|   | f < 8 GHz   | same values as with preselector on |
|   | 8 GHz ≤ f < 22 GHz  | < 2 dB (σ = 0.6 dB)                |
| 22 GHz ≤ f ≤ 26.5 GHz   | < 2.5 dB (σ = 0.75 dB)  |                                    |
| 26.5 GHz < f ≤ 50 GHz, span < 1 GHz                           | < 3 dB (σ = 1.0 dB)   |                                    |
| Attenuator switching uncertainty                              | f = 64 MHz, 0 dB to 70 dB, referenced to 10 dB attenuation  | < 0.2 dB (σ = 0.07 dB)             |
| Uncertainty of reference level setting                        | input mixer level ≤ -15 dBm   | 0 dB <sup>20</sup>                 |
|   | input mixer level > -15 dBm   | < 0.1 dB (nom.)                    |
| Bandwidth switching uncertainty                               | referenced to RBW = 10 kHz<br>f = 64 MHz  | < 0.2 dB (σ = 0.08 dB)             |

**Nonlinearity of displayed level**

|                           |                                      |                                 |
|---------------------------|--------------------------------------|---------------------------------|
| Logarithmic level display | S/N > 16 dB, 0 dB ≤ level ≤ -70 dB   | < 0.1 dB (σ = 0.04 dB)          |
|                           | S/N > 16 dB, -70 dB < level ≤ -90 dB | < 0.2 dB (σ = 0.08 dB)          |
| Linear level display      | S/N > 16 dB, 0 dB to -70 dB          | < 5 % of reference level (nom.) |

**Total measurement uncertainty**

|                     |   |          |
|---------------------|---|----------|
| YIG preselector on  | signal level = 0 dB to -70 dB below reference level, S/N > 20 dB, sweep time = auto, RF attenuation = 10 dB, 20 dB, 30 dB, 40 dB, RF preamplifier off, electronic attenuator off, span/RBW < 100, 95 % confidence level, +20 °C to +30 °C |          |
|                     | 9 kHz ≤ f ≤ 10 MHz  | ±0.37 dB |
|                     | 10 MHz < f ≤ 3.6 GHz  | ±0.27 dB |
|                     | 3.6 GHz < f ≤ 8 GHz   | ±0.37 dB |
|                     | 8 GHz < f ≤ 22 GHz  | ±1.4 dB  |
|                     | 22 GHz < f ≤ 26.5 GHz   | ±1.7 dB  |
| YIG preselector off | signal level = 0 dB to -70 dB below reference level, S/N > 20 dB, sweep time = auto, RF attenuation = 10 dB, 20 dB, 30 dB, 40 dB, RF preamplifier off, electronic attenuator off, span/RBW < 100, 95 % confidence level, +20 °C to +30 °C |          |
|                     | 8 GHz ≤ f ≤ 22 GHz  | ±1.0 dB  |
|                     | 22 GHz < f ≤ 26.5 GHz   | ±1.2 dB  |
|                     | 26.5 GHz < f ≤ 50 GHz   | ±1.7 dB  |

<sup>20</sup> The reference level setting affects only the graphical representation of the measurement result on the display, not the measurement itself. The reference level setting causes no additional uncertainty in measurement results.

## Trigger functions

| <b>Trigger</b>                   |                                  |  |
|----------------------------------|----------------------------------|--|
| Trigger source                   | spectrum analysis                | free run, video, external, IF power, RF power          |
| Trigger offset                   | span $\geq$ 10 Hz<br>span = 0 Hz | 5 ns to 20 s<br>(–sweep time) to 20 s                  |
| Min. trigger offset resolution   | span > 0 Hz                      | 5 ns   |
|                                  | span = 0 Hz, trigger offset > 0  | 5 ns   |
|                                  | span = 0 Hz, trigger offset < 0  | sweep time/number of sweep points                      |
| Max. deviation of trigger offset |                                  | 5 ns   |
| <b>IF power trigger</b>          |                                  |  |
| Sensitivity                      | min. signal power                | –60 dBm + RF attenuation – RF preamplifier gain (nom.) |
|                                  | max. signal power                | –10 dBm + RF attenuation – RF preamplifier gain (nom.) |
| IF power trigger bandwidth       | RBW > 500 kHz                    | 20 MHz (nom.) <sup>21</sup>                            |
|                                  | RBW $\leq$ 500 kHz, FFT          | 20 MHz (nom.)  |
|                                  | RBW $\leq$ 500 kHz, swept        | 6 MHz (nom.)   |
| <b>RF power trigger</b>          |                                  |  |
| Sensitivity                      | min. signal power                | –30 dBm + RF attenuation – RF preamplifier gain (nom.) |
|                                  | max. signal power                | +10 dBm + RF attenuation – RF preamplifier gain (nom.) |
| RF power trigger frequency range | f $\leq$ 8 GHz                   | 8 GHz (nom.)   |
|                                  | f > 8 GHz                        | center frequency $\pm$ 250 MHz (nom.) <sup>22</sup>    |
| <b>Gated sweep</b>               |                                  |  |
| Gate source                      |                                  | video, external, IF power, RF power                    |
| Gate delay                       |                                  | 5 ns to 20 s, min. resolution 5 ns                     |
| Gate length                      |                                  | 5 ns to 20 s, min. resolution 5 ns                     |
| Max. deviation of gate length    |                                  | $\pm$ 5 ns   |

## I/Q data (R&S®FSWP-B1 option required)

|  |  |                              |
|--|--|------------------------------|
| Memory length                              |  | max. 440 Msample I and Q     |
| Word length of I/Q samples                 | sampling rate > 100 MHz or number of samples > 300 Msample | 18 bit                       |
|  | otherwise  | 24 bit                       |
| Sampling rate                              | standard   | 100 Hz to 200 MHz            |
|  | with R&S®FSWP-B80 option                                   | 100 Hz to 200 MHz            |
|  | with R&S®FSWP-B320 option                                  | 100 Hz to 1 GHz              |
| Max. signal analysis bandwidth (equalized) | standard   | 10 MHz                       |
|  | with R&S®FSWP-B80 option                                   | 80 MHz (nom.) <sup>23</sup>  |
|  | with R&S®FSWP-B320 option                                  | 320 MHz (nom.) <sup>23</sup> |

| <b>Signal analysis bandwidth <math>\leq</math> 80 MHz</b> |   |  |
|---|---|--|
| Amplitude flatness  | $(1.25 \times \text{signal analysis bandwidth}) \leq f_{\text{center}} < 8 \text{ GHz}$ | $\pm 0.3 \text{ dB (nom.)}$                            |
|   | $f_{\text{center}} \geq 8 \text{ GHz}$ , YIG preselector off                            | $\pm 0.5 \text{ dB (nom.)}$                            |
| Deviation from linear phase                               | $(1.25 \times \text{signal analysis bandwidth}) \leq f_{\text{center}} < 8 \text{ GHz}$ | $\pm 1^\circ \text{ (nom.)}$                           |
|   | $f_{\text{center}} \geq 8 \text{ GHz}$ , YIG preselector off                            | $\pm 2^\circ \text{ (nom.)}$                           |
| Level display nonlinearity                                |   | see Nonlinearity of displayed level                    |
| Level measurement uncertainty                             |   | see Total measurement uncertainty, YIG preselector off |
| Third-order intermodulation distortion                    |   | see Third-order intercept point (TOI)                  |
| ADC related spurious response                             | mixer level = –30 dBm <sup>24</sup>   |  |
|   | analysis bandwidth < 17 MHz   | –100 dBc (nom.)  |
|   | 17 MHz $\leq$ analysis bandwidth < 80 MHz   | –80 dBc (nom.)   |
| Other spurious responses                                  |   | see Spurious responses                                 |

<sup>21</sup> Sweep optimization = auto.

<sup>22</sup> YIG preselector off for f  $\geq$  8 GHz.

<sup>23</sup> YIG preselector off for f  $\geq$  8 GHz.

<sup>24</sup> Level of a tone at the input mixer (also abbreviated as “mixer level”) = signal level – RF attenuation + preamplifier gain.

| <b>Signal analysis bandwidth 80 MHz to 160 MHz</b> |  |                                |
|--|--|--------------------------------|
| Amplitude flatness                                 | RF attenuation = 10/20/30/40 dB, RF preamplifier off, electronic attenuator off, YIG preselector off for $f \geq 8$ GHz  |                                |
|  | $150 \text{ MHz} \leq f_{\text{center}} < 4 \text{ GHz}$   | $\pm 0.5 \text{ dB (nom.)}$    |
|  | $4 \text{ GHz} \leq f_{\text{center}} < 8 \text{ GHz}$   | $\pm 0.7 \text{ dB (nom.)}$    |
|  | $8 \text{ GHz} \leq f_{\text{center}} < 26.5 \text{ GHz}$  | $\pm 1 \text{ dB (nom.)}$      |
|  | $26.5 \text{ GHz} \leq f_{\text{center}} \leq 50 \text{ GHz}$  | $\pm 2 \text{ dB (nom.)}$      |
| Deviation from linear phase                        | RF attenuation = 10/20/30/40 dB, RF preamplifier off, electronic attenuator off, YIG preselector off for $f \geq 8$ GHz  |                                |
|  | $150 \text{ MHz} \leq f_{\text{center}} < 4 \text{ GHz}$   | $\pm 1^\circ \text{ (nom.)}$   |
|  | $4 \text{ GHz} \leq f_{\text{center}} < 8 \text{ GHz}$   | $\pm 2^\circ \text{ (nom.)}$   |
|  | $8 \text{ GHz} \leq f_{\text{center}} < 26.5 \text{ GHz}$  | $\pm 2.5^\circ \text{ (nom.)}$ |
|  | $26.5 \text{ GHz} \leq f_{\text{center}} < 43.5 \text{ GHz}$   | $\pm 4^\circ \text{ (nom.)}$   |
|  | $43.5 \text{ GHz} \leq f_{\text{center}} \leq 50 \text{ GHz}$  | $\pm 8^\circ \text{ (nom.)}$   |
| Nonlinearity of displayed level                    | 0 dB to $-70$ dB   |                                |
| Level measurement uncertainty at center frequency  | add 0.2 dB (nom.) to the values in "Total measurement uncertainty – YIG preselector off"   |                                |
| Third-order intermodulation distortion             | reference level = signal level + 6 dB  |                                |
|  | $150 \text{ MHz} \leq f_{\text{center}} < 8 \text{ GHz}$ :<br>two $-20$ dBm tones at input mixer within analysis bandwidth <sup>24</sup> ,<br>$f_{\text{center}} \geq 8 \text{ GHz}$ :<br>two $-30$ dBm tones at input mixer within analysis bandwidth <sup>24</sup> | $-75 \text{ dBc (nom.)}$       |
| Residual spurious response                         | RF attenuation 0 dB, $f_{\text{center}} \geq 150 \text{ MHz}$  | $-90 \text{ dBm (nom.)}$       |
| ADC related spurious response                      | single tone within analysis bandwidth, mixer level = $-10 \text{ dBm}$ <sup>24</sup> , reference level = signal level, $f_{\text{center}} \geq 150 \text{ MHz}$  | $-78 \text{ dBc (nom.)}$       |
| Other spurious responses                           | see section "Spurious responses"   |                                |

| <b>Signal analysis bandwidth 160 MHz to 320 MHz</b> |  |                                |
|---|--|--------------------------------|
| Amplitude flatness                                  | RF attenuation = 10/20/30/40 dB, RF preamplifier off, electronic attenuator off, YIG preselector off for $f \geq 8$ GHz  |                                |
|   | $200 \text{ MHz} \leq f_{\text{center}} < 4 \text{ GHz}$   | $\pm 0.7 \text{ dB (nom.)}$    |
|   | $4 \text{ GHz} \leq f_{\text{center}} < 7 \text{ GHz}$   | $\pm 1.2 \text{ dB (nom.)}$    |
|   | $7 \text{ GHz} \leq f_{\text{center}} < 8 \text{ GHz}$ <sup>25</sup>   | $\pm 1.4 \text{ dB (nom.)}$    |
|   | $8 \text{ GHz} \leq f_{\text{center}} < 22 \text{ GHz}$  | $\pm 1.6 \text{ dB (nom.)}$    |
|   | $22 \text{ GHz} \leq f_{\text{center}} \leq 43.5 \text{ GHz}$  | $\pm 2 \text{ dB (nom.)}$      |
|   | $43.5 \text{ GHz} < f_{\text{center}} \leq 50 \text{ GHz}$   | $\pm 2.5 \text{ dB (nom.)}$    |
| Deviation from linear phase                         | RF attenuation = 10/20/30/40 dB, RF preamplifier off, electronic attenuator off, YIG preselector off for $f \geq 8$ GHz  |                                |
|   | $200 \text{ MHz} \leq f_{\text{center}} < 4 \text{ GHz}$   | $\pm 2.5^\circ \text{ (nom.)}$ |
|   | $4 \text{ GHz} \leq f_{\text{center}} < 8 \text{ GHz}$ <sup>25</sup>   | $\pm 4^\circ \text{ (nom.)}$   |
|   | $8 \text{ GHz} \leq f_{\text{center}} < 43.5 \text{ GHz}$  | $\pm 5^\circ \text{ (nom.)}$   |
|   | $43.5 \text{ GHz} \leq f_{\text{center}} \leq 50 \text{ GHz}$  | $\pm 8^\circ \text{ (nom.)}$   |
| Nonlinearity of displayed level                     | 0 dB to $-70$ dB   |                                |
| Level measurement uncertainty at center frequency   | add 0.2 dB (nom.) to the values in "Total measurement uncertainty – YIG preselector off"   |                                |
| Third-order intermodulation distortion              | reference level = signal level + 6 dB  |                                |
|   | $200 \text{ MHz} \leq f_{\text{center}} < 8 \text{ GHz}$ :<br>two $-20$ dBm tones at input mixer within analysis bandwidth <sup>24</sup> ,<br>$f_{\text{center}} \geq 8 \text{ GHz}$ :<br>two $-30$ dBm tones at input mixer within analysis bandwidth <sup>24</sup> | $-75 \text{ dBc (nom.)}$       |
| Residual spurious response                          | RF attenuation 0 dB, $f_{\text{center}} \geq 200 \text{ MHz}$  | $-90 \text{ dBm (nom.)}$       |
| ADC related spurious response                       | single tone within analysis bandwidth, mixer level = $-10 \text{ dBm}$ <sup>24</sup> , reference level = signal level  |                                |
|   | $200 \text{ MHz} \leq f_{\text{center}} \leq 460 \text{ MHz}$  | $-70 \text{ dBc (nom.)}$       |
|   | $f_{\text{center}} > 460 \text{ MHz}$  | $-72 \text{ dBc (nom.)}$       |
| Other spurious responses                            | see section "Spurious responses"   |                                |

<sup>25</sup> To obtain the set analysis bandwidth,  $(f_{\text{center}} + \frac{1}{2} \text{ analysis bandwidth}) \leq 8 \text{ GHz}$  must be met.

## R&S®FSWP-B13 highpass filters (R&S®FSWP-B1 option required)

| Frequency       |          |                   |
|-----------------|----------|-------------------|
| Frequency range | filter 1 | 1 GHz to 1.75 GHz |
|                 | filter 2 | 1.75 GHz to 3 GHz |

| Stopband attenuation |          |                |
|----------------------|----------|----------------|
| 500 MHz to 875 MHz   | filter 1 | > 20 dB (nom.) |
| 875 MHz to 1.5 GHz   | filter 2 | > 20 dB (nom.) |

| Other specifications          |  |  |
|-------------------------------|--|--|
| Level measurement uncertainty |  | see specifications in section<br>R&S®FSWP-B1 spectrum analyzer |
| Displayed average noise level |  |  |
| Intermodulation               |  |  |
| Measurement uncertainty       |  |  |

## R&S®FSWP-B21 LO/IF connections for external mixers (for R&S®FSWP26/R&S®FSWP50)

| LO signal       |                  |                    |
|-----------------|------------------|--------------------|
| Frequency range |                  | 7.65 GHz to 16 GHz |
| Level           | +20 °C to +30 °C | +15.5 dBm ± 1 dB   |
|                 | +5 °C to +40 °C  | +15.5 dBm ± 3 dB   |

| IF input                          |   |                      |
|-----------------------------------|---|----------------------|
| IF frequency                      | set signal analysis bandwidth   |                      |
|                                   | ≤ 80 MHz, bandwidth-dependent   | 1310 MHz to 1330 MHz |
| Full-scale level                  | compression < 1 dB  |                      |
|                                   | 2-port mixer<br>(LO output/IF input, front panel)   | -20 dBm (nom.)       |
|                                   | 3-port mixer (IF input, front panel)  | -20 dBm (nom.)       |
| Level uncertainty at IF frequency | IF input level = reference level = -25 dBm, RBW = 30 kHz, mixer conversion loss set to 0 dB, 2-port mixer, LO output/IF input connector (front panel) |                      |
|                                   | +20 °C to +30 °C  | < 1 dB               |
|                                   | +5 °C to +40 °C   | < 3 dB               |
|                                   | IF input level = reference level = -25 dBm, RBW = 30 kHz, mixer conversion loss set to 0 dB, 3-port mixer, IF input connector (front panel)           |                      |
|                                   | +20 °C to +30 °C  | < 1 dB               |
|                                   | +5 °C to +40 °C   | < 3 dB               |

| Inputs and outputs |  |                  |
|--------------------|--|------------------|
| LO output/IF input |  | SMA female, 50 Ω |
| IF input           |  | SMA female, 50 Ω |

## Phase noise sensitivity with two external mixers in cross correlation mode (R&S®FSWP-B60/R&S®FSWP-B61 and R&S®FSWP-B64 options required)

### With R&S®FSWP-B61 and R&S®FSWP-B64 option:

Start offset 1 Hz, correlation factor = 1, frequency reference internal, internal reference loop bandwidth 30 Hz, signal level = 0 dBm, specified values in dBc (1 Hz). For typical values subtract 6 dB.

| RF input frequency | Supported mixer | Offset frequency from the carrier |       |        |       |        |         |       |        |          |
|--------------------|-----------------|-----------------------------------|-------|--------|-------|--------|---------|-------|--------|----------|
|                    |                 | 1 Hz                              | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz | ≥ 30 MHz |
| 50 GHz to 75 GHz   | R&S®FS-Z75      | -34                               | -53   | -82    | -115  | -134   | -135    | -139  | -145   | -145     |
| 60 GHz to 90 GHz   | R&S®FS-Z90      | -33                               | -52   | -81    | -114  | -133   | -134    | -138  | -144   | -144     |
| 75 GHz to 110 GHz  | R&S®FS-Z110     | -31                               | -50   | -79    | -112  | -131   | -132    | -136  | -142   | -142     |

### With R&S®FSWP-B60 and R&S®FSWP-B64 option:

Start offset 1 Hz, correlation factor = 1, frequency reference internal, internal reference loop bandwidth 30 Hz, signal level = 0 dBm, specified values in dBc (1 Hz). For typical values subtract 6 dB.

| RF input frequency | Supported mixer | Offset frequency from the carrier |       |        |       |        |         |       |        |          |
|--------------------|-----------------|-----------------------------------|-------|--------|-------|--------|---------|-------|--------|----------|
|                    |                 | 1 Hz                              | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz | ≥ 30 MHz |
| 50 GHz to 75 GHz   | R&S®FS-Z75      | -18                               | -46   | -78    | -110  | -129   | -132    | -137  | -145   | -144     |
| 60 GHz to 90 GHz   | R&S®FS-Z90      | -17                               | -45   | -77    | -109  | -128   | -131    | -136  | -144   | -143     |
| 75 GHz to 110 GHz  | R&S®FS-Z110     | -15                               | -43   | -75    | -107  | -126   | -129    | -134  | -142   | -141     |

R&S®FSWP-B4 option improves the phase noise sensitivity at 1 Hz offset by 5 dB (nom.).

At other offsets the above specification applies.

| Improvement of phase noise sensitivity by number of correlations |      |       |       |        |
|--|------|-------|-------|--------|
| Correlations   | 10   | 100   | 1000  | 10 000 |
| Improvement  | 5 dB | 10 dB | 15 dB | 20 dB  |

## Phase noise sensitivity with one external mixer, with R&S®FSWP-B4 or R&S®FSWP-B61 option

| Start offset 1 Hz, frequency reference internal, signal level > -10 dBm, nominal values in dBc(1 Hz). |                 |                                   |       |        |       |        |         |       |        |          |
|---|-----------------|-----------------------------------|-------|--------|-------|--------|---------|-------|--------|----------|
| RF input frequency  | Supported mixer | Offset frequency from the carrier |       |        |       |        |         |       |        |          |
|   |                 | 1 Hz                              | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz | ≥ 30 MHz |
| 50 GHz to 75 GHz  | R&S®FS-Z75      | -32                               | -50   | -75    | -97   | -114   | -116    | -124  | -135   | -137     |
| 60 GHz to 90 GHz  | R&S®FS-Z90      | -31                               | -49   | -74    | -96   | -113   | -115    | -123  | -133   | -135     |
| 75 GHz to 110 GHz   | R&S®FS-Z110     | -29                               | -47   | -72    | -94   | -111   | -113    | -121  | -131   | -133     |

## Phase noise sensitivity with one external mixer, without R&S®FSWP-B4/-B61 options

| Start offset 1 Hz, frequency reference internal, signal level > -10 dBm, nominal values in dBc(1 Hz). |                 |                                   |       |        |       |        |         |       |        |          |
|---|-----------------|-----------------------------------|-------|--------|-------|--------|---------|-------|--------|----------|
| RF input frequency  | Supported mixer | Offset frequency from the carrier |       |        |       |        |         |       |        |          |
|   |                 | 1 Hz                              | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz | ≥ 30 MHz |
| 50 GHz to 75 GHz  | R&S®FS-Z75      | -23                               | -45   | -75    | -97   | -114   | -116    | -124  | -135   | -137     |
| 60 GHz to 90 GHz  | R&S®FS-Z90      | -22                               | -44   | -74    | -96   | -113   | -115    | -123  | -133   | -135     |
| 75 GHz to 110 GHz   | R&S®FS-Z110     | -20                               | -42   | -72    | -94   | -111   | -113    | -121  | -131   | -133     |

## R&S®FSWP-B24 RF preamplifier (R&S®FSWP-B1 option required)

| Frequency       |            |                     |
|-----------------|------------|---------------------|
| Frequency range | R&S®FSWP8  | 100 kHz to 8 GHz    |
|                 | R&S®FSWP26 | 100 kHz to 26.5 GHz |
|                 | R&S®FSWP50 | 100 kHz to 50 GHz   |

| Setting range        |                        |                                 |
|----------------------|------------------------|---------------------------------|
| RF preamplifier gain | R&S®FSWP8              | 15 dB/30 dB (nom.) (selectable) |
|                      | R&S®FSWP26, R&S®FSWP50 | 30 dB (nom.)                    |

| Other specifications          |  |  |
|-------------------------------|--|--|
| Level measurement uncertainty |  | See specifications in section R&S®FSWP-B1 spectrum analyzer. The RF preamplifier has no effect on phase noise analyzer specifications. |
| Displayed average noise level |  |  |
| Intermodulation               |  |  |
| Measurement uncertainty       |  |  |

## Ordering information

| Designation   | Type       | Order No.    |
|---|------------|--------------|
| Phase Noise Analyzer, 1 MHz to 8 GHz  | R&S®FSWP8  | 1322.8003.08 |
| Phase Noise Analyzer, 1 MHz to 26.5 GHz   | R&S®FSWP26 | 1322.8003.26 |
| Phase Noise Analyzer, 1 MHz to 50 GHz   | R&S®FSWP50 | 1322.8003.50 |
| <b>Accessories supplied</b>   |            |              |
| Power cable, quick start guide and CD-ROM (with operating manual and service manual),<br>R&S®FSWP26: adapter 3.5 mm (APC3.5-compatible) female/female,<br>R&S®FSWP50: adapter 1.85 mm female/female |            |              |

## Options

| Designation                                    | Type         | Order No.    | Retrofittable | Remarks  |
|--|--------------|--------------|---------------|--|
| Cross-Correlation, 8 GHz                       | R&S®FSWP-B60 | 1322.9800.08 | yes           | for R&S®FSWP8;<br>contact service center   |
| Cross-Correlation, 26 GHz                      | R&S®FSWP-B60 | 1322.9800.26 | yes           | for R&S®FSWP26;<br>retrofittable in factory  |
| Cross-Correlation, 50 GHz                      | R&S®FSWP-B60 | 1322.9800.50 | yes           | for R&S®FSWP50;<br>retrofittable in factory  |
| Cross-Correlation (low phase noise),<br>8 GHz  | R&S®FSWP-B61 | 1325.3719.08 | yes           | for R&S®FSWP8;<br>contact service center<br>includes R&S®FSWP-B4   |
| Cross-Correlation (low phase noise),<br>26 GHz | R&S®FSWP-B61 | 1325.3719.26 | yes           | for R&S®FSWP26;<br>retrofittable in factory<br>includes R&S®FSWP-B4  |
| Cross-Correlation (low phase noise),<br>50 GHz | R&S®FSWP-B61 | 1325.3719.50 | yes           | for R&S®FSWP50;<br>retrofittable in factory<br>includes R&S®FSWP-B4  |
| Additive Phase Noise Measurements              | R&S®FSWP-B64 | 1322.9900.26 | yes           | frequency range 10 MHz to<br>8 GHz for R&S®FSWP8,<br>10 MHz to 18 GHz for<br>R&S®FSWP26 and<br>R&S®FSWP50;<br>R&S®FSWP-B60 or B61 option<br>required;<br>contact service center        |
| High Stability OCXO                            | R&S®FSWP-B4  | 1325.3890.02 | yes           | user-retrofittable   |
| Spectrum Analyzer, 10 Hz to 8 GHz              | R&S®FSWP-B1  | 1322.9997.08 | yes           | for R&S®FSWP8;<br>retrofittable in factory   |
| Spectrum Analyzer, 10 Hz to 26 GHz             | R&S®FSWP-B1  | 1322.9997.26 | yes           | for R&S®FSWP26;<br>retrofittable in factory  |
| Spectrum Analyzer, 10 Hz to 50 GHz             | R&S®FSWP-B1  | 1322.9997.50 | yes           | for R&S®FSWP50;<br>retrofittable in factory  |
| External Generator Control                     | R&S®FSWP-B10 | 1325.5463.02 | yes           | contact service center   |
| Resolution Bandwidth > 10 MHz                  | R&S®FSWP-B8  | 1325.5028.26 | no            | for R&S®FSWP8/26 with<br>R&S®FSWP-B1 option;<br>the signal analysis bandwidth is<br>defined by the R&S®FSWP-<br>B80 option, not by the<br>R&S®FSWP-B8 option.                          |
| Resolution Bandwidth > 10 MHz                  | R&S®FSWP-B8  | 1325.5028.02 | no            | for R&S®FSWP50 with<br>R&S®FSWP-B1 option;<br>the signal analysis bandwidth is<br>defined by the R&S®FSWP-<br>B80 option, not by the<br>R&S®FSWP-B8 option;<br>export license required |
| Highpass Filter for Harmonic Measurements      | R&S®FSWP-B13 | 1325.4350.02 | yes           | for R&S®FSWP8/26/50 with<br>R&S®FSWP-B1 option;<br>user-retrofittable  |
| LO/IF Connections for external mixers          | R&S®FSWP-B21 | 1325.3848.02 | yes           | for R&S®FSWP26/50;<br>contact service center   |
| RF Preamplicifier, 100 kHz to 8 GHz            | R&S®FSWP-B24 | 1325.3725.08 | yes           | for R&S®FSWP8 with<br>R&S®FSWP-B1 option;<br>contact service center  |



| Designation                                    | Type          | Order No.    | Retrofittable | Remarks   |
|--|---------------|--------------|---------------|---|
| RF Preamplifier, 100 kHz to 26.5 GHz           | R&S®FSWP-B24  | 1325.3725.26 | yes           | for R&S®FSWP26 with R&S®FSWP-B1 option; contact service center      |
| RF Preamplifier, 100 kHz to 50 GHz             | R&S®FSWP-B24  | 1325.3725.50 | yes           | for R&S®FSWP50 with R&S®FSWP-B1 option; contact service center      |
| 80 MHz Analysis Bandwidth                      | R&S®FSWP-B80  | 1325.4338.02 | yes           | for R&S®FSWP8/26/50 with R&S®FSWP-B1 option; user-retrofittable     |
| 320 MHz Analysis Bandwidth                     | R&S®FSWP-B320 | 1338.3235.04 | yes           | for R&S®FSWP8/26/50 with R&S®FSWP-B1 option; contact service center |
| Spare Solid State Drive (removable hard drive) | R&S®FSWP-B18  | 1331.4313.02 | yes           | user-retrofittable  |

## Firmware

| Designation                                    | Type         | Order No.    | Retrofittable | Remarks                     |
|--|--------------|--------------|---------------|-----------------------------|
| Pulsed Phase Noise Measurements                | R&S®FSWP-K4  | 1325.5043.02 |               |                             |
| Pulse Measurement Application                  | R&S®FSWP-K6  | 1325.4421.02 |               | R&S®FSWP-B1 option required |
| Time Sidelobe Measurements                     | R&S®FSWP-K6S | 1325.5363.02 |               | R&S®FSWP-K6 option required |
| Analog Modulation Analysis for AM/FM/φM        | R&S®FSWP-K7  | 1325.4238.02 |               | R&S®FSWP-B1 option required |
| Noise Figure Measurements                      | R&S®FSWP-K30 | 1325.4244.02 |               | R&S®FSWP-B1 option required |
| Security Write Protection of solid state drive | R&S®FSWP-K33 | 1325.5040.02 |               |                             |
| Vector Signal Analysis                         | R&S®FSWP-K70 | 1325.4280.02 |               | R&S®FSWP-B1 option required |

## Recommended extras

| Designation   | Type               | Order No.                             |
|---|--------------------|---------------------------------------|
| IEC/IEEE Bus Cable, length: 1 m   | R&S®PCK            | 0292.2013.10                          |
| IEC/IEEE Bus Cable, length: 2 m   | R&S®PCK            | 0292.2013.20                          |
| Front Cover   | R&S®ZZF-511        | 1174.8825.00                          |
| 19" Rack Adapter  | R&S®ZZA-KN5        | 1175.3040.00                          |
| <b>Matching pads, 50/75 Ω</b>   |                    |                                       |
| L Section, matching at both ends  | R&S®RAM            | 0358.5414.02                          |
| Series Resistor, 25 Ω, matching at one end<br>(taken into account in instrument function RF INPUT 75 Ω) | R&S®RAZ            | 0358.5714.02                          |
| <b>High-power attenuators</b>   |                    |                                       |
| 100 W, 3/6/10/20/30 dB, 1 GHz   | R&S®RBU100         | 1073.8495.xx<br>(xx = 03/06/10/20/30) |
| 50 W, 3/6/10/20/30 dB, 2 GHz  | R&S®RBU50          | 1073.8695.xx<br>(xx = 03/06/10/20/30) |
| 50 W, 20 dB, 6 GHz  | R&S®RDL50          | 1035.1700.52                          |
| <b>Connectors and cables</b>  |                    |                                       |
| Coaxial adapter N (f) – SMA (f)   | (for R&S®FSWP8)    | 0343.0257.00                          |
| Coaxial adapter 3.5 mm (f/f) (APC3.5-compatible)  | (for R&S®FSWP26)   | 3587.7793.00                          |
| Coaxial adapter 1.85 mm (f/f) (APC3.5-compatible)   | (for R&S®FSWP50)   | 3588.9654.00                          |
| RF Cable, 50 cm, SMA (f/f)  | (for R&S®FSWP-B21) | 3586.9970.00                          |
| Probe Power Connector, 3-pin  |                    | 1065.9480.00                          |
| N-Type Adapter for R&S®RT-Zxx oscilloscope probes   | R&S®RT-ZA9         | 1417.0909.02                          |
| <b>DC blocks</b>  |                    |                                       |
| DC Block, 10 kHz to 18 GHz (N type)   | R&S®FSE-Z4         | 1084.7443.02                          |
| <b>External harmonic mixers (for instruments with R&amp;S®FSWP-B21 option)</b>                          |                    |                                       |
| Harmonic Mixer, 50 GHz to 75 GHz  | R&S®FS-Z75         | 1048.0271.02                          |
| Harmonic Mixer, 60 GHz to 90 GHz  | R&S®FS-Z90         | 1048.0371.02                          |
| Harmonic Mixer, 75 GHz to 110 GHz   | R&S®FS-Z110        | 1048.0471.02                          |
| <b>External I/Q mixers (for instruments with R&amp;S®FSWP-B64 option)</b>                               |                    |                                       |
| Marki Microwave   | MLIQ1845L          |                                       |

**Power sensors supported (R&S®FSWP-B1 option required)<sup>27</sup>**

| Designation                                     | Type         | Order No.    |
|---|--------------|--------------|
| <b>Universal power sensors</b>                  |              |              |
| 10 MHz to 8 GHz, 100 mW, 2-path                 | R&S®NRP-Z211 | 1417.0409.02 |
| 10 MHz to 8 GHz, 200 mW                         | R&S®NRP-Z11  | 1138.3004.02 |
| 10 MHz to 18 GHz, 100 mW, 2-path                | R&S®NRP-Z221 | 1417.0309.02 |
| 10 MHz to 18 GHz, 200 mW                        | R&S®NRP-Z21  | 1137.6000.02 |
| 10 MHz to 18 GHz, 2 W                           | R&S®NRP-Z22  | 1137.7506.02 |
| 10 MHz to 18 GHz, 15 W                          | R&S®NRP-Z23  | 1137.8002.02 |
| 10 MHz to 18 GHz, 30 W                          | R&S®NRP-Z24  | 1137.8502.02 |
| <b>Power sensor modules with power splitter</b> |              |              |
| DC to 18 GHz, 500 mW                            | R&S®NRP-Z27  | 1169.4102.02 |
| DC to 26.5 GHz, 500 mW                          | R&S®NRP-Z37  | 1169.3206.02 |
| <b>Thermal power sensors</b>                    |              |              |
| 0 Hz to 18 GHz, 100 mW                          | R&S®NRP18T   | 1424.6115.02 |
| 0 Hz to 18 GHz, 100 mW                          | R&S®NRP18TN  | 1424.6121.02 |
| 0 Hz to 33 GHz, 100 mW                          | R&S®NRP33T   | 1424.6138.02 |
| 0 Hz to 33 GHz, 100 mW                          | R&S®NRP33TN  | 1424.6144.02 |
| 0 Hz to 40 GHz, 100 mW                          | R&S®NRP40T   | 1424.6150.02 |
| 0 Hz to 40 GHz, 100 mW                          | R&S®NRP40TN  | 1424.6167.02 |
| 0 Hz to 50 GHz, 100 mW                          | R&S®NRP50T   | 1424.6173.02 |
| 0 Hz to 50 GHz, 100 mW                          | R&S®NRP50TN  | 1424.6180.02 |
| 0 Hz to 67 GHz, 100 mW                          | R&S®NRP67T   | 1424.6196.02 |
| 0 Hz to 67 GHz, 100 mW                          | R&S®NRP67TN  | 1424.6209.02 |
| 0 Hz to 110 GHz, 100 mW                         | R&S®NRP110T  | 1424.6215.02 |
| <b>Average power sensors</b>                    |              |              |
| 8 kHz to 6 GHz, 200 mW                          | R&S®NRP6A    | 1424.6796.02 |
| 8 kHz to 6 GHz, 200 mW                          | R&S®NRP6AN   | 1424.6809.02 |
| 9 kHz to 6 GHz, 2 W                             | R&S®NRP-Z92  | 1171.7005.02 |
| 8 kHz to 18 GHz, 200 mW                         | R&S®NRP18A   | 1424.6815.02 |
| 8 kHz to 18 GHz, 200 mW                         | R&S®NRP18AN  | 1424.6821.02 |
| <b>Three path diode power sensors</b>           |              |              |
| 100 pW to 200 mW, 10 MHz to 8 GHz               | R&S®NRP8S    | 1419.0006.02 |
| 100 pW to 200 mW, 10 MHz to 8 GHz, LAN version  | R&S®NRP8SN   | 1419.0012.02 |
| 100 pW to 200 mW, 10 MHz to 18 GHz              | R&S®NRP18S   | 1419.0029.02 |
| 100 pW to 200 mW, 10 MHz to 18 GHz, LAN version | R&S®NRP18SN  | 1419.0035.02 |
| 100 pW to 200 mW, 10 MHz to 33 GHz              | R&S®NRP33S   | 1419.0064.02 |
| 100 pW to 200 mW, 10 MHz to 33 GHz, LAN version | R&S®NRP33SN  | 1419.0070.02 |
| 100 pW to 100 mW, 50 MHz to 40 GHz              | R&S®NRP40S   | 1419.0041.02 |
| 100 pW to 100 mW, 50 MHz to 40 GHz, LAN version | R&S®NRP40SN  | 1419.0058.02 |
| <b>Wideband power sensor</b>                    |              |              |
| 50 MHz to 18 GHz, 100 mW                        | R&S®NRP-Z81  | 1137.9009.02 |

<sup>27</sup> For average power measurement only.

## Service options

| 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 Calibration Coverage, one year  | R&S®CW1 |   |
| Extended Warranty with Calibration Coverage, two years | R&S®CW2 |   |

### Extended warranty with a term of one to four years (WE1 to WE2)

Repairs carried out during the contract term are free of charge <sup>28</sup>. Necessary calibration and adjustments carried out during repairs are also covered. Simply contact the forwarding agent we name; your product will be picked up free of charge and returned to you in top condition a couple of days later.

### Extended warranty with calibration (CW1 to CW2)

Enhance your extended warranty by adding calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated, inspected and maintained during the term of the contract. It includes all repairs <sup>28</sup> and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

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For product brochure, see PD 3607.2090.12 and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)

<sup>28</sup> 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

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The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

## Sustainable product design

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- | Energy efficiency and low emissions
- | Longevity and optimized total cost of ownership

Certified Quality Management

**ISO 9001**

Certified Environmental Management

**ISO 14001**

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## Rohde & Schwarz training

[www.training.rohde-schwarz.com](http://www.training.rohde-schwarz.com)

## Regional contact

- | Europe, Africa, Middle East | +49 89 4129 12345  
[customersupport@rohde-schwarz.com](mailto:customersupport@rohde-schwarz.com)
- | North America | 1 888 TEST RSA (1 888 837 87 72)  
[customer.support@rsa.rohde-schwarz.com](mailto:customer.support@rsa.rohde-schwarz.com)
- | Latin America | +1 410 910 79 88  
[customersupport.la@rohde-schwarz.com](mailto:customersupport.la@rohde-schwarz.com)
- | Asia Pacific | +65 65 13 04 88  
[customersupport.asia@rohde-schwarz.com](mailto:customersupport.asia@rohde-schwarz.com)
- | China | +86 800 810 82 28 | +86 400 650 58 96  
[customersupport.china@rohde-schwarz.com](mailto:customersupport.china@rohde-schwarz.com)

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R&S®FSWP Phase Noise Analyzer

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