

R&S® FSL

Spectrum Analyzer

Specifications



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Specifications apply under the following conditions:

15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to.

Data without tolerances: typical values only. Data designated 'nominal' applies to design parameters and is not assured by Rohde & Schwarz.

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Frequency

| | | |
|----------------------|-----------|------------------------------------|
| Frequency range | R&S®FSL3 | 9 kHz to 3 GHz |
| | R&S®FSL6 | 9 kHz to 6 GHz |
| | R&S®FSL18 | 9 kHz to 18 GHz (overrange 20 GHz) |
| Frequency resolution | | 1 Hz |

| | | |
|---|----------------|--------------------|
| Reference frequency, internal, nominal | | |
| Aging per year | | 1×10^{-6} |
| Temperature drift | 0 °C to +50 °C | 1×10^{-6} |

| | | |
|---|---|--------------------|
| Reference frequency, internal, nominal | R&S®FSL-B4 OCXO reference frequency option, standard with the R&S®FSL18 | |
| Aging per year | | 1×10^{-7} |
| Temperature drift | 0 °C to +50 °C | 1×10^{-7} |

| | | |
|-----------------------------------|---------------------------------|--|
| Frequency readout | | |
| Marker resolution | | 1 Hz |
| Uncertainty | | $\pm(\text{marker frequency} \times \text{reference uncertainty} + 10 \% \times \text{resolution bandwidth} + \frac{1}{2} (\text{span} / (\text{sweep points} - 1)) + 1 \text{ Hz})$ |
| Marker tuning frequency step size | default | $\text{span} / 500$ |
| | marker step size = sweep points | $\text{span} / (\text{sweep points} - 1)$ |
| Frequency counter resolution | | 1 Hz |
| Count uncertainty | S/N > 25 dB | $\pm(\text{frequency} \times \text{reference uncertainty} + \frac{1}{2} (\text{last digit}))$ |
| Frequency span | | 0 Hz, 10 Hz to 3/6/20 GHz |
| Span uncertainty | | 3 % |

| | | |
|--|---------|---|
| Spectral purity SSB phase noise | | f = 500 MHz |
| Carrier offset | 1 kHz | typ. -95 dBc (1 Hz) |
| | 10 kHz | < -98 dBc (1 Hz), typ. -103 dBc (1 Hz) |
| | 100 kHz | < -98 dBc (1 Hz), typ. -105 dBc (1 Hz) |
| | 1 MHz | < -115 dBc (1 Hz), typ. -120 dBc (1 Hz) |

Sweep time

| | | |
|-------------|----------------------------------|---|
| Sweep time | span = 0 Hz | 1 μ s to 5 μ s in 125 ns steps 5 μ s to 16000 s in 5 % steps |
| | 10 Hz \leq span \leq 3.2 kHz | 2.5 ms to 5 s/Hz \times span |
| | 3.2 kHz < span \leq 1.5 GHz | 2.5 ms to 16000 s |
| | 1.5 GHz < span \leq 3 GHz | 5 ms to 16000 s |
| | span > 3 GHz | 10 ms to 16000 s |
| Uncertainty | span = 0 Hz | nominal 0.1 % |
| | span \geq 10 Hz | nominal 3 % |

Resolution bandwidths

| Sweep filters | | |
|---|------------------------|--|
| Resolution bandwidths | | 300 Hz to 10 MHz (–3 dB) in 1/3 sequence |
| | with R&S®FSL-B7 option | 10 Hz to 10 MHz (–3 dB) in 1/3 sequence |
| | zero span | 20 MHz (–3 dB) additionally |
| Resolution bandwidth uncertainty | | nominal < 3 % |
| Resolution filter shape factor 60 dB : 3 dB | | nominal < 5 (Gaussian type filters) |

| EMI filters | | |
|---------------------------|------------------------|-------------------------------|
| 6 dB bandwidths | | 9 kHz, 120 kHz, 1 MHz |
| | with R&S®FSL-B7 option | 200 Hz, 9 kHz, 120 kHz, 1 MHz |
| Bandwidth uncertainty | | nominal < 3 % |
| Shape factor 60 dB : 3 dB | | nominal < 6 |

| FFT filters | | |
|---------------------------|------------------------|----------------------------------|
| 3 dB bandwidths | | 300 Hz to 30 kHz in 1/3 sequence |
| | with R&S®FSL-B7 option | 1 Hz to 30 kHz in 1/3 sequence |
| Bandwidth uncertainty | | nominal 5 % |
| Shape factor 60 dB : 3 dB | | nominal 2.5 |

| Channel filters | | |
|------------------------|---|-----------------------------|
| Bandwidths | 300; 500 Hz; 1; 1.5; 2; 2.4; 2.7; 3; 3.4; 4; 4.5; 5; 6; 8.5; 9 kHz 10; 12.5; 14; 15; 16; 18 (RRC); 20; 21; 24.3 (RRC); 25; 30; 50; 100; 150; 192; 200; 300; 500 kHz 1; 1.228; 1.28 (RRC); 1.5; 2; 3; 3.84 (RRC); 4.096 (RRC); 5 MHz (RRC = root raised cosine) | |
| | with R&S®FSL-B7 option | 100 Hz, 200 Hz additionally |

| | | |
|------------------|---------------------------|--------------------------------|
| Video bandwidths | 1-pole lowpass RC filters | 1 Hz to 10 MHz in 1/3 sequence |
|------------------|---------------------------|--------------------------------|

| | | |
|------------------------|--|----------------|
| Demodulation bandwidth | | nominal 28 MHz |
|------------------------|--|----------------|

Level

| | | |
|---------------|--|----------------------------------|
| Display range | | displayed noise floor to +20 dBm |
|---------------|--|----------------------------------|

| Maximum rated input level R&S®FSL3 and R&S®FSL6 | | |
|---|-------------------|----------------------|
| DC voltage | | 50 V |
| CW RF power | | 30 dBm (= 1 W) |
| Peak RF power | | 36 dBm (= 4 W) < 3 s |
| Max. pulse voltage | | 150 V |
| Max. pulse energy | pulse width 10 µs | 10 mWs |

| Maximum rated input level R&S®FSL18 with RF attenuation ≥ 10 dB | | |
|---|-------------------|----------------------|
| DC voltage | | 50 V |
| CW RF power | | 30 dBm (= 1 W) |
| Peak RF power | | 36 dBm (= 4 W) < 3 s |
| Max. pulse voltage | | 100 V |
| Max. pulse energy | pulse width 10 µs | 2 mWs |

| Maximum rated input level R&S®FSL18 with RF attenuation < 10 dB | | |
|---|-------------------|-------------------|
| DC voltage | | 30 V |
| CW RF power | | 20 dBm (= 100 mW) |
| Peak RF power | | 26 dBm (= 400 mW) |
| Max. pulse voltage | | 30 V |
| Max. pulse energy | pulse width 10 µs | 0.2 mWs |

| Intermodulation R&S®FSL3 and R&S®FSL6 | | |
|---------------------------------------|--|-------------------------------------|
| Third-order intermodulation (TOI) | intermodulation-free dynamic range, level 2 × -20 dBm, reference level -10 dBm | |
| | $f_{in} < 30$ MHz | > 54 dBc (TOI +7 dBm, typ. +12 dBm) |
| | $f_{in} \geq 30$ MHz | > 60 dBc (TOI +10 dBm, typ +18 dBm) |
| Second harmonic intercept (SHI) | $f_{in} = 20$ MHz to 3 GHz | nominal +35 dBm |
| 1 dB compression of input mixer | 0 dB RF attenuation, $f > 200$ MHz | nominal +5 dBm |

| Intermodulation R&S®FSL18 | | |
|-----------------------------------|--|-------------------------------------|
| Third-order intermodulation (TOI) | intermodulation-free dynamic range, level 2 × -20 dBm, reference level -10 dBm | |
| | $f_{in} < 50$ MHz | > 54 dBc (TOI +7 dBm, typ. +10 dBm) |
| | 50 MHz $\leq f_{in} \leq 6$ GHz | > 60 dBc (TOI +10 dBm, typ +13 dBm) |
| | $f_{in} > 6$ GHz | nominal 60 dBc (TOI +10 dBm) |
| Second harmonic intercept (SHI) | $f_{in} = 20$ MHz to 9 GHz | nominal +35 dBm |
| 1 dB compression of input mixer | 0 dB RF attenuation, $f > 200$ MHz | nominal +5 dBm |

| Displayed average noise level R&S®FSL3 and R&S®FSL6 | | |
|--|-----------------------------------|--|
| 0 dB RF attenuation, termination 50 Ω, RBW = 1 kHz, VBW = 1 Hz, sample detector, log scaling, tracking generator OFF, normalized to 1 Hz | | |
| frequency | preamplifier = OFF | |
| 9 kHz to 1 MHz | < -100 dBm (1 Hz) | |
| 1 MHz to 10 MHz | < -115 dBm (1 Hz) | |
| 10 MHz to 50 MHz | < -130 dBm (1 Hz) | |
| 50 MHz to 3 GHz | < -140 dBm (1 Hz) | |
| 3 GHz to 5 GHz | < -136 dBm (1 Hz) | |
| 5 GHz to 6 GHz | < -130 dBm (1 Hz) | |
| frequency | preamplifier = ON | |
| 9 kHz to 1 MHz | < -115 dBm (1 Hz) | |
| 1 MHz to 10 MHz | < -130 dBm (1 Hz) | |
| 10 MHz to 50 MHz | < -145 dBm (1 Hz) | |
| 50 MHz to 3 GHz | < -152 dBm (1 Hz) | |
| 3 GHz to 5 GHz | < -146 dBm (1 Hz) | |
| 5 GHz to 6 GHz | < -140 dBm (1 Hz) | |
| frequency | preamplifier = ON, typical values | |
| 500 MHz | -162 dBm (1 Hz) | |
| 1 GHz | -160 dBm (1 Hz) | |
| 3 GHz | -158 dBm (1 Hz) | |
| 6 GHz | -147 dBm (1 Hz) | |

| Displayed average noise level R&S®FSL18 | | |
|--|-----------------------------------|--|
| 0 dB RF attenuation, termination 50 Ω, RBW = 1 kHz, VBW = 1 Hz, sample detector, log scaling, tracking generator OFF, normalized to 1 Hz | | |
| frequency | preamplifier = OFF | |
| 9 kHz to 1 MHz | < -100 dBm (1 Hz) | |
| 1 MHz to 10 MHz | < -115 dBm (1 Hz) | |
| 10 MHz to 50 MHz | < -130 dBm (1 Hz) | |
| 50 MHz to 3 GHz | < -140 dBm (1 Hz) | |
| 3 GHz to 12 GHz | < -136 dBm (1 Hz) | |
| 12 GHz to 18 GHz | < -130 dBm (1 Hz) | |
| 18 GHz to 20 GHz | < -123 dBm (1 Hz) | |
| frequency | preamplifier = ON | |
| 9 kHz to 1 MHz | < -115 dBm (1 Hz) | |
| 1 MHz to 10 MHz | < -130 dBm (1 Hz) | |
| 10 MHz to 50 MHz | < -145 dBm (1 Hz) | |
| 50 MHz to 3 GHz | < -152 dBm (1 Hz) | |
| 3 GHz to 5 GHz | < -149 dBm (1 Hz) | |
| 5 GHz to 6 GHz | < -145 dBm (1 Hz) | |
| frequency | preamplifier = ON, typical values | |
| 500 MHz | -162 dBm (1 Hz) | |
| 1 GHz | -161 dBm (1 Hz) | |
| 3 GHz | -158 dBm (1 Hz) | |
| 6 GHz | -152 dBm (1 Hz) | |

| Immunity to interference | | |
|--|---|-------------------------|
| Image frequency | $f_{in} - 2 \times 48.375 \text{ MHz}$ | < -80 dBc, typ. -90 dBc |
| | $f_{in} - 2 \times 838.375 \text{ MHz}$ | < -60 dBc, typ. -80 dBc |
| | $f_{in} - 2 \times 7158.375 \text{ MHz}$ | typ. -60 dBc |
| Intermediate frequency | 48.375 MHz, 838.375 MHz, 7158.375 MHz | < -60 dBc, typ. -80 dBc |
| Spurious response, inherent | $f > 30 \text{ MHz}$, without input signal, RF attenuation = 0 dB, $RBW \leq 10 \text{ kHz}$ | < -90 dBm |
| Spurious response related to local oscillators | $f \leq 6 \text{ GHz}$ | |
| | $\Delta f < 100 \text{ kHz}$ | typ. -60 dBc |
| | $\Delta f \geq 100 \text{ kHz}$ | < -60 dBc |
| | $f > 6 \text{ GHz}$ | |
| | $\Delta f < 100 \text{ kHz}$ | typ. -48 dBc |
| | $\Delta f \geq 100 \text{ kHz}$ | < -48 dBc |
| Spurious response | related to A/D conversion | typ. < -70 dBc |
| Spurious response | related to subharmonic of first LO (spur at $7158.375 \text{ MHz} - 2 \times f_{in}$) | typ. -60 dBc |
| Spurious response at mixer level < -10 dBm | related to harmonic of first LO (spur at $f_{in} - 3579.1875 \text{ MHz}$) | typ. -60 dBc |

| Level display | | |
|----------------------------------|---|--|
| Logarithmic level axis | 10 dB to 100 dB | |
| Linear level axis | 0 % to 100 %/10 divisions | |
| Number of traces | 4 | |
| Trace detectors | max peak, min peak, auto peak, sample, RMS, quasi peak, average | |
| Number of measurement points | default value | 501 |
| | range | 125 to 32001 in steps of about a factor of 2 |
| Trace functions | clear/write, max hold, average, min hold, view | |
| Setting range of reference level | logarithmic level display | -80 dBm to 20 dBm in steps of 2 dB, 5 dB or 10 dB |
| | linear level display | -80 dBm to 20 dBm, 0 % to 100 % |
| Units of level axis | logarithmic level display | dBm, dBmV, dBμV, dBμA, dBpW |
| | linear level display | μV, mV, V, μA, mA, A, pW, nW, μW, mW, W |

| Level measurement uncertainty | | |
|--|--|-----------------------|
| | 95 % confidence level, +20 °C to +30 °C, S/N > 16 dB, 0 dB to -50 dB from reference level | |
| | 10 MHz < f ≤ 3 GHz | < 0.5 dB |
| | 3 GHz < f ≤ 6 GHz | < 0.8 dB |
| | 6 GHz < f ≤ 18 GHz | < 1.2 dB |
| Absolute uncertainty at 65.83 MHz | | < 0.3 dB |
| Frequency response (+20 °C to +30 °C) | 9 kHz ≤ f < 30 kHz | nominal 1.5 dB |
| | 30 kHz ≤ f ≤ 3 GHz | < 0.5 dB, typ. 0.3 dB |
| | 3 GHz < f ≤ 6 GHz | < 0.8 dB, typ. 0.3 dB |
| | 6 GHz < f ≤ 18 GHz | < 1.2 dB, typ. 0.6 dB |
| | f > 18 GHz | nominal 2 dB |
| Attenuator uncertainty | | < 0.3 dB |
| Uncertainty of reference level setting | | nominal < 0.1 dB |

| Display nonlinearity | | |
|---------------------------------|-------------------------------|------------------|
| Logarithmic level display | S/N > 16 dB 0 dB to -50 dB | < 0.2 dB |
| Bandwidth switching uncertainty | reference: RBW = 10 kHz | nominal < 0.1 dB |

Trigger functions

| Trigger | | |
|------------------------|--|-------------------------------------|
| Trigger source | | free run, video, external, IF power |
| External trigger level | | TTL level |

I/Q data

| | | |
|------------------|----------------------|--------------------------|
| Interface | | LAN |
| | R&S®FSL-B10 | LAN or GPIB |
| Memory length | | max. 512 ksample I and Q |
| Sample rate | | 10 kHz to 65.8 MHz |
| Signal bandwidth | sample rate 65.8 MHz | nominal 28 MHz |

Inputs and outputs

| RF input R&S®FSL3 and R&S®FSL6 | | |
|---|------------------------|-----------------------------|
| Impedance | | 50 Ω |
| Connector | | N female |
| VSWR | RF attenuation ≥ 10 dB | |
| | 10 MHz ≤ f ≤ 1 GHz | nominal 1.2 |
| | 1 GHz < f ≤ 6 GHz | nominal 1.5 |
| Input attenuator | | 0 dB to 50 dB in 5 dB steps |

| RF input R&S®FSL18 | | |
|-------------------------------|------------------------|-----------------------------|
| Impedance | | 50 Ω |
| Connector | | N female |
| VSWR | RF attenuation ≥ 10 dB | |
| | 10 MHz ≤ f ≤ 8 GHz | nominal 1.2 |
| | 8 GHz < f ≤ 16 GHz | nominal 1.5 |
| | f > 16 GHz | nominal 2 |
| Input attenuator | | 0 dB to 40 dB in 5 dB steps |

| AF output | | |
|----------------------|--|-------------------------|
| Connector | | 3.5 mm mini jack |
| Output impedance | | < 100 Ω |
| Open-circuit voltage | | up to 1.5 V, adjustable |

| Tracking generator (models .13, .16 and .28 only) | | |
|--|---|---------------------------------|
| Connector | | N female, 50 Ω |
| Output power setting range | R&S®FSL3, R&S®FSL6 | -50 dBm to 0 dBm in 1 dB steps |
| | R&S®FSL18 | -30 dBm to 0 dBm in 10 dB steps |
| Frequency range | R&S®FSL3 | 1 MHz to 3 GHz |
| | R&S®FSL6 | 1 MHz to 6 GHz |
| | R&S®FSL18 | 10 MHz to 18 GHz |
| Dynamic range for isolation measurements | RF attenuation = 0 dB, source power 0 dBm | |
| | 10 MHz to 2 GHz | nominal 80 dB |
| | 2 GHz to f _{max} | nominal 60 dB |
| Reverse power | | |
| DC voltage | | 50 V |
| CW RF power | | 30 dBm (= 1 W) |
| Max. pulse voltage | | 150 V |
| Max. pulse energy (10 μs) | | 10 mWs |

| External reference | | |
|---------------------------|-----------------|------------------|
| Connector | | BNC female, 50 Ω |
| Input level | | 0 dBm to +10 dBm |
| Output level | with R&S®FSL-B4 | typ. 0 dBm |
| Frequency | | 10 MHz ±5 ppm |

| External trigger/gate input | | |
|------------------------------------|--|------------------|
| Connector | | BNC female, 50 Ω |
| Input level | | TTL compatible |

| | | |
|--------------------|--|---|
| Probe power | | +15 V DC, -12.6 V DC and ground, max. 150 mA, nominal |
|--------------------|--|---|

| External monitor | | |
|-------------------------|--|-----|
| Connector | | VGA |

General specifications

| Remote control | | |
|---------------------|-------------|--------------------|
| LAN interface | | 10/100BaseT, RJ-45 |
| IEC/IEEE bus (GPIB) | R&S®FSL-B10 | SCPI 1997.0 |

| Display | | |
|--------------------|--|------------------------|
| Resolution | | 640 × 480 pixels |
| Pixel failure rate | | < 2 × 10 ⁻⁵ |

| Mass memory | | |
|--------------|--|--|
| Mass memory | | flash disk (internal), USB memory stick (not supplied) |
| Data storage | | > 500 instrument settings and traces |

| Temperature | | |
|------------------|-------------------------------|--|
| | operating temperature range | +0 °C to +50 °C |
| | permissible temperature range | +0 °C to +55 °C |
| | storage temperature range | -40 °C to +70 °C |
| Climatic loading | | +25 °C/+40 °C at 85 % relative humidity (IEC 60068-2-30) |

| Mechanical resistance | | |
|-----------------------|------------|--|
| Vibration | sinusoidal | IEC 60068-2-6 |
| | random | IEC 60068-2-64 |
| Shock | | 40 g shock spectrum, in line with MIL-STD-810E, method 516.4 procedure 1, IEC 60068-2-27 |

| Power supply | | |
|----------------------------------|-------------------|--|
| Input voltage range, AC, nominal | | 100 V to 240 V |
| AC supply frequency | | 50 Hz to 400 Hz |
| Input current, AC | | 0.9 A to 0.3 A |
| Input voltage range, DC, nominal | R&S®FSL-B30 | 10 V to 28 V |
| Input current, DC | R&S®FSL-B30 | 8.0 A to 2.2 A |
| Power consumption | | typ. 45 W, max. 65 W with all options |
| Safety | | IEC 61010-1, EN 61010-1, UL 61010B-1, CSA C22.2 No. 1010-1 |
| Test mark | | VDE, GS, CSA, CSA-NRTL |
| EMC | | EMC Directive 2004/108/EC including: - IEC/EN 61326 class B (emission) - CISPR 11/EN 55011/group 1 class B (emission) - IEC/EN 61326 Table A.1 (immunity, industrial) |
| Dimensions (W × H × D) | with handle | 408.8 mm × 158.1 mm × 465.3 mm (16.09 in × 6.22 in × 18.32 in) |
| | without handle | 342.3 mm × 158.1 mm × 367.0 mm (13.48 in × 6.22 in × 14.45 in) |
| Weight | without options | < 7 kg (< 15.43 lb) |
| | with battery pack | < 8 kg (< 17.64 lb) |

| Recommended calibration interval | | |
|----------------------------------|-----------------------------------|---------|
| | | 1 year |
| | operation with external reference | 2 years |

R&S[®]FSL-B5 additional interfaces

| User port | | |
|------------------|--|-------------------------------------|
| Connector | | 9-pin D-Sub male |
| Output | | TTL-compatible, 0 V/5 V, max. 15 mA |
| Input | | TTL-compatible, max. 5 V |

| Noise source control | | |
|-----------------------------|--|--|
| Connector | | BNC female |
| Output | | 0 V/28 V, max. 100 mA, switchable, supply for noise source |

| Power sensor | | |
|---------------------|--|--|
| Connector | | 6-pin LEMOSA female for supported R&S [®] NRP-Zxx power sensors |

| IF/video out | | |
|-------------------------------------|---|---|
| Connector | | BNC female, 50 Ω |
| IF out | | |
| Bandwidth | | nominal 28 MHz |
| IF frequency | RBW 20 MHz, center frequency > 20 MHz, span 0 Hz | 17.45833 MHz (nominal) ±2 MHz, dependent on center frequency |
| Output level (gain versus RF input) | RF attenuation 0 dB, RF preamplifier = OFF, span 0 Hz, RBW 20 MHz center frequency | |
| | 100 MHz | approx. +3 dB |
| | 3 GHz | approx. -1 dB |
| | 6 GHz | approx. -7 dB |
| Video out | | |
| Bandwidth | | equal to VBW setting, max. RBW/2 |
| Output scaling | | log scaling with display scale set to log, lin scaling with display scale set to lin |
| Output level | center frequency > 10 MHz, span 0 Hz, signal at reference level and center frequency video 1 V | 1 V ±10 % (open circuit) (nominal) |
| | video 200 mV | 200 mV ±10 % (open circuit) (nominal) |

R&S® FSL-K7 AM/FM/φM measurement demodulator

| Measurement of analog modulation signals | | |
|--|--|---|
| Demodulation bandwidth | | 100 Hz to 6.4 kHz, binary steps 12.5 kHz to 1.6 MHz, binary steps 3 MHz, 5 MHz, 8 MHz, 10 MHz, 18 MHz |
| Recording length | maximum | 512 ksample |
| Recording time | demodulation bandwidth | |
| | 100 Hz | 3276.8 s |
| | 6.4 kHz | 51.2 s |
| | 12.5 kHz | 26.6 s |
| | 1.6 MHz | 200 ms |
| | 3 MHz | 100 ms |
| | 5 MHz | 50 ms |
| | 8 MHz | 25 ms |
| | 10 MHz | 12.5 ms |
| 18 MHz | 12.5 ms | |
| Display | frequency versus time (FM), amplitude versus time (AM), phase versus time (φM), RF power versus time, RF spectrum (FFT), AF spectrum (FFT), table with numeric values for: modulation deviation (peak, RMS), modulation frequency, carrier offset, carrier power (power of unmodulated carrier), THD, SINAD | |

| AF (modulation frequency) | | |
|---------------------------|--|---|
| Range | | ≤ 9 MHz max. 0.5 × demodulation bandwidth |
| Resolution | | 5 digits |
| Measurement uncertainty | | 0.1 % |
| AF filters | | |
| Lowpass | | 3 kHz, 15 kHz, 150 kHz, 5 %, 10 %, 25 % of demodulation bandwidth |
| Highpass | | 50 Hz, 300 Hz |
| Deemphasis | | 25 μs, 50 μs, 75 μs, 750 μs |

| AM demodulation | | |
|------------------------------|--|--------------------------------|
| Measurement range | modulation depth | 0 % to 100 % |
| Modulation depth uncertainty | AF ≤ 1 MHz | < 3 % of reading + residual AM |
| Residual AM | demodulation bandwidth ≤ 200 kHz, RMS, RF ≤ 3 GHz, RF input level ≥ (RF attenuation/dB – 30) dBm | 0.2 % |
| Distortion | 10 Hz ≤ AF ≤ 100 kHz | 0.3 % |
| FM rejection | AF ≤ 1 MHz and AF + deviation ≤ 0.5 × demodulation bandwidth | typ. 1 % + residual AM |

| FM demodulation | | |
|-----------------------|--|--------------------------------|
| Measurement range | frequency deviation | ≤ 9 MHz |
| Deviation uncertainty | AF ≤ 1 MHz and AF + deviation ≤ 0.5 × demodulation bandwidth | < 3 % of reading + residual FM |
| Residual FM | demodulation bandwidth ≤ 100 kHz, RMS, RF input level ≥ (RF attenuation/dB – 30) dBm | |
| | RF ≤ 1 GHz | 150 Hz |
| | RF = 3 GHz | 200 Hz |
| Distortion | 10 Hz ≤ AF ≤ 100 kHz, deviation < 400 kHz | 0.3 % |
| AM rejection | 100 Hz ≤ AF ≤ 1 kHz, modulation depth 50 % | 30 Hz |

| ϕM demodulation | | |
|--|--|---|
| AF | | ≤ 5 MHz, max. $0.5 \times$ demodulation bandwidth |
| Measurement range | phase deviation | < 1000 rad |
| Residual ϕ M | demodulation bandwidth ≤ 100 kHz, RMS, RF = 1 GHz, highpass 300 Hz, RF input level \geq (RF attenuation/dB – 30) dBm | 5 mrad |
| Deviation uncertainty | AF ≤ 1 MHz and AF + deviation $\leq 0.5 \times$ demodulation bandwidth | 3 % of reading + residual ϕ m |

| Carrier power versus time | | |
|----------------------------------|--|------------------------|
| Display range | | noise floor to +20 dBm |
| Measurement uncertainty | unmodulated carrier, S/N > 16 dB, RF: 50 kHz to 3 GHz | typ. 1 dB |
| Maximum dynamic range | demodulation bandwidth 200 kHz | typ. 75 dB |
| Display linearity | S/N > 16 dB | typ. 0.2 dB |

| AF spectrum | | |
|----------------------|--|----------------|
| Span | | ≤ 9 MHz |
| Resolution bandwidth | | 1 Hz to 10 MHz |

| RF spectrum | | |
|----------------------|--------------|----------------|
| Span | | ≤ 18 MHz |
| Resolution bandwidth | | 1 Hz to 10 MHz |
| Shape factor | 60 dB : 3 dB | 2.5, nominal |

| Modulation distortion | | |
|------------------------------|--|-----------------|
| Measurement functions | | THD, SINAD |
| Measurement range | | –100 dB to 0 dB |
| Resolution | | 0.01 dB |
| Measurement uncertainty | | typ. 0.5 dB |
| AF frequency range | | 10 Hz to 5 MHz |

| Trigger | | |
|-------------------|--|---|
| Trigger functions | | RF level, AM, FM, ϕ M demodulation |

R&S® FSL-K8 Bluetooth® TX measurements

The specifications below are based on the data sheet specifications of the R&S® FSL spectrum analyzer and have not been checked separately. Specifications apply under the following conditions: Unless otherwise stated, these specifications are with RF input level +20 dBm to -40 dBm within the Bluetooth® band (ISM) 2400 MHz to 2483.5 MHz and default settings.

| Output power | | |
|---------------------|--|---|
| Measurements | | average and peak power in line with Bluetooth® RF test specification 2.0.E.3, 5.1.3 |
| Level range | | -40 dBm to + 20 dBm |
| Level uncertainty | | < 0.7 dB |
| Packet type | | longest supported (DH1, DH3, DH5) |
| Payload | | PRBS9 |
| Synchronization | | RF burst, access code |
| Trigger | | IF power, external, free run |

| Modulation characteristics | | |
|-----------------------------------|-------------------------------------|--|
| Measurements | | FM deviation in line with Bluetooth® RF test specification 2.0.E.3, 5.1.9 $\Delta f_{1\max}$, $\Delta f_{2\max}$, $\Delta f_{1\text{avg}}$, $\Delta f_{2\text{avg}}$ and $\Delta f_{2\text{avg}}/\Delta f_{1\text{avg}}$ |
| Deviation range | | ±250 kHz |
| Deviation uncertainty | signal level > -25 dBm, 10 averages | < 6 kHz |
| Packet type | | all supported (DH1, DH3, DH5) |
| Payload | | 10101010 and 11110000, auto detect |
| Synchronization | | access code |
| Trigger | | IF power, external, free run |

| Initial carrier frequency tolerance (ICFT) | | |
|---|------------------------|--|
| Measurements | | ICFT in line with Bluetooth® RF test specification 2.0.E.3, 5.1.10 |
| Measurement range | | ±250 kHz |
| Measurement uncertainty | signal level > -30 dBm | < 3 kHz + carrier frequency × reference error |
| Packet type | | DH1 and all supported (DH1, DH3, DH5) |
| Payload | | PRBS9 |
| Synchronization | | access code |
| Trigger | | IF power, external, free run |

| Carrier frequency drift | | |
|--------------------------------|------------------------|--|
| Measurements | | carrier frequency drift in line with Bluetooth® RF test specification 2.0.E.3, 5.1.11 drift/packet and drift/50 μs |
| Measurement range | | ±250 kHz |
| Uncertainty | signal level > -30 dBm | < 5 kHz |
| Packet type | | all supported (DH1, DH3, DH5) |
| Payload | | 10101010 |
| Synchronization | | access code |
| Trigger | | IF power, external, free run |

| Adjacent channel power (ACP) | | |
|-------------------------------------|--|---|
| Measurements | | adjacent channel power in line with Bluetooth® RF test specification 2.0.E.3, 5.1.8 |
| Level range | | max. +20 dBm |
| Packet type | | DH1 |
| Payload | | PRBS9 |
| Synchronization | | none |
| Trigger | | external, free run |

| EDR relative TX power | | |
|------------------------------|--|---|
| Measurements | | GFSK and DPSK power in line with Bluetooth® RF test specification 2.0.E.3, 5.1.12 |
| Measurement range | | -40 dBm to +20 dBm |
| Level uncertainty | | < 0.7 dB |
| Packet type | | 2-DHx, 3-DHx, 2-EVx, 3-EVx |
| Payload | | PRBS9 |
| Synchronization | | GFSK access code and DPSK synchronization sequence |
| Trigger | | IF power, external, free run |

| EDR frequency stability | | |
|--------------------------------|---|--|
| Measurements | | frequency error initial (ω_i), per block (ω_0) and total ($\omega_i + \omega_0$) in line with Bluetooth® RF test specification 2.0.E.3, 5.1.13 |
| Measurement range | | ± 250 kHz |
| Uncertainty | frequency error initial, signal level > -25 dBm | < 1 kHz + carrier frequency \times reference error |
| | frequency error per block, signal level > -25 dBm | < 1 kHz |
| Packet type | | 2-DHx, 3-DHx, 2-EVx, 3-EVx |
| Payload | | PRBS9 |
| Synchronization | | |
| Trigger | | IF power, external, free run |

| EDR modulation accuracy | | |
|--------------------------------|------------------------------|---|
| Measurements | | RMS, peak and 99 % DEVM in line with Bluetooth® RF test specification 2.0.E.3, 5.1.13 |
| Uncertainty | RMS, signal level > -25 dBm | < 3 % |
| | peak, signal level > -25 dBm | < 8 % |
| Packet type | | 2-DHx, 3-DHx, 2-EVx, 3-EVx |
| Payload | | PRBS9 |
| Synchronization | | GFSK access code and DPSK synchronization sequence |
| Trigger | | IF power, external, free run |

| EDR differential phase encoding | | |
|--|--|---|
| Measurements | | bit error detection in line with Bluetooth® RF test specification 2.0.E.3, 5.1.14 |
| Packet type | | 2-DHx, 3-DHx, 2-EVx, 3-EVx |
| Payload | | PRBS9 |
| Synchronization | | GFSK access code and DPSK synchronization sequence |
| Trigger | | IF power, external, free run |

| EDR in-band spurious emissions | | |
|---------------------------------------|--|---|
| Measurements | | adjacent channel power and power between 1 MHz and 1.5 MHz from carrier in line with Bluetooth® RF test specification 2.0.E.3, 5.1.15 |
| Level range | | max. +10 dBm |
| Packet type | | 2-DHx, 3-DHx, 2-EVx, 3-EVx |
| Payload | | PRBS9 |
| Synchronization | | gated measurement |
| Trigger | | IF power, external, free run |

R&S®FSL-K20 cable TV measurements

The R&S®FSL-K20 option for the R&S®FSL spectrum analyzer makes it possible to perform measurements on analog and digital modulated TV signals in cable networks and also simplifies such measurements.

The option includes a software demodulator for analyzing digital TV signals and an internal TV trigger for analyzing analog TV signals.

General

| Frequency | | |
|------------------------------------|---|---|
| Range | vision carrier frequency with analog modulation or carrier frequency with digital modulation | 5 MHz to 1.5 GHz |
| Selection of measurement frequency | a channel table is used | selection of a channel and/or direct input of frequency |
| | no channel table is used | direct input of frequency |
| Channel tables | | |
| Characteristics | <p>The number of channel tables that can be saved is limited only by the memory capacity of the instrument.</p> <p>Max. 400 channels in each channel table.</p> <p>Channel bandwidths from 0.1 MHz to 10 MHz.</p> <p>Max. 50 modulation standards, i.e. signal characteristic sets, can be present in each channel table. The modulation standard assigned to the active channel automatically configures each measurement.</p> <p>Channel tables can be generated and edited on the instrument at any time.</p> <p>The most important standard channel tables and modulation standards are included.</p> | |
| Manual measurements | Operation is also possible without channel tables, in which case the user must select the measurement parameters. | |

Analog TV

| | | |
|---------------|--------------------------|--------------------|
| TV standards | B/G, D/K, I, K1, L, M, N | |
| Color system | PAL/SECAM/NTSC | |
| Sound systems | B/G | FM 5.5 MONO |
| | | FM 5.5/FM 5.742 |
| | | FM 5.5/NICAM 5.85 |
| | D/K/K1 | FM 6.5 MONO |
| | | FM 6.5/FM 6.742 |
| | | FM 6.5/FM 6.258 |
| | | FM 6.5/NICAM 5.85 |
| | I | FM 6.0 MONO |
| | | FM 6.0/NICAM 6.552 |
| | L | AM 6.5 MONO |
| | | AM 6.5/NICAM 5.85 |
| | M, N | FM 4.5 MONO |
| | | FM 4.5/FM 4.724 |
| FM 4.5 BTSC | | |
| FM 4.5 EIA-J | | |

| Measurements | | |
|-------------------|--|--|
| Spectrum | active channel/signal spectrum | |
| Carriers | vision carrier | frequency and level absolute; display of deviation from nominal values |
| | one or two sound carriers | frequency and level relative to vision carrier; display of deviation from nominal values |
| C/N | carrier to noise; peak level of vision carrier relative to noise in selectable bandwidth; noise floor correction can be activated | |
| | channel switched ON | in-service mode, measurement next to signal |
| | channel switched OFF | off-service mode |
| | channel switched ON, no scrambling | quiet-line mode, measurement during unmodulated line |
| CSO | composite second order (beat); peak level of vision carrier relative to second-order intermodulation product; noise floor correction can be activated | |
| | channel switched OFF | off-service mode |
| | channel switched ON, no scrambling, unmodulated video line present | quiet-line mode, measurement during unmodulated line |
| CTB | composite triple beat; channel switched OFF; peak level of vision carrier relative to third-order intermodulation product; noise floor correction can be activated | |
| Video scope | no scrambling, SWT = 25 μ s to 100 μ s, offset = -50 μ s to +50 μ s | luminance signal of a selectable video line versus time |
| Vision modulation | white-reference test line, no scrambling | modulation depth and residual carrier of vision carrier |
| Hum | no scrambling | modulation depth of unwanted AM, modulation frequency < 1 kHz |

Analog TV measurement ranges and measurement uncertainty

| Standards | All specified tolerances refer to a modulated TV signal in line with the PAL B/G standard. FM carriers are at 5.5 MHz and 5.742 MHz relative to the vision carrier, each modulated with 3 kHz. Vision carrier frequency range: 10 MHz < f \leq 1.5 GHz. | |
|---------------------------------|---|---|
| Measurements | | |
| Carriers | | |
| Vision carrier power, absolute | S/N (vision carrier) > 16 dB | typ. < 0.5 dB |
| Vision carrier frequency offset | frequency offset < 10 kHz | \pm (vision carrier frequency \times reference uncertainty + 0.5 Hz) |
| Sound carrier 1 power, relative | S/N (sound carrier 1) > 16 dB | typ. < 0.7 dB |
| Intercarrier 1 frequency offset | intercarrier 1 frequency offset < 100 Hz S/N (sound carrier 1) > 25 dB | \pm (intercarrier 1 frequency offset \times reference uncertainty + 0.5 Hz) |
| Sound carrier 2 power, relative | S/N (sound carrier 2) > 16 dB | typ. < 0.7 dB |
| Intercarrier 2 frequency offset | intercarrier 2 frequency offset < 100 Hz S/N (sound carrier 2) > 25 dB | \pm (intercarrier 2 frequency offset \times reference uncertainty + 0.5 Hz) |
| C/N | channel with vision carrier peak power -2 dBm; noise-reference bandwidth = 4 MHz; carrier and noise with 0 dB attenuation | |
| C/N (off-service) | preamp = OFF | C/N < 54 dB, typ. < 1 dB |
| | | C/N < 59 dB, typ. < 3 dB |
| | preamp = ON for noise measurement | C/N < 69 dB, typ. < 1 dB |
| | | C/N < 74 dB, typ. < 3 dB |

Digital TV

| | | |
|---------------------|---|--|
| QAM demodulator | user-configurable, block-based, open-loop software demodulator | |
| Standards | J.83/A (DVB-C Europe) | |
| | J.83/B (US cable) | |
| | J.83/C (Japanese cable) | |
| Measurements | | |
| Spectrum | active channel/signal spectrum | |
| Overview | result table, zoom of individual parameters possible | |
| | modulation error rate (peak and RMS value) | |
| | error vector magnitude (peak and RMS value) | |
| | frequency offset | |
| | symbol rate offset | |
| Constellation | color constellation diagram with zoom capability | |
| Modulation errors | result table, zoom of individual parameters possible | |
| | amplitude imbalance | |
| | quadrature error | |
| | carrier suppression | |
| | phase jitter | |
| | modulation error rate (peak and RMS value) | |
| | error vector magnitude (peak and RMS value) | |
| Channel analysis | -20 × symbol duration to +100 × symbol duration | magnitude of channel impulse response, zoom |
| Channel power | measurement of channel power | |
| APD | amplitude probability distribution, special channel filters (5 MHz, 6 MHz, 7 MHz, 8 MHz, 10 MHz) | |
| CCDF | complementary cumulative distribution function, special channel filters (5 MHz, 6 MHz, 7 MHz, 8 MHz, 10 MHz) | |

Digital TV measurement ranges and measurement uncertainty

| | | |
|-------------------------------|---|--|
| Demodulator | | |
| Adjustable symbol rate | 0.1 Hz steps | 0.1 MHz to 7.15 MHz |
| Permissible symbol rate error | referenced to symbol rate | typ. ±0.1 % |
| Permissible frequency error | | typ. ±30 kHz |
| Modulation formats | QAM | 4/16/32/64/128/256/512/1024 |
| Equalizer | ON/OFF/freeze/reset; fractionally spaced; taps from -5 symbols to +25 symbols | |
| Receive filter | root raised cosine | roll-off factor = 0.12/0.13/0.15/0.18 |
| Measurements | | |
| Overview | | |
| MER | 64QAM, roll-off factor = 0.15, symbol rate = 6.9 MHz, equalizer OFF, R&S®FSL-B4 OCXO option at 200 MHz, 400 MHz, 600 MHz, 800 MHz | typ. residual MER RMS greater (95 %) than 42.0 dB, 39.2 dB, 38.6 dB, 41.6 dB |
| | 256QAM, roll-off factor = 0.12, symbol rate = 5.3605369 MHz, equalizer OFF, R&S®FSL-B4 OCXO option at 200 MHz, 400 MHz, 600 MHz, 800 MHz | typ. residual MER RMS greater (95 %) than 42.3 dB, 40.8 dB, 39.3 dB, 41.9 dB |
| | | |
| | | |

TV analyzer

| | |
|---------------------|---|
| Standards | see "Analog TV" and "Digital TV" |
| Measurements | |
| Tilt | Display of the power of many channels versus frequency allows level differences/tilt to be detected. Channels are selected by specifying the frequency range and/or modulation characteristics. |

R&S®FSL-K30 application firmware for noise figure and gain measurements

Frequency

| | | |
|-----------------------|-----------------------------------|--|
| Frequency range | R&S®FSL3 | 100 kHz to 3 GHz |
| | R&S®FSL6 | 100 kHz to 6 GHz |
| | R&S®FSL18 | 100 kHz to 18 GHz (overrange 20 GHz) |
| Measurement bandwidth | R&S®FSL3/6 | 300 Hz to 10 MHz (–3 dB) in 1/3 sequence |
| | R&S®FSL3/6 with R&S®FSL-B7 option | 10 Hz to 10 MHz (–3 dB) in 1/3 sequence |

Noise figure and gain measurement

| | | |
|---------------------|---|---------------|
| Noise figure | | |
| Measurement range | | 0 dB to 35 dB |
| Resolution | | 0.01 dB |
| Accuracy | instrument uncertainty (95 % confidence level) | |
| | frequency range 100 kHz to 10 MHz | |
| | measurement with external preamplifier (gain 50 dB, noise figure < 5 dB), RBW < 10 kHz, DUT noise figure 1 dB to 10 dB and gain >10 dB | 0.3 dB |
| | frequency range >10 MHz to 6 GHz | |
| | measurement with external preamplifier (gain 30 dB, noise figure < 5 dB), RBW 1 MHz, DUT noise figure 1 dB to 10 dB and gain >10 dB | 0.3 dB |
| | R&S®FSL-B22 (internal preamplifier) active, measurement with external preamplifier (gain 20 dB, noise figure < 5 dB), RBW 1 MHz, DUT noise figure 1 dB to 10 dB and gain >10 dB | 0.3 dB |
| Accuracy | frequency range >6 GHz to 18 GHz | |
| | measurement with external preamplifier (gain 30 dB, noise figure < 5 dB), RBW 1 MHz, DUT noise figure 1 dB to 10 dB and gain >10 dB | 0.3 dB |

| | | |
|-------------------|--|---------------|
| Gain | | |
| Measurement range | | 0 dB to 60 dB |
| Resolution | | 0.01 dB |
| Accuracy | frequency range 100 kHz to 10 MHz | |
| | measurement with external preamplifier (gain 50 dB, noise figure < 5 dB), RBW < 10 kHz | 0.2 dB |
| | frequency range > 10 MHz to 18 GHz | |
| | measurement with external preamplifier (gain 30 dB, noise figure < 5 dB), RBW 1 MHz | 0.2 dB |

Required hardware

| | | |
|--------------------------|--|--|
| Spectrum analyzer | | |
| Noise source supply | via 28 V connector on R&S®FSL rear panel | R&S®FSL-B5 |
| Noise source | recommendation | NoiseCom NC346 |
| Preamplifier, external | frequency range 100 kHz to 3/6/18 GHz | gain approx. 30 dB, noise figure max. 5 dB |

R&S® FSL-K72 3GPP FDD base station test

The specifications below are based on the data sheet specifications of the R&S®FSL spectrum analyzer and have not been checked separately. Specifications apply under the following conditions: 15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and internal calibration performed. Data with tolerances are measurement uncertainties with a confidence level of 95 %. The specified level measurement errors do not take into account systematic errors due to reduced S/N ratio.

PMU = permissible measurement uncertainty in line with test specification 3GPP TS 25.141.

Frequency error

| Base station output power | test case 6.2.1 | |
|---------------------------|--|---------------------------|
| Level range | | -70 dBm to +30 dBm |
| Level uncertainty | total power $P_{\text{total}} > -60$ dBm | < 0.5 dB PMU: < 0.7 dB |

| CPICH power accuracy | test case 6.2.2 | |
|------------------------------------|--------------------------------|--|
| Level range of total power | | -40 dBm to +30 dBm |
| Level range of CPICH | | -40 dB to 0 dB |
| Level uncertainty (absolute power) | $P_{\text{CPICH}} \geq -10$ dB | < 0.52 dB ($\sigma = 0.019$) PMU: < 0.8 dB |
| | $P_{\text{CPICH}} \geq -20$ dB | < 0.59 dB ($\sigma = 0.024$) |
| Level uncertainty (relative power) | $P_{\text{CPICH}} \geq -10$ dB | < 0.021 dB ($\sigma = 0.006$) PMU: < 0.3 dB |
| | $P_{\text{CPICH}} \geq -20$ dB | < 0.088 dB ($\sigma = 0.022$) |

Frequency error

| Frequency error | test case 6.3 | |
|-------------------------|-------------------|---|
| Measurement range | CPICH synchronous | ± 5 kHz PMU: ± 1 kHz |
| | SCH synchronous | ± 1 kHz |
| Measurement uncertainty | SNR > 40 dB | < 5 Hz + Δf_{ref}^1 ($\sigma = 2$ Hz) PMU: < 12 Hz + Δf_{ref}^1 |

Output RF spectrum emissions

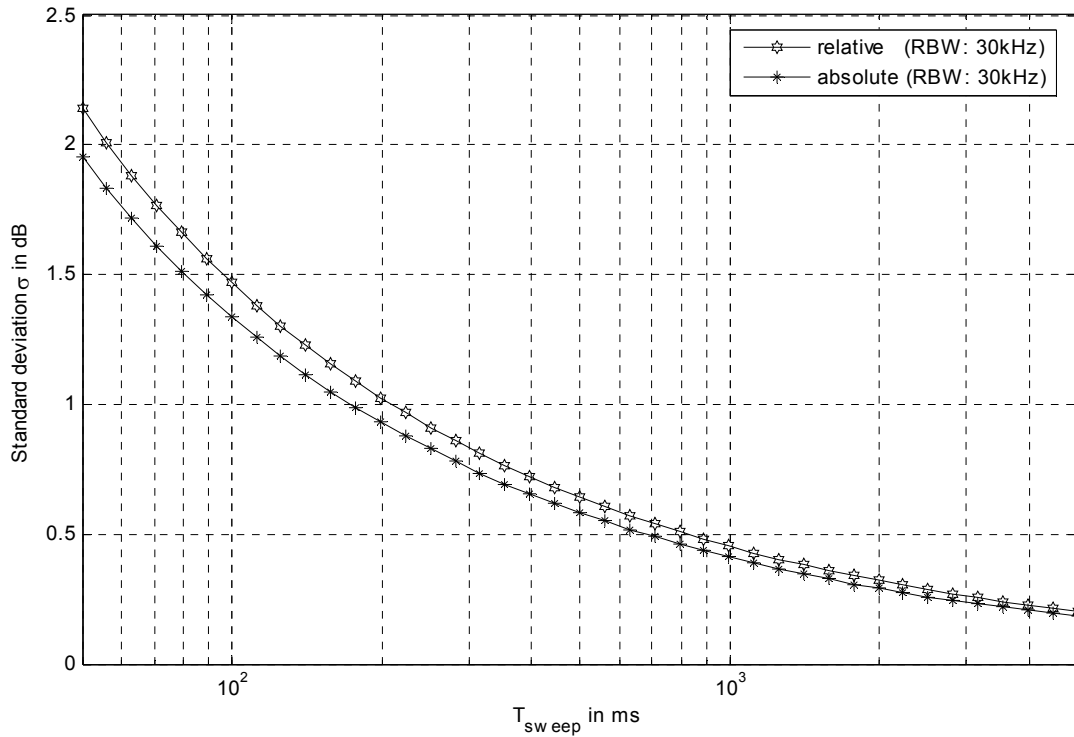
Measured (R&S®FSL) with RBW = 30 kHz, VBW = 300 kHz, OBW = 99 %, SWT = 200 ms, span = 11 MHz

| Occupied bandwidth | test case 6.5.1 | R&S®FSL |
|-------------------------|-----------------------------------|---|
| Measurement uncertainty | $P > -40$ dBm, span ≤ 10 MHz | < 38 kHz ($\sigma = 18$ kHz) PMU: < 100 kHz |

Measured (R&S®FSL) with RBW = 30 kHz, VBW = 300 kHz, span = 11 MHz

| Spectrum emission mask | test case 6.5.2.1 | |
|----------------------------|------------------------------|---|
| Dynamic range | $P_{\text{total}} > -20$ dBm | 55 dB |
| Relative level uncertainty | | < 0.25 dB + 2σ (T_{sweep}^1) PMU: < 1.5 dB |
| Absolute level uncertainty | | < 0.75 dB + 2σ (T_{sweep}^1) PMU: < 1.5 dB |

¹ The standard deviation σ (T_{sweep}) of Gaussian-distributed signals depends on the selected sweep time (T_{sweep}). Increasing the sweep time decreases the standard deviation (σ).



Standard deviation σ of spectrum emission mask measurement as a function of sweep time (T_{sweep})

Transmit modulation

| Composite EVM | test case 6.7.1 | |
|-------------------------|-----------------------------------|---|
| Measurement range | | 1.0 % to 25 % |
| Inherent EVM | | < 1.9 % |
| Measurement uncertainty | test models 1 to 5 P > -40 dBm | < 1 % ($\sigma = 0.3$ %) PMU: < 2.5 % |

| Peak code domain error power (PCDEP) | test case 6.7.2 | |
|--------------------------------------|-------------------------|--|
| Measurement range | -50 dB to 0 dB | 0 dB to -50 dB |
| Inherent PCDEP | | < -50 dB ($\sigma = 0.95$ dB) |
| Measurement uncertainty | -30 dB < PCDEP | < 0.15 dB ($\sigma = 0.05$ dB) PMU: < 1.0 dB |
| | -40 dB < PCDEP < -30 dB | < 0.15 dB ($\sigma = 0.05$ dB) PMU: < 1.0 dB |
| | -50 dB < PCDEP < -40 dB | < 0.15 dB ($\sigma = 0.05$ dB) PMU: < 1.0 dB |
| | -60 dB < PCDEP < -50 dB | < 0.15 dB ($\sigma = 0.05$ dB) PMU: < 1.0 dB |

R&S®FSL-K82 application firmware for CDMA2000® base station measurements

Frequency

| | | |
|-----------------|-----------|------------------------------|
| Frequency range | RF input | |
| | R&S®FSL3 | 3 MHz to 3 GHz |
| | R&S®FSL6 | 3 MHz to 6 GHz ² |
| | R&S®FSL18 | 3 MHz to 18 GHz ² |

Level

| | | |
|---------------|----------|--------------------|
| Level range | RF input | -60 dBm to +30 dBm |
| Level setting | | auto, manual |

Signal acquisition

| | | |
|---------------------|-------------------------------------|------------------------------|
| Supported standards | | CDMA2000® BTS IS-95 BTS |
| Capture length | | 2 to 12 power control groups |
| Sweep time | spectrum mask | max. 16000 s, auto |
| | ACPR (adjacent channel power ratio) | max. 16000 s |
| Sweep count | | 1 to 32767 |
| Trigger modes | RF input | free run, external |

Measurement parameters

| | | |
|--------------------------|----------------------|---|
| Frequency band | predefined bands | band classes 0 to 17 |
| | unspecified | limits can be user-specified |
| Link mode | | downlink (DL) |
| Modulation detection | | BPSK, QPSK, 8PSK, 16QAM |
| Predefined channel table | code domain analyzer | The predefined channel table allows the complete channel setup of the user signal for the code domain analyzer. |
| Spectrum emission mask | standard | in line with band classes 0 to 17 |
| | user | The spectrum emission mask measurement is performed based on either a manual user setting or a user-specified XML file. |

Result display

| | | |
|----------------------------------|--|---|
| Result summary | min./mean/current/max. values | global results: carrier frequency error (reading in Hz and ppm), chip rate error, trigger to frame, number of active channels |
| | | results for selected power control group: total power, pilot power, rho, composite EVM, I/Q imbalance, I/Q offset |
| | | results for selected power control group: absolute power, relative power, symbol EVM, modulation type, timing offset, phase offset |
| Code domain power | clear write, max. hold, min. hold, average, view | code domain power versus channel code domain error power versus channel |
| Peak code domain error | clear write, max. hold, min. hold, average, view | peak code domain error power versus power control group |
| Power versus power control group | clear write, max. hold, min. hold, average, view | power versus power control group for selected channel |

² All the values specified for R&S®FSL-K82 in this data sheet are valid up to 3 GHz.

| | | |
|-------------------------------------|---|---|
| Channel table | clear write, max. hold, min. hold, average, view | numeric result table for all channels including the following readings per channel: channel type, channel number, spreading factor, symbol rate, radio configuration, state, absolute power, relative power, timing offset, phase offset |
| Composite EVM | clear write, max. hold, min. hold, average, view | EVM versus power control group |
| EVM versus symbol | clear write, max. hold, min. hold, average, view | EVM versus symbol for selected channel and power control group |
| Power versus symbol | clear write, max. hold, min. hold, average, view | power versus symbol for selected channel and power control group |
| Channel constellation | clear write | constellation diagram for selected channel and power control group |
| Composite constellation | clear write | constellation diagram for composite signal |
| Bit stream | clear write | bit stream for selected channel and power control group |
| Output power | clear write, max. hold, min. hold, average, view, blank | integrated signal power over channel bandwidth |
| Adjacent channel power | clear write, max. hold, min. hold, average, view, blank | absolute and relative adjacent channel power |
| Multicarrier adjacent channel power | clear write, max. hold, min. hold, average, view, blank | spectrum mask limit check peak list evaluation |
| Occupied bandwidth | clear write, max. hold, min. hold, average, view, blank | occupied bandwidth measured in frequency domain |
| CCDF | clear write, view, blank | CCDF |

Measurement specification (nominal)

| | | |
|--|--|--|
| Composite EVM | | |
| Measurement range | | 1.7 % to 25 % |
| Inherent EVM | | < 1.7 % |
| Measurement uncertainty | | < 0.7 % of reading |
| Code domain power | | |
| Measurement range | | -60 dBm + 10 dBm |
| Level uncertainty, total power | | < 0.7 dB |
| Level uncertainty, pilot power | | < 0.7 dB |
| Level uncertainty, channel power, absolute | | < 0.7 dB |
| Level uncertainty, channel power, relative | | < 0.2 dB |
| Frequency error measurement | | |
| Lock range | | ±1 kHz |
| Measurement uncertainty | | 4 Hz + reference frequency uncertainty |
| Peak code domain error | | |
| Measurement range | | 0 dB to -50 dB |
| Inherent PCDE | | -50 dB |
| Trigger to frame | | |
| Measurement range | | < 100 µs |
| Accuracy | relative | ±110 ns |
| Rho | | |
| Measurement uncertainty | 0.9 to 1.0 | ±5 × 10 ⁻⁴ |
| Occupied bandwidth | | |
| Measurement uncertainty | 99 % power bandwidth, span 4.2 MHz | ±38 kHz |
| Spectrum emission mask | | |
| Dynamic range | $P_{total} > -20 \text{ dBm}$, $\Delta f = 750 \text{ kHz}$ | 60 dB |
| Level uncertainty | | 0.5 dB |
| Adjacent channel leakage ratio | | |
| Dynamic range | $P_{total} > -20 \text{ dBm}$ | 60 dB |
| Level uncertainty | | 0.5 dB |

R&S® FSL-K84 1xEV-DO base station measurement

Frequency

| | | |
|-----------------|-----------|------------------------------|
| Frequency range | RF input | |
| | R&S®FSL3 | 3 MHz to 3 GHz |
| | R&S®FSL6 | 3 MHz to 6 GHz ³ |
| | R&S®FSL18 | 3 MHz to 18 GHz ³ |

Level

| | | |
|---------------|----------|--------------------|
| Level range | RF input | -60 dBm to +30 dBm |
| Level setting | | auto, manual |

Signal acquisition

| | | |
|---------------------|--|--|
| Supported standards | | 1xEV-DO Revision 0 1xEV-DO Revision A |
| Capture length | | 2 to 12 power control groups |
| Sweep time | spectrum mask adjacent channel power ratio (ACPR) | max. 16000 s, auto max. 16000 s |
| Sweep count | | 1 to 32767 |
| Trigger modes | RF input | free run, external |

Measurement parameters

| | | |
|--------------------------|----------------------|--|
| Frequency band | predefined bands | band classes 0 to 17, |
| | unspecified | limits can be user-specified |
| Link mode | | downlink (DL) |
| Modulation detection | | automatic detection of BPSK, QPSK, 8PSK, 16QAM |
| Predefined channel table | code domain analyzer | The predefined channel table allows the complete channel setup of the user signal for the code domain analyzer |
| Spectrum emission mask | standard | in line with band classes 0 to 17 |
| | user | The spectrum emission mask measurement is performed based on either a manual user setting or a user-specified XML file |

Result display

| | | |
|-----------------|--|---|
| General results | clear write, max. hold, min. hold, average, view | <p>global results over all slots: carrier frequency error (reading in Hz and ppm), chip rate error, trigger to frame, rho of pilot channel over all slots, rho of MAC channel over all slots, rho of data channel over all slots, rho overall-1 (halfslot boundary), rho overall-2 (quarterslot boundary)</p> <p>results for selected slot: total power, pilot power, MAC power, data power, preamble power, rho, composite EVM</p> |
|-----------------|--|---|

³ All the values specified for R&S®FSL-K84 in this data sheet are valid up to 3 GHz.

| | | |
|-------------------------------------|---|---|
| Channel results | clear write, max. hold, min. hold, average, view | results for pilot channel: absolute power, peak code domain error, I/Q imbalance, IQ offset results for selected channel: symbol rate, timing offset, spreading factor, symbol EVM (reading in % RMS and % peak), modulation type, timing offset, phase offset, absolute channel power, relative channel power |
| Code domain power | clear write, max. hold, min. hold, average, view | code domain power versus channel |
| Peak code domain error | clear write, max. hold, min. hold, average, view | code domain error power versus channel |
| Channel table | clear write, max. hold, min. hold, average, view | peak code domain error power versus slot |
| Channel table | clear write, max. hold, min. hold, average, view | numeric result table for all active channels including the following readings per channel: channel type, channel number, spreading factor, symbol rate, modulation type, absolute power, relative power, timing offset, phase offset |
| Composite EVM | clear write, max. hold, min. hold, average, view | EVM versus slot |
| EVM versus symbol | clear write, max. hold, min. hold, average, view | EVM versus symbol for selected channel and slot |
| Power versus symbol | clear write, max. hold, min. hold, average, view | power versus symbol for selected channel and slot |
| Channel constellation | clear write | constellation diagram for selected channel and slot |
| Composite constellation | clear write | constellation diagram for composite signal |
| Bit stream | clear write | bit stream for selected channel and slot |
| Output power | clear write, max. hold, min. hold, average, view, blank | integrated signal power over channel bandwidth |
| Adjacent channel power | clear write, max. hold, min. hold, average, view, blank | absolute and relative adjacent channel power |
| Multicarrier adjacent channel power | clear write, max. hold, min. hold, average, view, blank | spectrum mask limit check |
| Spectrum emission mask | clear write, max. hold, min. hold, average, view, blank | peak list evaluation |
| Occupied bandwidth | clear write, max. hold, min. hold, average, view, blank | occupied bandwidth measured in frequency domain |
| CCDF | clear write, view, blank | CCDF |
| Power versus time | clear write, max. hold, min. hold, average, view, blank | check averaged halfslots against a limit mask in time domain; check separate limits for full slots and idle slots |

Measurement specification (nominal)

| | | |
|------------------------------------|----------|--|
| Composite EVM | | |
| Measurement range | | 1.7 % to 25 % |
| Inherent EVM | | < 1.7 % |
| Measurement uncertainty | | < 0.7 % |
| Code domain power | | |
| Measurement range | | -60 dBm to +10 dBm |
| Level uncertainty, total power | | < 0.7 dB |
| Level uncertainty, pilot power | | < 0.7 dB |
| Level uncertainty, channel power | absolute | < 0.7 dB |
| | relative | < 0.2 dB |
| Frequency error measurement | | |
| Lock range | | ±7 kHz |
| Measurement uncertainty | | 4 Hz + reference frequency uncertainty |
| Peak code domain error | | |
| Measurement range | | 0 dB to -53 dB |
| Inherent PCDE | pilot | -50 dB |
| | MAC | -47 dB |
| | data | -53 dB |
| | preamble | -50 dB |

| | | |
|---------------------------------------|--|------------------------|
| Trigger to frame | | |
| Measurement range | | < 100 μ s |
| Accuracy | relative | \pm 110 ns |
| Rho | | |
| Measurement uncertainty | 0.9 to 1.0 | $\pm 5 \times 10^{-4}$ |
| Occupied bandwidth | | |
| Measurement uncertainty | 99 % power bandwidth, span 4.2 MHz | \pm 38 kHz |
| Spectrum emission mask | | |
| Dynamic range | $P_{\text{total}} > -20$ dBm, $\Delta f = 750$ kHz | 60 dB |
| Level uncertainty | | < 0.5 dB |
| Adjacent channel leakage ratio | | |
| Dynamic range | $P_{\text{total}} > -20$ dBm | 60 dB |
| Level uncertainty | | < 0.5 dB |

R&S®FSL-K91 WLAN IEEE 802.11a/b/g/j OFDM analysis

R&S®FSL-K91n WLAN IEEE 802.11n OFDM analysis

The specifications of the R&S®FSL-K91 and R&S®FSL-K91n options are based on the data sheet of the R&S®FSL spectrum analyzer.

Specifications apply under the following conditions: 30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and all internal automatic adjustments performed. "Typical values" are designated with the abbreviation "typ." These values are verified during the final test but are not assured by Rohde & Schwarz. "Nominal values" are design parameters that are not assured by Rohde & Schwarz. These values are verified during product development but are not specifically tested during production.

OFDM analysis (IEEE 802.11a, IEEE 802.11g OFDM, IEEE 802.11j, IEEE 802.11n)

Frequency

| | | |
|-------------------|-----------|--|
| Frequency range | | |
| RF input | R&S®FSL3 | 50 MHz ⁴ to 3 GHz |
| | R&S®FSL6 | 50 MHz ⁴ to 6 GHz |
| | R&S®FSL18 | 50 MHz ⁴ to 18 GHz (overrange 20 GHz) |
| Frequency setting | | frequency |
| | | channel number |

Level

| | | |
|---------------|----------|---------------|
| Level range | RF input | up to +30 dBm |
| Level setting | | autorange |
| | | manual |

Signal acquisition

| | | |
|---------------------------------------|--|--|
| Supported standards | | IEEE 802.11a, IEEE 802.11g (OFDM), IEEE 802.11n (20 MHz), IEEE 802.11j (10 MHz), IEEE 802.11j (20 MHz) |
| Modulation format | | BPSK, QPSK, 16QAM, 64QAM |
| Demodulator setting | | auto, manual with/without test of signal field |
| Capture length | continuous | |
| | IEEE 802.11a, j | 24 µs to 15 ms |
| | IEEE 802.11g, n | 24 µs to 11.9 ms |
| Number of bursts that can be analyzed | manual | 1 to 10922 |
| Result length | PVT, spectrum FFT, CCDF | capture length, 1 to 10922 bursts or gate length |
| | EVM versus symbol and versus carrier, constellation versus symbol/versus carrier spectrum flatness, bit stream, signal field | capture length, 1 to 10922 bursts |
| Burst length | automatic detection of number of data symbols | 1 to 1366 data symbols |
| | manual | 1 to 1366 data symbols |
| Triggering | | free run, IF power, external |

⁴ 1 MHz to 50 MHz with restricted functionality depending on bandwidth (power trigger, auto level, IF overload).

Result display

| | | |
|-----------------------|------------------------------|--|
| Result list | min./mean/max. values | EVM all carriers |
| | | EVM pilots |
| | | EVM payload |
| | | I/Q offset |
| | | gain imbalance |
| | | quadrature error |
| | | center frequency error |
| | | symbol clock error |
| | | mean burst power |
| | | crest factor |
| Power versus time | | full burst |
| | | rising/falling edge |
| EVM | | EVM versus symbol |
| | | EVM versus carrier |
| Error versus preamble | | frequency error versus preamble |
| | | phase error versus preamble |
| Spectrum | | spectrum mask (IEEE & ETSI), ACP (IEEE 802.11j: abs./rel.), spectrum FFT |
| | | spectrum flatness |
| | | constellation diagram |
| Constellation | | constellation versus carrier |
| | | bit stream |
| Statistics | | signal field |
| | | CCDF |
| | | result list |
| Limit check | values in line with standard | EVM |
| | | spectrum mask |
| | | ACP |
| | | |

Adjustable parameters

| | | |
|--------------------|--|---------------|
| Pilot tracking | | phase ON/OFF |
| | | timing ON/OFF |
| | | level ON/OFF |
| Channel estimation | | data |
| | | preamble |

Measurement uncertainty (nominal) ⁵

| | | | |
|-------------------|---|--|----------------------------|
| Residual EVM | level -23 dBm to +15 dBm, average of 20 bursts | IEEE 802.11a/g/j signal | IEEE 802.11n signal 20 MHz |
| | input RF, f = 2.4 GHz/5 GHz | | |
| | channel estimation = preamble | -37 dB/-35 dB | -36 dB/-33 dB |
| | channel estimation = data | -40 dB/-38 dB | -40 dB/-36 dB |
| Frequency error | | | |
| Lock range | | 40 ppm | |
| Uncertainty | | 1 Hz + reference frequency uncertainty | |
| Level uncertainty | test of spectrum mask | 0.2 dB | |
| | output power | | |
| | f < 3 GHz | 0.5 dB | |
| | 3 GHz ≤ f ≤ 6 GHz | 0.8 dB | |
| | ACPR | 0.5 dB | |
| Spectrum flatness | | 0.5 dB | |

⁵ Valid for R&S®FSL3 without tracking generator: serial number ≥ 100838, R&S®FSL6 without tracking generator: serial number ≥ 100675, R&S®FSL3 with tracking generator: serial number ≥ 100704, R&S®FSL6 with tracking generator: serial number ≥ 100605.

DSSS/CCK/PBCC analysis (IEEE 802.11b, IEEE 802.11g CCK)

Frequency

| | | |
|-------------------|-----------|--|
| Frequency range | | |
| RF input | R&S®FSL3 | 50 MHz ⁶ to 3 GHz |
| | R&S®FSL6 | 50 MHz ⁶ to 6 GHz |
| | R&S®FSL18 | 50 MHz ⁶ to 18 GHz (overrange 20 GHz) |
| Frequency setting | | frequency |
| | | channel number |

Level

| | | |
|---------------|----------|---------------|
| Level range | RF input | up to +30 dBm |
| Level setting | | autorange |
| | | manual |

Signal acquisition

| | | |
|---------------------------------------|--|--|
| Supported standards | | IEEE 802.11b, IEEE 802.11g (CCK) |
| Modulation format | | DBPSK, DQPSK, CCK, short PLCP, long PLCP 5.5 Mbps, 11 Mbps PBCC |
| Demodulator setting | | auto |
| | | manual with/without test of signal field |
| Capture length | continuous | 24 µs to 11.9 ms |
| Number of bursts that can be analyzed | manual | 1 to 10922 |
| Result length | PVT, spectrum FFT, CCDF | capture length, 1 to 10922 bursts or gate length |
| | EVM versus symbol and versus carrier constellation versus symbol bit stream PLCP header | capture length, 1 to 10922 bursts |
| Burst length | automatic detection of number of data symbols | 1 to 4095 bytes |
| | manual | 1 to 4095 bytes |
| Triggering | | free run, IF power, external |

⁶ 1 MHz to 50 MHz with restricted functionality depending on bandwidth (power trigger, auto level, IF overload).

Result display

| | | |
|-----------------------|------------------------------|---|
| Result list | min./mean/max. values | peak vector error |
| | min./mean/max. values | burst EVM I/Q offset gain imbalance quadrature error center frequency error chip clock error rise time fall time mean burst power peak burst power crest factor |
| Power versus time | | up ramp/down ramp |
| EVM | | EVM versus symbol |
| Error versus preamble | | frequency error versus preamble phase error versus preamble |
| Spectrum | | spectrum mask, ACPR, spectrum FFT |
| Constellation | | constellation diagram |
| Statistics | | bit stream PLCP header CCDF |
| Limit check | values in line with standard | result list, power versus time, EVM, spectrum mask, ACP |

Adjustable parameters

| | | |
|----------|--|---|
| Tracking | | phase ON/OFF timing ON/OFF level ON/OFF |
|----------|--|---|

Measurement uncertainty (nominal)

| | | |
|-------------------|--|--|
| Residual EVM | level -23 dBm to +15 dBm average of 20 bursts, 11 Mbps CCK with short PLCP, burst EVM | |
| | f = 2.442 GHz | 1.8 % |
| Frequency error | | |
| Lock range | | ±0.6 MHz |
| Uncertainty | | 1 Hz + reference frequency uncertainty |
| Level uncertainty | test of spectrum mask | 0.2 dB |
| | output power | |
| | f < 3 GHz | 0.5 dB |
| | 3 GHz ≤ f ≤ 6 GHz | 0.8 dB |
| | ACPR | 0.5 dB |

R&S®FSL-K92 WiMAX™ IEEE 802.16 OFDM analysis (IEEE 802.16-2004, IEEE 802.16-2004/Cor1-2005, IEEE 802.16e-2005, P802.16-Rev2/D3 WiMAX™)

The specifications of the R&S®FSL-K92 WiMAX measurement application are based on the data sheet specifications of the R&S®FSL and R&S®ETL signal and spectrum analyzers, have not been checked separately and are not verified during instrument calibration. The specified level measurement errors do not take into account systematic errors due to reduced signal to noise ratio (S/N). Specifications apply under the following conditions: 30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and all internal automatic adjustments performed.

"Typical values" are designated with the abbreviation "typ.". These values are verified during the final test but are not assured by Rohde & Schwarz.

"Nominal values" are design parameters that are not assured by Rohde & Schwarz. These values are verified during product development but are not specifically tested during production.

Data without tolerance limits is not binding.

Frequency

| | | | |
|---------------------|-----------------------|-------------------------|-------------------------------|
| Frequency range | RF input | | |
| | R&S®FSL3 | | 9 kHz ⁷ to 3 GHz |
| | R&S®FSL6 | | 9 kHz ⁷ to 6 GHz |
| | R&S®FSL18 | | 9 kHz ⁷ to 18 GHz |
| | R&S®ETL | | 500 kHz ⁷ to 3 GHz |
| Frequency setting | | | frequency, channel number |
| Sampling rate F_s | model | serial number or lower | 1.44 MHz to 20 MHz |
| | R&S®FSL3 ⁸ | 100703 | |
| | R&S®FSL6 ⁸ | 100604 | |
| | R&S®FSL3 | 100945 | |
| | R&S®FSL6 | 100759 | |
| | R&S®ETL | | 1.44 MHz to 32 MHz |
| | model | serial number or higher | |
| | R&S®FSL3 ⁸ | 100704 | |
| | R&S®FSL6 ⁸ | 100605 | |
| | R&S®FSL3 | 100946 | |
| R&S®FSL6 | 100760 | | |
| | R&S®FSL18 | | 1.44 MHz to 32 MHz |

Level

| | | |
|---------------|----------|--------------------|
| Level range | RF input | -60 dBm to +30 dBm |
| Level setting | | auto, manual |

7 Restricted IF overload, power trigger and auto level functionality depending on carrier frequency and bandwidth at carrier frequencies < 50MHz.

8 With tracking generator.

Signal acquisition

| | | |
|---------------------------|--|--|
| Supported standards | | IEEE 802.16-2004 OFDM, IEEE 802.16e-2005 OFDM P802.16-Rev2/D3 OFDM |
| Capture length | | 24 μ s to 15.6 ms |
| Gate length | | 24 μ s to capture length |
| Number of analyzed bursts | | 1 to 10922 bursts |
| Result length | power versus time, EVM versus symbol, EVM versus carrier, frequency error versus preamble, phase error versus preamble, constellation versus symbol, constellation versus carrier, spectrum flatness, spectrum flatness difference, group delay, bit stream, burst summary | capture length ⁹ |
| | FFT spectrum, CCDF | capture length or gate length |
| | result summary | capture length ⁹ or 1 to 10922 bursts |
| Burst length | number of data symbols automatically detected, manually adjustable | 1 to 2425 |
| Sweep time | spectrum mask | 2.5 ms to 16000 s, auto |
| | adjacent channel power ratio (ACPR) | 10 ms to 16000 s |
| Sweep count | | 1 to 32767 |
| Trigger modes | RF input | free run, external, power |

Measurement parameters

| | | |
|--|------------------|--|
| Frequency band | predefined bands | preset combinations of sampling rate (F_s) and nominal channel bandwidth (BW) in line with standard |
| | unspecified | standard-compliant or user-defined F_s /BW ratios |
| Sampling rate (F_s), channel bandwidth (BW) | | If one of the parameters is set, the other is automatically set as required for the selected standard. The frequency band setting is taken into account |
| Guard period ratio $G = T_g/T_b$ | | 1/4, 1/8, 1/16, 1/32 |
| Link mode | | downlink (DL), uplink (UL) |
| Modulation detection | | none, first symbol, user, all (auto demod.) |
| Modulation format | | BPSK, QPSK, 16QAM, 64QAM |
| Subchannelization | uplink | ON/OFF |
| Subchannel index | uplink | 1 to 31 |
| UL physical modifier | uplink | 0 to 255 |
| Pilot tracking | | phase ON/OFF |
| | | timing ON/OFF |
| | | level ON/OFF |
| Channel estimation | | preamble, preamble and payload |
| Spectrum emission mask | standard | IEEE, ETSI |
| | user-definable | The spectrum emission mask is measured in line with the user setting files |

Result display

| | | |
|-------------------|-----------------------|---|
| Result summary | min./mean/max. values | EVM all carriers, EVM data carriers, EVM pilot carriers, I/Q offset, gain imbalance, quadrature error, frequency error, clock error, burst power, crest factor, RSSI, RSSI standard deviation, CINR, CINR standard deviation |
| Power versus time | | full burst |
| | | start/end |
| | | burst view depending on selected burst |
| EVM | min./mean/max. values | EVM versus symbol |
| | | EVM versus carrier |

⁹ Max. 2000 bursts per capture buffer.

| | | |
|-----------------------|---|---|
| Error versus preamble | min./mean/max. values | frequency error versus preamble phase error versus preamble |
| Spectrum | min./mean/max. values | spectrum flatness spectrum flatness difference |
| | min./mean/max. values clear write, max. hold | group delay IEEE ¹⁰ , ETSI ¹¹ , user-definable spectrum mask |
| | clear write, max. hold | ACPR (absolute/relative) |
| | clear write | FFT spectrum |
| Constellation | | constellation versus symbol constellation versus carrier |
| Statistics | | CCDF |
| | | bit stream |
| | | burst summary list |
| | | modulation format, burst length in symbols, power, EVM |

| | | |
|-------------|------------------------------|--|
| Limit check | values in line with standard | result list |
| | | EVM, I/Q offset, frequency error, clock error |
| | | spectrum flatness |
| | | spectrum flatness difference |
| | | spectrum mask |
| | | IEEE ¹² , ETSI ¹³ , user-definable |

Measurement uncertainty R&S[®]FSL (nominal)

| | | |
|-----------------------------------|---|--|
| Residual EVM ¹⁴ | level -30 dBm to +15 dBm, average of 20 bursts | |
| | f = 2.4 GHz | |
| | DL ¹⁵ , UL ¹⁶ channel estimation: preamble and payload | -40 dB |
| | f = 5 GHz | |
| | DL ¹⁵ , UL ¹⁶ channel estimation: preamble and payload | -37 dB |
| Frequency error | | |
| Max. measurement frequency window | DL ¹⁵ , UL ¹⁶ | 50 ppm |
| Uncertainty | | 1 Hz + R&S [®] FSL frequency uncertainty (see R&S [®] FSL reference frequency) |
| Level uncertainty | test of spectrum mask | like the R&S [®] FSL (see R&S [®] FSL total measurement uncertainty) |
| | output power | like the R&S [®] FSL (see R&S [®] FSL total measurement uncertainty) |
| | adjacent channel power ratio (ACPR) | like the R&S [®] FSL (see R&S [®] FSL total measurement uncertainty) |

¹⁰ In line with [1] IEEE 802.16-2004.

¹¹ In line with [10] ETSI EN 301 021 V1.6.1 (2003-07).

¹² In line with [1] IEEE 802.16-2004.

¹³ In line with [10] ETSI EN 301 021 V1.6.1 (2003-07).

¹⁴ Valid for R&S[®]FSL3 with tracking generator serial number ≥ 100704 , R&S[®]FSL6 with tracking generator serial number ≥ 100605 , R&S[®]FSL3 serial number ≥ 100946 , R&S[®]FSL6 serial number ≥ 100760 , R&S[®]FSL18.

¹⁵ This result is based on the following downlink signal: BW = 10 MHz, $T_g/T_b = 1/8$. The downlink subframe contains one burst of 30 OFDM symbols using a QPSK modulation format.

¹⁶ This result is based on the following uplink signal: BW = 10 MHz, $T_g/T_b = 1/8$. The uplink subframe contains one burst of 30 OFDM symbols using a QPSK modulation format.

Measurement uncertainty R&S®ETL¹⁷ (nominal)

| | | |
|-----------------------------------|---|--|
| Residual EVM | level -30 dBm to +10 dBm, average of 20 bursts | |
| | f = 2.4 GHz | |
| | DL ¹⁵ , UL ¹⁶ channel estimation: preamble and payload | -39 dB |
| Frequency error | | |
| Max. measurement frequency window | DL ¹⁵ , UL ¹⁶ | 50 ppm |
| Uncertainty | | 1 Hz + R&S®ETL frequency uncertainty (see R&S®ETL reference frequency) |
| Level uncertainty | test of spectrum mask | like the R&S®ETL (see R&S®ETL total measurement uncertainty) |
| | output power | like the R&S®ETL (see R&S®ETL total measurement uncertainty) |
| | adjacent channel power ratio (ACPR) | like the R&S®ETL (see R&S®ETL total measurement uncertainty) |

¹⁷ Valid for R&S®ETL fitted with preselector option R&S®ETL-B203. The preselector state is off.

R&S®FSL-K93 WiMAX™/WiBro IEEE 802.16 OFDMA SISO analysis (IEEE 802.16-2004, IEEE 802.16-2004/Cor1-2005, IEEE 802.16e-2005, P802.16-Rev2/D3 WiMAX™ and WiBro)

The specifications of the R&S®FSL-K93 WiMAX™ measurement application are based on the data sheet specifications of the R&S®FSL and R&S®ETL signal and spectrum analyzers, have not been checked separately and are not verified during instrument calibration. The specified level measurement errors do not take into account systematic errors due to reduced signal to noise ratio (S/N). Specifications apply under the following conditions: 30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and all internal automatic adjustments performed.

"Typical values" are designated with the abbreviation "typ.". These values are verified during the final test but are not assured by Rohde & Schwarz.

"Nominal values" are design parameters that are not assured by Rohde & Schwarz. These values are verified during product development but are not specifically tested during production.

Data without tolerance limits is not binding.

Frequency

| | | | |
|---------------------|------------------------|-------------------------|--------------------------------|
| Frequency range | RF input | | |
| | R&S®FSL3 | | 9 kHz ¹⁸ to 3 GHz |
| | R&S®FSL6 | | 9 kHz ¹⁸ to 6 GHz |
| | R&S®FSL18 | | 9 kHz ¹⁸ to 18 GHz |
| | R&S®ETL | | 500 kHz ¹⁸ to 3 GHz |
| Sampling rate F_s | model | serial number or lower | 1.44 MHz to 20 MHz |
| | R&S®FSL3 ¹⁹ | 100703 | |
| | R&S®FSL6 ¹⁹ | 100604 | |
| | R&S®FSL3 | 100945 | |
| | R&S®FSL6 | 100759 | |
| | R&S®ETL | | 1.44 MHz to 32 MHz |
| | model | serial number or higher | |
| | R&S®FSL3 ¹⁹ | 100704 | |
| | R&S®FSL6 ¹⁹ | 100605 | |
| | R&S®FSL3 | 100946 | |
| | R&S®FSL6 | 100760 | 1.44 MHz to 32 MHz |
| | R&S®FSL18 | | |

Level

| | | |
|---------------|----------|--------------------|
| Level range | RF input | -60 dBm to +30 dBm |
| Level setting | | auto |
| | | manual |

¹⁸ Restricted IF overload, power trigger and auto level functionality depending on carrier frequency and bandwidth at carrier frequencies < 50MHz.

¹⁹ With tracking generator.

Signal acquisition

| | | |
|------------------------------|---|---|
| Supported standards | | IEEE 802.16-2004 OFDMA SISO IEEE 802.16-2004/Cor1-2005 OFDMA SISO IEEE 802.16e-2005 OFDMA SISO P802.16-Rev2/D3 OFDMA SISO IEEE 802.16e-2005 based WiBro |
| Capture length | | 24 μ s to 15.6 ms |
| Gate length | | 24 μ s to capture length |
| Number of analyzed subframes | | 1 to 10922 subframes |
| Result length | EVM versus symbol, burst summary list, constellation versus symbol, bit stream | capture length ²⁰ |
| | FFT spectrum, CCDF | capture length or gate length |
| | result summary, power versus time, EVM versus carrier, spectrum flatness, spectrum flatness difference, group delay, frequency error versus sample, phase error versus sample | capture length ²⁰ or 1 to 10922 subframes |
| Frame length | | 2 ms to 15 ms |
| Sweep time | spectrum mask | 2.5 ms to 16000 s, auto |
| | adjacent channel power ratio (ACPR) | 10 ms to 16000 s |
| Sweep count | | 1 to 32767 |
| Trigger modes | RF input | free run, external, power |

Measurement parameters

| | | |
|---|---------------------|---|
| Frequency band | predefined bands | preset combinations of sampling rate (F_s) and nominal channel bandwidth (BW) in line with standard |
| | unspecified | standard-compliant or user-defined F_s /BW ratios |
| Sampling rate (F_s), channel bandwidth (BW) | | If one of the parameters is set, the other is automatically set as required for the selected standard. The frequency band setting is taken into account |
| Guard period ratio $G = T_g/T_b$ | | 1/4, 1/8, 1/16, 1/32 |
| N_{FFT} Zones | downlink (DL) | DL-PUSC, DL-FUSC, DL-AMC 2x3 |
| | uplink (UL) | UL-PUSC, UL-AMC 2x3 |
| Signal analysis | DL | in line with signal DL-MAP (auto demod.), normal DL-MAP, compressed DL-MAP |
| | DL, UL | in line with user-defined frame configuration |
| IDcell | | 0 to 31 |
| Segments | DL-PUSC | 0, 1, 2 |
| Preamble | preamble mode, auto | derived from IDcell and segment setting in line with standard |
| | preamble mode, user | defined by preamble index in line with standard |
| Subchannel bitmap used | DL-PUSC | 6-bit mask allocating subchannel groups to a segment |
| Burst modulation format | | BPSK (pilots only), QPSK, 16QAM, 64QAM |
| Pilot tracking | DL, UL | phase ON/OFF, timing ON/OFF, level ON/OFF |
| | DL, UL | use pilots in line with standard ²¹ use detected pilots ²² |

²⁰ Max. 100 zones/subframes per capture buffer, max. 1000 bursts per capture buffer.

²¹ The application computes the pilot modulation sequence used for tracking in line with the standard.

²² The application detects the pilot modulation sequence used for tracking the signal to be analyzed.

| | | |
|--|----------------|---|
| Channel estimation range | DL | preamble only |
| | | preamble and payload |
| | | payload only |
| | UL | payload only |
| Zone editor | | |
| Zone/segment list | DL, UL | zone type, segment, length in symbols, offset in symbols, PermBase |
| | DL | PRBS_ID |
| Zone/segment map | | graphical display of frame content defined by zone/segment list |
| Max. number of zones/segments per subframe/frame | | 26 |
| Burst editor | | |
| Burst list | DL | modulation, number of subchannels, number of symbols, offset in subchannels, offset in symbols, boosting, burst type: FCH, DL-MAP, data, restricted HARQ |
| | UL | modulation, duration in slots, offset in subchannels, offset in symbols, burst type: data, restricted fast feedback |
| Burst map | | graphical display of zone/segment content defined by burst list |
| Max. number of bursts per zone/segment | | 32 |
| Spectrum emission mask | standard | IEEE, ETSI, TTA |
| | user-definable | The spectrum emission mask is measured in line with the user setting files. |

Result display

| | | |
|---------------------|--|---|
| Frame configuration | auto demodulation | burst map in line with decoded signal map |
| Result summary | analyzed subframes min./mean/max. values | center frequency error, clock error, TD power DL preamble, TD power subframe, TD power zone, crest factor, RSSI, RSSI standard deviation, CINR, CINR standard deviation |
| | analyzed zones/segments min./mean/max. values | BER pilots, EVM data and pilots, EVM data, EVM pilots, unmodulated subcarrier error, I/Q offset, gain imbalance, quadrature error, power DL preamble, power data and pilots, power data, power pilots |
| Power versus time | min./mean/max. values | full subframe rising/falling |
| EVM | min./mean/max. values | EVM versus symbol EVM versus carrier |
| Error versus sample | min./mean/max. values | frequency error versus sample phase error versus sample |
| Spectrum | min./mean/max. values | spectrum flatness spectrum flatness difference |
| | min./mean/max. values | group delay |
| | clear write, max. hold | IEEE ²³ , ETSI ²⁴ , TTA, user-definable spectrum mask |
| | clear write, max. hold | ACP (absolute/relative) |
| | clear write | FFT spectrum |
| Constellation | | constellation diagram versus symbol |

²³ In line with [1] IEEE 802.16-2004.

²⁴ In line with [10] ETSI EN 301 021 V1.6.1 (2003-07).

| | | |
|-------------|------------------------------|--|
| Statistics | | CCDF |
| | | bit stream |
| | downlink, uplink | erroneous pilots are highlighted ²⁵ |
| | | burst summary: modulation format, burst area in slots, power, EVM |
| Limit check | values in line with standard | result list |
| | | center frequency error, clock error, EVM data and pilots, EVM data, I/Q offset |
| | | spectrum flatness |
| | | spectrum flatness difference |
| | | spectrum mask |
| | | IEEE ²⁶ , ETSI ²⁷ , TTA, user-definable |

Measurement uncertainty R&S[®]FSL (nominal)

| | | |
|-----------------------------------|--|---|
| Residual EVM ²⁸ | level -30 dBm to +15 dBm, average of 20 bursts | |
| | f = 2.4 GHz | |
| | DL ²⁹ , UL ³⁰ | |
| | channel estimation: preamble and payload | -40 dB |
| | f = 5 GHz | |
| | DL ²⁹ , UL ³⁰ | |
| | channel estimation: payload | -37 dB |
| Frequency error | | |
| Max. measurement frequency window | DL ²⁹ , UL ³⁰ | 30 ppm |
| Uncertainty | | 1 Hz + R&S [®] FSL frequency uncertainty (see R&S [®] FSL reference frequency) |
| Level uncertainty | test of spectrum mask | like the R&S [®] FSL (see R&S [®] FSL total measurement uncertainty) |
| | output power | like the R&S [®] FSL (see R&S [®] FSL total measurement uncertainty) |
| | ACPR (adjacent channel power ratio) | like the R&S [®] FSL (see R&S [®] FSL total measurement uncertainty) |

²⁵ The detected pilot sequence is compared with the standard-conforming pilot sequence. The standard-conforming pilot sequence depends on the IDcell, frame number [UL], PRBS_ID [DL], PermBase [DL] user settings.

²⁶ In line with [1] IEEE 802.16-2004.

²⁷ In line with [10] ETSI EN 301 021 V1.6.1 (2003-07).

²⁸ Valid for R&S[®]FSL3 with tracking generator serial number ≥ 100704 , R&S[®]FSL6 with tracking generator serial number ≥ 100605 , R&S[®]FSL3 serial number ≥ 100946 , R&S[®]FSL6 serial number ≥ 100760 , R&S[®]FSL18.

²⁹ This result is based on the following downlink signal: BW = 8.75 MHz, $N_{FFT} = 1024$, all 30 subchannels assigned to segment 0. The segment contains a downlink PUSC zone with one burst of 30 subchannels and 30 OFDMA symbols using a QPSK modulation format.

³⁰ This result is based on the following uplink signal: BW = 8.75 MHz, $N_{FFT} = 1024$, all 35 subchannels being used. The uplink PUSC zone contains one burst of 35 subchannels and 30 OFDMA symbols using a QPSK modulation format.

Measurement uncertainty R&S[®]ETL³¹ (nominal)

| | | |
|-----------------------------------|--|--|
| Residual EVM | level -30 dBm to +10 dBm, average of 20 bursts | |
| | f = 2.4 GHz | |
| | DL ²⁹ , UL ³⁰ | channel estimation: preamble and payload -39 dB |
| Frequency error | | |
| Max. measurement frequency window | DL ²⁹ , UL ³⁰ | 30 ppm |
| Uncertainty | | 1 Hz + R&S [®] ETL frequency uncertainty (see R&S [®] ETL reference frequency) |
| Level uncertainty | test of spectrum mask | like the R&S [®] ETL (see R&S [®] ETL total measurement uncertainty) |
| | output power | like the R&S [®] ETL (see R&S [®] ETL total measurement uncertainty) |
| | ACPR (adjacent channel power ratio) | like the R&S [®] ETL (see R&S [®] ETL total measurement uncertainty) |

References

- [1] IEEE 802.16-2004, IEEE Standard for Local and Metropolitan Area Networks. October 1, 2004.
- [2] IEEE 802.16e-2005 and IEEE 802.16-2004/Cor1-2005. February 28, 2006. Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1.
- [3] P802.16-Rev2/D2 (December 2007) (is a revision of IEEE 802.16-2004 and consolidates material from IEEE 802.16e-2005, IEEE 802.16-2004/Cor1-2005, IEEE 802.16f-2005 and IEEE 802.16g-2007).
- [4] P802.16-Rev2/D3 (February 2008) (is a revision of IEEE 802.16-2004 and consolidates material from IEEE 802.16e-2005, IEEE 802.16-2004/Cor1-2005, IEEE 802.16f-2005 and IEEE 802.16g-2007).
- [10] ETSI EN 301 021 V1.6.1 (2003-07). Fixed radio systems; point-to-multipoint equipment; time division multiple access (TDMA); point-to-multipoint digital radio systems in frequency bands in the range 3 GHz to 11 GHz.

³¹ Valid for R&S[®]ETL fitted with preselector option R&S[®]ETL-B203. The preselector state is off.

Ordering information

| Designation | Type | Order No. |
|--|-----------|--------------|
| Spectrum Analyzer, 9 kHz to 3 GHz | R&S®FSL3 | 1300.2502.03 |
| Spectrum Analyzer, 9 kHz to 3 GHz, with tracking generator | R&S®FSL3 | 1300.2502.13 |
| Spectrum Analyzer, 9 kHz to 6 GHz | R&S®FSL6 | 1300.2502.06 |
| Spectrum Analyzer, 9 kHz to 6 GHz, with tracking generator | R&S®FSL6 | 1300.2502.16 |
| Spectrum Analyzer, 9 kHz to 18 GHz | R&S®FSL18 | 1300.2502.18 |
| Spectrum Analyzer, 9 kHz to 18 GHz, with tracking generator | R&S®FSL18 | 1300.2502.28 |
| TV Analyzer, 500 kHz to 3 GHz, with tracking generator | R&S®ETL | 2112.0004.13 |
| Accessories supplied | | |
| Power cable, quick start guide and CD-ROM (with operating manual and service manual) | | |
| Recommended extras | | |
| Printed manual (includes operating manual and service manual) | | 1300.3338.32 |

Options

| Designation | Type | Order No. | Retrofittable | Remarks |
|--|--------------|--------------|---------------|--|
| Options | | | | |
| OCXO Reference Frequency | R&S®FSL-B4 | 1300.6008.02 | yes | standard with the R&S®FSL18 |
| Additional Interfaces | R&S®FSL-B5 | 1300.6108.02 | yes | video out, IF out, noise source control, AUX port, R&S®NRP-Zxx power sensor |
| TV Trigger | R&S®FSL-B6 | 1300.5901.02 | yes | |
| Narrow Resolution Filters | R&S®FSL-B7 | 1300.5601.02 | yes | |
| Gated Sweep | R&S®FSL-B8 | 1300.5701.02 | yes | |
| GPIB Interface | R&S®FSL-B10 | 1300.6208.02 | yes | |
| RF Preamp (3/6 GHz) | R&S®FSL-B22 | 1300.5953.02 | yes | |
| DC Power Supply | R&S®FSL-B30 | 1300.6308.02 | yes | |
| NiMH Battery Pack 4.5 Ah | R&S®FSL-B31 | 1300.6408.02 | yes | requires R&S®FSL-B30 |
| Li-Ion Battery Pack 10 Ah with Battery Charger | R&S®ETL-B235 | 2112.0262.02 | yes | requires R&S®FSL-B30 |
| Firmware/Software | | | | |
| AM/FM/ϕM Measurement Demodulator | R&S®FSL-K7 | 1301.9246.02 | | |
| Bluetooth® TX Measurements (1.1 and 2.0 + EDR) | R&S®FSL-K8 | 1301.9398.02 | | |
| Power Sensor Support | R&S®FSL-K9 | 1301.9530.02 | | requires R&S®FSL-B5 or R&S®NRP-Z3/4 |
| Spectrogram Measurements | R&S®FSL-K14 | 1302.0913.02 | | |
| Cable TV and TV Measurements | R&S®FSL-K20 | 1301.9675.02 | | |
| Application Firmware for Noise Figure and Gain Measurements | R&S®FSL-K30 | 1301.9817.02 | | requires R&S®FSL-B5 and preamplifier |
| 3GPP FDD BTS Application Firmware | R&S®FSL-K72 | 1302.0620.02 | | |
| CDMA2000® Base Station Analysis | R&S FSL-K82 | 1308.7803.02 | | |
| 1xEV-DO Base Station Measurement | R&S FSL-K84 | 1302.0159.02 | | |
| WLAN IEEE 802.11a/b/g/j Application Firmware | R&S®FSL-K91 | 1302.0094.02 | | |
| Upgrade of R&S®FSL-K91 to IEEE 802.11n | R&S®FSL-K91n | 1308.7903.02 | | |
| WiMAX™ IEEE 802.16 OFDM Application Firmware | R&S®FSL-K92 | 1302.0236.02 | | |
| WiMAX™ IEEE 802.16 OFDM/OFDMA Application Firmware | R&S®FSL-K93 | 1302.0736.02 | | |
| Upgrade from R&S®FSL-K92 to R&S®FSL-K93 | R&S®FSL-K92U | 1302.0307.02 | | |

Recommended extras

| Designation | Type | Order No. |
|---|---------------------------|--------------|
| 19" Rackmount Adapter | R&S [®] ZZA-S334 | 1109.4487.00 |
| Soft Carrying Bag | R&S [®] FSL-Z3 | 1300.5401.00 |
| Protective Hard Cover | R&S [®] EVS-Z6 | 5201.7760.00 |
| Additional Charger Unit | R&S [®] FSL-Z4 | 1300.5430.02 |
| Matching Pad 75 Ω , L section | R&S [®] RAM | 0358.5414.02 |
| Matching Pad 75 Ω , series resistor 25 Ω | R&S [®] RAZ | 0358.5714.02 |
| Matching Pad 75 Ω , L section, N to BNC | R&S [®] FSH-Z38 | 1300.7740.02 |
| SWR Bridge, 5 MHz to 3 GHz | R&S [®] ZRB2 | 0373.9017.52 |
| SWR Bridge, 40 kHz to 4 GHz | R&S [®] ZRC | 1039.9492.52 |
| SWR Bridge, 10 MHz to 3 GHz (incl. Open, Short, Load calibration standards) | R&S [®] FSH-Z2 | 1145.5767.02 |

Power sensors supported by R&S® FSL-K9

| Designation | Type | Order No. |
|---|-------------|--------------|
| Average Power Sensor 10 MHz to 8 GHz, 200 mW | R&S®NRP-Z11 | 1138.3004.02 |
| Average Power Sensor 10 MHz to 18 GHz, 200 mW | R&S®NRP-Z21 | 1137.6000.02 |
| Average Power Sensor 10 MHz to 18 GHz, 2 W | R&S®NRP-Z22 | 1137.7506.02 |
| Average Power Sensor 10 MHz to 18 GHz, 15 W | R&S®NRP-Z23 | 1137.8002.02 |
| Average Power Sensor 10 MHz to 18 GHz, 30 W | R&S®NRP-Z24 | 1137.8502.02 |
| Power Sensor Module with Power Splitter DC to 18 GHz, 500 mW | R&S®NRP-Z27 | 1169.4102.02 |
| Power Sensor Module with Power Splitter DC to 26.5 GHz, 500 mW | R&S®NRP-Z37 | 1169.3206.02 |
| Average Power Sensor 9 kHz to 6 GHz, 200 mW | R&S®NRP-Z91 | 1168.8004.02 |
| Thermal Power Sensor 0 Hz to 18 GHz, 100 mW | R&S®NRP-Z51 | 1138.0005.02 |
| Thermal Power Sensor 0 Hz to 40 GHz, 100 mW | R&S®NRP-Z55 | 1138.2008.02 |
| Wideband Power Sensor 50 MHz to 18 GHz, 100 mW | R&S®NRP-Z81 | 1137.9009.02 |

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