

Product Datasheet - Technical Specifications



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N9321C Basic Spectrum Analyzer

9 kHz to 4 GHz



Definitions and Conditions

Specification

Describes the performance of parameters covered by the product warranty and apply to the full temperature range of 5 to 45 °C, unless otherwise noted.

Typical

Describes additional product performance information that is not covered by the product warranty. It is performance beyond specifications that 80 percent of the units exhibit with a 95 percent confidence level over the temperature range 20 to 30 °C. This data does not include measurement uncertainty.

Nominal

Indicates expected performance or describe product performance that is useful in the application of the product but are not covered by the product warranty.

The analyzer will meet its specifications when:

- It is within its calibration cycle
- It has been turned on at least 30 minutes
- It has been stored at an ambient temperature within the allowed operating range for at least two hours before being turned on; if it had previously been stored at a temperature range inside the allowed storage, but outside the allowed operating range

Frequency and Time Specifications

| | | Supplemental information |
|---|--|--|
| Frequency | | |
| Range | 9 kHz to 4 GHz | AC coupled |
| Resolution | 1 Hz | |
| Frequency reference | | |
| | Option PFR | Standard |
| Nominal frequency | 10 MHz | 10 MHz |
| Aging rate | $\pm 1 \times 10^{-7}/\text{Year}$ | $\pm 1 \times 10^{-6}/\text{Year}$ |
| Temperature stability | | |
| 20 °C to 30 °C | $\pm 1.5 \times 10^{-8}$ | |
| 5 °C to 45 °C | $\pm 5 \times 10^{-8}$ | $\pm 1 \times 10^{-6}$ |
| Achievable initial calibration accuracy | $\pm 4 \times 10^{-8}$ | $\pm 1 \times 10^{-6}$ |
| Frequency readout accuracy (start, stop, center, marker) | | |
| Marker resolution | $(\text{frequency span})/(\text{number of sweep point} - 1)$ | |
| Uncertainty | $\pm (\text{freq indication} \times \text{freq reference uncertainty}^1 + 1\% \times \text{span} + 20\% \times \text{resolution bandwidth} + \text{marker resolution} + 1 \text{ Hz})$ | |
| Sweep point | 461, fixed | |
| Marker frequency counter | | |
| Resolution | 1 Hz | |
| Accuracy | $\pm [(\text{marker freq} \times \text{freq reference uncertainty}^1) + (\text{counter resolution})]$ | RBW/Span ≥ 0.02 Marker level to displayed noise level $> 25 \text{ dB}$, frequency offset = 0 Hz |

1. Frequency reference uncertainty = Aging rate x period since adjustment + temperature stability.

| | | Supplemental information |
|--|--|---|
| Frequency span (FFT and swept mode) | | |
| Range | 0 Hz (zero span), 50 Hz to 4 GHz | |
| Resolution | 1 Hz | |
| Accuracy | $\pm (0.22\% \times \text{span} + \text{span}/(\text{sweep point} - 1))$ | Nominal |
| Sweep time and triggering | | |
| Range | 2 ms to 1000 s | Span \geq 100 Hz |
| | 600 ns to 1000 s | Span = 0 Hz (minimum resolution = 600 ns, when RBW \geq 30 kHz) |
| Mode | Continuous, Single | |
| Sweep time rule | Accuracy or Speed | |
| Trigger | Free run, video, external, RF burst | |
| Trigger slope | Selectable positive or negative edge | |
| Trigger delay | \pm 12 ms to \pm 12 s, nominal | Span = 0 Hz |
| Time gated sweep (Option TMG) | | |
| Gate sources | External | |
| | Periodic timer | Sync sources include free and external Period 0 to 20 s (It should be greater than gate delay plus gate length) Offset -5 to +5 s |
| Gate delay range | 12 μ s to 10 s | Resolution = 200 ns |
| Gate length range | 84 μ s to 10 s | Resolution = 200 ns |
| RBW range | \geq 1 kHz | VBW is fixed and equal to RBW for efficiency |

| | | Supplemental information |
|-----------------------------------|-------------------------------|--|
| Resolution bandwidth (RBW) | | |
| Range (-3 dB bandwidth) | 10 Hz to 3 MHz | In 1-3-10 sequence |
| Accuracy | ± 5%, nominal | < 10% when RBW = 3 MHz |
| Resolution filter shape factor | < 5:1, nominal | 60 dB/3 dB bandwidth ratio, digital, Gaussian-like |
| EMI bandwidth (CISPR compliant) | 200 Hz, 9 kHz, 120 kHz, 1 MHz | Option EMC required |
| Accuracy | ± 10%, nominal | |
| Resolution filter shape factor | < 5:1, nominal | -60 dB/-6 dB bandwidth ratio |
| Video bandwidth (VBW) | | |
| Range | 1 Hz to 3 MHz | In 1-3-10 sequence |
| Accuracy | ± 10%, nominal | VBW = 1 Hz to 1 MHz |

Amplitude Specifications

| | | Supplemental information |
|---|---|---|
| Measurement range | | |
| 100 kHz to 1 MHz | Displayed average noise level (DANL) to +10 dBm | Preamp off |
| 1 MHz to 4 GHz | Displayed average noise level (DANL) to +20 dBm | |
| Input attenuator range | 0 to 50 dB, in 1 dB steps | |
| Maximum damage level | | |
| Average continuous power | +33 dBm, 3 minutes maximum | Input attn \geq 20 dB, 2 MHz to 4 GHz |
| DC voltage | \pm 50 VDC maximum | |
| Level display range | | |
| Scale units | dBm, dBmV, dB μ V, W, V, dBmV EMF, dB μ V EMF, V EMF | |
| Marker level readout | 0.01 dB | Log scale |
| Resolution | < 1% of signal level | Linear scale |
| Number of traces | 4 | |
| Detectors | Normal, positive peak, sample, negative peak, average (video, RMS, voltage), quasi-peak (option EMC required) | |
| Trace function | Clear/write, maximum hold, minimum hold, average | |
| Frequency response | | |
| 20 to 30°C, 30% to 70% relative humidity, attenuation 20 dB, reference frequency 50 MHz | | |
| 9 to 100 kHz | \pm 0.5 dB nominal | Preamp off |
| 100 kHz to 3 GHz | \pm 0.7 dB | Preamp off |
| 3 to 4 GHz | \pm 0.85 dB | Preamp off |
| 100 kHz to 3 GHz | \pm 0.7 dB | Preamp on |
| 3 to 4 GHz | \pm 0.9 dB | Preamp on |

| | | Supplemental information |
|---|---------------------------------|-------------------------------------|
| Input attenuation switching uncertainty at 50 MHz | | |
| 1 to 50 dB attenuation | ± 0.2 dB, typical | Relative to 20 dB reference setting |
| Resolution bandwidth switching uncertainty | | |
| 10 Hz to 3 MHz RBW | +0.1 dB, nominal | |
| Total absolute amplitude accuracy | | |
| 20 to 30 °C, 30% to 70% RH, peak detector, RBW 1 kHz, VBW 300 Hz, sweep time Accuracy, input signal -50 to 0 dBm, preamp off, attenuation 20 dB. Add additional ± 0.3 dB when sweep time rule is set to Speed | | |
| At 50 MHz | ± 0.3 dB | |
| At all frequencies | ± (0.3 dB + frequency response) | |
| 100 kHz to 3 GHz | ± 0.60 dB | 95th percentile |
| 3 to 4 GHz | ± 0.65 dB | 95th percentile |
| Preamp on | | |
| At 50 MHz | ± 0.4 dB | |
| At all frequencies | ± (0.4 dB + frequency response) | |
| 100 kHz to 3 GHz | ± 0.60 dB | 95th percentile |
| 3 to 4 GHz | ± 0.65 dB | 95th percentile |
| Preamplifier (Option P04) | | |
| Frequency range | 9 kHz to 4 GHz | |
| Gain | 25 dB, nominal | 100 kHz to 4 GHz |
| | 15 dB, nominal | 9 to 100 kHz |

Dynamic Range Specifications

| 1 dB gain compression | | | |
|---|--------------------------------------|----------------------------|----------------------------|
| 20 to 30°C, frequency ≥ 50 MHz, Ref level > -20 dBm, nominal | | | |
| Mixer power level (dBm) = input power (dBm) – input attenuation (dB) when preamp off | | | |
| Total power at the preamp = total power at the input (dBm) – input attenuation (dB) when preamp on | | | |
| Preamp off | 50 to 200 MHz | +2 dBm | |
| | 200 to 500 MHz | +4 dBm | |
| | 500 MHz to 4 GHz | +7 dBm | |
| Preamp on | > -32 dBm, total power at the preamp | | |
| Displayed average noise level | Normalized to 1 Hz | Minimum RBW | |
| 20 to 30 °C, input terminated 50 Ω, 0 dB input attenuation, RBW = 1 kHz, RMS detector, average ≥ 40 | | | |
| Preamp off | 9 to 100 kHz | -100 dBm, nominal | -90 dBm, nominal |
| | 100 kHz to 1 MHz | -108 dBm, typical -127 dBm | -98 dBm, typical -117 dBm |
| | 1 to 10 MHz | -128 dBm, typical -146 dBm | -118 dBm, typical -136 dBm |
| | 10 to 500 MHz | -142 dBm, typical -146 dBm | -132 dBm, typical -136 dBm |
| | 500 MHz to 2.5 GHz | -141 dBm, typical -145 dBm | -131 dBm, typical -135 dBm |
| | 2.5 to 4 GHz | -140 dBm, typical -144 dBm | -130 dBm, typical -134 dBm |
| Preamp on | 9 to 100 kHz | -110 dBm, nominal | -100 dBm, nominal |
| | 100 kHz to 1 MHz | -131 dBm, typical -150 dBm | -121 dBm, typical -140 dBm |
| | 1 to 10 MHz | -148 dBm, typical -163 dBm | -138 dBm, typical -153 dBm |
| | 10 to 500 MHz | -161 dBm, typical -164 dBm | -151 dBm, typical -154 dBm |
| | 500 MHz to 2.5 GHz | -159 dBm, typical -162 dBm | -149 dBm, typical -152 dBm |
| | 2.5 to 4 GHz | -158 dBm, typical -161 dBm | -148 dBm, typical -151 dBm |

Spurious response

Input terminated and 0 dB input attenuation, preamp off 20 to 30 °C

| | |
|-------------------|----------------------------|
| Residual response | < -90 dBm, typical -98 dBm |
|-------------------|----------------------------|

-30 dBm signal at input mixer 20 to 30 °C

| | |
|------------------------|--|
| Input related spurious | < -75 dBc |
| | Exceptions: |
| | -65 dBc (F1 - 21.4 MHz, with F1 input frequency) |
| | -65 dBc (F1 - 5.35 MHz, with F1 input frequency) |

Mixer signal level at -30 dBm, input attenuation 0 dB, preamp off, 20 to 30 °C

| | | |
|----------------------------|-----------------|-----------|
| Second harmonic distortion | 50 MHz to 3 GHz | < -65 dBc |
|----------------------------|-----------------|-----------|

| | | |
|--|------------|-----------|
| | 3 to 4 GHz | < -70 dBc |
|--|------------|-----------|

Two -20 dBm tones at input mixer, spaced by 100 kHz, input attenuation 0 dB, preamp off, reference level > -20 dBm, 20 to 30 °C

| | | |
|---|------------------|--------------------------|
| Third order intermodulation distortion (third order intercept) | 50 to 300 MHz | +9 dBm, typical +12 dBm |
| | 300 MHz to 4 GHz | +11 dBm, typical +15 dBm |

Phase noise

20 to 30 °C, center frequency = 1 GHz

| | | |
|-----------------------|---------|----------------------------------|
| Offset from CF signal | 10 kHz | Typical -90 dBc/Hz |
| | 100 kHz | -98 dBc/Hz, typical -100 dBc/Hz |
| | 1 MHz | -119 dBc/Hz, typical -121 dBc/Hz |

Residual FM

| | |
|-------------------------|-------------------------------|
| 20 to 30 °C, RBW 100 Hz | ≤ 10 Hz p-p in 20 ms, nominal |
|-------------------------|-------------------------------|

Option Specifications

| | | Supplemental information |
|---|--|--|
| Tracking generator (Option TG4) | | |
| Frequency range | 5 MHz to 4 GHz | |
| Output level | 0 to -20 dBm | 1 dB steps |
| Resolution bandwidth | 3 kHz to 3 MHz | |
| Output flatness | 1 dB | Nominal |
| VSWR | < 2.0:1 | Nominal |
| Connector and impedance | Type-N female, 50 Ω | |
| Maximum safe reverse level | 30 dBm (1W) | Average total power |
| | ± 50 VDC | DC voltage |
| Reflection measurement (Option RM4, requires Option TG4) | | |
| Frequency range | 5 MHz to 4 GHz | |
| Frequency resolution | 100 kHz | |
| Output power | -4 to +2 dBm, nominal | |
| Measurement speed | 2 s (full span 5 MHz to 4 GHz) | |
| Number of data points | 461 | |
| Directivity of calibrator | > 40 dB | Mechanical OSL calibrator |
| Return loss | | |
| Range | 0 to 60 dB | |
| Accuracy | $20 \times \log_{10} (1.1 + 10^{-(D-RL)/20}) + 0.016 \times 10^{(-RL/20)} + 10^{(-3+RL/20)}$ | Nominal, after average D: Directivity of calibrator RL: Return loss of the DUT |
| Resolution | 0.01 dB | |

| | | Supplemental information |
|---|---|--|
| Voltage standing wave ratio | | |
| Range | 1 to 65 | |
| Resolution | 0.01 | |
| Accuracy | Refer to return loss accuracy | |
| Insertion loss | | |
| Range | 0 to 30 dB | |
| Resolution | 0.01 dB | |
| Distance-to-fault (DTF) | | |
| Vertical range | 0 to 60 dB | Return loss |
| | 1 to 65 | VSWR |
| Range | (Number of data points – 1) × resolution | Number of data points = 461 |
| Resolution (meter) | $(1.5 \times 10^8) \times (V_P)/(F_2 - F_1)$ Hz | VP is the cable's relative propagation velocity F ₂ is the stop frequency F ₁ is the start frequency |
| Immunity to interface | | |
| On-channel | +17 dBm | Nominal |
| On-frequency | -5 dBm | Nominal |
| AM/FM modulation analysis (Option AMA) | | |
| Frequency range | 10 MHz to 4 GHz | |
| Carrier power accuracy | ± 1.8 dB | Nominal |
| Carrier power range | -30 to +10 dBm | 100 kHz to 2 MHz |
| | -30 to +20 dBm | 2 MHz to 4 GHz |

| | | Supplemental information |
|---|------------------------|-----------------------------------|
| AM measurement (included in Option AMA) | | |
| Modulation rate | 20 Hz to 100 kHz | |
| Accuracy | 1 Hz | Nominal (modulation rate < 1 kHz) |
| | < 0.1% modulation rate | Nominal (modulation rate > 1 kHz) |
| Depth | 5 to 95% | |
| Accuracy | ± 4% | Nominal |
| FM measurement (included in Option AMA) | | |
| Modulation rate | 20 Hz to 200 kHz | |
| Accuracy | 1 Hz | Nominal (modulation rate < 1 kHz) |
| | < 0.1% modulation rate | Nominal (modulation rate > 1 kHz) |
| Deviation | 20 Hz to 400 kHz | |
| Accuracy | ± 4% | Nominal |
| ASK/FSK modulation analysis (Option DMA) | | |
| Frequency range | 2.5 MHz to 4 GHz | |
| Carrier power accuracy | ± 2 dB | Nominal |
| Carrier power range | -30 to +20 dBm | Nominal |
| Carrier power displayed resolution | 0.01 dBm | |
| ASK measurement (included in Option DMA) | | |
| Symbol rate range | 100 Hz to 100 kHz | |
| Modulation depth/index | 5 to 95% | |
| Accuracy | ± 4% | Nominal |
| Displayed resolution | 0.1% | |

| | | Supplemental information |
|---|---|-----------------------------|
| FSK measurement (included in Option DMA) | | |
| FSK deviation | 100 Hz to 400 kHz | |
| Symbol rate range | 100 Hz to 20 kHz | $1 \leq \beta^1 \leq 20$ |
| | 20 to 50 kHz | $1 \leq \beta \leq 8$ |
| | 50 to 100 kHz | $1 \leq \beta \leq 4$ |
| Accuracy | $\pm 4\%$ | Nominal |
| Displayed resolution | 0.01 Hz | |
| Channel scanner (Option SCN) | | |
| Scan modes | Top N, bottom N, and list | |
| Channels displayed | 1 to 20 | |
| Displayed orientation | Vertical | Number of channels ≤ 5 |
| | Horizontal | Number of channels > 5 |
| Chart | Bar chart, and time chart | |
| Log file | *.csv | |
| Spectrum monitor (Option MNT) | | |
| Display modes | Spectrogram | |
| | Spectrum trace | |
| | Combination of spectrogram and spectrum trace in one screen | |
| Port control | Disable or enable LAN or USB connectors | |

1. β is the ratio of frequency deviation to symbol rate (deviation/rate).

| | | Supplemental information |
|---|--|---|
| Security features (Option SEC) | | |
| Security erase method | Erase the entire user flash memory by writing single character “1” over all memory locations | Non-recoverable |
| Port control | Disable or enable LAN or USB connectors | |
| Task planner (Option TPN) | | |
| Task plan execution mode | Auto, manual, and manual if fail | |
| Task plan file | *.TPN | Complementary task plan editor is available with Keysight HSA and BSA PC software |
| Number of tasks | Maximum 20 in a single .TPN file | |
| Measurements supported | Spectrum analysis and power suite (channel power, ACPR and OBW) | |
| | For more information, visit www.keysight.com/find/taskplanner | |
| USB average power sensor support (Option PWM) | | |
| Power sensor supported | Keysight U2000 Series USB power sensor | |
| Frequency range | 9 kHz to 24 GHz | Sensor dependent |
| Dynamic range | -60 to +44 dBm | Sensor dependent |
| USB peak and average power sensor support (Option PWP) | | |
| Power sensor supported | Keysight U2020 and U2042/44 X-Series USB peak and average power sensor | |
| Frequency range | 50 MHz to 40 GHz | Sensor dependent |
| Dynamic range | -30 to +20 dBm | Sensor dependent |

| | | Supplemental information |
|--|-----------------------------------|--------------------------|
| Base band input (Option BB1) | | |
| Frequency range | 9 kHz to 10 MHz | |
| Frequency span | 100 kHz to 9.997 MHz | |
| Frequency resolution | 1 Hz | |
| Measurement ranged | DANL to +10 dBm (9 kHz to 2 MHz) | |
| | DANL to +20 dBm (2 MHz to 10 MHz) | |
| Overall amplitude accuracy | | |
| 20 to 30°C, 30 to 70% RH, peak detector, input signal -50 to 0 dBm, 95 th percentile | | |
| 9 to 100 kHz | ± 2.5 dB | |
| 100 kHz to 10 MHz | ± 1.5 dB | |
| Displayed average noise level | | |
| 20 to 30 °C, 30 to 70% RH, 10 Hz RBW, 1 Hz VBW, 50 Ω termination on input, 0 dB attenuation, RMS detector, Trace average > 40, reference level < -35 dBm | | |
| 9 to 100 kHz | -135 dBm | Nominal |
| 100 kHz to 10 MHz | -145 dBm | |
| Phase noise | | |
| F _c = 5 MHz, RBW = 1 kHz, VBW = 30 Hz. Ref level -30 dBm, input attenuation 0 dB, input signal -20 dBm, average > 40 | | |
| Offset 30 kHz | -120 dBc/Hz | Nominal |
| Offset 100 kHz | -127 dBc/Hz | Nominal |
| Offset > 200 kHz | -130 dBc/Hz | Nominal |

| | | Supplemental information |
|--|---------------------|--|
| Base band input (Option BB1, continued) | | |
| Residual response | | |
| | < -120 dBm, nominal | 20 to 30°C, Ref level < -35 dBm 50 Ω termination on input 0 dB attenuation |
| Second harmonic distortion | | |
| | < -55 dBc nominal | F > 100 kHz Signal level -30 dBm Ref level -30 dBm Attenuation 0 dB |
| Third order intermodulation distortion | | |
| | < -55 dBc, nominal | F > 100 kHz -20 dBm tones at 100 kHz apart Ref level -20 dBm Attenuation 0 dB |

Inputs and Outputs

| Front panel | | |
|-------------------------|--------------------------------------|---|
| RF input connector | N-type female, 50 Ω , nominal | |
| VSWR | 10 MHz to 3 GHz | < 1.5:1, nominal, \geq 10 dB attenuation |
| | 3 to 4 GHz | < 2.0:1, nominal, \geq 10 dB attenuation |
| Calibration output | Amplitude | -25 ± 0.25 dBm |
| | Frequency | 40 MHz |
| | Connector and impedance | BNC-type female, 50 Ω , nominal |
| Probe power | Voltage/Current | +15 V, 150 mA maximum |
| | | -12.6 V, 150 mA maximum |
| RF output connector | N-type female, 50 Ω , nominal | Option TG4 installed |
| USB interface (host) | A plug, version 1.1 | |
| Rear panel | | |
| 10 MHz reference output | Output amplitude | > 0 dBm |
| | Frequency | 10 MHz \pm (10 MHz \times frequency reference accuracy) |
| | Connector and impedance | BNC-type female, 50 Ω , nominal |
| 10 MHz reference input | Input amplitude | -5 to +10 dBm, nominal |
| | Frequency | 10 MHz |
| | Connector and impedance | BNC-type female, 50 Ω , nominal |
| External trigger input | Input amplitude | 5 V TTL level, -12.6 V, 150 mA max (nominal) |
| | Connector and impedance | BNC-type female, 10 k Ω |
| LAN TCP/IP interface | 100Base-T, RJ-45 connector | |
| USB interface (device) | B plug, version 1.1 | |
| Mini USB (device) | Mini-AB female, version 1.1 | |
| GPIB interface | IEEE-488 bus connector | Optional G01 installed |

General

| Temperature and relative humidity | |
|--|---------------|
| Operating temperature range | +5 to +45 °C |
| Storage temperature range | -20 to +70 °C |
| Relative humidity | < 95% |
| EMC | |
| Complies with European EMC Directive 2014/30/EU | |
| IEC/EN 61326-1 | |
| CISPR Pub 11 group 1, class A | |
| AS/NZS-AS CISPR 11:2017 | |
| ICES/NMB-001 | |
| This ISM device complies with Canadian ICES-001 | |
| Cet appareil ISM est conforme à la norme NMB-001 du Canada | |
| Safety | |
| Complies with European Low Voltage Directive 2014/35/EU | |
| · IEC/EN 61010-1 3.1 Edition | |
| · Canada: CAN/CSA-C22.2 No 61010-1-12 | |
| · USA: UL 61010-1 3.1 Edition | |
| Audio noise | |
| Normal position. Per ISO 7779. | |
| Acoustic noise emission | LpA < 70 dB |

Environmental stress

Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of storage, transportation, and end-use; those stresses include, but are not limited to, temperature, humidity, shock, vibration, altitude, and power line conditions. Test methods are aligned with IEC 60068-2 and levels are similar to MILPRF-28800F Class 3

Power requirements

| | |
|---------------------------------|---|
| Voltage and frequency (nominal) | 100 to 240 VAC, 50 to 60 Hz, Auto ranging |
|---------------------------------|---|

| | |
|-------------------|-------------------------|
| Power consumption | ≤ 25 W, < 20 W, typical |
|-------------------|-------------------------|

Display

| | |
|------------|-----------|
| Resolution | 640 x 480 |
|------------|-----------|

| | |
|------|--|
| Size | 165.1 mm (6.5 inch) diagonal (nominal) |
|------|--|

Data storage

| | |
|----------|---------------|
| Internal | 64 MB nominal |
|----------|---------------|

| | |
|----------|--|
| External | Supports USB 3.0 compatible memory devices |
|----------|--|

Weight (without options)

| | |
|-----|----------------------------|
| Net | 7.9 kg (17.4 lbs), nominal |
|-----|----------------------------|

| | |
|----------|-----------------------------|
| Shipping | 14.5 kg (30.9 lbs), nominal |
|----------|-----------------------------|

Dimensions

| | |
|--------|---------------------|
| Height | 132.5 mm (5.2 inch) |
| Width | 320 mm (12.6 inch) |
| Length | 400 mm (15.7 inch) |

Warranty

The N9321C spectrum analyzer is supplied with a five-year warranty

Calibration cycle

The recommended calibration cycle is one year. Calibration services are available through Keysight service centers

