



# EXG X-Series Signal Generator

## N5173B Microwave Analog

9 kHz to 13, 20, 31.8, or 40 GHz

### Data Sheet



Anticipate — Accelerate — Achieve



Agilent Technologies

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## Definitions

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**Specification (spec):** Specifications represent warranted performance of a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 0 to 55 °C, unless otherwise stated, and after a 45 minute warm-up period. The specifications include measurement uncertainty. Data represented in this document are specifications unless otherwise noted.

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**Typical (typ):** Typical (typ) 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 at room temperature (approximately 25 °C). Typical performance does not include measurement uncertainty.

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**Nominal (nom) or measured (meas):** Nominal (nom) or measured (meas) describes a performance attribute that is by design or measured during the design phase for the purpose of communicating sampled, mean or average performance, such as the 50 ohm connector or amplitude drift vs. time. This data is not warranted and is measured at room temperature (approximately 25 °C).

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# Frequency Specifications

| Range  |                                       |                           |                           |
|--|---------------------------------------|---------------------------|---------------------------|
| Frequency range                                      | Option 513                            | 9 kHz to 13 GHz           |                           |
|  | Option 520                            | 9 kHz to 20 GHz           |                           |
|  | Option 532                            | 9 kHz to 31.8 GHz         |                           |
|  | Option 540                            | 9 kHz to 40 GHz           |                           |
| Resolution   | 0.001 Hz (nom)                        |                           |                           |
| Phase offset   | Adjustable in nominal 0.1° increments |                           |                           |
| Frequency switching speed <sup>1</sup> ( ) = typical |                                       |                           |                           |
|  | Standard                              | Option UNZ <sup>2,4</sup> | Option UZZ <sup>3,4</sup> |
| CW mode  |                                       |                           |                           |
| SCPI mode  | (≤ 5 ms)                              | ≤ 1.15 ms (≤ 750 μs)      | < 1.65 ms (1 ms)          |
| List/step sweep mode                                 | (≤ 5 ms)                              | ≤ 900 μs (≤ 600 μs)       | < 1.4 ms (850 μs)         |

1. Time from receipt of SCPI command or trigger signal to within 0.1 ppm of final frequency or within 100 Hz, whichever is greater.

2. For export control purposes CW switching speed to within 0.05% of final frequency is 190 us (meas).

3. For export control purposes CW switching speed to within 0.05% of final frequency is > 400 us (nom) below 20 GHz and > 600 us (nom) above 20 GHz.

4. Specifications apply when status register updates are off.

| Frequency reference   |   |
|---|---|
| <b>Accuracy</b>   | $\pm$ aging rate<br>$\pm$ temperature effects<br>$\pm$ line voltage effects<br>$\pm$ initial setting accuracy   |
| Internal time base reference oscillator aging rate <sup>1</sup> | $< \pm 1 \times 10^{-7}$ /year (nom)<br>$< \pm 5 \times 10^{-10}$ /day after 30 days (nom)  |
| Initial achievable calibration accuracy                         | $\pm 4 \times 10^{-8}$ or $\pm 40$ ppb  |
| Adjustment resolution   | $< 1 \times 10^{-10}$ (nom)   |
| Temperature effects   | $< \pm 2 \times 10^{-8}$ from 20 to 30 °C (nom)   |
| Line voltage effects  | $< \pm 1 \times 10^{-9}$ for $\pm 10\%$ change (nom)  |
| Reference output  |   |
| Frequency   | 10 MHz  |
| Amplitude   | $\geq +4$ dBm, (nom) into 50 $\Omega$ load  |
| External reference input  |   |
| Input frequency standard  | 10 MHz  |
| Input frequency Option 1ER                                      | 1 to 50 MHz (in multiples of 0.1 Hz)  |
| Lock range  | $\pm 1$ ppm (nom)   |
| Amplitude   | 5 dBm $\pm 2$ dB (nom) <sup>2</sup>   |
| Impedance   | 50 $\Omega$ (nom)   |
| Waveform  | Sine or square  |
| Sweep modes (frequency and amplitude)                           |   |
| Operating modes   | Step sweep (equally spaced frequency and amplitude or logarithmically spaced frequency steps)<br>List sweep (arbitrary list of frequency and amplitude steps)<br>Simultaneously sweep waveforms with N5182B; see baseband generator section for more detail |
| Sweep range   | Within instrument frequency range   |
| Dwell time  | 100 $\mu$ s to 100s   |
| Number of points  | 2 to 65535 (step sweep)<br>1 to 3201 (list sweep)   |
| Step change   | Linear or logarithmic   |
| Triggering  | Free run, trigger key, external, timer, bus ( GPIB, LAN, USB)   |

1. Aging rate is determined by design as a function of the OCXO.

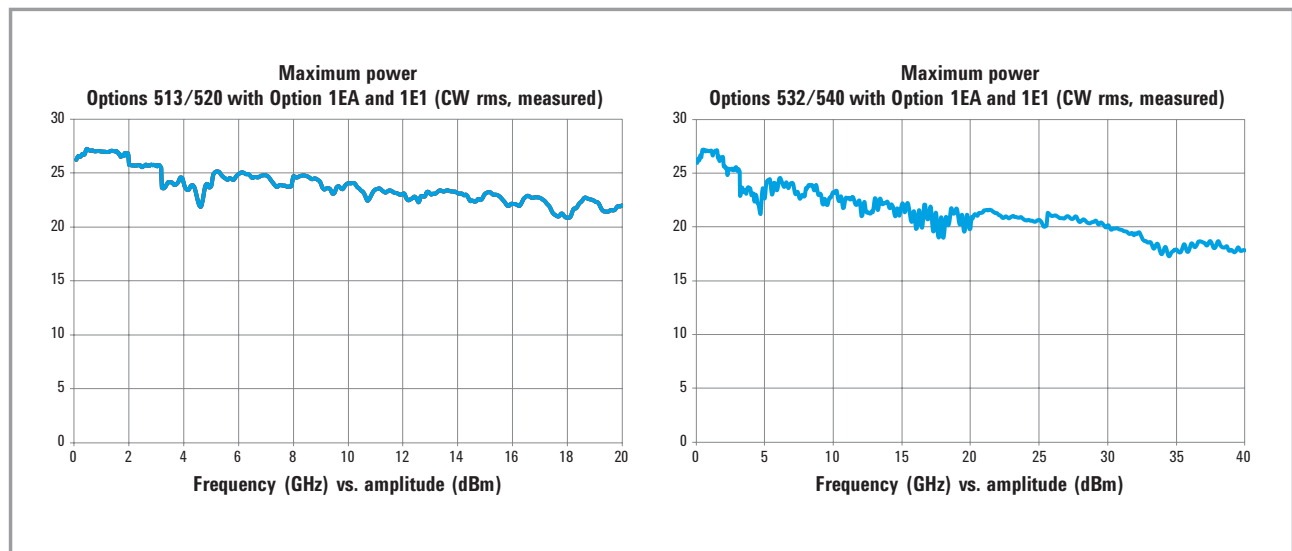
2. Inputs between +3 dBm to +20 dBm are allowed.

# Amplitude Specifications

| Output parameters                           |  |
|---|--|
| Settable range (with Option 1E1 and 1EA)    | +30 to -130 dBm  |
| Settable range (without Option 1E1 and 1EA) | +19 to -20 dBm   |
| Resolution                                  | 0.01 dB, (nom)   |
| Step attenuator (1E1)                       | 0 to 115 dB in 10 dB steps mechanical type   |
| Attenuator hold range                       | -15 dBm to maximum specified output power with step attenuator in 0 dB state; can be offset using option 1E1 mechanical attenuator |
| Connector                                   | 513/520 = 3.5 SMA male, 532/540 = 2.4 mm male, 50 Ω (nom)<br>(Option 1ED adds Type-N connector to a 513 or 520)                    |

| Max output power <sup>1</sup> (dBm, with or without step attenuator, Option 1E1) |          |                       |
|--|----------|-----------------------|
| Frequency  | Standard | High power Option 1EA |
| <b>Option 513, 520</b>   |          |                       |
| 9 kHz to 3.2 GHz   | +18      | +23                   |
| > 3.2 to 13 GHz  | +18      | +20                   |
| > 13 to 20 GHz   | +15      | +19                   |
| <b>Option 532, 540</b>   |          |                       |
| 9 kHz to 3.2 GHz   | +14      | +21                   |
| > 3.2 to 17 GHz  | +14      | +16                   |
| > 17 to 31.8 GHz   | +13      | +15                   |
| > 31.8 to 40 GHz   | +11      | +15                   |

1. Quoted specifications between 15 and 35 °C. Maximum output power typically decreases by 0.05 dB/°C for temperatures outside this range.

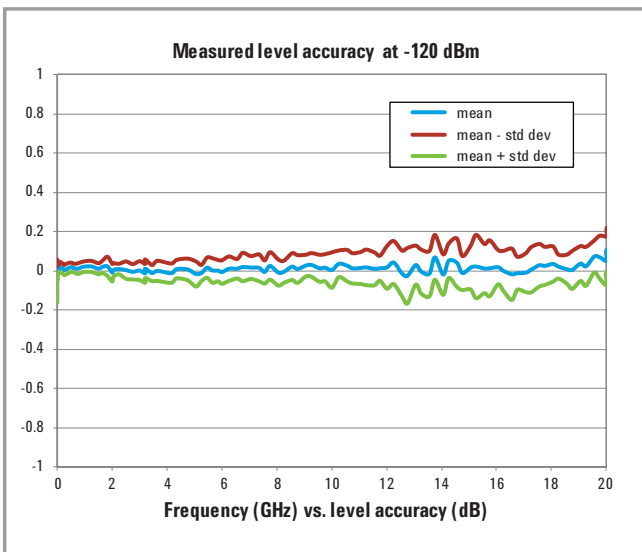
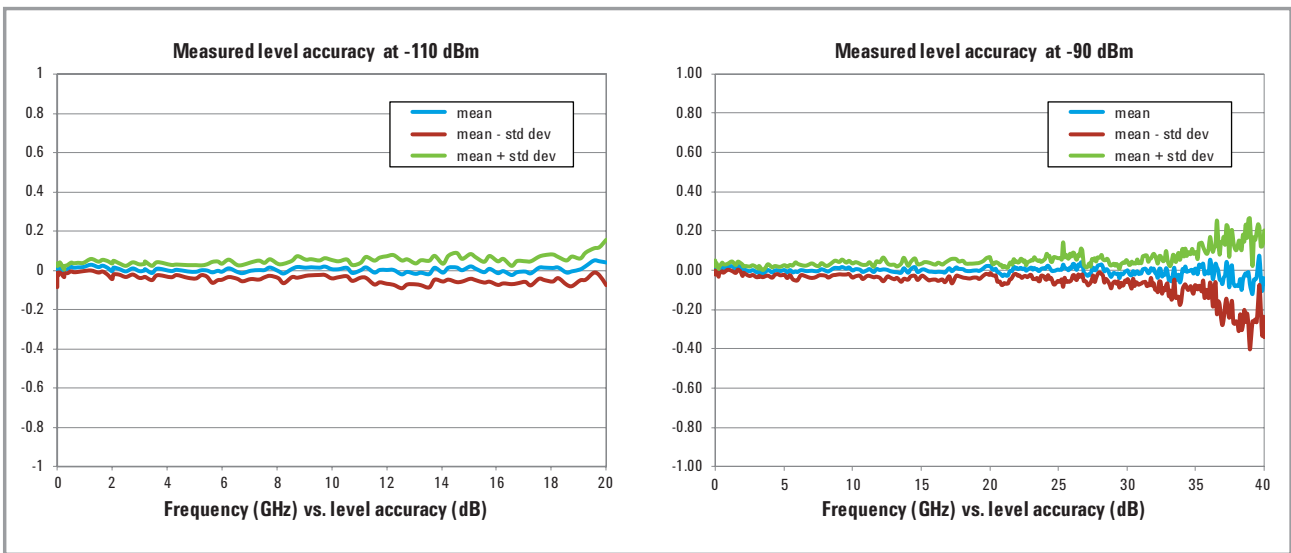


**Absolute level accuracy in CW mode<sup>1,2</sup> (ALC on) () = typical**

|                | With or without Option 1E1 |                  |                 | With Option 1E1  |                  |                   |
|----------------|----------------------------|------------------|-----------------|------------------|------------------|-------------------|
|                | Max power to +10 dBm       | < +10 to -10 dBm | < -10 to -20dBm | < -20 to -75 dBm | < -75 to -90 dBm | < -90 to -120 dBm |
| 9 kHz to 2 GHz | ± 0.6 dB                   | ± 0.6 dB         | ± 0.7 dB        | ± 0.7 dB         | ± 1.4 dB         | (± 0.3)           |
| > 2 to 20 GHz  | ± 0.9 dB                   | ± 0.7 dB         | ± 0.7 dB        | ± 0.7 dB         | ± 1.6 dB         | (± 0.3)           |
| > 20 to 40 GHz | ± 0.9 dB                   | ± 0.8 dB         | ± 1.1 dB        | ± 1.1 dB         | ± 2.0 dB         |                   |

1. Level accuracy applies between 15 °C and 35 °C. Specifications do not apply above the maximum specified power. For temperatures outside this range, absolute level accuracy degrades by 0.01 dB/degree C for frequencies ≤ 4.5 GHz and 0.02 dB/degree C for frequencies > 4.5 GHz.

2. For instruments with Type-N connectors (Option 1ED), specifications are degraded typically 0.2 dB above 18 GHz.



| SWR (measured CW mode) |                  |                  |
|------------------------|------------------|------------------|
| Frequency              | Attenuator state |                  |
|                        | 0 dB             | 5 dB and greater |
| ≤ 2 GHz                | < 1.7:1          | < 1.2:1          |
| > 2 to 8 GHz           | < 1.4:1          | < 1.4:1          |
| > 8 to 13 GHz          | < 1.6:1          | < 1.5:1          |
| > 13 to 20 GHz         | < 1.8:1          | < 1.7:1          |
| > 20 to 40 GHz         | < 1.6:1          | < 1.4:1          |

| External detector leveling <sup>1</sup> |                         |
|---|-------------------------|
| Range                                   | –0.2 mV to –0.5 V (nom) |
| Bandwidth                               | 10 kHz (typ)            |

| Amplitude switching speed <sup>2</sup> |                |
|--|----------------|
| SCPI mode                              | ≤ 2 ms (typ)   |
| Power search SCPI mode <sup>3</sup>    | < 12 ms (meas) |
| List/step sweep mode                   | ≤ 2 ms (typ)   |

| User flatness correction |  |
|--------------------------|--|
| Number of points         | 3201   |
| Number of tables         | Dependent on available free memory in instrument; 10,000 maximum   |
| Entry modes              | USB/LAN direct power meter control, LAN to GPIB and USB to GPIB, remote bus, and manual USB/GPIB power meter control |

| Sweep modes |  |
|-------------|--|
|             | See Frequency Specifications section for more detail |

1. Not intended for pulsed operation.

2. Time from receipt of SCPI command or trigger signal to amplitude settled within 0.2 dB. Specification does not apply when switching to or from frequencies < 5 MHz, or when ALC level is < 0 dBm, or when frequency crosses 0.002, 0.02, 0.1, 2.0, 3.2, 5.0, 6.4, 8, 10, 12.8, 16, 20, 25.6, or 32 GHz.

3. When ALC is off and power search mode is disabled amplitude switching is < 250 us (meas).

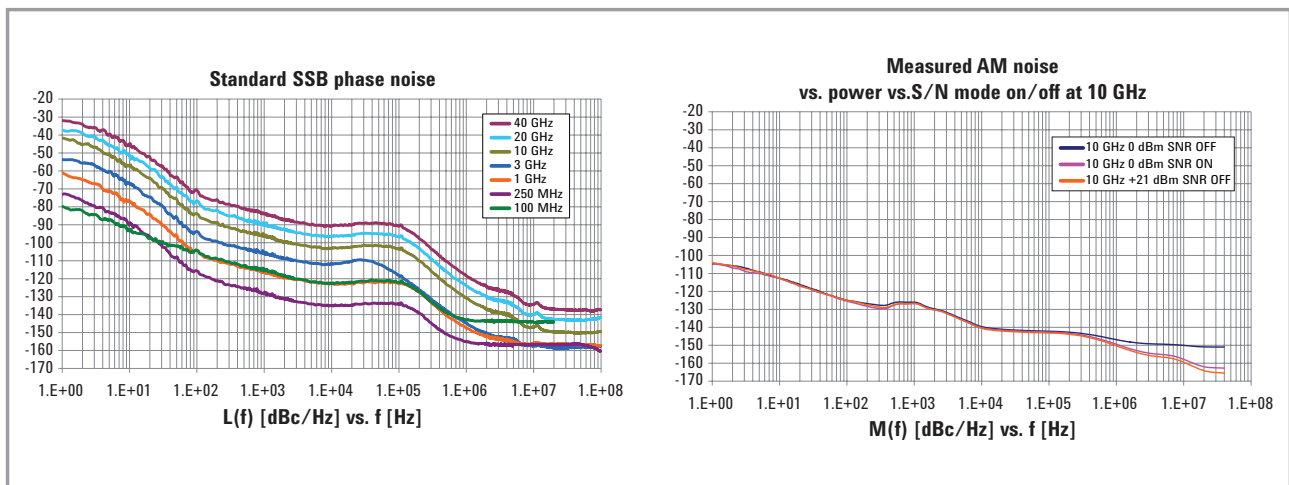
# Spectral Purity Specifications

| Standard absolute SSB phase noise (dBc/Hz) (CW) [at 20 kHz offset] <sup>1</sup> () = measured |             |
|---|-------------|
| 5 to < 250 MHz  | -115 (-120) |
| 250 MHz   | -129 (-134) |
| 500 MHz   | -124 (-128) |
| 1 GHz   | -118 (-122) |
| 2 GHz   | -111 (-116) |
| 3 GHz   | -105 (-110) |
| 4 GHz   | -104 (-110) |
| 6 GHz   | -99 (-104)  |
| 10 GHz  | -97 (-101)  |
| 20 GHz  | -90 (-95)   |
| 40 GHz  | -84 (-91)   |

| Standard absolute SSB phase noise (dBc/Hz) (CW) [at 100 Hz offset] () = measured |        |
|--|--------|
| 100 MHz  | (-104) |
| 250 MHz  | (-115) |
| 500 MHz  | (-110) |
| 1 GHz  | (-104) |
| 2 GHz  | (-97)  |
| 3 GHz  | (-93)  |
| 4 GHz  | (-91)  |
| 6 GHz  | (-89)  |
| 10 GHz   | (-83)  |
| 20 GHz   | (-76)  |
| 40 GHz   | (-70)  |

1. From 0 to 55 °C, measured at +10 dBm.





**Broadband noise<sup>1</sup> ( ) = measured**

|         |                |
|---------|----------------|
| 100 MHz | (-143 dBc/Hz)  |
| 500 MHz | (-155 dBc/Hz ) |
| 1 GHz   | (-163 dBc/Hz ) |
| 10 GHz  | (-150 dBc/Hz)  |
| 20 GHz  | (-143 dBc/Hz)  |
| 40 GHz  | (-135 dBc/Hz)  |

**Residual FM (CW mode, rms) See frequency band table for N value**

|                          |                    |
|--------------------------|--------------------|
| 0.3 to 3 kHz bandwidth   | < N* 0.5 Hz (meas) |
| 0.05 to 15 kHz bandwidth | < N* 3 Hz (meas)   |

**Residual AM (CW mode, +10 dBm, 0.3 kHz to 3 kHz bandwidth, rms)**

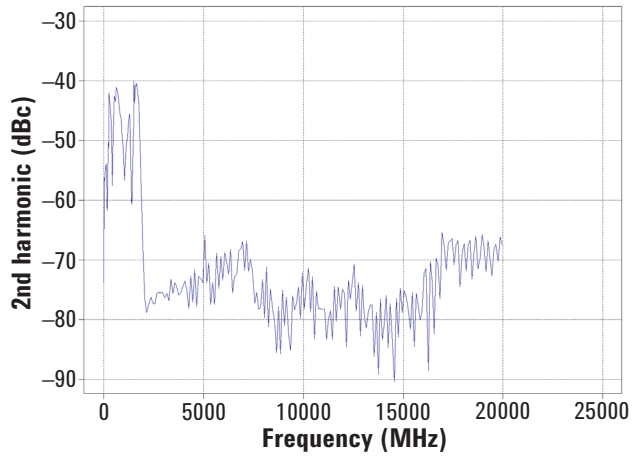
|         |                |
|---------|----------------|
| < 2 GHz | < 0.01% (meas) |
|---------|----------------|

**Harmonics [CW mode]<sup>2</sup> ( ) = typical**

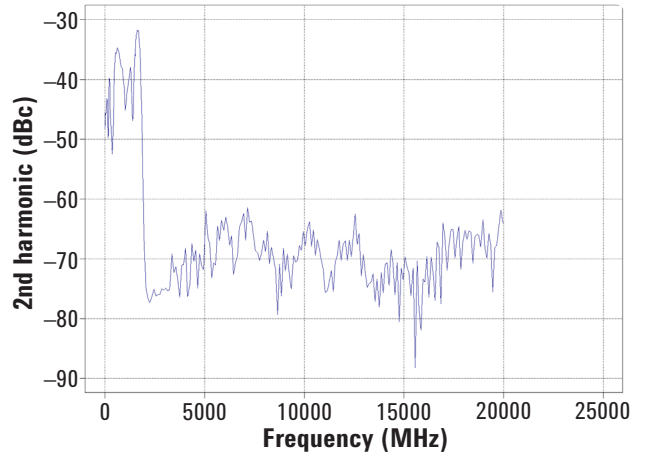
| Range              | CW mode at +10 dBm | CW mode at +20 dBm <sup>3</sup> |
|--------------------|--------------------|---------------------------------|
| 9 kHz to 200 MHz   | < -48 dBc (-54)    | < -38 dBc (-43)                 |
| > 200 MHz to 2 GHz | < -33 dBc (-40)    | < -25 dBc (-31)                 |
| > 2 to 20 GHz      | < -55 dBc (-65)    | < -50 dBc (-55)                 |

1. CW mode at +10 dBm for offsets > 10 MHz. In high signal to noise ratio mode (optimize S/N).
2. Specifications apply from +15 to +35 °C and are nominal for harmonics beyond specified frequency range.
3. Or maximum specified output power, whichever is lower.

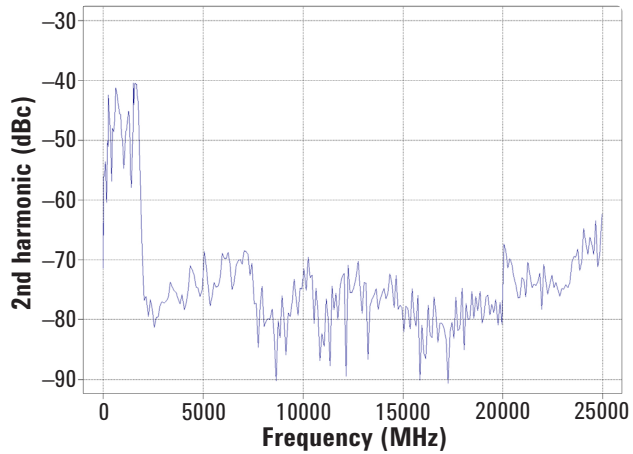
**Option 520 harmonics at +10 dBm (measured)**



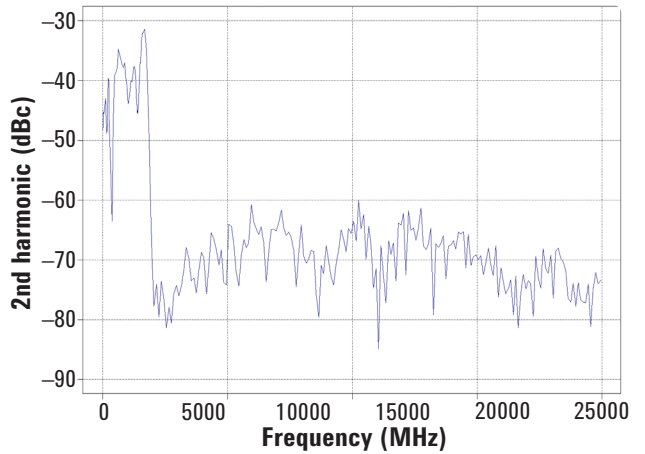
**Option 520 harmonics at +20 dBm (measured)**



**Option 540 harmonics at +10 dBm (measured)**



**Option 540 harmonics at +20 dBm (measured)**



| Nonharmonics (CW mode) <sup>1,2</sup> |                 |
|---------------------------------------|-----------------|
| Range                                 | > 10 kHz offset |
| Standard (dBc)                        |                 |
| 9 kHz to < 5 MHz                      | -65             |
| 5 to < 250 MHz                        | -75             |
| 250 to < 750 MHz                      | -78             |
| 750 MHz to < 1.5 GHz                  | -72             |
| 1.5 to < 3 GHz                        | -66             |
| 3 to < 20 GHz                         | -60             |
| 20 to 40 GHz                          | -54             |
| Subharmonics (CW mode)                |                 |
| 9 kHz to 1.5 GHz                      | None            |
| > 1.5 to 3.2 GHz                      | -75             |
| > 3.2 to 5 GHz                        | -67             |
| > 5 to 10 GHz                         | -67             |
| > 10 to 20 GHz                        | -56             |
| > 20 to 40 GHz                        | -53             |

1. CW mode at +10 dBm.

2. Power line related non-harmonics : 60 Hz to 300 Hz: < -50 dBc. Measured from 1 MHz to 40 GHz.

| Jitter <sup>1</sup> (measured) |                     |                   |         |             |
|--------------------------------|---------------------|-------------------|---------|-------------|
| Carrier frequency              | SONET/SDH data rate | rms jitter BW     | μUI rms | Picoseconds |
| 155 MHz                        | 155 MB/s            | 100 Hz to 1.5 MHz | 126     | 0.8         |
| 622 MHz                        | 622 MB/s            | 1 kHz to 5 MHz    | 62      | 0.1         |
| 2.488 GHz                      | 2488 MB/s           | 5 kHz to 20 MHz   | 251     | 0.1         |
| 9.953 GHz                      |                     | 10 kHz to 80 MHz  | 939     | 0.094       |
| 39.812 GHz                     |                     | 40 kHz to 320 MHz | 3408    | 0.086       |

1. Calculated from phase noise performance in CW mode at +10 dBm. For other frequencies, data rates, or bandwidths, please consult your sales representative.

# Analog Modulation Specifications

| Frequency bands |                      |                   |
|-----------------|----------------------|-------------------|
| Band #          | Frequency range      | N                 |
| 1               | 9 kHz to < 5 MHz     | Digital synthesis |
| 2               | 5 to < 250 MHz       | 1                 |
| 3               | 250 to < 375 MHz     | 0.25              |
| 4               | 375 to < 750 MHz     | 0.5               |
| 5               | 750 MHz to < 1.5 GHz | 1                 |
| 6               | 1.5 to < 3 GHz       | 2                 |
| 7               | 3 to < 6 GHz         | 4                 |
| 8               | 6 to < 12 GHz        | 8                 |
| 9               | 12 to < 24 GHz       | 16                |
| 10              | 24 to 40 GHz         | 32                |

| Frequency modulation (Option UNT) (See N value above)     |   |  |
|---|---|--|
| Max deviation   | N x 10 MHz (nom) <sup>1</sup>                                     |  |
| Resolution  | 0.025% of deviation or 1 Hz, whichever is greater (nom)           |  |
| Deviation accuracy  | < ± 2% + 20 Hz <sup>2</sup> [1 kHz rate, deviation is N x 50 kHz] |  |
| Modulation frequency response @ 100 KHz rate              | 1 dB bandwidth  | DC/5 Hz to 3 MHz (nom)   |
|   | 3 dB bandwidth  | DC/1 Hz to 7 MHz (nom)   |
| Carrier frequency accuracy<br>Relative to CW after DC cal | < ± 0.2% of set deviation + (N × 1 Hz) <sup>3</sup>               |  |
|   | < ± 0.06% of set deviation + (N × 1 Hz) (typ) <sup>4</sup>        |  |
| Distortion  | < 0.4% [1 kHz rate, deviation is N x 50 kHz]                      |  |
| FM using external inputs 1 or 2                           | Sensitivity   | +1 V peak for indicated deviation (nom)                                |
|   | Input impedance   | 50 Ω/600 Ω/1 MΩ (nom)  |
|   | Paths   | FM path 1 and FM path 2 are summed internally for composite modulation |

| Phase modulation (Option UNT) (See N value above) |  |  |
|---|--|--|
| Maximum deviation                                 | Normal bandwidth   | N × 5 radians (nom)  |
|   | High-bandwidth mode  | N × 0.5 radians (nom)  |
| Frequency response                                | Normal bandwidth (3 dB)  | DC to 1 MHz (nom)  |
|   | High-bandwidth mode (3 dB)                                       | DC to 4 MHz (nom)  |
| Resolution  | 0.1% of deviation  |  |
| Deviation accuracy                                | < +0.5% + 0.01 rad (typ) [1 kHz rate, normal BW mode]            |  |
| Distortion  | < 0.2% (typ) [1 kHz rate, N x 1 radian deviation normal BW mode] |  |
| ΦM using external inputs 1 or 2                   | Sensitivity  | +1 V peak for indicated deviation (nom)                                |
|   | Input impedance  | 50 Ω or 600 Ω or 1 MΩ (nom)  |
|   | Paths  | ΦM path 1 and ΦM path 2 are summed internally for composite modulation |

1. Digital synthesis band FM deviation is 5 MHz.

2. Specification applies from 15 to 35 °C.

3. Specification valid for temperature changes of less than ± 5 °C since last DC calibration.

4. Typical performance immediately after a DC calibration.

## Amplitude modulation (Option UNT) <sup>1</sup>

| Depth  |                     | Linear mode  | Exponential mode                        |
|--|---------------------|--|---|
| Settable depth<br>ALC ON with deep AM (default) or<br>ALC off <sup>2</sup> |                     | 0 to 100%  | 0 to 50 dB                              |
| Depth resolution   |                     | 0.1% (nom)   | 0.01 dB (nom)                           |
| AM depth accuracy<br>ALC on 3<br>[@ 1kHz rate, < 80% depth]                | f < 5 MHz           | < 1.5% of setting +1%<br>(typ 0.5% of setting +1%) | ± 2 dB @ 40 dB depth (typ) <sup>4</sup> |
|  | 5 MHz ≤ f ≤ 3.2 GHz | < 4% of setting + 1%                               | ± 2 dB @ 40 dB depth (typ) <sup>4</sup> |
|  | > 3.2 to 40 GHz     | (typ 3% of setting +1%)                            | ± 4 dB @ 40 dB depth (typ) <sup>4</sup> |

## Total harmonic distortion (@ 1 KHz rate)

|                    |           |               |
|--------------------|-----------|---------------|
| f < 5 MHz          | 30% depth | < 0.25% (typ) |
|                    | 80% depth | < 0.5% (typ)  |
| 5 MHz < f < 40 GHz | 30% depth | < 2%          |
|                    | 80% depth | < 3%          |

## Frequency response (30% depth, 3 dB BW)

|                    |                                  |
|--------------------|----------------------------------|
| 9 kHz to ≤ 3.2 GHz | DC/10 Hz to 50 kHz <sup>5</sup>  |
| > 3.2 to 40 GHz    | DC/10 Hz to 100 kHz <sup>5</sup> |

## AM inputs using External Inputs 1 and 2

|                 |  |
|-----------------|--|
| Sensitivity     | +1 V peak for indicated depth (over-range can be 200% or 2.2 V peak) |
| Input impedance | 50 Ω or 600 Ω or 1 MΩ, damage level: ± 5 V max                       |
| Paths           | AM Paths 1 and 2 are summed internally for composite modulation      |

## Simultaneous and composite modulation

|                         |  |
|-------------------------|--|
| Simultaneous modulation | All modulation types (FM, AM, φM and pulse modulation) may be simultaneously enabled except: FM and phase modulation cannot be combined; two modulation types cannot be simultaneously generated using the same modulation source. For example the Pulse, AM, and FM can run concurrently and all will modulate the output RF. This is useful for simulating signal impairments, FM chirp RADAR, or scan modulation. |
|-------------------------|--|

|                      |  |
|----------------------|--|
| Composite modulation | AM, FM, and φM each consist of two modulation paths which are summed internally for composite modulation. Modulation can be any combination of internal or external sources. |
|----------------------|--|

|       | AM | FM | Phase | Pulse |
|-------|----|----|-------|-------|
| AM    | +  | +  | +     | +     |
| FM    | +  | +  | –     | +     |
| Phase | +  | –  | +     | +     |
| Pulse | +  | +  | +     | –     |

+ = compatible, – = incompatible

1. AM specifications apply 6 dB below maximum specified power and down to –15 dBm for Option 520 or –20 dBm for Option 540 from 15 to 35 °C with ALC on.
2. ALC off is used for narrow pulse modulation and/or high AM depths with envelope peaks below ALC operating range. Carrier power level will be accurate after a power search is executed.
3. Deep AM with ALC on provides increased AM depths and improved distortion, together with closed-loop internal leveling. This mode requires a repetitive AM waveform (frequency > 10 Hz) with peaks > –5 dBm (nom), excluding step-attenuator setting).
4. ± 2 dB @ 40 dB, and 50 dB < 31.8 GHz, and ± 4 dB @ 50 dB > 31.8 GHz (meas).
5. From 5 MHz to 50 MHz carrier roll off is < 5 dB at 50 kHz rate. From 50 MHz to 3.2 GHz rate is useable up to 100 kHz. Above 3.2 GHz rate is useable to 1 MHz.

| External modulation inputs   |  |
|--|--|
| (Option UNT required for FM, AM, and phase modulation inputs; Option UNW required for pulse modulation inputs)   |  |
| EXT1   | AM, FM, PM   |
| EXT2   | AM, FM, PM   |
| PULSE  | Pulse (50 Ω only)  |
| Input impedance  | 50 Ω, 1 MΩ, 600 Ω, DC and AC coupled   |
| Standard internal analog modulation source   |  |
| (Waveform generator for use with AM, FM, phase modulation, and LF out; requires Option UNT)  |  |
| Waveform   | Sine, square, triangle, positive ramp, negative ramp   |
| Rate range   | 0.1 Hz to 2 MHz (tunable to 3 MHz)   |
| Resolution   | 0.1 Hz   |
| Frequency accuracy   | Same as RF reference source (nom)  |
| LF audio output  | 0 to 5 V peak into 50 Ω, -5 V to 5 V offset (nom)  |
| Multifunction generator (Option 303)   |  |
| The multifunction generator option (Option 303) consists of 7 waveform generators that can be set independently with up to 5 simultaneously using the composite modulation features in AM, FM/PM plus LF out |  |
| Waveform   |  |
| Function generator 1   | Sine, triangle, square, pos ramp, neg ramp, pulse  |
| Function generator 2   | Sine, triangle, square, pos ramp, neg ramp, pulse  |
| Dual function generator  | Sine, triangle, square, pos ramp, neg ramp, pulse, phase offset and amplitude ratio for Tone2 relative to Tone1      |
| Swept function generator   | Sine, triangle, square, pos ramp, neg ramp<br>Trigger: free run, trigger key, bus, external, internal, timer trigger |
| Noise generator 1  | Uniform, Gaussian  |
| Noise generator 2  | Uniform, Gaussian  |
| DC   | Only for LF output   |
| Frequency parameters   |  |
| Sine wave  | 0.1 Hz to 10 MHz   |
| Triangle, square, ramp, pulse  | 0.1 Hz to 1 MHz  |
| Noise bandwidth  | 10 MHz   |
| Resolution   | 0.1 Hz   |
| Frequency accuracy   | Same as RF reference source (nom)  |
| Narrow pulse modulation (Option UNW or UW2) <sup>1</sup>   |  |
| On/off ratio   | > 80 dB (typ) <sup>2</sup>   |
| Rise/fall times (Tr, Tf)   | < 10 ns; 7 ns (typ)  |
| Minimum pulse width ALC on/off <sup>3</sup>  | ≥ 1us (500 ns typ) / ≥ 20 ns   |
| Repetition frequency ALC on/off  | 10 Hz to 500 kHz / DC to 10 MHz  |
| Level accuracy (relative to CW) ALC on/off <sup>4</sup>  | ± 0.7 dB (± 0.5 typ) / (< ± 0.75 dB typ)   |
| Width compression (RF width relative to video out)   | < 5ns (typ)  |

1. Pulse specifications apply to frequencies > 100 MHz. and power set to > -3 dBm. Operable down to 10 MHz.

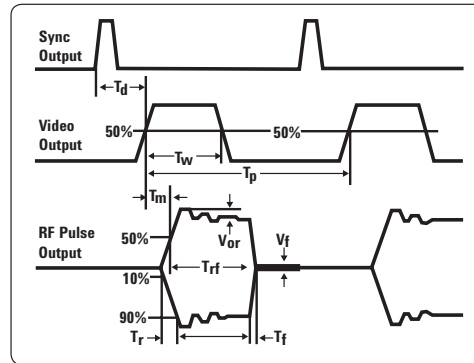
2. Above 35 GHz vernier > 0 dBm.

3. For export control purposes option UW2 limits minimum pulse width above 31.8 GHz to ≥ 500 ns.

4. With power search on.

|  |                                   |
|--|-----------------------------------|
| Video feed-through <sup>1</sup> < 3.2 / > 3.2GHz | < 50 mV (typ) / < 3 mV (typ)      |
| Video delay (external input to video)            | 40 ns, nominal                    |
| RF delay (video to RF output)                    | 45 ns, nominal                    |
| Pulse overshoot                                  | < 10% (typ)                       |
| Input level                                      | +1 V peak = RF On into 50 Ω (nom) |

Td video delay (variable)  
 Tw video pulse width (variable)  
 Tp pulse period (variable)  
 Tm RF delay  
 Trf RF pulse width  
 Tf RF pulse fall time  
 Tr RF pulse rise time  
 Vor pulse overshoot  
 Vf video feedthrough

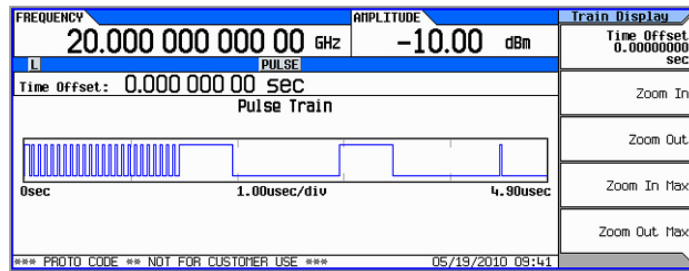


### Internal pulse generator (included with Option UNW or UW2)

|                                   |   |  |
|-----------------------------------|---|--|
| Modes                             | Free-run, square, triggered, adjustable doublet, trigger doublet, gated, and external pulse |  |
| Square wave rate                  | 0.1 Hz to 10 MHz, 0.1 Hz resolution (nom)   |  |
| Pulse period                      | 30 ns to 42 s (nom)   |  |
| Pulse width <sup>2</sup>          | 20 ns to pulse period –10 ns (nom)  |  |
| Resolution                        | 10 ns   |  |
| Adjustable trigger delay          | (–pulse period +10 ns) to (pulse width –10 ns)  |  |
| Settable delay                    | Free run  | –3.99 to 3.97 μs                                       |
|                                   | Triggered   | 0 to 40 s  |
| Resolution (delay, width, period) | 10 ns, nominal  |  |
| Pulse doublets                    | 1st pulse delay   | (Relative to sync out) 0 to 42 s – pulse width – 10 ns |
|                                   | 1st pulse width   | 20 ns to 42 s – delay – 10 ns                          |
|                                   | 2nd pulse delay   | 0 to 42 s – (delay1 + width2) – 10 ns                  |
|                                   | 2nd pulse width   | 20 ns to 42 s – (delay1 + delay2) – 10 ns              |

### Pulse train generator Option 320 (requires Option UNW or UW2)

|                                |               |
|--------------------------------|---------------|
| Number of pulse patterns       | 2047          |
| On/off time range <sup>2</sup> | 20 ns to 42 s |



1. Video feed through applies to power levels < +10 dBm.
2. For export control purposes option UW2 limits minimum pulse width above 31.8 GHz to ≥ 500 ns.

# General Characteristics

| Remote programming      |  |
|-------------------------|--|
| Interfaces              | GPIB IEEE-488.2, 1987 with listen and talk<br>LAN 1000BaseT LAN interface, LXI Class C compliant<br>USB Version 2.0  |
| Control languages       | SCPI Version 1997.0  |
| Compatibility languages | Agilent Technologies: N5181A\61A, N5182A\62A, N5183A, E4438C, E4428C, E442xB, E443xB, E8241A, E8244A, E8251A, E8254A, E8247C, E8257C/D, E8267C/D, 8648 series, 8656B, E8663B, 83711B/12B, 83731B/32B, 83751B/52B, 8340B/41B, 836xx series, 8664A, 8665A/B, 8644A, 8662A/63A<br>Aeroflex Incorporated: 3410 series<br>Rohde & Schwarz: SMR, SMF100A ,SMB100A, SMBV100A, SMU200A, SMJ100A, SMATE200A, SMIQ, SML, SMV<br>Anritsu: MG369xA/B/C |

## Power requirements

100 or 120 VAC, 50 or 60 Hz, 400 Hz  
220 or 240 VAC, 50 or 60 Hz  
280 Watts maximum

## Operating temperature range

0 to 55 °C

## Storage temperature range

-40 to 70 °C

## Operating and storage altitude

Up to 15,000 ft or 4,600 m

## Environmental stress

Samples of this product have been type tested in accordance with the Agilent 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 MIL-PRF-28800F Class 3.

## Safety

Complies with European Low Voltage Directive 2006/95/EC

- IEC/EN 61010-1, 3rd Edition
- Canada: CSA C22.2 No. 61010-1-12
- USA: UL 61010-1 3rd Edition

## EMC

Complies with European EMC Directive 2004/108/EC

- IEC/EN 61326
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- ICES/NMB-001



## Memory

Memory is shared by instrument states, user data files, sweep list files, and other files. Option 006 instrument security allows storage of up to 8 GB. Depending on how the memory is utilized, a maximum of 1000 instrument states can be saved.

## Security (Option 006)

Option 006 “Removable memory card & Instrument security” allows the following:

- Removable 8 GB solid state memory (SD card) from rear pane.
- User can force all files to be stored only on external memory card including instrument states, user data files, sweep list files, and other files
- Memory sanitizing, memory sanitizing on power on, and display blanking
- Disable USB ports

## Self-test

Internal diagnostic routines test most modules in a preset condition. For each module, if its node voltages are within acceptable limits, the module “passes” the test.

## Weight

N5173B-513/520: ≤ 14.5 kg (32 lb.) net, ≤ 29.5 kg (65 lb.) shipping

N5173B-532/540: ≤ 15.0 kg (33 lb.) net, ≤ 29.9 kg (66 lb.) shipping

## Dimensions

88 mm H x 426 mm W x 489 mm L (length includes rear panel feet)

(3.5 in H x 16.8 in W x 19.2 in L)

Max length (L) including RF connector tip to end of rear panel feet is 508 mm (20 in)

## Recommended calibration cycle

36 months

## ISO compliant

This instrument is manufactured in an ISO-9001 registered facility in concurrence with Agilent Technologies’ commitment to quality.

# Inputs and Outputs

| Front panel connectors (all connectors are BNC unless otherwise stated)  |  |
|--|--|
| RF output  | Output impedance 50 $\Omega$ (nom)   |
| Option 513/520   | Precision APC-3.5 male, or Type- N with Option 1ED   |
| Option 532/540   | Precision 2.4 mm male; plus 2.4—2.4 mm and 2.4-2.9 mm female adapters  |
| Maximum reverse power  | 0.5 W, 0 Vdc   |
| USB 2.0  | Used with a memory stick for transferring instrument states, licenses and other files into or out of the instrument. Also used with U2000 Series USB average power sensors.  |
| Rear panel connectors  |  |
| Rear panel inputs and outputs are 3.3 V CMOS, unless indicated otherwise. CMOS inputs will accept 5 V CMOS, 3 V CMOS, or TTL voltage levels. |  |
| RF output (1EM)  | <ul style="list-style-type: none"> <li>• Output impedance 50 <math>\Omega</math> (nom)</li> <li>• Option 513/520 : Precision APC-3.5 male, or Type- N with option 1ED</li> <li>• Option 532/540: Precision 2.4 mm male; plus 2.4—2.4 mm and 2.4-2.9 mm female adapters</li> </ul>  |
| Sweep out  | Generates output voltage, 0 to +10 V when the signal generator is sweeping. This output can also be programmed to indicate when the source is settled or output pulse video and is TTL and CMOS compatible in this mode. Output impedance < 1 $\Omega$ , can drive 2 k $\Omega$ . Damage levels are $\pm$ 15 V.  |
| Ext1   | External AM/FM/PM #1 input: Nominal input impedance is 50 $\Omega$ /600 $\Omega$ /1M $\Omega$ nominal: Damage levels are $\pm$ 5 V.  |
| Ext2   | External AM/FM/PM #2 input: Nominal input impedance is 50 $\Omega$ /600 $\Omega$ /1M $\Omega$ nominal: Damage levels are $\pm$ 5 V.  |
| Pulse  | External pulse modulation input. This input is TTL and CMOS compatible. Low logic levels are 0 V and high logic levels are +1 V. Nominal input impedance is 50 $\Omega$ . Input damage levels are $\leq$ -0.3 V and $\geq$ +5.3 V.   |
| Trigger 1 (in)   | Accepts TTL and CMOS level signals for triggering point-to-point in sweep mode. Damage levels are $\leq$ -0.3 V and $\geq$ +5.3 V.   |
| Trigger 2 (out)  | Default use is with sweep mode. The signal is high at start of dwell, or when waiting for point trigger in manual sweep mode; low when dwell is over or point trigger is received. This output can also be programmed to indicate when the source is settled, pulse synchronization, or pulse video. Outputs a 2.5V into 50 $\Omega$ nominal. Input damage levels are $\leq$ -0.3 V and $\geq$ +5.3 V. |
| Reference input  | Accepts a 10 MHz reference signal used to frequency lock the internal time base. Option 1ER adds the capability to lock to a frequency from 1 MHz to 50 MHz. Nominal input level -3.5 to +20 dBm, impedance 50 $\Omega$ , sine or square waveform.   |
| 10 MHz out   | Outputs the 10 MHz reference signal used by internal timebase. Level nominally +5 dBm. Nominal output impedance 50 $\Omega$ . Input damage level is +16 dBm.   |
| ALC in   | This female BNC connector is used for negative external detector leveling. <ul style="list-style-type: none"> <li>• Input impedance: 100 k<math>\Omega</math> (nominal)</li> <li>• Signal levels: -0.2 mV to -0.5 V</li> <li>• Damage levels: &lt; -12 V and &gt; 1 V</li> </ul>   |
| Z-Axis output  | This female BNC connector supplies a +5 V (nominal) level during retrace and band switch intervals of a step or list sweep. During step or list sweep, this connector supplies a -5 V (nominal) level when the RF frequency is at a marker frequency and intensity marker mode is on. The load impedance should be $\geq$ 5 k $\Omega$ .   |

|                  |   |
|------------------|---|
| USB Type-A       | There are two USB 2.0 Type-A connectors on the rear panel. Used with a memory stick for transferring instrument states, licenses and other files into or out of the instrument; also used with U2000 Series USB power sensors.  |
| USB Type-B       | There is one USB 2.0 Type-B connectors on the rear panel. The USB connector provides remote programming functions via SCPI.   |
| LAN (1000 BaseT) | The LAN connector provides the same SCPI remote programming functionality as the GPIB connector. The LAN connector is also used to access the internal web server and FTP server. The LAN supports DHCP, sockets SCPI, VXI-11 SCPI, connection monitoring, dynamic hostname services, TCP keep alive. This interface is LXI class C compliant. Trigger response time for the immediate LAN trigger is 0.5 ms (minimum), 4 ms (maximum), 2 ms (typ); delayed/alarm trigger is unknown. Trigger output response time is 0.5 ms (minimum), 4 ms (maximum), 2 ms typical. |
| GPIB             | The GPIB connector provides remote programming functionality via SCPI.  |

## Related Literature

### Agilent X-Series Signal Generators

*MXG Microwave Signal Generator Data Sheet 5991-3131EN*

*Microwave Signal Generator Flyer 5991-3594EN*

*X-Series Signal Generator Brochure 5990-9957EN*

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| France         | 0825 010 700*<br>*0.125 €/minute |
| Germany        | 49 (0) 7031 464 6333             |
| Ireland        | 1890 924 204                     |
| Israel         | 972-3-9288-504/544               |
| Italy          | 39 02 92 60 8484                 |
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