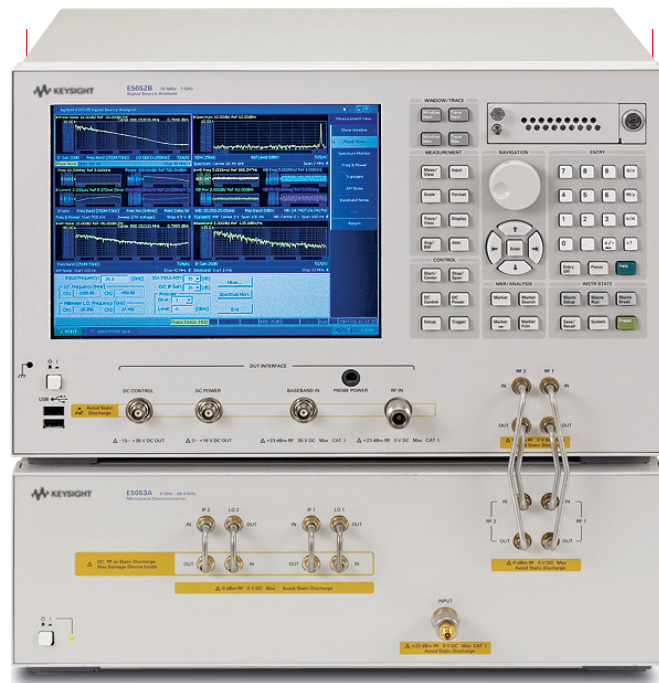


# Keysight Technologies

## E5052B Signal Source Analyzer

10 MHz to 7 GHz, 26.5 GHz, or 110 GHz

### Data Sheet



## Definitions

All specifications apply over a 23 °C ± 5 °C range (unless otherwise stated) and 30 minutes after the instrument has been turned on.

All specified and supplemental values for RF input signals are applicable to sinusoidal-wave carriers unless otherwise noted.

### Specification (spec.):

Warranted performance. Specifications include guard-bands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

Following supplemental information is intended to provide information that is helpful for using the instrument.

### Typical (typ.):

Describes performance that will be met by a minimum of 80% of all products.

### Supplemental performance data (SPD):

Represents the value of a parameter that is most likely to occur; the expected mean or average.

### General characteristics or nominal (nom.):

A general, descriptive term that does not imply a level of performance.

## RF Input Port

Table 1-1. RF IN port

| Description             | Specification                                                  |
|-------------------------|----------------------------------------------------------------|
| RF IN connector         | Type-N (female), 50 ohm nominal                                |
| RF IN frequency range   | 10 MHz to 7 GHz                                                |
| RF IN measurement level | –20 dBm to + 20dBm (> 30 MHz)<br>–15 dBm to +20 dBm (< 30 MHz) |
| Input attenuator        | 0 to 35 dB (in 5 dB step)                                      |
| Input damage level      | AC > +23 dBm, DC > 5V                                          |
| Input VSWR @50 ohm      |                                                                |
| 10 MHz to 30 MHz        | < 1.6                                                          |
| 30 MHz to 2 GHz         | < 1.2                                                          |
| 2 GHz to 3 GHz          | < 1.3                                                          |
| 3 GHz to 4 GHz          | < 1.3 typical                                                  |
| 4 GHz to 7 GHz          | < 1.5 typical                                                  |

## Phase Noise Measurement

Table 1-2. Phase noise measurement performance

| Description                                                          | Specification (E5052B)                                                                                                                                                                                     | Specification (E5052B Option 011)                                   |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| RF IN frequency range                                                | 10 MHz to 7 GHz                                                                                                                                                                                            |                                                                     |
| Measurement frequency bands                                          | 10 MHz to 41 MHz, 39 MHz to 101 MHz, 99 MHz to 1.5 GHz, 250 MHz to 7 GHz <sup>1</sup>                                                                                                                      |                                                                     |
| RF frequency tracking range                                          | 0.4% of carrier frequency                                                                                                                                                                                  |                                                                     |
| Measurement parameters                                               | SSB phase noise [dBc/Hz], Spurious noise [dBc], Integrated rms phase deviation [deg, rad] or time jitter [s], Residual FM [Hz rms]                                                                         |                                                                     |
| Number of trace                                                      | 1 data trace and 1 memory trace with 'data math' functions                                                                                                                                                 |                                                                     |
| Measurement trigger                                                  | continuous/single/hold      source: internal/external/manual/bus                                                                                                                                           |                                                                     |
| Offset frequency range (effective)                                   |                                                                                                                                                                                                            |                                                                     |
| RF carrier signal > 1 GHz<br>(> 400 MHz for wide capture mode)       | 1 Hz to 100 MHz<br>1 Hz to 40 MHz (wide capture mode)                                                                                                                                                      | 10 Hz to 100 MHz<br>10 Hz to 40 MHz (wide capture mode)             |
| RF carrier signal < 1 GHz<br>(< 400 MHz for wide capture mode)       | 1 Hz to 10% of carrier frequency                                                                                                                                                                           | 10 Hz to 10% of carrier frequency                                   |
| Phase noise uncertainty <sup>2</sup> at effective offset frequencies |                                                                                                                                                                                                            |                                                                     |
| Offset 1 Hz to 10 Hz                                                 | ± 4 dB (SPD)                                                                                                                                                                                               | N/A                                                                 |
| Offset 10 Hz to 100 Hz                                               | ± 4 dB (SPD)                                                                                                                                                                                               |                                                                     |
| Offset 100 Hz to 1 kHz                                               | ± 3 dB                                                                                                                                                                                                     |                                                                     |
| Offset 1 kHz to 40 MHz                                               | ± 2 dB (± 3 dB for wide capture range mode)                                                                                                                                                                |                                                                     |
| Offset 40 MHz to 100 MHz                                             | ± 3 dB                                                                                                                                                                                                     |                                                                     |
| SSB phase noise sensitivity                                          | See Table 1-3, 1-4, 1-5, Figure 1-1, 1-2, 1-3                                                                                                                                                              |                                                                     |
| IF gain setting                                                      | 0 dB to 50 dB in 10 dB step<br>( not available in wide capture mode)                                                                                                                                       | 0 dB to 30 dB in 10 dB step<br>(not available in wide capture mode) |
| Enhanced sensitivity                                                 | Cross-correlation method available.<br>Number of correlation = 1 to 10,000<br>See Table 1-5 and Figure 1-3                                                                                                 | N/A                                                                 |
| Built-in LO phase noise optimization                                 | < 150 kHz (optimized for better close-in phase noise measurement)<br>> 150 kHz (optimized for better far-out phase noise measurement)<br>See Figure 1-4.                                                   |                                                                     |
| Reference oscillator bandwidth optimization                          | Narrow / Wide      See Figure 1-5.                                                                                                                                                                         |                                                                     |
| Residual spurious response level                                     | < –80 dBc (SPD) at > 10 kHz offset frequency with correlation > 120 sec.<br>except for 23.5 MHz ± 1 MHz and 71 MHz ± 3 MHz of carrier frequency<br>< –65 dBc (typical) at 1 kHz to 10 kHz offset frequency |                                                                     |
| Measurement time                                                     | See Table 1-6                                                                                                                                                                                              |                                                                     |
| Measurement range                                                    | Capture mode: Normal or Wide                                                                                                                                                                               |                                                                     |
| PN mode (Regular)                                                    | RBW: Auto<br>X-axis: Offset frequency in log scale                                                                                                                                                         |                                                                     |
| Segment PN mode <sup>3</sup>                                         | RBW: 96 mHz to 25 kHz (stepped), Maximum offset<br>frequency span: 93.2 Hz to 24.4 MHz (stepped)<br>X-axis: Offset frequency in liner scale                                                                | N/A                                                                 |

1. Wide capture mode is available for 250 MHz to 7 GHz only

2. Phase noise uncertainty: specified at 10 MHz and 1 GHz of carrier frequency with 0 dBm level. PN level &gt; -60 dBc

3. Segment PN mode is available with the firmware revision 3.20 or later. In this datasheet, specification of phase noise sensitivity, residual spurious response level and measurement time are applicable to the regular PN mode. In the segment PN mode, number of these parameters depend on the measurement setting. For more detail, refer to the user's manual.

## Phase Noise Measurement – continued

Table 1-3. SSB phase noise sensitivity (dBc/Hz) in normal capture range mode (E5052B)

LO optimization: &lt; 150 kHz, Ref. BW: narrow, correlation = 1, RF input: +5 dBm, start offset frequency: 1 Hz, measurement time = 12.9 sec

| RF input frequency |               | Offset frequency [Hz] from the carrier |      |      |      |      |       |      |      |      |       |
|--------------------|---------------|----------------------------------------|------|------|------|------|-------|------|------|------|-------|
|                    |               | 1                                      | 10   | 100  | 1 k  | 10 k | 100 k | 1 M  | 10 M | 40 M | 100 M |
| 10 MHz             | specification |                                        |      |      | -148 | -156 | -166  | -168 | –    | –    | –     |
|                    | SPD           | -100                                   | -131 | -151 | -164 | -172 | -178  | -178 | –    | –    | –     |
| 100 MHz            | specification |                                        |      |      | -147 | -156 | -163  | -168 | -170 | –    | –     |
|                    | SPD           | -80                                    | -111 | -136 | -154 | -164 | -171  | -175 | -178 | –    | –     |
| 1 GHz              | specification |                                        |      |      | -128 | -137 | -144  | -160 | -170 | -168 | -169  |
|                    | SPD           | -60                                    | -91  | -116 | -135 | -146 | -155  | -171 | -178 | -178 | -177  |
| 3 GHz              | specification |                                        |      |      | -118 | -127 | -133  | -149 | -163 | -164 | -165  |
|                    | SPD           | -50                                    | -81  | -106 | -127 | -135 | -142  | -161 | -175 | -177 | -177  |
| 7 GHz              | specification |                                        |      |      | -111 | -120 | -127  | -143 | -157 | -158 | -159  |
|                    | SPD           | -43                                    | -74  | -99  | -121 | -129 | -138  | -154 | -171 | -174 | -175  |

Table 1-3-W. SSB phase noise sensitivity (dBc/Hz) in wide capture range mode (E5052B) (SPD)

LO optimization: &lt; 150 kHz, Ref. BW: narrow, correlation = 1, RF input: +5 dBm, start offset frequency: 1 Hz, measurement time = 12.9 sec

| RF input frequency |     | Offset frequency (Hz) from the carrier |    |     |      |      |       |      |      |      |
|--------------------|-----|----------------------------------------|----|-----|------|------|-------|------|------|------|
|                    |     | 1                                      | 10 | 100 | 1 k  | 10 k | 100 k | 1 M  | 10 M | 40 M |
| 1 GHz              | SPD | –                                      | –  | –   | -108 | -128 | -144  | -155 | -160 | -160 |
| 3 GHz              | SPD | –                                      | –  | –   | -107 | -119 | -134  | -150 | -158 | -158 |
| 7 GHz              | SPD | –                                      | –  | –   | -107 | -112 | -126  | -146 | -156 | -156 |

Table 1-4. SSB phase noise sensitivity (dBc/Hz) in normal capture range mode (E5052B Option 011)

LO optimization: &lt; 150 kHz, Ref. BW: narrow, correlation = 1, RF input: +5 dBm, start offset frequency: 10 Hz, measurement time = 3.3 sec

| RF input frequency |               | Offset frequency [Hz] from the carrier |      |      |      |       |      |      |      |       |
|--------------------|---------------|----------------------------------------|------|------|------|-------|------|------|------|-------|
|                    |               | 10                                     | 100  | 1 k  | 10 k | 100 k | 1 M  | 10 M | 40 M | 100 M |
| 10 MHz             | specification |                                        |      | -135 | -147 | -160  | -160 | –    | –    | –     |
|                    | SPD           | -120                                   | -135 | -151 | -163 | -170  | -170 | –    | –    | –     |
| 100 MHz            | specification |                                        |      | -142 | -152 | -154  | -156 | -159 | –    | –     |
|                    | SPD           | -107                                   | -128 | -149 | -160 | -168  | -170 | -170 | –    | –     |
| 1 GHz              | specification |                                        |      | -125 | -134 | -141  | -157 | -160 | -160 | -160  |
|                    | SPD           | -86                                    | -111 | -132 | -143 | -152  | -168 | -170 | -170 | -170  |
| 3 GHz              | specification |                                        |      | -115 | -124 | -130  | -146 | -160 | -160 | -160  |
|                    | SPD           | -76                                    | -101 | -124 | -132 | -139  | -158 | -170 | -170 | -170  |
| 7 GHz              | specification |                                        |      | -108 | -117 | -124  | -140 | -154 | -155 | -156  |
|                    | SPD           | -69                                    | -94  | -118 | -126 | -135  | -151 | -165 | -170 | -170  |

Table 1-5. SSB phase noise sensitivity improvement by correlation

| Number of correlation | 10   | 100   | 1,000 | 10,000 |
|-----------------------|------|-------|-------|--------|
| Improvement factor    | 5 dB | 10 dB | 15 dB | 20 dB  |

Table 1-6. E5052B Typical measurement time (sec) for phase noise

LO optimization: &lt; 150 kHz, Ref. BW: narrow, correlation = 1, RF input: +5 dBm

| Stop frequency (Hz) | Start frequency (Hz) |     |      |      |
|---------------------|----------------------|-----|------|------|
|                     | 1                    | 10  | 100  | 1 k  |
| 100k                | 8.8                  | 2.2 | 0.28 | 0.04 |
| 1M                  | 8.8                  | 2.2 | 0.28 | 0.04 |
| 10M                 | 10                   | 2.5 | 0.32 | 0.04 |
| 40M                 | 10                   | 2.5 | 0.32 | 0.04 |
| 100M                | 12.9                 | 3.3 | 0.41 | 0.05 |

Measurement time (sec) = ( 0.4 (Capture range narrow) or 0.6 (Capture range wide) ) + the above value x number of correlation when applying cross-correlation function (E5052B ONLY).

For E5052B Option 011, number of correlation = 1.

Phase Noise Measurement – continued

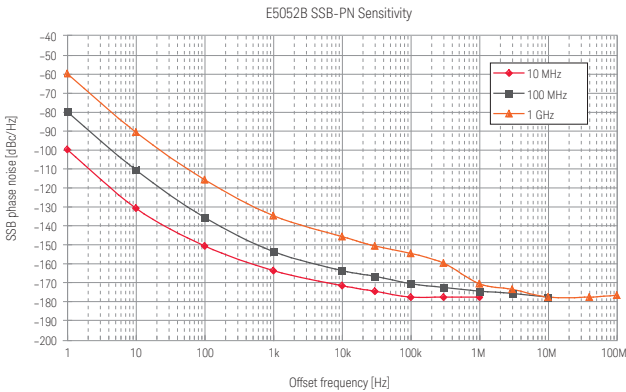


Figure 1-1. SSB phase noise sensitivity (E5052B, SPD) (LO < 150 kHz optimized, +5 dBm input, start offset frequency = 1 Hz, measurement time = 12.9 sec.)

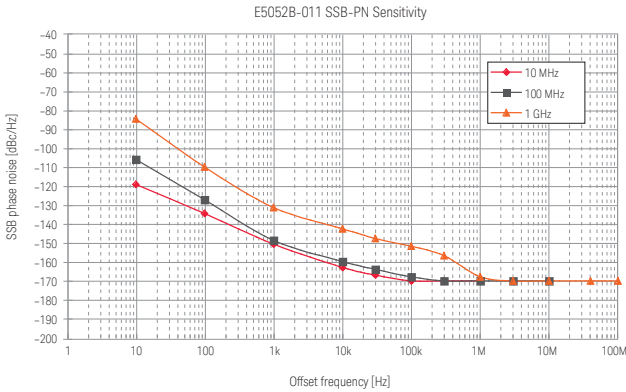


Figure 1-2. SSB phase noise sensitivity (E5052B Option 011, SPD) (LO < 150 kHz optimized, +5 dBm input, start offset frequency = 10 Hz, measurement time = 3.3 sec.)

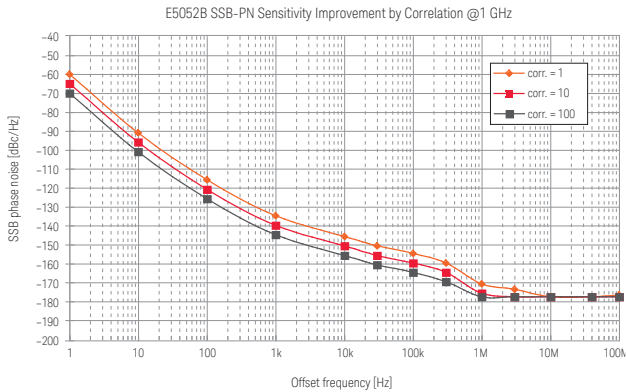


Figure 1-3. SSB phase noise sensitivity improvement by correlation (E5052B, SPD) (carrier 1 GHz, LO < 150 kHz optimized, +5 dBm input, start offset frequency = 1 Hz)

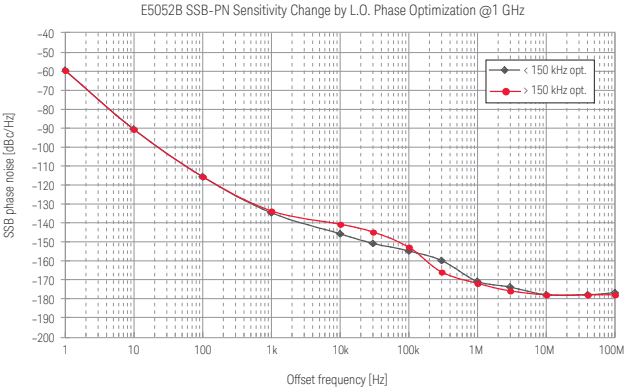


Figure 1-4. SSB phase noise change by LO optimization (SPD) (carrier 1 GHz, +5 dBm input, start offset frequency = 1 Hz, reference oscillator:narrowband)

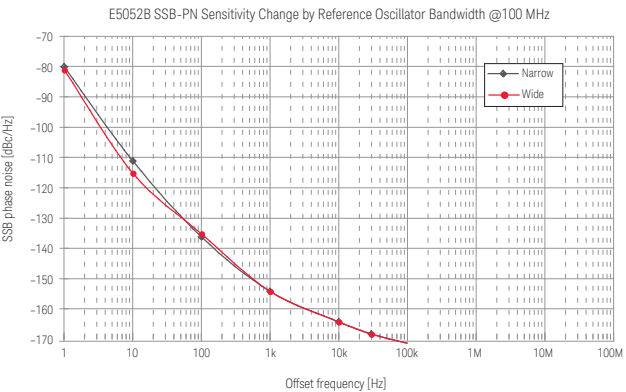


Figure 1-5. SSB phase noise sensitivity change by reference oscillator bandwidth (SPD) (carrier 100 MHz, +5 dBm input, start offset frequency = 1 Hz, LO optimization: < 150 kHz)

Spectrum Monitor Measurement

Table 2-1. Spectrum monitor performance

| Description                      | Specification                                               |
|----------------------------------|-------------------------------------------------------------|
| RF frequency range               | 10 MHz to 7 GHz                                             |
| Monitoring span                  | 15 MHz maximum with linear scale                            |
| RBW                              | 1.53 Hz to 400 kHz                                          |
| Measurement parameters           | dBm, dBV, watt, volt, dBm/Hz, dBV/Hz, watt/Hz, V/Hz         |
| Absolute measurement uncertainty | ± 2 dB typical @ -10 dBm (att. = 10 dB)                     |
| Relative measurement uncertainty | ± 1.5 dB (-60 dBm to -10 dBm, ratio)                        |
| Residual noise floor             | -95 dBm typical @ RBW = 24.4 Hz                             |
| Measurement trigger              | continuous/single/hold source: internal/external/manual/bus |

## Frequency and RF Power, DC Supply Current Measurements

Table 3-1. Frequency and power measurement performance

| Description                              | Specification (E5052B)                                                                                                                                                                                                                  | Specification (E5052B-011)                                                                                            |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| RF frequency range                       | 10 MHz to 7 GHz                                                                                                                                                                                                                         |                                                                                                                       |
| Measurement frequency bands              | 10 MHz to 1.5 GHz (low-band), 250 MHz to 7 GHz (high-band)                                                                                                                                                                              |                                                                                                                       |
| Sweep parameters                         | DC control voltage (Vc)<br>DC supply voltage (Vs)                                                                                                                                                                                       | N/A<br>(Vc and Vs: constant)                                                                                          |
| Measurement parameters                   | Full analysis capability available for<br>Frequency [Hz, ΔHz, %, ppm],<br>Tuning sensitivity (Δf/ΔVc)[Hz/V], frequency pushing<br>(Δf/ΔVs)[Hz/V],<br>RF power level [dBm],<br>DC supply current [A],<br>'Meter mode' is also available. | No 'Analysis mode'.<br>Only 'Meter mode' is available.<br>Frequency [Hz],<br>RF power [dBm],<br>DC supply current [A] |
| Frequency resolution                     | 10 Hz, 1 kHz, 64 kHz                                                                                                                                                                                                                    |                                                                                                                       |
| Frequency uncertainty                    | ± (frequency resolution + time-base uncertainty)                                                                                                                                                                                        |                                                                                                                       |
| RF power measurement range               | –20 dBm to +20 dBm (carrier 30 MHz to 7 GHz)<br>–15 dBm to +20 dBm (carrier 10 MHz to 30 MHz)                                                                                                                                           |                                                                                                                       |
| RF power resolution                      | 0.01 dB                                                                                                                                                                                                                                 |                                                                                                                       |
| RF power uncertainty (by peak detection) | ± 0.5 dB (carrier 30 MHz to 3 GHz, > –10 dBm)<br>± 1 dB (other than the above)                                                                                                                                                          |                                                                                                                       |
| DC (Vs) current measurement range        | 0 to 80 mA                                                                                                                                                                                                                              |                                                                                                                       |
| DC (Vs) current resolution               | 10 μA                                                                                                                                                                                                                                   |                                                                                                                       |
| DC (Vs) current uncertainty              | ± (0.2% of reading + 160 μA)                                                                                                                                                                                                            |                                                                                                                       |
| Swept measurement points                 | 2 to 1,001                                                                                                                                                                                                                              | N/A                                                                                                                   |
| DC supply voltage source (Vs) output     |                                                                                                                                                                                                                                         |                                                                                                                       |
| Setting range                            | 0 to +16 V (sweep)                                                                                                                                                                                                                      | 0 to +16 V (one point)                                                                                                |
| Setting resolution                       | 1 mV                                                                                                                                                                                                                                    |                                                                                                                       |
| Setting uncertainty                      | ± (0.2% of setting + 2 mV)                                                                                                                                                                                                              |                                                                                                                       |
| Maximum output current                   | 80 mA                                                                                                                                                                                                                                   |                                                                                                                       |
| Noise level                              | < 10 nVrms/√Hz @ 10 kHz typical                                                                                                                                                                                                         |                                                                                                                       |
| Output resistance                        | < 0.3 ohm typical                                                                                                                                                                                                                       |                                                                                                                       |
| DC control voltage source (Vc) output    |                                                                                                                                                                                                                                         |                                                                                                                       |
| Setting range                            | –15 V to +35 V (sweep)                                                                                                                                                                                                                  | –15 V to +35 V (one point)                                                                                            |
| Setting resolution                       | 0.1 mV                                                                                                                                                                                                                                  |                                                                                                                       |
| Setting uncertainty                      | ± (0.1% of (setting + 15 V) + 5 mV) (@Vc = –15 V to 0V) typical<br>± (0.1% of setting + 2 mV) (@Vc = 0 to +35 V) typical                                                                                                                |                                                                                                                       |
| Maximum output current                   | 20 mA typical                                                                                                                                                                                                                           |                                                                                                                       |
| Noise level                              | 1 nVrms/√Hz @ 10 kHz (Vc = 0 to +20V) typical<br>1.5 nVrms/√Hz @ 10 kHz (Vc: otherwise) typical                                                                                                                                         |                                                                                                                       |
| Output resistance                        | < 50 ohm (DC) typical                                                                                                                                                                                                                   |                                                                                                                       |
| Output settling time                     | < 20 ms @ 0.1% uncertainty typical                                                                                                                                                                                                      |                                                                                                                       |
| Measurement trigger                      | continuous/single/hold source: internal/external/manual/bus                                                                                                                                                                             |                                                                                                                       |

## Transient Measurement

Table 4-1. Transient measurement performance

| Description                                                         | Specification                                                                                                                                          |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Target frequency range                                              | 10 MHz to 7 GHz                                                                                                                                        |
| Measurement parameters                                              |                                                                                                                                                        |
| Narrowband mode                                                     | Frequency, RF power, phase                                                                                                                             |
| Wideband mode                                                       | Frequency                                                                                                                                              |
| Frequency transient bandwidth                                       |                                                                                                                                                        |
| Wideband                                                            | See Table 4-2.                                                                                                                                         |
| Narrowband                                                          | 3.125 kHz/ 25 kHz/ 200 kHz/ 1.6 MHz<br>25.6 MHz (> carrier 200 MHz)<br>80 MHz (> carrier 800 MHz)                                                      |
| Frequency measurement                                               |                                                                                                                                                        |
| Resolution                                                          | See Table 4-2. through Table 4-8.                                                                                                                      |
| Uncertainty                                                         | ± (resolution + time-base uncertainty)                                                                                                                 |
| Residual FM <sup>1</sup>                                            | $0.2f^{\frac{1}{3}}\sqrt{1+11f^{\frac{2}{3}}}$ (Hz <sub>rms</sub> /GHz), SPD<br>f=resolution                                                           |
| RF power measurement                                                |                                                                                                                                                        |
| Power level range                                                   | -20 dBm to +20 dBm                                                                                                                                     |
| Resolution                                                          | 0.1 dB typical                                                                                                                                         |
| Uncertainty                                                         | ± 2 dB typical                                                                                                                                         |
| Phase measurement (when DUT signal is locked to a target frequency) |                                                                                                                                                        |
| Uncertainty                                                         | 0.1 deg + 0.1 deg/GHz typical                                                                                                                          |
| Trace noise                                                         | 0.02 deg + 0.02 deg/GHz typical                                                                                                                        |
| Stability                                                           | 10 deg/sec typical                                                                                                                                     |
| Sweep measurement time                                              |                                                                                                                                                        |
| Time span                                                           | 10 μs to 10 s in 1,2,5 step (in advanced mode: maximum time span = time resolution * 10,000. up to 1000 sec.)<br>See Table 4-2 through 4-8. in details |
| Time resolution                                                     | 8 ns to 10 ms,<br>See Table 4-2. to 4-8. in details.<br>*Video filter time-constant: 260 ns to 16.78 ms                                                |
| Measurement trigger                                                 |                                                                                                                                                        |
| Trigger mode                                                        | continuous/single/hold                                                                                                                                 |
| Trigger source                                                      | internal/external/manual/bus/wide-video/narrow-video                                                                                                   |
| External trigger polarity                                           | positive/negative (TTL level)                                                                                                                          |
| Video trigger                                                       | positive/negative/frequency-band in/ frequency-band out                                                                                                |
| Pre-trigger delay                                                   | -80% of time span to + 1 s                                                                                                                             |
| External trigger delay adjustment                                   | 0 to 1 μs                                                                                                                                              |
| External trigger detection jitter                                   | < (1 μs + time resolution)                                                                                                                             |

1. Equation is based on simplified model of phase noise characteristic of local oscillator in the E5052B.

## Transient Measurement/Wideband Mode

Table 4-2. Wideband mode frequency resolution vs. time span and frequency band

| Wideband mode        |      |      |      |       | Transient time span (X-axis) setting |       |       |       |      |      |      |      |       |       |       |        |       |        |        |  |
|----------------------|------|------|------|-------|--------------------------------------|-------|-------|-------|------|------|------|------|-------|-------|-------|--------|-------|--------|--------|--|
| Time span [s]        | 10 μ | 20 μ | 50 μ | 0.1 m | 0.2 m                                | 0.5 m | 1 m   | 2 m   | 5 m  | 10 m | 20 m | 50 m | 0.1   | 0.2   | 0.5   | 1      | 2     | 5      | 10     |  |
| Time resolution [s]  | 8 n  | 16 n | 40 n | 80 n  | 0.16 μ                               | 0.4 μ | 1 μ   | 2 μ   | 5 μ  | 10 μ | 20 μ | 50 μ | 125 μ | 250 μ | 625 μ | 1.25 m | 2.5 m | 6.25 m | 12.5 m |  |
| Measurement point    | 1251 | 1251 | 1251 | 1251  | 1251                                 | 1251  | 1001  | 1001  | 1001 | 1001 | 1001 | 1001 | 801   | 801   | 801   | 801    | 801   | 801    | 801    |  |
| Frequency band [GHz] |      |      |      |       | Frequency resolution [Hz]            |       |       |       |      |      |      |      |       |       |       |        |       |        |        |  |
| 0.05 to 0.15         |      |      |      |       | 28 k                                 |       | 9 k   | 3 k   | 1 k  |      |      |      |       |       |       |        |       |        |        |  |
| 0.1 to 0.3           |      |      |      |       | 56 k                                 |       | 19 k  | 7 k   | 2 k  |      |      |      |       |       |       |        |       |        |        |  |
| 0.2 to 0.6           |      |      |      |       | 112 k                                |       | 39 k  | 14 k  | 4 k  |      |      |      |       |       |       |        |       |        |        |  |
| 0.3 to 0.9           |      |      |      |       | 168 k                                |       | 59 k  | 21 k  | 7 k  |      |      |      |       |       |       |        |       |        |        |  |
| 0.4 to 1.2           |      |      |      |       | 225 k                                |       | 79 k  | 28 k  | 9 k  |      |      |      |       |       |       |        |       |        |        |  |
| 0.5 to 1.5           |      |      |      |       | 281 k                                |       | 99 k  | 35 k  | 12 k |      |      |      |       |       |       |        |       |        |        |  |
| 0.6 to 1.8           |      |      |      |       | 337 k                                |       | 119 k | 42 k  | 14 k |      |      |      |       |       |       |        |       |        |        |  |
| 0.8 to 2.4           |      |      |      |       | 450 k                                |       | 159 k | 56 k  | 19 k |      |      |      |       |       |       |        |       |        |        |  |
| 1.0 to 3.0           |      |      |      |       | 562 k                                |       | 198 k | 70 k  | 24 k |      |      |      |       |       |       |        |       |        |        |  |
| 1.2 to 3.6           |      |      |      |       | 675 k                                |       | 238 k | 84 k  | 29 k |      |      |      |       |       |       |        |       |        |        |  |
| 1.4 to 4.2           |      |      |      |       | 787 k                                |       | 278 k | 98 k  | 34 k |      |      |      |       |       |       |        |       |        |        |  |
| 1.6 to 4.8           |      |      |      |       | 900 k                                |       | 318 k | 112 k | 39 k |      |      |      |       |       |       |        |       |        |        |  |
| 1.8 to 5.4           |      |      |      |       | 1.012 M                              |       | 357 k | 126 k | 44 k |      |      |      |       |       |       |        |       |        |        |  |
| 2.0 to 6.0           |      |      |      |       | 1.125 M                              |       | 397 k | 140 k | 49 k |      |      |      |       |       |       |        |       |        |        |  |
| 2.2 to 6.6           |      |      |      |       | 1.237 M                              |       | 437 k | 154 k | 54 k |      |      |      |       |       |       |        |       |        |        |  |
| 2.4 to 7.2           |      |      |      |       | 1.35 M                               |       | 477 k | 168 k | 59 k |      |      |      |       |       |       |        |       |        |        |  |



## Transient Measurement/Narrowband Mode

Table 4-3. Narrowband mode (80 MHz span)/frequency resolution vs. time span

|                           |          |          |          |       |            |           |         |         |         |          |          |          |           |           |           |        |       |        |        |
|---------------------------|----------|----------|----------|-------|------------|-----------|---------|---------|---------|----------|----------|----------|-----------|-----------|-----------|--------|-------|--------|--------|
| Time span [s]             | 10 $\mu$ | 20 $\mu$ | 50 $\mu$ | 0.1 m | 0.2 m      | 0.5 m     | 1 m     | 2 m     | 5 m     | 10 m     | 20 m     | 50 m     | 0.1       | 0.2       | 0.5       | 1      | 2     | 5      | 10     |
| Time resolution [s]       | 8 n      | 16 n     | 40 n     | 80 n  | 0.16 $\mu$ | 0.4 $\mu$ | 1 $\mu$ | 2 $\mu$ | 5 $\mu$ | 10 $\mu$ | 20 $\mu$ | 50 $\mu$ | 125 $\mu$ | 250 $\mu$ | 625 $\mu$ | 1.25 m | 2.5 m | 6.25 m | 12.5 m |
| Measurement point         | 1251     | 1251     | 1251     | 1251  | 1251       | 1251      | 1001    | 1001    | 1001    | 1001     | 1001     | 1001     | 801       | 801       | 801       | 801    | 801   | 801    | 801    |
| Frequency resolution [Hz] | 7 k      |          |          |       |            | 2.5 k     | 879     |         |         |          |          |          |           |           |           |        |       |        |        |

Table 4-4. Narrowband mode (25.6 MHz span)/frequency resolution vs. time span

|                           |          |          |          |       |            |           |         |         |         |          |          |          |           |           |           |        |       |        |        |
|---------------------------|----------|----------|----------|-------|------------|-----------|---------|---------|---------|----------|----------|----------|-----------|-----------|-----------|--------|-------|--------|--------|
| Time span [s]             | 10 $\mu$ | 20 $\mu$ | 50 $\mu$ | 0.1 m | 0.2 m      | 0.5 m     | 1 m     | 2 m     | 5 m     | 10 m     | 20 m     | 50 m     | 0.1       | 0.2       | 0.5       | 1      | 2     | 5      | 10     |
| Time resolution [s]       | 8 n      | 16 n     | 40 n     | 80 n  | 0.16 $\mu$ | 0.4 $\mu$ | 1 $\mu$ | 2 $\mu$ | 5 $\mu$ | 10 $\mu$ | 20 $\mu$ | 50 $\mu$ | 125 $\mu$ | 250 $\mu$ | 625 $\mu$ | 1.25 m | 2.5 m | 6.25 m | 12.5 m |
| Measurement point         | 1251     | 1251     | 1251     | 1251  | 1251       | 1251      | 1001    | 1001    | 1001    | 1001     | 1001     | 1001     | 801       | 801       | 801       | 801    | 801   | 801    | 801    |
| Frequency resolution [Hz] | 7 k      |          |          |       |            | 2.5 k     | 879     | 311     |         |          |          |          |           |           |           |        |       |        |        |

Table 4-5. Narrowband mode (1.6 MHz span)/frequency resolution vs. time span

|                           |                    |                    |                    |            |            |           |           |          |          |           |           |           |       |       |     |      |
|---------------------------|--------------------|--------------------|--------------------|------------|------------|-----------|-----------|----------|----------|-----------|-----------|-----------|-------|-------|-----|------|
| Time span [s]             | 0.1 m <sup>1</sup> | 0.2 m <sup>1</sup> | 0.5 m <sup>1</sup> | 1 m        | 2 m        | 5 m       | 10 m      | 20 m     | 50 m     | 0.1       | 0.2       | 0.5       | 1     | 2     | 5   | 10   |
| Time resolution [s]       | 0.13 $\mu$         | 0.26 $\mu$         | 0.64 $\mu$         | 0.64 $\mu$ | 1.28 $\mu$ | 3.2 $\mu$ | 6.4 $\mu$ | 16 $\mu$ | 80 $\mu$ | 160 $\mu$ | 320 $\mu$ | 800 $\mu$ | 1.6 m | 3.2 m | 8 m | 16 m |
| Measurement point         | 783                | 783                | 783                | 1564       | 1564       | 1564      | 1564      | 1251     | 626      | 626       | 626       | 626       | 626   | 626   | 626 | 626  |
| Frequency resolution [Hz] | 110                |                    |                    | 39         | 13.7       | 4.9       |           |          |          |           |           |           |       |       |     |      |

Table 4-6. Narrowband mode (200 kHz span)/frequency resolution vs. time span

|                           |                      |                      |                      |                       |                       |                       |                  |                  |                  |        |        |       |                 |
|---------------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|------------------|------------------|------------------|--------|--------|-------|-----------------|
| Time span [s]             | 1 m                  | 2 m                  | 5 m                  | 10 m                  | 20 m <sup>1</sup>     | 50 m <sup>1</sup>     | 0.1 <sup>1</sup> | 0.2 <sup>1</sup> | 0.5 <sup>1</sup> | 1      | 2      | 5     | 10 <sup>1</sup> |
| Time resolution [s]       | 1 $\mu$ <sup>1</sup> | 2 $\mu$ <sup>1</sup> | 5 $\mu$ <sup>1</sup> | 10 $\mu$ <sup>1</sup> | 20 $\mu$ <sup>1</sup> | 51 $\mu$ <sup>1</sup> | 128 $\mu$        | 256 $\mu$        | 640 $\mu$        | 1.28 m | 2.56 m | 6.4 m | 12.8 m          |
| Measurement point         | 978                  | 978                  | 978                  | 978                   | 978                   | 978                   | 783              | 783              | 783              | 783    | 783    | 783   | 783             |
| Frequency resolution [Hz] | 4.9                  | 4.9                  | 1.72                 | 0.61                  | 0.21                  |                       |                  |                  |                  |        |        |       |                 |

Table 4-7. Narrowband mode (25 kHz span)/frequency resolution vs. time span

|                           |           |            |                   |                  |                  |                  |        |        |        |         |
|---------------------------|-----------|------------|-------------------|------------------|------------------|------------------|--------|--------|--------|---------|
| Time span [s]             | 10 m      | 20 m       | 50 m <sup>1</sup> | 0.1 <sup>1</sup> | 0.2 <sup>1</sup> | 0.5 <sup>1</sup> | 1      | 2      | 5      | 10      |
| Time resolution [s]       | 8.2 $\mu$ | 16.4 $\mu$ | 41 $\mu$          | 82 $\mu$         | 164 $\mu$        | 410 $\mu$        | 1.02 m | 2.05 m | 5.12 m | 10.24 m |
| Measurement point         | 1222      | 1222       | 1222              | 1222             | 1222             | 1222             | 978    | 978    | 978    | 978     |
| Frequency resolution [Hz] | 0.21      |            | 0.08              | 0.03             | 0.01             |                  |        |        |        |         |

Table 4-8. Narrowband mode (3.125 kHz span)/frequency resolution vs. time span

|                           |                       |                        |                        |                        |        |                    |                    |
|---------------------------|-----------------------|------------------------|------------------------|------------------------|--------|--------------------|--------------------|
| Time span [s]             | 0.2 <sup>1</sup>      | 0.5 <sup>1</sup>       | 0.5 <sup>1</sup>       | 1                      | 2      | 5                  | 10                 |
| Time resolution [s]       | 65 $\mu$ <sup>1</sup> | 131 $\mu$ <sup>1</sup> | 328 $\mu$ <sup>1</sup> | 655 $\mu$ <sup>1</sup> | 1.31 m | 3.3 m <sup>1</sup> | 8.2 m <sup>1</sup> |
| Measurement point         | 1527                  | 1527                   | 1527                   | 1527                   | 1527   | 1527               | 1222               |
| Frequency resolution [Hz] | 0.01                  |                        | 3 m                    | 1 m                    | 0.4 m  |                    |                    |

1. Means approximately

## AM Noise Measurement

Table 5-1. AM noise measurement performance

| Description                          | Specification                                                                                                                |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| RF frequency range                   | 60 MHz to 7 GHz                                                                                                              |
| Effective offset frequency range     | 10 Hz to 40 MHz<br>(@ > carrier 400 MHz)<br>10 Hz to 10% of carrier frequency<br>(@ < carrier 400 MHz)                       |
| AM noise sensitivity                 | See Table 5-2.                                                                                                               |
| Measurement uncertainty <sup>1</sup> | ± 4 dB (100 Hz to 1 kHz offset) typical<br>± 2 dB (1 kHz to 1 MHz offset) typical<br>± 3 dB (1 MHz to 40 MHz offset) typical |
| Spurious level                       | < -65 dBc/Hz (at > 1 kHz offset) typical                                                                                     |
| Measurement trigger                  | continuous/single/hold source: internal/external/manual/bus                                                                  |

Table 5-2. AM noise sensitivity [dBc/Hz] correlation = 1, RF input: 0 dBm, > 400 MHz

| AM noise sensitivity                                                      | Offset frequency (Hz) from the carrier |      |      |      |      |       |      |      |      |
|---------------------------------------------------------------------------|----------------------------------------|------|------|------|------|-------|------|------|------|
|                                                                           | 1                                      | 10   | 100  | 1 k  | 10 k | 100 k | 1 M  | 10 M | 40 M |
| E5052B start frequency = 1 Hz, measurement time = 13 s                    |                                        |      |      |      |      |       |      |      |      |
| specification                                                             | -                                      | -    | -    | -127 | -138 | -147  | -150 | -154 | -155 |
| typical                                                                   | -                                      | -103 | -117 | -131 | -142 | -151  | -154 | -158 | -159 |
| E5052B-011 (Option 011) start frequency = 10 Hz, measurement time = 3.3 s |                                        |      |      |      |      |       |      |      |      |
| specification                                                             | -                                      | -    | -    | -124 | -135 | -144  | -147 | -151 | -152 |
| typical                                                                   | -                                      | -100 | -114 | -128 | -139 | -148  | -151 | -155 | -156 |

1. AM noise measurement uncertainty: specified at 1 GHz of carrier frequency with 0 dBm level. AM level > -60 dBc

## Baseband Noise Measurement

Table 6-1. Baseband noise measurement performance

| Description                          | Specification                                                    |
|--------------------------------------|------------------------------------------------------------------|
| Baseband input connector             | BNC, 50 ohm nominal, AC coupled                                  |
| Measurement frequency range          | 1 Hz to 100 MHz (E5052B)<br>10 Hz to 100 MHz (E5052B Option 011) |
| Measurement parameters               | dBV/Hz, dBm/Hz, V/ $\sqrt{\text{Hz}}$                            |
| Measurement level range              | < +5 dBm                                                         |
| Baseband input damage level          | > +23 dBm, > 35 V DC                                             |
| Noise floor level                    | See Table 6-2.                                                   |
| Measurement uncertainty <sup>1</sup> | $\pm 4$ dB (< 1 kHz) SPD<br>$\pm 2$ dB (> 1 kHz) typical         |
| Measurement trigger                  | continuous/single/hold source: internal/external/manual/bus      |

Table 6-2. Baseband noise floor [dBm/Hz] correlation = 1, baseband input: 0 ohm terminated

| BB noise floor                                                       | Baseband frequency [Hz] |      |      |      |      |       |      |      |      |       |
|----------------------------------------------------------------------|-------------------------|------|------|------|------|-------|------|------|------|-------|
|                                                                      | 1                       | 10   | 100  | 1 k  | 10 k | 100 k | 1 M  | 10 M | 40 M | 100 M |
| E5052B start frequency = 1 Hz, measurement time = 13 s               |                         |      |      |      |      |       |      |      |      |       |
| specification                                                        | –                       | –    | –    | –151 | –158 | –163  | –160 | –160 | –156 | –156  |
| typical                                                              | –119                    | –132 | –145 | –155 | –162 | –167  | –164 | –164 | –160 | –160  |
| E5052B Option 011 start frequency = 10 Hz, measurement speed = 3.3 s |                         |      |      |      |      |       |      |      |      |       |
| specification                                                        | –                       | –    | –    | –148 | –155 | –160  | –157 | –160 | –156 | –156  |
| typical                                                              | –                       | –129 | –142 | –152 | –159 | –164  | –161 | –164 | –160 | –160  |

## Internal Timebase

Table 7-1. Internal timebase (OCXO) performance

| Description                       | Specification                                                                   |
|-----------------------------------|---------------------------------------------------------------------------------|
| Frequency uncertainty             | $\pm 5$ Hz at 10 MHz ( $\pm 0.5$ ppm)                                           |
| Frequency temperature coefficient | < 0.5 ppb/degC                                                                  |
| Frequency aging rate              | < 0.5 ppb/day<br>24 hours after a cold start for < 30 days continuous operation |

1. Baseband measurement uncertainty: specified at > –60 dBm level.

## General Information

Table 8-1. Front panel information

| Description           | Supplemental information (nominal)                                               |
|-----------------------|----------------------------------------------------------------------------------|
| Connectors/terminals  |                                                                                  |
| RF IN                 | Type-N (female), 50 ohm                                                          |
| Baseband IN           | BNC (female), 50 ohm, AC coupled                                                 |
| DC power              | BNC (female),                                                                    |
| DC control            | BNC (female), 50 ohm                                                             |
| RF1/RF2, IN/OUT       | SMA (female), 50 ohm<br>See the simplified block diagram.                        |
| USB                   | 2 ports (designed for USB2.0)                                                    |
| Probe DC power output | +15 V, 150 mA maximum<br>-12.6 V, 150 mA maximum                                 |
| Ground terminal       | 1                                                                                |
| Display               | 10.4 inch TFT color LCD with touch screen<br>1,024 x 768 resolution <sup>1</sup> |

Table 8-2. Rear panel information

| Description                                     | Supplemental information (nominal)                                                     |
|-------------------------------------------------|----------------------------------------------------------------------------------------|
| External trigger input port                     |                                                                                        |
| Connector                                       | BNC (female)                                                                           |
| Input signal level                              | TTL level, (0 V to +5 V)<br>Threshold Low: 0.5 V, High: 2.1V                           |
| Trigger pulse width                             | > 2 $\mu$ s                                                                            |
| Trigger polarity                                | positive/negative edge selectable                                                      |
| Auxiliary output port                           |                                                                                        |
| Connector                                       | BNC (female)                                                                           |
| Output signal level                             | TTL level, L: 0 V, H:= +5 V, 50 mA max.                                                |
| pulse width                                     | 1 $\mu$ s                                                                              |
| Reference output port                           |                                                                                        |
| Connector                                       | BNC (female), 50 ohm                                                                   |
| Output frequency                                | same as timebase                                                                       |
| Output level                                    | 2.5 dBm $\pm$ 2 dB typical                                                             |
| Output signal waveform                          | Sinusoidal wave                                                                        |
| Reference input ports                           |                                                                                        |
| Connector                                       | (Ref In 1, Ref In 2)<br>BNC (female), 50 ohm                                           |
| Input frequency                                 | 10 MHz $\pm$ 10 Hz                                                                     |
| Input signal level                              | 0 dBm to 10 dBm                                                                        |
| PC connection ports                             |                                                                                        |
| 24 BIT I/O parallel port                        | 36-pin D-sub (female) connector to a handler system<br>TTL level, 8-bit I/O 16-bit Out |
| GPIO port                                       | 24-pin D-sub (female) connector (compatible with IEEE-488)                             |
| USB host ports                                  | 4 type-A (compatible with USB 2.0)                                                     |
| USB (USBTMC <sup>2</sup> ) port                 | 1 type-B (compatible with USBTMC-USB488 and USB 2.0)                                   |
| LAN port                                        | 10/100 base-T ethernet                                                                 |
| Video output port                               | 15-pin mini D-sub (female) connector drives XGA compatible monitors                    |
| AC power line (a third-wire ground is required) |                                                                                        |
| AC frequency                                    | 47 Hz to 63 Hz                                                                         |
| AC voltage                                      | 90 to 132 V, or 198 to 264 V (automatically selected)                                  |
| AC power                                        | 500 VA maximum                                                                         |

1. Valid pixels > 99.998%. Below 0.002% of fixed points of black, blue, green or red are not regarded as failures.

2. USB test and measurement class (TMC) interface that communicates over USB, complying with the IEEE-488.1 and IEEE-488.2 standards.

## General Information – continued

Table 8-3. Analyzer environment and dimensions

| Description                       | Supplemental information (nominal)                        |
|-----------------------------------|-----------------------------------------------------------|
| Operating environment             |                                                           |
| Temperature                       | +10 degC to +40 degC                                      |
| Humidity                          | RH 20% to 80% at wet bulb temp.< 29 degC (non-condensing) |
| Altitude                          | 0 to 2,000 m (0 to 6,561 feet)                            |
| Vibration                         | 0.21 G maximum, 5 Hz to 500 Hz                            |
| Non-operating storage environment |                                                           |
| Temperature                       | -10 degC to +60 degC                                      |
| Humidity                          | RH 20% to 90% at wet bulb temp.< 40 degC (non-condensing) |
| Altitude                          | 0 to 4,572 m (0 to 15,000 feet)                           |
| Vibration                         | 0.5 G maximum, 5 Hz to 500 Hz                             |
| Instrument dimensions             | See Figure 8-1, 8-2, 8-3.                                 |
| Weight (NET)                      | 24.5 kg                                                   |

Table 8-4. LXI compliance

| LXI                                                                               |                                                                                          |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
|  | Class C (only applies to units that are shipped with firmware revision A.03.10 or later) |

Table 8-5. EMC, safety, environment and compliance

| EMC                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>ISM 1-A | <p>European Council Directive 2004/108/EC</p> <p>IEC 61326-1:2012</p> <p>EN 61326-1:2013</p> <p>CISPR 11:2009 +A1:2010</p> <p>EN 55011: 2009 +A1:2010</p> <p>Group 1, Class A</p> <p>IEC 61000-4-2:2008</p> <p>EN 61000-4-2:2009</p> <p>4 kV CD / 8 kV AD</p> <p>IEC 61000-4-3:2006 +A1:2007 +A2:2010</p> <p>EN 61000-4-3:2006 +A1:2008 +A2:2010</p> <p>3 V/m, 80-1000 MHz, 1.4 - 2.0 GHz / 1V/m, 2.0 - 2.7 GHz, 80% AM</p> <p>IEC 61000-4-4:2004 +A1:2010</p> <p>EN 61000-4-4:2004 +A1:2010</p> <p>1 kV power lines / 0.5 kV signal lines</p> <p>IEC 61000-4-5:2005</p> <p>EN 61000-4-5:2006</p> <p>0.5 kV line-line / 1 kV line-ground</p> <p>IEC 61000-4-6:2008</p> <p>EN 61000-4-6:2009</p> <p>3 V, 0.15-80 MHz, 80% AM</p> <p>IEC 61000-4-8:2009</p> <p>EN 61000-4-8:2010</p> <p>30A/m, 50/60Hz</p> <p>IEC 61000-4-11:2004</p> <p>EN 61000-4-11:2004</p> <p>0.5-300 cycle, 0% / 70%</p> |
| ICES/NMB-001                                                                                  | ICES-001:2006 Group 1, Class A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|            | <p>AS/NZS CISPR11:2004</p> <p>Group 1, Class A</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |



KN11, KN61000-6-1 and KN61000-6-2  
Group 1, Class A

Safety



European Council Directive  
73/23/EEC, 93/68/EEC  
IEC 61010-1:2001  
EN 61010-1:2001  
IEC60825-1:1994

Measurement category I  
Pollution degree 2  
Indoor use  
Class 1 LED



CAN/CSA C22.2 61010-1-04

Measurement category I  
Pollution degree 2  
Indoor use

WEEE



European Council Directive

2002/96/EC

General Information – continued

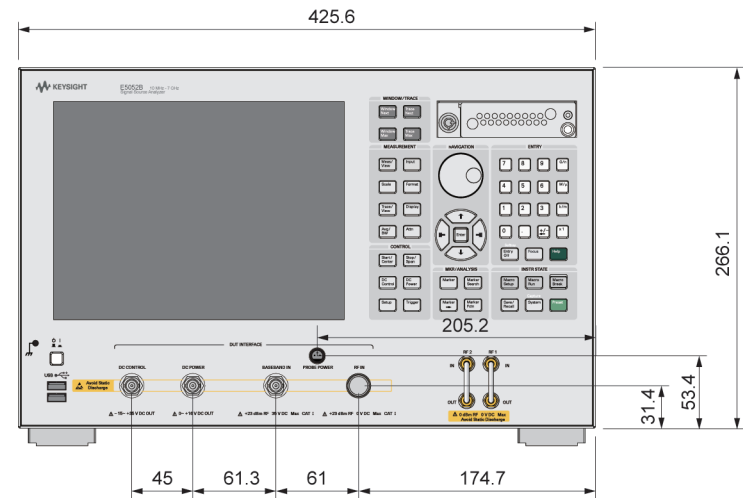


Figure 8-1. Front view

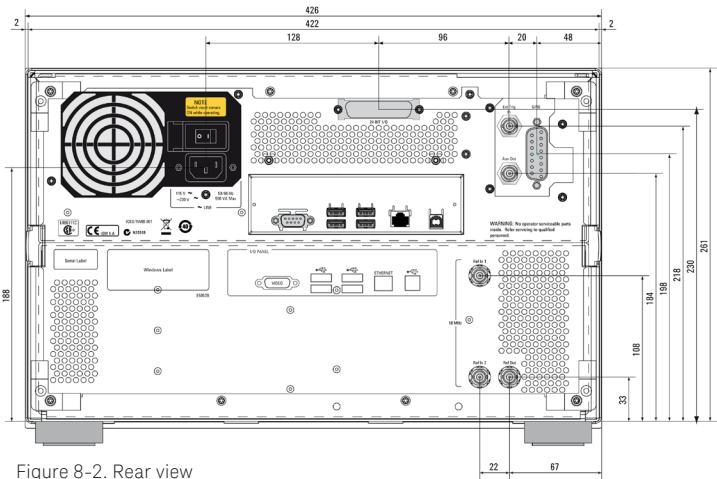


Figure 8-2. Rear view

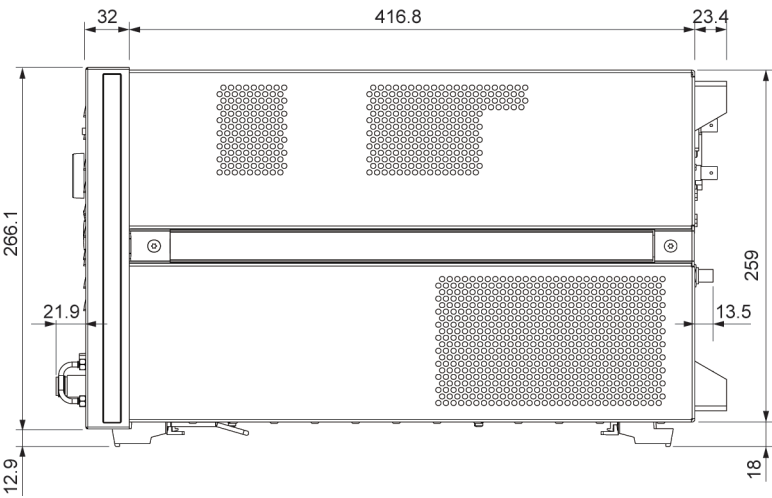


Figure 8-3. Side view

## Display Functions

Table 9-1. Display functions (windows and traces)

| Description           | General characteristics                                                                                                                                        |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement windows   | Up to 6 windows, and 1 user definable window                                                                                                                   |
| User definable window | 8 data traces and 8 memory traces                                                                                                                              |
| Trace functions       |                                                                                                                                                                |
| Data traces           | Display current measurement data and/or memory data                                                                                                            |
| Trace math            | Addition, subtraction, multiplication, or division of trace data                                                                                               |
| Title                 | Add customized title to each measurement window                                                                                                                |
|                       | Titles are printed on hard copies of displayed measurements.                                                                                                   |
| Auto scale            | Automatically selects scale resolution and reference value to vertically center the trace.                                                                     |
| Statistics            | Calculates and displays mean, standard deviation, and peak-to-peak deviation of the trace.                                                                     |
| Marker functions      |                                                                                                                                                                |
| Data markers          | 10 independent markers per trace.                                                                                                                              |
|                       | Reference marker available for "delta marker" operation.                                                                                                       |
| Marker search         | Maximum value, minimum value, peak, peak-left, peak-right, target, target-left, target-right, multi-peak and band markers with user-definable bandwidth value. |
| Marker-to             | Set, start, stop, center to active marker stimulus value.                                                                                                      |
|                       | Set reference to active marker response value.                                                                                                                 |
| Searching range       | User definable                                                                                                                                                 |
| Tracking              | Performs marker search continuously or on-demand.                                                                                                              |

## Data Processing Capabilities

Table 9-2. Data processing capabilities

| Description                 | General characteristics                                                                                                                                                                                             |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Graphical user interface    | The analyzer employs a graphical user interface based on Windows® OS.<br>There are three ways to operate the instrument manually; you can use a hard key interface, a touch-screen interface, or a mouse interface. |
| Limit-line test             | Define the test limit that appears on the display for pass/fail testing.<br>Defined limits may be any combination of horizontal or sloping lines and discrete data points.                                          |
| Data storage                |                                                                                                                                                                                                                     |
| Internal removable SSD      | Store and recall instrument states and trace data on internal removable solid state drive. Instrument states include all control settings and memory trace data.                                                    |
| File sharing                | Files on user disk drive (F:) can be accessed from an external Windows PC through LAN or USB (USB-TMC)                                                                                                              |
| Screen hard copy            | Print-outs of instrument data are directly produced on a printer via USB.                                                                                                                                           |
| Automation                  |                                                                                                                                                                                                                     |
| Built-in VBA®               | Applications can be developed in a built-in VBA (Visual Basic for Applications) language.                                                                                                                           |
| Controlling via GPIB or USB | The GPIB interface operates with IEEE488.2 and SCPI protocols. The instrument can be controlled by a GPIB external controller. The instrument can control external devices using a USB/GPIB interface.              |
| Controlling via USBTMC      | The USB interface operates with USBTMC and SCPI protocols. The instrument can be controlled by an external PC using the USB interface with a USB cable.                                                             |
| LAN                         | (10/100 base-T) Telnet, SICL-LAN                                                                                                                                                                                    |

## Optional Application Software

Table 9-3. E5001A SSA-J precision clock jitter analysis software

| Description                    | General characteristics                                                                                                             |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Measurement functions          | RJ (random jitter), PJ (periodic jitter) frequency, PJ decomposition with auto-trend correction                                     |
| Measurement parameters         | RJ: rms, PJ: frequency, rms, p-p, <b>d-d</b> ,<br>TJ (total jitter): p-p, jitter trend (phase deviation waveform), jitter histogram |
| Jitter spectrum analysis range | 1 Hz to 100 MHz (E5052B), 10 Hz to 100 MHz (E5052B Option 011)                                                                      |



## System Performance with the E5053A Microwave Downconverter

The system performance is the combination of the E5052B SSA and the E5053A microwave downconverter. All data is typical performance.

Table 10-1. System performance characteristics

| Description                          | Performance characteristics                                                                                                                                                                                                                        |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RF input port                        |                                                                                                                                                                                                                                                    |
| Input connector                      | APC-3.5 (female), 50 ohm nominal (E5053A input)                                                                                                                                                                                                    |
| Frequency range                      | 10 MHz to 3 GHz (E5052B RF IN port)<br>3 to 26.5 GHz (E5053A Input port)<br>3 to 10 GHz frequency band: fundamental mixing<br>9 to 26.5 GHz frequency band: third harmonics mixing                                                                 |
| Input level                          | -15 to +20 dBm (10 MHz to 3 GHz, E5052B RF IN port)<br>-30 to +10 dBm (3 to 10 GHz frequency band)<br>-20 to +5 dBm (9 to 26.5 GHz frequency band)                                                                                                 |
| Carrier search range                 | -10 to +10 dBm (3 to 10 GHz frequency band)<br>-10 to +5 dBm (9 to 26.5 GHz frequency band)                                                                                                                                                        |
| Phase noise measurement <sup>1</sup> |                                                                                                                                                                                                                                                    |
| SSB phase noise sensitivity          | See Table 10-2, Figure 10-2 and Figure 10-3.                                                                                                                                                                                                       |
| Frequency tracking range             | 1.8 MHz (< 4.9 GHz carrier in 3 to 10 GHz frequency band)<br>2.8 MHz (> 4.9 GHz carrier in 3 to 10 GHz frequency band)<br>1.3 MHz (< 10 GHz carrier in 9 to 26.5 GHz frequency band)<br>2.6 MHz (> 10 GHz carrier in 9 to 26.5 GHz frequency band) |
| Spectrum monitor measurement         |                                                                                                                                                                                                                                                    |
| Frequency span                       | 15 MHz maximum                                                                                                                                                                                                                                     |
| RBW (resolution bandwidth)           | 1.53 Hz to 400 kHz                                                                                                                                                                                                                                 |
| Level uncertainty                    | ± 4 dB                                                                                                                                                                                                                                             |
| Frequency & RF power measurement     |                                                                                                                                                                                                                                                    |
| Frequency measurement resolution     | 10 Hz, 1 kHz, or 64 kHz                                                                                                                                                                                                                            |
| RF power measurement uncertainty     | ± 2 dB (10 MHz to 3 GHz, E5052B RF IN port)<br>± 3 dB (low band: 3 to 10 GHz)<br>± 4 dB (high band: 9 to 26.5 GHz)<br>Power uncertainty can be improved by applying the 'user power cal.' function.                                                |
| Transient measurement                |                                                                                                                                                                                                                                                    |
| Wideband frequency range             | 50 MHz to 3 GHz (E5052B RF IN port)<br>500 MHz (E5053A Input port)                                                                                                                                                                                 |
| Narrowband frequency range           | 3.125 kHz, 25 kHz, 200 kHz, 1.6 MHz, 25.6 MHz, or 80 MHz                                                                                                                                                                                           |
| RF power measurement uncertainty     | ± 2 dB (10 MHz to 3 GHz, E5052B RF IN port)<br>± 3 dB (low band: 3 to 10 GHz)<br>± 4 dB (high band: 9 to 26.5 GHz)<br>Power uncertainty can be improved by applying the 'user power cal.' function.                                                |

1. Segment PN mode is available with the firmware revision 3.20 or later. In segment PN mode, offset frequency range is limited up to 99.9 MHz when frequency range is 9 to 26.5 GHz frequency band.

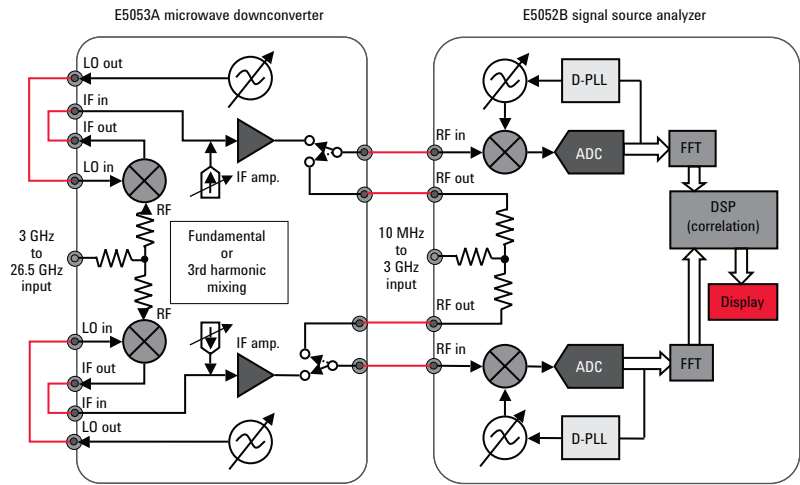


Figure 10-1. E5053A with E5052B simplified block diagram

System Performance with the E5053A Microwave Downconverter – continued

Table 10-2. System SSB phase noise sensitivity (dBc/Hz) in normal capture range mode (E5053A + E5052B) (SPD)  
0 dBm input, start offset frequency = 1 Hz, correlation = 1, LO optimization: < 150 kHz, measurement time = 13 sec

| Input frequency | Offset frequency (Hz) from the carrier |     |     |      |      |       |      |      |      |       |
|-----------------|----------------------------------------|-----|-----|------|------|-------|------|------|------|-------|
|                 | 1                                      | 10  | 100 | 1 k  | 10 k | 100 k | 1 M  | 10 M | 40 M | 100 M |
| 3 GHz           | -48                                    | -79 | -99 | -124 | -135 | -137  | -153 | -164 | -167 | -167  |
| 10 GHz          | -38                                    | -72 | -91 | -116 | -124 | -128  | -147 | -156 | -160 | -160  |
| 18 GHz          | -33                                    | -66 | -85 | -110 | -121 | -125  | -141 | -150 | -154 | -154  |
| 26.5 GHz        | -30                                    | -63 | -82 | -107 | -118 | -122  | -138 | -147 | -151 | -151  |

Table 10-2-W. System SSB phase noise sensitivity (dBc/Hz) in wide capture range mode (E5053A+E5052B) (SPD)  
0 dBm input, start offset frequency = 1 Hz, correlation = 1, LO optimization: < 150 kHz, measurement time = 13 sec

| Input frequency | Offset frequency (Hz) from the carrier |    |     |      |      |       |      |      |      |  |
|-----------------|----------------------------------------|----|-----|------|------|-------|------|------|------|--|
|                 | 1                                      | 10 | 100 | 1 k  | 10 k | 100 k | 1 M  | 10 M | 40 M |  |
| 3 GHz           | -                                      | -  | -   | -107 | -127 | -136  | -150 | -158 | -159 |  |
| 10 GHz          | -                                      | -  | -   | -107 | -122 | -127  | -146 | -154 | -157 |  |
| 18 GHz          | -                                      | -  | -   | -105 | -120 | -124  | -140 | -149 | -153 |  |
| 26.5 GHz        | -                                      | -  | -   | -104 | -117 | -122  | -137 | -146 | -150 |  |

Table 10-2-A. System AM noise sensitivity (dBc/Hz) (E5053A + E5052B) (SPD) correlation = 1, RF input: 0 dBm, > 400 MHz

| AM noise sensitivity                                                      | Offset frequency (Hz) from the carrier |       |      |      |      |       |      |      |      |  |
|---------------------------------------------------------------------------|----------------------------------------|-------|------|------|------|-------|------|------|------|--|
|                                                                           | 1                                      | 10    | 100  | 1 k  | 10 k | 100 k | 1 M  | 10 M | 40 M |  |
| E5052B start frequency = 1 Hz, measurement time = 13 s                    |                                        |       |      |      |      |       |      |      |      |  |
| 3 to 10 GHz                                                               | -                                      | - 100 | -110 | -117 | -127 | -130  | -137 | -137 | -137 |  |
| 10 to 26.5 GHz                                                            | -                                      | -100  | -110 | -117 | -127 | -129  | -129 | -129 | -129 |  |
| E5052B-011 (Option 011) start frequency = 10 Hz, measurement time = 3.3 s |                                        |       |      |      |      |       |      |      |      |  |
| 3 to 10 GHz                                                               | -                                      | -97   | -107 | -114 | -124 | -127  | -134 | -134 | -134 |  |
| 10 to 26.5 GHz                                                            | -                                      | -97   | -107 | -114 | -124 | -126  | -126 | -126 | -126 |  |

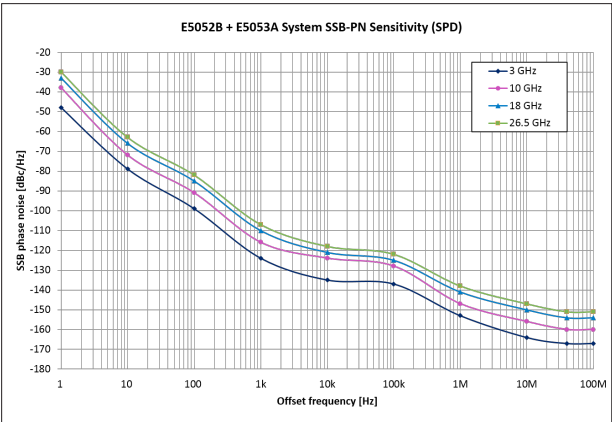


Figure 10-2. System phase noise sensitivity (E5053A + E5052B) (SPD)

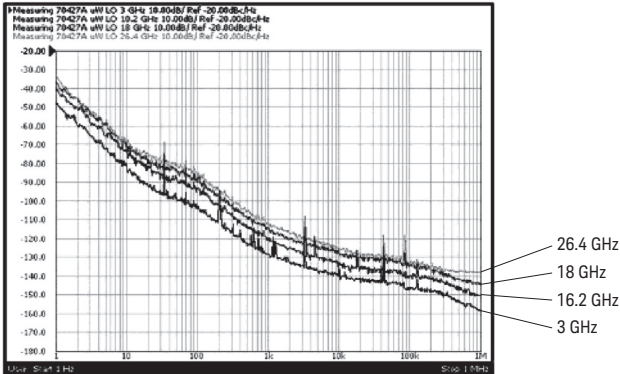


Figure 10-3. Measurement samples for the ultra-low noise N5507A LO

## System Performance with the E5053A Microwave Downconverter – continued

### About “mmW application”:

Phase noise measurements above 26.5 GHz can be done by using external harmonic mixers (such as Keysight Technologies, Inc. 11970 series) and a power divider (splitter) with E5053A LO and IF terminals. The E5052B’s mmW application software sets up appropriate LO frequencies for the harmonic mixers.

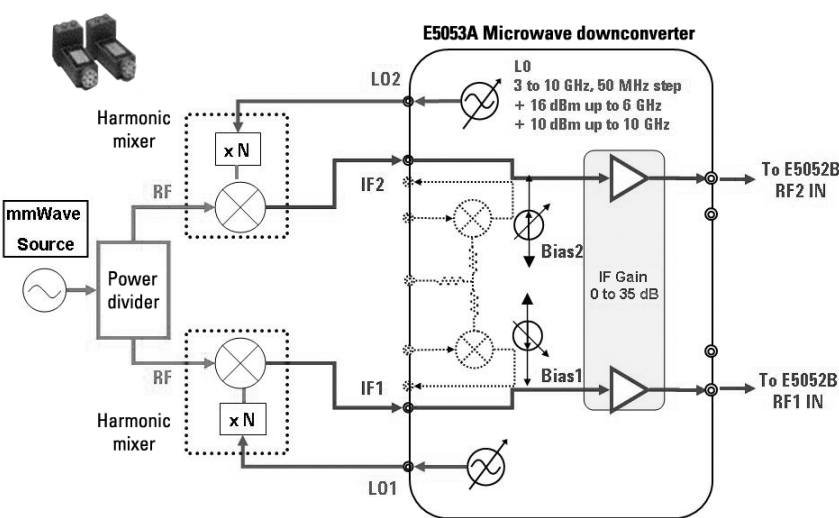


Figure 10-4. System set-up for harmonic mixers (E5053A + E5052B)

Table 10-2-H. Frequency band example of phase noise measurement with mmW harmonic mixers

| Mixer model | Frequency band | N  |
|-------------|----------------|----|
| 11970A      | 26.5 to 40 GHz | 8  |
| 11970Q      | 33 to 50 GHz   | 10 |
| 11970U      | 40 to 60 GHz   | 10 |
| 11970V      | 50 to 75 GHz   | 14 |
| 11970W      | 75 to 110 GHz  | 18 |

## E5053A Microwave Downconverter Specifications and General Information Summary

Table 10-3. E5053A front ports

| Description          | Specification                                                                                           |
|----------------------|---------------------------------------------------------------------------------------------------------|
| RF Input port        |                                                                                                         |
| Input connector      | APC-3.5 (female), 50 ohm nominal                                                                        |
| Frequency range      | 3 GHz to 26.5 GHz<br>3 GHz to 10 GHz (fundamental mixing)<br>9 GHz to 26.5 GHz (third harmonics mixing) |
| Input level          | < +10 dBm ( 3 GHz to 10 GHz band)<br>< +5 dBm (9 GHz to 26.5 GHz band)                                  |
| Input damage level   | > +23 dBm                                                                                               |
| LO outputs           |                                                                                                         |
| Output connector     | SMA (female), 50 ohm nominal                                                                            |
| Output frequency     | 3 GHz to 10 GHz                                                                                         |
| Frequency resolution | 50 MHz                                                                                                  |
| Output power         | 10 dBm to 16 dBm (3 GHz to 6 GHz)<br>10 dBm to 15 dBm (6 GHz to 10 GHz)                                 |
| LO spurious          | < -55 dBc (offset frequency > 300 Hz) typical                                                           |
| IF inputs            |                                                                                                         |
| Input connector      | SMA (female), 50 ohm nominal                                                                            |
| Frequency range      | 250 MHz to 1,250 MHz                                                                                    |
| Maximum input level  | 0 dBm typical                                                                                           |
| IF gain              | 0 dB to 35 dB in 5 dB step                                                                              |
| Noise floor          | < -162 dBm/Hz (SPD)                                                                                     |
| Mixer bias current   | -10 mA to +10 mA                                                                                        |

Table 10-4. General information

| Description                                      | Supplemental information (nominal)                           |
|--------------------------------------------------|--------------------------------------------------------------|
| External reference signal input port             |                                                              |
| Input connector                                  | BNC (female), 50 ohm nominal                                 |
| Input frequency                                  | 10 MHz ± 10 Hz typical                                       |
| Input level                                      | -6 dBm to 6 dBm typical                                      |
| Internal reference signal output port            |                                                              |
| Output connector                                 | BNC (female), 50 ohm nominal                                 |
| Output frequency                                 | 10 MHz ± 50 Hz typical                                       |
| Output level                                     | 2.5 dBm ± 3 dB typical                                       |
| USB port                                         | type-B (female),<br>provides connection to E5052A/B          |
| AC power Line (a third -wire ground is required) |                                                              |
| AC frequency                                     | 47 Hz to 63 Hz                                               |
| AC voltage                                       | 90 V to 132 V, or 198 V to 264 V<br>(automatically selected) |
| AC power                                         | 120 VA maximum                                               |

Table 10-5. Analyzer environmental and dimensions

| Description                       | Supplemental information (nominal)                            |
|-----------------------------------|---------------------------------------------------------------|
| Operating environment             |                                                               |
| Temperature                       | +10 degC to +40 degC                                          |
| Humidity                          | RH 20% to 80% at wet bulb temp.<br>< 29 degC (non-condensing) |
| Altitude                          | 0 to 2,000 m (0 to 6,561 feet)                                |
| Vibration                         | 0.21 G maximum, 5 Hz to 500 Hz                                |
| Non-operating storage environment |                                                               |
| Temperature                       | -10 degC to +60 degC                                          |
| Humidity                          | RH 20% to 90% at wet bulb temp.<br>< 40 degC (non-condensing) |
| Altitude                          | 0 to 4,572 m (0 to 15,000 feet)                               |
| Vibration                         | 0.5 G maximum, 5 Hz to 500 Hz                                 |
| Instrument dimensions             | See Figure 10-6, 10-7, 10-8.                                  |
| Weight (NET)                      | 11 kg                                                         |

# E5053A Microwave Downconverter Specifications and General Information Summary – continued

Table 10-6. E5053A LO phase noise performance (dBc/Hz)

| RF input frequency |               | Offset frequency [Hz] from the carrier |     |     |      |      |       |      |      |      |       |
|--------------------|---------------|----------------------------------------|-----|-----|------|------|-------|------|------|------|-------|
|                    |               | 1                                      | 10  | 100 | 1 k  | 10 k | 100 k | 1 M  | 10 M | 40 M | 100 M |
| 3 GHz              | specification | –                                      | –   | –   | –110 | –116 | –113  | –127 | –140 | –140 | –140  |
|                    | typical       | –49                                    | –79 | –94 | –114 | –120 | –117  | –131 | –144 | –144 | –144  |
| 6 GHz              | specification | –                                      | –   | –   | –104 | –110 | –109  | –123 | –140 | –140 | –140  |
|                    | Typical       | –43                                    | –73 | –88 | –108 | –114 | –113  | –127 | –144 | –144 | –144  |
| 10 GHz             | specification | –                                      | –   | –   | –100 | –103 | –102  | –119 | –140 | –140 | –140  |
|                    | typical       | –39                                    | –69 | –84 | –104 | –107 | –106  | –123 | –144 | –144 | –144  |

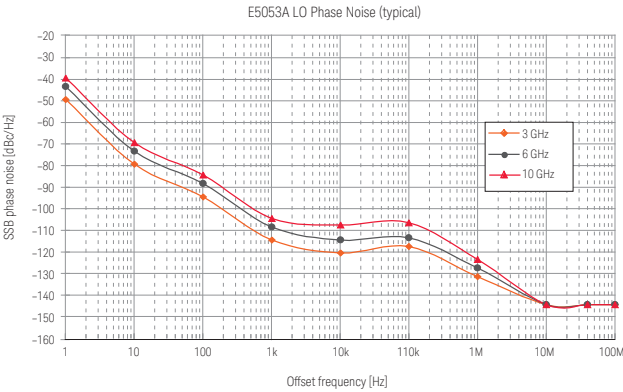


Figure 10-5. E5053A LO phase noise (typical)

## Web Sources

Visit our Signal Source Analyzer Web site for additional product information and literature.

<http://www.keysight.com/find/ssa>

Phase noise measurements;

<http://www.keysight.com/find/phasenoise>

Jitter measurements;

<http://www.keysight.com/find/jitter>

RF and microwave accessories

<http://www.keysight.com/find/mta>

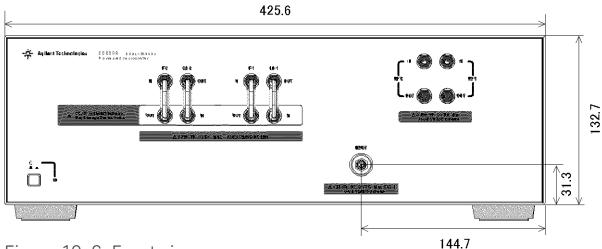


Figure 10-6. Front view

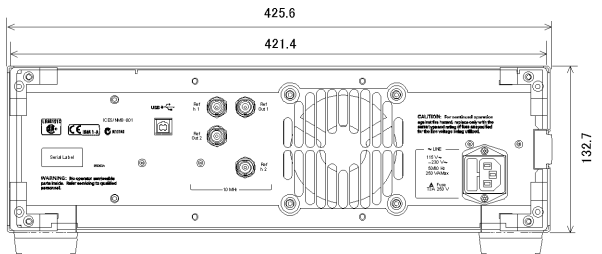


Figure 10-7. Rear view

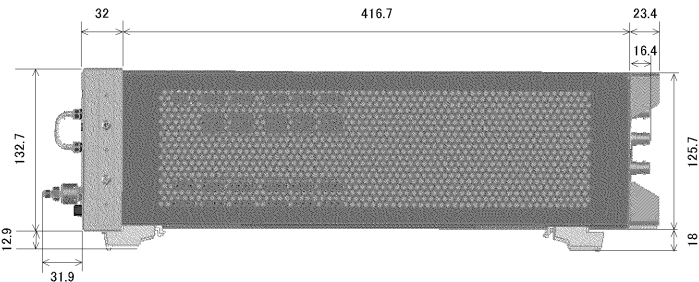
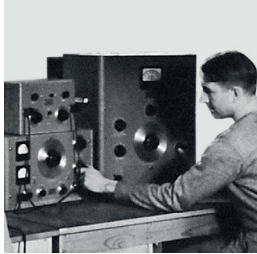


Figure 10-8. Side view

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| Germany        | 0800 6270999  |
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| Israel         | 1 809 343051  |
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| Luxembourg     | +32 800 58580 |
| Netherlands    | 0800 0233200  |
| Russia         | 8800 5009286  |
| Spain          | 800 000154    |
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