

# Keysight X-Series PXE EMI Receiver

This manual provides documentation for the following:  
N9048B PXE EMI Receiver

N9048B PXE  
Specifications  
Guide  
(Comprehensive  
Reference Data)

# Notices

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



## 1. Keysight PXE EMI Receiver

|                                                                           |    |
|---------------------------------------------------------------------------|----|
| Definitions and Requirements . . . . .                                    | 12 |
| Definitions . . . . .                                                     | 12 |
| Conditions Required to Meet Specifications . . . . .                      | 12 |
| Certification . . . . .                                                   | 13 |
| Frequency and Time . . . . .                                              | 14 |
| Frequency Range . . . . .                                                 | 14 |
| Band . . . . .                                                            | 14 |
| Band Overlaps . . . . .                                                   | 14 |
| Standard Frequency Reference . . . . .                                    | 16 |
| Precision Frequency Reference . . . . .                                   | 16 |
| Frequency Readout Accuracy . . . . .                                      | 18 |
| Frequency Counter . . . . .                                               | 19 |
| Frequency Span . . . . .                                                  | 19 |
| Sweep Time . . . . .                                                      | 20 |
| Triggers . . . . .                                                        | 21 |
| Gated Sweep . . . . .                                                     | 22 |
| Number of Frequency Sweep/Step Points (buckets) . . . . .                 | 22 |
| Resolution Bandwidth (RBW) . . . . .                                      | 23 |
| RF Preselector Filters . . . . .                                          | 25 |
| Microwave                                                                 |    |
| Preselector Bandwidth . . . . .                                           | 26 |
| Analysis Bandwidth . . . . .                                              | 26 |
| Video Bandwidth (VBW) . . . . .                                           | 26 |
| Amplitude Accuracy and Range . . . . .                                    | 27 |
| Measurement Range . . . . .                                               | 27 |
| Maximum Safe Input Level . . . . .                                        | 27 |
| Display Range . . . . .                                                   | 27 |
| Marker Readout . . . . .                                                  | 28 |
| Frequency Response . . . . .                                              | 29 |
| IF Frequency Response . . . . .                                           | 32 |
| IF Phase Linearity . . . . .                                              | 33 |
| Absolute Amplitude Accuracy . . . . .                                     | 34 |
| Input Attenuation Switching Uncertainty . . . . .                         | 39 |
| RF Input VSWR – RF Preselector Off . . . . .                              | 40 |
| RF Input VSWR – RF Preselector On . . . . .                               | 41 |
| Resolution Bandwidth Switching Uncertainty . . . . .                      | 42 |
| Reference Level . . . . .                                                 | 42 |
| Total Measurement Uncertainty . . . . .                                   | 43 |
| Display Scale Fidelity . . . . .                                          | 44 |
| Display Units . . . . .                                                   | 45 |
| Available Detectors . . . . .                                             | 45 |
| Amplitude Probability Distribution . . . . .                              | 45 |
| Dynamic Range . . . . .                                                   | 46 |
| Gain Compression . . . . .                                                | 46 |
| IF Prefilter Bandwidth . . . . .                                          | 47 |
| Displayed Average Noise Level . . . . .                                   | 48 |
| Indicated Noise (EMI Receiver Mode) . . . . .                             | 52 |
| DANL and Indicated Noise Improvement with Noise Floor Extension . . . . . | 54 |

# Contents

|                                                    |     |
|----------------------------------------------------|-----|
| Spurious Responses                                 | 56  |
| Second Harmonic Distortion                         | 58  |
| Third Order Intermodulation                        | 60  |
| Phase Noise                                        | 62  |
| Power Suite Measurements (RF Preselector off only) | 64  |
| Channel Power                                      | 64  |
| Occupied Bandwidth                                 | 64  |
| Adjacent Channel Power (ACP)                       | 65  |
| Multi-Carrier Adjacent Channel Power               | 68  |
| Power Statistics CCDF                              | 68  |
| Burst Power                                        | 69  |
| TOI (Third Order Intermodulation)                  | 69  |
| Harmonic Distortion                                | 69  |
| Spurious Emissions                                 | 70  |
| Spectrum Emission Mask                             | 71  |
| Options                                            | 72  |
| General                                            | 73  |
| Calibration Cycle                                  | 73  |
| Acoustic Noise                                     | 74  |
| Power Requirements                                 | 74  |
| Inputs/Outputs                                     | 77  |
| Front Panel                                        | 77  |
| Rear Panel                                         | 78  |
| Regulatory Information                             | 81  |
| <b>2. I/Q Analyzer</b>                             |     |
| Specifications Affected by I/Q Analyzer:           | 86  |
| Frequency                                          | 87  |
| Clipping-to-Noise Dynamic Range                    | 88  |
| Data Acquisition                                   | 89  |
| Time Record Length                                 | 89  |
| ADC Resolution                                     | 89  |
| <b>3. Option B25 - 25 MHz Analysis Bandwidth</b>   |     |
| Specifications Affected by Analysis Bandwidth      | 92  |
| Other Analysis Bandwidth Specifications            | 93  |
| IF Spurious Response                               | 93  |
| IF Frequency Response                              | 94  |
| IF Phase Linearity                                 | 95  |
| Data Acquisition                                   | 96  |
| Time Record Length                                 | 96  |
| ADC Resolution                                     | 96  |
| <b>4. Option B40 - 40 MHz Analysis Bandwidth</b>   |     |
| Specifications Affected by Analysis Bandwidth      | 98  |
| Other Analysis Bandwidth Specifications            | 99  |
| SFDR (Spurious-Free Dynamic Range)                 | 99  |
| Spurious Responses: Residual and Image             | 100 |

# Contents

|                                                                                    |     |
|------------------------------------------------------------------------------------|-----|
| Spurious Responses: Other . . . . .                                                | 101 |
| IF Frequency Response . . . . .                                                    | 102 |
| IF Phase Linearity . . . . .                                                       | 103 |
| EVM . . . . .                                                                      | 104 |
| Data Acquisition . . . . .                                                         | 106 |
| Time Record Length . . . . .                                                       | 106 |
| ADC Resolution . . . . .                                                           | 106 |
| <br>                                                                               |     |
| <b>5. Option CR3 - Connector Rear, 2nd IF Output</b>                               |     |
| Specifications Affected by Connector Rear, 2nd IF Output . . . . .                 | 108 |
| Other Connector Rear, 2nd IF Output Specifications . . . . .                       | 109 |
| Aux IF Out Port. . . . .                                                           | 109 |
| Second IF Out . . . . .                                                            | 109 |
| <br>                                                                               |     |
| <b>6. Option ESC - External Source Control</b>                                     |     |
| General Specifications . . . . .                                                   | 112 |
| Frequency Range . . . . .                                                          | 112 |
| Span Limitations . . . . .                                                         | 112 |
| Dynamic Range . . . . .                                                            | 113 |
| Power Sweep Range . . . . .                                                        | 114 |
| Measurement Time . . . . .                                                         | 114 |
| Supported External Sources . . . . .                                               | 114 |
| <br>                                                                               |     |
| <b>7. Option EXM - External Mixing</b>                                             |     |
| Specifications Affected by External mixing . . . . .                               | 116 |
| Other External Mixing Specifications . . . . .                                     | 117 |
| Connection Port EXT MIXER . . . . .                                                | 117 |
| Mixer Bias . . . . .                                                               | 117 |
| IF Input. . . . .                                                                  | 117 |
| LO Output . . . . .                                                                | 118 |
| <br>                                                                               |     |
| <b>8. Options P03, P08, P26, P44 - Preamplifiers</b>                               |     |
| Specifications Affected by Preamp . . . . .                                        | 120 |
| Other Preamp Specification . . . . .                                               | 121 |
| 1 dB Gain Compression Point . . . . .                                              | 122 |
| Absolute Amplitude Accuracy . . . . .                                              | 124 |
| Frequency Response - LNA ON. . . . .                                               | 134 |
| Frequency Response - LNA OFF . . . . .                                             | 137 |
| RF Input VSWR - Preselector Off . . . . .                                          | 139 |
| RF Input VSWR - Preselector On . . . . .                                           | 141 |
| Total Measurement Uncertainty . . . . .                                            | 143 |
| Displayed Average Noise Level (DANL) - LNA OFF . . . . .                           | 145 |
| Displayed Average Noise Level (DANL) -<br>LNA On . . . . .                         | 147 |
| DANL and Indicated Noise Improvement with Noise Floor Extension - LNA Off. . . . . | 149 |
| DANL and Indicated Noise Improvement with Noise Floor Extension - LNA On . . . . . | 150 |
| Indicated Noise (EMI Receiver Mode) . . . . .                                      | 152 |
| Second Harmonic Distortion . . . . .                                               | 154 |

|                                                                                   |     |
|-----------------------------------------------------------------------------------|-----|
| Third Order Intermodulation . . . . .                                             | 156 |
| <b>9. Option TDS - Time Domain Scan</b>                                           |     |
| General Specifications . . . . .                                                  | 160 |
| Frequency Range . . . . .                                                         | 160 |
| Trace Detectors . . . . .                                                         | 160 |
| TDS Measurement. . . . .                                                          | 160 |
| Resolution Bandwidth (RBW) . . . . .                                              | 161 |
| RF Preselector Filters . . . . .                                                  | 161 |
| Measurement Speed . . . . .                                                       | 162 |
| Absolute Amplitude Accuracy . . . . .                                             | 163 |
| Total Measurement Uncertainty. . . . .                                            | 164 |
| Total Measurement Uncertainty, LNA ON . . . . .                                   | 166 |
| Indicated Noise (EMI Receiver Mode) . . . . .                                     | 168 |
| Indicated Noise (EMI Receiver Mode), LNA On . . . . .                             | 170 |
| DANL and Indicated Noise Improvement with Noise Floor Extension. . . . .          | 172 |
| DANL and Indicated Noise Improvement with Noise Floor Extension, LNA On . . . . . | 173 |
| Third Order Intermodulation. . . . .                                              | 175 |
| Third Order Modulation (TDS Measurement) . . . . .                                | 175 |
| Third Order Modulation (TDS Measurement) . . . . .                                | 176 |
| <b>10. Option YAS - Y-Axis Screen Video Output</b>                                |     |
| Specifications Affected by Y-Axis Screen Video Output . . . . .                   | 180 |
| Other Y-Axis Screen Video Output Specifications. . . . .                          | 181 |
| General Port Specifications . . . . .                                             | 181 |
| Delay . . . . .                                                                   | 183 |
| Continuity and Compatibility . . . . .                                            | 184 |
| <b>11. Analog Demodulation Measurement Application</b>                            |     |
| RF Carrier Frequency and Bandwidth . . . . .                                      | 187 |
| Carrier Frequency . . . . .                                                       | 187 |
| Maximum Information Bandwidth (Info BW) . . . . .                                 | 187 |
| Capture Memory . . . . .                                                          | 187 |
| Post-Demodulation . . . . .                                                       | 188 |
| Maximum Audio Frequency Span. . . . .                                             | 188 |
| Filters. . . . .                                                                  | 188 |
| Frequency Modulation . . . . .                                                    | 190 |
| Conditions required to meet specification . . . . .                               | 190 |
| FM Measurement Range. . . . .                                                     | 190 |
| FM Deviation Accuracy. . . . .                                                    | 191 |
| FM Rate Accuracy. . . . .                                                         | 191 |
| Carrier Frequency Error. . . . .                                                  | 191 |
| Frequency Modulation . . . . .                                                    | 192 |
| Post-Demod Distortion Residual . . . . .                                          | 192 |
| Post-Demod Distortion Accuracy. . . . .                                           | 192 |
| Amplitude Modulation . . . . .                                                    | 193 |
| Conditions required to meet specification . . . . .                               | 193 |
| AM Measurement Range . . . . .                                                    | 193 |

# Contents

|                                                          |     |
|----------------------------------------------------------|-----|
| AM Depth Accuracy . . . . .                              | 194 |
| AM Rate Accuracy . . . . .                               | 194 |
| Amplitude Modulation . . . . .                           | 195 |
| Post-Demod Distortion Residual . . . . .                 | 195 |
| Post-Demod Distortion Accuracy . . . . .                 | 195 |
| FM Rejection . . . . .                                   | 195 |
| Phase Modulation . . . . .                               | 196 |
| Conditions required to meet specification . . . . .      | 196 |
| FM Measurement Range . . . . .                           | 196 |
| PM Deviation Accuracy . . . . .                          | 197 |
| PM Rate Accuracy . . . . .                               | 197 |
| Carrier Frequency Error . . . . .                        | 197 |
| Phase Modulation . . . . .                               | 198 |
| Post-Demod Distortion Residual . . . . .                 | 198 |
| Post-Demod Distortion Accuracy . . . . .                 | 198 |
| Analog Out . . . . .                                     | 199 |
| FM Stereo/Radio Data System (RDS) Measurements . . . . . | 201 |
| FM Stereo Modulation Analysis Measurements . . . . .     | 201 |



# 1 Keysight PXE EMI Receiver

This chapter contains the specifications for the EMI receiver. The specifications and characteristics for the measurement applications and options are covered in the chapters that follow.

## Definitions and Requirements

This book contains EMC receiver specifications and supplemental information. The distinction among specifications, typical performance, and nominal values are described as follows.

### Definitions

- Specifications describe the performance of parameters covered by the product warranty (temperature = 0° to 55°C, unless otherwise noted).
- 95th percentile values indicate the breadth of the population ( $\approx 2\sigma$ ) of performance tolerances expected to be met in 95% of the cases with a 95% confidence, for any ambient temperature in the range of 20 to 30°C. In addition to the statistical observations of a sample of instruments, these values include the effects of the uncertainties of external calibration references. These values are not warranted. These values are updated occasionally if a significant change in the statistically observed behavior of production instruments is observed.
- Typical describes additional product performance information that is not covered by the product warranty. It is performance beyond specification that 80% of the units exhibit with a 95% confidence level over the temperature range 20 to 30°C. Typical performance does not include measurement uncertainty.
- Nominal values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

### Conditions Required to Meet Specifications

The following conditions must be met for the receiver to meet its specifications.

- The receiver is within its calibration cycle. See the General section of this chapter.
- Under auto couple control, except that Auto Sweep Time Rules = Accy.
- For signal frequencies <10 MHz, DC coupling applied.
- Any receiver that has been stored at a temperature range inside the allowed storage range but outside the allowed operating range must be stored at an ambient temperature within the allowed operating range for at least two hours before being turned on.
- The receiver has been turned on at least 30 minutes with Auto Align set to Normal, or if Auto Align is set to Off or Partial, alignments must have been run recently enough to prevent an Alert message. If the Alert condition is changed from "Time and Temperature" to one of the disabled duration choices, the receiver may fail to meet specifications without informing the user. If Auto Align is set to Light, performance is not warranted, and nominal performance will degrade to become a factor of 1.4 wider for any specification subject to alignment, such as amplitude tolerances.

## Certification

Keysight Technologies certifies that this product met its published specifications at the time of shipment from the factory. Keysight Technologies further certifies that its calibration measurements are traceable to the International System of Units (SI) via national metrology institutes ([www.keysight.com/find/NMI](http://www.keysight.com/find/NMI)) that are signatories to the CIPM Mutual Recognition Arrangement.

## Frequency and Time

| Description             | Specifications              |                                    | Supplemental Information         |
|-------------------------|-----------------------------|------------------------------------|----------------------------------|
| <b>Frequency Range</b>  |                             |                                    |                                  |
| Maximum Frequency       |                             |                                    |                                  |
| RF Input 1              |                             |                                    |                                  |
| Option 503              | 3.6 GHz                     |                                    |                                  |
| Option 508              | 8.4 GHz                     |                                    |                                  |
| Option 526              | 26.5 GHz                    |                                    |                                  |
| Option 544              | 44 GHz                      |                                    |                                  |
| RF Input 2              | 1.0 GHz                     |                                    |                                  |
| Minimum Frequency       |                             |                                    |                                  |
| RF Preselector Off      | AC Coupled <sup>a</sup>     | DC Coupled                         |                                  |
| Preamp Off              | 10 MHz                      | 1 Hz                               |                                  |
| Preamp On               | 10 MHz                      | 9 kHz                              |                                  |
| Preamp Off, LNA On      | 10 MHz                      | 150 kHz                            |                                  |
| RF Preselector On       | AC Coupled <sup>a</sup>     | DC Coupled                         |                                  |
| Preamp Off              | 10 MHz                      | 1 Hz                               |                                  |
| Preamp On               | 10 MHz                      | 1 kHz                              |                                  |
| Preamp Off, LNA On      | 10 MHz                      | 150 kHz                            |                                  |
| <b>Band</b>             | <b>Harmonic Mixing Mode</b> | <b>LO Multiple (N<sup>b</sup>)</b> | <b>Band Overlaps<sup>c</sup></b> |
| 0 (2 Hz to 3.6 GHz)     | 1–                          | 1                                  | Options 503, 508, 526            |
| 1 (3.5 GHz to 8.4 GHz)  | 1–                          | 1                                  | Options 508, 526                 |
| 2 (8.3 GHz to 13.6 GHz) | 1–                          | 2                                  | Options 526                      |
| 3 (13.5 to 17.1 GHz)    | 2–                          | 2                                  | Option 526                       |
| 4 (17.0 to 26.5 GHz)    | 2–                          | 4                                  | Option 526                       |
| 5 (26.4 to 34.5 GHz)    | 2–                          | 4                                  | Options 544                      |
| 6 (34.4 to 50 GHz)      | 4–                          | 8                                  | Options 544                      |

a. AC Coupled only applicable to Freq Options 503, 508 and 526.

## Keysight PXE EMI Receiver Frequency and Time

- b. N is the LO multiplication factor. For negative mixing modes (as indicated by the “–” in the “Harmonic Mixing Mode” column), the desired 1st LO harmonic is higher than the tuned frequency by the 1st IF (5.1225 GHz for band 0, 322.5 MHz for all other bands).
- c. In the band overlap regions, for example, 3.5 to 3.6 GHz, the receiver may use either band for measurements, in this example Band 0 or Band 1. The receiver gives preference to the band with the better overall specifications (which is the lower numbered band for all frequencies below 26 GHz), but will choose the other band if doing so is necessary to achieve a sweep having minimum band crossings. For example, with  $CF = 3.58$  GHz, with a span of 40 MHz or less, the receiver uses Band 0, because the stop frequency is 3.6 GHz or less, allowing a span without band crossings in the preferred band. If the span is between 40 and 160 MHz, the receiver uses Band 1, because the start frequency is above 3.5 GHz, allowing the sweep to be done without a band crossing in Band 1, though the stop frequency is above 3.6 GHz, preventing a Band 0 sweep without band crossing. With a span greater than 160 MHz, a band crossing will be required: the receiver scans up to 3.6 GHz in Band 0; then executes a band crossing and continues the sweep in Band 1.  
Specifications are given separately for each band in the band overlap regions. One of these specifications is for the preferred band, and one for the alternate band. Continuing with the example from the previous paragraph (3.58 GHz), the preferred band is band 0 (indicated as frequencies under 3.6 GHz) and the alternate band is band 1 (3.5 to 8.4 GHz). The specifications for the preferred band are warranted. The specifications for the alternate band are not warranted in the band overlap region, but performance is nominally the same as those warranted specifications in the rest of the band. Again, in this example, consider a signal at 3.58 GHz. If the sweep has been configured so that the signal at 3.58 GHz is measured in Band 1, the analysis behavior is nominally as stated in the Band 1 specification line (3.5 to 8.4 GHz) but is not warranted. If warranted performance is necessary for this signal, the sweep should be reconfigured so that analysis occurs in Band 0. Another way to express this situation in this example Band 0/Band 1 crossing is this: The specifications given in the “Specifications” column which are described as “3.5 to 8.4 GHz” represent nominal performance from 3.5 to 3.6 GHz, and warranted performance from 3.6 to 8.4 GHz.

Keysight PXE EMI Receiver  
Frequency and Time

| Description                                                       | Specifications                                                                                                                       | Supplemental Information                                  |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Standard Frequency Reference</b>                               |                                                                                                                                      |                                                           |
| Accuracy                                                          | $\pm[(\text{time since last adjustment} \times \text{aging rate}) + \text{temperature stability} + \text{calibration accuracy}^a]$   |                                                           |
| Temperature Stability                                             |                                                                                                                                      |                                                           |
| 20 to 30°C                                                        | $\pm 2 \times 10^{-6}$                                                                                                               |                                                           |
| Full temperature range                                            | $\pm 2 \times 10^{-6}$                                                                                                               |                                                           |
| Aging Rate                                                        | $\pm 1 \times 10^{-6}/\text{year}^b$                                                                                                 |                                                           |
| Achievable Initial Calibration Accuracy                           | $\pm 1.4 \times 10^{-6}$                                                                                                             |                                                           |
| Settability                                                       | $\pm 2 \times 10^{-8}$                                                                                                               |                                                           |
| Residual FM<br>(Center Frequency = 1 GHz<br>10 Hz RBW, 10 Hz VBW) |                                                                                                                                      | $\leq 10 \text{ Hz} \times N^c$ p-p in 20 ms<br>(nominal) |
| <b>Precision Frequency Reference</b>                              |                                                                                                                                      |                                                           |
| <i>(Option PFR)</i>                                               |                                                                                                                                      |                                                           |
| Accuracy                                                          | $\pm[(\text{time since last adjustment} \times \text{aging rate}) + \text{temperature stability} + \text{calibration accuracy}^a]^d$ |                                                           |
| Temperature Stability                                             |                                                                                                                                      |                                                           |
| 20 to 30°C                                                        | $\pm 1.5 \times 10^{-8}$                                                                                                             |                                                           |
| Full temperature range                                            | $\pm 5 \times 10^{-8}$                                                                                                               |                                                           |
| Aging Rate                                                        |                                                                                                                                      | $\pm 5 \times 10^{-10}/\text{day}$ (nominal)              |
| Total Aging                                                       |                                                                                                                                      |                                                           |
| 1 Year                                                            | $\pm 1 \times 10^{-7}$                                                                                                               |                                                           |
| 2 Years                                                           | $\pm 1.5 \times 10^{-7}$                                                                                                             |                                                           |
| Settability                                                       | $\pm 2 \times 10^{-9}$                                                                                                               |                                                           |
| Warm-up and Retrace <sup>e</sup>                                  |                                                                                                                                      | Nominal                                                   |
| 300 s after turn on                                               |                                                                                                                                      | $\pm 1 \times 10^{-7}$ of final frequency                 |
| 900 s after turn on                                               |                                                                                                                                      | $\pm 1 \times 10^{-8}$ of final frequency                 |

Keysight PXE EMI Receiver  
Frequency and Time

| Description                                                                                                                                                                | Specifications         | Supplemental Information                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------------------------------------------------------|
| Achievable Initial Calibration Accuracy <sup>f</sup><br><br>Standby power to reference oscillator<br><br>Residual FM<br>(Center Frequency = 1 GHz<br>10 Hz RBW, 10 Hz VBW) | $\pm 4 \times 10^{-8}$ | Not supplied<br><br>$\leq 0.25 \text{ Hz} \times N^c$ p-p in 20 ms<br>(nominal) |

- a. Calibration accuracy depends on how accurately the frequency standard was adjusted to 10 MHz. If the adjustment procedure is followed, the calibration accuracy is given by the specification "Achievable Initial Calibration Accuracy."
- b. For periods of one year or more.
- c. N is the LO multiplication factor.
- d. The specification applies after the receiver has been powered on for four hours.
- e. Standby mode does not apply power to the oscillator. Therefore warm-up applies every time the power is turned on. The warm-up reference is one hour after turning the power on. Retracing also occurs every time warm-up occurs. The effect of retracing is included within the "Achievable Initial Calibration Accuracy" term of the Accuracy equation.
- f. The achievable calibration accuracy at the beginning of the calibration cycle includes these effects:
  - 1) Temperature difference between the calibration environment and the use environment
  - 2) Orientation relative to the gravitation field changing between the calibration environment and the use environment
  - 3) Retrace effects in both the calibration environment and the use environment due to turning the instrument power off.
  - 4) Settability

| Description                       | Specifications                                                                                                                                                          | Supplemental Information          |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| <b>Frequency Readout Accuracy</b> | $\pm(\text{marker freq} \times \text{freq ref accy.} + 0.25\% \times \text{span} + 5\% \times \text{RBW}^a + 2 \text{ Hz} + 0.5 \times \text{horizontal resolution}^b)$ | Single detector only <sup>c</sup> |
| Example for EMC <sup>d</sup>      |                                                                                                                                                                         | $\pm 0.0032\%$ (nominal)          |

- The warranted performance is only the sum of all errors under autocoupled conditions. Under non-autocoupled conditions, the frequency readout accuracy will nominally meet the specification equation, except for conditions in which the RBW term dominates, as explained in examples below. The nominal RBW contribution to frequency readout accuracy is 2% of RBW for RBWs from 1 Hz to 390 kHz, 4% of RBW from 430 kHz through 3 MHz (the widest autocoupled RBW), and 30% of RBW for the (manually selected) 4, 5, 6 and 8 MHz RBWs.  
*First example:* a 120 MHz span, with autocoupled RBW. The autocoupled ratio of span to RBW is 106:1, so the RBW selected is 1.1 MHz. The  $5\% \times \text{RBW}$  term contributes only 55 kHz to the total frequency readout accuracy, compared to 120 kHz for the  $0.0.10\% \times \text{span}$  term, for a total of 175 kHz.  
*Second example:* a 20 MHz span, with a 4 MHz RBW. The specification equation does not apply because the Span: RBW ratio is not autocoupled. If the equation did apply, it would allow 20 kHz of error (0.10%) due to the span and 200 kHz error (5%) due to the RBW. For this non-autocoupled RBW, the RBW error is nominally 30%, or 1200 kHz.
- Horizontal resolution is due to the marker reading out one of the sweep points. The points are spaced by  $\text{span}/(\text{Npts} - 1)$ , where Npts is the number of sweep points. For example, with the factory preset value of 1001 sweep points, the horizontal resolution is  $\text{span}/1000$ . However, there is an exception: When both the detector mode is "normal" and the  $\text{span} > 0.25 \times (\text{Npts} - 1) \times \text{RBW}$ , peaks can occur only in even-numbered points, so the effective horizontal resolution becomes doubled, or  $\text{span}/500$  for the factory preset case. When the RBW is autocoupled and there are 1001 sweep points, that exception occurs only for spans  $> 750$  MHz.
- Specifications apply to traces in most cases, but there are exceptions. Specifications always apply to the peak detector. Specifications apply when only one detector is in use and all active traces are set to Clear Write. Specifications also apply when only one detector is in use in all active traces and the "Restart" key has been pressed since any change from the use of multiple detectors to a single detector. In other cases, such as when multiple simultaneous detectors are in use, additional errors of 0.5, 1.0 or 1.5 sweep points will occur in some detectors, depending on the combination of detectors in use.
- In most cases, the frequency readout accuracy of the receiver can be exceptionally good. As an example, Keysight has characterized the accuracy of a span commonly used for Electro-Magnetic Compatibility (EMC) testing using a source frequency locked to the receiver. Ideally, this sweep would include EMC bands C and D and thus sweep from 30 to 1000 MHz. Ideally, the analysis bandwidth would be 120 kHz at  $-6$  dB, and the spacing of the points would be half of this (60 kHz). With a start frequency of 30 MHz and a stop frequency of 1000.2 MHz and a total of 16168 points, the spacing of points is ideal. The detector used was the Peak detector. The accuracy of frequency readout of all the points tested in this span was with  $\pm 0.0032\%$  of the span. A perfect receiver with this many points would have an accuracy of  $\pm 0.0031\%$  of span. Thus, even with this large number of display points, the errors in excess of the bucket quantization limitation were negligible.

Keysight PXE EMI Receiver  
Frequency and Time

| Description                          | Specifications                                                            | Supplemental Information |
|--------------------------------------|---------------------------------------------------------------------------|--------------------------|
| <b>Frequency Counter<sup>a</sup></b> |                                                                           | See note <sup>b</sup>    |
| Count Accuracy                       | $\pm(\text{marker freq} \times \text{freq ref accy.} + 0.100 \text{ Hz})$ |                          |
| Delta Count Accuracy                 | $\pm(\text{delta freq.} \times \text{freq ref accy.} + 0.141 \text{ Hz})$ |                          |
| Resolution                           | 0.001 Hz                                                                  |                          |

- a. Instrument conditions: RBW = 1 kHz, gate time = auto (100 ms), S/N  $\geq$  50 dB, frequency = 1 GHz  
b. If the signal being measured is locked to the same frequency reference as the receiver, the specified count accuracy is  $\pm 0.100$  Hz under the test conditions of footnote a. This error is a noisiness of the result. It will increase with noisy sources, wider RBWs, lower S/N ratios, and source frequencies  $> 1$  GHz.

| Description           | Specifications                                                    | Supplemental Information |
|-----------------------|-------------------------------------------------------------------|--------------------------|
| <b>Frequency Span</b> |                                                                   |                          |
| Range                 |                                                                   |                          |
| Swept and FFT         |                                                                   |                          |
| <i>Option 503</i>     | 0 Hz, 10 Hz to 3.6 GHz                                            |                          |
| <i>Option 508</i>     | 0 Hz, 10 Hz to 8.4 GHz                                            |                          |
| <i>Option 526</i>     | 0 Hz, 10 Hz to 26.5 GHz                                           |                          |
| <i>Option 544</i>     | 0 Hz, 10 Hz to 44 GHz                                             |                          |
| Resolution            | 2 Hz                                                              |                          |
| Span Accuracy         |                                                                   |                          |
| Stepped               | $\pm(0.25\% \times \text{span} + \text{horizontal resolution}^a)$ |                          |
| Swept                 | $\pm(0.25\% \times \text{span} + \text{horizontal resolution}^a)$ |                          |
| FFT                   | $\pm(0.1\% \times \text{span} + \text{horizontal resolution}^a)$  |                          |

- a. Horizontal resolution is due to the marker reading out one of the sweep points. The points are spaced by  $\text{span}/(\text{Npts} - 1)$ , where Npts is the number of sweep points. For example, with the factory preset value of 1001 sweep points, the horizontal resolution is  $\text{span}/1000$ . However, there is an exception: When both the detector mode is "normal" and the  $\text{span} > 0.25 \times (\text{Npts} - 1) \times \text{RBW}$ , peaks can occur only in even-numbered points, so the effective horizontal resolution becomes doubled, or  $\text{span}/500$  for the factory preset case. When the RBW is auto coupled and there are 1001 sweep points, that exception occurs only for spans  $> 750$  MHz.

# Keysight PXE EMI Receiver

## Frequency and Time

| Description                  | Specifications                                                          | Supplemental Information |
|------------------------------|-------------------------------------------------------------------------|--------------------------|
| <b>Sweep Time</b>            |                                                                         |                          |
| Range                        |                                                                         |                          |
| Span = 0 Hz                  | 1 $\mu$ s to 6000 s                                                     |                          |
| Span $\geq$ 10 Hz            | 1 ms to 4000 s                                                          |                          |
| Accuracy                     |                                                                         |                          |
| Span $\geq$ 10 Hz, swept     |                                                                         | $\pm 0.01\%$ (nominal)   |
| Span $\geq$ 10 Hz, FFT       |                                                                         | $\pm 40\%$ (nominal)     |
| Span = 0 Hz                  |                                                                         | $\pm 0.01\%$ (nominal)   |
| Sweep Trigger                | Free Run, Line, Video, External 1, External 2, RF Burst, Periodic Timer |                          |
| Delayed Trigger <sup>a</sup> |                                                                         |                          |
| Range                        |                                                                         |                          |
| Span $\geq$ 10 Hz, swept     | 0 to 500 ms                                                             |                          |
| Span = 0 Hz or FFT           | -150 ms to +500 ms                                                      |                          |
| Resolution                   | 0.1 $\mu$ s                                                             |                          |

a. Delayed trigger is available with line, video, RF burst and external triggers.

| Description                                              | Specifications | Supplemental Information                                                                                                                                               |
|----------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Triggers</b>                                          |                | Additional information on some of the triggers and gate sources                                                                                                        |
| <b>Video</b>                                             |                | Independent of Display Scaling and Reference Level                                                                                                                     |
| Minimum settable level                                   | –170 dBm       | Useful range limited by noise                                                                                                                                          |
| Maximum usable level                                     |                | Highest allowed mixer level <sup>a</sup> + 2 dB (nominal)                                                                                                              |
| Detector and Sweep Type relationships                    |                |                                                                                                                                                                        |
| Sweep Type = Swept                                       |                |                                                                                                                                                                        |
| Detector = Normal, Peak, Sample or Negative Peak         |                | Triggers on the signal before detection, which is similar to the displayed signal                                                                                      |
| Detector = Average                                       |                | Triggers on the signal before detection, but with a single-pole filter added to give similar smoothing to that of the average detector                                 |
| Sweep Type = FFT                                         |                | Triggers on the signal envelope in a bandwidth wider than the FFT width                                                                                                |
| <b>RF Burst</b>                                          |                |                                                                                                                                                                        |
| Level Range                                              |                | –50 <sup>b</sup> to –10 dBm plus attenuation (nominal)                                                                                                                 |
| Level Accuracy                                           |                | ±2 dB + Absolute Amplitude Accuracy (nominal)                                                                                                                          |
| Bandwidth (–10 dB)                                       |                |                                                                                                                                                                        |
| Most cases                                               |                | 16 MHz (nominal)                                                                                                                                                       |
| Sweep Type = FFT;<br>FFT Width = 25 MHz;<br>Span ≥ 8 MHz |                | 30 MHz (nominal)                                                                                                                                                       |
| Frequency Limitations                                    |                | If the start or center frequency is too close to zero, LO feedthrough can degrade or prevent triggering. How close is too close depends on the bandwidth listed above. |
| <b>External Triggers</b>                                 |                | See “ <b>Trigger Inputs (Trigger 1 In, Trigger 2 In)</b> ” on page 79                                                                                                  |

- a. The highest allowed mixer level depends on the IF Gain. It is nominally –10 dBm for Preamp Off and IF Gain = Low.
- b. Noise will limit trigger level range at high frequencies, such as above 15 GHz.

Keysight PXE EMI Receiver  
Frequency and Time

| Description                                | Specifications                                           | Supplemental Information                                                                                      |
|--------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <b>Gated Sweep</b>                         |                                                          |                                                                                                               |
| Gate Methods                               | Gated LO<br>Gated Video<br>Gated FFT                     |                                                                                                               |
| Span Range                                 | Any span                                                 |                                                                                                               |
| Gate Delay Range                           | 0 to 100.0 s                                             |                                                                                                               |
| Gate Delay Settability                     | 4 digits, $\geq 100$ ns                                  |                                                                                                               |
| Gate Delay Jitter                          |                                                          | 33.3 ns p-p (nominal)                                                                                         |
| Gate Length Range<br>(Except Method = FFT) | 1 $\mu$ s to 5.0 s                                       | Gate length for the FFT method is fixed at 1.83/RBW, with nominally 2% tolerance.                             |
| Gated Frequency and Amplitude Errors       |                                                          | Nominally no additional error for gated measurements when the Gate Delay is greater than the MIN FAST setting |
| Gate Sources                               | External 1<br>External 2<br>Line<br>RF Burst<br>Periodic | Pos or neg edge triggered                                                                                     |

| Description                                            | Specifications | Supplemental Information |
|--------------------------------------------------------|----------------|--------------------------|
| <b>Number of Frequency Sweep/Step Points (buckets)</b> |                |                          |
| Factory preset                                         | 1001           |                          |
| Range                                                  | 1 to 100,001   | Zero and non-zero spans  |

Keysight PXE EMI Receiver  
Frequency and Time

| Description                                | Specifications                                                                                                                                                                                                                                                                                   | Supplemental Information     |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Resolution Bandwidth (RBW)</b>          |                                                                                                                                                                                                                                                                                                  |                              |
| Range (–3.01 dB bandwidth)                 | 1 Hz to 8 MHz<br>Bandwidths above 3 MHz are 4, 5, 6, and 8 MHz.<br>Bandwidths 1 Hz to 3 MHz are spaced at 10% spacing using the E24 series 24 per decade: 1.0, 1.1, 1.2, 1.3, 1.5, 1.6, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.6, 3.9, 4.3, 4.7, 5.1, 5.6, 6.2, 6.8, 7.5, 8.2, 9.1 in each decade. |                              |
| CISPR Standard Bandwidths                  | 200 Hz, 9 kHz, 120 kHz, 1 MHz                                                                                                                                                                                                                                                                    | –6 dB, subject to CISPR mask |
| MIL Standard Bandwidths                    | 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz                                                                                                                                                                                                                                                     | –6 dB                        |
| Other Bandwidths                           | 1 Hz                                                                                                                                                                                                                                                                                             | –6 dB, requires Option WF1   |
|                                            | 30 Hz, 300 Hz, 3 kHz, 30 kHz, 300 kHz, 3 MHz, 10 MHz                                                                                                                                                                                                                                             | –6 dB                        |
| Power bandwidth accuracy <sup>a</sup>      |                                                                                                                                                                                                                                                                                                  |                              |
| <b>RBW Range</b>                           | <b>CF Range</b>                                                                                                                                                                                                                                                                                  |                              |
| 1 Hz to 750 kHz                            | All                                                                                                                                                                                                                                                                                              | ±1.0% (0.044 dB)             |
| 820 kHz to 1.2 MHz                         | < 3.6 GHz                                                                                                                                                                                                                                                                                        | ±2.0% (0.088 dB)             |
| 1.3 to 2.0 MHz                             | < 3.6 GHz                                                                                                                                                                                                                                                                                        | ±0.07 dB (nominal)           |
| 2.2 to 3 MHz                               | < 3.6 GHz                                                                                                                                                                                                                                                                                        | ±0.15 dB (nominal)           |
| 4 to 8 MHz                                 | < 3.6 GHz                                                                                                                                                                                                                                                                                        | ±0.25 dB (nominal)           |
| Accuracy (–3.01 dB bandwidth) <sup>b</sup> |                                                                                                                                                                                                                                                                                                  |                              |
| 1 Hz to 1.3 MHz RBW                        |                                                                                                                                                                                                                                                                                                  | ±2% (nominal)                |
| 1.5 MHz to 3 MHz RBW                       |                                                                                                                                                                                                                                                                                                  |                              |
| CF ≤ 3.6 GHz                               |                                                                                                                                                                                                                                                                                                  | ±7% (nominal)                |
| CF > 3.6 GHz                               |                                                                                                                                                                                                                                                                                                  | ±8% (nominal)                |
| 4 MHz to 8 MHz RBW                         |                                                                                                                                                                                                                                                                                                  |                              |
| CF ≤ 3.6 GHz                               |                                                                                                                                                                                                                                                                                                  | ±15% (nominal)               |
| CF > 3.6 GHz                               |                                                                                                                                                                                                                                                                                                  | ±20% (nominal)               |
| Selectivity (–60 dB/–3 dB)                 |                                                                                                                                                                                                                                                                                                  | 4.1:1 (nominal)              |

- a. The noise marker, band power marker, channel power and ACP all compute their results using the power bandwidth of the RBW used for the measurement. Power bandwidth accuracy is the power uncertainty in the results of these measurements due only to bandwidth-related errors. (The receiver knows this power bandwidth for each RBW with greater accuracy than the RBW width itself, and can therefore achieve lower errors.) The warranted specifications shown apply to the Gaussian RBW filters used in swept and zero span analysis. There are four different kinds of filters used in the receiver: Swept Gaussian, Swept Flattop, FFT Gaussian and FFT Flattop. While the warranted performance only applies to the swept Gaussian filters, because only they are kept under statistical process control, the other filters nominally have the same performance.
- b. Resolution Bandwidth Accuracy can be observed at slower sweep times than auto-coupled conditions. Normal sweep rates cause the shape of the RBW filter displayed on the receiver screen to widen by nominally 6%. This widening declines to 0.6% nominal when the Swp Time Rules key is set to Accuracy instead of Normal. The true bandwidth, which determines the response to impulsive signals and noise-like signals, is not affected by the sweep rate.

Keysight PXE EMI Receiver  
Frequency and Time

| Description                   | Specifications     | Supplemental Information          |
|-------------------------------|--------------------|-----------------------------------|
| <b>RF Preselector Filters</b> |                    |                                   |
| <b>Filter Band</b>            | <b>Filter Type</b> | <b>6 dB Bandwidth (Nominal)</b>   |
| 150 kHz                       | Fixed lowpass      | 289 kHz (–3 dB corner frequency)  |
| 30 MHz                        | Fixed lowpass      | 37 MHz (–3 dB corner frequency)   |
| 30 to 52 MHz                  | Fixed bandpass     | 28 MHz                            |
| 52 to 75 MHz                  | Fixed bandpass     | 39 MHz                            |
| 75 to 120 MHz                 | Fixed bandpass     | 63 MHz                            |
| 120 to 165 MHz                | Fixed bandpass     | 71 MHz                            |
| 165 to 210 MHz                | Fixed bandpass     | 69 MHz                            |
| 210 to 255 MHz                | Fixed bandpass     | 71 MHz                            |
| 255 to 300 MHz                | Fixed bandpass     | 68MHz                             |
| 300 to 475 MHz                | Fixed bandpass     | 284 MHz                           |
| 475 to 650 MHz                | Fixed bandpass     | 305 MHz                           |
| 650 to 825 MHz                | Fixed bandpass     | 302 MHz                           |
| 825 to 1000 MHz               | Fixed bandpass     | 314 MHz                           |
| 1 GHz                         | Fixed highpass     | 912 MHz (–3 dB corner frequency)  |
| 1.7 GHz                       | Fixed highpass     | 1.56 GHz (–3 dB corner frequency) |
| 2.9 GHz                       | Fixed highpass     | 2.29 GHz (–3 dB corner frequency) |
| <b>Notch Filter</b>           |                    |                                   |
| Reject band                   |                    | 2400 to 2500 MHz                  |
| Reject attenuation            |                    | 20 dB (nominal)                   |

| Description                            | Specifications | Supplemental Information                                                                 |                             |
|----------------------------------------|----------------|------------------------------------------------------------------------------------------|-----------------------------|
| <b>Microwave Preselector Bandwidth</b> |                | Relevant to many options, such as B25 Wide IF Bandwidth, in Bands 1 and higher. Nominal. |                             |
| Mean Bandwidth at CF <sup>a</sup>      |                | <b>Freq option ≤ 526</b>                                                                 | <b>Freq option &gt; 526</b> |
| 5 GHz                                  |                | 58 MHz                                                                                   | 46 MHz                      |
| 10 GHz                                 |                | 57 MHz                                                                                   | 52 MHz                      |
| 15 GHz                                 |                | 59 MHz                                                                                   | 53 MHz                      |
| 20 GHz                                 |                | 64 MHz                                                                                   | 55 MHz                      |
| 25 GHz                                 |                | 74 MHz                                                                                   | 56 MHz                      |
| 35 GHz                                 |                |                                                                                          | 62 MHz                      |
| 44 GHz                                 |                |                                                                                          | 70MHz                       |
| Standard Deviation                     |                | 9%                                                                                       | 7%                          |
| –3 dB Bandwidth                        |                | –7.5% relative to –4 dB bandwidth, nominal                                               |                             |

- a. The microwave preselector can have a passband ripple up to 3 dB. To avoid ambiguous results, the –4 dB bandwidth is characterized.

| Description                           | Specification | Supplemental information |
|---------------------------------------|---------------|--------------------------|
| <b>Analysis Bandwidth<sup>a</sup></b> |               |                          |
| Standard                              | 10 MHz        |                          |
| With <i>Option B25</i>                | 25 MHz        |                          |
| With <i>Option B40</i>                | 40 MHz        |                          |

- a. Analysis bandwidth is the instantaneous bandwidth available about a center frequency over which the input signal can be digitized for further analysis or processing in the time, frequency, or modulation domain.

| Description                  | Specifications                                                         | Supplemental Information                                  |
|------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Video Bandwidth (VBW)</b> |                                                                        |                                                           |
| Range                        | Same as Resolution Bandwidth range plus wide-open VBW (labeled 50 MHz) |                                                           |
| Accuracy                     |                                                                        | ±6% (nominal)<br>in swept mode and zero span <sup>a</sup> |

- a. For FFT processing, the selected VBW is used to determine a number of averages for FFT results. That number is chosen to give roughly equivalent display smoothing to VBW filtering in a swept measurement. For example, if  $VBW = 0.1 \times RBW$ , four FFTs are averaged to generate one result.

## Amplitude Accuracy and Range

| Description              | Specifications                           | Supplemental Information |
|--------------------------|------------------------------------------|--------------------------|
| <b>Measurement Range</b> |                                          |                          |
| Preamp Off               | Displayed Average Noise Level to +30 dBm |                          |
| Preamp On                | Displayed Average Noise Level to +30 dBm |                          |
| Input Attenuation Range  | 0 to 70 dB, in 2 dB steps                |                          |

| Description                     | Specifications  |                                     | Supplemental Information                                                                          |
|---------------------------------|-----------------|-------------------------------------|---------------------------------------------------------------------------------------------------|
| <b>Maximum Safe Input Level</b> | RF Input 1      | RF Input 2                          | Applies with or without preamp                                                                    |
| RF Input                        |                 |                                     |                                                                                                   |
| Average Total Power             | +30 dBm (1 W)   | +37 dBm (5 W)                       |                                                                                                   |
| Peak Pulse Power                | +50 dBm (100 W) | +50 dBm (100 W)                     | ( $\leq 10 \mu\text{s}$ pulse width,<br>$\leq 1\%$ duty cycle,<br>input attenuation $\geq 30$ dB) |
| Surge Power                     |                 | 2 kW (10 $\mu\text{s}$ pulse width) |                                                                                                   |
| DC voltage                      |                 |                                     |                                                                                                   |
| DC Coupled                      | $\pm 0.2$ Vdc   | $\pm 0.5$ Vdc                       |                                                                                                   |
| AC Coupled <sup>a</sup>         |                 |                                     |                                                                                                   |
| Option $\leq 526$               | $\pm 100$ Vdc   | $\pm 0.5$ Vdc                       |                                                                                                   |
| Option 544                      | $\pm 0.2$ Vdc   | $\pm 0.5$ Vdc                       |                                                                                                   |

a. AC Coupled only applicable to Freq Options 503, 508 and 526.

| Description          | Specifications                                                                                               | Supplemental Information |
|----------------------|--------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Display Range</b> |                                                                                                              |                          |
| Log Scale            | Ten divisions displayed;<br>0.1 to 1.0 dB/division in 0.1 dB steps, and<br>1 to 20 dB/division in 1 dB steps |                          |
| Linear Scale         | Ten divisions                                                                                                |                          |

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                    | Specifications | Supplemental Information      |
|--------------------------------|----------------|-------------------------------|
| <b>Marker Readout</b>          |                |                               |
| Resolution                     |                |                               |
| Log (decibel) units            |                |                               |
| Trace Averaging Off, on-screen | 0.01 dB        |                               |
| Trace Averaging On or remote   | 0.001 dB       |                               |
| Linear units resolution        |                | ≤1% of signal level (nominal) |

## Frequency Response

| Description                                                                                                                                                                               |                                                                                   |                                                                                   | Specifications                                |                  | Supplemental Information                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------|------------------|-----------------------------------------------------------------------------------------------|
| <b>Frequency Response</b><br><br>(Maximum error relative to reference condition (50 MHz)<br>Mechanical attenuator only<br>Non-FFT operation only <sup>b</sup><br>Preamp off: 10 dB atten) |                                                                                   |                                                                                   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                  | Refer to the footnote for <b>Band Overlaps on page 14.</b><br>Modes above 18 GHz <sup>a</sup> |
| Option 544 (mmW)                                                                                                                                                                          |                                                                                   |                                                                                   |                                               |                  |                                                                                               |
| Option 503, 508, or 526 (RF/μW)                                                                                                                                                           |                                                                                   |                                                                                   |                                               |                  |                                                                                               |
| <b>RF Preselector Off, Preamp Off</b>                                                                                                                                                     |  |  | <b>20 to 30°C</b>                             | <b>0 to 55°C</b> | <b>95th Percentile (<math>\approx 2\sigma</math>)</b>                                         |
| 1 Hz to 9 kHz <sup>c</sup>                                                                                                                                                                | X                                                                                 | X                                                                                 | ±0.45 dB                                      | ±0.60 dB         | ±0.16 dB                                                                                      |
| 9 kHz to 10 MHz <sup>c</sup>                                                                                                                                                              | X                                                                                 | X                                                                                 | ±0.45 dB                                      | ±0.60 dB         | ±0.25 dB                                                                                      |
| 10 to 50 MHz <sup>c</sup>                                                                                                                                                                 | X                                                                                 | X                                                                                 | ±0.40 dB                                      | ±0.50 dB         | ±0.25 dB                                                                                      |
| 50 MHz to 1 GHz                                                                                                                                                                           | X                                                                                 | X                                                                                 | ±0.40 dB                                      | ±0.60 dB         | ±0.25 dB                                                                                      |
| 1.0 to 3.6 GHz                                                                                                                                                                            | X                                                                                 | X                                                                                 | ±0.60 dB                                      | ±0.90 dB         | ±0.25 dB                                                                                      |
| 3.5 to 8.4 GHz <sup>de</sup>                                                                                                                                                              | X                                                                                 |                                                                                   | ±1.00 dB                                      | ±1.90 dB         | ±0.50 dB                                                                                      |
| 3.5 to 5.2 GHz <sup>de</sup>                                                                                                                                                              |                                                                                   | X                                                                                 | ±1.50 dB                                      | ±2.80 dB         | ±0.60 dB                                                                                      |
| 5.2 to 8.4 GHz <sup>de</sup>                                                                                                                                                              |                                                                                   | X                                                                                 | ±1.00 dB                                      | ±1.80 dB         | ±0.45 dB                                                                                      |
| 8.3 to 13.6 GHz <sup>de</sup>                                                                                                                                                             | X                                                                                 |                                                                                   | ±1.00 dB                                      | ±1.90 dB         | ±0.50 dB                                                                                      |
| 8.3 to 13.6 GHz <sup>de</sup>                                                                                                                                                             |                                                                                   | X                                                                                 | ±1.00 dB                                      | ±1.80 dB         | ±0.45 dB                                                                                      |
| 13.5 to 16 GHz <sup>de</sup>                                                                                                                                                              | X                                                                                 |                                                                                   | ±1.10 dB                                      | ±2.10 dB         | ±0.90 dB                                                                                      |
| 16 to 17.1 GHz <sup>de</sup>                                                                                                                                                              | X                                                                                 |                                                                                   | ±1.40 dB                                      | ±3.4 dB          | ±1.03 dB                                                                                      |
| 13.5 to 17.1 GHz <sup>de</sup>                                                                                                                                                            |                                                                                   | X                                                                                 | ±1.00 dB                                      | ±1.80 dB         | ±0.45 dB                                                                                      |
| 17.0 to 22 GHz <sup>de</sup>                                                                                                                                                              | X                                                                                 |                                                                                   | ±1.20 dB                                      | ±2.20 dB         | ±0.55 dB                                                                                      |
| 17 to 22 GHz <sup>de</sup>                                                                                                                                                                |                                                                                   | X                                                                                 | ±1.20 dB                                      | ±2.20 dB         | ±0.55 dB                                                                                      |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                                                                                            | X                                                                                 |                                                                                   | ±1.40 dB                                      | ±2.50 dB         | ±0.60 dB                                                                                      |
| 22 to 26.5 GHz <sup>de</sup>                                                                                                                                                              |                                                                                   | X                                                                                 | ±1.20 dB                                      | ±2.20 dB         | ±0.55 dB                                                                                      |
| 26.4 to 34.5 GHz <sup>de</sup>                                                                                                                                                            |                                                                                   | X                                                                                 | ±1.80 dB                                      | ±3.20 dB         | ±0.70 dB                                                                                      |
| 34.4 to 40 GHz <sup>de</sup>                                                                                                                                                              |                                                                                   | X                                                                                 | ±2.30 dB                                      | ±4.00 dB         | ±1.10 dB                                                                                      |
| 40 to 44 GHz <sup>de</sup>                                                                                                                                                                |                                                                                   | X                                                                                 | ±2.60 dB                                      | ±4.90 dB         | ±1.30 dB                                                                                      |

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                          |   |   | Specifications |          | Supplemental Information |
|--------------------------------------|---|---|----------------|----------|--------------------------|
| <b>RF Preselector On, Preamp Off</b> |   |   |                |          |                          |
| 1 Hz to 9 kHz <sup>c</sup>           | X | X | ±0.50 dB       | ±0.60 dB | ±0.20 dB                 |
| 9 kHz to 10 MHz <sup>c</sup>         | X | X | ±0.60 dB       | ±0.85 dB | ±0.25 dB                 |
| 10 to 30 MHz <sup>c</sup>            | X | X | ±0.50 dB       | ±0.70 dB | ±0.23 dB                 |
| 30 MHz to 1 GHz                      | X | X | ±0.50 dB       | ±0.70 dB | ±0.23 dB                 |
| 1 to 3.6 GHz <sup>f</sup>            | X | X | ±0.60 dB       | ±0.90 dB | ±0.25 dB                 |
| 3.5 to 8.4 GHz <sup>de</sup>         | X |   | ±1.00 dB       | ±1.90 dB | ±0.50 dB                 |
| 3.5 to 5.2 GHz <sup>de</sup>         |   | X | ±1.50 dB       | ±2.80 dB | ±0.60 dB                 |
| 5.2 to 8.4 GHz <sup>de</sup>         |   | X | ±1.00 dB       | ±1.80 dB | ±0.45 dB                 |
| 8.3 to 13.6 GHz <sup>de</sup>        | X |   | ±1.00 dB       | ±1.90 dB | ±0.50 dB                 |
| 8.3 to 13.6 GHz <sup>de</sup>        |   | X | ±1.00 dB       | ±1.80 dB | ±0.45 dB                 |
| 13.5 to 16 GHz <sup>de</sup>         | X |   | ±1.10 dB       | ±2.10 dB | ±0.90 dB                 |
| 16 to 17.1 GHz <sup>de</sup>         | X |   | ±1.40 dB       | ±3.4 dB  | ±1.03 dB                 |
| 13.5 to 17.1 GHz <sup>de</sup>       |   | X | ±1.00 dB       | ±1.80 dB | ±0.45 dB                 |
| 17.0 to 22 GHz <sup>de</sup>         | X |   | ±1.20 dB       | ±2.20 dB | ±0.55 dB                 |
| 17 to 22 GHz <sup>de</sup>           |   | X | ±1.20 dB       | ±2.20 dB | ±0.55 dB                 |
| 22.0 to 26.5 GHz <sup>de</sup>       | X |   | ±1.40 dB       | ±2.50 dB | ±0.60 dB                 |
| 22 to 26.5 GHz <sup>de</sup>         |   | X | ±1.20 dB       | ±2.20 dB | ±0.55 dB                 |
| 26.4 to 34.5 GHz <sup>de</sup>       |   | X | ±1.80 dB       | ±3.20 dB | ±0.70 dB                 |
| 34.4 to 40 GHz <sup>de</sup>         |   | X | ±2.30 dB       | ±4.00 dB | ±1.10 dB                 |
| 40 to 44 GHz <sup>de</sup>           |   | X | ±2.60 dB       | ±4.90 dB | ±1.30 dB                 |

- a. Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.
- b. For FFT based measurements, Frequency Response errors are more complicated. One case is where the input signal is at the center frequency of the FFT measurement. In this case, the Frequency Response errors are given by this table. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with the Frequency Response from this table. The other case is when the input signal is not at the center frequency of the FFT measurement. In this case, the total frequency response error is computed by adding the RF flatness errors of this table to the IF Frequency Response. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with this total frequency response error. An additional error source, the relative error in switching between swept and FFT-based measurements, is nominally ±0.01 dB. The effect of this relative error on absolute measurements is included with the "Absolute Amplitude Accuracy" specifications.

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

- c. Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at 10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
- d. Specifications for frequencies  $> 3.5$  GHz apply for sweep rates  $\leq 100$  MHz/ms.
- e. Microwave preselector centering applied.
- f. When the notch filter is selected, the specifications between 2.3 to 2.6 GHz is not applicable.

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                                                                                                  |                                         | Specifications                                            | Supplemental Information                |                                         |                                  |
|--------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------|-----------------------------------------|-----------------------------------------|----------------------------------|
| <b>IF Frequency Response<sup>a</sup></b><br>(Demodulation and FFT response relative to the center frequency) |                                         |                                                           | Modes above 18 GHz <sup>b</sup>         |                                         |                                  |
| <b>Freq (GHz)</b>                                                                                            | <b>Analysis Width<sup>c</sup> (MHz)</b> | <b>Max Error<sup>d</sup></b><br>(Exception <sup>e</sup> ) | <b>Midwidth Error (95th Percentile)</b> | <b>Slope (dB/MHz) (95th Percentile)</b> | <b>RMS<sup>f</sup> (nominal)</b> |
| <3.6 <sup>g</sup>                                                                                            | ≤10                                     | ±0.40 dB                                                  | ±0.12 dB                                | ±0.10                                   | 0.04 dB                          |
| ≥3.6, ≤ 26.5 GHz                                                                                             | ≤10 Preselected                         |                                                           |                                         |                                         | 0.25 dB                          |
| >26.5                                                                                                        | ≤10 Preselected                         |                                                           |                                         |                                         | 0.35 dB                          |

- The IF frequency response includes effects due to RF circuits such as input filters, that are a function of RF frequency, in addition to the IF passband effects.
- Signal frequencies above 18 GHz are prone to additional response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.
- This column applies to the instantaneous analysis bandwidth in use. In the Spectrum Analyzer Mode, this would be the FFT width.
- The maximum error at an offset (f) from the center of the FFT width is given by the expression  $\pm [\text{Midwidth Error} + (f \times \text{Slope})]$ , but never exceeds ±Max Error. Here the Midwidth Error is the error at the center frequency for a given FFT span. Usually, the span is no larger than the FFT width in which case the center of the FFT width is the center frequency of the analyzer. When using the Spectrum Analyzer mode with an analyzer span is wider than the FFT width, the span is made up of multiple concatenated FFT results, and thus has multiple centers of FFT widths; in this case the f in the equation is the offset from the nearest center. Performance is nominally three times better at most center frequencies.
- The specification does not apply for frequencies greater than 3.6 MHz from the center in FFT widths of 7.2 to 8 MHz.
- The “rms” nominal performance is the standard deviation of the response relative to the center frequency, integrated across the span. This performance measure was observed at a center frequency in each harmonic mixing band, which is representative of all center frequencies; it is not the worst case frequency.
- The Frequency Response with the RF Preselector on is verified at the analyzer center frequency in zero span. The effect of the RF Preselector is included in this Frequency Response specification. .

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                  |                       |                                  | Specifications | Supplemental Information                                                                          |                                  |
|------------------------------|-----------------------|----------------------------------|----------------|---------------------------------------------------------------------------------------------------|----------------------------------|
| <b>IF Phase Linearity</b>    |                       |                                  |                | Deviation from mean phase linearity<br>Modes above 18 GHz <sup>a</sup><br>RF preselector off only |                                  |
| <b>Center Freq<br/>(GHz)</b> | <b>Span<br/>(MHz)</b> | <b>Microwave<br/>Preselector</b> |                | <b>Nominal</b>                                                                                    | <b>RMS (nominal)<sup>b</sup></b> |
| ≥0.02, <3.6                  | ≤10                   | n/a                              |                | ±0.5°                                                                                             | 0.2°                             |
| ≥3.6, ≤26.5                  | ≤10                   | On                               |                | ±1.5°                                                                                             | 0.4°                             |
| >26.5                        | ≤10                   | On                               |                | ±1.5°                                                                                             | 0.5°                             |

- Signal frequencies above 18 GHz are prone to additional response errors due to modes in the Type-N connector used. With the use Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.
- The listed performance is the standard deviation of the phase deviation relative to the mean phase deviation from a linear phase condition, where the rms is computed across the span shown and over the range of center frequencies shown.

## Keysight PXE EMI Receiver Amplitude Accuracy and Range

| Description                                                                                                                                                                                                                                                                                                                                                                                                                    | Specifications                                                                                                                                                                                                                                                                                                                                                                                         | Supplemental Information                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Absolute Amplitude Accuracy<br>RF Preselector on/off<br>Preamp off<br><br>RF Input 1<br><br>At 50 MHz <sup>ab</sup><br>20 to 30°C<br>0 to 55°C<br><br>At all frequencies <sup>ab</sup><br>20 to 30°C<br>0 to 55°C<br><br>RF Input 2<br><br>At 50 MHz <sup>ab</sup><br>20 to 30°C<br>0 to 55°C<br><br>At all frequencies <sup>ab</sup><br>20 to 30°C<br>0 to 55°C<br><br>CISPR requirements<br><br>Amplitude Reference Accuracy | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz<br><br><br><br><br><br>±0.30 dB<br>±0.35 dB<br><br>±(0.30 dB + frequency response)<br>±(0.35 dB+ frequency response)<br><br><br><br>±0.35 dB<br>±0.40 dB<br><br>±(0.35 dB + frequency response)<br>±(0.40 dB + frequency response)<br><br>This instrument meets or exceeds the current CISPR 16-1-1:2019 sine wave accuracy requirements from 15 to 35°C | <br><br><br>95th percentile<br><br><br>±0.17 dB<br><br><br><br><br><br><br>±0.21 dB<br><br><br><br><br><br><br>±0.05 dB (nominal) |

- a. Absolute amplitude accuracy is the total of all amplitude measurement errors, and applies over the following subset of settings and conditions:  $1\text{ Hz} \leq \text{RBW} \leq 1\text{ MHz}$ ; Input signal  $-10$  to  $-50\text{ dBm}$ ; Input attenuation  $10\text{ dB}$ ; span  $< 5\text{ MHz}$  (nominal additional error for span  $\geq 5\text{ MHz}$  is  $0.02\text{ dB}$ ); all settings auto-coupled except Swp  
Time Rules = Accuracy; combinations of low signal level and wide RBW use  $\text{VBW} \leq 30\text{ kHz}$  to reduce noise.  
When using FFT sweeps, the signal must be at the center frequency.  
This absolute amplitude accuracy specification includes the sum of the following individual specifications under the conditions listed above: Scale Fidelity, Reference Level Accuracy, Display Scale Switching Uncertainty, Resolution Bandwidth Switching Uncertainty,  $50\text{ MHz}$  Amplitude Reference Accuracy, and the accuracy with which the instrument aligns its internal gains to the  $50\text{ MHz}$  Amplitude Reference.
- b. In the EMI Receiver Mode (Discrete Scan), add  $0.10\text{ dB}$  to the absolute amplitude accuracy specifications.

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                                                                                           |   |   | Specifications                                |            | Supplemental Information        |
|-------------------------------------------------------------------------------------------------------|---|---|-----------------------------------------------|------------|---------------------------------|
| <b>Absolute Amplitude Accuracy<br/>EMI Receiver Mode: Discrete (Stepped) Scan<br/>With Option WF1</b> |   |   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |            | Modes above 18 GHz <sup>a</sup> |
| (10 dB atten) <sup>b</sup>                                                                            |   |   |                                               |            |                                 |
| Option 544 (mmW)                                                                                      |   |   |                                               |            |                                 |
| Option 503, 508, or 526 (RF/μW)                                                                       |   |   |                                               |            |                                 |
| RF Preselector On, Preamp Off                                                                         |   |   | 20 to 30°C                                    | 15 to 35°C | ±0.40 dB (95th percentile)      |
|                                                                                                       |   |   |                                               |            |                                 |
| 1 Hz to 9 kHz                                                                                         | X | X |                                               |            |                                 |
| 9 to 150 kHz                                                                                          | X | X | ±0.90 dB                                      | ±0.95 dB   |                                 |
| 150 kHz to 10 MHz                                                                                     | X | X | ±0.90 dB                                      | ±0.95 dB   |                                 |
| 10 to 30 MHz                                                                                          | X | X | ±0.70 dB                                      | ±0.80 dB   |                                 |
| 30 MHz to 1 GHz                                                                                       | X | X | ±0.60 dB                                      | ±0.70 dB   |                                 |
| 1 to 3.6 GHz <sup>c</sup>                                                                             | X | X | ±0.70 dB                                      | ±0.90 dB   |                                 |
| 3.6 to 8.4 GHz <sup>de</sup>                                                                          | X |   | ±1.15 dB                                      | ±1.45 dB   |                                 |
| 3.6 to 5.2 GHz <sup>de</sup>                                                                          |   | X | ±2.20 dB                                      | ±2.50 dB   |                                 |
| 5.2 to 8.4 GHz <sup>de</sup>                                                                          |   | X | ±1.50 dB                                      | ±1.65 dB   |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                         | X |   | ±1.20 dB                                      | ±1.50 dB   |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                         |   | X | ±1.30 dB                                      | ±1.40 dB   |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                        | X |   | ±1.20 dB                                      | ±1.50 dB   |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                        |   | X | ±1.30 dB                                      | ±1.40 dB   |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                        | X |   | ±1.45 dB                                      | ±1.85 dB   |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                        |   | X | ±1.60 dB                                      | ±1.80 dB   |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                        | X |   | ±1.90 dB                                      | ±2.50 dB   |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                        |   | X | ±1.70 dB                                      | ±1.90 dB   |                                 |
| 26.5 to 34.5 GHz <sup>de</sup>                                                                        |   | X | ±2.50 dB                                      | ±2.80 dB   |                                 |
| 34.5 to 40.0 GHz <sup>de</sup>                                                                        |   | X | ±2.90 dB                                      | ±3.20 dB   |                                 |
| 40.0 to 44.0 GHz <sup>de</sup>                                                                        |   | X | ±3.30 dB                                      | ±3.60 dB   |                                 |

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                    |   |   | Specifications |            | Supplemental Information   |
|--------------------------------|---|---|----------------|------------|----------------------------|
| RF Preselector Off, Preamp Off |   |   | 20 to 30°C     | 15 to 35°C |                            |
| 1 Hz to 9 kHz                  | X | X |                |            | ±0.45 dB (95th percentile) |
| 9 to 150 kHz                   | X | X | ±0.70 dB       | ±0.80 dB   |                            |
| 150 kHz to 10 MHz              | X | X | ±0.70 dB       | ±0.80 dB   |                            |
| 10 to 30 MHz                   | X | X | ±0.60 dB       | ±0.80 dB   |                            |
| 30 MHz to 1 GHz                | X | X | ±0.60 dB       | ±0.80 dB   |                            |
| 1 to 3.6 GHz                   | X | X | ±0.70 dB       | ±0.90 dB   |                            |
| 3.6 to 8.4 GHz                 | X |   | ±1.15 dB       | ±1.45 dB   |                            |
| 3.6 to 5.2 GHz <sup>de</sup>   |   | X | ±2.20 dB       | ±2.50 dB   |                            |
| 5.2 to 8.4 GHz <sup>de</sup>   |   | X | ±1.50 dB       | ±1.65 dB   |                            |
| 8.4 to 13.6 GHz <sup>de</sup>  | X |   | ±1.20 dB       | ±1.50 dB   |                            |
| 8.4 to 13.6 GHz <sup>de</sup>  |   | X | ±1.30 dB       | ±1.40 dB   |                            |
| 13.6 to 17.1 GHz <sup>de</sup> | X |   | ±1.20 dB       | ±1.50 dB   |                            |
| 13.6 to 17.1 GHz <sup>de</sup> |   | X | ±1.30 dB       | ±1.40 dB   |                            |
| 17.1 to 22.0 GHz <sup>de</sup> | X |   | ±1.45 dB       | ±1.85 dB   |                            |
| 17.1 to 22.0 GHz <sup>de</sup> |   | X | ±1.60 dB       | ±1.80 dB   |                            |
| 22.0 to 26.5 GHz <sup>de</sup> | X |   | ±1.90 dB       | ±2.50 dB   |                            |
| 22.0 to 26.5 GHz <sup>de</sup> |   | X | ±1.70 dB       | ±1.90 dB   |                            |
| 26.5 to 34.5 GHz <sup>de</sup> |   | X | ±2.50 dB       | ±2.80 dB   |                            |
| 34.5 to 40.0 GHz <sup>de</sup> |   | X | ±2.90 dB       | ±3.20 dB   |                            |
| 40.0 to 44.0 GHz <sup>de</sup> |   | X | ±3.30 dB       | ±3.60 dB   |                            |

- Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.
- Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at 10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
- When the notch filter is selected the specifications between 2.3 GHz – 2.6 GHz is not applicable.
- Specifications for frequencies >3.5 GHz apply for sweep rates ≤ 100 MHz/ms.
- Microwave preselector centering applied.

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                                                                                              |   |   | Specifications                                |                   | Supplemental Information        |
|----------------------------------------------------------------------------------------------------------|---|---|-----------------------------------------------|-------------------|---------------------------------|
| <b>Absolute Amplitude Accuracy<br/>EMI Receiver Mode: Discrete (Stepped) Scan<br/>Without Option WF1</b> |   |   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                   | Modes above 18 GHz <sup>a</sup> |
| (10 dB atten) <sup>b</sup>                                                                               |   |   |                                               |                   |                                 |
| Option 544 (mmW)                                                                                         |   |   |                                               |                   |                                 |
| Option 503, 508, or 526 (RF/μW)                                                                          |   |   |                                               |                   |                                 |
| <b>RF Preselector On, Preamp Off</b>                                                                     | ↓ | ↓ | <b>20 to 30°C</b>                             | <b>15 to 35°C</b> |                                 |
| 10 Hz to 9 kHz                                                                                           | X | X |                                               |                   | ±0.31 dB (95th percentile)      |
| 9 to 150 kHz                                                                                             | X | X | ±1.15 dB                                      | ±1.20 dB          |                                 |
| 150 kHz to 10 MHz                                                                                        | X | X | ±1.15 dB                                      | ±1.20 dB          |                                 |
| 10 to 30 MHz                                                                                             | X | X | ±1.05 dB                                      | ±1.10 dB          |                                 |
| 30 MHz to 1 GHz                                                                                          | X | X | ±1.05 dB                                      | ±1.10 dB          |                                 |
| 1 to 3.6 GHz <sup>c</sup>                                                                                | X | X | ±1.10 dB                                      | ±1.25 dB          |                                 |
| 3.6 to 8.4 GHz <sup>de</sup>                                                                             | X |   | ±1.65 dB                                      | ±1.85 dB          |                                 |
| 3.6 to 5.2 GHz <sup>de</sup>                                                                             |   | X | ±2.20 dB                                      | ±2.50 dB          |                                 |
| 5.2 to 8.4 GHz <sup>de</sup>                                                                             |   | X | ±1.50 dB                                      | ±1.65 dB          |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                            | X |   | ±1.65 dB                                      | ±1.85 dB          |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                            |   | X | ±1.30 dB                                      | ±1.40 dB          |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                           | X |   | ±1.65 dB                                      | ±1.85 dB          |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                           |   | X | ±1.30 dB                                      | ±1.40 dB          |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                           | X |   | ±1.85 dB                                      | ±2.05 dB          |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                           |   | X | ±1.60 dB                                      | ±1.80 dB          |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                           | X |   | ±2.05 dB                                      | ±2.25 dB          |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                           |   | X | ±1.70 dB                                      | ±1.90 dB          |                                 |
| 26.5 to 34.5 GHz <sup>de</sup>                                                                           |   | X | ±2.50 dB                                      | ±2.80 dB          |                                 |
| 34.5 to 40.0 GHz <sup>de</sup>                                                                           |   | X | ±2.90 dB                                      | ±3.20 dB          |                                 |
| 40.0 to 44.0 GHz <sup>de</sup>                                                                           |   | X | ±3.30 dB                                      | ±3.60 dB          |                                 |

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                    |   |   | Specifications |            | Supplemental Information   |
|--------------------------------|---|---|----------------|------------|----------------------------|
| RF Preselector Off, Preamp Off |   |   | 20 to 30°C     | 15 to 35°C |                            |
| 10 Hz to 9 kHz                 | X | X |                |            | ±0.35 dB (95th percentile) |
| 9 to 150 kHz                   | X | X | ±1.00 dB       | ±1.05 dB   |                            |
| 150 kHz to 10 MHz              | X | X | ±1.00 dB       | ±1.05 dB   |                            |
| 10 to 30 MHz                   | X | X | ±0.95 dB       | ±1.05 dB   |                            |
| 30 MHz to 1 GHz                | X | X | ±0.95 dB       | ±1.05 dB   |                            |
| 1 to 3.6 GHz                   | X | X | ±1.15 dB       | ±1.25 dB   |                            |
| 3.6 to 8.4 GHz                 | X |   | ±1.65 dB       | ±1.85 dB   |                            |
| 3.6 to 5.2 GHz <sup>de</sup>   |   | X | ±2.20 dB       | ±2.50 dB   |                            |
| 5.2 to 8.4 GHz <sup>de</sup>   |   | X | ±1.50 dB       | ±1.65 dB   |                            |
| 8.4 to 13.6 GHz <sup>de</sup>  | X |   | ±1.65 dB       | ±1.85 dB   |                            |
| 8.4 to 13.6 GHz <sup>de</sup>  |   | X | ±1.30 dB       | ±1.40 dB   |                            |
| 13.6 to 17.1 GHz <sup>de</sup> | X |   | ±1.65 dB       | ±1.85 dB   |                            |
| 13.6 to 17.1 GHz <sup>de</sup> |   | X | ±1.30 dB       | ±1.40 dB   |                            |
| 17.1 to 22.0 GHz <sup>de</sup> | X |   | ±1.85 dB       | ±2.05 dB   |                            |
| 17.1 to 22.0 GHz <sup>de</sup> |   | X | ±1.60 dB       | ±1.80 dB   |                            |
| 22.0 to 26.5 GHz <sup>de</sup> | X |   | ±2.05 dB       | ±2.25 dB   |                            |
| 22.0 to 26.5 GHz <sup>de</sup> |   | X | ±1.70 dB       | ±1.90 dB   |                            |
| 26.5 to 34.5 GHz <sup>de</sup> |   | X | ±2.50 dB       | ±2.80 dB   |                            |
| 34.5 to 40.0 GHz <sup>de</sup> |   | X | ±2.90 dB       | ±3.20 dB   |                            |
| 40.0 to 44.0 GHz <sup>de</sup> |   | X | ±3.30 dB       | ±3.60 dB   |                            |

- Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.
- Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at 10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
- When the notch filter is selected the specifications between 2.3 GHz – 2.6 GHz is not applicable.
- Specifications for frequencies >3.5 GHz apply for sweep rates ≤ 100 MHz/ms.
- Microwave preselector centering applied.

## Keysight PXE EMI Receiver Amplitude Accuracy and Range

| Description                                                                                                                                                | Specifications | Supplemental Information                                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------|
| <b>Input Attenuation Switching Uncertainty</b><br><br>Atten >2 dB, preamp off<br>(Relative to 10 dB (reference setting))<br><br>50 MHz (reference setting) | ±0.20 dB       | Refer to the footnote for<br><b>Band Overlaps on page 14</b><br><br>±0.08 dB (typical) |

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                                                                                        | Specifications                                |                | Supplemental Information |
|----------------------------------------------------------------------------------------------------|-----------------------------------------------|----------------|--------------------------|
| <b>RF Input VSWR - RF Preselector Off<sup>a</sup></b><br>at tuned frequency<br>10 dB Atten, 50 MHz | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                | 1.07:1 (nominal)         |
| <b>Preamp Off</b>                                                                                  | Input Attenuation                             |                | Typical                  |
|                                                                                                    | <b>0 dB</b>                                   | <b>≥ 10 dB</b> |                          |
| DC Coupled                                                                                         |                                               |                | ≥ 10 dB Attenuation      |
| 9 kHz to 1 GHz                                                                                     | ---                                           | ---            |                          |
| 1 to 18 GHz <sup>b</sup>                                                                           | 3.0:1                                         | 2.0:1          | 1.8:1                    |
| 18 to 26.5 GHz <sup>c</sup>                                                                        | 3.0:1                                         | 2.0:1          | 1.8:1                    |
| 26.5 to 40 GHz                                                                                     | 3.0:1                                         | 2.5:1          | 1.8:1                    |
| 40 to 44 GHz                                                                                       |                                               |                | 2.0:1                    |
| AC Coupled ( <i>Option 503, 508,526</i> )                                                          |                                               |                |                          |
| 55 MHz to 1 GHz                                                                                    | ---                                           | ---            |                          |
| 1 to 18 GHz                                                                                        | 3.0:1                                         | 2.0:1          | 1.8:1                    |
| 18 to 26.5 GHz <sup>c</sup>                                                                        | 3.0:1                                         | 2.4:1          | 2.0:1                    |

- X-Series analyzers have a reflection coefficient that is excellently modeled with a Rayleigh probability distribution. Keysight recommends using the methods outlined in Application Note 1449-3 and companion Average Power Sensor Measurement Uncertainty Calculator to compute mismatch uncertainty.
- When the notch filter is selected the specs between 2.3 GHz – 2.6 GHz is not applicable.
- For *Option 526*, VSWR specifications above 18 GHz apply only with *Option C35* (3.5 mm connector).

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                                                                | Specifications                                |                | Supplemental Information  |
|----------------------------------------------------------------------------|-----------------------------------------------|----------------|---------------------------|
| <b>RF Input VSWR - RF Preselector On<sup>a</sup></b><br>at tuned frequency | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                |                           |
| <b>Preamp Off</b>                                                          | Input Attenuation                             |                | Typical                   |
|                                                                            | <b>0 dB</b>                                   | <b>≥ 10 dB</b> |                           |
| DC Coupled                                                                 |                                               |                | ≥ 10 dB Input Attenuation |
| 9 kHz to 1 GHz                                                             | 2.0:1                                         | 1.2:1          | 1.1:1                     |
| 1 to 3.6 GHz <sup>b</sup>                                                  | 3.0:1                                         | 2.0:1          | 1.5:1                     |
| 3.6 to 26.5 GHz <sup>c</sup>                                               | 3.0:1                                         | 2.0:1          | 1.8:1                     |
| 26.5 to 40 GHz                                                             | 3.0:1                                         | 2.5:1          | 1.8:1                     |
| 40 to 44 GHz                                                               |                                               |                | 2.0:1                     |
| AC Coupled ( <i>Option 503, 508, 526</i> )                                 |                                               |                |                           |
| 55 MHz to 1 GHz                                                            | 2.0:1                                         | 1.2:1          |                           |
| 1 to 18 GHz                                                                | 3.0:1                                         | 2.0:1          | 1.8:1                     |
| 18 to 26.5 GHz <sup>c</sup>                                                | 3.0:1                                         | 2.4:1          | 2.0:1                     |

- X-Series analyzers have a reflection coefficient that is excellently modeled with a Rayleigh probability distribution. Keysight recommends using the methods outlined in Application Note 1449-3 and companion Average Power Sensor Measurement Uncertainty Calculator to compute mismatch uncertainty.
- When the notch filter is selected the specs between 2.3 GHz – 2.6 GHz is not applicable.
- For *Option 526*, VSWR specifications above 18 GHz apply only with *Option C35* (3.5 mm connector).

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                                       | Specifications | Supplemental Information           |
|---------------------------------------------------|----------------|------------------------------------|
| <b>Resolution Bandwidth Switching Uncertainty</b> |                | Relative to reference BW of 30 kHz |
| 1.0 Hz to 1.5 MHz RBW                             | $\pm 0.05$ dB  |                                    |
| 1.6 MHz to 3 MHz RBW                              | $\pm 0.10$ dB  |                                    |
| Manually selected wide RBWs: 4, 5, 6, 8 MHz       | $\pm 1.0$ dB   |                                    |

| Description            | Specifications                                    | Supplemental Information |
|------------------------|---------------------------------------------------|--------------------------|
| <b>Reference Level</b> |                                                   |                          |
| Range                  |                                                   |                          |
| Log Units              | –170 to +30 dBm, in 0.01 dB steps                 |                          |
| Linear Units           | 707 pV to 7.07 V, with 0.01 dB resolution (0.11%) |                          |
| Accuracy               | 0 dB                                              |                          |

| Description                                | Specifications    | Supplemental Information |
|--------------------------------------------|-------------------|--------------------------|
| <b>Display Scale Switching Uncertainty</b> |                   |                          |
| Switching between Linear and Log           | 0 dB <sup>a</sup> |                          |
| Log Scale Switching                        | 0 dB <sup>a</sup> |                          |

a. Because Log/Lin and Log Scale Switching affect only the display, not the measurement, they cause no additional error in measurement results from trace data or markers.

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

| Description                                                                                                                                                                                                    | Specifications |   | Supplemental Information        |                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---|---------------------------------|--------------------------------------------------|
| <b>Total Measurement Uncertainty</b><br>Signal level 0 to 90 dB below reference point,<br>RF attenuation 0 to 40 dB, RBW ≤ 1 MHz,<br>20° to 30° C: AC coupled 10 MHz to 26.5 GHz<br>DC coupled 9 kHz to 44 GHz |                |   |                                 |                                                  |
| Option 544 (mmW)                                                                                                                                                                                               |                |   |                                 |                                                  |
| Option 503, 508, or 526 (RF/μW)                                                                                                                                                                                | ↓              | ↓ |                                 |                                                  |
|                                                                                                                                                                                                                | ↓              | ↓ |                                 |                                                  |
| <b>RF Preselector Off, Preamp Off</b>                                                                                                                                                                          |                |   | <b>95th Percentile</b><br>(≈2σ) |                                                  |
|                                                                                                                                                                                                                |                |   | <b>Spectrum Analyzer Mode</b>   | <b>EMI Receiver Mode Discrete (Stepped) Scan</b> |
| 9 kHz to 10 MHz                                                                                                                                                                                                | X              | X | ± 0.35 dB                       | ± 0.40 dB                                        |
| 10 MHz to 3.6 GHz                                                                                                                                                                                              | X              |   | ± 0.25 dB                       | ± 0.30 dB                                        |
| 10 MHz to 1 GHz                                                                                                                                                                                                |                | X | ± 0.25 dB                       | ± 0.30 dB                                        |
| 1 to 3.6 GHz                                                                                                                                                                                                   |                | X | ± 0.35 dB                       | ± 0.40 dB                                        |
| 3.6 to 18 GHz                                                                                                                                                                                                  | X              | X | ± 0.50 dB                       | ± 0.65 dB                                        |
| 18 to 26.5 GHz                                                                                                                                                                                                 | X              | X | ± 0.80 dB                       | ± 0.95 dB                                        |
| 26.5 to 44 GHz                                                                                                                                                                                                 |                | X | ± 1.20 dB                       | ± 1.50 dB                                        |
| <b>RF Preselector On, Preamp Off</b>                                                                                                                                                                           |                |   |                                 |                                                  |
| 9 kHz to 10 MHz                                                                                                                                                                                                | X              | X | ± 0.31 dB                       | ± 0.44 dB                                        |
| 10 MHz to 1 GHz                                                                                                                                                                                                | X              | X | ± 0.20 dB                       | ± 0.31 dB                                        |
| 1 to 3.6 GHz                                                                                                                                                                                                   | X              | X | ± 0.20 dB                       | ± 0.32 dB                                        |
| 3.6 to 18 GHz                                                                                                                                                                                                  | X              | X | ± 0.50 dB                       | ± 0.65 dB                                        |
| 18 to 26.5 GHz                                                                                                                                                                                                 | X              | X | ± 0.80 dB                       | ± 0.95 dB                                        |
| 26.5 to 44 GHz                                                                                                                                                                                                 |                | X | ± 1.20 dB                       | ± 1.50 dB                                        |

| Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Specifications                                          | Supplemental Information                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Display Scale Fidelity<sup>ab</sup></b></p> <p>Absolute Log-Linear Fidelity<br/>(Relative to the reference condition for Input 1:<br/>–25 dBm input through 10 dB attenuation,<br/>thus –35 dBm at the input mixer)</p> <p><b>Input mixer level<sup>c</sup></b></p> <p>–80 dBm ≤ ML ≤ –10 dBm</p> <p>ML &lt; –80 dBm</p> <p>Relative Fidelity<sup>d</sup></p> <p>Sum of the following terms:</p> <ul style="list-style-type: none"> <li>high level term</li> <li>instability term</li> <li>slope term</li> <li>prefilter term</li> </ul> | <p><b>Linearity</b></p> <p>±0.10 dB</p> <p>±0.15 dB</p> | <p>Applies for mixer level<sup>c</sup> range from –10 to –80 dBm, mechanical attenuator only, preamp off, and dither on.</p> <p><b>Nominal</b></p> <p>Up to ±0.045 dB<sup>e</sup></p> <p>Up to ±0.018 dB</p> <p>From equation<sup>f</sup></p> <p>Up to ±0.005 dB<sup>g</sup></p> |

- a. Supplemental information: The amplitude detection linearity specification applies at all levels below –10 dBm at the input mixer; however, noise will reduce the accuracy of low level measurements. The amplitude error due to noise is determined by the signal-to-noise ratio, S/N. If the S/N is large (20 dB or better), the amplitude error due to noise can be estimated from the equation below, given for the 3-sigma (three standard deviations) level.

$$3\sigma = 3(20\text{dB})\log(1+10-((S/N+3\text{dB})/20\text{dB}))$$

- The errors due to S/N ratio can be further reduced by averaging results. For large S/N (20 dB or better), the 3-sigma level can be reduced proportional to the square root of the number of averages taken.
- b. The scale fidelity is warranted with ADC dither set to On. Dither increases the noise level by nominally only 0.24 dB for the most sensitive case (preamp Off, best DANL frequencies). With dither Off, scale fidelity for low level signals, around –60 dBm or lower, will nominally degrade by 0.2 dB.
- c. Mixer level = Input Level – Input Attenuation
- d. The relative fidelity is the error in the measured difference between two signal levels. It is so small in many cases that it cannot be verified without being dominated by measurement uncertainty of the verification. Because of this verification difficulty, this specification gives nominal performance, based on numbers that are as conservatively determined as those used in warranted specifications. We will consider one example of the use of the error equation to compute the nominal performance.
- Example: the accuracy of the relative level of a sideband around –60 dBm, with a carrier at –5 dBm, using attenuation = 10 dB, RBW = 3 kHz, evaluated with swept analysis. The high level term is evaluated with P1 = –15 dBm and P2 = –70 dBm at the mixer. This gives a maximum error within ±0.025 dB. The instability term is ±0.018 dB. The slope term evaluates to ±0.050 dB. The prefilter term applies and evaluates to the limit of ±0.005 dB. The sum of all these terms is ±0.098 dB.
- e. Errors at high mixer levels will nominally be well within the range of  $\pm 0.045 \text{ dB} \times \{\exp[(P1 - Pref)/(8.69 \text{ dB})] - \exp[(P2 - Pref)/(8.69 \text{ dB})]\}$  (exp is the natural exponent function,  $e^x$ ). In this expression, P1 and P2 are the powers of the two signals, in decibel units, whose relative power is being measured. Pref is –10 dBm (–10 dBm is the highest power for which linearity is specified). All these levels are referred to the mixer level.

Keysight PXE EMI Receiver  
Amplitude Accuracy and Range

- f. Slope error will nominally be well within the range of  $\pm 0.0009 \times (P1 - P2)$ . P1 and P2 are defined in footnote e.
- g. A small additional error is possible. In FFT sweeps, this error is possible for spans under 4.01 kHz. For non-FFT measurements, it is possible for RBWs of 3.9 kHz or less. The error is well within the range of  $\pm 0.0021 \times (P1 - P2)$  subject to a maximum of  $\pm 0.005$  dB. (The maximum dominates for all but very small differences.) P1 and P2 are defined in footnote e.

| Description          | Specifications                                                                                           | Supplemental Information |
|----------------------|----------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Display Units</b> | dBm, dB $\mu$ V, dBmV, dB $\mu$ A, dBmA, Watts, Volts, Amps, dB $\mu$ V/m, dB $\mu$ A/m, dBpT, dBG, dBpW |                          |

| Description                | Specifications                                                                           | Supplemental Information                                                                                 |
|----------------------------|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <b>Available Detectors</b> | Normal, Peak, Sample, Negative Peak, Average<br><br>Quasi-Peak, EMI-Average, RMS-Average | Average detector works on RMS, Voltage and Logarithmic scales<br><br>Meet CISPR 16-1-1:2019 requirements |

| Description                                   | Specifications  | Supplemental Information             |
|-----------------------------------------------|-----------------|--------------------------------------|
| <b>Amplitude Probability Distribution</b>     |                 | Meets CISPR16-1-1:2019 requirements. |
| Dynamic Range                                 | > 70 dB         |                                      |
| Amplitude Accuracy                            |                 | $\leq \pm 2.7$ dB                    |
| Maximum Measurable Time Period (no dead time) | 2 minutes       |                                      |
| Minimum Measurable Probability                | $10^{-7}$       |                                      |
| Amplitude Level Assignment                    | 1000 levels     |                                      |
| Sampling Rate                                 | $\geq 10$ MSa/s | Within a 1 MHz RBW                   |
| Amplitude Resolution                          | 0.1881 dB       |                                      |

## Dynamic Range

### Gain Compression

| Description                                                                                | Specifications                                                                    |                                                                                   | Supplemental Information |                                                                                   |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------|-----------------------------------------------------------------------------------|
| <b>1 dB Gain Compression Point (Two-tone)<sup>abcd</sup></b><br>(RF Input 1 <sup>f</sup> ) | Maximum power at mixer <sup>e</sup>                                               |                                                                                   |                          |                                                                                   |
| <i>Option 544 (mmW)</i>                                                                    |                                                                                   |                                                                                   |                          |                                                                                   |
| <i>Option 503, 508, or 526 (RF/μW)</i>                                                     |                                                                                   |                                                                                   |                          |  |
| <b>RF Preselector On/Off, Preamp Off</b>                                                   |  |  |                          |                                                                                   |
| 9 kHz to 10 MHz                                                                            | X                                                                                 | X                                                                                 | 2 dBm (nominal)          |                                                                                   |
| 10 to 40 MHz                                                                               | X                                                                                 | X                                                                                 | 2 dBm (nominal)          |                                                                                   |
| 40 MHz to 1 GHz                                                                            | X                                                                                 | X                                                                                 | 5 dBm (nominal)          |                                                                                   |
| 1 to 3.6 GHz <sup>g</sup>                                                                  | X                                                                                 | X                                                                                 | 5 dBm (nominal)          |                                                                                   |
| 3.5 to 16 GHz                                                                              | X                                                                                 | X                                                                                 | 7 dBm (nominal)          |                                                                                   |
| 16 to 26.5 GHz                                                                             | X                                                                                 | X                                                                                 | 6 dBm (nominal)          |                                                                                   |
| 26.4 to 34.5 GHz                                                                           |                                                                                   | X                                                                                 | 4 dBm (nominal)          |                                                                                   |
| 34.4 to 44 GHz                                                                             |                                                                                   | X                                                                                 | 0 dBm (nominal)          |                                                                                   |

- Large signals, even at frequencies not shown on the screen, can cause the receiver to incorrectly measure on-screen signals because of two-tone gain compression. This specification tells how large an interfering signal must be in order to cause a 1 dB change in an on-screen signal.
- Specified at 1 kHz RBW with 100 kHz tone spacing. The compression point will nominally equal the specification for tone spacing greater than 5 times the prefilter bandwidth. At smaller spacings, ADC clipping may occur at a level lower than the 1 dB compression point.
- Reference level and off-screen performance: The reference level (RL) behavior differs from some earlier receivers in a way that makes this receiver more flexible. In other receivers, the RL controlled how the measurement was performed as well as how it was displayed. Because the logarithmic amplifier in these receivers had both range and resolution limitations, this behavior was necessary for optimum measurement accuracy. The logarithmic amplifier in this receiver, however, is implemented digitally such that the range and resolution greatly exceed other instrument limitations. Because of this, the receiver can make measurements largely independent of the setting of the RL without compromising accuracy. Because the RL becomes a display function, not a measurement function, a marker can read out results that are off-screen, either above or below, without any change in accuracy. The only exception to the independence of RL and the way in which the measurement is performed is in the input attenuation setting: When the input attenuation is set to auto, the rules for the determination of the input attenuation include dependence on the reference level. Because the input attenuation setting controls the tradeoff between large signal behaviors (third-order intermodulation, compression, and display scale fidelity) and small signal effects (noise), the measurement results can change with RL changes when the input attenuation is set to auto.

Keysight PXE EMI Receiver  
Dynamic Range

- d. When using EMI Receiver Mode Discrete (Stepped) Scan, all indicated values shown here are nominal values. It has been verified at 1 kHz RBW with 50 MHz tone spacing.
- e. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
- f. RF Input 2 operates to 1 GHz. The 1 dB gain compression is nominally 9 dB higher.
- g. When the notch filter is selected the specs between 2.3 GHz – 2.6 GHz is not applicable.

| Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Specifications                                     | Supplemental Information                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Clipping (ADC Over-range)</b><br><br>Any signal offset<br><br>Signal offset > 5 times IF prefilter bandwidth and IF Gain set to Low<br><br><b>IF Prefilter Bandwidth</b><br><br><div> <div>Zero Span or Swept, RBW =</div> <div>Sweep Type = FFT, FFT Width =</div> </div> <div> <div>≤3.9 kHz</div> <div>&lt; 4.01 kHz</div> </div> <div> <div>4.3 to 27 kHz</div> <div>&lt; 28.81 kHz</div> </div> <div> <div>30 to 160 kHz</div> <div>&lt; 167.4 kHz</div> </div> <div> <div>180 to 390 kHz</div> <div>&lt; 411.9 kHz</div> </div> <div> <div>430 kHz to 8 MHz</div> <div>&lt; 7.99 MHz</div> </div> | Maximum power at mixer <sup>a</sup><br><br>–10 dBm | Low frequency exceptions <sup>b</sup><br><br>+12 dBm (nominal)<br><br><br><br><b>–3 dB Bandwidth (nominal)</b><br><br>8.9 kHz<br>79 kHz<br>303 kHz<br>966 kHz<br>10.9 MHz |

- a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB) (–9 dB for RF Input 2).
- b. The ADC clipping level declines at low frequencies (below 50 MHz) when the LO feed through (the signal that appears at 0 Hz) is within 5 times the prefilter bandwidth (see table) and must be handled by the ADC. For example, with a 300 kHz RBW and prefilter bandwidth at 966 kHz, the clipping level reduces for signal frequencies below 4.83 MHz. For signal frequencies below 2.5 times the prefilter bandwidth, there will be additional reduction due to the presence of the image signal (the signal that appears at the negative of the input signal frequency) at the ADC.

## Displayed Average Noise Level

| Description                                                                                                                                |   |   | Specifications                                                                                                                                                          |                  | Supplemental Information                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------|---|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------------|
| <b>Displayed Average Noise Level (DANL)<sup>a</sup> - RF Preselector Off</b><br>(Spectrum Analyzer Mode)<br><br>(RF Input 1 <sup>b</sup> ) |   |   | Input terminated<br>Sample or Average detector<br>Averaging type = Log<br>0 dB input attenuation<br>IF Gain = High<br>NFE <sup>b</sup> Off<br>1 Hz Resolution Bandwidth |                  | Refer to the footnote for <b>Band Overlaps on page 14.</b> |
| Option 544 (mmW)                                                                                                                           |   |   |                                                                                                                                                                         |                  |                                                            |
| Option 503, 508, or 526 (RF/μW)                                                                                                            | ↓ | ↓ | <b>20 to 30°C</b>                                                                                                                                                       | <b>0 to 55°C</b> | <b>Typical DANL including NFE<sup>c</sup></b>              |
|                                                                                                                                            | ↓ | ↓ |                                                                                                                                                                         |                  |                                                            |
| 1 Hz <sup>d</sup>                                                                                                                          | X | X |                                                                                                                                                                         |                  | -70 dBm (nominal)                                          |
| 2 Hz to 10 Hz <sup>d</sup>                                                                                                                 | X |   |                                                                                                                                                                         |                  | -110 dBm (nominal)                                         |
| 2 Hz to 10 Hz <sup>d</sup>                                                                                                                 |   | X |                                                                                                                                                                         |                  | -105 dBm (nominal)                                         |
| 20 Hz <sup>d</sup>                                                                                                                         | X |   | -120 dBm                                                                                                                                                                | -110 dBm         |                                                            |
| 20 Hz <sup>d</sup>                                                                                                                         |   | X | -115 dBm                                                                                                                                                                | -105 dBm         |                                                            |
| 100 Hz <sup>d</sup>                                                                                                                        | X | X | -125 dBm                                                                                                                                                                | -115 dBm         |                                                            |
| 1 kHz <sup>d</sup>                                                                                                                         | X | X | -130 dBm                                                                                                                                                                | -120 dBm         |                                                            |
| 9 kHz to 150 kHz <sup>d</sup>                                                                                                              | X | X | -142 dBm                                                                                                                                                                | -141 dBm         |                                                            |
| 150 kHz to 1 MHz <sup>d</sup>                                                                                                              | X | X | -153 dBm                                                                                                                                                                | -152 dBm         |                                                            |
| 1 to 10 MHz <sup>d</sup>                                                                                                                   | X | X | -154 dBm                                                                                                                                                                | -153 dBm         |                                                            |
| 10 MHz to 1 GHz                                                                                                                            | X | X | -154 dBm                                                                                                                                                                | -153 dBm         | -164 dBm                                                   |
| 1 to 2.5 GHz                                                                                                                               | X | X | -151 dBm                                                                                                                                                                | -150 dBm         | -161 dBm                                                   |
| 2.5 to 3.6 GHz                                                                                                                             | X | X | -148 dBm                                                                                                                                                                | -147 dBm         | -158 dBm                                                   |
| 3.5 GHz to 8.4 GHz                                                                                                                         | X |   | -153 dBm                                                                                                                                                                | -152 dBm         | -163 dBm                                                   |
| 3.5 GHz to 8.4 GHz                                                                                                                         |   | X | -149 dBm                                                                                                                                                                | -148 dBm         | -161 dBm                                                   |
| 8.3 GHz to 13.6 GHz                                                                                                                        | X |   | -152 dBm                                                                                                                                                                | -151 dBm         | -162 dBm                                                   |
| 8.3 GHz to 13.6 GHz                                                                                                                        |   | X | -150 dBm                                                                                                                                                                | -149 dBm         | -162 dBm                                                   |
| 13.5 to 18 GHz                                                                                                                             | X |   | -150 dBm                                                                                                                                                                | -149 dBm         | -160 dBm                                                   |
| 13.5 to 18 GHz                                                                                                                             |   | X | -147 dBm                                                                                                                                                                | -146 dBm         | -158 dBm                                                   |

Keysight PXE EMI Receiver  
Dynamic Range

| Description      |   |   | Specifications |          | Supplemental Information |
|------------------|---|---|----------------|----------|--------------------------|
| 18 to 25 GHz     | X |   | –146 dBm       | –145 dBm | –155 dBm                 |
| 18 to 25 GHz     |   | X | –144 dBm       | –143 dBm | –155 dBm                 |
| 25 to 26.5 GHz   | X |   | –143 dBm       | –142 dBm | –155 dBm                 |
| 25 to 26.5 GHz   |   | X | –142 dBm       | –141 dBm | –154 dBm                 |
| 26.4 to 34.5 GHz |   | X | –142 dBm       | –140 dBm | –156 dBm                 |
| 34.4 to 40 GHz   |   | X | –137 dBm       | –135 dBm | –151 dBm                 |
| 40 to 42 GHz     |   | X | –135 dBm       | –133 dBm | –150 dBm                 |
| 42 to 44 GHz     |   | X | –133 dBm       | –131 dBm | –147 dBm                 |

- DANL for zero span and swept is measured in a 1 kHz RBW and normalized to the narrowest available RBW, because the noise figure does not depend on RBW and 1 kHz measurements are faster.
- RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
- NFE = Noise Floor Extension. Typical DANL including NFE = (Typical DANL – DANL improvement with NFE).
- DANL below 10 MHz is affected by phase noise around the LO feedthrough signal. Specifications apply with the best setting of the Phase Noise Optimization control, which is to choose the “Best Close-in  $\phi$  Noise” for frequencies below 25 kHz, and “Best Wide Offset  $\phi$  Noise” for frequencies above 25 kHz.

Keysight PXE EMI Receiver  
Dynamic Range

| Description                                                                                                                                               |   |   | Specifications                                                                                                                                                          |                  | Supplemental Information                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------------------------------------------------------|
| <b>Displayed Average Noise Level (DANL)<sup>a</sup> -<br/>RF Preselector On<sup>b</sup></b><br>(Spectrum Analyzer Mode)<br><br>(RF Input 1 <sup>c</sup> ) |   |   | Input terminated<br>Sample or Average detector<br>Averaging type = Log<br>0 dB input attenuation<br>IF Gain = High<br>NFE <sup>c</sup> Off<br>1 Hz Resolution Bandwidth |                  | Refer to the footnote for<br><b>Band Overlaps on<br/>page 14.</b> |
| Option 544 (mmW)                                                                                                                                          |   |   |                                                                                                                                                                         |                  |                                                                   |
| Option 503, 508, or 526 (RF/μW)                                                                                                                           | ↓ | ↓ | <b>20 to 30°C</b>                                                                                                                                                       | <b>0 to 55°C</b> | <b>Typical DANL including<br/>NFE<sup>d</sup></b>                 |
|                                                                                                                                                           | ↓ | ↓ |                                                                                                                                                                         |                  |                                                                   |
| 1 Hz <sup>e</sup>                                                                                                                                         | X | X |                                                                                                                                                                         |                  | -70 dBm (nominal)                                                 |
| 2 Hz to 10 Hz <sup>e</sup>                                                                                                                                | X |   |                                                                                                                                                                         |                  | -110 dBm (nominal)                                                |
| 2 Hz to 10 Hz <sup>e</sup>                                                                                                                                |   | X |                                                                                                                                                                         |                  | -105 dBm (nominal,)                                               |
| 20 Hz <sup>e</sup>                                                                                                                                        | X |   | -120 dBm                                                                                                                                                                | -110 dBm         |                                                                   |
| 20 Hz <sup>e</sup>                                                                                                                                        |   | X | -115 dBm                                                                                                                                                                | -105 dBm         |                                                                   |
| 100 Hz <sup>e</sup>                                                                                                                                       | X | X | -125 dBm                                                                                                                                                                | -115 dBm         |                                                                   |
| 1 kHz <sup>e</sup>                                                                                                                                        | X | X | -130 dBm                                                                                                                                                                | -120 dBm         |                                                                   |
| 9 to 100 kHz <sup>e</sup>                                                                                                                                 | X | X | -141 dBm                                                                                                                                                                | -140 dBm         | -143 dBm                                                          |
| 100 to 150 kHz <sup>e</sup>                                                                                                                               | X | X | -142 dBm                                                                                                                                                                | -141 dBm         | -163 dBm                                                          |
| 150 to 500 kHz <sup>e</sup>                                                                                                                               | X | X | -149 dBm                                                                                                                                                                | -148 dBm         | -161 dBm                                                          |
| 500 kHz to 30 MHz <sup>e</sup>                                                                                                                            | X | X | -153 dBm                                                                                                                                                                | -151 dBm         | -163 dBm                                                          |
| 30 MHz to 1 GHz                                                                                                                                           | X | X | -154 dBm                                                                                                                                                                | -152 dBm         | -165 dBm                                                          |
| 1 to 1.7 GHz                                                                                                                                              | X | X | -156 dBm                                                                                                                                                                | -154 dBm         | -166 dBm                                                          |
| 1.7 to 2.5 GHz                                                                                                                                            | X | X | -153 dBm                                                                                                                                                                | -151 dBm         | -163 dBm                                                          |
| 2.5 to 3.6 GHz                                                                                                                                            | X | X | -151 dBm                                                                                                                                                                | -149 dBm         | -161 dBm                                                          |
| 3.5 GHz to 8.4 GHz                                                                                                                                        | X |   | -153 dBm                                                                                                                                                                | -152 dBm         | -163 dBm                                                          |
| 3.5 GHz to 8.4 GHz                                                                                                                                        |   | X | -149 dBm                                                                                                                                                                | -148 dBm         | -161 dBm                                                          |
| 8.3 GHz to 13.6 GHz                                                                                                                                       | X |   | -152 dBm                                                                                                                                                                | -151 dBm         | -162 dBm                                                          |
| 8.3 GHz to 13.6 GHz                                                                                                                                       |   | X | -150 dBm                                                                                                                                                                | -149 dBm         | -162 dBm                                                          |
| 13.5 to 18 GHz                                                                                                                                            | X |   | -150 dBm                                                                                                                                                                | -149 dBm         | -160 dBm                                                          |

Keysight PXE EMI Receiver  
Dynamic Range

| Description      |   |   | Specifications |          | Supplemental Information |
|------------------|---|---|----------------|----------|--------------------------|
| 13.5 to 18 GHz   | X | X | -147 dBm       | -146 dBm | -158 dBm                 |
| 18 to 25 GHz     |   |   | -146 dBm       | -145 dBm | -155 dBm                 |
| 18 to 25 GHz     | X | X | -144 dBm       | -143 dBm | -155 dBm                 |
| 25 to 26.5 GHz   |   |   | -143 dBm       | -142 dBm | -155 dBm                 |
| 25 to 26.5 GHz   |   | X | -142 dBm       | -141 dBm | -154 dBm                 |
| 26.4 to 34.5 GHz |   | X | -142 dBm       | -140 dBm | -156 dBm                 |
| 34.4 to 40 GHz   |   | X | -137 dBm       | -135 dBm | -151 dBm                 |
| 40 to 42 GHz     |   | X | -135 dBm       | -133 dBm | -150 dBm                 |
| 42 to 44 GHz     |   | X | -133 dBm       | -131 dBm | -147 dBm                 |

- DANL for zero span and swept is measured in a 1 kHz RBW and normalized to the narrowest available RBW, because the noise figure does not depend on RBW and 1 kHz measurements are faster.
- When the notch filter is selected, the DANL specifications between 2.2 – 2.9 GHz is nominally specified.
- RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
- NFE = Noise Floor Extension. Typical DANL including NFE = (Typical DANL – DANL improvement with NFE).
- DANL below 10 MHz is affected by phase noise around the LO feedthrough signal. Specifications apply with the best setting of the Phase Noise Optimization control, which is to choose the “Best Close-in  $\phi$  Noise” for frequencies below 25 kHz, and “Best Wide Offset  $\phi$  Noise” for frequencies above 25 kHz.

Keysight PXE EMI Receiver  
Dynamic Range

| Description                                                                          |   |   | Specifications | Supplemental Information                                                                                                                                                                 |                                |
|--------------------------------------------------------------------------------------|---|---|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| <b>Indicated Noise (EMI Receiver Mode)<sup>a</sup></b><br>(RF Input 1 <sup>b</sup> ) |   |   |                | Input terminated<br><br>EMI Average detector<br>0 dB input attenuation<br>All indicated RBW are CISPR BW, except as noted.<br><br>EMI Receiver Mode Scan Type = Discrete (Stepped) Scan. |                                |
| <i>Option 544 (mmW)</i>                                                              |   |   |                |                                                                                                                                                                                          |                                |
| <i>Option 503, 508, or 526 (RF/μW)</i>                                               |   |   |                |                                                                                                                                                                                          |                                |
| <b>RF Preselector On, Preamp Off</b>                                                 | ↓ | ↓ |                | <b>Typical Indicated Noise including NFE<sup>c</sup></b>                                                                                                                                 |                                |
|                                                                                      |   |   |                | <b>Without Opt. WF1</b>                                                                                                                                                                  | <b>With Opt. WF1</b>           |
| 1 Hz (1 Hz RBW) <sup>d</sup>                                                         | X | X |                | 32 dBμV (nominal) <sup>e</sup>                                                                                                                                                           | 32 dBμV (nominal) <sup>e</sup> |
| 10 Hz (1 Hz RBW) <sup>d</sup>                                                        | X | X |                | 2 dBμV (nominal) <sup>e</sup>                                                                                                                                                            | 2 dBμV (nominal) <sup>e</sup>  |
| 20 Hz (1 Hz RBW) <sup>d</sup>                                                        | X |   |                | -19 dBμV <sup>e</sup>                                                                                                                                                                    | -19 dBμV <sup>e</sup>          |
| 20 Hz (10 Hz RBW) <sup>d</sup>                                                       |   | X |                | -9 dBμV <sup>e</sup>                                                                                                                                                                     | -9 dBμV <sup>e</sup>           |
| 100 Hz (10 Hz RBW) <sup>d</sup>                                                      | X | X |                | -11 dBμV <sup>e</sup>                                                                                                                                                                    | -11 dBμV <sup>e</sup>          |
| 1 kHz (100 Hz RBW) <sup>d</sup>                                                      | X | X |                | -9 dBμV <sup>e</sup>                                                                                                                                                                     | -18 dBμV <sup>e</sup>          |
| 9 to 150 kHz (200 Hz RBW)                                                            | X | X |                | -14 dBμV                                                                                                                                                                                 | -25 dBμV                       |
| 150 kHz to 1 MHz (9 kHz RBW)                                                         | X | X |                | -8 dBμV                                                                                                                                                                                  | -15 dBμV                       |
| 1 to 30 MHz (9 kHz RBW)                                                              | X | X |                | -12 dBμV                                                                                                                                                                                 | -14 dBμV                       |
| 30 MHz to 1 GHz (120 kHz)                                                            | X | X |                | -3 dBμV                                                                                                                                                                                  | -3 dBμV                        |
| 1 to 2.5 GHz (1 MHz RBW)                                                             | X | X |                | 8 dBμV                                                                                                                                                                                   | 8 dBμV                         |
| 2.5 to 3.6 GHz (1 MHz RBW)                                                           | X | X |                | 11 dBμV                                                                                                                                                                                  | 11 dBμV                        |
| 3.6 to 8.4 GHz (1 MHz RBW)                                                           | X |   |                | 8 dBμV                                                                                                                                                                                   | 8 dBμV                         |
| 3.6 to 8.4 GHz (1 MHz RBW)                                                           |   | X |                | 12 dBμV                                                                                                                                                                                  | 12 dBμV                        |
| 8.4 to 13.6 GHz (1 MHz RBW)                                                          | X |   |                | 11 dBμV                                                                                                                                                                                  | 11 dBμV                        |
| 8.4 to 13.6 GHz (1 MHz RBW)                                                          |   | X |                | 12 dBμV                                                                                                                                                                                  | 12 dBμV                        |
| 13.6 to 17.1 GHz (1 MHz RBW)                                                         | X |   |                | 12 dBμV                                                                                                                                                                                  | 12 dBμV                        |
| 13.6 to 17.1 GHz (1 MHz RBW)                                                         |   | X |                | 14 dBμV                                                                                                                                                                                  | 14 dBμV                        |
| 17.1 to 25 GHz (1 MHz RBW)                                                           | X |   |                | 14 dBμV                                                                                                                                                                                  | 14 dBμV                        |
| 17.1 to 25 GHz (1 MHz RBW)                                                           |   | X |                | 18 dBμV                                                                                                                                                                                  | 18 dBμV                        |

Keysight PXE EMI Receiver  
Dynamic Range

| Description                  |   |   | Specifications | Supplemental Information |               |
|------------------------------|---|---|----------------|--------------------------|---------------|
| 25 to 26.5 GHz (1 MHz RBW)   | X |   |                | 18 dB $\mu$ V            | 18 dB $\mu$ V |
| 25 to 26.5 GHz (1 MHz RBW)   |   | X |                | 19 dB $\mu$ V            | 19 dB $\mu$ V |
| 26.5 to 34.5 GHz (1 MHz RBW) |   | X |                | 18 dB $\mu$ V            | 18 dB $\mu$ V |
| 34.5 to 40 GHz (1 MHz RBW)   |   | X |                | 22 dB $\mu$ V            | 22 dB $\mu$ V |
| 40 to 42 GHz (1 MHz RBW)     |   | X |                | 24 dB $\mu$ V            | 24 dB $\mu$ V |
| 42 to 44 GHz (1 MHz RBW)     |   | X |                | 27 dB $\mu$ V            | 27 dB $\mu$ V |

- When the notch filter is selected, the Indicated Noise specifications between 2.2 – 2.9 GHz is nominally specified.
- RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
- Typical Indicated Noise including NFE = Typical DANL + RBW correction – DANL Improvement with NFE +107.
- Indicated RBW is a 6 dB bandwidth.
- NFE is not part of the difference between warranted and typical specifications at this frequency.

Keysight PXE EMI Receiver  
Dynamic Range

| Description                                                                         | Specifications |   | Supplemental Information               |                          |
|-------------------------------------------------------------------------------------|----------------|---|----------------------------------------|--------------------------|
| <b>DANL and Indicated Noise Improvement with Noise Floor Extension<sup>ab</sup></b> |                |   | 95th Percentile ( $\approx 2 \sigma$ ) |                          |
| <i>Option 544 (mmW)</i>                                                             |                |   |                                        |                          |
| <i>Option 503, 508, or 526 (RF/<math>\mu</math>W)</i>                               |                |   |                                        |                          |
|                                                                                     | ↓              | ↓ | <b>Spectrum Analyzer Mode</b>          | <b>EMI Receiver Mode</b> |
| <b>RF Preselector Off, Preamp Off</b>                                               |                |   |                                        |                          |
| <b>RF Input 1</b>                                                                   |                |   |                                        |                          |
| 10 MHz <sup>c</sup> to 3.6 GHz                                                      | X              | X | 9 dB                                   | 4 dB                     |
| 3.5 to 8.4 GHz                                                                      | X              | X | 10 dB                                  | 5 dB                     |
| 8.3 to 13.6 GHz                                                                     | X              | X | 10 dB                                  | 4 dB                     |
| 13.5 to 17.1 GHz                                                                    | X              | X | 9 dB                                   | 4 dB                     |
| 17.0 to 26.5 GHz                                                                    | X              | X | 10 dB                                  | 4 dB                     |
| 26.4 GHz to 34.5 GHz                                                                |                | X | 11 dB                                  | 5 dB                     |
| 34.4 GHz to 44 GHz                                                                  |                | X | 11 dB                                  | 5 dB                     |
| <b>RF Input 2</b>                                                                   |                |   |                                        |                          |
| 10 MHz <sup>c</sup> to 1 GHz                                                        | X              | X | 9 dB                                   | 4 dB                     |
| <b>RF Preselector On, Preamp Off</b>                                                |                |   |                                        |                          |
| <b>RF Input 1</b>                                                                   |                |   |                                        |                          |
| 150 kHz <sup>d</sup> to 30 MHz                                                      | X              | X | 10 dB                                  | 3 dB                     |
| 30 MHz to 1 GHz                                                                     | X              | X | 10 dB                                  | 5 dB                     |
| 1 to 3.6 GHz                                                                        | X              | X | 9 dB                                   | 4 dB                     |
| 3.5 to 8.4 GHz                                                                      | X              | X | 10 dB                                  | 5 dB                     |
| 8.3 to 13.6 GHz                                                                     | X              | X | 10                                     | 4 dB                     |
| 13.5 to 17.1 GHz                                                                    | X              | X | 9 dB                                   | 4 dB                     |
| 17 to 26.5 GHz                                                                      | X              | X | 10 dB                                  | 4 dB                     |
| 26.4 GHz to 34.5 GHz                                                                |                | X | 11 dB                                  | 5 dB                     |
| 34.4 GHz to 44 GHz                                                                  |                | X | 11 dB                                  | 5 dB                     |
| <b>RF Input 2</b>                                                                   |                |   |                                        |                          |
| 150 kHz <sup>d</sup> to 1 GHz                                                       | X              | X | 10 dB                                  | 3 dB                     |

## Keysight PXE EMI Receiver Dynamic Range

- a. This statement on the improvement in DANL is based on the statistical observations of the error in the effective noise floor after NFE is applied. That effective noise floor can be a negative or a positive power at any frequency. These 95th percentile values are based on the absolute value of that effective remainder noise power.
- b. Unlike other 95th percentiles, these table values do not include delta environment effects. NFE is aligned in the factory at room temperature. For best performance, in an environment that is different from room temperature, such as an equipment rack with other instruments, we recommend running the "Characterize Noise Floor" operation after the first time the analyzer has been installed in the environment, and given an hour to stabilize.
- c. NFE does not apply to the low frequency sensitivity. At frequencies below about 0.5 MHz, the sensitivity is dominated by phase noise surrounding the LO feedthrough. The NFE is not designed to improve that performance. At frequencies between 0.5 and 10 MHz the NFE effectiveness increases from nearly none to near its maximum
- d. For RF Preselector path, NFE does not apply at frequencies below 100 kHz. At frequencies between 100 kHz and 150 kHz, the NFE effectiveness is not measured, but is designed to be nominally the same as frequencies above 150 kHz.

## Spurious Responses

| Description                                                                                                                     |                 | Specifications                                |                                        |                                        | Supplemental Information                                          |                                                                |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------------------|----------------------------------------|----------------------------------------|-------------------------------------------------------------------|----------------------------------------------------------------|
| <b>Spurious Responses</b><br>RF Preselector on and off                                                                          |                 | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                                        |                                        | Preamp Off <sup>a</sup><br>(see <b>Band Overlaps on page 14</b> ) |                                                                |
| Residual Responses <sup>bc</sup><br>200 kHz to 8.4 GHz (swept)<br>Zero span or FFT or EMI Receiver<br>Mode or other frequencies |                 | –100 dBm                                      |                                        |                                        | –100 dBm (nominal)                                                |                                                                |
| Image Responses                                                                                                                 |                 |                                               |                                        |                                        |                                                                   |                                                                |
| Tuned Freq (f)                                                                                                                  | Excitation Freq | Mixer Level <sup>d</sup>                      | Response RF/μW                         | mmW                                    | RF/μW                                                             | mmW                                                            |
| 10 MHz to 26.5 GHz                                                                                                              | f+45 MHz        | –10 dBm                                       | –80 dBc                                | –80 dBc                                | –113 dBc (typical)                                                | –113 dBc (typical)                                             |
| 10 MHz to 3.6 GHz                                                                                                               | f+10245 MHz     | –10 dBm                                       | –80 dBc                                | –80 dBc                                | –107 dBc (typical)                                                | –107 dBc (typical)                                             |
| 10 MHz to 3.6 GHz                                                                                                               | f+645 MHz       | –10 dBm                                       | –80 dBc                                | –80 dBc                                | –108 dBc (typical)                                                | –108 dBc (typical)                                             |
| 3.5 to 13.6 GHz                                                                                                                 | f+645 MHz       | –10 dBm                                       | –81 dBc                                | –80 dBc                                | –85 dBc (typical)                                                 | –102 dBc (typical)                                             |
| 13.5 to 17.1 GHz                                                                                                                | f+645 MHz       | –10 dBm                                       | –81 dBc                                | –80 dBc                                | –86 dBc (typical)                                                 | –102 dBc (typical)                                             |
| 17.0 to 22 GHz                                                                                                                  | f+645 MHz       | –10 dBm                                       | –76 dBc                                | –80 dBc                                | –81 dBc (typical)                                                 | –100 dBc (typical)                                             |
| 22 to 26.5 GHz                                                                                                                  | f+645 MHz       | –10 dBm                                       | –69 dBc                                | –70 dBc                                | –76 dBc (typical)                                                 | –97 dBc (typical)                                              |
| 26.4 to 34.5 GHz                                                                                                                | f+645 MHz       | –30 dBm                                       |                                        | –70 dBc                                |                                                                   | –94 dBc (typical)                                              |
| 34.4 to 44 GHz                                                                                                                  | f+645 MHz       | –30 dBm                                       |                                        | –59 dBc                                |                                                                   | –79 dBc (typical)                                              |
| <b>Other Spurious Responses</b>                                                                                                 |                 |                                               |                                        |                                        |                                                                   |                                                                |
| Carrier Frequency ≤26.5 GHz                                                                                                     |                 |                                               |                                        |                                        |                                                                   |                                                                |
| First RF Order <sup>e</sup><br>(f ≥ 10 MHz from carrier)                                                                        |                 | –10 dBm                                       | –80 dBc +<br>20 × log(N <sup>f</sup> ) | –80 dBc +<br>20 × log(N <sup>f</sup> ) | Includes IF<br>feedthrough, LO<br>harmonic mixing<br>responses    | Includes IF<br>feedthrough, LO<br>harmonic mixing<br>responses |
| Higher RF Order <sup>g</sup><br>(f ≥ 10 MHz from carrier)                                                                       |                 | –40 dBm                                       | –80 dBc +<br>20 × log(N <sup>f</sup> ) | –80 dBc +<br>20 × log(N <sup>f</sup> ) | Includes higher<br>order mixer<br>responses                       | Includes IF<br>feedthrough, LO<br>harmonic mixing<br>responses |
| Carrier Frequency >26.5 GHz                                                                                                     |                 |                                               |                                        |                                        |                                                                   |                                                                |
| First RF Order <sup>e</sup><br>f ≥ 10 MHz from carrier)                                                                         |                 | –30 dBm                                       |                                        |                                        |                                                                   | –90 dBc (nominal)                                              |
| Higher RF Order <sup>g</sup><br>(f ≥ 10 MHz from carrier)                                                                       |                 | –30 dBm                                       |                                        |                                        |                                                                   | –90 dBc (nominal)                                              |

Keysight PXE EMI Receiver  
Dynamic Range

| Description                                                                      | Specifications |                                    |                                    | Supplemental Information                |                                         |
|----------------------------------------------------------------------------------|----------------|------------------------------------|------------------------------------|-----------------------------------------|-----------------------------------------|
| LO-Related Spurious Responses<br>(f > 600 MHz from carrier<br>10 MHz to 3.6 GHz) | -10 dBm        | -60 dBc +<br>$20 \times \log(N^f)$ | -60 dBc +<br>$20 \times \log(N^f)$ | -90 dBc + $20 \times \log(N)$ (typical) | -90 dBc + $20 \times \log(N)$ (typical) |
| Sidebands, offset from CW signal                                                 |                |                                    |                                    |                                         |                                         |
| ≤200 Hz                                                                          |                |                                    |                                    | -76 dBc <sup>h</sup><br>(nominal)       | -76 dBc <sup>h</sup><br>(nominal)       |
| 200 Hz to 3 kHz                                                                  |                |                                    |                                    | -66 dBc <sup>h</sup><br>(nominal)       | -66 dBc <sup>h</sup><br>(nominal)       |
| 3 kHz to 30 kHz                                                                  |                |                                    |                                    | -65 dBc (nominal)                       | -65 dBc (nominal)                       |
| 30 kHz to 10 MHz                                                                 |                |                                    |                                    | -58 dBc (nominal)                       | -58 dBc (nominal)                       |

- The spurious response specifications only apply with the preamp turned off. When the preamp is turned on, performance is nominally the same as long as the mixer level is interpreted to be: Mixer Level = Input Level – Input Attenuation + Preamp Gain. Mixer Level for RF Input 2 = Input Level – 9 dB – Input Attenuation + Preamp Gain.
- Input terminated, 0 dB input attenuation.
- RF Input 2 performance = RF Input 1 performance + 11 dB for Residual Responses.
- Input Mixer Level = Input Level – Input Attenuation.
- With first RF order spurious products, the indicated frequency will change at the same rate as the input, with higher order, the indicated frequency will change at a rate faster than the input.
- N is the LO multiplication factor.
- RBW=100 Hz. With higher RF order spurious responses, the observed frequency will change at a rate faster than the input frequency.
- Nominally -40 dBc under large magnetic (0.38 Gauss rms) or vibrational (0.21 g rms) environmental stimuli.

## Second Harmonic Distortion

| Description                                                                                                         |   |   | Specifications         | Supplemental Information |
|---------------------------------------------------------------------------------------------------------------------|---|---|------------------------|--------------------------|
| <b>Second Harmonic Distortion</b><br>(Input power = -9 dBm<br>Input attenuation = 6 dB<br>RF Input 1 <sup>a</sup> ) |   |   |                        |                          |
| <i>Option 544 (mmW)</i>                                                                                             |   |   |                        |                          |
| <i>Option 503, 508, or 526 (RF/μW)</i>                                                                              |   |   |                        |                          |
| <b>RF Preselector Off, Preamp Off</b>                                                                               | ↓ | ↓ | <b>SHI<sup>b</sup></b> | <b>Typical</b>           |
| <b>Source Frequency</b>                                                                                             |   |   |                        |                          |
| 10 to 500 MHz                                                                                                       | X |   | +54 dBm                | +61 dBm                  |
| 10 to 500 MHz                                                                                                       |   | X | +53 dBm                | +61 dBm                  |
| 500 MHz to 1.8 GHz                                                                                                  | X |   | +45 dBm                | +54 dBm                  |
| 500 MHz to 1.8 GHz                                                                                                  |   | X | +44 dBm                | +54 dBm                  |
| 1.8 to 4 GHz                                                                                                        | X |   | +60 dBm                | +67 dBm                  |
| 1.8 to 4 GHz                                                                                                        |   | X | +58 dBm                | +67 dBm                  |
| 4 to 11 GHz                                                                                                         | X |   | +65 dBm                | +74 dBm                  |
| 4 to 11 GHz                                                                                                         |   | X | +62 dBm                | +69 dBm                  |
| 11 to 13.25 GHz                                                                                                     | X | X | +65 dBm                | +73 dBm                  |
| 13.2 to 17.25 GHz                                                                                                   |   | X | +63 dBm                | +71 dBm                  |
| 17.2 to 22 GHz                                                                                                      |   | X | +54 dBm                | +67 dBm                  |
| <b>RF Preselector On, Preamp Off</b>                                                                                |   |   |                        |                          |
| <b>Source Frequency</b>                                                                                             |   |   |                        |                          |
| 10 to 30 MHz                                                                                                        | X | X | +45 dBm                | +50 dBm                  |
| 30 to 500 MHz                                                                                                       | X | X | +54 dBm                | +58 dBm                  |
| 500 MHz to 1 GHz                                                                                                    | X | X | +70 dBm                | +78 dBm                  |
| 1 to 1.6 GHz <sup>c</sup>                                                                                           | X | X | +62 dBm                | +70 dBm                  |
| 1.6 to 1.8 GHz                                                                                                      | X | X | +70 dBm                | +82 dBm                  |
| 1.8 to 4 GHz                                                                                                        | X |   | +60 dBm                | +67 dBm                  |
| 1.8 to 4 GHz                                                                                                        |   | X | +58 dBm                | +67 dBm                  |
| 4 to 11 GHz                                                                                                         | X |   | +65 dBm                | +74 dBm                  |

Keysight PXE EMI Receiver  
Dynamic Range

| Description       |   |   | Specifications | Supplemental Information |
|-------------------|---|---|----------------|--------------------------|
| 4 to 11 GHz       |   | X | +62 dBm        | +69 dBm                  |
| 11 to 13.25 GHz   | X | X | +65 dBm        | +73 dBm                  |
| 13.2 to 17.25 GHz |   | X | +63 dBm        | +71 dBm                  |
| 17.2 to 22 GHz    |   | X | +54 dBm        | +67 dBm                  |

- a. RF Input 2 operates to 1 GHz. The second harmonic distortion intercept is nominally 9 dB higher for RF Input 2.
- b. SHI = second harmonic intercept.
- c. When the notch filter is selected the specs between source frequency 1.15 GHz to 1.30 GHz is not applicable.

## Third Order Intermodulation

| Description                                                                                                                                                                                |   |   | Specifications               |                  | Supplemental Information |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|------------------------------|------------------|--------------------------|
| <b>Third Order Intermodulation<sup>ab</sup></b><br>(Tone separation > 5 times IF<br>Prefilter Bandwidth <sup>c</sup><br>Verification conditions <sup>ab</sup><br>RF Input 1 <sup>d</sup> ) |   |   |                              |                  |                          |
| Option 544 (mmW)                                                                                                                                                                           |   |   |                              |                  |                          |
| Option 503, 508, or 526 (RF/ $\mu$ W)                                                                                                                                                      |   |   |                              |                  |                          |
|                                                                                                                                                                                            | ↓ | ↓ | <b>Intercept<sup>e</sup></b> |                  |                          |
| <b>RF Preselector Off, Preamp Off</b>                                                                                                                                                      |   |   | <b>20 to 30°C</b>            | <b>0 to 55°C</b> | <b>Typical</b>           |
| 10 to 100 MHz                                                                                                                                                                              | X | X | +12 dBm                      | +10 dBm          | +17 dBm                  |
| 100 to 400 MHz                                                                                                                                                                             | X |   | +15 dBm                      | +13 dBm          | +18 dBm                  |
| 100 to 400 MHz                                                                                                                                                                             |   | X | +12 dBm                      | +11 dBm          | +18 dBm                  |
| 400 MHz to 3.6 GHz                                                                                                                                                                         | X | X | +17 dBm                      | +15 dBm          | +20 dBm                  |
| 3.5 to 8.4 GHz                                                                                                                                                                             | X | X | +15 dBm                      | +13 dBm          | +20 dBm                  |
| 8.3 to 13.6 GHz                                                                                                                                                                            | X | X | +16 dBm                      | +14 dBm          | +20 dBm                  |
| 13.5 to 26.5 GHz                                                                                                                                                                           | X |   | +12 dBm                      | +8 dBm           | +16 dBm                  |
| 13.5 to 26.5 GHz                                                                                                                                                                           |   | X | +9 dBm                       | +6 dBm           | +13 dBm                  |
| 26.4 to 34.5 GHz                                                                                                                                                                           |   | X | +11 dBm                      | +8 dBm           | +15.5 dBm                |
| 34.4 to 44 GHz                                                                                                                                                                             |   | X | +6 dBm                       | +2 dBm           | +10 dBm                  |
| <b>RF Preselector On, Preamp Off</b>                                                                                                                                                       |   |   |                              |                  |                          |
| 10 to 30 MHz                                                                                                                                                                               | X | X | +16.5 dBm                    | +15 dBm          | +18 dBm                  |
| 30 to 100 MHz                                                                                                                                                                              | X |   | +13.5 dBm                    | +13 dBm          | +15.5 dBm                |
| 30 to 100 MHz                                                                                                                                                                              |   | X | +12.5 dBm                    | +12 dBm          | +14.5 dBm                |
| 100 MHz to 1 GHz                                                                                                                                                                           | X |   | +15 dBm                      | +14 dBm          | +17 dBm                  |
| 100 MHz to 1 GHz                                                                                                                                                                           |   | X | +14.5 dBm                    | +14 dBm          | +16.5 dBm                |
| 1 to 1.5 GHz                                                                                                                                                                               | X | X | +16 dBm                      | +15.5 dBm        | +17.5 dBm                |
| 1.5 to 3.6 GHz <sup>f</sup>                                                                                                                                                                | X | X | +17 dBm                      | +16 dBm          | +19.5 dBm                |
| 3.5 to 8.4 GHz                                                                                                                                                                             | X | X | +15 dBm                      | +13 dBm          | +20 dBm                  |

Keysight PXE EMI Receiver  
Dynamic Range

| Description      |   |   | Specifications |         | Supplemental Information |
|------------------|---|---|----------------|---------|--------------------------|
| 8.3 to 13.6 GHz  | X | X | +16 dBm        | +14 dBm | +20 dBm                  |
| 13.5 to 26.5 GHz | X |   | +12 dBm        | +8 dBm  | +16 dBm                  |
| 13.5 to 26.5 GHz |   | X | +9 dBm         | +6 dBm  | +13 dBm                  |
| 26.4 to 34.5 GHz |   | X | +11 dBm        | +8 dBm  | +15.5 dBm                |
| 34.4 to 44 GHz   |   | X | +6 dBm         | +2 dBm  | +10 dBm                  |

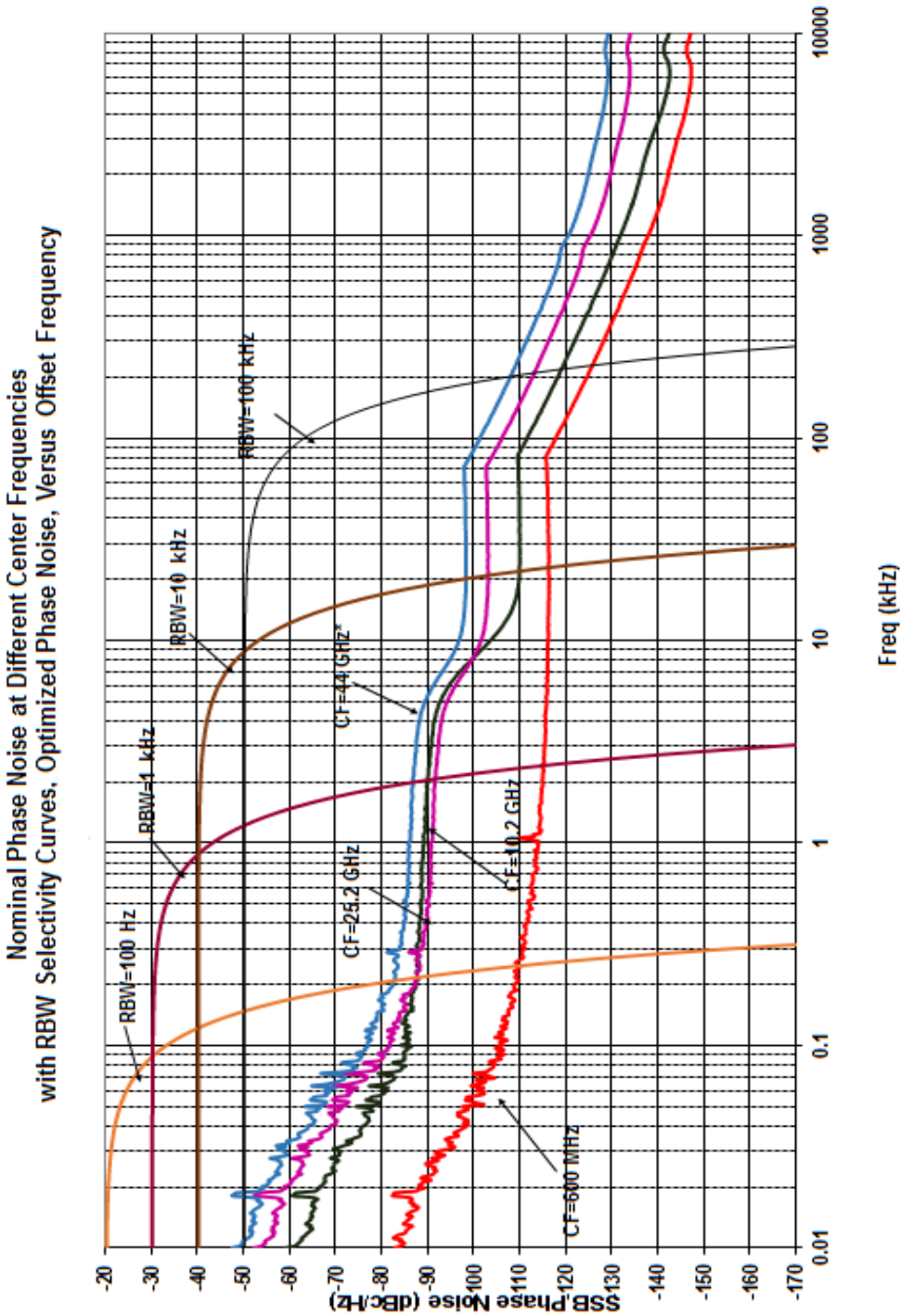
- Specified with two tones measurement in Spectrum Analyzer mode, each at -14 dBm at the input with 4 dB input attenuation, spaced by 100 kHz.
- When using EMI Receiver Mode Discrete (Stepped) Scan, all indicated values shown here are nominal values. It has been verified with two tones, each at -14 dBm at the input with 4 dB input attenuation, spaced by 50 MHz.
- See the IF Prefilter Bandwidth table in the Gain Compression specifications on [page 47](#). When the tone separation condition is met, the effect on TOI of the setting of IF Gain is negligible. TOI is verified with IF Gain set to its best case condition, which is IF Gain = Low.
- RF Input 2 operates to 1 GHz. The intercept is nominally 9 dB higher for RF Input 2.
- TOI = third order intercept. The TOI is given by the mixer tone level (in dBm) minus (distortion/2) where distortion is the relative level of the distortion tones in dBc.
- When the notch filter is selected the specs between source frequency 2.3 GHz to 2.6 GHz is not applicable.

## Phase Noise

| Description                                                                                                                               | Specifications    |                   | Supplemental Information |
|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|--------------------------|
| <b>Phase Noise</b><br><br>(Center Frequency = 1 GHz <sup>a</sup> Best-case Optimization <sup>b</sup><br>Internal Reference <sup>c</sup> ) |                   |                   | Noise Sidebands          |
| Offset Frequency                                                                                                                          | <b>20 to 30°C</b> | <b>Full range</b> |                          |
| 10 Hz                                                                                                                                     |                   |                   | –80 dBc/Hz (nominal)     |
| 100 Hz                                                                                                                                    | –91 dBc/Hz        | –90 dBc/Hz        | –100 dBc/Hz (typical)    |
| 1 kHz                                                                                                                                     | –109 dBc/Hz       | –108 dBc/Hz       | –112 dBc/Hz (typical)    |
| 10 kHz                                                                                                                                    | –113 dBc/Hz       | –113 dBc/Hz       | –114 dBc/Hz (typical)    |
| 100 kHz                                                                                                                                   | –116 dBc/Hz       | –115 dBc/Hz       | –117 dBc/Hz (typical)    |
| 1 MHz <sup>d</sup>                                                                                                                        | –134 dBc/Hz       | –134 dBc/Hz       | –136 dBc/Hz (typical)    |
| 10 MHz <sup>d</sup>                                                                                                                       |                   |                   | –148 dBc/Hz (nominal)    |

- The nominal performance of the phase noise at center frequencies different than the one at which the specifications apply (1 GHz) depends on the center frequency, band and the offset. For low offset frequencies, offsets well under 100 Hz, the phase noise increases by  $20 \times \log[(f + 0.3225)/1.3225]$ . For mid-offset frequencies such as 10 kHz, band 0 phase noise changes as  $20 \times \log[(f + 5.1225)/6.1225]$ . For mid-offset frequencies in other bands, phase noise changes as  $20 \times \log[(f + 0.3225)/6.1225]$  except  $f$  in this expression should never be lower than 5.8. For wide offset frequencies, offsets above about 100 kHz, phase noise increases as  $20 \times \log(N)$ .  $N$  is the LO Multiple as shown on [page 14](#);  $f$  is in GHz units in all these relationships; all increases are in units of decibels.
- Noise sidebands for lower offset frequencies, for example, 10 kHz, apply with the phase noise optimization (PhNoise Opt) set to Best Close-in  $\phi$  Noise. Noise sidebands for higher offset frequencies, for example, 1 MHz, as shown apply with the phase noise optimization set to Best Wide-offset  $\phi$  Noise.
- Specifications are given with the internal frequency reference. The phase noise at offsets below 100 Hz is impacted or dominated by noise from the reference. Thus, performance with external references will not follow the curves and specifications. The internal 10 MHz reference phase noise is about –120 dBc/Hz at 10 Hz offset; external references with poorer phase noise than this will cause poorer performance than shown.
- Analyzer-contributed phase noise at the low levels of this offset requires advanced verification techniques because broadband noise would otherwise cause excessive measurement error. Keysight uses a high level low phase noise CW test signal and sets the input attenuator so that the mixer level will be well above the normal top-of-screen level (–10 dBm) but still well below the 1 dB compression level. This improves dynamic range (carrier to broadband noise ratio) at the expense of amplitude uncertainty due to compression of the phase noise sidebands of the analyzer. (If the mixer level were increased to the "1 dB Gain Compression Point," the compression of a single sideband is specified to be 1 dB or lower. At lower levels, the compression falls off rapidly. The compression of phase noise sidebands is substantially less than the compression of a single-sideband test signal, further reducing the uncertainty of this technique.) Keysight also measures the broadband noise of the analyzer without the CW signal and subtracts its power from the measured phase noise power. The same techniques of overdrive and noise subtraction can be used in measuring a DUT.

Nominal Phase Noise at Different Center Frequencies [Plot]



## Power Suite Measurements (RF Preselector off only)

| Description                                                                                                                                                          | Specifications                    | Supplemental Information                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Channel Power</b><br>Amplitude Accuracy<br><br><b>Case: Radio Std = 3GPP W-CDMA, or IS-95</b><br><br>Absolute Power Accuracy<br>(20 to 30°C, Attenuation = 10 dB) | <br><br><br><br><br>$\pm 0.82$ dB | Absolute Amplitude Accuracy <sup>a</sup> +<br>Power Bandwidth Accuracy <sup>bc</sup><br><br>$\pm 0.23$ dB (95 <sup>th</sup> percentile) |

- a. See **"Absolute Amplitude Accuracy" on page 34.**
- b. See **"Frequency and Time" on page 14.**
- c. Expressed in dB.

| Description                                     | Specifications | Supplemental Information          |
|-------------------------------------------------|----------------|-----------------------------------|
| <b>Occupied Bandwidth</b><br>Frequency Accuracy |                | $\pm(\text{Span}/1000)$ (nominal) |

Keysight PXE EMI Receiver  
Power Suite Measurements (RF Preselector off only)

| Description                                                    |                    |               | Specifications        | Supplemental Information                                                          |                                         |
|----------------------------------------------------------------|--------------------|---------------|-----------------------|-----------------------------------------------------------------------------------|-----------------------------------------|
| <b>Adjacent Channel Power (ACP)</b>                            |                    |               |                       | RF Input 1, RF Preselector Off                                                    |                                         |
| <b>Case: Radio Std = None</b>                                  |                    |               |                       |                                                                                   |                                         |
| Accuracy of ACP Ratio (dBc)                                    |                    |               |                       | Display Scale Fidelity <sup>a</sup>                                               |                                         |
| Accuracy of ACP Absolute Power (dBm or dBm/Hz)                 |                    |               |                       | Absolute Amplitude Accuracy <sup>b</sup> + Power Bandwidth Accuracy <sup>cd</sup> |                                         |
| Accuracy of Carrier Power (dBm), or Carrier Power PSD (dBm/Hz) |                    |               |                       | Absolute Amplitude Accuracy <sup>b</sup> + Power Bandwidth Accuracy <sup>cd</sup> |                                         |
| Passband Width <sup>e</sup>                                    |                    |               | −3 dB                 |                                                                                   |                                         |
| <b>Case: Radio Std = 3GPP W-CDMA</b>                           |                    |               |                       | (ACPR; ACLR) <sup>f</sup>                                                         |                                         |
| Minimum power at RF Input                                      |                    |               |                       | −36 dBm (nominal)                                                                 |                                         |
| ACPR Accuracy <sup>g</sup>                                     |                    |               |                       | RRC weighted, 3.84 MHz noise bandwidth, method ≠ RBW                              |                                         |
| <b>Radio</b>                                                   | <b>Offset Freq</b> |               |                       |                                                                                   |                                         |
| MS (UE)                                                        | 5 MHz              |               | ±0.14 dB              | At ACPR range of −30 to −36 dBc with optimum mixer level <sup>h</sup>             |                                         |
| MS (UE)                                                        | 10 MHz             |               | ±0.21 dB              | At ACPR range of −40 to −46 dBc with optimum mixer level <sup>i</sup>             |                                         |
| BTS                                                            | 5 MHz              |               | ±0.49 dB <sup>h</sup> | At ACPR range of −42 to −48 dBc with optimum mixer level <sup>j</sup>             |                                         |
| BTS                                                            | 10 MHz             |               | ±0.44 dB              | At ACPR range of −47 to −53 dBc with optimum mixer level <sup>i</sup>             |                                         |
| BTS                                                            | 5 MHz              |               | ±0.21 dB              | At −48 dBc non-coherent ACPR <sup>k</sup>                                         |                                         |
| <b>Dynamic Range</b>                                           |                    |               |                       | RRC weighted, 3.84 MHz noise bandwidth                                            |                                         |
| <b>Noise Correction</b>                                        | Offset Freq        | <b>Method</b> |                       | <b>ACLR (typical)<sup>l</sup></b>                                                 | <b>Optimum ML<sup>m</sup> (Nominal)</b> |
| Off                                                            | 5 MHz              | Filtered IBW  |                       | −73 dB                                                                            | −8 dBm                                  |
| Off                                                            | 5 MHz              | Fast          |                       | −72 dB                                                                            | −9 dBm                                  |
| Off                                                            | 10 MHz             | Filtered IBW  |                       | −79 dB                                                                            | −2 dBm                                  |
| On                                                             | 5 MHz              | Filtered IBW  |                       | −78 dB                                                                            | −8 dBm                                  |
| On                                                             | 5 MHz              | Filtered IBW  |                       | −78 dB <sup>n</sup>                                                               | −8 dBm                                  |
| On                                                             | 10 MHz             | Filtered IBW  |                       | −82 dB                                                                            | −2 dBm                                  |

| Description                                                                                                    | Specifications | Supplemental Information                                |
|----------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------|
| RRC Weighting Accuracy <sup>o</sup><br>White noise in Adjacent Channel<br>TOI-induced spectrum<br>rms CW error |                | 0.00 dB nominal<br>0.001 dB nominal<br>0.012 dB nominal |

- a. The effect of scale fidelity on the ratio of two powers is called the relative scale fidelity. The scale fidelity specified in the Amplitude section is an absolute scale fidelity with  $-35$  dBm at the input mixer as the reference point. The relative scale fidelity is nominally only  $0.01$  dB larger than the absolute scale fidelity.
- b. See Amplitude Accuracy and Range section.
- c. See Frequency and Time section.
- d. Expressed in decibels.
- e. An ACP measurement measures the power in adjacent channels. The shape of the response versus frequency of those adjacent channels is occasionally critical. One parameter of the shape is its 3 dB bandwidth. When the bandwidth (called the Ref BW) of the adjacent channel is set, it is the 3 dB bandwidth that is set. The passband response is given by the convolution of two functions: a rectangle of width equal to Ref BW and the power response versus frequency of the RBW filter used. Measurements and specifications of analog radio ACPs are often based on defined bandwidths of measuring receivers, and these are defined by their  $-6$  dB widths, not their  $-3$  dB widths. To achieve a passband whose  $-6$  dB width is  $x$ , set the Ref BW to be  $x - 0.572 \times \text{RBW}$ .
- f. Most versions of adjacent channel power measurements use negative numbers, in units of dBc, to refer to the power in an adjacent channel relative to the power in a main channel, in accordance with ITU standards. The standards for W-CDMA analysis include ACLR, a positive number represented in dB units. In order to be consistent with other kinds of ACP measurements, this measurement and its specifications will use negative dBc results, and refer to them as ACPR, instead of positive dB results referred to as ACLR. The ACLR can be determined from the ACPR reported by merely reversing the sign.
- g. The accuracy of the Adjacent Channel Power Ratio will depend on the mixer drive level and whether the distortion products from the analyzer are coherent with those in the UUT. These specifications apply even in the worst case condition of coherent analyzer and UUT distortion products. For ACPR levels other than those in this specifications table, the optimum mixer drive level for accuracy is approximately  $-37$  dBm  $-(\text{ACPR}/3)$ , where the ACPR is given in (negative) decibels.
- h. To meet this specified accuracy when measuring mobile station (MS) or user equipment (UE) within 3 dB of the required  $-33$  dBc ACPR, the mixer level (ML) must be optimized for accuracy. This optimum mixer level is  $-22$  dBm, so the input attenuation must be set as close as possible to the average input power  $-( -22$  dBm). For example, if the average input power is  $-6$  dBm, set the attenuation to 16 dB. This specification applies for the normal 3.5 dB peak-to-average ratio of a single code. Note that, if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.
- i. ACPR accuracy at 10 MHz offset is warranted when the input attenuator is set to give an average mixer level of  $-14$  dBm.
- j. In order to meet this specified accuracy, the mixer level must be optimized for accuracy when measuring node B Base Transmission Station (BTS) within 3 dB of the required  $-45$  dBc ACPR. This optimum mixer level is  $-19$  dBm, so the input attenuation must be set as close as possible to the average input power  $-( -19$  dBm). For example, if the average input power is  $-7$  dBm, set the attenuation to 12 dB. This specification applies for the normal 10 dB peak-to-average ratio (at 0.01% probability) for Test Model 1. Note that, if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.
- k. Accuracy can be excellent even at low ACPR levels assuming that the user sets the mixer level to optimize the dynamic range, and assuming that the analyzer and UUT distortions are incoherent. When the errors from the UUT and the analyzer are incoherent, optimizing dynamic range is equivalent to minimizing the contribution of analyzer noise and distortion to accuracy, though the higher mixer level increases the display scale fidelity errors. This incoherent addition case is commonly used in the industry and can be useful for comparison of analysis equipment, but this incoherent addition model is rarely justified. This derived accuracy specification is based on a mixer level of  $-14$  dBm.

- l. Keysight measures 100% of the signal analyzers for dynamic range in the factory production process. This measurement requires a near-ideal signal, which is impractical for field and customer use. Because field verification is impractical, Keysight only gives a typical result. More than 80% of prototype instruments met this "typical" specification; the factory test line limit is set commensurate with an on-going 80% yield to this typical. The ACPR dynamic range is verified only at 2 GHz, where Keysight has the near-perfect signal available. The dynamic range is specified for the optimum mixer drive level, which is different in different instruments and different conditions. The test signal is a 1 DPCH signal.  
The ACPR dynamic range is the observed range. This typical specification includes no measurement uncertainty.
- m. ML is Mixer Level, which is defined to be the input signal level minus attenuation.
- n. All three production units hand-measured had performance better than 88 dB with a test signal even better than the "near-ideal" one used for statistical process control in production mentioned in the footnote<sup>1</sup> above. Therefore, this value can be considered "Nominal" not "Typical" by the definitions used within this document. These observations were done near 2 GHz because that is a common W-CDMA operating region in which the analyzer third-order dynamic range is near its best.
- o. 3GPP requires the use of a root-raised-cosine filter in evaluating the ACLR of a device. The accuracy of the passband shape of the filter is not specified in standards, nor is any method of evaluating that accuracy. This footnote discusses the performance of the filter in this instrument. The effect of the RRC filter and the effect of the RBW used in the measurement interact. The analyzer compensates the shape of the RRC filter to accommodate the RBW filter. The effectiveness of this compensation is summarized in three ways:
  - White noise in Adj Ch: The compensated RRC filter nominally has no errors if the adjacent channel has a spectrum that is flat across its width.
  - TOI-induced spectrum: If the spectrum is due to third-order intermodulation, it has a distinctive shape. The computed errors of the compensated filter are –0.001 dB for the 100 kHz RBW used for UE testing with the IBW method. It is 0.000 dB for the 27 kHz RBW filter used for BTS testing with the Filtered IBW method. The worst error for RBWs between 27 and 390 kHz is 0.05 dB for a 330 kHz RBW filter.
  - rms CW error: This error is a measure of the error in measuring a CW-like spurious component. It is evaluated by computing the root of the mean of the square of the power error across all frequencies within the adjacent channel. The computed rms error of the compensated filter is 0.012 dB for the 100 kHz RBW used for UE testing with the IBW method. It is 0.000 dB for the 27 kHz RBW filter used for BTS testing. The worst error for RBWs between 27 kHz and 470 kHz is 0.057 dB for a 430 kHz RBW filter.

| Description                                                                                                                                                                                                                                               | Specifications             | Supplemental Information                                                                                                   |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------|----|-----|-------|----|-----|-----|-------|----|----|---------------------------------------------------------------------|----------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------|---------------|---------|---------------|---------|------------|----------------------------|--------|---------|--------|---------|
| <b>Multi-Carrier Adjacent Channel Power</b><br><br><b>Case: Radio Std = 3GPP W-CDMA</b><br><br>ACPR Dynamic Range<br>(5 MHz offset, Two carriers)<br><br>ACPR Accuracy<br>(Two carriers, 5 MHz offset, −48 dBc ACPR)<br><br>ACPR Accuracy<br>(4 carriers) |                            | RF Input 1, RF Preselector Off<br><br>RRC weighted, 3.84 MHz noise bandwidth<br>−70 dB (nominal)<br><br>±0.42 dB (nominal) |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| <table><tr><th>Radio</th><th>Offset</th><th>Coher<sup>a</sup></th><th>NC</th></tr><tr><td>BTS</td><td>5 MHz</td><td>no</td><td>Off</td></tr><tr><td>BTS</td><td>5 MHz</td><td>no</td><td>On</td></tr></table>                                             | Radio                      | Offset                                                                                                                     | Coher <sup>a</sup> | NC | BTS | 5 MHz | no | Off | BTS | 5 MHz | no | On | <table><tr><td>±0.39 dB</td></tr><tr><td>±0.15 dB</td></tr></table> | ±0.39 dB | ±0.15 dB | <table><tr><th>UUT ACPR Range</th><th>MLOpt<sup>b</sup></th></tr><tr><td>−42 to −48 dB</td><td>−18 dBm</td></tr><tr><td>−42 to −48 dB</td><td>−21 dBm</td></tr><tr><th>Nominal DR</th><td>Nominal MLOpt<sup>c</sup></td></tr><tr><td>−64 dB</td><td>−18 dBm</td></tr><tr><td>−72 dB</td><td>−21 dBm</td></tr></table> | UUT ACPR Range | MLOpt <sup>b</sup> | −42 to −48 dB | −18 dBm | −42 to −48 dB | −21 dBm | Nominal DR | Nominal MLOpt <sup>c</sup> | −64 dB | −18 dBm | −72 dB | −21 dBm |
| Radio                                                                                                                                                                                                                                                     | Offset                     | Coher <sup>a</sup>                                                                                                         | NC                 |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| BTS                                                                                                                                                                                                                                                       | 5 MHz                      | no                                                                                                                         | Off                |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| BTS                                                                                                                                                                                                                                                       | 5 MHz                      | no                                                                                                                         | On                 |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| ±0.39 dB                                                                                                                                                                                                                                                  |                            |                                                                                                                            |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| ±0.15 dB                                                                                                                                                                                                                                                  |                            |                                                                                                                            |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| UUT ACPR Range                                                                                                                                                                                                                                            | MLOpt <sup>b</sup>         |                                                                                                                            |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| −42 to −48 dB                                                                                                                                                                                                                                             | −18 dBm                    |                                                                                                                            |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| −42 to −48 dB                                                                                                                                                                                                                                             | −21 dBm                    |                                                                                                                            |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| Nominal DR                                                                                                                                                                                                                                                | Nominal MLOpt <sup>c</sup> |                                                                                                                            |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| −64 dB                                                                                                                                                                                                                                                    | −18 dBm                    |                                                                                                                            |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| −72 dB                                                                                                                                                                                                                                                    | −21 dBm                    |                                                                                                                            |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |
| ACPR Dynamic Range<br>(4 carriers, 5 MHz offset)<br><br>Noise Correction (NC) off<br>Noise Correction (NC) on                                                                                                                                             |                            |                                                                                                                            |                    |    |     |       |    |     |     |       |    |    |                                                                     |          |          |                                                                                                                                                                                                                                                                                                                       |                |                    |               |         |               |         |            |                            |        |         |        |         |

- a. Coher = no means that the specified accuracy only applies when the distortions of the device under test are not coherent with the third-order distortions of the analyzer. Incoherence is often the case with advanced multi-carrier amplifiers built with compensations and predistortions that mostly eliminate coherent third-order effects in the amplifier.
- b. Optimum mixer level (MLOpt). The mixer level is given by the average power of the sum of the four carriers minus the input attenuation.
- c. Optimum mixer level (MLOpt). The mixer level is given by the average power of the sum of the four carriers minus the input attenuation.

| Description                                                           | Specifications | Supplemental Information |
|-----------------------------------------------------------------------|----------------|--------------------------|
| <b>Power Statistics CCDF</b><br><br>Histogram Resolution <sup>a</sup> | 0.01 dB        |                          |

- a. The Complementary Cumulative Distribution Function (CCDF) is a reformatting of a histogram of the power envelope. The width of the amplitude bins used by the histogram is the histogram resolution. The resolution of the CCDF will be the same as the width of those bins.

Keysight PXE EMI Receiver  
Power Suite Measurements (RF Preselector off only)

| Description                                      | Specifications | Supplemental Information                                                                                                                                                   |
|--------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Burst Power</b><br><br>Methods<br><br>Results |                | Power above threshold<br>Power within burst width<br><br>Output power, average<br>Output power, single burst<br>Maximum power<br>Minimum power within burst<br>Burst width |

| Description                                             | Specifications                                                                 | Supplemental Information                         |
|---------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------|
| <b>TOI (Third Order Intermodulation)</b><br><br>Results | Relative IM tone powers (dBc)<br>Absolute tone powers (dBm)<br>Intercept (dBm) | Measures TOI of a signal with two dominant tones |

| Description                                                              | Specifications                                                                                             | Supplemental Information |
|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Harmonic Distortion</b><br><br>Maximum harmonic number<br><br>Results | 10th<br><br>Fundamental Power (dBm)<br>Relative harmonics power (dBc)<br>Total harmonic distortion (% dBc) |                          |

| Description                                  | Specifications | Supplemental Information                                |
|----------------------------------------------|----------------|---------------------------------------------------------|
| <b>Spurious Emissions</b>                    |                | Table-driven spurious signals;<br>search across regions |
| <b>Case: Radio Std = 3GPP W-CDMA</b>         |                |                                                         |
| Dynamic Range <sup>a</sup><br>(1 to 3.6 GHz) | 96.7 dB        | 101.7 dB (typical)                                      |
| Sensitivity, absolute<br>(1 to 3.6 GHz)      | −85.4 dBm      |                                                         |
| Accuracy                                     |                | Attenuation = 10 dB                                     |
| 20 Hz to 3.6 GHz                             |                | ±0.29 dB (95th Percentile)                              |
| 3.5 to 8.4 GHz                               |                | ±1.17 dB (95th Percentile)                              |
| 8.3 to 13.6 GHz                              |                | ±1.54 dB (95th Percentile)                              |

- a. The dynamic range is specified with the mixer level at +3 dBm, where up to 1 dB of compression can occur, degrading accuracy by 1 dB.

| Description                                                  | Specifications | Supplemental Information                                    |
|--------------------------------------------------------------|----------------|-------------------------------------------------------------|
| <b>Spectrum Emission Mask</b>                                |                | Table-driven spurious signals;<br>measurement near carriers |
| <b>Case: Radio Std = cdma2000</b>                            |                |                                                             |
| Dynamic Range, relative<br>(750 kHz offset <sup>ab</sup> )   | 78.9 dB        | 85.0 dB (typical)                                           |
| Sensitivity, absolute<br>(750 kHz offset <sup>c</sup> )      | −100.7 dBm     |                                                             |
| Accuracy<br>(750 kHz offset)                                 |                |                                                             |
| Relative <sup>d</sup>                                        | ±0.12 dB       |                                                             |
| Absolute <sup>e</sup><br>(20 to 30°C)                        | ±0.88 dB       | ±0.27 dB (95th Percentile ≈ 2σ)                             |
| <b>Case: Radio Std = 3GPP W-CDMA</b>                         |                |                                                             |
| Dynamic Range, relative<br>(2.515 MHz offset <sup>ad</sup> ) | 81.9 dB        | 88.2 dB (typical)                                           |
| Sensitivity, absolute<br>(2.515 MHz offset <sup>c</sup> )    | −100.7 dBm     |                                                             |
| Accuracy<br>(2.515 MHz offset)                               |                |                                                             |
| Relative <sup>d</sup>                                        | ±0.12 dB       |                                                             |
| Absolute <sup>e</sup><br>(20 to 30°C)                        | ±0.86 dB       | ±0.27 dB (95th Percentile ≈ 2σ)                             |

- The dynamic range specification is the ratio of the channel power to the power in the offset specified. The dynamic range depends on the measurement settings, such as peak power or integrated power. Dynamic range specifications are based on default measurement settings, with detector set to average, and depend on the mixer level. Default measurement settings include 30 kHz RBW.
- This dynamic range specification applies for the optimum mixer level, which is about −18 dBm. Mixer level is defined to be the average input power minus the input attenuation.
- The sensitivity is specified with 0 dB input attenuation. It represents the noise limitations of the analyzer. It is tested without an input signal. The sensitivity at this offset is specified in the default 30 kHz RBW, at a center frequency of 2 GHz.
- The relative accuracy is a measure of the ratio of the power at the offset to the main channel power. It applies for spectrum emission levels in the offsets that are well above the dynamic range limitation.
- The absolute accuracy of SEM measurement is the same as the absolute accuracy of the spectrum analyzer. See **“Absolute Amplitude Accuracy” on page 34** for more information. The numbers shown are for 0 to 3.6 GHz, with attenuation set to 10 dB.

## Options

The following options and applications affect instrument specifications.

|                                   |                                                        |
|-----------------------------------|--------------------------------------------------------|
| <i>Option 503:</i>                | Frequency range, 1 Hz to 3.6 GHz                       |
| <i>Option 508:</i>                | Frequency range, 1 Hz to 8.4 GHz                       |
| <i>Option 526:</i>                | Frequency range, 1 Hz to 26.5 GHz                      |
| <i>Option 544:</i>                | Frequency range, 1 Hz to 44 GHz                        |
| <i>Option B25:</i>                | Analysis bandwidth, 25 MHz                             |
| <i>Option B40:</i>                | Analysis bandwidth, 40 MHz                             |
| <i>Option C35:</i>                | APC 3.5 mm connector (for Freq <i>Option 526</i> only) |
| <i>Option CR3:</i>                | Connector Rear, 2nd IF output                          |
| <i>Option ESC:</i>                | External Source Control                                |
| <i>Option EXM:</i>                | External Mixing                                        |
| <i>Option P03</i>                 | Preamplifier, 3.6 GHz                                  |
| <i>Option P08:</i>                | Preamplifier, 8.4 GHz                                  |
| <i>Option P26:</i>                | Preamplifier, 26.5 GHz                                 |
| <i>Option P44:</i>                | Preamplifier, 44 GHz                                   |
| <i>Option SF1:</i>                | Security Features, Exclude Launching Programs          |
| <i>Option SF2:</i>                | Security Features, Prohibit Saving Results             |
| <i>Option SS1:</i>                | Additional Removable Solid State Drive, Win 10         |
| <i>Option YAS:</i>                | Y-Axis Screen Video output                             |
| <i>N9048TDSB</i>                  | Standard Time Domain Scan measurement application      |
| <i>N9048WT1B or<br/>N9048WT2B</i> | Accelerated Time Domain Scan measurement               |
| <i>N9063EMOE:</i>                 | Analog Demodulation measurement application            |
| <i>N90EMESCB:</i>                 | External Source Control                                |

## General

| Description              | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| <b>Calibration Cycle</b> | 1 year         |                          |

| Description                                                                                                                                                                                                                 | Specifications                                                                             | Supplemental Information                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Environmental</b><br>Indoor use<br><b>Temperature Range</b><br>Operating<br>Altitude $\leq$ 2,300 m<br>Altitude = 4,600 m<br>Derating <sup>a</sup><br>Storage<br><b>Altitude</b><br><b>Humidity</b><br>Relative humidity | <br><br><br><br>0 to 55°C<br>0 to 47°C<br><br>–40 to +70°C<br>4,600 m (approx 15,000 feet) | <br><br><br><br><br><br><br><br><br><br>Type tested at 95%, +40°C (non-condensing)<br>Maximum Relative Humidity (non-condensing): 95%RH up to 40°C, decreases linearly to 45%RH at 55°C |

a. The maximum operating temperature derates linearly from altitude of 4,600 m to 2,300 m.

| Description          | Specifications | Supplemental Information                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Environmental</b> |                | Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of Storage, Transportation and End-use; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude and power line conditions. Test Methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3. |

| Description                    | Specifications                                                                                     | Supplemental Information |
|--------------------------------|----------------------------------------------------------------------------------------------------|--------------------------|
| <b>Screening Effectiveness</b> | Instrument meets CISPR requirements for Screening Effectiveness with exceptions at $f = f_{input}$ |                          |

| Description                       | Specification | Supplemental Information                                                                                                                                                                                       |
|-----------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Acoustic Noise                    |               | Values given are per ISO 7779 standard in the "Operator Sitting" position                                                                                                                                      |
| Ambient Temperature<br><br>< 40°C |               | Nominally under 55 dBA Sound Pressure. 55 dBA is generally considered suitable for use in quiet office environments.                                                                                           |
| ≥ 40°C                            |               | Nominally under 65 dBA Sound Pressure. 65 dBA is generally considered suitable for use in noisy office environments. (The fan speed, and thus the noise level, increases with increasing ambient temperature.) |

| Description                | Specification    | Supplemental Information                                         |
|----------------------------|------------------|------------------------------------------------------------------|
| <b>Power Requirements</b>  |                  |                                                                  |
| Low Range                  |                  |                                                                  |
| Voltage                    | 100/120 V        |                                                                  |
| Frequency                  | 50, 60 or 400 Hz |                                                                  |
| High Range                 |                  |                                                                  |
| Voltage                    | 220/240 V        |                                                                  |
| Frequency                  | 50 or 60 Hz      |                                                                  |
| Power Consumption, On      | 630 W            | Fully loaded with options                                        |
| Power Consumption, Standby | 20 W             | Standby power is not supplied to frequency reference oscillator. |

| Description                                             | Supplemental Information    |  |
|---------------------------------------------------------|-----------------------------|--|
| <b>Measurement Speed<sup>a</sup></b>                    | Nominal                     |  |
| Local measurement and display update rate <sup>bc</sup> | 10 ms (100/s)               |  |
| Remote measurement and LAN transfer rate <sup>bc</sup>  | 16 ms (62.5/s)              |  |
| Marker Peak Search                                      | 9 ms                        |  |
| Center Frequency Tune and Transfer (RF)                 | 33 ms                       |  |
| Center Frequency Tune and Transfer ( $\mu$ W)           | 63 ms                       |  |
| Measurement/Mode Switching                              | 120 ms                      |  |
| W-CDMA ACLR measurement time                            | See <a href="#">page 65</a> |  |
| Measurement Time vs. Span                               | See <a href="#">page 20</a> |  |

- Sweep Points = 101.
- Factory preset, fixed center frequency, RBW = 1 MHz, 10 MHz < span  $\leq$  600 MHz, stop frequency  $\leq$  3.6 GHz, Auto Align Off, RF Preselector Off.
- Phase Noise Optimization set to Fast Tuning, Display Off, 64 bit REAL, markers Off, single sweep, measured with IBM compatible PC (memory 500 Gb, Windows 7. Intel<sup>®</sup> Core<sup>™</sup> i5-6500 CPU 3.20 GHz), Agilent I/O Libraries Suite Version 16.3.16603.3, one meter GPIB cable, Keysight GPIB Card.

| Description                                  | Specifications    | Supplemental Information                                                                                      |
|----------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------|
| <b>Radio Disturbance Measuring Apparatus</b> | CISPR 16-1-1:2019 | The features in this instrument comply with the performance requirements of this basic standard. <sup>a</sup> |

- Tested in EMI Receiver mode. The use of Noise Floor Extension (NFE) is required to meet the CISPR requirements in Bands B, C and D.

| Description                | Specifications | Supplemental Information            |
|----------------------------|----------------|-------------------------------------|
| <b>Display<sup>a</sup></b> |                |                                     |
| Resolution                 | 1280 × 800     | Capacitive multi-touch screen       |
| Size                       |                | 269 mm (10.6 in) diagonal (nominal) |

- The LCD display is manufactured using high precision technology. However, if a static image is displayed for a lengthy period of time (~2 hours) you might encounter "image sticking" that may last for approximately 2 seconds. This is normal and does not affect the measurement integrity of the product in any way.

Keysight PXE EMI Receiver  
General

| Description         | Specifications | Supplemental Information                             |
|---------------------|----------------|------------------------------------------------------|
| <b>Data Storage</b> |                |                                                      |
| Internal Total      |                | Removable solid state drive (> 160 GB)               |
| Internal User       |                | > 9 GB available on separate partition for user data |

| Description               | Specifications             | Supplemental Information                               |
|---------------------------|----------------------------|--------------------------------------------------------|
| <b>Weight</b>             |                            |                                                        |
| Net                       |                            |                                                        |
| With options ≤ 526        | 24 kg (52 lbs) (nominal)   |                                                        |
| With <i>Option 544</i>    | 27 kg (59.5 lbs) (nominal) |                                                        |
| Shipping                  |                            |                                                        |
| With options ≤ 526        | 36 kg (79 lbs) (nominal)   |                                                        |
| With <i>Option 544</i>    | 39 kg (86 lbs) (nominal)   |                                                        |
| <b>Cabinet Dimensions</b> |                            |                                                        |
| Height                    | 177 mm (7 inches)          | Cabinet dimensions exclude front and rear protrusions. |
| Width                     | 426 mm (16.8 inches)       |                                                        |
| Length                    | 556 mm (21.9 inches)       |                                                        |

## Inputs/Outputs

### Front Panel

| Description               | Specifications                                                                                     | Supplemental Information                                   |
|---------------------------|----------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| <b>RF Input Connector</b> |                                                                                                    |                                                            |
| RF Input 1                | Type-N female (standard)<br>3.5 mm male ( <i>Option C35</i> )<br>2.4 mm male ( <i>Option 544</i> ) | <i>Option C35</i> is only available with <i>Option 526</i> |
| Impedance                 |                                                                                                    | 50 $\Omega$ (nominal)                                      |
| RF Input 2                | Type-N female only                                                                                 |                                                            |
| Impedance                 |                                                                                                    | 50 $\Omega$ (nominal)                                      |

| Description        | Specifications | Supplemental Information                                                                             |
|--------------------|----------------|------------------------------------------------------------------------------------------------------|
| <b>Probe Power</b> |                |                                                                                                      |
| Voltage/Current    |                | +15 Vdc, $\pm 7\%$ at 0 to 150 mA (nominal)<br>–12.6 Vdc, $\pm 10\%$ at 0 to 150 mA (nominal)<br>GND |

| Description                         | Specifications        | Supplemental Information |
|-------------------------------------|-----------------------|--------------------------|
| <b>USB Ports</b>                    |                       |                          |
| Host (3 ports)                      |                       | Compliant with USB 2.0   |
| Connector                           | USB Type "A" (female) |                          |
| Output Current                      |                       |                          |
| Port marked with Lightning Bolt     |                       | 1.2 A (nominal)          |
| Port not marked with Lightning Bolt | 0.5 A                 |                          |

| Description           | Specifications              | Supplemental Information                     |
|-----------------------|-----------------------------|----------------------------------------------|
| <b>Headphone Jack</b> |                             |                                              |
| Connector             | miniature stereo audio jack | 3.5 mm (also known as "1/8 inch")            |
| Output Power          |                             | 90 mW per channel into 16 $\Omega$ (nominal) |

## Rear Panel

| Description          | Specifications                                     | Supplemental Information |
|----------------------|----------------------------------------------------|--------------------------|
| <b>10 MHz Out</b>    |                                                    |                          |
| Connector            | BNC female                                         |                          |
| Impedance            |                                                    | 50 $\Omega$ (nominal)    |
| Output Amplitude     |                                                    | $\geq 0$ dBm (nominal)   |
| Output Configuration | AC coupled, sinusoidal                             |                          |
| Frequency            | 10 MHz $\times$ (1 + frequency reference accuracy) |                          |

| Description                                       | Specifications                                                     | Supplemental Information                                                                                                                                                                                                                                  |
|---------------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ext Ref In</b>                                 |                                                                    |                                                                                                                                                                                                                                                           |
| Connector                                         | BNC female                                                         | Note: Receiver noise sidebands and spurious response performance may be affected by the quality of the external reference used. See footnote <sup>c</sup> in the Phase Noise specifications within the Dynamic Range section on <a href="#">page 62</a> . |
| Impedance                                         |                                                                    | 50 $\Omega$ (nominal)                                                                                                                                                                                                                                     |
| Input Amplitude Range<br>sine wave<br>square wave |                                                                    | –5 to +10 dBm (nominal)<br>0.2 to 1.5 V peak-to-peak (nominal)                                                                                                                                                                                            |
| Input Frequency                                   |                                                                    | 1 to 50 MHz (nominal)<br>(selectable to 1 Hz resolution)                                                                                                                                                                                                  |
| Lock range                                        | $\pm 2 \times 10^{-6}$ of ideal external reference input frequency |                                                                                                                                                                                                                                                           |

| Description | Specifications | Supplemental Information |
|-------------|----------------|--------------------------|
| <b>Sync</b> |                |                          |
| Connector   | BNC female     | Reserved for future use  |

Keysight PXE EMI Receiver  
Inputs/Outputs

| Description                                           | Specifications | Supplemental Information              |
|-------------------------------------------------------|----------------|---------------------------------------|
| <b>Trigger Inputs</b><br>(Trigger 1 In, Trigger 2 In) |                | Either trigger source may be selected |
| Connector                                             | BNC female     |                                       |
| Impedance                                             |                | 10 k $\Omega$ (nominal)               |
| Trigger Level Range                                   | –5 to +5 V     | 1.5 V (TTL) factory preset            |

| Description                                              | Specifications | Supplemental Information |
|----------------------------------------------------------|----------------|--------------------------|
| <b>Trigger Outputs</b><br>(Trigger 1 Out, Trigger 2 Out) |                |                          |
| Connector                                                | BNC female     |                          |
| Impedance                                                |                | 50 $\Omega$ (nominal)    |
| Level                                                    |                | 0 to 5 V (CMOS)          |

| Description                                 | Specifications    | Supplemental Information                                      |
|---------------------------------------------|-------------------|---------------------------------------------------------------|
| <b>Monitor Output 1</b><br>VGA compatible   |                   |                                                               |
| Connector                                   | 15-pin mini D-SUB |                                                               |
| Format                                      |                   | XGA (60 Hz vertical sync rates, non-interlaced)<br>Analog RGB |
| <b>Monitor Output 2</b><br>Mini DisplayPort |                   |                                                               |

| Description       | Specifications | Supplemental Information                                                                                           |
|-------------------|----------------|--------------------------------------------------------------------------------------------------------------------|
| <b>Analog Out</b> |                | Refer to <a href="#">Chapter 10, “Option YAS - Y-Axis Screen Video Output”</a> , on page 179 for more information. |
| Connector         | BNC female     |                                                                                                                    |
| Impedance         |                | <140 $\Omega$ (nominal)                                                                                            |

| Description                              | Specifications   | Supplemental Information |
|------------------------------------------|------------------|--------------------------|
| <b>Noise Source Drive +28 V (Pulsed)</b> |                  |                          |
| Connector                                | BNC female       |                          |
| Output voltage on                        | 28.0 $\pm$ 0.1 V | 60 mA maximum current    |
| Output voltage off                       | < 1.0 V          |                          |

Keysight PXE EMI Receiver  
Inputs/Outputs

| Description                    | Specifications | Supplemental Information                                    |
|--------------------------------|----------------|-------------------------------------------------------------|
| <b>SNS Series Noise Source</b> |                | For use with Keysight Technologies SNS Series noise sources |

| Description            | Specifications        | Supplemental Information |
|------------------------|-----------------------|--------------------------|
| <b>USB Ports</b>       |                       |                          |
| Host, Super Speed      |                       | 2 ports                  |
| Compatibility          | USB 3.0               |                          |
| Connector              | USB Type "A" (female) |                          |
| Output Current         | 0.9 A                 |                          |
| Host, stacked with LAN |                       | 1 port                   |
| Compatibility          | USB 2.0               |                          |
| Connector              | USB Type "A" (female) |                          |
| Output Current         | 0.5 A                 |                          |
| Device                 |                       | 1 port                   |
| Compatibility          | USB 3.0               |                          |
| Connector              | USB Type "B" (female) |                          |

| Description           | Specifications         | Supplemental Information                                          |
|-----------------------|------------------------|-------------------------------------------------------------------|
| <b>GPIB Interface</b> |                        |                                                                   |
| Connector             | IEEE-488 bus connector |                                                                   |
| GPIB Codes            |                        | SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28, DT1, L4, C0 |
| Mode                  |                        | Controller or device                                              |

| Description                 | Specifications  | Supplemental Information |
|-----------------------------|-----------------|--------------------------|
| <b>LAN TCP/IP Interface</b> | RJ45 Ethertwist | 1000 BaseT               |

| Description              | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| <b>Aux I/O Connector</b> | 25-pin D-SUB   |                          |

## Regulatory Information

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010 3rd ed, and 664 respectively.

This product has been designed and tested in accordance with accepted industry standards, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

This product is intended for indoor use.

|                                                                                     |                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven). This product complies with all relevant directives.                                                                              |
| <a href="mailto:ccr.keysight@keysight.com">ccr.keysight@keysight.com</a>            | The Keysight email address is required by EU directives applicable to our product.                                                                                                                                                                                      |
| ICES/NMB-001                                                                        | "This ISM device complies with Canadian ICES-001."<br>"Cet appareil ISM est conforme a la norme NMB du Canada."                                                                                                                                                         |
| ISM 1-B (GRP.1 CLASS B)                                                             | This is a symbol of an Industrial Scientific and Medical Group 1 Class B product. (CISPR 11, Clause 4)                                                                                                                                                                  |
|   | The CSA mark is a registered trademark of the CSA International.                                                                                                                                                                                                        |
|  | The RCM mark is a registered trademark of the Australian Communications and Media Authority.                                                                                                                                                                            |
|  | This symbol indicates separate collection for electrical and electronic equipment mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive 2002/96/EC). |
|  | China RoHS regulations include requirements related to packaging, and require compliance to China standard GB18455-2001.                                                                                                                                                |
|  | This symbol indicates compliance with the China RoHS regulations for paper/fiberboard packaging.                                                                                                                                                                        |
|  | South Korean Certification (KC) mark; includes the marking's identifier code which follows this format:<br>R-R-Kst--ZZZZZZZZZZZZZZ.                                                                                                                                     |

**EMC:** Complies with the essential requirements of the European EMC Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

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

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme a la norme NMB-001 du Canada.

**NOTE**

This is a sensitive measurement apparatus by design and may have some performance loss (up to 25 dB above the Spurious Responses, Residual specification of -100 dBm) when exposed to ambient continuous electromagnetic phenomenon in the range of 80 MHz -2.7 GHz when tested per IEC 61326-1.

**South Korean Class B EMC declaration:**

This equipment is Class B suitable for home electromagnetic environments and is suitable for use in all areas..

|                                                                       |
|-----------------------------------------------------------------------|
| <b>B 급 기기</b><br>(가정용 방송통신기자재)                                        |
| 이 기기는 가정용(B 급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다. |

**SAFETY:** Complies with the essential requirements of the European Low Voltage Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC/EN 61010-1
- Canada: CSA C22.2 No. 61010-1
- USA: UL std no. 61010-1

**Acoustic statement:** (European Machinery Directive)

Acoustic noise emission

LpA <70 dB

Operator position

Normal operation mode per ISO 7779

To find a current **Declaration of Conformity** for a specific Keysight product, go to: <http://www.keysight.com/go/conformity>



## 2 I/Q Analyzer

This chapter contains specifications for the I/Q Analyzer measurement application (Basic Mode).

## Specifications Affected by I/Q Analyzer:

The specifications in this chapter apply for RF Input 1 and RF Preselector off.

| Specification Name                                 | Information                                                                                                                                                                                                             |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of Frequency Display Trace Points (buckets) | Does not apply.                                                                                                                                                                                                         |
| Resolution Bandwidth                               | See <b>“Frequency” on page 87</b> in this chapter.                                                                                                                                                                      |
| Video Bandwidth                                    | Not available.                                                                                                                                                                                                          |
| Clipping-to-Noise Dynamic Range <sup>a</sup>       | See <b>“Clipping-to-Noise Dynamic Range” on page 88</b> in this chapter.                                                                                                                                                |
| Resolution Bandwidth Switching Uncertainty         | Not specified because it is negligible.                                                                                                                                                                                 |
| Available Detectors                                | Does not apply.                                                                                                                                                                                                         |
| Spurious Responses <sup>a</sup>                    | The <b>“Spurious Responses” on page 56</b> of core specifications still apply. Additional bandwidth-option-dependent spurious responses are given in the Analysis Bandwidth chapter for any optional bandwidths in use. |
| IF Amplitude Flatness <sup>a</sup>                 | See <b>“IF Frequency Response” on page 32</b> of the core specifications for the 10 MHz bandwidth. Specifications for wider bandwidths are given in the Analysis Bandwidth chapter for any optional bandwidths in use.  |
| IF Phase Linearity <sup>a</sup>                    | See <b>“IF Phase Linearity” on page 33</b> of the core specifications for the 10 MHz bandwidth. Specifications for wider bandwidths are given in the Analysis Bandwidth chapter for any optional bandwidths in use.     |
| Data Acquisition <sup>a</sup>                      | See <b>“Data Acquisition” on page 89</b> in this chapter for the 10 MHz bandwidth. Specifications for wider bandwidths are given in the Analysis Bandwidth chapter for any optional bandwidths in use.                  |

- a. This specification addresses the performance of the IQ Analyzer using the 10 MHz analysis bandwidth. For IQ Analyzer performance specifications in the optional 25 MHz or 85 MHz analysis bandwidths, see the *Option B25* or *Option B85* chapter.

## Frequency

| Description                                                | Specifications                                                                                                              | Supplemental Information |
|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Frequency Span</b>                                      |                                                                                                                             |                          |
| Standard instrument                                        | 10 Hz to 10 MHz                                                                                                             |                          |
| <i>Option B25</i>                                          | 10 Hz to 25 MHz                                                                                                             |                          |
| <i>Option B40</i>                                          | 10 Hz to 40 MHz                                                                                                             |                          |
| <b>Resolution Bandwidth</b><br>(Spectrum Measurement)      |                                                                                                                             |                          |
| Range                                                      |                                                                                                                             |                          |
| Overall                                                    | 100 mHz to 3 MHz                                                                                                            |                          |
| Span = 1 MHz                                               | 50 Hz to 1 MHz                                                                                                              |                          |
| Span = 10 kHz                                              | 1 Hz to 10 kHz                                                                                                              |                          |
| Span = 100 Hz                                              | 100 mHz to 100 Hz                                                                                                           |                          |
| Window Shapes                                              | Flat Top, Uniform, Hanning, Hamming, Gaussian, Blackman, Blackman-Harris, Kaiser Bessel (K-B 70 dB, K-B 90 dB & K-B 110 dB) |                          |
| <b>Analysis Bandwidth (Span)</b><br>(Waveform Measurement) |                                                                                                                             |                          |
| Standard instrument                                        | 10 Hz to 10 MHz                                                                                                             |                          |
| <i>Option B25</i>                                          | 10 Hz to 25 MHz                                                                                                             |                          |
| <i>Option B40</i>                                          | 10 Hz to 40 MHz                                                                                                             |                          |

## Clipping-to-Noise Dynamic Range

| Description                                                | Specifications                                                | Supplemental Information                   |
|------------------------------------------------------------|---------------------------------------------------------------|--------------------------------------------|
| <b>Clipping-to-Noise Dynamic Range<sup>a</sup></b>         |                                                               | Excluding residuals and spurious responses |
| Clipping Level at Mixer                                    |                                                               | Center frequency $\geq 20$ MHz             |
| IF Gain = Low                                              | –10 dBm                                                       | –8 dBm (nominal)                           |
| IF Gain = High                                             | –20 dBm                                                       | –17.5 dBm (nominal)                        |
| Noise Density at Mixer<br>at center frequency <sup>b</sup> | $(\text{DANL}^c + \text{IFGainEffect}^d) + 2.25 \text{ dB}^e$ | Example <sup>f</sup>                       |

- This specification is defined to be the ratio of the clipping level (also known as “ADC Over Range”) to the noise density. In decibel units, it can be defined as  $\text{clipping\_level [dBm]} - \text{noise\_density [dBm/Hz]}$ ; the result has units of dBfs/Hz (fs is “full scale”).
- The noise density depends on the input frequency. It is lowest for a broad range of input frequencies near the center frequency, and these specifications apply there. The noise density can increase toward the edges of the span. The effect is nominally well under 1 dB.
- The primary determining element in the noise density is the **“Displayed Average Noise Level” on page 48**.
- DANL is specified with the IF Gain set to High, which is the best case for DANL but not for Clipping-to-noise dynamic range. The core specifications **“Displayed Average Noise Level” on page 48**, gives a line entry on the excess noise added by using IF Gain = Low, and a footnote explaining how to combine the IF Gain noise with the DANL.
- DANL is specified for log averaging, not power averaging, and thus is 2.51 dB lower than the true noise density. It is also specified in the narrowest RBW, 1 Hz, which has a noise bandwidth slightly wider than 1 Hz. These two effects together add up to 2.25 B.
- As an example computation, consider this: For the case where  $\text{DANL} = -151 \text{ dBm}$  in 1 Hz, IF Gain is set to low, and the “Additional DANL” is  $-160 \text{ dBm}$ , the total noise density computes to  $-148.2 \text{ dBm/Hz}$  and the Clipping-to-noise ratio for a  $-10 \text{ dBm}$  clipping level is  $-138.2 \text{ dBfs/Hz}$ .

## Data Acquisition

| Description               | Specifications            | Supplemental Information                                                                |
|---------------------------|---------------------------|-----------------------------------------------------------------------------------------|
| <b>Time Record Length</b> | 4,000,000 IQ sample pairs | ≈ 335 ms at 10 MHz span                                                                 |
| <b>Sample Rate</b>        | 100 MSa/s                 | IF Path ≤25 MHz                                                                         |
| <i>Option B40</i>         | 200 MSa/s                 | IF Path = 40 MHz                                                                        |
| <b>IQ Pairs</b>           |                           | Integer submultiples of 15Mpairs/s depending on the span for spans of 8 MHz or narrower |
| <b>ADC Resolution</b>     | 16 Bits                   | IF Path ≤25 MHz                                                                         |
| <i>Option B40</i>         | 12 Bits                   | IF Path = 40 MHz                                                                        |



### 3 Option B25 – 25 MHz Analysis Bandwidth

This chapter contains specifications for the *Option B25*, 25 MHz Analysis Bandwidth, and are unique to this IF Path.

## Specifications Affected by Analysis Bandwidth

The specifications in this chapter apply when the 25 MHz path is in use. In IQ Analyzer, this will occur when the IF Path is set to 25 MHz, whether by Auto selection (depending on Span) or manually.

The specifications in this chapter apply for RF Input 1 and RF Preselector off.

| Specification Name                                                         | Information                                                                                                                                                                           |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IF Frequency Response                                                      | See specifications in this chapter.                                                                                                                                                   |
| IF Phase Linearity                                                         | See specifications in this chapter.                                                                                                                                                   |
| Spurious and Residual Responses                                            | The <b>“Spurious Responses” on page 56</b> still apply. Further, bandwidth-option-dependent spurious responses are contained within this chapter.                                     |
| Displayed Average Noise Level, Third-Order Intermodulation and Phase Noise | The performance of the analyzer will degrade by an unspecified extent when using this bandwidth option. This extent is not substantial enough to justify statistical process control. |

## Other Analysis Bandwidth Specifications

| Description                             |                                     |                                |                | Specifications | Supplemental Information      |
|-----------------------------------------|-------------------------------------|--------------------------------|----------------|----------------|-------------------------------|
| <b>IF Spurious Response<sup>a</sup></b> |                                     |                                |                |                | Preamplifier Off <sup>b</sup> |
| IF Second Harmonic                      |                                     |                                |                |                |                               |
| <b>Apparent Freq</b>                    | <b>Excitation Freq</b>              | <b>Mixer Level<sup>c</sup></b> | <b>IF Gain</b> |                |                               |
| Any on-screen f                         | $(f + f_c + 22.5 \text{ MHz})/2$    | -15 dBm                        | Low            |                | -54 dBc (nominal)             |
|                                         |                                     | -25 dBm                        | High           |                | -54 dBc (nominal)             |
| IF Conversion Image                     |                                     |                                |                |                |                               |
| Apparent Freq                           | Excitation Freq                     | Mixer Level <sup>c</sup>       | IF Gain        |                |                               |
| Any on-screen f                         | $2 \times f_c - f + 45 \text{ MHz}$ | -10 dBm                        | Low            |                | -70 dBc (nominal)             |
|                                         |                                     | -20 dBm                        | High           |                | -70 dBc (nominal)             |

- The level of these spurs is not warranted. The relationship between the spurious response and its excitation is described in order to make it easier for the user to distinguish whether a questionable response is due to these mechanisms. f is the apparent frequency of the spurious signal,  $f_c$  is the measurement center frequency.
- The spurious response specifications only apply with the preamp turned off. When the preamp is turned on, performance is nominally the same as long as the mixer level is interpreted to be Mixer Level = Input Level - Input Attenuation - Preamp Gain.
- Mixer Level = Input Level - Input Attenuation.

Option B25 - 25 MHz Analysis Bandwidth  
Other Analysis Bandwidth Specifications

| Description                                                                                                  |                                   |                       | Specifications                                               | Supplemental Information         |                                  |                            |
|--------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------------|--------------------------------------------------------------|----------------------------------|----------------------------------|----------------------------|
| <b>IF Frequency Response<sup>a</sup></b><br>(Demodulation and FFT response relative to the center frequency) |                                   |                       |                                                              | Modes above 18 GHz <sup>b</sup>  |                                  |                            |
| Freq (GHz)                                                                                                   | Analysis Width <sup>c</sup> (MHz) | Microwave Preselector | Max Error <sup>d</sup> (Exceptions <sup>e</sup> ) Full range | Midwidth Error (95th Percentile) | Slope (dB/MHz) (95th Percentile) | RMS <sup>f</sup> (nominal) |
| ≤3.6                                                                                                         | 10 to ≤25                         | n/a                   | ±0.45 dB                                                     | ±0.12 dB                         | ±0.10                            | 0.051 dB                   |
| 3.6 to 26.5                                                                                                  | 10 to ≤25 <sup>g</sup>            | On                    |                                                              |                                  |                                  | 0.45 dB                    |
| >26.5                                                                                                        | 10 to ≤25                         | On                    |                                                              |                                  |                                  | 0.55 dB                    |

- The IF frequency response includes effects due to RF circuits such as input filters, that are a function of RF frequency, in addition to the IF passband effects.
- Signal frequencies above 18 GHz are prone to additional response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to -0.35 dB amplitude change, with phase errors of nominally up to ±1.2°. The effect of these modes is not included within the Max Error specification. The effect on the RMS is negligible, except to note that the modes make the ratio of worst-case error to RMS error unusually high.
- This column applies to the instantaneous analysis bandwidth in use. In the Spectrum Analyzer Mode, this would be the FFT width.
- The maximum error at an offset (f) from the center of the FFT width is given by the expression  $\pm [\text{Midwidth Error} + (f \times \text{Slope})]$ , but never exceeds  $\pm \text{Max Error}$ . Here the Midwidth Error is the error at the center frequency for the given FFT span. Usually, the span is no larger than the FFT width in which case the center of the FFT width is the center frequency of the analyzer. In the Spectrum Analyzer mode, when the analyzer span is wider than the FFT width, the span is made up of multiple concatenated FFT results, and thus has multiple centers of FFT widths so the f in the equation is the offset from the nearest center. These specifications include the effect of RF frequency response as well as IF frequency response at the worst case center frequency. Performance is nominally three times better at most center frequencies.
- The specification does not apply for frequencies greater than 3.6 MHz from the center in FFT widths of 7.2 to 8 MHz.
- The "RMS" nominal performance is the standard deviation of the response relative to the center frequency, integrated across the span. This performance measure was observed at a center frequency in each harmonic mixing band, which is representative of all center frequencies; it is not the worst case frequency.
- For information on the microwave preselector which affects the passband for frequencies above 3.6 GHz, see **"Microwave Preselector Bandwidth" on page 26**.

Option B25 - 25 MHz Analysis Bandwidth  
Other Analysis Bandwidth Specifications

| Description               |                   |                              | Specifications | Supplemental Information            |                                  |
|---------------------------|-------------------|------------------------------|----------------|-------------------------------------|----------------------------------|
| <b>IF Phase Linearity</b> |                   |                              |                | Deviation from mean phase linearity |                                  |
| <b>Center Freq (GHz)</b>  | <b>Span (MHz)</b> | <b>Microwave Preselector</b> |                | <b>Nominal</b>                      | <b>RMS (nominal)<sup>a</sup></b> |
| ≥0.02, <3.6               | ≤25               | N/A                          |                | ±0.5°                               | 0.2°                             |

- a. The listed performance is the standard deviation of the phase deviation relative to the mean phase deviation from a linear phase condition, where the RMS is computed across the span shown.

| Description                                         |  | Specification | Supplemental Information                                                               |
|-----------------------------------------------------|--|---------------|----------------------------------------------------------------------------------------|
| <b>Full Scale (ADC Clipping)<sup>a</sup></b>        |  |               |                                                                                        |
| Default settings, signal at CF<br>(IF Gain = Low)   |  |               |                                                                                        |
| Band 0                                              |  |               | –8 dBm mixer level <sup>b</sup> (nominal)                                              |
| Band 1 through 4                                    |  |               | –7 dBm mixer level <sup>b</sup> (nominal)                                              |
| High Gain setting, signal at CF<br>(IF Gain = High) |  |               |                                                                                        |
| Band 0                                              |  |               | –19.5 dBm mixer level <sup>b</sup> (nominal), subject to gain limitations <sup>c</sup> |
| Band 1 through 6                                    |  |               | –18.5 dBm mixer level <sup>b</sup> (nominal), subject to gain limitations <sup>c</sup> |
| Effect of signal frequency ≠ CF                     |  |               | up to ±3 dB (nominal)                                                                  |

- a. This table is meant to help predict the full-scale level, defined as the signal level for which ADC overload (clipping) occurs. The prediction is imperfect, but can serve as a starting point for finding that level experimentally. A SCPI command is also available for that purpose.
- b. Mixer level is signal level minus input attenuation.
- c. The available gain to reach the predicted mixer level will vary with center frequency. Combinations of high gains and high frequencies will not achieve the gain required, increasing the full scale level.

## Data Acquisition

| Description                    | Specifications            |                        | Supplemental Information                                                     |
|--------------------------------|---------------------------|------------------------|------------------------------------------------------------------------------|
| <b>Time Record Length</b>      |                           |                        |                                                                              |
| IQ Analyzer                    | 4,999,999 IQ sample pairs |                        | Waveform measurement <sup>a</sup>                                            |
| Advanced Tools                 | <b>Data Packing</b>       |                        | Fast Capture <sup>b</sup>                                                    |
|                                | <b>32-bit</b>             | <b>64-bit</b>          |                                                                              |
| Length (IQ sample pairs)       | 536 MSa ( $2^{29}$ Sa)    | 268 MSa ( $2^{28}$ Sa) | 2 GB total memory                                                            |
| <b>Maximum IQ Capture Time</b> | <b>Data Packing</b>       |                        |                                                                              |
| (Fast Capture)                 | <b>32-bit</b>             | <b>64-bit</b>          | Calculated by: Length of IQ sample pairs/Sample Rate (IQ Pairs) <sup>c</sup> |
| 10 MHz IFBW                    | 42.94 s                   | 21.47 s                |                                                                              |
| 25 MHz IFBW                    | 17.17 s                   | 8.58 s                 |                                                                              |
| <b>Sample Rate (IQ Pairs)</b>  | $1.25 \times \text{IFBW}$ |                        |                                                                              |
| <b>ADC Resolution</b>          | 16 bits                   |                        |                                                                              |

- This can also be accessed with the remote programming command of "read:wav0?".
- This can only be accessed with the remote programming command of "init:fcap" in the IQ Analyzer (Basic) waveform measurement.
- For example, using 32-bit data packing at 10 MHz IF bandwidth (IFBW) the Maximum Capture Time is calculated using the formula: "Max Capture Time = ( $2^{29}$ )/(10 MHz  $\times$  1.25)".

## 4 Option B40 – 40 MHz Analysis Bandwidth

This chapter contains specifications for the *Option B40* 40 MHz Analysis Bandwidth, and are unique to this IF Path.

## Specifications Affected by Analysis Bandwidth

The specifications in this chapter apply when the 40 MHz path is in use. In IQ Analyzer, this will occur when the IF Path is set to 40 MHz, whether by Auto selection (depending on Span) or manually.

| Specification Name                              | Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IF Frequency Response                           | See specifications in this chapter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| IF Phase Linearity                              | See specifications in this chapter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Spurious Responses                              | There are three effects of the use of Option B40 on spurious responses. Most of the warranted elements of the <b>“Spurious Responses” on page 56</b> still apply without changes, but the revised-version of the table on <b>page 56</b> , modified to reflect the effect of Option B40, is shown in its place in this chapter. The image responses part of that table have the same warranted limits, but apply at different frequencies as shown in the table. The "higher order RF spurs" line is slightly degraded. Also, spurious-free dynamic range specifications are given in this chapter, as well as IF Residuals. |
| Displayed Average Noise Level                   | See specifications in this chapter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Third-Order Intermodulation                     | This bandwidth option can create additional TOI products to those that are created by other instrument circuitry. These products do not behave with typical analog third-order behavior, and thus cannot be specified in the same manner. Nominal performance statements are given in this chapter, but they cannot be expected to decrease as the cube of the voltage level of the signals.                                                                                                                                                                                                                                 |
| Phase Noise                                     | The performance of the analyzer will degrade by an unspecified extent when using wideband analysis. This extent is not substantial enough to justify statistical process control.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Absolute Amplitude Accuracy                     | Nominally 0.5 dB degradation from base instrument absolute amplitude accuracy. (Refer to <b>Absolute Amplitude Accuracy on page 34.</b> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Frequency Range Over Which Specifications Apply | Specifications on this bandwidth only apply with center frequencies of 30 MHz and higher.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## Other Analysis Bandwidth Specifications

| Description                                     | Specifications | Supplemental Information     |
|-------------------------------------------------|----------------|------------------------------|
| <b>SFDR (Spurious-Free Dynamic Range)</b>       |                | Test conditions <sup>a</sup> |
| Signal Frequency within $\pm 12$ MHz of center  |                | –80 dBc (nominal)            |
| Signal Frequency anywhere within analysis BW    |                |                              |
| Spurious response within $\pm 18$ MHz of center |                | –79 dBc (nominal)            |
| Response anywhere within analysis BW            |                | –77 dBc (nominal)            |

a. Signal level is –6 dB relative to full scale at the center frequency. See the Full Scale table.

Option B40 – 40 MHz Analysis Bandwidth  
Other Analysis Bandwidth Specifications

| Description                                                                                         |                        | Specifications                 |                 | Supplemental Information                 |                        |
|-----------------------------------------------------------------------------------------------------|------------------------|--------------------------------|-----------------|------------------------------------------|------------------------|
| <b>Spurious Responses: Residual and Image<sup>a</sup></b><br>(see <b>Band Overlaps on page 14</b> ) |                        |                                |                 | Preamp Off <sup>b</sup>                  |                        |
| Residual Responses <sup>c</sup>                                                                     |                        |                                |                 | –100 dBm (nominal)                       |                        |
| Image Responses                                                                                     |                        |                                |                 | <b>Nominal</b>                           |                        |
| <b>Tuned Freq (f)</b>                                                                               | <b>Excitation Freq</b> | <b>Mixer Level<sup>d</sup></b> | <b>Response</b> | <b>Response<br/>RF/<math>\mu</math>W</b> | <b>Response<br/>mW</b> |
| 10 MHz to 3.6 GHz                                                                                   | f+10100 MHz            | –10 dBm                        | –80 dBc         | –120 dBc                                 | –123 dBc               |
| 10 MHz to 3.6 GHz                                                                                   | f+500 MHz              | –10 dBm                        | –80 dBc         | –100 dBc                                 | –101 dBc               |
| 3.5 to 13.6 GHz                                                                                     | f+500 MHz              | –10 dBm                        | –78 dBc         | –86 dBc                                  | –101 dBc               |
| 13.5 to 17.1 GHz                                                                                    | f+500 MHz              | –10 dBm                        | –74 dBc         | –85 dBc                                  | –101 dBc               |
| 17.0 to 22 GHz                                                                                      | f+500 MHz              | –10 dBm                        | –70 dBc         | –81 dBc                                  | –99 dBc                |
| 22 to 26.5 GHz                                                                                      | f+500 MHz              | –10 dBm                        | –68 dBc         | –78 dBc                                  | –94 dBc                |
| 26.4 to 34.5 GHz                                                                                    | f+500 MHz              | –30 dBm                        | –60 dBc         |                                          | –94 dBc                |
| 34.4 to 44 GHz                                                                                      | f+500 MHz              | –30 dBm                        | –57 dBc         |                                          | –84 dBc                |

- Preselector enabled for frequencies >3.6 GHz.
- The spurious response specifications only apply with the preamp turned off. When the preamp is turned on, performance is nominally the same as long as the mixer level is interpreted to be: Mixer Level = Input Level – Input Attenuation – Preamp Gain
- Input terminated, 0 dB input attenuation.
- Mixer Level = Input Level – Input Attenuation. Verify with mixer levels no higher than –12 dBm if necessary to avoid ADC overload.

Option B40 – 40 MHz Analysis Bandwidth  
Other Analysis Bandwidth Specifications

| Description                                                                           | Specifications                 |                                         | Supplemental Information                  |                         |
|---------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------|-------------------------------------------|-------------------------|
| <b>Spurious Responses: Other<sup>a</sup></b><br>(see <b>Band Overlaps</b> on page 14) | <b>Mixer Level<sup>b</sup></b> | <b>Response</b>                         | <b>Response<br/>RF/<math>\mu</math>W</b>  | <b>Response<br/>mmW</b> |
|                                                                                       |                                |                                         | <b>Nominal</b>                            |                         |
| First RF Order <sup>c</sup><br>(f $\geq$ 10 MHz from carrier)                         |                                |                                         |                                           |                         |
| Center Frequency $\leq$ 26.5 GHz                                                      | -10 dBm                        | $-80 \text{ dBc} + 20 \times \log(N^d)$ | -97 dBc                                   | -95 dBc                 |
| Center Frequency $>$ 26.5 GHz                                                         | -30 dBm                        |                                         |                                           | -94 dBc                 |
| Higher RF Order <sup>e</sup><br>(f $\geq$ 10 MHz from carrier)                        |                                |                                         |                                           |                         |
| Center Frequency $\leq$ 26.5 GHz                                                      | -40 dBm                        | $-78 \text{ dBc} + 20 \times \log(N^d)$ | -103 dBc                                  | -97 dBc                 |
| Center Frequency $>$ 26.5 GHz                                                         | -30 dBm                        |                                         |                                           | -95 dBc                 |
| LO-Related Spurious Response<br>(Offset from carrier 200 Hz to 10 MHz)                | -10 dBm                        | $-68 \text{ dBc} + 20 \times \log(N^d)$ |                                           |                         |
| Close-in Sidebands Spurious Response<br>(LO Related, offset $<$ 200 Hz)               |                                |                                         | $-73 \text{ dBc}^f + 20 \times \log(N^d)$ |                         |

- Preselector enabled for frequencies  $>$ 3.6 GHz.
- Mixer Level = Input Level – Input Attenuation. Verify with mixer levels no higher than -12 dBm if necessary to avoid ADC overload.
- With first RF order spurious products, the indicated frequency will change at the same rate as the input, with higher order, the indicated frequency will change at a rate faster than the input.
- N is the LO multiplication factor.
- RBW=100 Hz. With higher RF order spurious responses, the observed frequency will change at a rate faster than the input frequency.
- Nominally -40 dBc under large magnetic (0.38 Gauss rms) or vibrational (0.21 g rms) environmental stimuli.

| Description                  | Specification | Supplemental Information                                     |
|------------------------------|---------------|--------------------------------------------------------------|
| <b>IF Residual Responses</b> |               | Relative to full scale; see the Full Scale table for details |
| Band 0                       |               | -112 dBFS (nominal)                                          |

Option B40 – 40 MHz Analysis Bandwidth  
Other Analysis Bandwidth Specifications

| Description                              |                   |                    | Specifications | Supplemental Information                                                                     |                                  |
|------------------------------------------|-------------------|--------------------|----------------|----------------------------------------------------------------------------------------------|----------------------------------|
| <b>IF Frequency Response<sup>a</sup></b> |                   |                    |                | Relative to center frequency<br>Freq <i>Option 526</i> only: Modes above 18 GHz <sup>b</sup> |                                  |
| <b>Center Freq (GHz)</b>                 | <b>Span (MHz)</b> | <b>Preselector</b> |                | <b>Typical</b>                                                                               | <b>RMS (nominal)<sup>c</sup></b> |
| ≥ 0.03, < 3.6                            | ≤40               | n/a                | ±0.4 dB        | ±0.25 dB                                                                                     | 0.07 dB                          |
| ≥ 3.6, ≤ 26.5                            | ≤40               | On                 |                | See footnote <sup>d</sup>                                                                    |                                  |

- The IF frequency response includes effects due to RF circuits such as input filters, that are a function of RF frequency, in addition to the IF passband effects.
- Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector. Only analyzers with frequency *Option 526* that do not also have input connector *Option C35* will have these modes. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.
- The listed performance is the rms of the amplitude deviation from the mean amplitude response of a span/CF combination. 50% of the combinations of prototype instruments, center frequencies and spans had performance better than the listed values.
- The passband shape will be greatly affected by the preselector. See “**Microwave Preselector Bandwidth**” on page 26.

Option B40 – 40 MHz Analysis Bandwidth  
Other Analysis Bandwidth Specifications

| Description                  |                       |                    | Specifications | Supplemental Information                                               |                                  |
|------------------------------|-----------------------|--------------------|----------------|------------------------------------------------------------------------|----------------------------------|
| <b>IF Phase Linearity</b>    |                       |                    |                | Deviation from mean phase linearity<br>Modes above 18 GHz <sup>a</sup> |                                  |
| <b>Center Freq<br/>(GHz)</b> | <b>Span<br/>(MHz)</b> | <b>Preselector</b> |                | <b>Peak-to-peak<br/>(nominal)</b>                                      | <b>RMS (nominal)<sup>b</sup></b> |
| ≥ 0.02, < 3.6                | 40                    | n/a                |                | 0.5°                                                                   | 0.12°                            |

- a. Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector. Only analyzers with frequency *Option 526* that do not also have input connector *Option C35* will have these modes. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.
- b. The listed performance is the standard deviation of the phase deviation relative to the mean phase deviation from a linear phase condition, where the RMS is computed across the span shown.

Option B40 – 40 MHz Analysis Bandwidth  
Other Analysis Bandwidth Specifications

| Description                                                                                                                                                                                                                                                                                                    | Specification | Supplemental Information                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Full Scale (ADC Clipping)<sup>a</sup></b><br>Default settings, signal at CF<br>(IF Gain = Low; IF Gain Offset = 0 dB)<br>Band 0<br>High Gain setting, signal at CF<br>(IF Gain = High; IF Gain Offset = 0 dB)<br>Band 0<br>IF Gain Offset $\neq$ 0 dB, signal at CF<br>Effect of signal frequency $\neq$ CF |               | <b>Mixer Level (nominal)<sup>b</sup></b><br>–8 dBm<br>Mixer level <sup>b</sup> (nominal), subject to gain limitations <sup>c</sup><br>–18 dBm<br>See formula <sup>d</sup> , subject to gain limitations <sup>c</sup><br>up to $\pm 4$ dB (nominal) |

- This table is meant to help predict the full-scale level, defined as the signal level for which ADC overload (clipping) occurs. The prediction is imperfect, but can serve as a starting point for finding that level experimentally. A SCPI command is also available for that purpose.
- Mixer level is signal level minus input attenuation.
- The available gain to reach the predicted mixer level will vary with center frequency. Combinations of high gains and high frequencies will not achieve the gain required, increasing the full scale level.
- The mixer level for ADC clipping is nominally given by that for the default settings, minus IF Gain Offset, minus 10 dB if IF Gain is set to High.

| Description                                                                                                                                                                         | Specification | Supplemental Information |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------|
| <b>EVM</b><br>(EVM measurement floor for an 802.11g OFDM signal, MCS7, using 89600 VSA software equalization on channel estimation sequence and data, pilot tracking on)<br>2.4 GHz |               | 0.25% (nominal)          |

| Description                                                 | Specifications | Supplemental Information                                                                                                                                                    |
|-------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Third Order Intermodulation Distortion</b><br><br>Band 0 |                | Two tones of equal level<br>1 MHz tone separation<br>Each tone –13 dB relative to full scale (ADC clipping)<br>IF Gain = High<br>IF Gain Offset = 0 dB<br>–85 dBc (nominal) |

Option B40 – 40 MHz Analysis Bandwidth  
Other Analysis Bandwidth Specifications

| Description          |                               | Specifications | Supplemental Information                                              |
|----------------------|-------------------------------|----------------|-----------------------------------------------------------------------|
| <b>Noise Density</b> |                               |                | 0 dB attenuation; center of IF bandwidth <sup>a</sup> , IF Gain = Low |
| <b>Band</b>          | <b>Freq (GHz)<sup>b</sup></b> |                |                                                                       |
| 0                    | 1.80                          | –144 dBm/Hz    |                                                                       |

- The noise level in the IF will change for frequencies away from the center of the IF. Usually, the IF part of the total noise will get worse by nominally up to 3 dB as the edge of the IF bandwidth is approached.
- Specifications apply at the center of each band. IF Noise dominates the system noise, therefore the noise density will not change substantially with center frequency.

| Description                  |  | Specification | Supplemental Information                            |
|------------------------------|--|---------------|-----------------------------------------------------|
| <b>Signal to Noise Ratio</b> |  |               | Ratio of clipping level <sup>a</sup> to noise level |
| Example: 1.8 GHz             |  |               | 136 dBc/Hz, IF Gain = Low, IF Gain Offset = 0 dB    |

- For the clipping level, see the table above, "Full Scale." Note that the clipping level is not a warranted specification, and has particularly high uncertainty at high microwave frequencies.

## Data Acquisition

| Description                    | Specifications            |                        | Supplemental Information                                                     |
|--------------------------------|---------------------------|------------------------|------------------------------------------------------------------------------|
| <b>Time Record Length</b>      |                           |                        |                                                                              |
| IQ Analyzer                    | 4,999,999 IQ sample pairs |                        | Waveform measurement <sup>a</sup>                                            |
| Advanced Tools                 | <b>Data Packing</b>       |                        | Fast Capture <sup>b</sup>                                                    |
|                                | <b>32-bit</b>             | <b>64-bit</b>          |                                                                              |
| Length (IQ sample pairs)       | 536 MSa ( $2^{29}$ Sa)    | 268 MSa ( $2^{28}$ Sa) | 2 GB total memory                                                            |
| <b>Maximum IQ Capture Time</b> | <b>Data Packing</b>       |                        |                                                                              |
| (Fast Capture)                 | <b>32-bit</b>             | <b>64-bit</b>          | Calculated by: Length of IQ sample pairs/Sample Rate (IQ Pairs) <sup>c</sup> |
| 10 MHz IFBW                    | 42.94 s                   | 21.47 s                |                                                                              |
| 25 MHz IFBW                    | 17.17 s                   | 8.58 s                 |                                                                              |
| 40 MHz IFBW                    | 10.73 s                   | 5.36 s                 |                                                                              |
| <b>Sample Rate (IQ Pairs)</b>  | 1.25 × IFBW               |                        |                                                                              |
| <b>ADC Resolution</b>          | 12 bits                   |                        |                                                                              |

- This can also be accessed with the remote programming command of "read:wav0?".
- This can only be accessed with the remote programming command of "init:fcap" in the IQ Analyzer (Basic) waveform measurement.
- For example, using 32-bit data packing at 10 MHz IF bandwidth (IFBW) the Maximum Capture Time is calculated using the formula: "Max Capture Time = ( $2^{29}$ )/(10 MHz × 1.25)".

## 5 Option CR3 – Connector Rear, 2nd IF Output

This chapter contains specifications for *Option CR3*, Connector Rear, 2nd IF Output.

## Specifications Affected by Connector Rear, 2nd IF Output

No other analyzer specifications are affected by the presence or use of this option. New specifications are given in the following page.

## Other Connector Rear, 2nd IF Output Specifications

### Aux IF Out Port

| Description | Specifications | Supplemental Information  |
|-------------|----------------|---------------------------|
| Connector   | SMA female     | Shared with other options |
| Impedance   |                | 50 $\Omega$ (nominal)     |

### Second IF Out

| Description                                       | Specifications | Supplemental Information                                      |
|---------------------------------------------------|----------------|---------------------------------------------------------------|
| <b>Second IF Out</b>                              |                |                                                               |
| Output Center Frequency                           |                |                                                               |
| SA Mode, EMI Receiver Mode                        |                | 322.5 MHz                                                     |
| I/Q Analyzer Mode                                 |                |                                                               |
| IF Path $\leq$ 25 MHz                             |                | 322.5 MHz                                                     |
| Conversion Gain at 2nd IF output center frequency |                | -1 to +4 dB (nominal) plus RF frequency response <sup>a</sup> |
| Bandwidth                                         |                |                                                               |
| Low band                                          |                | Up to 140 MHz (nominal) <sup>b</sup>                          |
| High band                                         |                |                                                               |
| With microwave preselector                        |                | Depends on RF center frequency <sup>c</sup>                   |
| Residual Output Signals                           |                | -94 dBm or lower (nominal)                                    |

- "Conversion Gain" is defined from RF input to IF Output with 0 dB mechanical attenuation and the electronic attenuator off. The nominal performance applies in zero span.
- The passband width at -3 dB nominally extends from IF frequencies of 230 to 370 MHz.
- The YIG-tuned microwave preselector bandwidth nominally varies from 55 MHz for a center frequencies of 3.6 GHz through 57 MHz at 15 GHz to 75 MHz at 26.5 GHz. (Refer to page 23 for details.) The microwave pre-selector effect will dominate the passband width.

Option CR3 - Connector Rear, 2nd IF Output  
Other Connector Rear, 2nd IF Output Specifications

## 6 Option ESC – External Source Control

This chapter contains specifications for the N90EMESCB, External Source Control.

## General Specifications

| Description                               | Specification                                                                                                                                                                                                | Supplemental Information                                                                                                                                                                                                                |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Frequency Range</b>                    |                                                                                                                                                                                                              |                                                                                                                                                                                                                                         |
| SA Operating range                        | 1 Hz to 3.6 GHz<br>1 Hz to 8.4 GHz<br>1 Hz to 26.5 GHz<br>1 Hz to 44 GHz                                                                                                                                     | N9048B-503<br>N9048B-508<br>N9048B-526<br>N9048B-544                                                                                                                                                                                    |
| Source Operating range                    | 9 kHz to 3 GHz<br>9 kHz to 6 GHz<br><br>100 kHz to 3 GHz<br>100 kHz to 6 GHz<br>100 kHz to 20 GHz<br>100 kHz to 31.8 GHz<br>100 kHz to 40 GHz<br><br>9 kHz to 20 GHz<br>9 kHz to 31.8 GHz<br>9 kHz to 40 GHz | N5171B/72B/81B/82B-503<br>N5171B/72B/81B/82B-506<br><br>N5161A/N5162A/N5181A/N5182A-503<br>N5161A/N5162A/N5181A/N5182A-506<br>N5183A-520<br>N5183A-532<br>N5183A-540<br><br>N5173B/N5183B-520<br>N5173B/N5183B-532<br>N5173B/N5183B-540 |
| <b>Span Limitations</b>                   |                                                                                                                                                                                                              |                                                                                                                                                                                                                                         |
| Span limitations due to source range      |                                                                                                                                                                                                              | Limited by the source and SA operating range                                                                                                                                                                                            |
| <b>Offset Sweep</b>                       |                                                                                                                                                                                                              |                                                                                                                                                                                                                                         |
| Sweep offset setting range                |                                                                                                                                                                                                              | Limited by the source and SA operating range                                                                                                                                                                                            |
| Sweep offset setting resolution           | 1 Hz                                                                                                                                                                                                         |                                                                                                                                                                                                                                         |
| <b>Harmonic Sweep</b>                     |                                                                                                                                                                                                              |                                                                                                                                                                                                                                         |
| Harmonic sweep setting range <sup>a</sup> |                                                                                                                                                                                                              |                                                                                                                                                                                                                                         |
| Multiplier numerator                      |                                                                                                                                                                                                              | N = 1 to 1000                                                                                                                                                                                                                           |
| Multiplier denominator                    |                                                                                                                                                                                                              | N = 1 to 1000                                                                                                                                                                                                                           |
| <b>Sweep Direction<sup>b</sup></b>        |                                                                                                                                                                                                              | Normal, Reversed                                                                                                                                                                                                                        |

a. Limited by the frequency range of the source to be controlled.

b. The analyzer always sweeps in a positive direction, but the source may be configured to sweep in the opposite direction. This can be useful for analyzing negative mixing products in a mixer under test, for example.

Option ESC - External Source Control  
General Specifications

| Description                                                                                                      | Specification | Supplemental Information                                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Dynamic Range</b><br><br>(10 MHz to 3 GHz, Input terminated, sample detector, average type = log, 20 to 30°C) |               | Dynamic Range =<br>−10 dBm − DANL − 10 × log (RBW) <sup>a</sup>                                                                                                        |
| <b>SA span</b>                                                                                                   | <b>SA RBW</b> |                                                                                                                                                                        |
| 1 MHz                                                                                                            | 2 kHz         | 105.0 dB                                                                                                                                                               |
| 10 MHz                                                                                                           | 6.8 kHz       | 99.7 dB                                                                                                                                                                |
| 100 MHz                                                                                                          | 20 kHz        | 95.0 dB                                                                                                                                                                |
| 1000 MHz                                                                                                         | 68 kHz        | 89.7 dB                                                                                                                                                                |
| <b>Amplitude Accuracy</b>                                                                                        |               | Multiple contributors <sup>b</sup><br>Linearity <sup>c</sup><br>Source and Analyzer Flatness <sup>d</sup><br>YTF Instability <sup>e</sup><br>VSWR effects <sup>f</sup> |

- The dynamic range is given by this computation:  $-10 \text{ dBm} - \text{DANL} - 10 \times \log(\text{RBW})$  where DANL is the displayed average noise level specification, normalized to 1 Hz RBW, and the RBW used in the measurement is in hertz units. The dynamic range can be increased by reducing the RBW at the expense of increased sweep time.
- The following footnotes discuss the biggest contributors to amplitude accuracy.
- One amplitude accuracy contributor is the linearity with which amplitude levels are detected by the analyzer. This is called "scale fidelity" by most spectrum analyzer users, and "dynamic amplitude accuracy" by most network analyzer users. This small term is documented in the Amplitude section of the Specifications Guide. It is negligibly small in most cases.
- The amplitude accuracy versus frequency in the source and the analyzer can contribute to amplitude errors. This error source is eliminated when using normalization in low band (0 to 3.6 GHz). In high band the gain instability of the YIG-tuned microwave preselector in the analyzer keeps normalization errors nominally in the 0.25 to 0.5 dB range.
- In the worst case, the center frequency of the YIG-tuned microwave preselector can vary enough to cause very substantial errors, much higher than the nominal 0.25 to 0.5 dB nominal errors discussed in the previous footnote. In this case, or as a matter of good practice, the microwave preselector should be centered. See the user's manual for instructions on centering the microwave preselector.
- VSWR interaction effects, caused by RF reflections due to mismatches in impedance, are usually the dominant error source. These reflections can be minimized by using 10 dB or more attenuation in the analyzer, and using well-matched attenuators in the measurement configuration.

Option ESC - External Source Control  
General Specifications

| Description              | Specification | Supplemental Information          |
|--------------------------|---------------|-----------------------------------|
| <b>Power Sweep Range</b> |               | Limited by source amplitude range |

| Description                                                                                             | Specification | Supplemental Information                  |
|---------------------------------------------------------------------------------------------------------|---------------|-------------------------------------------|
| <b>Measurement Time</b><br><br>(RBW setting of the SA determined by the default for <i>Option ESC</i> ) |               | Nominal <sup>a</sup>                      |
|                                                                                                         |               | <b>RF MXG (N5181A/N5182A)<sup>b</sup></b> |
|                                                                                                         | <b>Band 0</b> | <b>Band 1</b>                             |
| 201 Sweep points (default setting)                                                                      | 450 ms        | 1.1 s                                     |
| 601 Sweep points                                                                                        | 1.1 s         | 3.3 s                                     |
|                                                                                                         |               | <b>μW MXG (N5183A)<sup>b</sup></b>        |
|                                                                                                         | <b>Band 0</b> | <b>Band 1</b>                             |
| 201 Sweep points (default setting)                                                                      | 470 ms        | 1.2 s                                     |
| 601 Sweep points                                                                                        | 1.1 s         | 3.9 s                                     |

- a. These measurement times were observed with a span of 100 MHz, RBW of 20 kHz and the point triggering method being set to EXT TRIG1. The measurement times will not change significantly with span when the RBW is automatically selected. If the RBW is decreased, the sweep time increase would be approximately 23.8 times Npoints/RBW.
- b. Based on MXG firmware version A.01.80 and *Option UNZ* installed.

| Description                                         | Specification | Supplemental Information                       |
|-----------------------------------------------------|---------------|------------------------------------------------|
| <b>Supported External Sources<sup>a</sup></b>       |               |                                                |
| Keysight EXG                                        |               | N5171B/72B/73B                                 |
| Keysight MXG                                        |               | N5161A/62A<br>N5181A/82A/83A<br>N5181B/82B/83B |
| IO interface connection between:<br>EXG/MXG and MXE |               | LAN, GPIB, or USB                              |

- a. Firmware revision A.19.50 or later is required for the signal analyzer.

## 7 Option EXM – External Mixing

This chapter contains specifications for the *Option EXM* External Mixing.

## Specifications Affected by External mixing

| Specification Name                                                                                   | Information                                                                                        |
|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| RF-Related Specifications, such as TOI, DANL, SHI, Amplitude Accuracy, and so forth.                 | Specifications do not apply; some related specifications are contained in IF Input in this chapter |
| IF-Related Specifications, such as RBW range, RBW accuracy, RBW switching uncertainty, and so forth. | Specifications unchanged, except IF Frequency Response - see specifications in this chapter.       |
| New specifications:<br>IF Input<br>Mixer Bias<br>LO Output                                           | See specifications in this chapter.                                                                |

## Other External Mixing Specifications

| Description                        | Specifications                                   | Supplemental Information                       |
|------------------------------------|--------------------------------------------------|------------------------------------------------|
| <b>Connection Port EXT MIXER</b>   |                                                  |                                                |
| Connector                          | SMA, female                                      |                                                |
| Impedance                          |                                                  | 50 $\Omega$ (nominal) at IF and LO frequencies |
| Functions                          | Triplexed for Mixer Bias, IF Input and LO output |                                                |
| <b>Mixer Bias</b>                  |                                                  |                                                |
| Bias Current                       |                                                  | Short circuit current                          |
| Range                              | $\pm 10$ mA                                      |                                                |
| Resolution                         | 10 $\mu$ A                                       |                                                |
| Accuracy                           |                                                  | $\pm 20$ $\mu$ A (nominal)                     |
| Output impedance                   |                                                  | 477 $\Omega$ (nominal)                         |
| Bias Voltage                       |                                                  | Open circuit                                   |
| Range                              |                                                  | $\pm 3.7$ V (nominal)                          |
| <b>IF Input</b>                    |                                                  |                                                |
| Maximum Safe Level                 | +7 dBm                                           |                                                |
| Center Frequency                   |                                                  |                                                |
| IF BW $\leq 25$ MHz                | 322.5 MHz                                        | includes swept                                 |
| IF BW = 40 MHz                     | 250.0 MHz                                        |                                                |
| Bandwidth                          |                                                  | Supports all optional IFs                      |
| ADC Clipping Level <sup>a</sup>    |                                                  |                                                |
| IF BW $\leq 25$ MHz                |                                                  | -14.5 $\pm$ 2.0 dBm (nominal)                  |
| IF BW = 40 MHz                     |                                                  | -20 $\pm$ 2.0 dBm (nominal)                    |
| 1 dB Gain Compression <sup>a</sup> |                                                  |                                                |
| IF BW $\leq 25$ MHz                |                                                  | -2 dBm (nominal)                               |
| IF BW = 40 MHz                     |                                                  | -2 dBm (nominal)                               |

Option EXM - External Mixing  
Other External Mixing Specifications

| Description                                  | Specifications |            | Supplemental Information |
|----------------------------------------------|----------------|------------|--------------------------|
| Gain Accuracy <sup>b</sup>                   | 20 to 30°C     | Full Range |                          |
| IF BW ≤25 MHz                                | ±1.2 dB        | ±2.5 dB    |                          |
| Wider IF BW                                  |                |            | ±1.2 dB (nominal)        |
| IF Frequency Response                        |                |            | RMS (nominal)            |
| <b>CF</b>                                    | <b>Width</b>   |            |                          |
| 322.5 MHz                                    | ±12.5 MHz      |            | 0.072 dB                 |
| 250.0 MHz                                    | ±20.0 MHz      |            | 0.109 dB                 |
| Noise Figure<br>(322.5 MHz, swept operation) |                |            | 9 dB (nominal)           |
| VSWR                                         |                |            | 1.3:1 (nominal)          |

- a. These specifications apply at the IF input port. The on-screen and mixer-input levels scale with the conversion loss and corrections values.
- b. The amplitude accuracy of a measurement includes this term and the accuracy with which the settings of corrections model the loss of the external mixer.

| Description                                                     | Specifications    |                   | Supplemental Information    |
|-----------------------------------------------------------------|-------------------|-------------------|-----------------------------|
| <b>LO Output</b>                                                |                   |                   |                             |
| Frequency Range                                                 | 3.75 to 14.1 GHz  |                   |                             |
| Output Power <sup>a</sup>                                       | <b>20 to 30°C</b> | <b>Full Range</b> |                             |
| 3.75 to 8.72 GHz <sup>b</sup>                                   | +15.0 to 18.0 dBm | +13.5 to 19.0 dBm | +16.2 to 16.7 dBm (nominal) |
| 7.8 to 14.1 GHz <sup>c</sup>                                    | +14.0 to 18.5 dBm | Not specified     | +16.4 to 16.7 dBm (nominal) |
| Second Harmonic                                                 |                   |                   | -20 dB (nominal)            |
| Fundamental Feedthrough<br>and Undesired Harmonics <sup>c</sup> |                   |                   | -15 dB (nominal)            |
| VSWR                                                            |                   |                   | < 2.2:1 (nominal)           |

- a. The LO output port power is compatible with Keysight M1970 and 11970 Series mixers except for the 11970K. The power is specified at the connector. Cable loss will affect the power available at the mixer. With non-Keysight mixer units, supplied loss calibration data may be valid only at a specified LO power that may differ from the power available at the mixer. In such cases, additional uncertainties apply.
- b. LO Doubler = Off settings.
- c. LO Doubler = On setting. Fundamental frequency = 3.9 to 7.0 GHz.

## 8 Options P03, P08, P26, P44 – Preamplifiers

This chapter contains specifications for the PXE EMI Receiver *Options P03, P08, P26 and P44* preamplifiers.

## Specifications Affected by Preamp

| Specification Name                                 | Information                                                                                                                                                     |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nominal Dynamic Range vs. Offset Frequency vs. RBW | The graphic from the core specifications does not apply with Preamp On.                                                                                         |
| Measurement Range                                  | The measurement range depends on displayed average noise level (DANL). See <b>“Amplitude Accuracy and Range” on page 27</b> .                                   |
| Gain Compression                                   | See specifications in this chapter.                                                                                                                             |
| DANL with NFE Off                                  | See specifications in this chapter.                                                                                                                             |
| DANL with NFE (Noise Floor Extension)              | See <b>“DANL and Indicated Noise Improvement with Noise Floor Extension” on page 54</b> of the core specifications.                                             |
| Frequency Response                                 | See specifications in this chapter.                                                                                                                             |
| Absolute Amplitude Accuracy                        | See <b>“Absolute Amplitude Accuracy” on page 34</b> of the core specifications.                                                                                 |
| RF Input VSWR                                      | See plot in this chapter.                                                                                                                                       |
| Display Scale Fidelity                             | See <b>Display Scale Fidelity on page 44</b> of the core specifications. Then, adjust the mixer levels given downward by the preamp gain given in this chapter. |
| Second Harmonic Distortion                         | See specifications in this chapter.                                                                                                                             |
| Third Order Intermodulation Distortion             | See specifications in this chapter.                                                                                                                             |
| Other Input Related Spurious                       | See <b>“Spurious Responses” on page 56</b> of the core specifications. Preamp performance is not warranted but is nominally the same as non-preamp performance. |
| Dynamic Range                                      | See plot in this chapter.                                                                                                                                       |
| Gain                                               | See “Preamp” specifications in this chapter.                                                                                                                    |
| Noise Figure                                       | See “Preamp” specifications in this chapter.                                                                                                                    |

## Other Preamp Specification

| Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Specifications | Supplemental Information                                                                                                                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preamplifier Gain</b> ( <i>Options P03, P08, P26, and P44</i> )<br><br><b>RF Preselector Off<sup>a</sup>, Preamp On, LNA Off</b><br>100 kHz to 3.6 GHz<br>3.6 to 26.5 GHz<br>26.5 to 44 GHz<br><br><b>RF Preselector On, Preamp On, LNA Off</b><br>1 to 150 kHz<br>150 kHz to 3.6 GHz<br><br><b>RF Preselector On/Off, Preamp Off, LNA On</b><br>150 kHz to 26.5 GHz<br>26.5 to 44 GHz<br><br><b>RF Preselector On/Off, Preamp On, LNA On</b><br>150 kHz to 3.6 GHz <sup>c</sup><br>3.6 to 26.5 GHz<br>26.5 to 44 GHz |                | <b>Maximum<sup>b</sup></b><br><br>+20 dB (nominal)<br>+28 dB (nominal)<br>+28 dB (nominal)<br><br>+20 dB (nominal)<br>+15 dB (nominal)<br><br>+20 dB (nominal)<br>+16 dB (nominal)<br><br>+20 dB (nominal)<br>+35 dB (nominal)<br>+36 dB (nominal) |

- For best possible sensitivity, the LNA can be turned on together with the Internal Preamp, although when operating both preamps together, the user should note that the TOI (distortion) specifications are impacted.
- Preamplifier Gain is the combined gain from the Preamp and LNA. It directly affects distortion and noise performance, but it also affects the range of levels that are free of final IF overload. The user interface has a designed relationship between input attenuation and reference level to prevent on-screen signal levels from causing final IF overloads. That design is based on the maximum preamplifier gains shown. Actual amplifier gains are modestly lower, by up to nominally 5 dB.
- If both the Preamp and LNA are set to ON by the user and the EMI Receiver is then tuned below 3.6 GHz, the Preamp will automatically be turned off by the instrument firmware.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                                                      |                                                                                   | Specifications                                                                    | Supplemental Information |
|----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------|
| <b>1 dB Gain Compression Point</b>                                                                                               |                                                                                   |                                                                                   |                          |
| <b>(Two-tone)<sup>ab</sup></b>                                                                                                   |                                                                                   |                                                                                   |                          |
| (RF Input1) <sup>c</sup><br>(Options P03, P08, or P26)<br>Maximum power at the amplifier <sup>d</sup> for 1 dB gain compression) |                                                                                   |                                                                                   |                          |
| Option 544 (mmW)                                                                                                                 |                                                                                   |                                                                                   |                          |
| Option 503, 508, or 526 (RF/ $\mu$ W)                                                                                            |                                                                                   |                                                                                   |                          |
| <b>RF Preselector Off, Preamp On, LNA Off</b>                                                                                    |  |  |                          |
| 10 MHz to 3.6 GHz                                                                                                                | X                                                                                 | X                                                                                 | –13 dBm (nominal)        |
| 3.5 to 26.5 GHz                                                                                                                  |                                                                                   |                                                                                   |                          |
| Tone spacing 100 kHz to 20 MHz                                                                                                   | X                                                                                 | X                                                                                 | –23 dBm (nominal)        |
| Tone spacing >70 MHz                                                                                                             | X                                                                                 | X                                                                                 | –16 dBm (nominal)        |
| 26.4 to 44 GHz                                                                                                                   |                                                                                   | X                                                                                 | –30 dBm (nominal)        |
| <b>RF Preselector On, Preamp On, LNA Off</b>                                                                                     |                                                                                   |                                                                                   |                          |
| 9 to 150 kHz                                                                                                                     | X                                                                                 | X                                                                                 | –17 dBm (nominal)        |
| 150 kHz to 10 MHz                                                                                                                | X                                                                                 | X                                                                                 | –11 dBm (nominal)        |
| 10 to 50 MHz                                                                                                                     | X                                                                                 | X                                                                                 | –13 dBm (nominal)        |
| 50 MHz to 3.6 GHz                                                                                                                | X                                                                                 | X                                                                                 | –10 dBm (nominal)        |
| 3.5 to 26.5 GHz                                                                                                                  |                                                                                   |                                                                                   |                          |
| Tone spacing 100 kHz to 20 MHz                                                                                                   | X                                                                                 | X                                                                                 | –23 dBm (nominal)        |
| Tone spacing >70 MHz                                                                                                             | X                                                                                 | X                                                                                 | –16 dBm (nominal)        |
| 26.4 to 44 GHz                                                                                                                   |                                                                                   | X                                                                                 | –30 dBm (nominal)        |
| <b>RF Preselector On/Off, Preamp Off, LNA On</b>                                                                                 |                                                                                   |                                                                                   |                          |
| 30 MHz to 3.6 GHz                                                                                                                | X                                                                                 | X                                                                                 | –16 dBm (nominal)        |
| 3.5 to 26.5 GHz                                                                                                                  |                                                                                   |                                                                                   |                          |
| Tone spacing 100 kHz to 20 MHz                                                                                                   | X                                                                                 | X                                                                                 | –13 dBm (nominal)        |
| Tone spacing >70 MHz                                                                                                             | X                                                                                 | X                                                                                 | –7 dBm (nominal)         |
| 26.4 to 44 GHz                                                                                                                   |                                                                                   | X                                                                                 | –18 dBm (nominal)        |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                     |   |   | Specifications | Supplemental Information |
|-------------------------------------------------|---|---|----------------|--------------------------|
| <b>RF Preselector On/Off, Preamp On, LNA On</b> |   |   |                |                          |
| 30 MHz to 3.6 GHz                               | X | X |                | –16 dBm (nominal)        |
| 3.5 to 26.5 GHz                                 |   |   |                |                          |
| Tone spacing 100 kHz to 20 MHz                  | X | X |                | –30 dBm (nominal)        |
| Tone spacing >70 MHz                            | X | X |                | –26 dBm (nominal)        |
| 26.4 to 44 GHz                                  |   | X |                | –35 dBm (nominal)        |

- Large signals, even at frequencies not shown on the screen, can cause the analyzer to mismeasure on-screen signals because of two-tone gain compression. This specification tells how large an interfering signal must be in order to cause a 1 dB change in an on-screen signal.
- Spectrum Analyzer Mode values are verified at 1 kHz RBW with 100 kHz tone spacing. EMI Receiver Mode values are verified at 1 kHz RBW with 50 MHz tone spacing.
- RF Input 2 operates to 1 GHz. The 1 dB gain compression is nominally 9 dB higher.
- Total power at the amplifier (dBm) = total power at the input (dBm) – input attenuation (dB).

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

[illegible]

- a. Absolute amplitude accuracy is the total of all amplitude measurement errors, and applies over the following subset of settings and conditions:  $1 \text{ Hz} \leq \text{RBW} \leq 1 \text{ MHz}$ ; Input signal  $-10$  to  $-50 \text{ dBm}$ ; Input attenuation  $10 \text{ dB}$ ; span  $< 5 \text{ MHz}$  (nominal additional error for span  $\geq 5 \text{ MHz}$  is  $0.02 \text{ dB}$ ); all settings auto-coupled except Swp  
Time Rules = Accuracy; combinations of low signal level and wide RBW use  $\text{VBW} \leq 30 \text{ kHz}$  to reduce noise. When using FFT sweeps, the signal must be at the center frequency.  
This absolute amplitude accuracy specification includes the sum of the following individual specifications under the conditions listed above: Scale Fidelity, Reference Level Accuracy, Display Scale Switching Uncertainty, Resolution Bandwidth Switching Uncertainty,  $50 \text{ MHz}$  Amplitude Reference Accuracy, and the accuracy with which the instrument aligns its internal gains to the  $50 \text{ MHz}$  Amplitude Reference.
- b. Same settings as footnote a, except that the signal level at the amplifier input is  $-40$  to  $-80 \text{ dBm}$ . Total power at the amplifier (dBm) = total power at the input (dBm) minus input attenuation (dB).
- c. In the EMI Receiver Mode (Discrete Scan), add  $0.10 \text{ dB}$  to the absolute amplitude accuracy specifications.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

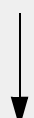
| Description                                                                                                     |   |   | Specifications                                |                   | Supplemental Information        |
|-----------------------------------------------------------------------------------------------------------------|---|---|-----------------------------------------------|-------------------|---------------------------------|
| <b>Absolute Amplitude Accuracy - LNA Off<br/>EMI Receiver Mode: Discrete (Stepped) Scan<br/>With Option WF1</b> |   |   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                   | Modes above 18 GHz <sup>a</sup> |
| (0 dB atten) <sup>b</sup>                                                                                       |   |   |                                               |                   |                                 |
| Option 544 (mmW)                                                                                                |   |   |                                               |                   |                                 |
| Option 503, 508, or 526 (RF/μW)                                                                                 |   |   |                                               |                   |                                 |
| <b>RF Preselector On, Preamp On</b>                                                                             |   |   | <b>20 to 30°C</b>                             | <b>15 to 35°C</b> |                                 |
|                                                                                                                 | ↓ | ↓ |                                               |                   |                                 |
| 1 to 9 kHz                                                                                                      | X | X |                                               |                   | ±0.40 dB (95th percentile)      |
| 9 to 150 kHz                                                                                                    | X | X | ±1.00 dB                                      | ±1.10 dB          |                                 |
| 150 kHz to 10 MHz                                                                                               | X | X | ±1.00 dB                                      | ±1.10 dB          |                                 |
| 10 to 30 MHz                                                                                                    | X | X | ±0.80 dB                                      | ±1.00 dB          |                                 |
| 30 MHz to 1 GHz                                                                                                 | X | X | ±0.60 dB                                      | ±0.70 dB          |                                 |
| 1 to 3.6 GHz <sup>c</sup>                                                                                       | X | X | ±0.70 dB                                      | ±0.80 dB          |                                 |
| 3.6 to 8.4 GHz <sup>de</sup>                                                                                    | X |   | ±1.20 dB                                      | ±1.55 dB          |                                 |
| 3.6 to 5.2 GHz <sup>de</sup>                                                                                    |   | X | ±2.20 dB                                      | ±2.50 dB          |                                 |
| 5.2 to 8.4 GHz <sup>de</sup>                                                                                    |   | X | ±1.60 dB                                      | ±1.70 dB          |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                                   | X |   | ±1.40 dB                                      | ±1.80 dB          |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                                   |   | X | ±1.40 dB                                      | ±1.60 dB          |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                                  | X |   | ±1.60 dB                                      | ±2.00 dB          |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                                  |   | X | ±1.40 dB                                      | ±1.60 dB          |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                                  | X |   | ±2.00 dB                                      | ±2.50 dB          |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                                  |   | X | ±1.80 dB                                      | ±2.00 dB          |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                  | X |   | ±2.25 dB                                      | ±2.80 dB          |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                  |   | X | ±1.90 dB                                      | ±2.20 dB          |                                 |
| 26.5 to 34.5 GHz <sup>de</sup>                                                                                  |   | X | ±2.60 dB                                      | ±2.90 dB          |                                 |
| 34.5 to 40.0 GHz <sup>de</sup>                                                                                  |   | X | ±3.00 dB                                      | ±3.30 dB          |                                 |
| 40.0 to 44.0 GHz <sup>de</sup>                                                                                  |   | X | ±3.40 dB                                      | ±3.70 dB          |                                 |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                    |   |   | Specifications |            | Supplemental Information |
|--------------------------------|---|---|----------------|------------|--------------------------|
| RF Preselector Off, Preamp On  |   |   | 20 to 30°C     | 15 to 35°C |                          |
| 100 kHz to 10 MHz              | X | X | ±1.25 dB       | ±1.30 dB   |                          |
| 10 to 30 MHz                   | X | X | ±1.15 dB       | ±1.20 dB   |                          |
| 30 MHz to 1 GHz                | X | X | ±0.80 dB       | ±0.90 dB   |                          |
| 1 to 3.6 GHz                   | X | X | ±0.80 dB       | ±0.90 dB   |                          |
| 3.6 to 8.4 GHz                 | X |   | ±1.20 dB       | ±1.55 dB   |                          |
| 3.6 to 5.2 GHz <sup>de</sup>   |   | X | ±2.20 dB       | ±2.50 dB   |                          |
| 5.2 to 8.4 GHz <sup>de</sup>   |   | X | ±1.60 dB       | ±1.70 dB   |                          |
| 8.4 to 13.6 GHz <sup>de</sup>  | X |   | ±1.40 dB       | ±1.80 dB   |                          |
| 8.4 to 13.6 GHz <sup>de</sup>  |   | X | ±1.40 dB       | ±1.60 dB   |                          |
| 13.6 to 17.1 GHz <sup>de</sup> | X |   | ±1.60 dB       | ±2.00 dB   |                          |
| 13.6 to 17.1 GHz <sup>de</sup> |   | X | ±1.40 dB       | ±1.60 dB   |                          |
| 17.1 to 22.0 GHz <sup>de</sup> | X |   | ±2.00 dB       | ±2.50 dB   |                          |
| 17.1 to 22.0 GHz <sup>de</sup> |   | X | ±1.80 dB       | ±2.00 dB   |                          |
| 22.0 to 26.5 GHz <sup>de</sup> | X |   | ±2.25 dB       | ±2.80 dB   |                          |
| 22.0 to 26.5 GHz <sup>de</sup> |   | X | ±1.90 dB       | ±2.20 dB   |                          |
| 26.5 to 34.5 GHz <sup>de</sup> |   | X | ±2.60 dB       | ±2.90 dB   |                          |
| 34.5 to 40.0 GHz <sup>de</sup> |   | X | ±3.00 dB       | ±3.30 dB   |                          |
| 40.0 to 44.0 GHz <sup>de</sup> |   | X | ±3.40 dB       | ±3.70 dB   |                          |

- Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.
- Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at 10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
- When the notch filter is selected the specifications between 2.3 GHz – 2.6 GHz is not applicable.
- Specifications for frequencies >3.5 GHz apply for sweep rates ≤ 100 MHz/ms.
- Microwave preselector centering applied.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                                    |                                                                                   |                                                                                   | Specifications                                  |                   | Supplemental Information        |
|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------|-------------------|---------------------------------|
| <b>Absolute Amplitude Accuracy - LNA ON<br/>EMI Receiver Mode: Discrete (Stepped) Scan<br/>With Option WF1</b> |                                                                                   |                                                                                   | RF Input 1: to 26.5 GHz<br>RF Input 2: to 1 GHz |                   | Modes above 18 GHz <sup>a</sup> |
| (0 dB atten) <sup>b</sup>                                                                                      |                                                                                   |                                                                                   |                                                 |                   |                                 |
| Option 544 (mmW)                                                                                               |                                                                                   |                                                                                   |                                                 |                   |                                 |
| Option 503, 508, or 526 (RF/μW)                                                                                |                                                                                   |                                                                                   |                                                 |                   |                                 |
| <b>RF Preselector Off, Preamp Off or On</b>                                                                    |  |  | <b>20 to 30°C</b>                               | <b>15 to 35°C</b> |                                 |
| 30 to 50 MHz                                                                                                   | X                                                                                 | X                                                                                 | ±0.80 dB                                        | ±0.90 dB          |                                 |
| 50 MHz to 1.0 GHz                                                                                              | X                                                                                 | X                                                                                 | ±0.70 dB                                        | ±0.90 dB          |                                 |
| 1.0 GHz to 3.6 GHz                                                                                             | X                                                                                 | X                                                                                 | ±0.70 dB                                        | ±0.90 dB          |                                 |
| <b>RF Preselector On, Preamp Off or On</b>                                                                     |                                                                                   |                                                                                   | <b>20 to 30°C</b>                               | <b>15 to 35°C</b> |                                 |
| 30 MHz to 1GHz                                                                                                 | X                                                                                 | X                                                                                 | ±0.60 dB                                        | ±0.70 dB          |                                 |
| 1.0 GHz to 3.6 GHz <sup>c</sup>                                                                                | X                                                                                 | X                                                                                 | ±0.70 dB                                        | ±1.00 dB          |                                 |
| <b>RF Preselector Off or On, Preamp Off</b>                                                                    |                                                                                   |                                                                                   | <b>20 to 30°C</b>                               | <b>15 to 35°C</b> |                                 |
| 3.6 to 8.4 GHz <sup>de</sup>                                                                                   | X                                                                                 |                                                                                   | ±1.25 dB                                        | ±1.65 dB          |                                 |
| 3.6 to 5.2 GHz <sup>de</sup>                                                                                   |                                                                                   | X                                                                                 | ±2.20 dB                                        | ±2.50 dB          |                                 |
| 5.2 to 8.4 GHz <sup>de</sup>                                                                                   |                                                                                   | X                                                                                 | ±1.80 dB                                        | ±2.00 dB          |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                                  | X                                                                                 |                                                                                   | ±1.50 dB                                        | ±1.95 dB          |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                                  |                                                                                   | X                                                                                 | ±1.50 dB                                        | ±1.70 dB          |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                                 | X                                                                                 |                                                                                   | ±1.60 dB                                        | ±2.00 dB          |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                                 |                                                                                   | X                                                                                 | ±1.50 dB                                        | ±1.70 dB          |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                                 | X                                                                                 |                                                                                   | ±1.90 dB                                        | ±2.50 dB          |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                                 |                                                                                   | X                                                                                 | ±1.90 dB                                        | ±2.10 dB          |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                 | X                                                                                 |                                                                                   | ±2.50 dB                                        | ±3.15 dB          |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                 |                                                                                   | X                                                                                 | ±2.00 dB                                        | ±2.30 dB          |                                 |
| 26.5 to 34.5 GHz <sup>de</sup>                                                                                 |                                                                                   | X                                                                                 | ±2.60 dB                                        | ±2.90 dB          |                                 |
| 34.5 to 40.0 GHz <sup>de</sup>                                                                                 |                                                                                   | X                                                                                 | ±3.00 dB                                        | ±3.30 dB          |                                 |
| 40.0 to 44.0 GHz <sup>de</sup>                                                                                 |                                                                                   | X                                                                                 | ±3.50 dB                                        | ±3.80 dB          |                                 |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                            |   |   | Specifications |            | Supplemental Information |
|----------------------------------------|---|---|----------------|------------|--------------------------|
| RF Preselector Off or On,<br>Preamp On |   |   | 20 to 30°C     | 15 to 35°C |                          |
| 3.6 to 8.4 GHz <sup>de</sup>           | X |   | ±1.35 dB       | ±1.75 dB   |                          |
| 3.6 to 5.2 GHz <sup>de</sup>           |   | X | ±2.20 dB       | ±2.50 dB   |                          |
| 5.2 to 8.4 GHz <sup>de</sup>           |   | X | ±1.80 dB       | ±2.00 dB   |                          |
| 8.4 to 13.6 GHz <sup>de</sup>          | X |   | ±1.50 dB       | ±1.90 dB   |                          |
| 8.4 to 13.6 GHz <sup>de</sup>          |   | X | ±1.50 dB       | ±1.70 dB   |                          |
| 13.6 to 17.1 GHz <sup>de</sup>         | X |   | ±1.70 dB       | ±2.10 dB   |                          |
| 13.6 to 17.1 GHz <sup>de</sup>         |   | X | ±1.50 dB       | ±1.70 dB   |                          |
| 17.1 to 22.0 GHz <sup>de</sup>         | X |   | ±1.90 dB       | ±2.40 dB   |                          |
| 17.1 to 22.0 GHz <sup>de</sup>         |   | X | ±1.90 dB       | ±2.10 dB   |                          |
| 22.0 to 26.5 GHz <sup>de</sup>         | X |   | ±2.50 dB       | ±3.15 dB   |                          |
| 22.0 to 26.5 GHz <sup>de</sup>         |   | X | ±2.00 dB       | ±2.20 dB   |                          |
| 26.5 to 34.5 GHz <sup>de</sup>         |   | X | ±2.70 dB       | ±3.00 dB   |                          |
| 34.5 to 40.0 GHz <sup>de</sup>         |   | X | ±3.10 dB       | ±3.40 dB   |                          |
| 40.0 to 44.0 GHz <sup>de</sup>         |   | X | ±3.50 dB       | ±3.80 dB   |                          |

- Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.
- Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at 10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
- When the notch filter is selected the specifications between 2.3 GHz – 2.6 GHz is not applicable.
- Specifications for frequencies >3.5 GHz apply for sweep rates ≤ 100 MHz/ms.
- Microwave preselector centering applied.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                                                                                             |   |   | Specifications                                |                   | Supplemental Information        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|-----------------------------------------------|-------------------|---------------------------------|
| <b>Absolute Amplitude Accuracy</b><br><b>EMI Receiver Mode: Discrete (Stepped) Scan</b><br><b>LNA OFF</b><br><b>Without Option WF1</b><br><br>(0 dB atten) <sup>b</sup> |   |   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                   | Modes above 18 GHz <sup>a</sup> |
| Option 544 (mmW)                                                                                                                                                        |   |   |                                               |                   |                                 |
| Option 503, 508, or 526 (RF/μW)                                                                                                                                         |   |   |                                               |                   |                                 |
| <b>RF Preselector On, Preamp On</b>                                                                                                                                     | ▼ | ▼ | <b>20 to 30°C</b>                             | <b>15 to 35°C</b> |                                 |
| 1 to 9 kHz                                                                                                                                                              | X | X |                                               |                   | ±0.40 dB (95th percentile)      |
| 9 to 150 kHz                                                                                                                                                            | X | X | ±1.35 dB                                      | ±1.45 dB          |                                 |
| 150 kHz to 10 MHz                                                                                                                                                       | X | X | ±1.35 dB                                      | ±1.45 dB          |                                 |
| 10 to 30 MHz                                                                                                                                                            | X | X | ±1.35 dB                                      | ±1.45 dB          |                                 |
| 30 MHz to 1 GHz                                                                                                                                                         | X | X | ±1.05 dB                                      | ±1.15 dB          |                                 |
| 1 to 3.6 GHz <sup>c</sup>                                                                                                                                               | X | X | ±1.10 dB                                      | ±1.20 dB          |                                 |
| 3.6 to 8.4 GHz <sup>de</sup>                                                                                                                                            | X |   | ±2.15 dB                                      | ±2.35 dB          |                                 |
| 3.6 to 5.2 GHz <sup>de</sup>                                                                                                                                            |   | X | ±2.20 dB                                      | ±2.50 dB          |                                 |
| 5.2 to 8.4 GHz <sup>de</sup>                                                                                                                                            |   | X | ±1.60 dB                                      | ±1.70 dB          |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                                                                                           | X |   | ±2.15 dB                                      | ±2.35 dB          |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                                                                                           |   | X | ±1.40 dB                                      | ±1.60 dB          |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                                                                                          | X |   | ±2.15 dB                                      | ±2.35 dB          |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                                                                                          |   | X | ±1.40 dB                                      | ±1.60 dB          |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                                                                                          | X |   | ±2.45 dB                                      | ±2.50 dB          |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                                                                                          |   | X | ±1.80 dB                                      | ±2.00 dB          |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                                                                          | X |   | ±2.65 dB                                      | ±2.85 dB          |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                                                                          |   | X | ±1.90 dB                                      | ±2.20 dB          |                                 |
| 26.5 to 34.5 GHz <sup>de</sup>                                                                                                                                          |   | X | ±2.60 dB                                      | ±2.90 dB          |                                 |
| 34.5 to 40.0 GHz <sup>de</sup>                                                                                                                                          |   | X | ±3.00 dB                                      | ±3.30 dB          |                                 |
| 40.0 to 44.0 GHz <sup>de</sup>                                                                                                                                          |   | X | ±3.40 dB                                      | ±3.70 dB          |                                 |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                    |   |   | Specifications |            | Supplemental Information |
|--------------------------------|---|---|----------------|------------|--------------------------|
| RF Preselector Off, Preamp On  |   |   | 20 to 30°C     | 15 to 35°C |                          |
| 100 kHz to 10 MHz              | X | X | ±1.25 dB       | ±1.30 dB   |                          |
| 10 to 30 MHz                   | X | X | ±1.15 dB       | ±1.20 dB   |                          |
| 30 MHz to 1 GHz                | X | X | ±1.15 dB       | ±1.20 dB   |                          |
| 1 to 3.6 GHz                   | X | X | ±1.25 dB       | ±1.35 dB   |                          |
| 3.6 to 8.4 GHz                 | X |   | ±2.15 dB       | ±2.35 dB   |                          |
| 3.6 to 5.2 GHz <sup>de</sup>   |   | X | ±2.20 dB       | ±2.50 dB   |                          |
| 5.2 to 8.4 GHz <sup>de</sup>   |   | X | ±1.60 dB       | ±1.70 dB   |                          |
| 8.4 to 13.6 GHz <sup>de</sup>  | X |   | ±2.15 dB       | ±2.35 dB   |                          |
| 8.4 to 13.6 GHz <sup>de</sup>  |   | X | ±1.40 dB       | ±1.60 dB   |                          |
| 13.6 to 17.1 GHz <sup>de</sup> | X |   | ±2.15 dB       | ±2.35 dB   |                          |
| 13.6 to 17.1 GHz <sup>de</sup> |   | X | ±1.40 dB       | ±1.60 dB   |                          |
| 17.1 to 22.0 GHz <sup>de</sup> | X |   | ±2.45 dB       | ±2.50 dB   |                          |
| 17.1 to 22.0 GHz <sup>de</sup> |   | X | ±1.80 dB       | ±2.00 dB   |                          |
| 22.0 to 26.5 GHz <sup>de</sup> | X |   | ±2.65 dB       | ±2.85 dB   |                          |
| 22.0 to 26.5 GHz <sup>de</sup> |   | X | ±1.90 dB       | ±2.20 dB   |                          |
| 26.5 to 34.5 GHz <sup>de</sup> |   | X | ±2.60 dB       | ±2.90 dB   |                          |
| 34.5 to 40.0 GHz <sup>de</sup> |   | X | ±3.00 dB       | ±3.30 dB   |                          |
| 40.0 to 44.0 GHz <sup>de</sup> |   | X | ±3.40 dB       | ±3.70 dB   |                          |

- Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.
- Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at 10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
- When the notch filter is selected the specifications between 2.3 GHz – 2.6 GHz is not applicable.
- Specifications for frequencies >3.5 GHz apply for sweep rates ≤ 100 MHz/ms.
- Microwave preselector centering applied.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                                                                                            |   |   | Specifications                                |                   | Supplemental Information        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|-----------------------------------------------|-------------------|---------------------------------|
| <b>Absolute Amplitude Accuracy</b><br><b>EMI Receiver Mode: Discrete (Stepped) Scan</b><br><b>LNA ON</b><br><b>Without Option WF1</b><br><br>(0 dB atten) <sup>b</sup> |   |   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                   | Modes above 18 GHz <sup>a</sup> |
| Option 544 (mmW)                                                                                                                                                       |   |   |                                               |                   |                                 |
| Option 503, 508, or 526 (RF/μW)                                                                                                                                        |   |   |                                               |                   |                                 |
| <b>RF Preselector Off, Preamp Off or On</b>                                                                                                                            | ↓ | ↓ | <b>20 to 30°C</b>                             | <b>15 to 35°C</b> |                                 |
| 30 to 50 MHz                                                                                                                                                           | X | X | ±1.05 dB                                      | ±1.10 dB          |                                 |
| 50 MHz to 1.0 GHz                                                                                                                                                      | X | X | ±1.05 dB                                      | ±1.10 dB          |                                 |
| 1.0 GHz to 3.6 GHz                                                                                                                                                     | X | X | ±1.15 dB                                      | ±1.25 dB          |                                 |
| <b>RF Preselector On, Preamp Off or On</b>                                                                                                                             |   |   | <b>20 to 30°C</b>                             | <b>15 to 35°C</b> |                                 |
| 30 MHz to 1GHz                                                                                                                                                         | X | X | ±1.05 dB                                      | ±1.15 dB          |                                 |
| 1.0 GHz to 3.6 GHz <sup>c</sup>                                                                                                                                        | X | X | ±1.10 dB                                      | ±1.20 dB          |                                 |
| <b>RF Preselector Off or On, Preamp Off</b>                                                                                                                            |   |   | <b>20 to 30°C</b>                             | <b>15 to 35°C</b> |                                 |
| 3.6 to 8.4 GHz <sup>de</sup>                                                                                                                                           | X |   | ±2.25 dB                                      | ±2.45 dB          |                                 |
| 3.6 to 5.2 GHz <sup>de</sup>                                                                                                                                           |   | X | ±2.20 dB                                      | ±2.50 dB          |                                 |
| 5.2 to 8.4 GHz <sup>de</sup>                                                                                                                                           |   | X | ±1.80 dB                                      | ±2.00 dB          |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                                                                                          | X |   | ±2.25 dB                                      | ±2.45 dB          |                                 |
| 8.4 to 13.6 GHz <sup>de</sup>                                                                                                                                          |   | X | ±1.50 dB                                      | ±1.70 dB          |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                                                                                         | X |   | ±2.25 dB                                      | ±2.45 dB          |                                 |
| 13.6 to 17.1 GHz <sup>de</sup>                                                                                                                                         |   | X | ±1.50 dB                                      | ±1.70 dB          |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                                                                                         | X |   | ±2.45 dB                                      | ±2.50 dB          |                                 |
| 17.1 to 22.0 GHz <sup>de</sup>                                                                                                                                         |   | X | ±1.90 dB                                      | ±2.10 dB          |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                                                                         | X |   | ±2.65 dB                                      | ±2.85 dB          |                                 |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                                                                         |   | X | ±2.00 dB                                      | ±2.30 dB          |                                 |
| 26.5 to 34.5 GHz <sup>de</sup>                                                                                                                                         |   | X | ±2.60 dB                                      | ±2.90 dB          |                                 |
| 34.5 to 40.0 GHz <sup>de</sup>                                                                                                                                         |   | X | ±3.00 dB                                      | ±3.30 dB          |                                 |
| 40.0 to 44.0 GHz <sup>de</sup>                                                                                                                                         |   | X | ±3.50 dB                                      | ±3.80 dB          |                                 |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                         |   |   | Specifications |            | Supplemental Information |
|-------------------------------------|---|---|----------------|------------|--------------------------|
| RF Preselector Off or On, Preamp On |   |   | 20 to 30°C     | 15 to 35°C |                          |
| 3.6 to 8.4 GHz <sup>de</sup>        | X |   | ±2.25 dB       | ±2.45 dB   |                          |
| 3.6 to 5.2 GHz <sup>de</sup>        |   | X | ±2.20 dB       | ±2.50 dB   |                          |
| 5.2 to 8.4 GHz <sup>de</sup>        |   | X | ±1.80 dB       | ±2.00 dB   |                          |
| 8.4 to 13.6 GHz <sup>de</sup>       | X |   | ±2.25 dB       | ±2.45 dB   |                          |
| 8.4 to 13.6 GHz <sup>de</sup>       |   | X | ±1.50 dB       | ±1.70 dB   |                          |
| 13.6 to 17.1 GHz <sup>de</sup>      | X |   | ±2.25 dB       | ±2.45 dB   |                          |
| 13.6 to 17.1 GHz <sup>de</sup>      |   | X | ±1.50 dB       | ±1.70 dB   |                          |
| 17.1 to 22.0 GHz <sup>de</sup>      | X |   | ±2.45 dB       | ±2.50 dB   |                          |
| 17.1 to 22.0 GHz <sup>de</sup>      |   | X | ±1.90 dB       | ±2.10 dB   |                          |
| 22.0 to 26.5 GHz <sup>de</sup>      | X |   | ±2.65 dB       | ±2.85 dB   |                          |
| 22.0 to 26.5 GHz <sup>de</sup>      |   | X | ±2.00 dB       | ±2.20 dB   |                          |
| 26.5 to 34.5 GHz <sup>de</sup>      |   | X | ±2.70 dB       | ±3.00 dB   |                          |
| 34.5 to 40.0 GHz <sup>de</sup>      |   | X | ±3.10 dB       | ±3.40 dB   |                          |
| 40.0 to 44.0 GHz <sup>de</sup>      |   | X | ±3.50 dB       | ±3.80 dB   |                          |

- Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.
- Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at 10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
- When the notch filter is selected the specifications between 2.3 GHz – 2.6 GHz is not applicable.
- Specifications for frequencies >3.5 GHz apply for sweep rates ≤ 100 MHz/ms.
- Microwave preselector centering applied.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                                                                                                                        |   |   | Specifications                                |                  | Supplemental Information                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|-----------------------------------------------|------------------|-----------------------------------------------------------------------------------------------|
| <b>Frequency Response - LNA ON</b>                                                                                                                                                                 |   |   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                  | Refer to the footnote for <b>Band Overlaps on page 14.</b><br>Modes above 18 GHz <sup>a</sup> |
| (Maximum error relative to reference condition (50 MHz)<br>Mechanical attenuator only<br>Non-FFT operation only <sup>b</sup><br>Preamp on LNA off/on: 0 dB atten<br>Preamp off LNA on: 0 dB atten) |   |   |                                               |                  |                                                                                               |
| Option 544 (mmW)                                                                                                                                                                                   |   |   |                                               |                  |                                                                                               |
| Option 503, 508, or 526 (RF/μW)                                                                                                                                                                    |   |   |                                               |                  |                                                                                               |
| <b>RF Preselector Off, Preamp On/Off</b>                                                                                                                                                           | ↓ | ↓ | <b>20 to 30°C</b>                             | <b>0 to 55°C</b> |                                                                                               |
| 30 to 50 MHz                                                                                                                                                                                       | X | X | ±0.50 dB                                      | ±0.70 dB         |                                                                                               |
| 50 to 1 GHz <sup>c</sup>                                                                                                                                                                           | X | X | ±0.50 dB                                      | ±0.70 dB         |                                                                                               |
| 1 to 3.6 GHz <sup>c</sup>                                                                                                                                                                          | X | X | ±0.60 dB                                      | ±1.00 dB         |                                                                                               |
| <b>RF Preselector On, Preamp On/Off</b>                                                                                                                                                            |   |   |                                               |                  |                                                                                               |
| 10 to 30 MHz <sup>c</sup>                                                                                                                                                                          | X | X |                                               |                  |                                                                                               |
| 30 MHz to 1 GHz <sup>c</sup>                                                                                                                                                                       | X | X | ±0.50 dB                                      | ±0.70 dB         |                                                                                               |
| 1 to 3.6 GHz <sup>cd</sup>                                                                                                                                                                         | X | X | ±0.60 dB                                      | ±0.80 dB         |                                                                                               |
| <b>RF Preselector On/Off, Preamp Off</b>                                                                                                                                                           |   |   |                                               |                  |                                                                                               |
| 3.5 to 8.4 GHz <sup>ef</sup>                                                                                                                                                                       | X |   | ±1.60 dB                                      | ±2.50 dB         |                                                                                               |
| 3.5 to 5.2 GHz <sup>ef</sup>                                                                                                                                                                       |   | X | ±1.70 dB                                      | ±3.00 dB         |                                                                                               |
| 5.2 to 8.4 GHz <sup>ef</sup>                                                                                                                                                                       |   | X | ±1.30 dB                                      | ±2.10 dB         |                                                                                               |
| 8.3 to 13.6 GHz <sup>ef</sup>                                                                                                                                                                      | X |   | ±1.60 dB                                      | ±2.50 dB         |                                                                                               |
| 8.3 to 13.6 GHz <sup>ef</sup>                                                                                                                                                                      |   | X | ±1.30 dB                                      | ±2.10 dB         |                                                                                               |
| 13.5 to 16.0 GHz <sup>ef</sup>                                                                                                                                                                     | X |   | ±1.60 dB                                      | ±2.50 dB         |                                                                                               |
| 16.0 to 17.1 GHz <sup>ef</sup>                                                                                                                                                                     | X |   | ±1.80 dB                                      | ±4.00 dB         |                                                                                               |
| 13.5 to 17.1 GHz <sup>ef</sup>                                                                                                                                                                     |   | X | ±1.30 dB                                      | ±2.10 dB         |                                                                                               |
| 17.0 to 22.0 GHz <sup>ef</sup>                                                                                                                                                                     | X |   | ±1.90 dB                                      | ±2.90 dB         |                                                                                               |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                      |   |   | Specifications |                         | Supplemental Information |
|----------------------------------|---|---|----------------|-------------------------|--------------------------|
| 17.0 to 22.0 GHz <sup>ef</sup>   | X | X | ±1.50 dB       | ±2.50 dB                | ±0.55 dB                 |
| 22.0 to 26.5 GHz <sup>ef</sup>   |   |   | ±1.90 dB       | ±2.90 dB                | ±0.95 dB                 |
| 22.0 to 26.5 GHz <sup>ef</sup>   |   | X | ±1.50 dB       | ±2.50 dB                | ±0.55 dB                 |
| 26.4 to 34.5 GHz <sup>ef</sup>   |   | X | ±2.00 dB       | ±3.40 dB                | ±0.70 dB                 |
| 34.4 to 40 GHz <sup>ef</sup>     |   | X | ±2.50 dB       | ±4.20 dB                | ±1.10 dB                 |
| 40 to 44 GHz <sup>ef</sup>       |   | X | ±2.90 dB       | ±5.20 dB                | ±1.30 dB                 |
| RF Preselector On/Off, Preamp On |   |   |                | 20 to 30°C    0 to 55°C | 95th Percentile (≈2σ)    |
| 3.5 to 8.4 GHz <sup>ef</sup>     | X |   | ±1.60 dB       | ±2.40 dB                | ±0.75 dB                 |
| 3.5 to 5.2 GHz <sup>ef</sup>     |   | X | ±1.70 dB       | ±3.00 dB                | ±0.65 dB                 |
| 5.2 to 8.4 GHz <sup>ef</sup>     |   | X | ±1.30 dB       | ±2.10 dB                | ±0.50 dB                 |
| 8.3 to 13.6 GHz <sup>ef</sup>    | X |   | ±1.60 dB       | ±2.40 dB                | ±0.75 dB                 |
| 8.3 to 13.6 GHz <sup>ef</sup>    |   | X | ±1.30 dB       | ±2.10 dB                | ±0.50 dB                 |
| 13.5 to 16.0 GHz <sup>ef</sup>   | X |   | ±1.60 dB       | ±2.40 dB                | ±1.02 dB                 |
| 16.0 to 17.1 GHz <sup>ef</sup>   | X |   | ±1.60 dB       | ±3.30 dB                | ±1.28 dB                 |
| 13.5 to 17.1 GHz <sup>ef</sup>   |   | X | ±1.30 dB       | ±2.10 dB                | ±0.50 dB                 |
| 17.0 to 22.0 GHz <sup>ef</sup>   | X |   | ±1.80 dB       | ±2.80 dB                | ±0.95 dB                 |
| 17.0 to 22.0 GHz <sup>ef</sup>   |   | X | ±1.50 dB       | ±2.50 dB                | ±0.55 dB                 |
| 22.0 to 26.5 GHz <sup>ef</sup>   | X |   | ±2.00 dB       | ±3.20 dB                | ±0.95 dB                 |
| 22.0 to 26.5 GHz <sup>ef</sup>   |   | X | ±1.50 dB       | ±2.50 dB                | ±0.55 dB                 |
| 26.4 to 34.5 GHz <sup>ef</sup>   |   | X | ±2.00 dB       | ±3.40 dB                | ±0.70 dB                 |
| 34.4 to 40 GHz <sup>ef</sup>     |   | X | ±2.60 dB       | ±4.70 dB                | ±1.20 dB                 |
| 40 to 44 GHz <sup>ef</sup>       |   | X | ±3.00 dB       | ±5.40 dB                | ±1.30 dB                 |

- a. Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

- b. For FFT based measurements, Frequency Response errors are more complicated. One case is where the input signal is at the center frequency of the FFT measurement. In this case, the Frequency Response errors are given by this table. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with the Frequency Response from this table. The other case is when the input signal is not at the center frequency of the FFT measurement. In this case, the total frequency response error is computed by adding the RF flatness errors of this table to the IF Frequency Response. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with this total frequency response error. An additional error source, the relative error in switching between swept and FFT-based measurements, is nominally  $\pm 0.01$  dB. The effect of this relative error on absolute measurements is included with the "Absolute Amplitude Accuracy" specifications.
- c. Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at 10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
- d. When the notch filter is selected, the specifications between 2.3 to 2.6 GHz is not applicable.
- e. Specification for frequencies  $> 3.5$  GHz apply for sweep rates  $\leq 100$  MHz/ms.
- f. Microwave preselector centering applied.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                                                                                                                        |   |   | Specifications                                |                  | Supplemental Information                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|-----------------------------------------------|------------------|-----------------------------------------------------------------------------------------------|
| <b>Frequency Response - LNA OFF</b>                                                                                                                                                                |   |   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                  | Refer to the footnote for <b>Band Overlaps on page 14.</b><br>Modes above 18 GHz <sup>a</sup> |
| (Maximum error relative to reference condition (50 MHz)<br>Mechanical attenuator only<br>Non-FFT operation only <sup>b</sup><br>Preamp on LNA off/on: 0 dB atten<br>Preamp off LNA on: 0 dB atten) |   |   |                                               |                  |                                                                                               |
| Option 544 (mmW)                                                                                                                                                                                   |   |   |                                               |                  |                                                                                               |
| Option 503, 508, or 526 (RF/μW)                                                                                                                                                                    |   |   |                                               |                  |                                                                                               |
| <b>RF Preselector Off</b>                                                                                                                                                                          | ↓ | ↓ | <b>20 to 30°C</b>                             | <b>0 to 55°C</b> | <b>95th Percentile (≈2σ)</b>                                                                  |
| 100 kHz to 10 MHz <sup>c</sup>                                                                                                                                                                     | X | X | ±0.70 dB                                      | ±0.80 dB         | ±0.36 dB                                                                                      |
| 10 to 50 MHz <sup>c</sup>                                                                                                                                                                          | X | X | ±0.60 dB                                      | ±0.70 dB         | ±0.25 dB                                                                                      |
| 50 to 1 GHz <sup>c</sup>                                                                                                                                                                           | X | X | ±0.60 dB                                      | ±0.70 dB         | ±0.25 dB                                                                                      |
| 1 to 3.6 GHz                                                                                                                                                                                       | X | X | ±0.70 dB                                      | ±1.00 dB         | ±0.30 dB                                                                                      |
| 3.5 to 8.4 GHz <sup>de</sup>                                                                                                                                                                       | X |   | ±1.50 dB                                      | ±2.40 dB         | ±0.75 dB                                                                                      |
| 3.5 to 5.2 GHz <sup>de</sup>                                                                                                                                                                       |   | X | ±1.70 dB                                      | ±3.00 dB         | ±0.65 dB                                                                                      |
| 5.2 to 8.4 GHz <sup>de</sup>                                                                                                                                                                       |   | X | ±1.20 dB                                      | ±2.00 dB         | ±0.50 dB                                                                                      |
| 8.3 to 13.6 GHz <sup>de</sup>                                                                                                                                                                      | X |   | ±1.50 dB                                      | ±2.40 dB         | ±0.75 dB                                                                                      |
| 8.3 to 13.6 GHz <sup>de</sup>                                                                                                                                                                      |   | X | ±1.20 dB                                      | ±2.00 dB         | ±0.50 dB                                                                                      |
| 13.5 to 16.0 GHz <sup>de</sup>                                                                                                                                                                     | X |   | ±1.50 dB                                      | ±2.40 dB         | ±1.02 dB                                                                                      |
| 16.0 to 17.1 GHz <sup>de</sup>                                                                                                                                                                     | X |   | ±1.50 dB                                      | ±3.20 dB         | ±1.21 dB                                                                                      |
| 13.5 to 17.1 GHz <sup>de</sup>                                                                                                                                                                     |   | X | ±1.20 dB                                      | ±2.00 dB         | ±0.50 dB                                                                                      |
| 17.0 to 22 GHz <sup>de</sup>                                                                                                                                                                       | X |   | ±1.80 dB                                      | ±2.80 dB         | ±0.95 dB                                                                                      |
| 17.0 to 22.0 GHz <sup>de</sup>                                                                                                                                                                     |   | X | ±1.40 dB                                      | ±2.30 dB         | ±0.50 dB                                                                                      |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                                                                                                     | X |   | ±2.00 dB                                      | ±3.20 dB         | ±0.95 dB                                                                                      |
| 22.0 to 26.5 GHz <sup>de</sup>                                                                                                                                                                     |   | X | ±1.40 dB                                      | ±2.30 dB         | ±0.50dB                                                                                       |
| 26.4 to 34.5 GHz <sup>de</sup>                                                                                                                                                                     |   | X | ±2.00 dB                                      | ±3.40 dB         | ±0.70 dB                                                                                      |
| 34.4 to 40 GHz <sup>de</sup>                                                                                                                                                                       |   | X | ±2.50 dB                                      | ±4.20 dB         | ±1.10 dB                                                                                      |
| 40 to 44 GHz <sup>de</sup>                                                                                                                                                                         |   | X | ±2.80 dB                                      | ±5.00 dB         | ±1.30 dB                                                                                      |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                    |   |   | Specifications |           | Supplemental Information              |
|--------------------------------|---|---|----------------|-----------|---------------------------------------|
| RF Preselector On              |   |   | 20 to 30°C     | 0 to 55°C | 95th Percentile ( $\approx 2\sigma$ ) |
| 1 to 9 kHz <sup>c</sup>        | X | X | ±0.50 dB       | ±0.60 dB  | ±0.20 dB                              |
| 9 kHz to 10 MHz <sup>c</sup>   | X | X | ±0.80 dB       | ±1.00 dB  | ±0.31 dB                              |
| 10 to 30 MHz <sup>c</sup>      | X | X | ±0.80 dB       | ±0.90 dB  | ±0.32 dB                              |
| 30 MHz to 1 GHz                | X | X | ±0.50 dB       | ±0.70 dB  | ±0.23 dB                              |
| 1 to 3.6 GHz <sup>f</sup>      | X | X | ±0.60 dB       | ±0.90 dB  | ±0.23 dB                              |
| 3.5 to 8.4 GHz <sup>de</sup>   | X |   | ±1.50 dB       | ±2.40 dB  | ±0.75 dB                              |
| 3.5 to 5.2 GHz <sup>de</sup>   |   | X | ±1.70 dB       | ±3.00 dB  | ±0.65 dB                              |
| 5.2 to 8.4 GHz <sup>de</sup>   |   | X | ±1.20 dB       | ±2.00 dB  | ±0.50 dB                              |
| 8.3 to 13.6 GHz <sup>de</sup>  | X |   | ±1.50 dB       | ±2.40 dB  | ±0.75 dB                              |
| 8.3 to 13.6 GHz <sup>de</sup>  |   | X | ±1.20 dB       | ±2.00 dB  | ±0.50 dB                              |
| 13.5 to 16.0 GHz <sup>de</sup> | X |   | ±1.50 dB       | ±2.40 dB  | ±1.02 dB                              |
| 16.0 to 17.1 GHz <sup>de</sup> | X |   | ±1.50 dB       | ±3.20 dB  | ±1.21 dB                              |
| 13.5 to 17.1 GHz <sup>de</sup> |   | X | ±1.20 dB       | ±2.00 dB  | ±0.50 dB                              |
| 17.0 to 22 GHz <sup>de</sup>   | X |   | ±1.80 dB       | ±2.80 dB  | ±0.95 dB                              |
| 17.0 to 22.0 GHz <sup>de</sup> |   | X | ±1.40 dB       | ±2.30 dB  | ±0.50 dB                              |
| 22.0 to 26.5 GHz <sup>de</sup> | X |   | ±2.00 dB       | ±3.20 dB  | ±0.95 dB                              |
| 22.0 to 26.5 GHz <sup>de</sup> |   | X | ±1.40 dB       | ±2.30 dB  | ±0.50 dB                              |
| 26.4 to 34.5 GHz <sup>de</sup> |   | X | ±2.00 dB       | ±3.40 dB  | ±0.70 dB                              |
| 34.4 to 40 GHz <sup>de</sup>   |   | X | ±2.50 dB       | ±4.20 dB  | ±1.10 dB                              |
| 40 to 44 GHz <sup>de</sup>     |   | X | ±2.80 dB       | ±5.00 dB  | ±1.30 dB                              |

a. Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

- b. For FFT based measurements, Frequency Response errors are more complicated. One case is where the input signal is at the center frequency of the FFT measurement. In this case, the Frequency Response errors are given by this table. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with the Frequency Response from this table. The other case is when the input signal is not at the center frequency of the FFT measurement. In this case, the total frequency response error is computed by adding the RF flatness errors of this table to the IF Frequency Response. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with this total frequency response error. An additional error source, the relative error in switching between swept and FFT-based measurements, is nominally  $\pm 0.01$  dB. The effect of this relative error on absolute measurements is included with the "Absolute Amplitude Accuracy" specifications.
- c. Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at 10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
- d. Specification for frequencies > 3.5 GHz apply for sweep rates  $\leq 100$  MHz/ms.
- e. Microwave preselector centering applied.
- f. When the notch filter is selected, the specifications between 2.3 to 2.6 GHz is not applicable.

| Description                                        | Specifications           |                                | Supplemental Information       |
|----------------------------------------------------|--------------------------|--------------------------------|--------------------------------|
| <b>RF Input VSWR<sup>a</sup> - Preselector Off</b> | RF Input 1: to 44 GHz    |                                |                                |
| at tuned frequency                                 | RF Input 2: to 1 GHz     |                                |                                |
| 10 dB Atten, 50 MHz                                |                          |                                | 1.07:1 (nominal)               |
| <b>Preamp On</b>                                   | <b>Input Attenuation</b> |                                | <b>Typical</b>                 |
|                                                    | <b>0 dB</b>              | <b><math>\geq 10</math> dB</b> |                                |
| DC Coupled                                         |                          |                                | $\geq 10$ dB Input Attenuation |
| 9 kHz to 1 GHz                                     | ---                      | ---                            |                                |
| 1 to 18 GHz                                        | 3.0:1                    | 2.0:1                          | 1.8:1                          |
| 18 to 26.5 GHz <sup>b</sup>                        | 3.0:1                    | 2.0:1                          | 1.8:1                          |
| 26.5 to 40 GHz                                     | 3.0:1                    | 2.5:1                          | 1.8:1                          |
| 40 to 44 GHz                                       |                          |                                | 2.0:1                          |
| AC Coupled ( <i>Option 503, 508, 526</i> )         |                          |                                |                                |
| 55 MHz to 1 GHz                                    | ---                      | ---                            |                                |
| 1 to 18 GHz                                        | 3.0:1                    | 2.0:1                          | 1.8:1                          |
| 18 to 26.5 GHz <sup>b</sup>                        | 3.0:1                    | 2.4:1                          | 2.0:1                          |
| <b>Preamp Off, LNA On</b>                          | <b>Input Attenuation</b> |                                |                                |
|                                                    | <b>0 dB</b>              | <b><math>\geq 10</math> dB</b> |                                |
| DC Coupled                                         |                          |                                |                                |
| 50 MHz to 1 GHz                                    | ---                      | ---                            |                                |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                               | Specifications    |                | Supplemental Information  |
|-------------------------------------------|-------------------|----------------|---------------------------|
| 1 to 18 GHz                               | 3.0:1             | 2.0:1          | 1.8:1                     |
| 18 to 26.5 GHz <sup>b</sup>               | 3.0:1             | 2.0:1          | 1.8:1                     |
| 26.5 to 40 GHz                            | 3.0:1             | 2.5:1          | 1.8:1                     |
| 40 to 44 GHz                              |                   |                | 2.0:1                     |
| AC Coupled ( <i>Option 503, 508,526</i> ) |                   |                |                           |
| 55 MHz to 1 GHz                           | ---               | ---            |                           |
| 1 to 18 GHz                               | 3.0:1             | 2.0:1          | 1.8:1                     |
| 18 to 26.5 GHz <sup>b</sup>               | 3.0:1             | 2.4:1          | 2.0:1                     |
| <b>Preamp On, LNA On</b>                  | Input Attenuation |                | Typical                   |
|                                           | <b>0 dB</b>       | <b>≥ 10 dB</b> |                           |
| DC Coupled                                |                   |                | ≥ 10 dB Input Attenuation |
| 50 MHz to 1 GHz                           | ---               | ---            |                           |
| 1 to 18 GHz                               | 3.0:1             | 2.0:1          | 1.8:1                     |
| 18 to 26.5 GHz <sup>b</sup>               | 3.0:1             | 2.0:1          | 1.8:1                     |
| 26.5 to 40 GHz                            | 3.0:1             | 2.5:1          | 1.8:1                     |
| 40 to 44 GHz                              |                   |                | 2.0:1                     |
| AC Coupled ( <i>Option 503, 508,526</i> ) |                   |                |                           |
| 55 MHz to 1 GHz                           | ---               | ---            |                           |
| 1 to 18 GHz                               | 3.0:1             | 2.0:1          | 1.8:1                     |
| 18 to 26.5 GHz <sup>b</sup>               | 3.0:1             | 2.4:1          | 2.0:1                     |

- a. X-Series analyzers have a reflection coefficient that is excellently modeled with a Rayleigh probability distribution. Keysight recommends using the methods outlined in Application Note 1449-3 and companion Average Power Sensor Measurement Uncertainty Calculator to compute mismatch uncertainty.
- b. For *Option 526*, VSWR specifications above 18 GHz apply only with *Option C35* (3.5 mm connector).

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                             | Specifications                                |                | Supplemental Information  |
|-------------------------------------------------------------------------|-----------------------------------------------|----------------|---------------------------|
| <b>RF Input VSWR - Preselector On<sup>a</sup></b><br>at tuned frequency | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                |                           |
| <b>Preamp On</b>                                                        | <b>Input Attenuation</b>                      |                | <b>Typical</b>            |
|                                                                         | <b>0 dB</b>                                   | <b>≥ 10 dB</b> |                           |
| DC Coupled                                                              |                                               |                | ≥ 10 dB Input Attenuation |
| 9 kHz to 1 GHz                                                          | 2.0:1                                         | 1.2:1          | 1.1:1                     |
| 1 to 3.6 GHz <sup>b</sup>                                               | 3.0:1                                         | 2.0:1          | 1.5:1                     |
| 3.6 to 26.5 GHz <sup>c</sup>                                            | 3.0:1                                         | 2.0:1          | 1.8:1                     |
| 26.5 to 40 GHz                                                          | 3.0:1                                         | 2.5:1          | 1.8:1                     |
| 40 to 44 GHz                                                            |                                               |                | 2.0:1                     |
| AC Coupled ( <i>Option 503, 508,526</i> )                               |                                               |                |                           |
| 55 MHz to 1 GHz                                                         | 2.0:1                                         | 1.2:1          |                           |
| 1 to 18 GHz <sup>b</sup>                                                | 3.0:1                                         | 2.0:1          | 1.8:1                     |
| 18 to 26.5 GHz <sup>c</sup>                                             | 3.0:1                                         | 2.4:1          | 2.0:1                     |
| <b>Preamp Off, LNA On</b>                                               | <b>Input Attenuation</b>                      |                | <b>Typical</b>            |
|                                                                         | <b>0 dB</b>                                   | <b>≥ 10 dB</b> |                           |
| DC Coupled                                                              |                                               |                | ≥ 10 dB Input Attenuation |
| 50 MHz to 1 GHz                                                         | 2.0:1                                         | 1.2:1          | 1.1:1                     |
| 1 to 3.6 GHz <sup>b</sup>                                               | 3.0:1                                         | 2.0:1          | 1.5:1                     |
| 3.6 to 26.5 GHz <sup>c</sup>                                            | 3.0:1                                         | 2.0:1          | 1.8:1                     |
| 26.5 to 40 GHz                                                          | 3.0:1                                         | 2.5:1          | 1.8:1                     |
| 40 to 44 GHz                                                            |                                               |                | 2.0:1                     |
| AC Coupled ( <i>Option 503, 508,526</i> )                               |                                               |                |                           |
| 55 MHz to 1 GHz                                                         | 2.0:1                                         | 1.2:1          |                           |
| 1 to 18 GHz <sup>b</sup>                                                | 3.0:1                                         | 2.0:1          | 1.8:1                     |
| 18 to 26.5 GHz <sup>c</sup>                                             | 3.0:1                                         | 2.4:1          | 2.0:1                     |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                | Specifications    |                | Supplemental Information  |
|--------------------------------------------|-------------------|----------------|---------------------------|
| <b>Preamp On, LNA On</b>                   | Input Attenuation |                | Typical                   |
|                                            | <b>0 dB</b>       | <b>≥ 10 dB</b> |                           |
| DC Coupled                                 |                   |                | ≥ 10 dB Input Attenuation |
| 50 MHz to 1 GHz                            | 2.0:1             | 1.2:1          | 1.1:1                     |
| 1 to 3.6 GHz <sup>b</sup>                  | 3.0:1             | 2.0:1          | 1.5:1                     |
| 3.6 to 26.5 GHz <sup>c</sup>               | 3.0:1             | 2.0:1          | 1.8:1                     |
| 26.5 to 40 GHz                             | 3.0:1             | 2.5:1          | 1.8:1                     |
| 40 to 44 GHz                               |                   |                | 2.0:1                     |
| AC Coupled ( <i>Option 503, 508, 526</i> ) |                   |                |                           |
| 55 MHz to 1 GHz                            | 2.0:1             | 1.2:1          |                           |
| 1 to 18 GHz <sup>b</sup>                   | 3.0:1             | 2.0:1          | 1.8:1                     |
| 18 to 26.5 GHz <sup>c</sup>                | 3.0:1             | 2.4:1          | 2.0:1                     |

- a. X-Series analyzers have a reflection coefficient that is excellently modeled with a Rayleigh probability distribution. Keysight recommends using the methods outlined in Application Note 1449-3 and companion Average Power Sensor Measurement Uncertainty Calculator to compute mismatch uncertainty.
- b. When the notch filter is selected the specs between 2.3 GHz – 2.6 GHz is not applicable.
- c. For *Option 526*, VSWR specifications above 18 GHz apply only with *Option C35* (3.5 mm connector).

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                                                                                                                                            | Specifications                        |   | Supplemental Information                                                                                                                           |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| <b>Total Measurement Uncertainty</b><br>Signal level 0 to 90 dB below reference point,<br>RF attenuation 0 to 40 dB, RBW $\leq$ 1 MHz,<br>20° to 30° C:<br>AC coupled 10 MHz to 26.5 GHz<br>DC coupled 9 kHz to 44 GHz | Option 544 (mmW)                      |   | <b>95th Percentile (<math>\approx 2\sigma</math>)</b><br><br><b>Spectrum Analyzer Mode</b><br><br><b>EMI Receiver Mode Discrete (Stepped) Scan</b> |               |
|                                                                                                                                                                                                                        | Option 503, 508, or 526 (RF/ $\mu$ W) |   |                                                                                                                                                    |               |
|                                                                                                                                                                                                                        | ↓                                     | ↓ |                                                                                                                                                    |               |
| <b>RF Preselector Off, Preamp On, LNA Off</b>                                                                                                                                                                          |                                       |   |                                                                                                                                                    |               |
| 100 kHz to 10 MHz                                                                                                                                                                                                      | X                                     | X | $\pm 0.40$ dB                                                                                                                                      | $\pm 0.45$ dB |
| 10 MHz to 3.6 GHz                                                                                                                                                                                                      | X                                     |   | $\pm 0.30$ dB                                                                                                                                      | $\pm 0.35$ dB |
| 10 MHz to 1 GHz                                                                                                                                                                                                        |                                       | X | $\pm 0.30$ dB                                                                                                                                      | $\pm 0.35$ dB |
| 1 to 3.6 GHz                                                                                                                                                                                                           |                                       | X | $\pm 0.35$ dB                                                                                                                                      | $\pm 0.40$ dB |
| 3.6 to 18 GHz                                                                                                                                                                                                          | X                                     | X | $\pm 0.65$ dB                                                                                                                                      | $\pm 0.70$ dB |
| 18 to 26.5 GHz                                                                                                                                                                                                         | X                                     | X | $\pm 0.90$ dB                                                                                                                                      | $\pm 1.10$ dB |
| 26.5 to 44 GHz                                                                                                                                                                                                         |                                       | X | $\pm 1.25$ dB                                                                                                                                      | $\pm 1.55$ dB |
| <b>RF Preselector On, Preamp On, LNA Off</b>                                                                                                                                                                           |                                       |   |                                                                                                                                                    |               |
| 9 kHz to 10 MHz                                                                                                                                                                                                        | X                                     | X | $\pm 0.36$ dB                                                                                                                                      | $\pm 0.41$ dB |
| 10 MHz to 1 GHz                                                                                                                                                                                                        | X                                     |   | $\pm 0.20$ dB                                                                                                                                      | $\pm 0.34$ dB |
| 10 MHz to 1 GHz                                                                                                                                                                                                        |                                       | X | $\pm 0.25$ dB                                                                                                                                      | $\pm 0.34$ dB |
| 1 to 3.6 GHz                                                                                                                                                                                                           | X                                     |   | $\pm 0.20$ dB                                                                                                                                      | $\pm 0.34$ dB |
| 1 to 3.6 GHz                                                                                                                                                                                                           |                                       | X | $\pm 0.25$ dB                                                                                                                                      | $\pm 0.34$ dB |
| 3.6 to 18 GHz                                                                                                                                                                                                          | X                                     | X | $\pm 0.65$ dB                                                                                                                                      | $\pm 0.70$ dB |
| 18 to 26.5 GHz                                                                                                                                                                                                         | X                                     | X | $\pm 0.90$ dB                                                                                                                                      | $\pm 1.10$ dB |
| 26.5 to 44 GHz                                                                                                                                                                                                         |                                       | X | $\pm 1.25$ dB                                                                                                                                      | $\pm 1.55$ dB |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                      |   |   | Specifications | Supplemental Information |           |
|--------------------------------------------------|---|---|----------------|--------------------------|-----------|
| <b>RF Preselector Off, Preamp On/Off, LNA On</b> |   |   |                |                          |           |
| 2 to 10 MHz <sup>a</sup>                         | X | X |                | ± 0.45 dB                | ± 0.50 dB |
| 10 MHz to 3.6 GHz                                | X |   |                | ± 0.30 dB                | ± 0.30 dB |
| 10 MHz to 1 GHz                                  |   | X |                | ± 0.30 dB                | ± 0.30 dB |
| 1 to 3.6 GHz                                     |   | X |                | ± 0.35 dB                | ± 0.35 dB |
| <b>RF Preselector On, Preamp On/Off, LNA On</b>  |   |   |                |                          |           |
| 10 MHz to 1 GHz                                  | X | X |                | ± 0.27 dB                | ± 0.33 dB |
| 1 to 3.6 GHz                                     | X | X |                | ± 0.27 dB                | ± 0.33 dB |
| <b>RF Preselector Off/On, Preamp Off, LNA On</b> |   |   |                |                          |           |
| 3.6 to 18 GHz                                    | X |   |                | ± 0.65 dB                | ± 0.65 dB |
| 3.6 to 18 GHz                                    |   | X |                | ± 0.65 dB                | ± 0.70 dB |
| 18 to 26.5 GHz                                   | X | X |                | ± 0.90 dB                | ± 1.15 dB |
| 26.5 to 44 GHz                                   |   | X |                | ± 1.25 dB                | ± 1.55 dB |
| <b>RF Preselector Off/On, Preamp On, LNA On</b>  |   |   |                |                          |           |
| 3.6 to 18 GHz                                    | X | X |                | ± 0.65 dB                | ± 0.70 dB |
| 18 to 26.5 GHz                                   | X | X |                | ± 0.90 dB                | ± 1.20 dB |
| 26.5 to 44 GHz                                   |   | X |                | ± 1.25 dB                | ± 1.55 dB |

a. For instruments with option WF1, specification starts at 6 MHz.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                         |                                                                                   |                                                                                   | Specifications                                                                                                                                                          |                  | Supplemental Information                                   |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------------|
| <b>Displayed Average Noise Level (DANL) - LNA OFF<sup>a</sup></b><br><br>(RF Input 1 <sup>b</sup> ) |                                                                                   |                                                                                   | Input terminated<br>Sample or Average detector<br>Averaging type = Log<br>0 dB input attenuation<br>IF Gain = High<br>NFE <sup>b</sup> Off<br>1 Hz Resolution Bandwidth |                  | Refer to the footnote for <b>Band Overlaps on page 14.</b> |
| Option 544 (mmW)                                                                                    |                                                                                   |                                                                                   |                                                                                                                                                                         |                  |                                                            |
| Option 503, 508, or 526 (RF/μW)                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                         |                  |                                                            |
| <b>RF Preselector Off, Preamp On</b>                                                                |  |  | <b>20 to 30°C</b>                                                                                                                                                       | <b>0 to 55°C</b> |                                                            |
| 100 kHz to 1 MHz <sup>d</sup>                                                                       | X                                                                                 | X                                                                                 | -157 dBm                                                                                                                                                                | -155 dBm         |                                                            |
| 1 to 10 MHz <sup>d</sup>                                                                            | X                                                                                 | X                                                                                 | -165 dBm                                                                                                                                                                | -163 dBm         |                                                            |
| 10 MHz to 1 GHz                                                                                     | X                                                                                 | X                                                                                 | -165 dBm                                                                                                                                                                | -163 dBm         | -174 dBm                                                   |
| 1 to 3.6 GHz                                                                                        | X                                                                                 | X                                                                                 | -161 dBm                                                                                                                                                                | -160 dBm         | -172 dBm                                                   |
| 3.5 GHz to 13.6 GHz                                                                                 | X                                                                                 |                                                                                   | -164 dBm                                                                                                                                                                | -163 dBm         | -174 dBm                                                   |
| 3.5 GHz to 8.4 GHz                                                                                  |                                                                                   | X                                                                                 | -162 dBm                                                                                                                                                                | -161 dBm         | -174 dBm                                                   |
| 8.3 GHz to 13.6 GHz                                                                                 |                                                                                   | X                                                                                 | -164 dBm                                                                                                                                                                | -163 dBm         | -174 dBm                                                   |
| 13.5 to 26.5 GHz                                                                                    | X                                                                                 | X                                                                                 | -160 dBm                                                                                                                                                                | -159 dBm         | -170 dBm                                                   |
| 26.4 GHz to 34.5 GHz                                                                                |                                                                                   | X                                                                                 | -158 dBm                                                                                                                                                                | -157 dBm         | -169 dBm                                                   |
| 34.4 GHz to 42 GHz                                                                                  |                                                                                   | X                                                                                 | -155 dBm                                                                                                                                                                | -154 dBm         | -165 dBm                                                   |
| 42 GHz to 43 GHz                                                                                    |                                                                                   | X                                                                                 | -151 dBm                                                                                                                                                                | -150 dBm         | -162 dBm                                                   |
| 43 GHz to 44 GHz                                                                                    |                                                                                   | X                                                                                 | -149 dBm                                                                                                                                                                | -148 dBm         |                                                            |
| <b>RF Preselector On<sup>e</sup>, Preamp On</b>                                                     |                                                                                   |                                                                                   |                                                                                                                                                                         |                  |                                                            |
| 1 kHz <sup>d</sup>                                                                                  | X                                                                                 | X                                                                                 | -145 dBm                                                                                                                                                                | -140 dBm         | -150 dBm                                                   |
| 9 to 100 kHz <sup>d</sup>                                                                           | X                                                                                 | X                                                                                 | -160 dBm                                                                                                                                                                | -158 dBm         | -161 dBm                                                   |
| 100 kHz to 1 MHz <sup>d</sup>                                                                       | X                                                                                 | X                                                                                 | -160 dBm                                                                                                                                                                | -158 dBm         | -171 dBm                                                   |
| 1 to 30 MHz <sup>d</sup>                                                                            | X                                                                                 | X                                                                                 | -163 dBm                                                                                                                                                                | -162 dBm         | -173 dBm                                                   |
| 30 MHz to 1 GHz                                                                                     | X                                                                                 | X                                                                                 | -164 dBm                                                                                                                                                                | -163 dBm         | -174 dBm                                                   |
| 1 to 1.7 GHz                                                                                        | X                                                                                 | X                                                                                 | -165 dBm                                                                                                                                                                | -164 dBm         | -174 dBm                                                   |
| 1.7 to 2.5 GHz                                                                                      | X                                                                                 | X                                                                                 | -164 dBm                                                                                                                                                                | -163 dBm         | -174 dBm                                                   |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description          |   |   | Specifications |          | Supplemental Information |
|----------------------|---|---|----------------|----------|--------------------------|
| 2.5 to 3.6 GHz       | X | X | -161 dBm       | -160 dBm | -172 dBm                 |
| 3.5 GHz to 13.6 GHz  | X |   | -164 dBm       | -163 dBm | -174 dBm                 |
| 3.5 GHz to 8.4 GHz   |   | X | -162 dBm       | -161 dBm | -174 dBm                 |
| 8.3 GHz to 13.6 GHz  |   | X | -164 dBm       | -163 dBm | -174 dBm                 |
| 13.5 to 26.5 GHz     | X | X | -160 dBm       | -159 dBm | -170 dBm                 |
| 26.4 GHz to 34.5 GHz |   | X | -158 dBm       | -157 dBm | -169 dBm                 |
| 34.4 GHz to 42 GHz   |   | X | -155 dBm       | -154 dBm | -165 dBm                 |
| 42 GHz to 43 GHz     |   | X | -151 dBm       | -150 dBm | -162 dBm                 |
| 43 GHz to 44 GHz     |   | X | -149 dBm       | -148 dBm |                          |

- DANL for zero span and swept is measured in a 1 kHz RBW and normalized to the narrowest available RBW, because the noise figure does not depend on RBW and 1 kHz measurements are faster.
- RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
- NFE = Noise Floor Extension. Typical DANL including NFE = (Typical DANL - DANL improvement with NFE).
- DANL below 10 MHz is affected by phase noise around the LO feedthrough signal. Specifications apply with the best setting of the Phase Noise Optimization control, which is to choose the "Best Close-in  $\phi$  Noise" for frequencies below 25 kHz, and "Best Wide Offset  $\phi$  Noise" for frequencies above 25 kHz.
- When the notch filter is selected the DANL specs between 2.2 GHz - 2.9 GHz is nominally specified.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                         |                                                                                   |                                                                                   | Specifications                                                                                                                                                          |                  | Supplemental Information                                   |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------------|
| <b>Displayed Average Noise Level (DANL) - LNA On <sup>a</sup></b><br><br>(RF Input 1 <sup>b</sup> ) |                                                                                   |                                                                                   | Input terminated<br>Sample or Average detector<br>Averaging type = Log<br>0 dB input attenuation<br>IF Gain = High<br>NFE <sup>b</sup> Off<br>1 Hz Resolution Bandwidth |                  | Refer to the footnote for <b>Band Overlaps on page 14.</b> |
| Option 544 (mmW)                                                                                    |                                                                                   |                                                                                   |                                                                                                                                                                         |                  |                                                            |
| Option 503, 508, or 526 (RF/μW)                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                         |                  |                                                            |
| <b>RF Preselector Off, Preamp On/Off</b>                                                            |  |  | <b>20 to 30°C</b>                                                                                                                                                       | <b>0 to 55°C</b> | <b>Typical DANL including NFE<sup>c</sup></b>              |
| 150 kHz to 1 MHz <sup>d</sup>                                                                       | X                                                                                 | X                                                                                 |                                                                                                                                                                         |                  | -92 dBm                                                    |
| 1 to 5 MHz <sup>d</sup>                                                                             | X                                                                                 | X                                                                                 |                                                                                                                                                                         |                  | -119 dBm                                                   |
| 5 to 30 MHz <sup>d</sup>                                                                            | X                                                                                 | X                                                                                 |                                                                                                                                                                         |                  | -148 dBm                                                   |
| 30 to 50 MHz                                                                                        | X                                                                                 | X                                                                                 | -161 dBm                                                                                                                                                                | -160 dBm         | -172 dBm                                                   |
| 50 to 150 MHz                                                                                       | X                                                                                 | X                                                                                 | -165 dBm                                                                                                                                                                | -164 dBm         | -172 dBm                                                   |
| 150 MHz to 2 GHz                                                                                    | X                                                                                 | X                                                                                 | -167 dBm                                                                                                                                                                | -166 dBm         | -172 dBm                                                   |
| 2 GHz to 3.6 GHz                                                                                    | X                                                                                 | X                                                                                 | -164 dBm                                                                                                                                                                | -162 dBm         | -172 dBm                                                   |
| <b>RF Preselector On<sup>e</sup>, Preamp On/Off</b>                                                 |                                                                                   |                                                                                   |                                                                                                                                                                         |                  |                                                            |
| 150 kHz to 1 MHz <sup>d</sup>                                                                       | X                                                                                 | X                                                                                 |                                                                                                                                                                         |                  | -100 dBm                                                   |
| 1 to 10 MHz <sup>d</sup>                                                                            | X                                                                                 | X                                                                                 |                                                                                                                                                                         |                  | -125 dBm                                                   |
| 10 to 30 MHz <sup>d</sup>                                                                           | X                                                                                 | X                                                                                 |                                                                                                                                                                         |                  | -165 dBm                                                   |
| 30 to 50 MHz                                                                                        | X                                                                                 | X                                                                                 | -163 dBm                                                                                                                                                                | -162 dBm         | -174 dBm                                                   |
| 50 to 100 MHz                                                                                       | X                                                                                 | X                                                                                 | -165 dBm                                                                                                                                                                | -164 dBm         | -174 dBm                                                   |
| 100 to 150 MHz                                                                                      | X                                                                                 | X                                                                                 | -166 dBm                                                                                                                                                                | -165 dBm         | -174 dBm                                                   |
| 150 MHz to 2 GHz                                                                                    | X                                                                                 | X                                                                                 | -166 dBm                                                                                                                                                                | -165 dBm         | -174 dBm                                                   |
| 2 GHz to 3.6 GHz                                                                                    | X                                                                                 | X                                                                                 | -165 dBm                                                                                                                                                                | -164 dBm         | -174 dBm                                                   |
| <b>RF Preselector On/Off<sup>e</sup>, Preamp Off</b>                                                |                                                                                   |                                                                                   |                                                                                                                                                                         |                  |                                                            |
| 3.5 to 8.4 GHz                                                                                      | X                                                                                 |                                                                                   | -165 dBm                                                                                                                                                                | -164 dBm         | -172 dBm                                                   |
| 3.5 GHz to 8.4 GHz                                                                                  |                                                                                   | X                                                                                 | -163 dBm                                                                                                                                                                | -161 dBm         | -172 dBm                                                   |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                             |   |   | Specifications |          | Supplemental Information |
|-----------------------------------------|---|---|----------------|----------|--------------------------|
| 8.3 to 13.6 GHz                         | X | X | -164 dBm       | -163 dBm | -171 dBm                 |
| 13.5 to 19 GHz                          | X |   | -163 dBm       | -162 dBm | -170 dBm                 |
| 13.5 to 19 GHz                          |   | X | -162 dBm       | -160 dBm | -170 dBm                 |
| 19 to 22 GHz                            | X |   | -161 dBm       | -160 dBm | -170 dBm                 |
| 19 to 22 GHz                            |   | X | -160 dBm       | -159 dBm | -170 dBm                 |
| 22.0 to 26.5 GHz                        | X |   | -157 dBm       | -156 dBm | -168 dBm                 |
| 22 GHz to 26.5 GHz                      |   | X | -157 dBm       | -155 dBm | -168 dBm                 |
| 26.4 GHz to 34.5 GHz                    |   | X | -155 dBm       | -153 dBm | -167 dBm                 |
| 34.4 GHz to 40 GHz                      |   | X | -149 dBm       | -147 dBm | -163 dBm                 |
| 40 GHz to 42 GHz                        |   | X | -149 dBm       | -146 dBm | -162 dBm                 |
| 42 GHz to 43 GHz                        |   | X | -146 dBm       | -143 dBm | -160 dBm                 |
| 43 GHz to 44 GHz                        |   | X | -146 dBm       | -143 dBm |                          |
| <b>RF Preselector On/Off, Preamp On</b> |   |   |                |          |                          |
| 3.5 to 8 GHz                            | X |   | -167 dBm       | -166 dBm | -174 dBm                 |
| 3.5 GHz to 8 GHz                        |   | X | -165 dBm       | -163 dBm | -174 dBm                 |
| 8 to 13.6 GHz                           | X | X | -166 dBm       | -165 dBm | -174 dBm                 |
| 13.5 to 19 GHz                          | X | X | -165 dBm       | -164 dBm | -173 dBm                 |
| 19 to 22 GHz                            | X | X | -164 dBm       | -163 dBm | -173 dBm                 |
| 22.0 to 26.5 GHz                        | X | X | -163 dBm       | -162 dBm | -172 dBm                 |
| 26.4 GHz to 34.5 GHz                    |   | X | -160 dBm       | -158 dBm | -170 dBm                 |
| 34.4 GHz to 40 GHz                      |   | X | -158 dBm       | -156 dBm | -169 dBm                 |
| 40 GHz to 42 GHz                        |   | X | -158 dBm       | -156 dBm | -168 dBm                 |
| 42 GHz to 43 GHz                        |   | X | -156 dBm       | -155 dBm | -167 dBm                 |
| 43 GHz to 44 GHz                        |   | X | -149 dBm       | -148 dBm |                          |

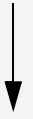
- DANL for zero span and swept is measured in a 1 kHz RBW and normalized to the narrowest available RBW, because the noise figure does not depend on RBW and 1 kHz measurements are faster.
- RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
- NFE = Noise Floor Extension. Typical DANL including NFE = (Typical DANL - DANL improvement with NFE).
- DANL below 10 MHz is affected by phase noise around the LO feedthrough signal. Specifications apply with the best setting of the Phase Noise Optimization control, which is to choose the "Best Close-in  $\phi$  Noise" for frequencies below 25 kHz, and "Best Wide Offset  $\phi$  Noise" for frequencies above 25 kHz.
- When the notch filter is selected the DANL specs between 2.2 GHz - 2.9 GHz is nominally specified.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                  | Specifications                                                                    |                                                                                   | Supplemental Information               |                          |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------|--------------------------|
| <b>DANL and Indicated Noise Improvement with Noise Floor Extension<sup>a</sup> - LNA Off</b> |                                                                                   |                                                                                   | 95th Percentile ( $\approx 2 \sigma$ ) |                          |
| <i>Option 544 (mmW)</i>                                                                      |                                                                                   |                                                                                   |                                        |                          |
| <i>Option 503, 508, or 526 (RF/<math>\mu</math>W)</i>                                        |                                                                                   |                                                                                   |                                        |                          |
| <b>RF Preselector Off, Preamp On<sup>b</sup></b>                                             |  |  | <b>Spectrum Analyzer Mode</b>          | <b>EMI Receiver Mode</b> |
| <b>RF Input 1</b>                                                                            |                                                                                   |                                                                                   |                                        |                          |
| 10 MHz <sup>c</sup> to 3.6 GHz                                                               | X                                                                                 | X                                                                                 | 10 dB                                  | 4 dB                     |
| 3.5 to 8.4 GHz                                                                               | X                                                                                 | X                                                                                 | 9 dB                                   | 4 dB                     |
| 8.3 to 13.6 GHz                                                                              | X                                                                                 | X                                                                                 | 10 dB                                  | 5 dB                     |
| 13.5 to 17.1 GHz                                                                             | X                                                                                 | X                                                                                 | 9 dB                                   | 5 dB                     |
| 17.0 to 26.5 GHz                                                                             | X                                                                                 | X                                                                                 | 8 dB                                   | 4 dB                     |
| 26.4 GHz to 34.5 GHz                                                                         |                                                                                   | X                                                                                 | 9 dB                                   | 5 dB                     |
| 34.4 GHz to 44 GHz                                                                           |                                                                                   | X                                                                                 | 8 dB                                   | 5 dB                     |
| <b>RF Input 2</b>                                                                            |                                                                                   |                                                                                   |                                        |                          |
| 10 MHz <sup>c</sup> to 1 GHz                                                                 | X                                                                                 | X                                                                                 | 10 dB                                  | 4 dB                     |
| <b>RF Preselector On, Preamp On<sup>b</sup></b>                                              |                                                                                   |                                                                                   |                                        |                          |
| <b>RF Input 1</b>                                                                            |                                                                                   |                                                                                   |                                        |                          |
| 150 kHz <sup>d</sup> to 30 MHz                                                               | X                                                                                 | X                                                                                 | 10 dB                                  | 3 dB                     |
| 30 MHz to 1 GHz                                                                              | X                                                                                 | X                                                                                 | 10 dB                                  | 4 dB                     |
| 1 to 3.6 GHz                                                                                 | X                                                                                 | X                                                                                 | 10 dB                                  | 4 dB                     |
| 3.5 to 8.4 GHz                                                                               | X                                                                                 | X                                                                                 | 9 dB                                   | 4 dB                     |
| 8.3 to 13.6 GHz                                                                              | X                                                                                 | X                                                                                 | 10 dB                                  | 5 dB                     |
| 13.5 to 17.1 GHz                                                                             | X                                                                                 | X                                                                                 | 9 dB                                   | 5 dB                     |
| 17 to 26.5 GHz                                                                               | X                                                                                 | X                                                                                 | 8 dB                                   | 4 dB                     |
| 26.4 GHz to 34.5 GHz                                                                         |                                                                                   | X                                                                                 | 9 dB                                   | 5 dB                     |
| 34.4 GHz to 44 GHz                                                                           |                                                                                   | X                                                                                 | 8 dB                                   | 5 dB                     |
| <b>RF Input 2</b>                                                                            |                                                                                   |                                                                                   |                                        |                          |
| 150 kHz <sup>d</sup> to 1 GHz                                                                | X                                                                                 | X                                                                                 | 10 dB                                  | 3 dB                     |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

- This statement on the improvement in DANL is based on the accuracy of the fit of the noise floor model to the measured values of that noise. This measure of the performance correlates well with improvement versus frequency. The improvement actually measured and specified in "Examples of Effective DANL" usually meet these limits as well, but not with the confidence in some cases.
- DANL of the preamp is specified with a 50  $\Omega$  source impedance. Like all amplifiers, the noise varies with the source impedance. When NFE compensates for the noise with an ideal source impedance, the variation in the remaining noise level with the actual source impedance is greatly multiplied in a decibel sense.
- NFE does not apply to the low frequency sensitivity. At frequencies below about 0.5 MHz, the sensitivity is dominated by phase noise surrounding the LO feedthrough. The NFE is not designed to improve that performance. At frequencies between 0.5 and 10 MHz the NFE effectiveness increases from nearly none to near its maximum
- For RF Preselector path, NFE does not apply at frequencies below 100 kHz. At frequencies between 100 kHz and 150 kHz, the NFE effectiveness is not measured, but is designed to be nominally the same as frequencies above 150 kHz.

| Description                                                                           | Specifications                                                                     |                                                                                    | Supplemental Information               |                   |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------|-------------------|
| DANL and Indicated Noise Improvement with Noise Floor Extension <sup>a</sup> - LNA On |                                                                                    |                                                                                    | 95th Percentile ( $\approx 2 \sigma$ ) |                   |
| Option 544 (mmW)                                                                      |                                                                                    |                                                                                    |                                        |                   |
| Option 503, 508, or 526 (RF/ $\mu$ W)                                                 |  |  |                                        |                   |
| RF Preselector Off, Preamp On/Off <sup>b</sup>                                        |                                                                                    |                                                                                    | Spectrum Analyzer Mode                 | EMI Receiver Mode |
| RF Input 1                                                                            |                                                                                    |                                                                                    |                                        |                   |
| 10 MHz <sup>c</sup> to 3.6 GHz                                                        | X                                                                                  | X                                                                                  | 10 dB                                  | 4 dB              |
| RF Input 2                                                                            |                                                                                    |                                                                                    |                                        |                   |
| 10 MHz <sup>c</sup> to 1 GHz                                                          | X                                                                                  | X                                                                                  | 10 dB                                  | 4 dB              |
| RF Preselector On, Preamp On/Off <sup>b</sup>                                         |                                                                                    |                                                                                    |                                        |                   |
| RF Input 1                                                                            |                                                                                    |                                                                                    |                                        |                   |
| 150 kHz <sup>d</sup> to 30 MHz                                                        | X                                                                                  | X                                                                                  | 10 dB                                  | 2 dB              |
| 30 MHz to 3.6 GHz                                                                     | X                                                                                  | X                                                                                  | 10 dB                                  | 4 dB              |
| RF Input 2                                                                            |                                                                                    |                                                                                    |                                        |                   |
| 150 kHz <sup>c</sup> to 1 GHz                                                         | X                                                                                  | X                                                                                  | 10 dB                                  | 2 dB              |
| RF Preselector On/ Off, Preamp Off                                                    |                                                                                    |                                                                                    |                                        |                   |
| RF Input 1                                                                            |                                                                                    |                                                                                    |                                        |                   |
| 3.5 to 8.4 GHz                                                                        | X                                                                                  | X                                                                                  | 10 dB                                  | 5 dB              |
| 8.3 to 13.6 GHz                                                                       | X                                                                                  | X                                                                                  | 10 dB                                  | 5 dB              |
| 13.5 to 17.1 GHz                                                                      | X                                                                                  | X                                                                                  | 10 dB                                  | 5 dB              |
| 17 to 26.5 GHz                                                                        | X                                                                                  | X                                                                                  | 9 dB                                   | 4 dB              |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                          |   |   | Specifications | Supplemental Information |      |
|------------------------------------------------------|---|---|----------------|--------------------------|------|
| 26.4 GHz to 34.5 GHz                                 |   | X |                | 10 dB                    | 5 dB |
| 34.4 GHz to 44 GHz                                   |   | X |                | 10 dB                    | 5 dB |
| <b>RF Preselector On/ Off, Preamp On<sup>b</sup></b> |   |   |                |                          |      |
| <b>RF Input 1</b>                                    |   |   |                |                          |      |
| 3.5 to 8.4 GHz                                       | X | X |                | 9 dB                     | 5 dB |
| 8.3 to 13.6 GHz                                      | X | X |                | 9 dB                     | 5 dB |
| 13.5 to 17.1 GHz                                     | X | X |                | 9 dB                     | 5 dB |
| 17 to 26.5 GHz                                       | X | X |                | 8 dB                     | 3 dB |
| 26.4 GHz to 34.5 GHz                                 |   | X |                | 8 dB                     | 4 dB |
| 34.4 GHz to 44 GHz                                   |   | X |                | 9 dB                     | 4 dB |

- This statement on the improvement in DANL is based on the accuracy of the fit of the noise floor model to the measured values of that noise. This measure of the performance correlates well with improvement versus frequency. The improvement actually measured and specified in "Examples of Effective DANL" usually meet these limits as well, but not with the confidence in some cases.
- DANL of the preamp is specified with a 50  $\Omega$  source impedance. Like all amplifiers, the noise varies with the source impedance. When NFE compensates for the noise with an ideal source impedance, the variation in the remaining noise level with the actual source impedance is greatly multiplied in a decibel sense.
- NFE does not apply to the low frequency sensitivity. At frequencies below about 0.5 MHz, the sensitivity is dominated by phase noise surrounding the LO feedthrough. The NFE is not designed to improve that performance. At frequencies between 0.5 and 10 MHz the NFE effectiveness increases from nearly none to near its maximum
- For RF Preselector path, NFE does not apply at frequencies below 100 kHz. At frequencies between 100 kHz and 150 kHz, the NFE effectiveness is not measured, but is designed to be nominally the same as frequencies above 150 kHz.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                              | Specifications |   | Supplemental Information                                                                                                                                                          |                      |
|------------------------------------------------------------------------------------------|----------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>Indicated Noise (EMI Receiver Mode)<sup>a</sup></b><br><br>(RF Input 1 <sup>b</sup> ) |                |   | Input terminated<br><br>EMI Average detector<br>0 dB input attenuation<br>All indicated RBW are CISPR BW, except as noted.<br>EMI Receiver Mode Scan Type = Discrete Stepped Scan |                      |
| Option 544 (mmW)                                                                         |                |   |                                                                                                                                                                                   |                      |
| Option 503, 508, or 526 (RF/μW)                                                          |                |   |                                                                                                                                                                                   |                      |
| <b>RF Preselector On, Preamp On, LNA Off</b>                                             | ↓              | ↓ | <b>Typical Indicated Noise including NFE<sup>c</sup></b>                                                                                                                          |                      |
|                                                                                          |                |   | <b>Without Opt. WF1</b>                                                                                                                                                           | <b>With Opt. WF1</b> |
| 1 kHz (100 Hz RBW) <sup>d</sup>                                                          | X              | X | -24 dBμV <sup>e</sup>                                                                                                                                                             | -24 dBμV             |
| 9 to 150 kHz (200 Hz RBW)                                                                | X              | X | -31 dBμV                                                                                                                                                                          | -31 dBμV             |
| 150 kHz to 1 MHz (9 kHz RBW)                                                             | X              | X | -17 dBμV                                                                                                                                                                          | -17 dBμV             |
| 1 to 30 MHz (9 kHz RBW)                                                                  | X              | X | -20 dBμV                                                                                                                                                                          | -19 dBμV             |
| 30 MHz to 1 GHz (120 kHz RBW)                                                            | X              | X | -11 dBμV                                                                                                                                                                          | -11 dBμV             |
| 1 to 2.5 GHz (1 MHz RBW)                                                                 | X              | X | -2 dBμV                                                                                                                                                                           | -1 dBμV              |
| 2.5 to 3.6 GHz (1 MHz RBW)                                                               | X              | X | 0 dBμV                                                                                                                                                                            | 1 dBμV               |
| 3.6 to 8.4 GHz (1 MHz RBW)                                                               | X              | X | -2 dBμV                                                                                                                                                                           | -2 dBμV              |
| 8.4 to 13.6 GHz (1 MHz RBW)                                                              | X              | X | -2 dBμV                                                                                                                                                                           | -2 dBμV              |
| 13.6 to 17.1 GHz (1 MHz RBW)                                                             | X              | X | -3 dBμV                                                                                                                                                                           | -3 dBμV              |
| 17.1 to 25 GHz (1 MHz RBW)                                                               | X              | X | 1 dBμV                                                                                                                                                                            | 1 dBμV               |
| 25 to 26.5 GHz (1 MHz RBW)                                                               | X              | X | 2 dBμV                                                                                                                                                                            | 2 dBμV               |
| 26.5 to 34.5 GHz (1 MHz RBW)                                                             |                | X | 2 dBμV                                                                                                                                                                            | 2 dBμV               |
| 34.5 to 40 GHz (1 MHz RBW)                                                               |                | X | 5 dBμV                                                                                                                                                                            | 5 dBμV               |
| 40 to 42 GHz (1 MHz RBW)                                                                 |                | X | 6 dBμV                                                                                                                                                                            | 6 dBμV               |
| 42 to 43 GHz (1 MHz RBW)                                                                 |                | X | 8 dBμV                                                                                                                                                                            | 8 dBμV               |
| 43 to 44 GHz (1 MHz RBW)                                                                 |                | X | 18 dBμV                                                                                                                                                                           | 18 dBμV              |
| <b>RF Preselector On, Preamp Off, LNA On</b>                                             |                |   |                                                                                                                                                                                   |                      |
| 30 MHz to 1 GHz (120 kHz RBW)                                                            | X              | X | -11 dBμV                                                                                                                                                                          | -10 dBμV             |
| 1 to 2.5 GHz (1 MHz RBW)                                                                 | X              | X | -5 dBμV                                                                                                                                                                           | -4 dBμV              |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                     |   |   | Specifications | Supplemental Information |         |
|-------------------------------------------------|---|---|----------------|--------------------------|---------|
| 2.5 to 3.6 GHz (1 MHz RBW)                      | X | X |                | -3 dBμV                  | -3 dBμV |
| 3.6 to 8.4 GHz (1 MHz RBW)                      | X |   |                | -4 dBμV                  | -4 dBμV |
| 3.6 to 8.4 GHz (1 MHz RBW)                      |   | X |                | -2 dBμV                  | -2 dBμV |
| 8.4 to 13.6 GHz (1 MHz RBW)                     | X |   |                | -3 dBμV                  | -3 dBμV |
| 8.4 to 13.6 GHz (1 MHz RBW)                     |   | X |                | -2 dBμV                  | -2 dBμV |
| 13.6 to 17.1 GHz (1 MHz RBW)                    | X | X |                | -2 dBμV                  | -2 dBμV |
| 17.1 to 25 GHz (1 MHz RBW)                      | X |   |                | 1 dBμV                   | 1 dBμV  |
| 17.1 to 25 GHz (1 MHz RBW)                      |   | X |                | 3 dBμV                   | 3 dBμV  |
| 25 to 26.5 GHz (1 MHz RBW)                      | X |   |                | 3 dBμV                   | 3 dBμV  |
| 25 to 26.5 GHz (1 MHz RBW)                      |   | X |                | 5 dBμV                   | 5 dBμV  |
| 26.5 to 34.5 GHz (1 MHz RBW)                    |   | X |                | 5 dBμV                   | 5 dBμV  |
| 34.5 to 40 GHz (1 MHz RBW)                      |   | X |                | 9 dBμV                   | 9 dBμV  |
| 40 to 42 GHz (1 MHz RBW)                        |   | X |                | 10 dBμV                  | 10 dBμV |
| 42 to 43 GHz (1 MHz RBW)                        |   | X |                | 13 dBμV                  | 13 dBμV |
| 43 to 44 GHz (1 MHz RBW)                        |   | X |                | 19 dBμV                  | 19 dBμV |
| <b>RF Preselector On/Off, Preamp On, LNA On</b> |   |   |                |                          |         |
| 3.6 to 8.4 GHz (1 MHz RBW)                      | X | X |                | -5 dBμV                  | -5 dBμV |
| 8.4 to 13.6 GHz (1MHz RBW)                      | X | X |                | -4 dBμV                  | -4 dBμV |
| 13.6 to 17.1 GHz (1MHz RBW)                     | X | X |                | -4 dBμV                  | -4 dBμV |
| 17.1 to 25 GHz (1 MHz RBW)                      | X | X |                | 0 dBμV                   | 0 dBμV  |
| 25 to 26.5 GHz (1 MHz RBW)                      | X | X |                | 0 dBμV                   | 0 dBμV  |
| 26.5 to 34.5 GHz (1 MHz RBW)                    |   | X |                | 2 dBμV                   | 2 dBμV  |
| 34.5 to 40 GHz (1 MHz RBW)                      |   | X |                | 4 dBμV                   | 4 dBμV  |
| 40 to 42 GHz (1 MHz RBW)                        |   | X |                | 4 dBμV                   | 4 dBμV  |
| 42 to 43 GHz (1 MHz RBW)                        |   | X |                | 5 dBμV                   | 5 dBμV  |
| 43 to 44 GHz (1 MHz RBW)                        |   | X |                | 18 dBμV                  | 18 dBμV |

- When the notch filter is selected, the Indicated Noise specifications between 2.2 – 2.9 GHz is nominally specified.
- RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
- Typical Indicated Noise including NFE = Typical DANL + RBW correction – DANL Improvement with NFE +107.
- Indicated RBW is a 6 dB bandwidth.
- NFE is not part of the difference between warranted and typical specifications at this frequency.

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                            | Specifications |   | Supplemental Information |
|--------------------------------------------------------|----------------|---|--------------------------|
| Second Harmonic Distortion <sup>a</sup>                |                |   |                          |
| Option 544 (mmW)                                       |                |   |                          |
| Option 503, 508, or 526 (RF/μW)                        |                |   |                          |
| RF Preselector Off, Preamp On, LNA Off <sup>b</sup>    | ↓              | ↓ | Nominal                  |
| Source Frequency                                       |                |   |                          |
| 10 MHz to 1.8 GHz <sup>c</sup>                         | X              | X | +33 dBm                  |
| 1.8 to 2.5 GHz <sup>d</sup>                            | X              | X | +20 dBm                  |
| 2.5 to 4 GHz <sup>d</sup>                              | X              | X | 0 dBm                    |
| 4 to 4.5 GHz <sup>d</sup>                              | X              | X | +5 dBm                   |
| 4.5 to 13.25 GHz <sup>d</sup>                          | X              | X | +10 dBm                  |
| 13.2 to 22 GHz                                         |                | X | +5 dBm                   |
| RF Preselector On, Preamp On, LNA Off <sup>b,ef</sup>  |                |   |                          |
| Source Frequency                                       |                |   |                          |
| 10 to 30 MHz                                           | X              | X | +43 dBm                  |
| 30 to 500 MHz                                          | X              | X | +56 dBm                  |
| 500 MHz to 1 GHz                                       | X              | X | +61 dBm                  |
| 1 to 1.6 GHz                                           | X              | X | +57 dBm                  |
| 1.6 to 1.8 GHz                                         | X              | X | +57 dBm                  |
| 1.8 to 2.5 GHz <sup>d</sup>                            | X              | X | +20 dBm                  |
| 2.5 to 4 GHz <sup>d</sup>                              | X              | X | 0 dBm                    |
| 4 to 4.5 GHz <sup>d</sup>                              | X              | X | +5 dBm                   |
| 4.5 to 13.25 GHz <sup>d</sup>                          | X              | X | +10 dBm                  |
| 13.2 to 22 GHz                                         |                | X | +5 dBm                   |
| RF Preselector Off, Preamp On/Off, LNA On <sup>b</sup> |                |   |                          |
| Source Frequency                                       |                |   |                          |
| 30 MHz to 1.8 GHz <sup>c</sup>                         | X              | X | +15 dBm                  |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                   |   |   | Specifications | Supplemental Information |
|---------------------------------------------------------------|---|---|----------------|--------------------------|
| <b>RF Preselector On, Preamp On/Off, LNA On<sup>bef</sup></b> |   |   |                |                          |
| <b>Source Frequency</b>                                       |   |   |                |                          |
| 30 to 300 MHz                                                 | X | X |                | +17 dBm                  |
| 300 to 500 MHz                                                | X | X |                | +17 dBm                  |
| 500 MHz to 1 GHz                                              | X | X |                | +17 dBm                  |
| 1 to 1.6 GHz                                                  | X | X |                | +15 dBm                  |
| 1.6 to 1.8 GHz                                                | X | X |                | +15 dBm                  |
| <b>RF Preselector On/Off, Preamp Off, LNA On<sup>b</sup></b>  |   |   |                |                          |
| <b>Source Frequency</b>                                       |   |   |                |                          |
| 1.8 to 13.25 GHz <sup>d</sup>                                 | X | X |                | +15 dBm                  |
| 13.2 to 22 GHz                                                |   | X |                | +12 dBm                  |
| <b>RF Preselector On/Off, Preamp On, LNA On<sup>b</sup></b>   |   |   |                |                          |
| <b>Source Frequency</b>                                       |   |   |                |                          |
| 1.8 to 4 GHz <sup>d</sup>                                     | X | X |                | -7 dBm                   |
| 4.0 to 13.25 GHz <sup>d</sup>                                 | X | X |                | -5 dBm                   |
| 13.2 to 22 GHz                                                |   | X |                | -7 dBm                   |

- RF Input 2 operates to 1 GHz. The second harmonic distortion intercept is nominally 9 dB higher for RF Input 2.
- Preamp level = Input level – Input Attenuation
- SHI is verified with input level = -25 dBm and input attenuation = 20 dB.
- SHI is verified with input level = -26 dBm and input attenuation = 24 dB.
- When the notch filter is selected the specs between source frequency 1.15 GHz to 1.30 GHz is not applicable.
- SHI is verified with input level = -9 dBm and input attenuation = 26 dB

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                                                                                                                                                |   |   | Specifications                                    |                  | Supplemental Information |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------------------------------------------------|------------------|--------------------------|
| <b>Third Order Intermodulation<sup>ab</sup></b><br>(Tone separation > 5 times IF<br>Prefilter Bandwidth <sup>c</sup><br>Verification conditions <sup>ab</sup><br>RF Input 1 <sup>d</sup> ) |   |   |                                                   |                  |                          |
| Option 544 (mmW)                                                                                                                                                                           |   |   |                                                   |                  |                          |
| Option 503, 508, or 526 (RF/μW)                                                                                                                                                            |   |   |                                                   |                  |                          |
| <b>RF Preselector Off, Preamp On, LNA Off<sup>f</sup></b>                                                                                                                                  | ↓ | ↓ | <b>Intercept<sup>e</sup></b><br><b>20 to 30°C</b> | <b>0 to 55°C</b> | <b>Typical</b>           |
| 10 to 500 MHz <sup>g</sup>                                                                                                                                                                 | X | X |                                                   |                  | +1 dBm (nominal)         |
| 500 MHz to 3.6 GHz <sup>g</sup>                                                                                                                                                            | X | X |                                                   |                  | +3 dBm (nominal)         |
| 3.5 to 26.5 GHz <sup>i</sup>                                                                                                                                                               | X |   |                                                   |                  | -10 dBm (nominal)        |
| 3.5 to 13.6 GHz <sup>i</sup>                                                                                                                                                               |   | X |                                                   |                  | -10 dBm (nominal)        |
| 13.5 to 26.5 GHz <sup>i</sup>                                                                                                                                                              |   | X |                                                   |                  | -15 dBm (nominal)        |
| 26.4 to 34.5 GHz                                                                                                                                                                           |   | X |                                                   |                  | -15 dBm (nominal)        |
| 34.4 to 44 GHz                                                                                                                                                                             |   | X |                                                   |                  | -20 dBm (nominal)        |
| <b>RF Preselector On, Preamp On, LNA Off<sup>fh</sup></b>                                                                                                                                  |   |   |                                                   |                  |                          |
| 10 to 30 MHz <sup>g</sup>                                                                                                                                                                  | X | X | +1 dBm                                            | 0 dBm            | +3 dBm                   |
| 30 MHz to 1 GHz <sup>g</sup>                                                                                                                                                               | X |   | -3 dBm                                            | -5 dBm           | -1 dBm                   |
| 30 MHz to 1 GHz <sup>g</sup>                                                                                                                                                               |   | X | -5 dBm                                            | -6 dBm           | -1 dBm                   |
| 1 to 2 GHz <sup>g</sup>                                                                                                                                                                    | X | X | -1 dBm                                            | -2 dBm           | +1 dBm                   |
| 2 to 3.6 GHz <sup>g</sup>                                                                                                                                                                  | X | X | -1 dBm                                            | -2 dBm           | +2 dBm                   |
| 3.5 to 26.5 GHz <sup>i</sup>                                                                                                                                                               | X |   |                                                   |                  | -10 dBm (nominal)        |
| 3.5 to 13.6 GHz <sup>i</sup>                                                                                                                                                               |   | X |                                                   |                  | -10 dBm (nominal)        |
| 13.5 to 26.5 GHz <sup>i</sup>                                                                                                                                                              |   | X |                                                   |                  | -15 dBm (nominal)        |
| 26.4 to 34.5 GHz                                                                                                                                                                           |   | X |                                                   |                  | -15 dBm (nominal)        |
| 34.4 to 44 GHz                                                                                                                                                                             |   | X |                                                   |                  | -20 dBm (nominal)        |
| <b>RF Preselector Off, Preamp On/Off, LNA On<sup>f</sup></b>                                                                                                                               |   |   |                                                   |                  |                          |
| 30 to 500 MHz <sup>g</sup>                                                                                                                                                                 | X | X |                                                   |                  | 0 dBm (nominal)          |
| 500 MHz to 3.6 GHz <sup>g</sup>                                                                                                                                                            | X | X |                                                   |                  | +1 dBm (nominal)         |

Options P03, P08, P26, P44 - Preamplifiers  
Other Preamp Specification

| Description                                                  |   |   | Specifications |        | Supplemental Information |
|--------------------------------------------------------------|---|---|----------------|--------|--------------------------|
| <b>RF Preselector On, Preamp On/Off, LNA On<sup>fh</sup></b> |   |   |                |        |                          |
| 30 MHz to 1 GHz <sup>g</sup>                                 | X | X | -8 dBm         | -9 dBm | -6 dBm                   |
| 1 to 2 GHz <sup>g</sup>                                      | X | X | -6 dBm         | -7 dBm | -4 dBm                   |
| 2 to 3.6 GHz <sup>g</sup>                                    | X | X | -4 dBm         | -5 dBm | -2 dBm                   |
| <b>RF Preselector On/Off, Preamp Off, LNA On<sup>f</sup></b> |   |   |                |        |                          |
| 3.5 to 13.6 GHz <sup>j</sup>                                 | X |   |                |        | +5 dBm (nominal)         |
| 3.5 to 13.6 GHz <sup>j</sup>                                 |   | X |                |        | 0 dBm (nominal)          |
| 13.5 to 26.5 GHz <sup>j</sup>                                | X |   |                |        | +1 dBm (nominal)         |
| 13.5 to 26.5 GHz <sup>j</sup>                                |   | X |                |        | -3 dBm (nominal)         |
| 26.4 to 34.5 GHz                                             |   | X |                |        | +2 dBm (nominal)         |
| 34.4 to 44 GHz                                               |   | X |                |        | -3 dBm (nominal)         |
| <b>RF Preselector On/Off, Preamp On, LNA On<sup>f</sup></b>  |   |   |                |        |                          |
| 3.5 to 13.6 GHz <sup>i</sup>                                 | X |   |                |        | -14 dBm (nominal)        |
| 3.5 to 13.6 GHz <sup>i</sup>                                 |   | X |                |        | -18 dBm (nominal)        |
| 13.5 to 26.5 GHz <sup>i</sup>                                | X | X |                |        | -20 dBm (nominal)        |
| 26.4 to 34.5 GHz                                             |   | X |                |        | -18 dBm (nominal)        |
| 34.4 to 44 GHz                                               |   | X |                |        | -27 dBm (nominal)        |

- Specified with two tones measurement in Spectrum Analyzer mode. Verified with two tones, each at -14 dBm at the input with 4 dB input attenuation, spaced by 100 kHz.
- When using EMI Receiver Mode, all indicated values shown here are nominal values. It has been verified with two tones, each at -14 dBm at the input with 4 dB input attenuation, spaced by 50 MHz.
- See the IF Prefilter Bandwidth table in the Gain Compression specifications on [page 46](#). When the tone separation condition is met, the effect on TOI of the setting of IF Gain is negligible. TOI is verified with IF Gain set to its best case condition, which is IF Gain = Low.
- RF Input 2 operates to 1 GHz. The intercept is nominally 9 dB higher for RF Input 2.
- TOI = third order intercept. The TOI is given by the mixer tone level (in dBm) minus (distortion/2) where distortion is the relative level of the distortion tones in dBc.
- Preamp level = Input level - Input Attenuation.
- TOI is verified with two tones, each at -14 dBm at the input with 22 dB input attenuation, spaced by 100 kHz.
- When the notch filter is selected the specs between source frequency 2.3 GHz to 2.6 GHz is not applicable.
- TOI is verified with two tones, each at -20 dBm at the input with 30 dB input attenuation, spaced by 100 kHz.
- TOI is verified with two tones, each at -20 dBm at the input with 14 dB input attenuation, spaced by 100 kHz.

## 9 Option TDS – Time Domain Scan

This chapter contains specifications for *Option N9048TDSB*, Time Domain Scan, and *Option N9048WT1B* or *N9048WT2B* Accelerated Time Domain Scan.

## General Specifications

| Description                                                                                                                                      | Specification                            | Supplemental Information |
|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|--------------------------|
| <b>Frequency Range</b><br><br>Standard time domain scan<br>Option N9048TDSB<br><br>Accelerated time domain scan<br>Option N9048WT1B or N9048WT2B | 20 Hz to 44 GHz<br><br>30 MHz to 3.2 GHz |                          |

| Description                                                                                                                  | Specification                        | Supplemental Information |
|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------|
| <b>Trace Detectors</b><br><br>Quasi-Peak <sup>a</sup> , Peak, EMI-Average, RMS-Average<br><br>Negative peak, Voltage Average | Meet CISPR 16-1-1:2019 requirements. | IF Gain = Low            |

a. For Acceleration = On, meets conditionally compliant requirement at pulse repetition frequency (PRF)  $\geq 10$  Hz.

| Description                                                               |                                    | Specification            | Supplemental Information |
|---------------------------------------------------------------------------|------------------------------------|--------------------------|--------------------------|
| <b>TDS Measurement</b>                                                    |                                    |                          |                          |
| <b>Maximum FFT Bandwidth</b><br>(Frequency segment processed in parallel) | <b>Acceleration = Off</b>          | <b>Acceleration = On</b> |                          |
| 20 Hz to 30 MHz                                                           | 30 MHz                             |                          |                          |
| 30 MHz to 3.2 GHz                                                         | 59 MHz                             | 350 MHz                  |                          |
| 3.2 to 3.6 GHz                                                            | 59 MHz                             |                          |                          |
| 3.6 to 44 GHz                                                             | 12.5 MHz                           |                          |                          |
| <b>FFT Overlap</b>                                                        | > 92%                              |                          |                          |
| <b>Measurement Time</b>                                                   | 10 $\mu$ s to 30 s                 |                          |                          |
| <b>Trace Point Range</b>                                                  | 1 to 4,000,001                     |                          |                          |
| <b>Frequency Step Size</b>                                                | 0.25 $\times$ Resolution Bandwidth |                          |                          |

Option TDS - Time Domain Scan  
General Specifications

| Description                            | Specification                                              | Supplemental Information |
|----------------------------------------|------------------------------------------------------------|--------------------------|
| <b>Resolution Bandwidth (RBW)</b>      |                                                            |                          |
| EMI Bandwidths (CISPR compliant)       | 200 Hz, 9 kHz, 120 kHz, 1 MHz                              |                          |
| EMI Bandwidths (MIL-STD-461 compliant) | 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz               |                          |
| Other Bandwidths (–6 dB)               | 1 Hz, 30 Hz, 300 Hz, 3 kHz, 30 kHz, 300 kHz, 3 MHz, 10 MHz |                          |

| Description                   |   |   | Specification      | Supplemental Information          |
|-------------------------------|---|---|--------------------|-----------------------------------|
| <b>RF Preselector Filters</b> |   |   |                    |                                   |
| <b>Filter Band</b>            |   |   |                    |                                   |
| <b>Acceleration = Off</b>     |   |   | <b>Filter type</b> | <b>6 dB Bandwidth (nominal)</b>   |
| <b>Acceleration = On</b>      |   |   |                    |                                   |
| 150 kHz                       |   | X | Fixed Lowpass      | 289 kHz (–3 dB corner frequency)  |
| 150 kHz to 30 MHz             |   | X | Fixed Bandpass     | 36 MHz                            |
| 30 to 300MHz                  | X |   | Fixed Bandpass     | 320 MHz                           |
| 30 to 52 MHz                  |   | X | Fixed Bandpass     | 28 MHz                            |
| 52 to 75 MHz                  |   | X | Fixed Bandpass     | 39 MHz                            |
| 75 to 120 MHz                 |   | X | Fixed Bandpass     | 63 MHz                            |
| 120 to 165 MHz                |   | X | Fixed Bandpass     | 71 MHz                            |
| 165 to 210 MHz                |   | X | Fixed Bandpass     | 69 MHz                            |
| 210 to 255 MHz                |   | X | Fixed Bandpass     | 71 MHz                            |
| 255 to 300 MHz                |   | X | Fixed Bandpass     | 68 MHz                            |
| 300 to 650 MHz                | X |   | Fixed Bandpass     | 515 MHz                           |
| 300 to 475 MHz                |   | X | Fixed Bandpass     | 284 MHz                           |
| 475 to 650 MHz                |   | X | Fixed Bandpass     | 305 MHz                           |
| 650 to 1000 MHz               | X |   | Fixed Bandpass     | 550 MHz                           |
| 650 to 825 MHz                |   | X | Fixed Bandpass     | 302 MHz                           |
| 825 to 1000 MHz               |   | X | Fixed Bandpass     | 314 MHz                           |
| 1 GHz                         | X | X | Fixed Highpass     | 912 MHz (–3 dB corner frequency)  |
| 1.7 GHz                       | X | X | Fixed Highpass     | 1.56 GHz (–3 dB corner frequency) |
| 2.9 GHz                       | X | X | Fixed Highpass     | 2.29 GHz (–3 dB corner frequency) |

Option TDS - Time Domain Scan  
General Specifications

| Description         |        |  | Specification | Supplemental Information |
|---------------------|--------|--|---------------|--------------------------|
| <b>Notch Filter</b> |        |  |               |                          |
| Reject Band         | Off/On |  |               | 2400 to 2500 MHz         |
| Reject Attenuation  |        |  |               | 20 dB (nominal)          |

| Description                                                                                                                 |  | Specification | Supplemental Information                         |                  |
|-----------------------------------------------------------------------------------------------------------------------------|--|---------------|--------------------------------------------------|------------------|
| <b>Measurement Speed</b>                                                                                                    |  |               | Measured Values                                  |                  |
|                                                                                                                             |  |               | <b>Acceleration = Off      Acceleration = On</b> |                  |
| CISPR band B, 150 kHz to 30 MHz,<br>RBW = 9 kHz,<br>measurement time = 100 ms,<br>Peak Detector                             |  |               | 110 ms (nominal)                                 |                  |
| CISPR band B, 150 kHz to 30 MHz,<br>RBW = 9 kHz, measurement time = 1 s,<br>Quasi-Peak Detector + EMI Average detector      |  |               | 2 s (nominal)                                    |                  |
| CISPR band C/D, 30 MHz to 1000 MHz,<br>RBW = 120 kHz,<br>measurement time = 10 ms<br>Peak Detector                          |  |               | 500 ms (nominal)                                 | 100 ms (nominal) |
| CISPR band C/D, 30 MHz to 1000 MHz,<br>RBW = 120 kHz, measurement time = 1 s,<br>Quasi-Peak Detector + EMI Average detector |  |               | 46.4 s (nominal)                                 | 5.8 s (nominal)  |

| Description                     |  | Specification              | Supplemental Information |
|---------------------------------|--|----------------------------|--------------------------|
| <b>Real Time Scan Bandwidth</b> |  |                            |                          |
| <i>Option N9048WT1B</i>         |  | Up to 170 MHz <sup>a</sup> |                          |
| <i>Option N9048WT2B</i>         |  | Up to 350 MHz              |                          |

- a. When the bandwidth is set wider than 170 MHz, a 15 to 60  $\mu$ s gap will be applied and cause a > 3 dB amplitude accuracy error.

## Absolute Amplitude Accuracy

| Description                                                  | Specification                                                                                                                                             | Supplemental Information |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Absolute Amplitude Accuracy</b><br><br>CISPR requirements | RF Input 1: to 44 GHz<br><br>RF Input 2: to 1 GHz<br><br>This instrument meets or exceeds the current CISPR 16-1-1 accuracy requirements from 15 to 35°C. |                          |

## Total Measurement Uncertainty

| Description                                                                                                                                                          | Specification                                                                     |                                                                                   | Supplemental Information                      |                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------|-------------------|
| <b>Total Measurement Uncertainty</b>                                                                                                                                 |                                                                                   |                                                                                   |                                               |                   |
| Signal level 0 to 90 dB below reference point, RF attenuation 0 to 40 dB, CISPR & MIL RBW, 20°C to 30°C, AC coupled 10 MHz to 26.5 GHz<br>DC coupled 9 kHz to 44 GHz |                                                                                   |                                                                                   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz |                   |
| Option 544 (mmW)                                                                                                                                                     |                                                                                   |                                                                                   | 95th Percentile ( $\approx 2\sigma$ )         |                   |
| Option 503, 508, or 526 (RF/ $\mu$ W)                                                                                                                                |                                                                                   |                                                                                   | Scan Type = Time Domain                       |                   |
| RF Preselector On, Preamp Off                                                                                                                                        |  |  | Acceleration = Off                            | Acceleration = On |
| 9 kHz to 150 kHz                                                                                                                                                     | X                                                                                 | X                                                                                 | ±0.54 dB                                      |                   |
| 150 kHz to 30 MHz                                                                                                                                                    | X                                                                                 | X                                                                                 | ±0.35 dB                                      |                   |
| 30 to 300 MHz                                                                                                                                                        | X                                                                                 | X                                                                                 | ±0.39 dB                                      | ±0.70 dB          |
| 300 MHz to 1 GHz                                                                                                                                                     | X                                                                                 | X                                                                                 | ±0.32 dB                                      | ±0.40 dB          |
| 1 to 3.6 GHz <sup>a</sup>                                                                                                                                            | X                                                                                 | X                                                                                 | ±0.32 dB                                      | ±0.40 dB          |
| 3.6 to 8.4 GHz                                                                                                                                                       | X                                                                                 |                                                                                   | ±0.55 dB                                      |                   |
| 3.6 to 5.2 GHz                                                                                                                                                       |                                                                                   | X                                                                                 | ±1.10 dB                                      |                   |
| 5.2 to 8.4 GHz                                                                                                                                                       |                                                                                   | X                                                                                 | ±0.65 dB                                      |                   |
| 8.4 to 13.5 GHz                                                                                                                                                      | X                                                                                 | X                                                                                 | ±0.55 dB                                      |                   |
| 13.6 to 17.1 GHz                                                                                                                                                     | X                                                                                 |                                                                                   | ±0.60 dB                                      |                   |
| 13.6 to 17.1 GHz                                                                                                                                                     |                                                                                   | X                                                                                 | ±0.65 dB                                      |                   |
| 17.1 to 22.0 GHz                                                                                                                                                     | X                                                                                 | X                                                                                 | ±0.70 dB                                      |                   |
| 22.0 to 26.5 GHz                                                                                                                                                     | X                                                                                 | X                                                                                 | ±0.85 dB                                      |                   |
| 26.5 to 34.5 GHz                                                                                                                                                     |                                                                                   | X                                                                                 | ±1.10 dB                                      |                   |
| 34.5 to 40.0 GHz                                                                                                                                                     |                                                                                   | X                                                                                 | ±1.50 dB                                      |                   |
| 40.0 to 44.0 GHz                                                                                                                                                     |                                                                                   | X                                                                                 | ±1.60 dB                                      |                   |
| RF Preselector On, Preamp On <sup>b</sup>                                                                                                                            |                                                                                   |                                                                                   |                                               |                   |
| 9 kHz to 150 kHz                                                                                                                                                     | X                                                                                 | X                                                                                 | ±0.55 dB                                      |                   |
| 150 kHz to 30 MHz                                                                                                                                                    | X                                                                                 | X                                                                                 | ±0.40 dB                                      |                   |
| 30 to 300 MHz                                                                                                                                                        | X                                                                                 | X                                                                                 | ±0.34 dB                                      | ±0.76 dB          |
| 300 MHz to 1 GHz                                                                                                                                                     | X                                                                                 | X                                                                                 | ±0.39 dB                                      | ±0.49 dB          |
| 1 to 3.6 GHz <sup>a</sup>                                                                                                                                            | X                                                                                 | X                                                                                 | ±0.37 dB                                      | ±0.48 dB          |

Option TDS - Time Domain Scan  
Total Measurement Uncertainty

| Description      |   |   | Specification | Supplemental Information |
|------------------|---|---|---------------|--------------------------|
| 3.6 to 8.4 GHz   | X |   |               | ±0.55 dB                 |
| 3.6 to 5.2 GHz   |   | X |               | ±1.15 dB                 |
| 5.2 to 8.4 GHz   |   | X |               | ±0.70 dB                 |
| 8.4 to 13.6 GHz  | X | X |               | ±0.55 dB                 |
| 13.6 to 17.1 GHz | X |   |               | ±0.85 dB                 |
| 13.6 to 17.1 GHz |   | X |               | ±0.70 dB                 |
| 17.1 to 18.0 GHz | X |   |               | ±0.95 dB                 |
| 17.1 to 18.0 GHz |   | X |               | ±0.70 dB                 |
| 18.0 to 26.5 GHz | X |   |               | ±1.15 dB                 |
| 18.5 to 26.5 GHz |   | X |               | ±0.90 dB                 |
| 26.5 to 34.5 GHz |   | X |               | ±1.15 dB                 |
| 34.5 to 40.0 GHz |   | X |               | ±1.50 dB                 |
| 40.0 to 44.0 GHz |   | X |               | ±1.60 dB                 |

- 3.2 GHz for Acceleration = On.
- The respective options *P03*, *P08*, and *P26* are required.

Option TDS - Time Domain Scan  
Total Measurement Uncertainty

| Description                                               |   |   | Specification                                 | Supplemental Information                                                                                                                                 |  |
|-----------------------------------------------------------|---|---|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Total Measurement Uncertainty, LNA ON</b>              |   |   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz | <b>95th Percentile (<math>\approx 2\sigma</math>)</b><br><br><b>Scan Type = Time Domain</b><br><br><b>Acceleration = Off</b><br><b>Acceleration = On</b> |  |
| Signal level 0 to 90 dB below reference point,            |   |   |                                               |                                                                                                                                                          |  |
| RF attenuation 0 to 40 dB, CISPR & MIL RBW, 20°C to 30°C, |   |   |                                               |                                                                                                                                                          |  |
| AC coupled 10 MHz to 26.5 GHz                             |   |   |                                               |                                                                                                                                                          |  |
| DC coupled 9 kHz to 44 GHz                                |   |   |                                               |                                                                                                                                                          |  |
| Option 544 (mmW)                                          |   |   |                                               |                                                                                                                                                          |  |
| Option 503, 508, or 526 (RF/ $\mu$ W)                     |   |   |                                               |                                                                                                                                                          |  |
| <b>RF Preselector On, Preamp On/Off<sup>a</sup></b>       | ↓ | ↓ |                                               |                                                                                                                                                          |  |
| 10 to 30 MHz                                              | X | X |                                               |                                                                                                                                                          |  |
| 30 to 300 MHz                                             | X | X |                                               |                                                                                                                                                          |  |
| 300 MHz to 1.0 GHz                                        | X | X |                                               |                                                                                                                                                          |  |
| 1.0 to 3.6 GHz <sup>b</sup>                               | X | X |                                               |                                                                                                                                                          |  |
| <b>RF Preselector On, Preamp Off<sup>a</sup></b>          |   |   |                                               |                                                                                                                                                          |  |
| 3.6 to 8.4 GHz                                            | X |   |                                               |                                                                                                                                                          |  |
| 3.6 to 5.2 GHz                                            |   | X |                                               |                                                                                                                                                          |  |
| 5.2 to 8.4 GHz                                            |   | X |                                               |                                                                                                                                                          |  |
| 8.4 to 13.5 GHz                                           | X | X |                                               |                                                                                                                                                          |  |
| 13.6 to 17.1 GHz                                          | X |   |                                               |                                                                                                                                                          |  |
| 13.6 to 17.1 GHz                                          |   | X |                                               |                                                                                                                                                          |  |
| 17.1 to 18.0 GHz                                          | X |   |                                               |                                                                                                                                                          |  |
| 17.1 to 18.0 GHz                                          |   | X |                                               |                                                                                                                                                          |  |
| 18.0 to 26.5 GHz                                          | X |   |                                               |                                                                                                                                                          |  |
| 18.5 to 26.5 GHz                                          |   | X |                                               |                                                                                                                                                          |  |
| 26.5 to 34.5 GHz                                          |   | X |                                               |                                                                                                                                                          |  |
| 34.5 to 40.0 GHz                                          |   | X |                                               |                                                                                                                                                          |  |
| 40.0 to 44.0 GHz                                          |   | X |                                               |                                                                                                                                                          |  |
| <b>RF Preselector On, Preamp On<sup>a</sup></b>           |   |   |                                               |                                                                                                                                                          |  |
| 3.6 to 8.4 GHz                                            | X |   |                                               |                                                                                                                                                          |  |
| 3.6 to 5.2 GHz                                            |   | X |                                               |                                                                                                                                                          |  |
| 5.2 to 8.4 GHz                                            |   | X |                                               |                                                                                                                                                          |  |
| 8.4 to 13.5 GHz                                           | X | X |                                               |                                                                                                                                                          |  |
| 13.6 to 17.1 GHz                                          | X |   |                                               |                                                                                                                                                          |  |
| 13.6 to 17.1 GHz                                          |   | X |                                               |                                                                                                                                                          |  |

Option TDS - Time Domain Scan  
Total Measurement Uncertainty

| Description      |   |   | Specification | Supplemental Information |
|------------------|---|---|---------------|--------------------------|
| 17.1 to 18.0 GHz | X |   |               | ±1.05 dB                 |
| 17.1 to 18.0 GHz |   | X |               | ±0.75 dB                 |
| 18.0 to 26.5 GHz | X |   |               | ±1.20 dB                 |
| 18.5 to 26.5 GHz |   | X |               | ±0.90 dB                 |
| 26.5 to 34.5 GHz |   | X |               | ±1.15 dB                 |
| 34.5 to 40.0 GHz |   | X |               | ±1.50 dB                 |
| 40.0 to 44.0 GHz |   | X |               | ±1.60 dB                 |

- The respective options *P03*, *P08*, *P26* and *P44* are required.
- 3.2 GHz for Acceleration = On.

## Indicated Noise (EMI Receiver Mode)

| Description                                                                          | Specification                                       |   | Supplemental Information                                                                                                                                                              |                          |
|--------------------------------------------------------------------------------------|-----------------------------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Indicated Noise (EMI Receiver Mode)<sup>a</sup></b><br>(RF Input 1 <sup>b</sup> ) |                                                     |   | Input terminated<br>EMI Average detector<br>0 dB input attenuation<br>IF Gain = High (Best Noise Level)<br>All indicated RBW are CISPR BW except as noted.<br>Scan Type = Time Domain |                          |
|                                                                                      | Option 544 (mmW)<br>Option 503, 508, or 526 (RF/μW) |   |                                                                                                                                                                                       |                          |
|                                                                                      | ↓                                                   | ↓ | <b>Typical Indicated Noise Including NFE<sup>c</sup></b>                                                                                                                              |                          |
| <b>RF Preselector On, Preamp Off</b>                                                 |                                                     |   | <b>Acceleration = Off</b>                                                                                                                                                             | <b>Acceleration = On</b> |
| 1 Hz (1 Hz RBW) <sup>d</sup>                                                         | X                                                   | X | 32 dBμV (nominal)                                                                                                                                                                     |                          |
| 10 Hz (1 Hz RBW) <sup>d</sup>                                                        | X                                                   | X | 2 dBμV (nominal)                                                                                                                                                                      |                          |
| 20 Hz (1 Hz RBW) <sup>d</sup>                                                        | X                                                   |   | -21 dBμV <sup>e</sup>                                                                                                                                                                 |                          |
| 20 Hz (1 Hz RBW) <sup>d</sup>                                                        |                                                     | X | -6 dBμV <sup>e</sup>                                                                                                                                                                  |                          |
| 100 Hz (10 Hz RBW) <sup>d</sup>                                                      | X                                                   |   | -20 dBμV <sup>e</sup>                                                                                                                                                                 |                          |
| 100 Hz (10 Hz RBW) <sup>d</sup>                                                      |                                                     | X | -15 dBμV <sup>e</sup>                                                                                                                                                                 |                          |
| 1 kHz (100 Hz RBW) <sup>d</sup>                                                      | X                                                   | X | -19 dBμV <sup>e</sup>                                                                                                                                                                 |                          |
| 9 kHz to 150 kHz (200 Hz RBW)                                                        | X                                                   | X | -24 dBμV                                                                                                                                                                              |                          |
| 150 kHz to 1 MHz (9 kHz RBW)                                                         | X                                                   | X | -20 dBμV                                                                                                                                                                              |                          |
| 1 MHz to 30 MHz (9 kHz RBW)                                                          | X                                                   | X | -19 dBμV                                                                                                                                                                              |                          |
| 30 MHz to 1 GHz (120 kHz RBW)                                                        | X                                                   |   | -3 dBμV                                                                                                                                                                               | 6 dBμV                   |
| 30 MHz to 1 GHz (120 kHz RBW)                                                        |                                                     | X | -3 dBμV                                                                                                                                                                               | 7 dBμV                   |
| 1 GHz to 2.5 GHz (1 MHz RBW)                                                         | X                                                   |   | 7 dBμV                                                                                                                                                                                | 15 dBμV                  |
| 1 GHz to 2.5 GHz (1 MHz RBW)                                                         |                                                     | X | 7 dBμV                                                                                                                                                                                | 16 dBμV                  |
| 2.5 GHz to 3.6 GHz (1 MHz RBW) <sup>f</sup>                                          | X                                                   |   | 10 dBμV                                                                                                                                                                               | 18 dBμV                  |
| 2.5 GHz to 3.6 GHz (1 MHz RBW) <sup>f</sup>                                          |                                                     | X | 10 dBμV                                                                                                                                                                               | 19 dBμV                  |
| 3.6 GHz to 8.4 GHz (1 MHz RBW)                                                       | X                                                   |   | 6 dBμV                                                                                                                                                                                |                          |
| 3.6 GHz to 8.4 GHz (1 MHz RBW)                                                       |                                                     | X | 9 dBμV                                                                                                                                                                                |                          |

Option TDS - Time Domain Scan  
Indicated Noise (EMI Receiver Mode)

| Description                                              |   |   | Specification | Supplemental Information |         |
|----------------------------------------------------------|---|---|---------------|--------------------------|---------|
| 8.4 GHz to 13.6 GHz (1 MHz RBW)                          | X |   |               | 7 dBμV                   |         |
| 8.4 GHz to 13.6 GHz (1 MHz RBW)                          |   | X |               | 8 dBμV                   |         |
| 13.6 GHz to 17.1 GHz (1 MHz RBW)                         | X |   |               | 9 dBμV                   |         |
| 13.6 GHz to 17.1 GHz (1 MHz RBW)                         |   | X |               | 11 dBμV                  |         |
| 17.1 GHz to 25.0 GHz (1 MHz RBW)                         | X |   |               | 10 dBμV                  |         |
| 17.1 GHz to 25.0 GHz (1 MHz RBW)                         |   | X |               | 14 dBμV                  |         |
| 25.0 GHz to 26.5 GHz (1 MHz RBW)                         | X |   |               | 14 dBμV                  |         |
| 25.0 GHz to 26.5 GHz (1 MHz RBW)                         |   | X |               | 15 dBμV                  |         |
| 26.5 GHz to 34.5 GHz (1 MHz RBW)                         |   | X |               | 15 dBμV                  |         |
| 34.5 GHz to 40 GHz (1 MHz RBW)                           |   | X |               | 19 dBμV                  |         |
| 40 GHz to 42 GHz (1 MHz RBW)                             |   | X |               | 20 dBμV                  |         |
| 42 GHz to 44 GHz (1 MHz RBW)                             |   | X |               | 23 dBμV                  |         |
| <b>RF Preselector On, Preamp On, LNA Off<sup>g</sup></b> |   |   |               |                          |         |
| 1 kHz (100 Hz RBW) <sup>d</sup>                          | X | X |               | -28 dBμV <sup>e</sup>    |         |
| 9 kHz to 150 kHz (200 Hz RBW)                            | X | X |               | -32 dBμV                 |         |
| 150 kHz to 1 MHz (9 kHz RBW)                             | X | X |               | -23 dBμV                 |         |
| 1 MHz to 30 MHz (9 kHz RBW)                              | X | X |               | -24 dBμV                 |         |
| 30 MHz to 1 GHz (120 kHz RBW)                            | X | X |               | -13 dBμV                 | -8 dBμV |
| 1 GHz to 2.5 GHz (1 MHz RBW)                             | X |   |               | -4 dBμV                  | 0 dBμV  |
| 1 GHz to 2.5 GHz (1 MHz RBW)                             |   | X |               | -4 dBμV                  | 1 dBμV  |
| 2.5 GHz to 3.6 GHz (1 MHz RBW) <sup>f</sup>              | X | X |               | -1 dBμV                  | 3 dBμV  |
| 3.6 GHz to 8.4 GHz (1 MHz RBW)                           | X |   |               | -5 dBμV                  |         |
| 3.6 GHz to 8.4 GHz (1 MHz RBW)                           |   | X |               | -3 dBμV                  |         |
| 8.4 GHz to 13.6 GHz (1 MHz RBW)                          | X | X |               | -4 dBμV                  |         |
| 13.6 GHz to 17.1 GHz (1 MHz RBW)                         | X | X |               | -5 dBμV                  |         |
| 17.1 GHz to 25.0 GHz (1 MHz RBW)                         | X | X |               | -1 dBμV                  |         |
| 25.0 GHz to 26.5 GHz (1 MHz RBW)                         | X | X |               | 0 dBμV                   |         |
| 26.5 GHz to 34.5 GHz (1 MHz RBW)                         |   | X |               | 1 dBμV                   |         |
| 34.5 GHz to 40 GHz (1 MHz RBW)                           |   | X |               | 6 dBμV                   |         |
| 40 GHz to 42 GHz (1 MHz RBW)                             |   | X |               | 7 dBμV                   |         |
| 42 GHz to 43 GHz (1 MHz RBW)                             |   | X |               | 9 dBμV                   |         |
| 43 GHz to 44 GHz (1 MHz RBW)                             |   | X |               | 18 dBμV                  |         |

a. When the notch filter is selected the Indicated Noise specs between 2.2 GHz – 2.9 GHz is nominally specified.

Option TDS - Time Domain Scan  
Indicated Noise (EMI Receiver Mode)

- b. RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
- c. Typical Indicated Noise including NFE = Typical DANL + RBW correction – DANL Improvement with NFE +107.
- d. Indicated RBW is a 6 dB bandwidth.
- e. NFE is not part of the difference between warranted and typical specifications at this frequency.
- f. 3.2 GHz for Acceleration = On.
- g. The respective options P03, P08, P26 and P44 are required.

| Description                                                                                  | Specification    |   | Supplemental Information                                                                                                                                                                  |          |
|----------------------------------------------------------------------------------------------|------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>Indicated Noise (EMI Receiver Mode), LNA On<sup>a</sup></b><br>(RF Input 1 <sup>b</sup> ) |                  |   | Input terminated<br><br>EMI Average detector<br>0 dB input attenuation<br>IF Gain = High (Best Noise Level)<br>All indicated RBW are CISPR BW except as noted.<br>Scan Type = Time Domain |          |
|                                                                                              | Option 544 (mmW) |   |                                                                                                                                                                                           |          |
| Option 503, 508, or 526 (RF/μW)                                                              | ↓                | ↓ |                                                                                                                                                                                           |          |
| RF Preselector On, Preamp On/Off <sup>d</sup>                                                |                  |   | <b>Typical Indicated Noise Including NFE<sup>c</sup></b><br><b>Acceleration = Off      Acceleration = On</b>                                                                              |          |
| 10 MHz to 30 MHz (9 kHz RBW)                                                                 | X                | X | −18 dBμV                                                                                                                                                                                  |          |
| 30 MHz to 1 GHz (120 kHz RBW)                                                                | X                |   | −12 dBμV                                                                                                                                                                                  | −12 dBμV |
| 30 MHz to 1 GHz (120 kHz RBW)                                                                |                  | X | −12 dBμV                                                                                                                                                                                  | −10 dBμV |
| 1 GHz to 2.5 GHz (1 MHz RBW)                                                                 | X                |   | −6 dBμV                                                                                                                                                                                   | −4 dBμV  |
| 1 GHz to 2.5 GHz (1 MHz RBW)                                                                 |                  | X | −6 dBμV                                                                                                                                                                                   | −2 dBμV  |
| 2.5 GHz to 3.6 GHz (1 MHz RBW) <sup>e</sup>                                                  | X                |   | −5 dBμV                                                                                                                                                                                   | −2 dBμV  |
| 2.5 GHz to 3.6 GHz (1 MHz RBW) <sup>e</sup>                                                  |                  | X | −5 dBμV                                                                                                                                                                                   | 0 dBμV   |
| <b>RF Preselector On, Preamp Off<sup>d</sup></b>                                             |                  |   |                                                                                                                                                                                           |          |
| 3.6 GHz to 8.4 GHz (1 MHz RBW)                                                               | X                |   | −6 dBμV                                                                                                                                                                                   |          |
| 3.6 GHz to 8.4 GHz (1 MHz RBW)                                                               |                  | X | −3 dBμV                                                                                                                                                                                   |          |
| 8.4 GHz to 13.6 GHz (1 MHz RBW)                                                              | X                |   | −5 dBμV                                                                                                                                                                                   |          |
| 8.4 GHz to 13.6 GHz (1 MHz RBW)                                                              |                  | X | −4 dBμV                                                                                                                                                                                   |          |
| 13.6 GHz to 17.1 GHz (1 MHz RBW)                                                             | X                |   | −5 dBμV                                                                                                                                                                                   |          |
| 13.6 GHz to 17.1 GHz (1 MHz RBW)                                                             |                  | X | −4 dBμV                                                                                                                                                                                   |          |
| 17.1 GHz to 25.0 GHz (1 MHz RBW)                                                             | X                |   | −2 dBμV                                                                                                                                                                                   |          |
| 17.1 GHz to 25.0 GHz (1 MHz RBW)                                                             |                  | X | 0 dBμV                                                                                                                                                                                    |          |
| 25.0 GHz to 26.5 GHz (1 MHz RBW)                                                             | X                |   | 1 dBμV                                                                                                                                                                                    |          |
| 25.0 GHz to 26.5 GHz (1 MHz RBW)                                                             |                  | X | 2 dBμV                                                                                                                                                                                    |          |

**Typical Indicated Noise Including NFE<sup>c</sup>**

**Acceleration = Off      Acceleration = On**

–18 dBμV

–12 dBμV      –12 dBμV

–12 dBμV      –10 dBμV

–6 dBμV      –4 dBμV

–6 dBμV      –2 dBμV

–5 dBμV      –2 dBμV

–5 dBμV      0 dBμV

–6 dBμV

–3 dBμV

–5 dBμV

–4 dBμV

–5 dBμV

–4 dBμV

–2 dBμV

0 dBμV

1 dBμV

2 dBμV

Option TDS - Time Domain Scan  
Indicated Noise (EMI Receiver Mode)

| Description                                     |   |   | Specification | Supplemental Information |
|-------------------------------------------------|---|---|---------------|--------------------------|
| 26.5 GHz to 34.5 GHz (1 MHz RBW)                |   | X |               | 2 dBμV                   |
| 34.5 GHz to 40 GHz (1 MHz RBW)                  |   | X |               | 7 dBμV                   |
| 40 GHz to 42 GHz (1 MHz RBW)                    |   | X |               | 8 dBμV                   |
| 42 GHz to 43 GHz (1 MHz RBW)                    |   | X |               | 11 dBμV                  |
| 43 GHz to 44 GHz (1 MHz RBW)                    |   | X |               | 19 dBμV                  |
| <b>RF Preselector On, Preamp On<sup>d</sup></b> |   |   |               |                          |
| 3.6 GHz to 8.4 GHz (1 MHz RBW)                  | X |   |               | -6 dBμV                  |
| 3.6 GHz to 8.4 GHz (1 MHz RBW)                  |   | X |               | -5 dBμV                  |
| 8.4 GHz to 13.6 GHz (1 MHz RBW)                 | X | X |               | -6 dBμV                  |
| 13.6 GHz to 17.1 GHz (1 MHz RBW)                | X | X |               | -5 dBμV                  |
| 17.1 GHz to 25.0 GHz (1 MHz RBW)                | X | X |               | -2 dBμV                  |
| 25.0 GHz to 26.5 GHz (1 MHz RBW)                | X | X |               | -1 dBμV                  |
| 26.5 GHz to 34.5 GHz (1 MHz RBW)                |   | X |               | 1 dBμV                   |
| 34.5 GHz to 40 GHz (1 MHz RBW)                  |   | X |               | 4 dBμV                   |
| 40 GHz to 42 GHz (1 MHz RBW)                    |   | X |               | 4 dBμV                   |
| 42 GHz to 43 GHz (1 MHz RBW)                    |   | X |               | 5 dBμV                   |
| 43 GHz to 44 GHz (1 MHz RBW)                    |   | X |               | 18 dBμV                  |

- When the notch filter is selected the Indicated Noise specs between 2.2 GHz – 2.9 GHz is nominally specified.
- RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
- Typical Indicated Noise including NFE = Typical DANL + RBW correction – DANL Improvement with NFE +107.
- The respective options *P03*, *P08*, *P26* and *P44* are required.
- 3.2 GHz for Acceleration = On.

Option TDS - Time Domain Scan  
Indicated Noise (EMI Receiver Mode)

| Description                                                                         |   |   | Specification                                 | Supplemental Information              |                          |
|-------------------------------------------------------------------------------------|---|---|-----------------------------------------------|---------------------------------------|--------------------------|
| <b>DANL and Indicated Noise Improvement with Noise Floor Extension<sup>ab</sup></b> |   |   | RF Input 1: to 44 GHz<br>RF Input 2: to 1 GHz | Best DANL                             |                          |
| Option 544 (mmW)                                                                    |   |   |                                               |                                       |                          |
| Option 503, 508, or 526 (RF/μW)                                                     |   |   |                                               |                                       |                          |
|                                                                                     | ↓ | ↓ |                                               | 95th Percentile ( $\approx 2\sigma$ ) |                          |
| <b>RF Preselector On, Preamp Off</b>                                                |   |   |                                               | Scan Type = Time Domain               |                          |
|                                                                                     |   |   |                                               | <b>Acceleration = Off</b>             | <b>Acceleration = On</b> |
| 150 kHz <sup>c</sup> to 30 MHz                                                      | X | X |                                               | 8 dB                                  |                          |
| 30 MHz to 1 GHz                                                                     | X | X |                                               | 6 dB                                  | 2 dB                     |
| 1 to 3.6 GHz <sup>d</sup>                                                           | X | X |                                               | 6 dB                                  | 2 dB                     |
| 3.6 to 8.4 GHz                                                                      | X | X |                                               | 8 dB                                  |                          |
| 8.4 to 13.6 GHz                                                                     | X | X |                                               | 8 dB                                  |                          |
| 13.6 to 17.1 GHz                                                                    | X | X |                                               | 7 dB                                  |                          |
| 17.1 to 26.5 GHz                                                                    | X | X |                                               | 8 dB                                  |                          |
| 26.5 GHz to 34.5 GHz                                                                |   | X |                                               | 8 dB                                  |                          |
| 34.5 GHz to 44 GHz                                                                  |   | X |                                               | 8 dB                                  |                          |
| <b>RF Preselector On, Preamp On, LNA Off<sup>e</sup></b>                            |   |   |                                               |                                       |                          |
| 150 kHz <sup>c</sup> to 30 MHz                                                      | X | X |                                               | 8 dB                                  |                          |
| 30 MHz to 1 GHz                                                                     | X | X |                                               | 6 dB                                  | 4 dB                     |
| 1 to 3.6 GHz <sup>d</sup>                                                           | X | X |                                               | 6 dB                                  | 4 dB                     |
| 3.6 to 8.4 GHz                                                                      | X |   |                                               | 7 dB                                  |                          |
| 3.6 GHz to 8.4 GHz                                                                  |   | X |                                               | 5 dB                                  |                          |
| 8.4 to 13.6 GHz                                                                     | X | X |                                               | 7 dB                                  |                          |
| 13.6 to 17.1 GHz                                                                    | X |   |                                               | 8 dB                                  |                          |
| 13.6 GHz to 17.1 GHz                                                                |   | X |                                               | 7 dB                                  |                          |
| 17.1 to 26.5 GHz                                                                    | X | X |                                               | 6 dB                                  |                          |
| 26.5 GHz to 34.5 GHz                                                                |   | X |                                               | 6 dB                                  |                          |
| 34.5 GHz to 44 GHz                                                                  |   | X |                                               | 4 dB                                  |                          |

- a. This statement on the improvement in DANL is based on the statistical observations of the error in the effective noise floor after NFE is applied. That effective noise floor can be a negative or a positive power at any frequency. These 95th percentile values are based on the absolute value of that effective remainder noise power.

Option TDS - Time Domain Scan  
Indicated Noise (EMI Receiver Mode)

- b. Unlike other 95th percentiles, these table values do not include delta environment effects. NFE is aligned in the factory at room temperature. For best performance, in an environment that is different from room temperature, such as an equipment rack with other instruments, we recommend running the "Characterize Noise Floor" operation after the first time the analyzer has been installed in the environment, and given an hour to stabilize.
- c. For RF Preselector path, NFE does not apply at frequencies below 100 kHz. At frequencies between 100 kHz and 150 kHz, the NFE effectiveness is not measured, but is designed to be nominally the same as frequencies above 150 kHz.
- d. 3.2 GHz for Acceleration = On.
- e. The respective options *P03*, *P08*, *P26* and *P44* are required.

| Description                                                                                                                                                                            | Specification                                   |   | Supplemental Information                                                                                           |      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------|------|
| <b>DANL and Indicated Noise Improvement with Noise Floor Extension, LNA On<sup>ab</sup></b><br><br><div> <div>Option 544 (mmW)</div> <div>Option 503, 508, or 526 (RF/μW)</div> </div> | RF Input 1: to 26.5 GHz<br>RF Input 2: to 1 GHz |   | Best DANL                                                                                                          |      |
|                                                                                                                                                                                        | <div> <div>↓</div> <div>↓</div> </div>          |   | <b>95th Percentile (≈2σ)</b><br><b>Scan Type = Time Domain</b><br><b>Acceleration = Off      Acceleration = On</b> |      |
| <b>RF Preselector On, Preamp On/Off<sup>c</sup></b>                                                                                                                                    |                                                 |   |                                                                                                                    |      |
| 10 MHz <sup>d</sup> to 30 MHz                                                                                                                                                          | X                                               | X | 8 dB                                                                                                               |      |
| 30 MHz to 1 GHz                                                                                                                                                                        | X                                               |   | 6 dB                                                                                                               | 7 dB |
| 30 MHz to 1 GHz                                                                                                                                                                        |                                                 | X | 6 dB                                                                                                               | 5 dB |
| 1 to 3.6 GHz <sup>e</sup>                                                                                                                                                              | X                                               |   | 6 dB                                                                                                               | 5 dB |
| 1 to 3.6 GHz <sup>e</sup>                                                                                                                                                              |                                                 | X | 6 dB                                                                                                               | 4 dB |
| <b>RF Preselector On, Preamp Off<sup>c</sup></b>                                                                                                                                       |                                                 |   |                                                                                                                    |      |
| 3.6 to 8.4 GHz                                                                                                                                                                         | X                                               |   | 7 dB                                                                                                               |      |
| 3.6 to 8.4 GHz                                                                                                                                                                         |                                                 | X | 6 dB                                                                                                               |      |
| 8.4 to 13.6 GHz                                                                                                                                                                        | X                                               | X | 7 dB                                                                                                               |      |
| 13.6 to 17.1 GHz                                                                                                                                                                       | X                                               |   | 8 dB                                                                                                               |      |
| 13.6 to 17.1 GHz                                                                                                                                                                       |                                                 | X | 7 dB                                                                                                               |      |
| 17.1 to 26.5 GHz                                                                                                                                                                       | X                                               | X | 7 dB                                                                                                               |      |
| 26.5 GHz to 34.5 GHz                                                                                                                                                                   |                                                 | X | 8 dB                                                                                                               |      |
| 34.5 GHz to 44 GHz                                                                                                                                                                     |                                                 | X | 7 dB                                                                                                               |      |
| <b>RF Preselector On, Preamp On<sup>c</sup></b>                                                                                                                                        |                                                 |   |                                                                                                                    |      |
| 3.6 to 8.4 GHz                                                                                                                                                                         | X                                               |   | 6 dB                                                                                                               |      |
| 3.6 to 8.4 GHz                                                                                                                                                                         |                                                 | X | 5 dB                                                                                                               |      |

Option TDS - Time Domain Scan  
Indicated Noise (EMI Receiver Mode)

| Description          |   |   | Specification | Supplemental Information |
|----------------------|---|---|---------------|--------------------------|
| 8.4 to 13.6 GHz      | X |   |               | 7 dB                     |
| 8.4 to 13.6 GHz      |   | X |               | 6 dB                     |
| 13.6 to 17.1 GHz     | X |   |               | 7 dB                     |
| 13.6 to 17.1 GHz     |   | X |               | 6 dB                     |
| 17.1 to 26.5 GHz     | X |   |               | 5 dB                     |
| 17.1 to 26.5 GHz     |   | X |               | 6 dB                     |
| 26.5 GHz to 34.5 GHz |   | X |               | 5 dB                     |
| 34.5 GHz to 44 GHz   |   | X |               | 4 dB                     |

- This statement on the improvement in DANL is based on the statistical observations of the error in the effective noise floor after NFE is applied. That effective noise floor can be a negative or a positive power at any frequency. These 95th percentile values are based on the absolute value of that effective remainder noise power.
- Unlike other 95th percentiles, these table values do not include delta environment effects. NFE is aligned in the factory at room temperature. For best performance, in an environment that is different from room temperature, such as an equipment rack with other instruments, we recommend running the "Characterize Noise Floor" operation after the first time the analyzer has been installed in the environment, and given an hour to stabilize.
- The respective options *P03*, *P08*, and *P26* are required.
- For RF Preselector path, NFE does not apply at frequencies below 100 kHz. At frequencies between 100 kHz and 150 kHz, the NFE effectiveness is not measured, but is designed to be nominally the same as frequencies above 150 kHz.
- 3.2 GHz for Acceleration = On.

## Third Order Intermodulation

| Description                                                         | Specification |   | Supplemental Information |                   |
|---------------------------------------------------------------------|---------------|---|--------------------------|-------------------|
| Third Order Modulation (TDS Measurement)                            |               |   |                          |                   |
| (Tone separation = 50 MHz with verification conditions <sup>a</sup> |               |   |                          |                   |
| RF Input 1 <sup>b</sup> )                                           |               |   |                          |                   |
| Option 544 (mmW)                                                    |               |   |                          |                   |
| Option 503, 508, or 526 (RF/μW)                                     |               |   |                          |                   |
|                                                                     | ↓             | ↓ | Intercept <sup>c</sup>   |                   |
|                                                                     |               |   | Acceleration = Off       | Acceleration = On |
| RF Preselector Off, Preamp Off, LNA Off                             |               |   | Nominal                  | Nominal           |
| Source Frequency                                                    |               |   |                          |                   |
| 10 to 400 MHz                                                       | X             | X | +14 dBm                  |                   |
| 400 MHz to 1 GHz                                                    | X             | X | +20 dBm                  |                   |
| 1 to 3.6 GHz                                                        | X             | X | +18 dBm                  |                   |
| 3.6 to 4 GHz                                                        | X             | X | +21 dBm                  |                   |
| 4 to 13.6 GHz                                                       | X             | X | +20 dBm                  |                   |
| 13.6 to 26.5 GHz                                                    | X             | X | +17 dBm                  |                   |
| 26.5 GHz to 44GHz                                                   |               | X | +14 dBm                  |                   |
| RF Preselector On, Preamp Off, LNA Off                              |               |   |                          |                   |
| Source Frequency                                                    |               |   |                          |                   |
| 10 to 250 MHz                                                       | X             | X | +16 dBm                  |                   |
| 30 to 150 MHz                                                       | X             |   |                          | +12 dBm           |
| 30 to 150 MHz                                                       |               | X |                          | +9 dBm            |
| 150 MHz to 250 MHz                                                  | X             |   |                          | +14 dBm           |
| 150 MHz to 250 MHz                                                  |               | X |                          | +13 dBm           |
| 250 MHz to 1 GHz                                                    | X             | X | +20 dBm                  |                   |
| 250 MHz to 1 GHz                                                    | X             |   |                          | +14 dBm           |
| 250 MHz to 1 GHz                                                    |               | X |                          | +13 dBm           |
| 1 to 3.6 GHz <sup>d</sup>                                           | X             | X | +19 dBm                  | +12 dBm           |

- a. Verified with two tones, each at -14 dBm at the input with 4 dB input attenuation, spaced by 50 MHz.
- b. RF Input 2 operates to 1 GHz. The intercept is nominally 9 dB higher for RF Input 2.
- c. TOI = third order intercept. The TOI is given by the mixer tone level (in dBm) minus (distortion/2) where distortion is the relative level of the distortion tones in dBc.
- d. When the notch filter is selected the specs between source frequency 2.3 GHz to 2.6 GHz is not applicable.

Option TDS - Time Domain Scan  
Third Order Intermodulation

| Description                                                               | Specification |   | Supplemental Information      |                              |
|---------------------------------------------------------------------------|---------------|---|-------------------------------|------------------------------|
| <b>Third Order Modulation (TDS Measurement)<sup>a</sup></b>               |               |   |                               |                              |
| (Tone separation = 50 MHz with verification,<br>RF Input 1 <sup>b</sup> ) |               |   |                               |                              |
| Option 544 (mmW)                                                          |               |   |                               |                              |
| Option 503, 508, or 526 (RF/μW)                                           |               |   | <b>Intercept<sup>c</sup></b>  |                              |
|                                                                           |               |   | <b>Acceleration<br/>= Off</b> | <b>Acceleration<br/>= On</b> |
| RF Preselector Off, Preamp Off, LNA On                                    |               |   | Nominal                       | Nominal                      |
| Source Frequency                                                          |               |   |                               |                              |
| 30 to 400 MHz <sup>d</sup>                                                | X             | X | −2 dBm                        |                              |
| 400 MHz to 1 GHz <sup>d</sup>                                             | X             | X | +8 dBm                        |                              |
| 1 to 3.6 GHz <sup>d</sup>                                                 | X             | X | +6 dBm                        |                              |
| 3.6 to 4 GHz <sup>e</sup>                                                 | X             | X | +2 dBm                        |                              |
| 4 to 13.6 GHz <sup>e</sup>                                                | X             | X | +2 dBm                        |                              |
| 13.6 to 26.5 GHz <sup>e</sup>                                             | X             | X | −2 dBm                        |                              |
| 26.5 to 44 GHz                                                            |               | X | −3 dBm                        |                              |
| <b>RF Preselector On, Preamp Off, LNA On<sup>d</sup></b>                  |               |   |                               |                              |
| Source Frequency                                                          |               |   |                               |                              |
| 30 to 400 MHz                                                             | X             | X | −1 dBm                        | −1 dBm                       |
| 400 MHz to 1 GHz                                                          | X             | X | +4 dBm                        | −2 dBm                       |
| 1 to 3.6 GHz <sup>f</sup>                                                 | X             | X | +2 dBm                        | −2 dBm                       |
| <b>RF Preselector Off, Preamp On, LNA Off</b>                             |               |   |                               |                              |
| 10 to 400 MHz <sup>d</sup>                                                | X             | X | −2 dBm                        |                              |
| 400 MHz to 1 GHz <sup>d</sup>                                             | X             | X | +6 dBm                        |                              |
| 1 to 3.6 GHz <sup>d</sup>                                                 | X             | X | +4 dBm                        |                              |
| 3.6 to 4 GHz <sup>g</sup>                                                 | X             | X | −11 dBm                       |                              |
| 4 to 13.6 GHz <sup>g</sup>                                                | X             | X | −11 dBm                       |                              |
| 13.6 to 26.5 GHz <sup>g</sup>                                             | X             | X | −10 dBm                       |                              |
| 26.5 to 44 GHz                                                            |               | X | −10 dBm                       |                              |

Option TDS - Time Domain Scan  
Third Order Intermodulation

| Description                                              |   |   | Specification | Supplemental Information     |                          |
|----------------------------------------------------------|---|---|---------------|------------------------------|--------------------------|
| <b>RF Preselector On, Preamp On, LNA Off<sup>d</sup></b> |   |   |               | <b>Intercept<sup>c</sup></b> |                          |
|                                                          |   |   |               | <b>Acceleration = Off</b>    | <b>Acceleration = On</b> |
| 10 to 250 MHz                                            | X | X |               | -1 dBm                       |                          |
| 30 to 200 MHz                                            | X |   |               |                              | -4 dBm                   |
| 30 to 200 MHz                                            |   | X |               |                              | -7 dBm                   |
| 250 MHz to 1 GHz                                         | X | X |               | +5 dBm                       |                          |
| 200 MHz to 1 GHz                                         | X | X |               |                              | -2 dBm                   |
| 1 to 3.6 GHz <sup>f</sup>                                | X | X |               | +4 dBm                       | -2 dBm                   |
| <b>RF Preselector Off, Preamp On, LNA On</b>             |   |   |               |                              |                          |
| 3.6 to 4 GHz <sup>g</sup>                                | X | X |               | -10 dBm                      |                          |
| 4 to 13.6 GHz <sup>g</sup>                               | X | X |               | -10 dBm                      |                          |
| 13.6 to 26.5 GHz <sup>g</sup>                            | X | X |               | -10 dBm                      |                          |
| 26.5 to 44 GHz                                           |   | X |               | -10 dBm                      |                          |

- Specified with two tones measurement spaced by 50 MHz in Time Domain Scan Measurement.
- RF Input 2 operates to 1 GHz. The intercept is nominally 9 dB higher for RF Input 2.
- TOI = third order intercept. The TOI is given by the mixer tone level (in dBm) minus (distortion/2) where distortion is the relative level of the distortion tones in dBc.
- Preamp level = Input level - Input Attenuation; input level = -14 dBm and RF input attenuation = 22 dB.
- Preamp level = Input level - Input Attenuation; input level = -20 dBm and RF input attenuation = 14 dB.
- When the notch filter is selected the specs between source frequency 2.3 GHz to 2.6 GHz is not applicable.
- Preamp level = Input level - Input Attenuation; input level = -20 dBm and RF input attenuation = 30 dB.



## 10 Option YAS – Y-Axis Screen Video Output

This chapter contains specifications for *Option YAS*, Y-Axis Screen Video Output.

## Specifications Affected by Y-Axis Screen Video Output

No other analyzer specifications are affected by the presence or use of this option. New specifications are given in the following pages.

# Other Y-Axis Screen Video Output Specifications

## General Port Specifications

| Description | Specifications | Supplemental Information  |
|-------------|----------------|---------------------------|
| Connector   | BNC female     | Shared with other options |
| Impedance   |                | <140Ω (nominal)           |

## Screen Video

| Description                                                                    | Specifications                                                                                                           | Supplemental Information                                                |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <b>Operating Conditions</b>                                                    |                                                                                                                          |                                                                         |
| Display Scale Types                                                            | All (Log and Lin)                                                                                                        | “Lin” is linear in voltage                                              |
| Log Scales                                                                     | All (0.1 to 20 dB/div)                                                                                                   |                                                                         |
| Modes                                                                          | Spectrum Analyzer only                                                                                                   |                                                                         |
| FFT & Sweep                                                                    | Select sweep type = Swept.                                                                                               |                                                                         |
| Gating                                                                         | Gating must be off.                                                                                                      |                                                                         |
| <b>Output Signal</b>                                                           |                                                                                                                          |                                                                         |
| Replication of the RF Input Signal envelope, as scaled by the display settings |                                                                                                                          |                                                                         |
| Differences between display effects and video output                           |                                                                                                                          |                                                                         |
| Detector = Peak, Negative, Sample, or Normal                                   | The output signal represents the input envelope excluding display detection                                              |                                                                         |
| Average Detector                                                               | The effect of average detection in smoothing the displayed trace is approximated by the application of a low-pass filter | Nominal bandwidth:<br>$LPFBW = \frac{Npoints - 1}{SweepTime \cdot \pi}$ |
| EMI Detectors                                                                  | The output will not be useful.                                                                                           |                                                                         |
| Trace Averaging                                                                | Trace averaging affects the displayed signal but does not affect the video output                                        |                                                                         |
| <b>Amplitude Range</b>                                                         |                                                                                                                          | Range of represented signals                                            |
| Minimum                                                                        | Bottom of screen                                                                                                         |                                                                         |
| Maximum                                                                        | Top of Screen + Overrange                                                                                                |                                                                         |
| Overrange                                                                      |                                                                                                                          | Smaller of 2 dB or 1 division, (nominal)                                |
| <b>Output Scaling<sup>a</sup></b>                                              |                                                                                                                          |                                                                         |
| Offset                                                                         | 0 to 1.0 V open circuit, representing bottom to top of screen respectively                                               | ±1% of full scale (nominal)                                             |
| Gain accuracy                                                                  |                                                                                                                          | ±1% of output voltage (nominal)                                         |

Option YAS – Y-Axis Screen Video Output  
Other Y-Axis Screen Video Output Specifications

| Description                                                  | Specifications | Supplemental Information                                             |
|--------------------------------------------------------------|----------------|----------------------------------------------------------------------|
| <b>Delay</b><br>RF Input to Analog Out<br>Without Option B40 |                | $1.67 \mu\text{s} + 2.56/\text{RBW} + 0.159/\text{VBW}$<br>(nominal) |

- a. The errors in the output can be described as offset and gain errors. An offset error is a constant error, expressed as a fraction of the full-scale output voltage. The gain error is proportional to the output voltage. Here's an example. The reference level is –10 dBm, the scale is log, and the scale is 5 dB/division. Therefore, the top of the display is –10 dBm, and the bottom is –60 dBm. Ideally, a –60 dBm signal gives 0 V at the output, and –10 dBm at the input gives 1 V at the output. The maximum error with a –60 dBm input signal is the offset error,  $\pm 1\%$  of full scale, or  $\pm 10$  mV; the gain accuracy does not apply because the output is nominally at 0 V. If the input signal is –20 dBm, the nominal output is 0.8 V. In this case, there is an offset error ( $\pm 10$  mV) plus a gain error ( $\pm 1\%$  of 0.8 V, or  $\pm 8$  mV), for a total error of  $\pm 18$  mV.

## Continuity and Compatibility

| Description                               | Specifications               | Supplemental Information                                                                                |
|-------------------------------------------|------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>Continuity and Compatibility</b>       |                              |                                                                                                         |
| Output Tracks Video Level                 |                              |                                                                                                         |
| During sweep                              | Yes                          | Except band breaks in swept spans                                                                       |
| Between sweeps                            | See supplemental information | Before sweep interruption <sup>a</sup><br>Alignments <sup>b</sup><br>Auto Align = Partial <sup>cd</sup> |
| External trigger, no trigger <sup>d</sup> | Yes                          |                                                                                                         |
| HP 8566/7/8 Compatibility <sup>e</sup>    |                              | Recorder output labeled “Video”                                                                         |
| Continuous output                         |                              | Alignment differences <sup>f</sup>                                                                      |
| Output impedance                          |                              | Two variants <sup>g</sup>                                                                               |
| Gain calibration                          |                              | LL and UR not supported <sup>h</sup>                                                                    |
| RF Signal to Video Output Delay           |                              | See footnote <sup>i</sup>                                                                               |

- There is an interruption in the tracking of the video output before each sweep. During this interruption, the video output holds instead of tracks for a time period given by approximately  $1.8/\text{RBW}$ .
- There is an interruption in the tracking of the video output during alignments. During this interruption, the video output holds instead of tracking the envelope of the RF input signal. Alignments may be set to prevent their interrupting video output tracking by setting Auto Align to Off.
- Setting Auto Align to Off usually results in a warning message soon thereafter. Setting Auto Align to Partial results in many fewer and shorter alignment interruptions, and maintains alignments for a longer interval.
- If video output interruptions for Partial alignments are unacceptable, setting the analyzer to External Trigger without a trigger present can prevent these from occurring, but will prevent there being any on-screen updating. Video output is always active even if the analyzer is not sweeping.
- Compatibility with the HP/Keysight 8560 and 8590 families, and the ESA and PSA, is similar in most respects.
- The HP 8566 family did not have alignments and interruptions that interrupted video outputs, as discussed above.
- Early HP 8566-family spectrum analyzers had a  $140\Omega$  output impedance; later ones had  $190\Omega$ . The specification was  $<475\Omega$ . The Analog Out port has a  $50\Omega$  impedance if the analyzer has *Option B40, DP2, or MPB*. Otherwise, the Analog Out port impedance is nominally  $140\Omega$ .
- The HP 8566 family had LL (lower left) and UR (upper right) controls that could be used to calibrate the levels from the video output circuit. These controls are not available in this option.
- The delay between the RF input and video output shown in **Delay on page 183** is much higher than the delay in the HP 8566 family spectrum analyzers. The latter has a delay of approximately  $0.554/\text{RBW} + 0.159/\text{VBW}$ .

## 11 Analog Demodulation Measurement Application

This chapter contains specifications for the N9063EM0E Analog Demodulation Measurement Application.

### Additional Definitions and Requirements

The warranted specifications shown apply to Band 0 operation (up to 3.6 GHz), unless otherwise noted, for all analyzers. The application functions, with nominal (non-warranted) performance, at any frequency within the frequency range set by the analyzer frequency options (see table). In practice, the lowest and highest frequency of operation may be further limited by AC coupling; by "folding" near 0 Hz; by DC feedthrough; and by Channel BW needed. Phase noise and residual FM generally increase in higher bands.

Warranted specifications shown apply when Channel BW  $\leq 1$  MHz, unless otherwise noted. (Channel BW is an important user-settable control.) The application functions, with nominal (non-warranted) performance, at any Channel BW up to the analyzer's bandwidth options (see table). The Channel BW required for a measurement depends on: the type of modulation (AM, FM, PM); the rate of modulation; the modulation depth or deviation; and the spectral contents (e.g. harmonics) of the modulating tone. Many specifications require that the Channel BW control is optimized: neither too narrow nor too wide.

Many warranted specifications (rate, distortion) apply only in the case of a single, sinusoidal modulating tone without excessive harmonics, non-harmonics, spurs, or noise. Harmonics, which are included in most distortion results, are counted up to the 10th harmonic of the dominant tone, or as limited by SINAD BW or post-demod filters. Note that SINAD will include Carrier Frequency Error (the "DC term") in FM by default; it can be eliminated with a HPF or Auto Carrier Frequency feature.

Warranted specifications apply to results of the software application; the hardware demodulator driving the Analog Out line is described separately.

Warranted specifications apply over an operating temperature range of 20° to 30°C; and mixer level

–23 to –18 dBm (mixer level = Input power level – Attenuation). Additional conditions are listed at the beginning of the FM, AM, and PM sections, in specification tables, or in footnotes.

See **"Definitions of terms used in this chapter"** on page 186.

**Definitions of terms used in this chapter**

Let  $P_{\text{signal}}$  (S) = Power of the signal;  $P_{\text{noise}}$  (N) = Power of the noise;  $P_{\text{distortion}}$  (D) = Power of the harmonic distortion ( $P_{H2} + P_{H3} + \dots + P_{H1}$  where  $H_i$  is the  $i^{\text{th}}$  harmonic up to  $i=10$ );  
 $P_{\text{total}}$  = Total power of the signal, noise and distortion components.

| Term       | Short Hand                | Definition                                                                                                                                                                                                                                                        |
|------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Distortion | $\frac{N + D}{S + N + D}$ | $(P_{\text{total}} - P_{\text{signal}})^{1/2} / (P_{\text{total}})^{1/2} \times 100\%$                                                                                                                                                                            |
| THD        | $\frac{D}{S}$             | $(P_{\text{distortion}})^{1/2} / (P_{\text{signal}})^{1/2} \times 100\%$<br>where THD is the total harmonic distortion                                                                                                                                            |
| SINAD      | $\frac{S + N + D}{N + D}$ | $20 \times \log_{10} [1/(P_{\text{distortion}})]^{1/2} = 20 \times \log_{10} [(P_{\text{total}})^{1/2} / (P_{\text{total}} - P_{\text{signal}})^{1/2}]$<br>where SINAD is Signal-to-Noise-And-Distortion ratio                                                    |
| SNR        | $\frac{S + N + D}{N}$     | $P_{\text{signal}} / P_{\text{noise}} \sim (P_{\text{signal}} + P_{\text{noise}} + P_{\text{distortion}}) / P_{\text{noise}}$<br>where SNR is the Signal-to-Noise Ratio. The approximation is per the implementations defined with the HP/Agilent/Keysight 8903A. |

**NOTE**

$P_{\text{noise}}$  must be limited to the bandwidth of the applied filters.  
 The harmonic sequence is limited to the 10th harmonic unless otherwise indicated.  
 $P_{\text{noise}}$  includes all spectral energy that is not near harmonic frequencies, such as spurious signals, power line interference, etc.

## RF Carrier Frequency and Bandwidth

| Description                                                | Specifications | Supplemental Information                                                                                                 |
|------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Carrier Frequency</b>                                   |                |                                                                                                                          |
| Maximum Frequency                                          |                |                                                                                                                          |
| <i>Option 503</i>                                          | 3.6 GHz        | RF/ $\mu$ W frequency option                                                                                             |
| <i>Option 508</i>                                          | 8.4 GHz        | RF/ $\mu$ W frequency option                                                                                             |
| <i>Option 513</i>                                          | 13.6 GHz       | RF/ $\mu$ W frequency option                                                                                             |
| <i>Option 526</i>                                          | 26.5 GHz       | RF/ $\mu$ W frequency option                                                                                             |
| <i>Option 532</i>                                          | 32 GHz         | mmW frequency option                                                                                                     |
| <i>Option 544</i>                                          | 44 GHz         | mmW frequency option                                                                                                     |
| Minimum Frequency                                          |                |                                                                                                                          |
| AC Coupled                                                 | 10 MHz         | In practice, limited by the need to keep modulation sidebands from folding, and by the interference from LO feedthrough. |
| DC Coupled                                                 | 10 Hz          |                                                                                                                          |
| <b>Maximum Information Bandwidth (Info BW)<sup>a</sup></b> |                |                                                                                                                          |
| <i>Option B25</i>                                          | 25 MHz         |                                                                                                                          |
| <i>Option B40</i>                                          | 40 MHz         |                                                                                                                          |
| <b>Capture Memory</b>                                      | 3.6 MSa        | Each sample is an I/Q pair.                                                                                              |
| (Sample Rate $\times$ Acq Time)                            |                | See note <sup>b</sup>                                                                                                    |

- a. The maximum Info BW indicates the maximum operational BW, which depends on the analysis BW option equipped with the analyzer. However, the demodulation specifications only apply to the Channel BW indicated in the following sections.
- b. Sample rate is set indirectly by the user, with the Span and Channel BW controls (viewed in RF Spectrum). The Info BW (also called Demodulation BW) is based on the larger of the two; specifically, Info BW = max [Span, Channel BW]. The sample interval is  $1/(1.25 \times \text{Info BW})$ ; e.g. if Info BW = 200 kHz, then sample interval is 4  $\mu$ s. The sample rate is  $1.25 \times \text{Info BW}$ , or  $1.25 \times \max [\text{Span}, \text{Channel BW}]$ . These values are approximate, to estimate memory usage. Exact values can be queried via SCPI while the application is running. Acq Time (acquisition time) is set by the largest of 4 controls:  
Acq Time = max[2.0 / (RF RBW), 2.0 / (AF RBW), 2.2  $\times$  Demod Wfm Sweep Time, Demod Time]

## Post-Demodulation

| Description                         | Specifications                | Supplemental Information                                                                                          |
|-------------------------------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------|
| <b>Maximum Audio Frequency Span</b> |                               | 1/2 × Channel BW                                                                                                  |
| <b>Filters</b>                      |                               |                                                                                                                   |
| High Pass                           | 20 Hz                         | 2-Pole Butterworth                                                                                                |
|                                     | 50 Hz                         | 2-Pole Butterworth                                                                                                |
|                                     | 300 Hz                        | 2-Pole Butterworth                                                                                                |
|                                     | 400 Hz                        | 10-Pole Butterworth; used to attenuate sub-audible signaling tones                                                |
| Low Pass                            | 300 Hz                        | 5-Pole Butterworth                                                                                                |
|                                     | 3 kHz                         | 5-Pole Butterworth                                                                                                |
|                                     | 15 kHz                        | 5-Pole Butterworth                                                                                                |
|                                     | 30 kHz                        | 3-Pole Butterworth                                                                                                |
|                                     | 80 kHz                        | 3-Pole Butterworth                                                                                                |
|                                     | 300 kHz                       | 3-Pole Butterworth                                                                                                |
|                                     | 100 kHz (>20 kHz Bessel)      | 9-Pole Bessel; provides linear phase response to reduce distortion of square-wave modulation, such as FSK or BPSK |
| Band Pass                           | Manual                        | Manually tuned by user, range 300 Hz to 20 MHz; 5-Pole Butterworth; for use with high modulation rates            |
|                                     | CCITT                         | ITU-T O.41, or ITU-T P.53; known as "psophometric"                                                                |
|                                     | A-Weighted                    | ANSI IEC rev 179                                                                                                  |
|                                     | C-Weighted                    | Roughly equivalent to 50 Hz HPF with 10 kHz LPF                                                                   |
|                                     | C-Message                     | IEEE 743, or BSTM 41004; similar in shape to CCITT, sometimes called "psophometric"                               |
|                                     | CCIR-1k Weighted <sup>a</sup> | ITU-R 468, CCIR 468-2 Weighted, or DIN 45 405                                                                     |
|                                     | CCIR-2k Weighted <sup>a</sup> | ITU 468 ARM or CCIR/ARM (Average Responding Meter), commonly referred to as "Dolby" filter                        |
|                                     | CCIR Unweighted               | ITU-R 468 Unweighted <sup>a</sup>                                                                                 |

Analog Demodulation Measurement Application  
Post-Demodulation

| Description                  | Specifications | Supplemental Information                                                                                                                                                                           |
|------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| De-emphasis<br>(FM only)     | 25 $\mu$ s     | Equivalent to 1-pole LPF at 6366 Hz                                                                                                                                                                |
|                              | 50 $\mu$ s     | Equivalent to 1-pole LPF at 3183 Hz; broadcast FM for most of world                                                                                                                                |
|                              | 75 $\mu$ s     | Equivalent to 1-pole LPF at 2122 Hz; broadcast FM for U.S.                                                                                                                                         |
|                              | 750 $\mu$ s    | Equivalent to 1-pole LPF at 212 Hz; 2-way mobile FM radio.                                                                                                                                         |
| SINAD Notch <sup>b</sup>     |                | Tuned automatically by application to highest AF response, for use in SINAD, SNR, and Distortion calculations; complies with TI-603 and ITU-O.132; stop bandwidth is $\pm 13\%$ of tone frequency. |
| Signaling Notch <sup>b</sup> |                | FM only; manually tuned by user, range 50 to 300 Hz; used to eliminate CTCSS or CDCSS signaling tone; complies with TIA-603 and ITU-O.132; stop bandwidth is $\pm 13\%$ of tone frequency.         |

- a. ITU standards specify that CCIR-1k Weighted and CCIR Unweighted filters use Quasi-Peak-Detection (QPD). However, the implementation in N9063EMOE is based on true-RMS detection, scaled to respond as QPD. The approximation is valid when measuring amplitude of Gaussian noise, or SINAD of a single continuous sine tone (e.g. 1 kHz), with harmonics, combined with Gaussian noise. The results may not be consistent with QPD if the input signal is bursty, clicky, or impulsive; or contains non-harmonically related tones (multi-tone, intermods, spurs) above the noise level. Use the AF Spectrum trace to validate these assumptions. Consider using Agilent/Keysight U8903A Audio Analyzer if true QPD is required.
- b. The Signaling Notch filter does not visibly affect the AF Spectrum trace.

## Frequency Modulation

### Conditions required to meet specification

- Peak deviation:  $\geq 200$  Hz to 400 kHz
- Modulation index (ModIndex) = PeakDeviation/Rate = Beta: 0.2 to 2000
- Channel BW:  $\leq 1$  MHz
- Rate: 20 Hz to 50 kHz
- SINAD bandwidth: (Channel BW) / 2
- Single tone - sinusoid modulation
- Center Frequency (CF): 2 MHz to 3.5 GHz, DC coupled for CF < 20 MHz

| Description                          | Specifications          | Supplemental Information |
|--------------------------------------|-------------------------|--------------------------|
| <b>FM Measurement Range</b>          |                         |                          |
| Modulation Rate Range <sup>abc</sup> | 1 Hz to (max info BW)/2 |                          |
| Peak Deviation Range <sup>abc</sup>  | < (max info BW)/2       |                          |

- a.  $((\text{Modulation Rate}) + (\text{Peak Deviation})) < (\text{max Info BW})/2$
- b. The measurement range is also limited by max capture memory. Specifically,  $\text{SamplingRate} \times \text{AcqTime} < 3.6 \text{ MSa}$ , where  $\text{SamplingRate} = 1.25 \times \text{Info BW}$ . For example, if the modulation rate is 1 Hz, then the period of the waveform is 1 second. Suppose  $\text{AcqTime} = 72$  seconds, then the max  $\text{SamplingRate}$  is 50 kHz, which leads to 40 kHz max Info BW. Under such condition, the peak deviation should be less than 20 kHz.
- c. Max info BW: See **"Maximum Information Bandwidth (Info BW)" on page 187**.

Analog Demodulation Measurement Application  
Frequency Modulation

| Description                                  | Specifications                                                                                | Supplemental Information |
|----------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------|
| <b>FM Deviation Accuracy</b> <sup>abc</sup>  | $\pm(1.0\% \times \text{Reading} + 0.2\% \times \text{Rate})$                                 |                          |
| <b>FM Rate Accuracy</b> <sup>de</sup>        |                                                                                               |                          |
| $0.2 \leq \text{ModIndex} < 10$              | $\pm(0.02\% \times \text{Reading}) + \text{rfa}$                                              |                          |
| $\text{ModIndex} \geq 10$                    | $\pm(0.005\% \times \text{Reading}) + \text{rfa}$                                             |                          |
| <b>Carrier Frequency Error</b> <sup>fg</sup> | $\pm(6 \text{ ppm} \times \text{Deviation} + 50 \text{ ppm} \times \text{Rate}) + \text{tfa}$ |                          |

- a. This specification applies to the result labeled "(Pk-Pk)/2".
- b. For optimum measurement, ensure that the Channel BW is set wide enough to capture the significant RF energy. Setting the Channel BW too wide will result in measurement errors.
- c. Reading is a measured frequency peak deviation in Hz, and Rate is a modulation rate in Hz.
- d. Reading is a measured modulation rate in Hz.
- e.  $\text{rfa} = \text{Modulation Rate} \times \text{Frequency reference accuracy}$
- f.  $\text{tfa} = \text{transmitter frequency} \times \text{frequency reference accuracy}$ .
- g. Deviation is peak frequency deviation in Hz, and Rate is a modulation rate in Hz.

## Frequency Modulation

| Description                                       | Specifications                             | Supplemental Information |
|---------------------------------------------------|--------------------------------------------|--------------------------|
| <b>Post-Demod Distortion Residual<sup>a</sup></b> |                                            |                          |
| Distortion (SINAD) <sup>b</sup>                   | $1.8\% / (\text{ModIndex})^{1/2} + 0.25\%$ |                          |
| THD                                               | $0.4\% / (\text{ModIndex})^{1/2} + 0.02\%$ |                          |

- a. For optimum measurement, ensure that the Channel BW is set wide enough to capture the significant RF energy. Setting the Channel BW too wide will result in measurement errors.  
b. SINAD [dB] can be derived by  $20 \times \log_{10}(1/\text{Distortion})$ .

| Description                                  | Specifications                                         | Supplemental Information                      |
|----------------------------------------------|--------------------------------------------------------|-----------------------------------------------|
| <b>Post-Demod Distortion Accuracy</b>        |                                                        |                                               |
| (Rate: 1 to 10 kHz,<br>ModIndex: 0.2 to 100) |                                                        |                                               |
| Distortion                                   | $\pm(2\% \times \text{Reading} + \text{DistResidual})$ |                                               |
| THD                                          | $\pm(2\% \times \text{Reading} + \text{DistResidual})$ | 2 <sup>nd</sup> and 3 <sup>rd</sup> harmonics |

## Amplitude Modulation

### Conditions required to meet specification

- Depth: 1% to 99%
- Channel BW:  $\leq 1$  MHz
- Channel BW:  $15 \times \text{Rate}$  ( $\text{Rate} \leq 50$  kHz) or  $10 \times \text{Rate}$  ( $50 \text{ kHz} < \text{Rate} \leq 100$  kHz)
- Rate: 50 Hz to 100 kHz
- SINAD bandwidth:  $(\text{Channel BW}) / 2$
- Single tone - sinusoid modulation
- Center Frequency (CF): 2 MHz to 3.5 GHz, DC coupled for CF < 20 MHz

| Description                        | Specifications          | Supplemental Information |
|------------------------------------|-------------------------|--------------------------|
| <b>AM Measurement Range</b>        |                         |                          |
| Modulation Rate Range <sup>a</sup> | 1 Hz to (max info BW)/2 |                          |
| Peak Deviation Range               | 0% to 100%              |                          |

a. Max info BW: See “Maximum Information Bandwidth (Info BW)” on page 187.

Analog Demodulation Measurement Application  
Amplitude Modulation

| Description                                                 | Specifications                                                             | Supplemental Information |
|-------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------|
| <b>AM Depth Accuracy<sup>ab</sup></b>                       | $\pm(0.15\% \times \text{Reading} + 0.06\%)$                               |                          |
| <b>AM Rate Accuracy<sup>c</sup></b><br>(Rate: 1 to 100 kHz) | $\pm[(3 \text{ ppm} \times \text{Reading}) \times (100\% / \text{Depth})]$ |                          |

- a. This specification applies to the result labeled "(Pk-Pk)/2".
- b. Reading is a measured AM depth in %.
- c. Reading is a modulation rate in Hz and depth is in %.

## Amplitude Modulation

| Description                           | Specifications                                   | Supplemental Information |
|---------------------------------------|--------------------------------------------------|--------------------------|
| <b>Post-Demod Distortion Residual</b> |                                                  |                          |
| Distortion (SINAD) <sup>a</sup>       | $0.13\% \times (100\% / \text{Depth}) + 0.05\%$  |                          |
| THD                                   | $0.018\% \times (100\% / \text{Depth}) + 0.06\%$ |                          |

a. SINAD [dB] can be derived by  $20 \times \log_{10}(1 / \text{Distortion})$ .

| Description                                                                      | Specifications                                         | Supplemental Information |
|----------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------|
| <b>Post-Demod Distortion Accuracy</b><br>(Rate: 1 to 10 kHz,<br>Depth: 5 to 90%) |                                                        |                          |
| Distortion                                                                       | $\pm(1\% \times \text{Reading} + \text{DistResidual})$ |                          |
| THD                                                                              | $\pm(1\% \times \text{Reading} + \text{DistResidual})$ |                          |

| Description                                                                       | Specifications | Supplemental Information                              |
|-----------------------------------------------------------------------------------|----------------|-------------------------------------------------------|
| <b>FM Rejection<sup>a</sup></b><br>(300 Hz HPF, 3 kHz LPF, 420 kHz<br>Channel BW) |                | Applied FM signal Rate = 1 kHz,<br>Deviation = 50 kHz |
| Instruments without <i>Option B40</i>                                             |                | 0.1% AM peak (nominal)                                |
| Instruments with <i>Option B40</i>                                                | 0.05% AM peak  |                                                       |

a. FM rejection describes the instrument's AM reading for an input that is strongly FMed (and no AM); this specification includes contributions from residual AM.

## Phase Modulation

### Conditions required to meet specification

- Peak deviation<sup>1</sup>: 0.2 to 100 rad
- Channel BW:  $\leq 1$  MHz
- Rate: 50 Hz to 50 kHz
- SINAD bandwidth: (Channel BW)/2
- Single tone – sinusoid modulation
- Center Frequency (CF): 2 MHz to 3.5 GHz, DC coupled for CF < 20 MHz

| Description                          | Specifications                                                 | Supplemental Information |
|--------------------------------------|----------------------------------------------------------------|--------------------------|
| <b>FM Measurement Range</b>          |                                                                |                          |
| Modulation Rate Range <sup>abc</sup> | 1 Hz to (max info BW)/2                                        |                          |
| Peak Deviation Range <sup>abc</sup>  | $< (\text{max info BW}) / (2 \times (\text{Modulation Rate}))$ |                          |

- a.  $((\text{Modulation Rate}) + (\text{Peak Deviation})) < (\text{max Info BW})/2$
- b. The measurement range is also limited by max capture memory. Specifically,  $\text{SamplingRate} \times \text{AcqTime} < 3.6 \text{ MSa}$ , where  $\text{SamplingRate} = 1.25 \times \text{Info BW}$ .
- c. Max info BW: See **“Maximum Information Bandwidth (Info BW)” on page 187**.

1. PeakDeviation (for phase, in rads) and Rate are jointly limited to fit within the Channel BW. For PM, an approximate rule-of-thumb is  $2 \times [\text{PeakDeviation} + 1] \times \text{Rate} < \text{Channel BW}$ , such that most of the sideband energy is within the Channel BW.

Analog Demodulation Measurement Application  
Phase Modulation

| Description                                                                                | Specifications                                                                                                   | Supplemental Information |
|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>PM Deviation Accuracy<sup>abc</sup></b><br>Rate: 100 Hz to 50 kHz                       | $\pm(0.1\% \times \text{Reading} + 2 \text{ mrad})$                                                              |                          |
| <b>PM Rate Accuracy<sup>deb</sup></b><br>Rate $\leq 200$ Hz<br>200 Hz < Rate $\leq 50$ kHz | $\pm(0.012 \text{ Hz} / \text{Deviation}) + \text{rfa}$<br>$\pm(0.5 \text{ Hz} / \text{Deviation}) + \text{rfa}$ |                          |
| <b>Carrier Frequency Error<sup>fgb</sup></b>                                               | $\pm(8 \text{ ppm} \times \text{Deviation} + 3 \text{ ppm}) \times \text{Rate} + \text{tfa}$                     |                          |

- This specification applies to the result labeled "(Pk-Pk)/2".
- For optimum measurement, ensure that the Channel BW is set wide enough to capture the significant RF energy. Setting the Channel BW too wide will result in measurement errors.
- Reading is the measured peak deviation in radians.
- Deviation is the peak deviation in radians.
- rfa = Modulation Rate Frequency reference accuracy.
- Rate is a Modulation Rate in Hz.
- tfa = transmitter frequency  $\times$  frequency reference accuracy.

## Phase Modulation

| Description                                       | Specifications            | Supplemental Information |
|---------------------------------------------------|---------------------------|--------------------------|
| <b>Post-Demod Distortion Residual<sup>a</sup></b> |                           |                          |
| Distortion (SINAD) <sup>bc</sup>                  | 0.7% / Deviation + 0.01%  |                          |
| THD <sup>b</sup>                                  | 0.09% / Deviation + 0.01% |                          |

- a. For optimum measurement, ensure that the Channel BW is set wide enough to capture the significant RF energy. Setting the Channel BW too wide will result in measurement errors.
- b. Deviation is a peak deviation in radians.
- c. SINAD [dB] can be derived by  $20 \times \log_{10}(1/\text{Distortion})$ .

| Description                           | Specifications                                         | Supplemental Information                      |
|---------------------------------------|--------------------------------------------------------|-----------------------------------------------|
| <b>Post-Demod Distortion Accuracy</b> |                                                        |                                               |
| (Rate: 1 to 10 kHz)                   |                                                        |                                               |
| Distortion (SINAD) <sup>c</sup>       | $\pm(2\% \times \text{Reading} + \text{DistResidual})$ |                                               |
| THD                                   | $\pm(2\% \times \text{Reading} + \text{DistResidual})$ | 2 <sup>nd</sup> and 3 <sup>rd</sup> harmonics |

## Analog Out

The "Analog Out" connector (BNC) is located at the analyzer's rear panel. It is a multi-purpose output, whose function depends on options and operating mode (active application). When the N9063EM0E Analog Demod application is active, this output carries a voltage waveform reconstructed by a real-time hardware demodulator (designed to drive the "Demod to Speaker" function for listening). The processing path and algorithms for this output are entirely separate from those of the N9063EM0E application itself; the Analog Out waveform is not necessarily identical the application's Demod Waveform.

Condition of "Open Circuit" is assumed for all voltage terms such as "Output range".

| Description               | Specifications | Supplemental Information                                                                                                    |                                                                                                                           |
|---------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
|                           |                | Instruments without B40                                                                                                     | Instruments with B40                                                                                                      |
| Bandwidth                 |                | ≤ 8 MHz                                                                                                                     | ≤ 8 MHz                                                                                                                   |
| Output impedance          |                | 140Ω (nominal)                                                                                                              | 50Ω (nominal)                                                                                                             |
| Output range <sup>a</sup> |                | 0 V to +1 V (nominal)                                                                                                       | −1 V to +1 V (nominal)                                                                                                    |
| AM scaling                |                |                                                                                                                             |                                                                                                                           |
| AM scaling factor         |                | 2.5 mV/%AM (nominal)                                                                                                        | 5 mV/%AM (nominal)                                                                                                        |
| AM scaling tolerance      |                | ±10% (nominal)                                                                                                              | ±10% (nominal)                                                                                                            |
| AM offset                 |                | 0.5 V corresponds to carrier power as measured at setup <sup>b</sup>                                                        | 0 V corresponds to carrier power as measured at setup <sup>b</sup>                                                        |
| FM scaling                |                |                                                                                                                             |                                                                                                                           |
| FM scaling factor         |                | 1 V/Channel BW (nominal), where Channel BW is settable by the user                                                          | 2 V/Channel BW (nominal), where Channel BW is settable by the user                                                        |
| FM scaling tolerance      |                | ±10% (nominal)                                                                                                              | ±10% (nominal)                                                                                                            |
| FM scale adjust           |                | User-settable factor, range from 0.5 to 10, default =1, applied to above FM scaling                                         | User-settable factor, range from 0.5 to 10, default =1, applied to above FM scaling                                       |
| FM offset                 |                |                                                                                                                             |                                                                                                                           |
| HPF off                   |                | 0.5 V corresponds to SA tuned frequency, and Carrier Frequency Errors (constant frequency offset) are included (DC coupled) | 0 V corresponds to SA tuned frequency, and Carrier Frequency Errors (constant frequency offset) are included (DC coupled) |
| HPF on                    |                | 0.5 V corresponds to the mean of peak-to-peak FM excursions                                                                 | 0 V corresponds to the mean of the waveform                                                                               |

Analog Demodulation Measurement Application  
Analog Out

| Description          | Specifications | Supplemental Information        |                               |
|----------------------|----------------|---------------------------------|-------------------------------|
| PM scaling           |                |                                 |                               |
| PM scaling factor    |                | $(1/2\pi)$ V/rad (nominal)      | $(1/\pi)$ V/rad (nominal)     |
| PM scaling tolerance |                | $\pm 10\%$ (nominal)            | $\pm 10\%$ (nominal)          |
| PM offset            |                | 0.5 V corresponds to mean phase | 0 V corresponds to mean phase |

- a. For AM, the output is the "RF envelope" waveform. For FM, the output is proportional to frequency deviation; note that Carrier Frequency Error (a constant frequency offset) is included as a deviation from the analyzer's tuned center frequency, unless a HPF is used. For PM, the output is proportional the phase-deviation; note that PM is limited to excursions of  $\pm\pi$ , and requires a HPF on to enable a phase-ramp-tracking circuit.  
Most controls in the N9063C application do not affect Analog Out. The few that do are:
  - choice of AM, FM, or PM (FM Stereo not supported)
  - tuned Center Freq
  - Channel BW (affects IF filter, sample rate, and FM scaling)
  - some post-demod filters and de-emphasis (the hardware demodulator has limited filter choices; it will attempt to inherit the filter settings in the app, but with constraints and approximations)
- b. For AM, the reference "unmodulated" carrier level is determined by a single "invisible" power measurement, of 2 ms duration, taken at setup. "Setup" occurs whenever a core parameter is changed, such as Center Frequency, modulation type, Demod Time, etc. Ideally, the RF input signal should be un-modulated at this time. However, if the AM modulating (audio) waveform is evenly periodic in 2 ms (i.e. multiples of 500 Hz, such as 1 kHz), the reference power measurement can be made with modulation applied. Likewise, if the AM modulating period is very short compared to 2ms (e.g. >5000 Hz), the reference power measurement error will be small.

## FM Stereo/Radio Data System (RDS) Measurements<sup>1</sup>

| Description                                       | Specifications                                                                                                                                                                                                                                                                                 | Supplemental Information                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>FM Stereo Modulation Analysis Measurements</b> |                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                   |
| MXP view                                          | RF Spectrum, AF Spectrum, Demod Waveform, FM Deviation (Hz) (Peak +, Peak-, (Pk-Pk)/2, RMS), Carrier Power (dBm), Carrier Frequency Error (Hz), SINAD (dB), Distortion (% or dB)                                                                                                               | MPX consists of FM signal multiplexing with the mono signal (L+R), stereo signal (L-R), pilot signal (at 19 kHz) and optional RDS signal (at 57 kHz). <ul style="list-style-type: none"> <li>– SINAD MPX BW, default 53 kHz, range from 1 kHz to 58 kHz.</li> <li>– Reference Deviation, default 75 kHz, range from 15 kHz to 150 kHz.</li> </ul> |
| Mono (L+R) / Stereo (L-R) view                    | Demod Waveform, AF Spectrum, Carrier Power (dBm), Carrier Frequency Error (Hz), Modulation Rate                                                                                                                                                                                                | Mono Signal is Left + Right<br>Stereo Signal is Left – Right                                                                                                                                                                                                                                                                                      |
| Left / Right view                                 | Demod Waveform, AF Spectrum, Carrier Power (dBm), Carrier Frequency Error (Hz), Modulation Rate, SINAD (dB), Distortion (% or dB), THD (% or dB)                                                                                                                                               | Post-demod settings: <ul style="list-style-type: none"> <li>– Highpass filter: 20, 50, or 300 Hz</li> <li>– Lowpass filter: 300 Hz, 3, 15, 80, or 300 kHz</li> <li>– Bandpass filter: A-Weighted, CCITT</li> <li>– De-Emphasis: 25, 50, 75 and 750 <math>\mu</math>s</li> </ul>                                                                   |
| RDS / RBDS Decoding Results view                  | BLER basic tuning and switching information, radio text, program item number and slow labeling codes, clock time and date                                                                                                                                                                      | BLER Block Count default 1E+8, range from 1 to 1E+16                                                                                                                                                                                                                                                                                              |
| Numeric Result view                               | MPX, Mono, Stereo, Left, Right, Pilot and RDS with FM Deviation result (Hz) of Peak+, (Pk-Pk)/2, RMS, Modulation Rate (Hz), SINAD (% or dB), THD (% or dB), Left to Right (dB), Mono to Stereo (dB), RF Carrier Power (dBm), RF Carrier Frequency Error (Hz), 38 kHz Carrier Phase Error (deg) |                                                                                                                                                                                                                                                                                                                                                   |

1. Requires *Option N9063C-3FP*, which in turn requires that the instrument also has *Option N9063C-2FP* installed and licensed.

Analog Demodulation Measurement Application  
 FM Stereo/Radio Data System (RDS) Measurements

| Description                                       | Specifications | Supplemental Information                                                                        |
|---------------------------------------------------|----------------|-------------------------------------------------------------------------------------------------|
| <b>FM Stereo Modulation Analysis Measurements</b> |                | FM Stereo with 67.5 kHz audio deviation at 1 kHz modulation rate plus 6.75 kHz pilot deviation. |
| SINAD<br>(with A-Weighted filter)                 |                | 62 dB (nominal)                                                                                 |
| SINAD<br>(with CCITT filter)                      |                | 69 dB (nominal)                                                                                 |
| Left to Right Ratio<br>(with A-Weighted filter)   |                | 63 dB (nominal)                                                                                 |
| Left to Right Ratio<br>(with CCITT filter)        |                | 72 dB (nominal)                                                                                 |

