

## Technical Datasheet

# Microwave Signal Generator

2500B Series - 100 kHz to 50 GHz



Ultra-Low Phase Noise and Fast-Switching Speed in a Single Unit

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# 2500B Series Microwave Signal Generator

Specifications formally describe product performance. A specification is a numerical value, or range of values, that bounds the performance of a product parameter. The product warranty covers the performance of parameters described by specifications. Products meet all specifications when shipped from the factory.

Typical and Nominal describe product performance that is useful in the application of the product, but is not covered by the product warranty. They describe performance that is expected of a given product at room temperature after 30 minutes warm-up time, but is not subject to the same statistical analysis of specification.

## Signal Generator Frequency Range

The 2500B series Microwave Signal Generators include six models covering 100 kHz to 50 GHz.

| Model Number | Frequency Range    | RF Output Connector |
|--------------|--------------------|---------------------|
| 2502B        | 100 kHz to 2.5 GHz | Type-N (F)          |
| 2508B        | 2 GHz to 8 GHz     | Type-N (F)          |
| 2520B        | 2 GHz to 20 GHz    | SMA (F)             |
| 2526B        | 2 GHz to 26.5 GHz  | SMA (F)             |
| 2540B        | 2 GHz to 40 GHz    | 2.92 mm (F)         |
| 2550B        | 2 GHz to 50 GHz    | 2.4 mm (F)          |

## Available Options

| Option | Description                                                                                            |
|--------|--------------------------------------------------------------------------------------------------------|
| 17A    | Add Internal and External Modulation Suite (includes internal function generator)                      |
| 17B    | Add External Modulation Suite                                                                          |
| 18     | Add 100 kHz to 2 GHz Frequency Range (10 MHz to 2 GHz with option 27)<br>(Standard on the 2502B model) |
| 20     | Add High RF Output Power                                                                               |
| 22     | Move RF Output Connector to Rear Panel                                                                 |
| 23     | Add Type-N RF Connector (for 2520B model only)                                                         |
| 26A    | Add 90 dB Mechanical Step Attenuator (for 2502B, 2508B, 2520B models only)                             |
| 26B    | Add 90 dB Mechanical Step Attenuator (for 2526B model only)                                            |
| 26C    | Add 90 dB Mechanical Step Attenuator (for 2540B model only)                                            |
| 26D    | Add 90 dB Mechanical Step Attenuator (for 2550B model only)                                            |
| 27     | Add 110 dB Electronic Step Attenuator (for 2502B, 2508B models only)                                   |
| 28     | Add Ultra-Low Close-in Phase Noise                                                                     |
| 29     | Add Fast Frequency Switching Speed                                                                     |
| 32     | Add Narrow Pulse Width $\leq 100$ ns (Requires Option 17A or 17B)                                      |
| 44     | Replace Standard Front Panel with Blank Front Panel (Requires Option 22)                               |

# 2500B Series Technical Specifications

## Frequency

|                                |                   |                     |
|--------------------------------|-------------------|---------------------|
| Range (with option 18)         | <b>2502B</b>      | 100 kHz to 2.5 GHz  |
|                                | <b>2508B</b>      | 100 kHz to 8 GHz    |
|                                | <b>2520B</b>      | 100 kHz to 20 GHz   |
|                                | <b>2526B</b>      | 100 kHz to 26.5 GHz |
|                                | <b>2540B</b>      | 100 kHz to 40 GHz   |
|                                | <b>2550B</b>      | 100 kHz to 50 GHz   |
| <b>Frequency Accuracy</b>      | Same as time base |                     |
| <b>Frequency Resolution</b>    | 0.001 Hz          |                     |
| <b>Power Slope</b>             | 0 to 0.5 dB/GHz   |                     |
| <b>Phase Adjust</b>            | ± 360°            |                     |
| <b>Phase Adjust Resolution</b> | 0.1°              |                     |

## Frequency Stability

|                                            |                                |                                                                             |
|--------------------------------------------|--------------------------------|-----------------------------------------------------------------------------|
| <b>Internal Reference Output</b>           | <b>10 MHz</b>                  | TTL level into 50 Ω                                                         |
|                                            | <b>100 MHz</b>                 | > +5 dBm square wave into 50 Ω                                              |
| <b>Aging Rate</b> <sup>1</sup>             | < 5 x 10 <sup>-10</sup> /day   |                                                                             |
| <b>Temperature Stability</b> <sup>2</sup>  | < ± 2.5 x 10 <sup>-8</sup>     |                                                                             |
| <b>External Reference Frequency Input</b>  | <b>Frequency</b>               | 10 MHz or 100 MHz                                                           |
|                                            | <b>Frequency Deviation</b>     | ± 1 ppm                                                                     |
|                                            | <b>Recommended Input Level</b> | > -5 dBm into 50 Ω for 10 MHz<br>> +5 dBm to < +8 dBm into 50 Ω for 100 MHz |
| <b>Reference Tuning</b>                    | <b>Voltage Range</b>           | 0 to 10V                                                                    |
|                                            | <b>Sensitivity</b>             | 2 ppm/V nominal<br>0.2 ppm/V nominal with option 28                         |
| <b>Lock/Level Indicator (CW Mode Only)</b> | Sync Out = +5 V (TTL High)     |                                                                             |

## Frequency Bands

| Band | Frequency                         | N   |
|------|-----------------------------------|-----|
| 0    | 0.1 to ≤ 10 MHz                   | N/A |
| 1    | > 10 to ≤ 15.625 MHz              | 512 |
| 2    | > 15.625 to ≤ 31 MHz              | 256 |
| 3    | > 31 to ≤ 63 MHz                  | 128 |
| 4    | > 63 to ≤ 125 MHz                 | 64  |
| 5    | > 125 to ≤ 250 MHz                | 32  |
| 6    | > 250 to ≤ 500 MHz                | 16  |
| 7    | > 500 to ≤ 1000 MHz               | 8   |
| 8    | > 1 to ≤ 2 GHz                    | 4   |
| 9    | > 2 to ≤ 4 GHz                    | 2   |
| 10   | > 4 to ≤ 10.1 GHz                 | 1   |
| 11   | > 10.1 to ≤ 20.2 GHz              | 1/2 |
| 12   | > 20.2 to ≤ 39.6 GHz <sup>3</sup> | 1/4 |
| 13   | > 39.6 to ≤ 50 GHz                | 1/6 |

<sup>1</sup> After 30 days

<sup>2</sup> Temperature stability over operating range of 0°C to +55°C after 30 days

<sup>3</sup> Band 12 frequency range extends to 40 GHz for model 2540B

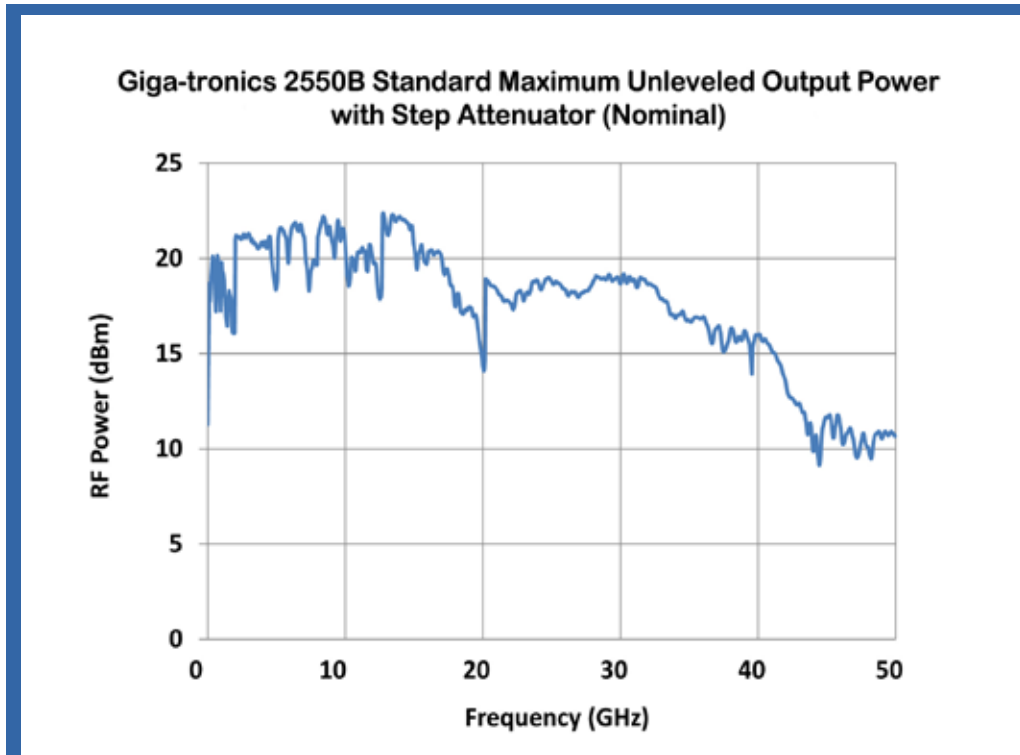
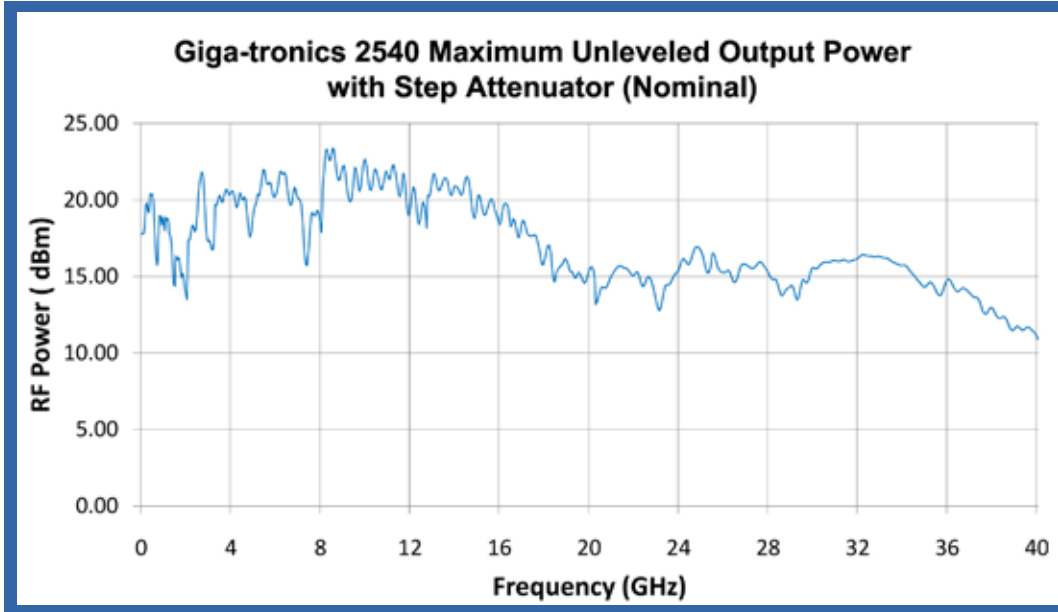
## Maximum Levelled Output Power in dBm

Specification applies into 50 Ω load over 0 °C to 35 °C range and degrades < 2 dB from 35 °C to 55 °C

Number in ( ) is for instruments with mechanical step attenuator option 26

Number in [ ] is for instruments with electronic step attenuator option 27

| Model              | 0.1 to 10 MHz <sup>4</sup> | 0.01 to 2 GHz | 2 to 8 GHz  | 8 to 20 GHz | 20 to 26.5 GHz | 26.5 to 40 GHz | 40 to 50 GHz |
|--------------------|----------------------------|---------------|-------------|-------------|----------------|----------------|--------------|
| 2502B <sup>5</sup> | 10 (9)                     | 12 (11) [7]   | N/A         | N/A         | N/A            | N/A            | N/A          |
| 2508B              | 10 (9)                     | 12 (11) [7]   | 14 (13) [7] | N/A         | N/A            | N/A            | N/A          |
| 2520B              | 10 (9)                     | 12 (11)       | 14 (13)     | 14 (12)     | N/A            | N/A            | N/A          |
| 2526B              | 10 (9)                     | 11 (10)       | 11 (10)     | 11 (9)      | 10 (8)         | N/A            | N/A          |
| 2540B              | 10 (9)                     | 11 (10)       | 11 (10)     | 11 (9)      | 10 (8)         | 10 (8)         | N/A          |
| 2550B <sup>6</sup> | 6 (5)                      | 6 (5)         | 5 (4)       | 5 (3)       | 5 (3)          | 5 (3)          | 5 (3)        |



<sup>4</sup> Specification is typical below 10 MHz

<sup>5</sup> Specification for model 2502B applies to its maximum frequency of 2.5 GHz

<sup>6</sup> Model 2550B frequency crossing is at 39.6 GHz instead of 40 GHz

## Option 20 Maximum Levelled Output Power in dBm

Specification applies into 50 Ω load over 0 °C to 35 °C range and degrades < 2 dB from 35 °C to 55 °C

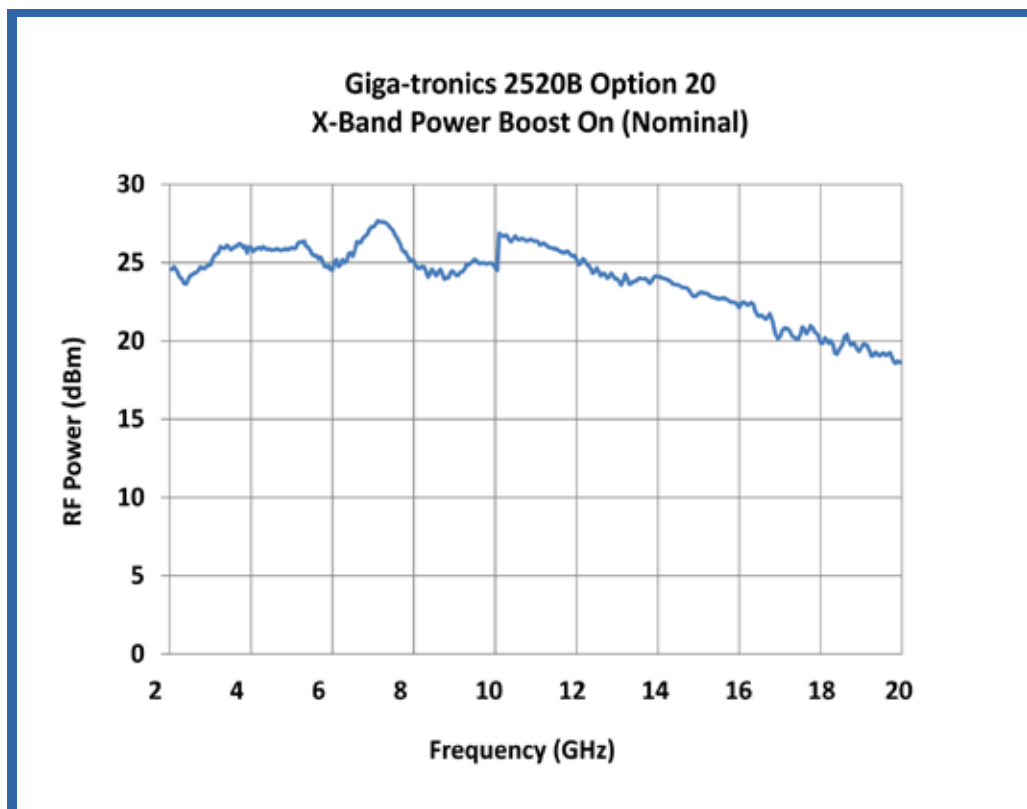
Number in ( ) is for instruments with mechanical step attenuator option 26

Number in [ ] is for instruments with electronic step attenuator option 27

| Model              | 0.1 to 10 MHz <sup>4</sup> | 0.01 to 2 GHz | 2 to 8 GHz   | 8 to 18.5 GHz | 18.5 to 20  | 20 to 26.5 GHz | 26.5 to 40 GHz | 40 to 50 GHz |
|--------------------|----------------------------|---------------|--------------|---------------|-------------|----------------|----------------|--------------|
| 2502B <sup>5</sup> | 10 (9)                     | 14 (13) [10]  | N/A          | N/A           | N/A         | N/A            | N/A            | N/A          |
| 2508B              | 10 (9)                     | 14 (13) [10]  | 17 (16) [10] | N/A           | N/A         | N/A            | N/A            | N/A          |
| 2520B              | 10 (9)                     | 14 (13)       | 17 (16)      | 20.5 (18.5)   | 18.5 (16.5) | N/A            | N/A            | N/A          |
| 2526B              | 10 (9)                     | 14 (13)       | 12 (11)      | 15 (13)       | 15 (13)     | 11 (9)         | N/A            | N/A          |
| 2540B              | 10 (9)                     | 14 (13)       | 12 (11)      | 15 (13)       | 15 (13)     | 11 (9)         | 11 (9)         | N/A          |
| 2550B <sup>6</sup> | 8 (7.5)                    | 8 (7.5)       | 12 (11)      | 15 (13)       | 15 (13)     | 15 (13)        | 15 (13)        | 11 (9)       |

### X-Band Power Boost<sup>7</sup>

X-Band Power Boost is a special feature included in 2520B with Option 20, and when enabled, increases the maximum unleveled output power to 23 (21) dBm nominal from 4 to 12.7 GHz.



<sup>4</sup> Specification is typical below 10 MHz

<sup>5</sup> Specification for model 2502B applies to its maximum frequency of 2.5 GHz

<sup>6</sup> Model 2550B frequency crossing is at 39.6 GHz instead of 40 GHz

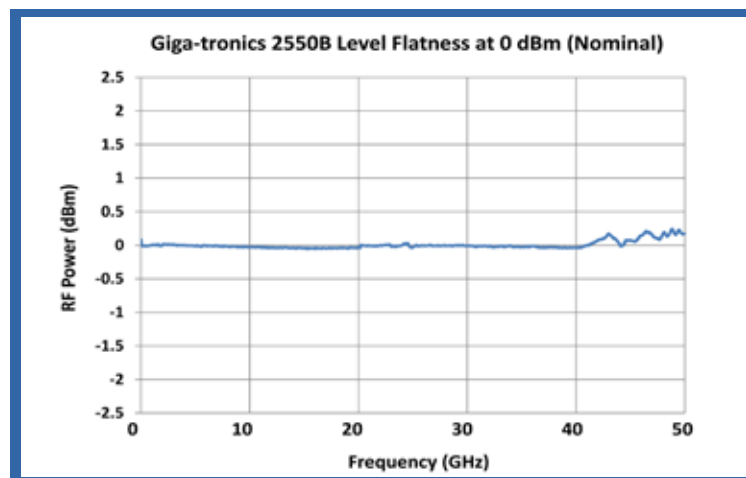
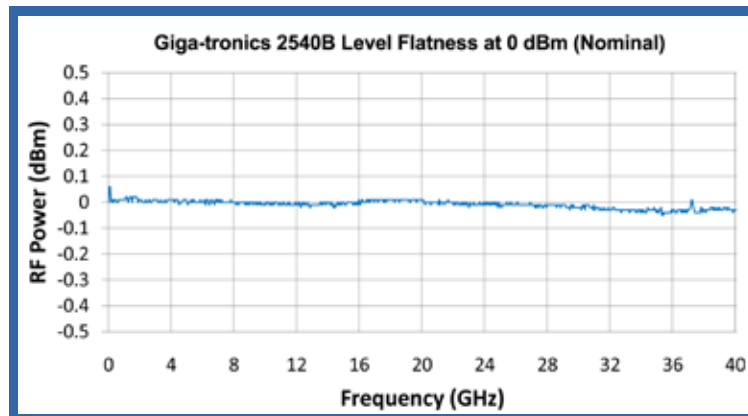
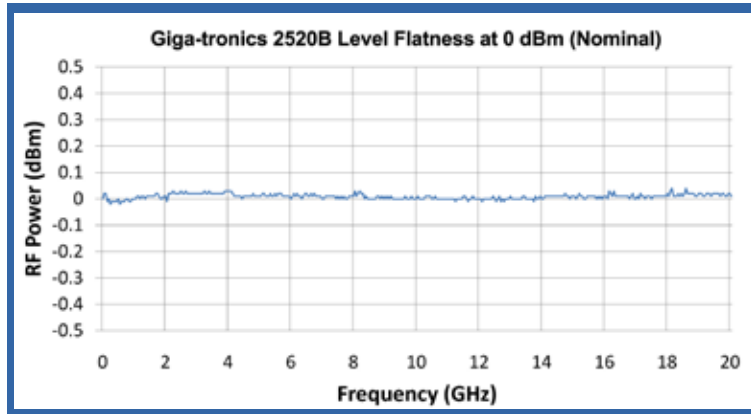
<sup>7</sup> AM specifications do not apply with X-Band Power Boost ON

## RF Power Level Accuracy (dB)

Specifications apply over 15 °C to 35 °C range and degrades < 0.1 dB/°C outside that range

### Standard performance

| Frequency Range  | > +5 dBm | +5 dBm to > -5 dBm | -5 dBm to -10 dBm |
|------------------|----------|--------------------|-------------------|
| 10 MHz to 20 GHz | ± 0.85   | ± 0.7              | ± 1.5             |
| 20 GHz to 40 GHz | ± 1.05   | ± 0.9              | ± 1.5             |
| 40 GHz to 50 GHz | ± 1.3    | ± 0.9              | ± 2.5             |



## RF Power Level Accuracy (dB)

Specifications apply over 15 °C to 35 °C range and degrades < 0.1 dB/°C outside that range

### Performance with mechanical step attenuator option 26:

| Frequency Range  | > +5 dBm | +5 dBm to > -5 dBm | -5 dBm to -90 dBm |
|------------------|----------|--------------------|-------------------|
| 10 MHz to 20 GHz | ± 0.85   | ± 0.7              | ± 1.2             |
| 20 GHz to 40 GHz | ± 1.05   | ± 0.9              | ± 1.5             |
| 40 GHz to 50 GHz | ± 1.3    | ± 0.9              | ± 2.5             |

### Performance with electronic step attenuator option 27:

| Frequency Range | > +5 dBm | +5 dBm to > -5 dBm | -5 dBm to -110 dBm <sup>8</sup> |
|-----------------|----------|--------------------|---------------------------------|
| 10 MHz to 8 GHz | ± 1.05   | ± 0.9              | ± 1.5                           |

## Minimum Levelled Output Power in dBm

Specification applies over 0 °C to 35 °C range and degrades < 2 dB from 35 °C to 55 °C

Number in ( ) is for instruments with mechanical step attenuator option 26

Number in [ ] is for instruments with electronic step attenuator option 27

| Model               | 0.1 to 10 MHz | 0.01 to 2 GHz     | 2 to 8 GHz        | 8 to 20 GHz | 20 to 26.5 GHz | 26.5 to 40 GHz | 40 to 50 GHz |
|---------------------|---------------|-------------------|-------------------|-------------|----------------|----------------|--------------|
| 2502B <sup>9</sup>  | -13 (-103)    | -10 (-100) [-127] | N/A               | N/A         | N/A            | N/A            | N/A          |
| 2508B               | -13 (-103)    | -10 (-100) [-127] | -10 (-100) [-127] | N/A         | N/A            | N/A            | N/A          |
| 2520B               | -13 (-103)    | -10 (-100)        | -10 (-100)        | -10 (-100)  | N/A            | N/A            | N/A          |
| 2526B               | -13 (-103)    | -10 (-100)        | -10 (-100)        | -10 (-100)  | -10 (-100)     | N/A            | N/A          |
| 2540B               | -13 (-103)    | -10 (-100)        | -10 (-100)        | -10 (-100)  | -10 (-100)     | -10 (-100)     | N/A          |
| 2550B <sup>10</sup> | -13 (-103)    | -10 (-100)        | -10 (-100)        | -10 (-100)  | -5 (-95)       | -5 (-95)       | -5 (-90)     |

### Additional Output Power Specifications

|                                      |                                                                             |
|--------------------------------------|-----------------------------------------------------------------------------|
| Power Offset (CW Mode)               | 0 to 10 dB                                                                  |
| Power Adjust Resolution              | 0.01 dB                                                                     |
| Temperature Stability                | 0.025 dB/°C                                                                 |
| Output Source Match (ALC on)<br>50 Ω | < 2.0:1 to 50 GHz<br>< 1.5:1 nominal, 2 GHz to 20 GHz,<br>+5 dBm to -10 dBm |

### External ALC

|                           |                                                                           |
|---------------------------|---------------------------------------------------------------------------|
| Polarity                  | Positive or negative diode detector, or positive power meter (selectable) |
| Range                     | -80 dBV (100 μV) to +6 dBV (2.0 V)                                        |
| Power Meter Leveling Rate | 0.7 Hz, typical                                                           |
| Input Impedance:          | 1 MΩ, typical                                                             |

<sup>8</sup> Specification is nominal for levels below -90 dBm

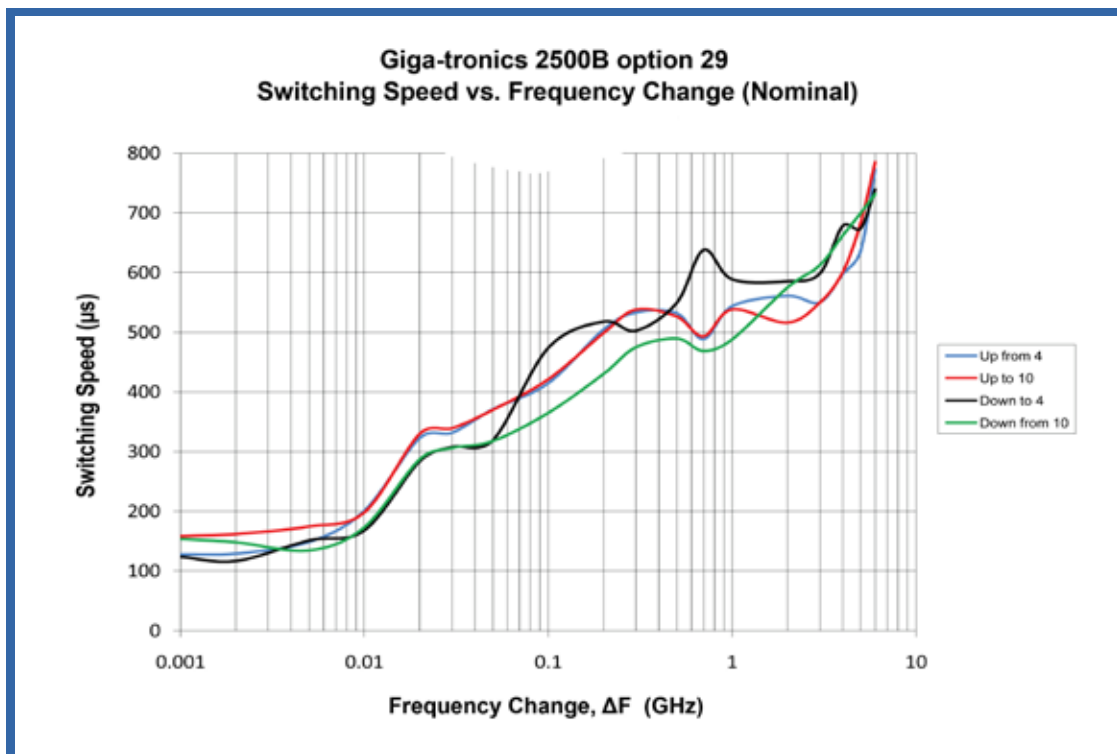
<sup>9</sup> Specification for model 2502B applies to its maximum frequency of 2.5 GHz

<sup>10</sup> Model 2550B frequency crossing is at 39.6 GHz instead of 40 GHz only



## List Mode

|                                                |                                                         |                                       |
|------------------------------------------------|---------------------------------------------------------|---------------------------------------|
| Number of Points                               | 4000                                                    |                                       |
| Frequency Settling <sup>11, 12</sup>           | 2 ms minimum                                            |                                       |
| Frequency Settling <sup>11, 12</sup> Option 29 | < 550 $\mu$ s for $\Delta F \leq 500$ MHz <sup>13</sup> |                                       |
| Amplitude Settling <sup>12, 14</sup>           | < 500 $\mu$ s                                           |                                       |
| Digital Sweep                                  | Trigger Modes                                           | External, GPIB GET, Software          |
|                                                | Sweep Modes                                             | Continuous, Single Step, Single Sweep |
| Step Time                                      | Standard                                                | 2 ms to 1 sec                         |
|                                                | Option 29                                               | 150 $\mu$ s to 1 sec                  |
| Sync Out Delay <sup>15</sup>                   | 50 $\mu$ s to 10 ms                                     |                                       |
| Sync Out Delay Resolution                      | 10 ns                                                   |                                       |



Frequency Change,  $\Delta F = | (F_{stop} \times N_{stop}) - (F_{start} \times N_{start}) |$  where N is the value in the Frequency Band Table

<sup>11</sup> Time for frequency to settle within 50 kHz of final value after a frequency switch

<sup>12</sup> Settling time not specified with FM turned on

<sup>13</sup>  $\Delta F = | (F_{stop} \times N_{stop}) - (F_{start} \times N_{start}) |$  where N is the value in the Frequency Band Table

<sup>14</sup> Time for amplitude to settle within 0.1 dB of final value after an amplitude switch

<sup>15</sup> Delay is specified from edge of trigger pulse

## Frequency and Power Sweep

|                                               |                                                                                           |
|-----------------------------------------------|-------------------------------------------------------------------------------------------|
| <b>Frequency Sweep Modes</b>                  | Start/Stop or Center/Span                                                                 |
| <b>Frequency Sweep Range</b>                  | Full Frequency Range                                                                      |
| <b>Frequency Range Resolution</b>             | 0.001 Hz                                                                                  |
| <b>Ramp Frequency Sweep Resolution</b>        | Analog Sweep, 401, 801 or 1601 points                                                     |
| <b>Analog Sweep Mode</b>                      | Provides very fine resolution sweep, for use with Scalar Network Analyzers                |
| <b>Ramp Frequency Sweep Time<sup>16</sup></b> | 30 ms to 200 sec                                                                          |
| <b>Frequency Sweep Time Resolution</b>        | 10 $\mu$ s                                                                                |
| <b>Step Sweep Step Time<sup>16</sup></b>      | 10 ms to 10 sec                                                                           |
| <b>Step Sweep Time Resolution</b>             | 1 ms                                                                                      |
| <b>Ramp Power Sweep</b>                       | 0 to 25 dB                                                                                |
| <b>Ramp Power Sweep Steps</b>                 | 2000 max                                                                                  |
| <b>Ramp Power Sweep Resolution</b>            | 0.01 dBm                                                                                  |
| <b>Ramp Power Sweep Time<sup>16</sup></b>     | 30 ms to 200 sec                                                                          |
| <b>Ramp Power Time Resolution</b>             | 10 $\mu$ s                                                                                |
| <b>Power Slope (CW Mode, List Mode)</b>       | 0 to 0.5 dB/GHz                                                                           |
| <b>Ramp Output</b>                            | 0 to 10V and 0.5 V/GHz (2502B, 2508B, 2520B) or 0.25 V/GHz (2526B, 2540B, 2550B)          |
| <b>Z-Axis Blanking</b>                        | +5V (Positive polarity only)                                                              |
| <b>Markers</b>                                | 5 Intensity markers and 5 Amplitude markers                                               |
| <b>Marker Resolution</b>                      | 0.001 Hz                                                                                  |
| <b>Save and Recall</b>                        | 10 Registers (0 through 9). These saved states are preserved until over-written or erased |

## Remote Programming

|                                        |                                                                                         |            |             |
|----------------------------------------|-----------------------------------------------------------------------------------------|------------|-------------|
| <b>Software Interface</b>              | SCPI, IVI-C, Automation Xpress                                                          |            |             |
| <b>Code Compatibility<sup>17</sup></b> | Giga-tronics 2400, GT7000, GT9000, GT12000 and HP 8340, 8350, 8360, 8370, 8663 and 8673 |            |             |
| <b>Execution Speed (GPIB)</b>          |                                                                                         | <b>AXI</b> | <b>SCPI</b> |
|                                        | <b>CW Switching (Typical)</b>                                                           | 2.5 ms     | 28 ms       |
|                                        | <b>4000 Point List Download (Typical)</b>                                               | 20 sec     | 28 sec      |
| <b>Remote Interface</b>                | GPIB, RS-232, USB 2.0, Ethernet LAN (100 Base T)                                        |            |             |

<sup>16</sup> Sweep Rate must be <500 MHz/msec <sup>13</sup> Settling time not specified with FM turned on

<sup>17</sup> See programming manual for supported commands. Basic emulation is included, and when emulating another signal generator, is limited to the capabilities, parameters and resolutions of the emulated instrument.

## Spectral Purity

|                              |                                                                                                                                           |                       |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>Harmonics</b>             | Maximum leveled output power or +10 dBm, whichever is lower. Specification for harmonics above instrument frequency range are typical     |                       |
|                              | 100 kHz to 10 MHz                                                                                                                         | -30 dBc               |
|                              | > 10 MHz to 100 MHz                                                                                                                       | -40 dBc <sup>18</sup> |
|                              | > 100 MHz to 39.6 GHz <sup>19</sup>                                                                                                       | -50 dBc <sup>20</sup> |
|                              | > 39.6 to 50 GHz                                                                                                                          | -30 dBc (typical)     |
| <b>Sub-Harmonics</b>         | Maximum leveled output power or +10 dBm, whichever is lower. Specification for sub-harmonics above instrument frequency range are typical |                       |
|                              | 100 kHz to 2.0 GHz                                                                                                                        | -80 dBc               |
|                              | > 2 to 20.2 GHz                                                                                                                           | -60 dBc               |
|                              | > 20.2 to 50 GHz                                                                                                                          | -40 dBc               |
| <b>Spurious</b>              | Specification is for offsets > 300 Hz                                                                                                     |                       |
|                              | Specification is -45 dBc + 20 log(1/N) dBc typical for offsets < 300 Hz                                                                   |                       |
|                              | 100 kHz to 10.1 GHz                                                                                                                       | -66 dBc               |
|                              | > 10.1 to 20.2 GHz                                                                                                                        | -60 dBc               |
|                              | > 20.2 to 39.6 GHz <sup>19</sup>                                                                                                          | -54 dBc               |
|                              | > 39.6 to 50 GHz                                                                                                                          | -50 dBc               |
| <b>Residual FM (typical)</b> | 50 Hz to 15 kHz Bandwidth                                                                                                                 |                       |
|                              | 100 kHz to 20.2 GHz                                                                                                                       | < 6 Hz                |
|                              | > 20.2 to 39.6 GHz <sup>19</sup>                                                                                                          | < 12 Hz               |
|                              | > 39.6 to 50 GHz                                                                                                                          | < 18 Hz               |
| <b>AM Noise (typical)</b>    | Offset > 5 MHz at maximum leveled power. Applies in CW only                                                                               |                       |
|                              | 100 kHz to 2 GHz                                                                                                                          | -130 dBm/Hz           |
|                              | > 2 to 20.2 GHz                                                                                                                           | -145 dBm/Hz           |
|                              | > 20.2 to 50 GHz                                                                                                                          | -132 dBm/Hz           |

<sup>18</sup> Specification is -35 dBc for frequencies < 50 MHz on 2550B model only

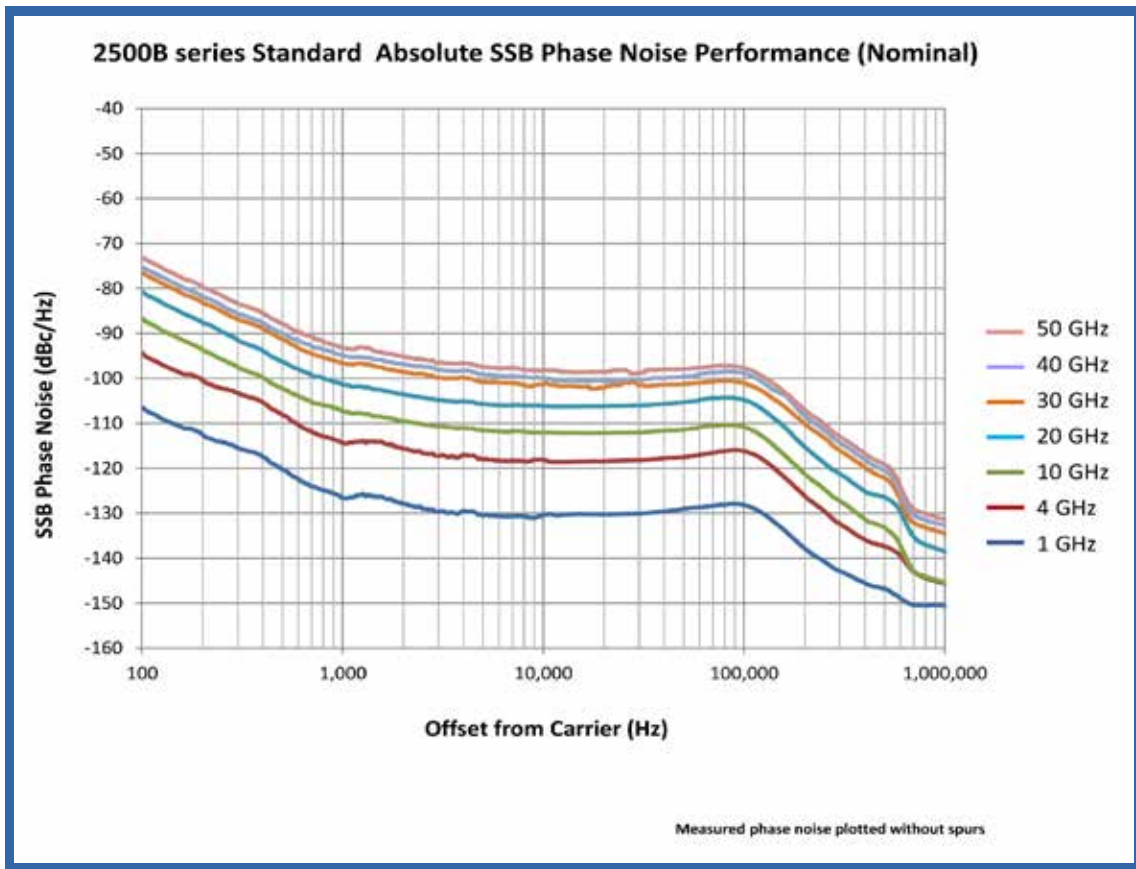
<sup>19</sup> Specification for model 2540B extends to 40 GHz

<sup>20</sup> Specification is nominally -25 dBc at +10 dBm with X-Band Power Boost enabled

## Phase Noise

### SSB Phase Noise - Standard

| Carrier          | Offset from Carrier (dBc/Hz) |       |        |         |       |
|------------------|------------------------------|-------|--------|---------|-------|
| CW (GHz)         | 100 Hz                       | 1 kHz | 10 kHz | 100 kHz | 1 MHz |
| 1                | -96                          | -109  | -121   | -121    | -147  |
| 4                | -84                          | -94   | -111   | -109    | -139  |
| 10               | -74                          | -96   | -106   | -105    | -135  |
| 20               | -68                          | -88   | -99    | -99     | -123  |
| 30               | -67                          | -79   | -96    | -96     | -124  |
| 40 <sup>21</sup> | -73                          | -90   | -97    | -96     | -129  |
| 50 <sup>21</sup> | -71                          | -89   | -96    | -95     | -128  |

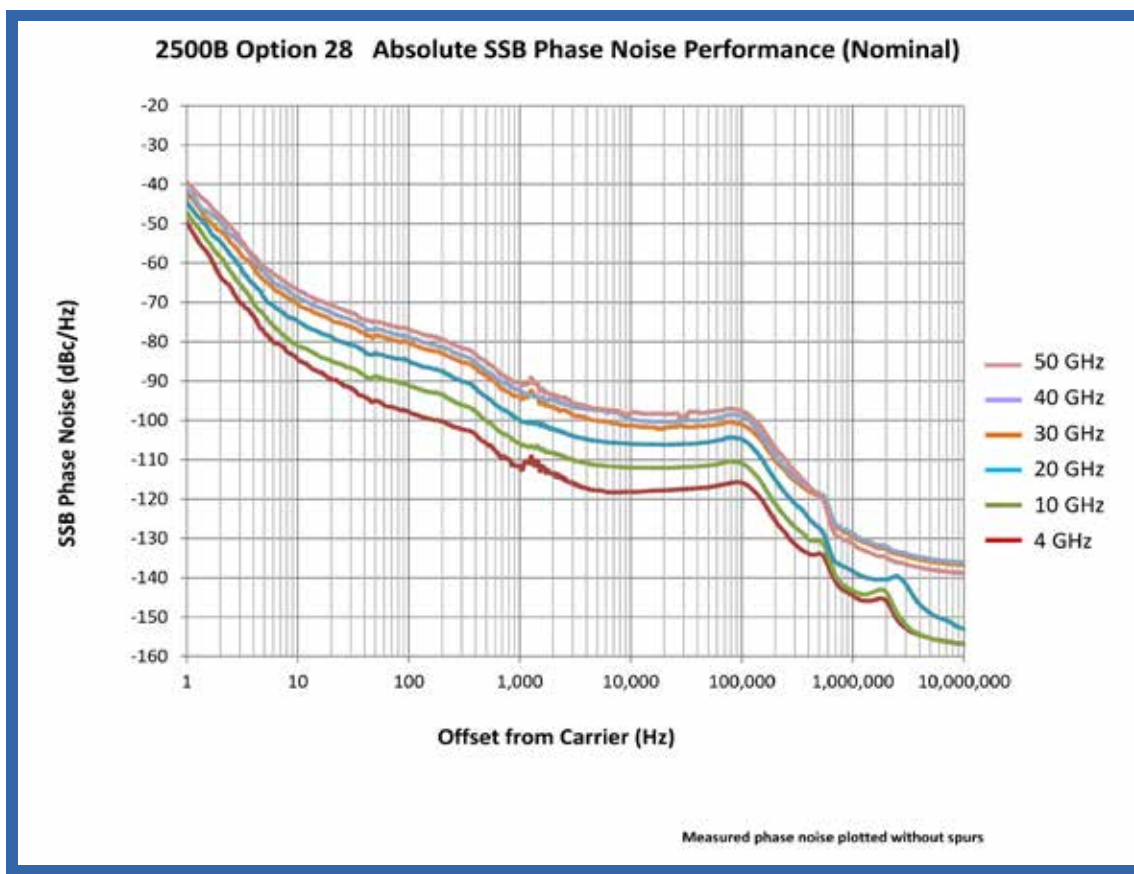


<sup>21</sup> Specifications for 40 GHz and 50 GHz are nominal

## Phase Noise

### SSB Phase Noise - Option 28

| Carrier          | Offset from Carrier (dBc/Hz) |       |        |       |        |         |       |
|------------------|------------------------------|-------|--------|-------|--------|---------|-------|
| CW (GHz)         | 1 Hz                         | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz |
| 1                | -55                          | -77   | -100   | -118  | -124   | -124    | -150  |
| 4                | -43                          | -67   | -90    | -108  | -114   | -112    | -142  |
| 10               | -35                          | -60   | -83    | -100  | -109   | -108    | -138  |
| 20               | -29                          | -54   | -77    | -94   | -102   | -102    | -126  |
| 30               | -23                          | -48   | -71    | -88   | -99    | -99     | -127  |
| 40 <sup>21</sup> | -38                          | -67   | -76    | -90   | -97    | -96     | -129  |
| 50 <sup>21</sup> | -36                          | -64   | -74    | -89   | -96    | -95     | -128  |



<sup>21</sup> Specifications for 40 GHz and 50 GHz are nominal

## Frequency Modulation Table

(Specification applies for frequencies above 10 MHz)

|                                                       |                                                                                                                                                            |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rate (3 dB bandwidth)                                 | DC to 5 MHz                                                                                                                                                |
| Peak Deviation<br>DC to 750 kHz<br>750 kHz to 5 MHz   | 1.5 MHz/N<br>15 MHz/N                                                                                                                                      |
| Modulation Index<br>DC to 750 kHz<br>750 kHz to 5 MHz | Deviation limited<br>< 25/N                                                                                                                                |
| Accuracy<br>5 kHz rate<br>1 MHz rate                  | ± 5% at 5 kHz rate with 1 V <sub>peak</sub> input, 12.024 kHz/V sensitivity<br>± 5% at 1 MHz rate with 1 V <sub>peak</sub> input, 2.4048 MHz/V sensitivity |
| Sensitivity Range                                     | 40 Hz/V to 20 MHz/V                                                                                                                                        |
| Sensitivity Resolution                                | 1 Hz/V                                                                                                                                                     |
| Input Range                                           | ± 1V                                                                                                                                                       |
| Input Impedance                                       | 50 Ω                                                                                                                                                       |

## Phase Modulation

(Specification applies for frequencies above 10 MHz)

|                        |                                                                           |
|------------------------|---------------------------------------------------------------------------|
| Rate (3 dB Bandwidth)  | 100 Hz to 100 kHz                                                         |
| Peak Deviation         | 10 rad-pk/N                                                               |
| Accuracy               | ± 5% at 1 kHz rate with 1 V <sub>peak</sub> input, 3.83 rad/V sensitivity |
| Sensitivity Range      | 0.001 rad/V to 50 rad/V                                                   |
| Sensitivity Resolution | 0.001 rad/V                                                               |
| Input Range            | ± 1V                                                                      |
| Input Impedance        | 50 Ω                                                                      |

## Amplitude Modulation<sup>22</sup>

(Specification applies for frequencies above 10 MHz)

|                                              |                                |
|----------------------------------------------|--------------------------------|
| Depth (0 dBm carrier level)                  | 0 to 90% (0 dB to 20 dB)       |
| Depth Resolution                             | 0.1%                           |
| Rate (3 dB bandwidth at 0 dBm carrier level) | DC to 100 kHz (Depth = 50%)    |
| Sensitivity                                  | 0 to 95%/V, selectable         |
| Sensitivity Resolution                       | 0.1%/V                         |
| Accuracy                                     | ± 10% of setting at 1 kHz rate |
| Input Range                                  | ± 1V                           |
| Input Impedance                              | 600 Ω                          |

<sup>22</sup> Modulation peaks must be less than maximum available power

## Pulse Modulation

(Specification applies for frequencies above 500 MHz)

| Parameter                                               | Specification                                                                         |                                |
|---------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------|
| Standard Operating Modes                                | Internal, External                                                                    |                                |
| Pulse On/Off Ratio <sup>23</sup>                        | > 80 dB minimum, 90 dB nominal                                                        |                                |
| Pulse Leveling Modes                                    | Always on (closed-loop), Always off (open-loop Cal), Off for pulse widths < 1 $\mu$ s |                                |
| Rise/Fall Times                                         | 500 MHz to 20 GHz                                                                     | < 10 ns maximum, 3 ns typical  |
|                                                         | 20 GHz to 50 GHz                                                                      | < 25 ns maximum, 10 ns typical |
| Minimum Leveled Pulse Width <sup>24</sup>               | Internal / External                                                                   | 100 ns                         |
| Minimum Unleveled Pulse Width <sup>24</sup> (Option 32) | Open-Loop Calibrated Level                                                            | 25 ns, 10 ns nominal           |
| Level Accuracy <sup>24</sup>                            | Pulse Width > 350 ns                                                                  | $\pm$ 0.5 dB                   |
|                                                         | Pulse width > 100 ns to 350 ns                                                        | + 1.5 dB/ - 0.5 dB             |
| Level Accuracy <sup>24</sup> (Option 32)                | Pulse Width > 25 ns to 100 ns                                                         | + 2.5 dB/ - 0.5 dB             |
| PRF (50% Duty Cycle)                                    | Leveled                                                                               | < 3 MHz                        |
|                                                         | Open-Loop Calibrated (Option 32)                                                      | < 10 MHz                       |
| Pulse Fidelity                                          | Video Feed-through, 500 MHz to 2 GHz                                                  | < 5%                           |
|                                                         | Video Feed-through, 2 GHz to 50 GHz                                                   | < 1%                           |
|                                                         | Compression                                                                           | < $\pm$ 5 ns                   |
|                                                         | RF Delay (skew)                                                                       | < 75 ns                        |
| Sync Out Delay                                          | External                                                                              | 50 ns to 10 ms                 |
| Sync Out Delay Resolution                               | External                                                                              | 10 ns                          |

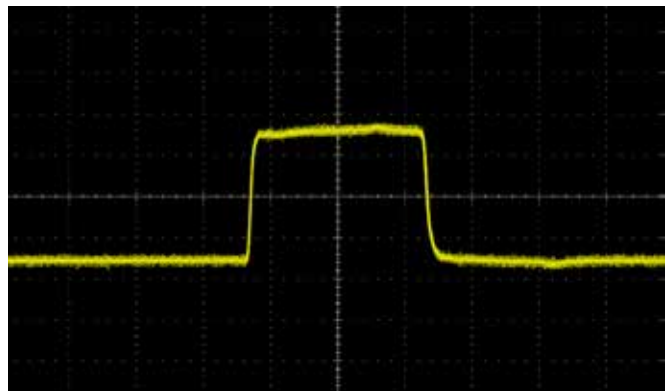
### 2500B Option 32 Narrow Pulse Performance (Nominal)

10 ns pulse at 750 MHz RF



Measured directly on wide-bandwidth Oscilloscope

20 ns pulse envelope at 10 GHz RF



Measured with low-capacitance Detector and wide-BW Oscilloscope

### Narrow Pulse Leveling Modes

Three ALC modes for pulse modulation exist. In the “Always On” mode the ALC automatically maintains the pulse amplitude accuracy for pulse widths as narrow as 350 ns over the full amplitude range, or as narrow as 100 ns at maximum leveled output power. In the “Always Off” mode the ALC provides accurate power output for pulses as low as 10 ns. Whenever RF is turned on, or the frequency or power settings are changed, the ALC turns on the RF on for 1 millisecond to calibrate the output power. After this initial calibration leveling is completed, the RF is turned off and pulse operation resumes. In the “Off for pulse widths < 1  $\mu$ s” mode the ALC automatically reengages leveling whenever the pulse width exceeds 1  $\mu$ s. This provides automatic closed loop leveling for pulse widths greater than 1  $\mu$ s while still providing accurate output power for pulse widths as low as 10 ns.

<sup>23</sup> Specification for model 2502B applies up to a frequency of 2.0 GHz.

<sup>24</sup> Duty Cycle must be >0.01%

## Internal Function Generator

|                                |                          |                                                                                |
|--------------------------------|--------------------------|--------------------------------------------------------------------------------|
| AM Source                      | Waveforms                | Sine, Square, Triangle, Ramp, Gaussian Noise                                   |
|                                | Rate                     | 0.01 Hz to 100 kHz, all waveforms                                              |
|                                | Resolution               | 0.01 Hz                                                                        |
|                                | Accuracy                 | Same as time base                                                              |
|                                | AM Out                   | 2 V <sub>peak-to-peak</sub> into 10 k $\Omega$ load                            |
| FM and Phase Modulation Source | Waveforms                | Sine, Square, Triangle, Ramp                                                   |
|                                | Rate                     | 0.01 Hz to 1 MHz, all waveforms                                                |
|                                | Resolution               | 0.01 Hz                                                                        |
|                                | Accuracy                 | Same as time base                                                              |
|                                | FM/ $\phi$ M Out         | 2 V <sub>peak-to-peak</sub> into 10 k $\Omega$ load                            |
| Pulse Modulation Modes         | Single Pulse Modes       | Continuous, Gated, Triggered                                                   |
|                                | Pulse Burst Modes        | Continuous, Gated, Triggered                                                   |
| Pulse Modulation Source        | Pulse Width              | 10 ns to 1 s                                                                   |
|                                | Pulse Repetition (PRI)   | 20 ns to 1 s                                                                   |
|                                | Pulse Burst Mode Pulses  | 2 to 300                                                                       |
|                                | Pulse Burst Period       | 30 ns to 10 s                                                                  |
|                                | Sync Out Delay           | -1 s to +1 s                                                                   |
|                                | Triggered RF Pulse Delay | 100 ns to 1 s                                                                  |
|                                | Resolution               | 10 ns                                                                          |
|                                | Pulse Accuracy           | $\pm 2\%$ of setting or $\pm 15$ ns whichever is greater. $\pm 0.08\%$ nominal |
|                                | Delay Accuracy           | $\pm 15$ ns                                                                    |
|                                | Pulse Modulation Out     | 2 V into 50 $\Omega$                                                           |
|                                | Gated Mode Input         | Active High or Active Low polarity                                             |
|                                | Triggered Mode Input     | Rising Edge or Falling Edge polarity                                           |

## Physical Table

|                                |                                                                                        |
|--------------------------------|----------------------------------------------------------------------------------------|
| Environmental                  | MIL-PRF-28800F, Class 3                                                                |
| Safety                         | EN61010                                                                                |
| Weight                         | < 35 lbs (15.9 kg)                                                                     |
| Emissions                      | EN61326                                                                                |
| Rack Height                    | 3U (5.25 inches) (133 mm)                                                              |
| Dimensions (with rack handles) | 19 inches (W) x 21 inches (D) x 5.2 inches (H)<br>483 mm (W) x 534 mm (D) x 133 mm (H) |
| Power                          | 90 to 253 VAC, 47 to 440 Hz<br>300 Watts nominal, 350 Watts max.                       |





## 2500B Series Rear Panel I/O Connector Descriptions

| Connector Label     | Specifications                                                                                            | Connector Type            |
|---------------------|-----------------------------------------------------------------------------------------------------------|---------------------------|
| EXT ALC             | External ALC Input                                                                                        | BNC                       |
| RF OUT              | 50 Ω Rear Panel Output, option 22 only                                                                    | SMA, N, 2.92 mm or 2.4 mm |
| FM/ φM OUT          | Internal modulation generator output; 2 Vp-p into 10 kΩ                                                   | BNC                       |
| PULSE OUT           | A +4 V video representation of the pulsed RF output signal                                                | BNC                       |
| AM OUT              | Internal modulation generator output; 2 Vp-p into 10 kΩ                                                   | BNC                       |
| PM SYNC OUT         | Synchronization output pulse width > 75 ns width                                                          | BNC                       |
| FM/ φM IN           | 50 Ω, +/- 1 V maximum                                                                                     | BNC                       |
| AM IN               | 600 Ω                                                                                                     | BNC                       |
| PULSE IN/PM TRIG IN | 50 Ω, TTL levels, polarity selectable                                                                     | BNC                       |
| LOCK/LEVEL          | +5 V indicator for phase/level lock for CW mode and in list mode                                          | BNC                       |
| REF TUNE            | 0 to +10 V                                                                                                | BNC                       |
| SYNC OUT            | +5 V output pulse                                                                                         | BNC                       |
| TRIGGER IN          | Used to trigger a list. Accepts a TTL level signal of > 50 ns width.                                      | BNC                       |
| BLANKING            | +5 V output indicator for band crossing, filter switching, and retraces                                   | BNC                       |
| RAMP OUT            | 0 to 10 V                                                                                                 | BNC                       |
| STOP SWP IN/OUT     | +5 V, 2 kΩ, active low                                                                                    | BNC                       |
| V/GHz               | 0.5 V/GHz (2502B, 2508B, 2520B) or 0.25 V/GHz (2526B, 2540B, 2550B)                                       | BNC                       |
| 100 MHz OUT         | +5 dBm typical, 50 Ω                                                                                      | BNC                       |
| 10 MHz OUT          | 2 Vp-p, 50 Ω                                                                                              | BNC                       |
| EXT REF IN          | 10 MHz ± 50 Hz (> -5 dBm), 100 MHz ± 500 Hz (> +5 dBm to +8 dBm), 50 Ω                                    | BNC                       |
| GPIB                | A 24-pin IEEE STD 488.2 connector for control of the instrument during remote operation using GPIB        | Type 57                   |
| RS-232              | A DB-9 connector for control of the instrument during remote operation using RS-232 serial communications | DB-9                      |
| USB                 | USB 2.0 (Device) for control of the instrument during remote operation using USB communications           | USB type B                |
| LAN                 | 100 Base T Ethernet for control of the instrument during remote operation using Ethernet                  | RJ45                      |
| AC POWER INPUT      | 90 to 253 VAC, auto-sensing, 47 Hz to 440 Hz                                                              | IEC Power Line            |

### Included Accessories

The 2500B series Microwave Signal Generators include the following items: Giga-tronics Automation Xpress software (AX), operation and programming manual (CD-ROM), AC power cord (6 foot) and combined rack mount and handle brackets.

# Ordering Information

Giga-tronics has a network of RF and Microwave instrumentation sales engineers and a staff of factory support personnel to help you find the best, most economical instrument for your specific applications. In addition to helping you select the best instrument for your needs, our staff can provide quotations, assist you in placing orders, and do everything necessary to ensure that your business transactions with Giga-tronics are handled efficiently.

| Model Number | Frequency Range    |
|--------------|--------------------|
| 2502B        | 100 kHz to 2.5 GHz |
| 2508B        | 2 GHz to 8 GHz     |
| 2520B        | 2 GHz to 20 GHz    |
| 2526B        | 2 GHz to 26.5 GHz  |
| 2540B        | 2 GHz to 40 GHz    |
| 2550B        | 2 GHz to 50 GHz    |

## Available Options and Accessories

| Option | Description                                                                       |
|--------|-----------------------------------------------------------------------------------|
| 17A    | Add Internal and External Modulation Suite (includes internal function generator) |
| 17B    | Add External Modulation Suite                                                     |
| 18     | Add 100 kHz to 2 GHz Frequency Range (Standard on the 2502B model)                |
| 20     | Add High RF Output Power                                                          |
| 22     | Move RF Output Connector to Rear Panel                                            |
| 23     | Add Type-N RF Connector (for 2520B model only)                                    |
| 26A    | Add 90 dB Mechanical Step Attenuator (for 2502B, 2508B, 2520B models only)        |
| 26B    | Add 90 dB Mechanical Step Attenuator (for 2526B model only)                       |
| 26C    | Add 90 dB Mechanical Step Attenuator (for 2540B model only)                       |
| 26D    | Add 90 dB Mechanical Step Attenuator (for 2550B model only)                       |
| 27     | Add 110 dB Electronic Step Attenuator (for 2502B, 2508B models only)              |
| 28     | Add Ultra-Low Close-in Phase Noise                                                |
| 29     | Add Fast Frequency Switching Speed                                                |
| 32     | Add Narrow Pulse Width $\leq 100$ ns (Requires Option 17A or 17B)                 |
| 44     | Replace Standard Front Panel with Blank Front Panel (Requires Option 22)          |
| 46     | Add Rack Slide Kit                                                                |
| EWS20  | Three Year Warranty (Two Year Extended Warranty)                                  |
| EWS40  | Five Year Warranty (Four Year Extended Warranty)                                  |



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