

# 2400B Series Microwave Synthesizer

## Signal Generator Frequency Range

2408B/2408S	10 MHz - 8 GHz
2420B/2420S	10 MHz - 20 GHz
2426B/2426S	10 MHz - 26.5 GHz
2440B/2440S	10 MHz - 40 GHz

## Available Options and Accessories

- 17 Delete Modulation Suite
- 18 Delete 0.01 to 2 GHz
- 23 Type N Connector (2420 Series only)
- 26 Delete Step Attenuator
- 31 2 msec. Switching Speed Limit
- 44 Delete Front Panel, 2400S series only
- 46 Rack Slide Kit
- 55 Command Sets

## Fast Frequency Switching

The fast frequency switching of the Giga-tronics 2400 Series Microwave Synthesizer pays dividends in any test environment where large amounts of data are collected. Regardless of the complexity of your application, such as antenna characterization or RFIC testing, the 2400 Series will quickly prove itself as your best test investment by providing quick settling of amplitude and frequency for minimum waiting between measurement points. In addition, the 2400 Series Automation Xpress software and interface option ensures unmatched 2.5 ms CW frequency and power switching performance, providing fast and flexible data exchange rates for faster testing and more device throughput.

## Low Phase Noise

The Giga-tronics 2400 Series Microwave Synthesizers deliver state of the art phase noise and fast switching simultaneously. The 2400 Series low noise, high power and excellent phase stability are ideal for your measurement system's local oscillator or low jitter clock.

## Faster to Program

Every 2400 Series Microwave Synthesizer comes with Giga-tronics Automation Xpress, a PC based software package designed for enhanced user interface and automatic test systems. Automation Xpress leverages industry-leading software applications, familiar Windows drop-down menus and other functions to perform tasks. Using Windows-based applications, such as Microsoft™ Excel or Notepad, engineers can create, manage and download complex lists in seconds.

## Simpler to Operate

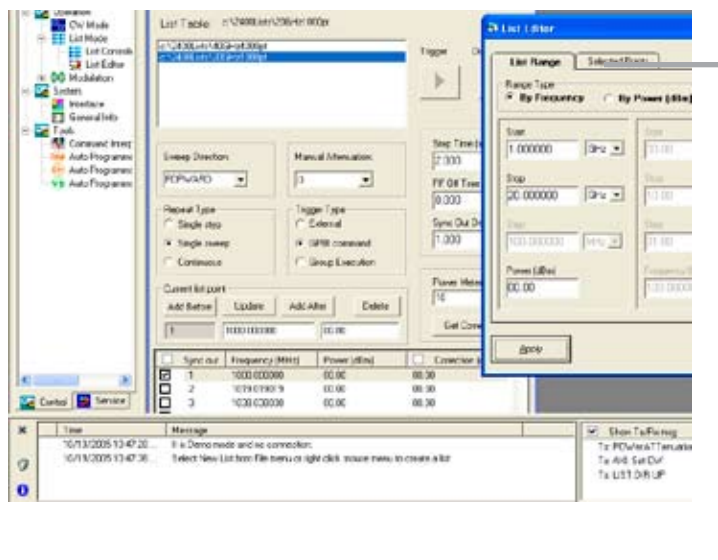
At first glance, it's clear the Giga-tronics 2400 Series is different. Its innovative design and intuitive interface will make you productive right out of the box. The 2400 was designed to streamline user navigation by moving complex testing functions from the front panel to the desktop PC. The result is a groundbreaking system that reduces training time, speeds workflow and dramatically boosts end-user productivity. To enhance user navigation, we minimized the number of soft screens and menu layers, simplifying content and improving operational performance. That means you'll spend less time scrolling through data menus and more time getting your work done.

## 2400 Series Optimized for ATE

With the 2400 Series, ATE integrators now have a system source specifically designed to match their unique performance needs. The 2400 Series works seamlessly with other instruments. It includes hardware triggering and synchronization signals with programmable delays to allow coordination with other test products in your system. Replacing other industry-standard microwave synthesizers can also be accommodated, making the 2400 Series the ideal choice for upgrading older systems.

## Standard 4 Year Warranty

Excellent reliability and trouble-free operation are features that you demand in a microwave synthesizer. At Giga-tronics, we're so confident of the 2400B series reliability, it comes with a 4 year warranty at no additional cost!



# 2400 Series

## Technical Specifications

All specifications apply over a 0°C to +55°C range after 30 minutes of warm-up time unless otherwise stated.

### Frequency (after 30 day warm-up)

Accuracy:	Same as time-base
Resolution:	0.1 Hz
Power Slope:	0 to 0.5 dB/GHz
Reference:	
Reference Output:	10 MHz, TTL level into 50 Ω
External Reference Input:	10 MHz or 100 MHz ± 1ppm > -5 dBm into 50 Ω
High Stability Time Base	10 MHz
Aging Rate	< 5 × 10 <sup>-10</sup> /day (after 30 day warm-up)
Temperature Stability	< 2.5 × 10 <sup>-8</sup> /°C (after 30 day warm-up)
Volts/GHz: 0 to 10V range:	0.50V/GHz, 0.01 – 20 GHz 0.25V/GHz, 20 – 40 GHz
Lock/Level Indicator:	Sync Out = TTL High

### Frequency Bands

Band	Frequency	N
0	10 – 15.99 MHz	512
1	16 – 30.99 MHz	256
2	31 – 62.99 MHz	128
3	63 – 124.99 MHz	64
4	125 – 249.99 MHz	32
5	250 – 499.99 MHz	16
6	500 – 999.99 MHz	8
7	1.0 – 1.99 GHz	4
8	2.0 – 3.99 GHz	2
9	4.0 – 7.99 GHz	1
10	8.0 – 15.99 GHz	1/2
11	16.0 – 31.99 GHz	1/4
12	32.0 – 40.00 GHz	1/8

### Output Power

Maximum Levelled (dBm)<sup>1</sup> (Specification applies over 0 to 35°C range and degrades <2.0 dB from 35°C to 55°C)

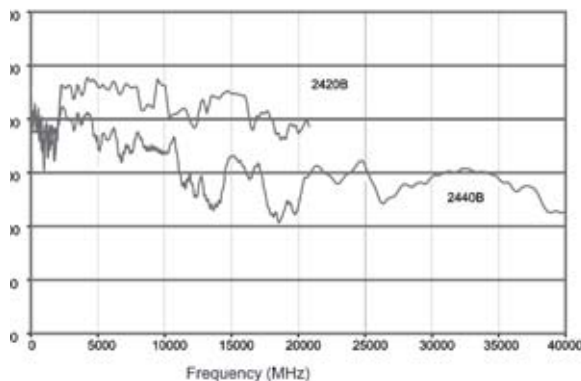
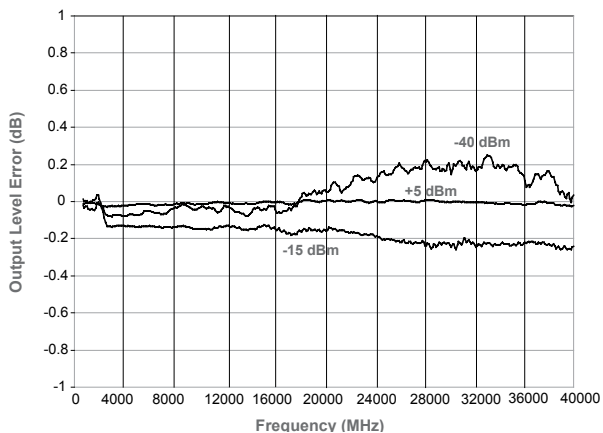
Model	.01 - <2 GHz (w/ Step Attenuator)	2 - <8 GHz (w/ Step Attenuator)	8 - 20 GHz (w/ Step Attenuator)	20-40 GHz <sup>2</sup> (w/ Step Attenuator)
8 GHz	+14 (13.2)	+15 (13.8)	—	—
20 GHz	+14 (13.2)	+15 (13.8)	+15 (12.5)	—
26.5 GHz	+13 (12)	+9 (7.8)	+10 (8.6)	+10 (8.6)
40 GHz	+10 (9)	+10 (7.8)	+9 (7.6)	+9 (7.6)

Minimum Settable:	-107 dBm, <20 GHz; -100 dBm, >20 GHz (Option 26) -17 dBm <20 GHz; -10 dBm, >20 GHz
Power Offset:	0 to 10 dB
Resolution	0.05 dB
Temperature Stability:	0.025 dB/°C
Output Source Match (typical):	< 2.0:1
Accuracy (dB) (Specifications apply over 15 to 35°C range and degrades <0.1 dB/°C outside the range)	

Model	> 5 dBm	> -10 dBm	> -100 dBm
.01 - 20 GHz	± 1.0	± 0.8	± 1.3
20 - 40 GHz	± 1.2	± 1.0	± 1.5

### Output Power and Level Accuracy for the 2400 Series

#### 2440B Series Output Level Error Accuracy



### Spectral Purity

Harmonics (Specifications for harmonics above instrument frequency range are typical.)

Frequency (GHz)	Standard (at +6 dBm)
0.01 – 20 GHz	- 55 dBc <sup>3</sup>
20 – 40 GHz	- 50 dBc

### Sub-Harmonics

Frequency (GHz)	Standard (at +6 dBm)
.01 – 2 GHz	- 80 dBc
2 – 20 GHz	- 60 dBc
20 – 40 GHz	- 50 dBc

Spurious (Specification is -45 dBc typical for offsets < 300 Hz)

Frequency (GHz)	Offsets > 300 Hz
.01 – 16 GHz	- 60 dBc
16 – 32 GHz	- 54 dBc
32 – 40 GHz	- 48 dBc

<sup>1</sup>With Option 26, Delete Step Attenuator. For standard models, the step Attenuator reduces power by 1.5 dB to 18 GHz; 2.0 dB, 18- 26.5 GHz, and 2.5 dB above 26.5 GHz.

<sup>2</sup>20 - 26.5 GHz for model 2426 series

<sup>3</sup>Frequencies > 100 MHz; for frequencies < 100 MHz, -45 dBc typical, worst case -40 dBc

# 2400 Series Technical Specifications

All specifications apply over a 0°C to +55°C range after 30 minutes of warm-up time unless otherwise stated.

## Spectral Purity Continued:

Residual FM (typical)

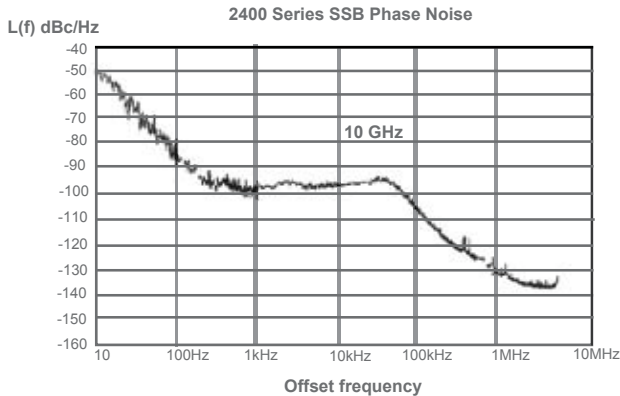
Frequency (GHz)	50 Hz - 15 kHz Bandwidth
.01 – 16 GHz	< 40 Hz
16 – 32 GHz	< 80 Hz
32 – 40 GHz	< 120 Hz

AM Noise (typical)

Frequency (GHz)	Offsets > 5 MHz
.01 – 2 GHz	- 130 dBm/Hz
2 – 20 GHz	- 145 dBm/Hz
20 – 40 GHz	- 140 dBm/Hz

## SSB Phase Noise

Frequency (GHz)	Offset from Carrier (dBc/Hz)				
	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
0.85	-92	-111	-112	-123	-130
1.85	-86	-105	-106	-117	-135
5.6	-75	-97	-98	-105	-130
10	-74	-92	-92	-101	-128
18	-68	-89	-90	-99	-123
23	-63	-85	-86	-93	-118
30	-61	-83	-84	-91	-115



## Frequency/Power Sweep - B Series and S Series

Ramp Frequency Sweep:	Full Frequency Coverage
Ramp Power Sweep:	0 to 25 dB
Power Slope:	0 to 0.5 dB/GHz
Power Flatness:	See Accuracy table
Ramp Output:	0 to 10V
Z-Axis Blanking:	+ 5V (Positive Only)
Sweep Time <sup>4</sup> :	100 msec — 200 secs

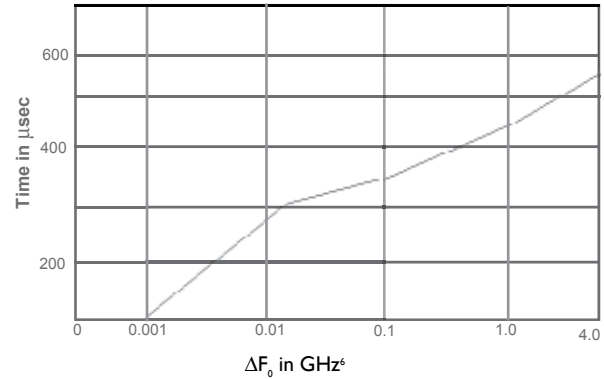
## List Mode

Number of List Points:	4000
Frequency Settling Time <sup>5</sup> :	< 550 $\mu$ sec for $\Delta F_0 \leq 500$ MHz
Amplitude Settling Time <sup>7</sup> :	< 500 $\mu$ sec
Step Time:	150 $\mu$ sec - 1 sec
	2 ms - 1 sec (option 31)
Sync Out Delay <sup>8</sup> :	50 $\mu$ sec - 10 msec
Trigger Modes:	EXT, GPIB GET, Software

## List Mode Continued:

Sweep Modes: Continuous, Single Step, & Single Sweep

2400 Typical Frequency Settling Time



## Remote Programming

Hardware Interface:	IEEE 488.2 RS-232 & USB (w/supplied adapter)
Software Interface:	SCPI, GT12000, GT9000, GT900 Automation Xpress Interface (Standard)

Execution Speed (IEEE 488.2):

	AXI	SCPI
CW Switching	2.5 ms	28 ms
4000 pt. List Download	13 sec	28 sec

## Automation Xpress Interface (AXI)

For use with Giga-tronics Automation Xpress software. The AXI provides Xpress 2.5 ms CW Frequency/Power switching, faster data exchange and functional downloads/executions, and a stable API programming interface for the ATE programming environment.

## Modulation Specifications:

### Amplitude Modulation<sup>9</sup>

Depth:	0 — 75% (Level = 0 dBm)
Rate (3 dB Bandwidth):	DC — 5 kHz (depth = 30%)
Sensitivity:	0 — 95% /V selectable
Accuracy:	$\pm$ 10% of setting at 1 kHz rate
Input:	
Range:	$\pm$ 1V
Impedance:	600 $\Omega$

### Scan Modulation (Specification applies for frequencies below 20 GHz)

Depth:	> 60 dB
Scan Time:	200 ms - 10 sec
Maximum Number of Points:	4000
Minimum Time per Point:	1 ms
Scan Pattern:	Sin (x) X

Minimum # of Lobes: 1

<sup>4</sup> Sweep rate must be < 500 MHz/msec.

<sup>5</sup> Time for frequency to settle within 50 kHz of final value after a frequency switch.

<sup>6</sup>  $\Delta F_0 = |(F_{stop} \times N_{stop}) - (F_{start} \times N_{start})|$  - See Frequency Bands Table for N values.

<sup>7</sup> Time for amplitude to settle within 0.1 dB of final value after an amplitude switch.

<sup>8</sup> Delay is specified from edge of trigger pulse.

<sup>9</sup> Modulation peaks must be less than maximum available power

## Modulation Specifications:

### Frequency Modulation

Narrow Mode: (Deviation Limited Modulation Index)

Rate (3 dB bandwidth): DC - 50 kHz  
Peak Deviation: 1 MHz  
N

Accuracy:  $\pm 5\%$  at 5 kHz rate  
with 1V peak input

Input:  
Range:  $\pm 1V$   
Impedance: 50  $\Omega$

Wide Mode: (Modulation Index  $< 15/N$ )

Rate (3 dB bandwidth): 1 kHz - 3 MHz  
Peak Deviation: 20 MHz  
N

Accuracy:  $\pm 5\%$  at 200 kHz rate with 1V  
peak input

Input:  
Range:  $\pm 1V$   
Impedance: 50  $\Omega$

### Pulse Modulation (Specification applies for frequencies above 500 MHz)

On/Off Ratio: 80 dB

Rise/Fall Times:

Frequency	Rise Time
0.5 - 20 GHz	< 10 ns
20 - 40 GHz	< 25 ns

Minimum Width: 100 ns  
Level Accuracy<sup>10</sup>:  $\pm 0.5$  dB Pulse Width > 250 ns  
(relative to CW) +1.5 / -0.5 dB Pulse Width >150 -250 ns  
+2.5 / -0.5 dB Pulse Width 125 - 150 ns

PRF (50% duty cycle): DC - 5 MHz

Pulse Fidelity (typical):  
Overshoot & Ringing: < 15%  
Video feed through: 0.5 - 2 GHz (< 5%)  
2 - 40 GHz (< 1%)

Compression: <  $\pm 5$  ns  
Delay: < 75 ns

Input  
Sensitivity: TTL levels (polarity selectable)  
Impedance: 50  $\Omega$

### Automation Xpress Requirements- All 2400 Series models

20 MB Disk Space  
Windows 2000, Windows XP  
128 MB RAM or greater

### Inputs & Outputs:

Connector		
EXT REF Input	RF Output	AM Output
AM IN	10 MHz REF Output	FM Output
FM IN	100 MHz REF Output	Pulse Output
PM/PM Trigger IN	V/GHz Output	Pulse Sync Output
External ALC	Sync Output	
Trigger In	Blanking Output	
Stop Sweep I/O	Ramp Output	
	Lock/Level Output	

## Internal Function Generator:

### AM Modulation Source

Waveforms: Sine, Square, Triangle, Ramp, Gaussian Noise  
Rate: 0.01 Hz to 10kHz, all waveforms  
Resolution: 0.01 Hz  
Accuracy: Same as time base  
AM Out: 2V, peak to peak into 10 k $\Omega$  Load

### FM Modulation Source

Waveforms: Sine, Square, Triangle, Ramp, Gaussian Noise  
Rate: 0.01 Hz to 1 MHz, all waveforms  
Resolution: 0.01 Hz  
Accuracy: Same as time base  
FM Out: 2V, peak to peak into 10 k $\Omega$  Load

### PM Modulation Source

Width: 0.05 uSec. to 0.01 Sec.  
Pulse Repetition Interval: 0.2 uS to 1 Sec.  
Sync. Out Delay: 0 to 10 mSec.  
Resolution: 10 nSec.  
Accuracy: Accuracy:  $\pm 0.1\%$  typical, worst case:  $\pm 2\%$   
of setting or  $\pm 20$ nS whichever is greater  
PM Out: 2Volts into 50  $\Omega$

## Physical

Environmental: MILPRF-28800F Class 3  
Safety: EN61010  
Weight: < 35 lbs  
Emissions: EN61326  
Rack Height: 3U (5.25 inches)  
Connector Types (All Series): 2408 (N(f)),  
2420/2426 (SMA(f))  
2440 (K(f))

## Remote Interface

GPIO (IEEE 488.2, 1987) with listen and talk  
RS - 232

## 2400S Series Only

2400S Series include:

Rear RF Output  
Delete Front Panel Option  
includes front panel LED Indicators: Power, EXT REF, Unleveled

## Giga-tronics Support Services

At Giga-tronics, we understand the challenges you face. Our support services begin from the moment you call us. We help you achieve both top-line growth and bottom-line efficiencies by working to identify your precise needs and implement smart and result orientated solutions. We believe and commit ourselves in providing you with more than our superior test solutions.



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<sup>10</sup> Duty Cycle must be  $> 0.01\%$  Data subject to change without notice.

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