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Replacement pages will become standard pages at the next printing cycle. The Front Matter (excluding Cover page), Table of Contents, List of Illustrations and Tables, Preface (in most cases) and Index will be updated at this cycle. For record purposes you are encouraged to retain this TPCI as a permanent part of the publication. Record changes in your publication's Preface section (Under newer Giga-tronics publications, "Record of Publication Changes", in older, "Record of Manual Changes").

Publication	Former P/N, Revision & Date	Updated P/N, Revision & Date
Series 12000A Microwave Synthesizers Operation Manual	31231, Rev. G, June 2002	31231, Rev. G1, August 2002

Publication Update Requirements

Change Originator			Replace Old Page(s)/ Add New Page(s)	Remarks
ECO	CAR	QIR		
ECO 8301			Replace old first 2 pages of the Front Matter with new.	Update to revision level on front matter to Rev. G1, date August 2002.
			Replace old pages 1-25 to 1-28 with new.	Update to Chapter 1.
			Replace old pages 4-17 to 4-18 with new.	Update to Chapter 4.

This Page will be left intentionally blank in most cases, due to continuity issues

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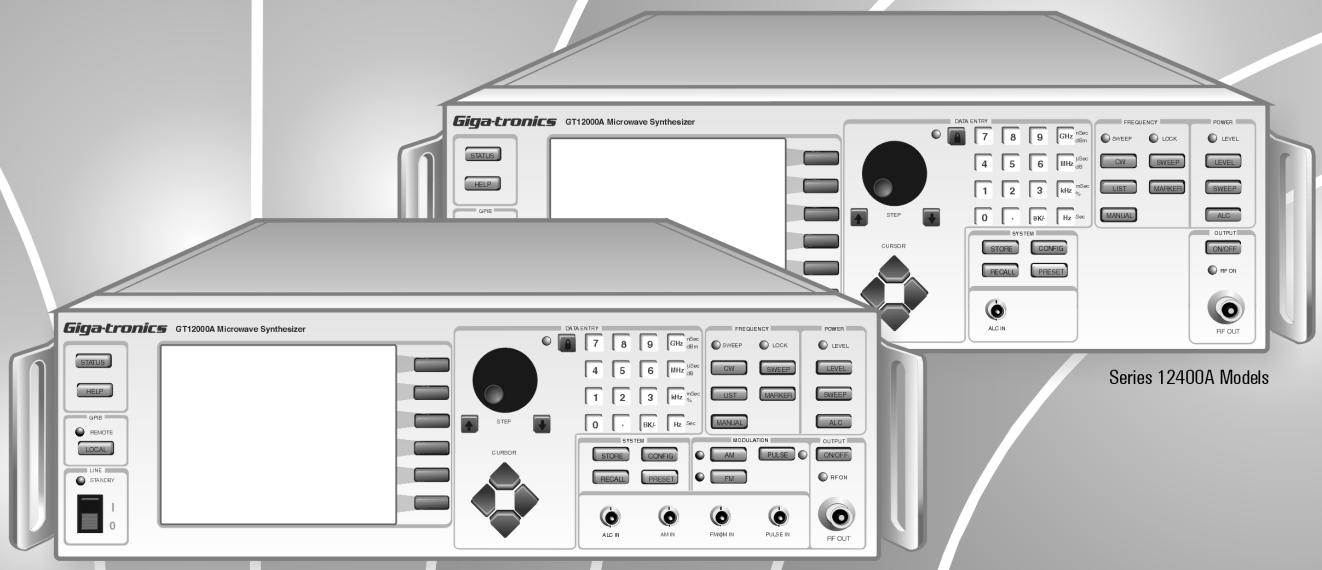

Series 12000A Microwave Synthesizers

Operation Manual

Publication 31231, Rev. G1, August 2002

Registered 04 June 1996 ❖ Amended 10 September 2001
CE
Certified Product

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ISO 9001
Certified Process
Registrar: BSI, Certification FM 34226

WARRANTY

Giga-tronics Series 12000A instruments are warranted against defective materials and workmanship for three years from date of shipment. Giga-tronics will at its option repair or replace products that are proven defective during the warranty period. This warranty DOES NOT cover damage resulting from improper use, nor workmanship other than Giga-tronics service. There is no implied warranty of fitness for a particular purpose, nor is Giga-tronics liable for any consequential damages. Specification and price change privileges are reserved by Giga-tronics.

MODEL NUMBERS

The Series 12000A has model numbers for each instrument with a specific frequency range as described in Chapter 1. All models are referred to in this manual by the general term 12000A, except where it is necessary to make a distinction between the models. In these cases, the specific model number(s) will be used.

1.7.3 Frequency Modulation (FM)

Specifications apply with Scan/AM and PM off. FM may be operated simultaneously with Linear AM and or PM (PM & Linear AM not allowed simultaneously).

1.7.3.1 Wide Mode Envelope Parameters

Maximum Deviation

See table contained in Section 1.7.3.2

Minimum Deviation

10 kHz at 4 - 8 GHz (Other ranges proportionally)

Modulation Resolution

1 kHz (Deviation $<$ 1 MHz); 10 kHz (Deviation $<$ 1 MHz) (at 4 - 8 GHz, other range proportionally)

Flatness

$\pm$2 dB for rates from 100 Hz to 1 MHz; $\pm$3 dB to 8 MHz

Residual FM

See table contained in Section 1.7.3.2

Modulation Accuracy

$\pm$5% at max deviation, 190 kHz modulation rate

Distortion

$<$5% ($\pm$1 MHz Deviation)

Incidental AM

$<\pm$0.2%/MHz of Deviation

1.7.3.2 Narrow Mode Envelope Parameters

Maximum Deviation

See table below

Modulation Resolution

10 Hz (Deviation < 10 kHz)
1 kHz (Deviation > 10 kHz) (at 4 - 8 GHz, other ranges proportional)

Flatness

±2 dB for rates from DC to 1 MHz (Measured at 1 V_{P-P} input, i.e., 500 KHz Deviation)
±3 dB for 1 MHz to 8 MHz

Residual FM

Same as CW

Modulation Accuracy

±5% at max Deviation, 190 kHz modulation rate

Distortion

< ±0.2%/MHz of Deviation

Incidental AM

< 5% (±1 MHz deviation)
< 1% @ 10 KHz (4 - 8 range)

Frequency (GHz)	**Max Wide Deviation** (Pk)	**Max Narrow Deviation** (Pk)	**Wide Mode Residual FM**
.010 to .016	40 kHz	2 kHz	< 200 Hz
> .016 to .032	80 kHz	4 kHz	< 200 Hz
> .032 to .064	160 kHz	8 kHz	< 200 Hz
> .064 to .125	320 kHz	16 kHz	< 200 Hz
> .125 to .25	640 kHz	32 kHz	< 200 Hz
> .25 to .5	1.25 MHz	64 kHz	< 200 Hz
> .5 - 1	2.5 MHz	125 kHz	< 375 Hz
> 1 - 2	5 MHz	250 kHz	< 750 Hz
> 2 - 4	10 MHz	.5 MHz	< 1.5 kHz
> 4 - 8	20 MHz	1 MHz	< 3 kHz
> 8 - 16	40 MHz	2 MHz	< 6 kHz
> 16 - 20	80 MHz	4 MHz	< 12 kHz

1.7.3.3 Internally Generated FM Envelope

See Option 24 specifications in Section 1.8.1

1.7.3.4 Externally Supplied FM Envelope

Waveform
Any waveform compatible with bandwidth considerations

Rate
DC to 8 MHz

Input Sensitivity, Settable
1 V_{P-P} for maximum Peak deviation (FM deviation control set to maximum)

Input Impedance
50 Ω (Nominal)

1.7.4 Phase Modulation (ϕM)

Specifications apply with SCAN/AM and PM off. ϕM may be operated simultaneously with Linear AM and or PM (PM & Linear AM not allowed simultaneously).

1.7.4.1 Wide Mode Envelope Parameter

Maximum Deviation

See table contained in Section 1.7.4.2

Maximum Resolution

10 kHz at 4 - 8 GHz (other ranges proportional)

Modulation Resolution

.01 radians (at 4 - 8 GHz, other ranges proportional)

Flatness

±2 dB for rates from 100 Hz to 100 kHz

Modulation Accuracy

±5% (relative to FM) at max. deviation, 100 kHz modulation rate

Distortion

< 5% (±1 MHz deviation)

Incidental AM

< ±0.2%/MHz of deviation

1.7.4.2 Narrow Mode Envelope Parameters

Maximum Deviation

See table is on next page

Modulation Resolution

.01 radians (at 4 - 8 GHz, other ranges proportional)

Flatness

±2 dB for rates from 100 Hz to 100 KHz (Measured at 1 V_{P-P} input, i.e., 500 KHz Deviation)

Maximizing Delay Discriminator Output

Obtaining a six division change on a 5 mV scale may be difficult to obtain for a 1 MHz change in frequency. Increasing output power will improve the output of the discriminator. The output of the UUT can be adjusted to levels as high as +13 dBm or higher for the 4 to 8 GHz frequency band. The output performance of discriminator is improved with a very high cable length ratio. Cable length ratios of 16 to 1 (48 inches to 3 inches) will produce a large number of frequency nulls within the 4 to 8 GHz frequency band.

☛ ***NOTE:*** *Increasing the number of frequency nulls increases the rate of change of the output voltage per unit frequency as the output transitions through the frequency null.*

Optimal Test Performance Null Selection

The maximum deviation of the Frequency Modulation test is ±10 MHz. The rate of change for the output voltage per unit frequency (ΔV/ΔF) must remain constant (linear) for the ±10 MHz deviation range. Rate changes within this deviation range will result in a non-symmetrical waveform and will produce invalid test results.

Identifying an optimal frequency null is achieved by sweeping the frequency through the frequency range of the test and observing the Delay Discriminator waveform on an oscilloscope.

Recommended Test Equipment (FM)

- Delay Discriminator
- Digital Oscilloscope
- Pulse Generator with 1 shot Capability
- BNC Cables and Tee

Recommended Configuration

1. Connect the input of the delay discriminator to the RF output of the 12000A and the output to the digital scope.
2. Set the 12000A to Sweep Mode with the following settings:
   a. Start Frequency: 4 GHz
   b. Stop Frequency: 8 GHz
   c. Sweep Type: Ramp
   d. Sweep Time: 900 msec
   e. Repeat Mode: Single Sweep
   f. Trigger Type: Trigger in BNC
   g. Power: +10 dBm
3. Connect the output of the pulse generator to the External Trigger Input or second channel of the digital scope and the Trigger In of the 12000A.
4. Set the trigger selection of the digital scope to the port where the trigger signal will be detected (Use the BNC Tee at this port).

5. Adjust the time base of the digital scope to 1 second for the entire span of the X axis (100 mSec typical). Set the vertical scale to 100 mV per division.

6. Pulse the generator to initiate the RF sweep.

Repeat the sweep several times. The output of the Delay Discriminator should not vary from one sweep to another. Review the waveform and identify the nulls where the voltage transitions through the nulls are steeper and linear for a ±50 mV range above and below the null. Perform the FM modulation tests at these frequency nulls.

For certain frequencies, which may be identified by experiment, the mixer will produce a DC voltage near zero. The number of null frequencies can be increased by making the delay lines longer in absolute terms or by increasing the ratio between their lengths. If the output becomes frequency modulated, the mixer output voltage will change, and the voltage variation will be proportional to FM deviation.

The polarity of the voltage change may be either directly or inversely related to the direction of frequency deviation. When voltage levels have been established for different frequencies, the mixer output can be monitored on an oscilloscope to provide a continuous display of FM deviation.

4.4.2.4 Procedure

1. Connect the FM test fixture to the RF OUT connector of the 12000A as shown in Figure 4-7. Monitor the mixer output with the oscilloscope. Set the 12000A to any null frequency between 4.0 and 7.99 GHz (that is, at a frequency where the mixer output voltage is zero); +10 dBm out, no modulation.

2. Establish the voltage at 1 MHz above and 1 MHz below the null frequency. Adjust the oscilloscope gain and the 12000A output power level (near +5 dBm) to place the null point at the center of the screen and the 1 MHz deviation points at 3 divisions above and 3 divisions below the null point.

3. Set the 12000A to Narrow EXT FM with 1 MHz deviation. Connect the function generator, set to a 100 kHz rate SINE wave, 1 V_{P-P}. Verify that the waveform is 6 divisions peak-to-peak.

4. Adjust the 12000A FM deviation for exactly a six division peak-to-peak display. Vary the function generator from 10 Hz to 1 MHz and verify that the display remains between five and seven divisions peak-to-peak.

5. Vary the function generator from 1 MHz to 8 MHz and verify that the display remains between 4 and 8 divisions.

6. Establish the voltage at 10 MHz above and below the null frequency. Adjust the oscilloscope gain and the 12000A output power level (near +5 dBm) to place the null point at the center of the screen and the 10 MHz deviation points at 3 divisions above and 3 divisions below the null point (terminate the Mixer output in 50 Ω).

7. Set the 12000A to Wide EXT FM with 10 MHz deviation. Set the function generator to 100 kHz. Verify that the waveform is 6 divisions peak-to-peak.

8. Adjust the 12000A FM deviation for exactly a 6-division peak-to-peak display. Vary the function generator from 100 Hz to 1 MHz and verify that the display remains between 4.7 and 7.3 divisions.

9. Vary the function generator from 1 MHz to 8 MHz and verify that the display remains between 4 and 8 divisions.