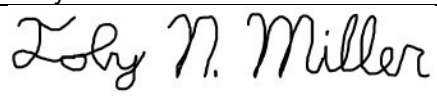
GX Low Power Modulator FCC Verification Measurements

This document is compiled to provide the data and records supporting a Verification of Compliance with FCC rules set forth in 47CFR Parts 2.1047(73.317) and 2.1055(73.155). Verification as described in 2.902 applies to all subsequent identical units marketed.

Use of the Verification method requires that the records identified in 2.955 are kept, and that they shall be retained for two years after the manufacture of the equipment has ceased. This document, along with certain other documents referenced herein, are the records for the verification of the equipment tested and described.

These tests are representative of all GX Low Power Modulators.

PERSONS PRIMARILY RESPONSIBLE FOR TESTING	
Name	Toby N. Miller
Signature	
Title	Electronic Design Engineer
Address for contact purposes.	Gates Air Corporation 3200 Wismann Lane Quincy, Il. 62305
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Name(s) of others who performed testing if applicable	N/A
Signature	
Date Signed	2/16/2024

1. Description of the EUT

Gates Air® GX™ is the next generation in solid state transmission for FM analog broadcasting.

The GX operates on any single channel in the 87.5-108 MHz FM band. There are three LPFM models with power output capability ranges of: GX50; 5W to 55W, GX150; 15W to 165W, & GX300; 30W to 330W, in FM only mode. The emission designator is: 400KD9W

Trade Name	GX
Model Tested	GX Low Power Modulator
FCC Identifier	GX300 BOI-GXLP300
Frequency Tested	Audio tests were performed at 98MHz.
Type (AM, FM, TV, etc)	FM
RF Frequency Range	87.5MHz to 108MHz
Date(s) on which testing was performed	July 2023 & February 2024
Address of test location	3200 Wismann Lane Quincy, Il. 62305

2. FCC Rules Reference/Checklist

√		47CFR2	47CFR73	Other	Comment
	Measurement Procedure	2.947			Outlines acceptable standards and procedures.
	Measurements Required	2.1041	NA	NA	Lists the required measurements according to paragraph number. These are what follows.
√	Modulation Characteristics.	2.1047	73.317	NA	Curve must be supplied showing the frequency response. 75us Pre-Emphasis Verification Data
√	Frequency Stability.	2.1055	73.155	ANSI/TIA-603-C-2004 2.2.2	+/- 2000 Hz limit. Use data taken in an environmental chamber

3. Modulation characteristics.

3.2.1 Rule 47CFR2.1047

2.1047 (a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage.

3.2.2 Criteria

The AES response plots should show a steep roll-off that protects the 19 kHz pilot from modulation.

Take response data with 75us Pre-emphasis Applied to the Analog input with De-emphasis in the Audio Precision. Data should be +/-0.5dB. Then remove De-emphasis from the Audio Precision and compare readings to De-emphasis curve values.

3.2.3 Test Setup

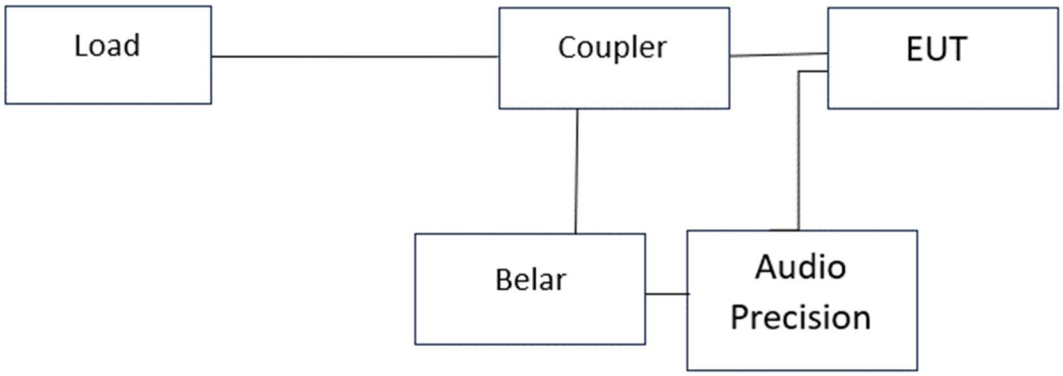


Figure 1: Modulation Testing Setup.

3.2.4 Equipment used.

Equipment	Model	Asset #	Cal. Due
Black Cable	N/A	N/A	N/A
15dB Pad	N/A	N/A	N/A
Coupler	Gates Air 971-0023-521	PRD651197-009	N/A
Load	Bird/Thermaline	S/N:114100024	N/A
Audio Precision	System 2: 2722	11235	12/26/2024
FM Monitor	Belar FMCS-1	12628	N/A

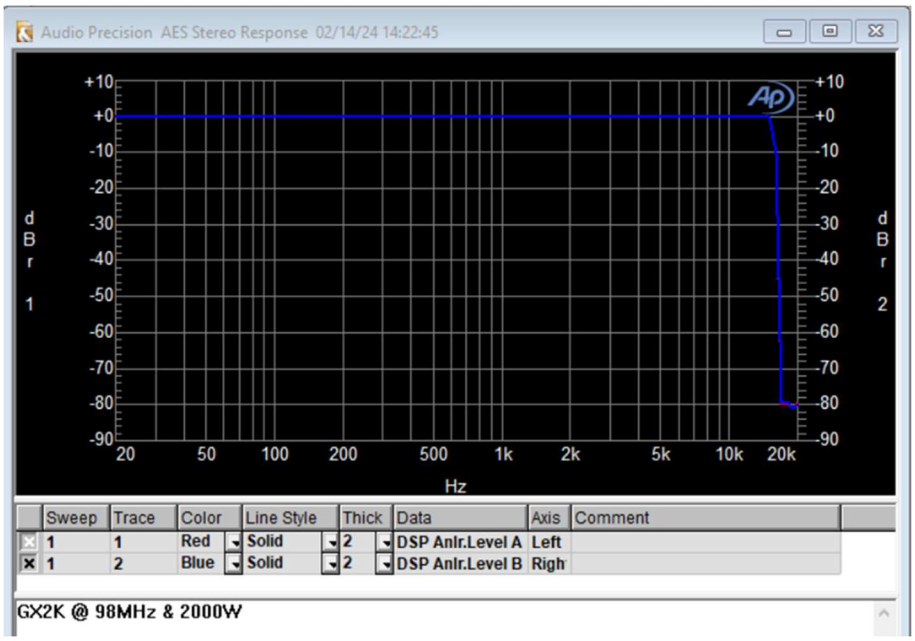
3.2.5 Measurement Procedure

The transmitter was modulated with a 20 Hz to 20 kHz sweep. A plot of the demodulated signal was captured and is presented below. Using the same sweep for all GX Low Power units since they use the same Modulator Board.

Testing performed February 2024.

3.2.6 Test Results:

AES Left and Right frequency response plot 20KHz down to 20Hz.



Take response data with 75us Pre-emphasis Applied to the Analog input with De-emphasis in the Audio Precision. Data should be +/-0.5dB. Then remove De-emphasis from the Audio Precision and compare readings to De-emphasis curve values.

Testing performed February 2024.

The GX Low Power modulator has 75us Pre-emphasis Applied to the Analog input while the Audio Precision applies de-emphasis to make this data look flat.

Audio Frequency (dB) using 75us Pre-emphasis						
	Operating at TPO Power MODULATION			Operating at Min Power MODULATION		
Frequency (Hz)	100%	50%	25%	100%	50%	25%
50	-0.009	-0.019	-0.019	-0.006	-0.013	-0.010
100	-0.040	0.008	-0.007	0.009	0.009	-0.007
400	-0.008	-0.007	-0.011	-0.011	-0.010	-0.010
1000	-0.030	-0.026	-0.029	-0.027	-0.027	-0.029
3000	-0.008	-0.009	-0.010	-0.011	-0.012	-0.011
8000	-0.032	-0.028	-0.024	-0.028	-0.031	-0.024
10000	-0.033	-0.030	-0.028	-0.032	-0.031	-0.029
15000	-0.034	-0.020	-0.030	-0.032	-0.025	-0.030

Audio Precision de-emphasis removed from this table

Audio Frequency (dB) using 75us Pre-emphasis							
	Operating at TPo Power MODULATION			Operating at Min Power MODULATION			
Frequency (Hz)	100%	50%	25%	100%	50%	25%	De-emphasis Value
50	-0.009	-0.019	-0.019	-0.006	-0.013	-0.010	0.000
100	-0.030	0.018	0.003	0.019	0.019	0.003	-0.010
400	0.167	0.168	0.164	0.164	0.165	0.165	-0.175
1000	0.840	0.844	0.841	0.843	0.843	0.841	-0.870
3000	4.762	4.761	4.760	4.759	4.758	4.759	-4.770
8000	11.788	11.792	11.796	11.792	11.789	11.796	-11.820
10000	13.627	13.630	13.632	13.628	13.629	13.631	-13.660
15000	17.036	17.050	17.040	17.038	17.045	17.040	-17.070

4 Frequency stability.

4.1.1 Reference 47CFR2.1055

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

. . . .

(3) From 0 deg. to +50 deg. centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10 deg. centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

4.1.2 Criteria

73.1545 (b) *FM stations.* (1) The departure of the carrier or center frequency of an FM station with an authorized transmitter output power more than 10 watts may not exceed ±2000 Hz from the assigned frequency.

4.1.3 Test Setup

The transmitter frequency is set by the frequency source on the modulator board. To demonstrate compliance, the EUT is placed in a temperature-controlled chamber and powered by an AC variable transformer. It is operated at a range of temperatures, from 0°C to 50°C. At each operating temperature the equipment was allowed to stabilize, then operated with the AC Variac set to nominal, -15% and +15%, recording the operating frequency at each setting.

Testing performed in July of 2023. Data taken applies to all GX Low Power units since they use the same Modulator board.

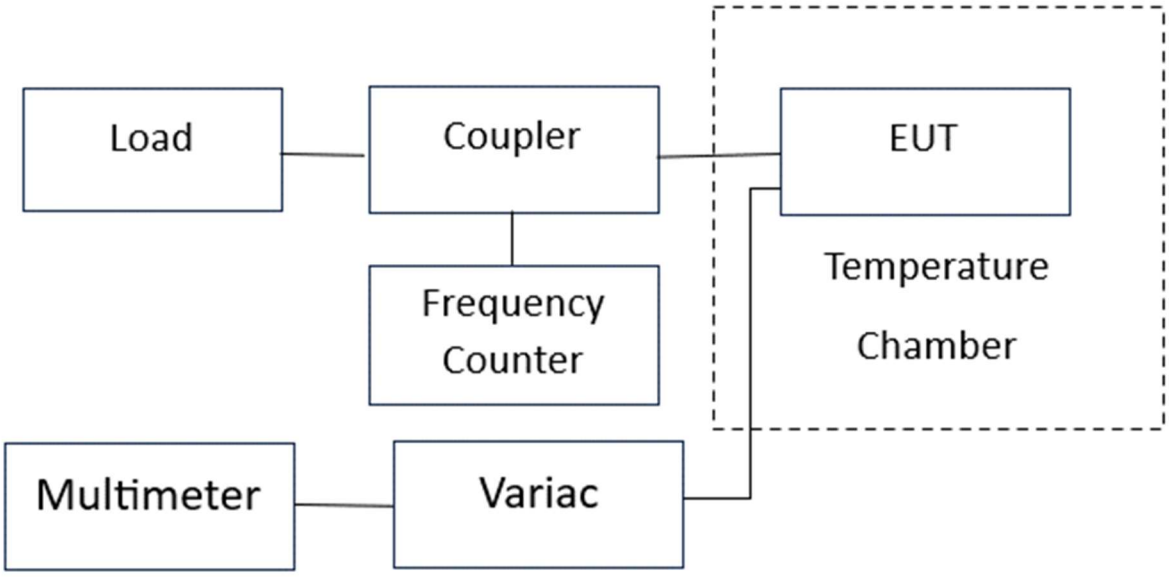


Figure 2: Frequency Stability Setup.

Equipment used	MFR / Model	Gates Air #	Calibration Due Date
Temperature Chamber	Sun Systems	12616	N/A
Frequency Counter	Agilent 53181A	11773	4/26/2024
Variac	Superior Electric CO. Powerstat / 1256T-3E-B SN:804	N/A	N/A
Load	Bird 8860 50ohm, 1500W SN: 1433	N/A	N/A
Multimeter	Fluke / 87-III	403	11/19/2023

Gates Air Test Data

The following tables list the frequency measurements made and demonstrate the equipment remains within ±2,000 Hz.

Temperature (°C)	**Hz at 187V (85%)**	**Hz at 220V (100%)**	**Hz at 253V (115%)**
0	97999990.2	97999989.5	97999989.2
10	97999990.5	97999990.9	97999991.1
20	97999996.4	97999996.3	97999996.8
25	98000002.6	98000002.5	98000001.8
30	98000014.7	98000015.4	98000015.2
40	98000026.4	98000026.8	98000026.0
50	98000032.7	98000033.4	98000033.8