

April 24, 2000

Federal Communications Commission
Authorized and Evaluation Division
7435 Oakland Mills Road
Columbia, MD 21046

Dear Sir/Madame:

Please find enclosed the application and technical exhibits for certification of Glenayre Electronics' transmitter, FCC ID BFLGL-T8311SA. This is an FM land-mobile base unit for use in the 138 to 174 MHz frequency range with an RF power output of 20 to 125 Watts.

The BFLGL-T8311SA is electrically the same as the BFLGL-T8311 previously type accepted by the FCC. The digital modulation filter has been changed from 150 μ sec risetime to 275 μ sec risetime to reduce the sidebands for narrowband 6.25 kHz channel spacing. Also a Scientific Atlanta RTC-1032B Remote Transmitter Controller is used to provide data to tone conversion for AFSK modulation in the narrowband 6.25 kHz channel spacing.

The transmitter utilizes digital signal processing (DSP) and direct digital synthesis (DDS) techniques for low level RF generation and processing of analog and digital modulations.

This application demonstrates FCC compliance for digital modulation at various data rates up to 9600 bits per second.

Glenayre requests that this transmitter be authorized to operate with an additional optional device.

1. The GL-C2000 which is a controller and external 10 MHz reference source. The GL-C2000 uses Global Positioning Satellite receivers for precision frequency control of the 10 MHz oven-controlled crystal oscillator and for timing synchronization of the system. The 10 MHz oscillator (Glenayre Part Number 6624.00002) used in the GL-C2000 is electrically the same as the one used in the transmitter. The GL-C2000 is connected to the BFL-GL8311SA by a 50-ohm coaxial cable.

The use of the optional external 10 MHz reference oscillator in no way degrades the spectral character of the BFLGL-T8311SA as presented in this submission.

Sincerely,



Steven C. Schmitt
Associate Compliance Engineer
Glenayre Electronics
TEL: 217-221-6495 or steve.schmitt@glenayre.com

April 27, 2000

Federal Communications Commission
7435 Oakland Mills Road
Columbia, MD 21406

We the undersigned, hereby certify that, in the case of the individual applicant, he or she is not subject to a denial of federal benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1988, 21 USC 853a or in the case of non-individual applicant (e.g. corporation, partnership or other unincorporated association), no party to the applicant is subject to a denial of federal benefits pursuant to that action.

Sincerely,

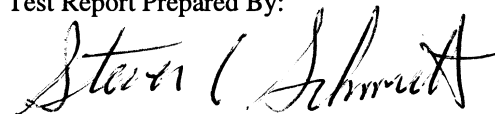


Joseph E. Jones, Jr., P.E., NCE
Director of Compliance Engineering
Glenayre Electronics
#1 Glenayre Way
Quincy, IL 62301

TYPE CERTIFICATION APPLICATION FOR
FCC ID: BFLGL-T8311SA

Model:	GL-T8311
Manufacturer:	Glenayre Electronics
Type of equipment:	VHF FM, Non-broadcast transmitter base station
Applicable Rule Parts:	22, 90
Emissions applied for:	16K0F3E, 19K6F1D, 5K60F1D, 5K60F2D
Test Dates:	April 17, 2000 through April 20, 2000

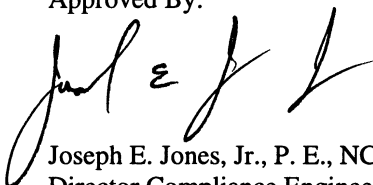
Test Report Prepared By:



Steven C. Schmitt
Associate Compliance Engineer
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USA

TEL: 217-223-3211
FAX: 217-221-6259

Approved By:



Joseph E. Jones, Jr., P. E., NCE
Director Compliance Engineering
Glenayre Electronics

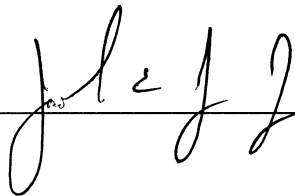
CERTIFICATION OF TEST DATA

I hereby certify that the test data identified below were taken by myself, or under my direct supervision; that the tests were conducted using accepted good engineering practice, and the data are true and correct according to knowledge and belief.

Measurement standards used for the transmitter is TIA/EIA-603.

Identification: BFLGL-T8311SA

Signed: _____



Date: _____

27 April 2000

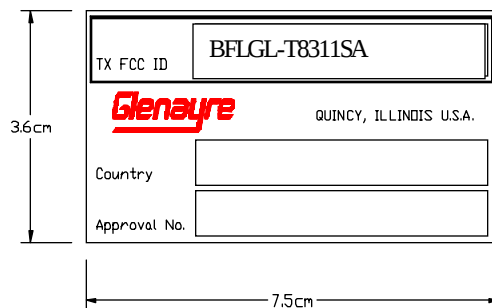
TABLE OF CONTENTS

EXHIBIT 1	FCC Identification Label
EXHIBIT 2	Technical Description
EXHIBIT 3	Test Procedures and Results
EXHIBIT 4	Construction Photographs
EXHIBIT 5	Technical Manuals
EXHIBIT 6	Schematic Diagrams

EXHIBIT 1

Equipment Identification Label (FCC 2.925)

Affixed to rear of RF Power Amplifier chassis



NOTES:

1. Color – Background Black. Blocks (3 Plcs) & lettering to be natural aluminum color.
2. Pressure sensitive adhesive backing to be 3M 467 or equivalent.
3. Positioned vertically on std. strip.
4. Block sizes – (A) 0.6 cm X 0.54 cm (B) 0.6 cm X 4.0 cm
5. Label must have manufacturer's identifier mark.
6. Affixed to rear of transmitter chassis.

EXHIBIT 2: TECHNICAL DESCRIPTION

Description	Transmitter Parameters
Type of Emissions	16K0F3E, 19K6F1D, 5K60F1D, 5K60F2D
Frequency Range	138 to 174 MHz
Operating Power Output	20 to 125 Watts
Maximum Occupied Bandwidth	16 kHz [22.359(b), 90.210(b)]
Maximum Occupied Bandwidth	5.6 kHz [90.210(e)]
Maximum Deviation	+/-5 kHz
Maximum Digital Information Rate (Bits per Second)	2 level modulation – 4800 bps 4 level modulation – 9600 bps
Final Power Amplifier voltage and current	28 Vdc, 6.5 A
Frequency stabilizing device	10 MHz Oven controlled Crystal Oscillator (+/- 0.001 ppm) used in all modulation modes.
Spurious and Harmonic suppression	In all modes of operation the transmitter uses two local oscillators to convert a 100 kHz signal to the output frequency. The first intermediate and second intermediate frequency (carrier frequency) are filtered to remove mixing products. A low pass filter follows the final power amplifier to remove harmonics.
Modulation limiting circuits	The DSP circuit controls limiting of the modulation for both analog and digital modes of operation. In the analog mode, the amplitude of the input signal is scaled so the desired deviation level for the signal is achieved. If the maximum scale value is reached at anytime, hard limiting occurs to clip the signal so overdeviation never occurs. In the digital mode, deviation is determined by the data state of the two TTL compatible data inputs. The exciter only recognizes two data states, (1 and 0) which represent one of four possible deviations. The DSP scales the value and never allows overdeviation.
Power limiting circuit	The operating power is maintained to +/- 0.5 dB by means of an automatic gain control circuit that continually monitors the power output of the transmitter and automatically adjusts the gain to hold power level.
Function of each active circuit	See Technical Manual EXHIBIT 6
Complete circuit diagram	See EXHIBIT 7
Technical Manual	See EXHIBIT 6
Tune up procedure	See Technical Manual EXHIBIT 6
Identification Label	See EXHIBIT 1

EXHIBIT 3:TEST PROCEDURES AND RESULTS

<u>DESCRIPTION</u>	<u>REF. FCC#</u>	<u>PAGE</u>
Test Equipment List		3.2
RF Power Output	2.1046	3.3
Modulation Characteristics	2.1047	3.4 - 3.9
Occupied Bandwidth	2.1049	3.10 – 3.27
Spurious Emissions	2.1051	3.28 – 3.29
Field Strength	2.1053	3.30 – 3.34
Transient Frequency Behavior	90.214	3.35 – 3.36
Frequency Stability (Temperature)	2.1055 (a)(b)(d) (1)	3.36 – 3.40
Test Setups		Appendix A

TEST EQUIPMENT LIST

Instrument	Type	Manufacturer	Serial No.	Cal Due
Modulation Analyzer	8901A	Hewlett Packard	213A01494	8-9-2000
Wattmeter	4421	Bird	1014	3-1-2001
50ohm Load	8325	Bird	2600	5-1-2000
Spectrum Analyzer	8563E	Hewlett Packard	3745A08025	3-16-2001
20dB Attenuator	768-20	NARDA	TE-A430	12-29-2000
Variac	1256D	Superior Electric	BP142090	N/A
EMI Receiver	8546A	Hewlett Packard	3746A00414	3-16-2001
RF Filter Section	85460A	Hewlett Packard	3704A00360	3-16-2001
Voltmeter	12	Fluke	56210002	8-1-2000
Bilog Antenna	3141	EMCO	9711-1081	6-17-2000
Horn Antenna	3115	EMCO	9801-5394	1-20-2001
Frequency Counter	53181A	Hewlett Packard	3548A01526	6-1-2000
Vector Signal Analyzer	89441A	Hewlett Packard	3416A01517	5-12-2000
RF Front End	89441A	Hewlett Packard	3509A0604	5-12-2000

RF POWER OUTPUT (FCC 2.985)

Tune the transmitter according to procedure in the operator's manual. Terminate the RF OUT terminal of the transmitter into a 50-ohm resistive load. Monitor RF Power out with a calibrated RF Wattmeter. The test configuration is shown in Appendix A Figure 1.

Record RF power out from wattmeter at both minimum and maximum rated power. Also measure and record DC voltage and current using a calibrated meter at minimum and maximum rated power.

EXHIBIT 3-1

Frequency Range: 138 – 174 MHz

Rated Power: 20 – 125 Watts

Power setting: **125 Watts**

Measured RF Power: 126.2 Watts

Measured DC voltage: 27.9 Volts

Measured DC current: 7.8 Amps

Calculated DC power input: 217.5 Watts

Power setting: **20 Watts**

Measured RF Power: 17.4 Watts

Measured DC voltage: 27.9 Volts

Measured DC current: 2.8 Amps

Calculated DC power input: 78.2 Watts

MODULATION CHARACTERISTICS - ANALOG (FCC 2.1047)

Frequency Response

Connect audio generator with variable output level to the transmitter audio input terminals. Meter audio level at input terminals. Terminate the transmitter antenna terminal with a 50-ohm resistive load. Sample transmitter RF power output with a deviation monitor.

Hold constant audio input level required producing ± 1.5 kHz frequency deviation at 1000 Hz. Use this level as 0-dB reference level.

Repeat at audio frequencies of 100, 200, 300, 500, 2000, 2500, 3000, 3500, 4000, and 5000 Hz.

Results: Reference EXHIBIT 3-2_for standard audio board.

Deviation Limiter Operation

Connect audio generator, with variable output level to transmitter audio input terminals. Terminate the transmitter antenna terminal with a 50-ohm resistive load. Sample RF output with a deviation monitor. Set audio input level to produce 50% modulation (2.5 kHz) at 1 kHz audio frequency.

Record the frequency deviation at each audio input level and frequency.

Repeat at audio input levels of -6, 0, +3, +6, +10, and +16 dB.

Repeat each set of measurements for audio frequencies of 300, 600, 1000, and 2500 Hz.

Results: Reference EXHIBIT 3-3 for standard audio board.

EXHIBIT 3-2
FREQUENCY RESPONSE

Audio Board: Standard

Audio Frequency (Hz)	Audio Output Level	
	Voice Input	Flat Input
100	-29.6	-0.19
300	-10.4	-0.14
500	-6.17	-0.1
1000	0	0
2000	+5.8	-0.3
2500	+8.0	-0.2
3000	+8.9	-0.8
3500	+6.2	-3.2
4000	-4.6	-8.5
4500	-30.8	-20.3
5000	-42.7	-44.3

EXHIBIT 3-3**DEVIATION LIMITER OPERATION**

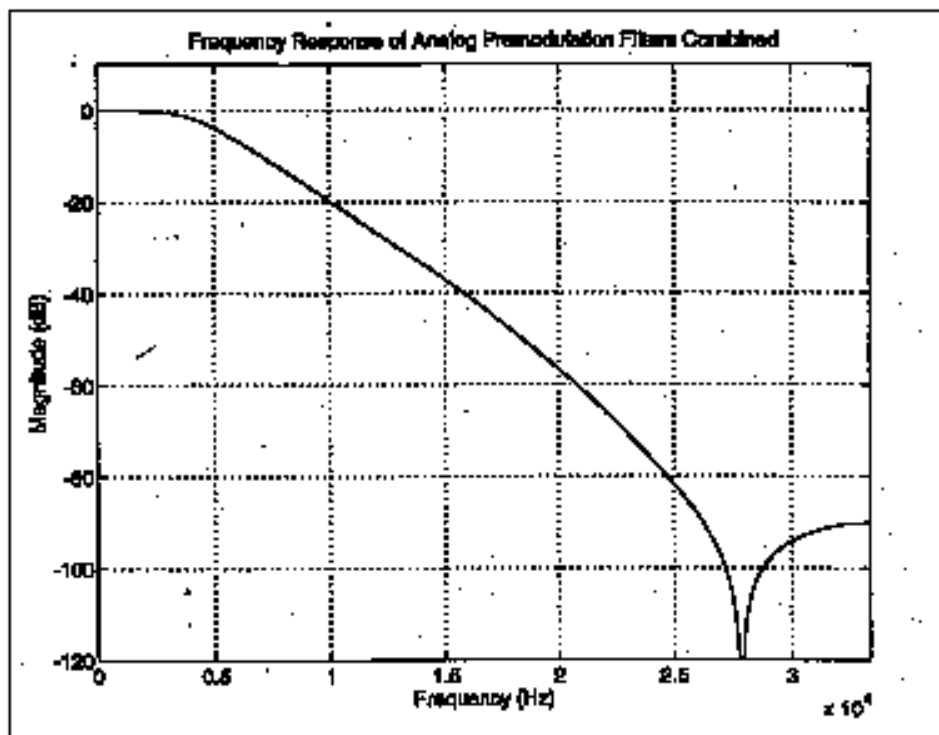
Audio Board: Standard

Audio Input Level	Frequency Deviation (kHz)			
	300 Hz	600 Hz	1000 Hz	2500 Hz
-6 dB	0.42	0.8	1.30	3.3
0 dB	0.8	1.60	2.50	4.8
+3 dB	1.1	2.20	3.60	4.8
+6 dB	1.60	3.10	4.8	4.8
+10 dB	2.50	4.80	4.90	4.8
+16 dB	4.80	4.8	4.8	4.8

ANALOG MODULATION FILTER

Analog modulation is generated and shaped by digital-signal processing techniques (DSP). The filter does not exist in a conventional analog sense. The frequency response plots for the analog filter is shown in the EXHIBIT 3-4. All data complies with 22.359(a) and 90.210(b) for occupied bandwidth submissions.

EXHIBIT 3-4



MODULATION FILTER – DIGITAL (FCC 2.1047)

Digital modulation is generated and shaped by digital signal processing techniques (DSP). The filter does not exist in a conventional analog sense. The frequency response plots for the 88 microsecond risetime digital filter is shown in EXHIBIT 3-7(A). The 275 microsecond risetime digital filter is shown in EXHIBIT 3-7(B). All data complies with 22.359(b)(2), 90.210(b), and 90.210(e) for occupied bandwidth submissions.

EXHIBIT 3-7(A)

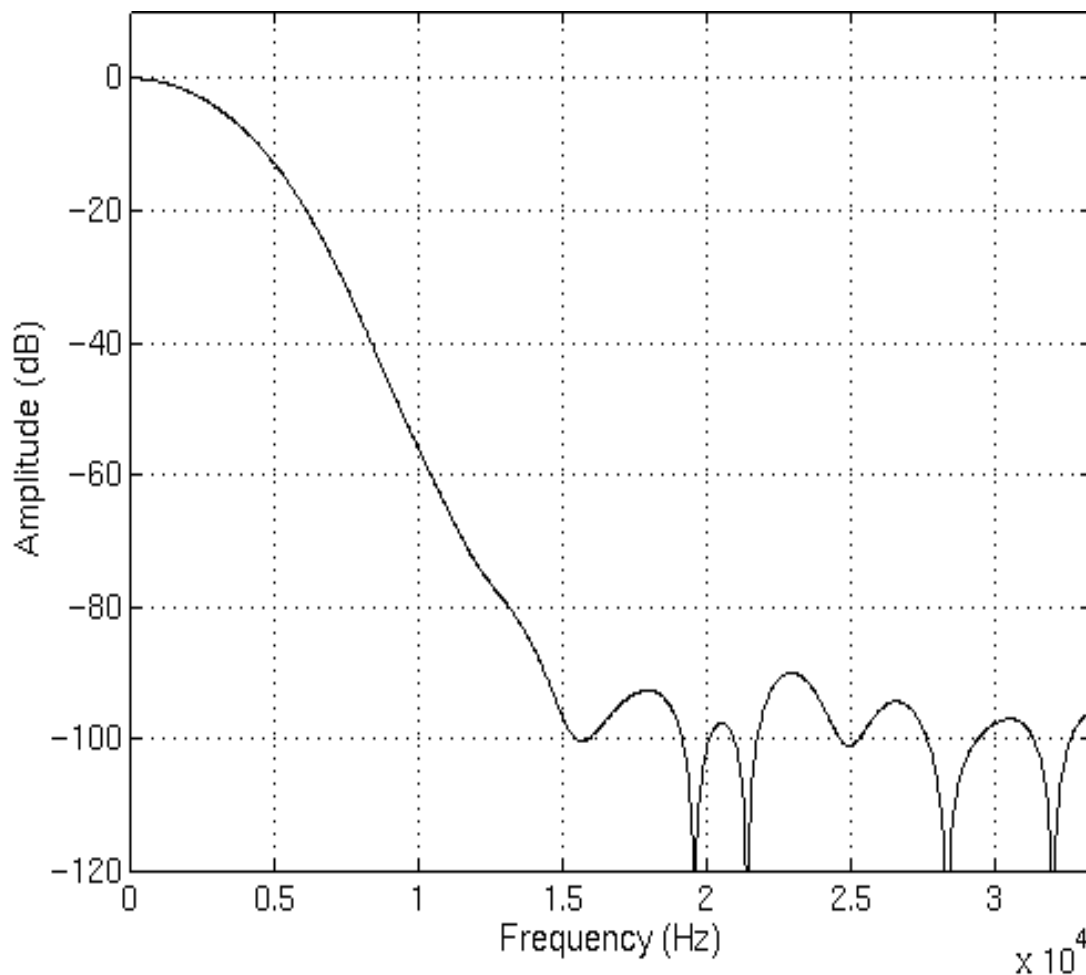
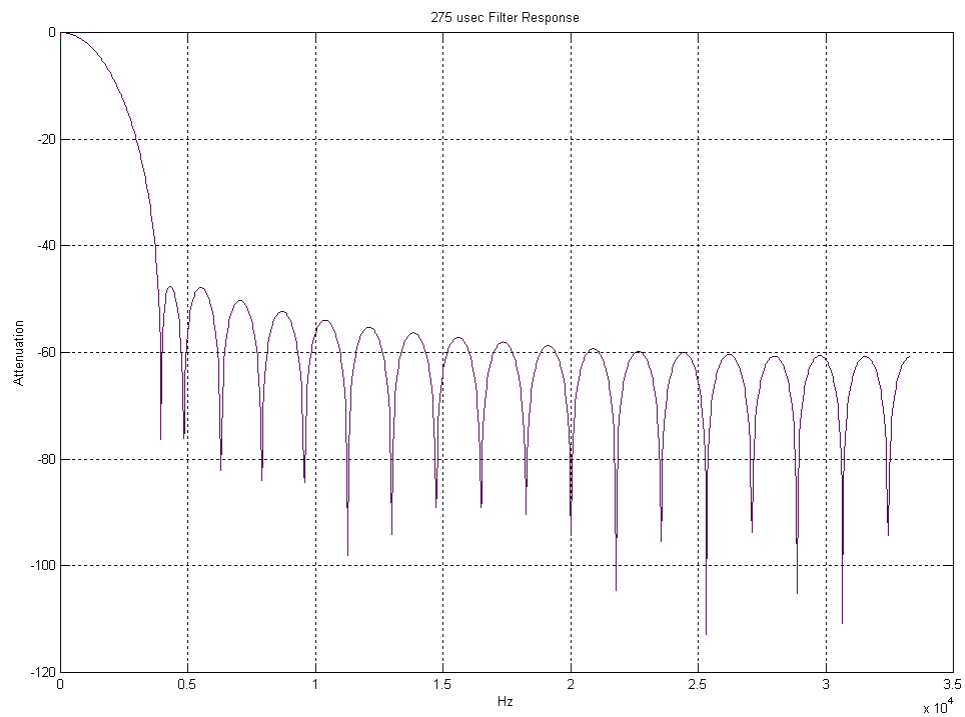


EXHIBIT 3-7(B)



OCCUPIED BANDWIDTH ANALOG (FCC 2.1049)

Per FCC Rule 22.359(a), 90.210(b)

Modulate the transmitter with a 2500 Hz tone at an input level 16 dB greater than that required to produce 50% modulation at 1 kHz at rated RF power output. Terminate the transmitter antenna terminal with a 50-ohm resistive load. Sample the RF output with a spectrum analyzer.

Record the relative amplitude referenced to the unmodulated carrier, of each modulation sideband 10 kHz or more removed from the carrier frequency. Calculate the power contained in each of the recorded sidebands. Total the sideband power above and below the authorized bandwidth, and compare to the total power in the load.

Refer to EXHIBIT 3-5(A) and 3-5(B).

Test results meet or exceed Part 22.359(a), 90.210(b).

The bandwidth calculation for 16K0F3E, the direct frequency modulation of the carrier in the analog mode is:

$$B_n = 2M + 2D$$

Where $M = 3.0 \text{ kHz}$ and $D = 5.0 \text{ kHz}$

$$B_n = 2(3.0 \text{ kHz}) + 2(5.0 \text{ kHz})$$

$$B_n = 16.0 \text{ kHz}$$

EXHIBIT 3-5(A)

OCCUPIED BANDWIDTH (ANALOG)

22.359(a), 90.210(b)

Reference set to 125 Watts

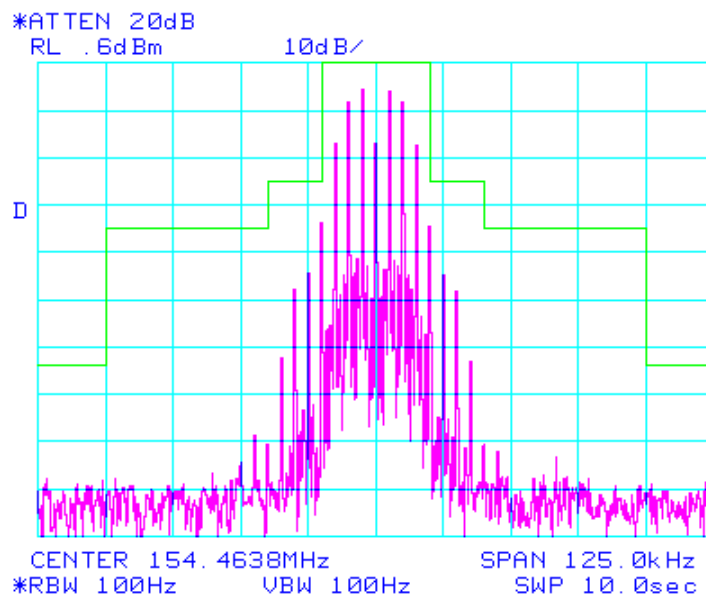
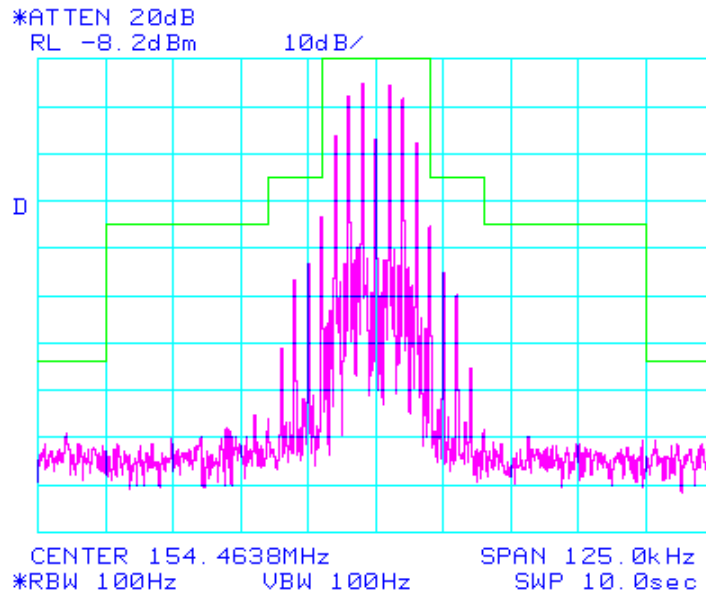


EXHIBIT 3-5(B)

OCCUPIED BANDWIDTH (ANALOG)

22.359(a), 90.210(b)

Power output set to 20 Watts



OCCUPIED BANDWIDTH ANALOG (FCC 2.1049)

Per FCC Rule 90.210(e)

Modulate the transmitter with a 2500 Hz tone at an input level 16 dB greater than that required to produce 50% modulation at 1 kHz at rated RF power output. Terminate the transmitter antenna terminal with a 50-ohm resistive load. Sample the RF output with a spectrum analyzer.

Record the relative amplitude referenced to the unmodulated carrier, of each modulation sideband. Calculate the power contained in each of the recorded sidebands. Total the sideband power above and below the authorized bandwidth, and compare to the total power in the load.

Refer to EXHIBIT 3-6(A) and 3-6(B).

Test results meet or exceed Part 90.210(e)

The bandwidth calculation for 5K60F2D, the direct frequency modulation of the carrier in the analog mode is:

$$B_n = 2M + 2D$$

Where $M = 1200 \text{ Hz}$ and $D = 1200 \text{ Hz}$

$$B_n = 2(1200 \text{ Hz}) + 2(1200 \text{ kHz})$$

$$B_n = 4.8 \text{ kHz}$$

EXHIBIT 3-6(A)

OCCUPIED BANDWIDTH (DIGITAL)

90.210(e)

Power output set to 125 Watts

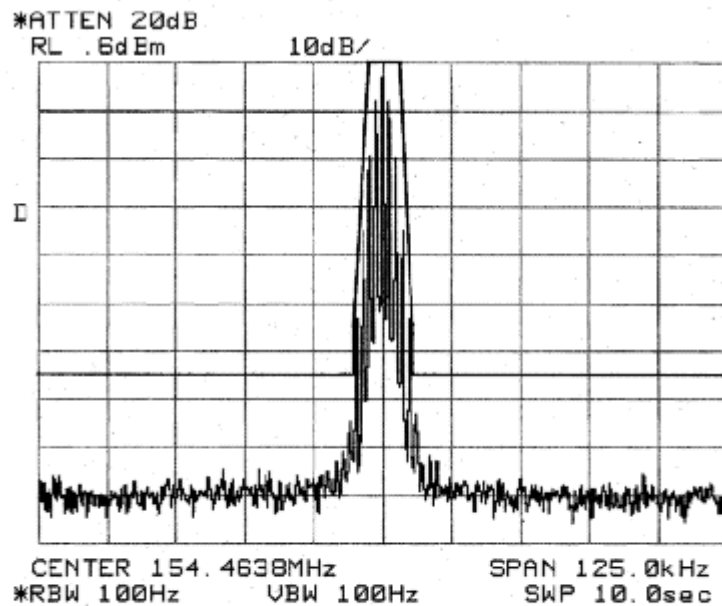
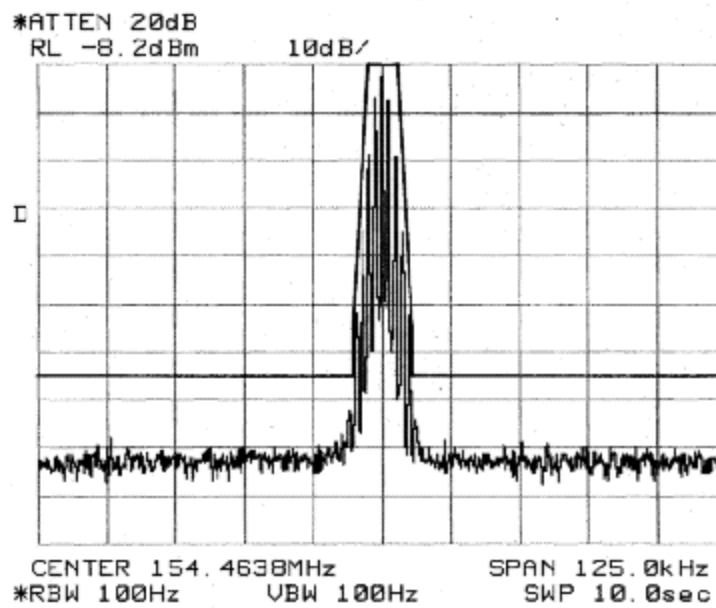


EXHIBIT 3-6(B)

OCCUPIED BANDWIDTH (DIGITAL)

90.210(e)

Power output set to 20 Watts



OCCUPIED BANDWIDTH - DIGITAL MODE

Per FCC Rule 22.359(b)

Test procedure: A digital signal is fed into the data input of the transmitter to simulate data. The transmitter is placed in the digital modulation mode and its RF output observed on a spectrum analyzer. The transmitter is set for a maximum deviation of ± 4.8 kHz. The spectrum is observed at both the maximum and minimum power output levels.

Refer to spectrum displays on following pages: EXHIBIT 3-8(A) and 3-8(B).

Results: Spectrum bandwidth limitations meet or exceed FCC requirements defined by Part 22.359(b)(2).

The bandwidth calculations for 16K0F1D, the direct frequency modulation of the carrier in the digital mode is:

Carson's bandwidth rule...

$$B_n = 2(M+D)$$

$$M = (9600 \text{ bits / second}) / \text{FSK level}$$

$$M = 9600 / 4$$

$$M = 2400 \text{ Hz}$$

$$D = \text{Highest Deviation rate. } \pm 4.8 \text{ kHz}$$

$$B_n = 2 (2400 + 4800)$$

$$B_n = 14.4 \text{ kHz}$$

EXHIBIT 3-8(A)

OCCUPIED BANDWIDTH (DIGITAL)

22.359(b)

Power output set to 125 Watts

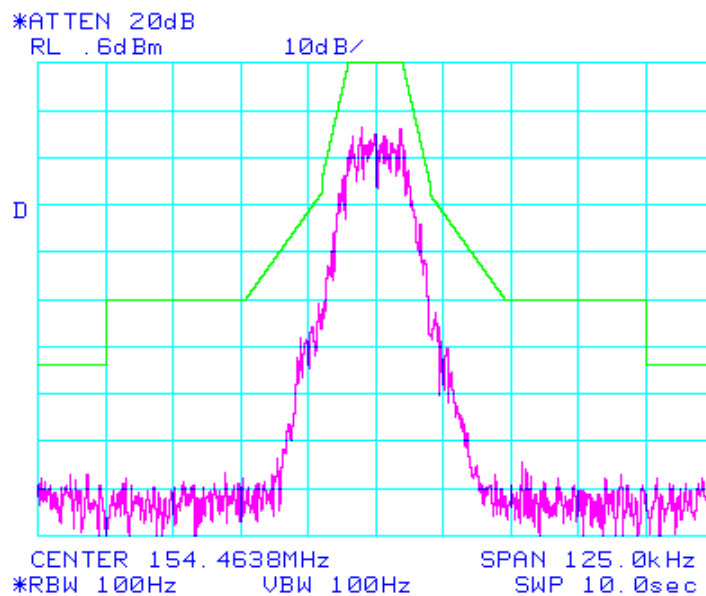
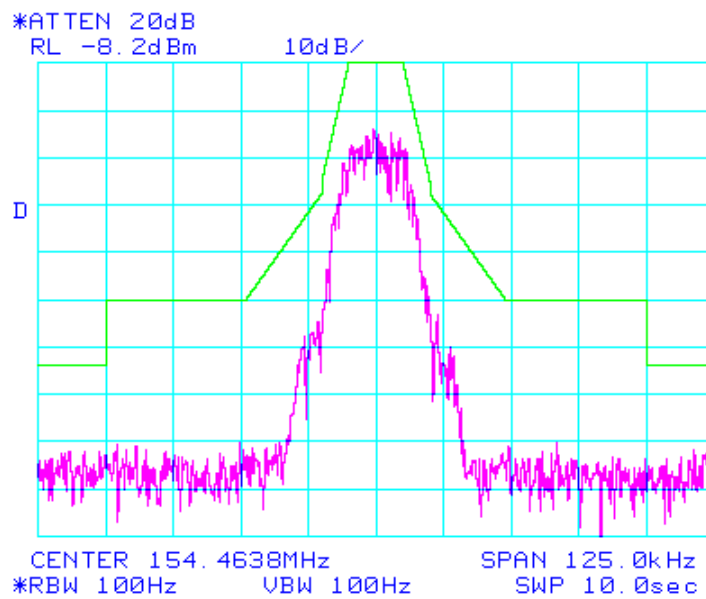


EXHIBIT 3-8(B)

OCCUPIED BANDWIDTH (DIGITAL)

22.359(b)

Power output set to 20 Watts



OCCUPIED BANDWIDTH - DIGITAL MODE

Per FCC Rule 90.210(b)

Test procedure: A digital signal is fed into the data input of the transmitter to simulate data. The transmitter is placed in the digital modulation mode and its RF output observed on a spectrum analyzer. The transmitter is set for a maximum deviation of ± 4.8 kHz. The spectrum is observed at both the maximum and minimum power output levels.

Refer to spectrum displays on following pages: EXHIBIT 3-9(A) and 3-9(B).

Results: Spectrum bandwidth limitations meet or exceed FCC requirements defined by Part 90.210(b).

The bandwidth calculations for 16K0F1D, the direct frequency modulation of the carrier in the digital mode is:

Carson's bandwidth rule...

$$B_n = 2(M+D)$$

$$M = (9600 \text{ bits / second}) / \text{FSK level}$$

$$M = 9600 / 4$$

$$M = 2400 \text{ Hz}$$

$$D = \text{Highest Deviation rate. } \pm 4.8 \text{ kHz}$$

$$B_n = 2 (2400 + 4800)$$

$$B_n = 14.4 \text{ kHz}$$

EXHIBIT 3-9(A)

OCCUPIED BANDWIDTH (DIGITAL)

90.210(b)

Power output set to 125 Watts

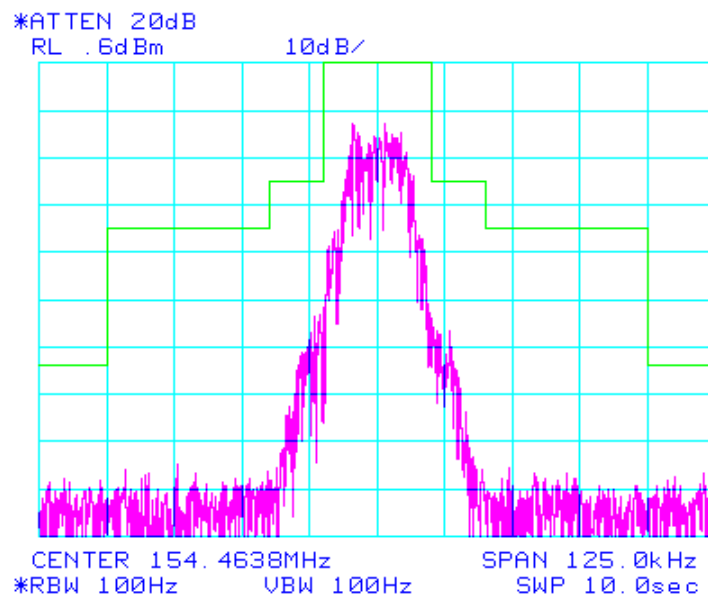
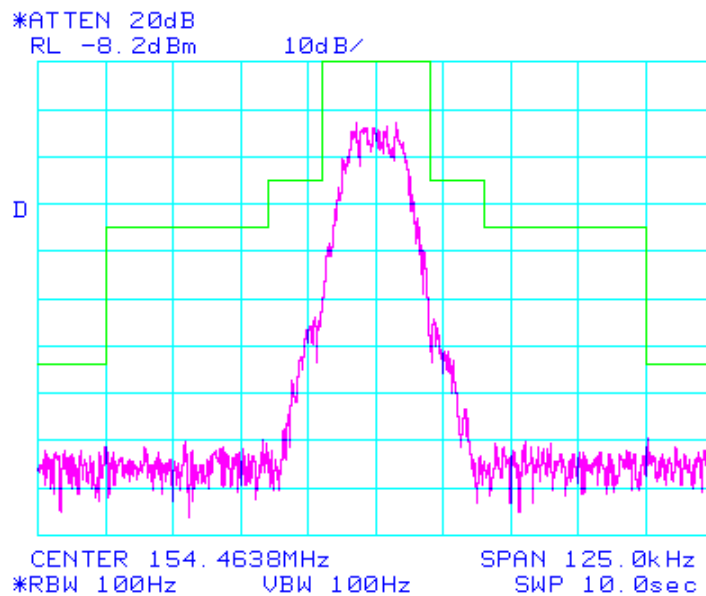


EXHIBIT 3-9(B)

OCCUPIED BANDWIDTH (DIGITAL)

90.210(b)

Power output set to 20 Watts



OCCUPIED BANDWIDTH - DIGITAL MODE

Per FCC Rule 90.210(e)

Test procedure: A digital signal is fed into the data input of the transmitter to simulate data. The transmitter is placed in the digital modulation mode and its RF output observed on a spectrum analyzer. The transmitter is set for a maximum deviation of ± 1200 Hz. The spectrum is observed at both the maximum and minimum power output levels.

Refer to spectrum displays on following pages: EXHIBIT 3-10(A) and 3-10(B).

Results: Spectrum bandwidth limitations meet or exceed FCC requirements defined by Part 90.210(e).

The bandwidth calculations for 5K60F1D, the direct frequency modulation of the carrier in the digital mode is:

Carson's bandwidth rule...

$$B_n = 2(M+D)$$

$$M = 1200(\text{ bits / second}) / \text{FSK level}$$

$$M = 1200 / 2$$

$$M = 600 \text{ Hz}$$

$$D = \text{Highest Deviation rate. } \pm 1200 \text{ kHz}$$

$$B_n =$$

$$B_n = 2.6 \text{ kHz}$$

EXHIBIT 3-10(A)

OCCUPIED BANDWIDTH – DIGITAL MODE

90.210(e)

Power output set to 125 Watts

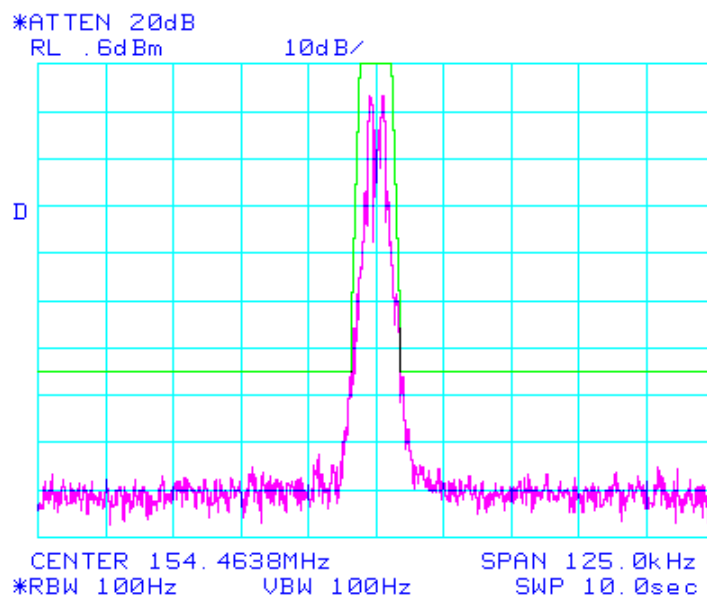
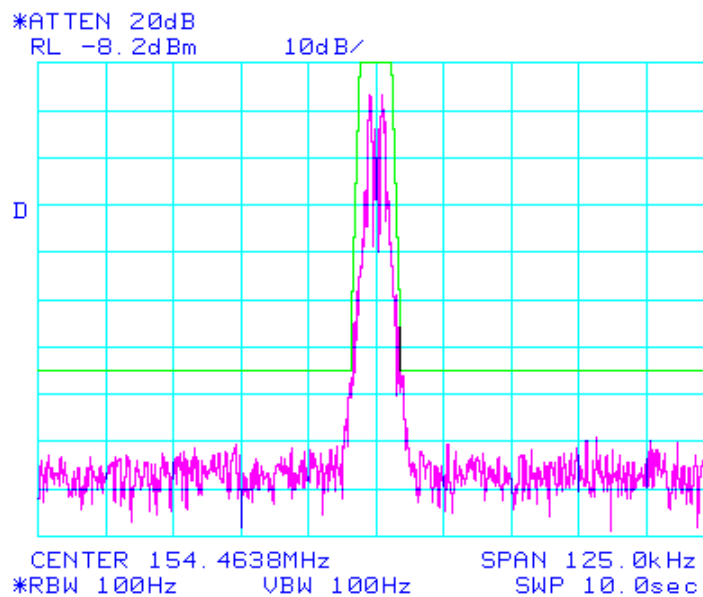


EXHIBIT 3-10(B)

OCCUPIED BANDWIDTH – DIGITAL MODE

90.210(e)

Power output set to 20 Watts



OCCUPIED BANDWIDTH - DIGITAL MODE

Per FCC Rule 90.210(e)

Test procedure: A digital signal is fed into the data input of the transmitter to simulate data. The transmitter is placed in the digital modulation mode and its RF output observed on a spectrum analyzer. The transmitter is set for a maximum deviation of ± 1200 Hz. The spectrum is observed at both the maximum and minimum power output levels.

Refer to spectrum displays on following pages: EXHIBIT 3-11(A) and 3-11(B).

Results: Spectrum bandwidth limitations meet or exceed FCC requirements defined by Part 90.210(e).

The bandwidth calculations for 5K60F1D, the direct frequency modulation of the carrier in the digital mode is:

Carson's bandwidth rule...

$$B_n = 2(M+D)$$

$$M = 357 \text{ (bits / second) / FSK level}$$

$$M = 357 / 2$$

$$M = 178.5 \text{ Hz}$$

$$D = \text{Highest Deviation rate. } \pm 1200 \text{ kHz}$$

$$B_n = 2(178.5) + 2(1200)$$

$$B_n = 2.757 \text{ kHz}$$

EXHIBIT 3-11(A)

OCCUPIED BANDWIDTH – DIGITAL MODE

90.210(e)

Power output set to 125 Watts

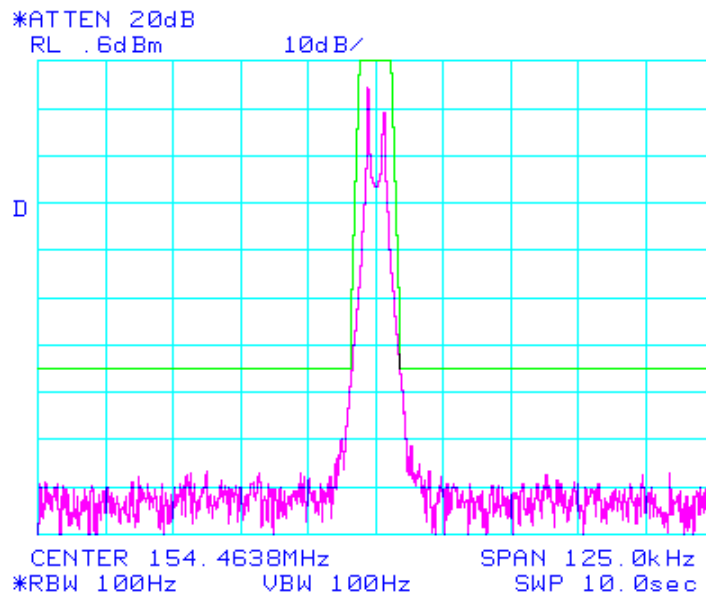
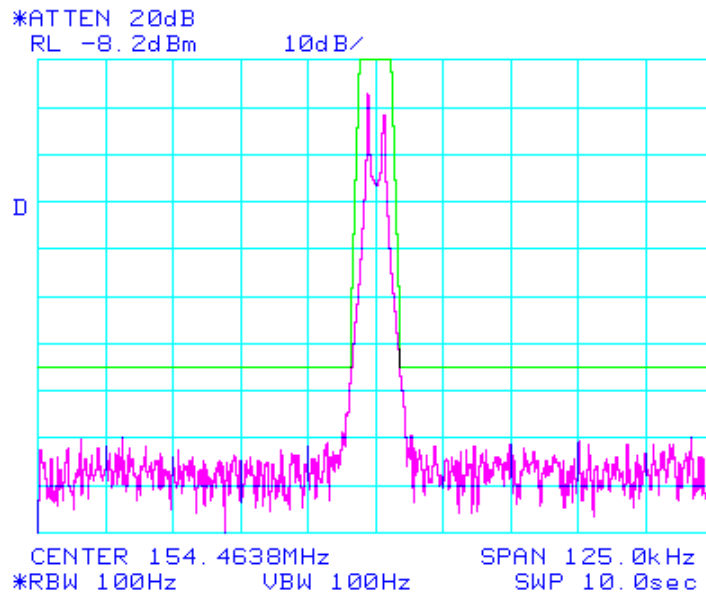


EXHIBIT 3-11(B)

OCCUPIED BANDWIDTH – DIGITAL MODE

90.210(e)

Power output set to 20 Watts



Spurious Emissions (FCC 2.1051)

Analog Test Procedure

Modulate the transmitter in analog mode with a 2500 Hz tone at an input level 16 dB greater than that required producing 50% modulation at 1 kHz and at maximum rated power output. Terminate the transmitter antenna terminal with a 50-ohm resistive load. Provide a sample of RF output that is frequency independent.

Apply RF sample to spectrum analyzer input through a notch filter tuned to transmitter carrier frequency.

Record the frequency and amplitude of each spurious response. The worst case emissions are recorded in this exhibit. The spurious emissions were scanned in all tests as indicated in Occupied Bandwidth measurement tests. Results are recorded in EXHIBIT 3-12.

Analyzer Settings:	Ref. Level	0dBm
	Res. Bandwidth	30 kHz
	Video Filter	30 kHz
	Detector:	Peak

EXHIBIT 3-12

Device Under Test:

Model: GL-T8311 (BFLGL-T8311SA)

Test Freq.: 154.46375 MHz

Method of calculation:

Measured level dBm = Spectrum analyzer reading + cable + Attenuator losses (dB)

Frequency (MHz)	Measured reading (dBm)	Limit dBm	Remarks/ Margin
463.39125	-30.5	-29	Passed

Note: There were no other detectable signals in the frequency range of 30-10,000 MHz

Digital Test Procedure

Modulate the transmitter in digital mode at a maximum 9600 bit rate with a test signal (square wave) for +/- 4.8 kHz deviation to simulate data transmission. Operate at maximum output power rating. Terminate transmitter antenna terminal with a 50-ohm resistive load. Provide a sample of RF output that is frequency independent.

Apply RF sample to spectrum analyzer input through a notch filter tuned to transmitter carrier frequency.

Record the frequency and amplitude of each spurious response. The worst case emissions are recorded in this exhibit. The spurious emissions were scanned in all tests as indicated in Occupied Bandwidth measurement tests. Results are recorded in EXHIBIT 3-13

Analyzer Settings:	Ref. Level	0dBm
	Res. Bandwidth	30 kHz
	Video Filter	30 kHz

EXHIBIT 3-13

Device Under Test:

Model: GL-T8311 (BFLGL-T8311SA)

Test Freq.: 154.46375 MHz

Method of calculation:

Measured level dBm = Spectrum analyzer reading + cable + Attenuator losses (dB)

Frequency (MHz)	Measured reading (dBm)	Limit dBm	Remarks/Margin
463.39125	-30.5	-29	Passed

Note: There were no other detectable signals in the frequency range of 30-10,000 MHz

Field Strength (FCC 2.1053)

Description of test site: 3-Meter Anechoic test Chamber, on file with Commission November 15, 1996. The receiver antenna is located 1 meter from the transmitter.

Test Procedure: Modulate the transmitter with a 2500 Hz tone at an input level 16 dB greater than that required to produce 50% modulation. Operate transmitter at maximum rated power output. Repeat tests at minimum rated power output.

If transmitter is to operate in digital mode, use the same modulation test setup as in spurious emissions (digital) tests, Page 3. Perform field strength test at both maximum and minimum rated power output.

Calibrated antennas are used as the receive antenna.

Final stage Power amplifier output $P_t = 125$ Watts
Theoretical Numerical gain of a dipole antenna = 1.64

The following formula can be used to compute a field strength at a known distance d (meters):

$$E(v/m) = \frac{\sqrt{30P_t G_A}}{d}$$
$$E(v/m) = 35.1 \text{ v/m @ 1 meter}$$

$$E(dB\mu v/m) = 20 \log(E \times 1 \times 10^6)$$
$$E(dB\mu v/m) = 150.9 \text{ dB}\mu v/m \text{ @ 1 meter}$$

FCC limit for harmonics:

$$\text{Limit(min)} = 43 + 10 \log(P_t) \quad P_t \text{ (Watts)}$$
$$\text{Limit(min)} = 43 + 10 \log(125)$$

$$\text{Limit(min)} = 64 \text{ dB}$$

FCC limit	(*)	$150.9 - 64 = 86.9 \text{ dB}\mu V/m$	Limit at 1 m test distance
FCC limit	(**)	$150.9 - 64 - 9.5 = 77.4 \text{ dB}\mu V/m$	Limit at 3 m test distance

EXHIBIT 3-14

Total Measured Value E (dB μ V/m) = Receiver/ analyzer reading dB μ V -Pre Amp. Gain + Cable Loss (dB) + AF (dB)

Note: There was no external pre amplifier used, so Pre- amp gain = 0 dB

Antennas used: 3141 Biconilog for 30 MHz to 1 GHz; 3115 Horn for 1 GHz to 10 GHz (see antenna factors after EXHIBIT 3-14).

Test distance = 1 meter for frequency range 1-10 GHz and 3.0 meters for 30-1000 MHz

Results: Device under test meets FCC requirements of Field Strength (FCC 2.1053)

Fundamental Freq. = 154.46375 MHz.

Analyzer Settings: Resolution BW 120 kHz
 Video BW 1 MHz
 Span/ auto/50 MHz
 Sweep 914 msec.
 Detector: Peak

Mode of Operation: Digital Modulation

S/N	Frequency MHz	Total Measured Value dB μ V/m	FCC Limit (*) dB μ V/m
2	308.9275	49	77.4
3	463.39125	44	77.4
4	617.855	47	77.4
5	772.31875	49	77.4
6	926.7825	46.5	77.4
7	1081.24625	51	77.4
8	1235.71	64	77.4
9	1390.17375	55	77.4
13	2008.02875	55	77.4
14	2162.4925	48	77.4
15	2316.95625	51.5	77.4
16	2471.42	55	77.4

Note: All data taken is worst case as transmitter is rotated 360 degrees and receiving antenna polarization is changed (H and V) and height was varied from 1-4 m. Frequency spectrum was checked for radiated spurious and harmonic emissions out to tenth harmonic. The range of spectrum scanned 30 MHz to 10 GHz. The S/N 8 through 10 levels are the analyzer base line levels. All other spurious emissions <<20 dB below the permissible level as calculated above.

ANTENNA FACTORS

Manufacturer: EMCO
Antenna: Biconilog
Model: 3141 – 3.0 Meter Calibration
S/N: 1081

FREQUENCY MHZ	ANTENNA FACTOR dB
26	13.8
28	13.1
30	12.4
40	9.0
50	7.3
60	7.7
70	8.8
80	9.8
90	10.2
100	10.1
110	9.8
120	9.4
130	9.3
140	9.9
150	10.4
160	10.7
170	11.0
180	10.9
190	10.9
200	11.1
225	12.3
250	13.1
275	14.0
300	15.4
325	15.4
350	15.8
375	16.4
400	16.7
425	16.9
450	17.4
475	17.9
500	18.4
525	19.1

550	19.6
575	20.3
600	20.9
625	21.0
650	21.0
675	21.5
700	21.9
725	21.9
750	22.0
775	22.3
800	22.4
825	22.7
850	23.1
875	23.8
900	24.1
925	24.1
950	24.1
975	24.3
1000	24.6
1050	24.8
1100	25.2
1150	26.2
1200	26.8
1250	26.2
1300	26.5
1350	27.5
1400	27.4
1450	27.2
1500	27.8
1550	29.0
1600	28.7
1650	28.4
1700	28.7
1750	29.8
1800	29.8
1850	30.2
1900	30.0
1950	30.3
2000	30.6

Antenna: Double Ridged Guide
Model: 3115 – 1.0 Meter Calibration
S/N: 1081

FREQUENCY MHZ	ANTENNA FACTOR dB
1000	25.1
1500	25.2
2000	27.5
2500	28.7
3000	30.6
3500	32.7
4000	32.1
4500	32.2
5000	33.9
5500	34.6
6000	35.0
6500	35.3
7000	36.1
7500	36.7
8000	37.1
8500	37.9
9000	38.4
9500	38.1
10000	38.2
10500	38.2
11000	38.4
11500	39.0
12000	39.2
12500	39.3
13000	40.8
13500	41.8
14000	41.5
14500	41.5
15000	39.9
15500	38.4
16000	38.3
16500	39.9
17000	41.9
17500	43.7
18000	48.3

TRANSIENT FREQUENCY BEHAVIOR

Test Procedure: A function generator with a TTL output level is connected to the transmitter keyline and the external trigger input to the Vector Signal Analyzer. The frequency is set to 0.5 Hz. Terminate transmitter antenna terminal with a 50-ohm resistive load. Provide a sample of RF to the Vector Signal Analyzer.

Plot carrier power and frequency as a function of time.

The transmitter exceeds the specification. See EXHIBIT 3-15(A) and 3-15(B).

EXHIBIT 3-15(A)

Plot for t1 and t2

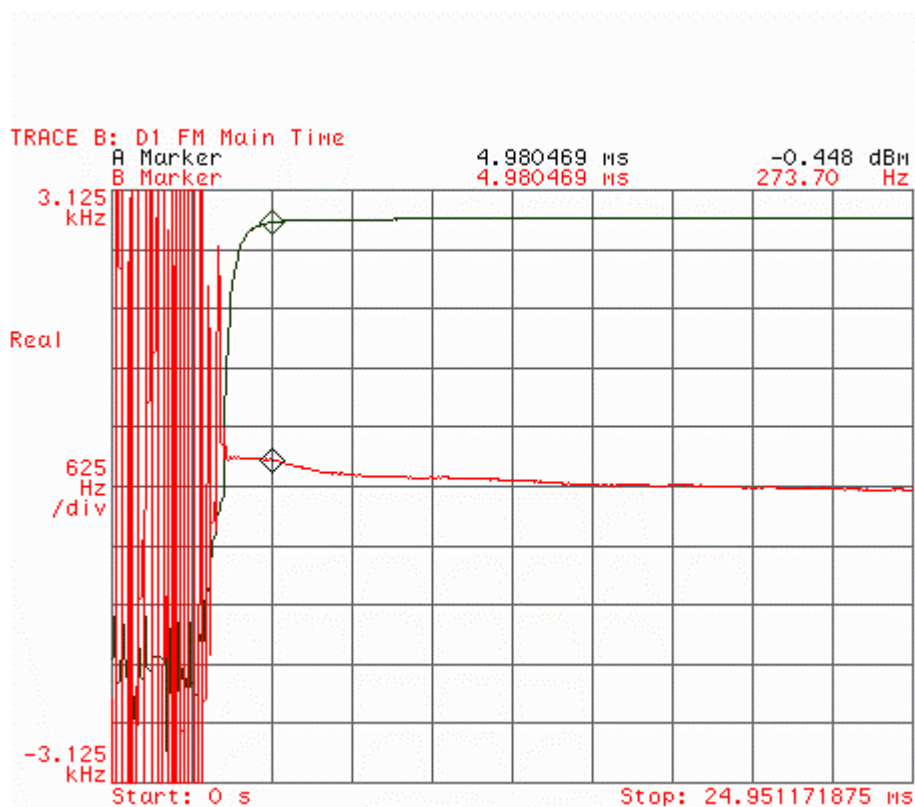
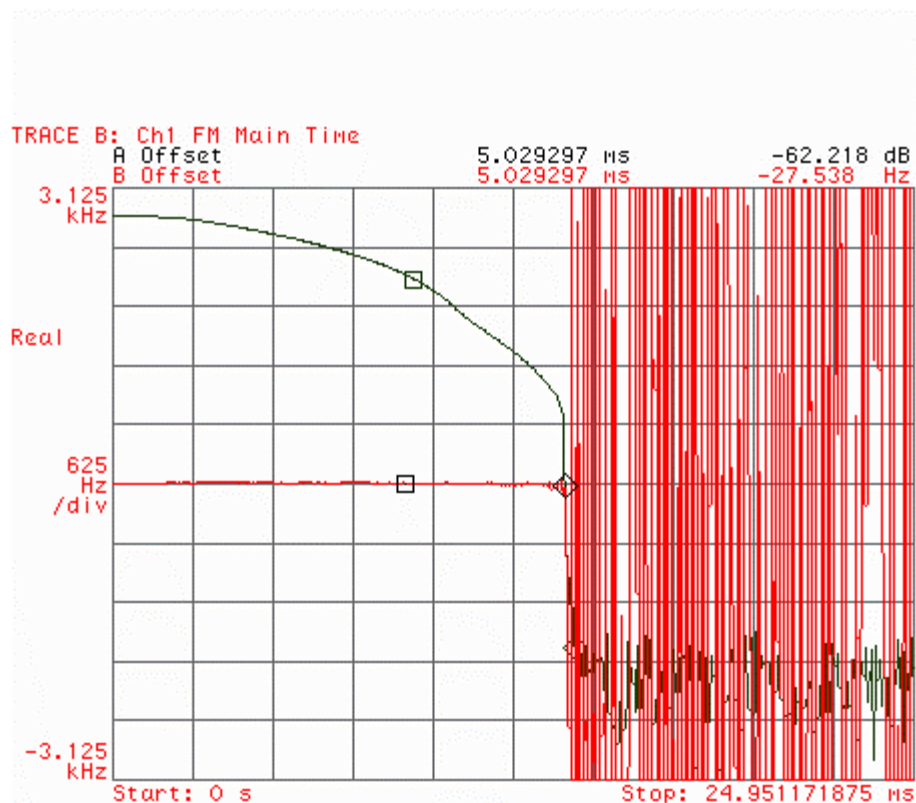


EXHIBIT 3-15(B)

Plot for t3



FREQUENCY STABILITY (FCC 2.1055)

Frequency Stability (Temperature)

Operate oscillator and other frequency determining circuit in a temperature chamber. Measure the oscillator frequency with a frequency counter capable of at least 1 Hz resolution. Record the oscillator frequency after the temperature within the temperature chamber has stabilized for 1 hour at each test temperatures of -30, -20, -10, 0, +10, +20, +30, +40, +50° C.

Refer to EXHIBIT 3-16 for test results.

Frequency Stability (Warm-up)

Operate oscillator and other frequency determining circuit in a temperature chamber. Measure the oscillator frequency with a frequency counter capable of at least 1 Hz resolution. Record the oscillator frequency at regular intervals until the frequency is within the published tolerance. Start each series of reading from a cold start at the beginning ambient room temperature. Repeat for beginning ambient temperature of -30, 0 and +50° C.

Refer to EXHIBIT 3-17 for test results.

Frequency Stability (Supply Voltage)

Operate transmitter into a 50-ohm load. Provide a sample of RF output to a frequency counter. Power the transmitter from a variable voltage, primary power source. Record transmitter frequency at each value of primary power source voltage. Repeat at voltages equal to 85%, 90%, 100%, 110%, and 115% of rated primary power source voltage.

Refer to EXHIBIT 3-18 for test results.

EXHIBIT 3-16

Frequency Stability (Temperature)

Oscillator Model: CPN 6624.00002 (High Stability)

Temperature (Degrees C)	Time (Hours)	Frequency (Hz)	Delta Frequency (Hz)
25 (room temp)	0	10,000,000.03	Ref
-30	1	10,000,000.04	+0.01
-20	2	10,000,000.04	+0.01
-10	3	10,000,000.04	+0.01
0	4	10,000,000.04	+0.01
+10	5	10,000,000.03	0.00
+20	6	10,000,000.03	0.00
+30	7	10,000,000.01	-0.02
+40	8	10,000,000.01	-0.02
+50	9	10,000,000.02	-0.01

EXHIBIT 3-17

Frequency Stability (Warm-up)

Oscillator Model: CPN 6624.00002 (High Stability)

Time (minutes)	10,000,000.03 Hz Ref Frequency (25°C)		
From Turn-On	-30°C Start	0°C Start	+50°C Start
1	10,000,395.84	10,000,247.59	10,000,070.71
2	10,000,377.86	10,000,203.35	10,000,024.64
3	10,000,449.63	10,000,156.09	10,000,001.71
4	10,000,314.14	10,000,114.15	9,999,987.61
5	10,000,275.39	10,000,078.65	9,999,996.72
6	10,000,232.38	10,000,052.15	9,999,999.15
7	10,000,191.16	10,000,031.05	9,999,997.61
8	10,000,156.50	10,000,015.15	9,999,999.77
9	10,000,125.16	10,000,003.30	9,999,999.78
10	10,000,094.90	9,999,997.16	9,999,999.80
11	10,000,071.31	9,999,997.25	9,999,999.84
12	10,000,051.42	9,999,998.61	9,999,999.86
13	10,000,033.63	9,999,999.91	9,999,999.88
14	10,000,019.82	9,999,999.93	9,999,999.92
15	10,000,011.21	9,999,999.95	9,999,999.94
16	10,000,003.64	9,999,999.96	9,999,999.96
18	9,999,999.87	9,999,999.97	9,999,999.98
20	9,999,999.83	9,999,999.98	9,999,999.98
22	9,999,999.92	9,999,999.99	10,000,000.00
24	9,999,999.94	10,000,000.00	10,000,000.03
26	9,999,999.96	10,000,000.01	10,000,000.03
28	9,999,999.97	10,000,000.01	10,000,000.03
32	9,999,999.99	10,000,000.02	10,000,000.03
36	10,000,000.00	10,000,000.02	10,000,000.03
40	10,000,000.01	10,000,000.03	10,000,000.03
44	10,000,000.01	10,000,000.04	10,000,000.03
48	10,000,000.03	10,000,000.04	
52	10,000,000.03		
56	10,000,000.04		
Stabilized	10,000,000.04	10,000,000.04	10,000,000.04

EXHIBIT 3-18**Frequency Stability (Supply Voltage)**

Oscillator Model: CPN 6624.00002 (High Stability)

Supply Voltage (%)	Volts (dc)	Frequency (Hz)	Delta Frequency (Hz)
77	20	9,999,999.75	0
100	26	9,999,999.75	0
115	30	9,999,999.75	0

The unit is designed for operation from a dc power source with an operating range of 20 to 30 volts, nominal 26 volts.

EXHIBIT 4

CONSTRUCTION PHOTOGRAPHS

The construction photographs are supplied as separate documents due to the size of the file required.

The file names are:

1. PA EXHIBIT 4
2. EXCITER-CONTROLLER EXHIBIT 4

EXHIBIT 5

TECHNICAL MANUALS

The technical manuals are supplied as separate documents due to the size of the file required.

The file names are:

1. Exciter Manual EXHIBIT 5
2. PA Manual EXHIBIT 5

EXHIBIT 6

SCHEMATIC DIAGRAMS

The schematic diagrams are supplied as separate documents due to the size of the file required.

The file name is:

1. SCHEMATICS EXHIBIT 6

APENDIX A – TEST SETUPS

Figure 1

Spurious Emissions and Occupied Bandwidth Test Setup

Note: Notch Filter only installed for Harmonic measurements

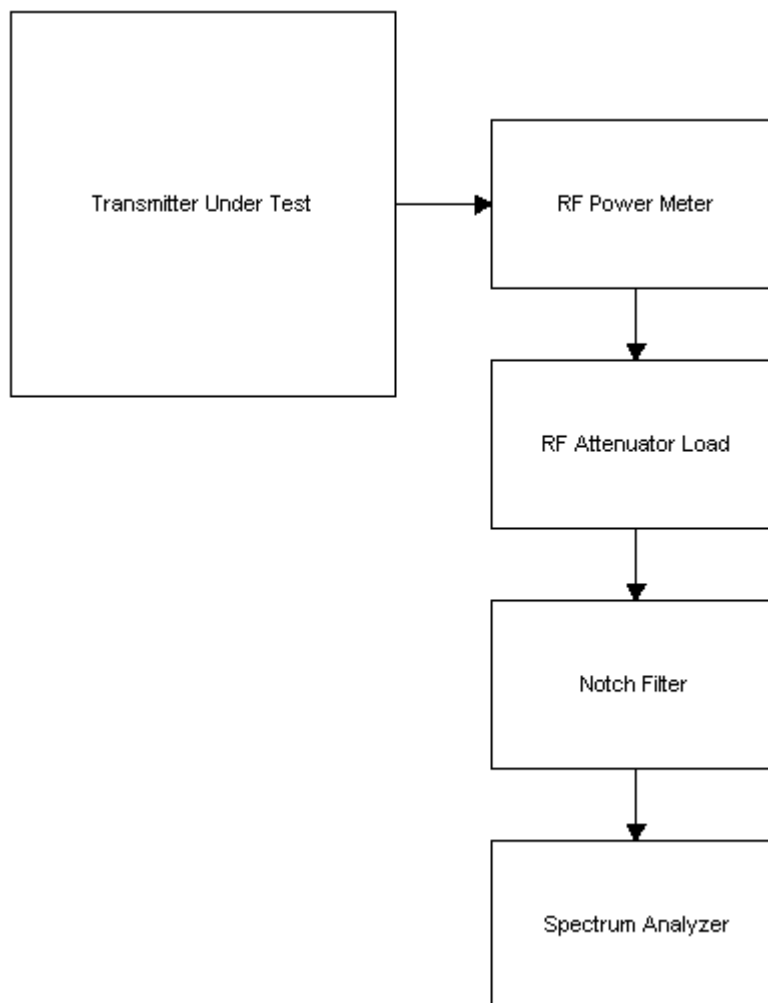


Figure 2

Audio Frequency Response, Limiter Operation Test Setup

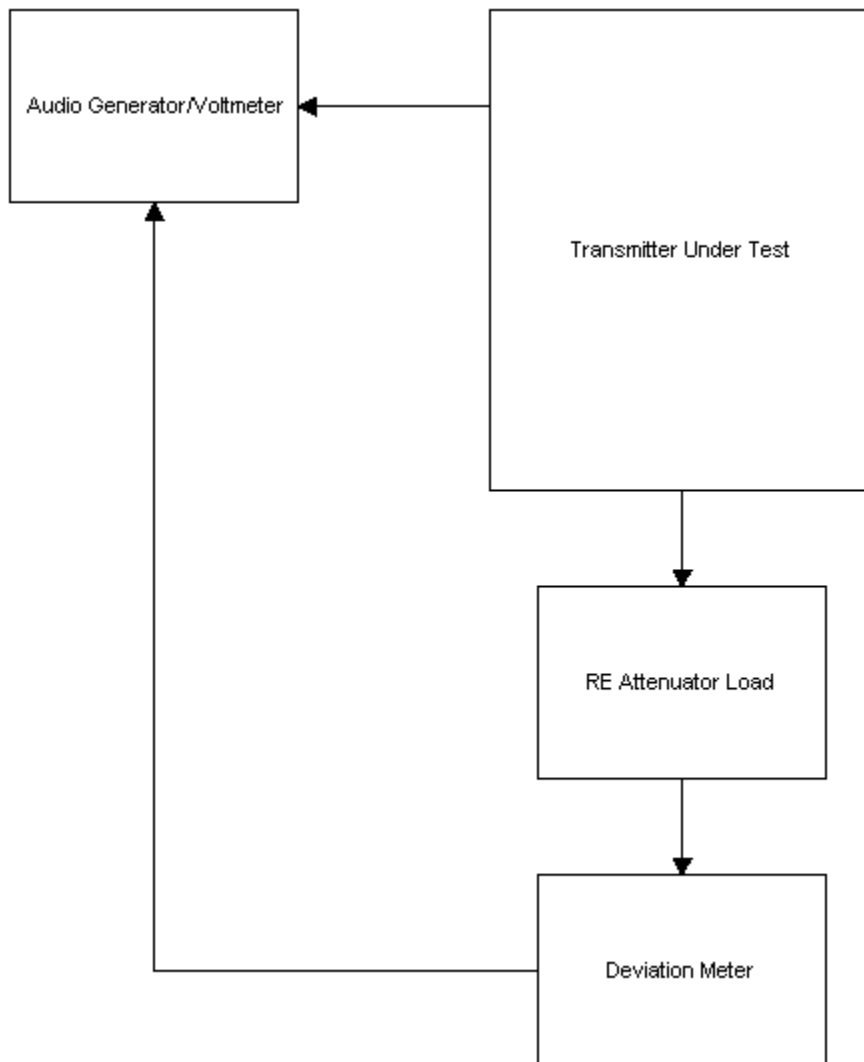


Figure 3

Frequency Stability vs. Line Voltage Test Setup

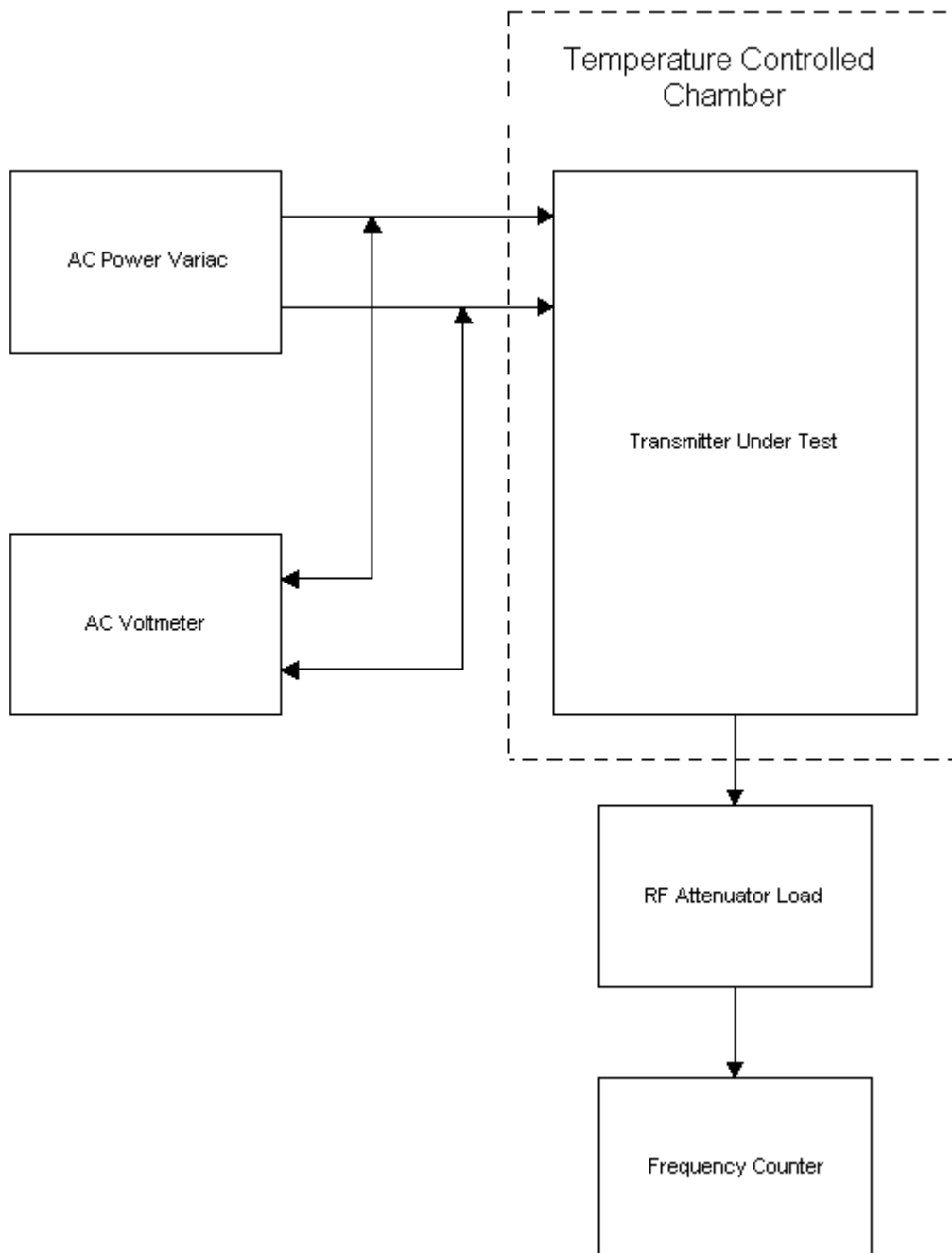


Figure 4

Transient Frequency Behavior

