TIMCO ENGINEERING, Inc.

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FCC PART 90
TEST REPORT

APPLICANT	MIDLAND RADIO CORPORATION
	5900 PARRETTA DRIVE
	KANSAS CITY MO 64120 USA
FCC ID	MMASD225V2
MODEL NUMBER	SD225V2
PRODUCT DESCRIPTION	DATA MODULE
DATE SAMPLE RECEIVED	6/06/2007
DATE TESTED	6/22/2007
TESTED BY	Richard Block
APPROVED BY	Mario de Aranzeta
TIMCO REPORT NO.	MIDLANDRADIO_MMA\2232AUT7TestReport.doc
TOTAL PAGES	31
TEST RESULTS	☒ PASS ☐ FAIL

ACCREDITED
Certificate # 0955-01

TABLE OF CONTENTS

STATEMENT OF COMPLIANCE

This equipment has been tested in accordance with the standards identified in the referenced test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report and demonstrate that the equipment complies with the appropriate standards. No modifications were made to the equipment during testing in order to demonstrate compliance with these standards.

I attest that the necessary measurements were made by me or under my supervision, at Timco Engineering, Inc. located at 849 N.W. State Road 45, Newberry, Florida 32669 USA.

Certificate #0955-01

Authorized by: S. S. Sanders

Signature: <*S. S. Sanders*>

Date: July 11, 2007

GENERAL INFORMATION

DUT Specification

The test results relate only to the items tested.	
DUT Description	DATA TRANSCEIVER MODULE
FCC ID	MMASD225V2
Model Number	SD225V2
Serial Number	N/A
Operating Frequency	150.05 – 173.925
No. of Channels	16
Type of Emission	F3E, F2D
Modulation	FM
DUT Power Source	☒ 110–120Vac/50– 60Hz
	☐ DC Power
	☐ Battery Operated Exclusively
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☒ Fixed
	☐ Mobile
	☐ Portable
Antenna Connector	BNC
Test Conditions	The temperature was 26°C with a relative humidity of 50%.
Modification to the DUT	None
Test Exercise	The DUT was placed in continuous transmit mode.
Applicable Standards	TIA 603-C:2004, FCC CFR 47 Part 90
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

TEST PROCEDURE

Power Line Conducted Interference: The procedure used was ANSI/TIA 603-C:2004 using a 50uH LISN. Both lines were observed with the DUT transmitting. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

Bandwidth 20 dB: The measurements were made with the spectrum analyzer's resolution bandwidth (RBW) = 1 MHz and the video bandwidth (VBW) = 3 MHz and the span set as shown on plot.

Power Output: The RF power output was measured at the antenna feed point using a peak power meter.

Antenna Conducted Emissions: The RBW = 100 kHz, VBW = 300 kHz and the span set to 10.0 MHz and the spectrum was scanned from 30 MHz to the 10th harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz
and the span to 50 MHz.

Radiation Interference: The test procedure used was ANSI C63.4-2003 using an Agilent spectrum receiver with pre-selector. The bandwidth (RBW) of the spectrum receiver was 100 kHz up to 1 GHz and 1 MHz above 1 GHz with an appropriate sweep speed. The VBW above 1 GHz was 3 MHz. The analyzer was calibrated in dB above a micro volt at the output of the antenna.

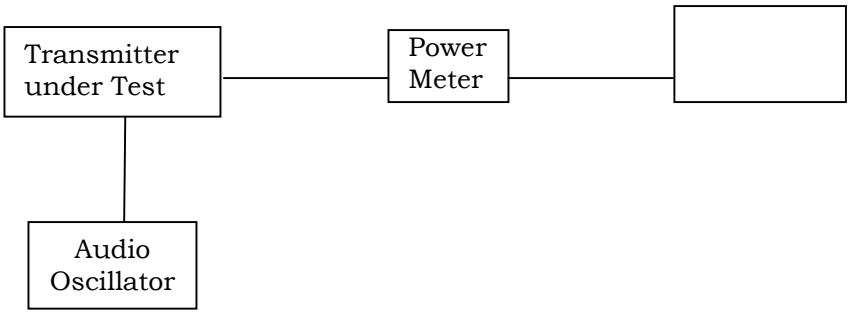
RF POWER OUTPUT

Rule Part No.: Part 2.1046(a),

Test Requirements:

Method of Measurement: RF power is measured by connecting a 50-ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage, and the transmitter properly adjusted the RF output measures:

Test Setup Diagram:



Test Data:

OUTPUT POWER: HIGH – 5.00 Watts
LOW - 1.00 Watts

Part 2.1033 (C)(8) DC Input into the final amplifier

FOR LOW POWER SETTING INPUT POWER: (12.0V)(0.5A) = 6.0 Watts
FOR HIGH POWER SETTING INPUT POWER: (12.0V)(1.6A) = 19.2Watts

MODULATION CHARACTERISTICS

Part 2.1033(c)
Part 2.1033(c) (4) Type of Emission: 11K2F1D , 11K2F2D, 11K2F3E, 16K0F3E, and 16K0F2D
Part 90.209
Part 90.207

Type of Emission: 11K2F2D
Bn = 2M + 2DK
M = B/2 = 9600/2= 4800
D = 800
K=1
Bn = 2(4800)+2(800) = 11.2k

Type of Emission: 11K2F3E
Bn = 2M + 2DK
M = 3000
D = 2100
K=1
Bn = 2(3000)+2(2100) = 10.2k

Type of Emission: 16K0F3E

Bn = 2M + 2DK
M = 3000
D = 4700
K=1
Bn = 2(3000)+2(4700) = 15.4k

Type of Emission: 20K0F2D

Bn = 2M + 2DK
M = B/2 = 19200/2
D = 400
K=1
Bn = 2(19200)+2(400) = 20k

MODULATION CHARACTERISTICS

Rule Part No.: Part 2.1047(a)(b)

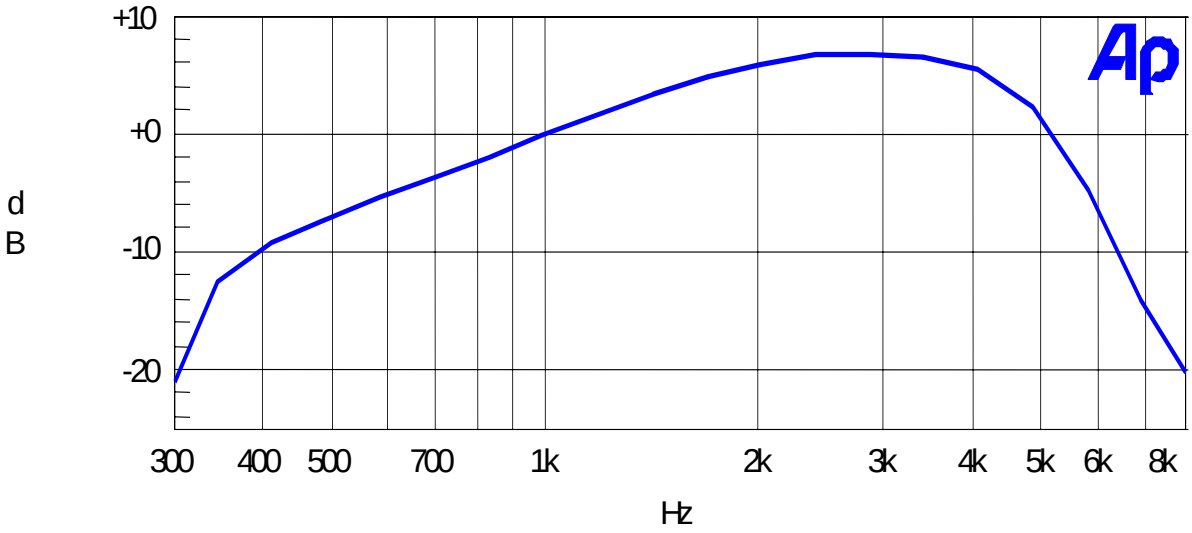
Test Requirements:

Method of Measurement:

Audio frequency response

The audio frequency response was measured in accordance with ANSI/TIA 603-C:2004. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 – 5000Hz shall be submitted. The audio frequency response curve is shown below.

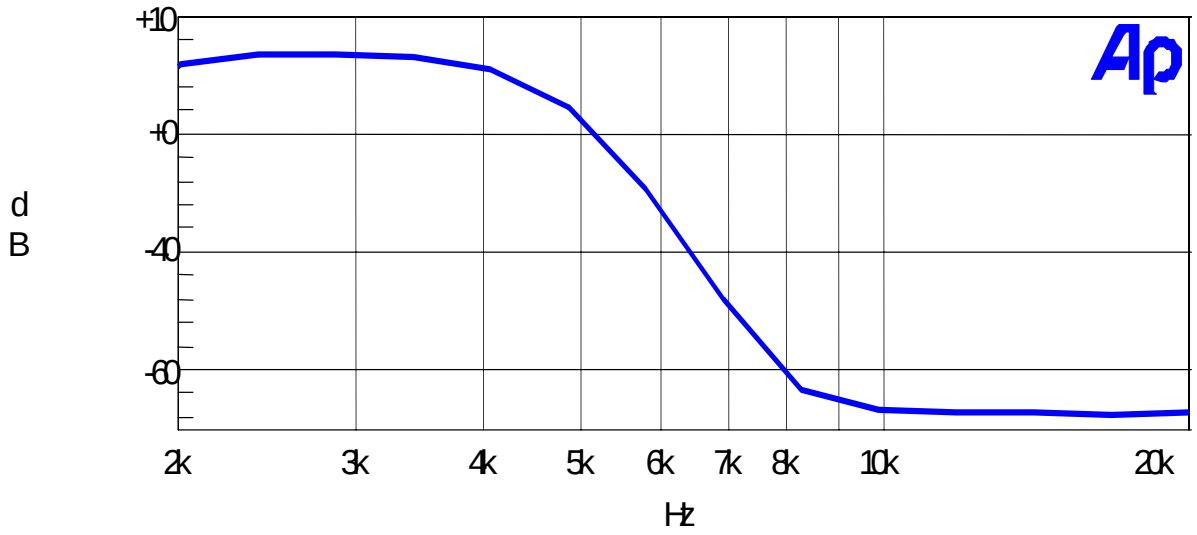
AUDIO FREQUENCY RESPONSE PLOT



VOICE MODULATED COMMUNICATION EQUIPMENT

Part 2.1047(a) Voice modulated communication equipment: For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all the circuitry installed between the modulation limiter and the modulated stage shall be submitted.

AUDIO LOW PASS FILTER



AUDIO INPUT VERSUS MODULATION

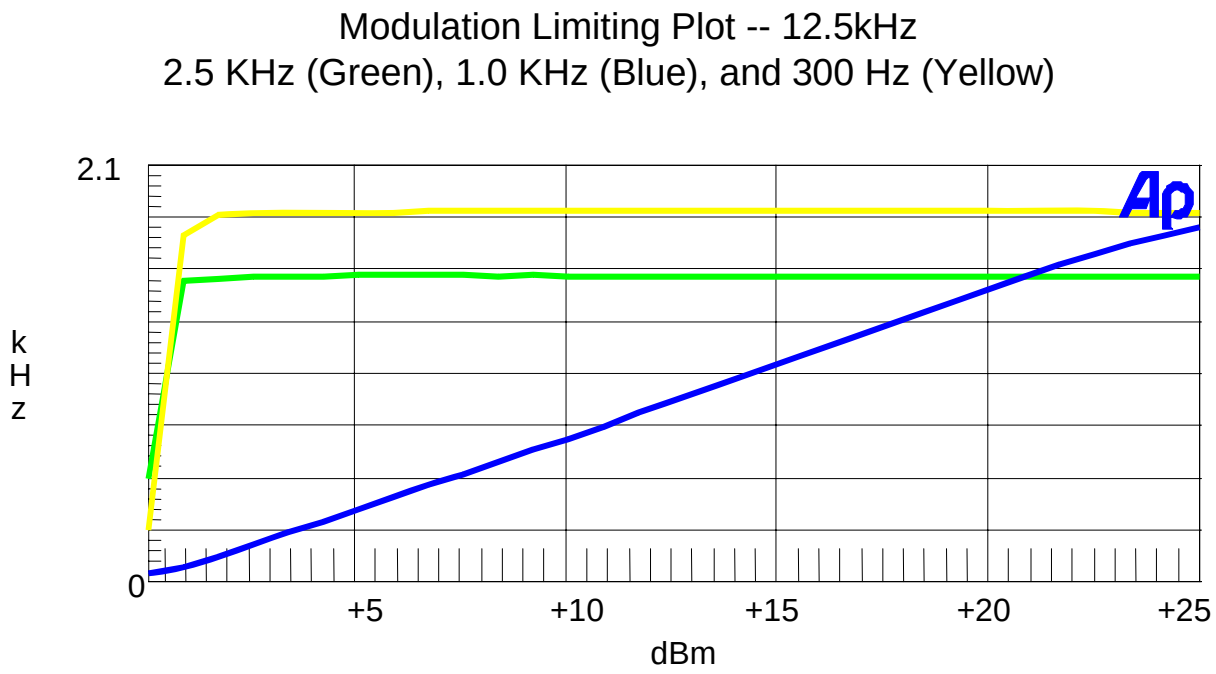
Rule Part No.: Part 2.1047(b) & 90

Test Requirements:

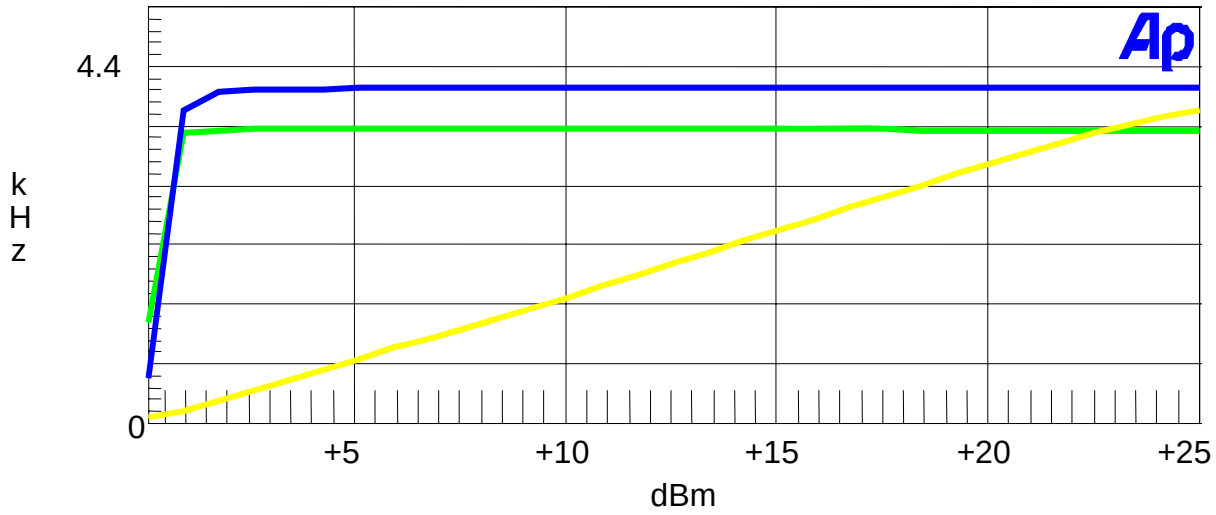
Method of Measurement: **Modulation cannot exceed 100%,** The audio input level needed for a particular percentage of modulation was measured in accordance with ANSI/TIA 603-C:2004. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and 2500 Hz.

Test data:

Modulation Limiting Plot



Modulation Limiting Plots – 25.0kHz
2.5 KHz (Green), 1.0 KHz (Blue), and 300 Hz (Yellow)



Part 2.1033(c)
Part 2.1033(c) (4) Type of Emission: 11K2F1D
Part 90.209
Part 90.207 Bn = 2M + 2DK
M = B/2 = 7200/2
D = 2000
K=1
Bn = 2(3600)+2(2000) = 11.2k

Part 2.1049(c) EMISSION BANDWIDTH:
Part 90.210(b) 25kHz Channel Spacing

Data in the plots show that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35 dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least 43 + 10log(P)dB.

Part 90.210(c) 12.5kHz Channel Spacing Not Equipped with a Low Pass Filter

For transmitters that are not equipped with an audio low pass filter pursuant to S90.211 (b), the power of any emission must be attenuated below the un-modulated carrier output power as follows; (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz but not more than10 kHz: At least 83 log (fd/5) dB; (2) ON any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250% of the authorized bandwidth: At least 29 log(fd2/11)dB or 50 dB, whichever is the lesser attenuation; (3) On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: At least 43+10 log(Po)dB.

Part 90.210(d) Emission Mask D - 12.5 kHz channel BW equipment.

For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27 (fd - 2.88 kHz) dB.
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10log(P) dB or 70 dB, whichever is the lesser attenuation.

Part 90.210(e) Emission Mask E – 6.25 kHz channel BW equipment.

For transmitters designed to operate with a 6.25 kHz bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

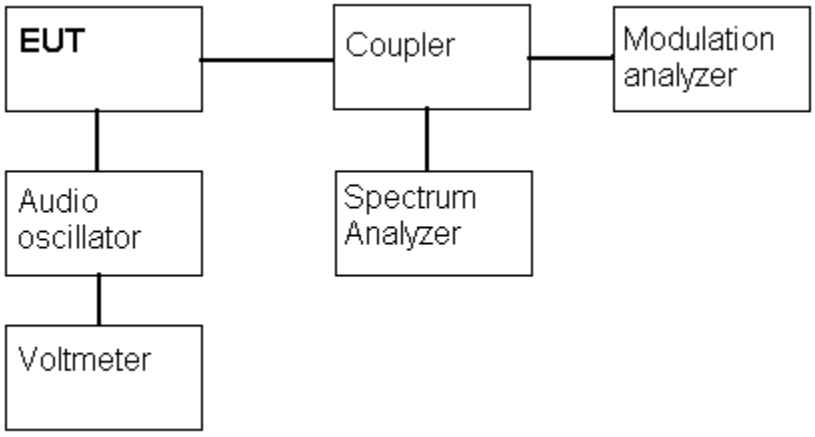
(1) On any frequency from the center of the authorized bandwidth f0 to 3.0 kHz removed from f0: Zero dB.
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(fd – 3.0 kHz) or 55 + 10 Log(P) or 65, whichever us the lesser attenuation.
(3) On any frequency removed from the center of the authorized bandwidth by more than 4.6kHz: At least 55 + 10log(P) dB or 65 dB, whichever is the lesser attenuation.

OCCUPIED BANDWIDTH MEASUREMENT

Test procedure: ANSI/TIA-603-C:2004 para 2.2.11.

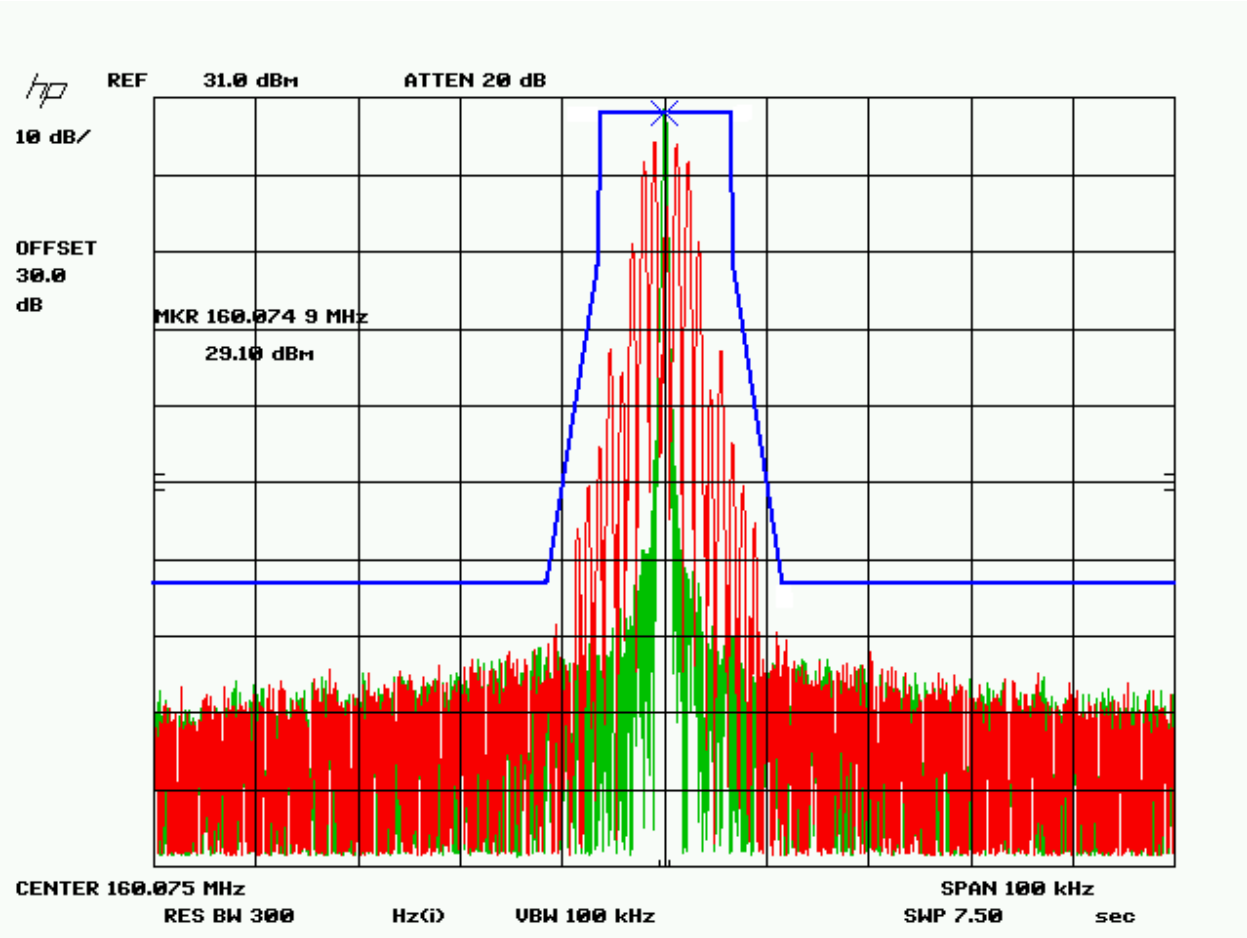
Test Setup Diagram:

OCCUPIED BANDWIDTH MEASUREMENT

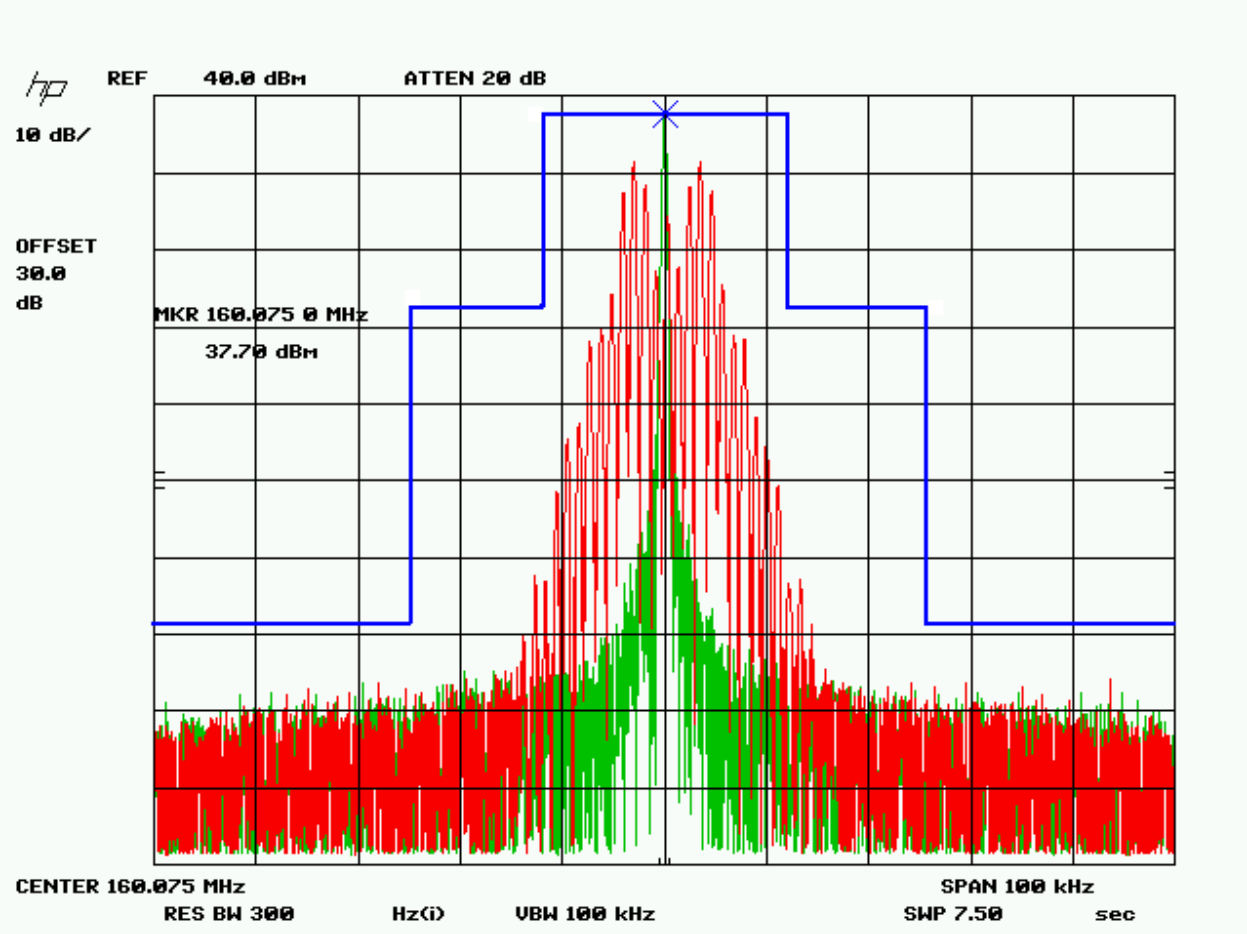


Test Data: See the plots below

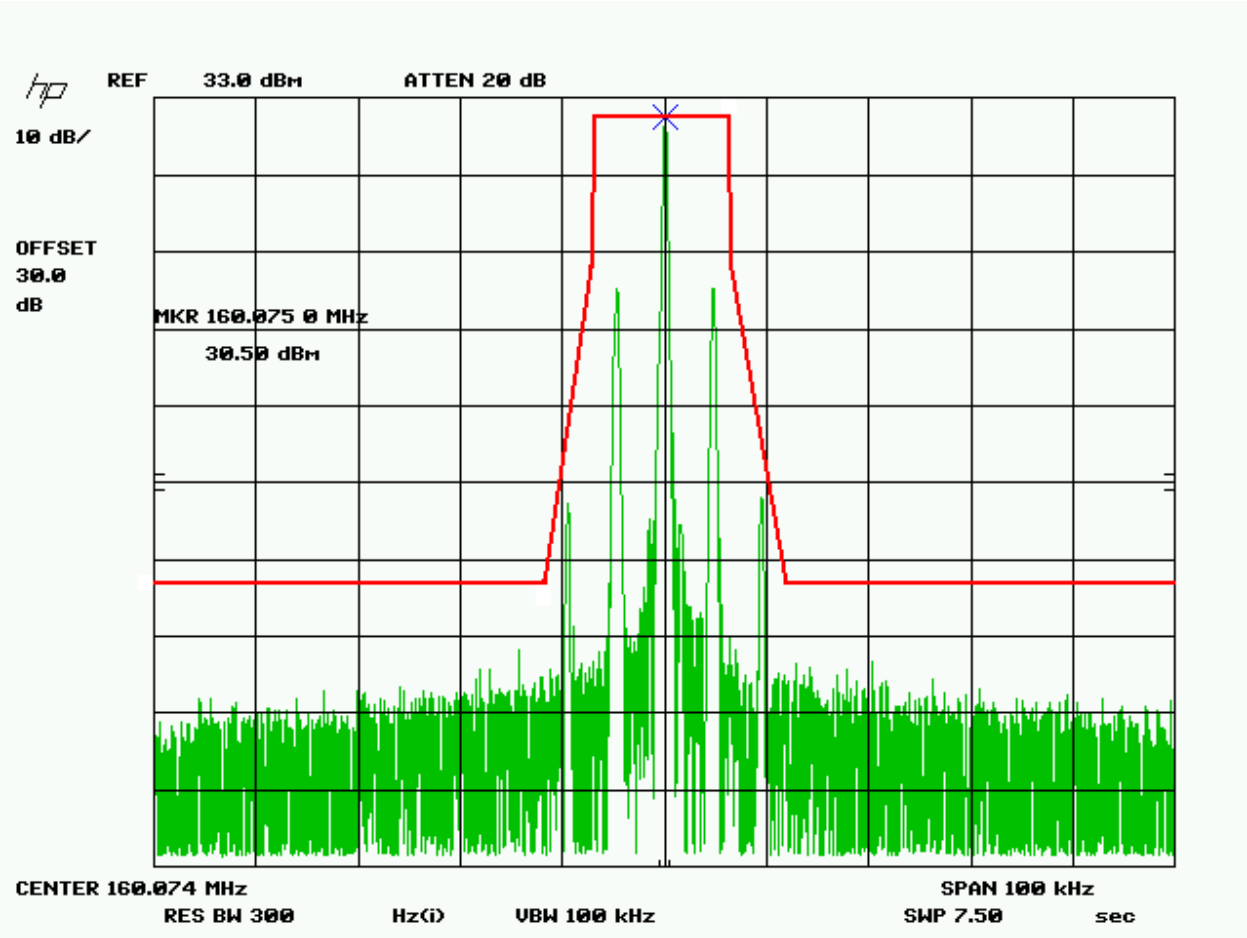
12.5kHz -- AUDIO



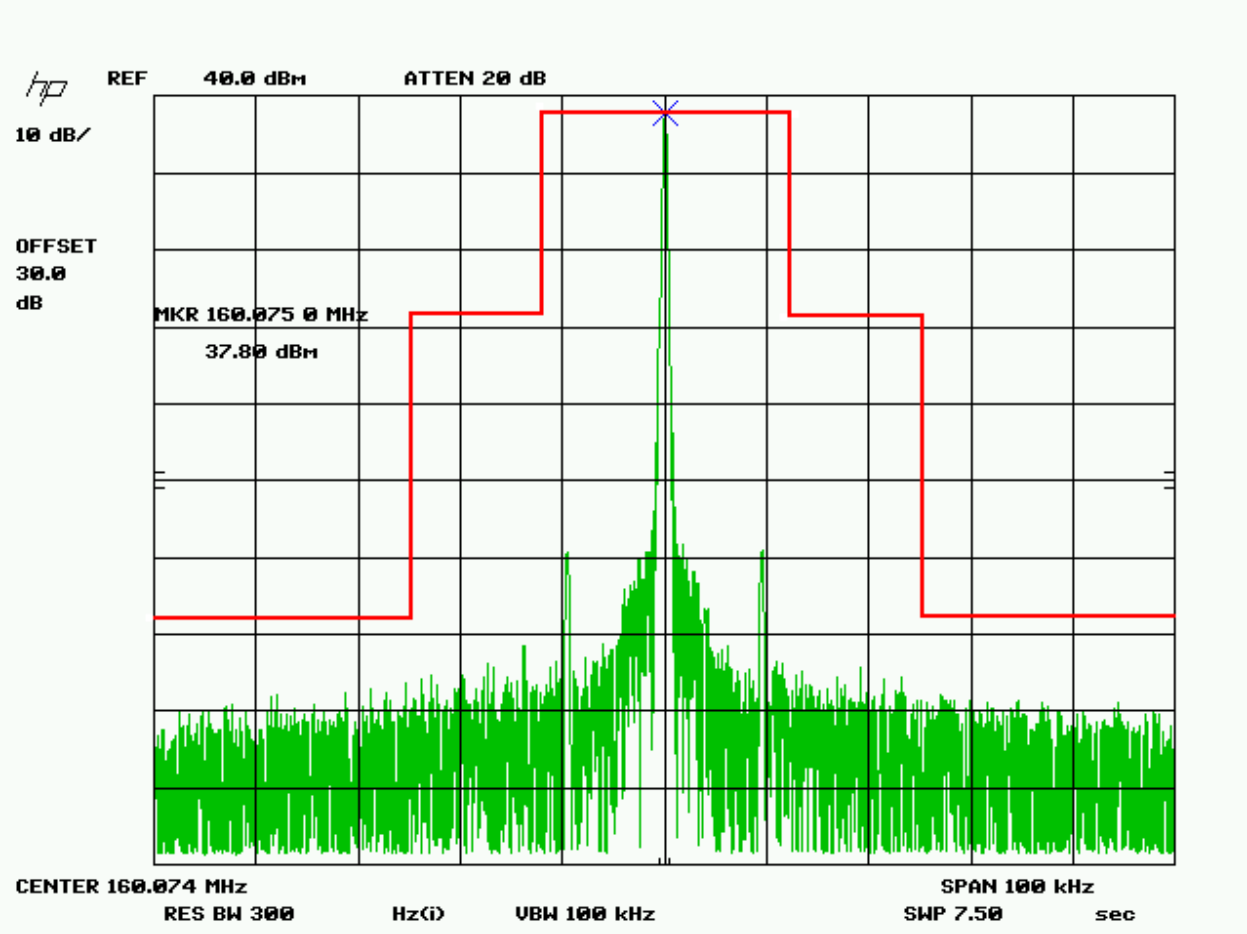
25.0kHz -- AUDIO



12.5kHz – DIGITAL



25.0kHz – DIGITAL



SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a)

Requirements: 25kHz Channel Spacing = 50dBc (for 5 Watts)

Method of Measurement: The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard TIA/EIA-603.

```
FCC Limit for:
      25kHz Channel Spacing = 50
      12.5kHz Spacing   = 57
      6.25kHz Channel Spacing = N/A
```

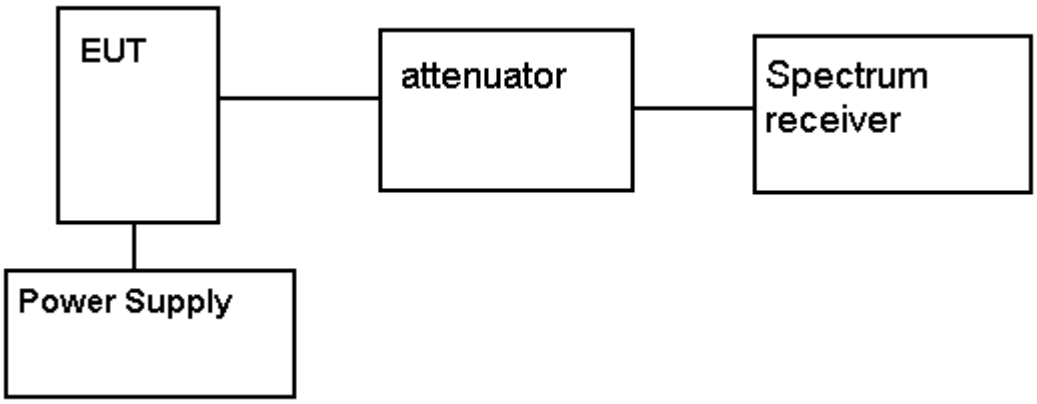
Test Data:

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
25kHz	**155.095**	0		12.5kHz	**155.095**	0
	310.190	67.9			**310.190**	67.5
	465.285	83.9			**465.285**	78.8
	620.380	89.1			**620.380**	82.9
	775.475	94.8			**775.475**	86.7
	930.570	94.5			**930.570**	87.4
	1085.665	92.1			**1085.665**	87.2
	1240.760	92.6			**1240.760**	86.0
	1395.855	93.4			**1395.855**	86.6
	1550.950	92.9			**1550.950**	86.1

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
25kHz	**160.025**	0		12.5kHz	**160.025**	0
	320.050	87.7			**320.050**	64.7
	480.075	91.3			**480.075**	79.2
	640.100	89.2			**640.100**	85.6
	800.125	93.0			**800.125**	84.6
	960.150	89.7			**960.150**	84.7
	1120.175	92.8			**1120.175**	84.3
	1280.200	88.6			**1280.200**	87.7
	1440.225	89.2			**1440.225**	82.9
	1600.250	95.3			**1600.250**	88.1

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
25kHz	**173.925**	0		12.5kHz	**173.925**	0
	347.850	81.2			**347.850**	69.6
	521.775	82.4			**521.775**	78.1
	695.700	95.1			**695.700**	84.2
	869.625	94.5			**869.625**	85.5
	1043.550	91.2			**1043.550**	84.8
	1217.475	94.1			**1217.475**	84.2
	1391.400	94.3			**1391.400**	85.0
	1565.325	94.5			**1565.325**	86.9
	1739.250	94.1			**1739.250**	87.7

Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was ANSI/TIA 603-C:2004. The measurements were made at TIMCO ENGINEERING INC. 849 N.W. State Road 45, Newberry, Florida 32669.

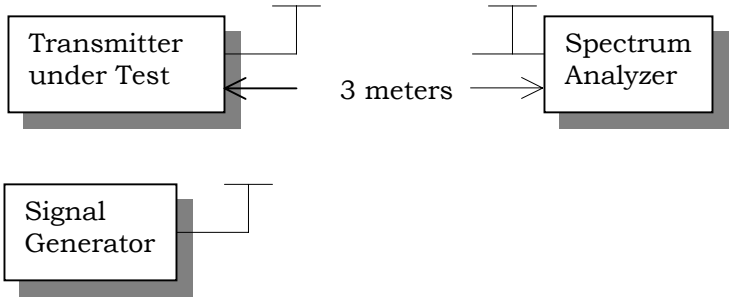
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: Part 2.1053

Requirements: The FCC limits for radiated emissions are the same as previously stated for the conducted emissions.

METHOD OF MEASUREMENT: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA/EIA STANDARD 603 using the substitution method. Measurements were made at the test site of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669.

Test Setup Diagram:



Test Data:

High Power 25 kHz

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
155.095	0	0
310.190	H	100.0
465.285	H	96.5
620.380	H	88.0
775.475	H	97.4
930.570	V	92.7
1085.665	V	74.4
1240.760	V	80.6
1395.855	V	73.7
1550.950	H	75.6

Low Power 12.5 kHz

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
155.095	0	0
310.190	H	93.6
465.285	H	93.5
620.380	H	87.5
775.475	H	96.0
930.570	H	93.4
1085.665	V	72.2
1240.760	H	77.2
1395.855	H	86.9
1550.950	H	71.1

High Power 25 kHz

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
160.03	0	0
320.05	H	98.1
480.08	H	86.8
640.10	H	86.7
800.13	H	88.8
960.15	H	82.5
1120.18	V	77.0
1280.20	V	80.4
1440.23	H	73.8
1600.25	H	84.7

Low Power 12.5 kHz

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
160.03	0	0
320.05	H	91.6
480.08	H	86.8
640.10	H	81.2
800.13	H	79.7
960.15	H	80.2
1120.18	V	79.3
1280.20	H	86.8
1440.23	H	76.4
1600.25	H	75.4

High Power 25 kHz

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
173.93	0	0
347.85	H	96.0
521.78	H	90.3
695.70	V	101.5
869.63	V	100.7
1043.55	V	71.0
1217.48	H	89.3
1391.40	H	88.5
1565.33	V	88.4
1739.25	H	89.8

High Power 25 kHz

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
173.93	0	0
347.85	H	87.6
521.78	H	87.1
695.70	H	86.2
869.63	H	96.4
1043.55	V	69.2
1217.48	H	79.5
1391.40	H	82.2
1565.33	H	80.7
1739.25	H	85.3

FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 90.213

Requirements: Temperature range requirements: -30 to +50° C.
Voltage Variation +, -15%
±1.5 PPM

Method of Measurements: ANSI/TIA 603-603-C:2004

Test Data:

Assigned Frequency (Ref. Frequency) (MHz)		160.075004
Temperature (°C)	**Frequency (MHz)**	**Frequency Stability (PPM)**
-30	160.075061	0.36
-20	160.075074	0.44
-10	160.074995	-0.06
0	160.074975	-0.18
+10	160.074994	-0.06
+20	160.075003	-0.01
+30	160.075001	-0.02
+40	160.074980	-0.15
+50	160.074923	-0.51

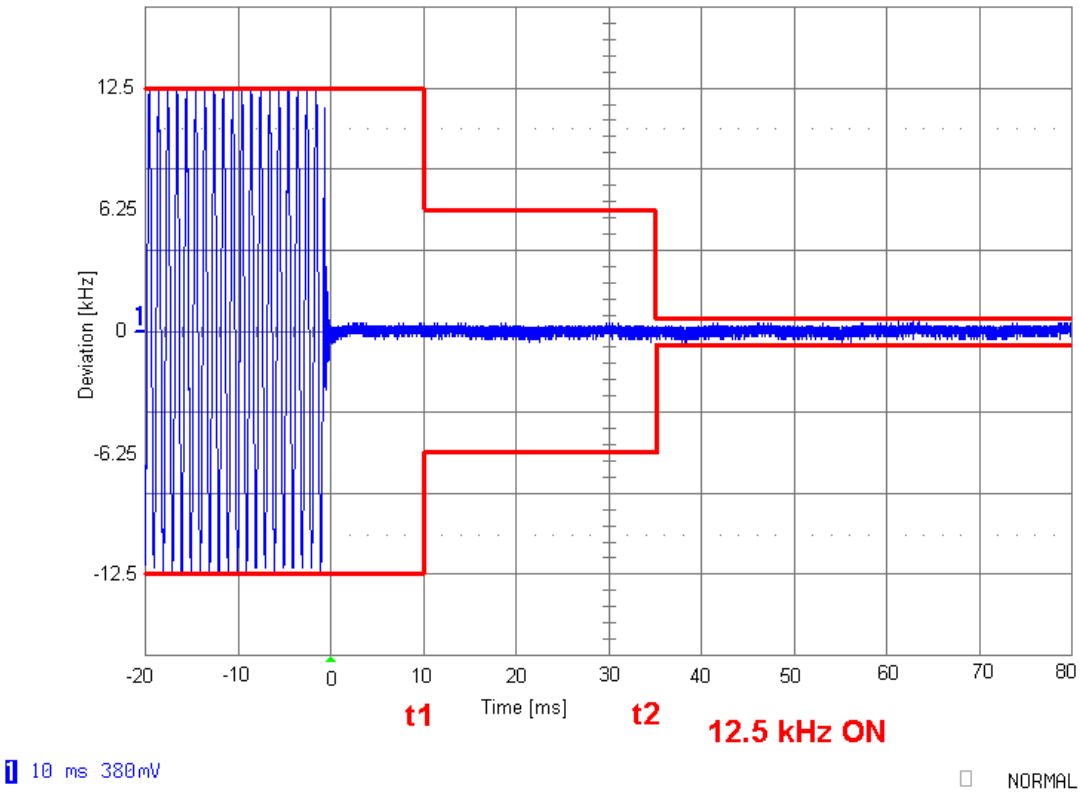
Assigned Frequency (Ref. Frequency) (MHz)		
% Battery	**Frequency (MHz)**	**Frequency Stability (PPM)**
-15%	160.075003	-0.01
0	160.075004	0.00
+15%	160.075002	-0.01

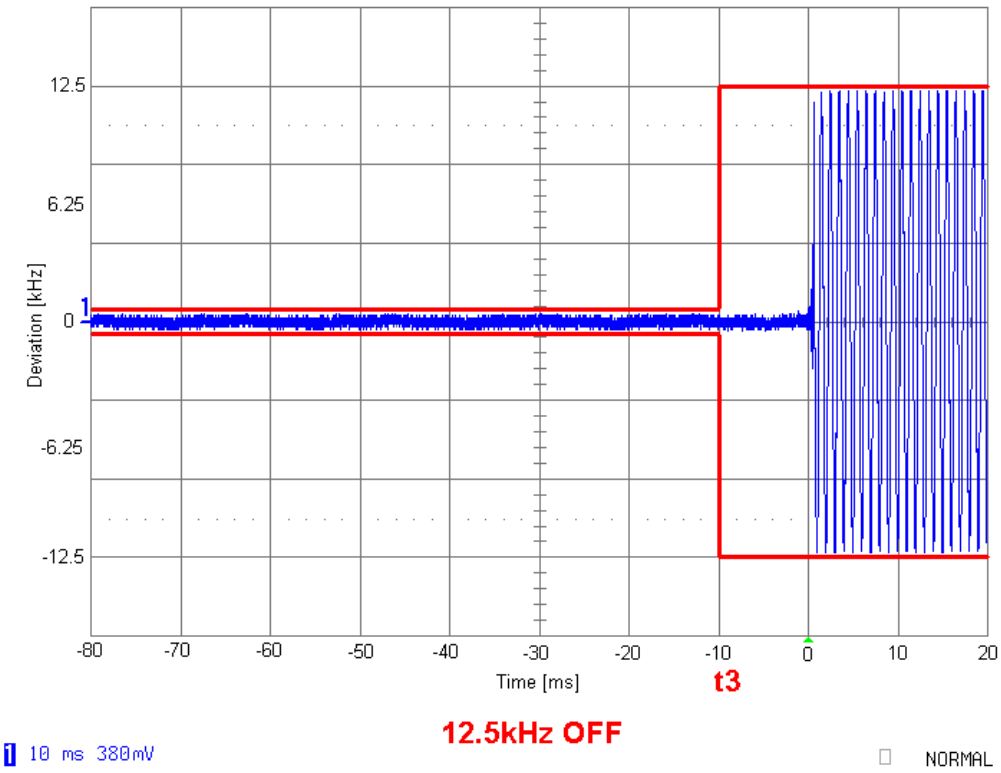
TRANSIENT FREQUENCY BEHAVIOR

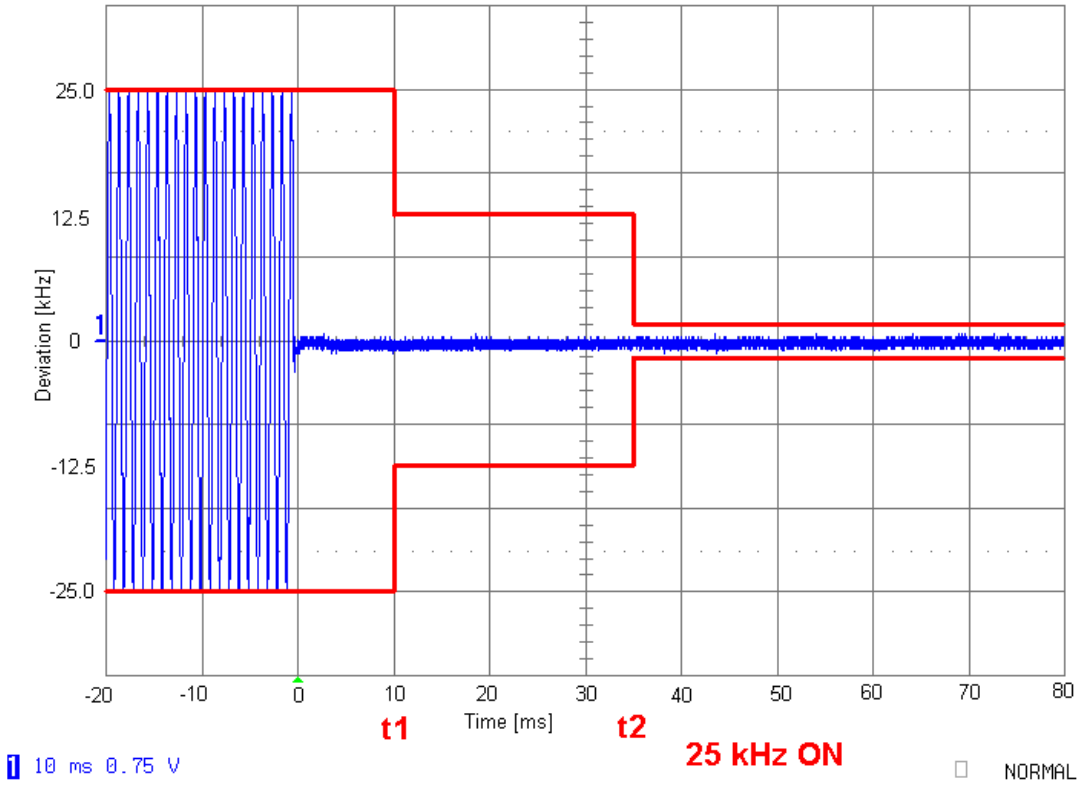
Part 2.1055(a)(1)
Part 90.214 Transient Frequency Behavior

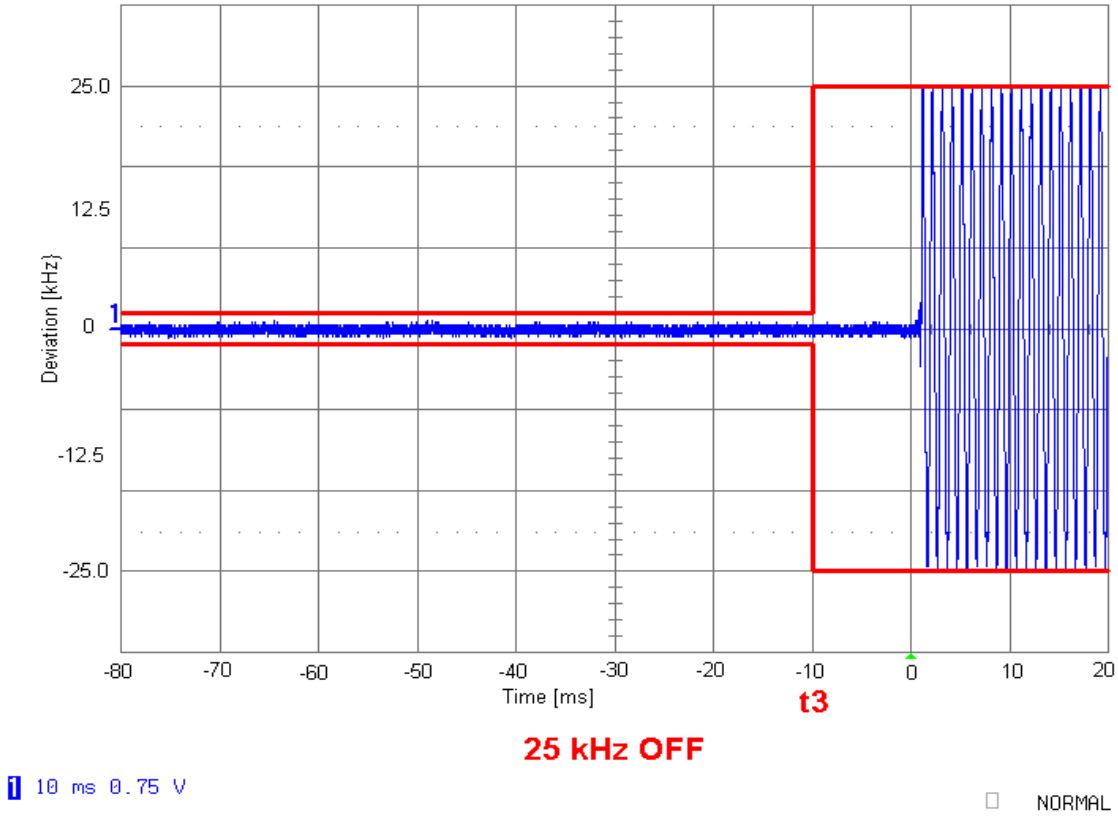
REQUIREMENTS: Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time Intervals	Maximum frequency difference	All Equipment	
		150-174 MHz	421-512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3[4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3[4]	±6.25 kHz	5.0 ms	10.0 ms


12.5
6.25
0
-6.25
-12.5
Deviation [kHz]
1
-20
-10
0
10
20
30
40
50
60
70
80
Time [ms]
t1
t2
12.5 kHz ON
1 10 ms 380mV
NORMAL

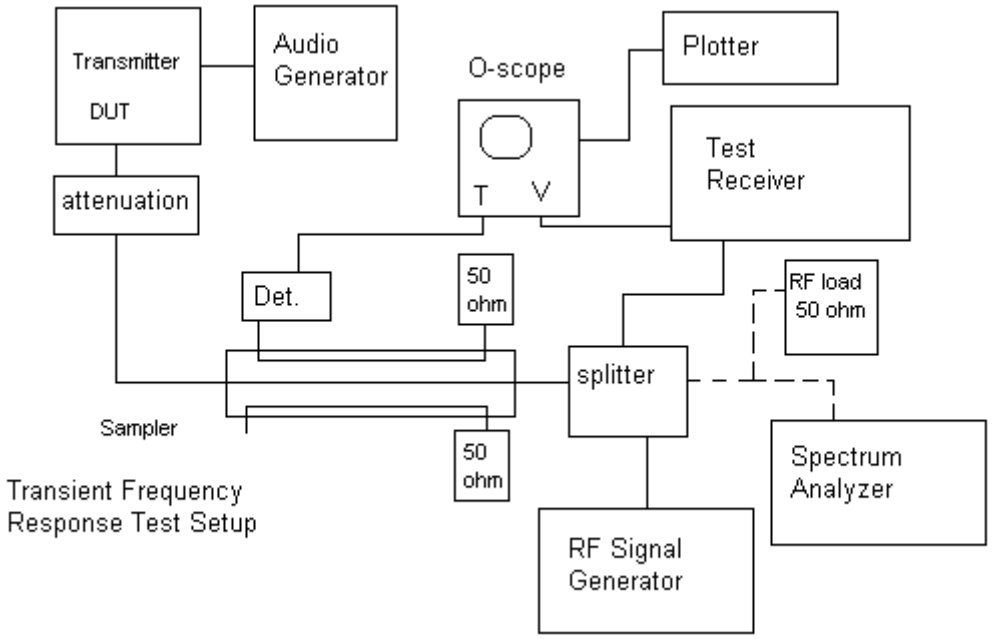

12.5
6.25
0
-6.25
-12.5
Deviation [kHz]
1
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
Time [ms]
t3
12.5kHz OFF
1 10 ms 380mV
NORMAL


25.0
12.5
0
-12.5
-25.0
Deviation [kHz]
1
-20
-10
0
10
20
30
40
50
60
70
80
Time [ms]
t1
t2
25 kHz ON
10 ms 0.75 V
NORMAL


25.0
12.5
0
-12.5
-25.0
Deviation [kHz]
1
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
Time [ms]
t3
25 kHz OFF
10 ms 0.75 V
NORMAL

TEST PROCEDURE: ANSI/TIA 603-C:2004 PARA 2.2.19

1. Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level, then the transmitter was turned off.
2. With the transmitter off the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained with the signal generator through-out the test.
3. Reduce the attenuation between the transmitter and the RF detector by 30 dB.
4. With the levels set as above the transient frequency behavior was observed & recorded.



Transient Frequency Response Test Setup

EMC EQUIPMENT LIST

Table 1

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 12/7/05	12/7/07
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 12/7/05	12/7/07
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 12/8/05	12/8/07
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 12/8/05	12/8/07
Antenna: Log-Periodic	Electro-Metrics	LPA-25	1122	CAL 12/1/06	12/1/08
Antenna: Double-Ridged Horn	Electro-Metrics	RGA-180	2319	CAL 12/29/04	12/29/06
LISN	Electro-Metrics	ANS-25/2	2604	CAL 10/5/06	10/5/08
Termaline Wattmeter	Bird Electronic Corporation	611	16405	CAL 3/15/07	3/15/09