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FCC PART 90 AND IC RSS-119, RSS-GEN TEST REPORT

APPLICANT	MIDLAND RADIO CORPORATION
	5900 PARRETTA DRIVE
	KANSAS CITY MO 64120 USA
FCC ID	MMASD225U1
IC CERTIFICATION	3690A-SD225U1
MODEL NUMBER	SD225U1
PRODUCT DESCRIPTION	DATA MODULE
DATE SAMPLE RECEIVED	8/14/2007
DATE TESTED	8/21/2007
TESTED BY	Joe Scoglio
APPROVED BY	Mario de Aranzeta
TIMCO REPORT NO.	MIDLANDRADIO_MMA\2818UT7TestReport.doc
TEST RESULTS	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

**THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.**



Certificate # 0955-01

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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: Mario de Aranzeta
Signature: <Mario de Aranzeta>
Date: September 6, 2007

GENERAL INFORMATION
DUT Specification



The test results relate only to the items tested.	
DUT Description	UHF DATA TRANSCEIVER MODULE
FCC ID	MMASD225U1
IC Certification	3690A-SD225U1
Model Number	SD225U1
Serial Number	N/A
Operating Frequency	FCC- 400-440 MHz IC – 406.1-430 MHz
Test Frequencies	400 MHz, 420 MHz, 439.9 MHz
No. of Channels	16
Type of Emission	F3E, F2D,F1D
Modulation	FM
DUT Power Source	<input type="checkbox"/> 110-120Vac/50- 60Hz
	<input checked="" type="checkbox"/> DC Power 12V
	<input type="checkbox"/> Battery Operated Exclusively
Test Item	<input type="checkbox"/> Prototype
	<input checked="" type="checkbox"/> Pre-Production
	<input type="checkbox"/> Production
Type of Equipment	<input checked="" type="checkbox"/> Fixed
	<input type="checkbox"/> Mobile
	<input type="checkbox"/> 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	ANSI/TIA 603-C:2004, FCC CFR 47 Part 90, IC RSS-119, RSS-GEN
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

TEST PROCEDURES

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.

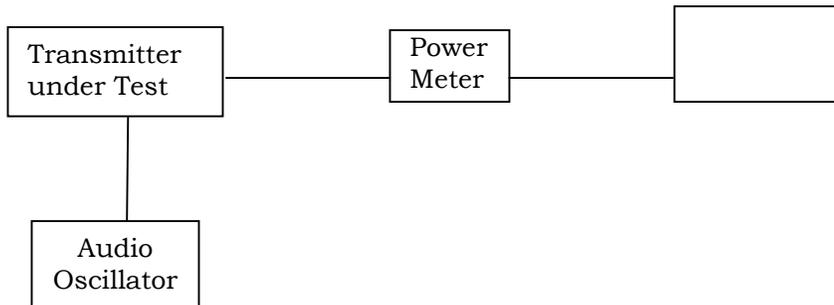
RF POWER OUTPUT

Rule Part No.: FCC Part 2.1046(a), IC RSS-119 4.1 and 5.4, RSS-GEN 4.8

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)(0.53A) = 6.36 Watts
 FOR HIGH POWER SETTING INPUT POWER: (12.0V)(1.39A) = 16.68 Watts

MODULATION CHARACTERISTICS

Part 2.1033(c)

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

FCC Part 90.209, IC RSS-119 5.5

FCC Part 90.207

Type of Emission: 11K2F2D, F1D

$$B_n = 2M + 2DK$$

$$M = B/2 = 9600/2 = 4800$$

$$D = 800$$

$$K=1$$

$$B_n = 2(4800)+2(800) = 11.2k$$

Type of Emission: 11K2F3E

$$B_n = 2M + 2DK$$

$$M = 3000$$

$$D = 2100$$

$$K=1$$

$$B_n = 2(3000)+2(2100) = 10.2k$$

Type of Emission: 16K0F3E

$$B_n = 2M + 2DK$$

$$M = 3000$$

$$D = 4700$$

$$K=1$$

$$B_n = 2(3000)+2(4700) = 15.4k$$

Type of Emission: 20K0F2D, F1D

$$B_n = 2M + 2DK$$

$$M = B/2 = 19200/2$$

$$D = 400$$

$$K=1$$

$$B_n = 2(19200)+2(400) = 20k$$

Applicant: MIDLAND RADIO

FCC ID: MMASD225U1

Report: M\MidlandRadio\MMA_\2818UT7\2818UT7TestReport.doc

AUDIO FREQUENCY RESPONSE

Rule Part No.: FCC Part 2.1047(a)(b), IC RSS-119 5.2

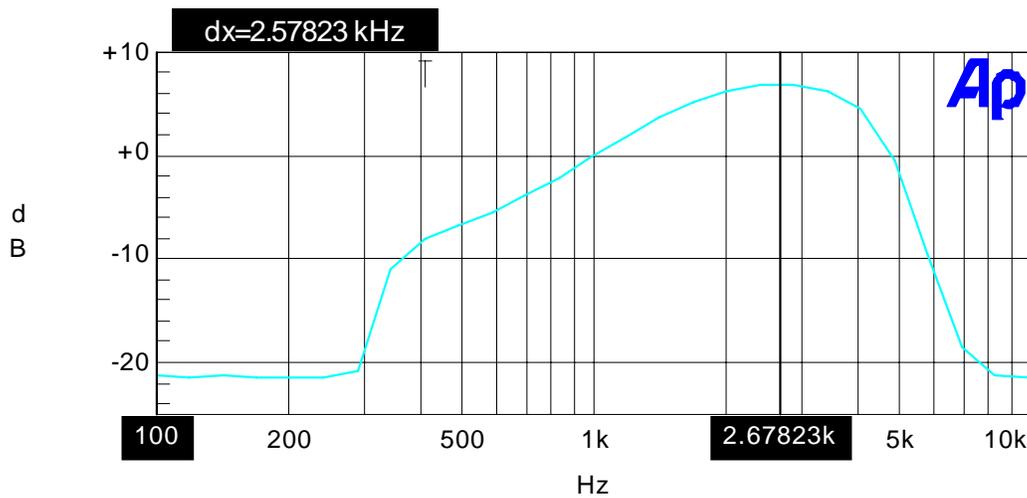
Test Requirements:

Method of Measurement:

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

Audio frequency response narrow 08/21/07 14:09:54
2818ut7

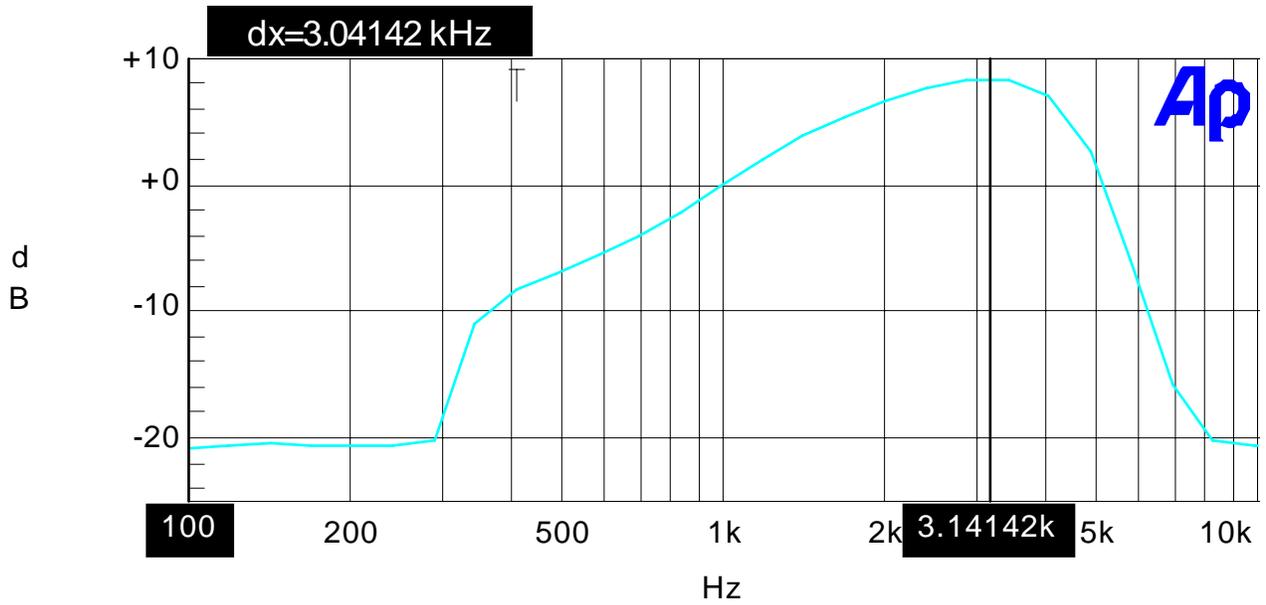


Color	Line Style	Thick	Data	Axis	Cursor1
Cyan	Solid	1	Anlr.Level A!Normalize	Left	..

MaxFreq.at1

Audio frequency response wide
2818ut7

08/21/07 14:45:22



Color	Line Style	Thick	Data	Axis	Cursor1
Cyan	Solid	1	Anlr.Level A!Normalize	Left	..

MaxFreq.at1

AUDIO LOW PASS FILTER

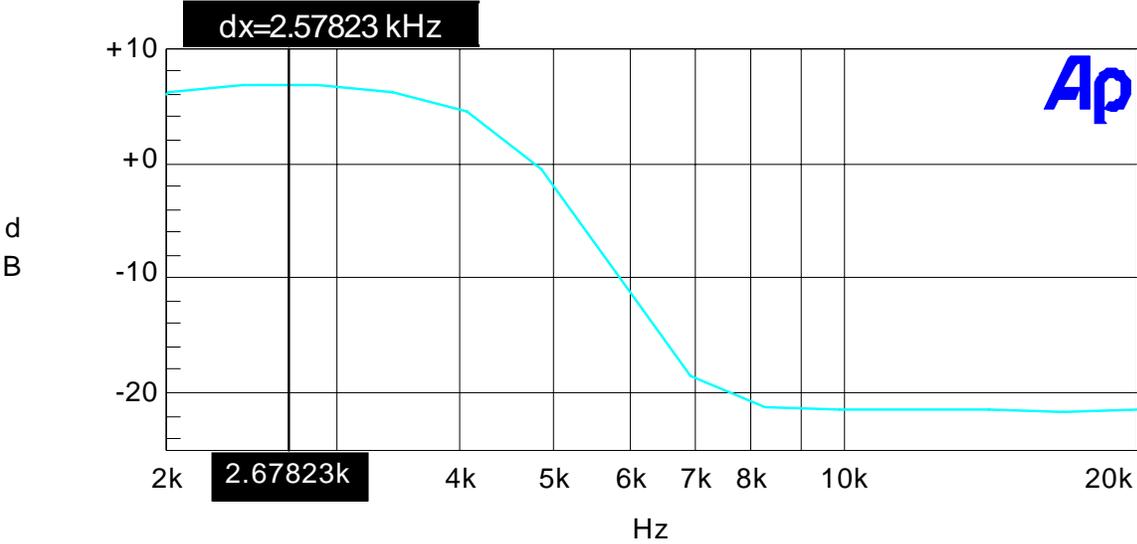
VOICE MODULATED COMMUNICATION EQUIPMENT

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 low pass narrow
2818ut7

08/21/07 14:09:54

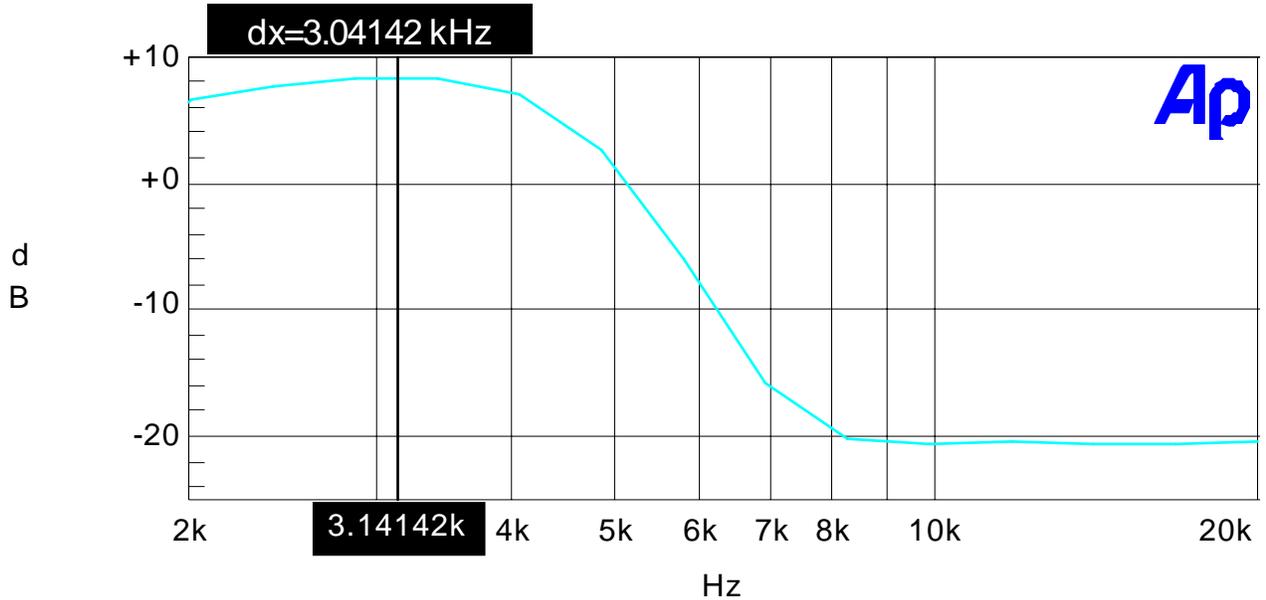


Color	Line Style	Thick	Data	Axis	Cursor1
Cyan	Solid	1	Anlr.Level A!Normalize	Left	..

MaxFreq.at1

Audio low pass wide
2818ut7

08/21/07 14:45:22



Color	Line Style	Thick	Data	Axis	Cursor1
Cyan	Solid	1	Anlr.Level A!Normalize	Left	..

MaxFreq.at1

AUDIO INPUT VERSUS MODULATION

Rule Part No.: FCC Part 2.1047(b) & 90, IC RSS-119 5.2

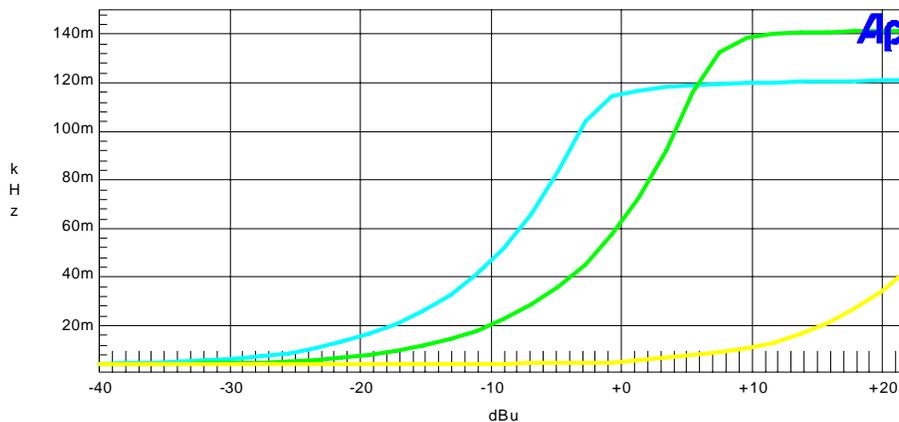
Test Requirements:

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

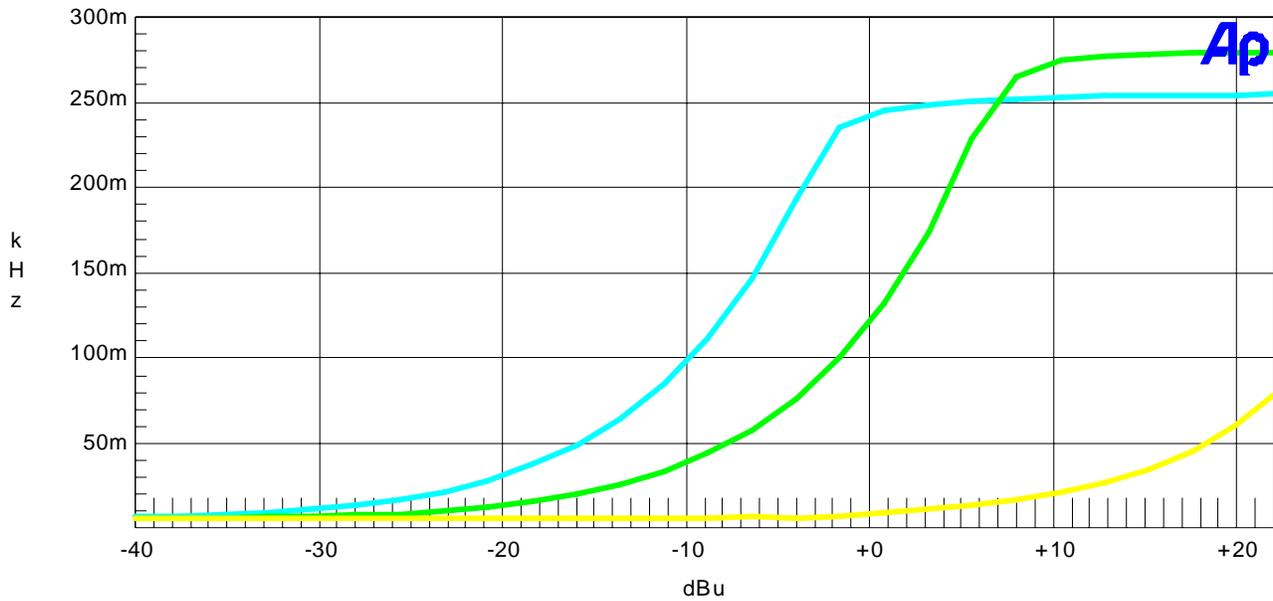
Modulation limiting narrow blue2.5k green1k yellow300hz
2818ut7



Color	Line Style	Thick	Data	Axis
Cyan	Solid	3	Anlr.Level A	Left
Green	Solid	3	Anlr.Level A	Left
Yellow	Solid	3	Anlr.Level A	Left

modulation limiting.at1

Modulation limiting wide
2818ut7



Color	Line Style	Thick	Data	Axis
Cyan	Solid	3	Anlr.Level A	Left
Green	Solid	3	Anlr.Level A	Left
Yellow	Solid	3	Anlr.Level A	Left

modulation limiting.at1

OCCUPIED BANDWIDTH

FCC Part 2.1049(c), RSS-GEN 4.6 EMISSION BANDWIDTH FCC Part 90.210(b) RSS-119 4.2 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 $43 + 10\log(P)$ 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 (f_d in kHz) of more than 5 kHz but not more than 10 kHz: At least $83 \log(f_d/5)$ dB; (2) ON any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250% of the authorized bandwidth: At least $29 \log(f_d/11)$ 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 $43 + 10 \log(P_0)$ 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 f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10\log(P)$ 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:

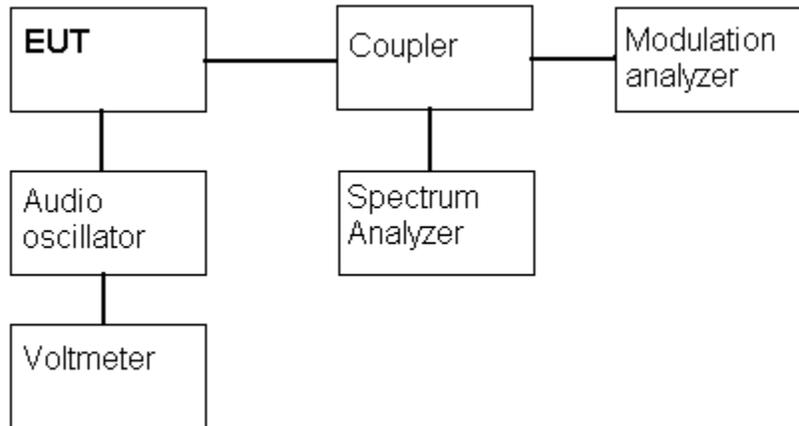
- (1) On any frequency from the center of the authorized bandwidth f_0 to 3.0 kHz removed from f_0 : Zero dB.
- (2) On any frequency from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least $30 + 16.67(f_d - 3.0 \text{ kHz})$ or $55 + 10 \log(P)$ or 65, whichever is the lesser attenuation.
- (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6kHz: At least $55 + 10\log(P)$ 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



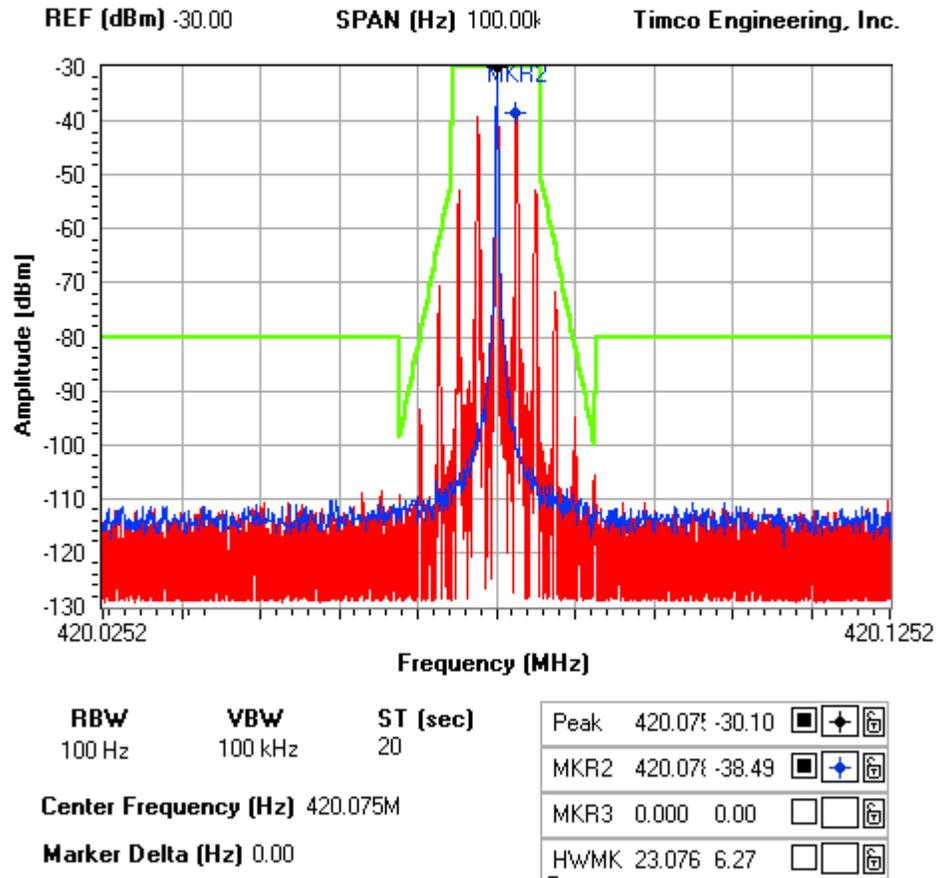
Test Data: See the plots below

12.5kHz

NOTES:

2818ut7 occupied bandwidth narrow

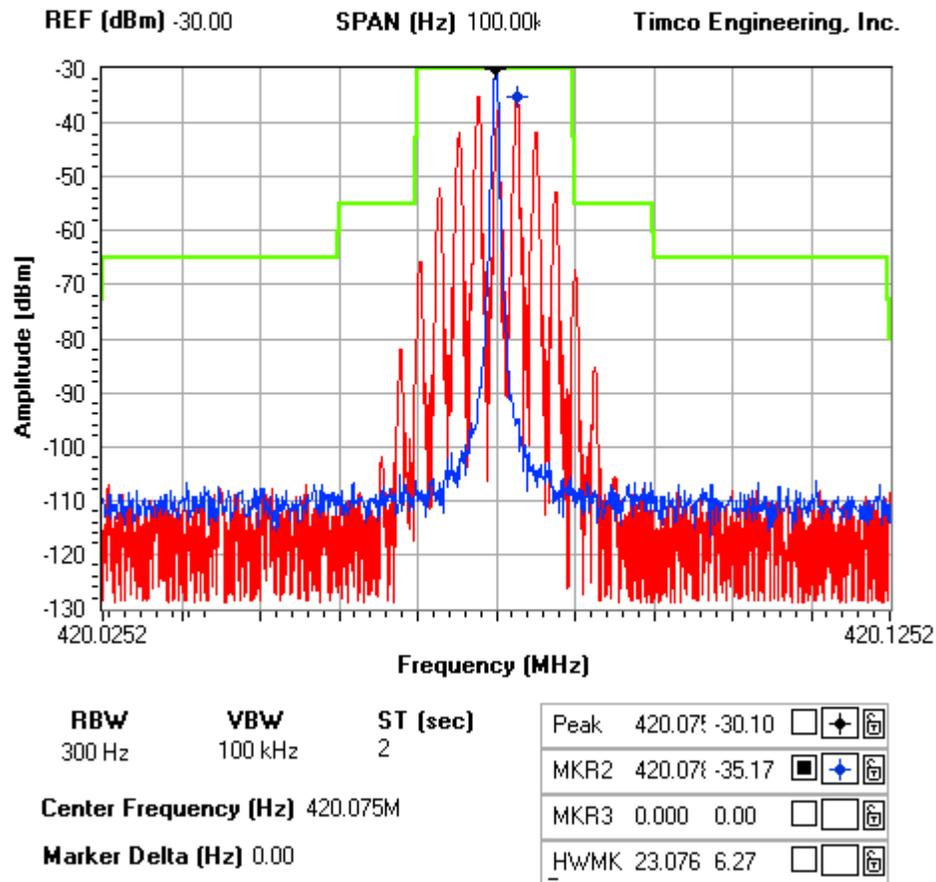
FCC 90.210 Mask D



25.0kHz

NOTES:

2818ut7 occupied bandwidth wide

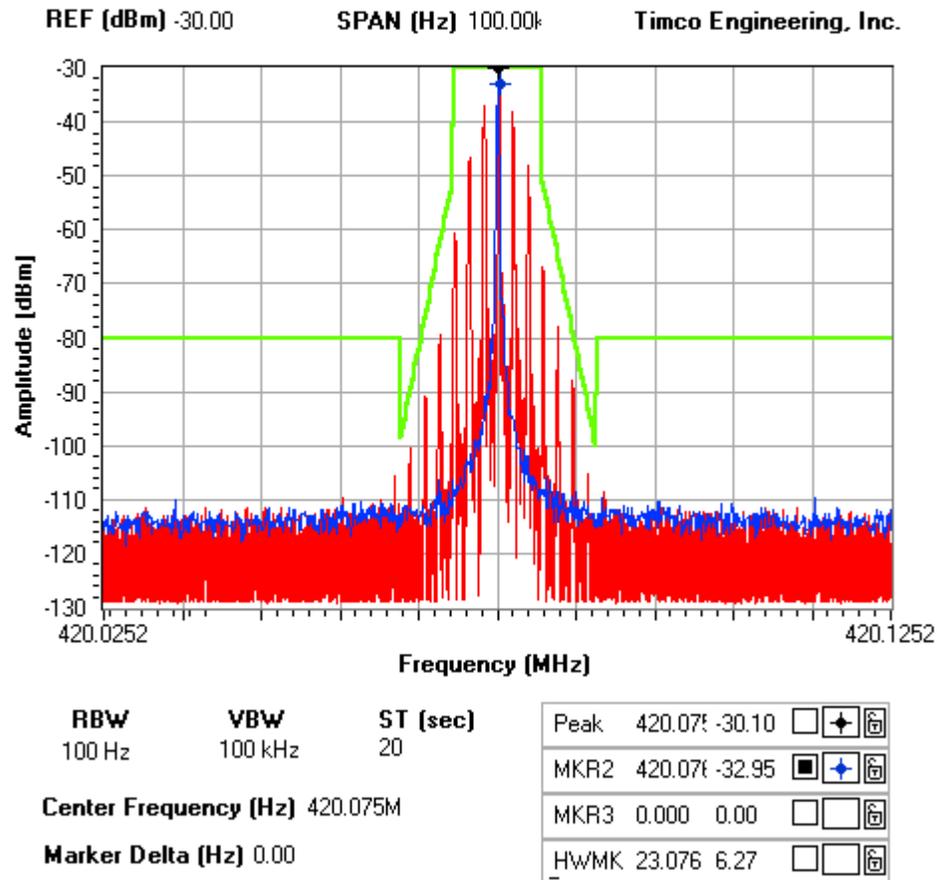


12.5kHz - DIGITAL

NOTES:

2818ut7 occupied bandwidth digital narrow

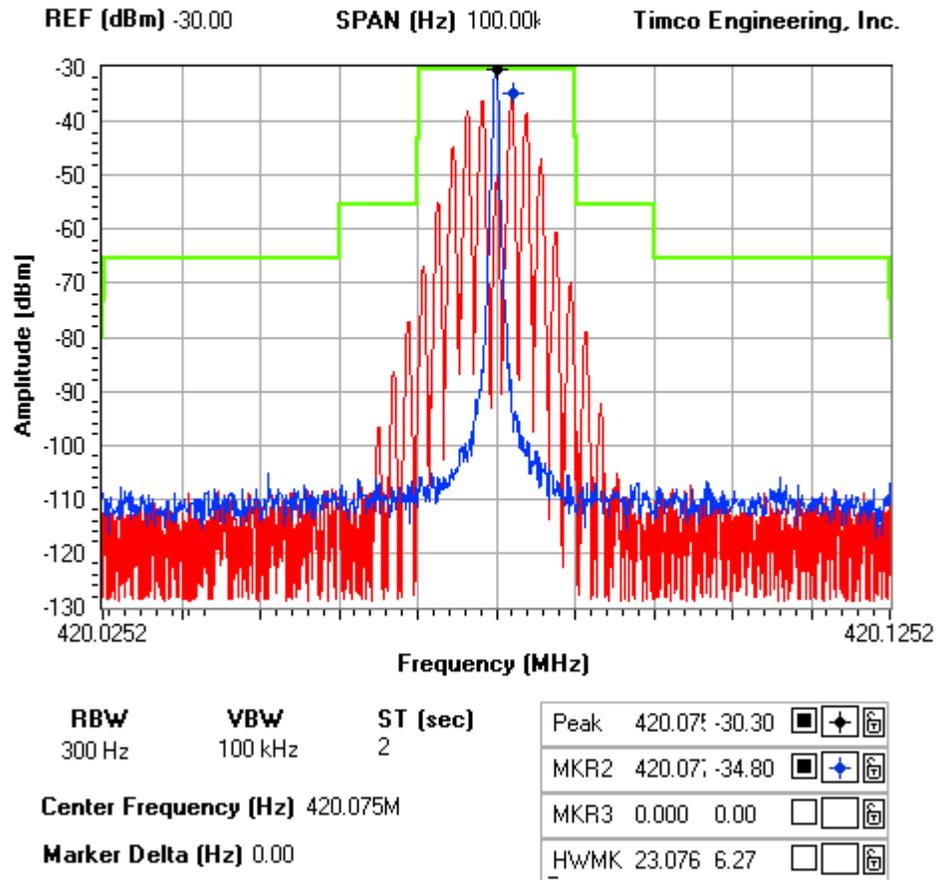
FCC 90.210 Mask D



25.0kHz – DIGITAL

NOTES:

2818ut7 occupied bandwidth digital wide



SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: FCC Part 2.1051(a), RSS-GEN 7.1.4

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

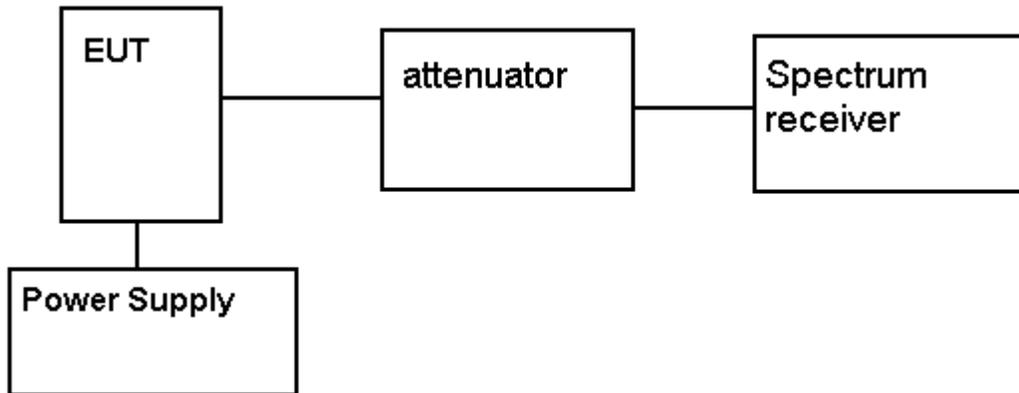
Test Data:

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
	400	0			400	0
	800.1	79.2			800.1	72.2
	1200.2	78.1			1200.2	75.5
	1600.3	65.9			1600.3	63.5
	2000.3	78.3			2000.3	79.9
	2400.4	97.4			2400.4	84.5
	2800.5	105.5			2800.5	108.1
	3200.6	101.2			3200.6	89.2
	3600.6	101.3			3600.6	89.5
	4000.7	98.7			4000.7	96.6

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
	420	0			420	0
	840.1	76.1			840.1	71.4
	1260.2	76.4			1260.2	75.9
	1680.3	76.6			1680.3	83.5
	2100.3	85			2100.3	92.3
	2520.4	90.2			2520.4	95.8
	2940.5	105			2940.5	103.5
	3360.6	98.4			3360.6	104.1
	3780.6	107.7			3780.6	93.4
	4200.7	102.9			4200.7	110

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
	439.9	0			439.9	0
	879.9	71.1			879.9	69.4
	1319.9	76.1			1319.9	73.8
	1759.9	87.9			1759.9	92.2
	2199.8	97.9			2199.8	94.9
	2639.8	101.9			2639.8	96.1
	3079.8	94.1			3079.8	94.9
	3519.8	90.1			3519.8	98.4
	3959.7	100			3959.7	96.9
	4399.7	101.6			4399.7	105.1

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.

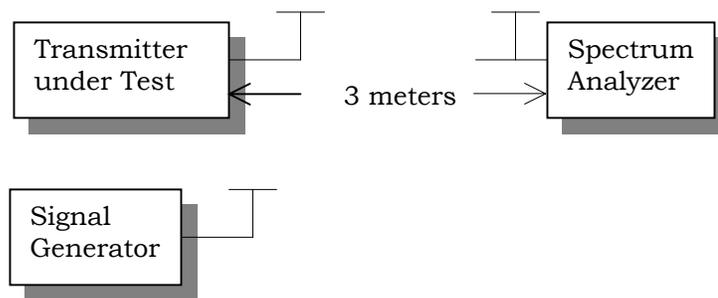
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: FCC Part 2.1053, RSS-GEN 4.9

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 ANSI/TIA 603-C:2004 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			Low Power			
Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)		Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
400.00	V	0		400.00	V	0
800.10	H	64.10		800.10	H	71.95
1200.20	H	59.61		1200.20	H	75.36
1600.30	H	71.30		1600.30	H	57.55
2000.30	H	64.95		2000.30	H	63.10
2400.40	V	76.70		2400.40	H	84.05
2800.50	H	99.85		2800.50	H	91.00
3200.60	V	85.60		3200.60	H	77.35
3600.60	V	90.31		3600.60	H	83.26
4000.70	V	90.90		NE		

High Power			Low Power			
Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)		Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
420.00	V	0		420.00	V	0
840.10	H	80.93		840.10	H	71.18
1260.20	H	75.81		1260.20	H	75.16
1680.30	H	60.05		1680.30	H	74.10
2100.30	H	80.91		2100.30	H	91.66
2520.40	H	88.82		2520.40	H	78.07
2940.50	H	98.45		2940.50	H	87.70
3360.60	H	86.59		3360.60	H	81.04
3780.60	H	96.08		4200.70	H	87.25
NE				NE	V	83.85

HIGH POWER

LOW POWER

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)		Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
439.90	V	0		439.90	V	0
879.90	H	75.46		879.90	H	71.61
1319.90	H	94.32		1319.90	H	87.97
1759.90	H	85.54		1759.90	H	78.19
2199.80	H	91.28		2199.80	H	87.73
2639.80	V	86.40		2639.80	H	87.75
3079.80	H	92.90		3079.80	H	85.25
3519.80	H	88.70		3519.80	H	86.65
3959.70	V	94.26		3959.70	H	89.71
4399.70	H	97.01		4399.70	V	89.66



RECEIVER RADIATED SPURIOUS EMISSIONS

Rule Parts. No.: FCC Part 15.109, RSS-GEN 4.10, 6

Requirements: 30-88 MHz 40.0 dBuV/m measured at 3 meters
 88-216 MHz 43.5 dbuV/m
 216-960 MHz 46.0 dbuV/m
 ABOVE 960 MHz 54.0 dbuV/m

TEST DATA:

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBuV	Ant Pol	Coax Loss dB	Correction Factor dB	Field Strength dBuV/m	Margin dB
400.0	354.90	13.2	V	1.15	14.70	29.05	16.95
400.0	354.90	22.8	H	1.15	15.00	38.95	7.05
400.0	709.80	3.6	V	1.72	20.50	25.82	20.18
400.0	709.80	5.4	H	1.72	21.00	28.12	17.88
400.0	1,064.70	12.6	H	2.15	27.42	42.17	11.83
420.0	374.90	10.3	V	1.17	15.20	26.67	19.33
420.0	374.90	18.4	H	1.17	15.30	34.87	11.13
420.0	749.80	4.0	V	1.80	20.60	26.40	19.60
420.0	749.80	5.0	H	1.80	21.59	28.39	17.61
420.0	1,124.70	13.4	H	2.20	27.52	43.12	10.88
439.9	394.80	10.1	V	1.19	15.65	26.94	19.06
439.9	394.80	15.8	H	1.19	15.94	32.93	13.07
439.9	789.60	4.7	H	1.88	21.60	28.18	17.82
439.9	789.60	4.8	V	1.88	20.90	27.58	18.42
439.9	1,184.50	15.3	V	2.25	27.63	45.18	8.82
439.9	1,184.50	16.6	H	2.25	27.63	46.48	7.52



FREQUENCY STABILITY

Rule Parts. No.: FCC Part 2.1055, Part 90.213, RSS-119 5.3, RSS-GEN 7.2.4

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

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

Test Data:

Assigned Frequency (Ref. Frequency) (MHz)		420.075000
Temperature (°C)	Frequency (MHz)	Frequency Stability (PPM)
-30	420.075631	1.50
-20	420.075604	1.44
-10	420.075317	0.75
0	420.075073	0.17
+10	420.075134	0.32
+20	420.074982	-0.04
+30	420.074738	-0.62
+40	420.074738	-0.62
+50	420.074371	-1.50

Assigned Frequency (Ref. Frequency) (MHz)		
% Battery (%)	Frequency (MHz)	Frequency Stability (PPM)
-15%	420.075088	0.21
+15%	420.075069	0.16

TRANSIENT FREQUENCY BEHAVIOR

FCC Part 2.1055(a)(1)

FCC Part 90.214, IC RSS-119 5.8

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

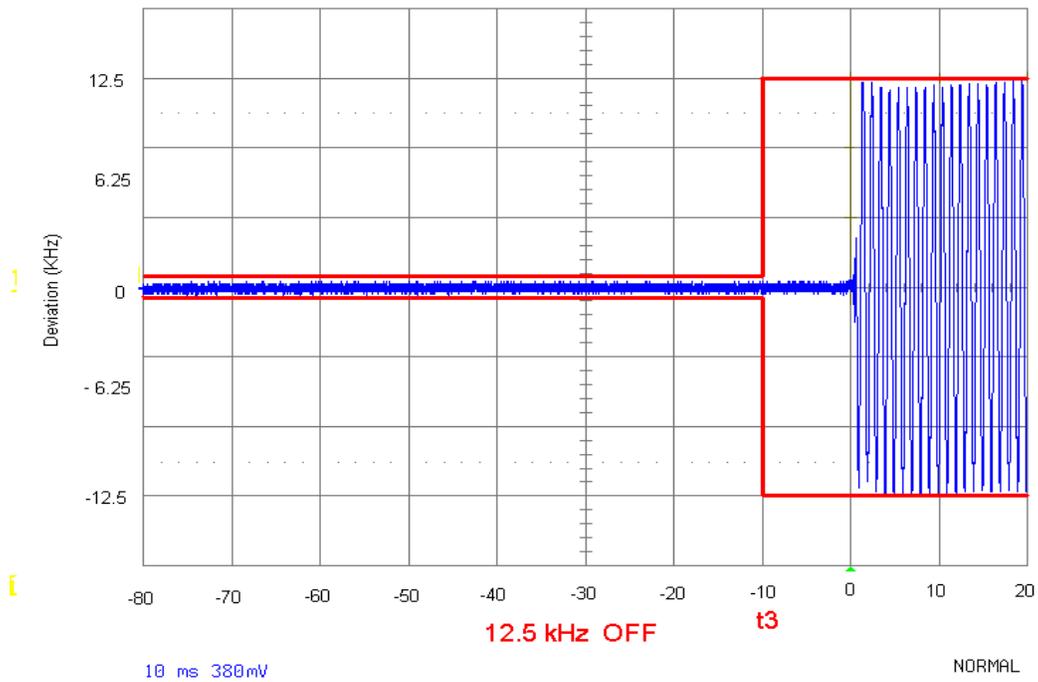
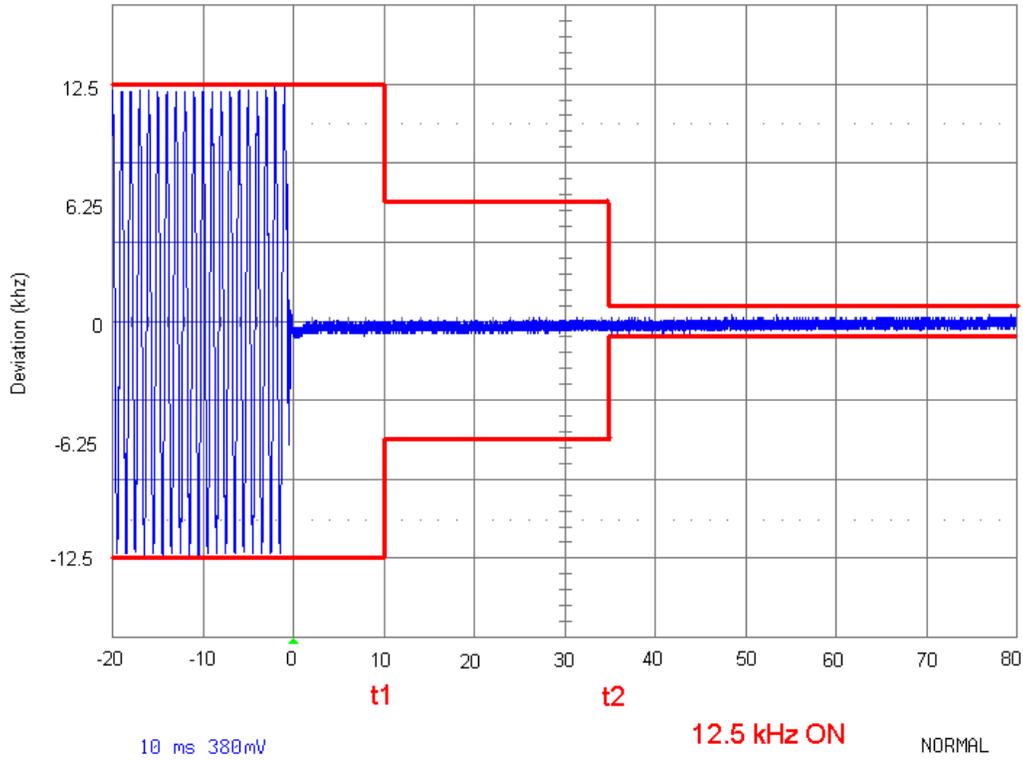
Time Intervals	Maximum frequency difference	150-174 MHz	421-512 MHz
t ₁ ⁴	±25.0 kHz	5.0 ms	10.0 ms
t ₂	±12.5 kHz	20.0 ms	25.0 ms
t ₃ ⁴	±25.0 kHz	5.0 ms	10.0 ms

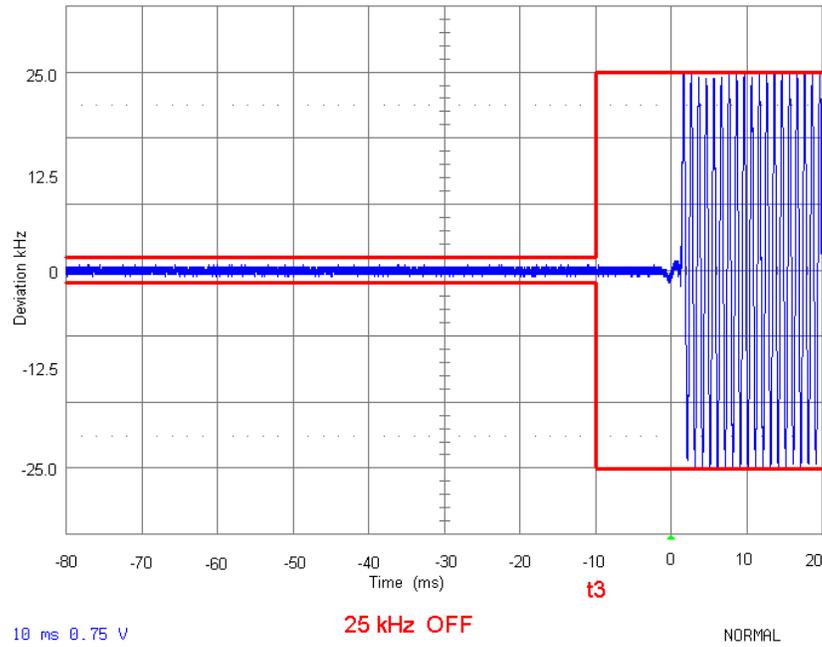
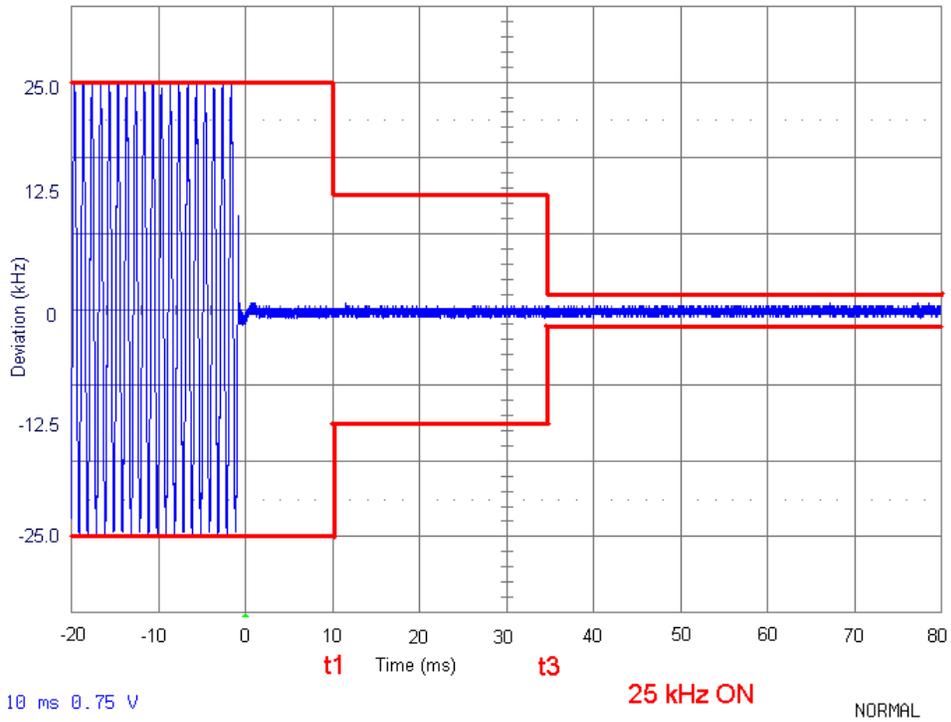
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels

Time Intervals	Maximum frequency difference	150-174 MHz	421-512 MHz
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

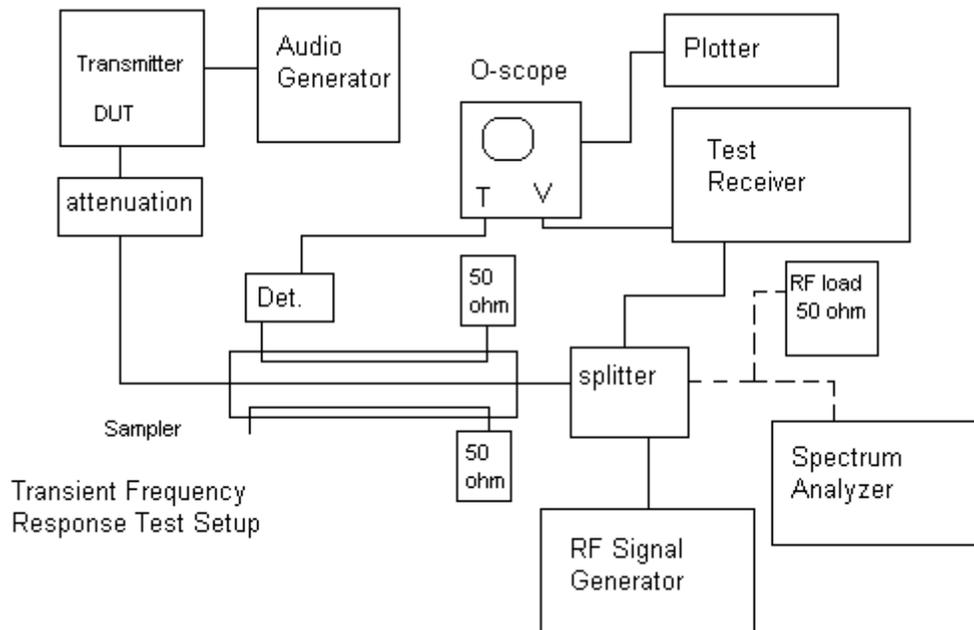
Time Intervals	Maximum frequency difference	150-174 MHz	421-512 MHz
t ₁ ⁴	±6.25 kHz	5.0 ms	10.0 ms
t ₂	±3.125 kHz	20.0 ms	25.0 ms
t ₃ ⁴	±6.25 kHz	5.0 ms	10.0 ms





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. With the levels set as above the transient frequency behavior was observed & recorded.



EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3/10-Meter OATS	TEI	N/A	N/A	Listed 3/20/07	3/19/10
3-Meter OATS	TEI	N/A	N/A	Listed 1/11/06	1/10/09
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	Listed 5/11/07	5/10/10
Biconnical Antenna	Eaton	94455-1	1057	CAL 12/12/05	12/12/07
Biconnical Antenna	Eaton	94455-1	1096	CAL 8/17/06	8/17/08
Tan Tower Quasi-Peak Adapter	HP	85650A	3303AO1690	CAL 12/8/05	12/8/07
Tan Tower RF Preselector	HP	85685A	32211A01400	CAL 12/7/05	12/7/07
Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 12/7/05	12/7/07
LISN	Electro-Metrics	ANS-25/2	2604	CAL 8/27/06	8/27/08
Log-Periodic Antenna	Eaton	96005	1243	CAL 12/14/05	12/14/07