849 NW STATE ROAD 45
NEWBERRY, FL 32669 USA
PH: 888.472.2424 OR 352.472.5500
FAX: 352.472.2030
EMAIL: INFO@TIMCOENGR.COM
HTTP://WWW.TIMCOENGR.COM

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

APPLICANT	NEPTUNE TECHNOLOGY GROUP INC.
	1600 ALABAMA HIGHWAY 229 TALLASSEE, ALABAMA 36078
FCC ID	P2S-SD250NTG
IC CERTIFICATION	4171B-SD250NTG
MODEL NUMBER	SD250NTG
PRODUCT DESCRIPTION	LMR DATA RADIO
DATE SAMPLE RECEIVED	5/4/2011
DATE TESTED	5/24/2011
TESTED BY	Nam Nguyen
APPROVED BY	Mario de Aranzeta
TIMCO REPORT NO.	913AUT11TestReport.doc
TEST RESULTS	☒ PASS ☐ FAIL

TABL[illegible]CONTENTS

ACCREDITED
Certificate # 0955-01

TABLE OF CONTENTS

GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

The test results relate only to the items tested.

Summary

The device under test does:
☒ fulfill the general approval requirements as identified in this test report
☐ not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025: 2005 requirements.

ACCREDITED

Testing Certificate # 0955-01

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, Fl 32669

Authorized Signatory Name:

Mario de Aranzeta C.E.T.
Compliance Engineer/ Lab. Supervisor

Date: September 2, 2011

GENERAL INFORMATION
DUT Specification

DUT Description	LMR DATA RADIO
FCC ID	P2S-SD250NTG
IC Certification	4171B-SD250NTG
Model Number	SD250NTG
Serial Number	N/A
Operating Frequency	(450.00 – 470.00) MHz
Test Frequencies	450.00, 460.00, and 470.00 MHz
Type of Emission	11K2GXW
Modulation	GMSK
DUT Power Source	☐ 110–120Vac/50– 60Hz
	☒ DC Power 12V
	☐ Battery Operated Exclusively
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☐ Fixed
	☒ Mobile
	☐ Portable
Test Conditions	Temperature: 26ºC Relative humidity: 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/TIA 603-C: 2004 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.

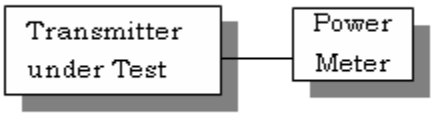
RF POWER OUTPUT

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 – 4.78 Watts
LOW - 0.50 Watts

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

FOR LOW POWER SETTING INPUT POWER: (12.0V)(1.10A) = 13.20 Watts
FOR HIGH POWER SETTING INPUT POWER: (12.0V)(1.40A) = 16.80 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
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, F1D

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

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

NA – RF DATA MODULE DEVICE

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

NA – RF DATA MODULE DEVICE

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:

NA – RF DATA MODULE DEVICE

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 + 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:

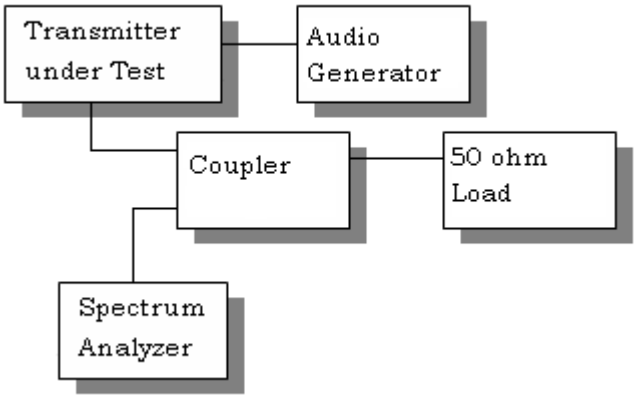
(1) On any frequency from the center of the authorized bandwidth f0 to 3.0 kHz removed from f0: Zero dB.
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(fd – 3.0 kHz) or 55 + 10 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



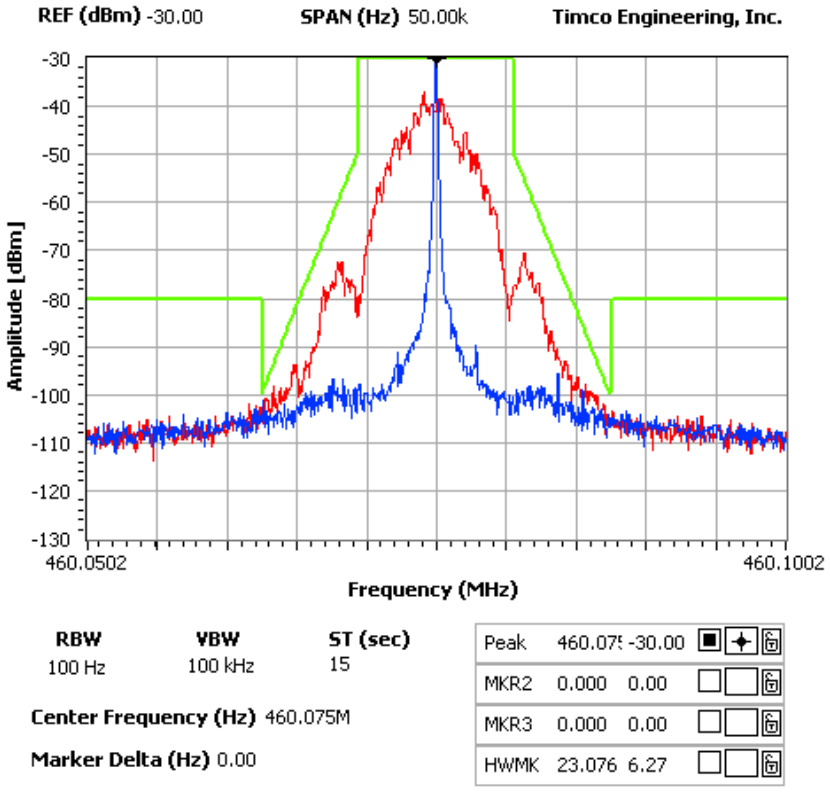
Test Data: See the plots below

12.5kHz – DIGITAL

NOTES:

MIDLAND RADIO CORPORATION - MODEL NUMBER: SD250NTG
OCCUPIED BANDWIDTH PLOT

FCC 90.210 Mask D



SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

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

Requirements: **1**2.5 kHz Channel Spacing = 57dBc (for 5 Watts)
12.5 kHz Channel Spacing = 47dBc (for 0.5 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 ANSI/TIA 603-C:2004.

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

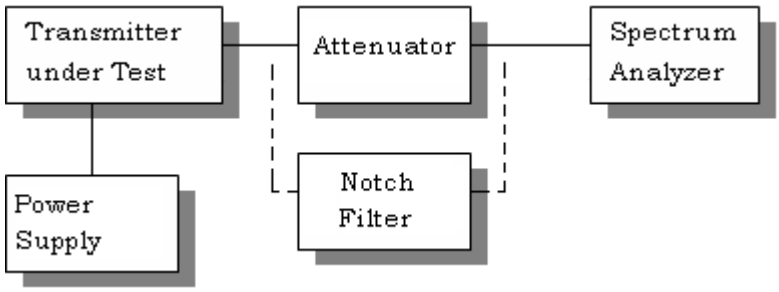
Test Data:

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
450.00	900.00	88.5		450.00	900.00	75.5
	1350.00	75.3			1350.00	76.8
	1800.00	93.5			1800.00	79.6
	2250.00	89.6			2250.00	86.2
	2700.00	92.7			2700.00	88.2
	3150.00	92.7			3150.00	88.9
	3600.00	NF			3600.00	NF
	4050.00	NF			4050.00	NF
	4500.00	NF			4500.00	NF

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
460.00	920.00	95.7		460.00	920.00	80.2
	1380.00	72			1380.00	74.6
	1840.00	90.8			1840.00	78.6
	2300.00	87.9			2300.00	88.6
	2760.00	90.3			2760.00	89.2
	3220.00	NF			3220.00	NF
	3680.00	NF			3680.00	NF
	4140.00	NF			4140.00	NF
	4600.00	NF			4600.00	NF

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
470.00	940.00	93.8		470.00	940.00	83.7
	1410.00	79.9			1410.00	76.8
	1880.00	87.2			1880.00	78.2
	2350.00	90.4			2350.00	82.5
	2820.00	86.2			2820.00	82.7
	3290.00	NF			3290.00	NF
	3760.00	NF			3760.00	NF
	4230.00	NF			4230.00	NF
	4700.00	NF			4700.00	NF

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.

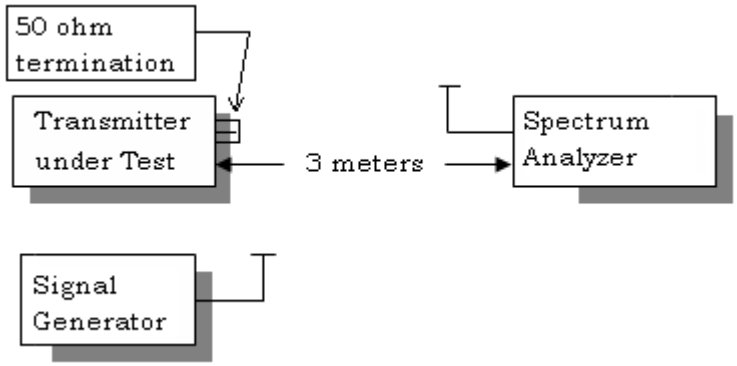
FIELD STRENGTH OF SPURIOUS EMISSIONS

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

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
450.00	0	0
900.00	V	88.44
1350.00	H	94.16
1800.00	H	96.30
2250.00	H/V	NF
2700.00	H/V	NF
3150.00	H/V	NF
3600.00	H/V	NF
4050.00	H/V	NF
4500.00	H/V	NF

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
450.00	0	0
900.00	V	76.65
1350.00	V	84.67
1800.00	V	81.71
2250.00	H/V	NF
2700.00	H/V	NF
3150.00	H/V	NF
3600.00	H/V	NF
4050.00	H/V	NF
4500.00	H/V	NF

High Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
460.00	0	0
920.00	V	91.18
1380.00	H	96.75
1840.00	H	94.78
2300.00	V	95.68
2760.00	H	95.89
3220.00	H/V	NF
3680.00	H/V	NF
4140.00	H/V	NF
4600.00	H/V	NF

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
460.00	0	0
920.00	V	82.39
1380.00	H	87.46
1840.00	H	85.89
2300.00	H	85.99
2760.00	H	85.70
3220.00	H/V	NF
3680.00	H/V	NF
4140.00	H/V	NF
4600.00	H/V	NF

HIGH POWER

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
470.00	0	0
940.00	V	99.22
1410.00	H	90.13
1880.00	H	95.45
2350.00	H	96.65
2820.00	H	92.85
3290.00	H/V	NF
3760.00	H/V	NF
4230.00	H/V	NF
4700.00	H/V	NF

LOW POWER

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
470.00	0	0
940.00	V	89.13
1410.00	H	80.44
1880.00	H	86.56
2350.00	H	86.26
2820.00	H	84.06
3290.00	H/V	NF
3760.00	H/V	NF
4230.00	H/V	NF
4700.00	H/V	NF

RECEIVER RADIATED SPURIOUS EMISSIONS

Receiver data as shown below is not part of the FCC certification process. Per FCC Rules Part 15.101(b), the receiver is subject to verification.

The data shown below is part of the IC Certification process only.

Rule Parts. No.: RSS-GEN 4.10, 6

Requirements:

Frequency MHz	Limits
30 – 88	40.0 dBµV/m measured @ 3 meters
88 – 216	43.5 dBµV/m measured @ 3 meters
216 – 960	46.0 dBµV/m measured @ 3 meters
Above 960	54.0 dBµV/m measured @ 3 meters

TEST DATA:

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Margin dB
450.0	232.00	21.8	H	0.96	11.72	34.48	11.52
450.0	249.60	17.4	V	1.00	12.87	31.27	14.73
450.0	253.60	25.3	H	1.01	13.12	39.43	6.57
450.0	288.00	21.4	V	1.08	15.16	37.64	8.36
450.0	464.80	17.0	H	1.26	17.65	35.91	10.09
450.0	465.60	17.7	V	1.27	17.66	36.63	9.37
450.0	596.00	13.2	V	1.59	19.80	34.59	11.41
450.0	596.80	15.4	H	1.59	19.80	36.79	9.21
450.0	1,201.00	17.0	H	2.26	27.76	47.02	6.98
450.0	1,201.00	18.3	V	2.26	27.76	48.32	5.68
460.0	239.20	24.3	H	0.98	12.15	37.43	8.57
460.0	251.20	23.7	V	1.00	12.97	37.67	8.33
460.0	273.60	25.5	H	1.05	14.55	41.10	4.90
460.0	348.00	23.1	V	1.15	15.00	39.25	6.75
460.0	464.00	18.0	V	1.26	17.64	36.90	9.10
460.0	464.00	22.1	H	1.26	17.64	41.00	5.00
460.0	595.20	15.2	V	1.59	19.80	36.59	9.41
460.0	731.20	12.9	H	1.76	21.72	36.38	9.62
460.0	1,202.00	15.8	H	2.26	27.76	45.82	8.18
460.0	1,202.00	18.7	V	2.26	27.76	48.72	5.28
470.0	239.20	25.1	H	0.98	12.15	38.23	7.77
470.0	260.00	27.9	H	1.02	13.50	42.42	3.58
470.0	276.00	21.9	V	1.05	14.72	37.67	8.33
470.0	380.00	22.5	V	1.18	15.60	39.28	6.72
470.0	464.00	15.6	H	1.26	17.64	34.50	11.50
470.0	465.60	16.8	V	1.27	17.66	35.73	10.27

TEST DATA CONTINUE:

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Margin dB
470.0	731.20	12.8	H	1.76	21.72	36.28	9.72
470.0	732.80	10.5	V	1.77	21.76	34.03	11.97
470.0	1,200.00	16.5	H	2.26	27.76	46.52	7.48
470.0	1,200.00	18.5	V	2.26	27.76	48.52	5.48

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)		460.075118
Temperature (ºC)	**Frequency (MHz)**	**Frequency Stability (PPM)**
-30	460.075513	0.86
-20	460.075253	0.29
-10	460.075243	0.27
0	460.075256	0.30
+10	460.075253	0.29
+20	460.075232	0.25
+30	460.075261	0.31
+40	460.075271	0.33
+50	460.075308	0.41

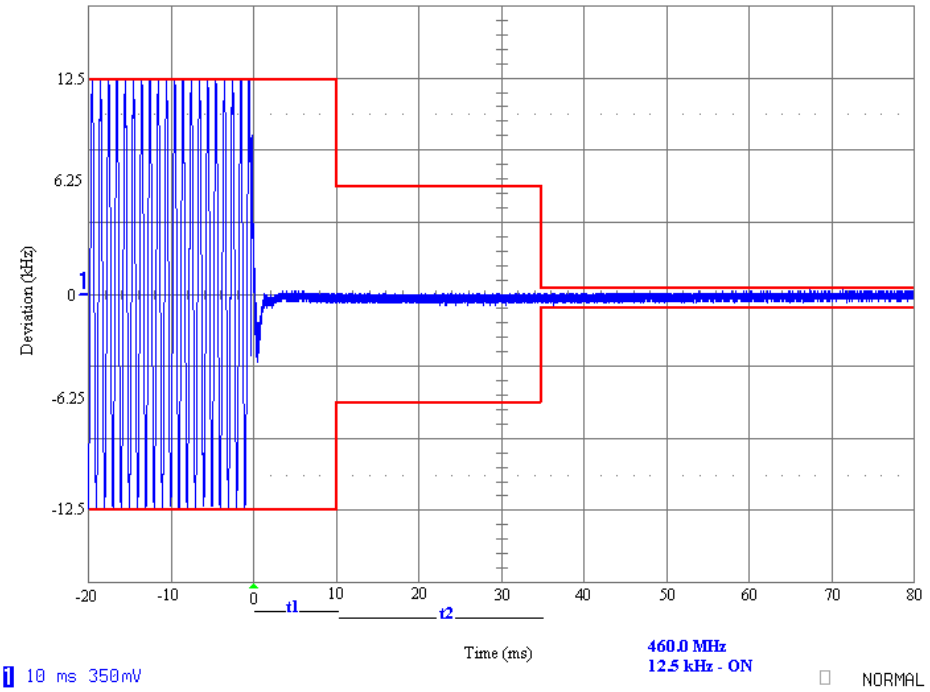
Assigned Frequency (Ref. Frequency) (MHz)		
% Battery (%)	**Frequency (MHz)**	**Frequency Stability (PPM)**
-15%	460.075122	0.01
	460.075118	0.00
+15%	460.075123	0.01

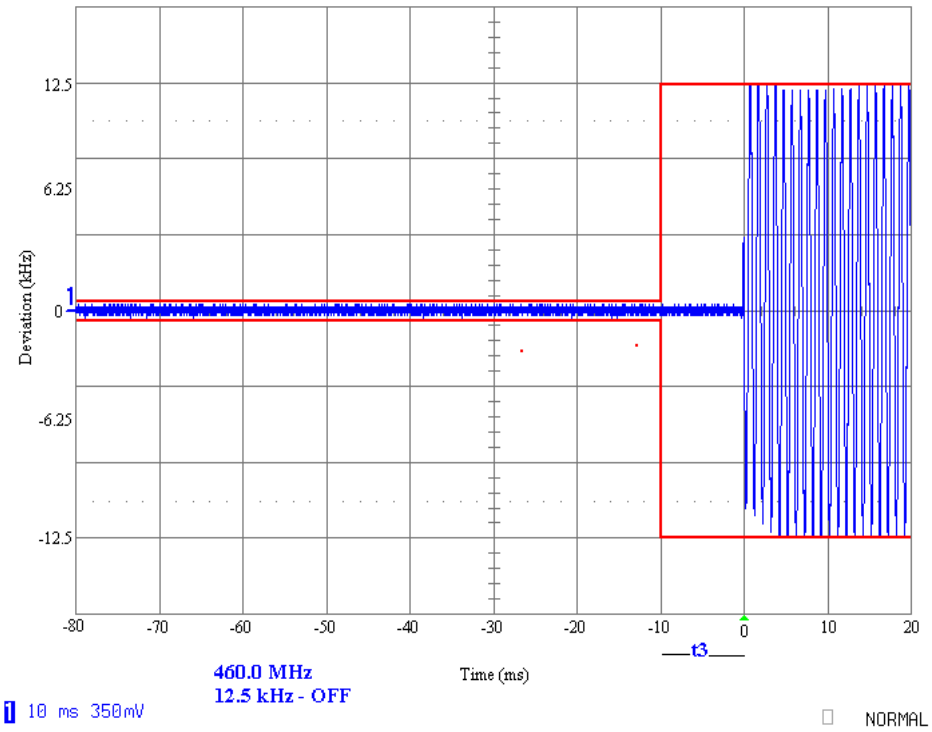
TRANSIENT FREQUENCY BEHAVIOR

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			
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)
-20
-10
0
10
20
30
40
50
60
70
80
t1
t2
Time (ms)
460.0 MHz
12.5 kHz - ON
10 ms 350mV
NORMAL

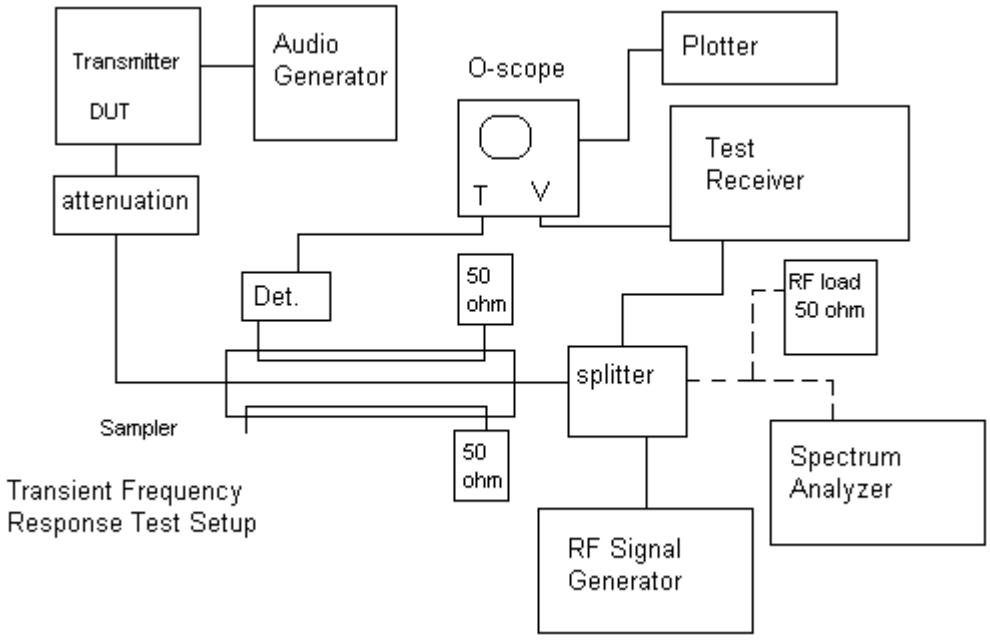

12.5
6.25
0
-6.25
-12.5
Deviation (kHz)
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
t3
460.0 MHz
12.5 kHz - OFF
Time (ms)
10 ms 350mV
NORMAL

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, and 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.



Transient Frequency Response Test Setup

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	Listed 3/10/10	3/10/12
AC Voltmeter	HP	400FL	2213A14499	CAL 3/23/09	3/23/12
Antenna: Dipole Kit	Electro-Metrics	TDA-30/1-4	153	CHAR 7/10/09	7/10/11
Frequency Counter	HP	5385A	3242A07460	CAL 5/26/09	5/26/12
Hygro-Thermometer	Extech	445703	0602	CAL 1/30/09	1/30/12
Modulation Analyzer	HP	8901A	3435A06868	CAL 5/26/09	5/26/12
Digital Multimeter	Fluke	FLUKE-77-3	79510405	CAL 5/18/09	5/18/12
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 11/21/09	11/21/11
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 11/22/09	11/22/11
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 11/21/09	11/21/11
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 11/24/09	11/24/11
Temperature Chamber	Tenney Engineering	TTRC	11717-7	CHAR 4/25/10	4/25/12