



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](http://WWW.TIMCOENGR.COM)

FCC

UHF PORTABLE PART 90

TEST REPORT

APPLICANT	VERTEX STANDARD USA, INC.
	8000 WEST SUNRISE BLVD. FT. LAUDERDALE FL 33322 USA
FCC ID	AXI11284720
MODEL NUMBER	VX-261-G7-5
PRODUCT DESCRIPTION	UHF PORTABLE LAND MOBILE RADIO
STANDARD APPLIED	CFR 47 Part 90
DATE SAMPLE RECEIVED	12/2/2014
DATE TESTED	12/9/2014
REPORT ISSUE DATE	12/17/2014
TESTED BY	Sid Sanders
APPROVED BY	Cory Leverett
TIMCO REPORT NO.	2216AUT14TestReport.docx
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.

TABLE OF CONTENTS

GENERAL REMARKS	3
GENERAL INFORMATION.....	4
TEST REPORT SUMMARY.....	5
TEST PROCEDURE	6
RF POWER OUTPUT	7
MODULATION CHARACTERISTICS	8
VOICE MODULATED COMMUNICATION EQUIPMENT.....	10
OCCUPIED BANDWIDTH	13
OCCUPIED BANDWIDTH PLOTS: ANALOG	15
Part 90.210(D) Emission Mask D - 12.5 KHz Channel Bandwidth - ANALOG	15
Part 90.210(D) Emission Mask D - 25.0 kHz Channel Bandwidth - ANALOG	16
SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)	17
FIELD STRENGTH OF SPURIOUS EMISSIONS.....	19
FREQUENCY STABILITY.....	20
TRANSIENT FREQUENCY BEHAVIOR.....	21
TRANSIENT FREQUENCY BEHAVIOR.....	22
TRANSIENT FREQUENCY BEHAVIOR.....	Error! Bookmark not defined.
EQUIPMENT LIST.....	26

GENERAL REMARKS

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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.

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:



A handwritten signature in blue ink is overlaid on a circular blue stamp. The stamp contains the text 'TIMCO ENGINEERING INC.' around the perimeter and 'FL' in the center.

Engineering Project Manager

Date: 12/11/2014

Table of Contents

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

GENERAL INFORMATION

EUT Specification

EUT Description	UHF PORTABLE LAND MOBILE RADIO
FCC ID	AXI11284720
Model Number	VX-261-G7-5
Operating Frequency	450-512MHz
Test Frequencies	450.3, 469.9, 512.0MHz
No. of Channels	
Type of Emission	11K0F3E, 16K0F3E
Modulation	FM
EUT Power Source	<input type="checkbox"/> 110–120Vac/50– 60Hz
	<input type="checkbox"/> DC Power 12V
	<input checked="" 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 type="checkbox"/> Fixed
	<input type="checkbox"/> Mobile
	<input checked="" type="checkbox"/> Portable
Test Conditions	The temperature was 24- 26°C with a relative humidity of 50 - 65%.
Revision History to the EUT	None
Test Exercise	The EUT was placed in continuous transmit mode.
Applicable Standards	ANSI/TIA 603-C:2004, FCC CFR 47 Part 90
Test Facility	Timco Engineering Inc. 849 NW State Road 45 Newberry, FL 32669 USA.

Table of Contents

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

TEST REPORT SUMMARY

Rule Part No.	Scope of Work	Status Pass/Fail/NA
<u>Part 2.1033(c)(8),</u> <u>Part 2.1046(a), Part 90</u>	RF Power Output	PASS
<u>Part 2.1033(c) (4)</u> <u>Part 2.1047(a)(6)</u>	Modulation Characteristics	PASS
<u>2.1049(c),</u> <u>90.210(b), 90.210 (c)</u> <u>90.210(d), 90.210(e)</u>	Emission Mask and Occupied Bandwidths	PASS
<u>2.1051(a)</u>	Antenna Conducted Emissions	PASS
<u>2.1053, Part 90</u>	Field Strength Spurious Emissions	PASS
<u>Part 2.1055, Part 90.213</u>	Frequency Stability	PASS
<u>Part 90.214</u>	Transient Frequency Behaviour	PASS

[Table of Contents](#)

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

TEST PROCEDURE

Power Line Conducted Interference: The procedure used was ANSI/TIA 603-D:2010, using a 50uH LISN. Both lines were observed with the EUT 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-D:2010, using an Rohde & Schwarz – EMI test receiver. 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 microvolt at the output of the antenna.

Table of Contents

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

RF POWER OUTPUT

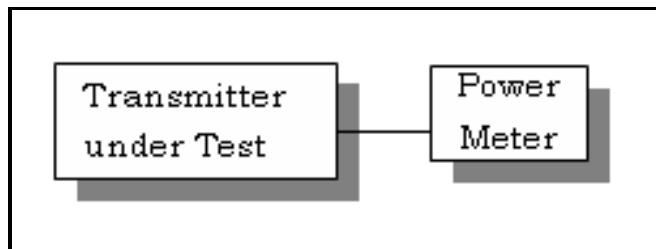
Rule Part No.: Part 2.1046(a), Part 90

Test Requirements: Manufacturer's Specification

Method of Measurement: RF power is measured by using a 50-ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage (if battery operated), or a properly adjusted power supply (if not battery operated), and the transmitter properly adjusted the RF output measures:

For the device with a fixed or integral antenna, the RF power is measured as ERP. The substitution method was used. The RF output measures:

Test Setup Diagram:



Test Data: RF power of the EUT can be set at 5W to 25W.

OUTPUT POWER:

Tuned Frequency MHz	High Power dBm	High Power Watts	Low Power dBm	Low Power Watts
450.3	36.3	4.26	29.2	0.83
469.9	37.0	5.01	29.7	0.93
512.0	36.5	4.47	29.2	0.83

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

FOR LOW POWER SETTING INPUT POWER: $(13.6V)(0.82A) = 11.16$ Watts

FOR HIGH POWER SETTING INPUT POWER: $(13.6V)(1.7A) = 23.12$ Watts

[Table of Contents](#)

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

MODULATION CHARACTERISTICS

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

Test Requirements:

Method of Measurement:

Part 2.1033(c)

Part 90.209

Part 90.207

Part 2.1033(c) (4) Type of Emission: 11K0F3E

$$Bn = 2M + 2DK$$

$$M = 3000$$

$$D = 2500$$

$$K=1$$

$$Bn = 2(3000) + 2(2500) = 11.0k$$

Part 2.1033(c) (4) Type of Emission: 16K0F3E

$$Bn = 2M + 2DK$$

$$M = 3000$$

$$D = 5000$$

$$K = 1$$

[Table of Contents](#)

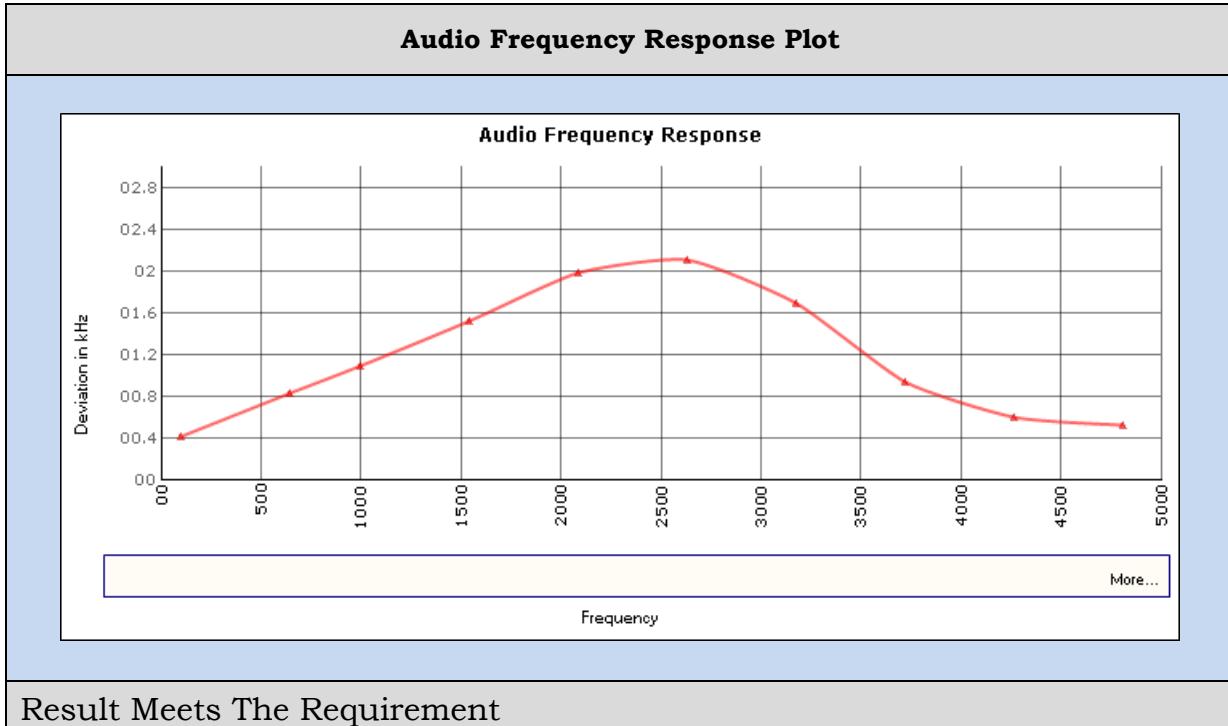
Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

Audio frequency response

The audio frequency response was measured in accordance with ANSI/TIA 603-D: 2010. 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.



VOICE MODULATED COMMUNICATION EQUIPMENT

Part 2.1047(a): 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.

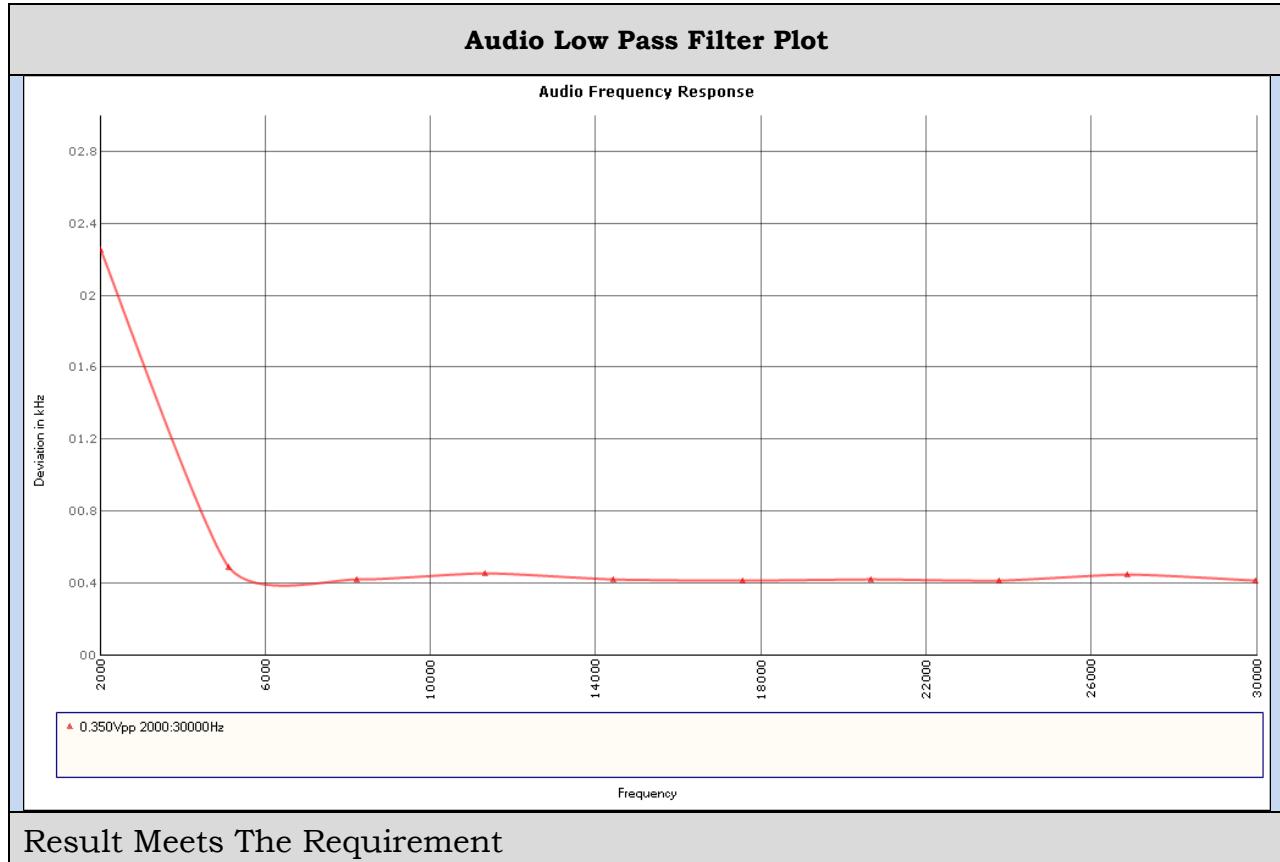


Table of Contents

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

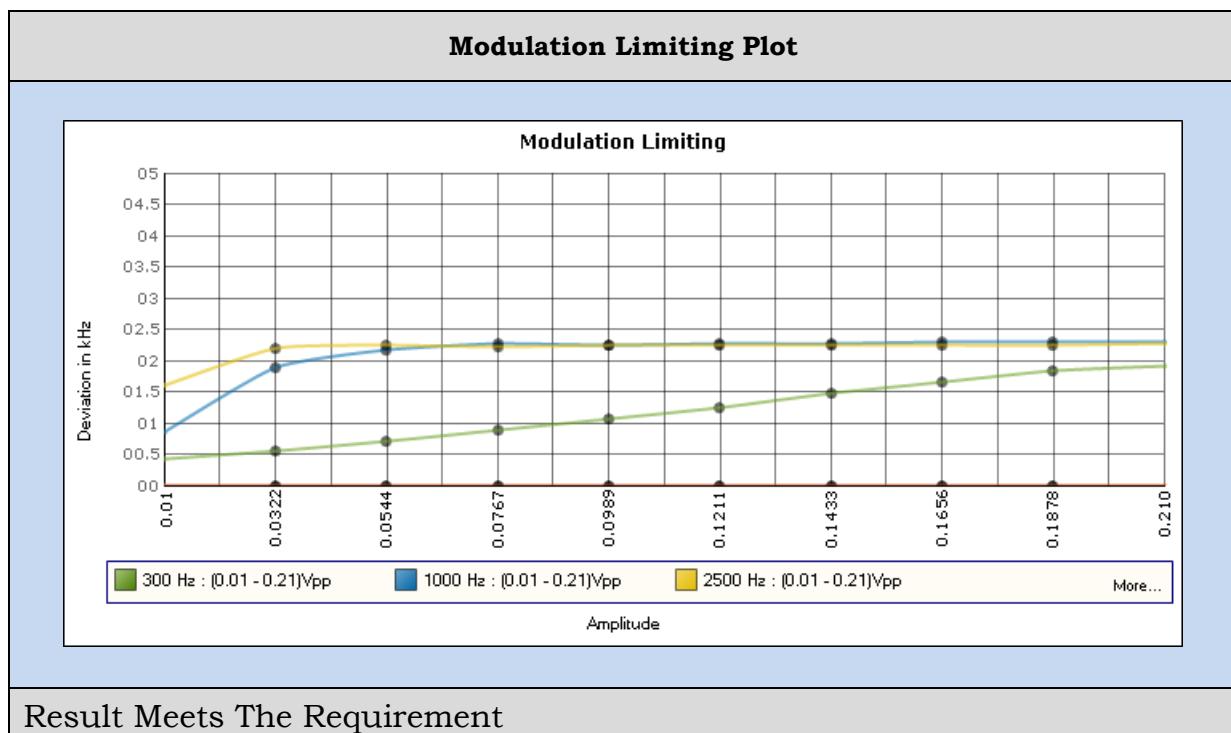
AUDIO INPUT VERSUS MODULATION 12.5kHz

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-D: 2010. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and 3000 Hz.

Test data: 12.5kHz



[Table of Contents](#)

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

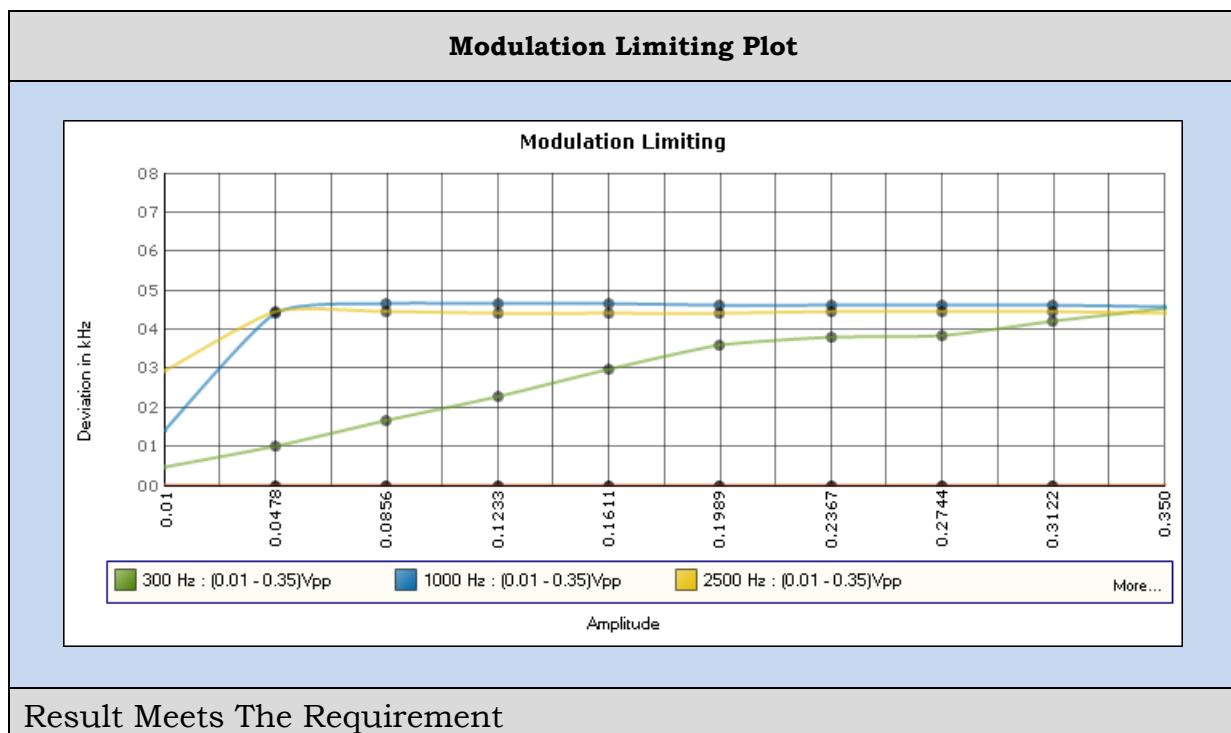
AUDIO INPUT VERSUS MODULATION 25kHz

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-D: 2010. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and 3000 Hz.

Test data: 25kHz



[Table of Contents](#)

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

OCCUPIED BANDWIDTH

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 $43 + 10\log(P)$ dB.

Part 90.210(c) 25 kHz 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 unmodulated 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 than 10 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 $29 \log(fd/11)$ 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 $7.27 \log(fd - 2.88)$ 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 $50 + 10\log(P)$ dB or 70 dB, whichever is the lesser attenuation.

[Table of Contents](#)

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

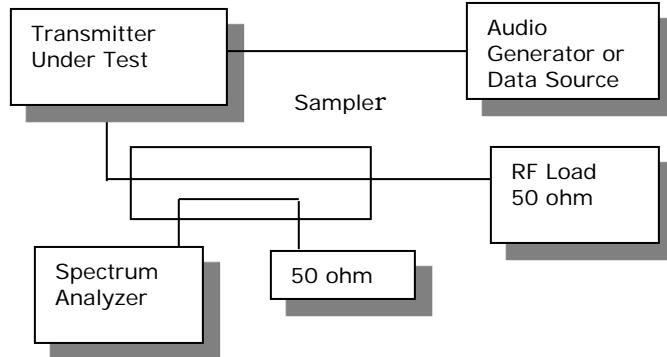
Part 90.210(e) Emission Mask E – 6.25 kHz channel BW equipment.

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 4.6 kHz: At least $55 + 10 \log(P)$ dB or 65 dB, whichever is the lesser attenuation.

Method of Measurement: ANSI/TIA 603-D: 2010

Test Setup Diagram:



Test Data: See the plots below

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

OCCUPIED BANDWIDTH PLOTS: ANALOG

Part 90.210(D) Emission Mask D - 12.5 KHz Channel Bandwidth - ANALOG

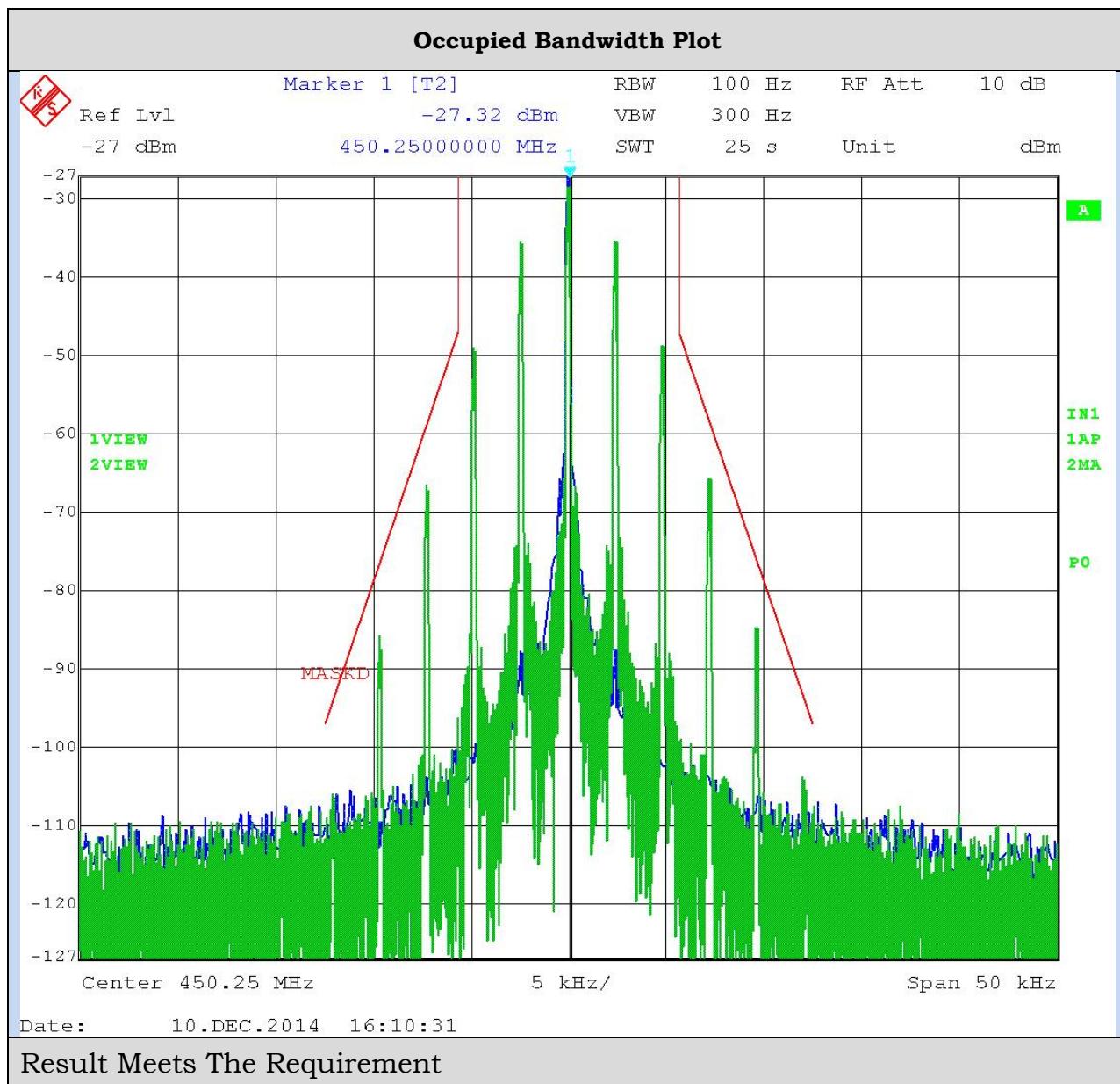
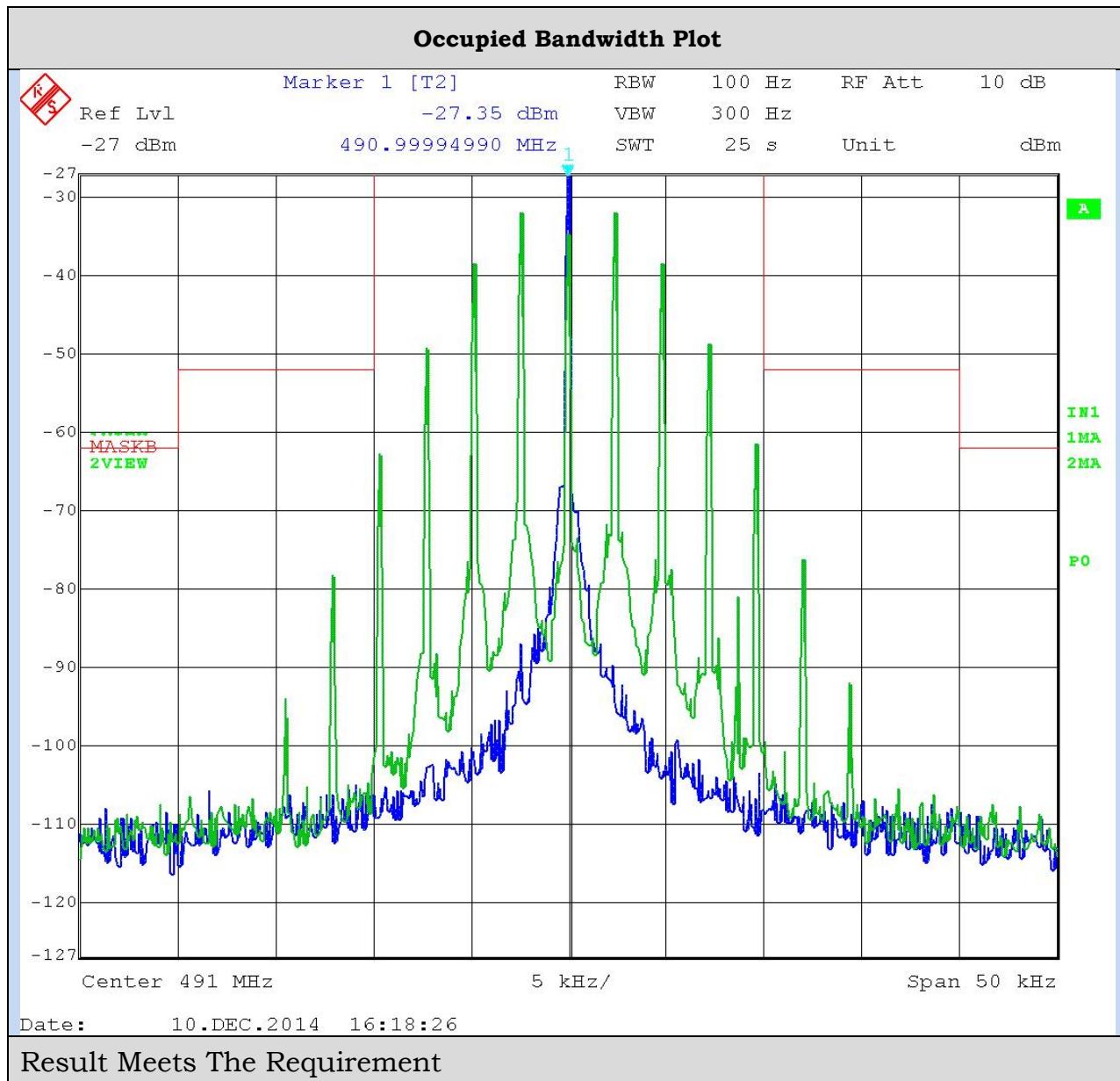


Table of Contents

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

Part 90.210(D) Emission Mask D - 25.0 kHz Channel Bandwidth - ANALOG

Table of Contents

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

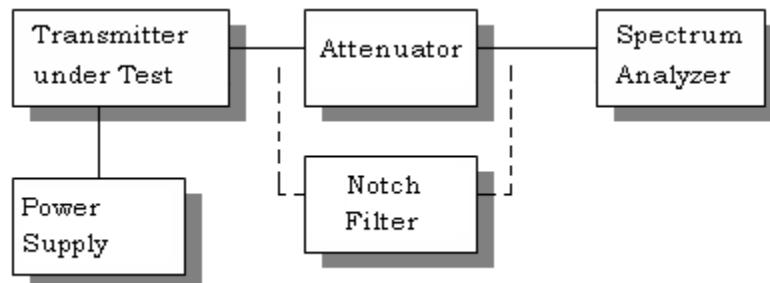
Rule Part No.: Part 2.1051(a)

Requirements:

12.5 kHz Channel Spacing = $50 + 10 \log (5.0) = 57.0 \text{ dBc}$ (high power)
12.5 kHz Channel Spacing = $50 + 10 \log (1.0) = 50.0 \text{ dBc}$ (low power)

Method of Measurement: The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from the lowest frequency generated to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard ANSI/TIA 603-D: 2010.

Method of Measuring Conducted Spurious Emissions



Test Data: High Power Low end of Band @ 450.3MHz

	dBm	Watts	MARGIN
Power Output	37	5	
LIMIT		60	
Frequency	dBc		
450.3	0	0	
900.6	66.8	6.8	
1350.9	66.4	6.4	
1801.2	66.3	6.3	
2251.5	63.8	3.8	
2701.8	63.7	3.7	
3152.1	64	4	
3602.4	63.5	3.5	
4052.7	64.5	4.5	
4503	64.7	4.7	

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: High Power Middle of Band @ 469.9MHz

	dBm	Watts	Margin
Power Output	36	5	
LIMIT		60	
Frequency		dBc	
469.9	0		
939.8	73.4	13.4	
1409.7	76	16	
1879.6	71.1	11.1	
2349.5	68.4	8.4	
2819.4	69.6	9.6	
3289.3	75.3	15.3	
3759.2	77.2	17.2	
4229.1	75.8	15.8	
4699	77.3	17.3	

Test Data: High Power High End of Band @ 512MHz

	dBm	Watts	Margin
Power Output	36	5	
LIMIT		60	
Frequency		dBc	
512	0		
1024	66.2	6.2	
1536	72.4	12.4	
2048	74.8	14.8	
2560	78.1	18.1	
3072	78.2	18.2	
3584	76.3	16.3	
4096	77.7	17.7	
4608	78.5	18.5	
5120	79.9	19.9	

RESULTS: MEETS REQUIREMENTS

[Table of Contents](#)

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

FIELD STRENGTH OF SPURIOUS EMISSIONS

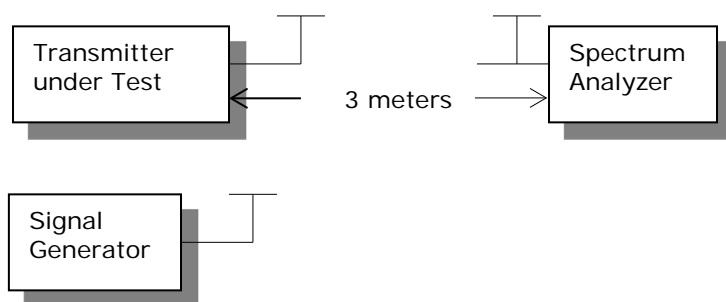
Rule Parts. No.: Part 2.1053

Requirements:

$$12.5\text{kHz Channel Spacing} = 50 + 10\log(\text{OP}) = \text{dBc}$$

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-D: 2010 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:

Emission Frequency (MHz)	Power Mode	ERP Power Output (dBm)	ERP Power Output (Watts)	FCC Requirement dB	Bandwidth - BW - kHz
512.00	Hi	37.00	5.01	57.00	12.50

Emission Frequency (MHz)	Ant. Polarity	Below Carrier (dBc)	Margin
1,024.00	H	81.31	24.31
1,536.00	H	77.18	20.18
2,048.00	H	73.73	16.73
2,560.00	H	77.90	20.90
3,072.00	H	73.75	16.75
3,584.00	H	72.65	15.65
4,096.00	V	69.01	12.01
4,608.00	H	78.20	21.20
5,120.00	H	65.33	8.33

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 90.213

Requirements: Temperature range requirements: -30 to +50° C.
Voltage Variation +, -15%
±2.5 PPM

Method of Measurements: ANSI/TIA 603-D: 2010.

Test Data:

Reference Frequency		469.749900	MHz			
Battery (%)		Frequency)		Frequency Stability (ppm)		
	-15	469.7499	MHz		0.01	
	0	469.7499	MHz		-0.01	
	15	469.7499	MHz		-0.04	
Temperature(C)		Frequency)		Frequency Stability (ppm)		
	-30	469.7496	MHz		-0.57	
	-20	469.7497	MHz		-0.43	
	-10	469.7497	MHz		-0.28	
	0	469.7498	MHz		-0.27	
	10	469.7498	MHz		-0.12	
	20	469.7499	MHz		0.04	
	30	469.7499	MHz		0.12	
	40	469.75	MHz		0.18	
	50	469.75	MHz		0.22	

Results: Meet Requirements.

Table of Contents

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V:\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

TRANSIENT FREQUENCY BEHAVIOR

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

[Table of Contents](#)

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx



TRANSIENT FREQUENCY BEHAVIOR

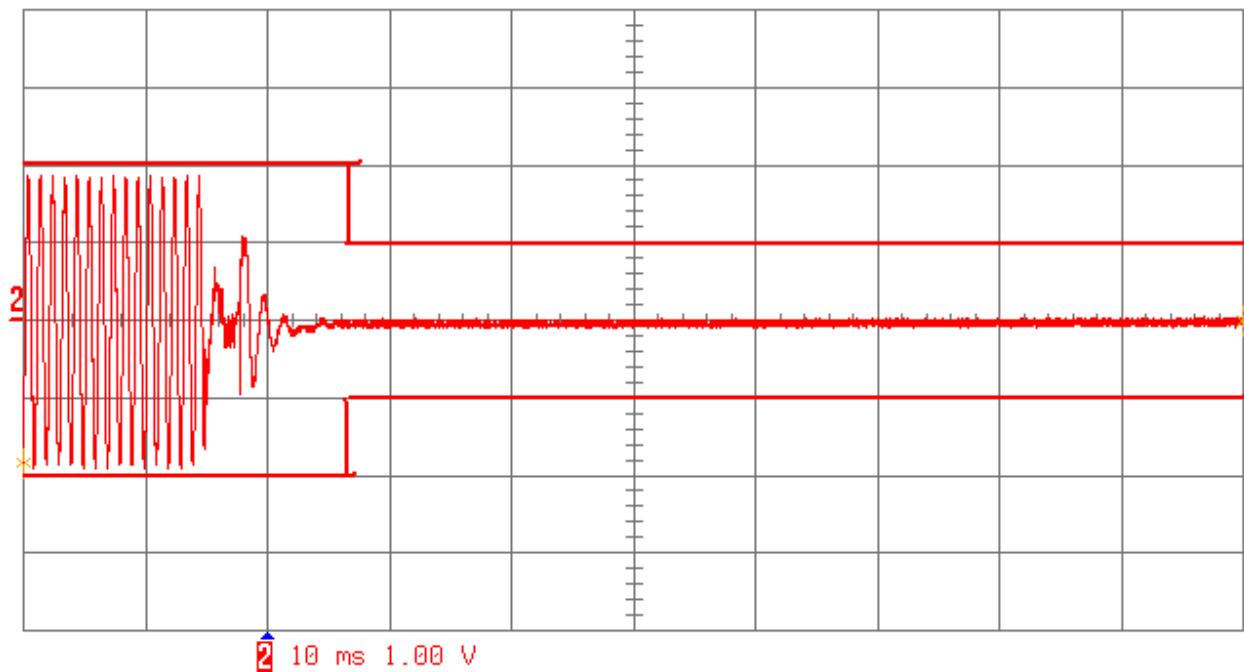
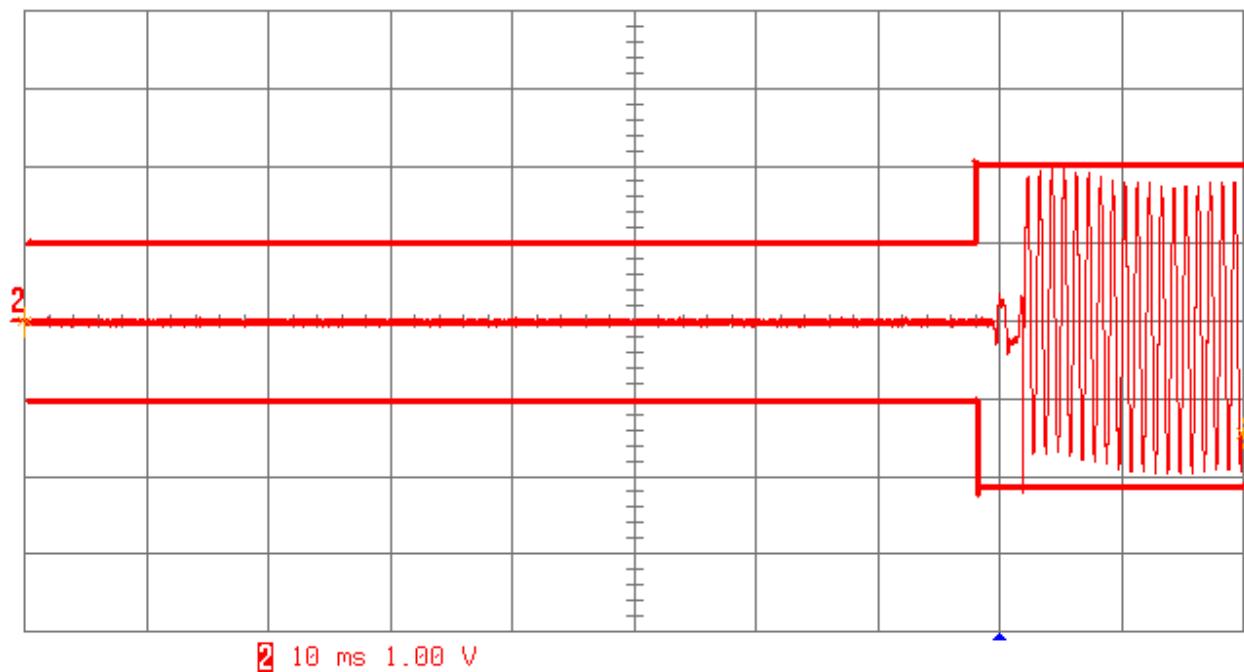
Transient Frequency Behavior Test Data:

12.5 KHz Channel Bandwidth

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

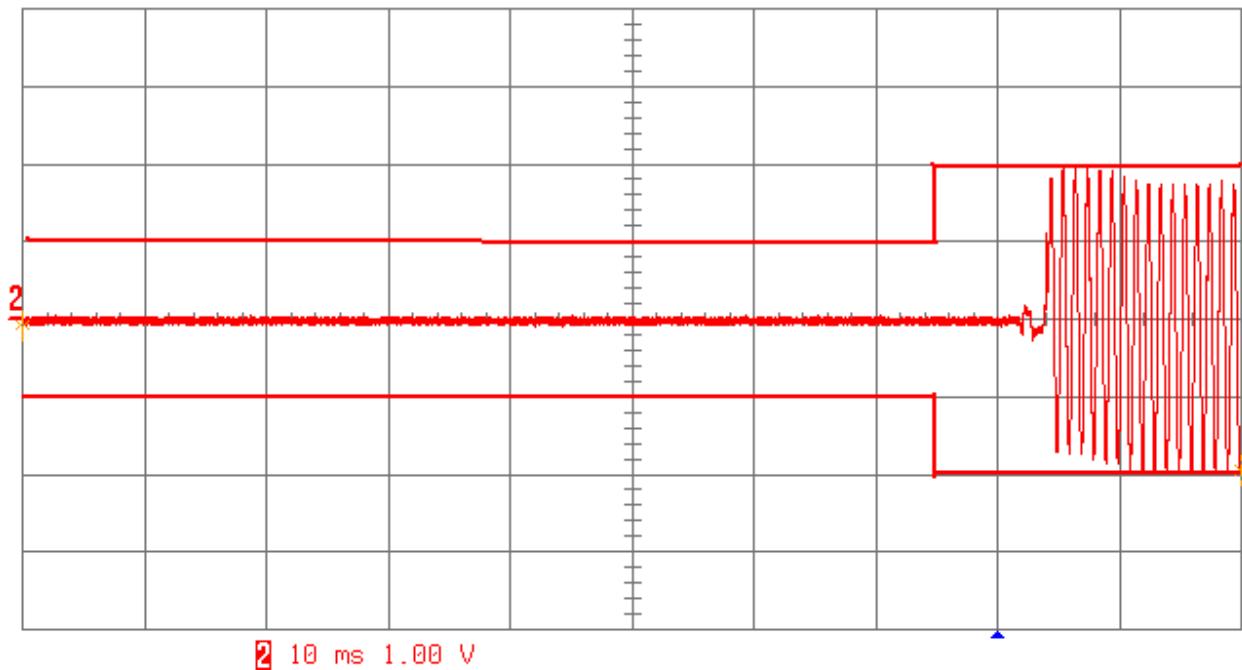
12.5 KHz Turn On

12.5 KHz Turn OFF

Transient Frequency Behavior Test Data:
25 KHz Channel Bandwidth

Applicant: VERTEX STANDARD USA, INC.

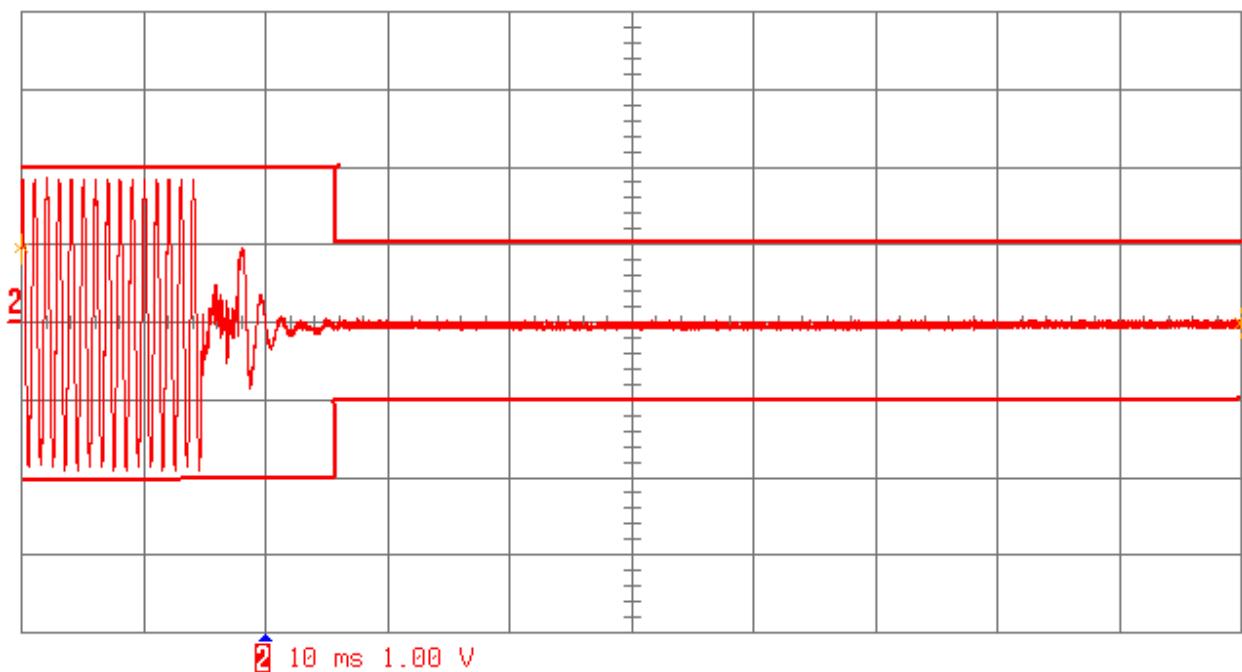
FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

25 KHz Turn Off



25 KHz Turn on



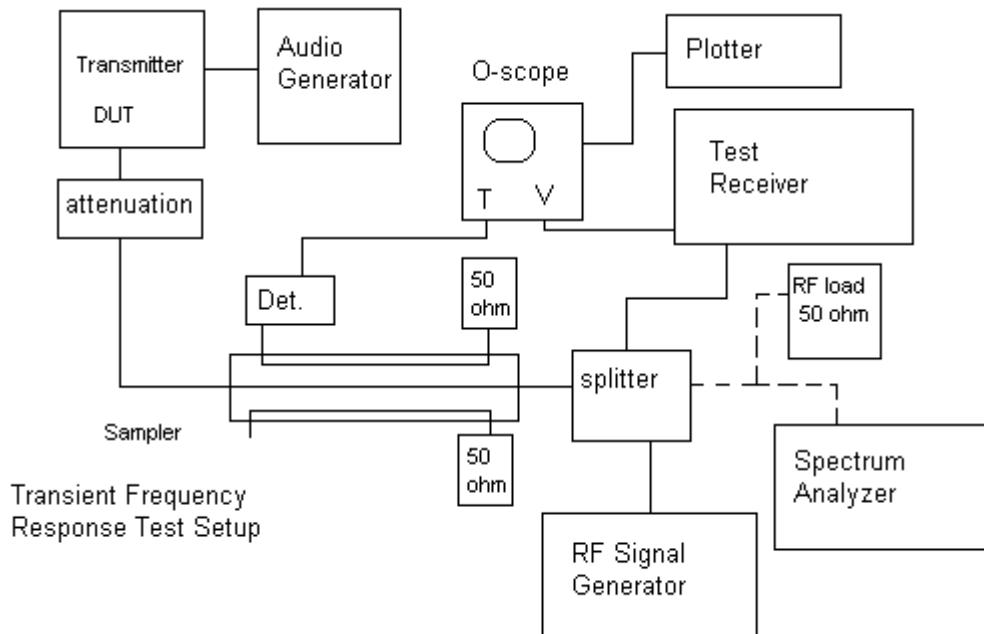
Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx

TEST PROCEDURE: ANSI/TIA 603-D:2010, the levels were set as follows:

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 and recorded.



EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Biconnical Chamber	Eaton Chamber	94455-1	1057	06/14/13	06/14/15
Antenna: Log-Periodic Chamber	Eaton	96005	1243	05/31/13	05/31/15
AC Voltmeter	HP	400FL	2213A1472 8	06/26/13	06/26/15
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/13	12/31/15
Antenna: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren Chamber	3117	00035923	06/13/14	06/13/16
EMI Test Receiver R & S ESIB 40 Screen Room	Rohde & Schwarz	ESIB 40	100274	08/12/14	08/12/16
Software: Field Strength Program	Timco	N/A	Version 4.0	12/12/99	12/12/99
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A0169 0	01/15/14	01/15/16
Analyzer Tan Tower Opt H02	HP	8449B	3008A0037 2	01/15/14	01/15/16
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A0778 6 3144A2066 1	01/15/14	01/15/16
Analyzer Tan Tower Attenuator/Switch Driver	HP	11713A	2508A1002 2	01/15/14	01/15/16
Analyzer Tan Tower RF Preselector	HP	85685A	3221A0140 0	01/15/14	01/15/16
Hygro-Thermometer	Extech	445703	0602	06/20/13	06/20/15
30 dB Attenuator	Narda	769-30	10267	03/15/13	03/15/15
Attenuator 30dB 500W	Bird	8325	1761	02/25/13	02/25/15

[Table of Contents](#)

Applicant: VERTEX STANDARD USA, INC.

FCC ID: AXI11284720

Report: V\VERTEX STANDARD USA\2216AUT14\2216AUT14TestReport.docx