FCC Part 90 RF TEST REPORT

Issued to

Alinco Incorporated, Electronics Division

For

VHF/UHF FM HANDHELD TRANSCEIVER

Model Name:	DJ-500
Trade Name:	ALINCO
Brand Name:	N.A
FCC ID:	PH3DJ-500TB
Standard:	47 CFR Part 90
Test date:	July 01, 2014 –July 25, 2014
Issue date:	July 26, 2014

By

Shenzhen Morlab Communications Technology Co., Ltd.
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Tested by Hou Yiyang
Hou Yiyang
(Test Engineer)
Date 2014.7.26

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Review by Wang Wei
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Date 2014.7.26

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1 EUT Description

EUT Type:	VHF/UHF FM HANDHELD TRANSCEIVER
Serial No:	(n.a., marked #1 by test site)
Hardware Version:	V1.00
Software Version:	V2.02
Applicant:	Alinco Incorporated, Electronics Division Yodoyabashi Dai-bldg 13F,4-4-9 Koraibashi, Chuo-Ku, Osaka 541-0043, Japan
Manufacturer:	Alinco Incorporated, Electronics Division Yodoyabashi Dai-bldg 13F,4-4-9 Koraibashi, Chuo-Ku, Osaka 541-0043, Japan
Operating Frequency Range:	136.000MHz-174.000MHz, 400.000MHz-406.000MHZ,406.100MHz-480.000MHz
Channel Information:	VHF band: 155.025MHz UHF band: 440.025MHz
Modulation Type:	FM Modulation
RF Output Power:	5 W (High) 2.5W(Middle) 1 W (Low)
Channel Separation:	12.5 KHz
Antenna Description:	Gain: 2.15dBi

Power supply:	**Battery**	
	Brand Name:	ALINCO
	Model No.:	EBP-87
	Serial No.:	(n.a. marked #1 by test site)
	Capacitance:	1500mAh
	Rated Voltage:	7.4V
	Charge Limit:	8.4V
Ancillary Equipment1:	**AC Adapter (Charger for Battery)**	
	Brand Name:	ALINCO
	Model No.:	EDC-191T
	Serial No.:	(n.a. marked #1 by test site)
	Rated Input:	~ 100-240V, 50/60Hz, 0.3A
	Rated Output:	⎓ 12V, 0.5A

NOTE:

1. For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.
2. The EUT only use Part90 frequency in the listed frequency range.

Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 90 (PRIVATE LAND MOBILE RADIO SERVICES) for the EUT FCC ID Certification:

No.	Identity	Document Title
1	47 CFR Part 90	Private Land Mobile Radio Services

Test detailed items/section required by FCC rules and results are as below:

No.	Section in CFR 47	Description	Result
1	2.1046、90.205	Maximum Transmitter Power	Pass
2	2.1047、90.207	Modulation Characteristics	Pass
3	2.1046、90.209	Occupied Bandwidth Of Emissions	Pass
4	2.1046、90.210	Emission Mask	Pass
5	2.1053、90.210	Radiated Spurious Emission	Pass
6	2.1051、90.210	Spurious Emission At Antenna Terminals	Pass
7	2.1055、90.213	Frequency Stability	Pass
8	90.214	Transient Frequency Behavior	Pass
Note 1: The tests were performed according to the method of measurements prescribed in TIA- 603 –D.			

1.2 Facilities and Accreditations

1.2.1 Facilities

Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L3572.

All measurement facilities used to collect the measurement data are located at FL.1, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10 2009, ANSI C63.4 2009 and CISPR Publication 22; the FCC registration number is 695796.

The IC registration number is 7183A-2.

1.2.2 Test Environment Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60
Atmospheric Pressure (kPa):	86-106

2. 47 CFR PART 90 REQUIREMENTS

2.1 Maximum Transmitter Power

2.1.1 Provisions Applicable

Per FCC §2.1046 and §90.205: Maximum ERP is dependent upon the station's antenna HAAT and required service area.

2.1.2 Test Procedure

2.1.2.1. Conducted Output Power

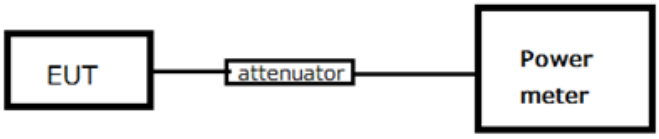
The RF output of VHF/UHF FM HANDHELD TRANSCEIVER was conducted to a power meter through an appropriate attenuator

2.1.2.2. Radiated Output Power

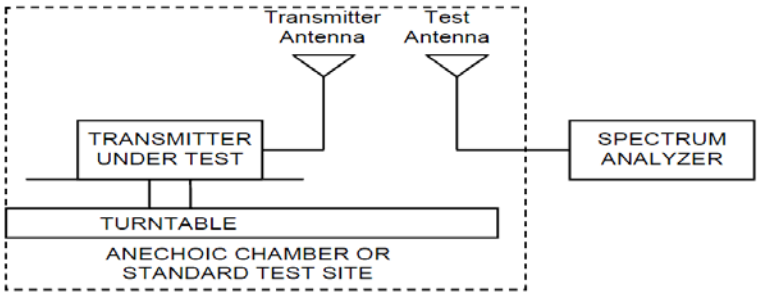
1. The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.
2. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT .The test was performed by placing the EUT on 3-orthogonal axis.
3. Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the ERP were measured by the substitution.
4. Absolute level = substituted level + Antenna gain – Cable Loss

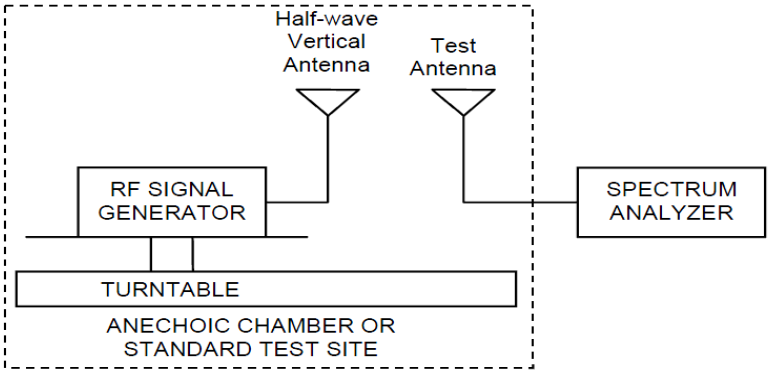
2.1.3 Test Setup Block Diagram

Conducted Output Power



Radiated Output Power (E.R.P)





2.1.4 Test Instruments

Name Of Equipment	Manufacturer	Model	S/N	Cal. Due Date	Cal. Due
Power Meter	Agilent	E4418B	MY45100845	2014.01.09	2015.01.09
Attenuator	SHX	DC-13	N.A	N.A	N.A
Signal Generator	Agilent	N5181A	MY50140888	2014.01.20	2015.01.20
Spectrum Analyzer	Agilent	E4407B	US39010211	2014.06.02	2015.06.02
Chamber	Albatross	9*6*6	4771011001	2014.04.07	2015.04.07
Test Antenna	Schaffner	CBLY12B	2529	2014.05.30	2015.05.30

2.1.5 Test Result

2.1.5.1 Conducted Output Power Test Result

The maximum Conducted Power (CP) is

12.5 KHz Channel Separation @ High power level:

Frequency (MHz)	In dBm	In W
155.025	36.87	4.86
440.025	36.58	4.55

12.5 KHz Channel Separation @ Middle power level:

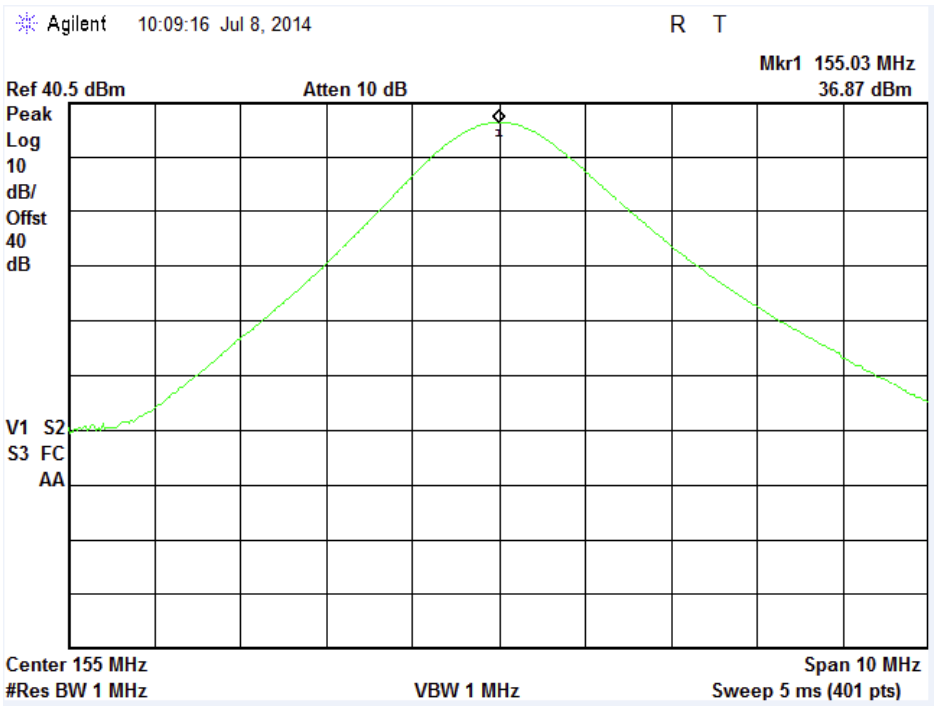
Frequency (MHz)	In dBm	In W
155.025	33.87	2.44
440.025	33.79	2.39

12.5 KHz Channel Separation @ Low power level:

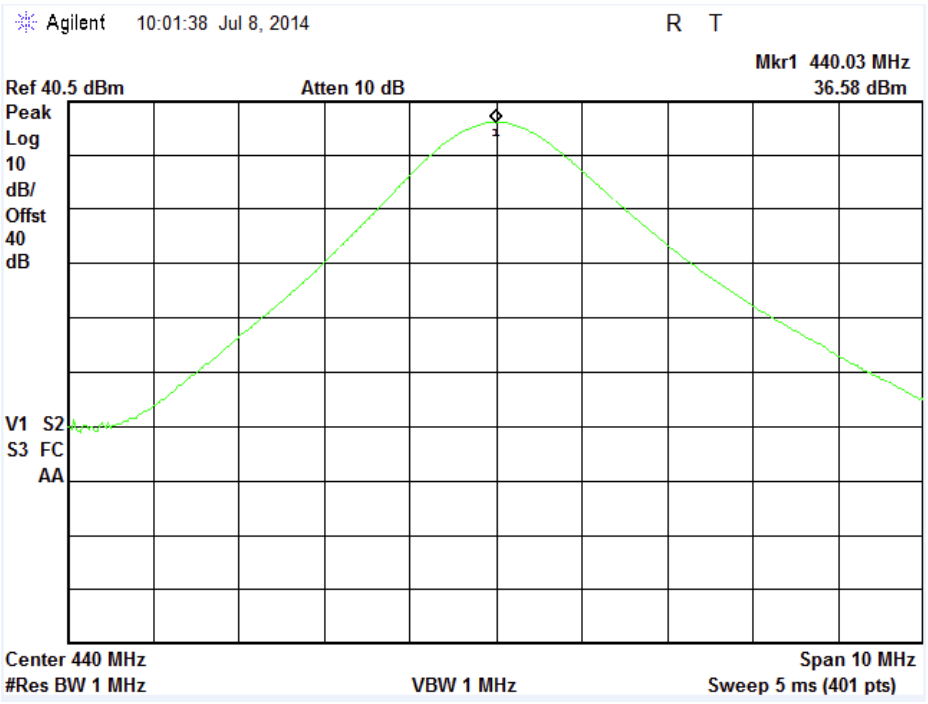
Frequency (MHz)	In dBm	In W
155.025	30.33	1.08
440.025	29.38	0.87

Test Result: PASS

12.5 KHz Channel Separation @ High power level

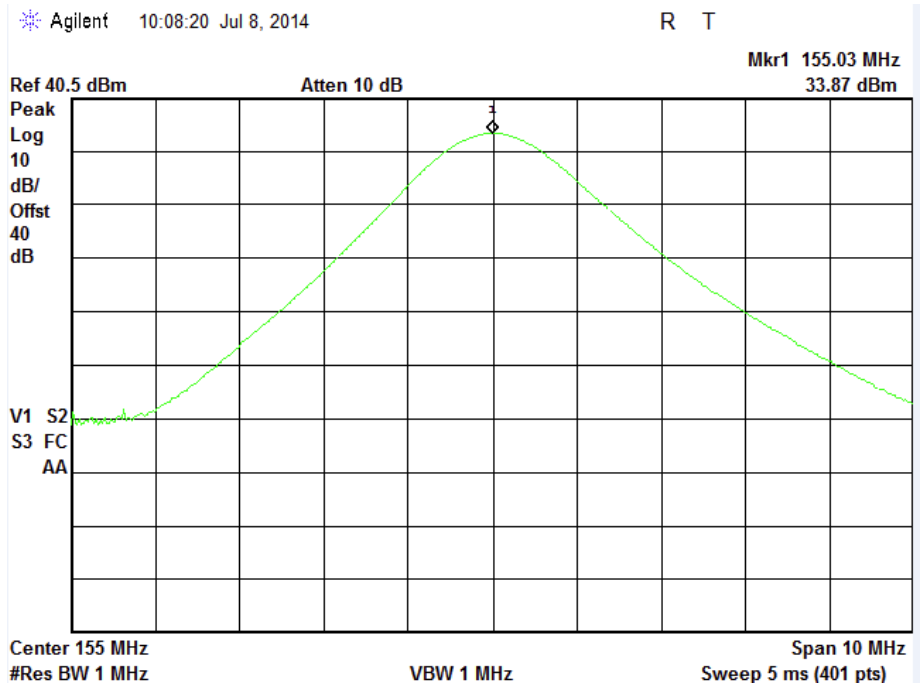


Plot A1 : 155.025MHz@ High power level

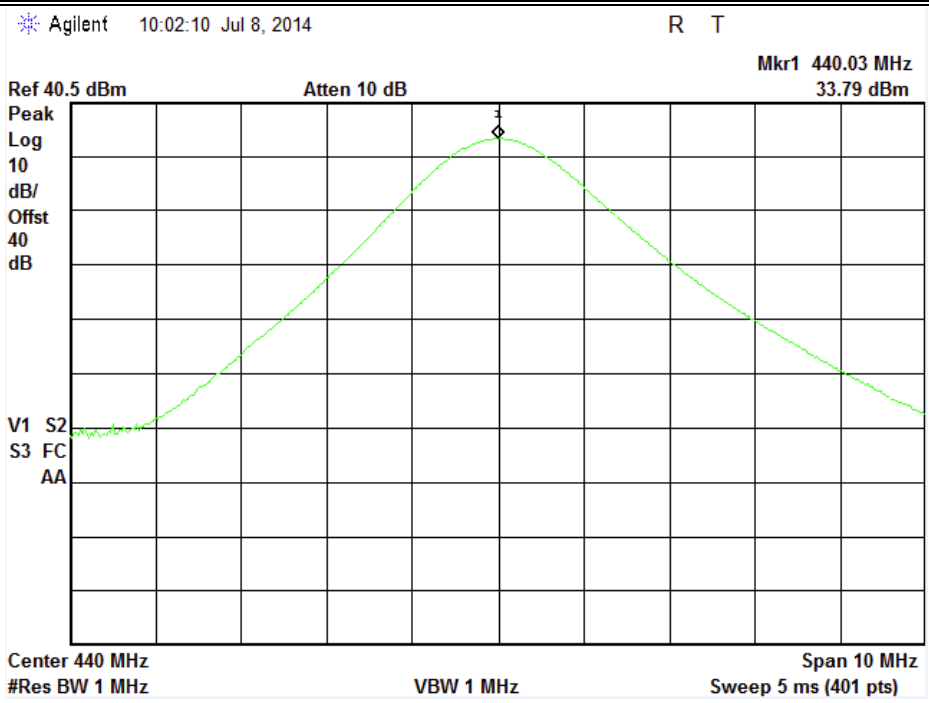


Plot A2 : 440.025MHz@ High power level

12.5 KHz Channel Separation @ Middle power level

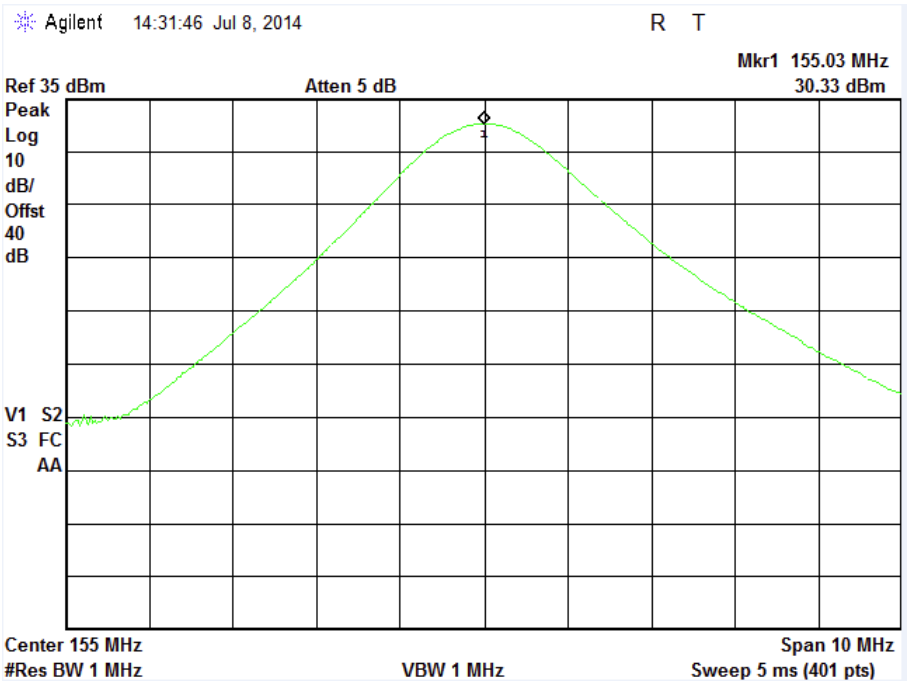


Plot A3 : 155.025MHz@ Middle power level

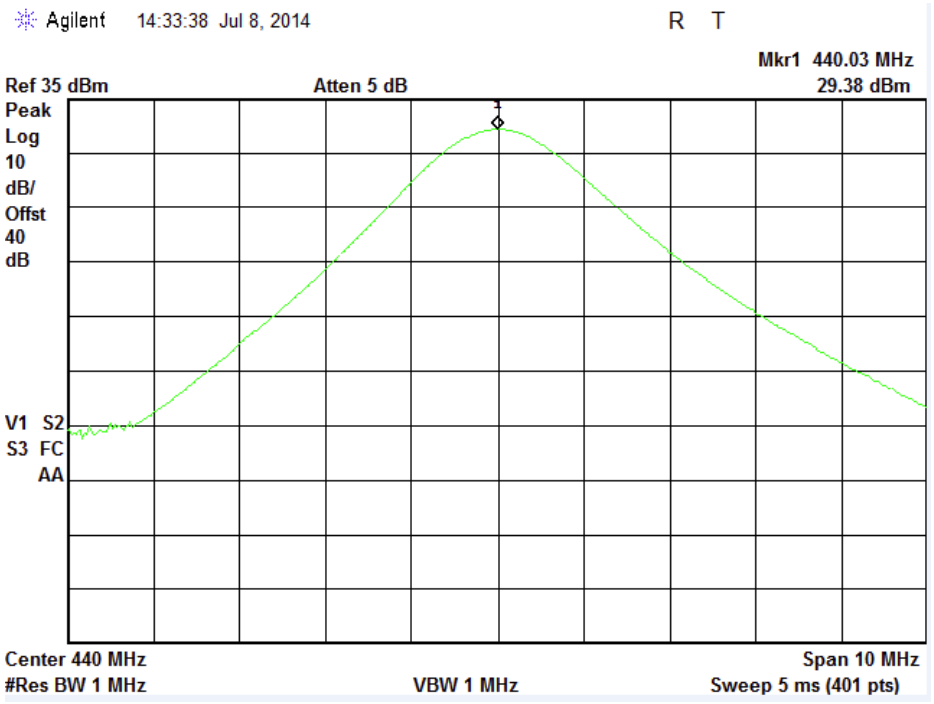


Plot A4 : 440.025MHz@ Middle power level

12.5 KHz Channel Separation @ Low power level



Plot A 5 : 155.025MHz@ Low High power level



Plot A 6 : 440.025MHz@ Low High power level

2.1.5.2 Radiated Output Power Test Result

12.5 KHz Channel Separation @ High power level:

Frequency MHz	SG+PA Reading dBm	Height Meter	Table Degree	Polar H/V	Antenna Gain Db	Cable loss Db	Corrected Ampl. dBm	ERP W
155.025	24.18	1.50	170	H	0	4.70	19.48	0.09
155.025	38.08	1.40	0	V	0	4.70	33.38	2.18
440.025	25.19	1.20	180	H	0	5.00	20.19	0.10
440.025	37.05	1.30	30	V	0	5.00	32.05	1.60

12.5 KHz Channel Separation @ Middle power level：

Frequency MHz	SG+PA Reading dBm	Height Meter	Table Degree	Polar H/V	Antenna Gain Db	Cable loss Db	Corrected Ampl. dBm	ERP W
155.025	22.18	1.50	170	H	0	4.70	17.48	0.06
155.025	36.08	1.40	0	V	0	4.70	31.38	1.37
440.025	23.19	1.20	180	H	0	5.00	18.19	0.07
440.025	35.05	1.30	30	V	0	5.00	30.05	1.01

12.5 KHz Channel Separation -@ Low power level

Frequency MHz	SG+PA Reading dBm	Height Meter	Table Degree	Polar H/V	Antenna Gain Db	Cable loss Db	Corrected Ampl. dBm	ERP W
155.025	19.61	1.40	150	H	0	4.70	14.91	0.03
155.025	27.49	1.40	0	V	0	4.70	22.79	0.16
440.025	21.09	1.50	180	H	0	5.00	16.09	0.04
440.025	27.55	1.40	40	V	0	5.00	22.55	0.18

Test Result: PASS

2.2 Modulation Characteristics

2.2.1 Provisions Applicable

According to CFR 47 section 2.1047(a) and 90.207, for Voice Modulation Communication Equipment, the frequency response of the audio modulation circuit over a range of 100 to 5000Hz shall be measured.

2.2.2 Measurement Method

2.2.2.1 Modulation Limit

1. Configure the EUT as shown in figure 1, adjust the audio input for 60% of rated system deviation at 1 KHz using this level as a reference (0dB) and vary the input level from –20 to +20dB. Record the frequency deviation obtained as a function of the input level.
2. Repeat step 1 with input frequency changing to 300, 1000, 1500 and 3000Hz in sequence.

2.2.2.2 Audio Frequency Response

1. Configure the EUT as shown in figure 1.
2. Adjust the audio input for 20% of rated system deviation at 1 KHz using this level as a reference (0dB).
3. Vary the Audio frequency from 100 Hz to 10 KHz and record the frequency deviation.
4. Audio Frequency Response = 20log10 (Deviation of test frequency/Deviation of 1 KHz reference).

2.2.2.3Audio Low Pass Filter Response

1. Connect the equipment in figure 2.
2. Connect the audio frequency generator as close as possible the input of the post limiter low pass filter within the transmitter under test.
3. Connect the audio spectrum analyzer to the output of the post limiter low pass filter within the transmitter under test.
4. Apply a 1000 Hz tone from the audio frequency generator and adjust the level per manufacturer's specifications.
5. Record the dB level of the 1000 Hz spectral line on the audio spectrum analyzer as LEV1 .
6. Set the audio frequency generator to the desired test frequency between 3000 Hz and the upper low pass filter limit.
7. Record audio spectrum analyzer levels, at the test frequency in step (6).
8. Record the dB level on the audio spectrum analyzer as LEV2 . Method of Measurement for Transmitters .
9. Calculate the audio frequency response at the test frequency as:low pass frequency response = LEV1-LEV2.
10. Repeat steps (6) through (9) for all the desired test frequencies.

2.2.3 Test Setup Block Diagram

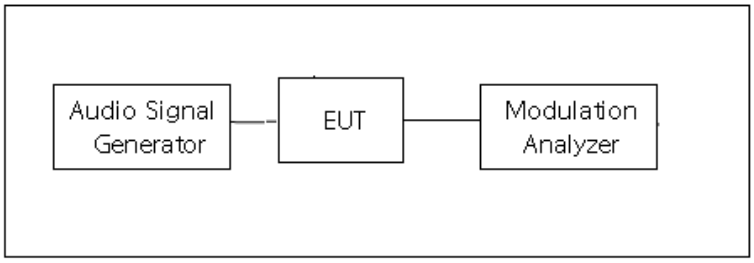


Figure 1

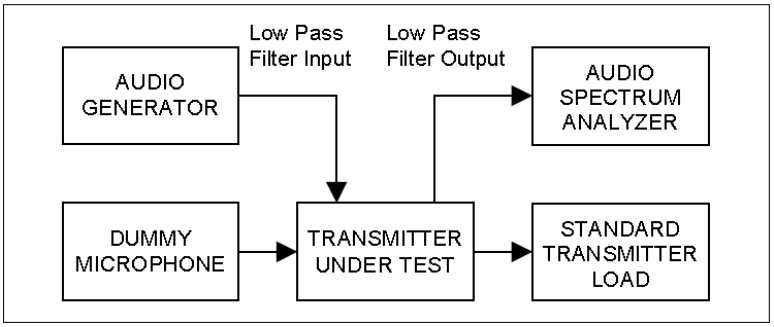


Figure 2

2.2.4 Measurement Instruments

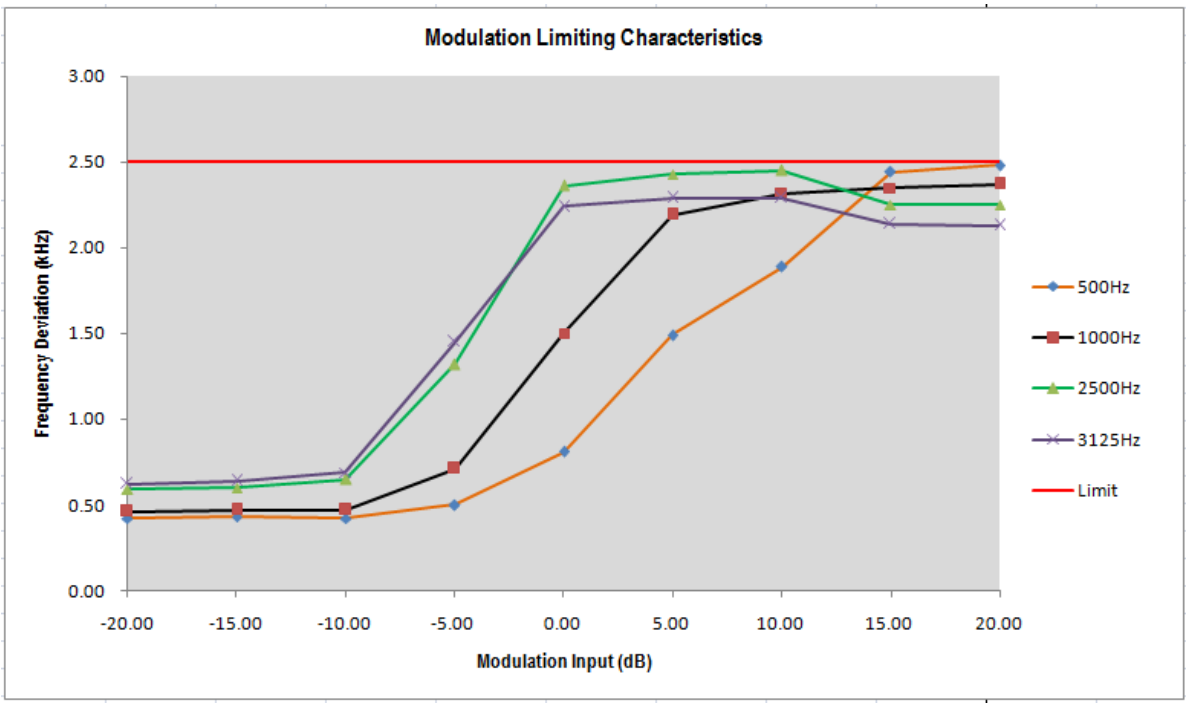
Name Of Equipment	Manufacturer	Model	S/N	Cal. Due Date	Cal. Due
Audio Signal Generator	R&S	UPV	17-253527	2013.09.08	2014.09.08
Modulation Analyzer	Agilent	8901B	2920A02186	2013.09.08	2014.09.08

2.2.5 Test Result

2.2.5.1 Modulation Limit:

155.025MHz @ 12.5 KHz Channel Separation

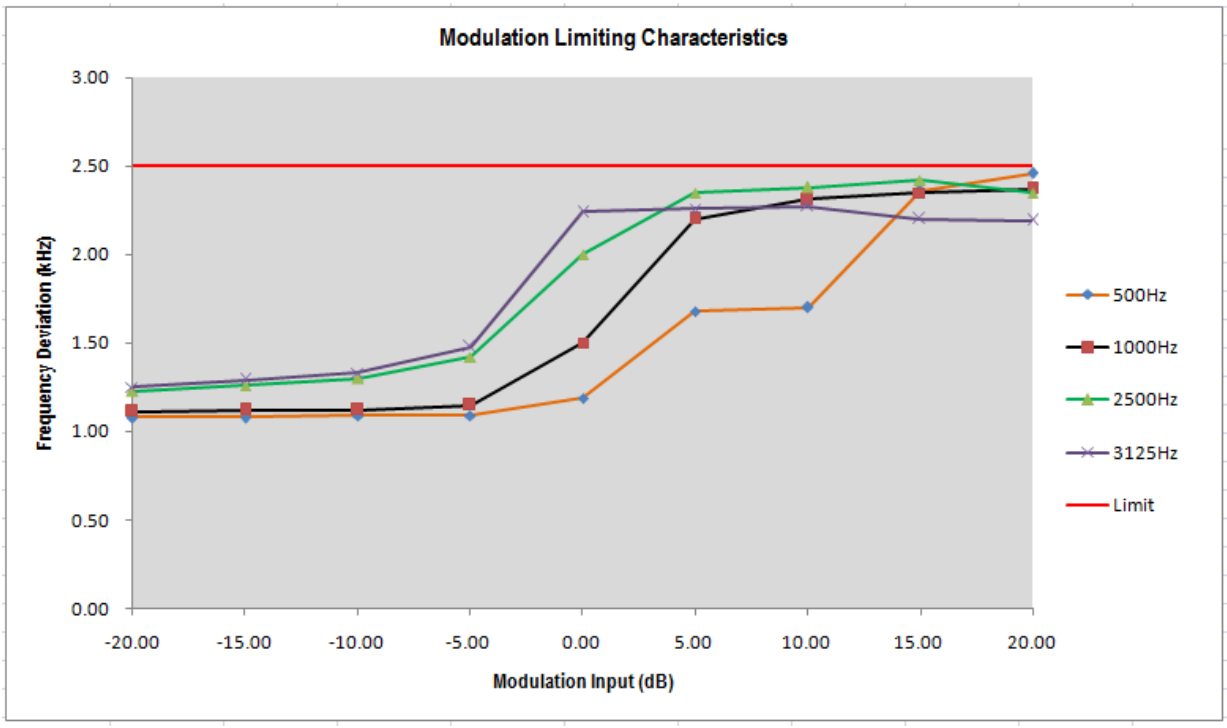
Modulation level (dB)	Peak freq dev at 300Hz	Peak freq dev at 1000Hz	Peak freq dev at 1500Hz	Peak freq dev at 3000Hz	Limit(KHz)
-20	0.42	0.46	0.59	0.62	2.50
-15	0.43	0.47	0.60	0.64	2.50
-10	0.42	0.47	0.65	0.69	2.50
-5	0.50	0.71	1.32	1.45	2.50
0	0.81	1.50	2.36	2.24	2.50
5	1.49	2.19	2.43	2.29	2.50
10	1.89	2.31	2.45	2.29	2.50
15	2.44	2.35	2.25	2.14	2.50
20	2.48	2.37	2.25	2.13	2.50



Plot B1 : 155.025MHz @ 12.5 KHz Channel Separation

440.025MHz @ 12.5 KHz Channel Separation

Modulation level (dB)	Peak freq dev at 300Hz	Peak freq dev at 1000Hz	Peak freq dev at 1500Hz	Peak freq dev at 3000Hz	Limit(KHz)
-20	1.08	1.11	1.23	1.25	2.50
-15	1.08	1.12	1.26	1.29	2.50
-10	1.09	1.12	1.30	1.33	2.50
-5	1.09	1.15	1.42	1.48	2.50
0	1.19	1.50	2.00	2.24	2.50
5	1.68	2.20	2.35	2.26	2.50
10	1.70	2.31	2.38	2.27	2.50
15	2.36	2.35	2.42	2.20	2.50
20	2.46	2.37	2.35	2.19	2.50

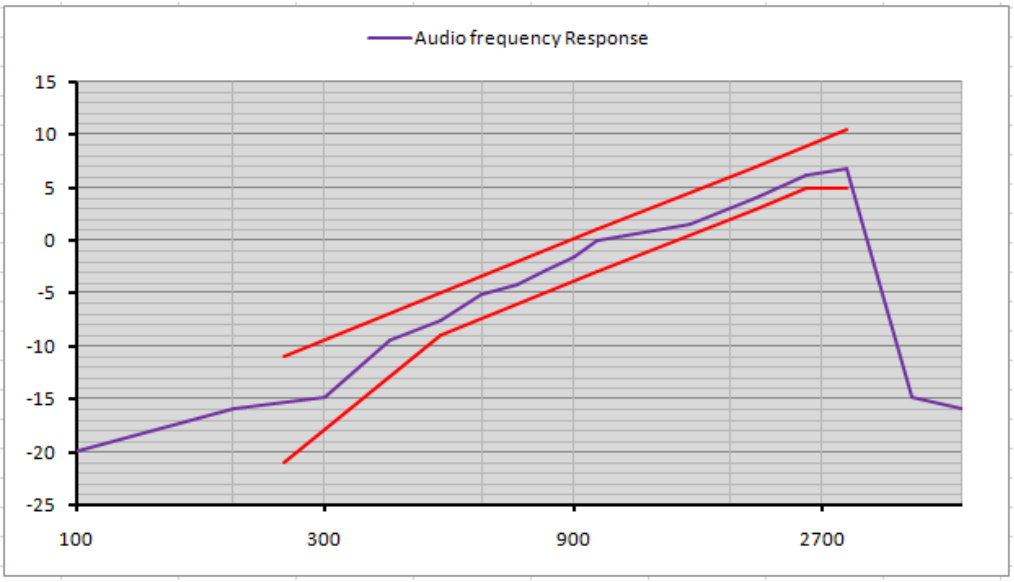


Plot B2: 440.025MHz @ 12.5 KHz Channel Separation

2.2.5.2 Audio Frequency Response -Transmitter:

155.025MHz @ 12.5 KHz Channel Separation

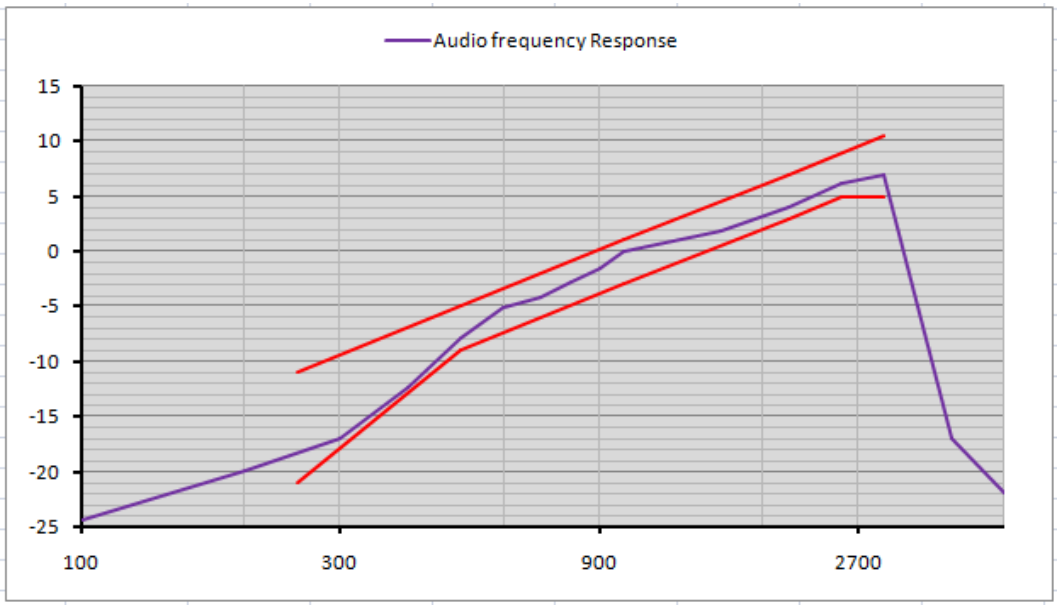
Audio frequency (Hz)	Deviation (KHz)	Response
100	0.05	-20.00
200	0.08	-15.92
300	0.09	-14.89
400	0.17	-9.37
500	0.21	-7.54
600	0.28	-5.04
700	0.31	-4.15
800	0.36	-2.85
900	0.42	-1.51
1000	0.50	0.00
1500	0.6	1.58
2000	0.79	3.97
2500	1.02	6.19
3000	1.1	6.85
4000	0.09	-14.89
5000	0.08	-15.92



Plot B3 : 155.025MHz @ 12.5 KHz Channel Separation

440.025MHz @ 12.5 KHz Channel Separation

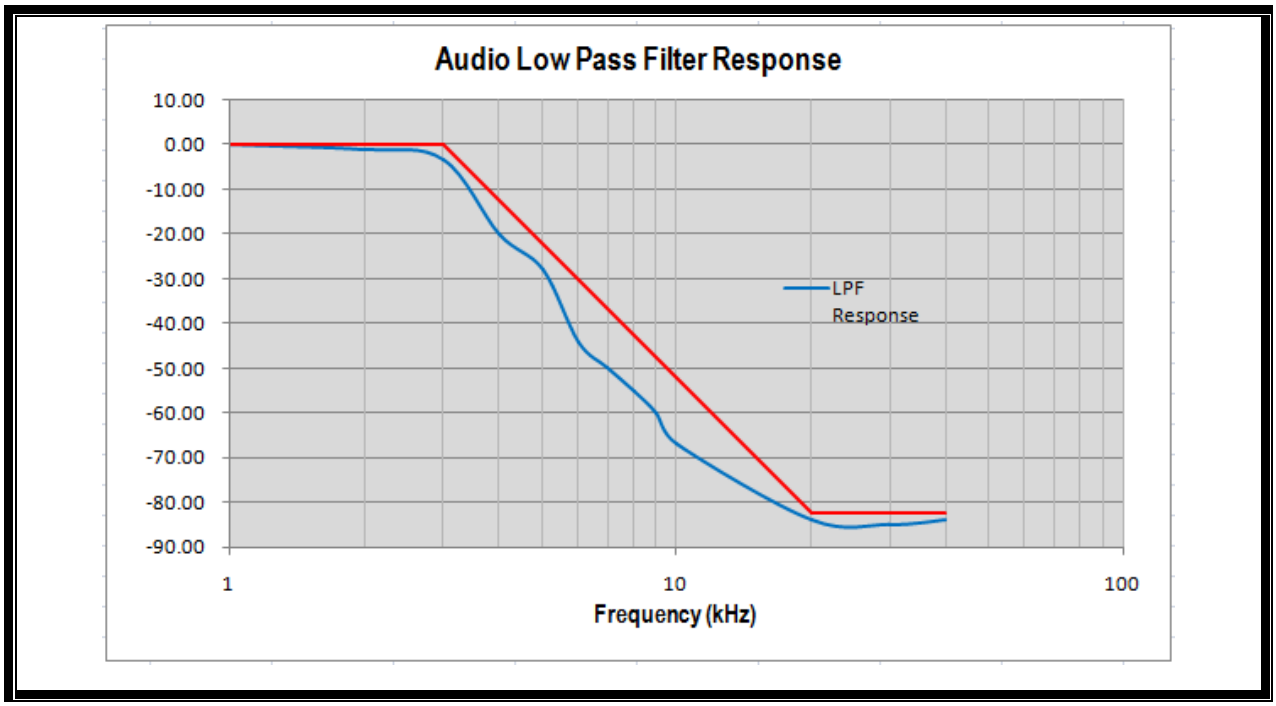
Audio frequency (Hz)	Deviation (KHz)	Response
100	0.03	-24.44
200	0.05	-20.00
300	0.07	-17.08
400	0.12	-12.40
500	0.20	-7.96
600	0.28	-5.04
700	0.31	-4.15
800	0.36	-2.85
900	0.42	-1.51
1000	0.50	0.00
1500	0.62	1.87
2000	0.79	3.97
2500	1.02	6.19
3000	1.12	7.00
4000	0.07	-17.08
5000	0.04	-21.94



Plot B4: 440.025MHz @ 12.5 KHz Channel Separation

2.2.5.3 Audio Low Pass Filter Response

Frequency(KHz)	Response (dB)
1	0.00
2	-1.00
3	-3.21
4	-20.00
5	-28.00
6	-44.00
7	-50.00
8	-55.00
9	-60.00
10	-67.00
20	-84.00
30	-85.00
40	-84.00



Test Result: PASS

2.3 Occupied Bandwidth of Emissions Mask

2.3.1 Provisions Applicable

According to FCC §2.1049, §90.209 and §90.210, the necessary attenuation requirements need to meet as the following:

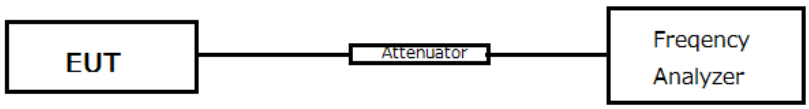
Emission Mask D For 12.5kHz bandwidth:

On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than12.5 kHz: At least 7.27(fd−2.88 kHz) dB. 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.

2.3.2 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The EUT was modulated by 2.5 KHz Sine wave audio signal, The level of the audio signal employed is 16 dB greater than that necessary to produce 50% of rated system deviation. Rated system deviation is 2.5 kHz (12.5 kHz channel spacing).
3. Set SPA Center Frequency = fundamental frequency, RBW=VBW= 300 Hz, Span =50 KHz.
4. Set SPA Max hold. Mark peak, -26 dB.

2.3.3 Test Setup Block Diagram



2.3.4 Test Instruments

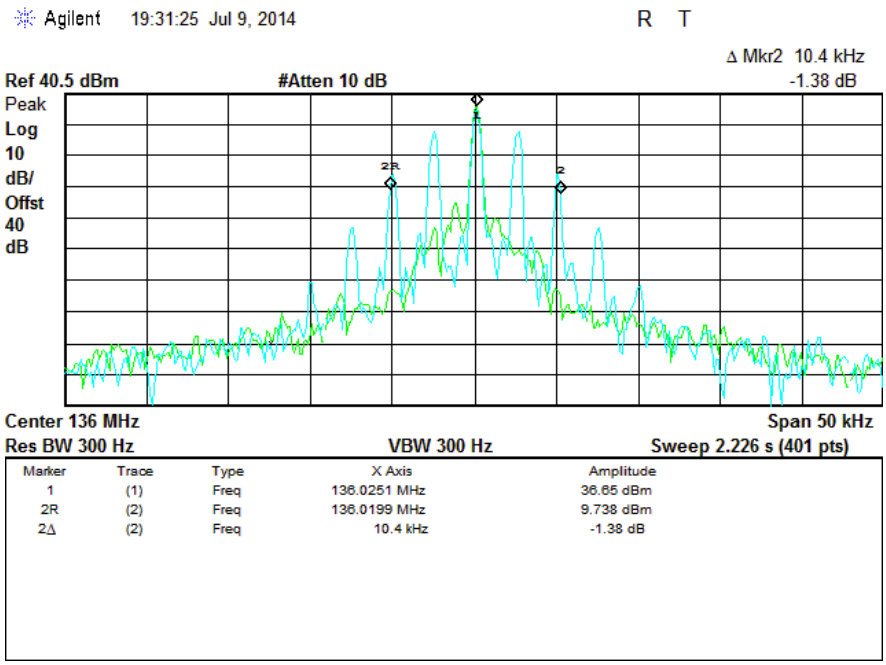
Name Of Equipment	Manufacturer	Model	S/N	Cal. Due Date	Cal. Due
Spectrum Analyzer	Agilent	E4407B	US39010211	2014.06.02	2015.06.02
Modulation Analyzer	Agilent	8901B	2920A02186	2013.09.08	2014.09.08
Attenuator	SHX	DC-13	N.A	N.A	N.A

2.3.5 Test Result

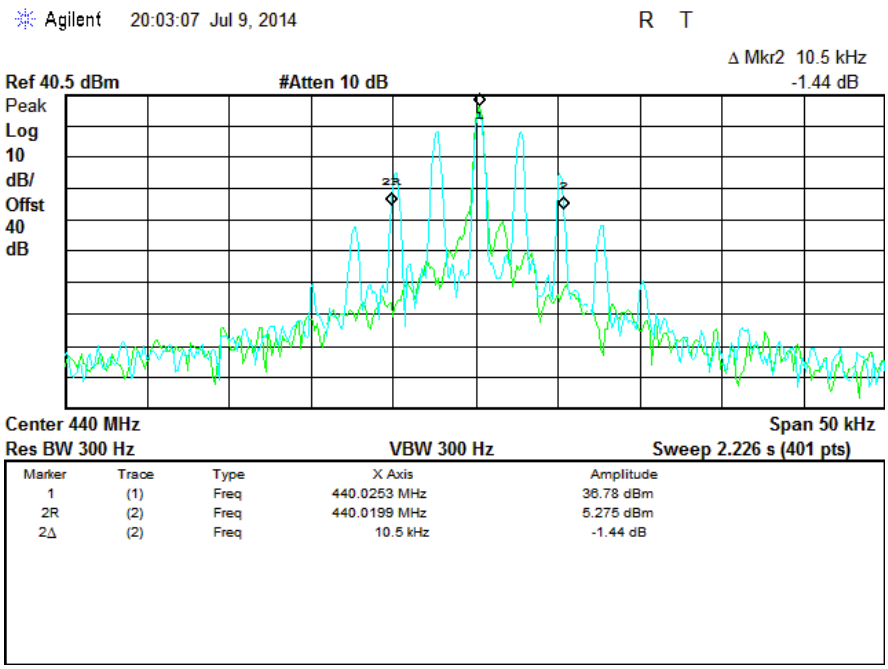
2.3.5.1 26 dB Bandwidth Measurement Result

Frequency (MHz)	Test Data	Limit
155.025	10.40	11.25
440.025	10.50	11.25

Test Result: PASS

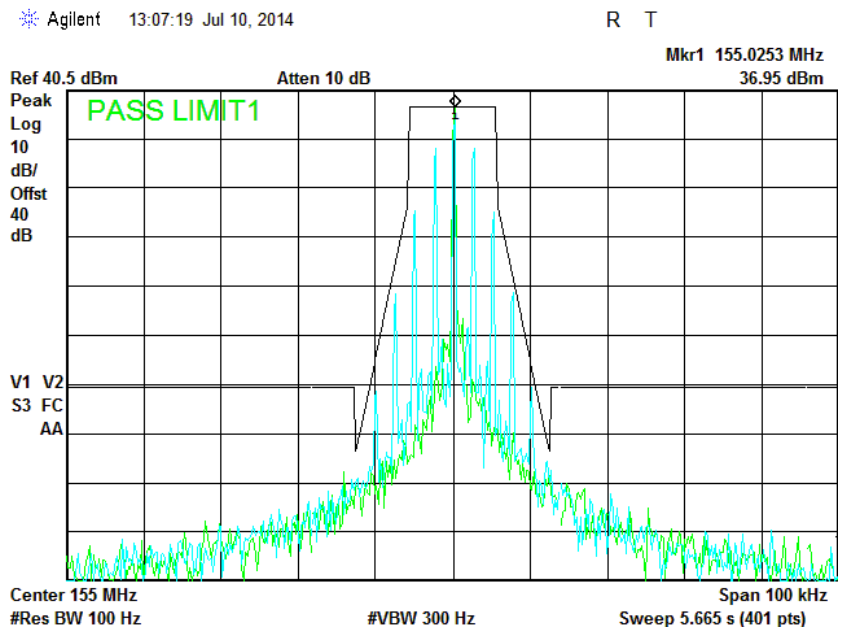


Plot C1 : 155.025MHz (Maximum) @ 12.5 KHz Channel Separation

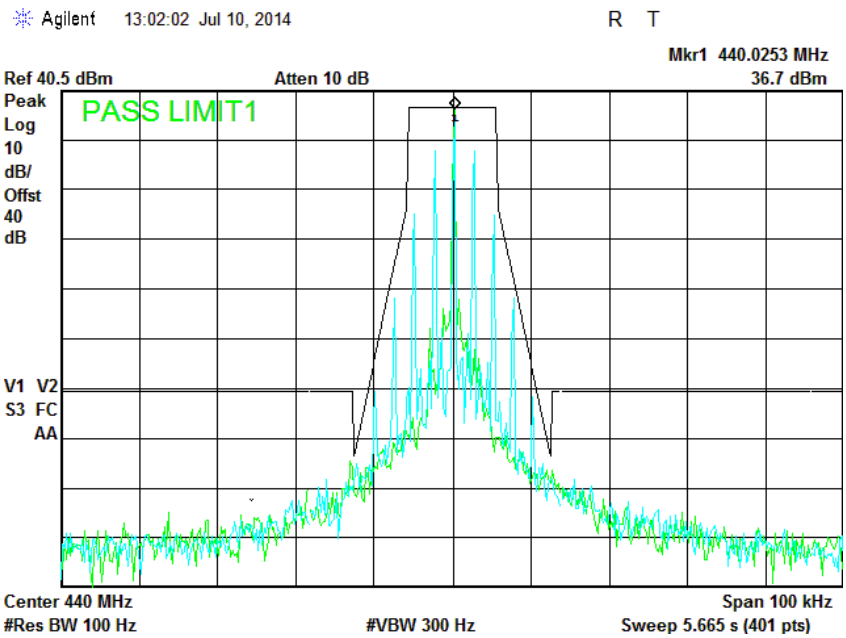


Plot C2 : 440.025MHz (Maximum) @ 12.5 KHz Channel Separation

2.3.5.2 EMISSION MASK PLOT



Plot C3 : 155.025MHz @ 12.5 KHz Channel Separation



Plot C4 : 440.025MHz @ 12.5 KHz Channel Separation

Test Result: PASS

2.4 Radiated Spurious Emission

2.4.1 Provisions Applicable

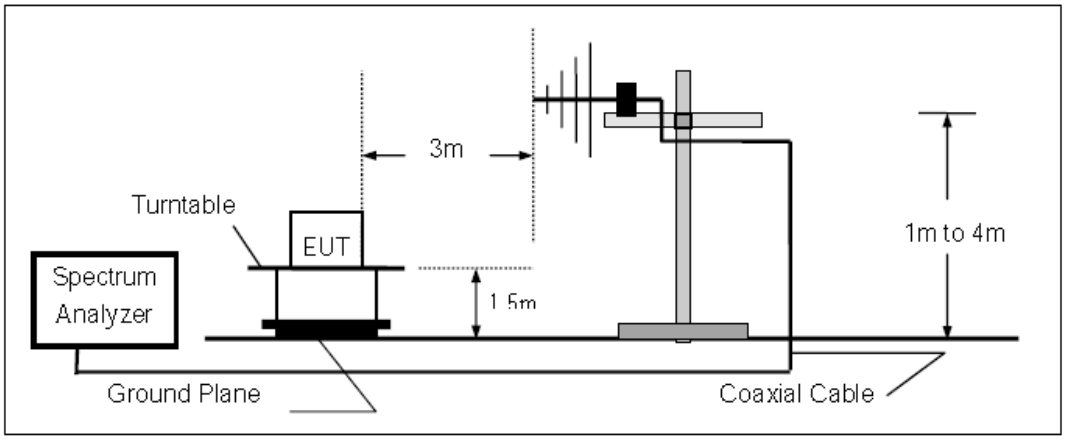
According to FCC section 2.1053 and FCC section 90.210. For 12.5 KHz channel separation, the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 50+10*log(P)dB. This calculated to be -20dBm.

2.4.2 Measurement Procedure

1. On a test site, the EUT shall be placed on a turntable and in the position closest to the normal use as declared by the user.
2. The test antenna shall be oriented initially for vertical polarization located 3m from the EUT to correspond to the transmitter.
3. The output of the antenna shall be connected to the measuring receiver and either a peak or quasi-peak detector was used for the measurement as indicated on the report. The detector selection is based on how close the emission level was approaching the limit.
4. The transmitter shall be switched on; if possible, without the modulation and the measurement receiver shall be tuned to the frequency of the transmitter under test.
5. The test antenna shall be raised and lowered through the specified range of height until the measuring receiver detects a maximum signal level.
6. The transmitter shall than be rotated through 360°in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
7. The test antenna shall be raised and lowered again through the specified range of height until the measuring receiver detects a maximum signal level.
8. The maximum signal level detected by the measuring receiver shall be noted.
9. The measurement shall be repeated with the test antenna set to horizontal polarization.
10. Replace the antenna with a proper Antenna (substitution antenna).
11. The substitution antenna shall be oriented for vertical polarization and, if necessary, the length of the substitution antenna shall be adjusted to correspond to the frequency of transmitting.
12. The substitution antenna shall be connected to a calibrated signal generator.
13. If necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.
14. The test antenna shall be raised and lowered through the specified range of the height to ensure that the maximum signal is received.
15. The input signal to substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuation setting of the measuring receiver.
16. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.

17. The measurement shall be repeated with the test antenna and the substitution antenna oriented for horizontal polarization.

2.4.3 Test Setup Block Diagram



2.4.4 Measurement Instruments

Name Of Equipment	Manufacturer	Model	S/N	Cal. Due Date	Cal. Due
Test Antenna - Bi-Log	Schaffner	CBL6112B	2529	2014.05.13	2015.05.13
Test Antenna - Bi-Log	Schaffner	Dvulp9118	2529	2014.05.13	2015.05.13
Receiver	R&S	ESU	100204	2014.04.24	2015.04.24
Semi-Anechoic Chamber	ALBATROSS	9m*6m*6m	4771011001	2014.04.24	2015.04.24
Test Antenna - Horn	Dahua	DH610-2	0911120001	2014.05.13	2015.05.13
Test Antenna - Horn	Dahua	DH610-2	89010	2014.05.13	2015.05.13

2.4.5 Test Result

High Power Level

Frequency	SG Reading	Height	Polar	Cable loss	Antenna Gain	Corrected Ampl.	FCC Part 90 Limit	FCC Part 90 Margin
MHz	dBm	Meter	H / V	dB	dB	dBm	dBm	dB
155.025MHz @ 12.5 KHz Channel Separation – High Power Level								
435.70	-35.28	1.50	V	1.50	0.00	-36.78	-20.00	16.78
435.70	-36.19	1.50	H	1.50	0.00	-37.69	-20.00	17.69
580.69	-39.28	1.30	V	2.20	0.00	-41.48	-20.00	21.48
580.69	-39.10	1.40	H	2.20	0.00	-41.30	-20.00	21.30
2899.00	-50.44	1.50	V	6.80	3.50	-60.74	-20.00	40.74
2899.00	-51.19	1.50	H	6.80	3.50	-61.49	-20.00	41.49
440.025 MHz @ 12.5 KHz Channel Separation – High Power Level								
870.81	-51.23	1.50	V	2.20	0.00	-53.43	-20.00	33.43
870.81	-54.08	1.30	H	2.20	0.00	-56.28	-20.00	36.28
1304.50	-39.89	1.60	V	3.00	2.80	-45.69	-20.00	25.69
1304.50	-41.76	1.50	H	3.00	2.80	-47.56	-20.00	27.56
1737.20	-48.72	1.40	V	3.60	3.10	-55.42	-20.00	35.42
1737.20	-46.25	1.50	H	3.60	3.10	-52.95	-20.00	32.95

Note:

Corrected Ampl = SG Reading – Cable loss + Antenna Gain

Margin = Limit - Corrected Ampl

Test Result: PASS

2.5 Spurious Emission At Antenna Terminals

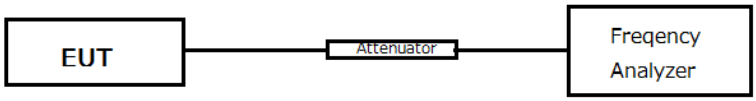
2.5.1 Provisions Applicable

According to FCC section 90.210. For 12.5 KHz channel separation, the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 50+10*log(P)dB. This calculated to be -20dBm.

2.5.2 Measurement Procedure

The EUT, which is powered by the Battery, is coupled to the Spectrum Analyzer (SA) with a Attenuator; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. The EUT is operate at the maximum output power.

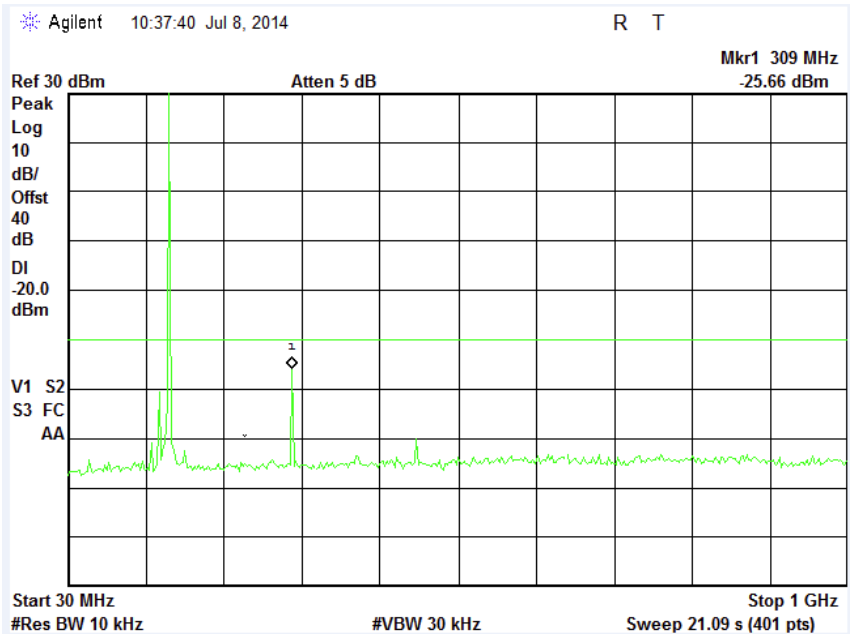
2.5.3 Test Setup Block Diagram



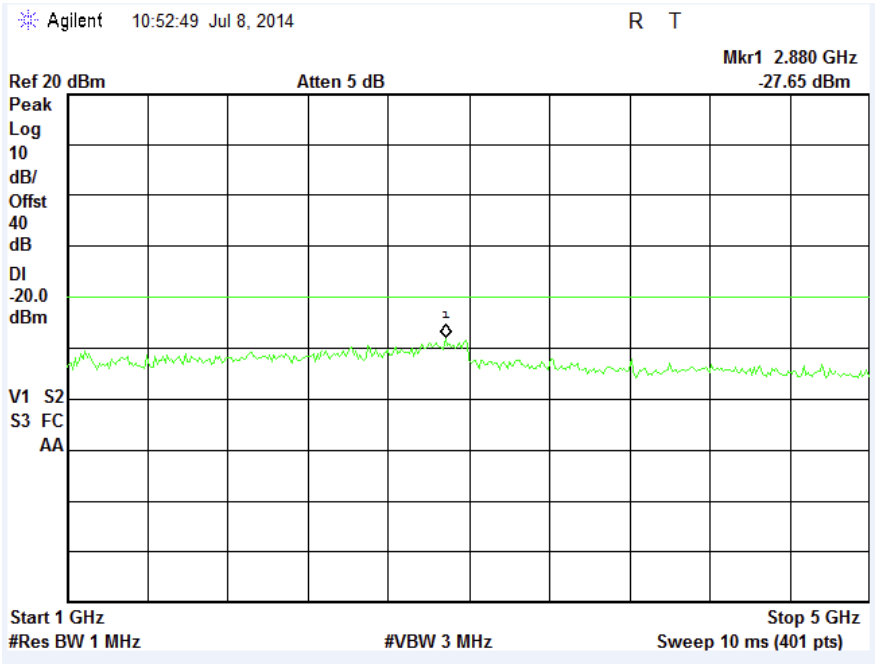
2.5.4 Measurement Instruments

Name Of Equipment	Manufacturer	Model	S/N	Cal. Due Date	Cal. Due
Spectrum Analyzer	Agilent	E4407B	US39010211	2014.06.02	2015.06.02
Attenuator	SHX	DC-13	N.A	N.A	N.A

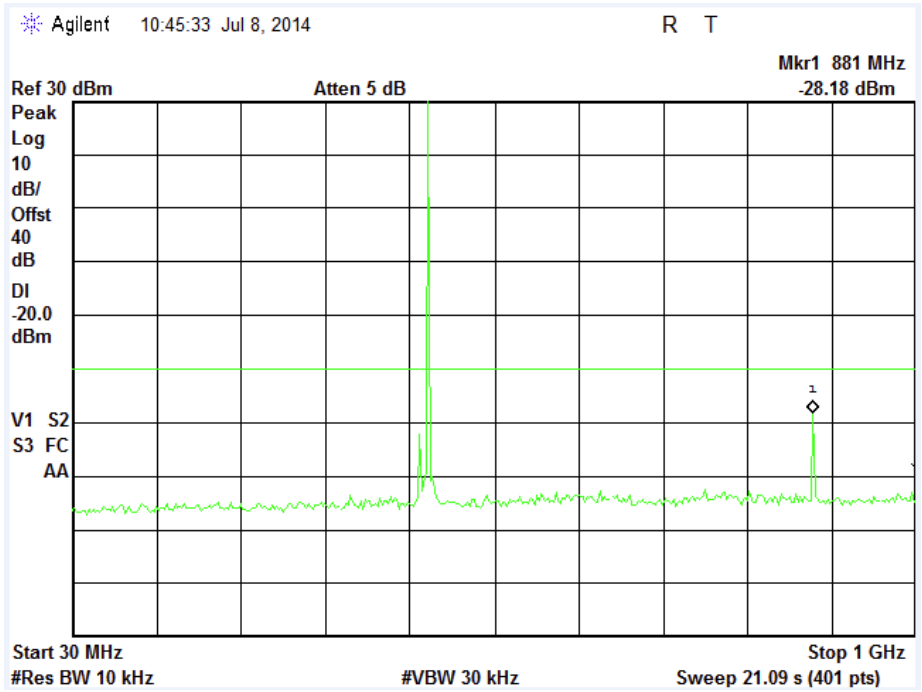
2.5.5 Test result



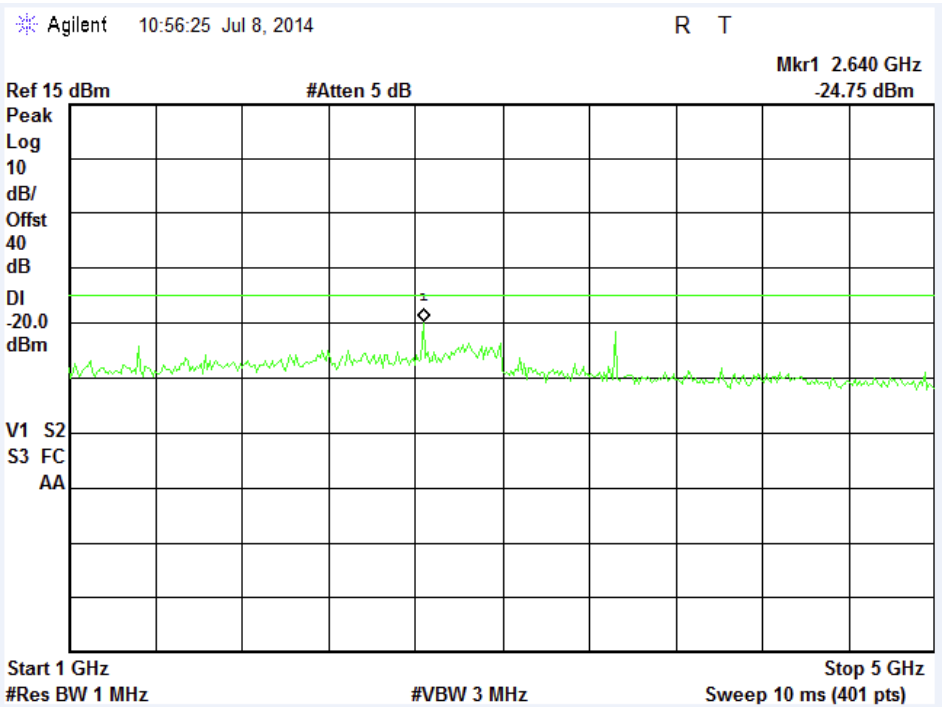
Plot D1 : 155.025 MHz @ 12.5 KHz Channel Separations – High Power Level



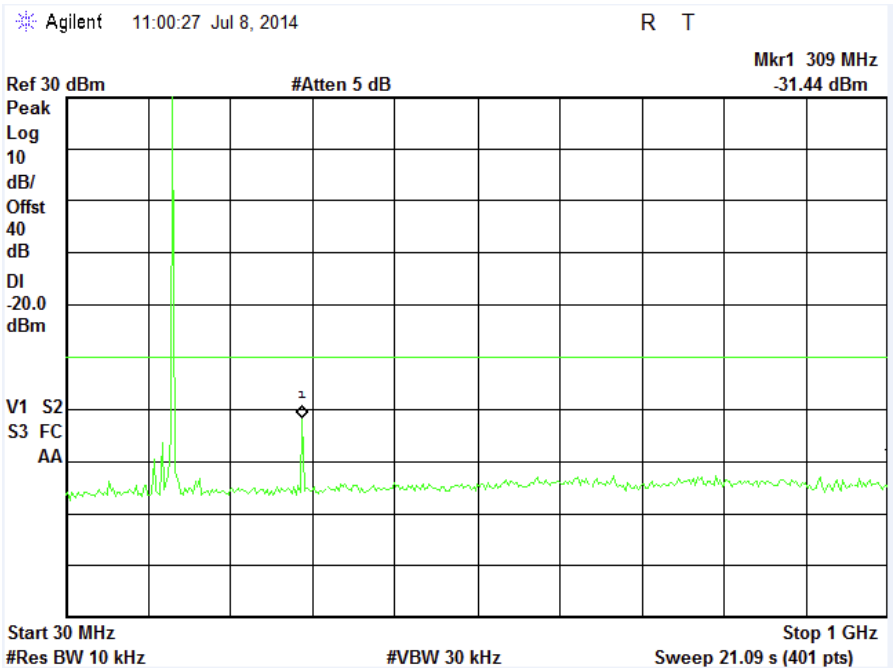
Plot D2 : 155.025 MHz @ 12.5 KHz Channel Separations – High Power Level



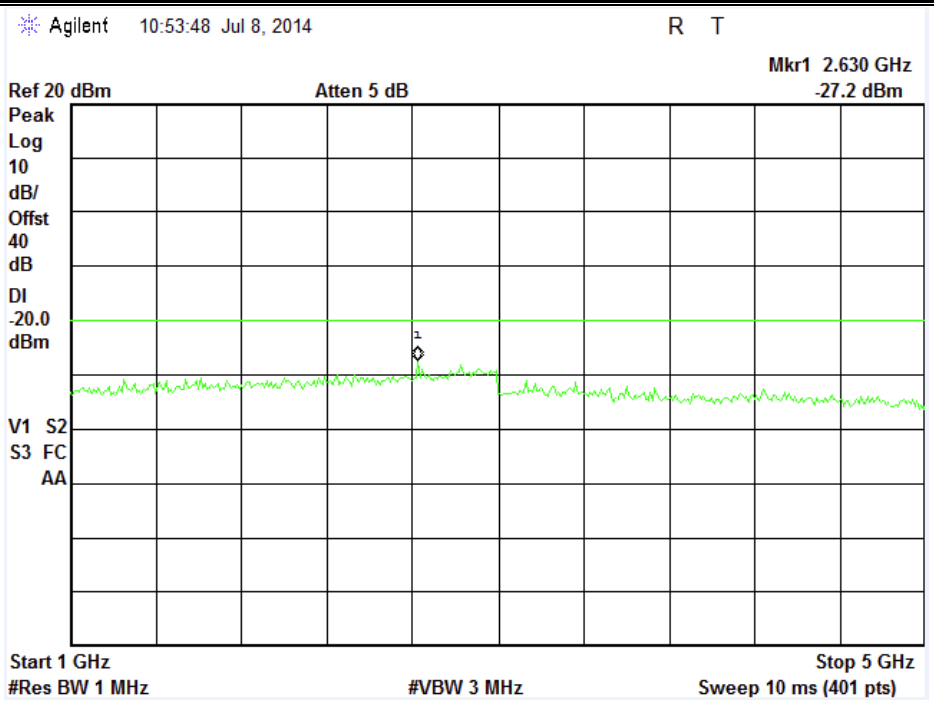
Plot D3 : 440.025 MHz @ 12.5 KHz Channel Separations – High Power Level



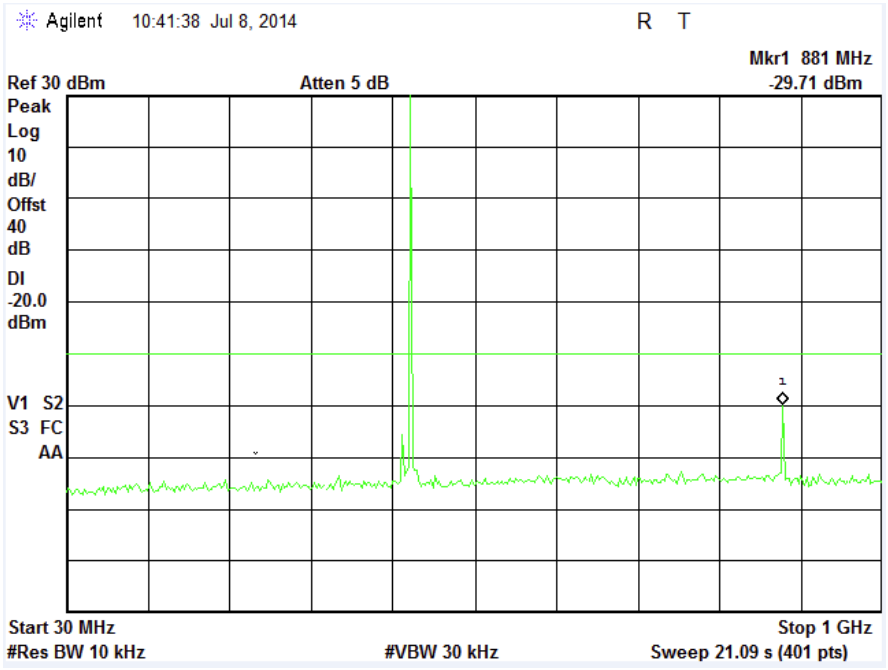
Plot D4 : 440.025 MHz @ 12.5 KHz Channel Separations – High Power Level



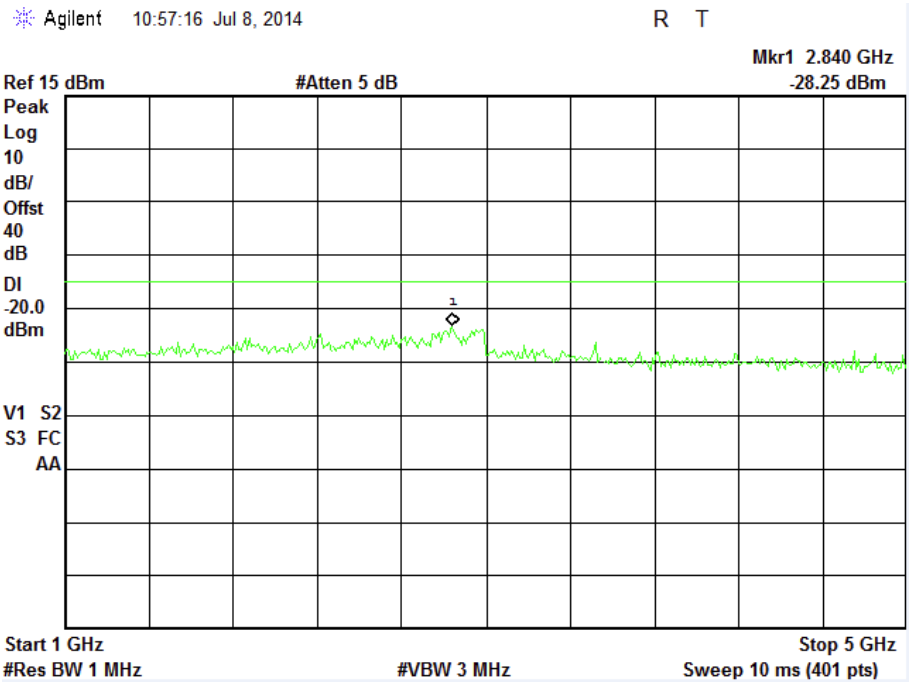
Plot D5 : 155.025 MHz @ 12.5KHz Channel Separations – Middle Power Level



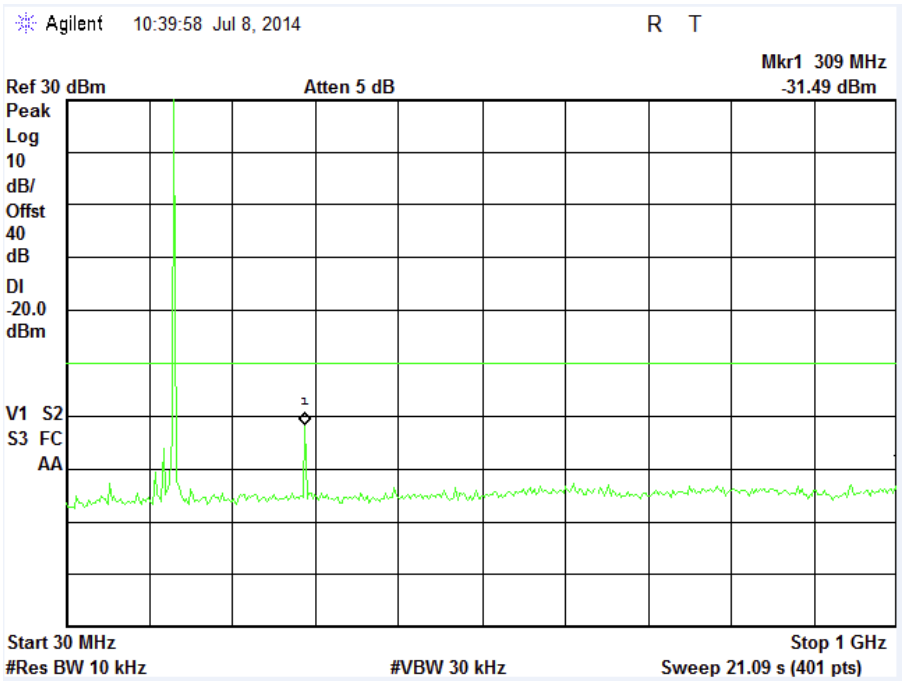
Plot D6 : 155.025 MHz @ 12.5KHz Channel Separations – Middle Power Level



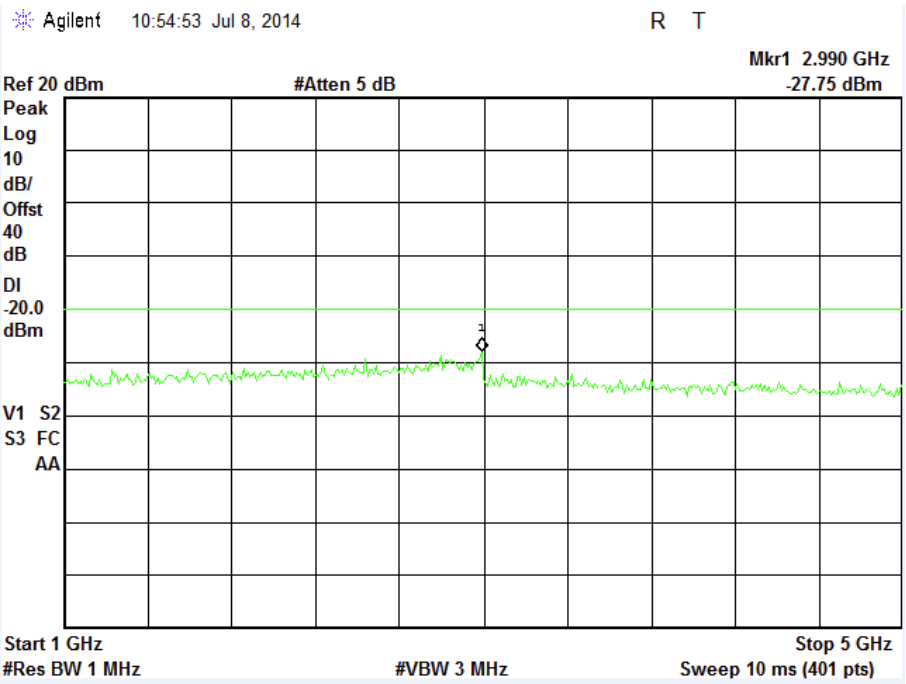
Plot D7 : 440.025 MHz @ 12.5 KHz Channel Separations – Middle Power Level



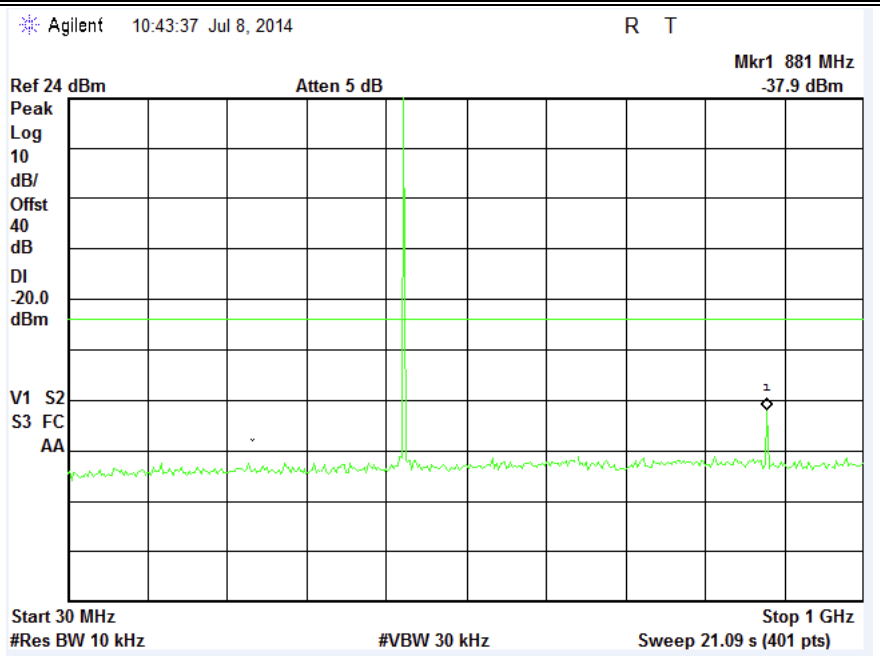
Plot D8 : 440.025 MHz @ 12.5 KHz Channel Separations – Middle Power Level



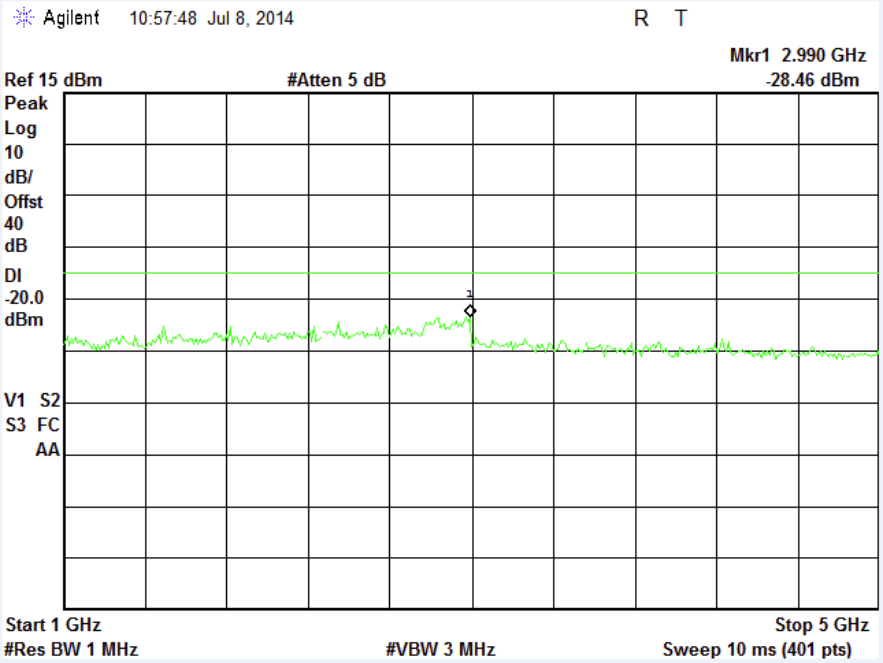
Plot D9 : 155.025 MHz @ 12.5 KHz Channel Separations –Low Power Level



Plot D10: 155.025 MHz @ 12.5 KHz Channel Separations –Low Power Level



Plot D11 : 440.025 MHz @12.5 KHz Channel Separations –Low Power Level



Plot D12 : 440.025 MHz @ 12.5 KHz Channel Separations –Low Power Level

Test Result: PASS

2.6 Frequency Stability

2.6.1 Provisions Applicable

1. According to FCC Part 2 Section 2.1055(a)(1), the frequency stability shall be measured with variation of ambient temperature from –20℃ to +55℃ centigrade.
2. According to FCC Part 2 Section 2.1055(d)(2), for battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery normal operating status, which is specified by the manufacturer.
3. According to FCC Part 90 Section 90.213, the frequency tolerance must be maintained within ±5ppm for 12.5 channel separation in 150-174MHz, while ±2.5ppm for 12.5KHz channel separation in 421-512 MHz .

2.6.2 Measurement Procedure

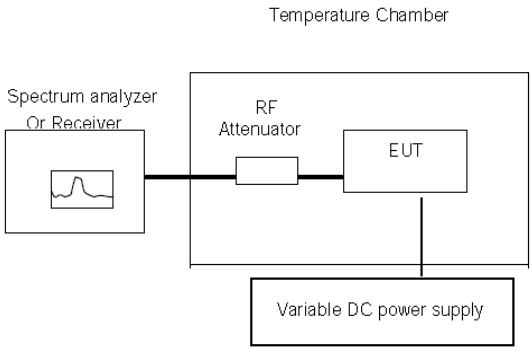
2.6.2.1 Frequency stability versus environmental temperature

1. Setup the configuration per figure 1 for frequencies measurement inside an environment chamber, Install new battery in the EUT.
2. Turn on EUT and set SA center frequency to the EUT radiated frequency. Set SA Resolution Bandwidth to 1KHz and Video Resolution Bandwidth to 1KHz and Frequency Span to 50KHz.Record this frequency as reference frequency.
3. Set the temperature of chamber to 55℃. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the chamber, turn the EUT on and measure the EUT operating frequency.
4. Repeat step 2 with a 10℃ decreased per stage until the lowest temperature -20℃ is measured, record all measured frequencies on each temperature step.

2.6.2.2 Frequency stability versus input voltage

1. Setup the configuration of the ambient temperature form -20ºC to 55ºC with sufficient time. And measure the different frequencies of the EUT with an artificial power from highest to end point voltage.
2. Set SA center frequency to the EUT radiated frequency. Set SA Resolution Bandwidth to 300Hz and Video Resolution Bandwidth to 300Hz. Record this frequency as reference frequency.

2.6.3 Test Setup Block Diagram



2.6.4 Measurement Instruments

Name Of Equipment	Manufacturer	Model	S/N	Cal. Due Date	Cal. Due
Spectrum Analyzer	Agilent	E4407B	US39010211	2014.06.02	2015.06.02
Power Supply	Agilent	66319D	MY43000556	2014.06.02	2015.06.02
Climate Chamber	Votsch	VT4002	58566087750080	2014.01.08	2015.01.08

2.6.5 Test result

12.5 KHz channel separation:

Voltage (V)	Temperature (℃)	Transmit Frequency (MHz)	
		155.025	440.025
		Frequency error (ppm)	
7.4	-20	0.16	0.15
	-10	0.05	0.11
	0	0.11	0.04
	10	0.12	0.08
	20	0.15	0.14
	30	0.17	0.16
	40	0.03	0.02
	50	0.10	0.02
	55	0.06	0.08
6.0	20	0.09	0.09
8.4	20	0.16	0.09
Max. frequency error (ppm)		0.17	0.11
Limit (ppm)		±5.00	±2.50
Result		Pass	Pass

Test Result: PASS

2.7 Transient Frequency Behavior

2.7.1 Provisions Applicable

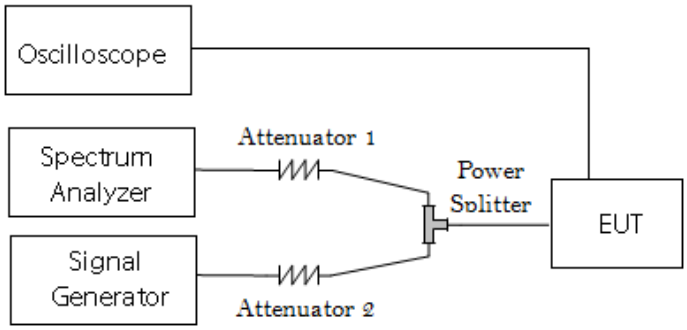
According to FCC Part 90 Section 90.214, the EUT must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals [1,2]	Maximum frequency difference [3]	All equipment	
		150 to 174 MHz	421 to 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

2.7.2 Measurement Procedure

1. Connect the transmitter under tests as shown in the above block diagram
2. Set the signal generator to the assigned frequency and modulate with a 1 KHz tone at +12.5 KHz deviation and its output level to be 50 dB below the transmitter RF output at the test receiver end.
3. Set the horizontal sweep rate on the storage scope to 10 milliseconds per division and adjust the display to continuously view the 1000 Hz tone from the Demodulator Output Port (DOP) of the Test Receiver. Adjust the vertical scale amplitude control of the scope to display the 1000 Hz at +4 divisions vertical Center at the display.
4. Adjust the scope so it will trigger on an increasing magnitude from the RF trigger signal of the transmitter under test when the transmitter was turned on. Set the controls to store the display.
5. The output at the DOP, due to the change in the ratio of the power between the signal generator input power and transmitter output power will, because of the capture effect of the test receiver, produce a change in display: For the first part of the sweep it will show the 1 KHz test signal. Then once the receiver's demodulator has been captured by the transmitter power, the display will show the frequency difference from the assigned frequency to the actual transmitter frequency versus time. The instant when the 1 KHz test signal is completely suppressed (including any capture time due to phasing) is considered to be ton. The trace should be maintained within the allowed divisions during the period t1 and t2.
6. During the time from the end of t2 to the beginning of t3 the frequency difference should not exceed the limits set by the FCC in Part 90.214 and the outlined in the Carrier Frequency Stability sections. The allowed limit is equal to FCC frequency tolerance limits specified in FCC 90.213.
7. Repeat the above steps when the transmitter was turned off for measuring t3.

2.7.3 Test Setup Block Diagram

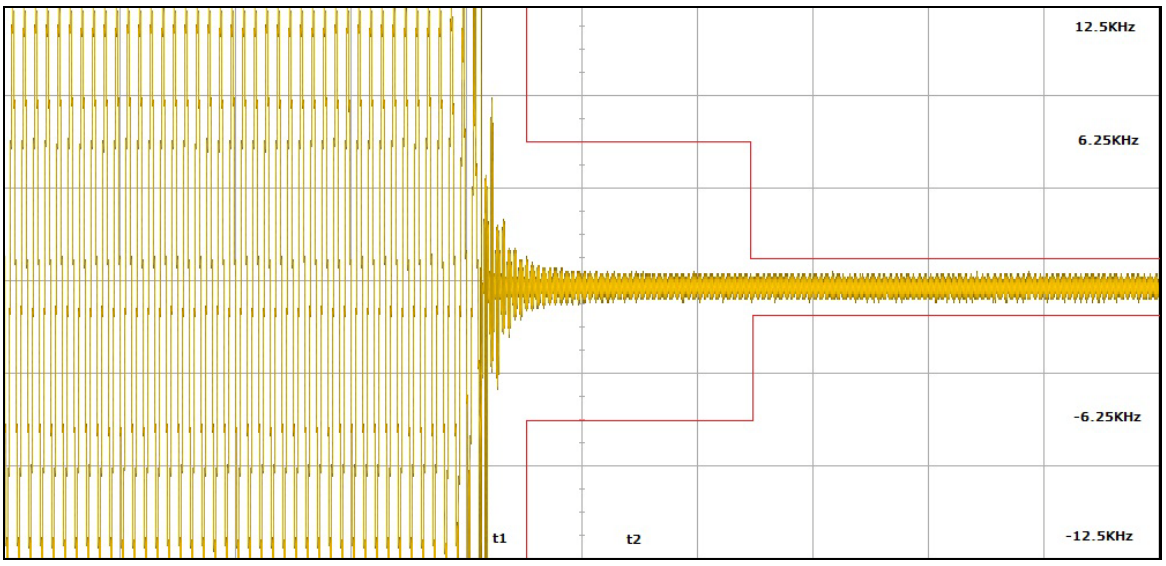


2.7.4 Measurement Instruments

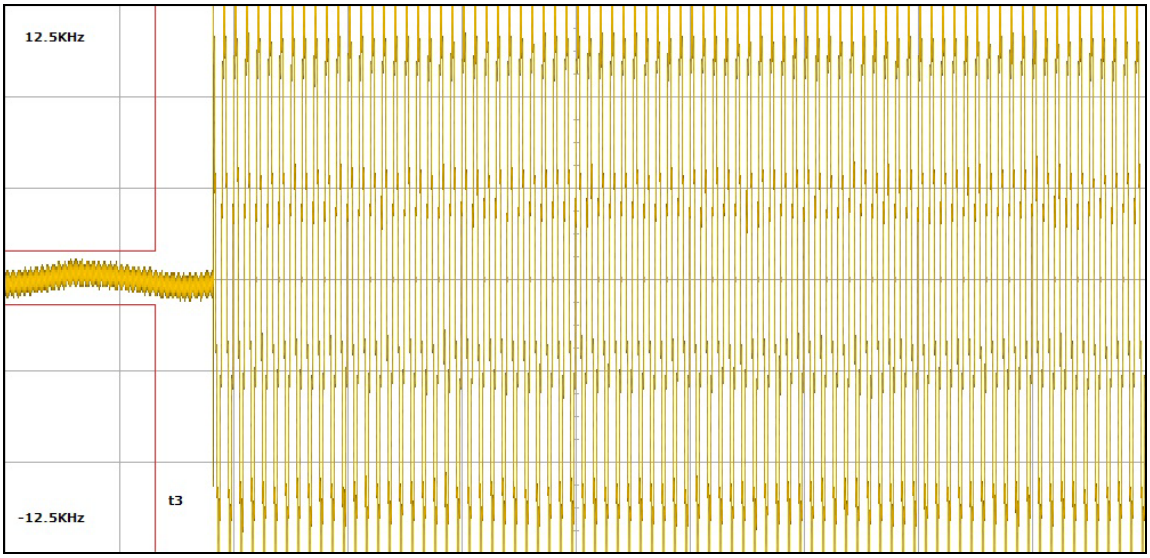
Name Of Equipment	Manufacturer	Model	S/N	Cal. Due Date	Cal. Due
Signal Generator	Agilent	E4418B	MY45100845	2014.01.09	2015.01.09
Oscilloscope	Agilent	MS6034A	MY44002532	2014.02.18	2015.02.18
Modulation Analyzer	Agilent	8901B	2920A02186	2013.09.08	2014.09.08

2.7.5 Test result

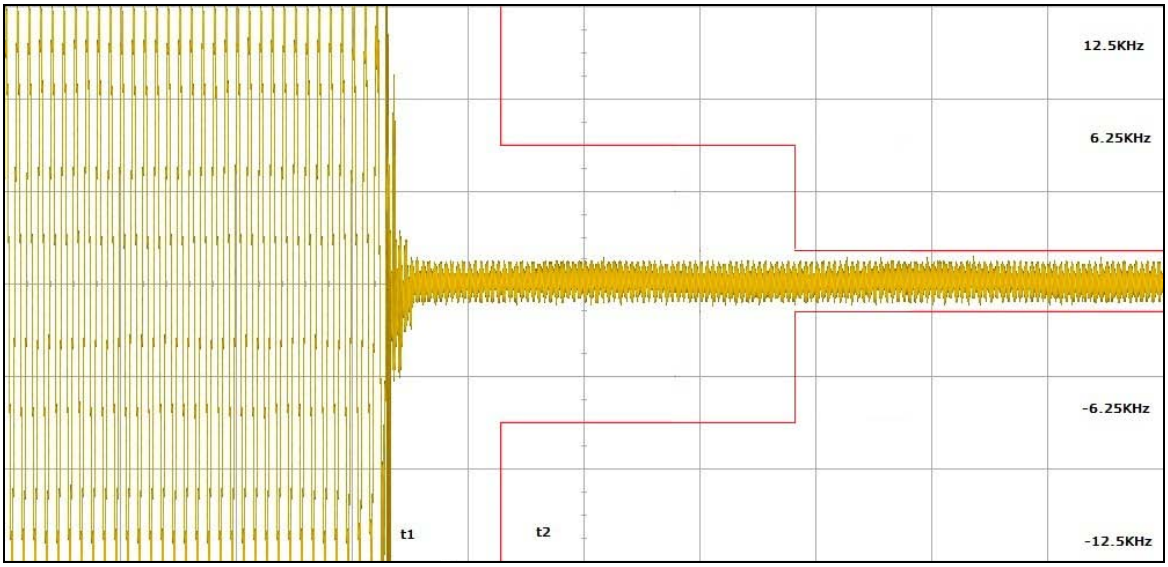
Test Result: PASS



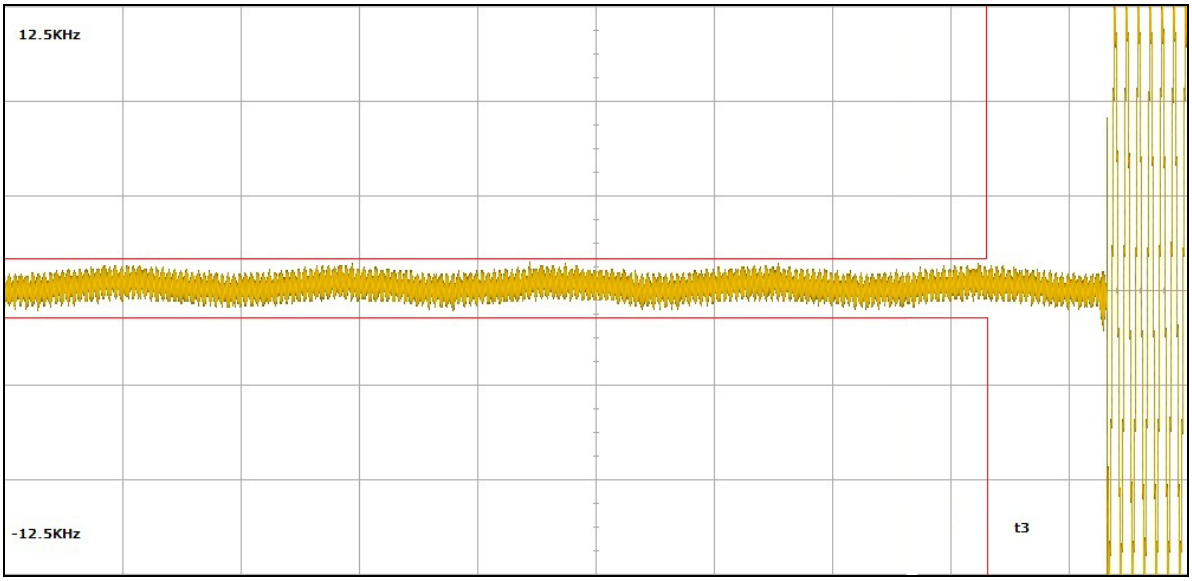
Plot E1 : 155.025MHz @ 12.5 KHz Channel Separation –Off to On



Plot E2 : 155.025MHz @ 12.5 KHz Channel Separation –On to Off



Plot E3 : 440.025MHz @ 12.5 KHz Channel Separation –Off to On



Plot E4: 440.025MHz @ 12.5 KHz Channel Separation –On to Off

**** END OF REPORT ****