

FCC PART 90 TEST REPORT

For

BTECH (BAOFENG TECH)

702 N Industrial Ave, Arlington, South Dakota, United States

FCC ID: 2AGNDUV50X3

Report Type: Original Report	Product Type: Mobile Radio
Test Engineer: <u>Dean Liu</u> <i>Dean Liu</i>	
Report Number: <u>RXM160406050-00</u>	
Report Date: <u>2016-05-24</u>	
Reviewed By: <u>Jerry Zhang</u> <i>Jerry Zhang</i> EMC Manager	
Test Laboratory: Bay Area Compliant Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn	

Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliant Laboratories Corp.

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *BTECH (BAOFENG TECH)*'s product, model: *UV-50X3 (FCC ID: 2AGNDUV50X3)* (the "EUT") in this report is a *Mobile Radio*, which was measured approximately: 16.0 cm (L) x 13.5 cm (W) x 4.5 cm (H), rated input voltage: DC13.8V from battery.

** All measurement and test data in this report was gathered from production sample serial number: 160406050. The EUT was received on 2016-04-08.*

Objective

This test report is prepared on behalf of *BTECH (BAOFENG TECH)* in accordance with Part 2, Part 90 of the Federal Communications Commission rules.

Related Submittal(s)/Grant(s)

No related submittal(s).

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA-603-D.

All emissions measurement was performed and Bay Area Compliant Laboratories Corp. (Dongguan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Test Facility

The Test site used by Bay Area Compliant Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliant Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in Compliant with the requirements of Section 2.948 of the FCC Rules on February 06, 2015.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode.

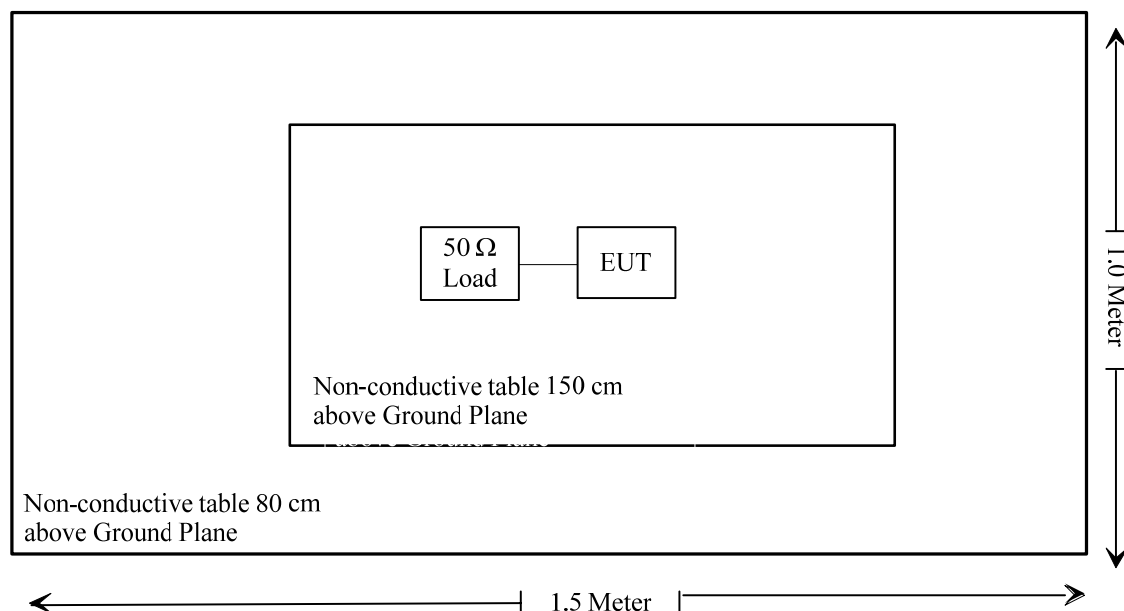
EUT Specification:

Frequency Band	VHF: 136-174 MHz UHF: 400-480MHz
Modulation Mode	FM
Channel Spacing	6.25 kHz ,12.5kHz
12.5 kHz Rated Output Power	VHF&UHF: High: 50W, Middle:20W, Low: 5W
6.25 kHz Rated Output Power	VHF&UHF: 1W

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	50 Load Teminal	100W	/

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
FCC§1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§2.1046;§90.205	RF Output Power	Compliant
§2.1047;§90.207	Modulation Characteristic	Compliant
§2.1049;§90.209; §90.210	Occupied Bandwidth & Emission Mask	Compliant
§2.1051;§90.210	Spurious Emission at Antenna Terminal	Compliant
§2.1053;§90.210	Spurious Radiated Emissions	Compliant
§2.1055; §90.213	Frequency Stability	Compliant
§90.214	Transient Frequency Behavior	Compliant

FCC §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for Maximum Permissible Exposure (MPE)

Limits for Occupational/Controlled Exposure				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E , H or S (minutes)
0.3- 3.0	614	1.63	(100)*	6
3.0 - 30	1842/f	4.89/f	(900/f ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6

f = frequency in MHz;

* = Plane-wave equivalent power density;

MPE Calculation

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where: S = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

MPE Results

The device support VHF and UHF, the highest Power is 50+/-1W for UHF band, and 50+/-1W for VHF band:

Frequency Bands	Antenna Gain		Max. Conducted Output Power	Output Power* 50% duty cycle (PTT)	P*G	S _{limit}
	(dBi)	(numeric)	(W)	(W)	(mW)	(mW/cm ²)
VHF(136-174MHz)	3.5	2.24	51	25.5	57087	1.0
UHF(400-480MHz)	3.5	2.24	51	25.5	57087	1.33

$$S = PG/4\pi R^2$$

$$\Rightarrow R^2 = PG/(S*4\pi)$$

$$\Rightarrow R^2 \text{ should more than } PG/(S_{\text{limit}}*4\pi)$$

For VHF:

$$R_{\text{VHF}} > [57087/(1 \times 4 \times 3.14)]^{0.5} = 67.4 \text{ cm}$$

For UHF:

$$R_{\text{UHF}} > [57087/(1.33 \times 4 \times 3.14)]^{0.5} = 58.4 \text{ cm}$$

Result: Compliance, The device meets MPE requirement for Occupational/Controlled use at 70 cm distance(> 67.4cm).

FCC §2.1046 & §90.205- RF OUTPUT POWER

Applicable Standard

FCC §2.1046 and §90.205.

Test Procedure

Conducted RF Output Power:

TIA-603-D section 2.2.1

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Spectrum Analyzer setting:

RBW	VBW
100 kHz	300 kHz

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE23437	2015-11-23	2016-11-22
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2015-07-08	2016-07-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2015-07-08	2016-07-08
N/A	Coaxial Cable	0.1m	N/A	2015-07-08	2016-07-08

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	26.5°C
Relative Humidity:	58 %
ATM Pressure:	100.5 kPa

The testing was performed by Dean Liu on 2016-04-15.

Test Result: Compliant. Please refer to following tables.

FM modulation,

Channel Spacing	Band	f_c	Reading (w)			Note
		MHz	High Power Level	Middle Power Level	Low Power Level	
12.5kHz	VHF	136.0125	50.01	20.03	5.05	Not for FCC Review
		155.0000	50.02	20.04	5.03	/
		173.9875	50.01	20.01	5.04	/
	UHF	400.0125	50.02	20.04	5.04	Not for FCC Review
		440.0000	50.03	20.03	5.06	/
		479.9875	50.01	20.03	5.02	/
6.25kHz	VHF	136.0125	1.05	/	/	Not for FCC Review
		155.0000	1.06	/	/	/
		173.9875	1.04	/	/	/
	UHF	400.0125	1.02	/	/	Not for FCC Review
		440.0000	1.05	/	/	/
		479.9875	1.03	/	/	/

Note: the rated power is 1W for 6.25kHz, 50W for 12.5kHz high power level, 20W for 12.5kHz Middle Power level, 5W for 12.5kHz Low Power level.

FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC**Applicable Standard**

FCC§2.1047 & §90.207:

- (a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
- (b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

Test Procedure

Test Method: TIA/EIA-603 2.2.3

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	RF Communications Test Set	8920A	00 235	2015-07-18	2016-07-17
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2015-07-08	2016-07-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2015-07-08	2016-07-08
N/A	Coaxial Cable	0.1m	N/A	2015-07-08	2016-07-08

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	26.5°C
Relative Humidity:	58 %
ATM Pressure:	100.5 kPa

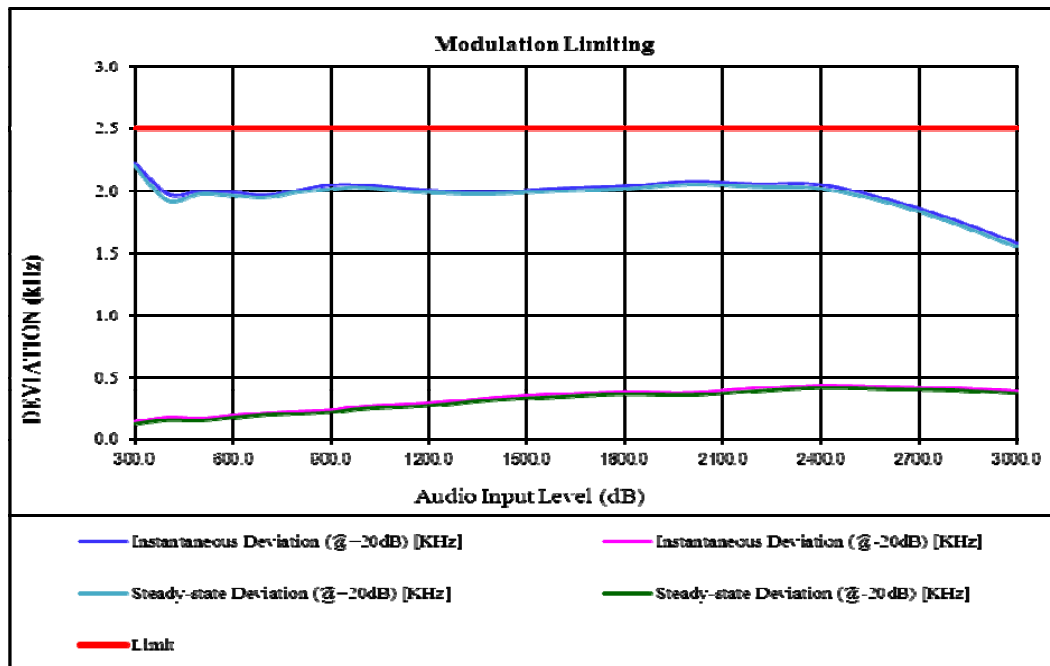
The testing was performed by Dean Liu on 2016-04-15.

Test Result: Compliant. Please refer to following table and plots.

MODULATION LIMITING

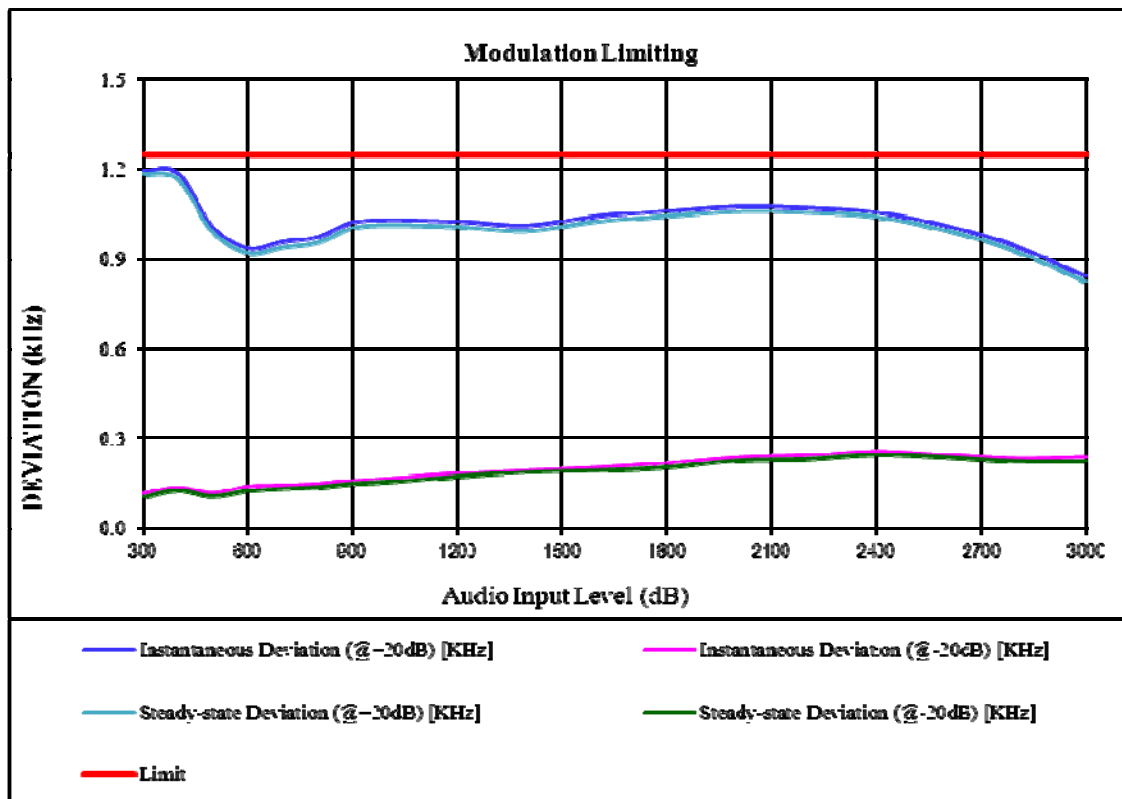
Carrier Frequency: 155 MHz, Channel Spacing = 12.5 kHz

Audio Frequency (Hz)	Instantaneous		Steady-state		Limit [kHz]
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	2.224	0.138	2.201	0.121	2.5
400	1.976	0.174	1.921	0.152	2.5
500	1.992	0.166	1.974	0.149	2.5
600	1.985	0.189	1.961	0.172	2.5
700	1.963	0.211	1.945	0.194	2.5
800	2.004	0.224	1.989	0.204	2.5
900	2.045	0.234	2.012	0.216	2.5
1000	2.044	0.266	2.024	0.245	2.5
1200	2.005	0.292	1.985	0.271	2.5
1400	1.992	0.336	1.976	0.317	2.5
1600	2.019	0.366	1.998	0.343	2.5
1800	2.036	0.385	2.014	0.365	2.5
2000	2.074	0.379	2.052	0.358	2.5
2200	2.055	0.416	2.032	0.391	2.5
2400	2.049	0.437	2.017	0.417	2.5
2600	1.931	0.429	1.908	0.408	2.5
2800	1.772	0.418	1.747	0.399	2.5
3000	1.579	0.392	1.549	0.373	2.5



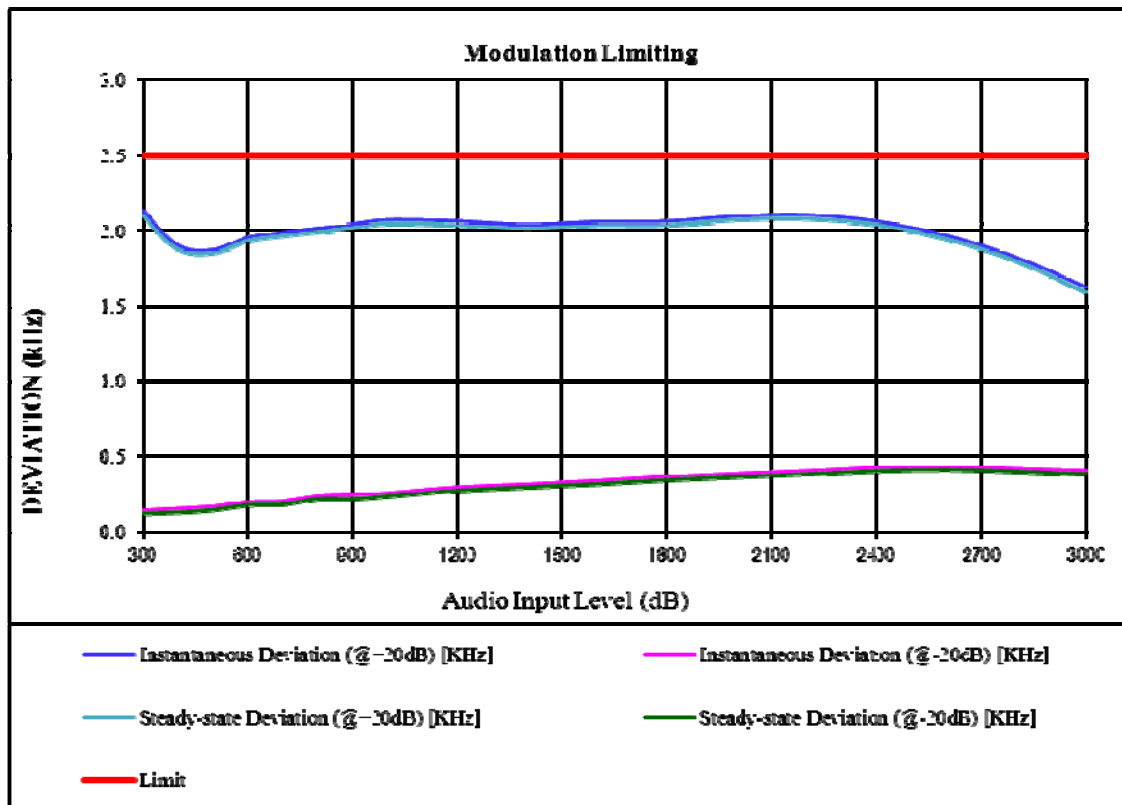
Carrier Frequency: 155 MHz, Channel Spacing = 6.25 kHz

Audio Frequency (Hz)	Instantaneous		Steady-state		Result
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	1.193	0.115	1.187	0.103	pass
400	1.187	0.135	1.169	0.125	pass
500	1.005	0.117	0.991	0.107	pass
600	0.936	0.138	0.921	0.124	pass
700	0.957	0.141	0.939	0.131	pass
800	0.973	0.146	0.954	0.136	pass
900	1.022	0.158	1.003	0.147	pass
1000	1.031	0.165	1.013	0.153	pass
1200	1.026	0.182	1.008	0.172	pass
1400	1.012	0.193	0.994	0.187	pass
1600	1.044	0.202	1.026	0.193	pass
1800	1.061	0.217	1.044	0.203	pass
2000	1.076	0.236	1.059	0.226	pass
2200	1.072	0.243	1.056	0.231	pass
2400	1.057	0.256	1.042	0.245	pass
2600	1.011	0.245	0.995	0.237	pass
2800	0.943	0.233	0.926	0.224	pass
3000	0.842	0.237	0.824	0.223	pass



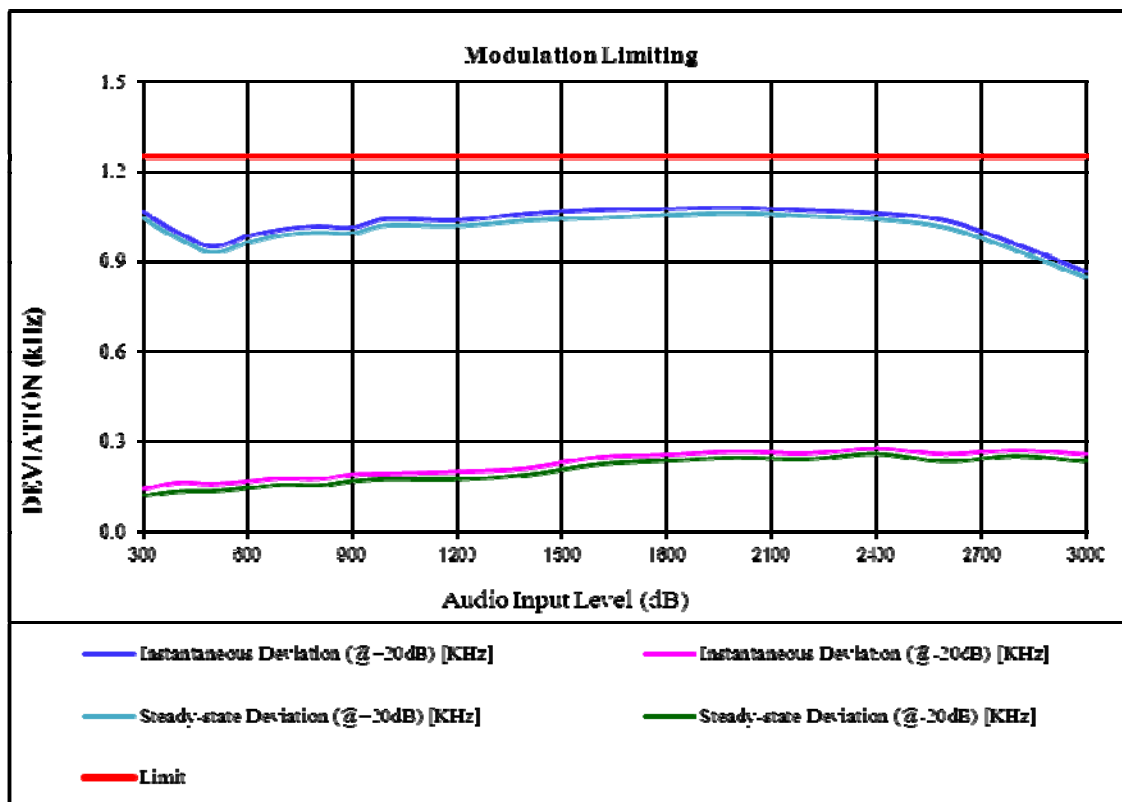
Carrier Frequency: 440 MHz, Channel Spacing =12.5 kHz

Audio Frequency (Hz)	Instantaneous		Steady-state		Limit [kHz]
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	2.123	0.143	2.094	0.122	2.5
400	1.902	0.155	1.879	0.131	2.5
500	1.873	0.168	1.851	0.146	2.5
600	1.954	0.198	1.933	0.177	2.5
700	1.987	0.204	1.965	0.181	2.5
800	2.014	0.237	1.991	0.218	2.5
900	2.038	0.244	2.016	0.219	2.5
1000	2.065	0.258	2.043	0.236	2.5
1200	2.058	0.296	2.034	0.275	2.5
1400	2.035	0.315	2.013	0.296	2.5
1600	2.054	0.339	2.033	0.317	2.5
1800	2.057	0.365	2.034	0.343	2.5
2000	2.089	0.386	2.067	0.363	2.5
2200	2.098	0.404	2.073	0.382	2.5
2400	2.057	0.426	2.037	0.403	2.5
2600	1.968	0.433	1.946	0.412	2.5
2800	1.823	0.419	1.801	0.399	2.5
3000	1.625	0.405	1.593	0.382	2.5



Carrier Frequency: 440 MHz, Channel Spacing =6.25 kHz

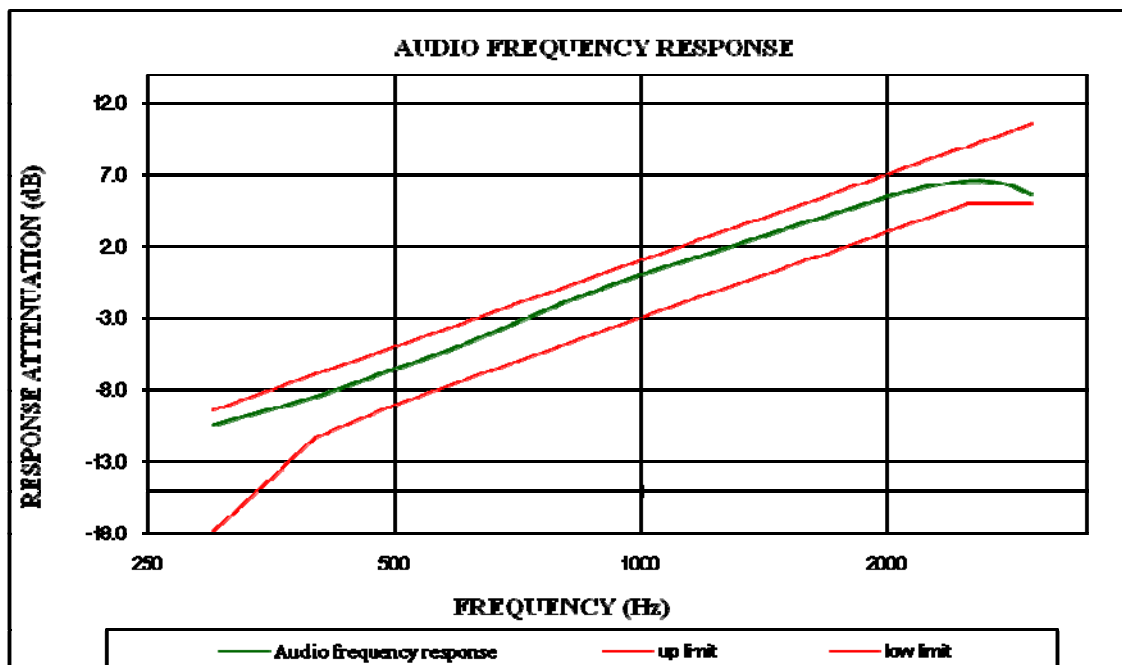
Audio Frequency (Hz)	Instantaneous		Steady-state		Result
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	1.062	0.139	1.041	0.117	pass
400	0.995	0.161	0.976	0.131	pass
500	0.948	0.157	0.928	0.133	pass
600	0.983	0.165	0.961	0.143	pass
700	1.005	0.176	0.986	0.154	pass
800	1.015	0.174	0.994	0.152	pass
900	1.011	0.189	0.992	0.166	pass
1000	1.039	0.192	1.018	0.173	pass
1200	1.035	0.198	1.016	0.173	pass
1400	1.057	0.209	1.034	0.188	pass
1600	1.069	0.245	1.043	0.221	pass
1800	1.074	0.253	1.052	0.233	pass
2000	1.078	0.264	1.059	0.243	pass
2200	1.068	0.258	1.049	0.238	pass
2400	1.059	0.275	1.038	0.256	pass
2600	1.034	0.256	1.011	0.231	pass
2800	0.956	0.269	0.935	0.249	pass
3000	0.865	0.255	0.846	0.231	pass



Audio Frequency Response

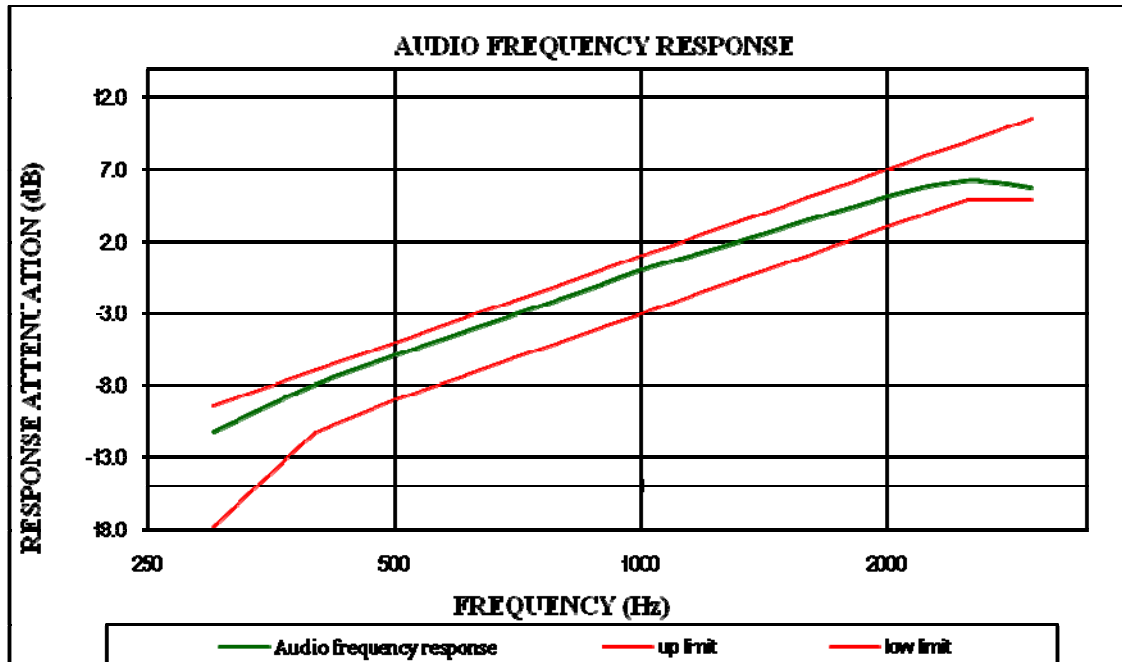
Carrier Frequency: 155 MHz, Channel Spacing = 12.5 kHz

Audio Frequency (Hz)	Response Attenuation (dB)
300	-10.44
400	-8.46
500	-6.56
600	-5.01
700	-3.38
800	-2.04
900	-0.94
1000	0.00
1200	1.47
1400	2.66
1600	3.74
1800	4.63
2000	5.43
2200	6.03
2400	6.47
2600	6.59
2800	6.31
3000	5.61



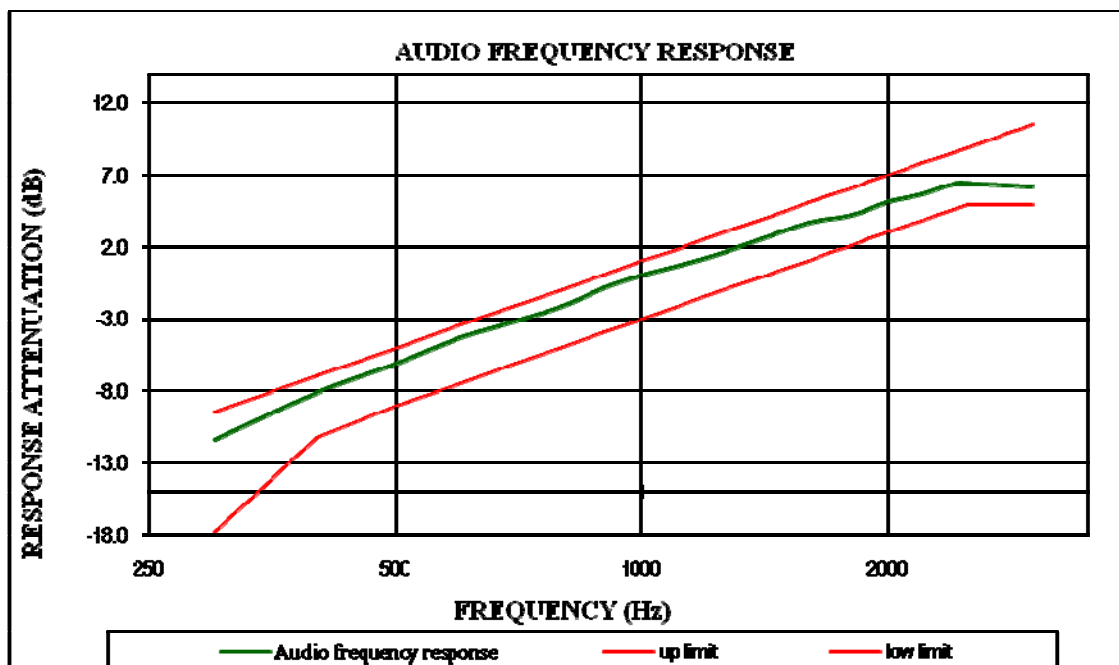
Carrier Frequency: 440 MHz, Channel Spacing = 12.5 kHz

Audio Frequency (Hz)	Response Attenuation (dB)
300	-11.21
400	-7.95
500	-5.95
600	-4.42
700	-3.11
800	-1.98
900	-0.93
1000	0.00
1200	1.31
1400	2.47
1600	3.47
1800	4.38
2000	5.13
2200	5.74
2400	6.13
2600	6.22
2800	5.98
3000	5.71



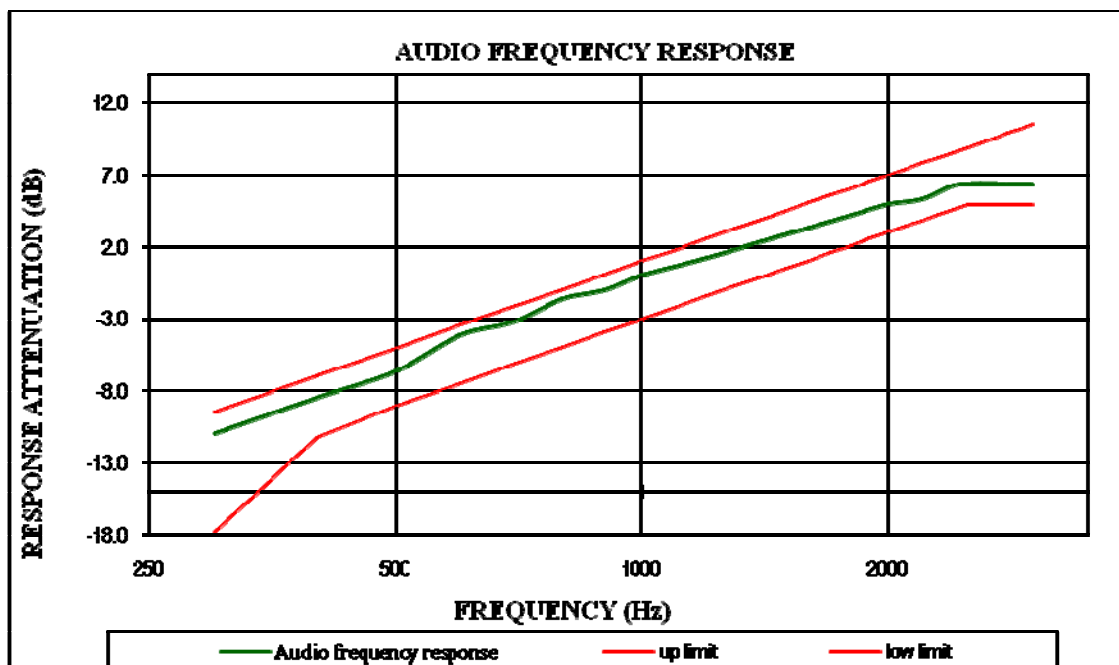
Carrier Frequency: 155 MHz, Channel Spacing = 6.25 kHz

Audio Frequency (Hz)	Response Attenuation (dB)
300	-11.37
400	-8.06
500	-6.07
600	-4.31
700	-3.19
800	-2.17
900	-0.84
1000	0.00
1200	1.24
1400	2.56
1600	3.68
1800	4.16
2000	5.11
2200	5.69
2400	6.39
2600	6.34
2800	6.27
3000	6.15



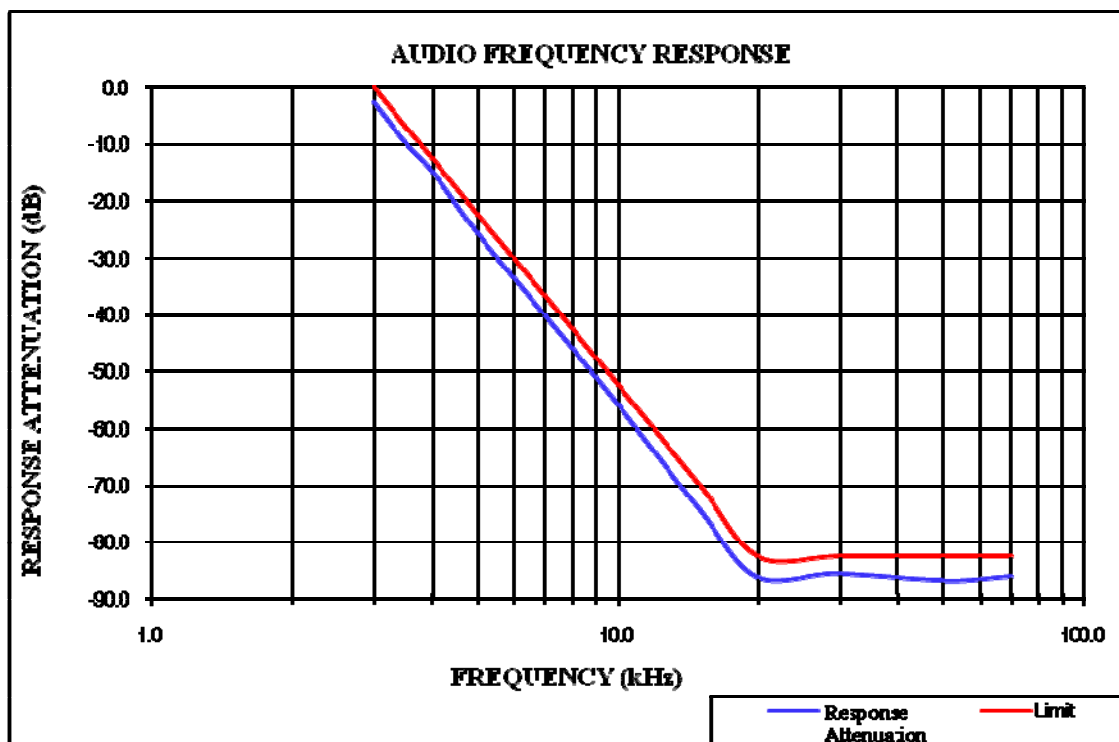
Carrier Frequency: 440 MHz, Channel Spacing = 6.25 kHz

Audio Frequency (Hz)	Response Attenuation (dB)
300	-10.97
400	-8.42
500	-6.61
600	-4.11
700	-3.19
800	-1.58
900	-0.97
1000	0.00
1200	1.21
1400	2.37
1600	3.34
1800	4.21
2000	4.99
2200	5.32
2400	6.28
2600	6.44
2800	6.39
3000	6.31



Audio Frequency Low Pass Filter Response

Audio Frequency	Response Attenuation	Limit
kHz	dB	dB
3.0	-2.5	0.0
3.5	-9.6	-6.7
4.0	-14.7	-12.5
5.0	-25.6	-22.2
7.0	-40.1	-36.8
10.0	-55.8	-52.3
15.0	-74.3	-69.9
20.0	-86.1	-82.5
30.0	-85.5	-82.5
50.0	-86.7	-82.5
70.0	-85.9	-82.5



FCC §2.1049&§90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK

Applicable Standard

FCC §2.1049, §90.209 and §90.210

Applicable Emission Masks		
Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25	A or B	A or C
25-50	B	C
72-76	B	C
150-174	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854	B	H
809-824/854-869	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M
5850-5925		
All other bands	B	C

Emission Mask D—12.5 kHz channel bandwidth 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 removed 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.
- (4) The reference level for showing Compliant with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show Compliant with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

(e) *Emission Mask E—6.25 kHz or less channel bandwidth equipment.* For transmitters designed to operate with a 6.25 kHz or less 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 removed 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 $30 + 16.67(f_d - 3 \text{ kHz})$ or $55 + 10 \log (P)$ or 65 dB, 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 $55 + 10 \log (P)$ or 65 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE23437	2015-11-23	2016-11-22
HP	RF Communications Test Set	8920A	00 235	2015-07-18	2016-07-17
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2015-07-08	2016-07-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2015-07-08	2016-07-08
N/A	Coaxial Cable	0.1m	N/A	2015-07-08	2016-07-08

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Test Data

Environmental Conditions

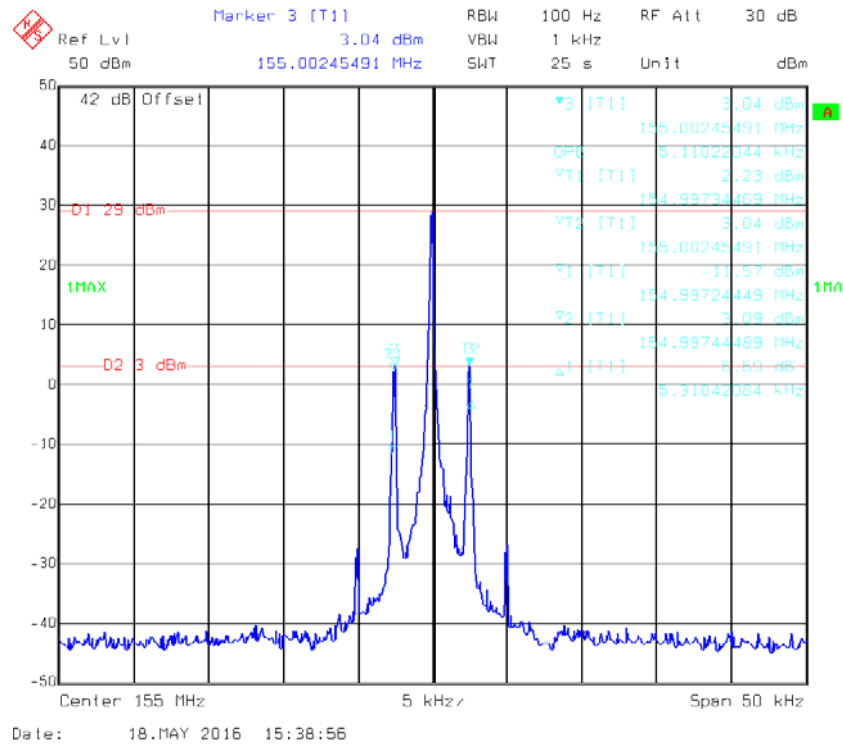
Temperature:	26.5~28.4 °C
Relative Humidity:	50~58 %
ATM Pressure:	100.5~100.6Pa

The testing was performed by Dean Liu on 2016-04-15 & 2016-05-18.

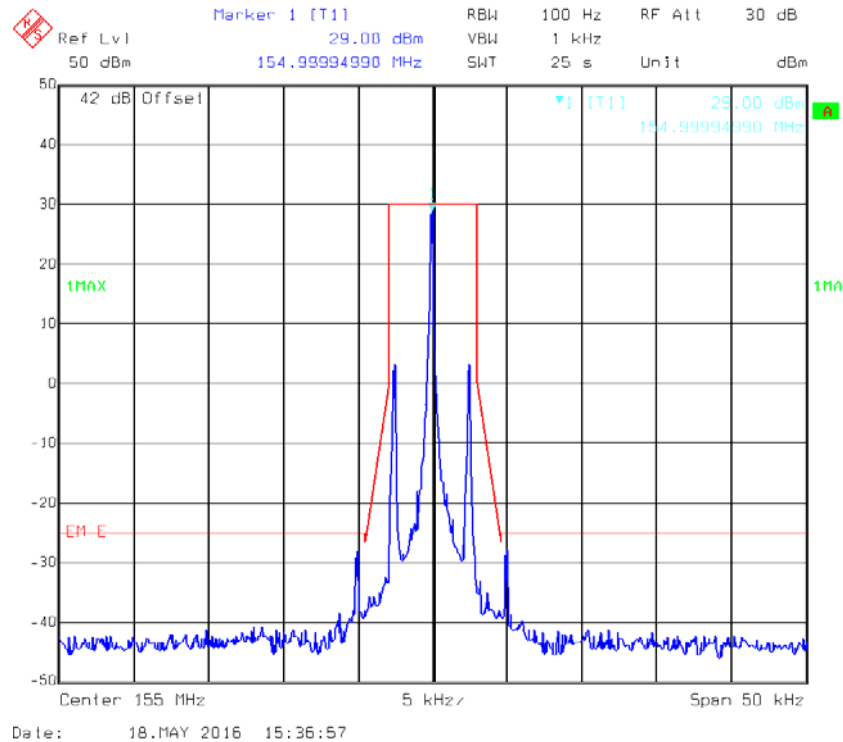
Test Result: Compliant. Please refer to the following tables and plots.

Modulation Mode	Channel Spacing	f_c	99% Bandwidth	26 dB Bandwidth	Power Level
	kHz	MHz	kHz	kHz	
FM	12.5	155	9.92	10.32	High
			9.92	10.32	Middle
			9.92	10.32	Low
		440	9.92	10.42	High
			9.92	10.32	Middle
			9.92	10.32	Low
	6.25	155	5.11	5.31	High
		440	5.11	5.21	High

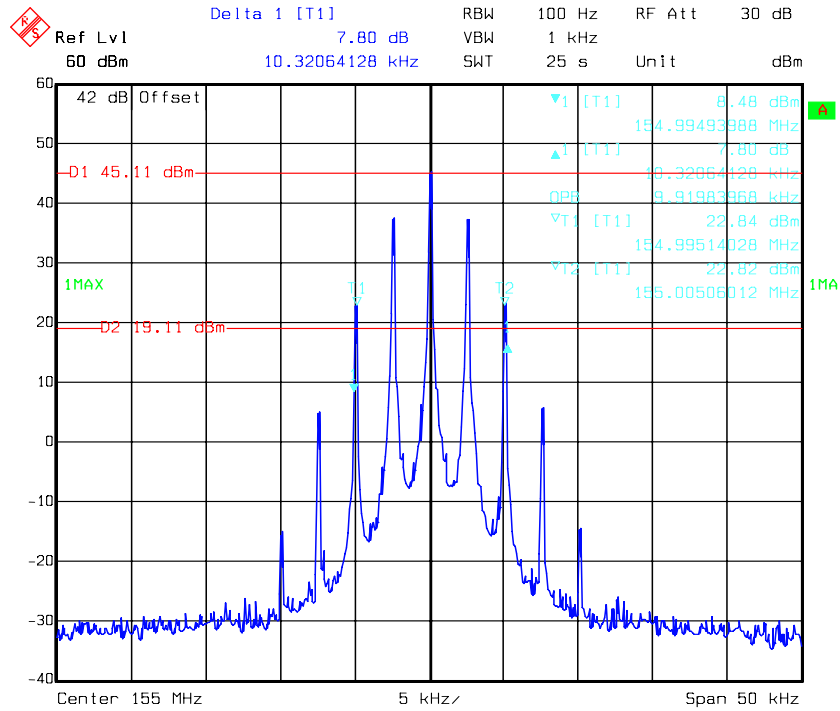
Occupied Bandwidth –6.25kHz, 155 MHz



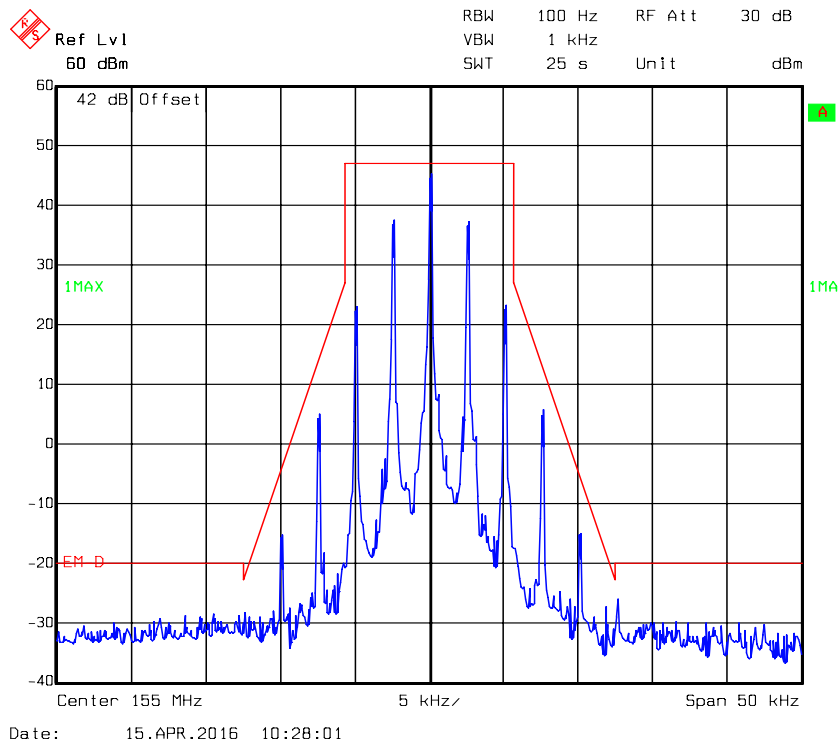
Emission Mask - Type E



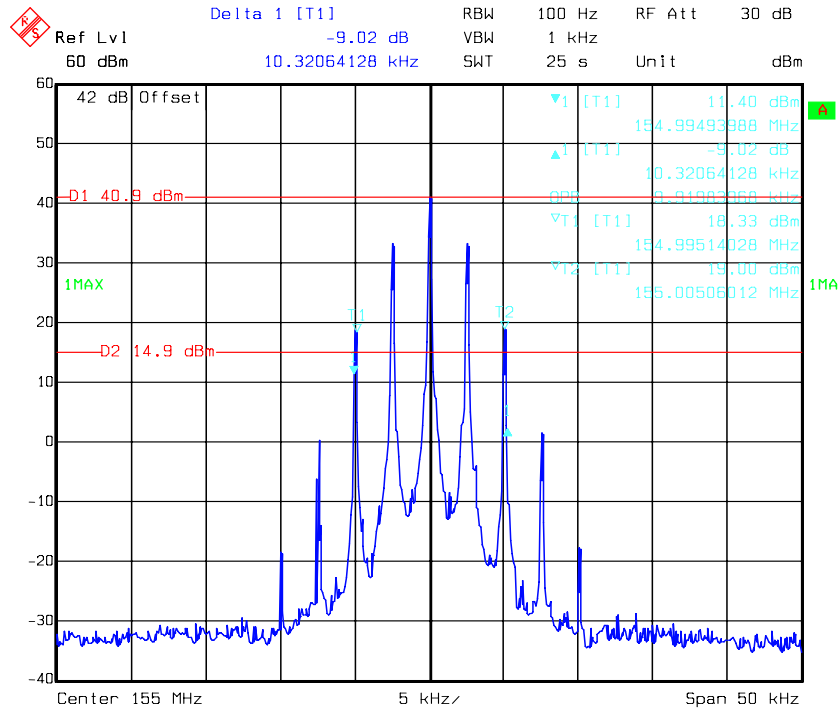
Occupied Bandwidth –12.5kHz, 155 MHz, High Power Level



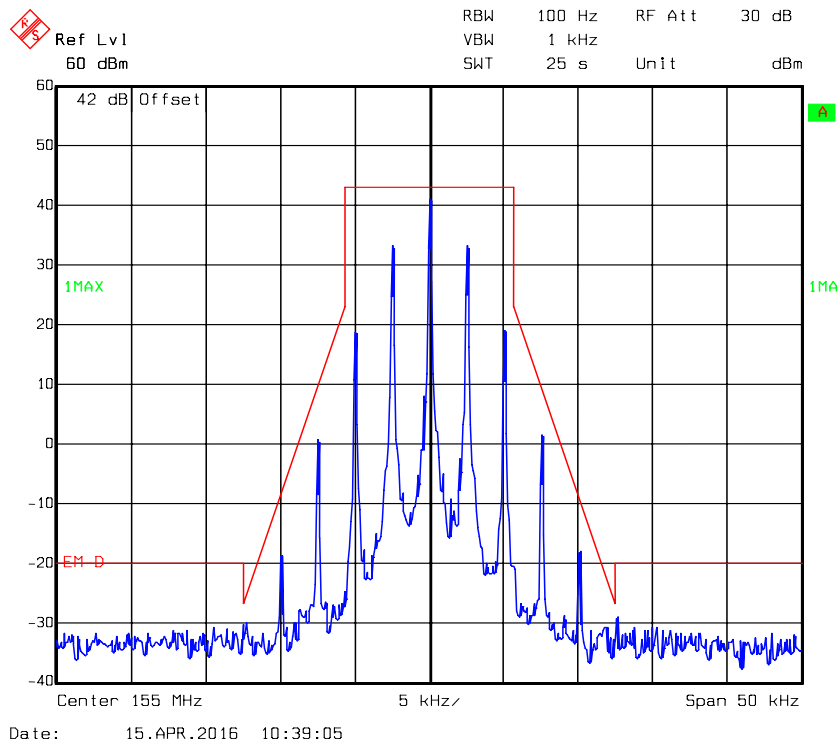
Emission Mask - Type D



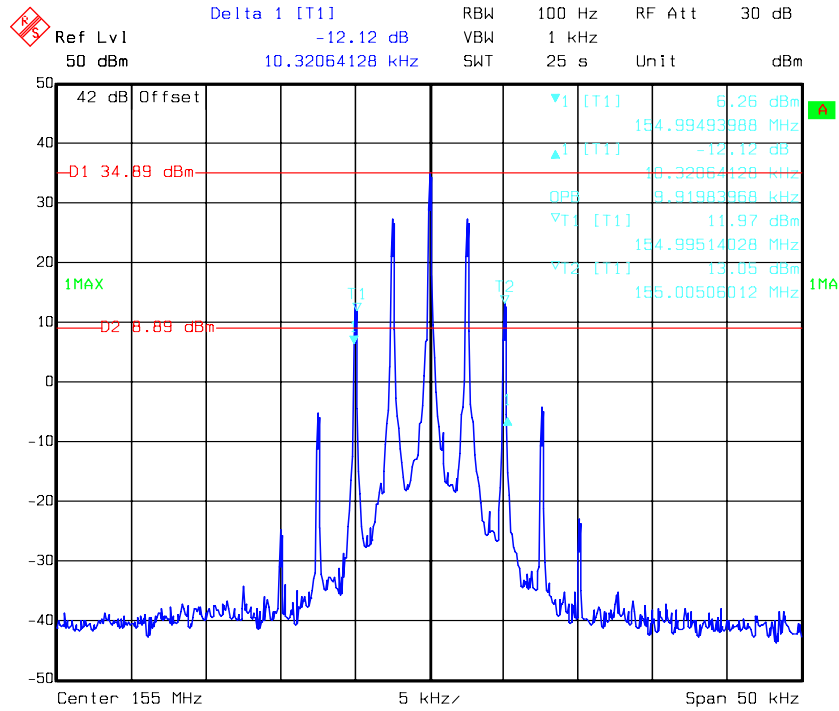
Occupied Bandwidth -12.5kHz, 155 MHz, Middle Power Level



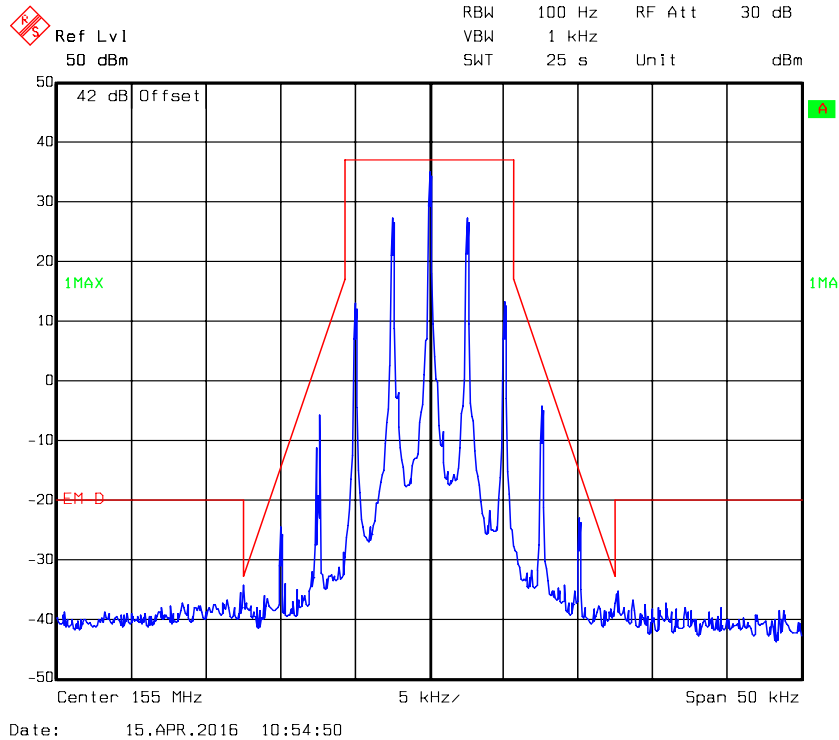
Emission Mask - Type D



Occupied Bandwidth – 12.5kHz, 155 MHz, Low Power Level



Emission Mask - Type D



K

Ref Lvl 50 dBm Delta 1 [T1] 1.09 dB RBW 100 Hz RF Att 30 dB
 5.21042084 kHz SWT 25 s Unit dBm

42 dB Offset

-29.02 dBm

1MAX

T1 T2

-29.02 dBm

Center 440 MHz 5 kHz Span 50 kHz

Marker	Freq	Power
T1	439.99714429 MHz	0.23 dBm
T2	440.00235471 MHz	1.32 dBm

Ref Lvl 50 dBm

Marker 1 [T1] 29.02 dBm

439.99974950 MHz

RBW 100 Hz

VBW 1 kHz

SWT 25 s

RF Att 30 dB

Unit dBm

42 dB Offset

1MAX

1MAX

EM E

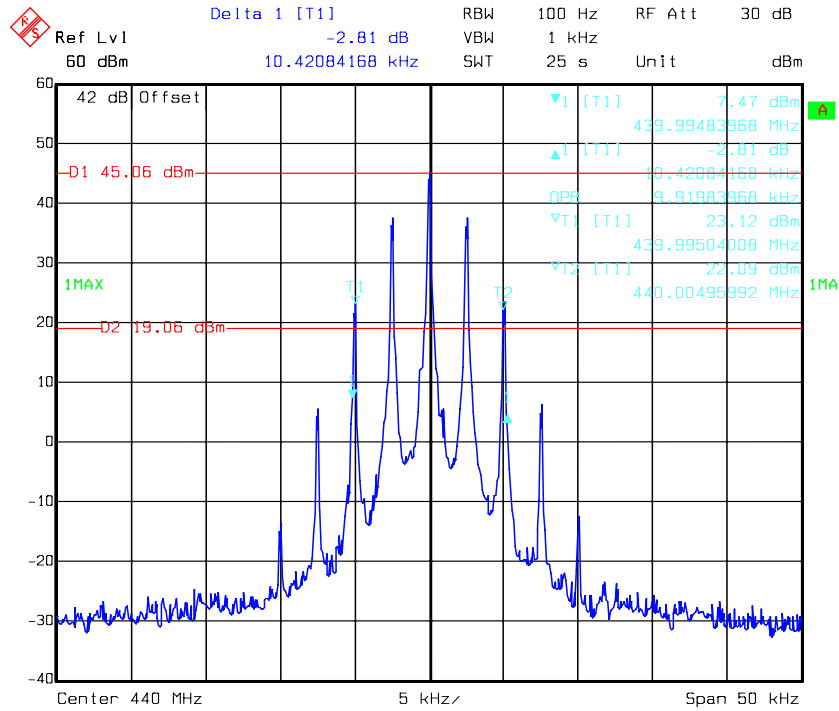
Center 440 MHz

5 kHz

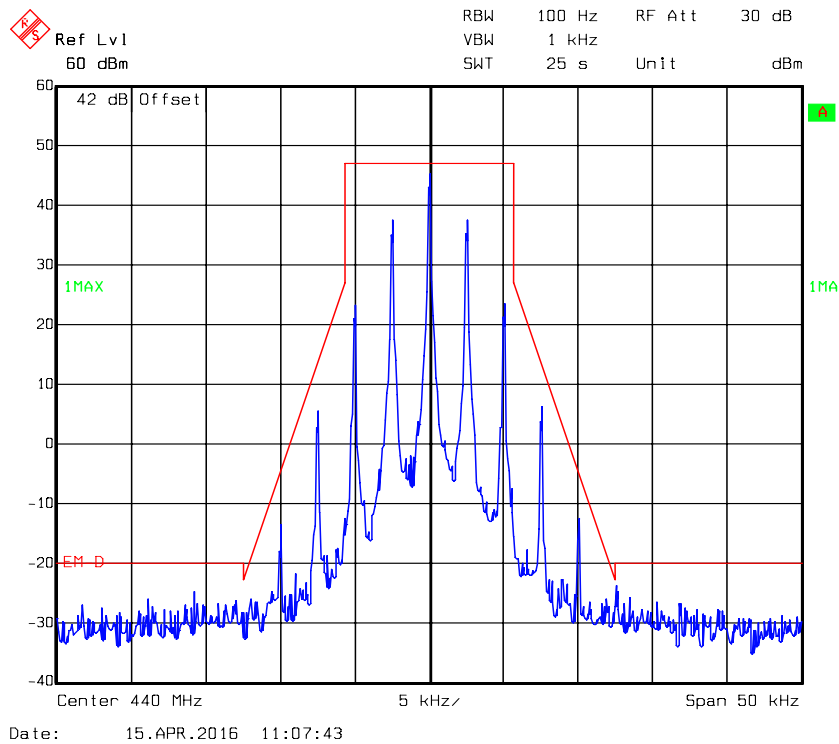
Span 50 kHz

Date: 18.MAY.2016 15:57:28

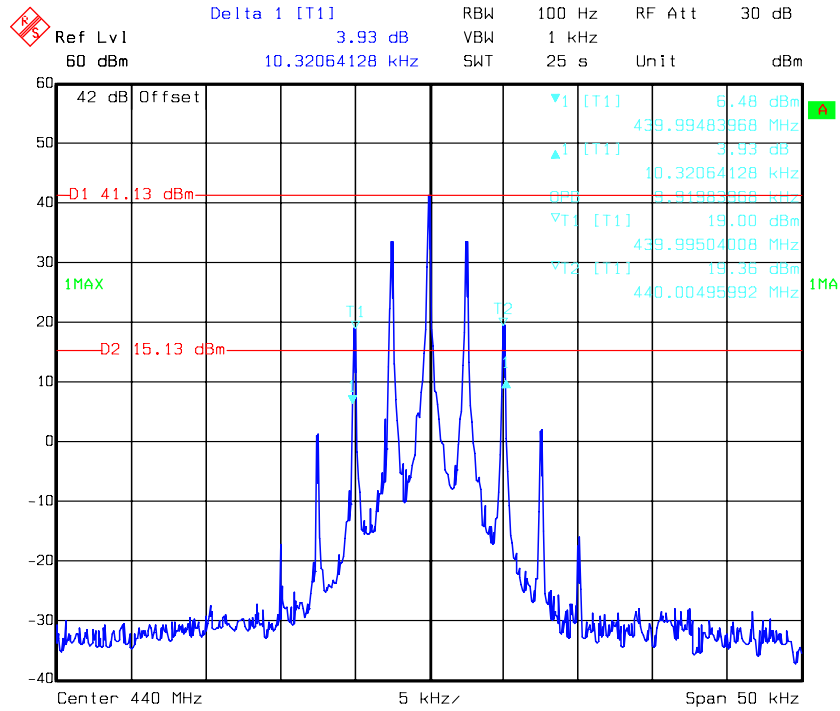
Occupied Bandwidth –12.5kHz, 440 MHz, High Power Level



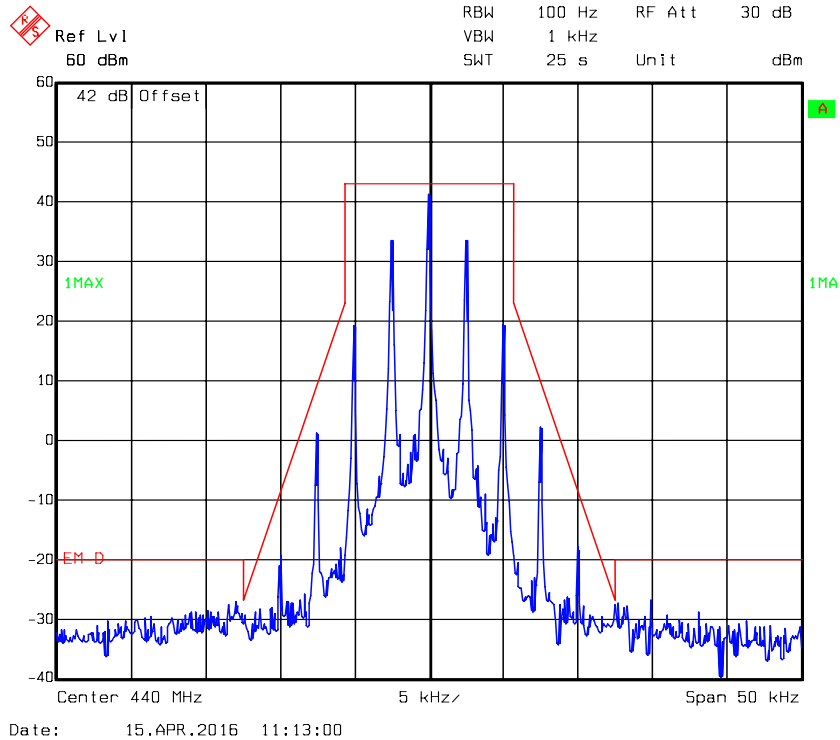
Emission Mask - Type D



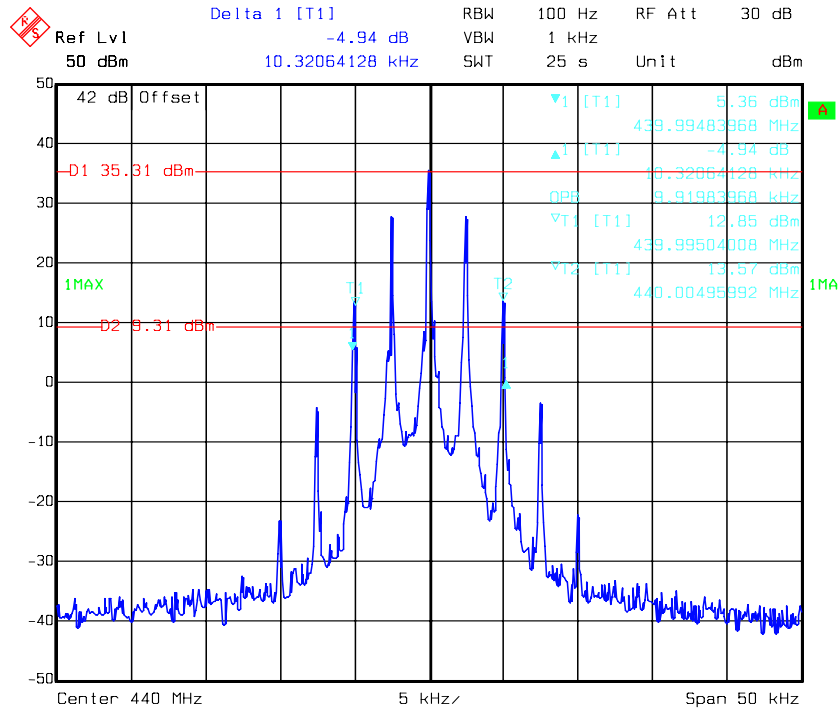
Occupied Bandwidth –12.5kHz, 440 MHz, Middle Power Level



Emission Mask - Type D

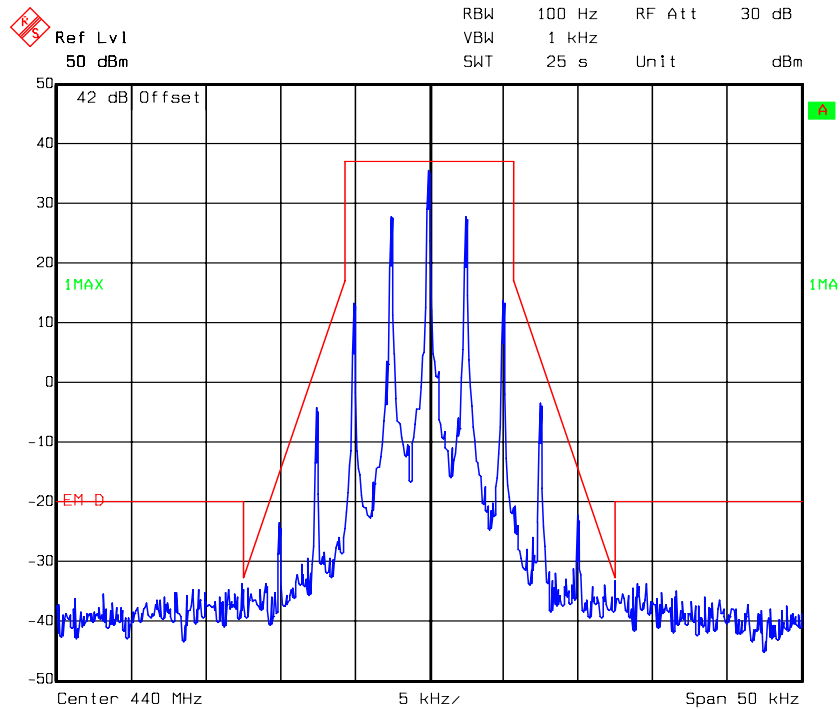


Occupied Bandwidth – 12.5kHz, 440 MHz, Low Power Level



Date: 15.APR.2016 11:16:17

Emission Mask - Type D



Date: 15.APR.2016 11:15:29

FCC §2.1051& §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Applicable Standard

Emission Mask D—12.5 kHz channel bandwidth 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 removed 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.
- (4) The reference level for showing Compliant with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show Compliant with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

Emission Mask E—6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less 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 removed 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 $30 + 16.67(f_d - 3 \text{ kHz})$ or $55 + 10 \log (P)$ or 65 dB, 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 $55 + 10 \log (P)$ or 65 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE23437	2015-11-23	2016-11-22
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2015-07-08	2016-07-08
Mini-Circuits	HIGH PASS FILTER	BHP-550+	YZU15801121	2015-07-08	2016-07-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2015-07-08	2016-07-08
N/A	Coaxial Cable	0.1m	N/A	2015-07-08	2016-07-08

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

Adjust the spectrum analyzer for the following settings:

- 1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
- 2) Video Bandwidth ≥ 3 times the resolution bandwidth.
- 3) Sweep Speed ≤ 2000 Hz per second.
- 4) Detector Mode = mean or average power.

Test Data**Environmental Conditions**

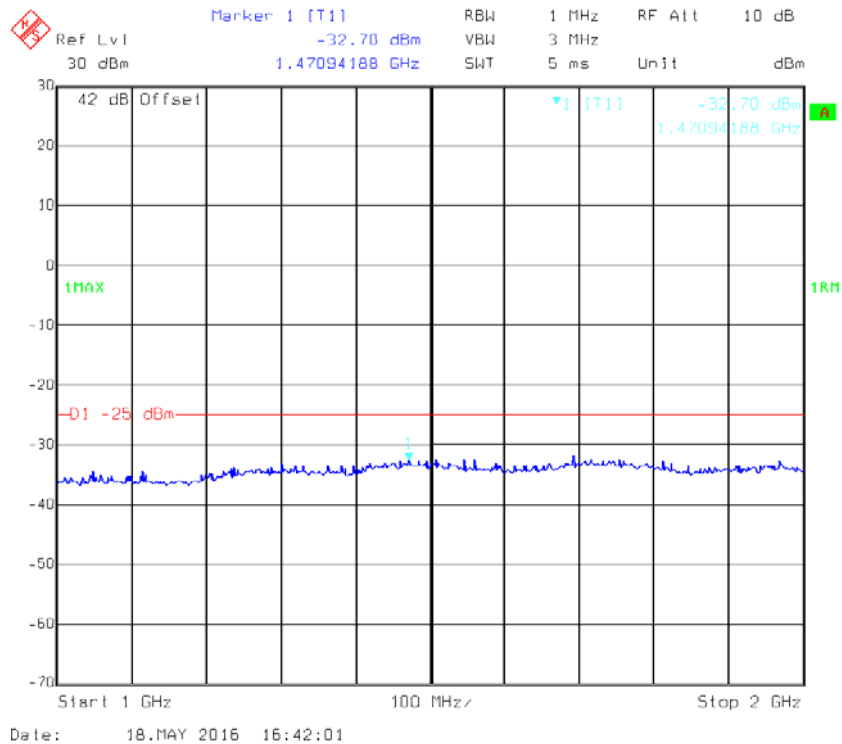
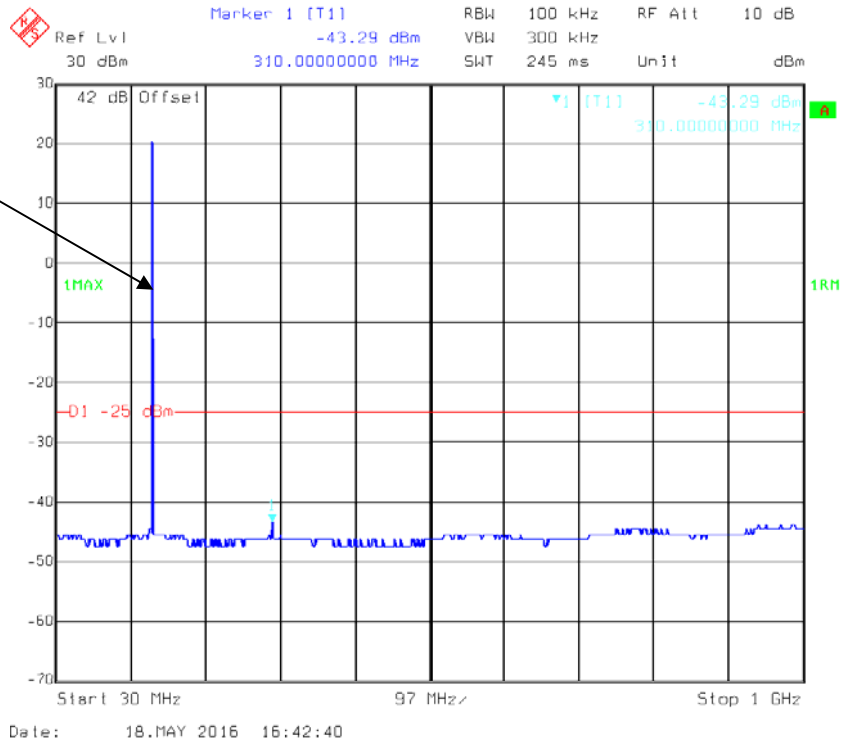
Temperature:	26.5~28.4 °C
Relative Humidity:	50~58 %
ATM Pressure:	100.5~100.6Pa

The testing was performed by Dean Liu on 2016-04-15 & 2016-05-18.

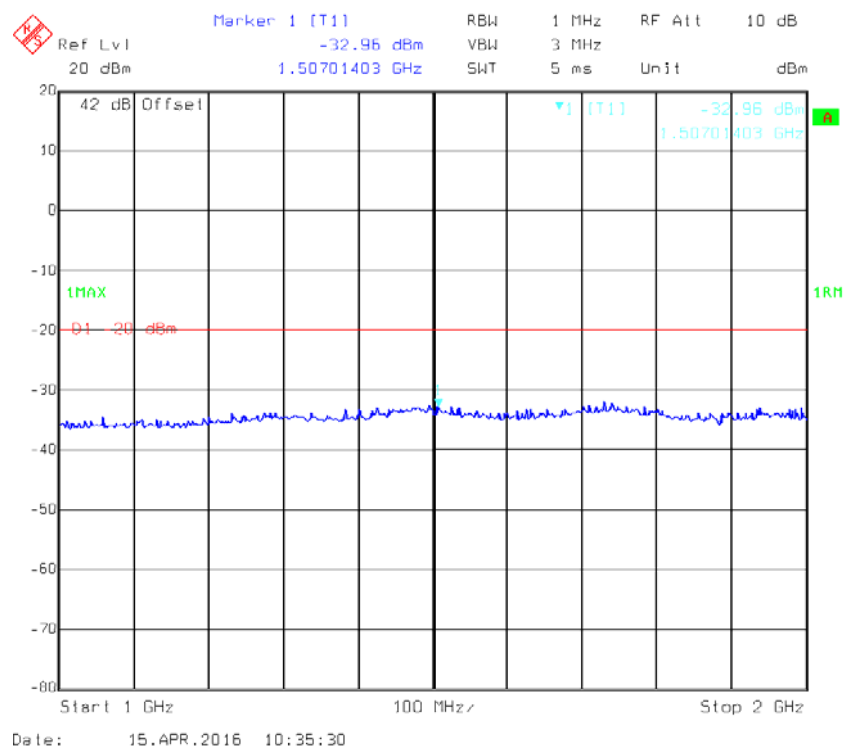
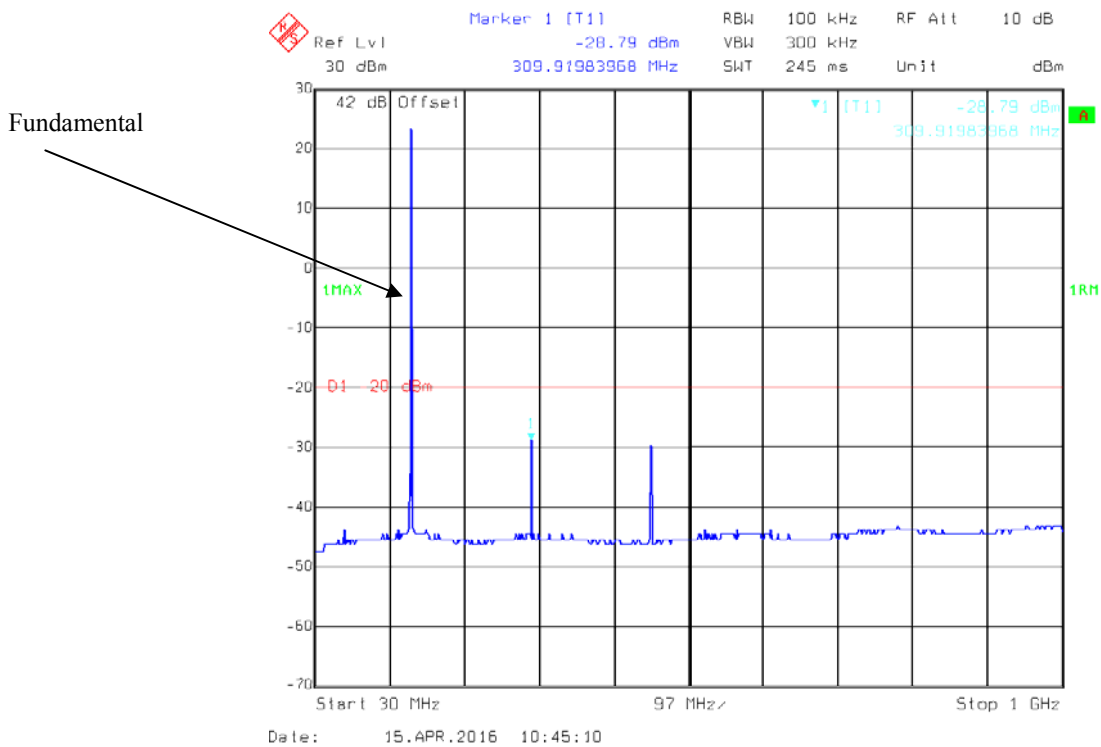
Note: For conducted spurious emissions were tested at high rated power, which was the worst case.

155 MHz – FM Mode, 6.25 kHz

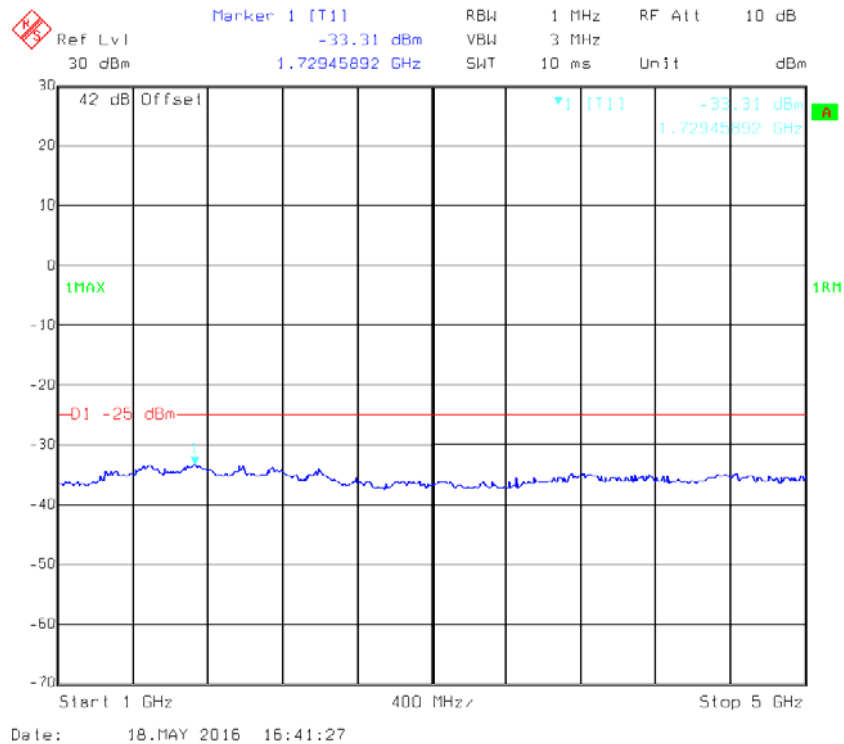
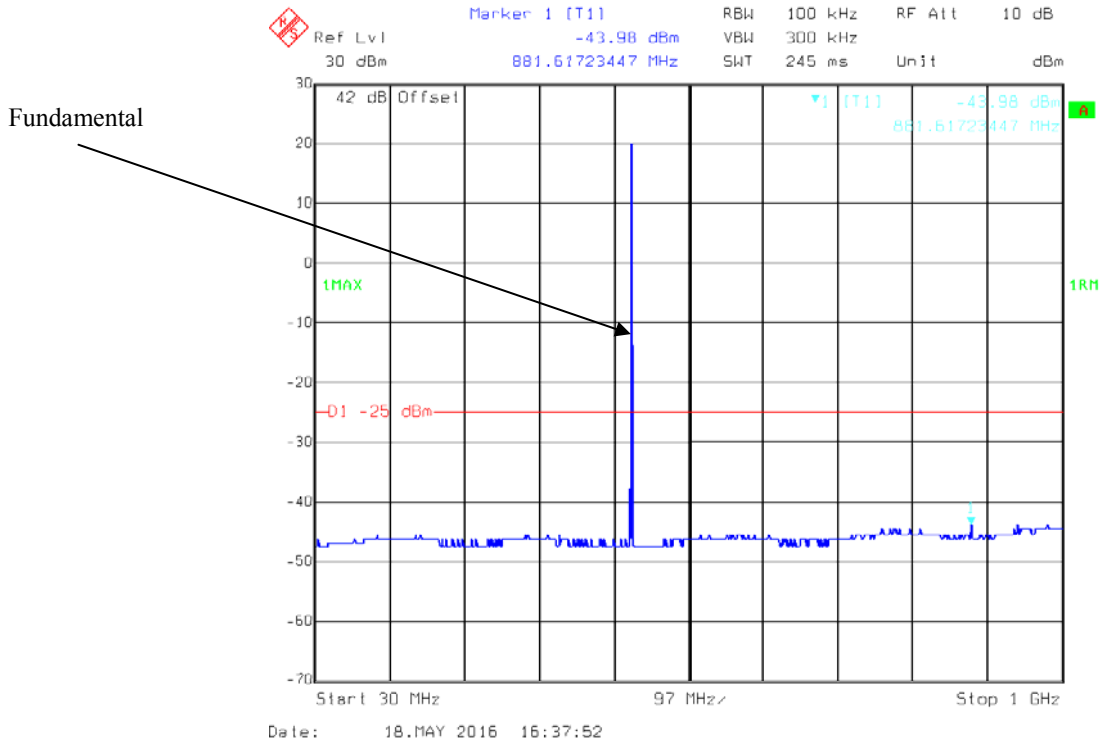
Fundamental



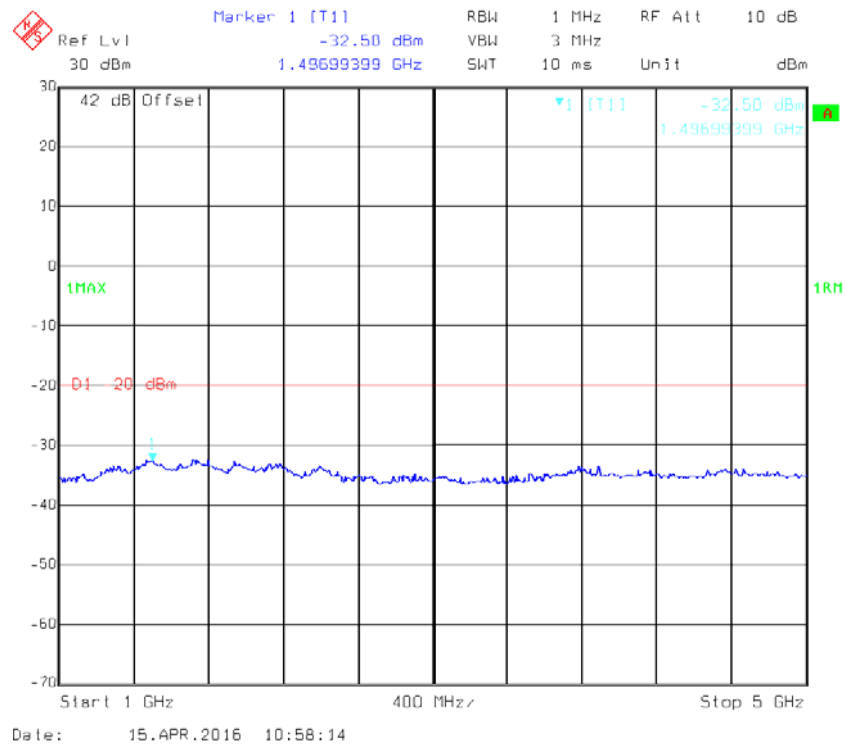
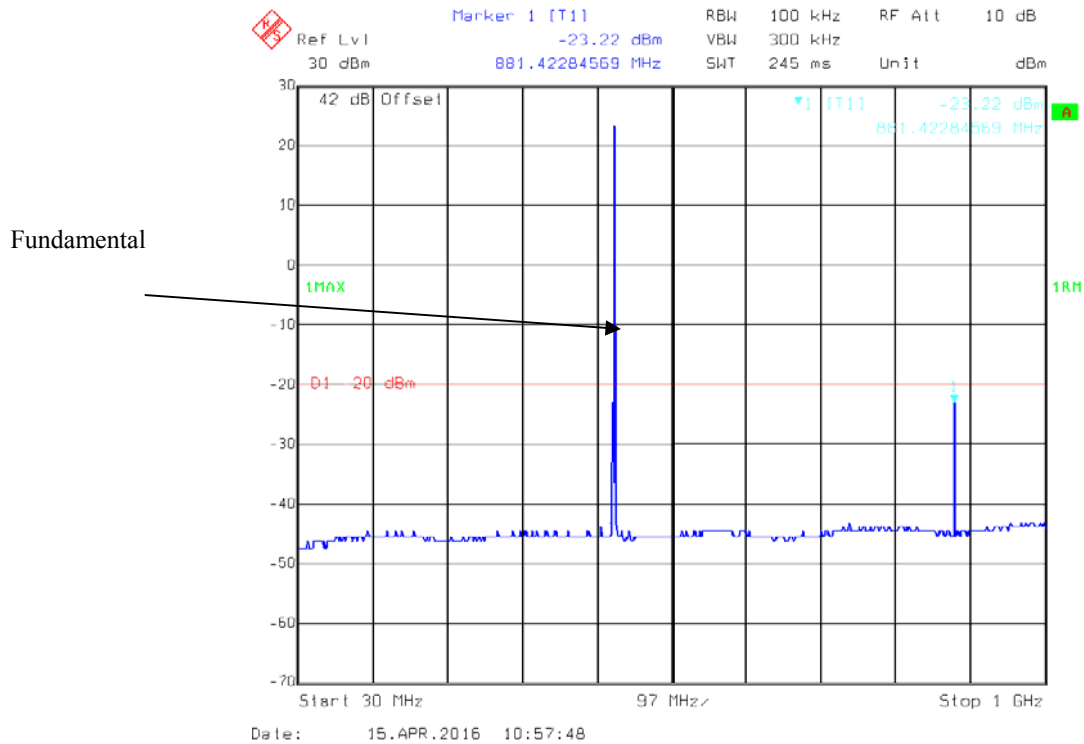
155 MHz – FM Mode, 12.5 kHz, High Power



440 MHz – FM Mode, 6.25 kHz



440 MHz –FM Mode,12.5 kHz,High Power



FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053 and §22.359 and §90.210

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2015-08-03	2016-08-02
Sunol Sciences	Antenna	JB3	A060611-3	2014-11-06	2017-11-05
HP	Amplifier	8447E	2434A02181	2015-09-01	2016-09-01
Agilent	Spectrum Analyzer	E4440A	SG43360054	2015-11-23	2016-11-22
ETS-Lindgren	Horn Antenna	3115	9808-5557	2015-09-06	2018-09-06
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2016-02-19	2017-02-19
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-011304	2014-06-16	2017-06-15
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
N/A	Coaxial Cable	14m	N/A	2015-07-08	2016-07-08
N/A	Coaxial Cable	8m	N/A	2015-07-08	2016-07-08
Mini-Circuits	HIGH PASS FILTER	BHP-550+	YZU15801121	2015-07-08	2016-07-08
Weinschel Corp	Terminal Load(100W)	1440-3	MD447	/	/

*** Statement of Traceability:** Bay Area Compliant Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.

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.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

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 spurious emissions were measured by the substitution.

For part 90:

Spurious emissions in dB = $10 \log_{10} (\text{TXpwr in Watts}/0.001)$ - the absolute level

Spurious attenuation limit in dB = $50 + 10 \log_{10}$ (power out in Watts) for EUT with a 12.5 kHz channel bandwidth.

Spurious attenuation limit in dB = $55 + 10 \log_{10}$ (power out in Watts) for EUT with a 6.25 kHz channel bandwidth.

Test Data

Environmental Conditions

Temperature:	25.5°C
Relative Humidity:	72 %
ATM Pressure:	100.6kPa

The testing was performed by Dean Liu on 2016-04-13.

Test Mode: Transmitting

Frequency	Polar	S.A. Reading	S.G. Level	Antenna Gain	Cable Loss	Absolute Level	Limit	Margin
MHz	H/V	dBμV	dBm	dBd/dBi	dB	dBm	dBm	dB
Frequency: 155 MHz, 6.25 kHz								
310.000	H	37.93	-46.7	0.0	0.5	-47.2	-25.0	22.2
310.000	V	43.29	-39.6	0.0	0.5	-40.1	-25.0	15.1
465.000	H	38.92	-42.3	0.0	0.7	-43.0	-25.0	18.0
465.000	V	37.85	-40.5	0.0	0.7	-41.2	-25.0	16.2
620.000	H	37.57	-41.5	0.0	0.8	-42.3	-25.0	17.3
620.000	V	38.11	-38.5	0.0	0.8	-39.3	-25.0	14.3
775.000	H	37.83	-37.8	0.0	0.9	-38.7	-25.0	13.7
775.000	V	38.33	-34.4	0.0	0.9	-35.3	-25.0	10.3
930.000	H	37.16	-36.4	0.0	1	-37.4	-25.0	12.4
930.000	V	37.60	-32.7	0.0	1	-33.7	-25.0	8.7
1085.000	H	41.76	-58.2	7.5	1.3	-52.0	-25.0	27.0
1085.000	V	40.42	-59.9	7.5	1.3	-53.7	-25.0	28.7
1240.000	H	38.36	-62	7.7	1.3	-55.6	-25.0	30.6
1240.000	V	36.29	-64.1	7.7	1.3	-57.7	-25.0	32.7
1395.000	H	38.90	-61.8	8.9	1.5	-54.4	-25.0	29.4
1395.000	V	37.76	-62.6	8.9	1.5	-55.2	-25.0	30.2
1550.000	H	35.92	-65.4	9.8	1.2	-56.8	-25.0	31.8
1550.000	V	34.63	-67.3	9.8	1.2	-58.7	-25.0	33.7
Frequency: 440 MHz, 6.25 kHz								
880.000	H	37.28	-37.3	0.0	1	-38.3	-25.0	13.3
880.000	V	38.12	-33.2	0.0	1	-34.2	-25.0	9.2
1320.000	H	41.75	-58.2	8.4	1.4	-51.2	-25.0	26.2
1320.000	V	37.17	-63.2	8.4	1.4	-56.2	-25.0	31.2
1760.000	H	35.06	-65.5	10.9	1.4	-56.0	-25.0	31.0
1760.000	V	33.69	-67.1	10.9	1.4	-57.6	-25.0	32.6
2200.000	H	36.21	-59.5	10.8	2	-50.7	-25.0	25.7
2200.000	V	35.46	-60.3	10.8	2	-51.5	-25.0	26.5

Frequency	Polar	S.A. Reading	S.G. Level	Antenna Gain	Cable Loss	Absolute Level	Limit	Margin
MHz	H/V	dBμV	dBm	dBd/dBi	dB	dBm	dBm	dB
Frequency: 155 MHz, 12.5 kHz								
310.000	H	39.31	-45.4	0.0	0.5	-45.9	-20.0	25.9
310.000	V	41.65	-41.3	0.0	0.5	-41.8	-20.0	21.8
465.000	H	37.86	-43.4	0.0	0.7	-44.1	-20.0	24.1
465.000	V	38.89	-39.4	0.0	0.7	-40.1	-20.0	20.1
620.000	H	39.25	-39.8	0.0	0.8	-40.6	-20.0	20.6
620.000	V	37.29	-39.3	0.0	0.8	-40.1	-20.0	20.1
775.000	H	39.62	-36	0.0	0.9	-36.9	-20.0	16.9
775.000	V	38.33	-34.4	0.0	0.9	-35.3	-20.0	15.3
930.000	H	37.35	-36.2	0.0	1	-37.2	-20.0	17.2
930.000	V	37.41	-32.9	0.0	1	-33.9	-20.0	13.9
1085.000	H	40.15	-59.9	7.5	1.3	-53.7	-20.0	33.7
1085.000	V	36.94	-63.4	7.5	1.3	-57.2	-20.0	37.2
1240.000	H	38.88	-61.4	7.7	1.3	-55.0	-20.0	35.0
1240.000	V	35.93	-64.5	7.7	1.3	-58.1	-20.0	38.1
1395.000	H	37.43	-63.2	8.9	1.5	-55.8	-20.0	35.8
1395.000	V	35.98	-64.4	8.9	1.5	-57.0	-20.0	37.0
1550.000	H	35.89	-65.5	9.8	1.2	-56.9	-20.0	36.9
1550.000	V	34.44	-67.5	9.8	1.2	-58.9	-20.0	38.9
Frequency: 440 MHz, 12.5 kHz								
880.000	H	37.11	-37.5	0.0	1	-38.5	-20.0	18.5
880.000	V	37.62	-33.7	0.0	1	-34.7	-20.0	14.7
1320.000	H	41.18	-58.8	8.4	1.4	-51.8	-20.0	31.8
1320.000	V	37.57	-62.8	8.4	1.4	-55.8	-20.0	35.8
1760.000	H	36.08	-64.4	10.9	1.4	-54.9	-20.0	34.9
1760.000	V	34.79	-66	10.9	1.4	-56.5	-20.0	36.5
2200.000	H	36.50	-59.2	10.8	2	-50.4	-20.0	30.4
2200.000	V	35.59	-60.2	10.8	2	-51.4	-20.0	31.4

Note1: For radiated spurious emissions were tested at high rated power, which was the worst case.

Note2: The unit of Antenna Gain is dBd for frequency below 1GHz, and the unit of Antenna Gain is dBi for frequency above 1GHz.

Note3: Absolute Level = SG Level - Cable loss + Antenna Gain
Margin = Limit-Absolute Level

FCC §2.1055 & §90.213- FREQUENCY STABILITY

Applicable Standard

FCC §2.1055, §90.213

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
Dongzhixu	High Temperature Test Chamber	DP1000	201105083-4	2015-09-10	2016-09-09
UNI-T	Multimeter	UT39A	M130199938	2015-04-10	2016-04-10
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2015-07-08	2016-07-08
N/A	Coaxial Cable	0.1m	N/A	2015-07-08	2016-07-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2015-07-08	2016-07-08

* **Statement of Traceability:** Bay Area Compliant Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to DC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The power leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

The frequency stability shall be measured with variation of primary supply voltage as follows:

- (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

Test Data

Environmental Conditions

Temperature:	25.1 °C
Relative Humidity:	55 %
ATM Pressure:	100.9 kPa

The testing was performed by Dean Liu on 2016-04-17.

Test Mode: Transmitting

Reference Frequency: 155 MHz, 12.5 kHz, Limit: 5.0 ppm			
Temperature	Voltage	Reading	Frequency Error
°C	V _{DC}	MHz	ppm
-30	13.8	155.000017	0.11
-20		155.000019	0.12
-10		155.000023	0.15
0		155.000017	0.11
10		155.000014	0.09
20		155.000018	0.12
30		155.000019	0.12
40		155.000021	0.14
50		155.000012	0.08
60		155.000019	0.12
25	11.7	155.000021	0.14
25	15.9	155.000023	0.15

Reference Frequency: 440 MHz, 12.5 kHz, Limit: 2.5 ppm			
Temperature	Voltage	Reading	Frequency Error
°C	V _{DC}	MHz	ppm
-30	13.8	439.999965	-0.08
-20		439.999957	-0.10
-10		439.999968	-0.07
0		439.999972	-0.06
10		439.999961	-0.09
20		439.999962	-0.09
30		439.999959	-0.09
40		439.999965	-0.08
50		439.999964	-0.08
60		439.999973	-0.06
25	11.7	439.999943	-0.13
25	15.9	439.999971	-0.07

Reference Frequency: 155 MHz, 6.25 kHz, Limit: 2.0 ppm			
Temperature	Voltage	Reading	Frequency Error
°C	V _{DC}	MHz	ppm
-30	13.8	154.999950	-0.32
-20		154.999943	-0.37
-10		154.999952	-0.31
0		154.999948	-0.34
10		154.999946	-0.35
20		154.999951	-0.32
30		154.999949	-0.33
40		154.999971	-0.19
50		154.999939	-0.39
60		154.999961	-0.25
25	11.7	154.999977	-0.15
25	15.9	154.999958	-0.27

Reference Frequency: 440 MHz, 6.25 kHz, Limit: 1.0 ppm			
Temperature	Voltage	Reading	Frequency Error
°C	V _{DC}	MHz	ppm
-30	13.8	439.999750	-0.57
-20		439.999768	-0.53
-10		439.999771	-0.52
0		439.999768	-0.53
10		439.999762	-0.54
20		439.999759	-0.55
30		439.999751	-0.57
40		439.999764	-0.54
50		439.999753	-0.56
60		439.999782	-0.50
25	11.7	439.999749	-0.57
25	15.9	439.999761	-0.54

FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

Applicable Standard

Regulations: FCC §90.214

Test method: ANSI/TIA-603-D 2010, section 2.2.19.3

Test Equipment List and Details

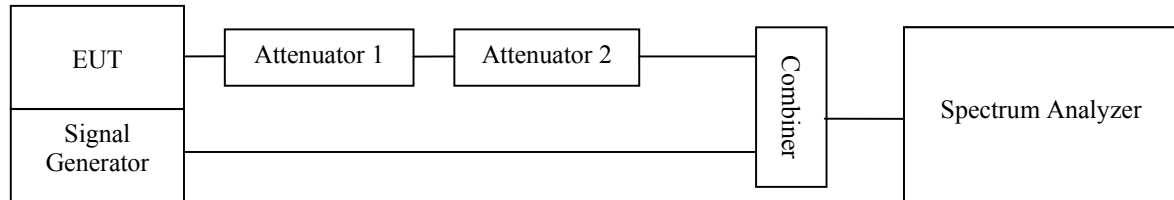
Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2015-05-09	2016-05-09
HP	Signal Generator	E4422B	MY41000355	2015-11-23	2016-11-22
Cheng Du Ou Li Tong	Two way power splitter	EMPD-T- 2-10-1000	OE01201041	2015-07-06	2016-07-06
AA-MCS	Attenuator(40dB)	CAT-50- 40-200- Nm-Nf	0602-010	2015-07-08	2016-07-08
N/A	Coaxial Cable*3	0.1m	N/A	2015-07-08	2016-07-08
E-Microwave	DC Blocking	EMDCB- 00036	0E01201047	2015-07-08	2016-07-08

* Statement of Traceability: Bay Area Compliant Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

- Connect the EUT and test equipment as shown on the following block diagram.
- Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.
- Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at ± 12.5 kHz deviation and set its output level to -100dBm.
- Turn on the transmitter.
- Supply sufficient attenuation via the RF attenuator to provide an input level to the Spectrum Analyzer that is 40 dB below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on the Spectrum Analyzer as P_0 .
- Turn off the transmitter.
- Adjust the RF level of the signal generator to provide RF power equal to P_0 . This signal generator RF level shall be maintained throughout the rest of the measurement.
- Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 dB when the transmitter is turned on.
- Adjust the vertical amplitude control of the spectrum analyzer to display the 1000 Hz at ± 4 divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to "Video", and tune the "trigger level" on suitable level. Then set the "trigger offset" to -10ms for turn on and -15ms for turn off.
- Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. Observe the stored display. The instant when the 1 kHz test signal is completely suppressed is considered to be t_{on} . The trace should be maintained within the allowed divisions during the period t_1 and t_2 .

- k) Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum Analyzer. The trace should be maintained within the allowed divisions during the period t_3 .



Test Data

Environmental Conditions

Temperature:	26.5~28.1 °C
Relative Humidity:	58~62 %
ATM Pressure:	100.5 ~ 100.8 kPa

The testing was performed by Dean Liu on 2016-04-15 and 2016-05-18.

For UHF Band:

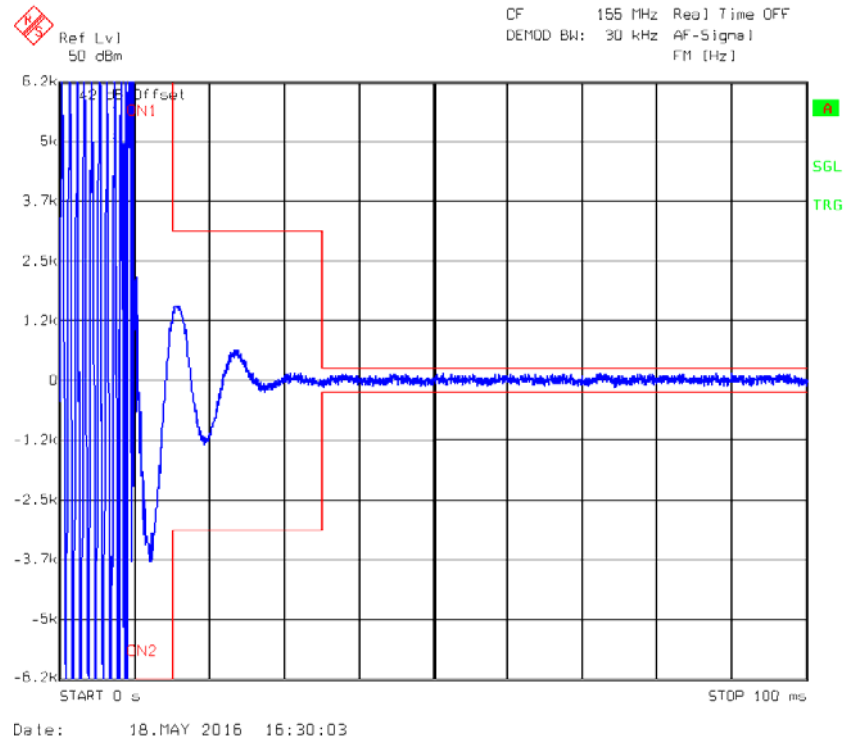
Channel Spacing (kHz)	Transient Period (ms)	Maximum frequency difference	Result
12.5	10(t_1)	± 12.5 kHz	Pass
	25(t_2)	± 6.25 kHz	
	10(t_3)	± 12.5 kHz	
6.25	10(t_1)	± 6.25 kHz	Pass
	25(t_2)	± 3.125 kHz	
	10(t_3)	± 6.25 kHz	

For VHF Band:

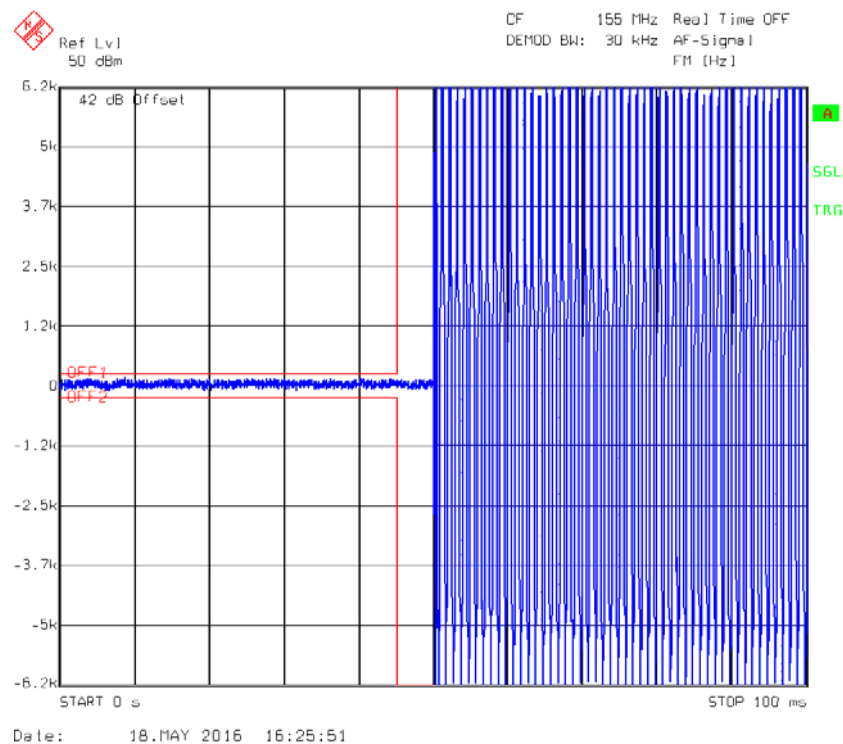
Channel Spacing (kHz)	Transient Period (ms)	Maximum frequency difference	Result
12.5	5(t_1)	± 12.5 kHz	Pass
	20(t_2)	± 6.25 kHz	
	5(t_3)	± 12.5 kHz	
6.25	5(t_1)	± 6.25 kHz	Pass
	20(t_2)	± 3.125 kHz	
	5(t_3)	± 6.25 kHz	

Please refer to the following plots.

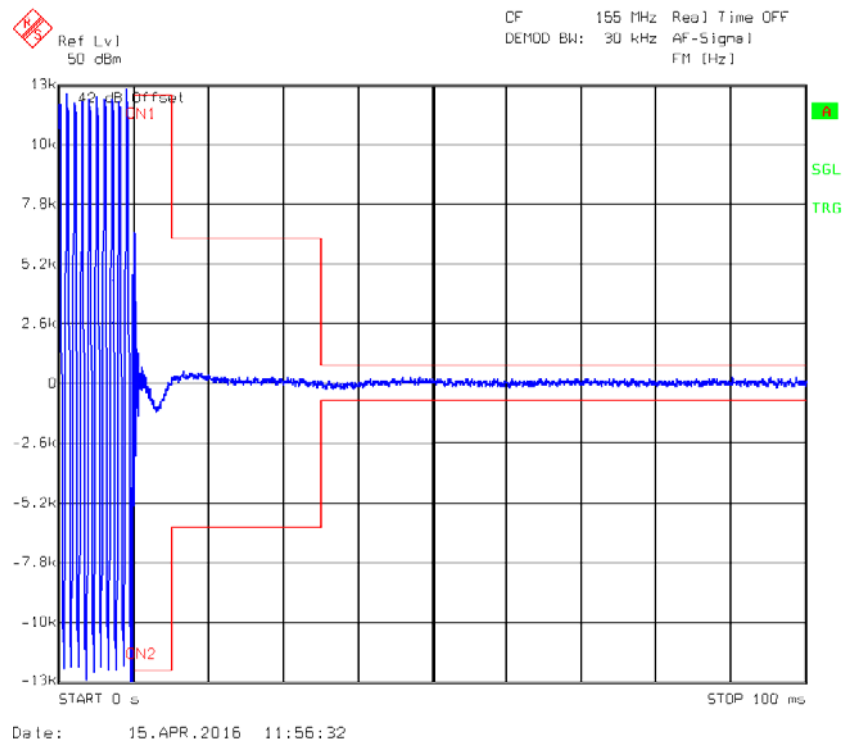
Turn on – 155 MHz, 6.25 kHz



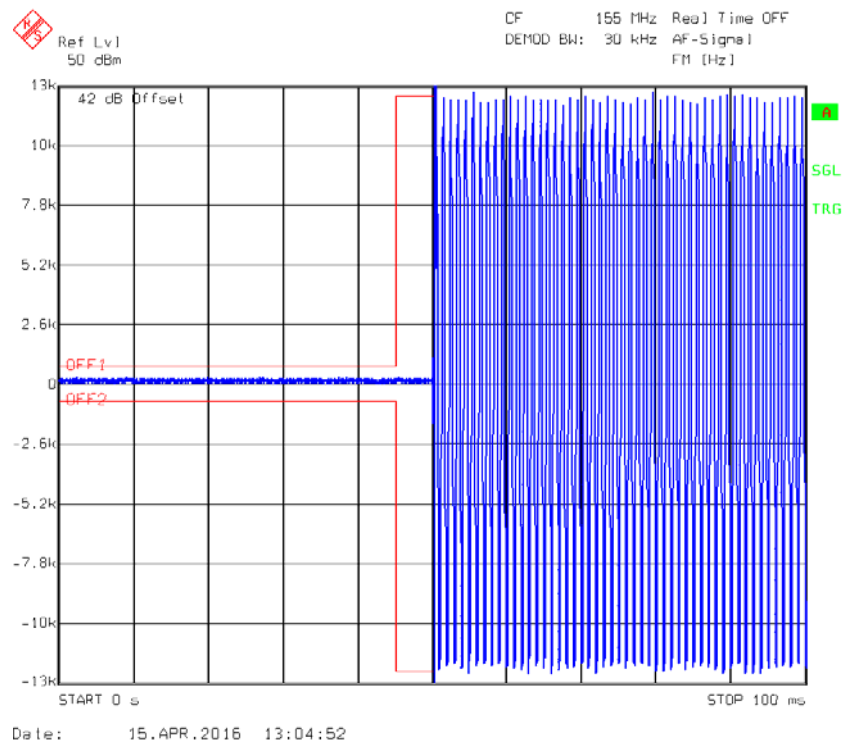
Turn off – 155 MHz, 6.25 kHz



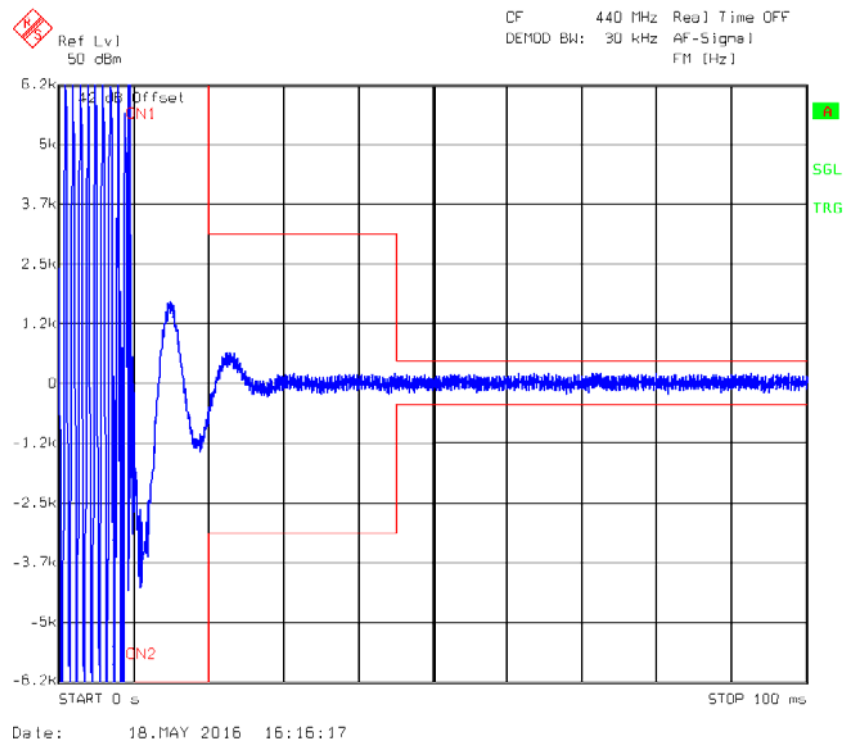
Turn on – 155 MHz, 12.5 kHz



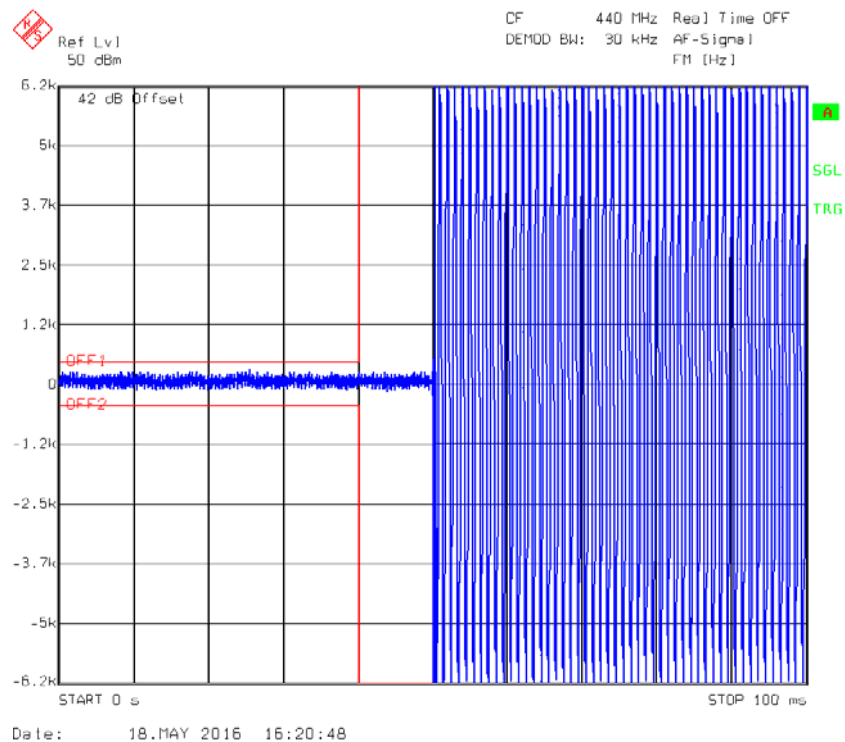
Turn off – 155 MHz, 12.5 kHz



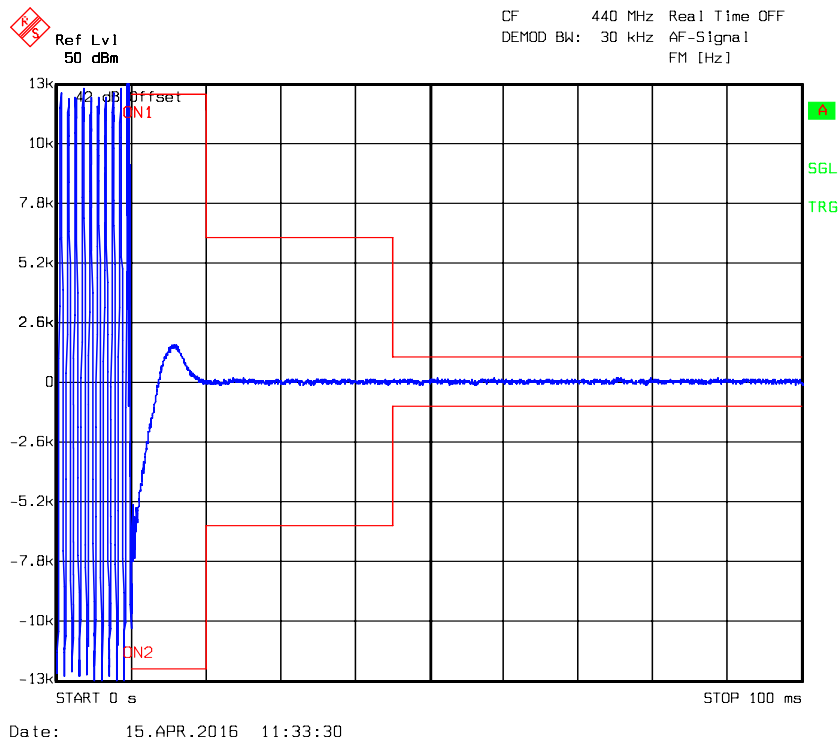
Turn on – 440 MHz, 6.25 kHz



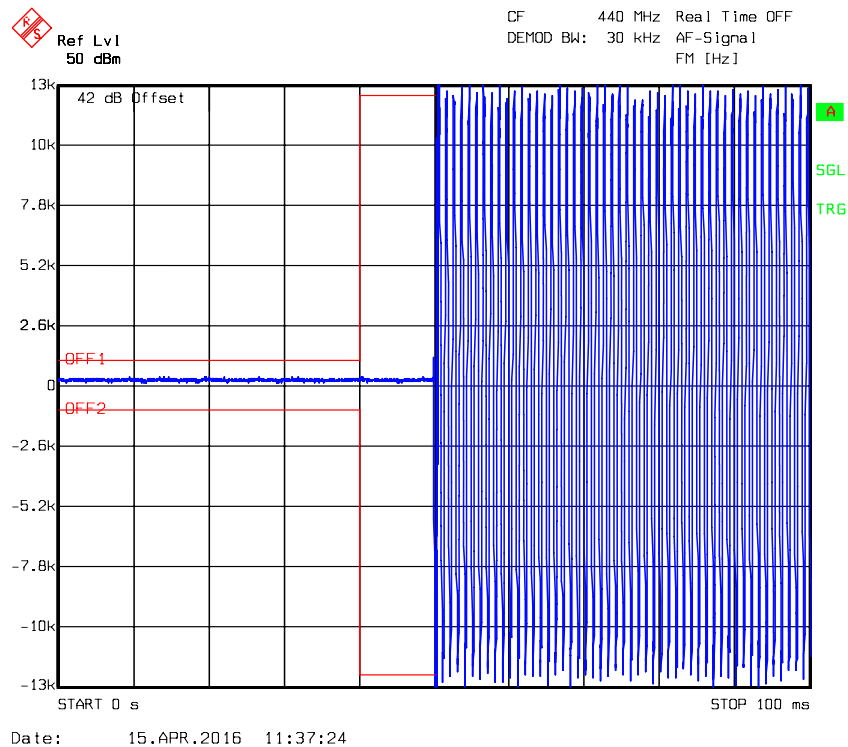
Turn off – 440 MHz, 6.25 kHz



Turn on – 440 MHz, 12.5 kHz



Turn off – 440MHz, 12.5 kHz



***** END OF REPORT *****