

FCC PART 22 and 90 TEST REPORT

For

Sepura plc

Radio House, St. Andrews Road, Cambridge CB4 1GR UK

FCC ID: XX6SEM8010

Report Type: Original Report	Product Type: DMR Mobile Radio
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Report Number: <u>RDG140724006-00</u>	
Report Date: <u>2014-12-17</u>	
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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 Compliance Laboratories Corp. This report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP*, or any agency of the Federal Government.

* This report may contain data that are not covered by the NVLAP accreditation and shall be marked with an asterisk "★" (Rev.2)

TABLE OF CONTENTS

GENERAL INFORMATION.....	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
OBJECTIVE	4
RELATED SUBMITTAL(S)/GRANT(S).....	4
TEST METHODOLOGY	4
TEST FACILITY	5
SYSTEM TEST CONFIGURATION.....	6
DESCRIPTION OF TEST CONFIGURATION	6
EQUIPMENT MODIFICATIONS	6
SUPPORT EQUIPMENT LIST AND DETAILS	6
BLOCK DIAGRAM OF TEST SETUP	7
SUMMARY OF TEST RESULTS	8
FCC §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)	9
APPLICABLE STANDARD	9
FCC §2.1046 & § 22.727 & §90.205- RF OUTPUT POWER	11
APPLICABLE STANDARD	11
TEST PROCEDURE	11
TEST EQUIPMENT LIST AND DETAILS.....	11
TEST DATA	11
FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC.....	13
APPLICABLE STANDARD	13
TEST PROCEDURE	13
TEST EQUIPMENT LIST AND DETAILS.....	13
TEST DATA	13
FCC §2.1049& §22.357 & § 22.731 & §90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK	17
APPLICABLE STANDARD	17
TEST EQUIPMENT LIST AND DETAILS.....	18
TEST PROCEDURE	18
TEST DATA	18
FCC §2.1051& §22.861 & §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS	26
APPLICABLE STANDARD	26
TEST EQUIPMENT LIST AND DETAILS.....	26
TEST PROCEDURE	27
TEST DATA	27
FCC §2.1053 & §22.861 & §90.210 - RADIATED SPURIOUS EMISSIONS	32
APPLICABLE STANDARD	32
TEST EQUIPMENT LIST AND DETAILS.....	32
TEST PROCEDURE	32
TEST DATA	33
FCC §2.1055 & § 22.355 & §90.213- FREQUENCY STABILITY	35
APPLICABLE STANDARD	35
TEST EQUIPMENT LIST AND DETAILS.....	35

TEST PROCEDURE35

TEST DATA35

FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR.....38

APPLICABLE STANDARD38

TEST EQUIPMENT LIST AND DETAILS.....38

TEST PROCEDURE38

TEST DATA39

FINAL

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Sepura plc*'s product, model: *SEM8010* (FCC ID: *XX6SEM8010*) (the "EUT") in this report is a *DMR Mobile Radio*, which was measured approximately: 17.2 cm (L) x 19.5 cm (H) x 5.8 cm (T), rated input voltage: 13.6 VDC or 15 VDC powered from AC/DC adapter.

** All measurement and test data in this report was gathered from production sample serial number: 7PR311426GD0019. The EUT was received on 2014-07-29.*

Objective

This test report is prepared on behalf of *Sepura plc* in accordance with Part 2, Part22, and 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 22 – Public Mobile Service

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA 603-D and ANSI 63.4-2003.

All emissions measurement was performed and Bay Area Compliance 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 Compliance 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 Compliance 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 compliance with the requirements of Section 2.948 of the FCC Rules on February 02, 2012. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

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.

Additionally, Bay Area Compliance Laboratories Corp. (Dongguan) is an ISO/IEC 17025 accredited laboratory, and is accredited by National Voluntary Laboratory Accredited Program (Lab Code 500069-0).



The current scope of accreditations can be found at <http://ts.nist.gov/standards/scopes/5000690.htm>

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode.

EUT Specification:

Test Software Version	DMR Manager_V1.89		
Test Frequency(MHz)	For FCC part 90		
	136.0125	155.0125	173.9875
	For FCC part 22		
	161.01		
Set	High Power Level: 25W, Low Power Level: 5W		

Operating Frequency Band	136-174 MHz
Modulation Mode	FM/4FSK
Channel Separation	12.5 kHz
Modulation Type	Analog(FM); Digital(4FSK)
Rated Output Power	25W(High); 5W(Low)

Equipment Modifications

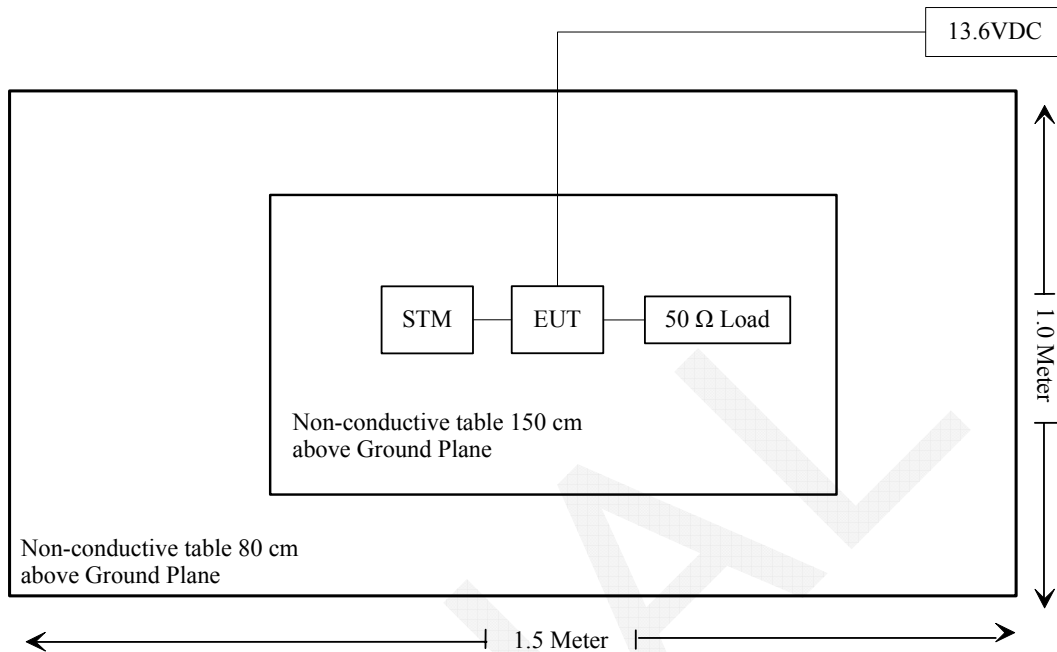
No modifications were made to the unit tested.

Support Equipment List and Details

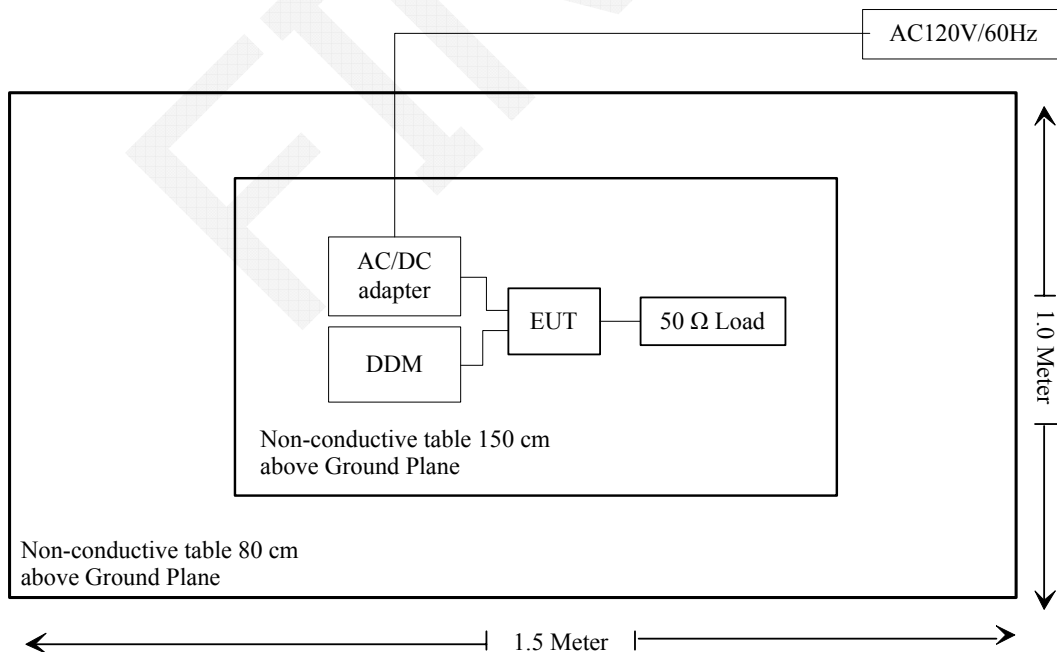
Manufacturer	Description	Model	Serial Number
Pro instrument	DC Power Supply	pps3300	N/A
MEAN WELL	AC/DC switching adapter	GS220A15	EB42201003
Sepura	STM(Std. Fist Mic.)	300-01077	7PR101426D30020
Sepura	DDM(DMR DESKTOP MIC)	300-01065	/

Block Diagram of Test Setup

Setup 1:



Setup 2:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§2.1091	Maximum Permissible Exposure	Compliance
§2.1046; § 22.727;§90.205	RF Output Power	Compliance
§2.1047;§90.207	Modulation Characteristic	Compliance
§2.1049;§22.357;§ 22.731;§90.209; §90.210	Occupied Bandwidth & Emission Mask	Compliance
§2.1051; §22.861;§90.210	Spurious Emission at Antenna Terminal	Compliance
§2.1053; §22.861;§90.210	Spurious Radiated Emissions	Compliance
§2.1055; § 22.355;§90.213	Frequency Stability	Compliance
§90.214	Transient Frequency Behavior	Compliance

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/cm²)	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);

Calculated Data:

Frequency	Conducted Output Power	Duty Cycle	Typical Antenna Gain		Distance	Power Density	Limit
MHz	mW		dBi	numeric	cm	mW/cm ²	mW/cm ²
155	28050	50%	0	1.0	75	0.20	1.0

Note1: The manufacturer does not specify an antenna to be used with this device, but a typical installation has a gain up to 0dBi.

Note2: The target power is 25W (43.98 dBm) $\pm 0.5\text{dB}$ = 28050mW (44.48dBm)

Radio Exposure Statement:

To comply with RF exposure requirements, a minimum separation distance of 75 cm is required between antenna and all public persons.

Result: Compliant.

FCC §2.1046 & § 22.727 & §90.205- RF OUTPUT POWER**Applicable Standard**

FCC §2.1046, § 22.727 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 No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2014-05-09	2015-05-09

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

Test Data**Environmental Conditions**

Temperature:	29 °C
Relative Humidity:	60 %
ATM Pressure:	100.3 kPa

The testing was performed by Dean Liu on 2014-08-16.

Test Mode: Transmitting

Test Result: Compliant. Please refer to following tables.

FCC Part 90:

Modulation mode	Channel Separation	f _c	Conducted Output Power		Note
		MHz	High	Low	
			W	W	
FM	12.5 kHz	136.0125	24.95	5.00	Not for FCC Review
		155.0125	24.83	5.17	/
		173.9875	24.55	5.31	/
4FSK		136.0125	24.96	5.01	Not for FCC Review
		155.0125	24.85	5.16	/
		173.9875	24.56	5.29	/

FCC Part 22:

Modulation mode	Channel Separation	f_c	Conducted Output Power		Note
		MHz	High	Low	
			W	W	
FM	12.5 kHz	161.01	24.92	5.02	/
4FSK		161.01	24.91	5.01	/

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 No.	Serial No.	Calibration Date	Calibration Due Date
HP	RF Communications Test Set	8920A	00 235	2014-05-09	2015-05-09

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

Test Data**Environmental Conditions**

Temperature:	29 °C
Relative Humidity:	60 %
ATM Pressure:	100.3 kPa

The testing was performed by Dean Liu on 2014-08-16.

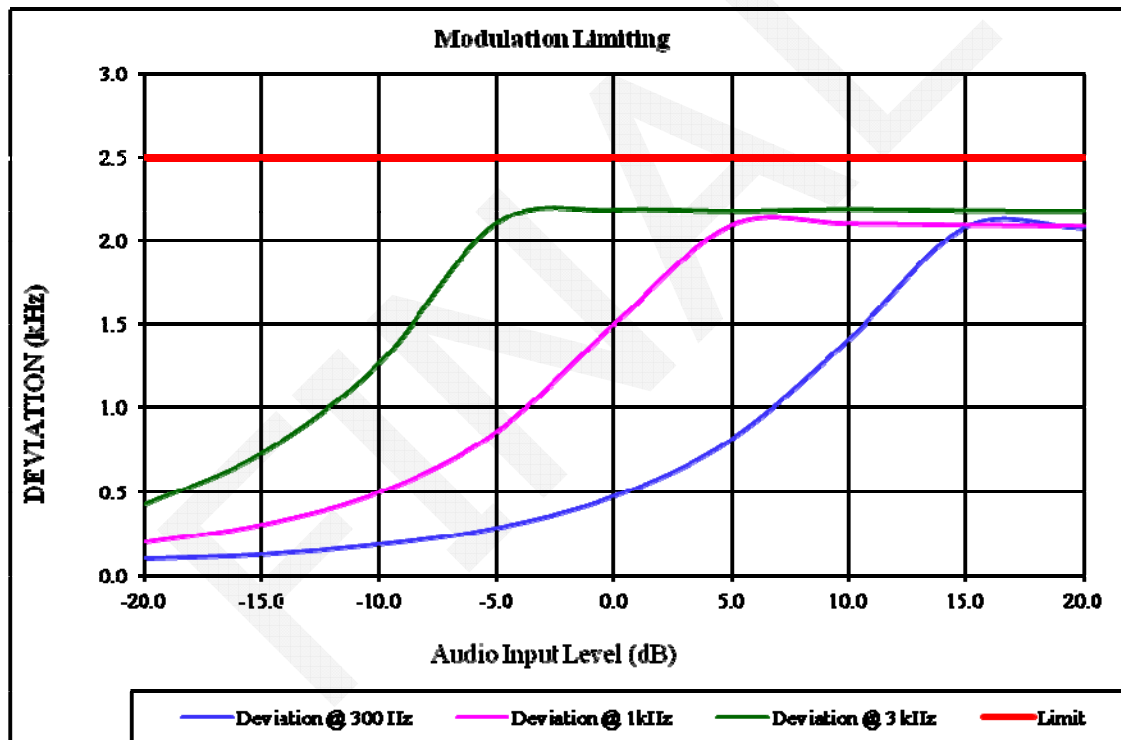
Test Mode: Transmitting

Test Result: Compliant. Please refer to following plots.

MODULATION LIMITING

Carrier Frequency: 155.0125 MHz, Channel Separation = 12.5 kHz, high power level

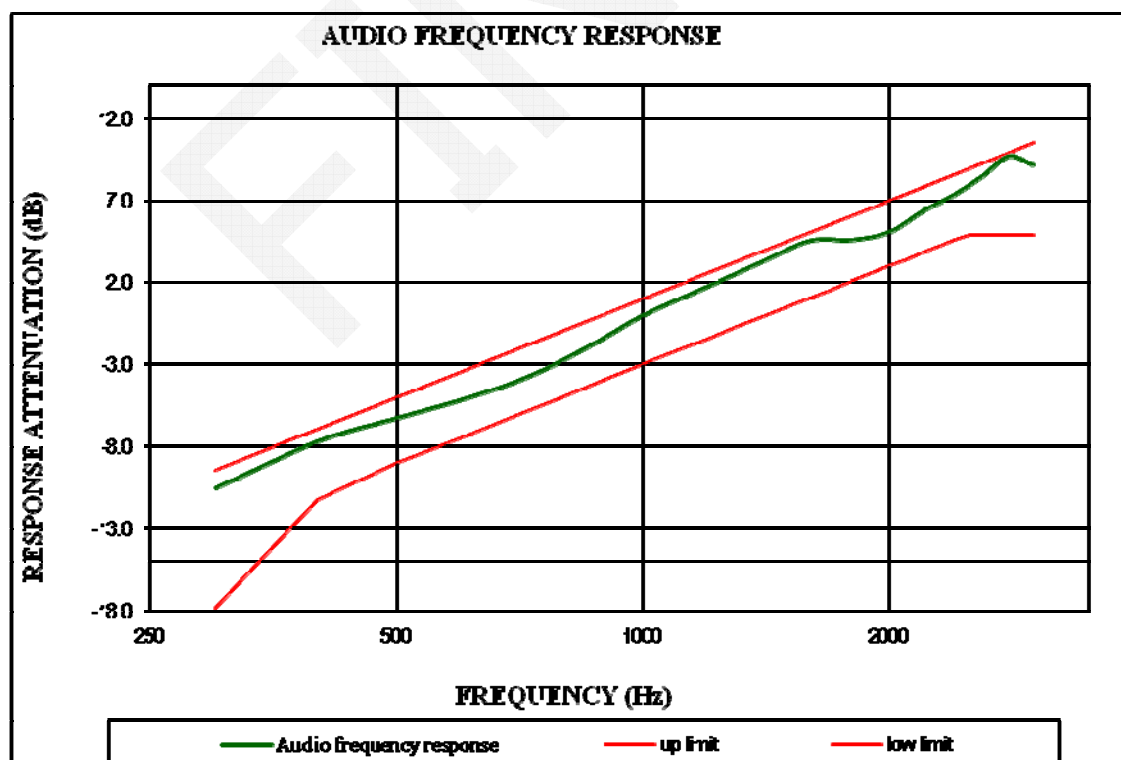
AUDIO INPUT LEVEL	DEVIATION (@300Hz)	DEVIATION (@ 1kHz)	DEVIATION (@ 3kHz)	Limit
dB	kHz	kHz	kHz	kHz
20.0	2.073	2.089	2.176	2.5
15.0	2.078	2.095	2.179	2.5
10.0	1.407	2.103	2.187	2.5
5.0	0.811	2.093	2.176	2.5
0.0	0.469	1.500	2.182	2.5
-5.0	0.279	0.859	2.103	2.5
-10.0	0.182	0.494	1.265	2.5
-15.0	0.123	0.299	0.731	2.5
-20.0	0.098	0.195	0.421	2.5



Audio Frequency Response

Carrier Frequency: 155.0125 MHz, Channel Separation = 12.5 kHz, high power level

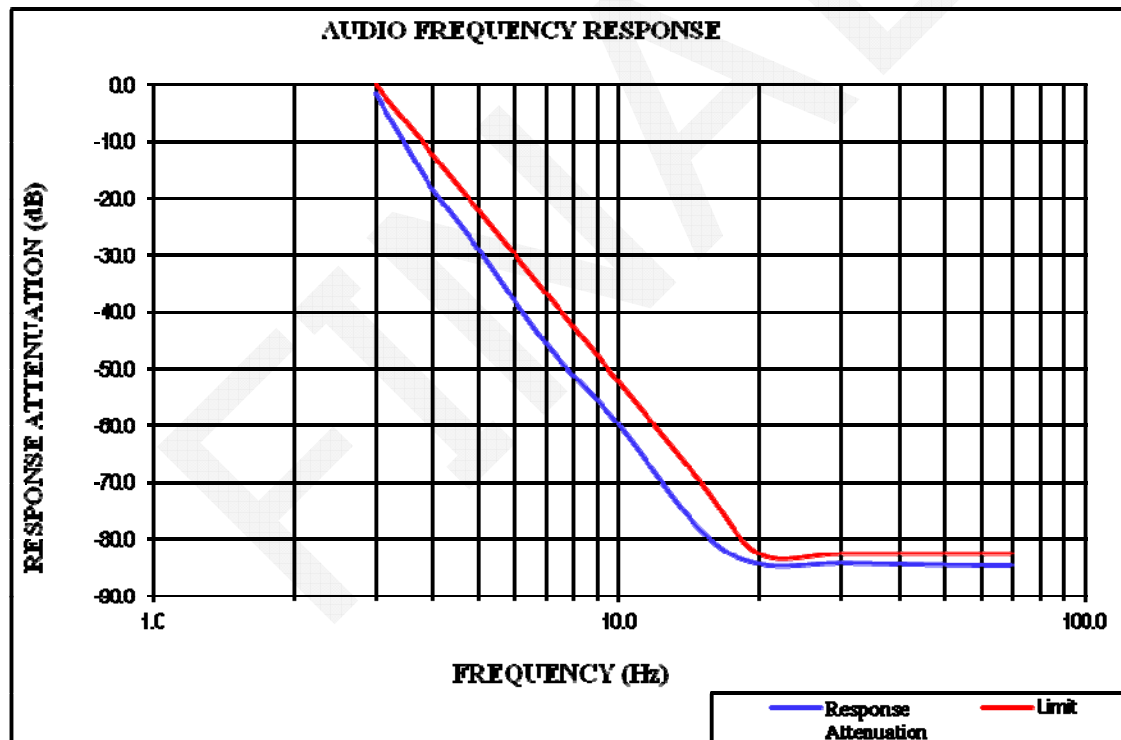
Audio Frequency	Response Attenuation
Hz	dB
300	-10.54
400	-7.70
500	-6.27
600	-5.15
700	-4.02
800	-2.71
900	-1.32
1000	0.00
1200	1.78
1400	3.29
1600	4.57
1800	4.62
2000	5.10
2200	6.41
2400	7.38
2600	8.51
2800	9.73
3000	9.19



Audio Frequency Low Pass Filter Response

Carrier Frequency: 155.0125 MHz, Channel Separation = 12.5 kHz, high power level

Audio Frequency	Response Attenuation	Limit
kHz	dB	dB
3.0	-1.4	0.0
3.5	-10.8	-6.7
4.0	-18.5	-12.5
5.0	-28.9	-22.2
7.0	-45.7	-36.8
10.0	-59.8	-52.3
15.0	-78.4	-69.9
20.0	-84.3	-82.5
30.0	-84.2	-82.5
50.0	-84.5	-82.5
70.0	-84.6	-82.5



FCC §2.1049 & §22.357 & § 22.731 & §90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK

Applicable Standard

FCC §2.1049, §22.357, § 22.731, §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 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.

§22.357 Emission types.

Any authorized station in the Public Mobile Services may transmit emissions of any type(s) that comply with the applicable emission rule, i.e. §22.359, §22.861 or §22.917

§22.731 Emission limitations.

Upon application for multichannel operation, the FCC may authorize emission bandwidths wider than those specified in §22.357, provided that spectrum utilization is equal to or better than that achieved by single channel operation.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2014-05-09	2015-05-09
HP	RF Communications Test Set	8920A	00 235	2014-05-09	2015-05-09

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, 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:	29~30.3 °C
Relative Humidity:	60~64 %
ATM Pressure:	99.8~100.3 kPa

The testing was performed by Dean Liu from 2014-08-16 and 2014-12-16.

Test Mode: Transmitting

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

FCC Part 90:

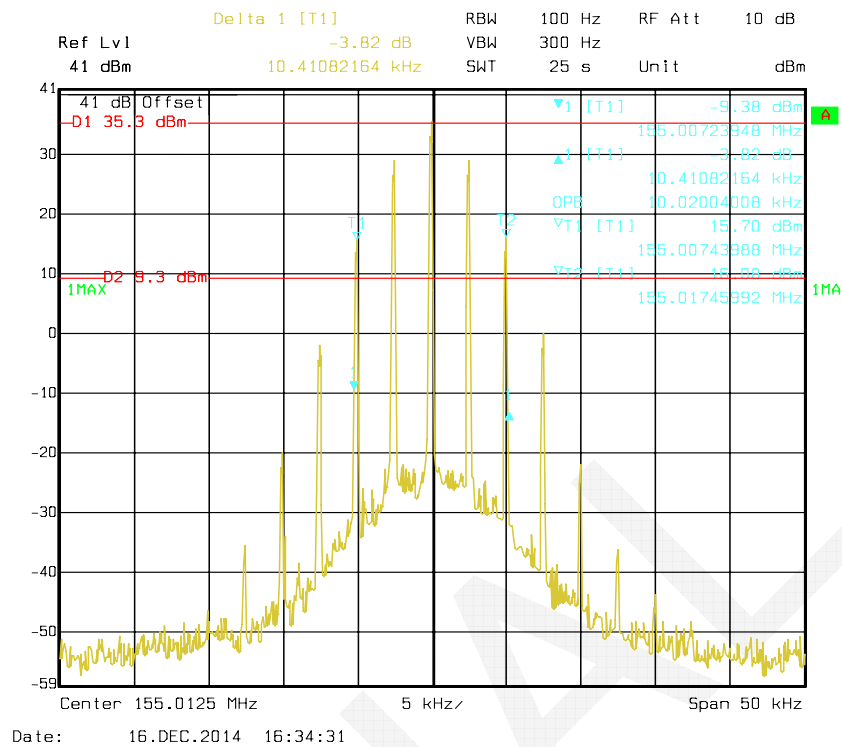
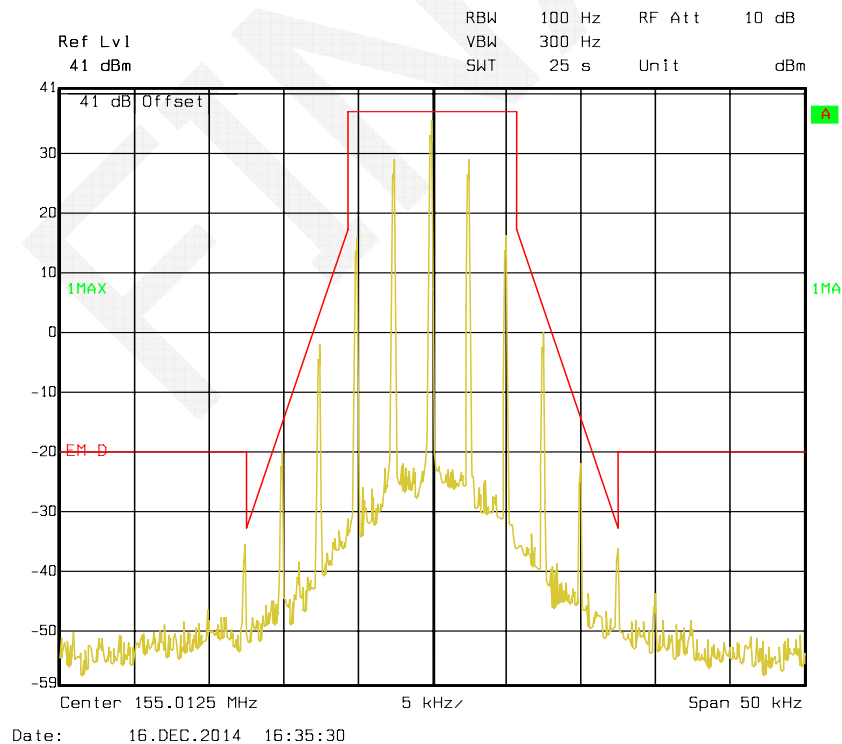
Modulation Mode	Channel Separation	f_c	99% Occupied Bandwidth	26 dB Bandwidth	Power Level
	kHz	MHz	kHz	kHz	
FM	12.5	155.0125	10.02	10.40	High
4FSK			6.91	8.92	
FM			10.02	10.41	Low
4FSK			6.91	9.01	

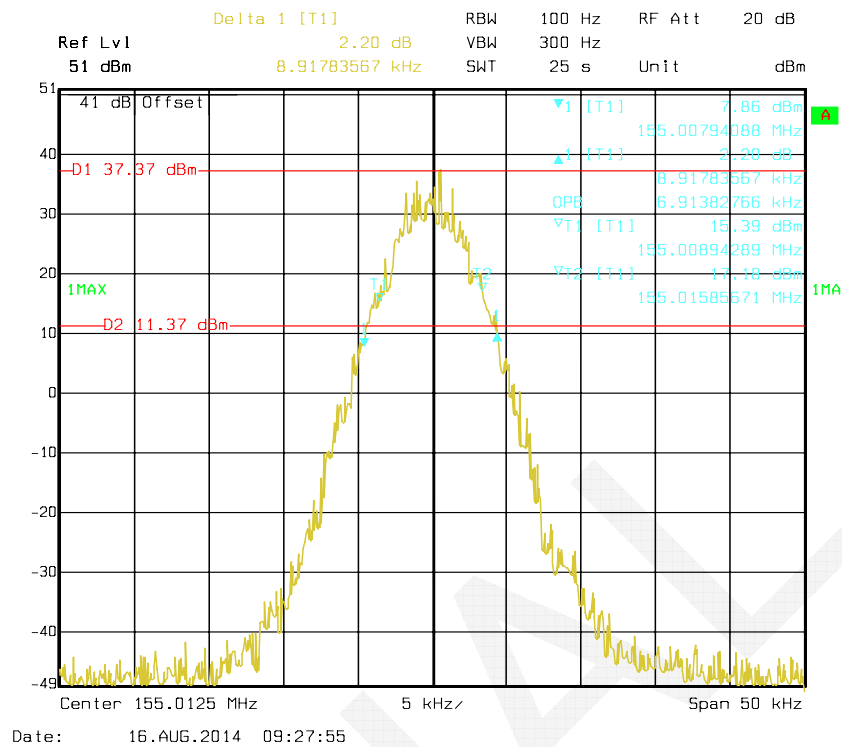
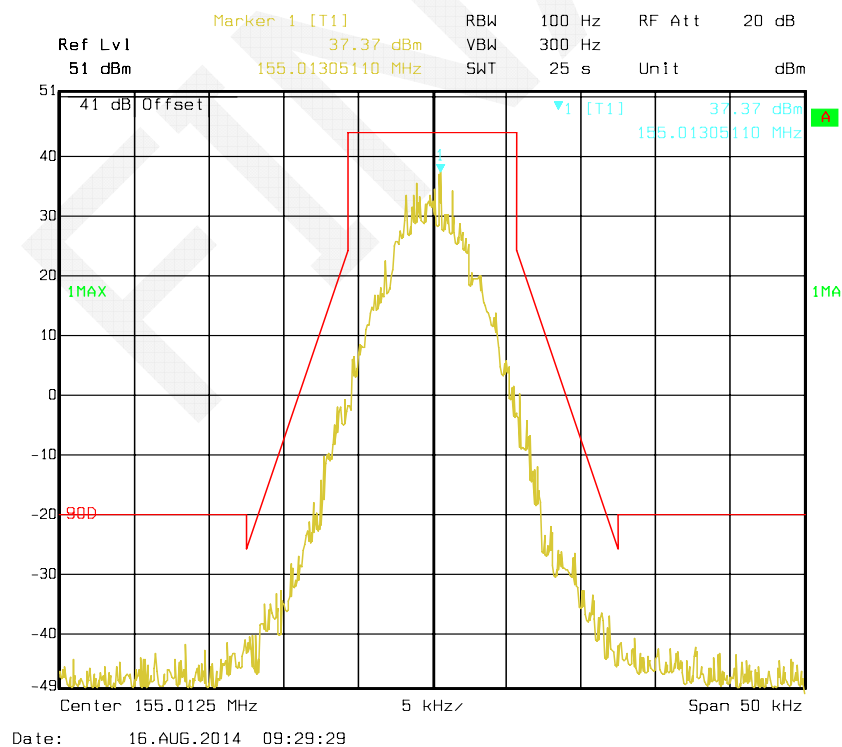
FCC Part 22:

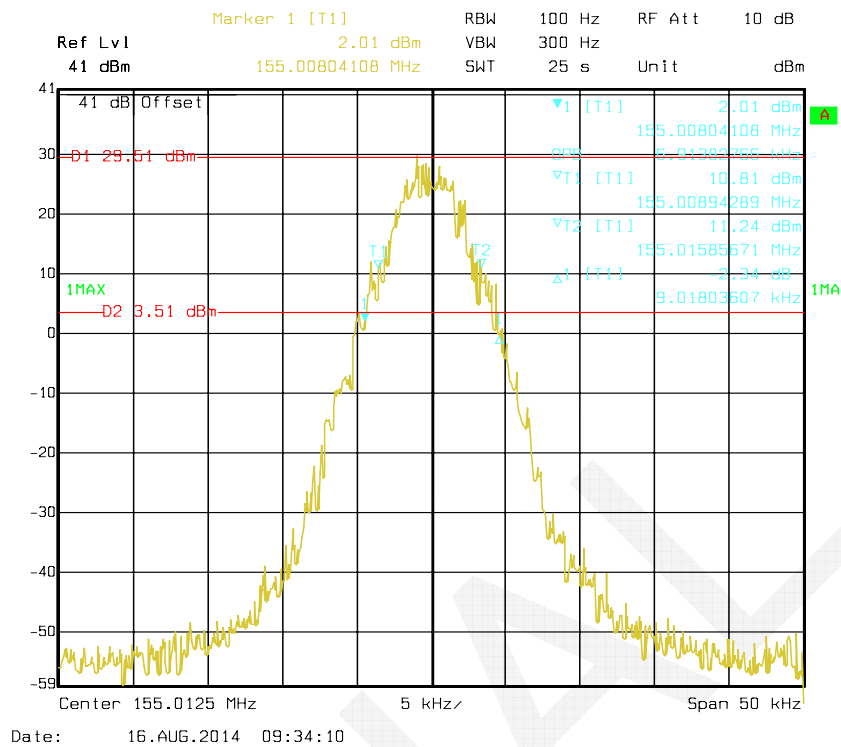
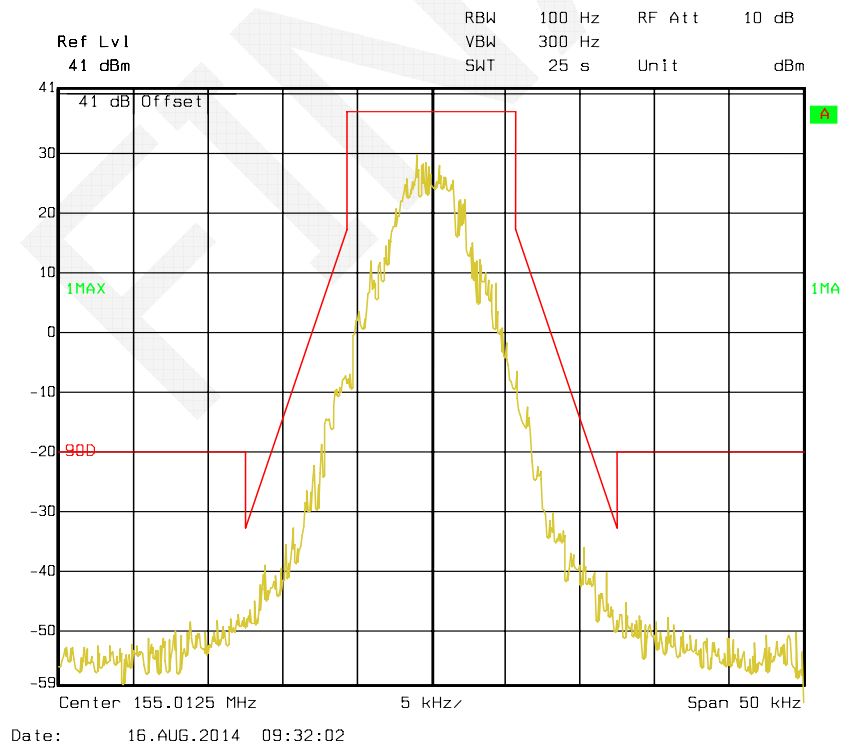
Modulation Mode	Channel Separation	f_c	99% Occupied Bandwidth	26 dB Bandwidth	Power Level
	kHz	MHz	kHz	kHz	
FM	12.5	161.01	10.02	10.41	High
4FSK			6.61	9.22	
FM			10.02	10.40	Low
4FSK			6.61	8.92	

Occupied Bandwidth – FM, 155.0125 MHz, High Power Level



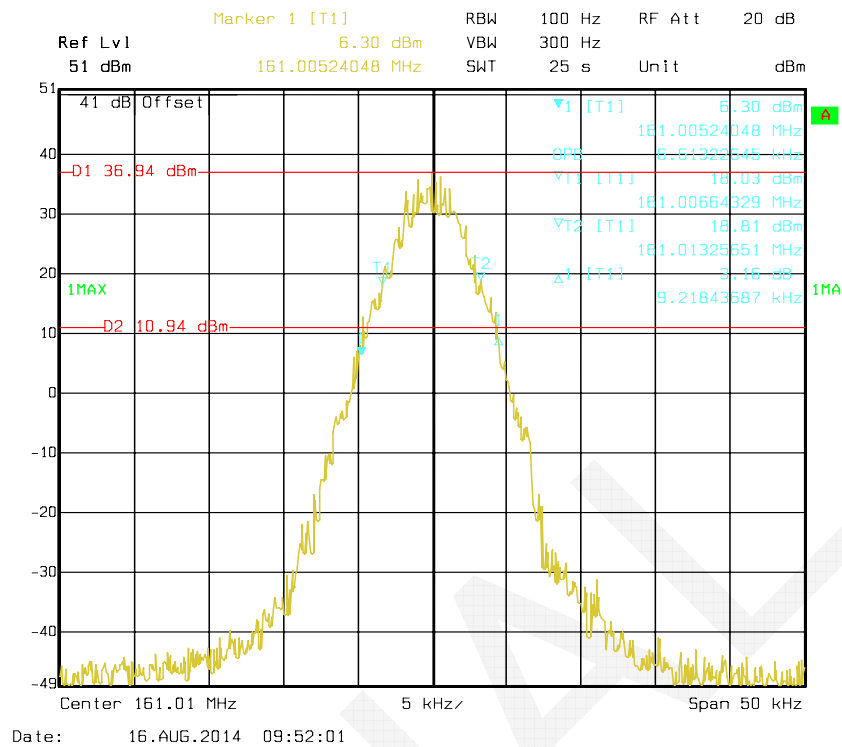
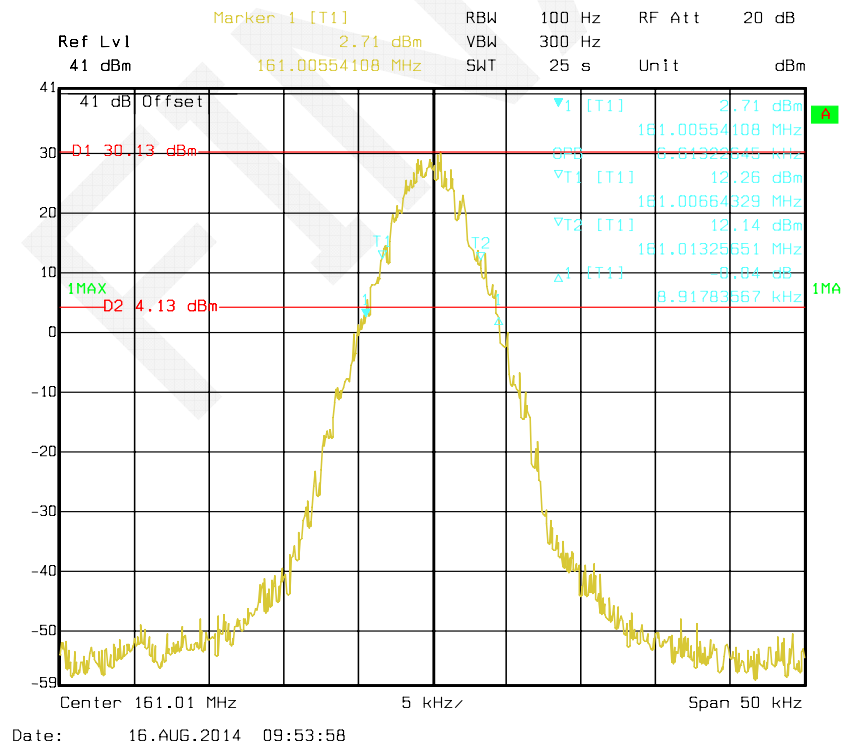
Occupied Bandwidth – FM, 155.0125 MHz, Low Power Level**Emission Mask - Type D**

Occupied Bandwidth –4FSK, 155.0125 MHz, High Power Level**Emission Mask - Type D**

Occupied Bandwidth – 4FSK, 155.0125 MHz, Low Power Level**Emission Mask - Type D**

Occupied Bandwidth – FM, 161.01 MHz, High Power Level



Occupied Bandwidth –4FSK, 161.01MHz, High Power Level**Occupied Bandwidth – 4FSK, 161.01 MHz, Low Power Level**

FCC §2.1051& §22.861 & §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 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.

§22.861 Emission limitations.

- (a) Out of band emissions. 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 $43 + 10 \log(P)$ dB.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2014-05-09	2015-05-09
HP	RF Communications Test Set	8920A	00 235	2014-05-09	2015-05-09

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

Test Procedure

Adjust the spectrum analyzer for the following settings:

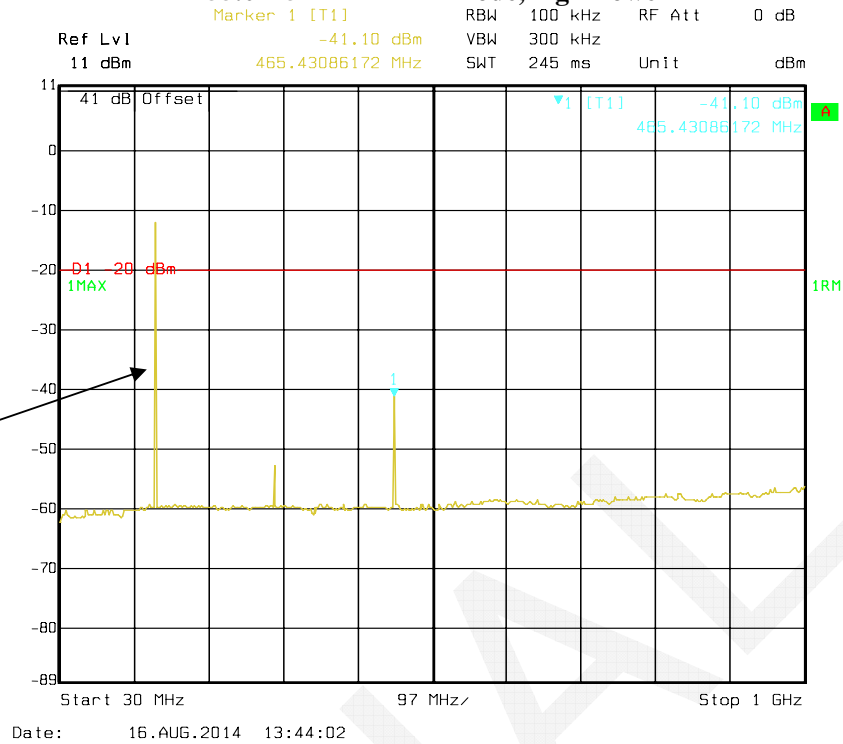
- 1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
- 2) Video Bandwidth ≥ 3 times the resolution bandwidth.
- 3) Sweep Speed ≤ 2000 Hz per second.
- 4) Detector Mode = mean or average power.

Test Data**Environmental Conditions**

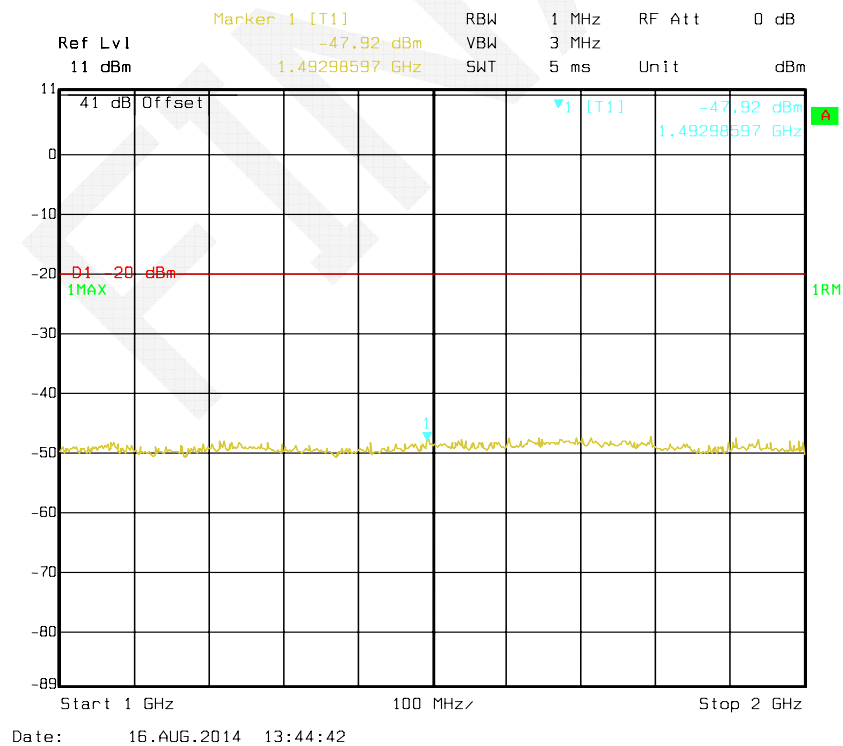
Temperature:	29 °C
Relative Humidity:	60 %
ATM Pressure:	100.3 kPa

The testing was performed by Dean Liu on 2014-08-16.

FCC PART 90
155.0125 MHz – FM Mode, High Power

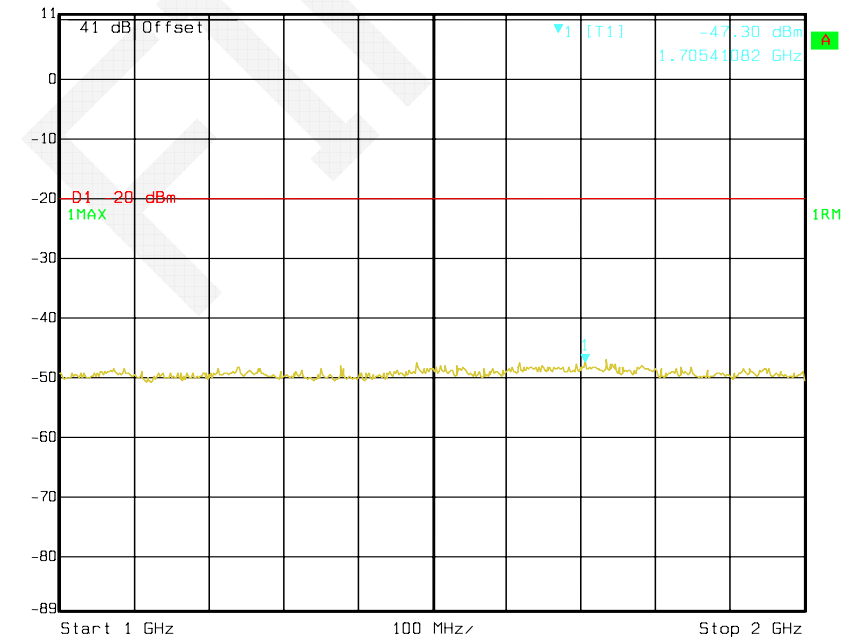


Fundamental test
with Band Reject
Filter



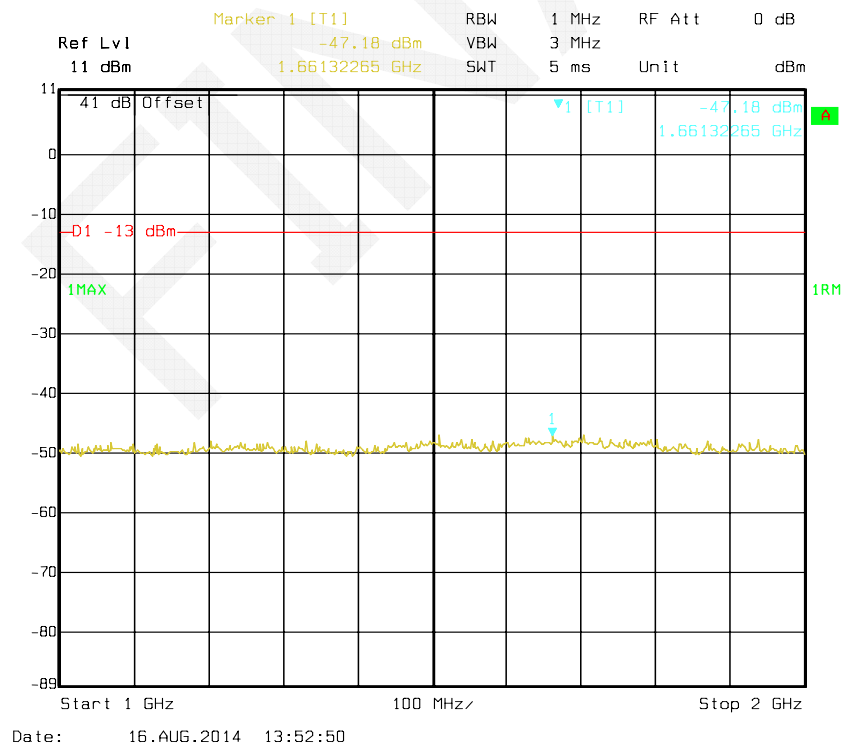
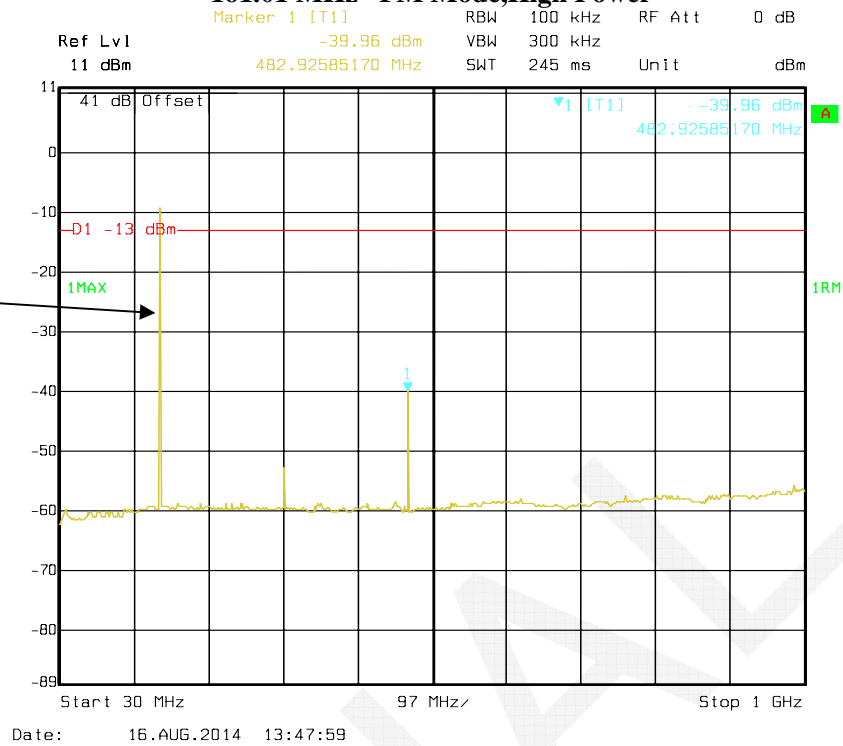
Marker 1 [T1]

Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	0 dB
11 dBm	-47.30 dBm	VBW	3 MHz		
	1.70541082 GHz	SWT	5 ms	Unit	dBm

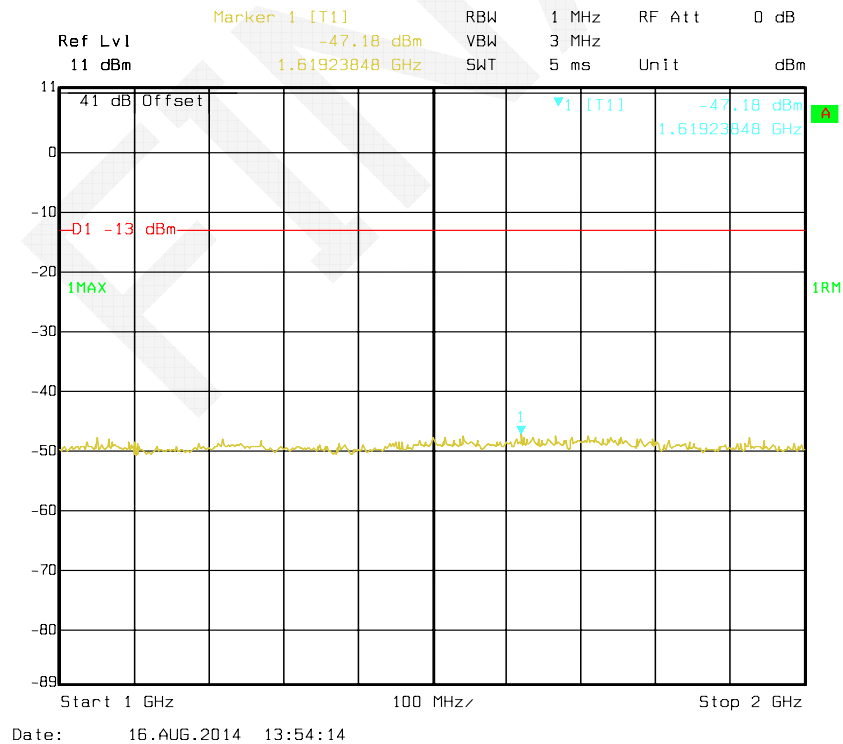
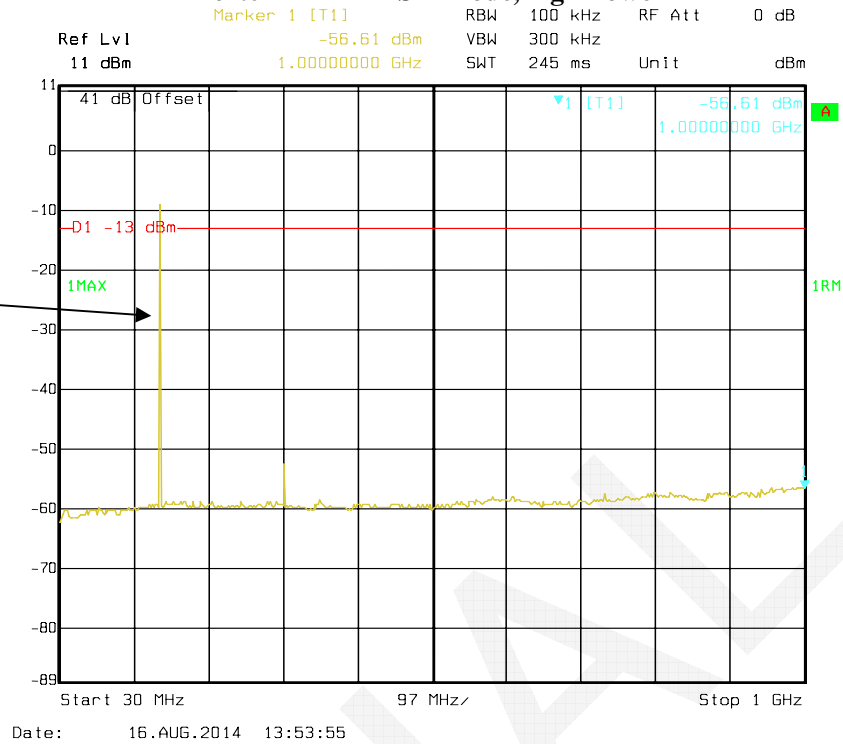


Date: 16.AUG.2014 13:46:03

FCC PART 22 161.01 MHz –FM Mode,High Power



FCC PART 22
161.01 MHz -4FSK Mode,High Power



FCC §2.1053 & §22.861 & §90.210 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053 and §22.861 and §90.210

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
Sunol Sciences	Antenna	JB3	A060611-1	2011-09-06	2014-09-05
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
R&S	EMI Test Receiver	ESCI	100224	2014-05-09	2015-05-09
Agilent	Signal Generator	E8247C	MY43321350	2012-10-15	2014-10-15
TDK RF	Horn Antenna	HRN-0118	130 084	2012-09-06	2015-09-06
ETS LINDGREN	Horn Antenna	3115	000 527 35	2012-09-06	2015-09-06
R&S	Spectrum Analyzer	FSEM	DE31388	2014-05-09	2015-05-09

*** 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 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 teeth 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 lg (TXpwr in Watts/0.001)-the absolute level

Spurious attenuation limit in dB = 50 + 10 Log₁₀ (power out in Watts) for EUT with a 12.5 kHz channel bandwidth.

For part 22:

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 43 + 10 log (P) dB.

Test Data**Environmental Conditions**

Temperature:	24.6~30.8°C
Relative Humidity:	37~59 %
ATM Pressure:	99.6~101.3 kPa

The testing was performed by Dean Liu from 2014-08-12 to 2014-11-03.

Test Mode: Transmitting (FM modulation mode, high power level, powered from 13.6 VDC)

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:155.0125MHz, FCC PART 90								
620.725	H	33.54	-45.5	0.0	0.8	-46.3	-20.0	26.3
620.045	V	35.02	-41.6	0.0	0.8	-42.4	-20.0	22.4
310.025	H	20.33	-64.3	0.0	0.5	-64.8	-20.0	44.8
310.025	V	20.11	-62.8	0.0	0.5	-63.3	-20.0	43.3
1085.088	H	26.38	-46.4	7.5	1.1	-40.0	-20.0	20.0
1085.088	V	27.11	-46.2	7.5	1.1	-39.8	-20.0	19.8
Frequency:161.010MHz, FCC PART 22								
322.020	V	23.44	-59.1	0.0	0.5	-59.6	-13.0	46.6
322.020	H	24.21	-60.2	0.0	0.5	-60.7	-13.0	47.7
644.980	V	23.44	-52.5	0.0	0.8	-53.3	-13.0	40.3
644.980	H	24.21	-54.2	0.0	0.8	-55.0	-13.0	42.0
1127.070	V	25.64	-47.6	7.4	1.1	-41.3	-13.0	28.3
1127.070	H	26.55	-46.3	7.4	1.1	-40.0	-13.0	27.0

Test Mode: Transmitting (4FSK modulation mode, high power level, powered from 13.6 VDC)

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:155.0125MHz, FCC PART 90								
620.725	H	33.47	-45.6	0.0	0.8	-46.4	-20.0	26.4
620.045	V	34.94	-41.6	0.0	0.8	-42.4	-20.0	22.4
310.025	H	20.31	-64.4	0.0	0.5	-64.9	-20.0	44.9
310.025	V	20.01	-62.9	0.0	0.5	-63.4	-20.0	43.4
1085.088	H	26.32	-46.5	7.5	1.1	-40.1	-20.0	20.1
1085.088	V	27.02	-46.3	7.5	1.1	-39.9	-20.0	19.9
Frequency:161.010MHz, FCC PART 22								
322.020	V	23.40	-59.2	0.0	0.5	-59.7	-13.0	46.7
322.020	H	24.17	-60.3	0.0	0.5	-60.8	-13.0	47.8
644.980	V	23.35	-52.6	0.0	0.8	-53.4	-13.0	40.4
644.980	H	24.14	-54.3	0.0	0.8	-55.1	-13.0	42.1
1127.070	V	25.62	-47.6	7.4	1.1	-41.3	-13.0	28.3
1127.070	H	26.46	-46.4	7.4	1.1	-40.1	-13.0	27.1

Test Mode: Transmitting (FM modulation mode, high power level, powered from AC/DC adapter)

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:155.0125MHz, FCC PART 90								
620.725	H	37.81	-41.1	0.0	0.8	-41.9	-20.0	21.9
620.045	V	39.92	-36.6	0.0	0.8	-37.4	-20.0	17.4
310.025	H	23.34	-61.2	0.0	0.5	-61.7	-20.0	41.7
310.025	V	23.56	-59.3	0.0	0.5	-59.8	-20.0	39.8
1085.088	H	27.14	-45.5	7.5	1.1	-39.1	-20.0	19.1
1085.088	V	27.62	-45.6	7.5	1.1	-39.2	-20.0	19.2
Frequency:161.010MHz, FCC PART 22								
322.02	V	27.69	-54.8	0.0	0.5	-55.3	-13.0	42.3
322.02	H	28.63	-55.7	0.0	0.5	-56.2	-13.0	43.2
644.98	V	26.46	-49.4	0.0	0.8	-50.2	-13.0	37.2
644.98	H	28.96	-49.4	0.0	0.8	-50.2	-13.0	37.2
1127.07	V	27.05	-46.1	7.4	1.1	-39.8	-13.0	26.8
1127.07	H	27.28	-45.5	7.4	1.1	-39.2	-13.0	26.2

Test Mode: Transmitting (4FSK modulation mode, high power level, powered from AC/DC adapter)

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:155.0125MHz, FCC PART 90								
620.725	H	37.26	-41.7	0.0	0.8	-42.5	-20.0	22.5
620.045	V	37.99	-38.5	0.0	0.8	-39.3	-20.0	19.3
310.025	H	23.75	-60.9	0.0	0.5	-61.4	-20.0	41.4
310.025	V	24.44	-58.4	0.0	0.5	-58.9	-20.0	38.9
1085.088	H	27.33	-45.4	7.5	1.1	-39	-20.0	19.0
1085.088	V	27.65	-45.6	7.5	1.1	-39.2	-20.0	19.2
Frequency:161.010MHz, FCC PART 22								
322.020	V	27.91	-54.6	0.0	0.5	-55.1	-13.0	42.1
322.020	H	28.66	-55.7	0.0	0.5	-56.2	-13.0	43.2
644.980	V	27.85	-48.0	0.0	0.8	-48.8	-13.0	35.8
644.980	H	28.55	-49.8	0.0	0.8	-50.6	-13.0	37.6
1127.070	V	27.26	-45.9	7.4	1.1	-39.6	-13.0	26.6
1127.070	H	27.38	-45.4	7.4	1.1	-39.1	-13.0	26.1

Note:

- 1) The unit of Antenna Gain is dBd for frequency below 1GHz, and the unit of Antenna Gain is dBi for frequency above 1GHz.
- 2) Absolute Level = SG Level - Cable loss + Antenna Gain
- 3) Margin = Limit-Absolute Level

FCC §2.1055 & § 22.355 & §90.213- FREQUENCY STABILITY**Applicable Standard**

FCC §2.1055, § 22.355, §90.213

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2014-05-09	2015-05-09
Dongzhixu	High Temperature Test Chamber	DP1000	201105083-3	2014-08-01	2015-08-01
UNI-T	Multimeter	UT39A	M130199938	2014-04-10	2015-04-10

* **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

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.
- (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

Test Data**Environmental Conditions**

Temperature:	29 °C
Relative Humidity:	60 %
ATM Pressure:	100.3 kPa

The testing was performed by Dean Liu on 2014-08-16.

Note: The EUT may be used in a base station or a mobile station configuration, the strict limits were applied.

Test Mode: Transmitting

FCC PART 90:

Reference Frequency: 155.0125 MHz, Limit: 2.5 ppm			
Temperature	Voltage	Reading	Frequency Error
°C	V _{DC}	MHz	ppm
-30	13.6	155.012490	-0.06
-20	13.6	155.012489	-0.07
-10	13.6	155.012492	-0.05
0	13.6	155.012487	-0.08
10	13.6	155.012489	-0.07
20	13.6	155.012493	-0.05
30	13.6	155.012490	-0.06
40	13.6	155.012483	-0.11
50	13.6	155.012496	-0.03
25	10.8	155.012490	-0.06
25	15.6	155.012495	-0.03

Reference Frequency: 155.0125 MHz, Limit: 2.5 ppm			
Temperature	Voltage	Reading	Frequency Error
°C	V _{AC}	MHz	ppm
-30	120	155.012487	-0.08
-20	120	155.012492	-0.05
-10	120	155.012486	-0.09
0	120	155.012491	-0.06
10	120	155.012488	-0.08
20	120	155.012490	-0.06
30	120	155.012494	-0.04
40	120	155.012489	-0.07
50	120	155.012493	-0.05
25	102	155.012485	-0.10
25	138	155.012492	-0.05

FCC PART 22:

Reference Frequency: 161.01 MHz, Limit: 5.0 ppm			
Temperature	Voltage	Reading	Frequency Error
°C	V _{DC}	MHz	ppm
-30	13.6	161.009987	-0.08
-20	13.6	161.009976	-0.15
-10	13.6	161.009994	-0.04
0	13.6	161.009989	-0.07
10	13.6	161.009980	-0.12
20	13.6	161.009992	-0.05
30	13.6	161.009975	-0.16
40	13.6	161.009979	-0.13
50	13.6	161.009992	-0.05
25	10.8	161.009987	-0.08
25	15.6	161.009983	-0.11

Reference Frequency: 161.01 MHz, Limit: 5.0 ppm			
Temperature	Voltage	Reading	Frequency Error
°C	V _{AC}	MHz	ppm
-30	120	161.009990	-0.06
-20	120	161.009987	-0.08
-10	120	161.009986	-0.09
0	120	161.009981	-0.12
10	120	161.009986	-0.09
20	120	161.009988	-0.07
30	120	161.009992	-0.05
40	120	161.009985	-0.09
50	120	161.009984	-0.10
25	102	161.009981	-0.12
25	138	161.009989	-0.07

FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

Applicable Standard

Regulations: FCC §90.214

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

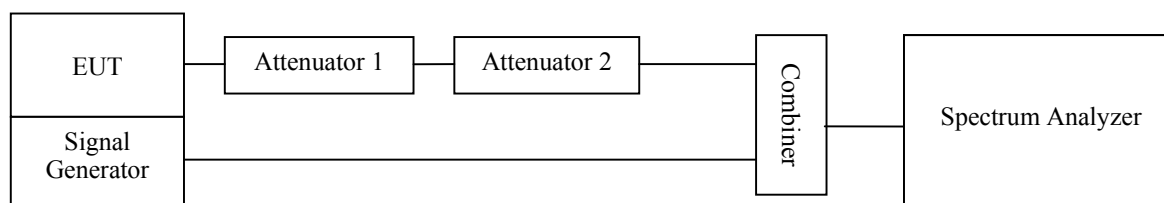
Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2013-05-09	2014-05-09
HP	Signal Generator	8648A	3426A00831	2013-11-06	2014-11-06

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, 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 .
- 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**

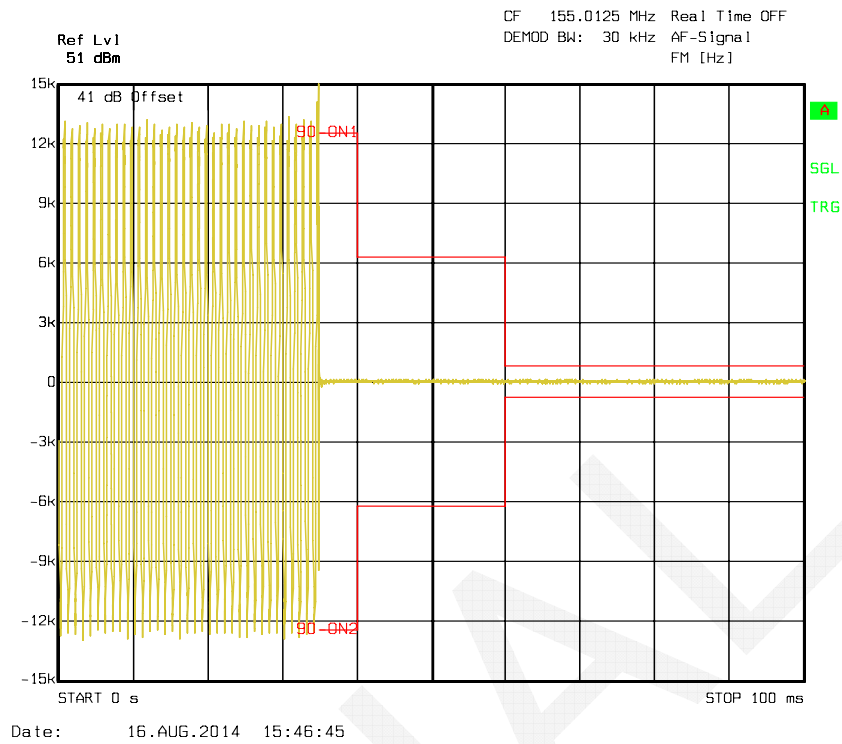
Temperature:	29 °C
Relative Humidity:	60 %
ATM Pressure:	100.3 kPa

The testing was performed by Dean Liu on 2014-08-16.

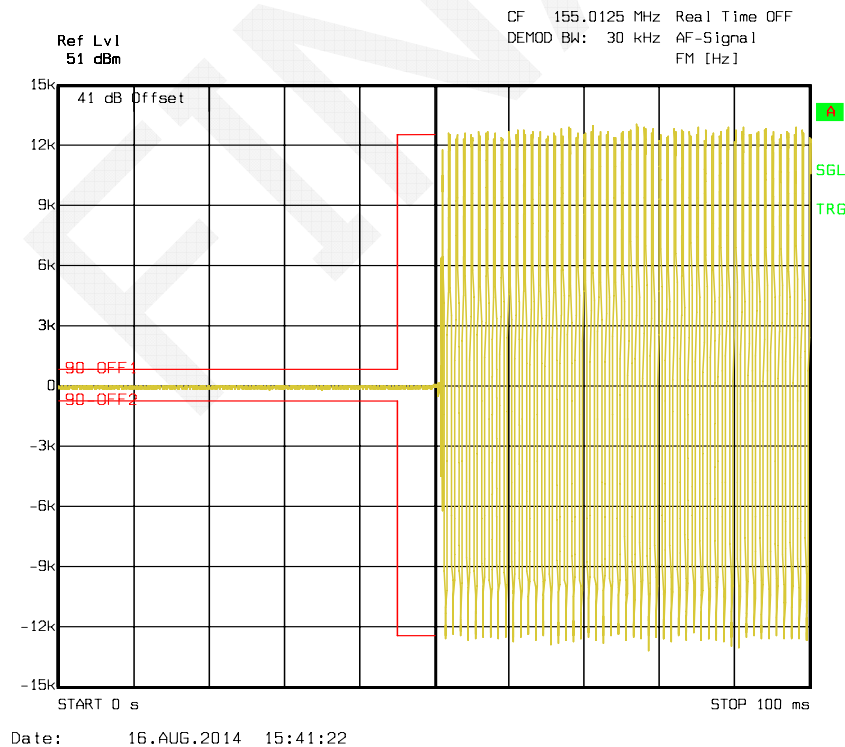
Channel Separation (kHz)	Transient Period (ms)	Maximum frequency difference	Result
12.5	<5(t_1)	± 12.5 kHz	Pass
	<20(t_2)	± 6.25 kHz	
	<5(t_3)	± 12.5 kHz	

Please refer to the following plots.

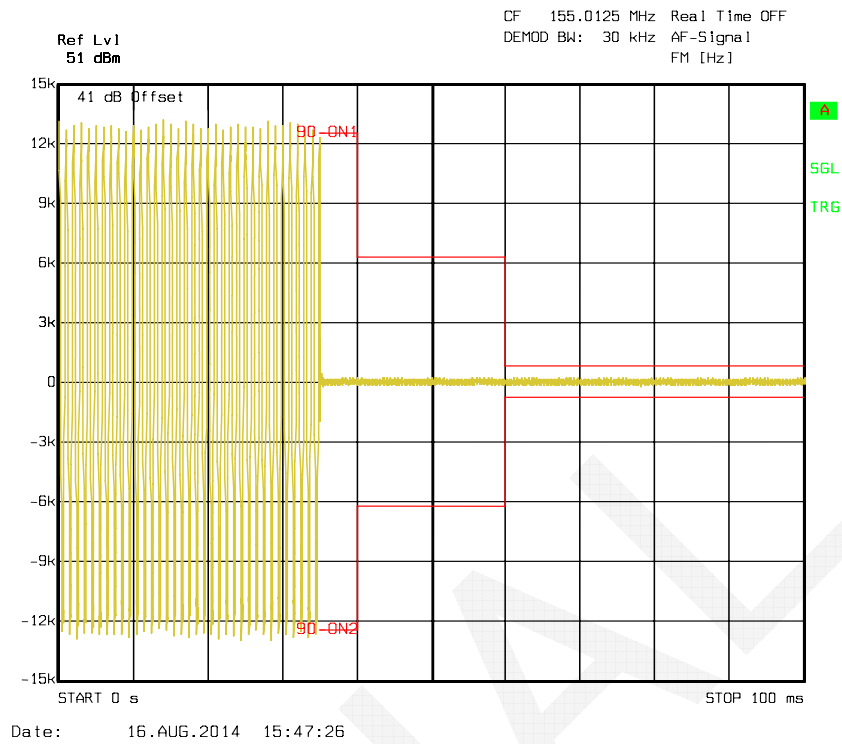
Turn on – 155.0125 MHz, High power level



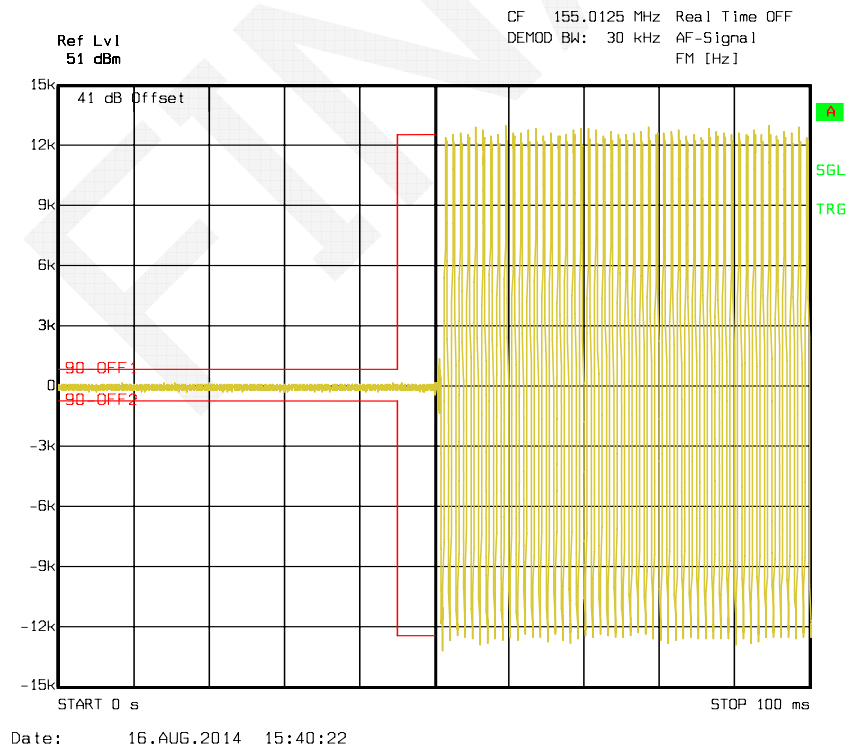
Turn off – 155.0125 MHz, High power level



Turn on – 155.0125 MHz, Low power level



Turn off – 155.0125 MHz, Low power level



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