FCC PART 90
TEST REPORT

For

PO FUNG ELECTRONIC(HK) INTERNATIOANL GROUP COMPANY

3/F FULOK BLDG 131-133 WING LOK ST SHEUNG WAN HONGKONG

FCC ID: 2AJGM-DM-5R

Report Type:	**Product Name:**
Original Report	VHF/UHF Two Way Radio

Test Engineer:	*Kevin Hu*
Report Number:	RXM160918052
Report Date:	2018-01-12
Reviewed By:	Henry Ding EMC Leader
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Chengdu) No. 5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China Tel: 028-65525123, Fax: 028-65525125 www.baclcorp.com

Note: This test report was 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. (Chengdu).

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
SUPPORT EQUIPMENT LIST AND DETAILS 6
BLOCK DIAGRAM OF TEST SETUP 6
SUMMARY OF TEST RESULTS **8**
FCC §1.1310 & §2.1093 - RF EXPOSURE **9**
APPLICABLE STANDARD 9
TEST RESULT 9
FCC §2.1046 & §90.205- RF OUTPUT POWER **10**
APPLICABLE STANDARD 10
TEST PROCEDURE 10
TEST EQUIPMENT LIST AND DETAILS 10
TEST DATA 10
FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC **12**
APPLICABLE STANDARD 12
TEST PROCEDURE 12
TEST EQUIPMENT LIST AND DETAILS 12
TEST DATA 12
FCC §2.1049&§90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK **19**
APPLICABLE STANDARD 19
TEST EQUIPMENT LIST AND DETAILS 20
TEST PROCEDURE 20
TEST DATA 20
FCC §2.1051& §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS **30**
APPLICABLE STANDARD 30
TEST EQUIPMENT LIST AND DETAILS 30
TEST PROCEDURE 31
TEST DATA 31
FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS **36**
APPLICABLE STANDARD 36
TEST EQUIPMENT LIST AND DETAILS 36
TEST PROCEDURE 36
TEST DATA 37
FCC §2.1055 & §90.213- FREQUENCY STABILITY **42**
APPLICABLE STANDARD 42
TEST EQUIPMENT LIST AND DETAILS 42
TEST PROCEDURE 42
TEST DATA 42

FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR **44**
APPLICABLE STANDARD 44
TEST EQUIPMENT LIST AND DETAILS 44
TEST PROCEDURE 44
TEST DATA 45

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The ***PO FUNG ELECTRONIC(HK) INTERNATIOANL GROUP COMPANY***'s product, model: ***DM-5R*** (***FCC ID: 2AJGM-DM-5R)*** (the "EUT") in this report is a ***VHF/UHF Two Way Radio***, which was measured approximately: 5.9 cm (L) x 3.6 cm (W) x 11.0 cm (H), rated input voltage: DC7.4V from Li-ion battery and DC 10V from adapter.

Adapter information:
MODEL:NLA060100W1A6
INPUT: 100-240V~ 50/60Hz 0.2A Max
OUTPUT: DC10V, 600mA

The products, test model: DM-5R, multiple model: DMR-5RA, DMR-5RB, DMR-5RC, DMR-5RE, GT-3 DMR, their differences were presented in Product Difference Statement provided by the applicant. And we selected DM-5R to fully test.

**All measurement and test data in this report was gathered from final production sample, serial number: 160918052 (assigned by the BACL, Chengdu). It may have deviation from any other sample. The EUT supplied by the applicant was received on 2016-09-29, and EUT conformed to test requirement.*

Objective

This test report is prepared on behalf of ***PO FUNG ELECTRONIC(HK) INTERNATIOANL GROUP COMPANY*** 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 SERVICES

Applicable Standards: TIA-603-D.

The uncertainty of any RF tests which use conducted method measurement is ±3.17 dB, the uncertainty of any radiation on emissions measurement is:

30M~200MHz: ±4.7 dB;
200M~1GHz: ±6.0 dB;
1G~6GHz: ±5.13dB;
6G~25GHz: ±5.47dB;

And the uncertainty will not be taken into consideration for all test data recorded in the report.

Test Facility

The test site used by BACL to collect test data is located No. 5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China

BACL(Chengdu) is accredited by A2LA in accordance with the recognized international standard ISO/IEC 17025, A2LA cert No.: 4324.01. The Federal communications commission has on file and is listed under FCC Test Firm Registration No.: 910975, the FCC Designation No. : CN1186.

BACL(Chengdu) has been fully described in reports on file and registered with the Innovation, Science and Economic Development Canada under Registration Numbers: 3062C-1

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode.

EUT Specification:

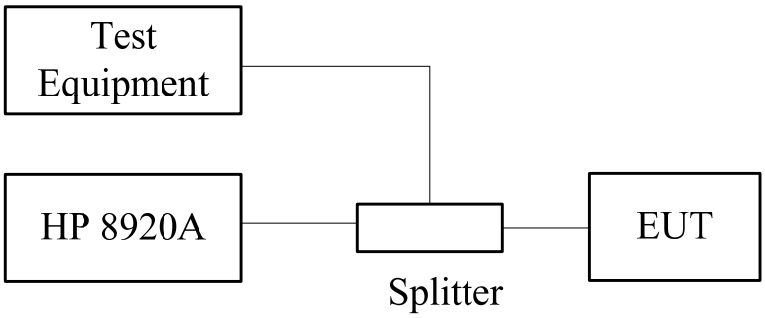
Frequency Band	VHF: 136-174MHz UHF: 400-480MHz
Modulation Mode	FM/4FSK
Channel Spacing	12.5kHz
Output Power	VHF:High: 5W, Low: 2W UHF:High: 4W, Low: 2W

Support Equipment List and Details

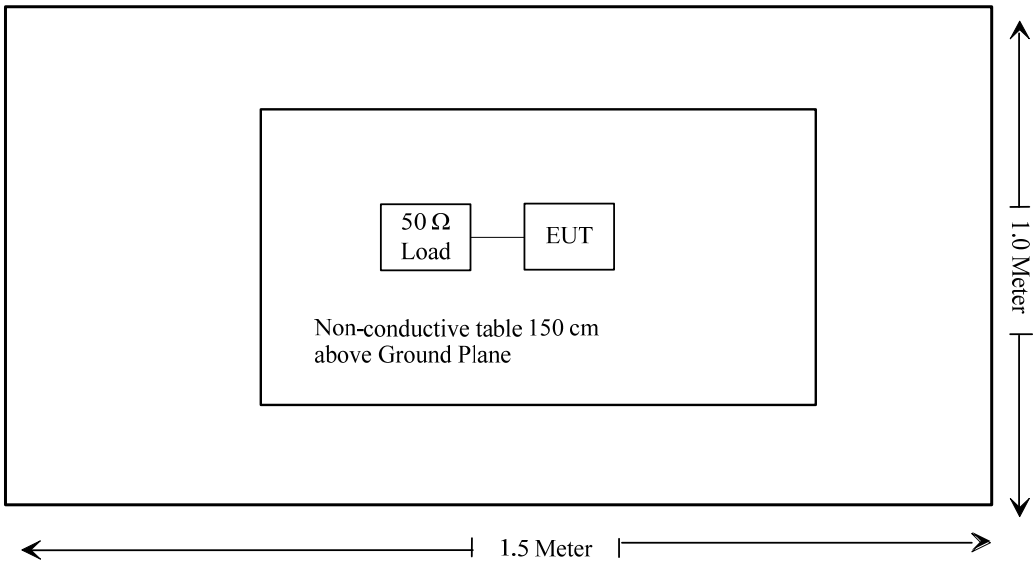
Manufacturer	Description	Model	Serial Number
Unknown	Terminal Load (50 Ω)	50Ω	Load-1
HP	RF Communications Test Set	8920A	00 247
Unknown	Splitter	Unknown	Splitter-1

Block Diagram of Test Setup

Conducted:



Radiated:


50 Ω
Load
EUT
Non-conductive table 150 cm
above Ground Plane
1.0 Meter
1.5 Meter

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
FCC§1.1310 & §2.1093	RF exposure	Compliant
§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 §1.1310 & §2.1093 - RF EXPOSURE

Applicable Standard

FCC§1.1310 and §2.1093.

Test Result

Compliant, please refer to the SAR report: RXM160918052-20.

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
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2016-09-21	2017-09-20
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	27.7 °C
Relative Humidity:	30 %
ATM Pressure:	101 kPa

The testing was performed by Kevin Hu on 2016-10-25.

Test Result: Compliant. Please refer to following tables.

Modulation Mode	Channel Separation	f_c (MHz)	Reading (w)		Note
			High Power Level	Low Power Level	
FM	12.5kHz	136.025	5.10	1.95	Not for FCC Review
		155.000	5.04	2.03	/
		155.7525	5.08	2.07	/
		173.975	5.12	1.99	Not for FCC Review
		400.025	4.05	1.92	Not for FCC Review
		420.000	4.01	1.98	/
		440.000	3.98	1.95	/
		460.000	3.94	2.02	/
		479.975	4.03	2.10	/
4FSK	12.5kHz	136.025	5.15	2.08	Not for FCC Review
		155.000	5.11	2.13	/
		155.7525	5.06	2.05	/
		173.975	5.09	2.01	Not for FCC Review
		400.025	4.05	1.96	Not for FCC Review
		420.000	4.01	1.98	/
		440.000	4.08	2.03	/
		460.000	4.13	1.94	/
		479.975	4.10	2.01	/

Note: For VHF band, the rated power is 5W for high power level, 2W for low Power level.
For UHF band, the rated power is 4W for high power level, 2W for 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-603D 2.2.3

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	RF Communications Test Set	8920A	00 247	2016-08-10	2017-08-09
LEADER	Millivoltmeter	LMV-181A	601561	2016-08-10	2017-08-09
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

*** Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	27.7 °C
Relative Humidity:	30 %
ATM Pressure:	101 kPa

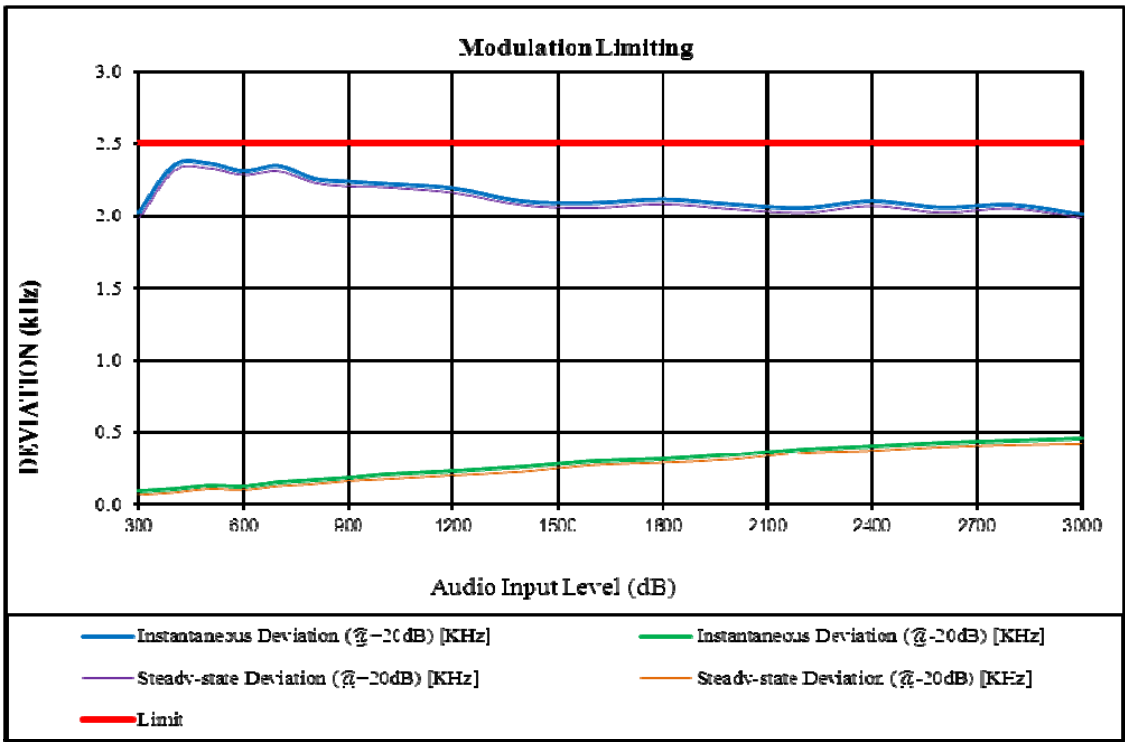
The testing was performed by Kevin Hu on 2016-10-25.

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

MODULATION LIMITING

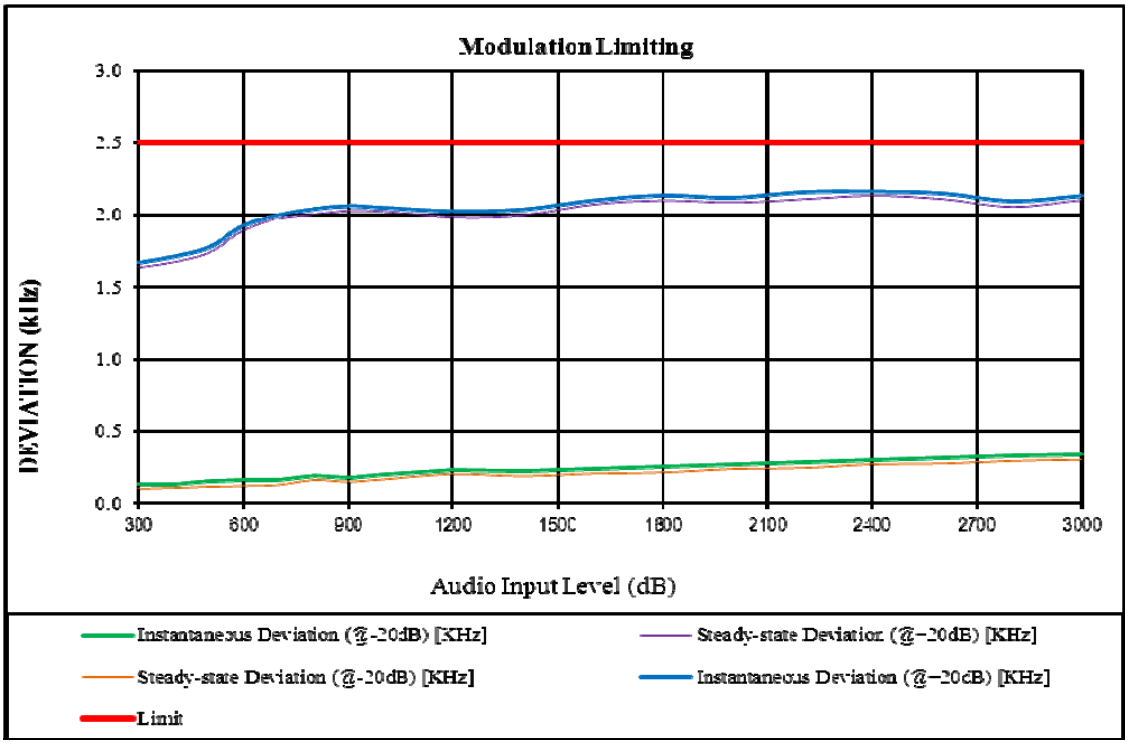
Carrier Frequency: 155.7525 MHz, Channel Spacing = 12.5 kHz

Audio Frequency (Hz)	Instantaneous		Steady-state		Limit [kHz]
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	2.023	0.093	1.978	0.064	2.5
400	2.350	0.104	2.313	0.080	2.5
500	2.363	0.128	2.330	0.105	2.5
600	2.311	0.122	2.285	0.099	2.5
700	2.346	0.150	2.311	0.124	2.5
800	2.260	0.164	2.233	0.138	2.5
900	2.239	0.181	2.206	0.160	2.5
1000	2.225	0.205	2.200	0.172	2.5
1200	2.193	0.231	2.162	0.198	2.5
1400	2.104	0.259	2.077	0.224	2.5
1600	2.093	0.294	2.059	0.269	2.5
1800	2.117	0.313	2.084	0.286	2.5
2000	2.083	0.345	2.051	0.310	2.5
2200	2.058	0.383	2.025	0.357	2.5
2400	2.105	0.400	2.072	0.372	2.5
2600	2.061	0.429	2.027	0.398	2.5
2800	2.080	0.445	2.055	0.413	2.5
3000	2.014	0.459	1.989	0.421	2.5



Carrier Frequency: 453.2125 MHz, Channel Spacing = 12.5 kHz

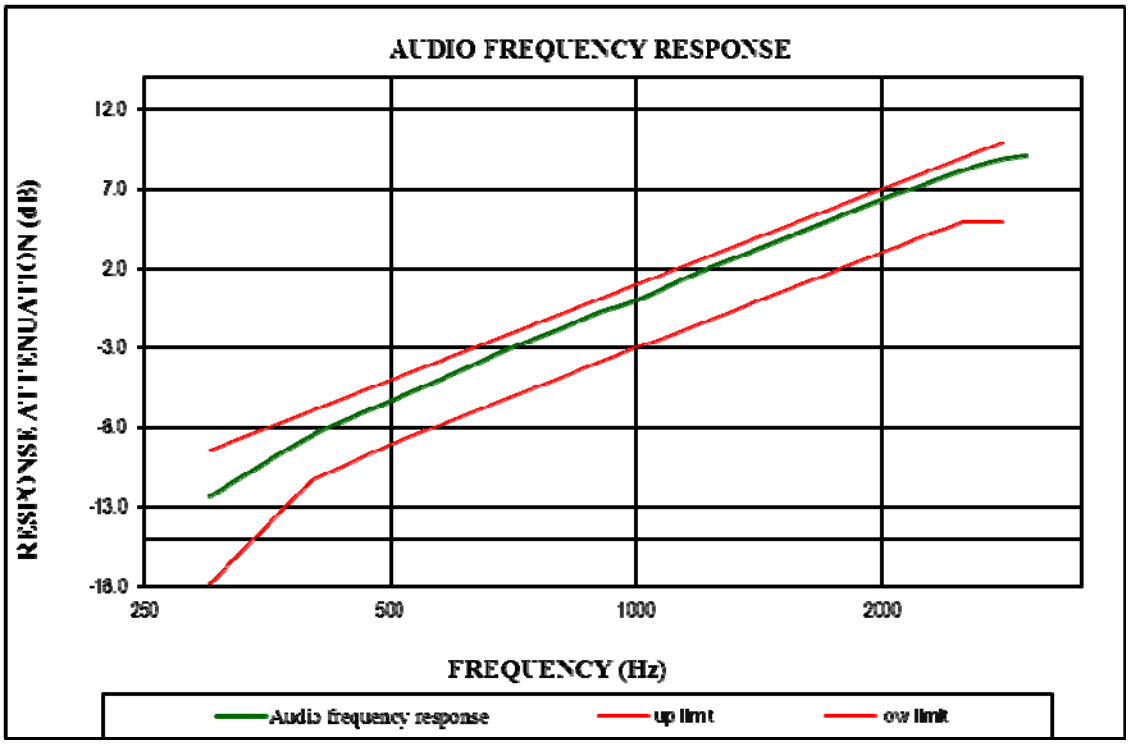
Audio Frequency (Hz)	Instantaneous		Steady-state		Limit [kHz]
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	1.668	0.125	1.635	0.099	2.5
400	1.712	0.131	1.674	0.105	2.5
500	1.775	0.147	1.738	0.113	2.5
600	1.925	0.155	1.892	0.118	2.5
700	2.000	0.161	1.978	0.125	2.5
800	2.042	0.189	2.005	0.159	2.5
900	2.063	0.175	2.031	0.147	2.5
1000	2.051	0.200	2.026	0.164	2.5
1200	2.027	0.226	1.989	0.200	2.5
1400	2.039	0.219	2.001	0.186	2.5
1600	2.101	0.234	2.074	0.203	2.5
1800	2.136	0.247	2.102	0.211	2.5
2000	2.120	0.263	2.087	0.235	2.5
2200	2.159	0.278	2.110	0.242	2.5
2400	2.163	0.294	2.135	0.267	2.5
2600	2.151	0.311	2.112	0.272	2.5
2800	2.097	0.329	2.058	0.291	2.5
3000	2.133	0.336	2.104	0.300	2.5



Audio Frequency Response

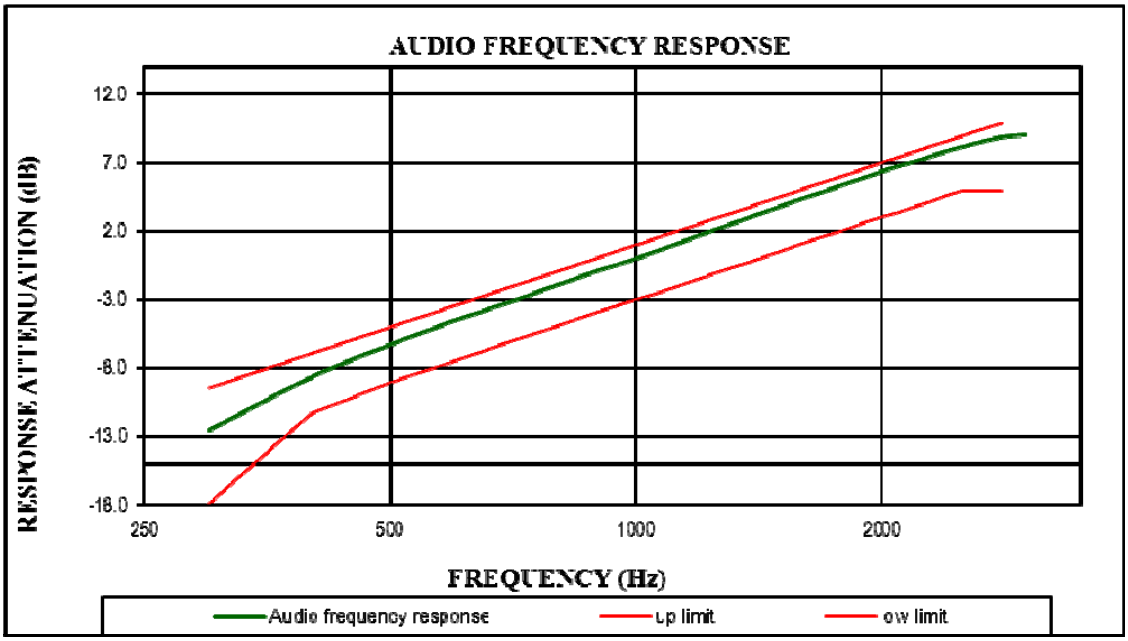
Carrier Frequency: 155.7525 MHz, Channel Spacing = 12.5 kHz

Audio Frequency (Hz)	Response Attenuation (dB)
300	-12.32
400	-8.51
500	-6.32
600	-4.55
700	-3.01
800	-1.87
900	-0.75
1000	0.00
1200	1.83
1400	3.17
1600	4.36
1800	5.42
2000	6.35
2200	7.10
2400	7.83
2600	8.42
2800	8.86
3000	9.07



Carrier Frequency: 453.2125 MHz, Channel Spacing = 12.5 kHz

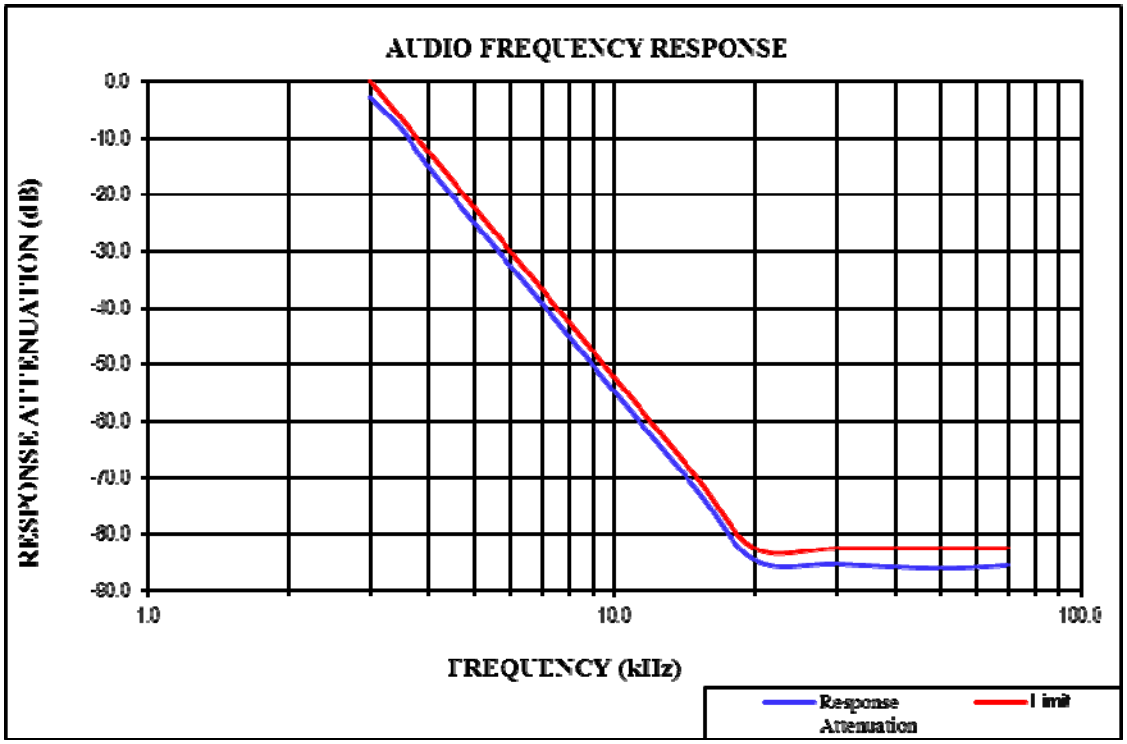
Audio Frequency (Hz)	Response Attenuation (dB)
300	-12.52
400	-8.65
500	-6.28
600	-4.51
700	-3.17
800	-1.93
900	-0.85
1000	0.00
1200	1.73
1400	3.16
1600	4.39
1800	5.41
2000	6.37
2200	7.11
2400	7.82
2600	8.40
2800	8.87
3000	9.03



Audio Frequency Low Pass Filter Response

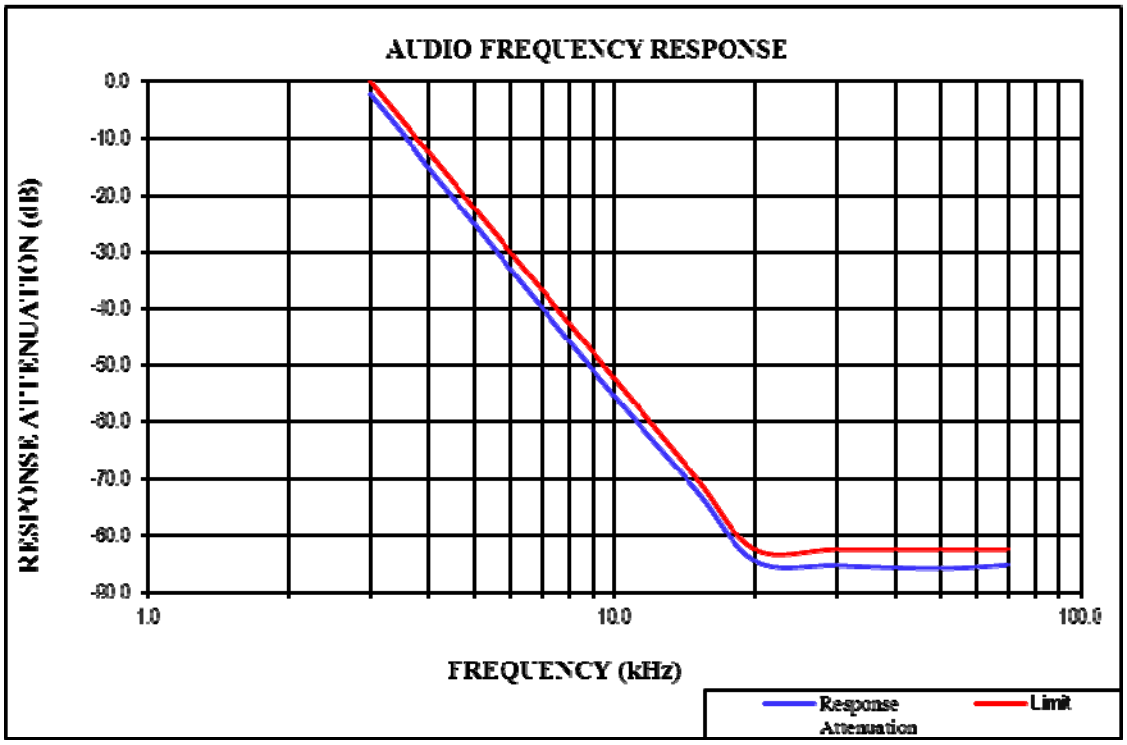
Carrier Frequency: 155.7525 MHz, Channel Spacing = 12.5 kHz

Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
3.0	-2.8	0.0
3.5	-8.5	-6.7
4.0	-15.2	-12.5
5.0	-24.9	-22.2
7.0	-39.3	-36.8
10.0	-54.8	-52.3
15.0	-72.1	-69.9
20.0	-84.6	-82.5
30.0	-85.3	-82.5
50.0	-86.0	-82.5
70.0	-85.5	-82.5



Carrier Frequency: 453.2125 MHz, Channel Spacing = 12.5 kHz

Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
3.0	-2.2	0.0
3.5	-8.9	-6.7
4.0	-15.3	-12.5
5.0	-25.0	-22.2
7.0	-39.9	-36.8
10.0	-55.4	-52.3
15.0	-72.1	-69.9
20.0	-84.5	-82.5
30.0	-85.3	-82.5
50.0	-85.8	-82.5
70.0	-85.2	-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 f0 to 5.625 kHz removed from f0: Zero dB.

(2) 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 than 12.5 kHz: At least 7.27(fd−2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 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.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2016-09-21	2017-09-20
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested 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:	28.4 °C
Relative Humidity:	31 %
ATM Pressure:	100.7 kPa

The testing was performed by Kevin Hu on 2016-10-24.

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

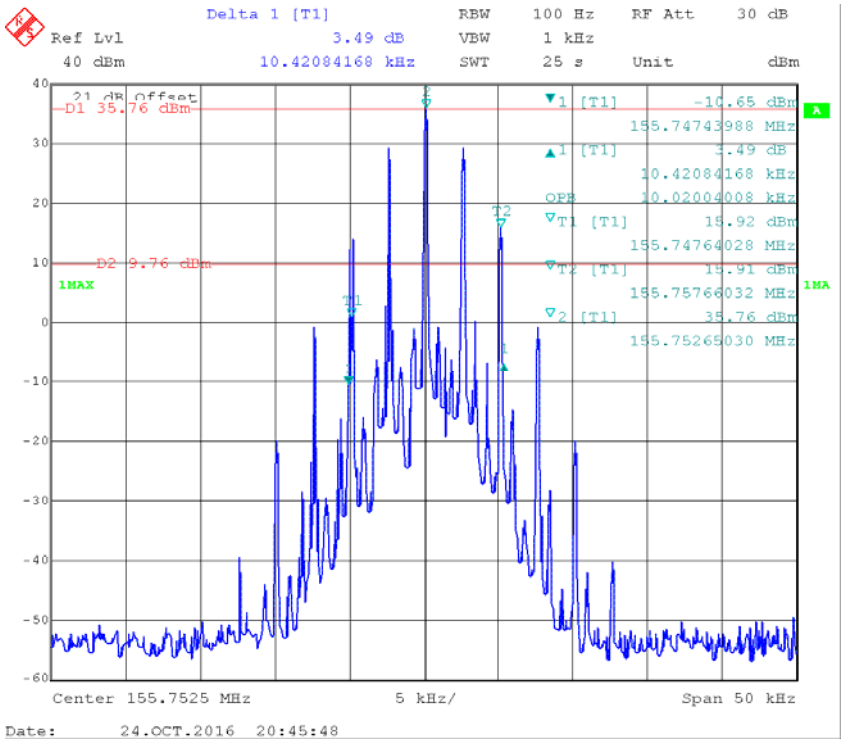
Modulation Mode	Channel Separation	f_c (MHz)	99% Occupied Bandwidth (kHz)	26 dB Bandwidth (kHz)	Emission Power
FM	12.5kHz	155.7525	10.020	10.421	High power level
			9.920	10.421	Low Power Level
	12.5kHz	453.2125	9.920	10.421	High power level
			9.920	10.421	Low Power Level
4FSK	12.5kHz	155.7525	7.315	9.820	High power level
			7.415	9.519	Low Power Level
	12.5kHz	453.2125	7.315	9.519	High power level
			7.214	9.820	Low Power Level

For FM Mode (Channel Spacing: 12.5 kHz)
Emission Designator 11K0F3E
In this case, the maximum modulating frequency is 3.0 kHz with a 2.5 kHz deviation.
BW = 2(M+D) = 2*(3.0 kHz + 2.5 kHz) = 11 kHz = 11K0
F3E portion of the designator represents an FM voice transmission
Therefore, the entire designator for 12.5 kHz channel spacing FM mode is 11K0F3E.

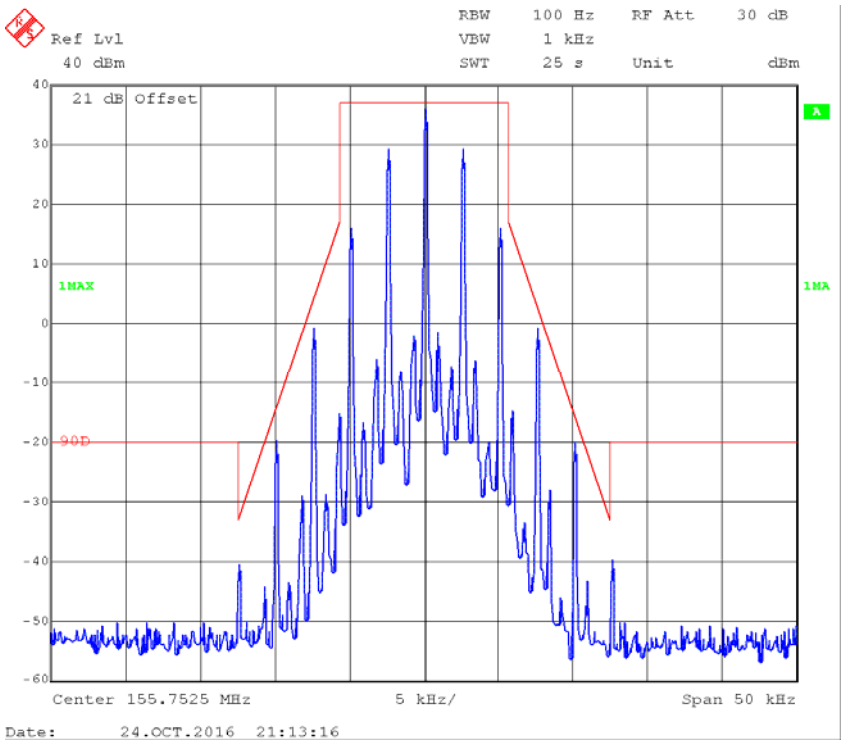
For Digital Mode (Channel Spacing: 12.5 kHz)
Emission Designator 7K60F1D and 7K60F1E
The 99% energy rule (title 47CFR 2.1049) was used for digital mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.60 kHz. The emission mask was obtained from 47CFR 90.210(d).
F1D and F1E portion of the designator indicates digital information.
Therefore, the entire designator for 12.5 kHz channel spacing digital mode is 7K60F1D and 7K60F1E.

FM Mode

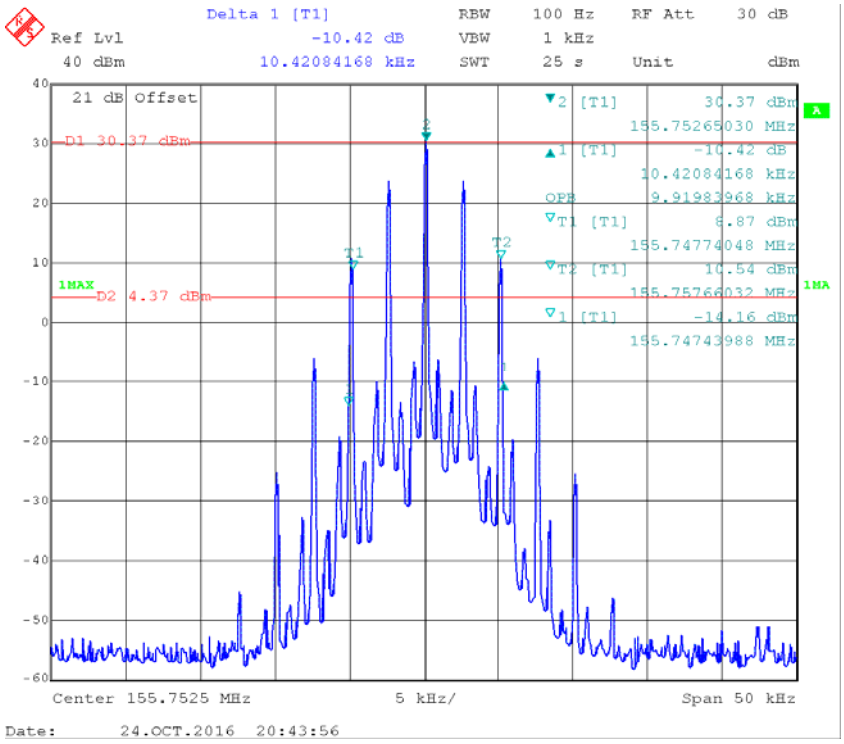
Occupied Bandwidth –12.5kHz, 155.7525 MHz, High Power Level



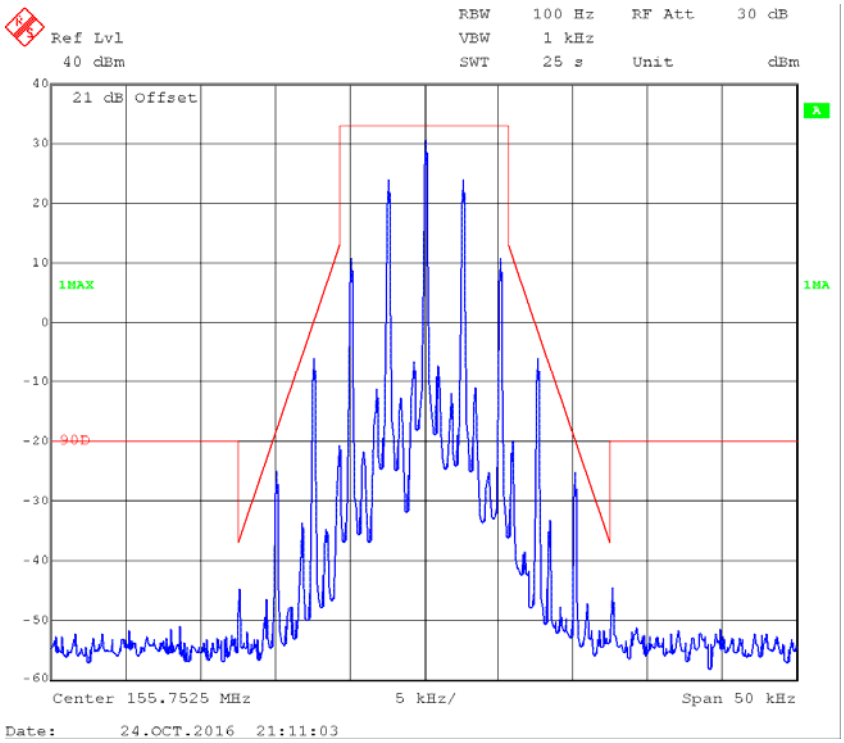
Emission Mask - Type D



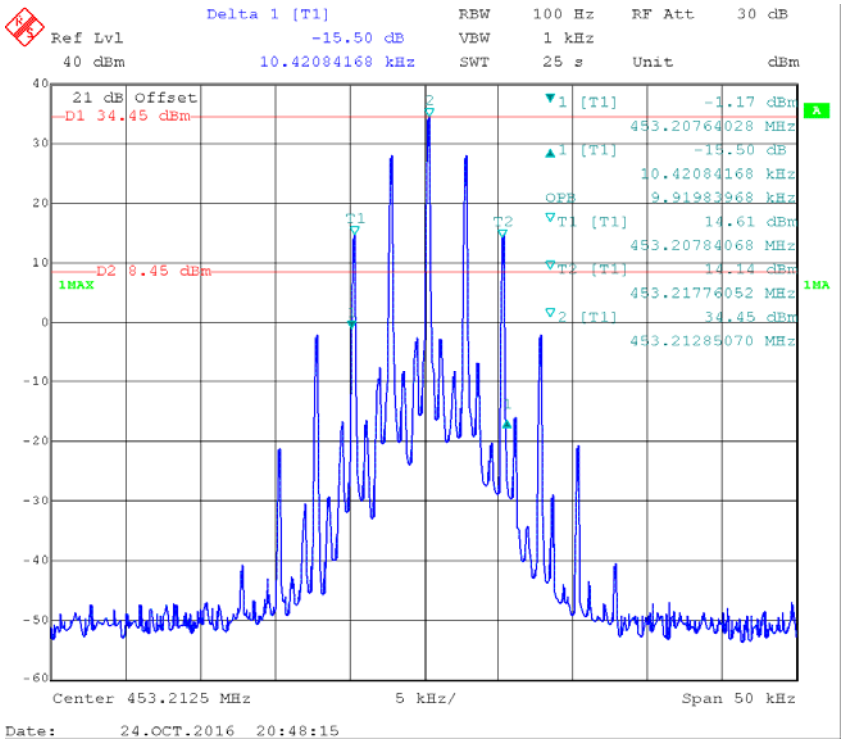
Occupied Bandwidth –12.5kHz, 155.7525 MHz, Low Power Level



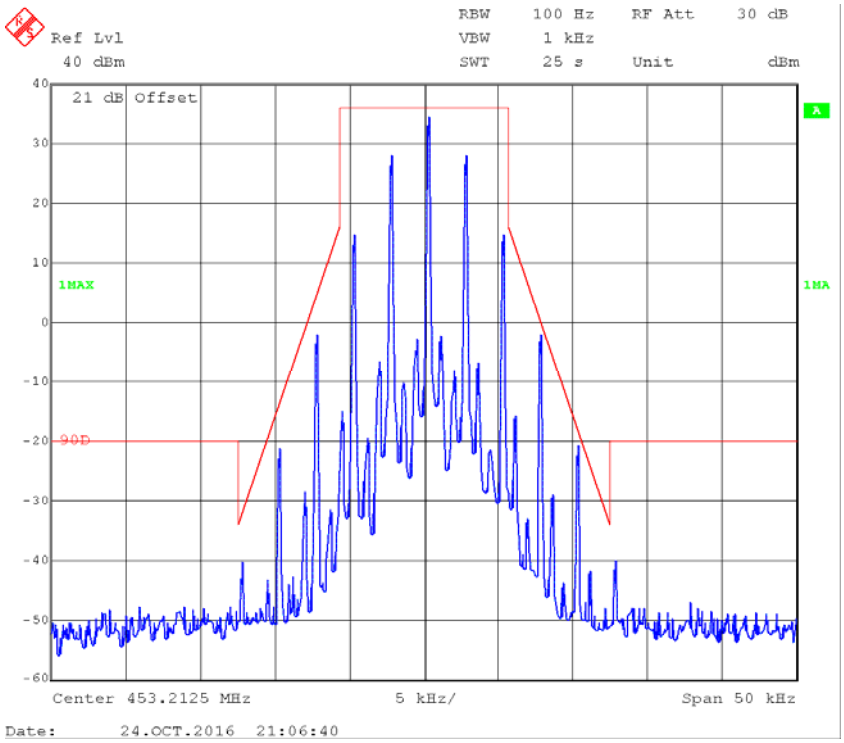
Emission Mask - Type D



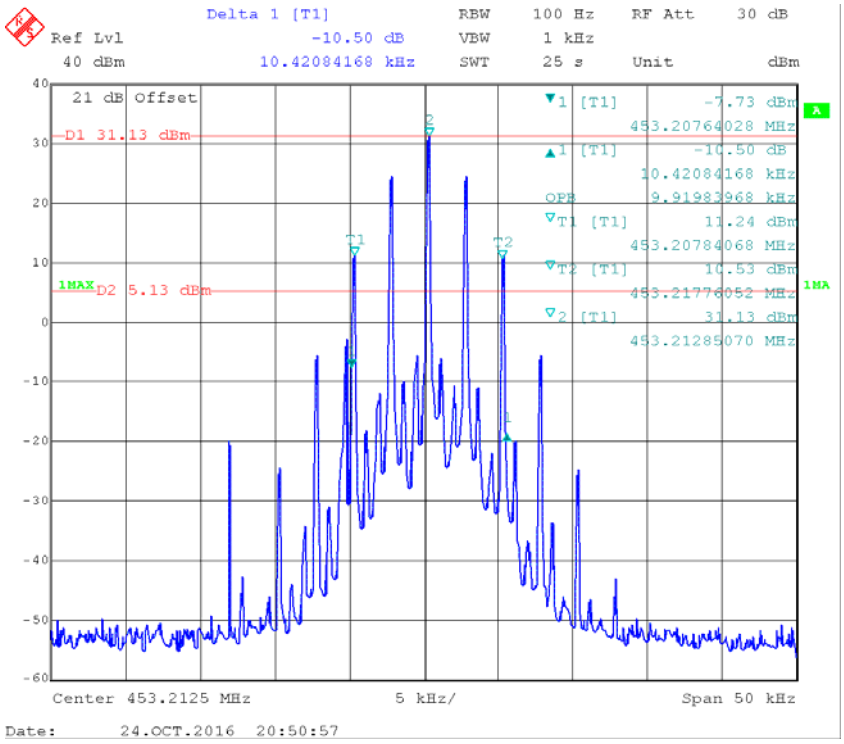
Occupied Bandwidth –12.5kHz, 453.2125 MHz, High Power Level



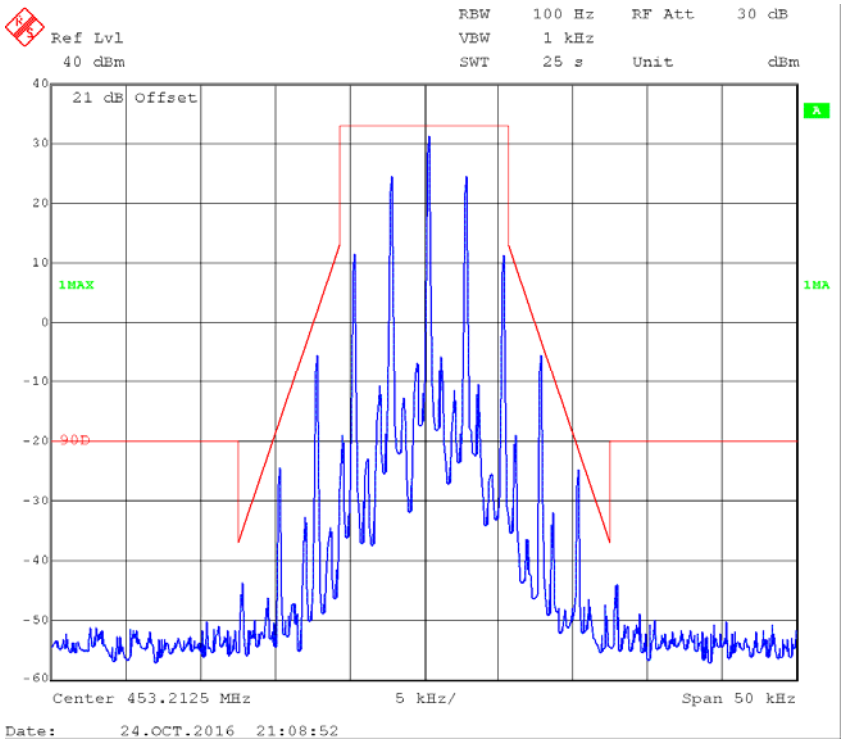
Emission Mask - Type D



Occupied Bandwidth –12.5kHz, 453.2125 MHz, Low Power Level

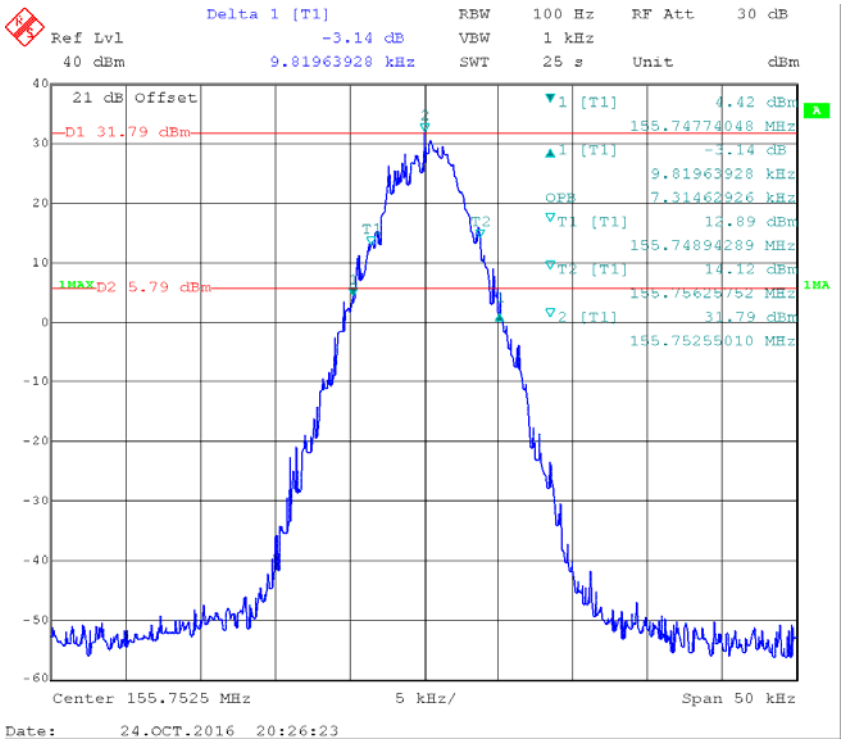


Emission Mask - Type D

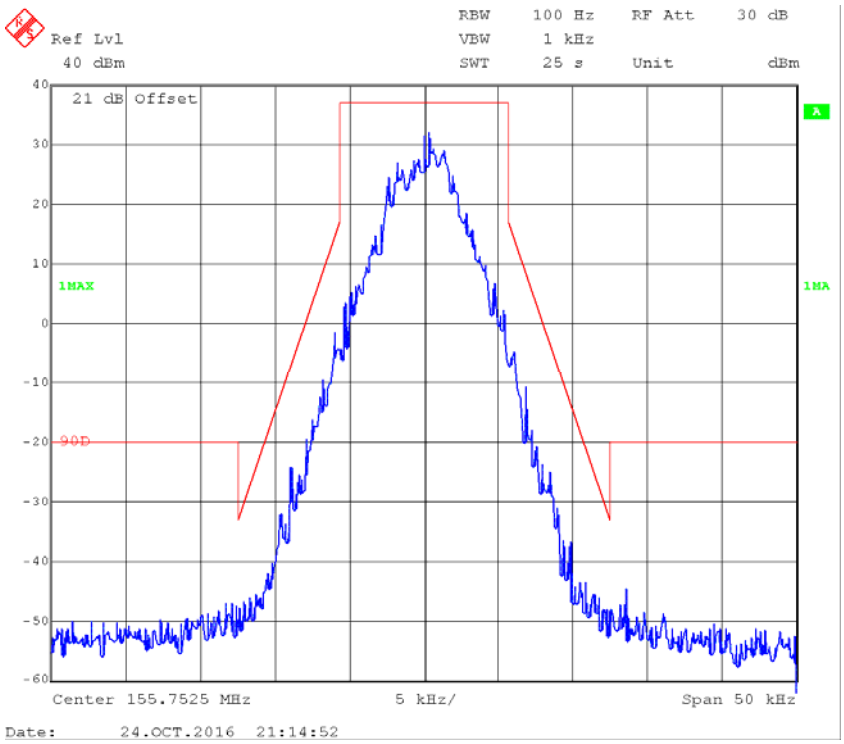


4FSK Mode

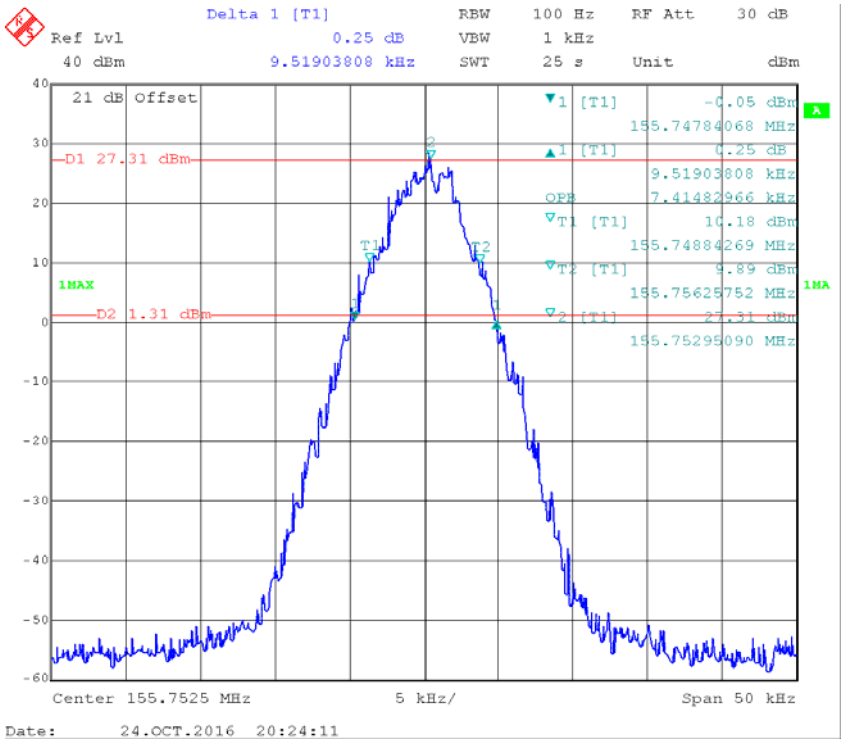
Occupied Bandwidth – 12.5kHz, 155.7525 MHz, High Power Level



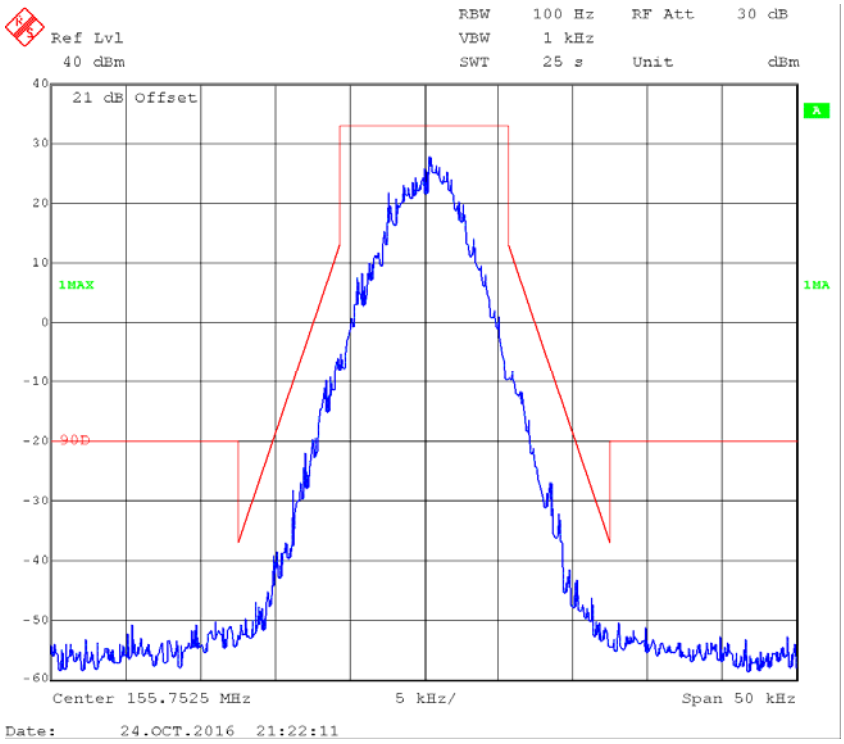
Emission Mask - Type D



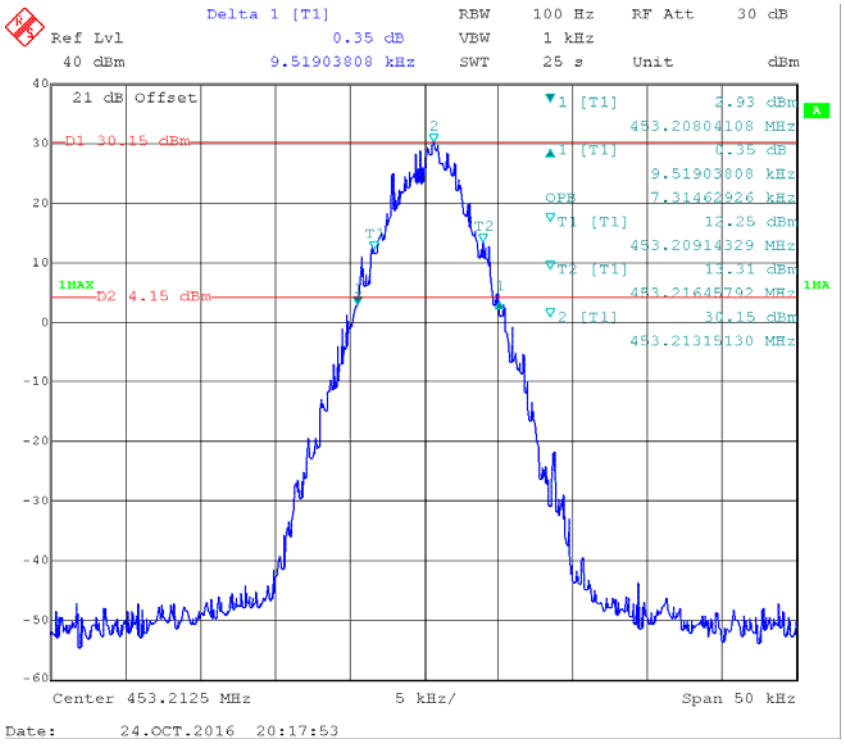
Occupied Bandwidth –12.5kHz, 155.7525 MHz, Low Power Level



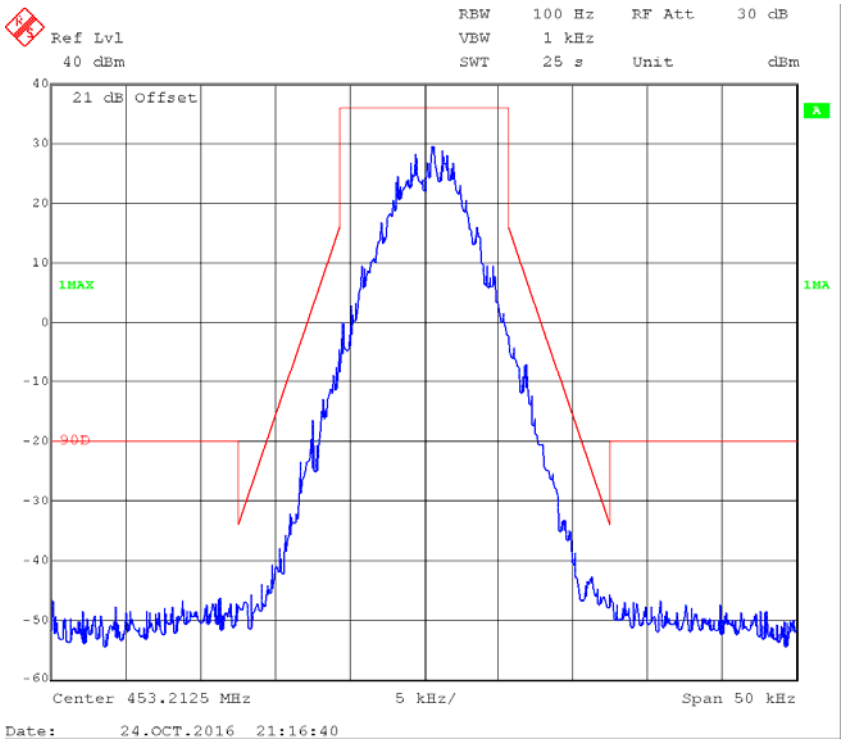
Emission Mask - Type D



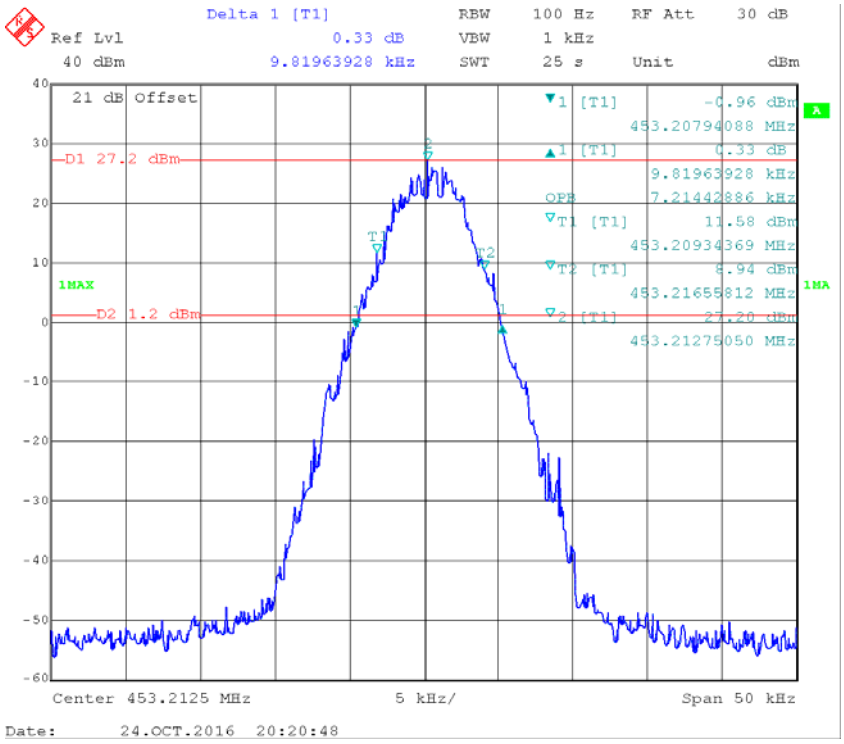
Occupied Bandwidth – 12.5kHz, 453.2125 MHz, High Power Level



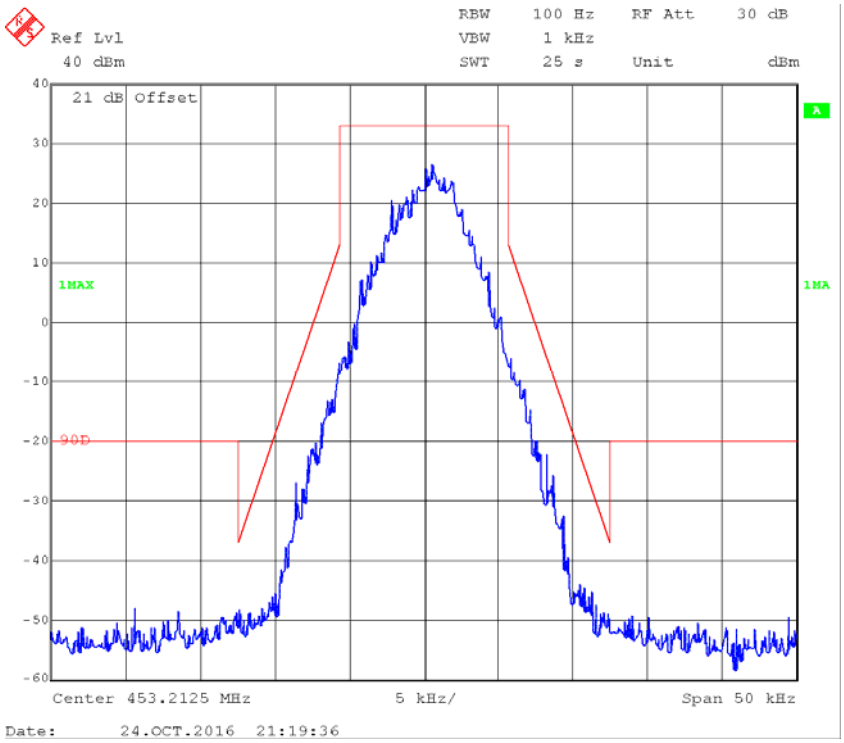
Emission Mask - Type D



Occupied Bandwidth –12.5kHz, 453.2125 MHz, Low Power Level



Emission Mask - Type D



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 f0 to 5.625 kHz removed from f0: Zero dB.

(2) 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 than 12.5 kHz: At least 7.27(fd−2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 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.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2016-09-21	2017-09-20
Oulitong	band rejection filter	130-180	2	Each Time	/
Oulitong	band rejection filter	400-520	8	Each Time	/
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested 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

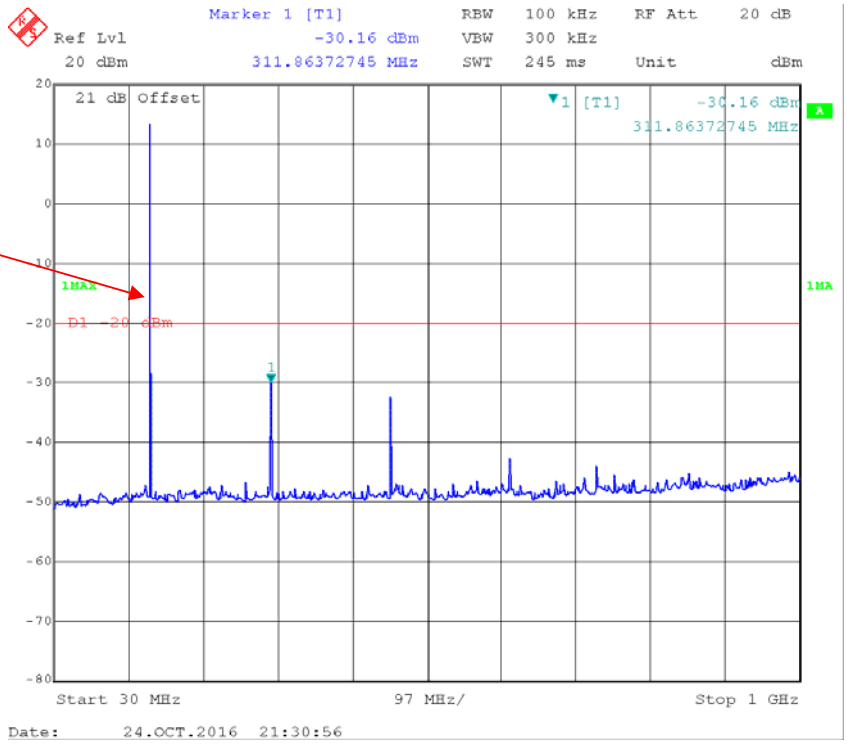
Temperature:	28.4 °C
Relative Humidity:	31 %
ATM Pressure:	100.7 kPa

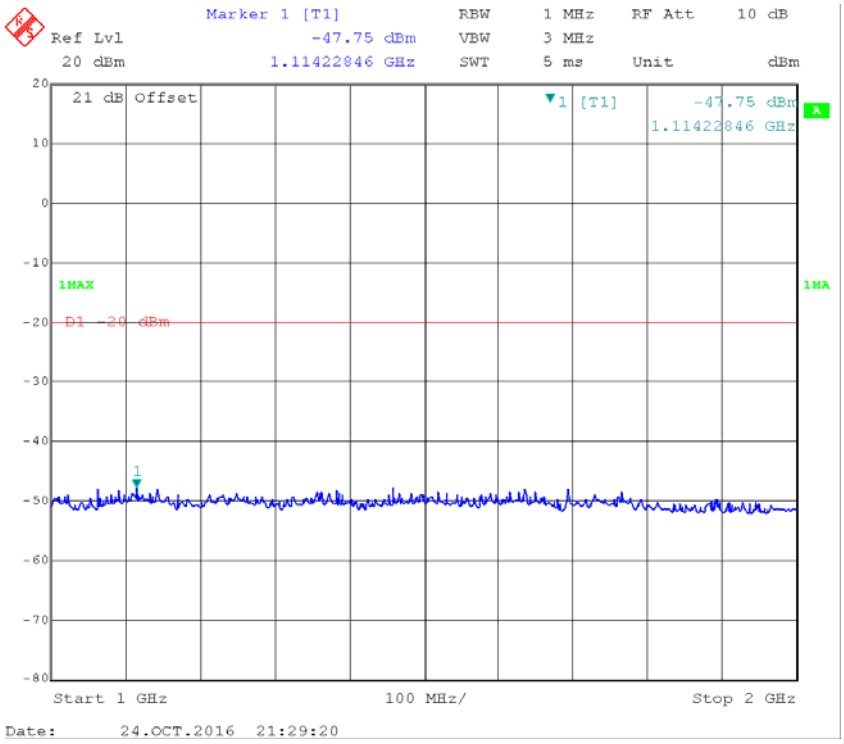
The testing was performed by Kevin Hu on 2016-10-24.

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

155.7525 MHz – FM Mode, 12.5 kHz

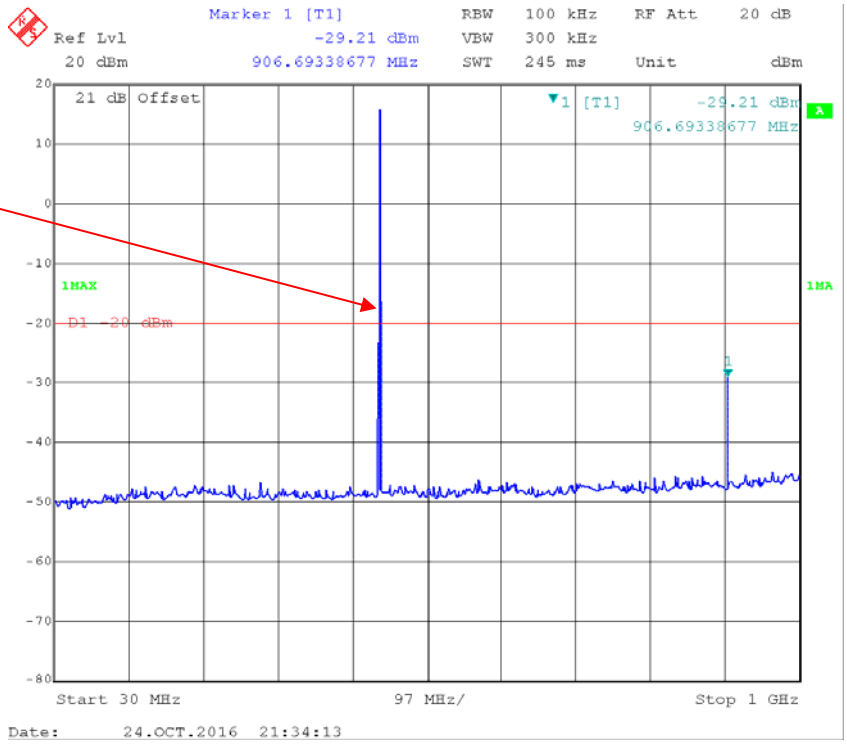
Fundamental Test with band rejection filter

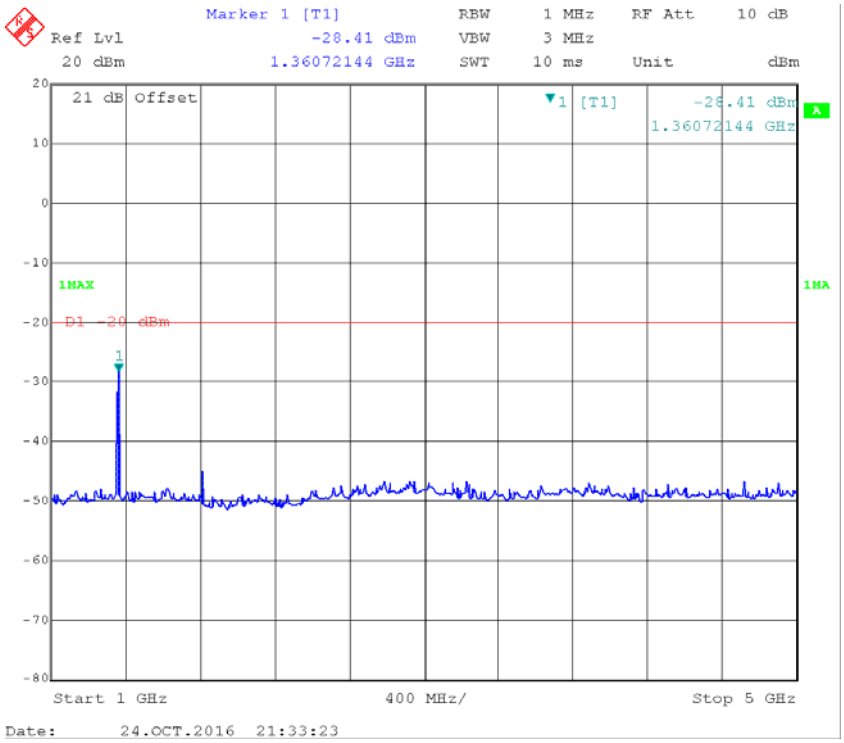




453.2125 MHz – FM Mode, 12.5 kHz

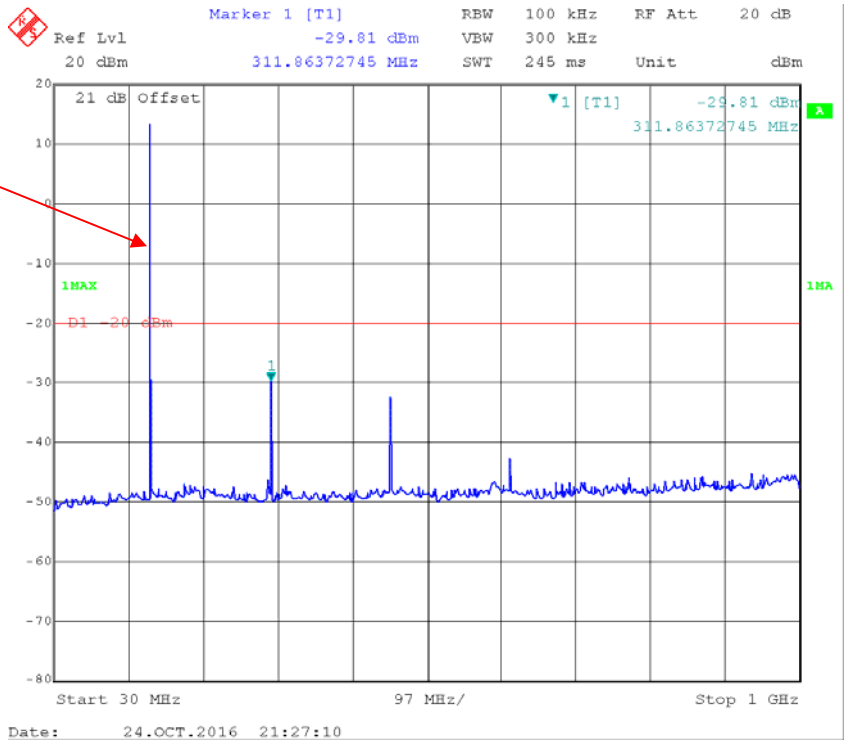
Fundamental Test with band rejection filter

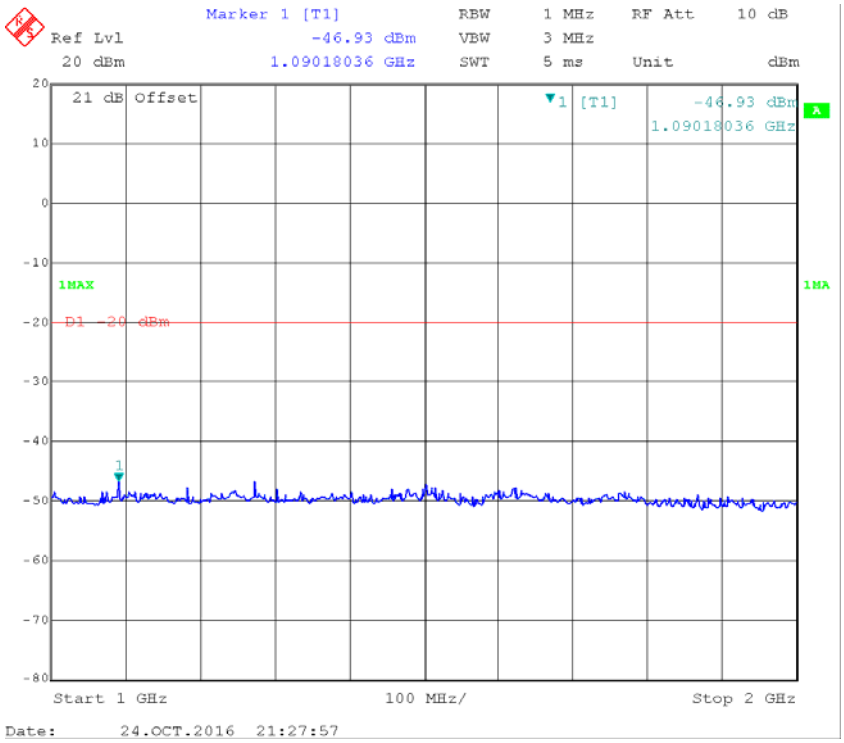




155.7525 MHz – 4FSK Mode, 12.5 kHz

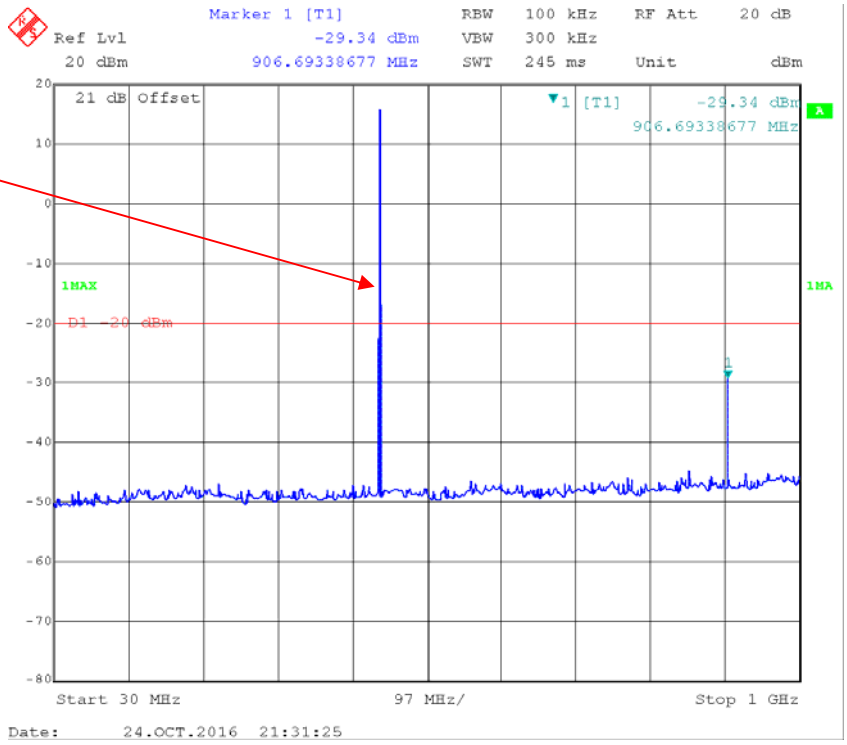
Fundamental Test with band rejection filter

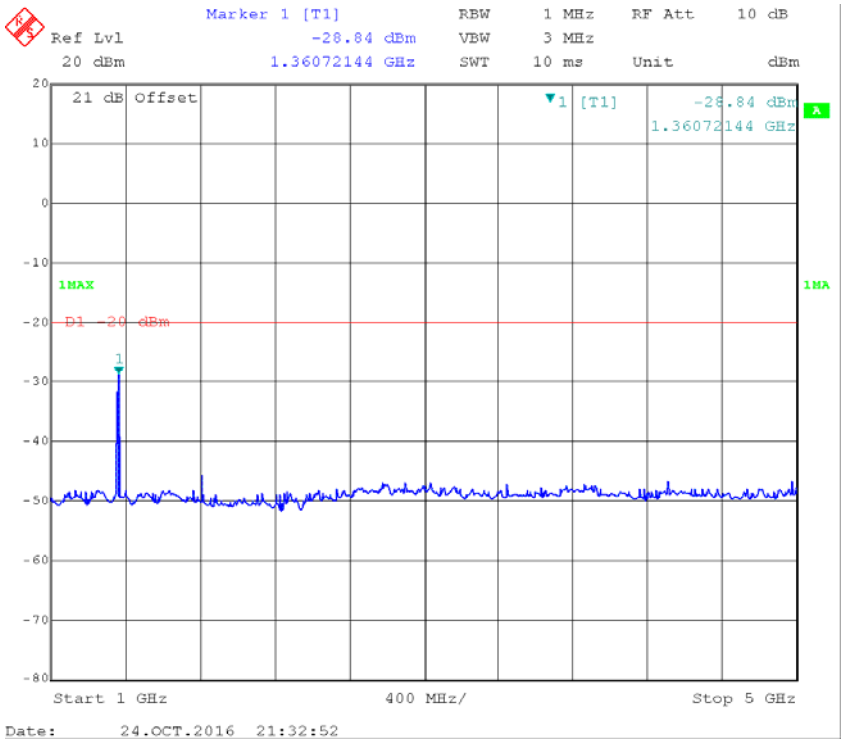




453.2125 MHz – 4FSK Mode, 12.5 kHz

Fundamental Test with band rejection filter





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
Agilent	Amplifier	8447D	2944A10442	2015-12-02	2016-12-01
Rohde & Schwarz	EMI Test Receiver	ESCI	100028	2015-12-02	2016-12-01
Sunol Sciences	Broadband Antenna	JB3	A121808	2016-04-10	2019-04-09
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2015-12-02	2016-12-01
ETS	Horn Antenna	3115	003-6076	2015-12-02	2016-12-01
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-0113024	2014-06-16	2017-06-15
EMCO	Adjustable Dipole Antenna	3121C	9109-258	N/A	N/A
HP	Signal Generator	8648C	3623A04150	2016-05-23	2017-05-22
WILTRON	SWEPT FREQUENCY SYNTHESIZER	6737	213001	2016-05-23	2017-05-22
Mini-circuits	Amplifier	ZVA-183-S+	771001215	2016-05-20	2017-05-19
EMCT	Semi-Anechoic Chamber	966	966-1	2015-04-24	2018-04-23
Unknown	RF Cable (below 1GHz)	Unknown	NO.1	2015-11-10	2016-11-09
Unknown	RF Cable (below 1GHz)	Unknown	NO.4	2015-11-10	2016-11-09
Unknown	RF Cable (above 1GHz)	Unknown	NO.2	2015-11-10	2016-11-09

* **Statement of Traceability:** BACL (Chengdu) attested 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 $1og_{10}$ (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.

Test Data

Environmental Conditions

Temperature:	27.7 °C
Relative Humidity:	30 %
ATM Pressure:	101 kPa

The testing was performed by Kevin Hu on 2016-10-25.

Test Mode: Transmitting-High power level(Per pretest, DM-5R is the worst case).

FM Mode:

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
frequency: 155.7525 MHz								
311.505	H	58.65	-25.3	0.0	0.3	-25.6	-20.0	5.6
311.505	V	49.89	-33.6	0.0	0.3	-33.9	-20.0	13.9
467.258	H	53.61	-28.4	0.0	0.4	-28.8	-20.0	8.8
467.258	V	47.94	-32.2	0.0	0.4	-32.6	-20.0	12.6
623.01	H	44.57	-32.8	0.0	0.5	-33.3	-20.0	13.3
623.01	V	38.8	-37.5	0.0	0.5	-38.0	-20.0	18.0
778.763	H	46.75	-29.9	0.0	0.6	-30.5	-20.0	10.5
778.763	V	40.23	-36.4	0.0	0.6	-37.0	-20.0	17.0
934.515	H	42.48	-33.6	0.0	0.6	-34.2	-20.0	14.2
934.515	V	36.91	-35	0.0	0.6	-35.6	-20.0	15.6
1090.268	H	56.19	-45.5	6.0	0.7	-40.2	-20.0	20.2
1090.268	V	50.45	-50.6	6.0	0.7	-45.3	-20.0	25.3
1246.02	H	52.21	-50	6.7	0.7	-44.0	-20.0	24.0
1246.02	V	46.48	-54.8	6.7	0.7	-48.8	-20.0	28.8
1401.773	H	53.65	-49.3	7.4	0.8	-42.7	-20.0	22.7
1401.773	V	47.39	-55	7.4	0.8	-48.4	-20.0	28.4
1557.525	H	50.02	-53.2	7.8	0.8	-46.2	-20.0	26.2
1557.525	V	43.54	-58.8	7.8	0.8	-51.8	-20.0	31.8
1713.278	H	61.37	-41.4	7.9	0.8	-34.3	-20.0	14.3
1713.278	V	54.6	-46.2	7.9	0.8	-39.1	-20.0	19.1
1869.03	H	57.84	-41.2	8.0	0.9	-34.1	-20.0	14.1
1869.03	V	50.58	-47.7	8.0	0.9	-40.6	-20.0	20.6
2024.783	H	53.3	-45.3	8.1	1.1	-38.3	-20.0	18.3
2024.783	V	48.07	-49.5	8.1	1.1	-42.5	-20.0	22.5

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBµV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
frequency: 453.2125 MHz								
906.425	H	51.74	-25.7	0.0	0.6	-26.3	-20.0	6.3
906.425	V	47.39	-25.4	0.0	0.6	-26.0	-20.0	6.0
1359.638	H	65.58	-37.3	7.2	0.8	-30.9	-20.0	10.9
1359.638	V	59.93	-42.2	7.2	0.8	-35.8	-20.0	15.8
1812.85	H	67.09	-33.1	8.0	0.9	-26.0	-20.0	6.0
1812.85	V	61.34	-38	8.0	0.9	-30.9	-20.0	10.9
2266.063	H	59.57	-40.2	8.5	1.4	-33.1	-20.0	13.1
2266.063	V	52.4	-44.2	8.5	1.4	-37.1	-20.0	17.1
2719.275	H	60.19	-39	8.8	1.1	-31.3	-20.0	11.3
2719.275	V	53.54	-44.8	8.8	1.1	-37.1	-20.0	17.1
3172.488	H	58.28	-38.8	8.7	1.2	-31.3	-20.0	11.3
3172.488	V	50.61	-46.7	8.7	1.2	-39.2	-20.0	19.2
3625.7	H	56.12	-39.8	8.8	1.3	-32.3	-20.0	12.3
3625.7	V	49	-47.3	8.8	1.3	-39.8	-20.0	19.8
4078.913	H	56.55	-38.5	9.0	1.6	-31.1	-20.0	11.1
4078.913	V	48.29	-46.7	9.0	1.6	-39.3	-20.0	19.3
4532.125	H	58.01	-37.4	10.2	1.6	-28.8	-20.0	8.8
4532.125	V	52.36	-43	10.2	1.6	-34.4	-20.0	14.4
4985.338	H	56.63	-37.4	9.8	1.7	-29.3	-20.0	9.3
4985.338	V	50.89	-43.2	9.8	1.7	-35.1	-20.0	15.1

4FSK Mode:

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
frequency: 155.7525 MHz								
311.505	H	59.75	-24.2	0.0	0.3	-24.5	-20.0	4.5
311.505	V	51.09	-32.4	0.0	0.3	-32.7	-20.0	12.7
467.258	H	52.42	-29.6	0.0	0.4	-30.0	-20.0	10.0
467.258	V	43.67	-36.4	0.0	0.4	-36.8	-20.0	16.8
623.01	H	41.84	-35.5	0.0	0.5	-36.0	-20.0	16.0
623.01	V	35.39	-40.9	0.0	0.5	-41.4	-20.0	21.4
778.763	H	45.2	-31.5	0.0	0.6	-32.1	-20.0	12.1
778.763	V	38.03	-38.6	0.0	0.6	-39.2	-20.0	19.2
934.515	H	43.96	-32.1	0.0	0.6	-32.7	-20.0	12.7
934.515	V	37.62	-34.2	0.0	0.6	-34.8	-20.0	14.8
1090.268	H	54.17	-47.5	6.0	0.7	-42.2	-20.0	22.2
1090.268	V	49.3	-51.7	6.0	0.7	-46.4	-20.0	26.4
1246.02	H	51.98	-50.2	6.7	0.7	-44.2	-20.0	24.2
1246.02	V	43.71	-57.6	6.7	0.7	-51.6	-20.0	31.6
1401.773	H	52.24	-50.7	7.4	0.8	-44.1	-20.0	24.1
1401.773	V	45.4	-57	7.4	0.8	-50.4	-20.0	30.4
1557.525	H	50.76	-52.5	7.8	0.8	-45.5	-20.0	25.5
1557.525	V	43.21	-59.2	7.8	0.8	-52.2	-20.0	32.2
1713.278	H	63.09	-39.7	7.9	0.8	-32.6	-20.0	12.6
1713.278	V	57.45	-43.4	7.9	0.8	-36.3	-20.0	16.3
1869.03	H	51.97	-47.1	8.0	0.9	-40.0	-20.0	20.0
1869.03	V	43.5	-54.8	8.0	0.9	-47.7	-20.0	27.7
2024.783	H	53.34	-45.2	8.1	1.1	-38.2	-20.0	18.2
2024.783	V	45.29	-52.3	8.1	1.1	-45.3	-20.0	25.3

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
frequency: 453.2125 MHz								
906.425	H	52.41	-25	0.0	0.6	-25.6	-20.0	5.6
906.425	V	46.1	-26.7	0.0	0.6	-27.3	-20.0	7.3
1359.638	H	67.37	-35.5	7.2	0.8	-29.1	-20.0	9.1
1359.638	V	62.94	-39.2	7.2	0.8	-32.8	-20.0	12.8
1812.85	H	66.09	-34.1	8.0	0.9	-27.0	-20.0	7.0
1812.85	V	60.45	-38.9	8.0	0.9	-31.8	-20.0	11.8
2266.063	H	63.3	-36.5	8.5	1.4	-29.4	-20.0	9.4
2266.063	V	57.63	-39	8.5	1.4	-31.9	-20.0	11.9
2719.275	H	61.18	-38	8.8	1.1	-30.3	-20.0	10.3
2719.275	V	53.71	-44.6	8.8	1.1	-36.9	-20.0	16.9
3172.488	H	60.05	-37	8.7	1.2	-29.5	-20.0	9.5
3172.488	V	53.93	-43.4	8.7	1.2	-35.9	-20.0	15.9
3625.7	H	57.28	-38.7	8.8	1.3	-31.2	-20.0	11.2
3625.7	V	50.44	-45.9	8.8	1.3	-38.4	-20.0	18.4
4078.913	H	55.9	-39.1	9.0	1.6	-31.7	-20.0	11.7
4078.913	V	48.76	-46.3	9.0	1.6	-38.9	-20.0	18.9
4532.125	H	54.32	-41.1	10.2	1.6	-32.5	-20.0	12.5
4532.125	V	48.65	-46.8	10.2	1.6	-38.2	-20.0	18.2
4985.338	H	51.18	-42.8	9.8	1.7	-34.7	-20.0	14.7
4985.338	V	44.43	-49.6	9.8	1.7	-41.5	-20.0	21.5

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 = Substituted 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
BACL	High Temperature Test Chamber	BTH-150	30024	2015-12-02	2016-12-01
FLUKE	Multimeter	1587	27870099	2015-12-30	2016-12-29
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2016-09-21	2017-09-20
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested 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) 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:	27.7 °C
Relative Humidity:	30 %
ATM Pressure:	101 kPa

The testing was performed by Kevin Hu on 2016-10-25.

Test Mode: Transmitting

Reference Frequency: 155.7525 MHz, 12.5 kHz, Limit: 5 ppm			
Temerature	**Voltage**	**Reading**	**Frequency Error**
℃	**V_{DC}**	**MHz**	**ppm**
-30	7.4	155.752860	2.32
-20		155.752820	2.06
-10		155.752880	2.45
0		155.752840	2.19
10		155.752800	1.94
20		155.752850	2.26
30		155.752830	2.13
40		155.752860	2.32
50		155.752810	2.00
20	6.2	155.752870	2.39

Reference Frequency: 453.2125 MHz, 12.5 kHz, Limit: 2.5ppm			
Temerature	**Voltage**	**Reading**	**Frequency Error**
℃	**V_{DC}**	**MHz**	**ppm**
-30	7.4	453.212800	0.66
-20		453.212830	0.73
-10		453.212870	0.82
0		453.212820	0.71
10		453.212790	0.64
20		453.212840	0.75
30		453.212810	0.68
40		453.212860	0.79
50		453.212830	0.73
20	6.2	453.212860	0.79

Note: Battery operating end point is declared by appliciant.

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

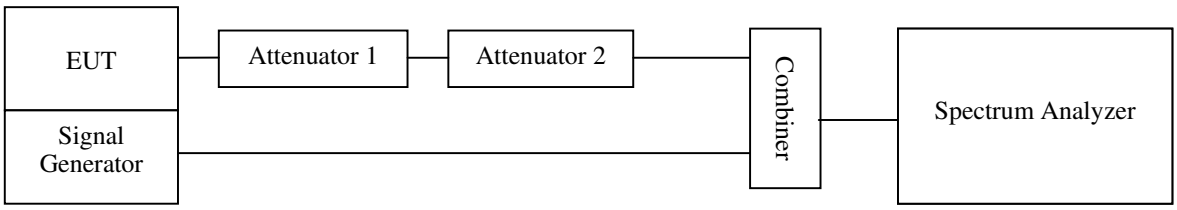
Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2016-09-21	2017-09-20
HP	RF Communications Test Set	8920A	00 247	2016-08-10	2017-08-09
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

a) Connect the EUT and test equipment as shown on the following block diagram.
b) Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.
c) 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.
d) Turn on the transmitter.
e) 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.
f) Turn off the transmitter.
g) 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.
h) Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 dB when the transmitter is turned on.
i) 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 “tiger offset” to -10ms for turn on and -15ms for turn off.
j) 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:	27.7 °C
Relative Humidity:	30 %
ATM Pressure:	101 kPa

The testing was performed by Kevin Hu on 2016-10-25.

155.7525MHz:

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	

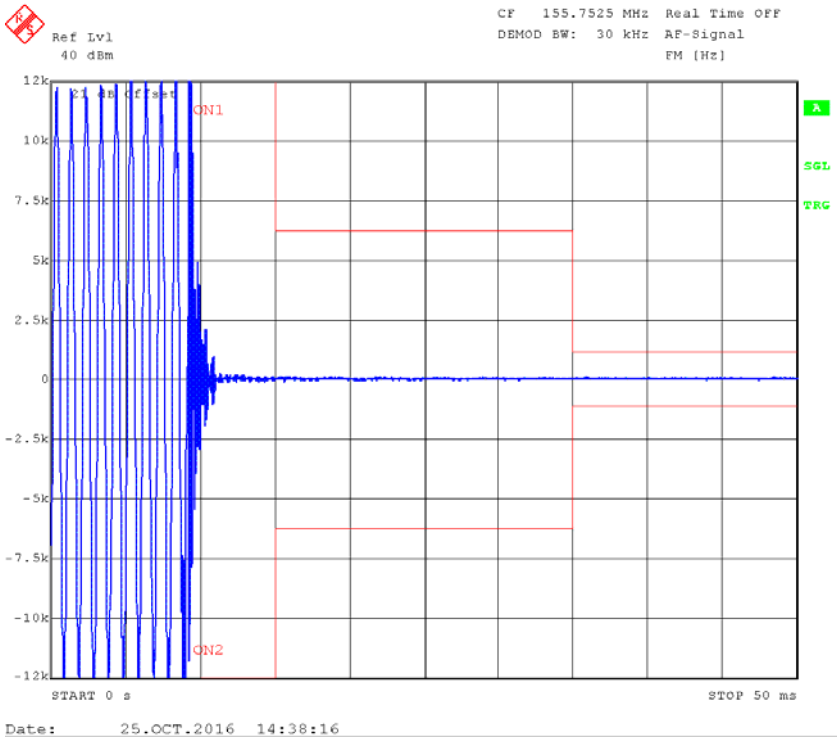
Please refer to the following plots.

453.2125MHz:

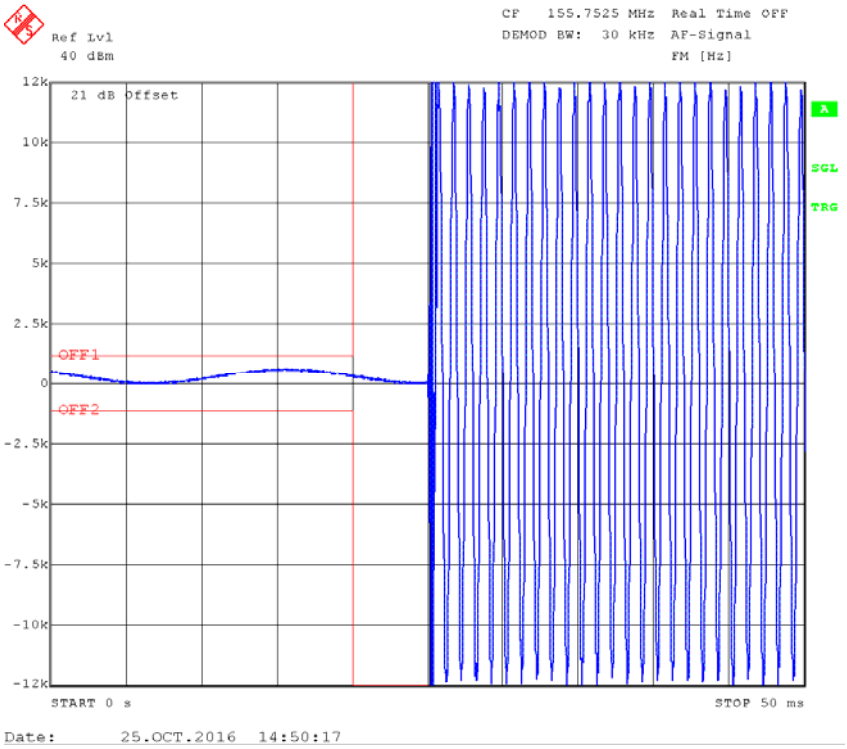
Channel Spacing (kHz)	Transient Period (ms)	Maximum frequency difference	Result
12.5	10(t_1)	±12.5 kHz	Pass
	25(t_2)	±6.25 kHz	
	10(t_3)	±12.5 kHz	

Please refer to the following plots.

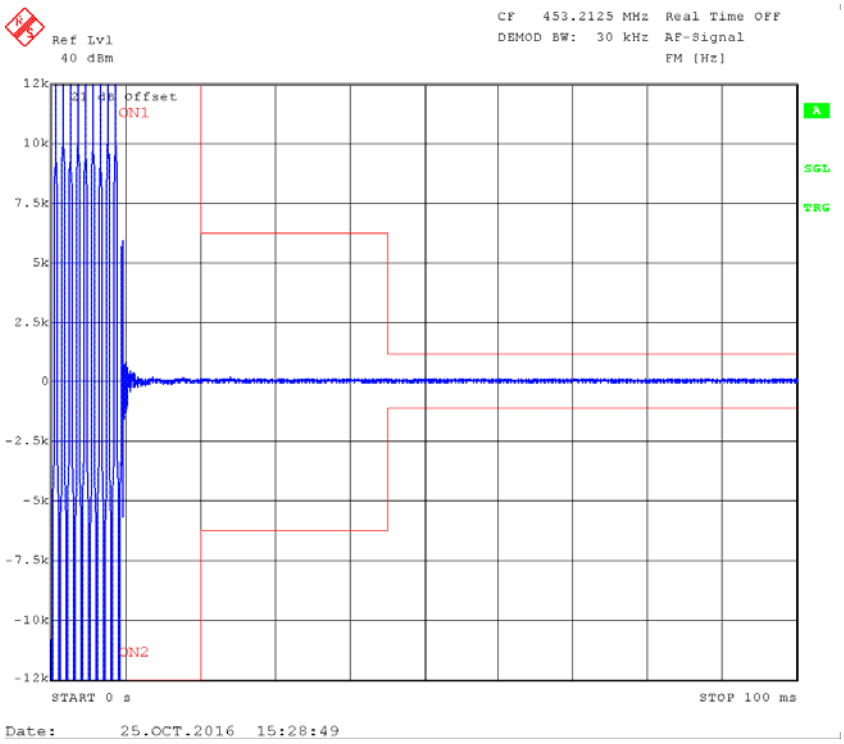
Turn on – 155.7525 MHz, FM Mode 12.5 kHz



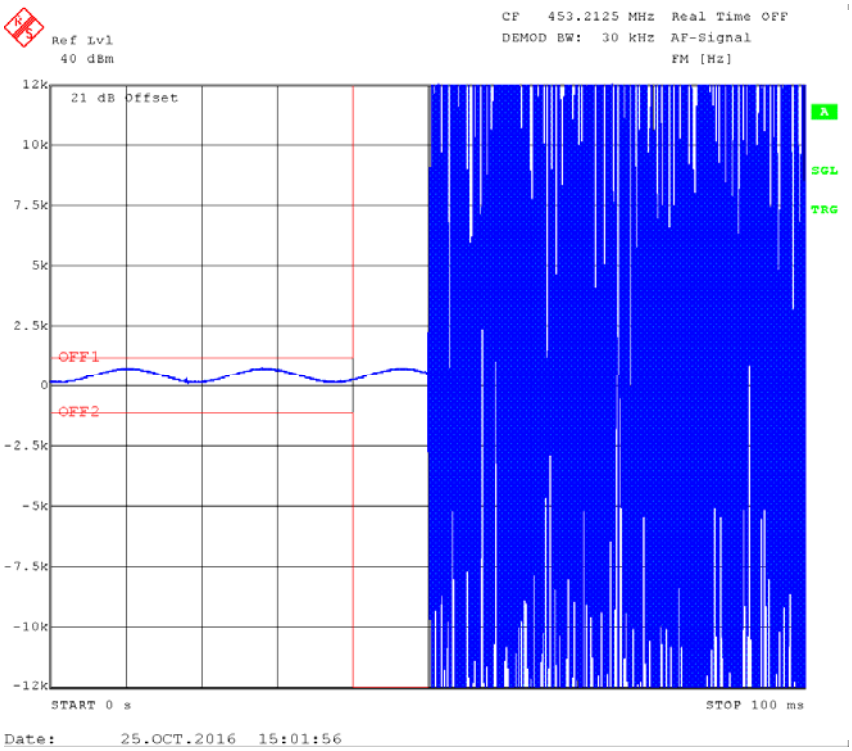
Turn off – 155.7525 MHz, FM Mode 12.5 kHz



Turn on – 453.2125 MHz, FM Mode 12.5 kHz



Turn off – 453.2125 MHz, FM Mode 12.5 kHz



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