

FCC PART 90 TEST REPORT

For

BTECH (BaoFeng Tech)

702N industrial Ave Arlington, South Dakota, United States, 57212

FCC ID: 2AGND-AMP-U

Report Type: Original Report	Product Name: Radio Amplifier
Report Number: RXM170920050-00	
Report Date: 2017-11-06	
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Reviewed By:	EMC Manager
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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. (Dongguan).

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The **BTECH (BaoFeng Tech)**'s product, model number: **AMP-U25 (FCC ID: 2AGND-AMP-U)** (the "EUT") in this report was a *Radio Amplifier*, which was measured approximately: 13.5 cm (L) x 11.5 cm (W) x 3.5 cm (H), DC13.8V.

Note: The series product, models AMP-U25 and AMP-U25D are electrically identical, we selected AMP-U25 for testing, the detail was explained in the attached declaration letter.

**All measurement and test data in this report was gathered from production sample serial number: 170920050 (Assigned by BACL,Dongguan). The EUT was received on 2017-09-22.*

Objective

This test report is prepared on behalf of **BTECH (BaoFeng Tech)** in accordance with Part 90 of the Federal Communications Commission rules.

Related Submittal(s)/Grant(s)

N/A

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.

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Unwanted Emissions, radiated	30MHz ~ 1GHz:5.85 dB 1G~26.5GHz: 5.23 dB
Unwanted Emissions, conducted	±1.5 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%

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 Industry Area, Tangxia, Dongguan, Guangdong, China

Bay Area Compliance Laboratories Corp. (Dongguan) has been accredited to ISO/IEC 17025 by CNAS(Lab code: L5662). And accredited to ISO/IEC 17025 by NVLAP(Test Laboratory Accreditation Certificate Number 500069-0), the FCC Designation No. CN5002 under the KDB 974614 D01.

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.

Bay Area Compliance Laboratories Corp. (Dongguan) was registered with ISED Canada under ISED Canada Registration Number 3062D.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode.

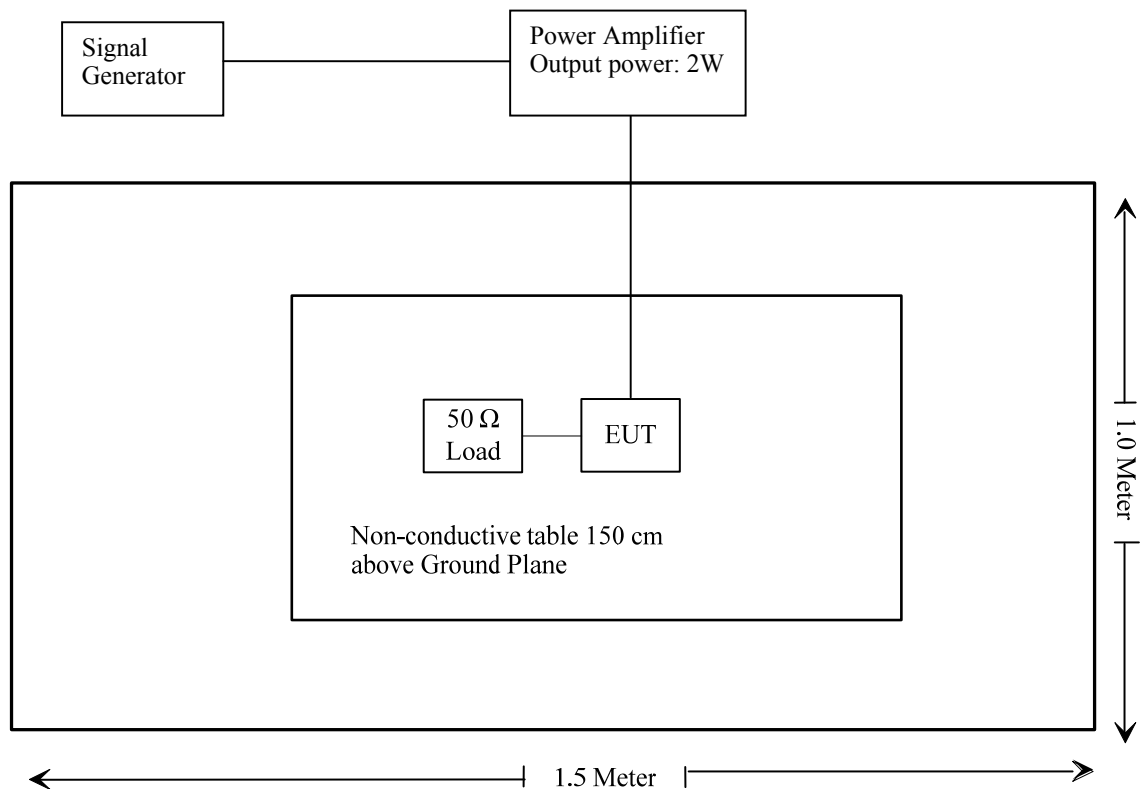
EUT Specification:

No software was used in test

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
N/A	Terminal Load(50 Ω)	N/A	N/A
R&S	Power Amplifier	15A250	12934
HP	RF Communications Test Set	8920A	00 235

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

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

Not Applicable: the device is no modulation mixing circuitry for the RF.

FCC §1.1310 & 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

Prediction of power density at the distance of the applicable MPE limit

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

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

Frequency (MHz)	Antenna Gain		Maximum output power including Tune-up Tolerance (mW)	Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
	(dBi)	(numeric)				
400-480	0	1	23000	40	1.1	1.33

Result: The device meet FCC MPE at 40 cm distance.

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 No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSIQ 26	831929/005	2017-8-31	2018-8-31
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	Each Time	/
E-Microwave	RF Attenuator	20dB	20dB-1	Each Time	/
E-Microwave	RF Attenuator	20dB	20dB-2	Each Time	/
Unknown	Coaxial Cable	0.1m	C-1	Each Time	/

* **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:	25.6 °C
Relative Humidity:	45 %
ATM Pressure:	101.4 kPa

The testing was performed by Costa Dong on 2017-10-26.

Test Result: Compliant. Please refer to following tables.

Modulation	Channel Spacing (kHz)	f_c (MHz)	Conducted Output Power (W)	Note
FM	12.5	400.0125	22.31	Not for FCC Review
		453.2125	22.38	/
		479.9875	22.36	/
4FSK	12.5	400.0125	22.39	Not for FCC Review
		453.2125	22.39	/
		479.9875	22.35	/

Note: the rated output power is 20W, maximum Input power 2W.

FCC §2.1049 & §22.357 & §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 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 No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSIQ 26	831929/005	2017-08-31	2018-08-31
HP	RF Communications Test Set	8920A	00 235	2017-07-11	2018-07-11
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	Each Time	/
E-Microwave	RF Attenuator	20dB	20dB-2	Each Time	/
E-Microwave	RF Attenuator	20dB	20dB-1	Each Time	/
Unknown	Coaxial Cable	0.1m	C-1	Each Time	/

* **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

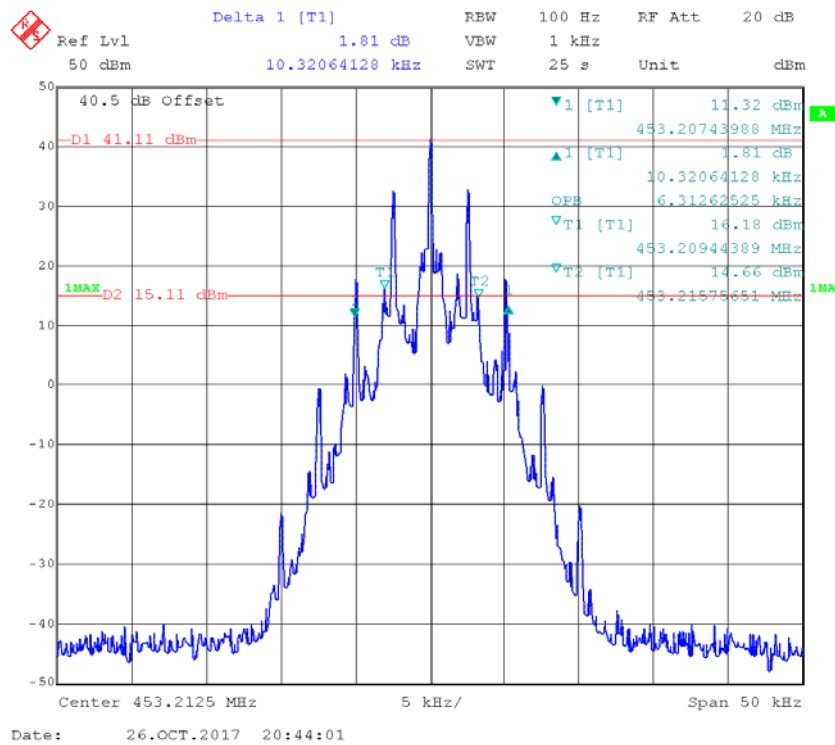
Temperature:	25.6~26.1 °C
Relative Humidity:	44~45 %
ATM Pressure:	101.4~101.6 kPa

The testing was performed by Costa Dong on 2017-10-26 and 2017-11-04.

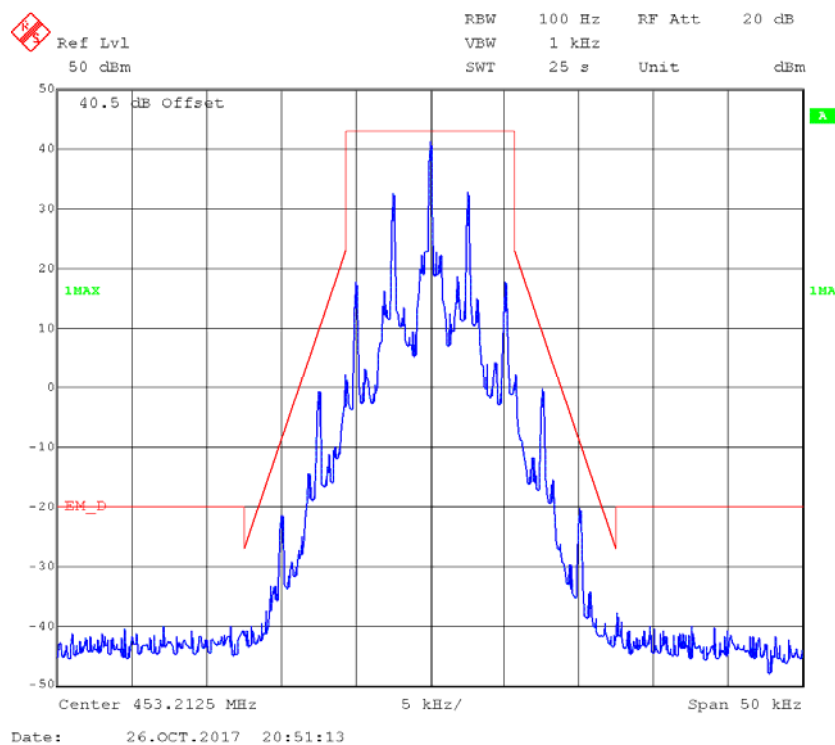
Test Result: Compliant. Please refer to the following tables and plots.

Modulation Mode	Channel Spacing	f_c	99% Occupied Bandwidth	26 dB Bandwidth
	kHz	MHz	kHz	kHz
FM	12.5 kHz	453.2125	6.31	10.32
4FSK	12.5 kHz		7.82	9.32

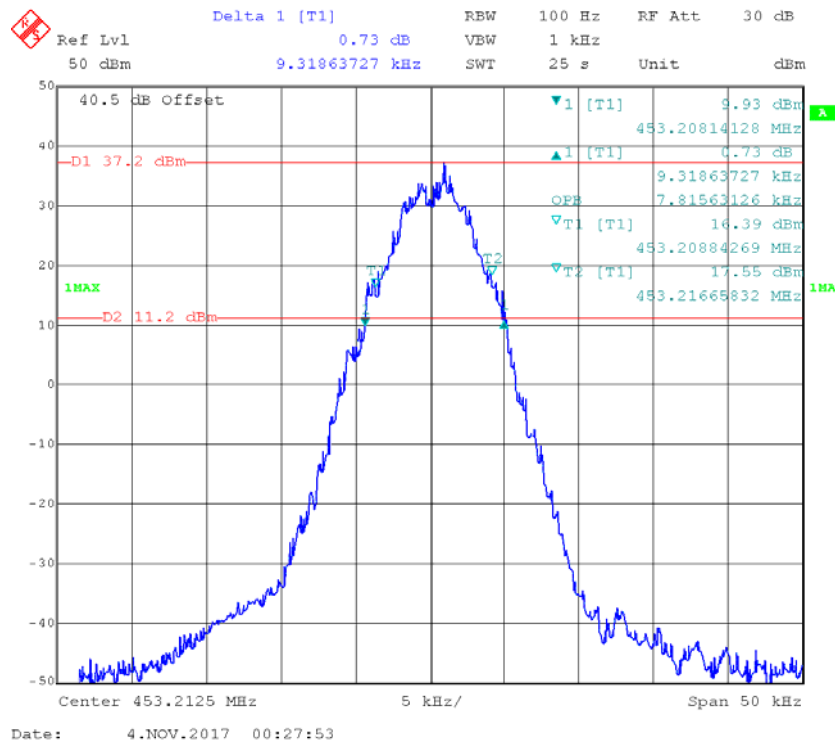
Occupied Bandwidth – FM, 453.2125 MHz



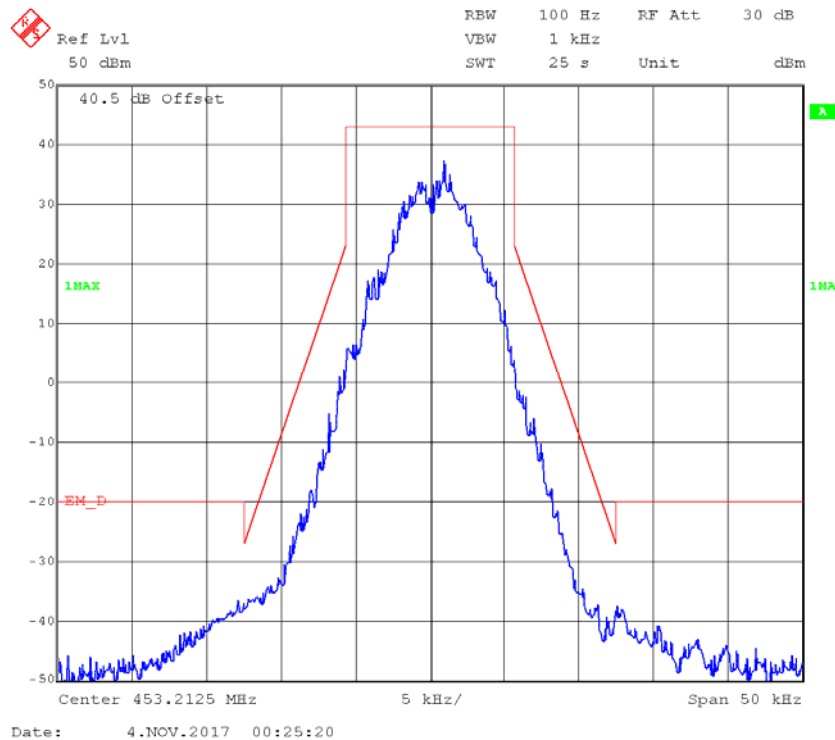
Emission Mask - Type D



Occupied Bandwidth – 4FSK, 453.2125 MHz



Emission Mask - Type D



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

Applicable Standard

§90.210 Emission limitations:

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.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSIQ 26	831929/005	2017-08-31	2018-08-31
HP	RF Communications Test Set	8920A	00 235	2017-07-11	2018-07-11
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2017-05-06	2018-05-06
E-Microwave	RF Attenuator	20dB	20dB-2	Each Time	/
E-Microwave	RF Attenuator	20dB	20dB-1	Each Time	/
Unknown	Coaxial Cable	0.1m	C-1	Each Time	/

* **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

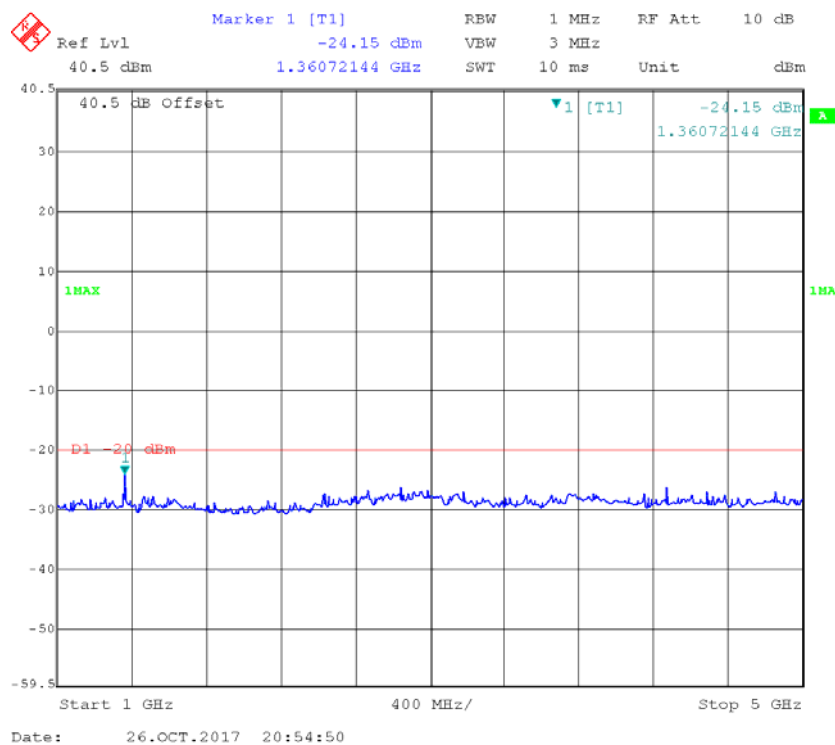
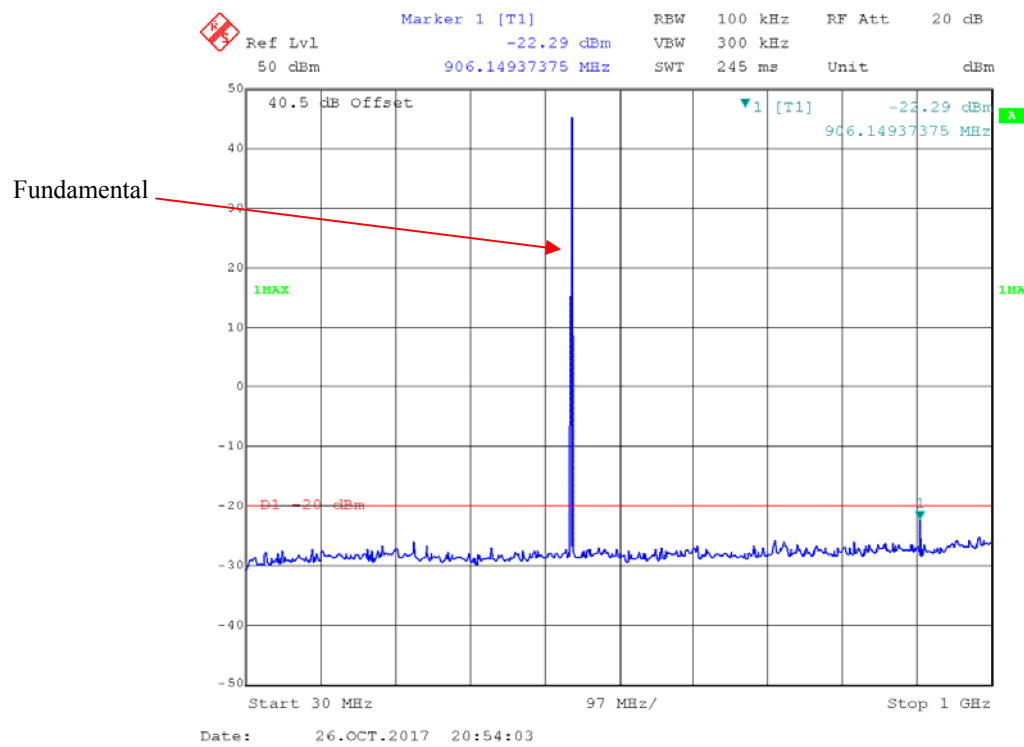
Adjust the spectrum analyzer for the following settings:

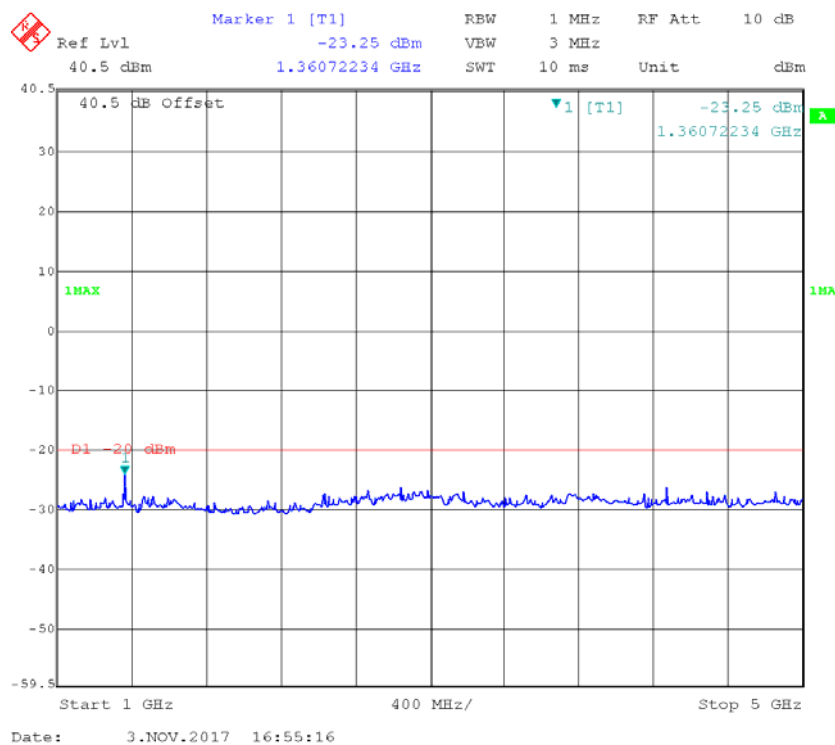
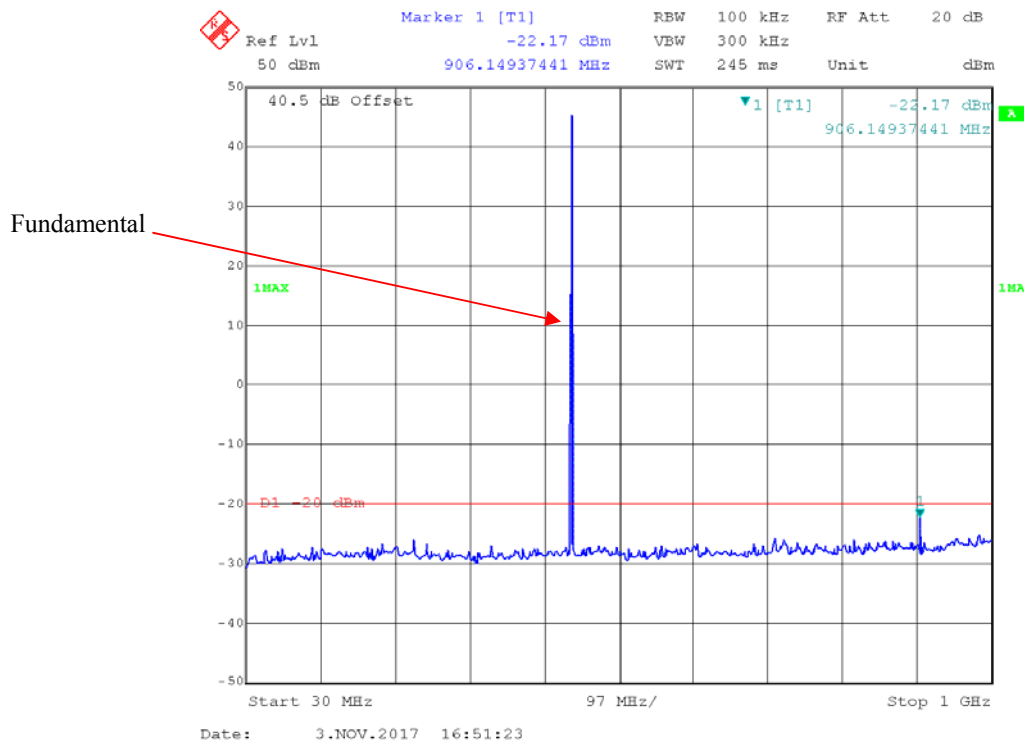
- 1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
- 2) Video Bandwidth ≥ 3 times the resolution bandwidth.
- 3) Sweep Speed ≤ 2000 Hz per second.
- 4) Detector Mode = peak.

Test Data**Environmental Conditions**

Temperature:	25.6~26.9 °C
Relative Humidity:	44~45 %
ATM Pressure:	101.4~101.6 kPa

The testing was performed by Costa Dong on 2017-10-26 and 2017-11-03.

453.2125 MHz – FM Mode,High Power

453.2125 MHz -4FSK Mode,High Power

FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053 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	2017-09-01	2018-09-01
Sunol Sciences	Antenna	JB3	A060611-1	2014-11-06	2017-11-05
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
R&S	Spectrum Analyzer	FSP 38	100478	2016-12-08	2017-12-08
ETS LINDGREN	Horn Antenna	3115	000 527 35	2016-01-05	2019-01-04
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2017-09-05	2018-09-05
HP	Signal Generator	1026	320408	2016-12-08	2017-12-08
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
TDK RF	Horn Antenna	HRN-0118	130 084	2016-01-05	2019-01-04
Unknown	Coaxial Cable	Chamber A-1	4m	2017-09-05	2018-09-05
Unknown	Coaxial Cable	Chamber B-1	0.75m	2017-09-05	2018-09-05
Unknown	Coaxial Cable	Chamber A-2	10m	2017-09-05	2018-09-05
Unknown	Coaxial Cable	Chamber B-2	8m	2017-09-05	2018-09-05

* **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.

Test Data**Environmental Conditions**

Temperature:	25~24.7 °C
Relative Humidity:	29~32 %
ATM Pressure:	100.8~101.6 kPa

The testing was performed by Sunny Cen on 2017-10-19 and Kakaxi Chen on 2017-11-03.

Test Mode: Transmitting

Frequency	Polar	S.A. Reading	Substituted Level	Antenna Gain	Cable Loss	Absolute Level	Limit	Margin
MHz	H/V	dBμV	dBm	dBd/dBi	dB	dBm	dBm	dB
FM, 12.5 kHz, Frequency: 453.2125 MHz								
1359.638	H	52.21	-61.2	8.7	1.2	-53.7	-20.0	33.7
1359.638	V	51.86	-62.2	8.7	1.2	-54.7	-20.0	34.7
1812.850	H	53.84	-60.3	11.1	0.7	-49.9	-20.0	29.9
1812.850	V	49.66	-65.1	11.1	0.7	-54.7	-20.0	34.7
2266.063	H	49.13	-63.1	11.1	1.2	-53.2	-20.0	33.2
2266.063	V	47.24	-64.9	11.1	1.2	-55.0	-20.0	35.0
1622.000	H	42.46	-72.2	10.3	0.7	-62.6	-20.0	42.6
1622.000	V	42.54	-72.7	10.3	0.7	-63.1	-20.0	43.1
906.425	H	43.07	-31.2	0.0	1.1	-32.3	-20.0	12.3
906.425	V	41.67	-29.3	0.0	1.1	-30.4	-20.0	10.4
4FSK, 12.5kHz, Frequency: 453.2125 MHz								
1359.638	H	51.76	-61.6	8.7	1.2	-54.1	-20.0	34.1
1359.638	V	50.57	-63.5	8.7	1.2	-56.0	-20.0	36.0
1812.850	H	53.52	-60.7	11.1	0.7	-50.3	-20.0	30.3
1812.850	V	49.28	-65.5	11.1	0.7	-55.1	-20.0	35.1
2266.063	H	48.83	-63.4	11.1	1.2	-53.5	-20.0	33.5
2266.063	V	46.85	-65.3	11.1	1.2	-55.4	-20.0	35.4
906.425	H	42.64	-31.6	0.0	1.1	-32.7	-20.0	12.7
906.425	V	40.14	-30.8	0.0	1.1	-31.9	-20.0	11.9

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	FSIQ 26	831929/005	2017-08-31	2018-08-31
Dongzhixu	High Temperature Test Chamber	DP1000	201105083-4	2017-09-10	2018-09-09
UNI-T	Multimeter	UT39A	M130199938	2017-04-10	2018-04-10
HP	RF Communications Test Set	8920A	00 235	2017-07-11	2018-07-11
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2017-05-06	2018-05-06
E-Microwave	RF Attenuator	20dB	20dB-1	Each Time	/
E-Microwave	RF Attenuator	20dB	20dB-2	Each Time	/
Pro instrument	DC Power Supply	pps3300	N/A	N/A	N/A
Unknown	Coaxial Cable	0.1m	C-1	Each Time	/

* **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:	25.6 °C
Relative Humidity:	45 %
ATM Pressure:	101.4 kPa

The testing was performed by Costa Dong on 2017-10-26.

Test Mode: Transmitting

Reference Frequency: 453.2125 MHz, Limit: 2.5 ppm			
Temperature	Voltage	Measured	Frequency Error
°C	V _{DC}	MHz	ppm
-30	13.8	453.212902	0.89
-20		453.212912	0.91
-10		453.212888	0.86
0		453.212912	0.91
10		453.212946	0.98
20		453.212878	0.83
30		453.212946	0.98
40		453.212904	0.89
50		453.212920	0.93
60		453.212900	0.88
25	11.7	453.212909	0.90

FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

Applicable Standard

FCC §90.214

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSIQ 26	831929/005	2017-08-31	2018-08-31
HP	RF Communications Test Set	8920A	00 235	2017-07-11	2018-07-11
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2017-05-06	2018-05-06
E-Microwave	RF Attenuator	20dB	20dB-1	Each Time	/
E-Microwave	RF Attenuator	20dB	20dB-2	Each Time	/
Unknown	Coaxial Cable	0.1m	C-1	Each Time	/

* **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 tests and measurements indicated in TIA-603-D.

Test Data

Environmental Conditions

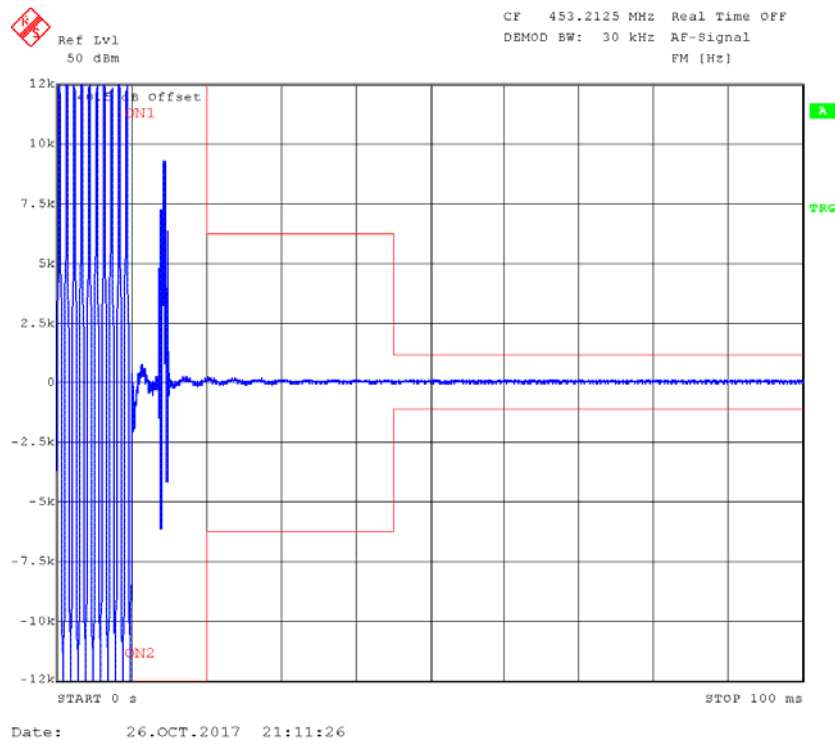
Temperature:	25.6 °C
Relative Humidity:	45 %
ATM Pressure:	101.4 kPa

The testing was performed by Costa Dong on 2017-10-26.

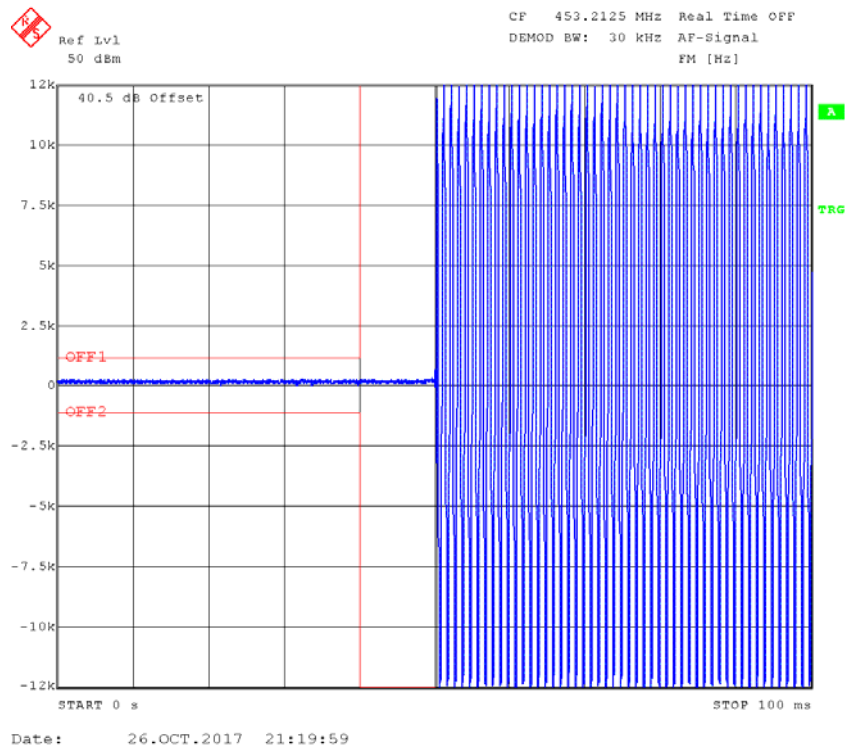
Channel Spacing (kHz)	Transient Period (ms)	Transient Frequency	Result
12.5	<10(t ₁)	±12.5 kHz	Pass
	<25(t ₂)	±6.25 kHz	
	<10(t ₃)	±12.5 kHz	

Please refer to the following plots.

Turn on – 453.2125 MHz, Low power level



Turn off – 453.2125 MHz, Low power level



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