TEST REPORT

Report Reference No. .....:	**171101003RFC-1**
FCC ID .....:	**YAMMD61XU1**
Applicant's name .....:	**Hytera Communications Corporation Limited**
Address .....:	Hytera Tower, Hi-Tech Industrial Park North, 9108# Beihuan Road, Nanshan District, Shenzhen, People's Republic of China
Manufacturer.....:	Hytera Communications Corporation Limited
Address.....:	Hytera Tower, Hi-Tech Industrial Park North, 9108# Beihuan Road, Nanshan District, Shenzhen, People's Republic of China
Test item description .....:	**Digital Mobile Radio**
Trade Mark.....:	Hytera
Model/Type reference .....:	MD615 U(1)
Listed Model(s).....:	MD612 U(1),MD616 U(1),MD618 U(1)
Standard.....:	**FCC Part 74**
Date of receipt of test sample.....:	June 12, 2017
Date of testing.....:	Sep. 26, 2017 – Oct. 29, 2017
Date of issue.....:	Oct. 30, 2017
Result ....:	**PASS**

Tested by: .....:	Senior Engineer	Kevin Liang
Reviewed by: .....:	Senior Supervisor	Jim Long
Approved by.....:	Technical Director	

Testing Laboratory Name.....:	**Shenzhen UnionTrust Quality and Technology Co., Ltd.**
Address .....:	16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China

Contents

1. TEST STANDARDS AND REPORT VERSION

1.1. Test Standards

The tests were performed according to following standards:
FCC Part 74 EXPERIMENTAL RADIO, AUXILIARY, SPECIAL BROADCAST AND OTHER PROGRAM DISTRIBUTIONAL SERVICES
FCC Part 2 Frequency allocations and radio treaty matters, general rules and regulations.
TIA/EIA 603 D: June 2010 Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.
KDB579009 D03 v01: Applications Part 90 Refarming Bands.
KDB971168 D01 v02r02: MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS

1.2. Report version

Version No.	Date of issue	Description
00	Oct. 30, 2017	Original

2. Test Description

Transmitter Requirement			
Test item	Standards requirement FCC Section(s)	Result	
		Pass	N/A
Maximum Transmitter Power	2.1046,74.461	☒	
Modulation Limiting	2.1047(b),74.463	☒	
Audio Frequency Response	-		☒
Occupied Bandwidth	74.462	☒	
Emission Mask	2.1049, 74.462(c)	☒	
Frequency Stability	2.1055, 74.464	☒	
Transmitter Frequency Behavior	74.462(c)	☒	
Transmitter Radiated Spurious Emission	2.1053, 2.1057,74.462(c)	☒	
Spurious Emission On Antenna Port	2.1051, 2.1057, 74.462(c)	☒	

3. SUMMARY

3.1. Client Information

Applicant:	Hytera Communications Corporation Limited
Address:	Hytera Tower, Hi-Tech Industrial Park North, 9108# Beihuan Road, Nanshan District, Shenzhen, People's Republic of China
Manufacturer:	Hytera Communications Corporation Limited
Address:	Hytera Tower, Hi-Tech Industrial Park North, 9108# Beihuan Road, Nanshan District, Shenzhen, People's Republic of China

3.2. Product Description

Name of EUT:	Digital Mobile Radio	
Trade mark:	Hytera	
Model/Type reference:	MD615 U(1)	
Listed mode(s):	MD612 U(1),MD616 U(1),MD618 U(1)	
Power supply:	DC 13.6V	
Battery information:	-	
Charger information:	-	
Adapter information:	-	
Operation Frequency Range:	From 400MHz to 470MHz	
Rated Output Power:	High Power: 45W (46.53dBm)/Low Power: 5W (36.99dBm)	
Modulation Type:	Analog Voice:	FM
	Digital Voice/Digital Data:	4FSK
Digital Type:	DMR	
Channel Separation:	Analog Voice:	☒ 12.5kHz ☒ 25kHz
	Digital Voice/Digital Data:	☒ 12.5kHz ☐ 6.25kHz
Emission Designator:	Analog Voice:	☒12.5kHz Channel Separation: 4K17F3E ☒25kHz Channel Separation: 8K09F3E
	Digital Voice& Data:	☒12.5kHz Channel Separation: 7K74FXW ☐6.25kHz Channel Separation: ---
	Digital Data:	☒12.5kHz Channel Separation: 7K74FXD ☐6.25kHz Channel Separation: ---
Support data rate:	9.6kbps	
Antenna Type:	External	
Maximum Transmitter Power:	Digital	45.92W for 12.5kHz Channel Separation
	Analog	45.19W for 12.5kHz Channel Separation
		46.92W for 25kHz Channel Separation

Note:

1)The product has the same digital working characters when operating in both two digitized voice/data mode. So only one set of test results for digital modulation modes are provided in this test report.

3.3. Test frequency list

FCC Part 74					
Mode	Modulation	Channel Separation (kHz)	Operation Frequency Range (MHz)	Test Channel	Test Frequency (MHz)
Analog	FM	12.5	450~454	CH_{L1}	452.025
			455~456	CH_{H1}	455.025
		25	450~454	CH_{L1}	452.025
			455~456	CH_{H1}	455.025
Digital	4FSK	12.5	450~454	CH_{L1}	452.025
			455~456	CH_{H1}	455.025

Note:

In section KDB 634817 D01 Sections II)f)1) and 2):

(1) Test only on the allowed frequencies.

(2) Test at least one frequency in each band for each rule part applied under and ensure the device is capable of operating on the frequency under each rule part. This requirement may result in testing on multiple frequencies. Testing on one frequency may be acceptable if multiple listed bands for a rule part with a continuous frequency range are split to remove a conflict with other rules and the technical requirements in the split bands are the same. Additional requirements for RF exposure may apply.

3.4. EUT operation mode

Test mode	Transmitting	Receiving	Power level		Digital	Analog	
			High	Low	12.5kHz	12.5kHz	25kHz
TX1	√		√		√		
TX2	√			√	√		
TX3	√		√			√	
TX4	√			√		√	
TX5	√		√				√
TX6	√			√			√

√: is operation mode.

3.5. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - supplied by the lab

●	Power Cable	Length (m) :	/
		Shield :	Unshielded
		Detachable :	Undetachable
○	Multimeter	Manufacturer :	/
		Model No. :	/

4. TEST ENVIRONMENT

4.1. Address of the test laboratory

Shenzhen UnionTrust Quality and Technology Co., Ltd..

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China 518109

Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

4.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L906
The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC/EN 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

IC-Registration No.: 21600-1
The 3m Semi-anechoic chamber of Shenzhen UnionTrust Quality and Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 21600-1.

A2LA-Lab Certificate No.: 4312.01
Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC Accredited Lab
Designation Number: CN1194
Test Firm Registration Number: 25948

4.3. Environmental conditions

Normal Conditon	
Relative humidity:	20 % to 75 %.
Air Pressure:	950~1050mba
Voltage:	DC 13.6V

4.4. Statement of the measurement uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
1	Conducted emission 9KHz-150KHz	±3.8 dB
2	Conducted emission 150KHz-30MHz	±3.4 dB
3	Radiated emission 9KHz-30MHz	±4.9 dB
4	Radiated emission 30MHz-1GHz	±4.7 dB
5	Radiated emission 1GHz-18GHz	±5.1 dB
6	Radiated emission 18GHz-26GHz	±5.2 dB
7	Radiated emission 26GHz-40GHz	±5.2 dB
8	Transmitter power conducted	±0.62 dB
9	Frequency stability	±28 Hz
10	Occupied Bandwidth	±37 Hz
11	FM deviation	±25 Hz
12	Modulation Limiting	±0.54 %
13	Low Pass Filter Response	±0.87 dB
14	Audio level	±0.80 dB
15	Transient Frequency Behavior	±7.4 %

4.5. Equipments Used during the Test

Radiated Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☑	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	N/A	Dec. 20, 2015	Dec. 19, 2018
☑	Receiver	R&S	ESIB26	100114	Dec. 22, 2016	Dec. 22, 2017
☑	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Dec. 22, 2016	Dec. 22, 2017
☑	Loop Antenna	ETS-LINDGREN	6502	00202525	Jun. 24, 2015	Jun. 23, 2018
☑	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Jul. 24, 2015	Jul. 23, 2018
☑	Preamplifier	HP	8447F	2805A02960	Dec. 22, 2016	Dec. 22, 2017
☑	Broadband Antenna (Pre-amplifier)	ETS-LINDGREN	3142E-PA	00201891	Dec. 30, 2016	Dec. 30, 2017
☐	Horn Antenna	ETS-LINDGREN	3117	00164202	Jul. 24, 2015	Jul. 23, 2018
☑	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	Dec. 30, 2016	Dec. 30, 2017
☐	Horn Antenna	ETS-LINDGREN	3116C	00200180	Jul. 28, 2015	Jul. 27, 2018
☑	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Jul. 29, 2015	Jul. 28, 2018
☑	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☑	High Pass Filter (600MHz)	hangwei	OSF-HPF60300P20-LC	N/A	Nov. 13, 2016	Nov. 12, 2017
☑	Test Software	Audix	e3	Software Version: 9.160323		

Conducted RF test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☑	Receiver	R&S	ESR7	1316.3003K07-101181-K3	Dec. 22, 2016	Dec. 22, 2017
☑	RF COMMUNITION TEST SET	HP	8920A	3813A10206	Nov.13, 2016	Nov.12, 2017
☑	Oscilloscope	Tektronix	TDS3032B	B013680	Sep.18, 2017	Sep.17, 2018
☑	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	Jan. 08, 2016	Jan. 07, 2018
☑	DC Source	KIKUSUI	PWR400L	LK003024	Sep. 21, 2016	Sep. 20, 2017
☑	Temp & Humidity chamber	Votisch	VT4002	58566133290020	Jun. 19, 2017	Jun. 18, 2018

5. TEST CONDITIONS AND RESULTS

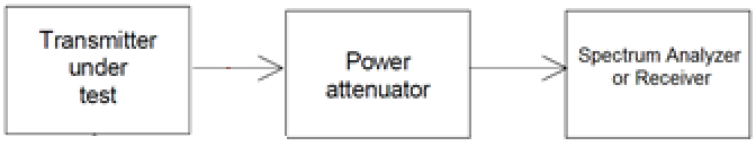
5.1. Maximum Transmitter Power

Applicants for licenses must request and use no more power than the actual power necessary for satisfactory operation.

LIMIT

Please refer to FCC 47 CFR 74.461 for specification details.

TEST CONFIGURATION



TEST PROCEDURE

Measurements shall be made to establish the radio frequency power delivered by the transmitter the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted bellow:
If the power output is adjustable, measurements shall be made for the highest and lowest power levels.
Connect the equipment as illustrated.

TEST MODE:

Please reference to the section 3.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

FCC Part 74				
Operation Mode	Test Channel	Measured power (dBm)	Measured power (W)	Limit (W)
TX1	CH_{L1}	46.51	44.77	-
	CH_{H1}	46.62	45.92	
TX2	CH_{L1}	36.40	4.37	-
	CH_{H1}	36.30	4.27	
TX3	CH_{L1}	46.55	45.19	-
	CH_{H1}	46.53	44.98	
TX4	CH_{L1}	37.14	5.18	-
	CH_{H1}	37.08	5.11	
TX5	CH_{L1}	46.62	45.92	-
	CH_{H1}	46.57	45.39	
TX6	CH_{L1}	36.95	4.95	-
	CH_{H1}	36.84	4.83	

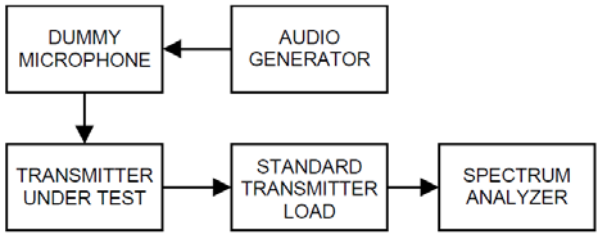
5.2. Occupied Bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits.

LIMIT

Please refer to FCC 47 CFR 2.1049, 74.462 for specification details.

TEST CONFIGURATION



TEST PROCEDURE

1 The EUT was modulated by 2.5kHz sine wave audio signal; the level of the audio signal employed is 16dB greater than that necessary to produce 50% of rated system deviation.
Rated system deviation is 2.5 kHz for 12.5kHz channel spacing).
2 Spectrum set as follow:
Centre frequency = fundamental frequency, span=50kHz for 12.5kHz channel spacing,
RBW=100Hz, VBW=300Hz, Sweep = auto,
Detector function = peak, Trace = max hold
3 Set 99% Occupied Bandwidth and 26dB Occupied Bandwidth
4 Measure and record the results in the test report.

TEST MODE:

Please reference to the section 3.4

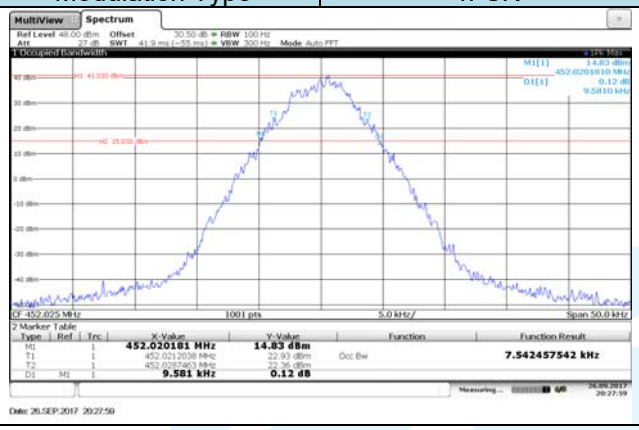
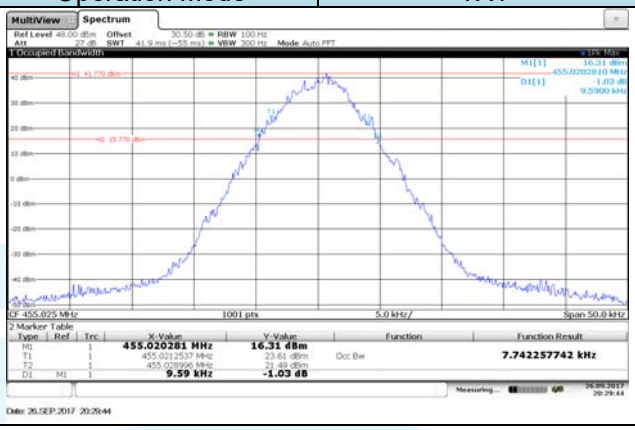
TEST RESULTS

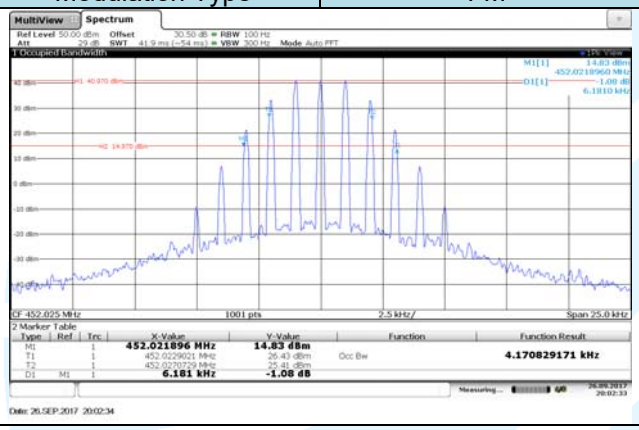
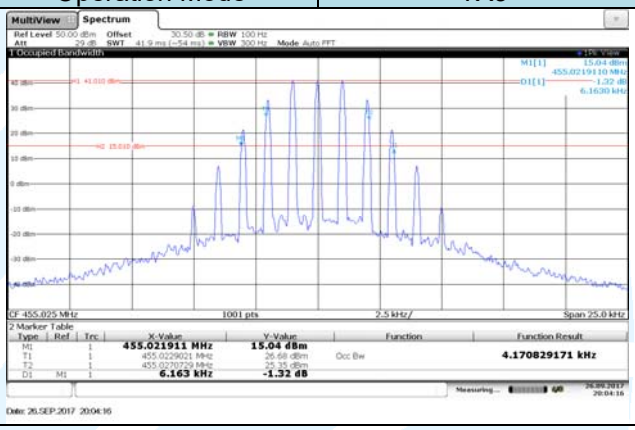
☒ **Passed** ☐ **Not Applicable**

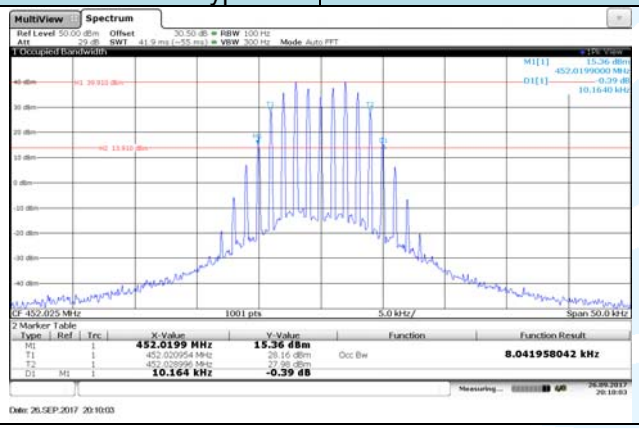
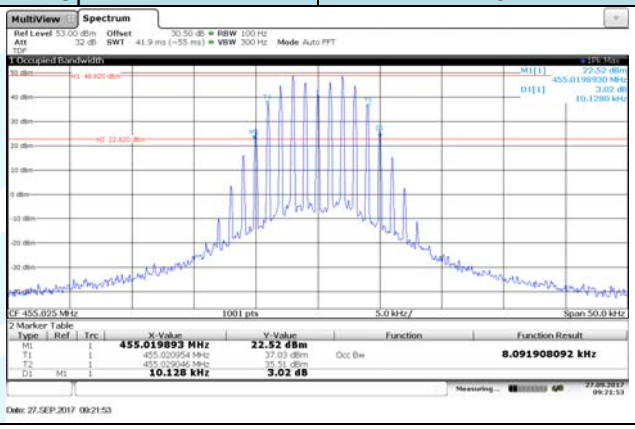
Note: have pre-tested TX1 to TX6 mode, record the worst case mode TX1,TX3 and TX5 on the report.

FCC Part 74					
Operation Mode	Test Channel	Occupied Bandwidth (kHz)		Limit(kHz)	Result
		99%	26dB		
TX1	CH_{L1}	7.54	9.581	⩽11.25	Pass
	CH_{H1}	7.74	9.590		
TX3	CH_{L1}	4.17	6.181	⩽11.25	Pass
	CH_{H1}	4.17	6.163		
TX5	CH_{L1}	8.04	10.164	⩽20	
	CH_{H1}	8.09	10.128		

Test plot as follows:

Modulation Type	4FSK	Operation Mode	TX1
			
CH_{L1}		CH_{H1}	

Modulation Type	FM	Operation Mode	TX3
			
CH_{L1}		CH_{H1}	

Modulation Type	FM	Operation Mode	TX5
			
CH_{L1}		CH_{H1}	

5.3. Emission Mask

Transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section.

LIMIT

Please refer to FCC 47 CFR 2.1049, 74.462(C) for specification details.

FCC Rules	Emission Mask
§ 74.462(c)§90.210(b)	B
§ 74.462(c)§90.210(d)	D

(b) Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

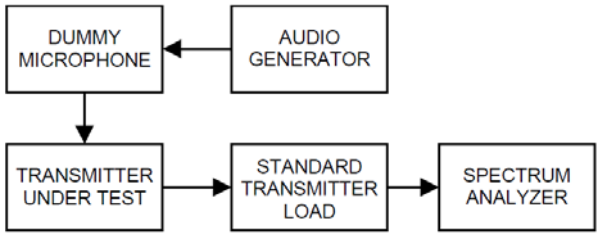
(d) Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(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 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.

TEST CONFIGURATION



TEST PROCEDURE

1 Connect the equipment as illustrated.

2 Spectrum set as follow:
Centre frequency = fundamental frequency, span=120kHz for 12.5kHz and 25kHz channel spacing, RBW=100Hz, VBW=1000Hz for 12.5kHz, RBW=300Hz, VBW=1000Hz for 25kHz,Sweep = auto, Detector function = peak, Trace = max hold

3 Key the transmitter, and set the level of the unmodulated carrier to a full scale reference line. This is the 0dB reference for the measurement.

4 Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of rated system deviation(Rated system deviation is 2.5 kHz for 12.5kHz channel spacing). The input level shall be established at the frequency of maximum response of the audio modulating circuit. Transmitters employing digital modulation techniques that bypass the limiter and the audio low-pass filter shall be modulated as specified by the manufacturer

5 Measure and record the results in the test report.

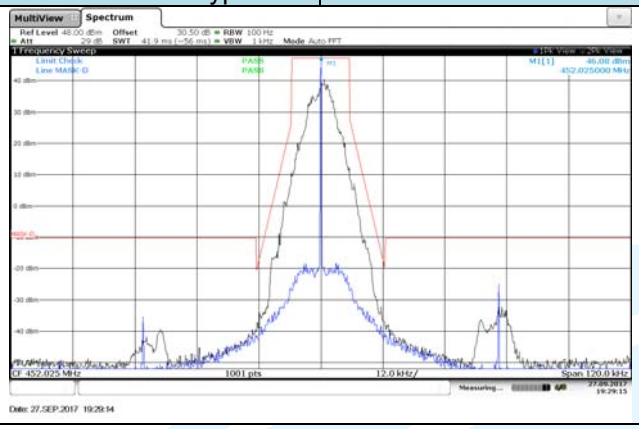
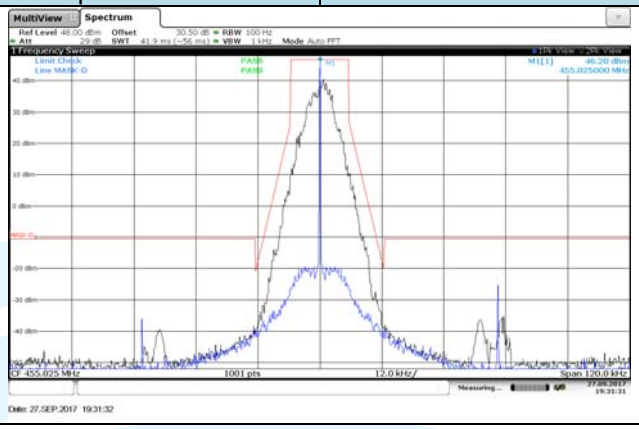
TEST MODE:

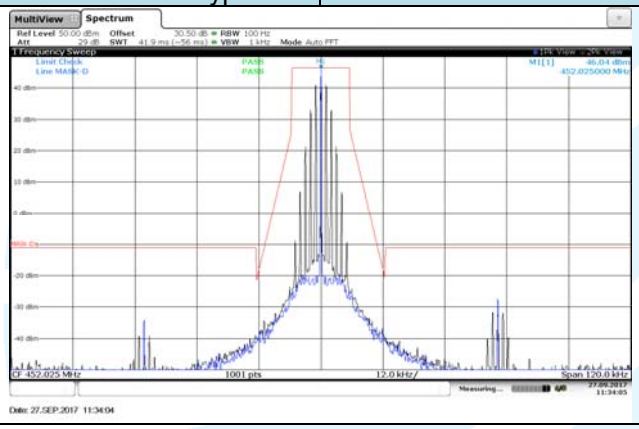
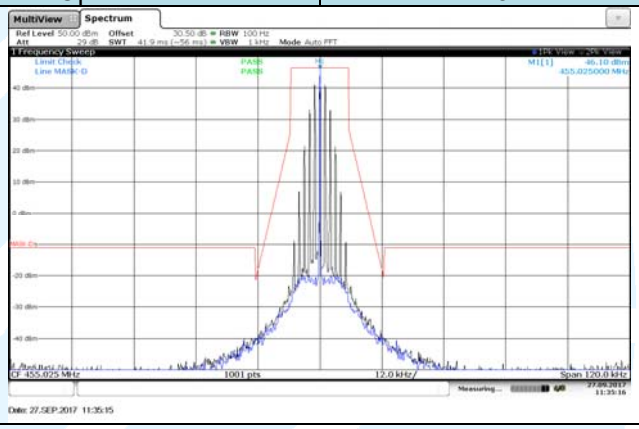
Please reference to the section 3.4

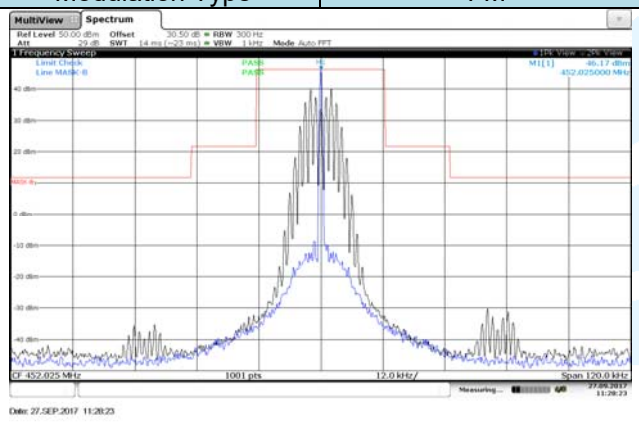
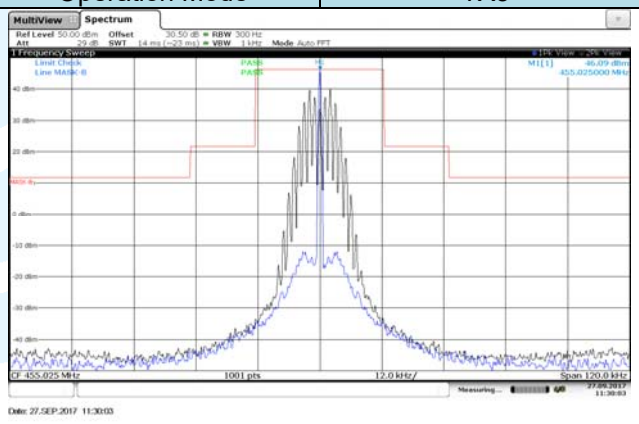
TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Note: have pre-tested TX1 to TX6 mode, record the worst case mode TX1,TX3 and TX5 on the report.

FCC part 74			
Modulation Type	4FSK	Operation Mode	TX1
			
CH_{L1}		CH_{H1}	

FCC part 74			
Modulation Type	FM	Operation Mode	TX3
			
CH_{L1}		CH_{H1}	

FCC part 74			
Modulation Type	FM	Operation Mode	TX5
			
CH_{L1}		CH_{H1}	

5.4. Modulation Limit

Modulation limiting is the transmitter circuit's ability to limit the transmitter from producing deviations in excess of a rated system deviation.

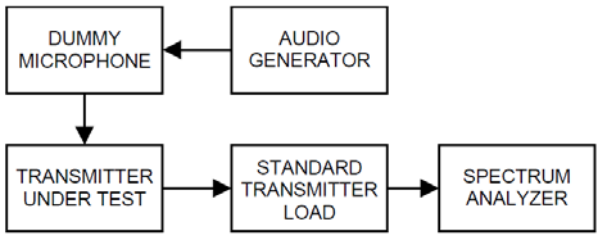
LIMIT

Please refer to FCC 47 CFR 2.1047 (b), 74.463 for specification details.

2.5kHz for 12.5 KHz Channel Spacing System

5kHz for 25 KHz Channel Spacing System

TEST CONFIGURATION



TEST PROCEDURE

1) Connect the equipment as illustrated.
2) Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
3) Set the test receiver to measure peak positive deviation. Set the audio bandwidth for ≤0.25 Hz to ≥15,000 Hz. Turn the de-emphasis function off.
4) Apply a 1000 Hz modulating signal to the transmitter from the audio frequency generator, and adjust the level to obtain 60% of full rated system deviation, this level is as a reference (0dB) and vary the input level from –20 to +20dB.
5) Measure both the instantaneous and steady-state deviation at and after the time of increasing the audio input level
6) Repeat step 4-5 with input frequency changing to 300Hz, 1004Hz, 1500Hz and 2500Hz in sequence.

TEST MODE:

Please reference to the section 3.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Note: have pre-tested TX3 to TX6 mode, record the worst case mode TX3 and TX5 on the report.

FCC Part 74						
TX3: CH_{H1}						
Modulation Level (dB)	Peak frequency deviation (kHz)				Limit (kHz)	Result
	300Hz	1004Hz	1500Hz	2500 Hz		
-20	0.062	0.168	0.286	0.457	2.5	Pass
-15	0.126	0.362	0.467	0.716		
-10	0.152	0.654	0.726	1.124		
-5	0.262	0.763	1.364	1.862		
0	0.432	1.542	1.735	1.56		
5	0.736	1.956	1.962	1.956		
10	0.962	2.132	1.869	1.823		
15	0.926	2.052	1.957	1.962		
20	0.852	2.042	1.932	1.986		

Test plot as follows:

FCC Part 74						
TX5: CH_{H1}						
Modulation Level (dB)	Peak frequency deviation (kHz)				Limit (kHz)	Result
	300Hz	1004Hz	1500Hz	2500 Hz		
-20	0.127	0.346	0.487	0.576	5	Pass
-15	0.231	0.582	0.832	0.986		
-10	0.312	1.004	1.476	1.755		
-5	0.782	2.125	2.345	2.672		
0	0.892	3.082	3.886	3.852		
5	1.458	4.125	4.062	3.962		
10	1.842	4.384	4.182	4.093		
15	1.823	4.286	4.196	4.018		
20	1.844	4.361	4.208	4.098		

Test plot as follows:

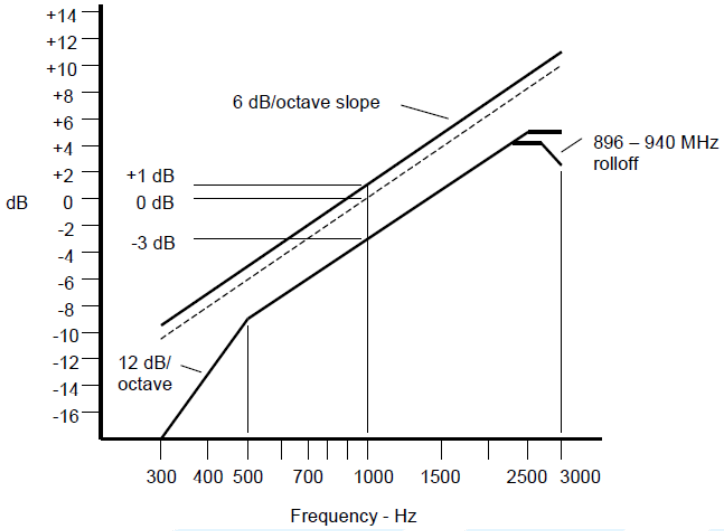
5.5. Audio Frequency Response

The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.

LIMIT

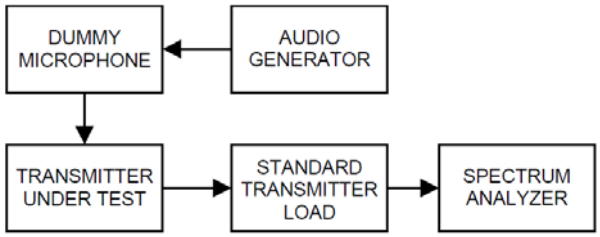
Please refer to FCC 47 CFR 2.1047(a) for specification details.

2.1047(a): Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.



An additional 6 dB per octave attenuation is allowed from 2500 Hz to 3000 Hz in equipment operating in the 25 MHz to 869 MHz range.

TEST CONFIGURATION



TEST PROCEDURE

1) Configure the EUT as shown in figure .
2) Adjust the audio input for 20% of rated system deviation at 1kHz using this level as a reference.
3) Vary the Audio frequency from 300Hz to 3 kHz and record the frequency deviation.
4) Audio Frequency Response =$20\log_{10}$ (V_{FREQ}/V_{REF}).

TEST MODE:

Please reference to the section 3.4

TEST RESULTS

☐ **Passed** ☒ **Not Applicable**

5.6. Frequency Stability Test

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

LIMIT

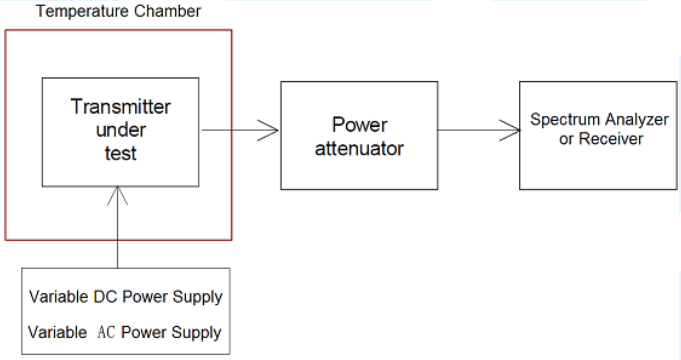
Please refer to FCC 47 CFR 2.1055, 74.464 for specification details.

FCC Part 74.464:

For operations on frequencies above 25 MHz using authorized bandwidths up to 30 kHz, the licensee of a remote pickup broadcast station or system shall maintain the operating frequency of each station in compliance with the frequency tolerance requirements of §90.213 of this chapter. For all other operations, the licensee of a remote pickup broadcast station or system shall maintain the operating frequency of each station in accordance with the following:

Frequency range	Tolerance (percent)	
	Base station	Mobile station
25 to 30 MHz:		
3 W or less	.002	.005
Over 3 W	.002	.002
30 to 300 MHz:		
3 W or less	.0005	.005
Over 3 W	.0005	.0005
300 to 500 MHz, all powers	.00025	.0005

TEST CONFIGURATION



TEST PROCEDURE

1. According to FCC Part 2 Section 2.1055 (a)(1), the frequency stability shall be measured with variation of ambient temperature from -30℃ to +50℃.
2. According to FCC Part 2 Section 2.1055 (d) (2), for battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacture.
3. Vary primary supply voltage from 85% to 115%.
4. The EUT was set in the climate chamber and connected to an external DC power supply. The RF output was directly connected to Spectrum Analyzer, The coupling loss of the additional cables was recorded and taken in account for all the measurements. After temperature stabilization (approx. 20 min for each stage), the frequency for the lower, the middle and the highest frequency range was recorded. For Frequency stability Vs. Voltage the EUT was connected to a DC power supply and the voltage was adjusted in the required ranges. The result was recorded.

TEST MODE:

Please reference to the section 3.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Note: have pre-tested TX1 to TX6 mode, record the worst case mode TX1,TX3 and TX5 on the report.

FCC Part 74					
TX1					
Test conditions		Frequency error (%)		Limit (%)	Result
Voltage(V)	Temp(℃)	CH_{L1}	CH_{H1}		
13.6	-30	-0.00013	-0.00015	±0.0005	Pass
	-20	-0.00014	-0.00018		
	-10	-0.00012	-0.00015		
	0	-0.00013	-0.00016		
	10	-0.00013	-0.00014		
	20	-0.00012	-0.00012		
	30	-0.00014	-0.00013		
	40	-0.00018	-0.00014		
	50	-0.00017	-0.00016		
15.64	20	-0.00016	-0.00020		
11.56	20	-0.00018	-0.00016		

FCC Part 74					
TX3					
Test conditions		Frequency error (%)		Limit (%)	Result
Voltage(V)	Temp(℃)	CH_{L1}	CH_{H1}		
13.6	-30	0.00008	0.00009	±0.0005	Pass
	-20	0.00006	0.00007		
	-10	0.00005	0.00005		
	0	0.00004	0.00006		
	10	0.00006	0.00008		
	20	0.00006	0.00007		
	30	0.00004	0.00009		
	40	0.00004	0.00008		
	50	0.00005	0.00006		
15.64	20	0.00006	0.00004		
11.56	20	0.00007	0.00005		

FCC Part 74					
TX5					
Test conditions		Frequency error (%)		Limit (%)	Result
Voltage(V)	Temp(℃)	CH_{L1}	CH_{H1}		
13.6	-30	0.00003	0.00005	±0.0005	Pass
	-20	0.00002	0.00004		
	-10	0.00004	-0.00005		
	0	0.00005	-0.00003		
	10	0.00006	0.00004		
	20	0.00005	0.00005		
	30	0.00002	-0.00006		
	40	0.00003	0.00005		
	50	0.00008	0.00008		
15.64	20	0.00006	0.00007		
11.56	20	0.00005	0.00005		

5.7. Transmitter Frequency Behaviour

LIMIT

Please refer to FCC 47 CFR 74.462(c),90.214 for specification details.

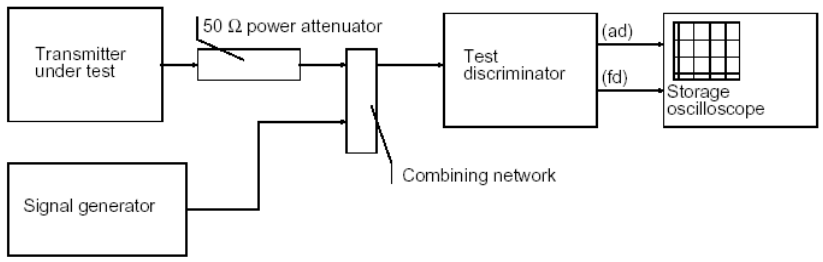
Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals[1,2]	Maximum frequency difference[3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3[4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3[4]	±6.25 kHz	5.0 ms	10.0 ms

Note:

1. On is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
   1) t_1 is the time period immediately following ton.
   2) t_2 is the time period immediately following t_1.
   3) t_3 is the time period from the instant when the transmitter is turned off until toff.
   4) t_{off} is the instant when the 1 kHz test signal starts to rise.
2. During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in § 90.213.
3. Difference between the actual transmitter frequency and the assigned transmitter frequency.
4. If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

TEST CONFIGURATION



TEST PROCEDURE

According to TIA/EIA-603 2.2.19 requirement, as for the product different from PTT, we use test steps as follows:

1. Connect DUT into Test discriminator and Storage Oscilloscope and keep DUT stats ON;
2. Input 1kHz signal into DUT;
3. Set the modulation domain analyzer to trigger on the rising edge of the waveform in order to capture a single-shot turn-on of the transmitter signals;
4. Keep DUT in OFF state and Key the PTT;
5. Observe the stored oscilloscope of modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the periods t_1 and t_2,and shall also remain within limits following t_2;
6. Adjust the modulation domain analyzer to trigger on the falling edge of the transmitter waveform in order to capture a single-shot turn-off transmitter of the transmitter signal.
7. Keep the digital portable radio in ON state and unkey the PTT;
8. Observe the stored oscilloscope of modulation domain analyzer, The signal trace shall be maintained within the allowable limits during the period t_3.
9. 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.
10. Turn on the transmitter.
11. Supply sufficient attenuation via the RF attenuator to provide an input level to the stored oscilloscope
12. 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 stored oscilloscope as P_0.
13. Turn off the transmitter.
14. 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.
15. Remove the attenuation, so the input power to the stored oscilloscope is increased by 30 dB when the transmitter is turned on.
16. Adjust the vertical amplitude control of the stored oscilloscope 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.
17. 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 ton. The trace should be maintained within the allowed divisions during the period t_1 and t_2.
18. Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum
19. Analyzer. The trace should be maintained within the allowed divisions during the period t_3.

TEST MODE:

Please reference to the section 3.4

TEST RESULTS

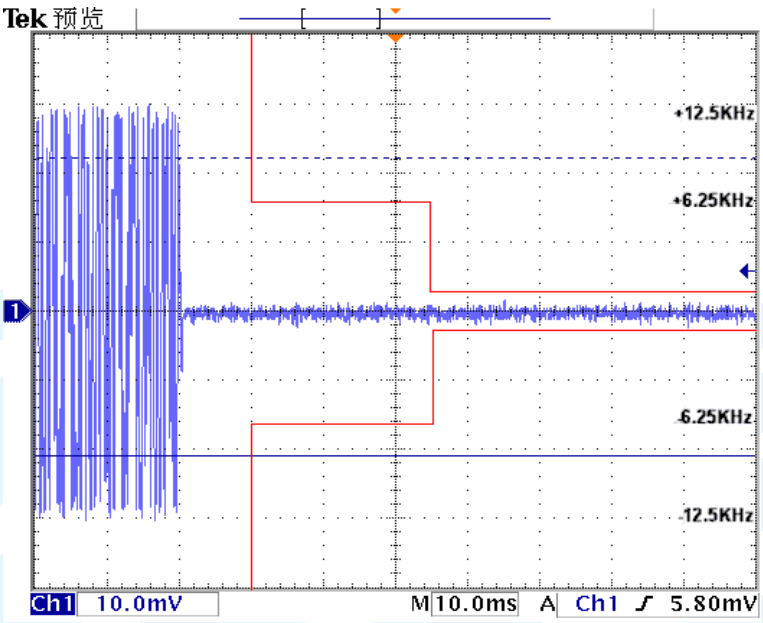
☒ **Passed** ☐ **Not Applicable**

Note: have pre-tested TX1 to TX6 mode, record the worst case mode TX1,TX3 and TX5 on the report.

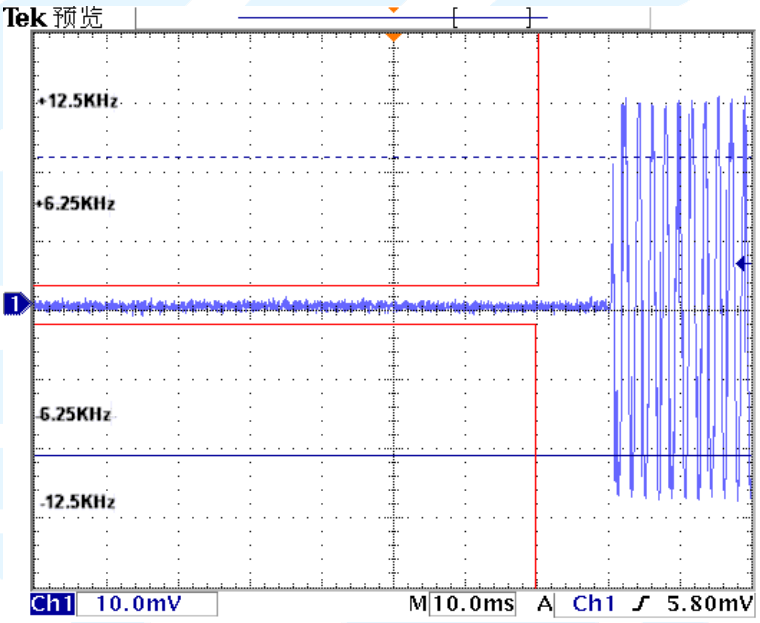
FCC Part 74:

Modulation Type: FM(TX1)

Transmitter Frequency Behaviour @ 12.5kHz Channel Separation------Off – On



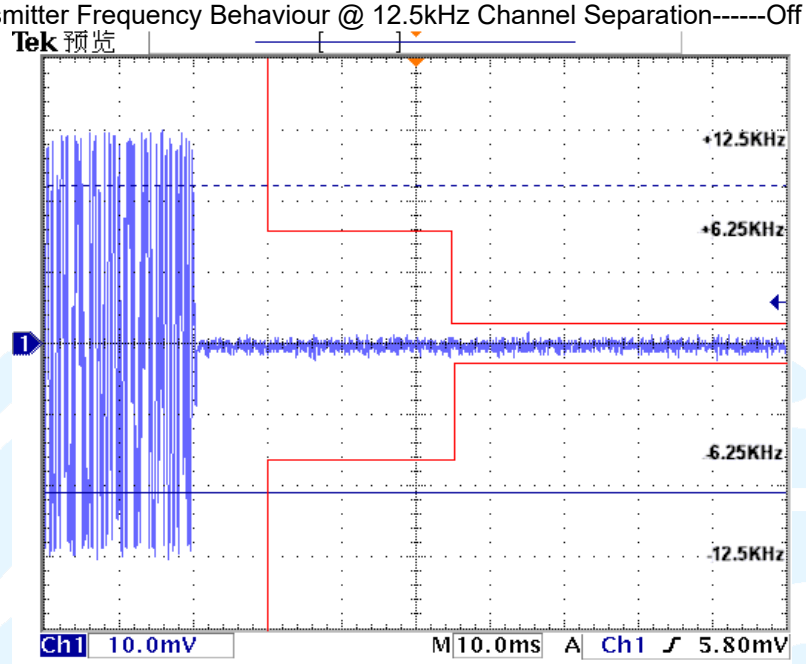
Transmitter Frequency Behaviour @ 12.5kHz Channel Separation------On – Off



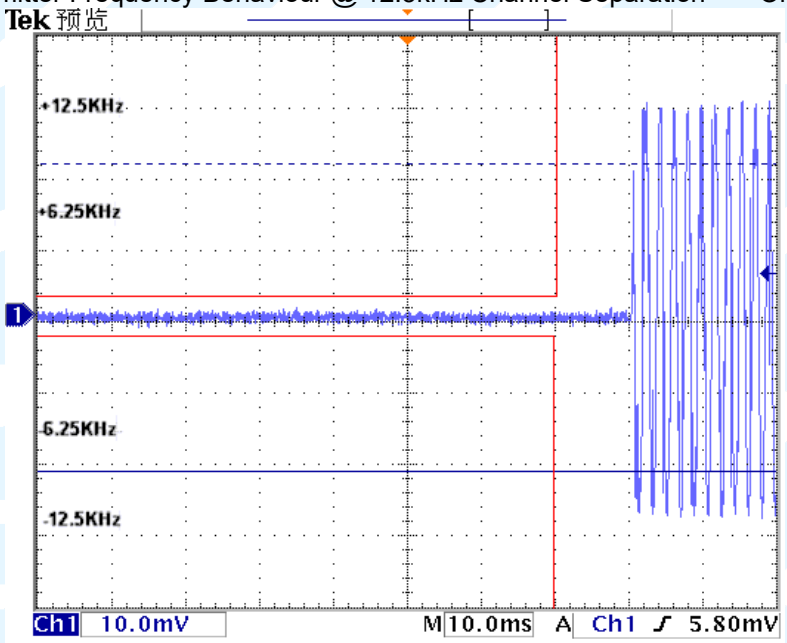
FCC Part 74:

Modulation Type: (TX3)

Transmitter Frequency Behaviour @ 12.5kHz Channel Separation------Off – On



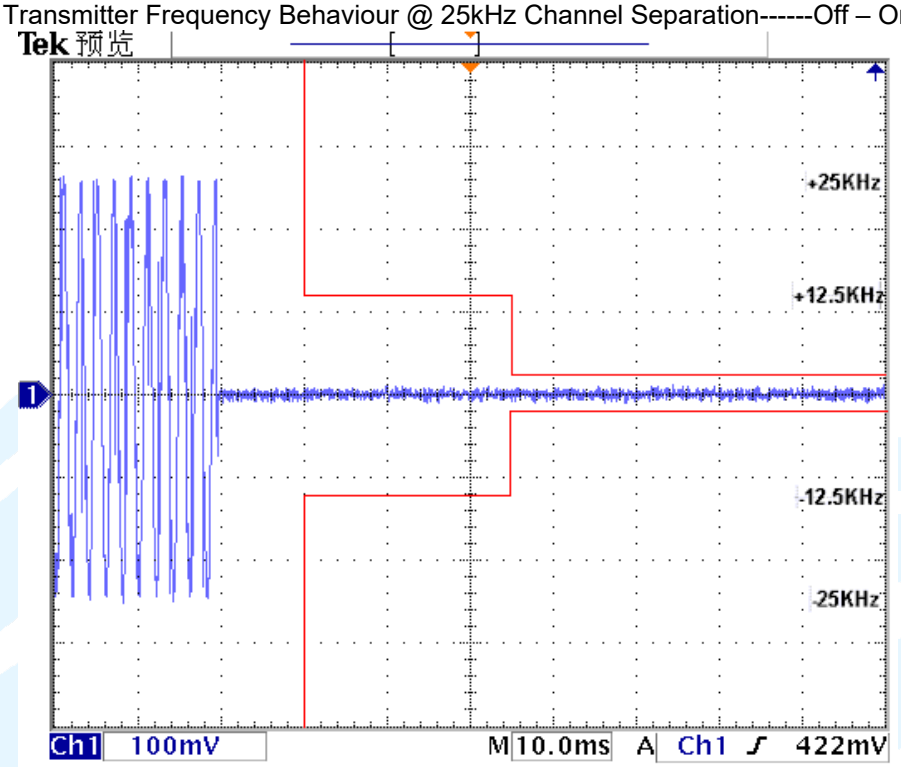
Transmitter Frequency Behaviour @ 12.5kHz Channel Separation------On – Off



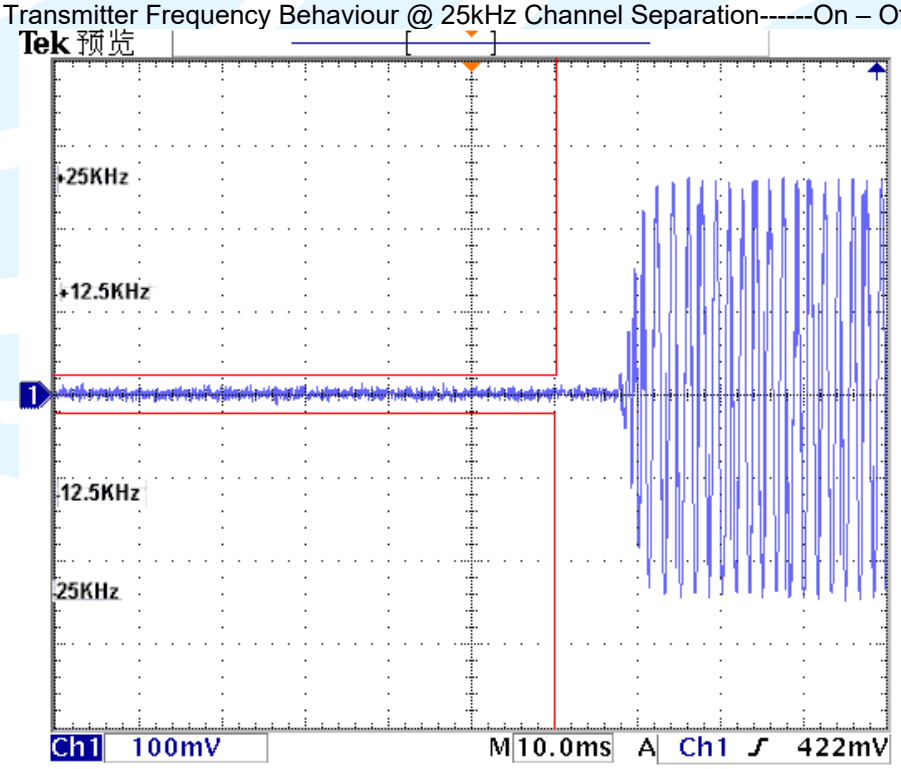
FCC Part 74:

Modulation Type: FM(TX5)

Transmitter Frequency Behaviour @ 25kHz Channel Separation------Off – On



Transmitter Frequency Behaviour @ 25kHz Channel Separation------On – Off



5.8. Spurious Emission on Antenna Port

Conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies that are outside a band sufficient to ensure transmission of information of required quality for the class of communication desired

LIMIT

Please refer to FCC 47 CFR 2.1051, 2.1057, 74.462(c) for specification details.

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Attenuation Limit (dBc)
§ 74.462(c)§90.210(b)(3)	At least 43 +10log10 (mean power in watts) dB
§ 74.462(c)§90.210(d)(3)	At least 50 +10log10 (mean power in watts) dB

50 +10 log (Pwatts)

Note: In general, the worse case attenuation requirement shown above was applied.

Calculation: Limit (dBm) =EL-50-10log10 (TP)

EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is P(dBm)

Limit (dBm) = P(dBm)-50-10 log (Pwatts) = -20dBm

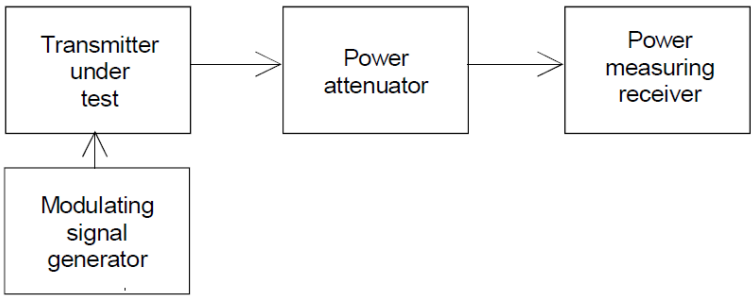
43 + 10 log (Pwatts)

Calculation: Limit (dBm) =EL-43-10log10 (TP)

Notes: EL is the emission level of the Output Power expressed in dBm,
In this application, the EL is P(dBm).

Limit (dBm) = P(dBm)-43-10 log (Pwatts) = -13 dBm

TEST CONFIGURATION



TEST PROCEDURE

1. The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation.
2. The resolution bandwidth of the spectrum analyzer was set to 100 kHz. Sufficient scans were taken to show any out of band emission up to 10th. Harmonic for the lower and the highest frequency range.
3. Set RBW 100 kHz, VBW 300 kHz in the frequency band 30MHz to 1GHz,while set RBW=1MHz.VBW=3MHz from the 1GHz to 10th Harmonic.
4. The audio input was set the unmodulated carrier, the resulting picture is print out for each channel separation.

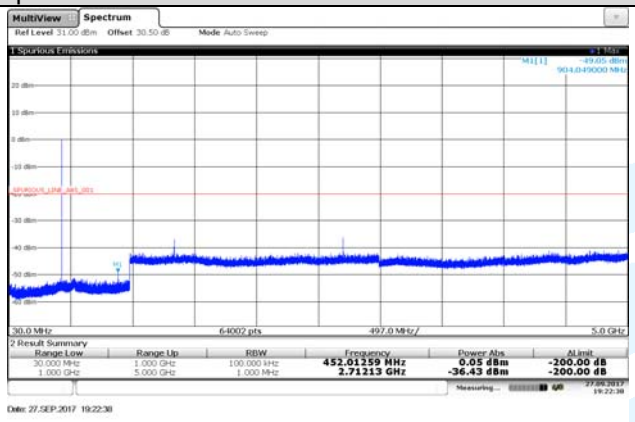
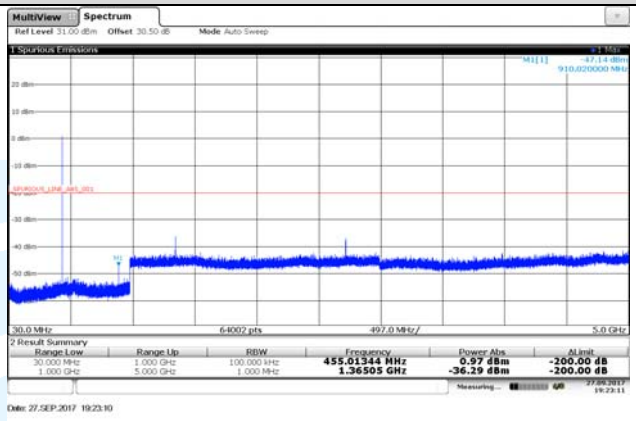
TEST MODE:

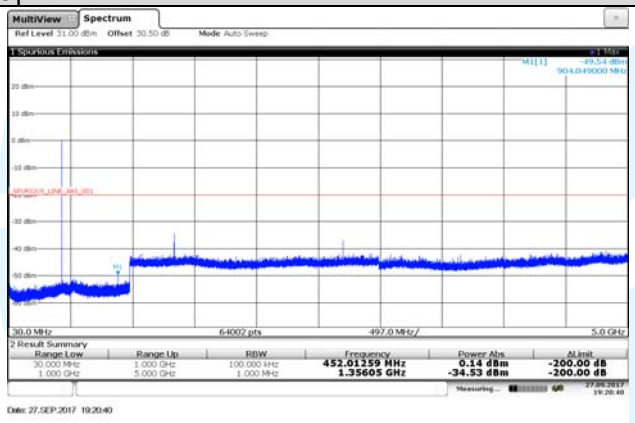
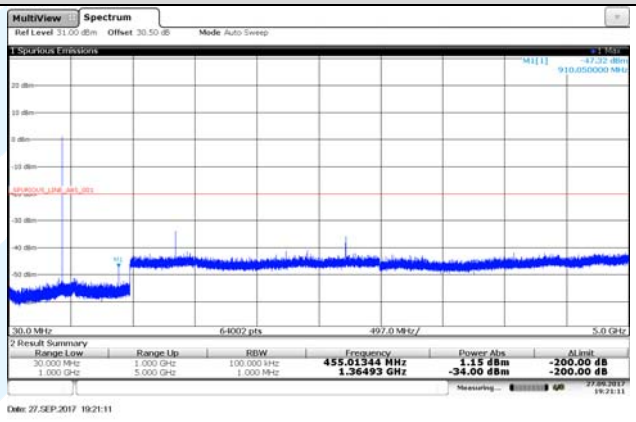
Please reference to the section 3.4

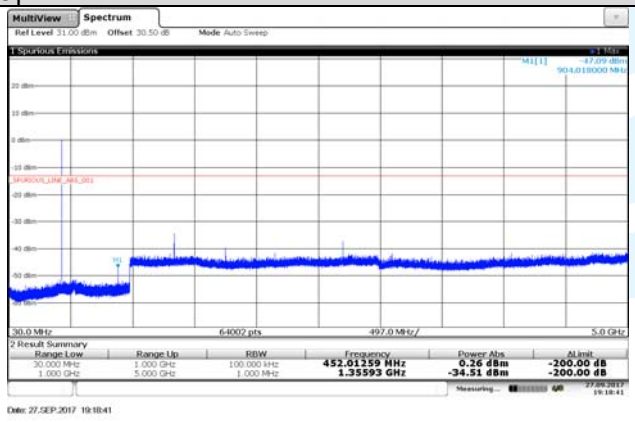
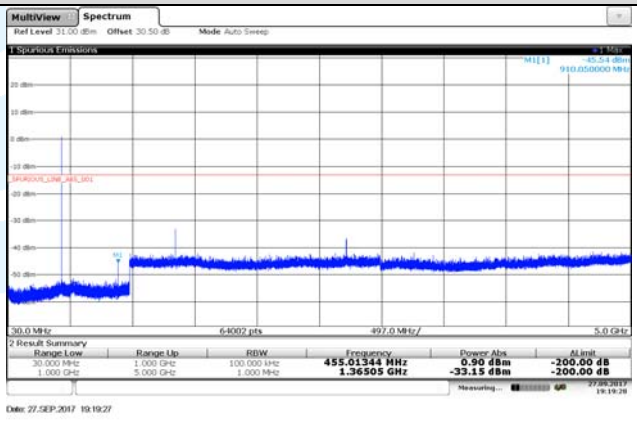
TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

1. The measurement frequency range from 30 MHz to 5 GHz.
2. We tested TX1 to TX6 recorded worst case TX1,TX3 and TX5.

FCC Part 74	
Operation Mode	TX1
	
CH_{L1}	CH_{H1}

FCC Part 74	
Operation Mode	TX3
	
CH_{L1}	CH_{H1}

FCC Part 74	
Operation Mode	TX5
	
CH_{L1}	CH_{H1}

5.9. Transmitter Radiated Spurious Emission

Radiated spurious emissions are emissions from the equipment when transmitting into a nonradiating load on a frequency or frequencies that are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communications desired.

LIMIT

Please refer to FCC 47 CFR 2.1051, 2.1057, 74.462(c) for specification details.

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Attenuation Limit (dBc)
§ 74.462(c)§90.210(b)(3)	At least 43 +10log10 (mean power in watts) dB
§ 74.462(c)§90.210(d)(3)	At least 50 +10log10 (mean power in watts) dB

50 +10 log (Pwatts)

Note: In general, the worse case attenuation requirement shown above was applied.

Calculation: Limit (dBm) =EL-50-10log10 (TP)

EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is P(dBm)

Limit (dBm) = P(dBm)-50-10 log (Pwatts) = -20dBm

43 + 10 log (Pwatts)

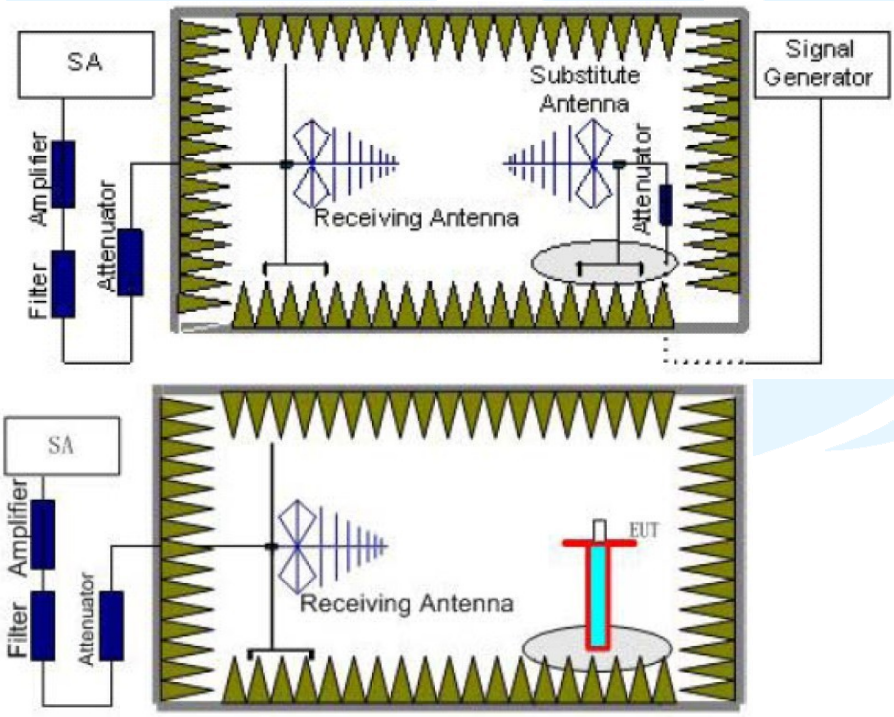
Calculation: Limit (dBm) =EL-43-10log10 (TP)

Notes: EL is the emission level of the Output Power expressed in dBm,
In this application, the EL is P(dBm).

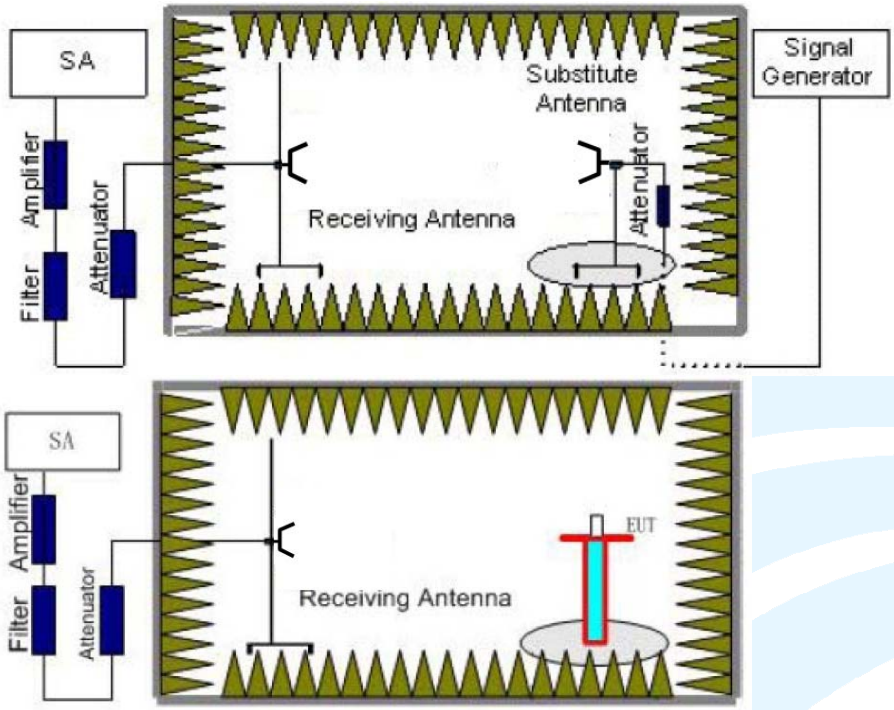
Limit (dBm) = P(dBm)-43-10 log (Pwatts) = -13 dBm

TEST CONFIGURATION

Below 1GHz:



Above 1GHz:



TEST PROCEDURE

1. Standard Transmitter Load with a 50Ω input impedance and an output impedance matched to the test equipment.
2. EUT was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1. 0 m. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in six channels were measured with peak detector.
3. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
4. The EUT is then put into continuously transmitting mode at its maximum power level during the test.Set Test Receiver or Spectrum RBW=1MHz,VBW=3MHz for above 1GHz and RBW=100kHz,VBW=300kHz for 30MHz to 1GHz, And the maximum value of the receiver should be recorded as (Pr).
5. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (PMea) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source (PMea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
6. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (Pcl) ,the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test.
   The measurement results are obtained as described below:
   Power(EIRP)=PMea- PAg - Pcl - Ga
   We used SMF100A micowave signal generator which signal level can up to 33dBm,so we not used power Amplifier for substituation test; The measurement results are amend as described below:
   Power(EIRP)=PMea- Pcl - Ga
7. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
8. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi.

TEST MODE:

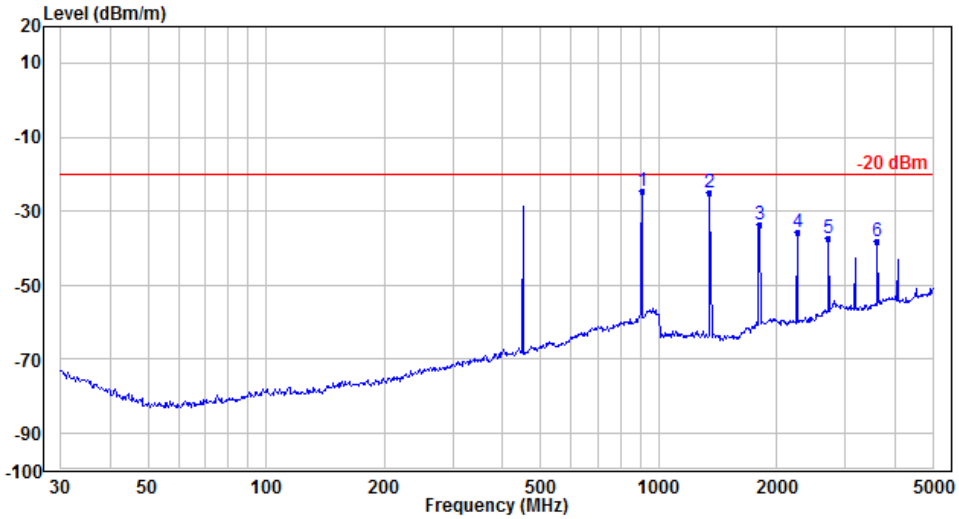
Please reference to the section 3.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Note:
1. In general, the worse case attenuation requirement shown above was applied.
2. The measurement frequency range from 30 MHz to 5 GHz.
3. We tested TX1 to TX6 recorded worst case TX1,TX3 and TX5.

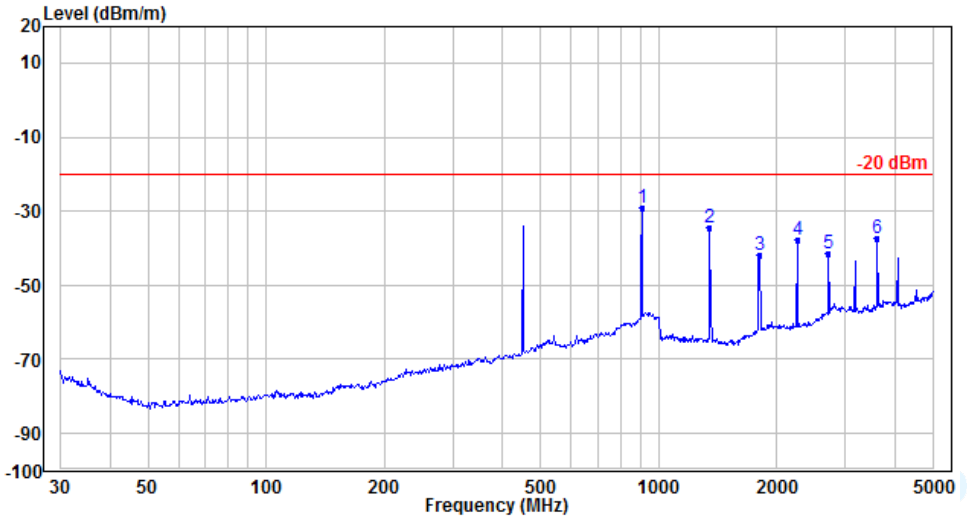
TX1			
Test Frequency:	CH_{L1}	Polarity:	Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1*	906.304	-34.07	9.56	-24.51	-20.00	4.51	Peak
2	1354.159	-18.80	-5.94	-24.74	-20.00	4.74	Peak
3	1810.241	-31.41	-2.37	-33.78	-20.00	13.78	Peak
4	2261.453	-34.14	-1.68	-35.82	-20.00	15.82	Peak
5	2709.125	-38.15	0.94	-37.21	-20.00	17.21	Peak
6	3621.562	-41.03	2.95	-38.08	-20.00	18.08	Peak

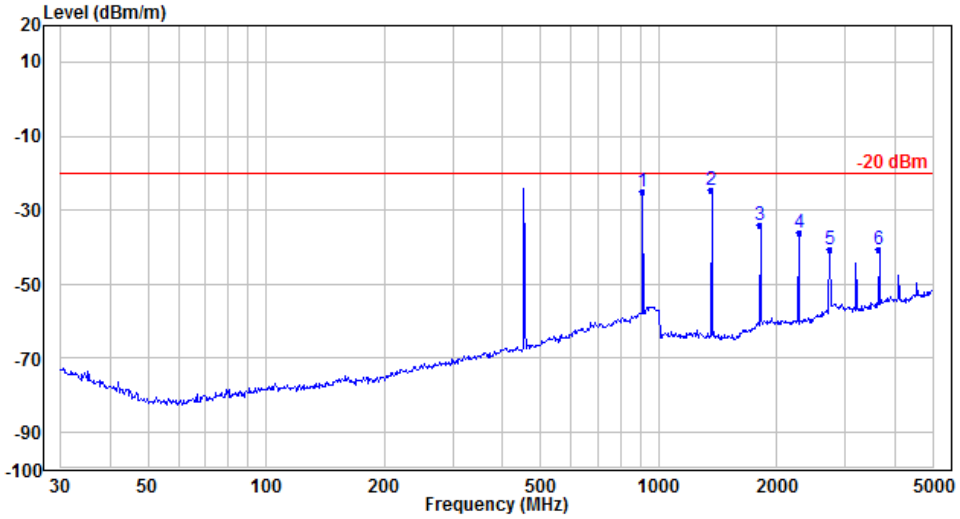
a

Test Frequency:	CH_{L1}	Polarity:	Vertical



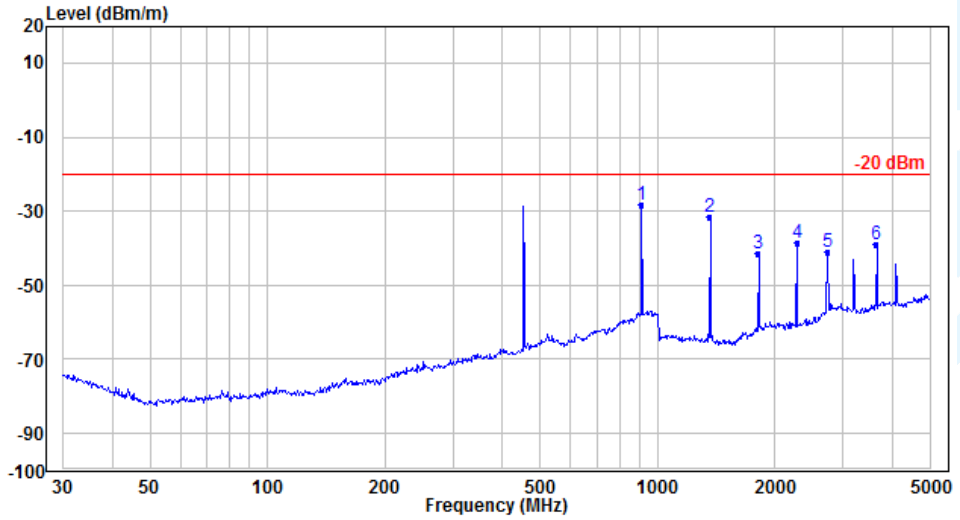
No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1*	906.304	-38.19	9.31	-28.88	-20.00	8.88	Peak
2	1354.159	-27.58	-7.03	-34.61	-20.00	14.61	Peak
3	1810.241	-38.08	-3.82	-41.90	-20.00	21.90	Peak
4	2261.453	-35.11	-2.57	-37.68	-20.00	17.68	Peak
5	2709.125	-41.86	0.50	-41.36	-20.00	21.36	Peak
6	3621.562	-39.48	2.31	-37.17	-20.00	17.17	Peak

TX1			
Test Frequency:	CH_{H1}	Polarity:	Horizontal



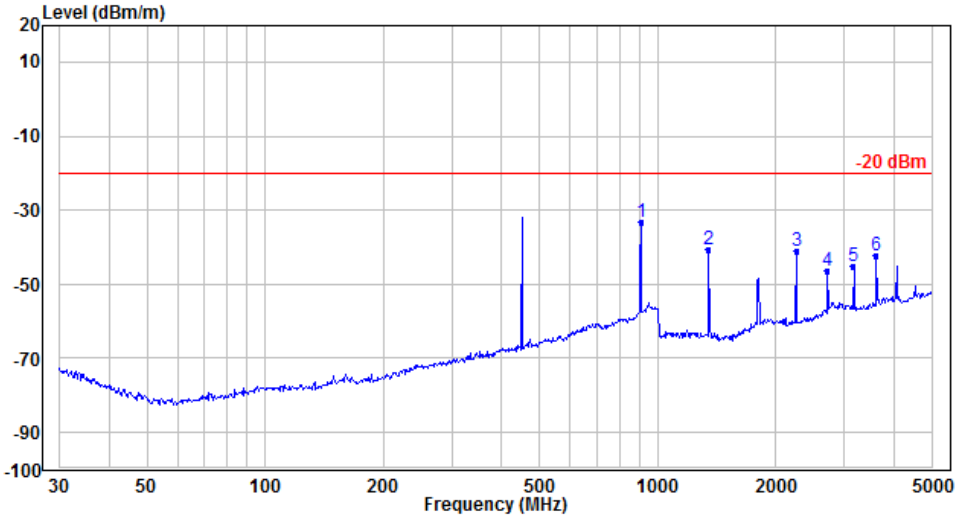
No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1	912.695	-34.47	9.60	-24.87	-20.00	4.87	Peak
2*	1362.923	-18.74	-5.97	-24.71	-20.00	4.71	Peak
3	1816.089	-31.86	-2.30	-34.16	-20.00	14.16	Peak
4	2276.088	-34.37	-1.65	-36.02	-20.00	16.02	Peak
5	2726.658	-41.74	1.12	-40.62	-20.00	20.62	Peak
6	3644.998	-43.72	3.05	-40.67	-20.00	20.67	Peak

Test Frequency:	CH_{H1}	Polarity:	Vertical



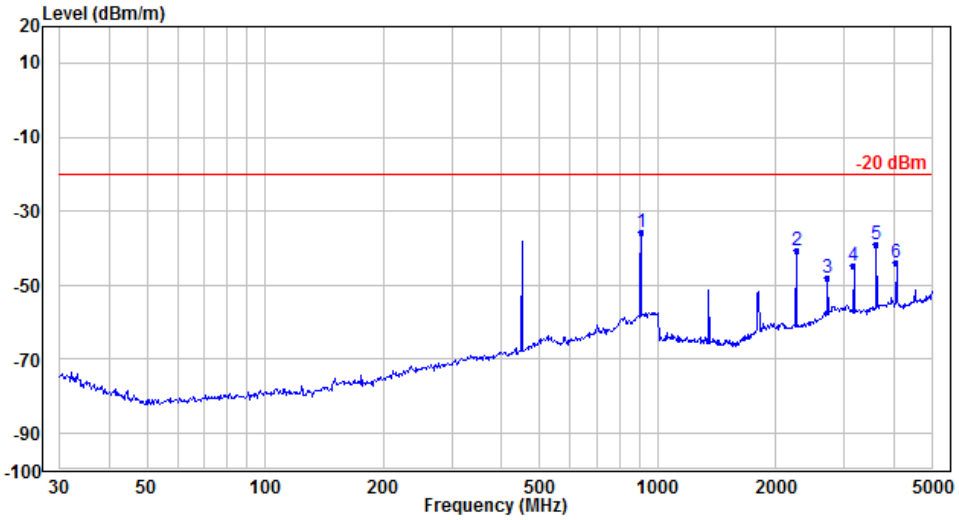
No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1*	912.695	-37.66	9.40	-28.26	-20.00	8.26	Peak
2	1362.923	-24.39	-7.06	-31.45	-20.00	11.45	Peak
3	1816.089	-37.76	-3.74	-41.50	-20.00	21.50	Peak
4	2276.088	-35.84	-2.53	-38.37	-20.00	18.37	Peak
5	2726.658	-41.69	0.69	-41.00	-20.00	21.00	Peak
6	3644.998	-41.53	2.39	-39.14	-20.00	19.14	Peak

TX3			
Test Frequency:	CH_{L1}	Polarity:	Horizontal



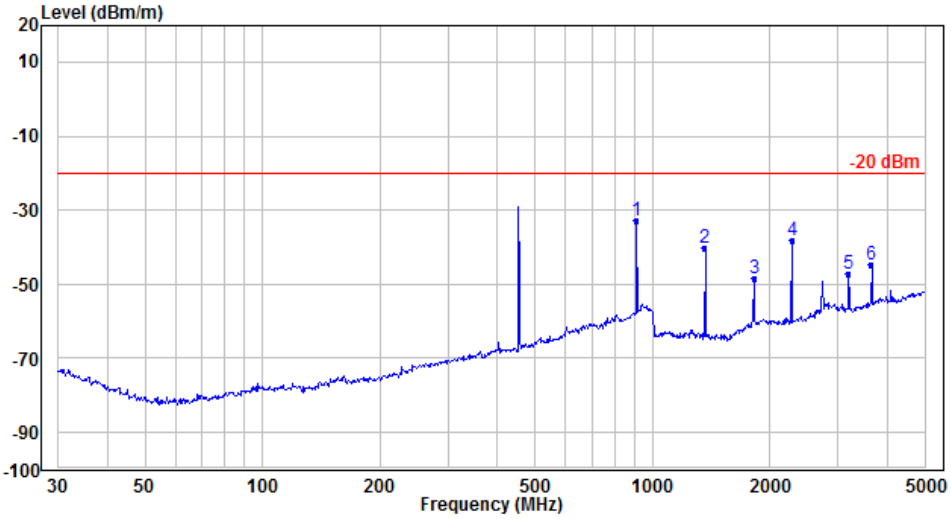
No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1	906.304	-42.84	9.56	-33.28	-20.00	13.28	Peak
2	1354.159	-34.88	-5.94	-40.82	-20.00	20.82	Peak
3	2261.453	-39.54	-1.68	-41.22	-20.00	21.22	Peak
4	2709.125	-47.24	0.94	-46.30	-20.00	26.30	Peak
5	3162.749	-47.09	1.75	-45.34	-20.00	25.34	Peak
6	3621.562	-45.31	2.95	-42.36	-20.00	22.36	Peak

Test Frequency:	CH_{L1}	Polarity:	Vertical



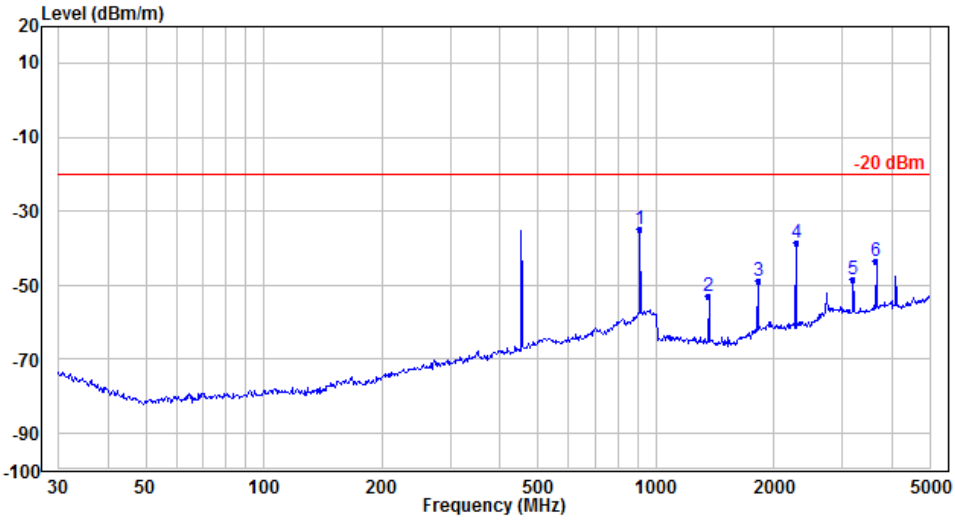
No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1	906.304	-45.04	9.31	-35.73	-20.00	15.73	Peak
2	2261.453	-37.95	-2.57	-40.52	-20.00	20.52	Peak
3	2709.125	-48.53	0.50	-48.03	-20.00	28.03	Peak
4	3162.749	-46.41	1.49	-44.92	-20.00	24.92	Peak
5	3621.562	-41.26	2.31	-38.95	-20.00	18.95	Peak
6	4067.453	-46.82	2.95	-43.87	-20.00	23.87	Peak

TX3			
Test Frequency:	CH_{H1}	Polarity:	Horizontal



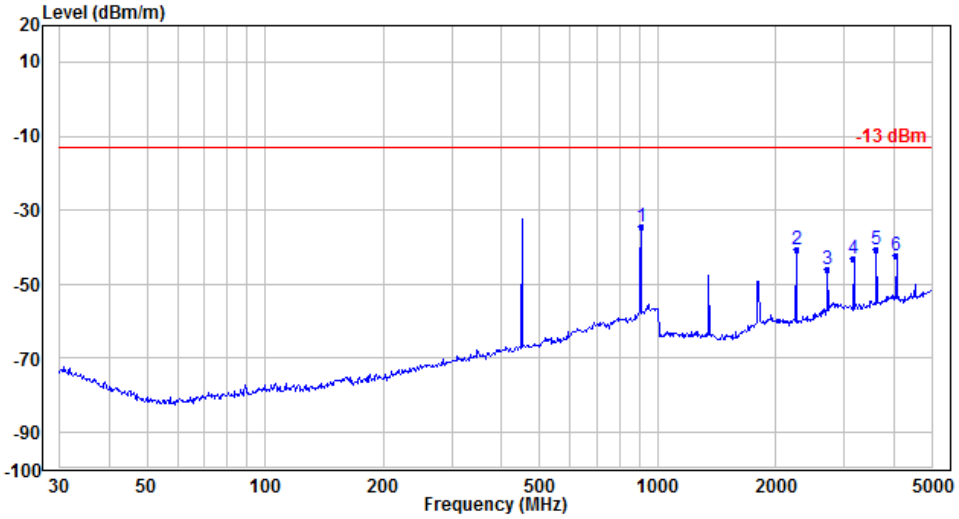
No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1	912.695	-42.28	9.60	-32.68	-20.00	12.68	Peak
2	1362.923	-34.15	-5.97	-40.12	-20.00	20.12	Peak
3	1821.956	-46.25	-2.24	-48.49	-20.00	28.49	Peak
4	2276.088	-36.70	-1.65	-38.35	-20.00	18.35	Peak
5	3183.217	-48.90	1.74	-47.16	-20.00	27.16	Peak
6	3644.998	-47.74	3.05	-44.69	-20.00	24.69	Peak

Test Frequency:	CH_{H1}	Polarity:	Vertical



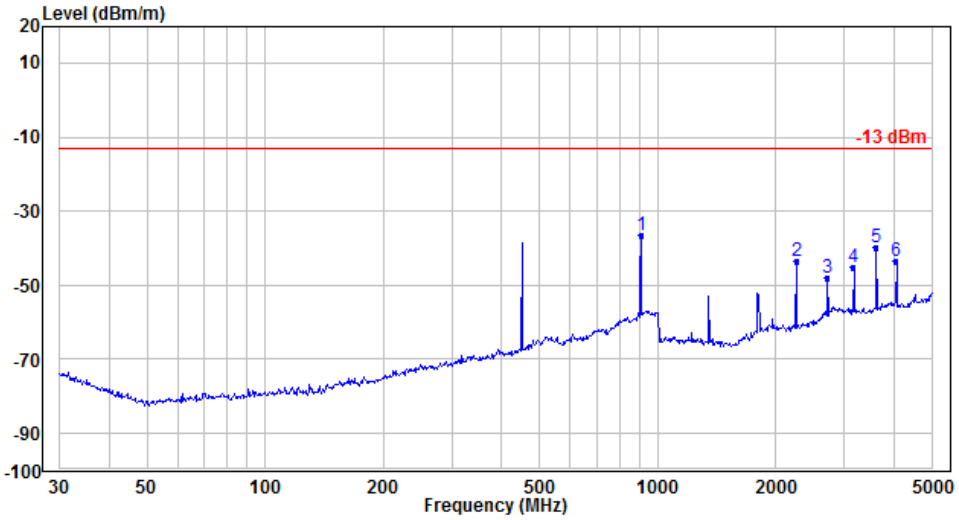
No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1	912.695	-44.34	9.40	-34.94	-20.00	14.94	Peak
2	1362.923	-45.73	-7.06	-52.79	-20.00	32.79	Peak
3	1821.956	-45.14	-3.66	-48.80	-20.00	28.80	Peak
4	2276.088	-36.02	-2.53	-38.55	-20.00	18.55	Peak
5	3183.217	-50.06	1.47	-48.59	-20.00	28.59	Peak
6	3644.998	-45.74	2.39	-43.35	-20.00	23.35	Peak

TX5			
Test Frequency:	CH_{L1}	Polarity:	Horizontal



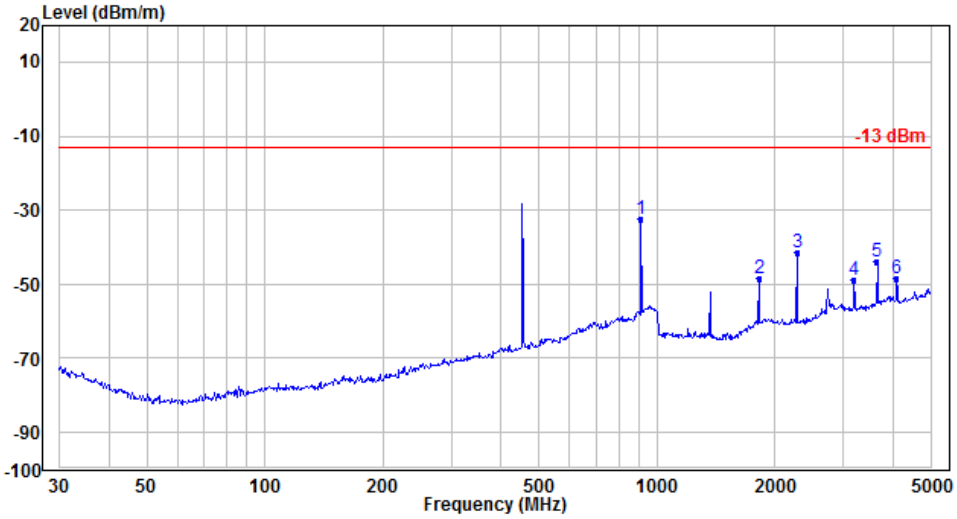
No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1	906.304	-44.11	9.56	-34.55	-13.00	21.55	Peak
2	2261.453	-39.11	-1.68	-40.79	-13.00	27.79	Peak
3	2709.125	-46.73	0.94	-45.79	-13.00	32.79	Peak
4	3162.749	-44.95	1.75	-43.20	-13.00	30.20	Peak
5	3621.562	-43.37	2.95	-40.42	-13.00	27.42	Peak
6	4067.453	-46.12	3.93	-42.19	-13.00	29.19	Peak

Test Frequency:	CH_{L1}	Polarity:	Vertical



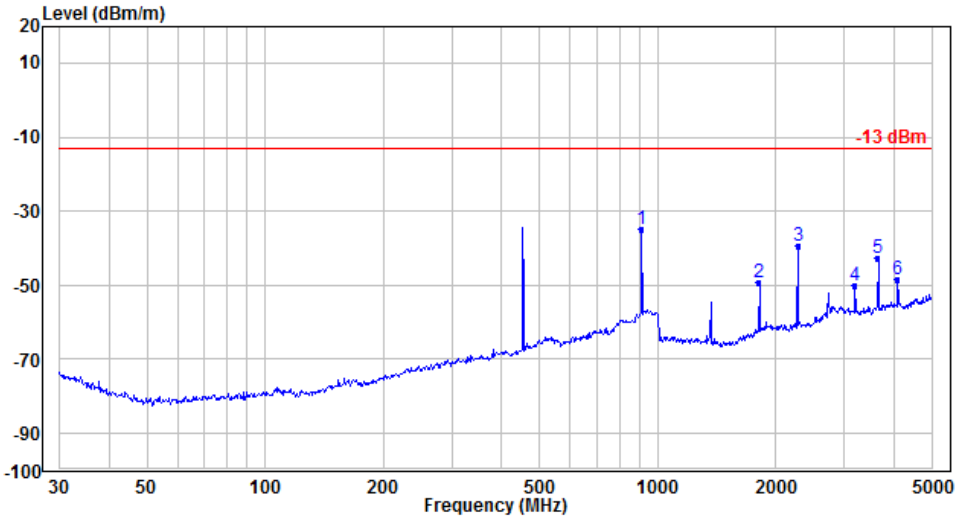
No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1	906.304	-45.93	9.31	-36.62	-13.00	23.62	Peak
2	2261.453	-40.77	-2.57	-43.34	-13.00	30.34	Peak
3	2709.125	-48.63	0.50	-48.13	-13.00	35.13	Peak
4	3162.749	-46.75	1.49	-45.26	-13.00	32.26	Peak
5	3621.562	-42.12	2.31	-39.81	-13.00	26.81	Peak
6	4067.453	-46.45	2.95	-43.50	-13.00	30.50	Peak

TX5			
Test Frequency:	CH_{H1}	Polarity:	Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1	912.695	-42.14	9.60	-32.54	-13.00	19.54	Peak
2	1821.956	-46.40	-2.24	-48.64	-13.00	35.64	Peak
3	2276.088	-39.92	-1.65	-41.57	-13.00	28.57	Peak
4	3183.217	-50.48	1.74	-48.74	-13.00	35.74	Peak
5	3644.998	-46.95	3.05	-43.90	-13.00	30.90	Peak
6	4093.776	-52.20	3.91	-48.29	-13.00	35.29	Peak

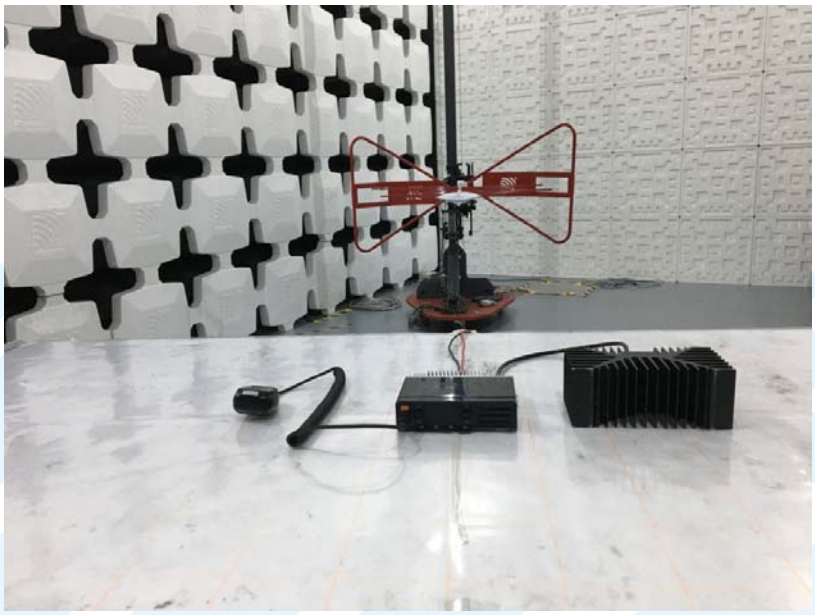
Test Frequency:	CH_{H1}	Polarity:	Vertical



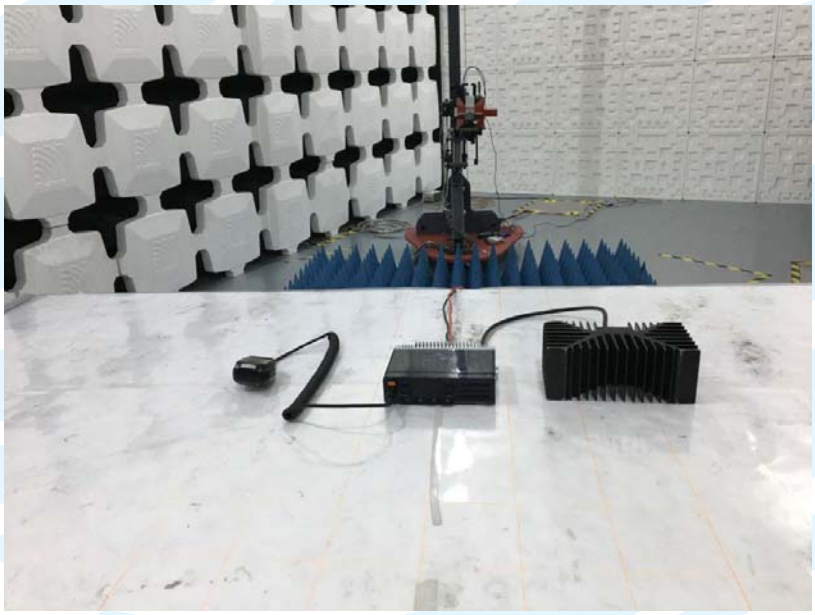
No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Rem ark
1	912.695	-44.26	9.40	-34.86	-13.00	21.86	Peak
2	1816.089	-45.51	-3.74	-49.25	-13.00	36.25	Peak
3	2276.088	-36.96	-2.53	-39.49	-13.00	26.49	Peak
4	3183.217	-51.40	1.47	-49.93	-13.00	36.93	Peak
5	3644.998	-45.21	2.39	-42.82	-13.00	29.82	Peak
6	4093.776	-51.55	2.95	-48.60	-13.00	35.60	Peak

6. Test Setup Photos of the EUT

Transmitter Radiated Spurious Emission:



30MHz-1GHz



Above 1GHz

Frequency stability:

7. External and Internal Photos of the EUT

Reference to Test Report No.: TRE1706008201.

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