

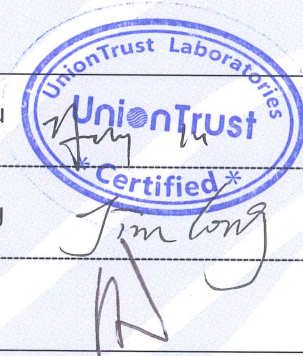
# TEST REPORT

**Report Reference No.**..... : 180201001RFC-1  
**FCC ID**..... : YAMMD61XVHF  
**Applicant's name**..... : Hytera Communications Corporation Limited  
**Address**..... : Hytera Tower, Hi-Tech Industrial Park North,9108# Beihuan Road, Nanshan District, Shenzhen, China  
**Manufacturer**..... : Hytera Communications Corporation Limited  
**Address**..... : Hytera Tower, Hi-Tech Industrial Park North,9108# Beihuan Road, Nanshan District, Shenzhen, China  
**Test item description** ..... : **Digital Mobile Radio**  
**Trade Mark** ..... : Hytera  
**Model/Type reference**..... : MD615 VHF  
**Listed Model(s)**..... : MD612 VHF, MD616 VHF, MD618 VHF  
**Standard** ..... : **FCC Part 74**  
**Date of receipt of test sample**..... : Nov. 16, 2017  
**Date of testing**..... : Nov. 17, 2017 – Jan. 19, 2018  
**Date of issue**..... : Feb. 05, 2018  
**Result**..... : **PASS**

**Tested by:** ..... : Engineer Henry Lu

**Reviewed by:** ..... : Assistant Manager Jim Long

**Approved by**..... : Technical Director Billy Li



**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

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## 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 15](#) Subpart B Unintentional Radiators

[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	Feb. 05, 2018	Original

## 2. Test Description

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

### 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, China
Manufacturer:	Hytera Communications Corporation Limited
Address:	Hytera Tower, Hi-Tech Industrial Park North,9108# Beihuan Road, Nanshan District, Shenzhen, China

#### 3.2. Product Description

Name of EUT:	Digital Mobile Radio	
Trade Mark:	Hytera	
Model No.:	MD615 VHF	
Listed Model(s):	MD612 VHF, MD616 VHF, MD618 VHF	
Power supply:	DC 13.6V	
Adapter information:	-	
Hardware version:	A	
Software version:	V1.01.13.001	
Operation Frequency Range:	From 136MHz to 174MHz	
Rated Output Power:	High Power: 50W (46.99dBm)/Low Power: 5W (36.99dBm)	
Modulation Type:	Analog Voice:	FM
	Digital Voice/Digital Data:	4FSK
Digital Type:	DMR	
Channel Separation:	Analog Voice:	<input checked="" type="checkbox"/> 12.5kHz <input checked="" type="checkbox"/> 25kHz
	Digital Voice/Digital Data:	<input checked="" type="checkbox"/> 12.5kHz <input type="checkbox"/> 6.25kHz
Emission Designator:	Analog Voice:	<input checked="" type="checkbox"/> 12.5kHz Channel Separation: 5K25F3E <input checked="" type="checkbox"/> 25kHz Channel Separation: 10K5F3E
	Digital Voice& Data:	<input checked="" type="checkbox"/> 12.5kHz Channel Separation: 7K34FXW <input type="checkbox"/> 6.25kHz Channel Separation: ---
	Digital Data:	<input checked="" type="checkbox"/> 12.5kHz Channel Separation: 7K34FXD <input type="checkbox"/> 6.25kHz Channel Separation: ---
Support data rate:	9.6kbps	
Antenna Type:	External	
Maximum Transmitter Power:	Digital	52.48W for 12.5kHz Channel Separation
	Analog	49.43W for 12.5kHz Channel Separation
		49.43W 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	152.885~154	CH <sub>L1</sub>	153.065
			157.45~161.575	CH <sub>M1</sub>	160.995
			161.625~161.775	CH <sub>M2</sub>	161.655
			162.0375~173.2	CH <sub>H1</sub>	173.175
		25	152.885~154	CH <sub>L1</sub>	153.065
			157.45~161.575	CH <sub>M1</sub>	160.995
			161.625~161.775	CH <sub>M2</sub>	161.655
			162.0375~173.2	CH <sub>H1</sub>	173.175
Digital	4FSK	12.5	152.885~154	CH <sub>L1</sub>	153.065
			157.45~161.575	CH <sub>M1</sub>	160.995
			161.625~161.775	CH <sub>M2</sub>	161.655
			162.0375~173.2	CH <sub>H1</sub>	173.175

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		GPS	BT
			High	Low	12.5kHz	12.5kHz	25kHz		
TX1	√		√		√				
TX2	√			√	√				
TX3	√		√			√			
TX4	√			√		√			
TX5	√		√				√		
TX6	√			√			√		
RX1		√			√				
RX2		√				√			
RX3		√					√		
RX4		√						√	
RX5		√							√

√: 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: L9069**

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: 259480



### 4.3. Environmental conditions

Normal Condition	
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)
<input checked="" type="checkbox"/>	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	N/A	Dec. 20, 2015	Dec. 19, 2018
<input checked="" type="checkbox"/>	Receiver	R&S	ESIB26	100114	Dec. 10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Dec. 10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	Loop Antenna	ETS-LINDGREN	6502	00202525	Dec. 22, 2017	Dec. 22, 2018
<input checked="" type="checkbox"/>	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Dec. 17, 2017	Dec. 17, 2018
<input checked="" type="checkbox"/>	Preamplifier	HP	8447F	2805A02960	Dec. 10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	Dec. 17, 2017	Dec. 17, 2018
<input checked="" type="checkbox"/>	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
<input checked="" type="checkbox"/>	High Pass Filter	hangwei	OSF-HPF60300P20-LC	N/A	N/A	N/A
<input checked="" type="checkbox"/>	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)
<input checked="" type="checkbox"/>	Receiver	R&S	ESR7	1316.3003K07-101181-K3	Dec. 10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	RF COMMUNICATION TEST SET	HP	8920A	3813A10206	Nov.11, 2017	Nov.11, 2018
<input checked="" type="checkbox"/>	Oscilloscope	Tektronix	TDS3032B	B013680	Sep.18, 2017	Sep.17, 2018
<input checked="" type="checkbox"/>	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	Jan. 08, 2016	Jan. 07, 2018
<input checked="" type="checkbox"/>	DC Source	KIKUSUI	PWR400L	LK003024	NA	NA
<input checked="" type="checkbox"/>	Temp & Humidity chamber	Votisch	VT4002	58566133290020	Jun. 19, 2017	Jun. 18, 2018

## 5. TEST CONDITIONS AND RESULTS

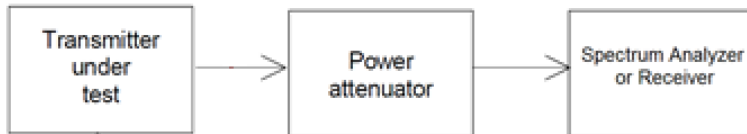
### 5.1. Maximum Transmitter Power

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 <sub>L1</sub>	47.1	51.29	-
	CH <sub>M1</sub>	47.2	52.48	
	CH <sub>M2</sub>	47.2	52.48	
	CH <sub>H1</sub>	47.1	51.29	
TX2	CH <sub>L1</sub>	37.0	5.01	-
	CH <sub>M1</sub>	36.9	4.90	
	CH <sub>M2</sub>	36.9	4.90	
	CH <sub>H1</sub>	37.0	5.01	
TX3	CH <sub>L1</sub>	46.88	48.75	-
	CH <sub>M1</sub>	46.94	49.43	
	CH <sub>M2</sub>	46.94	49.43	
	CH <sub>H1</sub>	46.84	48.31	
TX4	CH <sub>L1</sub>	36.74	4.72	-
	CH <sub>M1</sub>	36.63	4.60	
	CH <sub>M2</sub>	36.63	4.60	
	CH <sub>H1</sub>	36.71	4.69	
TX5	CH <sub>L1</sub>	46.88	48.75	-
	CH <sub>M1</sub>	46.94	49.43	
	CH <sub>M2</sub>	46.94	49.43	
	CH <sub>H1</sub>	46.83	48.19	
TX6	CH <sub>L1</sub>	36.72	4.70	-
	CH <sub>M1</sub>	36.65	4.62	
	CH <sub>M2</sub>	36.65	4.62	
	CH <sub>H1</sub>	36.73	4.71	

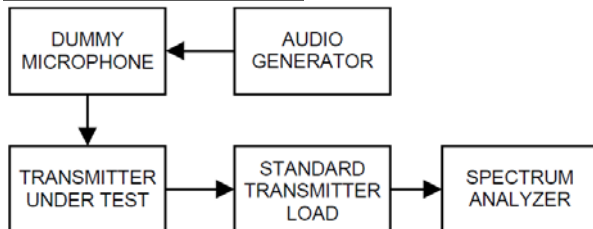
## 5.2. Occupied Bandwidth

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

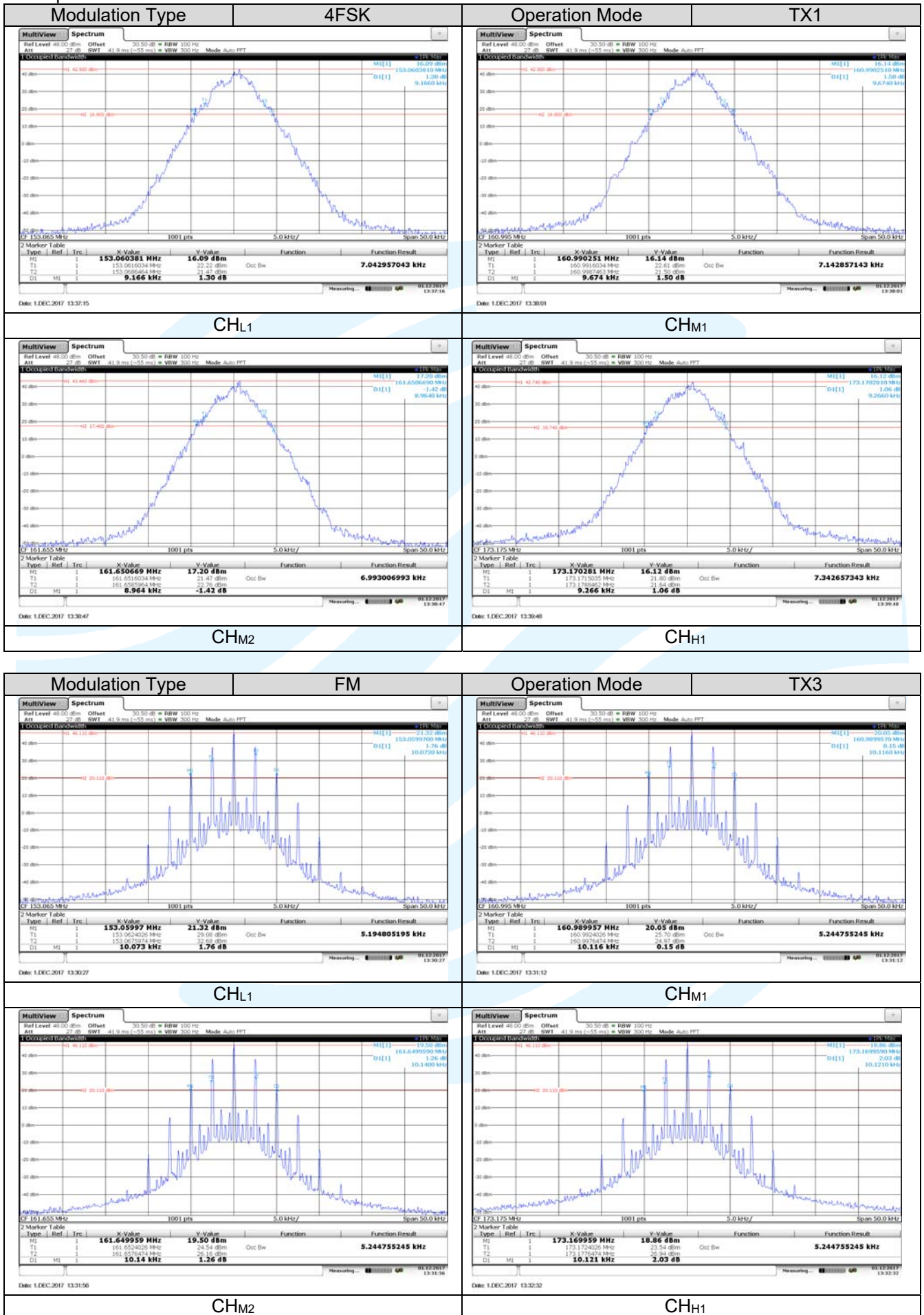
Passed       Not Applicable

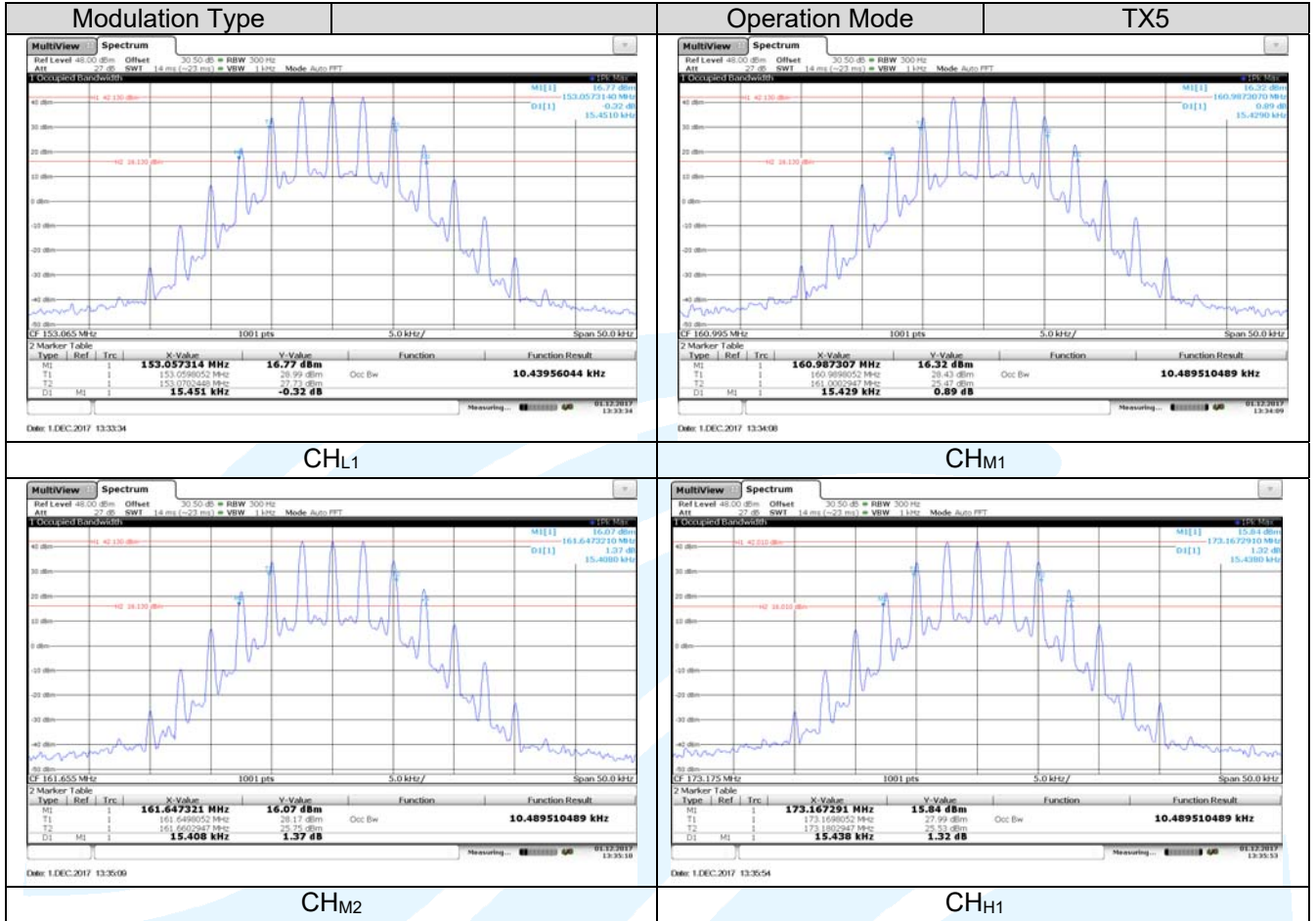
Note: Have pre-tested TX1 to TX6 mode, record the worst case mode TX1, TX3 and TX5 on the report.

FCC Part 74					
Operation Mode	Test Channel	Occupied Bandwidth (kHz)		Limit(kHz)	Result
		99%	26dB		
TX1	CH <sub>L1</sub>	7.043	9.166	≤ 11.25	Pass
	CH <sub>M1</sub>	7.143	9.674		
	CH <sub>M2</sub>	6.993	8.964		
	CH <sub>H1</sub>	7.343	9.266		
TX3	CH <sub>L1</sub>	5.195	10.073	≤ 11.25	Pass
	CH <sub>M1</sub>	5.245	10.116		
	CH <sub>M2</sub>	5.245	10.140		
	CH <sub>H1</sub>	5.245	10.121		
TX5	CH <sub>L1</sub>	10.440	15.451	≤ 20	Pass
	CH <sub>M1</sub>	10.490	15.429		
	CH <sub>M2</sub>	10.490	15.408		
	CH <sub>H1</sub>	10.490	15.438		



Test plot as follows:





### 5.3. Emission Mask

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

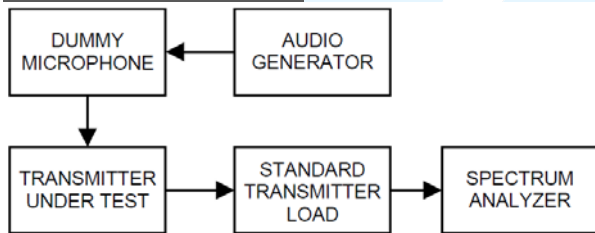
**LIMIT**

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:**

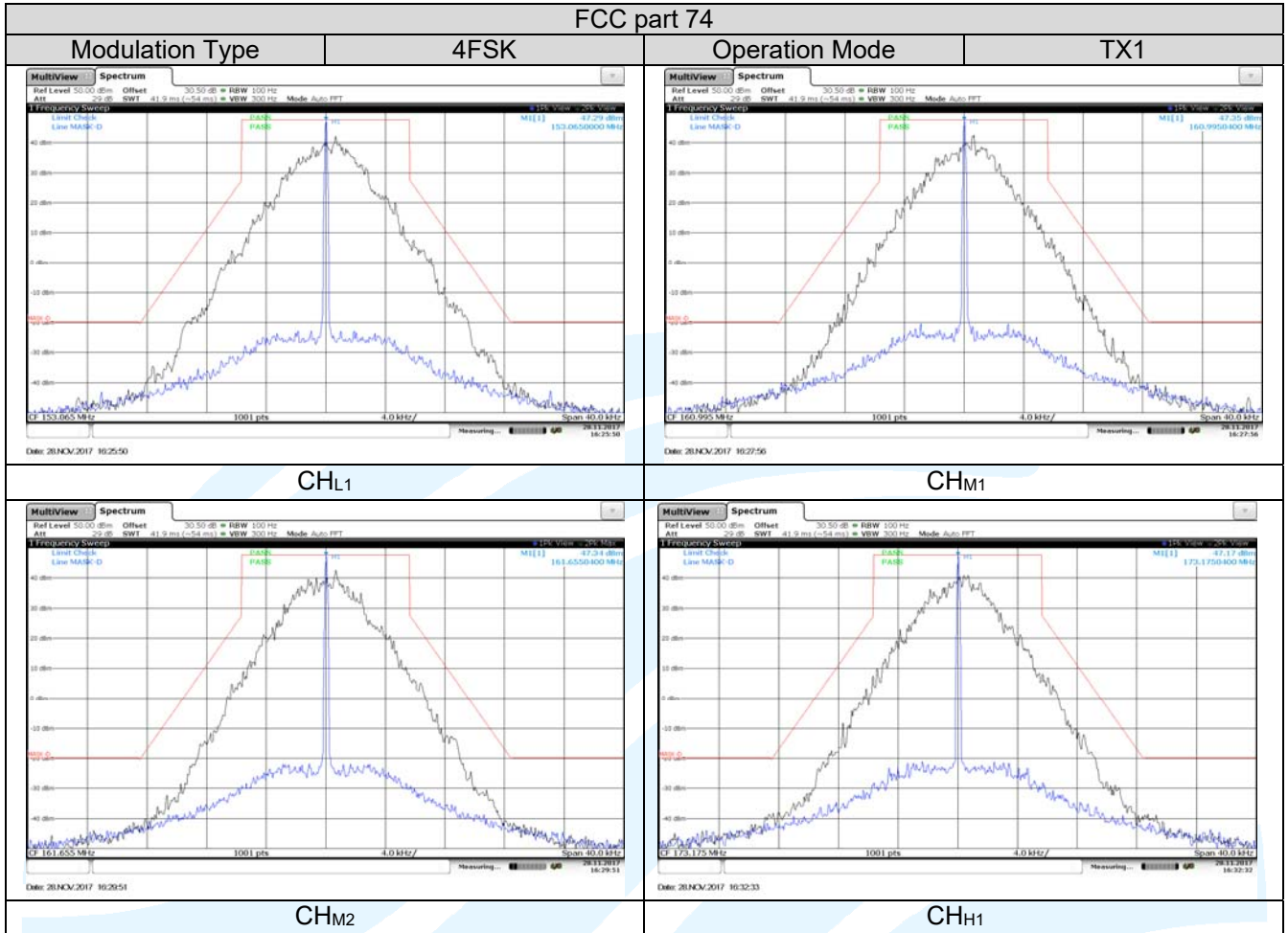
Please reference to the section 3.4

**TEST RESULTS**

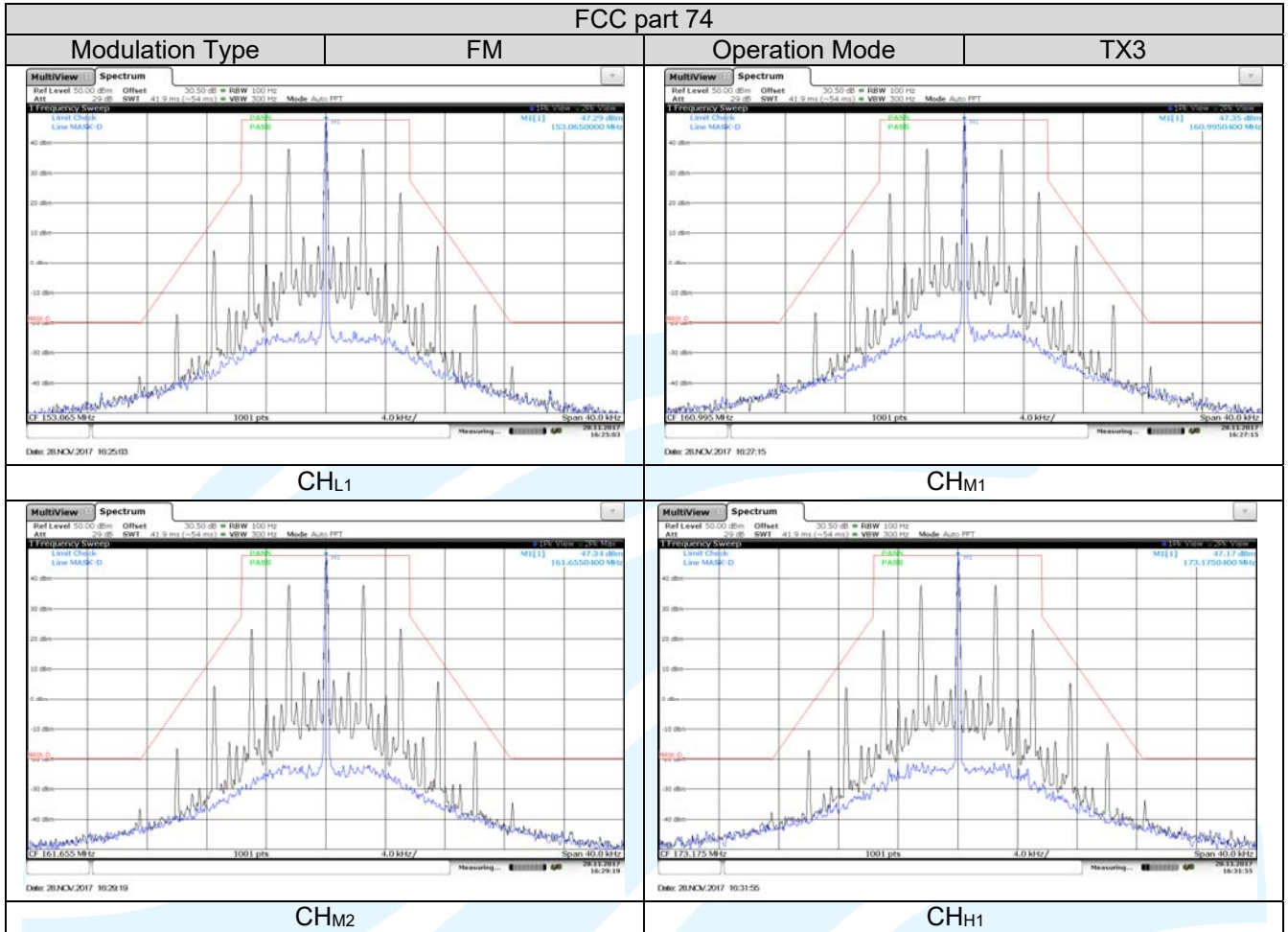
**Passed**       **Not Applicable**

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

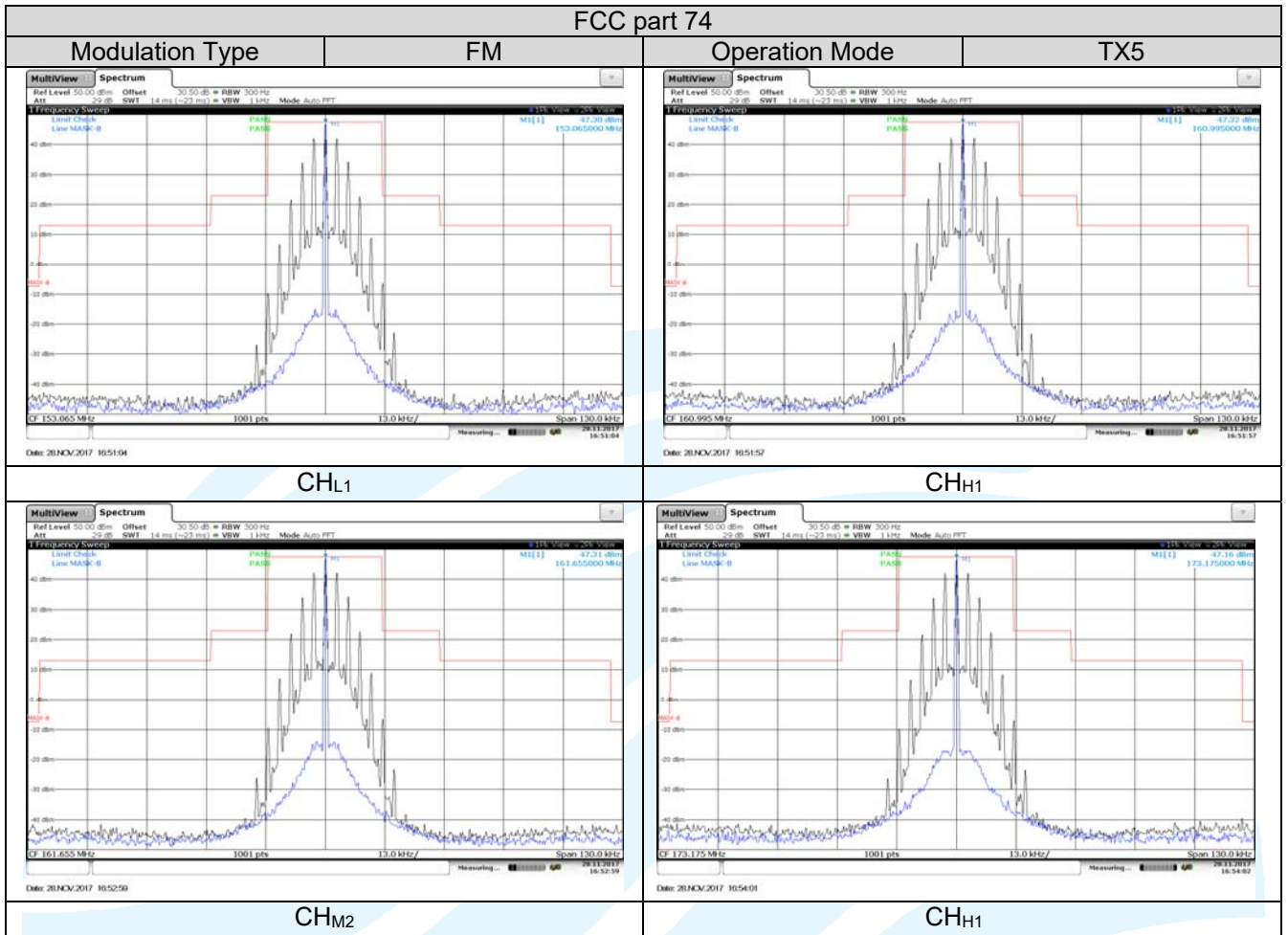
FCC part 74



FCC part 74









### 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.

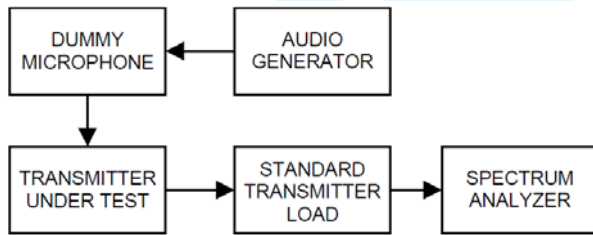
**LIMIT**

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  $\leq 0.25$  Hz to  $\geq 15,000$  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.

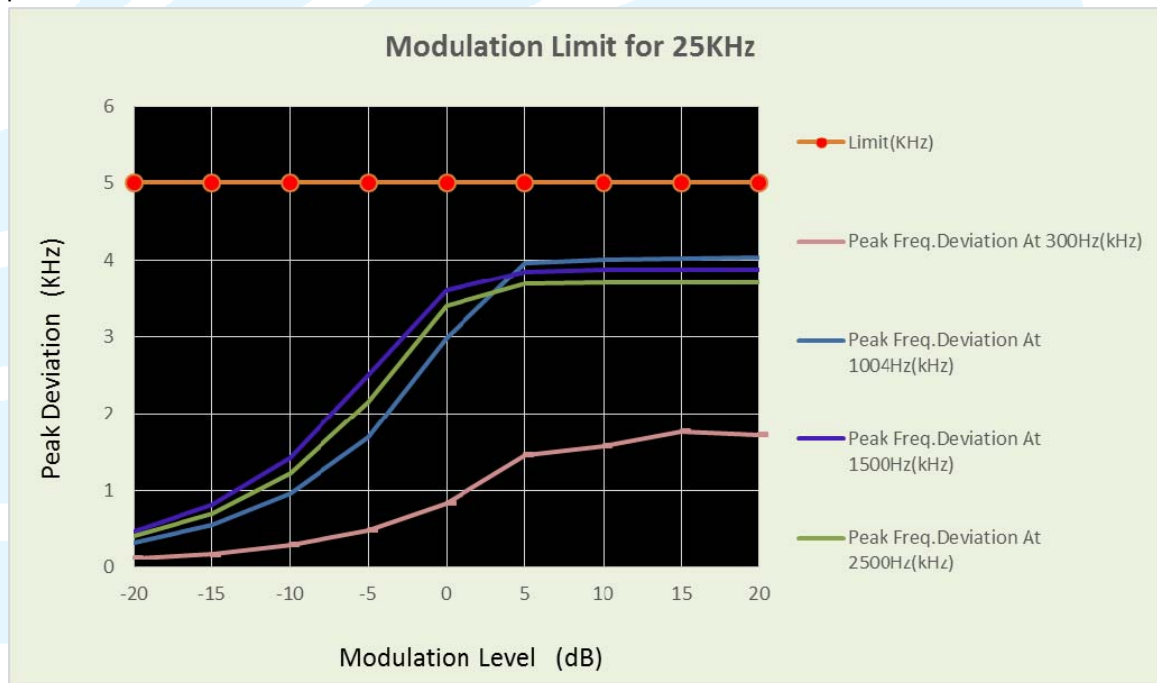
FCC Part 74						
TX3: CH <sub>H1</sub>						
Modulation Level (dB)	Peak frequency deviation (kHz)				Limit (kHz)	Result
	300Hz	1004Hz	1500Hz	2500Hz		
-20	0.091	0.180	0.256	0.224	2.5	Pass
-15	0.104	0.297	0.428	0.370		
-10	0.167	0.502	0.722	0.625		
-5	0.262	0.849	1.253	1.078		
0	0.445	1.512	1.822	1.703		
5	0.749	1.987	1.945	1.879		
10	0.872	2.013	1.952	1.880		
15	0.845	2.034	1.929	1.879		
20	0.862	2.019	1.923	1.883		

Test plot as follows:



FCC Part 74						
TX5: CH <sub>H1</sub>						
Modulation Level (dB)	Peak frequency deviation (kHz)				Limit (kHz)	Result
	300Hz	1004Hz	1500Hz	2500 Hz		
-20	0.123	0.328	0.473	0.413	5	Pass
-15	0.179	0.560	0.822	0.701		
-10	0.299	0.958	1.423	1.229		
-5	0.491	1.682	2.500	2.152		
0	0.838	2.979	3.601	3.403		
5	1.463	3.956	3.853	3.691		
10	1.573	4.004	3.878	3.707		
15	1.766	4.022	3.882	3.705		
20	1.718	4.034	3.876	3.698		

Test plot as follows:



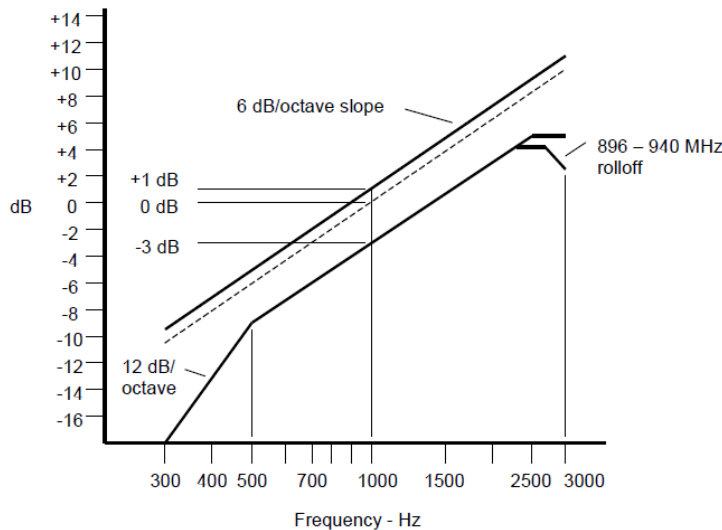
### 5.5. Audio Frequency Response

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

**LIMIT**

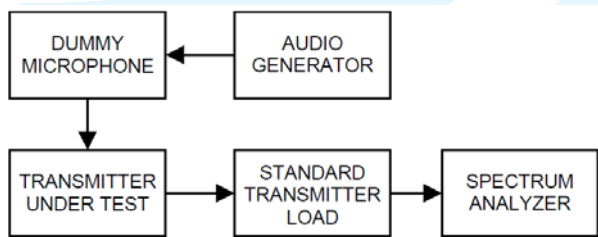
Please refer to FCC 47 CFR 2.1047(a) for specification details.

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**

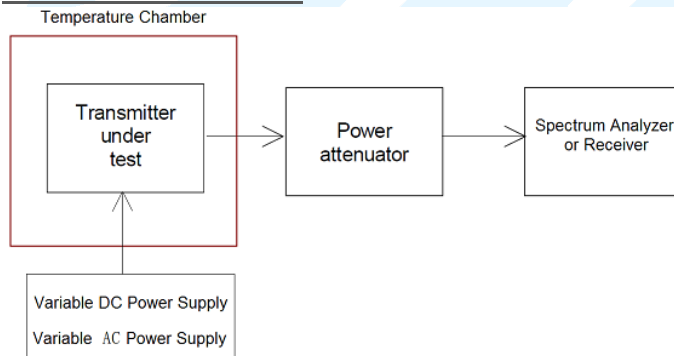
Please refer to FCC 47 CFR 2.1055, 74.464 for specification details.

**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°C to +50°C.
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% of the nominal value.
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(°C)	CH <sub>L1</sub>	CH <sub>M1</sub>	CH <sub>M2</sub>	CH <sub>H1</sub>		
13.6	-30	0.000022	0.000025	0.000027	0.000028	±0.0005	Pass
	-20	0.000023	0.000029	0.000020	0.000019		
	-10	0.000023	0.000025	0.000023	0.000022		
	0	0.000025	0.000027	0.000022	0.000021		
	10	0.000020	0.000023	0.000022	0.000022		
	20	0.000029	0.000024	0.000020	0.000193		
	30	0.000020	0.000022	0.000024	0.000022		
	40	0.000023	0.000029	0.000029	0.000024		
	50	0.000020	0.000021	0.000025	0.000027		
15.64	20	0.000022	0.000029	0.000026	0.000021		
11.56	20	0.000023	0.000019	0.000020	0.000025		

FCC Part 74							
TX3							
Test conditions		Frequency error (%)				Limit (%)	Result
Voltage(V)	Temp(°C)	CH <sub>L1</sub>	CH <sub>M1</sub>	CH <sub>M2</sub>	CH <sub>H1</sub>		
13.6	-30	0.000051	0.000050	0.000051	0.000055	±0.0005	Pass
	-20	0.000051	0.000049	0.000050	0.000050		
	-10	0.000055	0.000056	0.000050	0.000050		
	0	0.000056	0.000052	0.000053	0.000055		
	10	0.000049	0.000051	0.000055	0.000053		
	20	0.000056	0.000051	0.000053	0.000051		
	30	0.000055	0.000050	0.000054	0.000053		
	40	0.000054	0.000055	0.000056	0.000052		
	50	0.000054	0.000055	0.000052	0.000051		
15.64	20	0.000051	0.000053	0.000054	0.000056		
11.56	20	0.000053	0.000054	0.000052	0.000052		

FCC Part 74							
TX5							
Test conditions		Frequency error (%)				Limit (%)	Result
Voltage(V)	Temp(°C)	CH <sub>L1</sub>	CH <sub>M1</sub>	CH <sub>M2</sub>	CH <sub>H1</sub>		
13.6	-30	0.000058	0.000055	0.000056	0.000056	±0.0005	Pass
	-20	0.000060	0.000056	0.000053	0.000053		
	-10	0.000059	0.000057	0.000061	0.000060		
	0	0.000053	0.000058	0.000056	0.000058		
	10	0.000054	0.000061	0.000058	0.000060		
	20	0.000053	0.000055	0.000056	0.000055		
	30	0.000055	0.000056	0.000057	0.000055		
	40	0.000056	0.000054	0.000055	0.000058		
	50	0.000060	0.000054	0.000060	0.000054		
15.64	20	0.000055	0.000054	0.000060	0.000060		
11.56	20	0.000060	0.000055	0.000059	0.000059		

### 5.7. Transmitter Frequency Behaviour

**LIMIT**

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

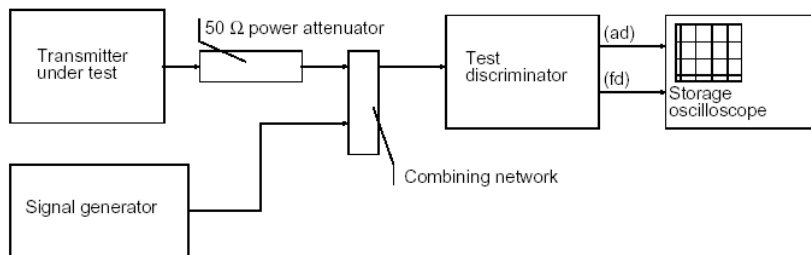
Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals <sup>1 2</sup>	Maximum frequency difference <sup>3</sup>	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t <sub>1</sub> <sup>4</sup>	±25.0 kHz	5.0 ms	10.0 ms
t <sub>2</sub>	±12.5 kHz	20.0 ms	25.0 ms
t <sub>3</sub> <sup>4</sup>	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t <sub>1</sub> <sup>4</sup>	±12.5 kHz	5.0 ms	10.0 ms
t <sub>2</sub>	±6.25 kHz	20.0 ms	25.0 ms
t <sub>3</sub> <sup>4</sup>	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t <sub>1</sub> <sup>4</sup>	±6.25 kHz	5.0 ms	10.0 ms
t <sub>2</sub>	±3.125 kHz	20.0 ms	25.0 ms
t <sub>3</sub> <sup>4</sup>	±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<sub>1</sub> is the time period immediately following ton.
  - 2) t<sub>2</sub> is the time period immediately following t<sub>1</sub>.
  - 3) t<sub>3</sub> is the time period from the instant when the transmitter is turned off until toff.
  - 4) toff is the instant when the 1 kHz test signal starts to rise.
2. During the time from the end of t<sub>2</sub> to the beginning of t<sub>3</sub>, 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  $\pm 12.5$  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  $\pm 4$  divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to "Video", and tune the "trigger level" on suitable level. Then set the "trigger offset" to -10ms for turn on and -15ms for turn off.
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  $t_{on}$ . 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

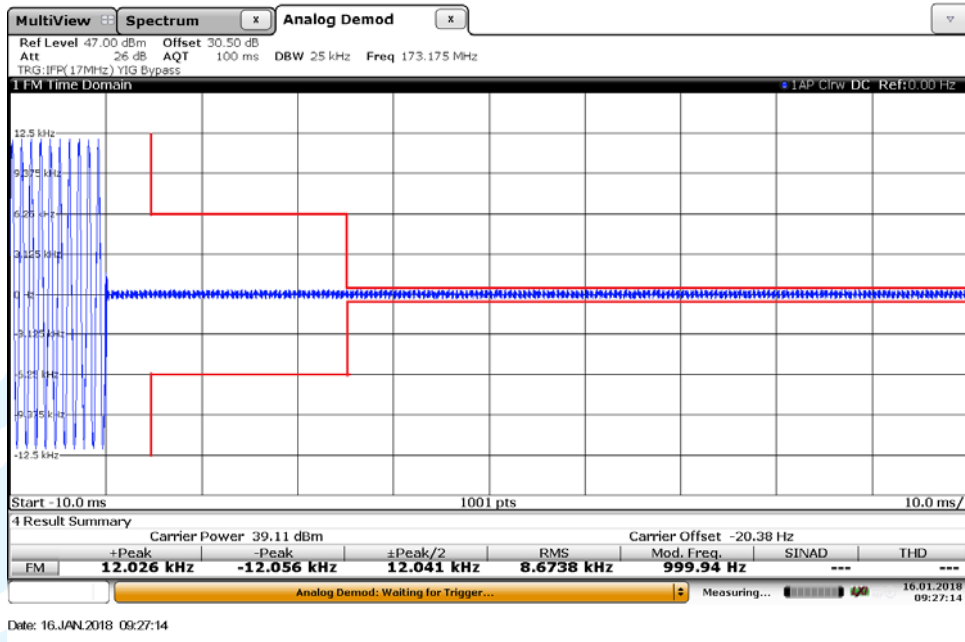
**TEST RESULTS**

**Passed**       **Not Applicable**

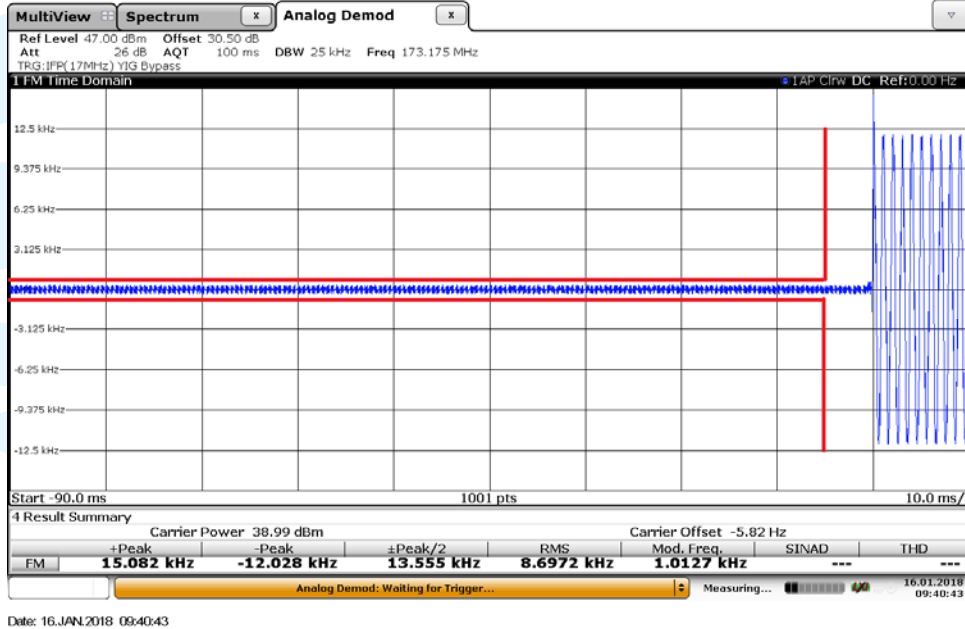
Note: Have pre-tested TX1 to TX6 mode, record the worst case mode TX1, TX3 and TX5 on the report.

FCC Part 74:

Modulation Type: 4FSK(TX1)  
 Transmitter Frequency Behaviour @ 12.5kHz Channel Separation-----Off – On



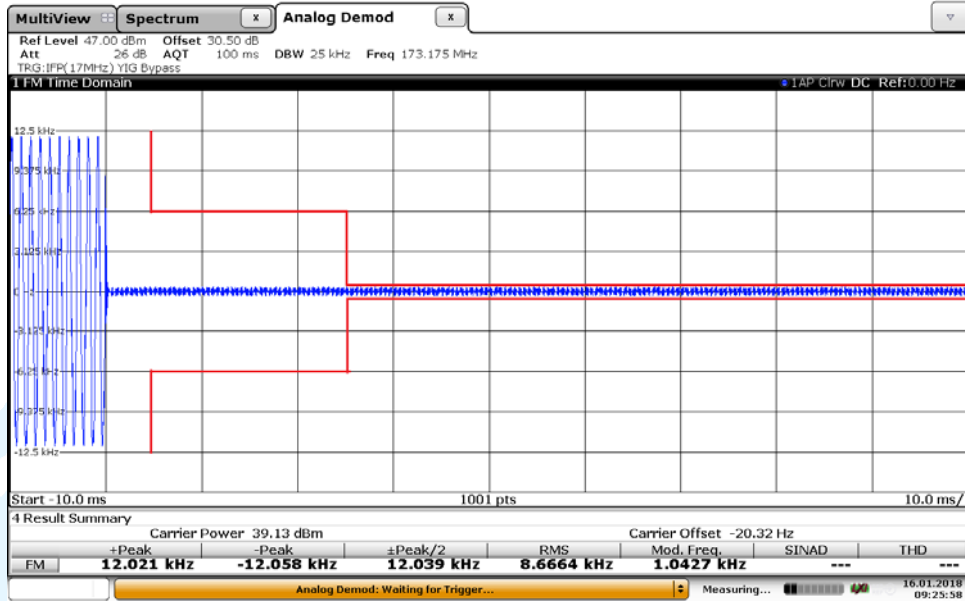
Transmitter Frequency Behaviour @ 12.5kHz Channel Separation-----On – Off



FCC Part 74:

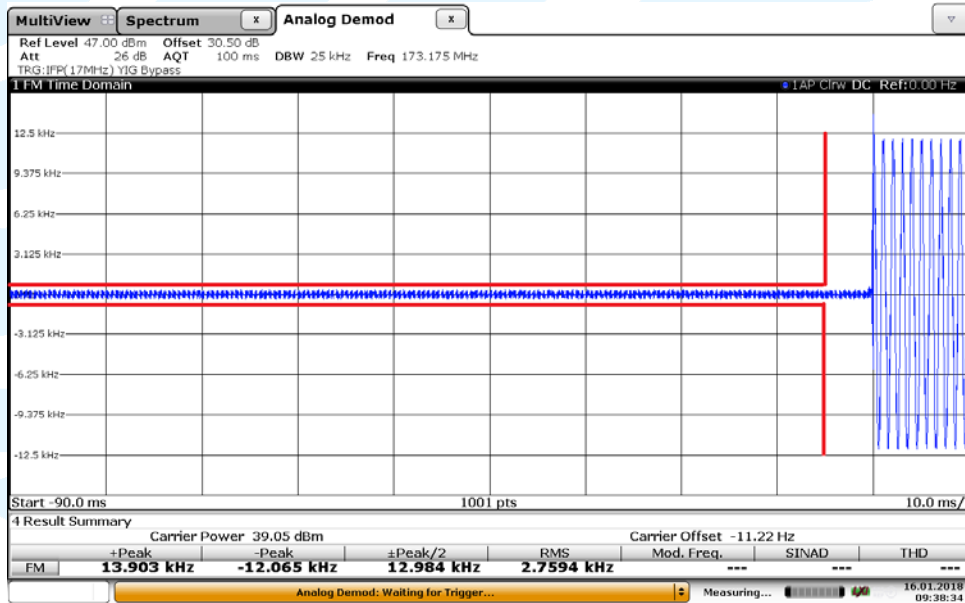
Modulation Type: (TX3)

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



Date: 16.JAN.2018 09:25:58

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

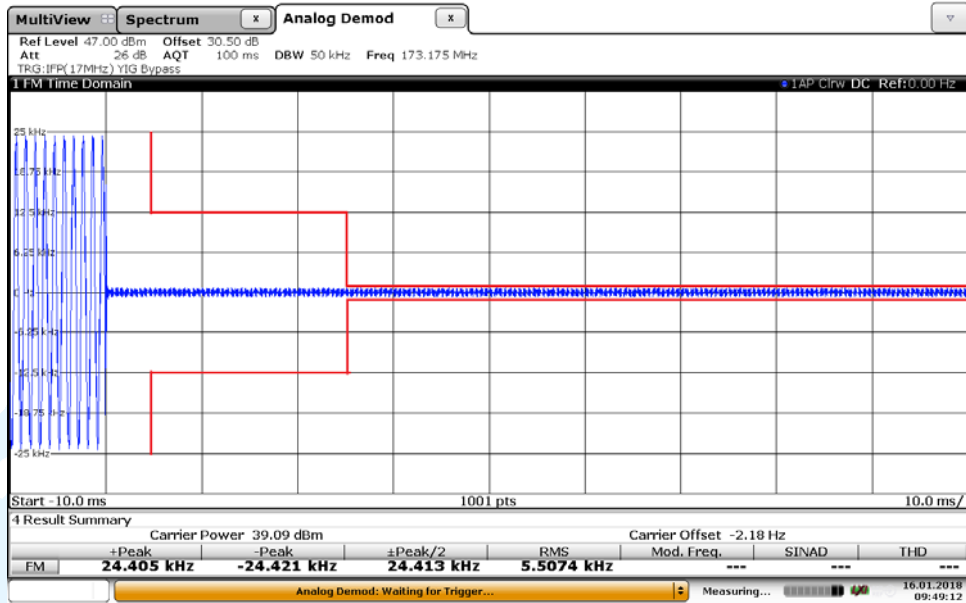


Date: 16.JAN.2018 09:38:34



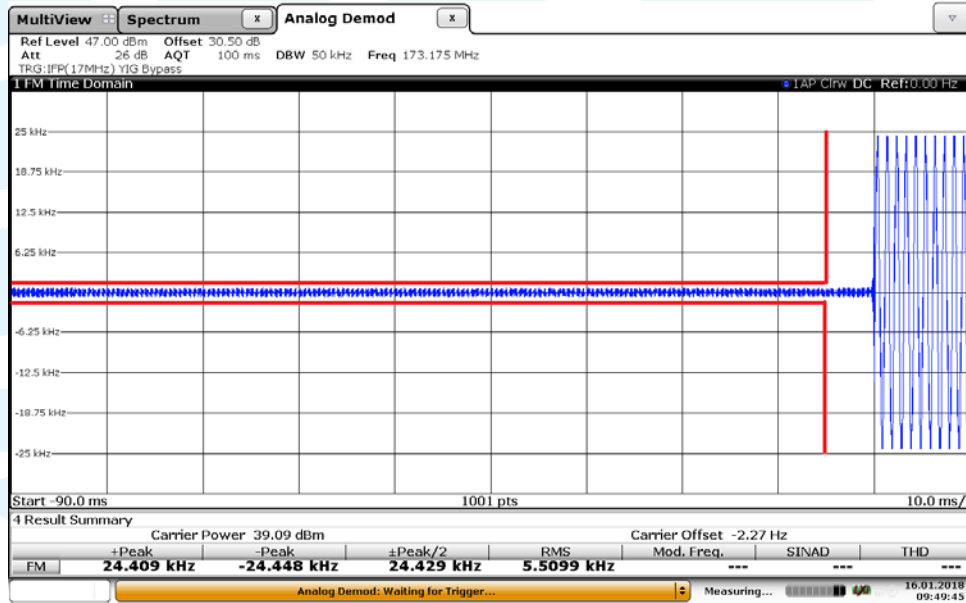
FCC Part 74:

Modulation Type: FM(TX5)  
 Transmitter Frequency Behaviour @ 25kHz Channel Separation-----Off – On



Date: 16.JAN.2018 09:49:12

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



Date: 16.JAN.2018 09:49:45

### 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

$50 + 10 \log (P_{\text{watts}})$

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

$43 + 10 \log (P_{\text{watts}})$

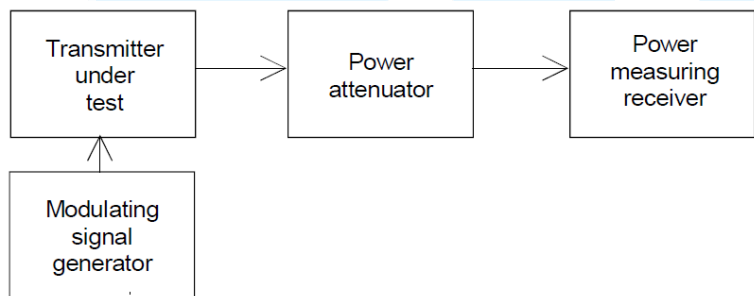
Calculation: Limit (dBm) =EL-43-10log10 (TP)

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 10<sup>th</sup>. 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 10<sup>th</sup> Harmonic.
4. The audio input was set the unmodulated carrier, the resulting picture is print out for each channel separation.

**TEST MODE:**

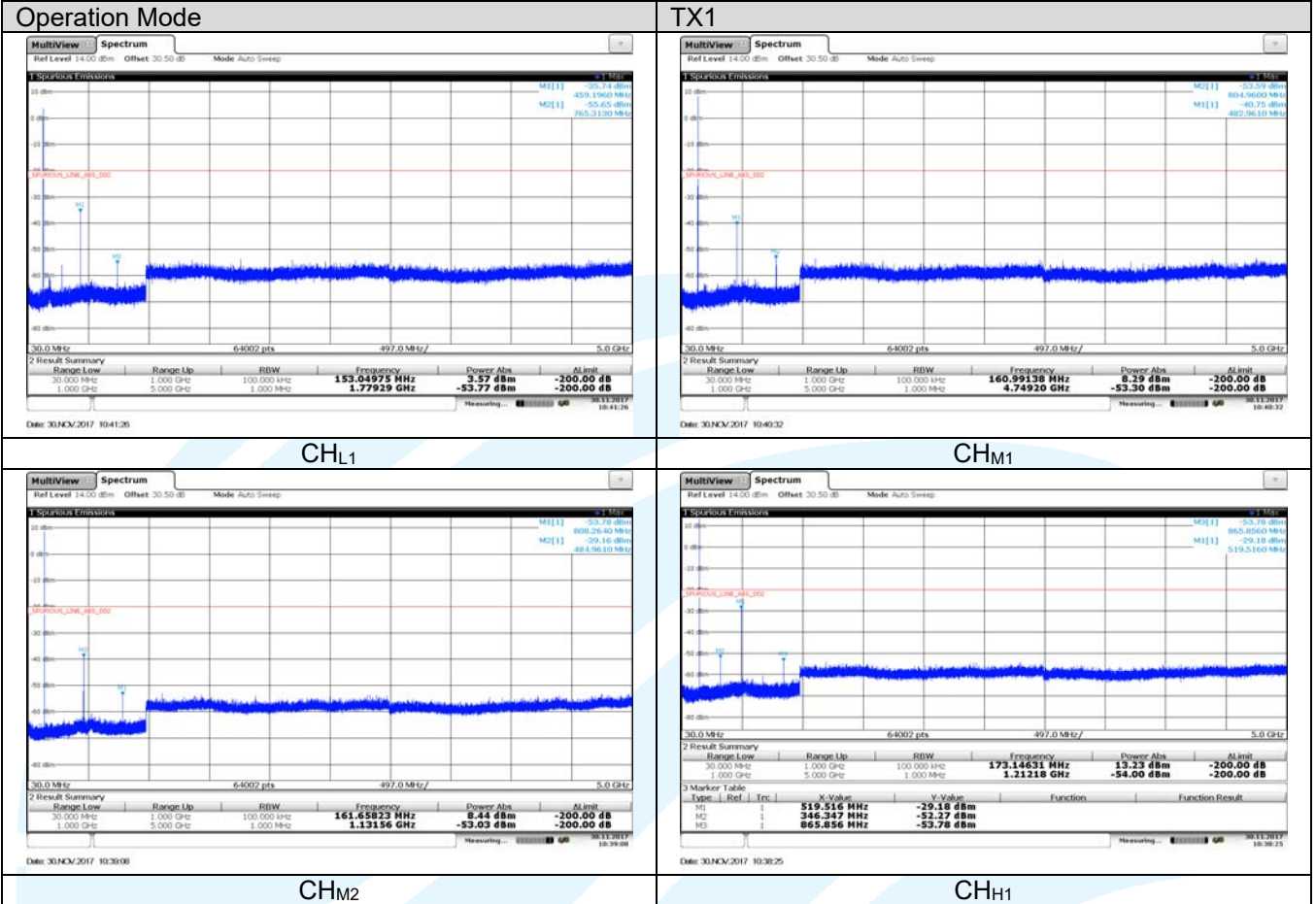
Please reference to the section 3.4

**TEST RESULTS**

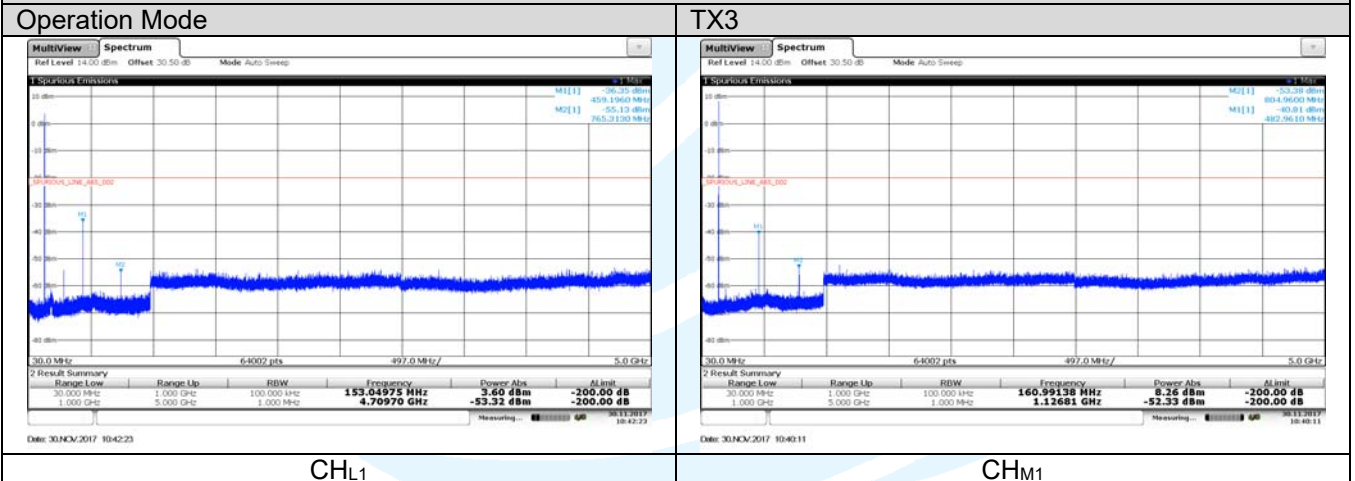
Passed       Not Applicable

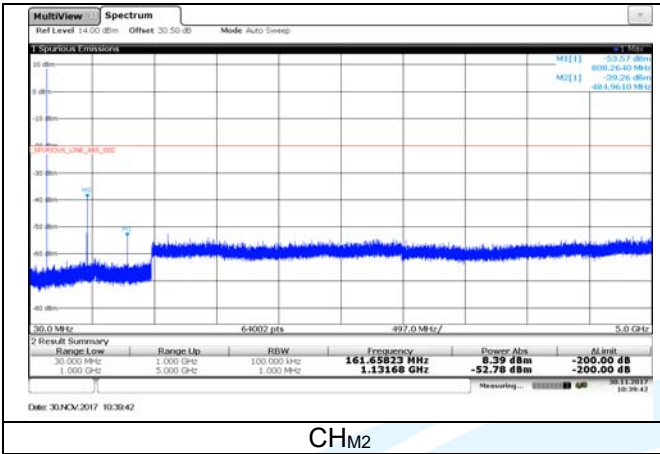
1. The measurement frequency range from 30 MHz to 5 GHz.
2. We tested TX1 to TX6 recorded worst case TX1, TX3 and TX5.

## FCC Part 74

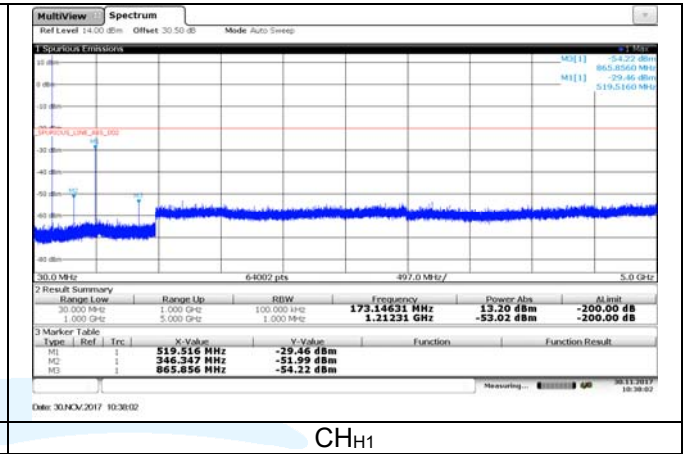


## FCC Part 74





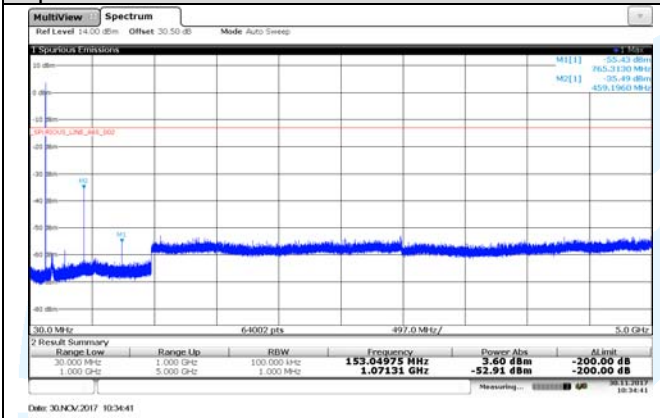
CHM2



CHH1

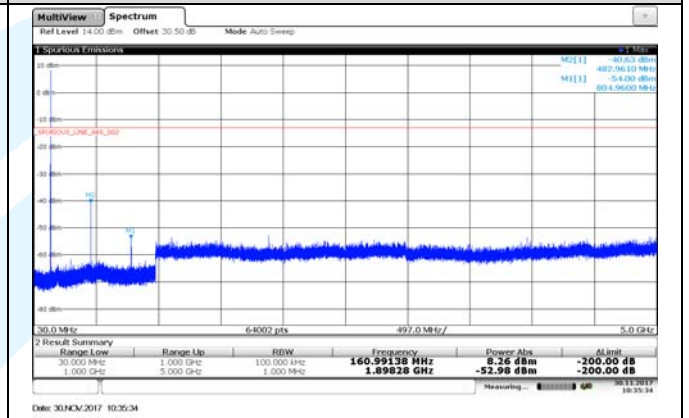
## FCC Part 74

### Operation Mode

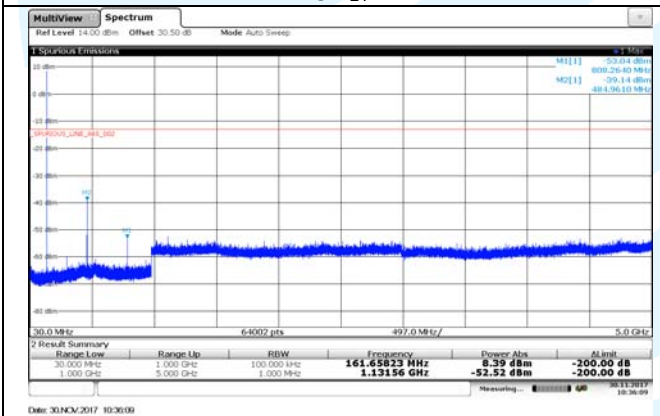


CHL1

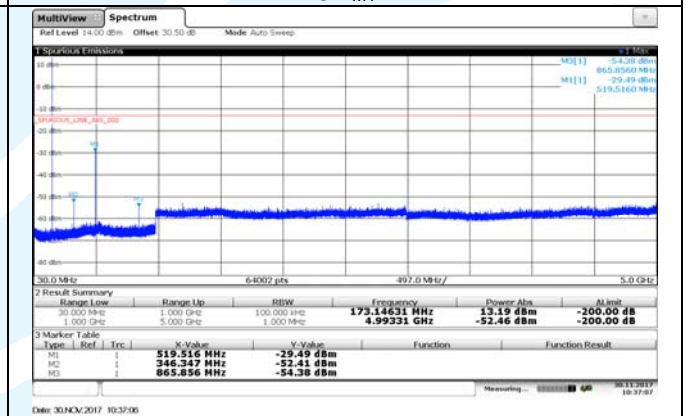
### TX5



CHM1



CHM2



CHH1