



TEST REPORT

Report Reference No. : TRE1709010001 R/C.....: 88182
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 22/FCC Part 80**
Date of receipt of test sample.....: June 12, 2017
Date of testing.....: Sep. 26, 2017 – Oct. 19, 2017
Date of issue.....: Oct. 20, 2017
Result: **PASS**

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Testing Laboratory Name : **Shenzhen Huatongwei International Inspection Co., Ltd.**

Address : 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, 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 22](#) PUBLIC MOBILE SERVICES

[FCC Part 80](#) STATIONS IN THE MARITIME 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. 20, 2017	Original

2. Test Description

Transmitter Requirement			
Test item	Standards requirement FCC Section(s)	Result	
		Pass	N/A
Maximum Transmitter Power	2.1046, 22.565, 80.215	<input checked="" type="checkbox"/>	
Modulation Limiting	2.1047(b), 80.213	<input checked="" type="checkbox"/>	
Audio Frequency Response	2.1047(a), 80.213(e)	<input checked="" type="checkbox"/>	
Occupied Bandwidth	2.1049, 80.211(f)	<input checked="" type="checkbox"/>	
Emission Mask	2.1049, 80.211(f)	<input checked="" type="checkbox"/>	
Frequency Stability	2.1055, 22.355, 80.209	<input checked="" type="checkbox"/>	
Transmitter Frequency Behavior	-		<input checked="" type="checkbox"/>
Transmitter Radiated Spurious Emission	2.1053, 2.1057, 22.359, 80.211(f)(3)	<input checked="" type="checkbox"/>	
Spurious Emission On Antenna Port	2.1051, 2.1057, 80.211(f)(3)	<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, 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:	<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: 4K17F3E <input checked="" type="checkbox"/> 25kHz Channel Separation: 8K09F3E
	Digital Voice& Data:	<input checked="" type="checkbox"/> 12.5kHz Channel Separation: 7K79FXW <input type="checkbox"/> 6.25kHz Channel Separation: ---
	Digital Data:	<input checked="" type="checkbox"/> 12.5kHz Channel Separation: 7K79FXD <input type="checkbox"/> 6.25kHz Channel Separation: ---
Support data rate:	9.6kbps	
Antenna Type:	External	
Maximum Transmitter Power:	Digital	45.39W for 12.5kHz Channel Separation
	Analog	45.29W for 12.5kHz Channel Separation
		46.88W 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 80					
Mode	Modulation	Channel Separation (kHz)	Operation Frequency Range (MHz)	Test Channel	Test Frequency (MHz)
Analog	FM	25	454~455	CH _{L1}	454.025
			456~460	CH _{M1}	458.025
			462.5375~470	CH _{H1}	465.025

FCC Part 22					
Mode	Modulation	Channel Separation (kHz)	Operation Frequency Range (MHz)	Test Channel	Test Frequency (MHz)
Analog	FM	12.5	454~455	CH _{L2}	454.025
			456~460	CH _{H2}	459.975
		25	454~455	CH _{L2}	454.025
			456~460	CH _{H2}	459.975
Digital	4FSK	12.5	454~455	CH _{L2}	454.025
			456~460	CH _{H2}	459.975

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

Laboratory: Shenzhen Huatongwei International Inspection Co., Ltd.

Address: 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

Phone: 86-755-26748019 Fax: 86-755-26748089

4.2. Test Facility

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

CNAS-Lab Code: L1225

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No.: 3902.01

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory 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-Registration No.: 762235

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 762235.

IC-Registration No.: 5377B-1

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377B-1.

ACA

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our A2LA accreditation.

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

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Huatongwei International Inspection Co., Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen Huatongwei laboratory is reported:

Test Items	Measurement Uncertainty	Notes
Frequency stability	25 Hz	(1)
Transmitter power conducted	0.57 dB	(1)
Transmitter power Radiated	2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	1.60 dB	(1)
Conducted Emission 9KHz-30MHz	3.39 dB	(1)
Radiated Emission 30~1000MHz	4.65 dB	(1)
Radiated Emission 1~18GHz	5.16 dB	(1)
Radiated Emission 18-40GHz	5.54 dB	(1)
Occupied Bandwidth	35 Hz	(1)
FM deviation	25 Hz	(1)
Audio level	0.62 dB	(1)
Low Pass Filter Response	0.76 dB	(1)
Modulation Limiting	0.42 %	(1)
Transient Frequency Behavior	6.8 %	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

4.5. Equipments Used during the Test

Conducted Emission				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Artificial Mains	Rohde&Schwarz	ESH2-Z5	100028	2016/11/13
EMI Test Receiver	Rohde&Schwarz	ESCS 30	100038	2016/11/13
Pulse Limiter	Rohde&Schwarz	ESHSZ2	100044	2016/11/13
EMI Test Software	Rohde&Schwarz	ES-K1 V1.71	N/A	N/A
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
Artificial Mains	Rohde&Schwarz	ESH3-Z6	100210	2016/11/13
Artificial Mains	Rohde&Schwarz	ESH3-Z6	100211	2016/11/13
Test cable	ENVIROFLEX	3651	1101902	2016/11/13

Modulation Characteristic				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
RF Cable	Chengdu E-Microwave	----	----	2016/11/13

Frequency Stability				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
Signal Generator	Rohde&Schwarz	SMT03	100059	2016/11/13
Climate Chamber	ESPEC	EL-10KA	05107008	2016/11/13
RF Cable	Chengdu E-Microwave	----	----	2016/11/13

Transmitter Radiated Spurious Emission				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Ultra-Broadband Antenna	Rohde&Schwarz	HL562	100015	2016/11/13
EMI Test Receiver	Rohde&Schwarz	ESI 26	100009	2016/11/13
RF Test Panel	Rohde&Schwarz	TS / RSP	335015/ 0017	N/A
HORN ANTENNA	Rohde&Schwarz	HF906	100039	2016/11/13
Turntable	ETS	2088	2149	N/A
Antenna Mast	ETS	2075	2346	N/A
EMI Test Software	Rohde&Schwarz	ES-K1 V1.71	N/A	N/A
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
Ultra-Broadband Antenna	ShwarzBeck	VULB9163	538	2016/11/13
Ultra-Broadband Antenna	ShwarzBeck	VULB9163	539	2016/11/13
HORN ANTENNA	ShwarzBeck	9120D	1012	2016/11/13
HORN ANTENNA	ShwarzBeck	9120D	1011	2016/11/13
TURNTABLE	MATURO	TT2.0	----	N/A
ANTENNA MAST	MATURO	TAM-4.0-P	----	N/A
Test cable	Siva Cables Italy	RG 58A/U	W14.02	2016/11/13

Maximum Transmitter Power & Spurious Emission On Antenna Port & Occupied Bandwidth & Emission Mask				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Receiver	Rohde&Schwarz	ESI 26	100009	2016/11/13
Attenuator	R&S	ESH3-22	100449	2016/11/13
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
Digital Radio Test Set	AEROFLEX	3920	299001967	2016/11/13
High-Pass Filter	Anritsu	MP526B	6220875256	2016/11/13
High-Pass Filter	Anritsu	MP526D	6220878392	2016/11/13
Spectrum Analyzer	Agilent	E4407B	MY44210775	2016/11/13
Spectrum Analyzer	Rohde&Schwarz	FSP40	1164.4391.40	2016/11/13
SPECTRUM ANALYZER	Agilent	E4407B	MY44210775	2016/11/13
Attenuator	Chengdu E-Microwave	EMCAXX-10RNZ-3	----	2016/11/13
RF Cable	Chengdu E-Microwave	----	----	2016/11/13
Combiner	Chengdu E-Microwave	EMPD-T-2-180-10-600	----	2016/11/13

Transient Frequency Behavior				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Signal Generator	Rohde&Schwarz	SMT03	100059	2016/11/13
Storage Oscilloscope	Tektronix	TDS3054B	B033027	2016/11/13
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
RF Cable	Chengdu E-Microwave	----	----	2016/11/13

The calibration interval was one year.

5. **TEST CONDITIONS AND RESULTS**

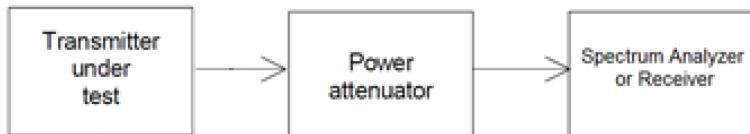
5.1. Maximum Transmitter Power

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 80.215 & 22.565 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 below:

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 80				
Operation Mode	Test Channel	Measured power (dBm)	Measured power (W)	Limit (W)
TX5	CH _{L1}	46.52	44.87	-
	CH _{M1}	46.71	46.88	
	CH _{H1}	46.58	45.50	
TX6	CH _{L1}	36.70	4.68	-
	CH _{M1}	36.79	4.78	
	CH _{H1}	36.83	4.82	

FCC Part 22				
Operation Mode	Test Channel	Measured power (dBm)	Measured power (W)	Limit (W)
TX1	CH _{L2}	46.54	45.08	-
	CH _{H2}	46.57	45.39	
TX2	CH _{L2}	36.80	4.79	-
	CH _{H2}	36.50	4.47	
TX3	CH _{L2}	46.56	45.29	-
	CH _{H2}	46.54	45.08	
TX4	CH _{L2}	37.05	5.07	-
	CH _{H2}	36.74	4.72	
TX5	CH _{L2}	46.55	45.19	-
	CH _{H2}	46.54	45.08	
TX6	CH _{L2}	36.96	4.97	-
	CH _{H2}	36.82	4.81	

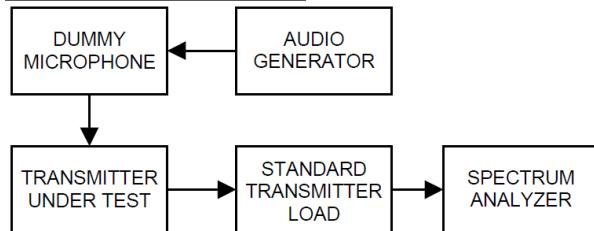
5.2. Occupied Bandwidth

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, 80.211(f) 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

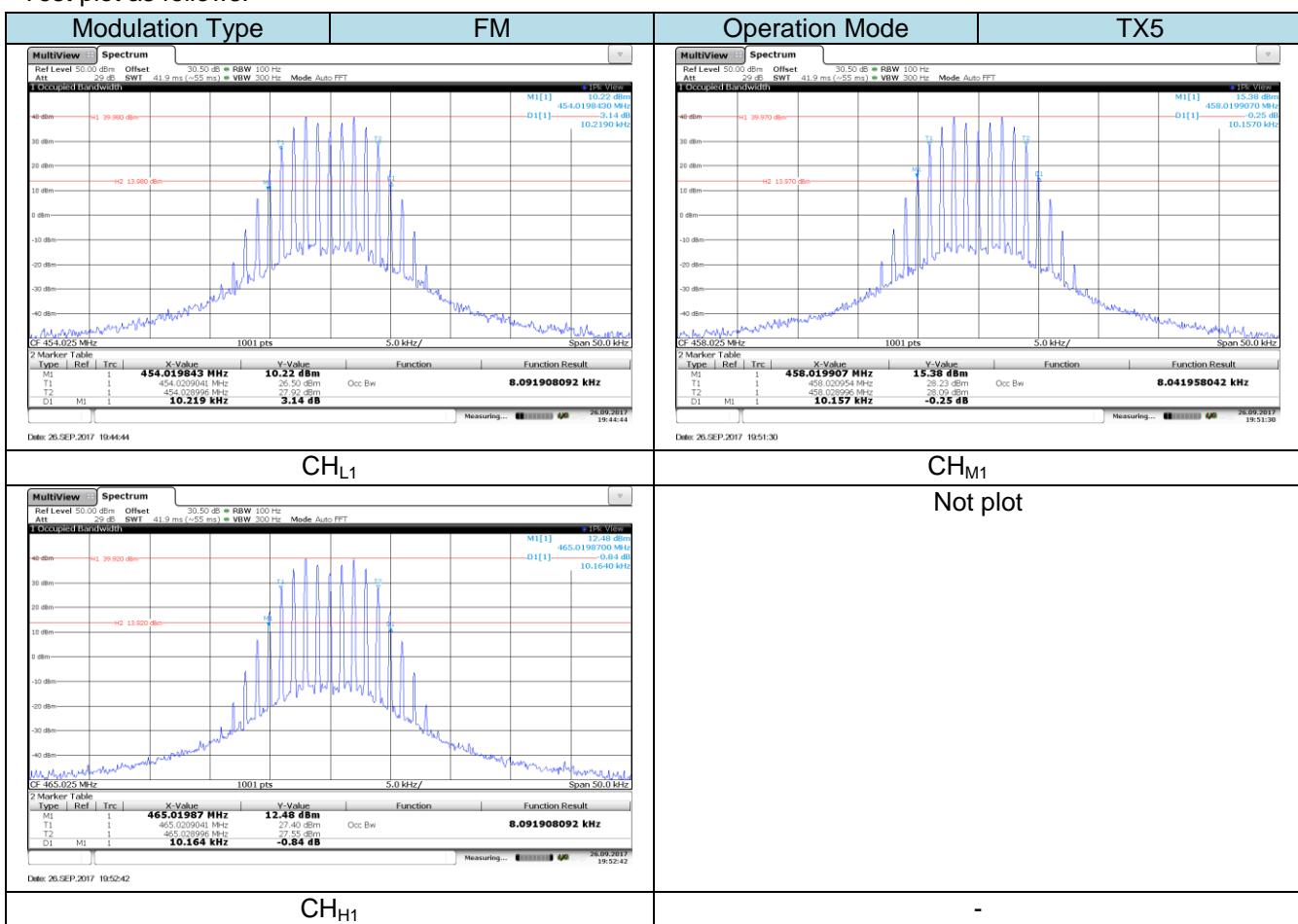
Passed Not Applicable

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

Test plot as follows:

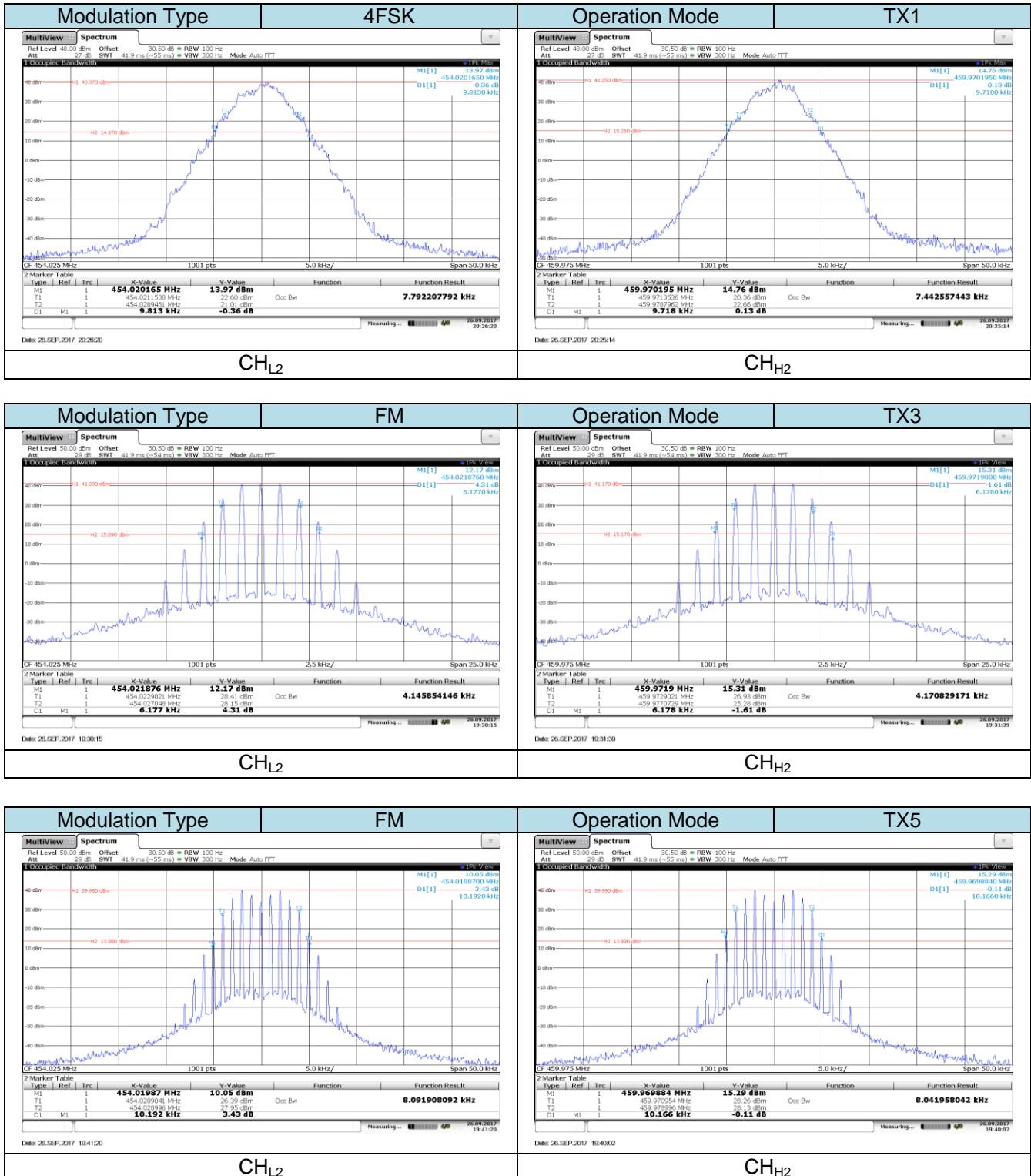
FCC Part 80					
Operation Mode	Test Channel	Occupied Bandwidth (kHz)		Limit(kHz)	Result
		99%	26dB		
TX5	CH _{L1}	8.09	10.219	≤20	Pass
	CH _{M1}	8.04	10.157		
	CH _{H1}	8.09	10.164		

Test plot as follows:



FCC Part 22					
Operation Mode	Test Channel	Occupied Bandwidth (kHz)		Limit(kHz)	Result
		99%	26dB		
TX1	CH _{L2}	7.79	9.813	≤ 11.25	Pass
	CH _{H2}	7.44	9.718		
TX3	CH _{L2}	4.15	6.177	≤ 11.25	Pass
	CH _{H2}	4.17	6.178		
TX5	CH _{L2}	8.09	10.192	≤ 20	Pass
	CH _{H2}	8.04	10.166		

Test plot as follows:



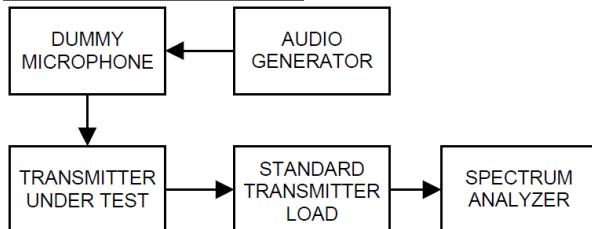
5.3. Emission Mask

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, 80.211(f) for specification details.

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.

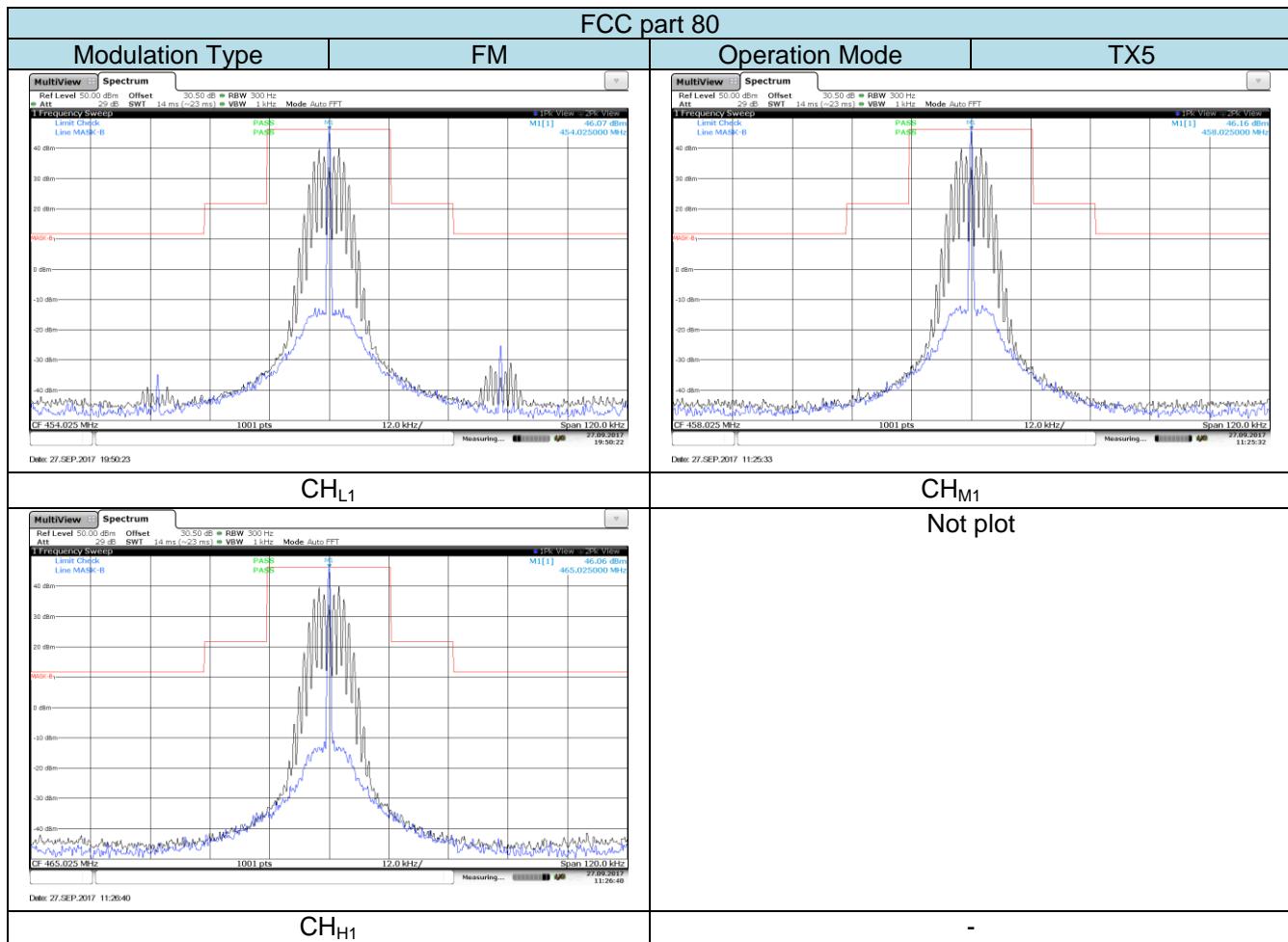
TEST MODE:

Please reference to the section 3.4

TEST RESULTS

Passed Not Applicable

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



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.

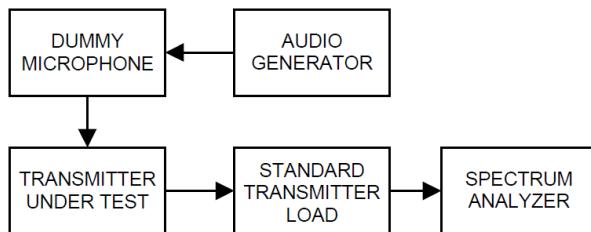
LIMIT

Please refer to FCC 47 CFR 2.1047 (b), 80.213 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 $\geq 15,000$ 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 TX5 to TX6 mode, record the worst case mode TX5 on the report.

FCC Part 80						
TX5: CH _{H1}						
Modulation Level (dB)	Peak frequency deviation (kHz)				Limit (kHz)	Result
	300Hz	1004Hz	1500Hz	2500 Hz		
-20	0.122	0.312	0.467	0.537	5	Pass
-15	0.242	0.602	0.853	0.992		
-10	0.308	1.011	1.412	1.75		
-5	0.763	2.112	2.324	2.686		
0	0.887	3.032	3.871	3.856		
5	1.431	4.113	4.025	3.968		
10	1.815	4.372	4.134	4.095		
15	1.853	4.313	4.152	4.085		
20	1.842	4.342	4.224	4.091		

Test plot as follows:



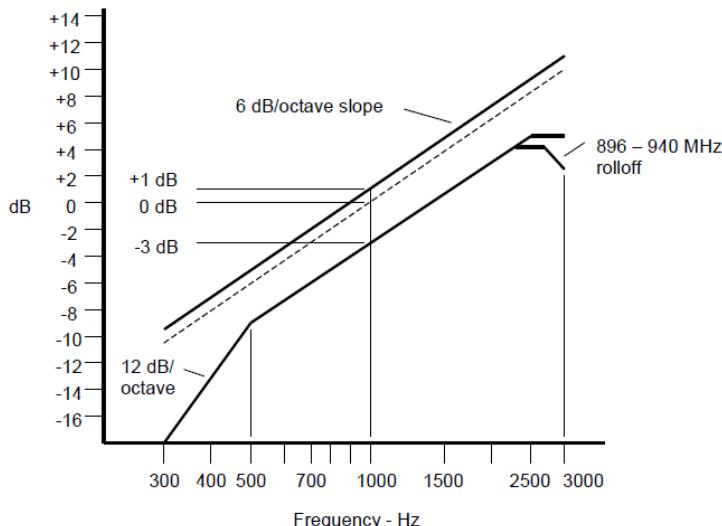
5.5. Audio Frequency Response

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

LIMIT

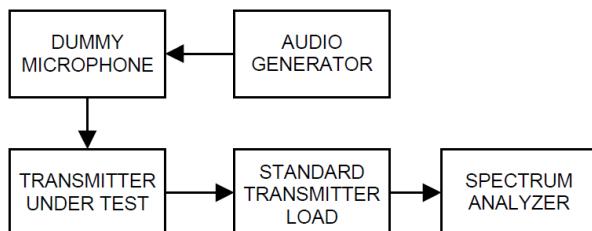
Please refer to FCC 47 CFR 2.1047(a), 80.213(e) for specification details.

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

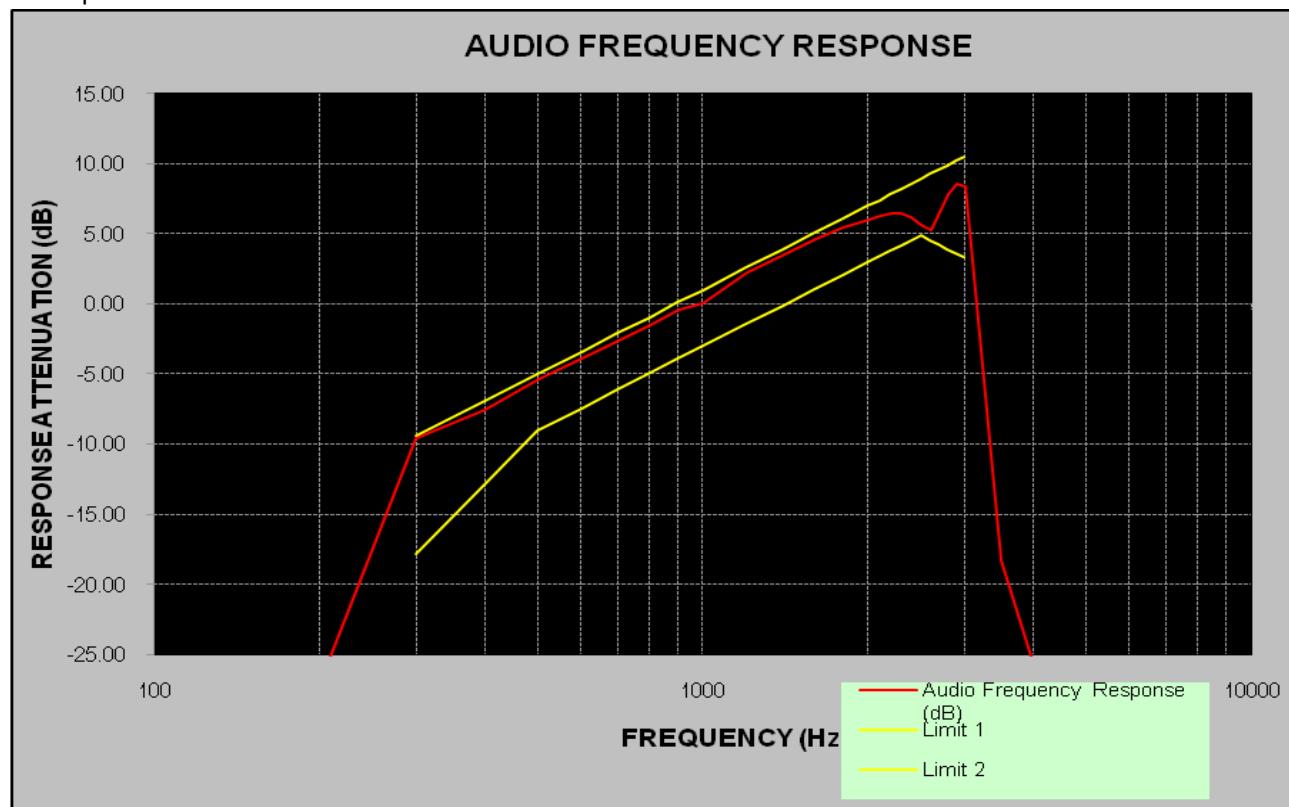
TEST RESULTS

Passed Not Applicable

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

FCC Part 80			
TX5: CH _{H1}			
Frequency (Hz)	Audio Frequency Response (dB)	Frequency (Hz)	Audio Frequency Response (dB)
100	-26.37	2100	6.27
200	-26.95	2200	6.45
300	-9.54	2300	6.42
400	-7.53	2400	6.21
500	-5.39	2500	5.65
600	-3.85	2600	5.23
700	-2.61	2700	6.51
800	-1.47	2800	7.86
900	-0.44	2900	8.55
1000	0.00	3000	8.38
1200	2.24	3500	-18.29
1400	3.56	4000	-25.72
1600	4.61	4500	-25.76
1800	5.44	5000	-26.42
2000	6.03	-	-

Test plot as follows:



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, 22.355, 80.209 for specification details.

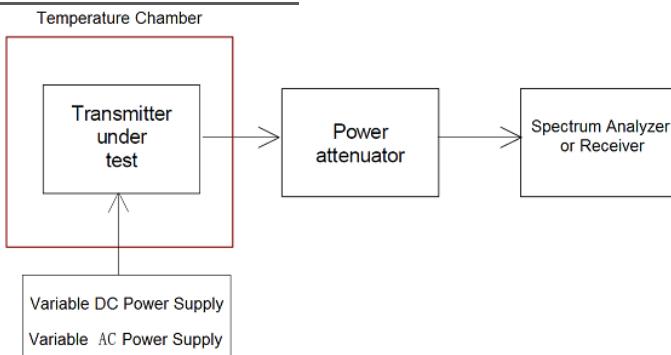
FCC Part 22.355:

Transmitters used must have minimum frequency stability as specified in the following table.

**TABLE C-1—FREQUENCY TOLERANCE FOR
TRANSMITTERS IN THE PUBLIC MOBILE SERVICES**

Frequency range (MHz)	Base, fixed (ppm)	Mobile ≤3 watts (ppm)	Mobile ≤3 watts (ppm)
25 to 50	20.0	20.0	50.0
50 to 450	5.0	5.0	50.0
450 to 512	2.5	5.0	5.0
821 to 896	1.5	2.5	2.5
928 to 929	5.0	n/a	n/a
929 to 960	1.5	n/a	n/a
2110 to 2220	10.0	n/a	n/a

TEST CONFIGURATION



TEST PROCEDURE

- 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.
- 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 manufacturer.
- Vary primary supply voltage from 85% to 115%.
- 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 80						
TX5						
Test conditions		Frequency error (ppm)			Limit (ppm)	Result
Voltage(V)	Temp(°C)	CH _{L1}	CH _{M1}	CH _{H1}		
13.6	-30	-0.04	-0.05	-0.06	±5	Pass
	-20	-0.06	-0.03	-0.04		
	-10	-0.04	-0.05	-0.05		
	0	-0.05	-0.04	-0.07		
	10	-0.04	-0.02	-0.06		
	20	-0.03	-0.01	-0.05		
	30	-0.06	-0.05	-0.06		
	40	-0.05	-0.04	-0.05		
	50	-0.03	-0.02	-0.08		
15.64	20	-0.04	-0.03	-0.07		
11.56	20	-0.03	-0.05	-0.06		

FCC Part 22					
TX1					
Test conditions		Frequency error (ppm)		Limit (ppm)	Result
Voltage(V)	Temp(°C)	CH _{L2}	CH _{H2}		
13.6	-30	-0.13	-0.15	±5	Pass
	-20	-0.11	-0.16		
	-10	-0.16	-0.14		
	0	-0.12	-0.13		
	10	-0.13	-0.14		
	20	-0.14	-0.12		
	30	-0.13	-0.14		
	40	-0.11	-0.16		
	50	-0.15	-0.15		
15.64	20	-0.14	-0.13		
11.56	20	-0.13	-0.15		

FCC Part 22					
TX3					
Test conditions		Frequency error (ppm)		Limit (ppm)	Result
Voltage(V)	Temp(°C)	CH _{L2}	CH _{H2}		
13.6	-30	0.03	0.05	±5	Pass
	-20	-0.02	0.04		
	-10	-0.05	0.04		
	0	-0.03	0.03		
	10	-0.01	0.04		
	20	0.00	0.03		
	30	0.01	0.05		
	40	0.02	0.02		
	50	-0.01	0.04		
15.64	20	-0.01	0.03		
11.56	20	-0.03	0.05		

FCC Part 22					
TX5					
Test conditions		Frequency error (ppm)		Limit (ppm)	Result
Voltage(V)	Temp(°C)	CH _{L2}	CH _{H2}		
13.6	-30	0.03	0.05	±5	Pass
	-20	-0.02	0.06		
	-10	0.02	0.03		
	0	0.01	0.05		
	10	-0.03	0.04		
	20	0.01	0.02		
	30	-0.03	0.04		
	40	0.02	0.05		
	50	-0.02	0.03		
15.64	20	0.03	0.04		
11.56	20	0.01	0.03		

5.7. Transmitter Frequency Behaviour

LIMIT

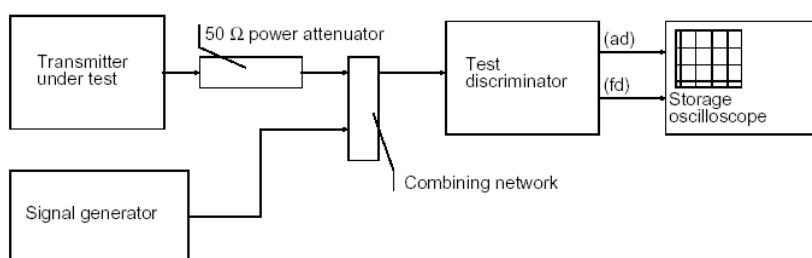
Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

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) t₁ is the time period immediately following ton.
- 2) t₂ is the time period immediately following t₁.
- 3) t₃ 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 t₂ to the beginning of t₃, 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 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 Analyzer. The trace should be maintained within the allowed divisions during the period t_3 .
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

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, 22.359 ,80.211(f)(3) for specification details.

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

FCC Rules	Attenuation Limit (dBc)
§ 22.359	At least $43 + 10 \log (P)$ dB
§ 80.211(f)(3)	At least $43 + 10 \log_{10}$ (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) = $\text{EL} - 50 - 10 \log_{10} (\text{TP})$

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

In this application, the EL is P(dBm)

Limit (dBm) = $P(\text{dBm}) - 50 - 10 \log (P_{\text{watts}}) = -20 \text{ dBm}$

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

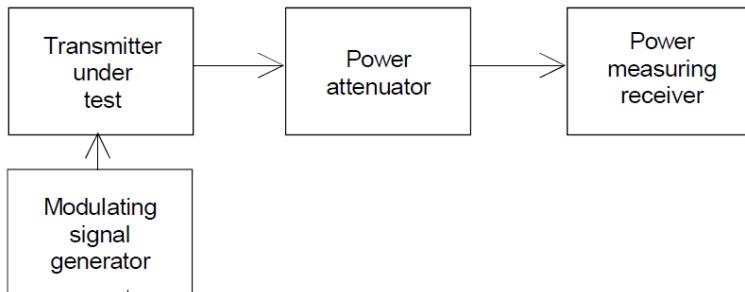
Calculation: Limit (dBm) = $\text{EL} - 43 - 10 \log_{10} (\text{TP})$

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

In this application, the EL is P(dBm).

Limit (dBm) = $P(\text{dBm}) - 43 - 10 \log (P_{\text{watts}}) = -13 \text{ dBm}$

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.

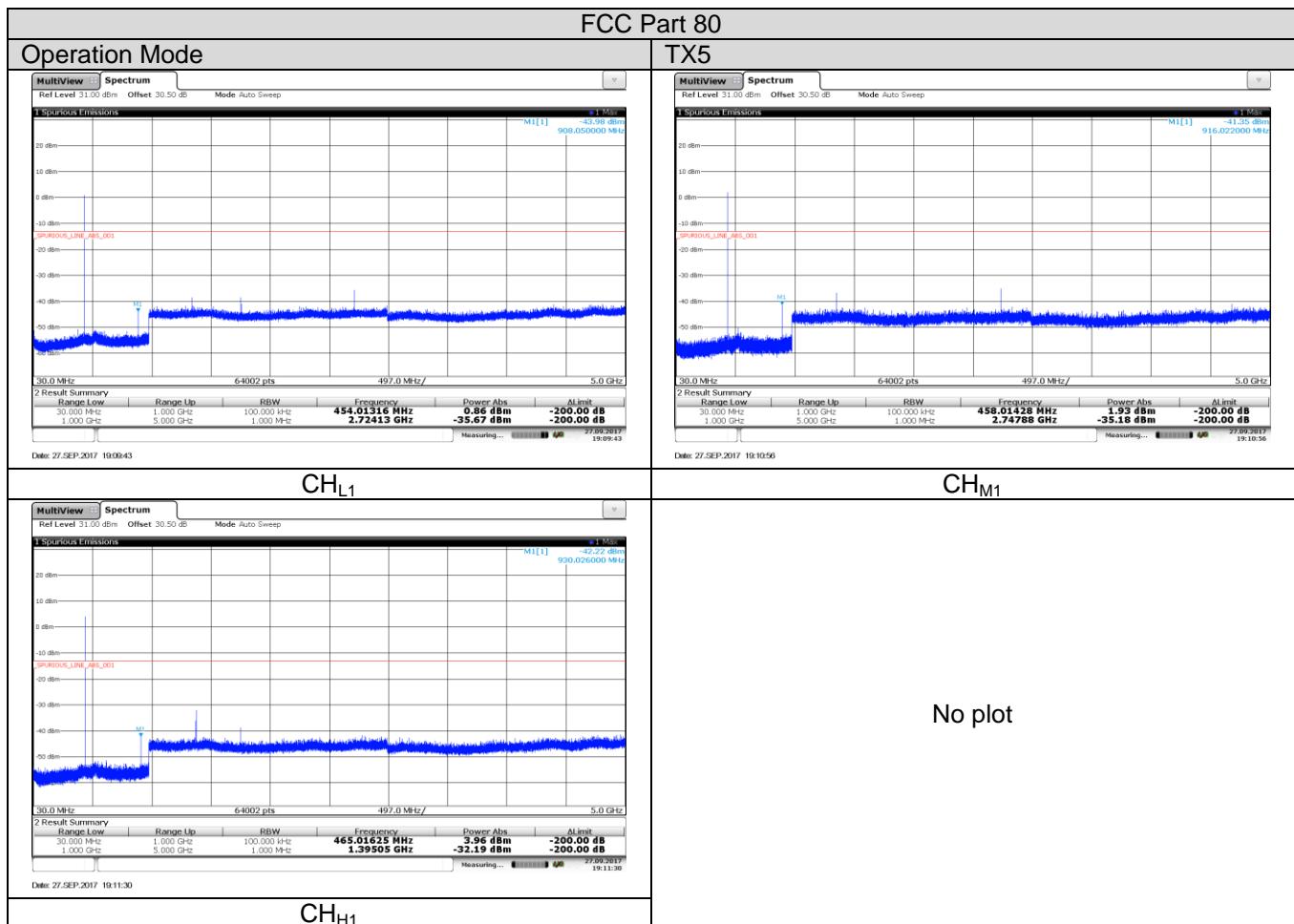
TEST MODE:

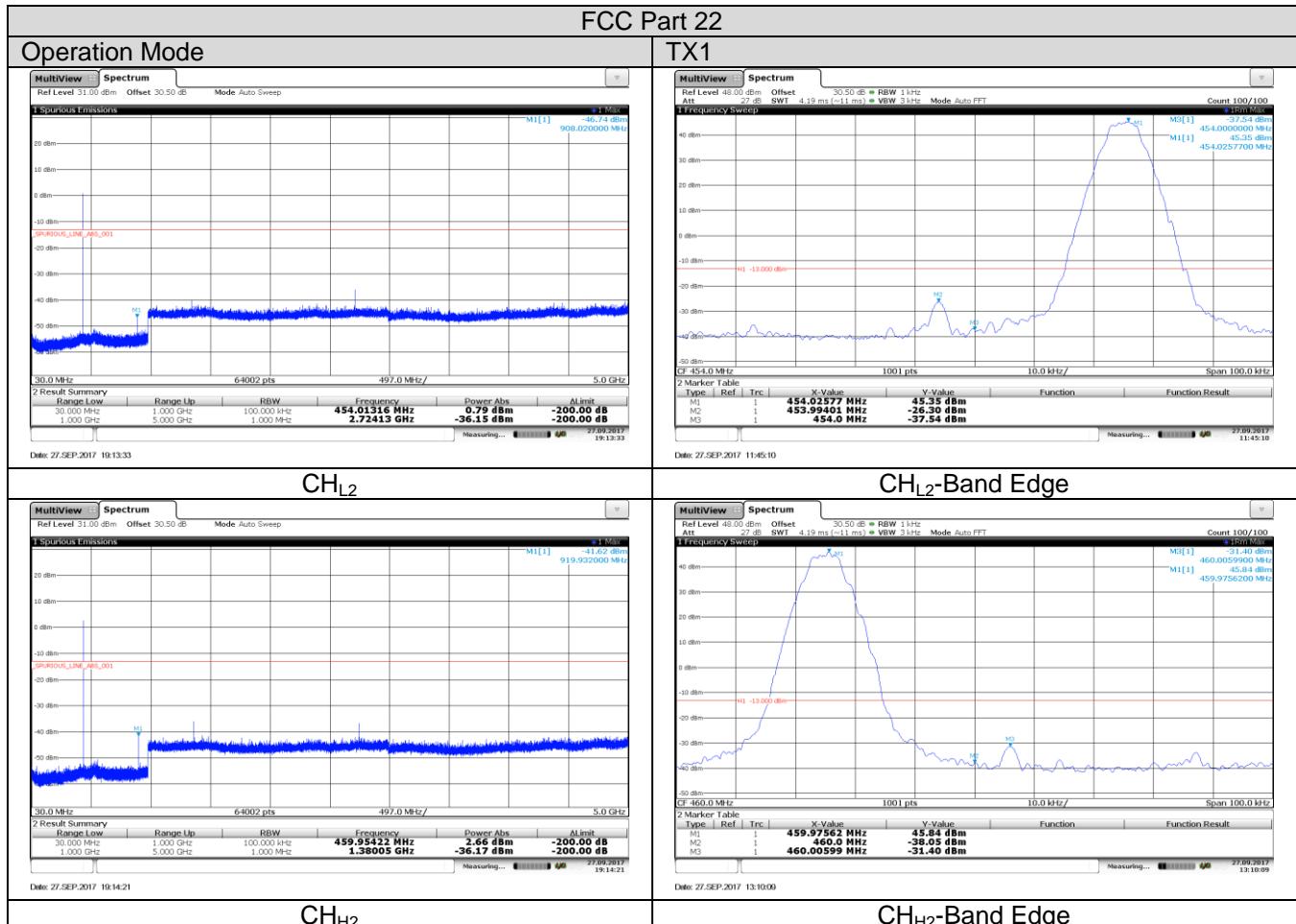
Please reference to the section 3.4

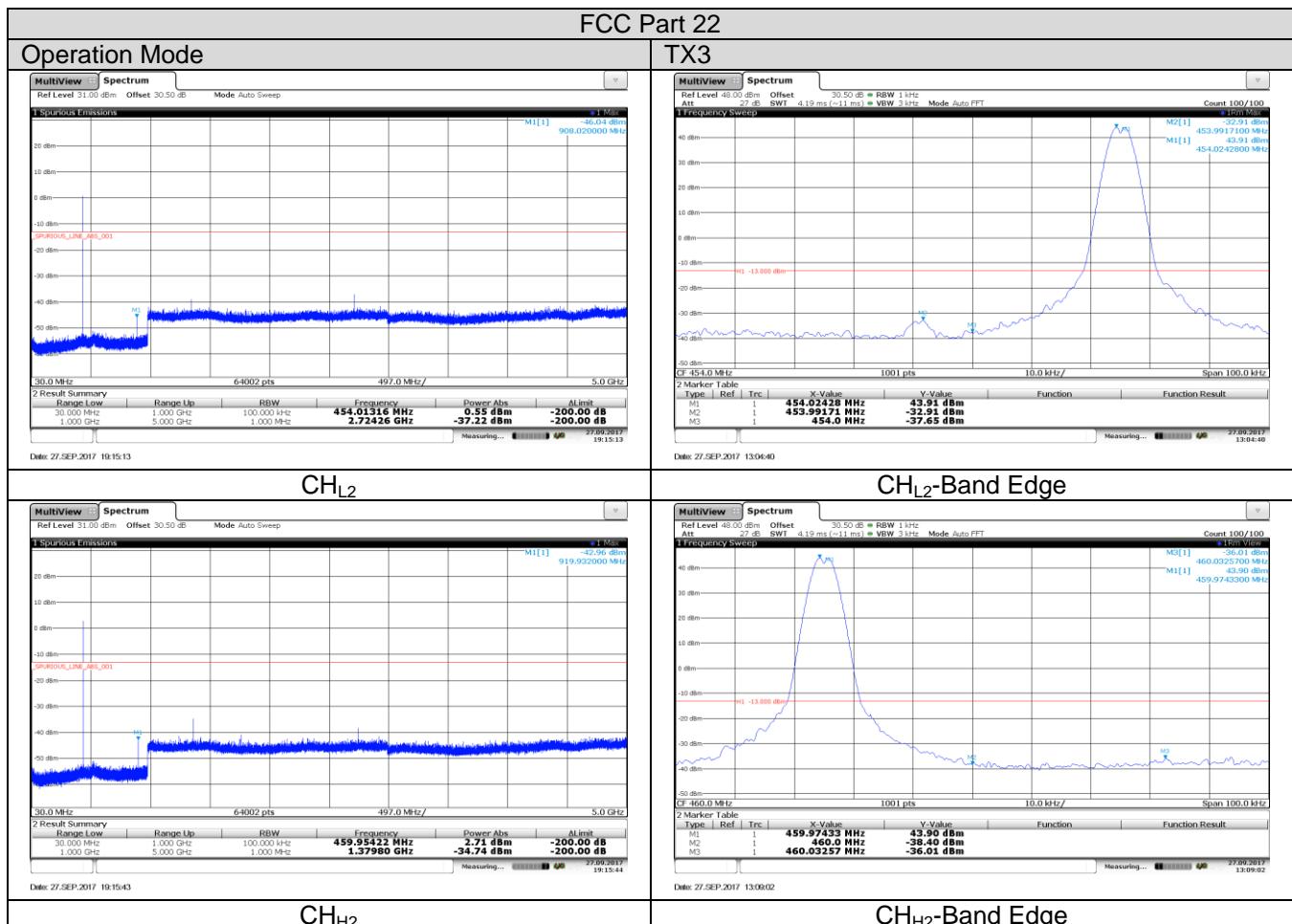
TEST RESULTS

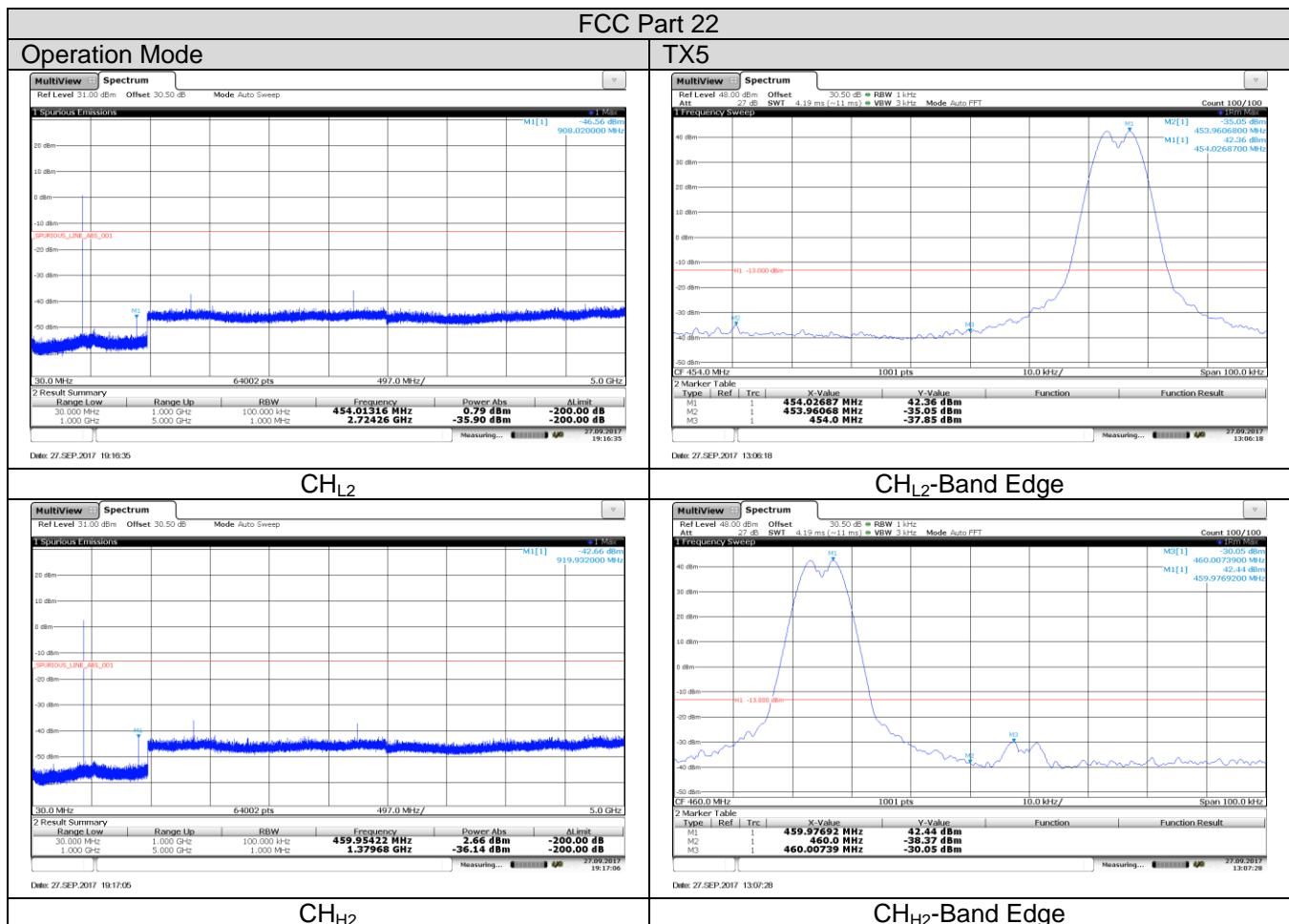
Passed Not Applicable

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









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, 22.359 ,80.211(f)(3) for specification details.

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

FCC Rules	Attenuation Limit (dBc)
§ 22.359	At least $43 + 10 \log (P)$ dB
§ 80.211(f)(3)	At least $43 + 10\log_{10}$ (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) = $\text{EL} - 50 - 10\log_{10} (\text{TP})$

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 (P_{watts}) = -20 dBm

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

Calculation: Limit (dBm) = $\text{EL} - 43 - 10\log_{10} (\text{TP})$

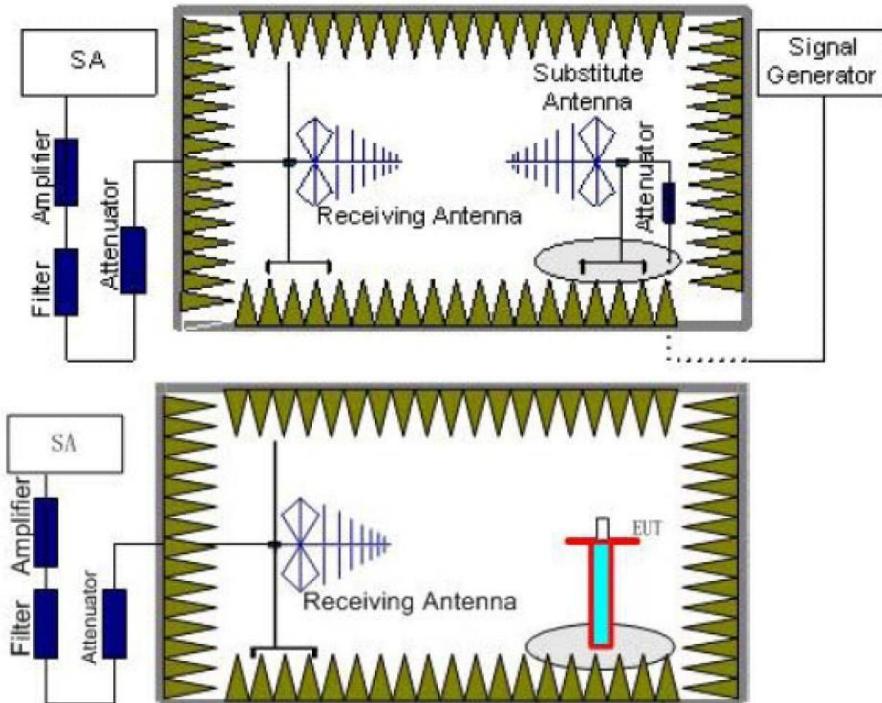
Notes: EL is the emission level of the Output Power expressed in dBm,

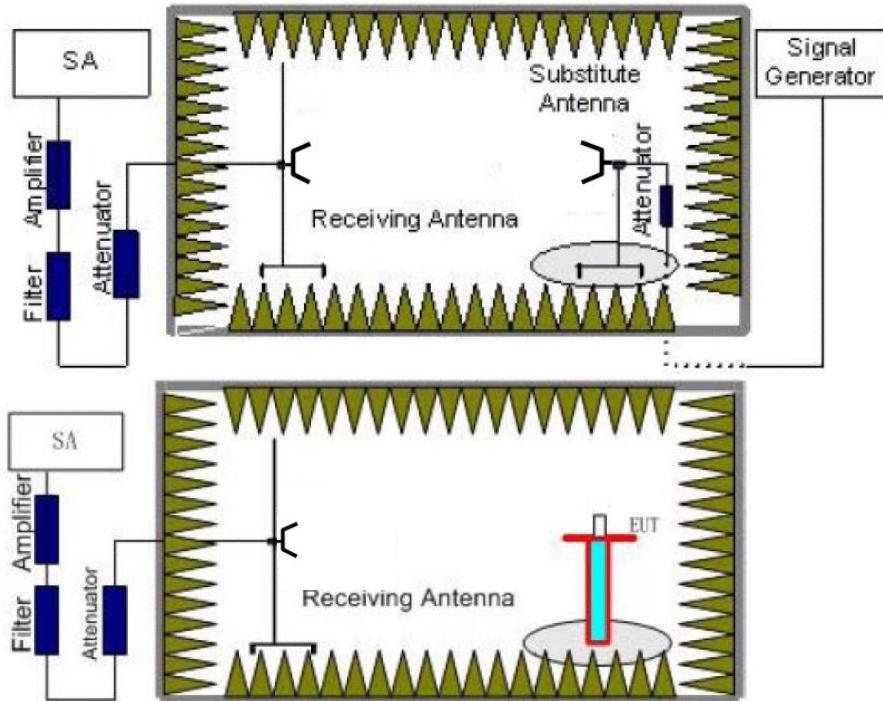
In this application, the EL is P (dBm).

Limit (dBm) = P (dBm) - 43 - 10 log (P_{watts}) = -13 dBm

TEST CONFIGURATION

Below 1GHz:



Above 1GHz:**TEST PROCEDURE**

1. Standard Transmitter Load with a $50\ \Omega$ 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:
$$\text{Power(EIRP)} = \text{PMea} - \text{PAg} - \text{Pcl} - \text{Ga}$$

We used SMF100A microwave signal generator which signal level can up to 33dBm, so we not used power Amplifier for substitution test; The measurement results are amend as described below:
$$\text{Power(EIRP)} = \text{PMea} - \text{Pcl} - \text{Ga}$$
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, $\text{ERP} = \text{EIRP} - 2.15\text{dBi}$.

TEST MODE:

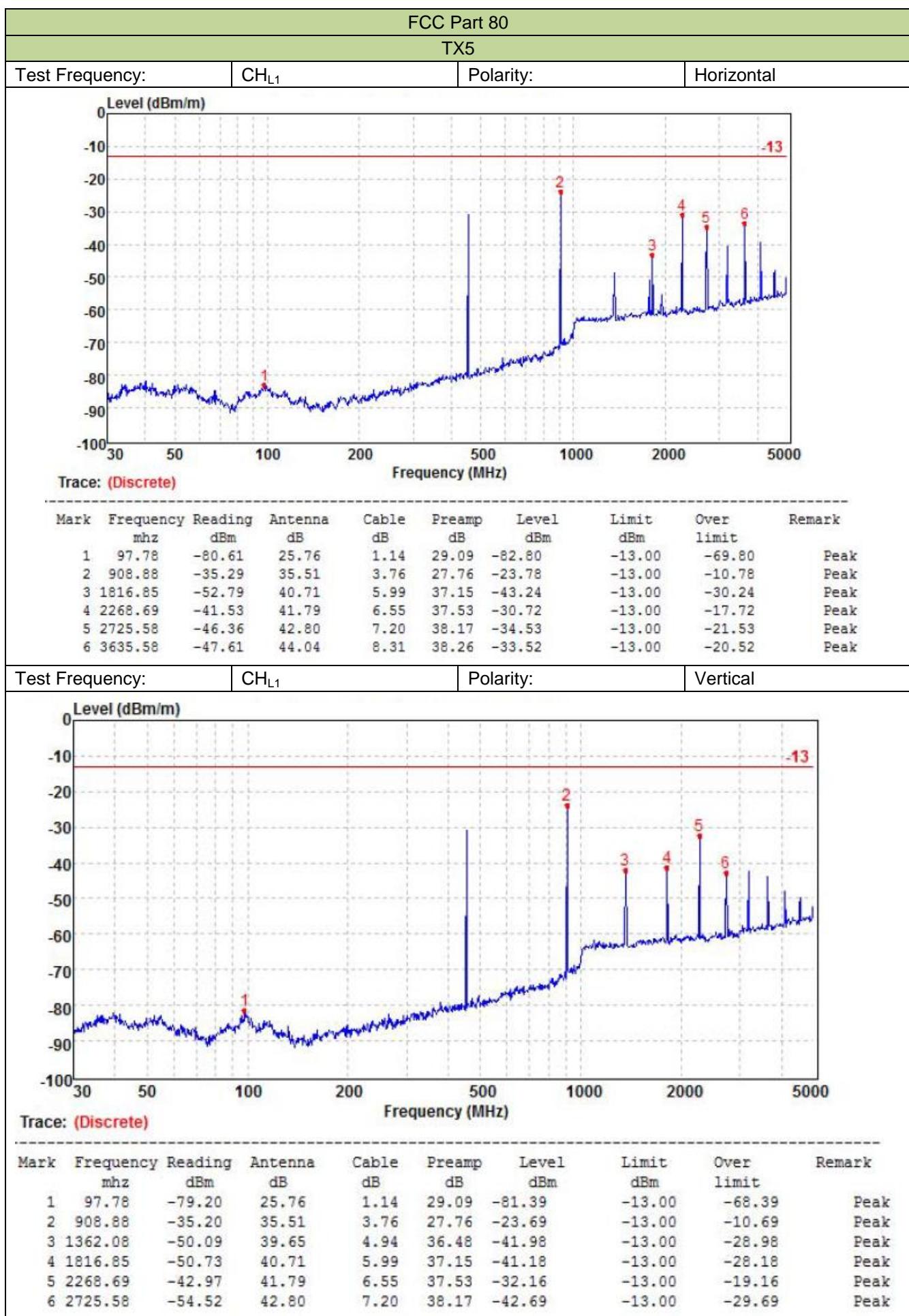
Please reference to the section 3.4

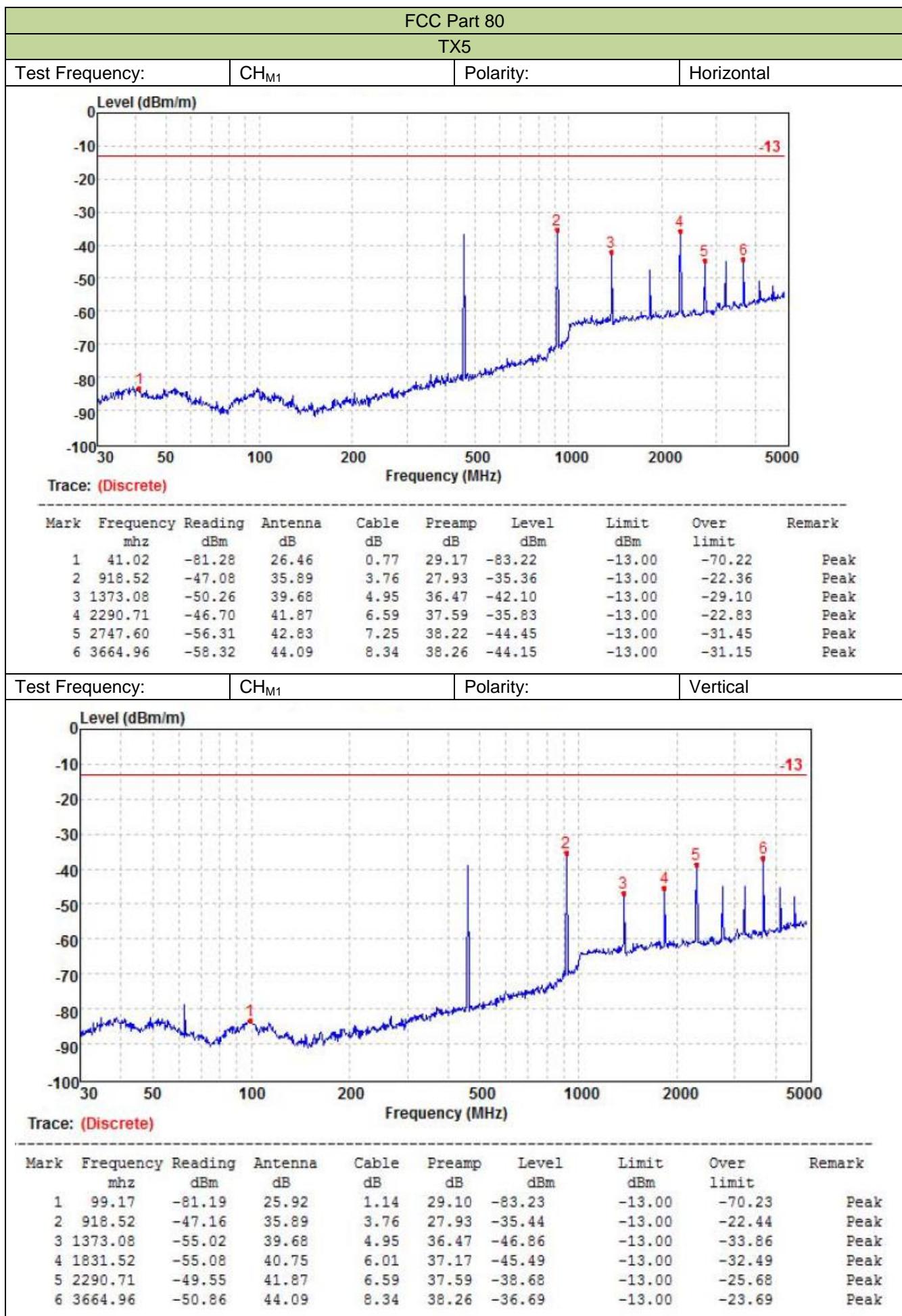
TEST RESULTS

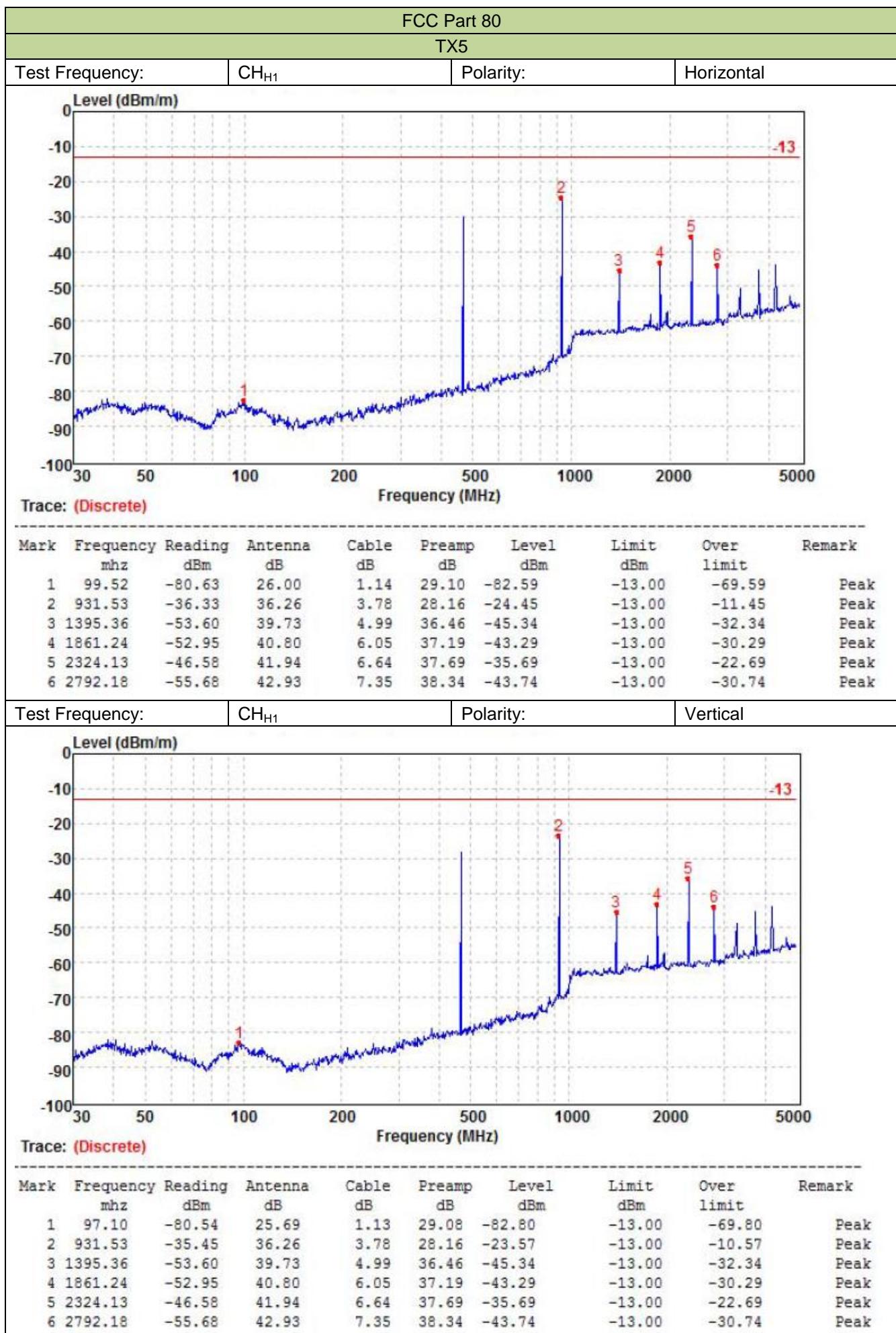
Passed **Not Applicable**

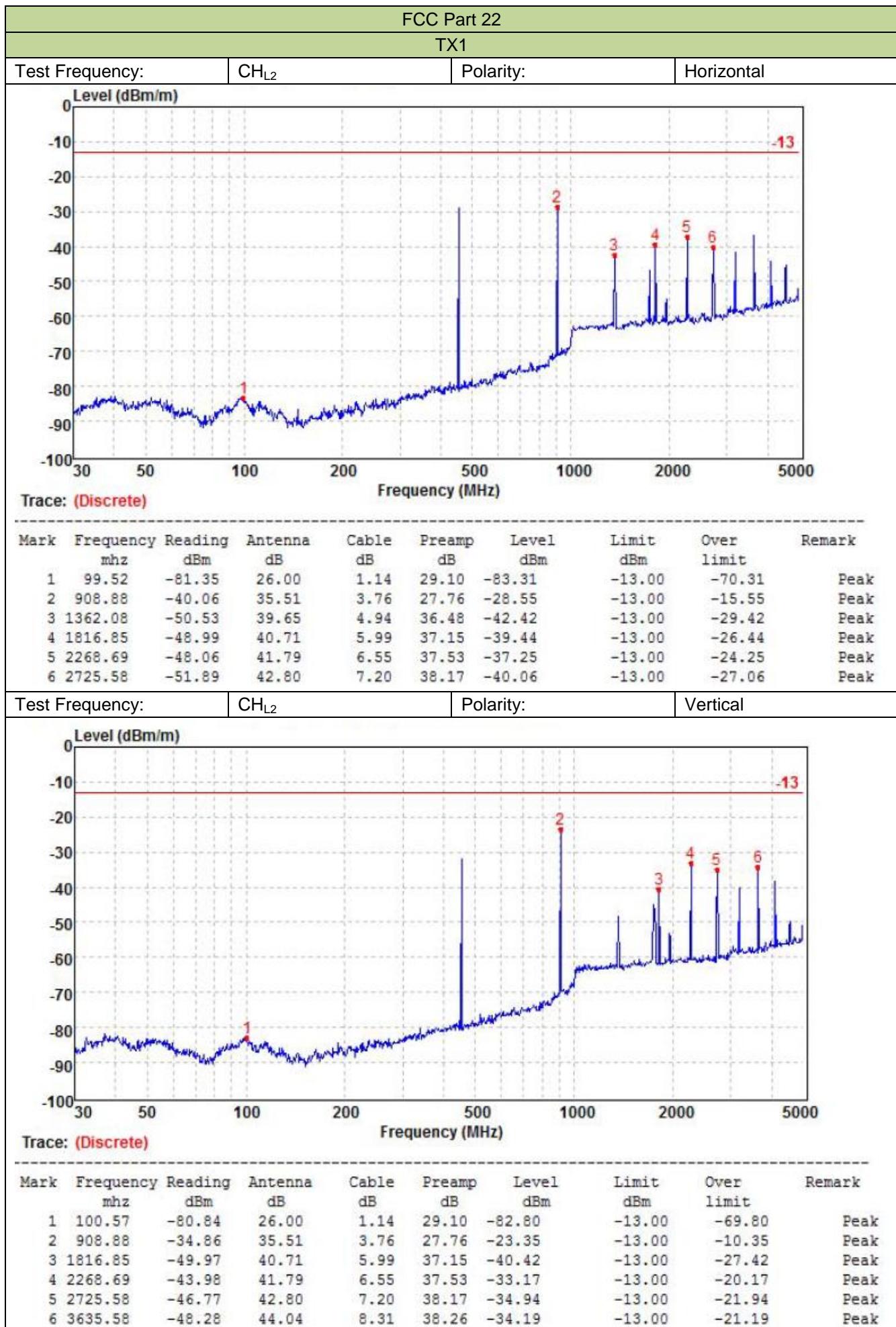
Note:

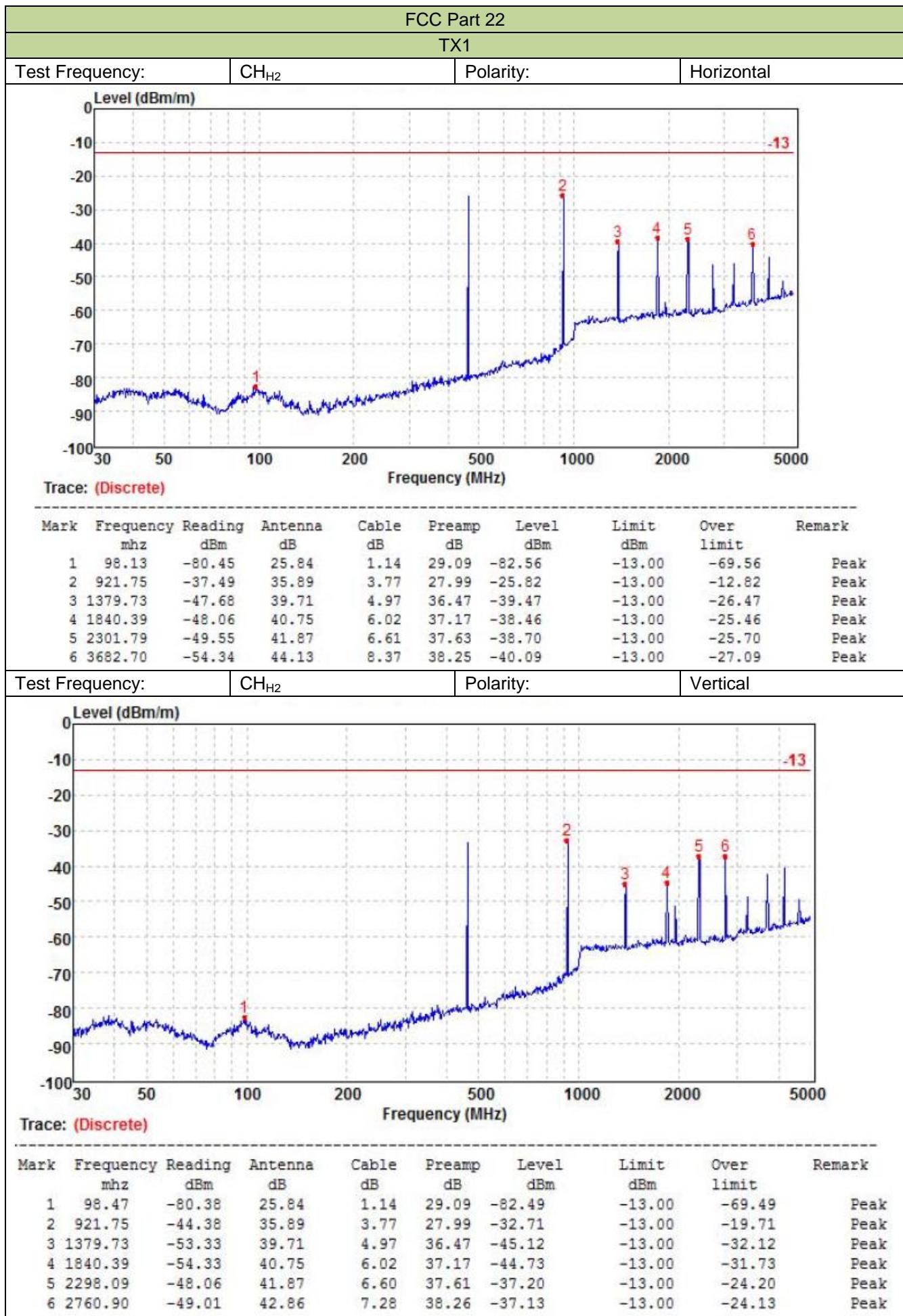
1. In general, the worse case attenuation requirement shown above was applied.
2. The measurement frequency range from 30 MHz to 5 GHz.
3. We tested TX1 to TX6 recorded worst case TX1,TX3 and TX5.

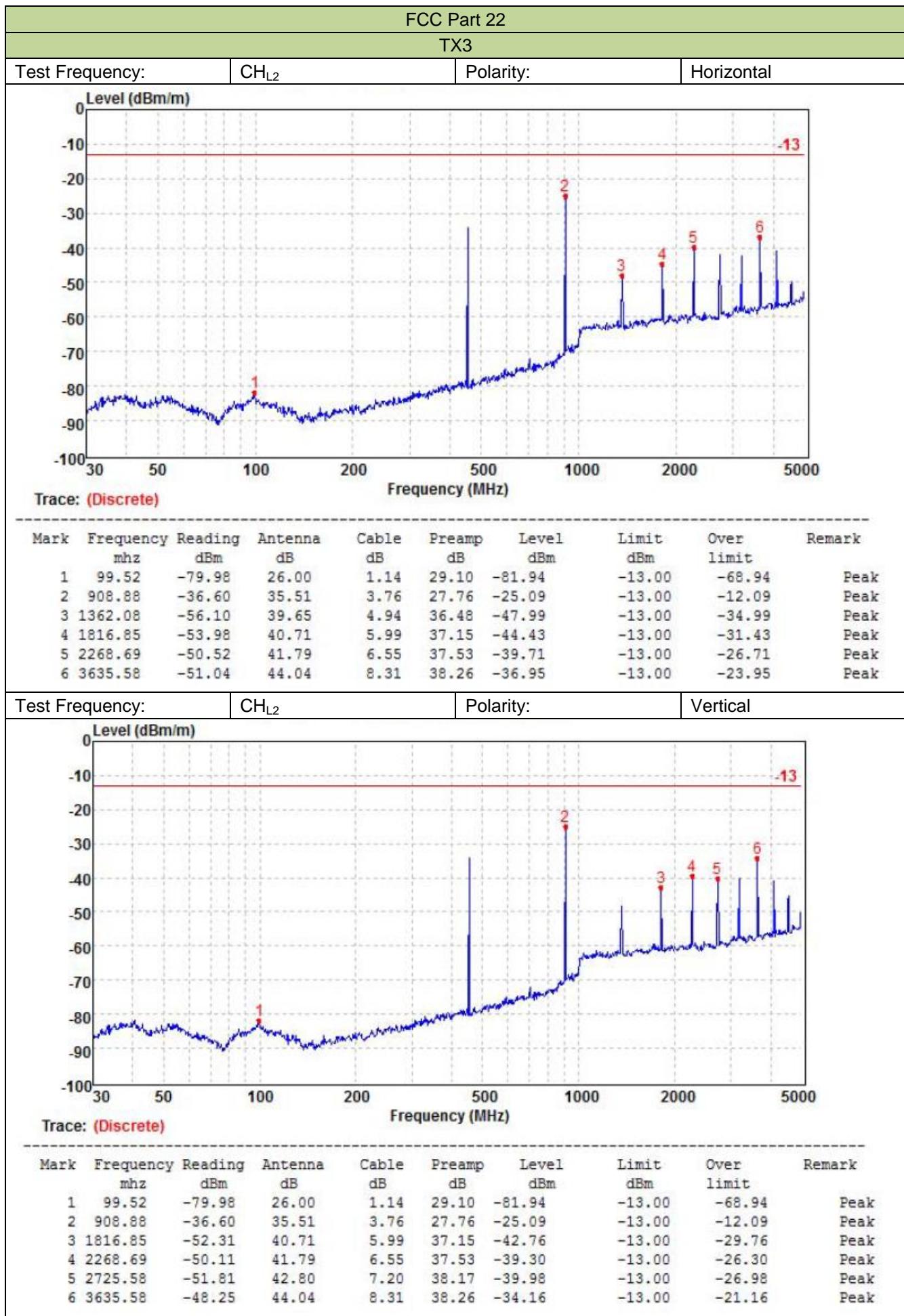


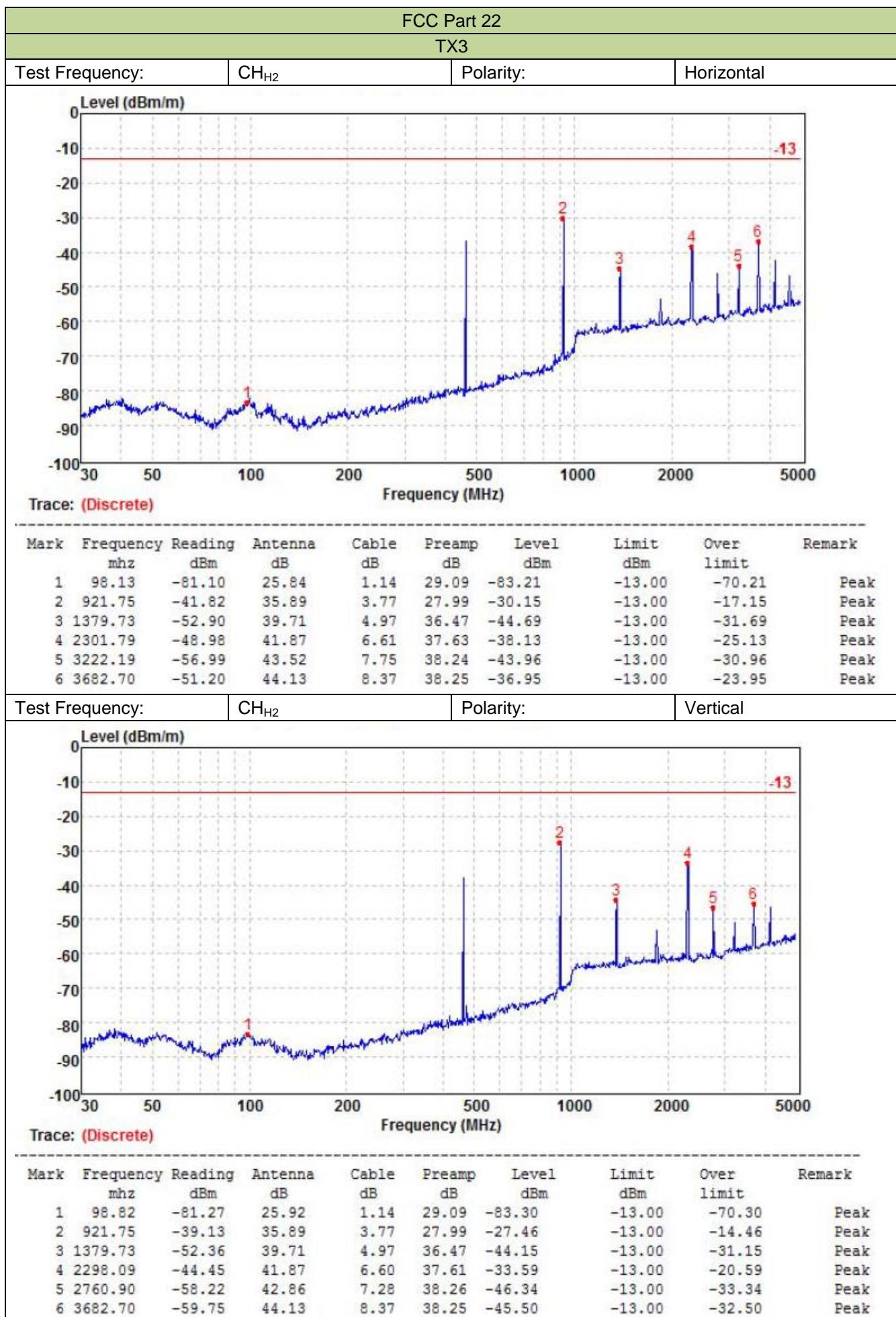


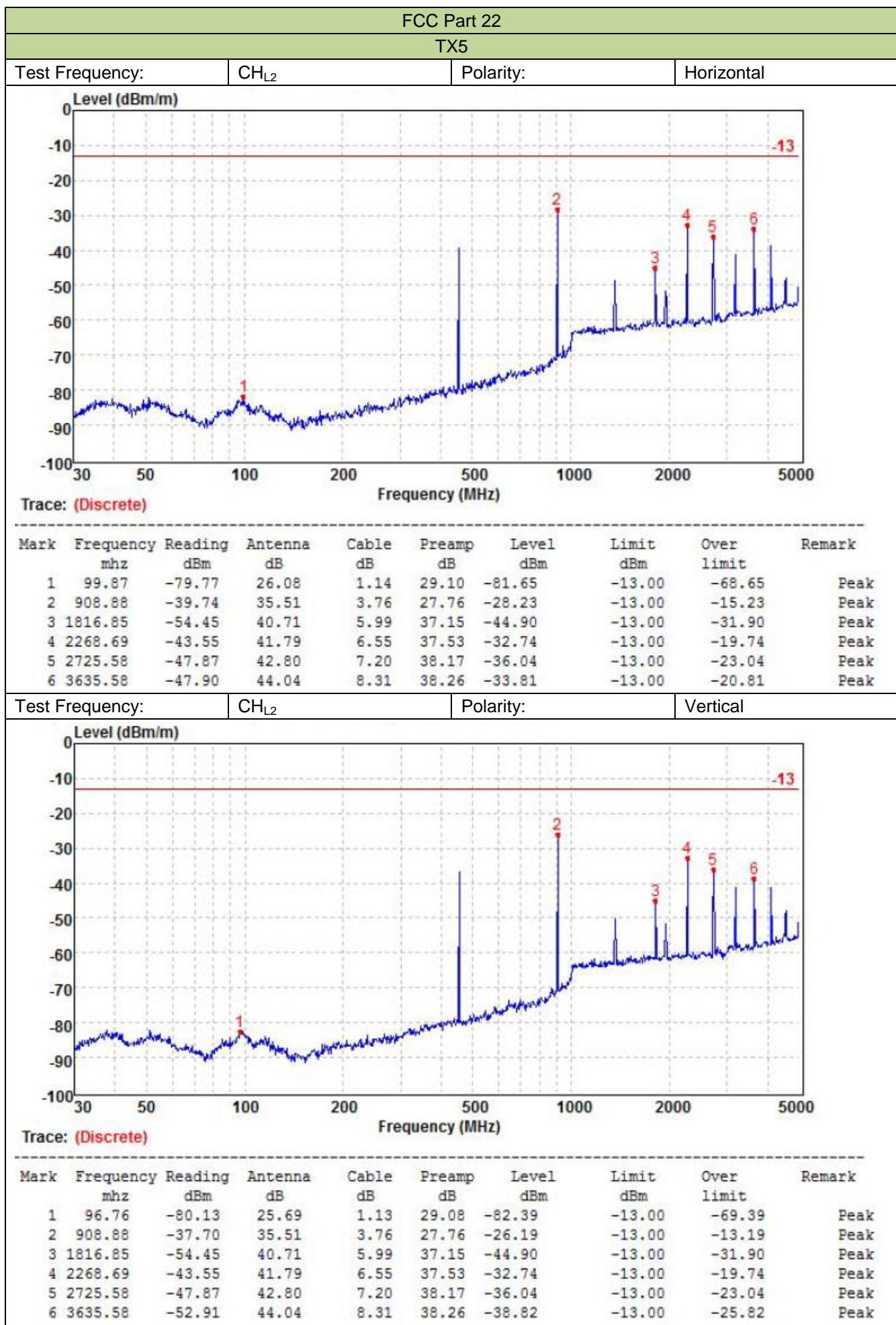


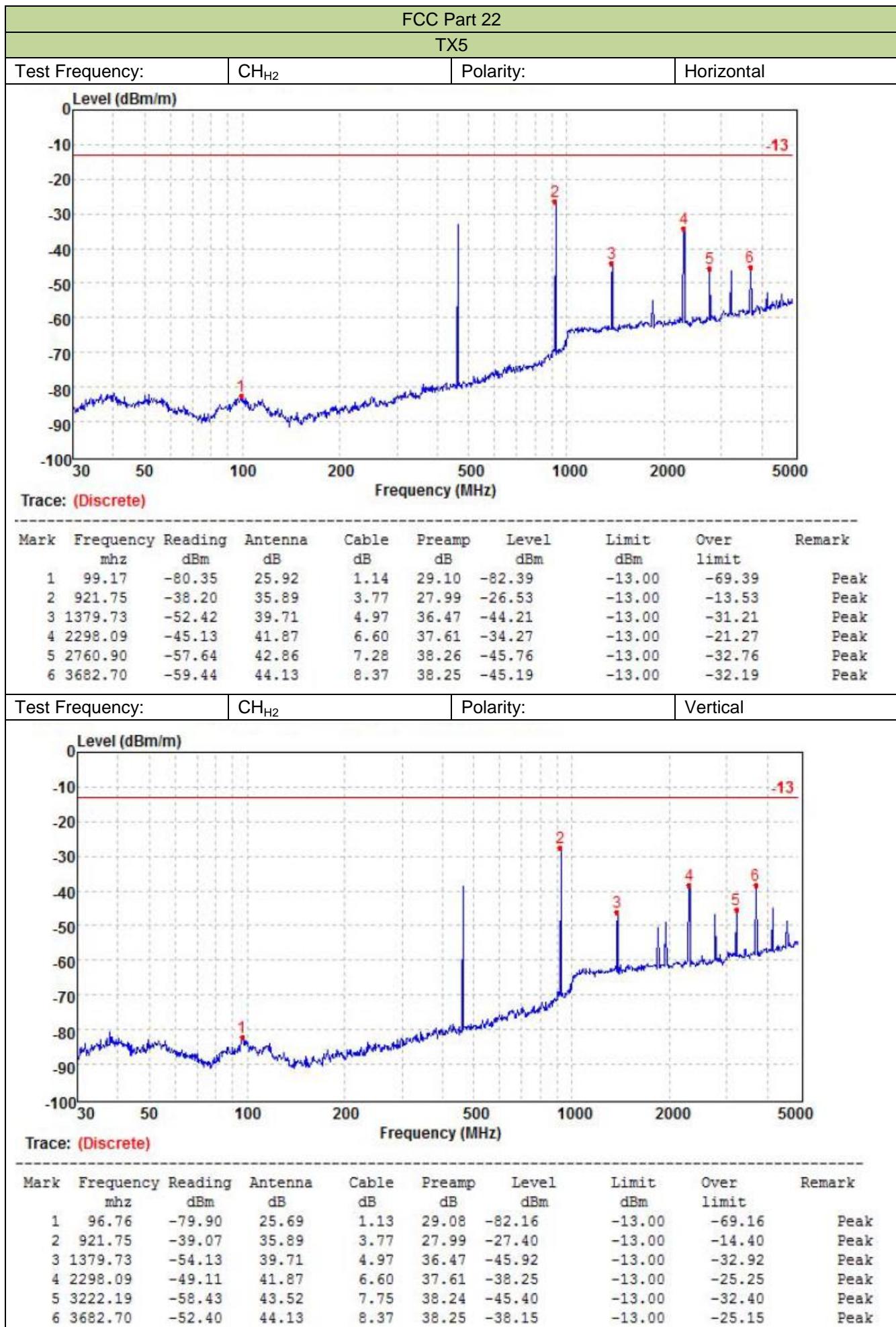






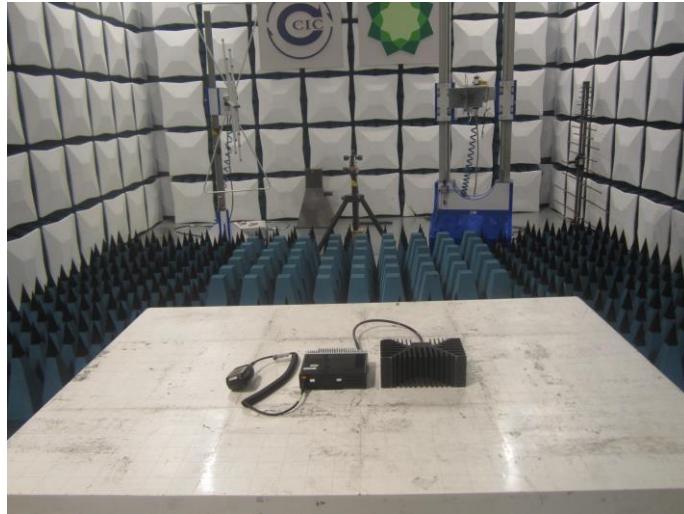






6. Test Setup Photos of the EUT

Transmitter Radiated Spurious Emission:

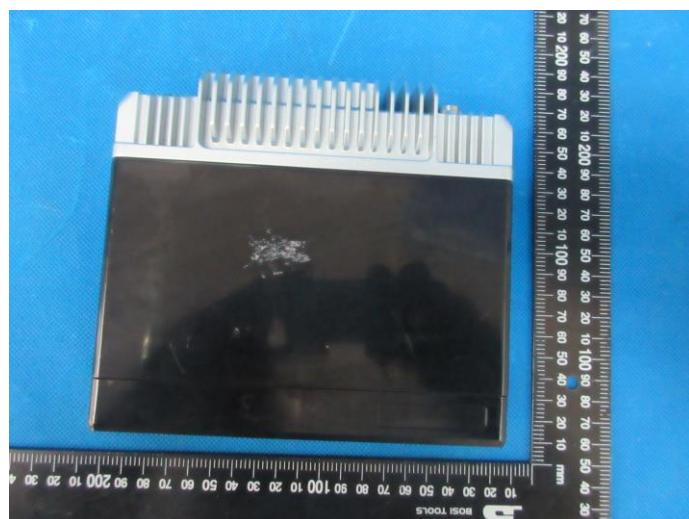
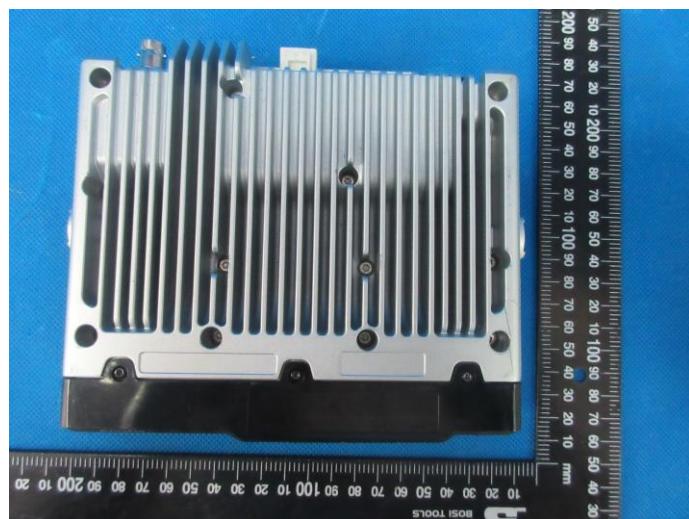


Frequency stability:



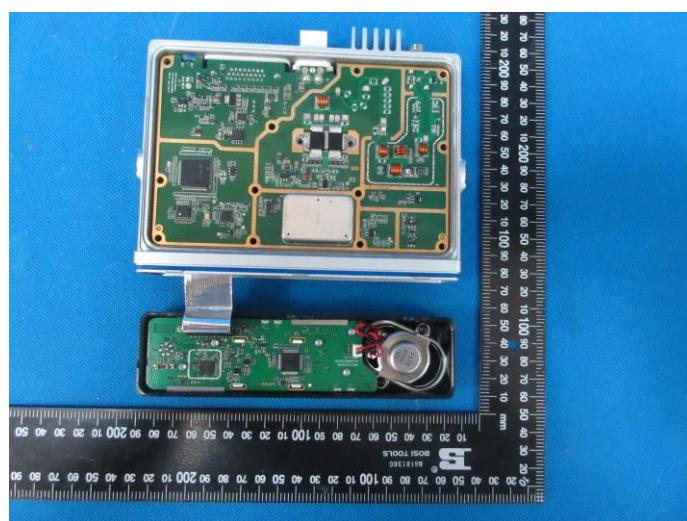
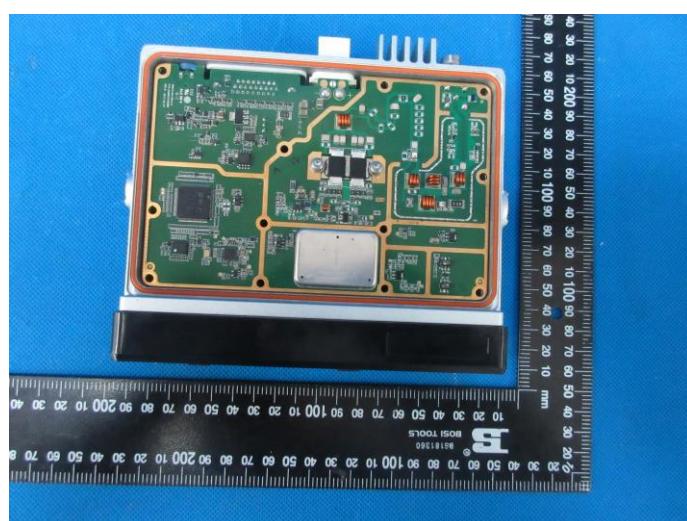
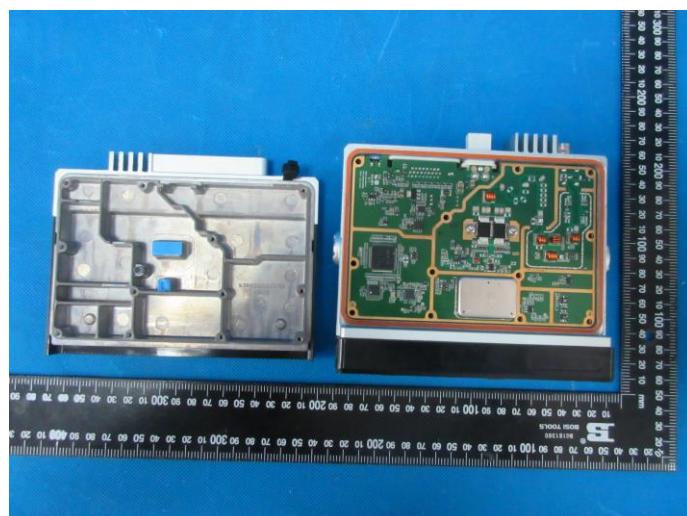
7. External and Internal Photos of the EUT

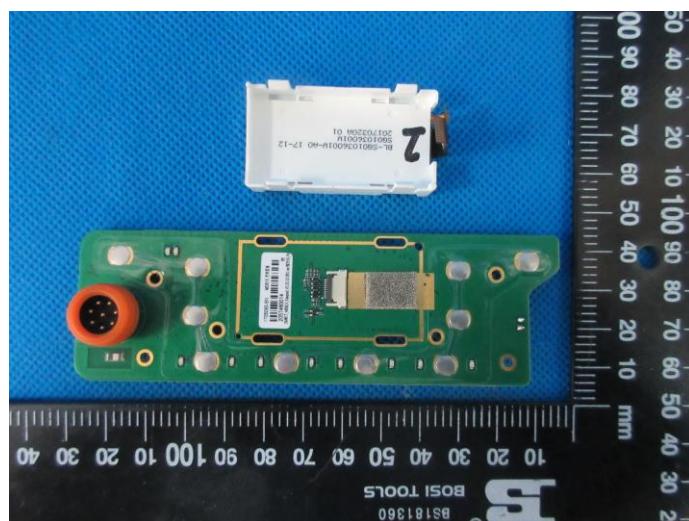
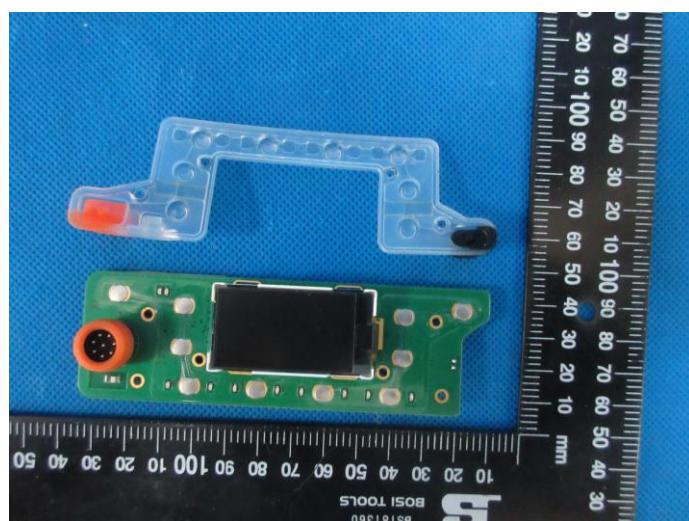
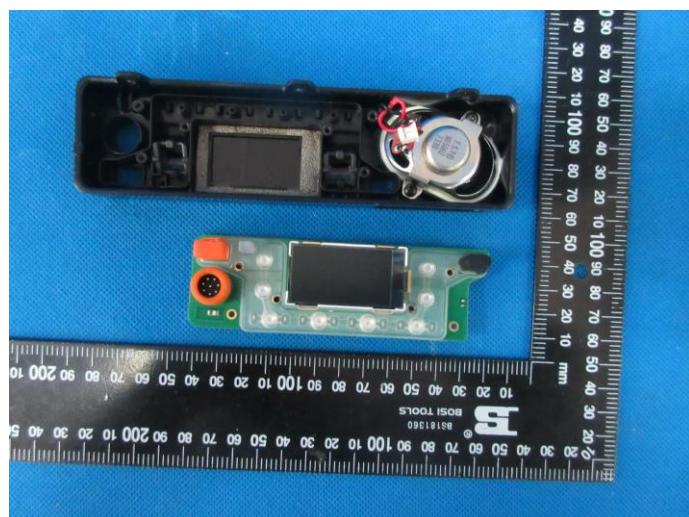
External Photos of the EUT

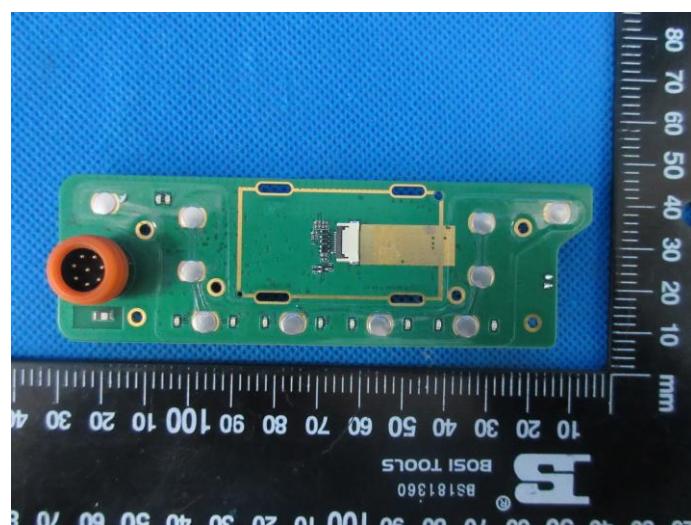
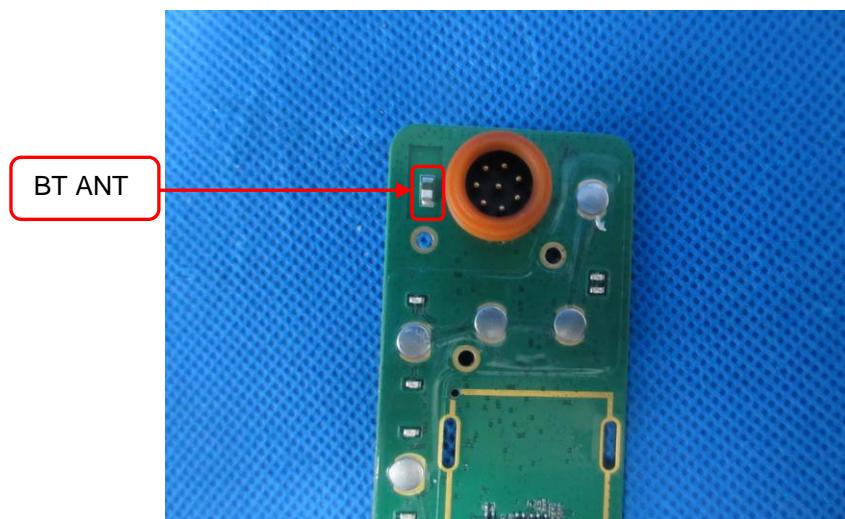


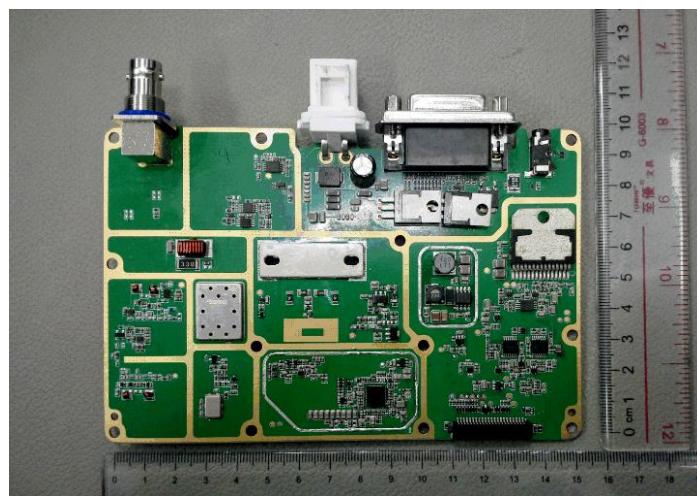
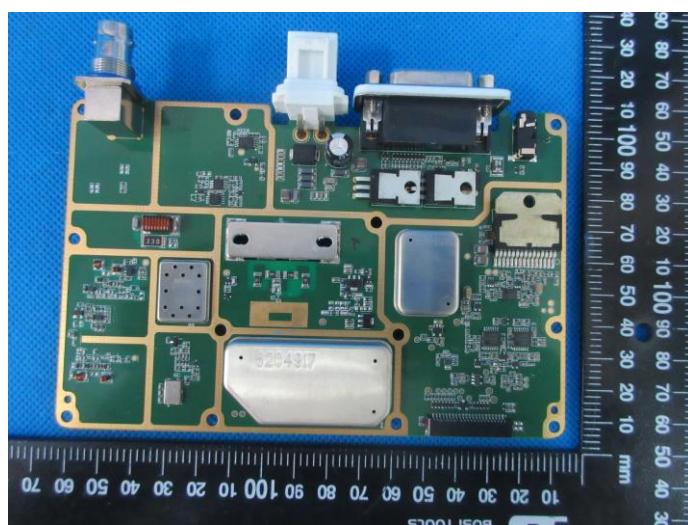


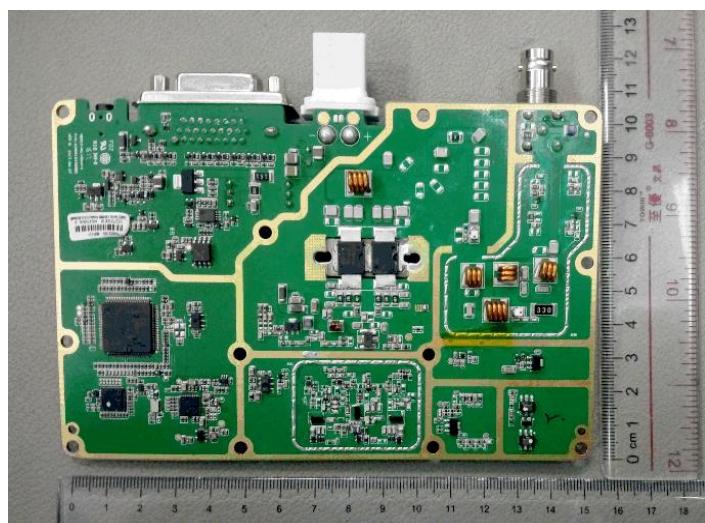
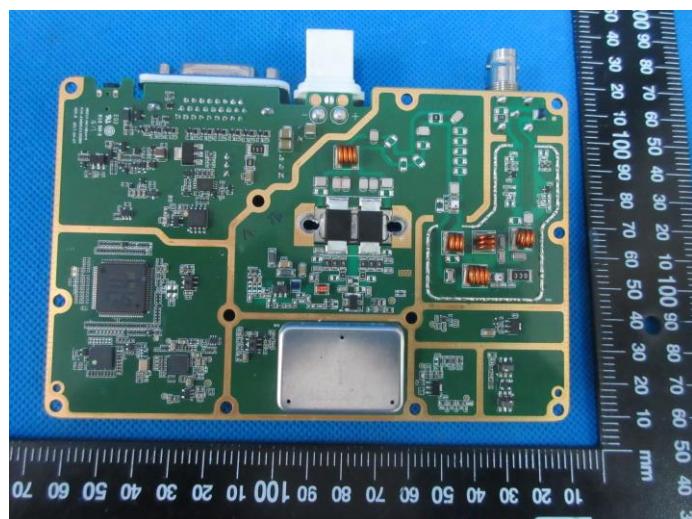


Internal Photos of the EUT









-----End of Report-----