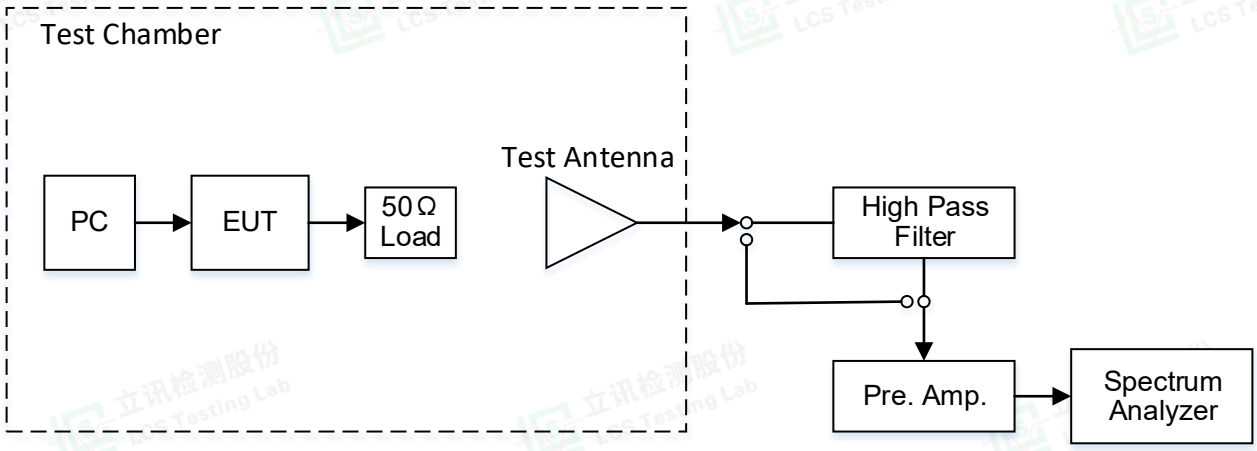
5.3.3 Test Arrangement



5.3.4 Test Procedure

1. EUT was placed on a 1.50 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 1.50 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.
2. 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.
3. 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=100 KHz, VBW=300 KHz for 30MHz to 1GHz, and the maximum value of the receiver should be recorded as (P_r).
4. The EUT shall be replaced by a substitution antenna. In the chamber, a 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 (P_{Mea}) is applied to the input of the substitution antenna, and adjusts the level of the signal generator output until the value of the receiver reach the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
5. An amplifier should be connected to the Signal Source output port. And the cable should be connecting between the Amplifier and the Substitution Antenna. The cable loss (P_{cl}), the Substitution Antenna Gain (G_a) and the Amplifier Gain (P_{Ag}) should be recorded after test.
   The measurement results are obtained as described below:
   Power (EIRP) = P_{Mea}- P_{Ag} - P_{cl} - G_a

The measurement results are amending as described below:
Power (EIRP) = P_{Mea}- P_{cl} - G_a

6. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
7. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi.

5.3.5 Limit

Modulation Type: 4FSK

FCC Part 90.210:

For 12.5 kHz bandwidth:
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:
Calculation: Limit (dBm) =EL-50-10log (TP) = -20 dBm
Notes: EL is the emission level of the Output Power expressed in dBm.

For 25 kHz bandwidth:
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 62.5 kHz at least:
Calculation: Limit (dBm) =EL-43-10log10 (TP) = -13 dBm
Notes: EL is the emission level of the Output Power expressed in dBm.

Note: 1. In general, the worst case attenuation requirement shown above was applied.
2. The measurement frequency range from 9 KHz to 5 GHz.
3. *** means that the emission level is too low to be measured or at least 20 dB down than the limit.
4. ERP for below 1GHz and EIRP above 1GHz.

5.3.5 Test Results

Temperature	24.5℃	Humidity	54.7%
Test Engineer	Jay Luo	Test Voltage	Normal Voltage

Remark:
1. Measured at TM1 to TM4, recorded worst case at TM1;
2. Please refer to following page.
3.All the modes have been tested and recorded worst mode in the report.

Modulation Type: 4FSK							
Operation Mode: TM1				Channel Separation:12.5KHz			
				Test Frequency:406.1125MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak EIRP (dBm)	Limit (dBm)	Polarization
906.34	-42.39	5.26	9.88	2.15	-36.25	-20.00	H
1359.41	-54.23	6.11	11.36	2.15	-46.73	-20.00	H
1812.56	-48.42	7.01	11.42	2.15	-41.88	-20.00	H
906.28	-50.55	5.26	9.88	2.15	-44.41	-20.00	V
1359.38	-52.53	6.11	11.36	2.15	-45.03	-20.00	V
1812.53	-58.32	7.01	11.42	2.15	-51.78	-20.00	V

Modulation Type: 4FSK							
Operation Mode: TM1				Channel Separation:12.5KHz			
				Test Frequency:430.1125MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak EIRP (dBm)	Limit (dBm)	Polarization
820.28	-42.46	5.26	9.88	2.15	-35.69	-20.00	H
1230.48	-53.09	6.11	11.36	2.15	-45.69	-20.00	H
1640.57	-48.56	7.01	11.42	2.15	-42.00	-20.00	H
820.30	-48.86	5.26	9.88	2.15	-42.09	-20.00	V
1230.47	-51.60	6.11	11.36	2.15	-44.20	-20.00	V
1640.60	-57.89	7.01	11.42	2.15	-51.33	-20.00	V

Modulation Type: 4FSK							
Operation Mode: TM1				Channel Separation:12.5KHz			
				Test Frequency: 453.2125MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak EIRP (dBm)	Limit (dBm)	Polarization
906.31	-42.44	5.39	9.38	2.15	-36.30	-20.00	H
1359.44	-54.18	5.67	11.02	2.15	-46.68	-20.00	H
1812.58	-48.41	6.59	10.98	2.15	-41.87	-20.00	H
906.30	-50.53	5.39	9.38	2.15	-44.39	-20.00	V
1359.40	-52.54	5.67	11.02	2.15	-45.04	-20.00	V
1812.54	-58.30	6.59	10.98	2.15	-51.76	-20.00	V

Modulation Type: 4FSK							
Operation Mode: TM1				Channel Separation:12.5KHz			
				Test Frequency: 459.624MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak EIRP (dBm)	Limit (dBm)	Polarization
906.29	-42.47	5.39	9.38	2.15	-36.33	-20.00	H
1359.43	-54.22	5.67	11.02	2.15	-46.72	-20.00	H
1812.52	-48.35	6.59	10.98	2.15	-41.81	-20.00	H
906.34	-50.51	5.39	9.38	2.15	-44.37	-20.00	V
1359.39	-52.57	5.67	11.02	2.15	-45.07	-20.00	V
1812.51	-58.32	6.59	10.98	2.15	-51.78	-20.00	V

Modulation Type: 4FSK							
Operation Mode: TM1				Channel Separation:12.5KHz			
				Test Frequency: 465.625MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak EIRP (dBm)	Limit (dBm)	Polarization
939.29	-42.56	5.28	9.37	2.15	-36.32	-20.00	H
1408.93	-53.68	5.62	10.9	2.15	-46.25	-20.00	H
1878.56	-46.55	6.73	10.83	2.15	-40.30	-20.00	H
939.26	-49.64	5.28	9.31	2.15	-43.46	-20.00	V
1408.97	-51.86	5.84	11.01	2.15	-44.54	-20.00	V
1878.52	-56.64	6.75	11.06	2.15	-50.18	-20.00	V

Modulation Type: 4FSK							
Operation Mode: TM1				Channel Separation:12.5KHz			
				Test Frequency: 469.9875MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak EIRP (dBm)	Limit (dBm)	Polarization
939.29	-42.51	5.28	9.37	2.15	-36.27	-20.00	H
1408.90	-53.67	5.62	10.9	2.15	-46.24	-20.00	H
1878.54	-46.51	6.73	10.83	2.15	-40.26	-20.00	H
939.30	-49.69	5.28	9.31	2.15	-43.51	-20.00	V
1408.94	-51.86	5.84	11.01	2.15	-44.54	-20.00	V
1878.60	-56.58	6.75	11.06	2.15	-50.12	-20.00	V

Notes:

1). Measuring frequencies from 9 KHz~10th harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30MHz;

2). Radiated emissions measured in frequency range from 9 KHz~10th harmonic (ex. 26GHz) were made with an instrument using Peak detector mode;

3). Peak EIRP = P_{Mea} + Path Loss + Antenna Gain + Correction Value (2.15).

5.4. Spurious Emission on Antenna Port

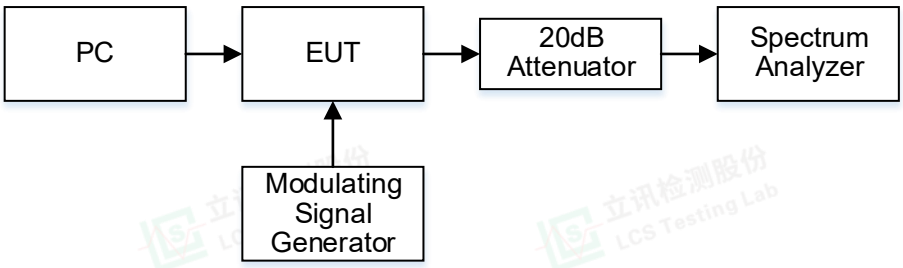
5.4.1 Test Applicable

The same as Section 5.3

5.4.2 Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. 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. Set RBW 1KHz, VBW 3KHz in the frequency band 9KHz to 150KHz, set RBW 10KHz, VBW 30 KHz in the frequency band 150KHz to 30 MHz, 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^{th} Harmonic.
The audio input was set to 0 to get the unmodulated carrier, the resulting picture is print out for each channel separation.

5.4.3 Test Configuration



5.4.4 Limit

Modulation Type: 4FSK

FCC Part and 90.210:

For 12.5 kHz bandwidth:
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:
Calculation: Limit (dBm) =EL-50-10log (TP) = -20 dBm
For 25 kHz bandwidth:
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 62.5 kHz at least:
Calculation: Limit (dBm) =EL-43-10log (TP) = -13 dBm
Notes: EL is the emission level of the Output Power expressed in dBm.

Note: 1. In general, the worst case attenuation requirement shown above was applied.
2. The measurement frequency range from 9 KHz to 6GHz.

5.4.5 Test Results

Temperature	22.6℃	Humidity	53.7%
Test Engineer	Jay Luo	Test Voltage	Normal Voltage

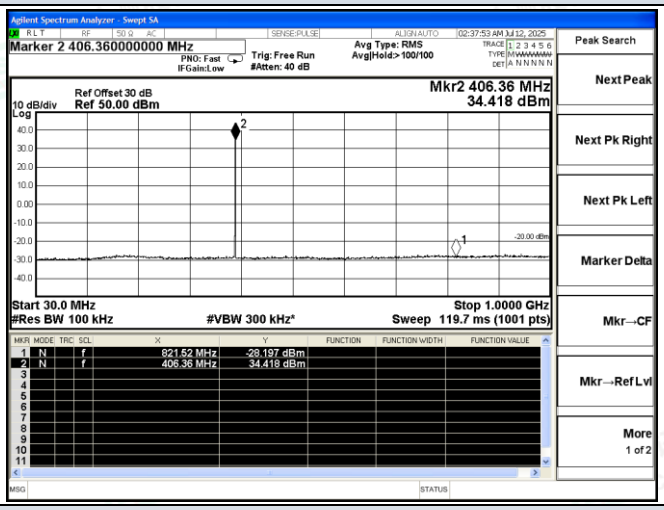
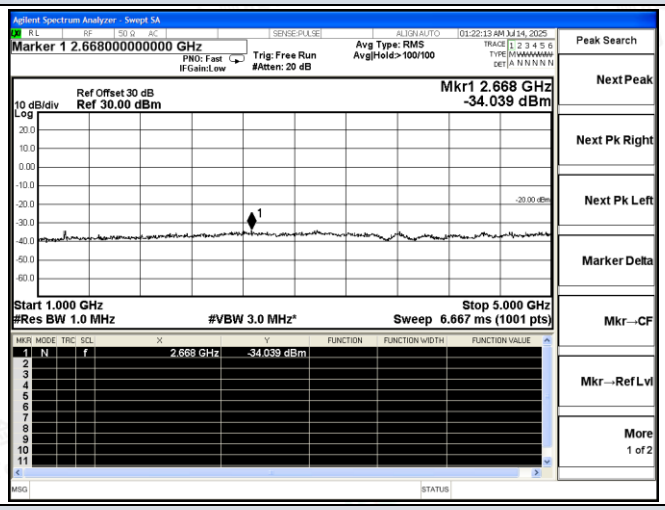
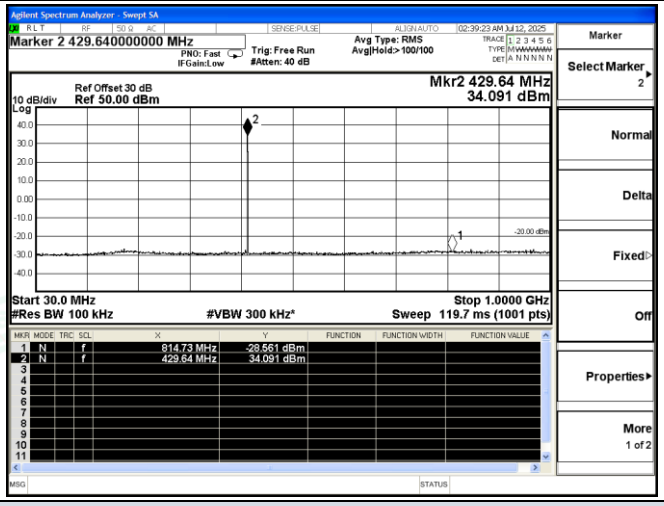
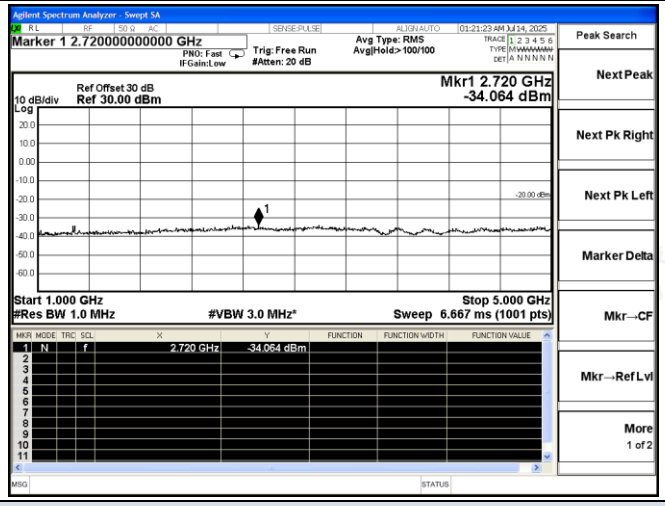
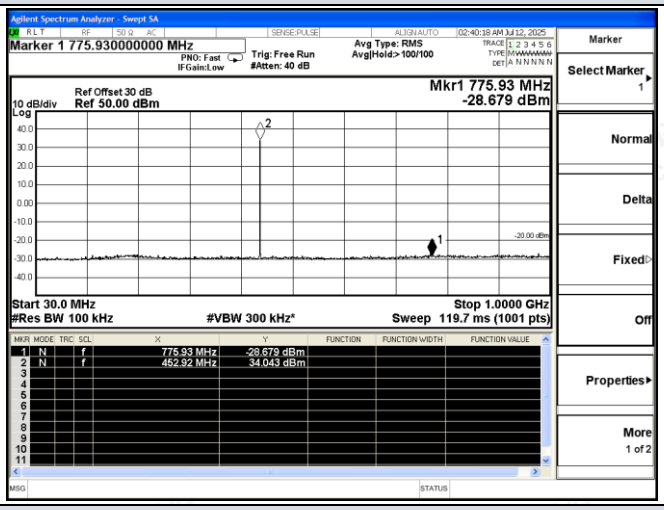
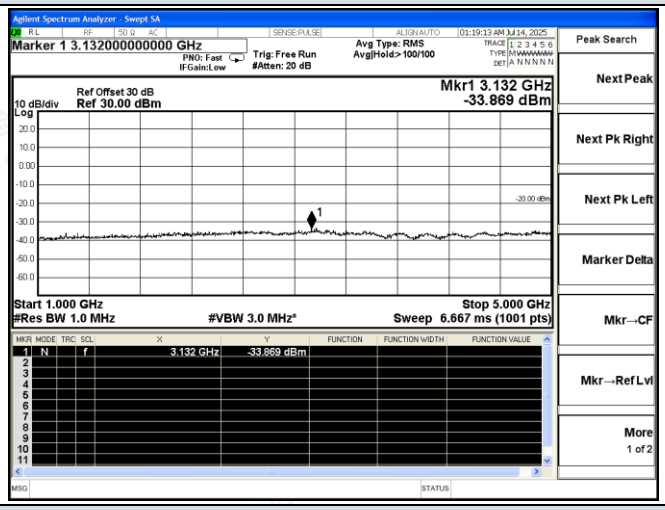
Operation Mode	Test Channel	Test Frequency (MHz)	Measured Frequency Range	Spurious RF Conducted Emission (dBc)	Limits (dBc)	Verdict
TM1	L	406.1125	9 KHz – 6 GHz	<-20	-20	PASS
	M 1	430.1125	9 KHz – 6 GHz	<-20		
	M 2	453.2125	9 KHz – 6 GHz	<-20		
	M 3	459.625	9 KHz – 6 GHz	<-20		
	M 4	465.625	9 KHz – 6 GHz	<-20		
	H	469.9875	9 KHz – 6 GHz	<-20		

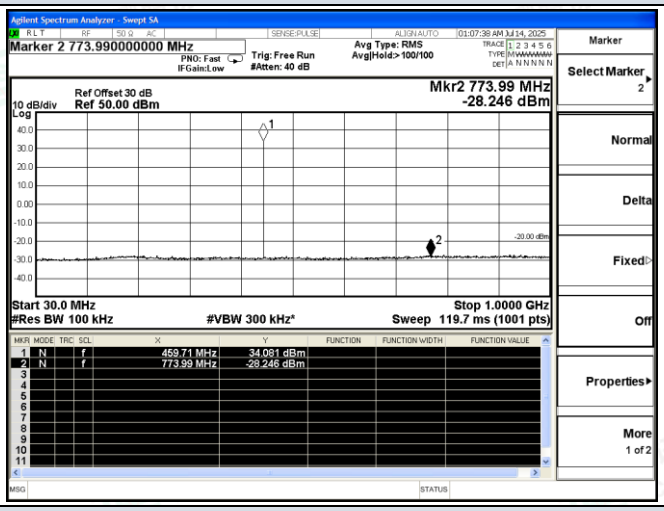
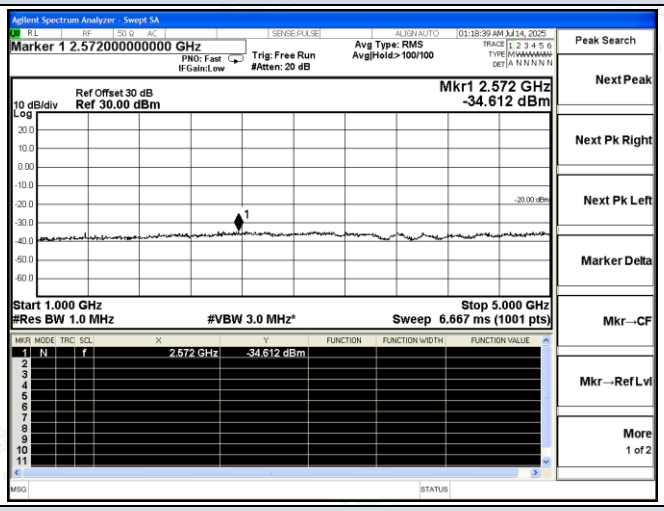
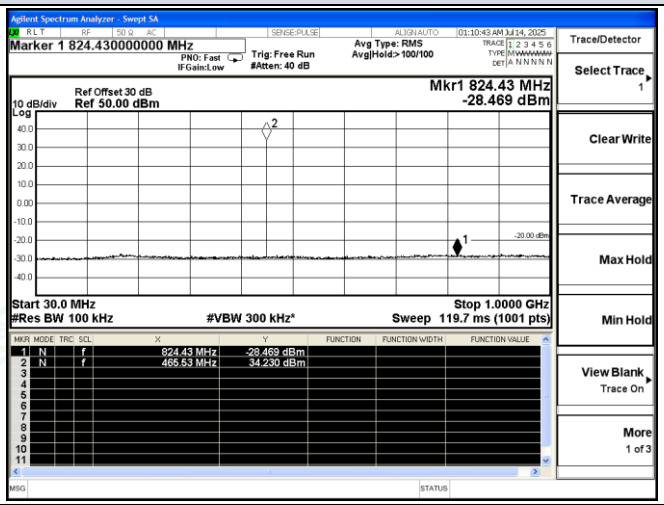
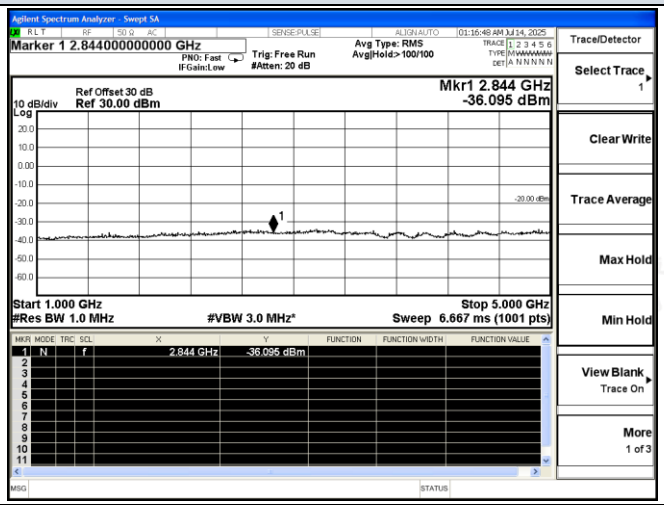
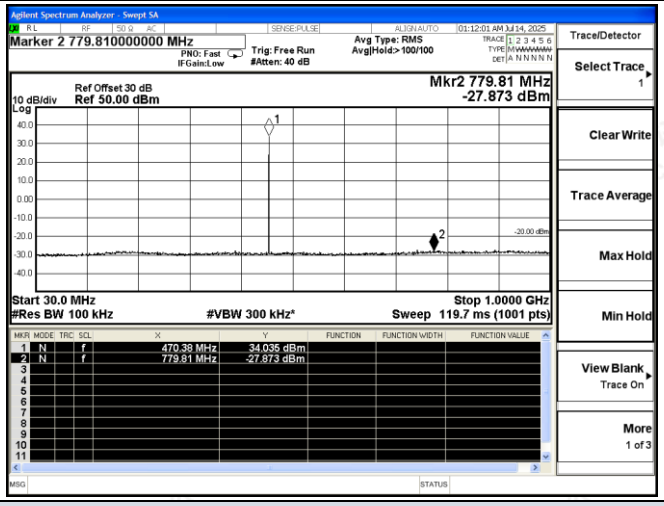
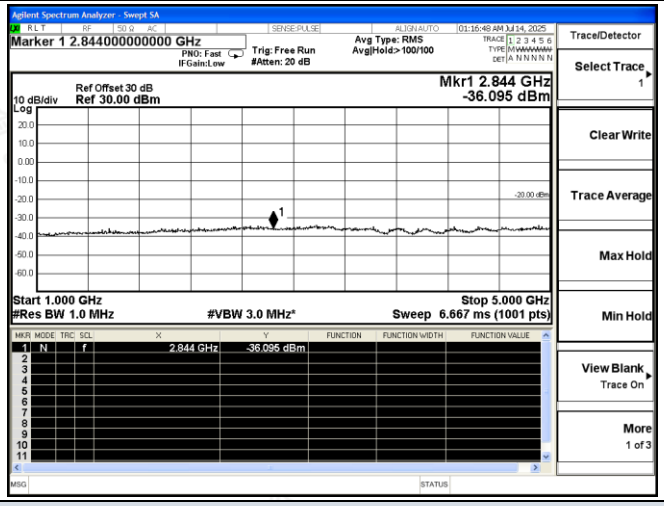
Remark:

1. Measured at TM1 to TM4, recorded worst case at TM1 ;

2. Please refer to following plot.

3.All the modes have been tested and recorded worst mode in the report.

Spurious Emission on Antenna Port	
TM1 /406.1125 MHz	
	
30 MHz – 1 GHz	*1 GHz – 5 GHz*
TM1 /430.1125 MHz	
	
30 MHz – 1 GHz	*1 GHz – 5 GHz*
TM1 /453.2125 MHz	
	
30 MHz – 1 GHz	*1 GHz – 5 GHz*

TM1 /459.625 MHz	
	
30 MHz – 1 GHz	*1 GHz – 5 GHz*
TM1 /465.625 MHz	
	
30 MHz – 1 GHz	*1 GHz – 5 GHz*
TM1 /469.9875 MHz	
	
30 MHz – 1 GHz	*1 GHz – 5 GHz*

5.5. Frequency Stability Test

5.5.1 Test Applicable

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 +60℃ centigrade.

2 According to FCC Part 2 Section 2.1055 (e) (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.

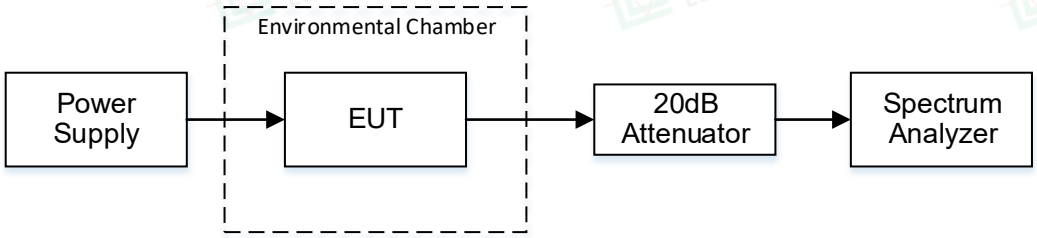
3 Vary primary supply voltage from 85 to 115 percent of the nominal value.

4 According to §90.213, the frequency stability limit is 2.5 ppm for 12.5KHz and 5.0ppm for 25KHz channel separation

5.5.2 Test Procedure

The EUT was set in the climate chamber and connected to an external DC power supply and AC power supply. The RF output was directly connected to Spectrum Analyzer ESCI3. 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 or AC power supply and the voltage was adjusted in the required ranges. The result was recorded.

5.5.3 Test Configuration



5.5.4 Test Limits

According to 90.213, Transmitters used must have minimum frequency stability as specified in the following table.

Frequency Range	Channel Bandwidth	Frequency Tolerance (ppm)		
		Fixed and Base Station	Mobile Stations	
			> 2W	≤ 2W
150-174MHz	6.25	1.0	2.0	2.0
	12.5	2.5	5.0	5.0
	25	5.0	5.0	50.0*
421-512MHz	6.25	0.5	1.0	1.0
	12.5	1.5	2.5	2.5
	25	2.5	5.0	5.0

* Stations operating in the 154.45 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.
* Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 1.5 ppm in the 421-512 MHz band.

5.5.5 Test Results

Temperature	24.5℃	Humidity	54.7%
Test Engineer	Jay Luo	Test Voltage	Normal Voltage

Operation Mode	Channel Separation	Test conditions		Frequency error (ppm)		
		Voltage(V)	Temp(℃)	406.1125	430.1125	453.2125
TM1	12.5KHz	12 V	-30	0.002	-0.008	-0.017
			-20	0.008	-0.008	-0.016
			-10	0.005	-0.005	-0.017
			0	0.011	-0.004	-0.013
			10	-0.009	-0.023	-0.019
			20	0.000	0.020	0.014
			30	0.012	0.003	0.005
			40	0.006	-0.013	-0.015
			50	0.000	0.005	0.010
		10.2(85% Rated)	20	-0.009	0.004	-0.011
		13.8(115% Rated)	20	0.007	0.000	0.001
Limit			2.5ppm			
Test Results			PASS			

Operation Mode	Channel Separation	Test conditions		Frequency error (ppm)		
		Voltage(V)	Temp(℃)	459.625	465.625	469.9875
TM1	12.5KHz	12 V	-30	0.015	-0.009	-0.002
			-20	-0.013	-0.001	-0.007
			-10	-0.001	-0.003	0.002
			0	-0.004	0.003	-0.006
			10	-0.002	0.008	-0.001
			20	-0.010	0.001	0.008
			30	0.000	0.015	0.016
			40	0.006	-0.009	-0.003
			50	0.000	-0.001	-0.021
		10.2(85% Rated)	20	-0.004	-0.008	-0.012
		13.8(115% Rated)	20	0.009	0.001	0.006
Limit			2.5ppm			
Test Results			PASS			

Remark:

1. Measured at TM1 to TM4, recorded worst case at TM1.

2. All the modes have been tested and recorded worst mode in the report.

5.6. Transient Frequency Behavior

5.6.1 Test Applicable

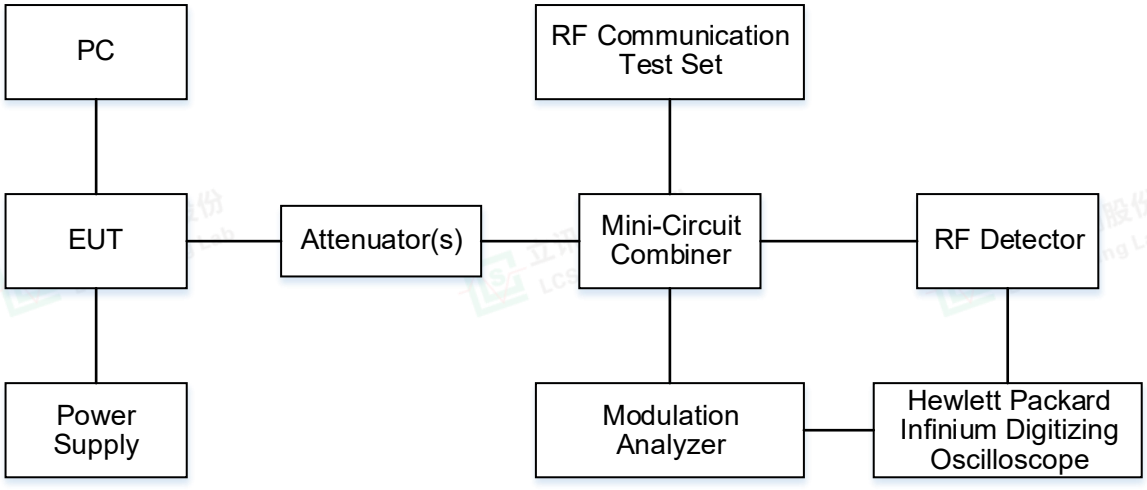
Section 90.214

Transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

Time intervals [1, 2]	Maximum frequency difference [3]	All equipment	
		1500 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25KHz Channels			
t_1 [4].....	± 25.0KHz	5.0ms	10.0ms
t_1	± 12.5KHz	20.0ms	25.0ms
t_3 [4].....	± 25.0KHz	5.0ms	10.0ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5KHz Channels			
t_1 [4].....	±12.5KHz	5.0ms	10.0ms
t_1	± 6.25KHz	20.0ms	25.0ms
t_3 [4].....	± 12.5KHz	5.0ms	10.0ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25KHz Channels			
t_1 [4].....	±6.25KHz	5.0ms	10.0ms
t_1	± 3.125KHz	20.0ms	25.0ms
t_3 [4].....	± 6.25KHz	5.0ms	10.0ms

1. t_{on} is the instant when a 1 KHz test signal is completely suppressed, including any capture time due to phasing.
   t_1 is the time period immediately following t_{on}.
   t_2 is the time period immediately following t_1.
   t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
   t_{off} is the instant when 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 for this time period.

5.6.2 Test Configuration



5.6.3 Test Procedure

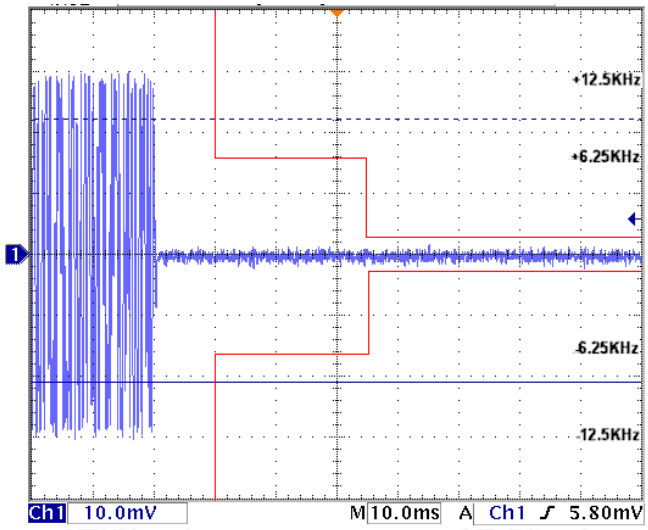
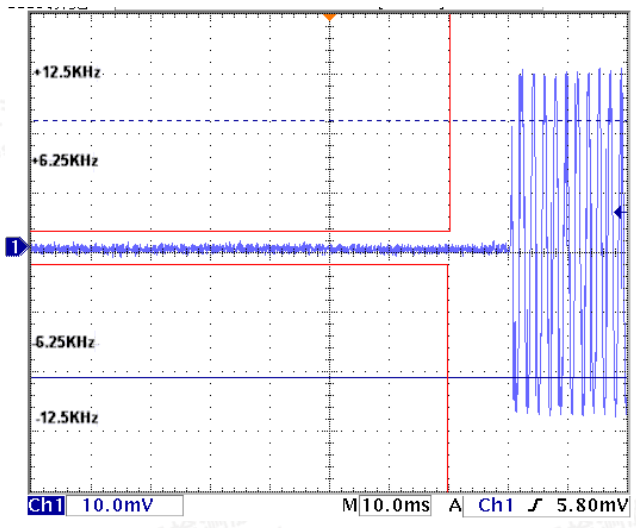
According to TIA/EIA-603 2.2.19 requirement.

5.6.4 Test Results

Temperature	24.5℃	Humidity	54.7%
Test Engineer	Jay Luo	Test Voltage	Normal Voltage

Measured at TM1 to TM4, recorded worst case at TM1.

Modulation Type: 4FSK

Transmitter Frequency Behavior	
	
12.5 KHz Channel Separation------Off – On	*12.5 KHz Channel Separation------On – Off*

5.7. FCC §2.1047 - MODULATION CHARACTERISTIC

5.7.1 Test Applicable

Section 90.214

Transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

Applicable Standard

FCC §2. 1047

(a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.

(b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

Test Procedure

Test Method: TIA-603-E 2.2.3

Test Data

Environmental Conditions

Temperature	24.5℃	Humidity	54.7%
Test Engineer	Jay Luo	Test Voltage	Normal Voltage

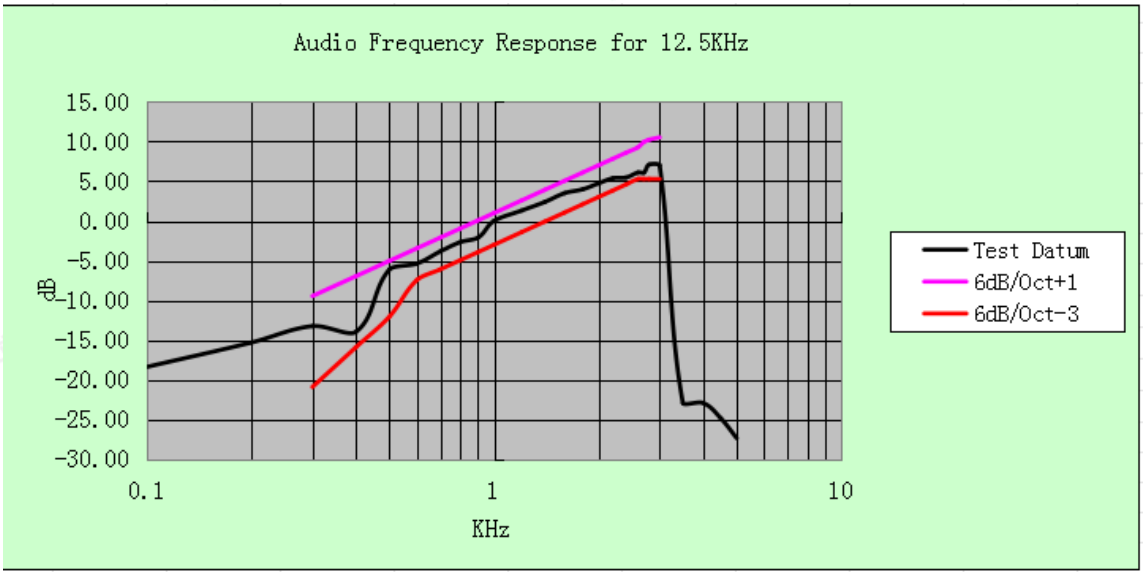
Test Mode: Transmitting

Test Result: Compliance. please refer to thefollowing tables.

Audio Frequency Response – High Power

12.5kHz:

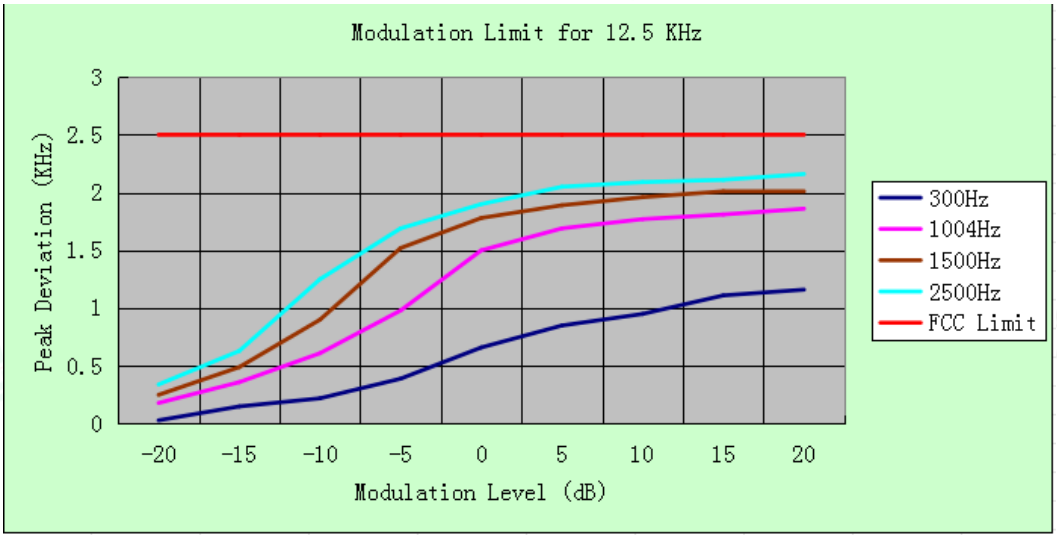
Carrier Frequency: 453.2125 MHz



MODULATION LIMITING – High Power

12.5kHz

Carrier Frequency: 453.2125 MHz



6. LIST OF MEASURING EQUIPMENT

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Power Meter	R&S	NRVS	100444	2025-05-22	2026-05-21
2	Power Sensor	R&S	NRP-Z81	100458	2025-05-22	2026-05-21
3	Power Sensor	R&S	U2021	10057	2025-05-22	2026-05-21
4	Test Software	Tonscend	JS1120-2	/	N/A	N/A
5	RF Control Unit	Tonscend	JS0806-2	N/A	2024-11-08	2025-11-07
6	MXA Signal Analyzer	Agilent	N9020A	MY50510140	2024-10-08	2025-10-07
7	DC Power Supply	Agilent	E3642A	N/A	2024-10-08	2025-10-07
8	EMI Test Software	AUDIX	E3	/	N/A	N/A
9	3m Semi Anechoic Chamber	Maorui	966	/	2023-10-12	2026-10-11
10	Positioning Controller	Max-Full	MF7802BS	MF780208586	N/A	N/A
11	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2024-07-13	2027-07-12
12	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2024-08-03	2027-08-02
13	Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1925	2024-07-13	2027-07-12
14	Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	791	2024-07-13	2027-07-12
15	Broadband Preamplifier	SCHWARZBECK	BBV9719	9719-025	2024-07-30	2027-07-29
16	EMI Test Receiver	R&S	ESR 7	101181	2025-05-22	2026-05-21
17	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2025-05-22	2026-05-21
18	Low-frequency amplifier	SchwarzZBECK	BBV9745	00253	2024-10-08	2025-10-07
19	High-frequency amplifier	JS Denki Pte	PA0118-43	JSPA21009	2024-10-08	2025-10-07
20	6dB Attenuator	/	100W/6dB	1172040	2025-05-22	2026-05-21
21	3dB Attenuator	/	2N-3dB	/	2024-10-08	2025-10-07
22	EMI Test Receiver	R&S	ESPI	101940	2025-05-22	2026-05-21
23	Artificial Mains	R&S	ENV216	101479	2025-05-23	2026-05-22
24	10dB Attenuator	SCHWARZBECK	MTS-IMP-136	261115-001-0032	2025-05-22	2026-05-21
25	EMI Test Software	Farad	EZ	/	N/A	N/A
26	Antenna Mast	Max-Full	MFA-515BSN	1308572	N/A	N/A
27	Pulse Limiter	R&S	ESH3-Z2	102750	2025-05-23	2026-05-22

7. TEST SETUP PHOTOGRAPHS OF EUT

Please refer to separated files for Test Setup Photos of the EUT.

8. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

9. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

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