



REPORT No.: SZ21010351W01

TEST REPORT

APPLICANT : ELECOM CO., LTD

PRODUCT NAME : Bluetooth headset

MODEL NAME : LBT-HSOH11

BRAND NAME : ELECOM

TEST RULE : MIC Notice No.88 Appendix No.43

STANDARD(S) : MIC Ordinance Regulating Radio Equipment
Article 49.20.

RECEIPT DATE : 2024-03-07

TEST DATE : 2024-03-07 to 2024-03-19

ISSUE DATE : 2024-03-25



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MORLAB

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Change History		
Version	Date	Reason for change
1.0	2021-03-31	First edition
2.0	2024-03-25	Update the test data of "Unwanted Emission Intensity" and "Time of Occupancy (Dwell time)". Replace the test report version 1.0



1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	ELECOM CO., LTD
Applicant Address:	Osaka-Midousuji Bldg 1-1 Fushimi-machi 4-chome Chuoku, Osaka, Japan
Manufacturer:	DongGuan Sky Wing Communication Electronic CO.,LTD
Manufacturer Address:	NO.63, Road 10, Longyan, Humen Town, Dongguan City, Guangdong, China (523920)

1.2. Equipment Under Test (EUT) Description

Product Name:	Bluetooth headset	
Serial No.:	(N/A, marked #1 by test site)	
Hardware Version:	HW-V008	
Software Version:	SW-V001	
Equipment Type:	Bluetooth classic	
Bluetooth Version:	5.0	
Modulation Technology:	FHSS	
Modulation Type:	GFSK(BR 1Mbps), $\pi/4$ -DQPSK(EDR 2Mbps), 8-DPSK(EDR 3Mbps)	
Package Type:	DH1, DH3, DH5, 2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5	
Operating Frequency Range:	2402MHz – 2480MHz (at interval of 1MHz)	
Power Supply:	Battery	
Test Voltage:	Normal(NV):	3.70V
	Lowest(LV):	3.33V
	Highest(HV):	4.07V

Note 1: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.



1.3. Table for Filed Antenna

Antenna Manufacture:	DongGuan Sky Wing Communication Electronic CO.,LTD
Brand Name:	ELECOM
Model Name:	LBT-HSOH11
Antenna Type:	PCB Antenna
Antenna Gain:	2.29dBi

1.4. Table for Carrier Frequency

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

Note 1: The black bold channels were selected for test.



1.5. Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Channel
Frequency Error	Un-modulation	0/39/78
Occupied Bandwidth and Spread-spectrum Bandwidth / Factor	GFSK, $\pi/4$ -DQPSK, 8-DPSK	0/39/78
Unwanted Emission Intensity		0/39/78
Antenna Power Error		0/39/78
Limitation of Collateral Emission of Receiver		0/39/78
Transmission Antenna Gain		0/39/78
Transmission Radiation Angle Width		0/39/78
Radio Interference Prevention Capability		0/39/78



1.6. Summary of the Test Result

Applied Rule: MIC Notice No.88 Appendix No.43, Item 19				
No.	Description of Test	Test Engineer	Result	Method Determination /Remark
1	Frequency Error	Liu Bo	PASS	No deviation
2	Time of Occupancy (Dwell time)	Tu Ya'nan	PASS	No deviation
3	Occupied Bandwidth and Spread-spectrum Bandwidth / Factor	Liu Bo	PASS	No deviation
4	Unwanted Emission Intensity	Tu Ya'nan	PASS	No deviation
5	Antenna Power Error	Liu Bo	PASS	No deviation
6	Limitation of Collateral Emission of Receiver	Liu Bo	PASS	No deviation
7	Transmission Antenna Gain (E.I.R.P. Antenna Power)	Liu Bo	PASS	No deviation
8	Transmission Radiation Angle Width (3dB Beamwidth)	Liu Bo	PASS	No deviation
9	Radio Interference Prevention Capability	Liu Bo	PASS	No deviation
10	Construction Protection Confirmation	N/A	PASS	No deviation
Note 1: Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.				
Note 2: When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.				

1.7. Environmental Conditions

Temperature (°C):	5-35
Relative Humidity (%):	45-85
Atmospheric Pressure (kPa):	86-106

2. Test Results

2.1. Frequency Error Measurement

2.1.1. Limit

Item	Limits
Frequency Tolerance	±50ppm

2.1.2. Measuring Instruments and Setting

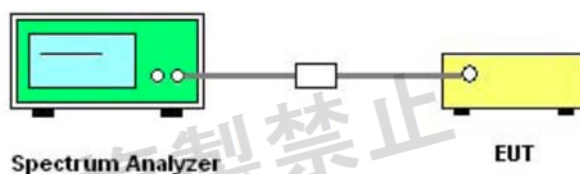
The following table is the setting of the spectrum.

Spectrum Parameter	Setting
Span Frequency	50kHz
RB/VB	10 kHz / 30 kHz

2.1.3. Test Procedures

1. Frequency accuracy of SA shall be less than 10% of limits tolerance (5ppm)
2. Setting of SA is following as: RB: 10kHz / VB: 30kHz / SPAN: 50kHz
3. Center Frequency: The center frequency of testing for EUT
4. Sweep time: Auto
5. Sweep mode: Continuous sweep
6. Detect mode: Positive peak
7. Mark function: Frequency Counter (Resolution 100Hz)
8. EUT have transmitted absence of modulation signal and fixed channelize. f is using the mark cursor to mark the peak frequency value f_c is declaring of channel frequency. Then the frequency error formula is $(f_c - f)/f_c \times 10^6$ ppm and the limit is less than 50ppm.

2.1.4. Test Setup Layout





2.1.5. Test Deviation

There is no deviation with the original standard.

2.1.6. EUT Operation during Test

The EUT was placed on the test table and programmed in un-modulation function.

2.1.7. Test Result

Test Voltage	Channel	Frequency f_c (MHz)	Test Frequency f (MHz)	Frequency Error (ppm)	Verdict
LV	0	2402	2401.9940	-2.50	PASS
	39	2441	2440.9927	-2.99	PASS
	78	2480	2479.9931	-2.78	PASS
NV	0	2402	2401.9941	-2.46	PASS
	39	2441	2440.9928	-2.95	PASS
	78	2480	2479.9931	-2.78	PASS
HV	0	2402	2401.9941	-2.46	PASS
	39	2441	2440.9927	-2.99	PASS
	78	2480	2479.9931	-2.78	PASS



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Frequency Error

CH0, 2402MHz, LV



CH39, 2441MHz, LV



CH78, 2480MHz, LV



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Frequency Error

CH0, 2402MHz, NV



CH39, 2441MHz, NV



CH78, 2480MHz, NV





Frequency Error

CH0, 2402MHz, HV



CH39, 2441MHz, HV



CH78, 2480MHz, HV



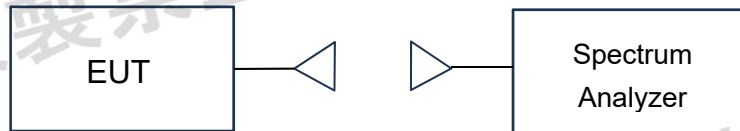
2.2. Time of Occupancy (Dwell time)

2.2.1. Requirement

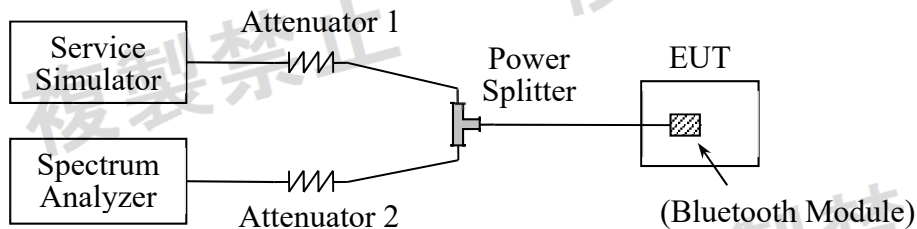
The dwell time in the frequency hopping method is 0.4 seconds or less (for transmitters used for radio control of model airplanes used outdoor is 0.05 seconds or less) and uses a frequency hopping method other than a combined method with direct sequence or orthogonal frequency division multiplexing.

In this case, the accumulated dwell time at any frequency within the time of 0.4 seconds multiplied by the spreading rate shall be 0.4 seconds or less.

2.2.2. Test Setup Layout



Test Setup:



The Bluetooth Module of the EUT, which is powered by the Battery, is coupled to the Spectrum Analyzer (SA) and the Bluetooth Service Simulator (SS) with Attenuators through the Power Splitter; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the SS.



2.2.3.Measurement instrument condition

Setting the spectrum analyzer as follows:

Center Frequency	: Test Frequency
Sweep Span	: 0 Hz
RBW	: 1 MHz
VBW	: Equal to RBW
Sweep Time	: Hopping Period
Triger Type	: Video
Sweep Type	: Single
Detector Type	: Positive Peak

2.2.4.EUT condition

Set to the test frequency and test spreading code, and modulate with the standard coded test signal.

2.2.5.Measurement procedure

1) Single Dwell Time

- Set the spectrum analyzer as shown in clause 2.2.3 and wait for the hopping signal at the test frequency.
- Read the maximum dwell time at the hopping frequency during the hopping period from the display screen of the spectrum analyzer, and check that it is less than 0.4s (0.05s for a transmitter used for radio control of a model airplane used outdoors).

2) Accumulated Dwell Time (Hopping Period can be determined)

- Using the same method as in 1) a, read the value of the dwell time at the hopping frequency in the hopping period.
- Multiply the value obtained by multiplying 0.4s by the spreading factor by the hopping period, and add to that value the dwell time at the hopping frequency measured in step a. Multiply the values to calculate the accumulated dwell time at the test frequency.
- If the hopping period can be specified and the hopping period exceeds the time equal to 0.4s multiplied by the spreading factor, measure the cumulative value of the time spent at the specific hopping frequency.

3) Accumulated Dwell Time (Hopping Period cannot be determined)

Measure the toral dwell time at a specific hop frequency within the time of 0.4s multiplied by the spreading rate.

4) Test Frequency

Repeat the measurement for each hopped frequency. However, if the frequency with the



maximum dwell time can be specified, measure at that frequency. Also, if the dwell time at each frequency is the same, measure at anyone frequency.

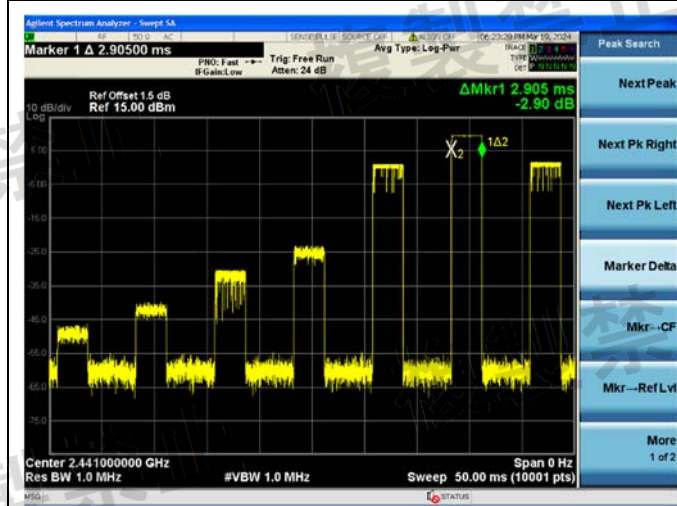
2.2.6. Test Result

The hopping period cannot be determined, and the dwell time at each frequency is same, so the results calculated and recorded as:

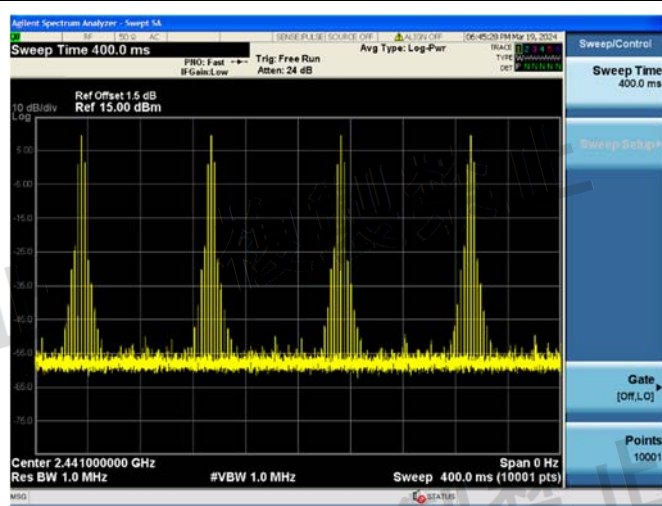
Transmission Rate (Mbps)	Packet Type	Test Freq. (MHz)	Single Dwell Time (ms)	Number of times occupied in 0.4s	Total Dwell Time in 0.4s (ms)	Accumulated Dwell Time (s)	Limit (s)	Verdict
1	DH5	2441	2.905	4	11.620	0.012	≤ 0.4	Good
2	DH5	2441	2.915	4	11.660	0.023	≤ 0.4	Good
3	DH5	2441	2.920	4	11.680	0.035	≤ 0.4	Good

GFSK Mode

Single Dwell Time



Number of times occupied in 0.4s

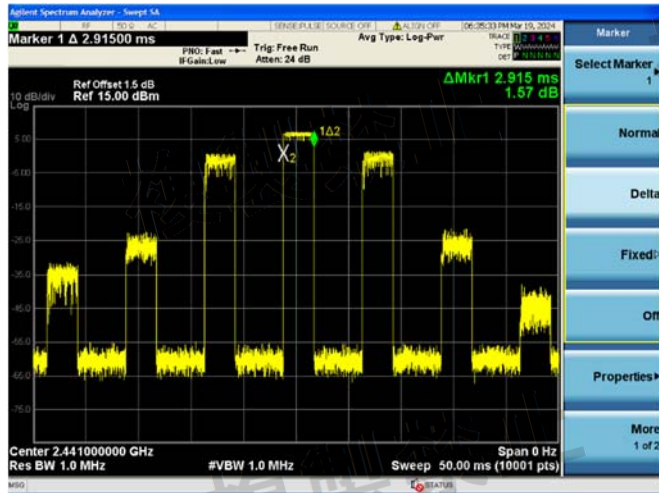
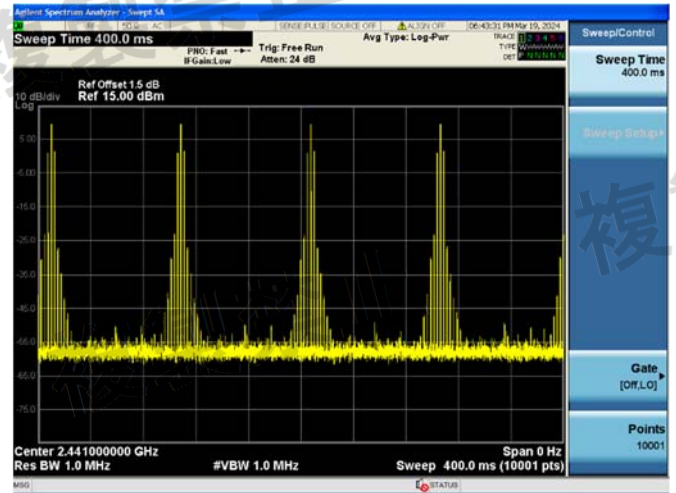




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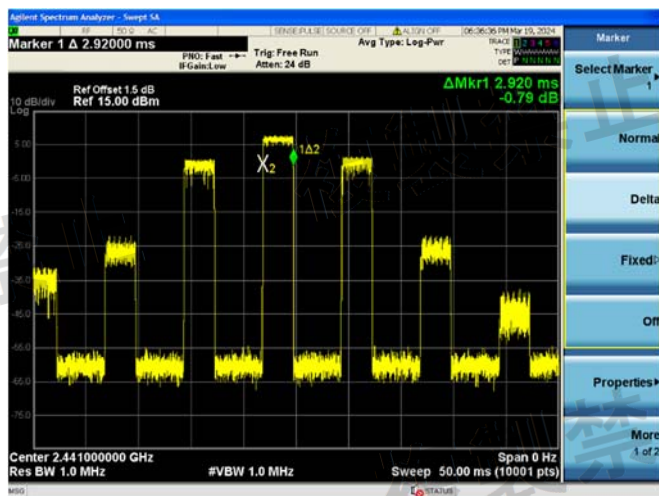
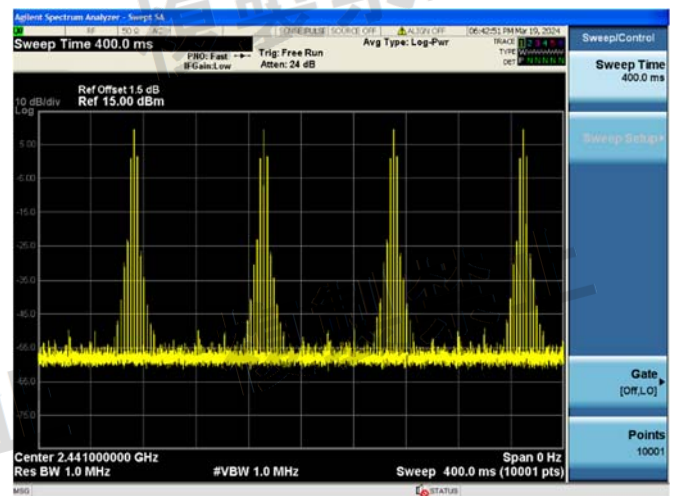
 $\pi/4$ -DQPSK Mode

Single Dwell Time

Number of times occupied
in 0.4s

8-DPSK Mode

Single Dwell Time

Number of times occupied
in 0.4s

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2.3.Occupied Bandwidth and Spread-spectrum Bandwidth / Factor

2.3.1.Limit

Item	Limits
Occupied Band Width	FH≤83.5MHz; OFDM, DS≤26MHz; Others≤26MHz;
Spread-spectrum Bandwidth	≥500KHz (FH, DS)

2.3.2.Measuring Instruments and Setting

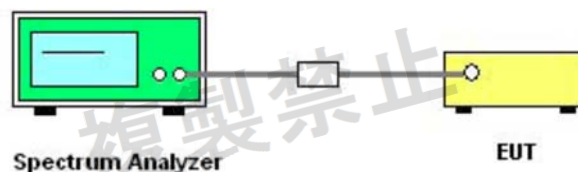
Please refer to section 5 in this report. The following table is the setting of the spectrum.

Spectrum Parameter	Setting
Span Frequency	100MHz
RB/VB	1MHz/1MHz

2.3.3.Test Procedures

1. Setting of SA is following as: RB: 1MHz / VB:1MHz / SPAN: 100MHz / Sweep time: Auto /Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold
2. EUT have transmitted the maximum modulation signal and fixed channelize (For DSSS or OFDM Device) or continuous maximum power of hopping mode (For FHSS Device). SA set to 99% of occupied bandwidth to measure occupied bandwidth. The limit is less than 26MHz (For DSSS or OFDM Device) or 83.5MHz (For FHSS Device).
3. SA set to 90% of occupied bandwidth to measure Spread Spectrum Bandwidth and must greater than 500kHz.
4. Spread Spectrum Factor = Spread Spectrum Bandwidth / modulation rate of EUT.
5. Spread Spectrum Factor limit is greater than 500kHz

2.3.4.Test Setup Layout





2.3.5. Test Deviation

There is no deviation with the original standard.

2.3.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

2.3.7. Test Result

Occupied Bandwidth

Test Mode	Test Voltage	Measured 99% Occupied Bandwidth (MHz)	Verdict
GFSK	LV	78.452	PASS
	NV	78.469	PASS
	HV	78.473	PASS
$\pi/4$ -DQPSK	LV	78.519	PASS
	NV	78.542	PASS
	HV	78.543	PASS
8-DPSK	LV	78.569	PASS
	NV	78.572	PASS
	HV	78.570	PASS

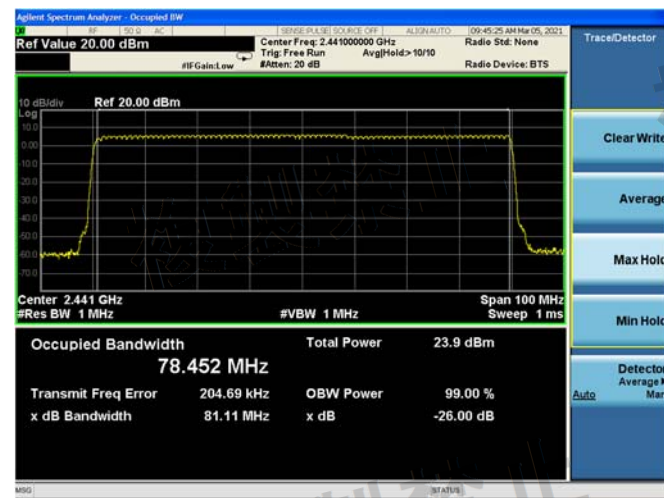
Spread-spectrum Bandwidth

Test Mode	Test Voltage	Measured 90% Spread-spectrum Bandwidth (MHz)	Spread Spectrum Factor	Verdict
GFSK	LV	70.901	70.901	PASS
	NV	70.974	70.974	PASS
	HV	70.977	70.977	PASS
$\pi/4$ -DQPSK	LV	70.790	35.395	PASS
	NV	70.867	35.434	PASS
	HV	70.911	35.456	PASS
8-DPSK	LV	70.914	23.638	PASS
	NV	71.010	23.670	PASS
	HV	70.981	23.660	PASS

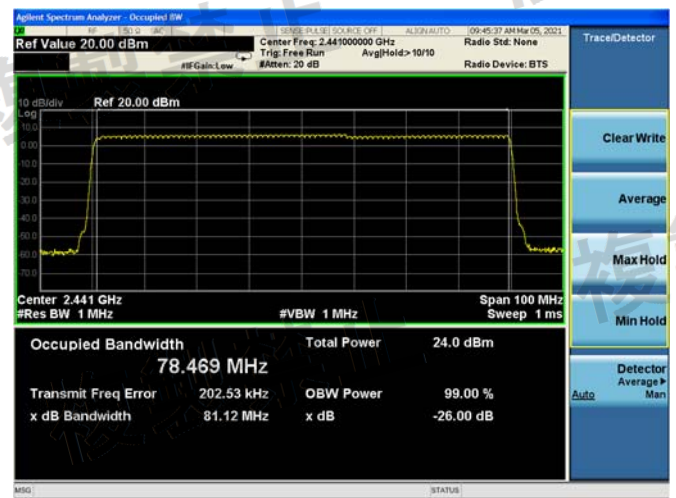


99% Occupied Bandwidth, GFSK Mode

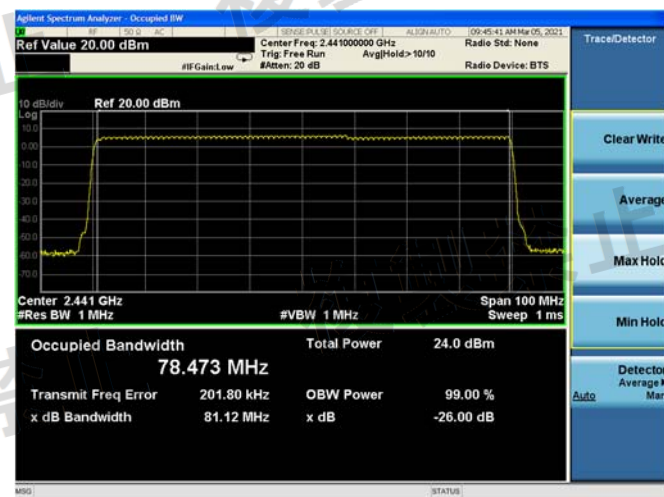
CH0, 2402MHz, LV



CH39, 2441MHz, NV

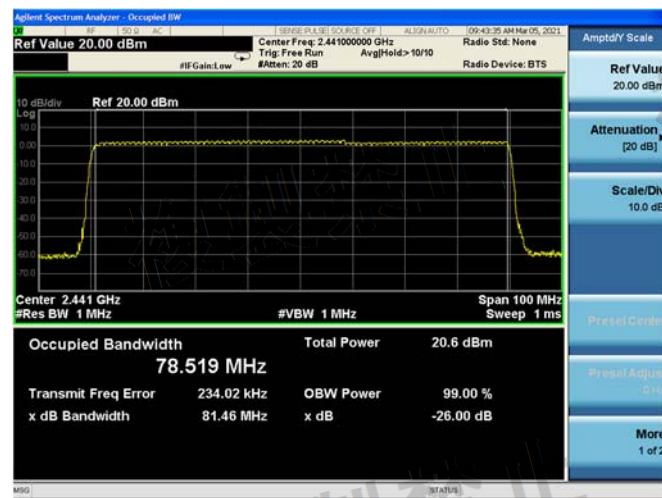


CH78, 2480MHz, HV

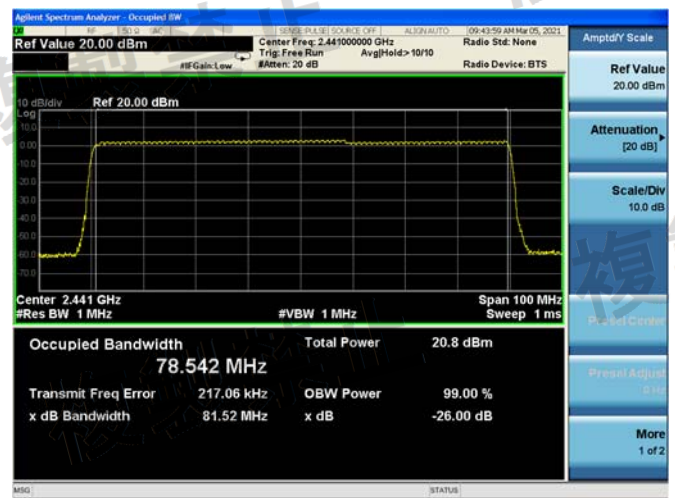


99% Occupied Bandwidth, $\pi/4$ -DQPSK Mode

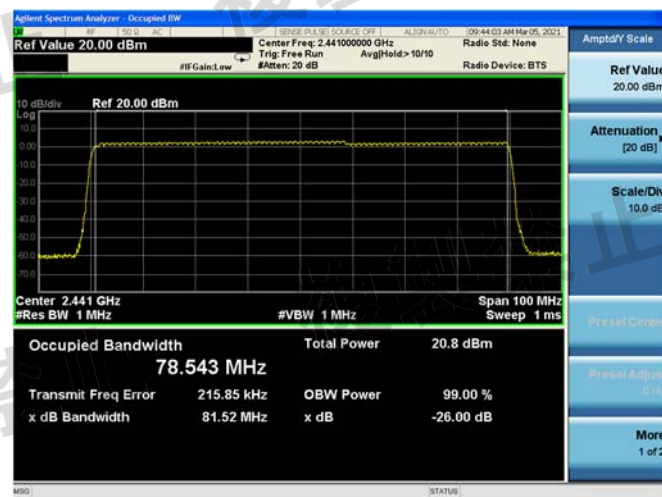
CH0, 2402MHz, LV



CH39, 2441MHz, NV



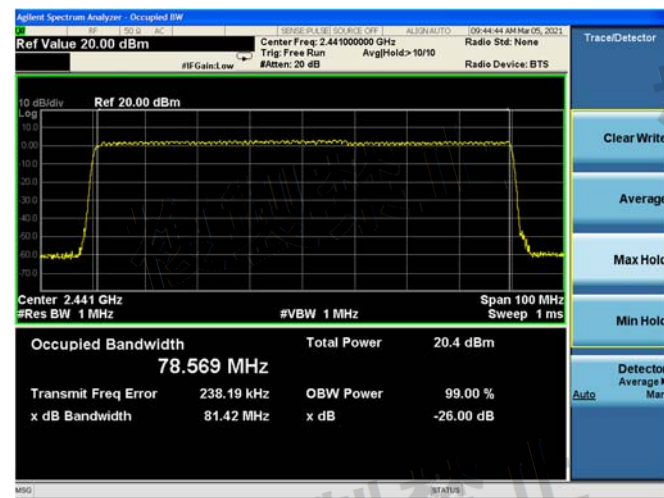
CH78, 2480MHz, HV





99% Occupied Bandwidth, 8-DPSK Mode

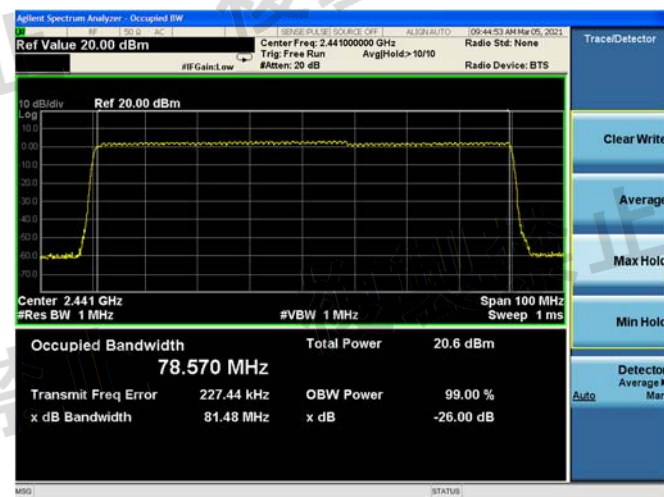
CH0, 2402MHz, LV



CH39, 2441MHz, NV



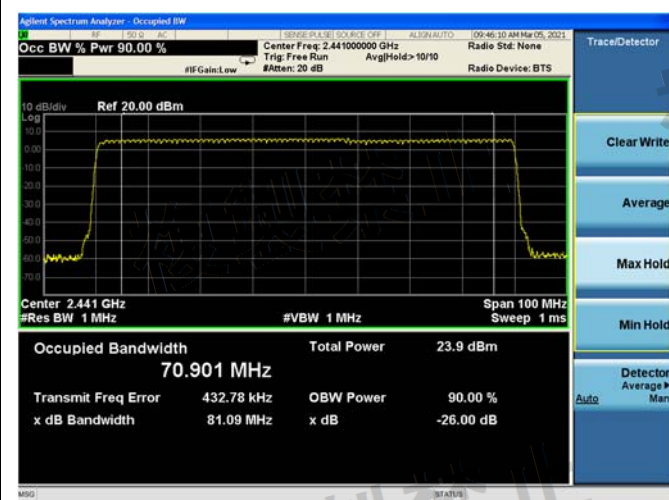
CH78, 2480MHz, HV



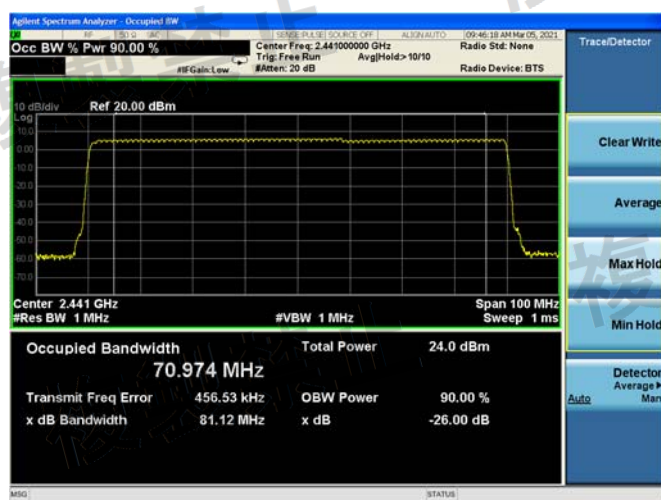


90% Spread-spectrum Bandwidth, GFSK Mode

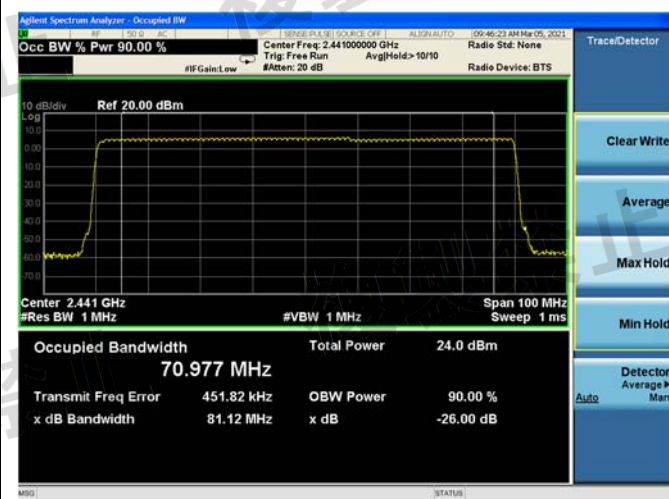
CH0, 2402MHz, LV



CH39, 2441MHz, NV

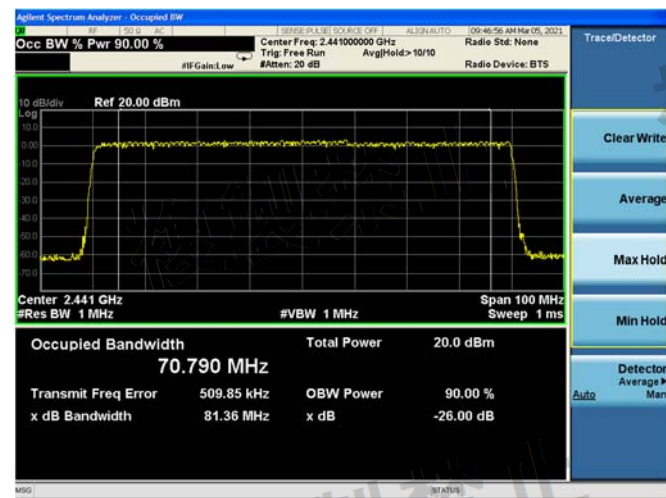


CH78, 2480MHz, HV

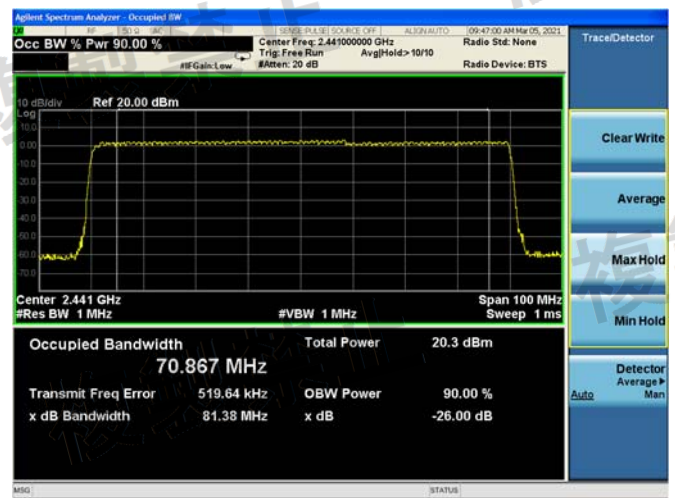


90% Spread-spectrum Bandwidth, $\pi/4$ -DQPSK Mode

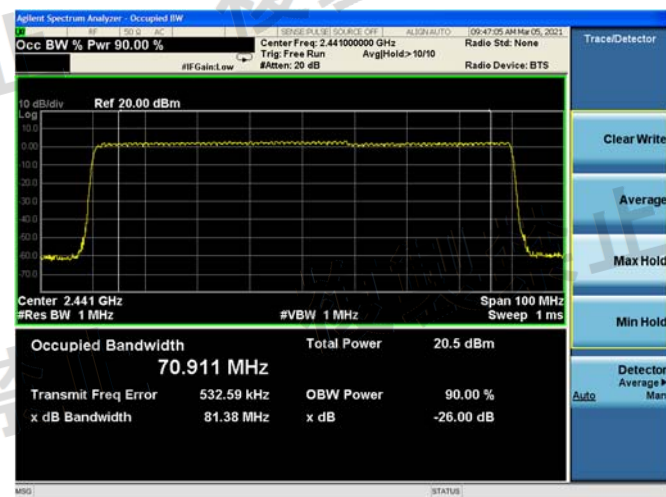
CH0, 2402MHz, LV



CH39, 2441MHz, NV



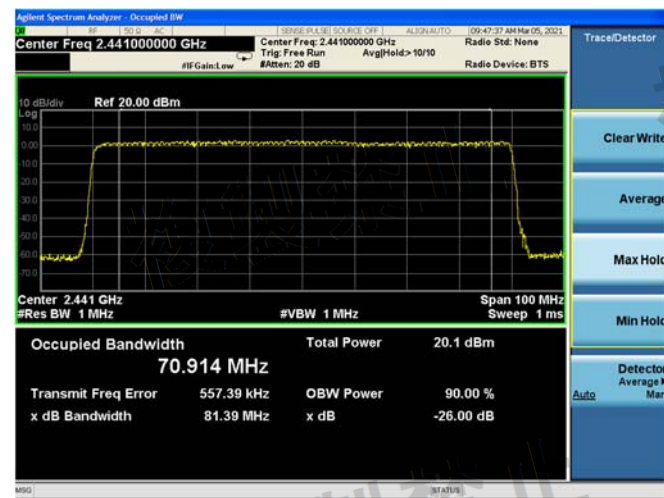
CH78, 2480MHz, HV





90% Spread-spectrum Bandwidth, 8-DPSK Mode

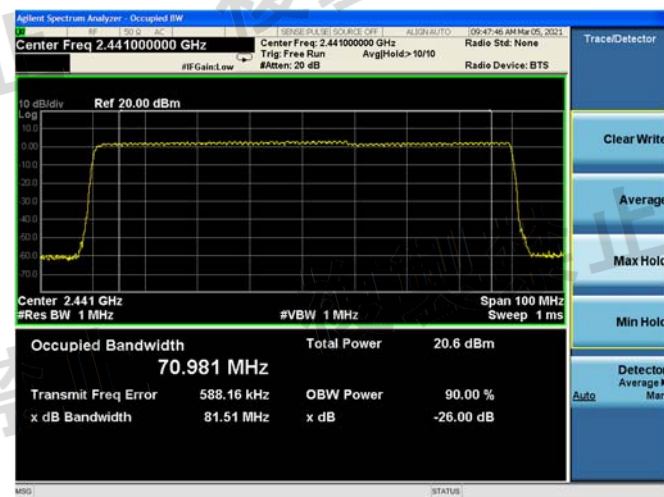
CH0, 2402MHz, LV



CH39, 2441MHz, NV



CH78, 2480MHz, HV



2.4.Unwanted Emission Intensity Measurement

2.4.1.Limit

Item	Limits
TX Spurious Emission	$\leq 2.5\mu\text{W}/\text{MHz}$ ($30\text{MHz} \leq f < 2387\text{MHz}$; $2496.5\text{MHz} < f$)
	$\leq 25\mu\text{W}/\text{MHz}$ ($2387\text{MHz} \leq f < 2400\text{MHz}$) ; ($2483.5\text{MHz} < f \leq 2496.5\text{MHz}$)

2.4.2.Measuring Instruments and Setting

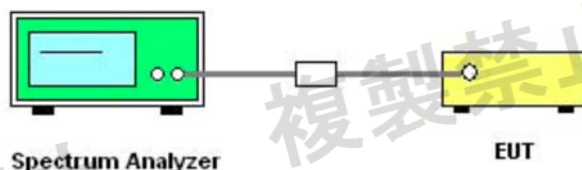
The following table is the setting of the spectrum.

Spectrum Parameter	Setting
Attenuation	Auto
RB/VB	100kHz/100kHz(below 1GHz emissions) ; 1MHz/1MHz(above 1GHz emissions)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

2.4.3.Test Procedures

1. EUT have transmitted the maximum modulation signal and fixed channelize.
2. Setting of SA is following as: RB/VB: 100 kHz/100kHz (below 1GHz emissions), 1MHz/1MHz (above 1GHz emissions) / Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold
3. Setting of SA is following as 30MHz and stop frequency 2387MHz Then to mark peak reading value + cable loss shall be less than 2.5μW.
4. SA adjusted to start frequency 2387MHz and stop frequency 2400MHz. Then to mark peak reading value + cable loss shall be less than 25μW.
5. SA adjusted to start frequency 2483.5MHz and stop frequency 2496.5MHz. Then to mark peak reading value + cable loss shall be less than 25μW
6. SA adjusted to start frequency 2496.5MHz and stop frequency 12500MHz. Then to mark peak reading value + cable loss shall be less than 2.5μW

2.4.4. Test Setup Layout



2.4.5. Test Deviation

There is no deviation with the original standard.

2.4.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

2.4.7. Test Result

GFSK Mode

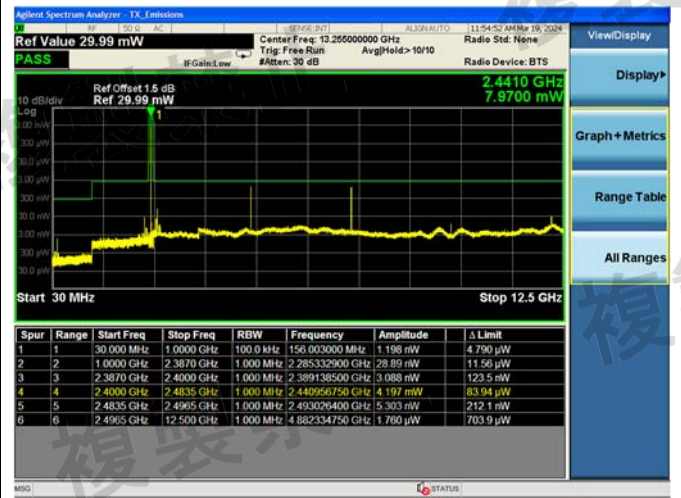
Test Channel	Test Frequency (MHz)	Test Result Value	Limit	Verdict
		Max Value		
0	30~1000	<0.25μW/100kHz	0.25μW/100kHz	PASS
	1000~2387	<2.5μW/MHz	2.5μW/MHz	PASS
	2387~2400	<25μW/MHz	25μW/MHz	PASS
	2483.5~2496.5	<25μW/MHz	25μW/MHz	PASS
	2496.5~12500	<2.5μW/MHz	2.5μW/MHz	PASS
39	30~1000	<0.25μW/100kHz	0.25μW/100kHz	PASS
	1000~2387	<2.5μW/MHz	2.5μW/MHz	PASS
	2387~2400	<25μW/MHz	25μW/MHz	PASS
	2483.5~2496.5	<25μW/MHz	25μW/MHz	PASS
	2496.5~12500	<2.5μW/MHz	2.5μW/MHz	PASS
78	30~1000	<0.25μW/100kHz	0.25μW/100kHz	PASS
	1000~2387	<2.5μW/MHz	2.5μW/MHz	PASS
	2387~2400	<25μW/MHz	25μW/MHz	PASS
	2483.5~2496.5	<25μW/MHz	25μW/MHz	PASS
	2496.5~12500	<2.5μW/MHz	2.5μW/MHz	PASS



30MHz – 12.5GHz, CH0, 2402MHz, LV



30MHz – 12.5GHz, CH39, 2441MHz, LV



30MHz – 12.5GHz, CH78, 2480MHz, LV

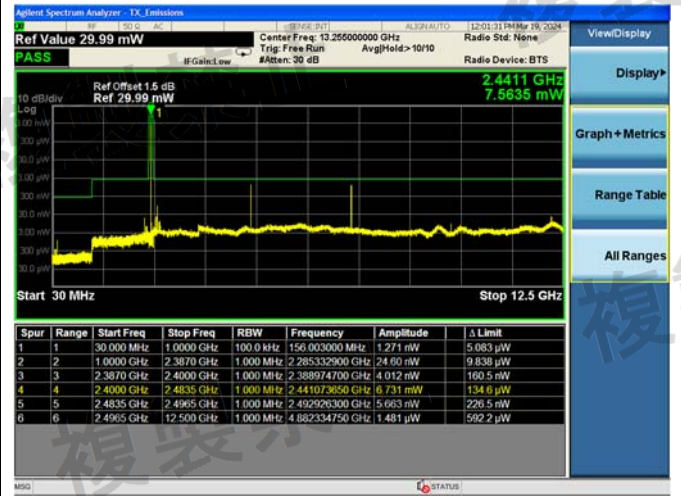




30MHz – 12.5GHz, CH0, 2402MHz, NV



30MHz – 12.5GHz, CH39, 2441MHz, NV



30MHz – 12.5GHz, CH78, 2480MHz, NV

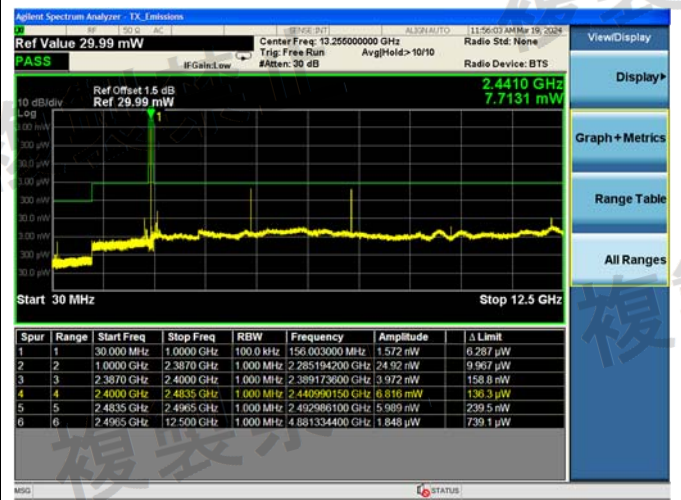




30MHz – 12.5GHz, CH0, 2402MHz, HV



30MHz – 12.5GHz, CH39, 2441MHz, HV



30MHz – 12.5GHz, CH78, 2480MHz, HV



Note 1: The spurious emissions mask that displayed on the plots is composed of several frequency ranges below:

Range	Start Freq. (MHz)	Stop Freq. (MHz)	RBW	VBW	Detector Type	Trace Mode	Limit (μW)
1	30	1000	100kHz	100kHz	Peak	Max Hold	0.25
2	1000	2387	1MHz	1MHz	Peak	Max Hold	2.5
3	2387	2400	1MHz	1MHz	Peak	Max Hold	25
4	2400	2483.5	1MHz	1MHz	Peak	Max Hold	20000
5	2483.5	2496.5	1MHz	1MHz	Peak	Max Hold	25
6	2496.5	12500	1MHz	1MHz	Peak	Max Hold	2.5

Note 2: Only the spurious with the minimum margin from the limit line will be displayed in the mark table(The lower window on the test plots).

 $\pi/4$ -DQPSK Mode

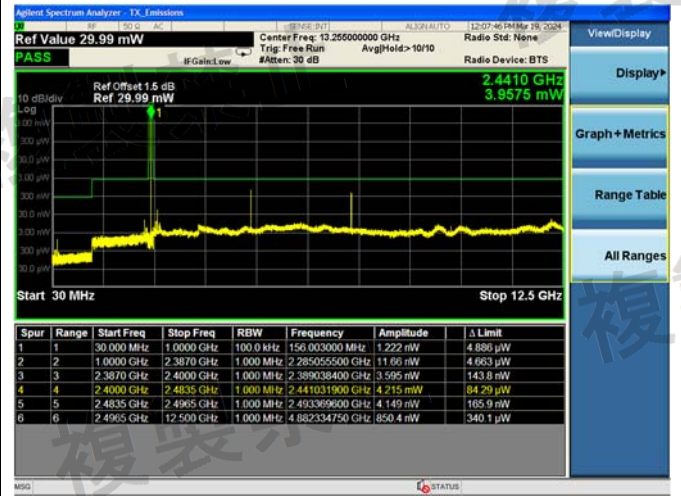
Test Channel	Test Frequency (MHz)	Test Result Value	Limit	Verdict
		Max Value		
0	30~1000	<0.25 μ W/100kHz	0.25 μ W/100kHz	PASS
	1000~2387	<2.5 μ W/MHz	2.5 μ W/MHz	PASS
	2387~2400	<25 μ W/MHz	25 μ W/MHz	PASS
	2483.5~2496.5	<25 μ W/MHz	25 μ W/MHz	PASS
	2496.5~12500	<2.5 μ W/MHz	2.5 μ W/MHz	PASS
39	30~1000	<0.25 μ W/100kHz	0.25 μ W/100kHz	PASS
	1000~2387	<2.5 μ W/MHz	2.5 μ W/MHz	PASS
	2387~2400	<25 μ W/MHz	25 μ W/MHz	PASS
	2483.5~2496.5	<25 μ W/MHz	25 μ W/MHz	PASS
	2496.5~12500	<2.5 μ W/MHz	2.5 μ W/MHz	PASS
78	30~1000	<0.25 μ W/100kHz	0.25 μ W/100kHz	PASS
	1000~2387	<2.5 μ W/MHz	2.5 μ W/MHz	PASS
	2387~2400	<25 μ W/MHz	25 μ W/MHz	PASS
	2483.5~2496.5	<25 μ W/MHz	25 μ W/MHz	PASS
	2496.5~12500	<2.5 μ W/MHz	2.5 μ W/MHz	PASS



30MHz – 12.5GHz, CH0, 2402MHz, LV



30MHz – 12.5GHz, CH39, 2441MHz, LV



30MHz – 12.5GHz, CH78, 2480MHz, LV

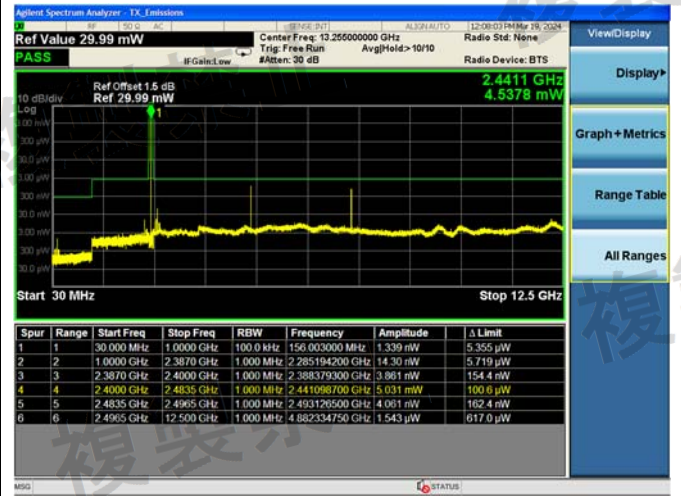




30MHz – 12.5GHz, CH0, 2402MHz, NV



30MHz – 12.5GHz, CH39, 2441MHz, NV

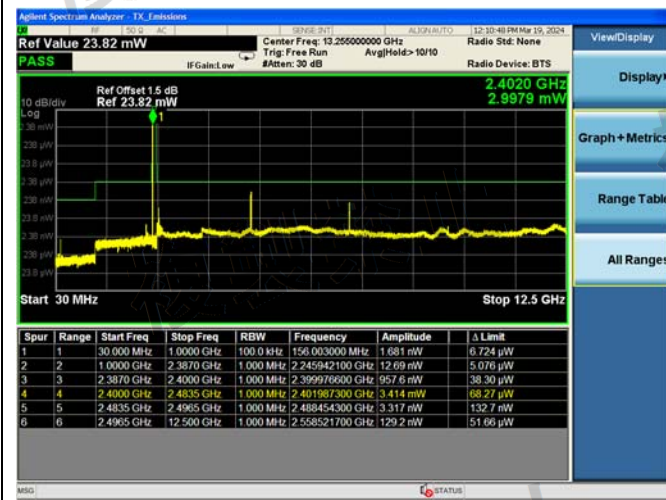


30MHz – 12.5GHz, CH78, 2480MHz, NV

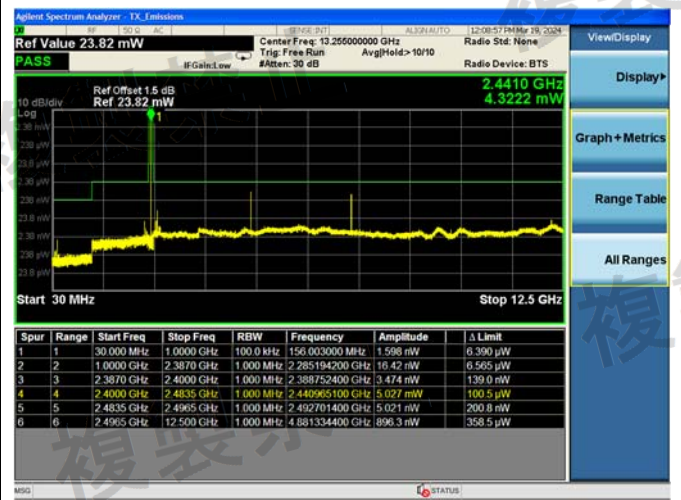




30MHz – 12.5GHz, CH0, 2402MHz, HV



30MHz – 12.5GHz, CH39, 2441MHz, HV



30MHz – 12.5GHz, CH78, 2480MHz, HV



Note1: The spurious emissions mask that displayed on the plots is composed of several frequency ranges below:

Range	Start Freq. (MHz)	Stop Freq. (MHz)	RBW	VBW	Detector Type	Trace Mode	Limit (μW)
1	30	1000	100kHz	100kHz	Peak	Max Hold	0.25
2	1000	2387	1MHz	1MHz	Peak	Max Hold	2.5
3	2387	2400	1MHz	1MHz	Peak	Max Hold	25
4	2400	2483.5	1MHz	1MHz	Peak	Max Hold	20000
5	2483.5	2496.5	1MHz	1MHz	Peak	Max Hold	25
6	2496.5	12500	1MHz	1MHz	Peak	Max Hold	2.5

Note 2: Only the spurious with the minimum margin from the limit line will be displayed in the mark table (The lower window on the test plots).



8-DPSK Mode

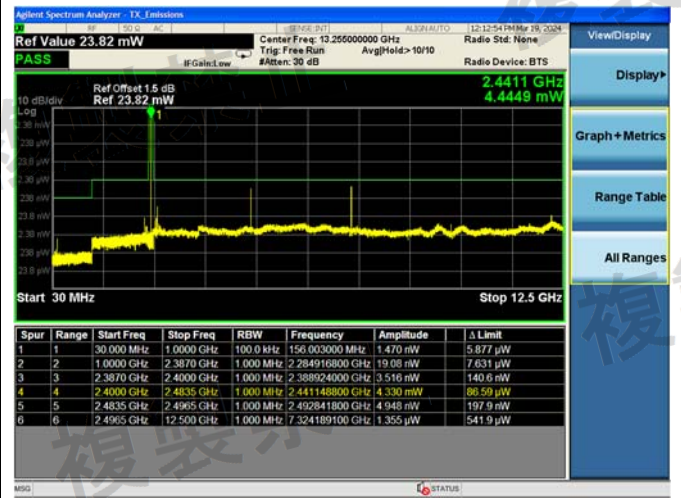
Test Channel	Test Frequency (MHz)	Test Result Value	Limit	Verdict
		Max Value		
0	30~1000	<0.25μW/100kHz	0.25μW/100kHz	PASS
	1000~2387	<2.5μW/MHz	2.5μW/MHz	PASS
	2387~2400	<25μW/MHz	25μW/MHz	PASS
	2483.5~2496.5	< 25μW/MHz	25μW/MHz	PASS
	2496.5~12500	<2.5μW/MHz	2.5μW/MHz	PASS
39	30~1000	<0.25μW/100kHz	0.25μW/100kHz	PASS
	1000~2387	<2.5μW/MHz	2.5μW/MHz	PASS
	2387~2400	<25μW/MHz	25μW/MHz	PASS
	2483.5~2496.5	< 25μW/MHz	25μW/MHz	PASS
	2496.5~12500	<2.5μW/MHz	2.5μW/MHz	PASS
78	30~1000	<0.25μW/100kHz	0.25μW/100kHz	PASS
	1000~2387	<2.5μW/MHz	2.5μW/MHz	PASS
	2387~2400	<25μW/MHz	25μW/MHz	PASS
	2483.5~2496.5	< 25μW/MHz	25μW/MHz	PASS
	2496.5~12500	<2.5μW/MHz	2.5μW/MHz	PASS



30MHz – 12.5GHz, CH0, 2402MHz, LV



30MHz – 12.5GHz, CH39, 2441MHz, LV



30MHz – 12.5GHz, CH78, 2480MHz, LV

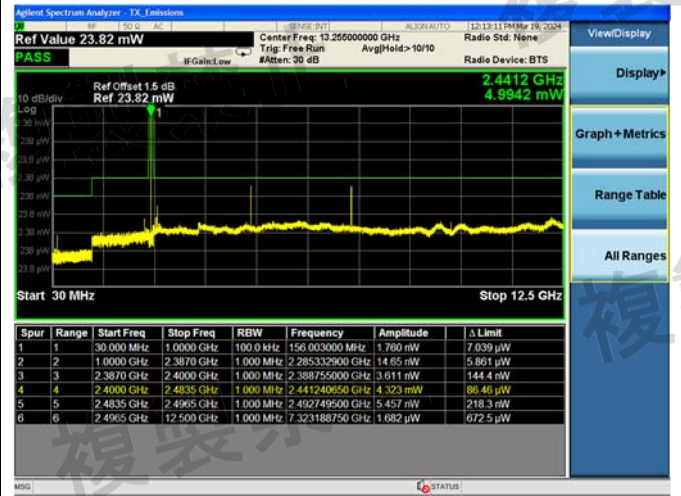




30MHz – 12.5GHz, CH0, 2402MHz, NV

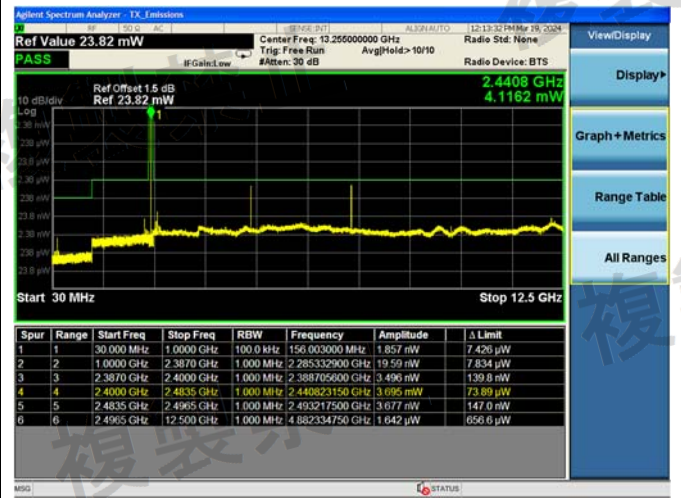


30MHz – 12.5GHz, CH39, 2441MHz, NV



30MHz – 12.5GHz, CH78, 2480MHz, NV



**30MHz – 12.5GHz, CH0, 2402MHz, HV****30MHz – 12.5GHz, CH39, 2441MHz, HV****30MHz – 12.5GHz, CH78, 2480MHz, HV**

Note 1: The spurious emissions mask that displayed on the plots is composed of several frequency ranges below:

Range	Start Freq. (MHz)	Stop Freq. (MHz)	RBW	VBW	Detector Type	Trace Mode	Limit (μW)
1	30	1000	100kHz	100kHz	Peak	Max Hold	0.25
2	1000	2387	1MHz	1MHz	Peak	Max Hold	2.5
3	2387	2400	1MHz	1MHz	Peak	Max Hold	25
4	2400	2483.5	1MHz	1MHz	Peak	Max Hold	20000
5	2483.5	2496.5	1MHz	1MHz	Peak	Max Hold	25
6	2496.5	12500	1MHz	1MHz	Peak	Max Hold	2.5

Note 2: Only the spurious with the minimum margin from the limit line will be displayed in the mark table (The lower window on the test plots).

2.5. Antenna Power Error Measurement

2.5.1. Limit

Item	Limits
Antenna Power Density	$\leq 3\text{mW/MHz}$ (FH form 2400~2483.5MHz) $\leq 10\text{mW/MHz}$ (OFDM, DS from 2400~2483.5MHz, 802.11b/g/n20) $\leq 5\text{mW/MHz}$ (OFDM, from 2400~2483.5MHz, 802.11n40) $\leq 10\text{ mW}$ (Other from 2400~2483.5MHz)
Antenna Power Error	+20%, -80% (Base on manufacturer declare antenna power density)

2.5.2. Measuring Instruments and Setting

The following table is the setting of the power meter.

Power Meter Parameter	Setting
Filter No.	Auto
Measurement time	0.135 s ~ 26 s
Used Average Sensor	NRV-Z55

2.5.3. Test Procedures

1. EUT has transmitted continuous maximum power of hopping mode (For FHSS Device).
2. The antenna power is equal to the power meter value dBm + cable loss dB + $10 \log_{10}(1/\text{Duty cycle})$ dB + $10 \log_{10}(1/\text{Spread Spectrum Bandwidth})$ dB
3. Antenna Power Error is definition that actual measure antenna power tolerance between +20% to -80% power range that base on manufacturer declare the conducted power density.

2.5.4. Test Setup Layout



2.5.5. Test Deviation

There is no deviation with the original standard.



2.5.6.EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

2.5.7.Test Result

GFSK Mode

Duty cycle =0.7707, Manufacturer declare the conducted power density = 0.08mW/MHz

Test Voltage	Spread-spectrum Bandwidth (MHz)	Power Test Value (dBm)	Antenna Power Density PD (dBm/ MHz)	Antenna Power Density PD (mW / MHz)	Antenna Power Error	Verdict
LV	70.90	0.23	-17.15	0.019	-75.88%	PASS
NV	70.97	0.24	-17.14	0.019	-75.85%	PASS
HV	70.98	0.21	-17.17	0.019	-76.02%	PASS

$\pi/4$ -DQPSK Mode

Duty cycle =0.7733, Manufacturer declare the conducted power density = 0.07mW/MHz

Test Voltage	Spread-spectrum Bandwidth (MHz)	Power Test Value (dBm)	Antenna Power Density PD (dBm/ MHz)	Antenna Power Density PD (mW / MHz)	Antenna Power Error	Verdict
LV	70.79	0.40	-16.98	0.020	-71.39%	PASS
NV	70.87	0.41	-16.98	0.020	-71.35%	PASS
HV	70.91	0.35	-17.04	0.020	-71.76%	PASS

8-DPSK Mode

Duty cycle =0.7760, Manufacturer declare the conducted power density = 0.05mW/MHz

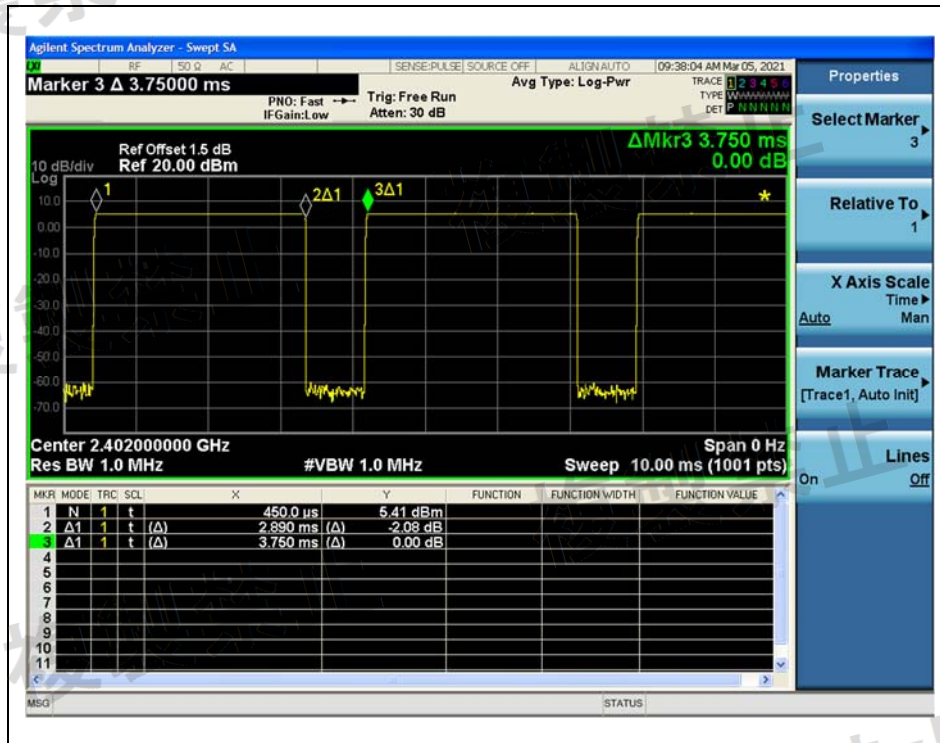
Test Voltage	Spread-spectrum Bandwidth (MHz)	Power Test Value (dBm)	Antenna Power Density PD (dBm/ MHz)	Antenna Power Density PD (mW / MHz)	Antenna Power Error	Verdict
LV	70.91	0.13	-17.28	0.019	-62.55%	PASS
NV	71.01	0.16	-17.25	0.019	-62.34%	PASS
HV	70.98	0.21	-17.20	0.019	-61.89%	PASS

Note: Antenna Power tolerance = $(PD - PD_c) / PD_c$

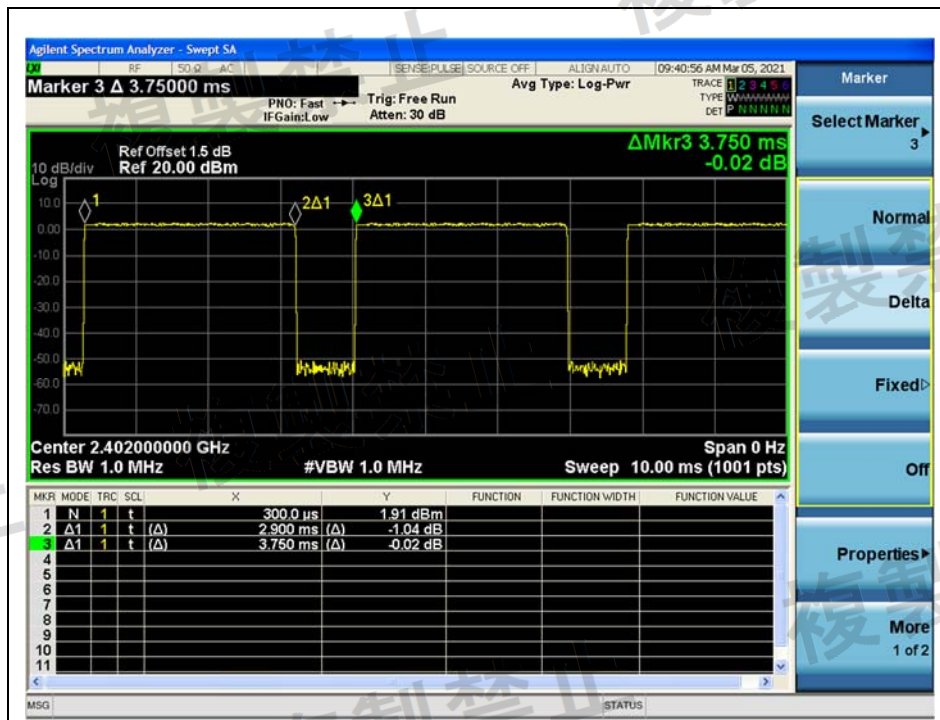
$$PD = P_t + 10 \cdot \log(1/X) + 10 \cdot \log(1/B)$$

PD: Antenna Power Density; X: Duty cycle; B: Spread-spectrum Bandwidth

P_t: Power test value; PD_c: The conducted power density declared by manufacturer.

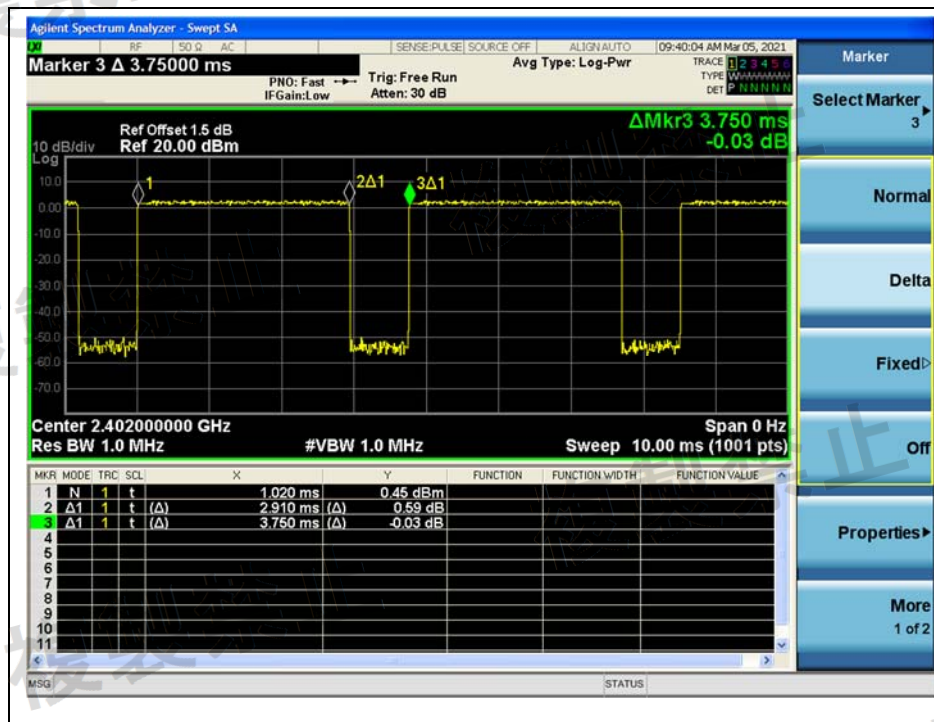


(Duty cycle, GFSK)


(Duty cycle, $\pi/4$ -DQPSK)



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(Duty cycle, 8-DPSK)

2.6.Limitation of Collateral Emission of Receiver Measurement

2.6.1.Limit

Item	Limits
RX Spurious Emission	$\leq 4\text{nW}$ ($f < 1\text{GHz}$)
	$\leq 20\text{nW}$ ($1\text{GHz} \leq f$)

2.6.2.Measuring Instruments and Setting

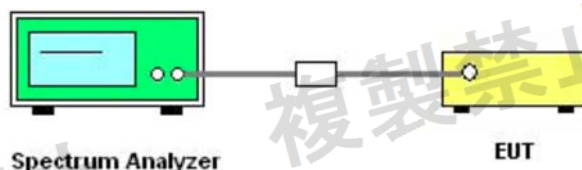
The following table is the setting of the spectrum.

Spectrum Parameter	Setting
Attenuation	Auto
RB/VB	100KHz/100KHz(below 1GHz emissions) ; 1MHz/1MHz(above 1GHz emissions)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

2.6.3.Test Procedures

- EUT has the continuous reception mode and fixed only one channelize.
- Setting of SA is following as Setting of SA is following as: RB/VB: 100 kHz/100kHz(below 1GHz emissions), 1MHz/1MHz(above 1GHz emissions) / Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold
- Adjust to start frequency 30MHz and stop frequency 1000MHz. Search to mark peak reading value + cable loss shall be less than 4nW
- Adjust to start frequency 1000MHz and stop frequency 12500MHz. Search to mark peak reading value + cable loss shall be less than 20nW
- If power level of lower emissions are more than 1/10 of limit (0.4nW for $f < 1\text{GHz}$, 2nW for $f \geq 1\text{GHz}$), all those are to be indicated in the 2nd and 3rd lines. If others are 1/10 or less more of the limit, no necessary to be indicated

2.6.4.Test Setup Layout



2.6.5.Test Deviation

There is no deviation with the original standard.

2.6.6.EUT Operation during Test

The EUT was programmed to be in continuously receiving mode.

2.6.7.Test Result

GFSK Mode

Test Channel	Test Frequency (MHz)	Measured Max. Emission (nW)	Limit (nW)	Verdict
0	30~1000	<4	≤4 (f<1GHz);	PASS
	1000~12500	<20	≤20 (1GHz≤f)	PASS
39	30~1000	< 4	≤4 (f<1GHz);	PASS
	1000~12500	<20	≤20 (1GHz≤f)	PASS
78	30~1000	< 4	≤4 (f<1GHz);	PASS
	1000~12500	<20	≤20 (1GHz≤f)	PASS



30MHz – 12.5GHz, CH0, 2402MHz, LV



30MHz – 12.5GHz, CH39, 2441MHz, LV



30MHz – 12.5GHz, CH78, 2480MHz, LV





30MHz – 12.5GHz, CH0, 2402MHz, NV

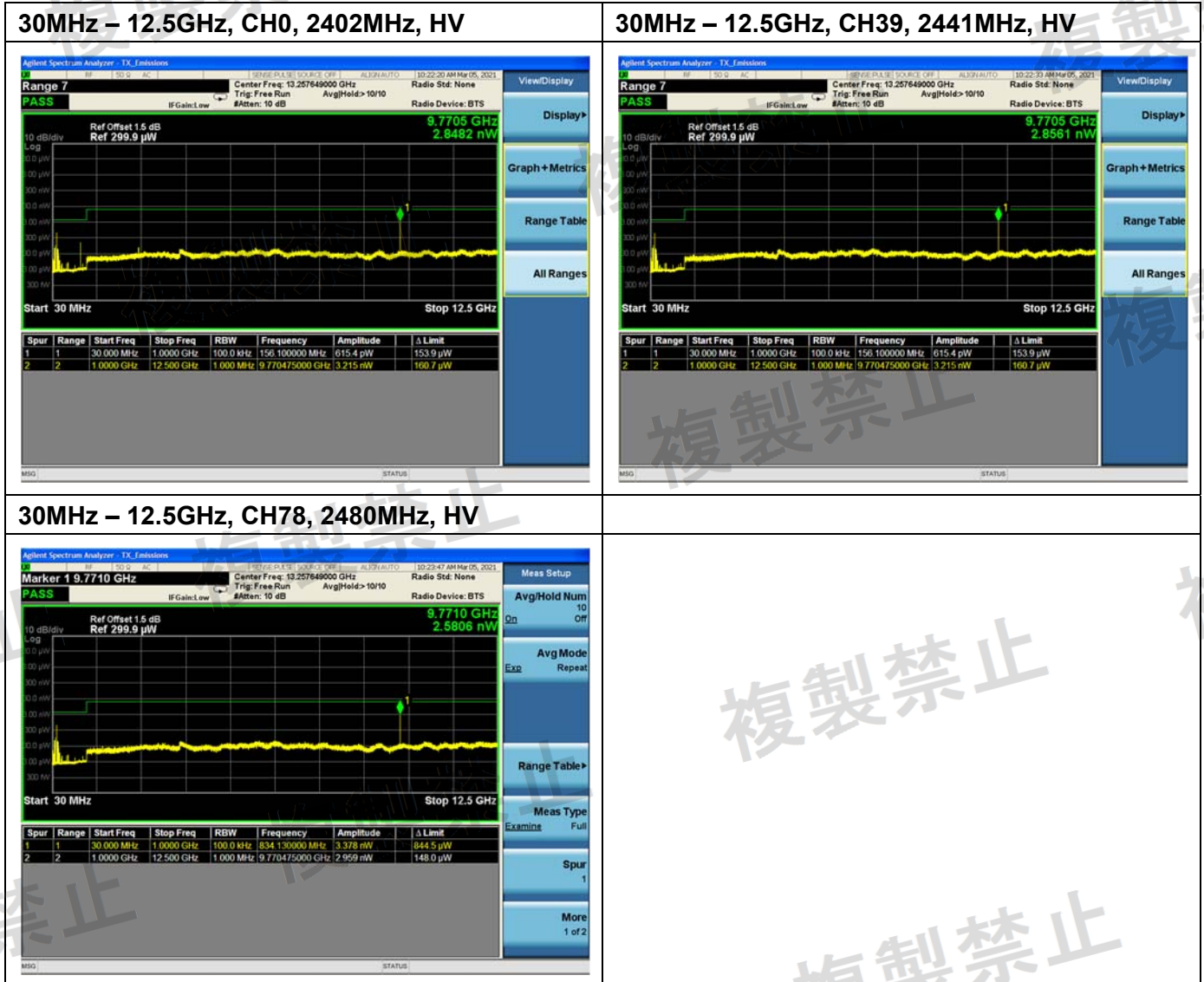


30MHz – 12.5GHz, CH39, 2441MHz, NV



30MHz – 12.5GHz, CH78, 2480MHz, NV





Note 1: The spurious emissions mask that displayed on the plots is composed of several frequency ranges below:

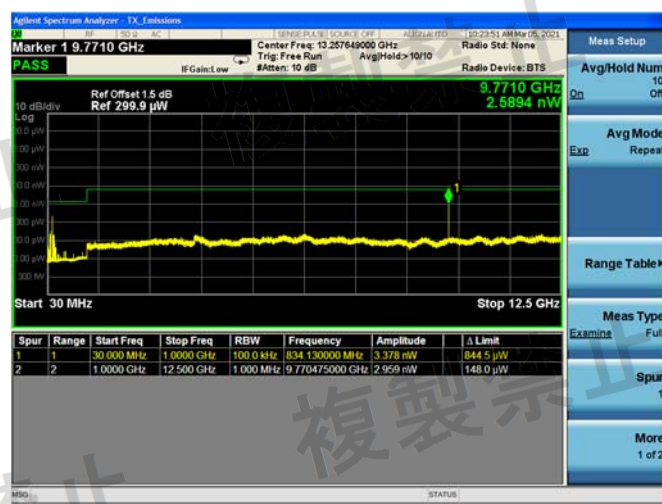
Range	Start Freq. (MHz)	Stop Freq. (MHz)	RBW	VBW	Detector Type	Trace Mode	Limit (nW)
1	30	1000	100kHz	100kHz	Peak	Max Hold	4
2	1000	12500	1MHz	1MHz	Peak	Max Hold	20

Note 2: Only the spurious with the minimum margin from the limit line will be displayed in the mark table (The lower window on the test plots).

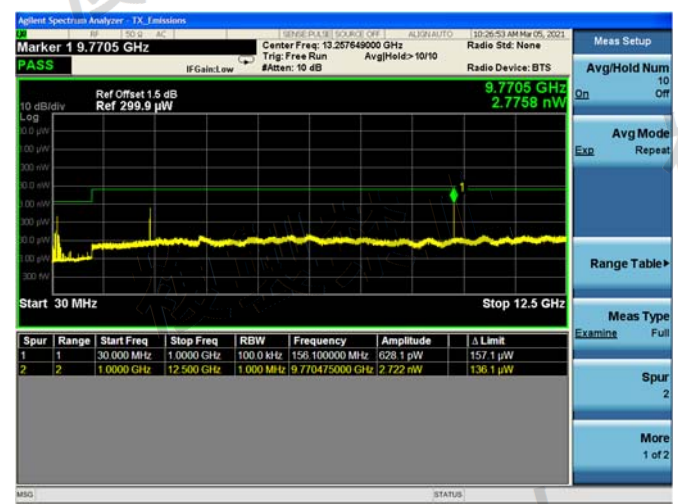
 $\pi/4$ -DQPSK Mode

Test Channel	Test Frequency (MHz)	Measured Max. Emission (nW)	Limit (nW)	Verdict
0	30~1000	<4	≤ 4 ($f < 1\text{GHz}$);	PASS
	1000~12500	<20	≤ 20 ($1\text{GHz} \leq f$)	PASS
39	30~1000	< 4	≤ 4 ($f < 1\text{GHz}$);	PASS
	1000~12500	<20	≤ 20 ($1\text{GHz} \leq f$)	PASS
78	30~1000	< 4	≤ 4 ($f < 1\text{GHz}$);	PASS
	1000~12500	<20	≤ 20 ($1\text{GHz} \leq f$)	PASS

30MHz – 12.5GHz, CH0, 2402MHz, LV



30MHz – 12.5GHz, CH39, 2441MHz, LV



30MHz – 12.5GHz, CH78, 2480MHz, LV





30MHz – 12.5GHz, CH0, 2402MHz, NV



30MHz – 12.5GHz, CH39, 2441MHz, NV



30MHz – 12.5GHz, CH78, 2480MHz, NV





30MHz – 12.5GHz, CH0, 2402MHz, HV



30MHz – 12.5GHz, CH39, 2441MHz, HV



30MHz – 12.5GHz, CH78, 2480MHz, HV



Note 1: The spurious emissions mask that displayed on the plots is composed of several frequency ranges below:

Range	Start Freq. (MHz)	Stop Freq. (MHz)	RBW	VBW	Detector Type	Trace Mode	Limit (nW)
1	30	1000	100kHz	100kHz	Peak	Max Hold	4
2	1000	12500	1MHz	1MHz	Peak	Max Hold	20

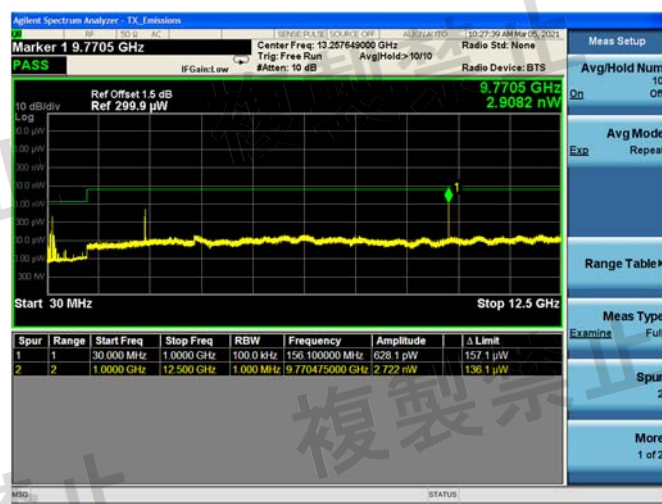
Note 2: Only the spurious with the minimum margin from the limit line will be displayed in the mark table (The lower window on the test plots).



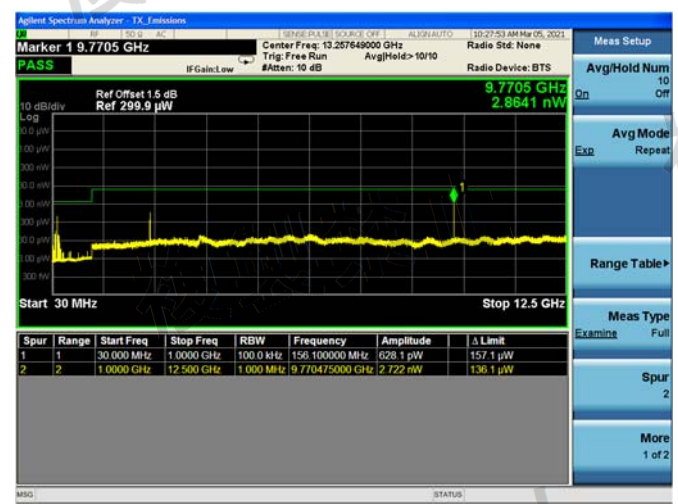
8-DPSK Mode

Test Channel	Test Frequency (MHz)	Measured Max. Emission (nW)	Limit (nW)	Verdict
0	30~1000	<4	≤4 (f<1GHz);	PASS
	1000~12500	<20	≤20 (1GHz≤f)	PASS
39	30~1000	< 4	≤4 (f<1GHz);	PASS
	1000~12500	<20	≤20 (1GHz≤f)	PASS
78	30~1000	< 4	≤4 (f<1GHz);	PASS
	1000~12500	<20	≤20 (1GHz≤f)	PASS

30MHz – 12.5GHz, CH0, 2402MHz, LV



30MHz – 12.5GHz, CH39, 2441MHz, LV



30MHz – 12.5GHz, CH78, 2480MHz, LV





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30MHz – 12.5GHz, CH0, 2402MHz, NV



30MHz – 12.5GHz, CH39, 2441MHz, NV



30MHz – 12.5GHz, CH78, 2480MHz, NV





30MHz – 12.5GHz, CH0, 2402MHz, HV



30MHz – 12.5GHz, CH39, 2441MHz, HV



30MHz – 12.5GHz, CH78, 2480MHz, HV



Note 1: The spurious emissions mask that displayed on the plots is composed of several frequency ranges below:

Range	Start Freq. (MHz)	Stop Freq. (MHz)	RBW	VBW	Detector Type	Trace Mode	Limit (nW)
1	30	1000	100kHz	100kHz	Peak	Max Hold	4
2	1000	12500	1MHz	1MHz	Peak	Max Hold	20

Note 2: Only the spurious with the minimum margin from the limit line will be displayed in the mark table (The lower window on the test plots).



2.7. Transmission Antenna Gain (E.I.R.P. Antenna Power) Measurement

2.7.1. Limit

Item	Limits
E.I.R.P. Power	12.14dBm/MHz or 22.14 dBm/MHz (OFDM,DS from 2400~2483.5MHz,802.11b/g/n20) 9.13dBm/MHz or 19.13 dBm/MHz (OFDM, from 2400~2483.5MHz,802.11n40) 12.14dBm or 22.14 dBm (Others from 2400~2483.5MHz) 6.91 dBm/MHz or 16.91 dBm/MHz(FH from 2400~2483.5MHz)
Note: This test item will not be applied to the transmission antenna which has a gain of 2.14dBi or less.	

2.7.2. Measuring Instruments and Setting

The following table is the setting of the spectrum.

Spectrum Parameter	Setting
RB/VB	1MHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

2.7.3. Test Procedures

1. Set EUT and measuring antenna at the same height and roughly facing each other.
2. Move the measuring antenna height up and down within $\pm 50\text{cm}$ of EUT height and swing it to find the maximum output of the measuring antenna. The output level at the spectrum analyzer is read as "E".
3. Remove the EUT from the turn table and put the replacing antenna facing to measuring antenna at same height. Set the standard signal generator (SSG) at same frequency and transmit on then receive the signal
4. Swing the replacing antenna give a maximum receiving level.
5. Move the measuring antenna height up and down within $\pm 50\text{cm}$ of replacing antenna height and swing it to find the maximum receiving level.
6. Set SSG output power at P_t to give the equivalent output level of "E" or calculate P_t with SSG output which gives the nearest of "E" and difference ($\pm 1\text{dB}$). Record the P_t .
7. Calculate E.I.R.P. by the formula below $E.I.R.P. = G_t - L + P_t$.

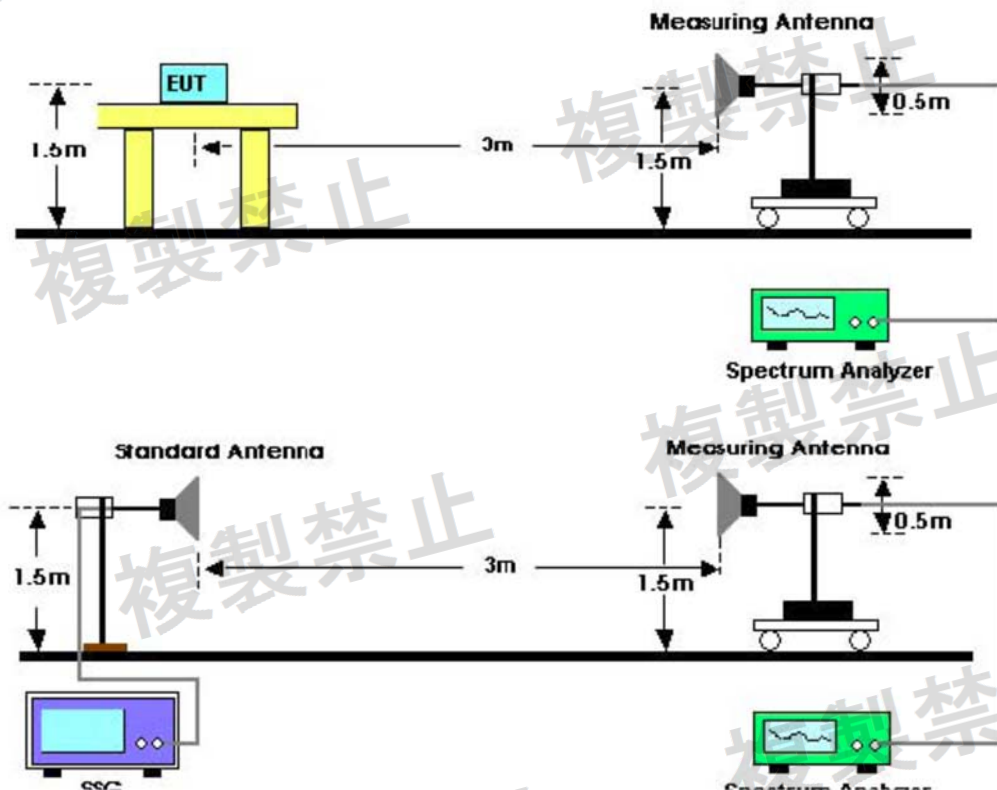
G_t : gain of replacing antenna (dBi)

L : feeder loss between SSG and replacing antenna

P_t : Output power of the SSG

8. If the antenna for the EUT has circular polarization, sum of V-field and H-field will be result if measuring antenna is linear polarization.

2.7.4. Test Setup Layout



2.7.5. Test Deviation

There is no deviation with the original standard.

2.7.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.



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2.7.7. Test Result

Test Mode	Measured E.I.R.P. (dBm/MHz)	Limit (dBm/MHz)	Verdict
GFSK	-14.85	6.91	PASS
$\pi/4$ -DQPSK	-14.69		PASS
8-DPSK	-14.91		PASS

2.8. Transmission Radiation Angle Width (3dB Beamwidth) Measurement

2.8.1. Limit

Item	Limits
3dB antenna beamwidth	$360/A$ (If $A < 1$; then $A = 1$) $A = \{E.I.R.P. / 12.14 \text{ for DS, OFDM, Other Digital Methods}\}$ or $A = \{E.I.R.P. / 6.91 \text{ for FHSS operating in 2400MHz-2483.5MHz}\}$
Note: This test item will not be applied to the transmission antenna which has a gain of 2.14dBi or less	

2.8.2. Measuring Instruments and Setting

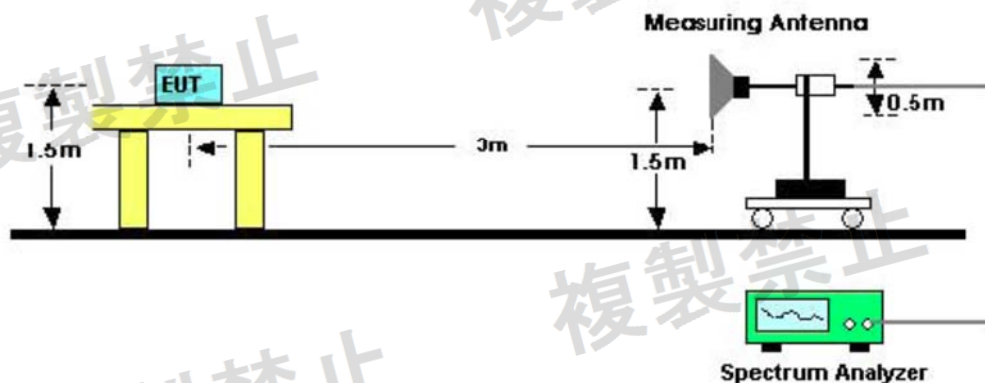
The following table is the setting of the spectrum.

Spectrum Parameter	Setting
RB	1 MHz
VB	1 KHz
Y scale	5 dB
Detector	Peak
Trace	Max Hold

2.8.3. Test Procedures

1. Set EUT and measuring antenna at the same height and roughly facing each other.
2. Set spectrum analyzer with condition in section 4.7.2 and tune reference level to observe receiving signal position.
3. Rotate directions of the EUT horizontally and vertically to find the maximum receiving power.
4. Move the measuring antenna height up and down within $\pm 50\text{cm}$ of EUT height and swing it to find the maximum output of measuring antenna. The output level at the spectrum analyzer is read as "E"
5. Calculate 3dB antenna beam width by the formula below $360/A$ (If $A < 1$; then $A = 1$). $A = \{E.I.R.P. \text{ Power [mW]} / 16.36 \text{ for DS, OFDM}\}$ or $A = \{E.I.R.P. \text{ Power [mW]} / 4.9 \text{ for FH}\}$

2.8.4. Test Setup Layout



2.8.5. Test Deviation

There is no deviation with the original standard.

2.8.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

2.8.7. Test Result

Test Mode	Measured E.I.R.P. (dBm/MHz)	3dB Beamwidth (Degree)	Limit (Degree)	Verdict
GFSK	-14.85	91	360	PASS
$\pi/4$ -DQPSK	-14.69	101	360	PASS
8-DPSK	-14.91	116	360	PASS

2.9. Radio Interference Prevention Capability Measurement

2.9.1. Limit

Item	Limits
Identification	≥ 48 bits

2.9.2. Test Procedures

1. In the case that the EUT has the function of automatically transmitting the identification code: a. Transmit the predetermined identification codes from EUT. b. Check the transmitted identification codes with the demodulator.
2. In the case of receiving the identification code: a. Transmit the predetermined identification codes from the counterpart. b. Check if communication is normal. c. Transmit the signals other than predetermined ID codes from the counterpart. d. check if the EUT stops the transmission, or if it displays that identification codes are different from the predetermined ones.

2.9.3. Test Setup Layout



2.9.4. Test Deviation

There is no deviation with the original standard.

2.9.5. EUT Operation during Test

The EUT was programmed to be in normal mode.

2.9.6. Test Result

The identification function is good.

2.10. Construction Protection Confirmation Method Limit

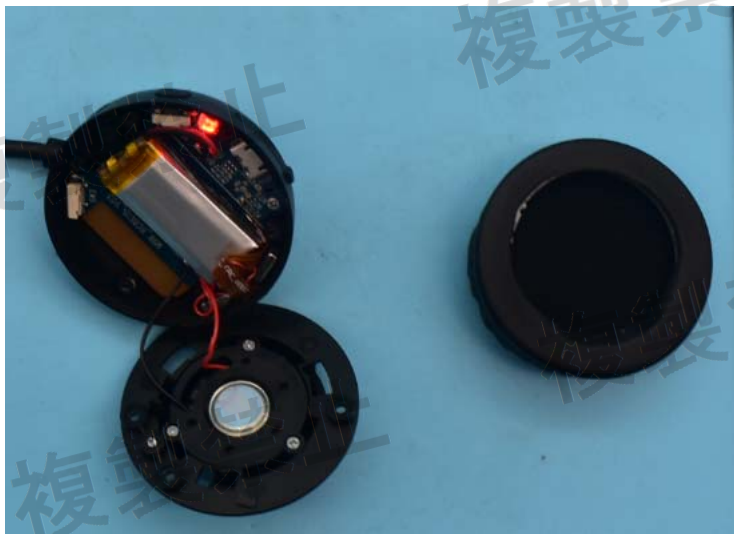
The high-frequency section and modulation section of the radio equipment except for the antenna system shall not be capable of being opened easily.

2.10.1. Confirmation Method

The RF and modulation portions are protected against illegal modification as following method:

Protected Method	Description
Surface Mount Technology	RF and Modulation part are mounted on PCB with surface mount technology and there are no any adjustable parts on PCB or adjustable parts are not exposed.

2.10.2. Reference Documents

Reference Documents	Item
Photo	



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Annex A Test Uncertainty

Test Items	Uncertainty	Remark
Frequency Error / 99% & 90% Bandwidth	$\pm 1.75 \times 10^{-6}$	Confidence levels of 95%
Antenna Power	$\pm 0.849\text{dB}$	Confidence levels of 95%
TX-RX Spurious Emissions	$\pm 0.614\text{dB}$	Confidence levels of 95%
Transmission Antenna Gain	$\pm 2.49\text{dB}$	Confidence levels of 95%
Temperature	$\pm 0.8^{\circ}\text{C}$	Confidence levels of 95%
Humidity	$\pm 4.1\%$	Confidence levels of 95%
DC / AC Power Source	$\pm 0.04\%$	Confidence levels of 95%



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Annex B Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Laboratory Address:	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China



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3. Test Equipments Utilized

Description	Manufacturer	Model	Serial No.	Cal. Date	Due Date
EXA Signal analyzer	Agilent	N9010A	MY53470836	2020.04.01	2021.03.31
				2024.02.19	2025.02.18
DC Power Supply	IVYTECH	IV3610	1709D36101 0	2020.10.26	2021.10.25
				2023.09.19	2024.09.18
Power Sensor	Agilent	U2021XA	MY54210011	2020.04.01	2021.03.31
				2023.10.17	2024. 10.16
Radio Communication Tester	R&S	CMW500	108950	2020.04.01	2021.03.31
				2024.01.25	2025.01.24
RF cable	CB01	RF01	Morlab	N/A	N/A
Note 1: The equipments were calibrated by CCIC (Shenzhen) Metrology&Testing Service Co.,Ltd and Shenzhen Academy of Metrology and Quality Inspection.					
Note 2: The cable loss is 0dB.					

List of Software Used

Description	Manufacturer	Software Version
Test System	Tonscend	V2.6
Power Panel	Agilent	V3.8

____ END OF REPORT ____