

**ARIB STD-T66 JAPAN MIC
CERTIFICATION TEST REPORT**

OF

SuperNote

MODEL No.: SN-A6

BRAND NAME: N/A

REPORT NO.: ES190610016W02

ISSUE DATE: July 16, 2019

Prepared for

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TEST RESULT CERTIFICATION

Applicant	Shanghai Ratta Smart technology Co.,Ltd Room 301, Building No.1,168 Jixin Road, Minhang, Shanghai, China
Manufacturer	Shanghai Ratta Smart technology Co.,Ltd Room 301, Building No.1,168 Jixin Road, Minhang, Shanghai, China
Factory:	Group Sense Ltd Cai Wu Industrial Park, Wusha, Chang An, Dongguan, P.R.C
Product Description	SuperNote
Brand Name	N/A
Model Number	SN-A6
File Number	ES190610016W02

Measurement Procedure Used:

APPLICABLE STANDARDS		
STANDARD	Test Procedure	TEST RESULT
ARIB STD-T66 V3.7 RE-740 49.20 MIC Requirements for Certification	MIC public notice 88:2004, annex 43 MIC public notice 88:2004, annex 1	PASS

The device described above is tested by EMTEK (SHENZHEN) CO., LTD. to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and EMTEK (SHENZHEN) CO., LTD. is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) was measured according to the test methods of Ordinance Concerning Technical Regulations Conformity Certification etc. of Specified Radio Equipment in Annex 1, the Ministry of Internal Affairs and Communication notification in Annex "43" of Article 88, Paragraph 1 or the test method more than equivalent and the result is technically compliant with the ARIB STD T-66 requirements.
The test results of this report relate only to the tested sample identified in this report

Date of Test : June 10, 2019 to July 15, 2019

Prepared by :

Yaping Shen

Yaping Shen/Editor

Joe Xia

Reviewer :

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Approve & Authorized Signer :

Lisa Wang/Manager



Modified Information

Rev.	Summary	Date of Rev.	Report No.
Ver.1.0	Original Report	/	ES190610016W02

Table of Contents

1	EUT TECHNICAL DESCRIPTION	5
2	SUMMARY OF TEST RESULT	6
3	TEST METHODOLOGY	7
3.1	GENERAL DESCRIPTION OF APPLIED STANDARDS	7
3.2	MEASUREMENT EQUIPMENT USED	7
3.3	DESCRIPTION OF TEST MODES	8
4	FACILITIES AND ACCREDITATIONS	9
4.1	FACILITIES	9
4.2	LABORATORY ACCREDITATIONS AND LISTINGS	9
5	TEST SYSTEM UNCERTAINTY	10
6	SETUP OF EQUIPMENT UNDER TEST	11
6.1	RADIO FREQUENCY TEST SETUP 1.....	11
6.2	RADIO FREQUENCY TEST SETUP 2.....	11
6.3	CONDUCTED EMISSION TEST SETUP	12
6.4	SUPPORT EQUIPMENT.....	12
7	WIRELESS MODULE VOLTAGE TEST IN EXTREME CONDITIONS	13
7.1	APPLICABLE STANDARD	13
7.2	TEST CONFIGURATION	13
7.3	TEST RESULTS.....	14
8	TEST REQUIREMENTS	15
8.1	FREQUENCY ERROR.....	15
8.2	OCCUPIED BANDWIDTH	17
8.3	SPREADING BANDWIDTH.....	21
8.4	HOPPING FREQUENCY STAYING TIME (DWELL TIME)	31
8.5	POWER TO ANTENNA (CONDUCTED).....	35
8.6	SPURIOUS EMISSIONS INTENSITY	39
8.7	COLLATERAL EMISSIONS OF RECEIVER	46
8.8	QUANTITY OF HOPPING CHANNEL	52
8.9	INTERFACE PREVENTION FUNCTION	54
9	APPENDIX I PHOTOGRAPHS OF TEST SETUP.....	55
10	APPENDIX II PHOTOGRAPHS OF EUT.....	56

1 EUT TECHNICAL DESCRIPTION

Characteristics	Description
Device Type:	Bluetooth Device
Data Rate:	1Mbps for GFSK modulation 2Mbps for pi/4-DQPSK modulation 3Mbps for 8DPSK modulation
Modulation:	GFSK, pi/4-DQPSK, 8DPSK for Bluetooth DSS;
Operating Frequency Range(s):	2402-2480MHz for Bluetooth;
Number of Channels:	79 channels for Bluetooth DSS;
Rated Antenna Power:	2mW/MHz for Bluetooth (Hopping);
Rated Antenna Power:	3mW/MHz for Bluetooth (AFH);
Antenna Type:	FPC antenna
Antenna Peak Gain	0.37 dBi;
Power supply:	AC 5V from external power DC 3.8V from internal Li-Polymer battery
Temperature Range:	-10°C ~ +55°C
Hardware version:	PCB,SN078MA06Av1.0
Software version:	SN078.B001.1905310211.143_release

2 SUMMARY OF TEST RESULT

ARIB STD-T66 Clause	Test Parameter	Verdict	Remark
Clause 3.2(2).(4)	Frequency Error	PASS	
Clause 3.2(2).(7)	Occupied Bandwidth	PASS	
Clause 3.2(2).(8)	Spreading Bandwidth	PASS	
Clause 3.2 (11)	Hopping Frequency Staying Time (Dwell Time)	PASS	
Clause 3.2 (2)	Power to Antenna (conducted)	PASS	
Clause 3.2 (6)	Spurious emission Intensity	PASS	
Clause 3.3 (1)	Collateral Emissions of Receiver	PASS	
Clause 3.2 (10)	Quantity of Hopping Channel	PASS	
Clause 3.4 (1)	Interference prevention function	PASS	
Note1: This test item is not applicable to omnidirectional antenna			

3 TEST METHODOLOGY

3.1 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to its specifications, the EUT must comply with the requirements of the following standards:
 ARIB STD-T66 Second Generation Low Power Data Communication System/Wireless LAN System
 RE-740 49.20 MIC Requirements for Certification

3.2 MEASUREMENT EQUIPMENT USED

3.2.1 Conducted Emission Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	Due CAL.
Test Receiver	Rohde & Schwarz	ESCS30	828985/018	May 18, 2019	May 17, 2020
L.I.S.N.	Schwarzbeck	NNLK8129	8129203	May 18, 2019	May 17, 2020
50Ω Coaxial Switch	Anritsu	MP59B	M20531	May 18, 2019	May 17, 2020
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100006	May 18, 2019	May 17, 2020
Voltage Probe	Rohde & Schwarz	TK9416	N/A	May 18, 2019	May 17, 2020
I.S.N	Rohde & Schwarz	ENY22	1109.9508.02	May 18, 2019	May 17, 2020

3.2.2 Radiated Emission Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	Calibration Lab.
EMI Test Receiver	Rohde & Schwarz	ESU	1302.6005.26	May 18, 2019	May 17, 2020
Pre-Amplifier	HP	8447D	2944A07999	May 18, 2019	May 17, 2020
Bilog Antenna	Schwarzbeck	VULB9163	142	May 18, 2019	May 17, 2020
Loop Antenna	ARA	PLA-1030/B	1029	May 18, 2019	May 17, 2020
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	May 18, 2019	May 17, 2020
Horn Antenna	Schwarzbeck	BBHA 9120	D143	May 18, 2019	May 17, 2020
Cable	Schwarzbeck	AK9513	ACRX1	May 18, 2019	May 17, 2020
Cable	Rosenberger	N/A	FP2RX2	May 18, 2019	May 17, 2020
Cable	Schwarzbeck	AK9513	CRPX1	May 18, 2019	May 17, 2020
Cable	Schwarzbeck	AK9513	CRRX2	May 18, 2019	May 17, 2020

3.2.3 Radio Frequency Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	Calibration Lab.
Spectrum Analyzer	Agilent	E4407B	88156318	May 18, 2019	May 17, 2020
Spectrum Analyzer	Agilent	N9010A	My53470879	May 18, 2019	May 17, 2020
Spectrum Analyzer	R & S	FSV40	132.1-3008K3 9-100967-AP	May 18, 2019	May 17, 2020
Power meter	Anritsu	ML2495A	0824006	May 18, 2019	May 17, 2020
Power sensor	Anritsu	MA2411B	0738172	May 18, 2019	May 17, 2020
Oscilloscope	Tektronix	TDS3012B	071-0964-03	May 18, 2019	May 17, 2020

Remark: Each piece of equipment is scheduled for calibration once a year.

3.3 DESCRIPTION OF TEST MODES

The EUT has been tested under its typical operating condition.

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

Those data rates (1Mbps for Bluetooth BR GFSK modulation; 2Mbps for Bluetooth EDR pi/4-DQPSK modulation; 3Mbps for Bluetooth EDR 8DPSK modulation) were used for all tests.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Frequency and Channel list for Bluetooth v4.0 with classic mode:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	39	2441	...	...
1	2403	40	2442	76	2478
2	2404	41	2443	77	2479
...	...	...	...	78	2480

Note: $f_c = 2402\text{MHz} + k \times 1\text{MHz}$ $k=0$ to 78

Test Frequency and channel for Bluetooth v4.0 with classic mode:

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	39	2441	78	2480

4 FACILITIES AND ACCREDITATIONS

4.1 FACILITIES

All measurement facilities used to collect the measurement data are located at Bldg 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.”

4.2 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description
EMC Lab.

: Accredited by CNAS, 2016.10.24

The certificate is valid until 2022.10.28

The Laboratory has been assessed and proved to be in compliance with CNAS/CL01:2006

The Certificate Registration Number is L2291

Accredited by FCC, August 06, 2018

The certificate is valid until August 07, 2020

Designation Number: CN1204

Test Firm Registration Number: 882943

Accredited by Industry Canada, November 09, 2018

The Conformity Assessment Body Identifier is CN0008.

Certificated by VCCI, Japan

Registration No.: R-2777

Valid until 2019/10/27

Certificated by VCCI, Japan

Registration No.: G-627

Valid until 2018/11/20

Certificated by VCCI, Japan

Registration No.: C-3065

Valid until 2019/10/27

Registration No.: T-1318

Valid until 2018/03/28

Name of Firm

: EMTEK (SHENZHEN) CO., LTD.

Site Location

: Bldg 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China

5 TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

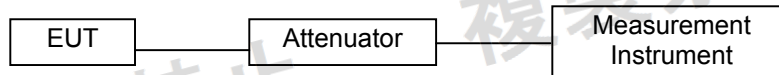
Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-5}$
Uncertainty for Output power test	$\pm 0.83\text{dB}$
Conducted Emissions Test	$\pm 2.0\text{dB}$
Radiated Emission Test	$\pm 2.0\text{dB}$
Occupied Bandwidth Test	$\pm 1.0\text{dB}$
Power density test	$\pm 1.85\text{dB}$
All emission, radiated	$\pm 3\text{dB}$
Antenna Port Emission	$\pm 3\text{dB}$
Temperature	$\pm 0.5^{\circ}\text{C}$
Humidity	$\pm 3\%$

Measurement Uncertainty for a level of Confidence of 95%

6 SETUP OF EQUIPMENT UNDER TEST

6.1 RADIO FREQUENCY TEST SETUP 1

The Bluetooth v4.0 with classic mode component's antenna ports(s) of the EUT are connected to the measurement instrument per an appropriate attenuator. The EUT is controlled by PC/software to emit the specified signals for the purpose of measurements.

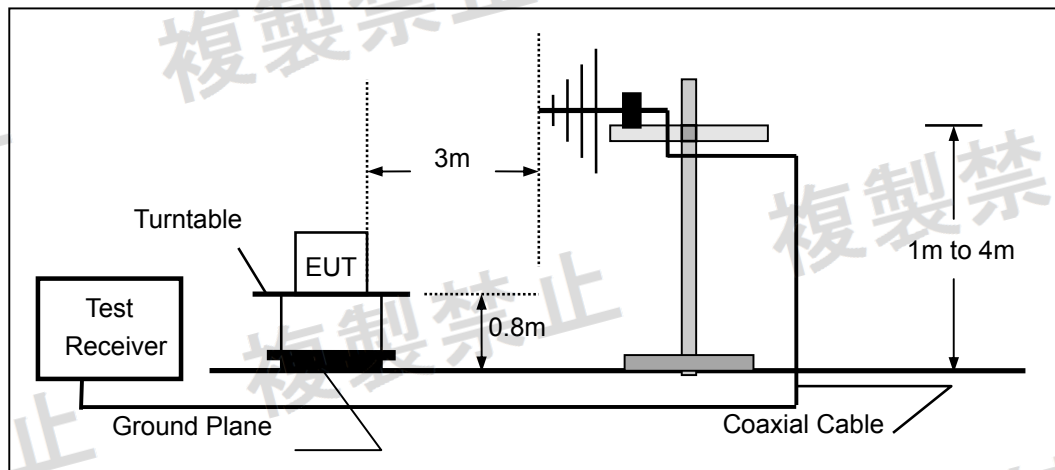


6.2 RADIO FREQUENCY TEST SETUP 2

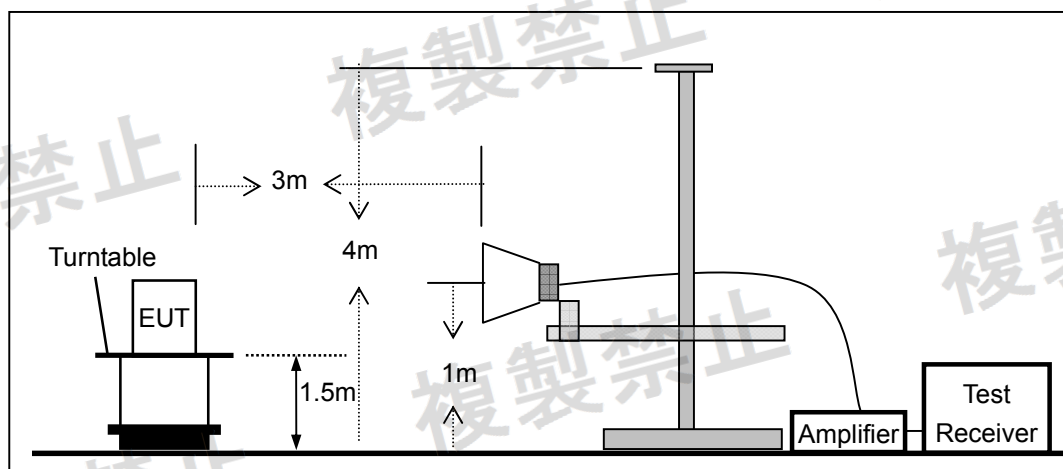
The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.4. The test distance is 3m. The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.4-2009 and CAN/CSA-CEI/IEC CISPR 22.

The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

(a) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(b) Radiated Emission Test Set-Up, Frequency above 1000MHz

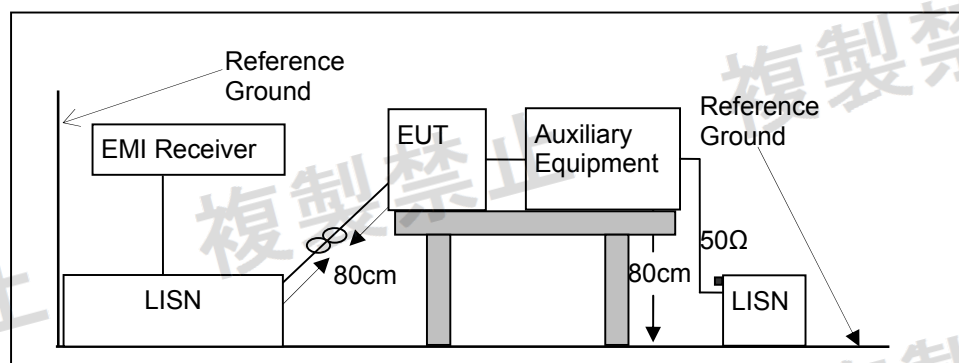


6.3 CONDUCTED EMISSION TEST SETUP

The mains cable of the EUT (maybe per AC/DC Adapter) must be connected to LISN. The LISN shall be placed 0.8 m from the boundary of EUT and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance is between the closest points of the LISN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8m from the LISN.

Ground connections, where required for safety purposes, shall be connected to the reference ground point of the LISN and, where not otherwise provided or specified by the manufacturer, shall be of same length as the mains cable and run parallel to the mains connection at a separation distance of not more than 0.1 m.

According to the requirements in Section 13.1.4.1 of ANSI C63.4-2014 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode.



6.4 SUPPORT EQUIPMENT

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
N/A	N/A	N/A	N/A	N/A	N/A

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.
3. Unless otherwise denoted as EUT in [Remark] column, device(s) used in tested system is a support equipment

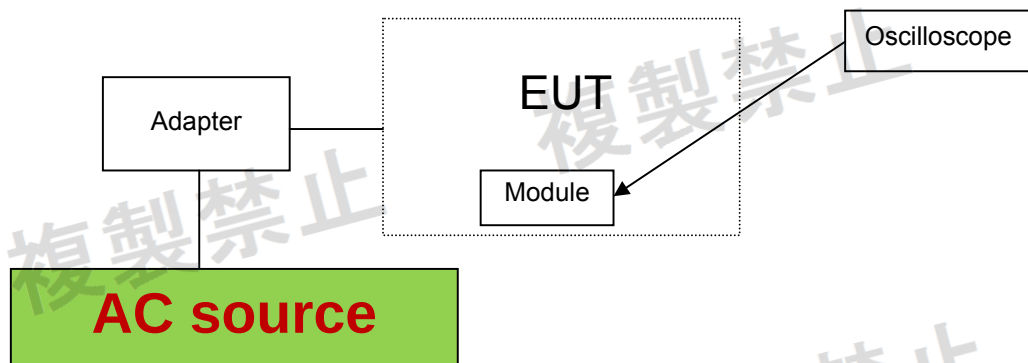
7 WIRELESS MODULE VOLTAGE TEST IN EXTREME CONDITIONS

7.1 Applicable Standard

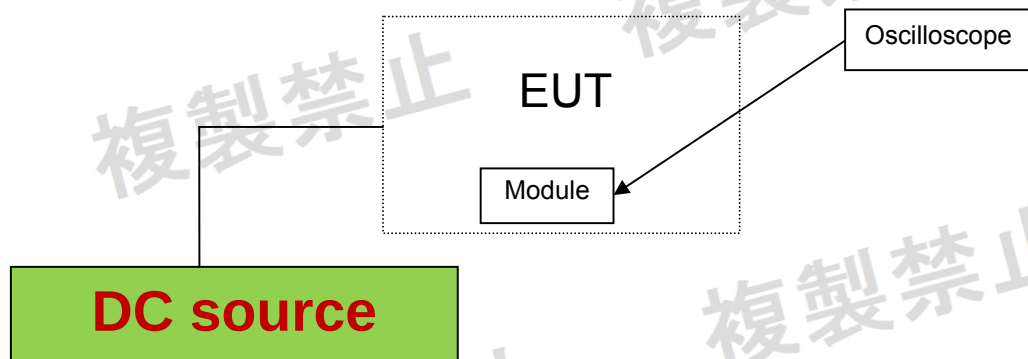
When there is a fluctuation of $\pm 10\%$ input voltage from external power to the test equipment. If the fluctuation of input voltage to the circuit of the radio part (excl. power) in the test equipment is confirmed below $\pm 1\%$, Measurement shall be tested with the rated voltage.

7.2 Test Configuration

Config A



Config B



7.3 Test Results

Temperature :	28℃	Test Date :	July 04, 2019
Humidity :	65 % Config A	Test By:	King Kong

Test Voltage	AC 90V	AC 100V	AC 110V
Module Test voltage	3.30	3.30	3.30
Module Ratedvoltage	3.30	3.30	3.30
The Range of Module Voltage(%)	0	0	0

Temperature :	28℃	Test Date :	July 04, 2019
Humidity :	65 % Config B	Test By:	King Kong

Test Voltage	DC 3.42V	DC 3.8V	DC 4.18V
Module Test voltage	3.31	3.30	3.31
Module Ratedvoltage	3.30	3.30	3.30
The Range of Module Voltage(%)	0.3	0	0.3

Note: In extreme conditions, EUT module power is confirmed below +/-1%.

8 TEST REQUIREMENTS

8.1 FREQUENCY ERROR

8.1.1 Applicable Standard

According to ARIB STD-T66, Clause 3.2(2).(4)

8.1.2 Conformance Limit

For the 2.4 GHz bands it shall be better than 50 ppm under the operational conditions

8.1.3 Test Configuration

Test according to clause 6.1 radio frequency test setup 1

8.1.4 Test Procedure

If the fluctuation of input voltage to the circuit of the radio part (excl. power) in the test equipment is confirmed below $\pm 1\%$, Measurement shall be tested with the rated voltage.

When there is a fluctuation of $\pm 10\%$ input voltage from external power to the test equipment. In case the test equipment is designed to function only within the specified fluctuation range of $\pm 10\%$ for the voltage source tests shall be conducted applying the rated voltage and a respective specified maximum/minimum value of fluctuation range.

Set the EUT on the test frequency and transmit.

Stop the modulation (stop the spreading), set on "continuous transmission of no-modulated radiation" in principle. If impossible, on "continuous burst transmission of no-modulated radiation", or a modulation mode to generate a specific frequency spectrum so that the frequency can be measured using a spectrum analyzer (example: a wave of the sub-carrier).

In case of no-modulation (consecutive or continuous burst), direct measurement is conducted with the frequency meter.

In case of burst wave, the measurement is conducted for a time period to achieve a sufficient accuracy. The mean value is employed as the measurement value.

In case of a test mode generating specific frequency spectrum, the spectrum frequency is measured with the spectrum analyzer.

8.1.5 Test Results

Temperature :	28°C	Test Date :	July 04, 2019
Humidity :	65 %	Test By:	King Kong
		Test voltage	Normal voltage

Modulation Mode	Channel Number	Channel Frequency (MHz)	Reading (MHz)	Deviation (kHz)	Tolerance (ppm)	Limit (ppm)	Verdict
Non-Modulation	0	2402	2402.013	13	5.4	50	PASS
	39	2441	2441.005	5	2.0	50	PASS
	78	2480	2480.011	11	4.4	50	PASS
Note: N/A (Not Applicable)							

8.2 OCCUPIED BANDWIDTH

8.2.1 Applicable Standard

According to ARIB STD-T66 Clause 3.2(2).(7)

8.2.2 Conformance Limit

Permissible value for occupied bandwidth using the FH system, a hybrid systems combining DS and FH systems or hybrid system combining FH and OFDM systems shall be 83.5MHz or less

8.2.3 Test Configuration

Test according to clause 6.1 radio frequency test setup 1

8.2.4 Test Procedure

Spectrum analyzer is set as below

Central Frequency	Test frequency
Sweeping Bandwidth	2 to 3.5 times the allowable value (SPAN=160MHz)
Resolution Bandwidth	Lower than 3 % of allowable value (RBW=10kHz)
Video Bandwidth	Same level as Resolution Bandwidth
Y-Axis Scale	10 dB/Div
Input Level	Carrier level is sufficiently higher than spectrum analyzer noise
Sweep Time	Minimum time to assure the measurement accuracy (In case of burst wave, 1 burst per 1 sample)
Sampling points	More than 400 points
Sweep Mode	Consecutive sweep
Phase-Detection Mode	Positive peak
Trigger Condition	Max-hold

The measured value of the spectrum analyzer is processed by the computer internally or externally

Conditions of EUT

Set the test frequency and the modulation is performed with the standard coded test signal. In case of OFDM with burst wave, the modulation is conducted to minimize the rate of the time that the number of sub-carrier is less (short preamble).

After a repetition of sweep so that no variation is found, values of all the data points are loaded into the array variable on the computer.

For all the data, the dB values are converted to antilogarithm of power dimension.

Power summation of all the data is estimated and stored as "total power value".

Starting with the data of the minimum frequency, the power is summed sequentially, and the limiting data point where the value achieves 0.5% of the total power is sensed. The limiting point is converted to frequency, stored as "lower limit".

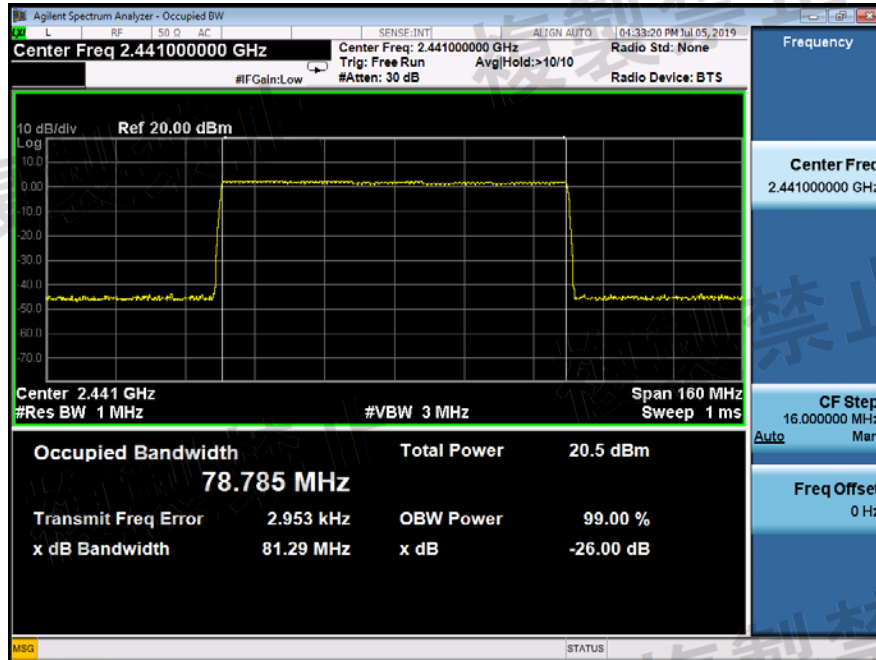
Starting with the data of the maximum frequency, the power is summed sequentially, and the limiting data point where the value achieves 0.5% of the total power is sensed. The limiting point is converted to frequency, stored as "upper limit"

8.2.5 Test Results

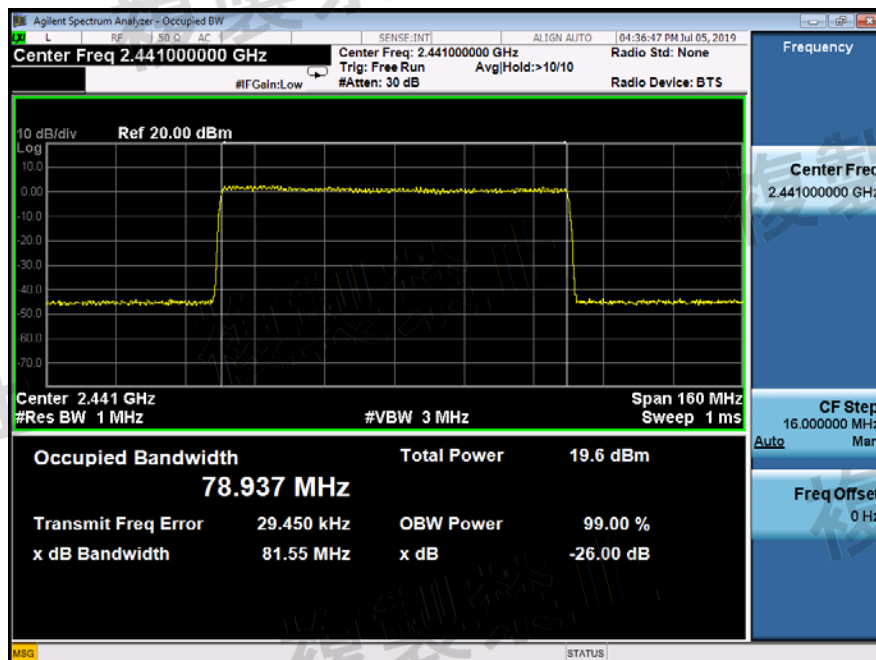
Temperature :	28°C	Test Date :	July 04, 2019
Humidity :	65 %	Test By:	King Kong
		Test voltage	Normal voltage

Modulation Mode	Occupied Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	78.785	<=83.5	PASS
pi/4-DQPSK	78.937	<=83.5	PASS
8DPSK	78.799	<=83.5	PASS
Note: N/A (Not Applicable)			

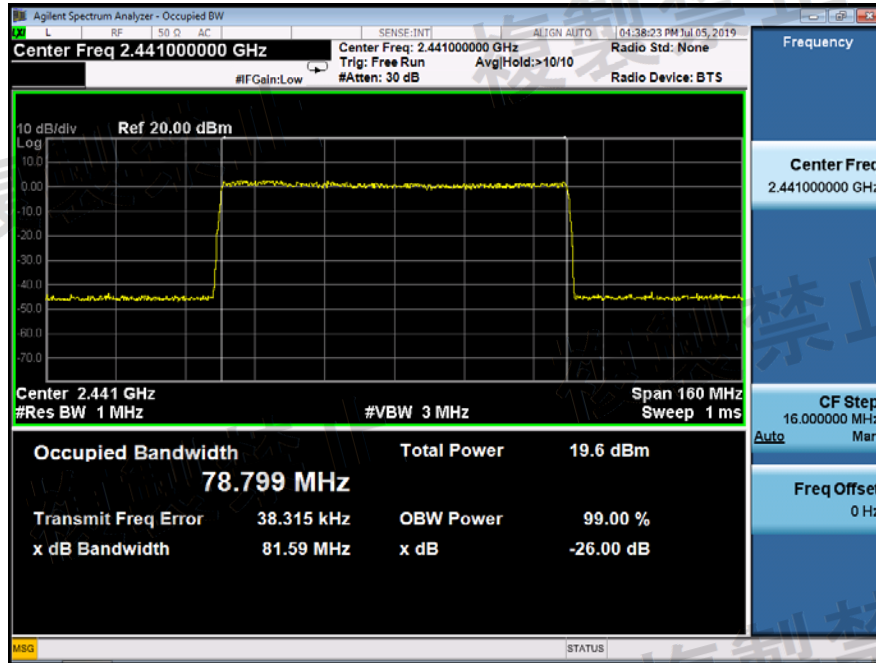
Test Model	Occupied Bandwidth	Bluetooth v4.0 with classic mode	Modulation	GFSK
	Test voltage	Normal voltage		



Test Model	Occupied Bandwidth	Bluetooth v4.0 with classic mode	Modulation	pi/4-DQPSK
	Test voltage	Normal voltage		



Test Model		Occupied Bandwidth		
Test voltage		Bluetooth v4.0 with classic mode		
		Normal voltage	Modulation	8DPSK



8.3 SPREADING BANDWIDTH

8.3.1 Applicable Standard

According to ARIB STD-T66 Clause 3.2(2).(8)

8.3.2 Conformance Limit

In spread spectrum systems, spread bandwidth (which refers to a frequency bandwidth with an upper limit and lower limit such that each of the mean powers radiated above the upper frequency limit and below the lower frequency limit is equal to 5% of the total mean power radiated ,this also applies hereafter) shall be 500kHz or more.

8.3.3 Test Configuration

Test according to clause 6.1 radio frequency test setup 1

8.3.4 Test Procedure

Spectrum analyzer is set as below

Central Frequency	Test frequency
Sweeping Bandwidth	2 to 3.5 times the allowable value
Resolution Bandwidth	Lower than 3 % of allowable value (RBW=10kHz)
Video Bandwidth	Same level as Resolution Bandwidth
Y-Axis Scale	10 dB/Div
Input Level	Carrier level is sufficiently higher than spectrum analyzer noise
Sweep Time	Minimum time to assure the measurement accuracy (In case of burst wave, 1 burst per 1 sample)
Sampling points	More than 400 points
Sweep Mode	Consecutive sweep
Phase-Detection Mode	Positive peak
Trigger Condition	Max-hold

The measured value of the spectrum analyzer is processed by the computer internally or externally
Conditions of EUT

Set the test frequency and the modulation is performed with the standard coded test signal. In case of OFDM with burst wave, the modulation is conducted to minimize the rate of the time that the number of sub-carrier is less (short preamble).

After a repetition of sweep so that no variation is found, values of all the data points are loaded into the array variable on the computer.

For all the data, the dB values are converted to antilogarithm of power dimension.

Power summation of all the data is estimated and stored as "total power value".

Starting with the data of the minimum frequency, the power is summed sequentially, and the limiting data point where the value achieves 5% of the total power is sensed. The limiting point is converted to frequency, stored as "lower limit".

Starting with the data of the maximum frequency, the power is summed sequentially, and the limiting data point where the value achieves 5% of the total power is sensed. The limiting point is converted to frequency, stored as "upper limit"

For systems using frequency hopping from 2,400MHz to 2,483.5MHz without any spreading technology, there are no spreading bandwidth restrictions (only the occupied bandwidth is restricted). However, it is necessary to measure the spreading bandwidth, in order to calculate the observation time for measuring the dwell time and the power density.

It shall be measured in the extreme hopping modes with the maximum amount of available channels and the

minimum (If AFH is applicable). As far as possible, the operational channels shall be clustered for the measurement of the minimal (spreading) bandwidth.

If clustering is not possible, the minimal spreading bandwidth can be approximated by:

- smallest spreading bandwidth of a single channel (L, M, H) + 0.9 x [(n-1) x channel separation]
- (n = minimum amount of channels)

8.3.5 Test Results

■ Maximum Spreading Bandwidth

Temperature :	28°C	Test Date :	July 04, 2019
Humidity :	65 %	Test By:	King Kong
		Test voltage	Normal voltage

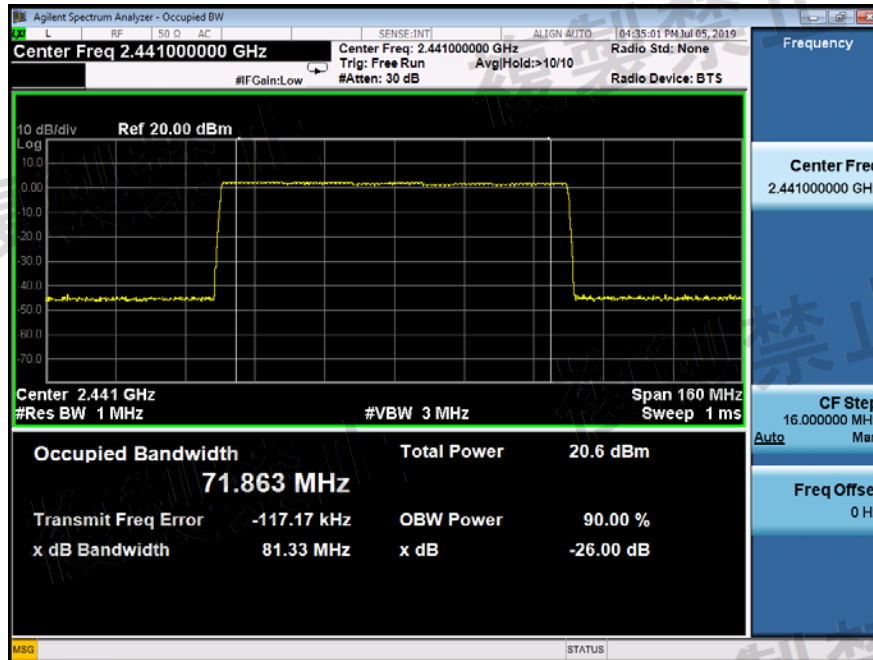
Modulation Mode	Spreading Bandwidth (MHz)	Limit (kHz)	Verdict
GFSK	71.863	>=500	PASS
pi/4-DQPSK	72.344	>=500	PASS
8DPSK	72.437	>=500	PASS
Note: N/A (Not Applicable)			

■ Minimal Spreading Bandwidth

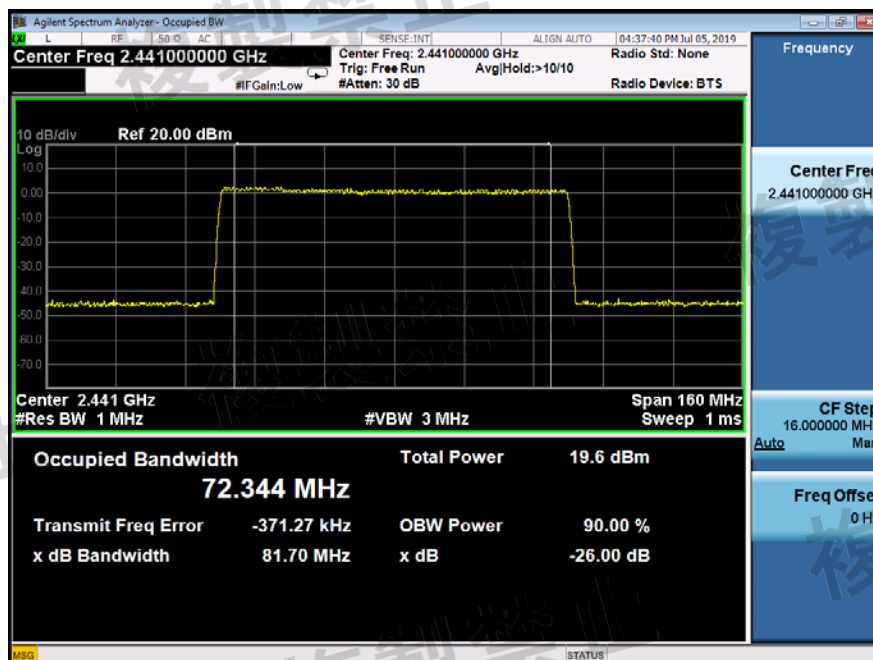
Temperature :	28°C	Test Date :	July 04, 2019
Humidity :	65 %	Test By:	King Kong
		Test voltage	Normal voltage

Modulation Mode	Channel Number	Channel Frequency (MHz)	Minimal Spreading Bandwidth (MHz)	Limit (kHz)	Verdict
GFSK	0	2402	19.599	>=500	PASS
	39	2441	19.583	>=500	PASS
	78	2480	19.600	>=500	PASS
pi/4-DQPSK	0	2402	19.977	>=500	PASS
	39	2441	19.970	>=500	PASS
	78	2480	19.987	>=500	PASS
8DPSK	0	2402	19.979	>=500	PASS
	39	2441	19.974	>=500	PASS
	78	2480	19.987	>=500	PASS
Note: N/A (Not Applicable)					

Test Model	Maximum Spreading Bandwidth	
	Normal voltage	GFSK Modulation



Test Model	Maximum Spreading Bandwidth	
	Normal voltage	pi/4-DQPSK Modulation

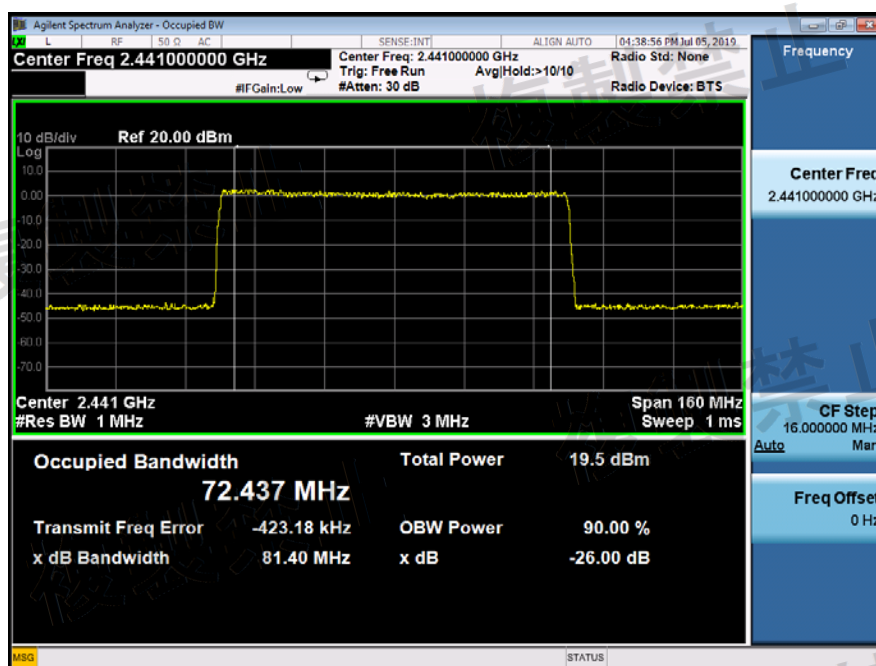


Test Model

Maximum Spreading Bandwidth

Normal voltage

8DPSK Modulation

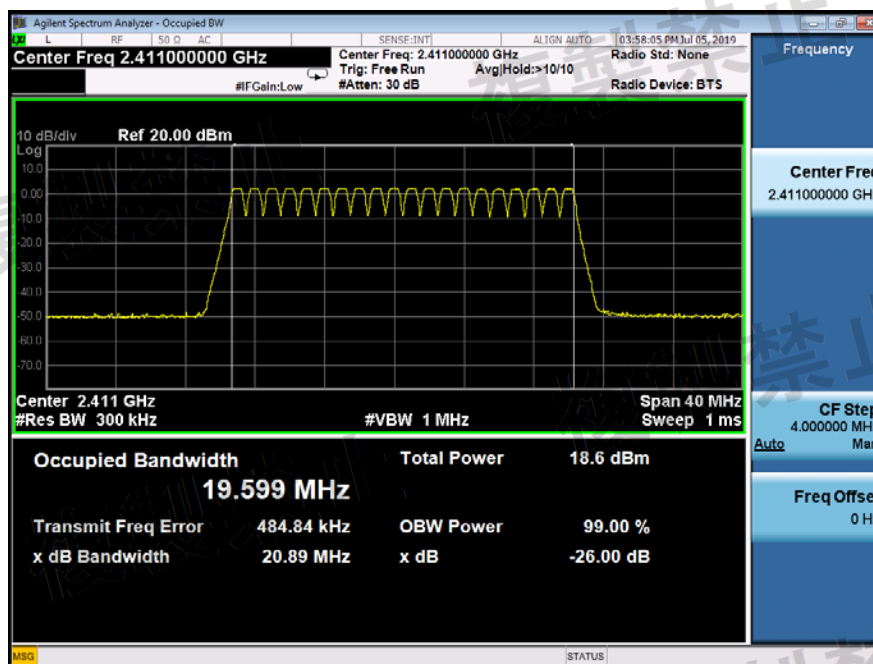


Test Model

Normal voltage

Minimal Spreading Bandwidth
GFSK Modulation

2402MHz

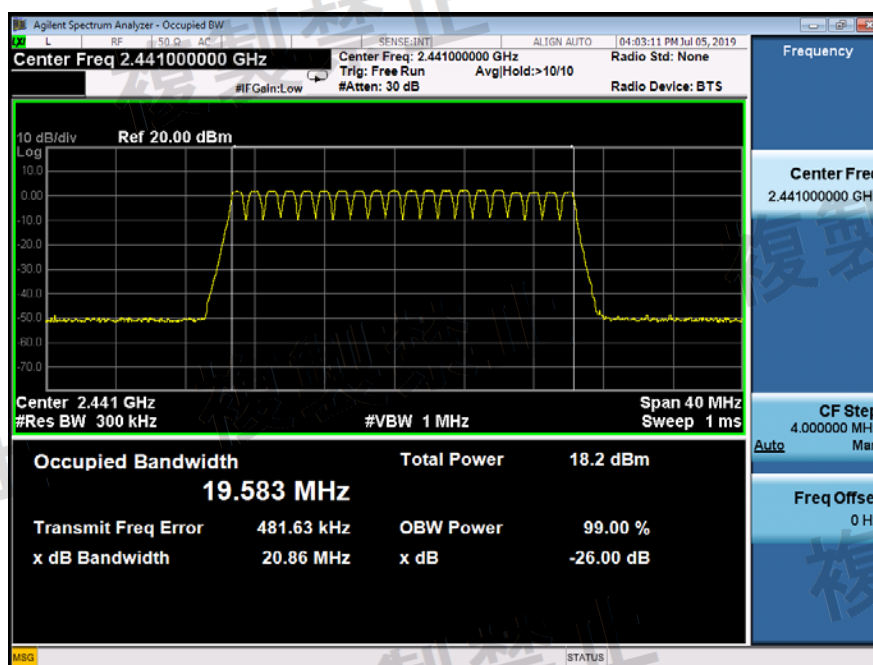


Test Model

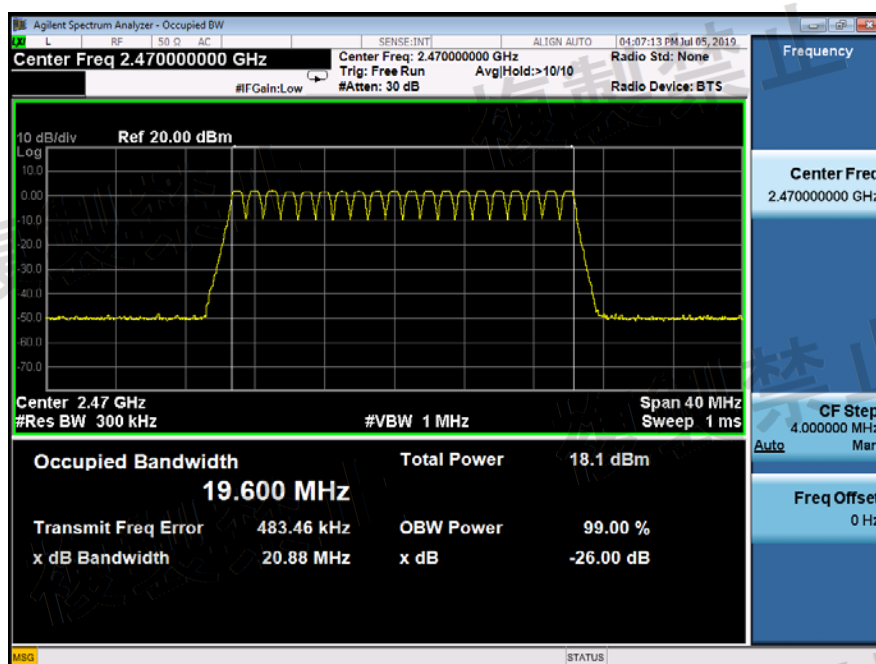
Normal voltage

Minimal Spreading Bandwidth
GFSK Modulation

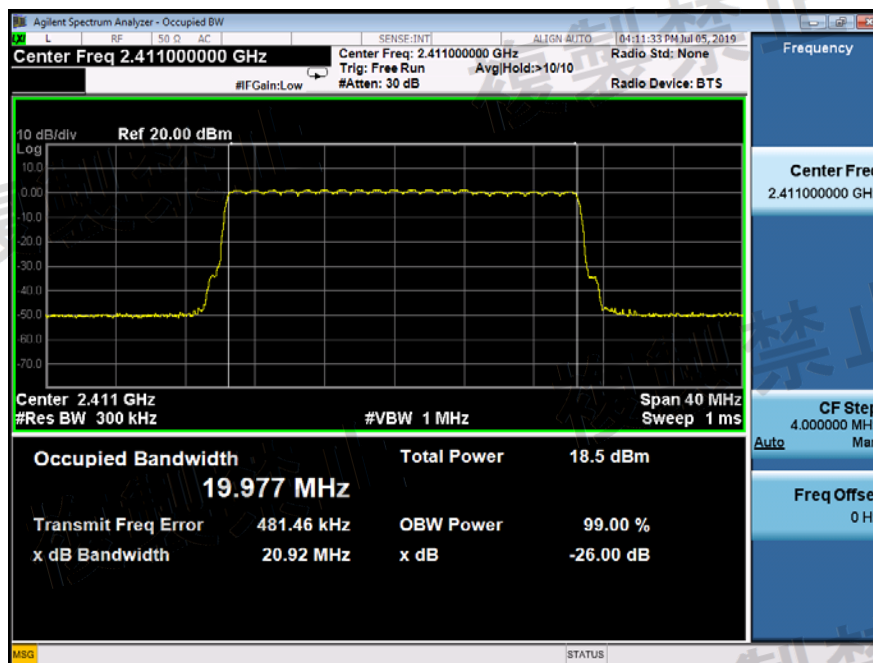
2441MHz



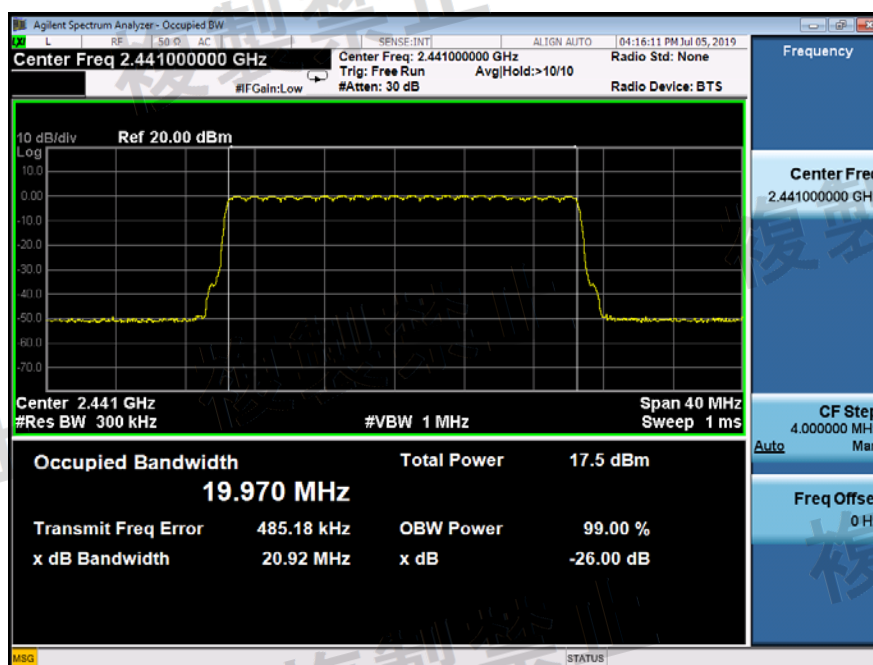
Minimal Spreading Bandwidth			
Test Model	Normal voltage	GFSK Modulation	2480MHz



Test Model	Minimal Spreading Bandwidth		
	Normal voltage	$\pi/4$ -DQPSK Modulation	2402MHz



Test Model	Minimal Spreading Bandwidth		
	Normal voltage	$\pi/4$ -DQPSK Modulation	2441MHz

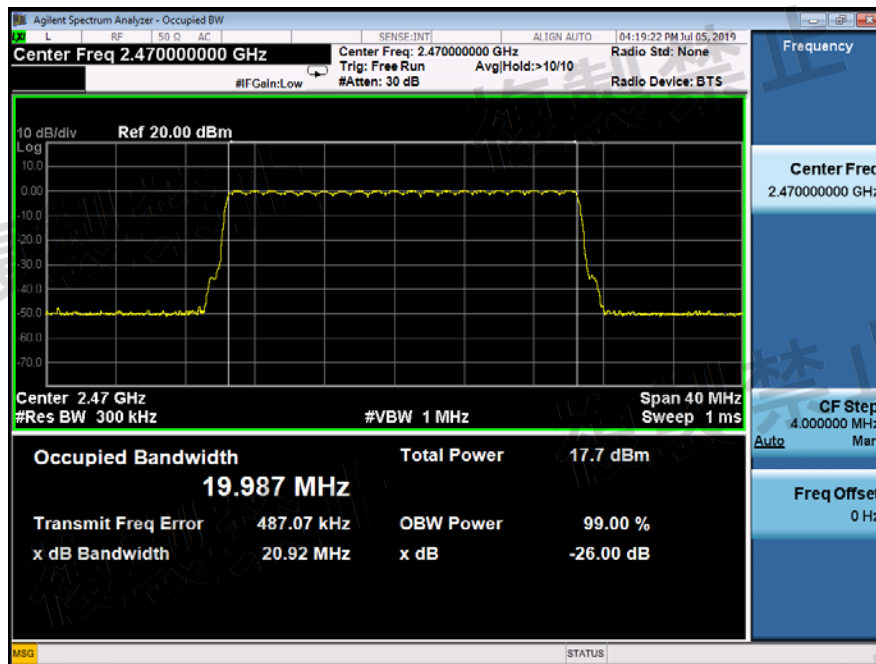


Test Model

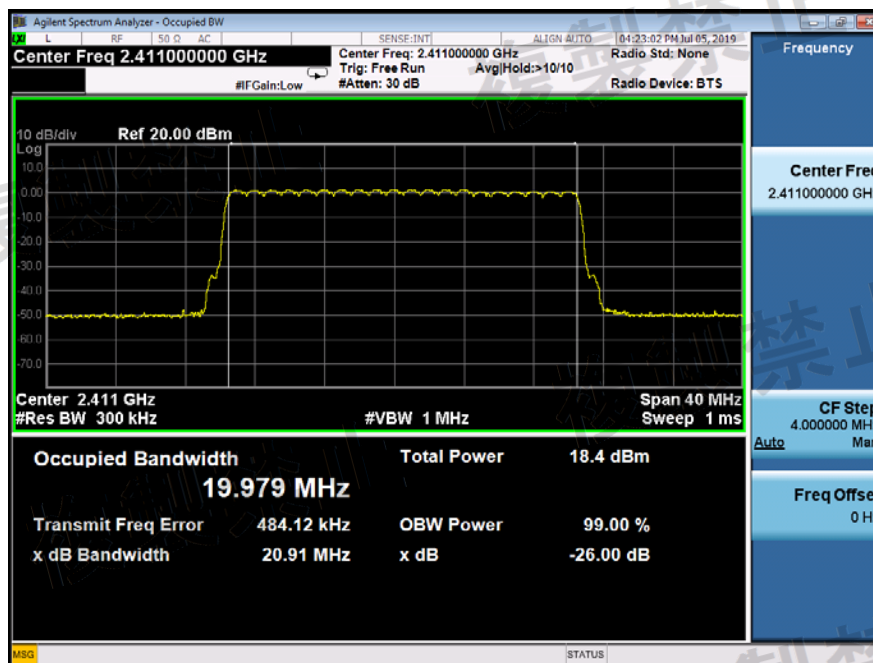
Normal voltage

Minimal Spreading Bandwidth
pi/4-DQPSK Modulation

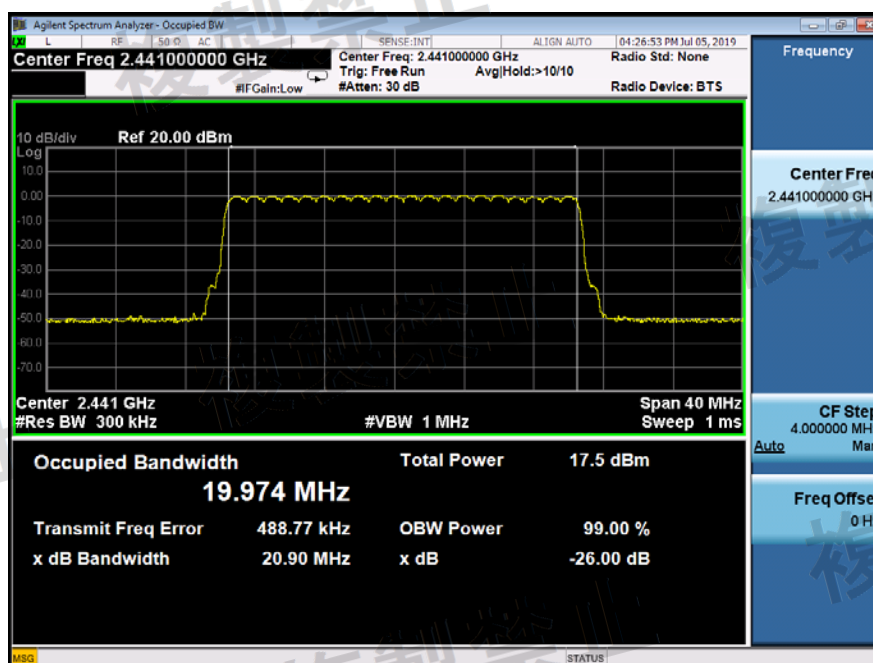
2480MHz



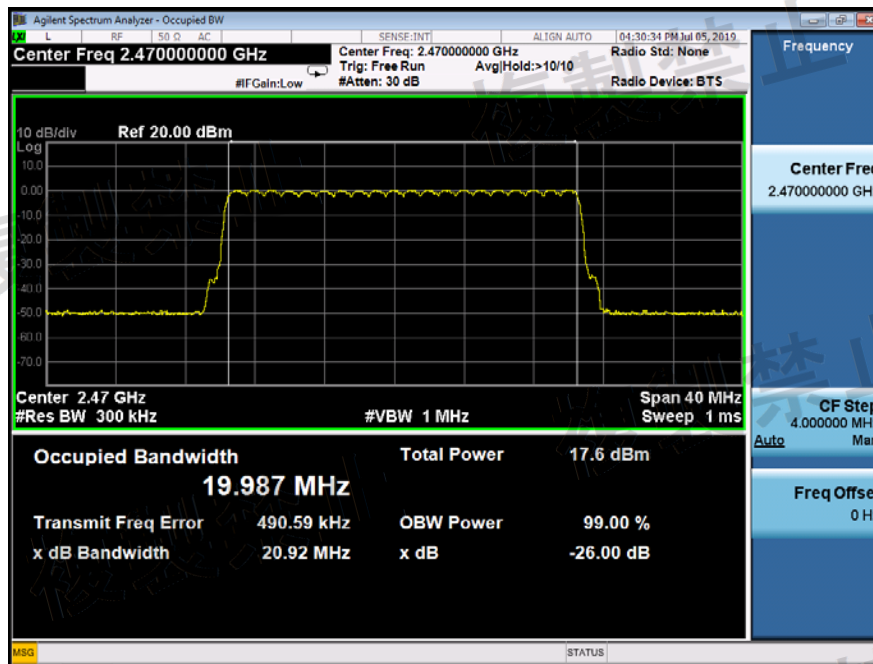
Test Model	Minimal Spreading Bandwidth		
	Normal voltage	8DPSK Modulation	2402MHz



Test Model	Minimal Spreading Bandwidth		
	Normal voltage	8DPSK Modulation	2441MHz



Test Model	Normal voltage	Minimal Spreading Bandwidth	2480MHz
		8DPSK Modulation	



8.4 HOPPING FREQUENCY STAYING TIME (DWEELL TIME)

8.4.1 Applicable Standard

According to ARIB STD-T66 Clause 3.2(11)

8.4.2 Conformance Limit

Frequency dwell time (time during which radio waves continue to be emitted at a specified frequency) of a transmitting equipment using the FH system shall be 0.4 seconds or less. When a simple system (except hybrid system) is used ,total frequency dwell time at an arbitrary frequency within the time period obtained by multiplying 0.4 seconds by the process gain shall be 0.4 seconds or less.

8.4.3 Test Configuration

Test according to clause 6.1 radio frequency test setup 1

8.4.4 Test Procedure

Set the EUT at the test frequency with test spreading code(Frequency Hopping), then modulation is performed with standard PN test signal

Spectrum analyzer is set as below

Central Frequency	Measurement hopping frequency
Sweep Frequency Bandwidth	0 MHz
Resolution Bandwidth	Approx. 1 MHz
Video Bandwidth	Same level as resolution bandwidth
Y-Axis Scale	10 dB/Div
Sweep Time	Hopping period
Sweep Mode	Single sweep
Trigger Condition	Video trigger
Phase-Detection Mode	Positive peak

Set the spectrum analyzer as in 2 above, wait for the hopping signal at the frequency to hop to.

Read the staying time from the trajectory on the screen at the frequency to hop in the hopping period by using marker, confirm the summation of the staying time to be less than 0.4 seconds.

In the same manner as (2), read the integral of the staying time at the frequency to hop in the hopping period. Calculate the total of the frequency staying time at the frequency to hop to as described in the equation below.

Repeat the measurement for each frequency to hop.

8.4.5 Test Results

All the modulation modes were tested the data of the worst mode (GFSK) are recorded in the following pages and all modulation methods do not exceed the above mentioned limits.

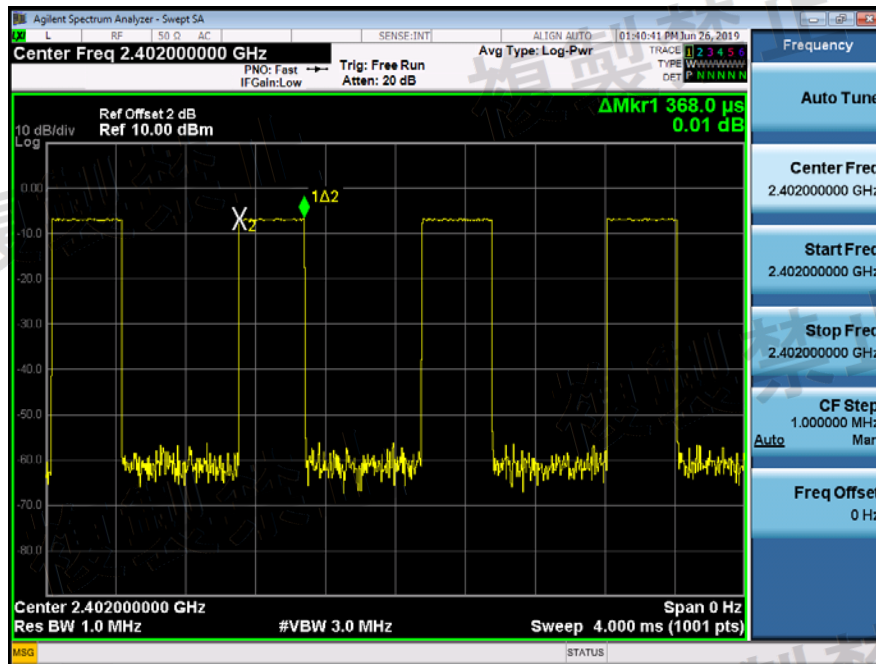
Temperature :	28°C	Test Date :	July 04, 2019
Humidity :	65 %	Test By:	King Kong

Modulation Mode	Channel Frequency (MHz)	packet type	observation time(s)	amount of bursts per second	Pluse width (ms)	dwel time(ms)	Limit (ms)	Verdict
GFSK	2402	DH1	0.4*79=31.6	1600/(2*79) =10.13	0.368	117.76	<400	PASS
		DH3		1600/(4*79) =5.06	1.631	260.96	<400	PASS
		DH5		1600/(6*79) =3.38	2.940	313.61	<400	PASS
Note: N/A (Not Applicable)								

Test Model

Average Time Of Occupancy (Dwell Time)
CH 0: 2402MHz

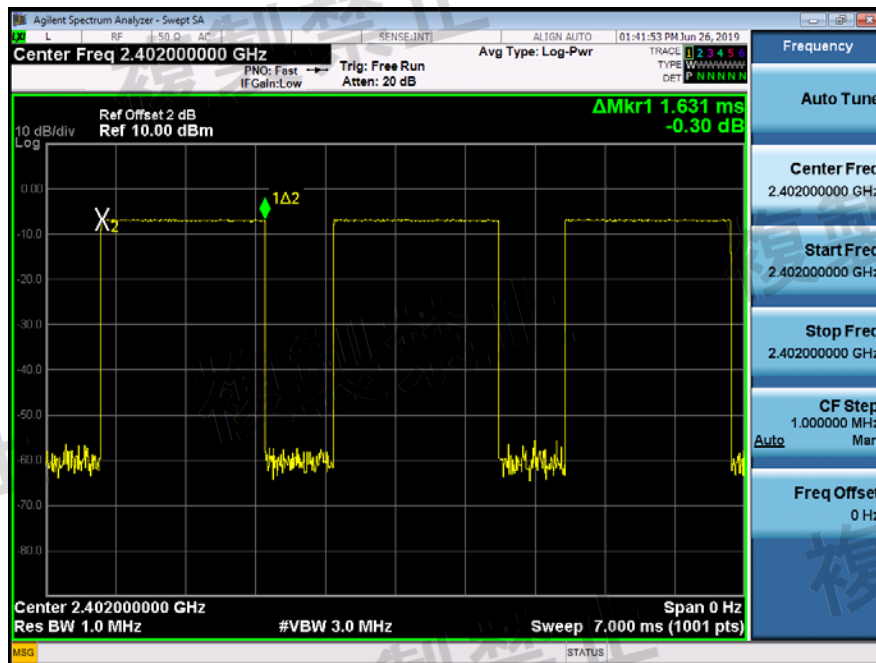
GFSK DH1



Test Model

Average Time Of Occupancy (Dwell Time)
CH 0: 2402MHz

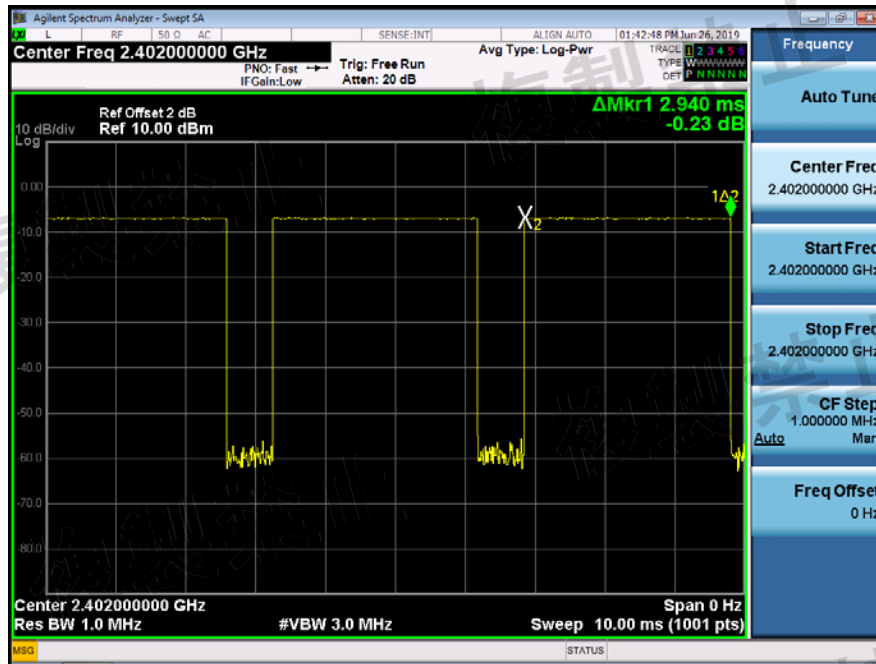
GFSK DH3



Test Model

Average Time Of Occupancy (Dwell Time)
CH 0: 2402MHz

GFSK DH5



8.5 POWER TO ANTENNA (CONDUCTED)

8.5.1 Applicable Standard

According to ARIB STD-T66 Clause 3.2

8.5.2 Conformance Limit

- $\leq 3 \text{ mW /MHz}$ (FHSS from 2402-2480 MHz)
- $\leq 10 \text{ mW /MHz}$ (DS OFDM (Occupied Bandwidth $< 26 \text{ MHz}$) from 2400-2483.5 MHz)
- $\leq 5 \text{ mW/MHz}$ (OFDM ($26 \text{ MHz} < \text{Occupied Bandwidth} < 38 \text{ MHz}$) from 2400-2483.5 MHz)
- $\leq 10 \text{ mW}$ (other from 2400-2483.5 MHz)

The Output Power Tolerance must be within +20%, -80%.

E.i.r.p:

- $\leq 6.91 \text{ dBm /MHz}$ (FHSS from 2402-2480 MHz)
- $\leq 12.14 \text{ dBm /MHz}$ (DS OFDM (Occupied Bandwidth $< 26 \text{ MHz}$) from 2400-2483.5 MHz)
- $\leq 9.14 \text{ dBm/MHz}$ (OFDM ($26 \text{ MHz} < \text{Occupied Bandwidth} < 38 \text{ MHz}$) from 2400-2483.5 MHz)
- $\leq 12.14 \text{ dBm}$ (other from 2400-2483.5 MHz)

Note: E.I.R.P will not be applied to the transmission antenna which has a gain of 2.14dBi or less.

8.5.3 Test Configuration

Test according to clause 6.1 radio frequency test setup 1

8.5.4 Test Procedure

Set the EUT on the test frequency and the consecutive TX mode or continuous (constant period, constant burst length) burst TX mode.

In case of spreading code used, set on the test spreading code, then the modulation is performed with standard coding test signal.

(1) Measure the equivalent noise bandwidth at the spectrum analyzer for resolution bandwidth of 1 MHz, then read the value correcting the resolution bandwidth on the 1 MHz equivalent bandwidth. In case of a spreading bandwidth lower than 1 MHz, however, perform the correction only for a higher value than "Spreading bandwidth (MHz) / Equivalent noise bandwidth (MHz)".

(2) The attenuation value of the attenuator shall be set to achieve the optimal operating input level at the spectrum analyzer.

(3) Spectrum analyzer for seeking the maximum antenna power is set as below.

Central Frequency	Test frequency
Sweeping Bandwidth	Approx. twice the Occupied Bandwidth
Resolution Bandwidth	1 MHz
Video Bandwidth	Approx. twice the resolution bandwidth (VBW=2MHz)
Y-Axis Scale	10 dB/Div
Sweep Time	Minimum time to assure the measurement accuracy (In case of burst wave, 1 burst per 1 sample)
Trigger Condition	Free run
Data points	More than 400 points
Sweep Mode	Consecutive sweep
Phase-Detection Mode	Positive peak
Display mode	Max-hold

(4) Spectrum analyzer for measuring the antenna power is set as below. In this case, calibrate the indication of the RF Power Meter on the output of the EUT with the RF Power Meter connected to the IF output of the spectrum analyzer.

Central Frequency	Frequency to achieve the maximum power (sought frequency)
Sweeping Bandwidth	0 Hz
Resolution Bandwidth	1 MHz
Video Bandwidth	Same level as the resolution bandwidth
Sweep Mode	Consecutive sweep
Phase-Detection Mode	Sample

Measurement Procedure

Frequency hopping system or combined systems of direct spread and frequency hopping:

- Connect the high frequency power meter to the output of the attenuator and measure the total power (without bandwidth limitation)
- Divide the total power by the spread bandwidth to find the "average" power per MHz.
- Confirm that frequency distribution of the hopping frequencies is homogeneous according to the supporting data. If frequency distribution of the frequencies is not homogeneous, consider other measurement or correction methods based on the supporting data.
- Set the antenna power as follows:
 - Continuous waves: value in b.
 - Burst waves: value in b. and value calculated from the average power within bursts from rates of transmission times (i.e. correction on the duty-cycle, to find the average within the transmit burst)

8.5.5 Test Results

■ Power Density for Maximum Spreading Bandwidth

Temperature :	28°C	Test Date :	July 04, 2019
Humidity :	65 %	Test By:	King Kong
		Test voltage	Normal voltage

Modulation Mode	Total Power (dBm)	Total Power (mW)	Maximum Spreading Bandwidth (MHz)	Power Density (mW/MHz)	Verdict
GFSK	20.6	114.82	71.863	1.60	PASS
pi/4-DQPSK	19.6	91.20	72.344	1.26	PASS
8DPSK	19.5	89.13	72.437	1.23	PASS
Note: 3mW/MHz for a frequency band of 2427.00 – 2470.75 MHz 10 mW/MHz for other frequency band					

■ Power Density for Minimal Spreading Bandwidth

Temperature :	28°C	Test Date :	November 02, 2018
Humidity :	65 %	Test By:	King Kong
		Test voltage	Normal voltage

Modulation Mode	Channel Number	Total Power (dBm)	Total Power (mW)	Minimal Spreading Bandwidth (MHz)	Power Density (mW/MHz)	Verdict
GFSK	0	17.1	51.29	19.599	2.62	PASS
	39	17.2	52.48	19.583	2.68	PASS
	78	17.1	51.29	19.600	2.62	PASS
pi/4-DQPSK	0	17.5	56.23	19.977	2.81	PASS
	39	17.5	56.23	19.970	2.82	PASS
	78	17.7	58.88	19.987	2.95	PASS
8DPSK	0	17.4	54.95	19.979	2.75	PASS
	39	17.5	56.23	19.974	2.82	PASS
	78	17.6	57.54	19.987	2.88	PASS

Note:
3mW/MHz for a frequency band of 2427.00 – 2470.75 MHz
10 mW/MHz for other frequency band

Modulation Mode	Channel number	Channel Frequency (MHz)	Power density (mW/MHz)	Rating antenna power (mW/MHz)	Antenna Power Error (mW/MHz) (20%,-80%)
GFSK	79	2441.00	1.60	2	-20.00%
pi/4-DQPSK	79	2441.00	1.26	2	-37.00%
8DPSK	79	2441.00	1.23	2	-38.50%

Note:
3mW/MHz for a frequency band of 2427.00 – 2470.75 MHz
10 mW/MHz for other frequency band

Modulation Mode	Channel number	Channel Frequency (MHz)	AFH Power density (mW/MHz)	Rating antenna power (mW/MHz)	Antenna Power Error (mW/MHz) (20%,-80%)
GFSK	20	2411.00	2.62	3	-12.67%
	20	2441.00	2.68	3	-10.67%
	20	2470.00	2.62	3	-12.67%
pi/4-DQPSK	20	2411.00	2.81	3	-6.33%
	20	2441.00	2.82	3	-6.00%
	20	2470.00	2.95	3	-1.67%
8DPSK	20	2411.00	2.75	3	-8.33%
	20	2441.00	2.82	3	-6.00%
	20	2470.00	2.88	3	-4.00%

Note:
3mW/MHz for a frequency band of 2427.00 – 2470.75 MHz
10 mW/MHz for other frequency band

For EIRP

Modulation Mode	Measure Antenna Power (mW/MHz)	Measure Antenna Power (dBm/MHz)	Antenna Gain(dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Verdict
GFSK	1.60	0.28	0.37	0.65	6.91	Pass
pi/4-DQPSK	1.26	0.27	0.37	0.64	6.91	Pass
8DPSK	1.23	0.27	0.37	0.64	6.91	Pass

Modulation Mode	AFH Antenna Power (mW/MHz)	AFH Antenna Power (dBm/MHz)	Antenna Gain(dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Verdict
GFSK	2.62	0.87	0.37	1.24	6.91	Pass
	2.68	0.88	0.37	1.25	6.91	Pass
	2.62	0.87	0.37	1.24	6.91	Pass
pi/4-DQPSK	2.81	0.88	0.37	1.25	6.91	Pass
	2.82	0.88	0.37	1.25	6.91	Pass
	2.95	0.89	0.37	1.26	6.91	Pass
8DPSK	2.75	0.87	0.37	1.24	6.91	Pass
	2.82	0.88	0.37	1.25	6.91	Pass
	2.88	0.88	0.37	1.25	6.91	Pass

8.6 SPURIOUS EMISSIONS INTENSITY

8.6.1 Applicable Standard

According to ARIB STD-T66 Clause 3.2(6)

8.6.2 Conformance Limit

Permissible mean power of spurious emission of each frequency supplied to a feeder, that is, mean power of spurious emission in the 1 MHz bandwidth at frequency f other than frequency band used shall be as follows:

- | | |
|---|-----------------------------------|
| a. $2,387\text{MHz} \leq f \leq 2,400\text{MHz}$ and $2,483.5\text{MHz} < f \leq 2,496.5\text{MHz}$ | 25 μW (-16dB) or less |
| b. $2,387\text{MHz} > f$ and $2,496.5\text{MHz} < f$ | 2.5 μW (-26dB) or less |

8.6.3 Test Configuration

Test according to clause 6.1 radio frequency test setup 1

8.6.4 Test Procedure

(1)Spectrum analyzer for seeking the spurious emission is set as below

Sweeping Bandwidth	For seeking the spurious emission, from frequency lowest possible to the 5 times the carrier frequency
Resolution Bandwidth	1 MHz
Video Bandwidth	Approx. As same as Resolution bandwidth
Y-Axis Scale	10 dB/Div
Input Level	Value of maximum dynamic range
Sweep Time	Minimum time to assure the measurement accuracy (Note 1)
Sweep Mode	Single sweep
Phase-Detection Mode	Positive peak

(2)The settings of the spectrum analyzer while conducting spurious amplitude measurements are as follows:

- Central Frequency: Acquired spurious frequencies in (1)
- Sweep Frequency 0 Hz
- Resolution Bandwidth 1 MHz
- Video Bandwidth same as Resolution Bandwidth
- Note: take into account that the requirement limits the power in a bandwidth of 1 MHz.
- If the measurement is carried out with a bandwidth of 100 kHz (for frequencies below 1 GHz), the limit shall be reduced with 10 dB.
- For example 2.5 μW in 1 MHz = -26 dBm limit, becomes -36 dBm for 100 kHz bandwidth.
- Y-Axis Scale 10 dB/Div
- Input Level: choose input level within the linear range of the SA mixer (so that no additional spurious are generated by the mixer)
- Sweep Time: Minimum amount of time to ensure measurement accuracy. However, in the case of burst waves, time exceeds duration of 1 burst.
- Data Points Over 400 points
- Sweep Mode: Single sweep
- Detection Mode Sample (BIN-Width $\ll$ RBW, so that all spurious emissions are captured) [BIN-width is the frequency difference between 2 adjacent sample points on the display)

(3)Set EUT as occupied bandwidth is measure. That is, Set the EUT on the test frequency and the continuous TX mode or continuous (constant period, constant burst length) burst TX mode. In case of spreading code used, set on the test spreading code, then the modulation is performed with standard coding test signal.

The spectrum analyzer is set as 2 (1). Seek the spurious emission If the amplitude of the sought spurious emission satisfies the specified value (in case of 2 (2) Note 1, the specified value is -3dB), the measurement of 2 (2) is not performed, then the estimated value is employed as the measured value.

In case the sought spurious emission amplitude exceeds the specified value, seek the spurious frequency by narrowing the sweeping band sequentially as 100 MHz, 10 MHz, 1 MHz for the purpose of higher accuracy of the spectrum analyzer. Set the spectrum analyzer as 2 (2). Estimate the mean value of the spurious amplitude, then employ it as the measured value (In case DSSS as well as OFDM with burst wave, the mean inside of the burst).

Sweep Bandwidth: 30MHz~2387MHz, 2483.5MHz~2496.5MHz, 2496.5MHz~12500MHz

Respectively mark the maximum results in the above sweep bandwidth.

8.6.5 Test Results

Test Model

Spurious Emission Intensity (30MHz to 12.5GHz)

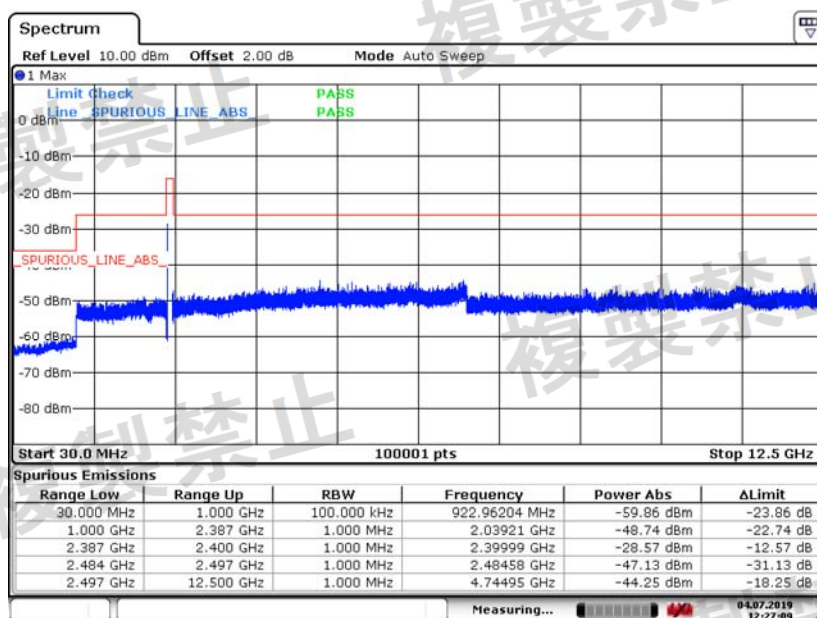
GFSK

Test condition

Normal voltage

Channel Frequency

2402MHz



Date: 4.JUL.2019 12:27:08

Test Model

Spurious Emission Intensity (30MHz to 12.5GHz)

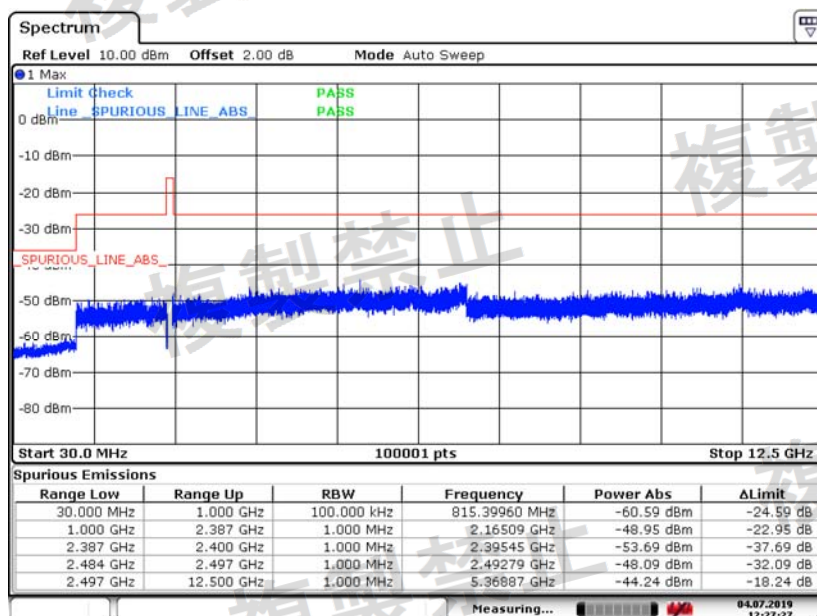
GFSK

Test condition

Normal voltage

Channel Frequency

2441MHz



Date: 4.JUL.2019 12:27:27

Test Model

Spurious Emission Intensity (30MHz to 12.5GHz)

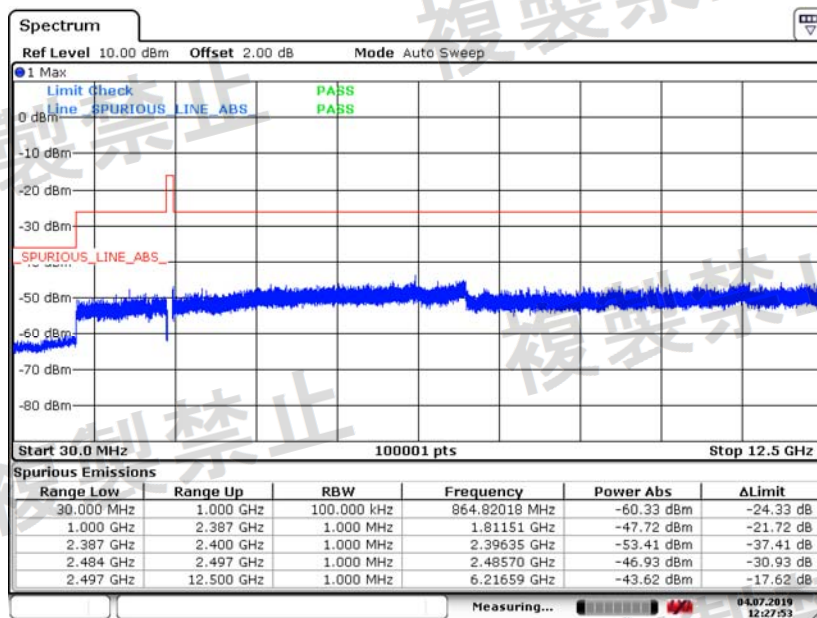
GFSK

Test condition

Normal voltage

Channel Frequency

2480MHz



Date: 4.JUL.2019 12:27:53

Test Model

Spurious Emission Intensity (30MHz to 12.5GHz)

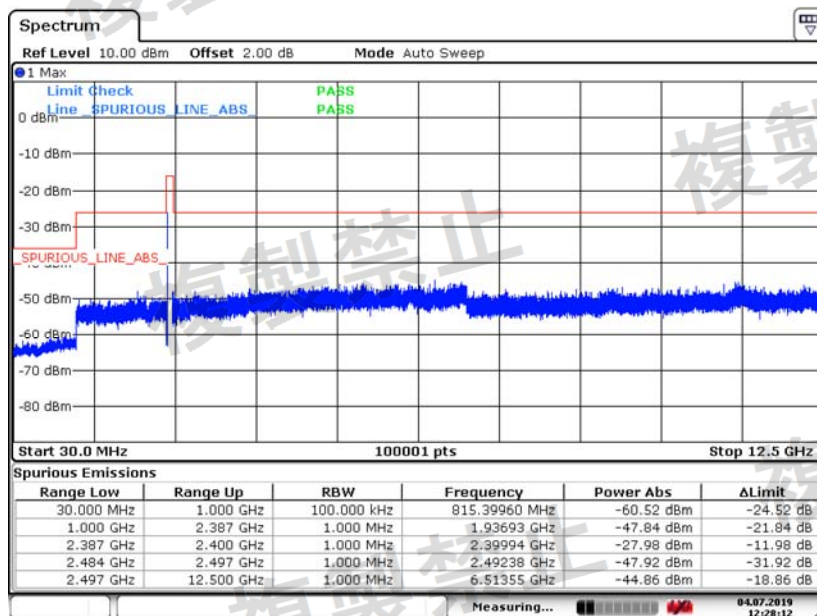
pi/4-DQPSK

Test condition

Normal voltage

Channel Frequency

2402MHz



Date: 4.JUL.2019 12:28:11

Spurious Emission Intensity (30MHz to 12.5GHz)
pi/4-DQPSK

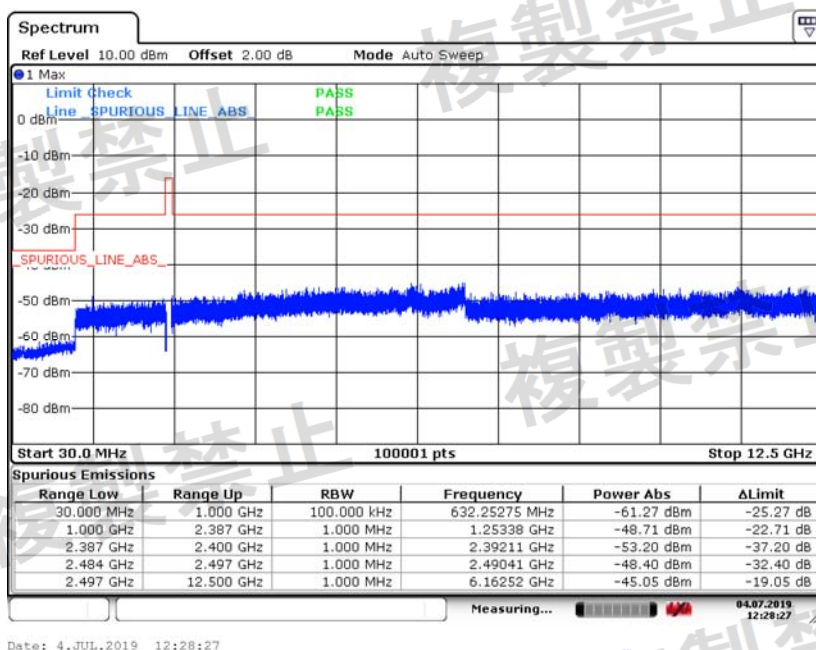
Test Model

Test condition

Normal voltage

Channel Frequency

2441MHz



Spurious Emission Intensity (30MHz to 12.5GHz)
pi/4-DQPSK

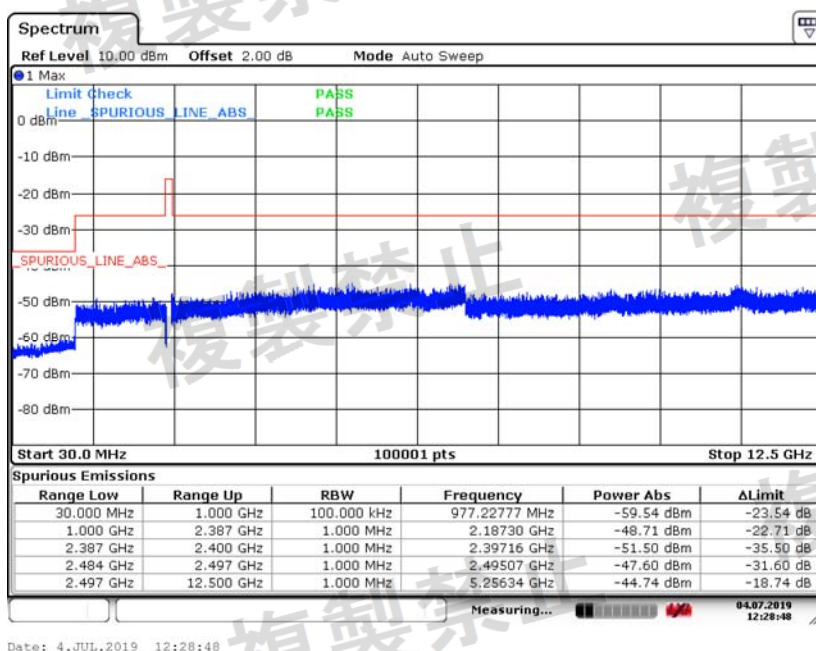
Test Model

Test condition

Normal voltage

Channel Frequency

2480MHz



Test Model

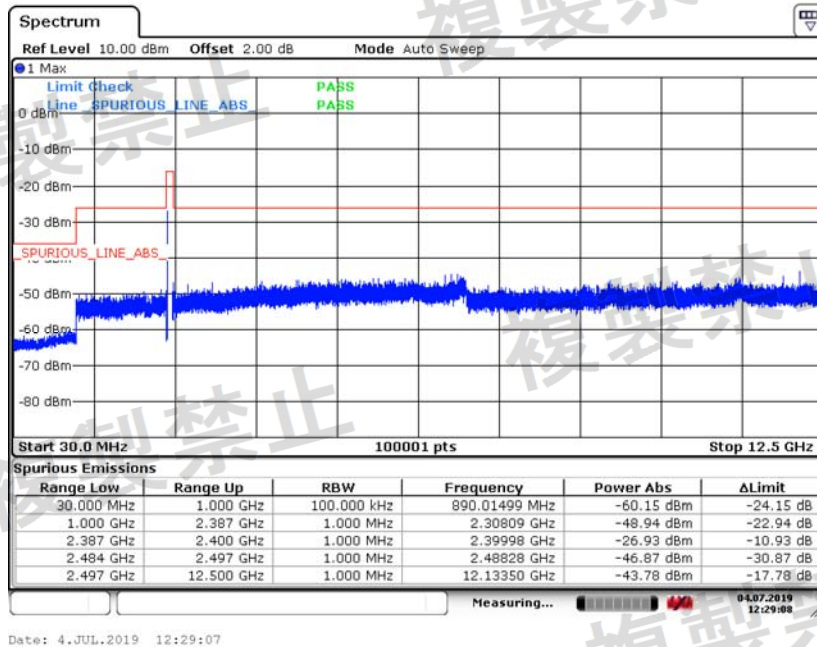
Spurious Emission Intensity (30MHz to 12.5GHz)
8DPSK

Test condition

Normal voltage

Channel Frequency

2402MHz



Test Model

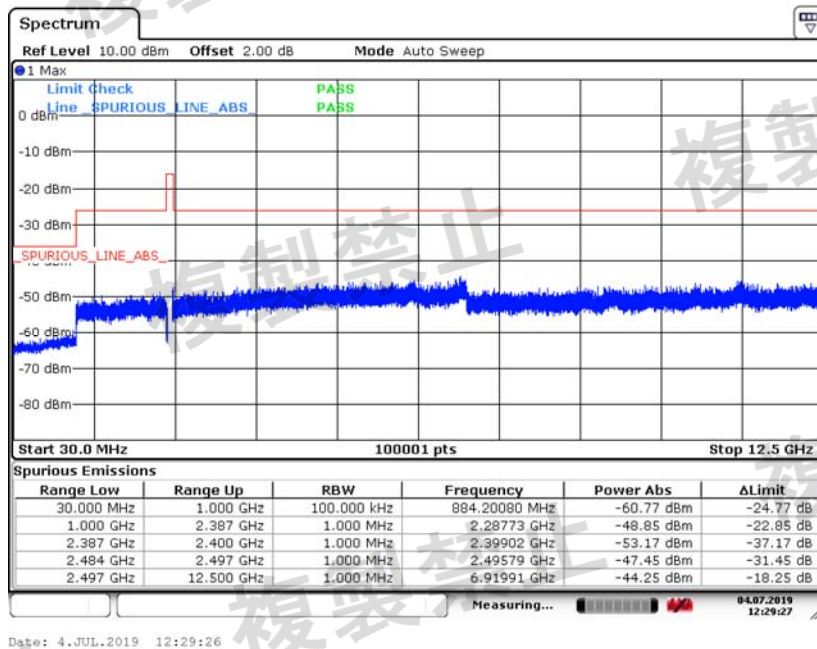
Spurious Emission Intensity (30MHz to 12.5GHz)
8DPSK

Test condition

Normal voltage

Channel Frequency

2441MHz



Spurious Emission Intensity (30MHz to 12.5GHz)
8DPSK

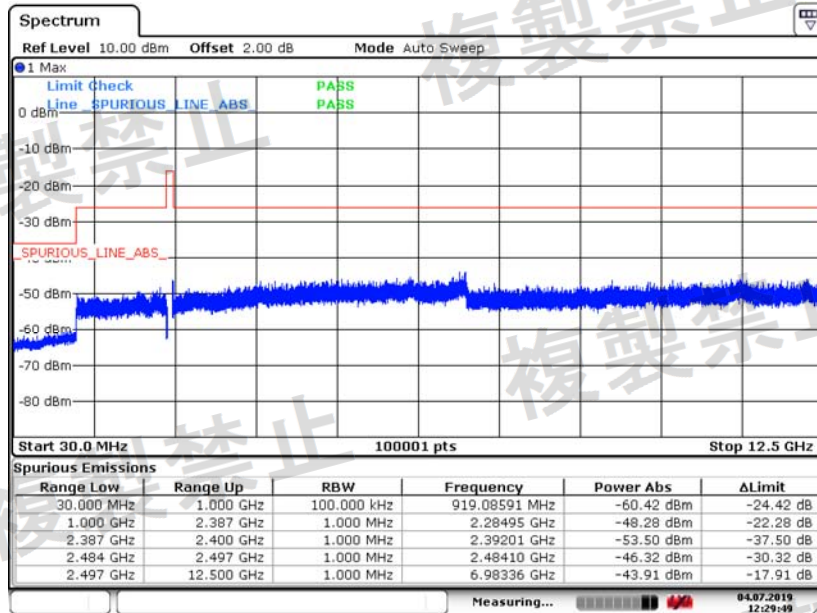
Test Model

Test condition

Normal voltage

Channel Frequency

2480MHz



Date: 4.JUL.2019 12:29:49

8.7 COLLATERAL EMISSIONS OF RECEIVER

8.7.1 Applicable Standard

According to ARIB STD-T66 Clause 3.3(1)

8.7.2 Conformance Limit

The limit on secondary emissions radiated from the receiving equipment within which the function of other radio equipment will not be impaired shall be, in terms of the power of a dummy antenna circuit that has the same electrical constant as the receiving antenna, 4 nW (-54dBm) or less at a frequency below 1 GHz and 20 nW(-47dBm) or less at a frequency of 1 GHz or higher as measured using the circuit.

- | | |
|----------------------|-----------------------|
| a. 30 MHz - 1000 MHz | 4 nW (-54dBm) or less |
| b. 1GHz – 12.5 GHz | 20 nW(-47dBm) or less |

8.7.3 Test Configuration

Test according to clause 6.1 radio frequency test setup 1

8.7.4 Test Procedure

Set the EUT so that the test frequency is can be measured receipt consecutively all the time.

(1) Set the attenuation value of the dummy load lowest as possible, due to low level of the measured object.

(2) Set Spectrum analyzer for seeking the collateral emission is set as below.

Sweeping Bandwidth	30MHz to 5 times of carrier frequency
Resolution Bandwidth	In case of frequency lower than 1 GHz, 100 kHz In case of frequency higher than 1 MHz
Video Bandwidth	Same level as the resolution bandwidth
Sweep Time	Minimum time to assure the measurement accuracy
Y-Axis Scale	10 dB/Div
Sweep Mode	Single sweep
Phase-Detection Mode	Positive peak

(3) Spectrum analyzer for measuring the collateral emission is set as below.

Central Frequency	Collateral emission frequency
Sweeping Bandwidth	0 Hz
Resolution Bandwidth	In case of frequency lower than 1 GHz, 100 kHz In case of frequency higher than 1 MHz
Video Bandwidth	Same level as the resolution bandwidth
Sweep Mode	Single sweep
Detection Mode	Sample

Set the spectrum analyzer as (2), seek the maximum amplitude of the collateral emission.

In case of sought result lower than 1/10 limit value, employ the sought value as the measured value.

In case the sought value exceeds 1/10 limit value, seek the collateral emission frequency by narrowing the sweeping band sequentially to 1/10 for the purpose of higher accuracy of the spectrum analyzer. Set the spectrum analyzer as (3).

8.7.5 Test Results

Collateral Emissions of Receiver (30MHz to 12.5GHz)

Test Model

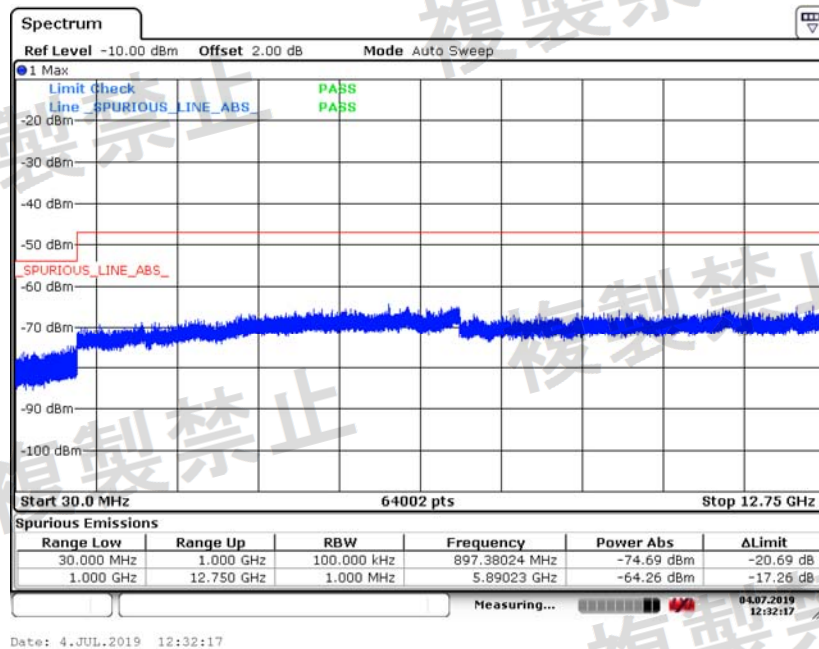
GFSK

Test condition

Normal voltage

Channel Frequency

2402MHz



Collateral Emissions of Receiver (30MHz to 12.5GHz)

Test Model

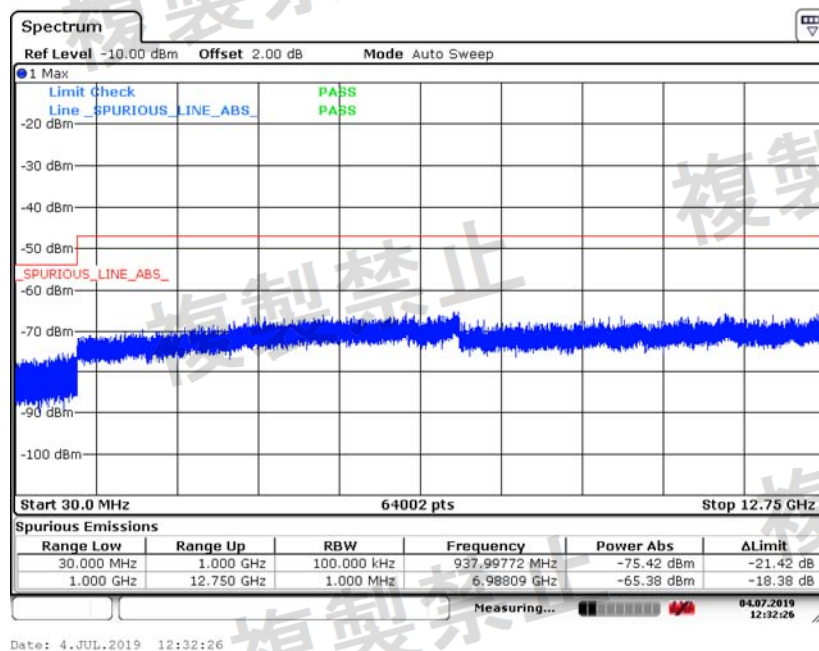
GFSK

Test condition

Normal voltage

Channel Frequency

2441MHz



Collateral Emissions of Receiver (30MHz to 12.5GHz)

Test Model

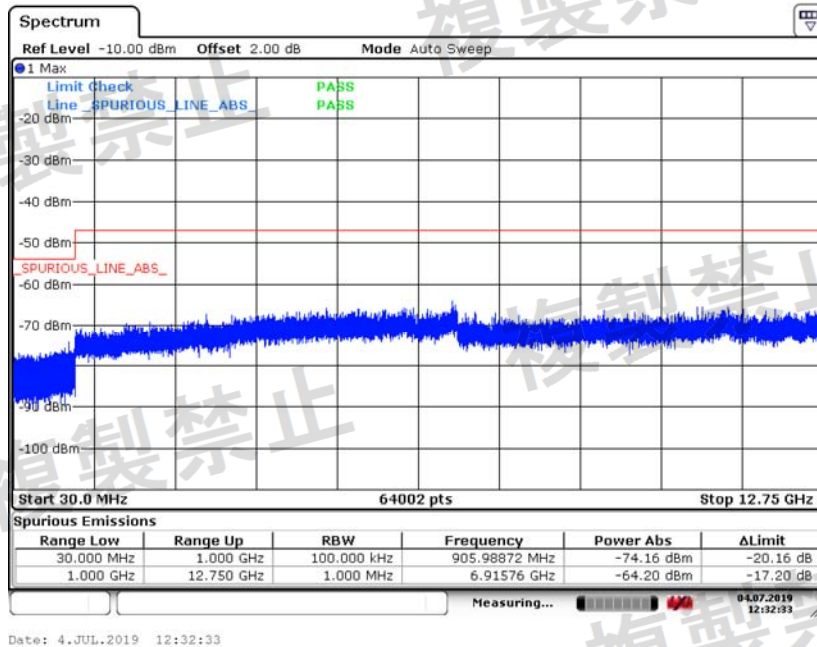
GFSK

Test condition

Normal voltage

Channel Frequency

2480MHz



Collateral Emissions of Receiver (30MHz to 12.5GHz)

pi/4-DQPSK

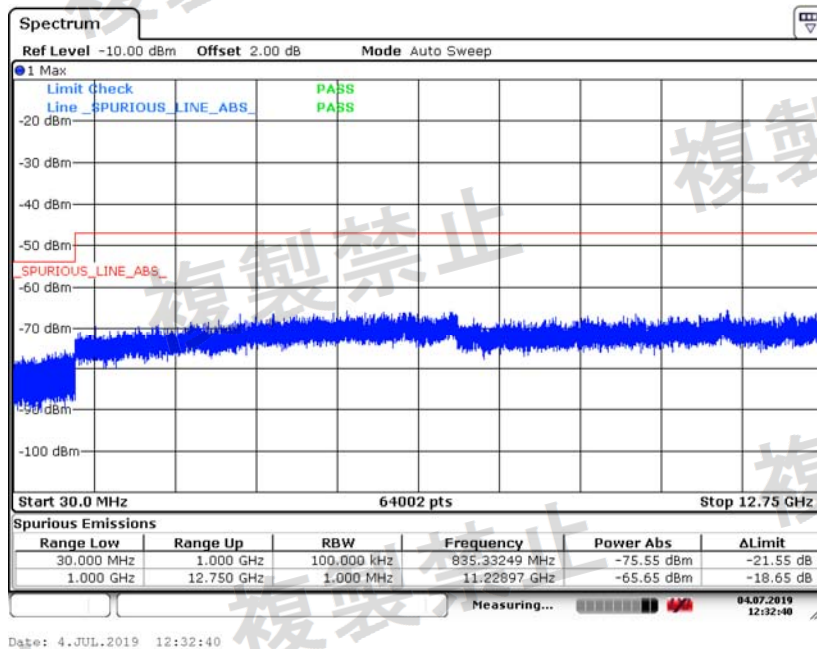
Test Model

Test condition

Normal voltage

Channel Frequency

2402MHz



Collateral Emissions of Receiver (30MHz to 12.5GHz)
pi/4-DQPSK

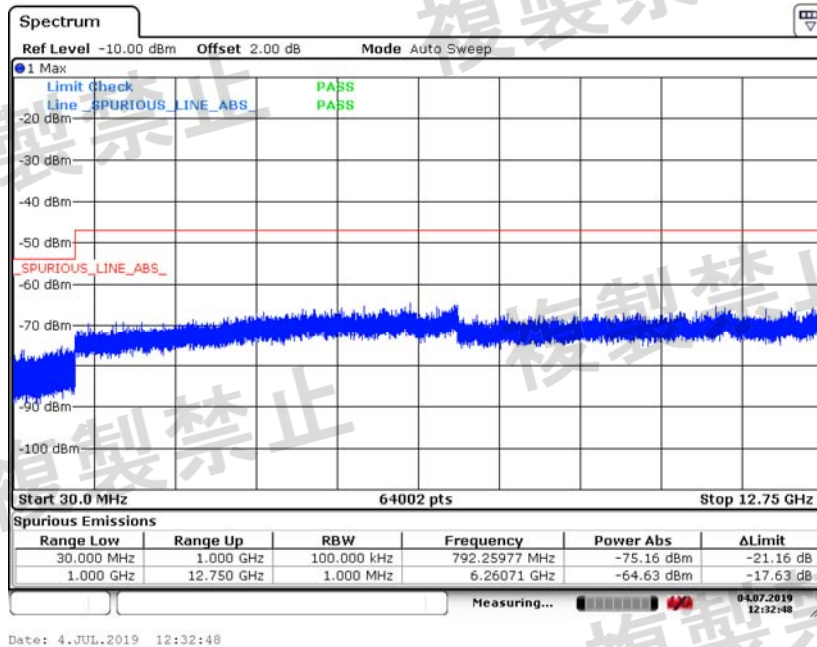
Test Model

Test condition

Normal voltage

Channel Frequency

2441MHz



Collateral Emissions of Receiver (30MHz to 12.5GHz)
pi/4-DQPSK

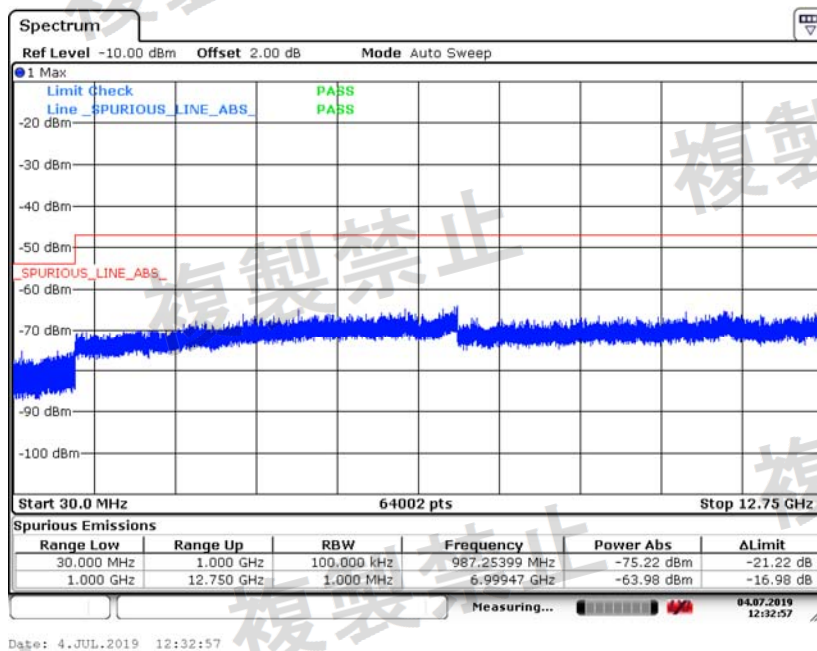
Test Model

Test condition

Normal voltage

Channel Frequency

2480MHz



Collateral Emissions of Receiver (30MHz to 12.5GHz)
8DPSK

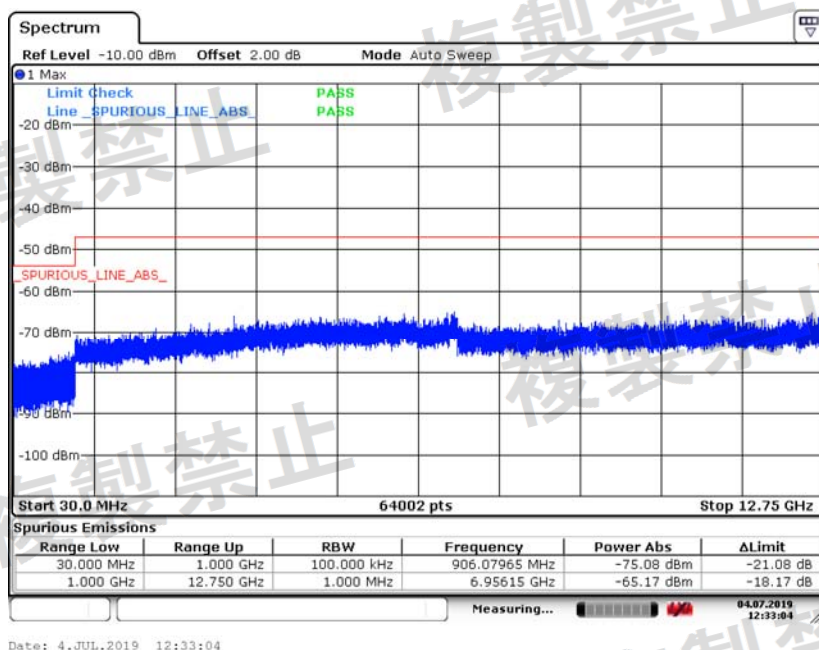
Test Model

Test condition

Normal voltage

Channel Frequency

2402MHz



Collateral Emissions of Receiver (30MHz to 12.5GHz)
8DPSK

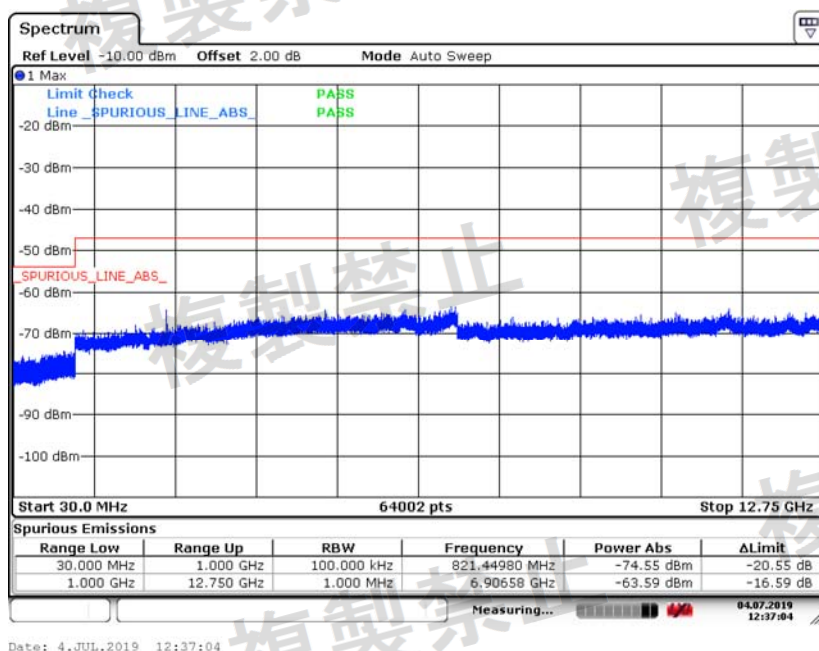
Test Model

Test condition

Normal voltage

Channel Frequency

2441MHz



Collateral Emissions of Receiver (30MHz to 12.5GHz)

Test Model

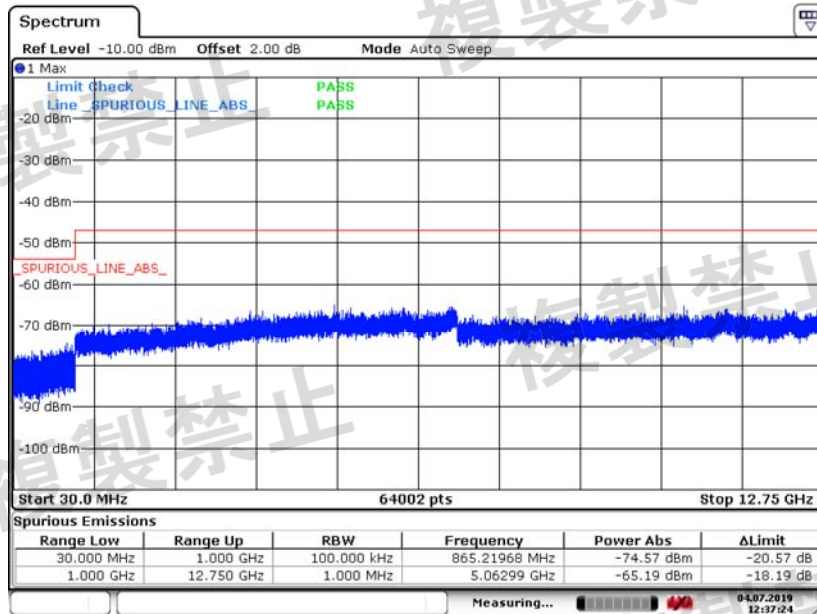
8DPSK

Test condition

Normal voltage

Channel Frequency

2480MHz



Date: 4.JUL.2019 12:37:24

8.8 QUANTITY OF HOPPING CHANNEL

8.8.1 Applicable Standard

According to ARIB STD-T66 Clause 3.1(10)

8.8.2 Conformance Limit

The system shall have one or more carriers per 1MHz bandwidth

8.8.3 Test Configuration

Test according to clause 6.1 radio frequency test setup 1

8.8.4 Test Procedure

Set the test frequency and the modulation is performed with the standard coded test signal. In case of OFDM with burst wave, the modulation is conducted to minimize the rate of the time that the number of sub-carrier is less (short preamble).

Spectrum analyzer is set as below

Central Frequency	Test frequency
Sweeping Bandwidth	2 to 3.5 times the allowable value
Resolution Bandwidth	1MHz
Video Bandwidth	Same level as Resolution Bandwidth
Y-Axis Scale	10 dB/Div
Input Level	Carrier level is sufficiently higher than spectrum analyzer noise
Sweep Time	Minimum time to assure the measurement accuracy (In case of burst wave, 1 burst per 1 sample)
Sampling points	More than 400 points
Sweep Mode	Consecutive sweep
Phase-Detection Mode	Positive peak
Trigger Condition	Max-hold

The measured value of the spectrum analyzer is processed by the computer internally or externally
The spectrum analyzer is set as 2 (1).

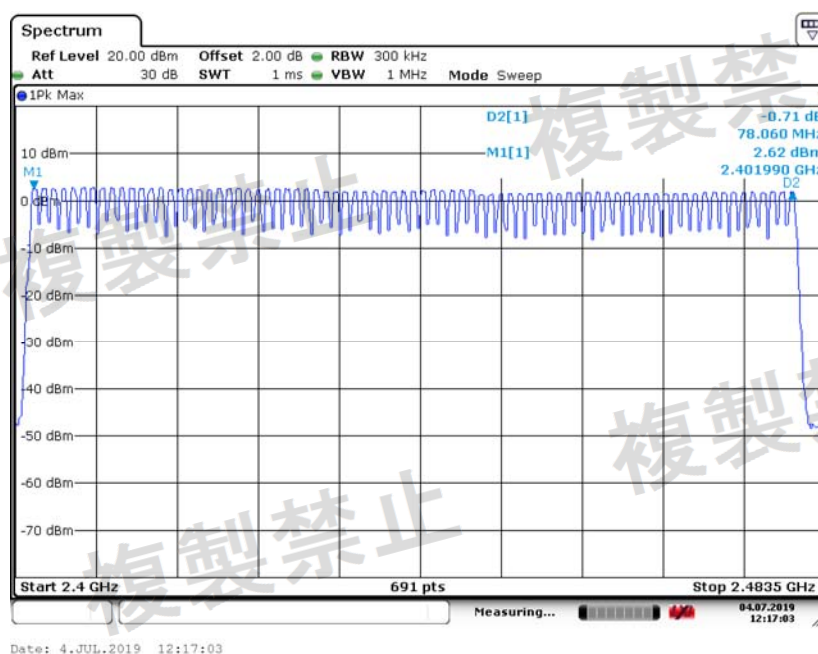
After a repetition of sweep so that no variation is found, values of all the data points are loaded into the array variable on the computer.

8.8.5 Test Results

Spectrum Detector:	Peak	Test Date :	July 04, 2019
Test By:	KK	Temperature :	24 °C
Test Result:	PASS	Humidity :	53 %

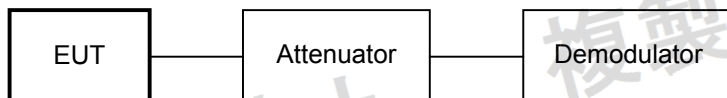
Hopping Channel Frequency Range	Quantity of Hopping Channel	Quantity of Hopping Channel limit
2400-2483.5	79	> 15

Test Model	Quantity of Hopping Channel	GFSK Modulation
	Modulation Mode	

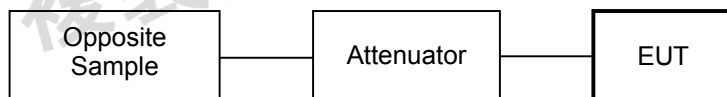


8.9 INTERFACE PREVENTION FUNCTION

(1) In case identification code is transmitted



(2) In case identification code is received



(3) Measuring Equipment Conditions

- a. The Demodulator shall demodulate the TX-signal transmitted by the EUT and be able to display the contents of the identification code.
- b. The opposite sample shall be able to transmit TX-signal equivalent to the TX-signal transmitted by the EUT.

(4) Conditions of EUT

The EUT is set on the usual operating mode.

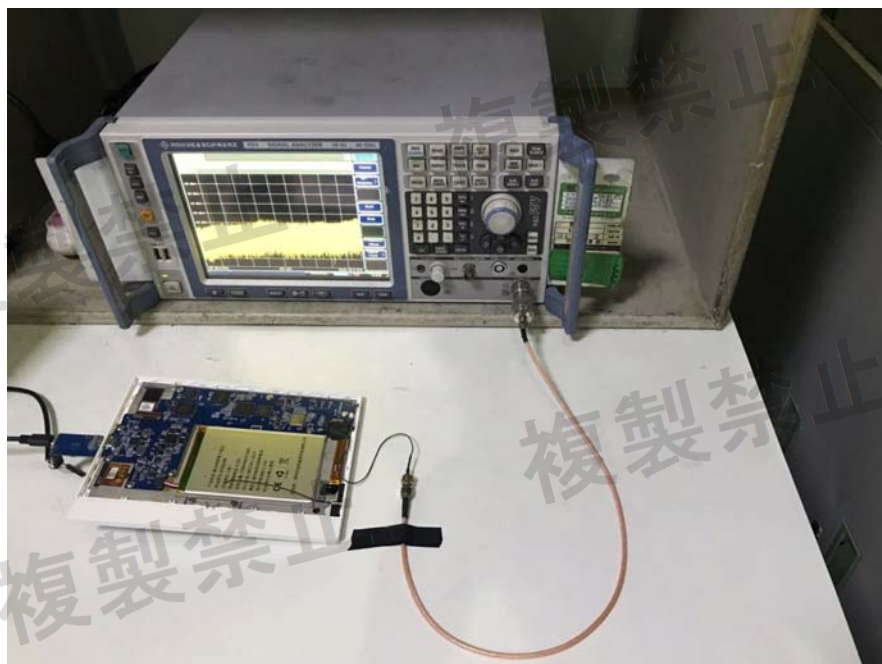
(5) Measurement Procedure

- (1) In case the EUT possesses function to transmit identification code automatically
 - a Predetermined identification code is transmitted by the EUT.
 - b Verify the transmitted identification code.
- (2) In case the EUT possesses function to receive identification code automatically
 - a Predetermined identification code is transmitted by the opposite sample.
 - b Verify the working of the normal communication.
 - c Other code than the predetermined identification code is transmitted by the opposite sample.
 - d Verify the EUT to stop transmitting or to display that the ID code is different.

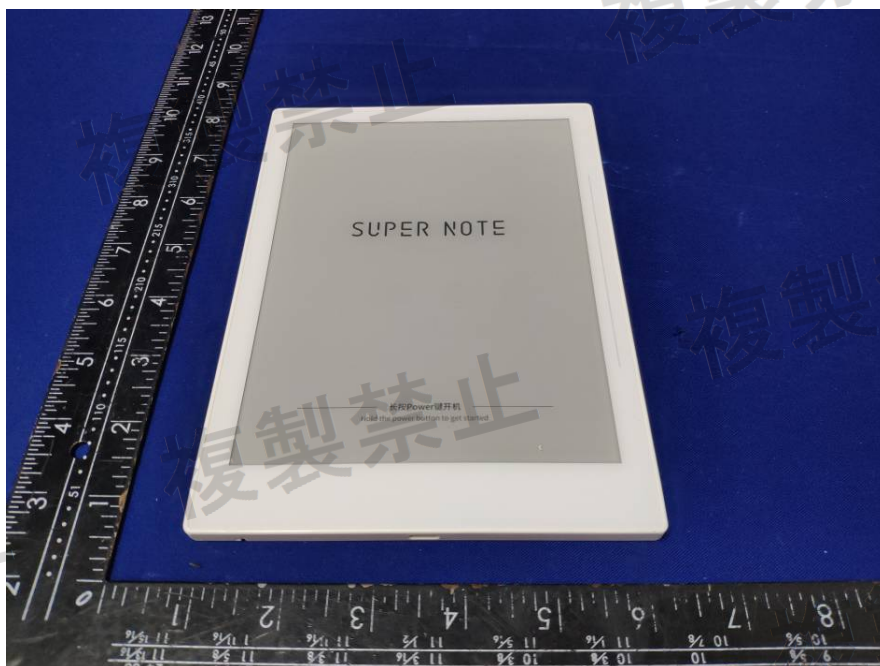
Carrier Sense

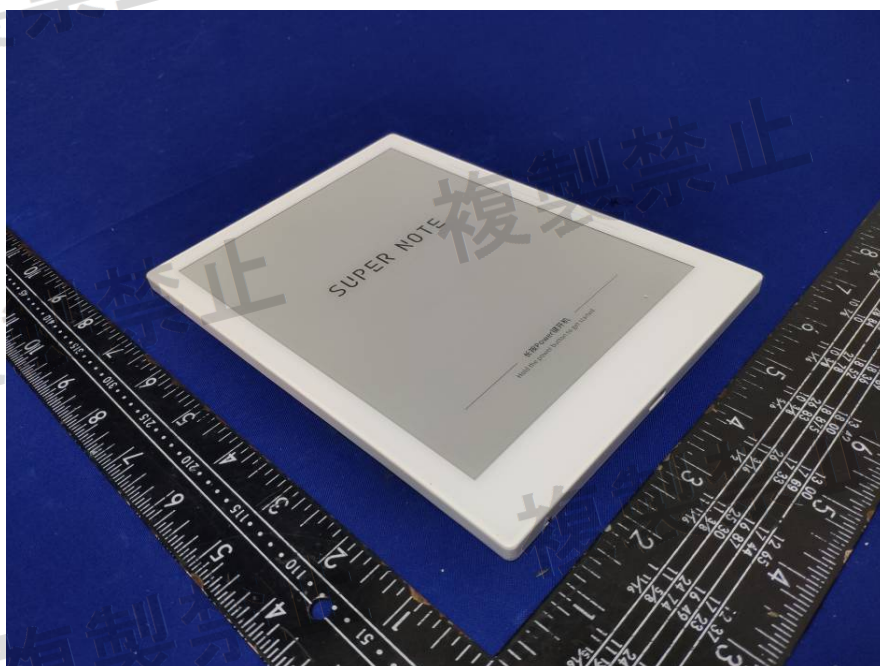
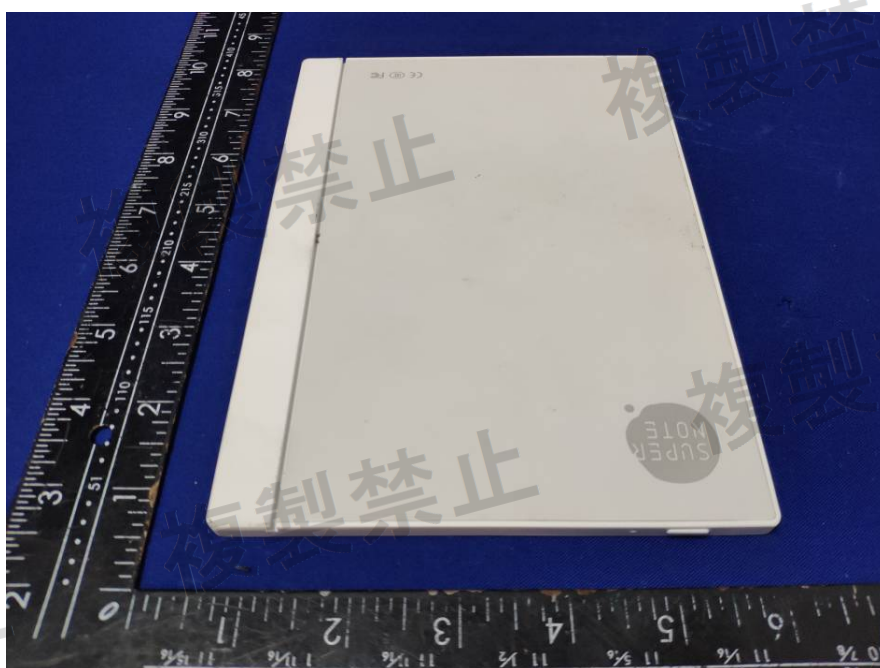
	Normal Voltage
Result	Pass

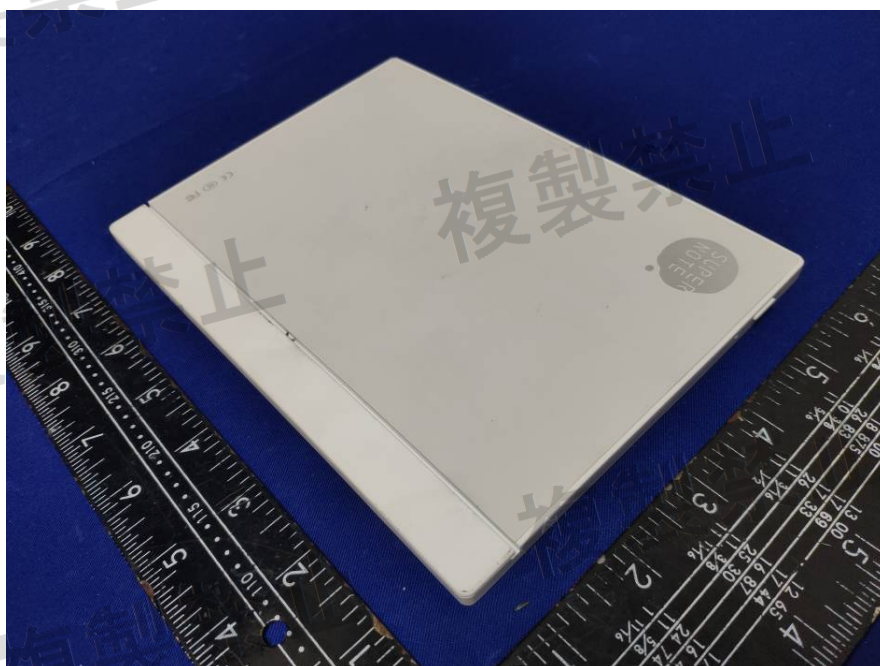
9 APPENDIX I PHOTOGRAPHS OF TEST SETUP

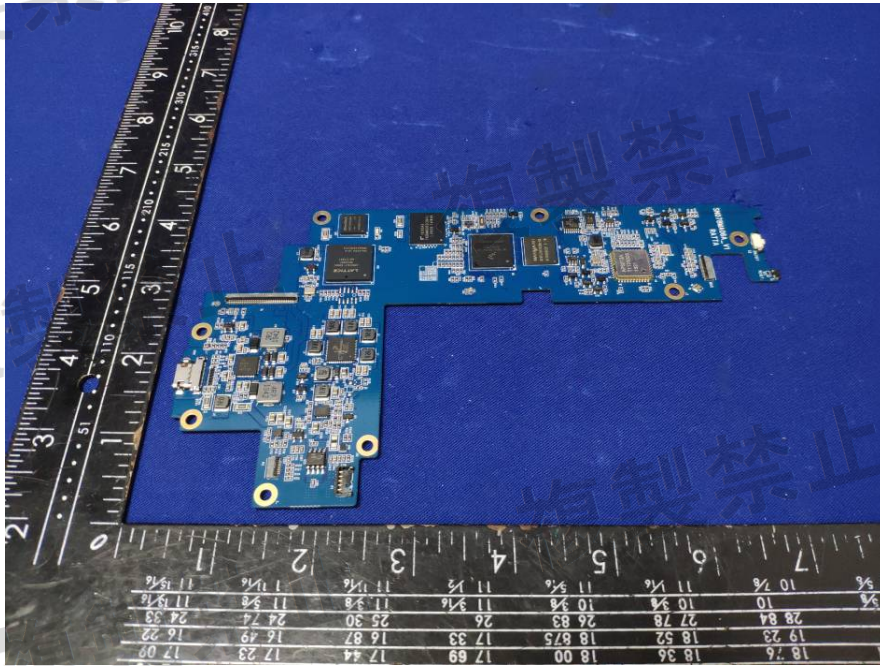
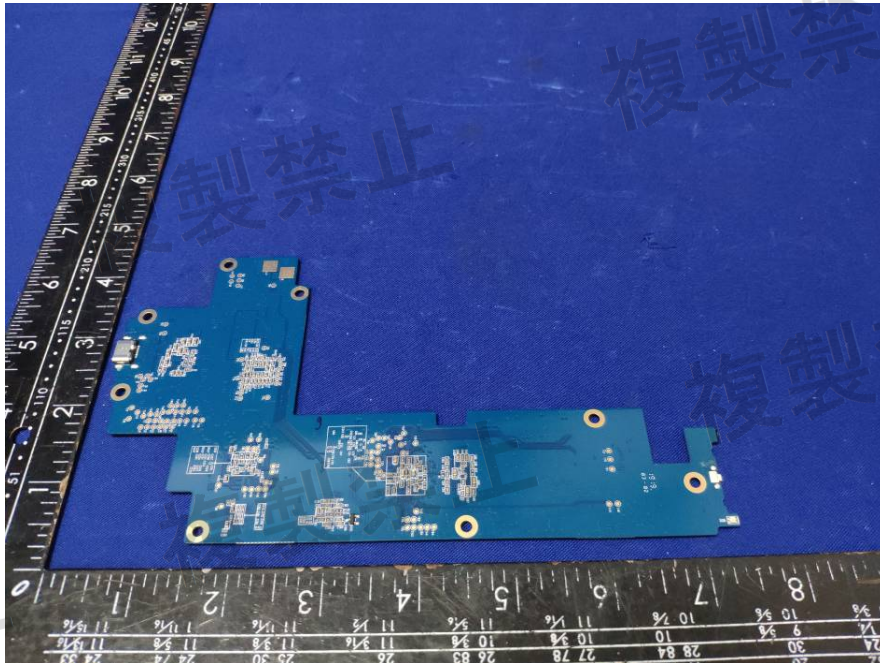


10 APPENDIX II PHOTOGRAPHS OF EUT





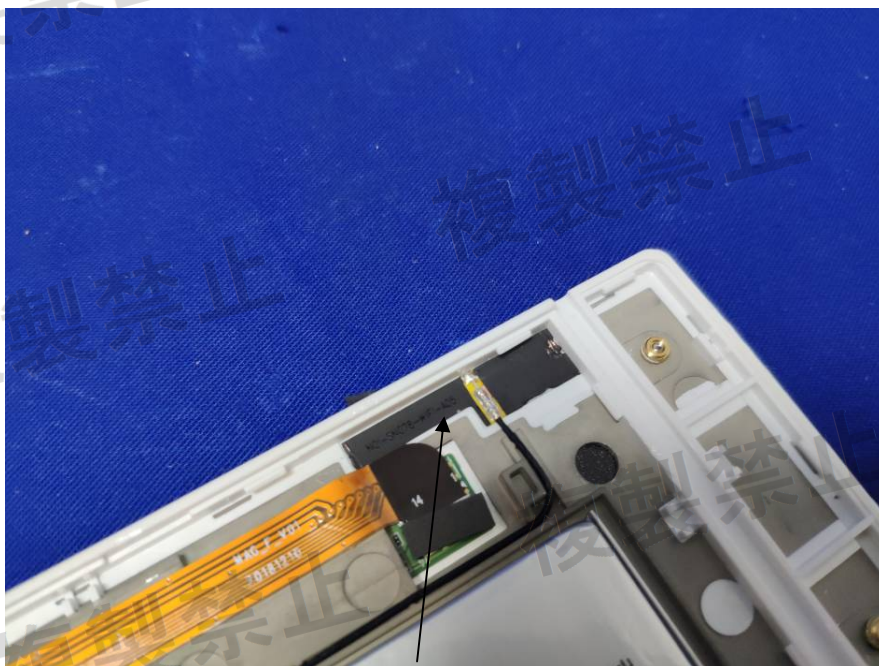






WIFI+BT Module





Antenna

END OF REPORT