



Certificate No.: 3745.01



China

FCC - TEST REPORT

Report Number : **7095021029103-00** Date of Issue: December 14, 2021

Model : VWBK1

Product Type : Wi-Fi and Bluetooth Module

Applicant : Hangzhou Tuya Information Technology Co.,Ltd

Address : Room701,Building3,More Center,No.87 GuDun
Road,Hangzhou,Zhejiang China

Manufacturer : Hangzhou Tuya Information Technology Co.,Ltd

Address : Room701,Building3,More Center,No.87 GuDun
Road,Hangzhou,Zhejiang China

Test Result : ☒ **Positive** ☐ **Negative**

Total pages including
Appendices : 58

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1 Table of Contents

1	Table of Contents.....	2
2	Details about the Test Laboratory	3
3	Description of the Equipment Under Test.....	4
4	Summary of Test Standards.....	6
5	Summary of Test Results	7
6	General Remarks.....	8
7	Test Setups	9
8	Systems test configuration.....	12
9	Technical Requirement	13
9.1	Conducted Emission.....	13
9.2	Conducted peak output power	16
9.3	20 dB bandwidth and 99% Occupied Bandwidth	21
9.4	Carrier Frequency Separation	28
9.5	Number of hopping frequencies.....	30
9.6	Dwell Time	32
	Test Graphs	33
9.7	Spurious RF conducted emissions	36
9.8	Band edge testing.....	44
9.9	Spurious radiated emissions for transmitter and receiver	51
10	Test Equipment List.....	56
11	System Measurement Uncertainty	57
12	Photographs of Test Set-ups.....	58
13	Photographs of EUT	59



2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
No.16 Lane, 1951 Du Hui Road,
Shanghai 201108,
P.R. China

Test Firm
Registration
Number: 820234

Test Firm IC
Registration
Number: 25988

Telephone: +86 21 6141 0123
Fax: +86 21 6140 8600

3 Description of the Equipment Under Test

Product:	Wi-Fi and Bluetooth Module
Model no.:	VWBK1
FCC ID:	2ANDL-VWBK1
Options and accessories:	NA
Rating:	DC 3.3-4.2V
RF Transmission Frequency:	For 802.11b/g/n-HT20: 2412~2462 MHz (Wi-Fi) For 802.15.1:2402~2480 MHz (BR/EDR +BLE5.0)
No. of Operated Channel:	2.4GHz WIFI: 11 for 802.11b/802.11g/802.11(HT20) 2.4GHz BLE: 40 2.4GHz BR/EDR:79
Modulation:	For 2.4GHz Wi-Fi: Direct Sequence Spread Spectrum (DSSS) for 802.11b Orthogonal Frequency Division Multiplexing (OFDM) for 802.11g/n For 2.4GHz BLE: GFSK For 2.4GHz BR/EDR: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Type:	On board PCB antenna
Antenna Gain:	0.66 dBi
Description of the EUT:	The Equipment Under Test (EUT) is a RF Module with Bluetooth and WI-FI function. Which support 2.4GHz Wi-Fi, BLE and BR/EDR. We tested it and listed the worst data in this report.
Test sample no.:	SHA-620363-1

The sample's mentioned in this report is/are submitted/ supplied/ manufactured by client. The laboratory therefore assumes no responsibility for accuracy of information on the brand name, model number, origin of manufacture, consignment, antenna gain or any information supplied.

Report Number: **7095021029103-00**



China

4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to Public Notice DA 00-705 -Frequency Hopper Spread Spectrum Test Procedure released by FCC on March 30, 2000 and C63.10 (2013).

5 Summary of Test Results

Technical Requirements				
Test Condition		Pages	Test Site	Test Result
§15.207	Conducted emission AC power port	12-14	Site 1	Pass
§15.247(b)(1)	Conducted peak output power	15-19	Site 1	Pass
§15.247(a)(1)	20dB bandwidth and 99% Occupied Bandwidth	20-26	Site 1	Pass
§15.247(a)(1)	Carrier frequency separation	27-28	Site 1	Pass
§15.247(a)(1)(iii)	Number of hopping frequencies	29-30	Site 1	Pass
§15.247(a)(1)(iii)	Dwell Time	31-34	Site 1	Pass
§15.247(e)	Power spectral density*	---	---	N/A
§15.247(d)	Spurious RF conducted emissions	35-42	Site 1	Pass
§15.247(d)	Band edge	43-49	Site 1	Pass
§15.247(d) & §15.209 &	Spurious radiated emissions for transmitter and receiver	50-54	Site 1	Pass
§15.203	Antenna requirement	See note 1		Pass

Note 1: N/A=Not Applicable.

Note 2: The EUT uses a on board PCB antenna, which gain is 0.6dBi. In accordance to RSS-Gen 6.8, It is considered sufficiently to comply with the provisions of this section.



6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2ANDL-VWBK1, complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules.

This report is only for the 2.4GHz BR/EDR test report, for the 2.4GHz BLE test report please refer to 7095021029104-00 and 2.4GHz Wi-Fi please refer to 7095021029123-00.

According to the client's declaration, the "A2LA Accredited" symbol is added to the product. So no additional tests are performed. The results as before are accepted.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

□ - **Not** Performed

The Equipment Under Test

■ - **Fulfills** the general approval requirements.

□ - **Does not** fulfill the general approval requirements.

Sample Received Date: November 12, 2021

Testing Start Date: December 7, 2021

Testing End Date: December 10, 2021

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

Reviewed by:

Prepared by:

Tested by:

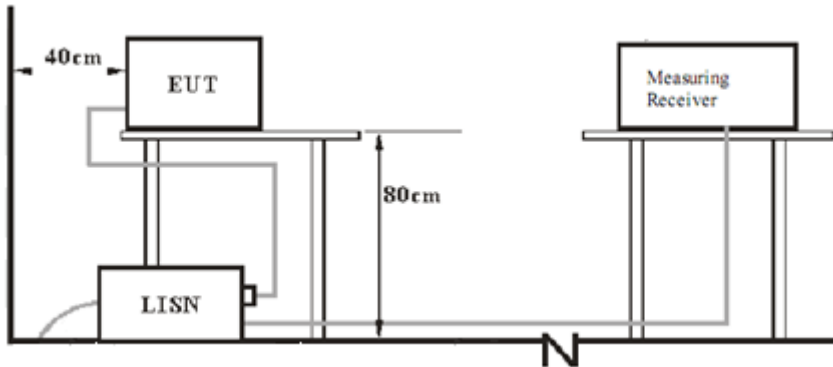
Hui TONG
Review Engineer

Wenqiang LU
EMC Project Engineer

Chengjie GUO
EMC Test Engineer

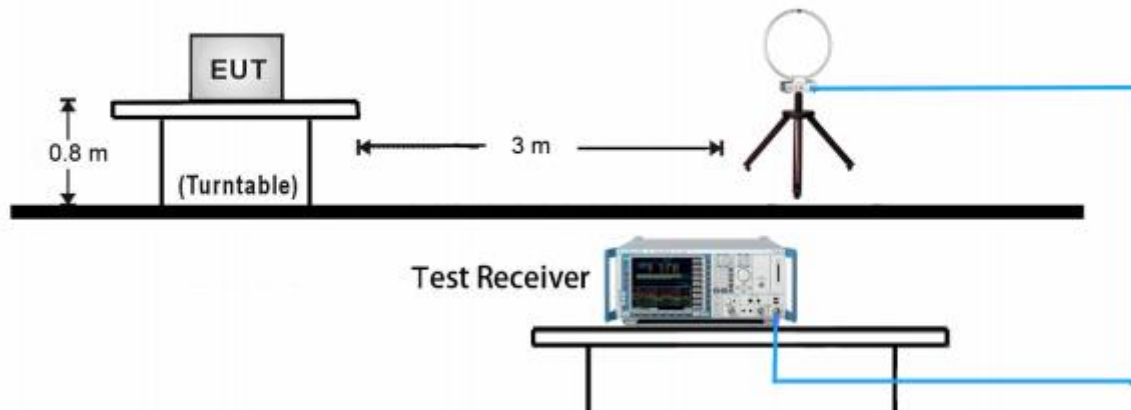
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

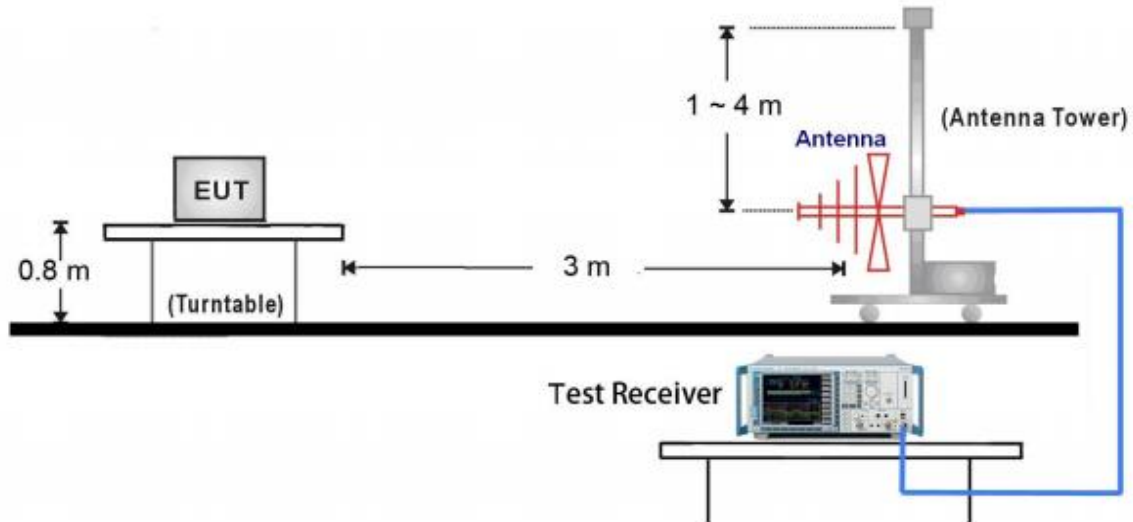


7.2 Radiated test setups

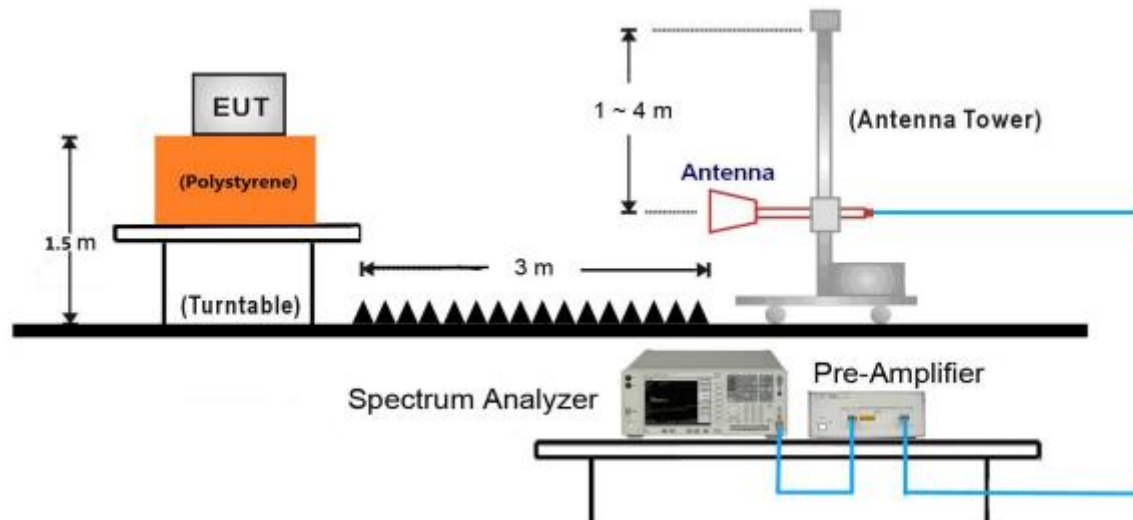
9kHz ~ 30MHz Test Setup:



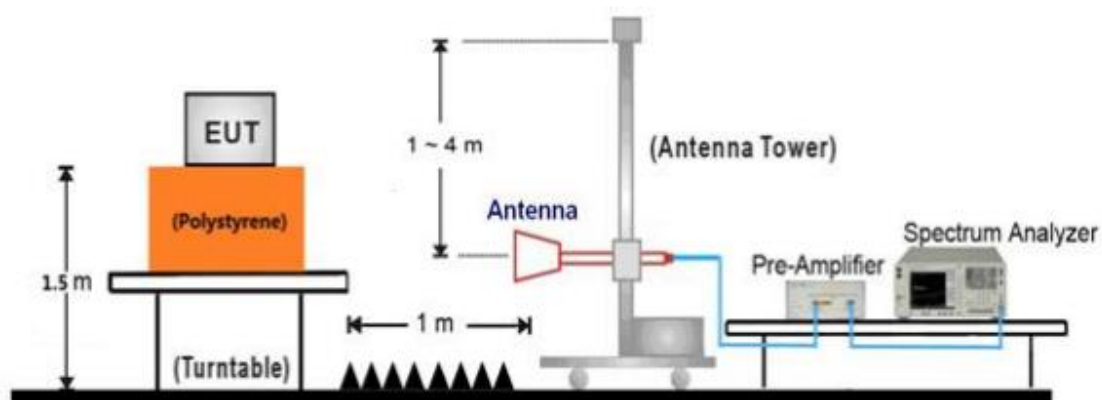
30MHz ~ 1GHz Test Setup:



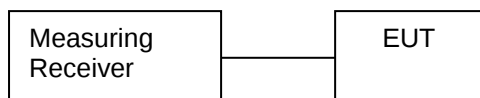
1GHz ~ 18GHz Test Setup:



18GHz ~ 25GHz Test Setup:



7.3 Conducted RF test setups



8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Notebook	Lenove	E470	Notebook

Test software: Test software: BEKEN_WIFI_TEST_V1.9.0, which used to control the EUT in continues transmitting mode.

The system was configured to hopping mode and non-hopping mode.

Hopping mode: typical working mode (normal hopping status)

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

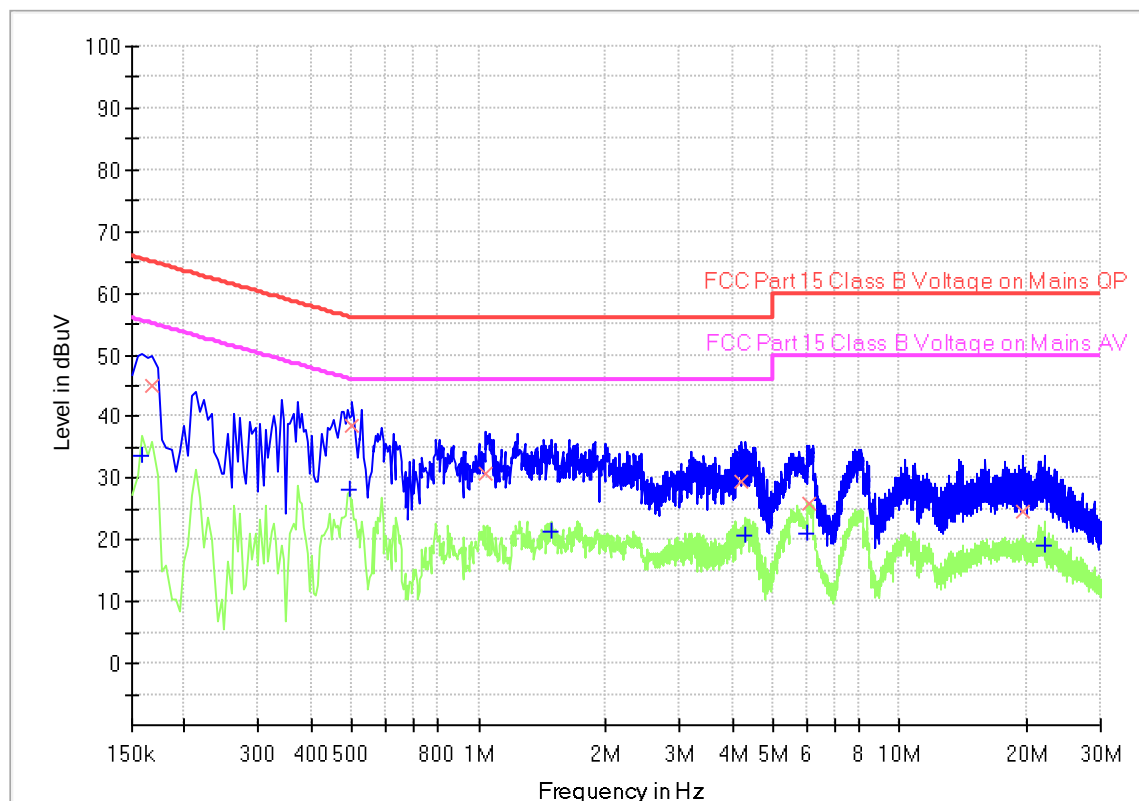
Limit

Frequency MHz	QP Limit dB μ V	AV Limit dB μ V
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Decreasing linearly with logarithm of the frequency

Conducted Emission

Product Type : Wi-Fi and Bluetooth module
 M/N : VWBK1
 Operating Condition : Mode 1: Tx_2480MHz(8DPSK)
 Test Specification : L-line
 Comment : AC 120V/60Hz (powered by notebook)

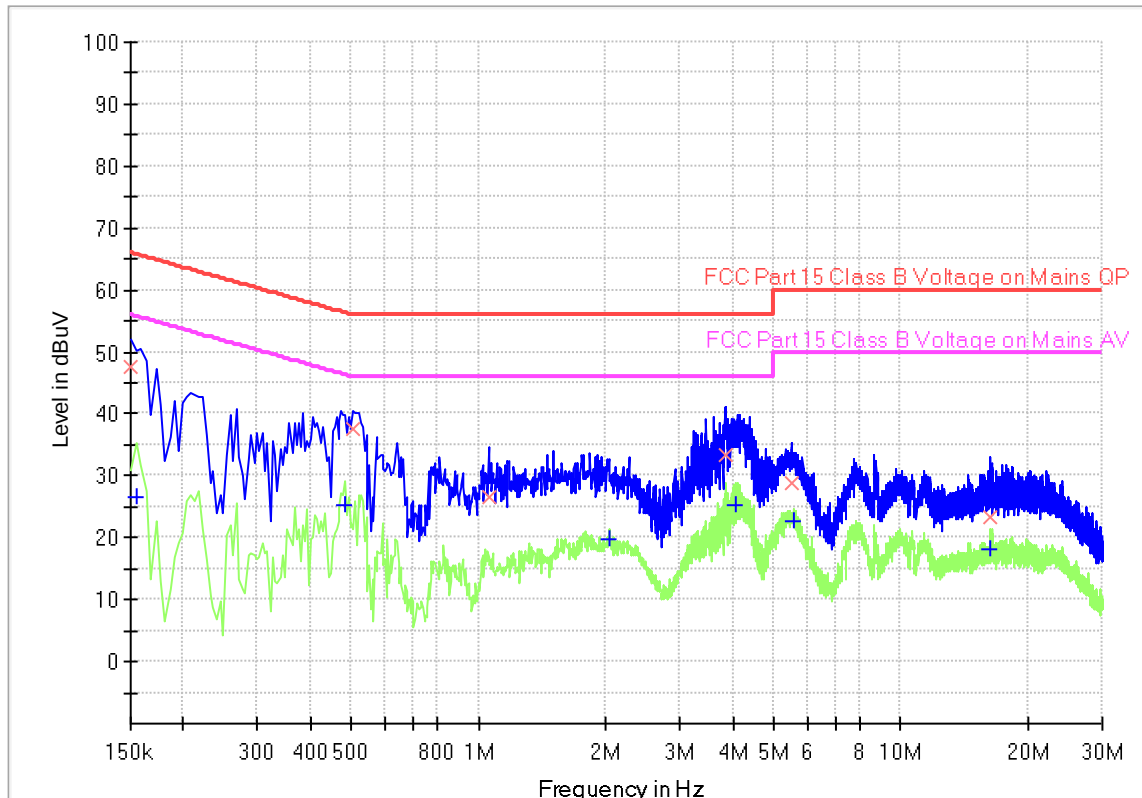


Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.159000	---	33.83	55.52	21.69	1000.0	9.000	L1	19.5
0.168000	45.07	---	65.06	19.99	1000.0	9.000	L1	19.5
0.492000	---	28.25	46.13	17.88	1000.0	9.000	L1	19.5
0.501000	38.55	---	56.00	17.45	1000.0	9.000	L1	19.5
1.036500	30.77	---	56.00	25.23	1000.0	9.000	L1	19.5
1.491000	---	21.32	46.00	24.68	1000.0	9.000	L1	19.5
4.218000	29.44	---	56.00	26.56	1000.0	9.000	L1	19.6
4.312500	---	20.63	46.00	25.37	1000.0	9.000	L1	19.6
6.049500	---	21.00	50.00	29.00	1000.0	9.000	L1	19.6
6.108000	26.00	---	60.00	34.00	1000.0	9.000	L1	19.6
19.653000	24.56	---	60.00	35.44	1000.0	9.000	L1	19.8
22.074000	---	18.97	50.00	31.03	1000.0	9.000	L1	20.0

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
 Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

Product Type : Wi-Fi and Bluetooth module
 M/N : VWBK1
 Operating Condition : Mode 1: Tx_2480MHz(8DPSK)
 Test Specification : N-line
 Comment : AC 120V/60Hz (powered by notebook)



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	47.51	---	66.00	18.49	1000.0	9.000	N	19.5
0.154500	---	26.54	55.75	29.21	1000.0	9.000	N	19.5
0.483000	---	25.38	46.29	20.91	1000.0	9.000	N	19.5
0.505500	37.49	---	56.00	18.51	1000.0	9.000	N	19.5
1.054500	26.48	---	56.00	29.52	1000.0	9.000	N	19.5
2.040000	---	19.84	46.00	26.16	1000.0	9.000	N	19.5
3.858000	33.33	---	56.00	22.67	1000.0	9.000	N	19.5
4.065000	---	25.36	46.00	20.64	1000.0	9.000	N	19.5
5.536500	28.92	---	60.00	31.08	1000.0	9.000	N	19.6
5.577000	---	22.69	50.00	27.31	1000.0	9.000	N	19.6
16.341000	---	18.06	50.00	31.94	1000.0	9.000	N	19.8
16.341000	23.47	---	60.00	36.53	1000.0	9.000	N	19.8

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
 Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

9.2 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured, VBW ≥ RBW,
Sweep = auto, Detector function = peak, Trace = max hold
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power

Limits

Conducted peak output power

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

Test result as below table

Bluetooth Mode GFSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	3.77	Pass
Middle channel 2441MHz	4.25	Pass
High channel 2480MHz	4.6	Pass

Bluetooth Mode $\pi/4$ -DQPSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	5.4	Pass
Middle channel 2441MHz	5.79	Pass
High channel 2480MHz	6.06	Pass

Bluetooth Mode 8DPSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	5.76	Pass
Middle channel 2441MHz	6.17	Pass
High channel 2480MHz	6.43	Pass

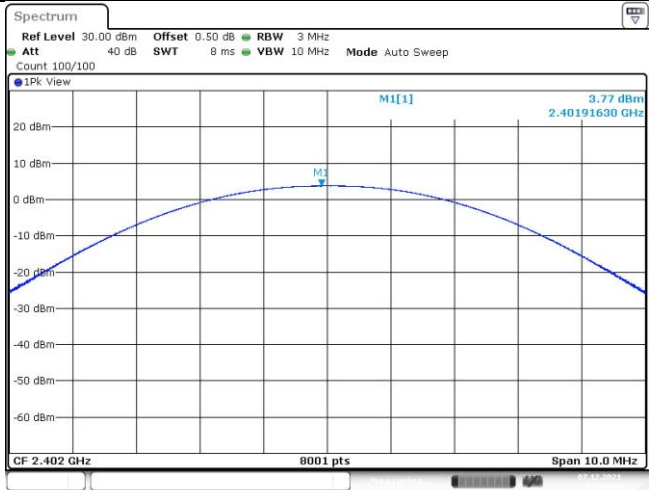
Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB)

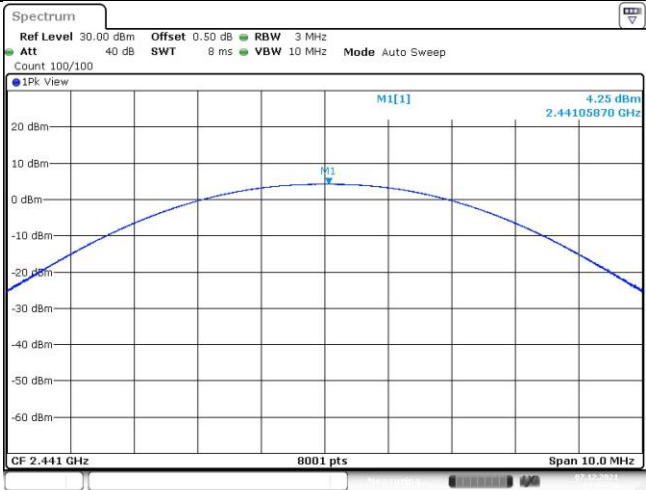
GFSK

Peak output power

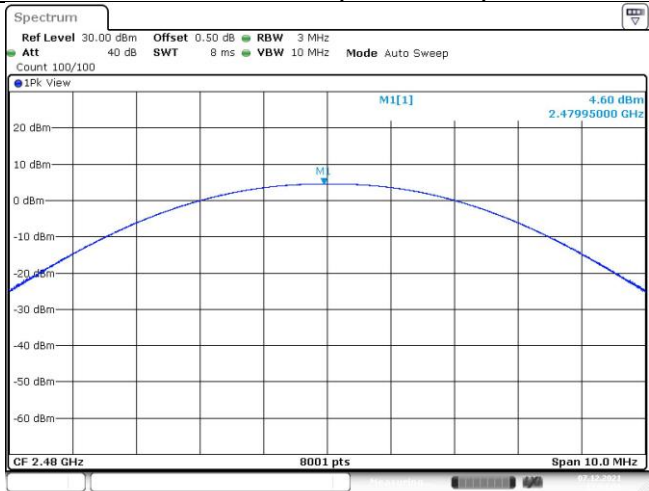
Channel 0 (2402MHz)



Channel 39 (2441MHz)



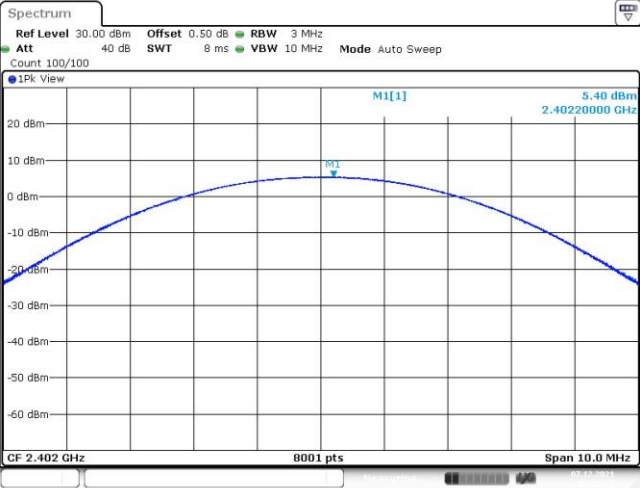
Channel 78 (2480MHz)



$\pi/4$ -DQPSK

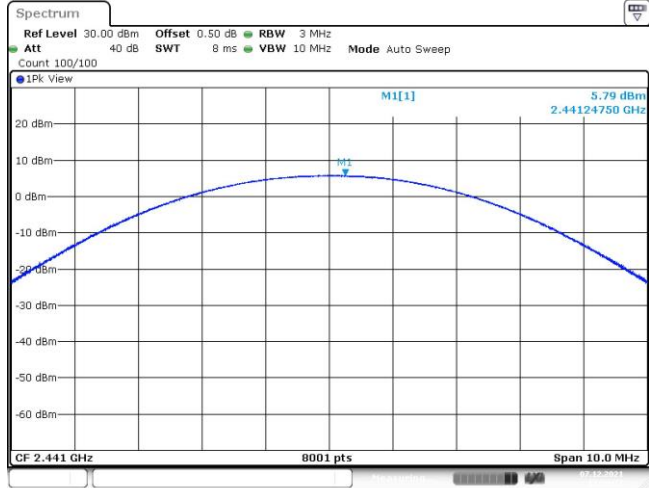
Peak output power

Channel 0 (2402MHz)



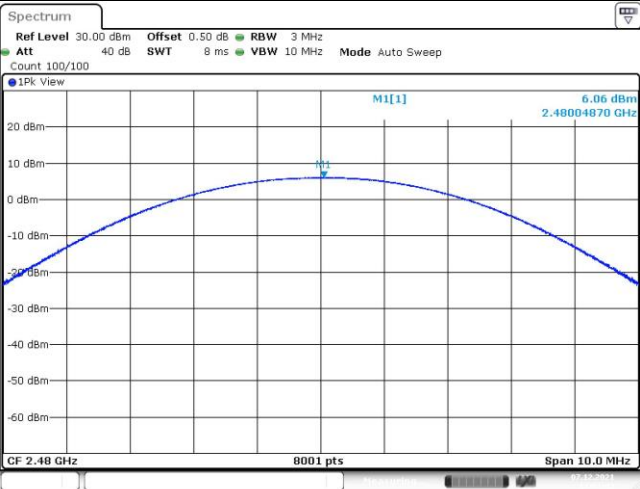
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Channel 39 (2441MHz)



Date: 7.DEC.2021 13:59:17

Channel 78 (2480MHz)

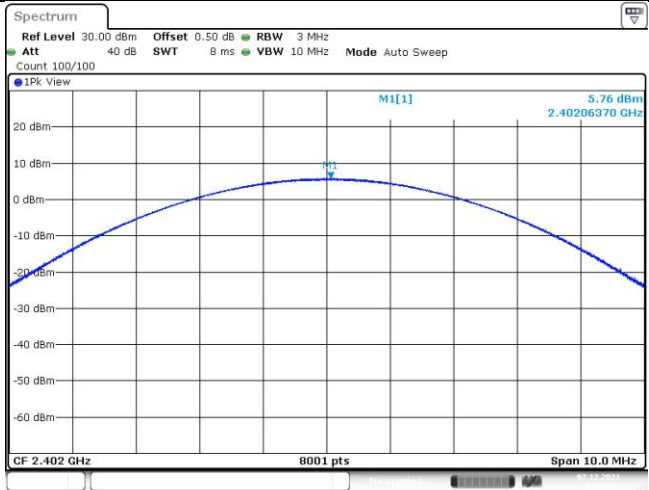


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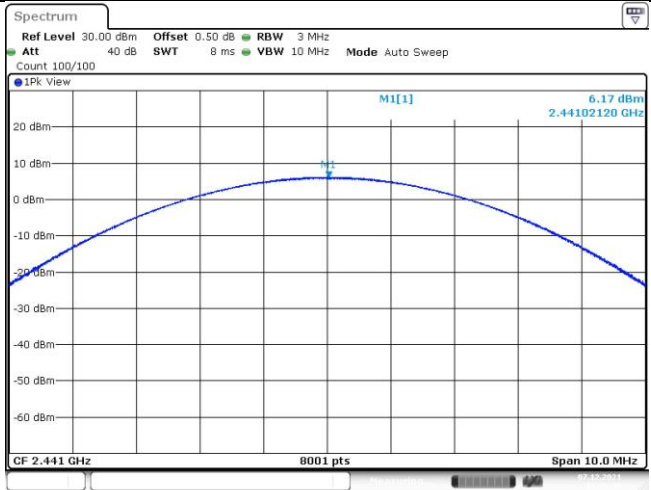
8DPSK

Peak output power

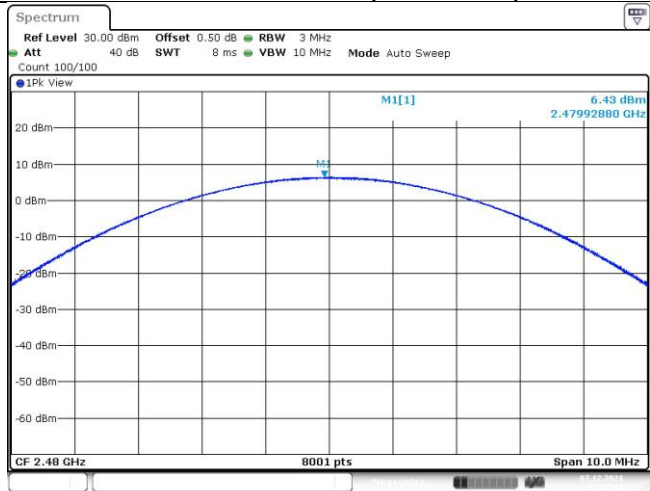
Channel 0 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)



9.3 20 dB bandwidth and 99% Occupied Bandwidth

Test Method

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Method for 99 % Bandwidth

1. Use the following spectrum analyzer settings:
RBW=1% to 5% of the actual occupied, VBW $\geq$ 3RBW, Sweep = auto,
Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]

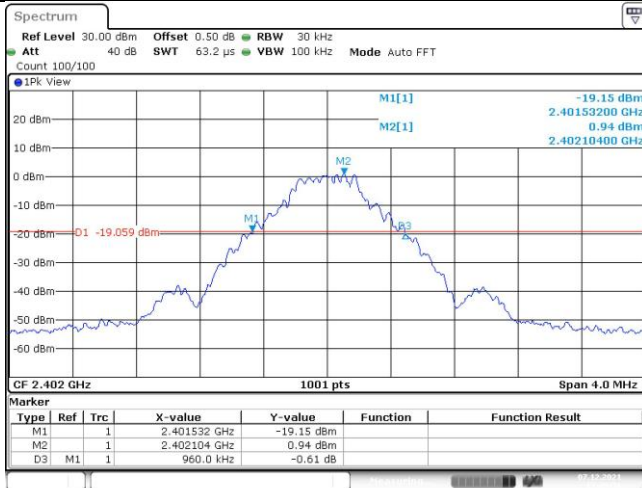
N/A

20 dB bandwidth

Bluetooth Mode GFSK Modulation test result

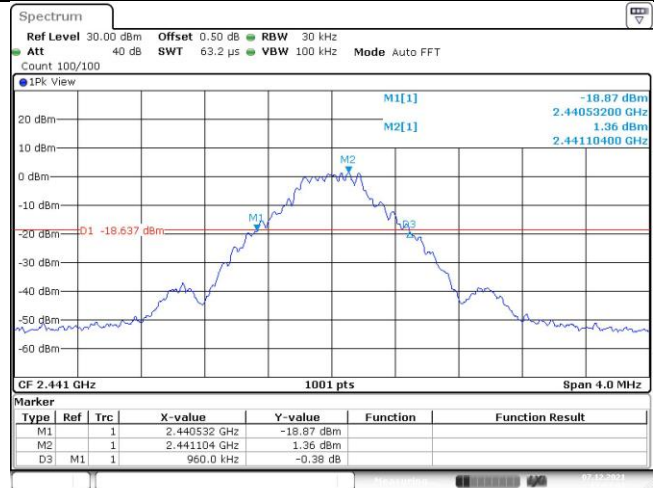
Frequency MHz	20 dB Bandwidth kHz	Limit kHz	Result
2402	960	--	Pass
2441	960	--	Pass
2480	960	--	Pass

Channel 1 (2402MHz)



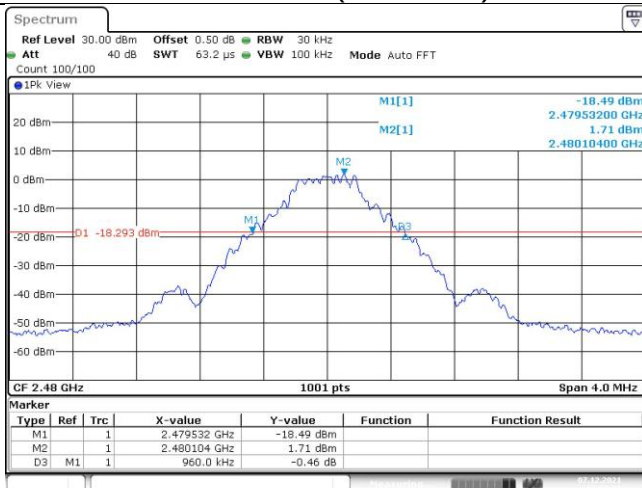
Date: 7.DEC.2021 13:49:28

Channel 39 (2441MHz)



Date: 7.DEC.2021 13:52:02

Channel 79 (2480MHz)



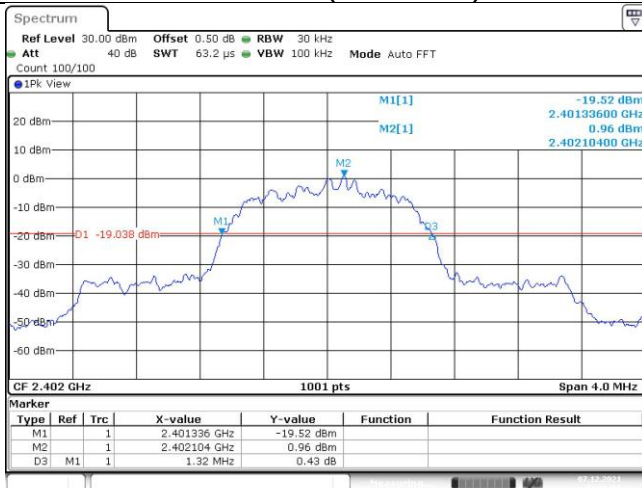
Date: 7.DEC.2021 13:53:52

20 dB bandwidth

Bluetooth Mode $\pi/4$ -DQPSK Modulation test result

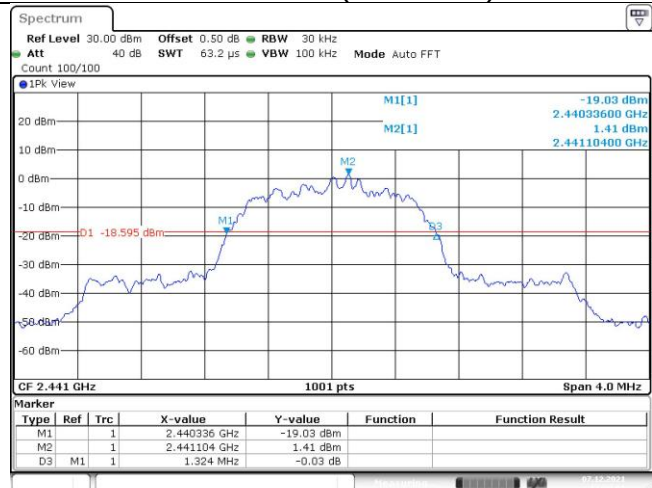
Frequency	20 dB Bandwidth	Limit	Result
MHz	kHz	kHz	
2402	1320	--	Pass
2441	1324	--	Pass
2480	1324	--	Pass

Channel 1 (2402MHz)



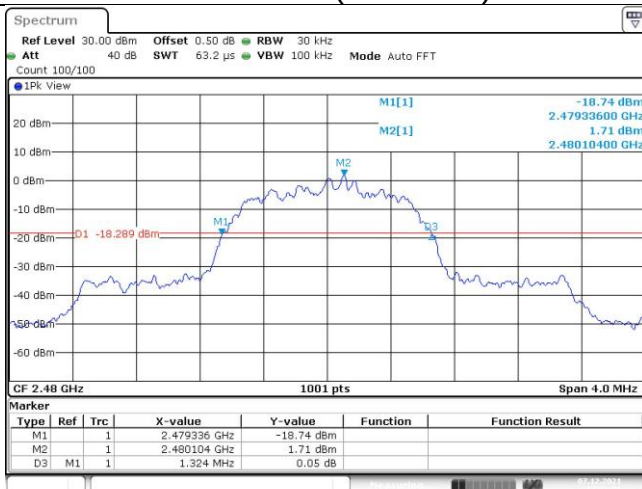
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Channel 39 (2441MHz)



Date: 7.DEC.2021 13:59:01

Channel 79 (2480MHz)



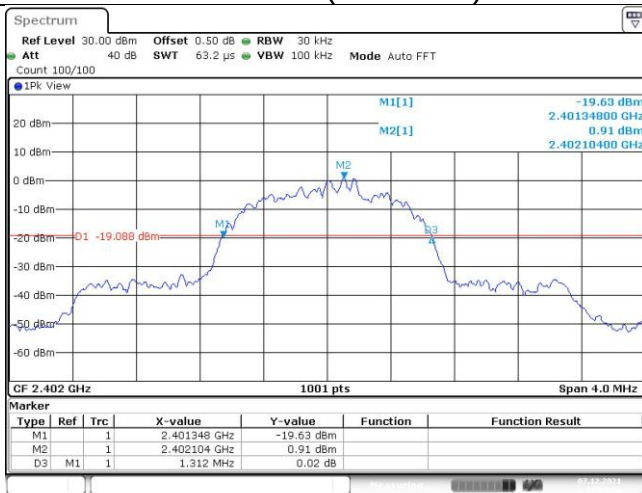
Date: 7.DEC.2021 14:01:26

20 dB bandwidth

Bluetooth Mode 8DPSK Modulation test result

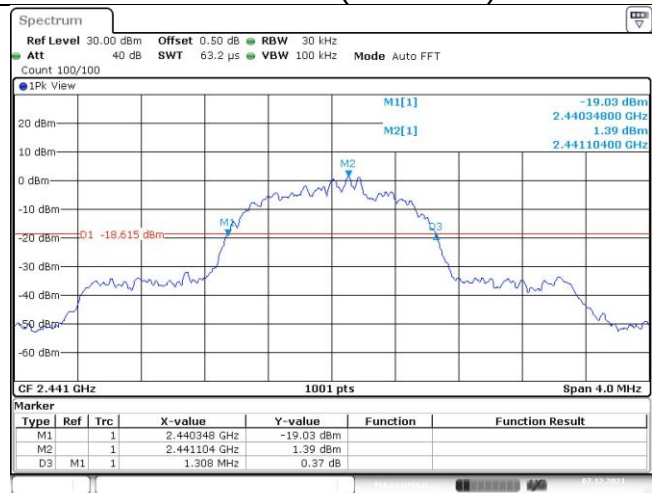
Frequency MHz	20 dB Bandwidth kHz	Limit kHz	Result
2402	1312	--	Pass
2441	1308	--	Pass
2480	1312	--	Pass

Channel 1 (2402MHz)



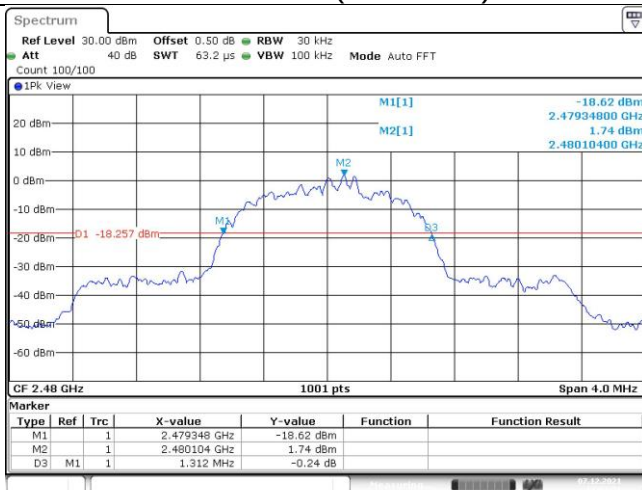
Date: 7 DEC 2021 14:03:18

Channel 39 (2441MHz)



Date: 7 DEC 2021 14:05:19

Channel 79 (2480MHz)



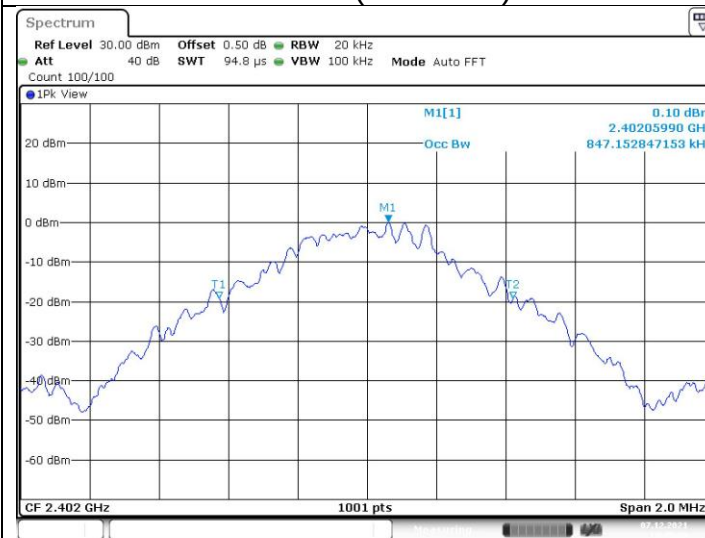
Date: 7 DEC 2021 14:07:28

99% Bandwidth

Bluetooth Mode GFSK Modulation test result

Frequency	99% Bandwidth	Limit	Result
MHz	kHz	kHz	
2402	847	--	Pass
2441	849	--	Pass
2480	849	--	Pass

Channel 1 (2402MHz)



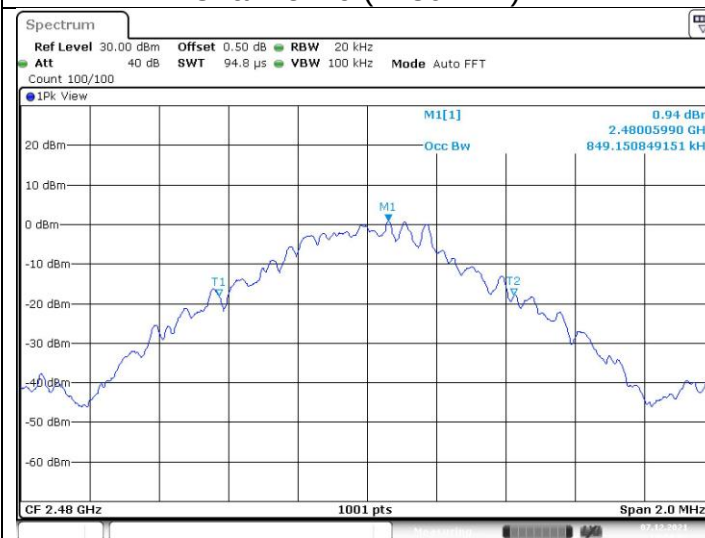
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Channel 39 (2441MHz)



Date: 7.DEC.2021 13:52:12

Channel 79 (2480MHz)

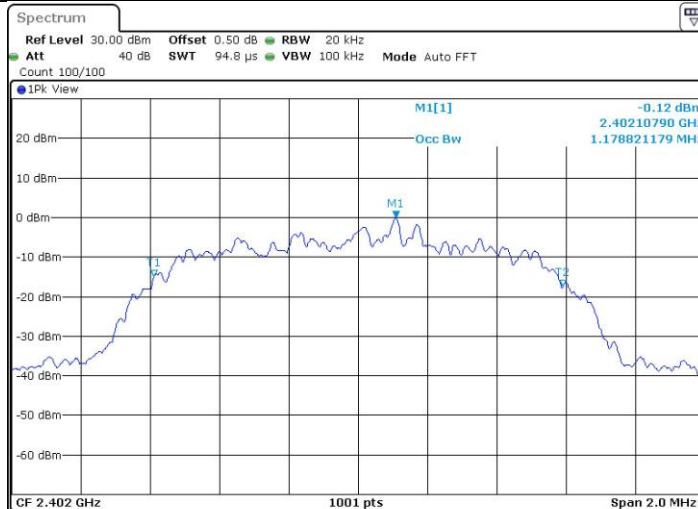


Date: 7.DEC.2021 13:54:02

Bluetooth Mode $\pi/4$ -DQPSK Modulation test result

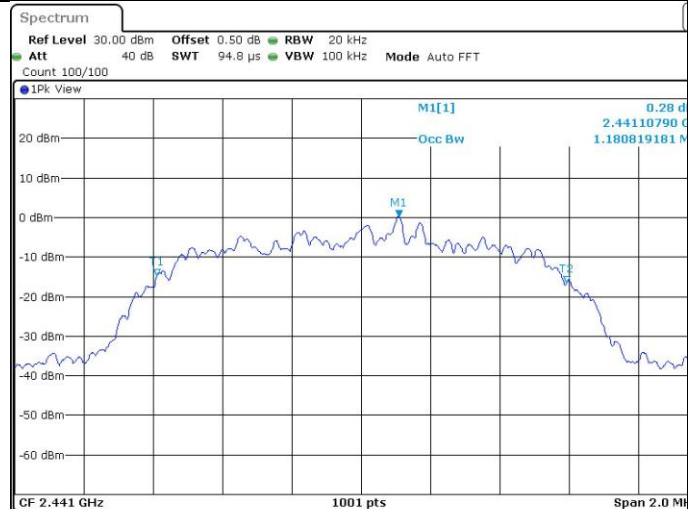
Frequency MHz	99% Bandwidth kHz	Limit kHz	Result
2402	1179	--	Pass
2441	1181	--	Pass
2480	1181	--	Pass

Channel 1 (2402MHz)



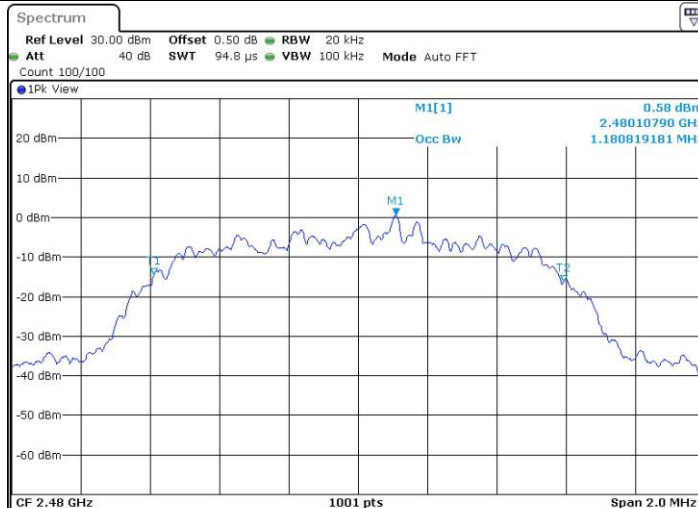
Date: 7.DEC.2021 13:58:11

Channel 39 (2441MHz)



Date: 7.DEC.2021 13:59:11

Channel 79 (2480MHz)



Date: 7.DEC.2021 14:01:36

Bluetooth Mode 8DPSK Modulation test result

Frequency MHz	99% Bandwidth kHz	Limit kHz	Result
2402	1189	--	Pass
2441	1189	--	Pass
2480	1189	--	Pass

Channel 1 (2402MHz)



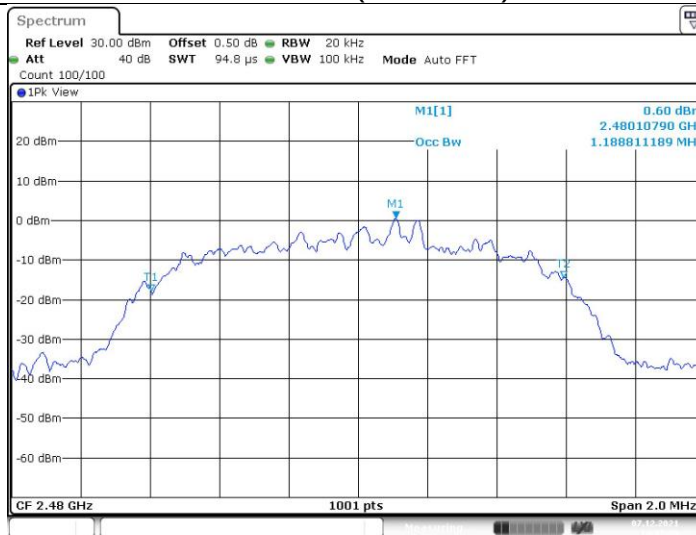
Date: 7.DEC.2021 14:03:28

Channel 39 (2441MHz)



Date: 7.DEC.2021 14:05:29

Channel 79 (2480MHz)



Date: 7.DEC.2021 14:07:38

9.4 Carrier Frequency Separation

Test Method

1. Use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels, $RBW \geq 1\%$ of the span, $VBW \geq RBW$, Sweep = auto, Detector function = peak
2. By using the Max-Hold function record the separation of two adjacent channels.
3. Measure the frequency difference of these two adjacent channels by spectrum analyzer marker function.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit kHz
$\geq 25\text{kHz}$ or $2/3$ of the 20 dB bandwidth which is greater

Limit

Frequency MHz	2/3 of 20 dB Bandwidth kHz
2402	640 (GFSK)
2441	883($\pi/4$ -DQPSK)
2402	875(8DPSK)

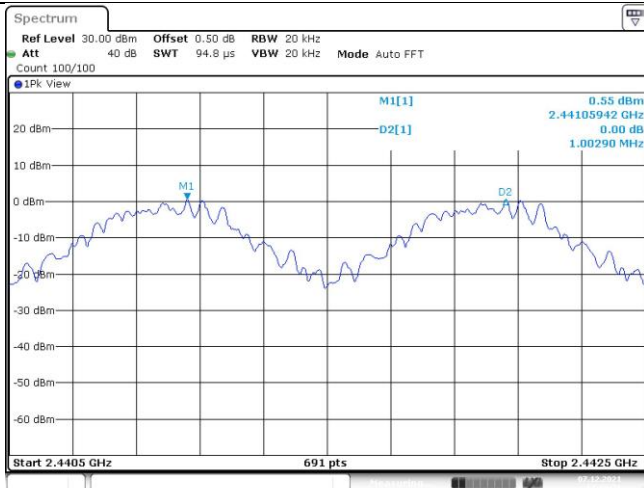
Carrier Frequency Separation

Test result: The measurement was performed with the typical configuration (normal hopping status), here GFSK modulation mode was used to show compliance.

test result

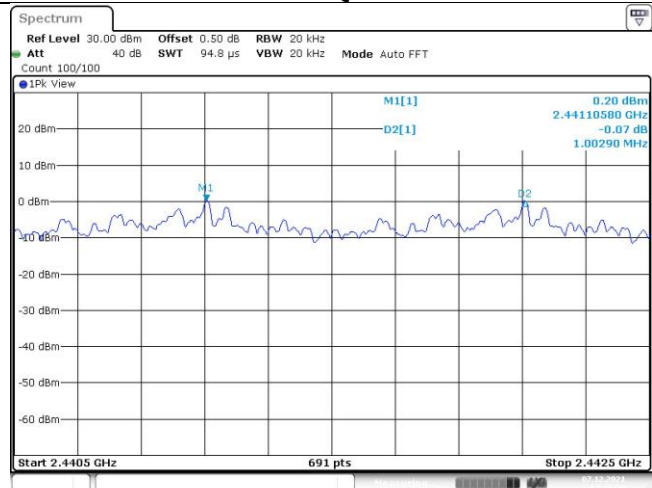
Modulation	Frequency MHz	Carrier Frequency Separation kHz	Result
GFSK	2441	1002.9	Pass
$\pi/4$ -DQPSK	2441	1002.9	Pass
8DPSK	2441	1000.0	Pass

GFSK



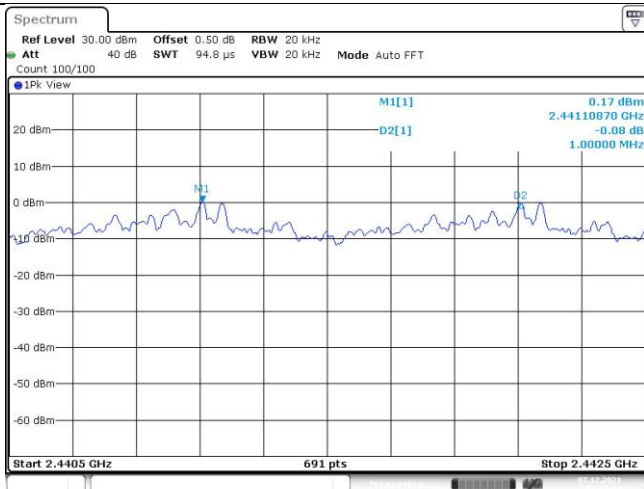
Date: 7.DEC.2021 14:10:29

$\pi/4$ -DQPSK



Date: 7.DEC.2021 14:13:28

8DPSK



Date: 7.DEC.2021 14:17:22

9.5 Number of hopping frequencies

Test Method

1. Use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels, $RBW \geq 1\%$ of the span, $VBW \geq RBW$, Sweep = auto, Detector function = peak
2. Set the spectrum analyzer on Max-Hold Mode, and then keep the EUT in hopping mode.
3. Record all the signals from each channel until each one has been recorded.
4. Repeat above procedures until all frequencies measured were complete.

Limit

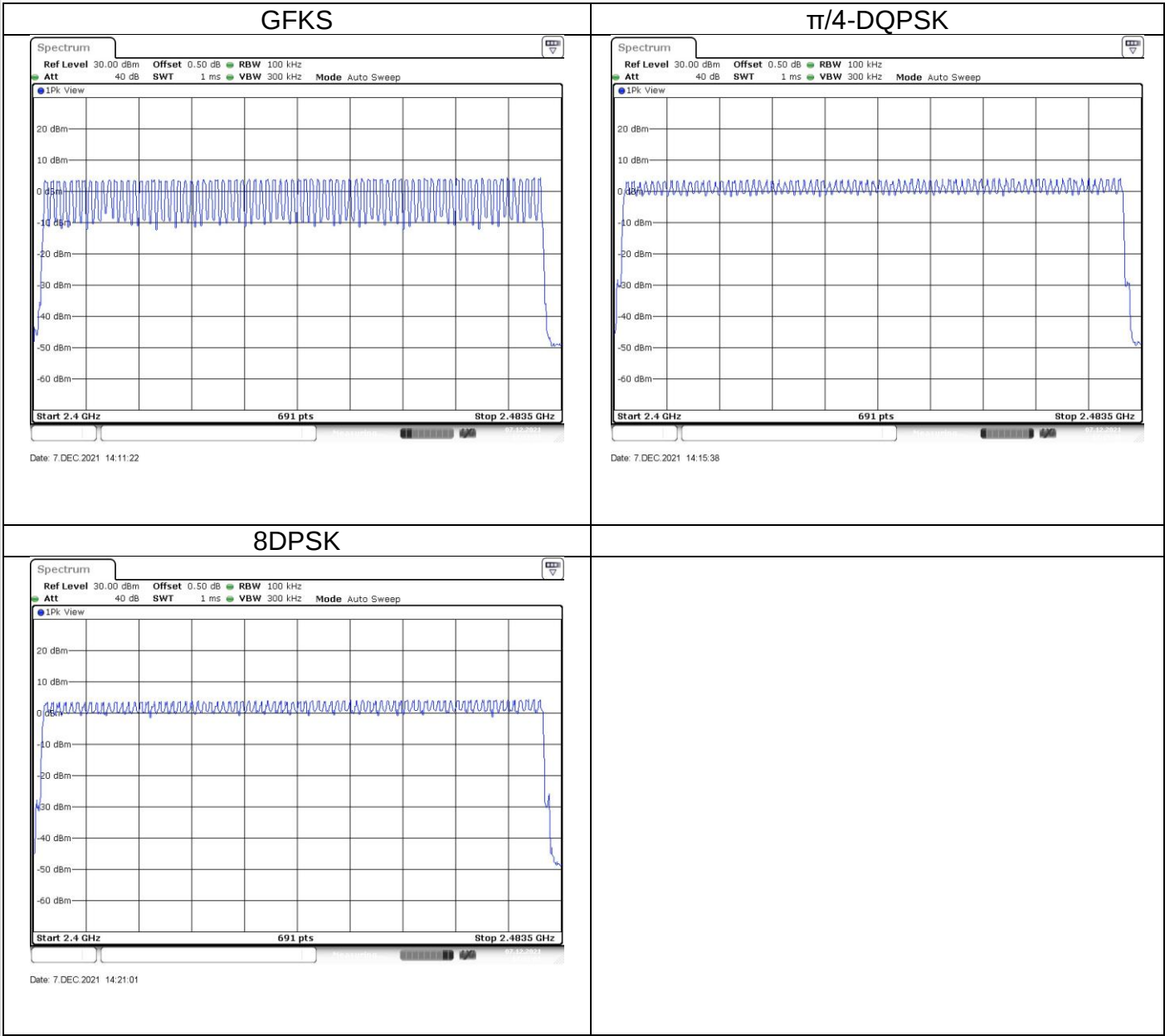
Limit
number

≥ 15

Number of hopping frequencies

Test result: The measurement was performed with the typical configuration (normal hopping status), and the total hopping channels is constant for the all modulation mode according with the Bluetooth Core Specification. Here GFSK modulation mode was used to show compliance.

Number of hopping frequencies	Result
79	Pass



9.6 Dwell Time

Test Method

1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable.
Equipment mode: Spectrum analyzer
2. RBW: 1MHz; VBW: 1MHz; SPAN: Zero Span
3. Adjust the center frequency of spectrum analyzer on any frequency be measured.
4. Measure the Dwell Time by spectrum analyzer Marker function.
5. Repeat above procedures until all frequencies measured were complete.

Limit

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Dwell time

The maximum dwell time shall be 0,4s.

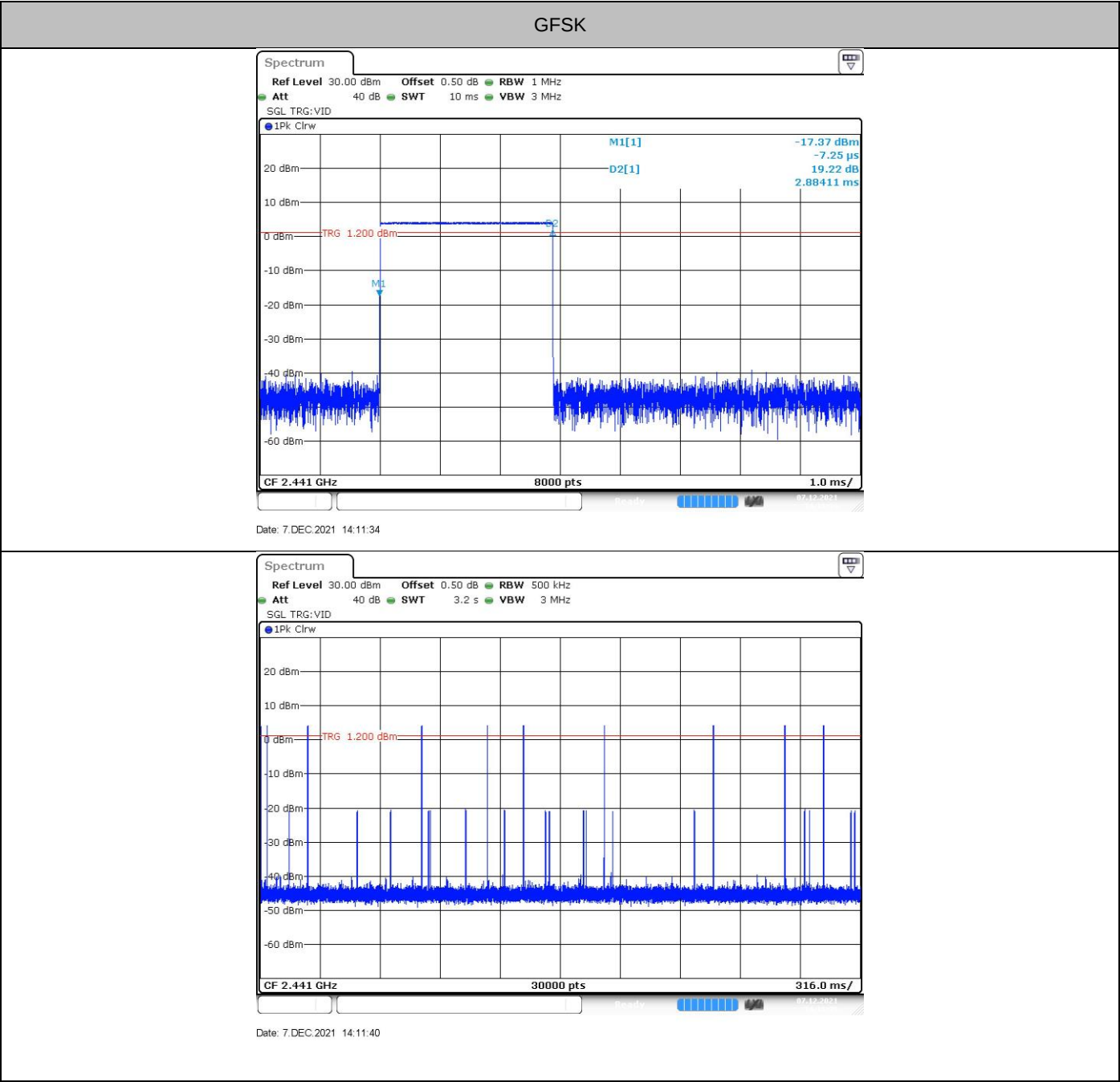
The Dwell time=Burst Width*Total Hops.

Test Modulation	Channel	Burst Width [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
GFSK	Hop	2.88	100	0.288	≤ 0.4	PASS
$\pi/4$ -DQPSK	Hop	2.88	100	0.288	≤ 0.4	PASS
8DPSK	Hop	2.88	80	0.23	≤ 0.4	PASS



China

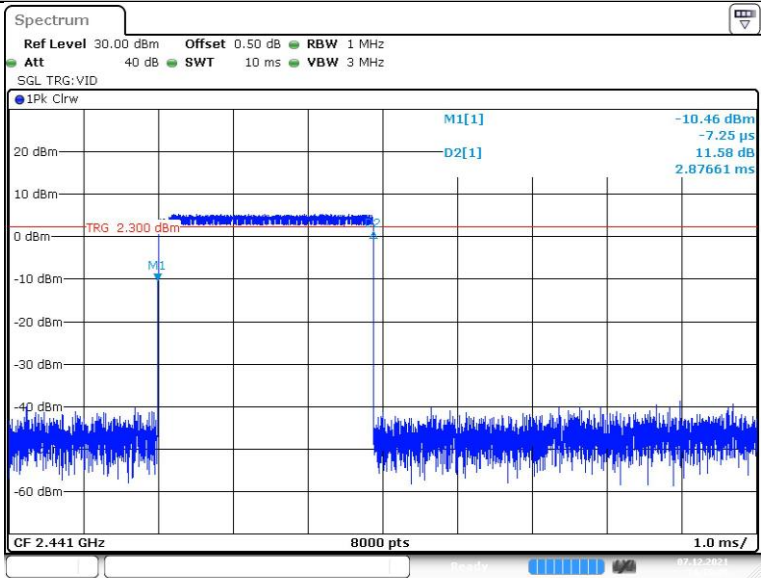
Test Graphs



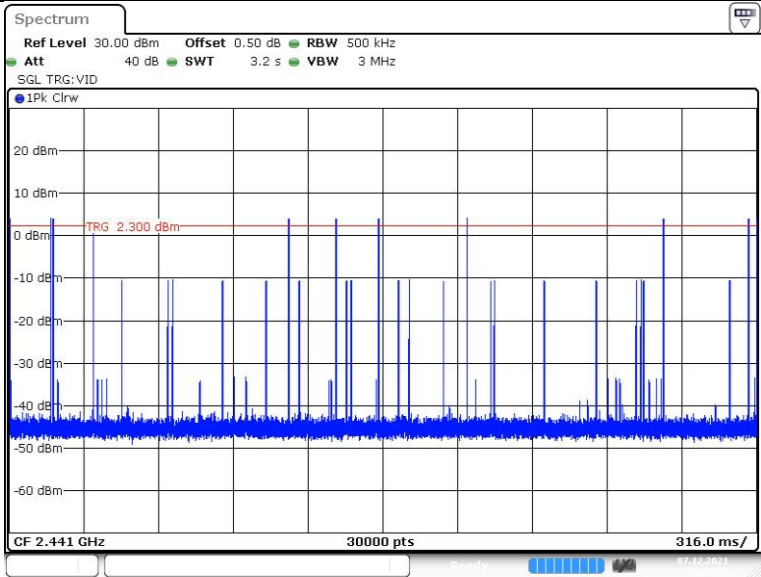


China

$\pi/4$ -DQPSK

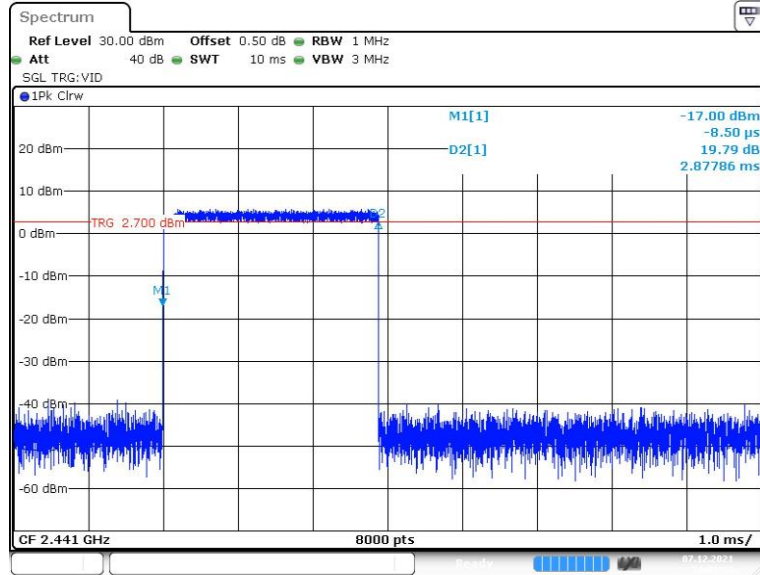


Date: 7.DEC.2021 14:15:50

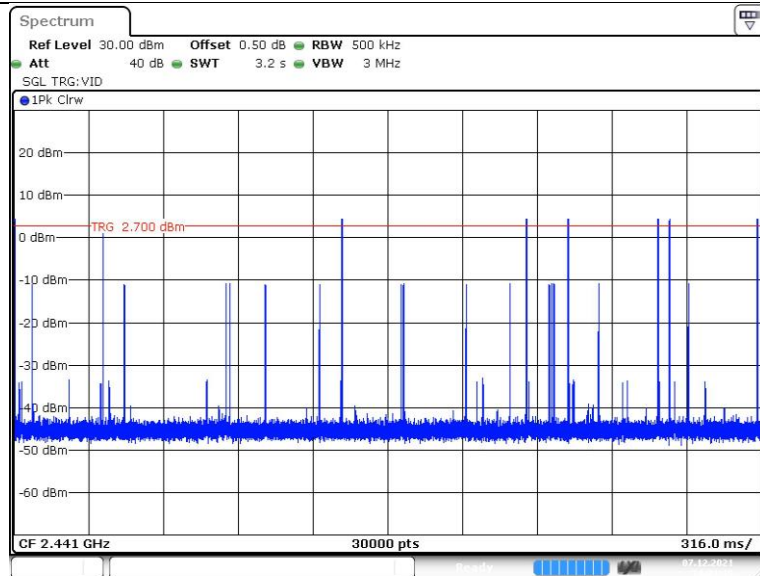


Date: 7.DEC.2021 14:15:56

8DPSK



Date: 7.DEC.2021 14:21:13



Date: 7.DEC.2021 14:21:19

9.7 Spurious RF conducted emissions

Test Method

1. Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
3. The level displayed must comply with the limit specified in this Section. Submit these plots.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

Spurious RF conducted emissions

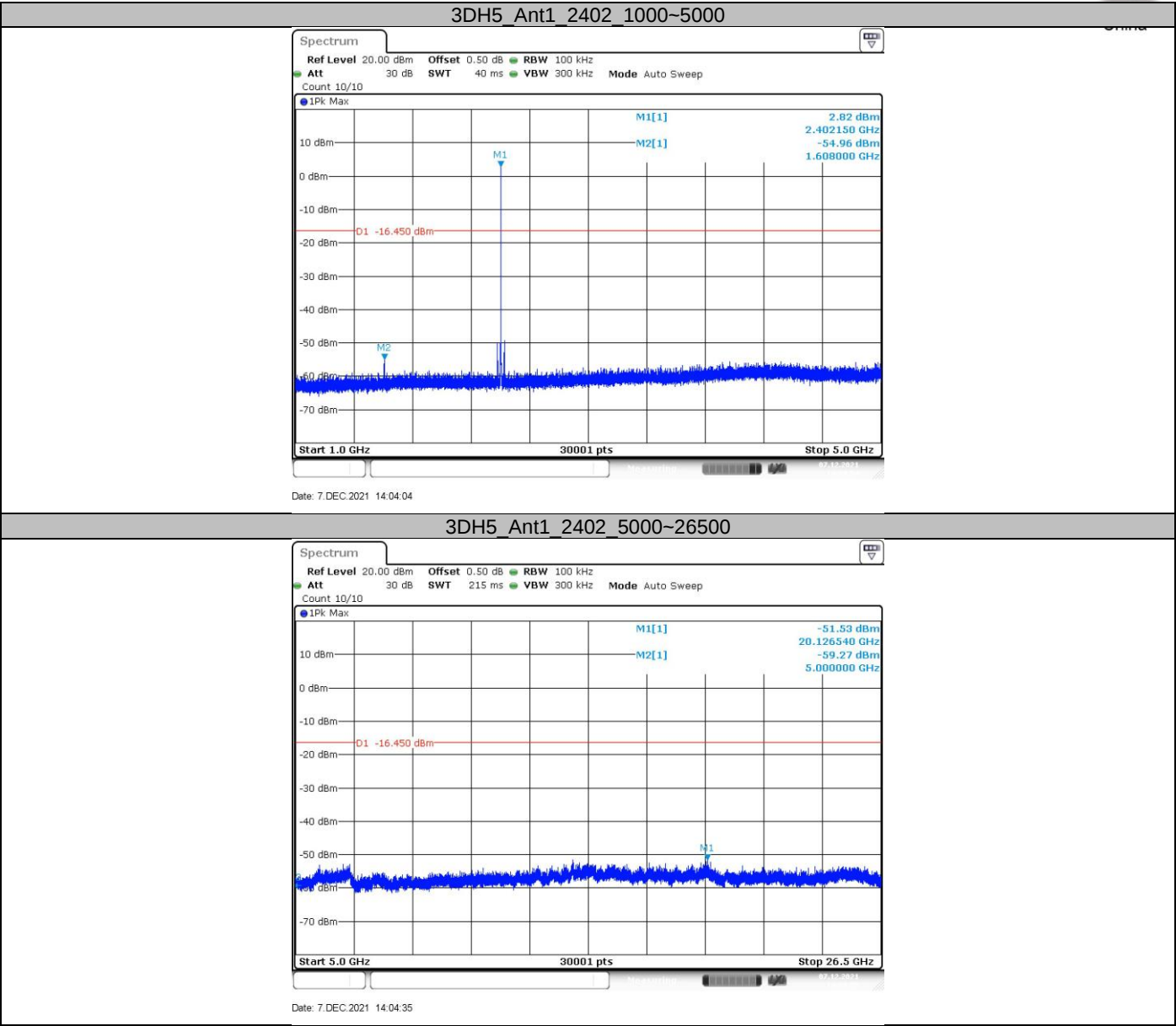
Only the worst case (which is subject to the maximum EIRP, 8DPSK mode) test result is listed in the report.

Test Mode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
3DH5	Ant1	2402	Reference	3.55	3.55	---	PASS
			30~1000	3.55	-57.42	<=-16.45	PASS
			1000~5000	3.55	-54.96	<=-16.45	PASS
			5000~26500	3.55	-51.53	<=-16.45	PASS
		2441	Reference	3.92	3.92	---	PASS
			30~1000	3.92	-57.55	<=-16.08	PASS
			1000~5000	3.92	-54.53	<=-16.08	PASS
			5000~26500	3.92	-50.63	<=-16.08	PASS
		2480	Reference	4.15	4.15	---	PASS
			30~1000	4.15	-58.51	<=-15.85	PASS
			1000~5000	4.15	-54.1	<=-15.85	PASS
			5000~26500	4.15	-51.32	<=-15.85	PASS

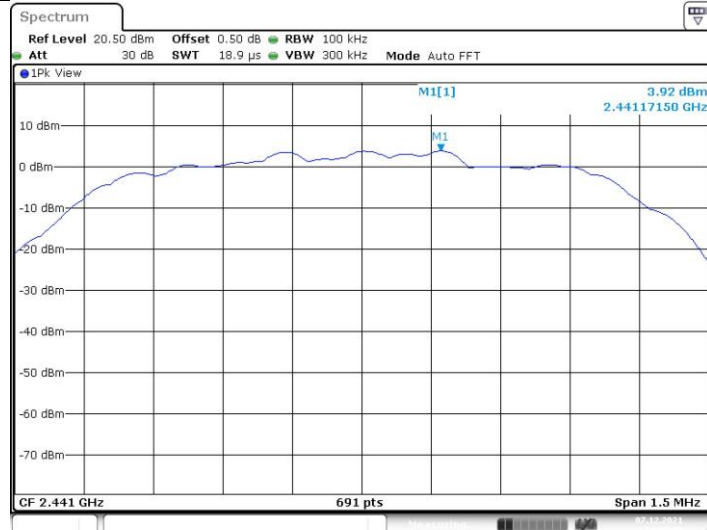


3DH5 Ant1 2402 30~1000



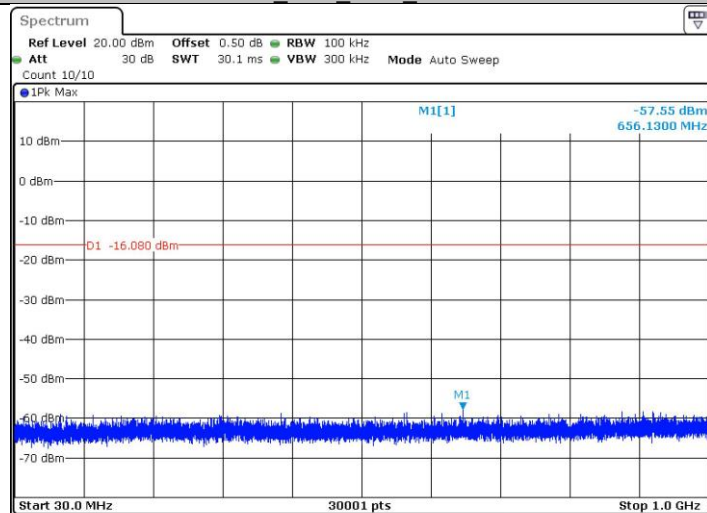


3DH5_Ant1_2441_0~Reference



Date: 7 DEC.2021 14:05:40

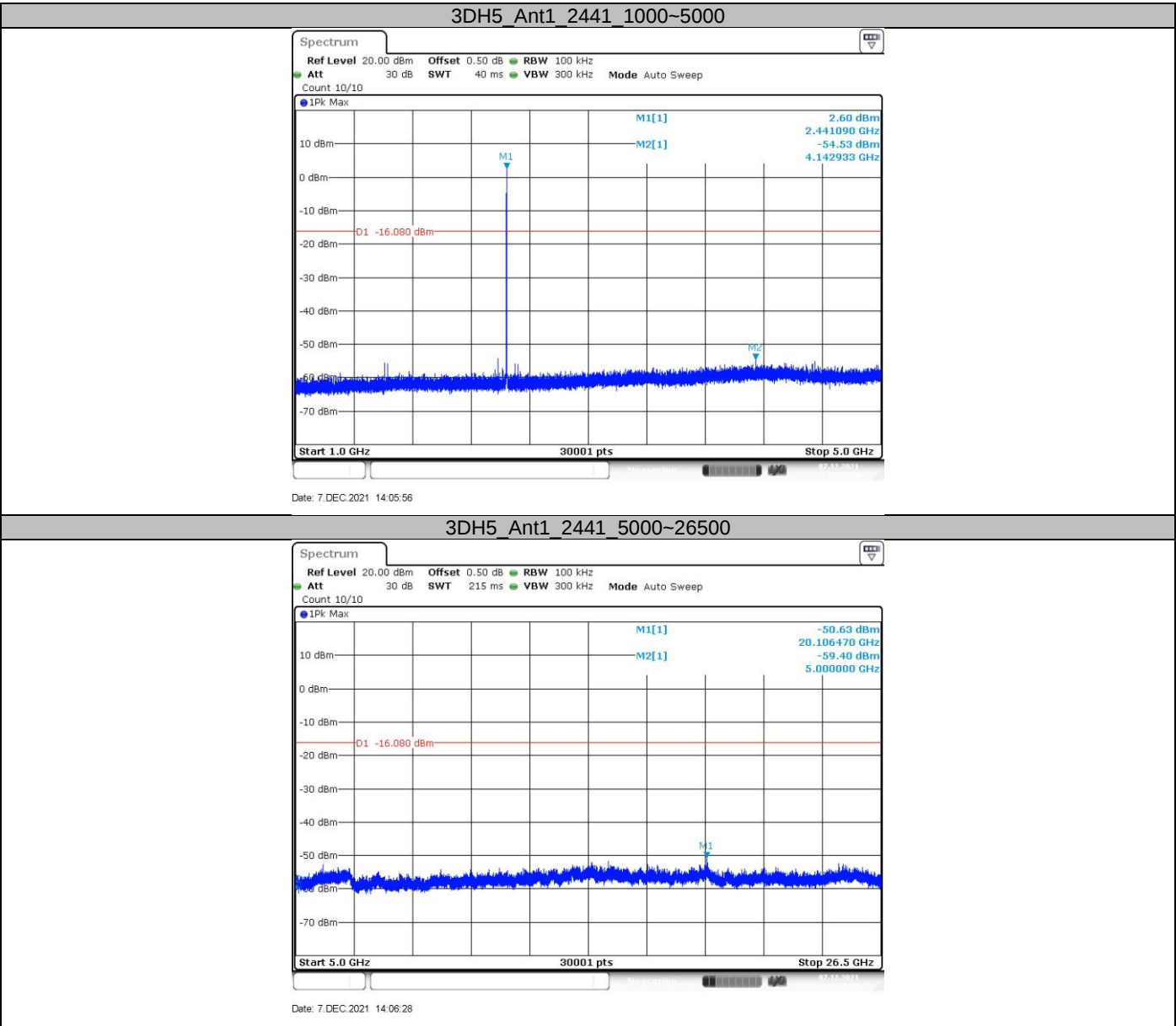
3DH5_Ant1_2441_30~1000



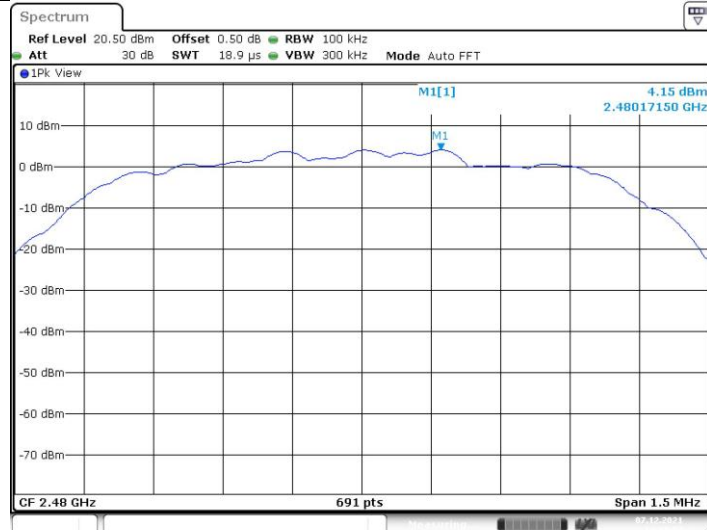
Date: 7 DEC.2021 14:05:44



China

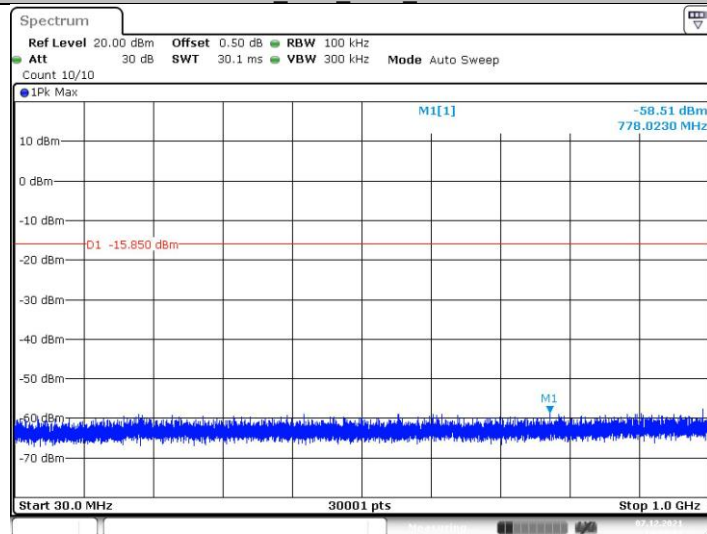


3DH5_Ant1_2480_0~Reference

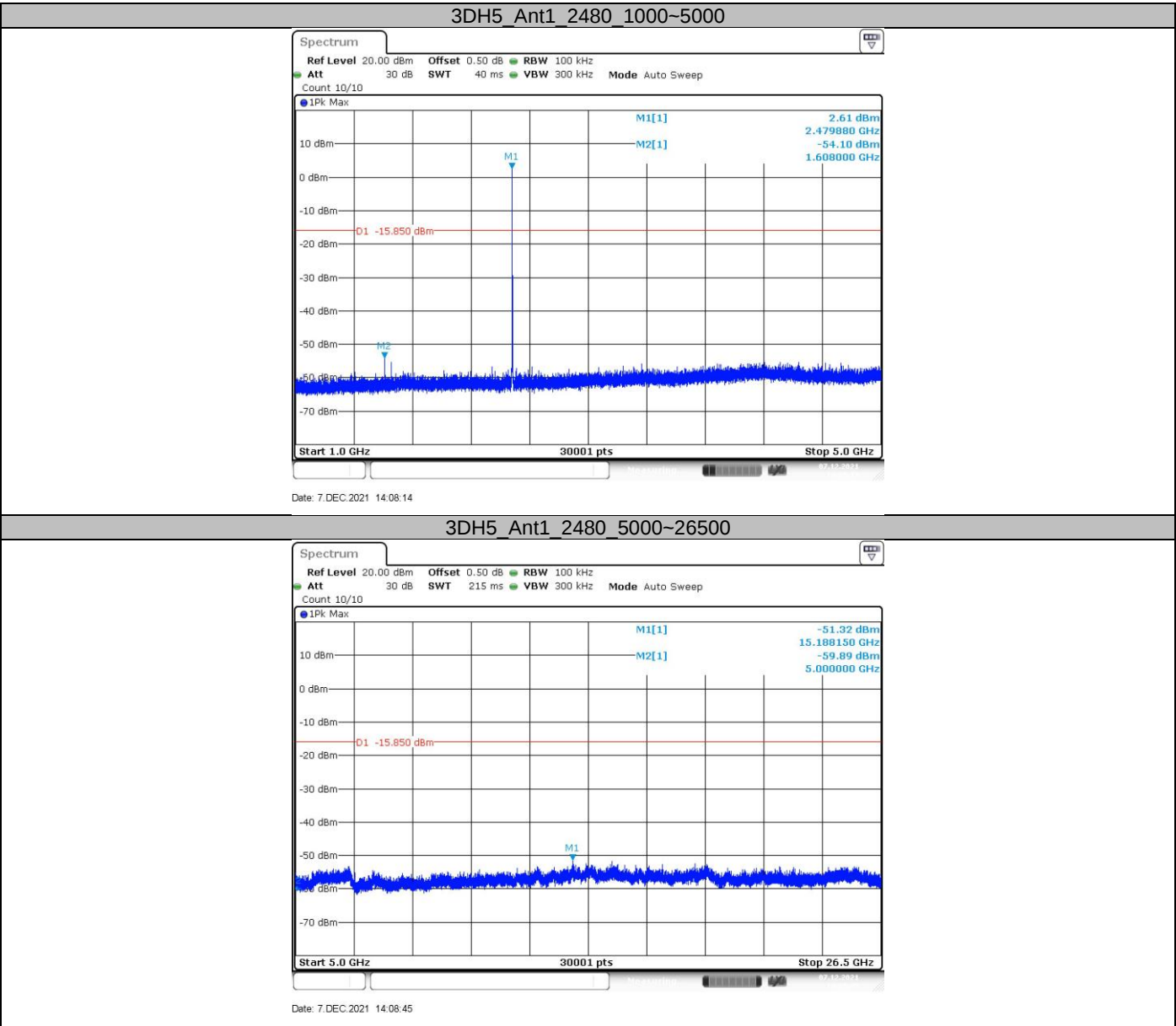


Date: 7 DEC.2021 14:07:57

3DH5_Ant1_2480_30~1000



Date: 7 DEC.2021 14:08:02



Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
Factor (dB) = Cable Loss (dB)

9.8 Band edge testing

Test Method

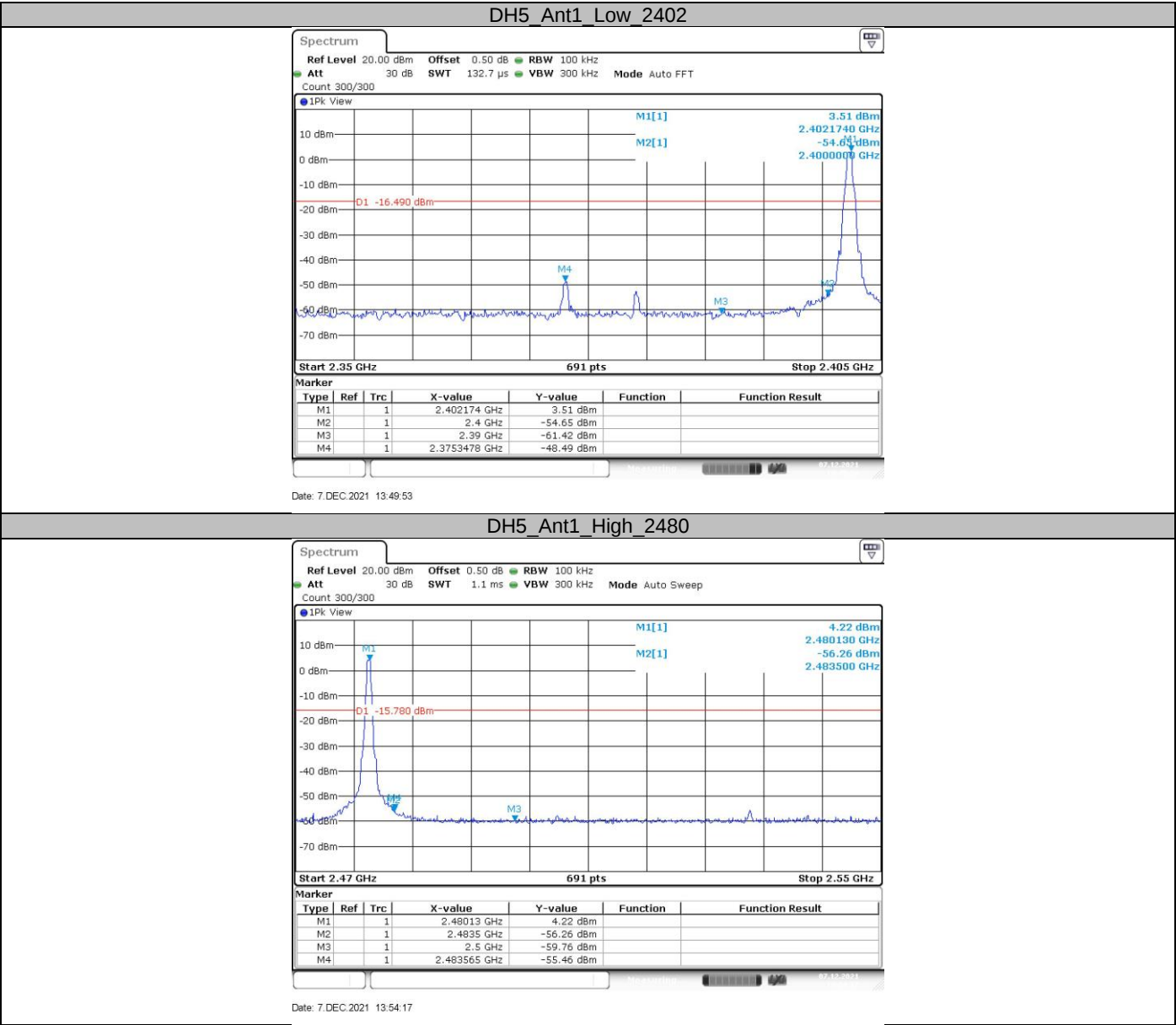
1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency
6. Set to the maximum power setting and enable the EUT hopping mode, repeat the test.

Limit:

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

Band edge testing

GFSK Modulation Test Result:
Hopping off mode:



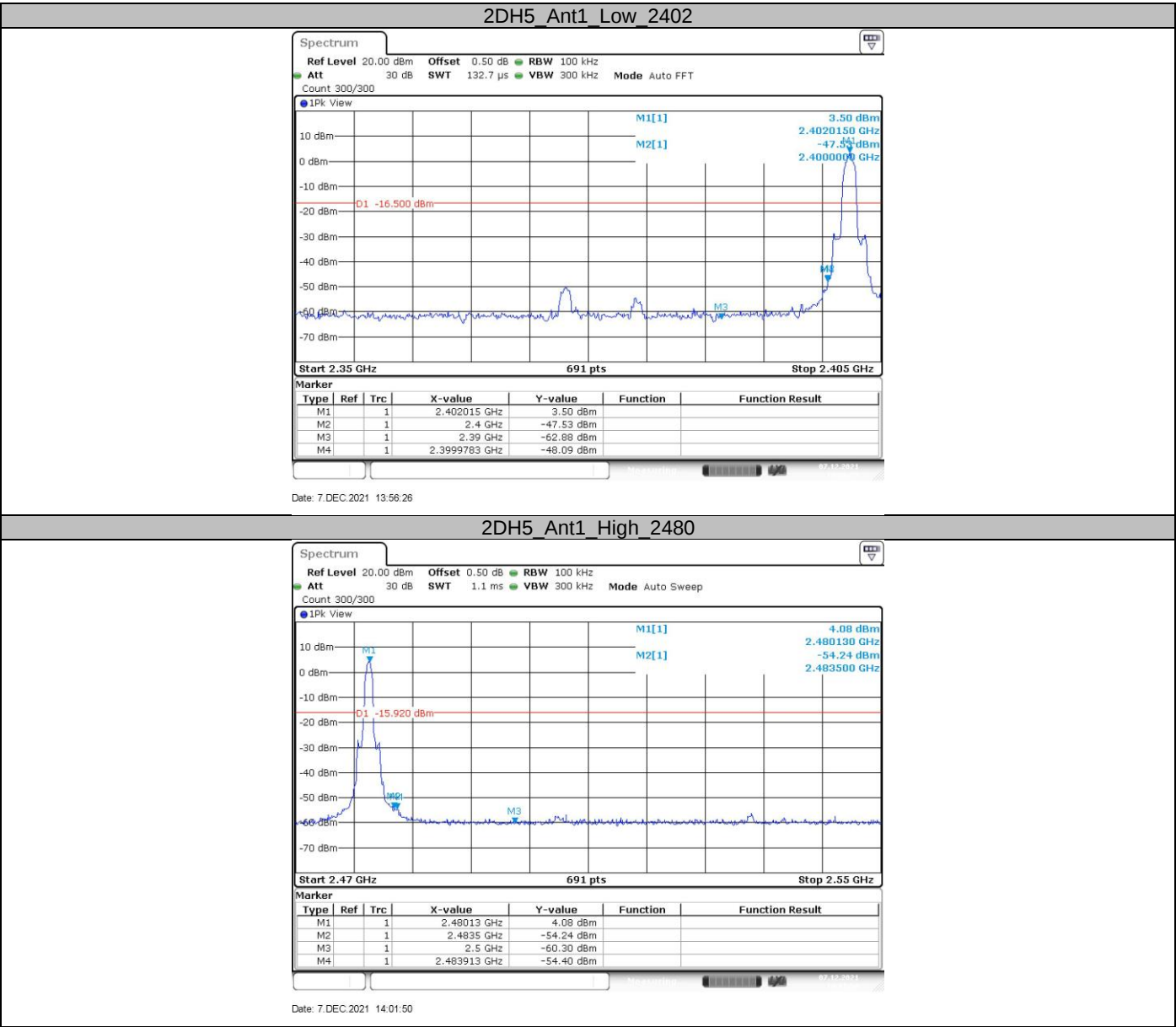
Hopping on mode:





China

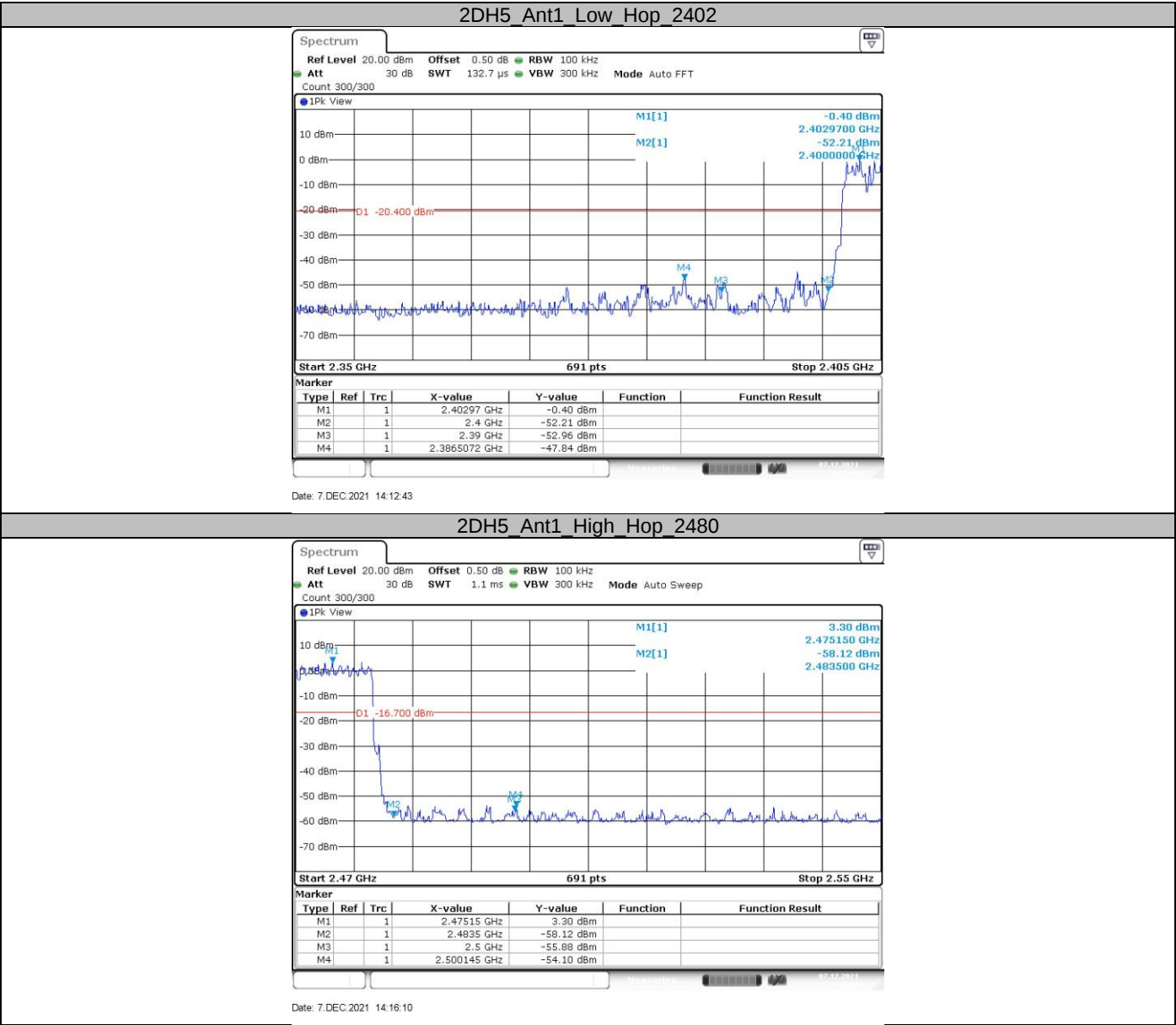
$\pi/4$ -DQPSK Modulation Test Result:
Hopping off mode:





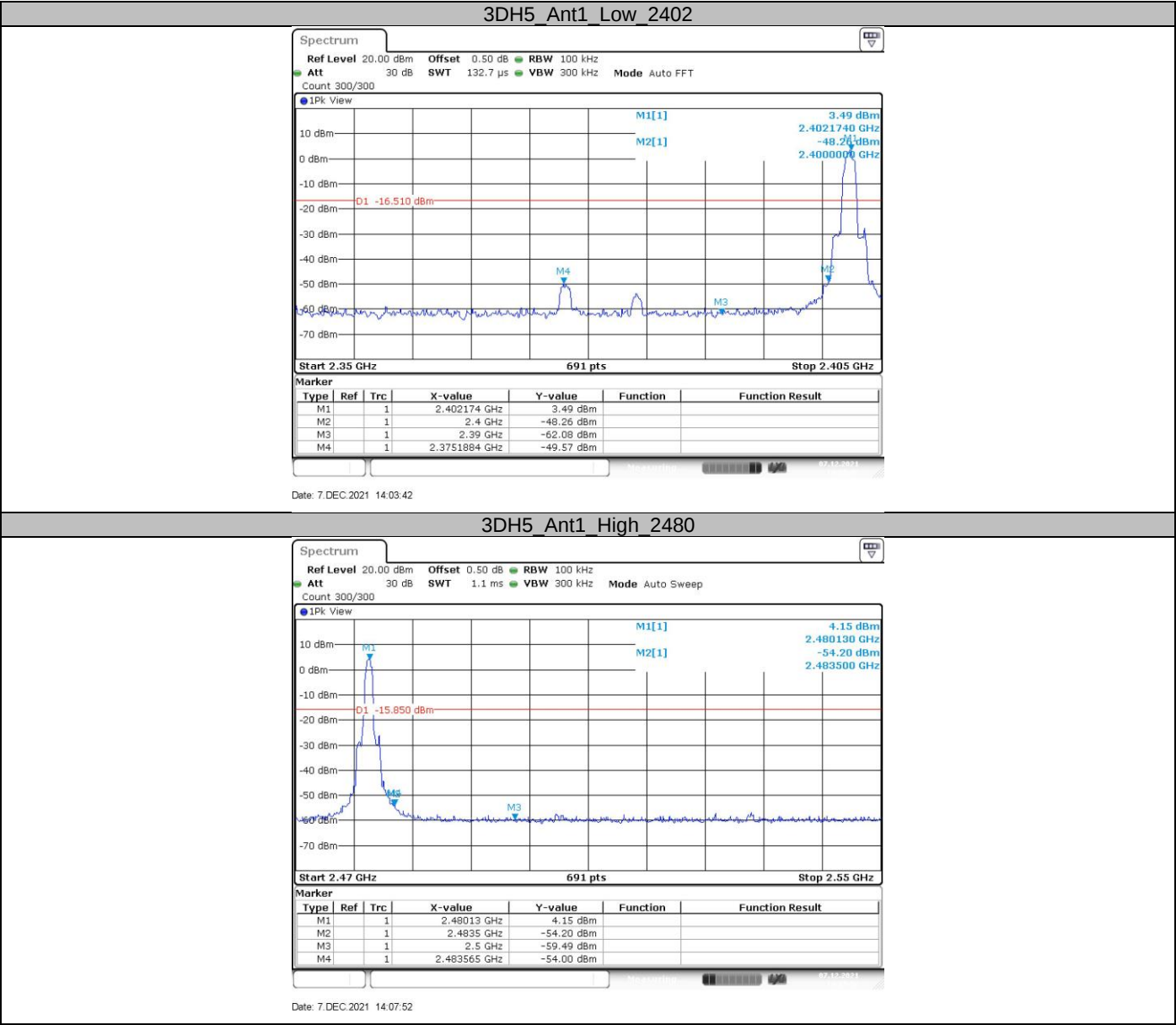
China

Hopping on mode:



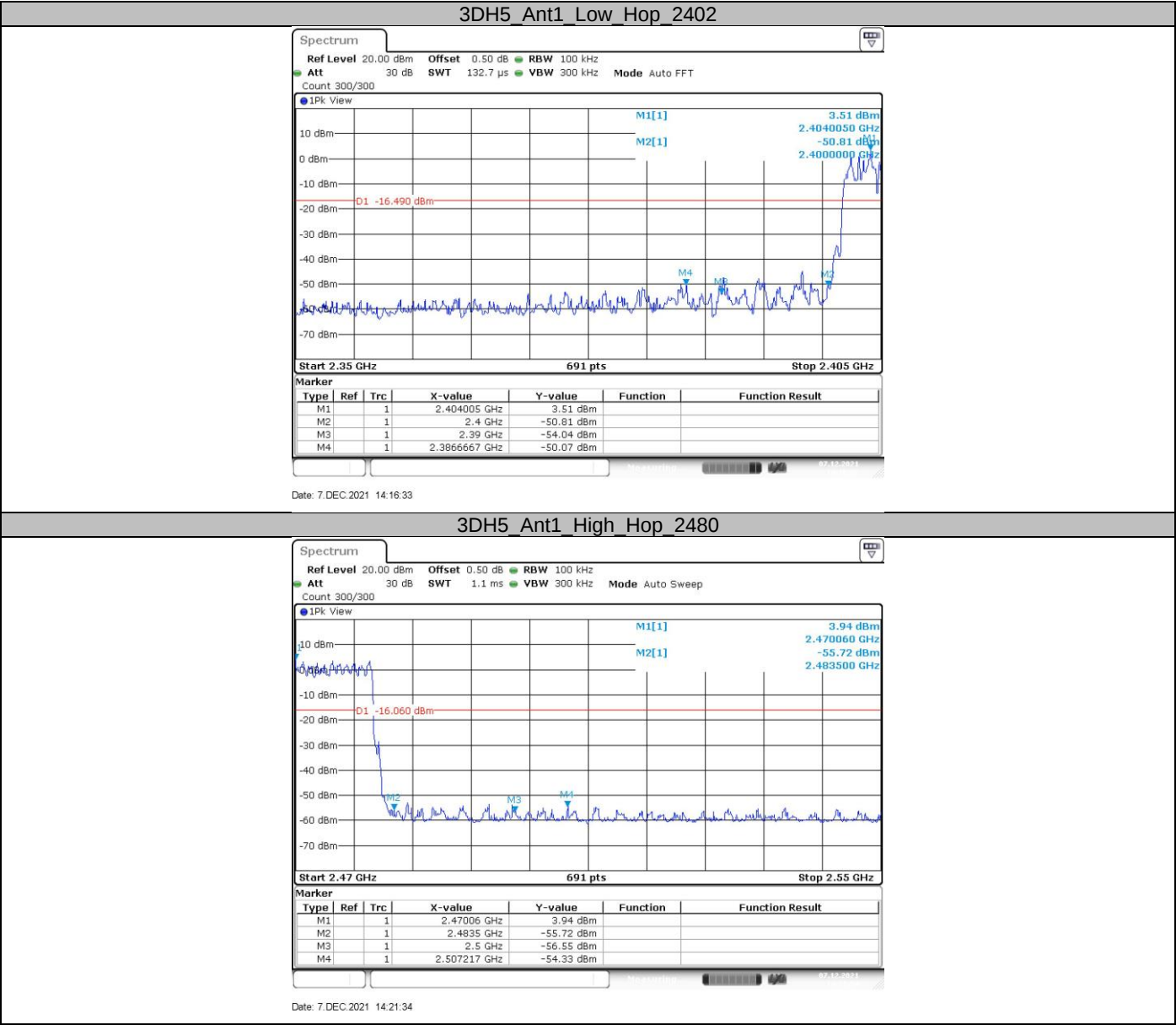


8DPSK Modulation Test Result:
Hopping off mode:





Hopping on mode:



9.9 Spurious radiated emissions for transmitter and receiver

Test Method

1. The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. Use the following spectrum analyzer settings According to C63.10:

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz to 120 kHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Procedures for average unwanted emissions measurements above 1000 MHz

Span=wide enough to capture the peak level of the in-band emission and all spurious
RBW=1MHz, VBW=10Hz, sweep=auto, Detector function=peak, Trace=max hold.

If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", Derived from $20\log(\text{dwell time}/100 \text{ ms})$, in an effort to demonstrate compliance with the 15.209.

If the emission is pulsed, modify the unit for continuous operation; use the setting shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation.

The setting method can refer to DA00-705

Limit

The radio emission outside the operating frequency band shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Radiated emissions which fall in the restricted bands, as defined in section 15.205 and RSS-GEN 8.10 must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Measured Distance Meters
0.009~0.490	2400/F (kHz)	300
0.490~1.705	24000/F (kHz)	30
1.705~30	30	30

Frequency MHz	Field Strength uV/m	Field Strength dBμV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

Spurious radiated emissions for transmitter and receiver

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Pre-scan with three orthogonal axis and worst case as X axis. The only worse case (which is subject to the maximum EIRP, 8DPSK mode) test result is listed in the report.

Transmitting spurious emission test result as below:

Bluetooth Mode 8DPSK Modulation 2402MHz Test Result

Frequency	Emission Level	Limit	Polarization	Detector	Margin	Result
MHz	dBuV/m	dBuV/m			dBuV/m	
2389.9	41.94	74.0	Horizontal	PK	32.06	Pass
2375.0	44.91	74.0	Horizontal	PK	29.09	Pass
2390.1	42.34	74.0	Vertical	PK	31.66	Pass
4802.9	43.77	74.0	Horizontal	PK	30.23	Pass
4812.5	42.31	74.0	Vertical	PK	31.69	Pass

Bluetooth Mode 8DPSK Modulation 2441MHz Test Result

Frequency	Emission Level	Limit	Polarization	Detector	Margin	Result
MHz	dBuV/m	dBuV/m			dBuV/m	
4888.4	41.48	74.0	Horizontal	PK	32.52	Pass
4883.6	40.71	74.0	Vertical	PK	33.29	Pass

Bluetooth Mode 8DPSK Modulation 2480MHz Test Result

Frequency	Emission Level	Limit	Polarization	Detector	Margin	Result
MHz	dBuV/m	dBuV/m			dBuV/m	
2483.4	53.4	54.0	Horizontal	PK	0.6	Pass
2483.4	49.61	74.0	Vertical	PK	24.39	Pass
4973.4	43.32	74.0	Horizontal	PK	30.68	Pass
4983.1	44.15	74.0	Vertical	PK	29.85	Pass

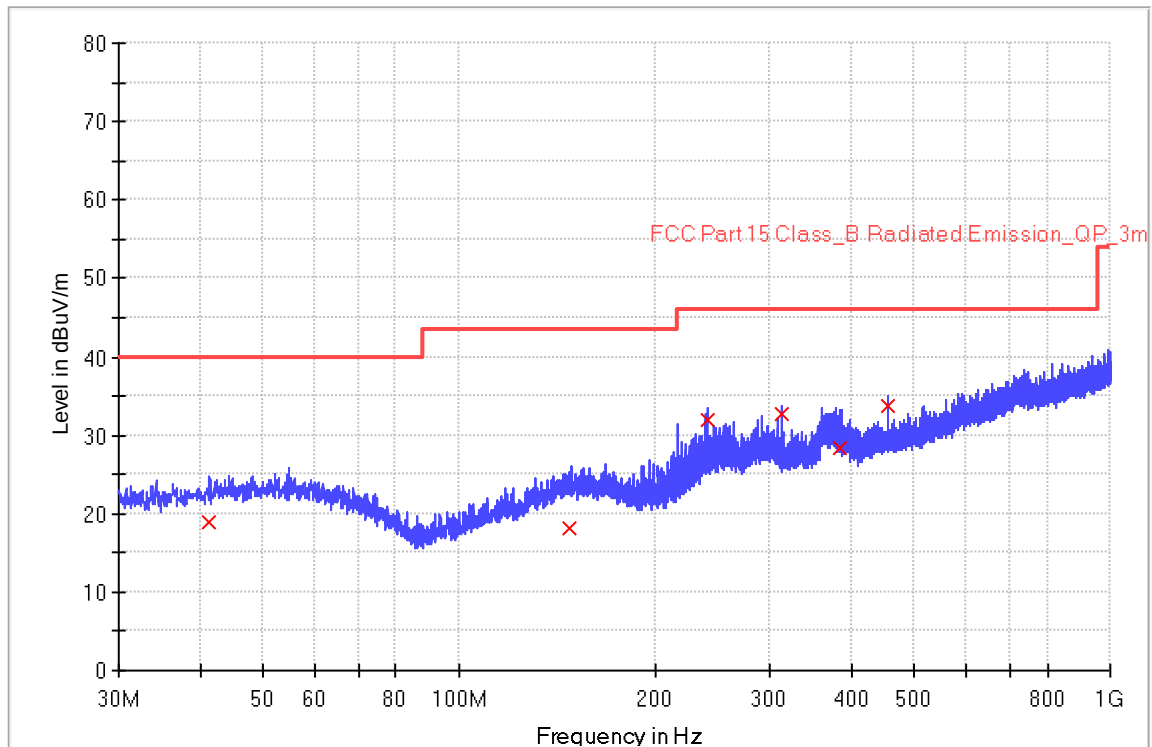
Remark:

- (1) Emission level= Original Receiver Reading + Correct Factor
- (2) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
- (3) Margin = limit – Corrected Reading

The worst case of Radiated Emission below 1GHz:

Site: 3 meter chamber	Time: 2021/12/10 - 09:01
Limit: FCC_Part15.209_RE(3m)_ClassB	Engineer: Wenqiang LU
Probe: VULB9168	Polarity: Horizontal
EUT: Wi-Fi and Bluetooth Module, Model no: VWBK1	Power: 120VAC, 60Hz
Note: Transmit by at channel 2480MHz. (8DPSK)	
Note: Pre-scan with three orthogonal axis and worst case as X axis	

RE_VULB9168_pre_Cont_30-1000



Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
41.360000	19.0	1000.0	120.000	100.4	H	354.0	20.1	21.0	40.0
147.480000	18.3	1000.0	120.000	100.4	H	22.0	20.9	25.2	43.5
240.000000	31.8	1000.0	120.000	100.4	H	256.0	19.6	14.2	46.0
312.040000	32.7	1000.0	120.000	100.4	H	153.0	21.9	13.3	46.0
383.960000	28.4	1000.0	120.000	100.4	H	359.0	23.8	17.6	46.0
455.960000	33.9	1000.0	120.000	100.4	H	3.0	25.9	12.2	46.0

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

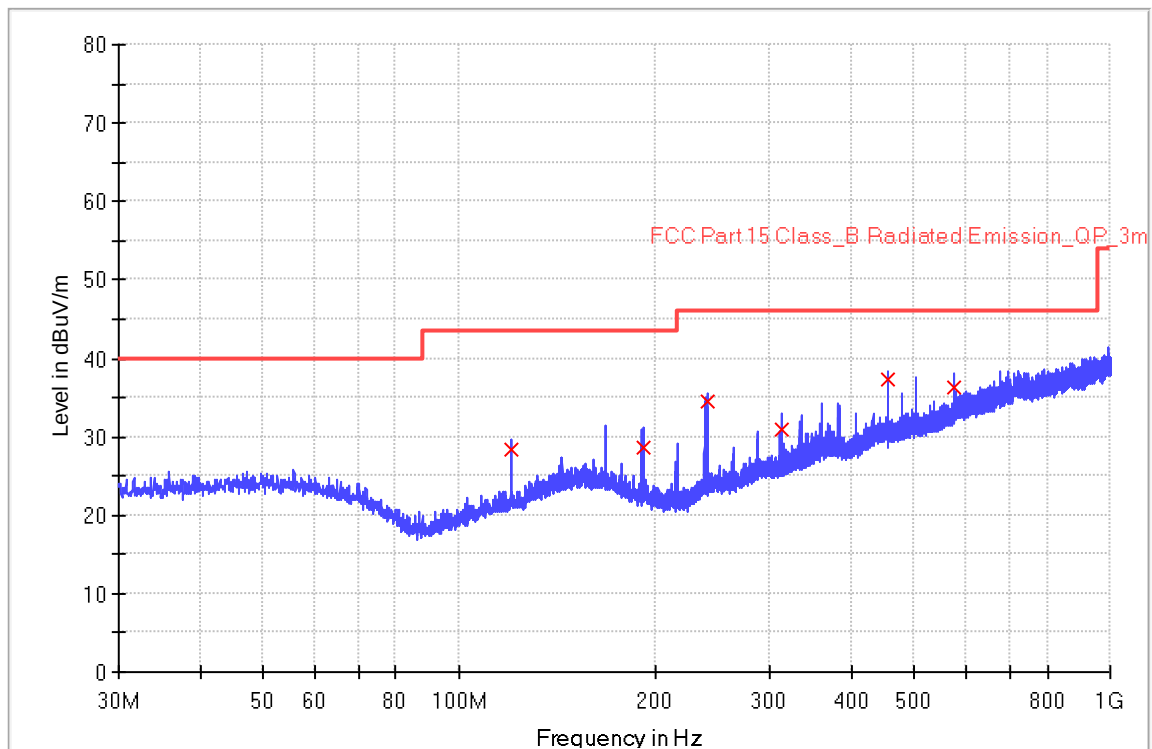
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.

The worst case of Radiated Emission below 1GHz:

Site: 3 meter chamber	Time: 2021/12/10 - 08:31
Limit: FCC_Part15.209_RE(3m)_ClassB	Engineer: Wenqiang LU
Probe: VULB9168	Polarity: Vertical
EUT: Wi-Fi and Bluetooth Module, Model no: VWBK1	Power: 120VAC, 60Hz
Note: Transmit by at channel 2480MHz. (8DPSK)	
Note: Pre-scan with three orthogonal axis and worst case as X axis	

RE_VULB9168_pre_Cont_30-1000



Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
119.960000	28.4	1000.0	120.000	100.4	V	161.0	18.1	15.1	43.5
191.520000	28.5	1000.0	120.000	100.4	V	137.0	18.4	15.0	43.5
239.960000	34.5	1000.0	120.000	100.4	V	188.0	19.6	11.5	46.0
312.040000	30.9	1000.0	120.000	100.4	V	112.0	21.9	15.1	46.0
455.960000	37.3	1000.0	120.000	100.4	V	71.0	25.9	8.7	46.0
576.000000	36.4	1000.0	120.000	100.4	V	1.0	28.0	9.6	46.0

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.

10 Test Equipment List

List of Test Instruments

Test Site1

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE	CAL. DUE DATE
C	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2021-8-2	2022-8-1
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2021-8-2	2022-8-1
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2021-8-2	2022-8-1
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2019-3-16	2022-3-15
	Horn Antenna	Rohde & Schwarz	HF907	102393	2021-4-13	2024-4-12
	Pre-amplifier	Rohde & Schwarz	SCU-18D	19006451	2021-8-2	2022-8-1
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2021-5-21	2022-5-20
	Double Ridged Horn Antenna	ETS-Lindgren	3116C	00222727	2020-9-23	2023-9-22
	Pre-amplifier	ETS-Lindgren	3116C-PA	----	2021-9-17	2022-9-16
CE	3m Semi-anechoic chamber	TDK	9X6X6	----	2021-5-8	2024-5-7
	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2021-8-2	2022-8-1
	LISN	Rohde & Schwarz	ENV216	101924	2021-8-2	2022-8-1
Measurement Software Information						
Test Item	Software	Manufacturer	Version			
C	Bluetooth and WiFi Test System	Shenzhen JS tonscentd co.,ltd	2.6.77.0518			
RE	EMC 32	Rohde & Schwarz	V9.15.00			
CE	EMC 32	Rohde & Schwarz	V9.15.03			

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density*
- Spurious RF conducted emissions
- Band edge

11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

Items	Extended Uncertainty
Conducted Disturbance at Mains Terminals	150kHz to 30MHz, LISN, $\pm 3.16\text{dB}$
Radiated Disturbance	30MHz to 1GHz, $\pm 5.03\text{dB}$ (Horizontal) $\pm 5.12\text{dB}$ (Vertical) 1GHz to 18GHz, $\pm 5.49\text{dB}$ 18GHz to 25GHz, $\pm 5.63\text{dB}$
Carrier power conducted measurement	50MHz~18GHz, $\pm 1.238\text{dB}$
Spurious Emission Conducted Measurement	9kHz ~40GHz, $\pm 1.224\text{dB}$



12 Photographs of Test Set-ups

Refer to the < Test Setup photos >.



13 Photographs of EUT

Refer to the < External Photos > & < Internal Photos >.

THE END