China

FCC - TEST REPORT

Report Number	:	**7088819112401-00**	Date of Issue:	October 24, 2019

Model	:	**ZS11E; ZS11MCE3**
Product Type	:	ISMART1.0
FCC ID	:	2AFIXISMART
Applicant	:	Jiangsu Toppower Automotive Electronics Co., Ltd
Address	:	No. 19 Fenghuang Avenue, Xuzhou Economic And Technological Development Zone Xuzhou, 221000 China
Manufacturer	:	Jiangsu Toppower Automotive Electronics Co., Ltd
Address	:	No. 19 Fenghuang Avenue, Xuzhou Economic And Technological Development Zone Xuzhou, 221000 China

Test Result	:	■ **Positive** ☐ **Negative**
Total pages including Appendices	:	57

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch is a subcontractor to TÜV SÜD Product Service GmbH according to the principles outlined in ISO 17025.

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch reports apply only to the specific samples tested under stated test conditions. Construction of the actual test samples has been documented. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. The manufacturer/importer is responsible to the Competent Authorities in Europe for any modifications made to the production units which result in non-compliance to the relevant regulations. TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full without our written approval.

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 10
8 Systems test configuration 13
9 Technical Requirement 14
9.1 Conducted peak output power 14
9.2 20 dB bandwidth and 99% Occupied Bandwidth 21
9.3 Carrier Frequency Separation 28
9.4 Number of hopping frequencies 30
9.5 Dwell Time 32
9.6 Spurious RF conducted emissions 35
9.7 Band edge testing 39
9.8 Spurious radiated emissions for transmitter and receiver 46
10 Test Equipment List 54
11 System Measurement Uncertainty 55
12 Photographs of Test Set-ups 56
13 Photographs of EUT 57

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

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

3 Description of the Equipment Under Test

Product:	ISMART1.0
Model no.:	ZS11E; ZS11MCE3
FCC ID:	2AFIXISMART
Options and accessories:	Test harness
Rating:	9~16V DC
RF Transmission Frequency:	2402~2480MHz for Bluetooth For 2.4G & 5G Wi-Fi For 802.11b/g/n-HT20: 2412~2462 MHz For 802.11n-HT40: 2422~2452 MHz 5180~5240MHz 5745~5825MHz
No. of Operated Channel:	79 for Bluetooth 4.1+EDR 40 for Bluetooth 4.1 BLE For 2.4GHz Wi-Fi

Operation Frequency each of channel For 802.11b/g/n(H20)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412MHz	4	2427MHz	7	2442MHz	10	2457MHz
2	2417MHz	5	2432MHz	8	2447MHz	11	2462MHz
3	2422MHz	6	2437MHz	9	2452MHz		

Operation Frequency each of channel For 802.11n(H40)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
		4	2427MHz	7	2442MHz		
		5	2432MHz	8	2447MHz		
3	2422MHz	6	2437MHz	9	2452MHz		

FOR 5180 ~ 5240MHz

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

Channel	Frequency	Channel	Frequency
36	5180 MHz	44	5220 MHz
40	5200 MHz	48	5240 MHz

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency
42	5210 MHz

FOR 5745 ~ 5825MHz:

5 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

Channel	Frequency	Channel	Frequency
149	5745 MHz	161	5805 MHz
153	5765 MHz	165	5825 MHz
157	5785 MHz		

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

Channel	Frequency	Channel	Frequency
151	5755 MHz	159	5795 MHz

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency
155	5775 MHz

Modulation: Bluetooth 4.0+EDR FHSS: GFSK, 8DPSK, π/4 DQPSK
Bluetooth BLE DHSS: QPSK
For Wi-Fi:
Direct Sequence Spread Spectrum (DSSS) for 802.11b
Orthogonal Frequency Division Multiplexing(OFDM) for 802.11g/n

Data speed: 1. Bluetooth: 1Mbps, 2Mbps, 3Mbps
2. Wi-Fi: 11b 1 ~ 11Mbps,
11g/a 6 ~ 54Mbps, 11n HT20 6.5 ~ 65Mbps,
11n HT 40 13.5 ~ 135Mbps,
11ac VHT40 13.5 ~ 180Mbps,
11ac VHT80 29.3 ~ 390Mbps

Duty Cycle: 100%

Antenna Type: PIFA Antenna

Antenna Gain: 2.4GHz: 2.04dBi
5.2GHz: 4.2dBi
5.8GHz: 5.52dBi

Description of the EUT: The Equipment Under Test (EUT) is a Car Radio with Bluetooth and WI-FI Module is equipment installed in a car to provide in-car entertainment and information for the vehicle occupants. It consisted of a simple FM/AM/DRM radio, media players and Bluetooth module. User can listen to FM/AM, DRM, USB audio by using the equipment.
The EUT support Bluetooth 4.1+EDR and support BLE function and Wi-Fi operated at 5GHz and 2.4GHz.
Only 2.4G Bluetooth 4.1+EDR included in this report.

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

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, KDB558074 D01 v05r02 and C63.10 (2013).

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

5 Summary of Test Results

Technical Requirements				
FCC Part 15 Subpart C				
Test Condition		Pages	Test Site	Test Result
§15.207	Conducted emission AC power port	---	---	N/A
§15.247(b)(1)	Conducted peak output power	14-20	Site 1	Pass
§15.247(a)(2)	6dB bandwidth	---	---	N/A
§15.247(a)(1)	20dB Occupied Bandwidth	21-27	Site 1	Pass
§15.247(a)(1)	Carrier frequency separation	28-29	Site 1	Pass
§15.247(a)(1)(iii)	Number of hopping frequencies	30-31	Site 1	Pass
§15.247(a)(1)(iii)	Dwell Time	32-34	Site 1	Pass
§15.247(e)	Power spectral density*	---	---	N/A
§15.247(d)	Spurious RF conducted emissions	35-38	Site 1	Pass
§15.247(d)	Band edge	39-45	Site 1	Pass
§15.247(d) & §15.209 &	Spurious radiated emissions for transmitter and receiver	46-53	Site 1	Pass
§15.203	Antenna requirement	See note 1		Pass

Note 1: N/A=Not Applicable. Conducted emission is not apply for battery operated device.
Note 2: The EUT uses a patch antenna, which gain is 2.04dBi for 2.4GHz. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.

15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

6 General Remarks

Remarks

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

This report in only for Bluetooth EDR. The TX and RX range is 2402MHz-2480MHz.

According to the client's declaration, we chose the ZS11E to perform the conductive RF tests, and chose ZS11E and ZS11MCE3 to perform the radiated emission test.

HARDWARE MODIFICATION	ZS11E	ZS11MCE3
Band	The same	The same
Power Amplifier	The same	The same
Antenna	The same	The same
PCB Layout	The same	The same
Components on PCB	Have DRM components	No DRM
DRM	Yes	No
LCD Structural Bracket	Not connected the AHU	Connected the AHU
LCD Size	8 "	10.1 "
Speaker	The same	The same
Camera	The same	The same
Bluetooth	The same	The same
WIFI	The same	The same

ZS11E and ZS11MCE3 are use same Bluetooth and WIFI module. Main PCB board is same in these 2 models. ZS11E and ZS11MCE3 all need to match LCD use.

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

SUMMARY:

All tests according to the regulations cited on page 7 were

■ - Performed

☐ - **Not** Performed

The Equipment Under Test

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

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

Sample Received Date: September 19, 2019

Testing Start Date: September 26, 2019

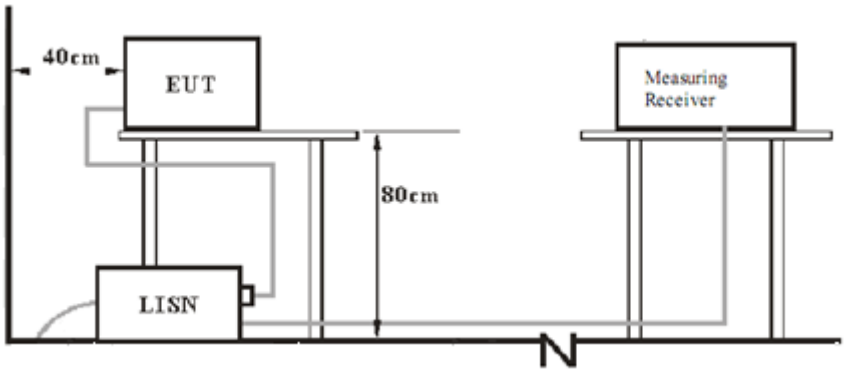
Testing End Date: October 16, 2019

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

Reviewed by:	Prepared by:	Tested by:
Hui TONG Review Engineer	Jiaxi XU Project Engineer	Wenqiang LU Test Engineer

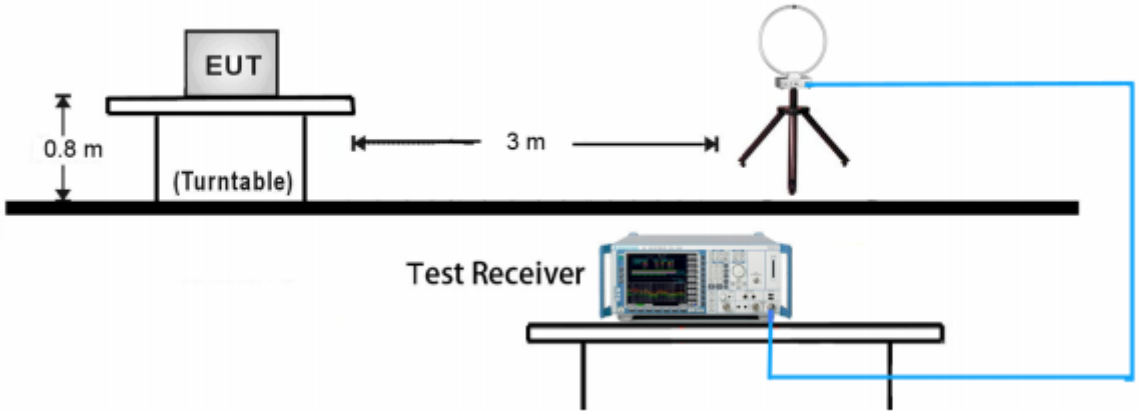
7 Test Setups

7.1 AC Power Line Conducted Emission test setups



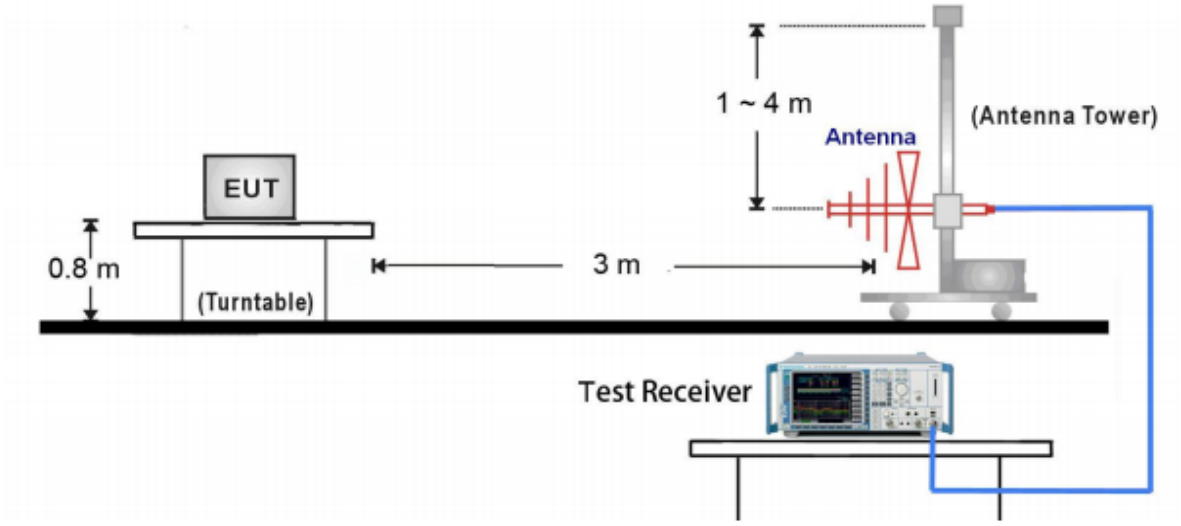
7.2 Radiated test setups

9kHz ~ 30MHz Test Setup:

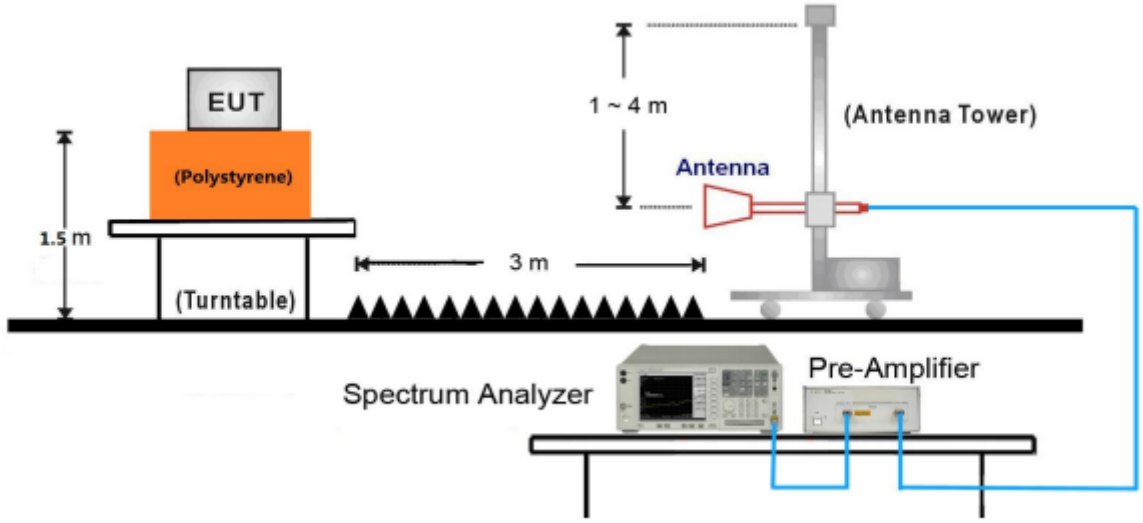


TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

30MHz ~ 1GHz Test Setup:

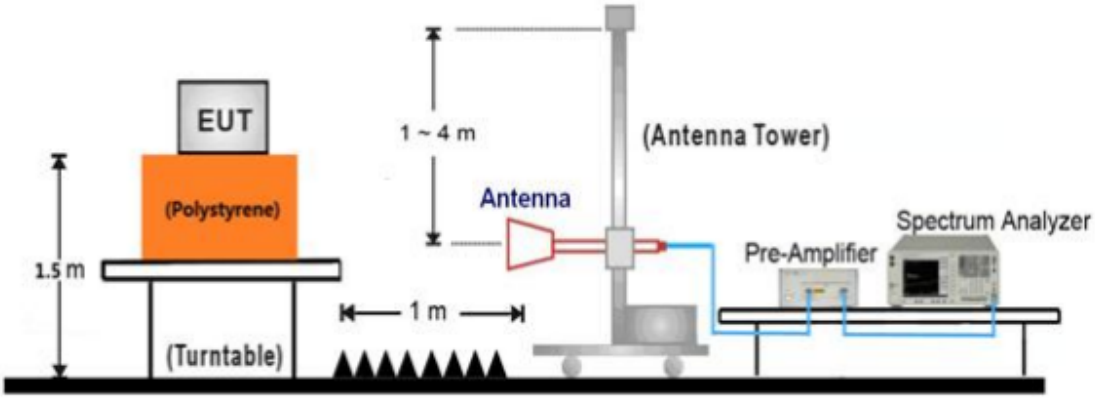


1GHz ~ 18GHz Test Setup:

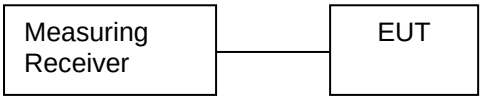


TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

18GHz ~ 25GHz Test Setup:



7.3 Conducted RF test setups



TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Notebook	Lenove	X240	--

Test software: SecureCRT, 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 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

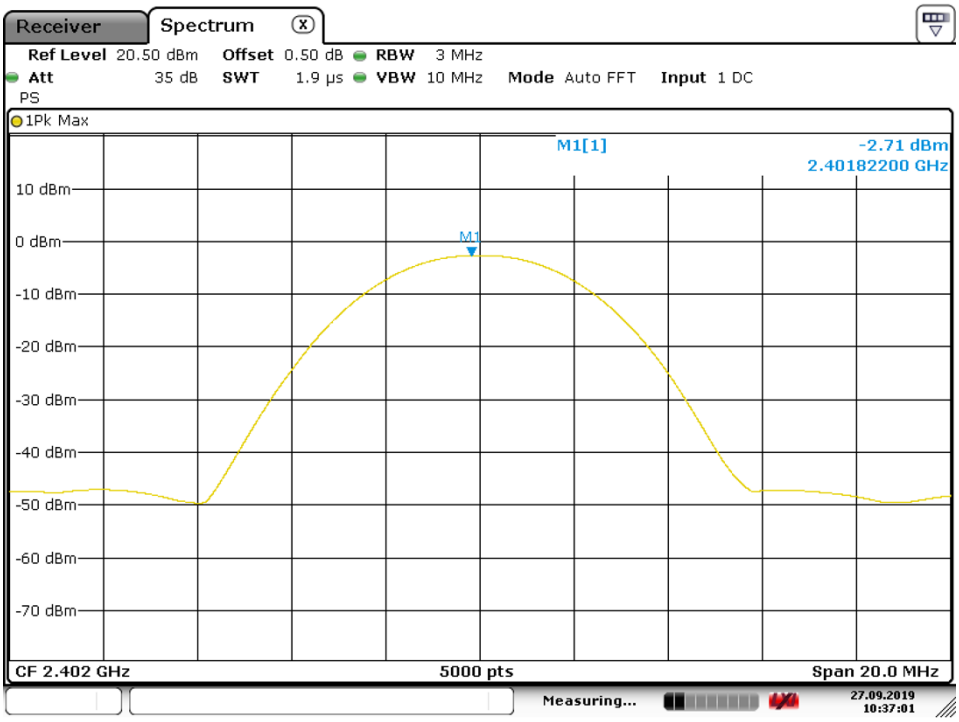
Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

Conducted peak output power

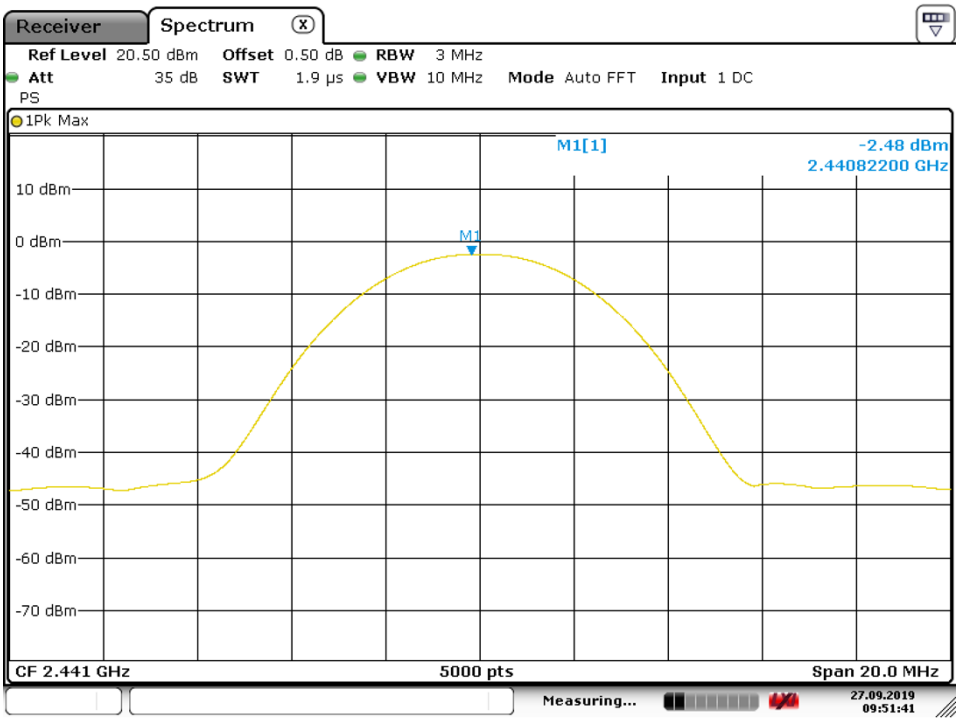
Bluetooth Mode GFSK DH5 modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-2.71	Pass
Middle channel 2441MHz	-2.48	Pass
High channel 2480MHz	-2.06	Pass

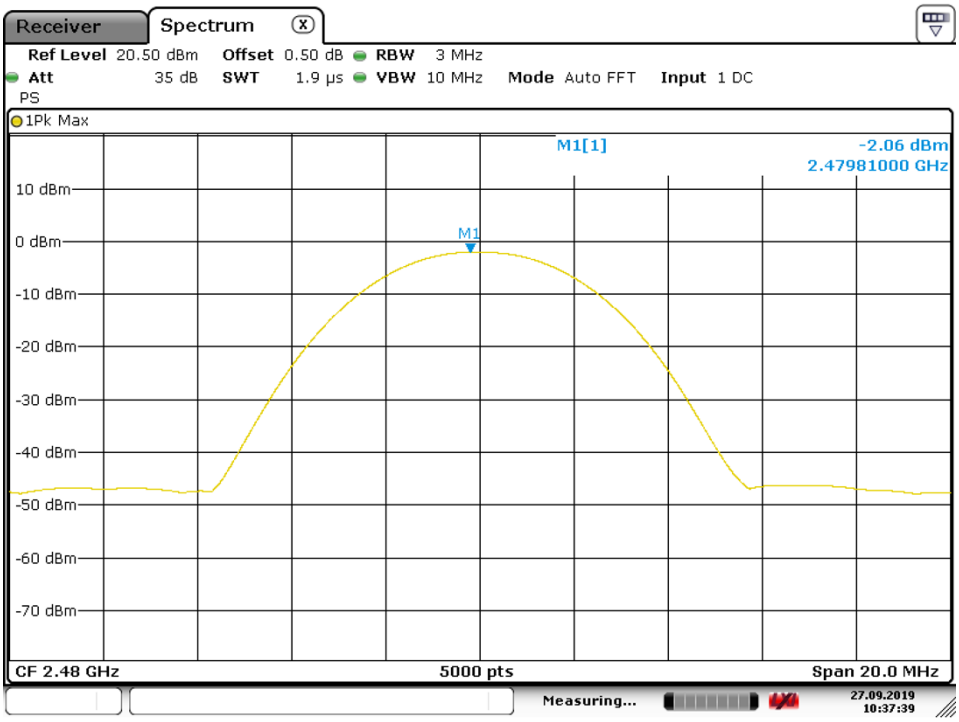


Date: 27.SEP.2019 10:37:01

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600



Date: 27.SEP.2019 09:51:42

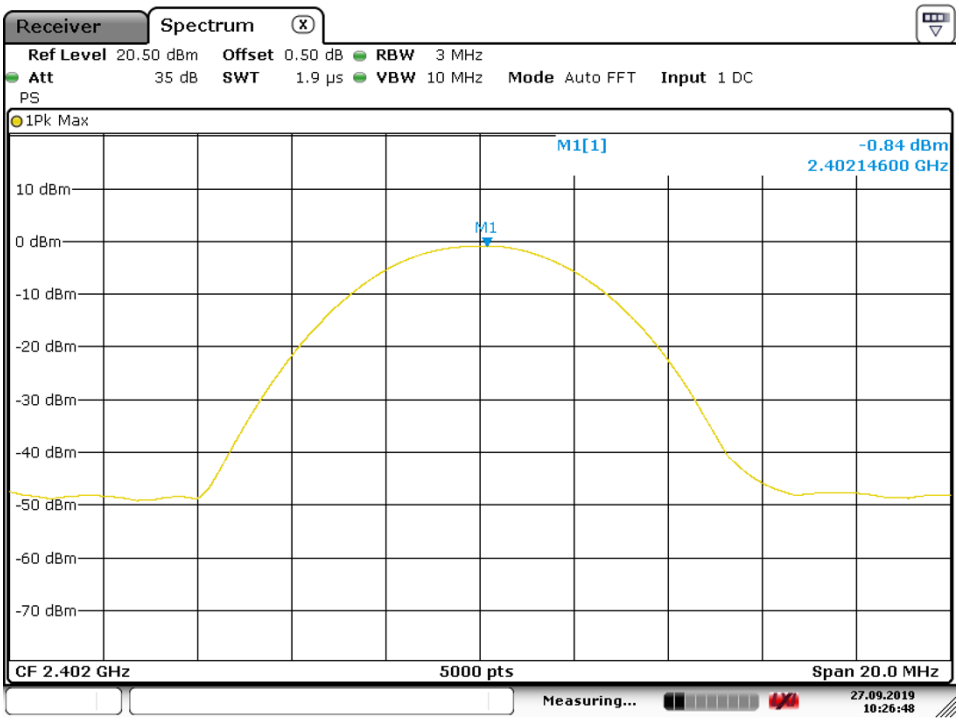


Date: 27.SEP.2019 10:37:38

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

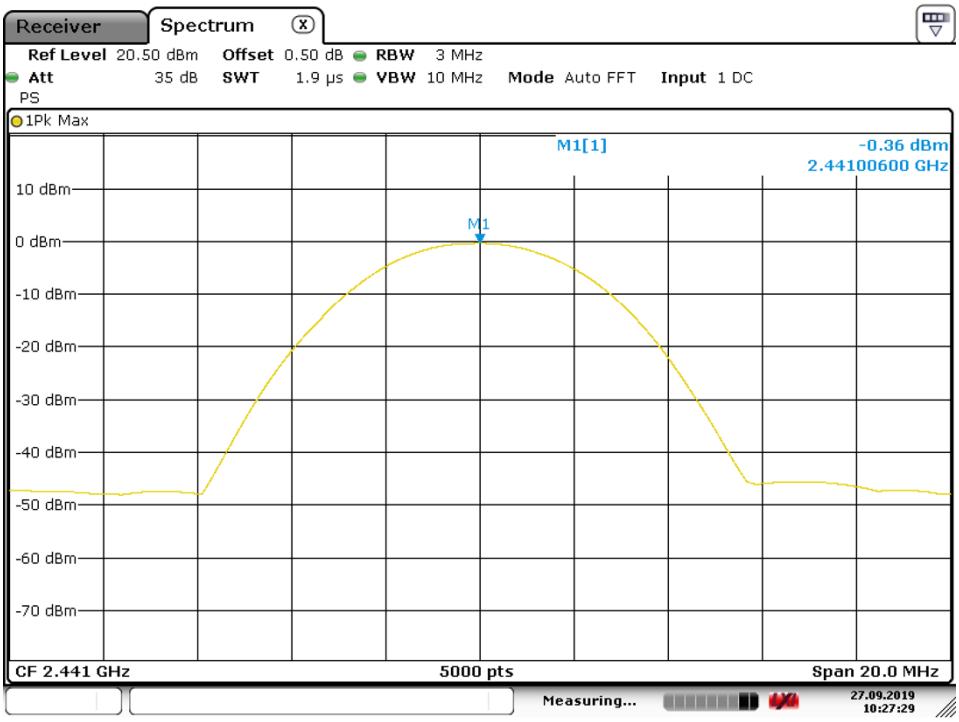
Bluetooth Mode π/4-DQPSK 2DH5 modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-0.84	Pass
Middle channel 2441MHz	-0.36	Pass
High channel 2480MHz	-0.36	Pass

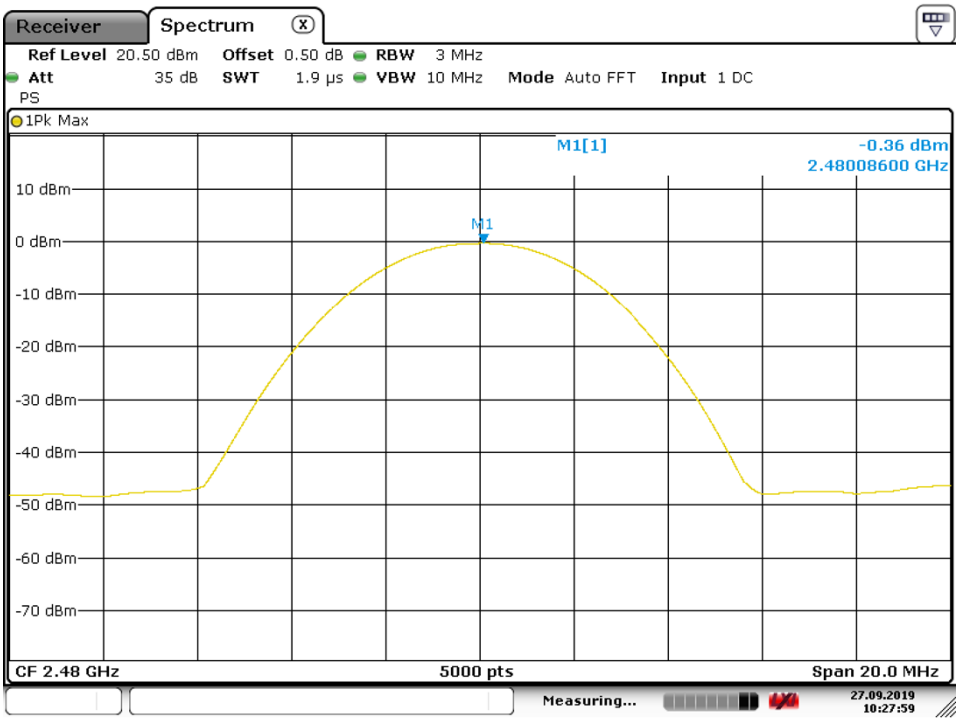


Date: 27.SEP.2019 10:26:47

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600



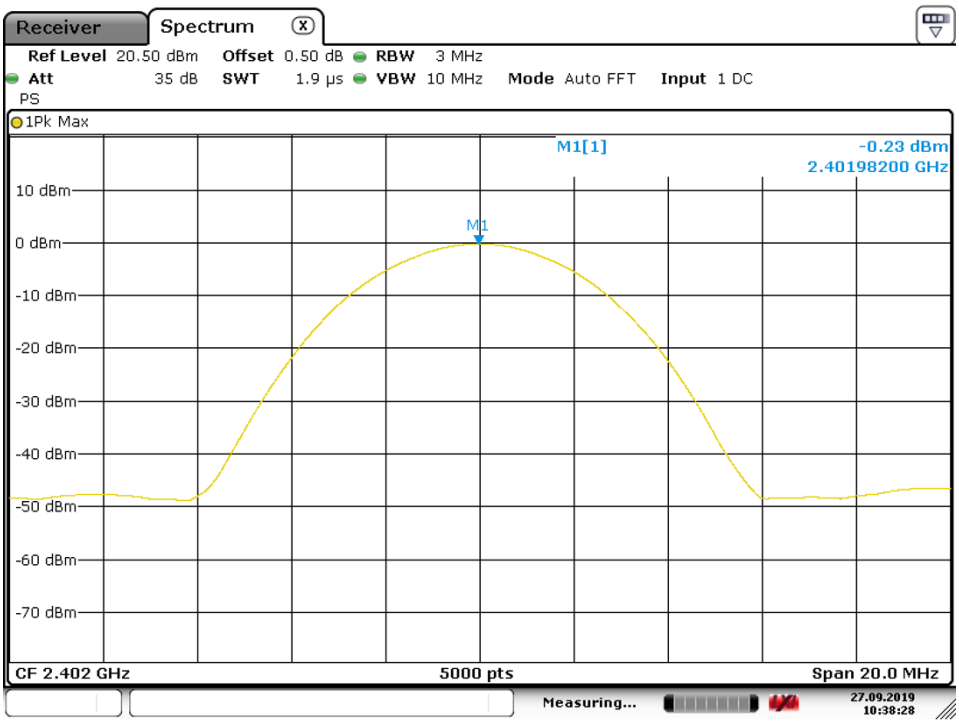
Date: 27.SEP.2019 10:27:29



Date: 27.SEP.2019 10:27:59

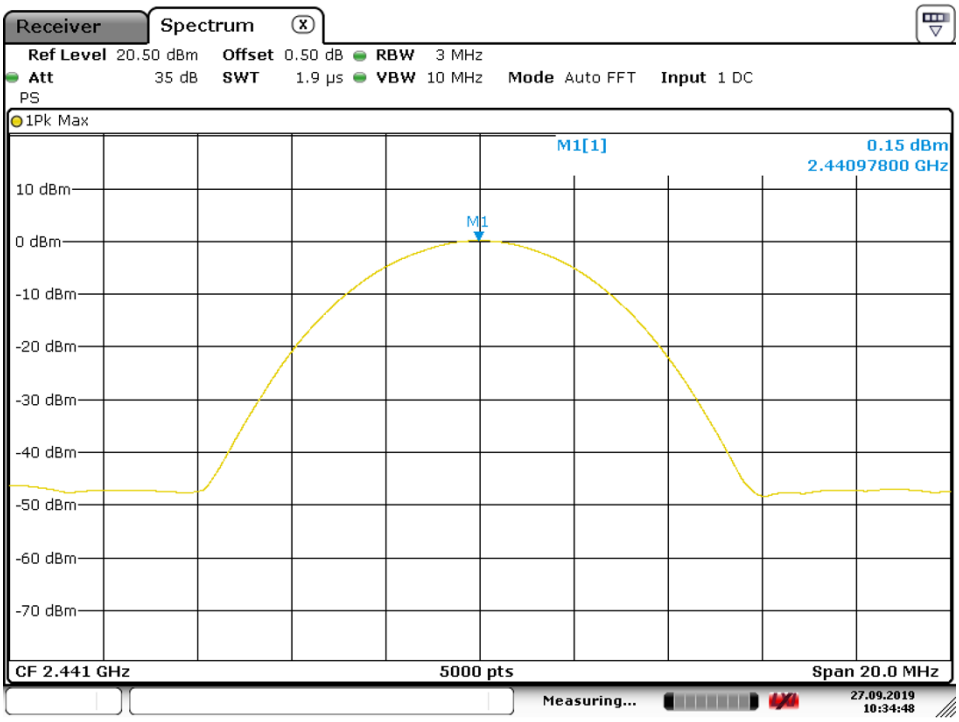
Bluetooth Mode 8DPSK 3DH5 modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-0.23	Pass
Middle channel 2441MHz	0.15	Pass
High channel 2480MHz	0.23	Pass

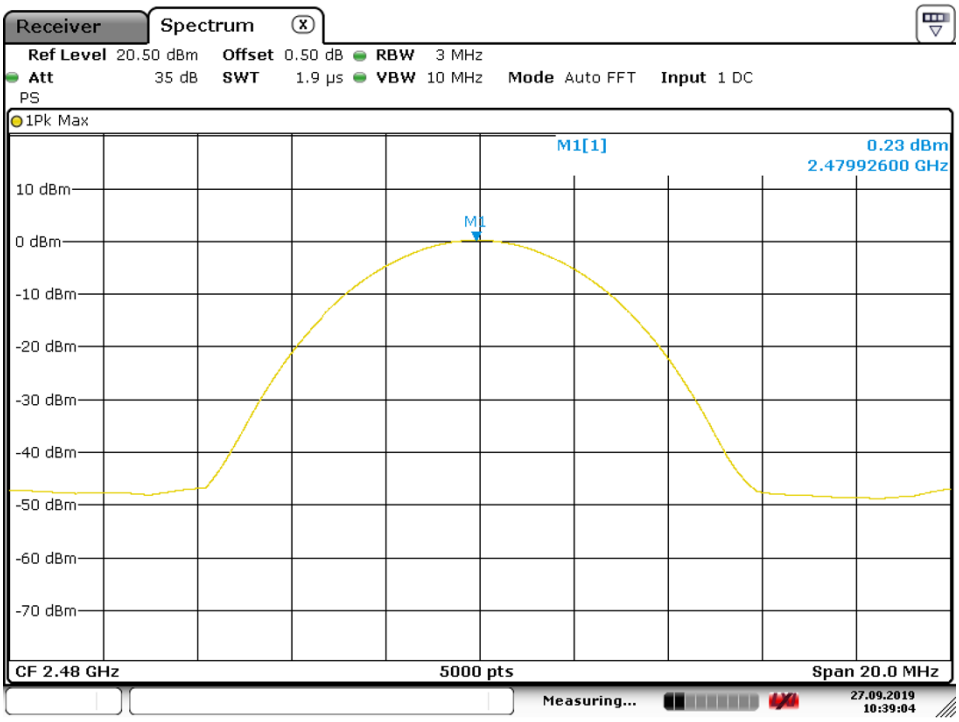


Date: 27.SEP.2019 10:38:28

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600



Date: 27.SEP.2019 10:34:48



Date: 27.SEP.2019 10:39:04

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

9.2 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.

Limit

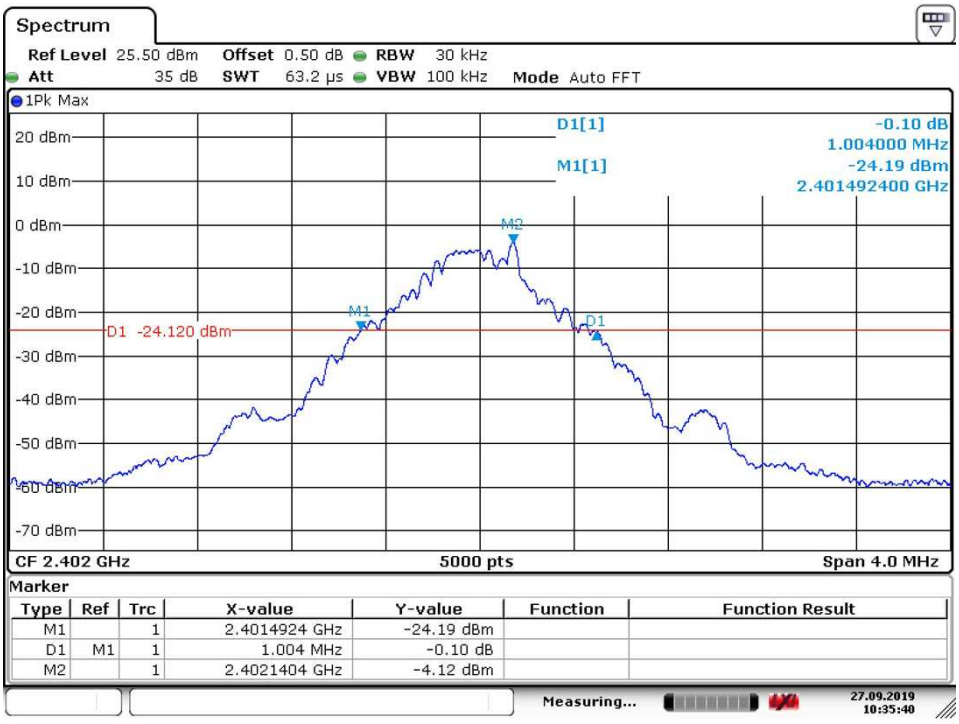
Limit [kHz]
N/A

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

20 dB Occupied Bandwidth

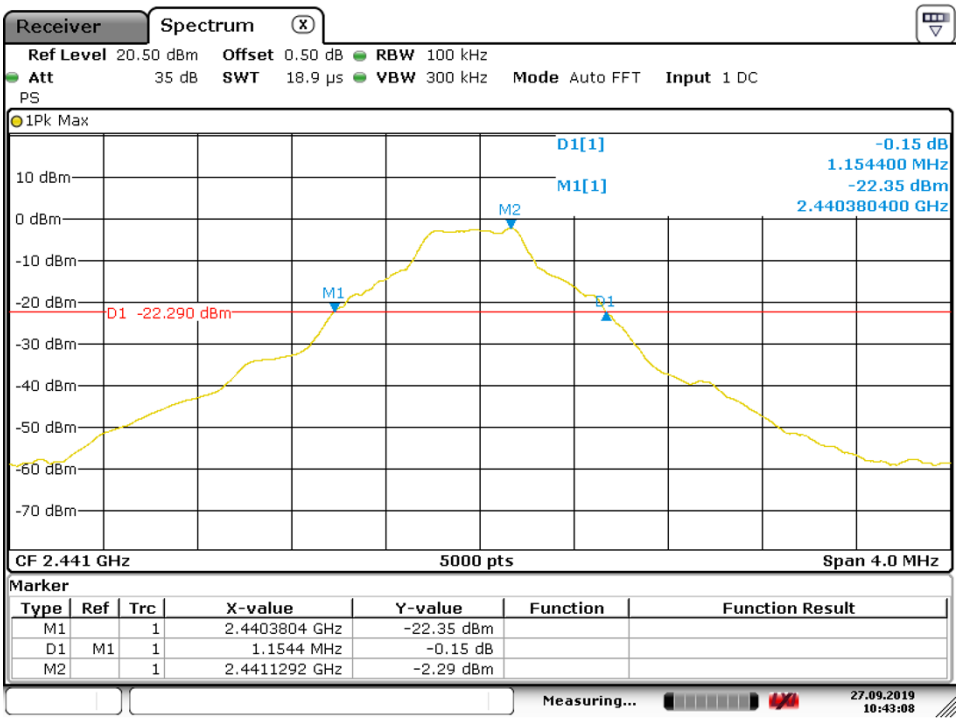
Bluetooth Mode GFSK Modulation test result

Frequency MHz	20 dB Bandwidth MHz	Limit kHz	Result
2402	1.004	--	Pass
2441	1.1544	--	Pass
2480	1.004	--	Pass

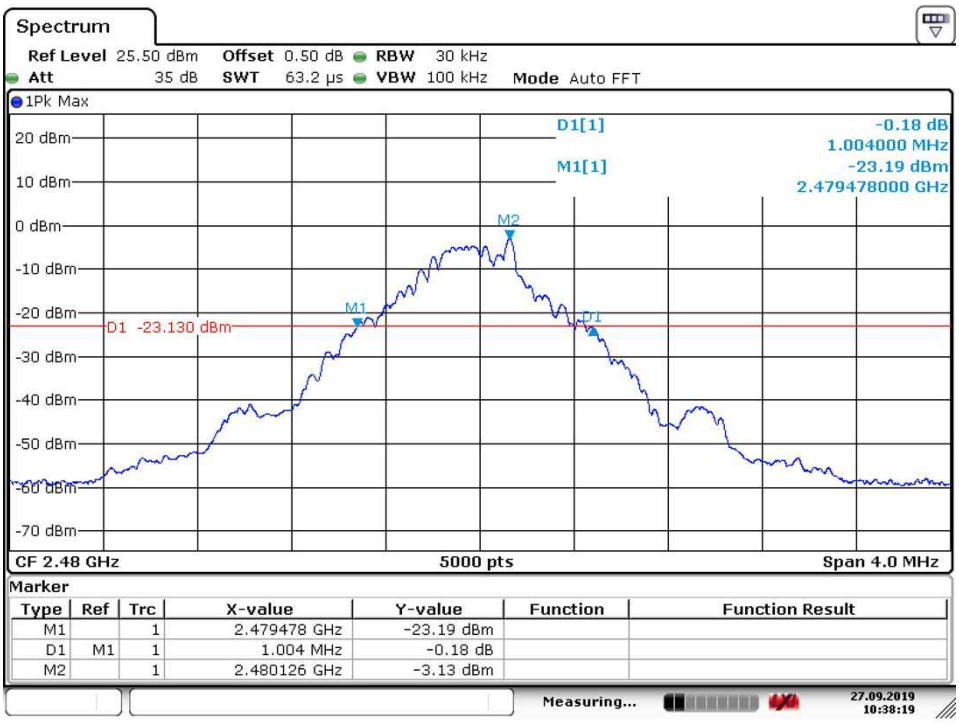


Date: 27.SEP.2019 10:35:40

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600



Date: 27.SEP.2019 10:43:08



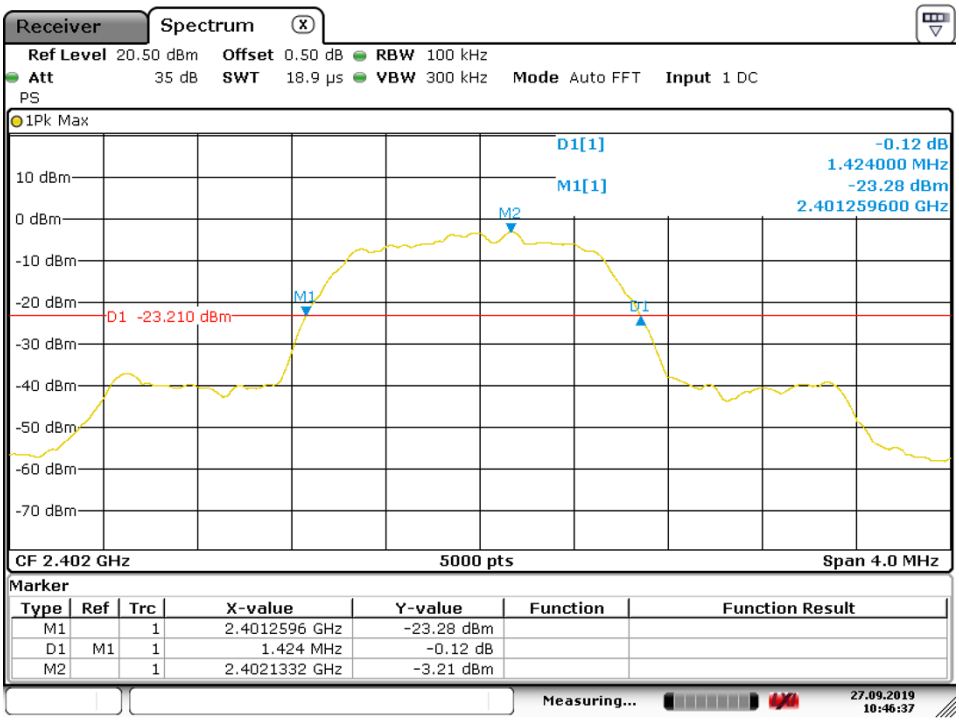
Date: 27.SEP.2019 10:38:19

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

20 dB Occupied Bandwidth

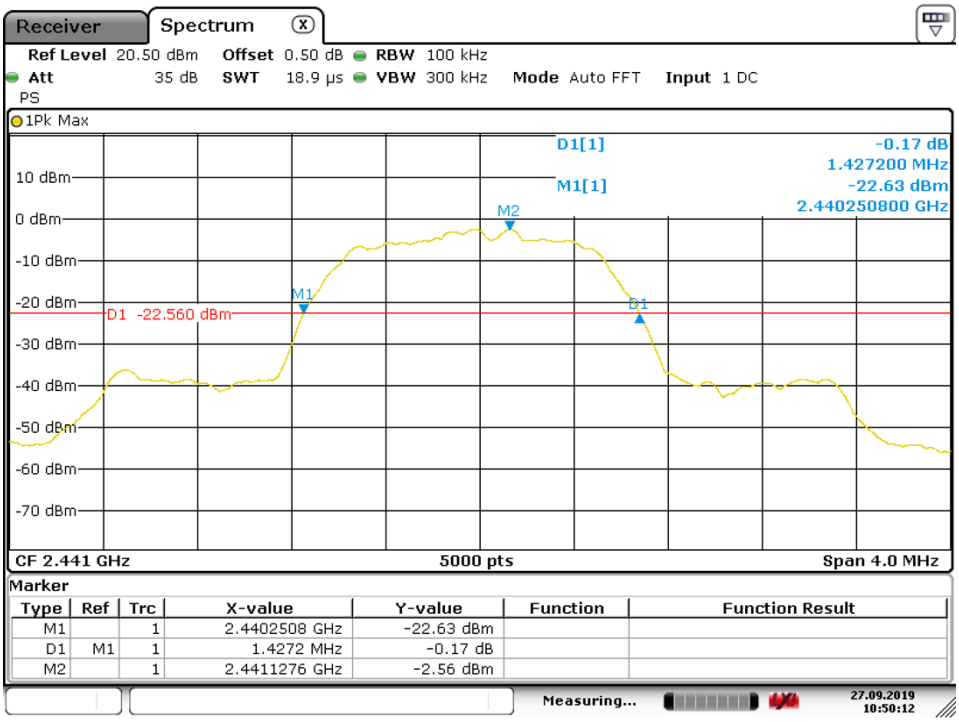
Bluetooth Mode π/4-DQPSK Modulation test result

Frequency MHz	20 dB Bandwidth MHz	Limit kHz	Result
2402	1.424	--	Pass
2441	1.4272	--	Pass
2480	1.4264	--	Pass

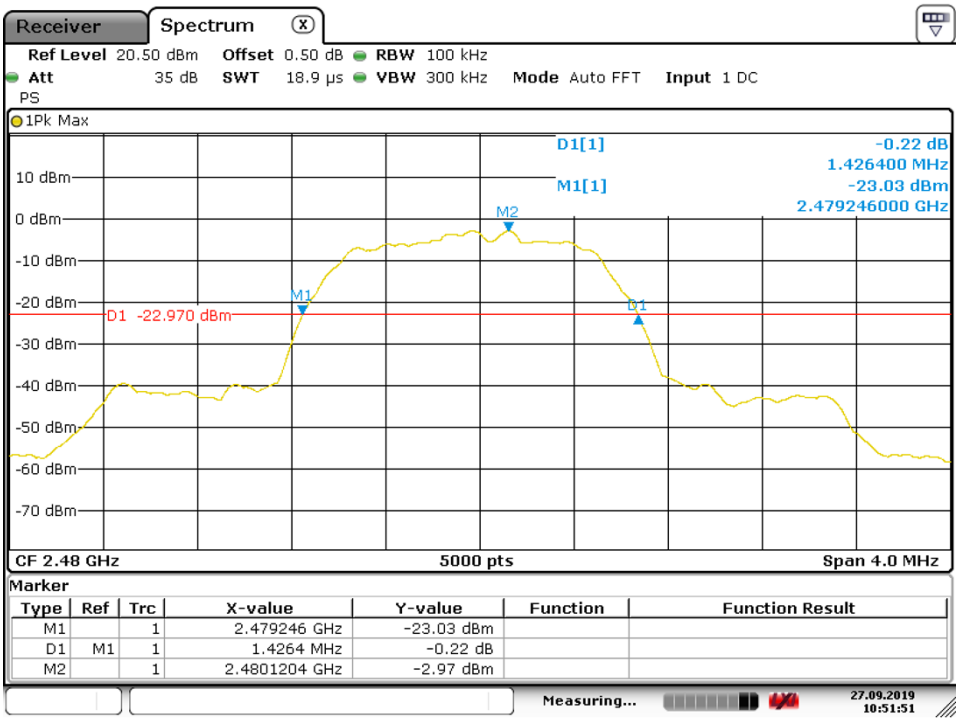


Date: 27.SEP.2019 10:46:37

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600



Date: 27.SEP.2019 10:50:12

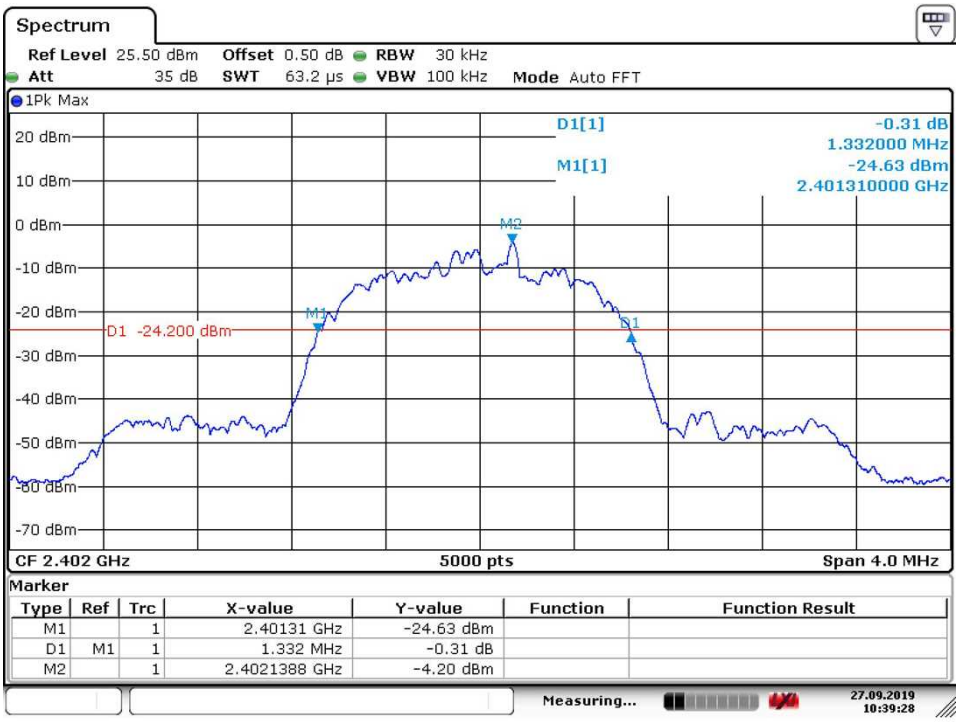


Date: 27.SEP.2019 10:51:51

20 dB Occupied Bandwidth

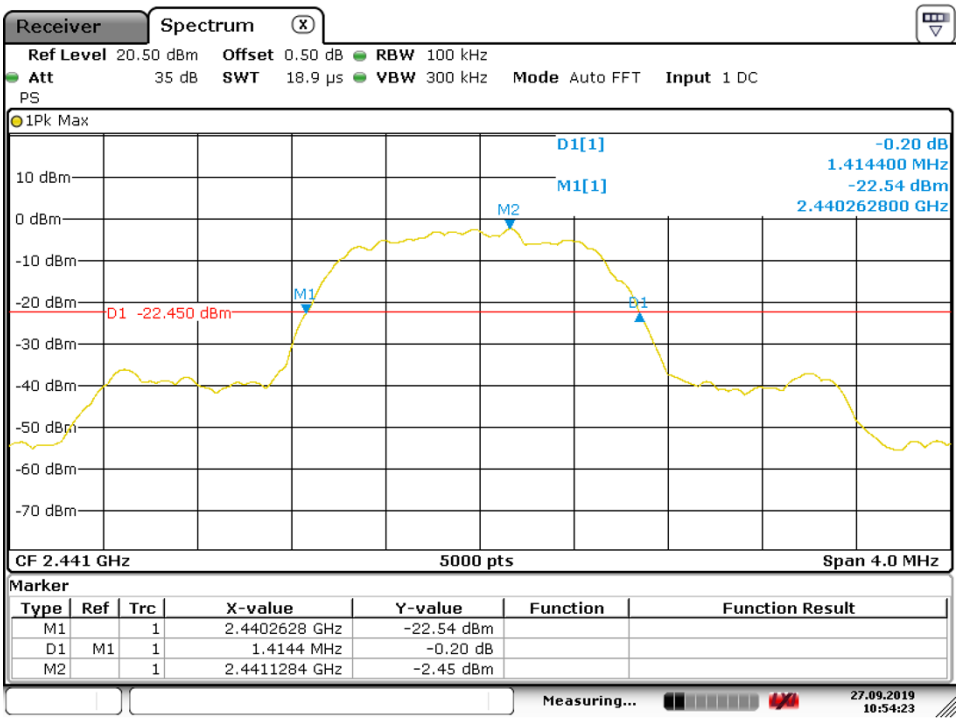
Bluetooth Mode 8DPSK Modulation test result

Frequency MHz	20 dB Bandwidth MHz	Limit kHz	Result
2402	1.332	--	Pass
2441	1.4144	--	Pass
2480	1.3256	--	Pass

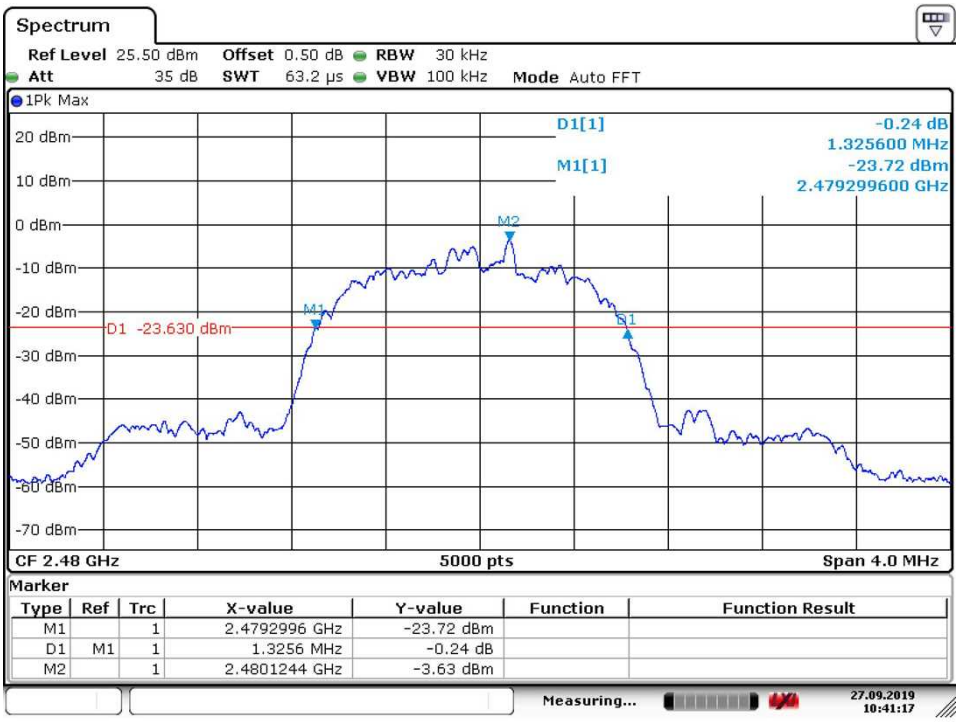


Date: 27.SEP.2019 10:39:29

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600



Date: 27.SEP.2019 10:54:24



Date: 27.SEP.2019 10:41:18

9.3 Carrier Frequency Separation

Test Method

1. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels, RBW ≥ 1% of the span, VBW) ≥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
≥25KHz or 2/3 of the 20 dB bandwidth which is greater

GFSK Modulation Limit

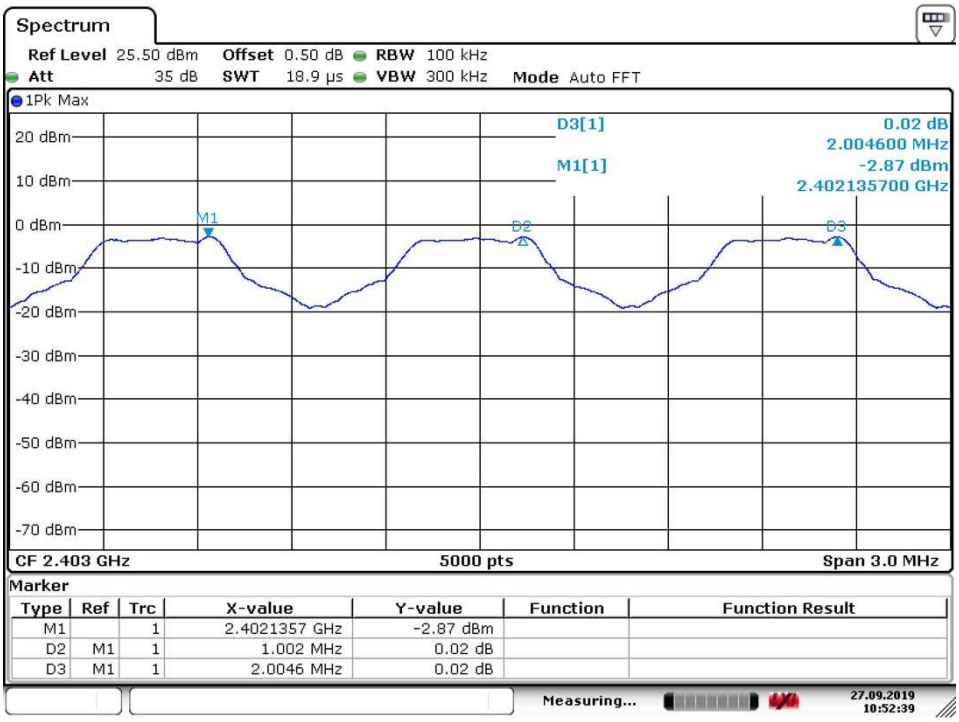
Frequency MHz	2/3 of 20 dB Bandwidth kHz
2402	0.669

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.

GFSK Modulation test result

Frequency MHz	Carrier Frequency Separation MHz	Result
2402	1.002	Pass



Date: 27.SEP.2019 10:52:39

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

9.4 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 ≥ 1% of the span, VBW) ≥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

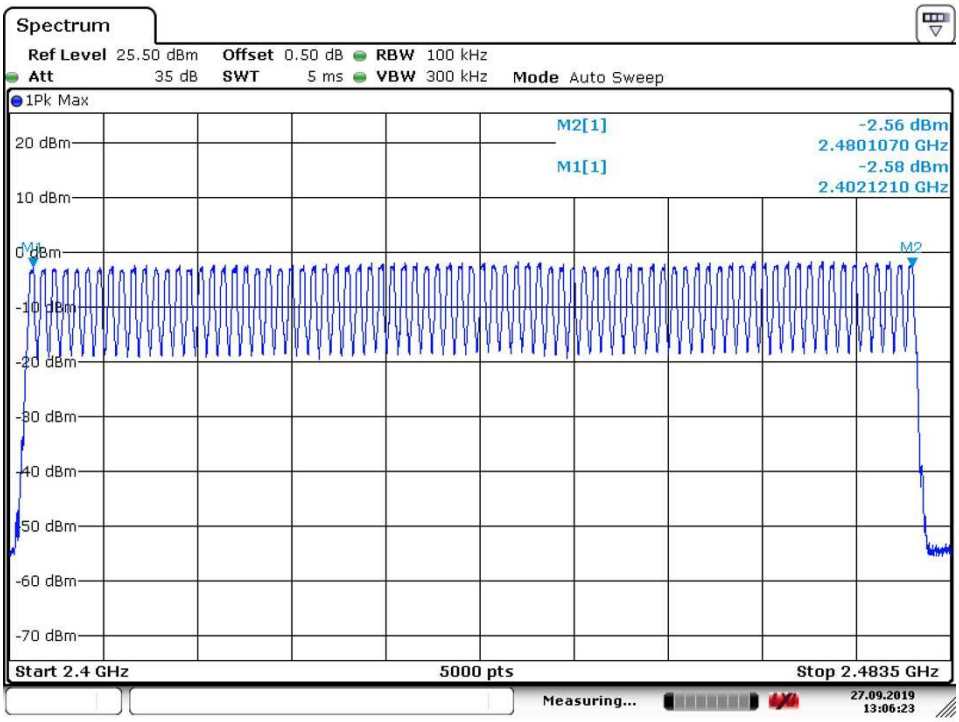
TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

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

DH5 test result



Date: 27.SEP.2019 13:06:23

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

9.5 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

Dwell time
The maximum dwell time shall be 0,4 s.
According to the Bluetooth Core Specification, the worse result (DH5 mode) was reported to show compliance.

The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 79 [ch] = 31.6 [s*ch];

The burst width, which is directly measured, refers to the duration on one channel hop.

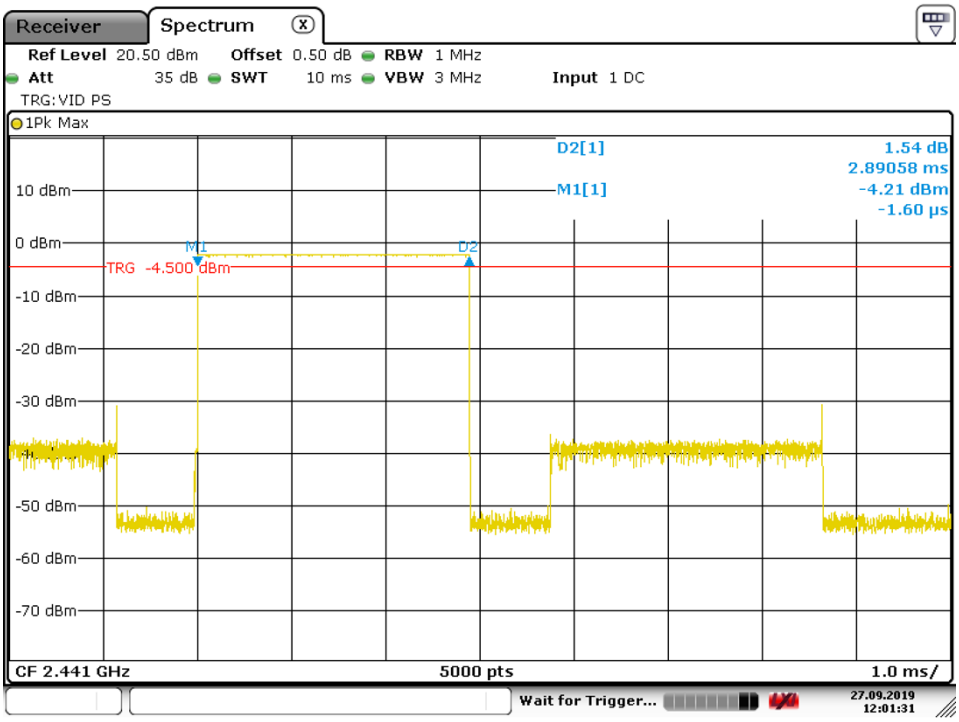
The maximum number of hopping channels in 31.6s for DH5=1600 / 6 / 79 *31.6=106.67

Test Result

Modulation	Mode	Reading (ms)	Total Hops	Test Result (ms)	Limit (ms)	Result
GFSK	DH5	2.89058	106.77	308.627227	< 400	Pass
π/4-DQPSK	2DH5	2.89258	106.77	308.840767	< 400	Pass
8-DPSK	3DH5	2.89458	106.77	309.054307	< 400	Pass

GFSK Modulation

DH5

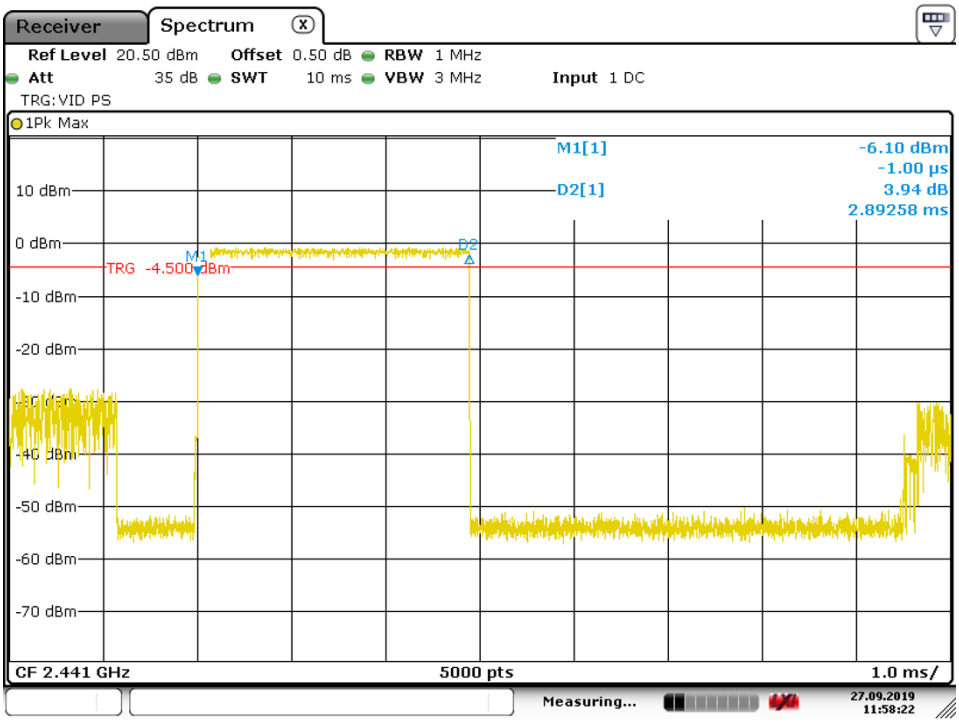


Date: 27.SEP.2019 12:01:31

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

π/4-DQPSK Modulation

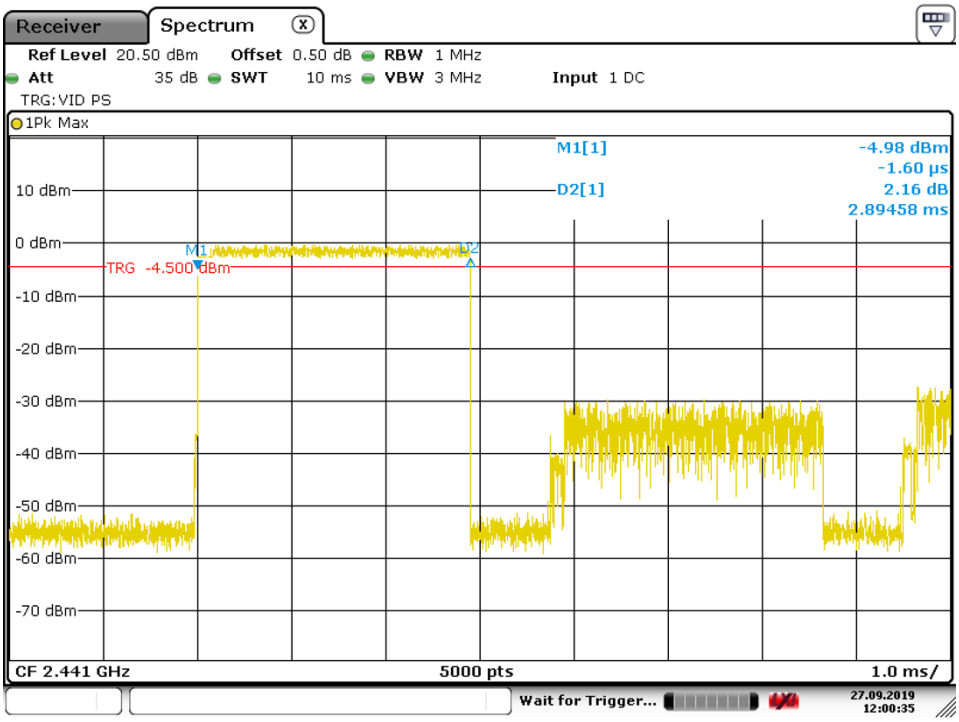
2DH5



Date: 27.SEP.2019 11:58:23

8-DPSK Modulation

3DH5



Date: 27.SEP.2019 12:00:36

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

9.6 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

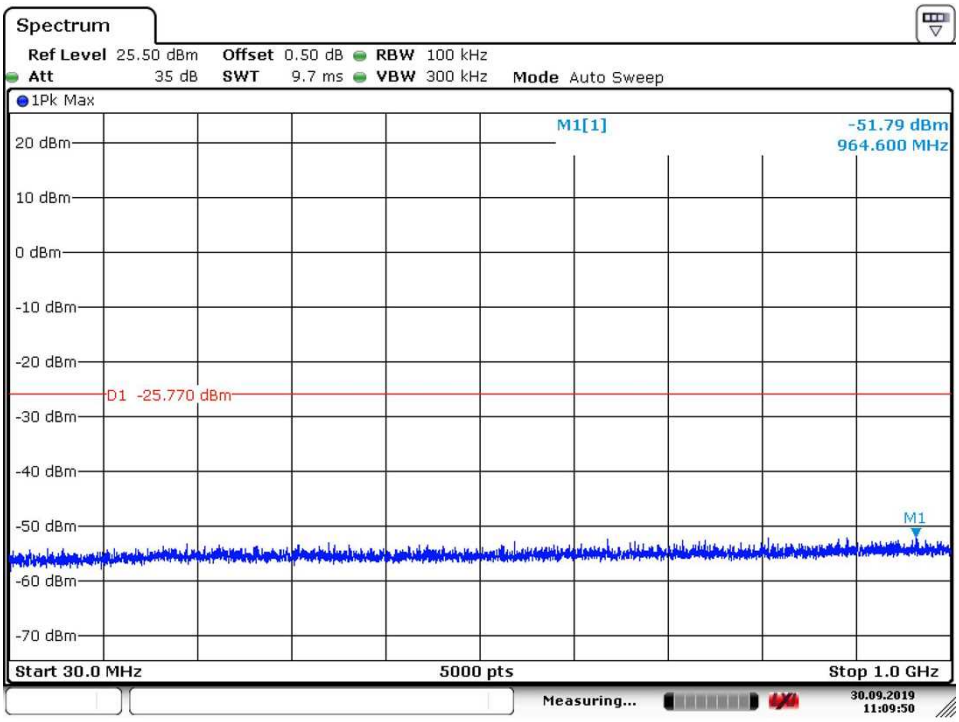
Frequency Range MHz	Limit (dBc)
30-25000	-20

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

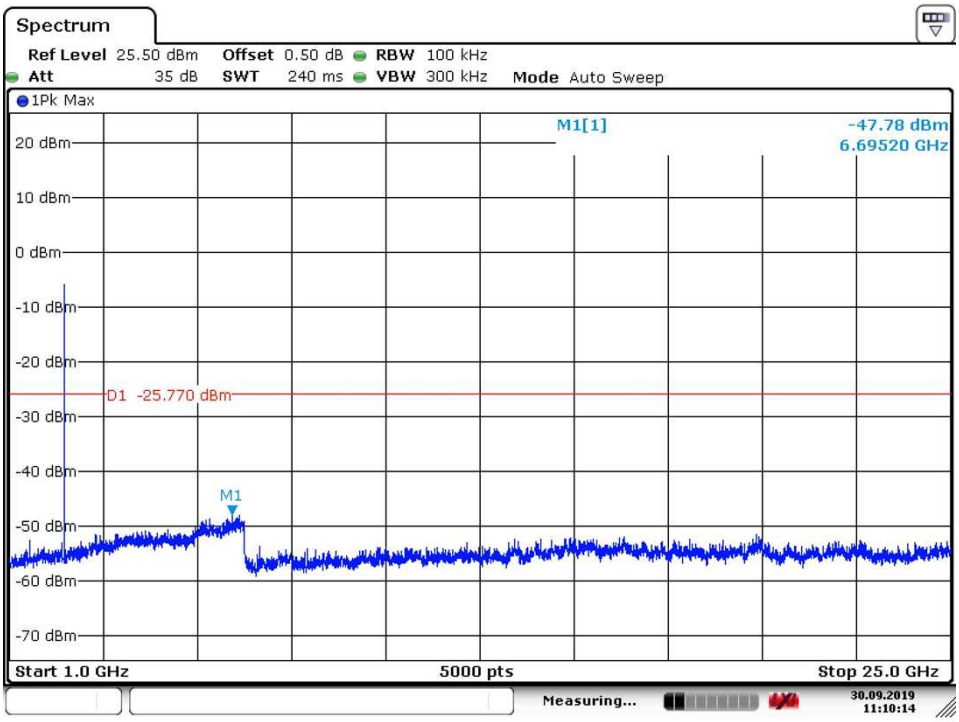
Spurious RF conducted emissions

Only the worst case (which is subject to the maximum EIRP, 8DPSK 3DH5 mode) test result is listed in the report.

2402MHz



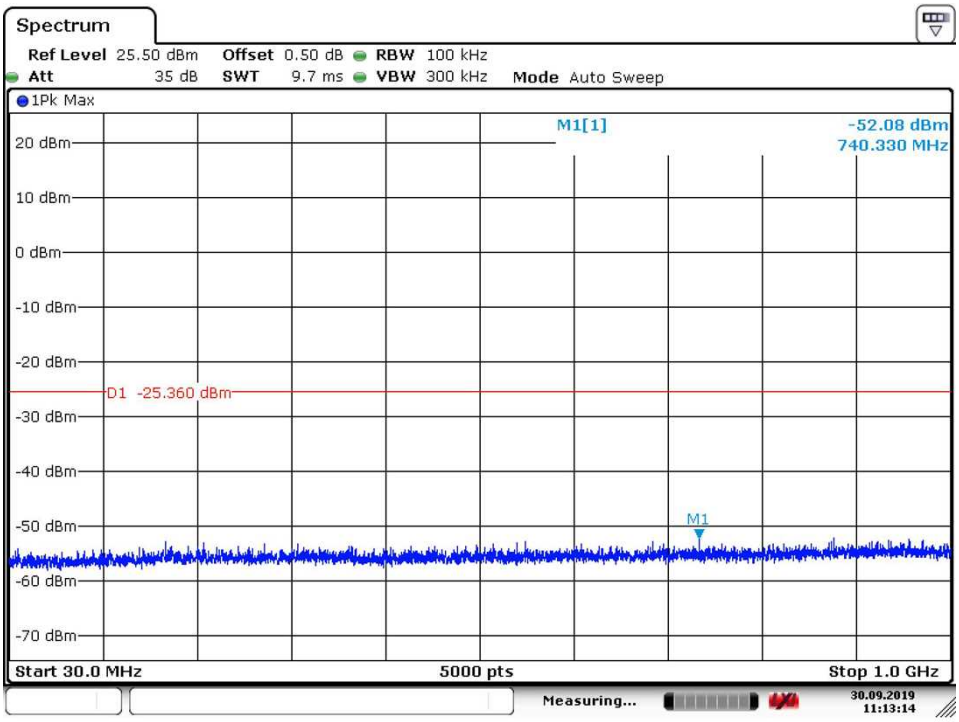
Date: 30.SEP.2019 11:09:51



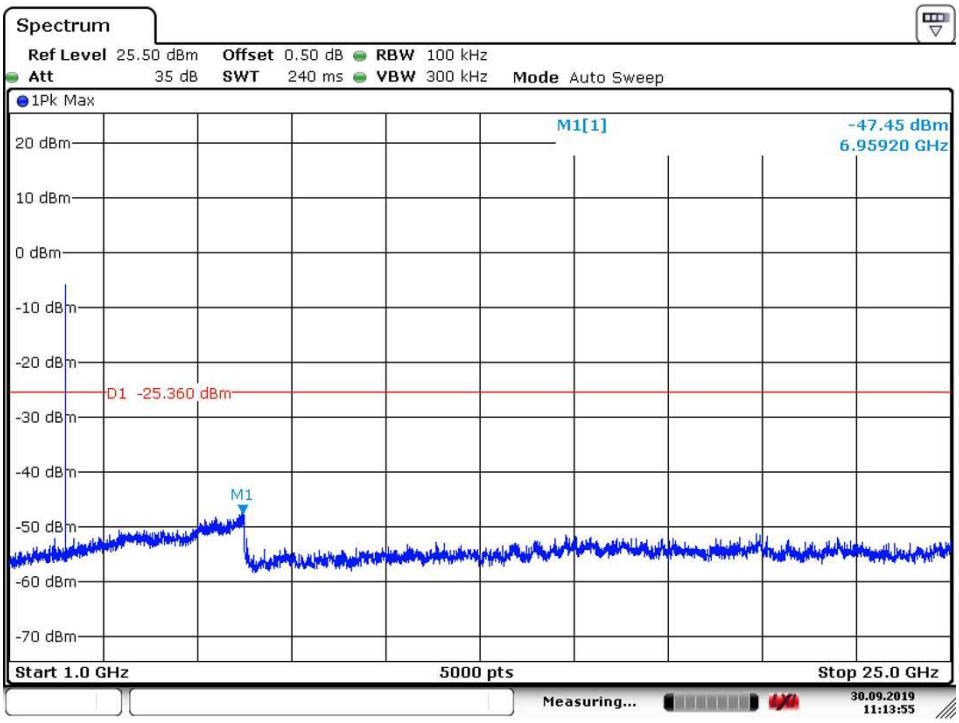
Date: 30.SEP.2019 11:10:14

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

2441MHz



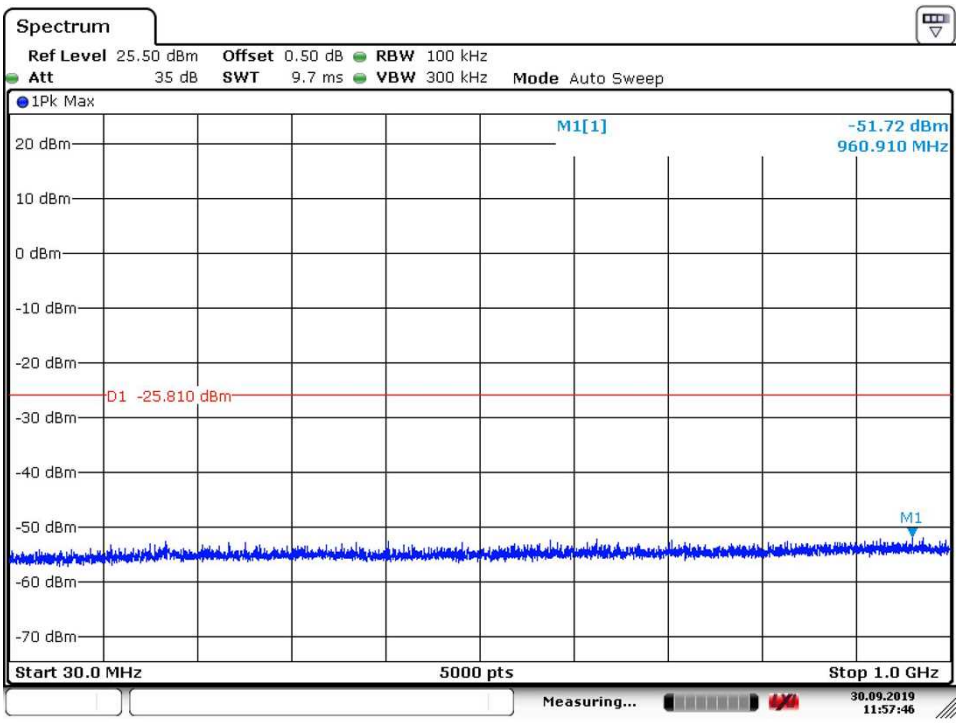
Date: 30.SEP.2019 11:13:14



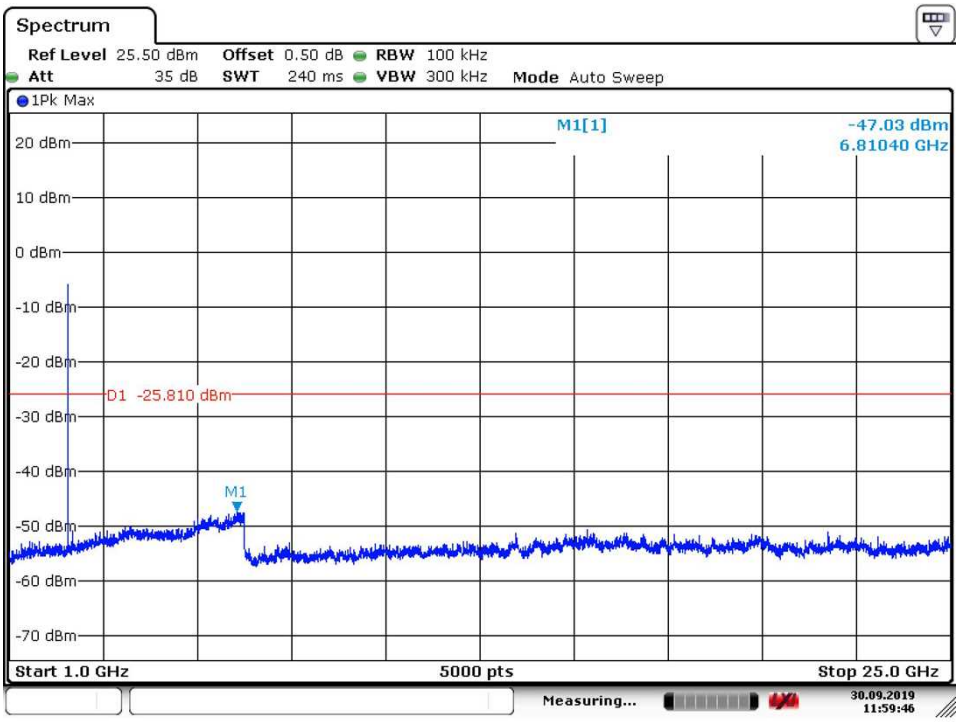
Date: 30.SEP.2019 11:13:55

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

2480MHz



Date: 30.SEP.2019 11:57:47



Date: 30.SEP.2019 11:59:46

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

9.7 Band edge testing

Test Method

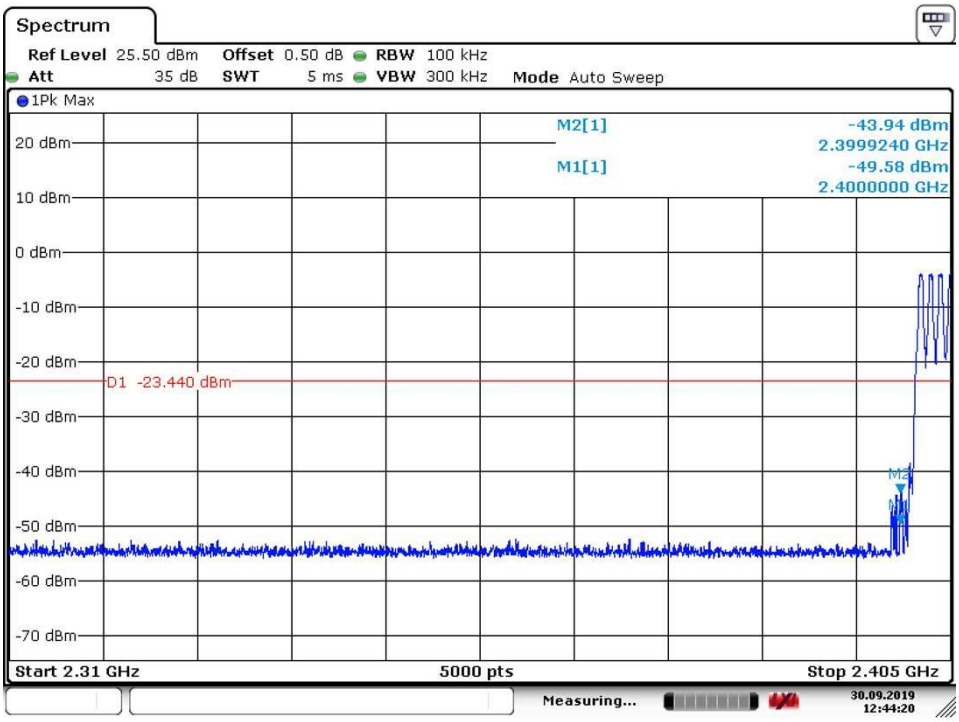
1. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious
   RBW = 100 kHz, VBW⩾RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Allow the trace to stabilize, use the peak and delta measurement to record the result.
3. The level displayed must comply with the limit specified in this Section.
4. Repeat the test at the hopping off and hopping on mode, submit all the plots.

Limit:

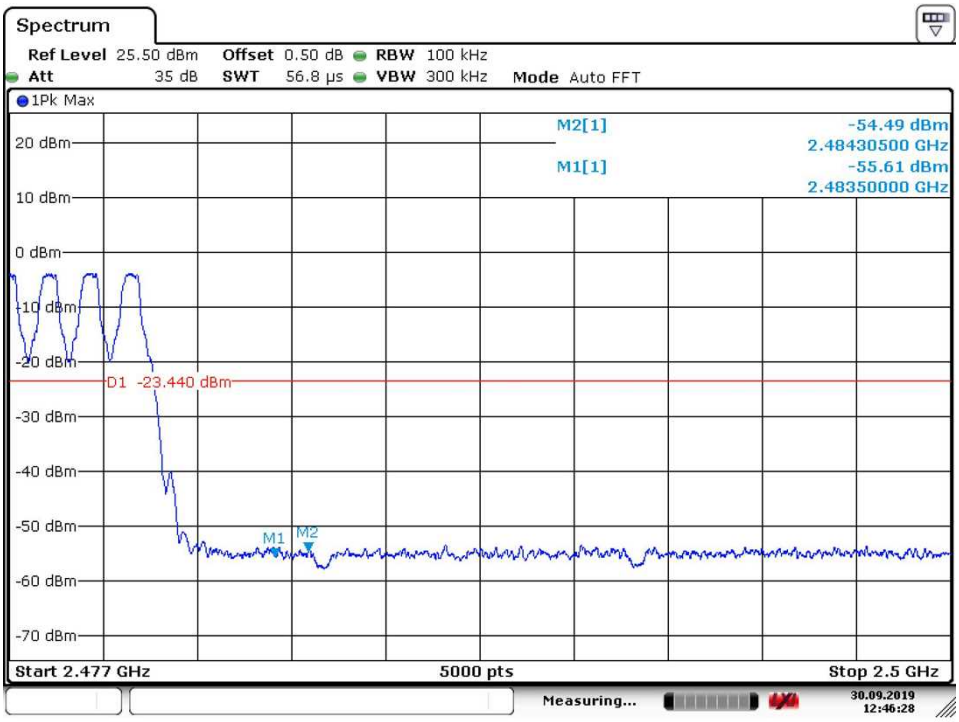
In any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

Band edge testing

GFSK Modulation Test Result:
Hopping on mode:



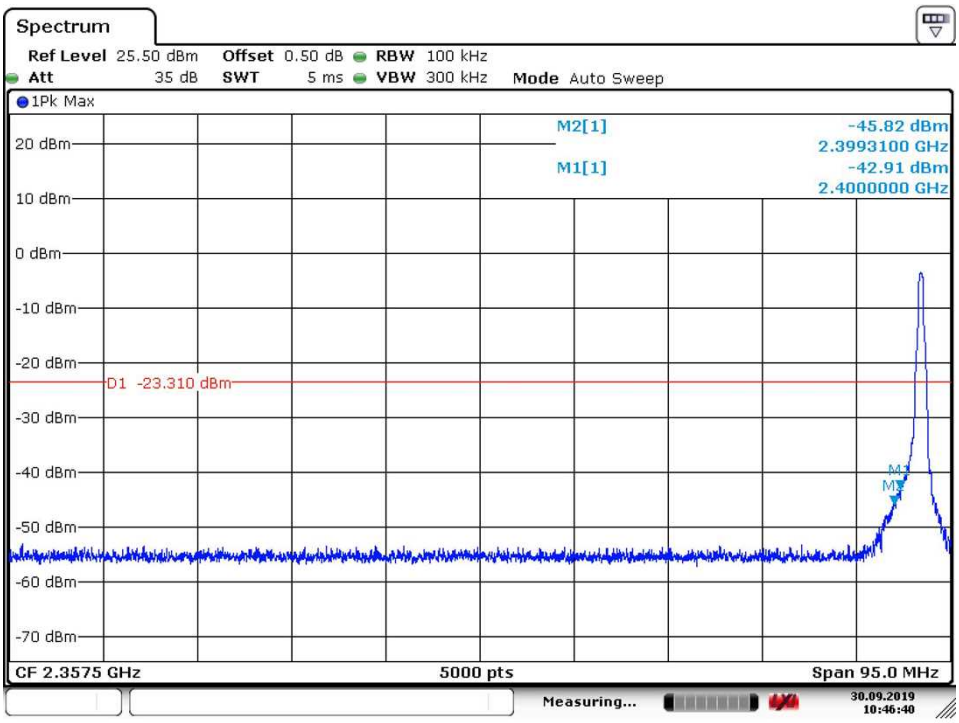
Date: 30.SEP.2019 12:44:20



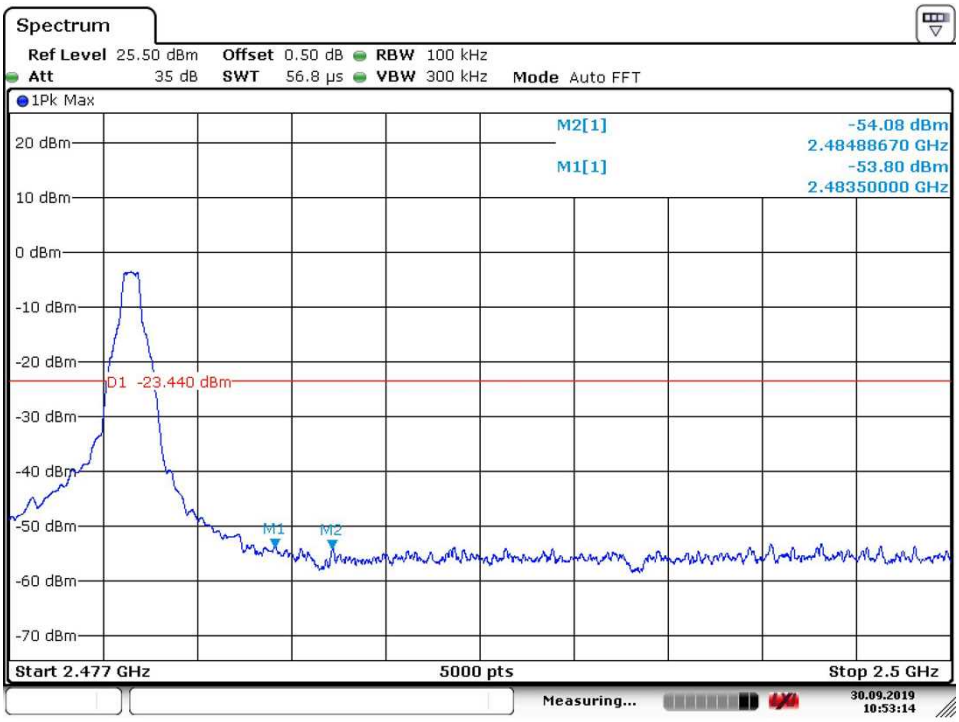
Date: 30.SEP.2019 12:46:28

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

Hopping off mode:



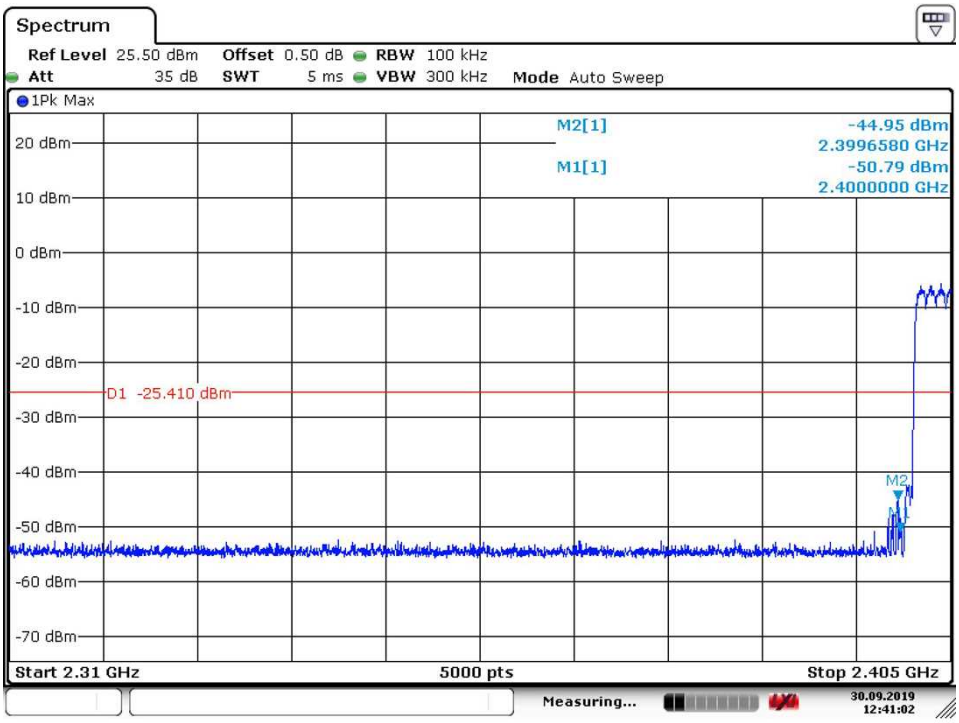
Date: 30.SEP.2019 10:46:40



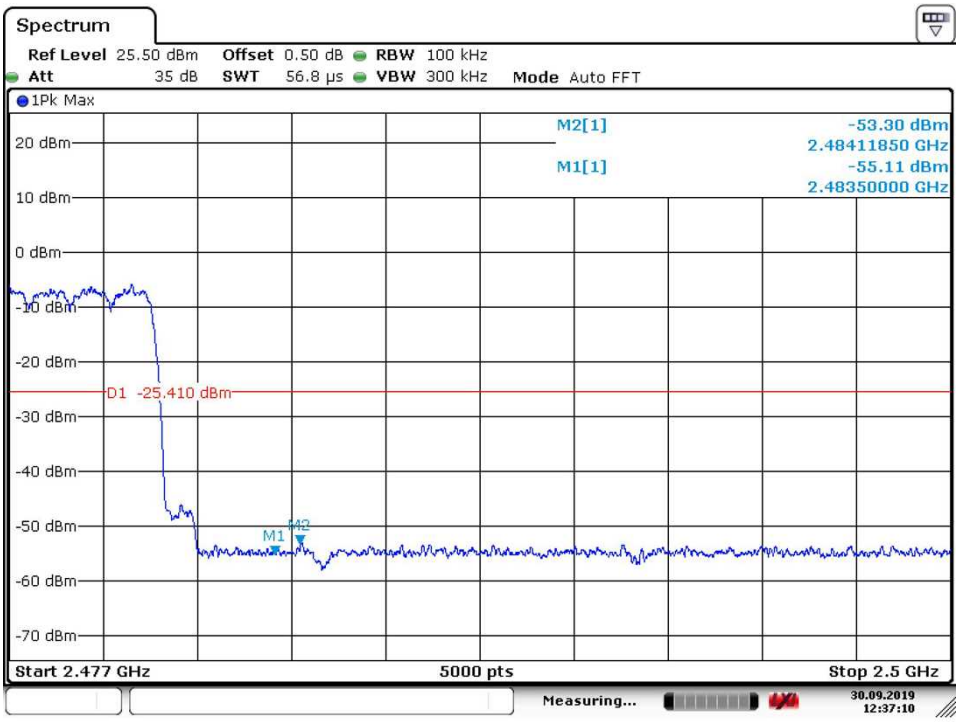
Date: 30.SEP.2019 10:53:14

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

π/4-DQPSK Modulation Test Result:
Hopping on mode:



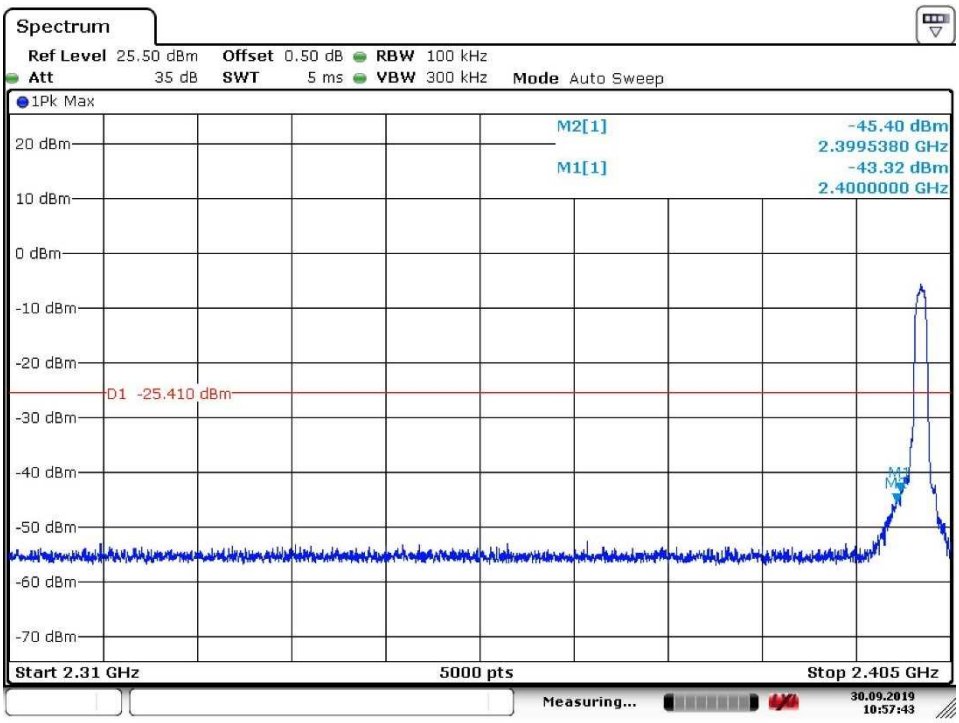
Date: 30.SEP.2019 12:41:02



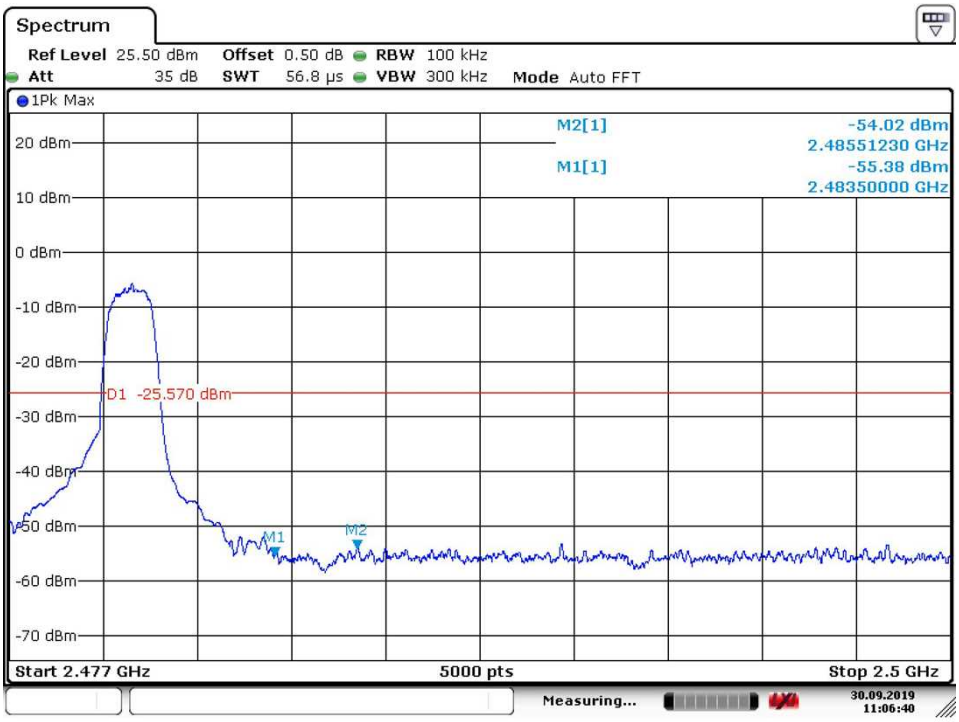
Date: 30.SEP.2019 12:37:10

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

Hopping off mode:

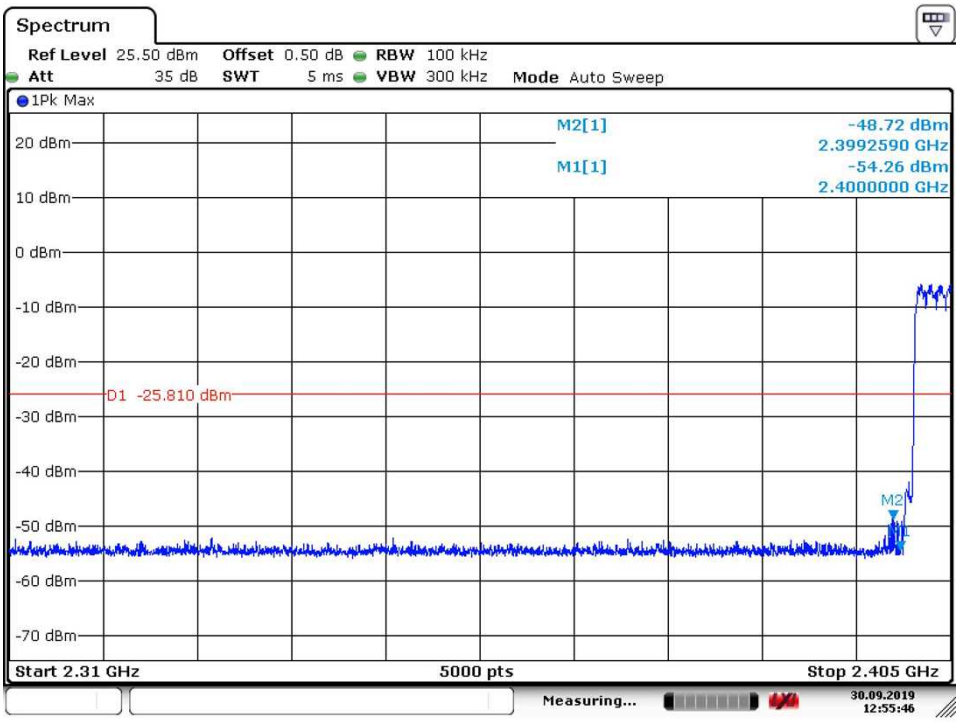


Date: 30.SEP.2019 10:57:44

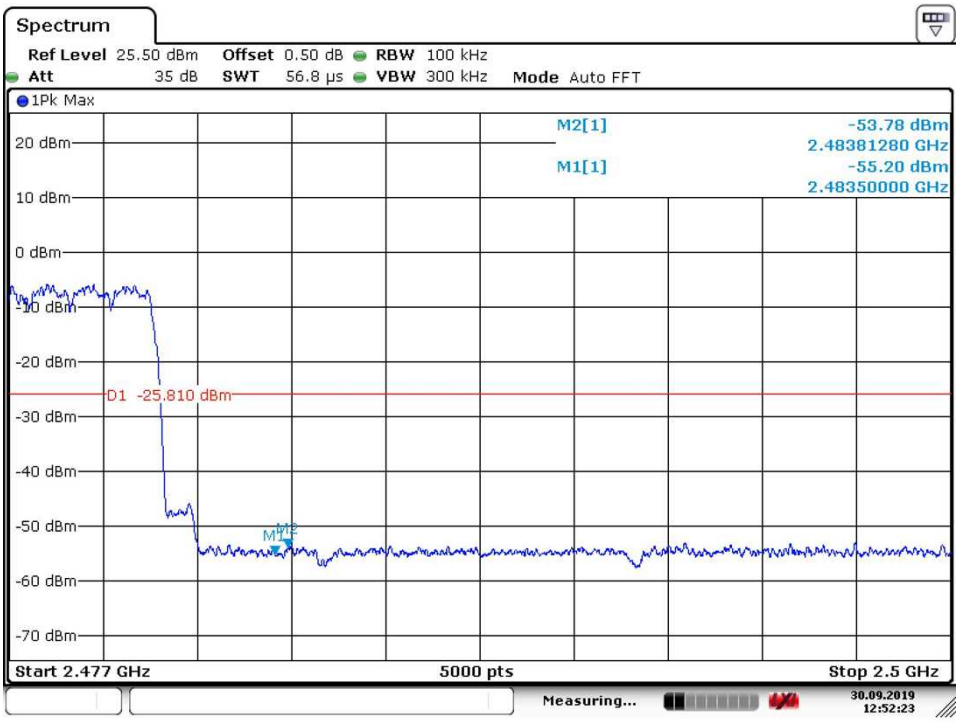


Date: 30.SEP.2019 11:06:40

8DPSK Modulation Test Result:
Hopping on mode:

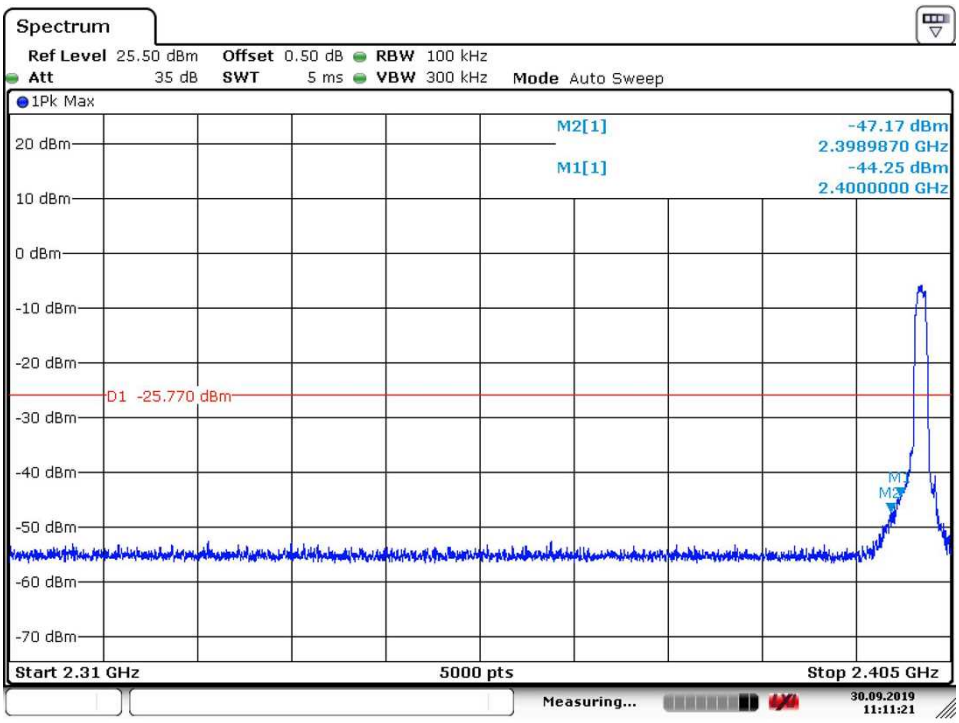


Date: 30.SEP.2019 12:55:46

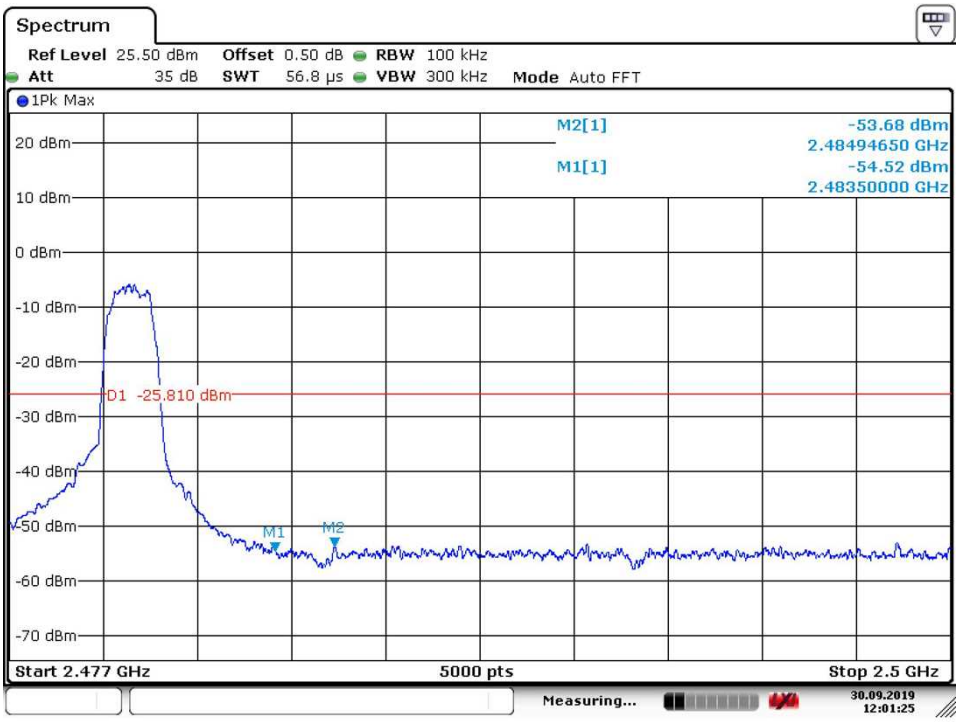


Date: 30.SEP.2019 12:52:23

Hopping off mode:



Date: 30.SEP.2019 11:11:21



Date: 30.SEP.2019 12:01:26

9.8 Spurious radiated emissions for transmitter and receiver

Test Method

1. The EUT was place 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

a) RBW = 1MHz.
b) VBW ≥ [3 × RBW].
c) Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ RBW / 2. Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
e) Sweep time = auto.
f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the

emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.
2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.
3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

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 section15.205, 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

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

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.

The only worse case (which is subject to the maximum EIRP, 8DPSK mode) test results for model ZS11E, ZS11MCE3 are listed in the report.

ZS11E Transmitting spurious emission test result as below:

Bluetooth Mode 8DPSK Modulation 2402MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	**dBuV/m**		**dBμV/m**		**dBuV/m**	
2390	35.28	H	74	PK	38.72	Pass
4804	40.41	H	74	PK	33.59	Pass
2368.8	38.16	V	74	PK	35.84	Pass
4804	38.01	V	74	PK	35.99	Pass

Bluetooth Mode 8DPSK Modulation 2441MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	**dBuV/m**		**dBμV/m**		**dBuV/m**	
4882	38.81	H	74	PK	35.19	Pass
4882	39.78	V	74	PK	34.22	Pass

Bluetooth Mode 8DPSK Modulation 2480MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	**dBuV/m**		**dBμV/m**		**dBuV/m**	
2483.5	43.62	H	74	PK	30.38	Pass
4960	40.49	H	74	PK	33.51	Pass
2483.6	45.26	V	74	PK	28.74	Pass
4960	39.63	V	74	PK	34.37	Pass

Remark:

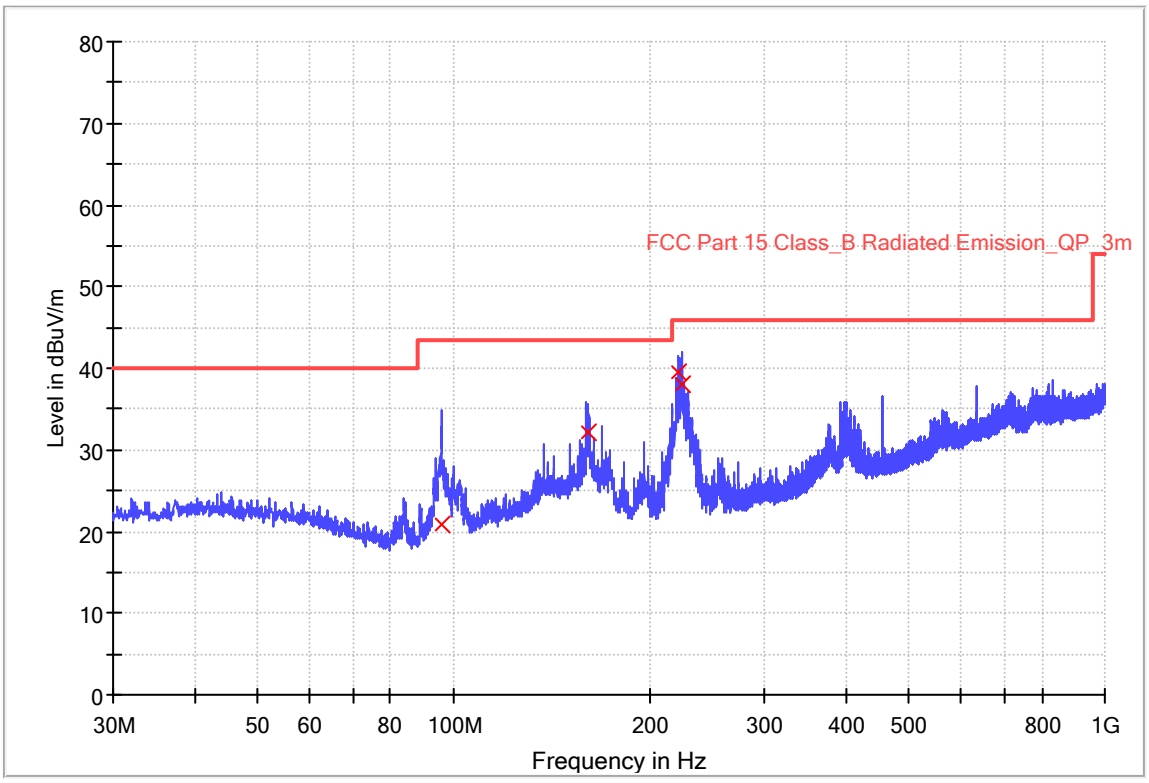
(1) Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Pre-amplifier
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
Emission Level =Reading level +Correction Factor

(The Reading Level is recorded by software which is not shown in the sheet)

The worst case of Radiated Emission below 1GHz:

Site: 3 meter chamber	Time: 2019/09/28 - 17:21
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Wenqiang LU
Probe: VULB9168	Polarity: Horizontal
EUT: ISMART1.0, Model no: ZS11E	Power: 12VDC
Note: There is the worst case within frequency range 30MHz~1GHz.	

RE_VULB9168_pre_Cont_EN 55014_30-1000



Limit and Margin

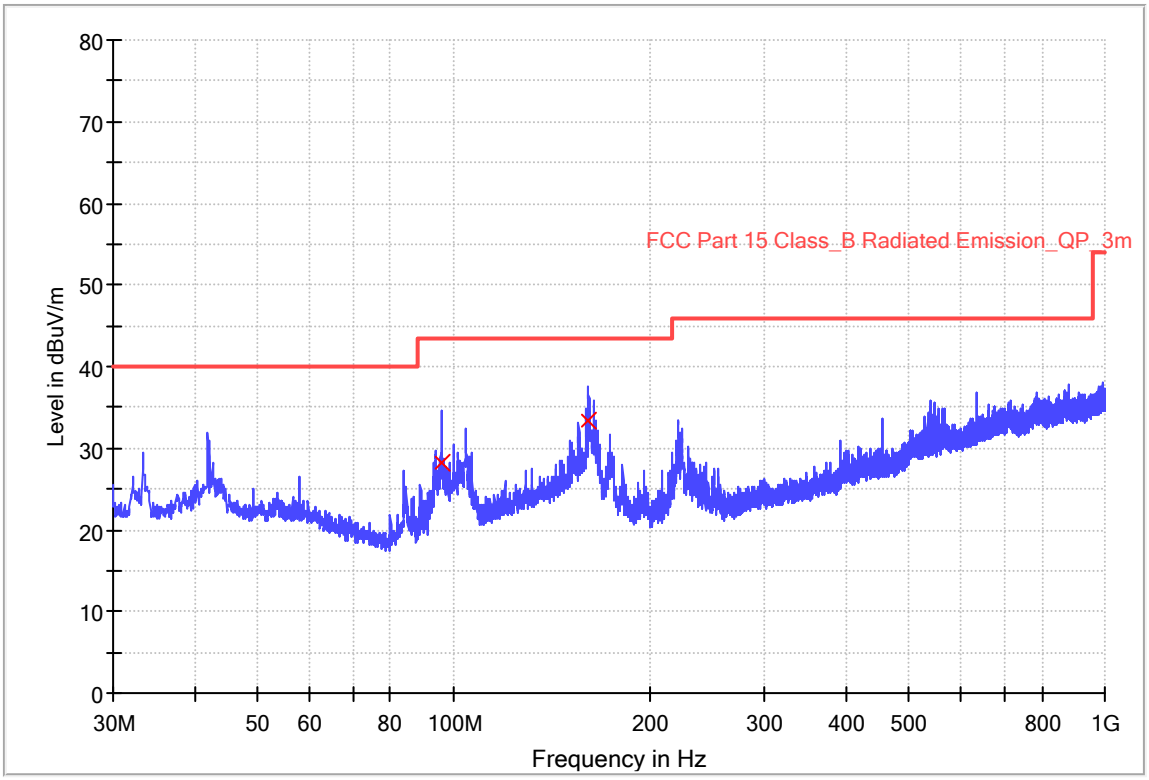
Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
95.960000	20.8	1000.0	120.000	100.0	H	1.0	11.0	22.7	43.5
161.240000	32.1	1000.0	120.000	100.0	H	358.0	15.5	11.4	43.5
221.920000	39.5	1000.0	120.000	100.0	H	1.0	12.6	6.5	46.0
224.320000	37.9	1000.0	120.000	100.0	H	359.0	12.7	8.1	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: 2019/09/28 - 17:40
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Wenqiang LU
Probe: VULB9168	Polarity: Vertical
EUT: ISMART1.0, Model no: ZS11E	Power: 12VDC
Note: There is the worst case within frequency range 30MHz~1GHz.	

RE_VULB9168_pre_Cont_EN 55014_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)
95.920000	28.1	1000.0	120.000	100.1	V	358.0	11.0	15.4	43.5
161.160000	33.3	1000.0	120.000	100.1	V	1.0	15.6	10.2	43.5

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.

ZS11MCE3 Transmitting spurious emission test result as below:

Bluetooth Mode 8DPSK Modulation 2402MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBuV/m	
2390	34.26	H	74	PK	39.74	Pass
4804	38.69	H	74	PK	35.31	Pass
2390	34.87	V	74	PK	39.13	Pass
4804	40.32	V	74	PK	33.68	Pass

Bluetooth Mode 8DPSK Modulation 2441MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBuV/m	
4882	39.49	H	74	PK	34.51	Pass
4882	37.89	V	74	PK	36.11	Pass

Bluetooth Mode 8DPSK Modulation 2480MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBuV/m	
2483.5	46.42	H	74	PK	27.58	Pass
4960	40.08	H	74	PK	33.92	Pass
2483.6	44.83	V	74	PK	29.17	Pass
4960	38.75	V	74	PK	35.25	Pass

Remark:

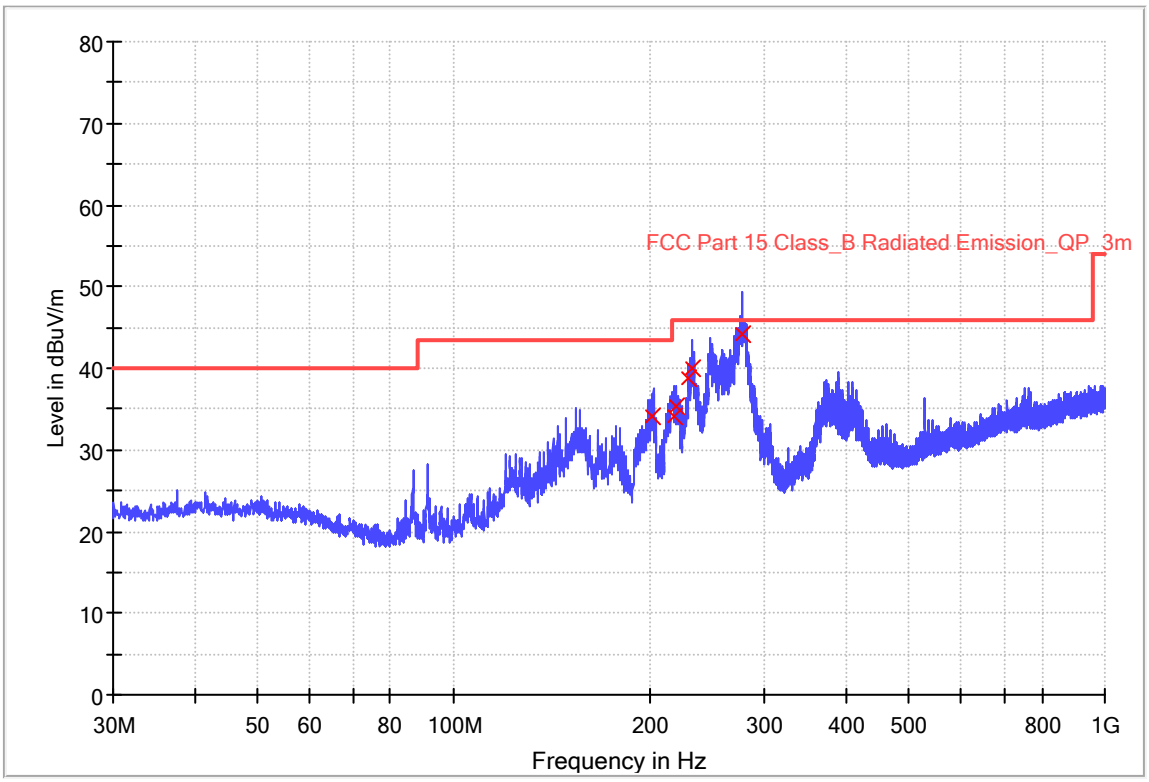
(1) Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Pre-amplifier
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
Emission Level =Reading level +Correction Factor
(The Reading Level is recorded by software which is not shown in the sheet)

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

The worst case of Radiated Emission below 1GHz:

Site: 3 meter chamber	Time: 2019/09/28 - 17:21
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Wenqiang LU
Probe: VULB9168	Polarity: Horizontal
EUT: ISMART1.0, Model no: ZS11MCE3	Power: 12VDC
Note: There is the worst case within frequency range 30MHz~1GHz.	

RE_VULB9168_pre_Cont_EN 55014_30-1000



Limit and Margin

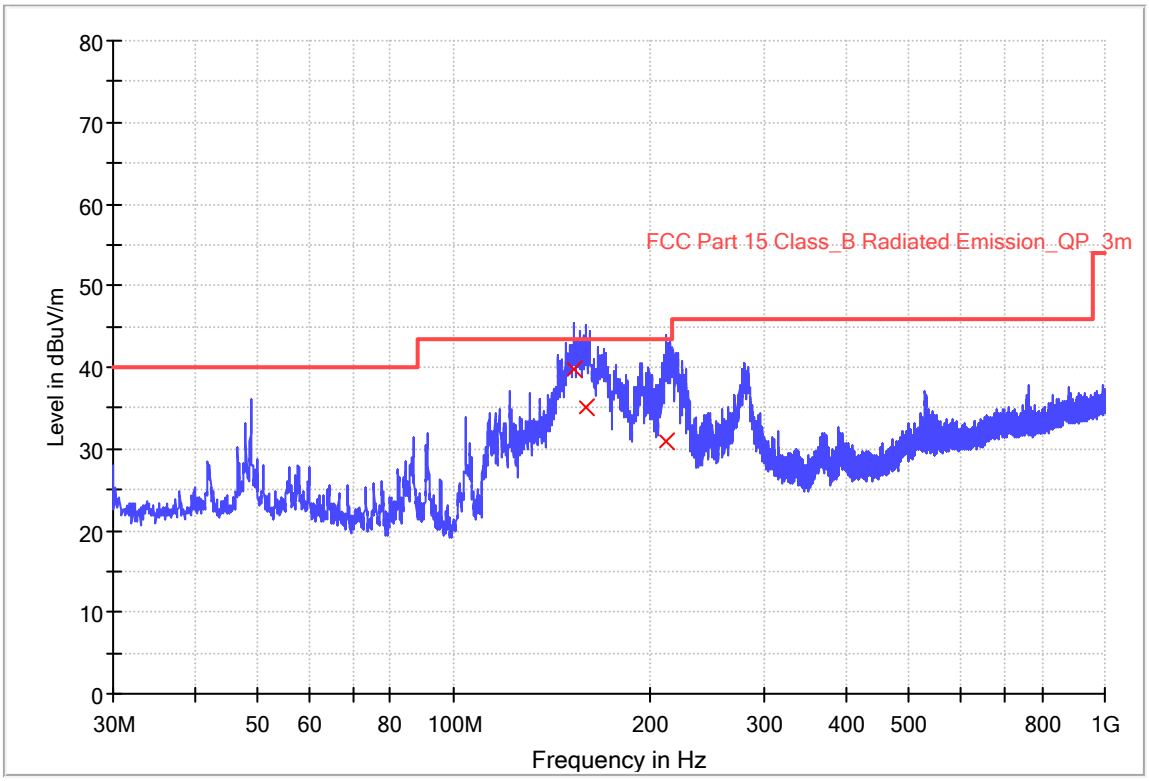
Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
202.400000	34.0	1000.0	120.000	100.0	H	6.0	11.7	9.5	43.5
217.640000	34.2	1000.0	120.000	100.0	H	359.0	12.4	11.9	46.0
220.200000	35.2	1000.0	120.000	100.0	H	1.0	12.5	10.8	46.0
229.800000	38.7	1000.0	120.000	100.0	H	2.0	12.9	7.3	46.0
232.200000	39.9	1000.0	120.000	100.0	H	358.0	13.0	6.1	46.0
277.720000	44.2	1000.0	120.000	100.0	H	358.0	14.4	1.8	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: 2019/09/28 - 17:40
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Wenqiang LU
Probe: VULB9168	Polarity: Vertical
EUT: ISMART1.0, Model no: ZS11MCE3	Power: 12VDC
Note: There is the worst case within frequency range 30MHz~1GHz.	

RE_VULB9168_pre_Cont_EN 55014_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)
153.320000	39.8	1000.0	120.000	100.0	V	255.0	15.7	3.7	43.5
159.960000	35.2	1000.0	120.000	100.0	V	1.0	15.7	8.3	43.5
212.120000	30.9	1000.0	120.000	100.0	V	358.0	12.2	12.6	43.5

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.

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

10 Test Equipment List

List of Test Instruments

Test Site1

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
C	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2020-8-4
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2020-8-4
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2020-8-4
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2022-3-15
	Horn Antenna	Rohde & Schwarz	HF907	102393	2021-4-1
	Pre-amplifier	Rohde & Schwarz	SCU-18D	19006451	2020-8-4
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2020-6-27
	DOUBLE-RIDGED WAVEGUIDE HORN WITH PRE-AMPLIFIER (18 GHZ - 40 GHZ)	ETS-Lindgren	3116C-PA	E326	2021-1-28
	3m Semi-anechoic chamber	TDK	9X6X6	----	2021-5-10
CE	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2020-8-4
	LISN	Rohde & Schwarz	ENV216	101924	2020-8-4

Measurement Software Information			
Test Item	Software	Manufacturer	Version
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
- 20dB bandwidth and 99% Occupied Bandwidth
- Carrier frequency separation
- Number of hopping frequencies
- Dwell Time
- 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, ±3.16dB
Radiated Disturbance	30MHz to 1GHz, ±5.03dB (Horizontal) ±5.12dB (Vertical) 1GHz to 18GHz, ±5.15dB (Horizontal) ±5.12dB (Vertical) 18GHz to 25GHz, ±4.76dB

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

12 Photographs of Test Set-ups

Refer to the < Test Setup photos >.

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

13 Photographs of EUT

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

THE END

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600