

FCC - TEST REPORT

Report Number : **68.950.20.0222.01** Date of Issue: May 08, 2020

Model : **MDZ-24-AA**

Product Type : Mi TV Stick

Applicant : Beijing Xiaomi Electronics Co., Ltd.

Address : Room 707,7F, Building 5, No 58, JinghaiWulu Road, Beijing
economic and Technological Development Zone, Beijing 100176 Beijing
City PEOPLE'S REPUBLIC OF CHINA

Production Facility : Beijing Xiaomi Electronics Co., Ltd.

Address : Room 707,7F, Building 5, No 58, JinghaiWulu Road, Beijing
economic and Technological Development Zone, Beijing 100176 Beijing
City PEOPLE'S REPUBLIC OF CHINA

Factory : Shenzhen Twowing Technologies Co., Ltd.

Address : Floor 1-12, Nangang Industrial Building, Tangtou Industrial Park, Shiyan, Baoan,
Shenzhen, Guangdong, China

Test Result : **Positive** **Negative**

Total pages including Appendices : 59

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2 Details about the Test Laboratory

Details about the Test Laboratory

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint
Road 2, Nanshan District
Shenzhen 518052
P.R. China

Telephone: 86 755 8828 6998
Fax: 86 755 828 5299

FCC Registration No.: 514049
IC Registration No: 10320A

3 Description of the Equipment Under Test

Product:	Mi TV Stick
Model no.:	MDZ-24-AA
Brand Name:	MI
FCC ID:	2AIMRMITVMDZ24AA
Options and accessories:	Adapter, USB Cable and Wireless Remote Control
Input Rating: Adapter:	5Vdc/1000mA (Supplied By AC/DC Adapter) Input:100-240V~50/60Hz 0.2A Output: 5V/1000mA
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	79
Modulation:	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Antenna Type:	PCB antenna
Antenna Gain:	1.0dBi
Description of the EUT:	The Equipment Under Test (EUT) is a TV Stick which support 2.4G WiFi, 5G WiFi, BR/EDR and BLE function. The 2.4G Wi-Fi, BR/EDR and BLE operated at 2400MHz to 2483.5MHz, The 5G WiFi operation 5150MHz to 5250MHz, and 5725MHz to 5825MHz.



4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2019 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB 558074 D01 v05r02 and Public Notice DA 00-705 - Frequency Hopper Spread Spectrum Test Procedure released by FCC on March 30, 2000 and ANSI C63.10-2013.

5 Summary of Test Results

Technical Requirements			
FCC Part 15 Subpart C			
Test Condition		Pages	Test Result
§15.207	Conducted emission AC power port	10	Pass
§15.247(b)(1)	Conducted peak output power	13	Pass
§15.247(e)	Power spectral density*	--	N/A
§15.247(a)(2)	6dB bandwidth	--	N/A
§15.247(a)(1)	20dB bandwidth and 99% Occupied Bandwidth	20	Pass
§15.247(a)(1)	Min. of Hopping Channel Carrier Frequency Separation	20	Pass
§15.247(a)(1)(iii)	Min number of hopping frequencies	30	Pass
§15.247(a)(1)(iii)	Dwell Time - Average Time of Occupancy	35	Pass
§15.247(d)	Spurious RF conducted emissions	39	Pass
§15.247(d)	Band edge	43	Pass
§15.247(d) & §15.209 &	Spurious radiated emissions for transmitter and receiver	48	Pass
§15.203	Antenna requirement	See note 2	Pass

Note 1: N/A=Not Applicable.

Note 2: The EUT uses a Integrated antenna, which gain is 1.0dBi. In accordance to §15.203, 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: 2ADQO3SB3350N5 and complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C rules.

The Equipment Under Test (EUT) is a TV Stick which support 2.4G Wi-Fi, 5G Wi-Fi, BR/EDR and BLE function. The 2.4G Wi-Fi, BR/EDR and BLE operated at 2400MHz to 2483.5MHz, The 5G Wi-Fi operation 5150MHz to 5250MHz, and 5725MHz to 5825MHz.

This is report for Bluetooth BDR+EDR only.

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: February 20, 2020

Testing Start Date: February 21, 2020

Testing End Date: April 27, 2020

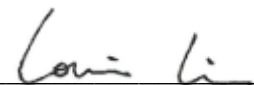
Reviewed by:

Prepared by:

Tested by:


Zhi John
EMC Section Manager

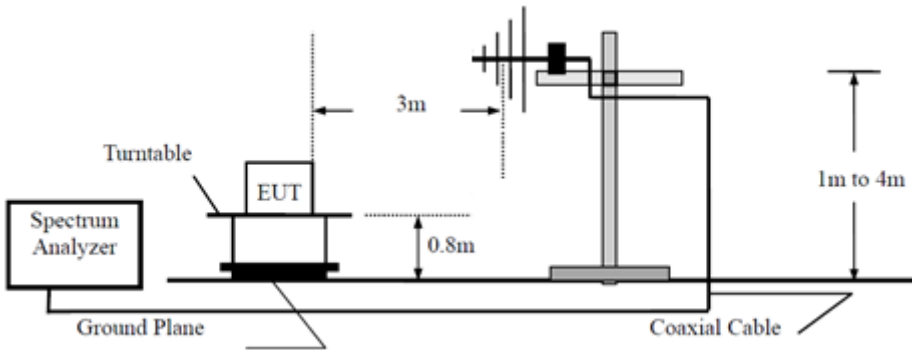

Warlen Song
EMC Project Engineer


Louise Liu
EMC Test Engineer

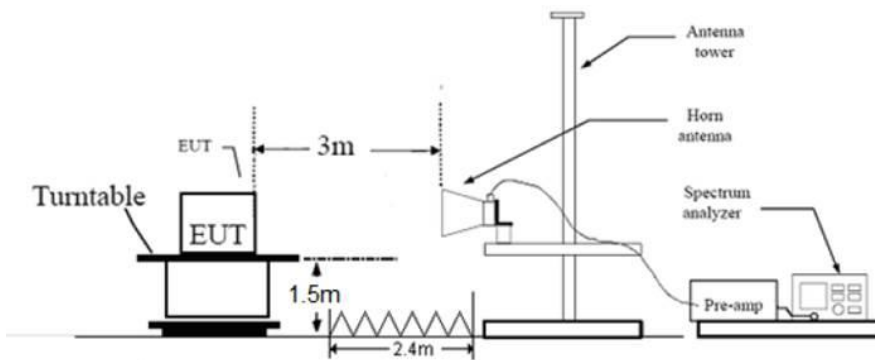
7 Test Setups

7.1 Radiated test setups

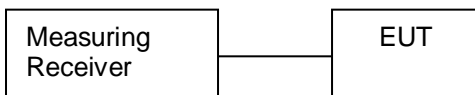
Below 1GHz



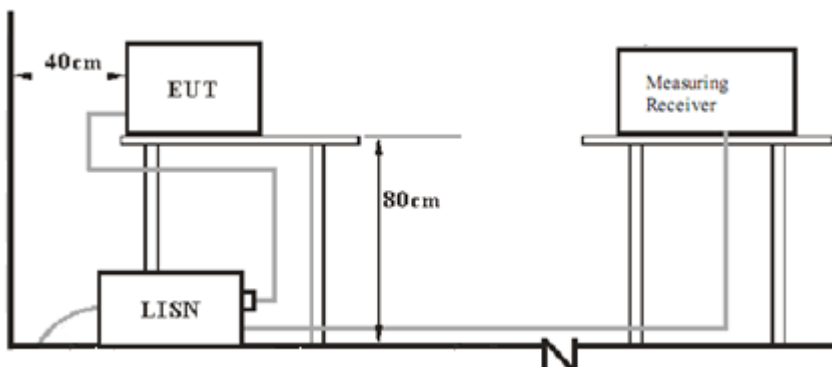
Above 1GHz



7.2 Conducted RF test setups



7.3 AC Power Line Conducted Emission test setups



8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.	S/N
Notebook	lenovo	X220	---

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

Hopping mode: typical working mode (normal hopping status)

Power Setting:0x15

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

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

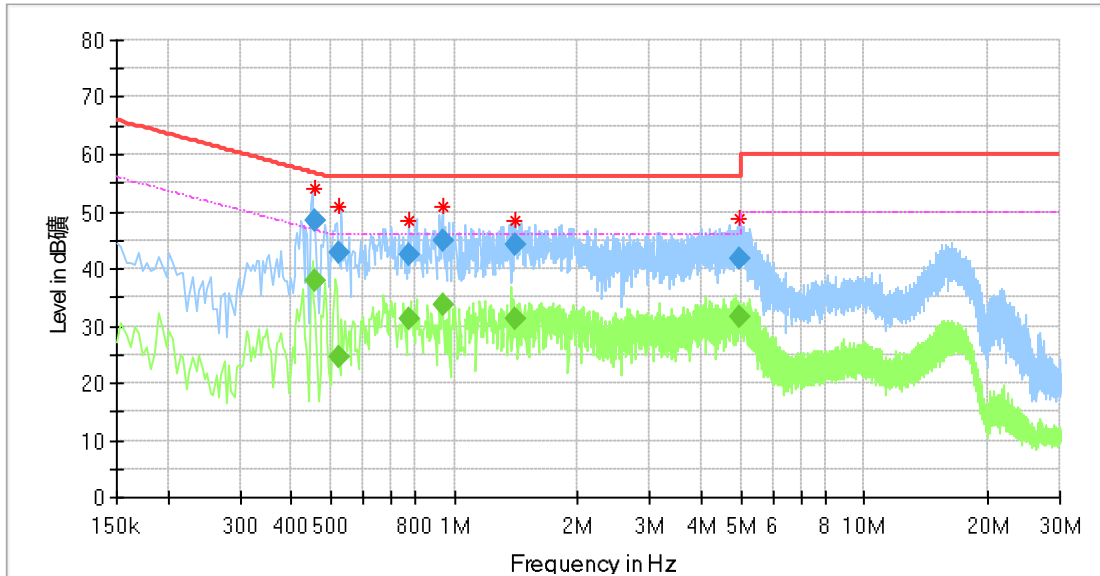
According to §15.207, conducted emissions limit as below:

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 : Mi TV Stick
 M/N : MDZ-24-AA
 Operating Condition : Wi-Fi connection+BT control
 Test Specification : Line
 Comment : AC 120V/60Hz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.454500	54.12	---	56.88	2.76	L1	10.3
0.525500	51.00	---	56.00	5.00	L1	10.3
0.773500	48.46	---	56.00	7.54	L1	10.3
0.933500	50.76	---	56.00	5.24	L1	10.3
1.413500	48.53	---	56.00	7.47	L1	10.3
4.937500	48.93	---	56.00	7.07	L1	10.5

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.454500	48.45	---	56.79	8.34	L1	10.3
0.454500	---	38.04	46.79	8.75	L1	10.3
0.525500	---	24.52	46.00	21.48	L1	10.3
0.525500	42.93	---	56.00	13.07	L1	10.3
0.773500	42.31	---	56.00	13.69	L1	10.3
0.773500	---	31.09	46.00	14.91	L1	10.3
0.933500	---	33.56	46.00	12.44	L1	10.3
0.933500	45.05	---	56.00	10.95	L1	10.3
1.413500	44.07	---	56.00	11.93	L1	10.3
1.413500	---	31.08	46.00	14.92	L1	10.3
4.937500	41.89	---	56.00	14.11	L1	10.5
4.937500	---	31.69	46.00	14.31	L1	10.5

Remark :

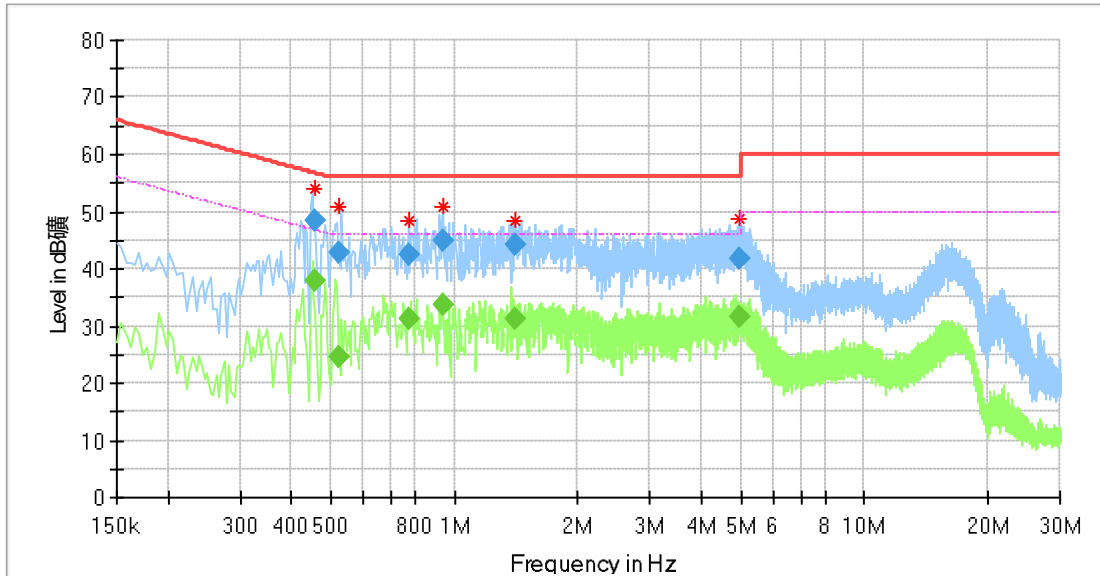
Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

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

Conducted Emission

Product Type : Mi TV Stick
 M/N : MDZ-24-AA
 Operating Condition : Wi-Fi connection+BT control
 Test Specification : Neutral
 Comment : AC 120V/60Hz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.454500	54.12	---	56.88	2.76	L1	10.3
0.525500	51.00	---	56.00	5.00	L1	10.3
0.773500	48.46	---	56.00	7.54	L1	10.3
0.933500	50.76	---	56.00	5.24	L1	10.3
1.413500	48.53	---	56.00	7.47	L1	10.3
4.937500	48.93	---	56.00	7.07	L1	10.5

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.454500	48.45	---	56.79	8.34	L1	10.3
0.454500	---	38.04	46.79	8.75	L1	10.3
0.525500	---	24.52	46.00	21.48	L1	10.3
0.525500	42.93	---	56.00	13.07	L1	10.3
0.773500	42.31	---	56.00	13.69	L1	10.3
0.773500	---	31.09	46.00	14.91	L1	10.3
0.933500	---	33.56	46.00	12.44	L1	10.3
0.933500	45.05	---	56.00	10.95	L1	10.3
1.413500	44.07	---	56.00	11.93	L1	10.3
1.413500	---	31.08	46.00	14.92	L1	10.3
4.937500	41.89	---	56.00	14.11	L1	10.5
4.937500	---	31.69	46.00	14.31	L1	10.5

Remark :

Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

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

9.2 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
 Span = approximately 5 times the 20dB bandwidth, centered on a hopping channel
 RBW > the 20dB 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 limit as below:

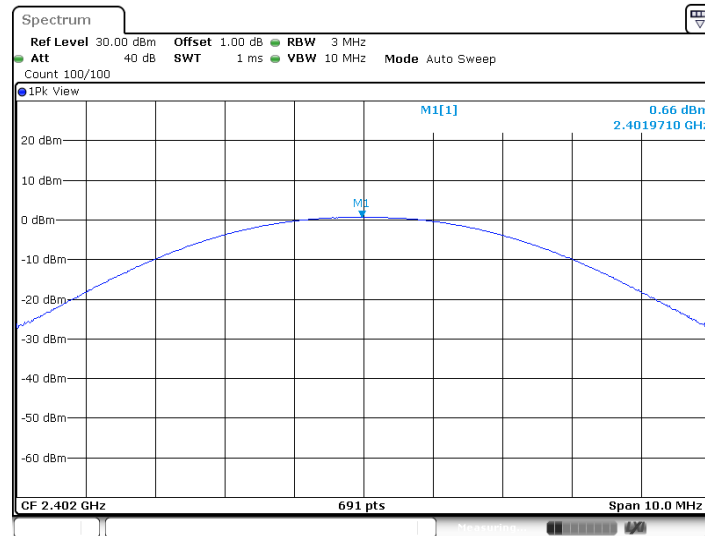
Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

Conducted peak output power

Bluetooth Mode GFSK modulation Test Result

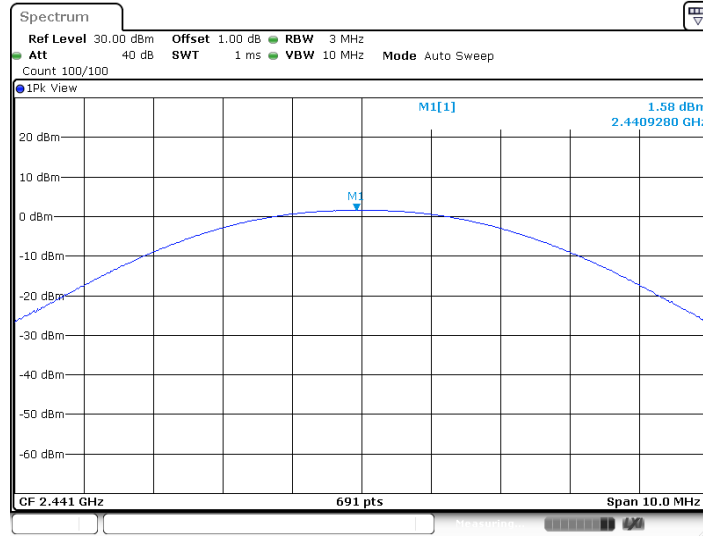
Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	0.66	Pass
Middle channel 2441MHz	1.58	Pass
High channel 2480MHz	1.15	Pass

Low channel 2402MHz

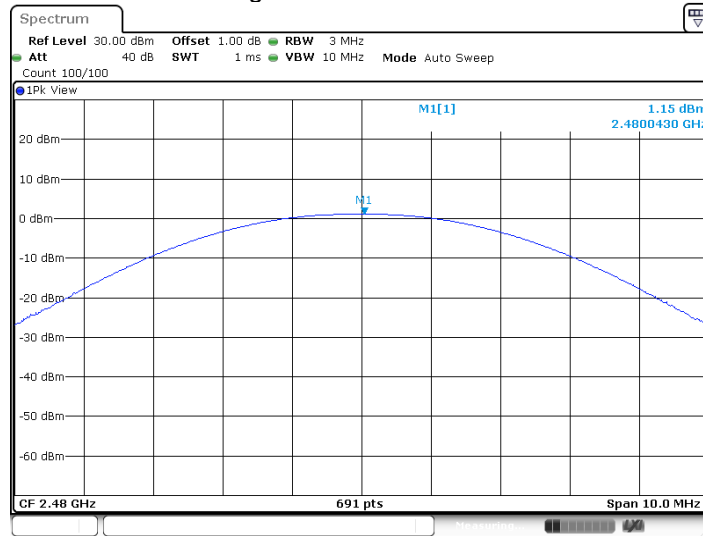


Date: 23 APR 2020 21:03:35

Middle channel 2441MHz



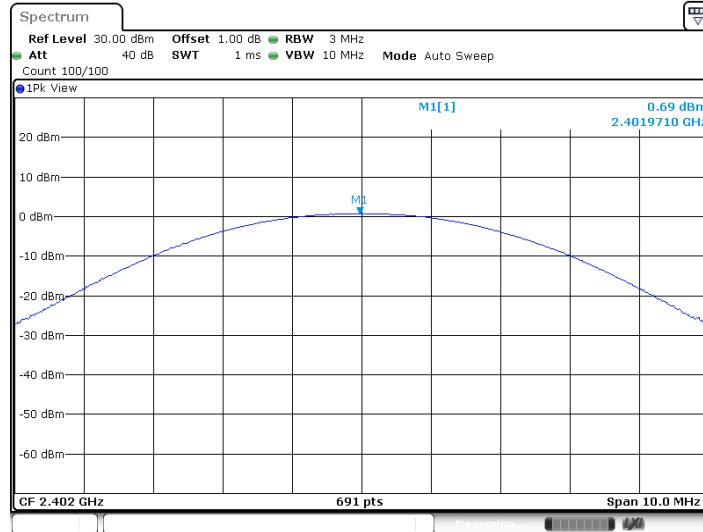
High channel 2480MHz



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

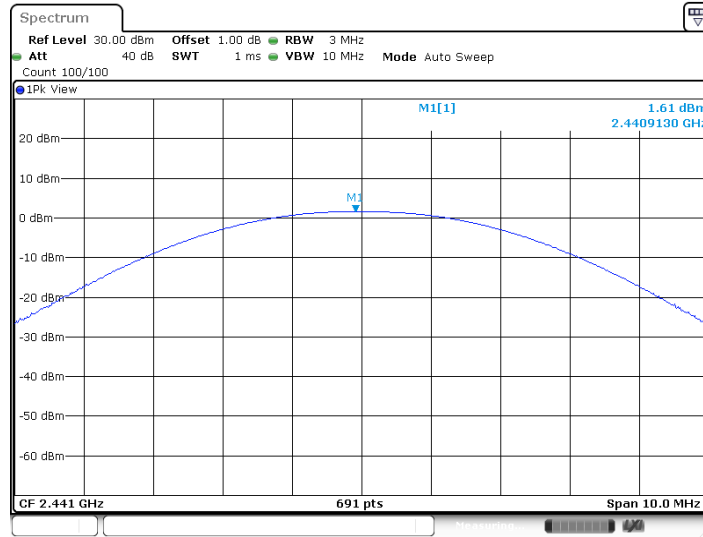
Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	0.69	Pass
Middle channel 2441MHz	1.61	Pass
High channel 2480MHz	1.15	Pass

Low channel 2402MHz



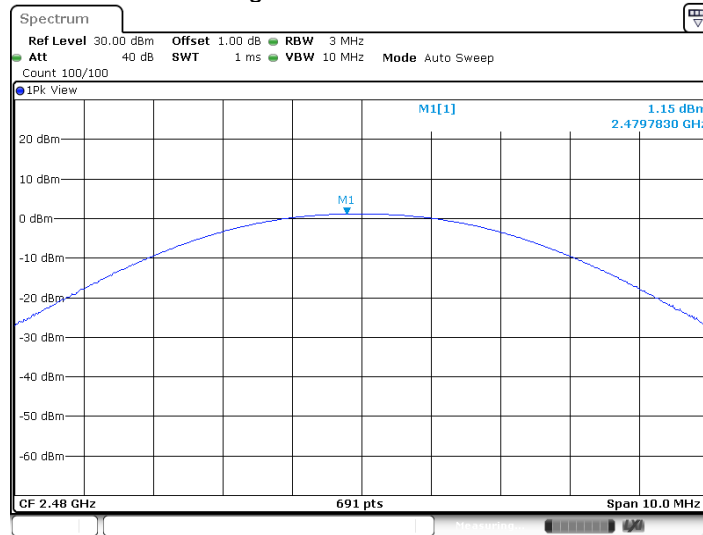
Date: 23.APR.2020 21:06:48

Middle channel 2441MHz



Date: 23 APR 2020 21:07:26

High channel 2480MHz

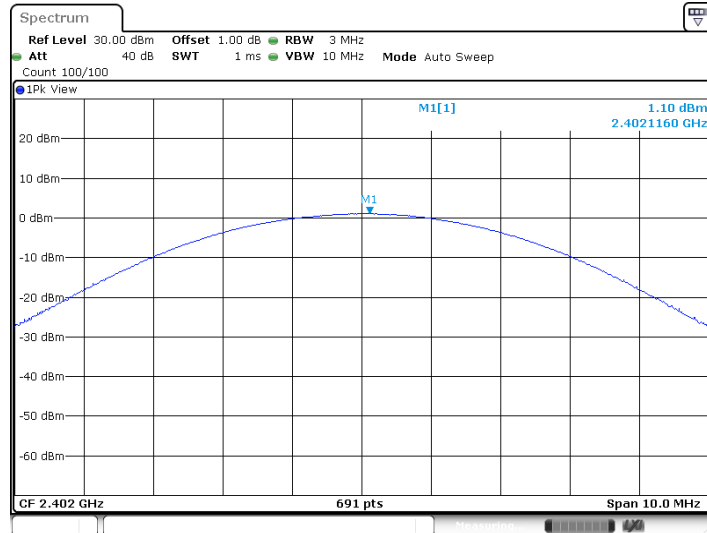


Date: 23 APR 2020 21:07:55

Bluetooth Mode 8DPSK modulation Test Result

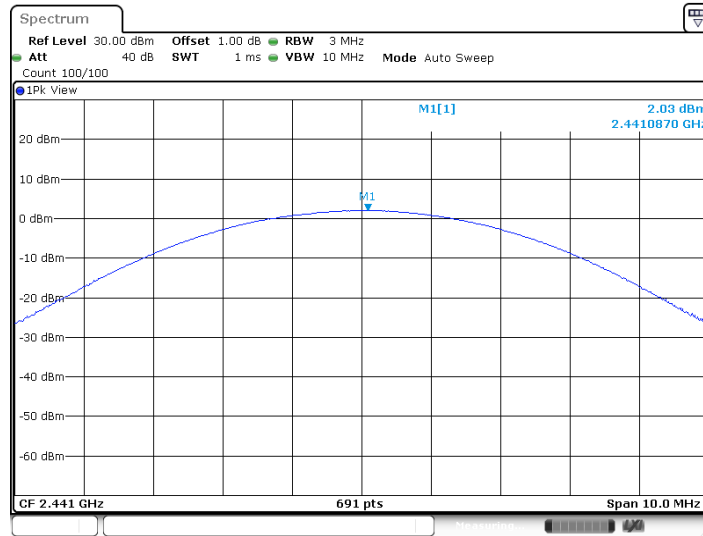
Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	1.1	Pass
Middle channel 2441MHz	2.03	Pass
High channel 2480MHz	1.61	Pass

Low channel 2402MHz



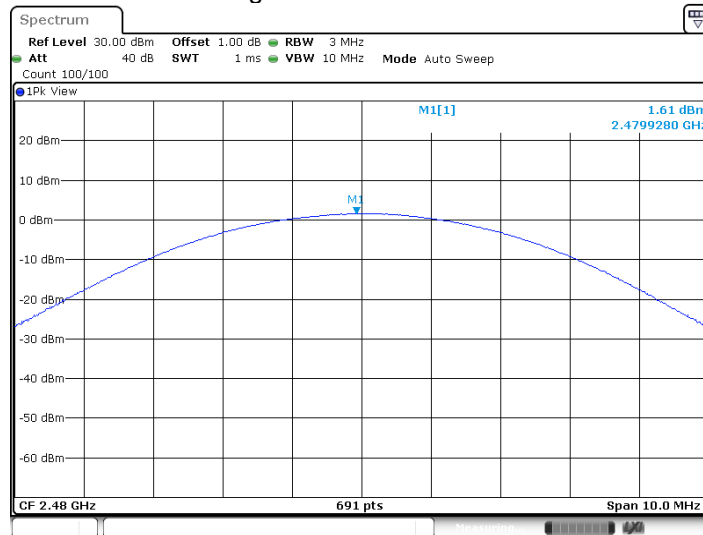
Date: 23 APR 2020 21:08:23

Middle channel 2441MHz



Date: 23 APR 2020 21:08:51

High channel 2480MHz



Date: 23 APR 2020 21:09:18

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.

Limit

Limit [kHz]

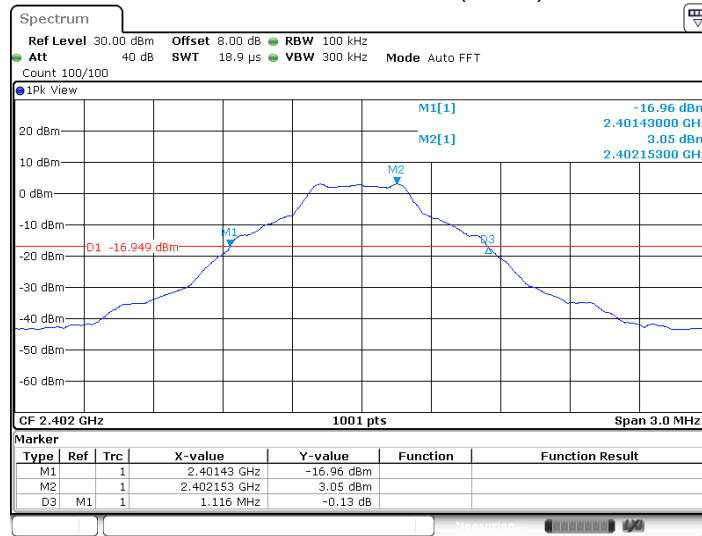
N/A

20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode GFSK Modulation test result

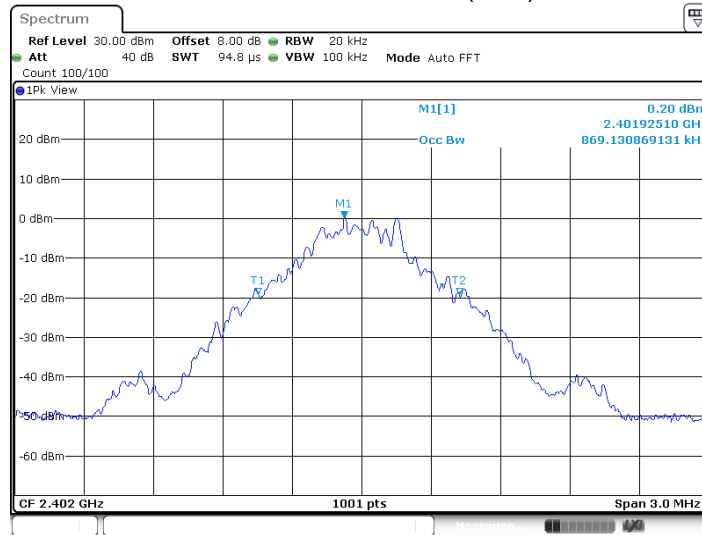
Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1116	869	--	Pass
2441	1110	860	--	Pass
2480	1107	854	--	Pass

Low channel 2402MHz (20 dB)



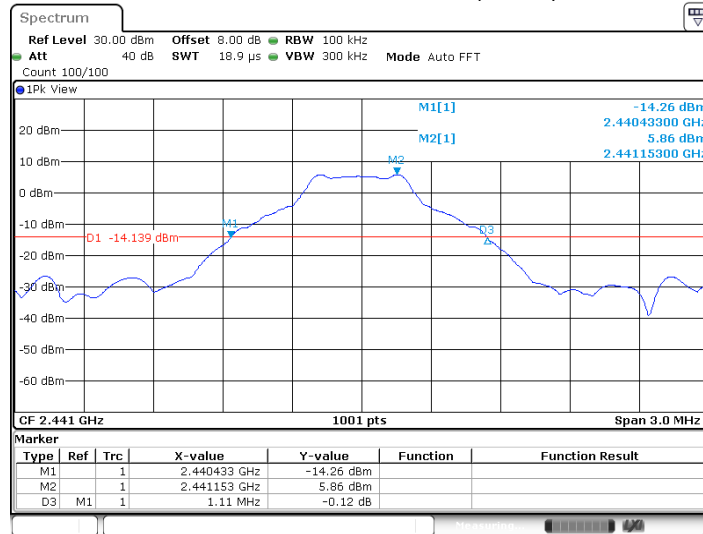
Date: 20 MAR 2020 19:10:18

Low channel 2402MHz (99%)



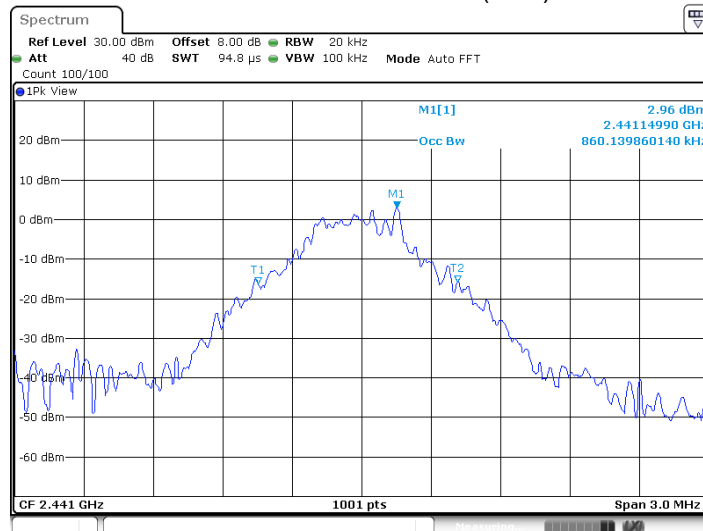
Date: 20 MAR 2020 19:10:29

Middle channel 2441MHz (20 dB)



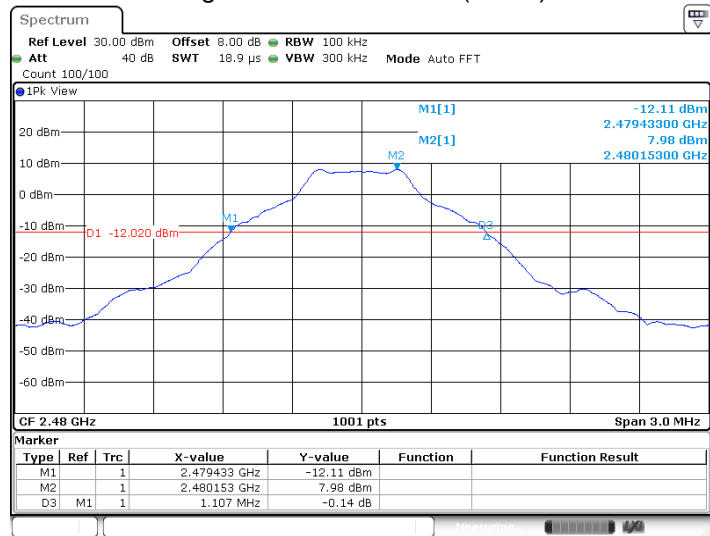
Date: 20 MAR. 2020 19:20:12

Middle channel 2441MHz (99%)



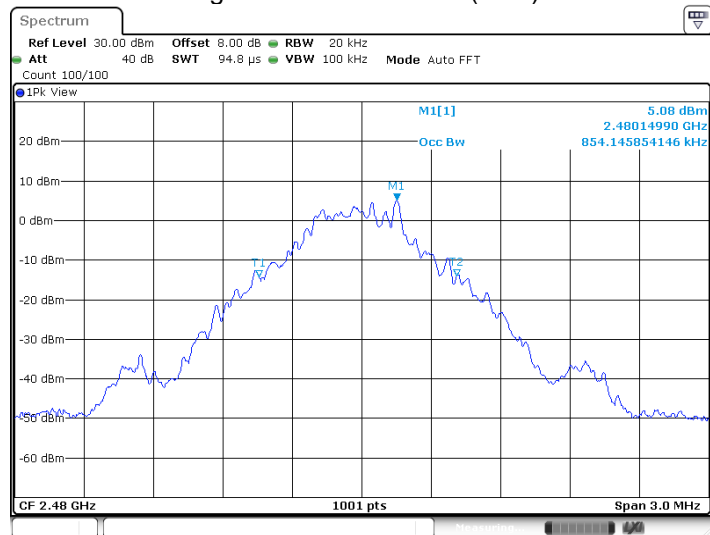
Date: 20 MAR. 2020 19:20:23

High channel 2480MHz (20 dB)



Date: 20 MAR 2020 19:21:51

High channel 2480MHz (99%)



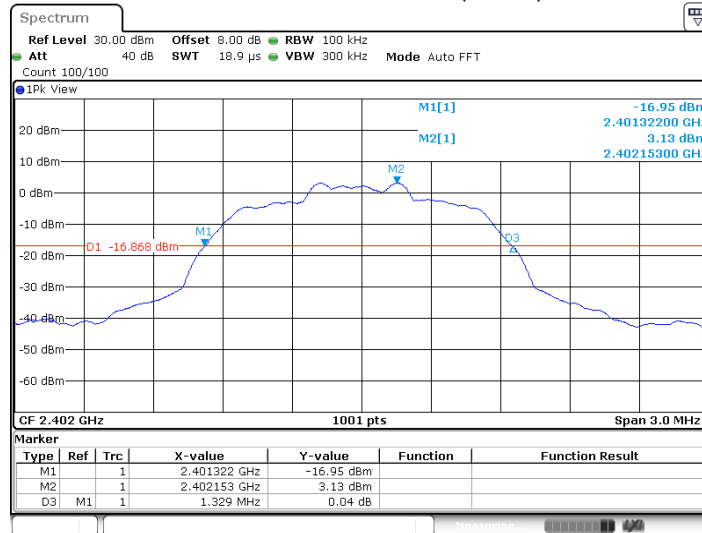
Date: 20 MAR 2020 19:22:02

20 dB bandwidth and 99% Occupied Bandwidth

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

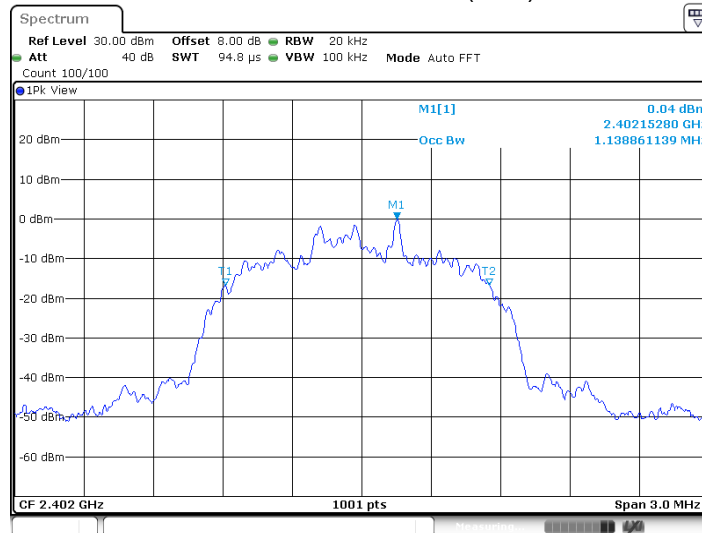
Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1329	1139	--	Pass
2441	1329	1142	--	Pass
2480	1332	1139	--	Pass

Low channel 2402MHz (20 dB)



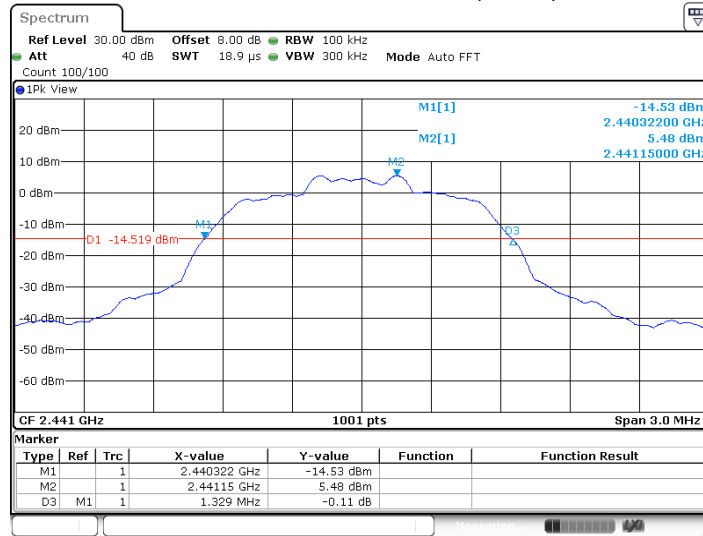
Date: 20 MAR 2020 19:33:11

Low channel 2402MHz (99%)



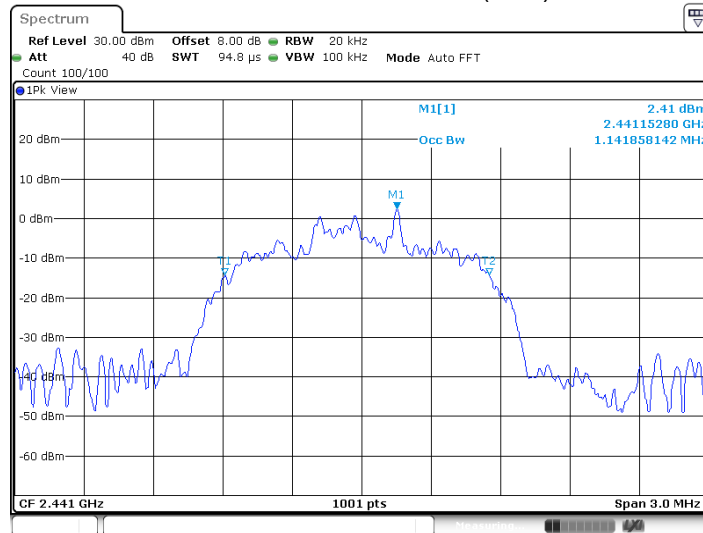
Date: 20 MAR 2020 19:33:22

Middle channel 2441MHz (20 dB)



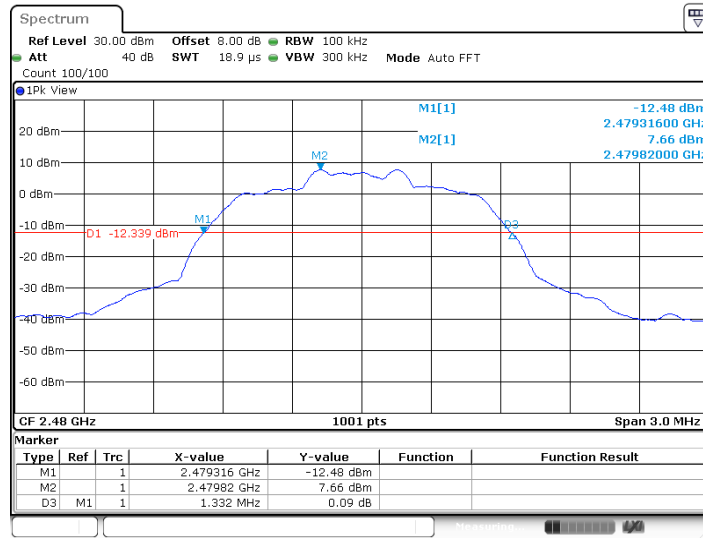
Date: 20 MAR 2020 19:35:52

Middle channel 2441MHz (99%)

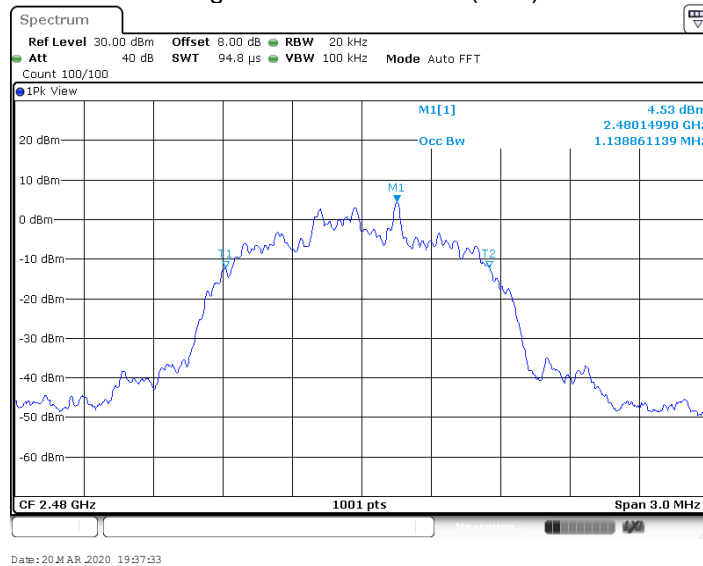


Date: 20 MAR 2020 19:36:03

High channel 2480MHz (20 dB)



High channel 2480MHz (99%)

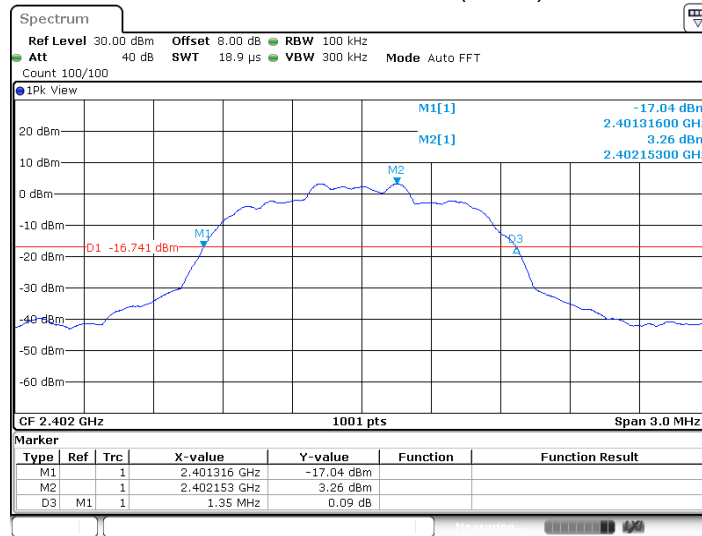


20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode 8DPSK Modulation test result

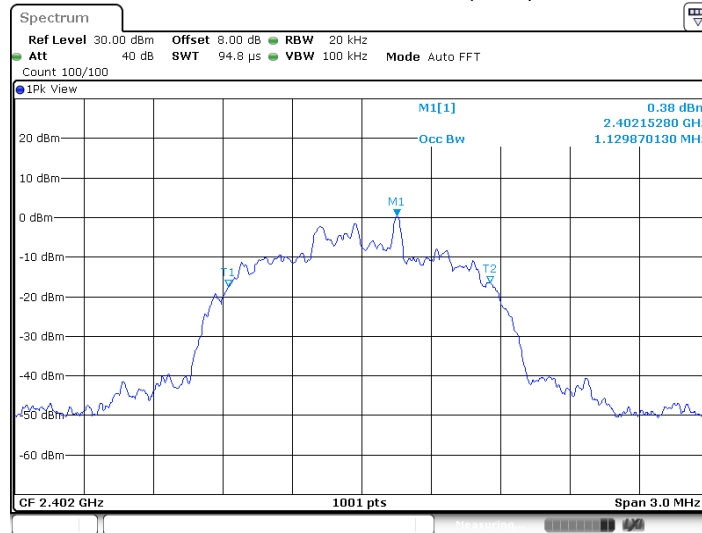
Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1350	1130	--	Pass
2441	1350	1133	--	Pass
2480	1350	1133	--	Pass

Low channel 2402MHz (20 dB)



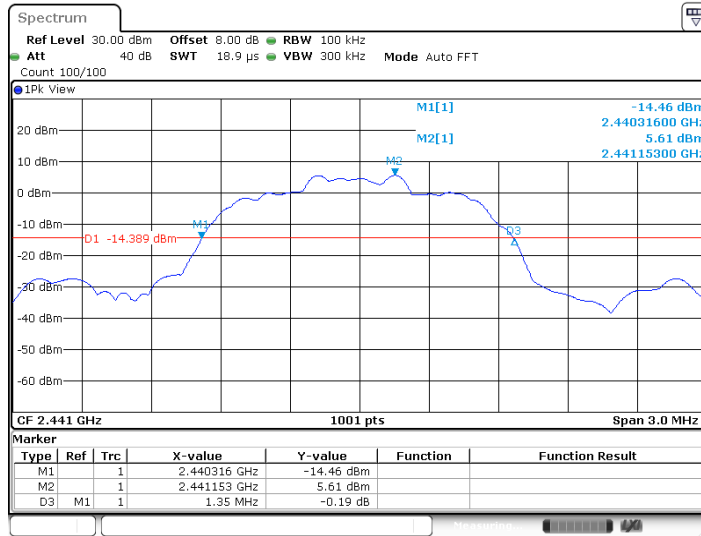
Date: 20 MAR. 2020 19:50:34

Low channel 2402MHz (99%)



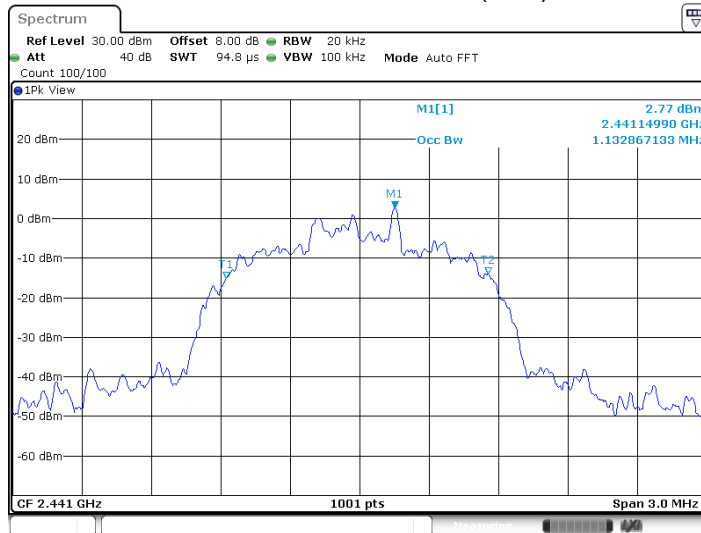
Date: 20 MAR. 2020 19:50:45

Middle channel 2441MHz



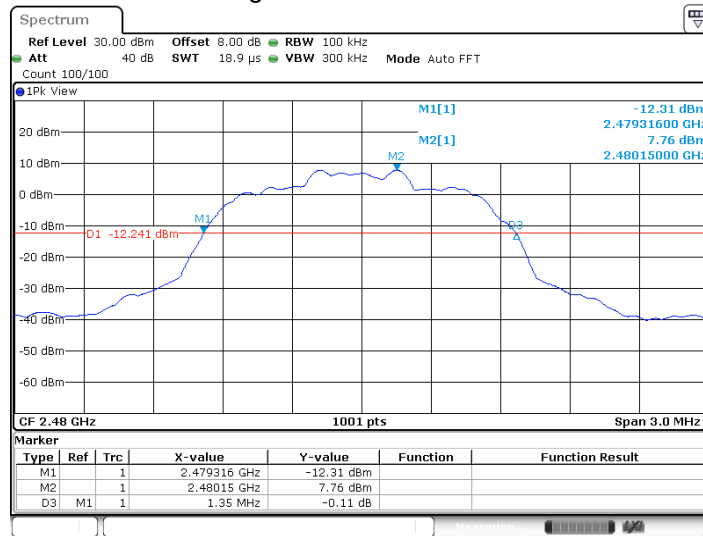
Date: 20 MAR 2020 19:53:07

Middle channel 2441MHz (99%)



Date: 20 MAR 2020 19:53:18

High channel 2480MHz



Date: 20 MAR 2020 19:54:31

High channel 2480MHz (99%)



Date: 20 MAR 2020 19:54:42



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

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

GFSK Modulation Limit

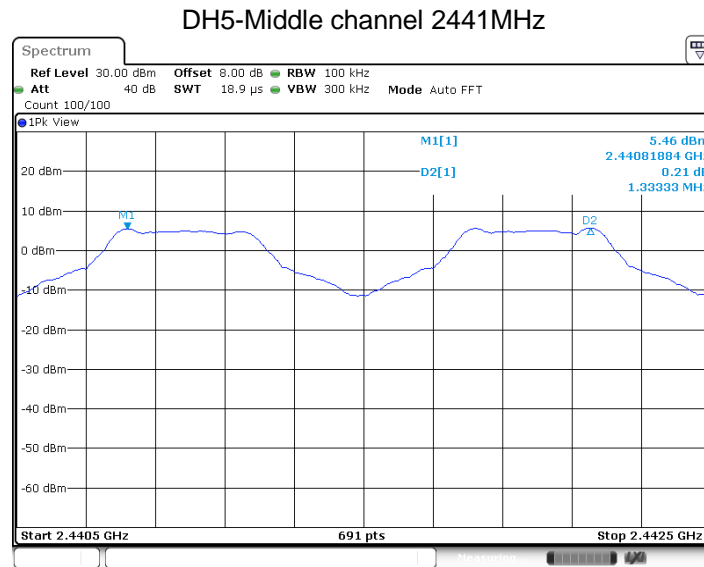
Frequency MHz	2/3 of 20 dB Bandwidth kHz
2402	900
2441	900
2480	900

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.

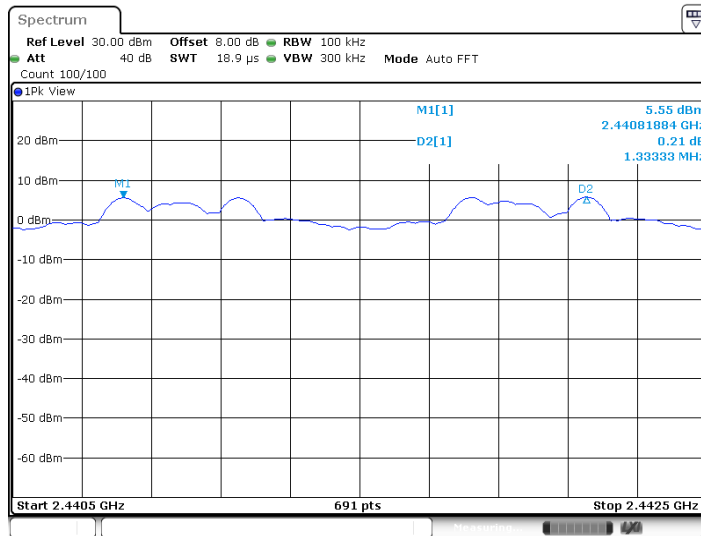
Test result

TestMode	Carrier Frequency Separation kHz	Result
DH5	1333	Pass
2DH5	1333	Pass
3DH5	1000	Pass



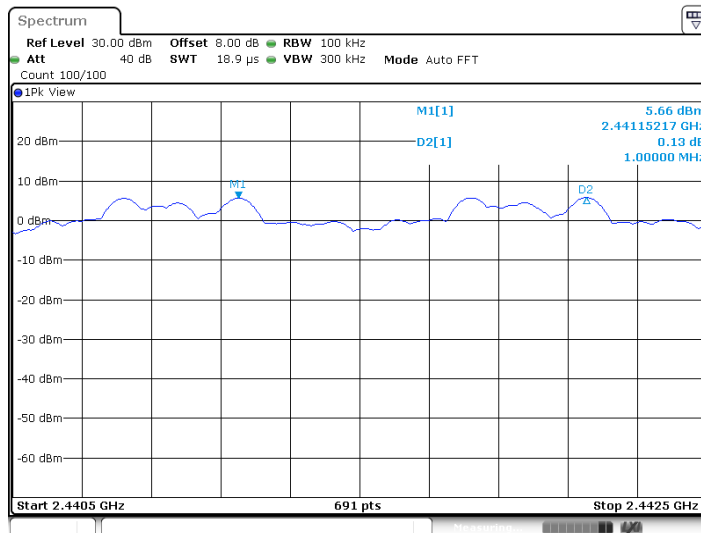
Date: 20 MAR 2020 19:58:00

2DH5-Middle channel 2441MHz



Date: 20 MAR 2020 20:06:32

3DH5-Middle channel 2441MHz



Date: 20 MAR 2020 20:12:19

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

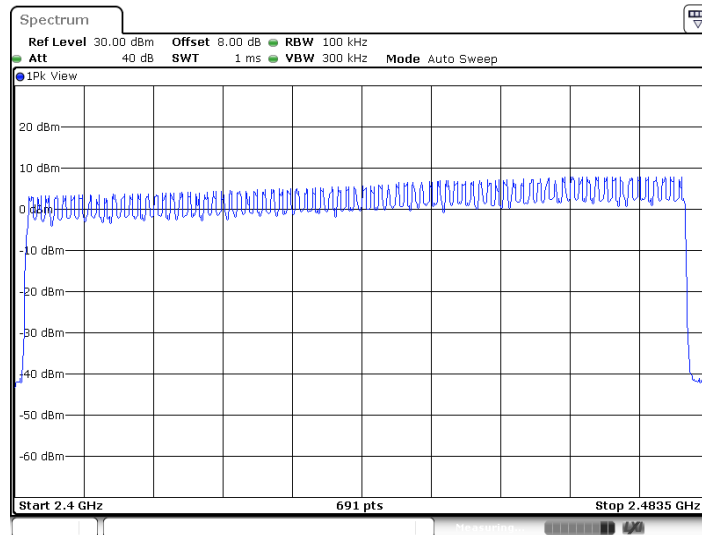
**Limit
number**

≥ 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



Date: 20 MAR. 2020 20:13:18

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

Dwell time

The maximum dwell time shall be 0.4 s.

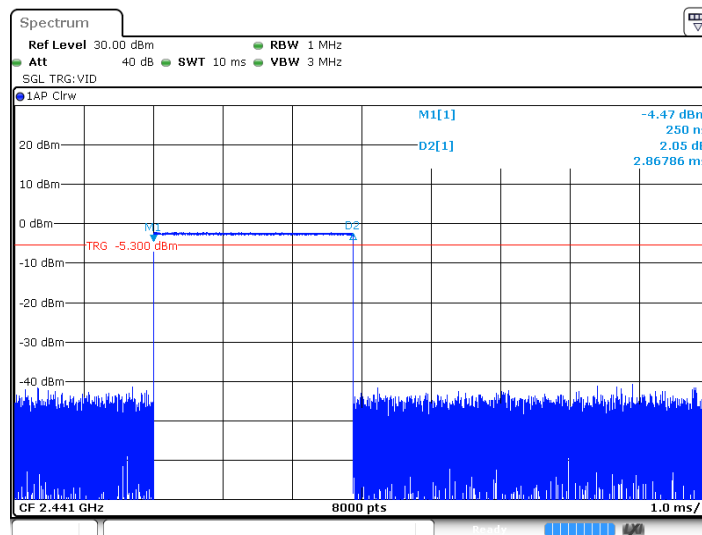
According to the Bluetooth Core Specification, the worse result (DH5 mode) was reported to show compliance.

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];

Test Result

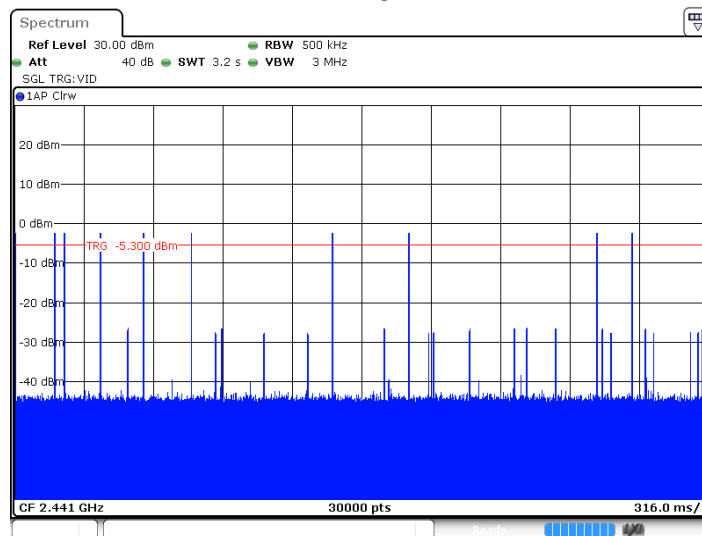
Modulation	Mode	Reading (us)	Total Hops	Test Result (ms)	Limit (ms)	Result
GFSK	DH5	2867.86	100.00	286.79	< 400	Pass
$\pi/4$ -DQPSK	2DH5	2872.86	100.00	287.29	< 400	Pass
8-DPSK	3DH5	2874.11	100.00	287.41	< 400	Pass

GFSK Modulation



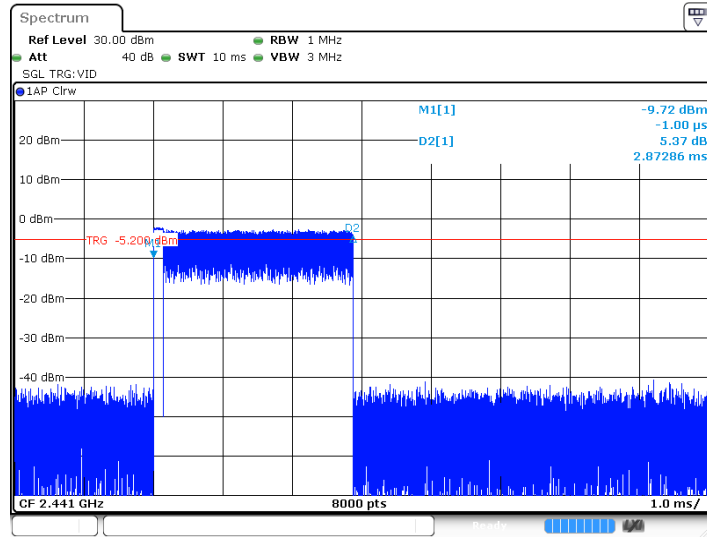
Date: 20 MAR 2020 19:58:45

DH5



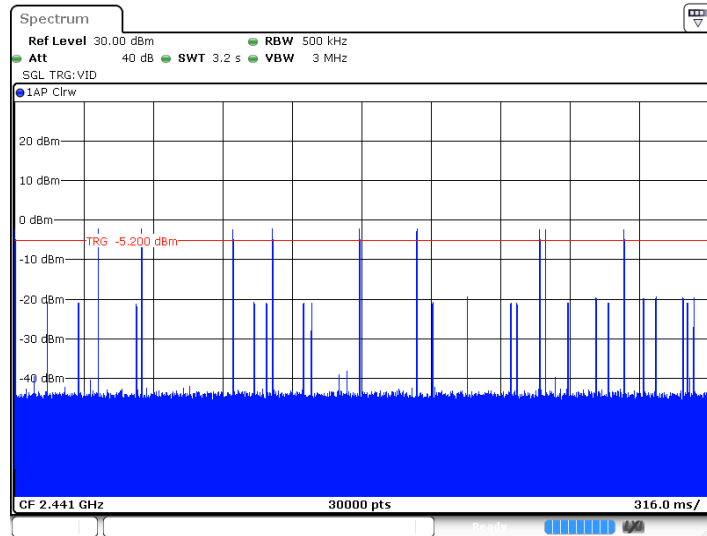
Date: 20 MAR 2020 19:58:50

$\pi/4$ -DQPSK Modulation



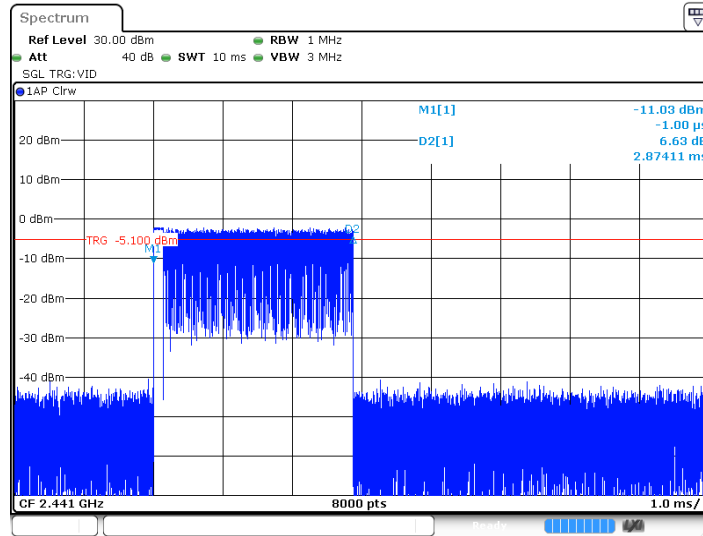
Date: 20 MAR 2020 20:08:29

2DH5



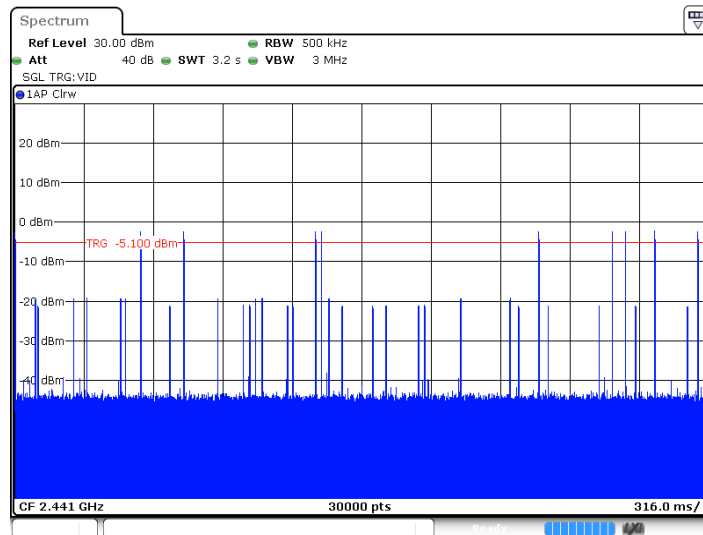
Date: 20 MAR 2020 20:08:35

8-DPSK Modulation



Date: 20 MAR 2020 20:14:39

3DH5



Date: 20 MAR 2020 20:14:45

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

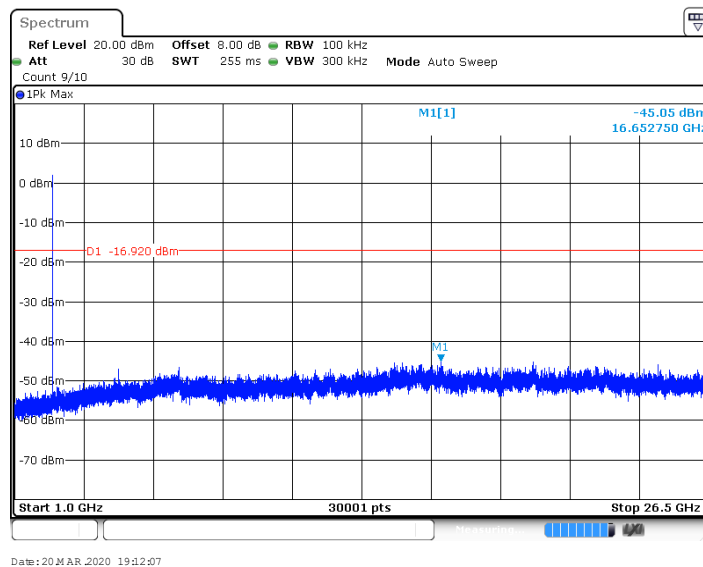
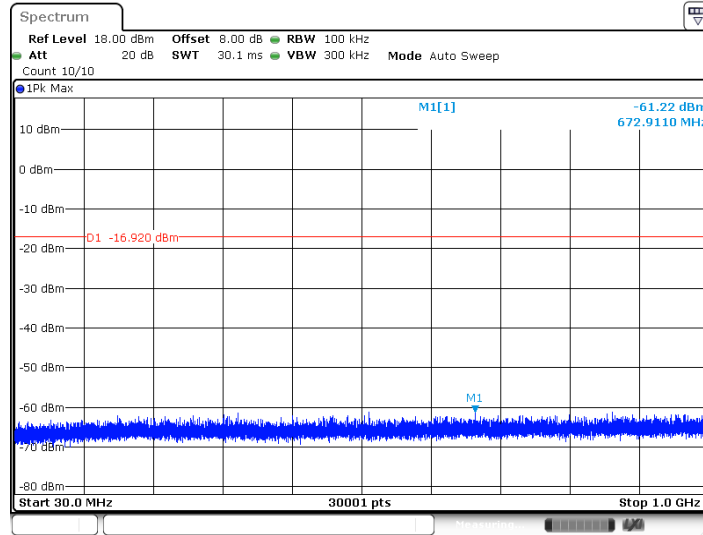
Frequency Range MHz	Limit (dBc)
30-25000	-20

Spurious RF conducted emissions

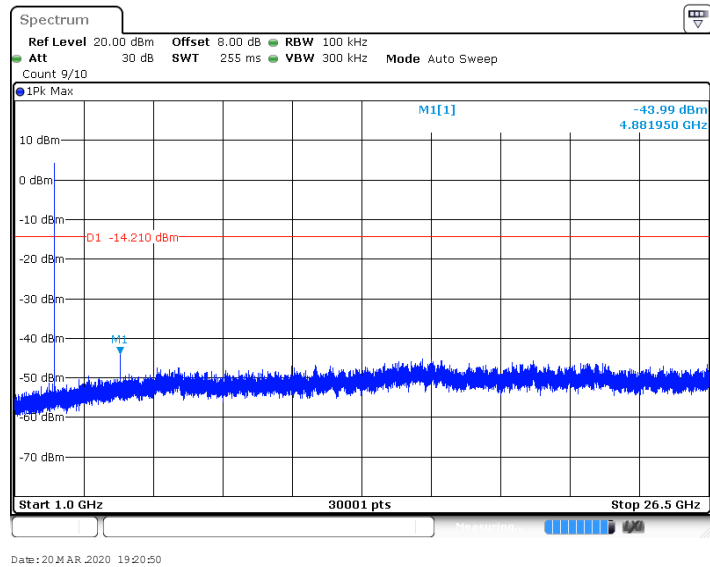
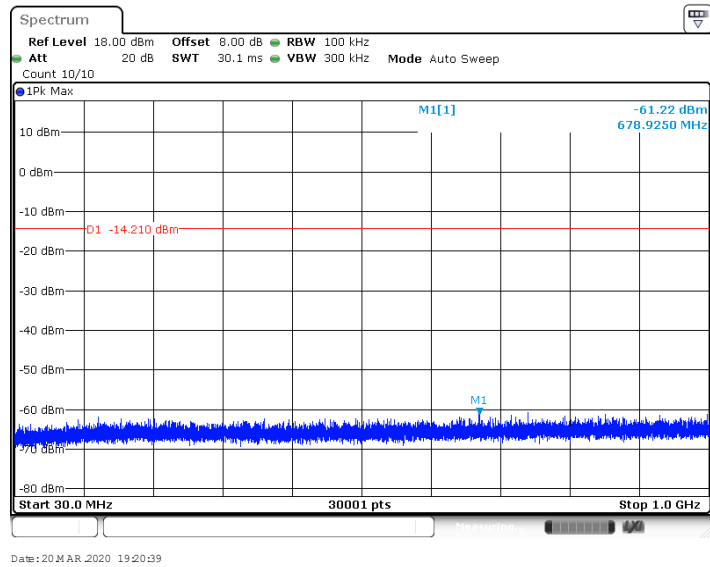
Only the worse case (which is subject to the maximum EIRP, GFSK mode) test result is listed in the report.

BT3.0 GFSK Modulation:

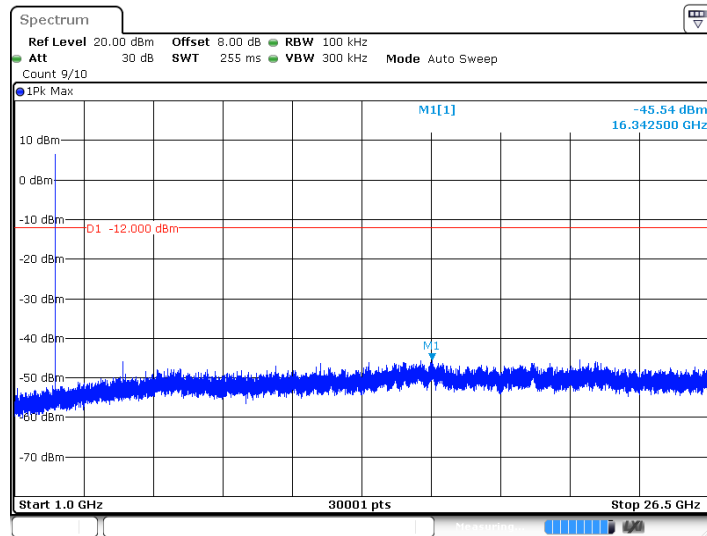
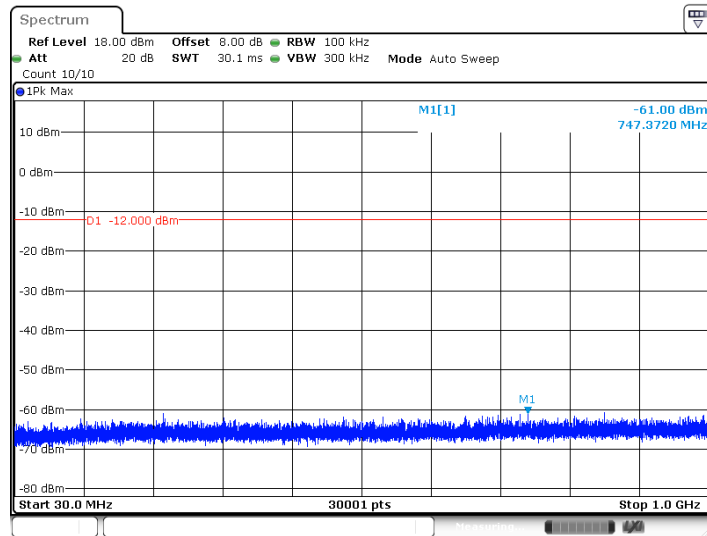
Low channel 2402MHz



Middle channel 2441MHz



High channel 2480MHz



9.8 Band edge testing

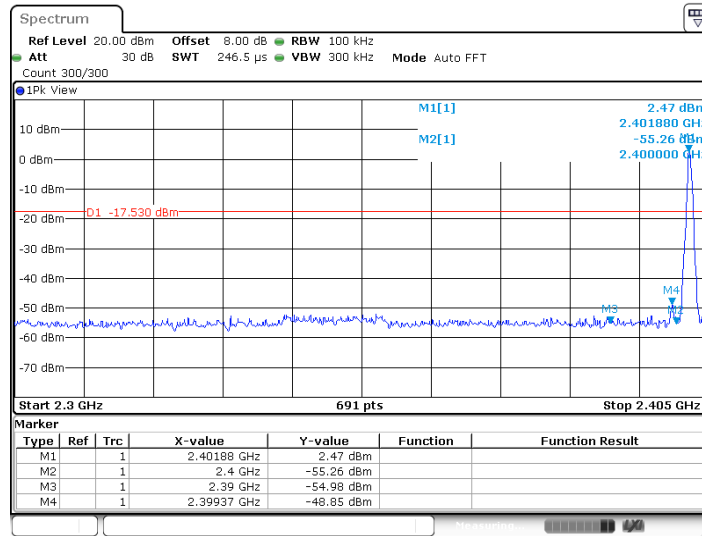
Test Method

- 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 \geq 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.

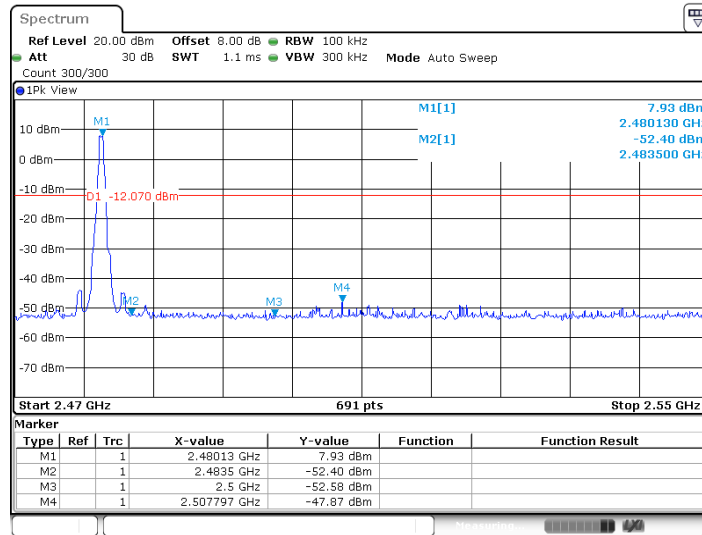
Limit:

In any 100 kHz bandwidth outside the frequency 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.

GFSK mode:

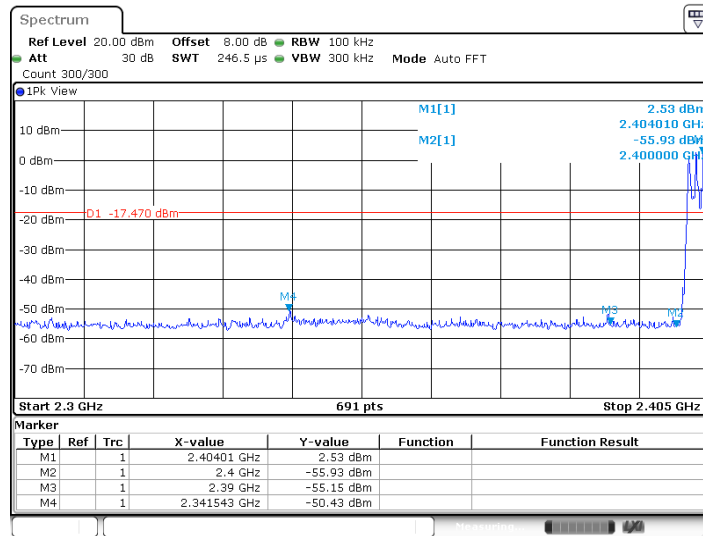


Date: 20 MAR. 2020 19:10:38

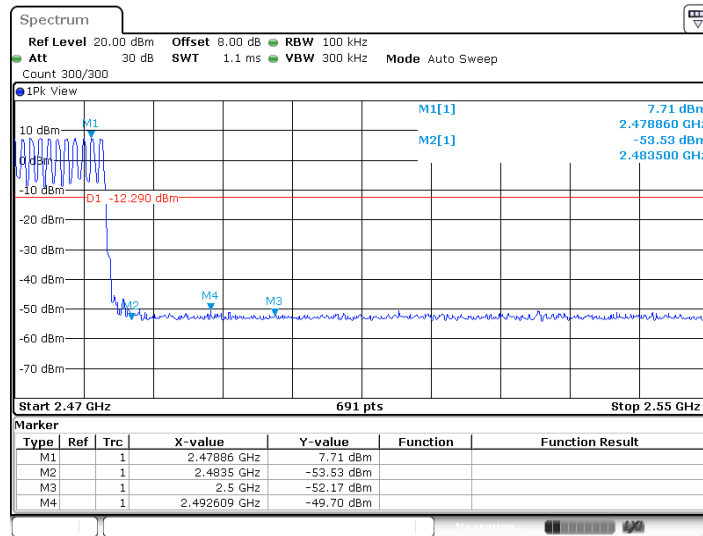


Date: 20 MAR. 2020 19:22:11

GFSK mode:

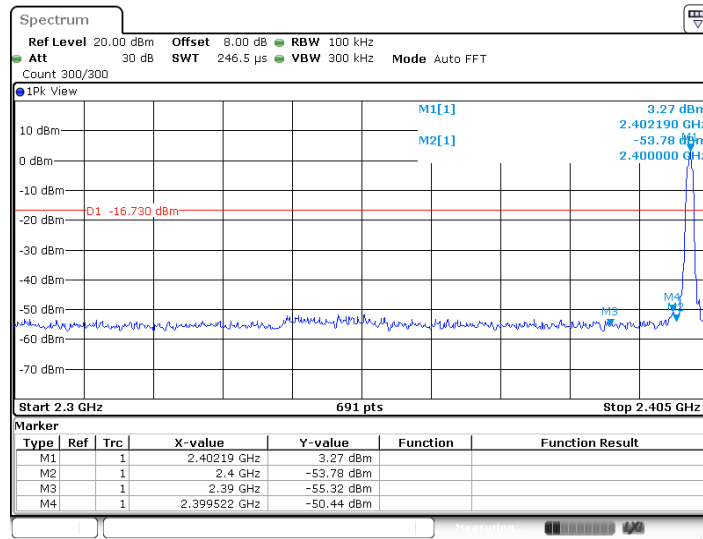


Date: 20 MAR 2020 19:56:45

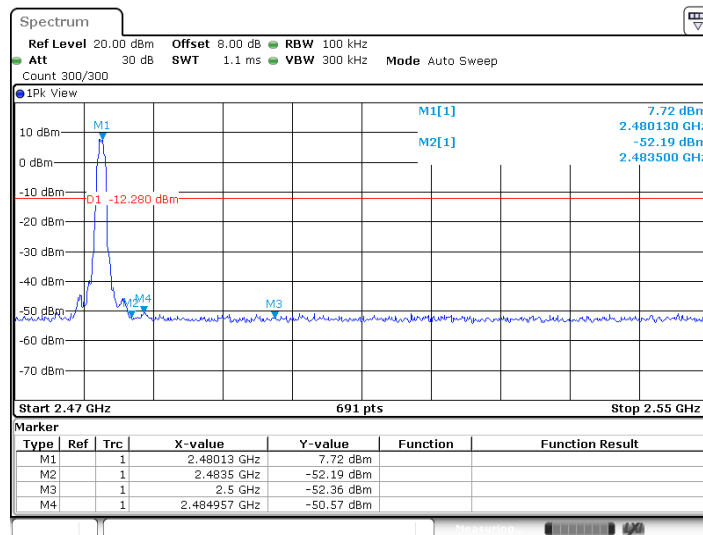


Date: 20 MAR 2020 20:00:46

8DPSK mode:

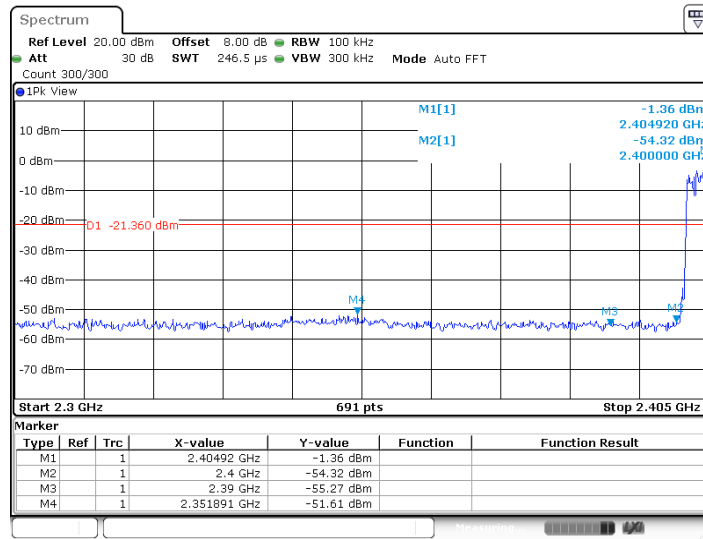


Date: 20 MAR 2020 19:50:55

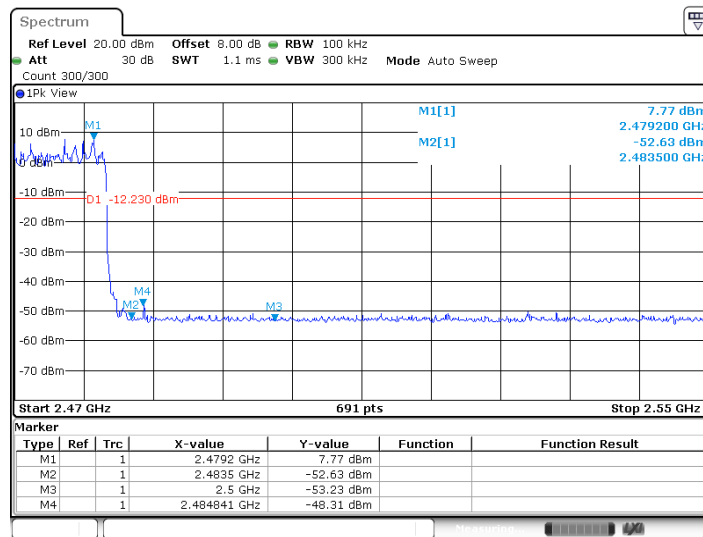


Date: 20 MAR 2020 19:54:51

8DPSK mode:



Date: 20 MAR 2020 20:11:17



Date: 20 MAR 2020 20:17:22

9.9 Spurious radiated emissions for transmitter

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 120KHz, VBW \geq 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 \geq 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 limit.

If the emission is pulsed, modify the unit for continuous operation; use the settings 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, must comply with the radiated emission limits specified in section 15.209.

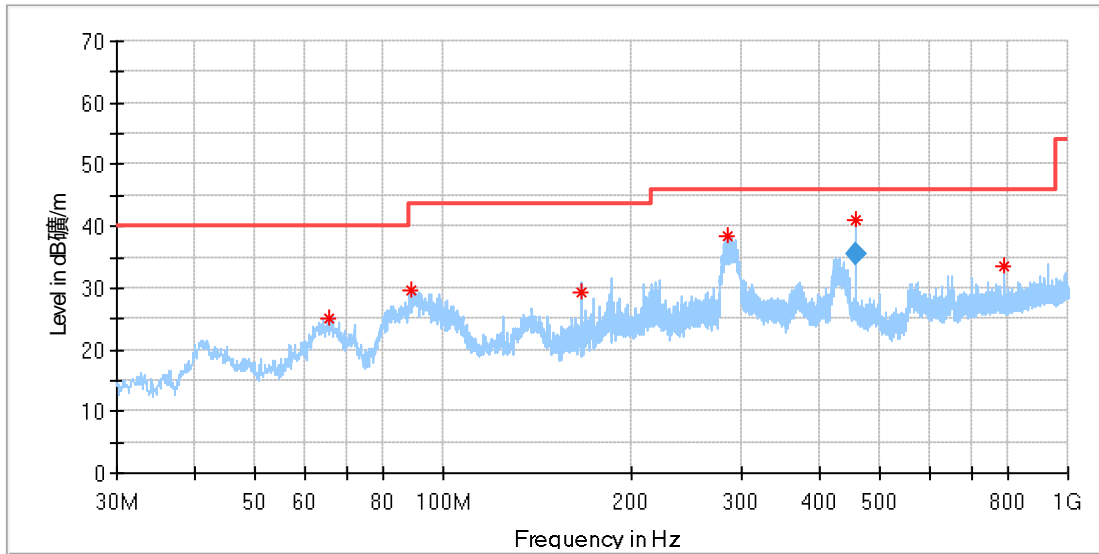
Frequency MHz	Field Strength uV/m	Field Strength dB μ V/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

Spurious radiated emissions for transmitter

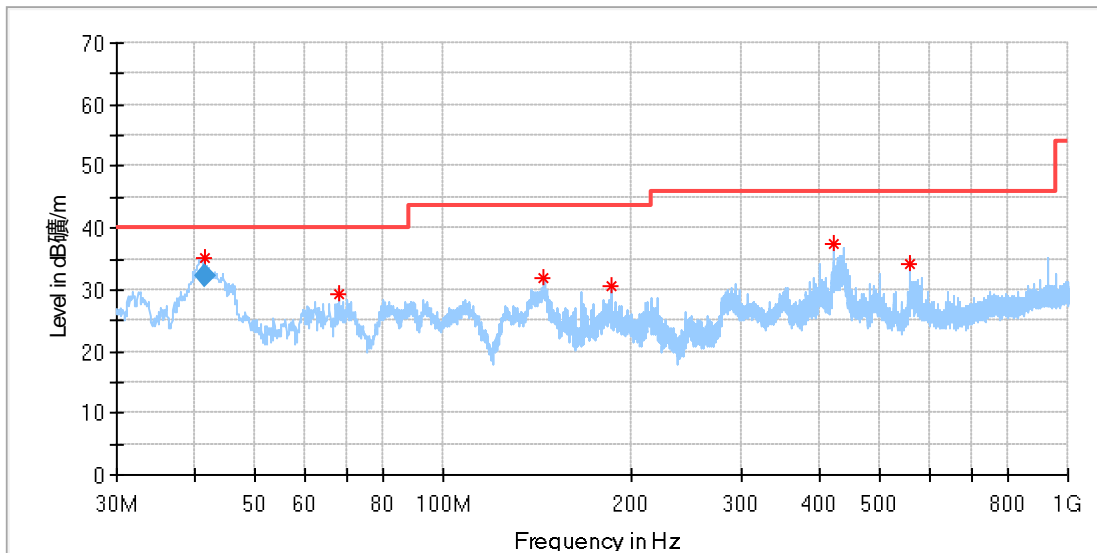
According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Transmitting spurious emission test result as below:

Below 1G:

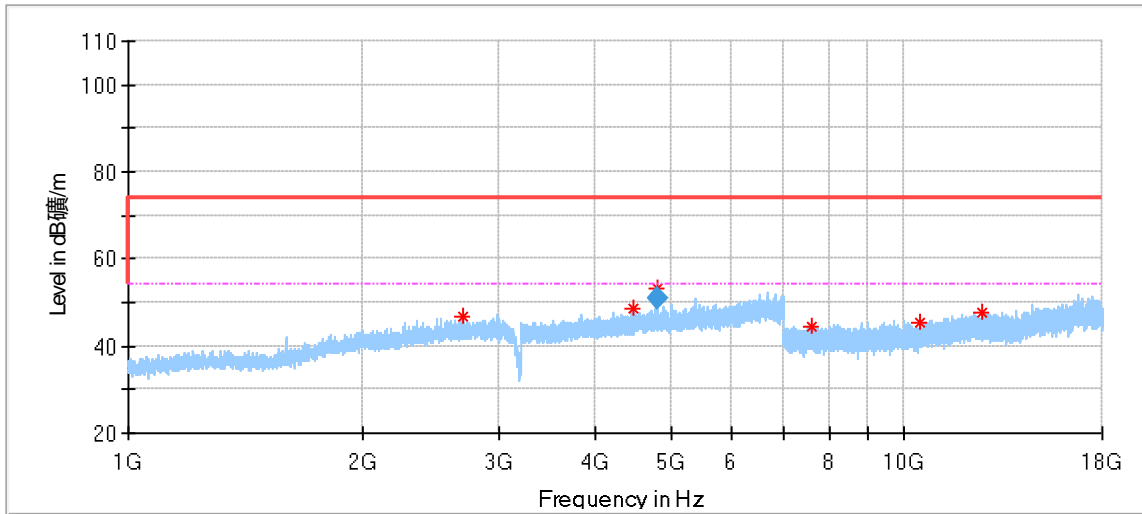


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
65.829375	25.13	40.00	14.87	200.0	H	14.0	15
89.048750	29.69	43.50	13.81	200.0	H	4.0	14
166.709375	29.40	43.50	14.10	100.0	H	30.0	13
285.231250	38.51	46.00	7.49	100.0	H	46.0	18
456.002813	40.92	46.00	5.08	179.0	H	285.0	22
791.328750	33.56	46.00	12.44	100.0	H	260.0	28
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
456.002813	35.64	46.00	10.36	179.0	H	285.0	22

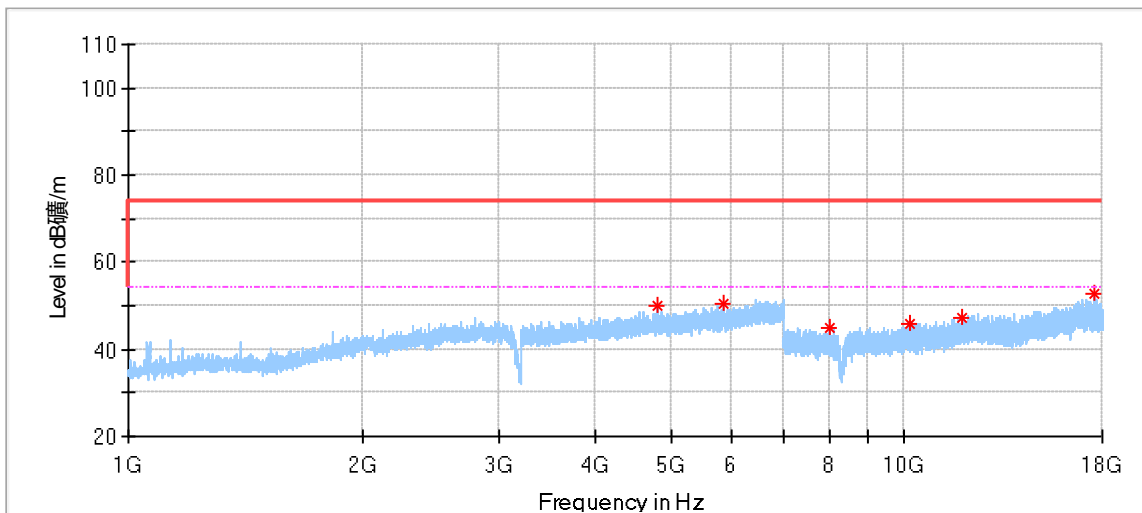


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
41.518750	35.28	40.00	4.72	100.0	V	217.0	17
68.072500	29.45	40.00	10.55	100.0	V	302.0	15
145.066250	31.97	43.50	11.53	100.0	V	0.0	12
185.563750	30.65	43.50	12.85	100.0	V	100.0	15
422.971250	37.35	46.00	8.65	100.0	V	225.0	22
556.891875	34.18	46.00	11.82	100.0	V	178.0	24
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
41.518750	32.28	40.00	7.72	100.0	V	217.0	17

GFSK Modulation 2402MHz Test Result

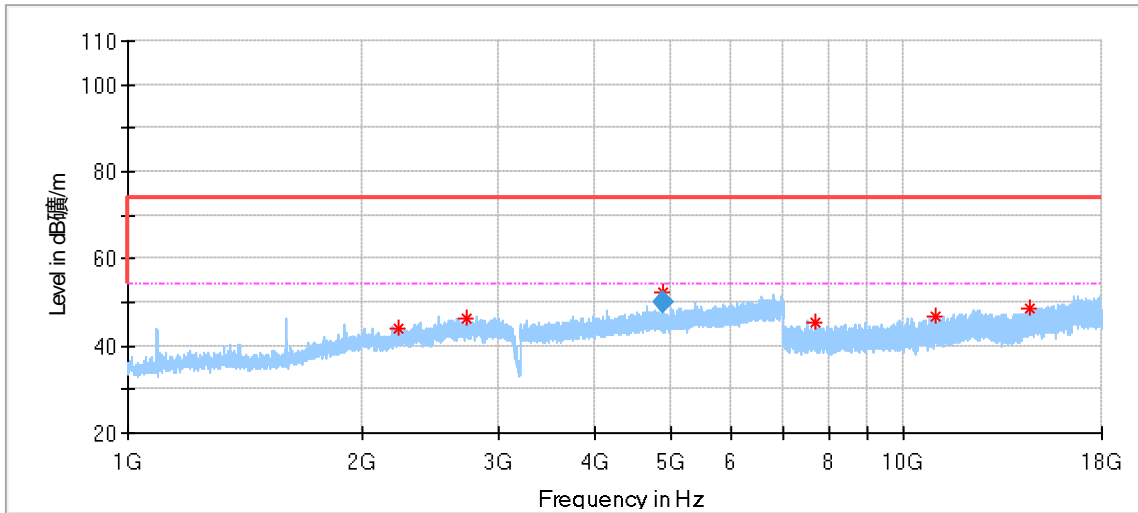


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2707.500000	46.93	74.00	27.07	150.0	H	213.0	-3.3
4470.000000	48.73	74.00	25.27	150.0	H	252.0	2.8
4804.500000	53.24	74.00	20.76	150.0	H	93.0	2.5
7581.500000	44.24	74.00	29.76	150.0	H	2.0	6.6
10467.500000	45.40	74.00	28.60	150.0	H	204.0	8.1
12622.000000	47.50	74.00	26.50	150.0	H	118.0	9.9
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4804.500000	50.86	54.00	3.14	150.0	H	93.0	2.5

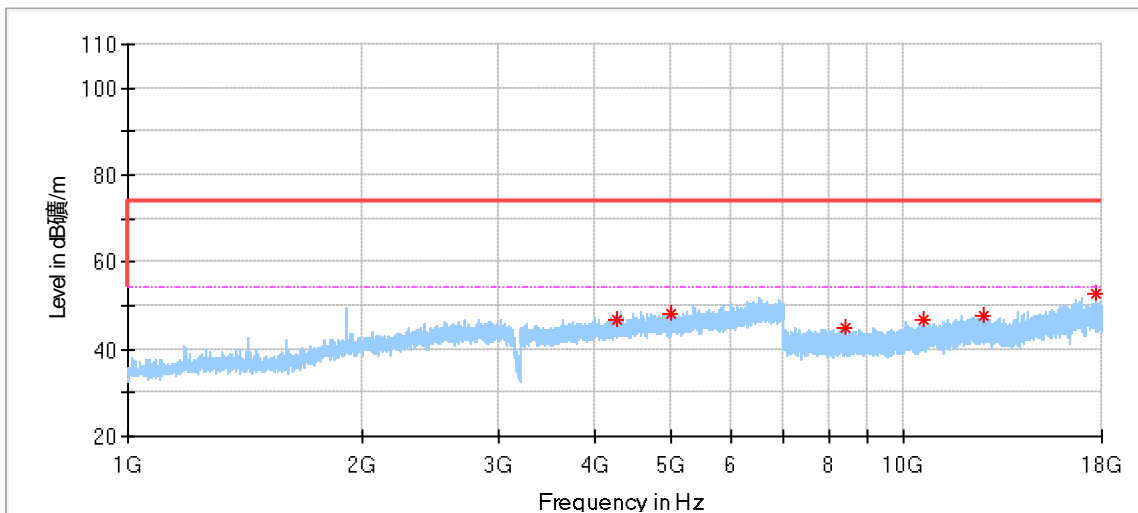


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4804.500000	49.93	74.00	24.07	150.0	V	204.0	2.5
5862.000000	50.40	74.00	23.60	150.0	V	272.0	4.2
8032.500000	45.12	74.00	28.88	150.0	V	82.0	6.4
10169.000000	45.81	74.00	28.19	150.0	V	185.0	8.2
11897.500000	47.29	74.00	26.71	150.0	V	63.0	9.6
17593.500000	52.58	74.00	21.42	150.0	V	325.0	17.4

GFSK Modulation 2441MHz Test Result

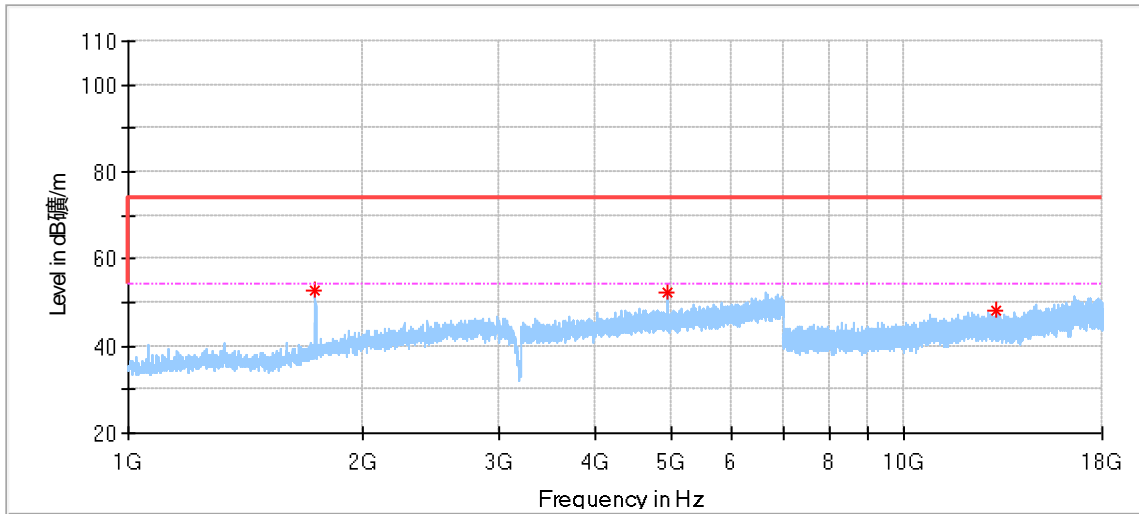


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2233.000000	44.09	74.00	29.91	150.0	H	356.0	-4.8
2736.500000	46.41	74.00	27.59	150.0	H	243.0	-3.2
4882.000000	52.21	74.00	21.79	150.0	H	26.0	2.6
7693.000000	45.44	74.00	28.56	150.0	H	134.0	6.0
11001.000000	46.85	74.00	27.15	150.0	H	98.0	8.4
14495.500000	48.48	74.00	25.52	150.0	H	153.0	11.0
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4882.000000	49.87	54.00	4.13	150.0	H	26.0	2.6

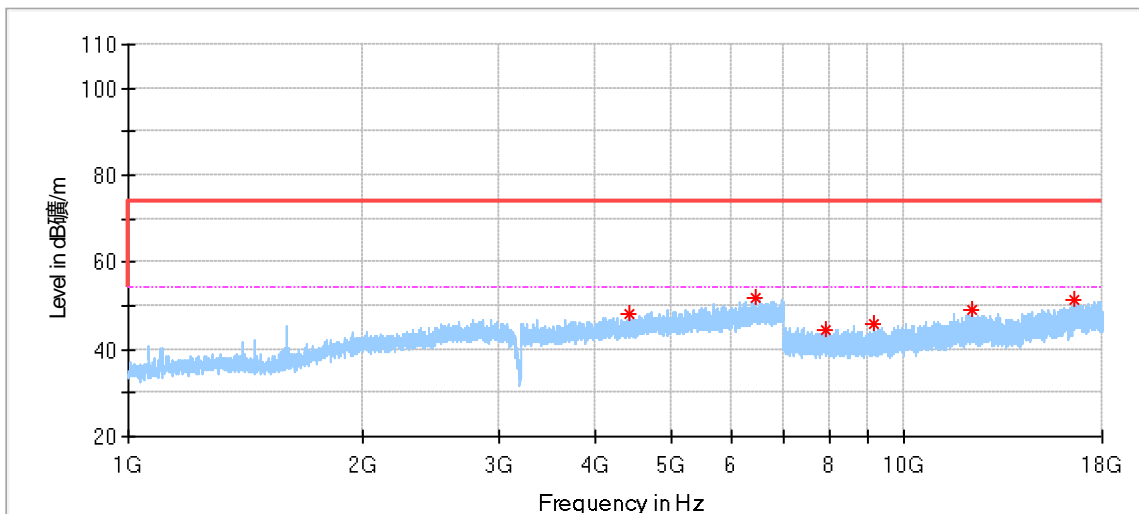


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4280.500000	46.97	74.00	27.03	150.0	V	334.0	1.7
5015.500000	48.25	74.00	25.75	150.0	V	305.0	2.8
8425.500000	45.06	74.00	28.94	150.0	V	332.0	6.4
10611.500000	46.54	74.00	27.46	150.0	V	207.0	8.2
12636.000000	47.78	74.00	26.22	150.0	V	243.0	10.1
17713.000000	52.67	74.00	21.33	150.0	V	123.0	17.8

GFSK Modulation 2480MHz Test Result

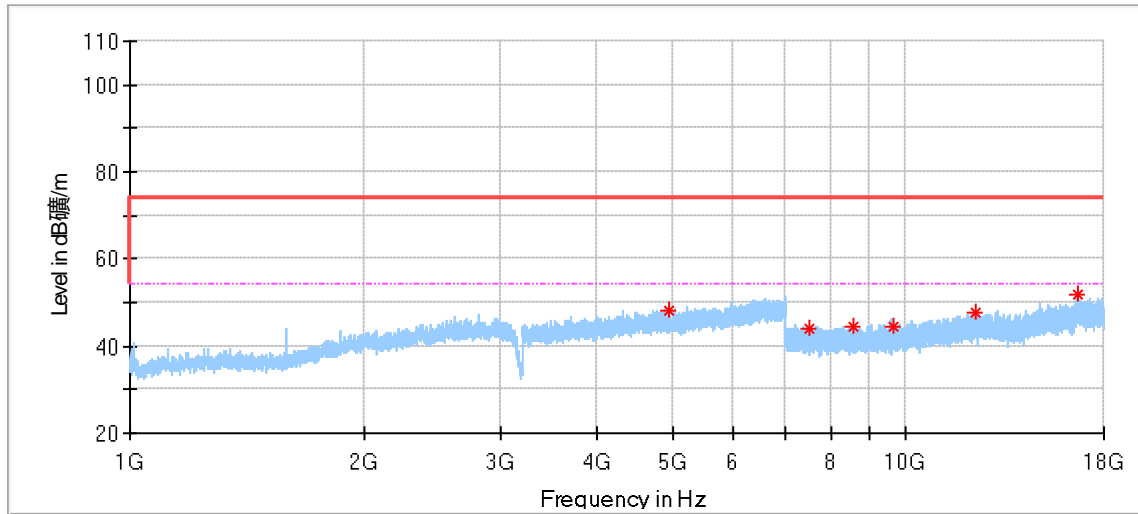


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1742.500000	52.56	74.00	21.44	150.0	H	17.0	-7.1
4960.500000	52.16	74.00	21.84	150.0	H	100.0	1.5
13116.000000	48.15	74.00	25.85	150.0	H	252.0	9.8

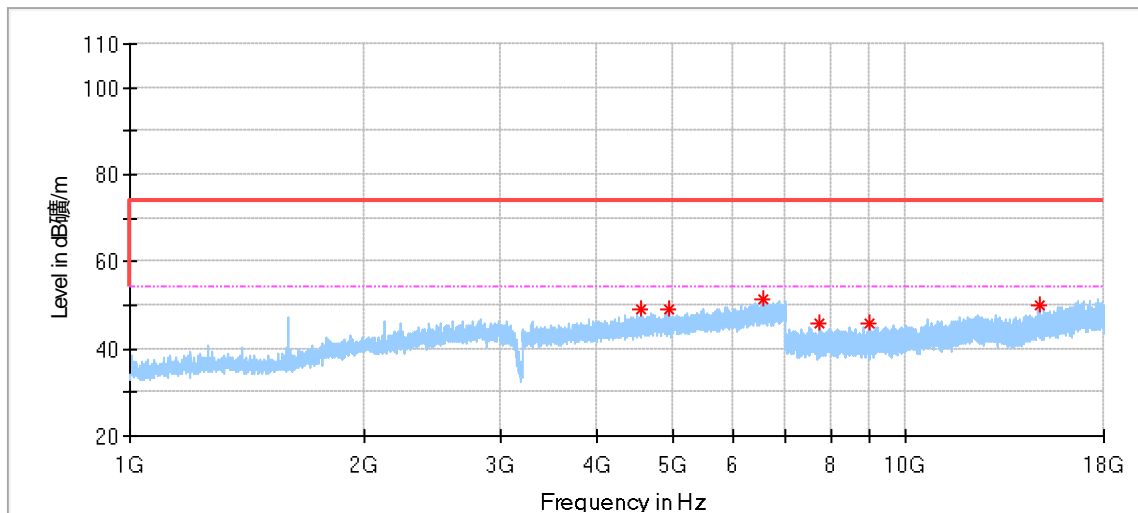


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4430.000000	48.18	74.00	25.82	150.0	V	348.0	2.2
6435.500000	51.70	74.00	22.30	150.0	V	48.0	6.1
7921.500000	44.60	74.00	29.40	150.0	V	61.0	6.8
9157.500000	45.99	74.00	28.01	150.0	V	79.0	7.1
12206.000000	49.16	74.00	24.84	150.0	V	217.0	9.6
16581.000000	51.45	74.00	22.55	150.0	V	164.0	16.0

8DPSK Modulation 2402MHz Test Result

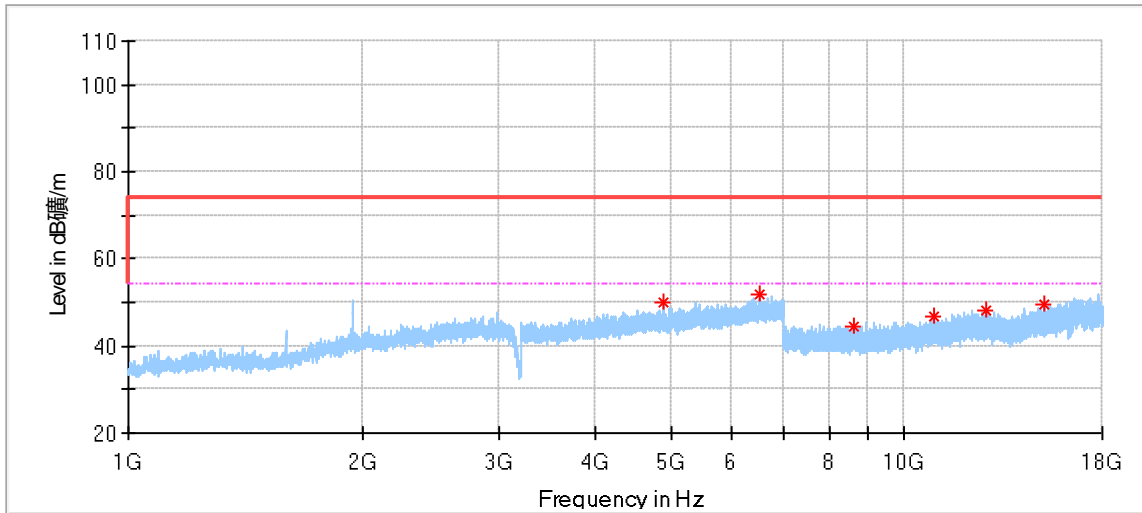


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4960.000000	48.10	74.00	25.90	150.0	H	32.0	1.5
7504.000000	44.07	74.00	29.93	150.0	H	175.0	6.5
8558.000000	44.32	74.00	29.68	150.0	H	260.0	6.5
9635.000000	44.62	74.00	29.38	150.0	H	260.0	7.6
12312.500000	47.79	74.00	26.21	150.0	H	5.0	10.1
16615.000000	51.85	74.00	22.15	150.0	H	39.0	16.1

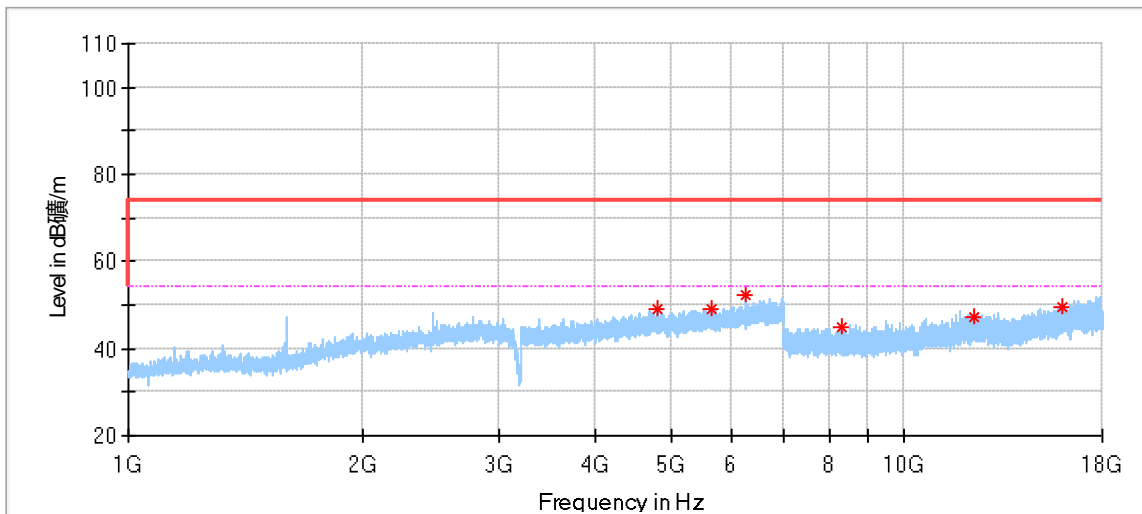


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4546.500000	49.25	74.00	24.75	150.0	V	153.0	3.0
4961.000000	48.98	74.00	25.02	150.0	V	15.0	1.5
6568.500000	51.49	74.00	22.51	150.0	V	170.0	6.8
7748.000000	45.90	74.00	28.10	150.0	V	356.0	6.2
8994.500000	45.79	74.00	28.21	150.0	V	26.0	7.0
14887.000000	49.82	74.00	24.18	150.0	V	180.0	12.3

8DPSK Modulation 2441MHz Test Result

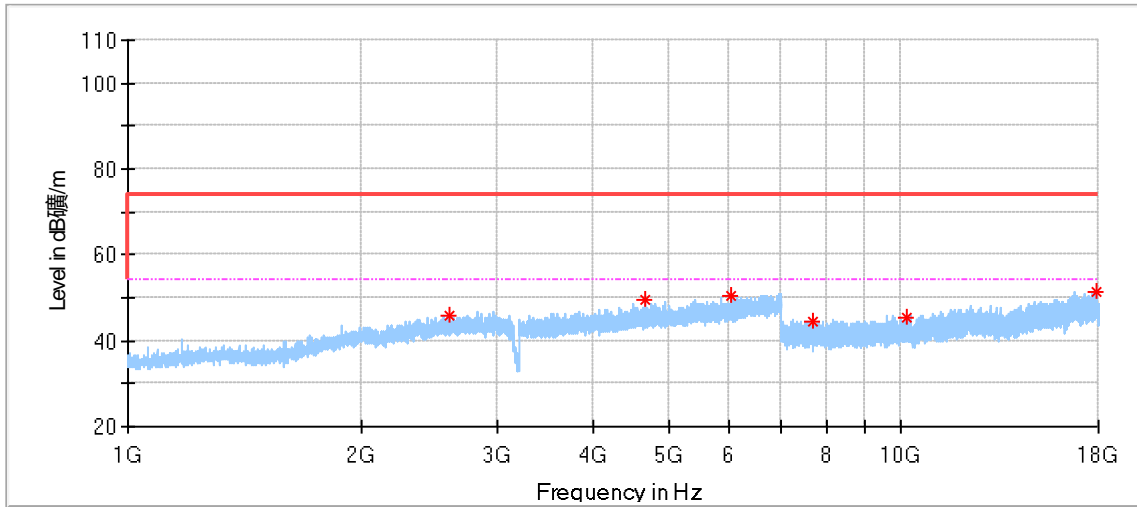


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Corr. (dB)
4882.000000	50.21	74.00	23.79	150.0	H	38.0	2.6	---
6516.000000	51.77	74.00	22.23	150.0	H	286.0	6.5	---
8602.000000	44.40	74.00	29.60	150.0	H	47.0	6.6	---
10952.000000	46.96	74.00	27.04	150.0	H	169.0	8.1	---
12767.500000	48.21	74.00	25.79	150.0	H	152.0	10.1	---
15147.500000	49.35	74.00	24.65	150.0	H	345.0	12.3	---

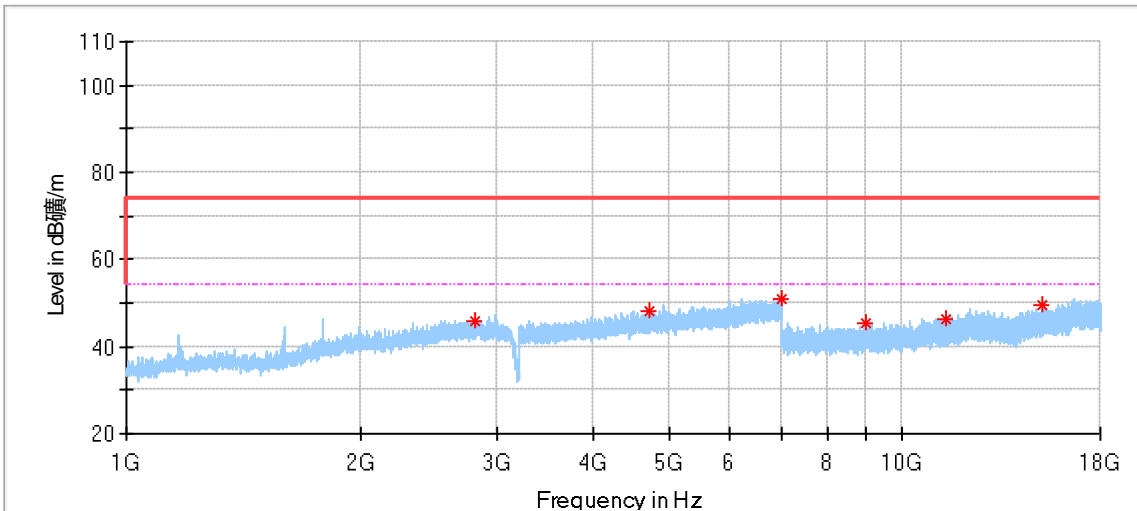


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4817.000000	49.01	74.00	24.99	150.0	V	290.0	2.5
5649.500000	49.22	74.00	24.78	150.0	V	290.0	3.2
6243.000000	52.09	74.00	21.91	150.0	V	21.0	5.8
8295.500000	45.01	74.00	28.99	150.0	V	324.0	6.7
12283.000000	47.23	74.00	26.77	150.0	V	222.0	9.7
15984.500000	49.48	74.00	24.52	150.0	V	99.0	14.0

8DPSK Modulation 2480MHz Test Result



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2608.500000	45.89	74.00	28.11	150.0	H	323.0	-3.3
4658.000000	49.61	74.00	24.39	150.0	H	157.0	2.8
6024.500000	50.55	74.00	23.45	150.0	H	86.0	5.0
7690.000000	44.57	74.00	29.43	150.0	H	138.0	6.0
10145.000000	45.28	74.00	28.72	150.0	H	155.0	8.2
17886.500000	51.44	74.00	22.56	150.0	H	120.0	17.5



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2813.000000	45.70	74.00	28.30	150.0	V	26.0	-3.2
4730.000000	48.37	74.00	25.63	150.0	V	66.0	2.7
6980.000000	51.11	74.00	22.89	150.0	V	233.0	7.1
8995.000000	45.61	74.00	28.39	150.0	V	243.0	7.0
11374.500000	46.48	74.00	27.52	150.0	V	87.0	8.5
15160.000000	49.62	74.00	24.38	150.0	V	352.0	12.5

Remark:

- (1) “*” means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- (2) Data of measurement within this frequency range shown “--” in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
- (3) Level=Reading Level + Correction Factor
Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss

10 Test Equipment List

List of Test Instruments

Radiated Emission Test

Description	Manufacturer	Model no.	Serial no.	cal. due date
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2020-6-28
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2020-6-28
Horn Antenna	Rohde & Schwarz	HF907	102294	2020-6-22
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2020-6-28
Signal Generator	Rohde & Schwarz	SMY01	839369/005	2020-6-28
Attenuator	Agilent	8491A	MY39264334	2020-6-28
3m Semi-anechoic chamber	TDK	9X6X6	----	2020-7-7
Test software	Rohde & Schwarz	EMC32	Version 9.15.00	N/A

Conducted Emission Test

Description	Manufacturer	Model no.	Serial no.	cal. due date
EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2020-6-28
LISN	Rohde & Schwarz	ENV4200	100249	2020-6-28
LISN	Rohde & Schwarz	ENV432	101318	2020-7-19
LISN	Rohde & Schwarz	ENV216	100326	2020-6-28
ISN	Rohde & Schwarz	ENY81	100177	2020-6-28
ISN	Rohde & Schwarz	ENY81-CA6	101664	2020-6-28
High Voltage Probe	Rohde & Schwarz	TK9420(VT94 20)	9420-584	2020-6-24
RF Current Probe	Rohde & Schwarz	EZ-17	100816	2020-7-2
Attenuator	Shanghai Huaxiang	TS2-26-3	080928189	2020-6-28
Test software	Rohde & Schwarz	EMC32	Version9.15.00	N/A
Shielding Room	TDK	CSR	----	2020-7-19

TS8997 Test System

Description	Manufacturer	Model no.	Serial no.	cal. due date
Signal Generator	Rohde & Schwarz	SMB100A	108272	2020-6-28
Vector Signal Generator	Rohde & Schwarz	SMBV100A	262825	2020-6-28
Communication Synthetical Test Instrument	Rohde & Schwarz	CMW 270	101251	2020-5-31
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2020-6-28
Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2020-6-28
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2020-6-28
Power Splitter	Weinschel	1580	SC319	2020-7-7
10dB Attenuator	Weinschel	4M-10	43152	2020-7-6
10dB Attenuator	R&S	DNF	DNF-001	2020-6-28
10dB Attenuator	R&S	DNF	DNF-002	2020-6-28
10dB Attenuator	R&S	DNF	DNF-003	2020-6-28
10dB Attenuator	R&S	DNF	DNF-004	2020-6-28
Test software	Tonscend	System for BT/WIFI	Version 2.5.77.0418	N/A

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:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Conducted Emission 150kHz-30MHz (for test using AMN ENV432 or ENV4200)	3.21dB
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 5.12dB; Vertical: 5.10dB;
Uncertainty for Radiated Emission in 3m chamber 1000MHz-18000MHz	Horizontal: 5.01dB; Vertical: 5.00dB;
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.81dB; Vertical: 4.89dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.69dB; Vertical: 4.68dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 4.89dB; Vertical: 4.87dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.16dB Frequency test involved: 0.6x10 ⁻⁷ or 1%