

RADIO PERFORMANCE TEST REPORT

Test Report No. : OT-228-RWD-011

Reception No. : 2207002095

Applicant : CHIPSEN. Co., Ltd

Address : B1 C-17, 15, Gyeongin-ro 53-gil, Guro-gu, Seoul, South Korea

Manufacturer : CHIPSEN. Co., Ltd

Address : B1 C-17, 15, Gyeongin-ro 53-gil, Guro-gu, Seoul, South Korea

Type of Equipment : Wireless Communication Module

FCC ID. : 2APB6-BOT-CDA110

Model Name : BoT-cDA110

Multiple Model Name : N/A

Serial number : N/A

Total page of Report : 49 pages (including this page)

Date of Incoming : July 11, 2022

Date of issue : August 09, 2022

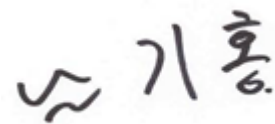
SUMMARY

The equipment complies with the regulation; **FCC PART 15 SUBPART C Section 15.247**

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

This report is not correlated with the "KS Q ISO/IEC 17025 and KOLAS accreditation" of Korean Laboratory Accreditation Scheme.



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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-228-RWD-011	August 09, 2022	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : CHIPSEN. Co., Ltd
Address : B1 C-17, 15, Gyeongin-ro 53-gil, Guro-gu, Seoul, South Korea
Contact Person : Young Min Park / Senior Engineer
Telephone No. : 070-8708-5990
FCC ID : 2APB6-BOT-CDA110
Model Name : BoT-cDA110
Brand Name : N/A
Serial Number : N/A
Date : August 09, 2022

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Wireless Communication Module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2020
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 KDB 558074 D01 15.247 Meas Guidance v05r02
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	Minimum 6 dB Bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	Peak Power Spectral Density	Met the Limit / PASS
15.209	Radiated Emission Limits	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247.

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2020. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea.

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-20122/ C-14617/ G-10666/ T-11842

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A-3

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The CHIPSEN. Co., Ltd, Model BoT-cDA110 (referred to as the EUT in this report) is a Wireless Communication Module. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	Wireless Communication Module		
Temperature Range	-30 °C ~ 85 °C		
Operating Frequency	2 402 MHz ~ 2 480 MHz		
MAX. RF OUTPUT POWER	Bluetooth	1 Mbps	5.09 dBm
		2 Mbps	2.04 dBm
		3 Mbps	-4.84 dBm
	Bluetooth LE	1 Mbps	5.30 dBm
		2 Mbps	5.32 dBm
Number of Channel	Bluetooth	79 Channels	
	Bluetooth LE	40 Channels	
Modulation Type	Bluetooth	GFSK for 1 Mbps, π /4-DQPSK for 2 Mbps, 8-DPSK for 3 Mbps	
	Bluetooth LE	GFSK	
Antenna Type	Chip Antenna		
Antenna Gain	5.53 dBi		
List of each Osc. or crystal Freq.(Freq. $\geq$ 1 MHz)	24 MHz		
Rated Supply Voltage	DC 3.3 V		

3.2 Alternative type(s)/model(s); also covered by this test report.

-. The following lists consist of the added model and their differences.

Model Name	Differences	Tested
BoT-cDA110	Basic Model	☒
BoT-cDA110SI	This model is derived for Marketing purpose. It is identical to the basic model except for the model name.	☐
BoT-cDA110SU		☐
BoT-cDA110DI		☐
BoT-cDA110DU		☐
BoT-cDA110DS		☐

Note: 1. Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.

2. The Applicant/manufacturer is responsible for the compliance of all variants.

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	CHIPSEN. Co., Ltd	N/A	N/A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
BoT-cDA110	CHIPSEN. Co., Ltd	Wireless Communication Module (EUT)	
Ideapad 320	LENOVO	Notebook PC	EUT
IPS-12B05D	INTERACT	DC Power Supply	EUT

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting is programmed.

For final testing, the EUT was set at 2 402 MHz, 2 440 MHz, and 2 480 MHz to get a maximum emission levels from the EUT. The EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XY” axis, but the worst data was recorded in this report.

-. Frequency / Channel Operations

Channel	Frequency
0	2 402
19	2 440
39	2 480

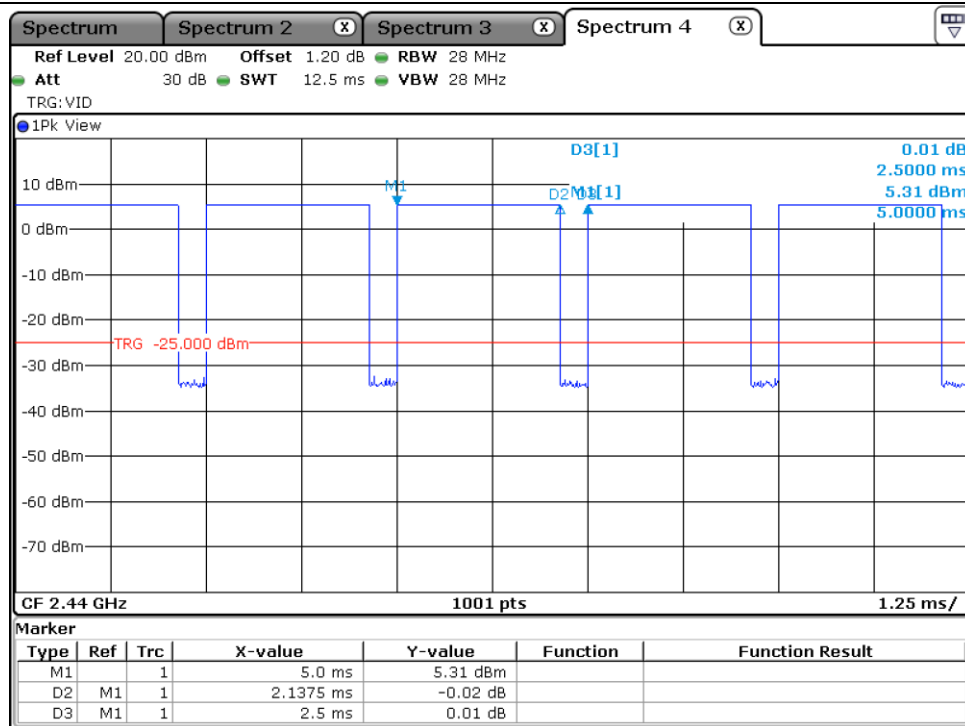
- Duty Cycle

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Bluetooth LE 1 Mbps	2.14	0.363	85.50	0.68
Bluetooth LE 2 Mbps	1.08	0.792	57.69	2.39

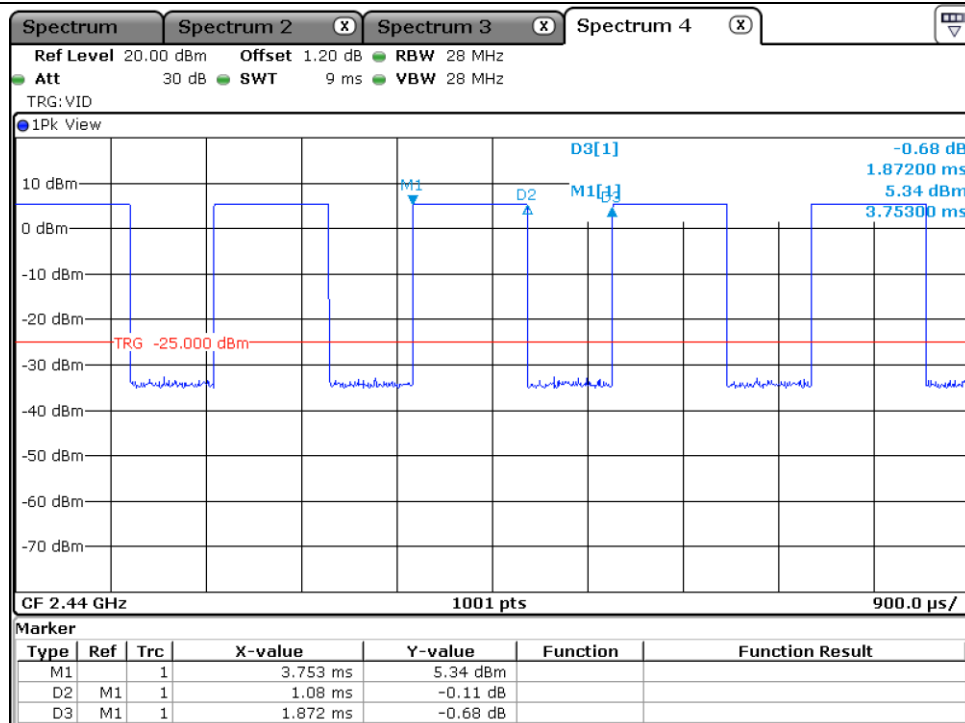
Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

Correction Factor : $10 * \log(1 / (\text{Duty Cycle} / 100))$

- Test Plot



Bluetooth LE 1 Mbps



Bluetooth LE 2 Mbps

5.4 Configuration of Test System

- Line Conducted Test:** The EUT was tested in the Transmitting mode. All supporting equipment were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2020 to determine the worse operating conditions.
- Radiated Emission Test:** Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2020 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.
- The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

For intentional device, according to section 15.203, 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.

Antenna Construction:

The antenna of the EUT is a Chip Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

6.2 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

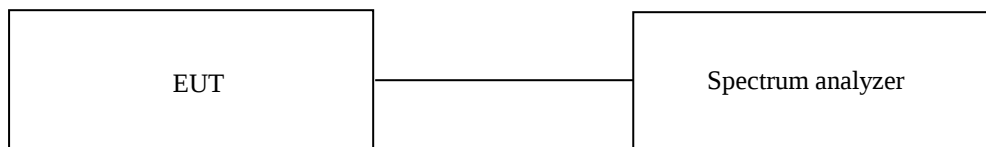
7. MINIMUM 6 dB BANDWIDTH

7.1 Operating environment

Temperature : 24°C
Relative humidity : 49% R.H.

7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



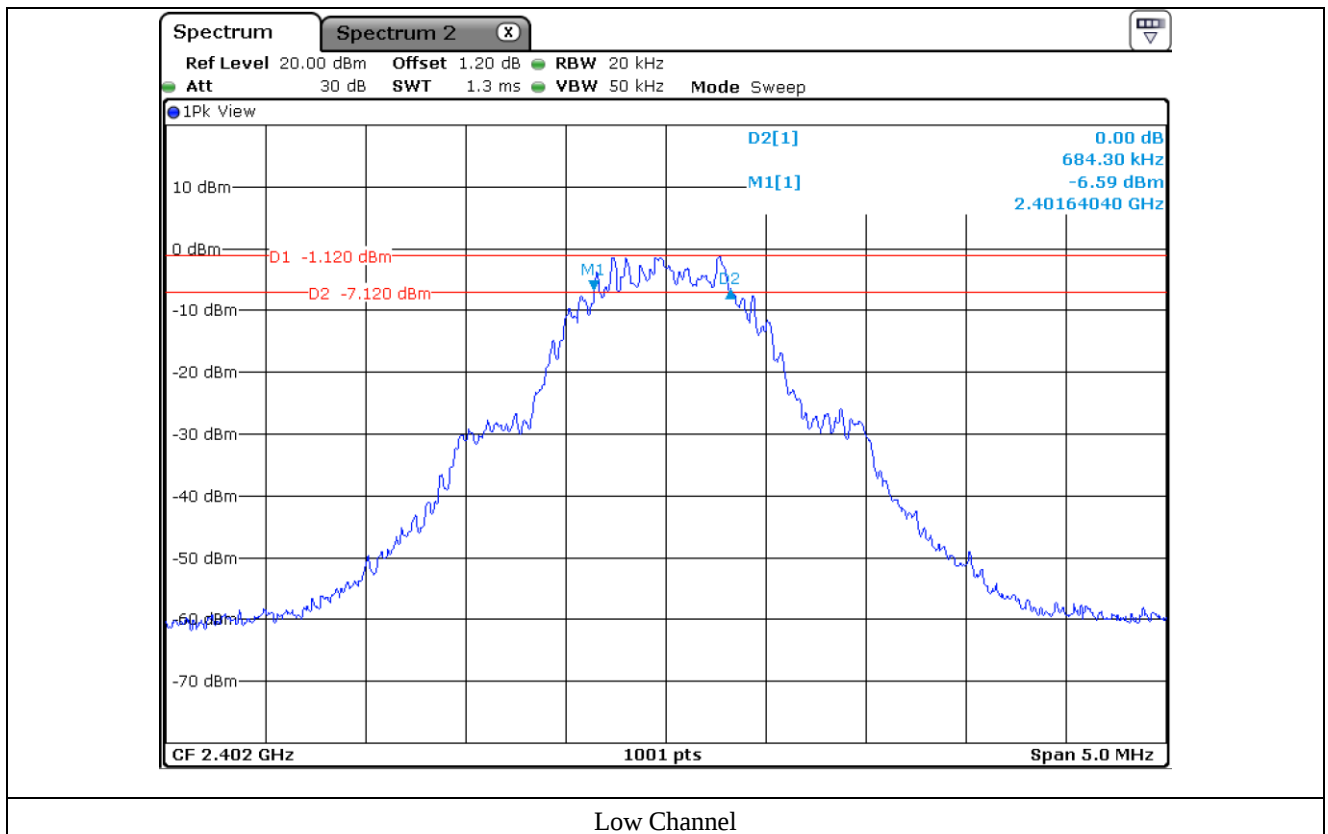
7.3 Test Date

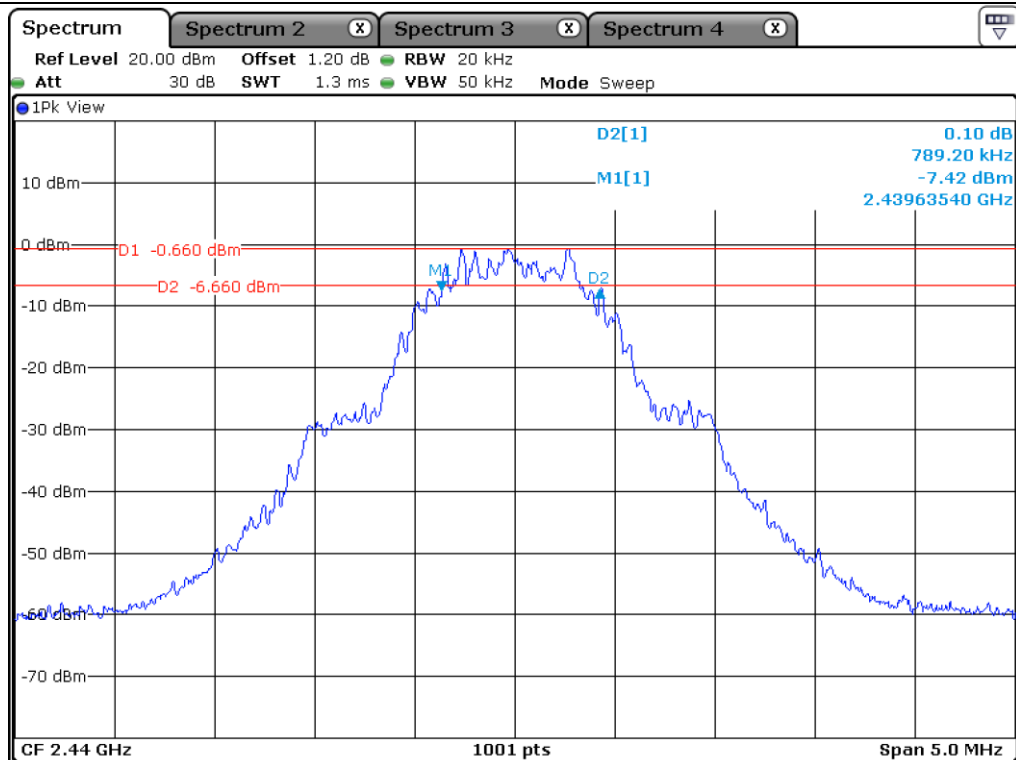
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7.4 Test data for Bluetooth LE 1 Mbps

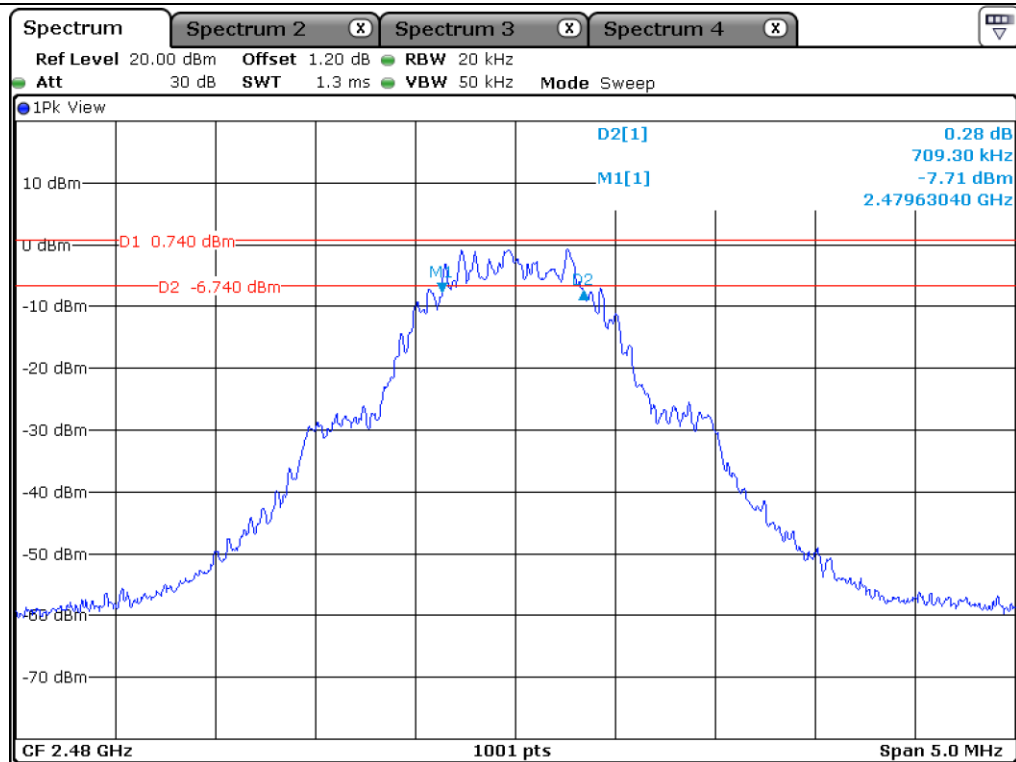
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402.00	684.30	500.00	184.30
Middle	2 440.00	789.20	500.00	289.20
High	2 480.00	709.30	500.00	209.30

Remark. Margin = Measured Value - Limit





Middle Channel

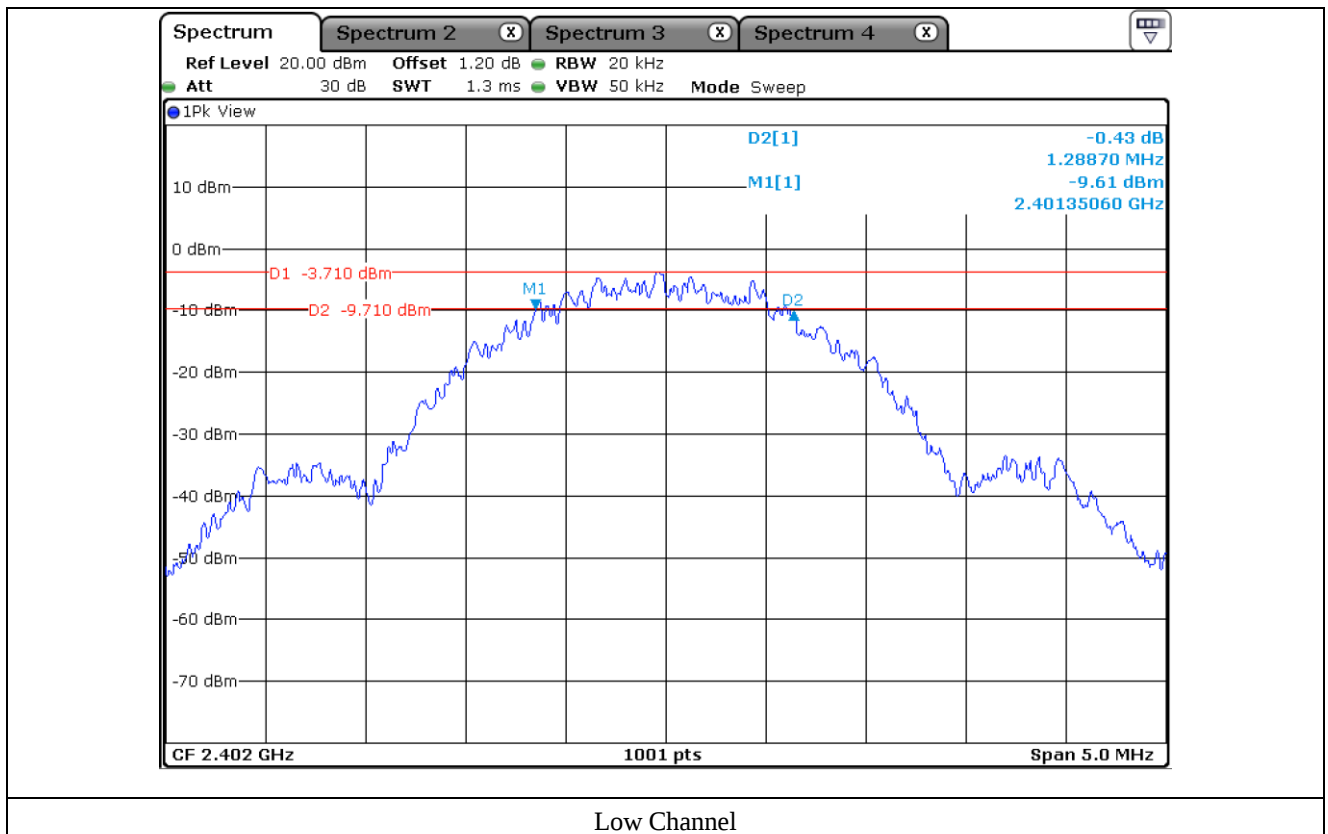


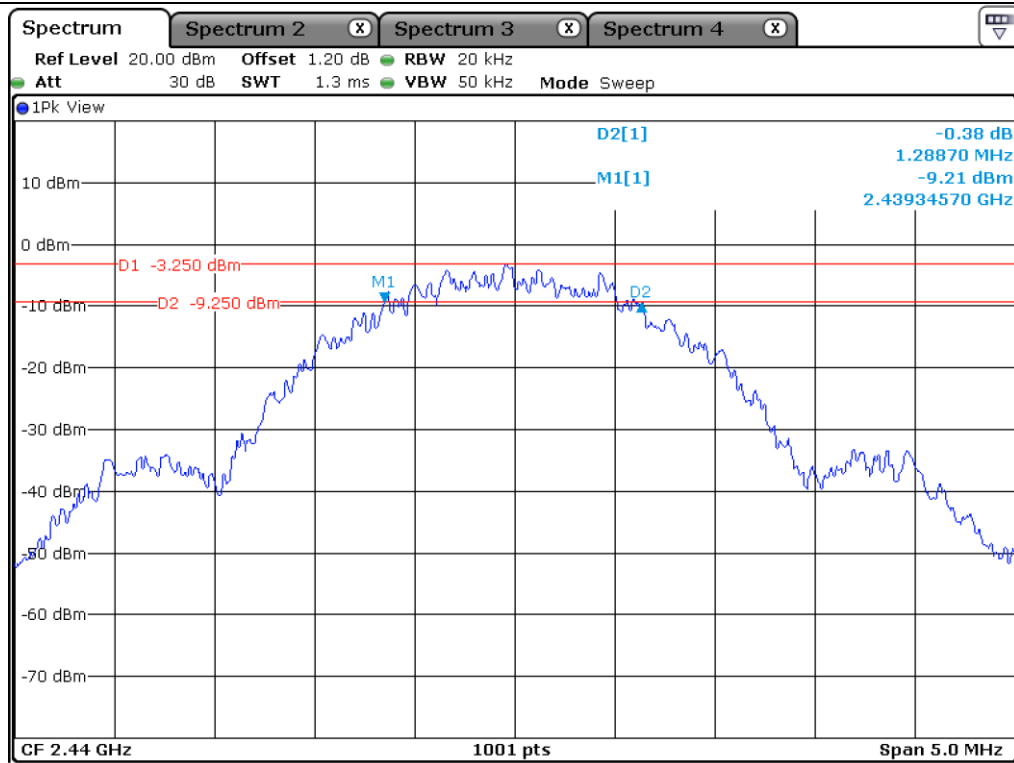
High Channel

7.5 Test data for Bluetooth LE 2 Mbps

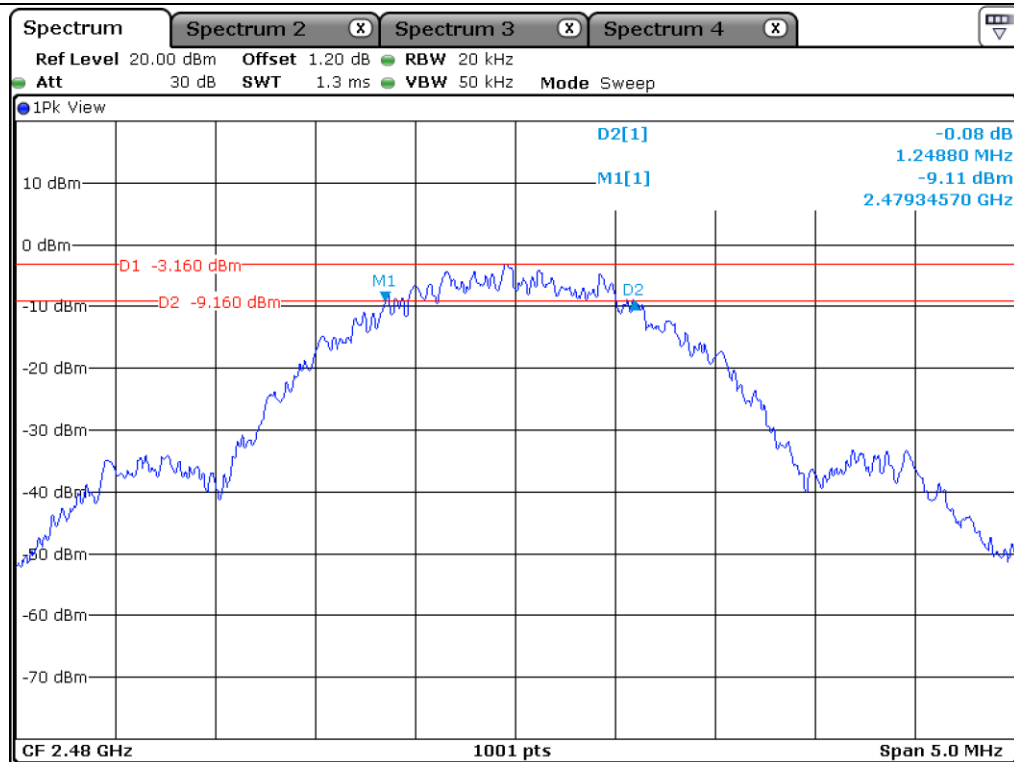
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402.00	1 288.70	500.00	788.70
Middle	2 440.00	1 288.70	500.00	788.70
High	2 480.00	1 248.80	500.00	748.80

Remark. Margin = Measured Value - Limit





Middle Channel



High Channel

8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

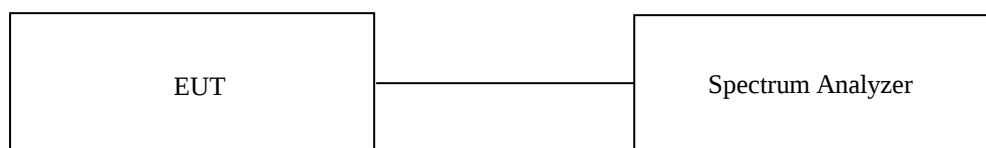
Temperature : 24 °C

Relative humidity : 49 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

The resolution bandwidth is set to $\geq$ DTS Bandwidth, the video bandwidth is set to 3 times the resolution bandwidth.



8.3 Test Date

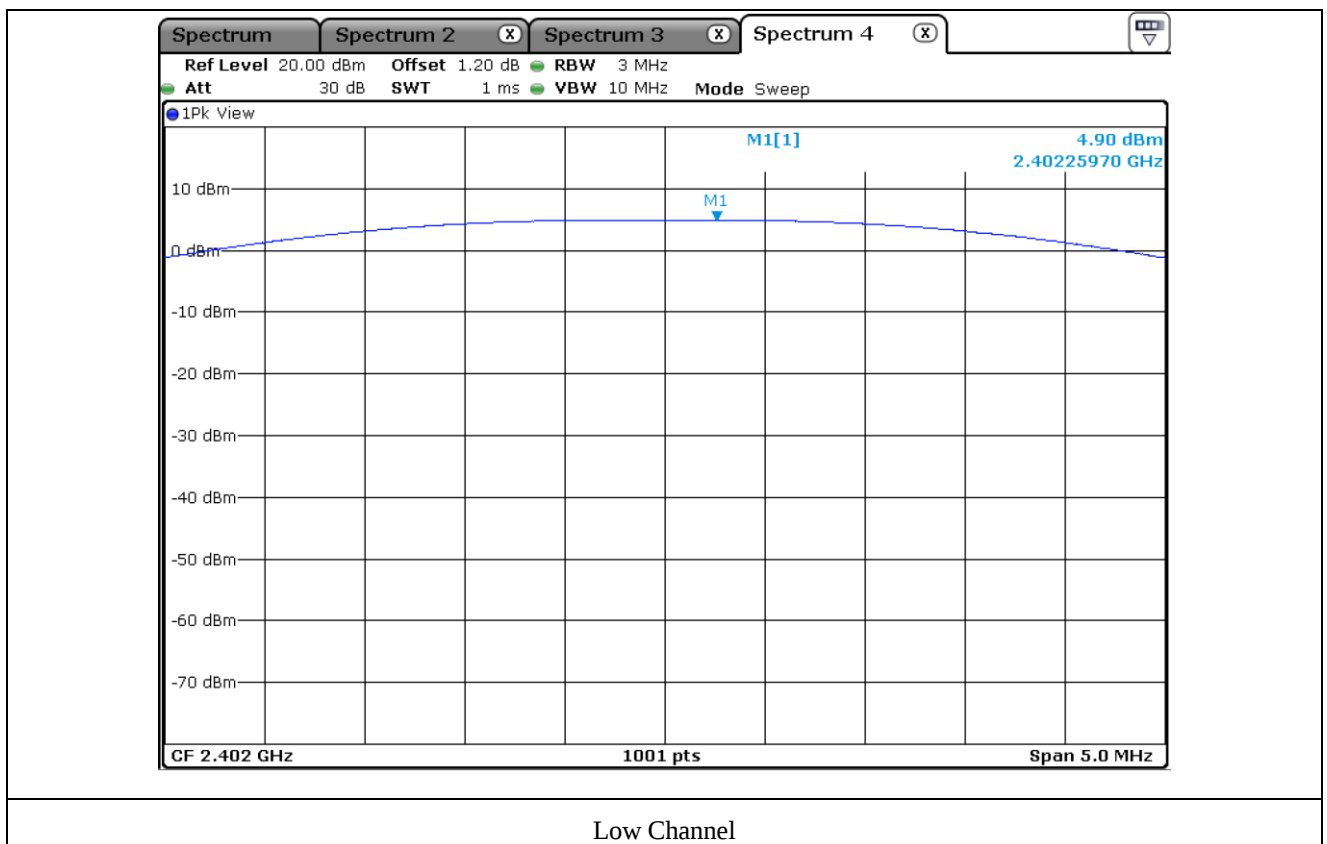
July 11, 2022 ~ July 25, 2022

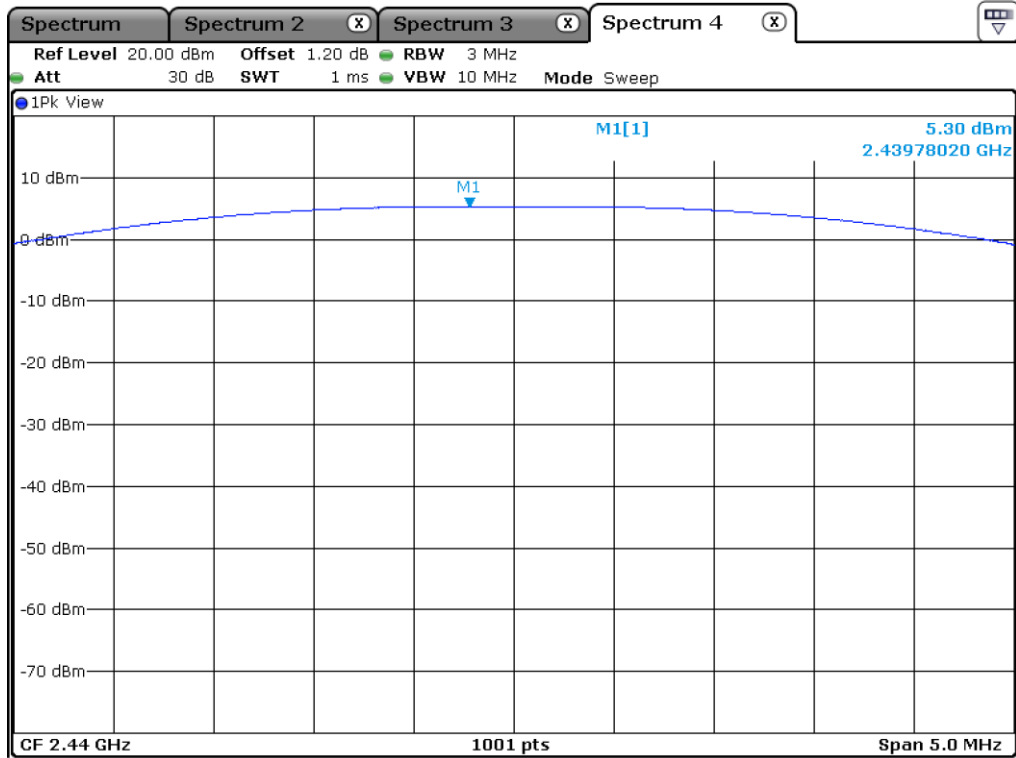
8.4 Test data for Bluetooth LE 1 Mbps

-. Test Result : Pass

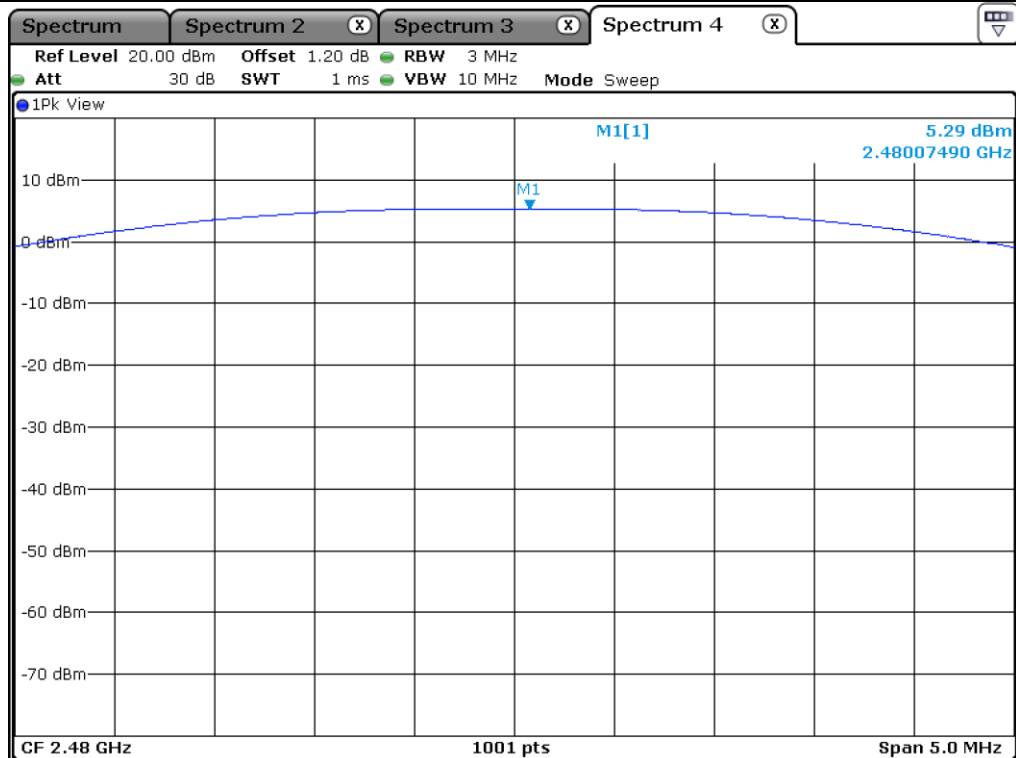
CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	4.90	30.00	25.10
MIDDLE	2 440.00	5.30	30.00	24.70
HIGH	2 480.00	5.29	30.00	24.71

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)





Middle Channel



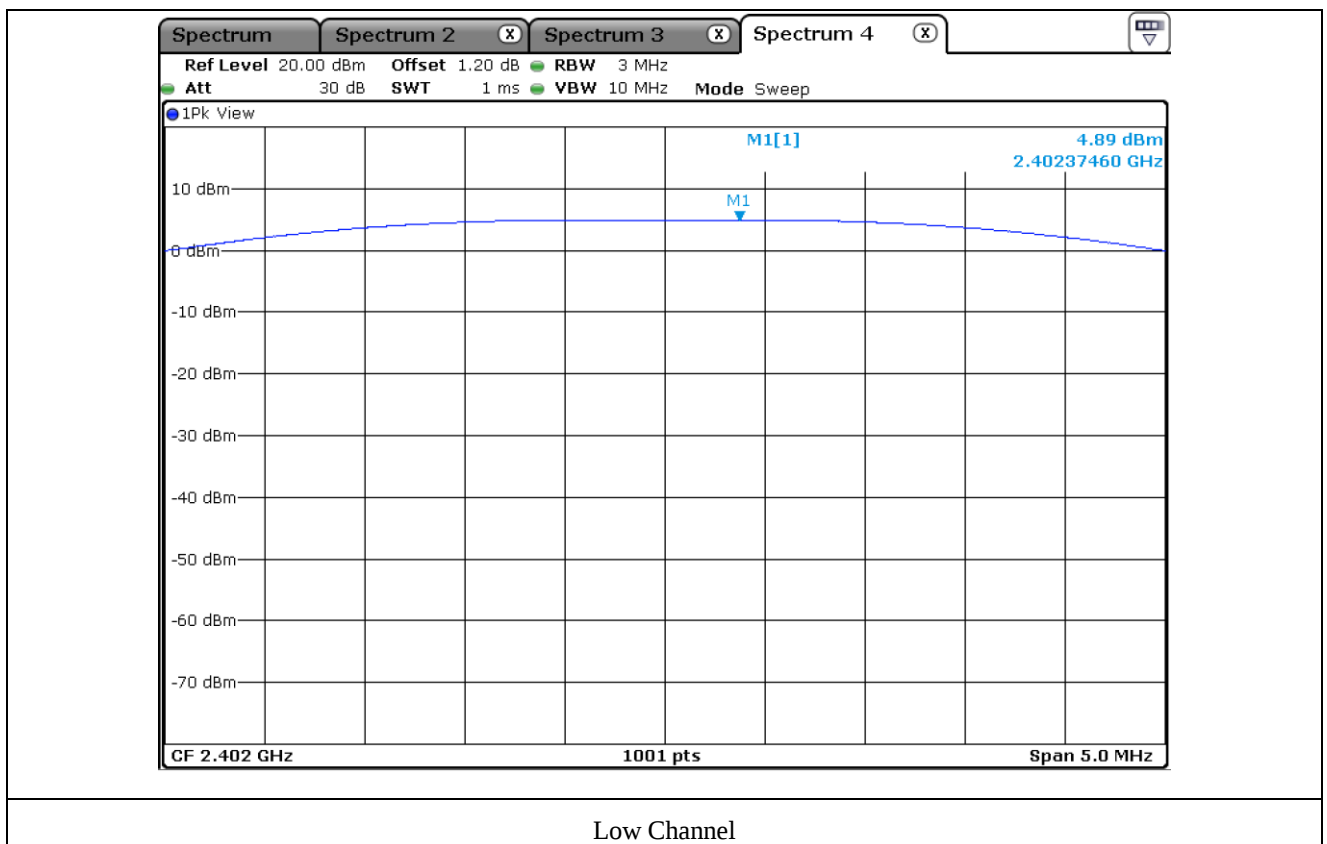
High Channel

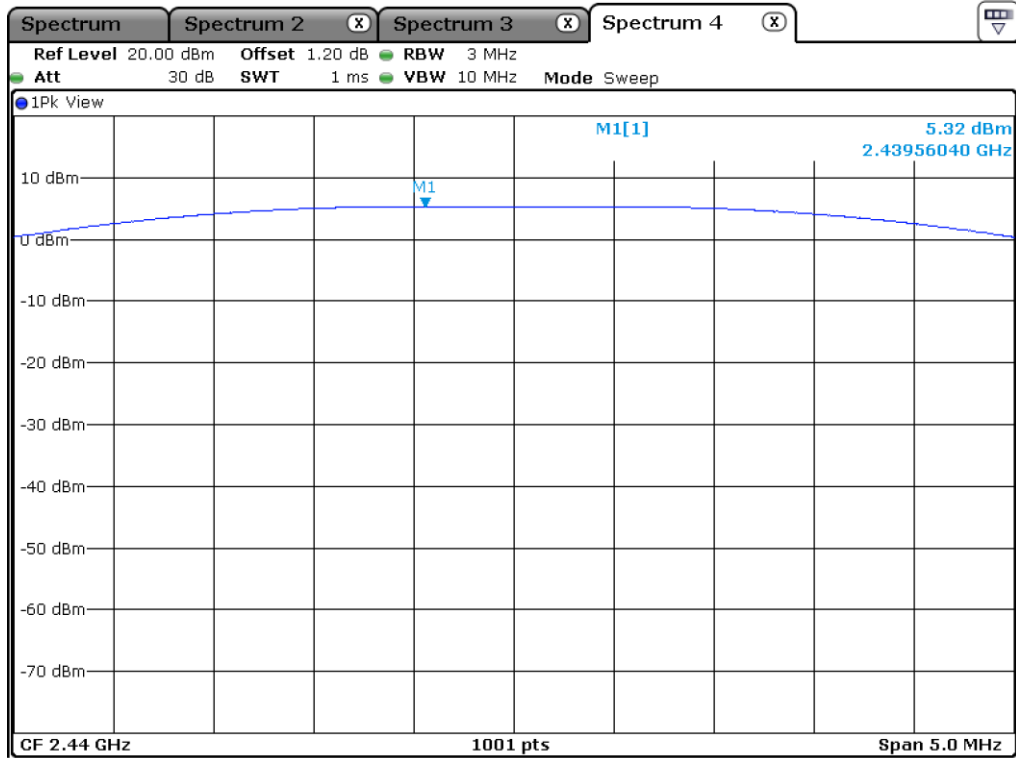
8.5 Test data for Bluetooth LE 2 Mbps

-. Test Result : Pass

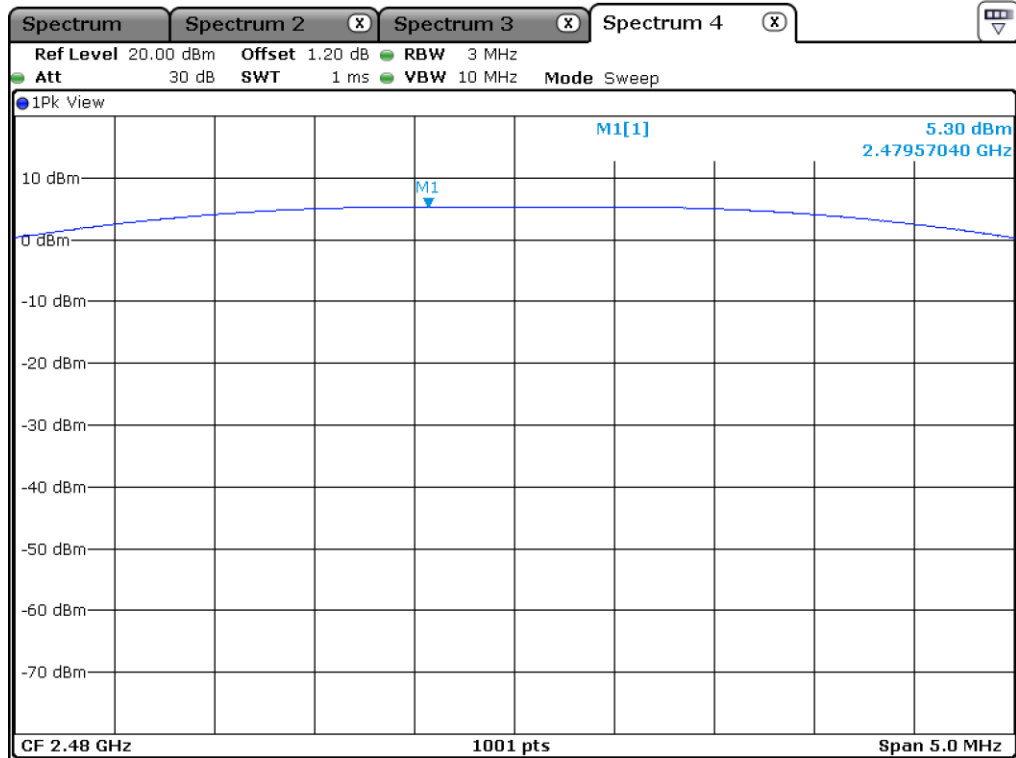
CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	4.89	30.00	25.11
MIDDLE	2 440.00	5.32	30.00	24.68
HIGH	2 480.00	5.30	30.00	24.70

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)





Middle Channel



High Channel

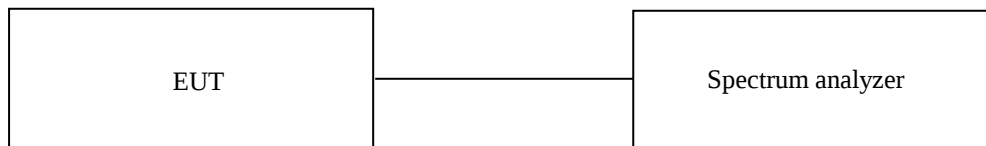
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 24°C
Relative humidity : 49% R.H.

9.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, the video bandwidth is set to 3 times the resolution bandwidth and peak detection was used.



9.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

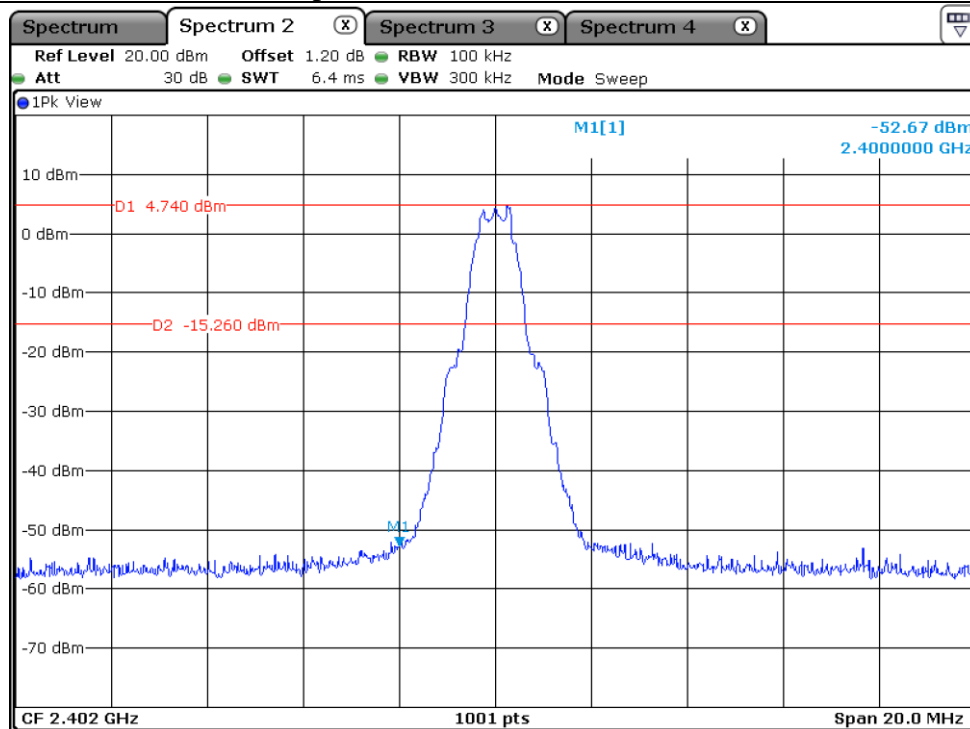
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

9.4 Test Date

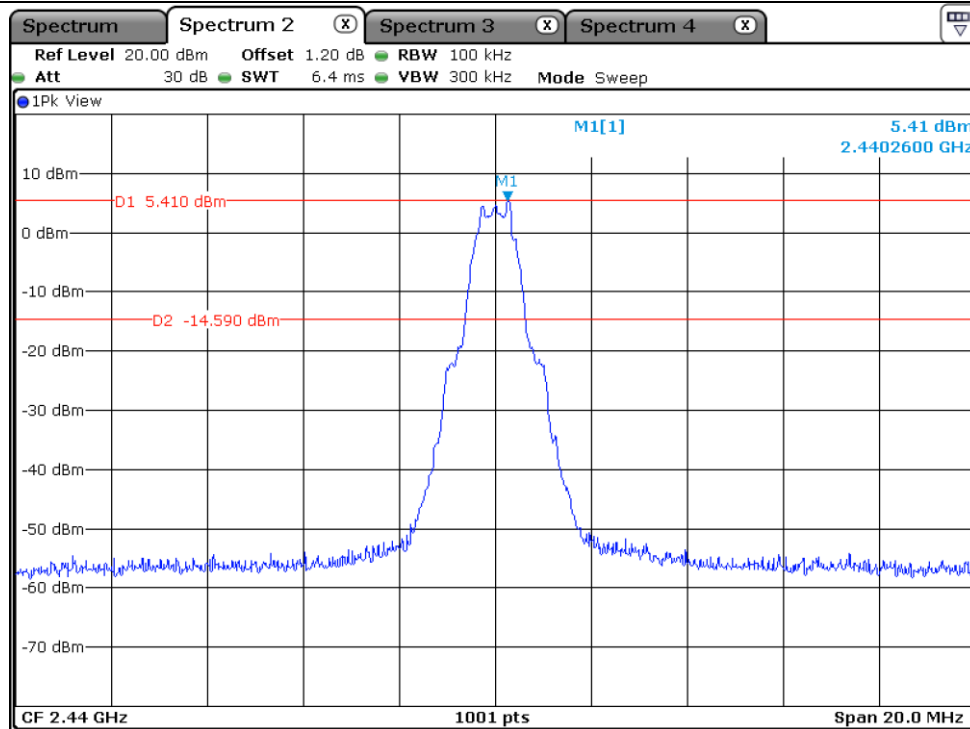
July 11, 2022 ~ July 25, 2022

9.5 Test data for conducted emission

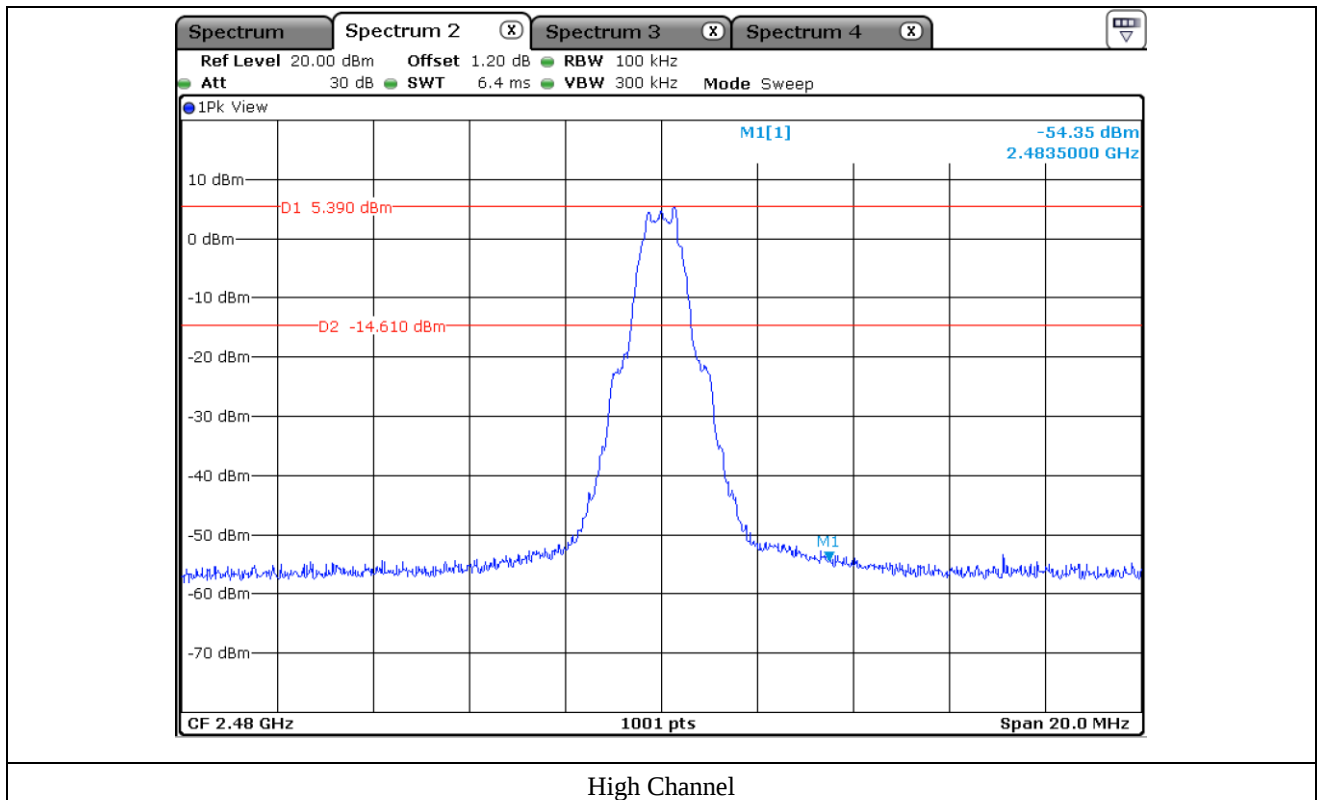
9.5.1 Test data for Bluetooth LE 1 Mbps

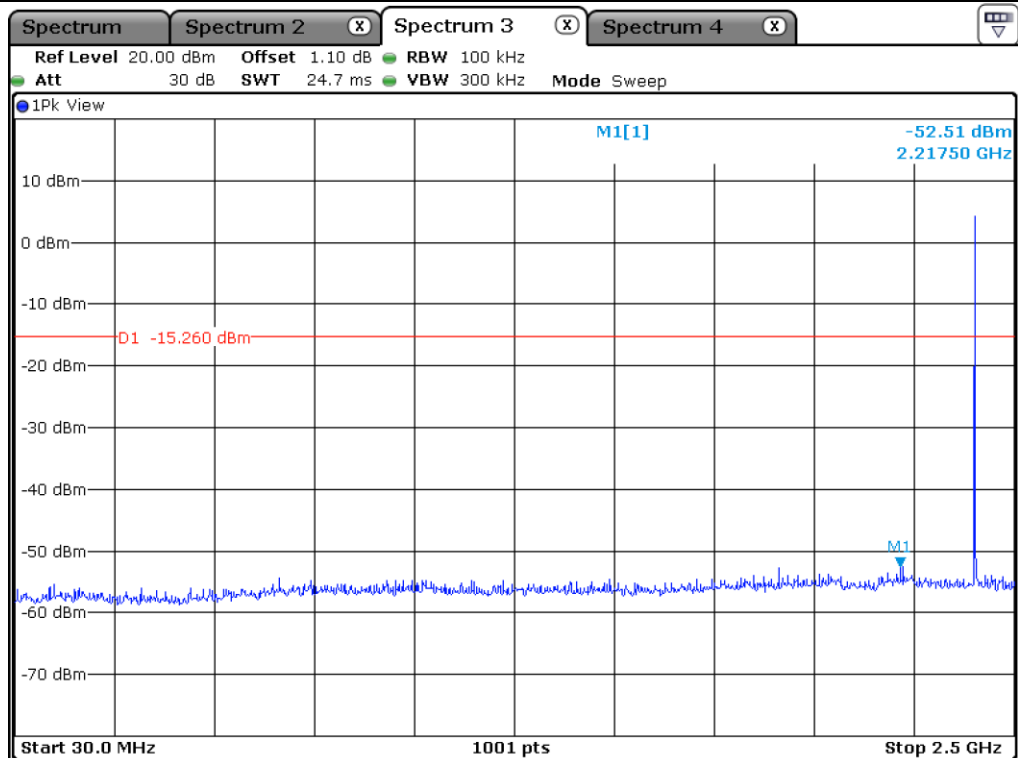


Low Channel

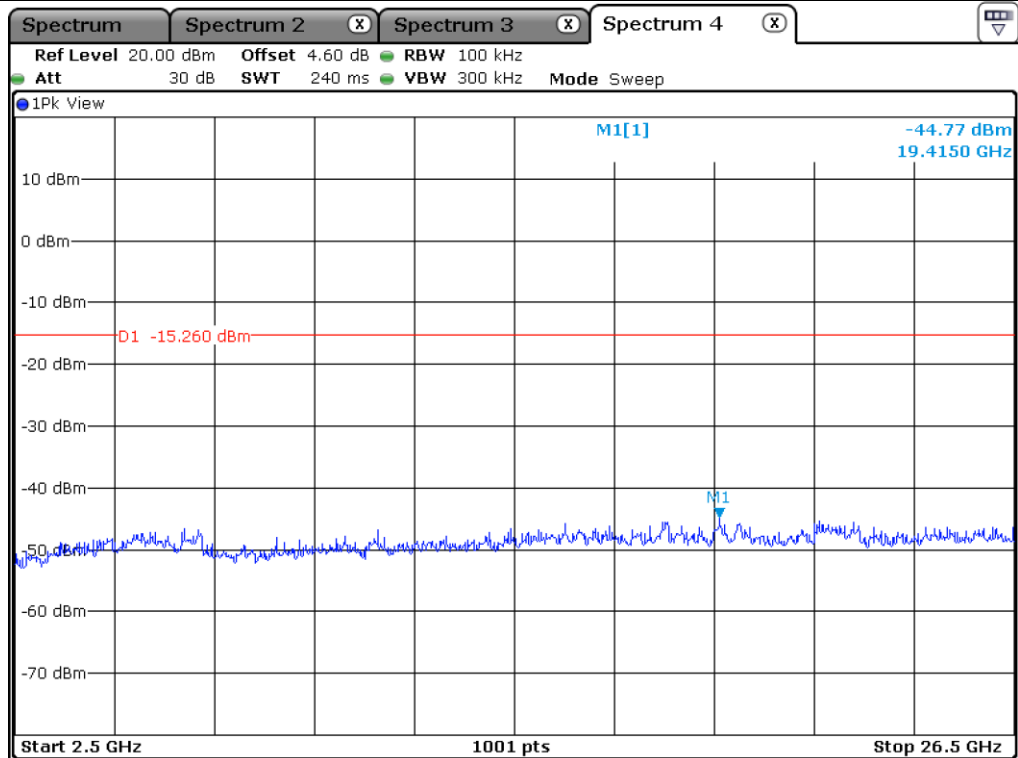


Middle Channel

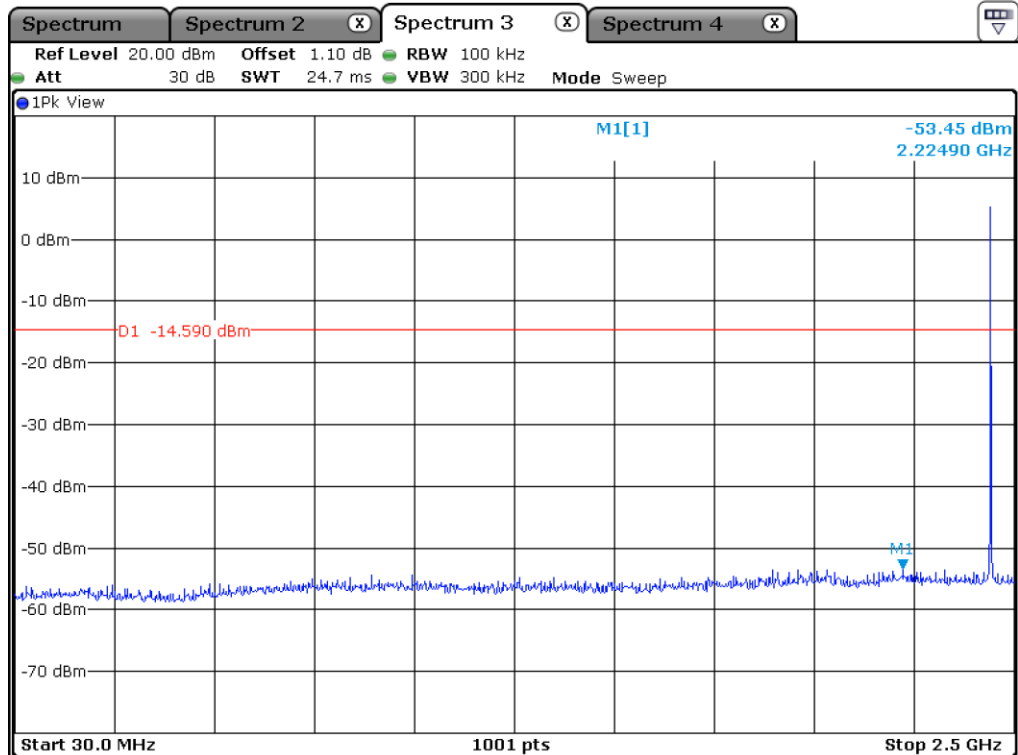




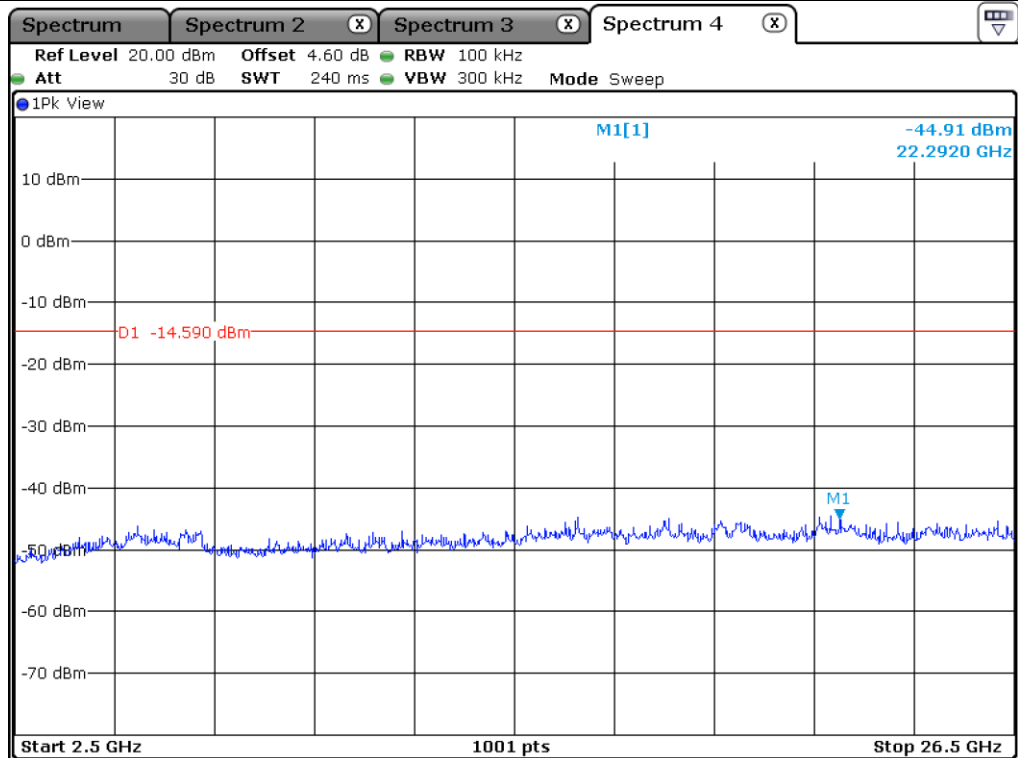
Low Channel



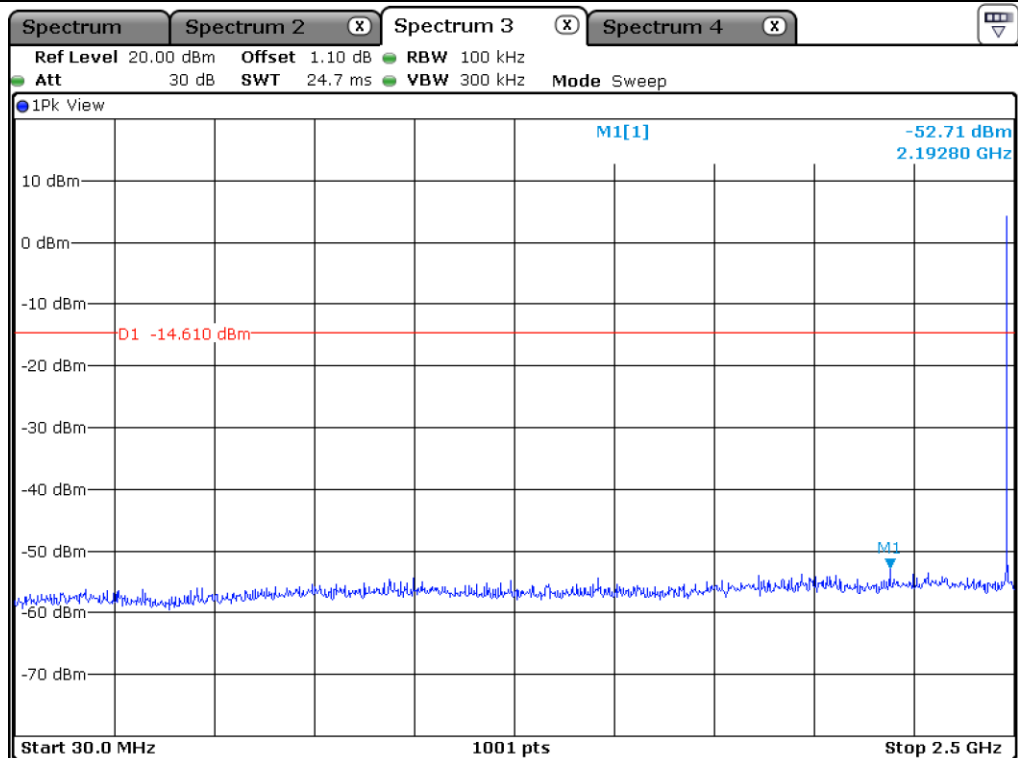
Low Channel



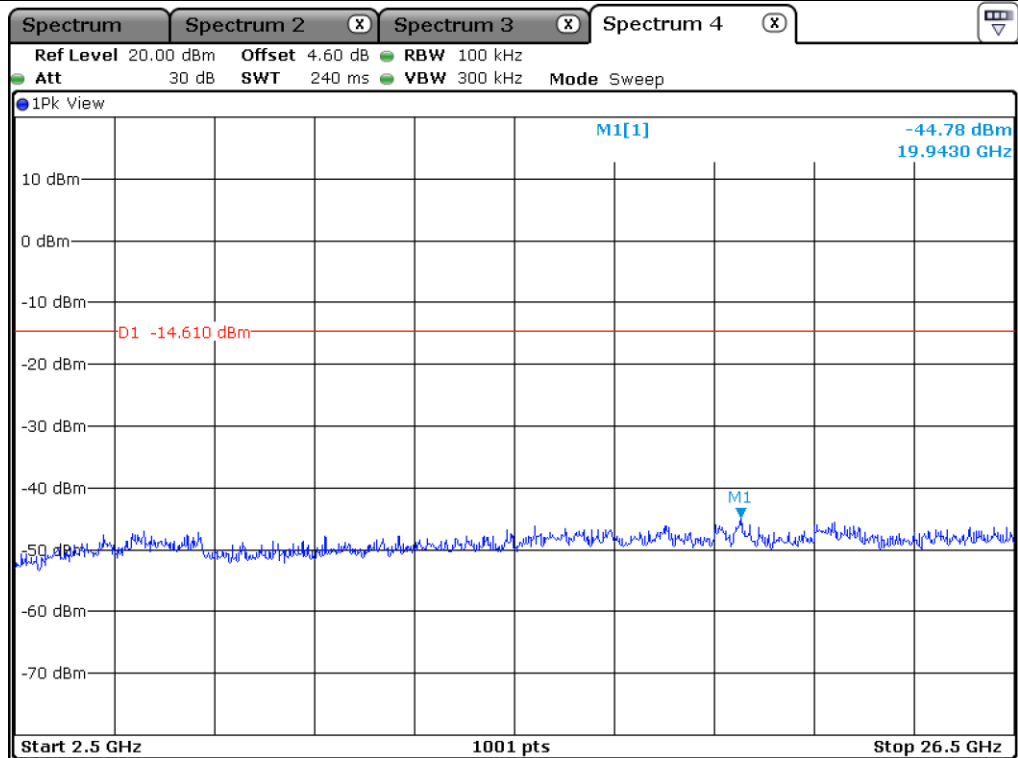
Middle Channel



Middle Channel

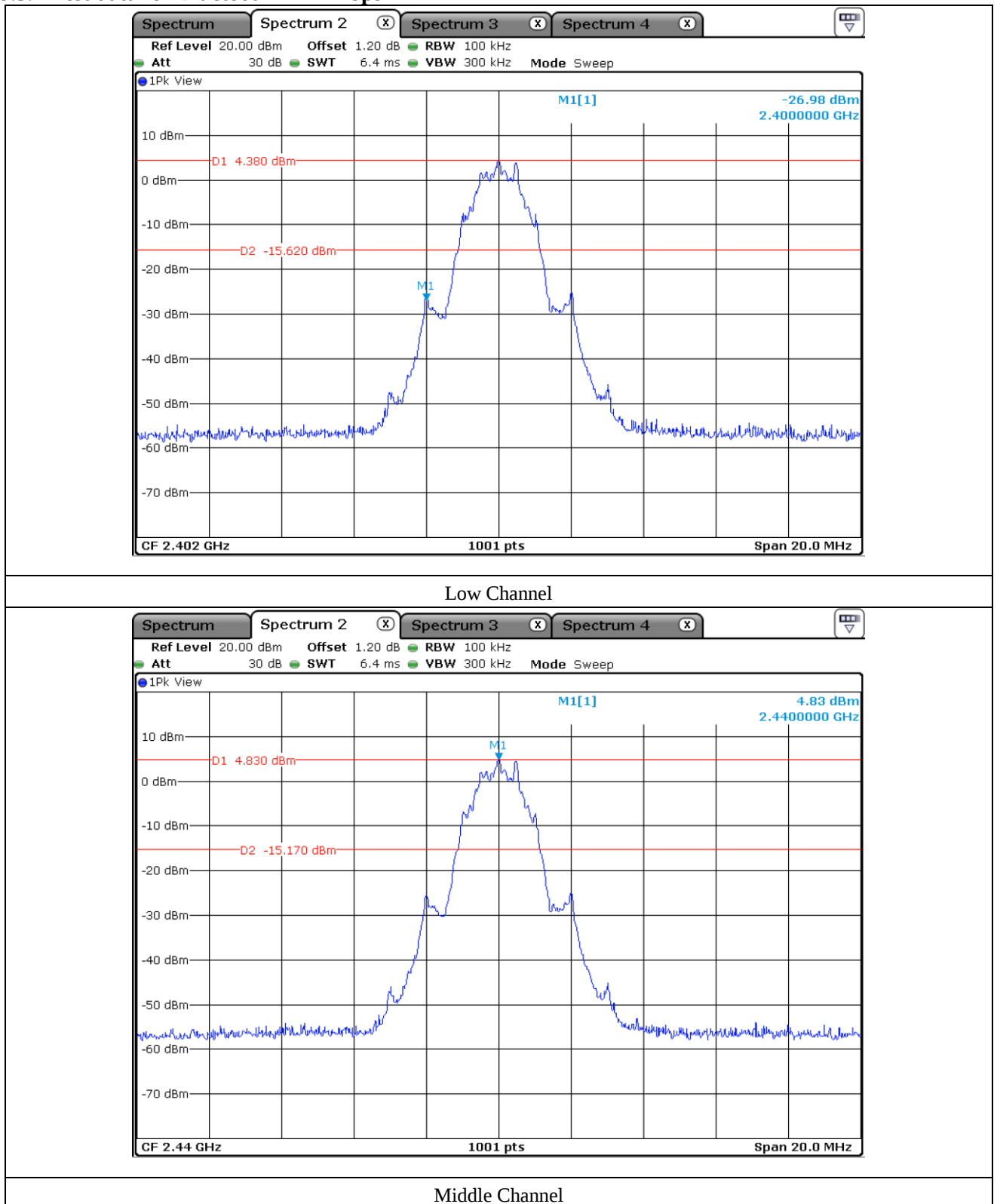


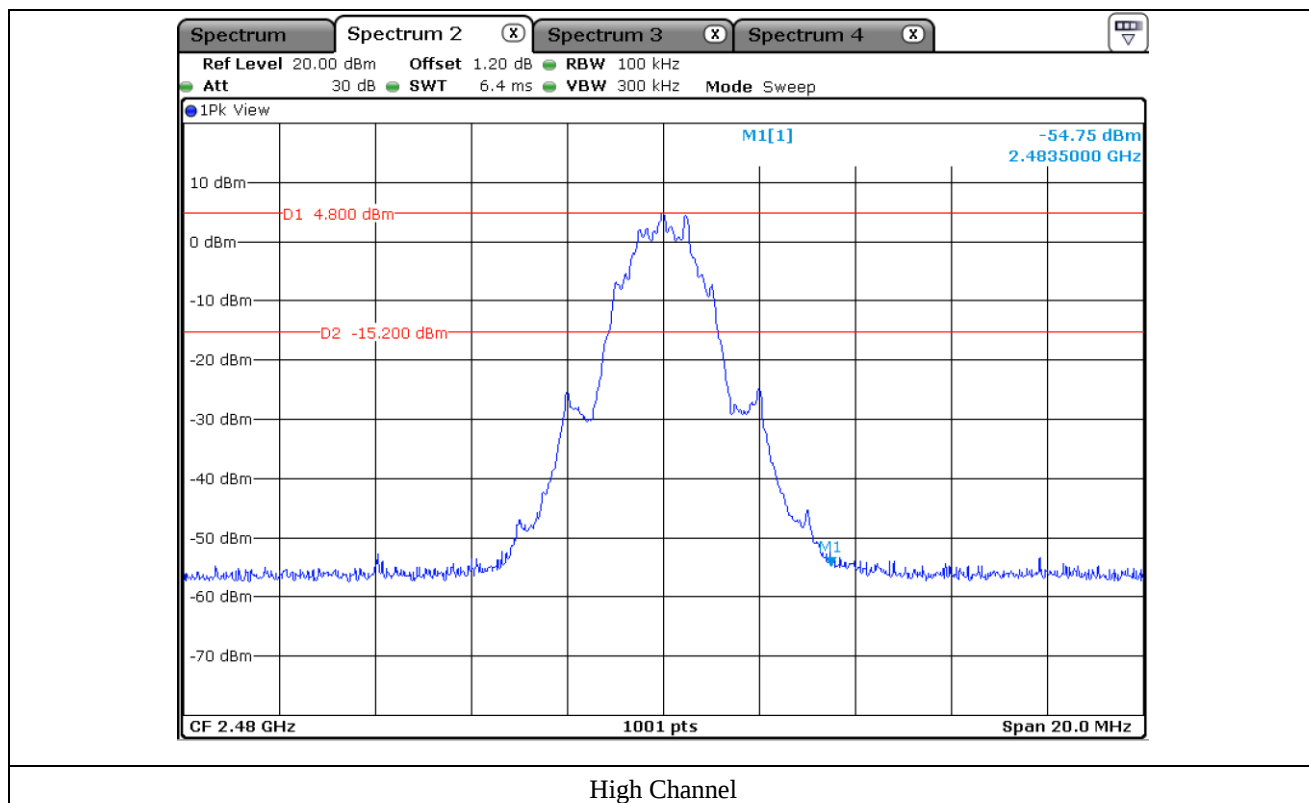
High Channel

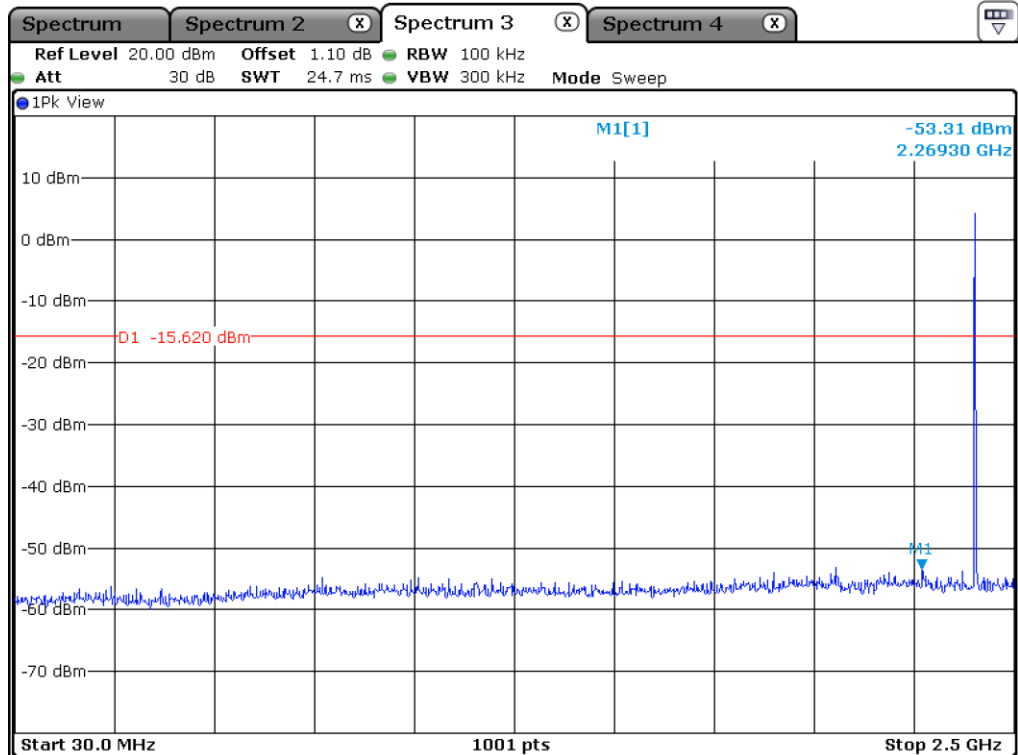


High Channel

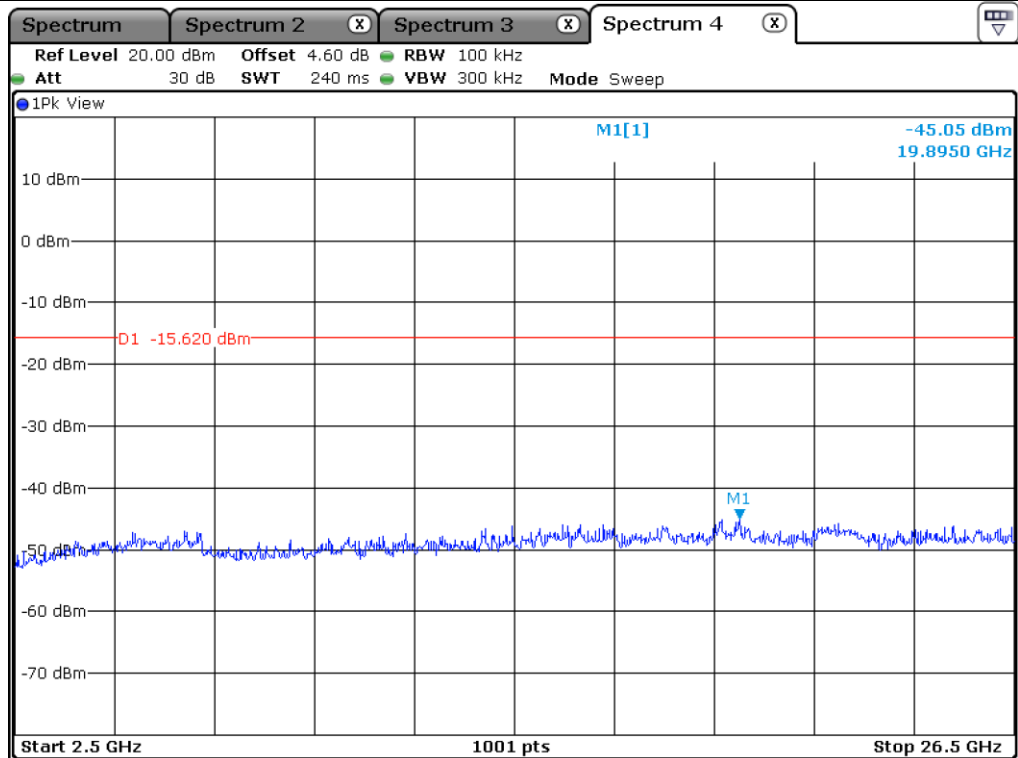
9.5.2 Test data for Bluetooth LE 2 Mbps



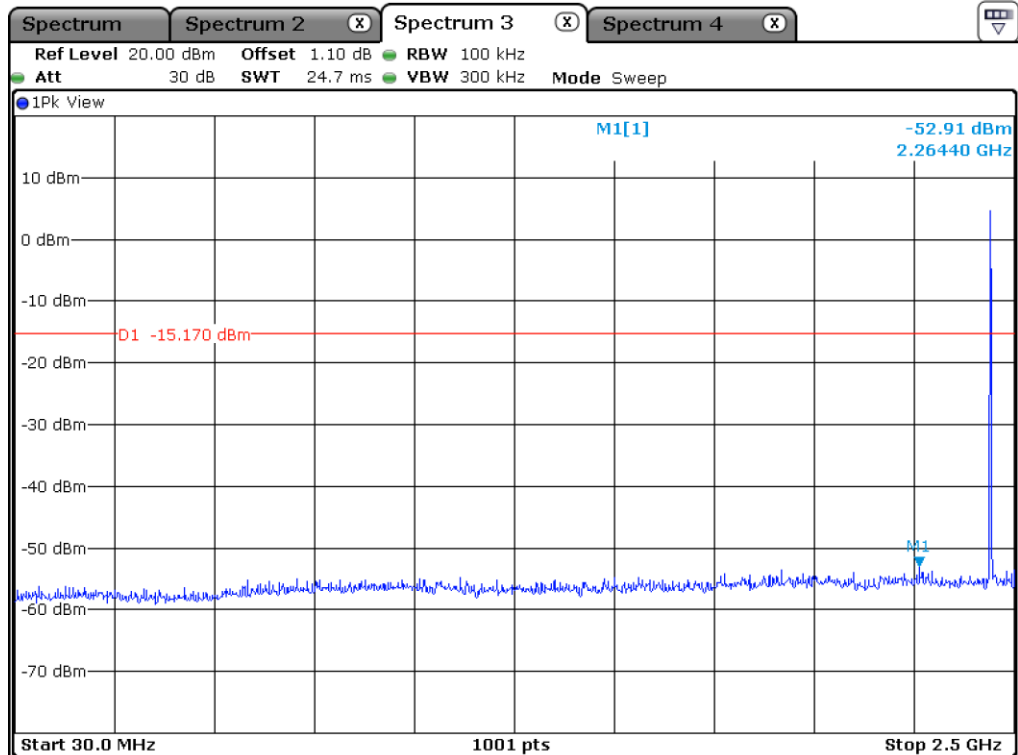




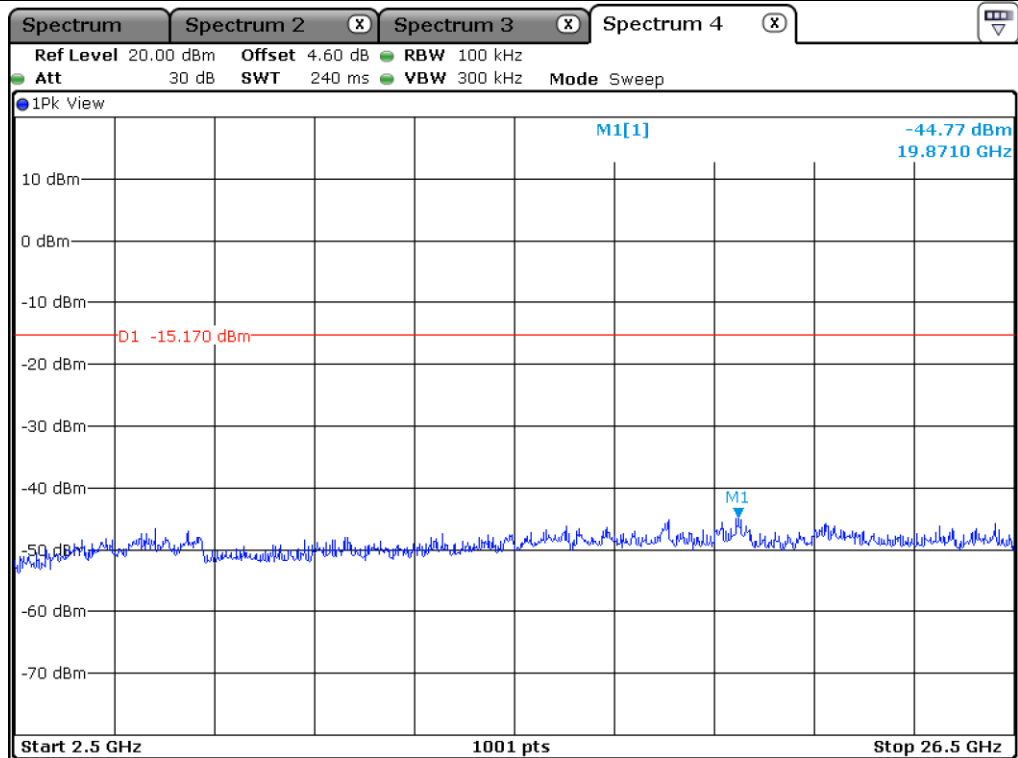
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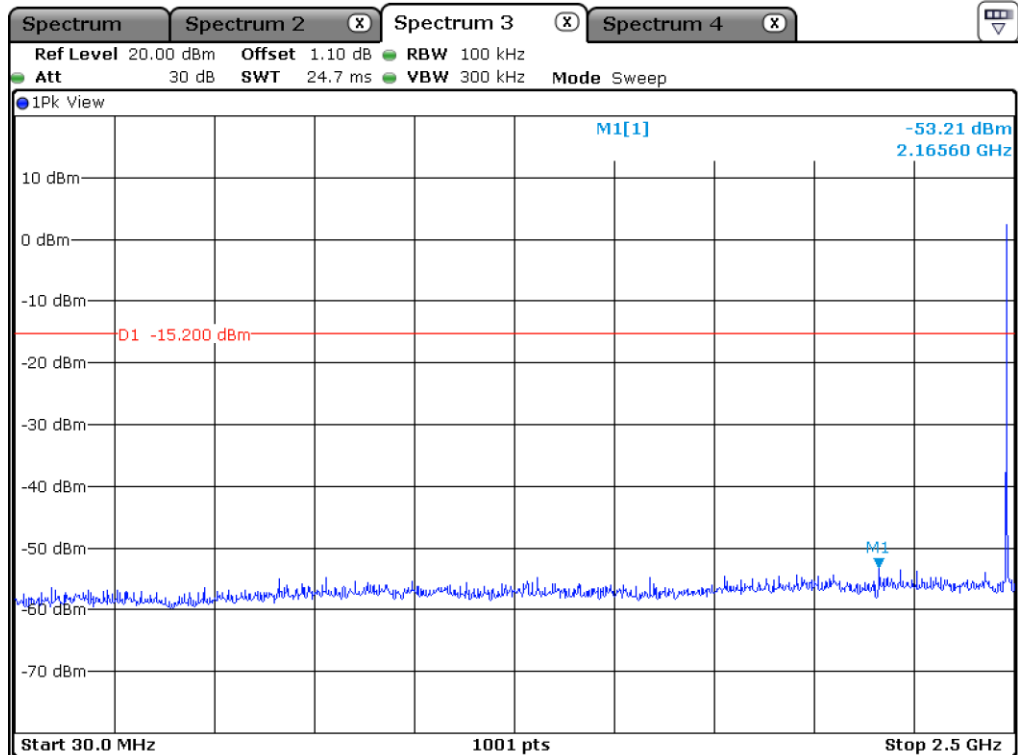
Low Channel



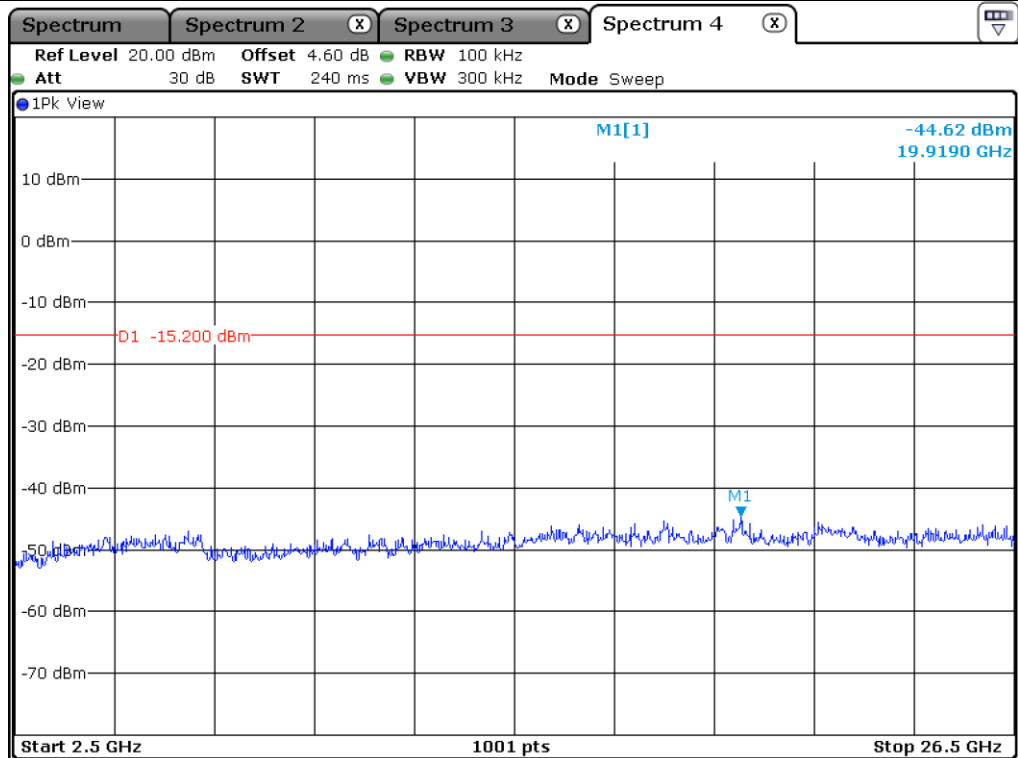
Middle Channel



Middle Channel



High Channel



High Channel

9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band

9.6.1.1 Test data for Bluetooth LE 1 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : 85.50 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
2 334.77	52.56	Peak	H	28.00	5.30	44.90	-	40.96	74.00	33.04
2 335.31	41.61	Average	H	28.00	5.30	44.90	0.68	30.69	54.00	23.31
2 319.39	52.42	Peak	V	28.00	5.30	44.90	-	40.82	74.00	33.18
2 360.12	41.56	Average	V	28.00	5.30	44.90	0.68	30.64	54.00	23.36
Test Data for High Channel										
2 491.19	53.41	Peak	H	28.80	5.50	44.90	-	42.81	74.00	31.19
2 484.74	41.55	Average	H	28.80	5.50	44.90	0.68	31.63	54.00	22.37
2 487.12	52.96	Peak	V	28.80	5.50	44.90	-	42.36	74.00	31.64
2 492.21	41.44	Average	V	28.80	5.50	44.90	0.68	31.52	54.00	22.48

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} + \text{Duty Factor} - \text{Amp Gain}$$

9.6.1.2 Test data for Bluetooth LE 2 Mbps

- . Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : 57.69 %
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
2 343.67	53.21	Peak	H	28.00	5.30	44.90	-	41.61	74.00	32.39
2 346.90	41.55	Average	H	28.00	5.30	44.90	2.39	32.34	54.00	21.66
2 337.37	52.60	Peak	V	28.00	5.30	44.90	-	41.00	74.00	33.00
2 329.82	41.47	Average	V	28.00	5.30	44.90	2.39	32.26	54.00	21.74
Test Data for High Channel										
2 497.63	52.47	Peak	H	28.80	5.50	44.90	-	41.87	74.00	32.13
2 487.50	41.39	Average	H	28.80	5.50	44.90	2.39	33.18	54.00	20.82
2 492.11	52.66	Peak	V	28.80	5.50	44.90	-	42.06	74.00	31.94
2 489.98	41.70	Average	V	28.80	5.50	44.90	2.39	33.49	54.00	20.51

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Duty Factor – Amp Gain

9.6.2 Spurious & Harmonic Radiated Emission

9.6.2.1 Test data for Bluetooth LE 1 Mbps

- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
1 MHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Duty Cycle : 85.50 %
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
4 804.00	60.04	Peak	H	33.50	7.50	44.60	-	56.44	74.00	17.56
4 804.00	52.74	Average	H	33.50	7.50	44.60	0.68	49.82	54.00	4.18
4 804.00	58.79	Peak	V	33.50	7.50	44.60	-	55.19	74.00	18.81
4 804.00	50.02	Average	V	33.50	7.50	44.60	0.68	47.10	54.00	6.90
Test Data for Middle Channel										
4 880.00	60.58	Peak	H	33.50	7.60	44.60	-	57.08	74.00	16.92
4 880.00	53.99	Average	H	33.50	7.60	44.60	0.68	51.17	54.00	2.83
4 880.00	58.69	Peak	V	33.50	7.60	44.60	-	55.19	74.00	18.81
4 880.00	51.54	Average	V	33.50	7.60	44.60	0.68	48.72	54.00	5.28
Test Data for High Channel										
4 960.00	59.85	Peak	H	33.60	7.80	44.70	-	56.55	74.00	17.45
4 960.00	53.00	Average	H	33.60	7.80	44.70	0.68	50.38	54.00	3.62
4 960.00	58.79	Peak	V	33.60	7.80	44.70	-	55.49	74.00	18.51
4 960.00	50.46	Average	V	33.60	7.80	44.70	0.68	47.84	54.00	6.16

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Duty Factor - Amp Gain

9.6.2.2 Test data for Bluetooth LE 2 Mbps

- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
1 MHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : 57.69 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
4 804.00	59.83	Peak	H	33.50	7.50	44.60	-	56.23	74.00	17.77
4 804.00	50.77	Average	H	33.50	7.50	44.60	2.39	49.56	54.00	4.44
4 804.00	57.53	Peak	V	33.50	7.50	44.60	-	53.93	74.00	20.07
4 804.00	47.74	Average	V	33.50	7.50	44.60	2.39	46.53	54.00	7.47
Test Data for Middle Channel										
4 880.00	60.57	Peak	H	33.50	7.60	44.60	-	57.07	74.00	16.93
4 880.00	52.03	Average	H	33.50	7.60	44.60	2.39	50.92	54.00	3.08
4 880.00	58.49	Peak	V	33.50	7.60	44.60	-	54.99	74.00	19.01
4 880.00	48.59	Average	V	33.50	7.60	44.60	2.39	47.48	54.00	6.52
Test Data for High Channel										
4 960.00	59.80	Peak	H	33.60	7.80	44.70	-	56.50	74.00	17.50
4 960.00	51.07	Average	H	33.60	7.80	44.70	2.39	50.16	54.00	3.84
4 960.00	57.81	Peak	V	33.60	7.80	44.70	-	54.51	74.00	19.49
4 960.00	48.17	Average	V	33.60	7.80	44.70	2.39	47.26	54.00	6.74

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} + \text{Duty Factor} - \text{Amp Gain}$$

10. PEAK POWER SPECTRAL DENSITY

10.1 Operating environment

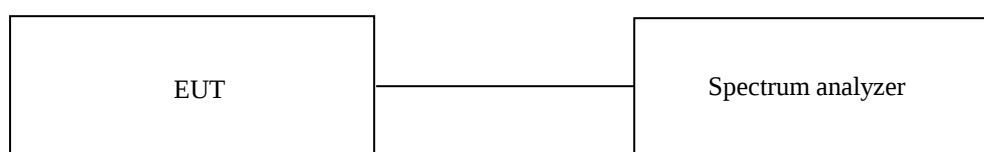
Temperature : 24 °C

Relative humidity : 49 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

The resolution bandwidth is set to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$, the video bandwidth is set to 3 times the resolution bandwidth.



10.3 Test Date

July 11, 2022 ~ July 25, 2022

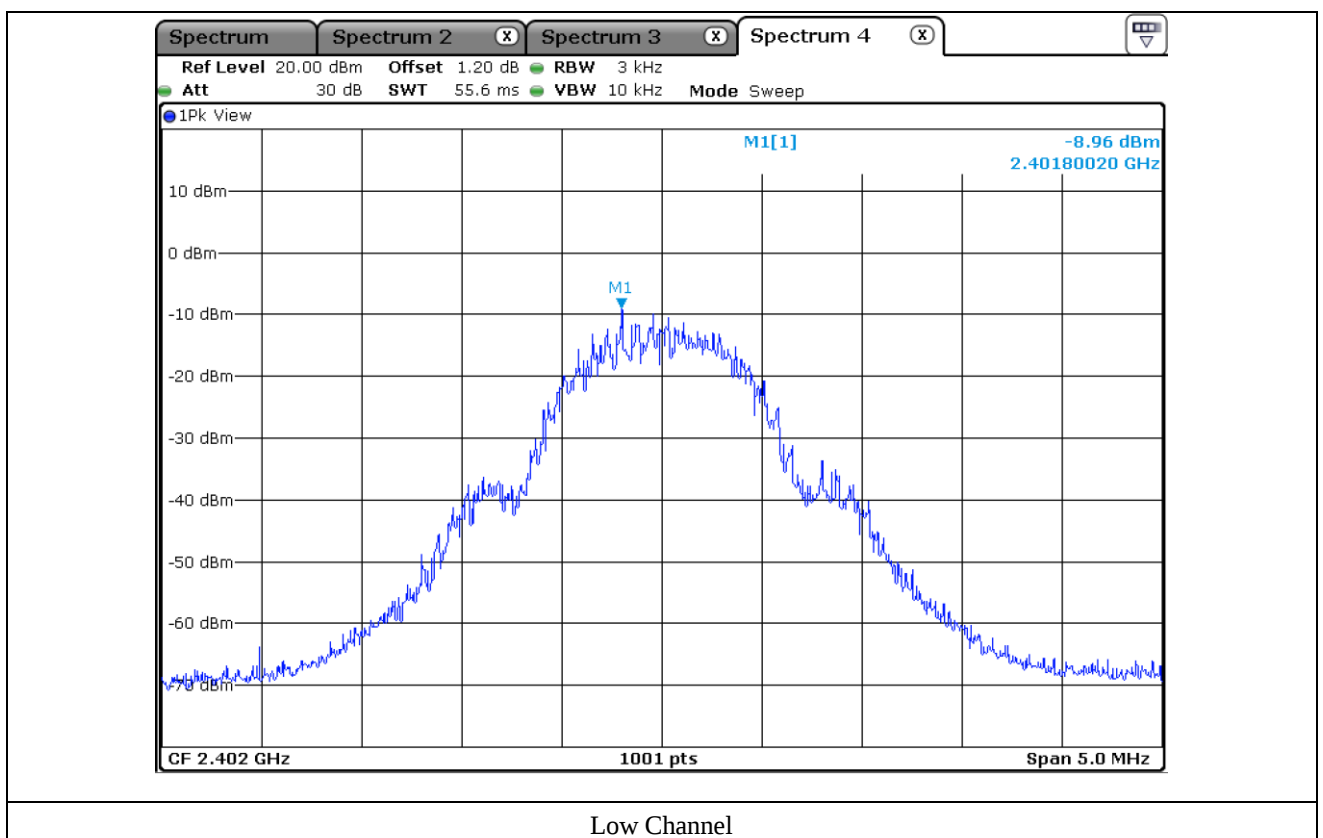
10.4 Test data for Bluetooth LE 1 Mbps

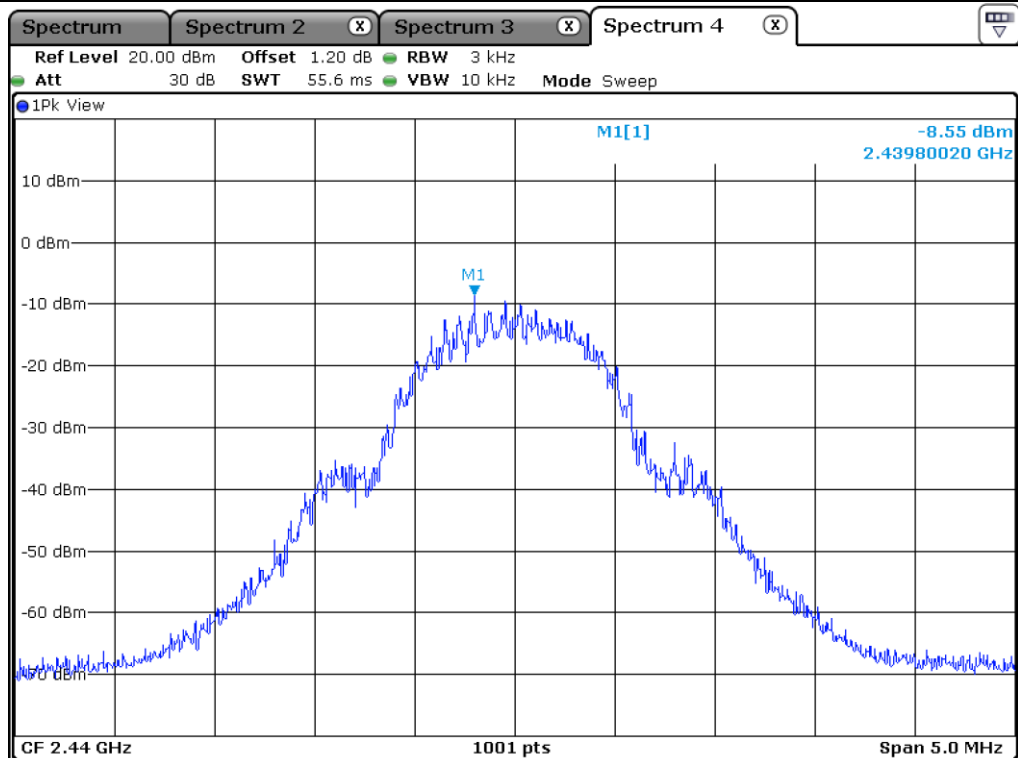
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

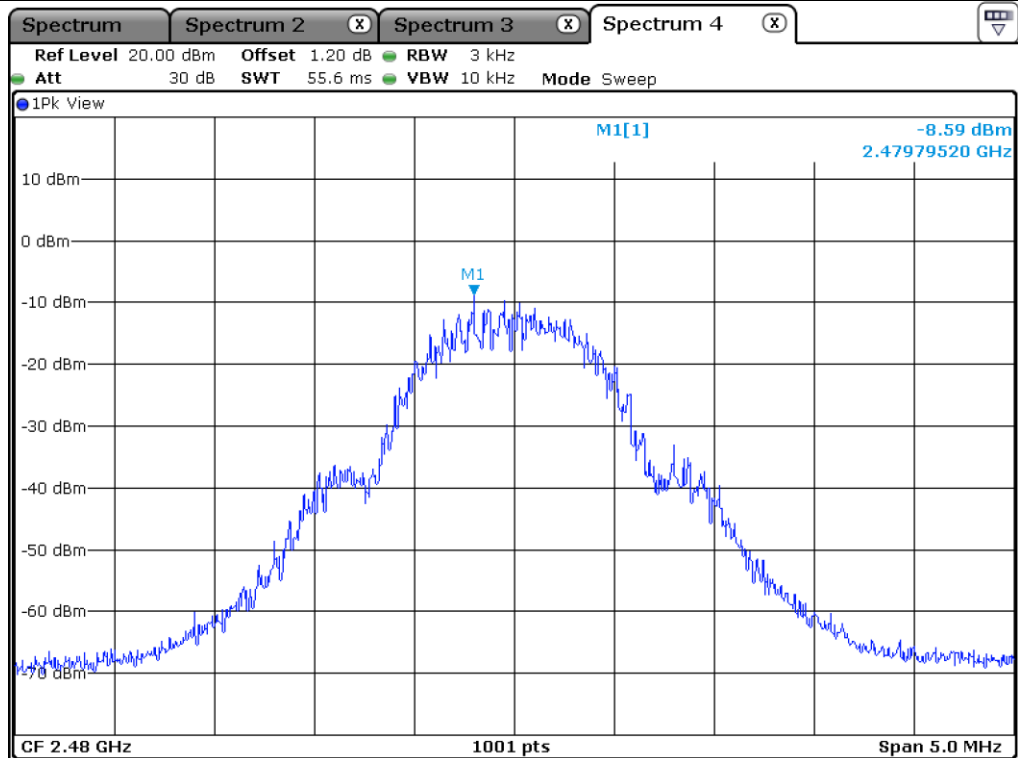
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402.00	-8.96	8.00	16.96
Middle	2 440.00	-8.55	8.00	16.55
High	2 480.00	-8.59	8.00	16.59

Remark. Margin = Limit – Measured value





Middle Channel



High Channel

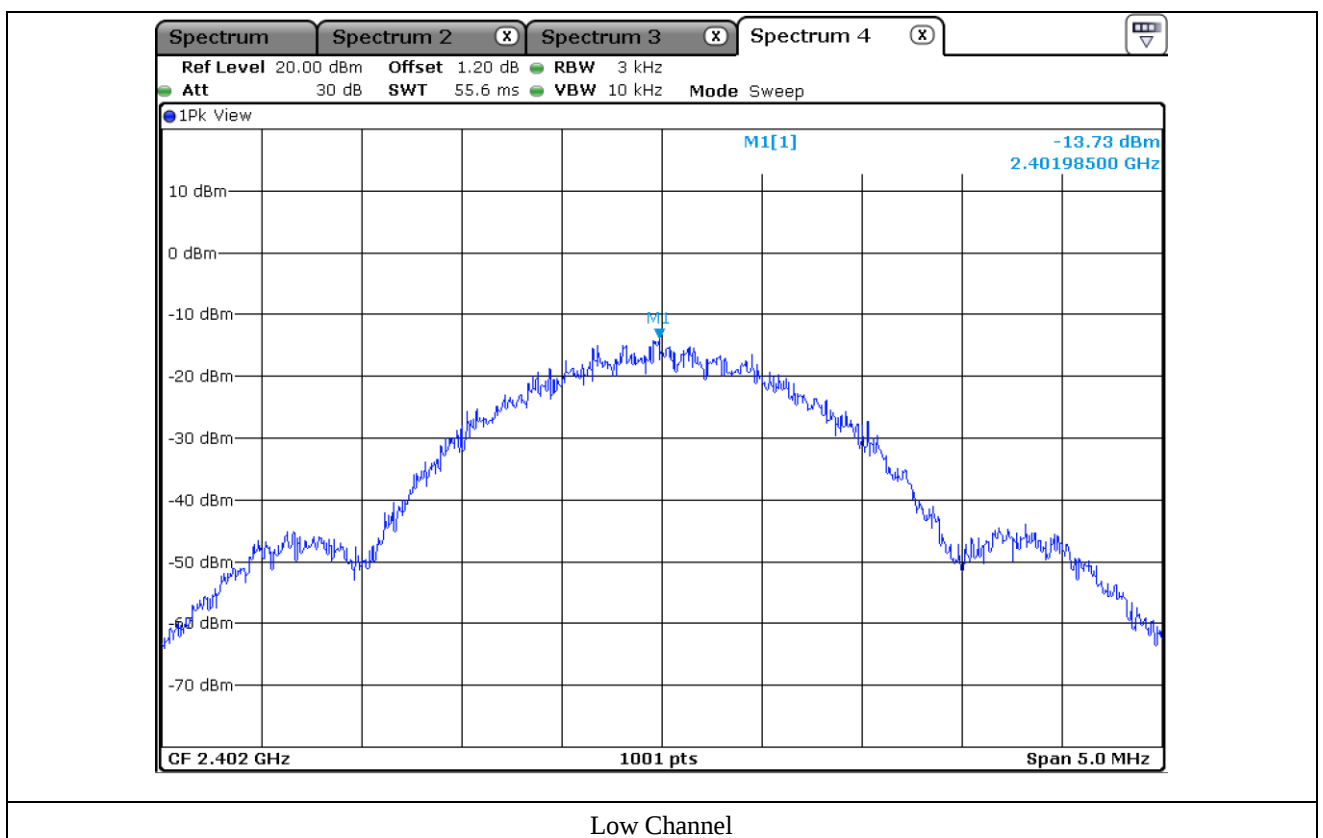
10.5 Test data for Bluetooth LE 2 Mbps

-. Test Result : Pass

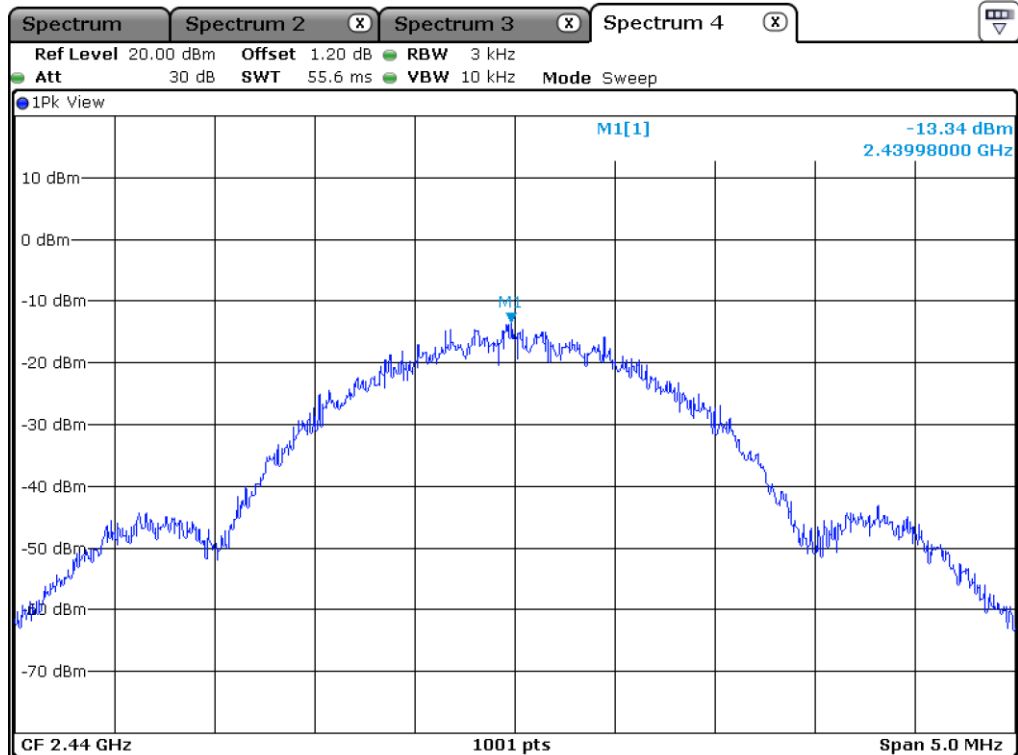
-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402.00	-13.73	8.00	21.73
Middle	2 440.00	-13.34	8.00	21.34
High	2 480.00	-13.39	8.00	21.39

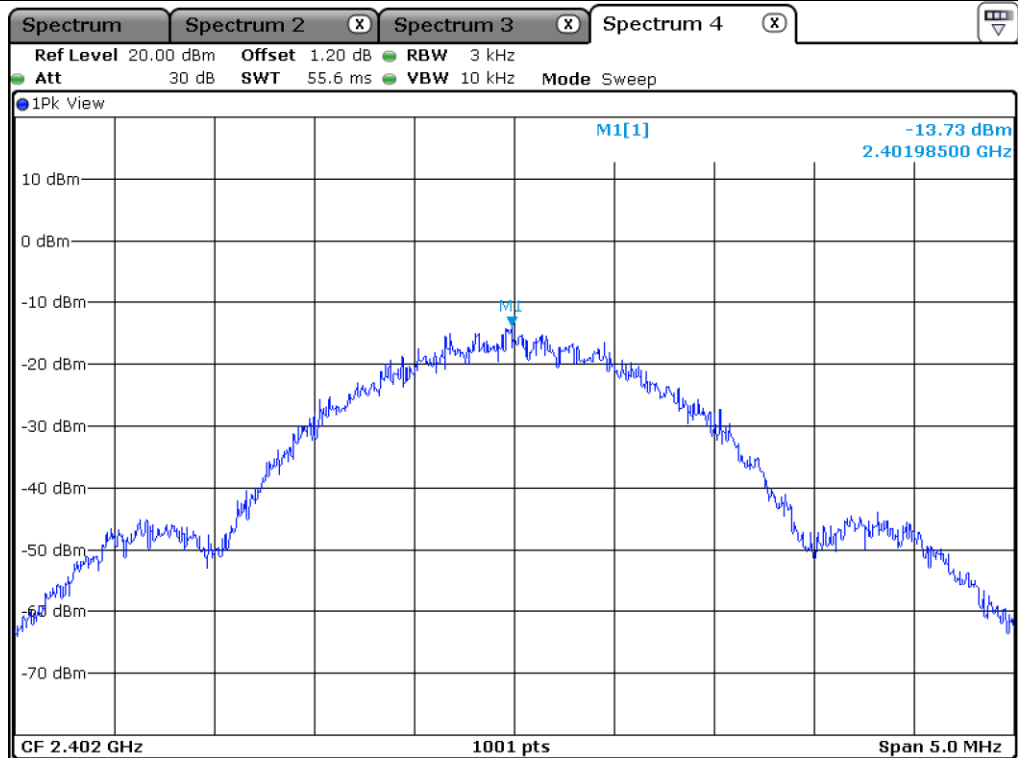
Remark. Margin = Limit – Measured value



Low Channel



Middle Channel



High Channel

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 24 °C
Relative humidity : 49 % R.H.

11.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

11.3 Test Date

July 11, 2022 ~ July 25, 2022

11.4 Test data for 30 MHz ~ 1000 MHz

Humidity Level : 49 % R.H.

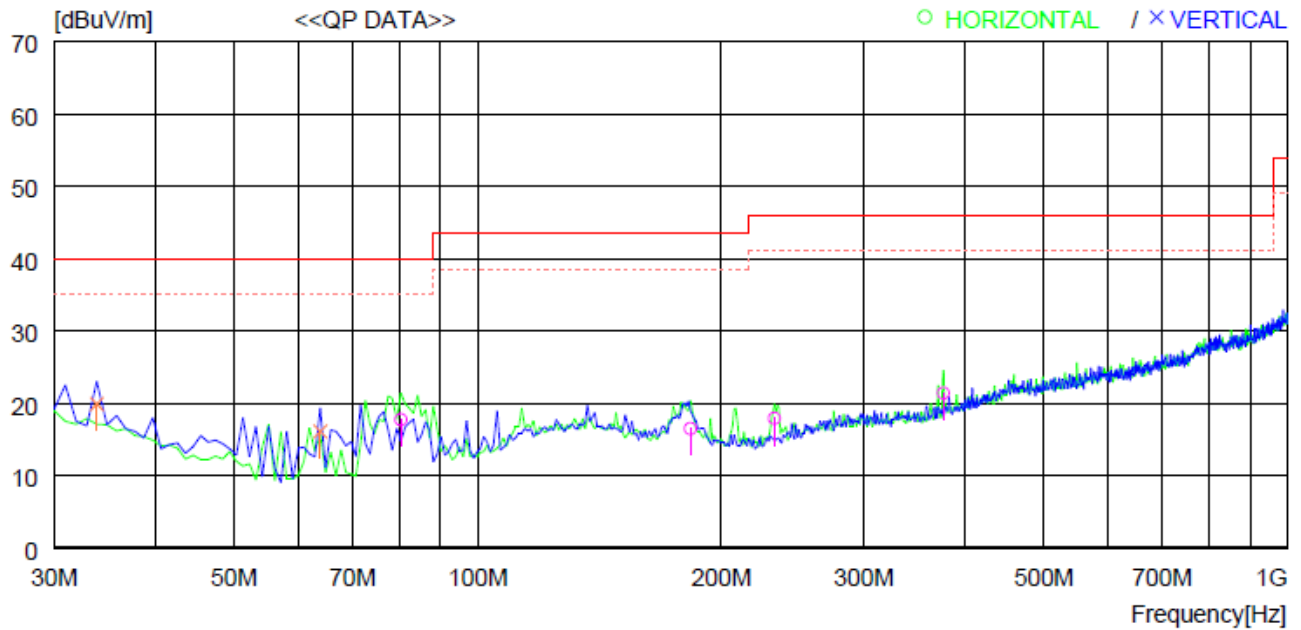
Temperature: 24 °C

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : Wireless Communication Module

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	80.440	35.8	13.3	1.7	33.1	17.7	40.0	22.3	300	356
2	183.260	30.5	16.5	2.5	33.0	16.5	43.5	27.0	200	162
3	232.730	31.5	16.5	2.9	33.0	17.9	46.0	28.1	200	0
4	376.290	29.8	20.8	3.8	33.0	21.4	46.0	24.6	100	359
----- Vertical -----										
5	33.880	32.1	19.8	1.1	33.1	19.9	40.0	20.1	100	0
6	63.950	35.0	12.7	1.5	33.1	16.1	40.0	23.9	100	0

11.5 Test data for Below 30 MHz

- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.									

11.6 Test data for above 1 GHz

- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.									

12. CONDUCTED EMISSION TEST

12.1 Operating environment

Temperature : 24 °C

Relative humidity : 49 % R.H.

12.2 Test set-up

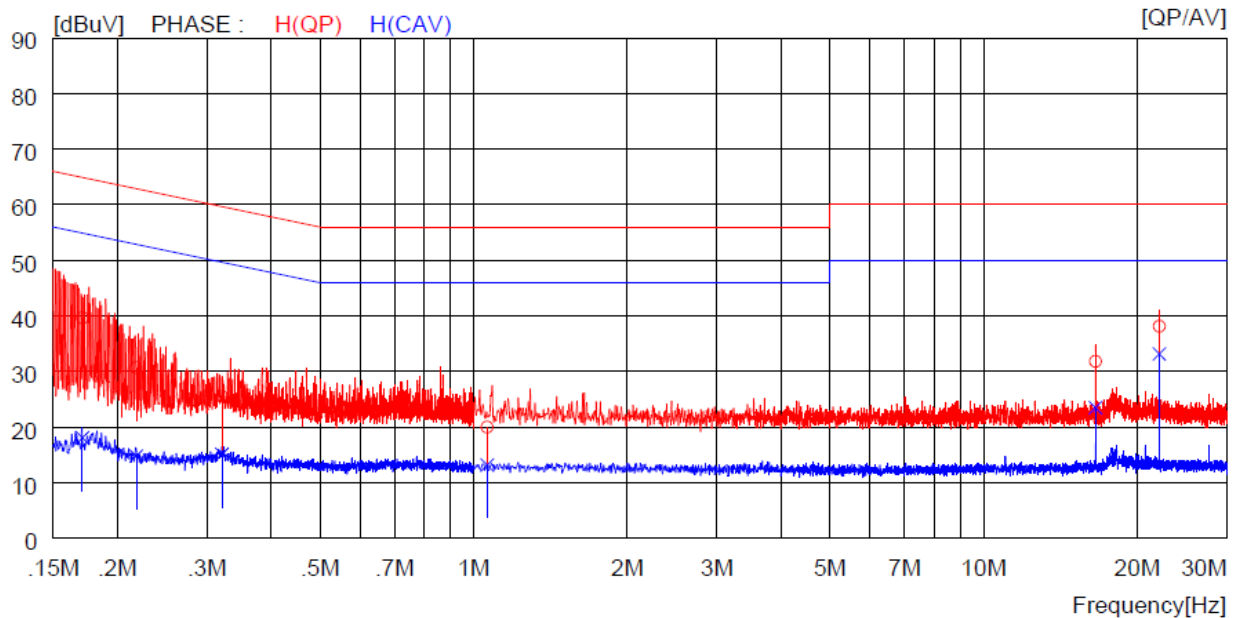
The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

12.3 Test Date

July 11, 2022 ~ July 25, 2022

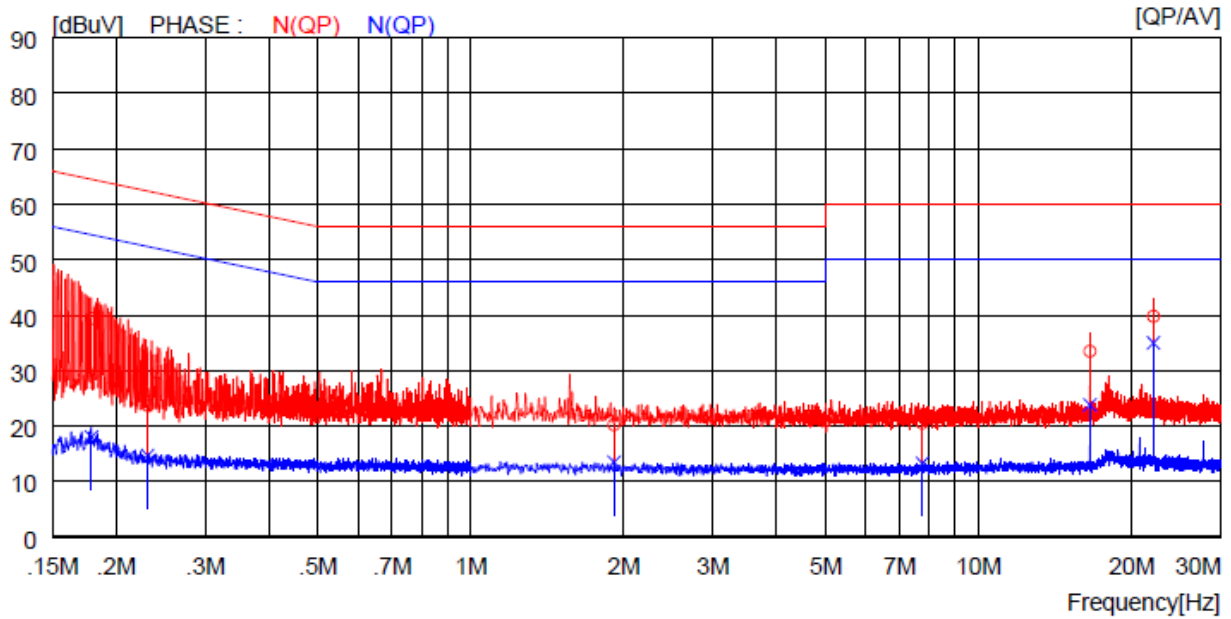
12.4 Test data

- . Resolution bandwidth : 9 kHz
- . Frequency range : 0.15 MHz ~ 30 MHz
- . Tested Line : HOT LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.17100	29.7	----	10.0	39.7	----	64.9	----	25.2	----	H (QP)
2	0.21800	20.7	----	10.0	30.7	----	62.9	----	32.2	----	H (QP)
3	0.32100	15.4	----	10.1	25.5	----	59.7	----	34.2	----	H (QP)
4	1.06400	9.7	----	10.3	20.0	----	56.0	----	36.0	----	H (QP)
5	16.59000	21.2	----	10.6	31.8	----	60.0	----	28.2	----	H (QP)
6	22.12000	27.4	----	10.7	38.1	----	60.0	----	21.9	----	H (QP)
7	0.17100	----	8.1	10.0	----	18.1	----	54.9	----	36.8	H (CAV)
8	0.21800	----	4.8	10.0	----	14.8	----	52.9	----	38.1	H (CAV)
9	0.32100	----	5.0	10.1	----	15.1	----	49.7	----	34.6	H (CAV)
10	1.06400	----	2.9	10.3	----	13.2	----	46.0	----	32.8	H (CAV)
11	16.59000	----	12.9	10.6	----	23.5	----	50.0	----	26.5	H (CAV)
12	22.12000	----	22.5	10.7	----	33.2	----	50.0	----	16.8	H (CAV)

-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.17900	29.4	----	10.0	39.4	----	64.5	----	25.1	----	N (QP)
2	0.23100	13.6	----	10.1	23.7	----	62.4	----	38.7	----	N (QP)
3	1.91600	9.9	----	10.3	20.2	----	56.0	----	35.8	----	N (QP)
4	7.75500	10.2	----	10.3	20.5	----	60.0	----	39.5	----	N (QP)
5	16.59000	22.9	----	10.6	33.5	----	60.0	----	26.5	----	N (QP)
6	22.12000	29.1	----	10.7	39.8	----	60.0	----	20.2	----	N (QP)
7	0.17900	----	8.0	10.0	----	18.0	----	54.5	----	36.5	N (CAV)
8	0.23100	----	4.6	10.1	----	14.7	----	52.4	----	37.7	N (CAV)
9	1.91600	----	3.2	10.3	----	13.5	----	46.0	----	32.5	N (CAV)
10	7.75500	----	3.0	10.3	----	13.3	----	50.0	----	36.7	N (CAV)
11	16.59000	----	13.2	10.6	----	23.8	----	50.0	----	26.2	N (CAV)
12	22.12000	----	24.3	10.7	----	35.0	----	50.0	----	15.0	N (CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

13. LIST OF TEST EQUIPMENT

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
FSV30	Rohde & Schwarz	Signal Analyzer	101372	Jul. 14, 2022 (1Y)
ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 18, 2021 (1Y)
ESR7	Rohde & Schwarz	EMI Test Receiver	102190	Oct. 12, 2021 (1Y)
ESH3-Z2	Rohde & Schwarz	Pulse Limiter	100655	Mar. 14, 2022 (1Y)
NSLK8128	Schwarzbeck Mess-ELE	Artificial Main Networks	8128216	Mar. 14, 2022 (1Y)
310N	Sonoma Instrument	AMPLIFIER	392756	Oct. 14, 2021 (1Y)
SCU18	Rohde & Schwarz	Signal Conditioning unit	102266	Jul. 12, 2022 (1Y)
SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Jan. 18, 2022 (1Y)
DT2000-2t	Innco Systems GmbH	Turn Table	N/A	N/A
CO3000	Innco Systems GmbH	Controller	1026/40960617/P	N/A
MA-4640-XPET	Innco Systems GmbH	Antenna Master	MA4640/652/43100318/P	N/A
HLP-2008	TDK RF Solutions	Hybrid Antenna	131316	Mar. 07, 2022 (2Y)
BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 06, 2022(1Y)
BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1349	Jul. 08, 2022 (1Y)
FMZB 1513	Schwarzbeck	Loop Antenna	1513-235	Mar. 24, 2022(2Y)
HPF 3GHz	Rohde & Schwarz	High Pass Filter	N/A	Jan. 18, 2022 (1Y)
IPS-12B05D	INTERACT	DC POWER SUPPLY	81103	Apr. 21, 2022 (1Y)